

# RGB LED Sphere Soldering Project

## Introduction

This is a DIY project, which soldering 132 PCs RGB W2812B LEDs on the surface of a 3" diameter sphere. The frame of this sphere was build by tin Coated Wire. The tin coated wires are also functioned as Ground and Power wires. In this project, a 3D printed template will help to shape tin coated wire to designed frame of 2 half sphere and distribute LEDs uniformly. Besides, tin coated wires will be cut to 1 jumper and use to connect digital in and out leads of two adjacent LEDs, which will make LEDs to a stripe. After, users need to assembly 2 half sphere together and fix ESP32 control board into sphere. This RGB LED sphere will show 7 beautiful animations.

## Tips

- ❖ This package is DIY kit. It need weld and install by user. Please be patient until the installation is complete, which is verified as 12 hrs-20hrs time need project.
- ❖ The soldering iron can't touch the components for a long time(1.0 second), otherwise it will damage the components.
- ❖ Pay attention to the positive and negative of the components. Strictly prohibit short circuit.
- ❖ Please wear anti-static gloves or anti-static wristbands when installing electronic components.
- ❖ User must install the LEDs according to the specified rules. Otherwise some LEDs will not light up.
- ❖ It is strongly recommended to read the installation manual before starting installation!!!

## Tools List

- 1. Pincer pliers
  - 2. Side cutters
  - 3. Soldering station
  - 4. Tweezers
  - 5. Soldering Flux
  - 6. Permanent marker pen
  - 7. Multi-meter
  - 8. Tin Rosin Core Wire
  - 9. 3.3-5V USB power supply
- 1. ESP32 board
  - 2. Micro USB cable(0.2m length)
  - 3. WS2812b RGB LEDs(132PCs for project + 10 PCs back up)
  - 4. 3D printed mold--(4 pieces and 2 rings)
  - 5. Tinning coated copper wire (Diameter 0.7mm\* Length 6 Meter)
  - 6. 60 PCs C Jumper
  - 7. 5.5cm Jumper Wire (1PC Red , 2PC Black & 2 PCs Green)
  - 8. Operator Manual



Figure1. Tools-(User should prepare)



Figure2. Materials

## W2812B LED introduction

W2812B is a intelligent control LED light source that the control circuit and RGB chip are integrated in a package of 5050 components. Each pixel of the three primary color can achieve 256 brightness display. It cascades port transmission signal by single line, which allow to make many lights as a strip and control by one line signal.

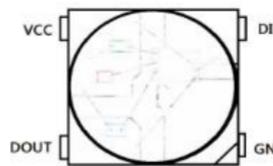


Figure.3 LED Pins

Symbol	Function
VCC	Power supply to LED
DOUT	Control data signal output
GND	Ground
DIN	Control data signal input

Table1. Pin Function

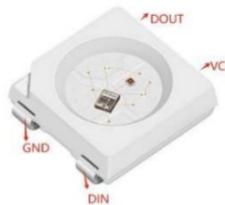


Figure.4 LED Front

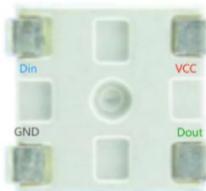


Figure.5 LED Backside

## Schematic Design

Circuit design showing in below picture is a simple demo of how the project works when there are 16 LEDs dividing into 2 rings. Given using ESP32 to control LEDs digital signal, tinning coated wire to be LEDs' power supply and ground wire, jumpers to connect digital signal in and out pin. In our project the sphere is divided into 2 same half sphere, each have 5 rings. LED numbers on 5 rings are listed below.

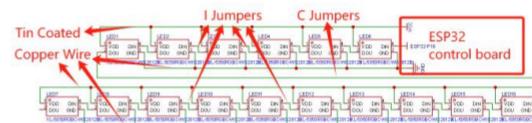


Figure.6 LED Front

Ring No.	LED Qty
1	6
2	10
3	14
4	16
5	20

Table2. LED No.

## Soldering Steps

### Preparation

#### A. LED

1. **Mark all LEDs ' GND leads--**Get All LEDs out after tearing the transparent plastic on LED tape Packaging, mark all the GND leads of the LEDs (There is a corner mark which helps to locate the GND lead)from the bottom with a black permanent pen to be able to recognize where the GND leads is located. (10min)
2. **Dip LED in solder flux--** Dip each LED in the flux before inserting it so it would hold in the slot better.(10 Min)



## B. Wire Circles for Rings

- Cut 20 tin coated wires**--The sphere consists of 10 LED rings, each ring is formed of 2 wires in the form of a circle and some amount of LEDs. For the full sphere you will need 20 tin coated wire circles in total. Each ring is of a different size. Wires for rings should be cut from 6M tin coated wire as the length and amount in below form. (5Min)

Ring No.	Wire	No.	Length(mm)	Length(inch)	Qty(PCS)
1	GND (Ground)	1-1	72	2.835	2
	VCC (Power Supply)	1-2	104	4.094	2
2	GND (Ground)	2-1	124	4.882	2
	VCC (Power Supply)	2-2	153	6.024	2
3	GND (Ground)	3-1	168	6.614	2
	VCC (Power Supply)	3-2	191	7.520	2
4	GND (Ground)	4-1	207	8.150	2
	VCC (Power Supply)	4-2	216	8.504	2
5	GND (Ground)	5-1	222	8.740	2
	VCC (Power Supply)	5-2	227	8.937	2

Table3. Wires Length and Quantity for Rings

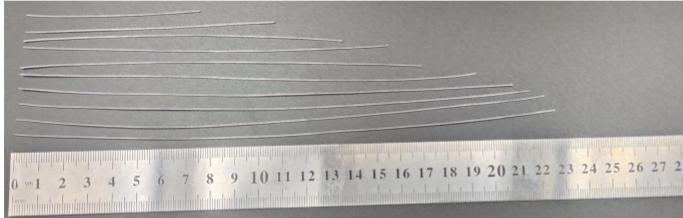


Figure.7 Ready Wires

- Make wire circles**--To make it easier, a sheet of paper with a complete drawing of ring shapes for the one half-sphere is prepared as page.4 of this operator manual.(15 Min)

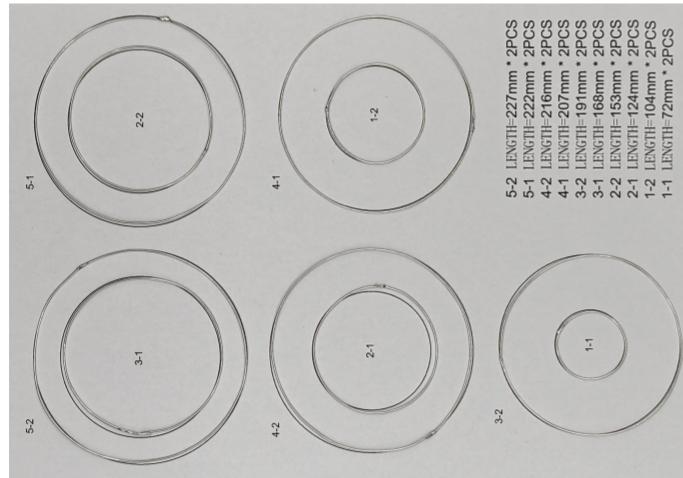


Figure.8 Ready Wire Circles

## C. I Jumpers

**Cut I jumpers from tin coated wire**--Cut 122 Pieces 10mm length wires from left tin coated wire,  $\pm 1\text{mm}$  length variance could be acceptable. These short wires will be used as I jumpers to connect digital out(DOUT) pin to digital in(DIN) pin of next led. (5min)



Figure.9 Ready I Jumpers

## Soldering

### A. Template

**3D printed template set up**--In the received components list, there is 4 pieces 3D printed template, which could be bound together by two rings - like a barrel. (Attention: Please do not use glue even if there is tiny gap) (5min)

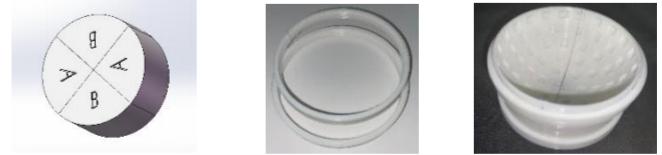


Figure 10. AB pieces sequence of template, Rings and ready Template

### B. Soldering 5 rings

- Place LEDs into template**--Use tweezers to insert 6 LEDs into the most bottom ring in the template as shown in the left picture, with backside of LED facing to outside. Place all LEDs in a such a way that the GND pin faces the inner ring, and VCC lead the outer ring. This is important! Each ring will be exactly like this! Inner wire is ground, outer wire is power. (2min)
- Soldering GND and VCC leads**--Insert the inner ring(1-1) and solder all the GND pins to it. Insert the outer ring(1-2) and solder all the VCC pins to it. VCC pins is located diagonally from the GND pin. Make sure the rings are not connecting any of the DATA (DIN and DOUT) leads of the LEDs. (5min)
- Repeat until you have 5 rings** (70Min)

Ring No.	Wire	No.
1	GND (Ground)	1-1
	VCC (Power Supply)	1-2
2	GND (Ground)	2-1
	VCC (Power Supply)	2-2
3	GND (Ground)	3-1
	VCC (Power Supply)	3-2
4	GND (Ground)	4-1
	VCC (Power Supply)	4-2
5	GND (Ground)	5-1
	VCC (Power Supply)	5-2

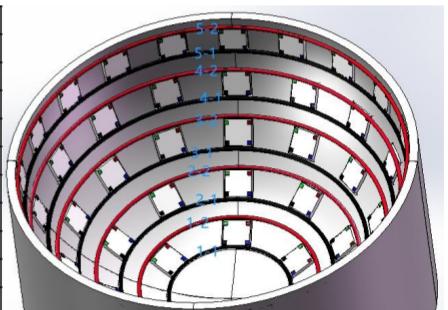
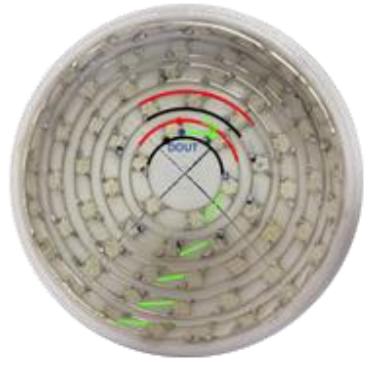


Figure 11. LEDs and Wire Circles Location for Rings

- Soldering DIN & DOUT leads of LED**--DIN is located next to the GND pin and DOUT next to the VCC pin. Using the I jumpers made in preparation stage, solder the DIN and DOUT pins of two adjacent LEDs, each ring leave one pair DIN and DOUT pins open (indicated by the green line in left picture), and solder total of 61 I jumpers.(65Min)



5. **Soldering 4 open pairs DIN and DOUT using C jumpers**--Soldering the reserved DOUT and DIN pins on the adjacent upper and lower circles in sequence, requiring 4 jumpers. 1 DOUT leads in ring No.1 and 1 DIN leads in ring No.5 are left open. (5min)

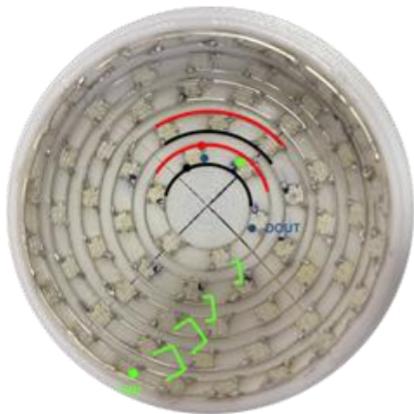


Figure 12. C Jumper for open DIN & DOUT

6. **Soldering GND wire of rings together using C jumpers**--Using C jumpers to connect GNDs of two adjacent rings , Each ring uses 4 jumpers to ensure rings are connected stably together (16 jumpers total), as shown in the following figure (15Min)



Figure 13. C Jumper for GND wires between rings

7. **Soldering VCC wire of rings together using C jumpers**--Use C-shaped jumpers to connect VCC of two adjacent rings , Each ring uses 4 jumpers to ensure rings are connected stably together (16 jumpers total) (15Min)

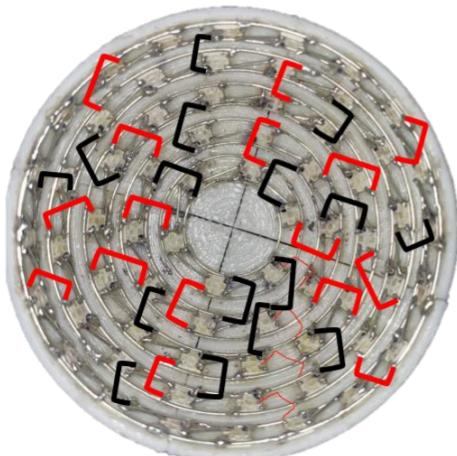


Figure 14. C Jumper for VCC wires between rings

### C. Test(10min)

- Visual check**--Visual inspect and make sure all joints are soldered.
- Multi-meter check**--Turn on multi-meter and set to the on/off mode:
  - Press black probe on 1-1 GND wire, red probe touch the GND wires 2-1, 3-1, 4-1 & 5-1 one by one, beeping sound is good. If it is not, please check C jumpers joints which connect GND wires and fixed cold joints.
  - Press red probe on 1-2 VCC wire, black probe touch the GND wires 2-2, 3-2, 4-2 & 5-2 one by one, beeping sound is good. If it is not, please check C jumpers joints which connect VCC wires and fixed cold joints.
  - Press black probe on 1-1 GND wire and red probe on 5-2 VCC wires, no beeping sound is good. If it is not, please check to find faulty C jumpers joints which may connect VCC wires to GND wires.
- Take out half sphere**--After everything is good, take off 2 rings and 4 pieces templates. Then you can get 1st half sphere.



Figure 15. Ready 1<sup>st</sup> half sphere

### 4. Power on test--

- Solder the two ends of red wire to the 5-2 VCC wire and the ESP32 module +3V pin
- Solder the two ends of the black wire to the 5-1 GND wire and the ESP32 module GND pin
- Solder the two ends of the green wire to the ESP32 19 pin and the DIN lead which left open on No.5 ring.
- After three wires are connected, plug in the Micro end of the Micro USB cable into the ESP32 Micro connector, and plug the other end to a USB power supply (DC 3.7V-5V). Check if all LEDs light up. The wiring is shown in below figure

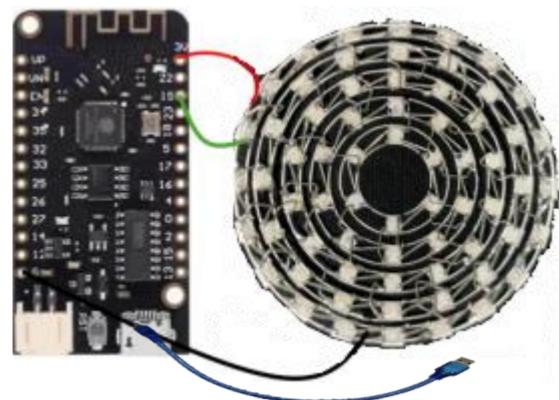


Figure 15. Power on Test Set up

## D. Repeat to get ready 2nd half sphere

Repeat steps of A,B and C part in Solder chapter to get 2nd half sphere(265Min)

## E. Debug

Problems	Possible reasons
Single LED doesn't light up	VCC/GND leads cold weld
	LED was placed to slot with wrong GND position
LEDs don't light up after one particular led	Cold joint of jumper
	I jumper connects with VCC/GND
Rings can't light up	Cold joint of C jumper
	C jumper connects with VCC/GND
LEDs blink or doesn't change color after one particular led	The DIN of this particular LED is cold joint.
All LEDs don't light up	Check the if red and black wire connect to wrong ESP32 pin.
	Green wire connect to wrong DIN leads or ESP32 pin

Table3. Debug Guidance

## Set Up and Test

### A. Soldering ESP32 to 2<sup>nd</sup> half sphere

1. **Soldering the metal shell of the MICRO USB to No.1 ring**-- Install ESP32 upright on the 2nd half sphere and weld the metal shell of the MICRO USB on ESP32 to the smallest circle. Please pay attention that do not allow solder metal enter into the internal of MICRO USB connector.
2. **Soldering 3 pins on ESP32 to GND wires on sphere**--Cut 3 tin coated copper wires as needed length. One end of each wire weld to 3 pins on ESP32 (red circle marked in the figure below) and the other end weld to GND wires(1-1, 2-1, 3-1, 4-1 or 5-1) of the 2nd half sphere to help on fixing ESP32 control board to the sphere.
3. **Soldering +3V pin on ESP32 to VCC wire on sphere**--Cut 1 more tin coated copper wires as needed length. One end of this wire weld to the ESP32 +3V pin and the other end weld to VCC wires (1-2, 2-2, 3-2, 4-2 or 5-2) on the 2nd half sphere to help on fixing ESP32 control board to the sphere.

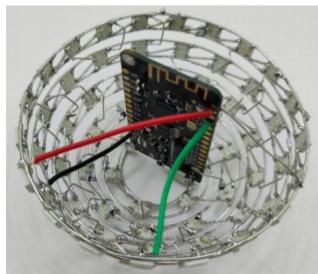


Figure 15. Ready ESP32 in 2<sup>nd</sup> half sphere

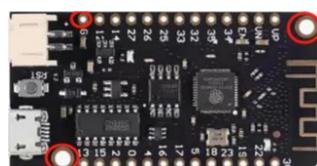


Figure 16. 3 GNDs on ESP32

### B. Soldering 2 half spheres together

1. **Connect DIN and DOUT left open on 2 half spheres**--Weld two end of green wire to the DIN pin left open on No.5 ring of the 1<sup>st</sup> sphere and the DOUT pin left open on No.5 ring of the 2<sup>nd</sup> sphere
2. **Using black wire to connect GND of 2 half spheres**--Weld two end of black wire to GND wire(any of 1-1, 2-1, 3-1, 4-1 or 5-1) on 2 half spheres.
3. **Pre-soldering tin coated wire on ESP32 to fix to the 1<sup>st</sup> sphere**--Weld one end of a 50mm tin coated copper wire to ESP32 pin marked by red circle as the arrow direction.

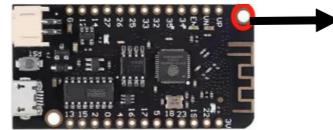
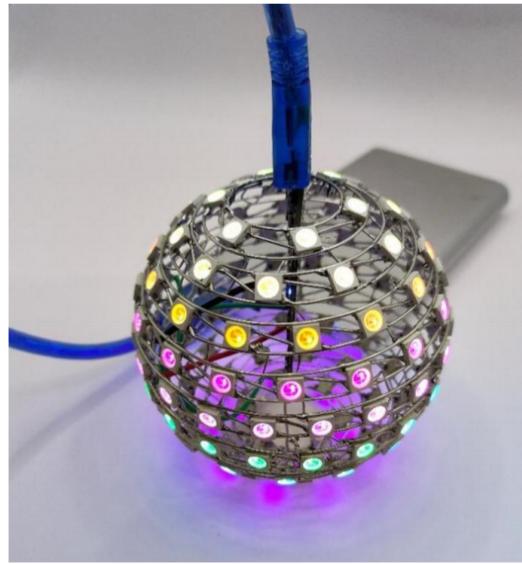


Figure 17. Wire Direction

4. **Using Tin coated wire to fix 2 half spheres**--Cut 4pcs 5mm short tin coated, two ends of 4 wires weld to 5-2 VCC wire of 2 half sphere.
5. **Soldering last joint to fix the two Sphere connection**--Weld left end of tin coated wire to GND wire (1-1, 2-1, 3-1, 4-1 or 5-1) on 1st half sphere and cut the extra length.

### C. Power on test

1. **Visual check**--Visual inspect and make sure all joints are soldered.
2. **Power on Check**--Plug in the Micro end of the Micro USB cable into the ESP32 Micro connector, and plug the other end to a USB power supply (DC 3.7V-5V). All LEDs light up and the RGB ball will automatically show animation.



If you are capable and would like to develop more fun animations, you can visit below github link to get software and instructions. ESP32 control board provided are capable of battery charging management. You can plug in Li Battery (1000 mah etc.) to make it portable.

1. ESP32 control board data sheet & RGB LED Arduino animation code  
<https://github.com/Leisure-Base/RGB-LED-SPHERE>
2. Open source Arduino IDE download link  
<https://www.arduino.cc/en/software>

You can also find operator manual in below Github Link.

<https://github.com/Leisure-Base/RGB-LED-SPHERE>