ALTERA MAX10 Development & Education Board (DE10-Lite)

Title: **DE10-Lite**

Size	Document Number	Rev
B	Cover Page	E0

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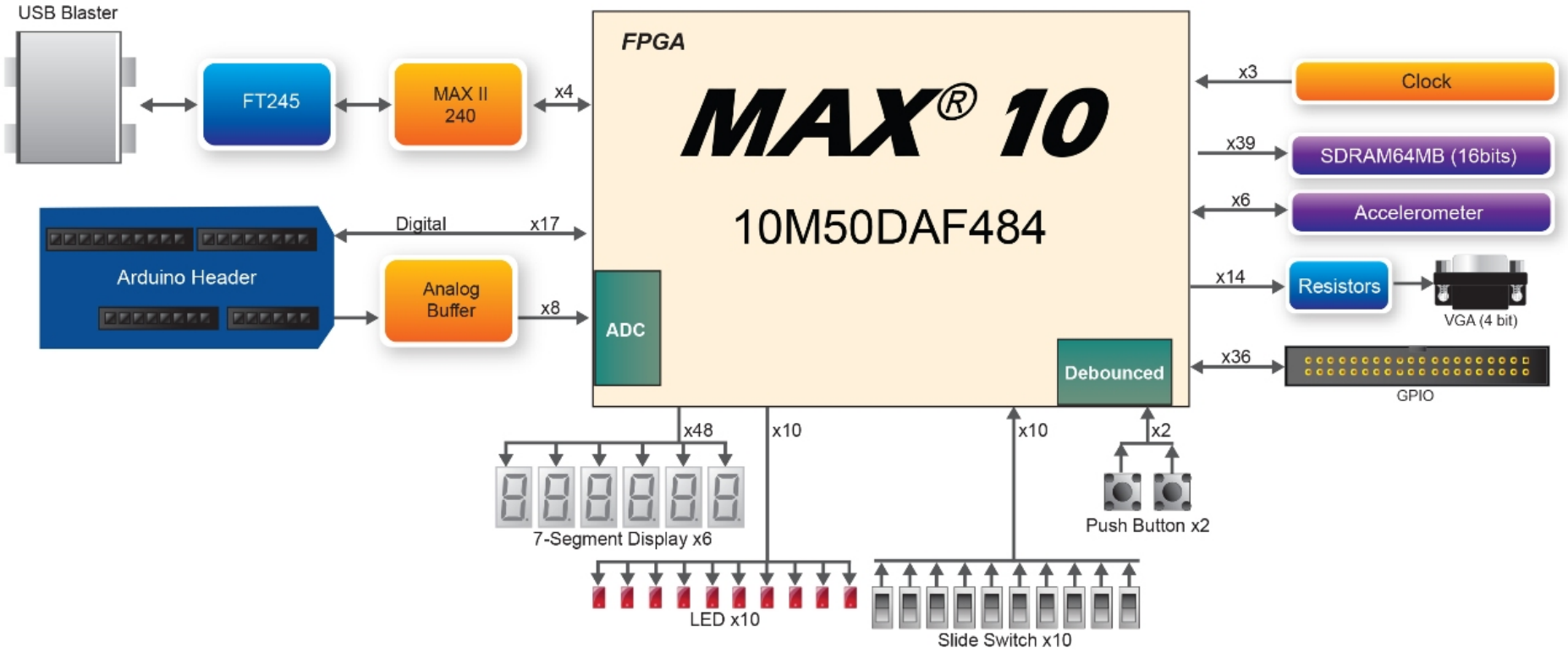

Title
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Size	Document Number	Rev
B	Block Diagram	E0

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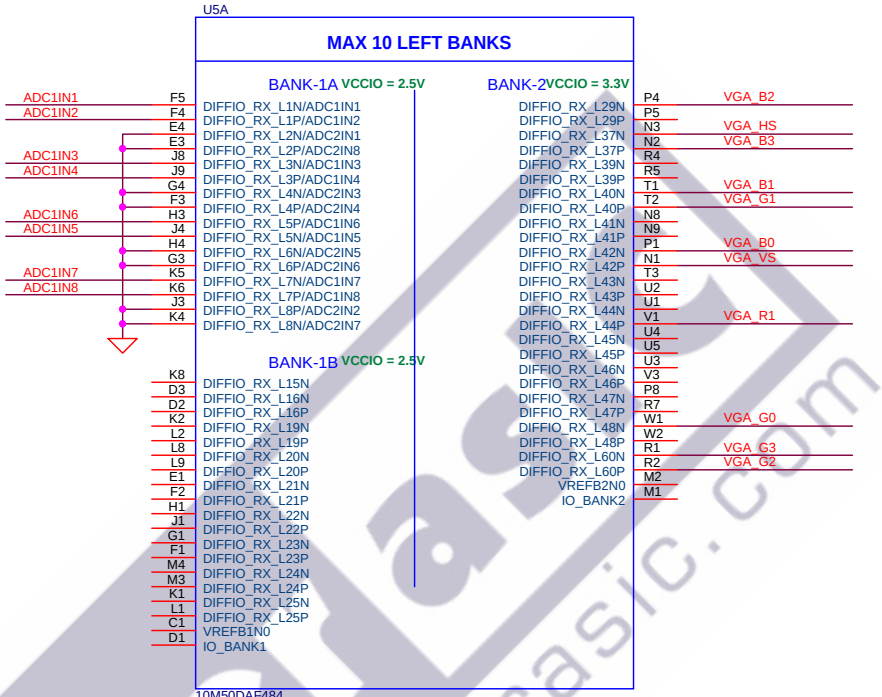
MAX10 Bank 1 & 2

Analog input interface

13 ADC1IN[8..1]

VGA

4,15 VGA_R[3..0]
15 VGA_G[3..0]
15 VGA_B[3..0]
15 VGA_HS
15 VGA_VS



Title: **DE10-Lite**

Size	Document Number	Rev
B	MAX 10 Bank 1 & 2	E0

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MAX10 Bank 3 & 4

GPIO 0

7,13 — GPIO_[35..0]

Arduino Digital Interface

13 — Arduino_IO[15..0]

Digital Accelerometer

15 — GSENSOR_SDI
15 — GSENSOR_SCLK
15 — GSENSOR_INT1
15 — GSENSOR_INT2
15 — GSENSOR_CS_n
15 — GSENSOR_SDO

VGA

3,15 — VGA_R[3..0]

U5B

MAX 10 BOTTOM BANKS

		BANK-3 VCCIO = 3.3V	BANK-4 VCCIO = 3.3V		
GPIO_25	Y7	DIFFIO_RX_B10N	DIFFIO_RX_B25N	W11	GPIO_19
GPIO_23	Y8	DIFFIO_RX_B10P	DIFFIO_RX_B25P	Y11	GPIO_17
GPIO_34	AB2	DIFFIO_RX_B12N	DIFFIO_RX_B27N	AB10	GPIO_20
GPIO_32	AB3	DIFFIO_RX_B12P	DIFFIO_RX_B27P	AB11	GPIO_18
GPIO_33	Y3	DIFFIO_RX_B14N	DIFFIO_RX_B29N	AB12	GPIO_16
GPIO_31	Y4	DIFFIO_RX_B14P	DIFFIO_RX_B29P	AB13	GPIO_15
GPIO_30	AA5	DIFFIO_RX_B17N	DIFFIO_RX_B35N	W12	GPIO_14
Arduino_IO0	AB5	DIFFIO_RX_B17P	DIFFIO_RX_B35P	W13	GPIO_13
Arduino_IO1	AB6	DIFFIO_RX_B19N	DIFFIO_RX_B38N	AA14	GPIO_12
Arduino_IO2	AB7	DIFFIO_RX_B19P	DIFFIO_RX_B38P	AB15	GSENSOR_SCLK
GPIO_24	AA8	DIFFIO_RX_B21N	DIFFIO_RX_B40N	AA15	GPIO_11
Arduino_IO3	AB8	DIFFIO_RX_B21P	DIFFIO_RX_B40P	Y16	
GPIO_22	AA9	DIFFIO_RX_B23N	DIFFIO_RX_B42N	AB16	GSENSOR_CS_n
Arduino_IO4	AB9	DIFFIO_RX_B23P	DIFFIO_RX_B42P	AA16	
	V4	DIFFIO_RX_B2N	DIFFIO_RX_B44N	AB19	Arduino_IO10
GPIO_9	V5	DIFFIO_RX_B2P	DIFFIO_RX_B44P	AB20	Arduino_IO13
VGA_R3	Y1	DIFFIO_RX_B4N	DIFFIO_RX_B46N	AA19	Arduino_IO11
VGA_R2	Y2	DIFFIO_RX_B4P	DIFFIO_RX_B46P	Y18	
VGA_R0	AA1	DIFFIO_RX_B6N	DIFFIO_RX_B50N	AB21	Arduino_IO14
GPIO_35	AA2	DIFFIO_RX_B6P	DIFFIO_RX_B50P	AA20	Arduino_IO15
GPIO_29	Y5	DIFFIO_RX_B8N	DIFFIO_RX_B58N	AB17	Arduino_IO8
GPIO_27	Y6	DIFFIO_RX_B8P	DIFFIO_RX_B58P	AB18	
GPIO_3	W9	DIFFIO_TX_RX_B11N	DIFFIO_TX_RX_B24N	V11	GSENSOR_SDI
GPIO_1	W10	DIFFIO_TX_RX_B11P	DIFFIO_TX_RX_B24P	V12	GSENSOR_SDO
GPIO_7	W7	DIFFIO_TX_RX_B13N	DIFFIO_TX_RX_B26N	R12	
GPIO_5	W8	DIFFIO_TX_RX_B13P	DIFFIO_TX_RX_B26P	P12	
	R10	DIFFIO_TX_RX_B15N	DIFFIO_TX_RX_B28N	AA11	Arduino_IO6
	P10	DIFFIO_TX_RX_B15P	DIFFIO_TX_RX_B28P	AA12	Arduino_IO7
GPIO_28	AA6	DIFFIO_TX_RX_B16N	DIFFIO_TX_RX_B34N	V13	
GPIO_26	AA7	DIFFIO_TX_RX_B16P	DIFFIO_TX_RX_B34P	W14	
GPIO_10	W5	DIFFIO_TX_RX_B1N	DIFFIO_TX_RX_B36N	R13	
GPIO_8	W6	DIFFIO_TX_RX_B1P	DIFFIO_TX_RX_B36P	P13	
Arduino_IO5	Y10	DIFFIO_TX_RX_B22N	DIFFIO_TX_RX_B37N	Y13	GSENSOR_INT2
GPIO_21	AA10	DIFFIO_TX_RX_B22P	DIFFIO_TX_RX_B37P	Y14	GSENSOR_INT1
	U6	DIFFIO_TX_RX_B3N	DIFFIO_TX_RX_B39N	V14	
	U7	DIFFIO_TX_RX_B3P	DIFFIO_TX_RX_B39P	W15	
	W4	DIFFIO_TX_RX_B5N	DIFFIO_TX_RX_B41N	U15	
	W3	DIFFIO_TX_RX_B5P	DIFFIO_TX_RX_B41P	V16	
GPIO_6	V7	DIFFIO_TX_RX_B7N	DIFFIO_TX_RX_B43N	AA17	Arduino_IO9
GPIO_4	V8	DIFFIO_TX_RX_B7P	DIFFIO_TX_RX_B43P	Y17	
	R9	DIFFIO_TX_RX_B9N	DIFFIO_TX_RX_B45N	V15	
	P9	DIFFIO_TX_RX_B9P	DIFFIO_TX_RX_B45P	W16	
	AA3	VREFB3N0	DIFFIO_TX_RX_B49N	Y19	Arduino_IO12
	AB4	IO_BANK3	DIFFIO_TX_RX_B49P	W18	
			VREFB4N0	AA13	
			IO_BANK4	AB14	

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Title: **DE10-Lite**

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B	MAX 10 Bank 3 & 4	E0

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MAX10 Bank 5 & 6

SDRAM

12 DRAM_ADDR[12..0]
12 DRAM_DQ[15..0]

12 DRAM_CKE
12 DRAM_LDQM
12 DRAM_UDQM
12 DRAM_WE_N
12 DRAM_CAS_N
12 DRAM_RAS_N
12 DRAM_CS_N
12 DRAM_BA0
12 DRAM_BA1

SWITCH

6,14 SW[9..0]

KEY

6,14 KEY[1..0]

LED

6,14 LEDR[9..0]

7-segment Display

6,14 HEX0[7..0]
6,14 HEX1[7..0]
6,14 HEX2[7..0]
6,14 HEX3[7..0]
14 HEX4[7..0]
14 HEX5[7..0]

U5C

MAX 10 RIGHT BANKS

		BANK-5 VCCIO = 3.3V
DRAM_ADDR4	U19	DIFFIO_RX_R19N
DRAM_ADDR2	V18	DIFFIO_RX_R19P
DRAM_ADDR3	U18	DIFFIO_RX_R1P/RUP
DRAM_ADDR0	U17	DIFFIO_RX_R1N/RDN
DRAM_DQ5	W22	DIFFIO_RX_R20N
DRAM_DQ4	Y22	DIFFIO_RX_R20P
DRAM_DQ6	W20	DIFFIO_RX_R21N
DRAM_ADDR1	W19	DIFFIO_RX_R21P
DRAM_DQ0	Y21	DIFFIO_RX_R22N
DRAM_DQ1	Y20	DIFFIO_RX_R22P
DRAM_CS_N	U20	DIFFIO_RX_R23N
DRAM_WE_N	V20	DIFFIO_RX_R23P
DRAM_LDQM	V22	DIFFIO_RX_R24N
DRAM_DQ7	V21	DIFFIO_RX_R24P
	R14	DIFFIO_RX_R25N/DQ1R
	R15	DIFFIO_RX_R25P/DQ1R
DRAM_BA1	T22	DIFFIO_RX_R26N
DRAM_BA0	T21	DIFFIO_RX_R26P
DRAM_ADDR5	T18	DIFFIO_RX_R27N/DM1R
DRAM_ADDR6	T19	DIFFIO_RX_R27P/DQ1R
DRAM_ADDR12	R20	DIFFIO_RX_R28N/DQ1R
DRAM_ADDR10	T20	DIFFIO_RX_R28P/DQ1R
DRAM_RAS_N	U22	DIFFIO_RX_R29N
DRAM_CAS_N	U21	DIFFIO_RX_R29P
DRAM_DQ2	AA22	DIFFIO_RX_R2N
DRAM_DQ3	AA21	DIFFIO_RX_R2P
	P14	DIFFIO_RX_R30N/DQ1R
	P15	DIFFIO_RX_R30P/DQ1R
DRAM_CKE	N22	DIFFIO_RX_R31N
DRAM_DQ8	P21	DIFFIO_RX_R31P
DRAM_ADDR8	P18	DIFFIO_RX_R32N/DQSN1R
DRAM_ADDR7	R18	DIFFIO_RX_R32P/DQS1R
DRAM_ADDR11	P20	DIFFIO_RX_R33N/DQ1R
DRAM_ADDR9	P19	DIFFIO_RX_R33P/DQ1R
	L22	DIFFIO_RX_R34N
	M21	DIFFIO_RX_R34P
	M22	DIFFIO_RX_R35N
	N21	DIFFIO_RX_R35P
	P22	VREFB5N0
	R22	IO_BANK5

		BANK-6 VCCIO = 3.3V
	H21	DIFFIO_RX_R39N
DRAM_DQ10	H22	DIFFIO_RX_R39P
DRAM_DQ11	J21	DIFFIO_RX_R41N
DRAM_UDQM	J22	DIFFIO_RX_R41P
DRAM_DQ9	G19	DIFFIO_RX_R42N
DRAM_DQ14	G20	DIFFIO_RX_R42P
DRAM_DQ13	F22	DIFFIO_RX_R43N
DRAM_DQ15	G22	DIFFIO_RX_R43P
DRAM_DQ12	M14	DIFFIO_RX_R44N/DQ2R
	M15	DIFFIO_RX_R44P/DQ2R
	E21	DIFFIO_RX_R45N
HEX32	E22	DIFFIO_RX_R45P
HEX31	N19	DIFFIO_RX_R46N/DM2R
HEX55	N18	DIFFIO_RX_R46P/DQ2R
HEX53	M20	DIFFIO_RX_R47P/DQ2R
HEX54	N20	DIFFIO_RX_R47N/DQ2R
HEX56	F20	DIFFIO_RX_R48N
HEX46	F21	DIFFIO_RX_R48P
HEX30	C22	DIFFIO_RX_R49N
HEX25	D22	DIFFIO_RX_R49P
HEX37	L18	DIFFIO_RX_R51N/DQ2R
HEX52	M18	DIFFIO_RX_R51P/DQ2R
	L20	DIFFIO_RX_R52N/DQ2R
HEX57	L19	DIFFIO_RX_R52P/DQ2R
HEX40	F18	DIFFIO_RX_R53N
HEX42	E19	DIFFIO_RX_R53P
HEX41	E20	DIFFIO_RX_R54N
HEX45	F19	DIFFIO_RX_R54P
	K15	DIFFIO_RX_R55N/DQSN3R
	K14	DIFFIO_RX_R55P/DQS3R
HEX35	D19	DIFFIO_RX_R56N
HEX34	C20	DIFFIO_RX_R56P
HEX43	J18	DIFFIO_RX_R57N/DQ3R
	K18	DIFFIO_RX_R57P/DQ3R
HEX51	K20	DIFFIO_RX_R58N/DQ3R
	K19	DIFFIO_RX_R58P/DQ3R
HEX36	E17	DIFFIO_RX_R59N
HEX47	F17	DIFFIO_RX_R59P
HEX24	B21	DIFFIO_RX_R60N
HEX26	B22	DIFFIO_RX_R60P
	J15	DIFFIO_RX_R61N/DM3R
	J14	DIFFIO_RX_R61P/DQ3R
HEX23	A21	DIFFIO_RX_R62N
HEX20	B20	DIFFIO_RX_R62P
	H18	DIFFIO_RX_R63N/DQ3R
HEX44	H19	DIFFIO_RX_R63P/DQ3R
	H20	DIFFIO_RX_R64N/DQ3R
HEX50	J20	DIFFIO_RX_R64P/DQ3R
HEX12	E18	DIFFIO_RX_R70N/CK#_6
HEX11	D18	DIFFIO_RX_R70P/CK_6
	D21	VREFB6N0
	C21	IO_BANK6

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MAX10 Bank 7 & 8

7-segment Display

14 HEX0[7..0]
5,14 HEX1[7..0]
5,14 HEX2[7..0]
5,14 HEX3[7..0]
5,14 HEX4[7..0]
5,14 HEX5[7..0]

SWITCH

14 SW[9..0]

KEY

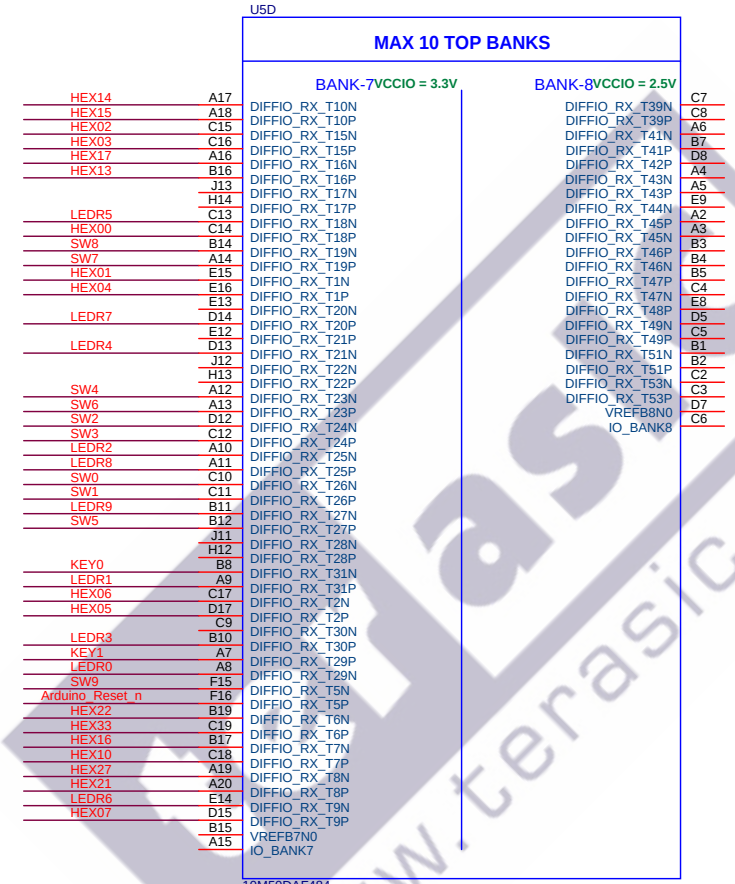
14 KEY[1..0]

LED

14 LEDR[9..0]

Arduino Digital Interface

13 Arduino_Reset_n



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MAX10 Clock

GPIO 0

4,13 — GPIO_[35..0]

SDRAM

12 — DRAM_CLK

U5E

MAX 10 CLOCK

BANK-2 VCCIO = 3.3V

ADC_CLK_10	N4	DIFFIO_RX_L28N/CLK0N	DIFFIO_RX_L38N/DPCLK0	P3
	N5	DIFFIO_RX_L28P/CLK0P	DIFFIO_RX_L38P/DPCLK1	R3
	M8	DIFFIO_RX_L36N/CLK1N	DIFFIO_RX_L59N/PLL_L_CLKOUTN	T5
	M9	DIFFIO_RX_L36P/CLK1P	DIFFIO_RX_L59P/PLL_L_CLKOUTP	T6

BANK-3 VCCIO = 3.3V

GPIO_2	V9	DIFFIO_TX_RX_B18N/CLK6N
GPIO_0	V10	DIFFIO_TX_RX_B18P/CLK6P
	R11	DIFFIO_TX_RX_B20N/CLK7N
MAX10_CLK1_50	P11	DIFFIO_TX_RX_B20P/CLK7P

BANK-4 VCCIO = 3.3V

DIFFIO_TX_RX_B57N/PLL_B_CLKOUTN		W17
DIFFIO_TX_RX_B57P/PLL_B_CLKOUTP		V17

BANK-6 VCCIO = 3.3V

MAX10_CLK2_50	N15	DIFFIO_RX_R38N/CLK2N	DIFFIO_RX_R50N/DPCLK2/DQSn2R	L15	
	N14	DIFFIO_RX_R38P/CLK2P	DIFFIO_RX_R50P/DPCLK3/DQS2R	L14	DRAM_CLK
	K21	DIFFIO_RX_R40N/CLK3N	DIFFIO_RX_R69N/PLL_R_CLKOUTN	G17	
	K22	DIFFIO_RX_R40P/CLK3P	DIFFIO_RX_R69P/PLL_R_CLKOUTP	H17	

BANK-8 VCCIO = 2.5V

	E10	DIFFIO_RX_T38N/CLK4N		
	E11	DIFFIO_RX_T38P/CLK4P		
	J10	DIFFIO_RX_T40P/CLK5P	DIFFIO_RX_T52N/PLL_T_CLKOUTN	E6
	H11	DIFFIO_RX_T40N/CLK5N	DIFFIO_RX_T52P/PLL_T_CLKOUTP	D6

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CAD Note:
Place near IC power pin

VCC3P3

C159 10u 6.3V
C56 0.1u 10V
C52 0.1u 10V

VCC3P3

C9 12p 50V
Y2 24.00MHz
C11 12p 50V

U16

1	VDD	VDDO	8	VCC3P3	
2	XOUT	SSCLK1	4	R17 18.2	ADC_CLK_10
3	XIN/CLKIN	SSCLK3	7	R10 18.2	MAX10_CLK1_50
5	VSS	SSCLK2	6	R9 18.2	MAX10_CLK2_50

Si51211

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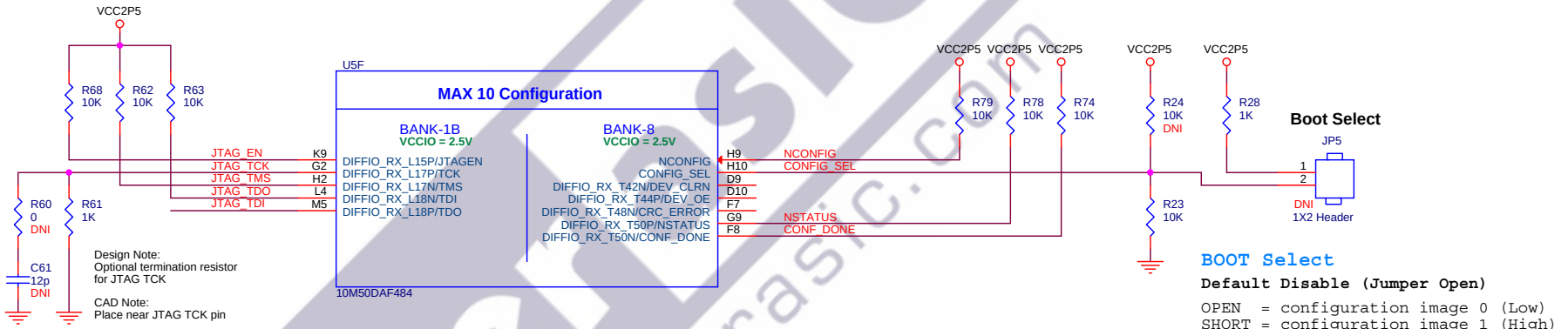
MAX10 Configuration

JTAG Interface

18 JTAG_TCK
18 JTAG_TMS
18 JTAG_TDI
18 JTAG_TDO
18 JTAG_EN

FPGA CONFIG

18 NCONFIG
18 NSTATUS
18 CONF_DONE
18 CONFIG_SEL



BOOT Select

Default Disable (Jumper Open)

OPEN = configuration image 0 (Low)
SHORT = configuration image 1 (High)

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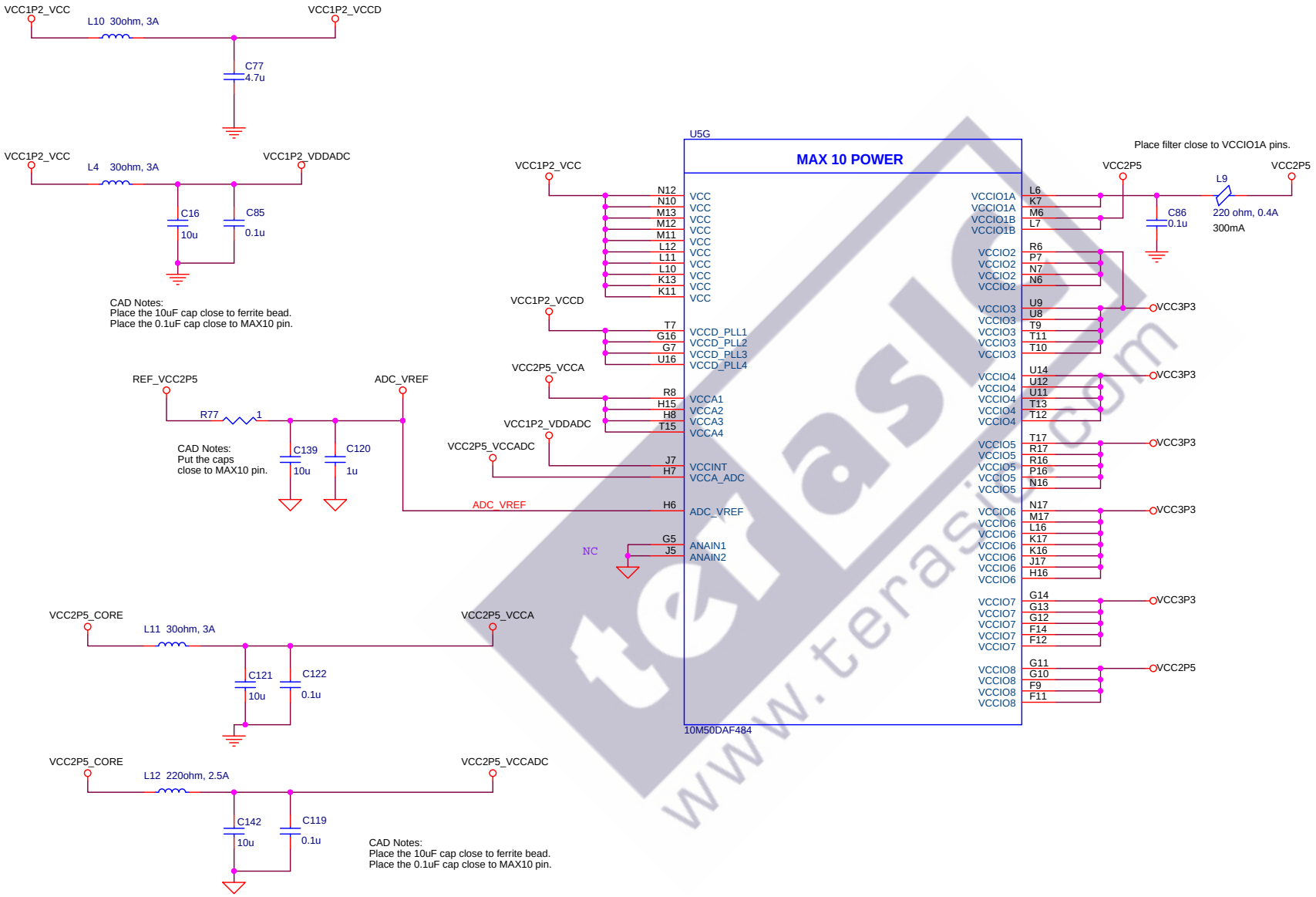
MAX10 Power



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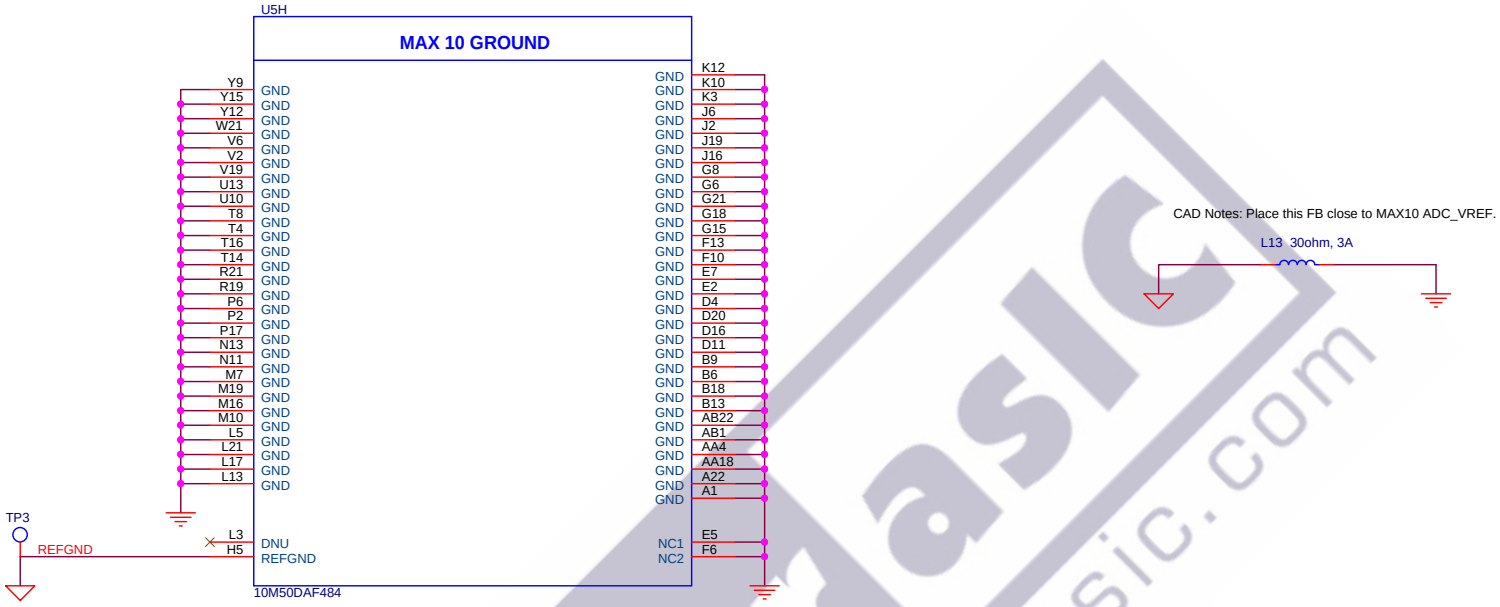
MAX10 Ground



1. Use REFGND as ground reference.
2. Route analog input signal adjacent to AVSSREF as possible.

CAD Notes: Place this FB close to MAX10 ADC_VREF.

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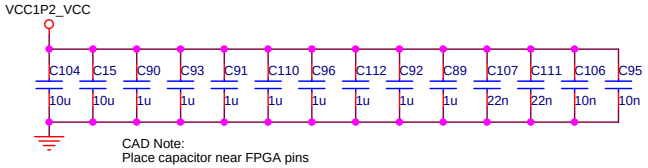
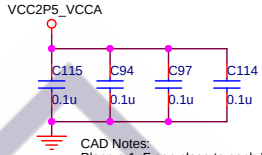
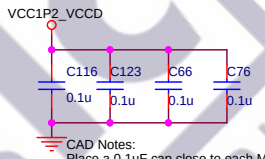
MAX10 Decoupling



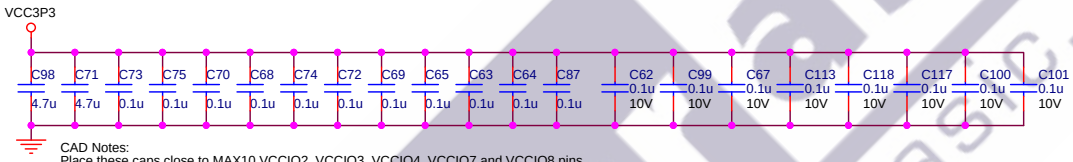
CAD Note:
Place capacitor near FPGA pins



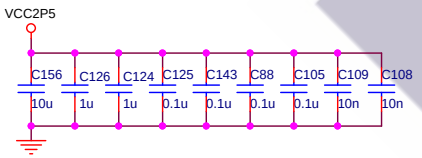
CAD Notes:
Place a 1uF cap close to each MAX10 VCCA pins.



CAD Notes:
Place a 0.1uF cap close to each MAX10 VCCD pins.



CAD Notes:
Place these caps close to MAX10 VCCIO2, VCCIO3, VCCIO4, VCCIO7 and VCCIO8 pins.



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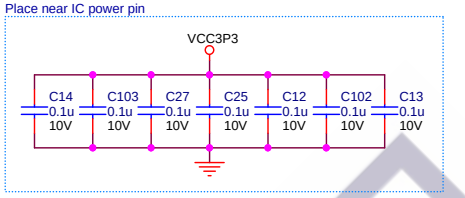
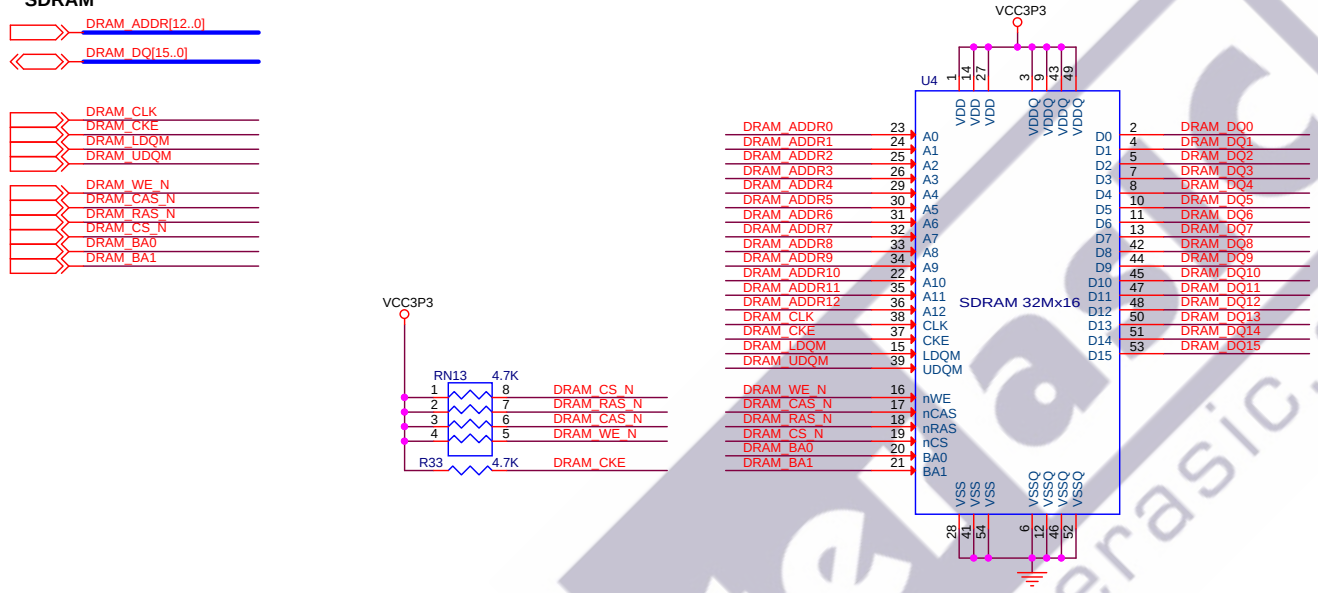
SDRAM

CAD Note:
Place near IC power pin





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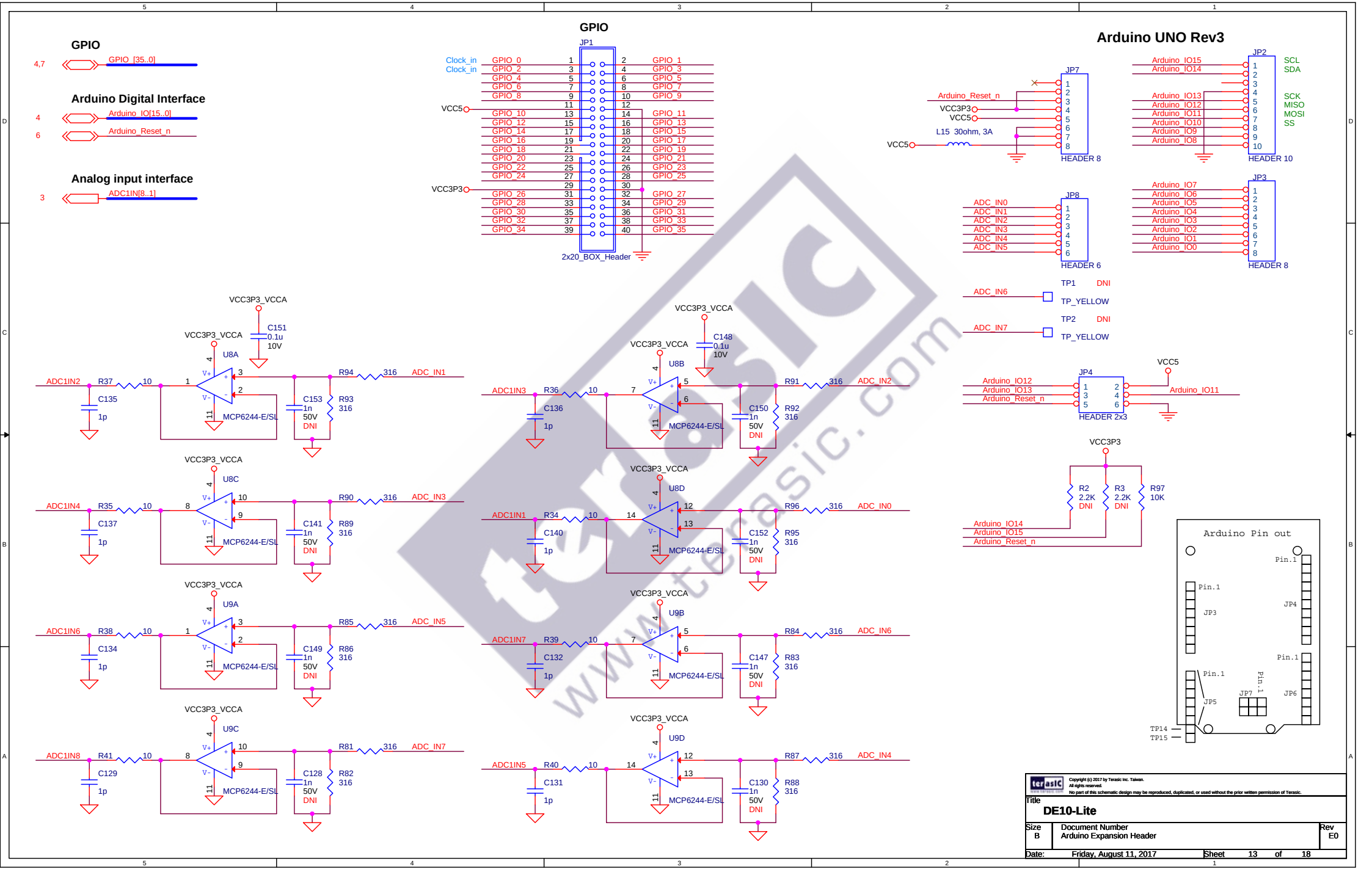

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B	Arduino Expansion Header	E0

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User IO, 7-Seg, LED

SWITCH

6 SW[9..0]

KEY

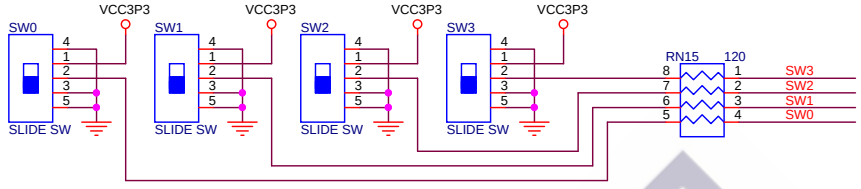
6 KEY[1..0]

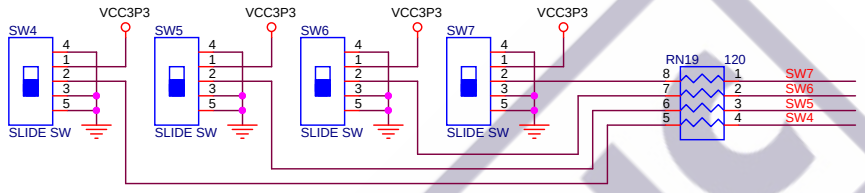
LED

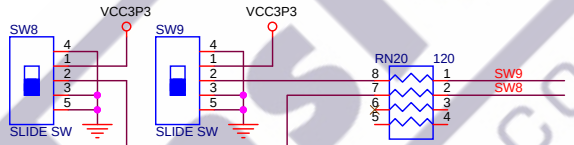
6 LEDR[9..0]

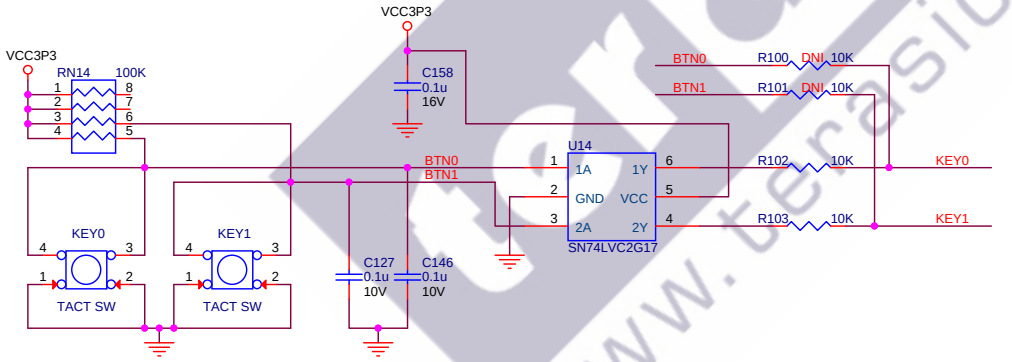
7-segment Display

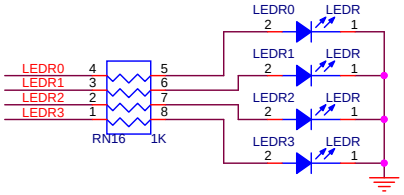
6 HEX0[7..0]
5,6 HEX1[7..0]
5,6 HEX2[7..0]
5,6 HEX3[7..0]
5 HEX4[7..0]
5 HEX5[7..0]

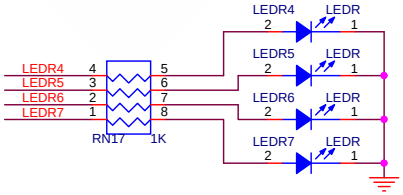


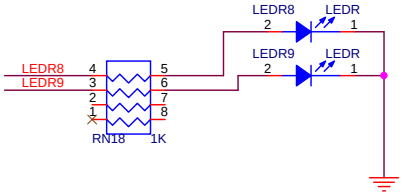


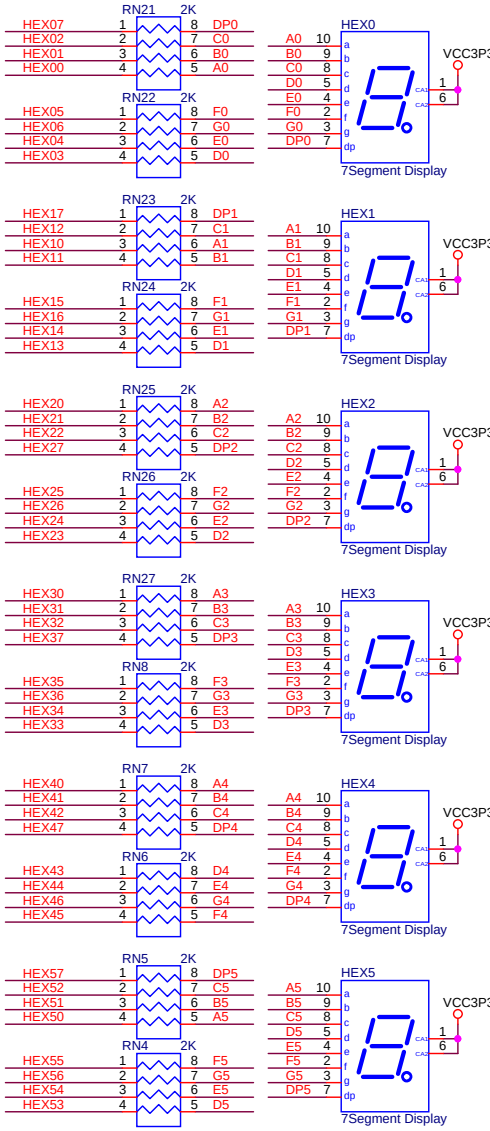












Title
DE10-Lite

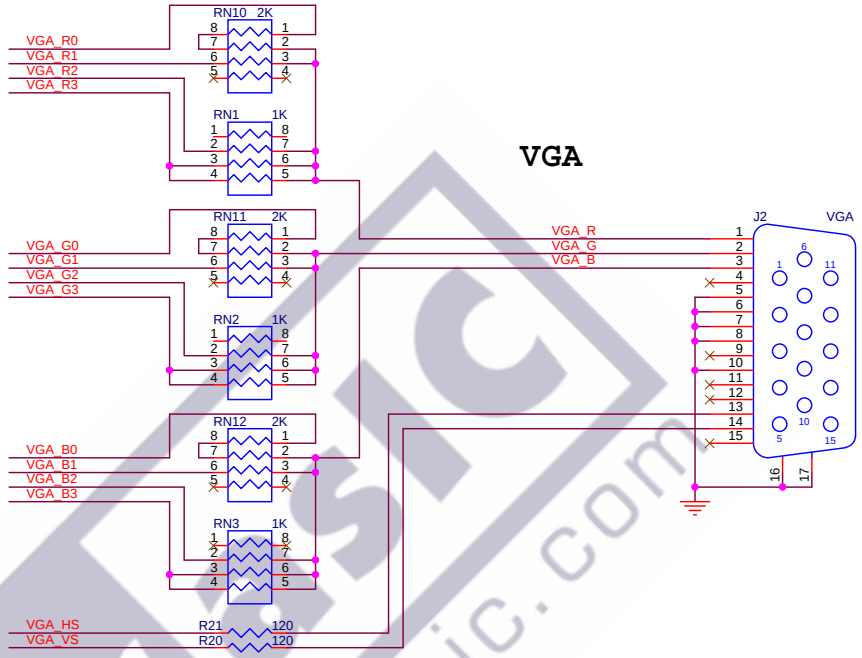
Size	Document Number	Rev
B	LED, 7'Segment, User I/O	E0

Date: Friday, August 04, 2017 Sheet 14 of 18

VGA and Accelerometer

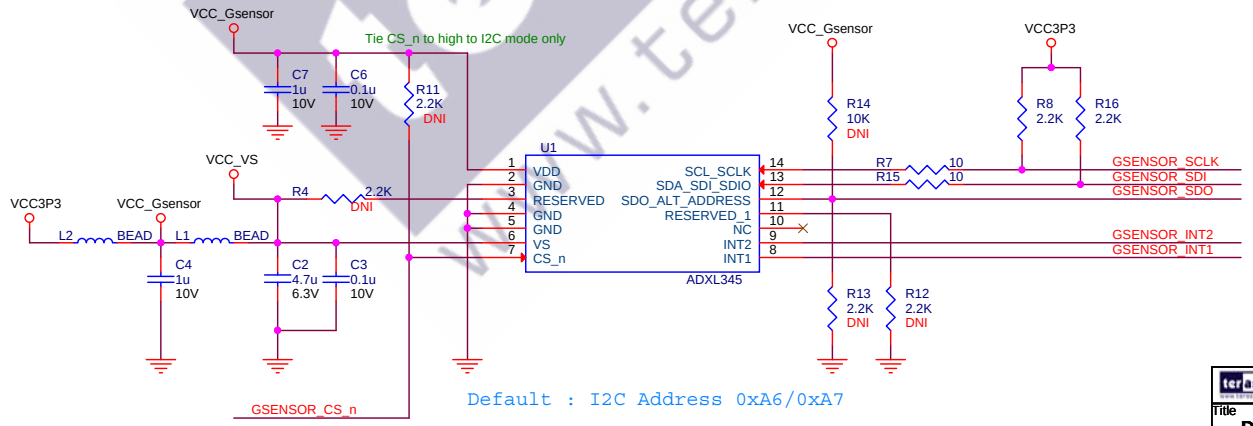
VGA

3,4 VGA_R[3..0]
3 VGA_G[3..0]
3 VGA_B[3..0]
3 VGA_HS
3 VGA_VS



Digital Accelerometer

4 GSENSOR_SDI
4 GSENSOR_SCLK
4 GSENSOR_INT1
4 GSENSOR_INT2
4 GSENSOR_CS_n
4 GSENSOR_SDO

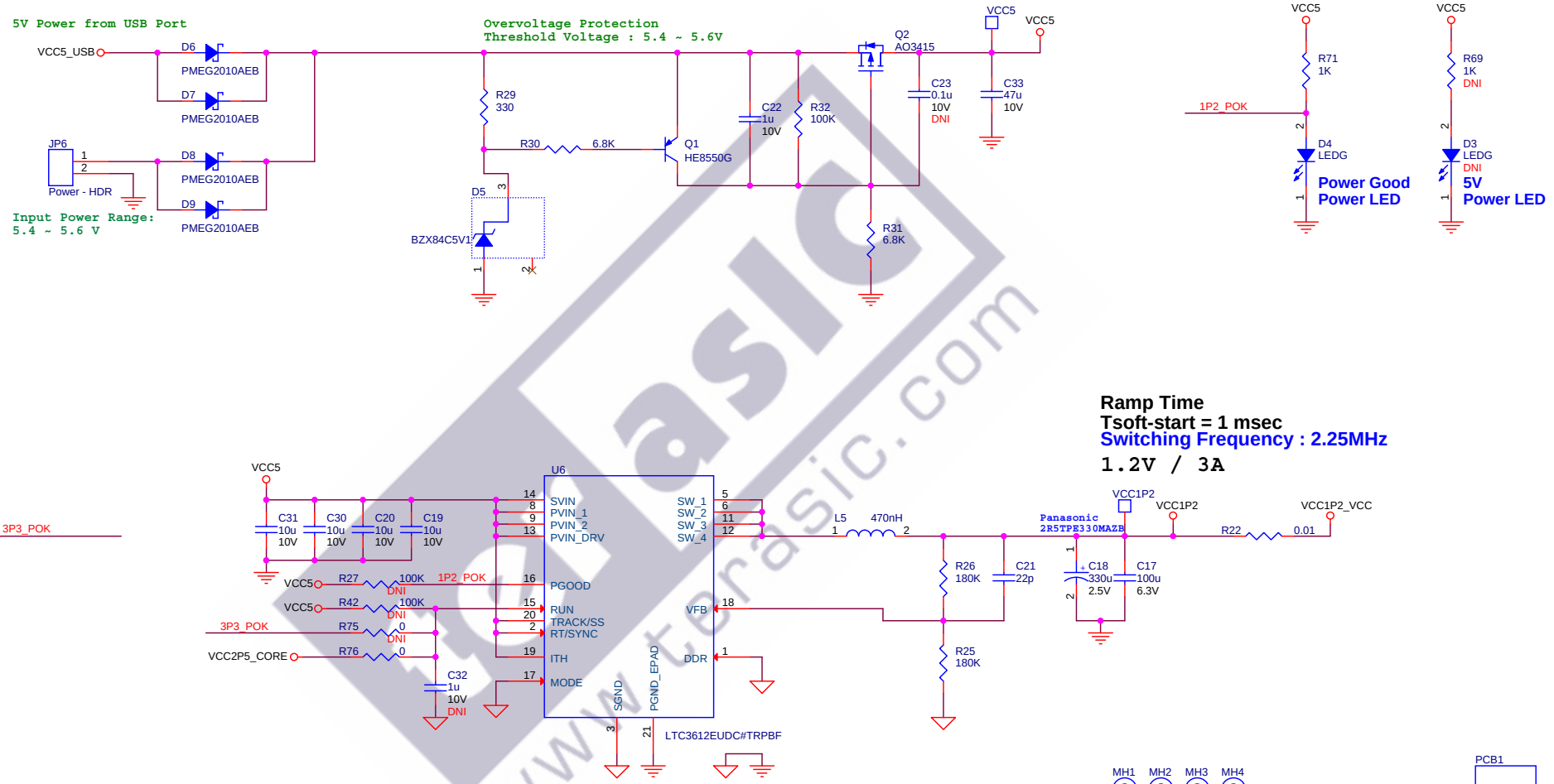


Default : I2C Address 0xA6/0xA7

Title	DE10-Lite	
Size B	Document Number VGA and Accelerometer	Rev E0
Date: Thursday, April 13, 2017	Sheet 15 of 18	

Power - 5V_DCIN / 1.2V

Power up Sequence:
VCC5---> VCC2P5, VCC3P3 ---> VCC1P2_VCC



Title: DE10-Lite		
Size: B	Document Number: Power - 12V, 5V	Rev: E0
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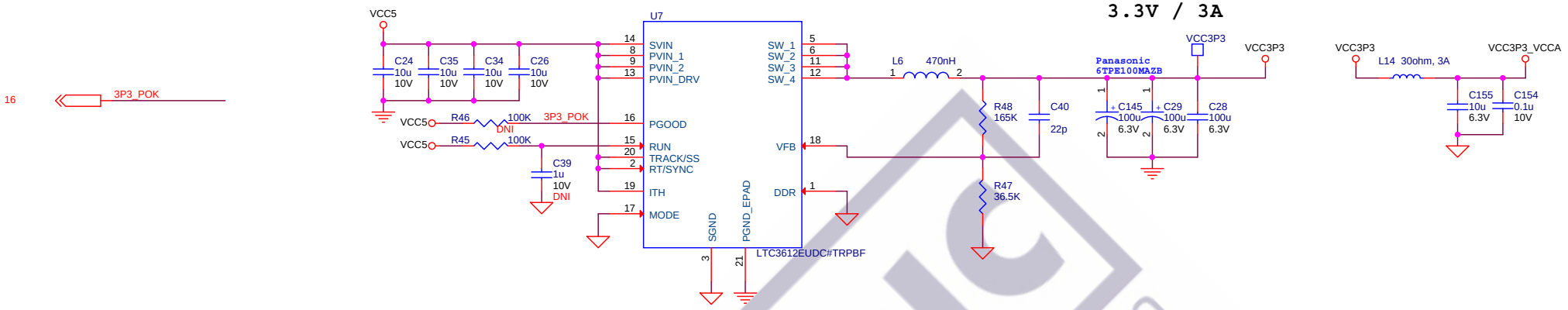
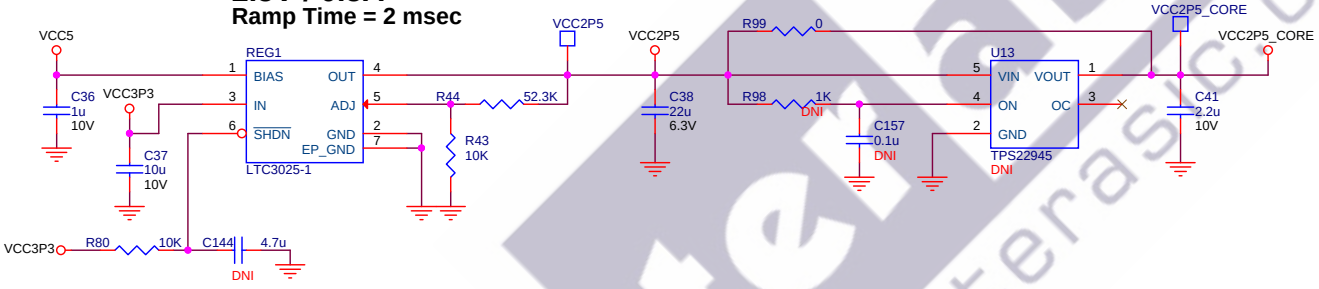
Power - 3.3V / 2.5V

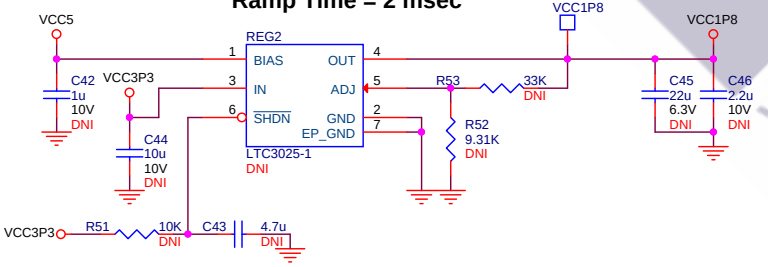
Ramp Time
Tsoft-start = 1 msec
Switching Frequency : 2.25MHz
3.3V / 3A



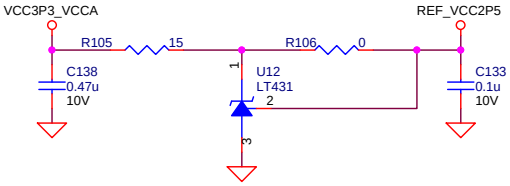
2.5V / 0.5A
Ramp Time = 2 msec



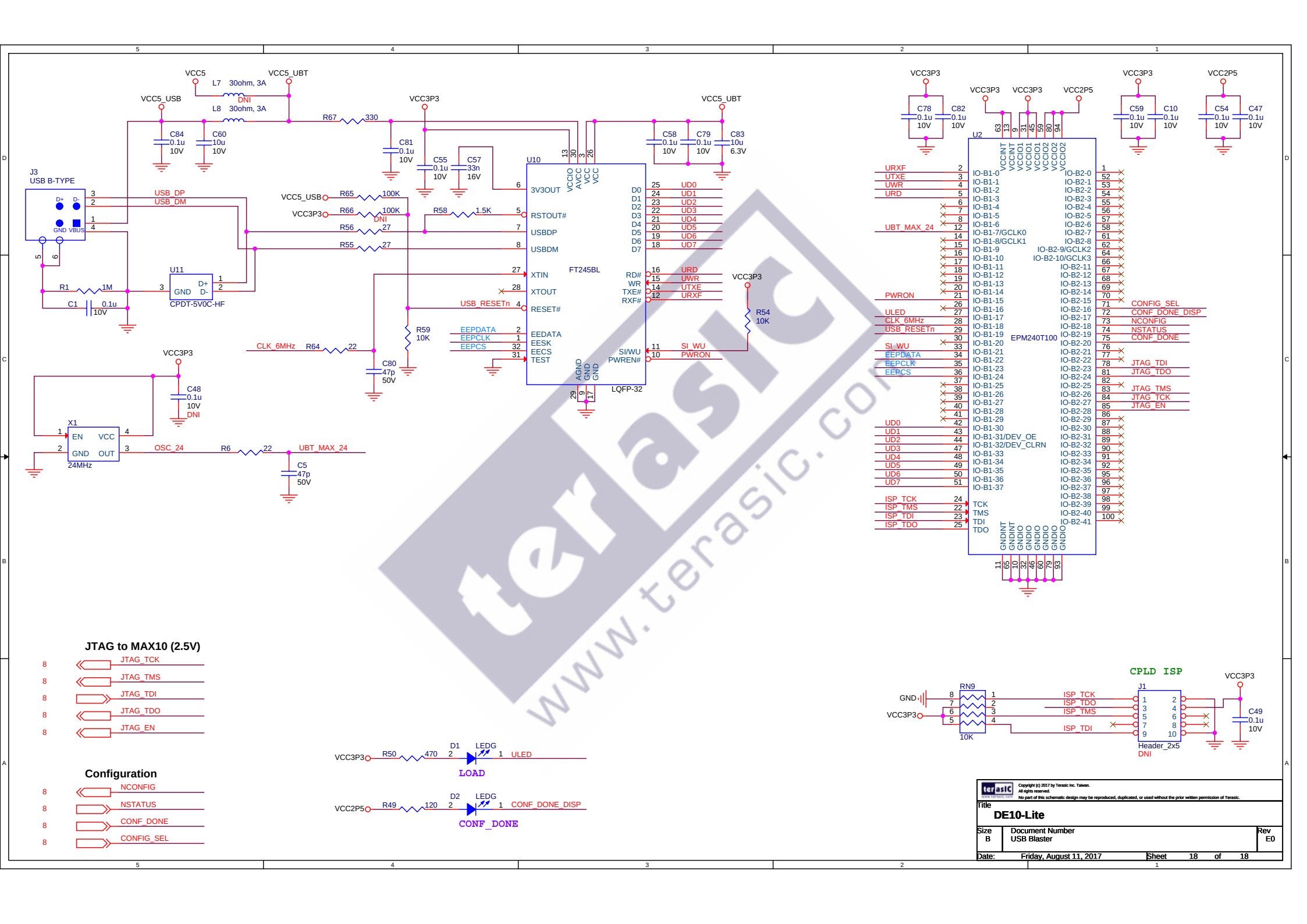
1.8V / 0.5A
Ramp Time = 2 msec



Voltage Reference



Title	DE10-Lite	
Size B	Document Number Power - 1.8V, 2.5V, 3.3V	Rev E0
Date: Friday, August 04, 2017	Sheet 17 of 18	



Title	DE10-Lite	
Size B	Document Number USB Blaster	Rev E0
Date: Friday, August 11, 2017	Sheet 18 of 18	