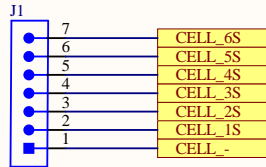
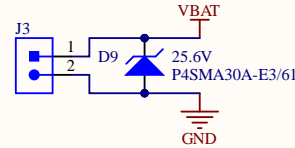


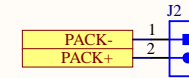
Battery Balancing



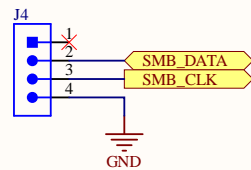
Battery In



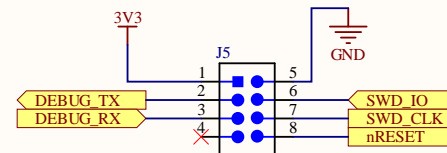
Pack Out



EV2400



Debug/Programing



Title Connectors

Size: Letter

Drawn By: Ayesha Ebrahim

Date: 2020-08-13

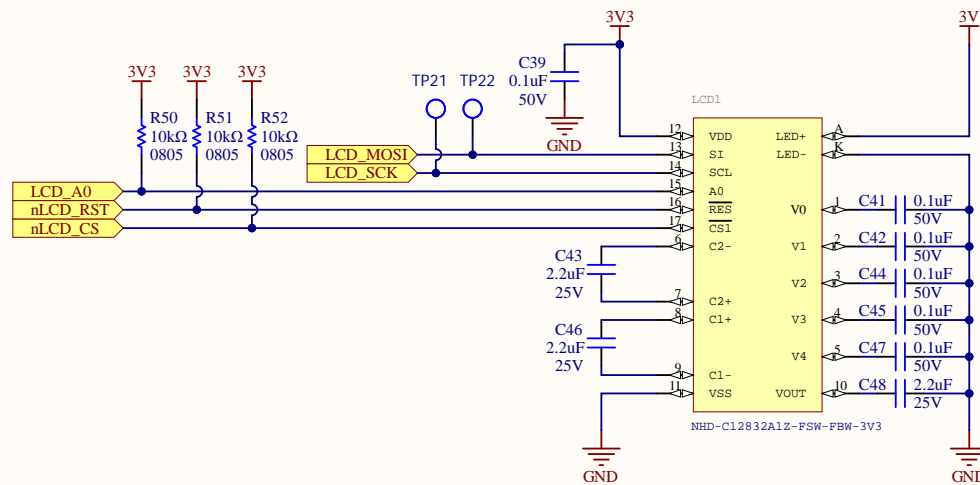
Sheet 2 of 6

File: C:\Users\ayesh\Documents\GitHub\MarsRover2020-PCB\Projects\Battery Management System\Rev1\SH2 - CONNECTORS

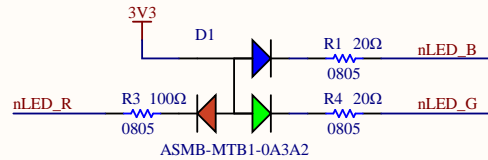
UW Robotics
200 University Avenue
Waterloo
Ontario
Canada N2L 3G6



LCD



Test LEDs

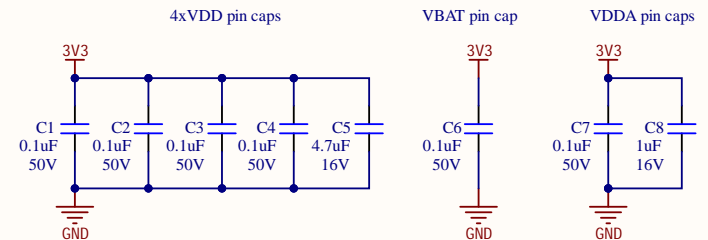


Current Calculations

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

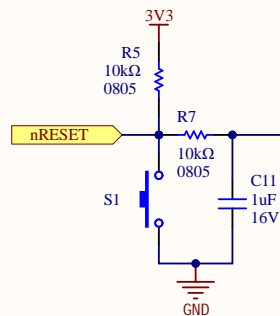
RGB LED voltage drops:
 - Red: 2.1V: $I = (3.3 - 2.1V) / 100 = 12mA$
 - Blue: 3.1V: $I = (3.3 - 3.1V) / 20 = 10mA$
 - Green: 3.1V: $I = (3.3 - 3.1V) / 20 = 10mA$

Decoupling Caps



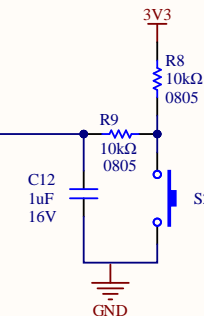
STM32F446RET6

Reset Button



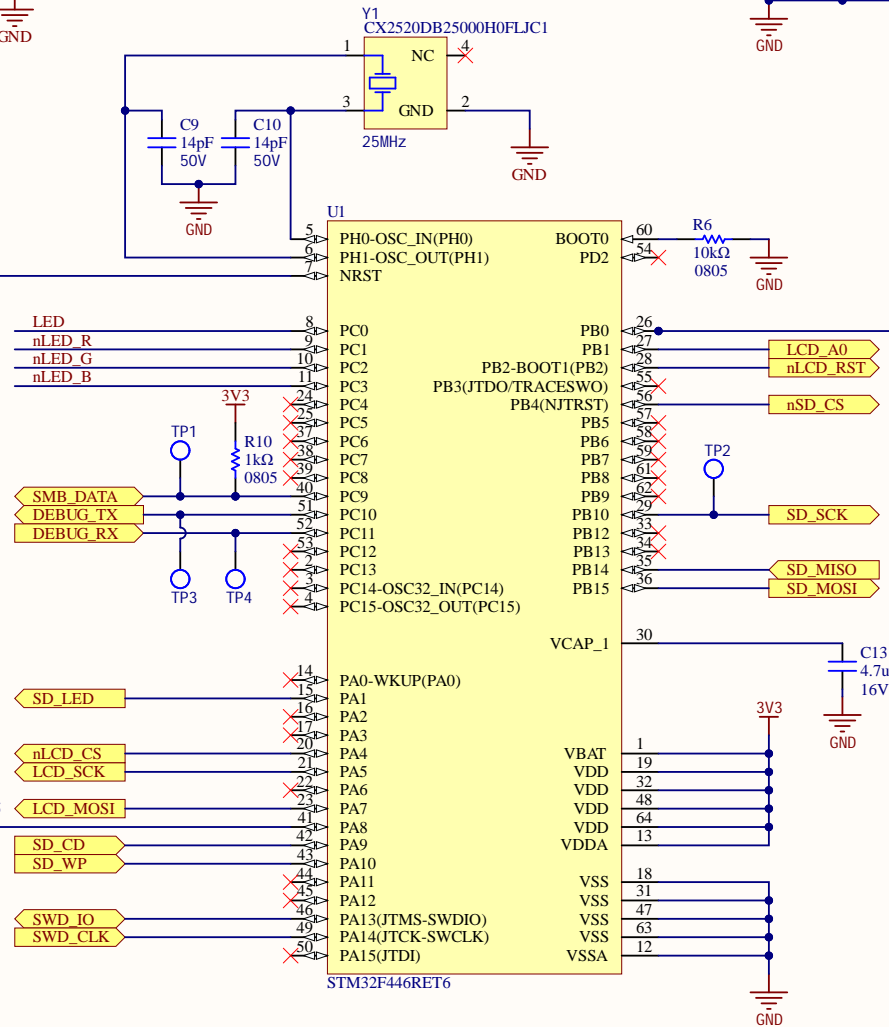
For Debounce Circuit:
 $T = RC \rightarrow C = T/R$
 $C = 10ms / 10kOhms = 1\mu F$

Test Button



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

GND Test Point



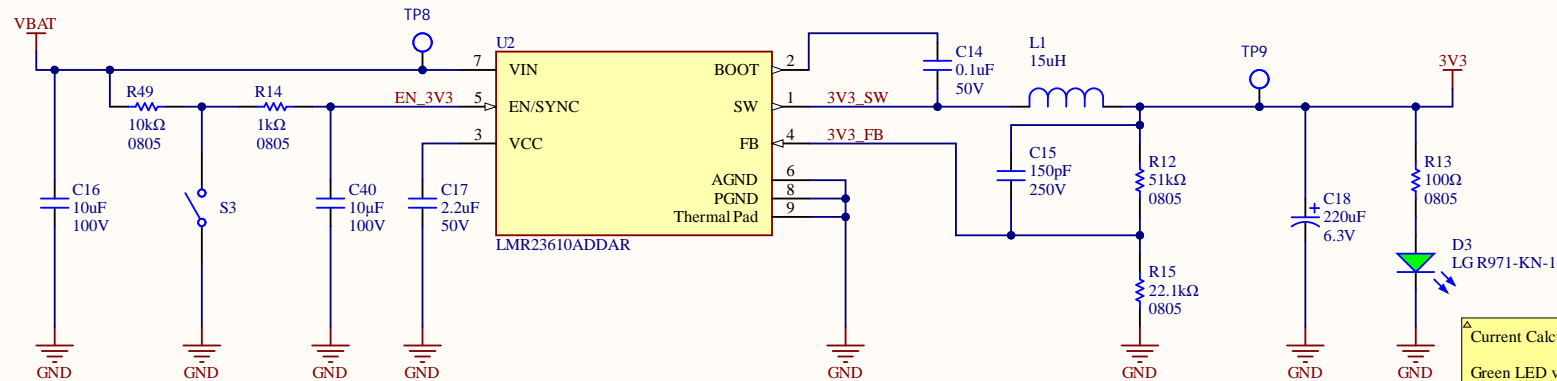
Battery Voltage to 3V3 Buck @ 1A Max

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:

$$T=RC \rightarrow C= T/R$$

$$C= 10ms/1kOhms= 10uF$$

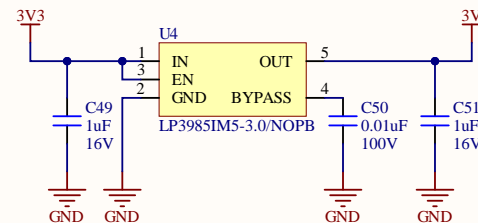
Current Calculations

$$\text{Green LED voltage drop: } 2.2V$$

$$I = (3.3-2.2V)/100 = 11mA$$

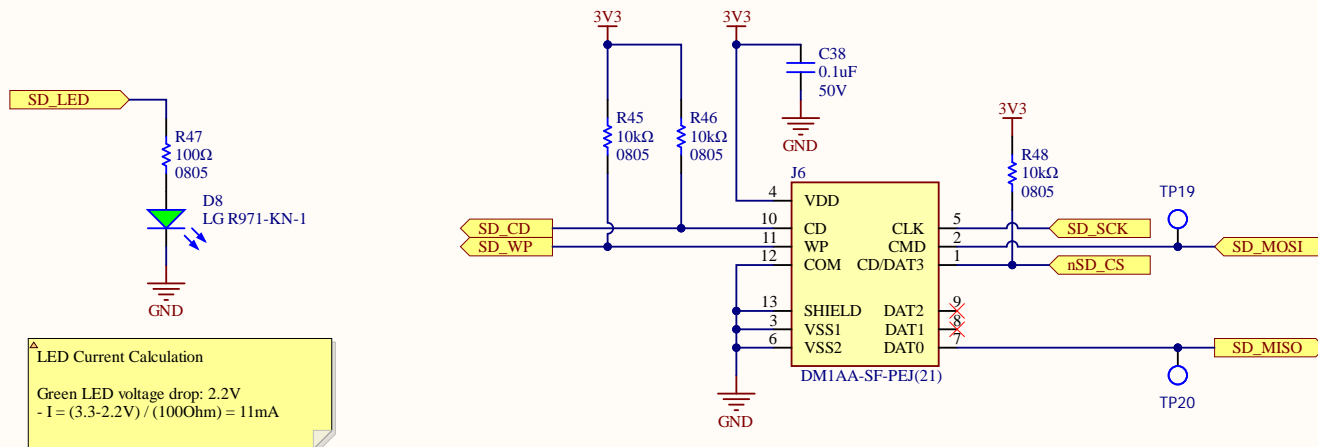
Max expected power on output = 1.65W
Max current = 0.5A
Expected Efficiency at 1A > 87.7%

3V3 to 3V LDO @ 150mA Max



Title	Power
Size: Letter	Drawn By: Ayesha Ebrahi m
Date: 2020-08-13	Sheet 5 of 6
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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			C1, C4, C7, C14, C19, C20, C24, C28, C29, C30, C31, C32, C33, C34, C35, C37, C38, C39, C41, C42, C44, C45, C47	2	Murata Electronics	GC0218B71H1046 A01L	490-11955-1-ND	Digi-Key	
CAP CER 1UF 16V X7R 0805			C8, C11, C12, C49, C51	5	Fagor	C108050007R788 205	311-1365-1-ND	Digi-Key	
Cap Ceramic 14pF 50V DCG 5% SMD 0603 155C Carbonated TFR			C9, C10	2	Samsung	CL10C14088NNNC	1276-2187-1-ND	Digi-Key	
CAP CER 4.7UF 16V X5R 0805	C13			1	Samsung Electro-Mechanics	CL21A473K05NN NE	1276-1066-1-ND	Digi-Key	
CAP CER 150PF 250V C0G NPO 0805	C15			1	Murata Electronics	GRM031A0C21511 W01D	490-12755-1-ND	Digi-Key	
CAP CER 100UF 100V K75 1210 CAP CER Tuf 100V K75 10% 1210	C16, C40			2	Murata Electronics, Murata	GRM030C12A100K 005L	490-16266-2-ND, 490-16266-1-ND	Digi-Key	
CAP CER 2.2UF 50V X7R 1206	C17			1	Murata Electronics	CGM3130R74025 6A55L	490-4796-1-ND	Digi-Key	
CAP ALUM POLY 220UF 20% 6.3V 3MAD	C18			1	Panasonic Electronic Components	65VFC220MM	F1683ACT-ND	Digi-Key	
CAP CER 100PF 50V C0G NPO 0805			C21, C22, C23, C24, C25, NPO 0805	5	KEMET	C0805C1015GAC TU	399-1122-1-ND	Digi-Key	
CAP CER 2.2UF 100V X7R 1210	C26			1	Taiyo Yuden	FRMC22B2225KM GP	583-5396-1-ND	Digi-Key	
CAP CER 10000PF 100V X7R 0805	C27, C30			2	KEMET	C0805C103R18AC TU	399-1105-1-ND	Digi-Key	
CAP CER 2.2UF 25V X7R 0805	C43, C46, C48			1	Murata Electronics	GRM030R70225V A73L	490-3331-2-ND	Digi-Key	
LED RGB DIFFUSED 4000K SMD	D1			1	Brocade	ASMB-MT181-8A143	516-3280-1-ND	Digi-Key	
LED GREEN DIFFUSED 3805 SMD	D2, D3, D8			3	OSRAM	LC-RW17-KN-1	475-1410-1-ND	Digi-Key	
DIOCE SCHOTTKY 40V 500MA S0123	D4, D7			2	Diodes Incorporated	S0123-FLAT	805-40W-7-F	805-40W-FDTR-ND	Digi-Key
DIOCE XLNIR 14V 500MA S0123	D5			1	Diodes Incorporated	S0123-FLAT	805-40W-7-F	805-40W-FDTR-ND	Digi-Key
DIOCE GEN PUMP 10V 300MA S0123	D6			1	Diodes Incorporated	S0123-FLAT	805-40W-7-F	805-40W-FDTR-ND	Digi-Key
1Y5 DIODE 400W 25.4V UNL DO-214AC	D9			1	Infineon Technologies	DO-214AC-UNI	P45MA30A-E3/G1	P45MA30A-E3/G1CT-ND	Digi-Key
CONN HEADER RH SIDE 2.54MM	J1			1	ST Sales America Inc.	578-3H-A07300	455-2240-ND	Digi-Key	
CONN THERM BLOCK 2POS 15MMx1.8MMx0.5MM	J2			1	Molex	MOLEX-09P000302	509200302	MM020114-ND	Digi-Key
HIGH QUALITY GOLD PLATED XTAL 32.768KHZ	J3			1	DFRobot	XT90	FT10588	1738-1438-ND	Digi-Key
CONN HEADER R/A 2.54MM	J4			1	Molex	MOLEX-22-05-3041-V	22-05-3041	MM4302-ND	Digi-Key
CONN HEADER VERT 2.54MM	J5			1	Harwin Inc.	HEADER_204	HA02-P080446	493-2122-ND	Digi-Key
12, 2+2, Position Card Connector Secure Digital - SD Surface Mount, Right Angle Gold	J6			1	Hirose Electric Co Ltd	SD_CARD_CON	DM1AA-SF-FEJ21	HR040CT-ND	Digi-Key
FIXED IND 150H 1.9A 1% BROADWAVE SMD	L1			1	Bourns Inc.	IND_150H_1.9A	SRN045-150M	SRN045-150MCT-ND	Digi-Key
LED COG GRAMIC 128X32	LED1			1	Newhaven Display Inc.	NHD-12832A12-FSW-FBW-3V3	NHD-12832A12-FSW-FBW-3V3	NHD-12832A12-FSW-FBW-3V3-ND	Digi-Key
6cm x 6cm	MH1, MH2, MH3, MH4			4					
MOSFET P-CH 40V 40A TO252	Q1, Q2			2	Alpha & Omega Semiconductor Inc.	PMV05_40V_40A	ACD4189	785-1351-1-ND	Digi-Key
MAX7219 I2C 100V 210A POWER100	Q3, Q4, Q5, Q6			6	ON Semiconductor	MAX7219	29BL0240N100CT-ND	29BL0240N100CT-ND	Digi-Key
MAX7219 I2C 100V 210A POWER100	Q7			1	Wingate	MAX7219	29BL0240N100CT-ND	29BL0240N100CT-ND	Digi-Key
MAX7219 I2C 100V 210A POWER100	Q8			1	Bohm Semiconductor	MAX7219	29BL0240N100CT-ND	29BL0240N100CT-ND	Digi-Key
RES SMD 300OHM 1% 1/8W 0805	R1, R4			2	Fagor	RC0805FR-0720R	311-20-000CT-ND	311-20-000CT-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, R37, R38, R39, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52			14	Fagor	RC0805FR-07100R	311-1000CT-ND	311-1000CT-ND	Digi-Key
RES SMD 10K OHM 1% 1/8W 0805	R53, R54, R57, R58, R59, R60, R61, R62, R63, R64, R65, R66, R67, R68, R69, R70, R71, R72, R73, R74, R75, R76, R77, R78, R79, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100, R101, R102, R103, R104, R105, R106, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R125, R126, R127, R128, R129, R130, R131, R132, R133, R134, R135, R136, R137, R138, R139, R140, R141, R142, R143, R144, R145, R146, R147, R148, R149, R150, R151, R152, R153, R154, R155, R156, R157, R158, R159, R160, R161, R162, R163, R164, R165, R166, R167, R168, R169, R170, R171, R172, R173, R174, R175, R176, R177, R178, R179, R180, R181, R182, R183, R184, R185, R186, R187, R188, R189, R190, R191, R192, R193, R194, R195, R196, R197, R198, R199, R200, R201, R202, R203, R204, R205, R206, R207, R208, R209, R210, R211, R212, R213, R214, R215, R216, R217, R218, R219, R220, R221, R222, R223, 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