

F1Tenth Power Board v2024.1

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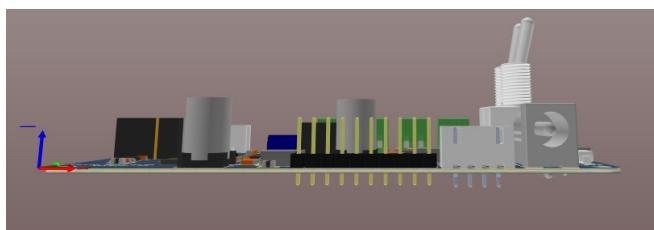


Figure 1: PCB side view

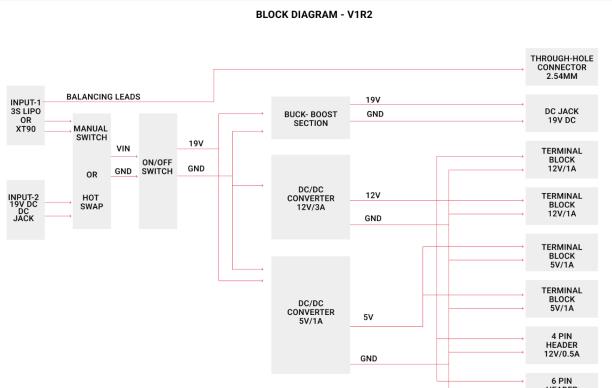
General Description

1

This is the power distribution board for the F1TENTH autonomous vehicles.

2 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



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Figure 2: Block Diagram

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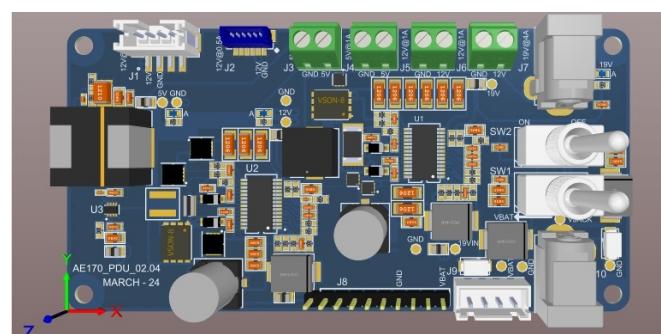


Figure 3: PCB top view

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. The original documents are available as well. 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](#)
- Bill of Materials:
 - [Datasheet Bill of Materials Section](#)
 - [XLSX](#) (note: the datasheet version is zoomed out so this may be easier to view)
- Mechanical Drawing:
 - [Datasheet Mechanical Drawing Section](#)
 - [DXF](#)
 - [PDF](#)
- Gerber Files
 - (only original files available)
 - [ZIP](#)

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

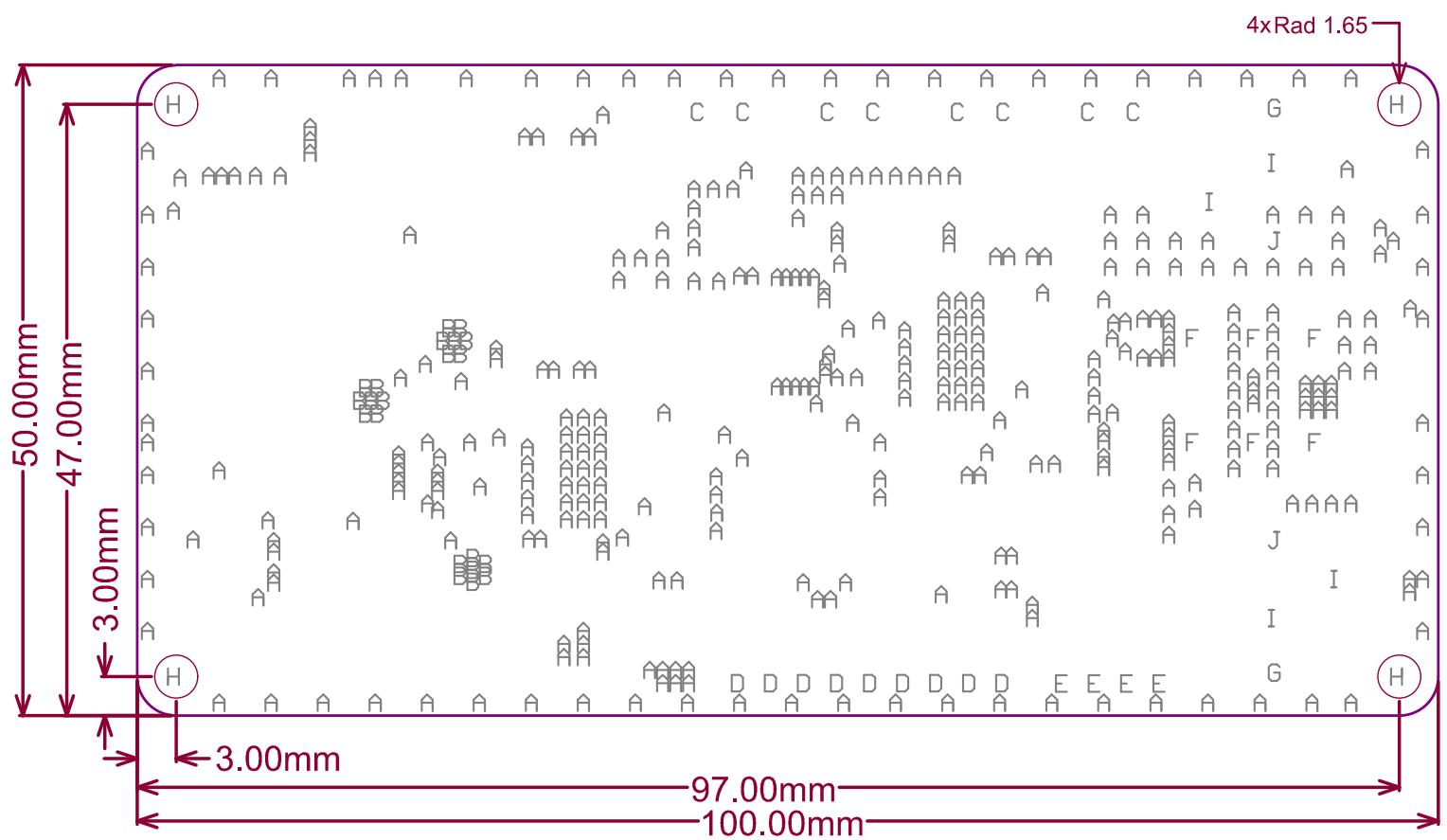
Table 2: Electrical Output Specifications

Parameter	Voltage	Min.	Typ.	Max.	Unit	Notes
DC Jack Output	19V		2	4	A	Powers the Jetson Orin Nano
B4B-PH-SM4-TB ¹	12V		0.5		A	4-pin header for HOKUYO 30LX LIDAR
BM06B-SRSS-TB ¹	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	

¹ Only the power pins are connected - other lines left unconnected.

Table 3: Size Specifications

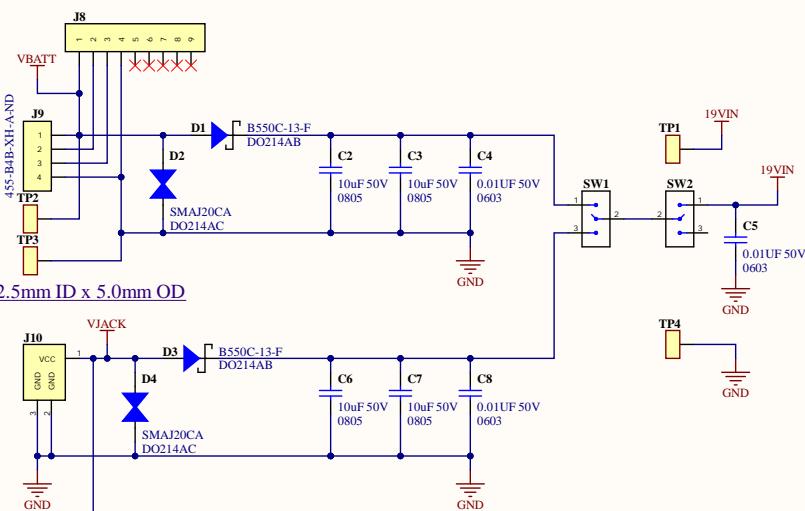
Parameter	Value	Unit
Length	100	mm
Width	50	mm
Height	28.81	mm



1	2	3	4
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Power Supply input and selection switch

Balancing Leads



2.5mm ID x 5.0mm OD

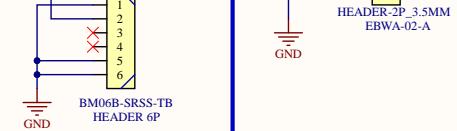
Jetson Orin Nano Devkit

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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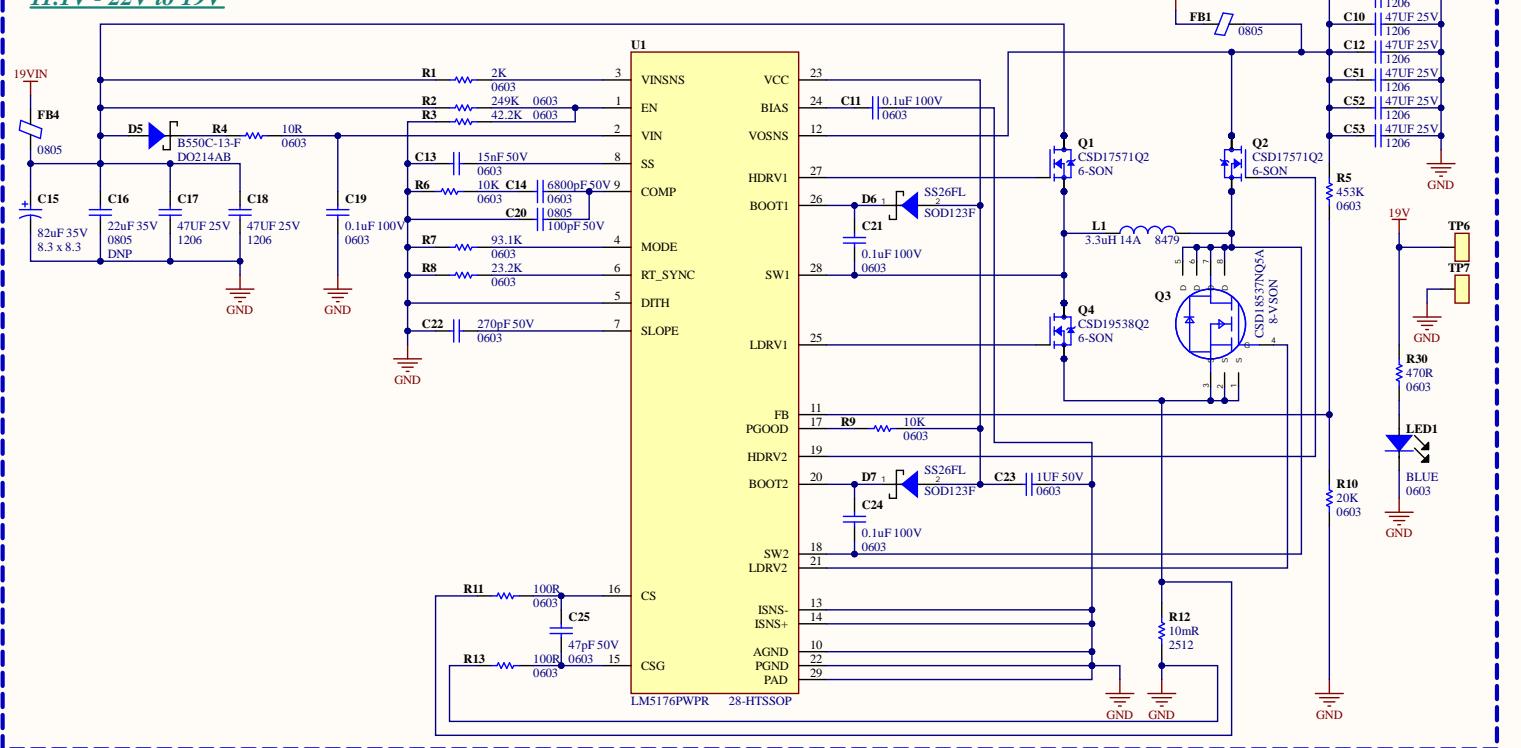
1	2	3	4
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2

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4

11.1V - 22V to 19V



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Design By:

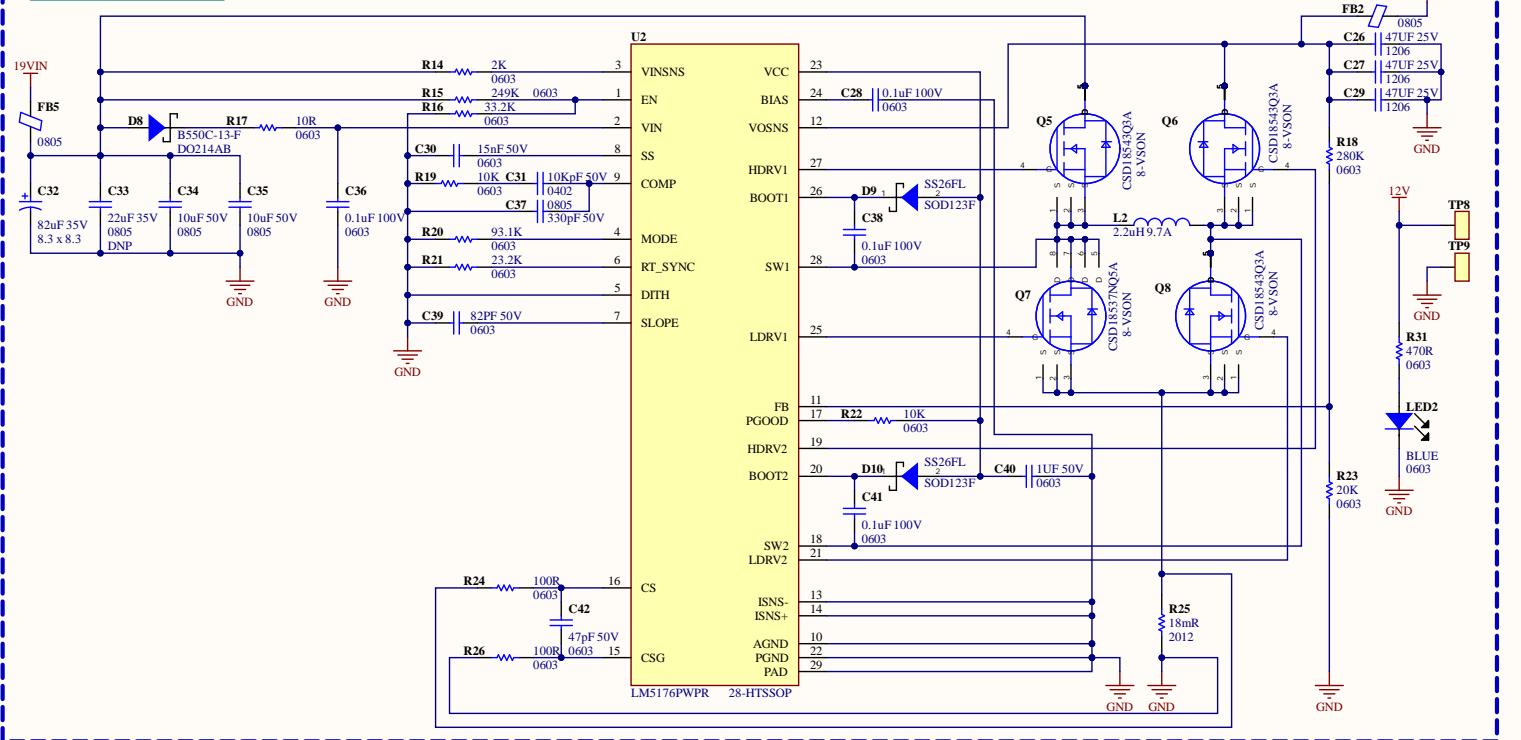
**AMBIMAT
ELECTRONICS**

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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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	