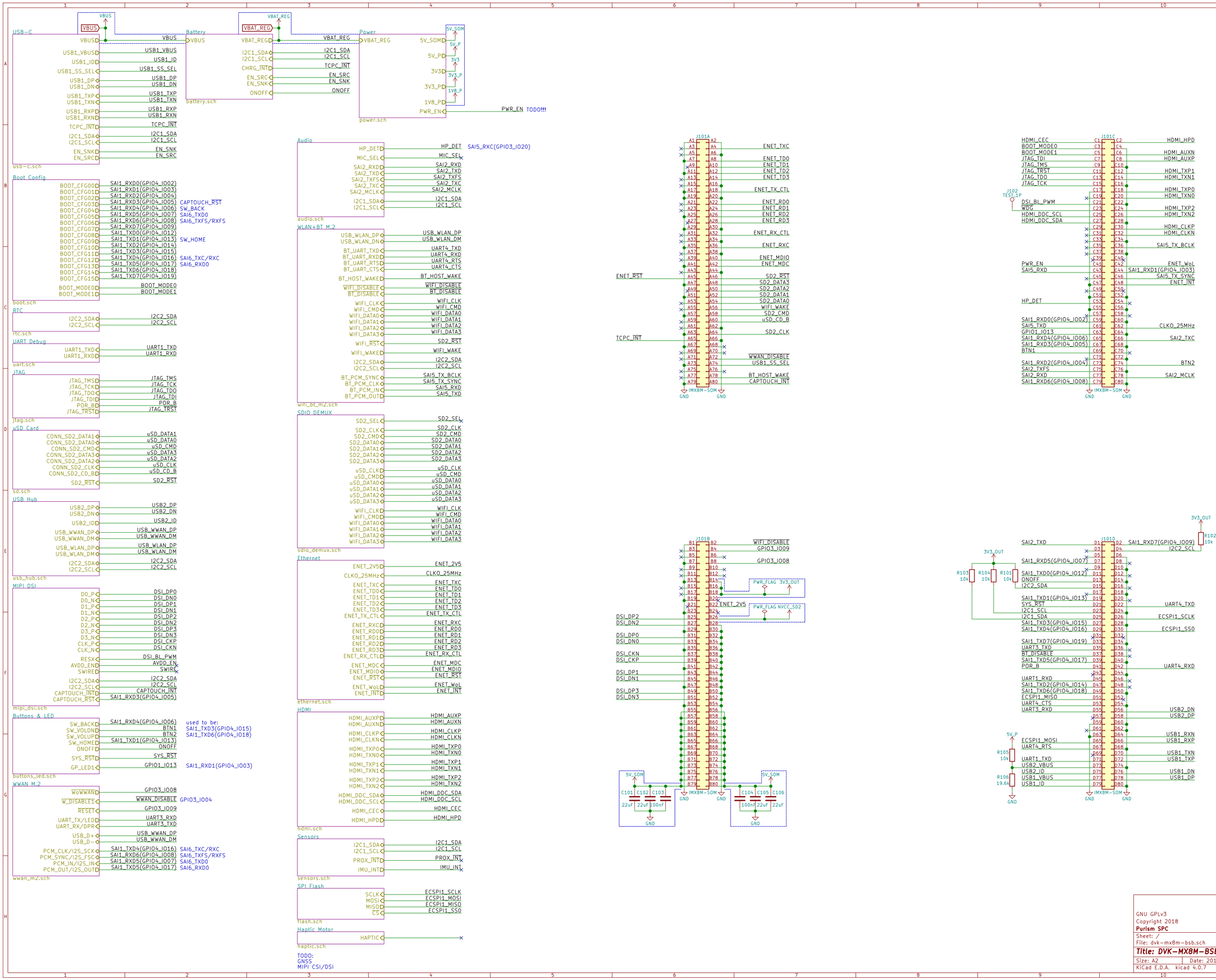


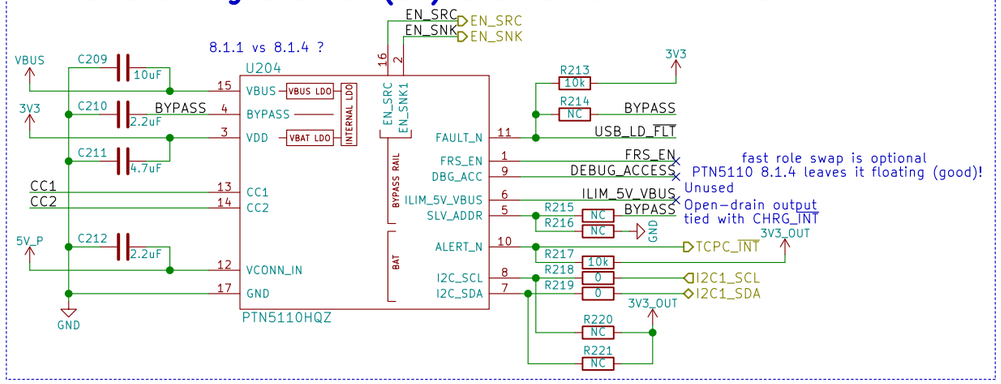
GNU GPLv3
Copyright 2018
Purism SPC
Sheet: /
File: dvk-mx8m-bsb.sch

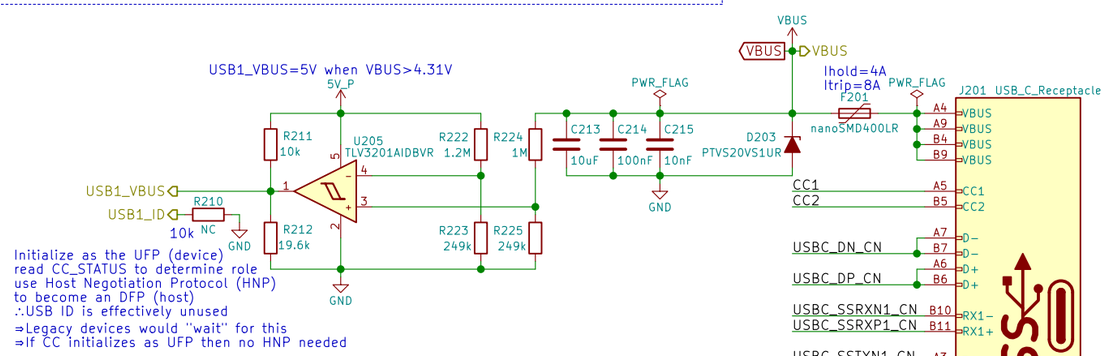
Title: DVK-MX8M-BSB

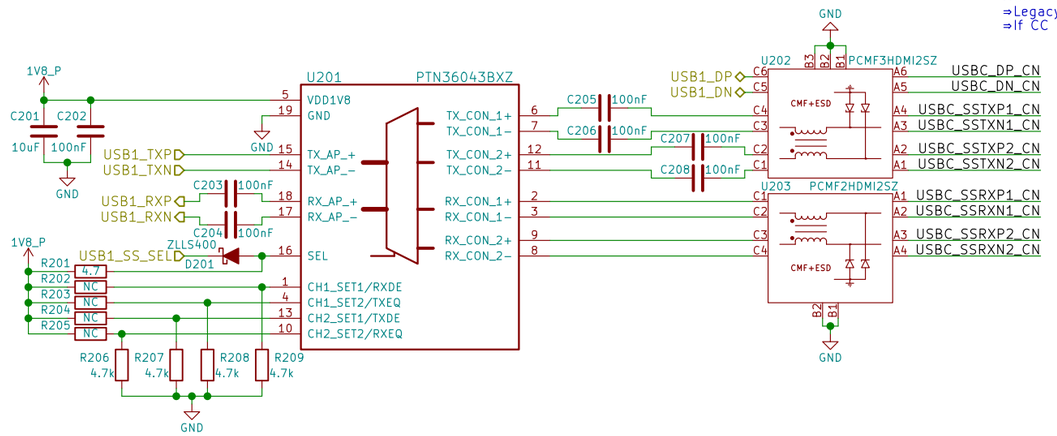
Size: A2	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 1/21

"Under dead battery operation, PTN5110 applies voltage clamps to both CC pins so that the system may receive power as a Sink. To support platforms with buck-boost configuration, PTN5110 asserts EN_SNK1 pin based on validity of VBUS voltage (facilitates 5 V VBUS sinking)."

USB-C Config Channel (CC) and PD Role Controller

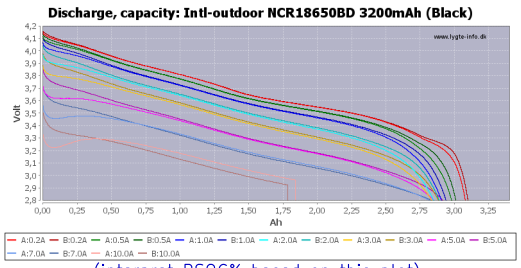






Sheet: /USB-C/		
File: usb-c.sch		
Title: USB Type C		
Size: A3	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 2/21

Battery Charge Controller



(interpret RSOC% based on this plot)

use AUTO_DPDM_EN
to auto-detect IINLIM

1.658≤ILIM≤2.063
ILIM(nom)≅1.859
3.9≤VIN≤14

U301 BQ25896

I(Lsat)=7A

3.5~4.25V

~110uF

Default LOW:
adapter source

Open-drain output
tied with TCPC_INT

If enough I/O is available then
separate CHRG_INT & TCPC_INT

This disables charging
but maybe not VBUS->VOUT
if PTN5110HQ's FAULT_STATUS[6]==1
(Force Off VBUS bit) then set EN_HiZ=1
EN_HiZ may be auto-set when in hiccup

Reading PTN5110HQ's CC_STATUS and POWER_STATUS
registers will tell TCPM (i.MX8M) when to set EN_HiZ

Also, reading PTN5110HQ's CC_STATUS and POWER_STATUS
registers will tell TCPM (i.MX8M) when to set OTG_CONFIG=1
(this will also happen when PTN5110HQ sets EN_SRC HIGH)

BC1.2 is not mandated by PD spec
ICO used to determine max current
Also negotiated from CC pins (I2C)

Ihold=3.5A
Itrip=6.3A
Ttrip(max)=5s@8A

VBAT(DPL)=2.15~2.5V

NCR18650B is recommended

VBAT(nom)=REG06[7:2]
VBAT(default_max_ovp)=(REG06[7:2]×1.005)×1.04=4.3982016V
REG06[7:2]=010111⇒VBAT(max_ovp)=4.3814784
BQ29705 provides 4.425V as OVP!!!

reference design: http://www.ti.com/lit/ug/sluuba2b/sluuba2b.pdf

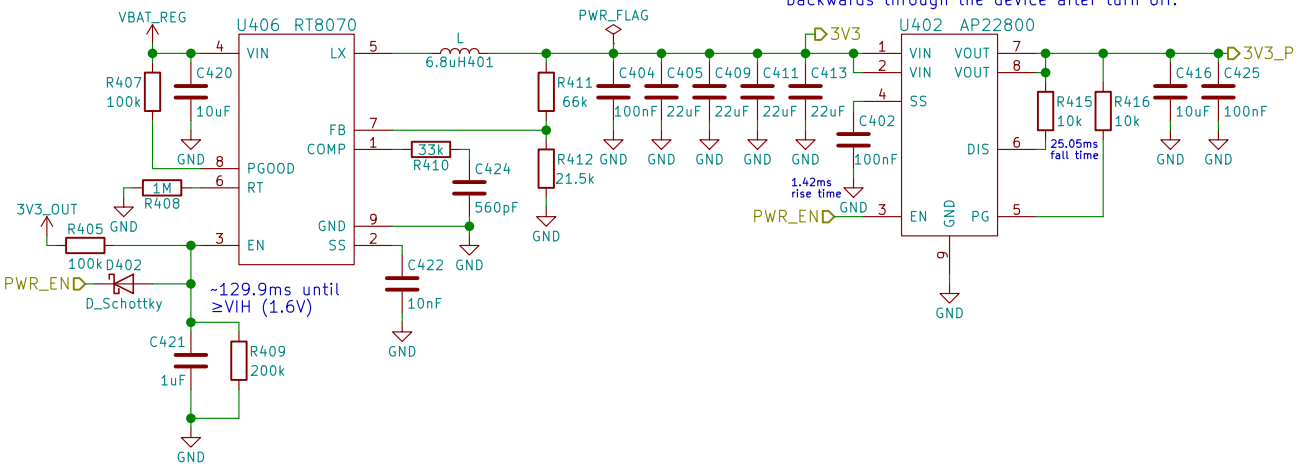
may want to include BQ29705 protection as in:
http://www.ti.com/lit/ug/tiducl1/tiducl1.pdf
schematic: http://www.ti.com/lit/df/tidrp70/tidrp70.pdf
(PTC may be good enough)

Sheet: /Battery/		
File: battery.sch		
Title: Battery		
Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 3/21

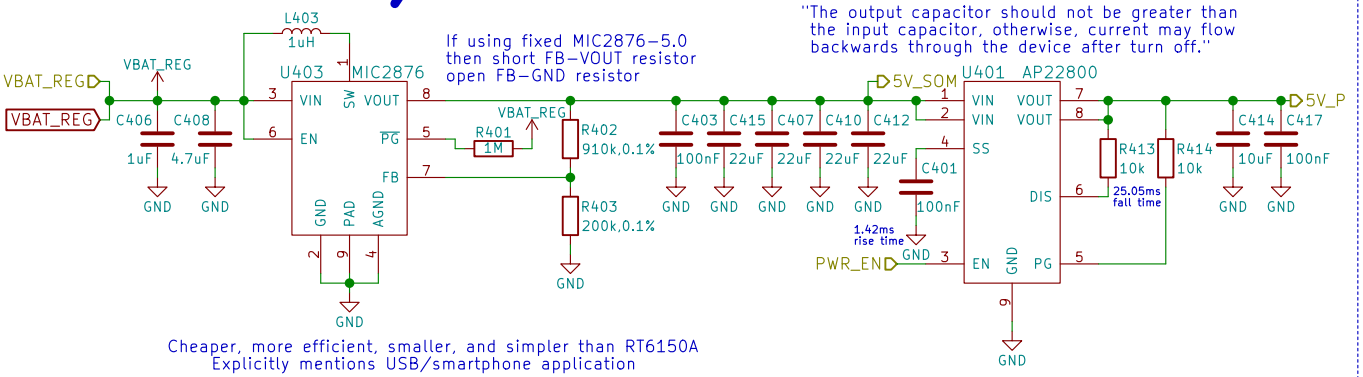
3.3V/3A

When VBAT can fall below 3.3V use TPS63020 instead

"The output capacitor should not be greater than the input capacitor, otherwise, current may flow backwards through the device after turn off."

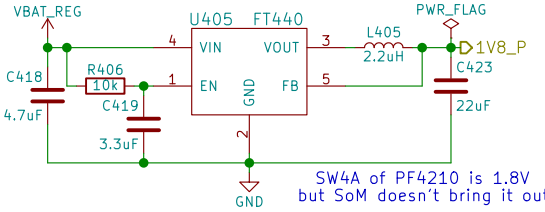


5.0V/3.8A



Cheaper, more efficient, smaller, and simpler than RT6150A
Explicitly mentions USB/smartphone application

1.8V/600mA



SW4A of PF4210 is 1.8V but SoM doesn't bring it out

$V_{IH(typ)} = 1.0V \cong 30.3\% \times 3.3V$
$t(0-30.3\%) \approx 0.361RC$
$\Rightarrow 0.361RC \approx 10ms$
$\therefore R = 10k$
$C = 2.77uF \cong 3.3uF$

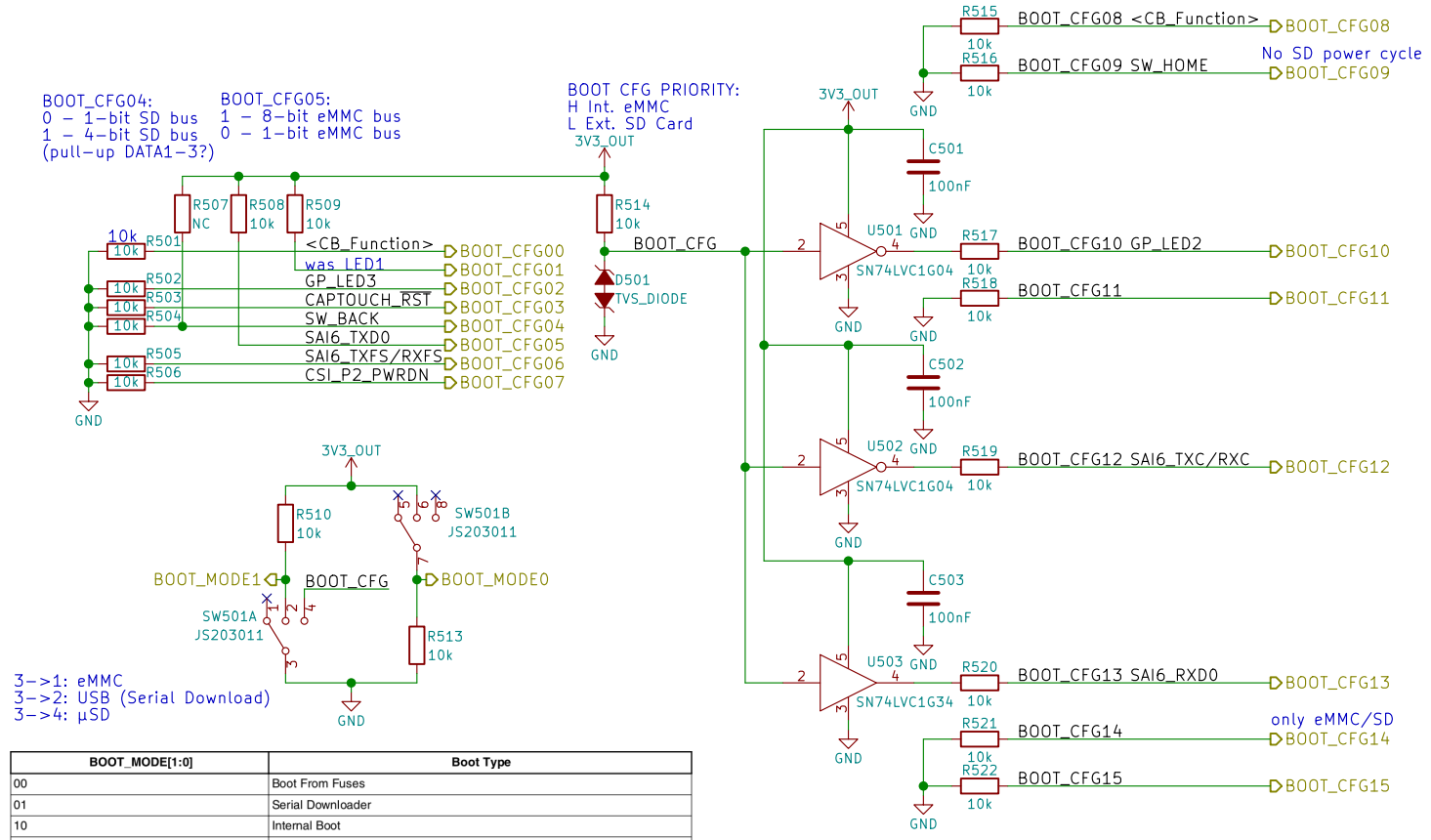
Buck instead of TLV70218 LDO saving up to ~100mW loss
LM3670MF-1.8 is much more expensive
ST1S12G18R is a drop-in

TODO:
add parallel 100nF bulk caps!
& spread all over the power plane

Sheet: /Power/		
File: power.sch		
Title: Power		
Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 4/21

BOOT_CFG[14:12]	Boot device
001	SD/eSD
010	MMC/eMMC
011	NAND

Fuse	Config	Definition	GPIO[1]	Shipped value	Settings
BOOT_CFG[11:10]	OEM	USDHC port selection	Yes	00	00 - USDHC-1 01 - USDHC-2 10 - USDHC-3 else - reserved

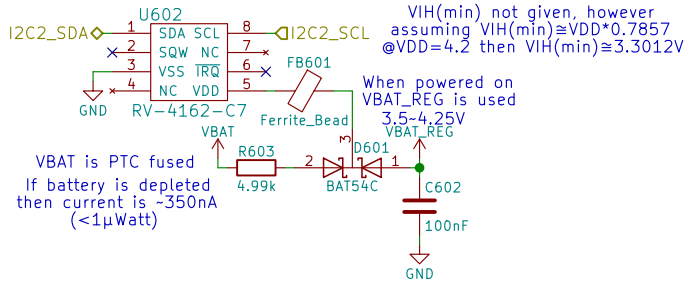


BOOT_MODE[1:0]	Boot Type
00	Boot From Fuses
01	Serial Downloader
10	Internal Boot
11	Reserved

Sheet: /Boot Config/
File: boot.sch

Title: Boot Configuration

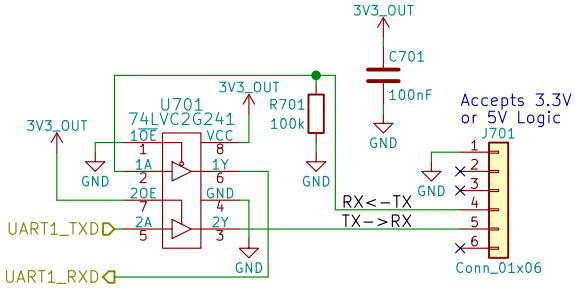
Size: A4	Date: 2018–05–16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 5/21



Sheet: /RTC/
File: rtc.sch

Title: RTC

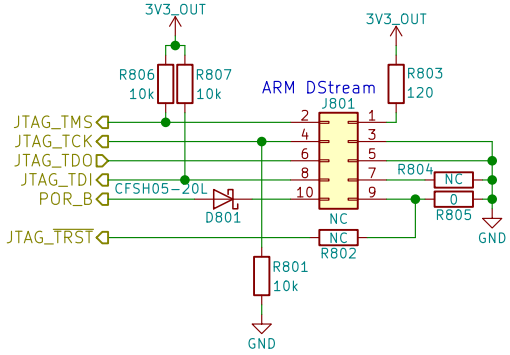
Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 6/21



Sheet: /UART Debug/
File: uart.sch

Title: UART Debug

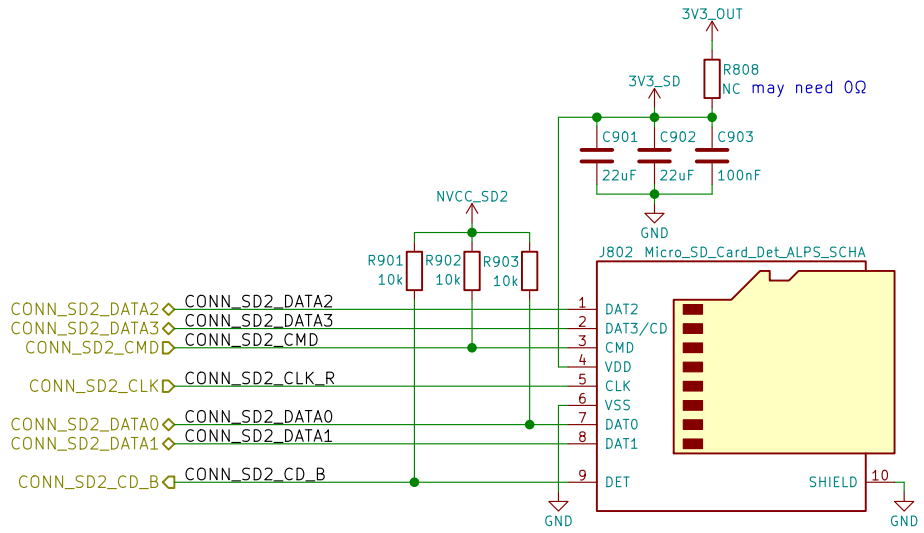
Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 7/21

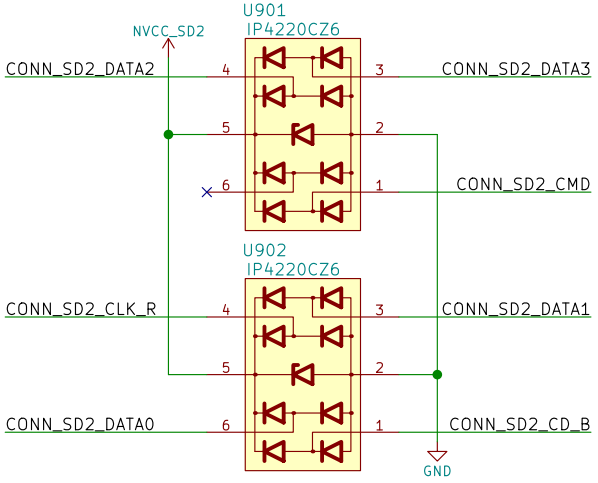


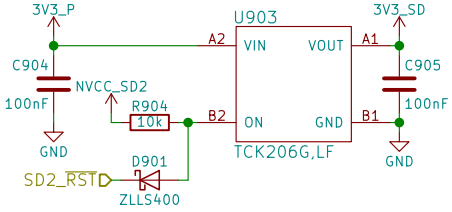
Sheet: /JTAG/
File: jtag.sch

Title: JTAG

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 8/21







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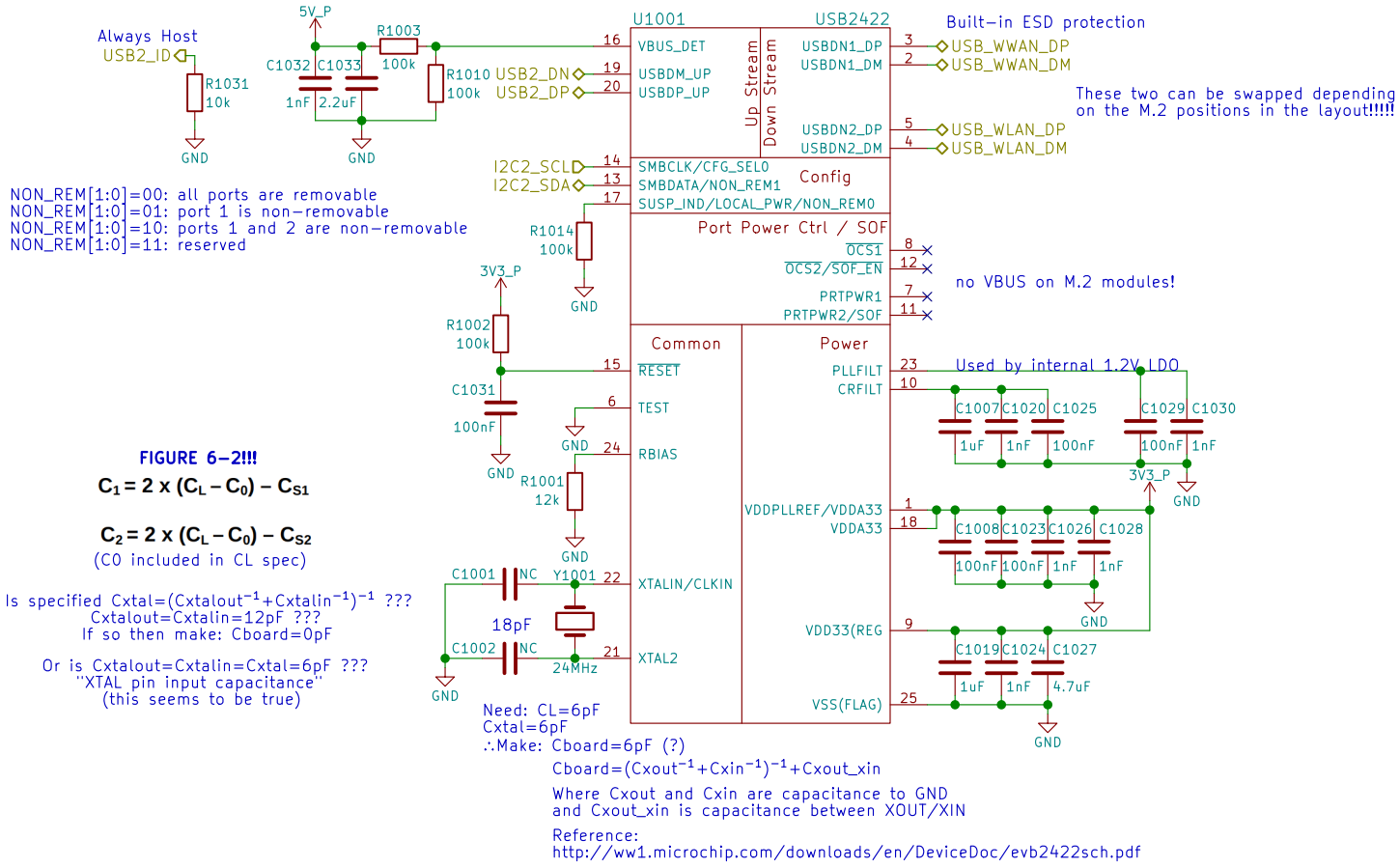
Sheet: /uSD Card/
File: sd.sch

Title: uSD Card

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 9/21

TODO:
Use USB4640???



NON_REM[1:0]=00: all ports are removable
NON_REM[1:0]=01: port 1 is non-removable
NON_REM[1:0]=10: ports 1 and 2 are non-removable
NON_REM[1:0]=11: reserved

FIGURE 6-2!!!

$$C_1 = 2 \times (C_L - C_0) - C_{S1}$$

$$C_2 = 2 \times (C_L - C_0) - C_{S2}$$

(C0 included in CL spec)

Is specified Cxtal=$(Cxtalout^{-1}+Cxtalin^{-1})^{-1}$???
Cxtalout=Cxtalin=12pF ???
If so then make: Cboard=0pF

Or is Cxtalout=Cxtalin=Cxtal=6pF ???
"XTAL pin input capacitance"
(this seems to be true)

Need: CL=6pF
Cxtal=6pF
∴Make: Cboard=6pF (?)
Cboard=$(Cxout^{-1}+Cxin^{-1})^{-1}+Cxout\_xin$

Where Cxout and Cxin are capacitance to GND
and Cxout_xin is capacitance between XOUT/XIN

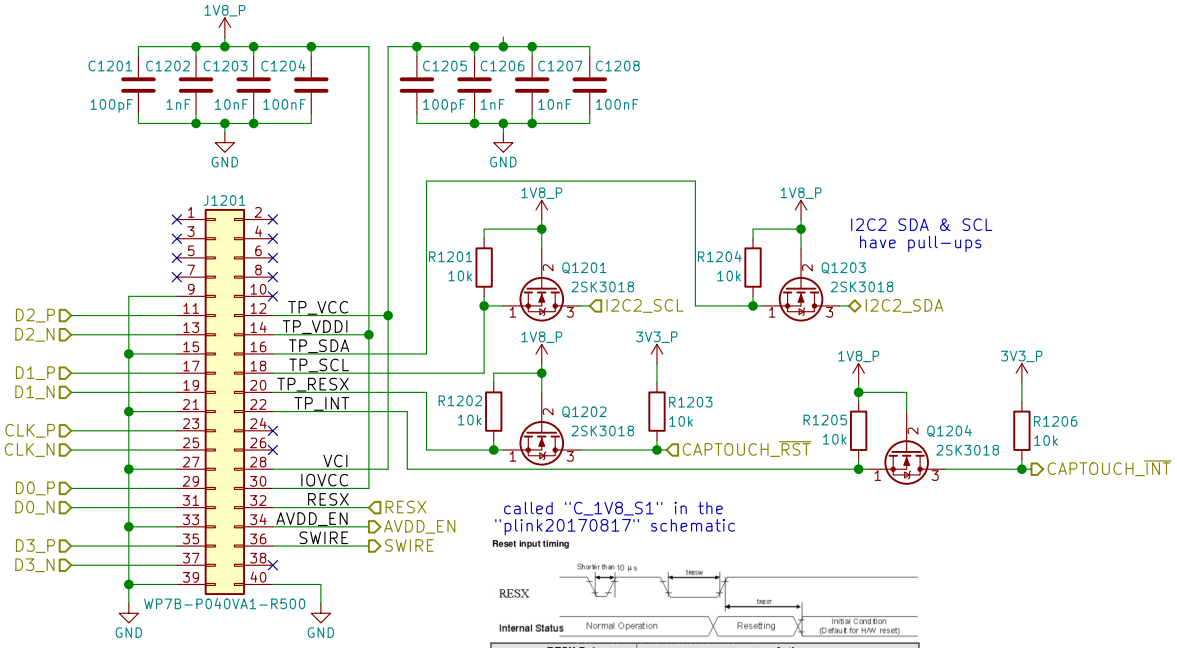
Reference:
http://ww1.microchip.com/downloads/en/DeviceDoc/evb2422sch.pdf

Sheet: /USB Hub/
File: usb_hub.sch

Title:

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 10/21

TODO:
ensure power sequence is satisfied
based on the display used



called "C_1V8_S1" in the
"plink20170817" schematic

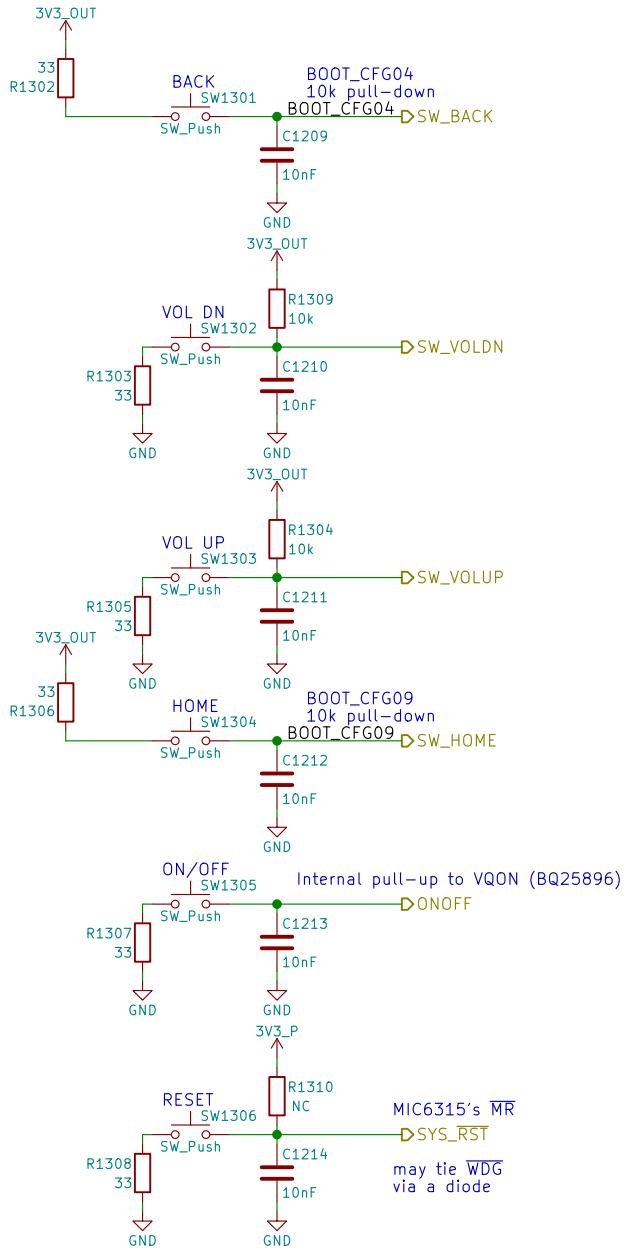
RESX Puise	Action
Shorter than 5µs	Invalid Reset
Longer than 10µs	Valid Reset
Between 5µs and 10µs	Reset Initialization Precedure

TODO: low power state signal??

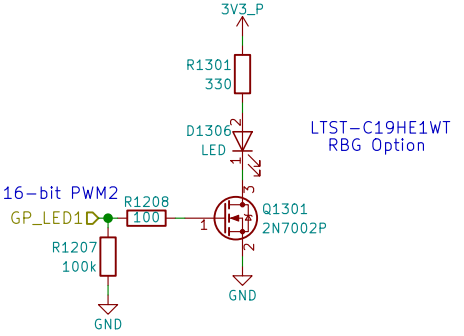
Sheet: /MIPI DSI/
File: mipi_dsi.sch

Title: MIPI DSI

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 11/21



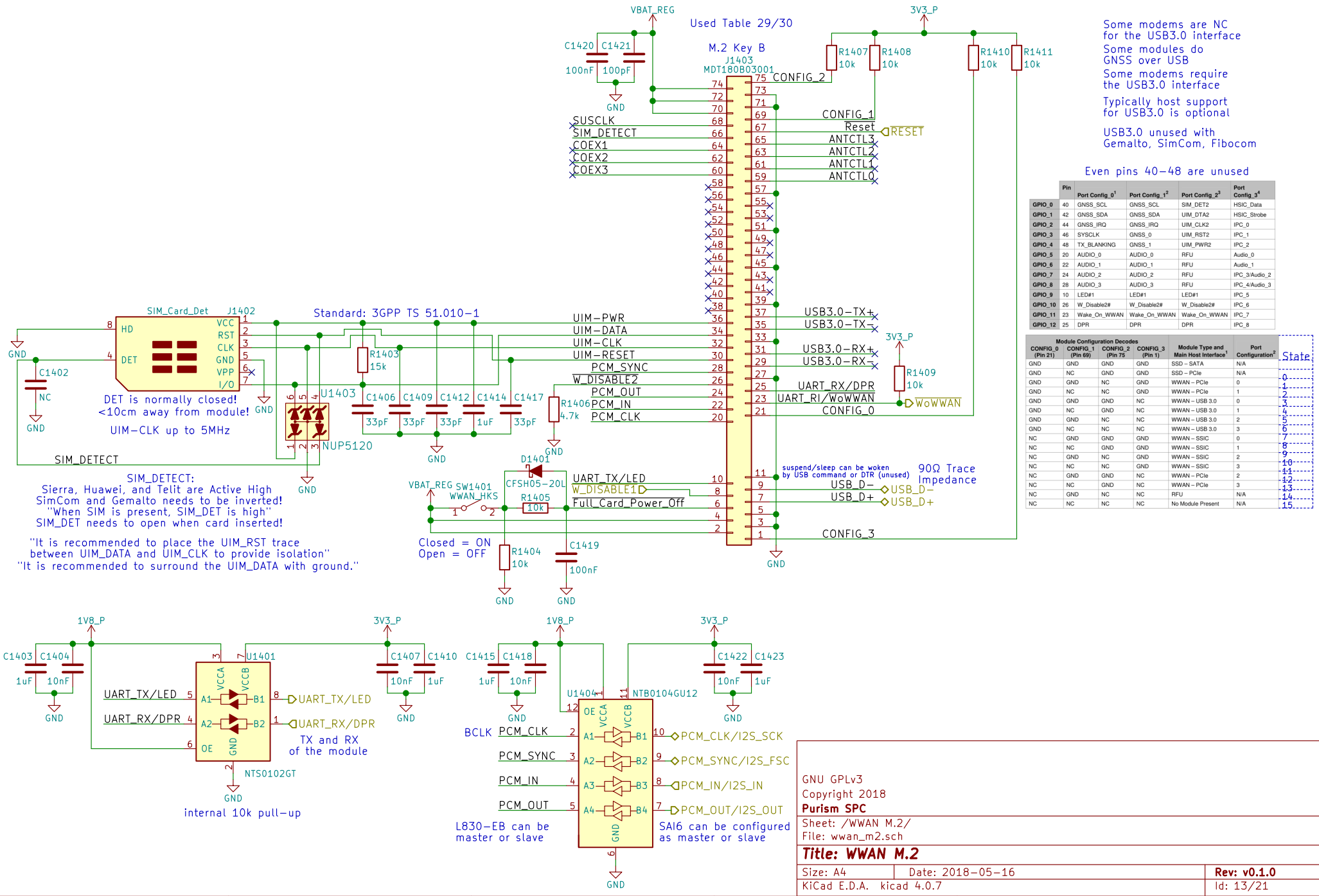
Use PWM2_PWMSAR to set the compare value (duty cycle)
Use PWM2_PWMCR[15:4] to set the PRESCALER (frequency)
Use PWM2_PWMPR to set the top of the counter (frequency)



Sheet: /Buttons & LED/
File: buttons_led.sch

Title: Buttons & LED

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 12/21



	Pin	Port Config_0[1]	Port Config_1[2]	Port Config_2[3]	Port Config_3[4]
GPIO_0	40	GNSS_SCL	GNSS_SCL	SIM_DET2	HSIC_Data
GPIO_1	42	GNSS_SDA	GNSS_SDA	UIM_DTA2	HSIC_Strobe
GPIO_2	44	GNSS_IRQ	GNSS_IRQ	UIM_CLK2	IPC_0
GPIO_3	46	SYSCLK	GNSS_0	UIM_RST2	IPC_1
GPIO_4	48	TX_BLANKING	GNSS_1	UIM_PWR2	IPC_2
GPIO_5	20	AUDIO_0	AUDIO_0	RFU	Audio_0
GPIO_6	22	AUDIO_1	AUDIO_1	RFU	Audio_1
GPIO_7	24	AUDIO_2	AUDIO_2	RFU	IPC_3/Audio_2
GPIO_8	28	AUDIO_3	AUDIO_3	RFU	IPC_4/Audio_3
GPIO_9	10	LED#1	LED#1	LED#1	IPC_5
GPIO_10	26	W_Disable2#	W_Disable2#	W_Disable2#	IPC_6
GPIO_11	23	Wake_On_WWAN	Wake_On_WWAN	Wake_On_WWAN	IPC_7
GPIO_12	25	DPR	DPR	DPR	IPC_8

Module Configuration Decodes						State
CONFIG_0 (Pin 21)	CONFIG_1 (Pin 69)	CONFIG_2 (Pin 75)	CONFIG_3 (Pin 1)	Module Type and Main Host Interface[1]	Port Configuration[2]	
GND	GND	GND	GND	SSD – SATA	N/A	
GND	NC	GND	GND	SSD – PCIe	N/A	
GND	GND	NC	GND	WWAN – PCIe	0	0
GND	NC	NC	GND	WWAN – PCIe	1	1
GND	GND	GND	NC	WWAN – USB 3.0	0	2
GND	NC	GND	NC	WWAN – USB 3.0	1	3
GND	GND	NC	NC	WWAN – USB 3.0	2	4
GND	NC	NC	NC	WWAN – USB 3.0	3	5
NC	GND	GND	GND	WWAN – SSIC	0	6
NC	NC	GND	GND	WWAN – SSIC	1	7
NC	GND	NC	GND	WWAN – SSIC	2	8
NC	NC	NC	GND	WWAN – SSIC	3	9
NC	GND	GND	NC	WWAN – PCIe	2	10
NC	NC	GND	NC	WWAN – PCIe	3	11
NC	GND	NC	NC	RFU	N/A	12
NC	NC	NC	NC	No Module Present	N/A	13
						14
						15

Sheet: /WWAN M.2/
File: wwan_m2.sch

Title: WWAN M.2

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 13/21

Reference:
http://www.52rd.com/S_txt/2011_3/TXT26685.htm
http://www.sengpielaudio.com/calculator-transferfactor.htm
https://electronics.stackexchange.com/questions/31442/how-can-i-switch-this-audio-jack-using-its-own-mechanical-switches-without-cre
(Nit6 does the same)
+Zener diode to protect against ranges outside of −0.9V to 3.3V

dB specs in datasheet is a unit of power gain (not dBu or VU)
with respect to the DAC's unattenuated output

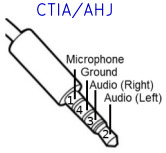
"HP Output – 62.5mW max, 1.02kHz sine into 16Ω load at 3.3 V"
⇒ $(1V)^2/(16Ω)=62.5mW$
∴ Vrms=1V ⇒ Vp(amplitude)=1.414V
∴ Irms(max)=62.5mA

If HP_DET is HIGH for >100ms then HPs are present

S/E button on earbud headsets
shorts the mic for key function

Could use FSA8008 to detect mic

CTIA/AHJ



U1501 SGTL5000
VDDIO VDDD VDDA
LINEINL LINEINR MIC MICBIAS
LINEOUT_R LINEOUT_L
CTRL_DATA CTRL_CLK
I2S_DOUT I2S_DIN I2S_LRCLK I2S_SCLK SYS_MCLK
HP_L HP_R HPVGND VAG
GND

Mute via MUTE_LO=1
may use lineout left channel for pseudo-earpiece speaker

MIC_IN
MIC_BIAS
I2C1_SDA
I2C1_SCL
SAI2_RXD
SAI2_TXD
SAI2_TXFS
BCLK
SAI2_TXC
SAI2_MCLK

U1406 PAM8301
IN SD GND VDD OUT+ OUT−

LS1401 AS01608MS-SP9
8Ω

DLW21SN900SQ2L
FL1401
C1425 220pF
C1432 220pF

fc=106Hz

C1424 150nF
C1504 220u
C1505 220u
C1502 NC
C1503 NC
C1506 100n
C1507 100p
R1501 33
R1502 15k
C1508 100n
C1509 100p
R1503 33
R1504 15k
C1510 270p
C1501 100n
R1413 NC

D1501 ESD5B5.0S
D1502 ESD5B5.0S
C1512 270p

Z(hp)≥16Ω

HP_DET

<3.3µA
R1412 1M

J1404
SMD Equivalent: SJ-43515RS-SMT-TR
SJ-43515TS

Pin 5 (tip switch) is NC,
open when inserted

If just headphones then
HP_DET=HIGH, R(mic)=0

D1402 SZMM5Z3V3T1G
Vz=3.3V
Vf=0.9V

may add ~220uF cap
parallel to Zener

C1430 100nF
C1431 10nF

U1405 FSA6157L6X
MIC_SEL
SW1402A SW_DPST_x2

Ext-Mic enabled
MIC_SEL=LOW

Int-Mic enabled
MIC_SEL=LOW

TODO:
DPST with
camera!

SW Mute Mic:
MUTE_ADC=1

MIC_IN
C1513 100nF
BLM15AX601SN1D
FB1501
C1514 270pF
MIC_BIAS
R1505 2.2k
C1511 1uF

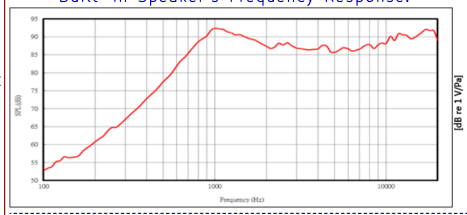
2.2kΩ
MK1401
CMC-6022

Add TVS next to int-mic?
(OpenMoko does this)

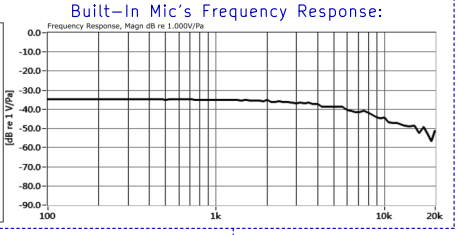
−37dB=14.1254mV/Pa
∴ mic produces 14.1254mVrms when exposed to a 1kHz tone of 94dB-SPL at the capsule (or 19.98mV amplitude)

⇒ 40dB gain would produce ~2V amplitude (4Vpp, clipping)
30dB gain would produce ~0.632V amplitude (1.264Vpp)
38.33dB gain would yield 3.3Vpp

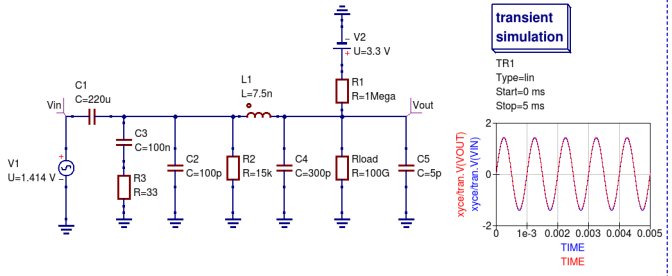
Built-In Speaker's Frequency Response:



Built-In Mic's Frequency Response:



Simulation of 1kHz output
without HP jack inserted:



LCR Measurements:

Earbud Microphone:	Headset Speaker:	Headphone Speaker:
@1kHz	@1kHz	@1kHz
Ls = 3.844mH	Ls = 244.4uH	Ls = 25.2uH
Lp = 15.757H	Lp = 141.99mH	Lp = 311.0mH
Cs = 6.583uF	Cs = 103.6uF	Cs = 1.0mF
Cp = 1612.8pF	Cp = 178.77nF	Cp = 81.95nF
Rs = 1.5465kOhms	Rs = 36.860hms	Rs = 17.0300hms
Rp = 1.5478kOhms	Rp = 36.860hms	Rp = 17.0340hms
θ = −0.8deg	θ = −2.3deg	θ = 0.5deg

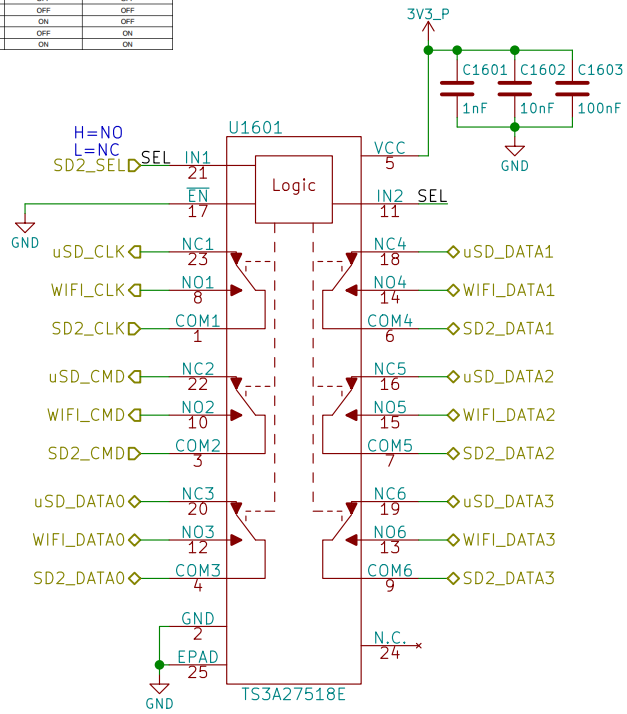
Sheet: /Audio/
File: audio.sch

Title: Audio

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 14/21

Can swap around signals in the layout:

EN	IN1	IN2	NC1/2/3 TO COM1/2/3, COM1/2/3 TO NC1/2/3	NC4/5/6 TO COM4/5/6, COM4/5/6 TO NC4/5/6	NO1/2/3 TO COM1/2/3, COM1/2/3 TO NO1/2/3	NO4/5/6 TO COM4/5/6, COM4/5/6 TO NO4/5/6
H	X	X	OFF	OFF	OFF	OFF
L	L	L	ON	ON	OFF	OFF
L	H	L	OFF	OFF	ON	OFF
L	L	H	ON	OFF	OFF	ON
L	H	H	OFF	OFF	ON	ON

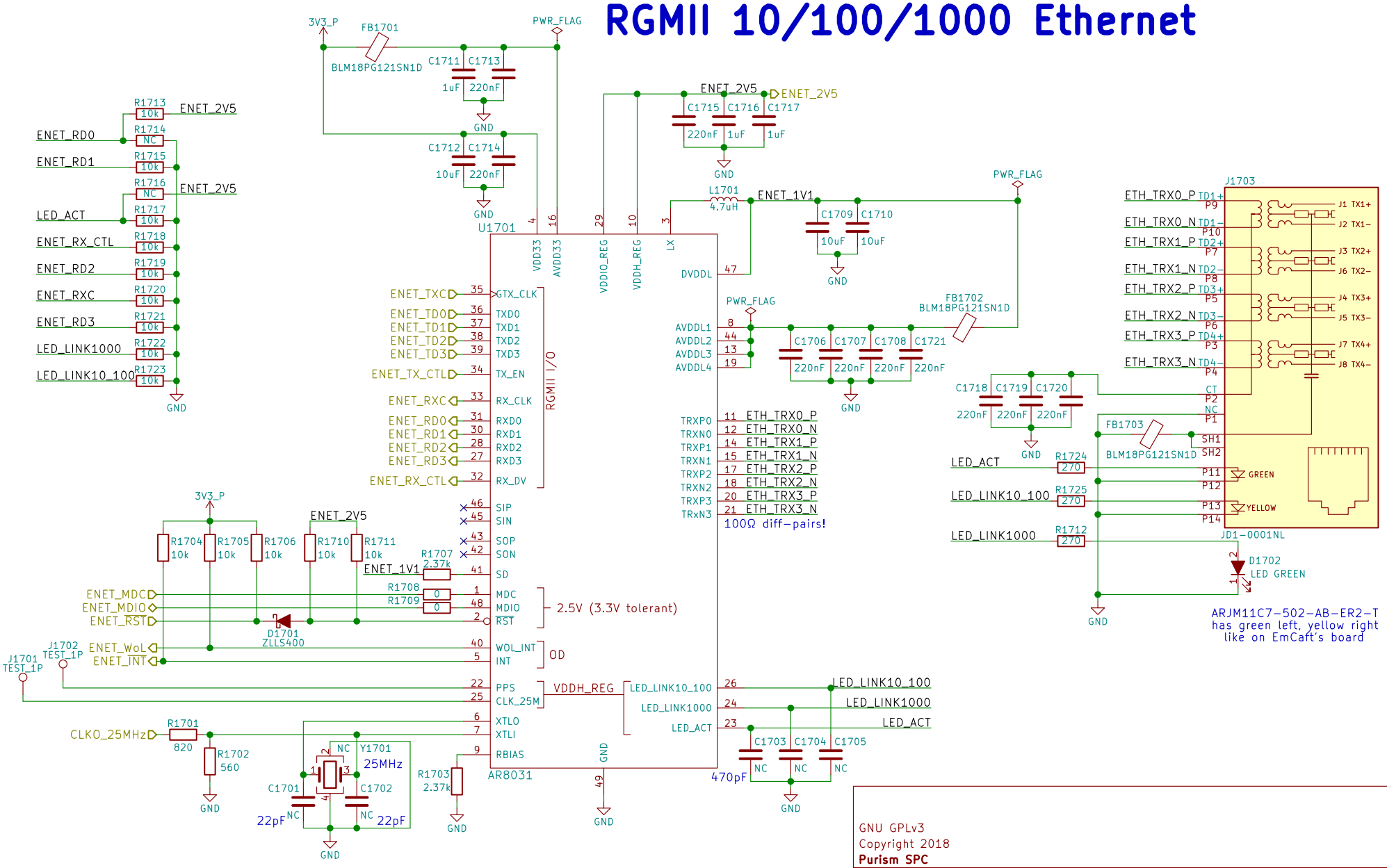


Sheet: /SDIO DEMUX/
File: sdio_demux.sch

Title: SDIO Demultiplexer

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 15/21

RGMII 10/100/1000 Ethernet



Sheet: /Ethernet/		
File: ethernet.sch		
Title: Ethernet		
Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 16/21

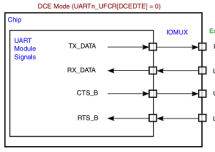
6.2 M.2 Signal Directions

RS9116 NC:
RTS, CTS, BT_HOST_WAKE

RS9116 datasheet says
no WIFI_WAKE
but the schematic has it

Module: Table 23
Socket: Table 46

UARTn_UFCR[DCEDTE]=0 on POR



TX output
RX input
CTS output
RTS input

⇒TX→RX
RX←TX
CTS→CTS
RTS←RTS

RedPine RS9116 MB0
Requires 5V on
Pin 54 for USB!

J1502

USB_WLAN_DP
USB_WLAN_DN
WIFI_CLK
WIFI_CMD
WIFI_DATA0
WIFI_DATA1
WIFI_DATA2
WIFI_DATA3
WIFI_WAKE
WIFI_RST
W_DISABLE1

M2_PCM_CLK
M2_PCM_SYNC
M2_PCM_IN
M2_PCM_OUT
SoC's IN/OUT

BT_HOST_WAKE
BT_UART_RXD
SoC's RX
Module's TX
SoC's TX
Module's RX
BT_UART_TXD
BT_UART_RTS
BT_UART_CTS

RS9116 SUSCLK
is a GPIO (unused)
SUSCLK
W_DISABLE2
W_DISABLE1
M2_I2C_SDA
M2_I2C_SCL

M.2_Key_E

3V3_P
1V8_P
GND

R1506 10k
D1503 ZLLS400
D1504 ZLLS400

i.MX8M in DCE mode has
CTS output, RTS input

TODO:
Pin 54 on RS9116 is USB_VBUS Sink!!!

U1502A 74AUP2G08
U1502B 74AUP2G08
R1726 10k
BT_DISABLE
WIFI_DISABLE

D1505 CFSH05-20L
Closed = ON (*_DISABLE HIGH)
Open = OFF
SW1501 WWAN_HKS
R1508 10k
C1515 100nF
R1510 10k

R1507 10k
R1509 10k
Q1501 FDV301N
Q1502 FDV301N
M2_I2C_SDA
M2_I2C_SCL
I2C2_SDA
I2C2_SCL

TODO!!!
verify if translators
with PWR_EN is needed!

RS9116 has SCL as output
⇒master?
(only device on I2C2 bus)

U1702 NTB0104GU12
C1722 1uF
C1723 10nF
C1724 10nF
C1725 1uF

BT_UART_RXD
BT_UART_TXD
BT_UART_RTS
BT_UART_CTS

RX, TX, RTS, CTS
of the SoC

internal 10k pull-up

U1504 NTB0104GU12
C1520 1uF
C1521 10nF
C1522 10nF
C1523 1uF

BCLK
M2_PCM_CLK
M2_PCM_SYNC
M2_PCM_IN
M2_PCM_OUT

BT_PCM_CLK
BT_PCM_SYNC
BT_PCM_IN
BT_PCM_OUT

configure as slave

Sheet: /WLAN+BT M.2/
File: wifi_bt_m2.sch

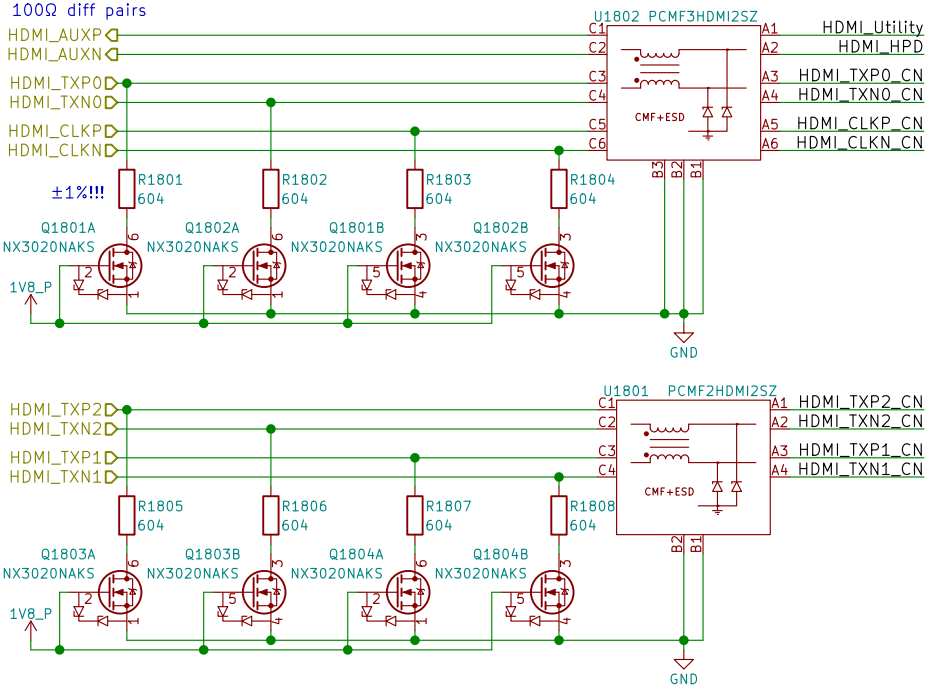
Title: WLAN+BT M.2

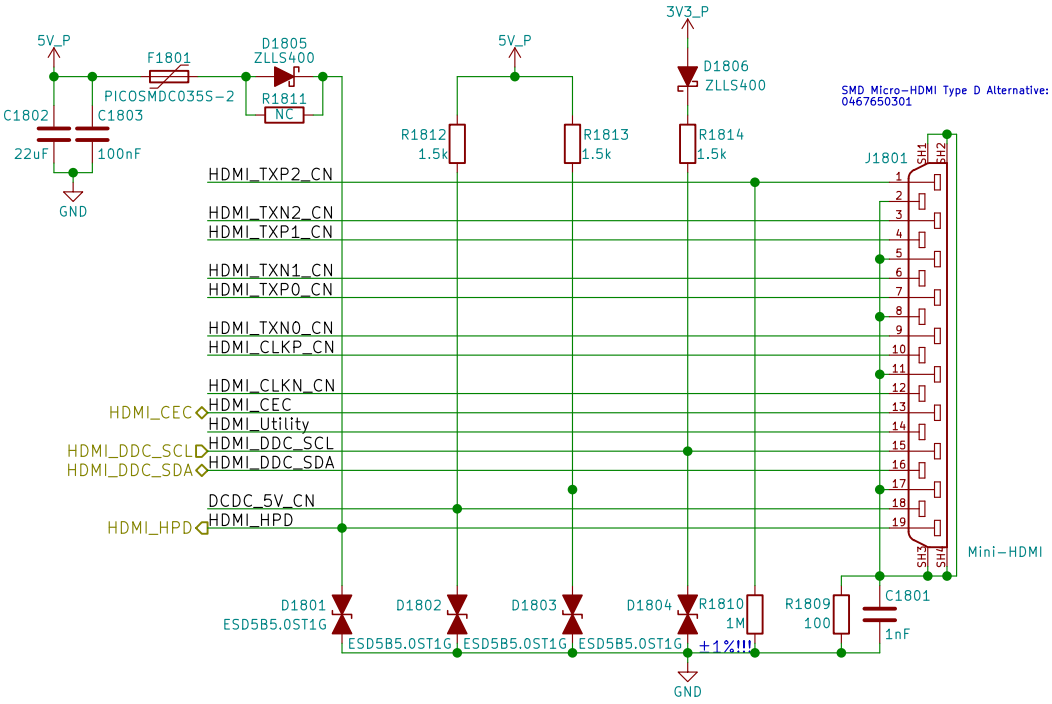
Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 17/21

HD3SS460 can be used for DP over USB-C

Layout Note:
May need swap some signals
due to micro-HDMI pinout diff
depending on pin location/routing

100Ω diff pairs



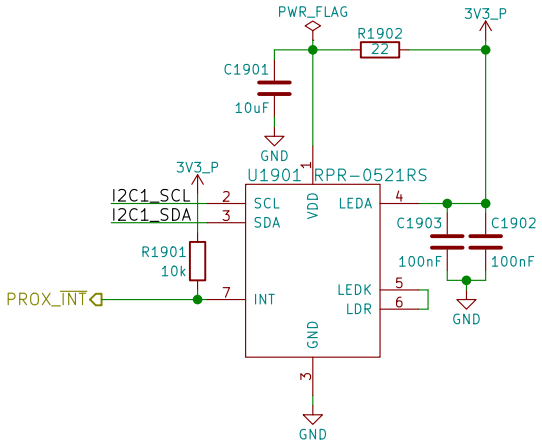


Sheet: /HDMI/
File: hdmi.sch

Title: HDMI

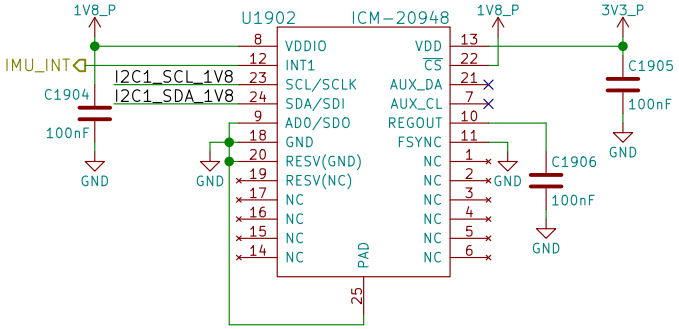
Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 18/21

Proximity & Ambient Light



Reference:
http://www.rohm.com/web/global/sensor-shield-support/ps-als-sensor

9-Axis IMU



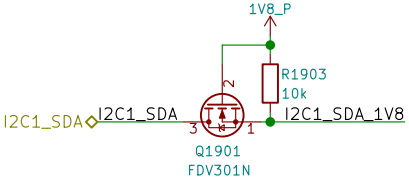
Reference:
https://store.invensense.com/datasheets/invensense/AN-IVS-0001EVB-00%20v1%202.pdf

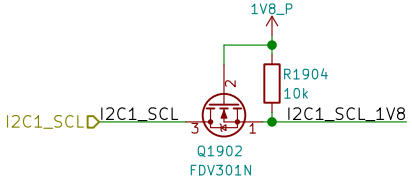
AD0 sets the slave address's LSB (110100X)

INT1_ACTL sets if IMU_INT
is active-high or active-low

"FSYNC - Connect to GND if unused"

I2C's VIH=1.8V





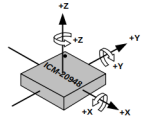


Figure 12. Orientation of Axes of Sensitivity and Polarity of Rotation

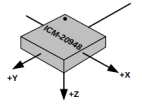
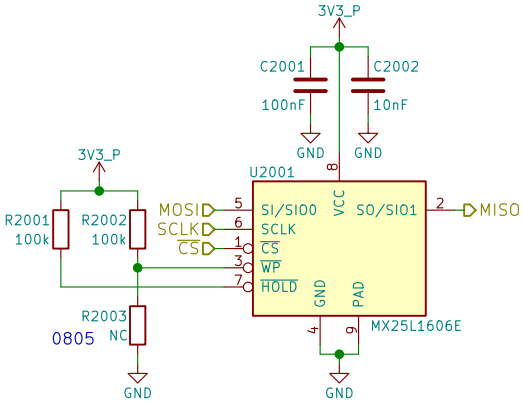


Figure 13. Orientation of Axes of Sensitivity for Magnetometer

Sheet: /Sensors/
File: sensors.sch

Title: Sensors

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 19/21

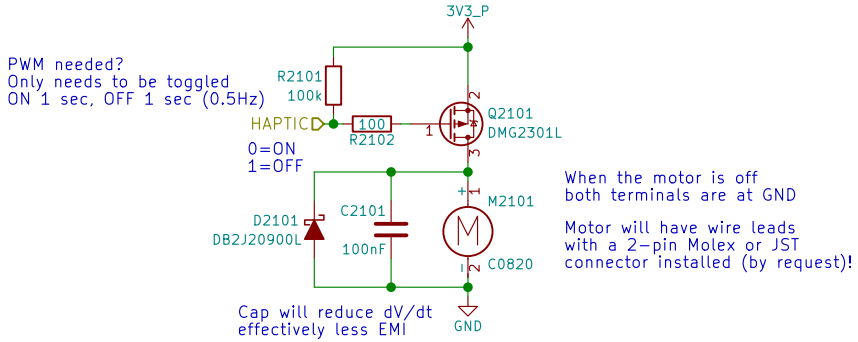


Sheet: /SPI Flash/
File: flash.sch

Title: SPI NOR Flash

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 20/21

PWM pins occupied:
GPIO1_IO01 – DSI (DSI_BL_PWM??)
GPIO1_IO13 – LED
GPIO1_IO14 – Ethernet (CLKO_25MHz)
GPIO1_IO15 – CSI (CLKO2)



Sheet: /Haptic Motor/
File: haptic.sch

Title: Haptic/Vibration Motor

Size: A4	Date: 2018-05-16	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 21/21