Spare GPIO:
GPIO1_IO05 (was CSI_P2_PWDN)

GPIO that can be swapped around:
GPIO1_IO05 (was CSI_P2_PWDN)
GPIO1_IO12 (was IR_CAP)
GPIO3_IO19 (was LED1)
GPIO3_IO20
GPIO3_IO25
GPIO5_IO03 (was PWM3)
GPIO5_IO05 (was PWM1)

TODO:
GNSS
MIPI CSI/DSI

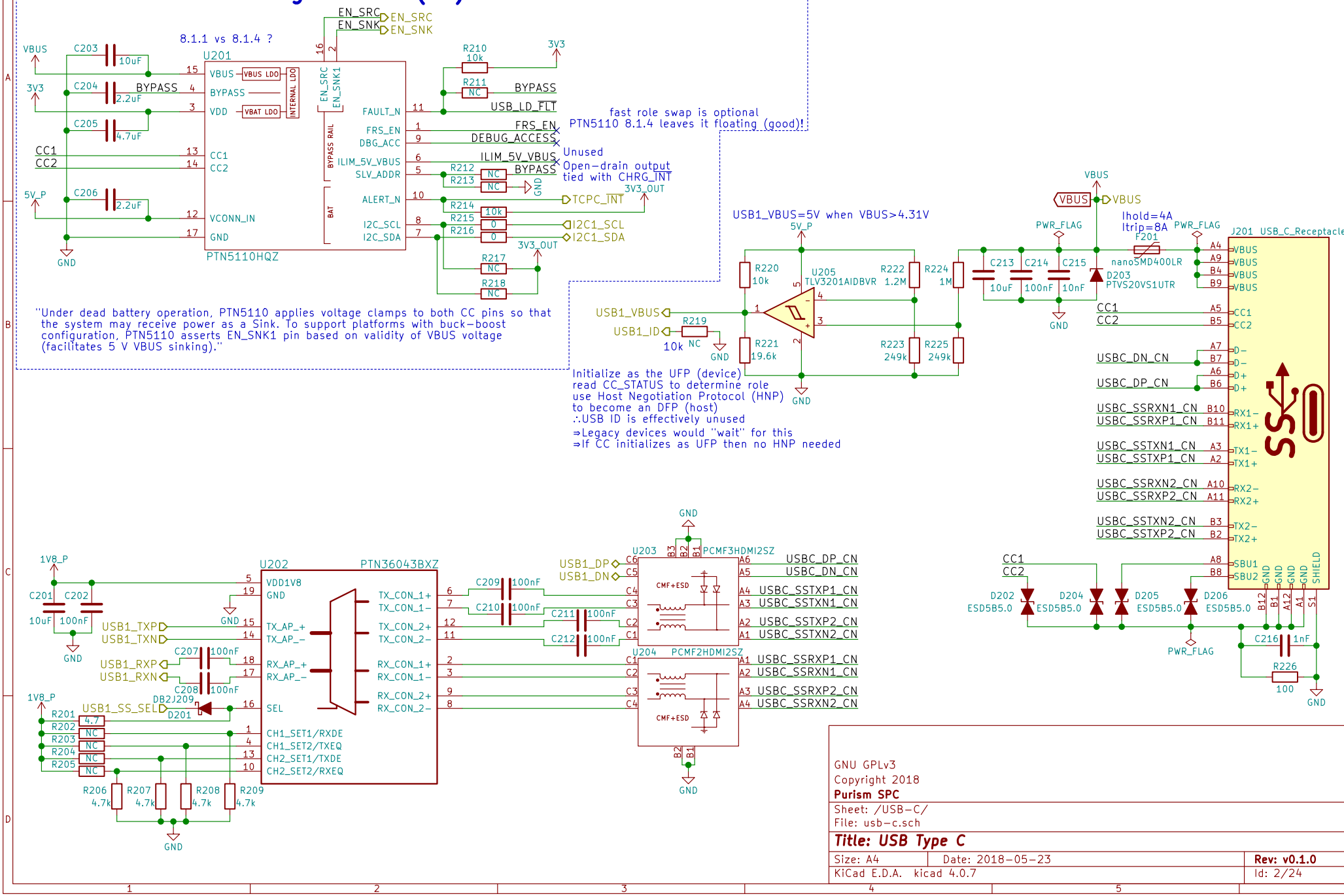
Purism SPC

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

Title: DVK-MX8M-BSB

Size: A2	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 1/24

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



GNU GPLv3
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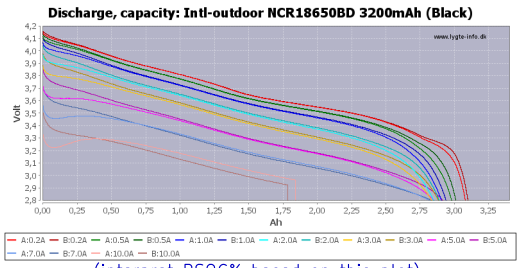
Purism SPC

Sheet: /USB-C/
File: usb-c.sch

Title: USB Type C

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 2/24

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

L301 1uH

L302 HI1206T500R

3.5~4.25V PWR_FLAG

~110uF

JP301 NC

R308 NC

R309 330

1.4mA~7mA

D304 GREEN_LED

D303 SM6T6V8A

Vrm=5.8V
Vz=6.8

Default LOW:
adapter source

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

nanoSMD350LR F301

BT301 18650

R307 5.23k RGEN

R306 30.1k

TH301 10k

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

Q301 2SK3018

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)

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

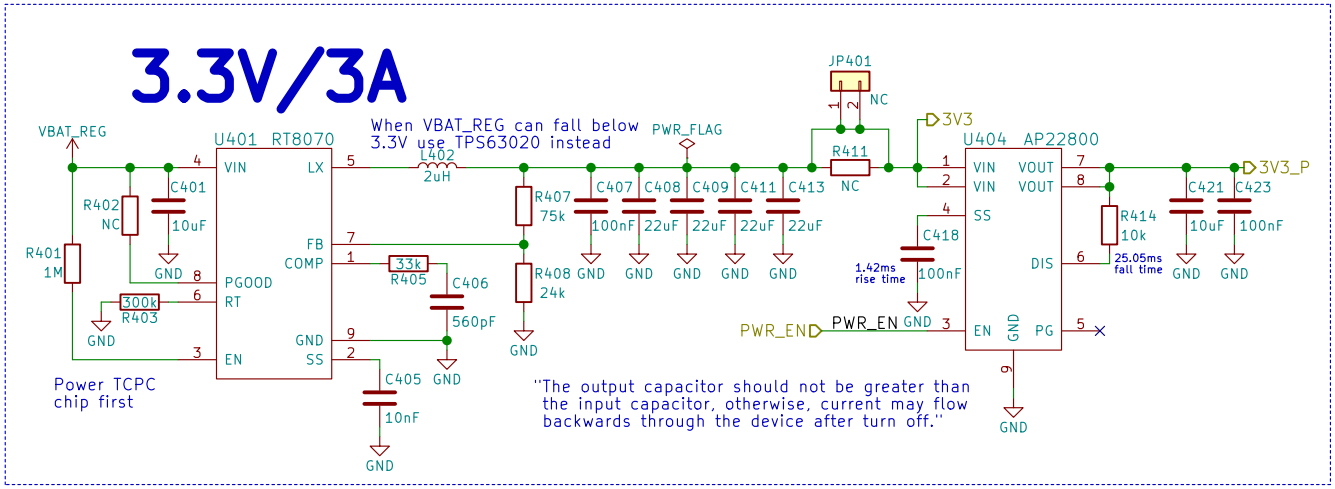
may want to include BQ29705 protection as in:
http://www.ti.com/lit/ug/tiducl1/tiducl1.pdf
schematic: http://www.ti.com/lit/df/tidrp70/tidrp70.pdf
(PTC may be good enough)

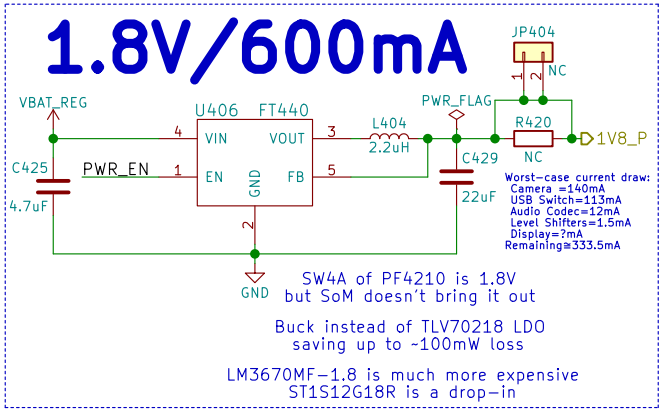
TODO:
Keystone 1042 footprint???

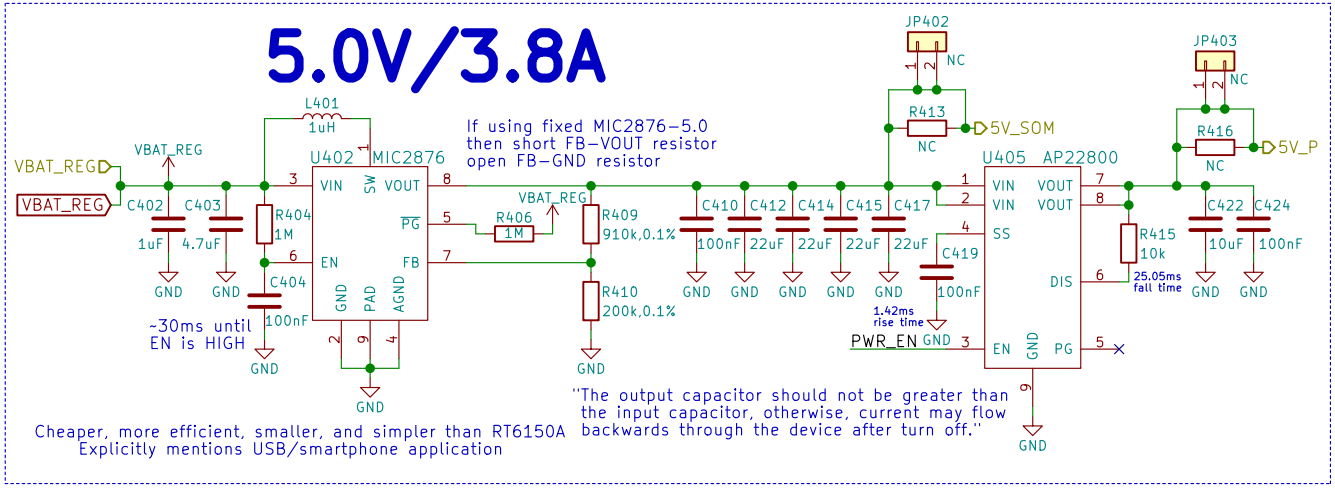
Battery holder gives ~1mm clearance underneath the battery
Thermistor is 1.1±0.15mm thick, should fit fine with stack-up

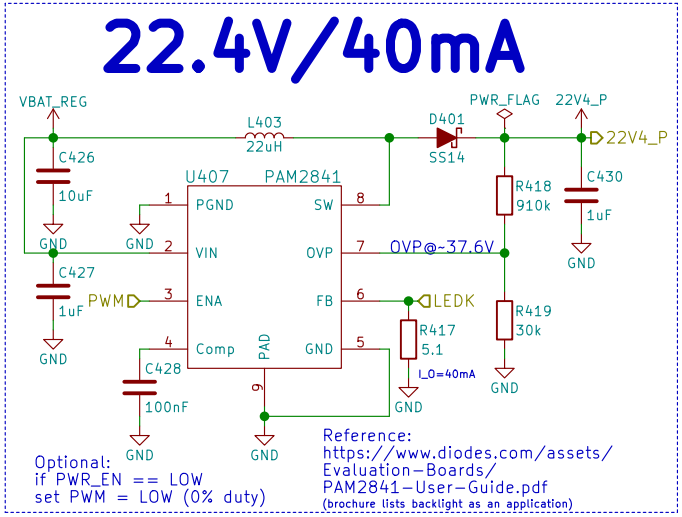
Battery holder seems to fit up to ~68.88mm long batteries
need to test 18650 protected cells which are ~69.35mm long

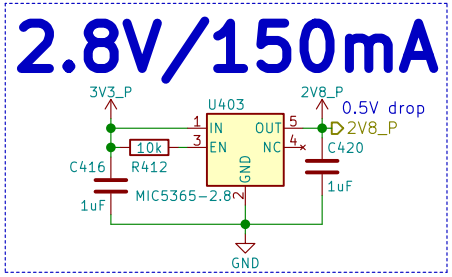
Sheet: /Battery/		
File: battery.sch		
Title: Battery		
Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 3/24











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

Sheet: /Power/		
File: power.sch		
Title: Power		
Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 4/24

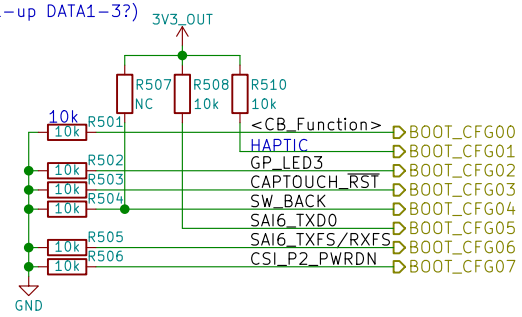
Only eMMC

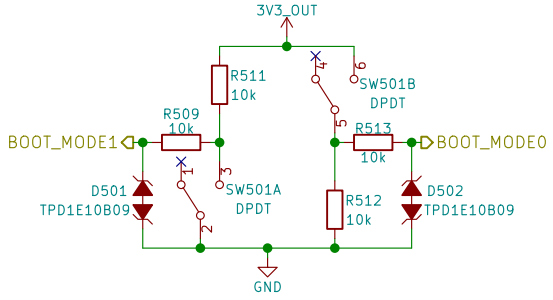
BOOT_CFG[14:12]	Boot device
001	SD/eSD
010	MMC/eMMC
011	NAND

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_CFG04:
0 – 1–bit SD bus
1 – 4–bit SD bus
(pull–up DATA1–3?)

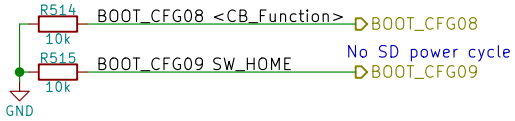
BOOT_CFG05:
1 – 8–bit eMMC bus
0 – 1–bit eMMC bus

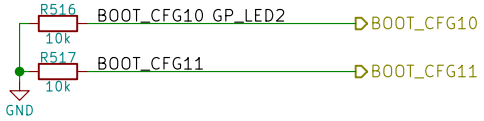


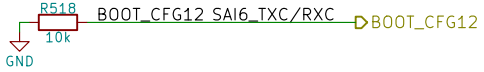


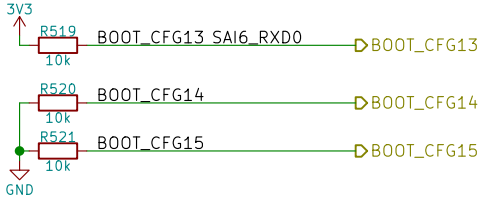
2–>1: eMMC
2–>3: USB (Serial Downloader)

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





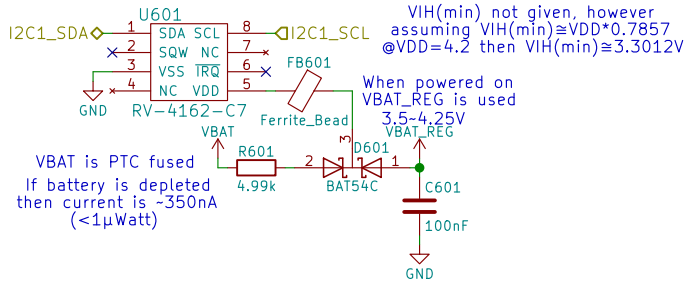




Sheet: /Boot Config/
File: boot.sch

Title: Boot Configuration

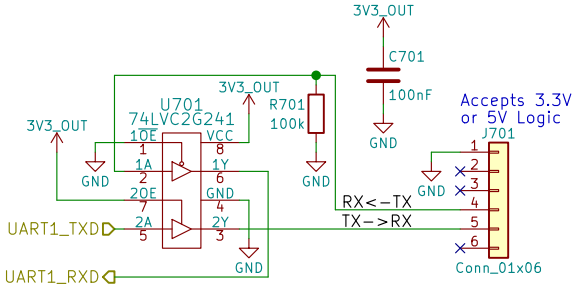
Size: A4	Date: 2018–05–23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 5/24



Sheet: /RTC/
File: rtc.sch

Title: RTC

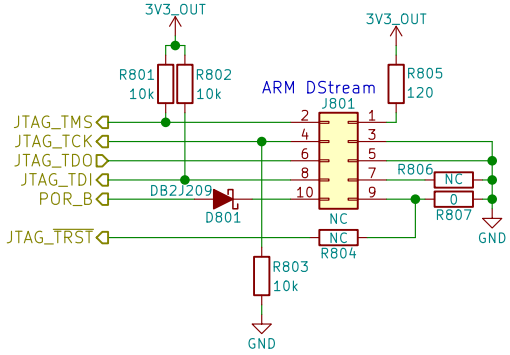
Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 6/24



Sheet: /UART Debug/
File: uart.sch

Title: UART Debug

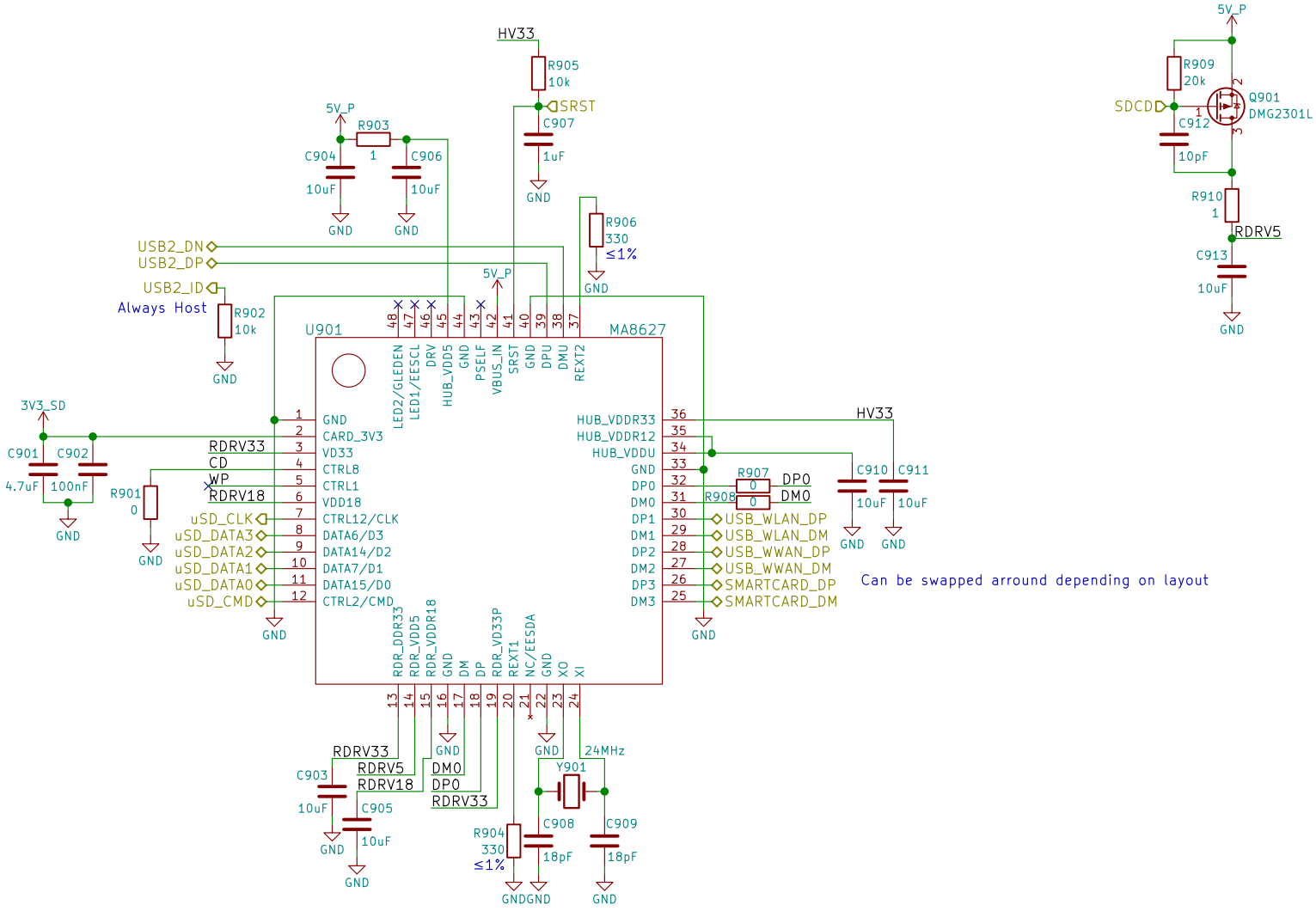
Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 7/24



Sheet: /JTAG/
File: jtag.sch

Title: JTAG

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 8/24



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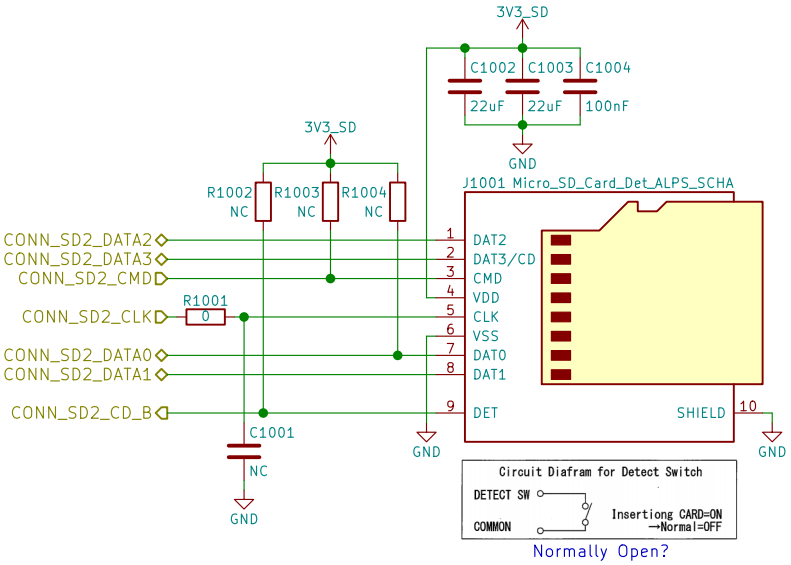
Sheet: /USB Hub + SDIO Bridge/
File: usb_hub_sdio.sch

Title:

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 9/24

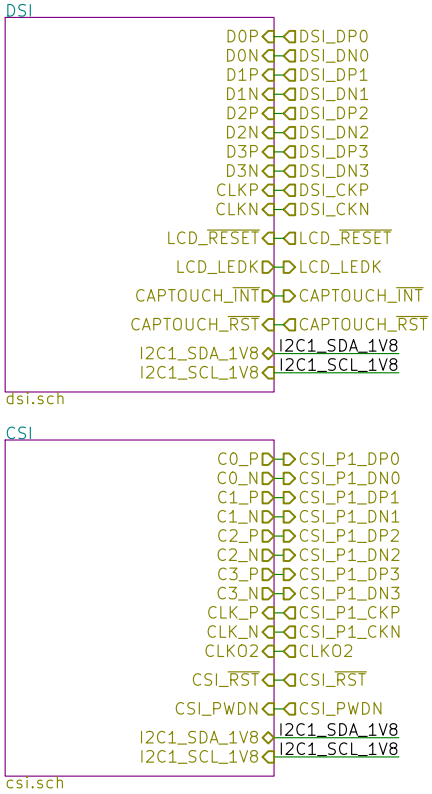


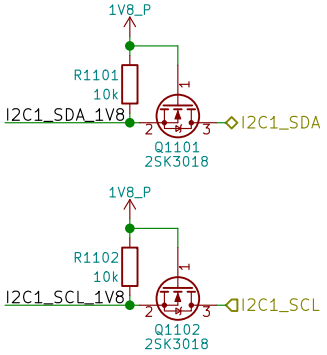
Purism SPC

Sheet: /uSD Card/
File: sd.sch

Title: uSD Card

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 10/24

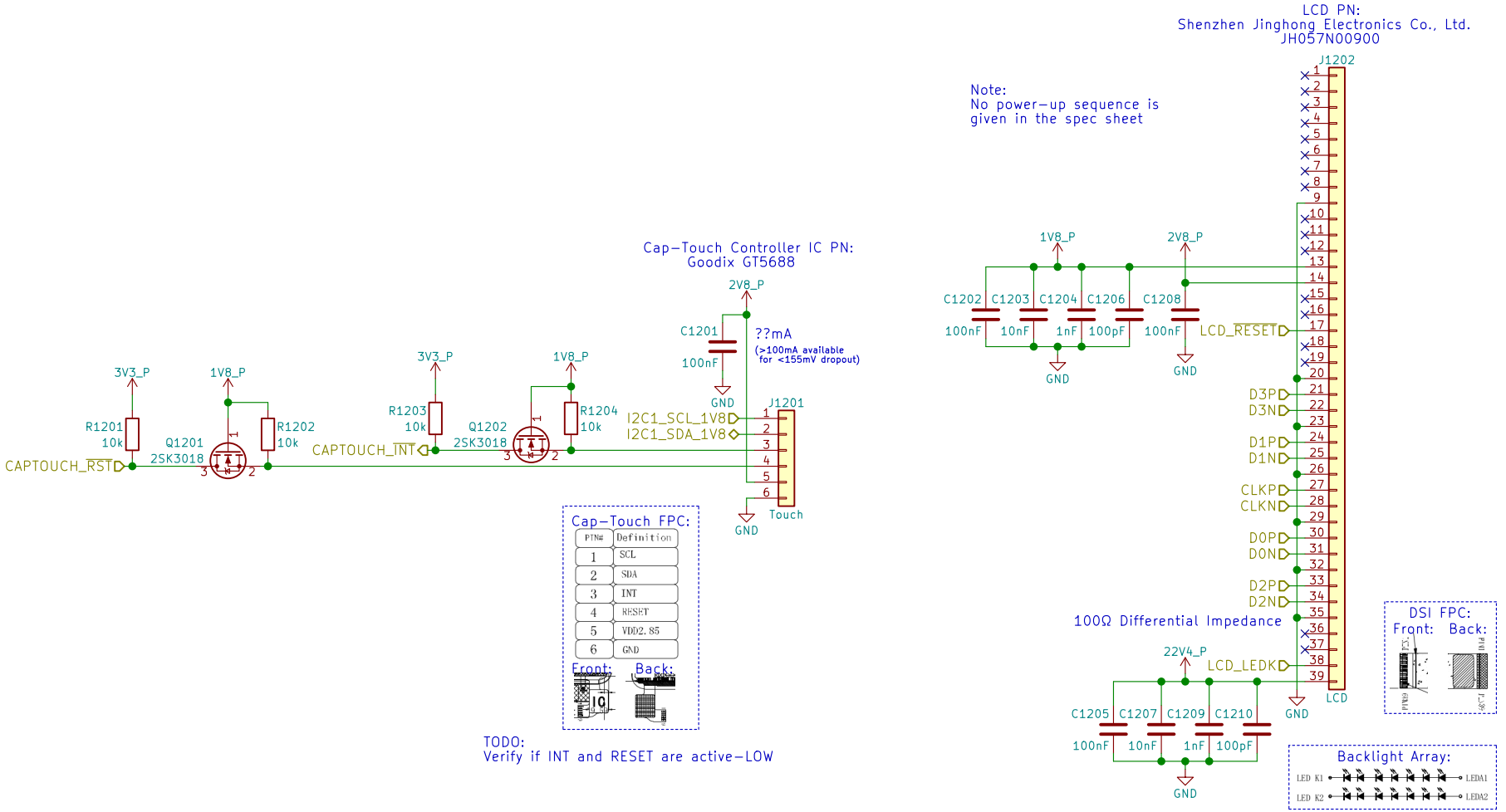




Sheet: /MIPI/
File: mipi.sch

Title:

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 11/24



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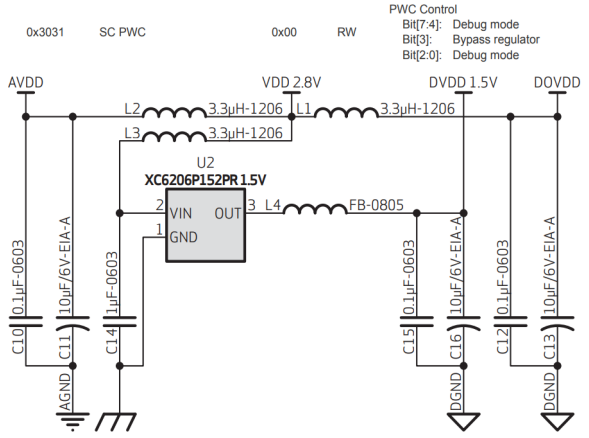
Purism SPC

Sheet: /MIPI/DSI/
File: dsi.sch

Title: MIPI DSI

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 12/24

Using Internal DVDD 1.5V Regulator:



2.7 POWER UP SEQUENCE

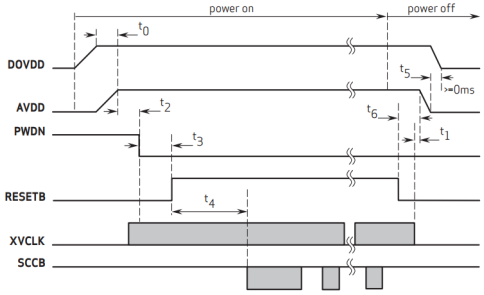
Based on the system power configuration (1.8V or 2.8V for I/O power, using external DVDD or internal DVDD, requiring access to the I2C during power up period or not), the power up sequence will differ. If 1.8V is used for I/O power, using the internal DVDD is preferred. If 2.8V is used for I/O power, due to a high voltage drop at the internal DVDD regulator, there is a potential heat issue. Hence, for a 2.8V power system, OmniVision recommends using an external DVDD source. Due to the higher power down current when using an external DVDD source, OmniVision strongly recommends cutting off all powers, including the external DVDD, when the sensor is not in use in the case of 2.8V I/O and external DVDD.

2.7.1 POWER UP WITH INTERNAL DVDD

For powering up with the internal DVDD and I2C access during the power ON period, the following conditions must occur:

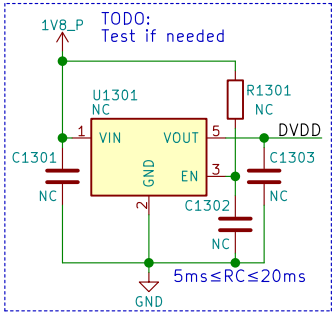
1. when DOVDD and AVDD are turned ON, make sure DOVDD becomes stable before AVDD becomes stable
2. PWDN is active high with an asynchronized design (does not need clock)
3. PWDN pin tied to digital ground if it is not controlled.
4. if PWDN pin is controlled as below, for PWDN to go low, power must first become stable (AVDD to PWDN ≥ 5 ms)
5. RESETB is active low with an asynchronized design
6. master clock XVCLK should provide at least 1 ms before host accesses the sensor's registers
7. host can access I2C bus (if shared) during entire period. 20ms after RESETB goes high, host can access the sensor's registers to initialize sensor

figure 2-3 power up timing with internal DVDD

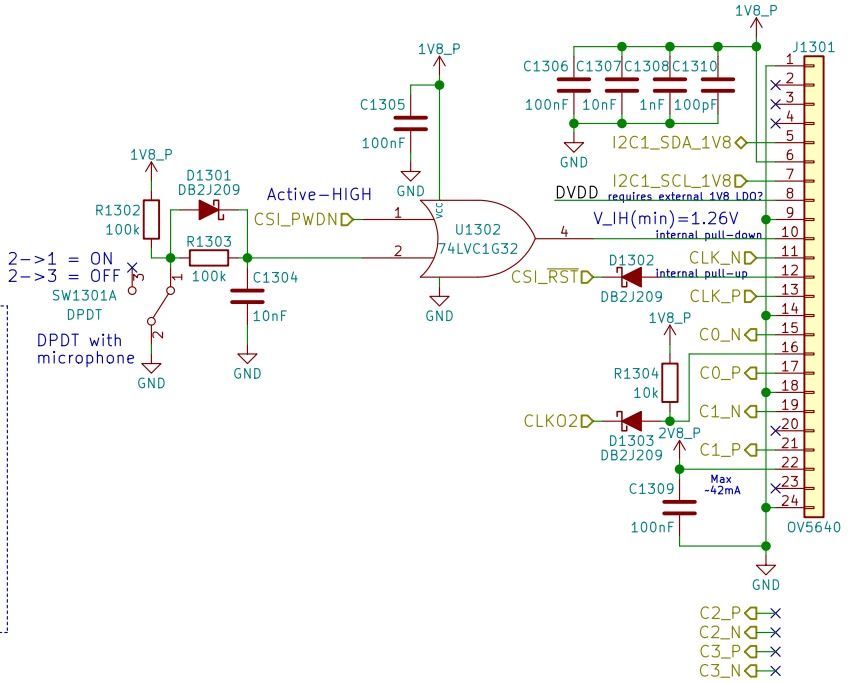


note
t_0 ≥ 0ms, delay from DOVDD stable to AVDD stable, it is recommended to power up AVDD shortly after DOVDD has been powered up
t_1 ≥ 0ms, delay from XVCLK off to AVDD off
t_2 ≥ 5ms, delay from AVDD stable to sensor power up stable, PWDN can be pulled low after this point, XVCLK can be turned on after power on
t_3 ≥ 1ms, delay from sensor power up stable to RESETB pull up
t_4 ≥ 20ms, delay from RESETB pull high to SCCB initialization
t_5 ≥ 0ms, delay from AVDD off to DOVDD off
t_6 ≥ 0ms, delay from RESETB pull low to AVDD off

S640_DS_2_2



Will draw up to 125mA from DVDD

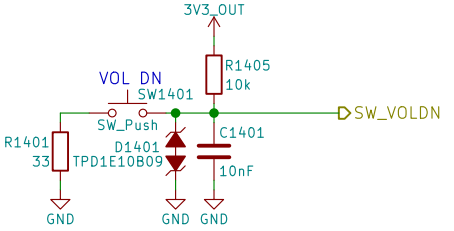


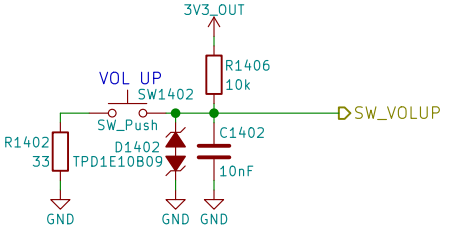
OV5640 CMOS Image Sensor Datasheet:
https://cdn.sparkfun.com/datasheets/Sensors/LightImaging/OV5640_datasheet.pdf

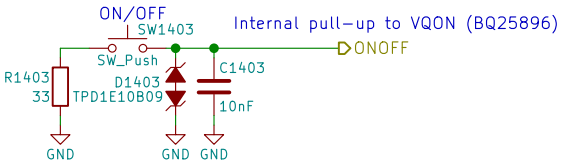
Sheet: /MIPI/CSI/
File: csi.sch

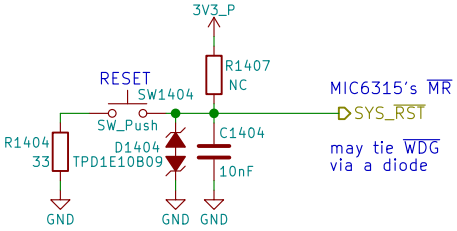
Title:

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 13/24

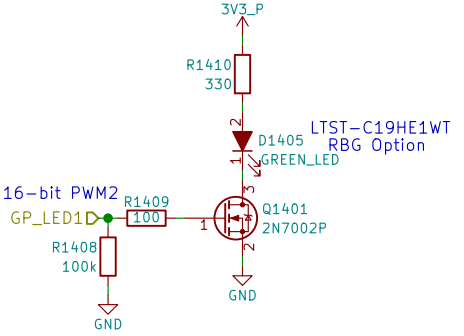








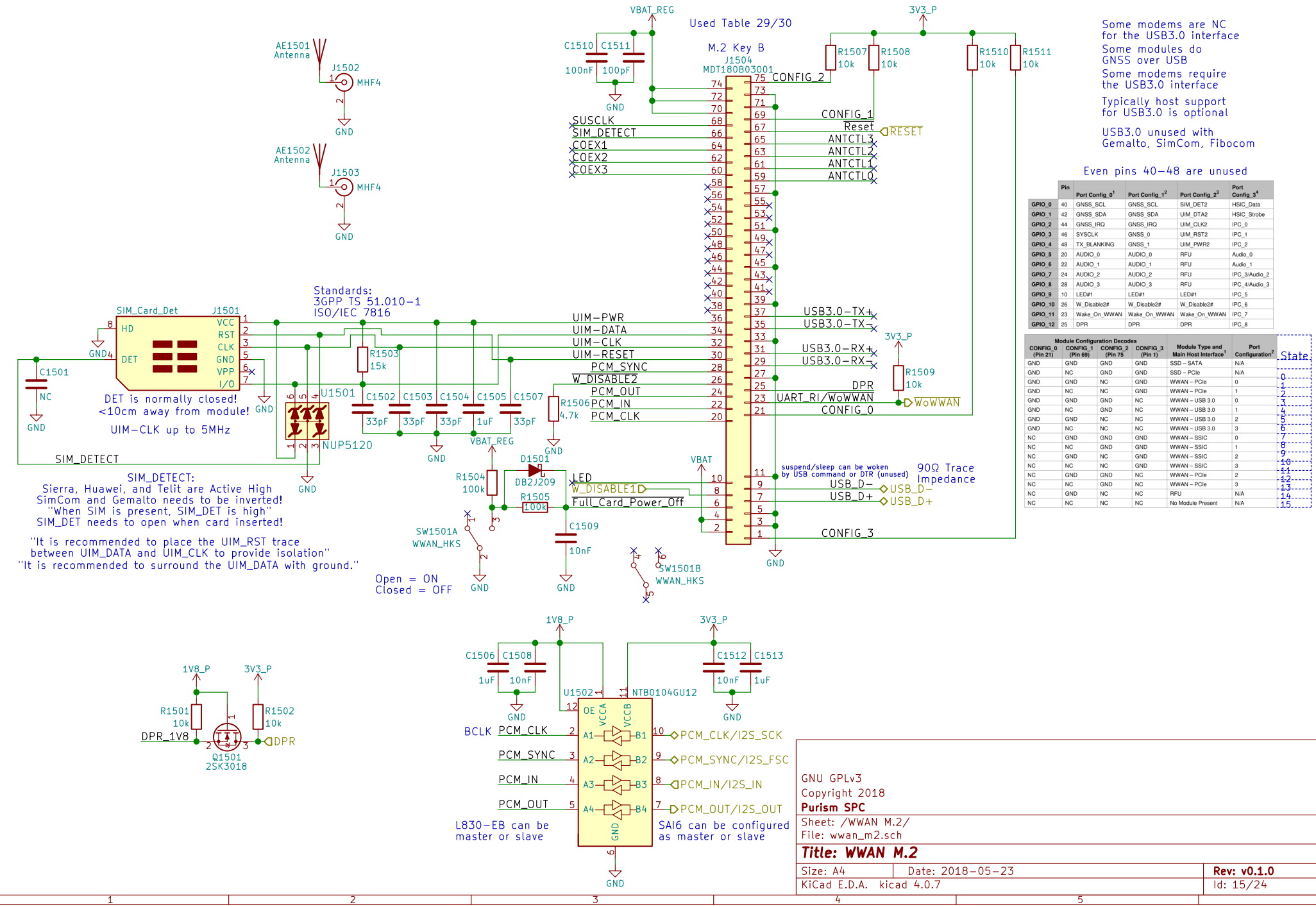
Use PWM2_PWMSAR to set the compare value (duty cycle)
Use PWM2_PWMCR[15:4] to set the PRESCALER (frequency)
Use PWM2_PWMPR to set the top of the counter (frequency)



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

Title: Buttons & LED

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 14/24



	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: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 15/24

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

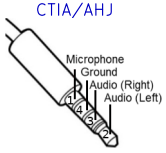
"HP Output – 62.5mW max, 1.02kHz sine into 16Ω load at 3.3 V"
⇒ $(1V)^2/(16Ω)=62.5mW$
∴ Vrms=1V ⇒ Vp(amplitude)=1.414V
∴ Irms(max)=62.5mA

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

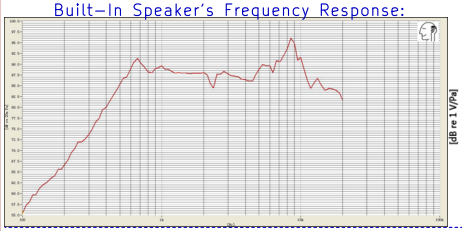
S/E button on earbud headsets
shorts the mic for key function

Could use FSA8008 to detect mic

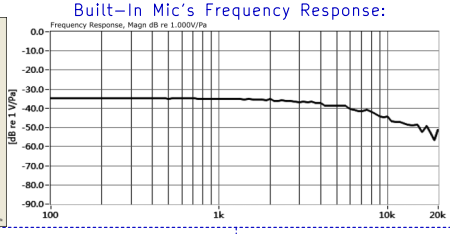
CTIA/AHJ



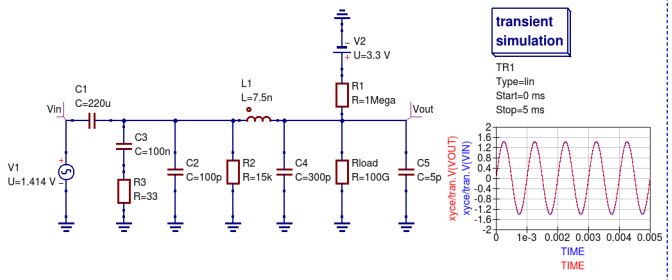
Built-In Speaker's Frequency Response:



Built-In Mic's Frequency Response:



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

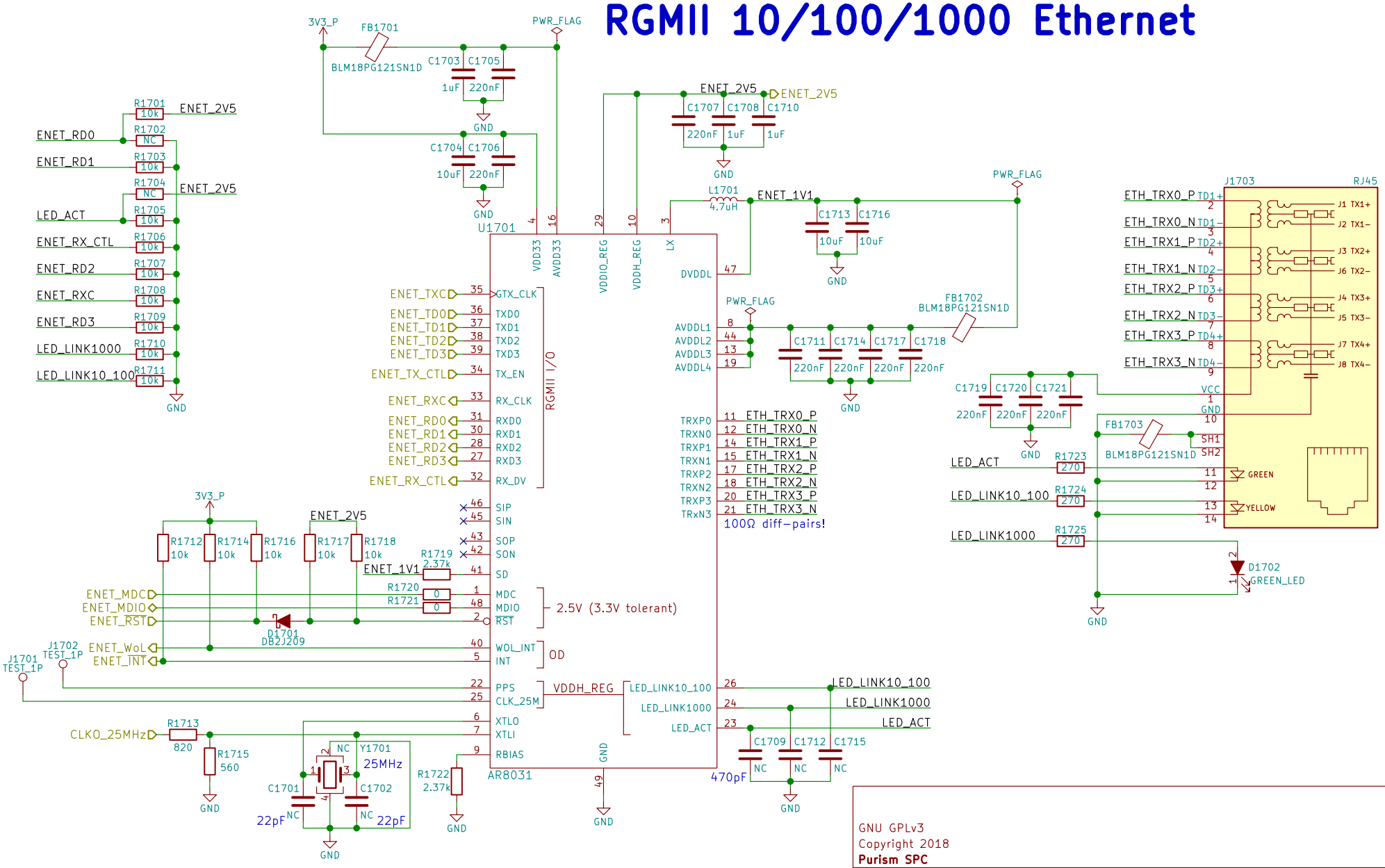
Purism SPC

Sheet: /Audio/
File: audio.sch

Title: Audio

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 16/24

RGMII 10/100/1000 Ethernet



Sheet: /Ethernet/		
File: ethernet.sch		
Title: Ethernet		
Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 17/24

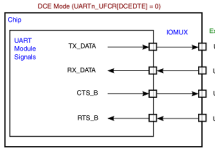
Module: Table 23
Socket: Table 46

RS9116 NC:
RTS, CTS, BT_HOST_WAKE

RS9116 datasheet says
no WIFI_WAKE
but the schematic has it

6.2 M.2 Signal Directions

UARTn_UFCR[DCEDTE]=0 on POR



TX output
RX input
CTS output
RTS input

⇒TX→RX
RX←TX
CTS→CTS
RTS←RTS

AE1801 Antenna
J1801 MHF4
AE1802 Antenna
J1802 MHF4

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

J1803 M.2_Key_E

SoC's IN/OUT
M2_PCM_CLK
M2_PCM_SYNC
M2_PCM_IN
M2_PCM_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

i.MX8M in DCE mode (POR state)
has CTS output, RTS input

WIFI_CLK
WIFI_CMD
WIFI_DATA0
WIFI_DATA1
WIFI_DATA2
WIFI_DATA3
WIFI_WAKE
WIFI_RST
W_DISABLE1
W_DISABLE2
M2_I2C_SDA
M2_I2C_SCL
SUSCLK
USB_WLAN_DP
USB_WLAN_DN

R1801 100k
D1801 DB2J209
D1802 DB2J209
VIH=2.31V

RedPine RS9116
has 100k pull-up to
3.3V making SDIO_RST
~2.55V when HIGH

R1802 NC
JP1801 NC

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

RS9116 SUSCLK
is a GPIO (unused)
R1803 10k

U1803A 74AUP2G08
U1803B 74AUP2G08

C1809 100nF
C1810 10nF

D1803 DB2J209
R1805 100k
R1807 100k

SW1801A WLAN_HKS
SW1801B WLAN_HKS
Open = ON
Closed = OFF

R1804 10k
R1806 10k
Q1801 2SK3018
Q1802 2SK3018

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

U1801 NTB0104GU12
C1801 1uF
C1802 10nF
C1803 10nF
C1804 1uF

BT_UART_RXD
BT_UART_TXD
BT_UART_RTS
BT_UART_CTS

RX, TX, RTS, CTS
of the SoC

internal 10k pull-up

U1802 NTB0104GU12
C1805 1uF
C1806 10nF
C1807 10nF
C1808 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

IN, OUT
of the SoC

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

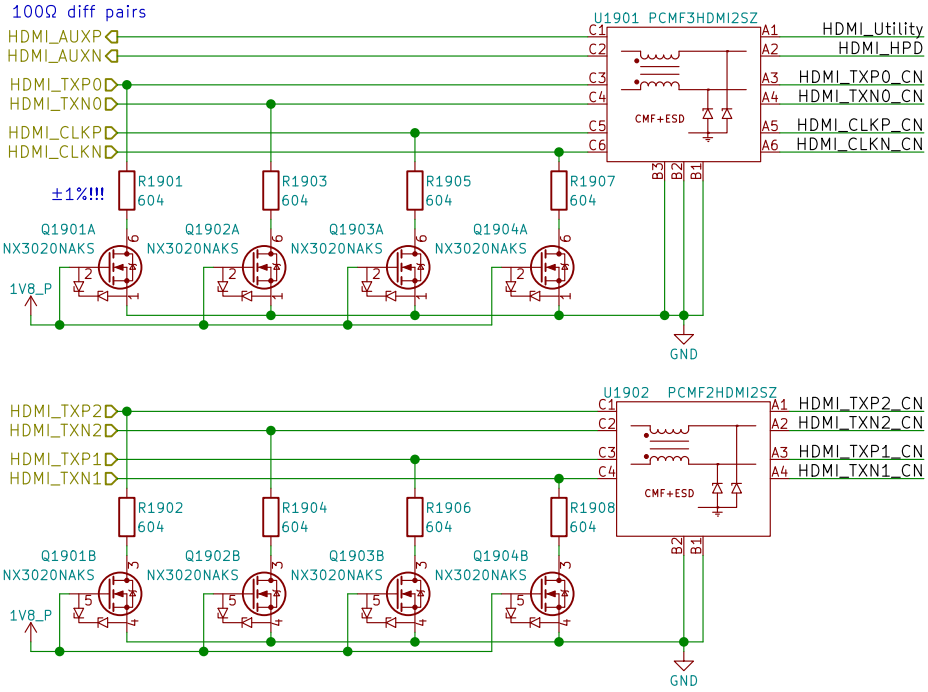
Title: WLAN+BT M.2

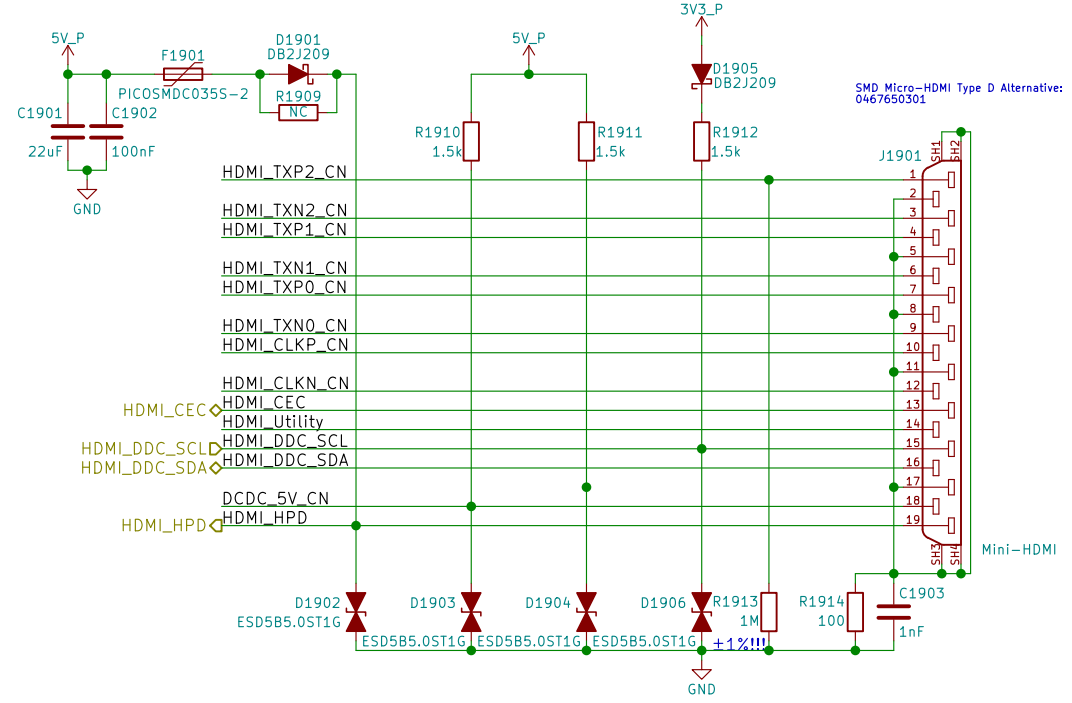
Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 18/24

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



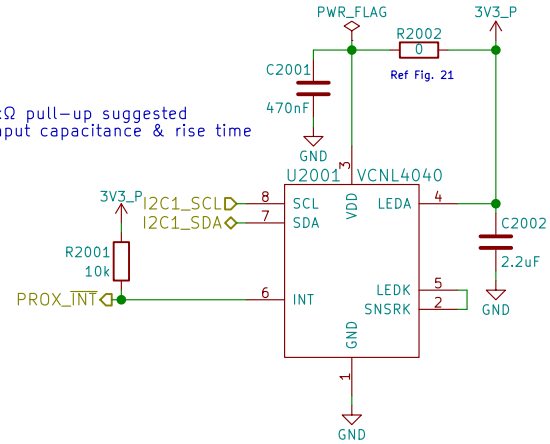


Sheet: /HDMI/
File: hdmi.sch

Title: HDMI

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 19/24

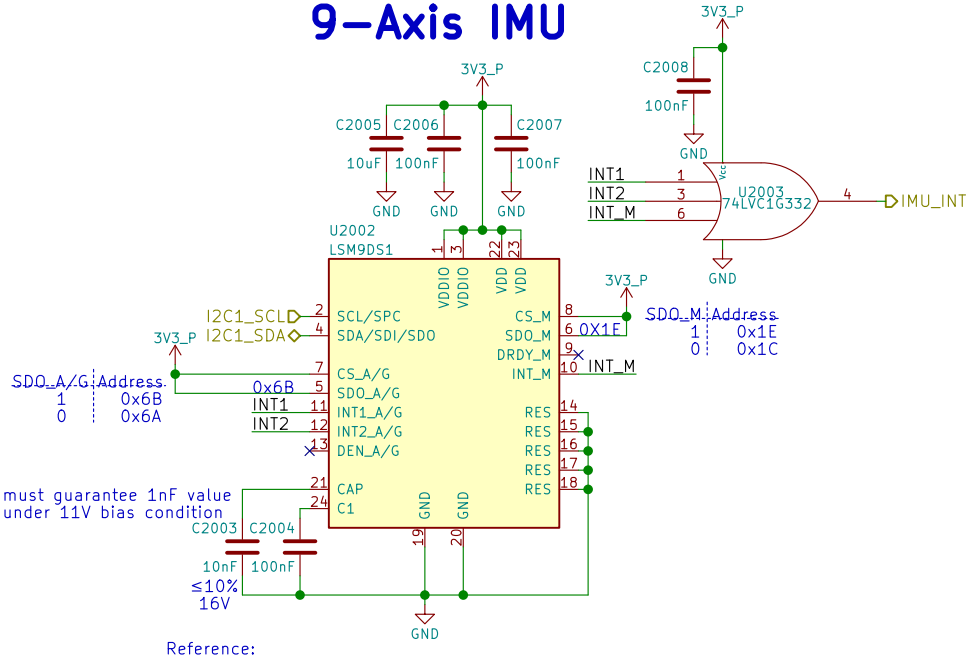
Proximity & Ambient Light



Note:
I2C 2.2kΩ pull-up suggested
check input capacitance & rise time

Reference:
https://www.vishay.com/docs/84307/designingvcnl4040.pdf
http://www.vishay.com/docs/84931/vcnl4040sensorboardfiles.pdf

9-Axis IMU



Reference:
http://www.st.com/en/evaluation-tools/steval-mki159v1.html

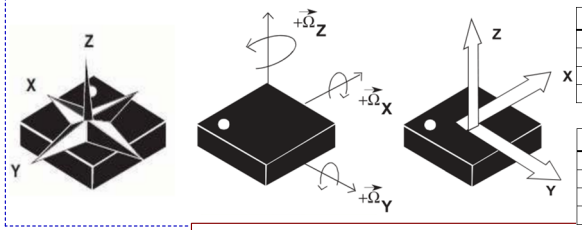


Table 19. Accelerometer and gyroscope SAD+Read/Write patterns

Command	SAD[6:1]	SAD[0] = SA0	R/W	SAD+R/W
Read	110101	0	1	11010101 (D5h)
Write	110101	0	0	11010100 (D4h)
Read	110101	1	1	11010111 (D7h)
Write	110101	1	0	11010110 (D6h)

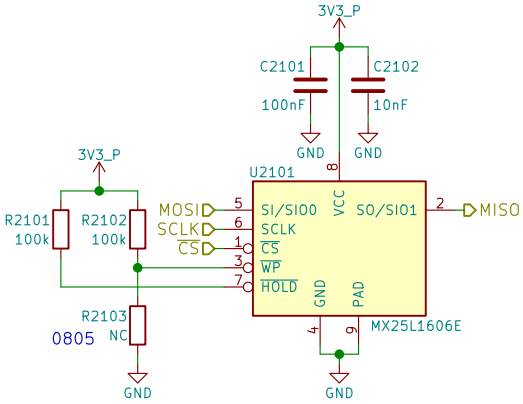
Table 20. Magnetic sensor SAD+Read/Write patterns

Command	SAD[6:2]	SAD[1] = SDO/SA1	SAD[0]	R/W	SAD+R/W
Read	00111	0	0	1	00111001 (39h)
Write	00111	0	0	0	00111000 (38h)
Read	00111	1	0	1	00111101 (3Dh)
Write	00111	1	0	0	00111100 (3Ch)

Sheet: /Sensors/
File: sensors.sch

Title: Sensors

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 20/24

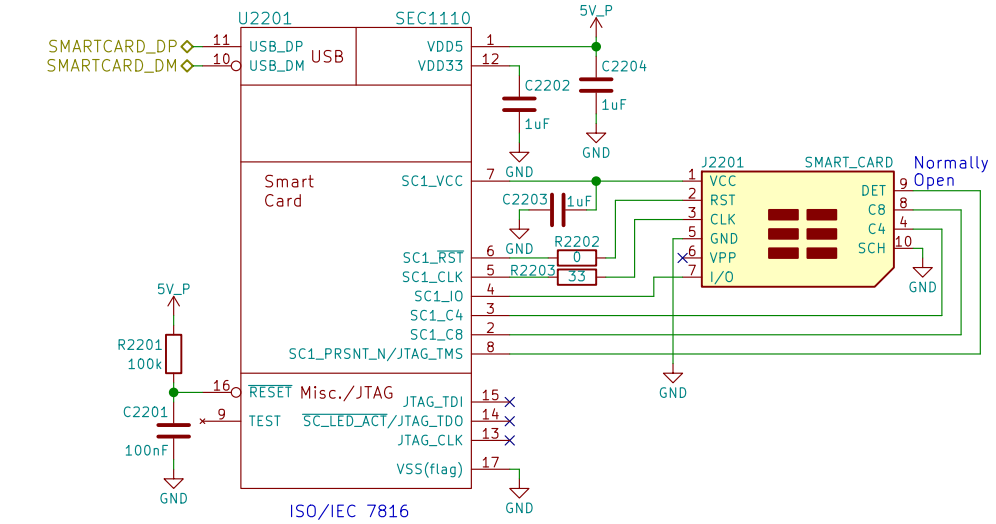


GNU GPLv3
Copyright 2018
Purism SPC

Sheet: /SPI Flash/
File: flash.sch

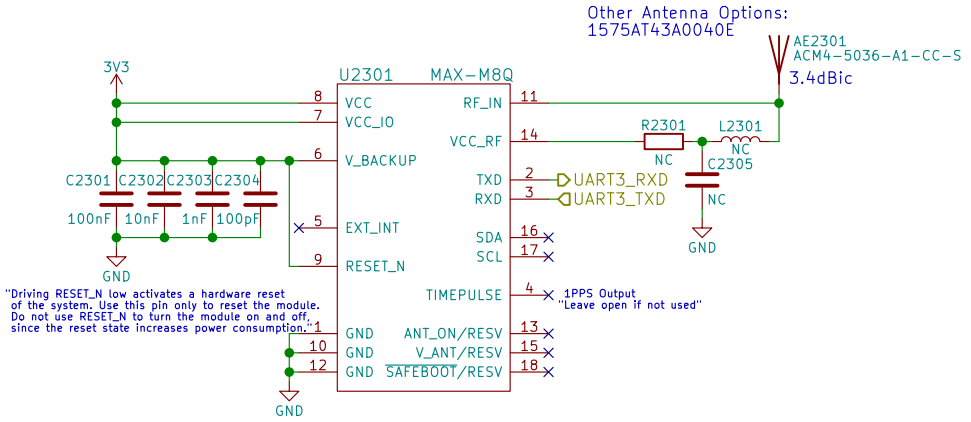
Title: SPI NOR Flash

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 21/24



Reference:
http://www.microchip.com/DevelopmentTools/ProductDetails.aspx?PartNO=EVB-SEC1110

Sheet: /Smart Card/		
File: smartcard.sch		
Title: Smart Card		
Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 22/24



Reference:
https://www.u-blox.com/sites/default/files/MAX-8-M8-FW3_HardwareIntegrationManual_%28UBX-15030059%29.pdf

Sheet: /GNSS/
File: gnss.sch

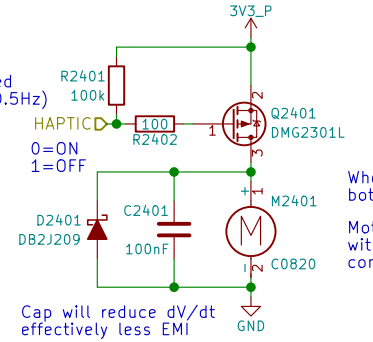
Title: GNSS

Size: A4	Date: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 23/24

PWM pins occupied:
GPIO1_IO01 – LCD Backlight
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: 2018-05-23	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.7		Id: 24/24