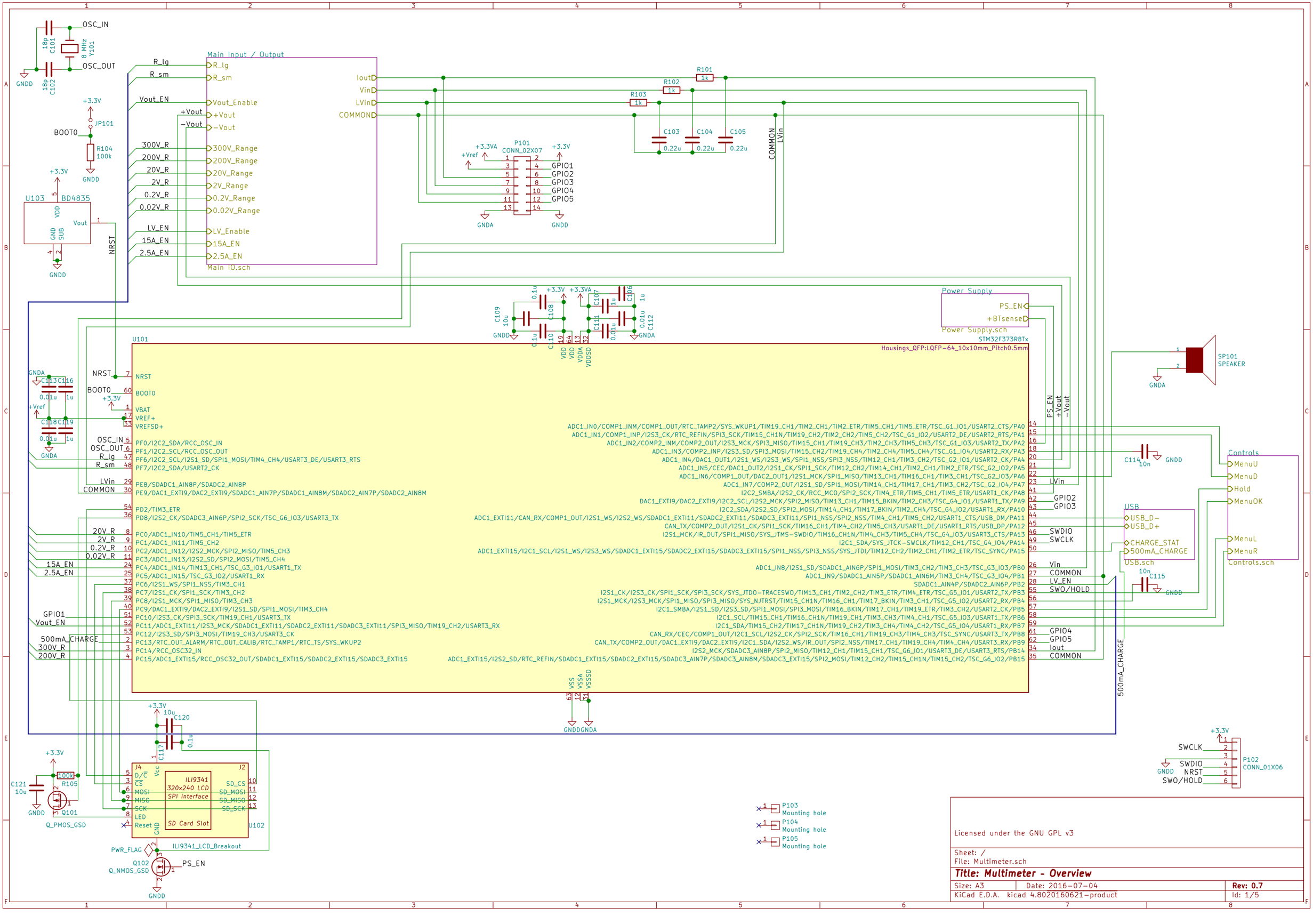
OSC_IN
OSC_OUT
18p C101
18p C102
8 MHz Y101
GNDD
+3.3V
JP101
BOOT0
R104 100k
GNDD
U103 BD4835
VDD
Vout
GND SUB
NRST
GNDD
Main Input / Output
R_lg
R_sm
Vout_EN
+Vout
−Vout
300V_R
200V_R
20V_R
2V_R
0.2V_R
0.02V_R
LV_EN
15A_EN
2.5A_EN
Iout
Vin
LVin
COMMON
300V_Range
200V_Range
20V_Range
2V_Range
0.2V_Range
0.02V_Range
LV_Enable
15A_EN
2.5A_EN
Main IO.sch
R101 1k
R102 1k
R103 1k
C103 0.22u
C104 0.22u
C105 0.22u
COMMON
LVin
+3.3VA
+Vref
P101
CONN_02X07
+3.3V
GPIO1
GPIO2
GPIO3
GPIO4
GPIO5
GNDA
GNDD
C109 10u
C108 0.1u
C110 0.1u
C107 1u
C106 1u
C111 0.01u
C112 0.01u
VDD
VDD
VDDA
VDDSD
GNDA
Power Supply
PS_EN
+BTsense
Power Supply.sch
U101
STM32F373R8Tx
Housings_QFP:LQFP-64_10x10mm_Pitch0.5mm
NRST
BOOT0
VBAT
VREF+
VREFSD+
PF0/I2C2_SDA/RCC_OSC_IN
PF1/I2C2_SCL/RCC_OSC_OUT
PF6/I2C2_SCL/I2S1_SD/SPI1_MOSI/TIM4_CH4/USART3_DE/USART3_RTS
PF7/I2C2_SDA/USART2_CK
PE8/SDADC1_AIN8P/SDADC2_AIN8P
PE9/DAC1_EXTI9/DAC2_EXTI9/SDADC1_AIN7P/SDADC1_AIN8M/SDADC2_AIN7P/SDADC2_AIN8M
PD2/TIM3_ETR
PD8/I2S2_CK/SDADC3_AIN6P/SPI2_SCK/TSC_G6_IO3/USART3_TX
PC0/ADC1_IN10/TIM5_CH1/TIM5_ETR
PC1/ADC1_IN11/TIM5_CH2
PC2/ADC1_IN12/I2S2_MCK/SPI2_MISO/TIM5_CH3
PC3/ADC1_IN13/I2S2_SD/SPI2_MOSI/TIM5_CH4
PC4/ADC1_IN14/TIM13_CH1/TSC_G3_IO1/USART1_TX
PC5/ADC1_IN15/TSC_G3_IO2/USART1_RX
PC6/I2S1_WS/SPI1_NSS/TIM3_CH1
PC7/I2S1_CK/SPI1_SCK/TIM3_CH2
PC8/I2S1_MCK/SPI1_MISO/TIM3_CH3
PC9/DAC1_EXTI9/DAC2_EXTI9/I2S1_SD/SPI1_MOSI/TIM3_CH4
PC10/I2S3_CK/SPI3_SCK/TIM19_CH1/USART3_TX
PC11/ADC1_EXTI11/I2S3_MCK/SDADC1_EXTI11/SDADC2_EXTI11/SDADC3_EXTI11/SPI3_MISO/TIM19_CH2/USART3_RX
PC12/I2S3_SD/SPI3_MOSI/TIM19_CH3/USART3_CK
PC13/RTC_OUT_ALARM/RTC_OUT_CALIB/RTC_TAMP1/RTC_TS/SYS_WKUP2
PC14/RCC_OSC32_IN
PC15/ADC1_EXTI15/RCC_OSC32_OUT/SDADC1_EXTI15/SDADC2_EXTI15/SDADC3_EXTI15
ADC1_IN0/COMP1_INM/COMP1_OUT/RTC_TAMP2/SYS_WKUP1/TIM19_CH1/TIM2_CH1/TIM2_ETR/TIM5_CH1/TIM5_ETR/TSC_G1_IO1/USART2_CTS/PA0
ADC1_IN1/COMP1_INP/I2S3_CK/RTC_REFIN/SPI3_SCK/TIM15_CH1N/TIM19_CH2/TIM2_CH2/TIM5_CH2/TSC_G1_IO2/USART2_DE/USART2_RTS/PA1
ADC1_IN2/COMP2_INM/COMP2_OUT/I2S3_MCK/SPI3_MISO/TIM15_CH1/TIM19_CH3/TIM2_CH3/TIM5_CH3/TSC_G1_IO3/USART2_TX/PA2
ADC1_IN3/COMP2_INP/I2S3_SD/SPI3_MOSI/TIM15_CH2/TIM19_CH4/TIM2_CH4/TIM5_CH4/TSC_G1_IO4/USART2_RX/PA3
ADC1_IN4/DAC1_OUT1/I2S1_WS/I2S3_WS/SPI1_NSS/SPI3_NSS/TIM12_CH1/TIM3_CH2/TSC_G2_IO1/USART2_CK/PA4
ADC1_IN5/CEC/DAC1_OUT2/I2S1_CK/SPI1_SCK/TIM12_CH2/TIM14_CH1/TIM2_CH1/TIM2_ETR/TSC_G2_IO2/PA5
ADC1_IN6/COMP1_OUT/DAC2_OUT1/I2S1_MCK/SPI1_MISO/TIM13_CH1/TIM16_CH1/TIM3_CH1/TSC_G2_IO3/PA6
ADC1_IN7/COMP2_OUT/I2S1_SD/SPI1_MOSI/TIM14_CH1/TIM17_CH1/TIM3_CH2/TSC_G2_IO4/PA7
I2C2_SMBA/I2S2_CK/RCC_MCO/SPI2_SCK/TIM4_ETR/TIM5_CH1/TIM5_ETR/USART1_CK/PA8
DAC1_EXTI9/DAC2_EXTI9/I2C2_SCL/I2S2_MCK/SPI2_MISO/TIM13_CH1/TIM15_BKIN/TIM2_CH3/TSC_G4_IO1/USART1_TX/PA9
I2C2_SDA/I2S2_SD/SPI2_MOSI/TIM14_CH1/TIM17_BKIN/TIM2_CH4/TSC_G4_IO2/USART1_RX/PA10
ADC1_EXTI11/CAN_RX/COMP1_OUT/I2S1_WS/I2S2_WS/SDADC1_EXTI11/SDADC2_EXTI11/SDADC3_EXTI11/SPI1_NSS/SPI2_NSS/TIM4_CH1/TIM5_CH2/USART1_CTS/USB_DM/PA11
CAN_TX/COMP2_OUT/I2S1_CK/SPI1_SCK/TIM16_CH1/TIM4_CH2/TIM5_CH3/USART1_DE/USART1_RTS/USB_DP/PA12
I2S1_MCK/IR_OUT/SPI1_MISO/SYS_JTMS-SWDIO/TIM16_CH1N/TIM4_CH3/TIM5_CH4/TSC_G4_IO3/USART3_CTS/PA13
I2C1_SDA/SYS_JTCK-SWCLK/TIM12_CH1/TSC_G4_IO4/PA14
ADC1_EXTI15/I2C1_SCL/I2S1_WS/I2S3_WS/SDADC1_EXTI15/SDADC2_EXTI15/SDADC3_EXTI15/SPI1_NSS/SPI3_NSS/SYS_JTDI/TIM12_CH2/TIM2_CH1/TIM2_ETR/TSC_SYNC/PA15
ADC1_IN8/I2S1_SD/SDADC1_AIN6P/SPI1_MOSI/TIM3_CH2/TIM3_CH3/TSC_G3_IO3/PB0
ADC1_IN9/SDADC1_AIN5P/SDADC1_AIN6M/TIM3_CH4/TSC_G3_IO4/PB1
SDADC1_AIN4P/SDADC2_AIN6P/PB2
I2S1_CK/I2S3_CK/SPI1_SCK/SPI3_SCK/SYS_JTDO-TRACESWO/TIM13_CH1/TIM2_CH2/TIM3_ETR/TIM4_ETR/TSC_G5_IO1/USART2_TX/PB3
I2S1_MCK/I2S3_MCK/SPI1_MISO/SPI3_MISO/SYS_NJTRST/TIM15_CH1N/TIM16_CH1/TIM17_BKIN/TIM3_CH1/TSC_G5_IO2/USART2_RX/PB4
I2C1_SMBA/I2S1_SD/I2S3_SD/SPI1_MOSI/SPI3_MOSI/TIM16_BKIN/TIM17_CH1/TIM19_ETR/TIM3_CH2/USART2_CK/PB5
I2C1_SCL/TIM15_CH1/TIM16_CH1N/TIM19_CH1/TIM3_CH3/TIM4_CH1/TSC_G5_IO3/USART1_TX/PB6
I2C1_SDA/TIM15_CH2/TIM17_CH1N/TIM19_CH2/TIM3_CH4/TIM4_CH2/TSC_G5_IO4/USART1_RX/PB7
CAN_RX/CEC/COMP1_OUT/I2C1_SCL/I2S2_CK/SPI2_SCK/TIM16_CH1/TIM19_CH3/TIM4_CH3/TSC_SYNC/USART3_TX/PB8
CAN_TX/COMP2_OUT/DAC1_EXTI9/DAC2_EXTI9/I2C1_SDA/I2S2_WS/IR_OUT/SPI2_NSS/TIM17_CH1/TIM19_CH4/TIM4_CH4/USART3_RX/PB9
I2S2_MCK/SDADC3_AIN8P/SPI2_MISO/TIM12_CH1/TIM15_CH1/TSC_G6_IO1/USART3_DE/USART3_RTS/PB14
ADC1_EXTI15/I2S2_SD/RTC_REFIN/SDADC1_EXTI15/SDADC2_EXTI15/SDADC3_AIN7P/SDADC3_AIN8M/SDADC3_EXTI15/SPI2_MOSI/TIM12_CH2/TIM15_CH1N/TIM15_CH2/TSC_G6_IO2/PB15
VSS
VSSA
VSSSD
GNDDGNDA
PS_EN
+Vout
−Vout
LVin
COMMON
GPIO2
GPIO3
SWDIO
SWCLK
GPIO4
GPIO5
Iout
LV_EN
SWO/HOLD
500mA_CHARGE
SP101 SPEAKER
C114 10n
Controls
MenuU
MenuD
Hold
MenuOK
MenuL
MenuR
Controls.sch
USB
USB_D−
USB_D+
CHARGE_STAT
500mA_CHARGE
USB.sch
C115 10n
C113 0.01u
C116 1u
C118 0.01u
C119 1u
C120 10u
C117 0.1u
J4
J2
ILI9341
320x240 LCD
SPI Interface
SD Card Slot
D/C
CS
MOSI
MISO
SCK
LED
Reset
Vcc
GND
SD_CS
SD_MOSI
SD_MISO
SD_SCK
U102
ILI9341_LCD_Breakout
C121 10u
R105 100k
Q101 Q_PMOS_GSD
Q102 Q_NMOS_GSD
PWR_FLAG
P102 CONN_01X06
SWCLK
SWDIO
NRST
SWO/HOLD
P103 Mounting hole
P104 Mounting hole
P105 Mounting hole
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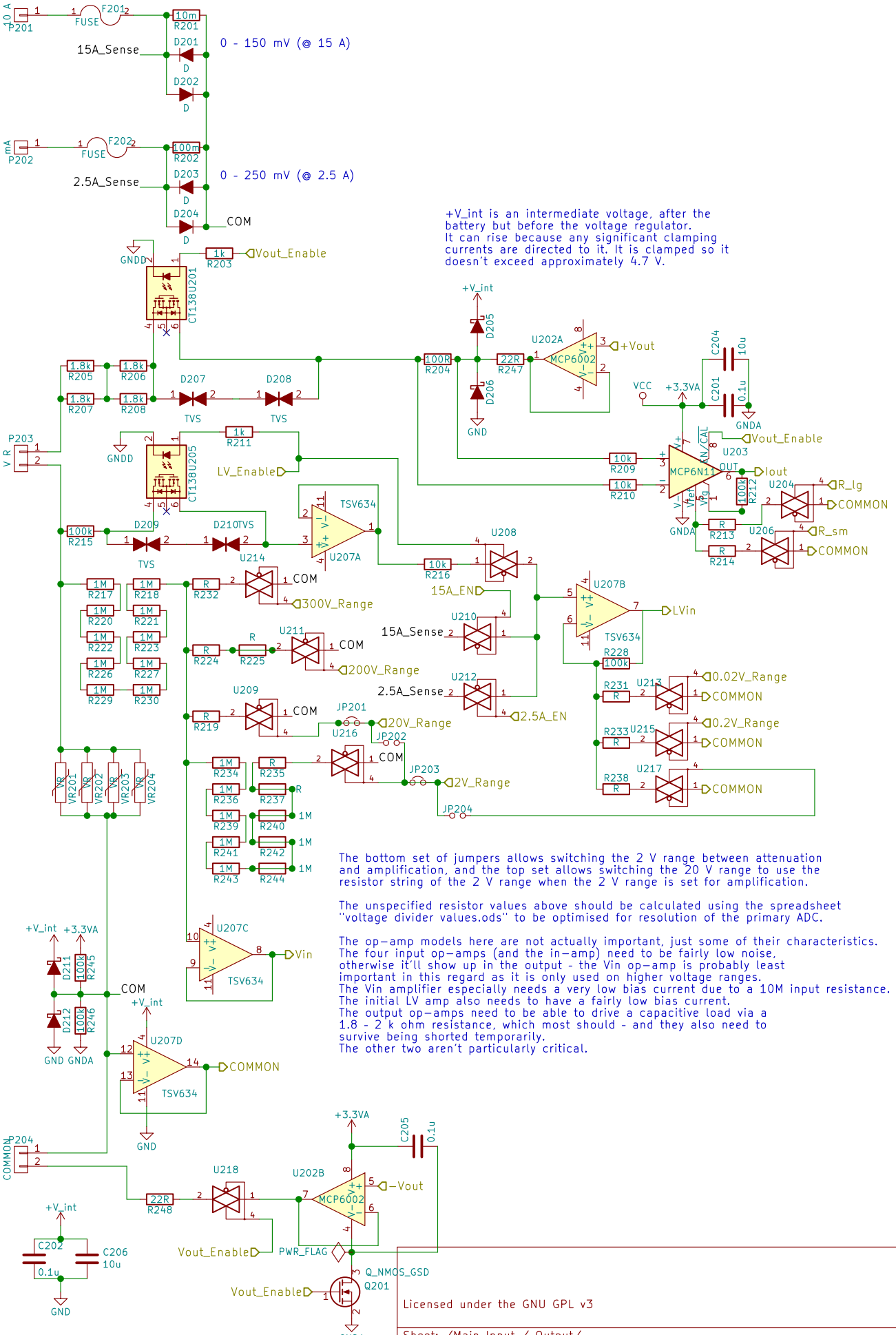
Sheet: /
File: Multimeter.sch
Title: Multimeter - Overview
Size: A3
Date: 2016-07-04
Rev: 0.7
KiCad E.D.A. kicad 4.8020160621-product
Id: 1/5


10 A
P201
FUSE
F201
10m
R201
15A_Sense
D201
D202
0 - 150 mV (@ 15 A)
mA
P202
FUSE
F202
100m
R202
2.5A_Sense
D203
D204
0 - 250 mV (@ 2.5 A)
COM
GNDD
1k
R203
Vout_Enable
CT138U201
+V_int is an intermediate voltage, after the battery but before the voltage regulator. It can rise because any significant clamping currents are directed to it. It is clamped so it doesn't exceed approximately 4.7 V.
+V_int
D205
D206
GND
100R
R204
22R
R247
U202A
MCP6002
+Vout
C204
10u
C201
0.1u
VCC
+3.3VA
GNDA
1.8k
R205
R206
R207
R208
D207
D208
TVS
P203
V R
GNDD
1k
R211
LV_Enable
CT138U205
10k
R209
10k
R210
U203
MCP6N11
AN/CAL
OUT
Iout
100k
R212
U204
R_lg
COMMON
R213
U206
R_sm
R214
100k
R215
D209
D210
TSV634
U207A
U208
10k
R216
15A_EN
U207B
LVin
TSV634
U214
1M
R217
R218
R
R232
300V_Range
U210
15A_Sense
U211
R224
R225
200V_Range
U212
2.5A_Sense
2.5A_EN
R228
100k
U209
R219
JP201
20V_Range
U216
JP202
JP203
2V_Range
JP204
R231
U213
0.02V_Range
R233
U215
0.2V_Range
R238
U217
VR201
VR202
VR203
VR204
R234
R235
R236
R237
R239
R240
R241
R242
R243
R244
1M
U207C
Vin
TSV634
D211
D212
100k
R245
R246
GND
GNDA
U207D
TSV634
P204
COMMON
22R
R248
U218
U202B
MCP6002
-Vout
C205
0.1u
C202
C206
10u
Vout_Enable
PWR_FLAG
Q_NMOS_GSD
Q201
The bottom set of jumpers allows switching the 2 V range between attenuation and amplification, and the top set allows switching the 20 V range to use the resistor string of the 2 V range when the 2 V range is set for amplification.
The unspecified resistor values above should be calculated using the spreadsheet "voltage divider values.ods" to be optimised for resolution of the primary ADC.
The op-amp models here are not actually important, just some of their characteristics.
The four input op-amps (and the in-amp) need to be fairly low noise, otherwise it'll show up in the output - the Vin op-amp is probably least important in this regard as it is only used on higher voltage ranges.
The Vin amplifier especially needs a very low bias current due to a 10M input resistance.
The initial LV amp also needs to have a fairly low bias current.
The output op-amps need to be able to drive a capacitive load via a 1.8 - 2 k ohm resistance, which most should - and they also need to survive being shorted temporarily.
The other two aren't particularly critical.
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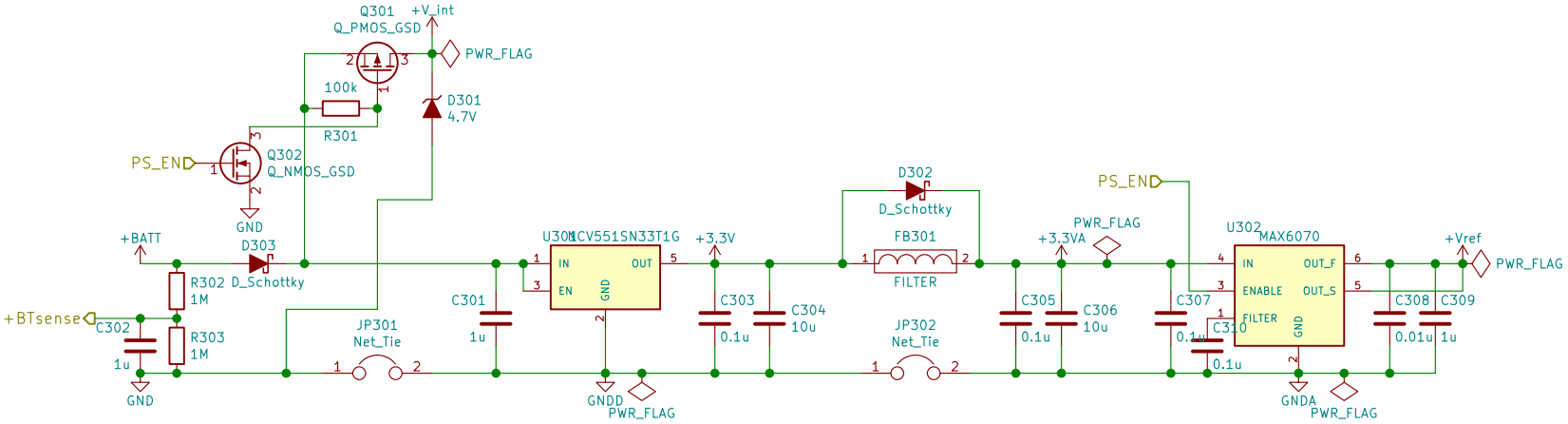
Sheet: /Main Input / Output/
File: Main IO.sch
Title: Main I/O
Size: A4
Date: 2016-07-04
Rev: 0.7
KiCad E.D.A. kicad 4.8020160621-product
Id: 2/5



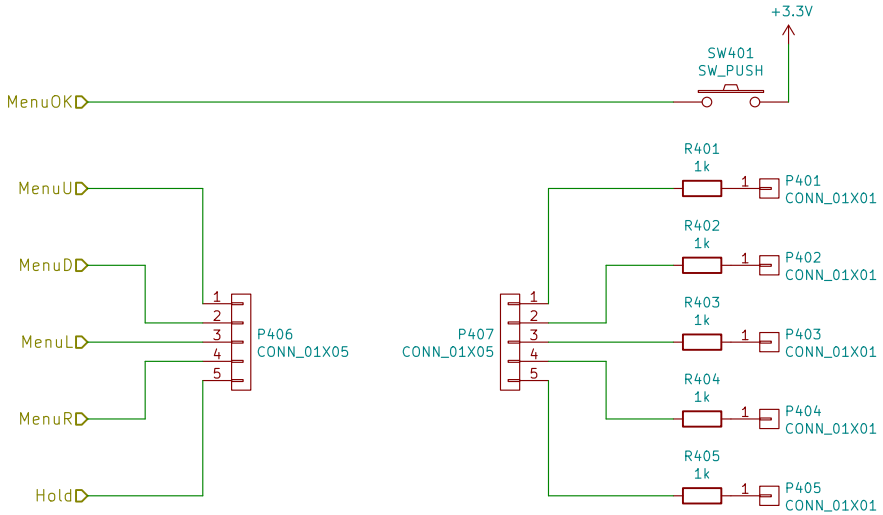
The net ties put the grounds on different nets while leaving them connected so that they can be routed separately on the PCB.

Sheet: /Power Supply/
File: Power Supply.sch

Title: Power supply

Size: A4	Date: 2016-07-04	**Rev: 0.7**
KiCad E.D.A. kicad 4.8020160621-product		Id: 3/5

The touch buttons are on their own board that is in contact with the case (or the underside of the case itself).



Capacitance
Resistance / diode / continuity (select with Range)
LCR
Voltage - AC/DC, RMS, DC offset, peaks, frequency, duty cycle
Current, as for voltage
Power, power factor, voltage, current, much as for voltage (probably can't fit all at once; select connection style with Range)

Could probably auto-detect voltage, current, power, but that conflicts with manual ranging. Power always does though, because it has both current and voltage.

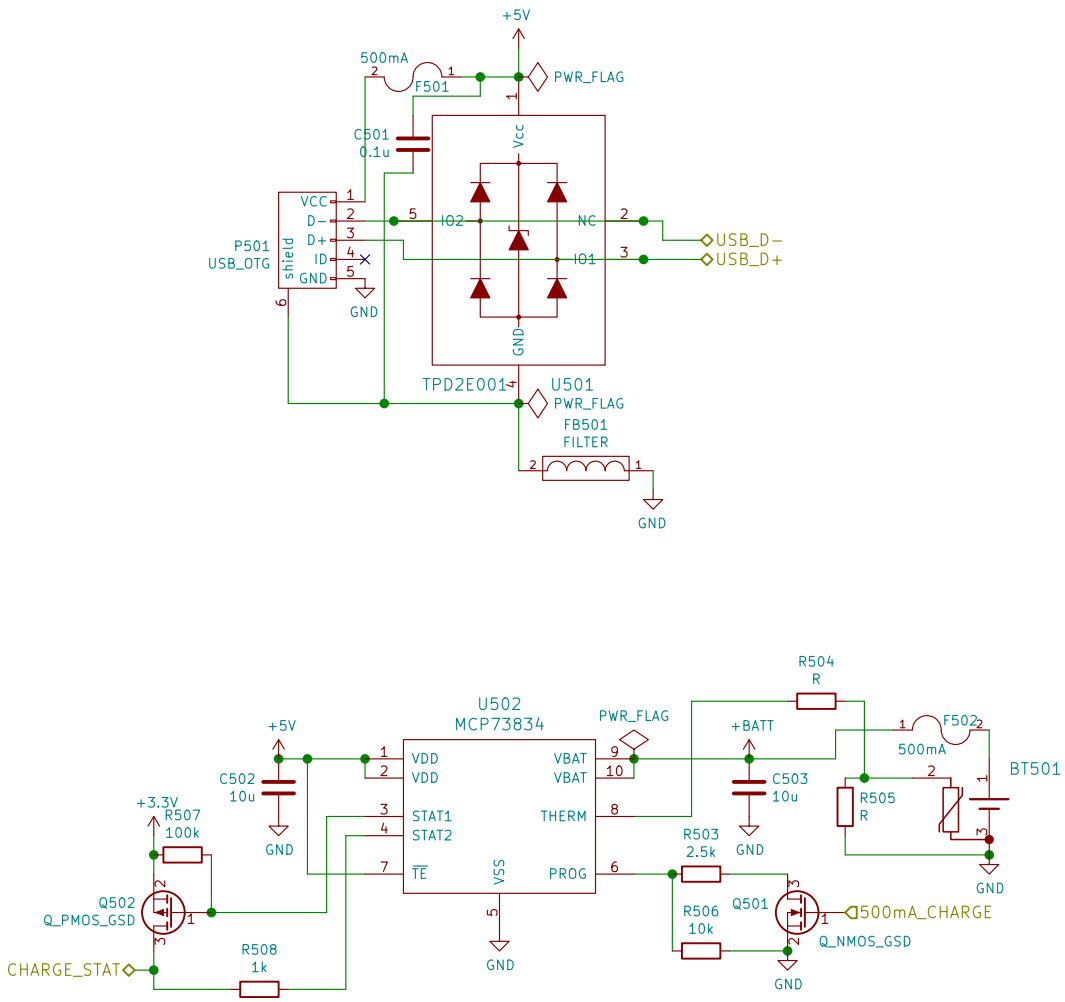
Power has four connection styles, although two are the same from the point of view of power: Current and Common on negative / neutral or on positive / live (positive or negative voltage readings, respectively), and Current upstream or downstream of Common for each of the previous two (positive or negative current readings, respectively). Combining both negative shows positive power, but negative components unless known. Combining one of each shows one component negative, but also shows negative power, unless known. We need to know because negative power is very real - the "load" is actually a source, and would be useful for things like batteries where power flows in both directions.

Range +/-: Increase or decrease through possible ranges - probably don't wrap, but not sure yet. Both returns to auto-ranging.
Rel: Relative measurement. For voltage or current, also has long-term max and min - however, they could have problems with a zero reading, for instance when changing measurement terminals.

Sheet: /Controls/
File: Controls.sch

Title: Interface inputs

Size: A4	Date: 2016-07-04	**Rev: 0.7**
KiCad E.D.A. kicad 4.8020160621-product		Id: 4/5



Sheet: /USB/
File: USB.sch

Title: USB and charging

Size: A4	Date: 2016-07-04	**Rev: 0.7**
KiCad E.D.A. kicad 4.8020160621-product		Id: 5/5