ALTERA MAX10 Development & Education Board (DE10-Lite)

Title: **DE10-Lite**

Size	Document Number	Rev
B	Cover Page	A1

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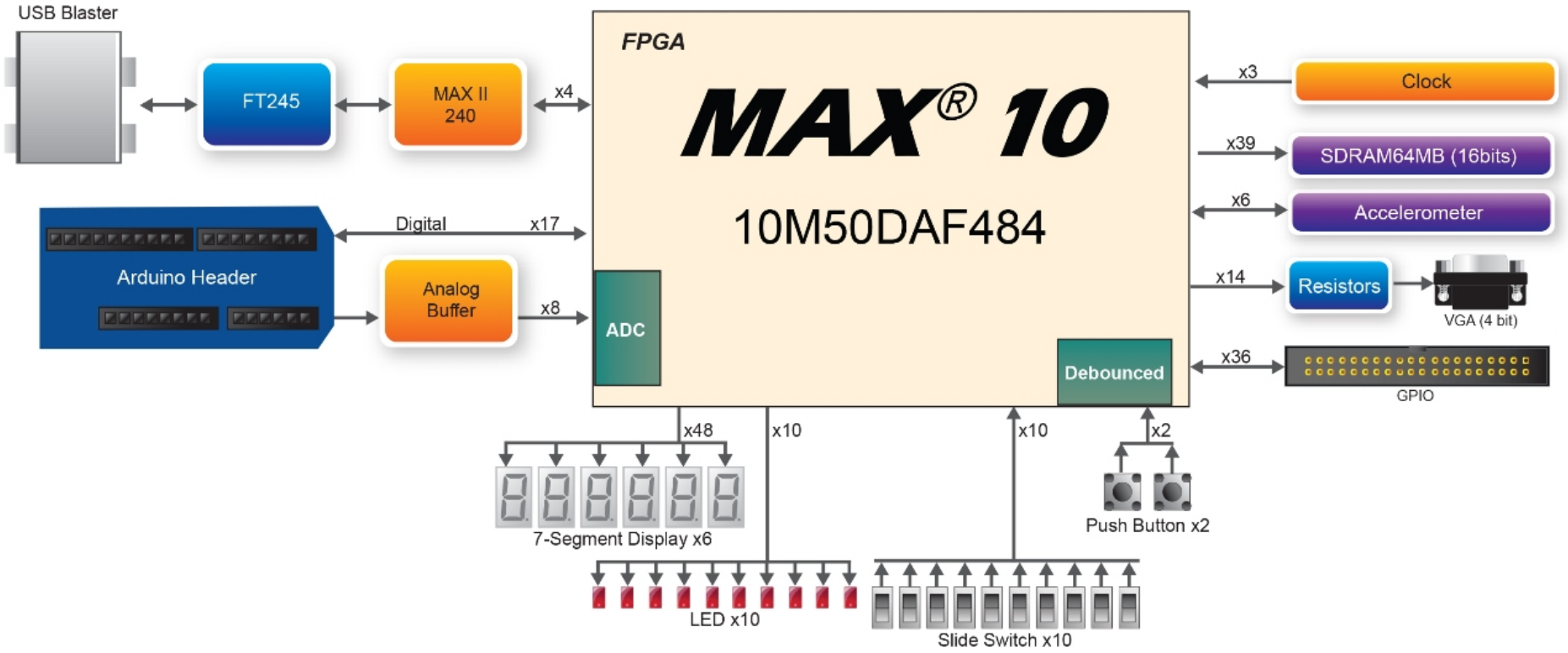

Title
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B	Block Diagram	A1

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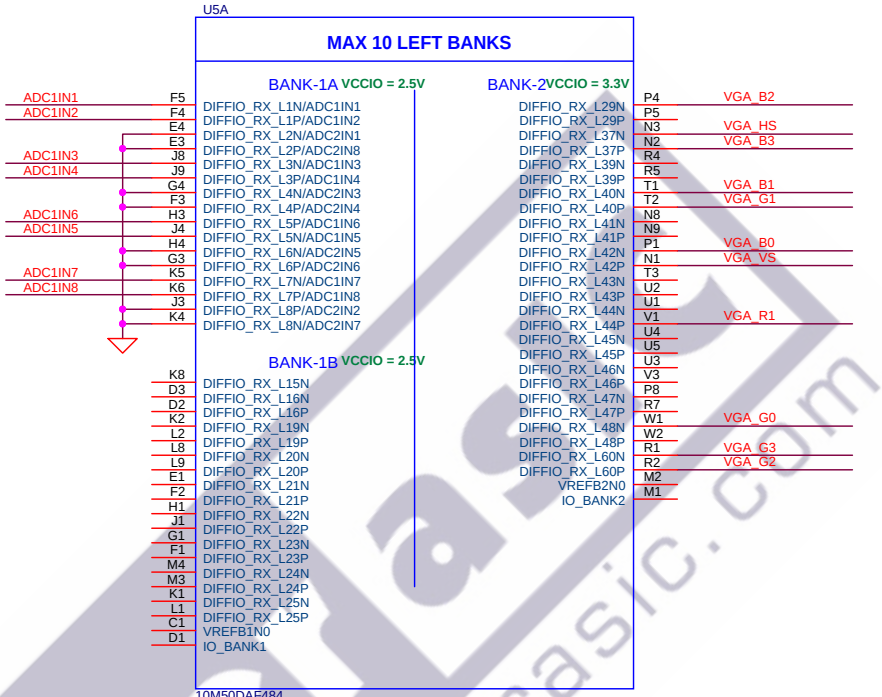
MAX10 Bank 1 & 2

Analog input interface

13 ADC1IN[8..1]

VGA

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



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Size	Document Number	Rev
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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

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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B	MAX 10 Bank 3 & 4	A1

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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

14 SW[9..0]

KEY

14 KEY[1..0]

LED

14 LEDR[9..0]

7-segment Display

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

U5C

MAX 10 RIGHT BANKS

		BANK-5 VCCIO = 3.3V	BANK-6 VCCIO = 3.3V		
DRAM_ADDR4	U19	DIFFIO_RX_R19N	DIFFIO_RX_R39N	H21	DRAM_DQ10
DRAM_ADDR2	V18	DIFFIO_RX_R19P	DIFFIO_RX_R39P	H22	DRAM_DQ11
DRAM_ADDR3	U18	DIFFIO_RX_R1P/RUP	DIFFIO_RX_R41N	J21	DRAM_UDQM
DRAM_ADDR0	U17	DIFFIO_RX_R1N/RDN	DIFFIO_RX_R41P	J22	DRAM_DQ9
DRAM_DQ5	W22	DIFFIO_RX_R20N	DIFFIO_RX_R42N	G19	DRAM_DQ14
DRAM_DQ4	Y22	DIFFIO_RX_R20P	DIFFIO_RX_R42P	G20	DRAM_DQ13
DRAM_DQ6	W20	DIFFIO_RX_R21N	DIFFIO_RX_R43N	F22	DRAM_DQ15
DRAM_ADDR1	W19	DIFFIO_RX_R21P	DIFFIO_RX_R43P	G22	DRAM_DQ12
DRAM_DQ0	Y21	DIFFIO_RX_R22N	DIFFIO_RX_R44N/DQ2R	M14	
DRAM_DQ1	Y20	DIFFIO_RX_R22P	DIFFIO_RX_R44P/DQ2R	M15	
DRAM_CS_N	U20	DIFFIO_RX_R23N	DIFFIO_RX_R45N	E21	HEX32
DRAM_WE_N	V20	DIFFIO_RX_R23P	DIFFIO_RX_R45P	E22	HEX31
DRAM_LDQM	V22	DIFFIO_RX_R24N	DIFFIO_RX_R46N/DM2R	N19	HEX55
DRAM_DQ7	V21	DIFFIO_RX_R24P	DIFFIO_RX_R46P/DQ2R	N18	HEX53
	R14	DIFFIO_RX_R25N/DQ1R	DIFFIO_RX_R47P/DQ2R	M20	HEX54
	R15	DIFFIO_RX_R25P/DQ1R	DIFFIO_RX_R47N/DQ2R	N20	HEX56
DRAM_BA1	T22	DIFFIO_RX_R26N	DIFFIO_RX_R48N	F20	HEX46
DRAM_BA0	T21	DIFFIO_RX_R26P	DIFFIO_RX_R48P	F21	HEX30
DRAM_ADDR5	T18	DIFFIO_RX_R27N/DM1R	DIFFIO_RX_R49N	C22	HEX25
DRAM_ADDR6	T19	DIFFIO_RX_R27P/DQ1R	DIFFIO_RX_R49P	D22	HEX37
DRAM_ADDR12	R20	DIFFIO_RX_R28N/DQ1R	DIFFIO_RX_R51N/DQ2R	L18	HEX52
DRAM_ADDR10	T20	DIFFIO_RX_R28P/DQ1R	DIFFIO_RX_R51P/DQ2R	M18	
DRAM_RAS_N	U22	DIFFIO_RX_R29N	DIFFIO_RX_R52N/DQ2R	L20	
DRAM_CAS_N	U21	DIFFIO_RX_R29P	DIFFIO_RX_R52P/DQ2R	L19	HEX57
DRAM_DQ2	AA22	DIFFIO_RX_R2N	DIFFIO_RX_R53N	F18	HEX40
DRAM_DQ3	AA21	DIFFIO_RX_R2P	DIFFIO_RX_R53P	E19	HEX42
	P14	DIFFIO_RX_R30N/DQ1R	DIFFIO_RX_R54N	E20	HEX41
	P15	DIFFIO_RX_R30P/DQ1R	DIFFIO_RX_R54P	F19	HEX45
DRAM_CKE	N22	DIFFIO_RX_R31N	DIFFIO_RX_R55N/DQSN3R	K15	
DRAM_DQ8	P21	DIFFIO_RX_R31P	DIFFIO_RX_R55P/DQS3R	K14	
DRAM_ADDR8	P18	DIFFIO_RX_R32N/DQSN1R	DIFFIO_RX_R56N	D19	HEX35
DRAM_ADDR7	R18	DIFFIO_RX_R32P/DQS1R	DIFFIO_RX_R56P	C20	HEX34
DRAM_ADDR11	P20	DIFFIO_RX_R33N/DQ1R	DIFFIO_RX_R57N/DQ3R	J18	HEX43
DRAM_ADDR9	P19	DIFFIO_RX_R33P/DQ1R	DIFFIO_RX_R57P/DQ3R	K18	
	L22	DIFFIO_RX_R34N	DIFFIO_RX_R58N/DQ3R	K20	HEX51
	M21	DIFFIO_RX_R34P	DIFFIO_RX_R58P/DQ3R	K19	
	M22	DIFFIO_RX_R35N	DIFFIO_RX_R59N	E17	HEX36
	N21	DIFFIO_RX_R35P	DIFFIO_RX_R59P	F17	HEX47
	P22	VREFB5N0	DIFFIO_RX_R60N	B21	HEX24
	R22	IO_BANK5	DIFFIO_RX_R60P	B22	HEX26
			DIFFIO_RX_R61N/DM3R	J15	
			DIFFIO_RX_R61P/DQ3R	J14	
			DIFFIO_RX_R62N	A21	HEX23
			DIFFIO_RX_R62P	B20	HEX20
			DIFFIO_RX_R63N/DQ3R	H18	
			DIFFIO_RX_R63P/DQ3R	H19	HEX44
			DIFFIO_RX_R64N/DQ3R	H20	
			DIFFIO_RX_R64P/DQ3R	J20	HEX50
			DIFFIO_RX_R70N/CK#_6	E18	HEX12
			DIFFIO_RX_R70P/CK_6	D18	HEX11
			VREFB6N0	D21	
			IO_BANK6	C21	

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MAX10 Bank 7 & 8

7-segment Display

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

SWITCH

14 SW[9..0]

KEY

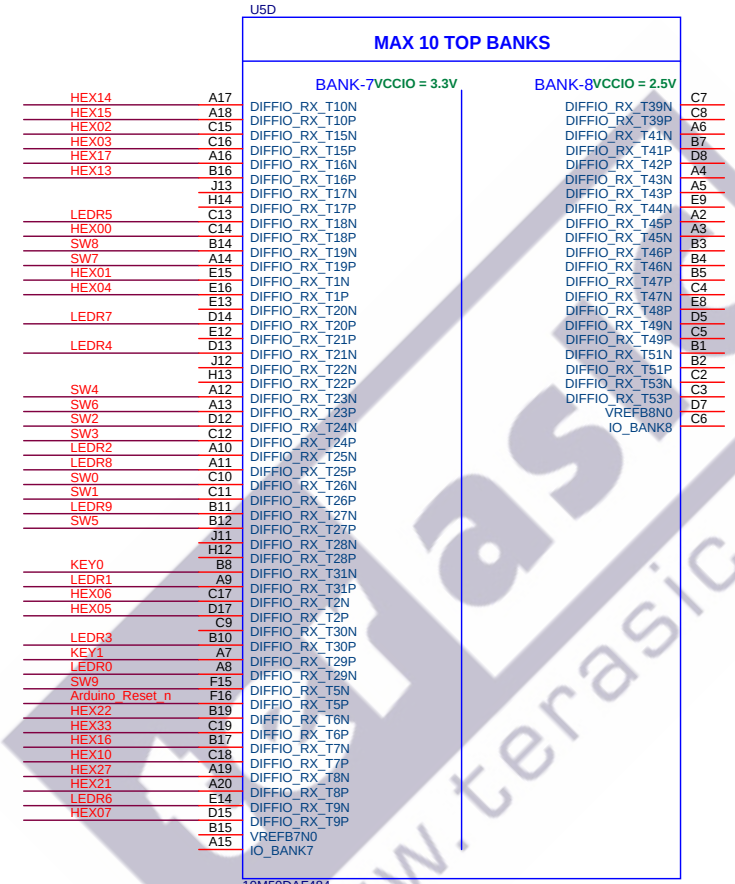
14 KEY[1..0]

LED

14 LEDR[9..0]

Arduino Digital Interface

13 Arduino_Reset_n



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MAX10 Clock

18 UBT_CLK_24

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 pin 3 and 5 (C3 & C322)

CAD Note: Place near IC power pin

VCC1P8 — C50 0.01u 50V — C51 1n 50V — L3 220 ohm, 0.4A — VCC3P3

C53 0.1u 10V — C56 0.1u 10V — C52 0.1u 10V — C8 4.7u 6.3V

U3 CDCE937PWRG4

C9 4p 6.3V DNI — C11 4p 6.3V DNI — Y1 24.00MHz

VCC3P3 — R19 4.7K — R18 4.7K

Xin/Clk	Y1	R57 18.2	UBT_CLK_24
Xout	Y2		
S0	Y3	R17 18.2	ADC_CLK_10
S1/SDA	Y4	R10 18.2	MAX10_CLK2_50
S2/SCL	Y5	R9 18.2	MAX10_CLK1_50
Vctrl	Y6		
	Y7		

Default: 24MHz
Default: 24MHz
Default: 10MHz
Default: 50MHz
Default: 50MHz
Default: 50MHz
Default: 50MHz

Default : I2C Address 0xDA/0xDB

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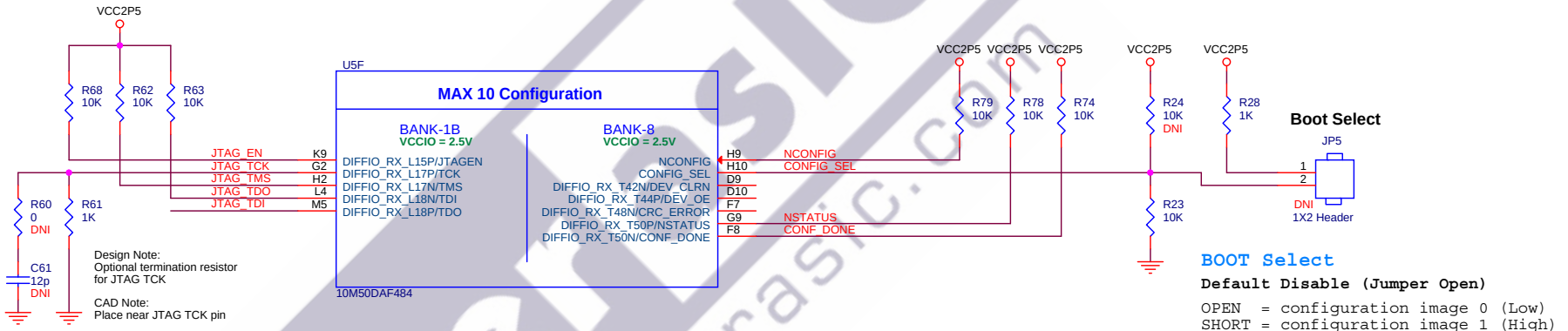
MAX10 Configuration

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



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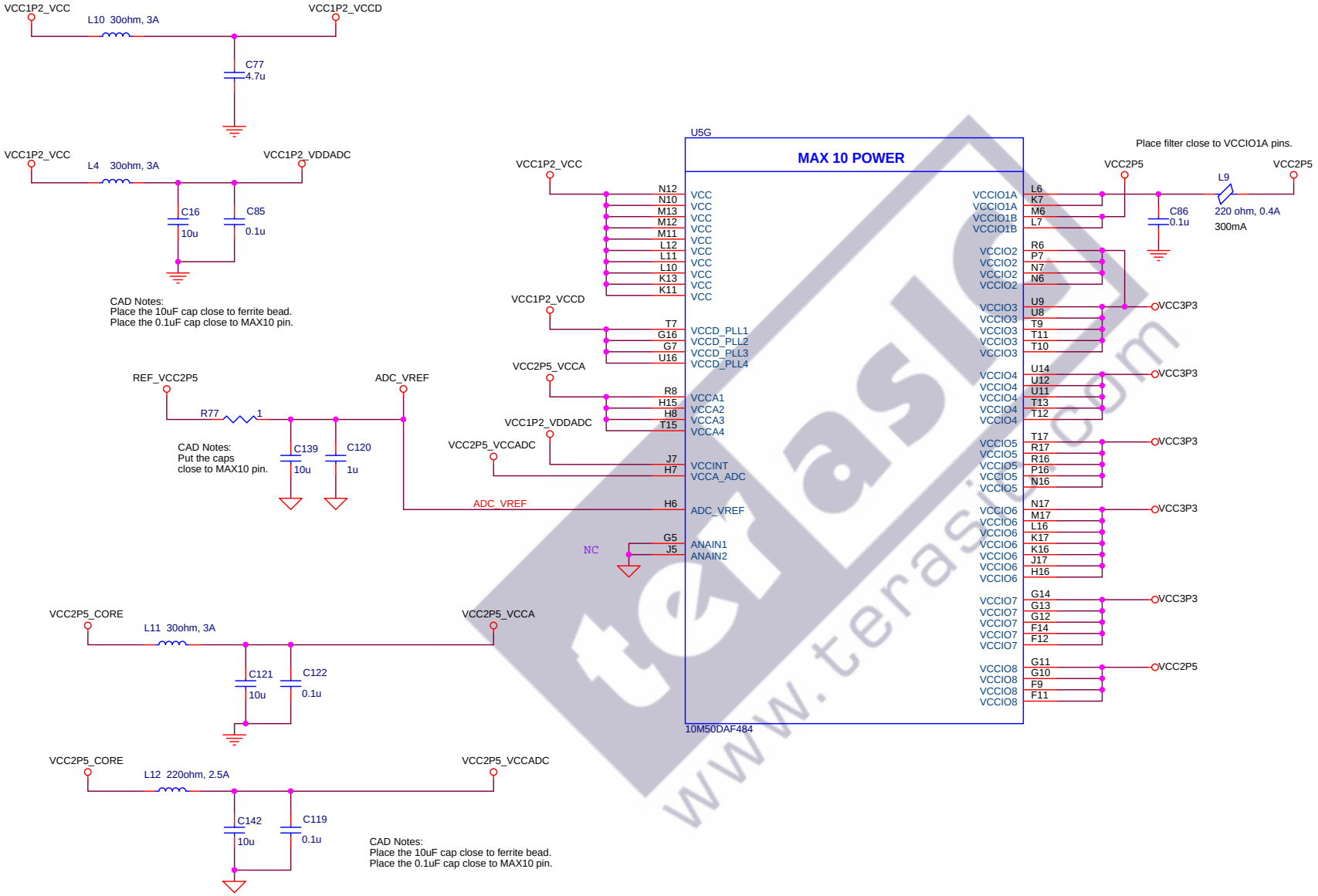
MAX10 Power



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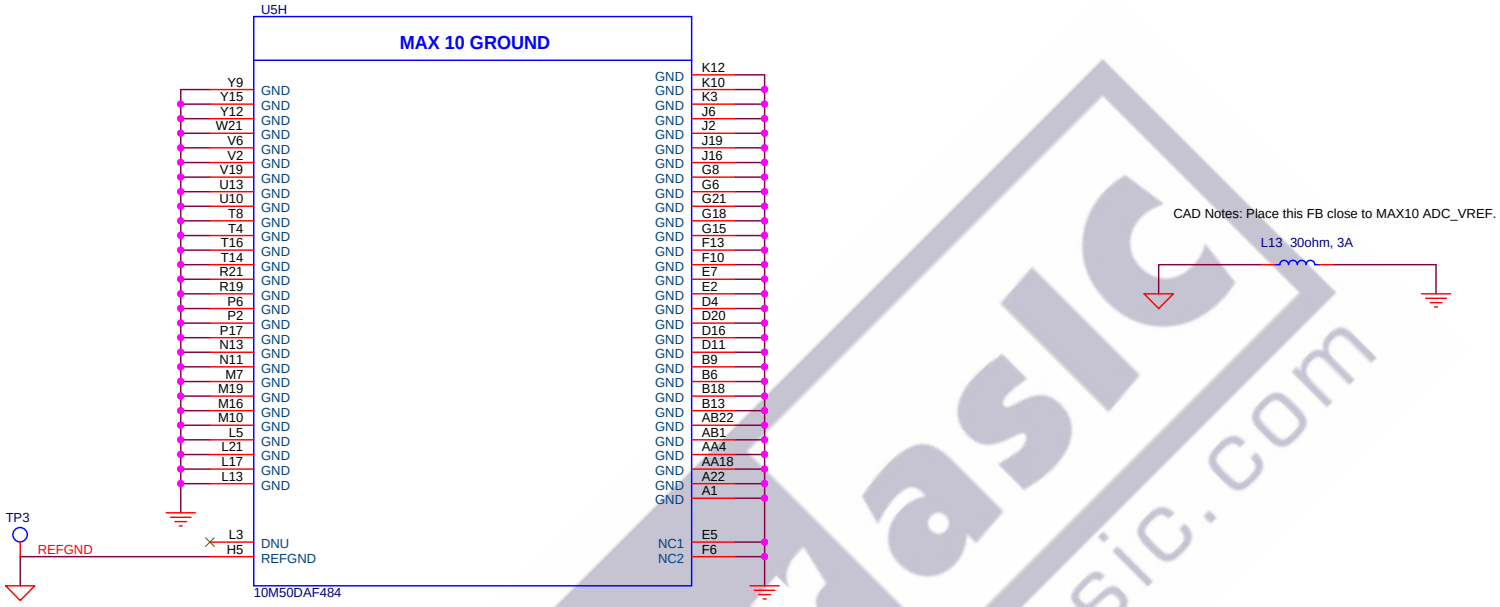
MAX10 Ground



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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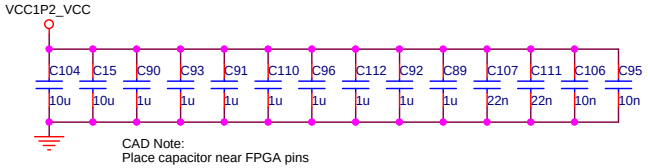
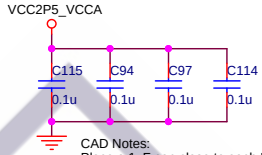
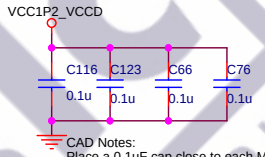
MAX10 Decoupling



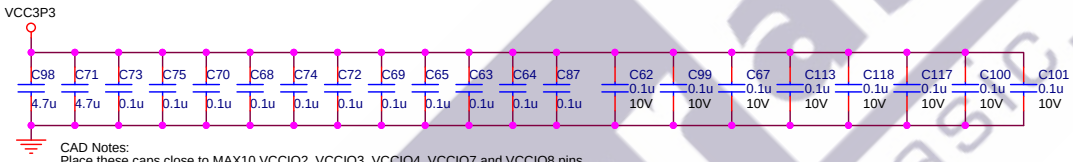
CAD Note:
Place capacitor near FPGA pins



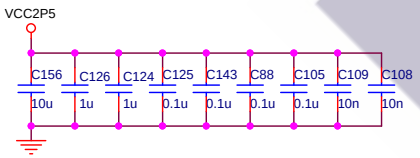
CAD Notes:
Place a 1uF cap close to each MAX10 VCCA pins.



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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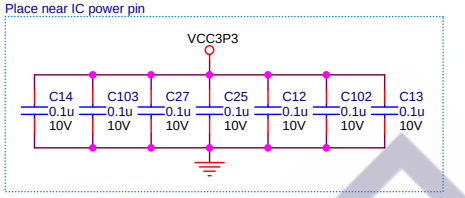
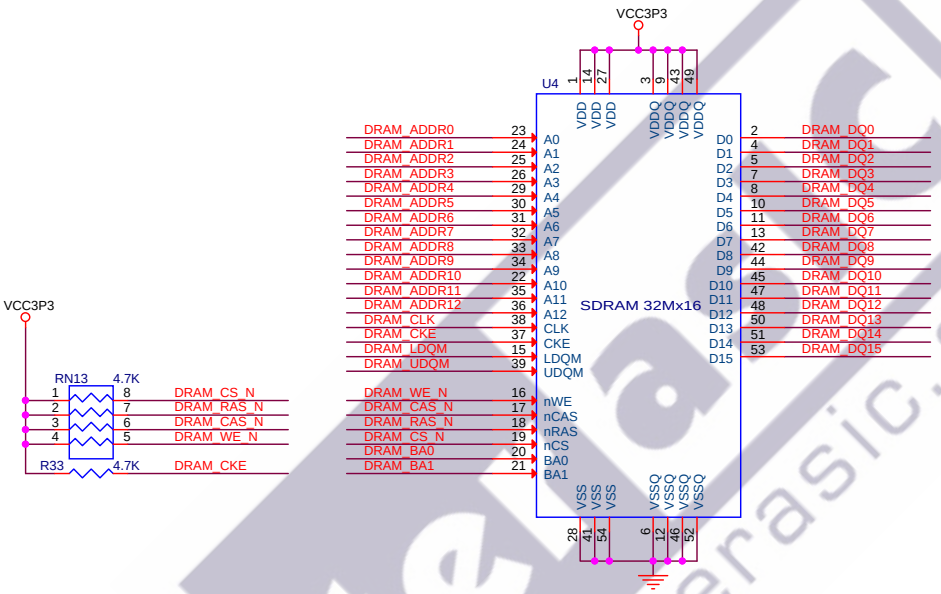
SDRAM

DRAM_ADDR[12..0]
DRAM_DQ[15..0]
DRAM_CLK
DRAM_CKE
DRAM_LDQM
DRAM_UDQM
DRAM_WE_N
DRAM_CAS_N
DRAM_RAS_N
DRAM_CS_N
DRAM_BA0
DRAM_BA1

CAD Note:
Place near IC power pin





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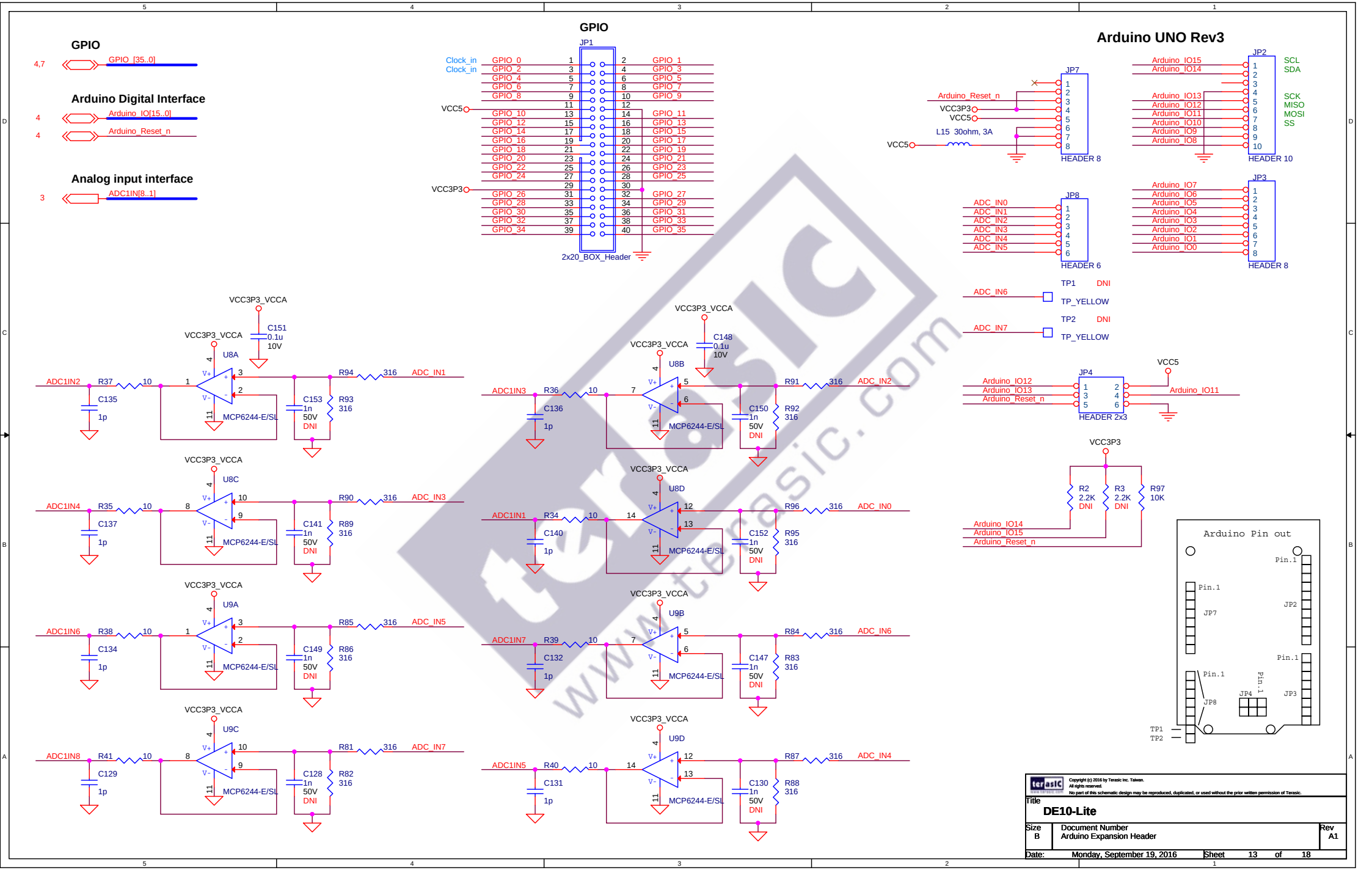
GPIO
4,7
GPIO_[35..0]
Arduino Digital Interface
4
Arduino_IO[15..0]
4
Arduino_Reset_n
Analog input interface
3
ADC1IN[8..1]
GPIO
JP1
Clock_in
Clock_in
GPIO_0
GPIO_2
GPIO_4
GPIO_6
GPIO_8
GPIO_10
GPIO_12
GPIO_14
GPIO_16
GPIO_18
GPIO_20
GPIO_22
GPIO_24
GPIO_26
GPIO_28
GPIO_30
GPIO_32
GPIO_34
GPIO_1
GPIO_3
GPIO_5
GPIO_7
GPIO_9
GPIO_11
GPIO_13
GPIO_15
GPIO_17
GPIO_19
GPIO_21
GPIO_23
GPIO_25
GPIO_27
GPIO_29
GPIO_31
GPIO_33
GPIO_35
VCC5
VCC3P3
2x20_BOX_Header
Arduino UNO Rev3
JP7
Arduino_Reset_n
VCC3P3
VCC5
L15 30ohm, 3A
VCC5
HEADER 8
JP2
Arduino_IO15
Arduino_IO14
Arduino_IO13
Arduino_IO12
Arduino_IO11
Arduino_IO10
Arduino_IO9
Arduino_IO8
SCL
SDA
SCK
MISO
MOSI
SS
HEADER 10
JP8
ADC_IN0
ADC_IN1
ADC_IN2
ADC_IN3
ADC_IN4
ADC_IN5
HEADER 6
JP3
Arduino_IO7
Arduino_IO6
Arduino_IO5
Arduino_IO4
Arduino_IO3
Arduino_IO2
Arduino_IO1
Arduino_IO0
HEADER 8
ADC_IN6
TP1 DNI
TP_YELLOW
ADC_IN7
TP2 DNI
TP_YELLOW
VCC5
JP4
Arduino_IO12
Arduino_IO13
Arduino_Reset_n
Arduino_IO11
HEADER 2x3
VCC3P3
R2 2.2K DNI
R3 2.2K DNI
R97 10K
Arduino_IO14
Arduino_IO15
Arduino_Reset_n
Arduino Pin out
VCC3P3_VCCA
U8A
C151 0.1u 10V
ADC1IN2
R37 10
C135 1p
MCP6244-E/SL
C153 1n 50V DNI
R93 316
R94 316
ADC_IN1
U8C
ADC1IN4
R35 10
C137 1p
C141 1n 50V DNI
R89 316
R90 316
ADC_IN3
U9A
ADC1IN6
R38 10
C134 1p
C149 1n 50V DNI
R86 316
R85 316
ADC_IN5
U9C
ADC1IN8
R41 10
C129 1p
C128 1n 50V DNI
R82 316
R81 316
ADC_IN7
U8B
C148 0.1u 10V
ADC1IN3
R36 10
C136 1p
C150 1n 50V DNI
R92 316
R91 316
ADC_IN2
U8D
ADC1IN1
R34 10
C140 1p
C152 1n 50V DNI
R95 316
R96 316
ADC_IN0
U9B
ADC1IN7
R39 10
C132 1p
C147 1n 50V DNI
R83 316
R84 316
ADC_IN6
U9D
ADC1IN5
R40 10
C131 1p
C130 1n 50V DNI
R88 316
R87 316
ADC_IN4
MCP6244-E/SL
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Arduino Expansion Header
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User IO, 7-Seg, LED

SWITCH

5 SW[9..0]

KEY

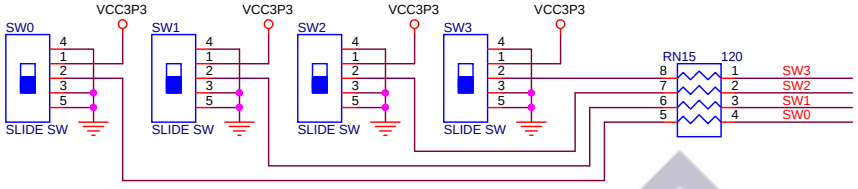
5 KEY[1..0]

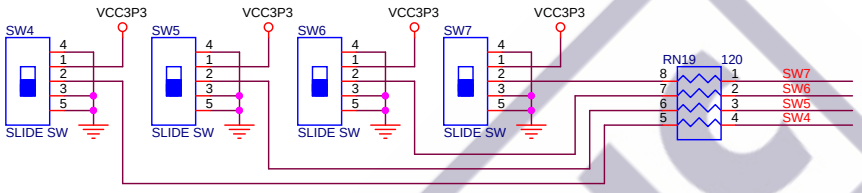
LED

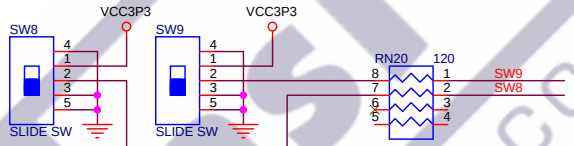
5 LEDR[9..0]

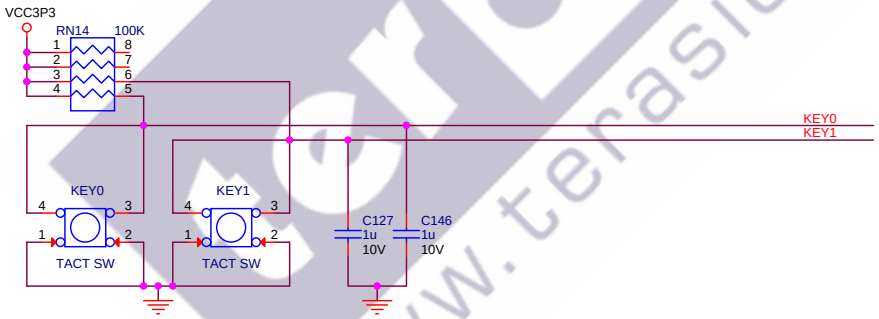
7-segment Display

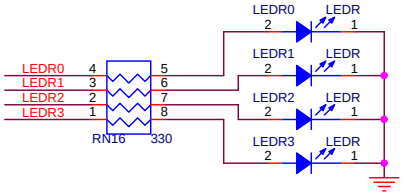
6 HEX0[7..0]
6 HEX1[7..0]
6 HEX2[7..0]
6 HEX3[7..0]
6 HEX4[7..0]
6 HEX5[7..0]

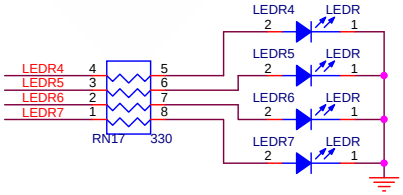


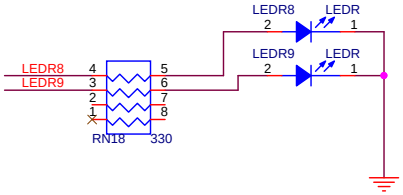


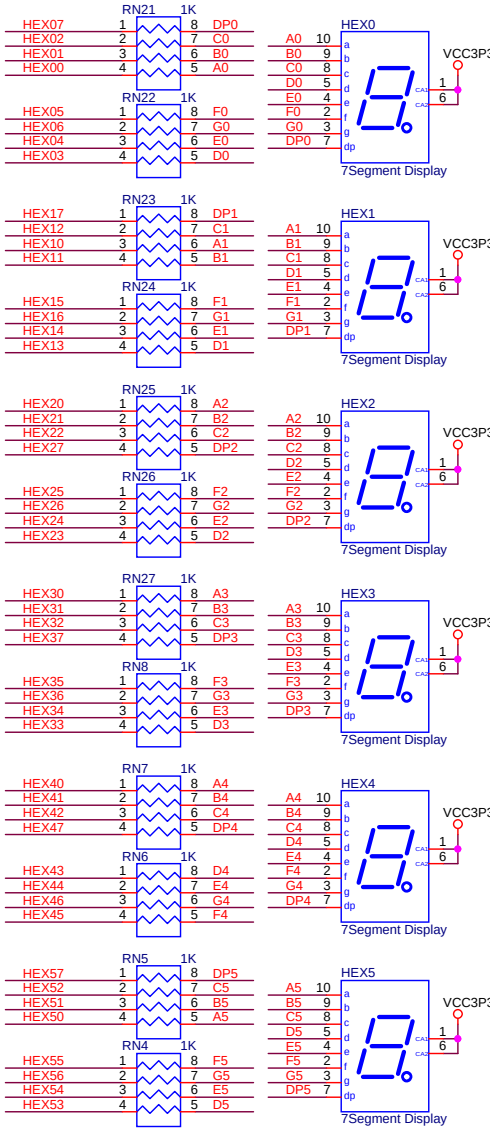












Title: **DE10-Lite**

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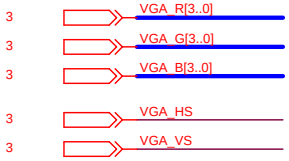
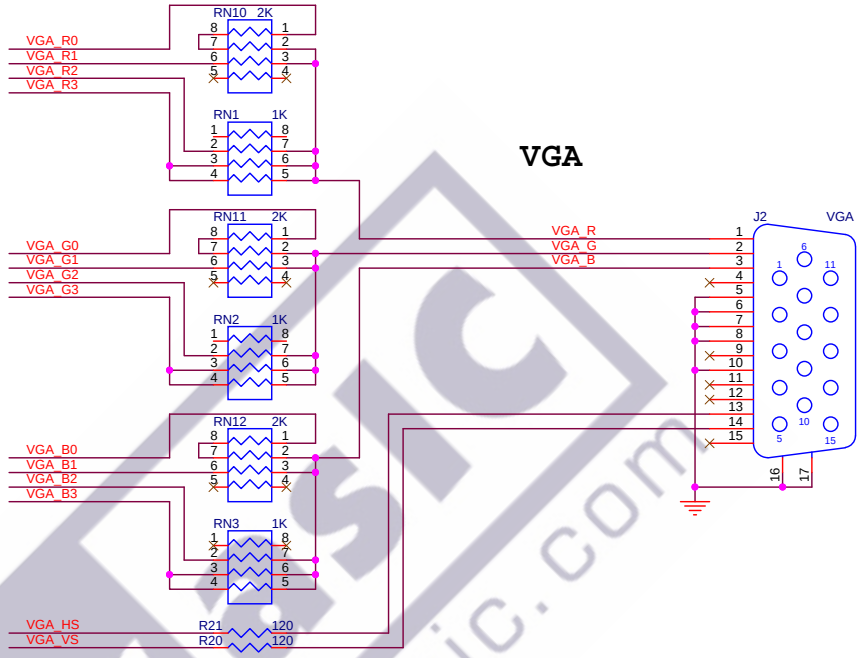
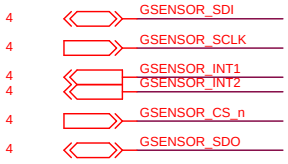
VGA and Accelerometer

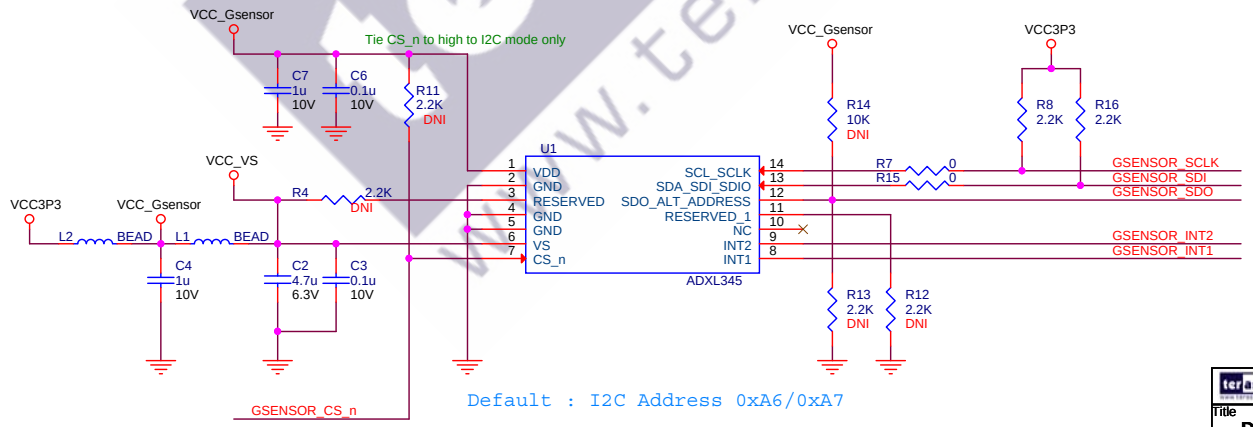
VGA





Digital Accelerometer





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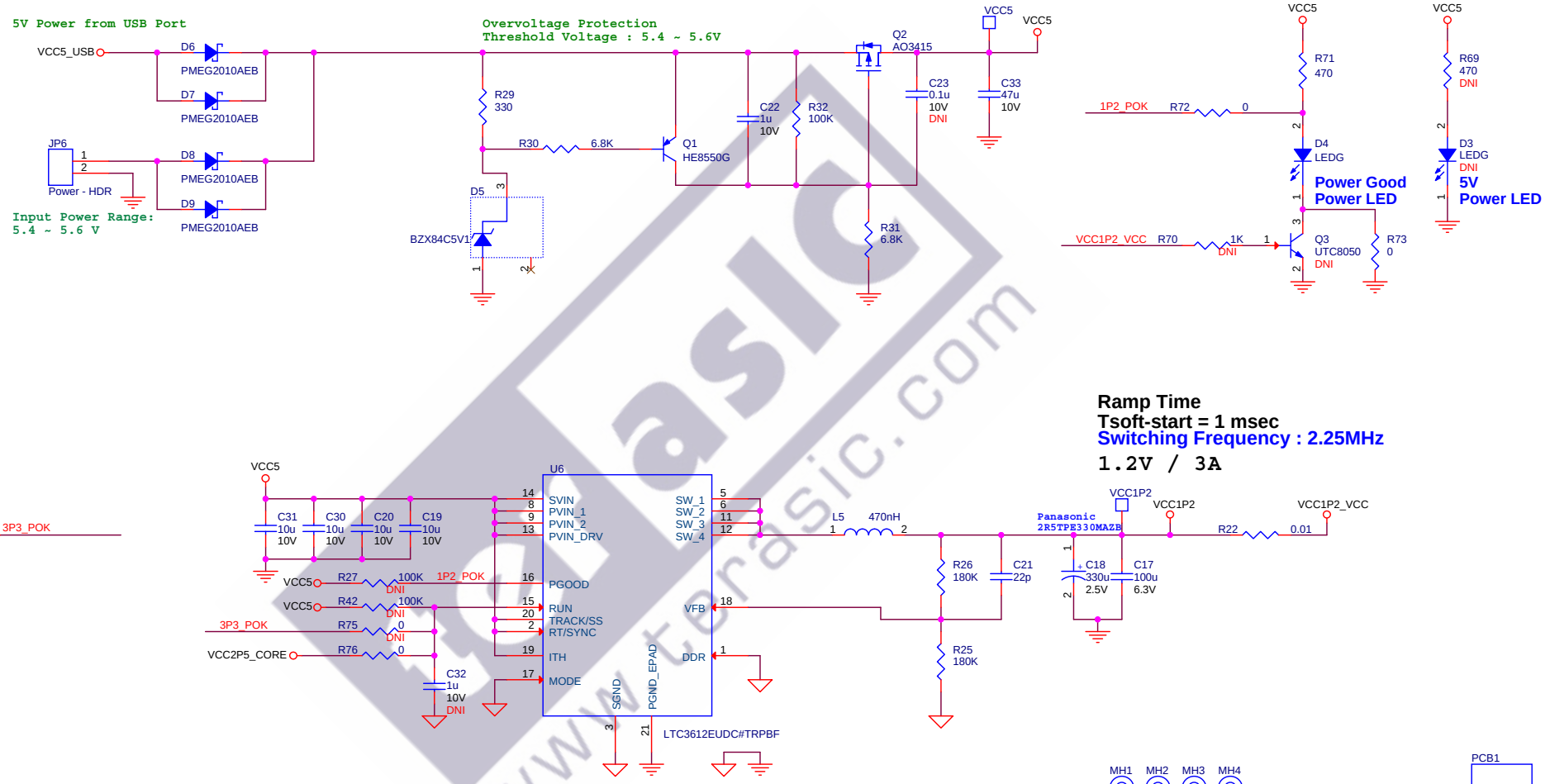
Power - 5V_DCIN / 1.2V

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



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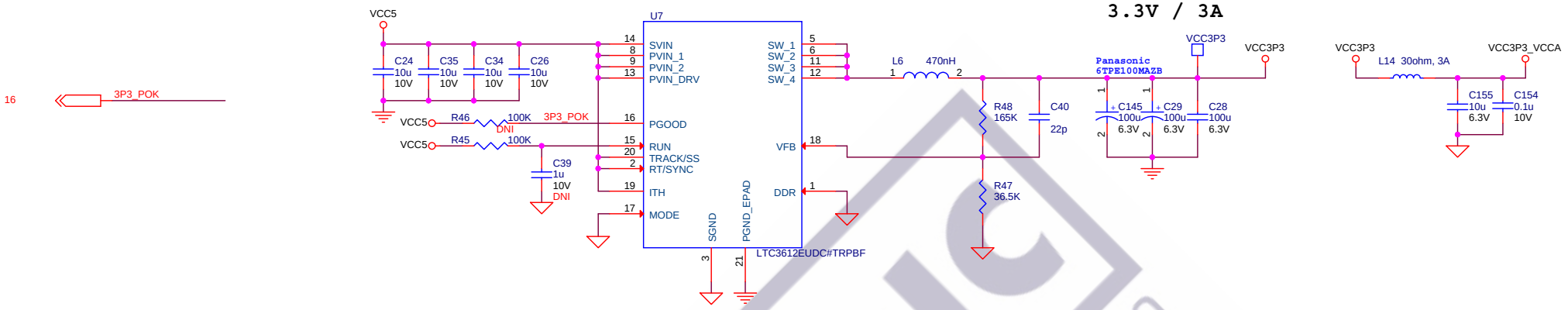
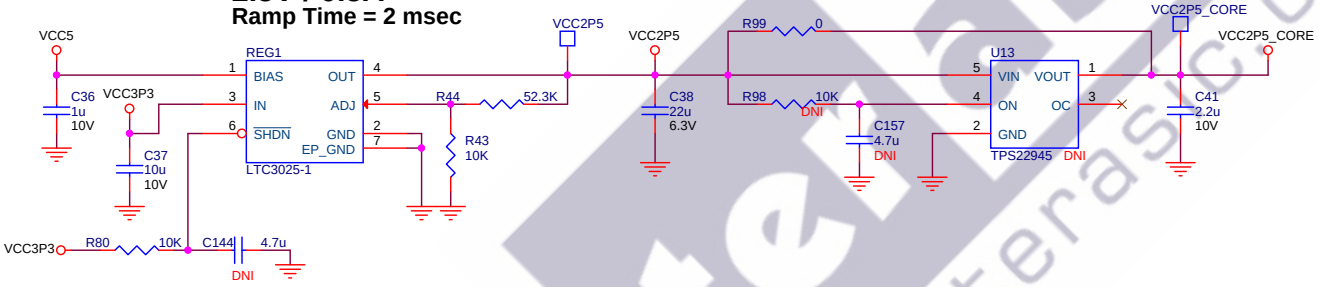
Power - 3.3V / 2.5V

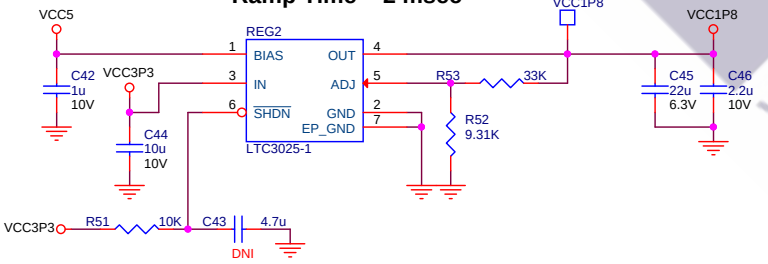
Ramp Time
Tsoft-start = 1 msec
Switching Frequency : 2.25MHz
3.3V / 3A



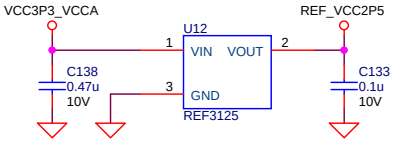
2.5V / 0.5A
Ramp Time = 2 msec



1.8V / 0.5A
Ramp Time = 2 msec



Voltage Reference



Title	DE10-Lite	
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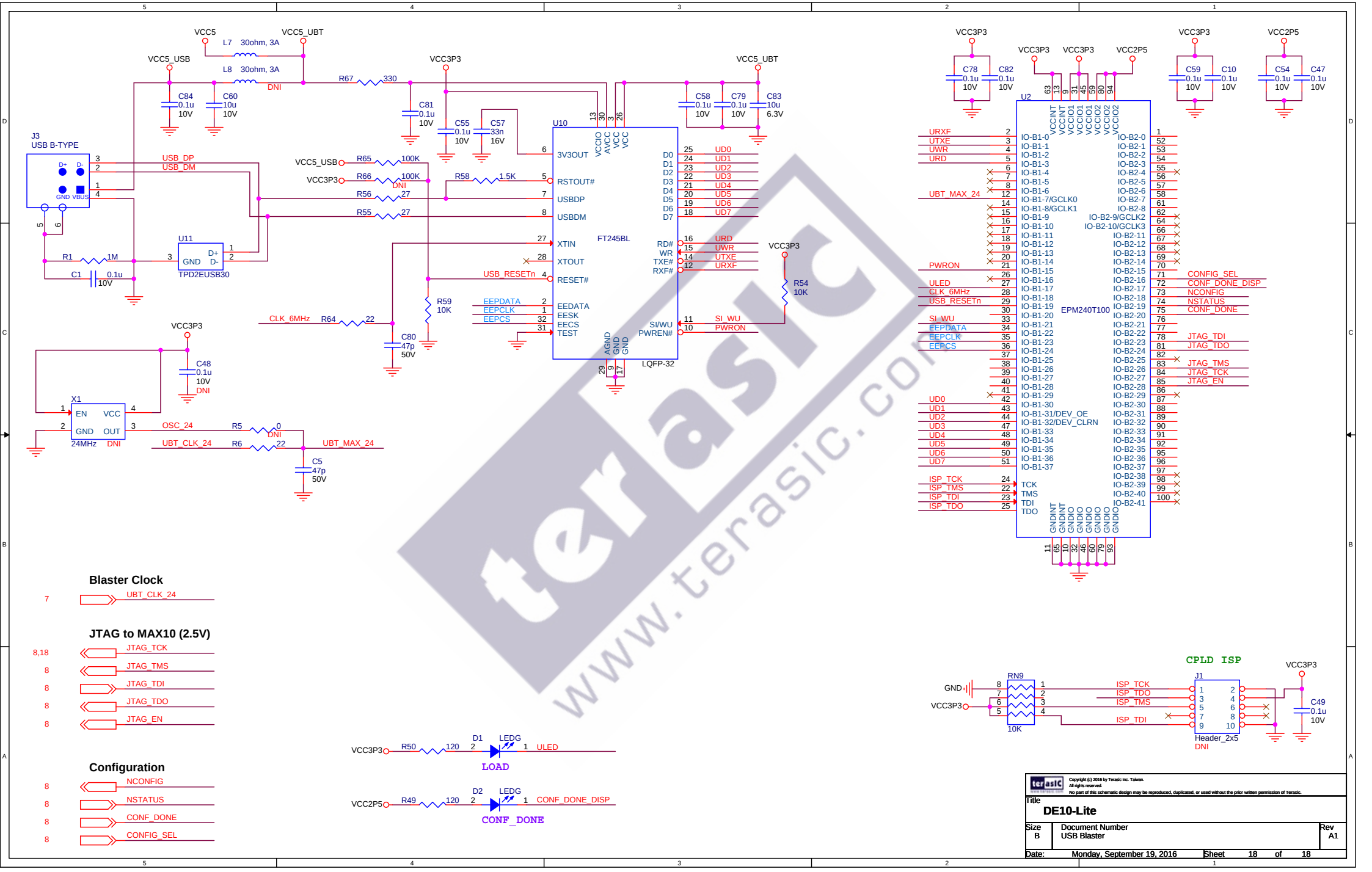

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