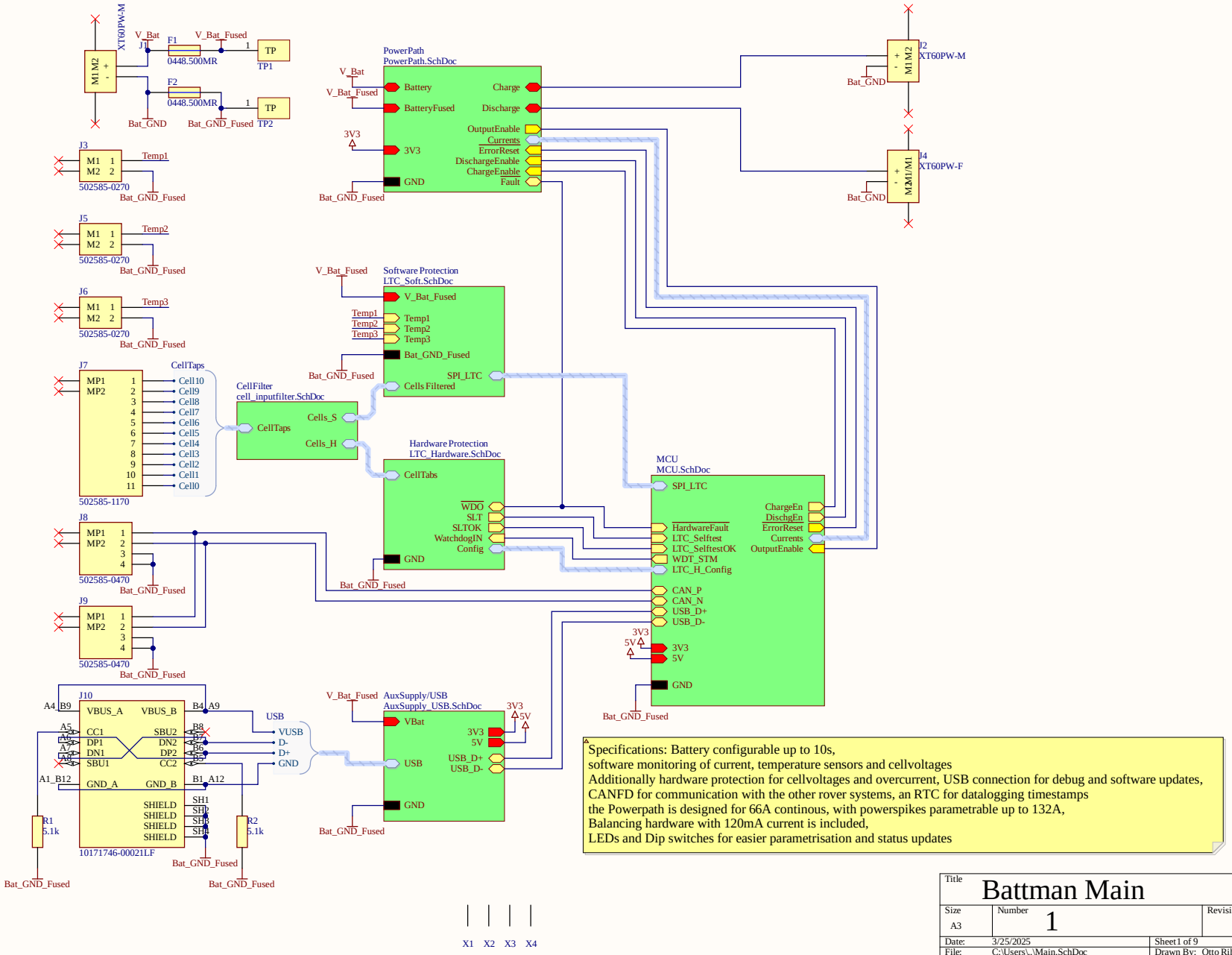
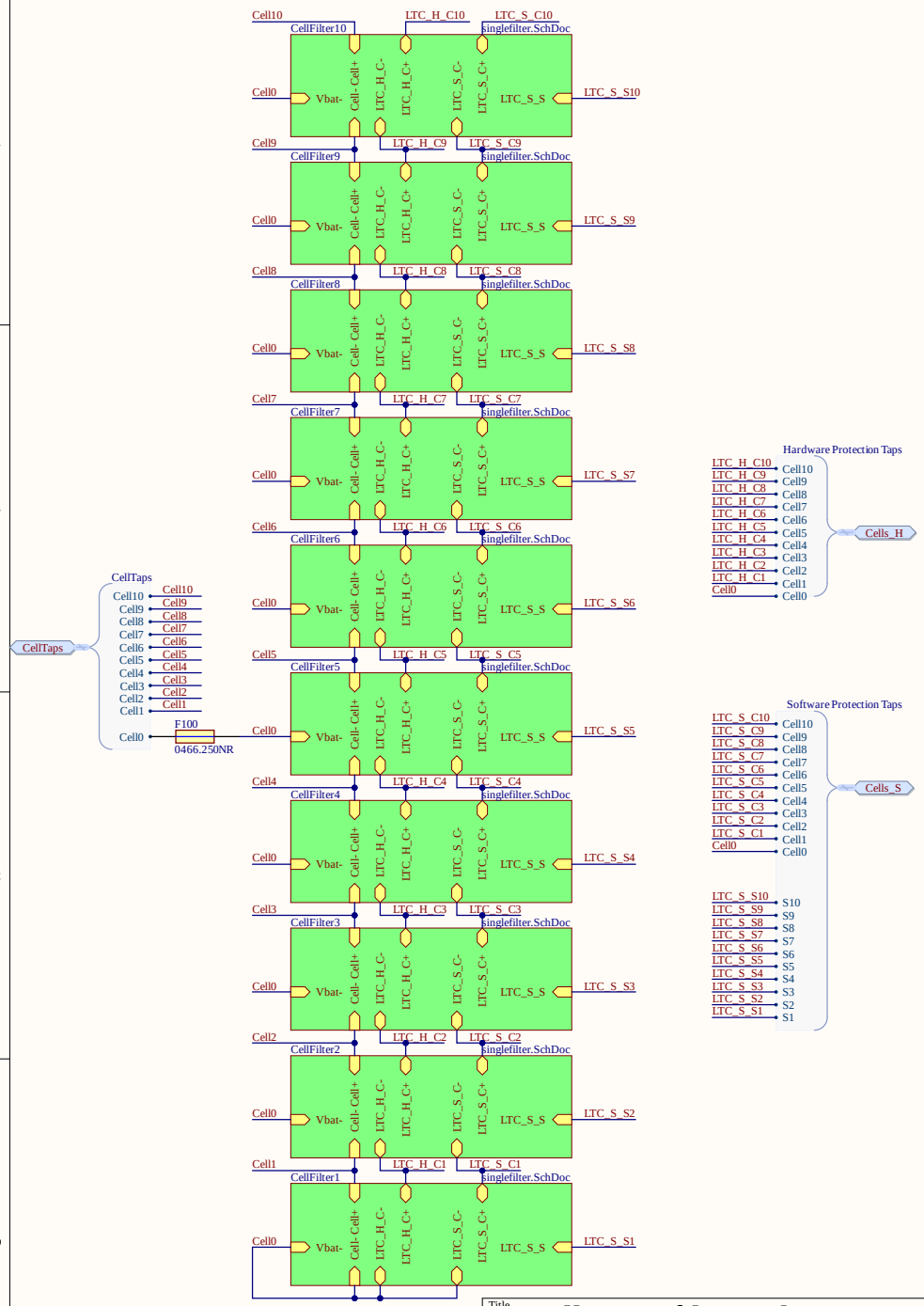
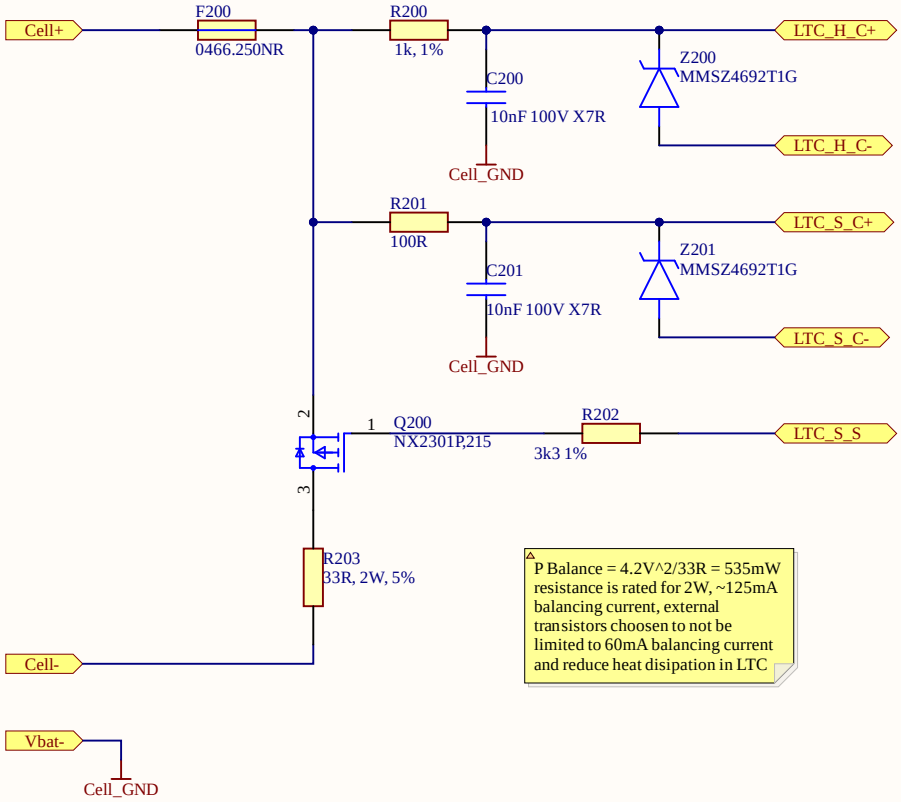

XT60PW-M
M1.M2
V_Bat
J1
F1
0448.500MR
V_Bat_Fused
TP
TP1
F2
0448.500MR
TP2
Bat_GND
Bat_GND_Fused
PowerPath
PowerPath.SchDoc
Battery
BatteryFused
3V3
GND
Charge
Discharge
OutputEnable
Currents
ErrorReset
DischargeEnable
ChargeEnable
Fault
J2
XT60PW-M
J4
XT60PW-F
J3
J5
J6
M1
M2
502585-0270
Temp1
Temp2
Temp3
J7
MP1
MP2
502585-1170
CellTaps
Cell10
Cell9
Cell8
Cell7
Cell6
Cell5
Cell4
Cell3
Cell2
Cell1
Cell0
CellFilter
cell_inputfilter.SchDoc
Cells_S
Cells_H
Software Protection
LTC_Soft.SchDoc
Cells Filtered
SPI_LTC
Hardware Protection
LTC_Hardware.SchDoc
CellTabs
WDO
SLT
SLTOK
WatchdogIN
Config
MCU
MCU.SCHDoc
HardwareFault
LTC_Selftest
LTC_SelftestOK
WDT_STM
LTC_H_Config
ChargeEn
DischgEn
ErrorReset
Currents
OutputEnable
CAN_P
CAN_N
USB_D+
USB_D-
5V
J8
J9
502585-0470
J10
VBUS_A
VBUS_B
CC1
CC2
DP1
DP2
DN1
DN2
SBU1
SBU2
GND_A
GND_B
SHIELD
10171746-00021LF
USB
VUSB
D-
D+
GND
AuxSupply/USB
AuxSupply_USB.SchDoc
VBat
USB
R1
5.1k
R2
5.1k
Specifications: Battery configurable up to 10s,
software monitoring of current, temperature sensors and cellvoltages
Additionally hardware protection for cellvoltages and overcurrent, USB connection for debug and software updates,
CANFD for communication with the other rover systems, an RTC for datalogging timestamps
the Powerpath is designed for 66A continous, with powerspikes parametrable up to 132A,
Balancing hardware with 120mA current is included,
LEDs and Dip switches for easier parametrisation and status updates
X1
X2
X3
X4
Title
Battman Main
Size
A3
Number
1
Revision
A2
Date:
3/25/2025
Sheet 1 of 9
File:
C:\Users\..\Main.SchDoc
Drawn By:
Otto Riha



Title	cell_inputfilter.SchDoc		
Size: A4	Number: 1	Revision: A0	
Date: 3/25/2025	Sheet 2 of 10		
File: C:\Users\..\cell_inputfilter.SchDoc	Drawn By: Otto Riha		



recommended filtering from LTC 6801 datasheet: 1kOhm 10nF to GND

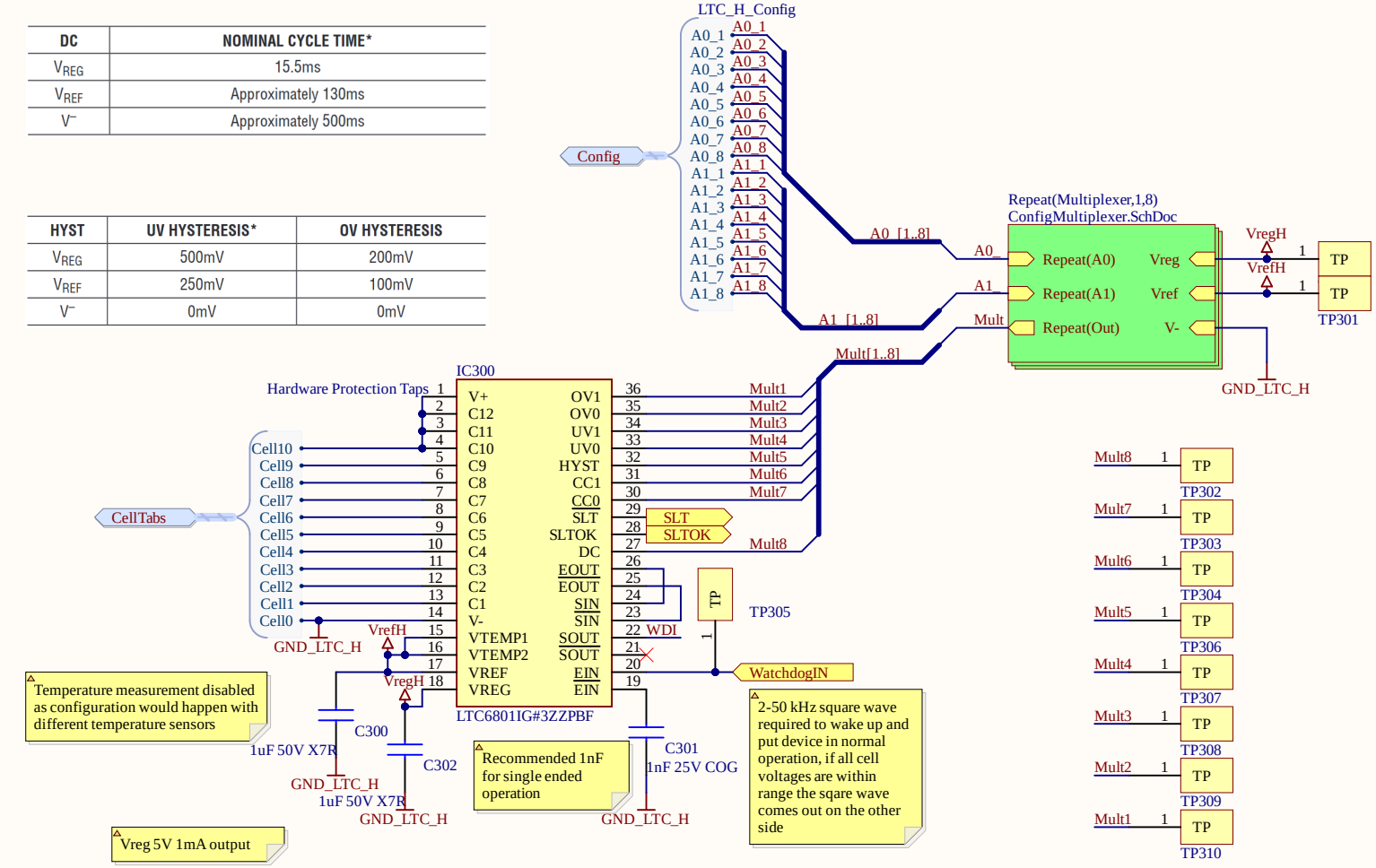
recomended filter components for maximum measurement accuracy from LTC 6811 datasheet: 100R 10nF, the zeners are there to reduce stress on internal protection circuit

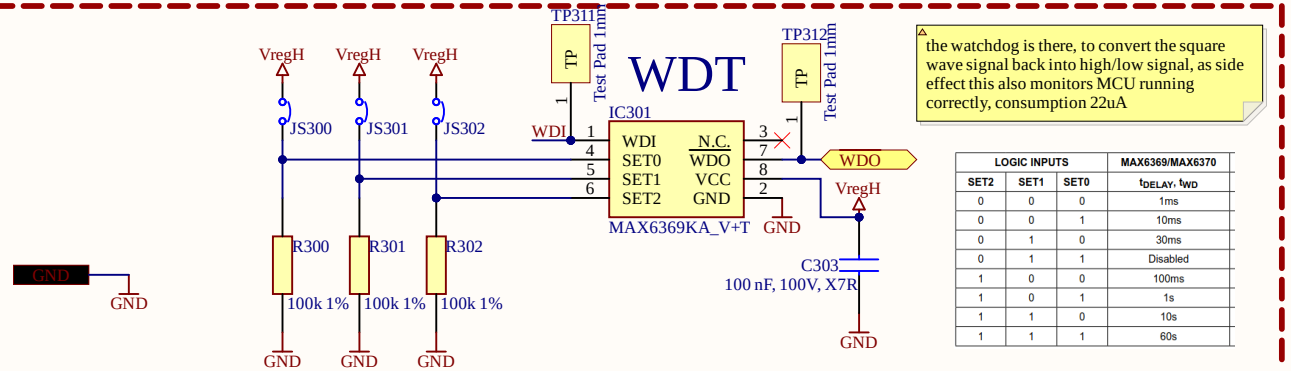
P Balance = 4.2V^2/33R = 535mW resistance is rated for 2W, ~125mA balancing current, external transistors choosen to not be limited to 60mA balancing current and reduce heat disipation in LTC

Title	singlefilter.SchDoc		
Size: A4	Number: 1	Revision: A1	
Date: 3/25/2025		Sheet 3 of 10	
File: C:\Users\..\singlefilter.SchDoc		Drawn By: Otto Riha	

DC	NOMINAL CYCLE TIME*
V_{REG}	15.5ms
V_{REF}	Approximately 130ms
V^-	Approximately 500ms

HYST	UV HYSTERESIS*	OV HYSTERESIS
V_{REG}	500mV	200mV
V_{REF}	250mV	100mV
V^-	0mV	0mV





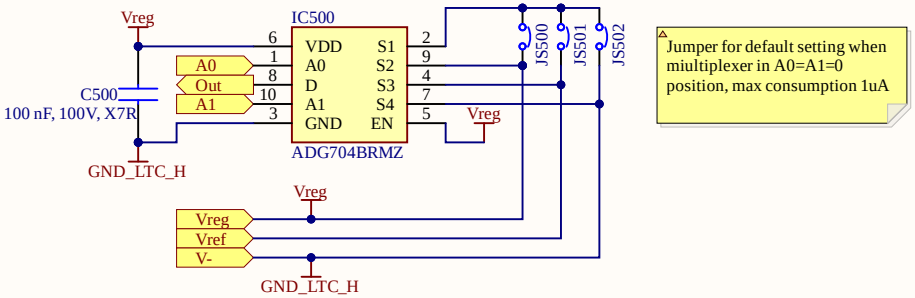
LOGIC INPUTS			MAX6369/MAX6370
SET2	SET1	SET0	t_{DELAY}, t_{WD}
0	0	0	1ms
0	0	1	10ms
0	1	0	30ms
0	1	1	Disabled
1	0	0	100ms
1	0	1	1s
1	1	0	10s
1	1	1	60s

OV1	OV0	OVERVOLTAGE THRESHOLD (V)
V_{REG}	V_{REG}	4.498
V_{REG}	V_{REF}	4.403
V_{REG}	V^-	4.307
V_{REF}	V_{REG}	4.211
V_{REF}	V_{REF}	4.116
V_{REF}	V^-	4.020
V^-	V_{REG}	3.924
V^-	V_{REF}	3.828
V^-	V^-	3.733

UV1	UV0	UNDERVOLTAGE THRESHOLD (V)
V_{REG}	V_{REG}	2.871
V_{REG}	V_{REF}	2.680
V_{REG}	V^-	2.489
V_{REF}	V_{REG}	2.297
V_{REF}	V_{REF}	2.106
V_{REF}	V^-	1.914
V^-	V_{REG}	1.723
V^-	V_{REF}	1.531
V^-	V^-	0.766

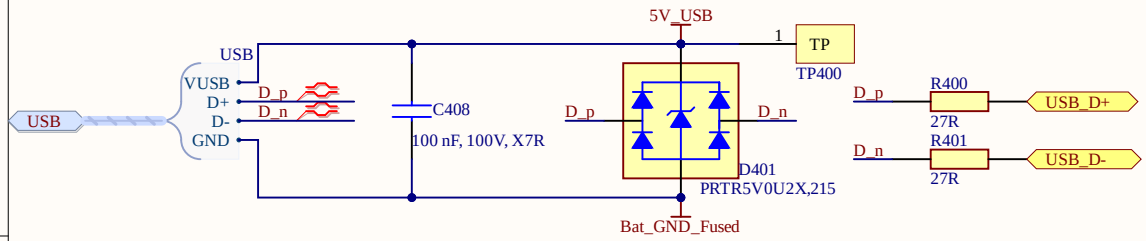
CC1	CC0	CELL COUNT
V_{REG}	V_{REG}	12
V_{REG}	V_{REF}	11
V_{REG}	V^-	10
V_{REF}	V_{REG}	9
V_{REF}	V_{REF}	8
V_{REF}	V^-	7
V^-	V_{REG}	6
V^-	V_{REF}	5
V^-	V^-	4

Title	LTC_Hardware.SchDoc	
Size: A4	Number: 1	Revision: A1
Date: 3/25/2025		Sheet 4 of 10
File: C:\Users\..\LTC_Hardware.SchDoc		Drawn By: Otto Riha

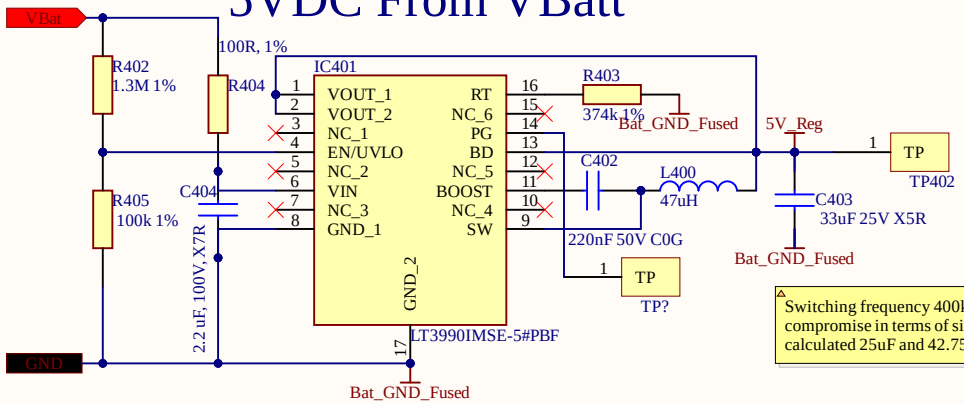


Title	ConfigMultiplexer.SchDoc		
Size: A4	Number: 1	Revision: A1	
Date: 3/25/2025		Sheet 5 of 10	
File: C:\Users\..\ConfigMultiplexer.SchDoc		Drawn By: Otto Riha	

USB INPUT Protection



5VDC From VBatt



Switching frequency 400kHz is a good compromise in terms of size and losses, calculated 25uF and 42.75uH

Undervoltage Lockup configured for 16.7V which corresponds to 2.4V/ cell on 7s and is an additional measure against deep discharge

$$L = 3\frac{V_{OUT} + V_D}{f_{SW}}$$

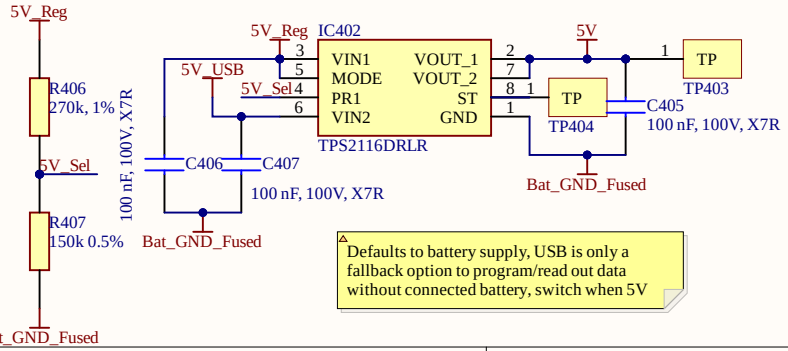
$$C_{OUT} = \frac{50}{V_{OUT} \cdot f_{SW}}$$

Consumption on 5V:

3.3V LDO	70.1mA
CAN Transceiver	110mA
Total	170.1mA

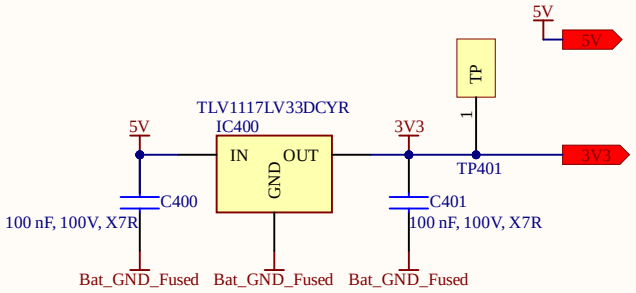
5V Selector

Switch threshold 4.5V



Defaults to battery supply, USB is only a fallback option to program/read out data without connected battery, switch when 5V

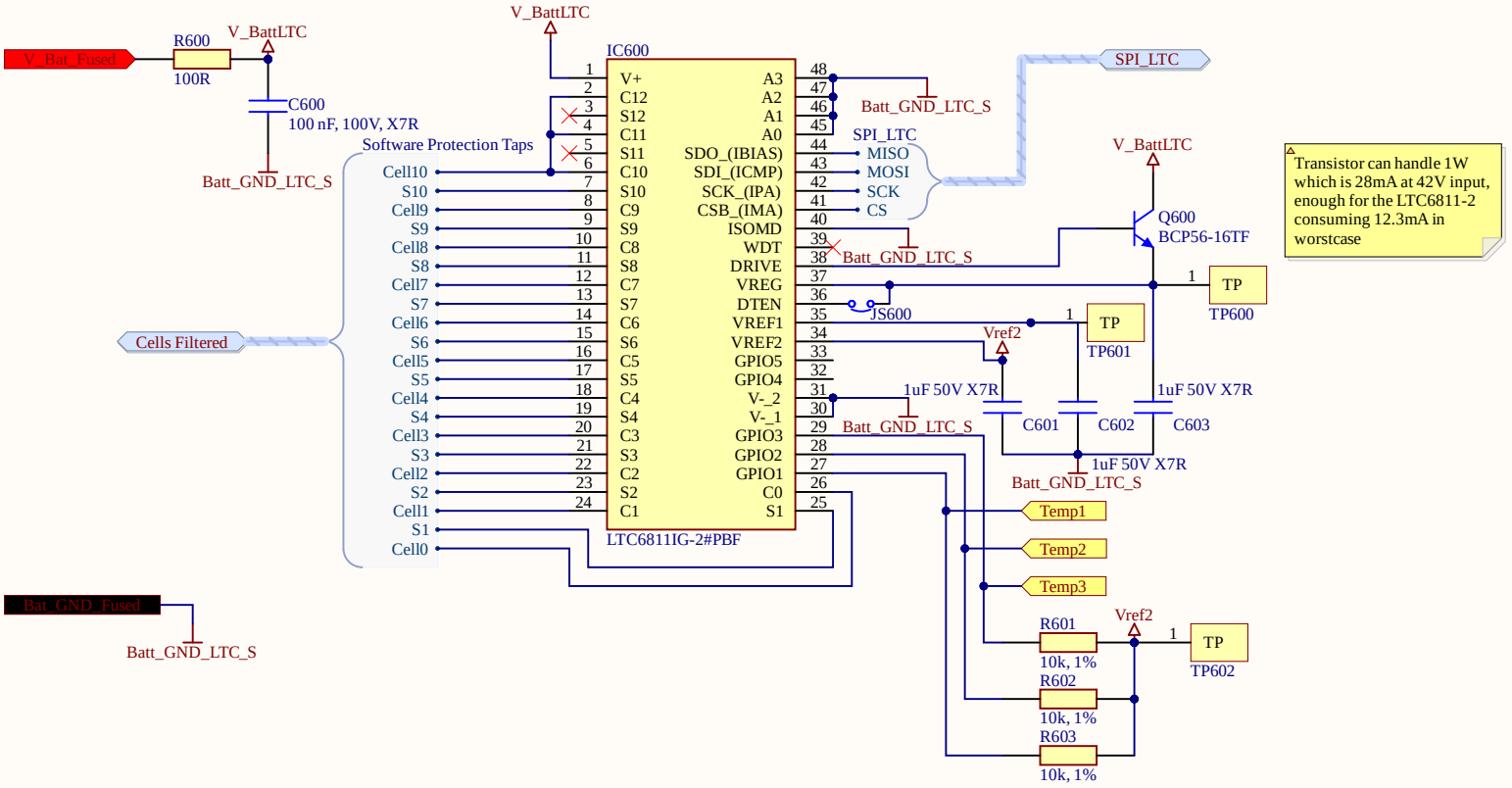
3,3V LDO



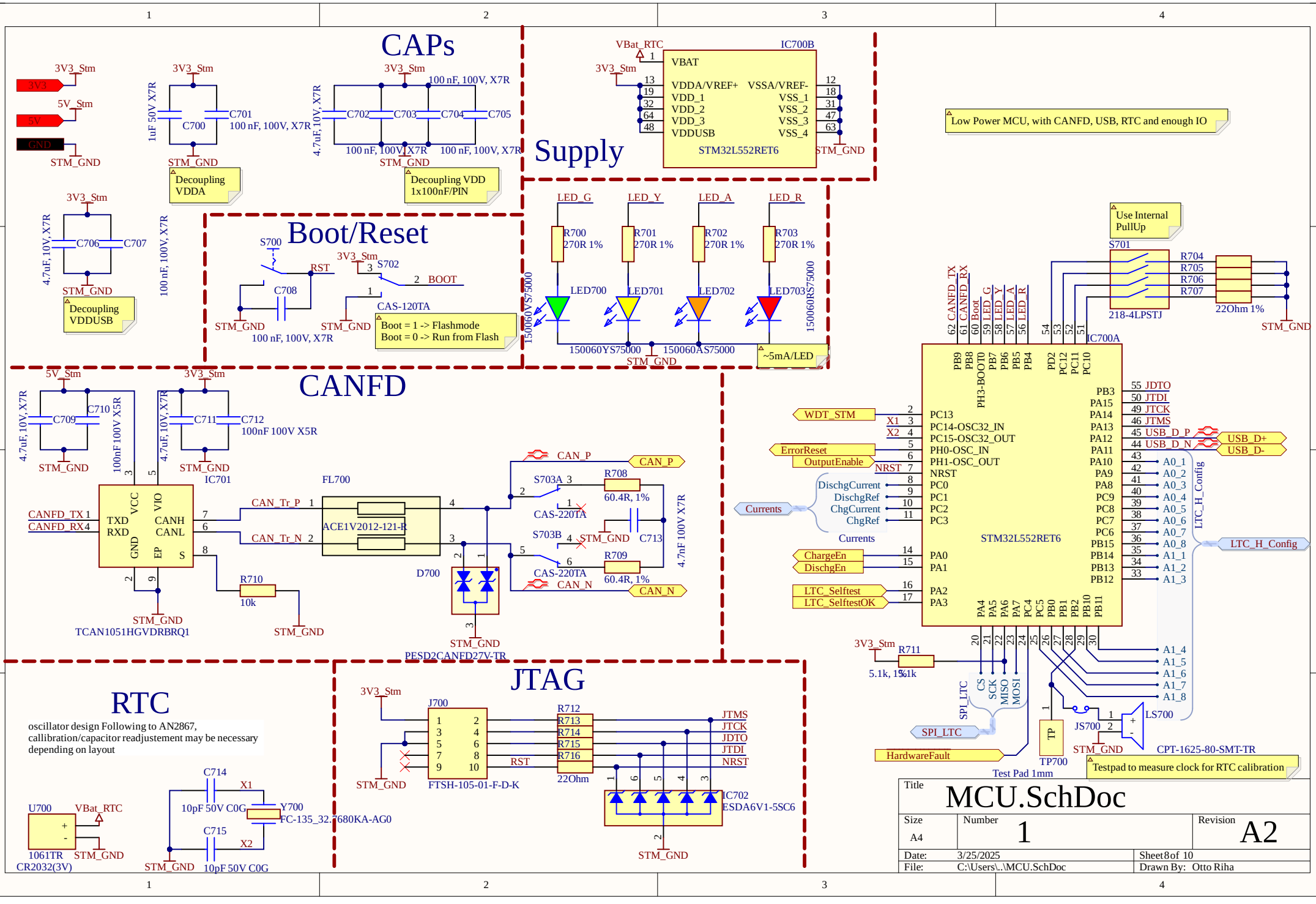
Consumption on 3.3V:

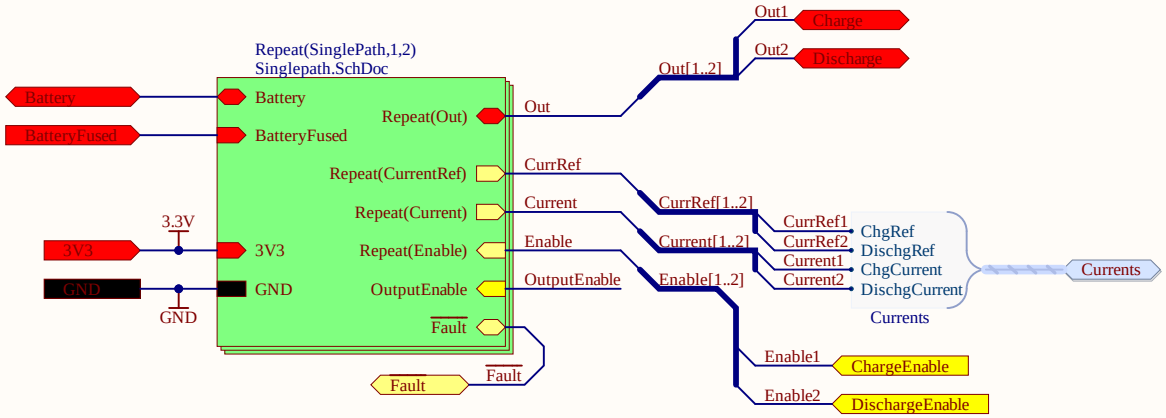
MCU	5.1mA
LED	20mA
Pullups	2mA
Latch	10mA
Current Sensors	30mA
Buzzer	3mA
Total	70.1mA

Title	AuxSupply_USB.SchDoc		
Size	A4	Number 1	Revision A1
Date:	3/25/2025		Sheet6of 10
File:	C:\Users\..\AuxSupply_USB.SchDoc		Drawn By: Otto Riha

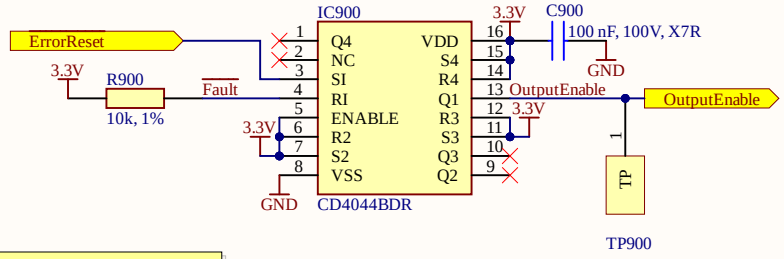


Title	LTC_Soft.SchDoc	
Size: A4	Number: 1	Revision: A1
Date: 3/25/2025		Sheet 7 of 10
File: C:\Users\..\LTC_Soft.SchDoc		Drawn By: Otto Riha


CAPs
Supply
Boot/Reset
CANFD
RTC
JTAG
Low Power MCU, with CANFD, USB, RTC and enough IO
STM32L552RET6
IC700B
IC700A
3V3_Stm
5V_Stm
STM_GND
Decoupling VDDA
Decoupling VDD 1x100nF/PIN
Decoupling VDDUSB
C700
C701
100 nF, 100V, X7R
1uF 50V X7R
C702
C703
C704
C705
4.7uF, 10V, X7R
C706
C707
100 nF, 100V, X7R
S700
S702
RST
BOOT
CAS-120TA
C708
Boot = 1 -> Flashmode
Boot = 0 -> Run from Flash
LED_G
LED_Y
LED_A
LED_R
R700 270R 1%
R701 270R 1%
R702 270R 1%
R703 270R 1%
LED700
LED701
LED702
LED703
150060YS75000
150060AS75000
150060RS75000
~5mA/LED
Use Internal PullUp
S701
218-4LPSTJ
R704
R705
R706
R707
22Ohm 1%
C709
C710
C711
C712
100nF 100V X5R
4.7uF, 10V, X7R
100nF 100V X5R
IC701
TCAN1051HGVDRBRQ1
CANFD_TX
CANFD_RX
TXD
RXD
VCC
VIO
CANH
CANL
GND
EP
S
FL700
ACE1V2012-121-R
CAN_Tr_P
CAN_Tr_N
CAN_P
CAN_N
S703A
S703B
CAS-220TA
R708
R709
60.4R, 1%
C713
4.7nF 100V X7R
D700
PESD2CANFD27V-TR
R710
10k
WDT_STM
ErrorReset
OutputEnable
NRST
DischgCurrent
DischgRef
ChgCurrent
ChgRef
Currents
ChargeEn
DischgEn
LTC_Selftest
LTC_SelftestOK
PC13
PC14-OSC32_IN
PC15-OSC32_OUT
PH0-OSC_IN
PH1-OSC_OUT
PH3-BOOT0
USB_D_P
USB_D_N
USB_D+
USB_D-
LTC_H_Config
A0_1
A0_2
A0_3
A0_4
A0_5
A0_6
A0_7
A0_8
A1_1
A1_2
A1_3
A1_4
A1_5
A1_6
A1_7
A1_8
R711
5.1k, 1%
SPI_LTC
CS
SCK
MISO
MOSI
HardwareFault
TP
TP700
Test Pad 1mm
JS700
LS700
CPT-1625-80-SMT-TR
Testpad to measure clock for RTC calibration
RTC
oscillator design Following to AN2867,
callibration/capacitor readjustement may be necessary
depending on layout
U700
VBat_RTC
1061TR
CR2032(3V)
C714
C715
10pF 50V C0G
X1
X2
Y700
FC-135_32.7680KA-AG0
JTAG
J700
FTSH-105-01-F-D-K
R712
R713
R714
R715
R716
22Ohm
RST
JTMS
JTCK
JDTO
JTDI
NRST
IC702
ESDA6V1-5SC6
Title
MCU.SchDoc
Size
A4
Number
1
Revision
A2
Date:
3/25/2025
Sheet 8 of 10
File:
C:\Users\..\MCU.SchDoc
Drawn By:
Otto Riha



Error latch



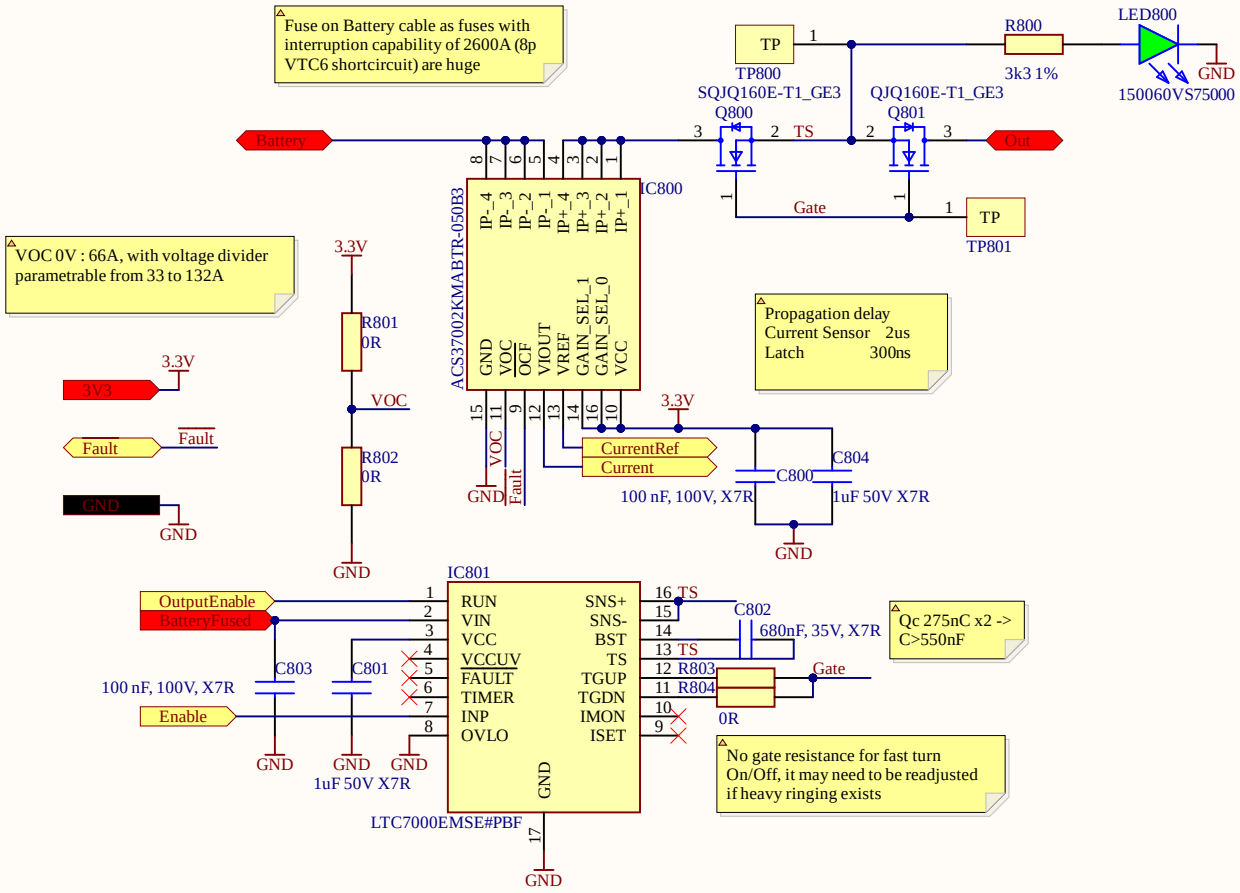
S	R	E	Q
X	X	0	OC*
1	1	1	NC+
0	1	1	1
1	0	1	0
0	0	1	Δ Δ

*OPEN CIRCUIT
+ NO CHANGE
Δ Δ DOMINATED BY R=0 INPUT

CD4044B

Pullup needed as current sensor and WDT outputs are all open drain

Title	PowerPath.SchDoc		
Size: A4	Number: 1		Revision: A1
Date: 3/25/2025		Sheet 9 of 10	
File: C:\Users\..\PowerPath.SchDoc		Drawn By: Otto Riha	



Title	Singlepath.SchDoc	
Size: A4	Number: 1	Revision: A2
Date: 3/25/2025	Sheet 10 of 10	
File: C:\Users\..\Singlepath.SchDoc	Drawn By: Otto Riha	