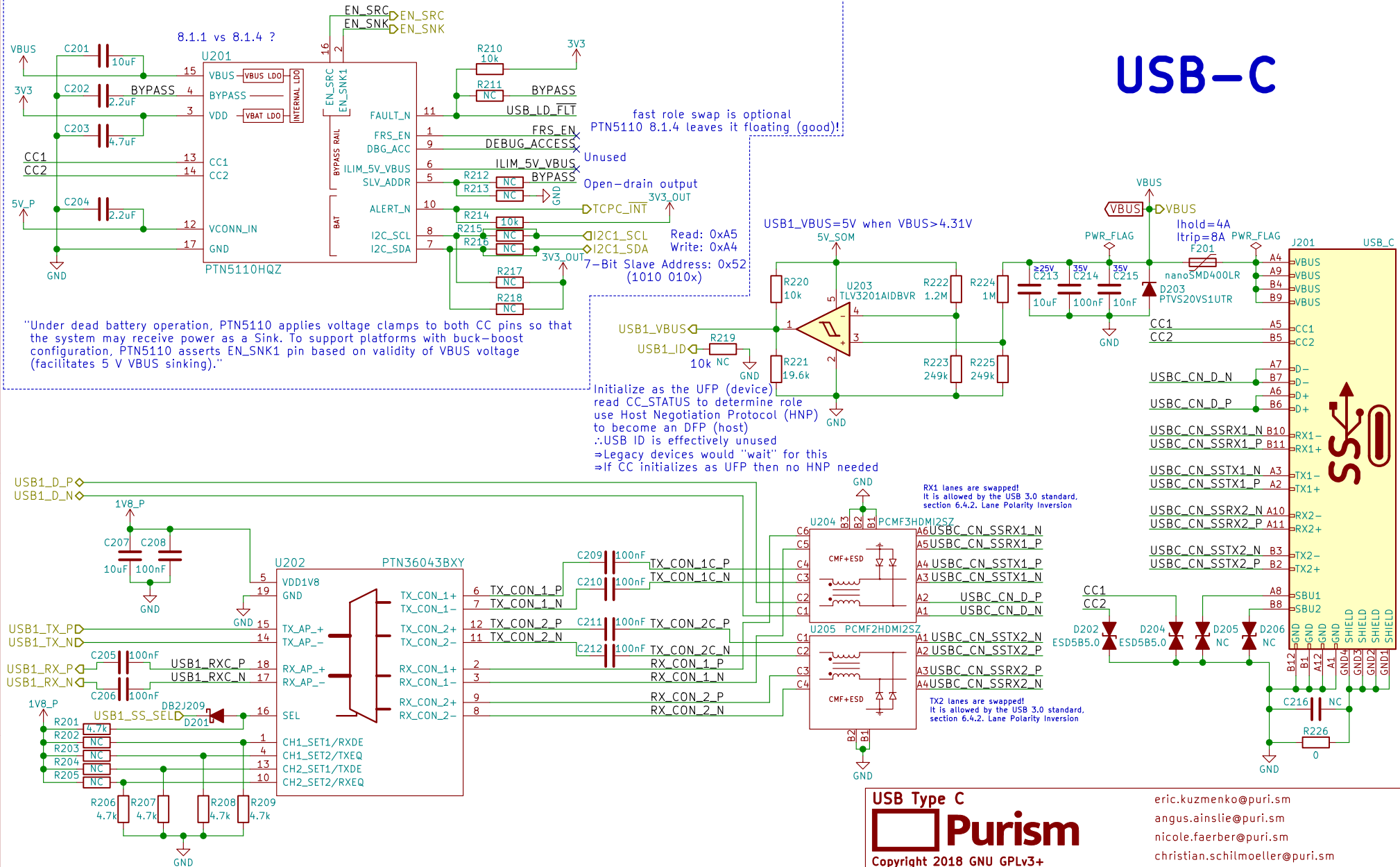


USB-C TCPC - Config Channel (CC) and PD Role Controller

USB-C



USB Type C

Purism

Copyright 2018 GNU GPLv3+

Sheet: /USB-C/

File: usb-c.sch

Size: A4

Date: 2018-11-08

KiCad E.D.A. kicad 5.1.6-1.fc31

Rev: v1.0.0

Id: 2/25



[1]

Battery Charge Controller

use EN_ICO (=1 by default)
to auto-detect IINLIM

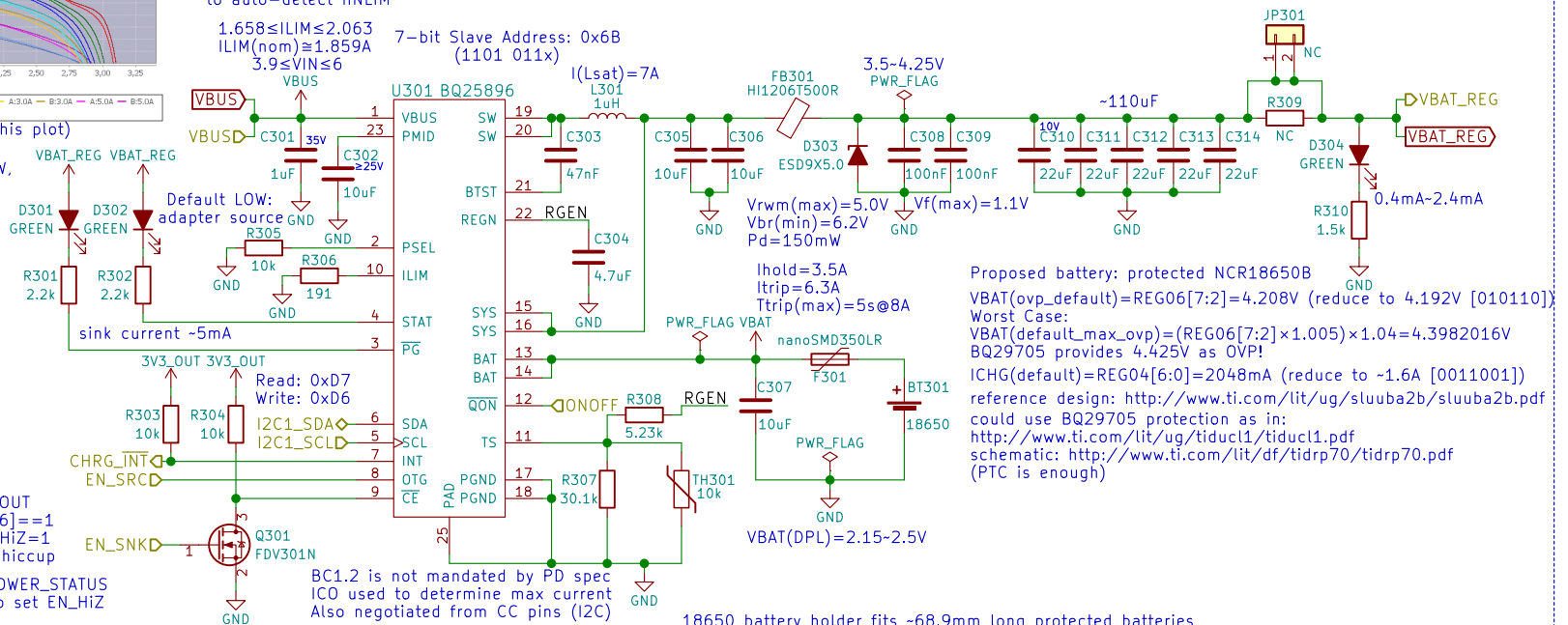
$1.658 \leq I_{LIM} \leq 2.063$
 $I_{LIM}(\text{nom}) \approx 1.859A$
 $3.9 \leq V_{IN} \leq 6$

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

$I(L_{sat}) = 7A$

(interpret RSOC% based on this plot)

Drawing ~320mA,
or consuming $\leq 1.152W$,
should give close to
10 hours going from
100% to 0% charge



Proposed battery: protected NCR18650B
VBAT(ovp_default)=REG06[7:2]=4.208V (reduce to 4.192V [010110])
Worst Case:
VBAT(default_max_ovp)=(REG06[7:2]×1.005)×1.04=4.3982016V
BQ29705 provides 4.425V as OVP!
ICHG(default)=REG04[6:0]=2048mA (reduce to ~1.6A [0011001])
reference design: <http://www.ti.com/lit/ug/sluuba2b/sluuba2b.pdf>
could use BQ29705 protection as in:
<http://www.ti.com/lit/ug/tiduc1/tiduc1.pdf>
<http://www.ti.com/lit/df/tidrp70/tidrp70.pdf>
(PTC is enough)

18650 battery holder fits ~68.9mm long protected batteries

EN_SNK disables charging
but does not disable VBUS→VOUT
so 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)

Battery

Purism

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Sheet: /Battery/
File: battery.sch

Size: A4 Date: 2018-11-08

KiCad E.D.A. kicad 5.1.6-1.fc31

eric.kuzmenko@puri.sm

angus.ainslie@puri.sm

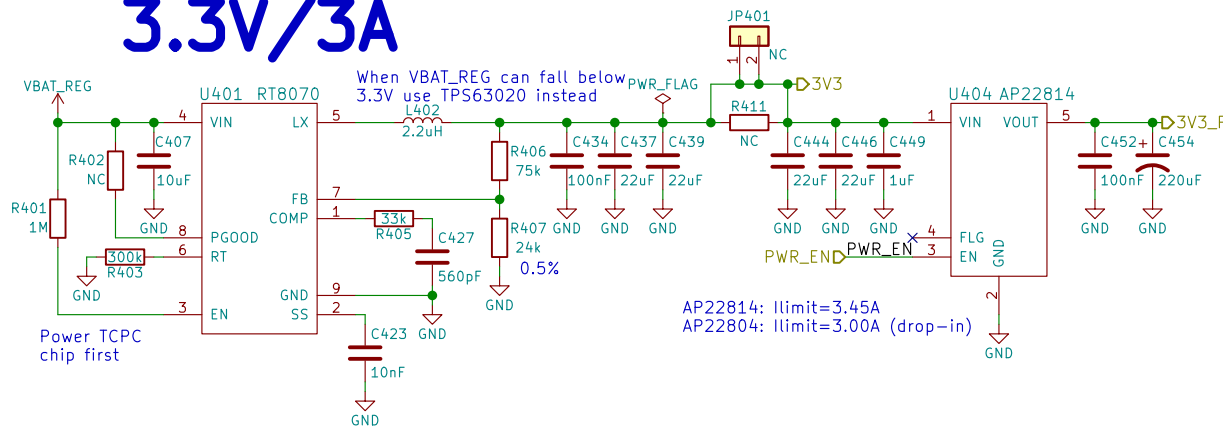
nicole.farber@puri.sm

christian.schilmoeller@puri.sm

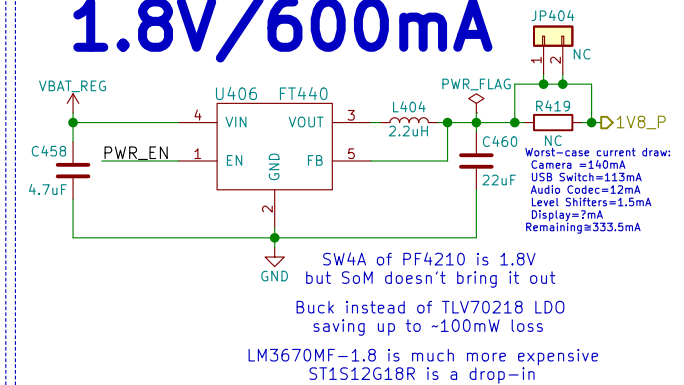
Rev: v1.0.0

Id: 3/25

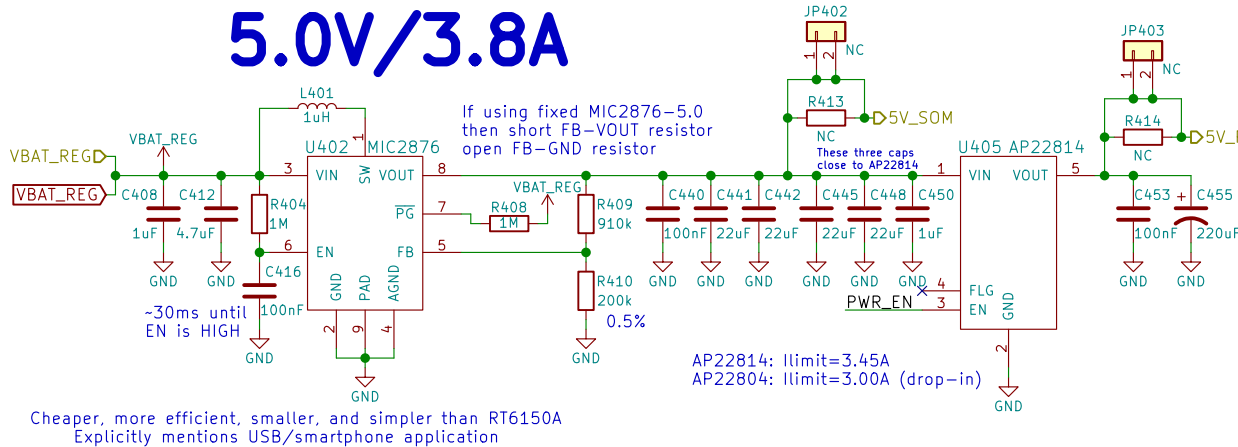
3.3V/3A



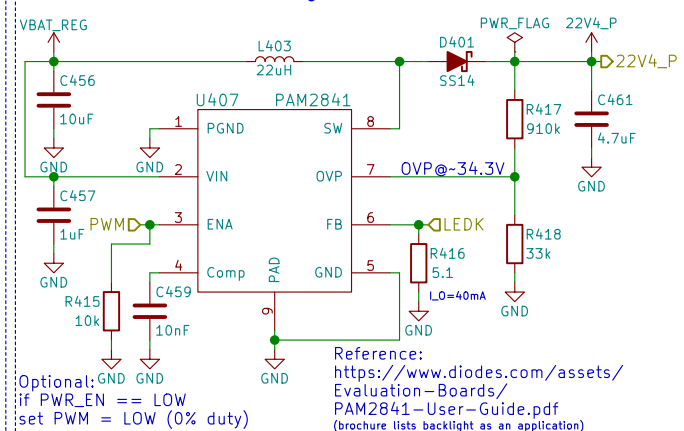
1.8V/600mA



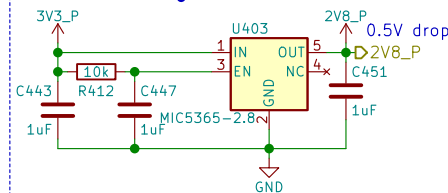
5.0V/3.8A



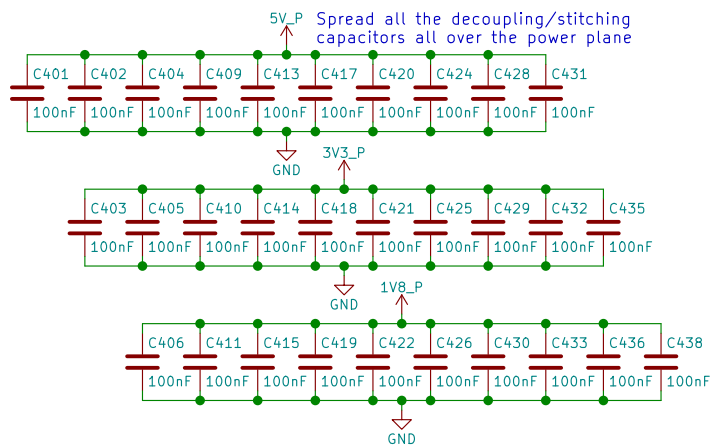
22.4V/40mA



2.8V/150mA



Power



Power

Purism

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Sheet: /Power/
File: power.sch

Size: A4
KiCad E.D.A. kicad 5.1.6-1.fc31

eric.kuzmenko@puri.sm

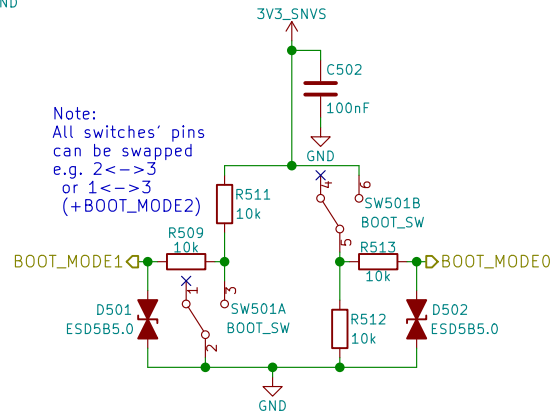
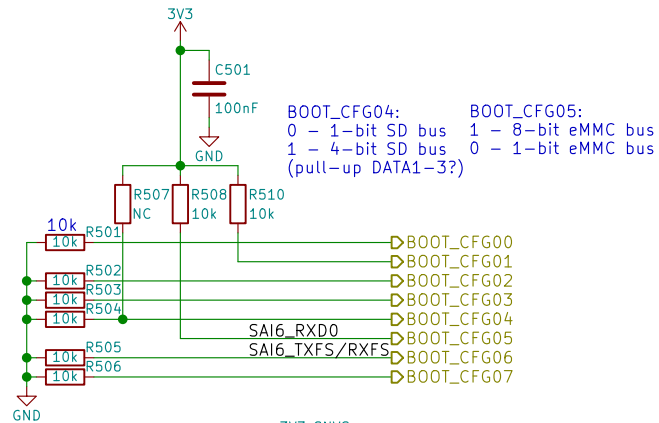
angus.ainslie@puri.sm

nicole.faeber@puri.sm

christian.schilmoeller@puri.sm

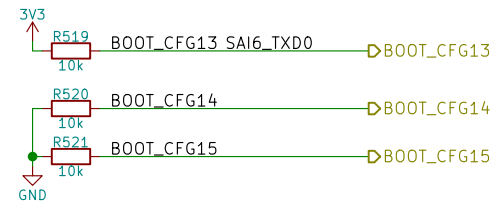
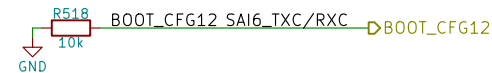
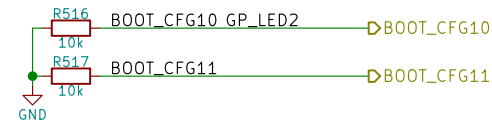
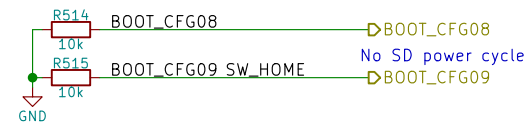
Rev: v1.0.0
Id: 4/25

Boot Config



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

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



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Sheet: /Boot Config/
File: boot.sch

Size: A4
KiCad E.D.A. kicad 5.1.6-1.fc31

eric.kuzmenko@puri.sm

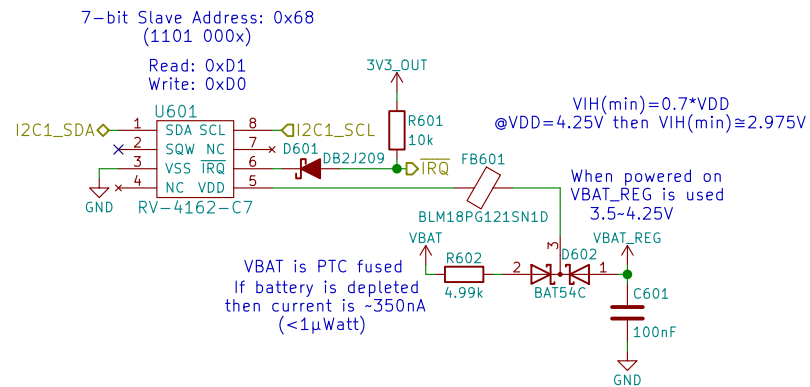
angus.ainstlie@puri.sm

nicole.farber@puri.sm

christian.schilmoeller@puri.sm

Rev: v1.0.0

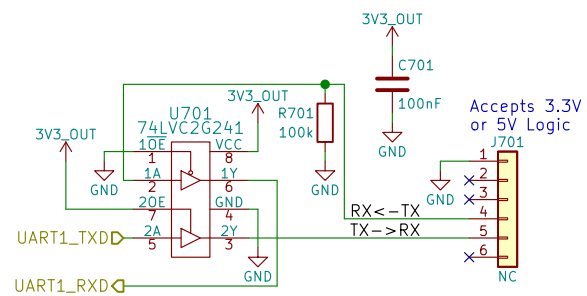
Id: 5/25



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-nblob/8848e94b2f889fe44f6736e2d4c98851a2215mx6qdl-mtp.dtsi#L351>

The diagram shows a 74LVC2G24 inverter (U701) used as a logic level converter. The input side (left) has two pins: UART1_TXDD (pin 2) and UART1_RXDD (pin 5). The output side (right) has two pins: 3V3_OUT (pin 8) and 3V3_OUT (pin 6). A 100k resistor (R701) is connected between the 3V3_OUT output and GND. A 100nF capacitor (C701) is connected between the 3V3_OUT output and GND. The inverter is configured with VCC (pin 1) to GND and GND (pin 4) to GND. The output of the inverter is connected to the 3V3_OUT output. The input of the inverter is connected to the UART1_TXDD and UART1_RXDD inputs. The output of the inverter is connected to the 3V3_OUT output. The output of the inverter is connected to the 3V3_OUT output. The output of the inverter is connected to the 3V3_OUT output.



Purism

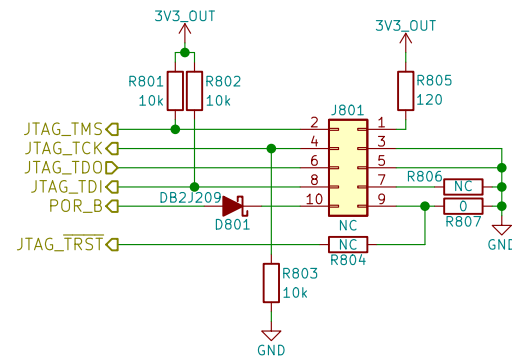
eric.kuzmenko@puri.sm
angus.ainslie@puri.sm
nicole.farber@puri.sm
christian.schilmoeller@puri.sm

File: uart.sch

Rev: v1.0.0

Id: 7/25

JTAG



JTAG



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Sheet: /JTAG/

File: jtag.sch

Size: A4 Date: 2018-11-08

KiCad E.D.A. kicad 5.1.6-1.fc31

eric.kuzmenko@puri.sm

angus.ainstlie@puri.sm

nicole.farber@puri.sm

christian.schilmoeller@puri.sm

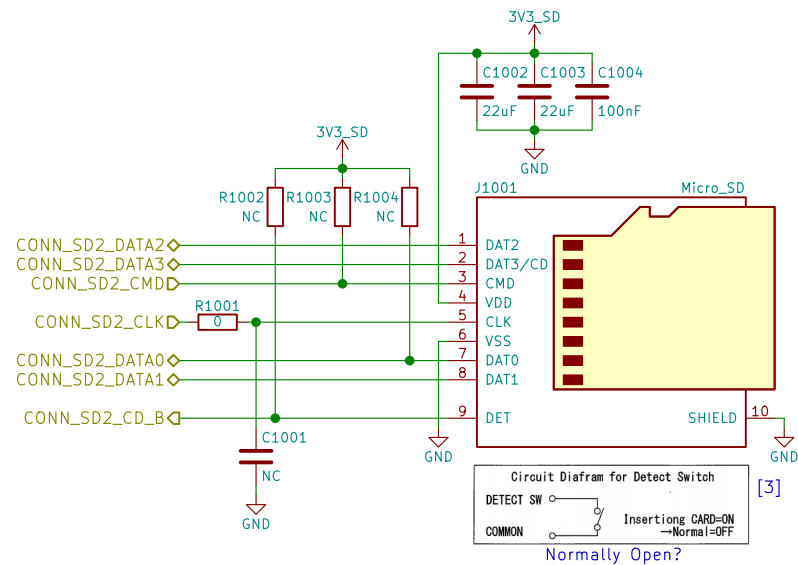
Rev: v1.0.0

Id: 8/25

[illegible]

Id: 9/25

μSD



uSD Card



Purism

Copyright 2018 GNU GPLv3+

Sheet: /uSD Card/

File: sd.sch

eric.kuzmenko@puri.sm

angus.ainslie@puri.sm

nicole.faerber@puri.sm

christian.schilmoeller@puri.sm

Size: A4

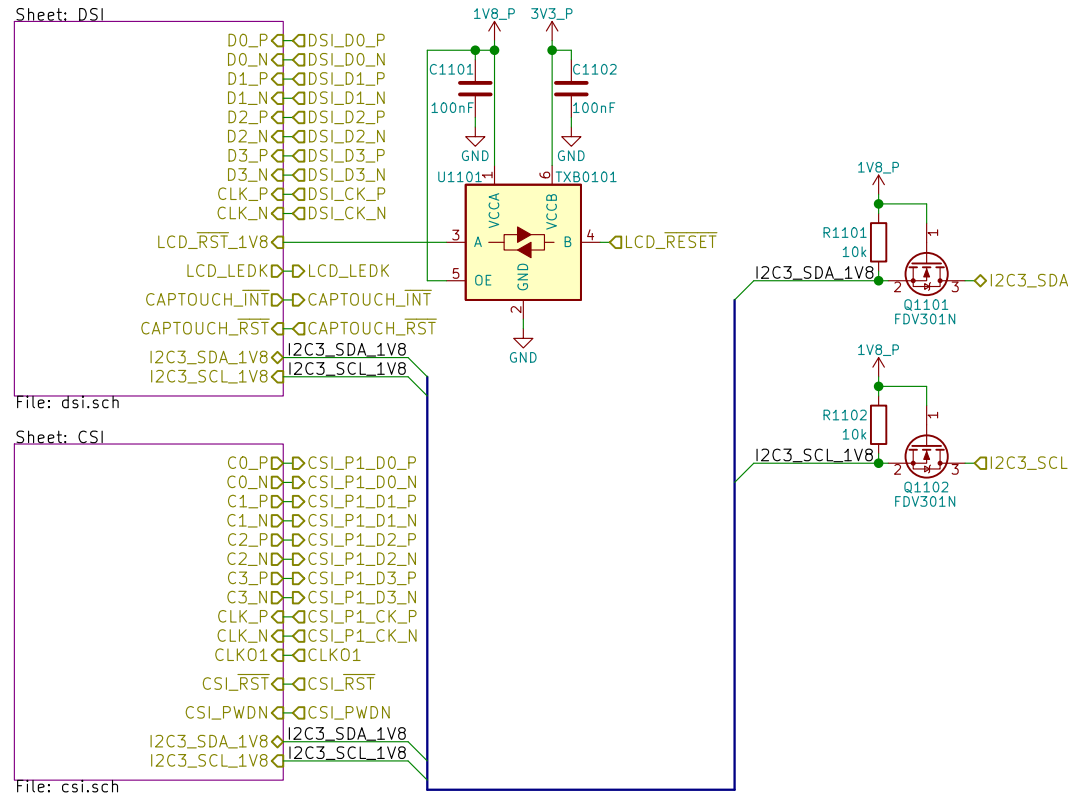
Date: 2018-11-08

Size: 7M	Date: 2018-11-11
KiCad E.D.A.	kicad 5.1.6-1.fc31

Rev: v1.0.0

Id: 10/25

MIPI



MIPI



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Sheet: /MIPI/

File: mipi.sch

Size: A4 Date: 2018-11-08

KiCad E.D.A. kicad 5.1.6-1.fc31

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christian.schilmoeller@puri.sm

Rev: v1.0.0

Id: 11/25

Display & Touch Controller

LCD PN:
Rocktech / Shenzhen Jinghong Electronics Co., Ltd.
JH057N00900

Display Driver IC PN:
Sitronix ST7703

Display_JH057N00900

DISP1201

5.7 "
RGB
720 x 1440
pixels

FPC6
Touch

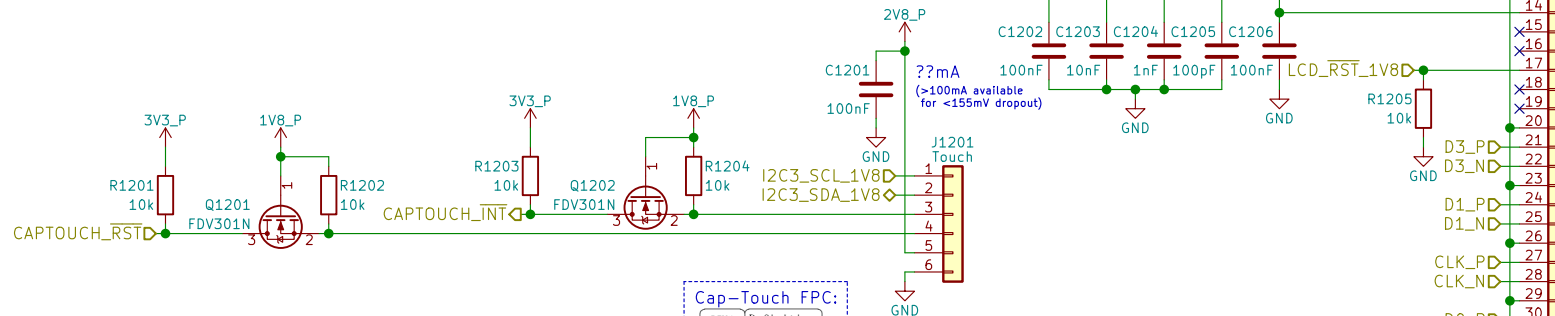
FPC39
Display +
Backlight

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

7-bit Slave Address: 0x5D
(1011 101x)

Read: 0xBB
Write: 0xBA

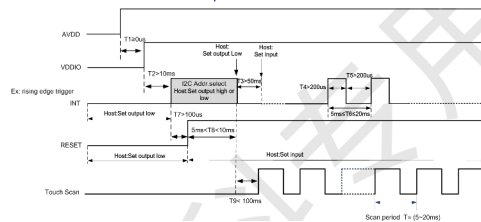
Cap-Touch Controller IC PN:
Goodix GT5688



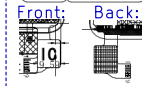
The upper 7 bits are the address,
and bit 0 is used to select read or write.
GT5688 has two slave device addresses to choose from:

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

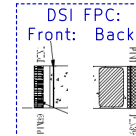
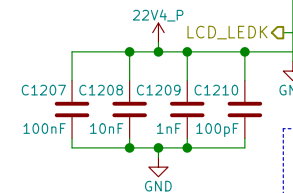
Every time you power on or reset, you need
to use the INT pin to set the I2C address:



Pin#	Definition
1	SCL
2	SDA
3	INT
4	RESET
5	VDD2, 85
6	GND



90Ω Differential Impedance



Backlight Array:



MIPI DSI



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

Size: A4 Date: 2018-11-08
KiCad E.D.A. kicad 5.1.6-1.fc31

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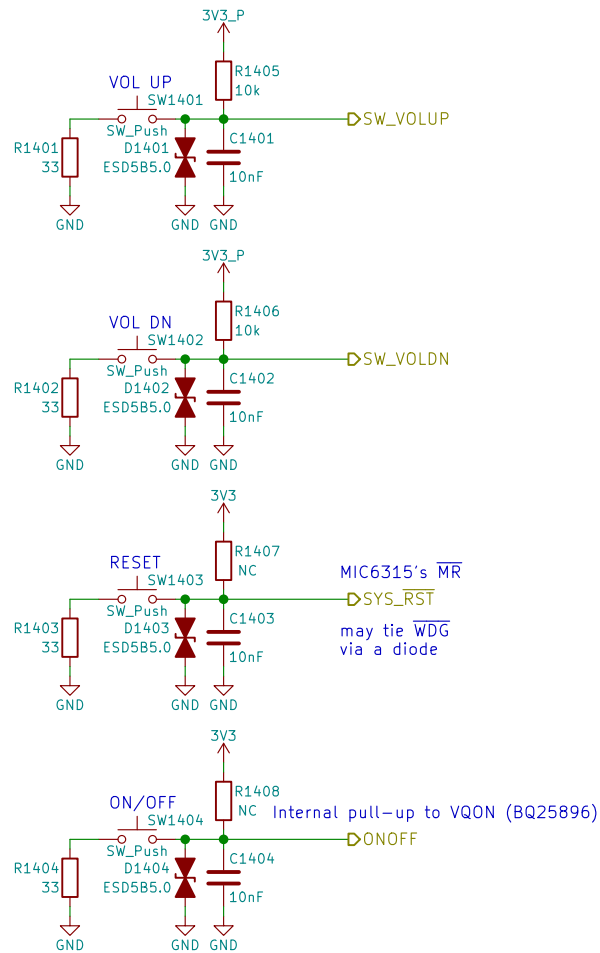
nicole.farber@puri.sm

christian.schilmoeller@puri.sm

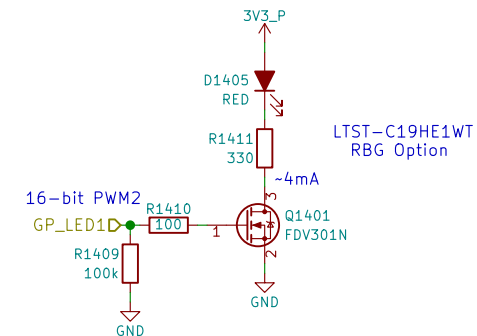
Rev: v1.0.0
Id: 12/25

Id: 13/25

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: 2018-11-08

KiCad E.D.A. kicad 5.1.6-1.fc31

eric.kuzmenko@puri.sm

angus.ainstie@puri.sm

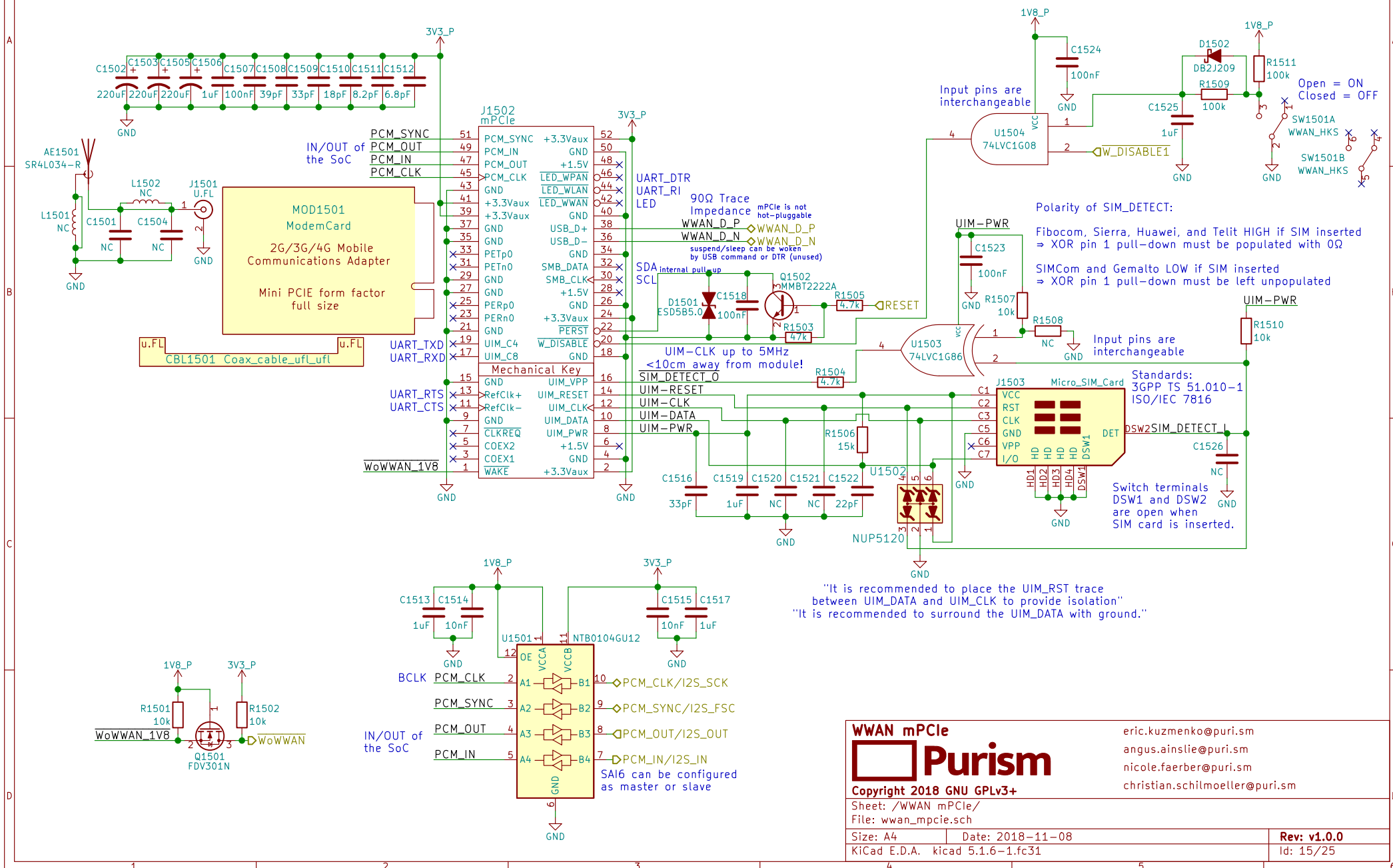
nicole.farber@puri.sm

christian.schilmoeller@puri.sm

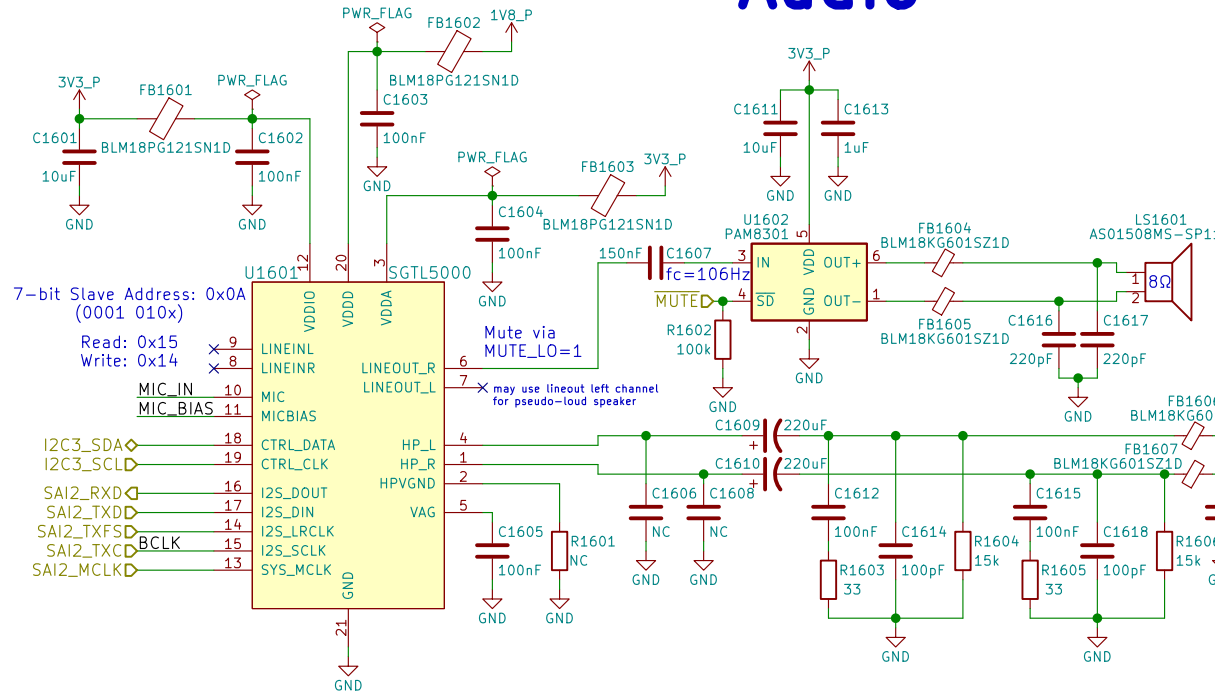
Rev: v1.0.0

Id: 14/25

WWAN mPCIe



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-crc>
 (Nit6 does the same)
 +Zener diode to protect against ranges outside of -0.9V to 3.3V

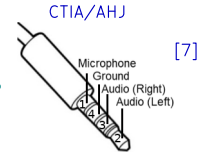
dB specs in datasheet is a unit of power gain (not dBu or VU) with respect to the DAC's unattenuated output

"HP Output - 62.5mW max, 1.02kHz sine into 16Ω load at 3.3 V"
 $\Rightarrow (1V)^2 / (16\Omega) = 62.5mW$
 $\therefore V_{rms} = 1V \Rightarrow V_p(\text{amplitude}) = 1.414V$
 $\therefore I_{rms}(\text{max}) = 62.5mA$

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

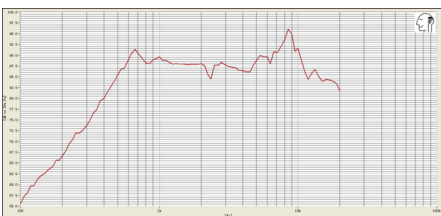
S/E button on earbud headsets shorts the mic for key function

Could use FSA8008 to detect mic

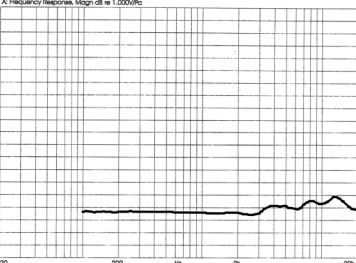


[7]

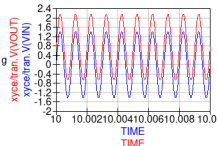
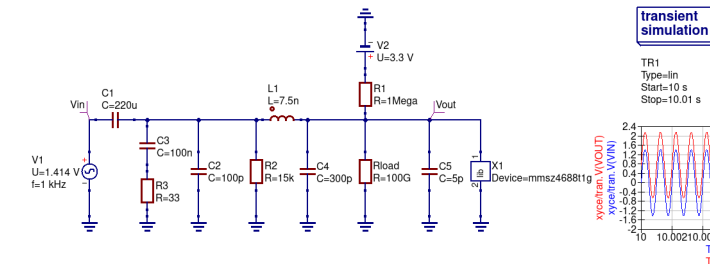
Built-In Speaker's Frequency Response: [8]



Built-In Mic's Frequency Response: [9]



Simulation of HP_DET without HP jack inserted:



LCR Measurements:

Earbud Microphone:	Headset Speaker:	Earbud Speaker:
1kHz	1kHz	1kHz
$L_s = 3.844mH$	$L_s = 244.4uH$	$L_s = 25.2uH$
$L_p = 15.757H$	$L_p = 141.99mH$	$L_p = 311.0mH$
$C_s = 6.583uF$	$C_s = 103.6uF$	$C_s = 1.0mF$
$C_p = 1612.8pF$	$C_p = 178.77nF$	$C_p = 81.95nF$
$R_s = 1.5465k\Omega$	$R_s = 36.860\Omega$	$R_s = 17.030\Omega$
$R_p = 1.5478k\Omega$	$R_p = 36.860\Omega$	$R_p = 17.034\Omega$
$\theta = -0.8deg$	$\theta = -2.3deg$	$\theta = 0.5deg$

Audio

Purism

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Sheet: /Audio/
File: audio.sch

Size: A4
KiCad E.D.A. kicad 5.1.6-1.fc31

Date: 2018-11-08

eric.kuzmenko@puri.sm

angus.ainslie@puri.sm

nicole.farber@puri.sm

christian.schilmoeller@puri.sm

Rev: v1.0.0

Id: 16/25

RGMII 10/100/1000 Ethernet

3V3_P FB1701 BLM18PG121SN1D C1703 C1705 1uF 220nF GND C1704 C1706 10uF 220nF GND U1701 4 16 VDD33 AVDD33 VDDIO_REG VDDH_REG LX DVDDL 47 PWR_FLAG ENET_2V5 ENET_2V5 C1707 C1708 C1710 220nF 1uF 1uF GND L1701 4.7uH ENET_1V1 C1713 C1716 10uF 220nF GND PWR_FLAG FB1702 BLM18PG121SN1D C1711 C1714 C1717 C1718 220nF 220nF 220nF 2.2uF GND C1719 C1720 C1721 220nF 220nF 220nF GND LED_ACT R1723 270 FB1703 BLM18PG121SN1D SH1 SH2 GREEN LED_LINK10_100 R1724 270 YELLOW LED_LINK1000 R1725 270 GND

ENET_RD0 R1701 10k ENET_2V5 R1702 NC ENET_RD1 R1703 10k ENET_2V5 R1704 NC R1705 10k LED_ACT R1706 10k ENET_RX_CTL R1707 10k ENET_RD2 R1708 10k ENET_RXC R1709 10k ENET_RD3 R1710 10k LED_LINK1000 R1711 10k LED_LINK10_100 R1712 10k ENET_2V5 R1713 10k R1714 10k R1716 10k R1717 10k R1718 1.62k 1x R1721 2.37k ENET_1V1 R1719 NC R1720 NC 2.5V (3.3V tolerant) D1701 DB2J209 ENET_MDIO ENET_RST ENET_WoL ENET_INT TP1701 TEST_1P TP1702 TEST_1P CLK02 R1713 NC R1715 NC GND C1701 27pF Y1701 25MHz C1702 27pF R1722 2.37k GND

ENET_TXC 35 GTX_CLK 36 TXD0 37 TXD1 38 TXD2 39 TXD3 34 TX_EN 33 RX_CLK 31 RXD0 30 RXD1 28 RXD2 27 RXD3 32 RX_DV 46 SIP 45 SIN 43 SOP 42 SON 41 SD 1 MDC 48 MDIO 2 RST 40 WOL_INT 5 INT 22 PPS 25 CLK_25M LED_LINK10_100 26 LED_LINK1000 24 LED_ACT 23 XTLO 7 XTLI 9 RBIAS AR8031 49 GND

ETH_TRX0_P TD1+ 2 J1701 RJ45 ETH_TRX0_N TD1- 3 J2 TX1+ ETH_TRX1_P TD2+ 4 J3 TX2+ ETH_TRX1_N TD2- 5 J4 TX3+ ETH_TRX2_P TD3+ 6 J5 TX3- ETH_TRX2_N TD3- 7 J6 TX4+ ETH_TRX3_P TD4+ 8 J7 TX4- ETH_TRX3_N TD4- 9 J8 TX4- VCC 1 GND 10 SH1 SH2 GREEN YELLOW D1702 GREEN

Ethernet
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Sheet: /Ethernet/
File: ethernet.sch
Size: A4 Date: 2018-11-08 Rev: v1.0.0
KiCad E.D.A. kicad 5.1.6-1.fc31 Id: 17/25



Purism

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christian.schilmoeller@puri.sm

Rev: v1.0.0
Id: 17/25

WLAN+BT M.2

RS9116 NC:
RTS, CTS, BT_HOST_WAKE
RS9116 datasheet says
no WIFI_WAKE
but the schematic has it

RedPine RS9116 MB0
Requires 5V on
Pin 54 if USB used

WLAN_D_P
WLAN_D_N
WIFI_CLK
WIFI_CMD
WIFI_DATA0
WIFI_DATA1
WIFI_DATA2
WIFI_DATA3
WIFI_WAKE

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

MOD1801
WifiBTCard
WiFi + Bluetooth
M.2 Form Factor
Key ID "E"
width: 22 mm
length: 30 mm

Socket: Table 46
Module: Table 23

M.2 Key E

3V3_P

NC

Key E

1

2

3

4

5

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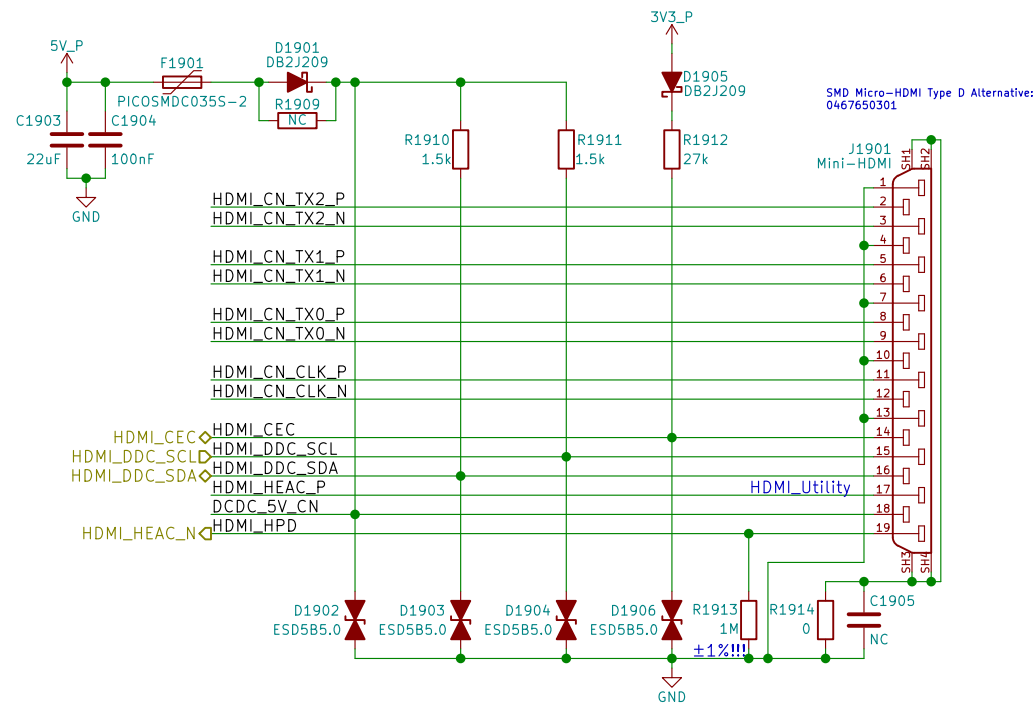
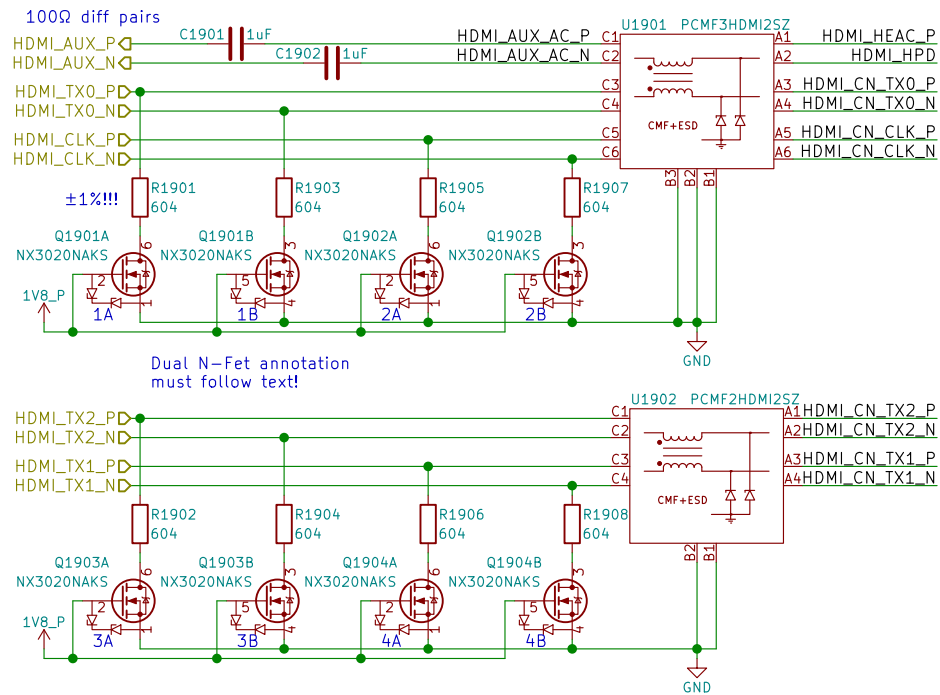
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TUSB546A-DCI can be used for HDMI over USB-C

HDMI



HDMI



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Sheet: /HDMI/
File: hdmi.sch

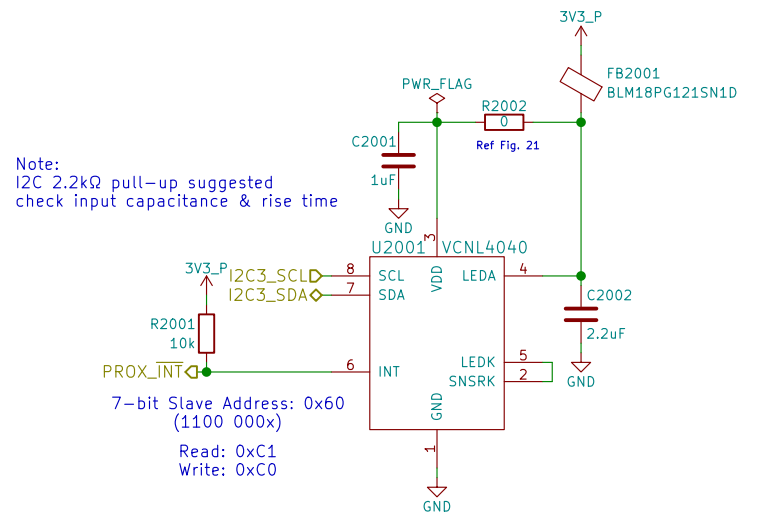
Size: A4 Date: 2018-11-08
KiCad E.D.A. kicad 5.1.6-1.fc31

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Rev: v1.0.0
Id: 19/25

Sensors

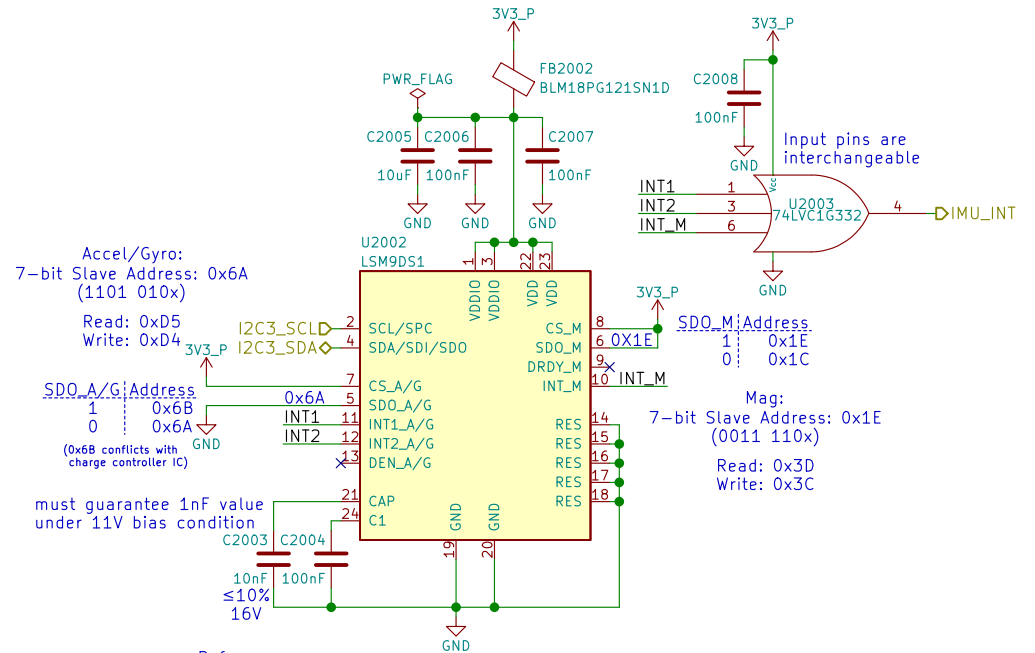
Proximity & Ambient Light



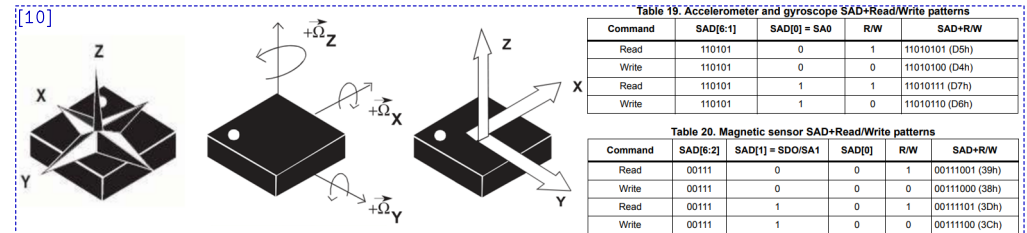
Note:
I2C 2.2k Ω pull-up suggested
check input capacitance & rise time

Reference:
<https://www.vishay.com/docs/84307/designingvcnl4040.pdf>
<http://www.vishay.com/docs/84931/vcni4040sensorboardfiles.pdf>

9-Axis IMU



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



Sensors



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Sheet: /Sensors/
File: sensors.sch

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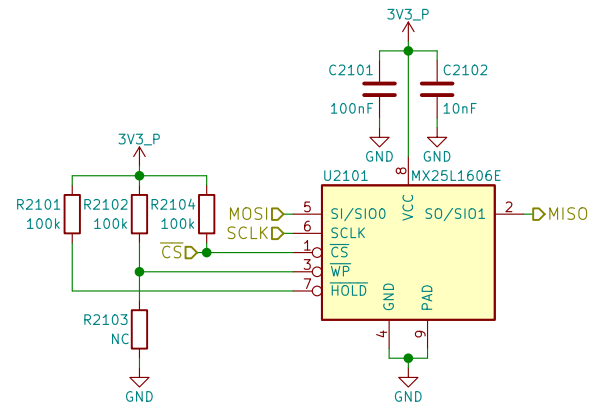
Size: A4	Date: 2018-11-08
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Rev: v1.0.0

Id: 20/25

SPI NOR Flash



SPI NOR Flash



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Sheet: /SPI Flash/
File: flash.sch

Size: A4 Date: 2018-11-08
KiCad E.D.A. kicad 5.1.6-1.fc31

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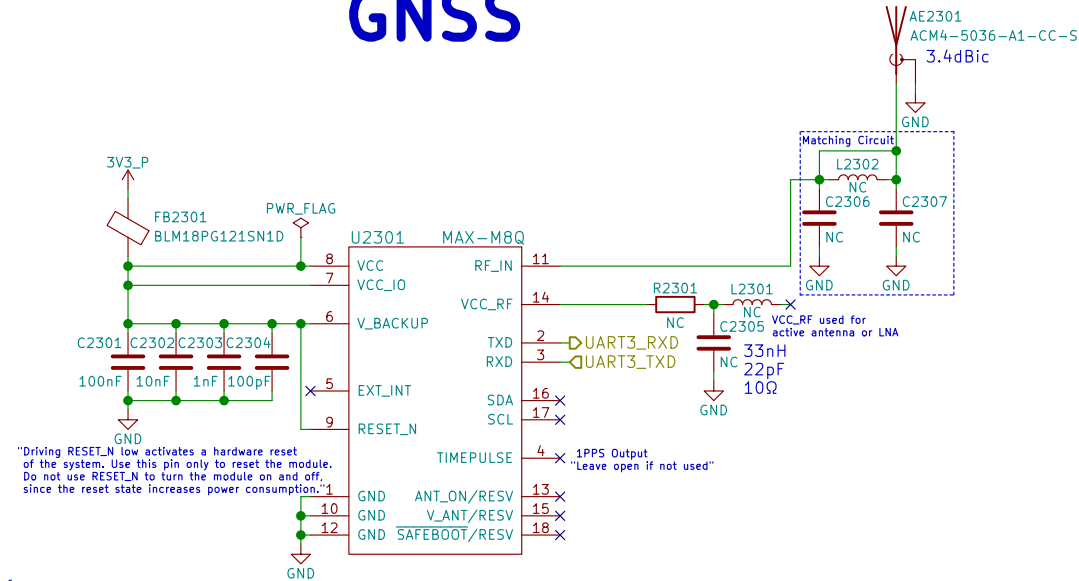
Smart Card



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Id: 22/25

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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Sheet: /GNSS/
 File: gnss.sch

Size: A4 Date: 2018-11-08
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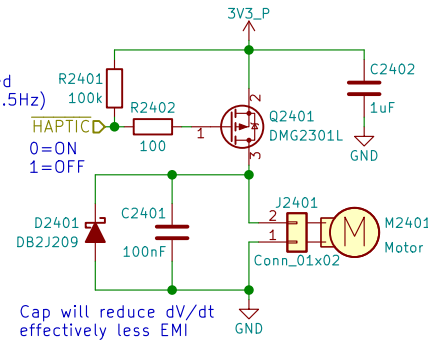
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Rev: v1.0.0
 Id: 23/25

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
 thick adhesive layer underneath
 (not connected to either pin)

Haptic/Vibration Motor



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Id: 24/25

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- [2] i.MX 8M Dual/8M QuadLite/8M Quad Applications Processors Reference Manual, Rev. 0, 01/2018
- [3] https://www.mouser.com/datasheet/2/15/alps_SCHA4B0419-1155906.pdf
- [4] Goodix GT5688 Programming Guide, Rev.01a, 2015-12-25
- [5] JH057N00900 LCD Module Specification, v1.0
- [6] OV5640 Datasheet, Version 2.03, 05.26.2011
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- [9] <https://www.cui.com/product/resource/cmc-2242pbl-a.pdf>
- [10] <http://www.st.com/content/ccc/resource/technical/document/datasheet/1e/3f/2a/d6/25/eb/48/46/DM00103319.pdf/files/DM00103319.pdf/jcr:content/translations/en.DM00103319.pdf>

References



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Sheet: /References/

File: references.sch

Size: A4 Date: 2018-11-08

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