

UNIVERSITY OF SOUTHAMPTON, SOUTHAMPTON, HAMPSHIRE
ELECTRONIC ENGINEERING, SEMESTER 1 YEAR 4

GlacTracker Hardware Manual

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1 PSU PCB

1.1 Overview

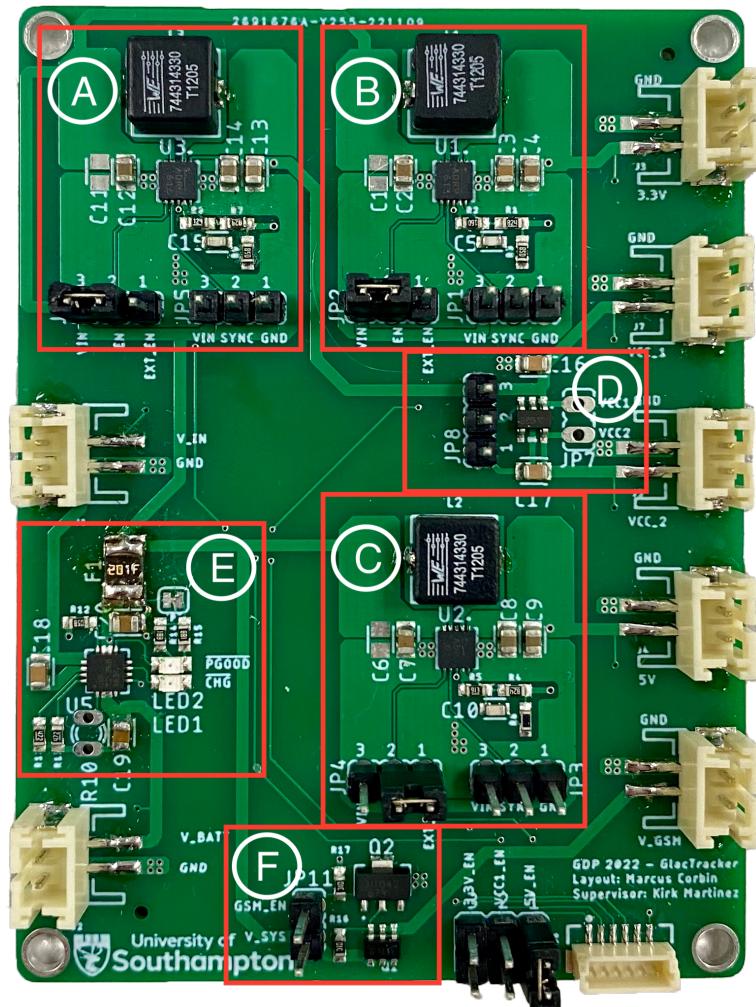


Figure 1: PSU PCB with key blocks labelled

- A 4.0V SMPS¹
- B 3.3V SMPS
- C 5.0V SMPS
- D 3.3V LDO²
- E Battery management circuit
- F Switchable connection to output of battery management circuit³

1.2 Connectors & Jumpers

Figure 2 shows an image of the PSU PCU with the connectors labeled. Each SMPS also has two 3-way jumpers.

The first is between VIN, EN and EXT_EN. When the jumper is connected between VIN and EN, the SMPS is forced on, irrespective of what the external enable pin is connected to. When the jumper is connected between EN and EXT_EN, the SMPS is controllable via its external enable pin - exposed on the connector labelled “External PSU EN signals”. Note the external enable pin can also be forced low by connecting a jumper across the headers next to the “External PSU EN signals” connector.

The second is between the SYNC/MODE pin of the SMPS and either VIN or GND. This changes whether the SMPS is always in PWM mode or auto-switching between pulse skipping mode and PWM mode. **No jumper should be connected across these pins.** More details are explained in subsection 1.4.

¹Resistors specified in BOM mean this will be 3.3V unless modification has been carried out. See subsection 1.4

²Unused in current GlacsWeb System

³Unused in current GlacsWeb System

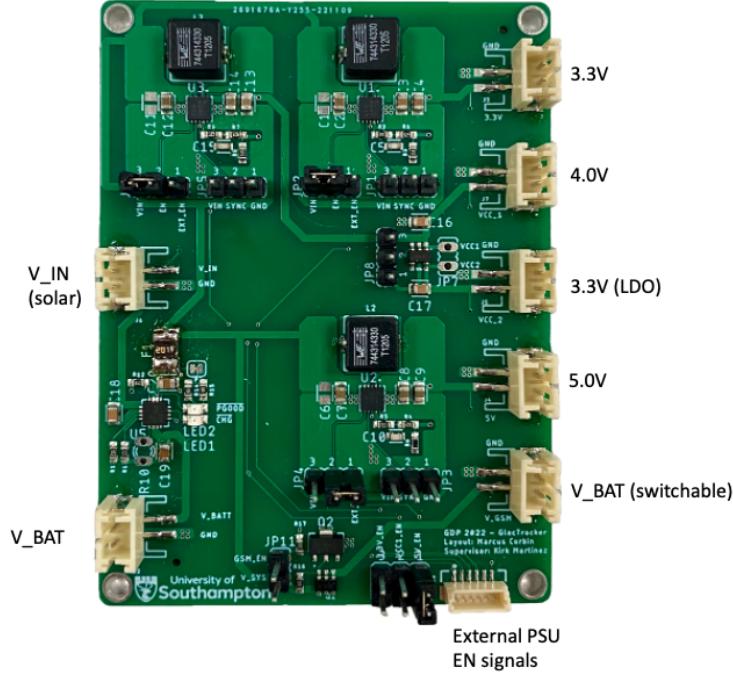


Figure 2: PSU PCB with connectors labeled

1.3 Build

As the PCB uses a number of difficult-to-hand solder QFN packages, the best option for manufacture is using a pick-and-place service.

When ordering from JLC PCB, a bill of materials (BOM), component placement list, and Gerber files must be uploaded. See the design archive for these files.

Some components are not available from JLC - those listed on the BOM (Appendix B) without a JLC part number. These must be hand soldered when the boards arrive.

1.4 Modifications

- JST right angle connectors were not available. Vertical connectors were used instead. This means the positive and negative connections are the reverse of the JST standard. **Extra care must therefore be taken when using pre-made 2-way JST connectors.**

The pins can be swapped on the male JST connectors to match those fitted to the PCB. When new PCBs are ordered, use the specified right-angled connectors instead.

- “GSM-ENABLE” circuitry is not used - can be removed but not essential.
Instead VCC_1 is set to 4V and used to power the GSM module. Set VCC_1 to 4V by changing R8 to $120\text{k}\Omega$
- LDO circuit is unused - can be removed, but no need to do so
- The MODE/SYNC on each SMPS pin should be connected to the SMPS enable signal. This forces MODE/SYNC = 0 when output is off and 1 when on - gives the best of both low noise when on and low power consumption when off. See Figure 3 for an image of the modification.

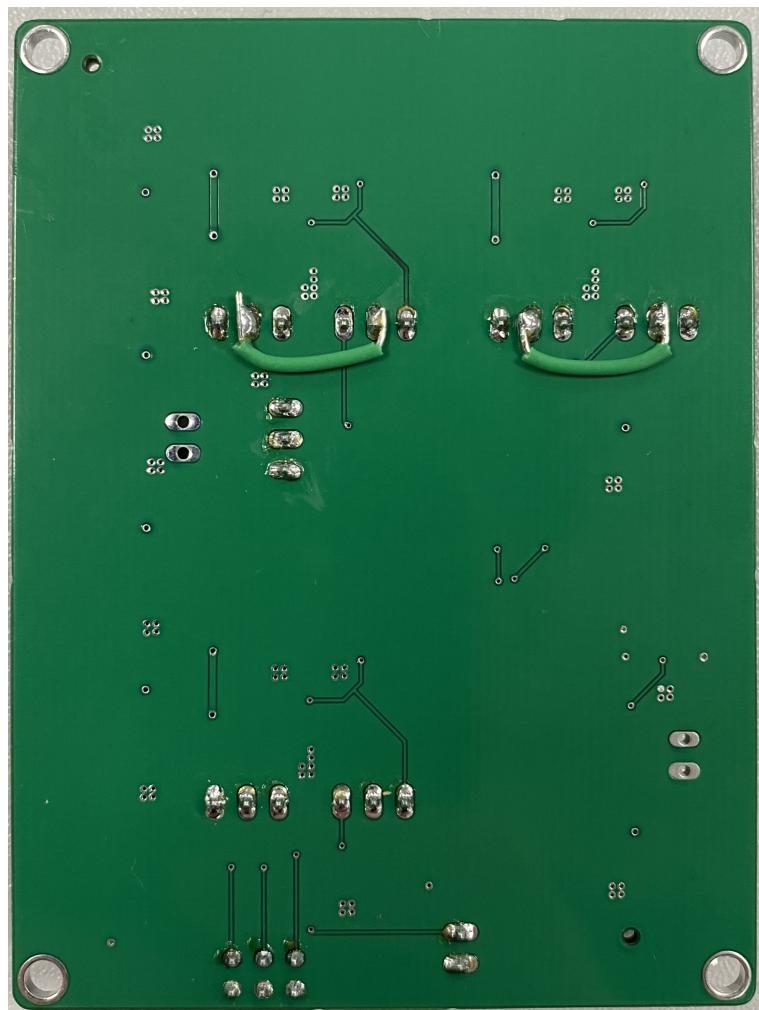


Figure 3: Image showing MODE/SYNC modification on PSU PCB. NOTE: if using the 5V SMPS, this should also be modded

2 MCU & Communications PCB

2.1 Overview

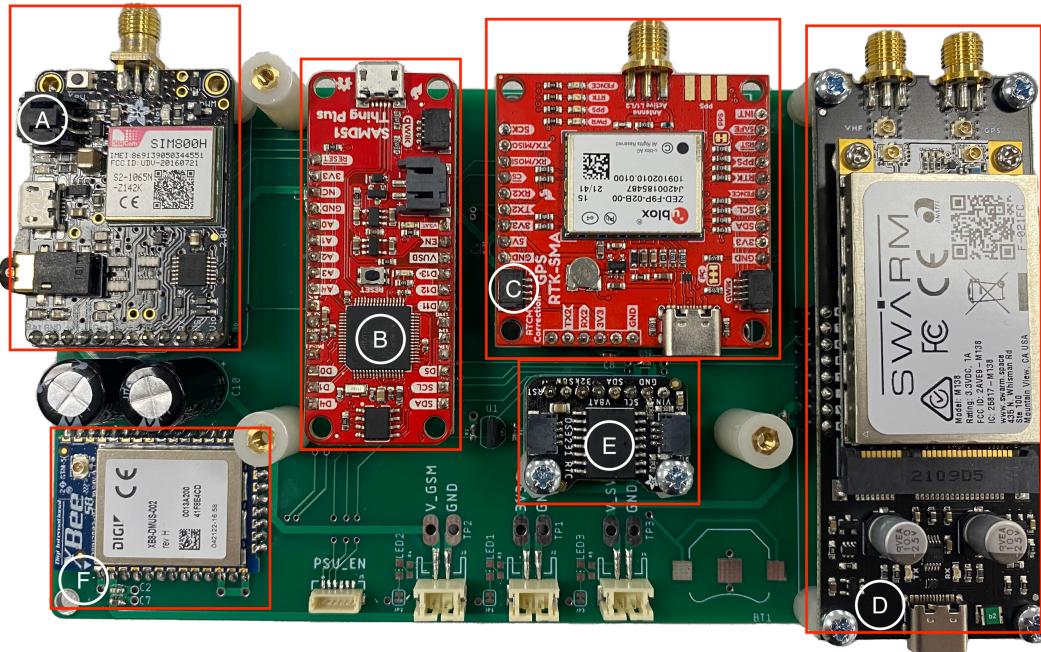


Figure 4: MCU PCB with key-blocks labeled

- A Adafruit SIM800 FONA
- B SparkFun SAMD51 Thing Plus
- C SparkFun RTK GPS
- D SWARM
- E Adafruit DS3231 RTC
- F Digi XBee SX 868 RF Module

2.2 Connections

Figure 5 shows the connections between the PSU and the MCU PCBs.

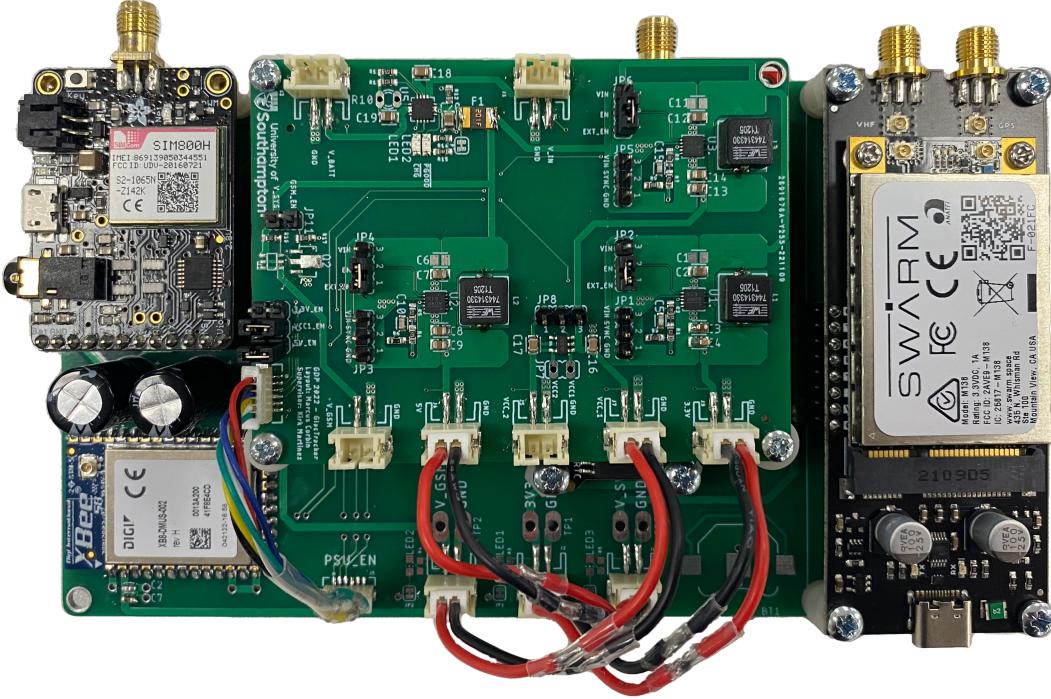


Figure 5: MCU PCB with PSU PCB mounted showing connections between them

2.3 Build

The MCU PCB is mostly through-hole to accommodate the various breakout boards. PCB sockets should be soldered allowing the breakout boards to be easily added and removed without de-soldering.

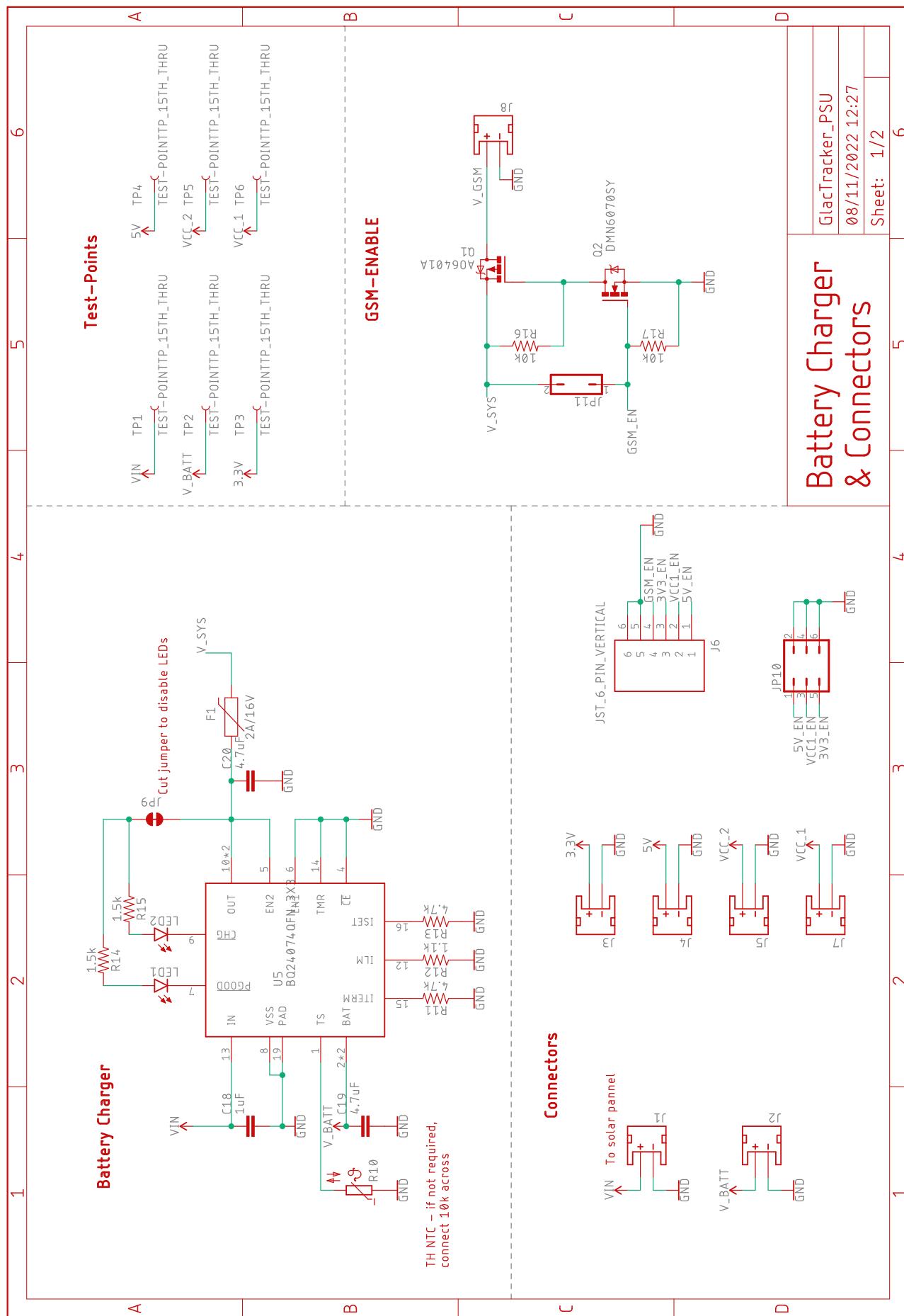
The surface mount parts can be fitted as per the BOM (Appendix D). There is an optional extra battery holder to provide an additional coin cell battery for the RTC

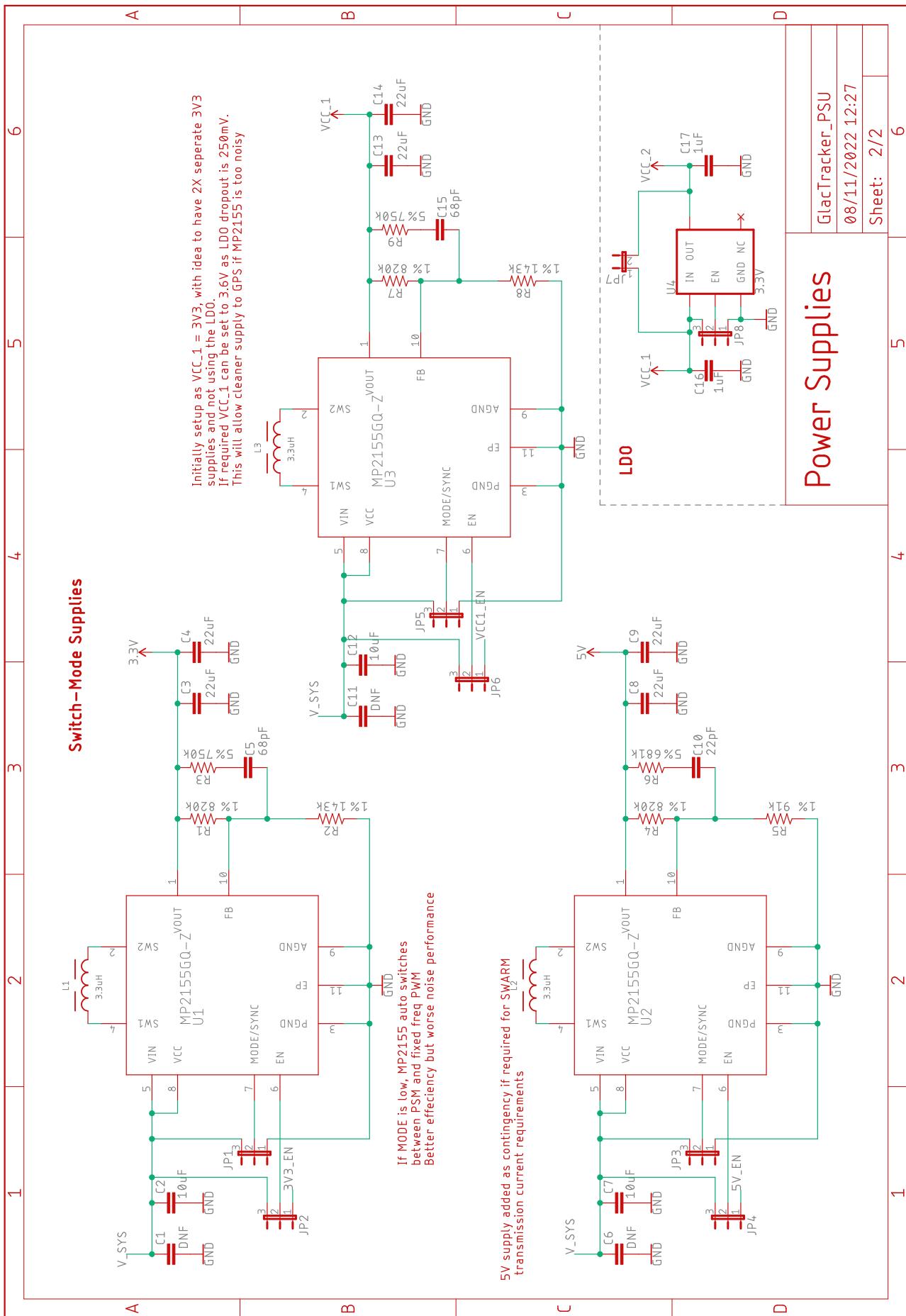
NOTE: when building a rover the SWARM and GSM modules do not need to be fitted.

Next to each connector is an LED which is on when power is supplied. These can be disabled by cutting the jumper near the LED with a sharp blade.

Appendices

A PSU Schematic

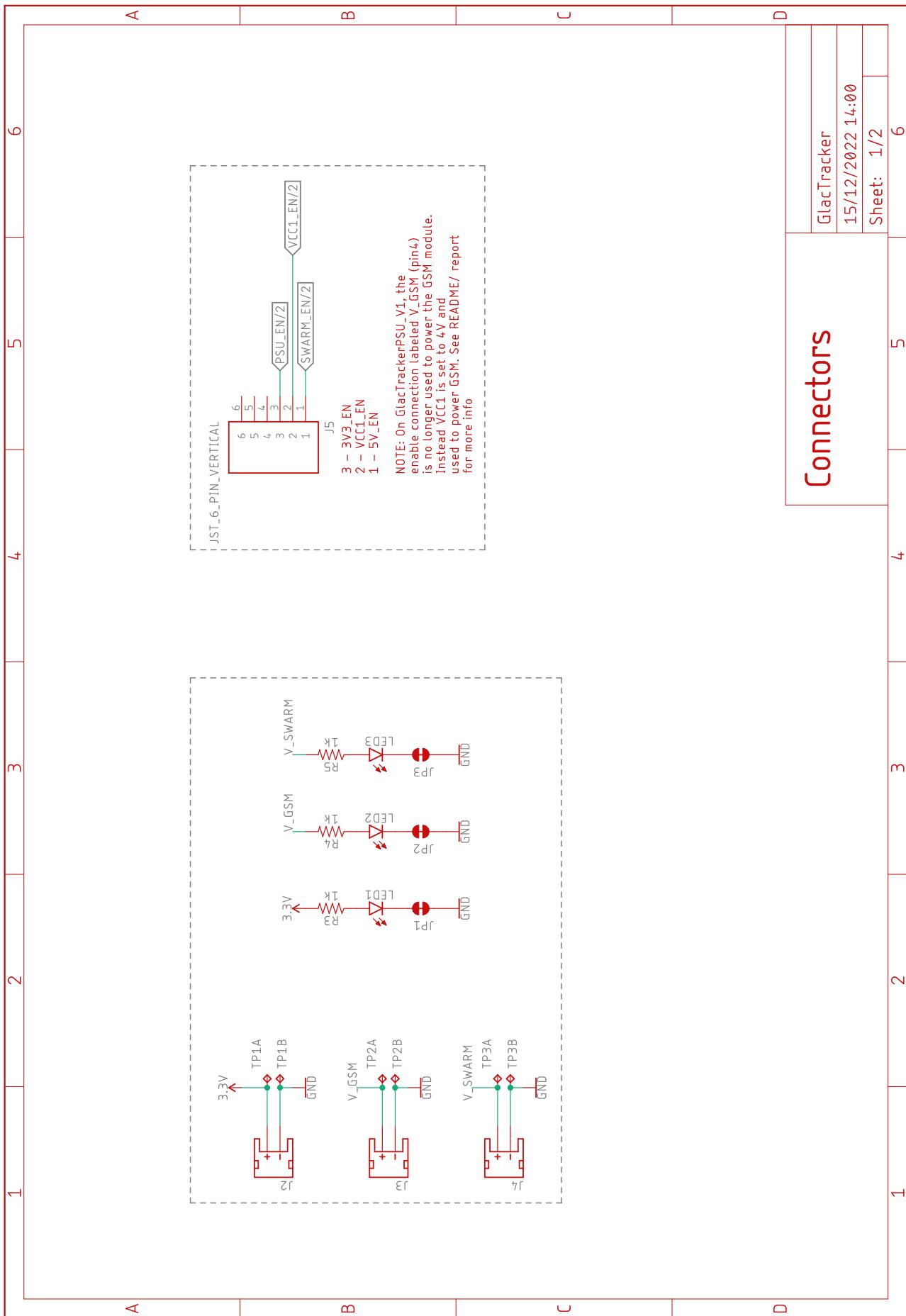


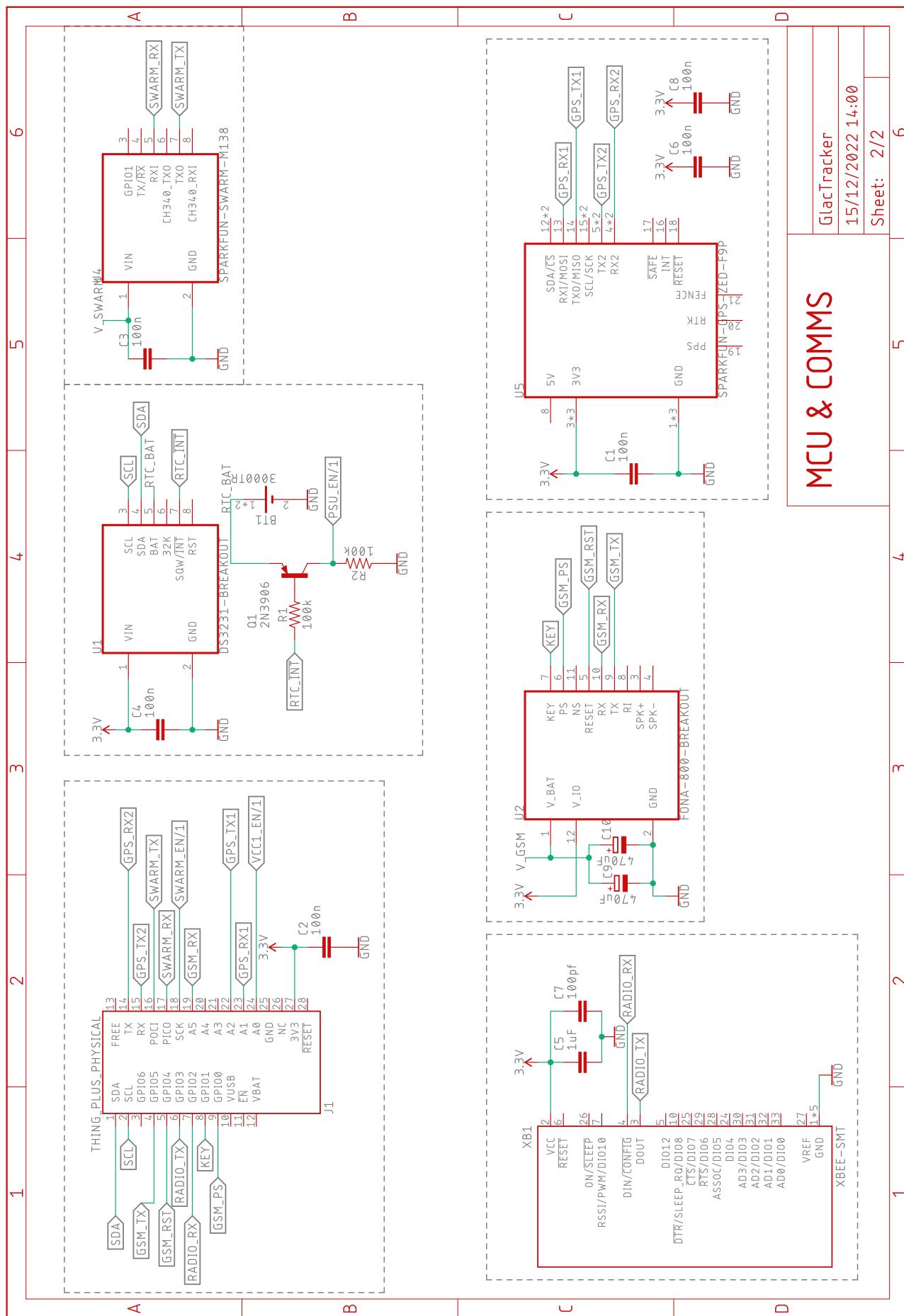


B PSU BOM

Designator	Quantity	Value	Footprint	Manufacturer Part #	Supplier Part #	Description
C1,C6,C11	3	DNF		0603CG2201500NNT	JLC: C91701	SMD Capacitor
C10	1	22pF	0603	0805B105K500NT	JLC: C215803	SMD Capacitor
C16,C17,C18	3	1uF	0805	0805X475K500CT	JLC: C296082	SMD Capacitor
C19,C20	2	4.7uF	0805	0805B106K100NT	JLC: C90544	SMD Capacitor
C2,C7,C12	3	10uF	0805	0805X226M100NT	JLC: C503482	SMD Capacitor
C3,C4,C8,C9,C13,C14	6	22uF	0805	06035A6801AT2A	JLC: C210002	LED Red
C5,C15	2	68pF	0603	D-R08050813-KS2	JLC: C130114	P-Channel 30V 5A 1.3V @ 250uA 47mΩ @ 5A,10V 2W
LED1,LED2	2		TSOP-6	AO6401A	JLC: C102604	MOSFET N-Trench 60V 4.1A 3V @ 250uA 85 mΩ @ 2.5A,10V
Q1	1		SOT-89-3	DMN6070SY-13	JLC: C129583	100mW 50V ±100ppm/°C ±1% -55°C~+155°C
Q2	1		RS-03K8203FT	RS-03K8203FT	JLC: C322006	100mW Thick Film Resistors 75V ±100ppm/°C ±1% -55°C~+155°C
R1,R4,R7	3	820k	0603	0603WAFA4701T5E	JLC: C23162	100mW Thick Film Resistors 75V ±100ppm/°C ±1% -55°C~+155°C
R11,R13	2	4.7k	0603	0603WAFA1101T5E	JLC: C22764	100mW Thick Film Resistors 75V ±100ppm/°C ±1% -55°C~+155°C
R12	1	1.1k	0603	0603WAFA1501T5E	JLC: C22843	100mW Thick Film Resistors 75V ±100ppm/°C ±1% -55°C~+155°C
R14,R15	2	1.5k	0603	0603WAFA1002T5E	JLC: C25804	100mW Thick Film Resistors 50V ±100ppm/°C ±1% -55°C~+125°C
R16,R17	2	10k	0603	CR0603FA1433G	JLC: C100772	100mW Thick Film Resistors 75V ±100ppm/°C ±1% -55°C~+155°C
R2,R8	2	143k	0603	0603WAFT503T5E	JLC: C23240	100mW Thick Film Resistors 75V ±100ppm/°C ±1% -55°C~+155°C
R3,R9	2	750k	0603	0603WAFA9102T5E	JLC: C23265	100mW Thick Film Resistors 150V ±100ppm/°C ±1% -55°C~+155°C
R5	1	91k	0603	ER33KFF6813V	JLC: C403328	100mW Thick Film Resistors 75V ±100ppm/°C ±1% -55°C~+155°C
R6	1	681k	0603	QFN-10_MP2155_GQ-Z	JLC: C10397	QFN-10_3x3x05P DC-DC Converter
U1,U2,U3	3	MP2155GQ-Z	SOT23-5	MP2155GQ-Z	JLC: C51118	Fixed 3.3V LDO
U4	1	3.3V	BQ24074QFN_3X3	AP2112K-3.3TRG1	JLC: C54313	Battery Management IC
U5	1		1812	BQ24074RGTR	RS: 647-8263	2A/8V PPTC Fuse
F1	1			MF-MSMF200-2	RS: 688-1353	JST 2MM MALE RA CONNECTOR
J1,J2,J3,J4,J5,J7,J8	7			S2B-PH-SMA4-TB	RS: 546-8827	JST 6 pin vertical connector
J6	1			SM06B-SRSS-TB		Shielded Wire-wound SMD inductor
					RS: J36-1951	
					744314330	
					7050	
					3	

C MCU Schematic





D MCU BOM

Designator	Quantity	Value	Footprint	Description
BT1	1	3000TR	BAT_3000TR	Ultra Low Profile SMT Coin Cell Battery Contact Retainer for 12 mm Cell
C1, C2, C3, C4, C6, C8	100n		0603	Capacitor - Generic
C5	1uF		0603	Capacitor - Generic
C7	100pf		0603	Capacitor - Generic
C9, C10	470uF		TH	Capacitor Polarised - Generic
J1	1	SPARKFUN-SAMD51-THINGPLUS	TH	
J2, J3, J4	1	JST_6_PIN_VERTICAL	JST-2-SMD	JST 2MM MALE RA CONNECTOR
J5	1	LED1, LED2, LEDs	JST-6-SMD-VERT-1.0MM CHIP-LED0805	JST 6 pin vertical connector LED
Q1	1	2N3906	TO92	PNP Transistor
R1, R2	1	100k	0603	Generic Resistor Package
R3, R4, R5	1	1k	0603	Generic Resistor Package
U1	1	DS3231-BREAKOUT	TH	
U2	1	FONA-800-BREAKOUT	TH	
U4	1	SPARKFUN-SWARM-M138	TH	
U5	1	SPARKFUN-GPS-ZED-F9P	TH	
XB1	1	XBEE-SX868	TH	XBee(TM)/XBee-PRO(TM) ZB SMT RF Modules.