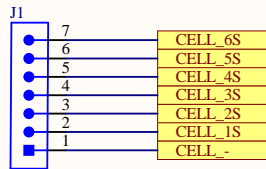
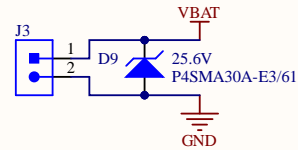


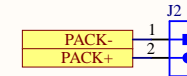
Battery Balancing



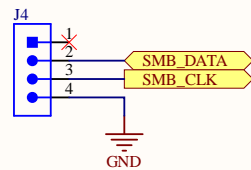
Battery In



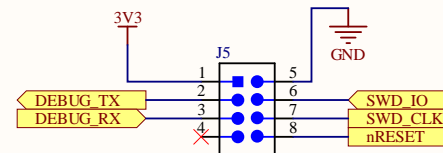
Pack Out



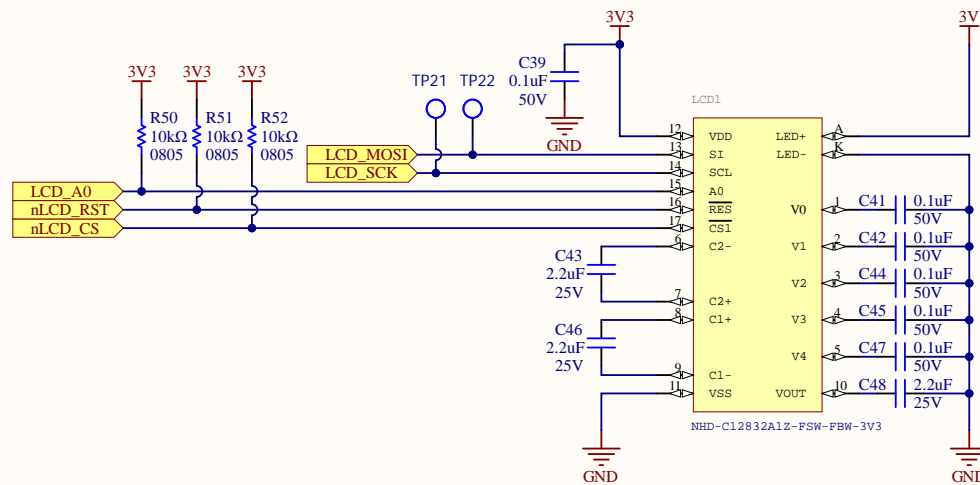
EV2400



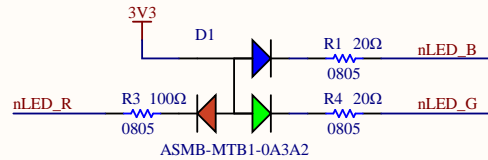
Debug/Programing



LCD



Test LEDs

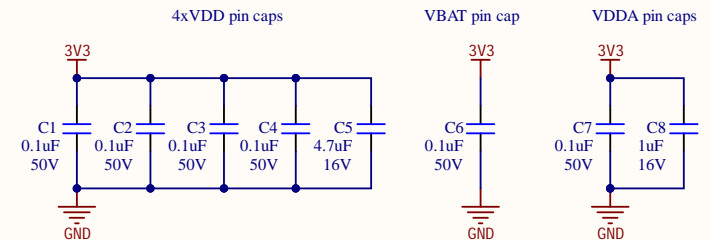


Current Calculations

Green LED voltage drop: 2.2V
 $I = (3.3 - 2.2V) / 100 = 11mA$

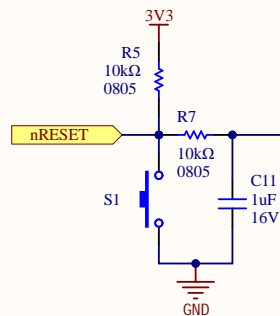
RGB LED voltage drops:
 - Red: 2.1V: $I = (3.3 - 2.1V) / 100 = 12mA$
 - Blue: 3.1V: $I = (3.3 - 3.1V) / 20 = 10mA$
 - Green: 3.1V: $I = (3.3 - 3.1V) / 20 = 10mA$

Decoupling Caps

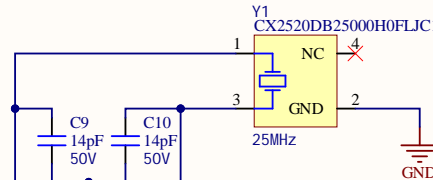


STM32F446RET6

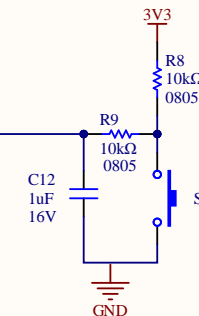
Reset Button



For Debounce Circuit:
 $T = RC \rightarrow C = T/R$
 $C = 10ms / 10kOhms = 1\mu F$



Test Button



For Debounce Circuit:
 $T = RC \rightarrow C = T/R$
 $C = 10ms / 10kOhms = 1\mu F$

GND Test Point



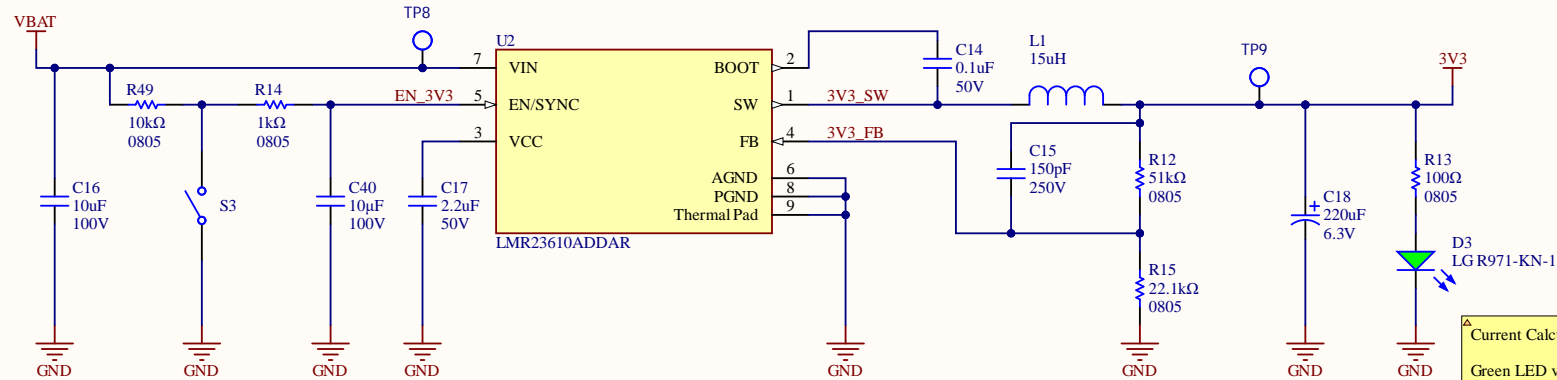
Battery Voltage to 3V3 Buck @ 1A Max

Designed for 15V-25.2V input

Route for 0.5A in

Inductor: SRN6045-150M
15uH, 20%, 95.8mOhm DCR (max)
1.9A (rms), 2.3A (sat), 4.5mm tall

Route for 1A out



For Debounce Circuit:

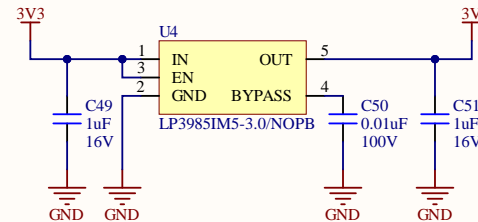
$T=RC \rightarrow C= T/R$
 $C= 10ms/1kOhms= 10uF$

Current Calculations

Green LED voltage drop: 2.2V
 $I = (3.3-2.2V)/100 = 11mA$

Max expected power on output = 1.65W
Max current = 0.5A
Expected Efficiency at 1A > 87.7%

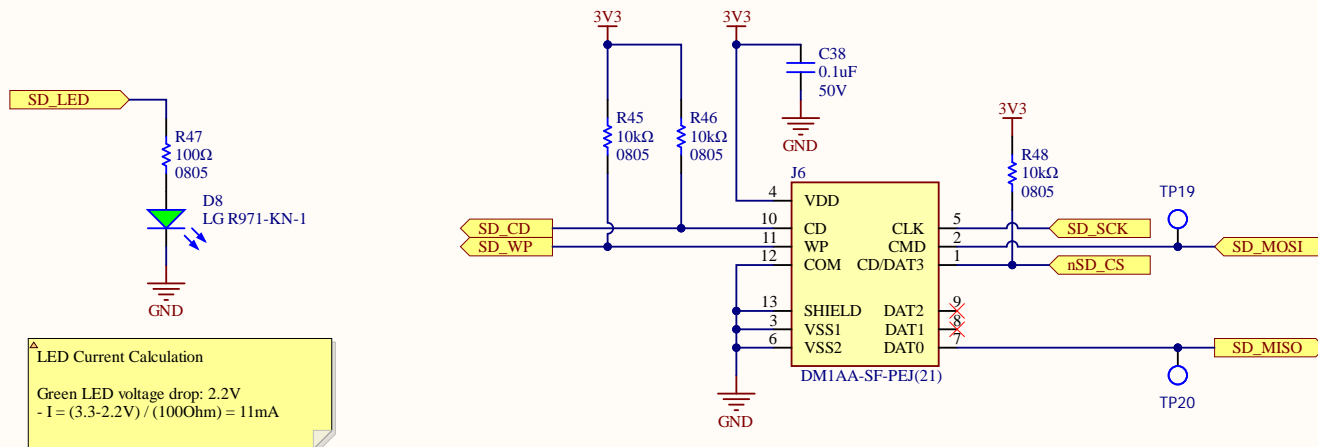
3V3 to 3V LDO @ 150mA Max

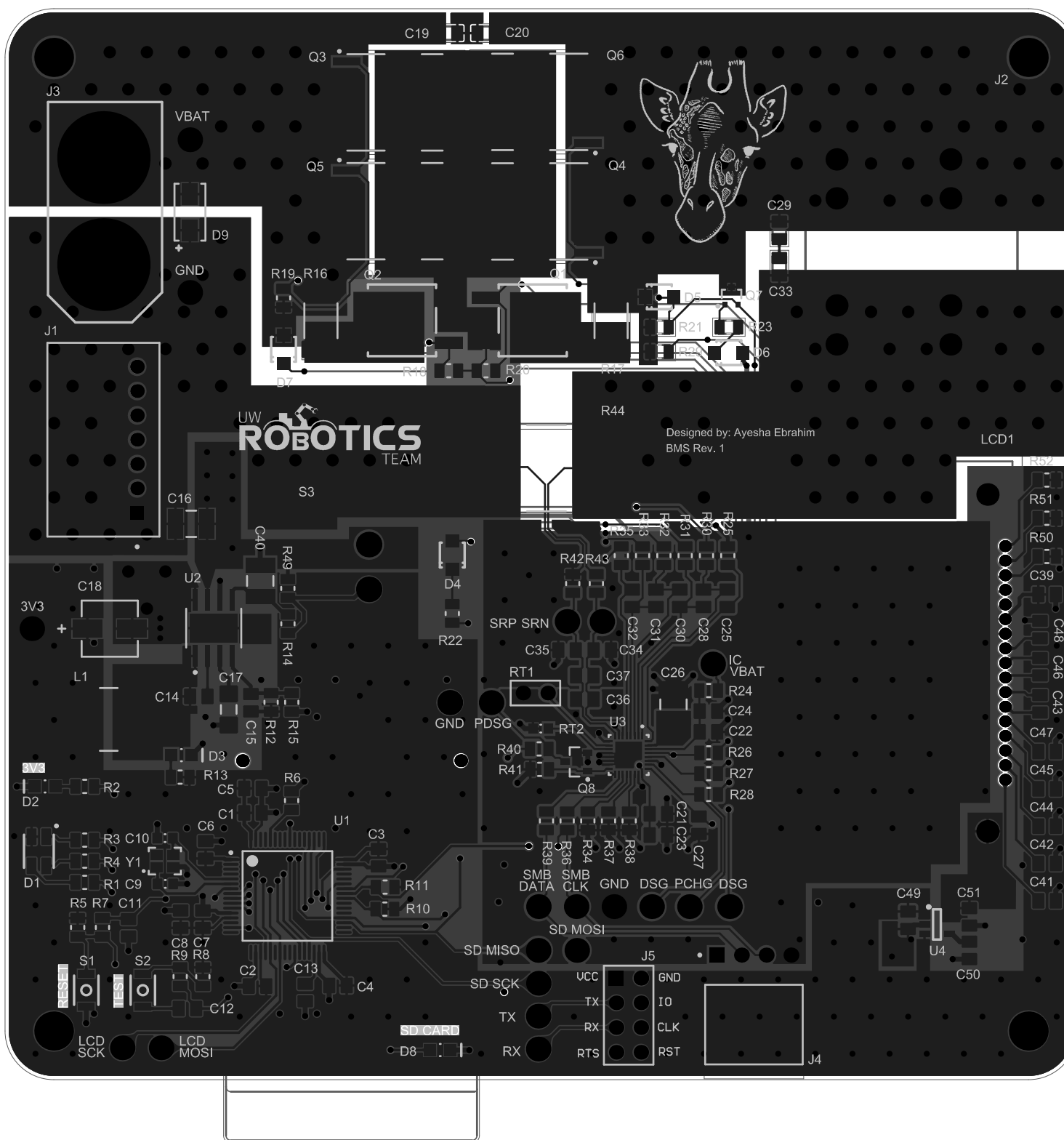


Title	Power
Size: Letter	Drawn By: Ayesha Ebrahi m
Date: 2020-08-11	Sheet 5 of 6
File: C:\Users\ayesh\Documents\GitHub\MarsRover2020-PCB\Projects\Battery Management System\Rev1\SH1 - POWER.Sch	



SD Card Connector





Description	Designator	Footprint	Libref	Quantity	Manufacturer 1	Manufacturer Part Number 1	Supplier Part Number 1	Supplier 1
CAP CER 0.1UF 50V X7R 0805		CAP2012X140N	CAP_0.1uF_50V_0805	2	Murata Electronics	GC0218B71H1046 A01L	490-11955-1-ND	Digi-Key
CAP CER 1UF 16V X7R 0805		CAPC2012X140N	CAP_1uF_16V_0805	5	Fagor	C108050007R788 205	311-1365-1-ND	Digi-Key
Cap Ceramic 14pF 50V DC 5% SMD 0603 155C Carbonoid TFR	C9, C10	CAPC0603160B05_N	C110C14088NNVC	2	Samsung	C110C14088NNVC	1276-2187-1-ND	Digi-Key
CAP CER 4.7UF 16V X5R 0805	C13	CAPC2012X140N	CAP_4.7uF_16V_0805	1	Samsung Electro-Mechanics	C121A473K05NN NE	1276-1066-1-ND	Digi-Key
CAP CER 100PF 250V C0G NPO 0805	C15	CAPC2012X140N	CAP_100pF_250V_0805	5	Murata Electronics	GRM031A0C21511 W01D	490-12755-1-ND	Digi-Key
CAP CER 100UF 100V K75 1210 CAP CER 1uF 100V K75 10% 1210	C16, C40	CAPC1210C3225	CAP_10uF_100V_1210	1	Murata Electronics	GRM031C72A1006 B05L	490-16266-2-ND, 490-16266-1-ND	Digi-Key
CAP CER 2.2UF 50V X7R 1206	C17	CAPC1206C3216	CAP_2.2uF_50V_1206	1	Murata Electronics	CGM3130R714025 W05L	490-4796-1-ND	Digi-Key
CAP ALUM POLY 220uF 20% 6.3V 3MAD	C18	PCAP_SVP_B6_P0403	CAP_220uF_6.3V_3MAD	1	Panasonic Electronic Components	65VFC220MM	F1683ACT-ND	Digi-Key
CAP CER 100PF 50V C0G NPO 0805	C21, C22, C23, C24, C25 NPO 0805	CAPC2012X140N	CAP_100pF_50V_0805	5	KEMET	C0805C1015GAC TU	399-1122-1-ND	Digi-Key
CAP CER 2.2UF 100V X7R 1210	C26	CAPC1210C3225	CAP_2.2uF_100V_1210	1	Taiyo Yuden	FRMC22B7225MM GP	583-5396-1-ND	Digi-Key
CAP CER 10000PF 100V X7R 0805	C27, C30	CAPC2012X140N	CAP_0.01uF_100V_0805	2	KEMET	C0805C030R18AC TU	399-1105-1-ND	Digi-Key
CAP CER 2.2UF 25V X7R 0805	C43, C44, C48	CAPC2012X140N	CAP_2.2uF_25V_0805	1	Murata Electronics	GRM030B70225W A73L	490-3331-2-ND	Digi-Key
LED RGB DIFFUSED 4000K SMD	D1	LED_RGB	LED_RGB	1	Broadcom	ASMB-MT181-8A343	516-3280-1-ND	Digi-Key
LED GREEN DIFFUSED 3805 SMD	D2, D3, D8	LED_0805_LINE	WIO_LED_G	3	OSRAM	LC-RW71-KN-1	475-1410-1-ND	Digi-Key
DIOCE SCHOTTKY 40V 500MA S01213	D4, D7	S0D_123_FLAT	DIO_SCHOTTKY_40V_500mA	1	Diodes Incorporated	805-40W-7-F	805-40W-FDTR-ND	Digi-Key
DIOCE XLNIR 14V 500MA S01213	D5	S0D_123_FLAT	DIO_ZENER_14V	1	Diodes Incorporated	MM5ZC246B-7-F	MM5ZC246B-FDTR-ND	Digi-Key
DIOCE GEN PUMP 10V 300MA S01213	D6	S0D_123_FLAT	DIO_10V_300mA	1	Diodes Incorporated	1M4148W-7-F	1M4148W-FDCT-ND	Digi-Key
1%5 DIODE 400W 25.4V UNL DO-214AC	D9	DO_214AC_UNI	PHSMA30A-E3/G1	1	Infineon Semiconductors	PHSMA30A-E3/G1	PHSMA30A-E3/G1GCT-ND	Digi-Key
CONN HEADER RH SIDE 25PIN 2.54MM	J1	857_57B-W-A07300	CON_7M_1TH_8A	1	ST Sales America Inc.	57B-W-A07300	455-2240-ND	Digi-Key
CONN 10MM BLOCK 2POS 15MM 1.18MM 1.18MM	J2	MOLEX-0399200302	SCREW_TERM_115A	1	Molex	0399200302	MM020114-ND	Digi-Key
HIGH QUALITY GOLD PLATED XTAL 32.768KHZ	J3	XT90	XT90	1	DFRobot	XT10588	1738-1438-ND	Digi-Key
CONN HEADER R/A 25PIN 2.54MM	J4	MOLEX-22-05-3041_V	CON_4M_1TH_8A	1	Molex	22-05-3041	MM4302-ND	Digi-Key
CONN HEADER VERT 8POS 2.54MM	J5	HEADER_204	HEADER_4X2	1	Horwin Inc.	M09-P08046	493-2122-ND	Digi-Key
12, 2+2, Position Card Connector Secure Digital - SD Surface Mount, Right Angle Gold	J6	MSD_DMTAA-SF-PE121	SD_CARD_CON	1	Hirose Electric Co Ltd	DMTAA-SF-PE121	W845CT-ND	Digi-Key
FIXED IND 150H 1.9A 1% BROADWAVE SMD	L1	IND_BOURNES_SMD45	IND_15uH_1.9A	1	Bourns Inc.	SRN045-150M	SRN045-150MCT-ND	Digi-Key
LED COG GRAMIC 128X32	LED1	NH4C-12832A12FSW-BW-V3	NH4C-12832A12FSW-BW-V3	1	Newhaven Display Inc.	NH4C-12832A12FSW-BW-V3	NH4C-12832A12FSW-BW-V3GCT-ND	Digi-Key
6cm x 6cm	MH1, MH2, MH3, MH4	MOUNTING_HOLE	MOUNTING_HOLES	4				
MOSET P-CH 40V 40A TO252	Q1, Q2	Q-PAK	PMOS_40V_40A	1	Alpha & Omega Semiconductor Inc.	AOCD4189	785-1351-1-ND	Digi-Key
MAX7219 I2C 100V 210A POWER160	Q3, Q4, Q5, Q6	6-HP50F	NMOS_120V_210A	1	ON Semiconductor	F08L0240N100	F08L0240N100CT-ND	Digi-Key
NMOS N-CH 40V 310mA SOT-23	Q7	SOT23	NMOS_40V_310mA	1	Wingate	2N7102BKW-115	1727-4788-1-ND	Digi-Key
NMOS N-CH 50V 200mA 1.2V DRIVE SOT-23	Q8	SOT23-3	NMOS_50V_200mA	1	Rohm Semiconductor	BUK0020N0540G116	BUK0020N0540G116CT-ND	Digi-Key
RES SMD 300OHM 1% 1/8W 0805	R1, R4	RES2012X60N	RES_200_0805	2	Fagor	RC0805FR-0720R	311-20-008CT-ND	Digi-Key
RES SMD 100 OHM 1% 1/8W 0805	R2, R3, R24, R25, R26, R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R39, R42, R43, R47	RES2012X60N	RES_1000_0805	14	Fagor	RC0805FR-07100R	311-1000CT-ND	Digi-Key
RES SMD 10K OHM 1% 1/8W 0805	R5, R6, R7, R8, R9, R22, R27, R34, R37, R38, R45, R46, R49, R50, R51, R52	RES2012X60N	RES_10K0_0805	17	Fagor	RC0805FR-0710K	311-10-0KCRCT-ND	Digi-Key
RES SMD 1K OHM 1% 1/8W 0805	R10, R11, R26, R28	RES2012X60N	RES_1K0_0805	4	Fagor	RC0805FR-071K	311-1-00KCRCT-ND	Digi-Key
RES SMD 51K OHM 1% 1/8W 0805	R12	RES2012X60N	RES_51K0_0805	1	Whitby Dale	CR080505100K-1A	441-51-0KCT-ND	Digi-Key
RES SMD 1K OHM 1% 1/8W 0805	R14	RES2012X60N	RES_1K0_0805	1	Fagor	RC0805FR-071K	311-1-00KCRCT-ND	Digi-Key
RES SMD 22 1K OHM 1% 1/8W 0805	R15	RES2012X60N	RES_22_1K0_0805	1	Whitby Dale	CR08050522K1FA	541-22-1KCT-ND	Digi-Key
RES 200 OHM 1% 1W 2512	R16, R17	RES06532X75N	RES_2000_2512	1	Stackpole Electronics Inc.	RMCT2512T200R	RMCT2512T200R-CT-ND	Digi-Key
RES SMD 10M OHM 1% 5W 1/8W 0805	R18, R19, R20, R21, R40, R41	RES2012X60N	RES_10M0_0805	6	Fagor	RC0805GR-0710M	311-10M0CT-ND	Digi-Key
RES SMD 510 OHM 1% 1/8W 0805	R22	RES2012X60N	RES_5100_0805	1	Fagor	RC0805FR-07105R	311-5100CT-ND	Digi-Key
RES SMD 1 1K OHM 1% 1/8W 0805	R29	RES2012X60N	RES_1_1K0_0805	1	Fagor	RC0805FR-071K1	311-1-10KCRCT-ND	Digi-Key
RES 0.001 OHM 1% 10W 5931	R44	RES-5931	RES_1m0_5931	1	Whitby Dale	WDL5931T1L000P-1A	441-10T12-1-ND	Digi-Key
THERMISTOR NTC 10K OHM 1% 300K BEAD	R71	480T02 - PTH	THERM_10K_FRT_1A	1	Murata	NMT150H10FA2-B100	490-5630-ND	Digi-Key
THERMISTOR NTC 10K OHM 0.002	R72	RES0603160B05_N	THERM_10K_0603	1	TDK	NTC1643F103F11	445-2564-1-ND	Digi-Key
Tactile Switch (Ergo)	S1, S2	B30-1000P	SW_TACTILE	1	Omron Electronics Inc-EMC Div	B30-1000P	SW1000CT-ND	Digi-Key
SWITCH SLIDE SPST 500mA (DC) 8.5A (AC) 120V	S3	GF123054	GF-123-054	1	CW Industries	GF-123-054	CW1233-ND	Digi-Key
Loop Endpoint through-hole pad		TESTPOINT_LOOP	TESTPOINT_LOOP	2	Keystone Electronics	5002	36-5002-ND	Digi-Key
ARM Cortex M4 32-bit MCU w/ 4KB Flash, 128KB Internal RAM, 50 I/Os, 64 Pins, LQFP -40 to 85 degC, Tray	U1	STM-LQFP44_L	MCU_STM32F446RET6	1			491-15376-ND	Digi-Key
IC REG BUCK ADJUSTABLE 1A BCPWR POWER	U2	B-SD PowerPad	BUCK_1-28VOUT_1A	1	Texas Instruments	LMR23610A0DAR	296-47267-1-ND	Digi-Key
MANAGEMENT IC: Battery Multi-Function Controller IC Lithium Ion Polymer 32 VCFN (4x4)	U3	BQ40Z08RSM	BATT_MANAGER	1	Texas Instruments	BQ40Z08RSM	296-BQ40Z08RSMCT-ND	Digi-Key
IC REG LINEAR 3V 150MA SOT23-5	U4	SOT23-5	LP3985MS-1/0NCP8	1	Texas Instruments	LP3985MS-1/0NCP8	LP3985MS-1/0NCP8R-ND	Digi-Key
CRYSTAL 25.0000MHz 12PF SMD	Y1	SCV25470T10A4404N	CRYSTAL_25MHZ	1	Epson America Inc	CXCS250025000H-01UC1	1253-1724-1-ND	Digi-Key