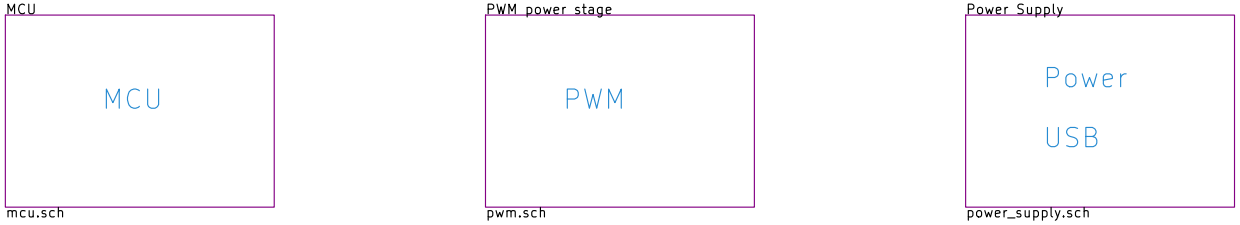
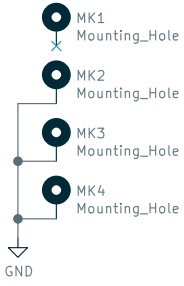
PWM Solar Charge Controller 20A



Main Specifications

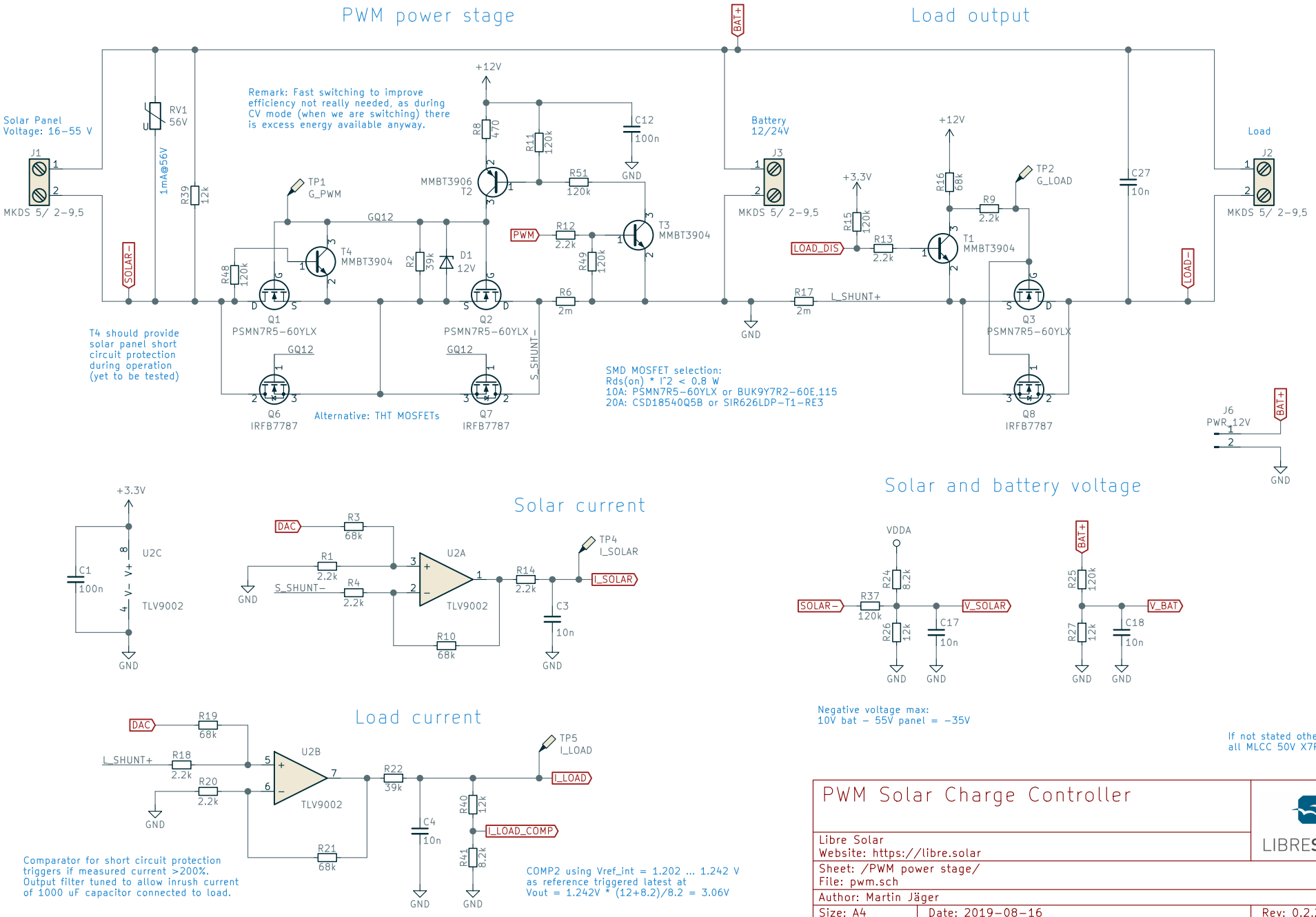
- 12V/24V battery voltage
- 20A max. charge current (10A with cheaper MOSFETs possible)
- 55V max. solar input
- 32bit ARM MCU (STM32L072)
- Expandable via Olimex Universal Extension Connector (UEXT) featuring I2C, Serial and SPI interface (e.g. used for display, WIFI communication, etc.)
- USB charging (single port)
- Low-side load switching

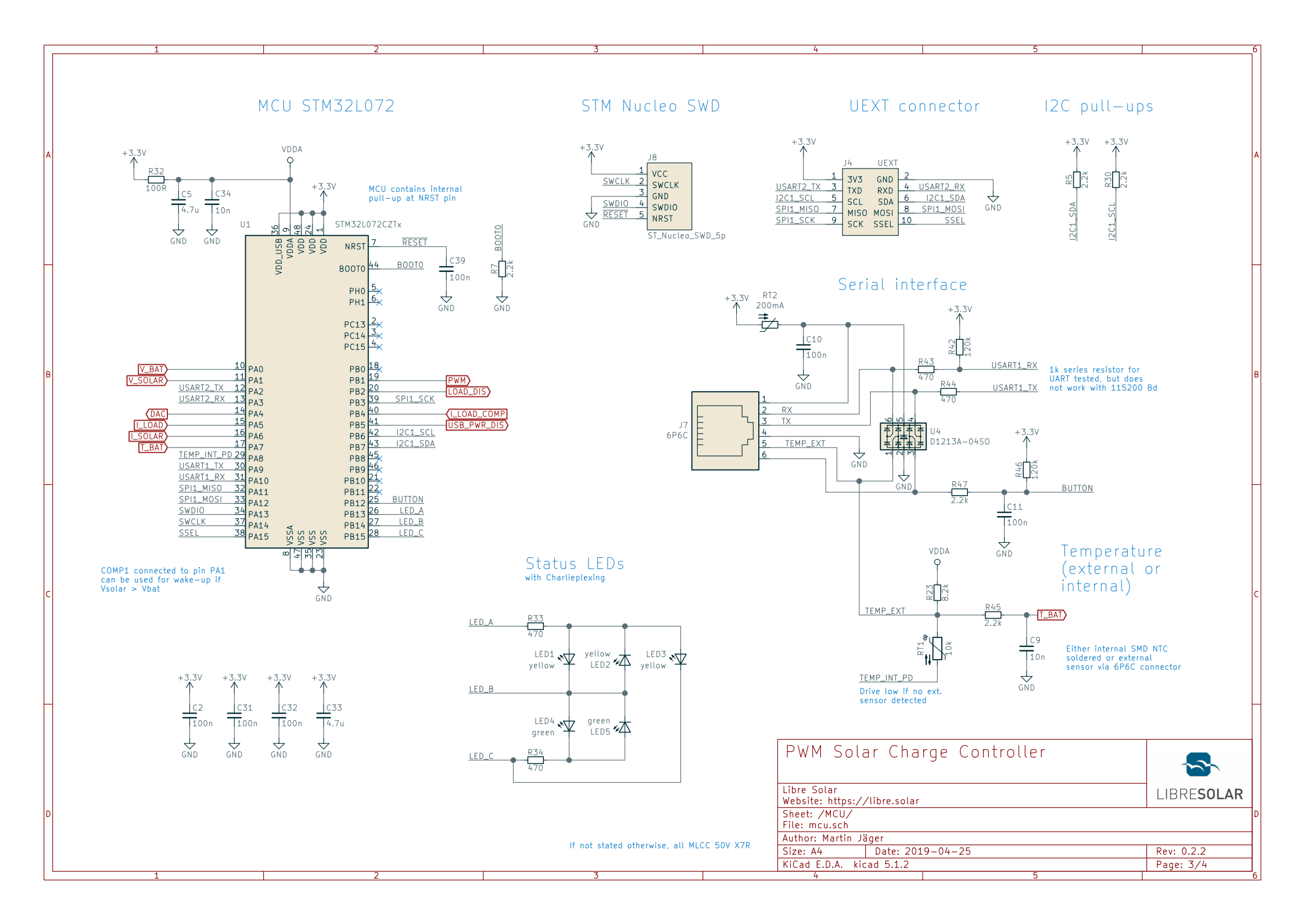


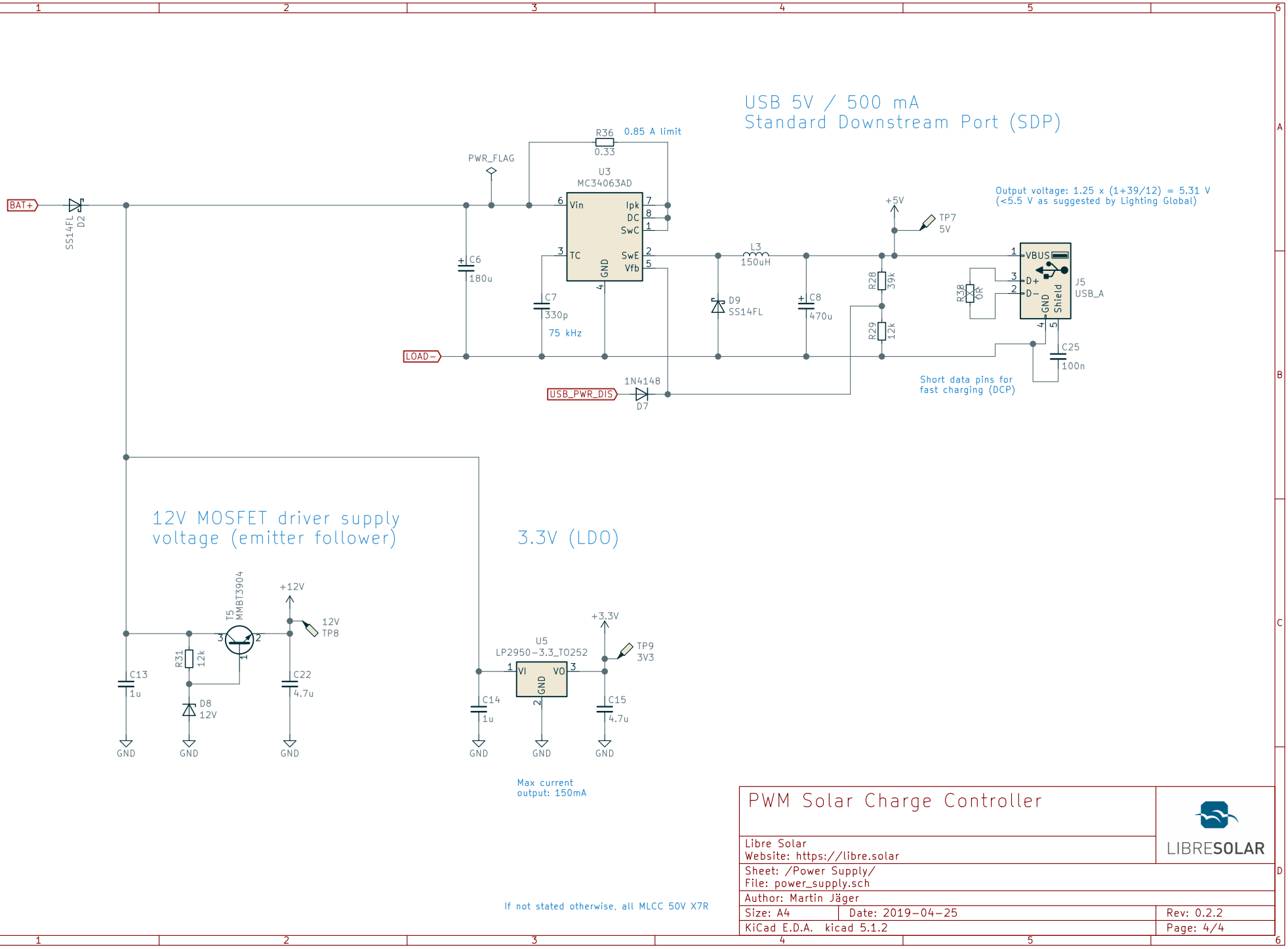
LOGO1 LIBRE_SOLAR

LOGO2 OPEN_HARDWARE

PWM Solar Charge Controller		LIBRESOLAR
Libre Solar Website: https://libre.solar		
Sheet: / File: pwm-2420-lus.sch		
Author: Martin Jäger		
Size: A4	Date: 2019-04-25	Rev: 0.2.2
KiCad E.D.A. kicad 5.1.2		Page: 1/4


PWM power stage
Load output
Solar Panel
Voltage: 16–55 V
J1
MKDS 5/ 2–9,5
RV1
56V
1mA@56V
R39
12k
SOLAR–
Remark: Fast switching to improve efficiency not really needed, as during CV mode (when we are switching) there is excess energy available anyway.
+12V
R8
470
R11
120k
C12
100n
GND
MMBT3906
T2
R51
120k
TP1
G_PWM
GQ12
R48
120k
T4
MMBT3904
R2
39k
D1
12V
PWM
R12
2.2k
T3
MMBT3904
R49
120k
Q1
PSMN7R5–60YLX
Q2
PSMN7R5–60YLX
R6
2m
S_SHUNT–
T4 should provide solar panel short circuit protection during operation (yet to be tested)
GQ12
Q6
IRFB7787
Alternative: THT MOSFETs
Q7
IRFB7787
SMD MOSFET selection:
Rds(on) * I^2 < 0.8 W
10A: PSMN7R5–60YLX or BUK9Y7R2–60E,115
20A: CSD18540Q5B or SIR626LDP–T1–RE3
BAT+
Battery
12/24V
J3
MKDS 5/ 2–9,5
+3.3V
R45
120k
LOAD_DIS
R13
2.2k
T1
MMBT3904
R16
68k
R9
2.2k
TP2
G_LOAD
R17
2m
L_SHUNT+
Q3
PSMN7R5–60YLX
C27
10n
LOAD–
Load
J2
MKDS 5/ 2–9,5
J6
PWR_12V
+3.3V
U2C
C1
100n
V+
V–
TLV9002
Solar current
DAC
R3
68k
R1
2.2k
S_SHUNT–
R4
2.2k
U2A
TLV9002
R14
2.2k
TP4
I_SOLAR
C3
10n
R10
68k
Solar and battery voltage
VDDA
R24
8.2k
SOLAR–
R37
120k
V_SOLAR
R26
12k
C17
10n
BAT+
R25
120k
V_BAT
R27
12k
C18
10n
Negative voltage max:
10V bat – 55V panel = –35V
Load current
DAC
R19
68k
L_SHUNT+
R18
2.2k
R20
2.2k
U2B
TLV9002
R22
39k
TP5
I_LOAD
I_LOAD_COMP
R40
12k
R41
8.2k
C4
10n
R21
68k
Comparator for short circuit protection triggers if measured current >200%.
Output filter tuned to allow inrush current of 1000 uF capacitor connected to load.
COMP2 using Vref_int = 1.202 ... 1.242 V as reference triggered latest at Vout = 1.242V * (12+8.2)/8.2 = 3.06V
If not stated otherwise, all MLCC 50V X7R
PWM Solar Charge Controller
Libre Solar
Website: https://libre.solar
LIBRESOLAR
Sheet: /PWM power stage/
File: pwm.sch
Author: Martin Jäger
Size: A4
Date: 2019–08–16
Rev: 0.2.2
KiCad E.D.A. kicad 5.1.2
Page: 2/4


MCU STM32L072
STM Nucleo SWD
UEXT connector
I2C pull-ups
Serial interface
Status LEDs
with Charlieplexing
Temperature (external or internal)
MCU contains internal pull-up at NRST pin
COMP1 connected to pin PA1 can be used for wake-up if Vsolar > Vbat
1k series resistor for UART tested, but does not work with 115200 Bd
Either internal SMD NTC soldered or external sensor via 6P6C connector
Drive low if no ext. sensor detected
If not stated otherwise, all MLCC 50V X7R
PWM Solar Charge Controller
LIBRESOLAR
Libre Solar
Website: https://libre.solar
Sheet: /MCU/
File: mcu.sch
Author: Martin Jäger
Size: A4
Date: 2019-04-25
Rev: 0.2.2
KiCad E.D.A. kicad 5.1.2
Page: 3/4



PWM Solar Charge Controller		LIBRESOLAR
Libre Solar Website: https://libre.solar		
Sheet: /Power Supply/ File: power_supply.sch		
Author: Martin Jäger		
Size: A4	Date: 2019-04-25	Rev: 0.2.2
KiCad E.D.A. kicad 5.1.2		Page: 4/4