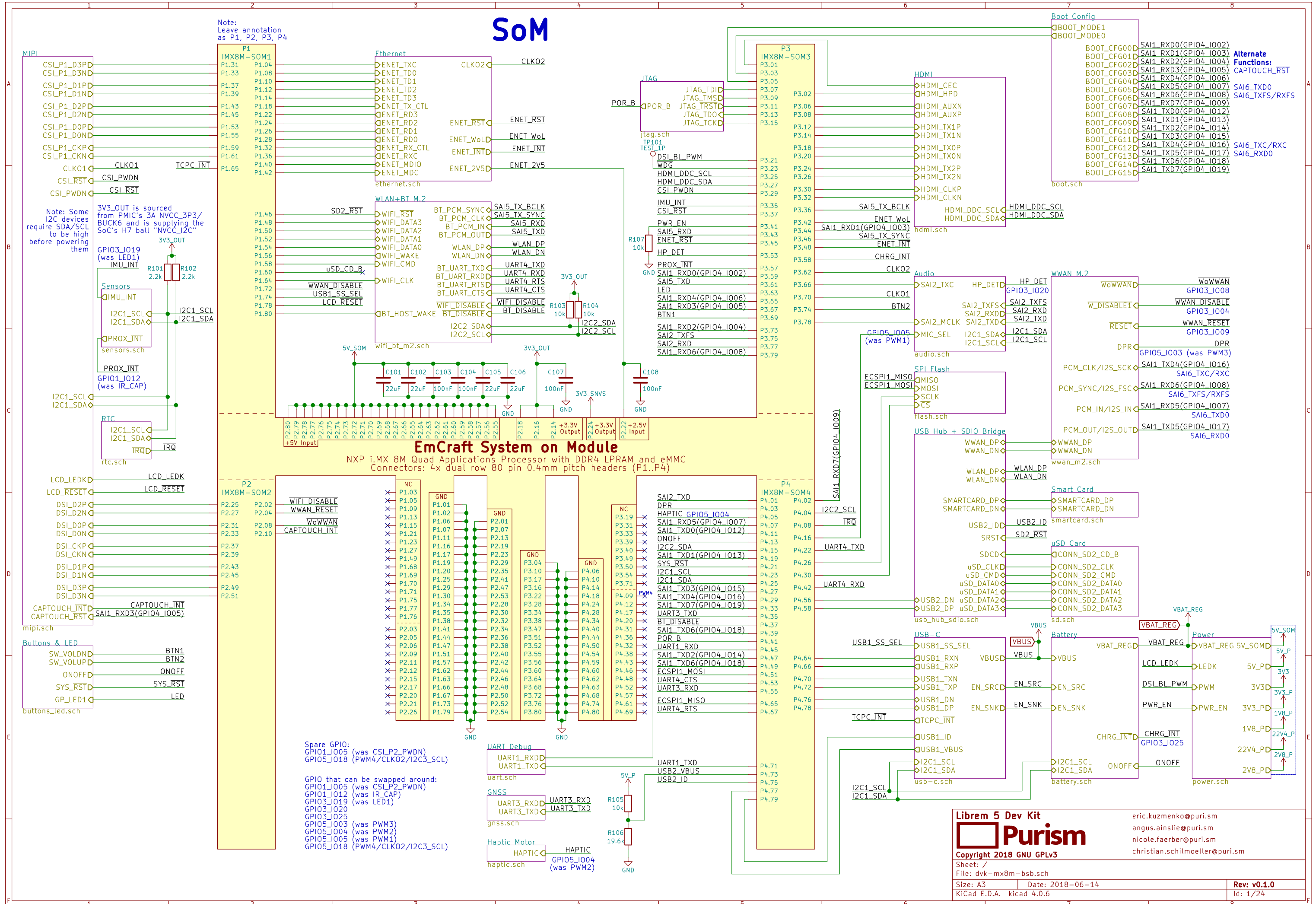


SoM

Note:
Leave annotation
as P1, P2, P3, P4

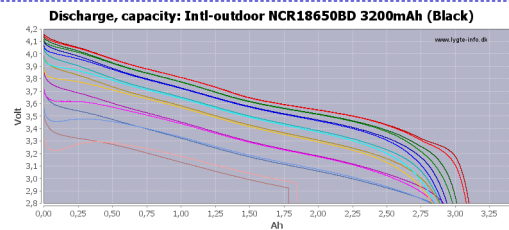


USB-C



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christian.schilmoeller@puri.sm

Rev: v0.1.0
Id: 2/24

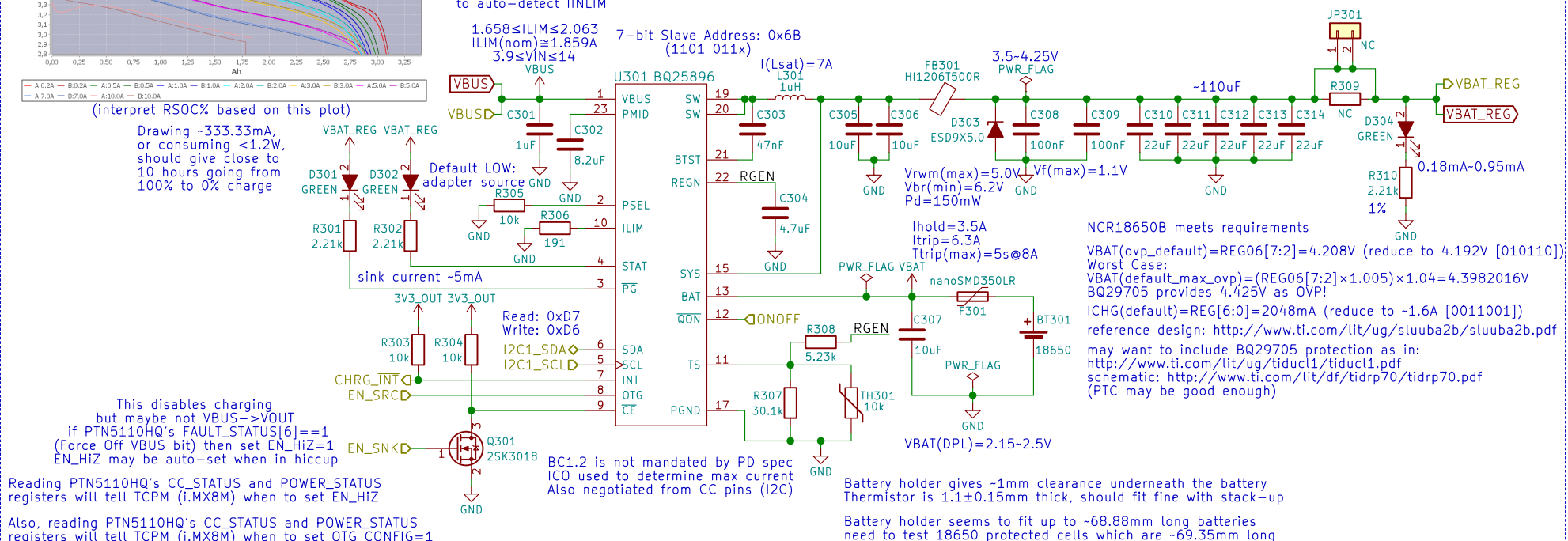


```
use AUTO_DPDM_EN
to auto-detect IINLIM
```

$$\begin{aligned} 1.658 \leq I_{LIM} \leq 2.063 \\ I_{LIM(nom)} \cong 1.859A \\ 3.9 \leq V_{IN} \leq 14 \end{aligned}$$

7-bit Slave Address: 0x6B
(1101 011x)

Battery Charge Controller



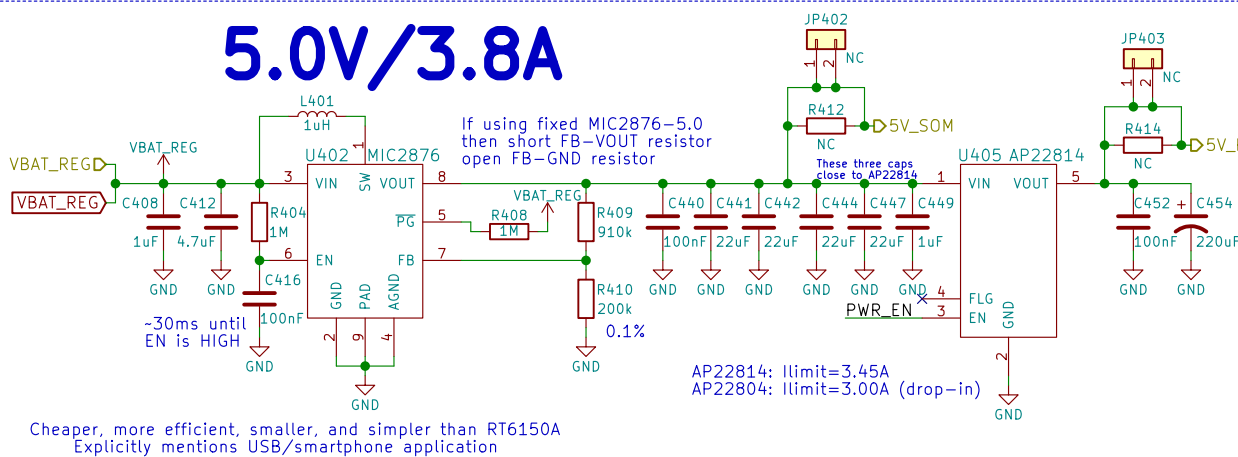
3.3V/3A



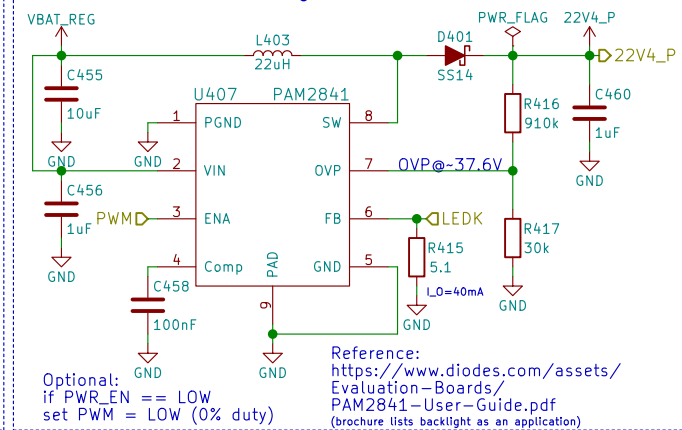
1.8V/600mA



5.0V/3.8A



22.4V/40mA



2.8V/150mA



Power

Power

Purism

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Sheet: /Power/
File: power.sch

Size: A4
KiCad E.D.A. kicad 4.0.6

Date: 2018-06-14

Rev: v0.1.0

Id: 4/24

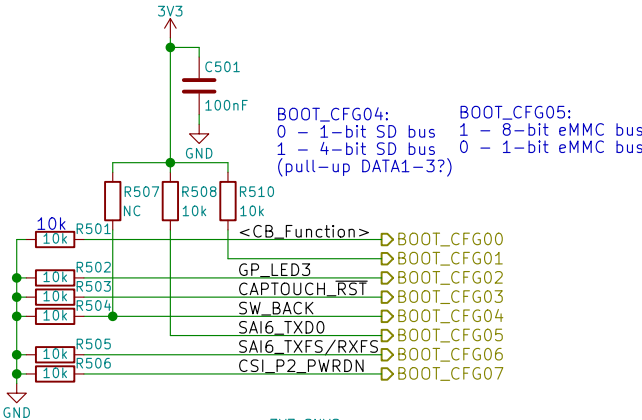
eric.kuzmenko@puri.sm

angus.ainslie@puri.sm

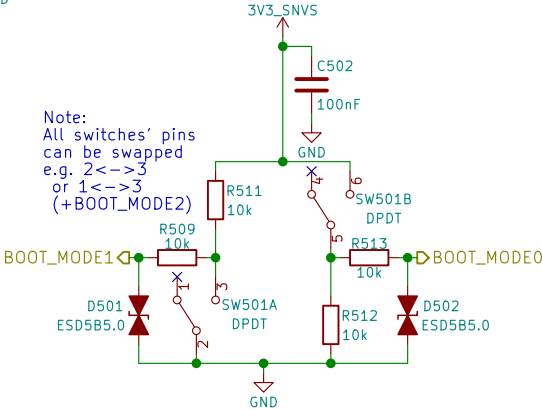
nicole.farber@puri.sm

christian.schilmoeller@puri.sm

Boot Config



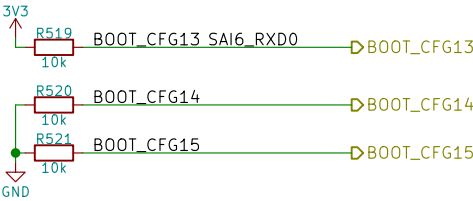
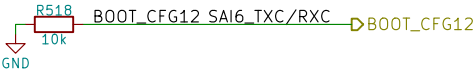
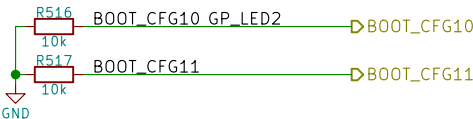
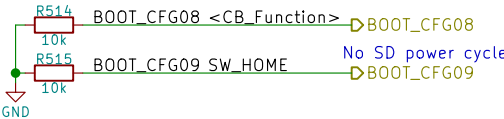
BOOT_CFG04: 0 - 1-bit SD bus
1 - 4-bit SD bus (pull-up DATA1-3?)
BOOT_CFG05: 1 - 8-bit eMMC bus
0 - 1-bit eMMC bus




Note:
All switches' pins
can be swapped
e.g. 2<->3
or 1<->3
(+BOOT_MODE2)

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

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 Configuration

Purism

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Sheet: /Boot Config/
File: boot.sch

Size: A4
KiCad E.D.A. kicad 4.0.6

Date: 2018-06-14

Rev: v0.1.0
Id: 5/24

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Real-Time Clock



Note:

Datasheet says slave address is 0xD0
with a R/W bit appended, since 0xD must
be 4-bits wide the actual 7-bit address is
0x68 (110 1000), and becomes 0xD0 during a
write operation (1101 0000)

Reference:

https://github.com/HIO-Project/linux-imx6-nano-imx_3.10.17_1.0.1_ga/blob/8848e94b2f889fe44f6736e2d4c98851a2282275/arch/arm/boot/dts/imx6qdl-mtp.dtsi#L351

RTC



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Sheet: /RTC/

File: rtc.sch

Size: A4

Date: 2018-06-14

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Rev: v0.1.0

Id: 6/24


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The diagram shows a 3.3V UART-to-I2C module. It features a 74LVC2G41 (U701) hex inverter, a 100k pull-up resistor (R701), and a 100nF decoupling capacitor (C701). The module is powered by 3V3_OUT and GND. The UART interface includes UART1_TXD and UART1_RXD inputs, and RX<-TX and TX->RX outputs. The I2C interface includes a 6-pin header (J701) with pins 1-6 labeled 1 through 6, and a label 'Debug_UART'.

UART Debug  Purism		eric.kuzmenko@puri.sm angus.ainslie@puri.sm nicole.faeber@puri.sm christian.schilmoeller@puri.sm
Copyright 2018 GNU GPLv3		
Sheet: /UART Debug/ File: uart.sch		
Size: A4	Date: 2018-06-14	Rev: v0.1.0
KiCad E.D.A. kicad 4.0.6		Id: 7/24

JTAG



JTAG



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Sheet: /JTAG/

File: jtag.sch

Size: A4 Date: 2018-06-14

KiCad E.D.A. kicad 4.0.6

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angus.ainstlie@puri.sm

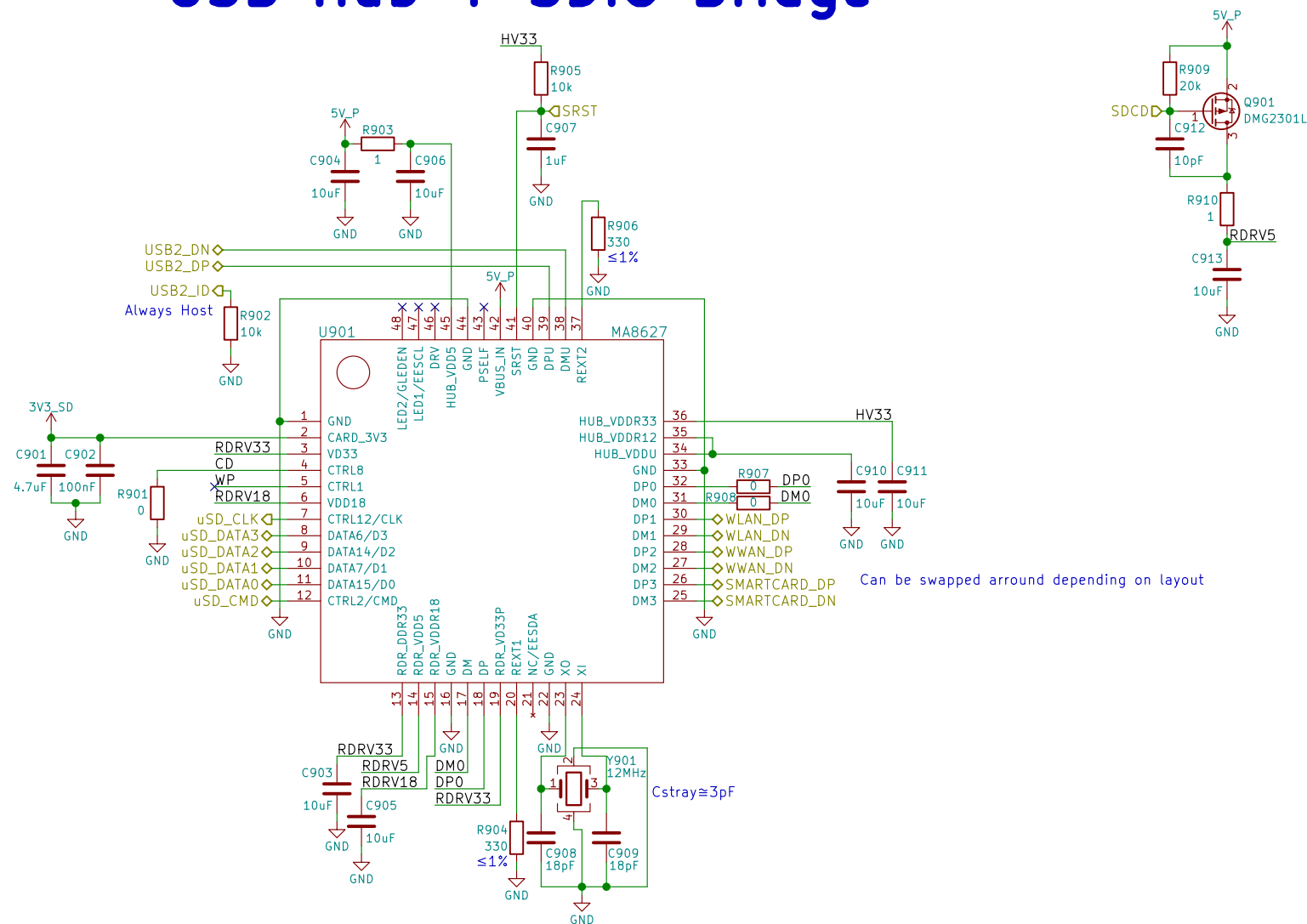
nicole.farber@puri.sm

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Rev: v0.1.0

Id: 8/24

USB Hub + SDIO Bridge



USB Hub + SDIO Bridge



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Sheet: /USB Hub + SDIO Bridge/

File: usb_hub_sdio.sch

Size: A4	Date: 2018-06-14
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Size: A4	Date:
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eric.kuzmenko@puri.sm

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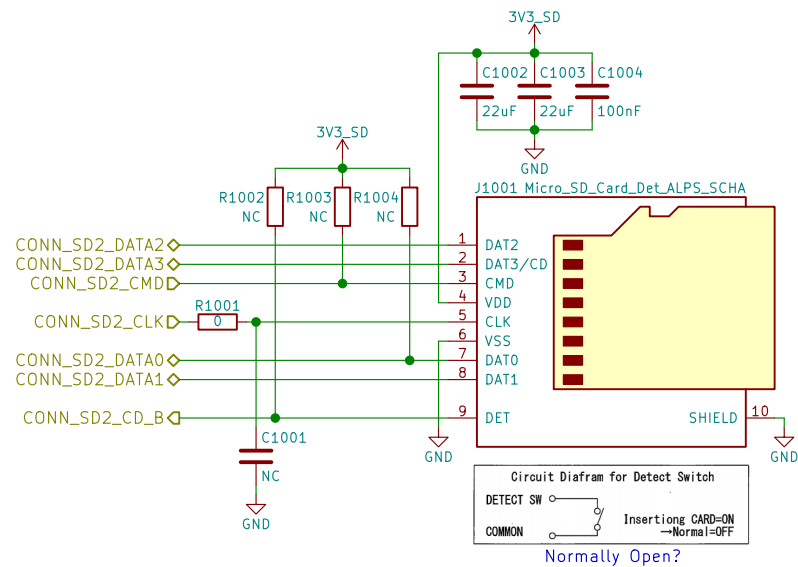
nicole.ferber@puri.sm

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Rev: v0.1.0

Id: 9/24

μ SD



uSD Card



Purism

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Sheet: /uSD Card/

File: sd.sch

eric.kuzmenko@puri.sm

angus.ainslie@puri.sm

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christian.schilmoeller@puri.sm

Size: A4

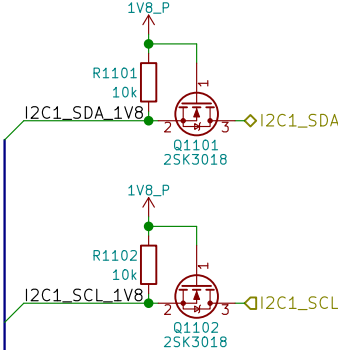
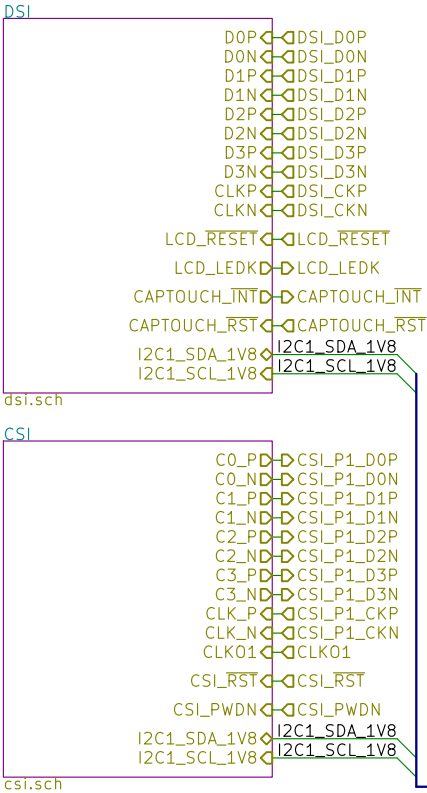
Date: 2018-06-14

Rev: v0.1.0

KiCad E.D.A. kicad 4.0.6

Id: 10/24

MIPI



MIPI



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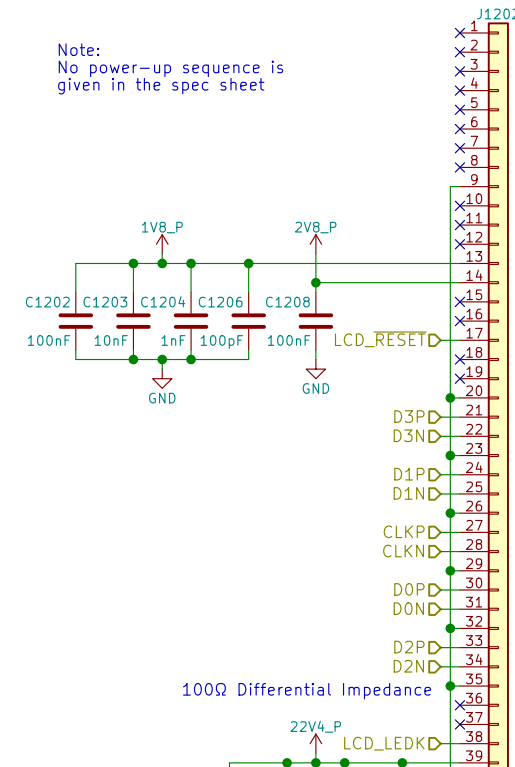
Sheet: /MIPI/
File: mipi.sch

Size: A4	Date: 2018-06-14	Rev: v0.1.0
KiCad E.D.A. kicad 4.0.6		Id: 11/24

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nicole.farber@puri.sm
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LCD PN:
Shenzhen Jinghong Electronics Co., Ltd.
JH057N00900

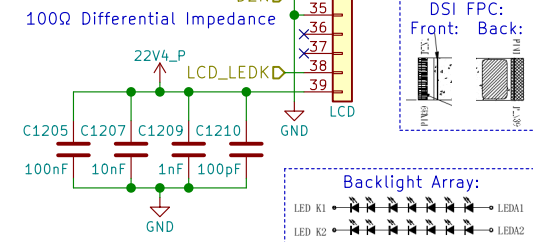
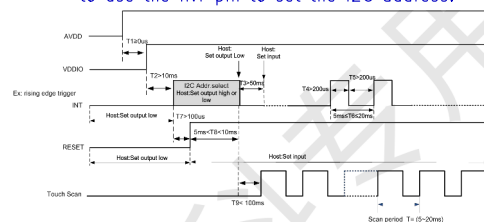
Note:
No power-up sequence is
given in the spec sheet



	7Bit Address	8-Bit Write Address	8-Bit Read Address
LOW	0x5D	0xBA	0xBB
HIGH	0x14	0x28	0x29

	7Bit Address	8-Bit Write Address	8-Bit Read Address
LOW	0x5D	0xBA	0xBB
HIGH	0x14	0x28	0x29

Cap-Touch FPC:	
PTiNE	Definition
1	SCL
2	SDA
3	INT
4	RESET
5	VDD2.85
6	GND



MIPI DSI



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Sheet: /MIPI/DSI/

File: dsi.sch

Size: A4	Date: 2018-06-14
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SIZE: A1	DATE:
KiCad E.D.A.	kicad 4.0.6

eric.kuzmenko@puri.sm

angus.ainslie@puri.sm

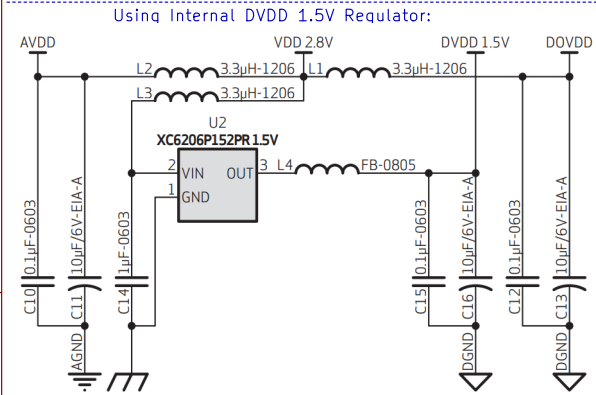
nicole.ferber@puri.sm

christian.schilmoeller@puri.sm

Rev: v0.1.0

Id: 12/24

Camera



2.7 POWER UP SEQUENCE

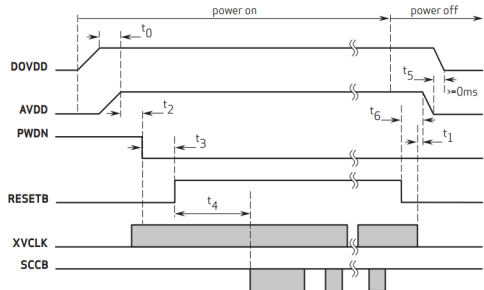
Based on the system power configuration (1.8V or 2.8V for I/O power, using external DVDD or internal DVDD, requiring access to the I2C during power up period or not), the power up sequence will differ. If 1.8V is used for I/O power, using the internal DVDD is preferred. If 2.8V is used for I/O power, 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 asynchronous 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 asynchronous 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 $t_0 \geq 0\text{ms}$, delay from DOVDD stable to AVDD stable, it is recommended to power up AVDD shortly after DOVDD has been powered up

$t_1 \geq 0\text{ms}$, delay from XVCLK off to AVDD off

$t_2 \geq 5\text{ms}$, 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

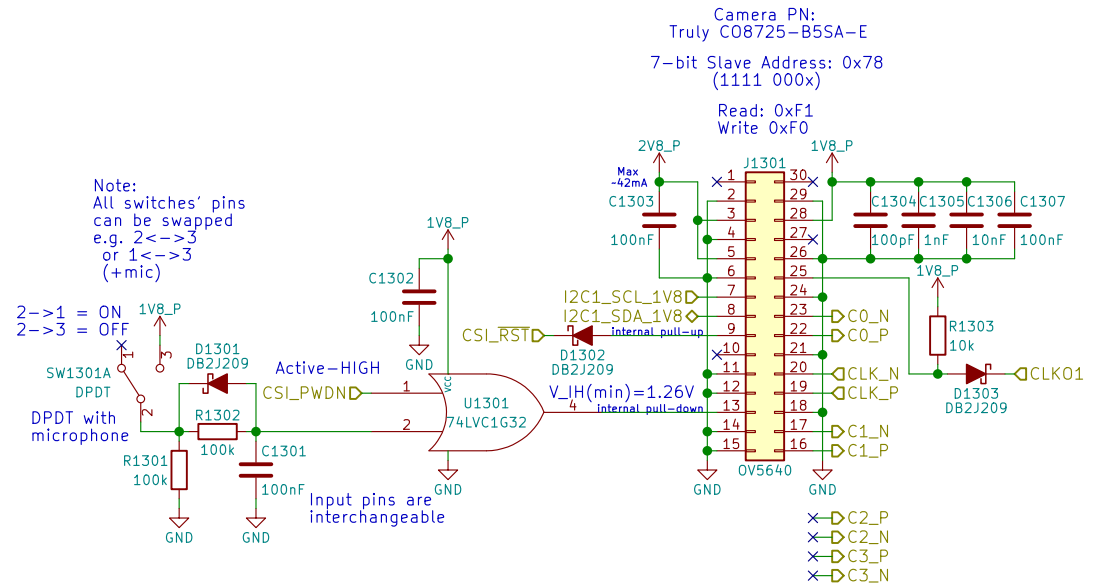
$t_3 \geq 1\text{ms}$, delay from sensor power up stable to RESETB pull up

$t_4 \geq 20\text{ms}$, delay from RESETB pull high to SCCB initialization

$t_5 \geq 0\text{ms}$, delay from AVDD off to DOVDD off

$t_6 \geq 0\text{ms}$, delay from RESETB pull low to AVDD off

5640_05.2.2



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



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Sheet: /MIPI/CSI/

File: csi.sch

Size: A4	Date: 2018-06-14
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KiCad E.D.A. kicad 4.0.6

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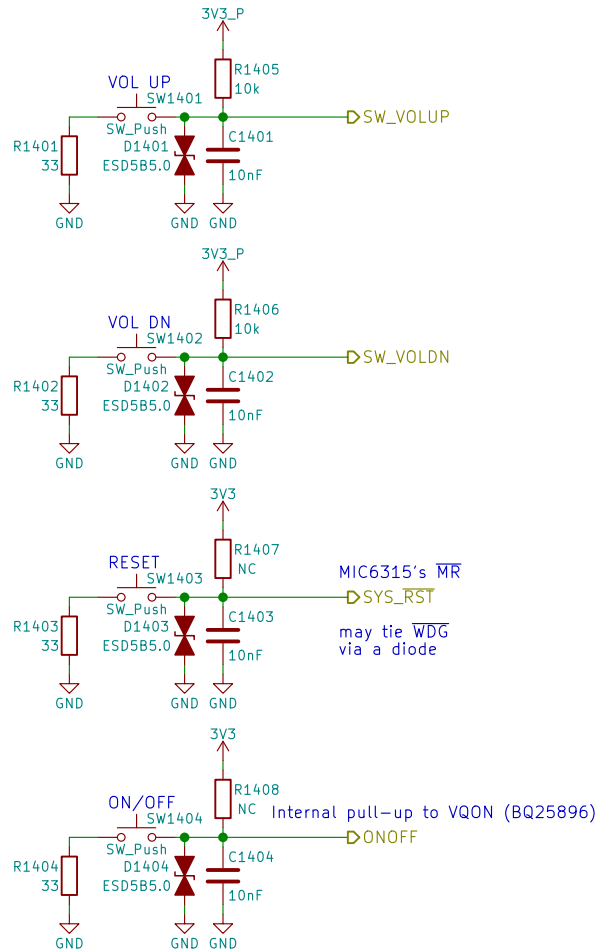
nicole.faerber@puri.sm

christian.schilmoeller@puri.sm

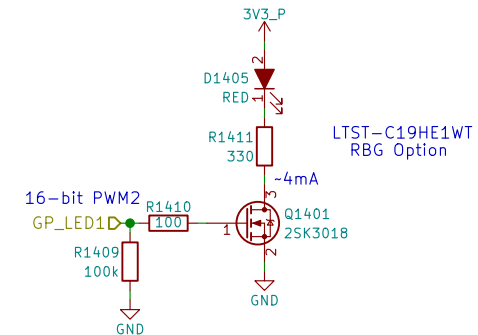
Rev: v0.1.0

Id: 13/24

Buttons & LED



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)



Buttons & LED



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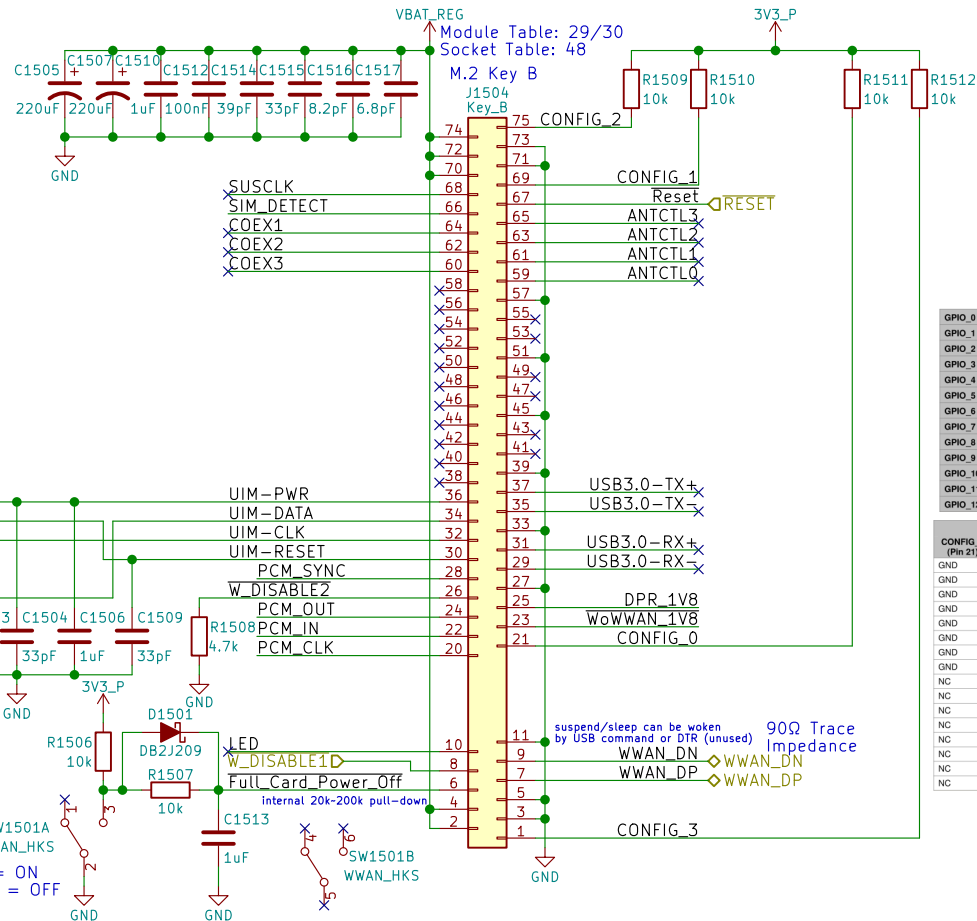
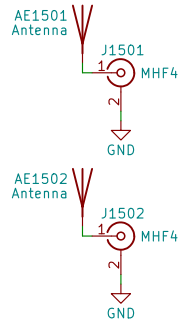
Sheet: /Buttons & LED/
File: buttons_led.sch

Size: A4 Date: 2018-06-14
KiCad E.D.A. kicad 4.0.6

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nicole.farber@puri.sm
christian.schilmoeller@puri.sm

Rev: v0.1.0
Id: 14/24

WWAN M.2

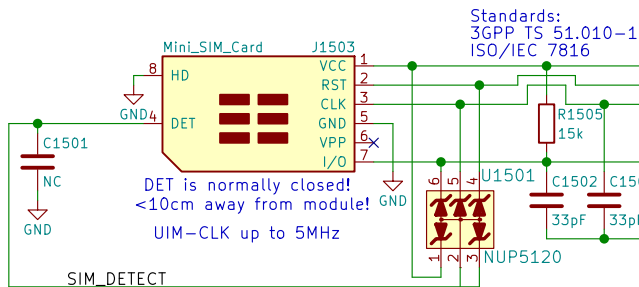


Some modems are NC for the USB3.0 interface
Some modules do GNSS over USB
Some modems require the USB3.0 interface
Typically host support for USB3.0 is optional
USB3.0 unused with Gemalto, SimCom, Fibocom

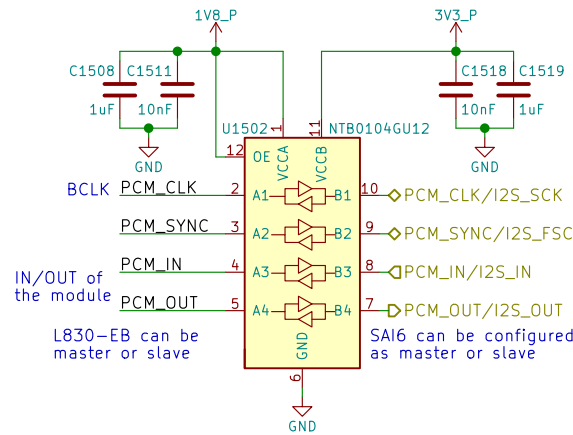
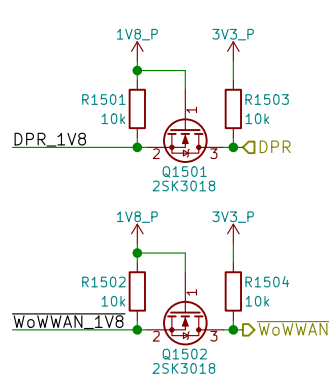
Even pins 40-48 are unused

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



SIM_DETECT:
Sierra, Huawei, and Telit are Active High
SimCom and Gemalto needs to be inverted!
"When SIM is present, SIM_DET is high"
SIM_DET needs to open when card inserted!
"It is recommended to place the UIM_RST trace between UIM_DATA and UIM_CLK to provide isolation"
"It is recommended to surround the UIM_DATA with ground."



WWAN M.2

Purism

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

Size: A4 Date: 2018-06-14
KiCad E.D.A. kicad 4.0.6

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nicole.farber@puri.sm
christian.schilmoeller@puri.sm

Rev: v0.1.0
Id: 15/24

Audio

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-circuitry>
 (Nt6 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"
 $\Rightarrow (1V)^2/(16\Omega)=62.5mW$
 $\therefore V_{rms}=1V \Rightarrow V_p(\text{amplitude})=1.414V$
 $\therefore I_{rms}(\text{max})=62.5mA$

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



$Z_{hp} \geq 16\Omega$

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

Ext-Mic enabled MIC_SEL=LOW
 Int-Mic enabled MIC_SEL=LOW
 Add TVS next to int-mic? (OpenMoko does this)
 $-37dB=14.1254mV/Pa$
 $\therefore \text{mic produces } 14.1254mV_{rms} \text{ when exposed to a } 1kHz \text{ tone of } 94dB-SPL \text{ at the capsule (or } 19.98mV \text{ amplitude)}$
 $\Rightarrow 40dB \text{ gain would produce } -2V \text{ amplitude (4Vpp, clipping)}$
 $30dB \text{ gain would produce } -0.632V \text{ amplitude (1.264Vpp)}$
 $38.33dB \text{ gain would yield } 3.3V_{pp}$

LCR Measurements:

Earbud Microphone: @1kHz
 $L_s = 3.844mH$
 $L_p = 15.757H$
 $C_s = 6.583uF$
 $C_p = 1612.8pF$
 $R_s = 1.5465k\Omega$
 $R_p = 1.5478k\Omega$
 $\theta = -0.8deg$

Headset Speaker: @1kHz
 $L_s = 244.4uH$
 $L_p = 141.99mH$
 $C_s = 103.6uF$
 $C_p = 178.77nF$
 $R_s = 36.860\Omega$
 $R_p = 36.860\Omega$
 $\theta = -2.3deg$

Earbud Speaker: @1kHz
 $L_s = 25.2uH$
 $L_p = 311.0mH$
 $C_s = 1.0mF$
 $C_p = 81.95nF$
 $R_s = 17.0300\Omega$
 $R_p = 17.0340\Omega$
 $\theta = 0.5deg$

Audio

Purism

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Sheet: /Audio/
 File: audio.sch

Size: A4 Date: 2018-06-14

KiCad E.D.A. kicad 4.0.6

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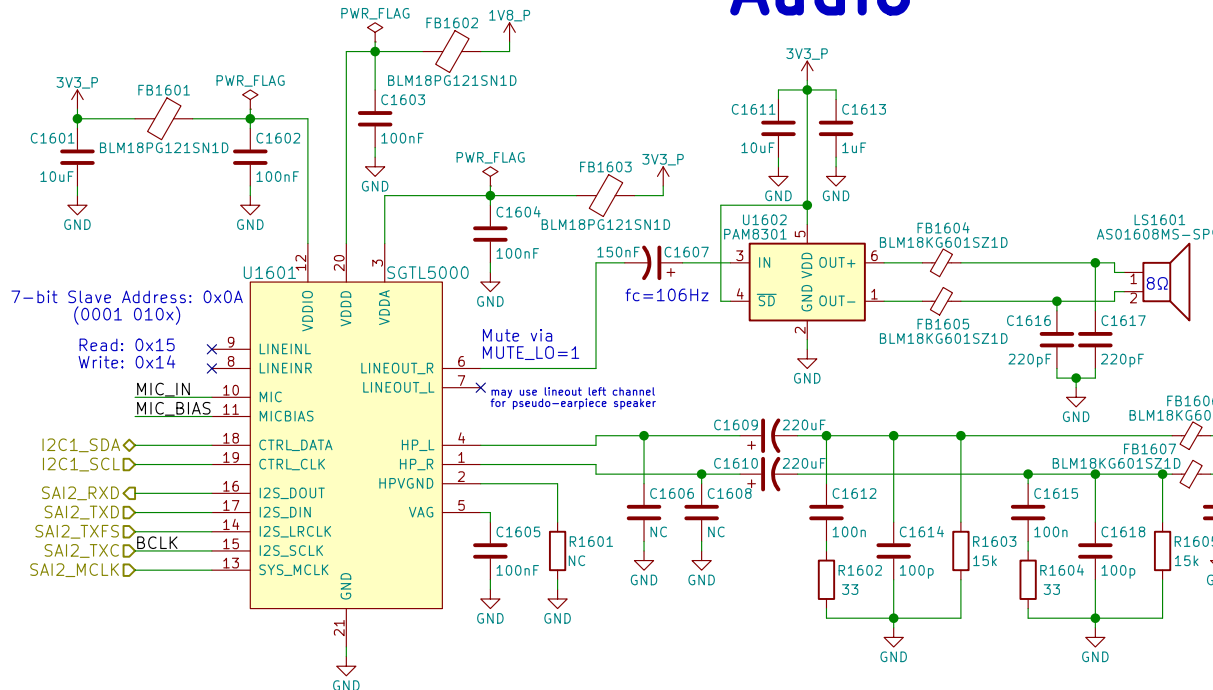
angus.ainslie@puri.sm

nicole.farber@puri.sm

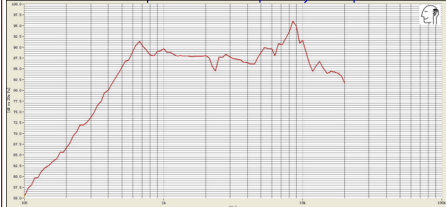
christian.schilmoeller@puri.sm

Rev: v0.1.0

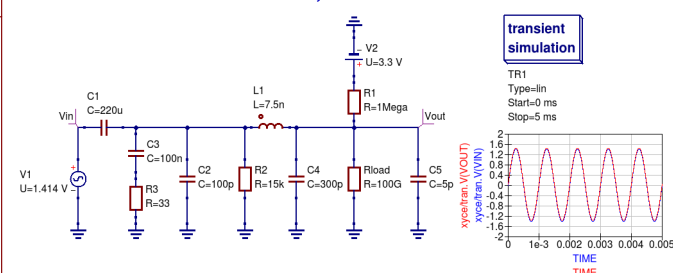
Id: 16/24



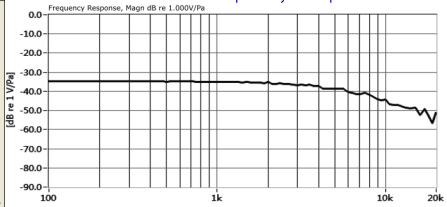
Built-In Speaker's Frequency Response:



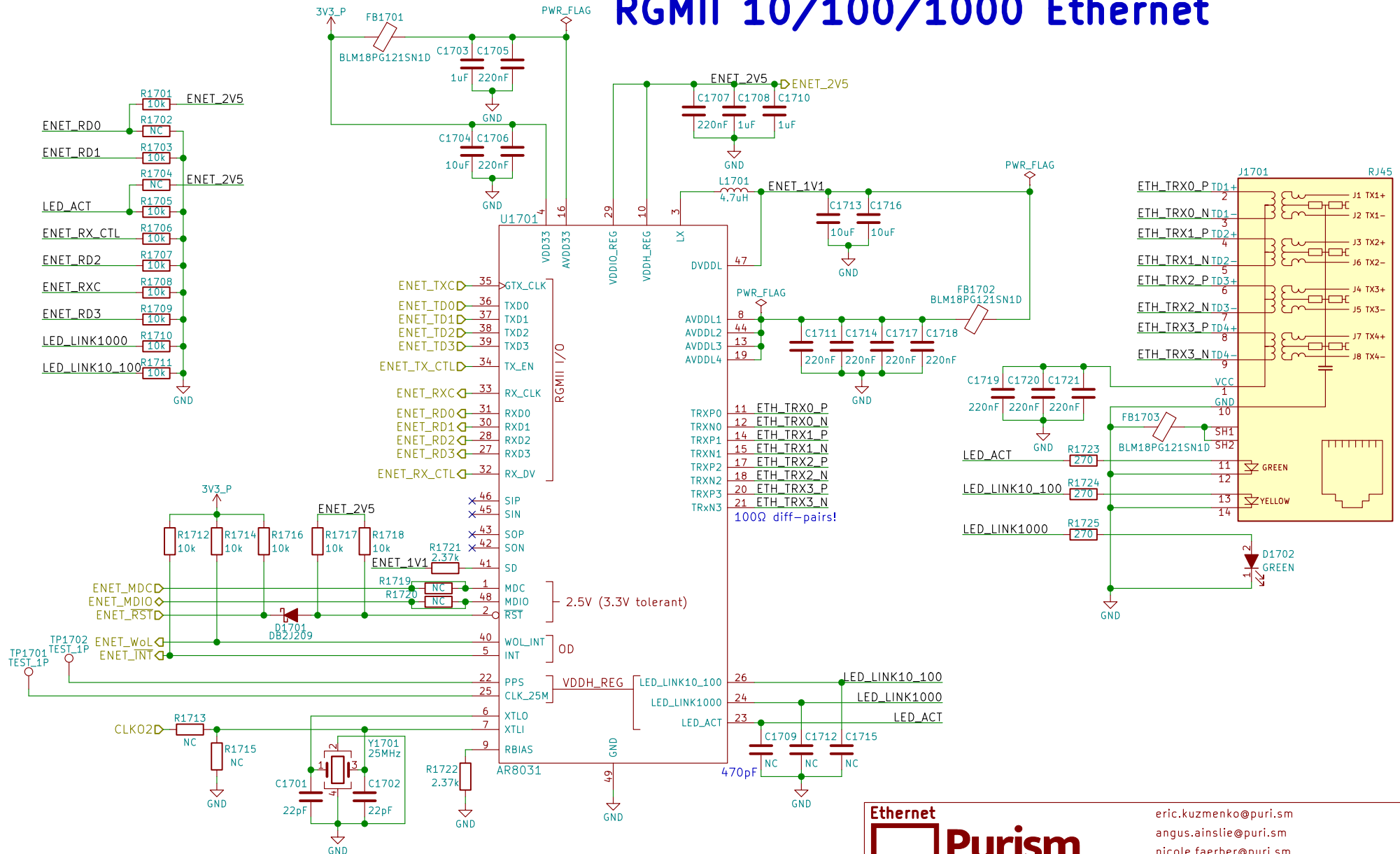
Simulation of HP_DET @ 1kHz output without HP jack inserted:



Built-In Mic's Frequency Response:



RGMII 10/100/1000 Ethernet



Ethernet

Purism

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Sheet: /Ethernet/
File: ethernet.sch

Size: A4 Date: 2018-06-14
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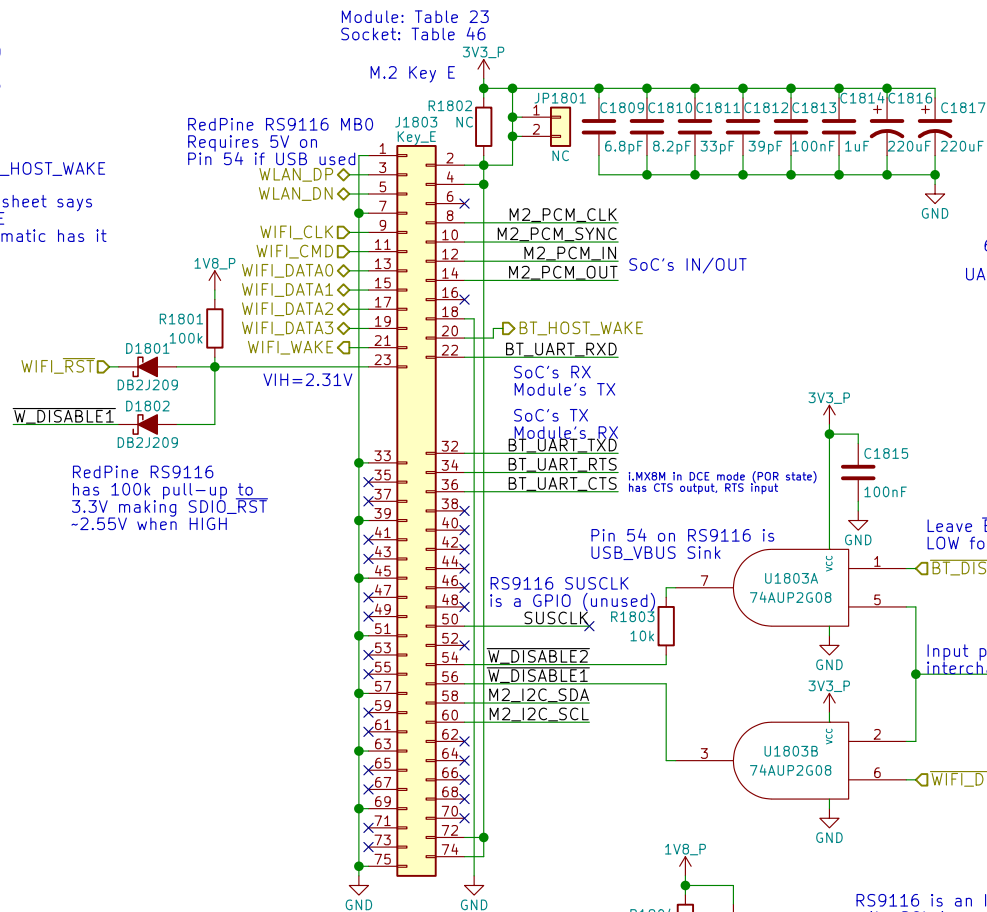
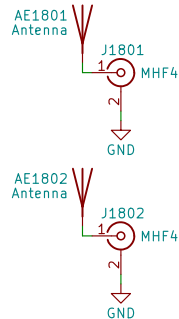
Rev: v0.1.0

Id: 17/24

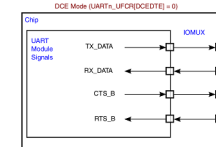
WLAN+BT M.2

RS9116 NC:
RTS, CTS, BT_HOST_WAKE

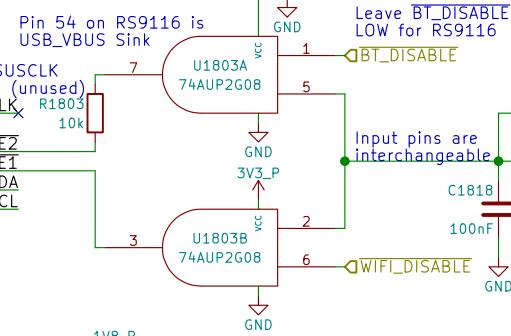
RS9116 datasheet says
no WIFI_WAKE
but the schematic has it



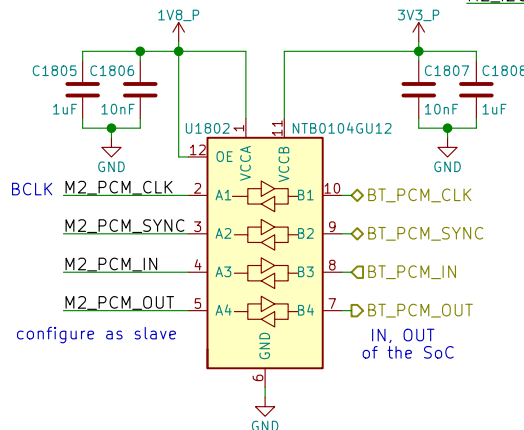
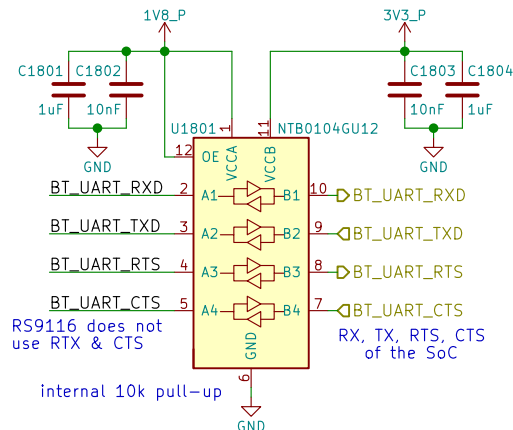
6.2 M.2 Signal Directions
UARTn_UFCR[DCEDTE]=0 on POR



TX output
RX input
CTS output
RTS input
⇒ TX→RX
RX→TX
CTS→CTS
RTS→RTS



Note:
All switches' pins
can be swapped
e.g. 2<->3
or 1<->3
Open = ON
Closed = OFF



WLAN+BT M.2

Purism

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

Size: A4 Date: 2018-06-14
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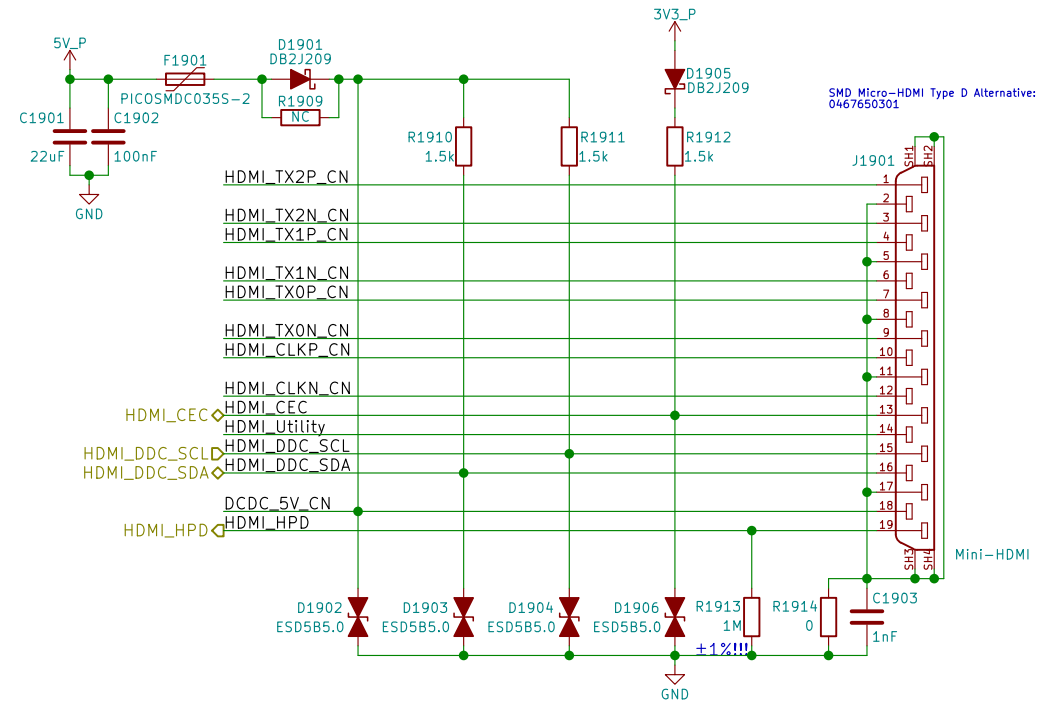
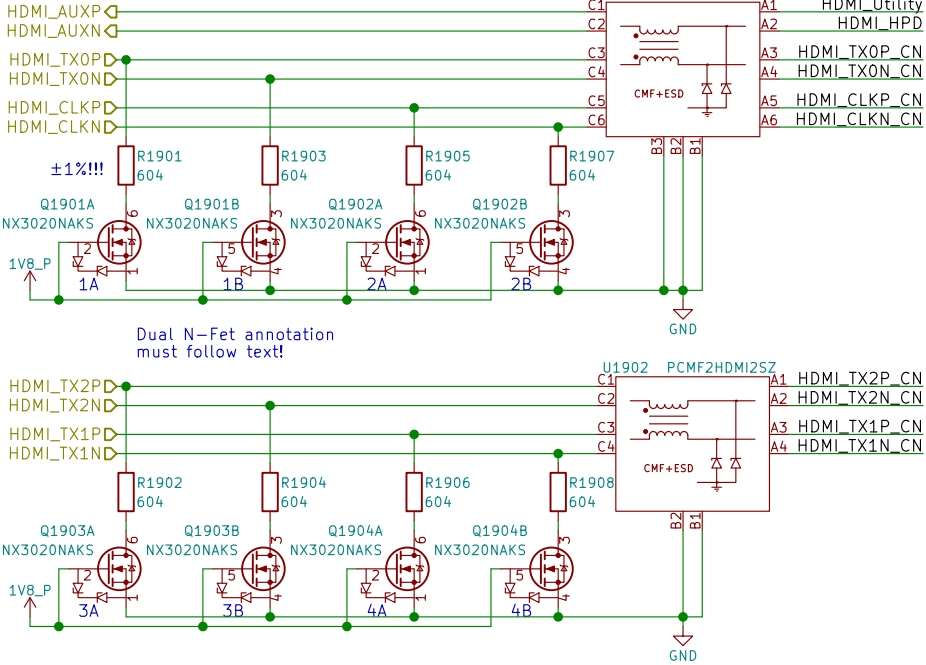
Rev: v0.1.0
Id: 18/24

TUSB1046 can be used for DP over USB-C

HDMI

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

100Ω diff pairs



HDMI



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Sheet: /HDMI/
File: hdmi.sch

Size: A4
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Date: 2018-06-14

Rev: v0.1.0
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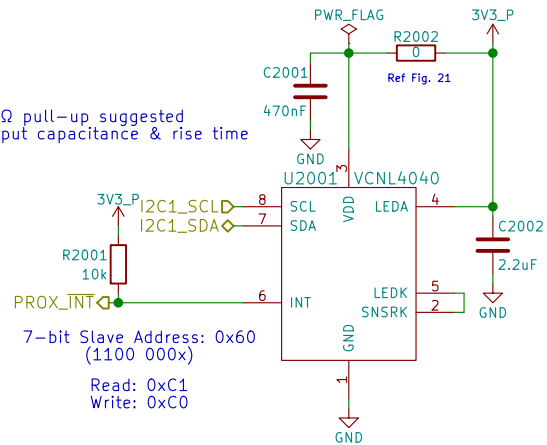
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christian.schilmoeller@puri.sm

Sensors

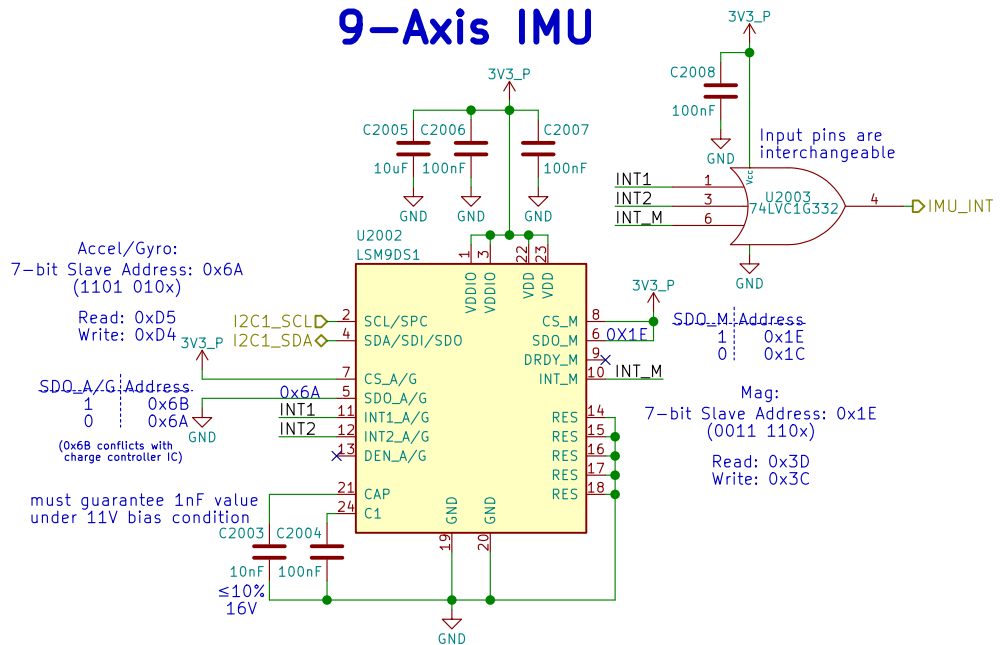
Proximity & Ambient Light

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)

Sensors



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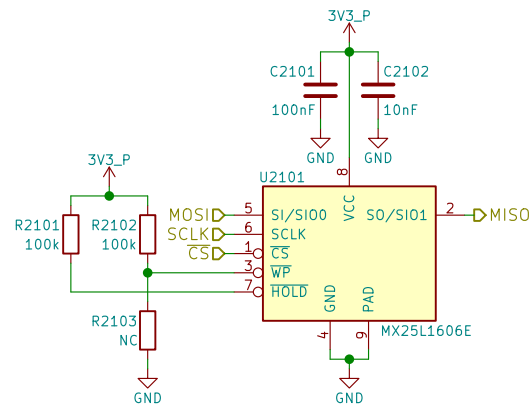
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SPI NOR Flash



SPI NOR Flash



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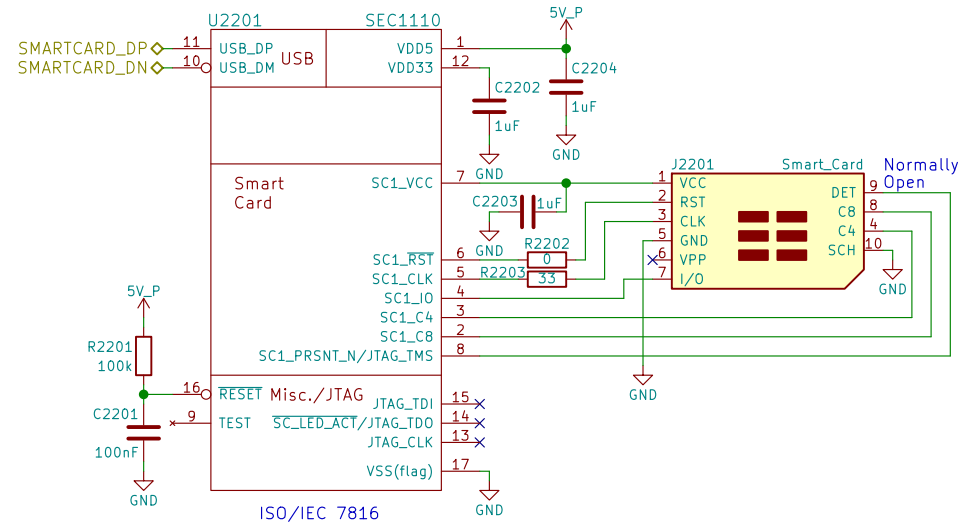
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Id: 21/24

Smart Card



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

Smart Card



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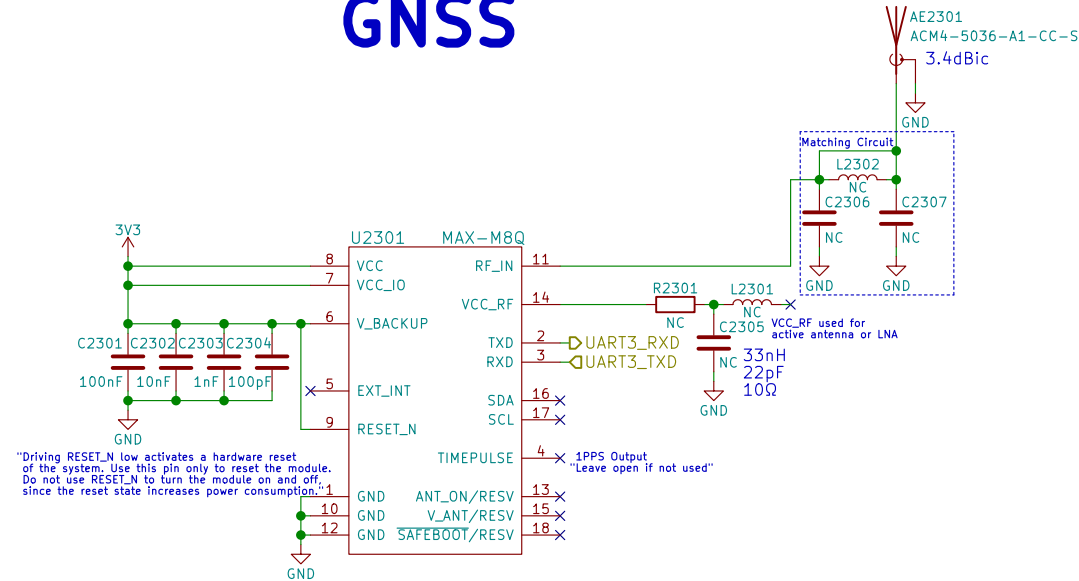
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Rev: v0.1.0

Id: 22/24

GNSS



References:

https://www.u-blox.com/sites/default/files/MAX-M8_HardwareIntegrationManual_L%28UBX-13004876%29.pdf
https://www.u-blox.com/sites/default/files/MAX-8-M8-FW3_HardwareIntegrationManual_L%28UBX-15030059%29.pdf

GNSS



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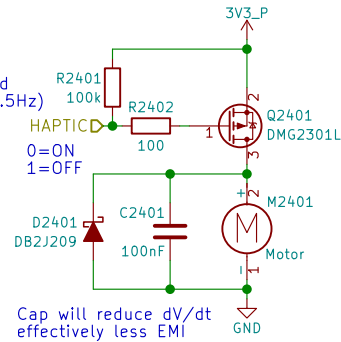
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Haptic Motor

PWM pins occupied:
 GPIO1_I001 - LCD Backlight
 GPIO1_I013 - LED
 GPIO1_I014 - Ethernet (CLKO_25MHz)
 GPIO1_I015 - 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 Boom Precision
 connector installed (by request!)
 Metal housing is floating
 (not connected to either pin)
 => could connect housing to GND

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

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

Motor Datasheet:
<https://cloud.puri.sm/s/z8JR6DJ4KrJYzoW>

Motor PN:
 BY0820Z021L20

Haptic/Vibration Motor



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Sheet: /Haptic Motor/
 File: haptic.sch

Size: A4 Date: 2018-06-14

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Rev: v0.1.0

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