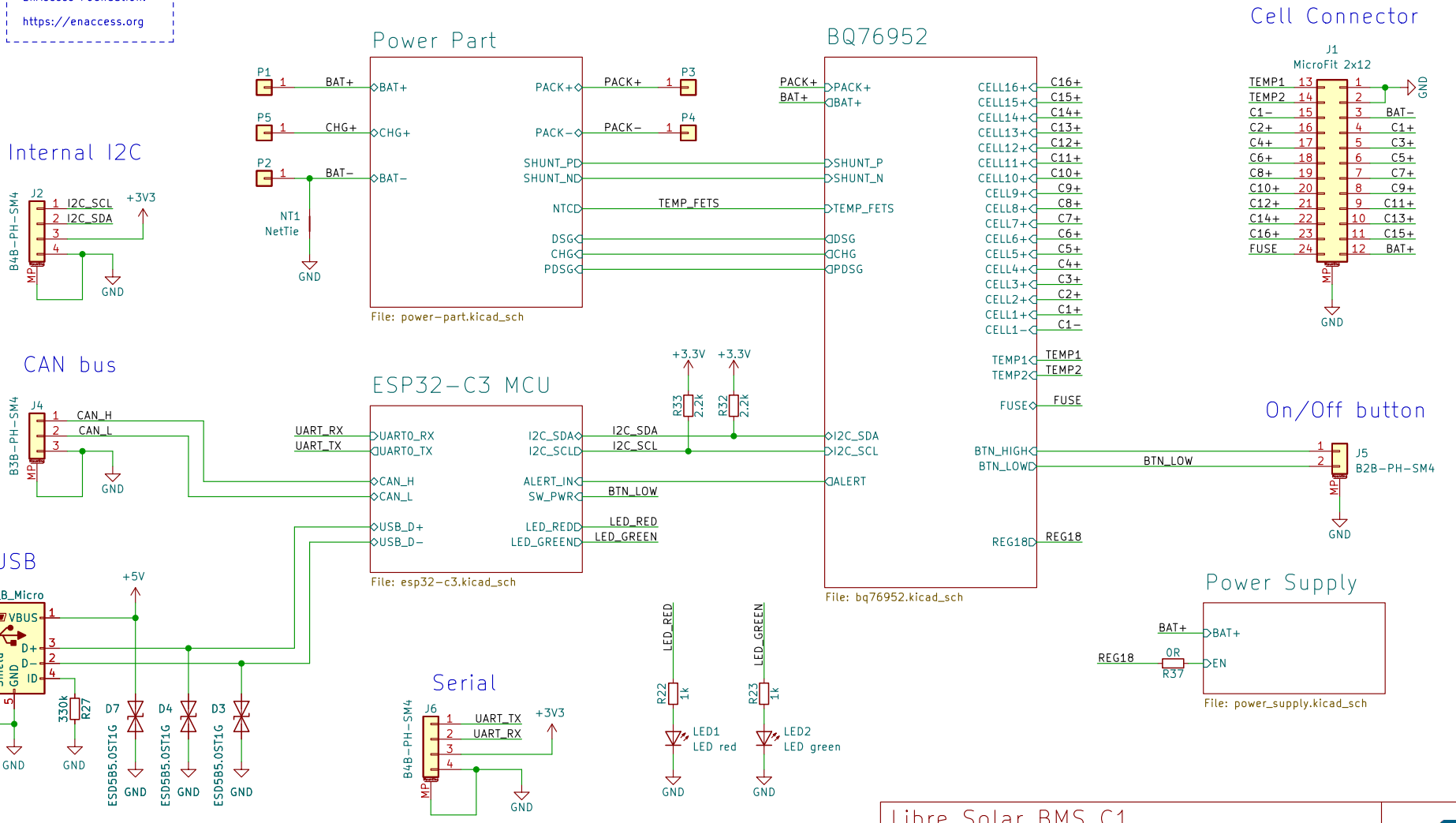
Libre Solar BMS for 3–16 cells

Based on TI bq76952 and ESP32-C3

Development funded by EnAccess Foundation.

https://enaccess.org



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Libre Solar Technologies GmbH
Author: Martin Jäger
Website: https://libre.solar

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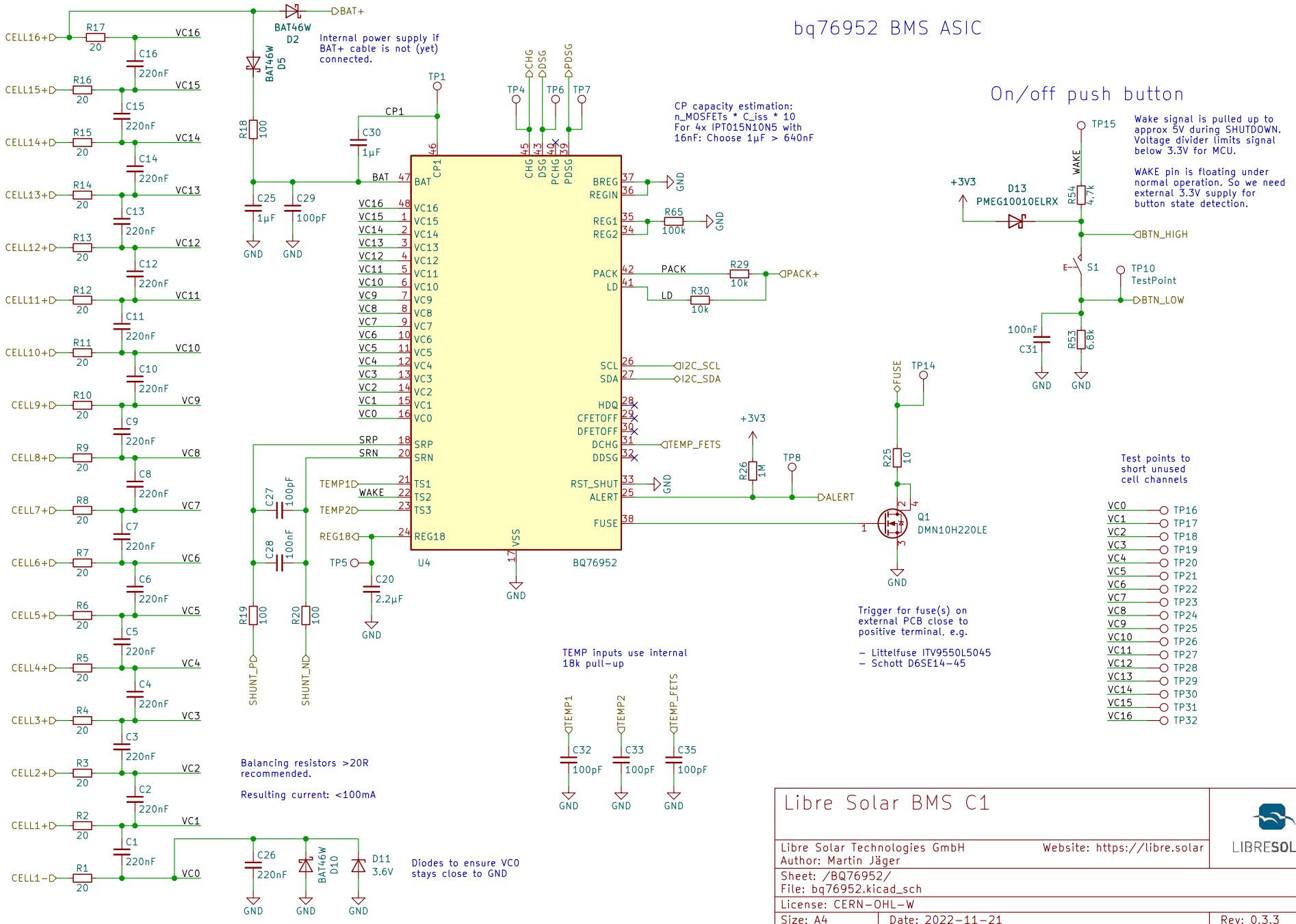
bq76952 BMS ASIC
On/off push button
Internal power supply if BAT+ cable is not (yet) connected.
CP capacity estimation:
n_MOSFETs * C_iss * 10
For 4x IPT015N10N5 with 16nF: Choose 1µF > 640nF
Wake signal is pulled up to approx 5V during SHUTDOWN. Voltage divider limits signal below 3.3V for MCU.
WAKE 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
BQ76952
U4
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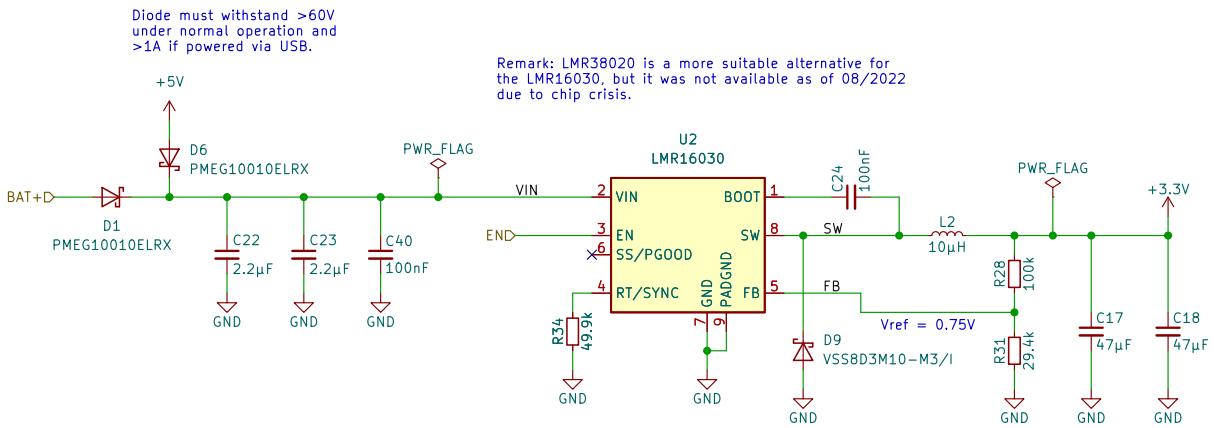
Battery to 3.3V (SMPS)

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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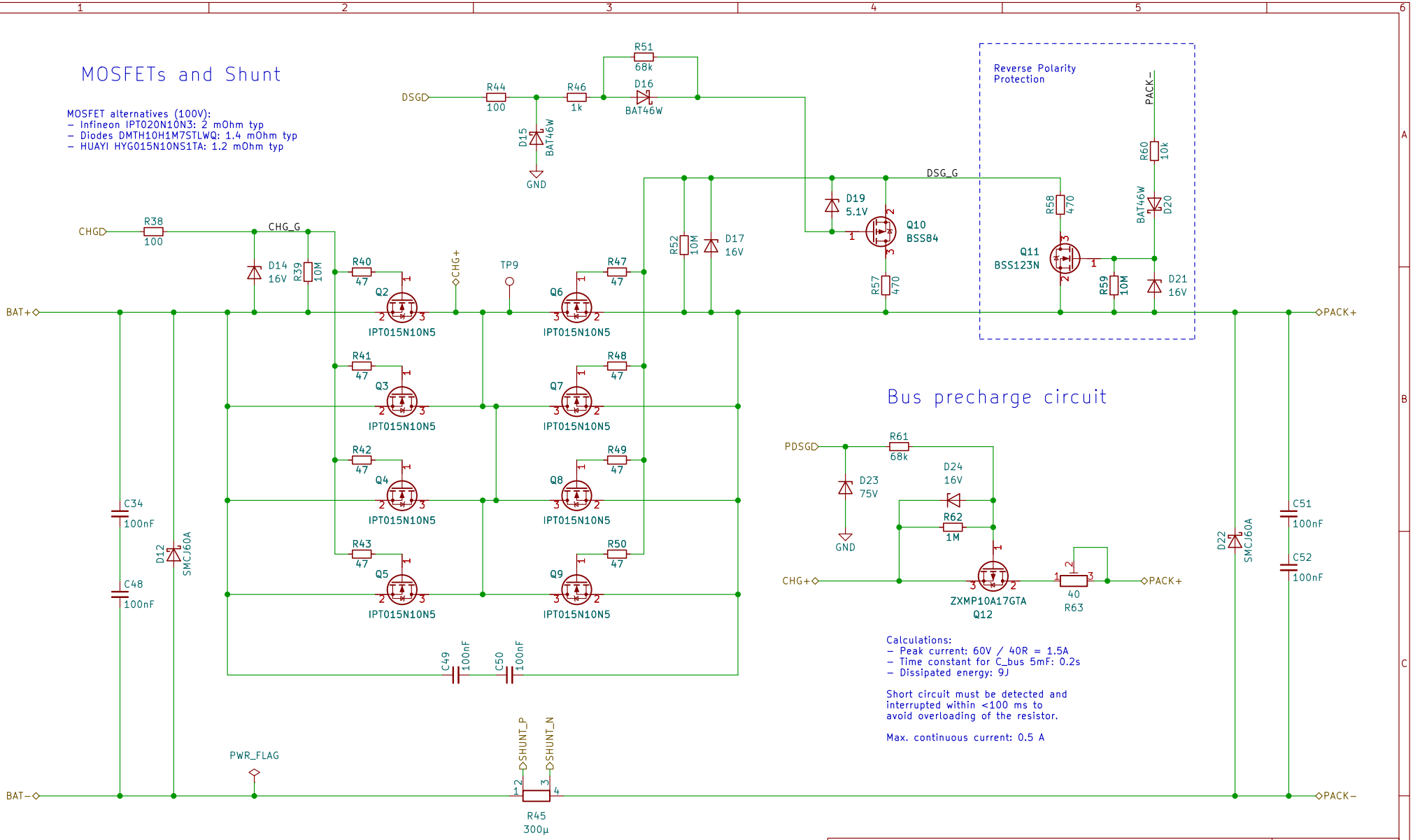
MOSFETs and Shunt
MOSFET alternatives (100V):
– Infineon IPT020N10N3: 2 mOhm typ
– Diodes DMTH10H1M7STLWQ: 1.4 mOhm typ
– HUAYI HYG015N10NS1TA: 1.2 mOhm typ
DSG
R44
100
R46
1k
R51
68k
D16
BAT46W
D15
BAT46W
GND
Reverse Polarity Protection
PACK–
R60
10k
BAT46W
D20
D21
16V
R59
10M
R58
470
Q11
BSS123N
DSG_G
D19
5.1V
Q10
BSS84
R57
470
R52
10M
D17
16V
CHG
R38
100
CHG_G
D14
16V
R39
10M
R40
47
Q2
IPT015N10N5
CHG+
TP9
R47
47
Q6
IPT015N10N5
BAT+
PACK+
R41
47
Q3
IPT015N10N5
R48
47
Q7
IPT015N10N5
R42
47
Q4
IPT015N10N5
R49
47
Q8
IPT015N10N5
R43
47
Q5
IPT015N10N5
R50
47
Q9
IPT015N10N5
C34
100nF
C48
100nF
D12
SMCJ60A
C49
100nF
C50
100nF
Bus precharge circuit
PDSG
R61
68k
D23
75V
GND
D24
16V
R62
1M
CHG+
ZXMP10A17GTA
Q12
40
R63
PACK+
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
D22
SMCJ60A
C51
100nF
C52
100nF
BAT–
PACK–
PWR_FLAG
SHUNT_P
SHUNT_N
R45
300µ
MOSFET temperature sensor
NTC
10k
RT1
GND
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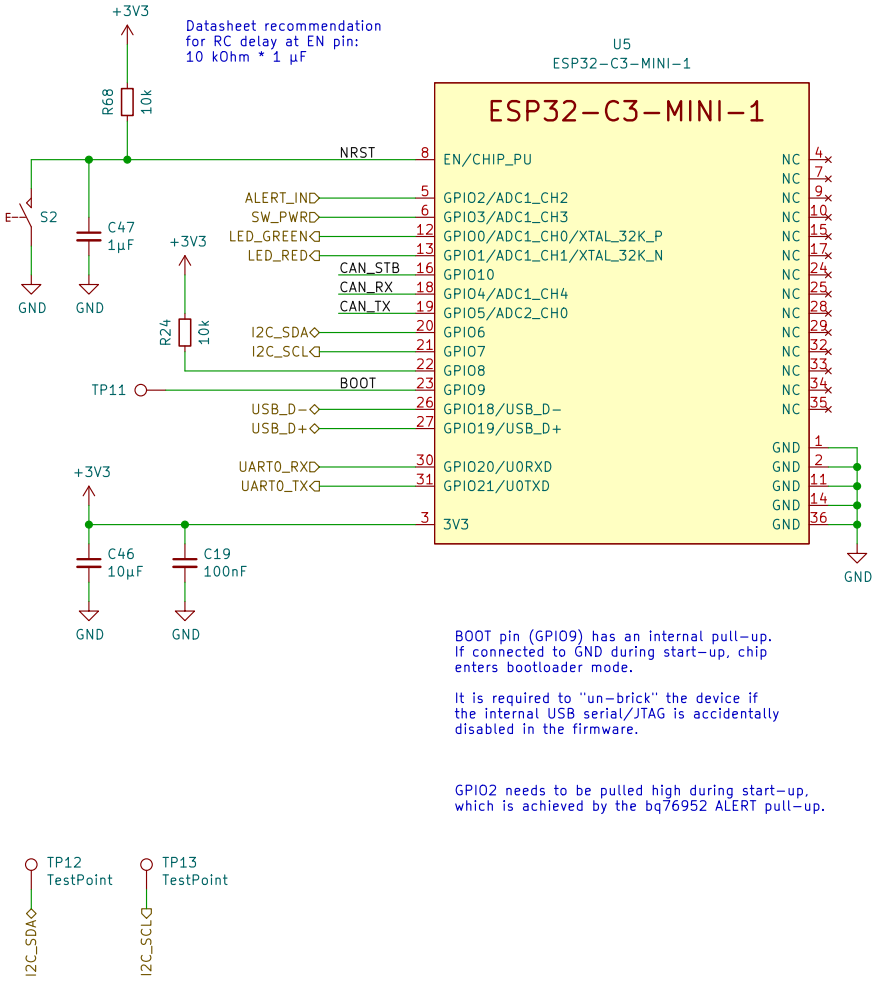
ESP32-C3 module

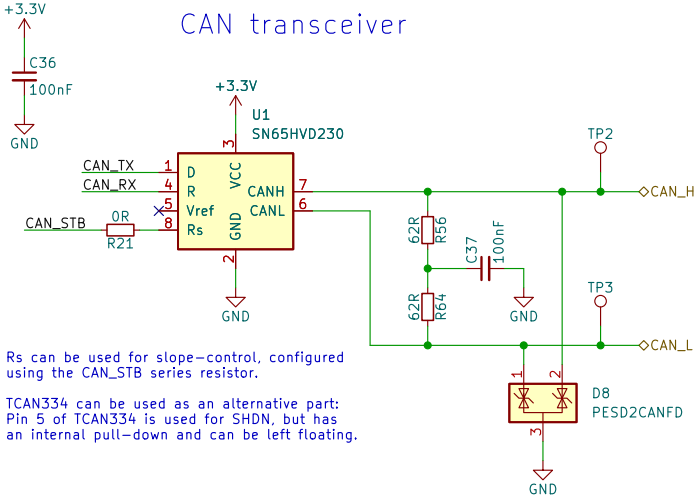


BOOT pin (GPIO9) has an internal pull-up. If connected to GND during start-up, chip enters bootloader mode.

It is required to "un-brick" the device if the internal USB serial/JTAG is accidentally disabled in the firmware.

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

CAN transceiver



Rs can be used for slope-control, configured using the CAN_STB series resistor.

TCAN334 can be used as an alternative part: Pin 5 of TCAN334 is used for SHDN, but has an internal pull-down and can be left floating.

PESD2CAN or NUP2105L also suitable, but FD versions are more common nowadays.

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