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Comment

Keep calm, but start placing orders

With solid growth continuing, extended lead times seem to be creeping up and shortages are starting to appear

At the end of last year members of the Electronics Component Supply Network (ecsn) forecast that the electronics component market in the UK and Ireland would grow strongly in the first quarter of 2018 and recent figures suggest that this has certainly been the case.

According to Adam Fletcher, chairman of ecsn, the Sales by Month “three month moving average” for all electronic components, while remaining in-line with historical trends, suggested that the strong growth seen at the end of 2017 had continued into the first quarter of 2018.

Recent consolidated results for March show that Total Monthly Billings (Net Sales Invoiced less Credits) increased by 77% when compared to the previous month and by 6% compared to the same month in 2017.

The UK has experienced an extended period of growth, one of the longest since 2000, however it is not alone and similar patterns of growth are being seen globally. As a result, manufacturers are struggling to keep up with demand and lead times are extending.

Anglia Components has just advised its customers that now is the time to ensure they have sufficient orders/inventory to cover their needs.

One component that is being badly affected is chip resistors with global demand massively outstripping supply. Shortages and price increases have already heavily impacted the supply chain.

The demand for chip resistors has risen exponentially due to the increase in electronics content in automotive, industrial and consumer applications.

Material prices are also on the rise driven by the increase in demand, and this is combining to create a situation whereby chip resistors will remain in short supply and prices will continue increasing in the short to medium term.

Commenting Steve Rawlins, CEO of Anglia, said “It’s ironic that a chip resistor might be one of the cheapest items on the BOM, but without it, you can be looking at thousands in lost revenue if you are not able to complete the assembly of the end product it is going into.”

So, it looks like if you want to ensure your production is not disrupted, now would be a good time to take action and start placing orders for components.

Neil Tyler
Editor, New Electronics
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Manufacturers building Industry 4.0 smart devices are realising a harsh reality: implementing cloud backend services down to the end node is a complex and expensive endeavour. Further, Industry 4.0 implementations, to be cost effective, must offer a high degree of device interoperability, scalability and portability across changing or unknown cloud backends.

To address these challenges, Mentor has introduced the Mentor Embedded IoT Framework (MEIF) – the industry’s first comprehensive, cloud vendor-agnostic embedded software framework (see Figure 1). Featuring well-defined interfaces engineered to extend a cloud vendor software development kit (SDK), MEIF streamlines the integration of Industry 4.0 networks by complementing leading cloud providers such as Amazon Web Services (AWS), Eclipse IoT, Microsoft Azure, and Siemens MindSphere. MEIF is OS-agnostic, which means it supports any processor architecture and scales from resource-constrained end nodes up to IoT gateways/devices powered by multicore processors.

Enhanced communications from cloud backend to end node, Mentor’s offering supports a breadth of services to enable successful device management (Figure 2). This includes authentication and provisioning; configuration and control; monitoring and diagnostics; and software updates and maintenance. The framework also features advanced capabilities to help manufacturers manage the reliability and overall quality of Industry 4.0 devices. MEIF is extensible so manufacturers can integrate and enable their own diagnostics as well.

Security from the bottom up
MEIF incorporates the Mentor Embedded runtime platforms, which support security from device power-on with a hardware-based root of trust and a complete software chain of trust. Additionally, MEIF includes a GUI-based utility to sign, encrypt, and package artefacts which are then delivered to the devices where they can be securely validated and authenticated.

The new Mentor Embedded IoT Framework for Industry 4.0 addresses a host of common challenges associated with security, portability, inter-operability, and cloud vendor lock-in.

For more information on this complete solution, visit https://www.mentor.com/embedded-software/iot-framework
Getting makers excited

E-paper displays represent an entirely new class of user interface. A new open source adapter board makes it easier than ever to get started with this new, innovative technology, as Jarek Lupinski explains.

Figure 1: The three figures on this page highlight the connectors needed to interface the e-paper board to the Teensy-LC.

For anyone experimenting with electronic products today there is one common requirement that spans all applications: to develop something that can be called ‘low power’. Of course, ‘low’ is relative but in the IoT era it often means operating for thousands of hours from a single cell, or even from energy harvested from the local environment (typically light, heat or vibration).

It is these kinds of applications that get makers excited, by getting the absolute best out of a device using the fewest possible resources. This class of application is more accurately called ‘ultra-low power’ and could be defined as any device that has active power levels in the micro-Watts, while using deep sleep modes to reduce current consumption to the nano-Amps.

These are extremely tough requirements to meet, but less so if averaged over the entire operational lifetime of the device. If the functionality allows for short bursts of activity, followed by long periods of inactivity, overall system power can be kept to an absolute minimum.

Conceptually, this is entirely possible. Modern MCUs are designed with power in mind, and semiconductor manufacturers promote the low power credentials of their products. The key, as mentioned above, is often in implementing innovative sleep modes. These are often multi-tiered and progressively reduce or remove power to parts of the MCU, until the only thing active is a timer ready to wake the core up at a predetermined time or after receiving an external interrupt.

These hibernation modes are perfect for devices that are not required to interact with users when they are inactive, or devices that can give the appearance of constant operation by waking periodically and reacting accordingly, such as smoke alarms. But what about devices that require greater degrees of user interaction?

Often the only solution here is to use some form of indicator, and for many...
years this has taken the form of LEDs, providing an indication of status (green LEDs typically indicate everything is working correctly, while red LEDs might be used to alert a user to a problem, for example). While LEDs can consume very little power, they are not so suitable for applications that are expected to operate for many hours from a single charge, or from harvested power.

The development of e-paper displays has permanently changed this landscape for embedded designers. Thanks to their bistable nature, electronic paper displays (EPDs) enable ultra-low power applications to include a user interface without busting the power budget, because an EPD only consumes power when the screen is updating, and needs no power to retain its contents. The screen's contents remain even when power is totally removed, hence the name ‘e-paper’.

In order to make it easier for embedded engineers to explore this innovative technology, SonikTech has developed an open source interface board that provides the crucial link between an MCU and an e-paper display. The adapter has been designed with the Pervasive Displays was also able to address the e-paper. Interfacing the e-paper board to generate the voltages needed to drive the display were also incorporated into the adapter board. The connectors needed to interface the e-paper board to the Teensy-LC microcontroller platform comprise the main part of the board, as shown in the schematic in Figure 1.

Evaluating the e-paper display using the Teensy-LC is a simple process of...

**Necessity the mother of invention**

The idea of experimenting with an e-paper display came from another project, a weather forecaster which was originally powered from a mains outlet. User feedback centered on making it battery powered, but the LEDs used would have consumed far too much power to make that feasible.

An alternative and altogether more user-friendly solution was a low power LCD screen, and it was thought that adding a solar power cell would keep the battery charged. This worked well outside on sunny days, even though the LCD backlight needed to be on constantly, consuming power. However, on a cloudy day or if located inside, it was difficult to keep the battery charged using just the solar panel.

An e-paper display seemed to offer a better solution, as these displays are sunlight-readable and don’t require power until the screen’s contents need to be updated. However, at the time it was felt that driving an e-paper display was complex, demanding multiple voltages at irregular levels and polarities, which in turn required a lot of bespoke support circuitry. In high volumes this could be incorporated into an ASIC, but for low volume users or hobbyists these complexities could put e-paper displays outside the reach of many.

This proved not to be the case with the Pervasive Displays products. As well as offering a simple physical interface, the displays handle most of the complexities involved with e-paper. Pervasive Displays was also able to supply some open source code that formed the basis for a driver, as well as some circuit examples.

Within a very short period of development time — just a couple of days — the first iteration of the interface board was working. The prototype PCB was manufactured using OSH Park, a community-based service. The adapter board was subsequently launched on CrowdSupply. The firmware was rewritten to make it compatible with the Arduino project and bundled with some demonstration code, all of which can be obtained free of charge on Hackaday and GitHub.

The display chosen for this project offers a resolution of 110dpi, with 208 x 112 pixels. It has built-in circuitry to drive the active matrix TFT screen, which is controlled over an SPI interface. The few peripheral components required by the e-paper board to generate the voltages needed to drive the display were also incorporated into the adapter board. The connectors needed to interface the e-paper board to the Teensy-LC microcontroller platform comprise the main part of the board, as shown in the schematic in Figure 1.

Evaluating the e-paper display using the Teensy-LC is a simple process of...

**Image data input sequence:**

Line 1: (1,1)>(2,1)>...>(112,1)>
Line 2: (1,2)>(2,2)>...>(112,2)>

:  

Line 208: (.................>(112,208)

**Total:** 112 x 208 + 23296 bits = 2912 bytes
Display Technology

plugging the adapter board into the
display and then into the Teensy-LC
board, which is then connected to a PC
via USB. The software used to drive
the Teensy-LC board, and therefore
the display, is Teensyduino; a software
add-on for the Arduino platform.
The Teensy platform accepts all
standard Arduino instructions (such as
digitalWrite, analogRead and so on), as
well as standard Arduino libraries. Once
the software is installed and running and
the hardware is connected, users can run
example programs which include sample
images that will be displayed on the
e-paper screen.

The pseudocode in Figure 2 shows
how the screen is updated, while
the flowchart in Figure 3 covers the
sequence, including references to how
the control pins should be driven during
the update.

Design challenges

While the adapter board may seem
simple, part of the challenge of
developing it was to ensure it worked
correctly with the complex drivers
integrated on the e-paper display.
This includes getting the width and
length of the PCB tracks just right,
which must be optimised for the
display. After experimenting with
several prototypes this design goal was
achieved.

As e-paper display designs are
generally proprietary and bespoke there
really isn’t a ‘standard’ approach to
their interface, so any adapter board is
necessarily going to be unique to the
chosen manufacturer’s format. In this
case that is Pervasive Displays, which
uses an SPI interface to communicate
with the display coupled with control
pins for the internal Tcon driver (iTC),
the signals for which also need to be
produced by the host MCU.

As well as the driver (supplied as
open source by Pervasive Displays)
the software’s complexity really lies
in the look-up table (LUT) which is
needed to update the screen. Most
LUTs are created for specific screens
and may cover different operating
conditions, such as partial updates.
The software may also need to cater for
other conditions such as temperature
variations (which can influence how
the screen behaves), initialisation
and variable duty cycles. Because
temperature is an important factor, the
adapter board includes a temperature
sensor which is also connected to the
SPI bus. The software uses the sensor
to choose the optimal operating mode.

Conclusion

The option of adding a high-resolution
display to an ultra-low power
application offers many benefits.
Progress made in e-paper displays, such
as the integration of the screen driver,
means it is now easier than ever to
incorporate a display into almost any
application, even in designs that must
operate from extremely low power and
based on very modest microcontrollers.

The ability of e-paper displays to
hold their contents when all power is
removed, means they can be used in
applications that no other display can.
The small amount of energy needed
to refresh the screen can be applied in
many ways. Conventionally, this might
involve a battery, but it is now equally
possible to only apply power during
an update. This may even be applied
wirelessly, for example.

Because it is unlike any other
display technology, e-paper will enable
new and innovative applications. The
adapter board featured here is intended
to help makers get started with e-paper
displays - so let’s get creative!
How a machine interface performs is the determining factor in its success. With the rise of the internet of things (IoT) and industry 4.0, the users of machines are becoming empowered with information and the ability to make decisions. This will also include the ability to decide which machine interfaces are fit for purpose and which are not.

Users of machines, whether they are a nurse in a hospital or a machine controller in a factory will not be satisfied unless the interface meets their performance requirements. To this end quite often a touch screen interface alone will not be sufficient.

Designers are increasingly opting for a combination of leading edge technologies that includes a projected capacitive multi touch screen along with secret until lit keys that incorporate, colour changes for operator feedback or colour coded visual directions to allow machine operators comprehensive control. This twin input option allows the user of the machine to rapidly change menus using keys that light or disappear as and when certain options are available. Backlit icons also give the user a visual reassurance that certain functions of the machine are switched on or off, rather than go through touch screen menus which can be a time consuming and frustrating experience.

Creating interfaces where user functionality and stylish design are required in equal measures requires an in depth knowledge of the related components and how they work together. SCHURTER are the market leaders in the design and manufacture of capacitive HMI devices and provide customers with the perfect solution for their application. SCHURTER products offer full customisation of items such as the graphics and thickness of the glass or plastic, the display requirements, multi-colour backlighting and touch controller.

SCHURTER’s latest products cater for all environmental conditions which encompass ATEX requirements, water rejection and gloved hand use. In addition, all customised SCHURTER products benefit from a product lifecycle guarantee. SCHURTER will take responsibility to provide a form, fit and function product regardless of the obsolescence of individual components such as the display or IC.

For further information:
Running cool
How to choose cool running, high power, scalable POL regulators and save board space, according to Afshin Odabaee

While the art of designing efficient and compact DC/DC converters is practiced by a select group of engineers, IC designers often escape dealing with the dreaded topic of heat - a job that usually falls to the package engineer.

Heat is a significant concern for point-of-load (POL) converters, where space is tight among delicate ICs. A POL regulator generates heat because no voltage conversion is 100% efficient (yet). Thermal impedance of the package not only raises temperature of the POL regulator, but it also increases the temperature of the PCB and surrounding components.

Heat mitigation for a DC/DC converter package on a PCB is achieved through two major strategies: distribute it through the PCB, or add airflow (other methods include passive and active heat sinking, which are considered subsets of the second category here.)

When faced with rising component temperatures, the PCB designer can use a range of standard heat-mitigation techniques, but applying these remedies can diminish the end product’s competitive edge in the market.

Successful thermal management around high power POL regulators requires choosing the right regulator, which demands careful research.

A number of market factors drive the need to improve thermal performance in electronic equipment. Most obvious as performance continuously improves even as products shrink in size so POL regulators must increase in power density: (power)/(volume) or (power)/(area).

It is no surprise that power density is often cited in regulator literature as the headline specification.

Product designers want to squeeze higher power into tighter spaces - but how significant is power density in achieving a successful final design? Less than you might think.

A POL regulator must meet the requirements of its application. In choosing a POL regulator, one must assure its ability to do the job on the PCB, where the treatment of heat can make or break the application.

Selection process
Ignore power density numbers: power density specifications ignore thermal derating, which has a significantly greater effect on the effective, real world “power density.”

Check the regulator’s thermal derating curves: The data sheet should show the output current capability of the POL regulator under real world operating conditions, so you can judge
the regulator by its thermal and load current abilities. Remember, output current derating relates to the thermal performance of the device. The two are closely related, and equally important.

Look at efficiency: Efficiency results, when used exclusively, can present an inaccurate picture of the thermal characteristics of a DC/DC regulator. Of course, efficiency numbers are required to calculate input current and load current, input power consumption, power dissipation and junction temperature. But, efficiency values must be combined with output current derating and other thermal data related to the device and its package.

Consider the ease of cooling the POL regulator: The package thermal impedance values provided in the data sheet are key to simulate and calculate rise in junction, ambient and case temperatures of the device. Because much of the heat in surface mount packages flow from the bottom of the package to the PCB, layout guidance and discussions about thermal measurements must be articulated in the data sheet to minimise surprises during system prototyping.

A well-designed package should efficiently dissipate heat evenly throughout its surfaces, eliminating hot spots, which degrade the reliability of a POL regulator.

The PCB is responsible for absorbing and routing much of the heat from surface mountable POL regulators. But with the prevalence of forced airflow in dense and complex systems, a cleverly designed POL regulator should also tap this “free” cooling opportunity to remove heat from heat generating components, such as MOSFETs and inductors.

Guiding heat
A high-power switching POL regulator depends on an inductor or transformer to convert the input supply voltage to a regulated output voltage. In a non-isolated step-down POL regulator, the device uses an inductor. The inductor and accompanying switching elements, such as MOSFETs, produce heat during DC/DC conversion.

New packaging advances allowed an entire DC/DC regulator circuit, including the magnetics, to be designed and fitted inside moulded plastic, called modules or SiP, where much of the heat generated inside the moulded plastic is routed to the PCB via the bottom of the package. Any conventional attempt to improve heat removal capability of the package contributes to a larger package, such as attaching a heat sink to the top of the surface mount package.

A few years ago, an innovative module packaging technique was developed to take advantage of available airflow to aid in cooling. In this design, a heat sink is integrated into the module.
package and over moulded. Inside the package, the bottom of the heat sink is directly connected to the MOSFETs and inductors, the heat generators, while the topside of the heat sink is a flat surface exposed at top of the package. This new intra-packaging heat sinking technique allows a device to be cooled quickly with airflow.

**Go vertical**
The size of an inductor in a POL regulator depends on voltage, switching frequency, current handling and its construction. In a module approach, where the DC/DC circuit including the inductor is over moulded and encapsulated in a plastic package and resembles an IC, the inductor dictates the thickness, volume and weight of the package more than any other component. The inductor is also a significant source of heat.

Integrating the heat sink into the package helps to conduct heat from the MOSFETs and inductor to the top of the package, where it can be dissipated to air, a cold plate or a passive heat sink. This technique is effective when relatively small, low current inductors easily fit inside the plastic mould compound of the pack-age, but not so effective when POL regulators depend on larger and higher current inductors, where placement of the magnetics inside the package forces other circuit components to be farther apart, significantly expanding the PCB footprint of the package. To keep the footprint small while improving heat dissipation, the package engineers have developed another trick: vertical, stack or 3D.

Small PCB footprint, more power and better thermal performance - all three are simultaneously possible with 3D packaging, a new method in construction of POL regulators. The LTM4636 is a µModule regulator with onboard DC/DC regulator IC, MOSFETs, supporting circuitry and a large inductor to decrease output ripple and deliver load currents up to 40A from 12V input to precisely regulated output voltages ranging from 3.3V to 0.6V.

Four LTM4636 devices running in parallel can current share to provide 160A of load current. The footprint of the package is only 16mm × 16mm. Another regulator in the family, the LTM4636-1, detects overtemperature and input/output overvoltage conditions and can trip an upstream power supply or circuit breaker to protect itself and its load. This technique is effective when relatively small, low current inductors easily fit inside the plastic mould compound of the pack-age, but not so effective when POL regulators depend on larger and higher current inductors, where placement of the magnetics inside the package forces other circuit components to be farther apart, significantly expanding the PCB footprint of the package. To keep the footprint small while improving heat dissipation, the package engineers have developed another trick: vertical, stack or 3D.

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However, power density numbers tell an incomplete story. There are other benefits that this µModule regulator brings to the system designer’s toolbox: superior thermal performance, resulting from impressive DC/DC conversion efficiency, and an unparalleled ability to disperse heat.

To minimise the regulator’s footprint (16mm × 16mm BGA), the inductor is elevated and secured on two copper lead frame structures so that other circuit components can be soldered under it on the substrate. If the inductor is placed on the substrate, the µModule regulator can occupy more than 1,225mm2 of PCB, instead of small 256mm2 footprint.

Stacked-inductor construction rewards system designers with a compact POL regulator, with the additional benefit of superior thermal performance.

**Performance and efficiency**
The LTM4636 is a 40A-capable µModule regulator benefits from 3D packaging technology, or component-
The body of the package is an over-moulded 16mm × 16mm × 1.91mm BGA package. With the inductor stacked on top of the moulded section, the total package height is just 7.16mm.

In addition to dissipating heat from the top, the LTM4636 is designed to efficiently disperse heat from the bottom of the package to the PCB. It has 144 BGA solder balls with banks dedicated to GND, VIN and VOUT where high current flows. Collectively, these solder balls act as a heat sink to the PCB.

Even operating with a significant conversion ratio, 12V input/1V output, and at a full load current of 40A (40W) and standard 200LFM airflow, the package temperature rises only 40°C over ambient temperature (25°C–26.5°C).

At 200LFM, the LTM4636 delivers a full current of 40A up to an 83°C ambient temperature. Half-current, 20A, derating only occurs at an excessively high ambient temperature of 110°C. This allows the device to perform at high capacity as long as some airflow is available.

The high conversion efficiency is mainly a result of top performing MOSFETs and strong drivers of the LTM4636. One LTM4636 is rated for 40A load current delivery. Two LTM4636s in current sharing mode (or parallel) can support 80A, while four will support 160A. Upscaling a power supply with parallel LTM4636s is easy: simply copy and paste the single-regulator footprint (symbols and footprints are available).

The current mode architecture of the LTM4636 enables precision current sharing among the 40A blocks. Precise current sharing, in turn, produces a power supply that spreads the heat evenly between devices. The figure above shows that all devices in the 4-µModule 160A regulator operate within a degree of each other, ensuring that no individual device is overloaded or overheated. This greatly simplifies heat mitigation.

The complete 160A design does not require a clock device for the LTM4636s to operate out-of-phase respective of each other - clocking and phase control is included. Multiphase operation reduces output and in-put ripple current, reducing the number of required input and output capacitors.

Here, the four LTM4636s are running 90° out-of-phase.

Choosing a POL regulator for a densely populated system requires scrutiny beyond voltage and amperage ratings of the device. Evaluation of its package’s thermal characteristics is essential, as it determines cost of cooling, cost of PCB and final product size. Advances in 3D allow high power POL module regulators to fit a small PCB footprint, but more importantly, enable efficient cooling.
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