

Application Segment Overview – Wireless Power Transfer

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Introduction

Explosion of “mobile” and need to support the mobile lifestyle

The explosive growth of mobile computing has led to faster and more powerful portable devices. The need to keep these power-hungry devices charged has spurred the next wave of innovation, leading to wirelessly charge our smartphones and tablets, as well other gadgets such as Bluetooth headsets, portable computers, game controllers, and more.

While still in the early stages of development and commercial acceptance, wireless power transfer is seeing an increase in interest from both the consumer and industrial sectors. In general, acceptance has been slow. However, technological innovations of late have resulted in the industry being cautiously optimistic about the future. If 2012 was a turning point for the integration of this type of technology in mobile devices, 2013 promises to be an active year for the potential deployment of wireless charging in devices.

Wireless power transfer has use cases from very low to high power needs, ranging from Bluetooth headsets to electric vehicles, and beyond. The focus of this overview is on the lower power range encompassing portable consumer electronics requiring up to 25 watts of power.

Key Market Drivers

A long term goal of the businesses involved in the development of wireless power innovations for electronic devices is the ubiquitous availability to consumers of wireless charging, thus enabling their electronic devices to be charged everywhere: at home, in the office, at the coffee shop and on the go. The key drivers pushing forward initiatives in this area are:

- Smarter, faster, more powerful mobile devices
- Convenience
- “Sealed” electronics

Smarter, faster, more powerful mobile devices

Before the widespread proliferation of smartphones, it was common for a typical mobile phone to last several days with a single charge. Today’s smartphones, with advanced computing capabilities, large high-resolution screens, and advanced modem technologies, necessitate more frequent recharges to maintain the battery within the thin outlines of modern handsets.

Convenience

Wireless charging can offer consumers an ability to “top off” their battery throughout the day. Leave the house with a full charge and continue to top off power on the way to the office via an in-car wireless charger. At the office, there can conceivably be wireless charging pads at a desk, a conference table and a lunch room. In the true wireless power world, wireless power will be everywhere, e.g., at coffee shops, airports, airplanes, trains, hotels, shopping malls, and more.

“Sealed” electronics

Most smartphones and tablets today no longer need to connect directly to a computer or network to synchronize. Similarly, Bluetooth and wireless headphones are reducing reliance on the use of a stereo headphone jack. These technologies help to eliminate the need for open ports on a device. Removing reliance on a power cord and shifting a device to make use of wireless charging will accomplish two things. First, in the next few years it could potentially allow device manufacturers to create sealed devices, i.e., electronics without exposed ports. Second, it could help eliminate the need to physically connect to a wall. Removing the need for a connection to a wall could potentially result in a long term environmental benefit by eliminating the need to dispose of these accessory components typically delivered with an electronics device.

Key Metrics

With competing technologies in the marketplace it is important to distinguish what differentiates one from the other. A typical wireless power system consists of a transmission pad and a device with a wireless power receiver capable of receiving energy and charging the battery. A transmission pad in a wireless power system differs in size and makeup depending upon the underlying technology and overall use case. The two primary technologies gaining traction in the marketplace are flexibly coupled, and tightly coupled, wireless power transfer. Tight coupling refers to a two-coil system that exhibits high coupling coefficient and generally delivers energy by a close physical proximity between the transmitter and receiver. True to its name, flexible coupling provides greater freedom to charge by allowing for a spatial separation between the two. This section highlights the key metrics both technologies focus on and distinguish one from another.

Freedom of movement

The ability to move a device along the horizontal plain within a charging area defines its freedom of movement. The typical tightly coupled charging system offers relatively little movement away from its dedicated charging spot while flexible coupling allows the device the ability to freely move within the space, as shown in figures 1 and 2.

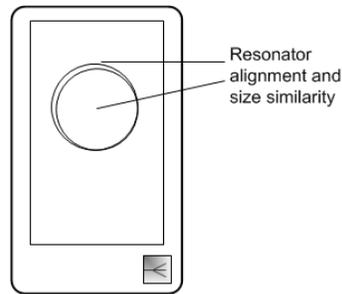


Figure 1 - Charging surface, tightly coupled single coil

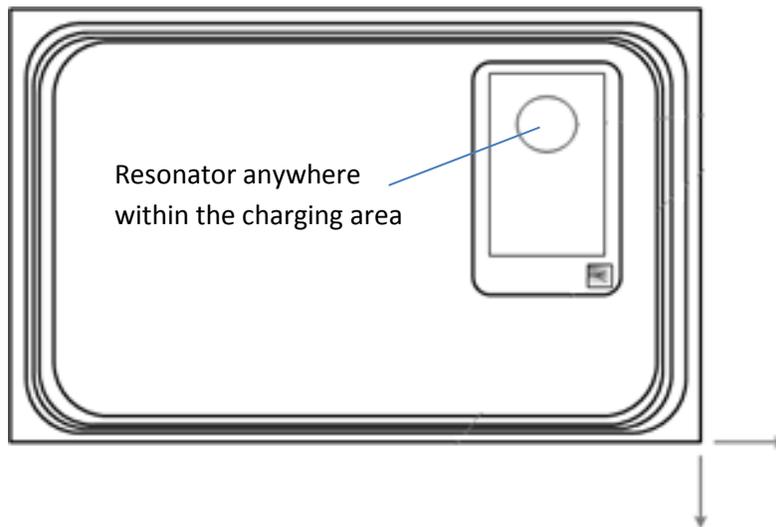


Figure 2 - Charging surface, flexibly coupled

Vertical separation

Allowing for wireless charging at a distance above the transmission pad also distinguishes technologies. Whereas tightly coupled systems require the device to rest on or near the transmission source, flexibly coupled systems are designed to permit a spatial gap between the two. Such an allowance has practical applications in industries such as automotive and furniture by granting the latter technology a better ability to satisfy mechanical constraints of the applications as well as enable retrofitting the charger into existing fixtures with minimal rework.

Multiple device types

It's not just the smartphone or tablet that needs a charge throughout the day, but a multitude of devices including Bluetooth headsets, game controllers and remote controls. Being able to charge these different types of devices that have varying power needs simultaneously on the same transmitter pad is important to develop a successful ecosystem for the technology. Requiring different charging spots or

separate pads for different power needs may lead to a negative consumer experience and further delay market acceptance.

Heating of metallic objects

Due to transmission frequency selection, the various wireless power technologies react differently to the presence of electrically conducting objects within the charging area. These objects can consist of coins, pens, paper clips, and even certain types of chewing gum wrappers. For wireless power technologies operating at lower frequencies, metallic objects tend to heat to unsafe levels. Systems that have significant issues with heating objects require mechanisms and protocols to detect foreign objects. If the transmitter senses a problem material within the charging area, it automatically disables the charge process.

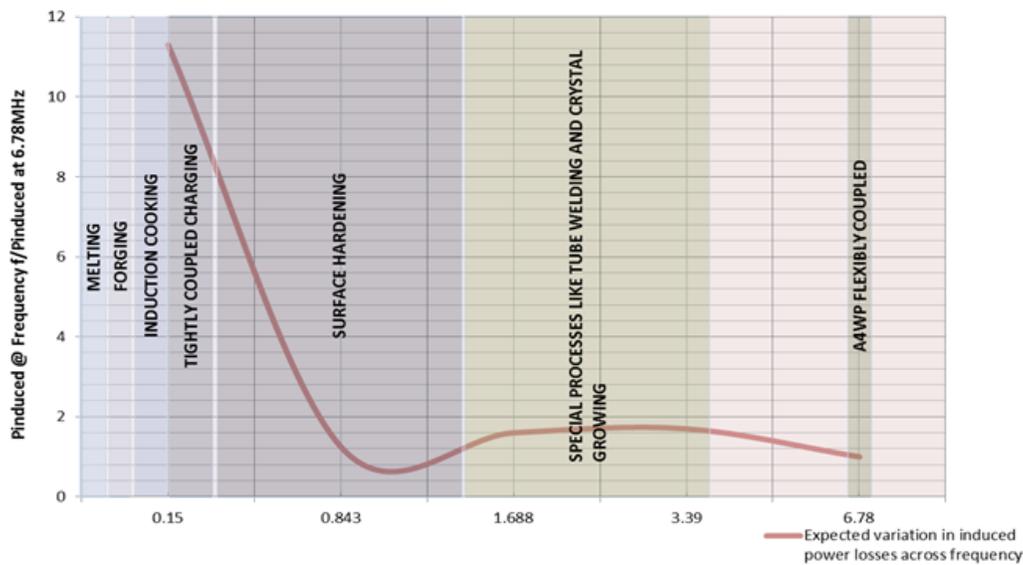


Figure 3 – Wireless charging solutions in the 100s of KHz range generate approximately 10x the amount of induced power in metallic foreign objects as that of a 6.78 MHz system

Trends

Wireless power transfer is in the early stages of adoption. Solutions available up until the latter half of 2012 sparked little interest from consumers. Beginning in late 2012, the industry began to see a greater push by technology providers to integrate wireless power transfer receivers into mobile devices. Several trial programs were kicked off to embed transmitters in select coffee shops and arenas. Results from such trials could influence decisions by OEMs and ecosystem partners on future commitments to wireless power charging of electronic devices.

There is a clear shift from the first-generation tightly coupled wireless power transfer technology to the next-generation flexibly coupled wireless power transfer technology. Analysts predict, and the industry

tends to agree, that only with flexibly coupled wireless power transfer solutions the technology can enjoy a broad acceptance.

Wireless power transfer and charging applications appear to be almost limitless. However, due to the ubiquitous nature of smartphones and the pressing need to frequently charge, the mobile device industry will likely be the first consumer segment to fully embrace the use of wireless power transfer. To drive mass adoption, wireless power transfer technologies must be flexible enough to support real-world industrial design applications and simple and efficient enough for businesses and consumers to adopt.

Challenges

Wireless power transfer still has challenges to overcome, including:

Efficiency

Occasional comment is made to the efficiency of the use of wireless power transfer when compared to the use of wired power. While the percentage of power that makes it from the wall to the device is typically lower when using wireless power, there are several other factors to consider. First, research efforts are being undertaken on wireless power transfer technologies to continue to increase efficiency and the fruits of these research efforts can be seen with every new product introduction. Features such as sleep mode and power regulation may actually make the use of wireless power transfer more efficient than the use of wired power in the future, thanks to the ability to communicate between transmitter and receivers. Furthermore, as multiple devices can be simultaneously charged on the same pad, there are fewer chargers connected and draining energy from the grid when left overnight. Second, in dollar terms, the amount of “extra” energy required to wirelessly charge a device is insignificant. There are many different types of appliances in a household that consume substantially more power in a stand-by condition. Finally, from a consumer’s perspective, the use of wireless power transfer has shown to be on par or within acceptable range with respect to the charging time normally achieved with the use of traditional wired power.

Worldwide standard compliance and safety

As with most technologies, wireless power transfer is subject to oversight by various global regulatory bodies. Specific to wireless power, these regulators look to factors including frequency, induced electric fields, induced current density, and specific absorption rate, to deem a device acceptable or unacceptable to its regulated population. It is the responsibility of individual companies in the wireless power industry to design their technology to meet these regulations on a country by country basis.

Electromagnetic interference and electromagnetic compatibility

Wireless power systems are being developed to operate at different frequencies. Each frequency has its own distinct set of advantages and disadvantages. Frequency selection has a direct impact on electromagnetic interference (EMI) and electromagnetic compatibility (EMC), allowing system to operate differently as it relates to each. Both tightly coupled and flexibly coupled wireless power

transfer technologies have issues to overcome to comply with EMI and EMC requirements, though these differ by use case and frequency choice.

Cost

As wired power cords continue to be included at no cost with device purchase and a complete wireless charging system may cost over \$50, businesses and consumers may not be willing to adopt wireless power transfer en masse. However, including a wireless power charging transmitter, receiver, or both with a device when it is purchased, or a meaningful rebate for a consumer's purchase of a wireless charging system for use with a device, can potentially help spur adoption, as will greater availability of wireless charging platforms.

The development and commercialization of wireless power transfer technologies is going through a process similar to that of technologies such as Wi-Fi, Bluetooth and NFC. Each of these technologies existed for many years before becoming widely adopted and commercially deployed. Consumers appear to finally recognize a need for better device power transfer management for their devices, and to assign value to the convenience and ease of wireless charging for their electronic devices. The cellular industry took almost 20 years to reach its first one billion subscribers. Given the ubiquity of mobile devices today it may take a lot less time to reach the first billion users of wireless power transfer to charge their devices.