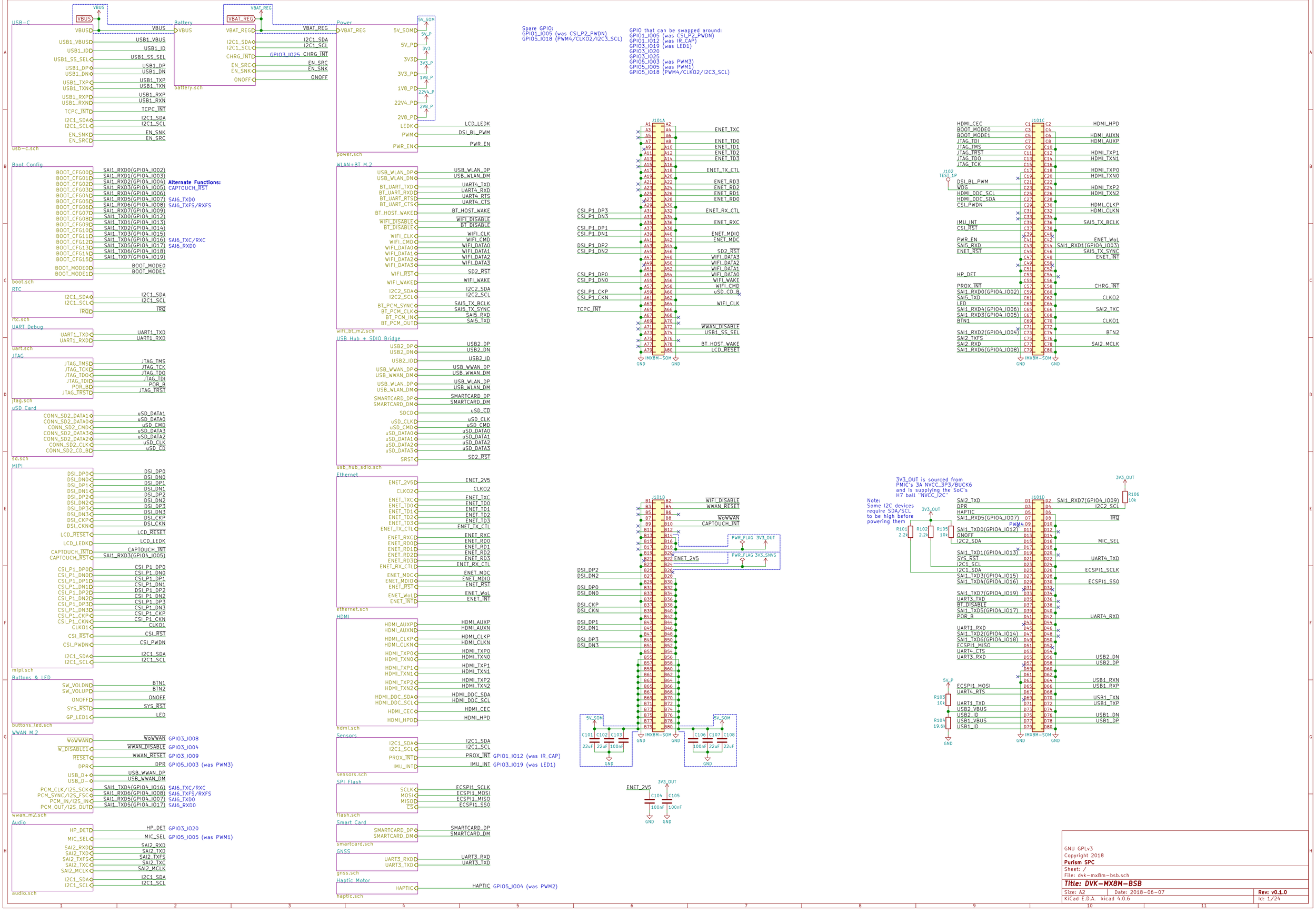
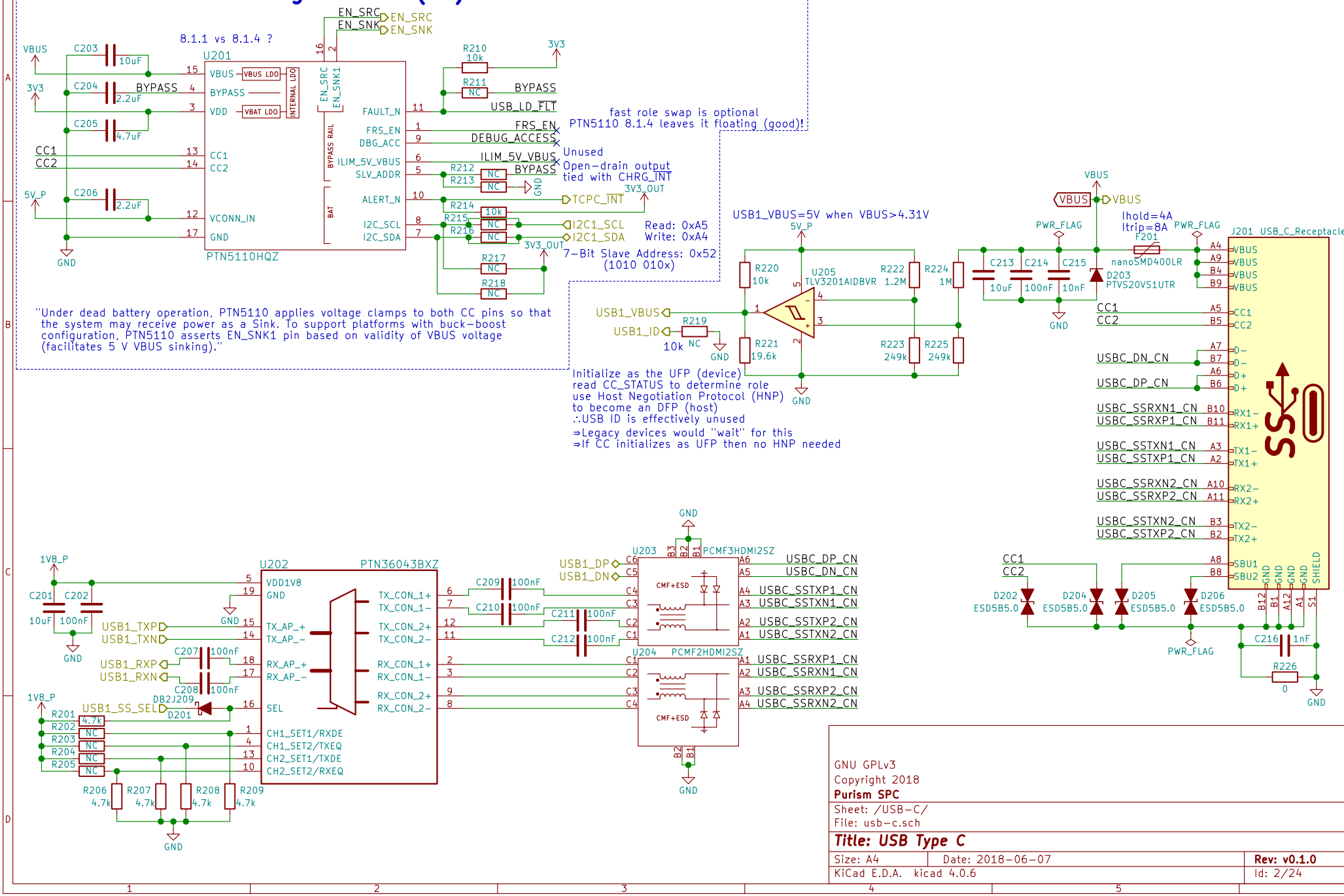

USB-C
VBUS
USB1_VBUS
USB1_ID
USB1_SS_SEL
USB1_DP
USB1_DN
USB1_TXP
USB1_TXN
USB1_RXP
USB1_RXN
TCPC_INT
I2C1_SDA
I2C1_SCL
EN_SNK
EN_SRC
usb-c.sch
Battery
VBUS
battery.sch
VBAT_REG
I2C1_SDA
I2C1_SCL
CHRG_INT
EN_SRC
EN_SNK
ONOFF
Power
VBAT_REG
5V_SOM
5V_P
3V3
3V3_P
1V8_P
22V4_P
2V8_P
LEDK
PWM
PWR_EN
power.sch
LCD_LEDK
DSI_BL_PWM
PWR_EN
Spare GPIO:
GPIO1_IO05 (was CSI_P2_PWDN)
GPIO5_IO18 (PWM4/CLKO2/I2C3_SCL)
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)
GPIO5_IO18 (PWM4/CLKO2/I2C3_SCL)
Boot Config
BOOT_CFG00
BOOT_CFG01
BOOT_CFG02
BOOT_CFG03
BOOT_CFG04
BOOT_CFG05
BOOT_CFG06
BOOT_CFG07
BOOT_CFG08
BOOT_CFG09
BOOT_CFG10
BOOT_CFG11
BOOT_CFG12
BOOT_CFG13
BOOT_CFG14
BOOT_CFG15
SAI1_RXD0(GPIO4_IO02)
SAI1_RXD1(GPIO4_IO03)
SAI1_RXD2(GPIO4_IO04)
SAI1_RXD3(GPIO4_IO05)
SAI1_RXD4(GPIO4_IO06)
SAI1_RXD5(GPIO4_IO07)
SAI1_RXD6(GPIO4_IO08)
SAI1_RXD7(GPIO4_IO09)
SAI1_TXD0(GPIO4_IO12)
SAI1_TXD1(GPIO4_IO13)
SAI1_TXD2(GPIO4_IO14)
SAI1_TXD3(GPIO4_IO15)
SAI1_TXD4(GPIO4_IO16)
SAI1_TXD5(GPIO4_IO17)
SAI1_TXD6(GPIO4_IO18)
SAI1_TXD7(GPIO4_IO19)
Alternate Functions:
CAPTOUCH_RST
SAI6_TXD0
SAI6_TXFS/RXFS
SAI6_TXC/RXC
SAI6_RXD0
BOOT_MODE0
BOOT_MODE1
boot.sch
RTC
I2C1_SDA
I2C1_SCL
IRQ
rtc.sch
UART Debug
UART1_TXD
UART1_RXD
uart.sch
JTAG
JTAG_TMS
JTAG_TCK
JTAG_TDO
JTAG_TDI
POR_B
JTAG_TRST
jtag.sch
uSD Card
CONN_SD2_DATA1
CONN_SD2_DATA0
CONN_SD2_CMD
CONN_SD2_DATA3
CONN_SD2_DATA2
CONN_SD2_CLK
CONN_SD2_CD_B
uSD_DATA1
uSD_DATA0
uSD_CMD
uSD_DATA3
uSD_DATA2
uSD_CLK
uSD_CD
sd.sch
MIPI
DSI_DP0
DSI_DN0
DSI_DP1
DSI_DN1
DSI_DP2
DSI_DN2
DSI_DP3
DSI_DN3
DSI_CKP
DSI_CKN
LCD_RESET
LCD_LEDK
CAPTOUCH_INT
CAPTOUCH_RST
SAI1_RXD3(GPIO4_IO05)
CSI_P1_DP0
CSI_P1_DN0
CSI_P1_DP1
CSI_P1_DN1
CSI_P1_DP2
CSI_P1_DN2
CSI_P1_DP3
CSI_P1_DN3
CSI_P1_CKP
CSI_P1_CKN
CLKO1
CSI_RST
CSI_PWDN
I2C1_SDA
I2C1_SCL
mipi.sch
Buttons & LED
SW_VOLDN
SW_VOLUP
ONOFF
SYS_RST
GP_LED1
BTN1
BTN2
ONOFF
SYS_RST
LED
buttons_led.sch
WWAN_M.2
WoWWAN
W_DISABLE1
RESET
DPR
USB_D+
USB_D-
PCM_CLK/I2S_SCK
PCM_SYNC/I2S_FSC
PCM_IN/I2S_IN
PCM_OUT/I2S_OUT
WoWWAN
WWAN_DISABLE
WWAN_RESET
DPR
USB_WWAN_DP
USB_WWAN_DM
SAI1_TXD4(GPIO4_IO16)
SAI1_RXD6(GPIO4_IO08)
SAI1_RXD5(GPIO4_IO07)
SAI1_TXD5(GPIO4_IO17)
GPIO3_IO08
GPIO3_IO04
GPIO3_IO09
GPIO5_IO03 (was PWM3)
SAI6_TXC/RXC
SAI6_TXFS/RXFS
SAI6_TXD0
SAI6_RXD0
wwan_m2.sch
Audio
HP_DET
MIC_SEL
SAI2_RXD
SAI2_TXD
SAI2_TXFS
SAI2_TXC
SAI2_MCLK
I2C1_SDA
I2C1_SCL
GPIO3_IO20
GPIO5_IO05 (was PWM1)
audio.sch
WLAN+BT M.2
USB_WLAN_DP
USB_WLAN_DM
BT_UART_TXD
BT_UART_RXD
BT_UART_RTS
BT_UART_CTS
BT_HOST_WAKE
WIFI_DISABLE
BT_DISABLE
WIFI_CLK
WIFI_CMD
WIFI_DATA0
WIFI_DATA1
WIFI_DATA2
WIFI_DATA3
WIFI_RST
WIFI_WAKE
I2C2_SDA
I2C2_SCL
BT_PCM_SYNC
BT_PCM_CLK
BT_PCM_IN
BT_PCM_OUT
SAI5_TX_BCLK
SAI5_TX_SYNC
SAI5_RXD
SAI5_TXD
wifi_bt_m2.sch
USB Hub + SDIO Bridge
USB2_DP
USB2_DN
USB2_ID
USB_WWAN_DP
USB_WWAN_DM
USB_WLAN_DP
USB_WLAN_DM
SMARTCARD_DP
SMARTCARD_DM
SDCD
uSD_CLK
uSD_CMD
uSD_DATA0
uSD_DATA1
uSD_DATA2
uSD_DATA3
SRST
SD2_RST
usb_hub_sdio.sch
Ethernet
ENET_2V5
CLKO2
ENET_TXC
ENET_TD0
ENET_TD1
ENET_TD2
ENET_TD3
ENET_TX_CTL
ENET_RXC
ENET_RD0
ENET_RD1
ENET_RD2
ENET_RD3
ENET_RX_CTL
ENET_MDC
ENET_MDIO
ENET_RST
ENET_WoL
ENET_INT
ethernet.sch
HDMI
HDMI_AUXP
HDMI_AUXN
HDMI_CLKP
HDMI_CLKN
HDMI_TXP0
HDMI_TXN0
HDMI_TXP1
HDMI_TXN1
HDMI_TXP2
HDMI_TXN2
HDMI_DDC_SDA
HDMI_DDC_SCL
HDMI_CEC
HDMI_HPD
hdmi.sch
Sensors
I2C1_SDA
I2C1_SCL
PROX_INT
IMU_INT
GPIO1_IO12 (was IR_CAP)
GPIO3_IO19 (was LED1)
sensors.sch
SPI Flash
SCLK
MOSI
MISO
CS
ECSPI1_SCLK
ECSPI1_MOSI
ECSPI1_MISO
ECSPI1_SS0
flash.sch
Smart Card
SMARTCARD_DP
SMARTCARD_DM
smartcard.sch
GNSS
UART3_RXD
UART3_TXD
gnss.sch
Haptic Motor
HAPTIC
GPIO5_IO04 (was PWM2)
haptic.sch
J101A
ENET_TXC
ENET_TD0
ENET_TD1
ENET_TD2
ENET_TD3
ENET_TX_CTL
ENET_RD3
ENET_RD2
ENET_RD1
ENET_RD0
SD2_RST
WIFI_DATA3
WIFI_DATA2
WIFI_DATA1
WIFI_DATA0
WIFI_CMD
uSD_CD_B
WIFI_CLK
WWAN_DISABLE
USB1_SS_SEL
BT_HOST_WAKE
LCD_RESET
CSI_P1_DP3
CSI_P1_DN3
CSI_P1_DP1
CSI_P1_DN1
DSI_P1_DP2
CSI_P1_DN2
CSI_P1_DP0
CSI_P1_DN0
CSI_P1_CKP
CSI_P1_CKN
TCPC_INT
ENET_RX_CTL
ENET_RXC
ENET_MDIO
ENET_MDC
IMX8M-SOM
GND
J101B
WIFI_DISABLE
WWAN_RESET
WoWWAN
CAPTOUCH_INT
PWR_FLAG 3V3_OUT
PWR_FLAG 3V3_SNVS
ENET_2V5
DSI_DP2
DSI_DN2
DSI_DP0
DSI_DN0
DSI_CKP
DSI_CKN
DSI_DP1
DSI_DN1
DSI_DP3
DSI_DN3
5V_SOM
C101
C102
C103
22uF
22uF
100nF
C106
C107
C108
100nF
22uF
22uF
3V3_OUT
C104
C105
100nF
100nF
J101C
HDMI_CEC
BOOT_MODE0
BOOT_MODE1
JTAG_TDI
JTAG_TMS
JTAG_TRST
JTAG_TDO
JTAG_TCK
J102
TEST_1P
DSI_BL_PWM
WDG
HDMI_DDC_SCL
HDMI_DDC_SDA
CSI_PWDN
IMU_INT
CSI_RST
PWR_EN
SAI5_RXD
ENET_RST
HP_DET
PROX_INT
SAI1_RXD0(GPIO4_IO02)
SAI5_TXD
LED
SAI1_RXD4(GPIO4_IO06)
SAI1_RXD3(GPIO4_IO05)
BTN1
SAI1_RXD2(GPIO4_IO04)
SAI2_TXFS
SAI2_RXD
SAI1_RXD6(GPIO4_IO08)
HDMI_HPD
HDMI_AUXN
HDMI_AUXP
HDMI_TXN1
HDMI_TXP1
HDMI_TXN2
HDMI_TXP2
HDMI_CLKN
HDMI_CLKP
SAI5_TX_BCLK
ENET_WoL
SAI1_RXD1(GPIO4_IO03)
SAI5_TX_SYNC
ENET_INT
CHRG_INT
CLKO2
SAI2_TXC
HDMI_TXP1
HDMI_TXN1
ECSPI1_SCLK
ECSPI1_SS0
UART4_RXD
BTN2
SAI2_MCLK
3V3_OUT is sourced from PMIC's 3A NVCC_3P3/BUCK6 and is supplying the SoC's H7 ball "NVCC_I2C"
Note: Some I2C devices require SDA/SCL to be high before powering them
3V3_OUT
R101 2.2k
R102 2.2k
R105 10k
R106 10k
PWM4
SAI2_TXD
DPR
HAPTIC
SAI1_RXD5(GPIO4_IO07)
SAI1_TXD0(GPIO4_IO12)
ONOFF
I2C2_SDA
SAI1_TXD1(GPIO4_IO13)
SYS_RST
I2C1_SCL
I2C1_SDA
SAI1_TXD3(GPIO4_IO15)
SAI1_TXD4(GPIO4_IO16)
SAI1_TXD7(GPIO4_IO19)
UART3_TXD
BT_DISABLE
SAI1_TXD5(GPIO4_IO17)
POR_B
UART1_RXD
SAI1_TXD2(GPIO4_IO14)
SAI1_TXD6(GPIO4_IO18)
ECSPI1_MISO
UART4_CTS
UART3_RXD
5V_P
ECSPI1_MOSI
UART4_RTS
UART1_TXD
USB2_VBUS
USB2_ID
USB1_VBUS
USB1_ID
R103 10k
R104 19.6k
SAI1_RXD7(GPIO4_IO09)
I2C2_SCL
MIC_SEL
UART4_TXD
ECSPI1_SCLK
ECSPI1_SS0
UART4_RXD
USB2_DN
USB2_DP
USB1_RXN
USB1_RXP
USB1_TXN
USB1_TXP
USB1_DN
USB1_DP
GNU GPLv3
Copyright 2018
Purism SPC
Sheet: /
File: dvk-mx8m-bsb.sch
Title: DVK-MX8M-BSB
Size: A2
Date: 2018-06-07
Rev: v0.1.0
KiCad E.D.A. kicad 4.0.6
Id: 1/24

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



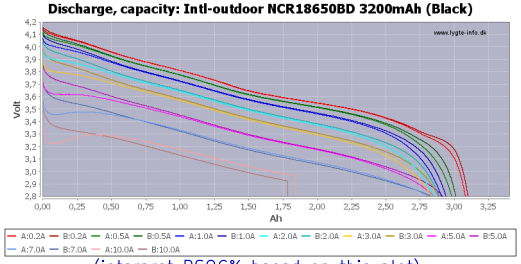
GNU GPLv3
Copyright 2018
Purism SPC

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

Title: USB Type C

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 2/24

Battery Charge Controller



(interpret RSOC% based on this plot)

Drawing ~333.33mA, or consuming <1.2W, should give close to 10 hours going from 100% to 0% charge

use AUTO_DPDM_EN to auto-detect IINLIM

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

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

U301 BQ25896

I(Lsat)=7A

FB301 HI1206T500R

3.5~4.25V PWR_FLAG

~110uF

JP301 NC

R309 NC

D304 GREEN

0.18mA~0.95mA

R310 2.21k 1%

VBAT_REG

D301 GREEN D302 GREEN

Default LOW: adapter source

sink current ~5mA

Read: 0xD7
Write: 0xD6

I2C1_SDA I2C1_SCL

CHRG_INT EN_SRC EN_SNK

Q301 2SK3018

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

nanoSMD350LR F301

BT301 18650

THT Option: Keystone 1043

VBAT(DPL)=2.15~2.5V

NCR18650B meets requirements

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)=REG[6:0]=2048mA (reduce to ~1.6A [0011001])

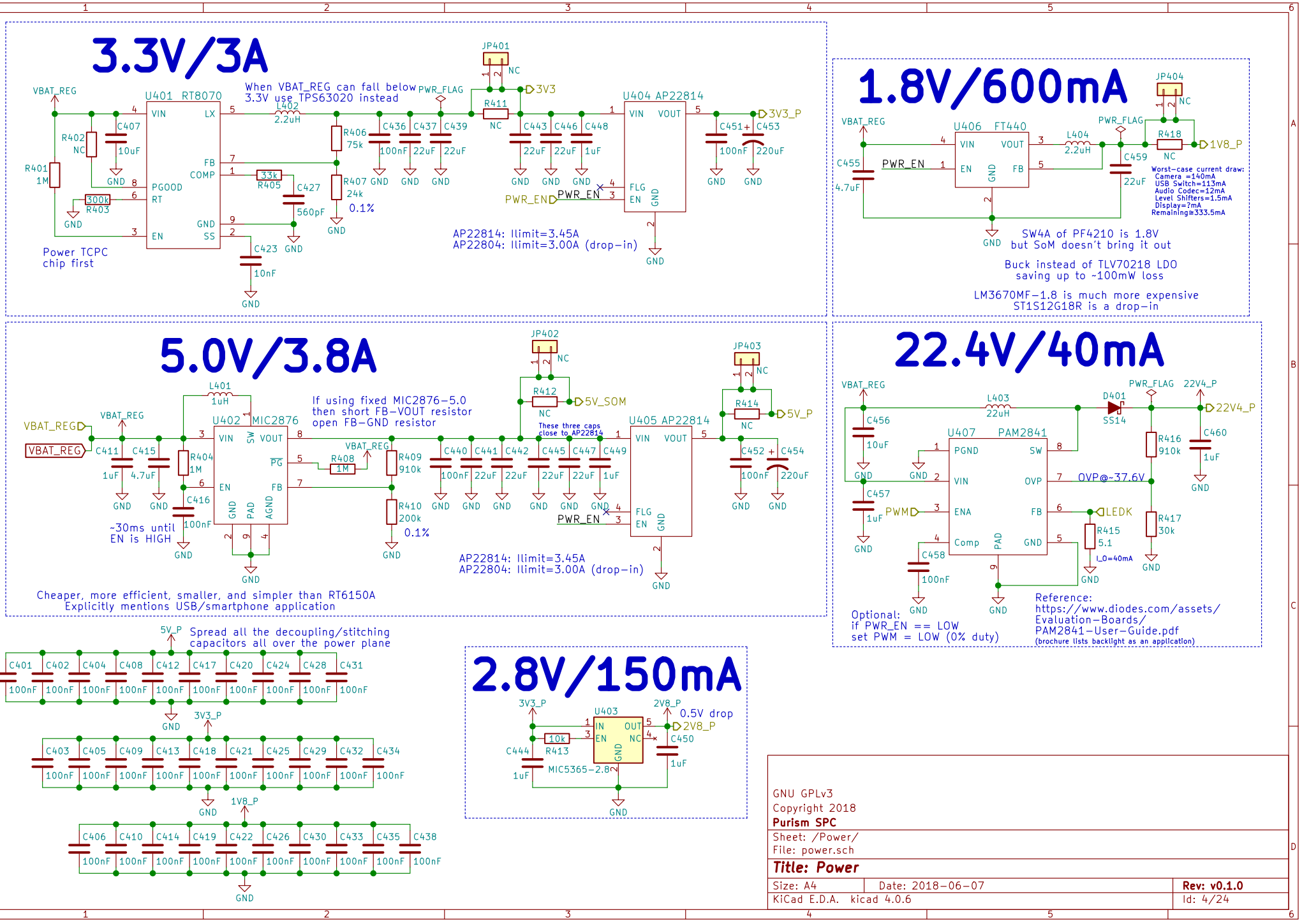
reference design: http://www.ti.com/lit/ug/sluuba2b/sluuba2b.pdf

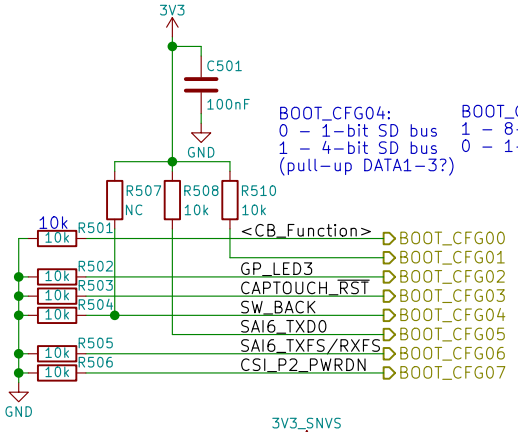
may want to include BQ29705 protection as in:
http://www.ti.com/lit/ug/tiducl1/tiducl1.pdf
schematic: http://www.ti.com/lit/df/tidrp70/tidrp70.pdf
(PTC may be good enough)

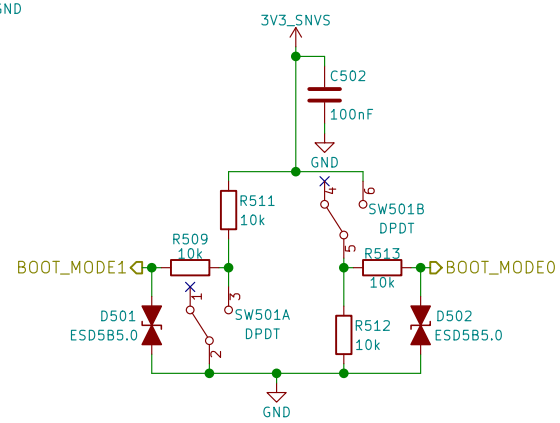
Battery holder gives ~1mm clearance underneath the battery
Thermistor is 1.1±0.15mm thick, should fit fine with stack-up

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: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 3/24


3.3V/3A
When VBAT_REG can fall below 3.3V use TPS63020 instead
Power TCPC chip first
AP22814: Ilimit=3.45A
AP22804: Ilimit=3.00A (drop-in)
1.8V/600mA
SW4A of PF4210 is 1.8V but SoM doesn't bring it out
Buck instead of TLV70218 LDO saving up to ~100mW loss
LM3670MF-1.8 is much more expensive
ST1S12G18R is a drop-in
Worst-case current draw:
Camera =140mA
USB Switch=113mA
Audio Codec=12mA
Level Shifters=1.5mA
Display=?mA
Remaining≅333.5mA
5.0V/3.8A
If using fixed MIC2876-5.0 then short FB-VOUT resistor open FB-GND resistor
These three caps close to AP22814
~30ms until EN is HIGH
AP22814: Ilimit=3.45A
AP22804: Ilimit=3.00A (drop-in)
Cheaper, more efficient, smaller, and simpler than RT6150A
Explicitly mentions USB/smartphone application
22.4V/40mA
Optional: if PWR_EN == LOW set PWM = LOW (0% duty)
Reference: https://www.diodes.com/assets/Evaluation-Boards/PAM2841-User-Guide.pdf
(brochure lists backlight as an application)
Spread all the decoupling/stitching capacitors all over the power plane
2.8V/150mA
0.5V drop
GNU GPLv3
Copyright 2018
Purism SPC
Sheet: /Power/
File: power.sch
Title: Power
Size: A4
Date: 2018-06-07
Rev: v0.1.0
KiCad E.D.A. kicad 4.0.6
Id: 4/24





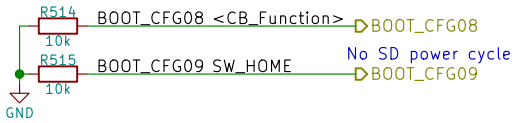
2–>1: eMMC
2–>3: USB (Serial Downloader)

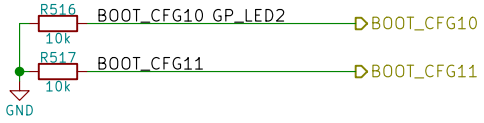
BOOT_MODE[1:0]	Boot Type
00	Boot From Fuses
01	Serial Downloader
10	Internal Boot
11	Reserved

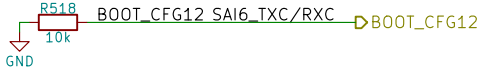
Only eMMC

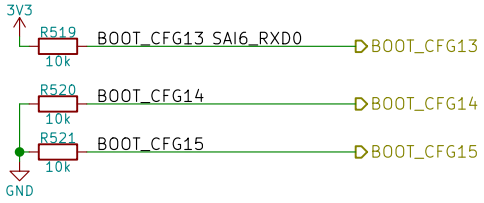
BOOT_CFG[14:12]	Boot device
001	SD/eSD
010	MMC/eMMC
011	NAND

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





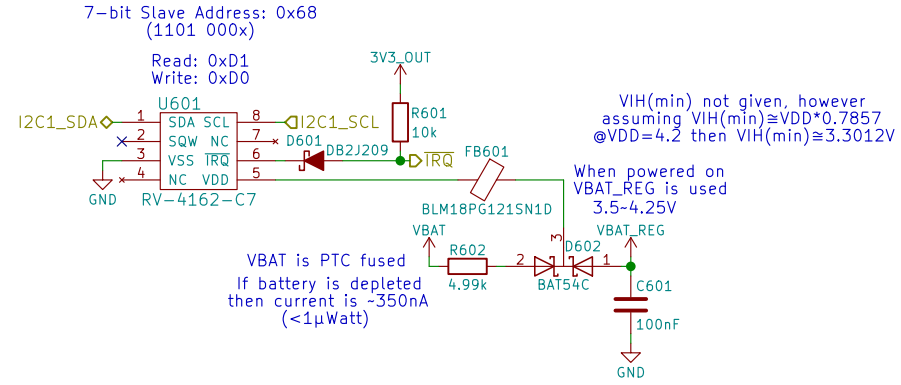




Sheet: /Boot Config/
File: boot.sch

Title: Boot Configuration

Size: A4	Date: 2018–06–07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 5/24



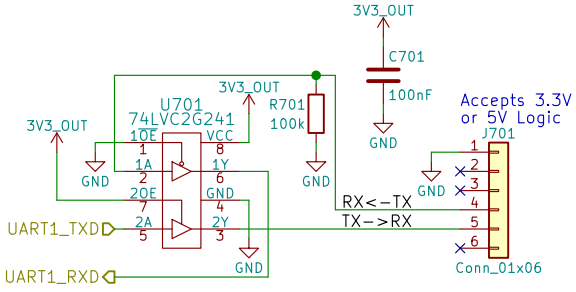
Note:
Datasheet says slave address is 0xD0
with a R/W bit appended, since 0xD must
be 4-bits wide the actual 7-bit address is
0x68 (110 1000), and becomes 0xD0 during a
write operation (1101 0000)

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

Sheet: /RTC/
File: rtc.sch

Title: RTC

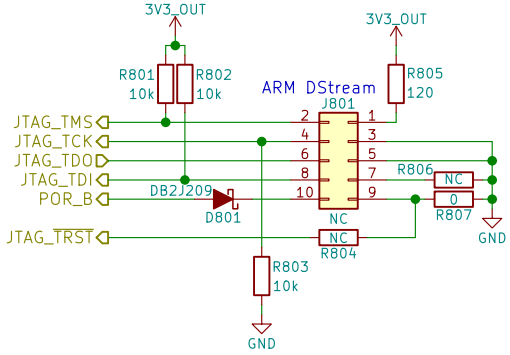
Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 6/24



Sheet: /UART Debug/
File: uart.sch

Title: UART Debug

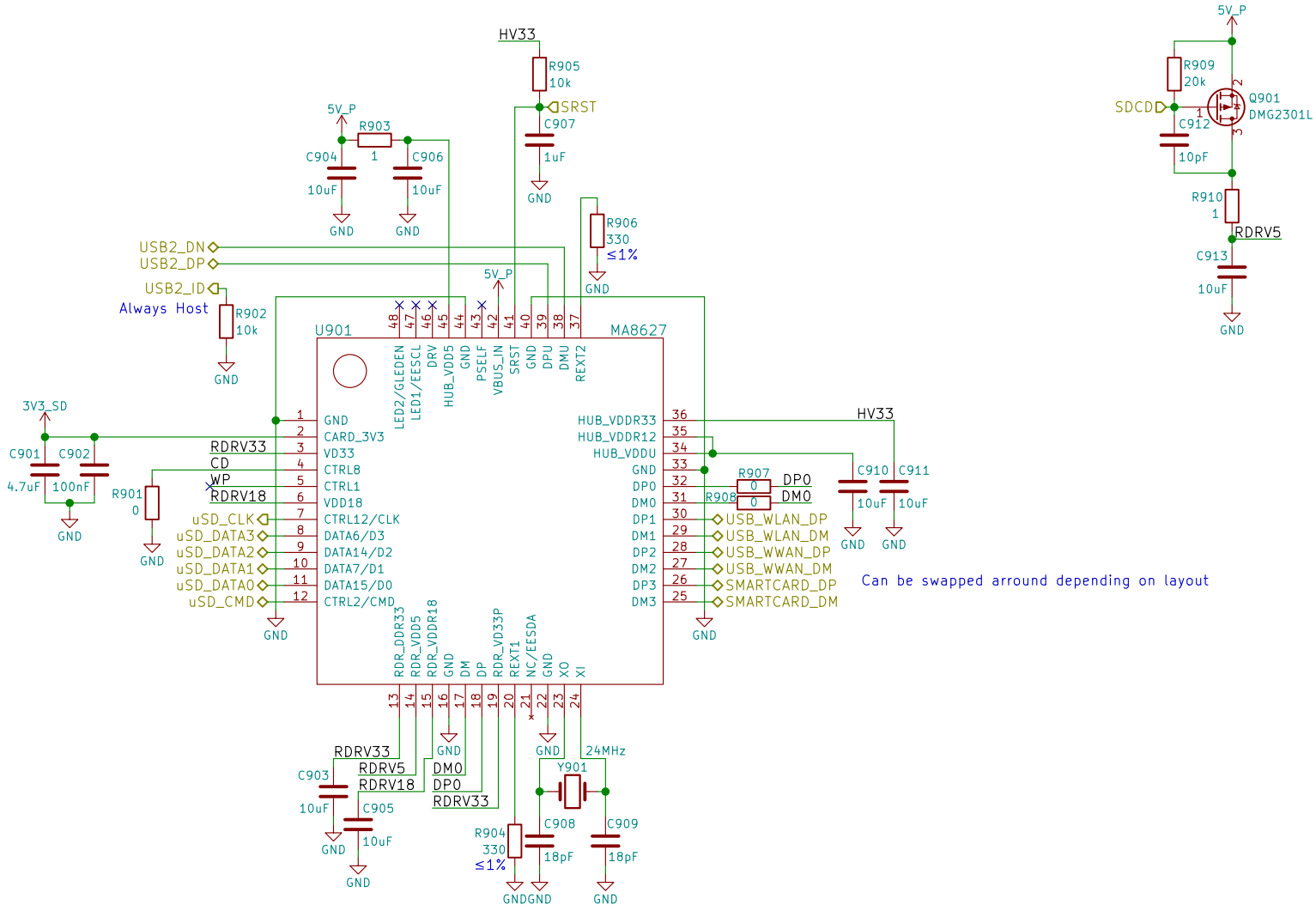
Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 7/24



Sheet: /JTAG/
File: jtag.sch

Title: JTAG

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 8/24

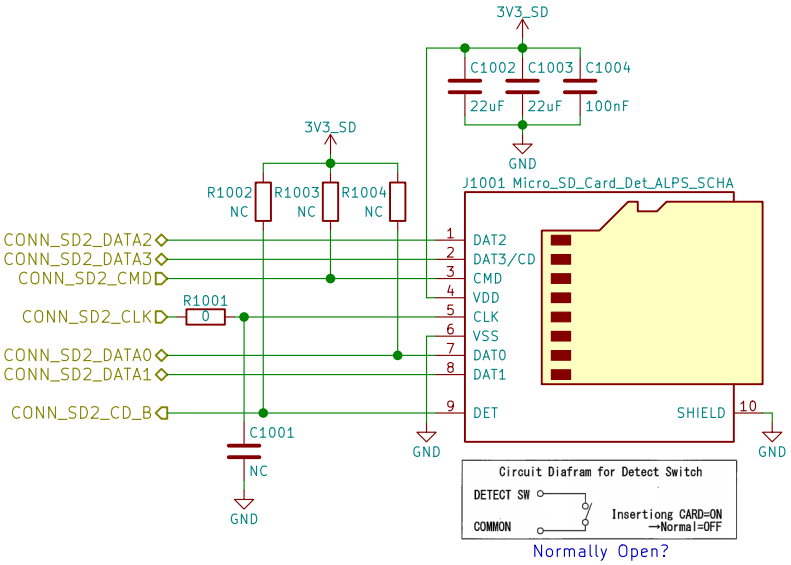


GNU GPLv3
Copyright 2018
Purism SPC

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

Title: USB Hub + SDIO Bridge

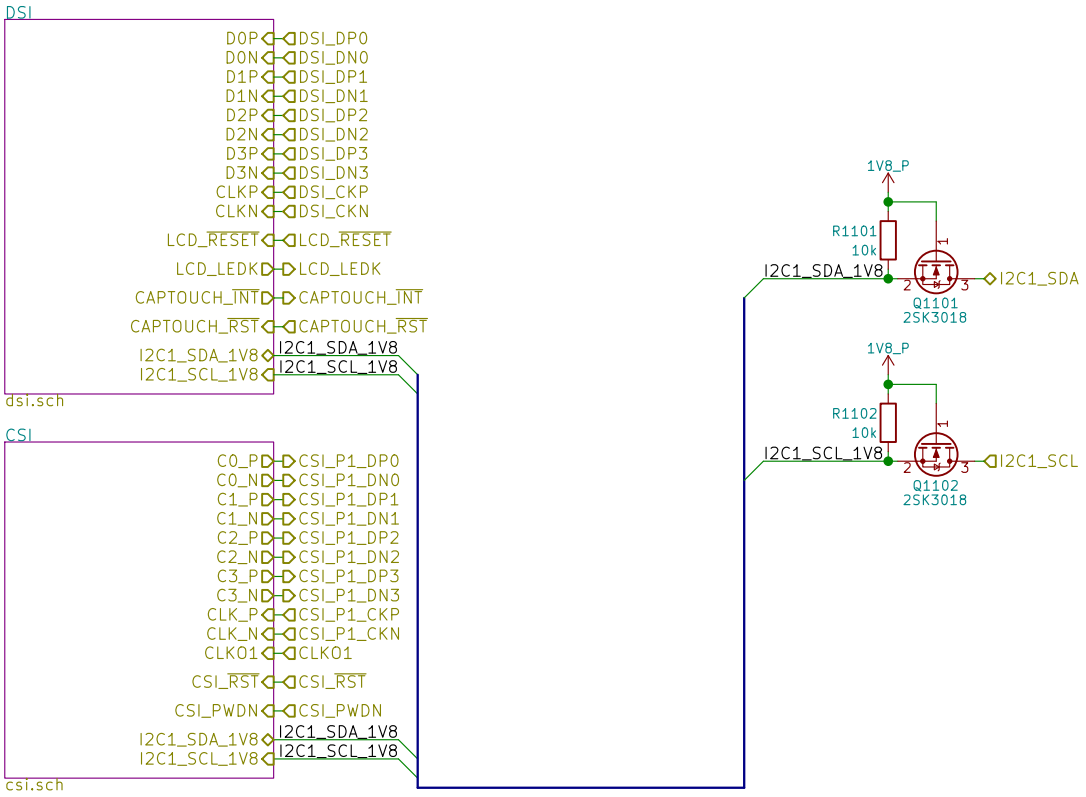
Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 9/24



Sheet: /uSD Card/
File: sd.sch

Title: uSD Card

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 10/24



Sheet: /MIPI/
File: mipi.sch

Title: MIPI

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 11/24

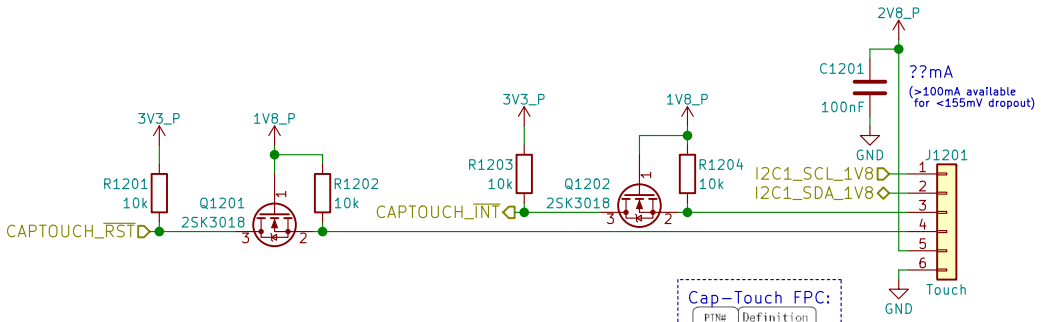
LCD PN:
Shenzhen Jinghong Electronics Co., Ltd.
JH057N00900

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



Cap-Touch FPC:

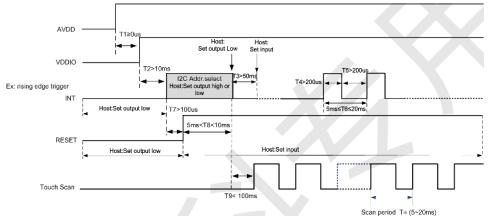
PIN#	Definition
1	SCL
2	SDA
3	INT
4	RESET
5	VDD2.85
6	GND

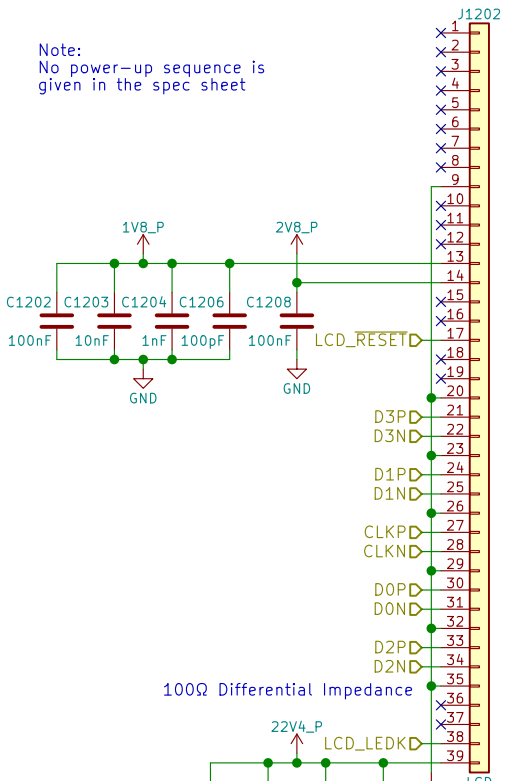
Front: Back:

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:

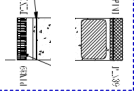
INT	7-Bit Address	8-Bit Write Address	8-Bit Read Address
LOW	0x5D	0xBA	0xBB
HIGH	0x14	0x28	0x29

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





DSI FPC:
Front: Back:



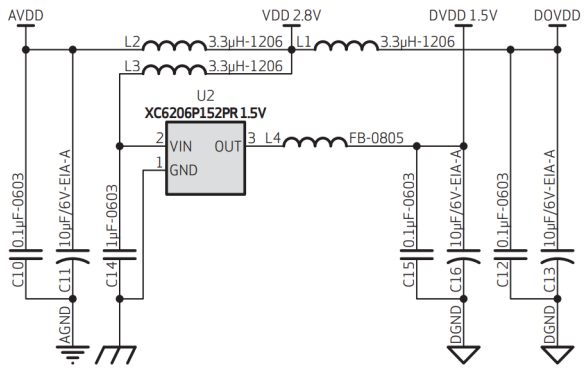
Backlight Array:

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

Title: MIPI DSI

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 12/24

Using Internal DVDD 1.5V Regulator:



2.7 POWER UP SEQUENCE

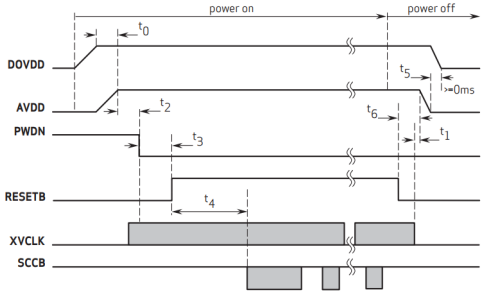
Based on the system power configuration (1.8V or 2.8V for I/O power, using external DVDD or internal DVDD, requiring access to the I2C during power up period or not), the power up sequence will differ. If 1.8V is used for I/O power, using the internal DVDD is preferred. If 2.8V is used for I/O power, 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:

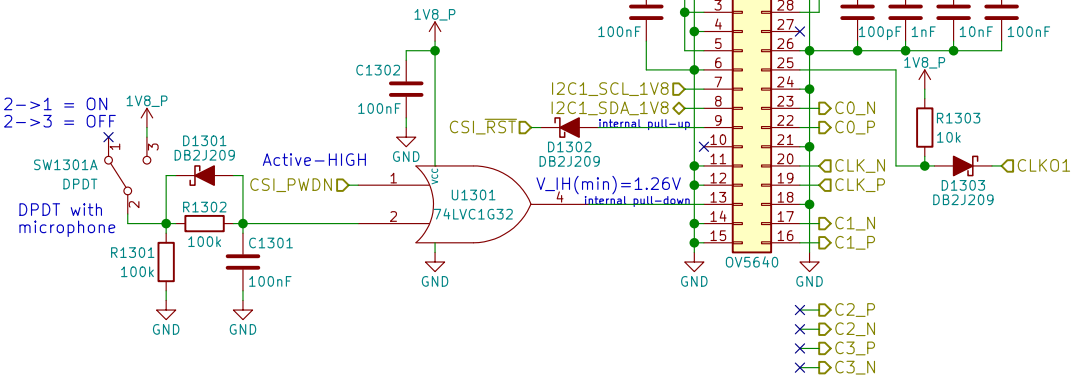
1. when DOVDD and AVDD are turned ON, make sure DOVDD becomes stable before AVDD becomes stable
2. PWDN is active high with an asynchronized design (does not need clock)
3. PWDN pin tied to digital ground if it is not controlled.
4. if PWDN pin is controlled as below, for PWDN to go low, power must first 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



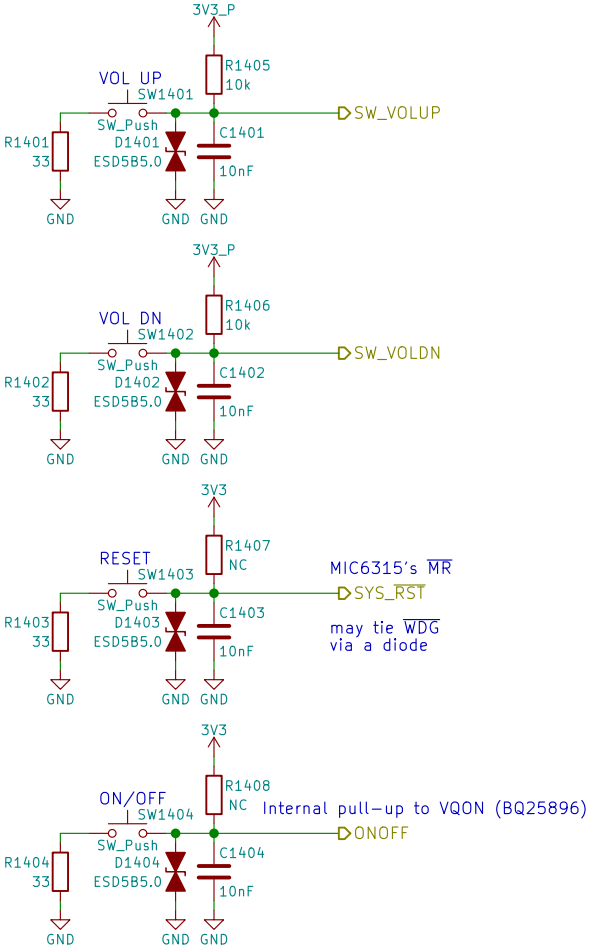
Camera PN:
Truly CO8725-B5SA-E

7-bit Slave Address: 0x78
(1111 000x)

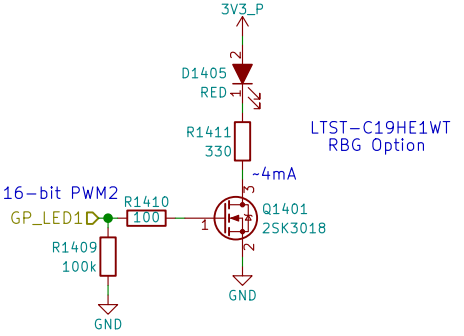
Read: 0xF1
Write 0xF0

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

Sheet: /MIPI/CSI/		
File: csi.sch		
Title: MIPI CSI		
Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 13/24



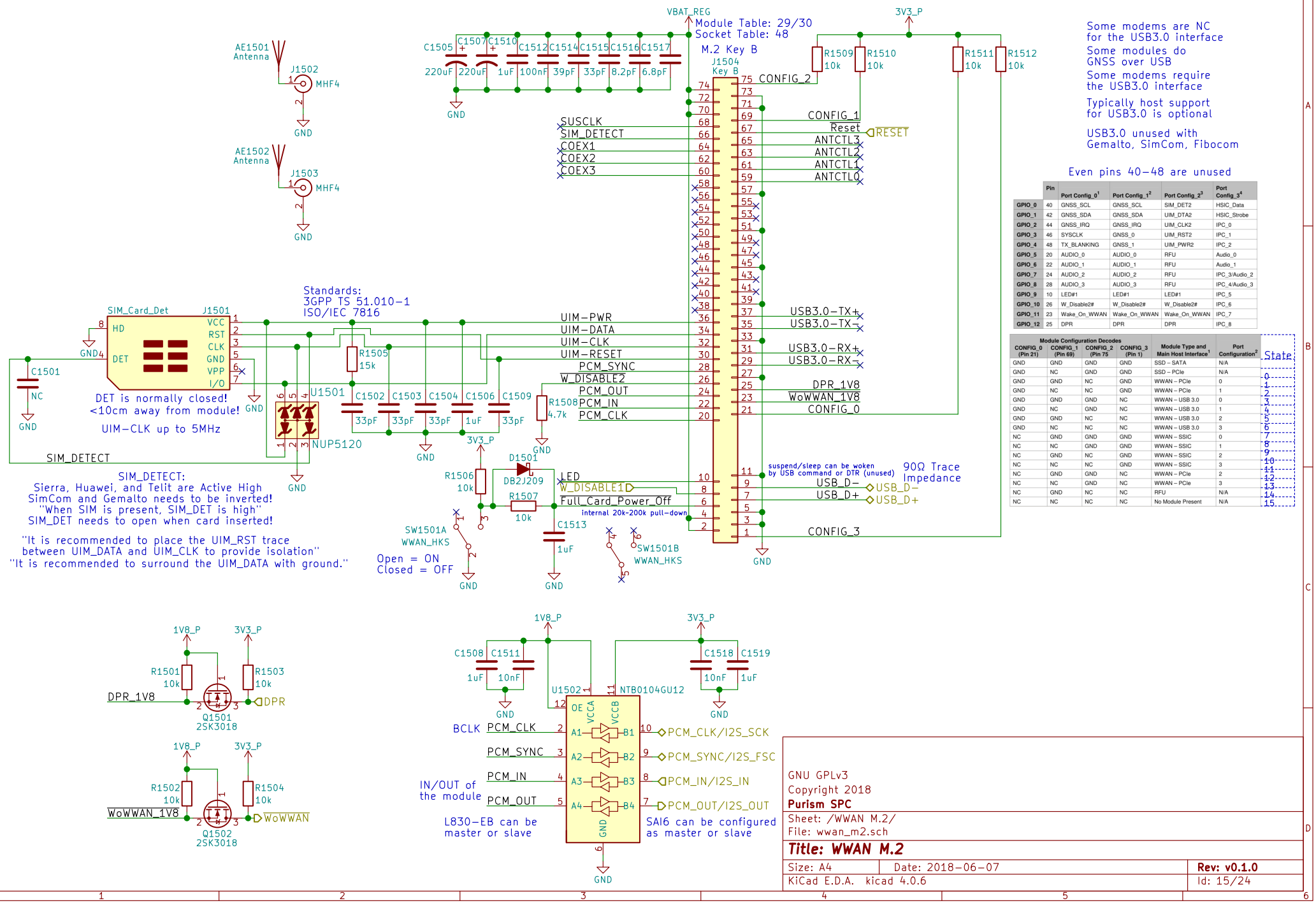
Use PWM2_PWMSAR to set the compare value (duty cycle)
Use PWM2_PWMCR[15:4] to set the PRESCALER (frequency)
Use PWM2_PWMPR to set the top of the counter (frequency)



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

Title: Buttons & LED

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 14/24


AE1501
Antenna
J1502
MHF4
GND
AE1502
Antenna
J1503
MHF4
GND
VBAT_REG
Module Table: 29/30
Socket Table: 48
M.2 Key B
J1504
Key B
C1505 220uF
C1507 220uF
C1510
C1512 1uF
C1514 100nF
C1515 39pF
C1516 33pF
C1517 8.2pF
6.8pF
3V3_P
R1509 10k
R1510 10k
R1511 10k
R1512 10k
CONFIG_2
CONFIG_1
Reset
RESET
SUSCLK
SIM_DETECT
COEX1
COEX2
COEX3
ANTCTL3
ANTCTL2
ANTCTL1
ANTCTL0
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
Standards:
3GPP TS 51.010-1
ISO/IEC 7816
SIM_Card_Det
J1501
HD
DET
VCC
RST
CLK
GND
VPP
I/O
C1501
NC
GND
R1505 15k
U1501
NUP5120
C1502 33pF
C1503 33pF
C1504 33pF
C1506 1uF
C1509 33pF
R1508 4.7k
UIM-PWR
UIM-DATA
UIM-CLK
UIM-RESET
PCM_SYNC
W_DISABLE2
PCM_OUT
PCM_IN
PCM_CLK
USB3.0-TX+
USB3.0-TX-
USB3.0-RX+
USB3.0-RX-
DPR_1V8
WoWWAN_1V8
CONFIG_0
CONFIG_3
DET is normally closed!
<10cm away from module!
UIM-CLK up to 5MHz
SIM_DETECT
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."
R1506 10k
D1501
DB2J209
LED
R1507 10k
W_DISABLE1
Full_Card_Power_Off
internal 20k-200k pull-down
C1513 1uF
SW1501A
WWAN_HKS
SW1501B
WWAN_HKS
Open = ON
Closed = OFF
suspend/sleep can be woken
by USB command or DTR (unused)
90Ω Trace
Impedance
USB_D-
USB_D+
Module Configuration Decodes
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]
State
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
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
1V8_P
3V3_P
R1501 10k
R1503 10k
DPR_1V8
DPR
Q1501
2SK3018
R1502 10k
R1504 10k
WoWWAN_1V8
WoWWAN
Q1502
2SK3018
C1508 1uF
C1511 10nF
C1518 10nF
C1519 1uF
U1502
NTB0104GU12
OE
VCCA
VCCB
GND
BCLK
PCM_CLK
PCM_SYNC
PCM_IN
PCM_OUT
PCM_CLK/I2S_SCK
PCM_SYNC/I2S_FSC
PCM_IN/I2S_IN
PCM_OUT/I2S_OUT
IN/OUT of
the module
L830-EB can be
master or slave
SAI6 can be configured
as master or slave
GNU GPLv3
Copyright 2018
Purism SPC
Sheet: /WWAN M.2/
File: wwan_m2.sch
Title: WWAN M.2
Size: A4
Date: 2018-06-07
Rev: v0.1.0
KiCad E.D.A. kicad 4.0.6
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

7-bit Slave Address: 0x0A
(0001 010x)
Read: 0x15
Write: 0x14

Mute via MUTE_LO=1

may use lineout left channel for pseudo-earpiece speaker

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

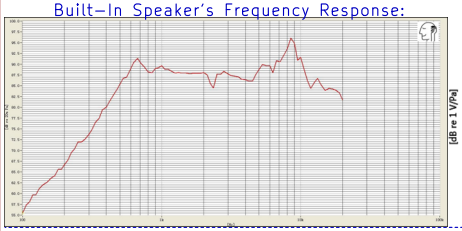
Add TVS next to int-mic?
(OpenMoko does this)

DPDT with camera
5->4 = ON
5->6 = OFF

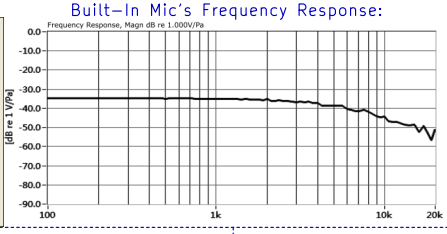
-37dB=14.1254mV/Pa
∴ mic produces 14.1254mVrms when exposed to a 1kHz tone of 94dB-SPL at the capsule (or 19.98mV amplitude)

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

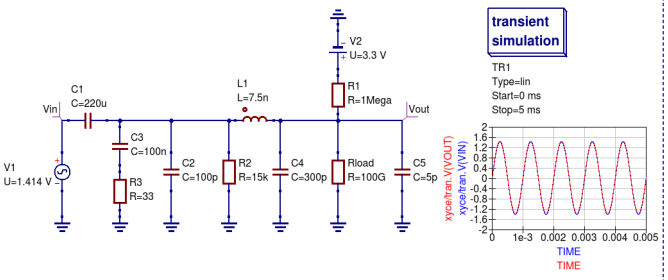
Built-In Speaker's Frequency Response:



Built-In Mic's Frequency Response:



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

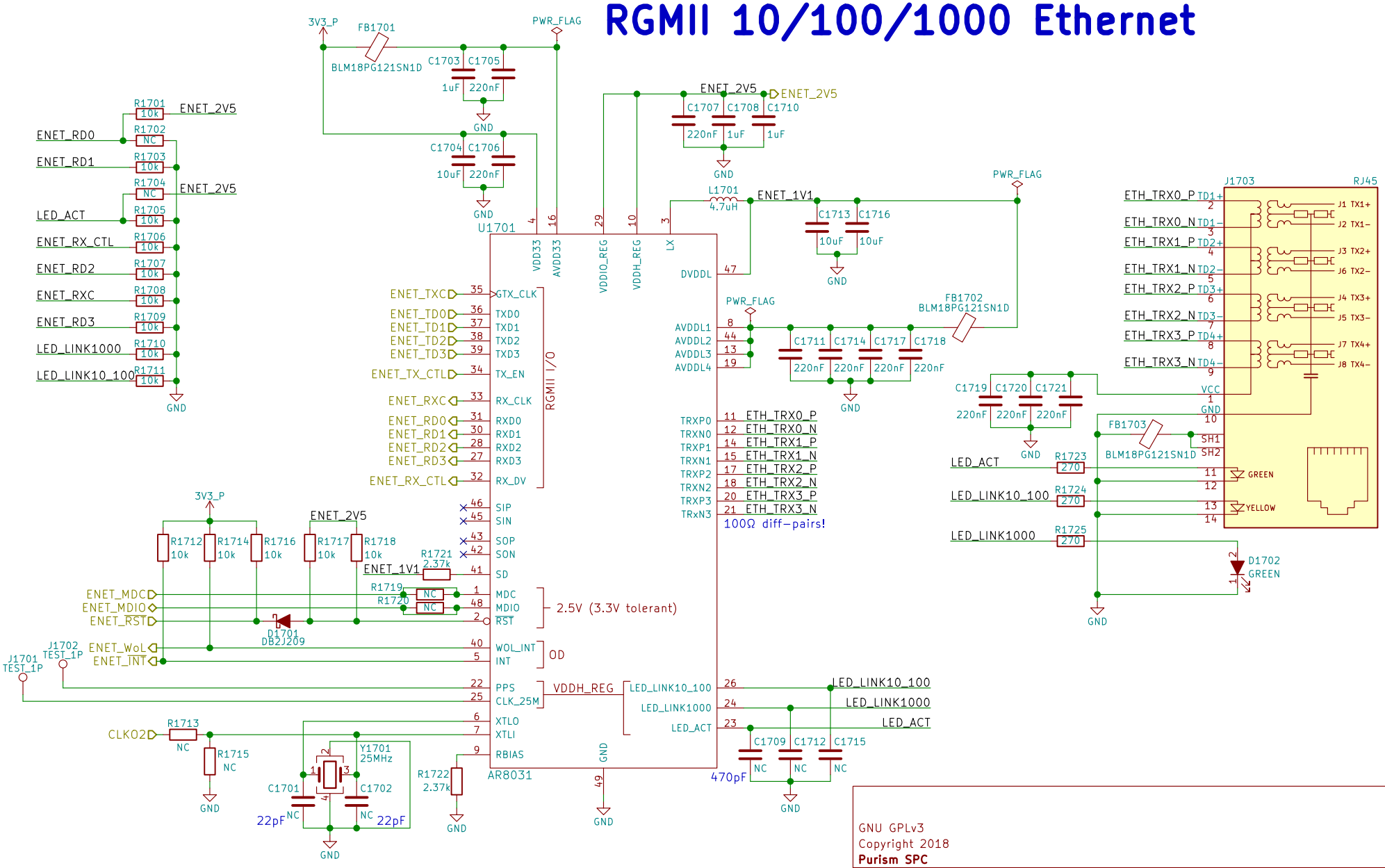


LCR Measurements:

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: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 16/24

RGMII 10/100/1000 Ethernet



Sheet: /Ethernet/
File: ethernet.sch

Title: Ethernet

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		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

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

M.2 Key E

SoC's IN/OUT

SoC's RX
Module's TX

SoC's TX
Module's RX

VIH=2.31V

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

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

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

Pin 54 on RS9116 is
USB_VBUS Sink

RS9116 SUSCLK
is a GPIO (unused)

Open = ON
Closed = OFF

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

RS9116 does not
use RTX & CTS

internal 10k pull-up

RX, TX, RTS, CTS
of the SoC

configure as slave

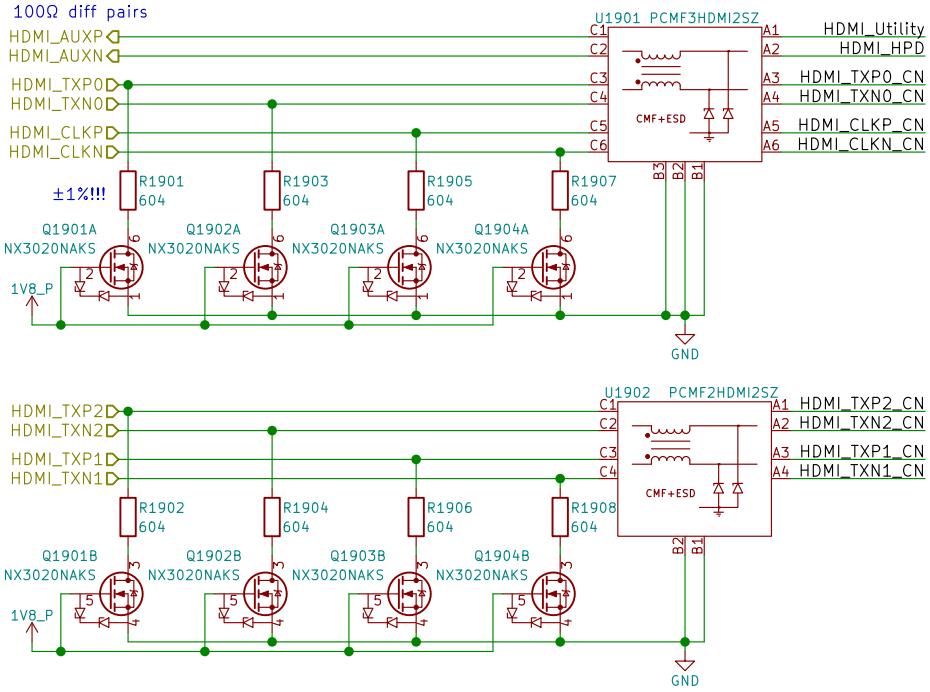
IN, OUT
of the SoC

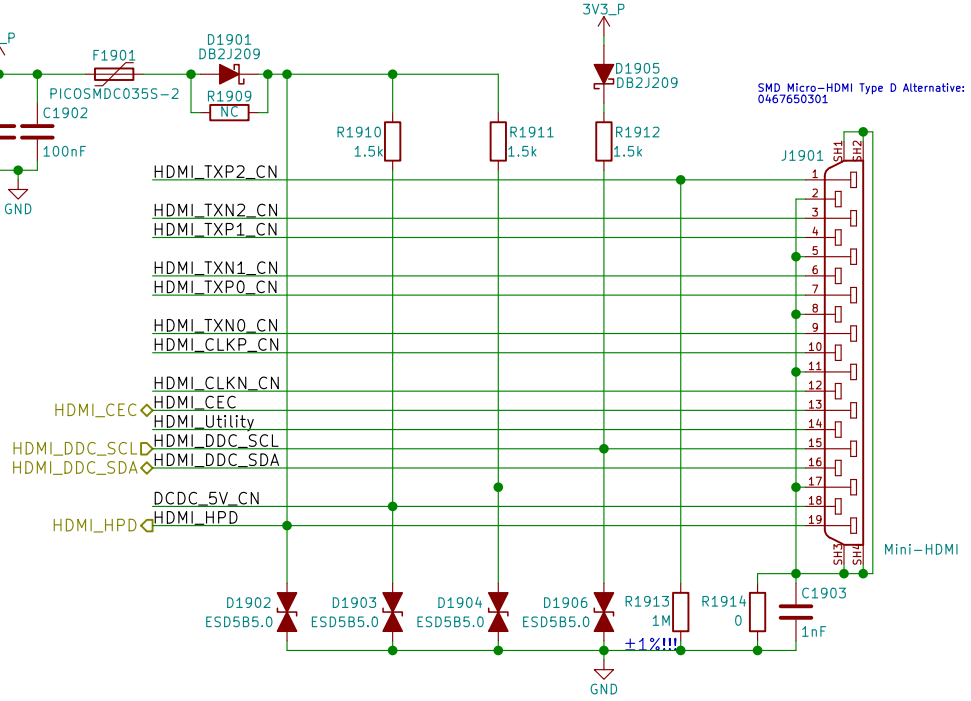
Sheet: /WLAN+BT M.2/	
File: wifi_bt_m2.sch	
Title: WLAN+BT M.2	
Size: A4	Date: 2018-06-07
KiCad E.D.A. kicad 4.0.6	**Rev: v0.1.0**
	Id: 18/24

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



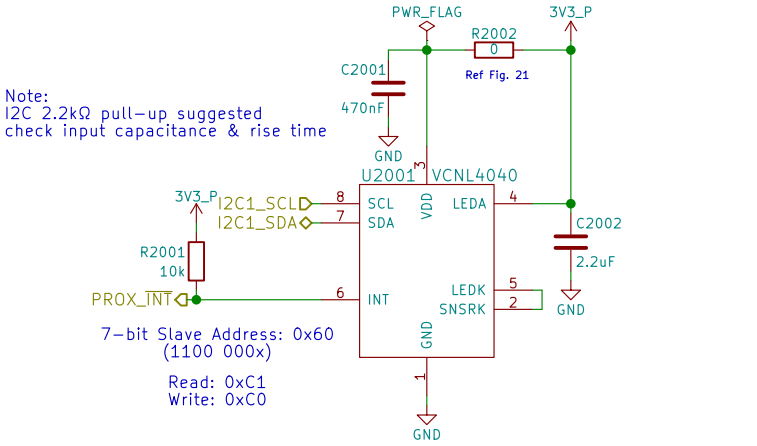


Sheet: /HDMI/
File: hdmi.sch

Title: HDMI

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 19/24

Proximity & Ambient Light



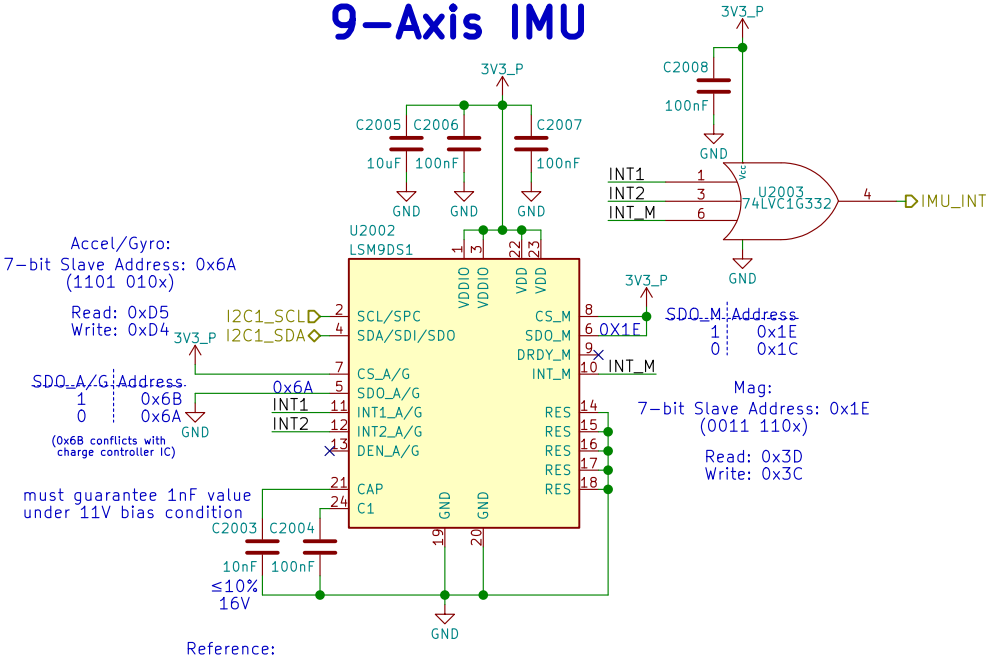
Note:
I2C 2.2kΩ pull-up suggested
check input capacitance & rise time

7-bit Slave Address: 0x60
(1100 000x)

Read: 0xC1
Write: 0xC0

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

9-Axis IMU



Accel/Gyro:
7-bit Slave Address: 0x6A
(1101 010x)

Read: 0xD5
Write: 0xD4

must guarantee 1nF value
under 11V bias condition
≤10%
16V

Mag:
7-bit Slave Address: 0x1E
(0011 110x)

Read: 0x3D
Write: 0x3C

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

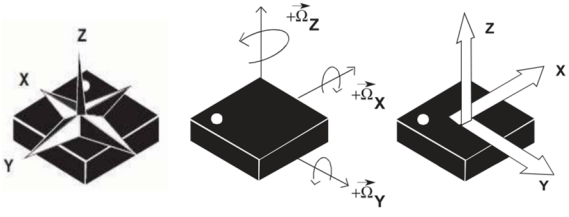


Table 19. Accelerometer and gyroscope SAD+Read/Write patterns

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)

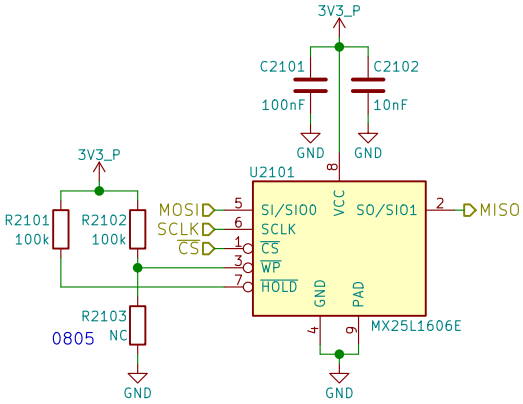
Table 20. Magnetic sensor SAD+Read/Write patterns

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

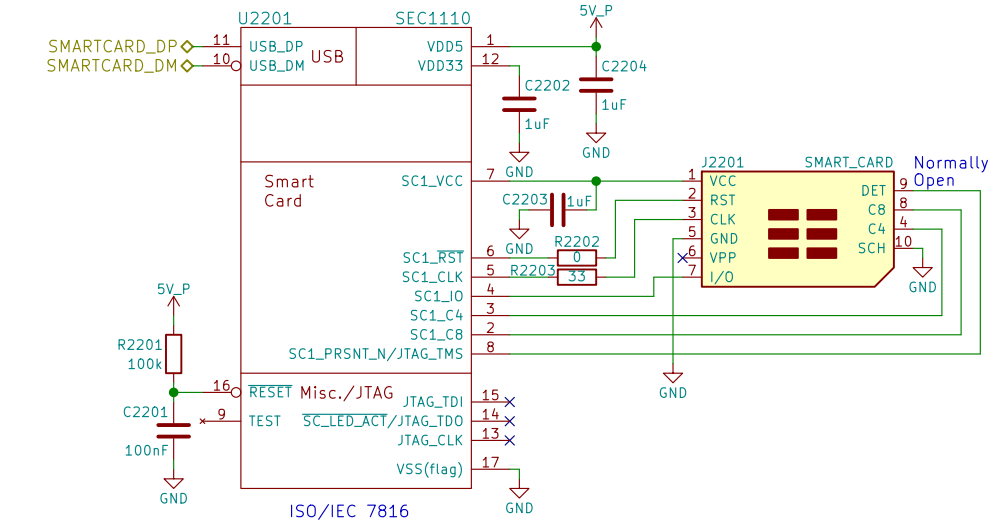
Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 20/24



Sheet: /SPI Flash/
File: flash.sch

Title: SPI NOR Flash

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 21/24

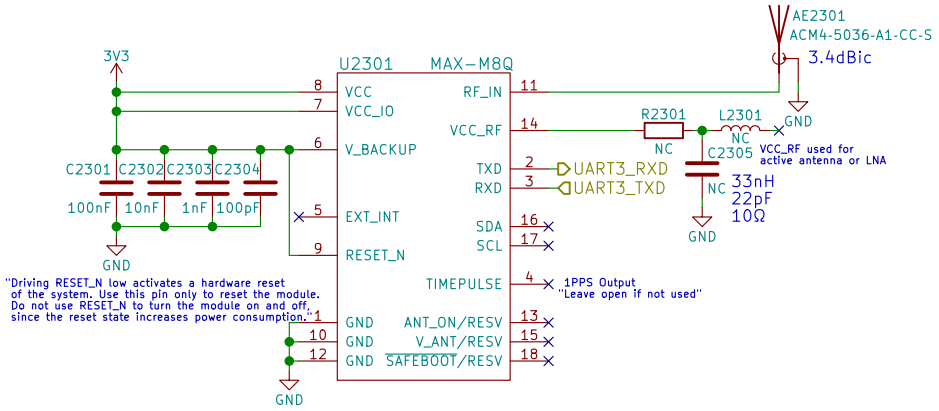


Reference:
http://www.microchip.com/DevelopmentTools/ProductDetails.aspx?PartNO=EVB-SEC1110

Sheet: /Smart Card/
File: smartcard.sch

Title: Smart Card

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		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

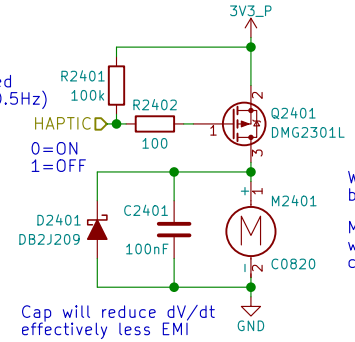
Title: GNSS

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		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 Boom Precision
connector installed (by request)!

Cap will reduce dV/dt
effectively less EMI

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

Sheet: /Haptic Motor/
File: haptic.sch

Title: Haptic/Vibration Motor

Size: A4	Date: 2018-06-07	**Rev: v0.1.0**
KiCad E.D.A. kicad 4.0.6		Id: 24/24