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Global Electronics Sales Soar, But For How Long?

This year is proving extremely profitable for the international electronics industry. Thus, as Electronica 2014, the world’s largest electronics show, opens its doors, it begs the question: Will the good times keep rolling or is the crest of the financial wave about to break?

This year’s Electronica event finds itself in much calmer financial waters compared to the Euro crisis that hovered over the 2012 show. The overwhelming question on people’s minds back then was how the electronics industry would deal with the Eurozone monetary crisis that threatened not only the downfall of that currency, but a serious weakening of the European Union in its entirety.

At that time, Europe’s semiconductor manufacturers experienced a drop in revenues; as an industry group, the decline was put at around 8% with some individual companies experiencing a 15% reduction. However, analysts and pundits were stubbornly optimistic that 2013 and 2014 would develop into a boom time for the industry, with growth rates being quoted from 6% to 9%.

Trying to accurately predict how a market sector will trade is a tricky business. Here at Electronic Design Europe, we gathered up all available industry statistics and threw them into a mathematical melting pot. The goal was to come up with a good average market growth figure that had a credible chance of being accurate compared to actual numbers calculated for post-2014 analyses.

DID WE GET IT RIGHT?

The simple answer is, no, we didn’t. Our estimate that overall growth for the semiconductor industry in 2014 would range from 7% to 9% was way too conservative, confirmed by statistics revealed earlier this year by industry association SEMI.

According to SEMI, the worldwide semiconductor manufacturing equipment billings reached US$ 10.15 billion in the first quarter of 2014, an astounding 39% higher than the same quarter from a year ago. This analysis should be taken seriously because data is gathered jointly with the Semiconductor Equipment Association of Japan from over 100 global equipment companies that provide monthly market information.

These figures are important because no industry that feels it’s in a phase of recession will invest heavily in manufacturing equipment (Fig. 1). That will only change when the industry outlook has a promise of buoyancy, and even then companies can be reluctant to overly commit on capital expenditure.

Numbers from SEMI Silicon Manufacturers Group’s analysis on worldwide silicon-wafer-area shipments further endorsed 2014’s good fortunes. Shipments increased during the second quarter of 2014, according to its quarterly report on the silicon wafer industry. In addition, total silicon-wafer-area shipments were 2587 million square inches during the most recent quarter, close to a 10% increase from the previous quarter.

1. According to SEMI, most electronic industry segments will experience double-digit fab equipment spending growth. Forecasts show that MPUs will experience the largest increase, followed by memory, analog, logic, and MEMS.
2. Dedicated foundries are expected to add 10% to 11% more capacity in 2014, while flash will boost capacity by 10% this year.

Analysis done by the SEI (Semiconductor Industry Association) also revealed positive figures. Worldwide sales of semiconductors reached $82.7 billion during the second quarter of 2014—an increase of 5.5% over the previous quarter and a 10.9% jump over the second quarter of 2013. Global sales in June this year topped almost $28 billion, marking the industry’s highest monthly sales ever recorded. Year-to-date sales during the first half of 2014 were 11% higher than they were at the same point in 2013.

Furthermore, analysis released on September 9, 2014 shows the latest Cowan LRA model forecasts 2014’s global semiconductor sales to reach $335.5 billion. Cowan’s updated sales forecast result, derived from the World Semiconductor Trade Statistics’ (WSTS) July 2014 actual sales, yields a 2014 sales growth forecast of 9.8% when compared to 2013’s $305.6 billion.

The newly calculated year-over-year sales growth forecast rose slightly from last month’s published forecast estimate of 9.5%, which was based on the WSTS’s June 2014 actual sales reported last month (global sales of $27.600 billion).

Looking at geographic regions, 2014 sales figures compared to June 2013 figures showed increases in the Americas (12.1 %), Europe (12.1%), Asia Pacific (10.5 %), and Japan (8.5 %). All four regional markets posted better year-to-date sales through the first half of 2014 versus mid-year 2013.

WELL...WHAT ABOUT EUROPE?

Electronica may well be an international event, but geographically it’s also regarded as having a strong European influence. So does all of the optimism and industry growth reported in this column also include Europe? The answer is maybe.

Why so unsure? Even though the major Euro currently crisis that served as a backdrop to 2012 Electronica may have dis-
sipated, there are various harbingers indicating dark financial clouds could bubble up on the horizon.

Italy and France, for example, recently posted disappointing economic results. France may well be the fifth largest economy in the world and the second largest in the EU, but its growth has stagnated at 0.0%. And Italy’s gross domestic product figures have declined for the past three years. Thus, it’s no surprise that the country is now officially considered to be back in recession, which is particularly troubling news for Europe since it’s the third largest economy in the Eurozone.

WORRISOME SIGNS

France and Italy aren’t the only countries facing uncomfortable economic truths. Germany, Europe’s industrial powerhouse, is combating a weakening economy with a GDP decline of 0.2%, while Portugal and Greece can’t seem to climb out of their financial stresses of recent years.

One European Union member experiencing a positive economic situation is the United Kingdom. Estimates of 3.2% GDP growth comes in well above the March 2014 forecast of 2.7% made by the Office for Budget Responsibility, the UK Government’s independent fiscal watchdog.

Earlier this month, the Bank of England upgraded its growth forecast for this year to 3.5% from 3.4%. However, it must be remembered that the UK is not a member of the Eurozone, having decided to stick with its own pound currency.

While the Eurozone economic woes may have declined since those days of Electronica 2012, it’s quite clear they haven’t vanished. Nonetheless, the question we asked in this magazine at that time, “Can The Chip Makers Beat The Euro Zone Blues?”, has been answered with a resounding yes.

The WSTS would certainly agree. It predicts that the world semiconductor market will reach US$325 billion in 2014, up 6.5% from 2013. Moreover, all major product categories will show a high single-digit growth rate, except for a soft decline in microprocessors. Smartphones, tablets, and automotive applications will largely drive the growth. Overall highest growth rates belong to the analog (9.1%) and sensor (9.1%) sectors.

In summary, the global electronics industry can continue to prosper and grow despite the economic concerns that continue to stalk nations in the Eurozone and the cyclical financial downturns that inevitably affect countries economies throughout the world. Prosperity will continue thanks to the development of new technologies to serve the constantly expanding number of tech-reliant applications, much of which will be on display at Electronica 2014.

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Beacon Technology
Opens Door to Micro-Location-Based Services

Bluetooth Smart beacons have been a hot topic since Apple came out in support of the technology last year. Case in point: The market will reach 60 million units in 2019, according to ABI Research.

A beacon essentially comprises a small Bluetooth Smart transmitter that sits in a fixed location, transmitting its identity to nearby Bluetooth Smart-enabled devices like smartphones. If the user has the correct app installed on his/her device, receiving the beacon’s transmission triggers a response, such as the launch of the app or a notification of some kind (Fig. 1). The type of action that’s triggered depends on the beacon’s identity.

For example, you could be viewing an exhibit in a museum, and you happen to have installed that establishment’s app. If a beacon is placed near that exhibit, it could prompt the app to pop up more information about what’s on display. Another example could involve a beacon in the boarding lounge of an airport—if you installed the airline’s app, the beacon could open up your boarding pass.

The beacons don’t transmit any information other than their own identity. Only the app uses that information to decide on what action is taken, if any, and initiates the appropriate response. This technology is set to make smartphones aware of their location on a micro-scale, largely in places GPS can’t reach, such as indoor environments.

Driving this concept is Bluetooth Smart, the low-energy version of Bluetooth that allows coin-cell-operated accessories to communicate with smartphone apps. No doubt, Bluetooth Smart’s popularity is stronger than ever—it comes with practically every smartphone on the market.

Determined to get in on the beacon trend, Apple launched iBeacon in 2013. The company also decided that from iOS 7.1 onwards, iPhones will automatically switch on Bluetooth Smart capability by default when booting up. As a result, iPhones listen continuously for beacons in their vicinity. That advance alone has propelled the adoption of beacon technology.

“Apple's iBeacon initiative, in particular, has pushed a critical mass of awareness for the use of beacons and has provided some structure that the market has been able to use to help drive the use cases,” says Clive Watts, Senior Product Marketing Manager at CSR. “The iBeacon initiative is also driving a common standard for the way a beacon operates, so that consumers will have a consistent experience when interacting with them, regardless of where they have been installed.”

POSSIBLE APPLICATIONS

Major use cases for beacons so far have focused on contextual advertising in the retail environment. Large retailers would love to know where their customers are in-store to better target advertising locations. This would most likely mean that when you step into the pet food aisle, your phone pops up a notification advertising a special offer on a brand of dog food. Or in a clothing store, a notification might tell you that the item you’re...
looking at is available in other color choices from the store’s Web site. Of course, these actions only occur if that store’s app is installed on your phone. If you find the notifications annoying, just get rid of the app. “We are only just beginning to see the benefits of beacons,” says Watts. “If GPS worked reliably indoors and had a 1m resolution capability, we wouldn’t need beacons. But those limitations of GPS don’t eliminate the desire of developers to use micro-location through proximity in all the same ways they use GPS.”

Watts predicts an explosion in the use of beacons for applications such as home automation, green buildings, healthcare monitoring, automated sign-on, location-based security, and workflow optimization.

Asset tracking is another good application of this technology, with hardware small enough to be stuck to everyday objects (Fig. 2). This can also extend to people: Beacon manufacturer Kontakt’s hardware solution will soon include Bluetooth Smart wristbands for tracking people such as children in schools, healthcare patients, and workers in manufacturing facilities for health and safety purposes. In some cases, the technology can also be made to work with mobile payment technology.

US startup Cover’s beacon app can detect when diners leave, upon receiving transmission from Estimote beacon hardware placed in a restaurant, and charge their credit card with the bill. PayPal also has its own Bluetooth Smart beacon solution designed specifically for point-of-sale applications.

SECURITY ISSUES

Once a technology becomes popular, it’s usually only a matter of time before spammers, or worse, hackers, try to come up with a way to abuse it. Would it be possible to say, place a beacon in a crowded place and try to get unwanted advertising messages to as many people as possible?

“Today, I would say that iBeacon is not the best way to do that, because it needs a physical infrastructure,” says David Edwin, senior software architect and Bluetooth evangelist at Nordic Semiconductor. Edwin points out that each beacon has a limited range, and that such a scheme would have to be complemented by a rogue app on people’s phones. Even if it did happen, a beacon can’t trigger an attack on vectors, such as launching a Web site (at least, not with iBeacon; the Android situation is still developing, though). An iBeacon simply launches an app that’s already been installed and pops up notifications.

Is there a possibility that beacons could collect data on people’s movements, thereby invading their privacy?

“Beacons only transmit data, they don’t connect with the phone,” adds John Leonard, Nordic’s tactical marketing manager. “In theory, the app could collect data and then potentially transmit the log of the information, but the beacon itself can’t gather information.”

In fact, compared to other wireless technologies like Wi-Fi, the threat to consumer privacy from beacons is pretty small, agrees David Edwin.

“Beacons are designed from the ground up for privacy,” says Edwin. “Your phone’s Bluetooth Smart address keeps changing, unlike its Wi-Fi MAC address; it’s simple to track you based on your MAC address. But a Bluetooth Smart device from the phone side was always a moving target. You couldn’t track anybody for more than 15 minutes. With beacons, even that is not possible because you’ll only be passively receiving the data. You never actually transmit anything.”

BEACON HARDWARE

A key challenge in beacon hardware design concerns power consumption, since beacons are intended to run on batteries for years rather than months on one charge. CSR recommends its CSR101x family of Bluetooth Smart radios (with integrated MCU) for beacon hardware, because they can run from a 3-V battery and connect directly to a printed-circuit-board (PCB) antenna. The chips use a hardware solution to manage the Bluetooth Smart radio links, resulting in longer battery life.

Kits suitable for developing beacons based on the CSR101x include the company’s Proximity Beacon reference design (Fig. 3), which comes with a directional antenna and firmware package. The company’s beacon application software runs on either the Beacon kit or the CSR1010/CSR10111 dev kits (reference apps are available for iOS and Android, too). A fieldservice app being developed will enable maintenance of beacons in the field using a smartphone or tablet.

Also suitable for beacon hardware is Nordic Semiconductor’s nRF51822 Bluetooth Smart and proprietary 2.4-GHz radio system-on-a-chip (SoC), which incorporates a 32-bit ARM Cortex M0 core and 256 kbytes of flash. This device uses the programmable-peripheral-interconnect (PPI) technique to optimize a beacon’s battery life by letting analog and digital peripherals interact without CPU intervention.
Munich, microprocessors, beer, and bratwurst.
Paul Whytock takes a lighthearted look at how to make the most of your time at the show and in the city.

Munich’s mega techfest, aka the Electronica 2014 show, becomes golden this year, as it celebrates its 50th anniversary. From November 11 to 14, approximately 2700 electronics companies from around the globe will display their latest innovations.

For some people, the thought of visiting this enormous event, trudging many kilometers through what seems like a never-ending maze of exhibition halls, is about as attractive as making a trip to the dentist’s office.

But forget those wannabe technology lud-dites. Electronica is still considered by electronics engineers, designers, purchasers, and academics as an opportunity of utopian proportions to catch up on the latest electronics technology. That’s why this year’s show expects to attract over 70,000 visitors.

At the exhibition, they’ll be presented with a bewildering array of electronic technologies housed in a baffling number of halls and loca-
tions (Fig. 1). But after being bewildered and baffled during the busy day, don’t expect the confusion to stop. Come the evening, some critically important decisions must be made. Like where shall I eat and drink tonight, and what train must I catch to get to these venues.

Before taking a look at the nocturnal delights offered by Munich, I’d better mention a few things about Electronica 2014. Foremost, there are innovations…by the bushel-full, and the bushel is the size of a small city. Innovations spread across the entire electronics landscape, from semiconductor technology, displays, nano-systems, sensors, test and measurement, EDA, and passive components to electro mechanics, power electronics, PCBs, and automotive and wireless-related technologies.

CLIMBING THE TECHNO-MOUNTAIN
Do not get overwhelmed trying to scale this mountain of technology. First thing to do upon entering the show is grab a show guide. They’re easy to recognize—similar in thickness to Mr. Schwarzenegger’s forearm and heavy enough to knock out a rhinoceros. Seize this redoubtable tome, sit down, and begin meticulously planning your itinerary for the day. This

 Survivial Guide

1. The Munich show ground, venue for Electronica 2014, is huge, so plan your itinerary carefully to avoid severe dehydration and potential insanity.

3. In the middle of Munich and right beside the Church of Our Lady cathedral sits one of the city’s most original and traditional public houses—the Nuremberg Bratwurst Glöckl. A very relaxing venue. Dress code? Anything pretty much goes, including lederhosen.
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will not only save an enormous amount of time, it will also considerably reduce the number of blisters on your feet, and improve your chances of leaving the show with a modicum of your sanity intact.

**FORUMS AND CONFERENCES**

Electronica isn’t just a massive exhibition, though. A slew of forums and conferences are on tap that cover a multitude of technologies.

Efficient energy consumption will be a prime subject this year, especially when you consider that manufacturing machines account for two-thirds of all electricity consumed by the industrial sector. According to the German Electrical and Electronic Manufacturers’ Association, intelligent automation systems could save 10% to 15% of all energy used in Germany’s industrial sector. That corresponds to a potential savings of at least €4 billion.

Improving the power network infrastructure could further increase efficiency. Expanding renewable energies as part of the overall drive toward energy efficiency presents networks with major design challenges due to fluctuating power flows. Electronica’s forum on this subject will present technical ideas and offer possible solutions.

**CARS AIN’T WHAT THEY USED TO BE**

Automotive electronics has now firmly established itself as one of the most important market sectors for electronic components. The increased networking of automobiles, or “electromobility” as it’s sometimes called, coupled with the development of autonomous driving, will mean additional design work and eventual sales for the international electronics industry.

Germany’s economic development agency, Trade and Invest, revealed that the global market for automotive electronics in 2013 approximated €200 billion. According to analysis by the German Electrical and Electronic Manufacturers’ Association, it predicts that market to increase to more than €430 billion by 2025.

Klaus Meder, chairman of the automotive electronics division at Robert Bosch, tends to agree with the strong outlook: “The future of driving is electrified, automated, and networked.”

With electronics of course playing a central role in the rise of electromobility, the value of hardware and software in the automobile will continue to grow in the years to come. Expanded Euro NCAP guidelines, used to assess vehicle safety, are driving the spread of assistance systems such as advanced emergency braking systems. Customers and manufacturers alike are putting their money on more and more networked functions in the automobile, and new drive solutions will make it possible to further reduce CO₂ emissions and conserve resources.”

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- ARM-based computers & processors
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- Small-form-factor boards: Tools & software
- Electronic lighting software development
- Medical electronics
- Organic electronics

Learn more about Electronica 2014 at: http://www.electronica.de/

**GETTING TO THE SHOW**

To see and embrace all that technology, you’ve first got to find a way to the show. With over 70,000 people in attendance, that can turn into a rather challenging prospect.
Nearly half of the people that visited Electronica 2012 came from abroad. So, if you’re flying into Munich airport, there are a few ways to get to the exhibition grounds. Unless there’s a group of you, taxis can be very expensive. The best and most economical transport, by far, are the regular buses that run from just outside the airport terminal to the Messestadt (show ground).

If your first port of call is central Munich, the city’s train system is a joy to use. It’s clean, reliable, and efficient. Options include the S Bahn or U Bahn trains. (There’s also the Lufthansa City Bus Service that runs into central Munich and terminates at the Hauptbahnhof, Munich’s main railway station.)

The S Bahn lines are the suburban trains that run within the city and to outlying areas. The U Bahn constitutes the central city lines. Without a doubt, the majority of people staying in central Munich take the U Bahn. The U2 line runs to the show and makes two stops at the fairground, Messestadt West (Fig. 2) and Ost (east).

**BAFFLING TICKET TARIFFS**

So far, so good, but there is just one major headache when it comes to riding the train—the mind-numbingly complex ticket tariffs that not only totally baffle overseas visitors, but also confuse any citizen of Munich with an IQ under 140.

Above all else, remember this: The Munich rail system works on an honesty policy. There are no entrance or exit barriers, so nothing can physically stop you from completing your journey without a ticket. Do not attempt this, though, no matter how tempting and easy it may seem.

Decipher the complex instructions on the ticket-issuing machines and get your ticket. Before entering the platforms, make certain you use one of the small machines nearby to date- and time-stamp your ticket before boarding the train. If you forget, it’s at your own peril, because you’re considered to be riding illegally without a ticket.

**DO NOT PLAY THE DUMB TOURIST**

To stress the above point, plain-clothed officials riding aboard Munich’s trains will spot-check passengers to see if they have a ticket and whether it’s date- and time-stamped. And when questioned by those ticket inspectors regularly patrolling the trains, don’t act like the dumb non-German-speaking tourist—you’re not going to get away without having a ticket. They have heard it all before, and the fines are steep.

Find essential transportation help at: http://europeforvisitors.com/munich/articles/u-bahn-s-bahn.htm
Grab a map of the Munich rail network here. Print it, you’re gonna need it:

**LET THE EVENING FUN BEGIN**

Like the vast proportion of Electronica’s international visitors, I stay in Munich. No matter what, don’t be tempted to stay in a hotel near the show. It may be very time efficient in the morning, but it’s a very boring otherwise and you’ll miss out on a fantastic city. Need convincing? Take a look at:
http://www.panorama-cities.net/munich/images_munich.html

My advice is stay as near to Marienplatz—the central square of Munich—as possible. From here, it’s an easy train ride into the show in the morning. In the evenings, though, it’s also the place for beer and food. Munich is world famous for its variety and quality of beer and a great pub guide can be found at:
http://www.europeanbeerguide.net/munipubs.htm

Now I’m more of a wine man than a lager beer person. But that changes when I’m in Munich… I drink both! The beer is great and so are some of the beer halls where you drink it. They’re invariably linked to the breweries that produce the stuff, so they’re a must-visit. To get a “taste” of the major breweries, check out:
http://www.beerdrinkersguide.com/BDGWebsite/MunichBeer/BigSix.htm
The Hoff Brau House is the best known and, consequently, way too much of a tourist trap for my taste. However, it’s where Adolf Hitler made some of his early political speeches during his quest for dictatorship and world domination, so it does hold a certain dark fascination. Expect to see typical Bavarians dressed in their lederhosen quaffing enormous glassfuls of beer. Even more astonishing are the Bavarian waitresses who can carry armfuls of these full glasses to your table. Prost.

BIG ‘N BRASH

Back to the beer halls, one of my favorites is the Augustiner Großgaststätte. It’s huge, historic, authentic, brash, very Bavarian, and both the beer and food are good. Do not expect microscopic portions of designer food. Beer comes in bucket-sized glasses and the food portions are Fred Flintstone size. The suckling pig is particularly good. The Augustiner is centrally located and only a short stumble from Marienplatz:
http://www.augustiner-restaurant.com/

Another traditional venue well worth considering is the Nuremberg Bratwurst Glöckl (Fig. 3). Don’t be confused about the name; this restaurant is smack bang in the middle of Munich right next to the cathedral. Its Web site gives you a clue that this is not a quiet, refined establishment, but rather an exuberant taste of traditional Bavarian hospitality and fun:
http://www.bratwurst-gloeckl.de/

But some prefer to visit a nice restaurant that doesn’t serve mountainous joints of pig accompanied by bucket loads of sauerkraut and soccer-ball-sized dumplings. Don’t worry, because Munich has plenty of fine dining experiences. One is the restaurant at the Königshof Hotel, which boasts a great wine cellar:
http://www.koenigshof-hotel.de/en/restaurants

MAKE MINE MINIMALIST

Alternatively, there’s the well-rated Spatenhaus, with its splendid views of the Munich Opera House, and a new addition to the city’s gastronomique hierarchy, the ultra modern Les Deux. Well worth trying if you like minimalist décor combined with high-quality modern European food. You won’t need your chainsaw for pig knuckles in this joint!
http://www.lesdeux-muc.de/restaurat/

There are, in fact, plenty of excellent restaurants in this city. A lot of them can be found at:
http://www.munich-info.de/restaurants/lists/restaurants_en.html

LOVE THE SMELL OF WEISSWURST IN THE MORNING

One final culinary point for first time visitors to Munich involves white sausages called weisswurst. First created around 1850, they’re made from veal and bacon flavored with parsley, onions, ginger, and cardamom. They look very anemic, and for many people, are hideously unattractive. I like them, but you should only eat them between breakfast time and 12:00 noon.

The sausages are made daily and the tradition of consuming them in the morning dates back to days before modern refrigeration. You will see Munich’s citizens eating them for breakfast with a substantial dollop of sweet mustard and very often a cold glass of Pils. And don’t eat the skin, only the meat inside.
DC-DC Converter Power Density: Too Much of a Good Thing?

Alexander Goncharov, CEO, AEPS-group, Andrey Kuznetsov, CTO, AEPS-group

WHEN TRACKING THE development of dc-dc converters, the trend of greater power density becomes readily apparent. Fueling this trend are constant advances in circuit engineering and materials, coupled with the goal of lowering the weight and dimensions of power-supply systems. Market leaders decisively push values of 100 W/in.² and above. But does this power density dynamic really get us closer to the goal?

It is well known that dc-dc converters emit thermal energy that needs to be dissipated by some method, often times external heat sinks. Increasing power density means less heat-conducting surface area to transfer thermal energy to the heat sink. At the same time, the decreased surface area lowers the heat sink’s efficiency, leading to an increase in its dimensions. Thus, the power-density parameter conflicts with cooling efficiency and with the size of the heat sink required. This explains why reducing a dc-dc converter’s dimensions becomes ineffective after a certain point. The need of an external heat sink or forced-air cooling inhibits further downsizing of the whole structure—converter + heat sink (+ fan).

Moreover, one should keep in mind that many applications exclude the use of forced-air cooling (fans). Any solution should thus make it difficult to determine the best option among the vast variety of dc-dc converters available in the market. In this article, we would like to introduce JETD—a new line of dc-dc converters in brick format—produced by the Czech-based company AEPS-group. We will outline the key differences of these products compared to the other modules in the same form factor. In some cases, these characteristics prove to be decisive factors based on project requirements.

The JETD product line currently consists of dc-dc converters with power levels ranging from 20 to 400 W, and dimensions from 1/16 brick to full brick. You can find detailed characteristics of these units at www.teslaelectric-eu.com.

The JETD units feature the ultra-wide case operating-temperature range of −60 to +125°C, and come encapsulated in a heat-conducting compound. As a result, they are well-suited for harsh-environment applications. Most available dc-dc converters in the market feature maximum case operating temperatures around 100 to 105°C. When limited to brick-format dimensions and forced-air cooling is not an option, the heat sink can be decreased (or completely eliminated) in one of two ways: Increase the unit’s efficiency and/or increase maximum case operating temperature. Regarding efficiency, most manufacturers offer approximately equal levels. Let’s examine how a higher maximum case operating temperature helps build more compact dc-dc converter/heat-sink systems.

First, consider how output power depends on ambient temperature, in natural convection conditions, for several brick formats without a heat sink. We assume that the efficiency is 90% and brick-format dimensions determine thermal resistance (case-air). This thermal resistance parameter differs slightly depending on the manufacturer, so our calculation will use an approximate average: $\theta_{ca}(1/4\ brick) = 10°C/W, \theta_{ca}(1/2\ brick) = 7°C/W, \theta_{ca}(full\ brick) = 3.7°C/W$.

For each of the three case types, let’s check the dependency of the output power (no heat sink) on the ambient air temperature. Each time, we will examine two options in terms of maximum case operating temperature: $100°C$ and $120°C$.

The figures show the maximum power provided by the brick-sized units and the difference between dc-dc converters with 100 and 120°C maximum. Mathematically, this translates to:

$$P_{out,max}(T_a) = \frac{(T_{case,max} - T_a)}{\theta_e \eta / (1-\eta)}$$

where $P_{out,max}$ = maximum output power, $T_a$ = ambient temperature, $\theta_e$ = thermal resistance, and $\eta$ = efficiency.

Based on Equation 1, we can express the advantage in maximum power achieved by...
changing the maximum case temperature from 100 to 120°C:

\[ P_{\text{out, max}}(120°C(T_a)) - P_{\text{out, max}}(100°C(T_a)) = 20°C/\eta*(1 - \eta) \] (2)

For 90% efficiency, it becomes:

\[ \Delta P(120°C - 100°C) = 20°C*9/\eta = 180°C/\eta \] (3)

Equations 1, 2, and 3 are relevant for applications with or without a heat sink, given that the thermal resistance of the chosen heat sink is taken into account.

The figures also show the level of power (depending on ambient temperature) that necessitates use of a heat sink for each brick form factor. For instance, several manufacturers produce full brick-sized units with power levels of 250 to 700 W. The power density of such modules requires a bulky heat sink that’s several times larger than the cooled unit itself.

Another important point must be made at this juncture: Using heat sinks in natural convection conditions diminishes cooling efficiency. For example, consider the 61-by 58.5- by 12.7-mm 1/2 brick. When combined with a heat sink of the same size (surface area and height), and with the grills number equaling 10, there’s virtually no decrease in thermal resistance according to the datasheets.

This creates a seemingly paradoxical situation. The thermal resistance of the 1/2-brick case (we used \( \eta = 7.0°C/W \)) on its own is almost the same as with a 12.7-mm-high heat sink. Given some loss in heat conductivity at the interlock, there could actually be an increase in thermal resistance. For a heat sink twice as tall (25.4 mm), thermal resistance will fall to 4.5 to 4.6°C/W. This double-sized heat sink increased the total height threefold, yet the thermal resistance dropped only 1.5 times.

In fact, increasing the maximum case operating temperature from 100 to 120°C is similar (in terms of maximum power) to installing a cooling heat sink. For instance, calculating using Equation 1, the thermal resistance of this equivalent heat sink at \( T_a = 50°C \) is lower than that of the case alone in the following proportion:

\( \frac{(120-50)}{(100-50)} = 70/50 = 1.4 \)

In the JETD product line, additional measures were taken to lower the effective thermal resistance using the printed-circuit board (PCB) that hosts the unit. The surface of the copper foil on that PCB acts as an additional heat dissipater, lowering the case’s thermal resistance.

To take advantage of this factor, the JETD units are designed for maximum thermal bond between the case and the mounting grommets, as well as between the case and the output pins. Effective case thermal resistance thus drops further—up to 25% for 1/16 bricks and 1/8 bricks. For 1/2-brick and full-brick form factors, thermal resistance will lower 5% to 10%.

So, can there be too much power density? Yes, if you cannot put up with a large and heavy heat sink. Power density cannot be evaluated in isolation from the other product features. Higher values of power density should not be seen as a guarantee of a more compact power-supply system.

On the other hand, increased maximum case operating temperature can substantially help fulfill this objective. The JETD series, with its temperature maximum of 120 to 125°C instead of the more common 100 to 105°C, gives engineers the ability to design significantly more compact and lightweight power-supply systems.
Behind the ENGINEERING that Goes into a Leg Prosthesis

A microprocessor-controlled knee joint gives the C-Leg prosthetic human-like flexibility, and a pump-based socket design delivers cushioned comfort.

In 1919, a German prosthetist named Otto Bock surveyed the results of the bloody butchery of World War I and set out to improve the functionality of the artificial limbs that wounded soldiers and civilians needed to carry on their lives. His first innovation was to make the production of artificial limbs into a production-line operation, rather than a custom process for each amputee, as it had been in the past. Needless to say, the rest of the 20th Century provided more than ample opportunity to refine and innovate the mass-produced, fitable, artificial limb.

Mr. Bock died in 1960. Today, Otto Bock Healthcare, the company named after him, is a global organization headquartered in Duderstadt, Germany, with engineering facilities worldwide, including Minneapolis.

The company is known, among other things, for its “C-Leg” a microprocessor-controlled above-the-knee prosthesis (Fig. 1). There are numerous videos on the Web showing men and women who wear the leg riding bicycles, enjoying strenuous sports, and otherwise living full lives. The engineering story behind the C-Leg is intriguing.

RE-CLOSING THE FEEDBACK LOOP

Our human, upright-stance, two-legged locomotion shouldn’t be possible. It’s a constant battle against gravity, based on sensors located everywhere from our ears to our limbs to our toes. A request for a movement is initiated by the brain, which sends impulses through the spinal cord and nerves to the muscles, particularly, the calf muscle. For most of us, muscle activity and nerve stimulation are constantly interacting at about 20 times a second.

To attempt to duplicate at least part of this control system, in the C-Leg, pressure sensors in the leg’s knee and ankle supply information to a microprocessor. Based on this information,
a program running on an RTOS in the C-Leg’s microprocessor controls a system of hydraulics in the leg.

In the software, walking is divided into a “stance” phase and a “swing” phase. During the stance phase, the primary task is to stabilize the leg, so that it can support the body weight when the user is not yet in motion.

The swing phase, when the user is in motion, places a greater load on the microcontroller. The prosthetic lower leg must be controlled as it comes off the ground, swings through its arc, at the pace set by the user, and is then slowed down in preparation for the next step.

In the stance phase, a C-Leg employs hydraulic damping to provide stability. It exits this state and enters the swing state when two criteria are met simultaneously: first, the knee must be fully extended, and second, approximately 70% of the body weight of the prosthesis wearer must be supported by the on the natural leg.

IT’S ALL ABOUT THE KNEES

The C-Leg’s microprocessor-controlled knees are intended to function much like those in a human leg. When the software in the microprocessor receives the sensor information, it has sufficient information to determine exactly where the knee is in the walking or gait cycle. The algorithm is based on data the company collected by analyzing the walking techniques of literally thousands of people. With that information reduced to an algorithm, the microprocessor can anticipate what the leg needs to do moment by moment. This was a breakthrough by Otto Bock Healthcare. It ultimately made the prostheses proactive, rather than reactive.

For example, in a sound leg, at the end of a swing phase, just before the heel scrapes the ground, the quadriceps and hamstrings simultaneously contract and prepare for loading that will occur at heel-strike. This prevents the knee from collapsing and allows it to act as a shock absorber while also creating a smooth, efficient gait. The software and pneumatic system in the artificial leg is able to emulate this.

In finer detail, what happens is this: There are two sensors in the prosthesis, one near the ankle and one at the knee joint. They provide the microcontroller with a constant stream of information, updated 50 times a second, about the user’s gait and environment. The algorithm in effect enables the C-Leg to anticipate the demands about to be placed on the system and adjust resistance to leg flexion and extension.

Mechanically, it’s more complicated: Based on information from the sensors, the microprocessor-controlled servo-motors open and close valves in the hydraulic channels, increasing or reducing resistance in the knee. These channels can be engaged alone or simultaneously, similar to the large muscles of the leg, to create the appropriate resistance no matter where the user is in the gait cycle. Because each C-Leg user is unique, the practitioner will use Otto Bock software designed for the C-Leg to set special resistance parameters.

The company’s BionicLink system takes advantage of Bluetooth technology, so that the user or a prosthetist can set semi-permanent system parameters tuned to the wearer’s physical characteristics. The various parameters allow the C-Leg to “predict” where the user will be, moment to moment, and enable it to function proactively. The link also allows the wearer to switch among parameters dynamically, in order to adapt to terrain or the type of physical activity he or she is involved in.

Based on sensor information, during the swing phase, the microprocessor anticipates when the leg is about to make heel contact, enabling it to calculate the resistance parameters that will be needed for stance-phase security. With that calculation, it can instantaneously adjust the knee’s flexion valve to adjust resistance in a way that conforms to the user’s gait pattern and the current environment.

Then, at the end of each stance phase, the microprocessor recognizes forefoot pressure in conjunction with a straight knee and opens the flexion valve to prepare for swing phase.

The sophistication of the gate cycle part of the algorithm even allows for “stance flexion,” or the natural flexing of the knee that normally occurs after heel contact in a sound leg. This acts like a shock absorber and provides the user with a more natural gait while simultaneously helping him or her expend less energy.

Another aspect of the algorithm is that it restricts the C-Leg from swinging freely unless two criteria are met: the knee must be fully extended and there must be at least 70% of the user’s weight on the forefoot. These points are important because, if the user starts to trip or stumble, it causes the knee to default to its most stable setting, preventing the fall. This is what allows users to walk down stairs and slopes step over step with absolute security.

(continued on p. 31)
Apple introduced two new models, the iPhone 6 and iPhone 6 Plus. The main new feature is larger screens, 4.7 inches diagonally and 5.5 inches diagonally, respectively. These are major increases over the iPhone 5’s 4-inch screen which is considerably smaller than its rival’s screens. Samsung with its Galaxy 5 and 5.5-inch screen and those from HTC, LG, and others have been taking sales away from Apple. With this introduction, Apple catches up with the marketplace. Screen resolution on the iPhone 6 remains at 326 pixels per inch, but the iPhone 6 Plus gets an upgrade to 401 pixels per inch for its larger screen. Both phones should do well against the competition.

The iPhone 6 models now include near field communications (NFC), a short range 13.56-MHz radio technology that permits very secure data transfer over a range of a few inches or less. This not-so-new technology targets the wireless payments movement, where a tap or wave of an NFC smartphone replaces credit cards for retail payments. Many Android smartphones have had this technology for years, but have not been useful as most retailers have yet to buy the readers and adopt the payment software and systems. With Apple’s inclusion of NFC, the wireless payment movement should make a leap forward. It’s up to the retailers to welcome the millions of new Apple customers and deploy the capability. An extra layer of security has been added to reduce the potential for hacking, as a fingerprint and new coding is required for payment.

There is no better all-in-one communicator than a smartphone, and Apple’s new iPhone offerings make such communicators even better. In case you missed Apple’s introduction Tuesday, September 9th, here are some highlights and my take.

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To aid the NFC payment system, Apple has also implemented Apple Pay, a system that allows consumers to use their existing American Express, Mastercard, and Visa cards at many new locations in addition to major retailers such as Macy’s, McDonald’s, and Walgreens. Apple will get a cut of the transaction fees. Again, this new system should advance the nascent digital wallet concept.

The new iPhones also sport new computer technology, including an upgraded multicores A8 processor and an update of the iOS operating system. The new 64-bit processor is faster than the older A7, and has an accompanying M8 motion processor. The iOS8 upgrade offers better synching to iPads and iMacs amongst other updates. The iOS8 will also work on iPhone 5s.

The new iPhone 6s now include 802.11ac Wi-Fi. This faster version of Wi-Fi operating in the 5 GHz band has been around for a while, but not widely adopted. Many new 11ac access points have already been deployed, and the Apple adoption should let consumers enjoy the faster download speeds that approach upwards of 1 Gbit/s. Apple is also making it possible to use Wi-Fi voice offload to make calls if cellular coverage is poor. Some carriers are beginning to adopt this method (e.g., T-Mobile).

The latest iPhones also incorporate the latest in Long Term Evolution (LTE) technology, including VoLTE. LTE, of course, is the 4G technology enabling high-speed data applications over cellular networks. This means boosting download speeds to 150 Mb/s under the right conditions and incorporating the new and unique 4G bands used by each service provider. Apple supports up to 20 LTE bands, more than most manufacturers, meaning a greater number of potential LTE cell sites can be accommodated. As for voice over LTE (VoLTE), this improved voice technology is gradually being phased in by most of the carriers replacing the currently dominant 2G/3G voice technology.

The Apple Watch is another major product introduction. It is available in three basic forms, a standard watch, a sports model, and a fashion piece. All have multiple band choices, allowing users to customize the watch to their style and need. These watches come with a color touchscreen and communicate with an iPhone 5 or iPhone 6 via Bluetooth. The Watches boast superior time-keeping accuracy based on a new technology. I was not able to determine the technology used, but it may be the wireless connection to NIST’s ultra-accurate time station WWVB using the 60-kHz (yes, kHz) frequency. There are also a huge number of time display options to satisfy everyone. The watches respond to and can handle voice calls, texts and email. There are too many other features to describe here.

While I believe the new phones will do well, I am not sure how the Watch will sell. It is a high price to pay for what is essentially a peripheral to the iPhone. Samsung, Sony, Pebble, and others have been offering smartwatches for over a year, yet the watches have not been widely accepted by consumers. Those offering sports and fitness watches have been the most successful. Apple could suffer the same poor acceptance as the others, or it could generate a new level of interest in the smartwatch movement. We’ll keep a close eye on whether or not Apple’s “magic” still works.

Other features worthy of note are the addition of a barometer to the iPhone 6 sensors. Cool feature. While camera resolutions remain at 8 Mpixels, the video camera can now achieve 240 frames per second to enable slow-motion playback. Take a look at the Apple website to see even more details.

The new iPhone 6s went on sale September 19th and will be available from Apple as well as the main carriers—AT&T, Sprint, T-Mobile and Verizon. Prices are $199 for the iPhone 6 with a two-year contract and $299 for the iPhone 6 Plus with a two-year contract. Most carriers now offer unsubsidized installment payment plans in lieu of the two-year contract. The Apple Watch will be available early next year for $349, a very high-end accessory.

Overall the latest announcements are very impressive, and all of these new products should succeed as the Apple faithful upgrade while others switch over.
Okay, you have an embedded project in mind. Enhancements are the goal, which means changing the peripheral complement. With the last project, however, it was hard to add peripherals due to limited peripheral interface hardware on the development board. Cables ran all over the place. At this point, a more modular system would be nice.

One evolving option comes from E3 Embedded Systems. It took the Processor Independent Embedded Platform (PIEP) to Kickstarter on August 15th to see if the embedded community could take advantage of its modular prototyping system (Fig. 1).

Essentially the platform is a small motherboard that has a socket for a processor module and lots of sockets for peripheral interfaces. It also has many small cable connectors. PIEP is built around peripheral modules (Fig. 2) that measure 1.25-in. on a side and contain a stackable 10-pin header. Two holes provide a rigid, three-point mount. The header provides power and ground along with eight signal lines. There are four types of sockets on the motherboard: SPI, I2C, UART, and discrete I/O. The stackability depends on the type of module.

For example, the SPI modules often have three of the signals dedicated to chip selects. Typically, wires connect these signals to the chip select on the module. Two need to be cut if the module is stacked, allowing two other SPI modules to be added in the stack. The use of wires instead of slide switches reduces cost. Also, it's easy to solder a wire back if changes are necessary.

PIEP sockets reside on both sides of the motherboard. That's a dozen PIEP sites, although most are digital sockets mixed in with a pair of SPI, I2C, and UART sockets. PIEP modules can take up more space, but usually their primary interface uses one of the connectors.

The key to the system is the easy attachment of peripheral modules, as well as the robustness of a finished system. Typical development platforms offer one or two expansion connectors and usually a giant header to expose all of the devices pins. It’s then up to the developer to figure out how to connect those to the outside world.

The hardware comes with connection maps, since each processor module exposes different interfaces. It’s also useful to know what pins will be connected to what devices. Many processors have pin-remapping capabilities, providing even more system flexibility.

The 10-pin, low-profile sockets spaced around the board are complementary to PIEP 10-pin headers. The sockets provide power and ground, allowing off-board peripheral connections.

The processor modules initially include:
- Atmel SAM3X with dual CAN and Ethernet support
- Freescale MC9S12 with 512 kbytes of flash and CAN support
- Microchip dsPIC33 with 280 kbytes of flash and CAN support

Each processor has distinct advantages. The Atmel module is based on the 32-bit ARM Cortex-M3 platform, while Freescale...
and Microchip offerings use 16-bit architectures. Freescale’s MC9S12 is an automotive part that will be around a long time. Microchip’s dsPIC33 is a robust digital signal controller (see “16-bit DSC Handles Dual Motor Control And USB Communication” at http://electronicdesign.com/boards/16-bit-dsc-handles-dual-motor-control-and-usb-communication).

Hardware primarily comes from E3 Embedded Systems. You will need development debugging tools to program and develop applications. The processor modules expose their debug interface on the motherboard. JTAG debuggers can plug into the usual header, while the Microchip MPLAB ICD 3 with MPLAB X (see “NetBeans Powers New PIC IDE” at http://electronicdesign.com/embedded/netbeans-powers-new-pic-ide) requires an adapter.

**ADVANTAGES AND DISADVANTAGES**

Of course, there ain’t no such thing as a free lunch (TANSTAAFL), and that’s the case with PIEP. The PIEP platform is similar to other module expansion systems like DigiNet’s Pmod used on its Cerebot family. The Pmods are about the same size as E3’s modules, but have one or two rows of right angle headers on the modules. This makes for a cheap processor board with lots of Pmod sockets. The downside is they are held in place by the header pins alone, which can be precarious. In this case, the PIEP has the advantage.

Other stackable solutions are out there, such as PC/104, which uses much larger boards. Most vendors offer expansion options for their own development boards, but the available peripheral complement tends to be related to their other products. For example, Texas Instrument’s BoosterPack for its Launchpad series has a single socket set, although it’s possible to have multiple sets on a board. Microchip’s PICtails are expansion boards for its development kits.

The limitation on E3’s current offering concerns the processor side. Though there are only three available modules, they provide a good selection for targeted application areas. The system can be utilized by almost any microprocessor and the processor modules are relatively simple to design.

Another advantage to PIEP is simplicity. The 10-pin headers are limiting, but modules can be easily designed for them. Laying out a board is a relatively trivial process; in fact, most will be double-layer boards. There just isn’t space to get too complicated. Even hand-soldering is practical, although some surface-mount chips might present a challenge. On the other hand, the PIEP can be applied to other platforms as well.

**SUPPORTING THE ARDUINO**

The PIEP Shield Adapter for Arduino (Fig. 3) might be an alternative for some designers. It features a pair of dual-personality PIEP sockets. One set has an SPI and digital interface and the other has an I²C plus digital interface. Other connectors spaced around the board have 10-pin PIEP interfaces. I find the shield a more compelling platform if standard processor modules don’t fit your requirements. The Arduino started with an 8-bit Atmel AVR, but its popularity has led to many new Arduino and third party Arduino-compatible boards, such as Freescale’s Freedom boards (see “Cortex-M0+ Freedom Modules Support Arduino Shields” at http://electronicdesign.com/microcontrollers/cortex-m0-freedom-modules-support-arduino-shields) and DigiNet’s boards with Microchip’s 32-bit PIC32 (see “Arduino Expands Into More Demanding Applications” at http://electronicdesign.com/boards/arduino-expands-more-demanding-applications).

Lots of shields are available for the Arduino, and it’s possible to stack them. However, that stack can get large and expensive. PIEP modules are much smaller.

**HANDS-ON PIEP**

I had a chance to check out the PIEP system with all three processor modules and the main motherboard, as well as the PIEP Shield Adapter. I started with the Microchip module, since I knew where my ICD 3 was hiding. The adapter mount isn’t very solid, but it works. A new version might be forthcoming.

Debugging was on par with other Microchip development boards. However, I had to do a bit more work to figure out what devices were connected to which pins. It was to be expected, though, and it tends to be done once for a particular project. I didn’t stack a lot of modules, so I actually left some of the jumpers intact. If you don’t drive the lines, then they essentially float.

Some of the first modules I used included the LED display and button module. The problem with the system is that without these, there’s little feedback. In fact, the button module is handy because it has four LEDs and four switches. The breakout boards only provide cable connections.

Overall, the PIEP approach is useful for MCU projects from robots to process control. Whether you have an Arduino-compatible system or are looking for a better development platform, then the PIEP is worth a look. 

In an effort to broaden business opportunities in Europe, North American distributors hope to capitalize on Electronica 2014 exhibit to make new connections.

Europe remains an important target for supply-chain companies based in North America. As the outsourcing trend trudges on, companies look to cultivate current and new business opportunities across the continent. The trend has companies large and small focused on expanding their presence with new locations, personnel, marketing programs, and other services aimed at satisfying demand in both the design-engineering and production sides of the business.

Texas-based independent distributor Smith & Associates represents one such company. Smith has maintained a presence in Europe for 15 years, and will use the upcoming Electronica 2014 Trade Fair as an important marketing tool. Scheduled to be held in Munich November 11-14, 2014, the 26th Annual Trade Fair for Electronic Components, Systems, and Applications—known as Electronica—is one of the electronics industry’s top attractions, held every two years.

 “[We are] exhibiting at Electronica Munich with a full complement of sales, purchasing, marketing, and business development staff to offer in-depth views of Smith’s global procurement support services,” says Mark Bollinger, Smith’s vice president of marketing. “At Electronica, Smith will highlight our unique and long-standing capabilities that are focused on meeting Europe’s high standards for quality and specific regulatory requirements, including RoHS, WEEE, CE, among other regulatory compliances.”

Smith is not alone. Other top distributors will use Electronica as a platform to grow and develop business over the next two years. And it’s no surprise, considering that the electronics supply chain has become increasingly global, with Europe playing an important role in the transformation.

“Europe’s progressive outlook on automation and energy conservation make it an important market,” adds Bollinger, pointing to large-scale municipal and Smart City projects in Europe that demand localized support and leading-edge medical device and automotive electronics research, design, and manufacturing that demand both quality as well as strong support services.

“We view the European market as a growth opportunity,” continues Smith’s Bollinger, “and our company’s strategy is to continue supporting the vital projects of Europe’s leading electronics innovators.”

NORTH AMERICAN OUTSOURCING TRENDS

To what regions is your company outsourcing design and production work?

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The tre...
OUTSOURCING DRIVES BUSINESS GROWTH

More than 60% of North American electronic component buyers say their companies outsource manufacturing and design services to other regions and that Europe remains one of the top attractions, according to Global Purchasing’s 2014 Profile Survey of approximately 800 purchasing and supply chain professionals.

Released in October, the report showed that 16% of companies outsource design and manufacturing services to Europe, making the region fourth behind outsourcing to other locations in the United States (72%), China (32%), and Mexico (16.5%). Europe came in just ahead of other key regions such as India (14%) and Canada (12%).

Another U.S.-based distributor capitalizing on the trend is Minnesota-based Digi-Key Corp., which developed a new footprint in Europe over the past two years, focusing on the region’s production business. Digi-Key used Electronica 2012 as a launching pad for its new presence in the region, and has big plans for this year’s show as well, according to the company’s corporate communications director Michelle Gjerde.

“This is our fifth Electronica, and we’re going all out as we typically do,” explains Gjerde, pointing to key marketing and promotion efforts aimed at attracting attendees Digi-Key. The distributor will raffle chances to win a 2014 Tesla and is sponsoring hourly iPad giveaways, for instance. Plans also include celebrity look-alikes, interactive games, and special student-targeted promotions. Digi-Key will give away two Vespas and 10 laptops during the exhibition’s Student Day event.

“We can really point to impressive growth in the region,” says Gjerde, noting that Germany, the United Kingdom, and other regions of Europe represent Digi-Key’s largest growth in recent years—upwards of 30%.

Digi-Key will take advantage of the four-day event to announce new Web and e-commerce initiatives, as well as a slate of new design tools as part of its recent partnership with software provider Mentor Graphics.

Other distributors that already have a strong foothold in Europe will also be making waves at Electronica. Avnet Electronics Marketing EMEA, for instance, will introduce its MSC Technologies division during the show as part of the Embedded Platforms Conference.

“We focus on intelligent embedded and display solutions for various industrial applications—everything from a single source,” according to Wolfgang Eisenbarth, director of communications at MSC Technologies. In doing so, the company promises scalable processor technologies, advanced communications interfaces, and maintenance-free system solutions, especially for future markets such as home automation and energy technology.


GO TO ELECTRONICDESIGN.COM

Medical Technology

(continued from p. 25)

That’s a basic description of the primary mode of operation. For special situations, there is a second mode that can be programmed for each user by C-Leg practitioners. This second mode can be used to create a free-swinging leg for bicycle riding, for instance, or higher resistance for standing, such as a surgeon might require during long procedures.

While afoot, users can switch between modes in two ways. There is a hand-held remote control that can toggle the switch. But for more intuitive operation, the user can bounce on the toe three times. For users who have grown more comfortable with the C-Leg, the remote control lets allows them to make incremental adjustments to swing-phase dynamics.

Finally, there is also a “standing” mode, something no other artificial limb offers. This mode sets the knee at any flexion angle between 7 and 70 degrees to allow the user to shift weight so the prosthesis can relax their sound limb. To engage the standing mode, the user selects this option on the remote control, flexes the knee, and then straightens it slightly to the desired flexion angle.

ALTERNATE VERSIONS

There are actually two versions of the C-Leg knee, the Standard and the Compact. The Standard version is intended for those users who can utilize second mode for varied activities; those with higher activity levels who can take advantage of the microprocessor-controlled swing-phase features; those who could improve their gait when using extension damping; and those who would benefit from the standing mode—in other words, the whole gamut of features described above.

The Compact, on the other hand, is best suited for those who need optimum stance-phase stability, but who, because of a more limited activity level, would not benefit from highly variable swing-phase adjustments. Moreover, these users would not frequently engage in activities for which they require the second mode.

MAKING IT FIT

The C-Leg is more than its microprocessor-controlled knee joint. It’s also engineered for comfortable, reliable fit, and long periods of wear (Fig. 2). According to an Otto Bock patent, (US8568489), C-Legs provide a socket for the limb, with a plastic liner. A battery-powered pump creates a vacuum that forces the residuum of the user’s leg down against a squishy, fluid-filled, donut-shaped, soft plastic piece. When a vacuum is applied, fluid is forced out of the donut through a two-way valve and into a flexible reservoir.

The valve arrangement allows dynamic cushioning between the residuum of the leg and the socket as the user walks without breaking the suction that secures the prosthesis to the user. The vacuum pump is also controlled by the microprocessor that controls the swing and stance modes of the knee joint.

MEDICAL TECHNOLOGY
Automotive
LOU FRENZEL | Contributing Editor

Will Electric Cars Ever Be Practical?

I LOVE ELECTRIC CARS. I REALLY DO. They seem to be the ideal solution to many transportation issues. You’re not going to see any electric 18 wheelers or FedEx trucks, but electrics are ideal for the consumer. They are relatively simple, silent and clean. But they are still fraught with a batch of problems that keep them from going main stream. And these are the same problems that have been keeping electric cars from the masses since they were first introduced in the early 1900s. When will these problems be solved, if ever?

Electric cars, not including hybrids, make up less than 1% of the automotive market. Why? Because even the best electric vehicles still have a short range, long recharge time, a dearth of recharging infrastructure, and high prices. The typical gasoline automobile has a range of 300 to 400 miles before a refill is needed. A typical electric vehicle has a range of less than 100 miles. Some manufacturers are closing in on 200 miles, but at a very high price. This one limitation keeps most people from buying an electric car. Running out of gas, or energy in this case, is a giant pain in the rear, inconvenient, and usually expensive.

While running out of fuel still happens, such an event is much less of a problem with a gasoline vehicle. For short commutes, an all-electric may be okay. But for the typical user, more range is needed for everyday utility and comfort level.

Recharge time is also an issue. Most electric-vehicle manufacturers assume you will recharge overnight. That is the best way, of course, since it takes three to 12 hours for a full recharge. However, while you are on the road, even if you can find a charging station nearby, who wants to wait three or four hours for the recharge? With a gasoline car, you can refill in ten minutes or so and be on your way.

But that’s not all. What if you need to charge while on the road? There are a few recharge stations in some cities, but not enough. The few that I have seen are usually in use and in the middle of a four-hour recharge. How inconvenient. To be practical, electrical vehicles need a system of recharge stations. In fact, a whole infrastructure is needed if electric vehicles are really going to replace gasoline vehicles in a major way.

Finally, cost is an issue. Electric cars are still expensive. Even the cheapest are in the $30K to $40K range and over $100K for a Tesla. Low volume and high battery costs are the reasons. And don’t forget the couple of thousand dollars you will need to spend for your home 240-V recharging station. Plus the increase in your electric bill. One announced hope is that the prices of the Tesla cars may decrease if the company is successful in building the massive battery plant it is said to be contemplating. But that is years away.

What’s the solution? A better battery. One that can hold more charge per density and cost less. We have all been waiting for that battery for years. The energy of a Sears Diehard in an AA size at AA prices would be nice. Battery chemistry just does not change as fast as other technologies. Progress is being made, but it is at a geological pace instead of the Moore’s law pace of semiconductors that we are accustomed to dealing with. Fuel cells have not made much progress either, and as for the potential of a hydrogen-based refueling infrastructure, forget that. Maybe one of these days we will see solar panels on cars for recharging. Or some such breakthrough.

In the meantime, I believe electric cars will remain a niche for those who can live with the disadvantages and want to be “green.” For the rest of you, stay comfortable with your gasoline cars. If you want an electric, a hybrid is the way to go. ☛
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