



# F1Tenth Power Board v2024.1

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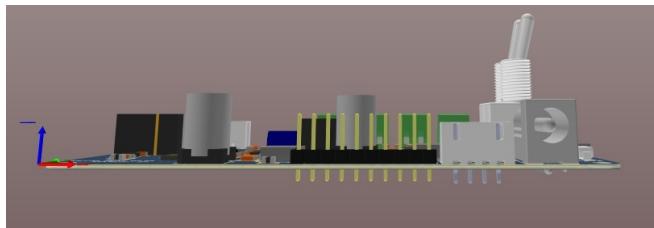


Figure 1: PCB side view

## General Description

- 1 This is the power distribution board for the F1TENTH autonomous vehicles. It is a four-layer printed circuit board with 12V and 5V outputs, as well as 6-pin and 4-pin outputs to power HOKUYO 10LX and 30LX LIDARs.
- 2

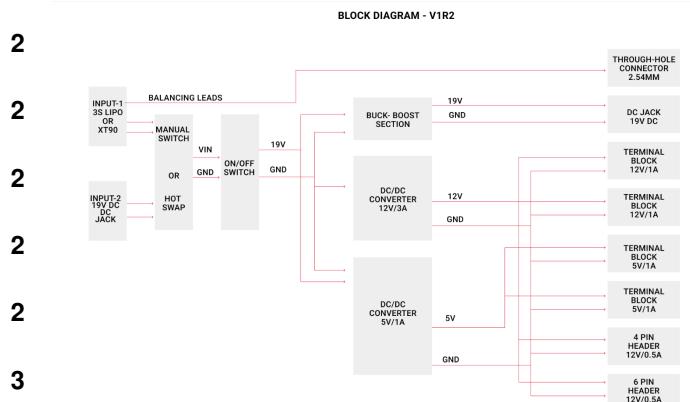


Figure 2: Block Diagram

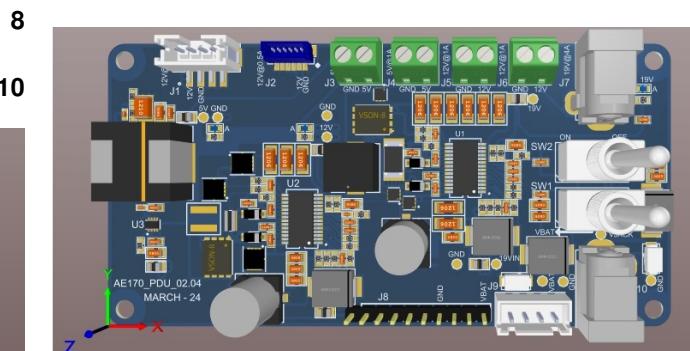


Figure 3: PCB top view

## Disclaimer

The F1TENTH team is not liable for any accidents that result due to improper use of the power distribution board. Read through this entire document carefully before proceeding.

## Features

- Can be powered by either a 3s LiPo battery input (11.1V) or a DC jack input (19V).
- A voltage beeper may be attached to the board to monitor LiPo battery voltage.
- One DC jack output at 19V to power the Jetson.
- Two 5V terminal block outputs.
- Two 12V terminal block outputs.
- One 4-pin header for HOKUYO 30LX LIDAR.
- One 6-pin header for HOKUYO 10LX LIDAR.
- On-board switch to turn the power on/off.
- On-board switch to select between battery and DC jack input.

## Barrel Jack Specifications

The board uses a 2.5x5.5mm header. The center pin is POWER - do not use a power jack whose center pin is ground.

## Input selection / Switch configuration

There are two on board switches. The pin labels are swapped - for further details refer to [Ambimat User Manual](#) included in the end.

## LiPo voltage buzzer

The PCB includes a 9-pin header to solder a [LiPo Voltage Checker](#). The checker must be soldered such that the 8-bit display faces inwards.

## Supporting documents

All the important documents have been included in this datasheet for easy access. Original documents are also available on the [GitHub repository](#). What follows is a list of two links for each document - a hyperlink to the section in this datasheet followed by a link to the original document online.

- Schematic:
  - [Datasheet Schematics Section](#)
  - [PDF hosted on GitHub](#)
- Bill of Materials:
  - [Datasheet Bill of Materials Section](#)
  - [XLSX hosted on GitHub](#)
- Mechanical Drawing:
  - [Datasheet Mechanical Drawing Section](#)
  - [PDF hosted on GitHub](#)

The layout and gerber files are present in the GitHub repository.

## Safety Precautions

- Always hold the PCB by the outer edges, never touch any of the components directly. This will minimize component failures due to electrostatic discharge.
- Avoid touching the components of the PCB especially when the PCB is powered on. This is because some components may heat up and will cause pain if touched.
- Avoid drawing more than **2A in total** from either the 5V or 12V supply. Refer to [Electrical Output Specifications](#) for more information.

## Specifications

All electrical specifications are at ambient temperatures ( $20^{\circ}\text{C} \leq T \leq 40^{\circ}\text{C}$ ) unless otherwise noted.

**Table 1: Electrical Input Specifications**

Parameter	Min.	Typ.	Max.	Unit	Notes
DC Jack Input		19		V	
3s Battery Input	9	11.1	12.6	V	Can be selected using an on-board switch

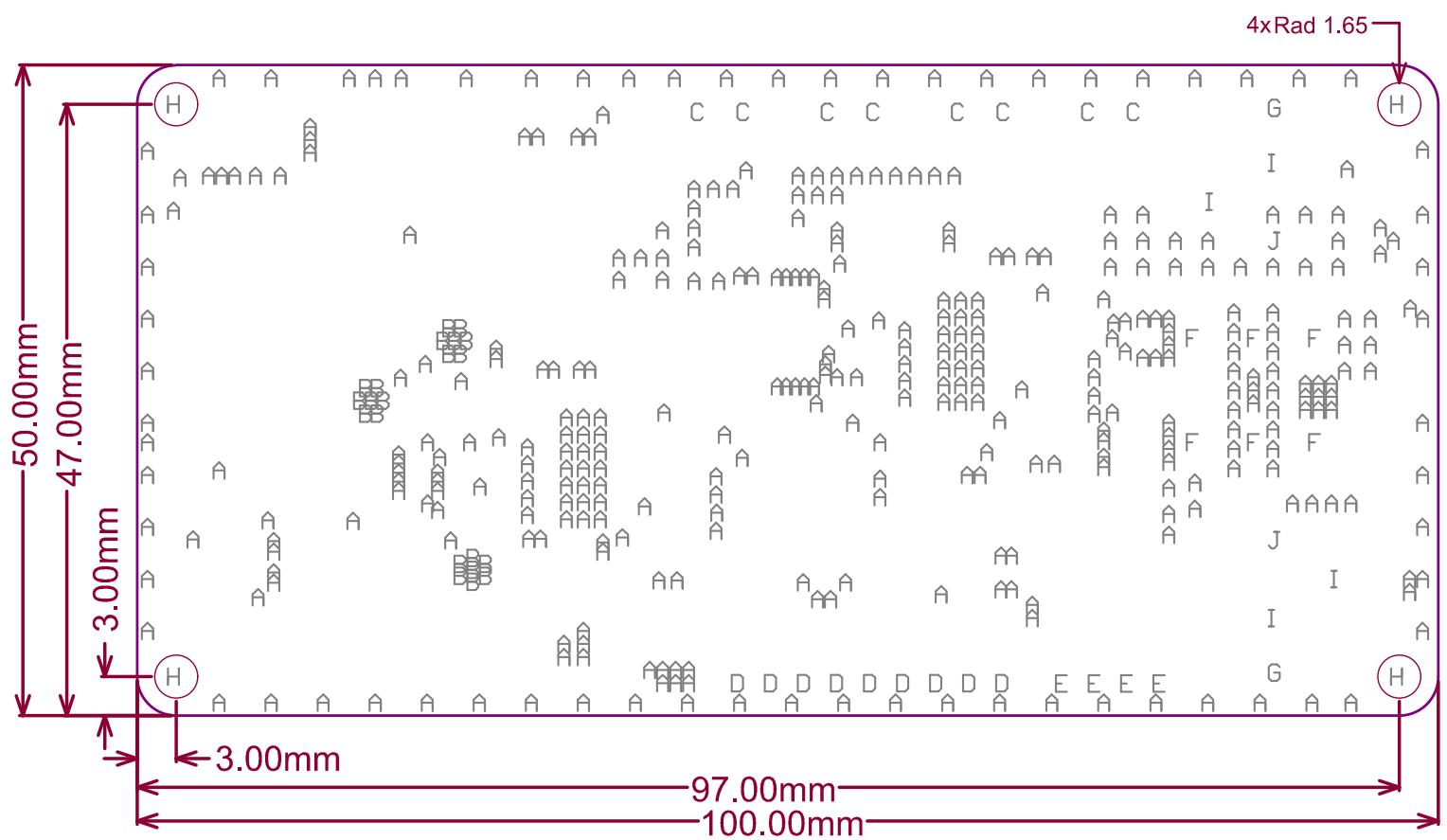
**Table 2: Electrical Output Specifications**

Parameter	Voltage	Min.	Typ.	Max.	Unit	Notes
DC Jack Output	19V		2	4	A	Powers the Jetson Orin Nano
B4B-PH-SM4-TB <sup>1</sup>	12V		0.5		A	4-pin header for HOKUYO 30LX LIDAR
BM06B-SRSS-TB <sup>1</sup>	12V		0.5		A	6-pin header for HOKUYO 10LX LIDAR
Terminal Block	12V	0	0.5	1	A	Outputs can supply a max of 2A when used together
Terminal Block	12V	0	0.5	1	A	
Terminal Block	5V	0	0.5	1	A	Outputs can supply a max of 2A when used together
Terminal Block	5V	0	0.5	1	A	

<sup>1</sup> Only the power pins are connected - other lines left unconnected.

**Table 3: Size Specifications**

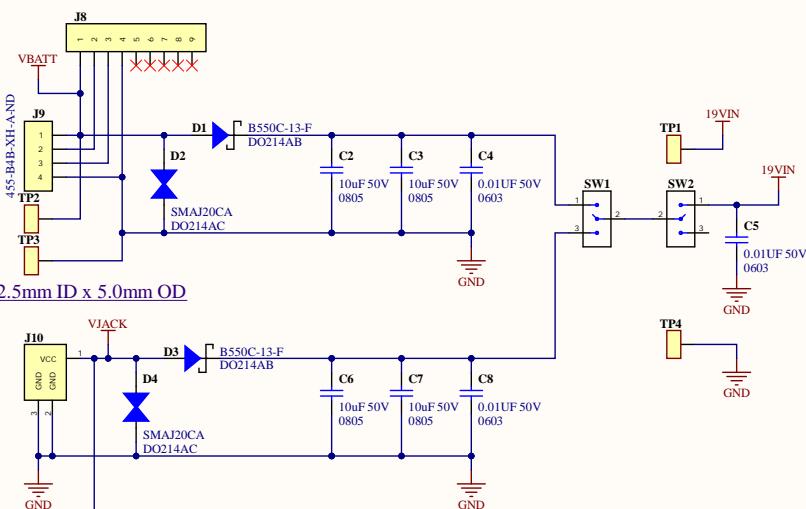
Parameter	Value	Unit
Length	100	mm
Width	50	mm
Height	28.81	mm



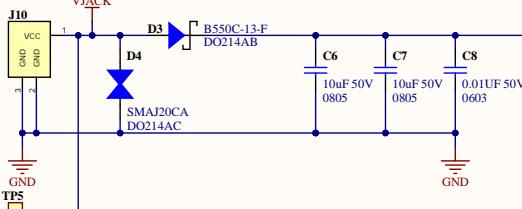
1	2	3	4
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Power Supply input and selection switch

Balancing Leads

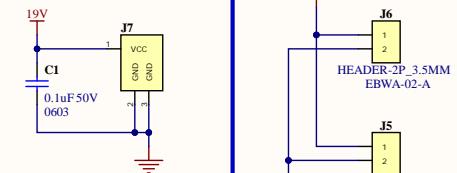


2.5mm ID x 5.0mm OD

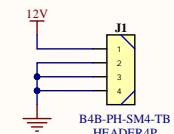


Jetson Orin Nano Devkit

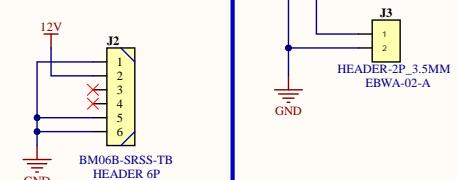
2.5mm ID x 5.0mm OD



Hokuyo 30LX LiDAR



Hokuyo 10XL LiDAR



Design By:

**AMBIMAT  
ELECTRONICS**

TITLE: Input Section and Output Connectors

Document Number: SCH\_AE170

26-03-2024 | Rev: 02.04 | Sheet: 2 of 6

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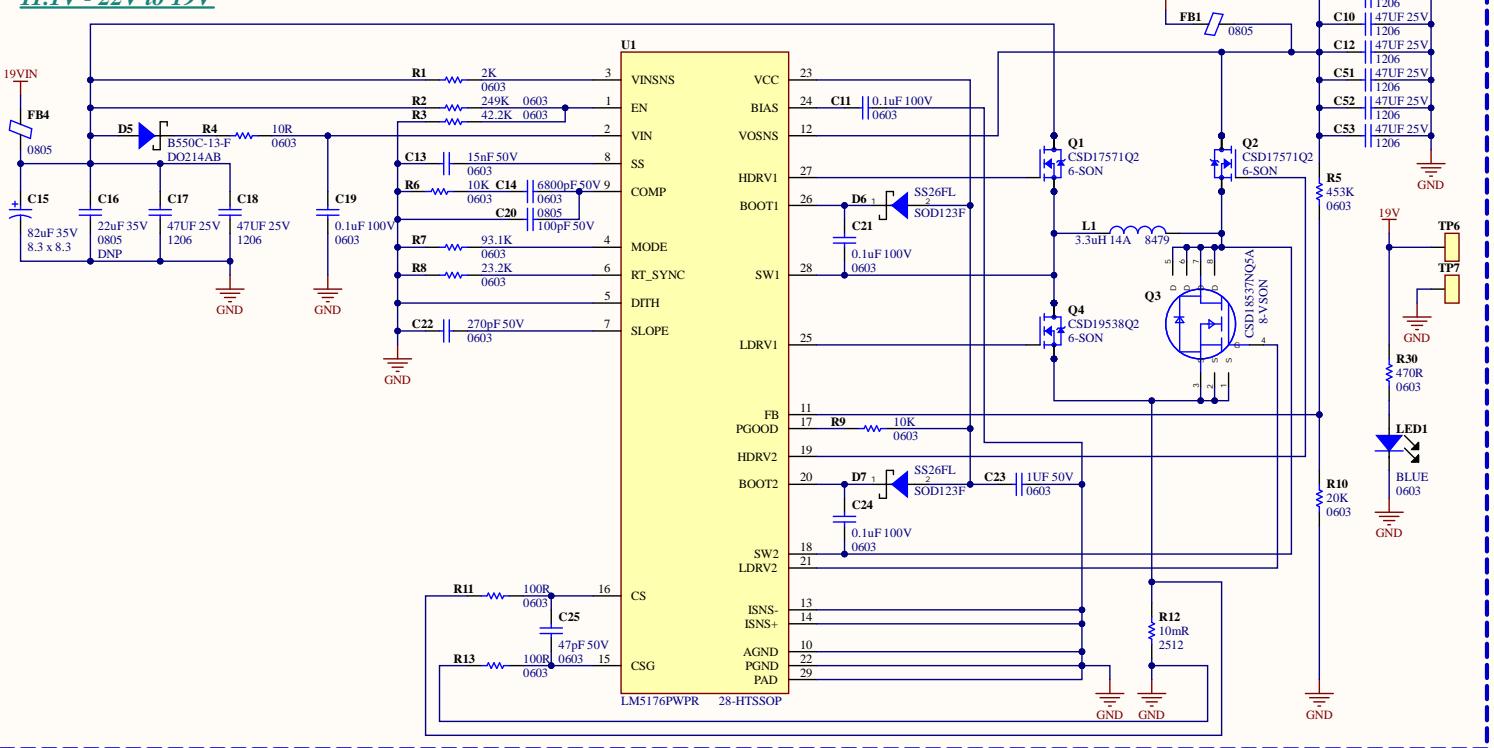
1	2	3	4
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2

3

4

11.1V - 22V to 19V



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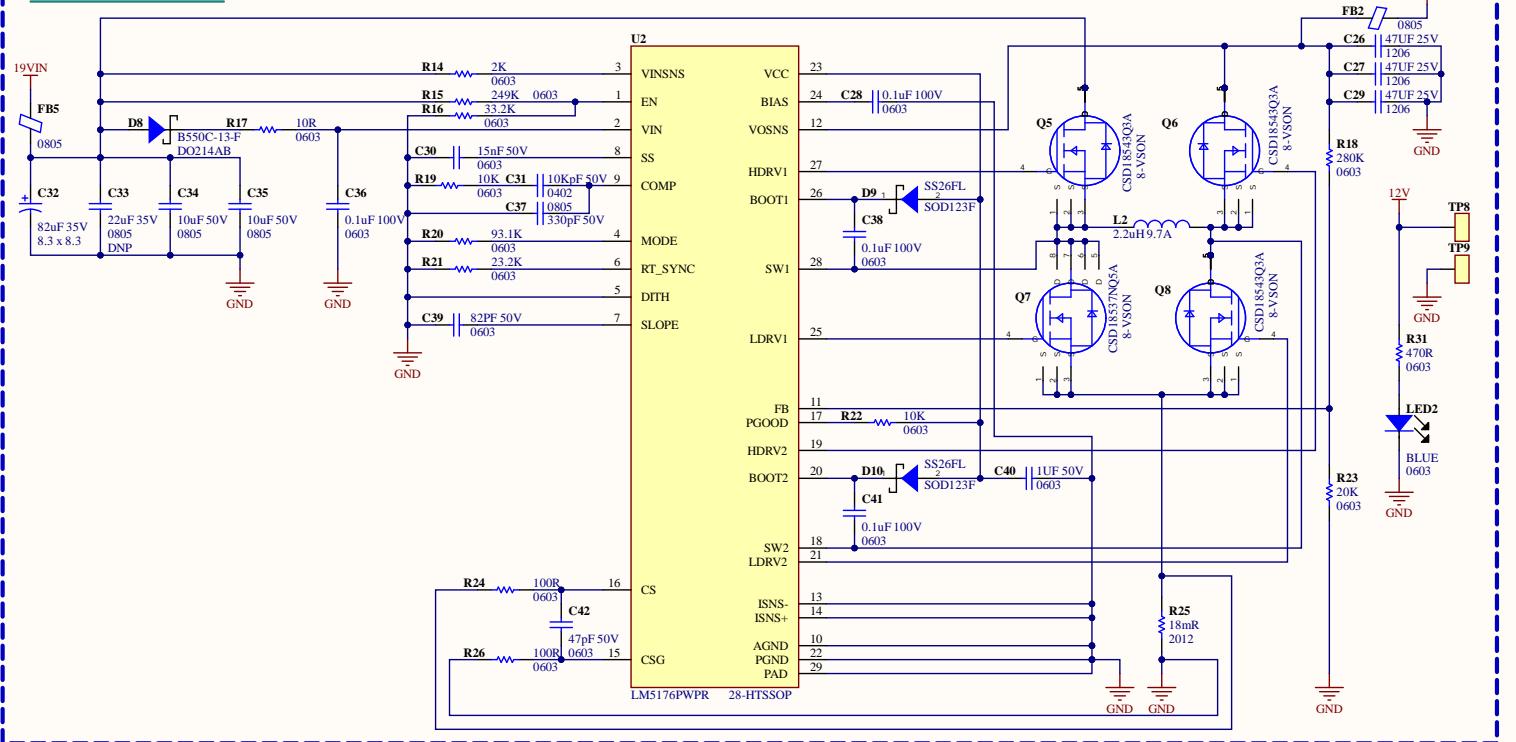
**AMBIMAT  
ELECTRONICS**

TITLE: Power Supply - 2: 11V-22 to 19V

Document Number: **SCH\_AE170**

26-03-2024 | Rev: 02.04 | Sheet: 3 of 6

11.1V - 22V to 12V



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Design By:

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TITLE: Power Supply - 2; 11V-22 to 12V

Document Number: **SCH\_AE170**

26-03-2024 | Rev: 02.04 | Sheet: 4 of 6



## F1Tenth Power Board User Manual for V02.04

### SWITCHES

- There are two switches on the Power Board namely SW1 and SW2
- Their use cases are as follows:
  - SW1 – Selection for VJACK (Wall Adapter) and VBAT (Battery Powered)
  - SW2 – Power ON and OFF
- When the Power Board is OFF using SW2 the position of the SW1 will be immaterial to the circuit.

### CONNECTORS:

- Input Side
  - J9: Battery Connector/Socket
  - J10: DC Power Jack from the wall socket or Battery connector

Please note J10 can also take in input from a battery connector and with no changes to the other parts of the board will work as is.

- Output Side
  - J1: 12VDC output (at suggested current)
  - J2: 12VDC output (at suggested current)
  - J3: 5VDC output (at suggested current)
  - J4: 5VDC output (at suggested current)
  - J5: 12VDC output (at suggested current)
  - J6: 12VDC output (at suggested current)
  - J7: 19VDC output (at suggested current)

Please note that across **all output connectors put together** the total rated maximum current that can be drawn is as follows:

- 19VDC max current 4A
- 12VDC max current 2A
- 5VDC max current 1A



Various scenarios of the switch are explained below:

Scenario 1: Power Board OFF and SW1 is set up to take Power from the DC Power Jack



Scenario 2: Power Board ON and SW1 is set up to take Power from the DC Power Jack



Scenario 3: Power Board ON and SW1 is set up to take Power from the Battery



Sr.#	Quantity	Designator	Description	PCB Footprint	Manu Part Number	Manufacturer	Vendor-1	Vendor-1 Part Number	Vendor-2	Vendor-2 Part Number
1	12	C1, C11, C19, C21, C24, C28, C36, C38, C41, C43, C45, C49	CAP CER 0.1UF 100V X7R 0603	0603	CC0603KRX7R0BB104	YAGEO	DIGIKEY	311-1523-1-ND	MOUSER	
2	8	C2, C3, C6, C7, C34, C35, C44, C48	CAP CER 10UF 50V X5R 0805	0805	GRM21BR11H100KE43	Murata Electronics	DIGIKEY	490-18663-1-ND	FARNELL	
3	3	C4, C5, C8	CAP CER 1000PF 50V X7R 0603	0603	CC0603KRX7R9BB103	Yageo	DIGIKEY	311-1572-1-ND	FARNELL	
4	11	C9, C10, C12, C17, C18, C26, C27, C29, C51, C52, C53	CAP CER 47UF 25V X5R 1206	1206	C3216X5R1E476M160A	TDK Corporation	DIGIKEY	445-8047-1-ND	FARNELL	
5	2	C13, C30	CAP CER 0.015UF 50V X7R 0603	0603	CL108153K88NNNC	Samsung Electro-Mechanics	DIGIKEY	1276-1277-1-ND	FARNELL	
6	1	C14	CAP CER 6800PF 50V X7R 0603	0603	AC0603KRX7R9BB88Z	YAGEO	Digikey	13-AC0603KRX7R9BB88ZCT-ND	Element14	
7	2	C15, C32	CAP ALUM POLY 82UF 20% 35V SMD	8.3 x 8.3	35SVPF82N	Panasonic	DIGIKEY	P16562C2T-ND	FARNELL	
8	1	C20	CAP CER 100PF 50V COG/NPO 0805	0805	08055A10JAT2A	AVX Corporation	DIGIKEY	478-1316-1-ND	FARNELL	
9	1	C22	CAP CER 270PF 50V X7R 0603	0603	CC0603KRX7R9BB271	Yageo	Digikey	311-1185-1-ND	Element14	
10	2	C23, C40	CAP CER 1UF 50V X7R 0603	0603	CC0603KRX7R9BB105	Yageo	DIGIKEY	311-2082-1-ND	FARNELL	
11	2	C25, C42	CAP CER 47PF 50V X7R 10% 0603	0603	C0603C470K5RA7C87	KEMET	DIGIKEY	399-16402-1-ND	FARNELL	
12	1	C31	CAP CER 1000PF 50V X7R 0402	0402	CGA2B3X7R1H103K050B8	TDK Corporation	DIGIKEY	445-693-1-ND	FARNELL	
13	1	C37	CAP CER 330PF 50V COG/NPO 0805	0805	CC0805JRNPF09BN331	YAGEO	Digikey	311-1117-1-ND	Element14	
14	1	C39	CAP CER 82PF 50V COG/NPO 0603	0603	CC0603JRNPF09BN820	Yageo	DIGIKEY	311-1068-1-ND	FARNELL	
15	1	C46	CAP CER 47PF 50V COG/NPO 0402	0402	CL05C470J85NNNC	Samsung Electro-Mechanics	DIGIKEY	1276-1699-1-ND	FARNELL	
16	1	C47	CAP CER 47UF 16V X5R 1210	1210	GRM32ER81C476K15L	Murata Electronics	DIGIKEY	490-6539-1-ND	FARNELL	
17	1	C50	CAP CER 0.033UF 10V X7R 0402	0402	GRM155R71A333KA01D	Murata Electronics	DIGIKEY	490-1315-1-ND	FARNELL	
18	2	D1, D3	DIODE SCHOTTKY 50V 5A SMA	D0214AB	B550C-13-F	Diodes Incorporated	DIGIKEY	B550C-FD1CT-ND	MOUSER	
19	2	D2, D4	TVS DIODE 20WMM 32.4VC DO214AC	DO214AC	SMAJ20CA	Littelfuse Inc.	DIGIKEY	SMAJ20CALFCFT-ND	MOUSER	
20	2	D5, D8	DIODE SCHOTTKY 50V 5A SMA	D0214AB	B550C-13-F	Diodes Incorporated	DIGIKEY	B550C-FD1CT-ND	MOUSER	
21	4	D6, D7, D9, D10	DIODE SCHOTTKY 60V 2A SOD123F	SOD123F	SS26FL	onsemi	DIGIKEY	SS26FLCT-ND	MOUSER	
22	6	FB1, FB2, FB3, FB4, FB5, FB6	FERRITE BEAD 120 OHM 0805 1LN	0805	ABUJP02021209121Y00	Pulse Electronics	Digikey	553-ABUJP02021209121Y00CT-ND		
23	1	J1	CONN HEADER SMD 4P 2MM	HEADER-4P_2.0MM	B4B-PH-SM4-TB	JST Sales America Inc.	DIGIKEY	455-B4B-PH-SM4-TBCT-ND	FARNELL	sunrom 6334
24	1	J2	CONN HEADER SMD 6POS 1MM	HEADER 6P	BM06B-SRSS-TB	JST Sales America Inc.	DIGIKEY	455-BM06B-SRSS-TBCT-ND	FARNELL	
25	4	J3, J4, J5, J6	EURO BLOCK 2P	HEADER-2P_3.5MM	EBWA-02-A	Adam Tech	DIGIKEY	2057-EBWA-02-A-ND	FARNELL	
26	2	J7, J10	CONN PWR JACK 2.5X5.5MM SOLDER	TH 3P	PJ-050BH	CUI Inc	DIGIKEY	CP-050BH-ND	FARNELL	sunrom 7070
27	1	J8	CONN HEADER 9P 2.54MM	1x9 2.54MM HEADER			DIGIKEY			Local
28	1	J9	CONN HEADER VERT 4POS 2.5MM	HEADER-4P_2.5MM	B4B-XH-A	JST Sales America Inc.	DIGIKEY	455-B4B-XH-A-ND	FARNELL	sunrom 5225
29	1	L1	FIXED IND 3.3UH 14A 8.2 MOHM SMD	8479	744340330	Würth Elektronik	Digkey	732-2165-1-ND		
30	1	L2	FIXED IND 2.2UH 9.7A 14.5MOHM SM	5553	SRP5030CA-2R2M	Bourns Inc.	Digkey	SRP5030CA-2R2MCT-ND		
31	1	L3	FIXED IND 10UH 5A 21 MOHM SMD	12.7 X 12.7	SRR1208-100ML	Bourns Inc.	Digkey	SRR1208-100MLCT-ND	MOUSER	
32	3	LED1, LED2, LED3	LED BLUE CLEAR 3MM 470NM	0603	LB Q395-LZN2-35-1	OSRAM Opto Semiconductors Inc	DIGIKEY	475-2816-1-ND	FARNELL	165210
33	2	Q1, Q2	MOSFET N-CH 30V 22A 6SON	6-SON	CSD1751702	Texas Instruments	DIGIKEY	296-37193-1-ND		
34	2	Q3, Q7	MOSFET N-CH 60V 50A 8VSON	8-VSON	CSD18537N05A	Texas Instruments	DIGIKEY	296-36455-1-ND		
35	1	Q4	MOSFET N-CH 100V 14.4A 6WSON	6-SON	CSD1953802	Texas Instruments	DIGIKEY	296-47322-1-ND		
36	3	Q5, Q6, Q8	MOSFET N-CH 60V 60A 8VSON	8-VSON	CSD18543Q3A	Texas Instruments	DIGIKEY	296-47321-1-ND		
37	2	R1, R14	RES SMD 2K OHM 5% 1/10W 0603	0603	ERJ-3CEYJ202V	Panasonic	DIGIKEY	P2.0KGCT-ND	FARNELL	
38	2	R2, R15	RES SMD 249K OHM 1% 1/10W 0603	0603	AC0603FR-07249KL	Yageo	DIGIKEY	13-AC0603FR-07249KLCT-ND	FARNELL	
39	1	R3	RES 42.2K OHM 1% 1/10W 0603	0603	RC0603FR-07424KL	Yageo	DIGIKEY	311-42.2KHRC7-ND	FARNELL	
40	2	R4, R17	RES SMD 10 OHM 1% 1/10W 0603	0603	CRCW060310RFKEA	Vishay Dale	DIGIKEY	541-10.0HCT-ND	FARNELL	
41	1	R5	RES 43K OHM 1% 1/10W 0603	0603	RC0603FR-07453KL	Yageo	DIGIKEY	311-453KHRC7-ND	FARNELL	
42	5	R6, R9, R19, R22, R28	RES SMD 10K OHM 5% 1/10W 0603	0603	RC0603JR-0710KL	Yageo	DIGIKEY	311-10KGRC7-ND	FARNELL	
43	2	R7, R20	RES 93.1K OHM 1% 1/10W 0603	0603	RC0603FR-0793K1L	YAGEO	DIGIKEY	311-93.1KHRC7-ND	FARNELL	
44	2	R8, R21	RES 23.2K OHM 1% 1/10W 0603	0603	RC0603FR-0723K3L	YAGEO	DIGIKEY	311-23.2KHRC7-ND	FARNELL	
45	2	R10, R23	RES SMD 20K OHM 5% 1/10W 0603	0603	CRCW060320KJNEA	Vishay Dale	DIGIKEY	541-20KGCT-ND	FARNELL	
46	4	R11, R13, R24, R26	RES SMD 100 OHM 1% 1/10W 0603	0603	CRCW0603100RFKEA	Vishay Dale	DIGIKEY	541-100HCT-ND	FARNELL	
47	1	R12	RES 0.01 OHM 1% 2512	2512	PA2512KE770R01E	YAGEO	DIGIKEY	13-PA2512KE770R01ECT-ND	FARNELL	
48	1	R16	RES SMD 33.2K OHM 1% 1/10W 0603	0603	ERJ-3EKF3322V	Panasonic Electronic Components	DIGIKEY	P3.2KHCT-ND	FARNELL	
49	1	R18	RES SMD 280K OHM 1% 1/10W 0603	0603	CRCW0603280KFKEA	Vishay Dale	DIGIKEY	541-280KHCT-ND	FARNELL	
50	1	R25	RES 0.018 OHM 1W 1206 WIDE	2012	PRL1632-R018-F-T1	Susumu	DIGIKEY	PRL1632-018FCT-ND	FARNELL	
51	1	R27	RES 62.3K OHM 1% 1/10W 0603	0603	RC0603FR-0752K3L	YAGEO	DIGIKEY	311-52.3KHRC7-ND	FARNELL	
52	3	R30, R31, R32	RES 470 OHM 1W 10% 0603 SMD	0603	RC0603JR-07470RL	YAGEO	DIGIKEY	311-470GRCT-ND	MOUSER	
53	2	SW1, SW2	SWITCH TOGGLE SPDT 7.5A 125V	E101SY2QE	E101SY2QE	C&K	DIGIKEY	CKN1519-ND	MOUSER	
54	2	U1, U2	LMS176WPWR	28-HTSSOP	LMS176WPWR	Texas Instruments	DigiKey	296-49223-1-ND	Element14	
55	1	U3	IC REG BUCK ADJ 2A SOT583	SOT-583	TPS62932DRRLR	Texas Instruments	DigiKey	296-TPS62932DRRLRCT-ND	MOUSER	