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Interview with Mark Tyndall, Senior VP of Corporate Development and Strategy, Dialog Semiconductor

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Traditional flyback converters have either an optocoupler or a dedicated winding feedback circuit for obtaining a stable output voltage. However, these flyback converters from ROHM have neither, resulting in a drastic reduction in part count which allows for a highly reliable, smaller-sized isolated DC power supply.

These converters have an output load compensation feature, enabled using one resistor and one capacitor, which corrects for voltage sag during load increases. Also, the output voltage can be set by two external resistors and the transformer turns ratio.

The BD7F100 is a 1-Amp part which has a supply voltage range of 3 V to 40 V. The BD7F200 is a 2-Amp part and has a supply voltage range from 8 V to 40 V.

These two parts offer features including a fixed 400 kHz switching frequency, a low output ripple voltage, a highly efficient light-load mode using PFM operation, and over-current protection.

Industrial equipment requiring isolated power supplies are ideal applications for these optocoupler-less DC-to-DC power converters. And as always, ROHM guarantees long-term support for these devices which is very important for safety and EMI testing.

For more information, visit ROHM.com.
Scientists Develop the First Self-Destructing Battery

Of the 21 batteries used per year by the average household, only 5% of rechargeable batteries and 2% of disposable batteries are recycled, resulting in an increasing amount of toxic waste without a sustainable mode of elimination. This issue will only be compounded by the global battery demand forecasted to rise 7.7% per year until 2019. Now, researchers from Iowa State University have built the world’s first stable transient battery that dissolves in water.
Led by Reza Montazami, an assistant professor of mechanical engineering, the achievement represents a culmination of years of hard work, resulting in a self-destructing, lithium-ion battery capable of delivering 2.5 volts—more than the voltage of an AA or AAA battery—and disintegrating in 30 minutes when dropped in the water. The solution is a dramatic step forward in practicality, doubling the voltage of previous self-destructing prototypes, while systematically reducing the time it takes to dissolve—two steps closer toward a practical solution.

To date, the battery can power a calculator for up to 15 minutes, which, while it may not sound like a long time, still sees a device powered by a dissolvable battery. “Unlike conventional electronics that are designed to last for extensive periods of time, a key and unique attribute of transient electronics is to operate over a typically short and well-defined period, and undergo fast and, ideally, complete self-deconstruction and vanish when transiency is triggered,” Montazami writes in the paper, published in the Journal of Polymer Science.

In its current form, the battery measures 5 mm in length, 1 mm in thickness, and 6 mm in width and is similar to commercial batteries regarding structure and components; it contains an anode, cathode, and an electrolyte separator, uniquely placed within two layers of a water-soluble polyvinyl alcohol-based polymer. Once exposed to water, the polymer casing dissolves, disbursing nano- and micro-particles of lithium salts and silver that make up the electrodes. Incidentally, there’s no mention of any subsequent clean-up process, leaving the question of what to do with the battery residue unanswered. Washing it down the drain or dumping it into the ocean would simply trade one problem for another, which is a rather tough sell.

Therefore, the question that ultimately needs answering is, why might we need self-destructing batteries in the first place? Biotech and military technology present a few of the more obvious applications. Considering that some medical implants are not intended for permanent use, the inclusion of a dissolvable battery may eliminate the need to perform a second invasive surgery to remove the device. A trigger or timer may initiate a countdown to degrade the device over time.

Secondly, military technology armed with dissolvable batteries may function as a kill switch to render the device useless if ever it were seized by an unintended recipient. Assuming the enemy captured a highly computerized weapon system, a single button-press could disarm it, rendering it completely obsolete.

The technology is too nascent to begin forecasting any tangible application, and the current prototype is more of a proof of concept than anything practical. At the same time, the ability to dissolve even one small battery within a device invites a host of possibilities of not just device control, but possible waste management.

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—Reza Montazami in Journal of Polymer Science
HARDWARE DESIGN MADE EASY.

PCBWeb Designer is a free CAD desktop application for designing and manufacturing electronics hardware. The tool supports schematic capture and board layout, including integrated "click-to-order" manufacturing.

www.PCBWeb.com
Programmable Features Improve fast charging

By Steve Schnier, systems engineer, Texas Instruments

There have been many wearable devices released to the market in recent years. Functional improvements to these devices have resulted in better data for consumers who want to monitor movement (whether it is walking, running, biking, or climbing stairs), as well as heart rate and sleep quality.

These additional functions compel most users to wear their devices at all times. But this makes charging a challenge, because how do they charge their wearable device if they are wearing it? Adding capacity to the battery will extend the time between charges, but it also makes the device larger. And that still doesn’t solve the problem that at some point the device will need to be charged.
Charging while wearing the device requires complex and bulky components for energy harvesting, so that is not the answer (at least not yet). The answer is to take advantage of a window during which users normally remove their device: to shower. With improved fast charging, the length of time during which users prepare for their day is enough time to charge the battery for as much as a day or even a week, depending on the wearable energy-consumption profile.

Normal fast charging

Most wearables use a rechargeable Lithium-Ion (Li-ion) battery, which requires a specialized charger to properly pre-charge, fast charge and terminate charge to safely recharge the battery as well as maximize its life span. A charger usually uses several control loops that influence the charge current: a constant current loop (CC), constant voltage loop (CV), input current limit and input voltage drop regulation.

During the charging process, all loops are enabled and the one that is dominant takes control. The charge current is regulated to a fast charge current setting in the constant current phase until the voltage between BAT and GND reaches the regulation voltage. The voltage between BAT and GND is regulated to the desired battery voltage in the constant voltage phase while the charge current naturally tapers down. When termination is enabled, the device monitors the charging current during CV mode, and once the charge current tapers down to the termination threshold, the device terminates charging. Figure 1 shows this charging cycle.

Improved fast charging

To reduce the amount of time spent charging, more energy needs to go into the battery in a shorter amount of time. Some battery-makers are enabling charging greater than the typical 0.5C charge rate. The charging profile will depend on what the battery-maker specifies, but in general the charger will need to be able to dynamically change the battery’s regulation voltage, adjust the fast charge current, monitor the battery temperature and provide feedback to a host controller to change parameters dynamically through a communication interface such as I2C.

Figure 2 is a flowchart for a typical improved fast-charge algorithm. In this case, the initial battery-charge voltage is set lower than the final battery-charge voltage, and the fast charge current is set higher than the 0.5C charge rate. When the battery voltage reaches the 4.2-V level, the charge current is reduced and the battery voltage is increased through the host through the I2C interface.

Figure 1. Normal fast charge cycle.

Figure 2. Example of an improved fast-charge flowchart.

**Figure 1.** Normal fast charge cycle.

**Figure 2.** Example of an improved fast-charge flowchart.
Implementing Figure 2 with a smart battery charger and a simple host controller results in the charge-cycle plot shown in Figure 3. Comparing the normal fast charge cycle with the improved fast charge cycle, you can see that the normal fast charge cycle reached termination at 190 minutes but the improved fast charge cycle reached termination at 150 minutes—an improvement of 40 minutes.

More importantly though, by plotting the coulombs entered into the battery and looking at the first 30 minutes, it is obvious that more energy was delivered to the battery faster when using the improved fast charge method. The resulting data simulates a real-world case where the consumer charges the battery for only a short amount of time each day. Figure 4 shows the results.
The bq25120 is an example of a device capable of implementing the improved fast charge I have described in this article. This device provides all the features necessary to implement the improved fast charge algorithm to extend the run time of wearable batteries when in use. In addition to the configurable charger, this device integrates a configurable load switch or LDO, a low-power DC/DC buck, and a push-button input with reset control. Ultra-low power-optimized power management is especially important for wearable devices. Depending on the specific power rail, the quiescent current (IQ) or shutdown current are critical parameters.

For subsystems that are always on, such as the microcontroller unit (MCU), low IQ is critical. However, for subsystems that turn on and off, such as heart-rate monitors (HRMs), displays and the Bluetooth® low energy radio, shutdown current is more important. In many cases, shutdown current is so important that you will need to implement a load switch to keep the leakage current at extremely low levels.

Whatever your ultra-low-power challenge is, the high integration levels of modern wearable-optimized devices such as the bq25120 provide a compelling system solution capable of extending time between charges and improving fast charging.

**REFERENCES**

Download the [bq25120](#) data sheet.

Get a Longer Laptop Battery Life by Picking a Better Browser

Well, thanks to the folks at Microsoft, we now know that answer. The company performed two tests to measure browser power consumption—the first was done in a lab-controlled environment measuring typical browsing behavior on top-visited sites; the second experiment recorded how long the laptop battery lasted while streaming HD video on Chrome, Microsoft’s new Edge browser, Mozilla’s Firefox, and Opera.

To no one’s surprise, Microsoft Edge came out on top.

While it’s no secret that Google’s Chrome is the biggest battery draining web browser on the market, what’s relatively unknown is by how much.
In an attempt to further prove the company’s point—that it has created a browser superior to all the rest—Microsoft will also release telemetry data from millions of Windows 10 machines, which will detail how much more energy efficient Edge and Firefox are than Chrome.

It is interesting the amount of additional power that is required to run Chrome and Firefox than Opera and Edge. In fact, Chrome’s issues are so well known, Google has already released several updates in an attempt to improve its performance. None have made a significant difference yet.

So how do you get longer life out of your laptop battery? Simple—you pick a better browser. Or, if you are a Chrome devotee, make sure to exit the browser when closing the laptop.

Now, it is worth pointing out that while this report might provide some good, valuable information, Microsoft has been looking for ways to create buzz around its new Edge browser because it has not really taken off yet. One of the biggest things holding it back is the fact that the browser lacks support for extensions, and will not have this feature available until later in the summer, when it will launch alongside the Anniversary Update to Windows 10.

The company has promised even more power-saving features with the update to Edge, including fewer CPU cycles and less memory consumption, as well as controls on background activity and Flash ads.

As to whether this becomes a bigger issue remains to be seen—Chrome has skyrocketed in popularity since its initial launch, and its battery drainage issues, while a headache, appears to be a non-issue to its users.

Reports like that which Microsoft has put together here are interesting, but at the end of the day, they probably won’t make much of a difference.
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Handheld devices are popular among users due to their compact size and user-friendly interfaces. These devices are constantly being reinvented to handle a growing variety of apps and tools, creating the need for stronger power adapters to charge the devices—though users aren’t willing to sacrifice the existing small, sleek aesthetic of the device or charger. Dialog Semiconductor recognized this need and began utilizing GaN technology, which has long been used in other areas of power. EEWeb met with Mark Tyndall to discuss how Dialog Semiconductor executed their idea to harness GaN’s power to develop smaller power adapters.
Give us a bit of your background.

I started out as an analog designer at Philips Semiconductor in the mid-1980s, focusing mainly on telephony systems. From there, I moved to Fujitsu Microelectronics, initially working on the early, first-generation GSM cellular, and subsequently other networking, multimedia and broadband technologies through the 90s. After that, I moved to Infineon and began the shift from a technical marketing role to a business development role. During this period, I was responsible for many of the M&A and investment activities at Infineon, particularly through the dot-com craze when Infineon was acquiring and divesting a variety of businesses as it separated from Siemens and its subsequent IPO.

In 2008, I moved to Dialog Semiconductor to oversee corporate strategy and development. I also lead the emerging business group, where Dialog fosters new technology development before bringing it to the market.

Why did Dialog decide to enter the GaN market?

GaN technology has been around for more than ten years in compound semiconductor manufacturers, various small fabs, and research institutions. Dialog saw enormous potential with GaN, but we were really triggered to enter the market when TSMC indicated they were going to begin offering GaN foundry services. Working with TSMC gives us the ability to mass produce for a large consumer market. The whole value proposition around GaN is clear. You have a higher switching frequency without the efficiency trade-offs, which allows for improvement of the whole system configuration for power conversion products like portable adapters for smartphones and other computing devices, reducing cost, size, and power.

On the power conversion side, we initially had to decide on our focus area. There are quite a few opportunities and markets GaN can target. We saw a problem emerging in power adapters for mobile devices—particularly associated with the challenge of maintaining small form factor size while still delivering higher power. This is where GaN provides a neat solution.

Can you speak more to the problems associated with power adapters and form factor size?

Let me answer that by first giving you a bit of background. In 2013, Dialog acquired iWatt, a Silicon Valley semiconductor start-up company. iWatt was a power conversion integrated circuit (IC) company focused on solid-state lighting and AC/DC power adapters, primarily for portable computing devices such as smartphones and tablets. Following this acquisition, Dialog has become the clear leader in providing semiconductor power adapters for smartphones. This leadership came with the advent of quick charging and various derivatives thereof. We estimate that Dialog now has somewhere around 70 percent market share in fast charging for portable devices, particularly in China.

With that in mind, the first problem we saw and addressed is that there are more and more applications emerging for smartphones: videos, social networking, gaming, emails, photos, etc. In order to handle all of these applications, the application processor must become more sophisticated and will therefore consume more power. Dialog addresses this problem by providing highly integrated power management ICs (PMICs) and sub-PMICs to efficiently power these application processors and other systems in the smartphone.

The second problem is on the adapter side. As the power demands increase, larger capacity batteries are required and can be found in the latest smartphones being released. Charging these larger capacity battery requires more current, and in turn, increases the size of the power adapter.

Additionally, consumers may want to charge several devices with the same adapter, compounding the adapter’s size issue. However, as a user and consumer, I think it’s safe to say that we don’t want a power adapter larger than the one we already have when we move on to our next smartphone.

Can you give us an overview of how GaN plays into power conversion? How is Dialog working to solve the problems you mentioned?

More current is required to charge larger capacity batteries, creating bulkier components. However, creating a larger power adapter is not the best option. Nobody wants to carry around a power adapter the size of a brick to quickly charge their smartphone. This was why we focused in on GaN to solve the problem. By leveraging the position we have in the adapter market for fast charging with the power conversion products of iWatt, we believed we could add value to that solution by incorporating Gallium Nitride technology.

From there, our vision became to provide a chipset for a universal multi-input power adapter in the order of 45 watts, while fitting into today’s 25-watt housing at no additional cost. This required us to optimize the solution on the system level, supplying a solution for both the primary and secondary side, including our patented digital primary side controller, synchronous rectifier, and a GaN half-bridge device.

It’s important to point out that we’re not just using standard GaN components, simple FET replacements or FET plus driver modules. Instead, our first GaN device is monolithic, integrating the power switches together with logic and also the driver circuitry. As one of the early GaN players, this is where we are driving the industry forward.

What are the benefits of using a monolithic approach versus some of the other approaches out there?
History has proven in the semiconductor industry that a true monolithic integration always wins in terms of cost and yield, versus discrete components or a co-packaged device. Additionally, monolithic integration is obviously better in terms of avoiding all the parasitic noise elements that are detrimental in such a design, especially with such high frequency interconnected devices.

**What are Dialog’s objectives with GaN technology in the future? How will you meet the demands your products will bring about?**

Dialog’s first objective is to kick start the GaN market into high volume. We see ourselves as the chicken and the egg in our industry, as we lead the push. Basically, you always need consumer level volume to drive the next level of investment into manufacturing and subsequently drive the wafer price down, otherwise GaN will remain a niche manufacturing technology. Together with TSMC, we believe we can achieve this.

The volume potential is already there with adapters, and that is what will get us quickly to mass production. We’re not far off from where we need to be. Our second target is to scale the solution and address higher value markets. At the moment, we’re at 25-watts for mobile power adapters, working toward computing at 45W-90W-watts. Then we’d like to go beyond that to address the server market.

To give you confidence in our capabilities, when Dialog started with PMIC’s seven or eight years ago, they were quite small and at a low level of complexity: six, seven square millimeters. Since then, we have driven that level of complexity to the point where, if you open your smartphone or tablet and look at an industry teardown, you’ll see PMICs close to 60 square millimeters, which is huge for an analog circuit.

We’ve migrated from 0.25 microns to 0.18 BCD, making Dialog one of the first to use BCD as a high-volume technology for power circuits. As the number-one PMIC manufacturer in the world, we have driven the BCD process now to 0.13 microns and are utilizing 300 millimeter wafer manufacturing at TSMC. To move an industry, you need a strong partner beside you. TSMC is the largest foundry in the world and therefore the partner we believe will be able to support our manufacturing needs. We aren’t interested in small niche applications for GaN. There is a huge opportunity out there and it’s an exciting market. When I see the level of excitement and traction from our customers for GaN, I know we are addressing and solving a genuine problem.
A NEW issue is coming!

Until then, enjoy these current magazines.