

A

B

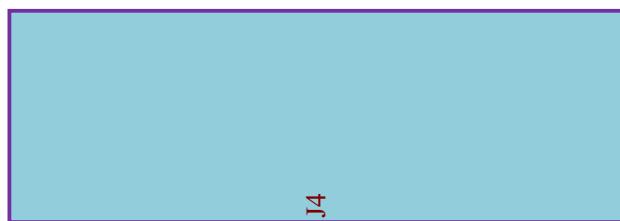
C

D

1

1

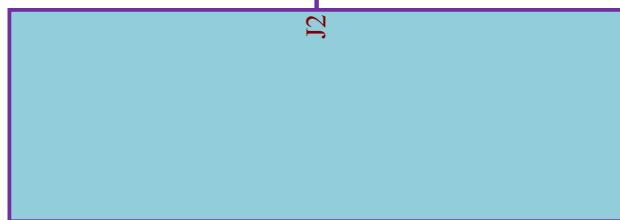
Control Board



14



Power Board



12

Designer's signature

Supervisor's signature

Sheet title: Main

Project title: Balancing Robot

Designer: Pedro Javier Belmonte Miñano

Date: 29/12/2021

Revision: v1

Sheet 1 of 1

Tecnologías de Circuitos Impresos
Grado en Ingeniería de Tecnologías de
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18014, Granada, Granada, Spain



A

B

C

D

A

B

C

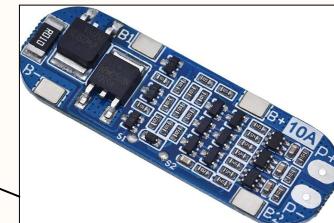
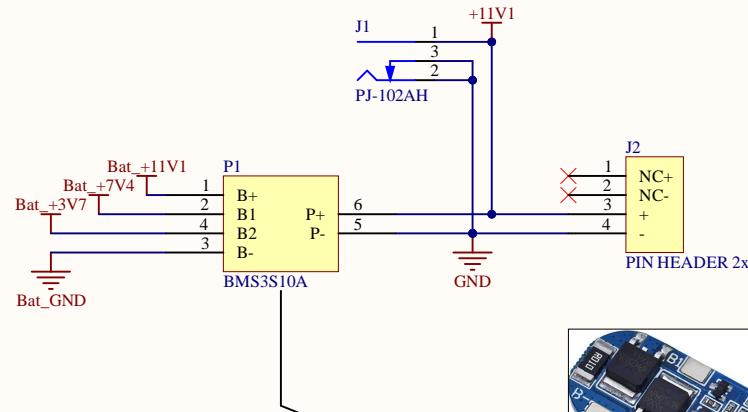
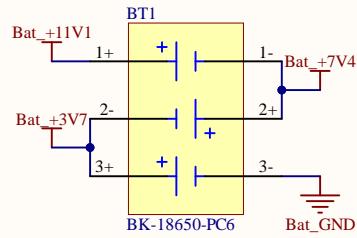
D

A

B

C

D



Model: BMS HX-3S-FL10
Size: 53*17*4 mm
Max Working Current: 6-8 A
Instant Max Working Current: 10-13 A
Charging Voltage: 12.6-13 V
Working Temperature: -40° C - +50° C

Designer's signature

Sheet title: **Bottom Board**Project title: **Balancing Robot**

Supervisor's signature

Designer: **Pedro Javier Belmoonte Miñano**Date: **29/12/2021**Revision: **V1**

Sheet 1 of 1

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A

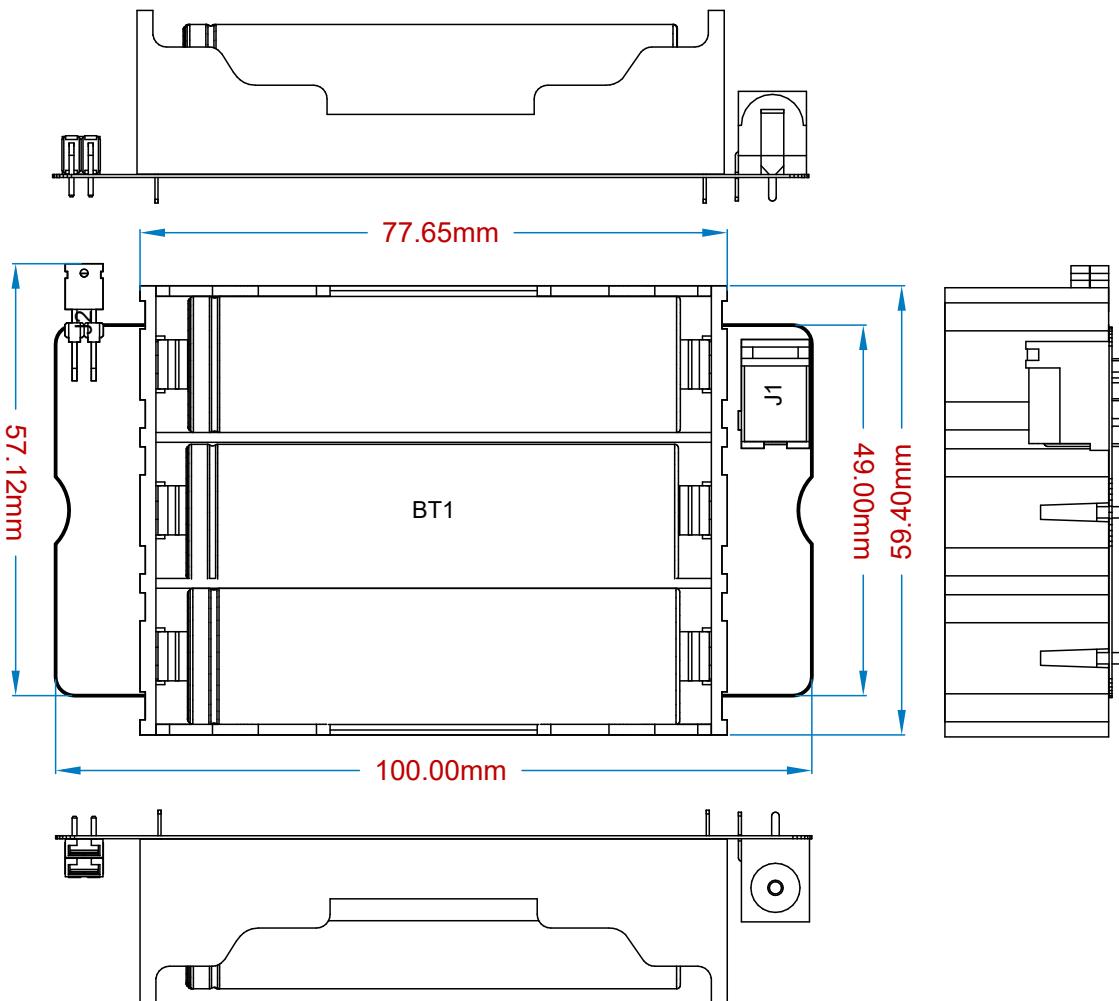
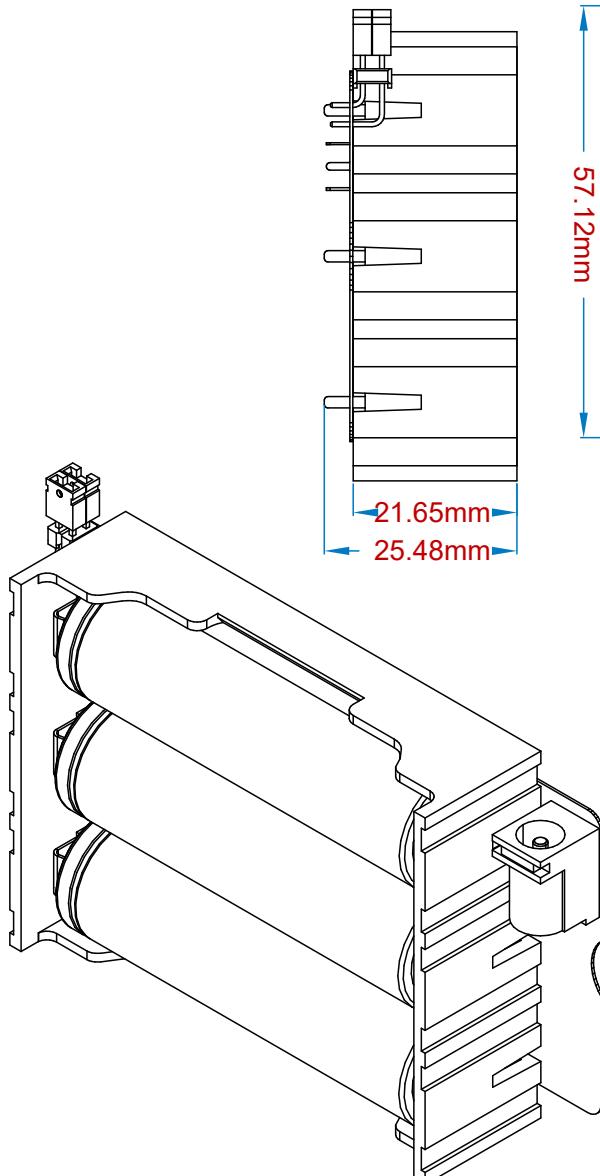
B

C

D

E

F



Bill Of Materials

Line #	Designator	Comment	Quantity
1	BT1	BK-18650-PC6	1
2	J1	PJ-102AH	1
3	J2	PIN HEADER 2x1	1
4	P1	BMS3S10A	1

Designer's signature:

Sheet title:

Board Assembly ViewSupervisor's signature:

Project title:

PowerBoard.PjrPcb

Designer:

Pedro Javier Belmonte Miñano

Size: A4

Scale: 1:1

Date: 29/12/2021

Revision: V 1

Sheet 1 of 2

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Granada, Spain



A

B

C

D

E

F

A

B

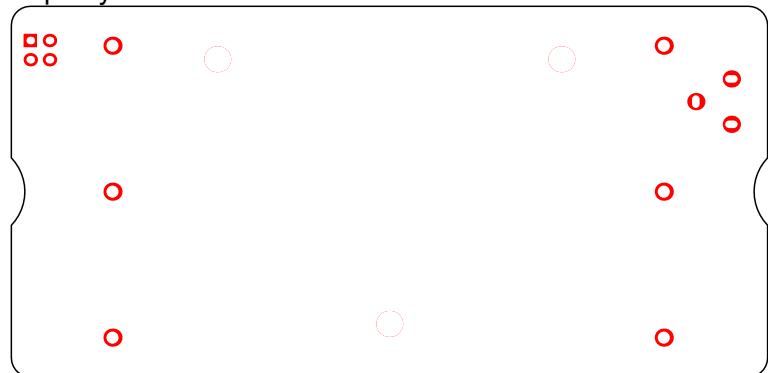
C

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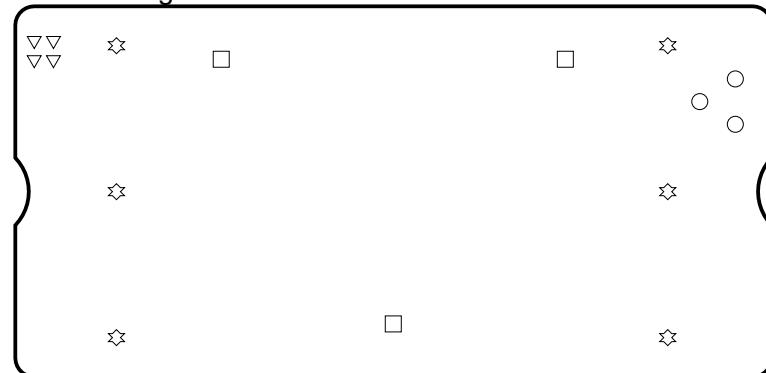
E

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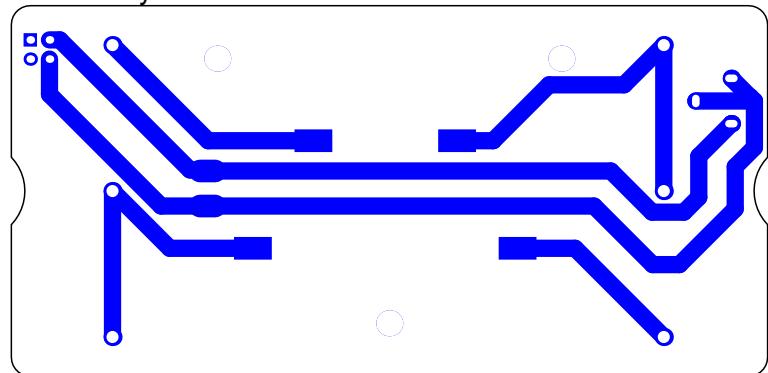
Top Layer



Drill Drawing View



Bottom Layer



Drill Table

Symbol	Count	Hole Size	Plated	Hole Tolerance
○	3	1.00mm	Plated	
▽	4	1.02mm	Plated	
☆	6	1.60mm	Plated	
□	3	3.44mm	Plated	
16 Total				

A

B

C

D

E

F

Designer's signature:
Supervisor's signature:

Sheet title:

Project title:

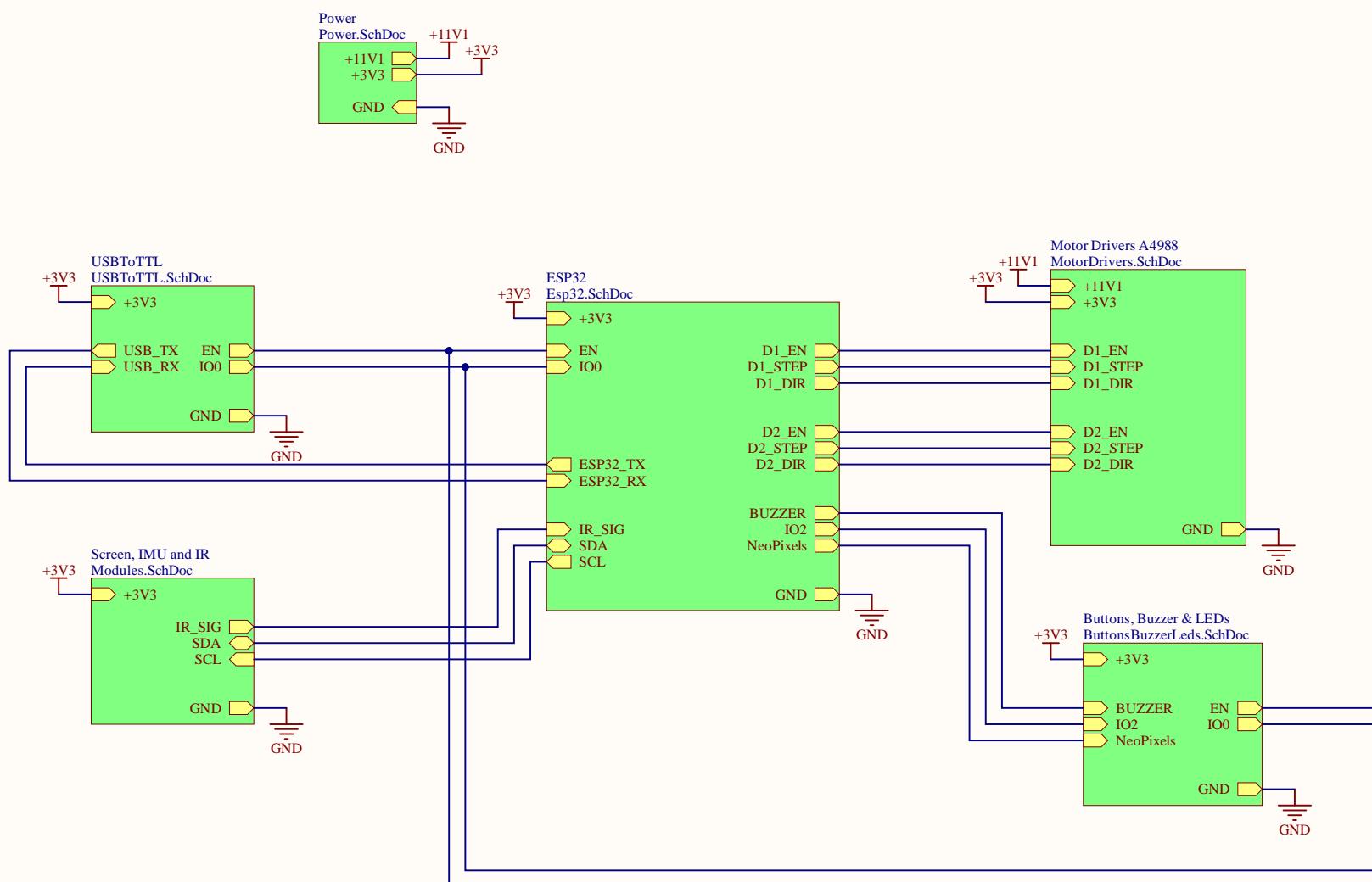
Designer:

Size:

Fabrication View**PowerBoard.PjrPcb****Pedro Javier Belmonte Miñano****A4****1:1****29/12/2021****V 1****Revision:****Sheet 2 of 2**

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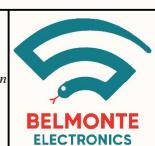


Designer's signature

Supervisor's signature

Sheet title: **Control Board**Project title: **Balancing Robot**Designer: **Pedro Javier Belmonte Miñao**Date: **29/12/2021** Revision: **V1**

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A

B

C

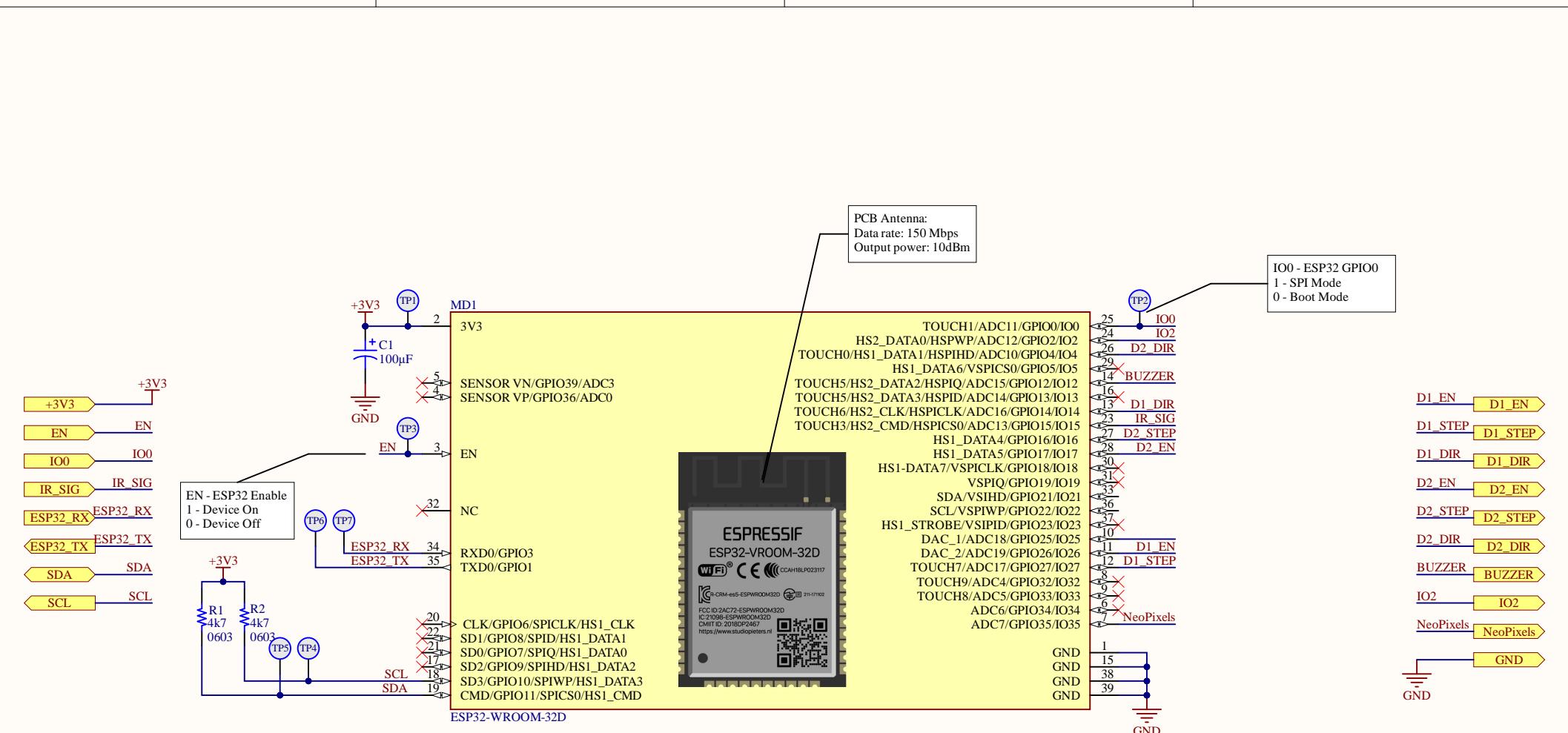
D

A

B

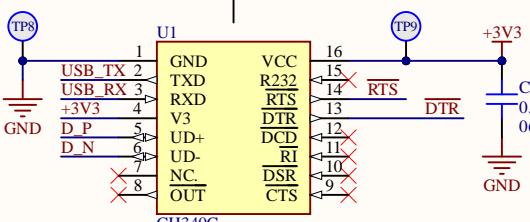
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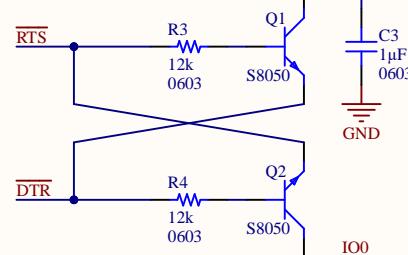
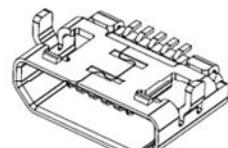
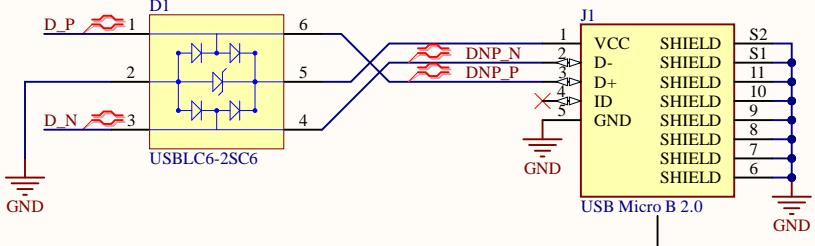


A

Model: CH340C
 Compatible with USB V2.0
 Support 5V and 3.3V power supply even 3V
 CH340C, CH340G and CH340B have built-in crystal and are compatibles.
 SOP-16 lead-free RoHS compliant package



+3V3
 USB TX
 USB RX



Auto Reset & Program Circuit

DTR	RTS	EN	IO0
1	1	1	1
0	0	1	1
1	0	0	1
0	1	1	0

Normal Mode
 Normal Mode
 Reset
 Program Mode

EN - ESP32 Enable
 1 - Device On
 0 - Device Off

IO0 - ESP32 GPIO0
 1 - SPI Mode
 0 - Boot Mode

Designer's signature

Sheet title: **USB To TTL**Project title: **Balancing Robot**

Supervisor's signature

Designer: **Pedro Javier Belmonte Miñao**

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A

104

E

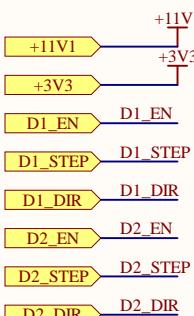
104

6

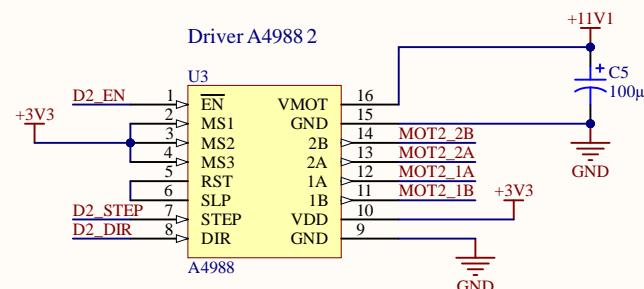
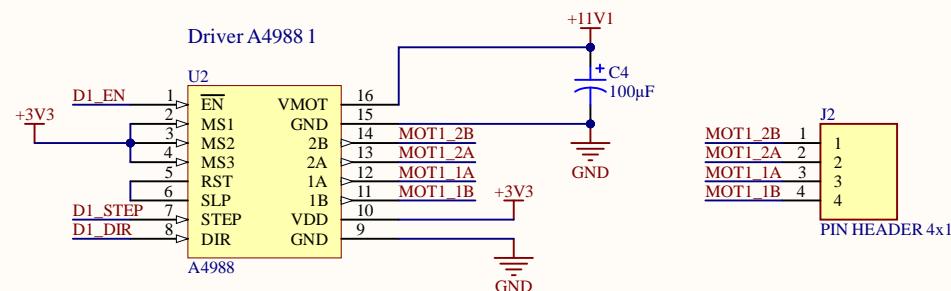
104

E

1



A4988 Stepper Motor Driver Carrier
Minimum operating voltage: 8 V
Maximum operating voltage: 35 V
Continuous current per phase: 1 A
Maximum current per phase: 2 A
Minimum logic voltage: 3 V
Maximum logic voltage: 5.5 V
Microstep resolutions: full, 1/2, 1/4, 1/8
and 1/16
Reverse voltage protection: No
Bulk packaged: No
Header pins soldered: No



MOT1_2B	1	J2
MOT1_2A	2	
MOT1_1A	3	
MOT1_1B	4	

PIN HEADER 4x1

PIN HEADER 4x1

MOT2_2B	1
MOT2_2A	2
MOT2_1A	3
MOT2_1B	4

PIN HEADER 4x1

GND

Microstepping Resolution Table			
MS1	MS2	MS3	Resolution
LOW	LOW	LOW	FULL
HIGH	LOW	LOW	1/2
LOW	HIGH	LOW	1/4
HIGH	HIGH	LOW	1/8
HIGH	HIGH	HIGH	1/16

Designer's signature

234

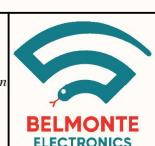
Supervisor's signat

Table 1. Summary of the main characteristics of the four groups.

第十一章 财务管理

Designer: Pedro Javier Belmonte Miñano

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Granada, Spain*



A

A

B

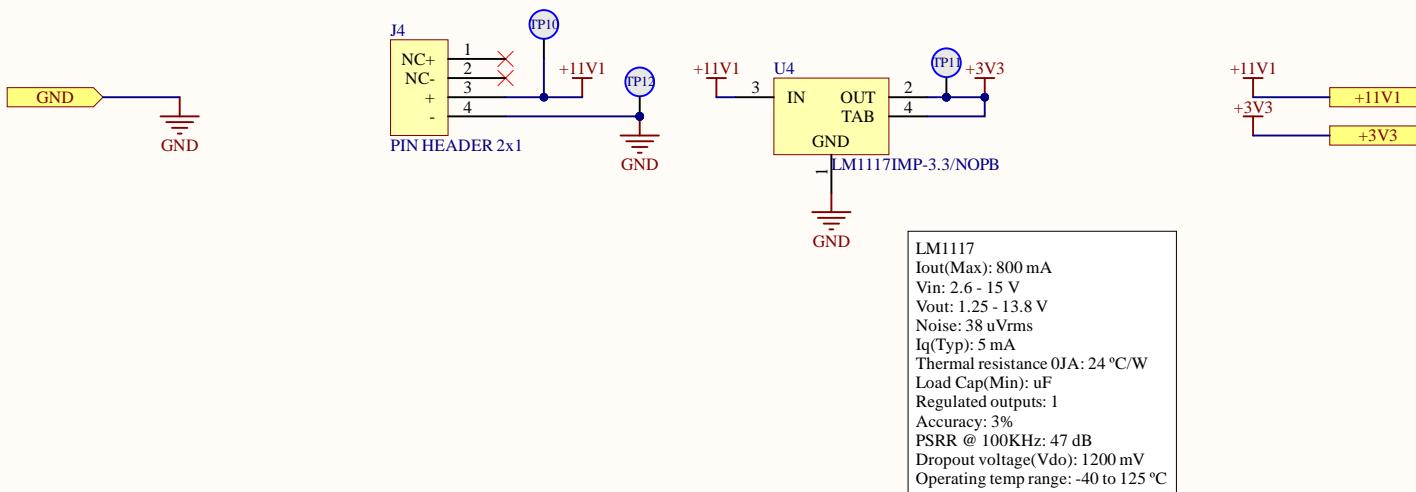
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C

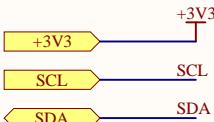
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D

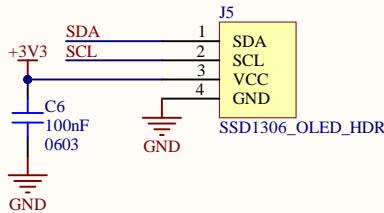
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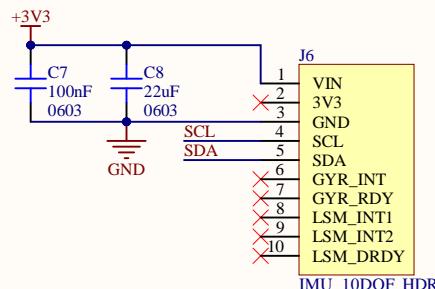
Designer's signature	Sheet title: Power			Tecnologías de Circuitos Impresos Grado en Ingeniería de Tecnologías de Telecommunicación ETSIIT, University of Granada C/ Periodista Daniel Saucedo Aranda, s/n. 18014, Granada, Granada, Spain
Project title: Balancing Robot				
Supervisor's signature	Designer: Pedro Javier Belmonte Miñano			
	Date: 29/12/2021	Revision: V1	Sheet 5 of 7	

INPUT**SSD1306 OLED HDR Screen 128x64**

▲ The connection to the I2C of the ESP32 does not need pull up resistors as the OLED is connected between the IMU (which already has pull up resistors) and the SDA and SCL of the ESP32.

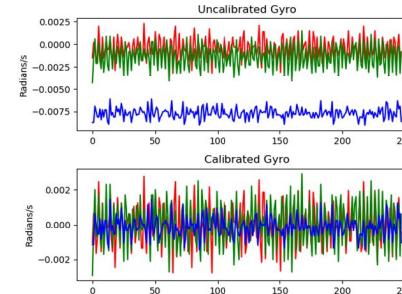
**REAL MODEL****DATASHEET**

	OLED SCREEN
POWER SUPPLY	1.65 to 3.3 V
SEGMENT MAXIMUM SOURCE CURRENT	1.25 to 1.6 V
COMMON MAXIMUM SINK CURRENT	940 nm
AMBIENT TEMPERATURE RANGE	-40 to + 85 °C

Adafruit IMU 10 DOF**DATASHEET**

	L3GD20
SUPPLY VOLTAGE	2.4 to 3.6 V
CURRENT CONSUMPTION	5 µA to 6.1 mA
OPERATING TEMPERATURE	-40 to +85 °C
MEASUREMENT RANGE	±250 to ±2000 dps (degrees per second)
SENSITIVITY	250 dps → 8.75 mdps/digit 500 dps → 17.5 mdps/digit 2000 dps → 70 mdps/digit

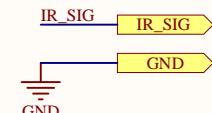
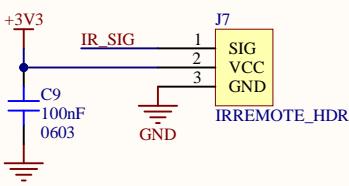
	LSM303DLHC
SUPPLY VOLTAGE	2.16 to 3.16 V
CURRENT CONSUMPTION	1 to 110 µA
OPERATING TEMPERATURE	-40 to +85 °C
MAGNETIC RESOLUTION	2 gauss
LINEAR ACCEL. ZERO-G	± 60 mg
LEVEL OFFSET ACCURACY	

GYROSCOPE CALIBRATION COMPARISON CHART:**REAL MODEL**

▲ The labels GYR_RDY, GYR_INT, LSM_INT_1, LSM_INT_2, LSM_DRDY are for extra settings (WE DO NOT USE THEM)

Infrared Remote Receiver KY-022**REAL MODEL****DATASHEET**

Operating Voltage	2.7 to 5.5V
Operating Current	0.4 to 1.5mA
Reception Distance	18 meters
Reception Angle	±45°
Ambient Light Filter	up to 500 Lux
Carrier Frequency	38 kHz

OUTPUT

Designer's signature

Sheet title: **Screen, LED and IR**Project title: **Balancing Robot**

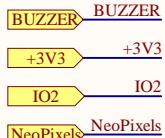
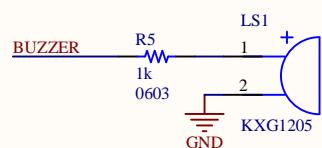
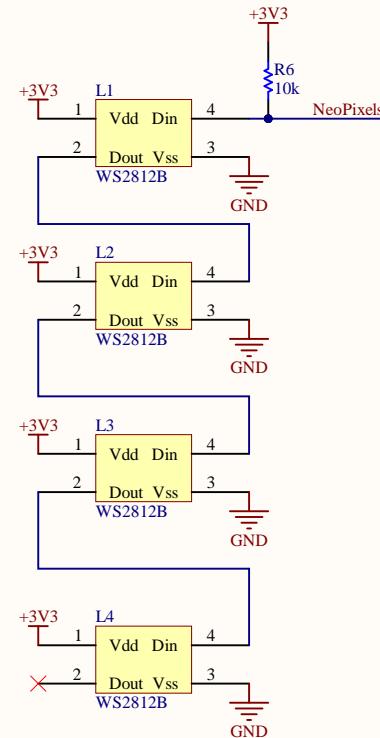
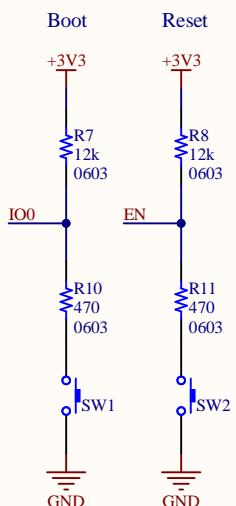
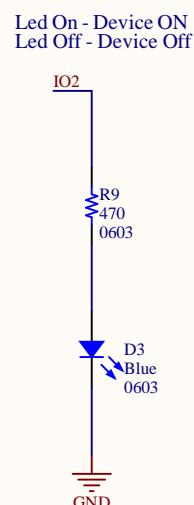
Supervisor's signature

Designer: **Pedro Javier Belmonte Miñano**Date: **29/12/2021**Revision: **V1**

Sheet 6 of 7

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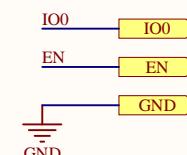


INPUT**MAGNETIC BUZZER KXG1205****REAL MODEL****CORNER LEDS****BUTTONS****DEVICE STATE LED**

Designer's signature

Sheet title: **Buzzer and LEDs**Project title: **Balancing Robot**

Supervisor's signature

Designer: **Pedro Javier Belmonte Miñao**Date: **29/12/2021** Revision: **V1**Sheet **7** of **7****OUTPUT**

A

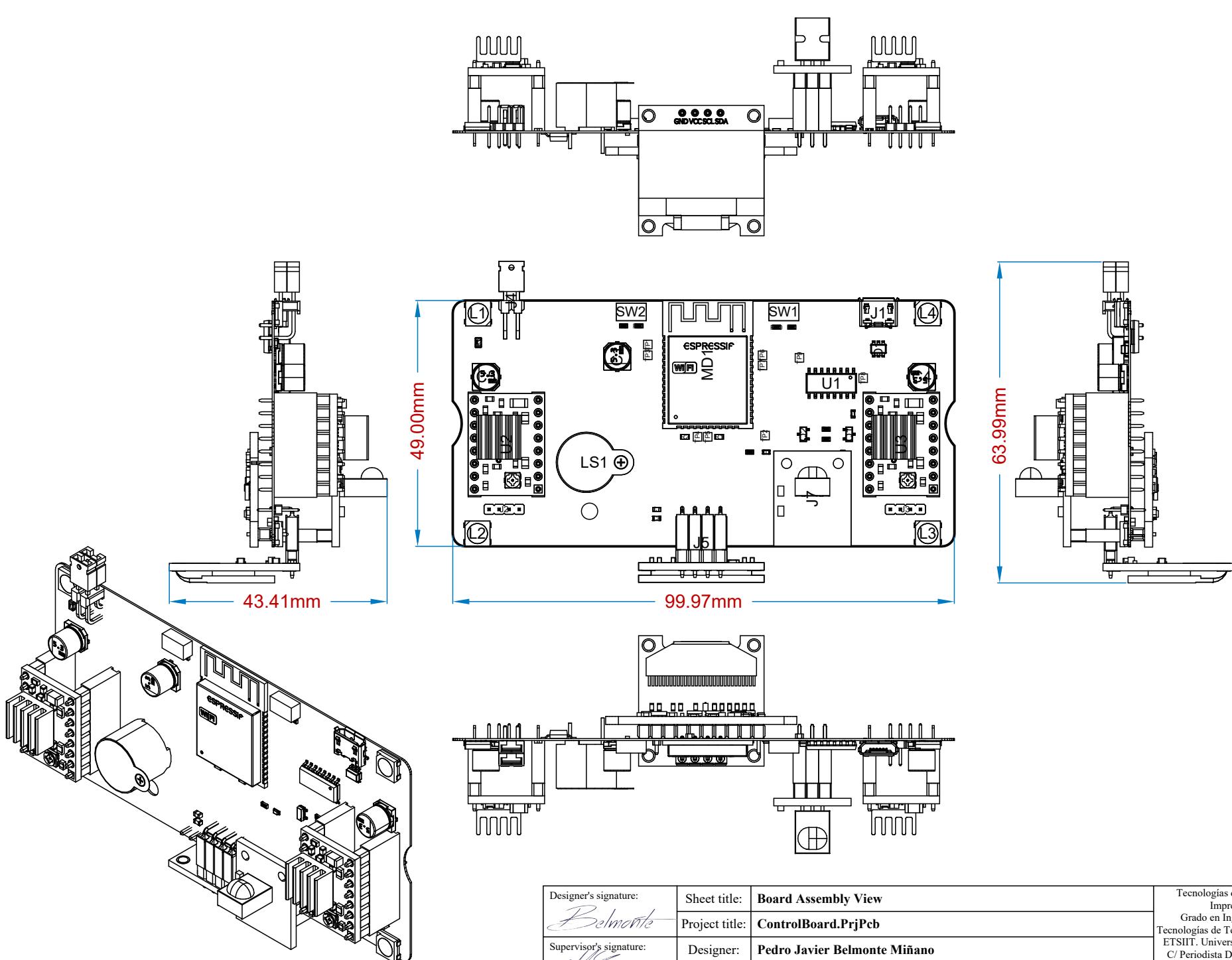
B

C

D

E

F

Designer's signature:
Belmonte

Sheet title:

Board Assembly ViewProject title:
ControlBoard.PnjPcb

Project title:

Pedro Javier Belmonte Miñano

Supervisor's signature:
Garcia

Designer:

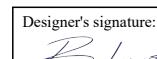
Size: A4 Scale: 1:1 Date: 12/29/2021 Revision: V 1 Sheet 1 of 3

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Granada, Spain



Bill Of Materials

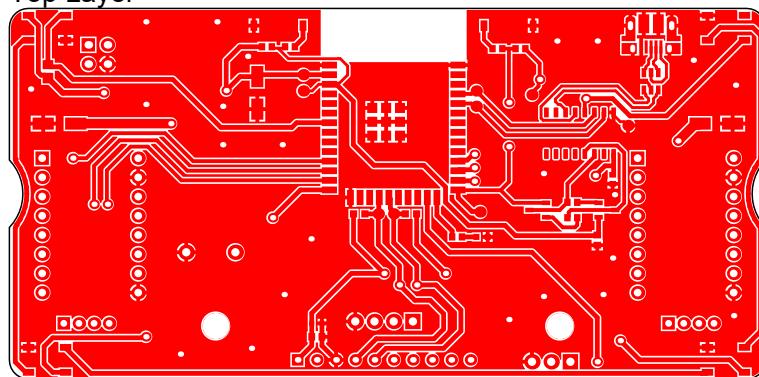
Designator	Quantity	Value	Category	Size	Description
C1, C4, C5	3	100 μ F	Cap	0603	CAP ALUM 100UF 4V 2000H
C2	1	0.1 μ F	Cap	0603	CAP CER 0.1UF 50V X7R 0603
C3	1	1 μ F	Cap	0603	CAP CER 0603 1UF 16V X7R 10%
C6, C7, C9	3	0.1 μ F	Cap	0603	CAP CER 0.1UF 6.3V X7R 0603
C8	1	22 μ F	Cap	0603	CAP CER 22UF 4V X5R 0603
D1	1		Diode		Very low capacitance ESD protection, 3.5 pF, -40 to 125 degC, 6-Pin SOT23, RoHS, Tape and Reel
D3	1	Blue	LED	0603	LED BLUE 0603 SMD
J1	1		Connectors		USB - micro B USB 2.0 Receptacle Connector 5 Position Surface Mount, Right Angle; Through Hole
J2, J3	2				Connector
J4	1				M20-9950245 Pin Connector
J5	1		OLED Screen		CONN HDR 4POS 0.1 TIN PCB
J6	1		IMU		CONN HDR 10POS 0.1 TIN PCB
J7	1		IR Receiver		CONN HDR 3POS 0.1 GOLD PCB
L1, L2, L3, L4	4		LED		Intelligentcontrol LED integrated light source WS2812B
LS1	1				BUZZER KXG1205
MD1	1		Chip		WIFI MODULE 32MBITS SPI FLASH
Q1, Q2	2				Transistor
R1, R2	2	4.7 k Ω	Res	0603	Precision Thick Film Chip Resistor, 4.7 KOhm, +/- 1%, -55 to 155 degC, 0603 (1608 Metric), RoHS, Tape and Reel
R3, R4, R7, R8	4	12 k Ω	Res	0603	RES 12K OHM 5% 1/10W 0603
R5	1	1 k Ω	Res	0603	RES SMD 1K OHM 1% 1/4W 0603
R6	1	10k			Resistor
R9, R10, R11	3	470 Ω	Res	0603	RES 470 OHM 5% 1/10W 0603
SW1, SW2	2				FSMSM Push Button Switch, 50 mA, -35 to 85 degC, 2-Pin SMD, RoHS, Tape and Reel
U1	1		Chip		USB to serial chip CH340
U2, U3	2		Motor Driver		Pololu A4988 Stepper Motor Driver Carrier
U4	1		Voltage Regulator		800mA Low-Dropout Linear Regulator, 4-pin SOT-223, Pb-Free

Designer's signature:
Sheet title:
Bill Of MaterialsProject title:
ControlBoard.PpjPcbSupervisor's signature:
Designer:
Pedro Javier Belmonte Miñano

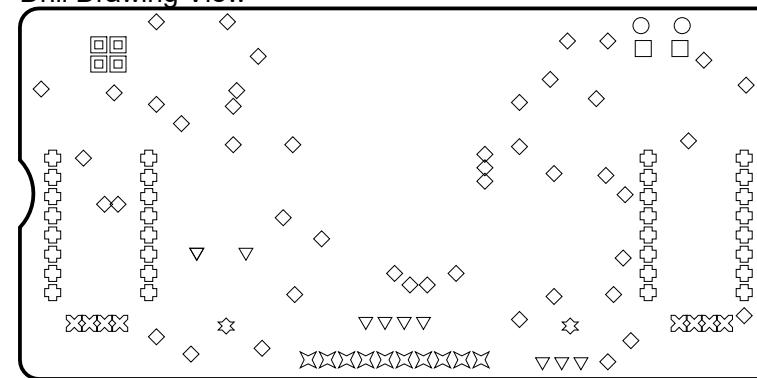
Size: A4 Scale: 1:1 Date: 12/29/2021 Revision: V1 Sheet 2 of 3

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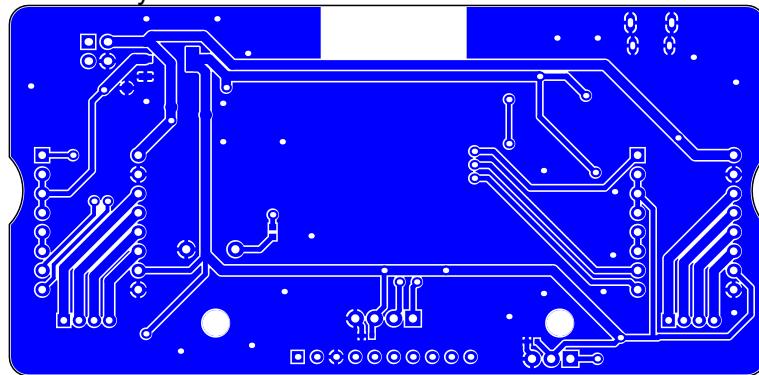
Top Layer



Drill Drawing View



Bottom Layer



Drill Table

Symbol	Count	Hole Size	Plated	Hole Tolerance
□	2	0.65mm	Plated	
○	2	0.70mm	Plated	
◊	46	0.71mm	Plated	
☒	10	0.76mm	Plated	
✗	8	0.90mm	Plated	
▣	4	1.02mm	Plated	
✚	32	1.02mm	Plated	
▽	10	1.10mm	Plated	
✖	2	3.44mm	Plated	
116 Total				

Designer's signature:
Supervisor's signature:

Sheet title:

Project title:

Designer:

Size:

Scale:

Date:

Revision:

Sheet

Fabrication View

ControlBoard.PnjPcb

Pedro Javier Belmonte Miñano

A4

1:1

12/29/2021

V 1

3 of 3

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