Wireless Charging Through a Collapsible Mobile Device Grip

Christina Gilbert

Follow this and additional works at: https://www.tdcommons.org/dpubs_series

Recommended Citation
Gilbert, Christina, "Wireless Charging Through a Collapsible Mobile Device Grip", Technical Disclosure Commons, (September 13, 2019)
https://www.tdcommons.org/dpubs_series/2476

This work is licensed under a Creative Commons Attribution 4.0 License.
This Article is brought to you for free and open access by Technical Disclosure Commons. It has been accepted for inclusion in Defensive Publications Series by an authorized administrator of Technical Disclosure Commons.
Wireless Charging Through a Collapsible Mobile Device Grip

Abstract:

This publication describes systems and techniques directed to wireless charging through a collapsible mobile device grip. A receiver (Rx) coil that is attached to a collapsible cable is affixed inside the top, planar surface of the collapsible mobile device grip. The location of the Rx coil is such that the receiver coil can be placed proximate a complementary transmission (Tx) coil disposed inside a top, planar surface of a wireless charging pad. A collapsible cable connects the Rx coil to a pogo-pin interface, which can be integrated into a backplate of the mobile device or into a casing of the mobile device, to electrically couple the Rx coil to a charging system of the mobile device.

Keywords:

grip, transmission coil, Tx coil, reception coil, Rx coil, wireless charging, wireless power transfer, wireless charging pad, pogo pin, Qi protocol, cell phone, case, accessory, extending socket

Background:

Wireless charging is a popular technology that is common in a mobile device today. Also common is the use of a collapsible mobile device grip (or socket) that is attached to a backside surface of the mobile device to allow a user of a mobile device to hold the mobile device more ergonomically.

Generally, a system used to wirelessly charge the wireless device includes a reception coil (e.g., an Rx coil) integrated near a backside surface of the mobile device and a transmission coil (e.g., a Tx coil) integrated proximate a topside surface of a charging pad. In general, by placing
the backside surface of the mobile device adjacent the topside surface of the wireless charger, the \( R_x \) coil and the \( T_x \) coil are brought close to one another to maximize a power transfer efficiency during inductive wireless charging.

The power transfer efficiency during wireless charging has been shown to degrade with the cube of a distance separating the \( R_x \) coil and the \( T_x \) coil. The attachment of a collapsible mobile device grip to the backside of a mobile device can create a distance of separation between the \( R_x \) coil and the \( T_x \) coil that, even with collapsible mobile device grip in a “collapsed” state, can be greater than seven millimeters (> 7 mm) and negatively impact the power transfer efficiency. In many cases, the mobile device will fail to charge at all.

**Description:**

This publication describes systems and techniques directed to wireless charging through a collapsible mobile device grip. FIG. 1, below, illustrates such a collapsible mobile grip:
The mobile device of FIG. 1 includes a collapsible mobile device grip with a receiver coil (e.g., an R\textsubscript{x} coil) affixed inside the top, planar surface of the collapsible mobile device grip. The location of the R\textsubscript{x} coil is such that the R\textsubscript{x} coil can be placed proximate to a complementary transmission (T\textsubscript{x}) coil disposed inside a top, planar surface of a wireless charging pad. A collapsible cable connects the R\textsubscript{x} coil to a pogo-pin interface, which can be integrated into a backside plate of the mobile device or into a casing of the mobile device, to electrically couple the R\textsubscript{x} coil to a charging system of the mobile device.

A charging circuit (e.g., including the R\textsubscript{x} coil) of the mobile device of FIG. 1 may comply with an open interface standard that defines wireless power transfer using inductive charging, such as the Qi standard developed by the Wireless Power Consortium. Although illustrated as a smartphone, the mobile device of FIG. 1 may be a tablet, a personal digital assistant (PDA), a handheld gaming system, a system that uses global navigation satellite system (GNSS) data for locating purposes, and so on.

FIG. 2, below, illustrates a reception (R\textsubscript{x}) coil that is attached to a collapsible cable in accordance with one or more aspects.
As illustrated in FIG. 2, the Rx coil includes first end connection point that is a positive electrical terminal (e.g., a (+) connection point) and a second connection point that is a negative electrical terminal (e.g., a (-) connection point). The Rx coil may be a material that is electrically conductive, such as copper (Cu) or aluminum (Al). Example fabrication techniques of the Rx coil may include drawing the Rx coil from a wire or stamping the Rx coil from a thin sheet of material. The Rx coil may be affixed inside a top, planar surface of the mobile device grip and connect to a collapsible cable at the respective connection points.

FIG. 3, below, illustrates a first example implementation of wireless charging through a collapsible mobile device grip in accordance with one or more aspects, including a backplate pogo-pin interface that electrically couples the mobile device grip to a charging system of the mobile device.

![Diagram of wireless charging setup](#)

**FIG. 3**

As illustrated by FIG. 3, the Rx coil is affixed inside a top, planar surface of the mobile device grip. The Rx coil may be affixed inside the top, planar surface of the mobile device grip, for example, using heat welding techniques or an epoxy. A collapsible cable is connected to the Rx coil and may behave in a helical fashion.
In the example implementation of FIG. 3, the collapsible mobile device grip electrically couples to a charging system (including a battery) of the mobile device through a backplate pogo-pin interface that is manufactured as part of the mobile device. The example backplate pogo-pin interface of FIG. 3 includes an embedded alternating current (AC) / direct current (DC) converter device that may be soldered or embedded into the backplate pogo-pin interface. The example backplate pogo-pin interface of FIG. 3 may include pads for soldering electrical terminals of the collapsible cable, pads for surface mounting the AC/DC converter device, electrical traces, and so on. The backplate pogo-pin interface may include gold plated pogo-pins that are spring-loaded, positioned using guide barrels, and electrically connect to the charging system of the mobile device.

FIG. 4, below, illustrates a second example implementation of wireless charging through a collapsible mobile device grip in accordance with one or more aspects, including a mobile device casing with circuitry that electrically couples the mobile device grip to a charging system of the mobile device.

FIG. 4

In the example implementation of FIG. 4, the collapsible mobile device grip electrically couples to a charging system (including a battery) of the mobile device through a mobile device
casing that is manufactured separately from the mobile device and includes a casing pogo-pin interface. Like the pogo-pin interface of FIG. 3, the example casing pogo-pin interface of FIG. 4 includes an embedded alternating current (AC) / direct current (DC) converter device that may be soldered or embedded into the casing pogo-pin interface. The example backplate pogo-pin interface of FIG. 4 may include pads for soldering electrical terminals of the collapsible cable, pads for surface mounting the AC/DC converter device, electrical traces, and so on. The casing pogo-pin interface may include gold plated pogo-pins that are spring-loaded, positioned using guide barrels, and electrically connect to the charging system of the mobile device.

Permutations of the described systems and techniques are many. As a first example permutation, an alternative using an $R_x$ coil that is drawn or stamped, the $R_x$ coil may be part of a printed circuit board (PCB) that is fixed to an interior surface of the mobile device grip. In this first example permutation, a pogo-pin interface having pogo-pins with “long-travel” (e.g., travel corresponding to the “collapsing distance”’ of the mobile device grip may electrically couple the PCB to the charging system of the mobile device. As a second example permutation, a configuration of the $R_x$ coil may include a coil that has transmission ($T_x$) capabilities for cross-charging or sharing power with another mobile device. As a third example permutation, the previously described AC/DC converter may be included as part of the mobile device and not as part of a pogo-pin interface. And, as a fourth example permutation, an interface that uses electrical coupling mechanisms other than pogo-pins (e.g., micro-electromechanical systems (MEMs) such as formed springs, cantilever interconnects, and so on) may be used.

In summary, the described systems and techniques accommodate wirelessly charging a mobile device with a collapsible mobile device grip attached to the backside of the mobile device.
Through the R\textsubscript{x} coil that is affixed inside the top, planar surface of the collapsible mobile device grip, power transfer efficiencies during inductive, wireless charging is maintained.

**References:**
