WaCS-1 ESP32 Remote Robotics Control System
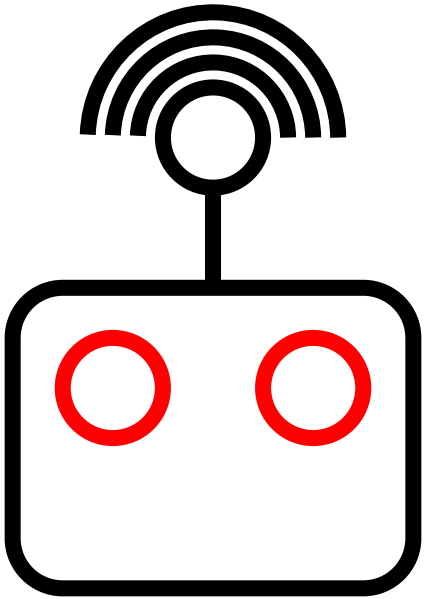
Dan Tatum

10 September 2024

WaCS-1 ESP32 Remote Robotics Control System Overview

- Up to 8 PWM servos
- Dual SparkFun QWIIC / Adafruit STEMMA I^{2}C connections
- Dual Adafruit STEMMA analog connections
- USB-C connector for firmware upload
- U.FL connector for improved antenna performance
- Voltage monitors for on board 3.3V supply, ESC, and external battery
- High efficiency switch mode power supply
- Reconfigurable to support potentiometer inputs from remote controller
- 1.92" x 1.66" PCBA area
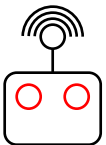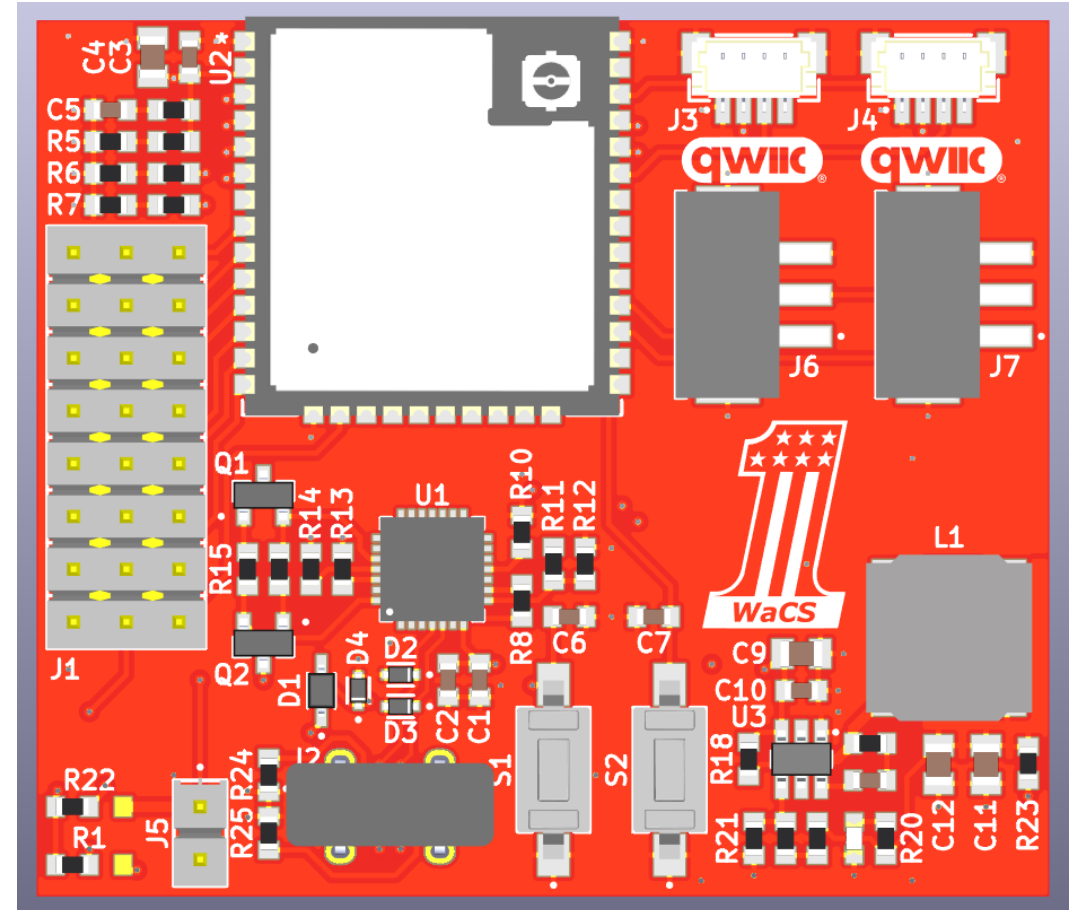
Up to 8 PWM Servos

- Supports up to 8 PWM based servos

- 0.1" square pin headers

- ESC power pass through to servos

- Controller powered by ESC
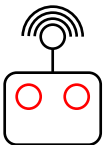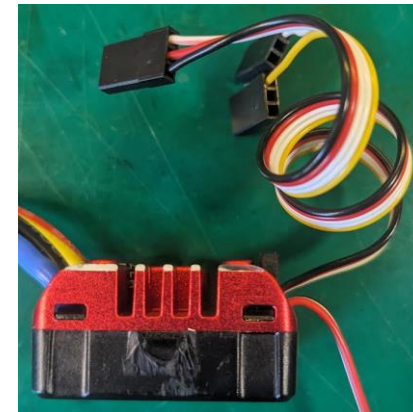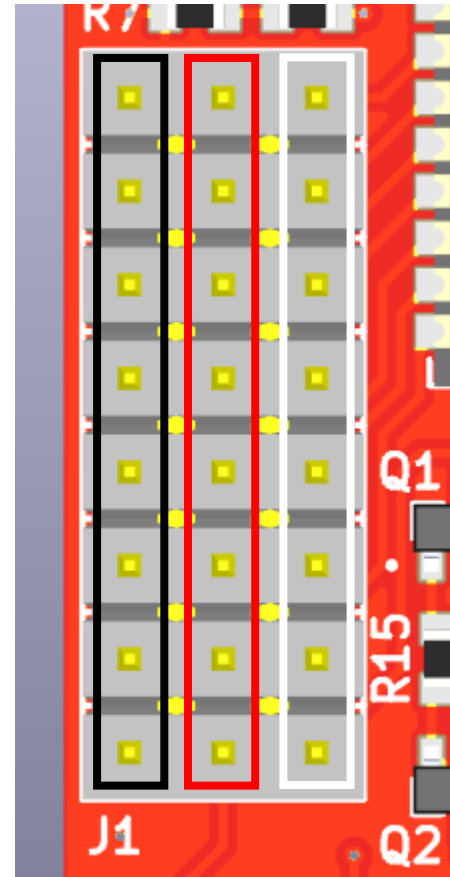
Dual SparkFun QWIIC / Adafruit STEMMA QT I^{2}C Connections

- A world of possibilities with readily available off-the-shelf components

- JST type SH 4-pin 1mm connector

- GPS, IMU, screens, sensors, etc.

- Developers can focus on software and ditch the rat's nest

- https://www.sparkfun.com/categories/399

- https://www.adafruit.com/category/1018
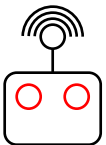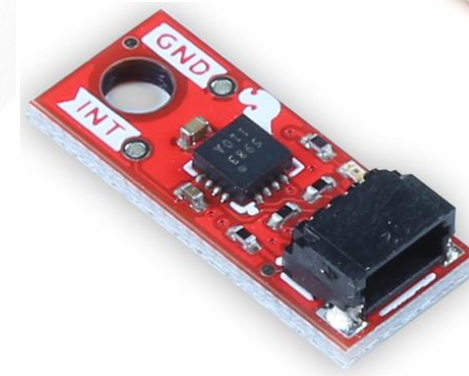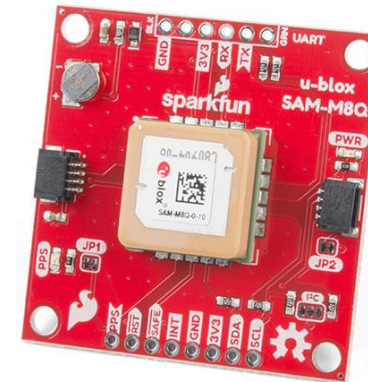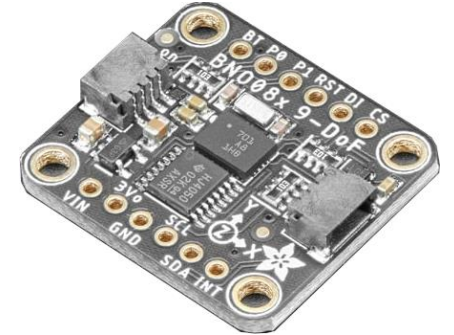
Dual Adafruit STEMMA Analog Connections

- Analog and GPIO
- A world of possibilities with readily available off-the-shelf components
- JST type PH 3-pin 2mm connector
- IR communication, buttons, amplifiers, etc.
- https://www.adafruit.com/category/1019
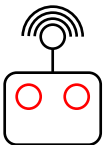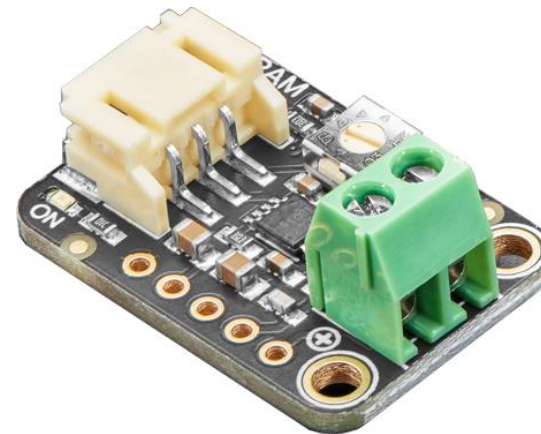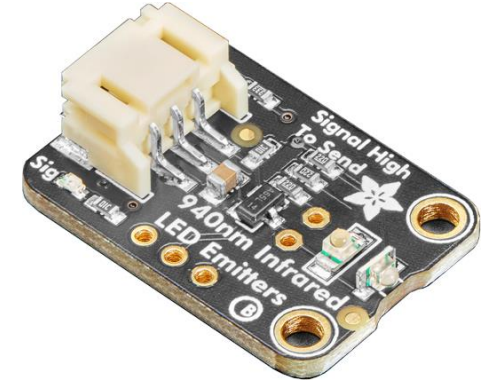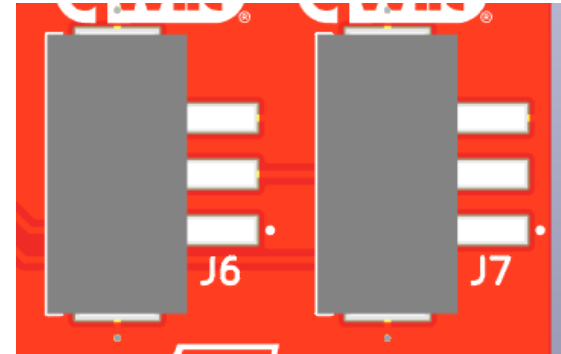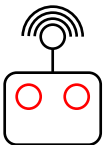
USB-C connector for firmware upload

- Common, current, reversable connection

- Integrated Silicon Labs CP2102 USB to serial converter

- No hunting for old, oddball cables or adapters

- Mounted perpendicular to board for easy in-unit access

- USB 2.0 for easy compatibility
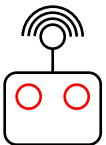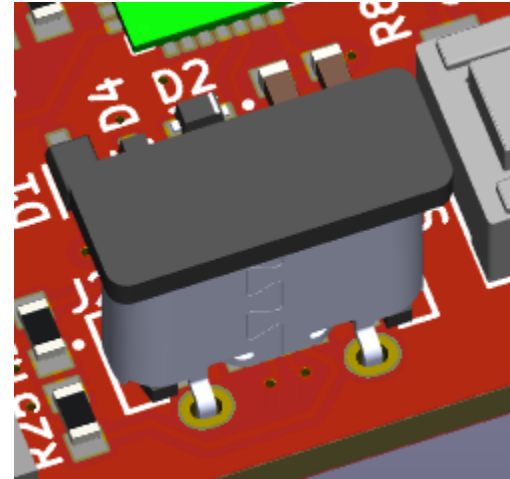
Additional Connections

- U.FL connector for improved antenna performance

- Voltage monitors for on board 3.3V supply, ESC, and external battery
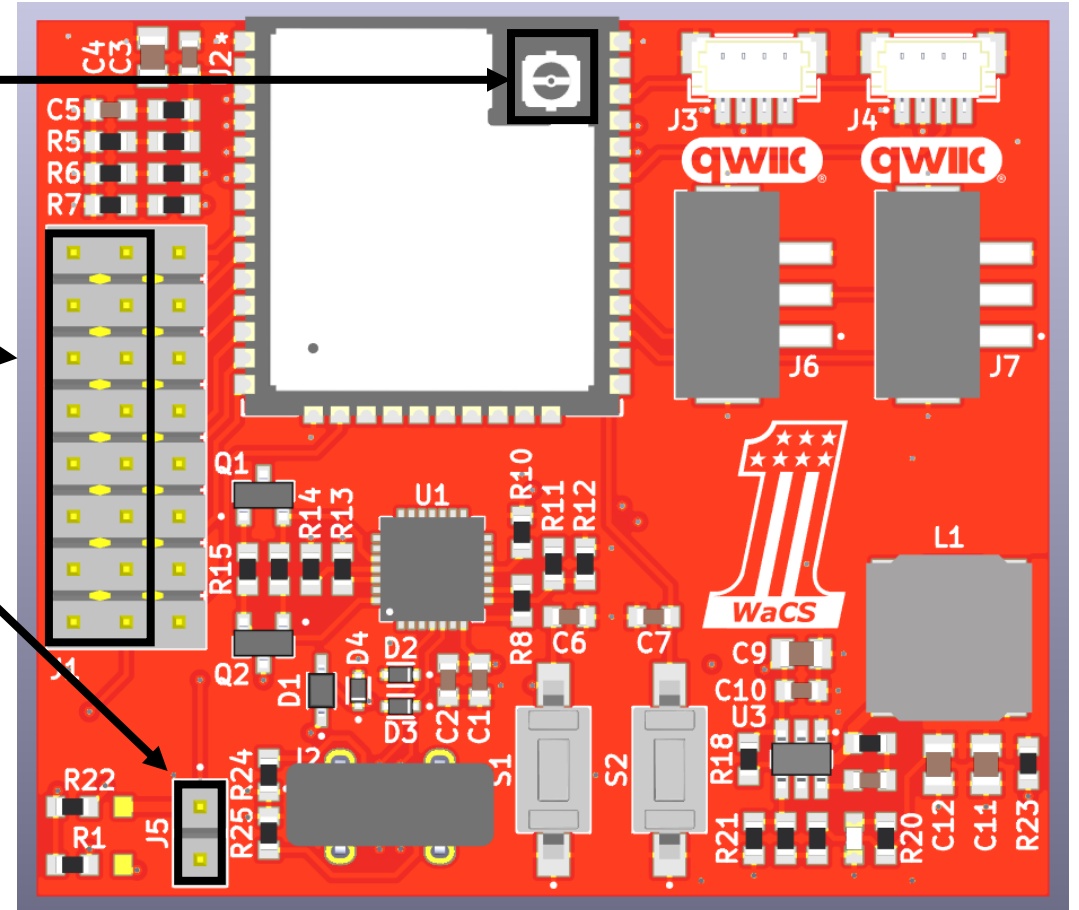
High efficiency switch mode power supply

- Operational input voltage 4.2V-18V

- 3.3V, 2A output to PCBA and external accessories
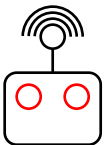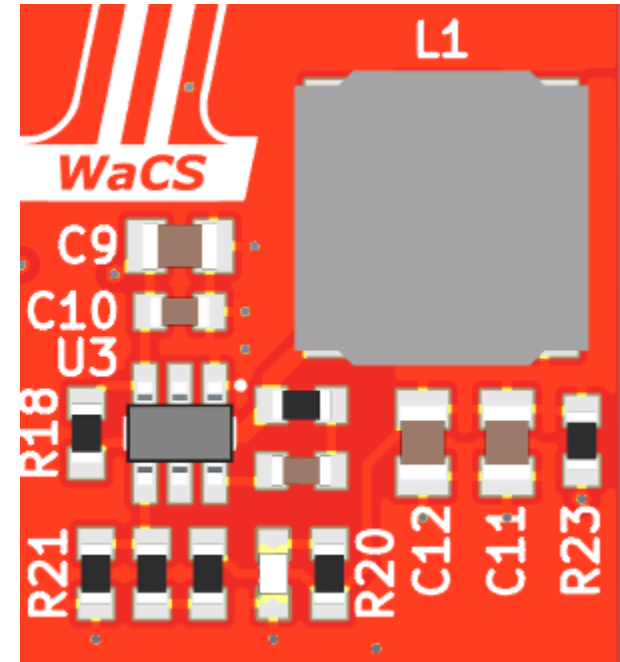
Reconfigurable for Potentiometer Inputs from Remote Controller

- Populate R1, R22 to left side pads

- Input power sourced from J5 external power monitoring input

- J1 sources 3.3V to external potentiometers and connects wiper to ADC input

- Inputs reconfigured in software

PCBA 3D View

PCBA Front

PCBA Back

PCBA Front Isometric

PCBA Schematic

ESP32

RC1 — RC1
RC2 — RC2
RC3 — RC3
RC4 — RC4
RC5 — RC5
RC6 — RC6
RC7 — RC7
RC8 — RC8

SCL — SCL
SDA — SDA

V_CSD
V_CLK
V_MOSI
V_MISO

IR_OUT — IR_OUT
IR_IN — IR_IN

VSNS1 — VSNS1
VSNS2 — VSNS2
VSNS3 — VSNS3

File: ESP32.kicad_sch

PSU
PVIN — PVIN   P3V3 — P3V3D
File: PSU.kicad_sch

PVESC   PVIN   P3V3

GND

R22
0
PVESC — PVESC
PVIN — PVIN
NC — PVBATT

R1
0
PVRC — PVRC
P3V3 — P3V3
NC

J1A — TSW-108-07-T-T
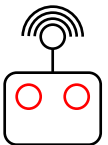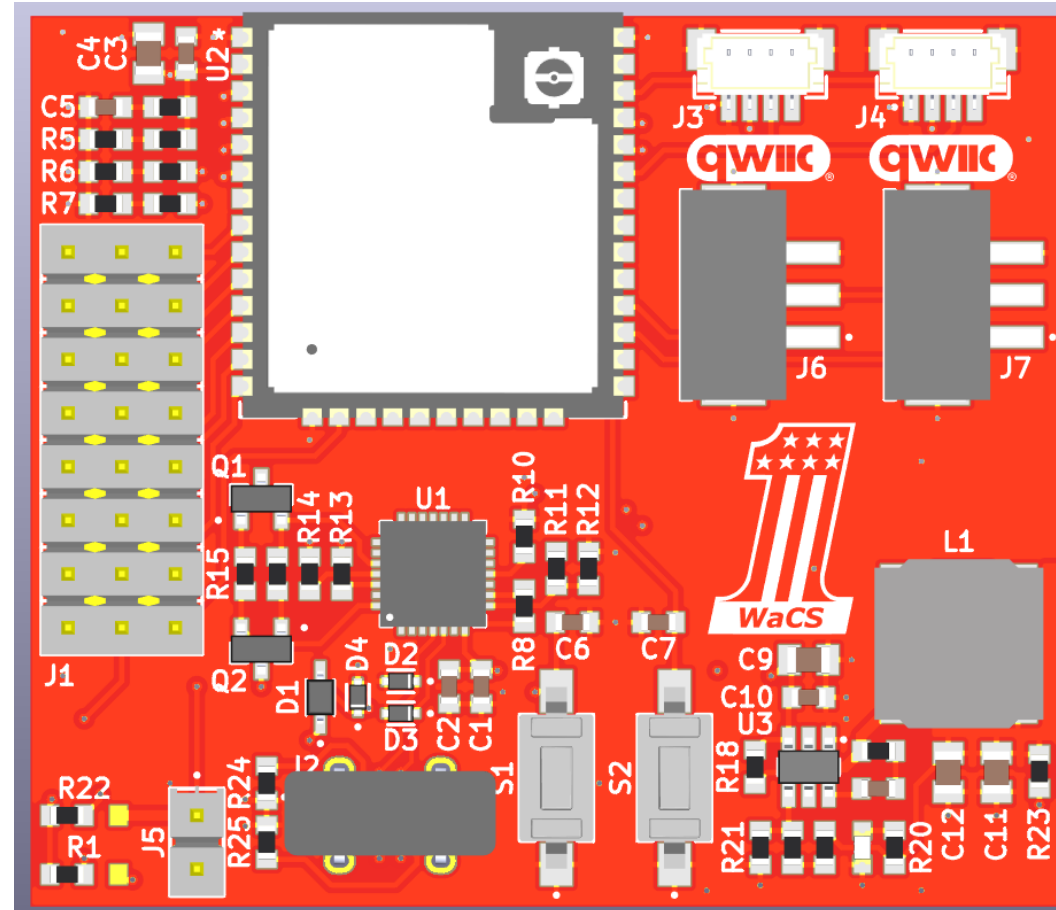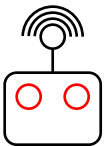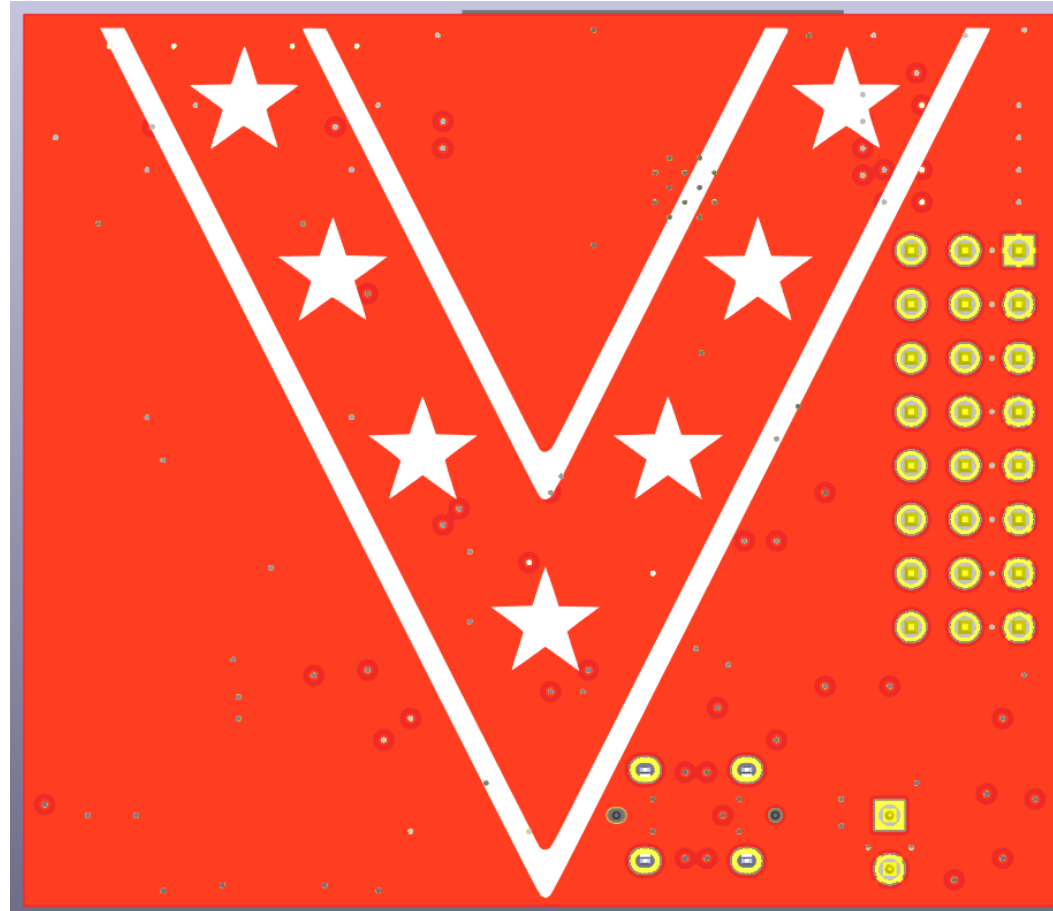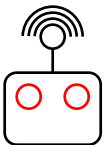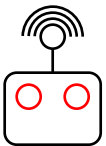RC1 — 03
PVRC — 02
GND — 01

J1B — TSW-108-07-T-T
RC2 — 06
PVRC — 05
GND — 04

J1C — TSW-108-07-T-T
RC3 — 09
PVRC — 08
GND — 07

J1D — TSW-108-07-T-T
RC4 — 12
PVRC — 11
GND — 10

J1E — TSW-108-07-T-T
RC5 — 15
PVRC — 14
GND — 13

J1F — TSW-108-07-T-T
RC6 — 18
PVRC — 17
GND — 16

J1G — TSW-108-07-T-T
RC7 — 21
PVRC — 20
GND — 19

J1H — TSW-108-07-T-T
RC8 — 24
PVRC — 23
GND — 22

P3V3
R2 10k
VSNS1
R5 10k
GND

PVESC
R3 26.1k
VSNS2
R6 10k
GND

PVBATT
R4 100k
VSNS3
R7 10k
GND

J3 — BM04B-SRSS-TB
GND — 1
P3V3 — 2
SDA — 3
SCL — 4
MP1 / MP2 — GND
qwiic

J4 — BM04B-SRSS-TB
GND — 1
P3V3 — 2
SDA — 3
SCL — 4
MP1 / MP2 — GND
qwiic

J5 — 2011-1X02G00SD025B
PVBATT — 01
GND — 02

J6 — B3B-PH-SM4-TB
IR_OUT — 1
P3V3 — 2
GND — 3
MP1 / MP2 — GND

J7 — B3B-PH-SM4-TB
IR_IN — 1
P3V3 — 2
GND — 3
MP1 / MP2 — GND

15

16

Title: ESP32 RC Controller

| Size: USLetter | Date: 2024-09-04 | Rev: 0 |
| KiCad E.D.A. 8.0.4 | | Id: 3/3 |

PCBA Gerbers

PCBA Extents

BOARD CHARACTERISTICS

Copper Layer Count:	4	Board Thickness: 60.28 mils
Board overall dimensions:	1920.00 mils x 1660.00 mils	
Min track/spacing:	5.00 mils / 5.00 mils	Min hole diameter: 8.00 mils
Copper Finish:	ENIG	Impedance Control: No
Castellated pads:	No	Plated Board Edge: No
Edge card connectors:	No	

Layer Name	Type	Material	Thickness (mils)	Color	Epsilon R	Loss Tangent
F.Silkscreen	Top Silk Screen	Taiyo-SS	0 mils	White	1	0
F.Paste	Top Solder Paste		0 mils		1	0
F.Mask	Top Solder Mask	Taiyo-SM	0.6 mils	Red	3.3	0
F.Cu	copper		1.8 mils		1	0
Dielectric	prepreg	Isola 370HR	7.04 mils	FR4 natural	4.04	0.021
In1.Cu	copper		1.2 mils		1	0
Dielectric	core	Isola 370HR	39 mils	FR4 natural	4.04	0.021
In2.Cu	copper		1.2 mils		1	0
Dielectric	prepreg	Isola 370HR	7.04 mils	FR4 natural	4.04	0.021
B.Cu	copper		1.8 mils		1	0
B.Mask	Bottom Solder Mask	Taiyo-SM	0.6 mils	Red	3.3	0
B.Paste	Bottom Solder Paste		0 mils		1	0
B.Silkscreen	Bottom Silk Screen	Taiyo-SS	0 mils	White	1	0

Dan Tatum
Wireless and Control Systems LLC
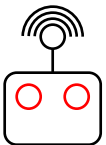Sheet:
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Title: ESP32 RC
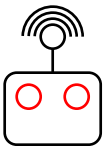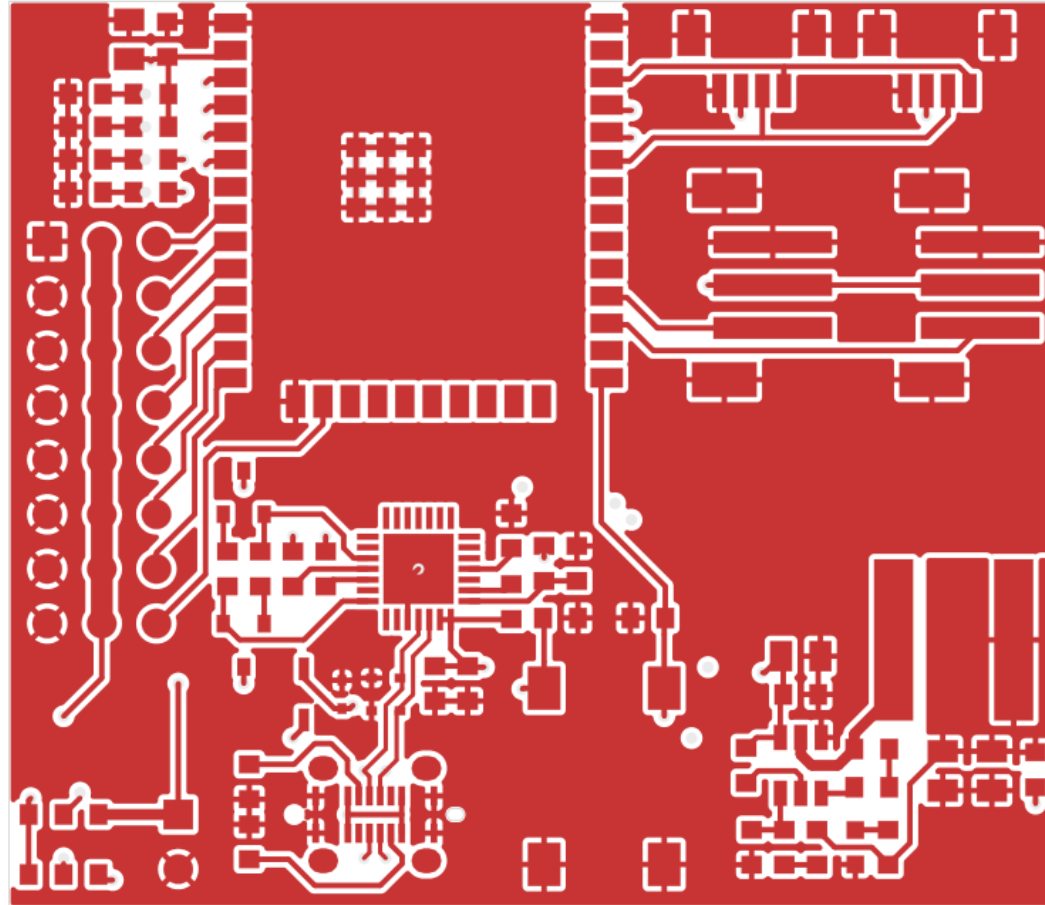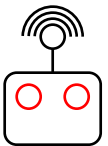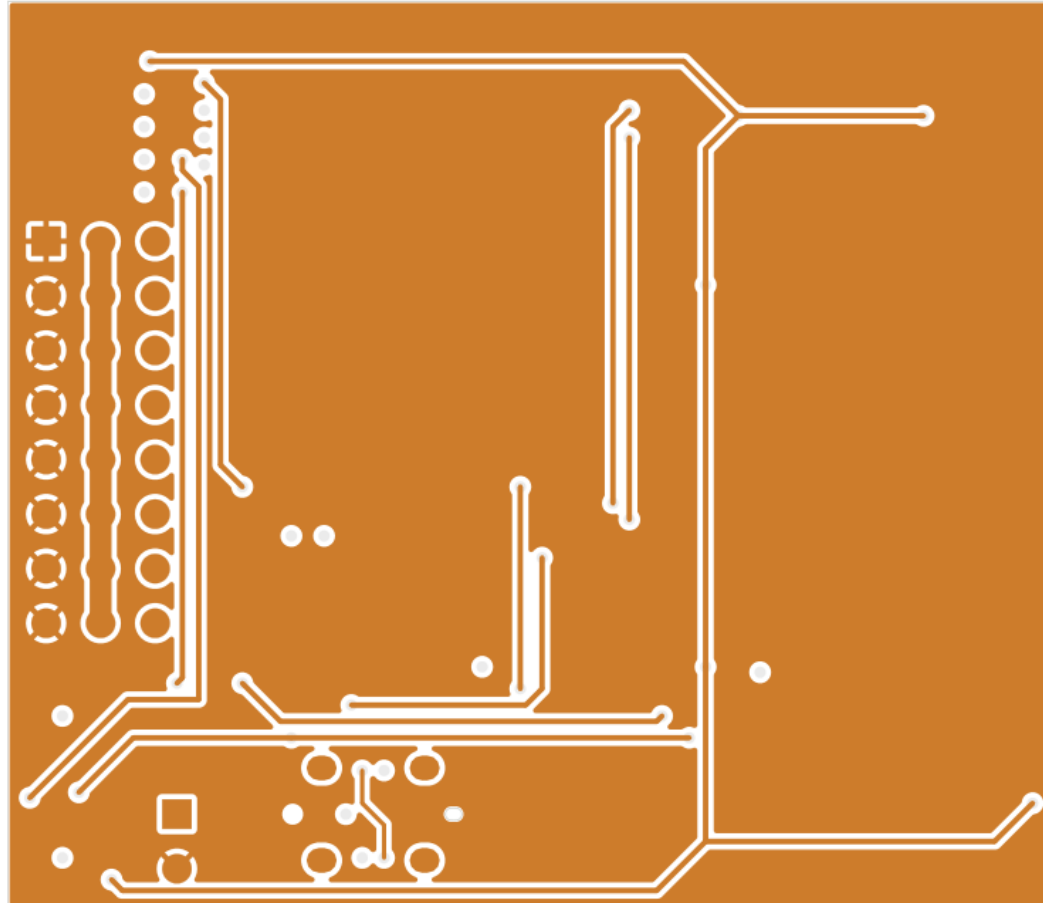Size: USLetter | Date: 2024-08-30 | Rev: 0
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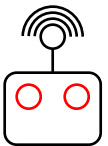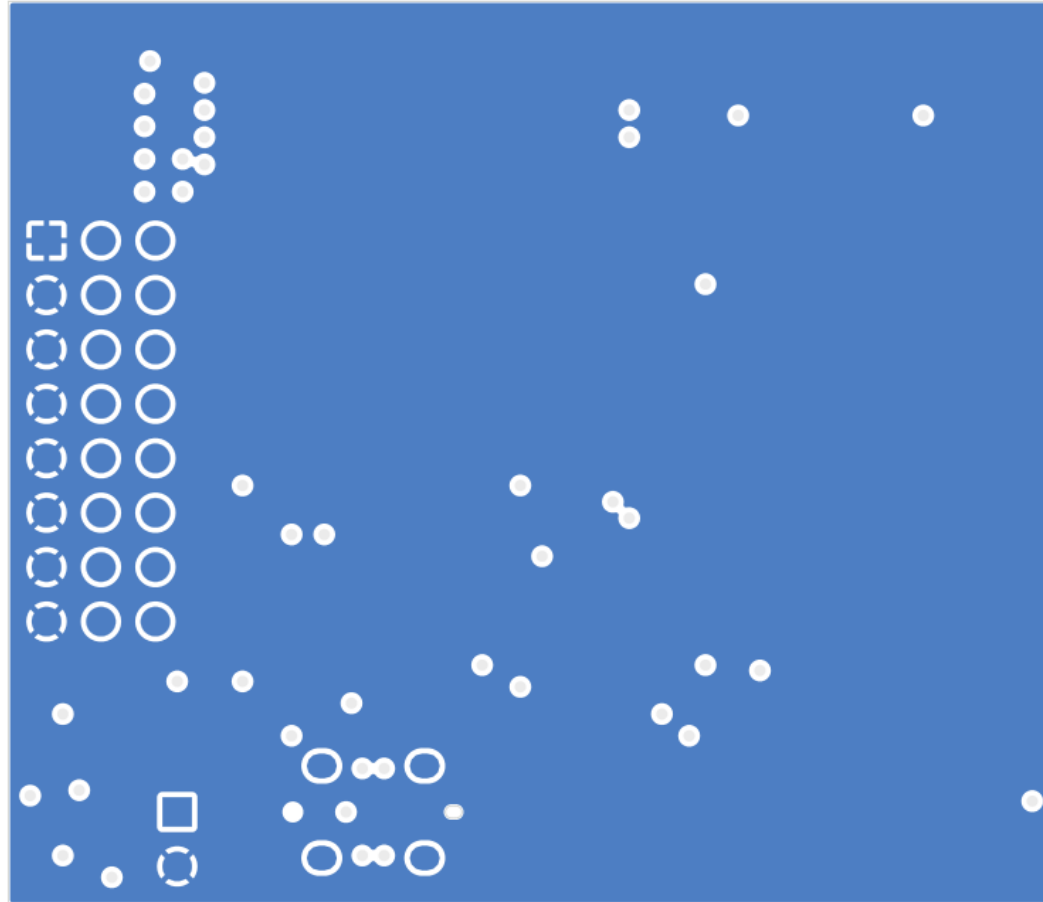
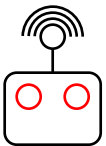# PCBA Top Layer

PCBA Layer 1
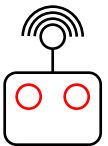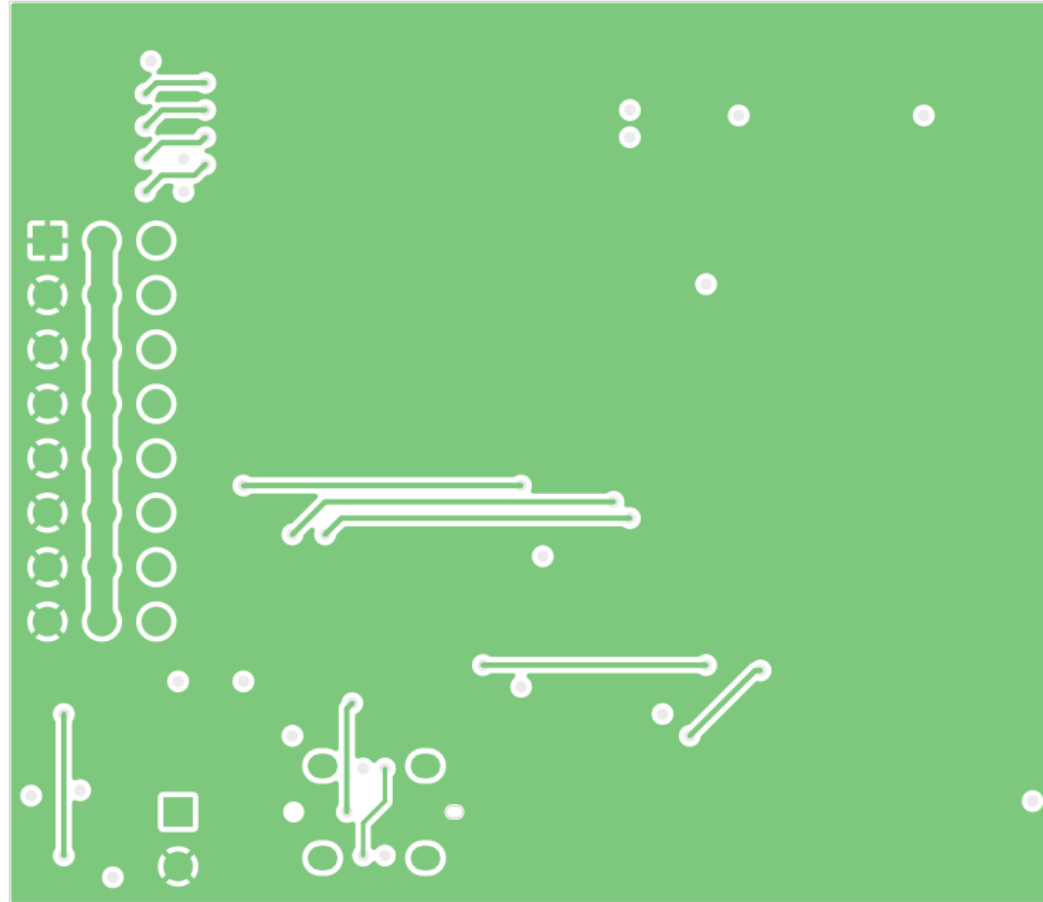
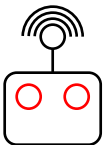# PCBA Layer 2

PCBA Bottom Layer

Upcoming Milestones and Future Work

Upcoming Milestones and Future Work

- Initial prototype materials due in lab week of 23 September 2024
- PCBA checkout, PSU stability testing, USB functionality
- Initial draft of firmware

WaCS-1 Availability

Developmental units will be made available by contacting the developer Dan Tatum via email dan@wcsrf.com