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**Industry Intelligence Program**



**Communications**



# Wireless Power Transfer Technology—Latest Development and Major Vendors' Patent Deployment

## **Abstract**

Wireless power has a broad range of applications in the ICT industry, including smartphones, wearable devices, tablets, electronic vehicles, implantable medical devices, and robots. This report profiles the major wireless power transfer technologies, together with a thorough patent mining analysis to pinpoint major vendors' patent deployment in the field.

by David Chen

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## 1. Overview of Major Wireless Power Transfer Technologies

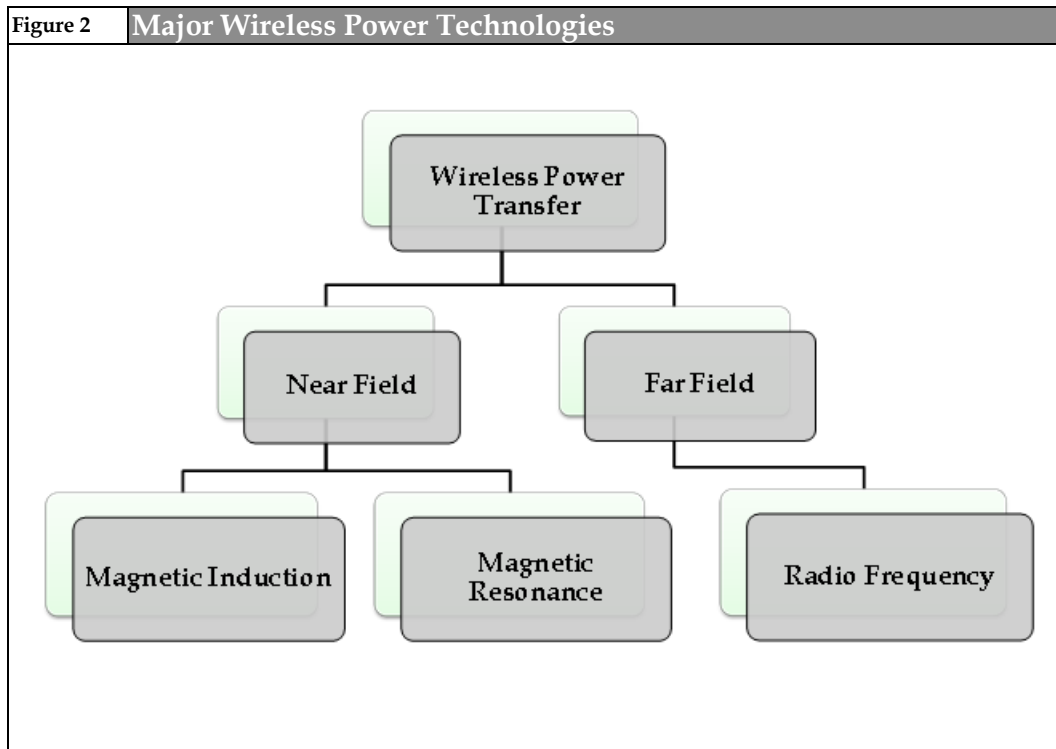
Wireless power, a.k.a. wireless charging, is an emerging way of transferring electrical energy and storing it through the conversion of magnetic energy into electrical energy. A wireless charger thus eliminates the necessity of wires and plugs. Commercial products providing wireless power transfer capability have been available in the market, such as Nokia's wireless charging plate DT-900.

According to the transmission distance between the transmitter and receiver, wireless power technologies can be divided into near field and far field categories. Near field wireless power techniques include magnetic induction and magnetic resonance while far field ones are mainly based on radio frequency.

Research data indicate that wireless charging through magnetic induction can work properly within 4 meters. Magnetic resonance can function as far as 5 meters, and radio frequency can go beyond 10 meters.

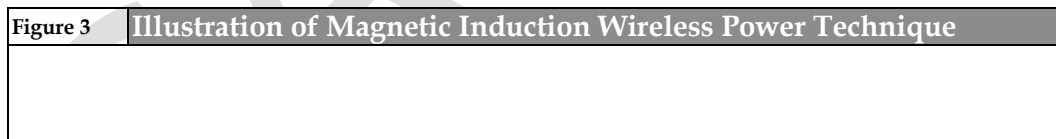


Source: Nokia, compiled by MIC, April 2014



Source: MIC, April 2014

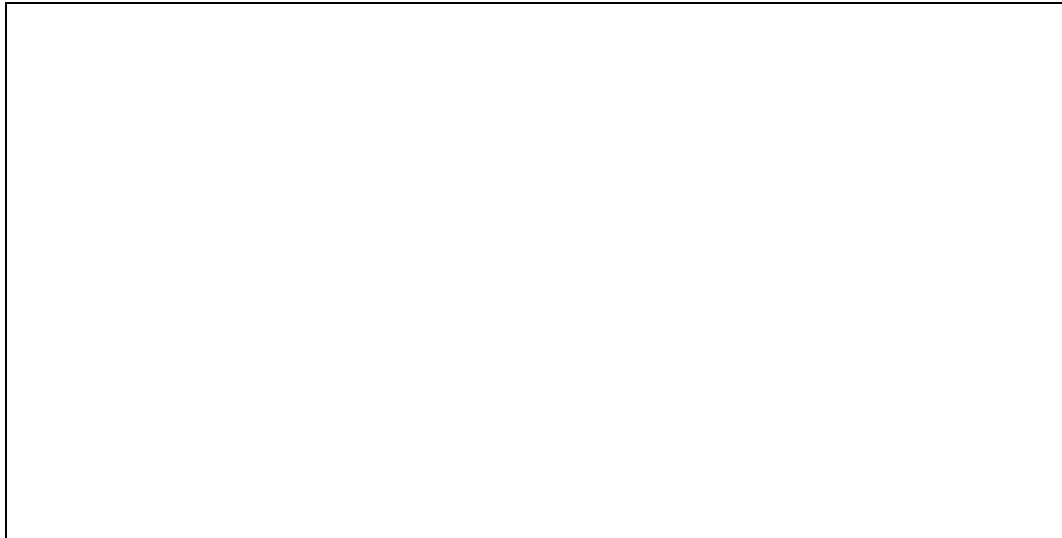
## 1.1 Magnetic Induction



Source: MIC, April 2014



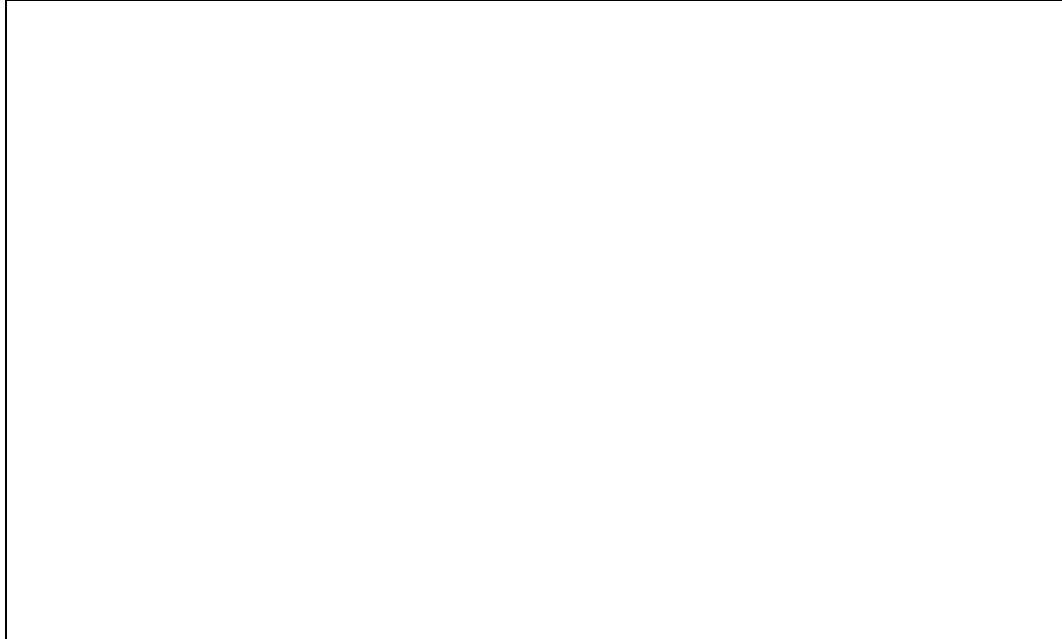




Source: LG, compiled by MIC, April 2014

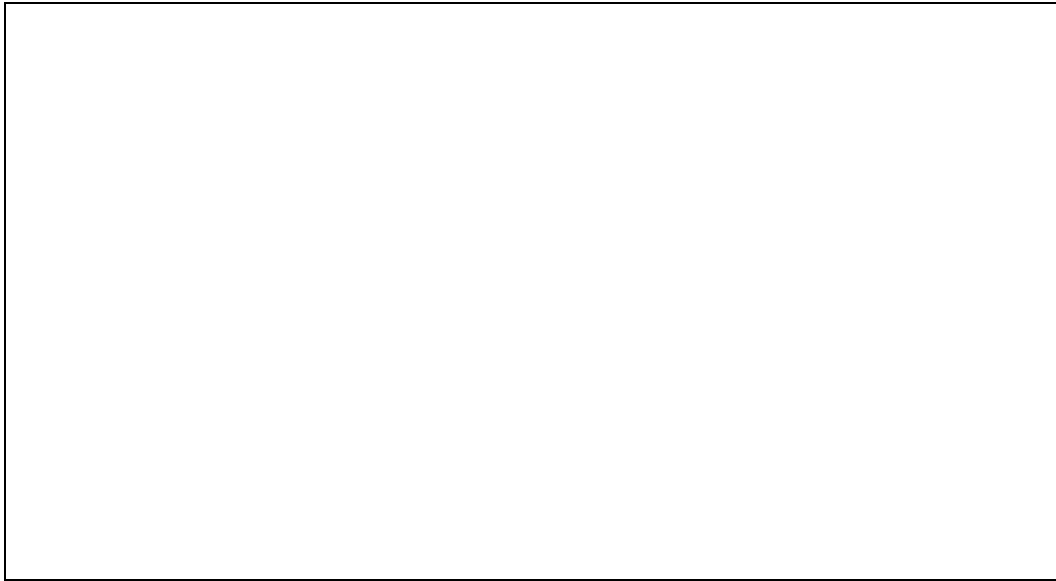
## 1.2 Magnetic Resonance

**Figure 5** Illustration of Magnetic Resonance Wireless Power Technique



Source: Respective companies, compiled by MIC, April 2014

**Figure 6** Example of Magnetic Resonance Wireless Power: WiT 2000

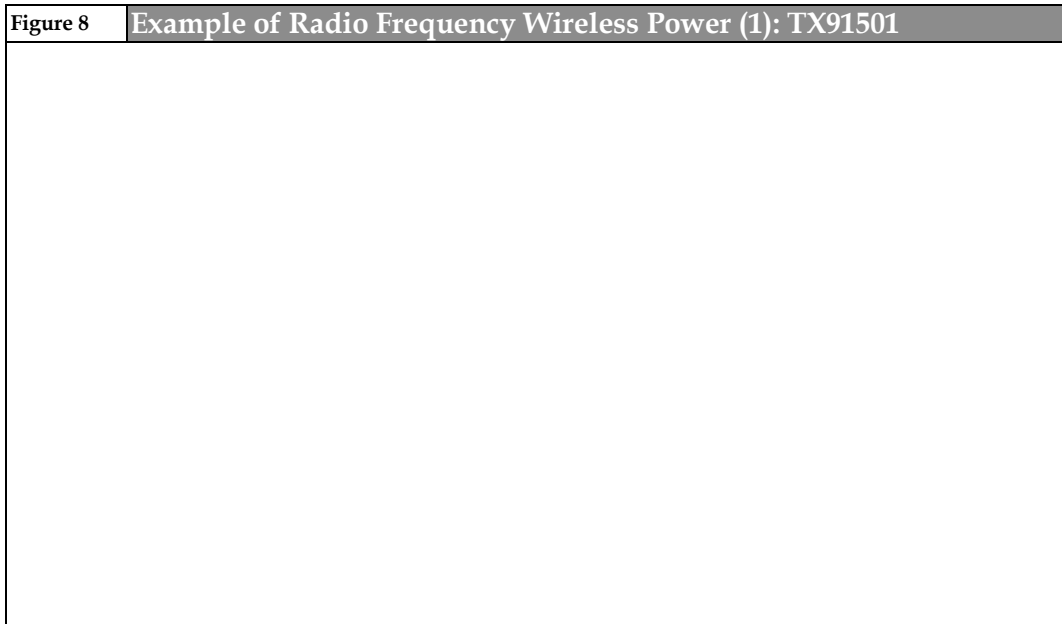


Source: WiTricity, compiled by MIC, April 2014

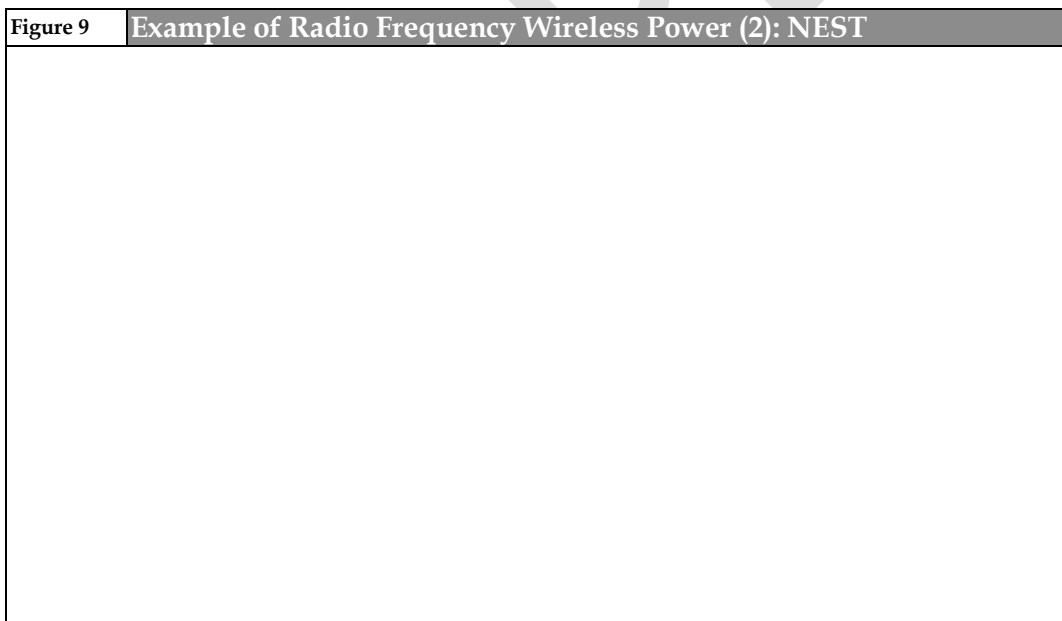
### 1.3 Radio Frequency

Figure 7	Illustration of Radio Frequency Wireless Power Technique

Source: MIC, April 2014



Source: Powercast, compiled by MIC, April 2014



Source: Humavox, compiled by MIC, April 2014

Table 1	Pros and Cons of Various Wireless Power Transfer Technologies	
	Advantages	Disadvantages
Magnetic Induction	•	•
Magnetic Resonance	•	•
Radio Frequency	•	•

Source: Respective companies, compiled by MIC, April 2014

## 2. Patent Mining of Wireless Power Technologies

### 2.1 Patent Search Procedure

MIC surveyed and analyzed the patent portfolios related to wireless power technologies, aiming to profile the current key players' patent deployment in the industry and provide an insight into the impact on the industry's development in the future.

#### 2.1.1 Selecting a Patent Database

This research is based on the search results obtained from the USPTO (United States Patent and Trademark Office) database.

#### 2.1.2 Identifying Search Keywords

Major keywords related to wireless power technologies were identified through reviewing publicly available data from research papers, news reports, key vendors' information, patent litigation

cases, keyword search, patent classification, and technical blog articles.

MIC uses IPC codes, USPTO codes, and keywords as major searching criteria in the mining process, including H01F, H01J, H04B, 455/572, 455/573, "wireless power", "radio frequency", "inductive", and so on. In addition, other columns such as Claim, Abstract, and Description are also used for keyword search.

### **2.1.3 Data Selection**

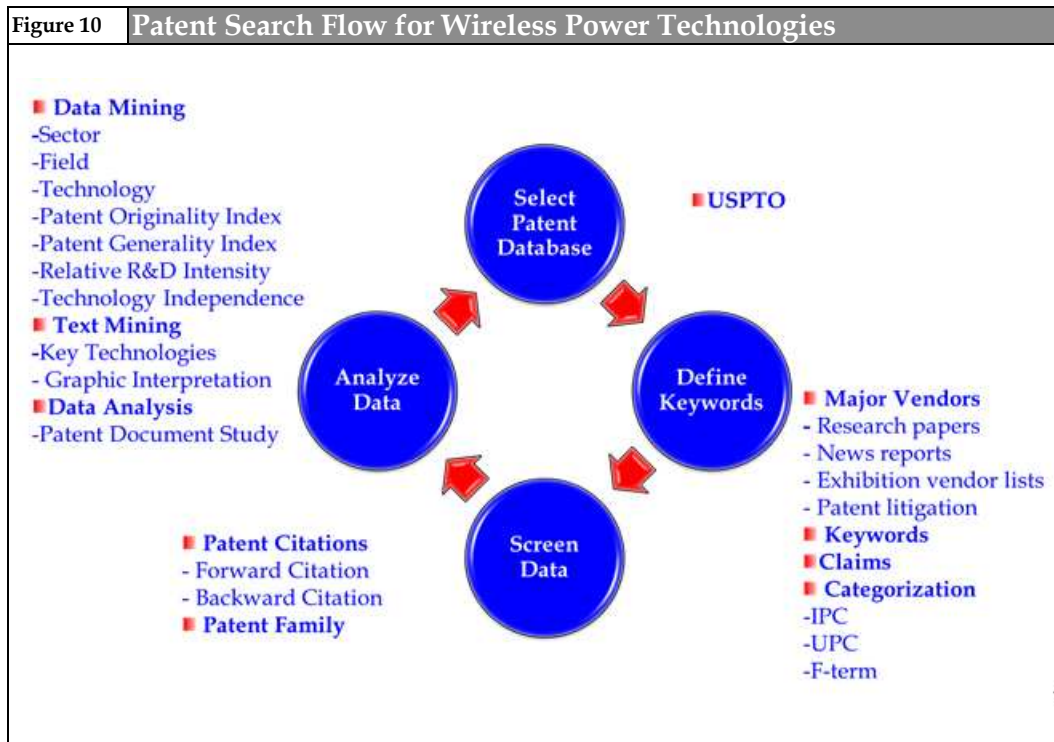
Based on the preliminary results of patent search, MIC conducted relevant researches and necessary adjustments. A total of 539 patents related to wireless power were selected for data analysis.

### **2.1.4 Data Analysis**

Leveraging data mining techniques, MIC analyzed and cross-examined the 539 patents in different sectors, fields, and technology types. Besides, MIC also conducted thorough analysis on patent holders' relative R&D intensity and technology independence.

Text mining techniques were then used to analyze the technologies covered by the 539 patents in order to gain a full picture of the key technologies.

In addition, for each patent, MIC surveyed its number of citations and patent families. The ten top-ranking patents in terms of citation and family numbers are marked as important patents in the field. For each of the ten patents, Patent Originality Index and Patent Generality Index are calculated as a measurement to evaluate its potential value and impact on the industry.



Source: MIC, April 2014

Table 2 Criteria for Patent Mining		
Number	Criteria	Number of Patents Found
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

---

Source: MIC, April 2014

## 2.2 Results of Patent Mining

### 2.2.1 Text Mining

Ranking	Technology	Patents	Ranking	Technology	Patents
1			15		
2			16		
3			17		
4			18		
5			19		
6			20		
7			21		
8			22		
9			23		
10			24		
11			25		
12			26		
13			27		
14			28		

Source: Respective companies, compiled by MIC, April 2014

### 2.2.2 Data Mining

--

Source: MIC, April 2014







3			
4			
5			
6			
7			
8			
9			
10			

Source: MIC, April 2014

Table 7		Matrix Analysis of 10 Most Important Patents Related to Wireless Power Technology						
No.	US Patent Number	Sector		Patent Originality Index	Patent Generality Index	Filing Date	Issue Date	Assignee
		Electrical Engineering	Basic Communication Processes					
		Electrical Machinery, Apparatus, Energy						
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Source: MIC, April 2014

### 3. Tracking and Observing Highlights

### 3.1 Application Aspect



Source: MIC, April 2014

### 3.2 Industry Aspect

<b>Table 8</b>	<b>Major Vendors and Industry Standard Organizations in the Wireless Power Industry</b>		
	<b>Magnetic Induction</b>	<b>Magnetic Resonance</b>	<b>Radio Frequency</b>
<b>Standard Organization</b>			
<b>International Standard</b>			



<b>Table 10 Taiwanese Vendors' Wireless Power Patents in USPTO</b>			
	<b>US Patent No.</b>	<b>Patent Title</b>	<b>Assignee</b>
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Source: Respective companies, compiled by MIC, April 2014

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## Appendix

### Glossary of Terms

A4WP	Association for Wireless Power
PMA	Power Matters Alliance
RFID	Radio Frequency Identification
WPC	Wireless Power Consortium

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## List of Companies

Abbott Diabetes Care  
Access Business Group  
Apple  
Broadcom  
ConvenientPower  
Creative Kingdoms  
Dupont  
ETRI  
Etymotic Research  
Fu Da Tong Technology  
Foxconn  
General Electric Company  
Hanrim Postech  
Hewlett-Packard  
Humavox  
IBM  
Intel  
LG  
Magna Electronics  
MediaTek  
MIT  
Mojo Mobility  
National Taipei University  
of Technology  
Navy  
Nokia  
Omniletric  
Philips  
Powercast  
Powermat  
Powertech  
Primax Electronics  
Qualcomm  
Raytheon Company

Realtek Semiconductor

Rohm

Samsung

Semiconductor Energy  
Laboratory

SONY

TDK Corporation

Texas Instruments

The Invention Science  
Fund I

USPTO

United States Patent and Trademark Office

Whirlpool Corporation

WiTricity

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