

THE FUTURE OF CHARGING

USB Power Delivery & Wireless Charging

INTRODUCTION:

Walk into the average home or office, and you'll see cables and chargers everywhere. Phones, televisions, stereos, computers, and other accessories are typically connected to a thicket of connectors. But if you take a closer look at those chargers and cables, many of them aren't interchangeable. There are AC wall plugs, USB connectors of a variety of configurations, special Apple Lightning cables, and a host of other distinct-looking connectors and ports. All of these cables and connectors exist for one goal—charging your electronics.

When users charge electronics, they transmit power from wall plugs (or alternative sources like external batteries) into the devices themselves. Starting roughly in the early 2000s, electronics charging for many smaller devices began to center around several different iterations of the USB (Universal Serial Bus) interface. Although USB was originally designed for data transfer between devices, manufacturers quickly began using it for charging smaller electronics. As of 2016, the most popular forms of USB interfaces are the backward-compatible USBs 3.1, 3.0, and 2.0. Those three interfaces vary mostly in the speed of their data signaling, transfer rates, and power outputs.

Two new methods for charging devices, however, are offering new options for consumers. USB-Power Delivery (aka USB-PD) is a rapid charging protocol for a wide range of devices, and two new

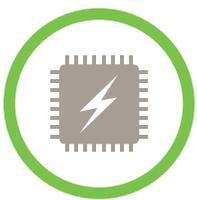
wireless charging protocols allow smaller devices like smartphones to charge... just by placing them on top (or even adjacent) to a charger. Together, they offer a new world of customer convenience—and a wide range of potential for new electronics products.

INNOVATIONS 1: USB-PD

In addition to the latest USB 3.1 specification, electronic manufacturers are also introducing the USB Type-C connector (or, as it's better known, USB-C™). It is quite different from older USB connectors and ports that have been in use since the 1990s. USB-C uses a uniquely shaped connector and port that aren't backward-compatible with older USB protocols without a converter. That's because USB-C was built to take advantage of newer and better protocols like USB-PD, which delivers rapid charging for a wide range of devices, and takes advantage of USB-C's full potential.

USB-PD-compliant chargers allow for power output of up to 100 watts, which means laptops can be charged via USB cables. This isn't just convenient for customers and end users; it also means a potential world where a single charger can be used to recharge laptops, tablets, smartphones, and consumer electronics at lightning-quick speeds.

Because USB-PD charges smaller devices more quickly, there are particular benefits for



USB-PD is a rapid charging protocol for a wide range of devices... offer[ing] a new world of customer convenience—and a wide range of potential for new electronics products.

THE 5 STANDARD POWER PROFILES OF USB-PD

- Up to 5V max (3 Amps max)
- Up to 9V max (3 Amps max)
- Up to 15V max (3 Amps max)
- Up to 20V max (3 Amps max)
- Up to 20V (5 Amps max, requires a dedicated 5-Amp cable)



The wireless charging protocols Qi and PMA are incompatible with each other. They are promoted by two different organizations: The Wireless Power Consortium (Qi) and the AirFuel Alliance (PMA).

smartphone owners. For smartphones, the benefit is comparable to Quick Charge 2.0 and 3.0 technology; Belkin has found that current generation phones charge 50 percent more quickly than conventional 5-watt charging for a device similar to a Nexus 6P. Unlike Qualcomm's Quick Charge 3.0, which also works with the USB-C connector, the USB-PD protocol can safely handle a wider range of devices (Quick Charge 3.0 is restricted to products with Snapdragon™ chipsets), and allows more devices to interact with a single charger controller.

USB-PD also offers major benefits for tomorrow's phones and tablets. They will have even more demands on the processor and graphic fronts, and USB-PD-based rapid charging means that they won't have to sit tethered to a charger for hours daily. Belkin has found that a staggering 61.8 percent of customers are likely to buy a charger that can recharge a phone within minutes¹... and USB-PD makes that a possibility.

For users, USB-PD also means an end to storing and carrying around multiple charging adapters for different devices. Manufacturers are committing to integrating USB-PD into future devices. This means the same charger can be used on phones, tablets, laptops, and other devices.

The public expects more mobility from their computing experiences, and USB-PD offers that. The protocol offers access to powerful accessories at home, and the ability to take their computing with them on the go. With USB-PD, laptops or ultrabooks can be connected to a single USB-C cable. In turn, the USB-C cable is connected up to a dock that provides power and connection to all kinds of other devices such as an external HDD, speakers, printers, keyboard, mouse, and monitor.

To give one example of how this changes things, an external HDD traditionally requires two cable connections: one for power, the other for data. With USB-C and Power Delivery, only one cable is required since both data and power transfer through the same connection.

There's also a lot of momentum behind

this technology. According to industry blog Electronic Design, USB-C has the highest adoption rate of any USB protocol in history².

USB-PD chargers aren't just power chargers—they're miniature computers in and of themselves. When a USB-C device connects to a charger, the device interfaces with a special controller in the charger. These chargers can have many different power delivery "profiles," which are pegged to the different voltage levels specifically required by devices of completely different sizes, like a smartphone and a laptop. A chipset in the charger automatically determines which profile it is interfacing with, and matches the appropriate voltage to the device. The number of profiles depends on the device, with some chargers just supporting charging smartphones at faster speeds, while computers and other devices charge at slower speeds. However, higher-end USB-PD chargers can have up to five different standard power profiles (or possibly more if manufacturers implement their own specific voltage profiles), allowing support for anything from a smartphone to a power-hungry laptop from the same charger.

In order for USB-PD to work to its full potential, both the device and the charger need to have embedded USB-PD controller chips, and share the correct settings for voltage and amperage. But even if the device doesn't, Belkin's chargers are backward-compatible, and support the highest amperage for any given voltage profile, so they will work with as many devices as possible.

Even Apple, which has traditionally released its own proprietary cords and chargers, is embracing USB-PD. The computing and mobile giant now offers USB-C to Lightning Cables³ and promotes fast charging on the iPad Pro (12.9-inch) via USB-PD (optimally at 14.5 volts, maximum 2 Amps, while other voltage levels may be supported up to 2 Amps maximum).

INNOVATIONS 2: WIRELESS CHARGING

USB-PD and conventional charging technologies like USB-C and Quick Charge 3.0 aren't the only change to the way devices



MAJOR USB-PD-COMPATIBLE DEVICES ON MARKET TODAY

Apple

iPad Pro (12.9-inch)
MacBook

Asus

Book Flip
EeeBook E202
T100HA Transformer

Google

Chromebook Pixel
Nexus 5X
Nexus 6P
Pixel C

HP

Elite x3
Pro Tablet 608
Pavilion x2

HTC

One M10

Huawei

MateBook

LG

G5

Nokia/Microsoft

Lumia 950
Lumia 950 XL

Samsung

Galaxy TabPro S

The electronics industry is adopting USB-C at a staggering rate thanks to, among other things, the rapid charging that USB-PD offers.

charge—wireless charging is changing things as well. Wireless charging protocols such as Qi⁴ (pronounced “chee”) and PMA⁵ make it possible to recharge smaller devices such as phones by placing them on top of a charger—without wires. The two protocols, which are incompatible with each other, are promoted by two different organizations: The Wireless Power Consortium (Qi) and the AirFuel Alliance (PMA).

Both PMA and Qi allow for wireless charging through a technique that’s roughly similar to how a wireless electric toothbrush recharges. When coils in the phone and in the charger are in very close contact, and aligned in the center, electricity flows safely and wirelessly from the charger to the phone. There is a bit of tolerance built in for situations like the phone being enclosed in a case, or placed slightly off-center with the wireless charger, but, otherwise, the phone has to lie directly on the charger—and unless the charger works with both protocols, the phone and charger have to match up in the protocol they use. Manufacturers like Belkin allow for the best experience possible with these technologies by implementing designs that are certified directly by the Wireless Power Consortium and AirFuel Alliance.

Qi is the more commonly found protocol, with most compatible devices capable of outputting 1 Amp at 5 volts—which is considerably less than what conventional wired chargers offer for recharging devices. Chargers featuring Qi technology are primarily marketed to home and office consumers, and are readily available from manufacturers (including Belkin) through online retailers, big box stores, and specialty outlets.

PMA is a system that recharges devices at similar rates to Qi. However, unlike Qi, businesses can access an analytics service offered by Powermat Technologies that monitors metrics including how much time users spend charging their phone⁶. According to Powermat, they offer businesses the ability to send contextual messages including special offers and surveys to customers’ phones as well. While the Qi model is based around bringing wireless chargers into homes and offices, Powermat Technology monetizes wireless chargers in coffee shops, restaurants, and stores

by turning them into vehicles for advertising.

Market consulting firm Grandview Research says that this rapidly growing sector of the market is expected to account for \$22.25 billion by 2022 and manufacturers are rushing to integrate the technology into their phones. Wireless charging is also being integrated into home furniture like coffee tables and nightstands by manufacturers like Ikea⁷, as well as luxury cars like the 2016 BMW 7 Series.⁸

Research conducted by Belkin indicates that users don’t seek to use wireless charging as their primary charging method but that they do value the convenience the technology offers, especially in public places. Samsung is the main adopter of the technology as of mid-2016, with wireless charging integrated into many Galaxy phones without the need of a special USB adapter, but other manufacturers such as LG are expected to integrate wireless charging in the next several years.

Meanwhile, consumers and end users have something even better to look forward to: the speed at which phones charge will become much faster. In mid-2015, Qi announced updates to their protocol that allow for rapidly charging at 15 watts, which is up to three times faster than wireless chargers today. These speeds are now similar to what wired charging offers via USB-PD and Quick Charge 3.0.

Belkin offers several wireless phone chargers, and focuses on compatibility with both protocols so users can be assured their phone will charge. These include the first-to-market F8M744tt for both Qi and PMA users, and the F8M741tt for Qi users.

A SIMPLER FUTURE

The electronics industry is adopting USB-C at a staggering rate thanks to, among other things, the rapid charging that USB-PD offers. Major manufacturers such as Google, LG, HTC, Samsung, and even Apple have begun using USB-C and USB-PD in their products to some degree. Many of these same manufacturers have begun to integrate wireless charging into



PHONES THAT OFFER WIRELESS QI/POWERMAT CHARGING

Google
Nexus 5
Nexus 7 Tablet

Nokia/Microsoft
Lumia 950
Lumia 950 XL

Samsung
Galaxy S7
Galaxy S6
Galaxy S6 edge
Galaxy S6 edge+
Galaxy S6 active
Galaxy Note 5

Other phones can be enabled with wireless charging with the addition of an insert card or external phone case, including many iPhone models.



Belkin's USB-C cables are USB-IF compliant... so customers can rest assured their cables will work safely and efficiently.

their product plans as well.

While the market for other USB devices and cables will live on for some time, Belkin wants to bring the benefits of USB-PD and wireless charging to a mass audience as quickly as possible. A world where we only need one cord for our phone, tablet, and laptop—or no cord at all—is just around the corner, and it's an exciting thing.

In the future, we expect to see USB-PD transform USB-C into a rival to the standard AC outlet. Well-produced USB-C- and USB-PD-compliant accessories allow for quick, safe, and seamless power and data transfer without juggling multiple accessories.

Power strips of the future may potentially have up to six USB-C ports, all outputting enough power to bring everything in your home to life. With the rise of smart homes, this also means plugging into an outlet may also allow devices to transmit and receive data at rapid speed. For instance, users could use the outlets to upload music or videos to a central data repository that projects images and plays music in different rooms.

Importantly, they're going to get better—right now, most USB-PD-compliant devices cap out at 60 watts even though the standard allows for up to 100 watts. Once perfected, this will allow high-powered devices to use USB-PD-compliant chargers and cables in lieu of AC outlets and converters. Alternately, wireless charging could dispense with the need for wires and let users charge phones and tablets overnight simply by leaving them on their nightstand.

Because previous iterations of USB have been around for more than 15 years, they haven't necessarily kept pace with the latest technological innovations. Charging through micro-USB, for instance, can't offer delivery rates comparable to USB-PD.

In the coming years—especially as major trade shows such as the Consumer Electronics Show and Mobile World Congress allow manufacturers to debut their new flagship

products—Belkin expects to see USB-C penetration into smartphones and tablets, and USB-PD penetration into cables and chargers expand greatly. In the coming years, expect most flagship devices to be based around the rapid charging and data transfer opportunities USB-PD offers.

There is also an up-and-coming wireless charging protocol called magnetic resonance charging that works through hard surfaces and doesn't require exact alignment of devices—this can be used in the near future for things like charging a smartphone in the cup holder of your car at any angle. While magnetic resonance charging has not made it into the mainstream of the consumer and enterprise technology worlds just yet, it is expected to drastically increase customer satisfaction with wireless charging.

THE BELKIN DIFFERENCE

Belkin's top priorities for all charging products—whether for USB-PD, wireless charging, or otherwise—are safety and quality. Belkin strenuously tests all of their chargers and cables, and makes sure that customers can easily use them without worry.

Extensive testing such as Belkin's is especially important for USB-PD products as they are used for much higher power outputs than in the past. These higher power outputs mean that there isn't just a risk of shoddy, badly tested chargers breaking down as in the past—they can also cause bodily injury for users. In the United Kingdom, for instance, the London Fire Brigade regularly posts pictures to their Twitter feed showing fires started by counterfeit chargers. Belkin tests all their chargers extensively, which can't be said for many of the cheaper, low-end chargers on the market.

Poor quality control from some of Belkin's cheaper competitors has even led Amazon to ban the sale of some cables. In March of 2016, the e-commerce giant banned the sale of many USB-C cables and devices⁹; the banned products don't adhere to standard specifications issued by the USB Implementers Forum. Belkin's cables are USB Implementers Forum compliant¹⁰ and the company believes

HOW DO I GET IT? To get Power Delivery, you need 3 things:



USB-C DEVICE
WITH USB-PD
(like a smartphone,
tablet, or Ultrabook)



USB-C CHARGER
WITH USB-PD
(like a wall charger,
car charger, or laptop)



USB-C TO USB-C CABLE
WITH USB-PD
(all certified C-C cables
are PD-capable)

This all ties back to what matters for Belkin: offering devices and peripherals that are reliable, affordable, and top-quality.

in rigorous design and engineering, and always maintains the highest quality standards in their manufacturing processes. Testing adheres to USB Implementers Forum benchmarks so customers can rest assured their cables will work safely and efficiently¹¹. In addition, Belkin's chargers follow USB-IF specs to the letter.

In other words, quality matters. Because a single charger or cable serves devices ranging from phones to laptops in the post-USB-PD world, customers need to make sure they have the best product possible—and not to worry that their cheap accessories will short out devices, render them useless, or even worse.

Belkin sees both USB-PD and wireless charging as the future of power. Belkin's strategy for USB-PD revolves around utilizing the USB-C port to its fullest extent; they won't put a USB-C port on a charger unless that charger will deliver at least 15 watts of power so it easily serves multiple devices at fast charging rates.

Many of their competitors implement USB-C ports but only offer standard slow charging rates—something Belkin doesn't believe in.

Their wireless charging portfolio will continue to support both Qi and Powermat, and safe and quick wireless charging of phones and similar devices. As wireless charging capabilities are added to more phones and tablets in the future, they'll be keeping close tabs on the area as well.

This all ties back to what matters for Belkin: offering devices and peripherals that are reliable, affordable, and top-quality. Power delivery is, more than anything else, a means to the end of powering your favorite electronics. And whether your devices are charged through USB-PD, wireless charging, or another mechanism, Belkin's products offer the best experience on the market.

Endnotes

¹ Internal sales deck.

² <http://electronicdesign.com/interconnects/qa-what-s-behind-blazingly-fast-adoption-usb-type-c>

³ Apple

⁴ <https://www.wirelesspowerconsortium.com/>

⁵ <http://airfuel.org/>

⁶ <https://www.powermat.com/article/powermat-s-mobile-engagement-platform-designed-to-drive-repeat-business>

⁷ http://www.ikea.com/us/en/catalog/categories/departments/wireless_charging/

⁸ http://www.bmw.com/com/en/newvehicles/7series/sedan/2015/showroom/innovative_functionality.html

⁹ <https://consumerist.com/2016/03/30/amazon-bans-the-sale-of-substandard-usb-c-cables/>

¹⁰ Belkin <http://www.belkin.com/us/Resource-Center/USB-C/USB-C-quality/>

¹¹ <http://www.usb.org/developers/compliance/>