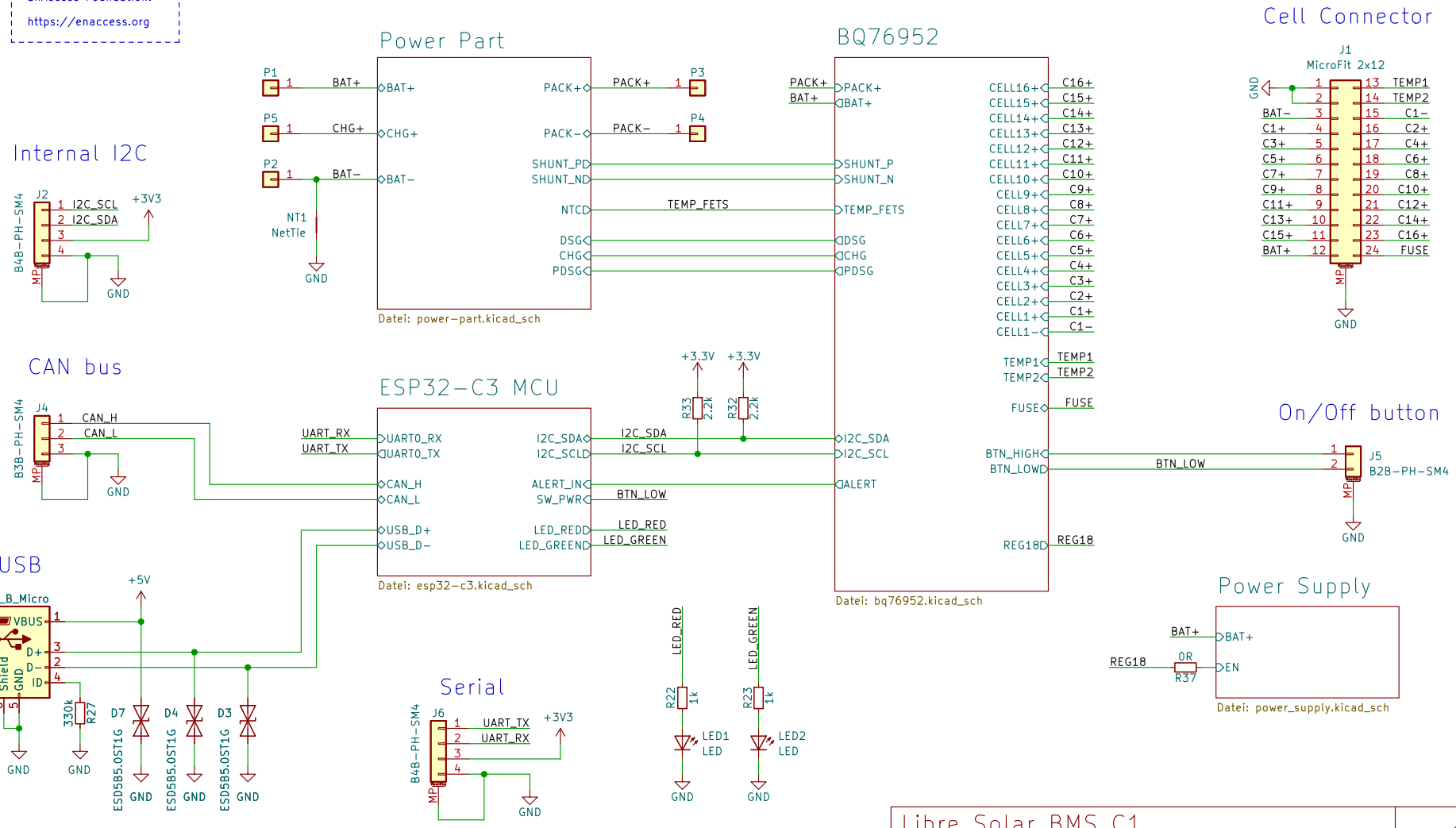
Libre Solar BMS for 3–16 cells

Based on TI bq76952 and ESP32-C3

Development funded by EnAccess Foundation.

https://enaccess.org



Libre Solar BMS C1

Libre Solar Technologies GmbH Author: Martin Jäger	Website: https://libre.solar
Sheet: / File: bms-c1.kicad_sch	
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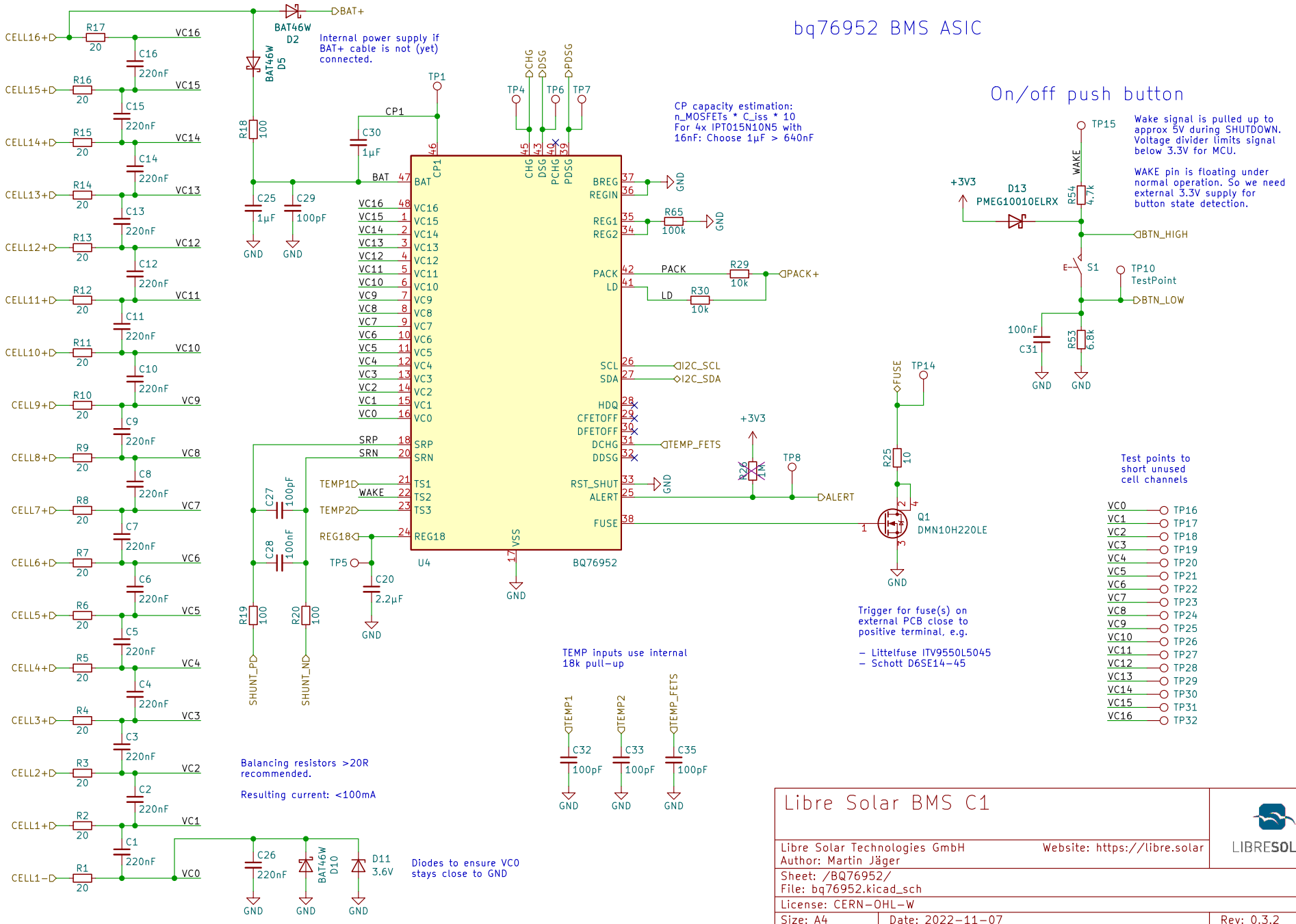
bq76952 BMS ASIC
On/off push button
BQ76952
U4
Internal power supply if BAT+ cable is not (yet) connected.
CP capacity estimation: n_MOSFETs * C_iss * 10 For 4x IPT015N10N5 with 16nF: Choose 1µF > 640nF
Wake signal is pulled up to approx 5V during SHUTDOWN. Voltage divider limits signal below 3.3V for MCU.
WAKE pin is floating under normal operation. So we need external 3.3V supply for button state detection.
Test points to short unused cell channels
Trigger for fuse(s) on external PCB close to positive terminal, e.g.
– Littelfuse ITV9550L5045
– Schott D6SE14-45
TEMP inputs use internal 18k pull-up
Balancing resistors >20R recommended.
Resulting current: <100mA
Diodes to ensure VC0 stays close to GND
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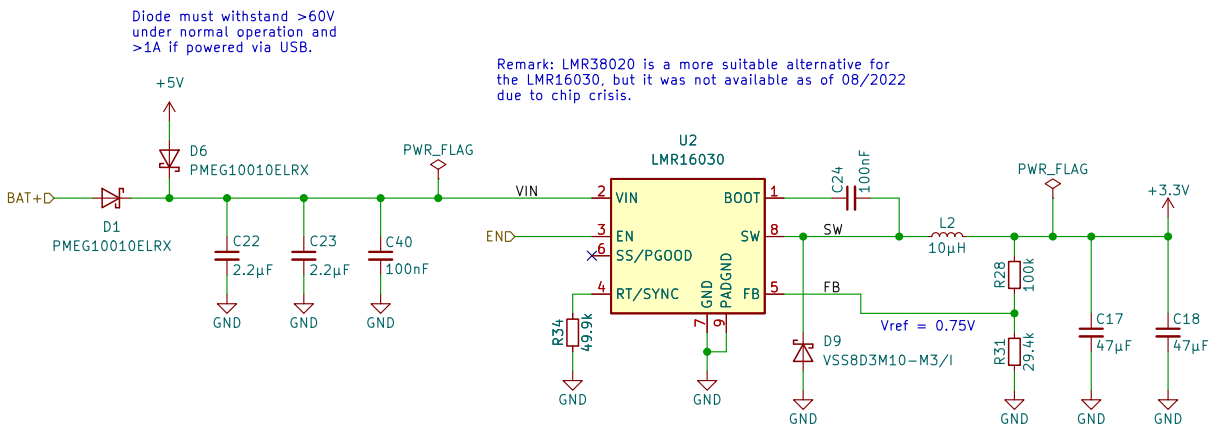
Battery to 3.3V (SMPS)

ESP32-C3 requires power supply with at least 500 mA



Layout for 500 kHz, 2A output

For a future 500 mA SMPS (after chip shortage) the PMEG10010ELRX can be re-used for D9 to reduce part variation.

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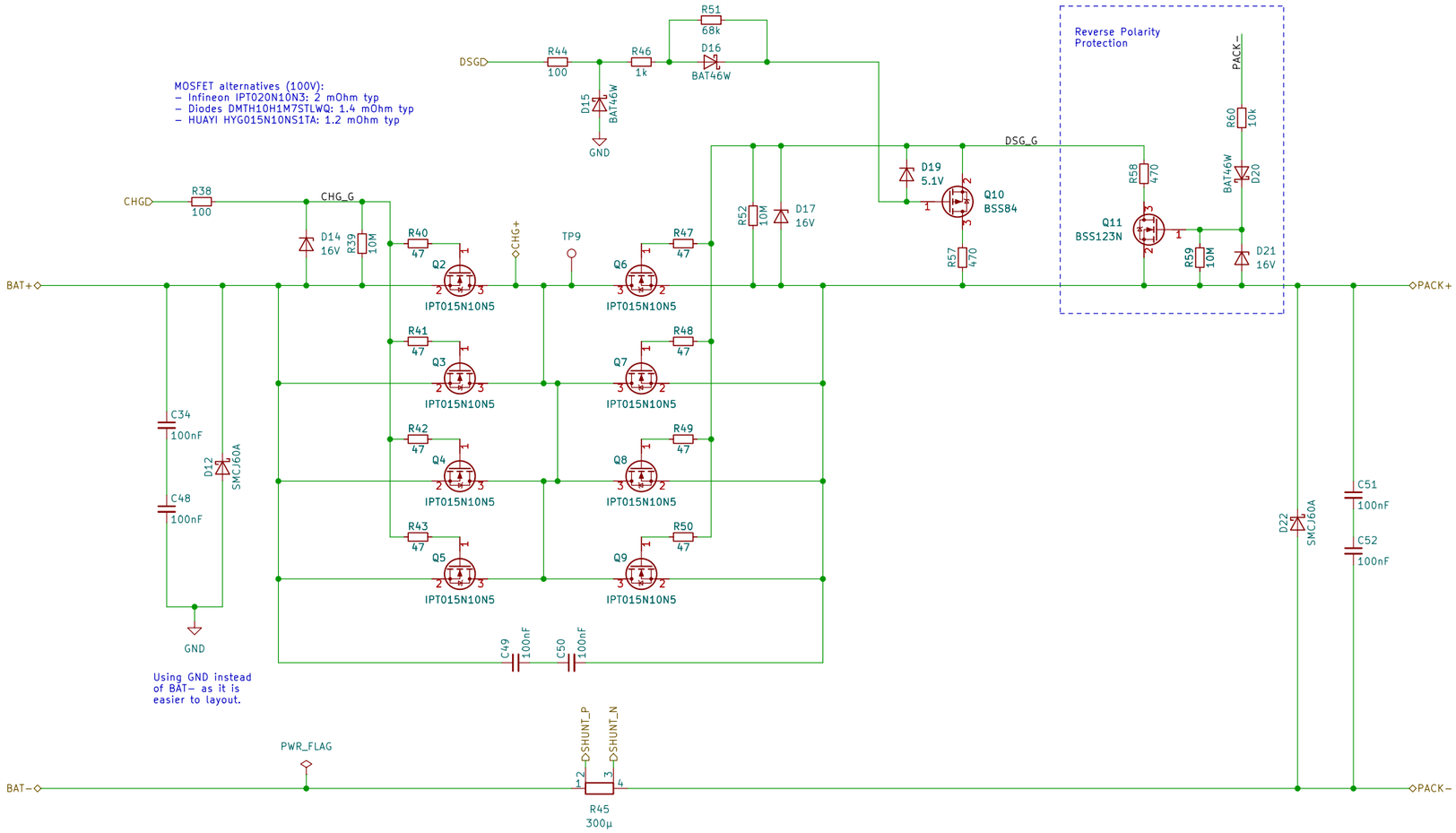
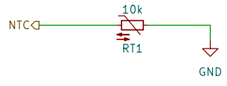
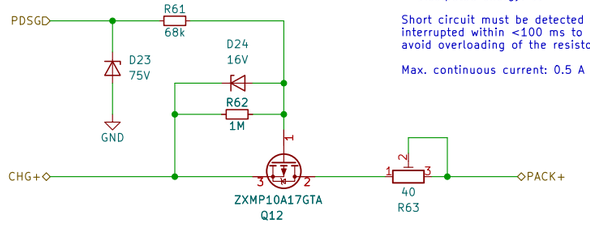
Power Part – MOSFETs and Shunt



MOSFET temperature sensor



Bus precharge circuit



Calculations:
– Peak current: 60V / 40R = 1.5A
– Time constant for C_bus 5mF: 0.2s
– Dissipated energy: 9J

Short circuit must be detected and interrupted within <100 ms to avoid overloading of the resistor.

Max. continuous current: 0.5 A

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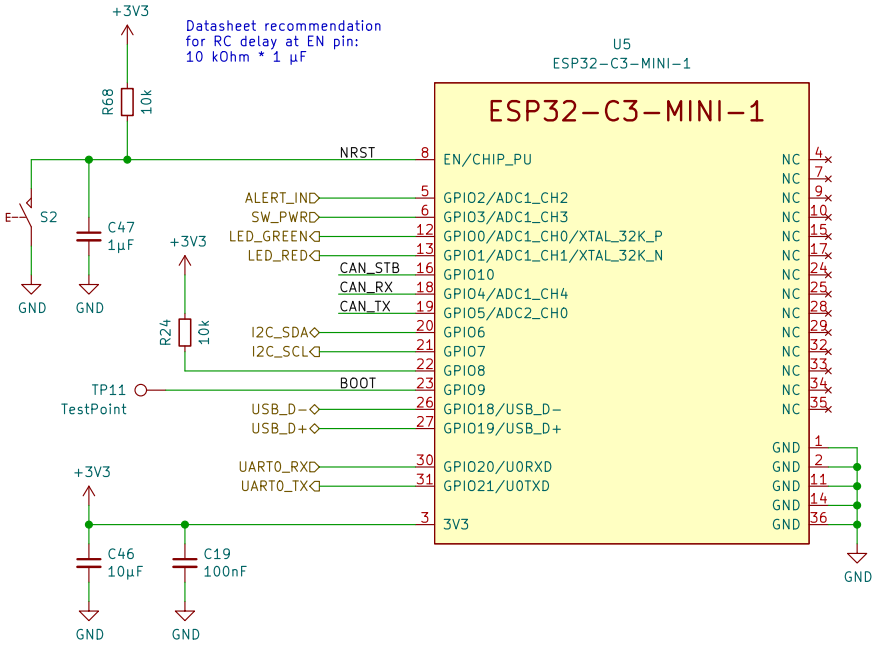
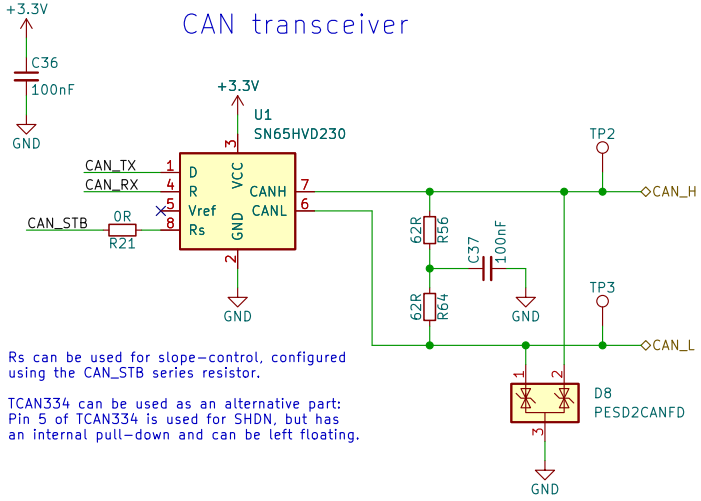
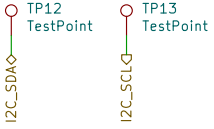
ESP32-C3 module







The ESP32-C3 has only one I2C peripheral, which is required for communication with the BMS IC bq76952.

The UEXT I2C pins will not be connected.

SPI0 and SPI1 are used internally for flash memory access, so we use SPI2 here.

BOOT pin (GPIO9) has an internal pull-up. If connected to GND during start-up, chip enters bootloader mode. Expecting BOOT pin is not required if built-in JTAG is used for firmware upload.

GPIO2 needs to be pulled high during start-up, which is achieved by the bq76952 ALERT pull-up.

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