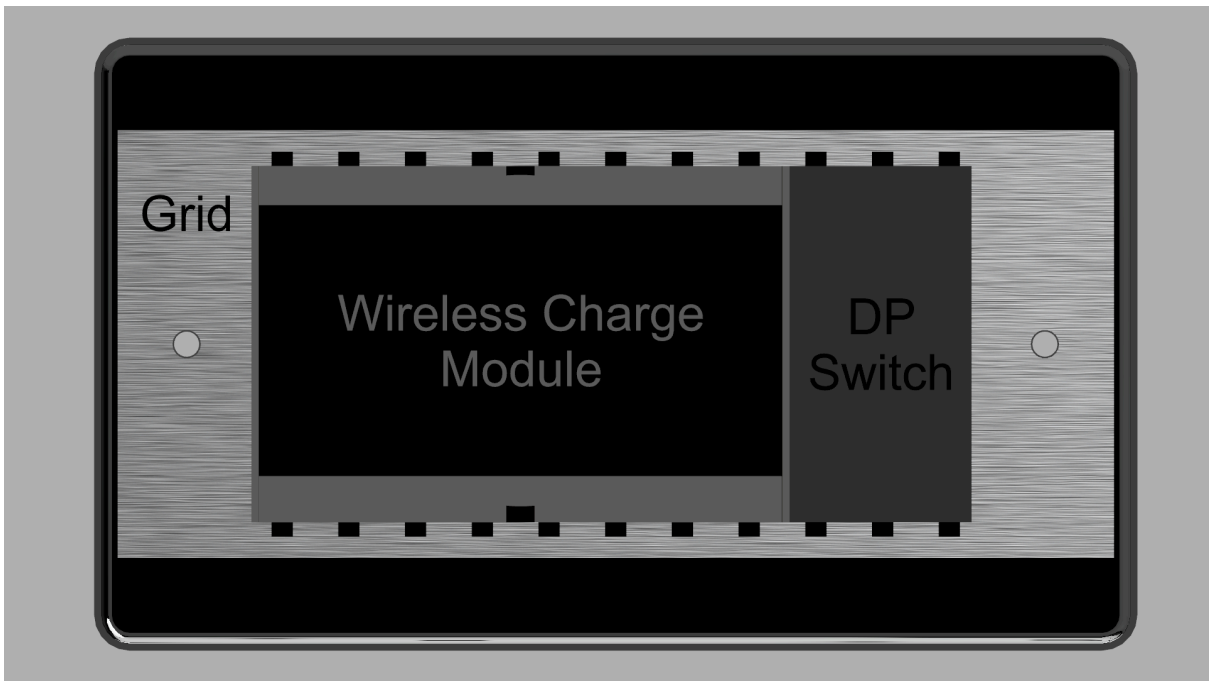


Mag Charge

ROONTECH



Comprehensive Prototype

By Christopher John Rooney (BSc)

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Summary

This document is based upon the design and prototype build of a unique wireless charger plus accessories for mobile phones, earbuds and other small devices. The report will detail where the idea comes from, why it is necessary and who the target market is. A CAD conceptual design will be visualised and a schematic drawing will detail critical dimensions. A CNC Manufacturing Suite within Fusion360 will use the CAD drawings to develop bespoke components which are to be machined on a CNC Milling Machine and STL files created and converted to G-code for 3D Printing the Module Housing. Components that are not internally manufactured are externally sourced and fully justified as to why they have been selected. The assembly of machined parts and off the shelf components will be combined and thus a Prototype will be ready for testing to see if the method was valid or not.

One aspect to overcome is the myth and stigma associated with the interference of Neodymium Magnets with regards to wireless charging. This will be challenged using a unique design approach and correct positioning. The document will also include Competitor Analysis, a Patent Application and a glimpse into the future variant of the Mag Charge. Also to be discussed is the correct Electrical Installation of the device and how to prepare the device for Insulation Resistance tests regarding ring mains and radial circuits operating between 3A to 32A on MCB/RCD/RCBO/AFDD devices.

More interestingly is the cost of development, I have a budget of £100, I believe to bring about the Mag Charge 001 Prototype within that budget. Using my experience as an Electrician of 25 years with a Mechanical Engineering Degree combined with creativity, CAD, CAM, CNC, Advanced Mathematics, R&D and Hyperfocus courtesy of ADHD (The Good Type). I already own a 3D Printer and CNC Desktop Mill, and I have plenty of Epoxy Glue left over from my Laser Line Guidance Template Project so I believe it to be a reality. For the purpose of Rapid Prototyping Epoxy Glue shall be favoured over time consuming clip and screw methodology, specifically relating to the Module Housing.

Introduction

Introducing the Mag Charge, a unique wireless charging device aimed at those who seek innovative sustainable charging products. The Mag Charge is completely unique, unlike any other charger, there are no power cables, USBs adapters or protruding holders on display. It functions like a Socket Outlet, it has actually been designed to replace existing wiring and position of a (UK) Double Socket Outlet. This method integrates wireless charging with Electrical Installations. Due to the nature of installation one needs a competent person to swap out an existing socket without building control notification. Alternatively, a new installation will require an Electrician. ROONTECH will offer a discount on purchase and fitting which will be cheaper than using an external Electrician. This specifically relates to works carried out in the East Midlands, but will be extended to the whole of the UK if the business is successful.

Unique

Being the only magnetic vertical wireless charging device it also becomes space saving with less than 20mm width with regards to charging a phone. The Mag Charge is wall mounted, surfaces that would normally be used for charging can be used for something else. Therefore, a sleek, stylish clutterless approach to charging which comes in many colours. The device will suit any Electrical Socket Installation decor from Brass, Rose Pink to Matt Black. Bespoke variants are also available with the customer having the ability to choose the colour of the Face Plate, Switch and Interface.

Safety

The Mag Charge increases safety and component longevity due to the Double Pole Isolator, thus a safer approach when compared to existing sockets with USBs where you cannot isolate the USB Modules. The Isolator also acts as a reset point when a wireless connection is not guaranteed to charge without first isolating a plug socket or reconnecting a USB for example. This is a problem for many wireless chargers, but not the Mag Charge.

Variants

There are two Mag Charge versions, the first version is referred to as the Minimum Viable Product (MVP), denoted as 001 and the second future product is denoted as 002. Both of these devices will be able to accept Dispersion Add-on accessories. This report concentrates on developing 001, with the intention of sales increasing the likelihood of developing the more sophisticated 002 variant if all goes to plan..

About

The Mag Charge range was founded by the need for clutterless space saving techniques regarding charging small devices to which a unique vertical wireless charging methodology has been developed. The device has been designed to increase wireless charging capabilities aiding the development of ingress proof Mobile Phones and other small devices such as Ear Buds. Using existing power supplies such as Ring Mains or Radial Circuits enables the Mag Charge to be powered which removes the need for transformer plugs and USB cables.

How It Works

It operates by using the wireless charge capabilities of Mobile Phones, Earbuds and other small devices. The idea is to fit a Magnetic Ring which is often denoted as a Mag Ring to your phone's case as a primary example. This method of charging is becoming so popular that mobile phone Manufacturers such as Apple and Samsung are incorporating the Magnetic Rings into their own protective cases.

How To Use

Simply line-up your Phone's Magnetic Ring with the device's transmitter position, the Magnetics will secure the Phone with a solid connection, then press the Rocker Switch to connect the power for charging to commence. I call this technique "Attach & Latch", the Body of the MAG Charge is made of Steel, therefore, magnets are the marringing tool to complete the attachment. Latching refers to a "Latching Rocker Switch". The Switch serves more than a purpose of powering the device for charging. It acts as a local reset point which is a requirement for Wireless charging. The Switch aids safety because it can be turned off unlike current Socket Outlets with USBs. This is an efficient way to operate saving energy whilst the side-effect results in a positive increase regarding component longevity.

Space Saving

The normal operation of wireless phone charging is to put it on a flat Charge Plate, some brands use Magnets to help align the phone so charging is efficient. The Charge Plate is then connected via a USB cable to either a USB Outlet or a Transformer Plug operated by a Socket Outlet. The Mag Charge is designed to remove all of the cables, adapters and charge plate clutter, hence a Space Saving device. The distance from a wall to the edge of a phone using the Mag Charge is less than 20mm.

Aesthetics

A sleek non-intrusive device has been designed to suit any environment regarding Electrical Socket Outlets and comes with a range of colours available to suit any Electrical Installation Decor such as White, Brass, Chrome, Matt Black and even Pink.

Repairs & Upgrades

The Mag Charge has been intentionally designed with the ability of upgrading components for future proofing the device, meaning the replacement of components are equally accessible. This forms part of the company's sustainable and fair pricing policy.

Add-Ons

Due to the nature of this device many other additional devices could be added under the "Attach & Latch" methodology. An Air-Wick type fragrance dispersion device will replace traditional plug-ins. This would increase sales for low level applications of the Mag Charge. Plug-ins can cause fires due to being left on by mistake, the Mag Charge aims to eliminate this threat by using its thermal cut-out capability.

Wellbeing

Another unique Add-on is the Particle Dispersion Unit, designed to disperse Minerals and Vitamins in particle form. It works similar to an Air-Wick for clarification, Vitamins and Minerals included are; B12, C, Iron, Zinc, Magnesium and Copper to name a few. This Add-on serves as a wellbeing device allowing people to top-up on minerals without taking supplements, or worst case, injections. Many people cannot absorb Minerals or vitamins orally and need an injection; this is an alternative solution.

Application

Designed for offices, and homes, for mid level installations the Mag Charge is ideally situated above kitchen worktops, desktops and bedside tables with regards to charging your phones. Hotels would also benefit from the Mag Charge, many USB ports have become outdated in Hotels due to Industry upgrade of the double ended Type-C that comes with new phones. To future proof, swap to the Mag Charge and never worry about upgrades again.

For low and high level applications ROONTECH's wireless charging Fragrance and Particle Dispersion units are best suited, but not limited to.

Target Market

Gadget hunters, innovation lovers, the safety and wellbeing conscious, anyone that likes efficiency, sustainability and clutterless technology, the Mag Charge is built and designed for you and me.

Personal Thoughts

The Mag Charge is not just an efficient, sustainable, space saving Charger, it is also a Wellness device. Made by someone who really does care about the quality, costs and health of his customers.

Dimensions

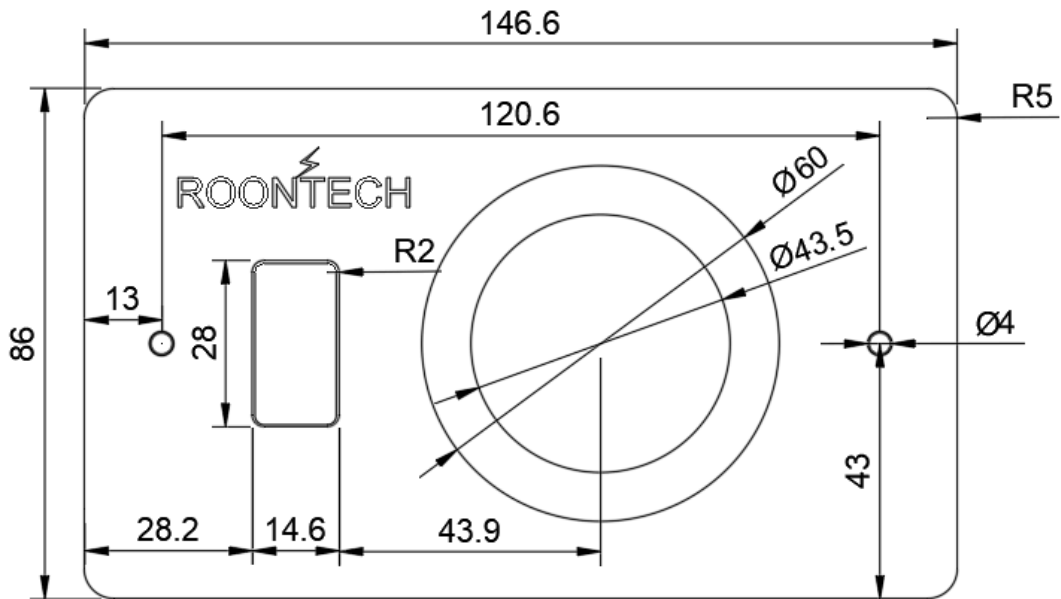


Fig 1 Front View Dimensions

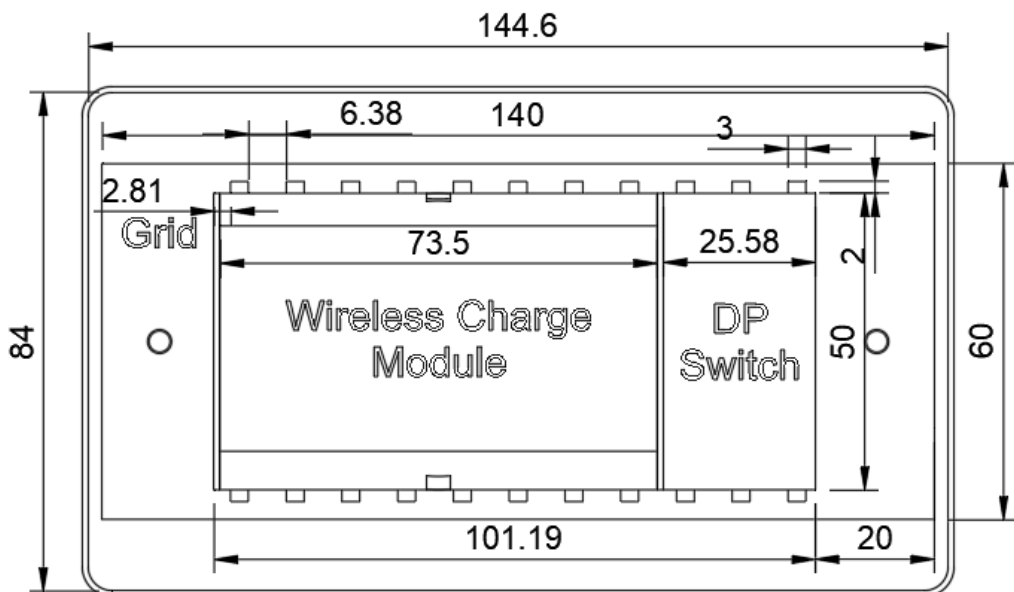


Fig 2 Rear View Dimensions

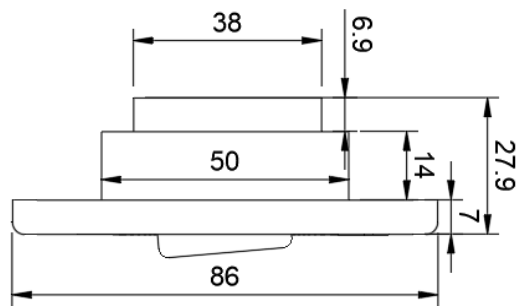


Fig 3 Side View Dimensions

Features

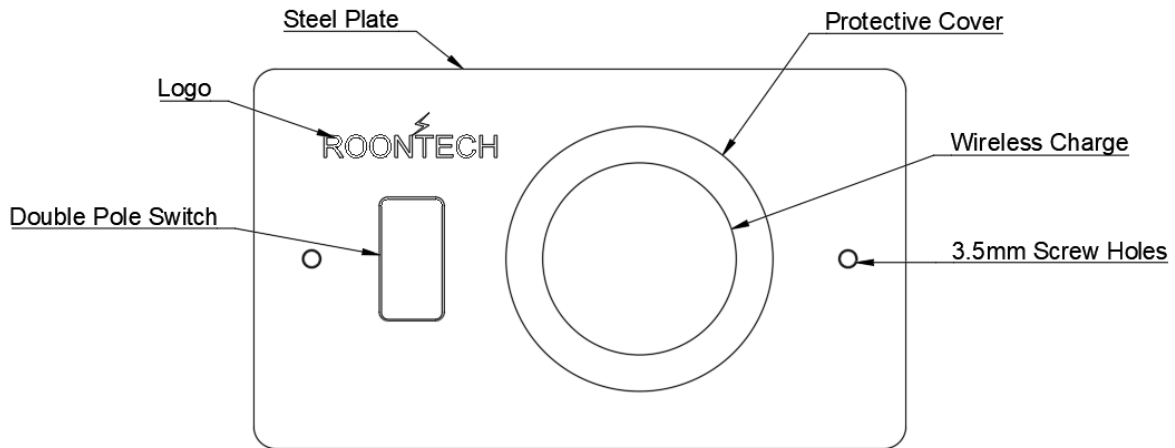


Fig 4 Front View Features

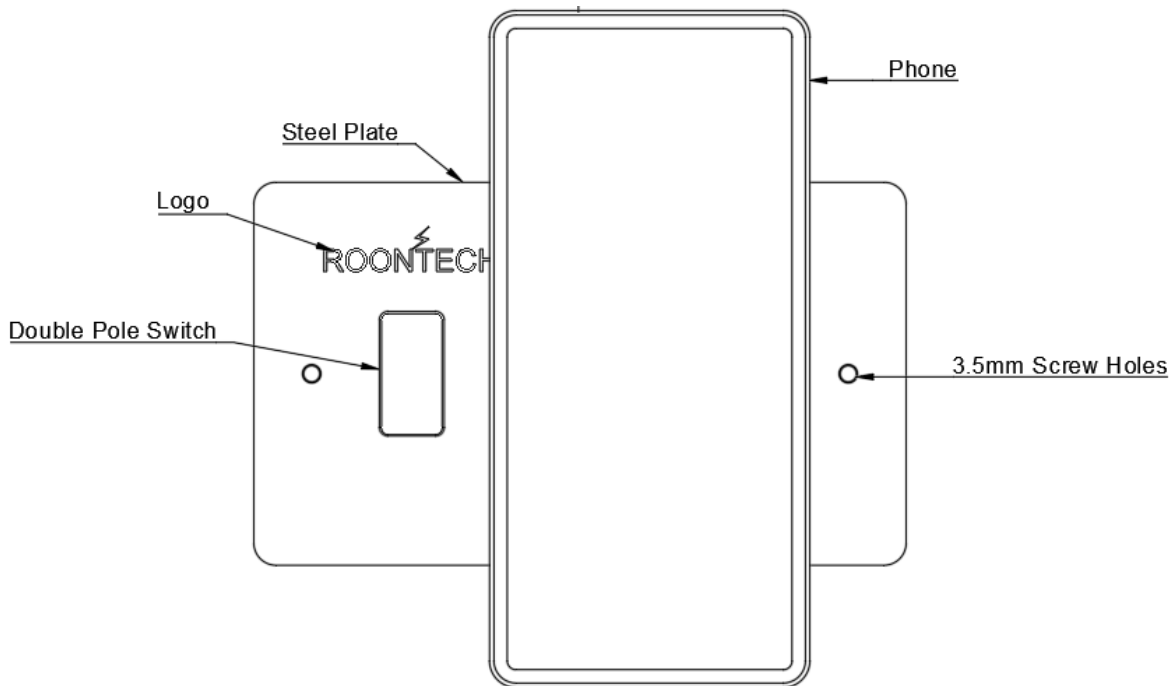


Fig 5 Front View & Phone

Connect

Simply line up a phone with a Mag Ring Case and position over the wireless charger. The phone attaches via a Mag Ring and then you latch using the Rocker Switch. With regards to your phone, buy the right case so the camera doesn't protrude the rear. If it does you can always double-up on Mag Rings, fitting one directly to the Mag Charge in order to span the camera's gap, remember, the charge range is up to 8mm. For those who do not have wireless capability inbuilt you can buy external wireless receivers that simply plug into your USB port.

Design Styles



Fig 6 Chrome Mirror

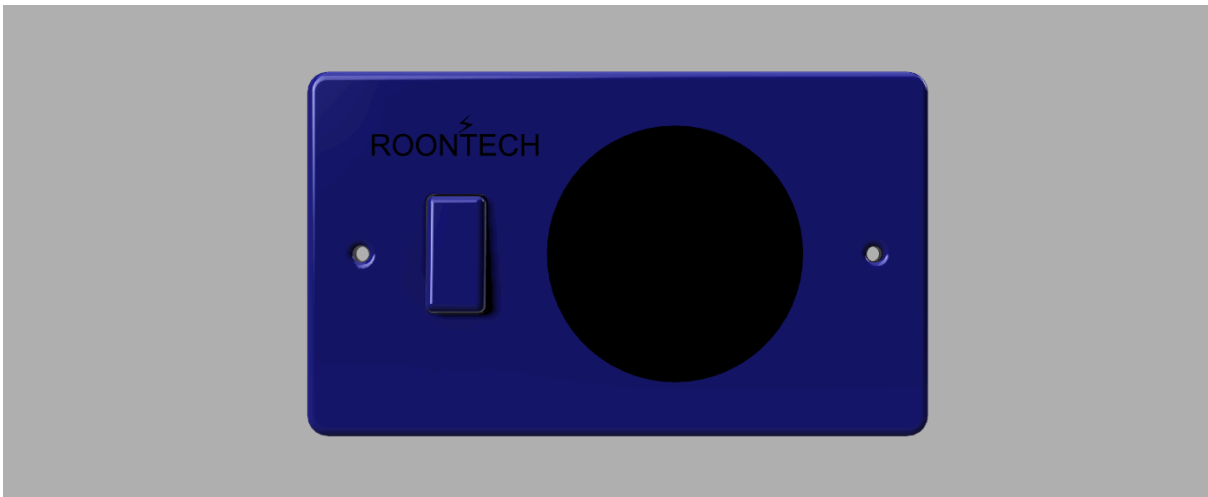


Fig 7 Reflex Blue

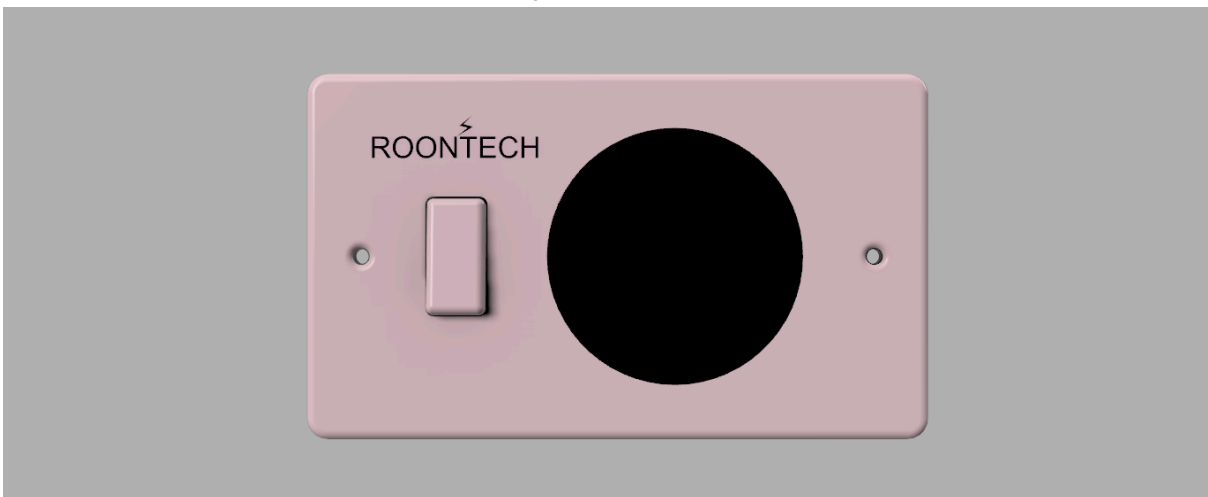


Fig 8 Rose Pink

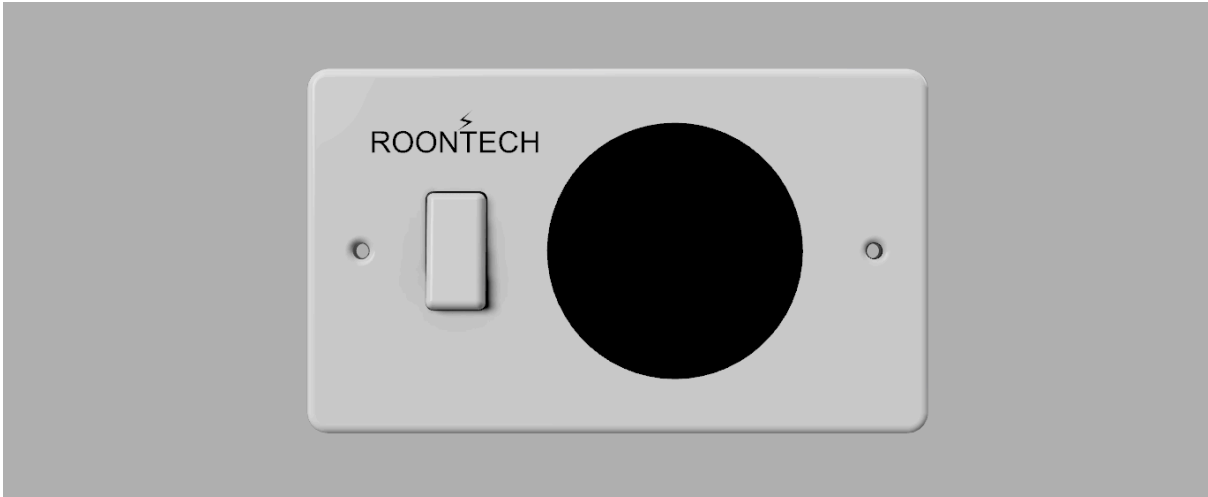


Fig 9 White

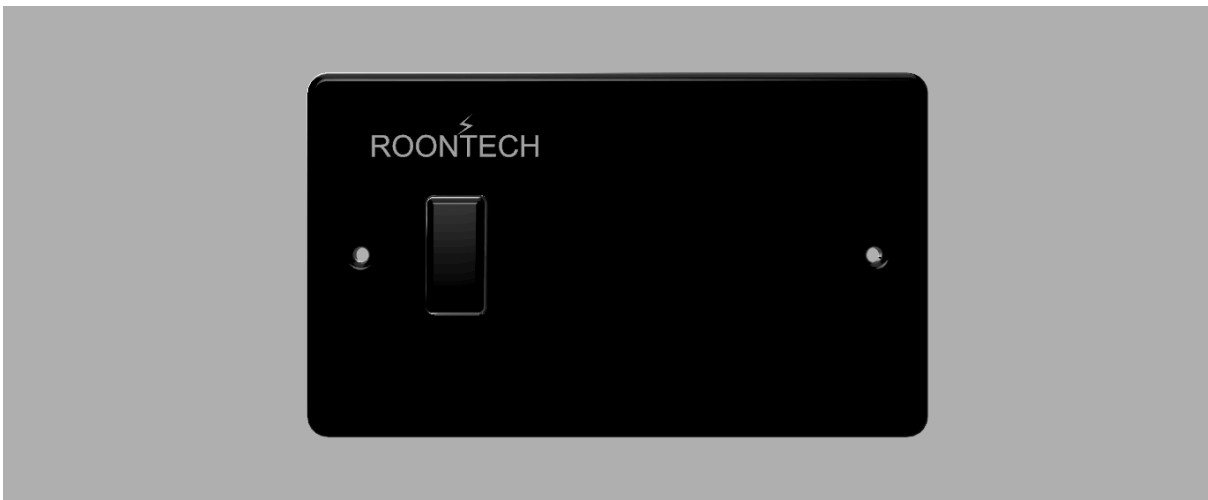


Fig 10 Black

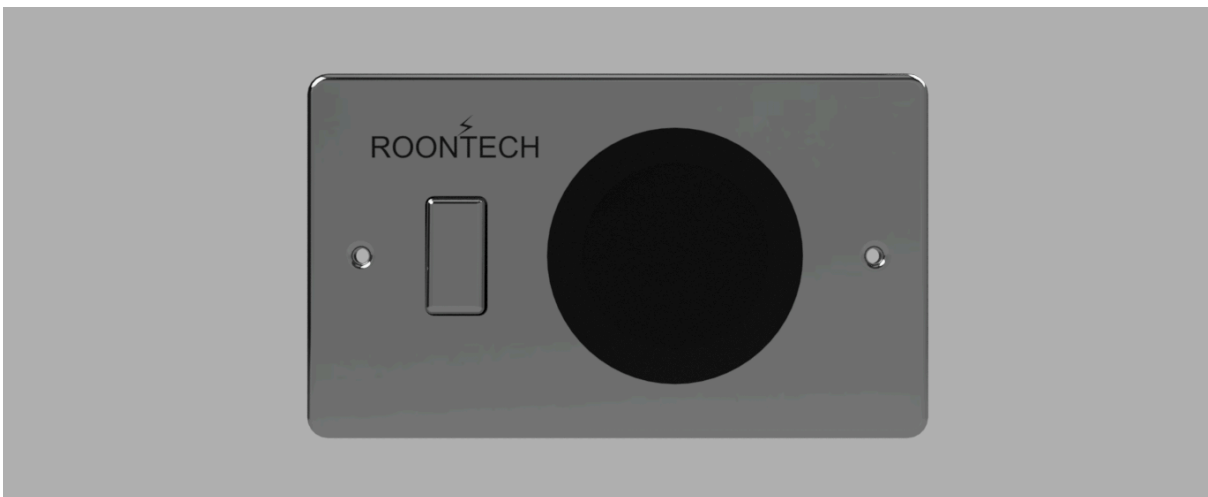


Fig 11 Grey

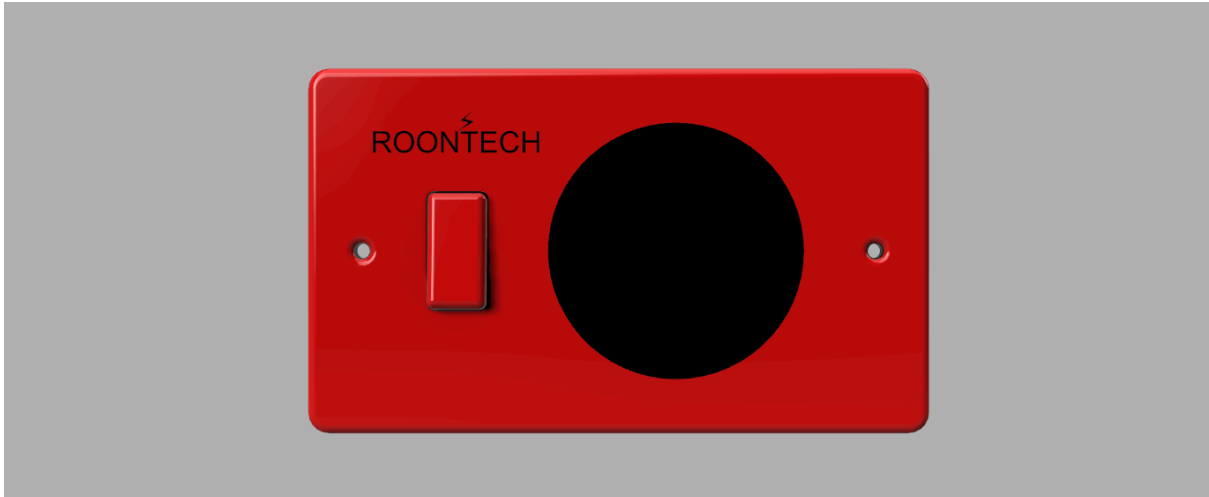


Fig 12 Pillow Box Red

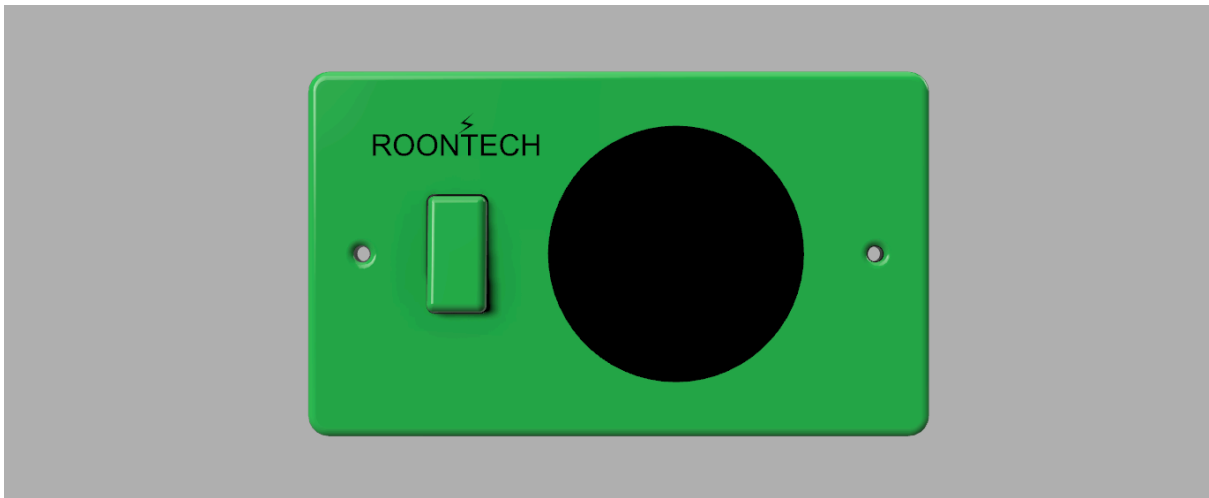


Fig 13 Beryl Green

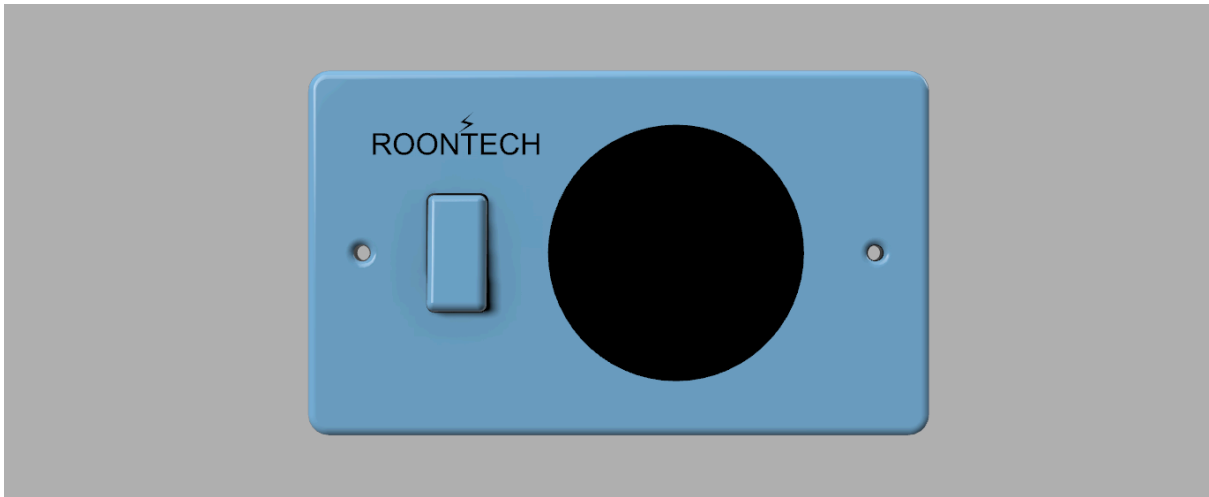


Fig 14 Lily Duck Egg Blue

Aesthetics

All the colours shown above are available and many more, from Brass to Brushed, with the ability to be customised to suit any customer requirements. The website www.roontech.co.uk/mag-charge will allow you to select options for either standard or customised products.

Competitor Analysis

So I have a design, this now needs to be compared to competitors. No need for a Pugh Matrix or House of Quality. A simple yet highly effective tally chart is all that is required. There are many wireless chargers to choose from but I use what sells best. The three Phone and wireless charge manufactures are Samsung, Apple and Tesla.

Table 1 Competitor Analysis

	Samsung Charge Pad	Apple Magsafe	Tesla Charge Platform	Mag Charge
Cost	4	3	0	3
Sustainability	3	4	1	4
Brand Image	5	5	5	0
Disassembly	1	1	1	4
Safety	4	4	4	5
Magnetic	0	4	0	5
Devices	2	2	5	2
Adapter/Lead	1	1	1	5
15W	5	5	5	5
Score	25	29	22	33

ROONTECH

Whilst I cannot compete with big company brand image, I can in other aspects and surpass. For example, wattage, disassembly, clutterless, magnetic, safety, finish, integration, Add-ons, vertical charging, space saving and component longevity.

Samsung Charge Pad

Is just a standard charger costing £52, with average features. Designed for a single device, it requires an adapter and lead which increases clutter and further expense.

Apple Magsafe

Again, this is just another over-priced charger costing £45 with basic features. This is designed for a single device but also requires an adapter and lead, but it is magnetic.

Tesla Charge Platform

Tesla costs a lot, £300, it can hold three devices but it is bulky, it requires an adapter and lead. The most unsustainable design of all as there are numerous transmitter coils, it would be wiser to position fewer correctly.

Procurement

With a design in place and dimensions calculated I need to buy the components. Component justification is simply based on necessity, and cost.

Components List

Table 2 Component List

	Quantity	Cost
Blank Plate	1	£5
4 Gang Grid/Yoke	1	£5
DP Switch	1	£7
3.1A USB Module	1	£15
USB Cable	1	£2
Wireless Transmitter	1	£8
3mm Perspex	1	£2
Epoxy Glue	1	£8
Neodymium Magnets	10	£4

Not exactly cheap but this is the world we live in, £58, granted the glue will last a bit so technically £50. Retail will be around £120 plus delivery and installation.



Fig 15 Component Procurement

Manufacture

Blank Plate

The Blank Plate was brought from British General (Nexus), a steel chrome mirror finished double blanking plate designed to suit the prototype application.

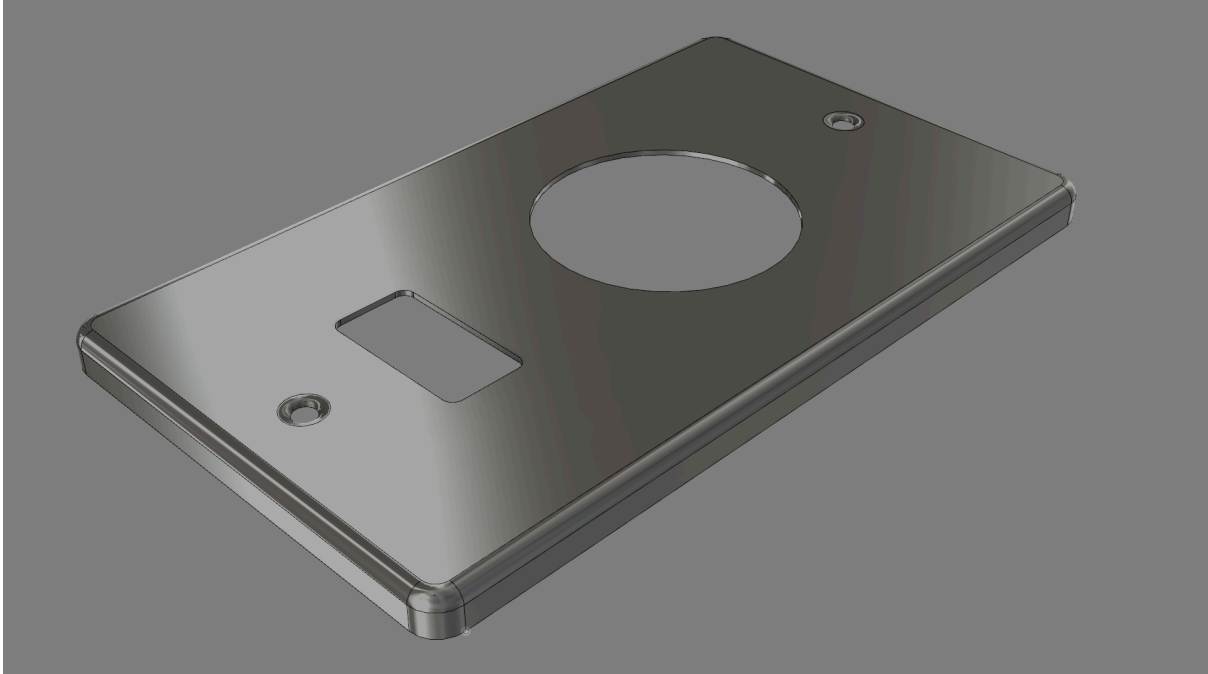


Fig 16 Blank Plate

Tool Paths

Are created using Fusion360 Manufacturing Suit, The Steel Plate being 1mm thick was Milled using a 3.175mm Ball Nose End Mill. Step Downs of 0.05mm to 4mm using the Centre Boundary Contour tool path were used to reduce contact stresses.

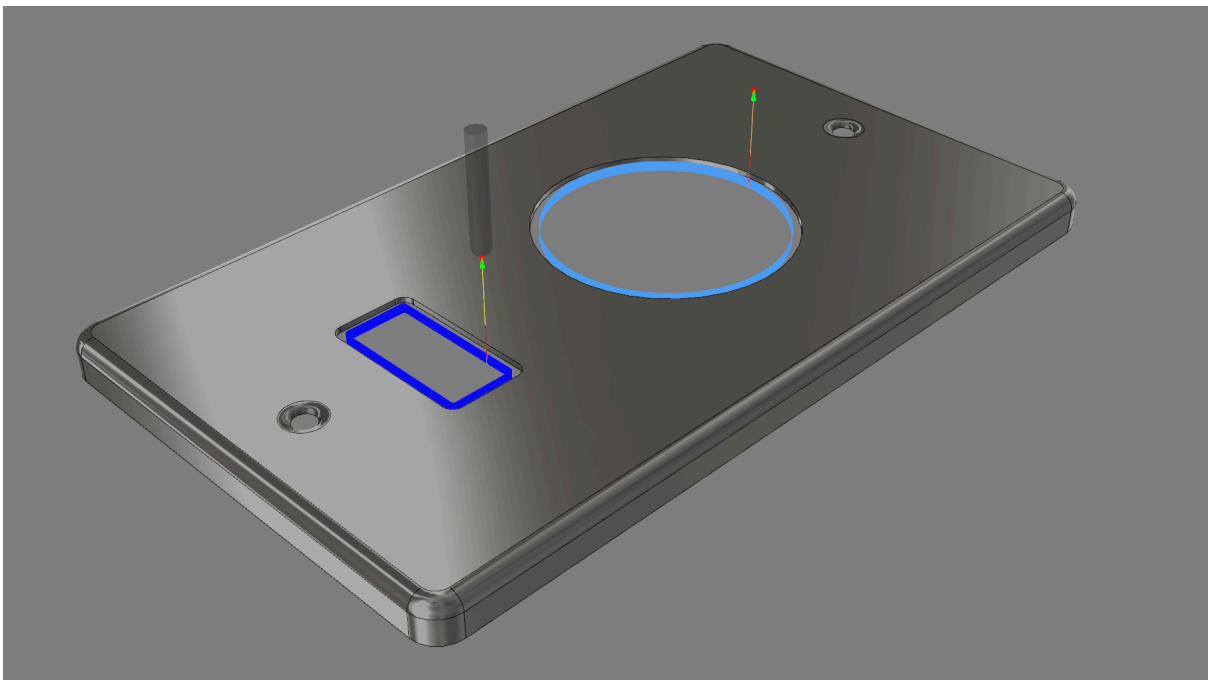


Fig 17 Tool Paths

Perspex

The Perspex sheet was brought as a 3mm thick 200 x 200mm dark tinted sheet. These dimensions were replicated into Fusion360. A 43.5mm and 50mm circle sketch were added prior to the Manufacturing Suite to which a Contour Tool depicts both circular sketches. Using a 3.175mm Flat End Mill and the Outside Boundary tool were used to step Down 1mm using 0.2mm increments forming the 43.5mm blind hole. Then a 3mm Step Down with same increments was created to cut-out the 50mm piece which also used the Outside Boundary tool, the part created is known as the interface shown bottom left of the picture below.

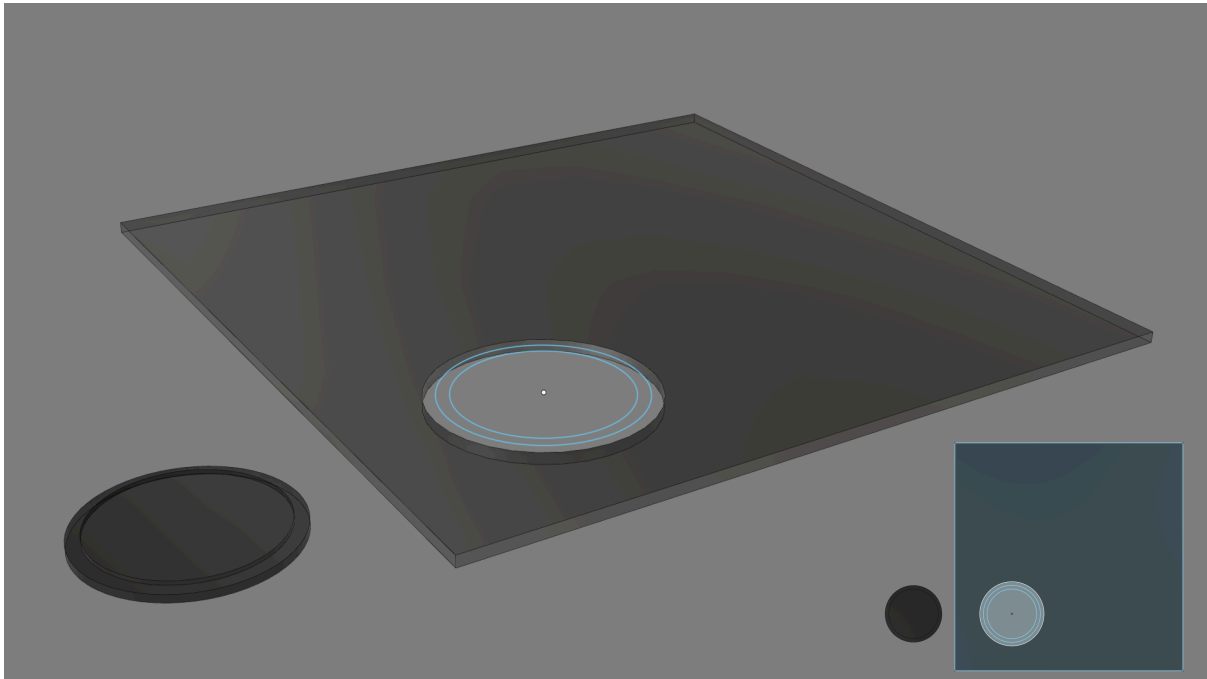


Fig 18 Perspex

Module Housing

The Module Housing comes in two 3D Printed PLA parts, denoted as the “Top and Bottom”, these were designed in Fusion360.

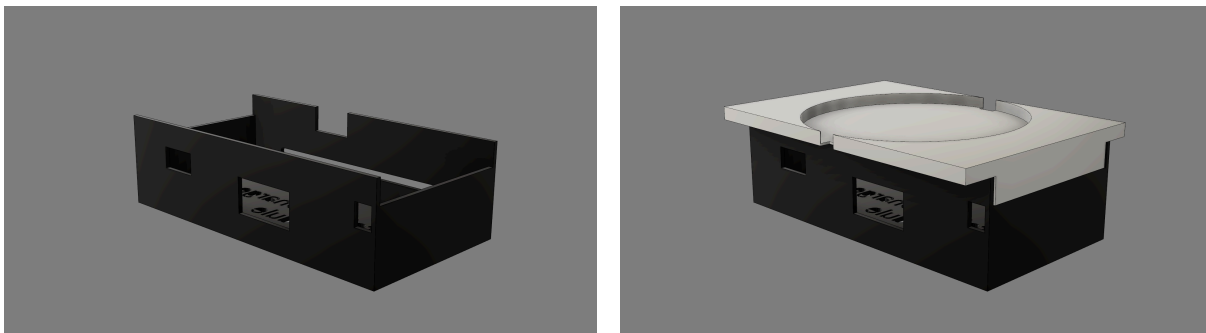


Fig 19 Module Housing

Method

Two STL files were downloaded onto the Creality Slicer Programme and converted to G-code files which were uploaded onto a USB stick. At this point it was plugged into the 3D printer (Creality Ender Pro v2) and both components were printed.

3D Print

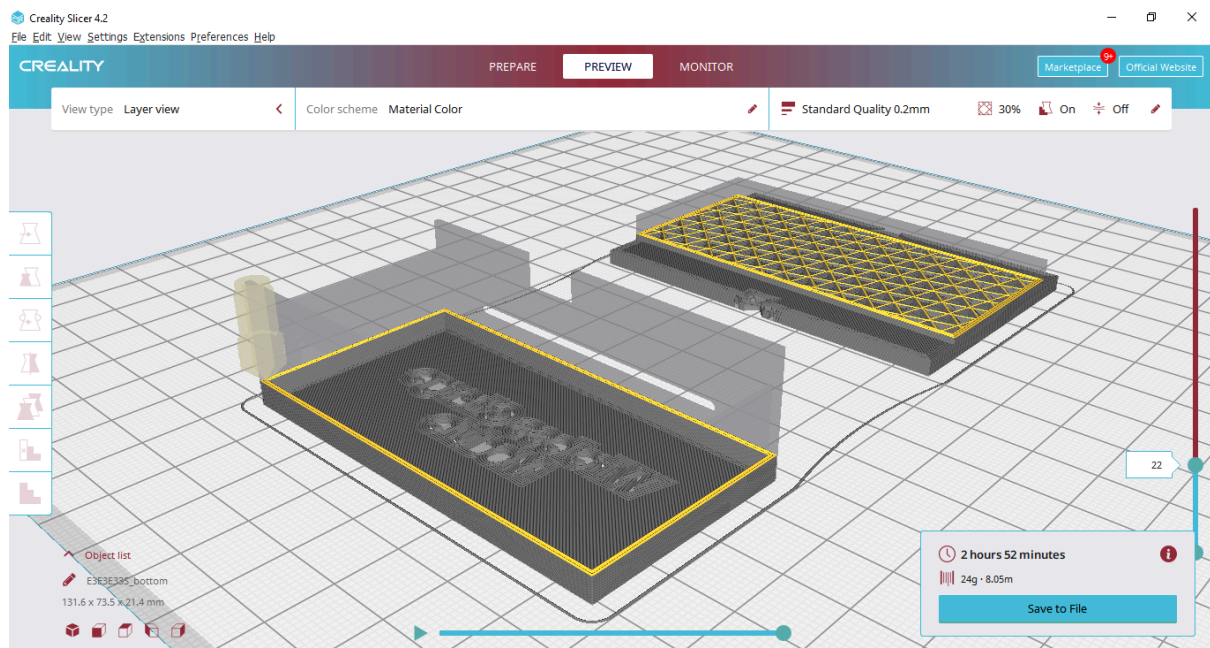


Fig 20 3D Print Preview 1

22% Preview

Selecting the preview tool allows for a visual from 0 to 100%. It shows how the layers of PLA are to be applied. From this you can adjust and add supports and rafts to stabilise whilst 3D Printing.

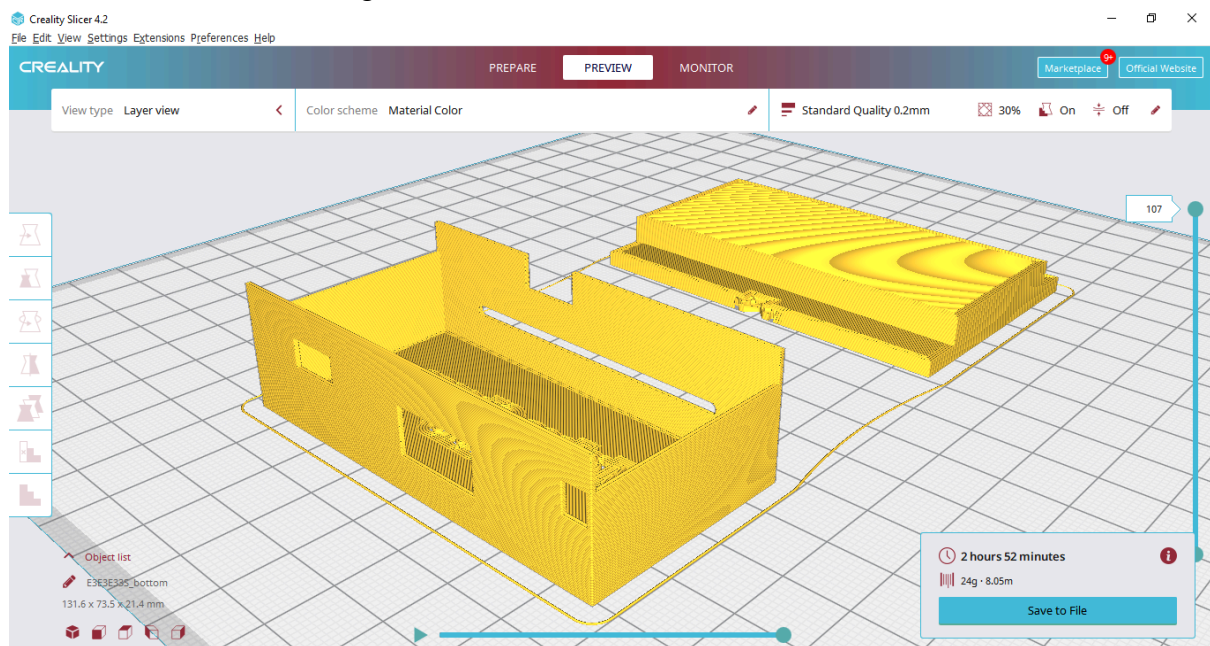


Fig 21 3D Print Preview 2

100% Preview

For Prototype Purposes 3D printing is ideal, PLA is an insulator and therefore no part should ever become live. It is also quick and relatively easy. Within 3 hours both Components were ready for Assembly. Regarding mass manufacturer Injection Moulding would be the preferred method of production. Not shown are the supports and rafts for visual reasons.

Prototype Assembly

With the Components purchased and Blank Plate and Perspex cut, and the Module Housing 3D Printed, it is now a matter of Assembly.



Fig 22 Component Assembly

Assembly Order

1. Epoxy Glue Wireless Transmitter to the Top part of the Module Housing
2. Fit the USB Module inside the Bottom part of the Module Housing.
3. Connect USB cable to USB Module.
4. Connect USB cable 3.0 Type-C to Wireless Transmitter.
5. Epoxy Glue Top and Bottom Housing Module together.
6. Add the 50mm interface to the Blank Plate using Epoxy Glue.
7. Fit the Module and Interface to the Grid Plate.
8. Add the Double Pole Switch to the Grid Plate
9. Use Neodymium Magnets to offset the grid from the Blank Plate.
10. Add ROONTECH logo in black vinyl.
11. Fit vinyl 60mm OD to 43.5mm ID protector ring around the Interface.

Prototype

For the purpose of the Prototype, Epoxy Glue is used to secure the Wireless Module. However, full production manufacture will be using screws and clips for disassembly aiding future upgrades and repairs.

Mag Charge Prototype

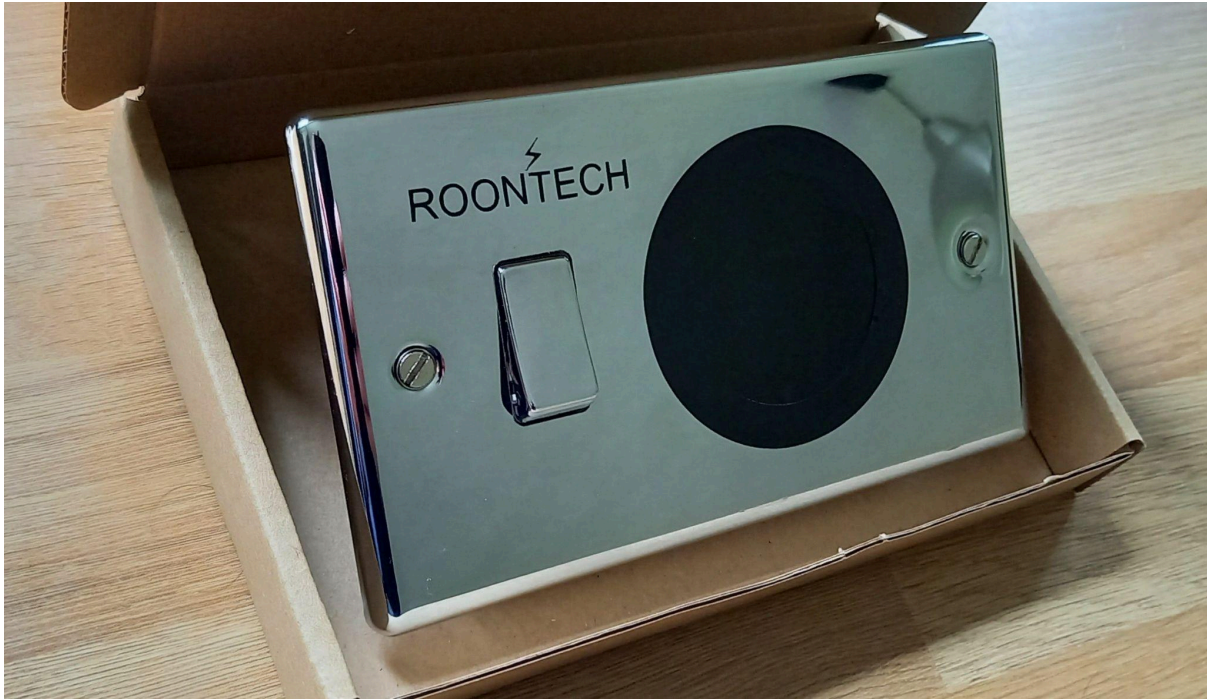


Fig 23 Finished Prototype

Conclusion

It works well, it charges correctly, the myth of Magnetic and Wireless interference is unjust. The Magnetic Connection is super reliable, in fact, you could position the Mag Charge upside down with no trouble at all. Both Earbuds and Huawei phones were Attached and Latched correctly. A Mag Ring and Non intrusive 5mm diameter 1mm thick Neodymium Magnets were positioned correctly on the rear of the phone and Earbuds ensuring a solid connection.

Specification

Parameters

Table 3 Parameters

Brand	Application	Power Supply	USB Module	Watts	Dimension (mm)
Roontech	Wireless Charger	230v 5v	0.065A 3.1A	15	86 x 146 x 7

Component Brands

Table 4 Component Brands

Housing	Magnets	USB Module	DPSwitch	Transmitter
Nexus	Neodymium	Knightsbridge	Nexus	Chips Fans

Component Standards

Table 5 Component Standards

Housing	Magnets	USB Module	DP Switch	Transmitter
BS 5733	ISO/FDIS 24544	BS EN 5733 BS EN 62368	BS EN 60669-2-1 BS EN 5733	Qi

Features

Table 6 Features

Housing	Magnets	USB Module	DP Switch	Transmitter
Chrome Steel	5mm Diameter 2mm Width	USB 3.0	20A	USB Type-C

Accessory Attachment

Table 7

Accessories	Phone	Particle	Fragrance	Earbuds
Magnet	Mag Ring	Mag Ring	Mag Ring	Neodymium
Dimensions	45mm/55mm	45mm/55mm	45mm/55mm	5mm/1mm

Operation

1. Attach device to Mag Charge
2. Turn on Rocker Switch.
3. Charge until necessary.
4. Turn off Rocker Switch.
5. Remove the device.

Electrical Installation

Competent Person

To fit this yourself at home you need to know 5 critical factors.

1. You must be deemed competent and must work safely, disconnect the MCB controlling the existing Socket Outlet at the Consumer Unit, and lock it off.
2. You can only swap a Double Socket for a Mag Charge, this is called Non Notifiable work as you are not altering any circuit cables.
3. You cannot install new Ring Mains or Radial Circuits for the Mag Charge without using a fully qualified Electrician or without notifying Building Control.
4. A 35mm Pattress/Back Box is the minimum requirement.
5. Make sure all connections are correct, you must Earth this device.

Qualified Electricians (BS 7671)

In order to fit this understand the following.

1. For Insulation Resistance Tests ensure to switch off the Rocker first if you are testing at 500v DC. Sensitivity is not an issue done this way, however, be sure to use the 250v DC setting if you are in doubt as this is sensitive equipment.
2. Do not disconnect the Load side of the Double Pole Switch.
3. The Mag Charge looks different to traditional accessories, however, the same principle as wiring a Double Pole Spur minus the fuse.

Connections

Connect the live and Neutral (Brown and Blue) to the Double Pole Switch marked Supply. Most importantly, connect the earth cable (Green and Yellow) to the Earth terminal.

Wiring & Calculations

The Mag Charge consumes just 15 watts of power, the DC Module requires 5v thus, $15/5 = 3A$. However, this is converted back to nominal 230v UK supply, and therefore $15/230 = 0.065A$. For independent installations a 3A fuse is recommended to be installed at the Consumer Unit and should be governed by an RCD/RCBO. It is recommended that no more than 20 devices be connected on to a single 3A Radial Circuit and the supply cable should be no less than 1.5mm. The 3A fuse can provide up to 690 watts of power, $690/15 = 46$ Mag Charge devices. However, take into account volt drops for large cable runs and the 80% maximum capacity of MCB's.

Existing Wiring

Wiring onto an existing Ring Main or Radial Circuit dedicated to Sockets and Spurs is permitted. Do not connect to any other circuit such as Lighting or Boiler circuits.

Technology Adoption

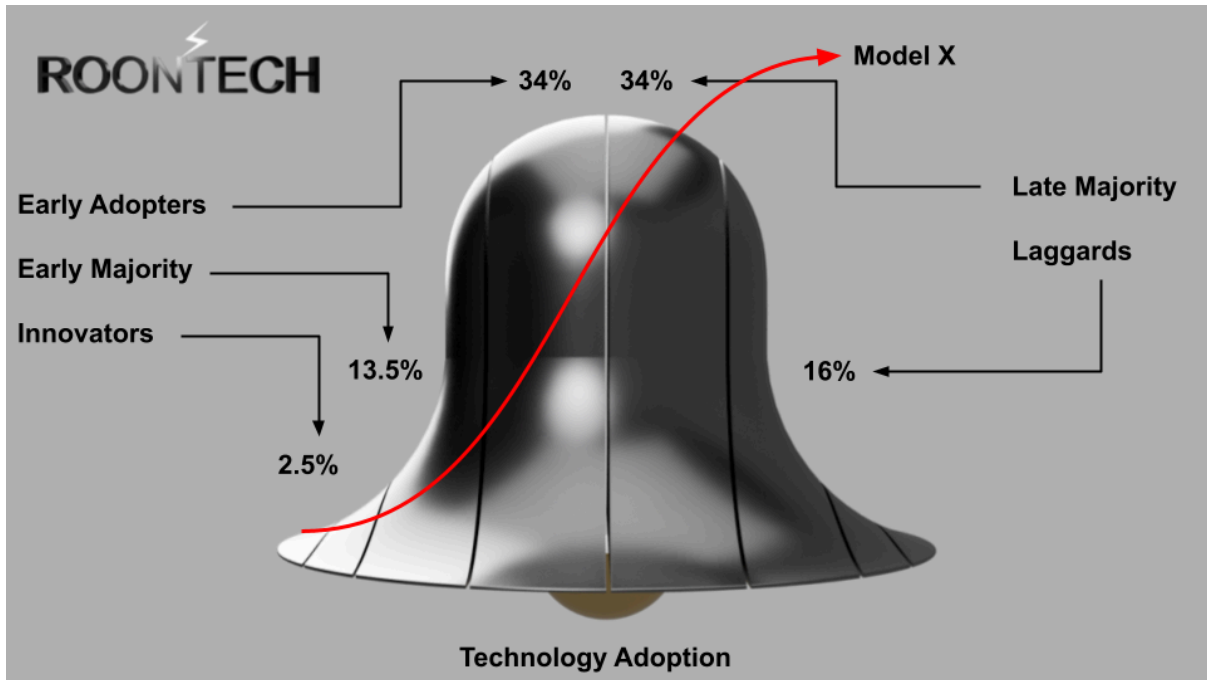


Fig 24 Technology Adoption

Technology Adoption

Is highly important towards starting up and maintaining a business, understanding the Market whilst sales dictate future release dates of new products.



Fig 25 001 Model

Model 001

001 is unique and worthy, but unfortunately due to limited funds, manufacturer and component availability, I cannot bring the ideal version to the table just yet. However, this variant is more than acceptable and outperforms many competitors.

Model 002

The 002 variant is the ideal solution, changes to 001 include a new switch position, digital display and a 13A Socket Outlet as well as the original Wireless Charger.



Fig 26 002 Model

Technology Threats

Future releases of the Mag Charge created a business that thrives, innovation is absolutely essential regarding progression. The downside is competition, from new entries, ripp-off substitutes, supplier contracts and customer loyalty. Unfortunately for those it affects I will hold the Design Patent to this technology. Obtaining customers who are elsewhere loyal may be a challenge but with the uniqueness of exceptional Add-ons, longevity, safety, clutterless, space saving, colour variety, it can be done.

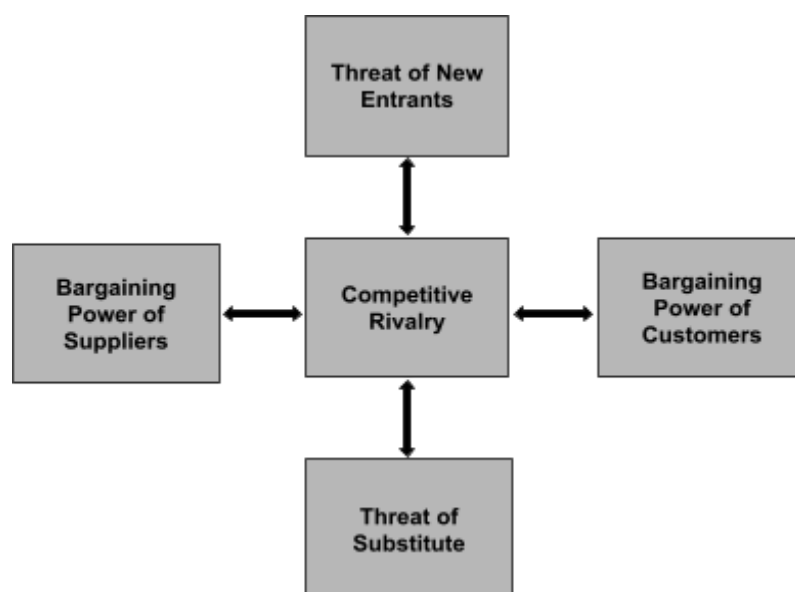


Fig 27 Competitive Rivalry

Design Patent Application



Designed By Christopher John Rooney (BSc), Director of ROONTECH LTD.

Abstract

The Mag Charge range was founded by the need for clutterless space saving techniques regarding charging small devices to which a unique vertical wireless charging methodology has been developed. The device has been designed to increase wireless charging capabilities aiding the development of ingress proof Mobile Phones and other small devices such as Ear Buds. Using existing power supplies such as Ring Mains or Radial Circuits enables the Mag Charge to be powered, which removes the need for transformer plugs and USB cables.

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A sleek non-intrusive device has been designed to suit any environment regarding Electrical Sockets Outlets and comes with a range of colours available to suit any Electrical Installation Decor such as White, Brass, Chrome, Matt Black and even Rose Pink.

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Due to the nature of this device many other additional devices could be added under the "Attach & Latch" methodology. An Air-Wick type fragrance dispersion device will replace traditional plug-ins. This would increase sales for low level applications of the Mag Charge. Plug-ins can cause fires due to being left on by mistake, the Mag Charge aims to eliminate this threat by using its thermal cut-out capability.

Wellbeing

Another unique Add-on is the Particle Dispersion Unit, designed to disperse Minerals and Vitamins in particle form. It works similar to an Air-Wick for clarification, Vitamins and Minerals included are; B12, C, Iron, Zinc, Magnesium and Copper to name a few. This Add-on serves as a wellbeing device allowing people to top-up on minerals without taking supplements, or worst case, injections. Many people cannot absorb Minerals or Vitamins orally and need an injection; this is an alternative solution.

Application

Designed for offices, and homes, for mid level installations the Mag Charge is ideally situated above kitchen worktops, desktops and bedside tables with regards to charging your Phones. Hotels would also benefit from the Mag Charge, many USB ports have become outdated in Hotels due to Industry upgrade of the double ended Type-C that comes with new phones. To future proof, swap to the Mag Charge and never worry about upgrades again.

For low and high level applications ROONTECH's wireless charging Fragrance and Particle Dispersion units are best suited, but not limited to.

Target Market

Gadget hunters, innovation lovers, the safety and wellbeing conscious, anyone that likes efficiency, sustainability and clutterless technology, the Mag Charge is built and designed for you and me.

Personal Thoughts

The Mag Charge is not just an efficient, sustainable, space saving Charger, it is also a Wellness device. Made by someone who really does care about the quality, costs and health of customers and people in general.

Claims

Claim 1; Vertical Wireless Charging

The Mag Charge is the only wall mounted mains powered, magnetic vertical wireless charging product that uses a Steel Housing to secure a device over an interface.

Claim 2; Socket Outlet Integration

The Mag Charge is the only Charger to replace a space previously occupied by a working Double Socket Outlet.

Claim 3; Power Supply & Switching

The Mag Charge is the only magnetic wireless charger to use 230v nominal voltage directly from existing and new Ring Mains and Radial Circuits in order to power the device.

Claim 4; Method

“Attach and Latch”, this is a unique method, process and catchphrase dedicated to the Mag Charge, it is not permitted to be used by anything else in any shape or form without consent.

Claim 5; Add-Ons

Wireless Fragrance and Particle Dispersion Units are designed Solely to be used with the Mag Charge and are not to be used with any other device that does not belong to ROONTECH without consent.

Claim 6; Aesthetics

No other wireless charger looks anything like the Mag charge due to its operating characteristics and therefore no mimicking of design is acceptable unless consent is given.

Claim 7; Documentation

Documentation and illustrations relating to the Mag Charge are copyright protected for 75 years and belong solely to ROONTECH. Anybody who uses documentation without consent will face court action or equivalent.

Declaration

Table 8 Signature

Print Name	Signature	Date
Christopher John Rooney		29/10/2023