

# PRODUCT DESIGN SPECIFICATIONS

## Inductive Charging

*Practicum Team 10*



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**Project repository:** <https://github.com/tjgilbert/ece411>

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# 1 Introduction

## 1.1 Objective

Create a portable and intuitive to use wireless charger for a mobile device (*portable and intuitive are defined further in the Requirements section*). The use of the product requires the user only to place their device on the charging station and their device will begin charging.

## 1.2 Needs Statement

The need for this technology is sufficed by the convenient enhancements upon wired chargers. Wireless chargers negate the need to plug and unplug the device. The technology can also help people with physical impairments that are unable to manipulate traditional charging cords. Wireless charging technology is also inherently more robust than a physical connector. Charging cords wear out and receptacles can be damaged by careless insertion.

# 2 Requirements

The purpose of the requirements document is to outline the direction of this project within the requirements of the *ECE411* practicum. All of the requirements weighted *Must* need to be satisfied in order to qualify as a minimum viable product. Requirements weighted *Should* specify desired features, which should be realized before the products' final release, but are not necessary for the minimum function. *May* requirements are convenience features. Their inclusion is at the pleasure of the *Must* and *Should* requirements

## 2.1 Functional

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
1.1	Wirelessly charge a USB device	Must	This is the premise of the project, this is its sole purpose
1.2	Have one or more sensors and actuators	Must	Course requirement
1.3	Have a digital or analog processor	Must	Course requirement
1.4	Turn on transmitter when device to be charged is placed in range	Should	This will save energy because the product will not transmit energy if no device is present
1.5	Turn off transmitter when device is removed	Should	Same as 1.4

## 2.2 Performance

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
2.1	Provide USB spec power (4.75-5.25V, 500mA) [2] to the receiving device	Should	Meeting this spec would guarantee it would work on most mobile devices

## 2.3 Economic

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
3.1	Prototypes not to exceed \$75 each	Should	We are not made of money
3.2	Product not to exceed \$20 in components each for quantity 1000	Should	We are not paying our engineers, or technicians, If we sell the product for \$20+S&H we <i>might</i> turn a profit

## 2.4 Power

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
4.1	Charging unit will be powered by a 12VDC supply	Should	If supplied by 12VDC, product can be adapted for automotive use

## 2.5 Health and Safety

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
5.1	Shut off if base draws excessive current (current rating of Tx coil wire)	Must	This will serve as short circuit protection, which could lead to damage of product, and/or fire
5.2	Shut off if the base unit overheats (exceeds 35°C)	Must	35°C is the maximum operating temperature of the iPhone [3]

## 2.6 Legal

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
6.1	Code and hardware design will be made by us	Must	To preserve our academic honesty and integrity
6.2	Any borrowed or modified code/designs will be credited according to the applicable license	Must	It's the right thing to do

## 2.7 Environmental

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
7.1	Charging unit compliant with IP22 [4]	Should	Users may spill liquids on the base unit, but as most mobile devices are generally not water resistant, the receive units will not carry this rating

## 2.8 Maintainability

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
8.1	Transmitter board to be screw removable from enclosure	Should	Removable parts will ease debugging and repair

## 2.9 Manufacturability

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
9.1	Device will use no BGA, QFN or SMD parts smaller than 0604	Should	Course requirement and for small runs the PCBs need to be easily assembled by hand

## 2.10 Physical

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
10.2	Can fit charging unit into a backpack (300mm x 300mm x 150mm)	Should	Meeting these dimensions would qualify the charging unit as portable
10.3	Receiver is smaller or equal to 138mm x 67mm	Should	This is the dimension of the iPhone 7, meeting this footprint would make it compatible with more devices

### 2.11 Reliability & Availability

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
11.1	MTTF of > 2 years	Should	About half of smartphone users upgrade every two years [5]

### 2.12 Social & cultural

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
12.1	Have a hip enclosure design, to be judged as hip by at least 4 non-engineering majors	May	A good looking charger will differentiate it among other wireless charging solutions

### 2.13 Political

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
13.1	Comply with FCC rules on radiating devices	May	Radiating devices sold in the United States must pass FCC rules for permitted emissions

### 2.14 Usability

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
14.1	Orientation/location for device placement on charging unit is marked	Should	Marking the location for optimal charging will reduce the time to full charge
14.2	User able set up within 5 minutes without user manual by a college student	Should	This is a metric to decide if the device is user friendly
14.3	Base station will indicate when device is coupled/charging	Should	User feedback will increase confidence that the product is operating correctly
14.4	Base station will indicate when device is done charging	May	Further user feedback on charge state would be a more obvious indication than having to check the phone

### 2.15 Documentation

<i>Req#</i>	<i>Requirement</i>	<i>Weight</i>	<i>Justification</i>
15.1	Graphic Instruction Card	Must	A pictorial style instruction card removes need for translation and eases internationalization
15.2	Magnetic Field Warning Sticker	Should	Magnetic fields produced by device could damage information held on magnetic media like cassettes and cards

## References

- [1] Faust, Mark. "Requirements Specification" ECE 411 Industry Design Practices. Portland State University, Portland, OR. 18 October 2016. Lecture/PowerPoint
- [2] "Universal Serial Bus Specification Revision 2.0" *Compaq Computer Corporation, Hewlett-Packard Company, Intel Corporation, Lucent Technologies Inc, Microsoft Corporation, NEC Corporation, Koninklijke Philips Electronics N.V.* [PDF DOCUMENT], 2000 1
- [3] "Keeping iPhone, iPad, and iPod Touch within Acceptable Operating Temperatures." *Apple Support*. N.p., 28 Sept. 2016. Web. 24 Oct. 2016. <https://support.apple.com/en-us/HT201678> 2
- [4] "IP Rated Enclosures Explained" *The Enclosure Company (International) Ltd* N.p., n.d. Web. 23 Oct. 2016. <http://www.enclosurecompany.com/ip-ratings-explained.php> 2
- [5] "How Often Do Americans Upgrade Their Smartphones?" *Forbes*. Forbes Magazine, 9 July, 2015. Web. 24 Oct. 2016. 3