September 13, 2019

Wireless Charging Through a Collapsible Mobile Device Grip

Christina Gilbert

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 (R_x) 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 R_x coil is such that the receiver coil can be placed proximate a complementary transmission (T_x) coil disposed inside a top, planar surface of a wireless charging pad. A collapsible cable connects the R_x 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 R_x coil to a charging system of the mobile device.

Keywords:

grip, transmission coil, T_x coil, reception coil, R_x 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 R_x coil) integrated near a backside surface of the mobile device and a transmission coil (*e.g.*, a T_x 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:

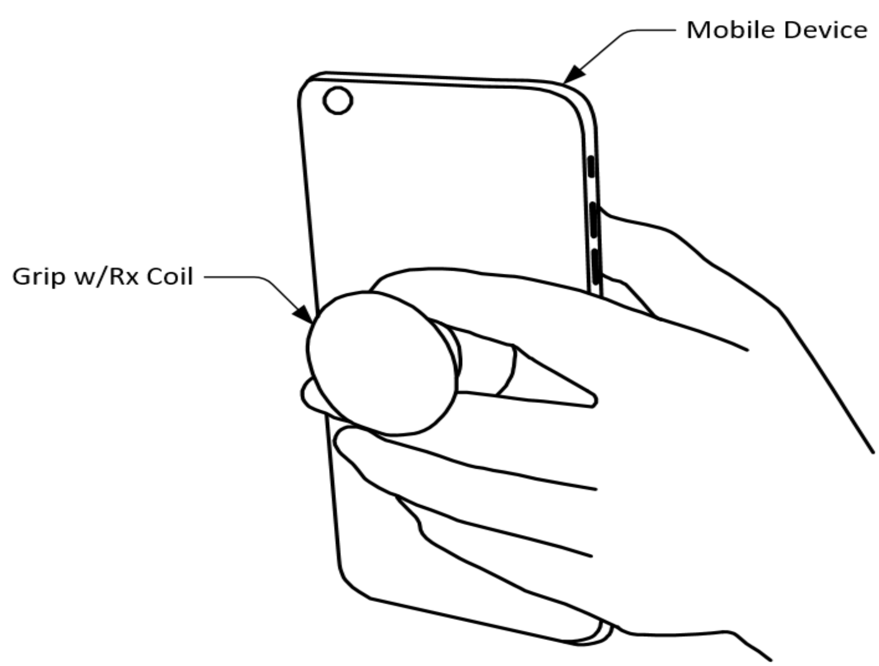

FIG. 1

The mobile device of FIG. 1 includes a collapsible mobile device grip with a receiver coil (*e.g.*, an R_x coil) affixed inside the top, planar surface of the collapsible mobile device grip. The location of the R_x coil is such that the R_x coil can be placed proximate to a complementary transmission (T_x) coil disposed inside a top, planar surface of a wireless charging pad. A collapsible cable connects the R_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_x coil to a charging system of the mobile device.

A charging circuit (*e.g.*, including the R_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_x) coil that is attached to a collapsible cable in accordance with one or more aspects.

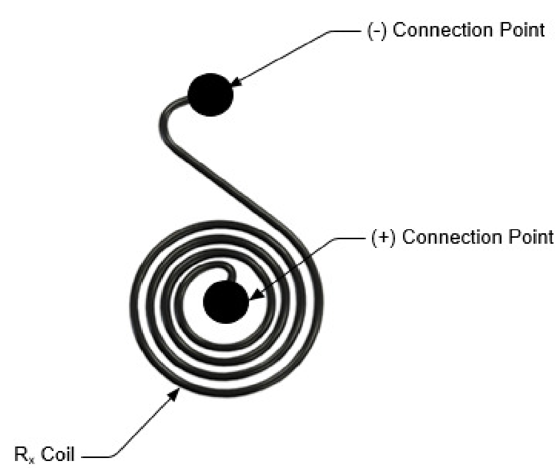

FIG. 2

As illustrated in FIG. 2, the R_x 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 R_x coil may be a material that is electrically conductive, such as copper (Cu) or aluminum (Al). Example fabrication techniques of the R_x coil may include drawing the R_x coil from a wire or stamping the R_x coil from a thin sheet of material. The R_x 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.

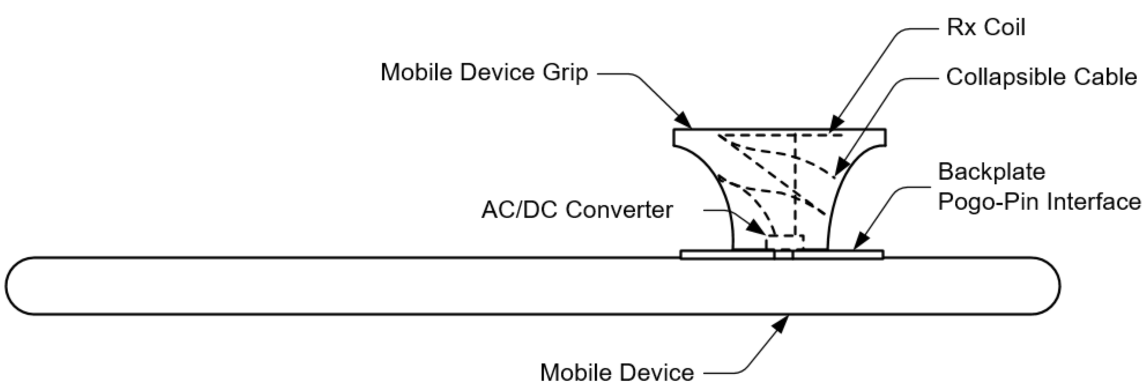

FIG. 3

As illustrated by FIG. 3, the R_x coil is affixed inside a top, planar surface of the mobile device grip. The R_x 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 R_x 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.

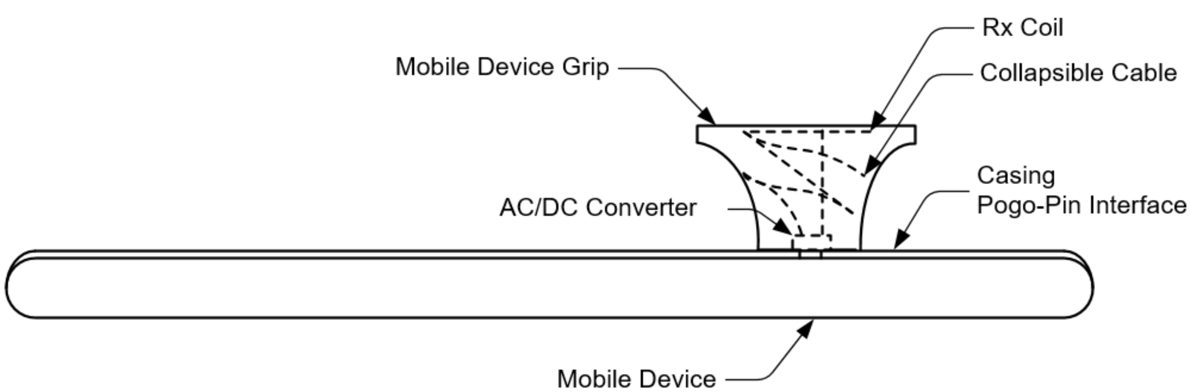

FIG. 4

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_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:

[1] KR 20190043045 A, Wireless Charging Device for Portable Device with Accessory Attaching on Back Cover of Portable Device, Filing Date October 27, 2017.

[2] US 20170134063 A1, Device Cover for Accessory Attachment, Filing Date June 14, 2016.