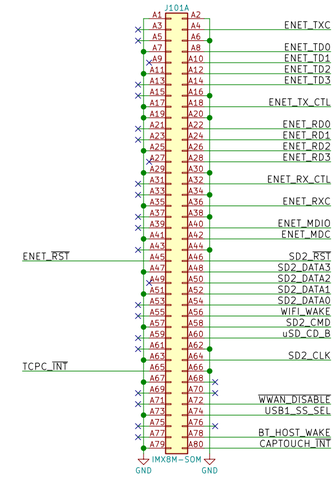
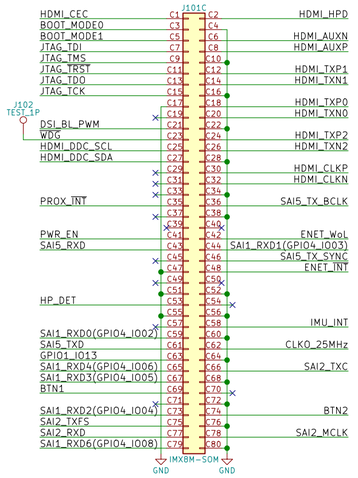
Spare GPIO:
GPIO5_IO03 (was PWM3)

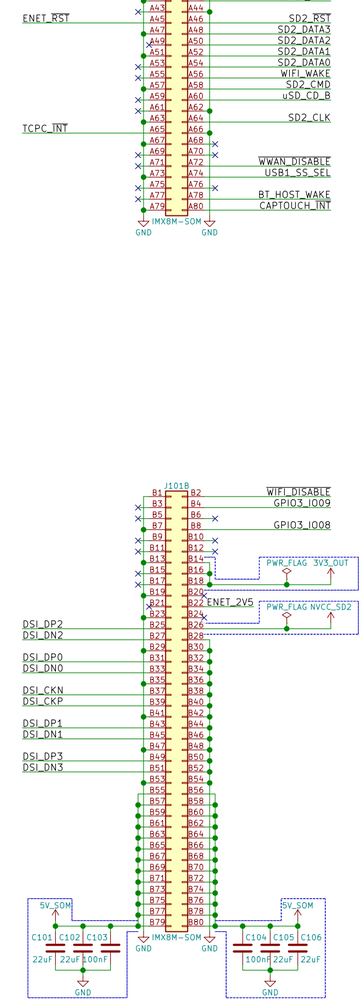
GPIO that can be swapped around:
GPIO3_IO20
GPIO3_IO25
GPIO3_IO19 (was LED1)
GPIO5_IO05 (was PWM1)
GPIO5_IO03 (was PWM3)

USB-C
usb-c.sch
Battery
battery.sch
Power
power.sch
Audio
audio.sch
Boot Config
boot.sch
RTC
rtc.sch
UART Debug
uart.sch
JTAG
jtag.sch
uSD Card
sd.sch
USB Hub
usb_hub.sch
MIPI DSI
mipi_dsi.sch
Buttons & LED
buttons_led.sch
WWAN M.2
wwan_m2.sch
WLAN+BT M.2
wifi_bt_m2.sch
SDIO DEMUX
sdio_demux.sch
Ethernet
ethernet.sch
HDMI
hdmi.sch
Sensors
sensors.sch
SPI Flash
flash.sch
Haptic Motor
haptic.sch

TODO:
GNSS
MIPI CSI/DSI







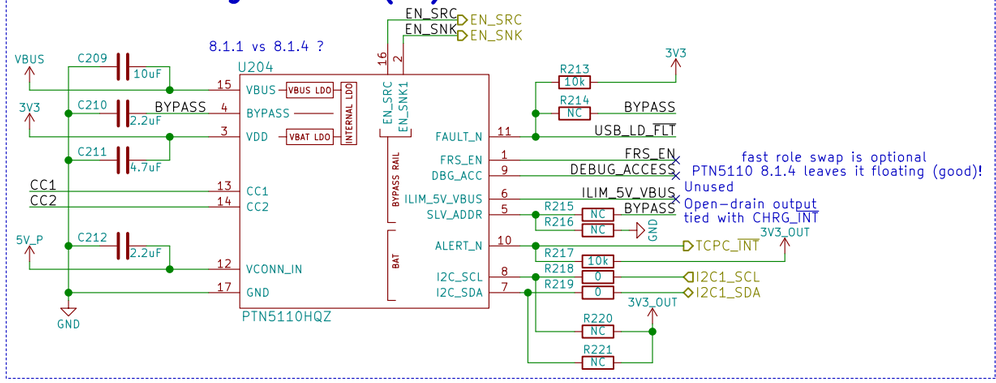
Sheet: /
File: dvk-mx8m-bsb.sch

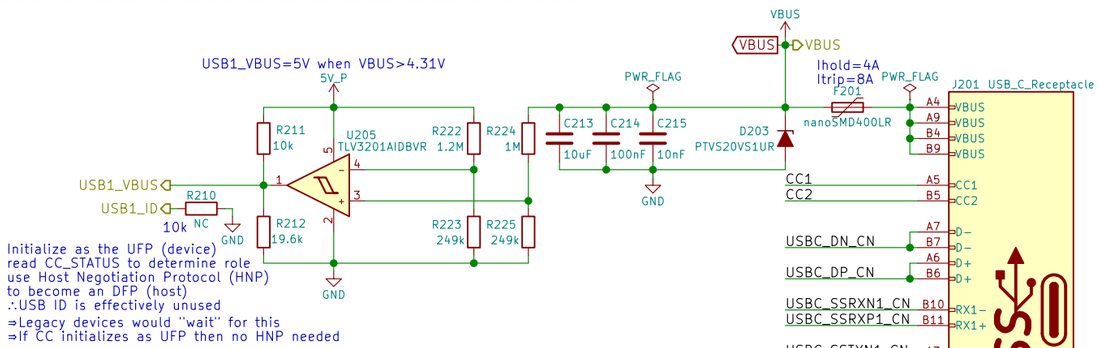
Title: DVK-MX8M-BSB

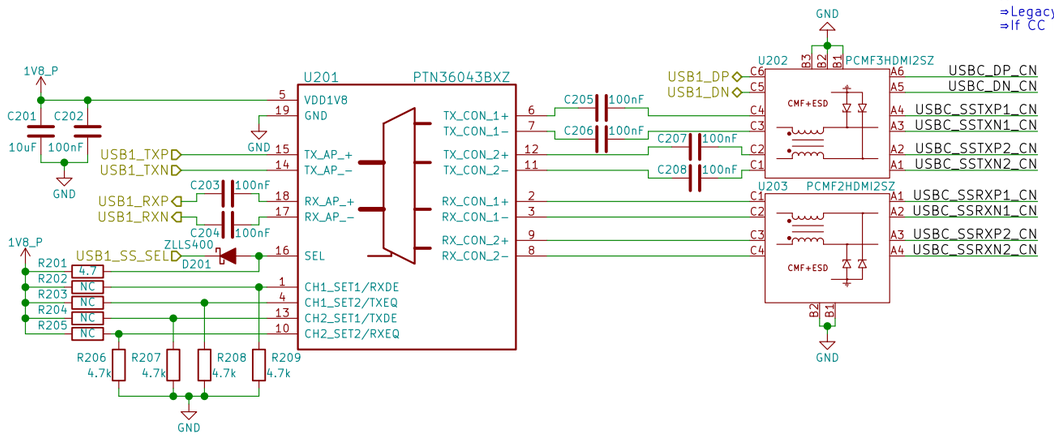
Size: A2	Date: 2018-05-18	Rev: v0.1.0
KiCad E.D.A. kicad 4.0.7		Id: 1/21

"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

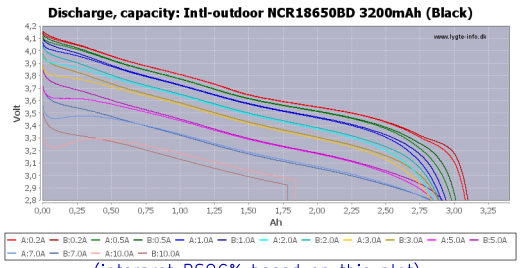






Sheet: /USB-C/		
File: usb-c.sch		
Title: USB Type C		
Size: A3	Date: 2018-05-18	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 2/21

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

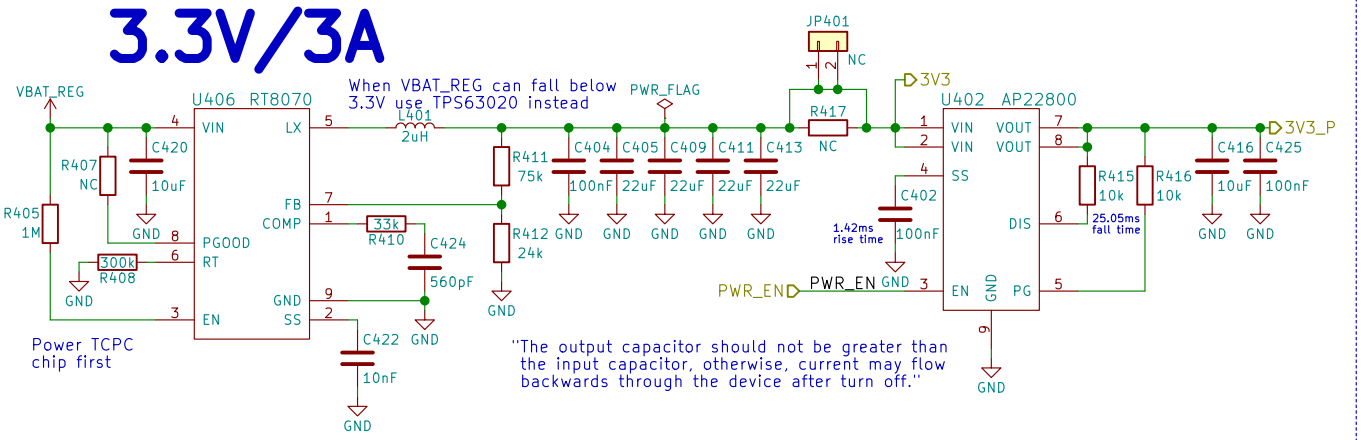
VBAT(nom)=REG06[7:2]
VBAT(default_max_ovp)=(REG06[7:2]×1.005)×1.04=4.3982016V
REG06[7:2]=010111⇒VBAT(max_ovp)=4.3814784
BQ29705 provides 4.425V as OVP!!!

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

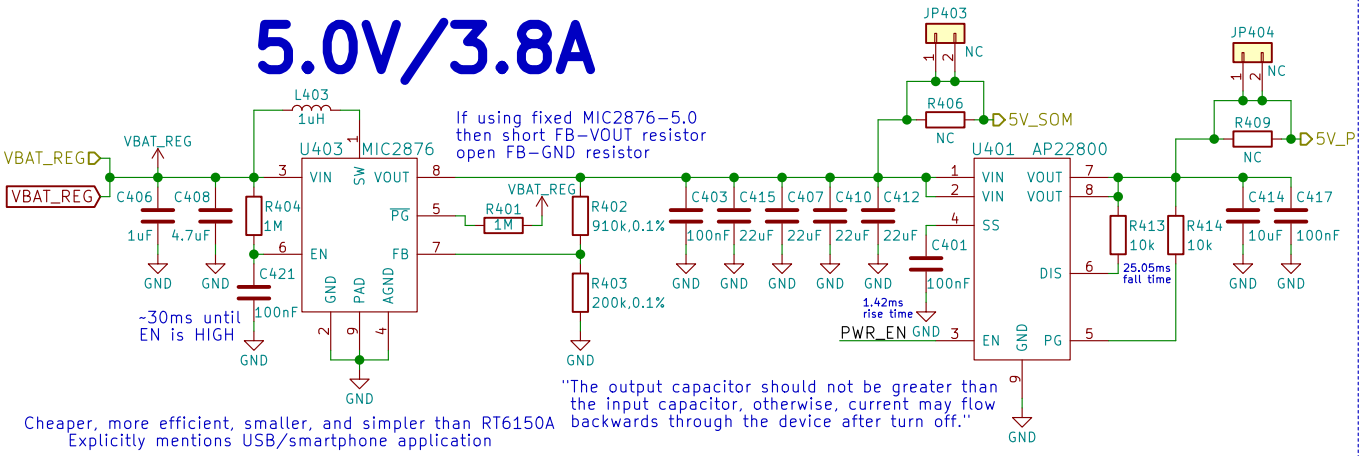
may want to include BQ29705 protection as in:
http://www.ti.com/lit/ug/tiducl1/tiducl1.pdf
schematic: http://www.ti.com/lit/df/tidrp70/tidrp70.pdf
(PTC may be good enough)

Sheet: /Battery/		
File: battery.sch		
Title: Battery		
Size: A4	Date: 2018-05-18	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 3/21

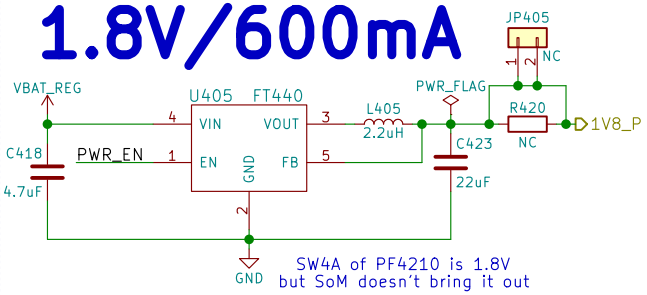
3.3V/3A



5.0V/3.8A



1.8V/600mA



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

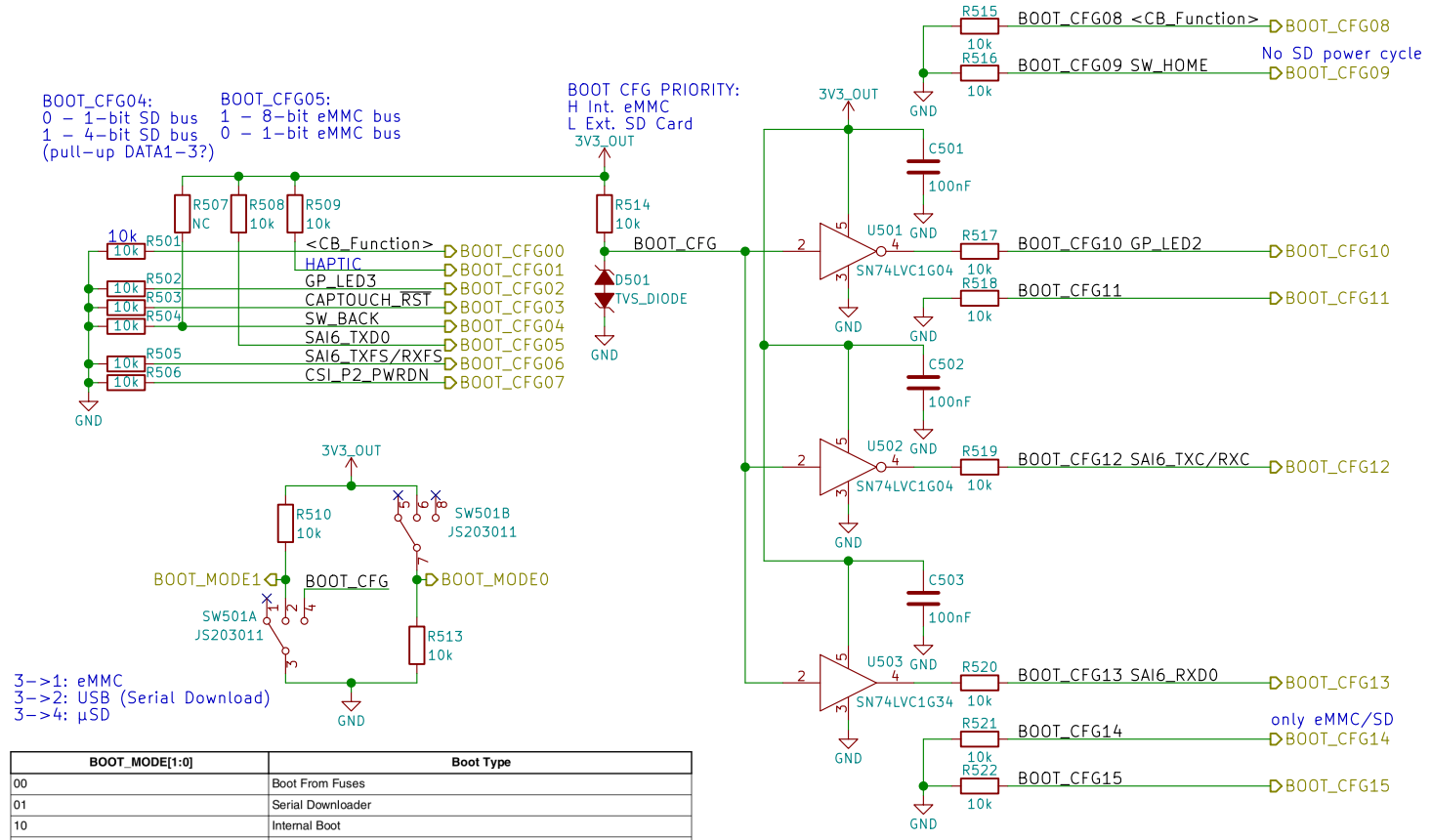
Sheet: /Power/
File: power.sch

Title: Power

Size: A4	Date: 2018-05-18	**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

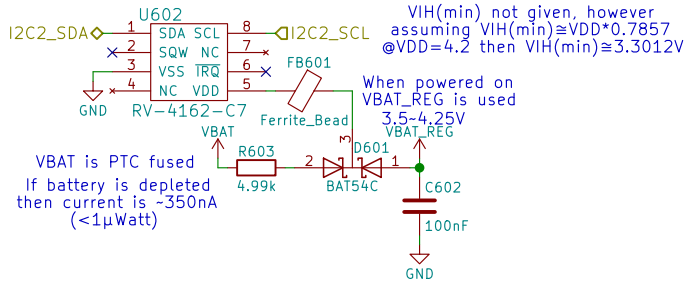


BOOT_MODE[1:0]	Boot Type
00	Boot From Fuses
01	Serial Downloader
10	Internal Boot
11	Reserved

Sheet: /Boot Config/
File: boot.sch

Title: Boot Configuration

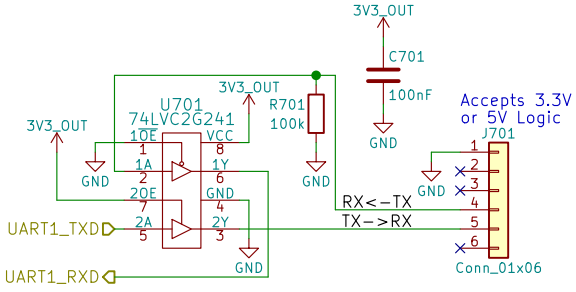
Size: A4	Date: 2018–05–18	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 5/21



Sheet: /RTC/
File: rtc.sch

Title: RTC

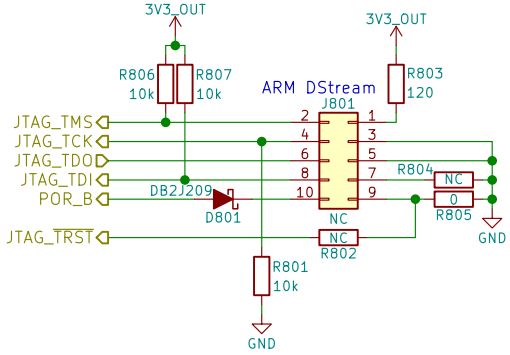
Size: A4	Date: 2018-05-18	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 6/21



Sheet: /UART Debug/
File: uart.sch

Title: UART Debug

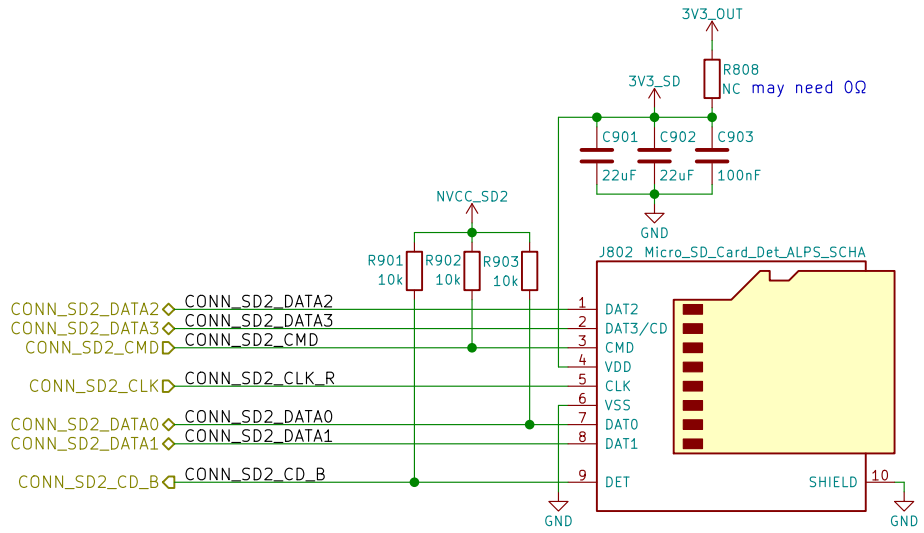
Size: A4	Date: 2018-05-18	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 7/21

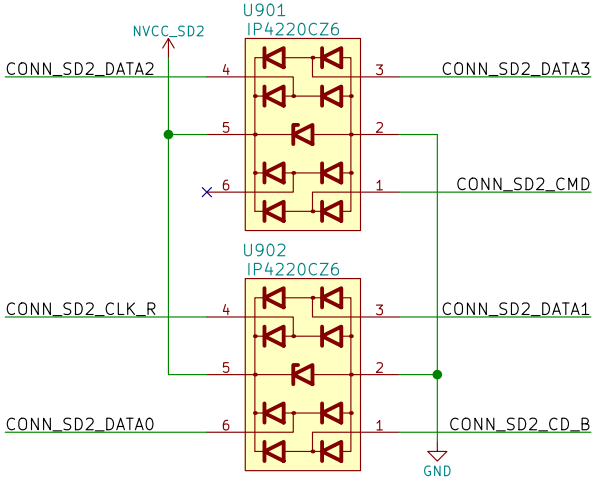


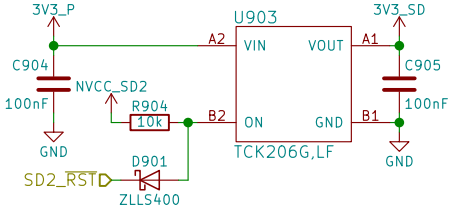
Sheet: /JTAG/
File: jtag.sch

Title: JTAG

Size: A4	Date: 2018-05-18	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 8/21







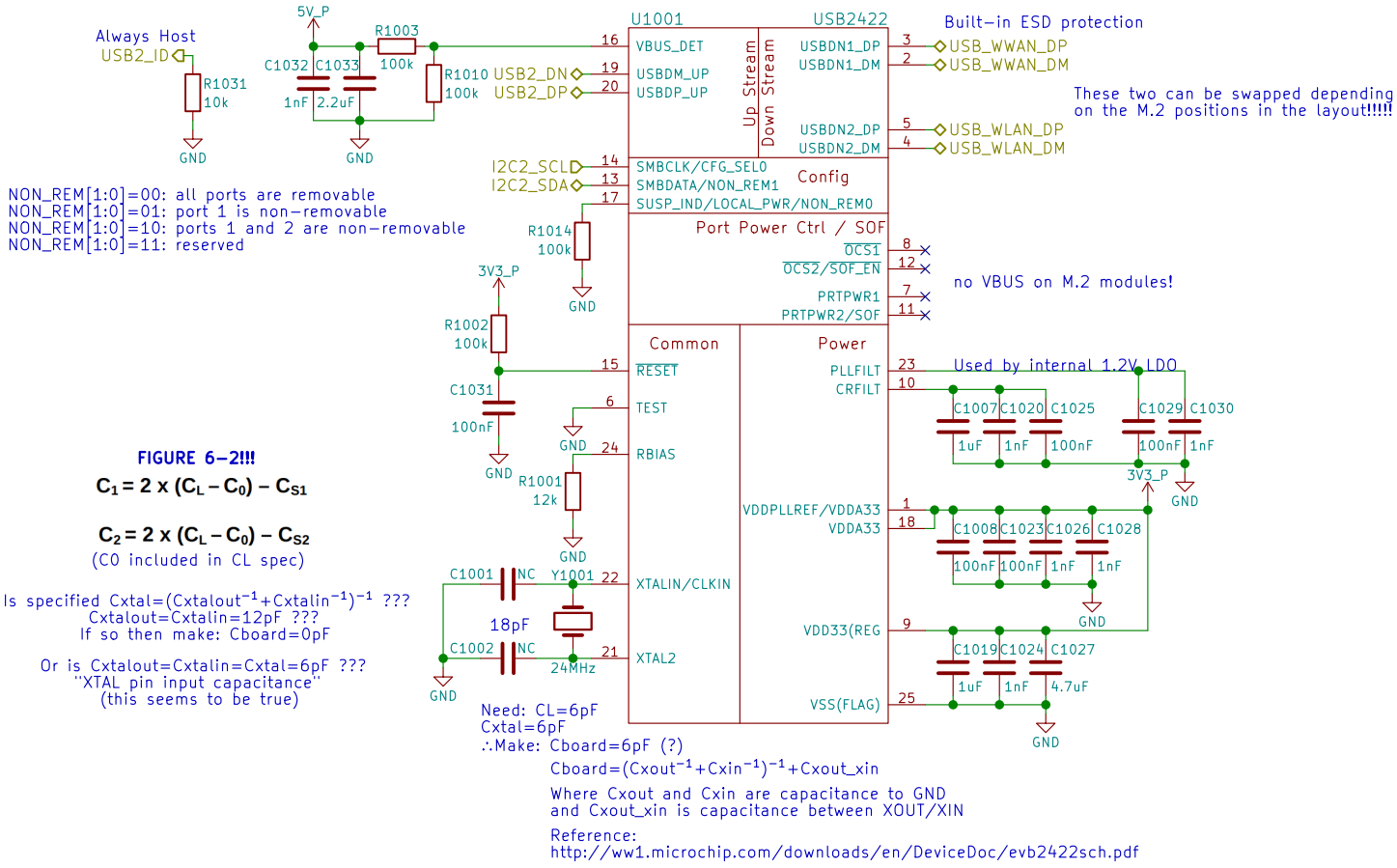
GNU GPLv3
Copyright 2018
Purism SPC

Sheet: /uSD Card/
File: sd.sch

Title: uSD Card

Size: A4	Date: 2018-05-18	**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

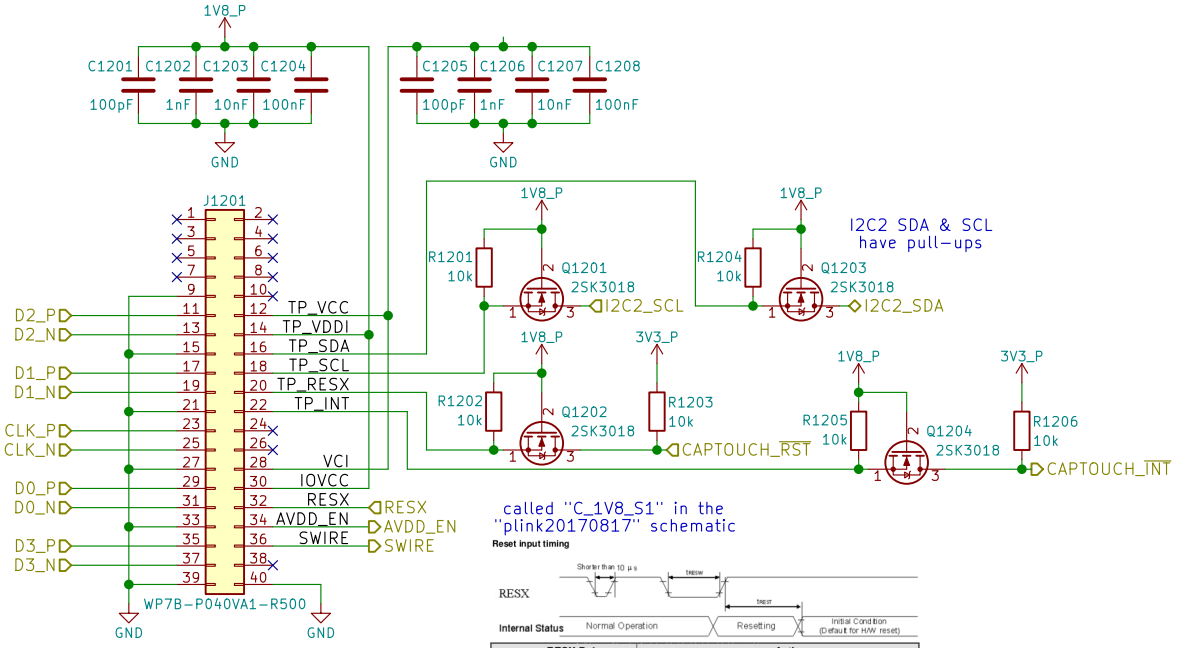
Reference:
http://ww1.microchip.com/downloads/en/DeviceDoc/evb2422sch.pdf

Sheet: /USB Hub/
File: usb_hub.sch

Title:

Size: A4	Date: 2018-05-18	**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

Reset input timing

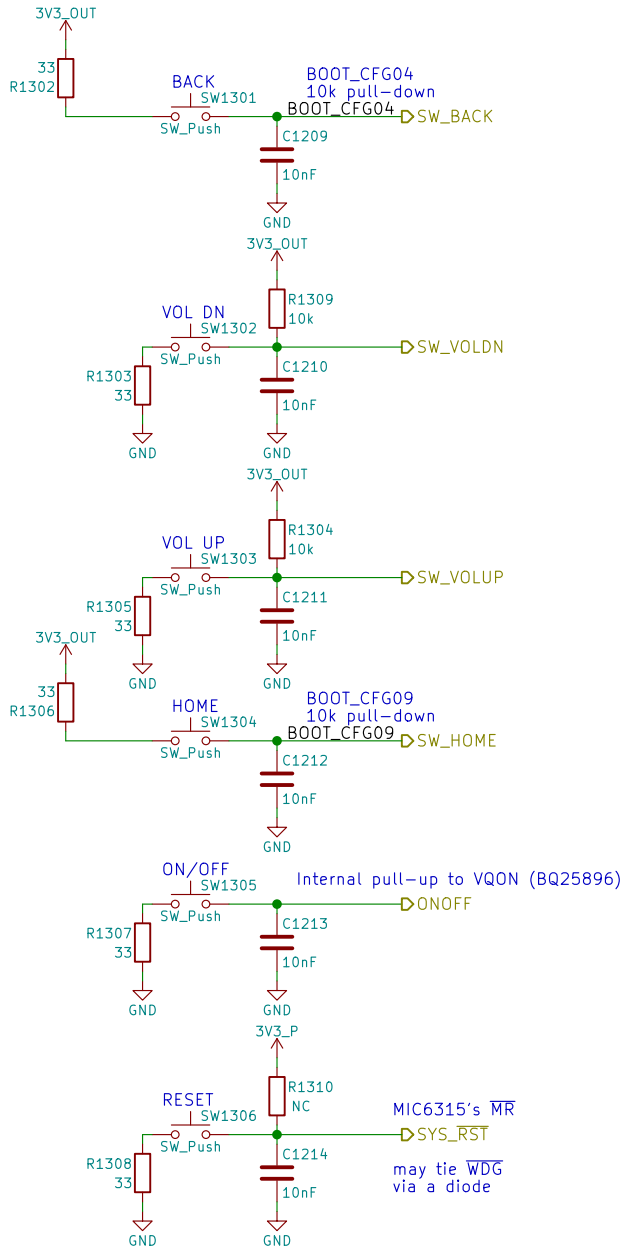
RESX Puise	Action
Shorter than 5µs	Invalid Reset
Longer than 10µs	Valid Reset
Between 5µs and 10µs	Reset Initialization Precedure

TODO: low power state signal??

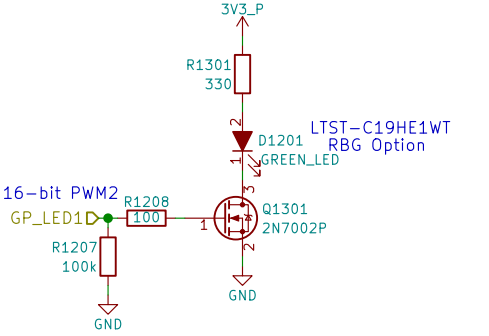
Sheet: /MIPI DSI/
File: mipi_dsi.sch

Title: MIPI DSI

Size: A4	Date: 2018-05-18	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 11/21



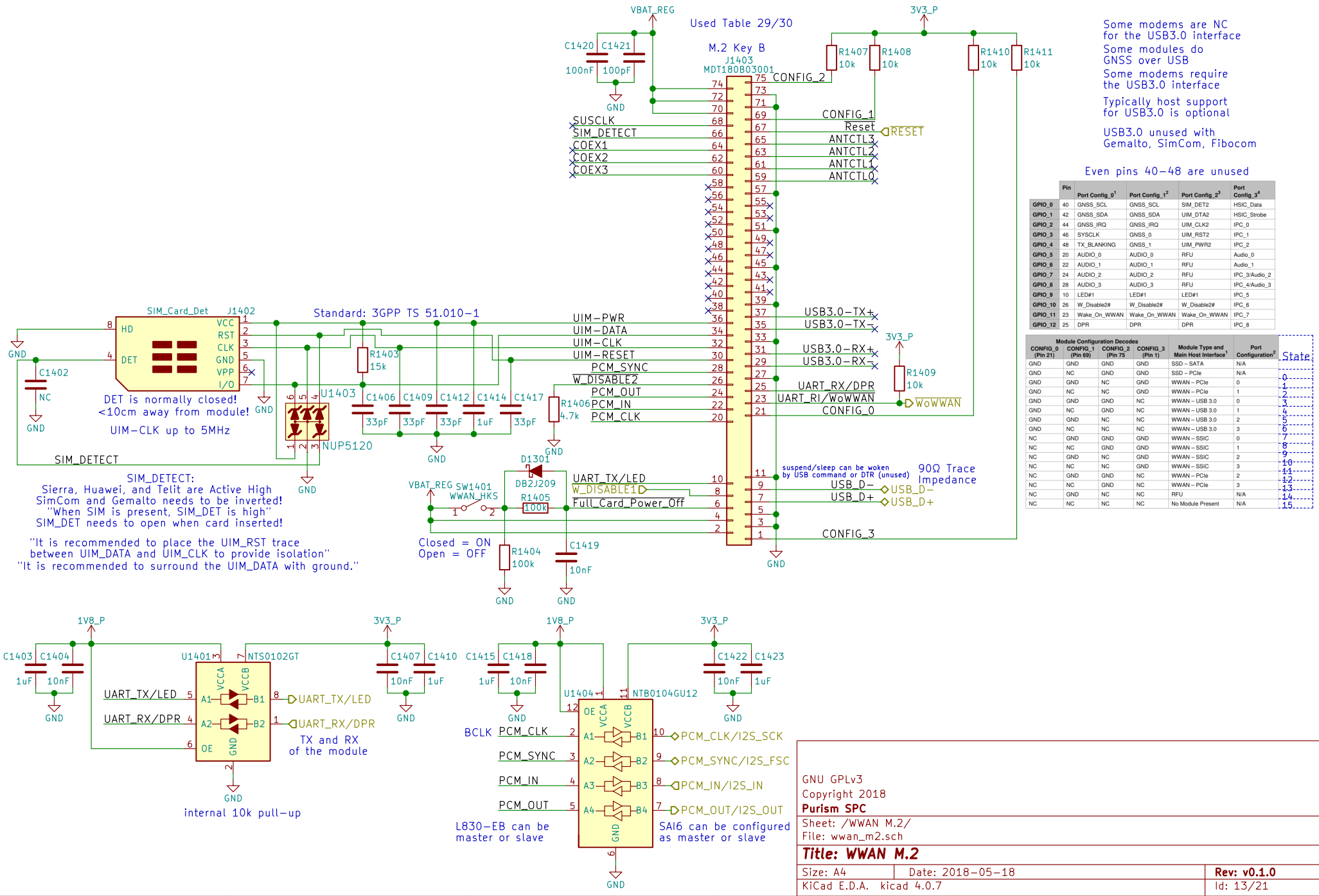
Use PWM2_PWMSAR to set the compare value (duty cycle)
Use PWM2_PWMCR[15:4] to set the PRESCALER (frequency)
Use PWM2_PWMPR to set the top of the counter (frequency)



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

Title: Buttons & LED

Size: A4	Date: 2018-05-18	**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: 2018-05-18	**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

Microphone
Ground
Audio (Right)
Audio (Left)

Mute via
MUTE_LO=1

may use lineout left channel
for pseudo-earpiece speaker

Z(hp)≥16Ω

<3.3µA

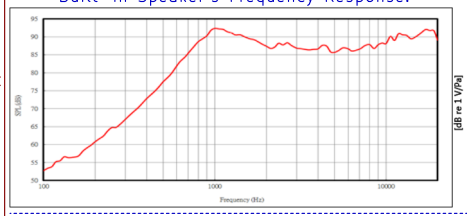
Pin 5 (tip switch) is NC,
open when inserted

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

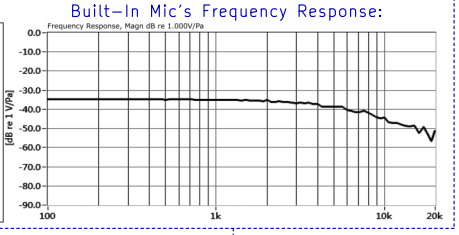
may add ~220uF cap
parallel to Zener

Vz=3.3V
Vf=0.9V

Built-In Speaker's Frequency Response:



Built-In Mic's Frequency Response:



SW Mute Mic:
MUTE_ADC=1

Ext-Mic enabled
MIC_SEL=LOW

Int-Mic enabled
MIC_SEL=LOW

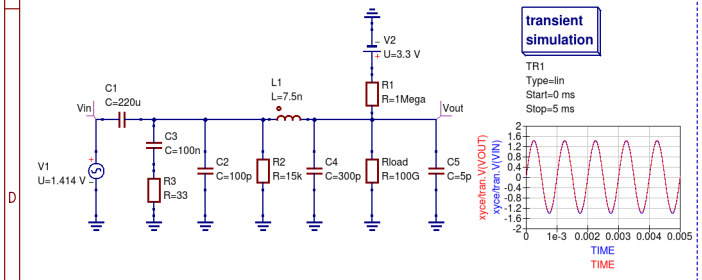
TODO:
DPST with
camera!

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

Simulation of HP_DET @ 1kHz output
without HP jack inserted:



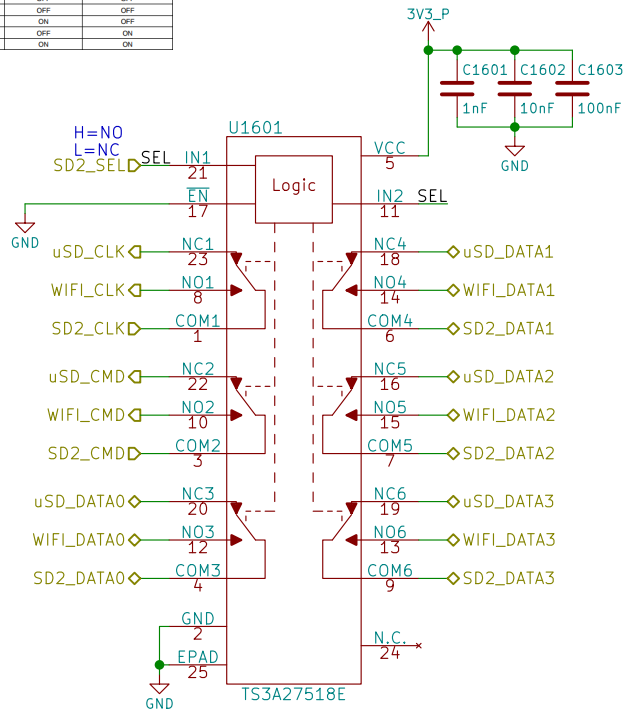
LCR Measurements:

Earbud Microphone: @1kHz	Headset Speaker: @1kHz	Earbud Speaker: @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: 2018-05-18	**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

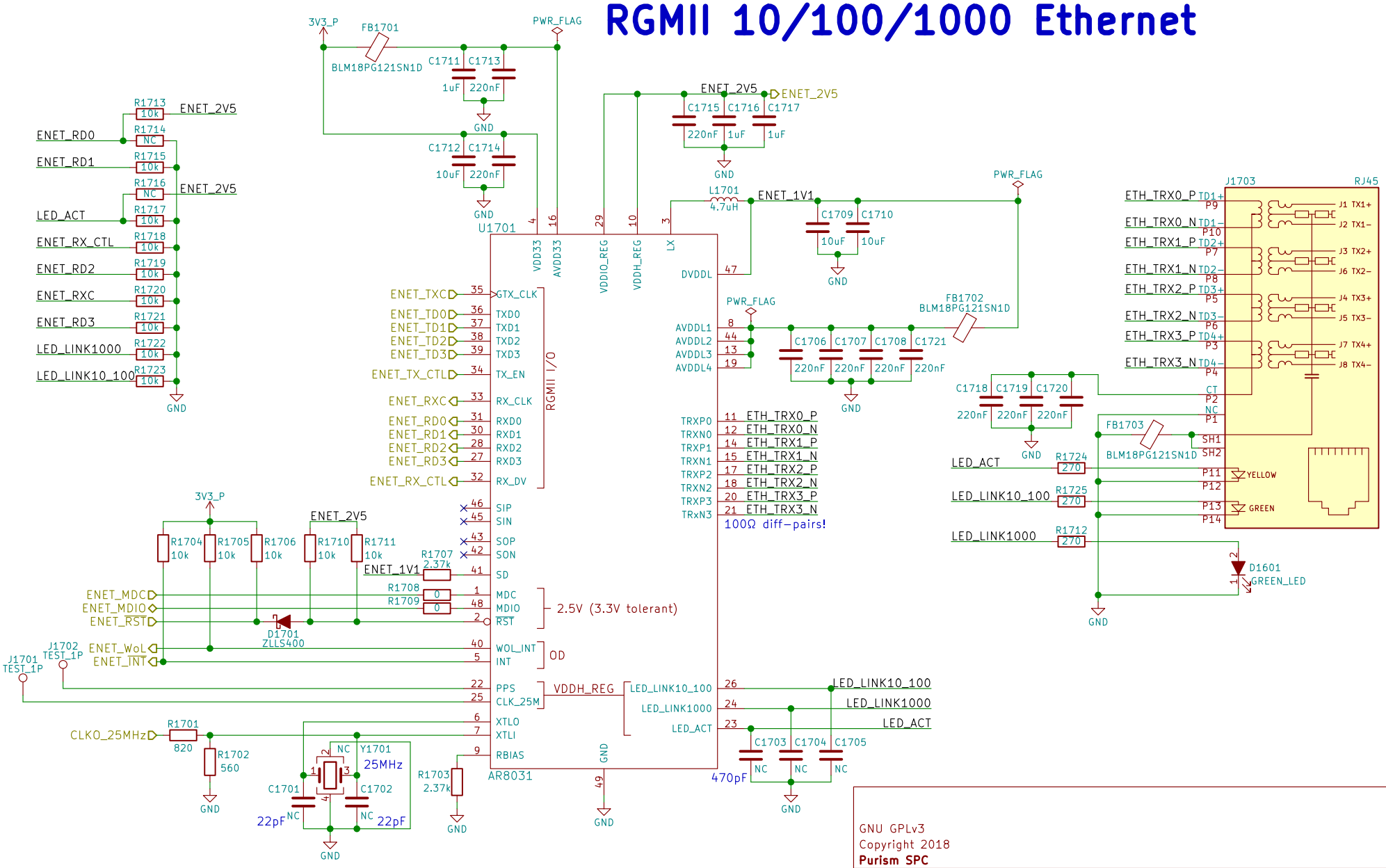


Sheet: /SDIO DEMUX/
File: sdio_demux.sch

Title: SDIO Demultiplexer

Size: A4	Date: 2018-05-18	**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: 2018-05-18	**Rev: v0.1.0**
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RS9116 NC:
RTS, CTS, BT_HOST_WAKE

RS9116 datasheet says
no WIFI_WAKE
but the schematic has it

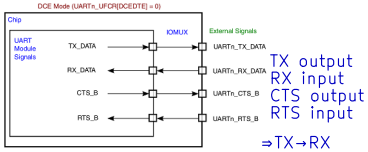
6.2 M.2 Signal Directions
Module: Table 23
Socket: Table 46

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

3V3_P
JP1701
R1727 NC
NC
J1502
USB_WLAN_DP
USB_WLAN_DN
WIFI_CLK
WIFI_CMD
WIFI_DATA0
WIFI_DATA1
WIFI_DATA2
WIFI_DATA3
WIFI_WAKE
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
GND

1V8_P
R1506 10k
D1503 ZLLS400
WIFI_RST
D1504 ZLLS400
W_DISABLE1

UARTn_UFCR[DCEDTE]=0 on POR



TX output
RX input
CTS output
RTS input

⇒TX→RX
RX←TX
CTS→CTS
RTS←RTS

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

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

3V3_P
U1502A 74AUP2G08
U1502B 74AUP2G08
R1726 10k
BT_DISABLE
WIFI_DISABLE
GND

D1703 DB2J209
Closed = ON (*_DISABLE HIGH)
Open = OFF
SW1501 WWAN_HKS
R1508 100k
C1515 10nF
R1510 100k

1V8_P
R1507 10k
M2_I2C_SDA
I2C2_SDA
Q1501 FDV301N

RS9116 is an I2C master
⇒its SCL is an output
(ok bc only device on I2C2)

R1509 10k
M2_I2C_SCL
I2C2_SCL
Q1502 FDV301N

C1722 C1723 1uF 10nF
C1724 C1725 10nF 1uF
U1702 NTB0104GU12
OE VCCA VCCB GND
BT_UART_RXD A1 B1 BT_UART_RXD
BT_UART_TXD A2 B2 BT_UART_TXD
BT_UART_RTS A3 B3 BT_UART_RTS
BT_UART_CTS A4 B4 BT_UART_CTS
RX, TX, RTS, CTS
of the SoC
internal 10k pull-up

C1520 C1521 1uF 10nF
C1522 C1523 10nF 1uF
U1504 NTB0104GU12
BCLK M2_PCM_CLK A1 B1 BT_PCM_CLK
M2_PCM_SYNC A2 B2 BT_PCM_SYNC
M2_PCM_IN A3 B3 BT_PCM_IN
M2_PCM_OUT A4 B4 BT_PCM_OUT
configure as slave

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

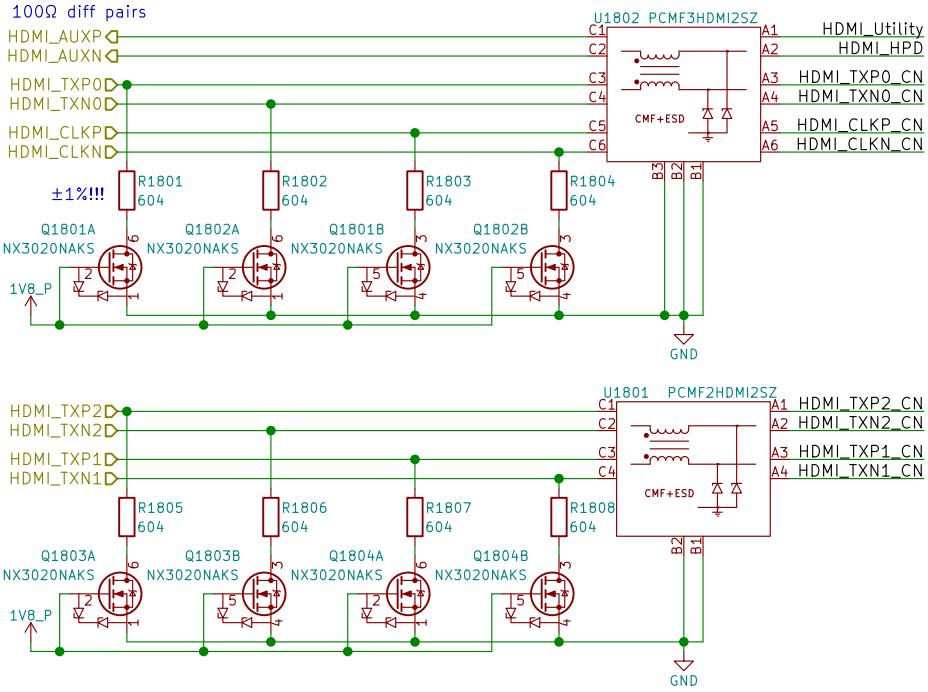
Title: WLAN+BT M.2

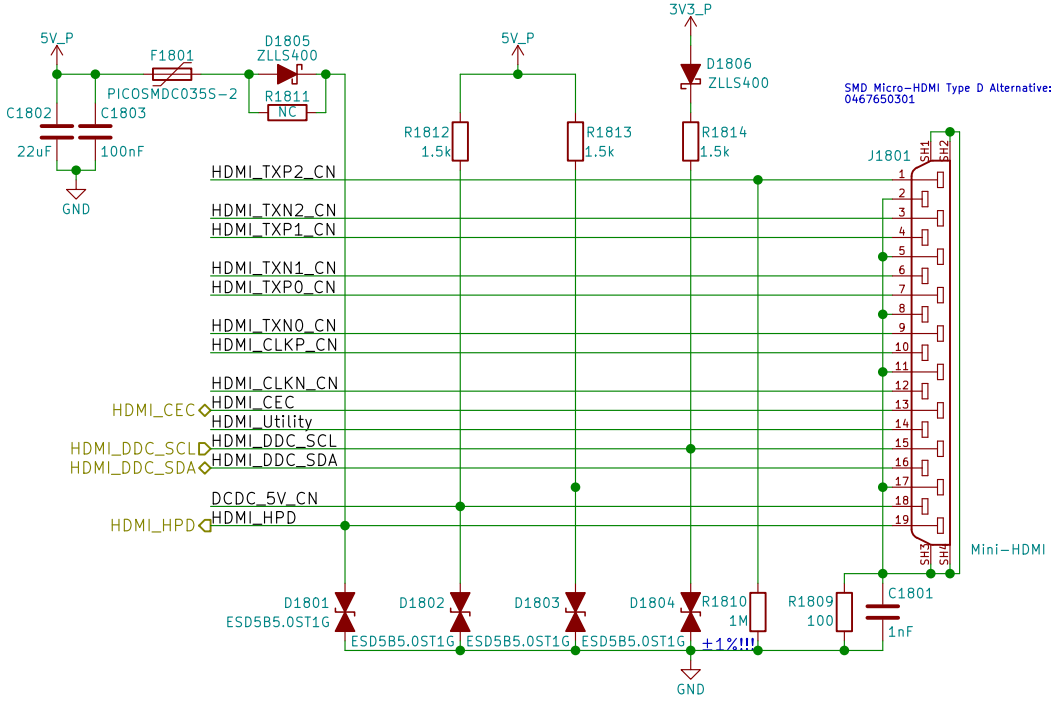
Size: A4	Date: 2018-05-18	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 17/21

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: 2018-05-18	**Rev: v0.1.0**
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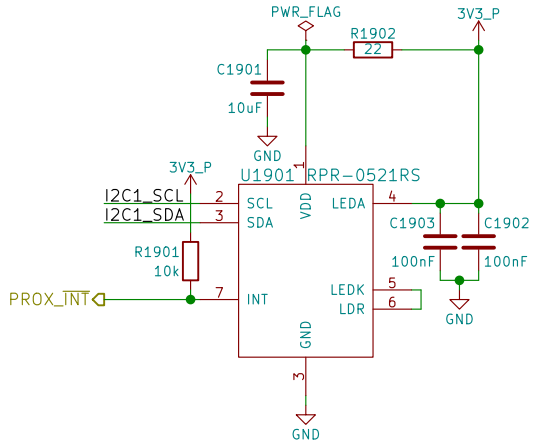
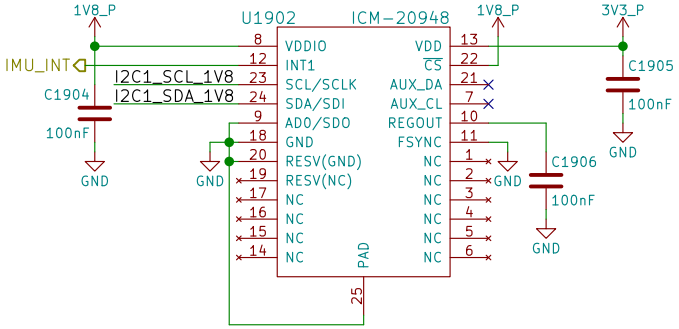
Proximity & Ambient Light



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

9-Axis IMU



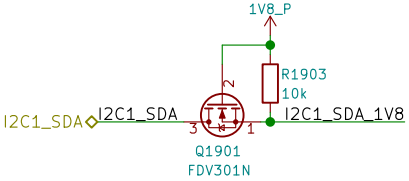
Reference:
https://store.invensense.com/datasheets/invensense/AN-IVS-0001EVB-00%20v1%202.pdf

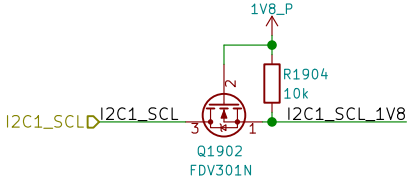
AD0 sets the slave address's LSB (110100X)

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

"FSYNC - Connect to GND if unused"

I2C's VIH=1.8V





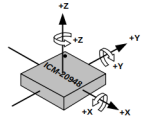


Figure 12. Orientation of Axes of Sensitivity and Polarity of Rotation

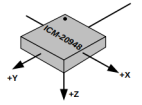


Figure 13. Orientation of Axes of Sensitivity for Magnetometer

Sheet: /Sensors/
File: sensors.sch

Title: Sensors

Size: A4	Date: 2018-05-18	**Rev: v0.1.0**
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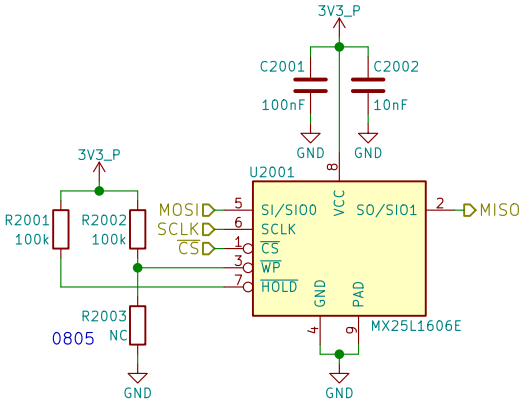


Sheet: /SPI Flash/
File: flash.sch

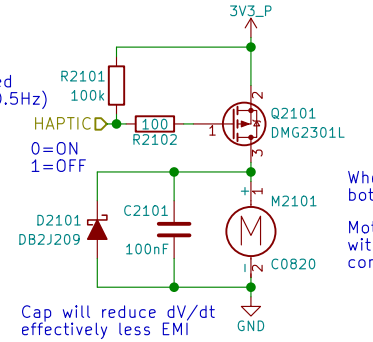
Title: SPI NOR Flash

Size: A4	Date: 2018-05-18	**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)

PWM needed?
Only needs to be toggled
ON 1 sec, OFF 1 sec (0.5Hz)

Can MUX as either
GPIO or PWM2
swapping with LED



When the motor is off
both terminals are at GND

Motor will have wire leads
with a 2-pin Molex or JST
connector installed (by request)!

Cap will reduce dV/dt
effectively less EMI

Motor Connector:
https://lcsc.com/product-detail/1-25T-Connectors_1-25T-1-2AW_C10832.html

Alibaba Alternative Motor:
https://www.alibaba.com/product-detail/Coin-motor-vibration-dc-motor
cellphone_1994583657.html?spm=a2700.8443308.0.0.5aa13e5f1wxHgs

Sheet: /Haptic Motor/
File: haptic.sch

Title: Haptic/Vibration Motor

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