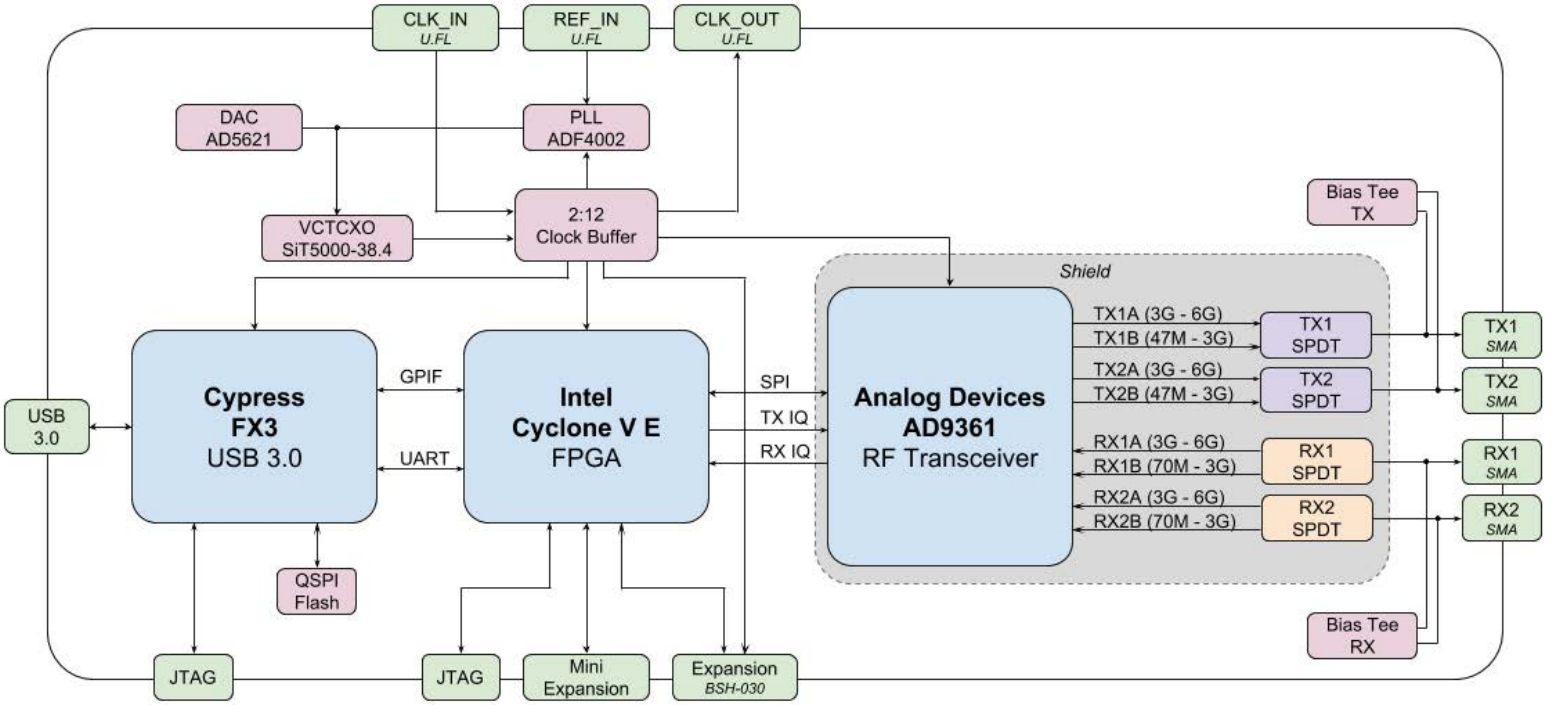
bladeRF micro – USB 3.0 Software Defined Radio



MOUNTING HOLES - 80 mil holes
120 annular ring
To be placed in each corner of board

MH1 MH2 MH3 MH4

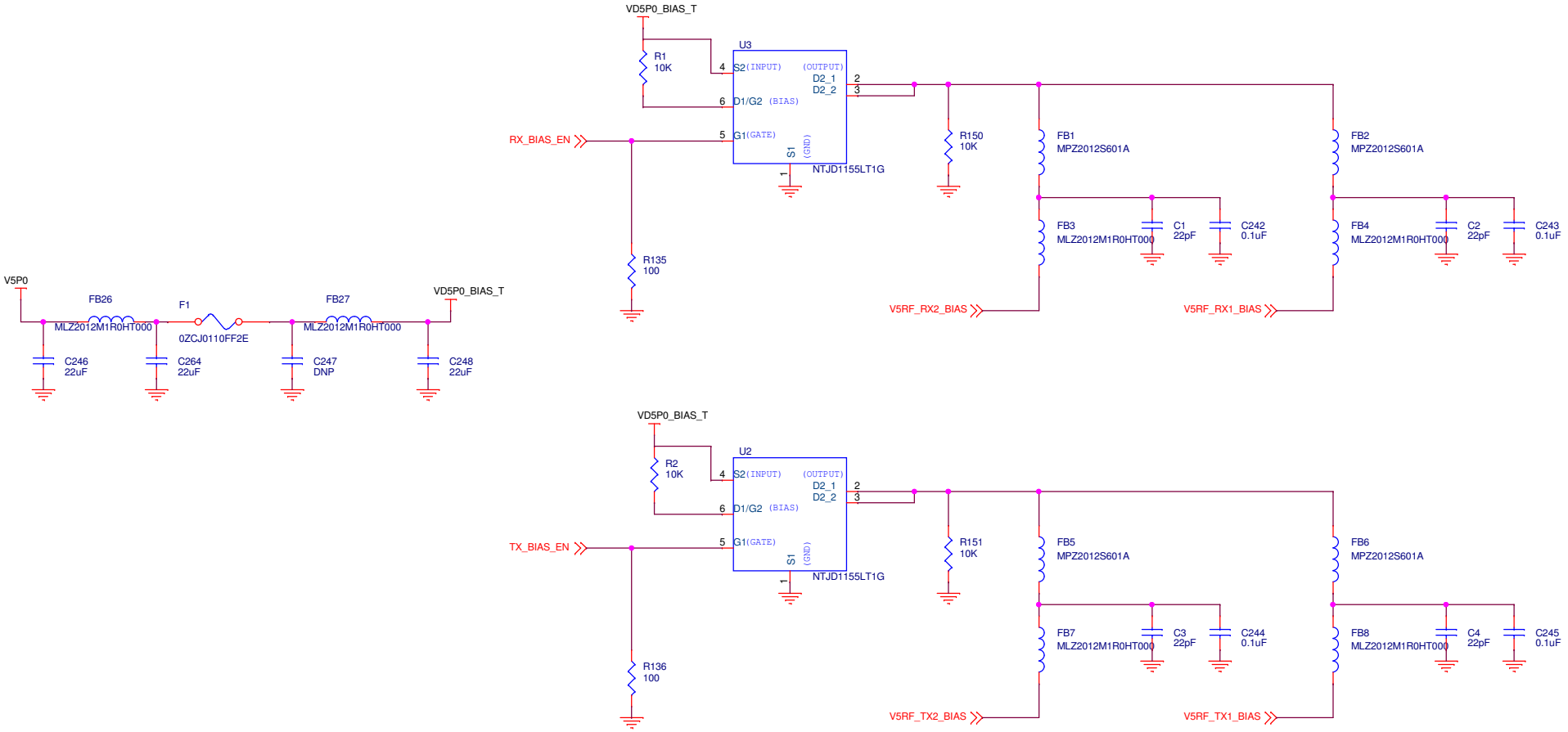
Scatter these testpoints throughout the design.
Testpoints will be PTH

TP23 TP39

nuand

Title: Nuand		
Size: B	Document Number	Rev: A
Date:	Sheet 1 of 17	

RF SMA BIAS TEE



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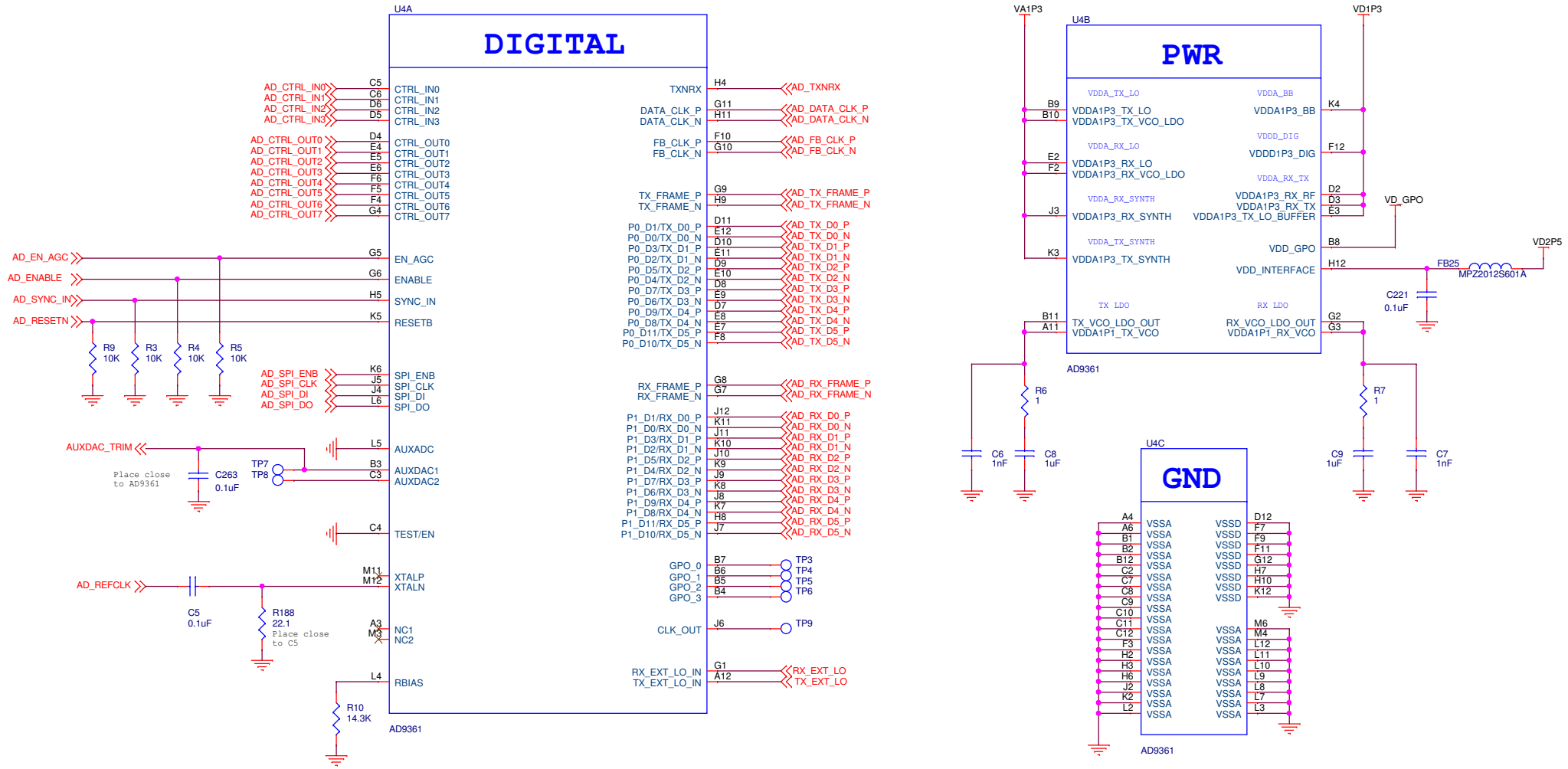
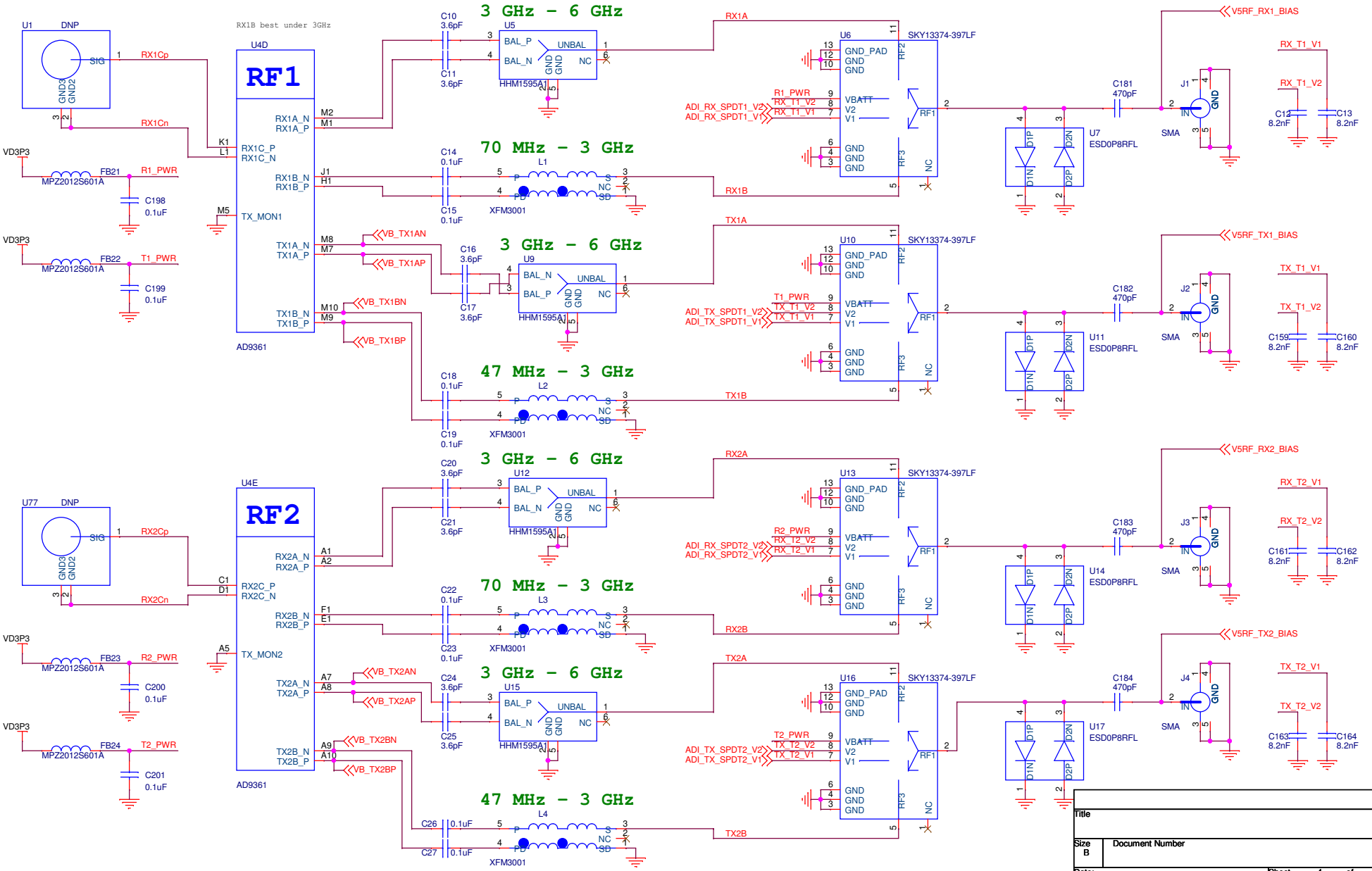
Size: B	Document Number	Rev: A
Date:	Sheet 2 of 17	

AD9361 - Digital



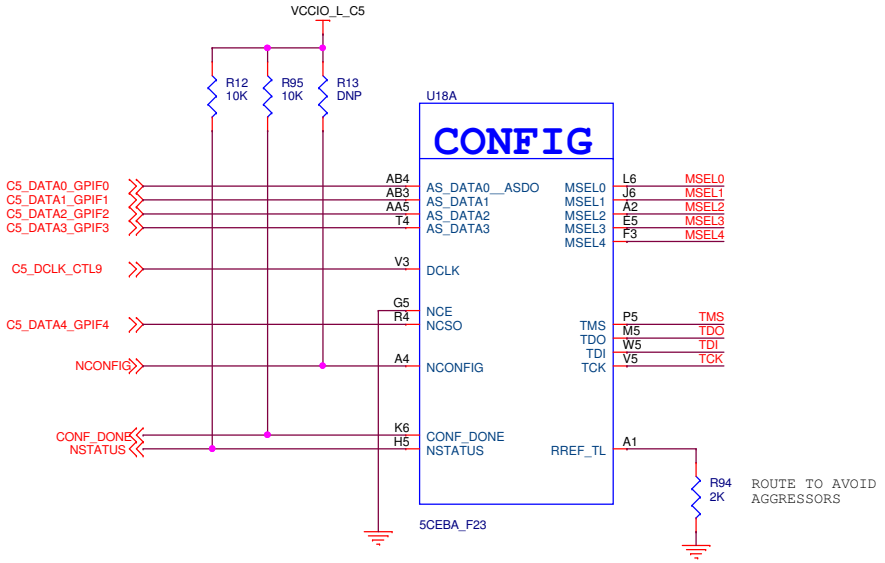
Title	Nuand	
Size B	Document Number	Rev A
Date:	Sheet 3 of 17	

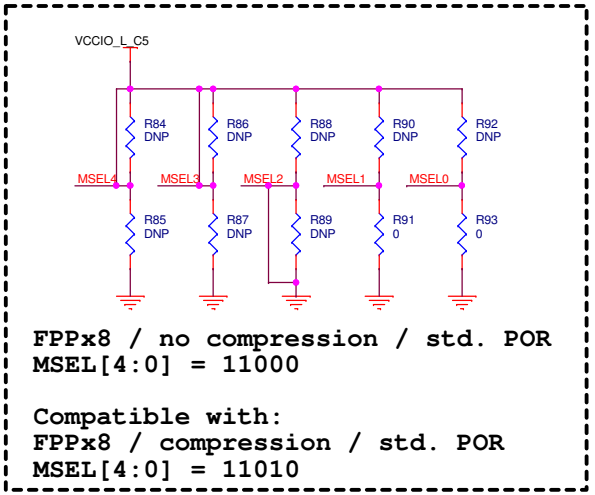
AD9361 – 2x2 MIMO RF (47MHz – 6GHz)

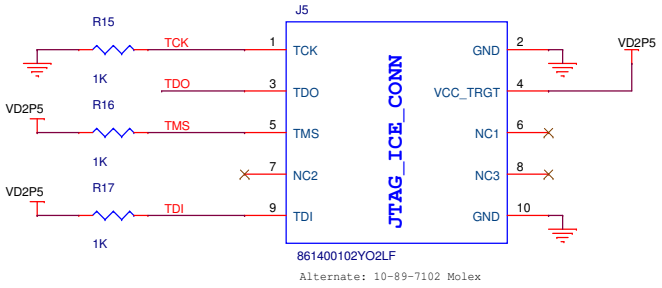


Title			
Size B	Document Number		Rev
Date:		Sheet 4 of 17	

CYCLONE V - CONFIGURATION







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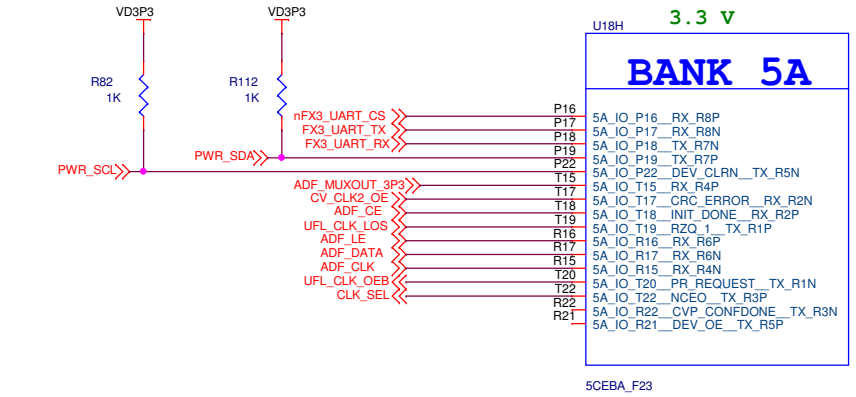
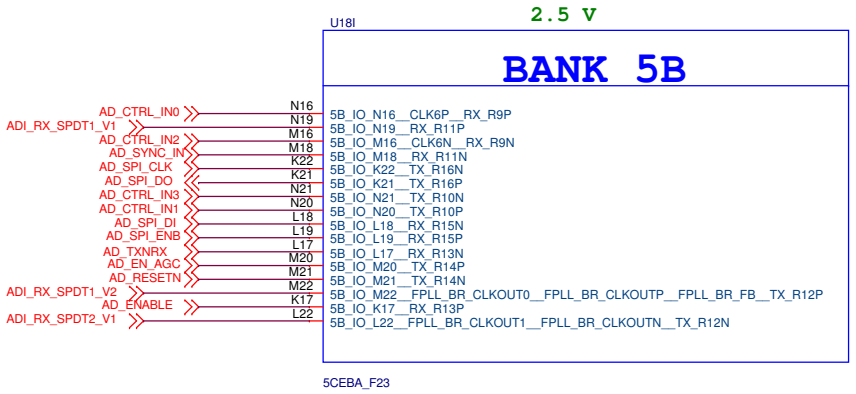
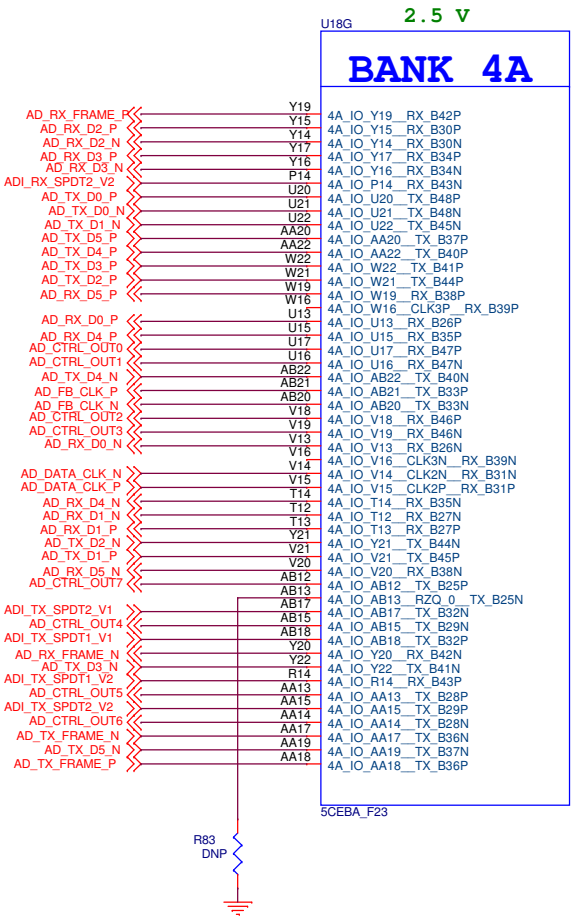
Size B	Document Number	Rev A
Date:	Sheet 5 of 17	

CYCLONE V – BANKS 4A / 5A / 5B







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Size: B	Document Number	Rev: A
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CYCLONE V – BANKS 3A / 3B / 7A / 8A / EXPANSION

XB_VCCIO (3.3 V / 2.5 V / 1.8 V)

U18K

BANK 8A

XB_GPIO13_E2F_6P	G6	8A_IO_G6__RX_T39P
XB_GPIO30_CLK_F2E_N	G8	8A_IO_G8__FPLL_TL_CLKOUT1__FPLL_TL_CLKOUTN__TX_T28N
XB_GPIO15_CLK_E2F_P	G10	8A_IO_G10__CLK9P__RX_T25P
XB_GPIO29_F2E_6P	F7	8A_IO_F7__TX_T40P
XB_GPIO6_E2F_3N	F9	8A_IO_F9__CLK8N__FPLL_TL_FBN__RX_T33N
XB_GPIO17_F2E_0P	L7	8A_IO_L7__TX_T26P
XB_GPIO11_E2F_5P	E9	8A_IO_E9__RX_T37P
XB_GPIO28_F2E_6N	E7	8A_IO_E7__TX_T40N
XB_GPIO14_CLK_E2F_N	F10	8A_IO_F10__CLK9N__RX_T25N
XB_GPIO16_F2E_0N	K7	8A_IO_K7__TX_T26N
XB_GPIO7_E2F_3P	E10	8A_IO_E10__CLK8P__FPLL_TL_FBP__RX_T33P
XB_GPIO10_E2F_5N	D9	8A_IO_D9__RX_T37N
XB_GPIO24_F2E_4N	D6	8A_IO_D6__TX_T36N
XB_GPIO27_F2E_5P	D7	8A_IO_D7__TX_T38P
XB_GPIO0_E2F_0N	J8	8A_IO_J8__RX_T27N
XB_GPIO3_E2F_1P	J9	8A_IO_J9__RX_T29P
XB_GPIO1_E2F_0P	J7	8A_IO_J7__RX_T27P
XB_GPIO4_E2F_2N	C9	8A_IO_C9__RX_T31N
XB_GPIO26_F2E_5N	C8	8A_IO_C8__TX_T38N
XB_GPIO25_F2E_4P	C6	8A_IO_C6__TX_T36P
XB_GPIO20_F2E_2N	B5	8A_IO_B5__TX_T32N
XB_GPIO23_F2E_3P	B6	8A_IO_B6__TX_T34P
XB_GPIO22_F2E_3N	B7	8A_IO_B7__TX_T34N
XB_GPIO31_CLK_F2E_P	H8	8A_IO_H8__FPLL_TL_CLKOUT0__FPLL_TL_CLKOUTP__FPLL_TL_FB__TX_T28P
XB_GPIO12_E2F_6N	H9	8A_IO_H9__RX_T29N
XB_GPIO9_E2F_4P	H6	8A_IO_H6__RX_T39N
XB_GPIO5_E2F_2P	B10	8A_IO_B10__RX_T31P
XB_GPIO19_F2E_1P	A10	8A_IO_A10__TX_T30P
XB_GPIO21_F2E_2P	A5	8A_IO_A5__TX_T32P
XB_GPIO8_E2F_4N	A7	8A_IO_A7__RX_T35N
XB_GPIO18_F2E_1N	A9	8A_IO_A9__TX_T30N
XB_GPIO9_E2F_4P	A8	8A_IO_A8__RX_T35P

5CEBA_F23

1.8 V

U18F

BANK 3B

	Y11	3B_IO_Y11__TX_B24N
FX3_CTL11	Y10	3B_IO_Y10__TX_B17N
GPIF31	M9	3B_IO_M9__CLK0P__FPLL_BL_FBP__RX_B15P
GPIF29	M8	3B_IO_M8__CLK0N__FPLL_BL_FBN__RX_B15N
GPIF27	P12	3B_IO_P12__TX_B20P
FX3_CTL5	AB5	3B_IO_AB5__TX_B9P
C5_DATA1_GPIF1	AB6	3B_IO_AB6__TX_B9N
C5_DATA0_GPIF0	AB7	3B_IO_AB7__TX_B12P
GPIF22	AB8	3B_IO_AB8__TX_B13P
GPIF25	Y9	3B_IO_Y9__TX_B17P
FX3_CTL0	R9	3B_IO_R9__RX_B18P
FX3_CTL1	U12	3B_IO_U12__RX_B19P
FX3_CTL4	U11	3B_IO_U11__RX_B19N
FX3_CTL2	U10	3B_IO_U10__RX_B14P
GPIF26	V10	3B_IO_V10__RX_B10P
GPIF19	AA7	3B_IO_AA7__TX_B12N
C5_DATA2_GPIF2	T10	3B_IO_T10__RX_B18N
	P8	3B_IO_P8__RX_B11N
GPIF20	P9	3B_IO_P9__CLK1N__RX_B23N
FX3_CTL10	AB10	3B_IO_AB10__FPLL_BL_CLKOUT1__FPLL_BL_CLKOUTN__TX_B21N
FX3_CTL6	AB11	3B_IO_AB11__FPLL_BL_CLKOUT0__FPLL_BL_CLKOUTP__FPLL_BL_FB__TX_B21P
FX3_CTL8	V9	3B_IO_V9__RX_B10N
GPIF18	R12	3B_IO_R12__TX_B20N
FX3_CTL3	R10	3B_IO_R10__RX_B22N
FX3_CTL7	R11	3B_IO_R11__RX_B22P
PWR_STAT	N8	3B_IO_N8__RX_B11P
GPIF21	N9	3B_IO_N9__CLK1P__RX_B23P
FX3_PCLK	AA10	3B_IO_AA10__TX_B16N
GPIF28	AA12	3B_IO_AA12__TX_B24P
FX3_CTL12	T9	3B_IO_T9__RX_B14N
GPIF24	AA9	3B_IO_AA9__TX_B16P
GPIF30	AA8	3B_IO_AA8__TX_B13N
GPIF23		

5CEBA_F23

XB_VCCIO (3.3 V / 2.5 V / 1.8 V)

U18J

BANK 7A

	H18	7A_IO_H18__RX_T5N
	H10	7A_IO_H10__TX_T16N
	H11	7A_IO_H11__RX_T21P
DAC_SDIN	H13	7A_IO_H13__CLK10P__RX_T17P
CV_CLK2	H14	7A_IO_H14__RX_T13P
MINI_EXP_2	H15	7A_IO_H15__CLK11N__RX_T9N
MINI_EXP_1	H16	7A_IO_H16__CLK11P__RX_T9P
	G18	7A_IO_G18__RX_T5P
	G17	7A_IO_G17__TX_T4P
	G16	7A_IO_G16__TX_T4N
XB_PRESENT	G15	7A_IO_G15__TX_T12P
	G13	7A_IO_G13__CLK10N__RX_T17N
DAC_NSYNC	G12	7A_IO_G12__RX_T21N
	G11	7A_IO_G11__TX_T18P
	L8	7A_IO_L8__TX_T22P
	F12	7A_IO_F12__TX_T18N
	F13	7A_IO_F13__RX_T15N
XB_I2C_SDA	F14	7A_IO_F14__TX_T12N
	F15	7A_IO_F15__RX_T7N
	K9	7A_IO_K9__TX_T22N
HW_REV_0	E12	7A_IO_E12__RX_T23N
HW_REV_1	E15	7A_IO_E15__RX_T7P
	E14	7A_IO_E14__RX_T15P
	E16	7A_IO_E16__RX_T3N
LED3	K20	7A_IO_K20__RX_T1P
	D17	7A_IO_D17__RX_T3P
	K16	7A_IO_K16__TX_T10N
LED1	K19	7A_IO_K19__RX_T1N
SYNC_1P8	C13	7A_IO_C13__RX_T19N
SYNC_1P1	C11	7A_IO_C11__TX_T24P
	C16	7A_IO_C16__TX_T2N
	C15	7A_IO_C15__RX_T11P
XB_CLK_EN	D12	7A_IO_D12__RX_T23P
	D13	7A_IO_D13__RX_T19P
LED2	B16	7A_IO_B16__TX_T2P
XB_I2C_SCL	B15	7A_IO_B15__RX_T11N
	B12	7A_IO_B12__TX_T20P
	B13	7A_IO_B13__TX_T14P
	B11	7A_IO_B11__RZQ_2__TX_T24N
	J18	7A_IO_J18__TX_T6N
	J19	7A_IO_J19__TX_T6P
	J17	7A_IO_J17__TX_T10P
	J13	7A_IO_J13__RX_T13N
RX_BIAS_EN	J11	7A_IO_J11__TX_T16P
	A15	7A_IO_A15__TX_T8P
	A14	7A_IO_A14__TX_T8N
TX_BIAS_EN	A13	7A_IO_A13__TX_T14N
DAC_SCLK	A12	7A_IO_A12__TX_T20N

5CEBA_F23

R97 1K

R98 DNP

1.8 V

U18E

BANK 3A

GPIF17	M7	3A_IO_M7__PR_ERROR__RX_B7P
GPIF15	M6	3A_IO_M6__PR_DONE__RX_B7N
GPIF8	R5	3A_IO_R5__DATA8__RX_B1P
GPIF6	R6	3A_IO_R6__DATA6__RX_B1N
GPIF16	R7	3A_IO_R7__PR_READY__TX_B8N
GPIF11	W9	3A_IO_W9__DATA11__TX_B4P
GPIF9	W8	3A_IO_W8__DATA9__TX_B4N
C5_DATA4_GPIF4	P6	3A_IO_P6__DATA10__RX_B3N
GPIF14	P7	3A_IO_P7__TX_B8P
C5_DCLK_CTL9	V6	3A_IO_V6__DATA15__TX_B6P
GPIF7	U8	3A_IO_U8__DATA7__TX_B2P
GPIF5	U7	3A_IO_U7__DATA5__TX_B2N
C5_DATA3_GPIF3	U6	3A_IO_U6__DATA13__TX_B6N
GPIF10	N6	3A_IO_N6__DATA12__RX_B3P
GPIF13	T8	3A_IO_T8__CLKUSR__RX_B5P
GPIF12	T7	3A_IO_T7__DATA14__RX_B5N

5CEBA_F23

XB_CLK_EN

R187 1K

XB_VCCIO

U74

BSH-030-01-F-D-A

	1	2	XB_CLK_3P3V
RX_EXT_LO	3	4	TX_EXT_LO
XB_I2C_SCL	5	6	XB_PRESENT
XB_I2C_SDA	7	8	XB_CLK_EN
XB_VCCIO_SEL1	9	10	XB_VCCIO_SEL2
XB_GPIO31_CLK_F2E_P	11	12	XB_GPIO15_CLK_E2F_P
XB_GPIO30_CLK_F2E_N	13	14	XB_GPIO14_CLK_E2F_N
	15	16	
XB_GPIO29_F2E_6P	17	18	XB_GPIO13_E2F_6P
XB_GPIO28_F2E_6N	19	20	XB_GPIO12_E2F_6N
	21	22	
XB_GPIO27_F2E_5P	23	24	XB_GPIO11_E2F_5P
XB_GPIO26_F2E_5N	25	26	XB_GPIO10_E2F_5N
	27	28	
XB_GPIO25_F2E_4P	29	30	XB_GPIO9_E2F_4P
XB_GPIO24_F2E_4N	31	32	XB_GPIO8_E2F_4N
	33	34	
XB_GPIO23_F2E_3P	35	36	XB_GPIO7_E2F_3P
XB_GPIO22_F2E_3N	37	38	XB_GPIO6_E2F_3N
	39	40	
XB_GPIO21_F2E_2P	41	42	XB_GPIO5_E2F_2P
XB_GPIO20_F2E_2N	43	44	XB_GPIO4_E2F_2N
	45	46	
XB_GPIO19_F2E_1P	47	48	XB_GPIO3_E2F_1P
XB_GPIO18_F2E_1N	49	50	XB_GPIO2_E2F_1N
	51	52	
XB_GPIO17_F2E_0P	53	54	XB_GPIO1_E2F_0P
XB_GPIO16_F2E_0N	55	56	XB_GPIO0_E2F_0N
V5P0	57	58	V5P0
	59	60	

R143 0

R142 0

J51

4-103321-5

MINI_EXP_1	1
MINI_EXP_2	2
	3

XB_VCCIO

R154 DNP

R155 10K

HW_REV_1

XB_VCCIO

R152 DNP

R153 10K

HW_REV_0

VD3P3

D1 LTST-C190KGKT

R18 820

LED1

D2 LTST-C190KGKT

R19 820

LED2

D3 LTST-C190KGKT

R20 820

LED3

Title			
Size B	Document Number		Rev
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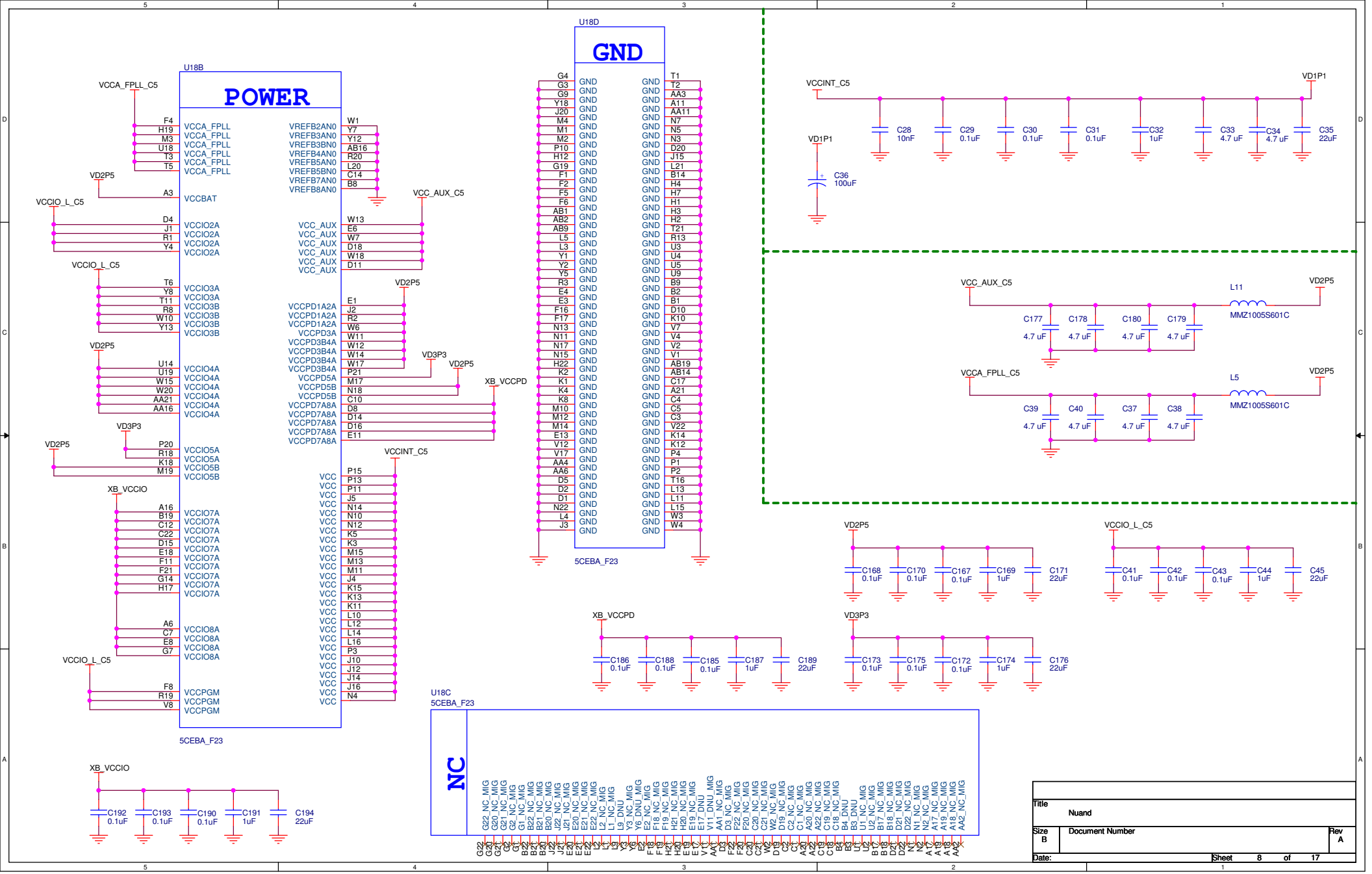
U18B
POWER
VCCA_FPLL_C5
VD2P5
VCCIO_L_C5
VCC_AUX_C5
VD3P3
XB_VCCIO
XB_VCCPD
VCCINT_C5
5CEBA_F23
U18D
GND
5CEBA_F23
U18C
NC
5CEBA_F23
VCCINT_C5
VD1P1
C28 10nF
C29 0.1uF
C30 0.1uF
C31 0.1uF
C32 1uF
C33 4.7 uF
C34 4.7 uF
C35 22uF
C36 100uF
VCC_AUX_C5
L11
MMZ1005S601C
C177 4.7 uF
C178 4.7 uF
C180 4.7 uF
C179 4.7 uF
VCCA_FPLL_C5
L5
MMZ1005S601C
C39 4.7 uF
C40 4.7 uF
C37 4.7 uF
C38 4.7 uF
C168 0.1uF
C170 0.1uF
C167 0.1uF
C169 1uF
C171 22uF
C41 0.1uF
C42 0.1uF
C43 0.1uF
C44 1uF
C45 22uF
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C188 0.1uF
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C189 22uF
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C176 22uF
C192 0.1uF
C193 0.1uF
C190 0.1uF
C191 1uF
C194 22uF
Title
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Size B
Document Number
Rev A
Date:
Sheet 8 of 17

FX3 GPIF + BOOT

U19A

P – PORT
SEC 1/7

VIO1

DQ0	F10	GPIF0
DQ1	F9	GPIF1
DQ2	F7	GPIF2
DQ3	G10	GPIF3
DQ4	G9	GPIF4
DQ5	F8	GPIF5
DQ6	H10	GPIF6
DQ7	H9	GPIF7
DQ8	J10	GPIF8
DQ9	J9	GPIF9
DQ10	K11	GPIF10
DQ11	L10	GPIF11
DQ12	K10	GPIF12
DQ13	K9	GPIF13
DQ14	J8	GPIF14
DQ15	G8	GPIF15
PCLK	J6	FX3_PCLK
CTL0	K8	FX3_CTL0
CTL1	K7	FX3_CTL1
CTL2	J7	FX3_CTL2
CTL3	H7	FX3_CTL3
CTL4	G7	FX3_CTL4
CTL5	G6	FX3_CTL5
CTL6	K6	FX3_CTL6
CTL7	H8	FX3_CTL7
CTL8	G5	FX3_CTL8
CTL9	H6	FX3_CTL9
CTL10	K5	FX3_CTL10
CTL11	J5	FX3_CTL11
CTL12	H5	FX3_CTL12
PMODE0	G4	PMODE0
PMODE1	H4	PMODE1
PMODE2	L4	PMODE2
INT_N_CTL15	L8	
RESET_N	C5	

FX3

C5_DATA0_GPIF0	R100	10	GPIF0
C5_DATA1_GPIF1	R101	10	GPIF1
C5_DATA2_GPIF2	R102	10	GPIF2
C5_DATA3_GPIF3	R103	10	GPIF3
C5_DATA4_GPIF4	R104	10	GPIF4
C5_DCLK_CTL9	R105	10	FX3_CTL9

VIO1_FX: R30 DNP; CVDDQ: R31 10K

C52 2.2uF

U19B

S0 – PORT
SEC 2/7

VIO2

DQ16	K2	GPIF16
DQ17	J4	GPIF17
DQ18	K1	GPIF18
DQ19	J2	GPIF19
DQ20	J3	GPIF20
DQ21	J1	GPIF21
DQ22	H2	GPIF22
DQ23	H3	GPIF23
DQ24	F4	GPIF24
DQ25	G2	GPIF25
DQ26	G3	GPIF26
DQ27	F3	GPIF27
GPIO45	F2	

FX3

U19C

S1 – PORT
SEC 3/7

VIO3

DQ28	F5	GPIF28
DQ29	E1	GPIF29
DQ30	E5	GPIF30
DQ31	E4	GPIF31
I2S-CLK	D1	FX3_GPIO50
I2S-SD	D2	FX3_GPIO51
I2S-WS	D3	FX3_GPIO52

VIO4

UART-RTS_SPI-SCK	D4	SPI_CLK
UART-CTS_SPI-SSN	C1	SPI-SSN_UART-CS
UART-TX_SPI-MISO	C2	SPI-MISO_UART-TX
UART-RX_SPI-MOSI	D5	SPI-MOSI_UART-RX
I2S-MCLK	C4	

FX3

nFX3_UART_CS
FX3_UART_TX
FX3_UART_RX

In 32-bit GPIF mode UART is (FX3 data pg 33):
GPIO[55](C2)=UART_TX
GPIO[56](D5)=UART_RX
UART_CS was added to allow the FPGA to use the MISO/MOSI lines to communicate via UART with the FX3.
CS can also be deasserted to write to flash after boot.

PMODE[2..0]

PMODE2: R28 10K

PMODE1: R22 DNP

PMODE0: R23 DNP

FX3 datasheet pg 7:
SPI+USB is primary, USB only should be achievable
SPI+USB on failure – PMODE[2:0] = "0F1"
USB boot – PMODE[2:0] = "F11"

NSTATUS – FX3_GPIO52
NCONFIG – FX3_GPIO51
CONF_DONE – FX3_GPIO50

J6
1 FX3_UART_RX
2 FX3_UART_TX
3
DNP

SPI Flash

VIO4_FX

R27 4.7K, R26 4.7K, R25 4.7K

U20

SPI-MOSI_UART-RX	5	D
SPI-MISO_UART-TX	2	Q
SPI_CLK	6	C
SPI_Hold#_flash	7	HOLD
SPI-SSN_UART-CS	1	CS
SPI_Wp#_flash	3	W/VPP
	8	VCC (25 mA)
	4	VSS

C51 0.1uF

R21 4.7K, R24 100K, R29 DNP

PART_NUMBER = W25Q32JVSSIQ
Manufacturer = Winbond
FLASH VCC : 3.3V

Add R21 so that SPI-boot works. C5's HIGH-Z state has a weak pull up, so it can be balanced out with a weak pull-down.

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FX3 DEBUG + CLOCK SEL

U19F

MISC
SEC 6/7
VIO5

I2C-GPIO58_SCL	D9	
I2C-GPIO59_SDA	D10	
I2C-GPIO60_CHARGER-DETECT	D11	
TCK	F6	TCK
TDI	E7	TDI
TDO	C10	TDO
TMS	E8	TMS
TRST_N	B11	TRST_N

FX3

FSLC[2..0]

FX3 datasheet pg 8:
38.4MHz input CLK - FSLC[2:0] = "110"

CVDDQ — R32 10K — FSLC2
CVDDQ — R33 10K — FSLC1
FSLC0 — R34 10K

FX3 JTAG

VD1P8 — 10K — TRST_N (R35)
DNP — TDI (R36)
DNP — TMS (R37)
DNP — TCK (R38)
DNP — RTCK (R39)
VD1P8

J8 — JTAG_ICE_CONN

1	VT_REF	V_SUPPLY	2
3	N_TRST	GND1	4
5	TDI	GND2	6
7	TMS	GND3	8
9	TCK	GND4	10
11	RTCK	GND5	12
13	TDO	GND6	14
15	N_SRST	GND7	16
17	DBGRQ	GND8	18
19	DBGACK	GND9	20

DNP

PART_NUMBER = M50-3601042
Manufacturer = Harwin

U19E

XTAL / CLK
SEC 5/7
CVDDQ

FSLC0	B2	FSLC0
FSLC1	B4	FSLC1
FSLC2	E6	FSLC2
XTALIN	C6	
XTALOUT	C7	
CLKIN	D7	FX3_CLK
CLKIN_32	D6	

FX3

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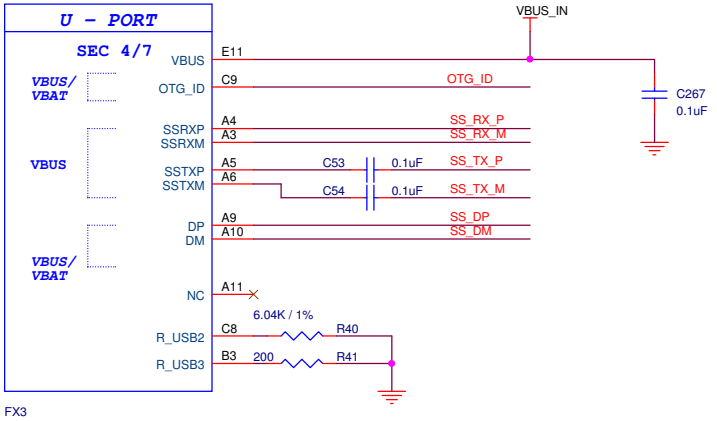
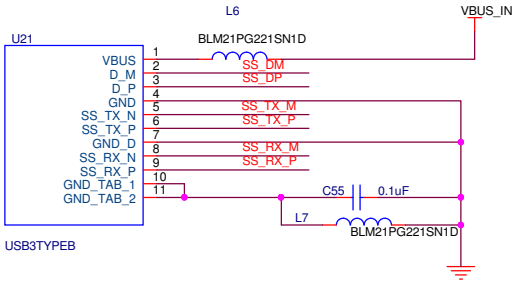
USB CONNECTIONS

U19D



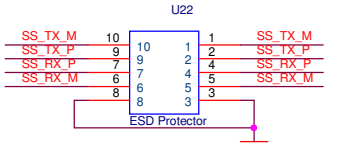
FX3

USB3.0 TYPE B



USB3TYPEB

ESD DEVICE



PART_NUMBER = SP3010-04UTG
Manufacturer = Littlefuse

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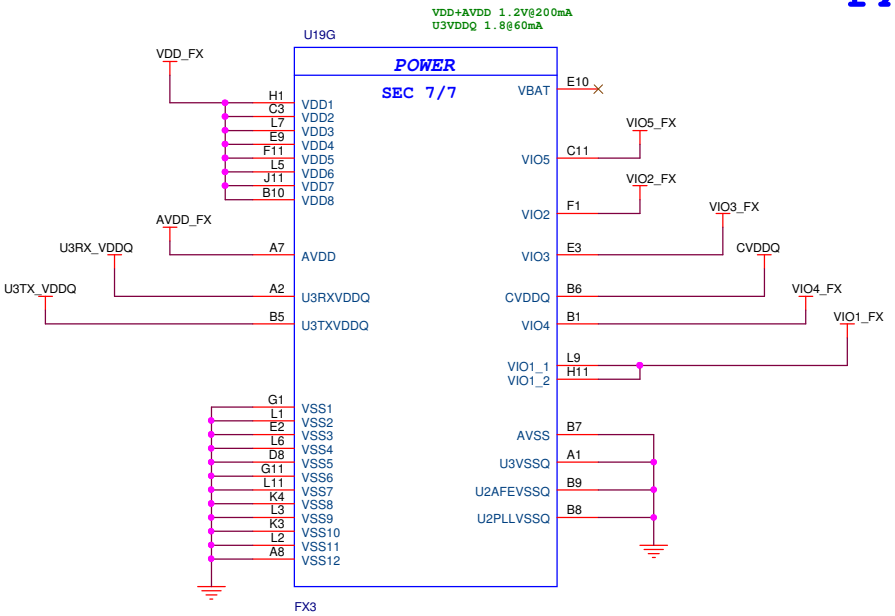
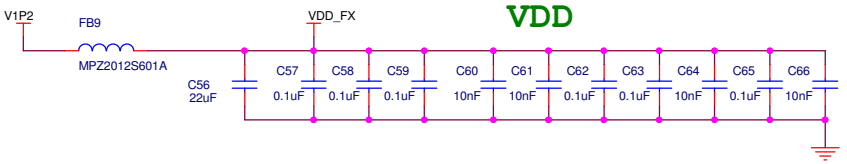
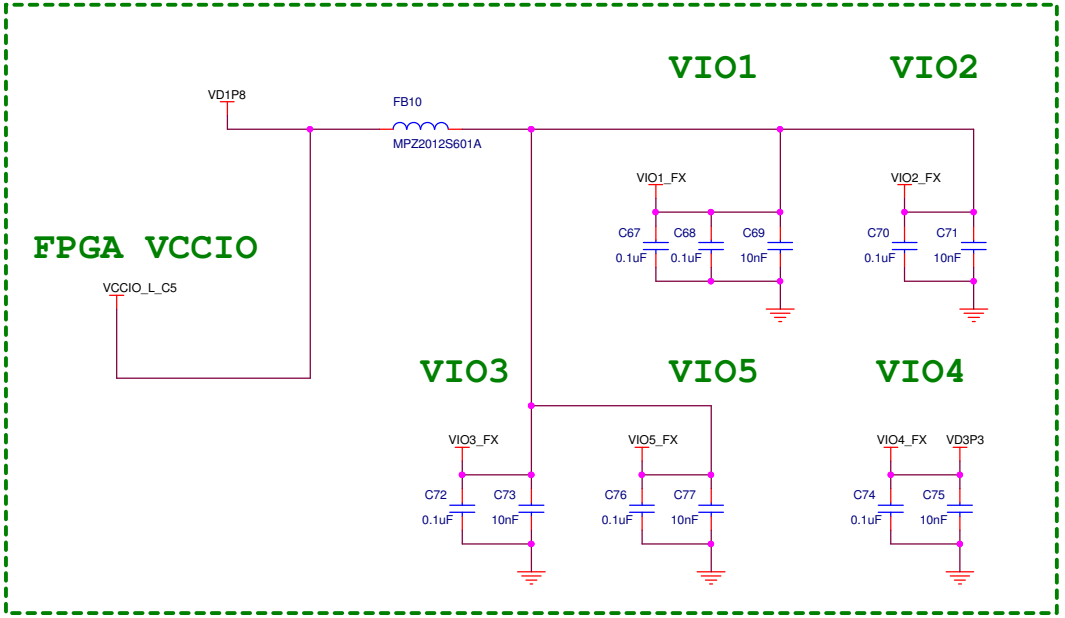
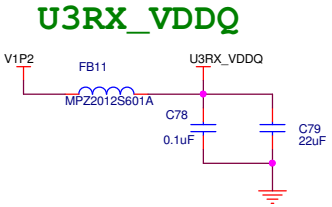
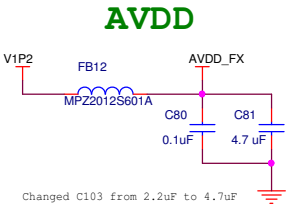
FX3 POWER

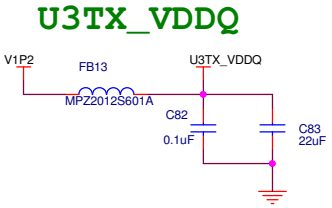


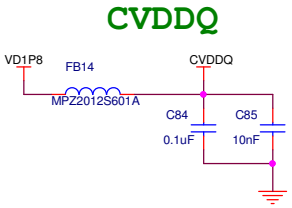













```
U3RX_VDDQ = V1P2
U3TX_VDDQ = V1P2
AVDD      = V1P2
CVDDQ     = V1P8
VDD       = V1P8
VIO1      = V1P8
VIO2      = V1P8
VIO3      = V1P8
VIO4      = V3P3
VIO5      = V1P8
```

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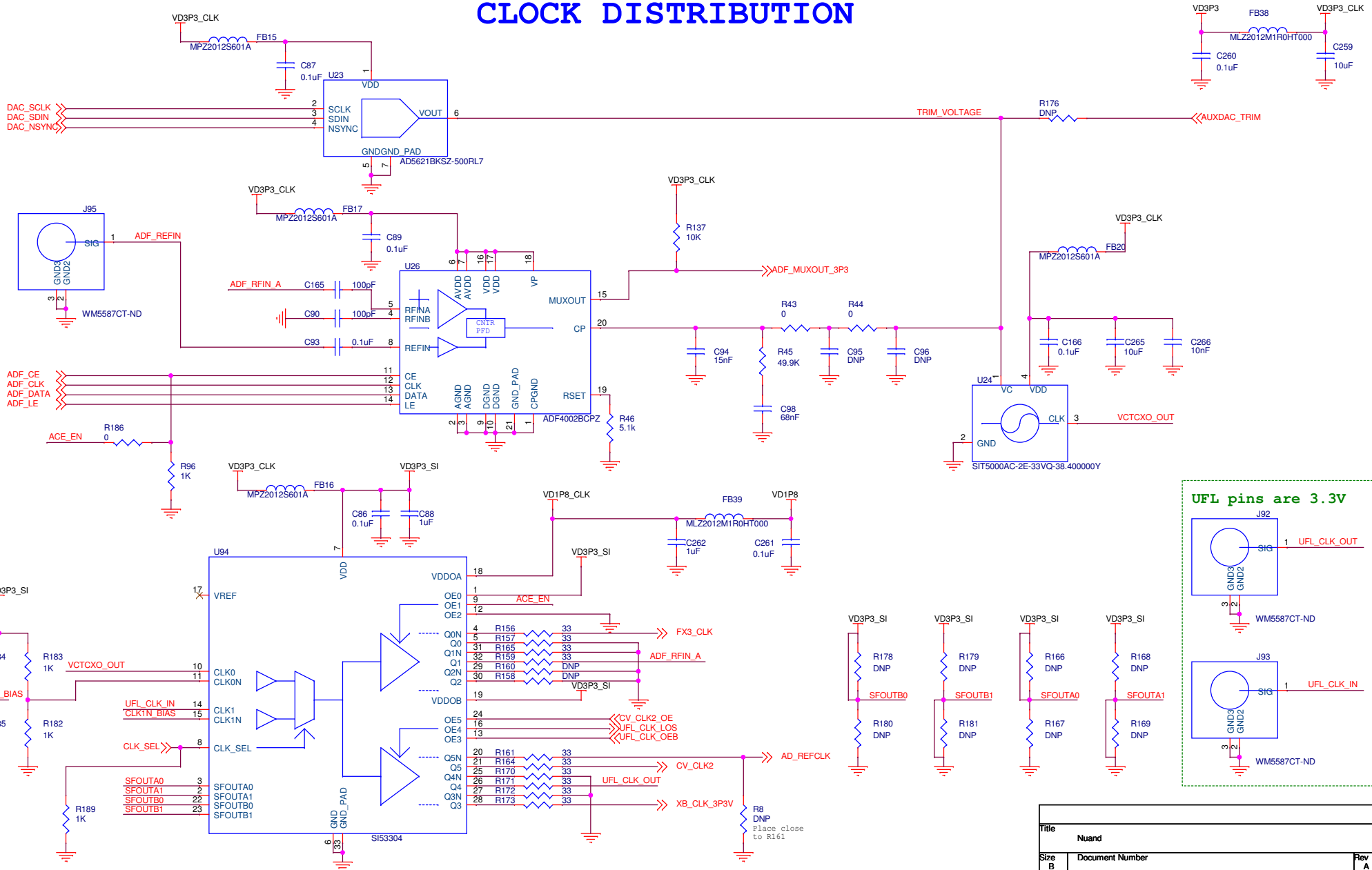
CLOCK DISTRIBUTION



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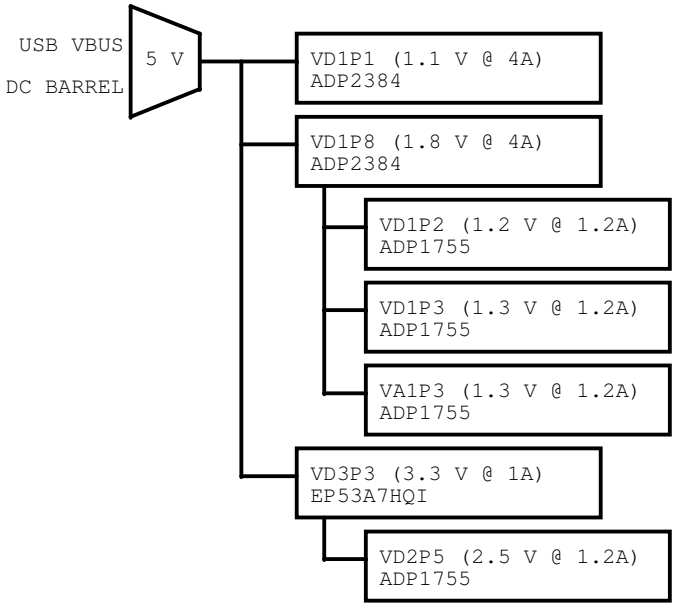
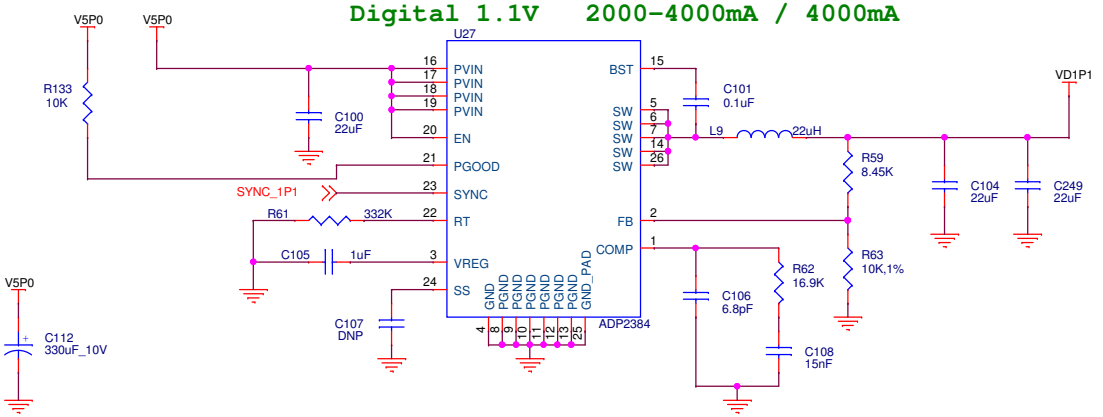
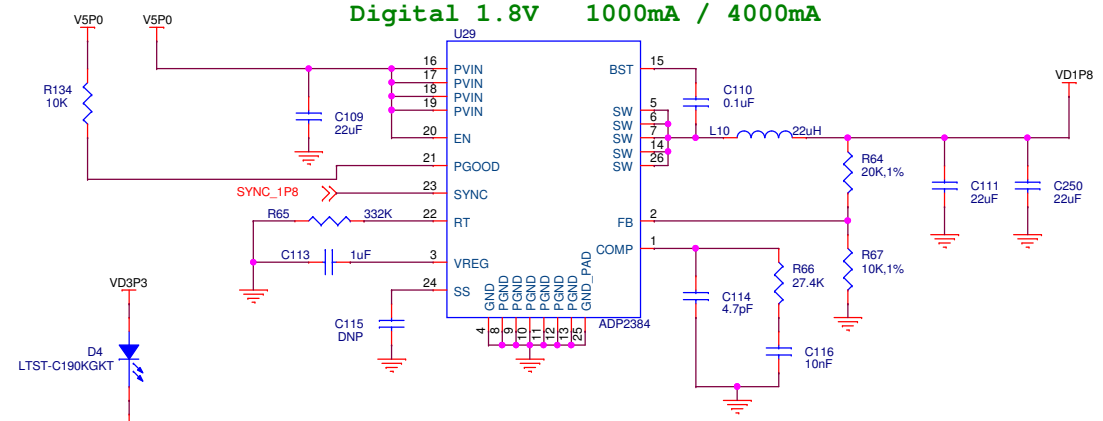
POWER - 1.1V/1.8V/3.3V



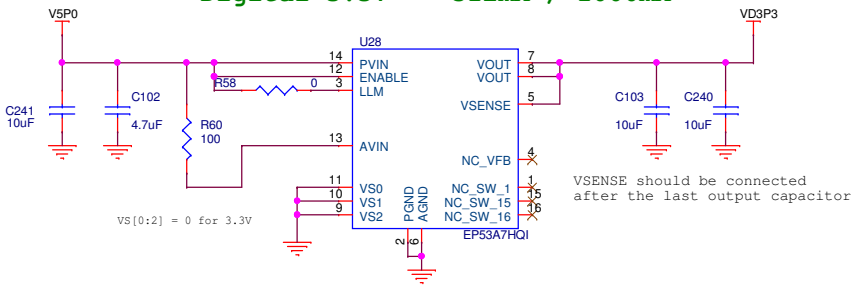
Digital 1.1V 2000-4000mA / 4000mA



Digital 1.8V 1000mA / 4000mA



Digital 3.3V 512mA / 1000mA



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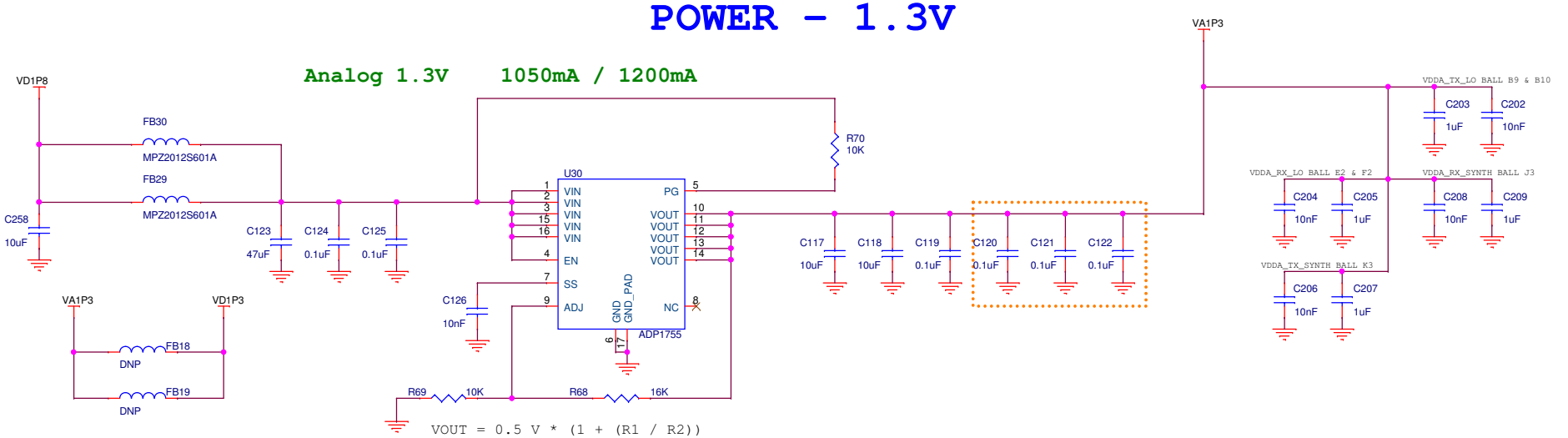
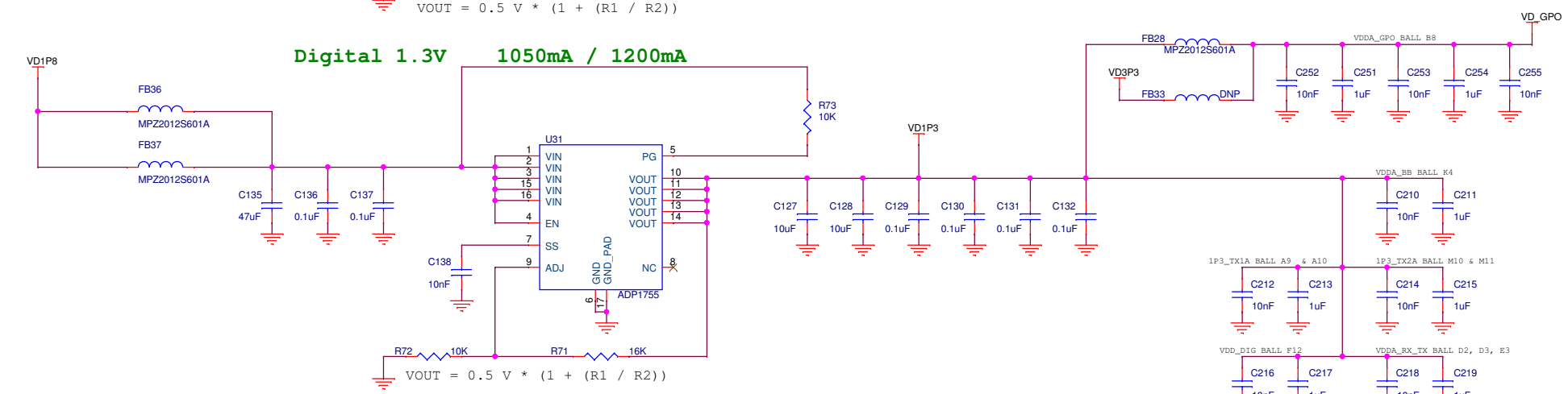
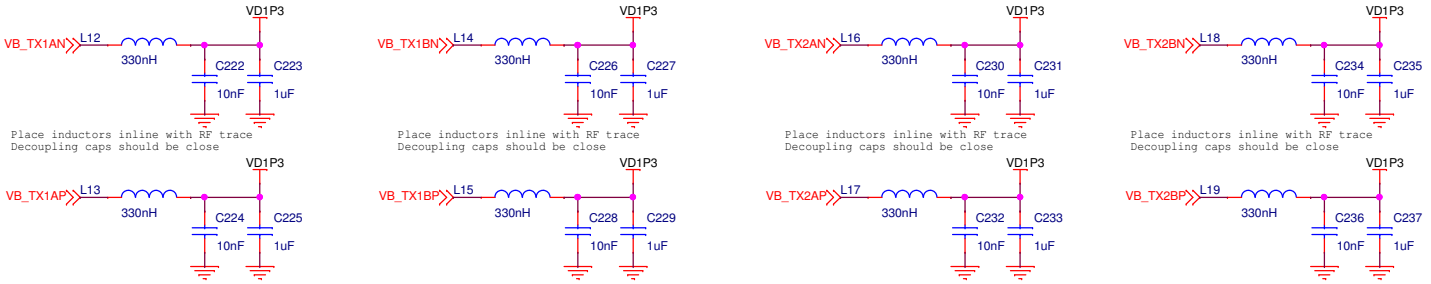
POWER - 1.3V

Analog 1.3V 1050mA / 1200mA



Digital 1.3V 1050mA / 1200mA





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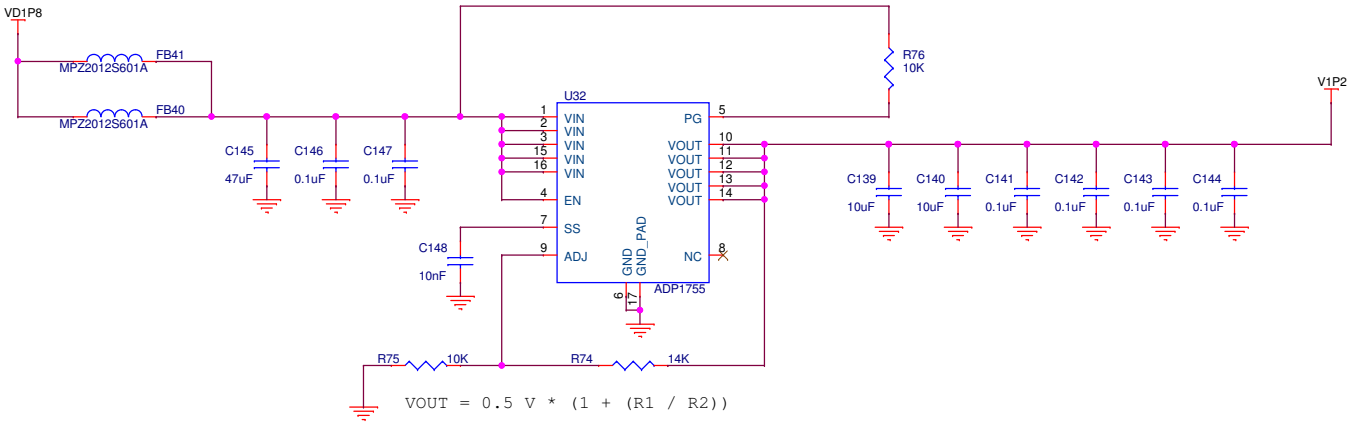
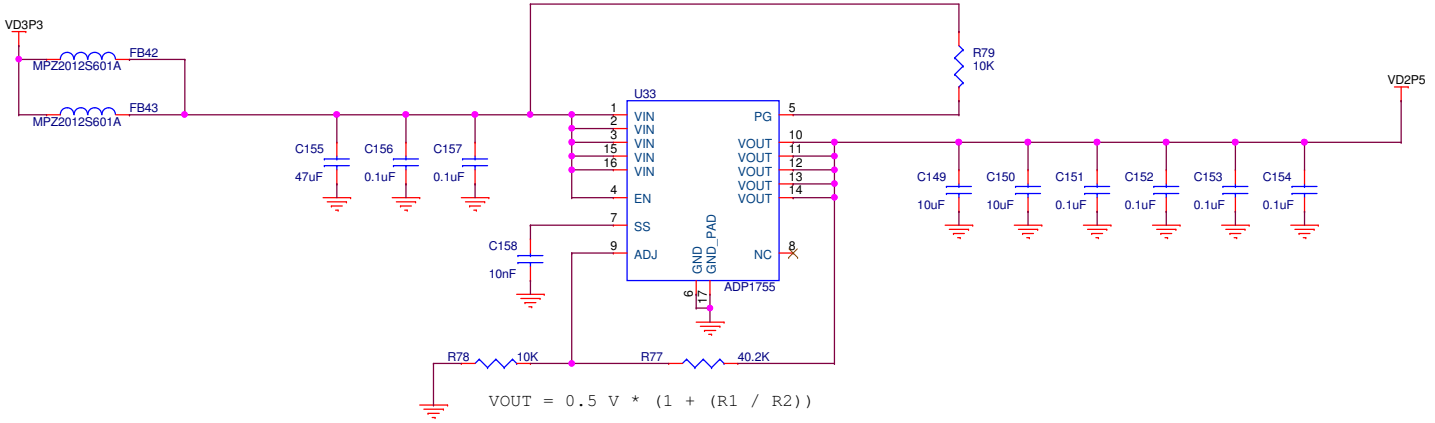
POWER - 1.2V/2.5V

Digital 1.2V 197mA / 1200mA



Digital 2.5V 307mA / 1200mA



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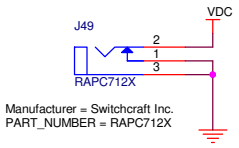
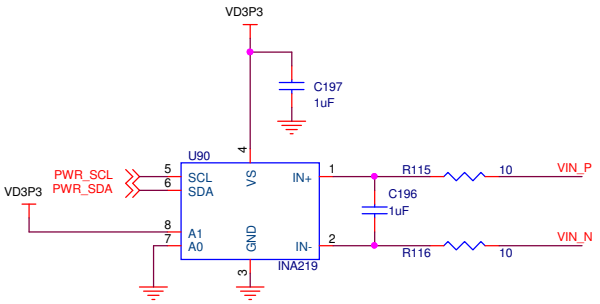
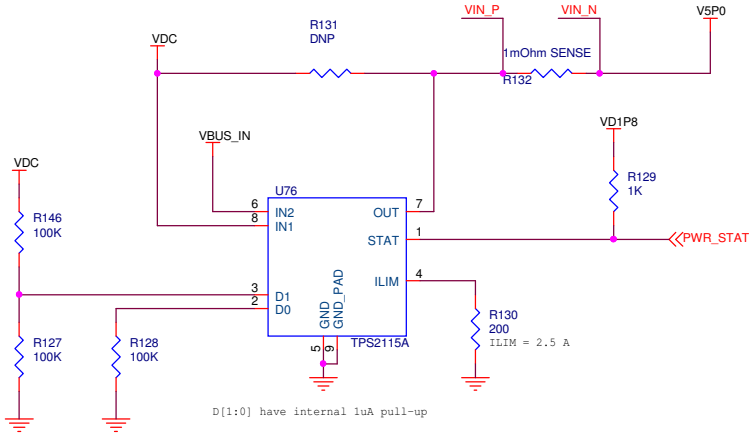
POWER MUXES AND MONITOR



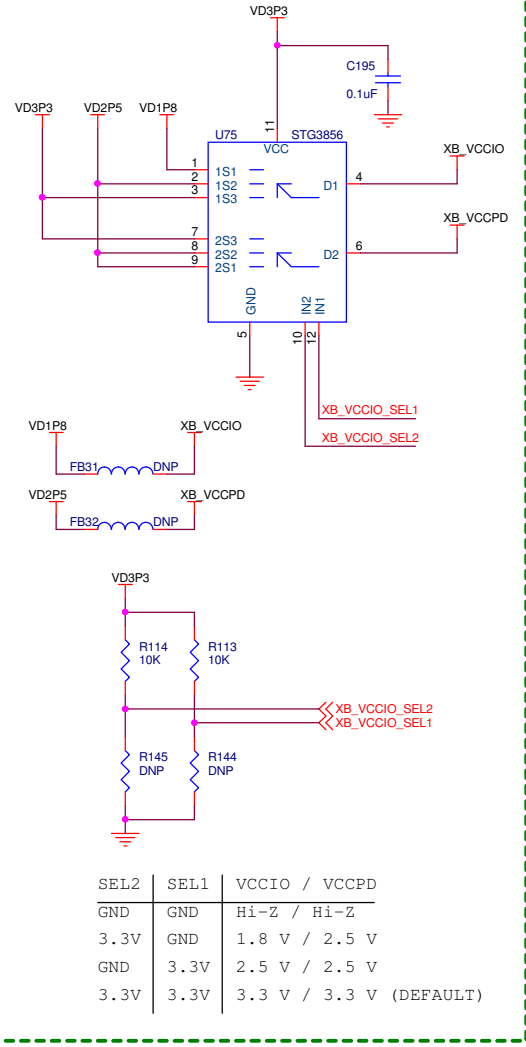




D1	D0	VIN2 > VIN1	STAT	OUT
<0.7V	<0.7V	X	Z	IN2
>2V	<0.7V	X	0	IN1

If DC barrel jack (VDC) is floating or does not provide at least 4 V, power mux will select USB VBUS.

XB VCCIO SELECTION



SEL2	SEL1	VCCIO / VCCPD
GND	GND	Hi-Z / Hi-Z
3.3V	GND	1.8 V / 2.5 V
GND	3.3V	2.5 V / 2.5 V
3.3V	3.3V	3.3 V / 3.3 V (DEFAULT)

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