NOTES:

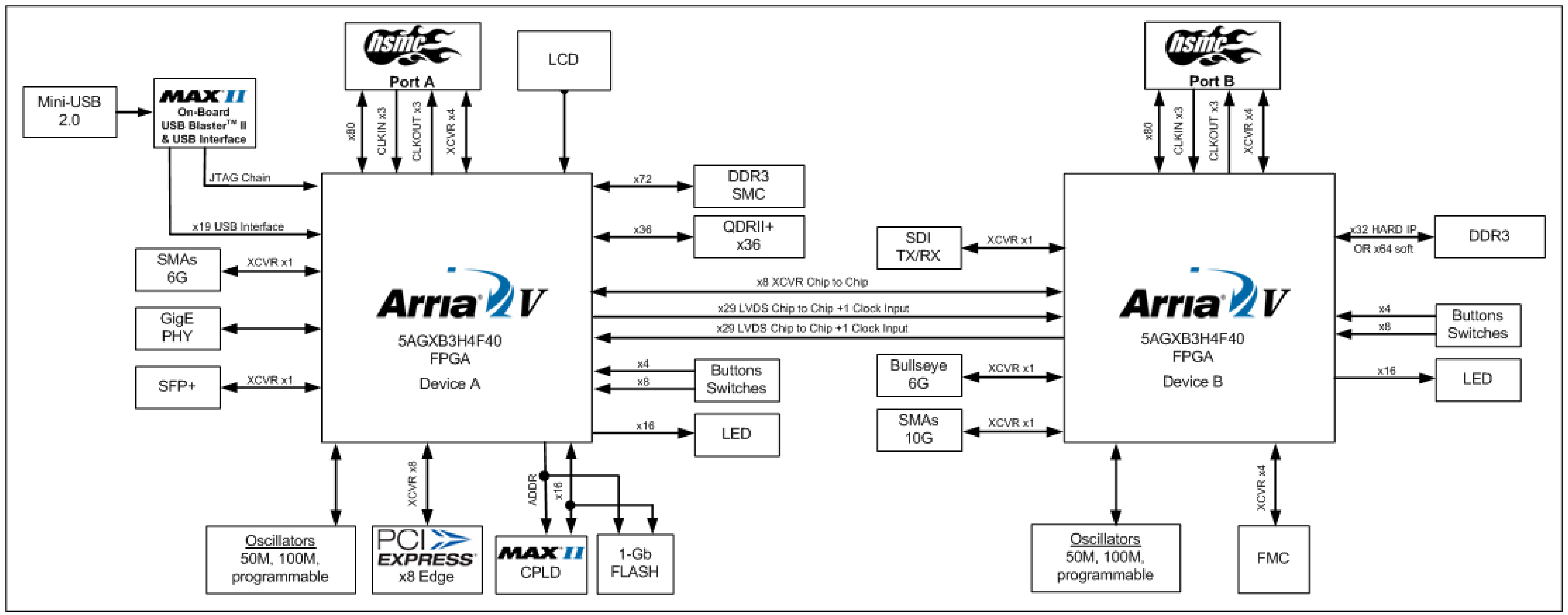
1. Project Drawing Numbers:

Raw PCB	100-0320804-B1
Gerber Files	110-0320804-B1
PCB Design Files	120-0320804-B1
Assembly Drawing	130-0320804-B1
Fab Drawing	140-0320804-B1
Schematic Drawing	150-0320804-B1
PCB Film	160-0320804-B1
Bill of Materials	170-0320804-B1
Schematic Design Files	180-0320804-B1
Functional Specification	210-0320804-B1
PCB Layout Guidelines	220-0320804-B1
Assembly Rework	320-0320804-B1

2. 1699 Parts, 87 Library Parts, 1962 Nets, 9866 Pins

REV	DATE	PAGES	DESCRIPTION
A	12/14/2011	All	Initial Released Rev A
B	5/16/2012	Many	1. Separated VCC into 2 power rails (VCC and VCCP) including decoupling caps. 2. A5_VCCIO_FMC power pin correction 3. Added FM_A26 to MAX II device 4. Corrected FPGA 2 config bus 5. hardwired CLKIN50 to enabled on power up 6. Constrain MSEL pins to known states for both FPGAs 7. Tie FPGA pin N6 to GND 8. Mini-USB pin 5 coonected to board GND 9. Correct reverse power diode pin connections 10. Add CLOCK_SDA and CLOCK_SCL to FPGA1 11. Removed FPGA2 and MAXII devices from JTAG chain 12. Removed unused PCIe JTAG circuit 13. Added x2 clock buffer for eye measurement via Bullseye cables 14. C2C_DIN_P/N9 pin swapped 15. Reduced C2C to x29 and added C2C clock inputs 16. PCIE_PERSTn moved to pin N9 17. MAX3378 decoupling added 18. Moved DDR3*_CKE to discrete 4.7K pulldown 19. Moved DDR3*_RESET to discrete 51 Ohm to 1.5V 20. Moved SMA AC-coupling from TX pins to RX pins 21. Removed backplane interface

Arria V GX FPGA Development Kit Board



PAGE	DESCRIPTION	PAGE	DESCRIPTION
1	Title, Notes, Block Diagram, Rev. History	30	HSMC Port A & Port B
2	FPGA 1 Package Top	31	FMC
3	FPGA 2 Package Top	32	Ethernet PHY & RJ-45
4	PCI Express Edge Connector	33	On-Board USB Blaster II
5	Arria V GX 1 Bank 3	34	User I/O (FPGA 1)
6	Arria V GX 1 Bank 4	35	User I/O (FPGA 2)
7	Arria V GX 1 Bank 7	36	Arria V GX 1 Power
8	Arria V GX 1 Bank 8	37	Arria V GX 2 Power
9	Arria V GX 1 Transceiver Banks	38	Power 1 - DC Input, 12V, 3.3V
10	Clocks (Part 1 of 2)	39	Power 2 - 1.1V (VCCINT)
11	Clocks (Part 2 of 2)	40	Power 3 - 2.5V, 1.2V, 1.5V, 1.8V
12	Arria V GX 1 Clocks	41	Power 4 - 3.3V
13	Arria V GX 2 Clocks	42	Power 5 - Linear Regulator
14	Arria V GX Configuration	43	Power 6 - Power & Temp Monitor
15	JTAG	44	Decoupling (FPGA 1)
16	Arria V GX 2 Bank 3	45	Decoupling (FPGA 2)
17	Arria V GX 2 Bank 4	46	Arria V GX Power (GND/NC)
18	Arria V GX 2 Bank 7		
19	Arria V GX 2 Bank 8		
20	Arria V GX 2 Transceiver Banks		
21	DDR3A - Part 1 of 2		
22	DDR3A - Part 2 of 2		
23	QDRII+ SRAM		
24	DDR3B -x32		
25	DDR3C -x32		
26	Flash		
27	5M2210 System Controller		
28	SFP+ Interface		
29	SDI TX Cable Driver & SMB		

Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 1 of 46

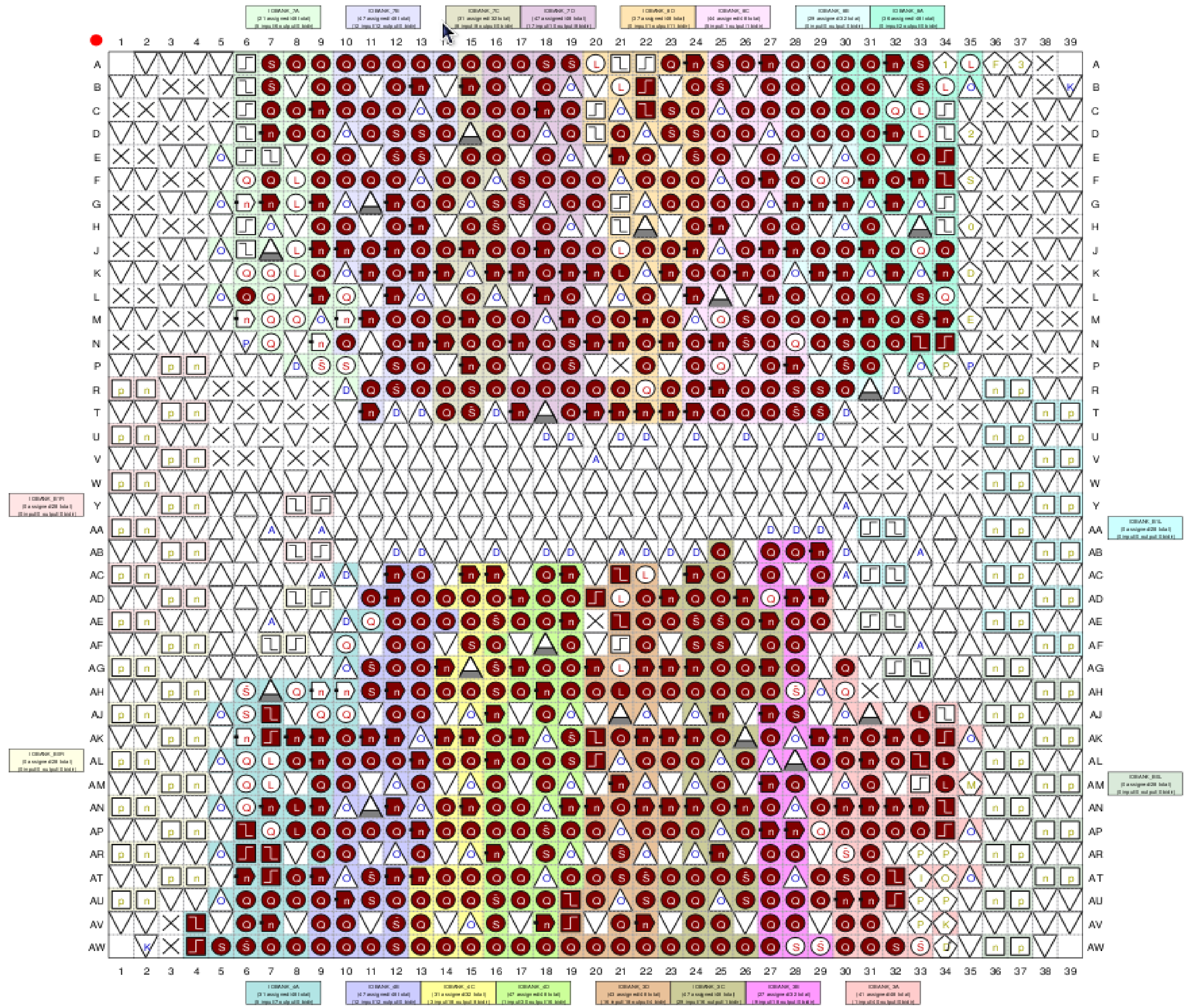
FPGA 1 Package Top View

BANK 7A
BANK 7B
BANK 7C
BANK 7D
VCCIO = 2.5V
Chip-to-Chip (LVDS)
LCD, USER IO

BANK 8A
BANK 8B
BANK 8C
BANK 8D
VCCIO = 1.5V
DDR3, Embedded USB Blaster II

Top View - Flip Chip

Arria V - 5AGXFB3H4F40C5



XCVR BANK QR2 (GT option only)
HSMC Port x4 (Total XCVR x8)
Bullseye SMAs (6G) x2
Bullseye SMA (10G)

XCVR BANK QL2 (GT option only)
SFP+ x1
Bullseye SMA (10G)

XCVR BANKS QR0, QR1
HSMC Port A x4
Chip-to-Chip x8

XCVR BANKS: QL0, QL1
PCI Express x8
SFP+ x1
SMA (6G)

BANK 4A
BANK 4B
BANK 4C
BANK 4D
VCCIO = 2.5V
HSMA,
SFP+ control,
User IO
Ethernet, PCIe,
SFP+ control

BANK 3A
BANK 3B
BANK 3C
BANK 3D
VCCIO = 1.8V
QDRII+, FM
FLASH, FM bus

Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121	
Title	Arria V GX FPGA Development Kit Board
Size: B	Document Number: 150-0320804-B1 (6XX-44096R)	Rev: B
Date: Tuesday, July 31, 2012	Sheet 2 of 46

FPGA 2 Package Top View

BANK 7A
BANK 7B
BANK 7C
BANK 7D
VCCIO = 2.5V
Chip-to-Chip (LVDS)

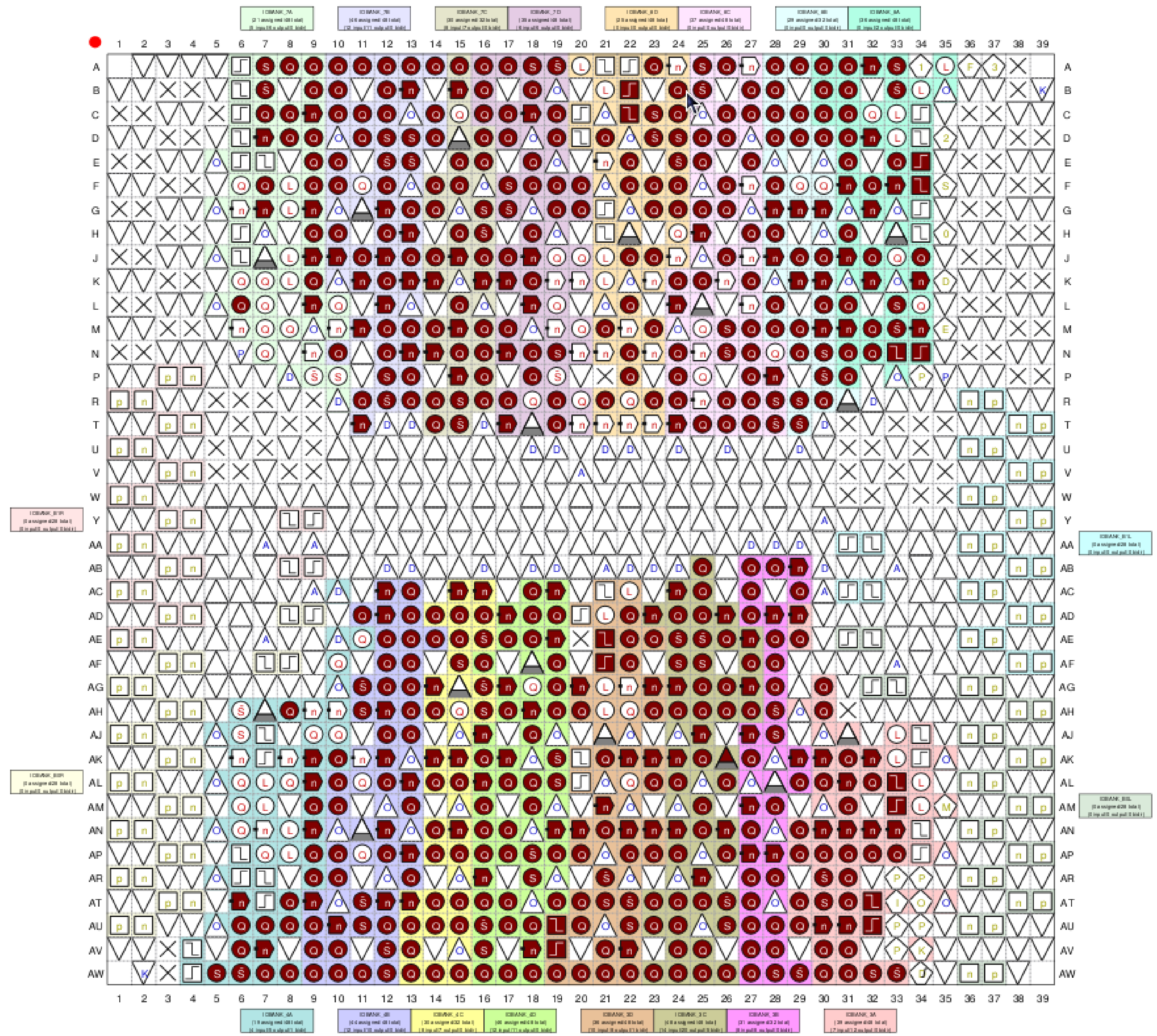
BANK 8A
BANK 8B
BANK 8C
BANK 8D
VCCIO = 1.5V
DDR3 x32 (2 Individual Interfaces)

Top View - Flip Chip

Arria V - 5AGXFB3H4F40C5

XCVR BANK QR2 (GT option only)
FMC x6 (Total FMC x10)

XCVR BANK QL2 (GT option only)
Bullseye SMA (10G)



XCVR BANKS QR0, QR1

HSMC Port B x4
SDI
FMC x4
Bullseye SMA (6G)
SMA (10G)

XCVR BANKS: QL0, QL1

Chip-to-Chip x8

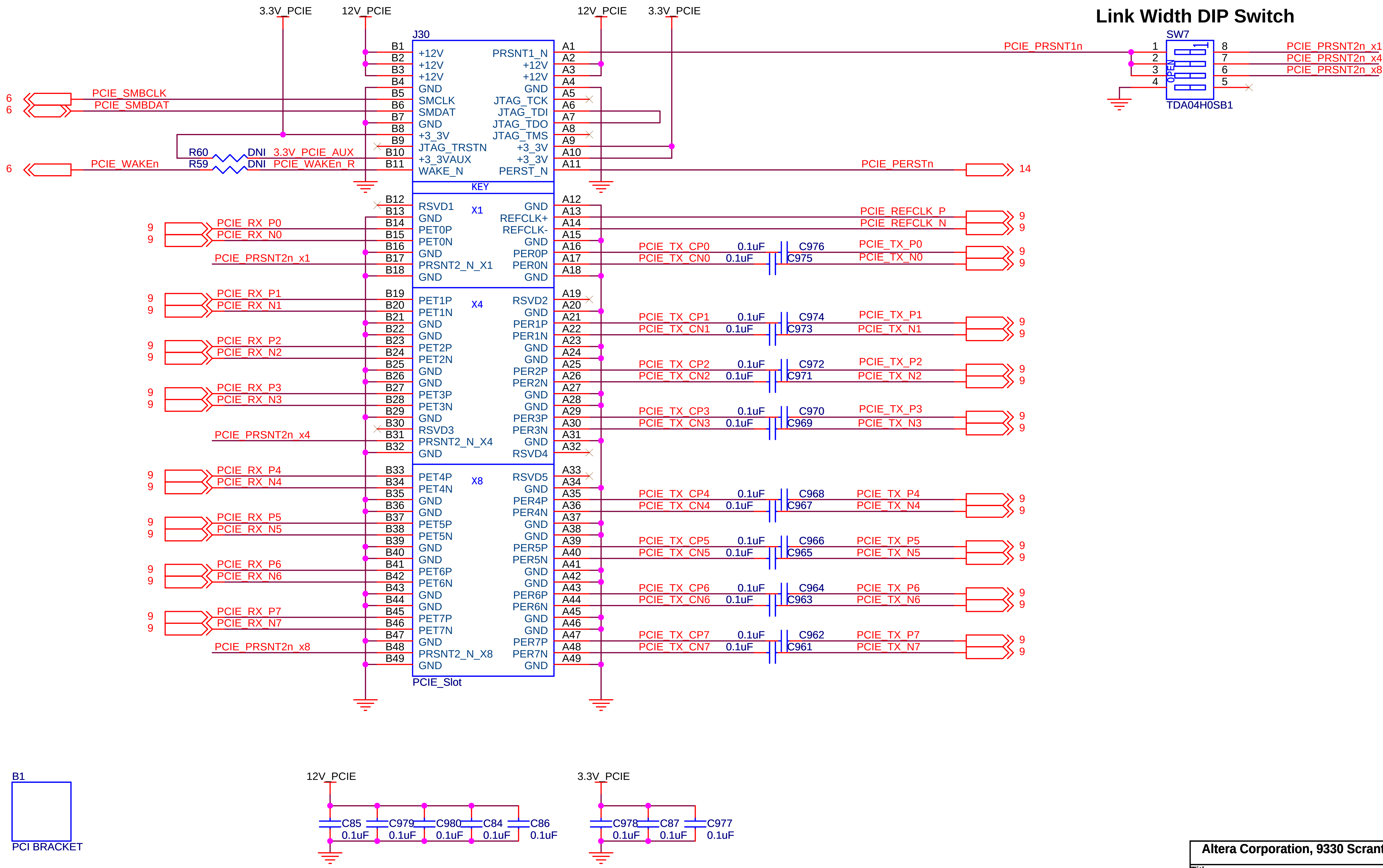
BANK 4A
BANK 4B
BANK 4C
BANK 4D
BANK 3D
VCCIO = 2.5V
FMC

BANK 3A
BANK 3B
BANK 3C
VCCIO = 2.5V
HSMC Port B
SDI
USER I/O

ALTERA

Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121	
Title	**Arria V GX FPGA Development Kit Board**
	Copyright (c) 2012, Altera Corporation. All Rights Reserved.
Size: B	Document Number: 150-0320804-B1 (6XX-44096R) — Rev: B
Date: Tuesday, July 31, 2012	Sheet 3 of 46

PCI Express Edge Connector



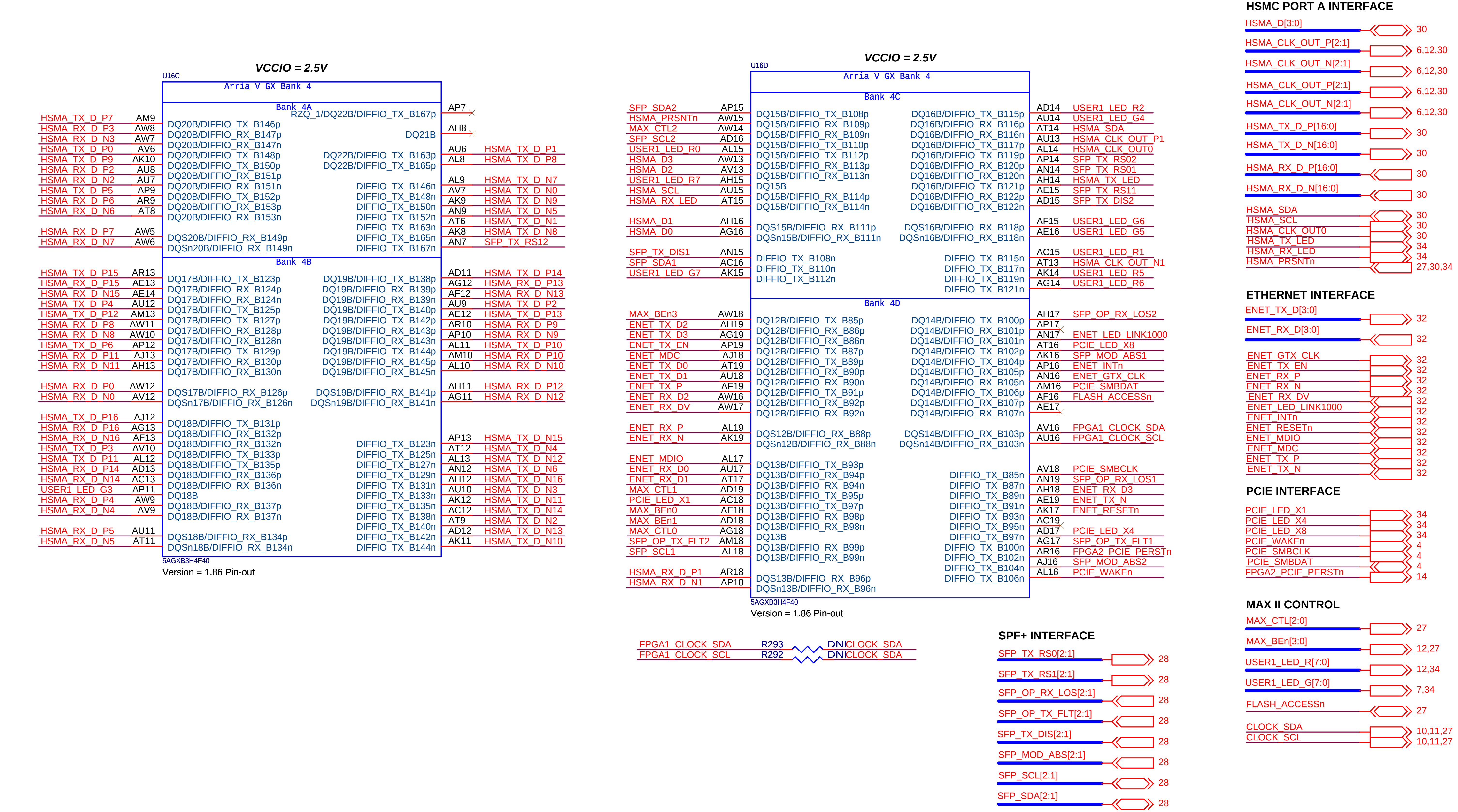
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121			
Title	**Arria V GX FPGA Development Kit Board**		
	Copyright (c) 2012, Altera Corporation. All Rights Reserved.		
Size B	Document Number 150-0320804-B1	(6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012		Sheet 4 of 46	

Arria V GX FPGA 1, Bank 3

Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board	
	Copyright (c) 2012, Altera Corporation. All Rights Reserved.	
Size B	Document Number 150-0320804-B1 (6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012	Sheet 5 of 46	

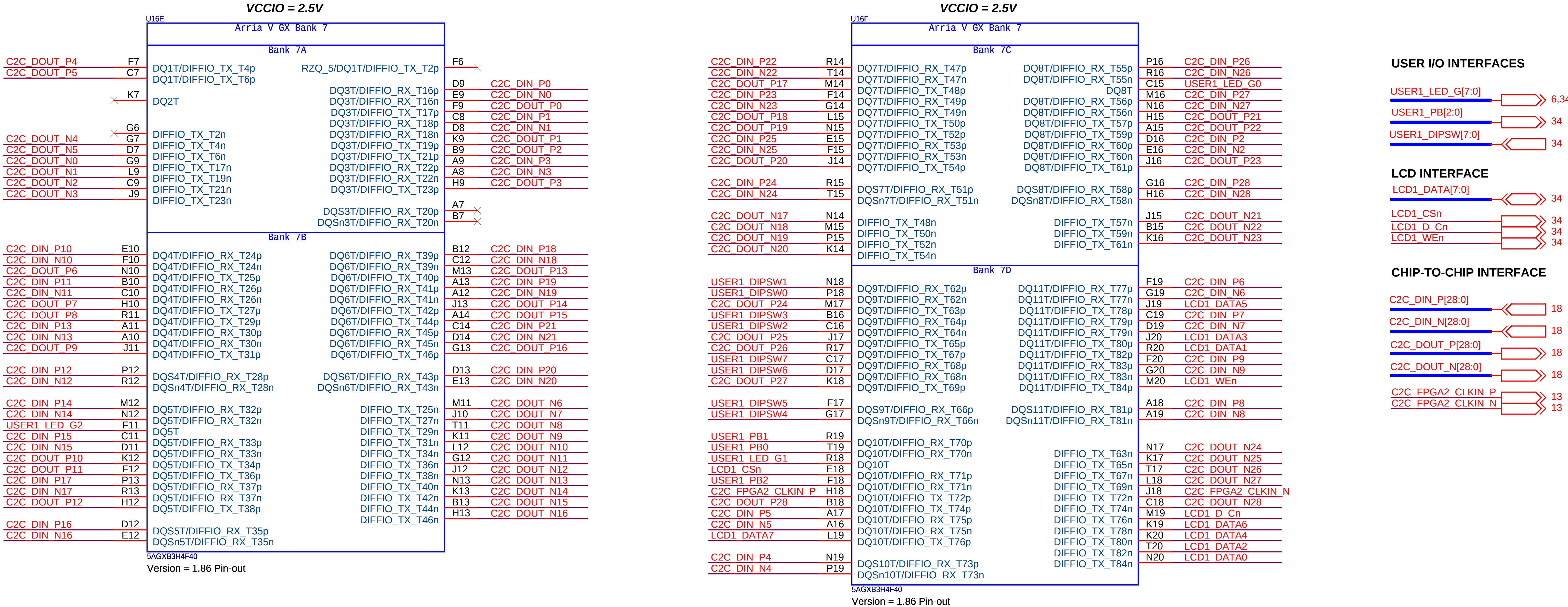
Arria V GX FPGA 1, Bank 4



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board	
Size B	Document Number 150-0320804-B1 (6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012	Sheet 6 of 46	

Arria V GX FPGA 1, Bank 7

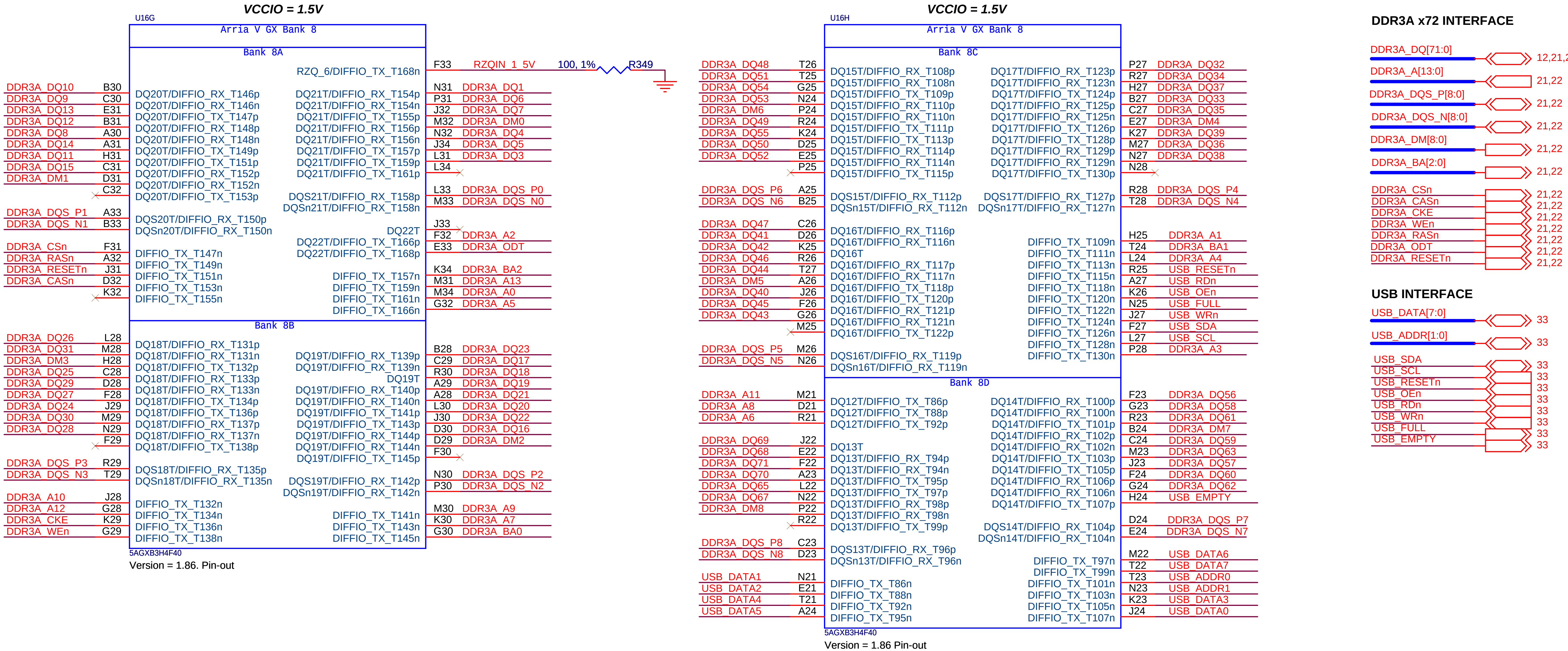


ALTERA®

Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board	
	Copyright (c) 2012, Altera Corporation. All Rights Reserved.	
Size: B	Document Number: 150-0320804-B1 (6XX-44096R)	Rev: B
Date: Tuesday, July 31, 2012	Sheet 7 of 46	

Arria V GX FPGA 1, Bank 8



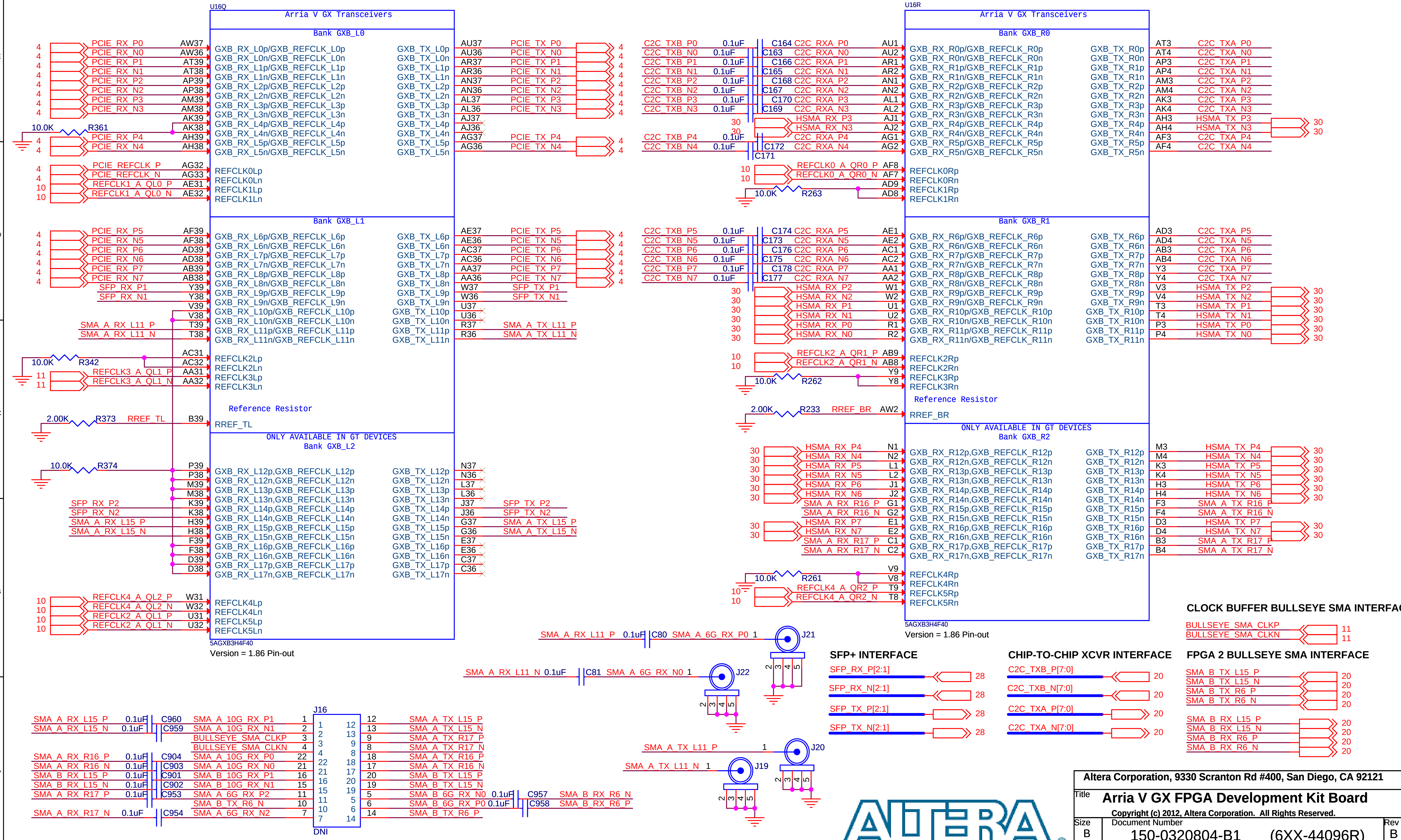
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 8 of 46

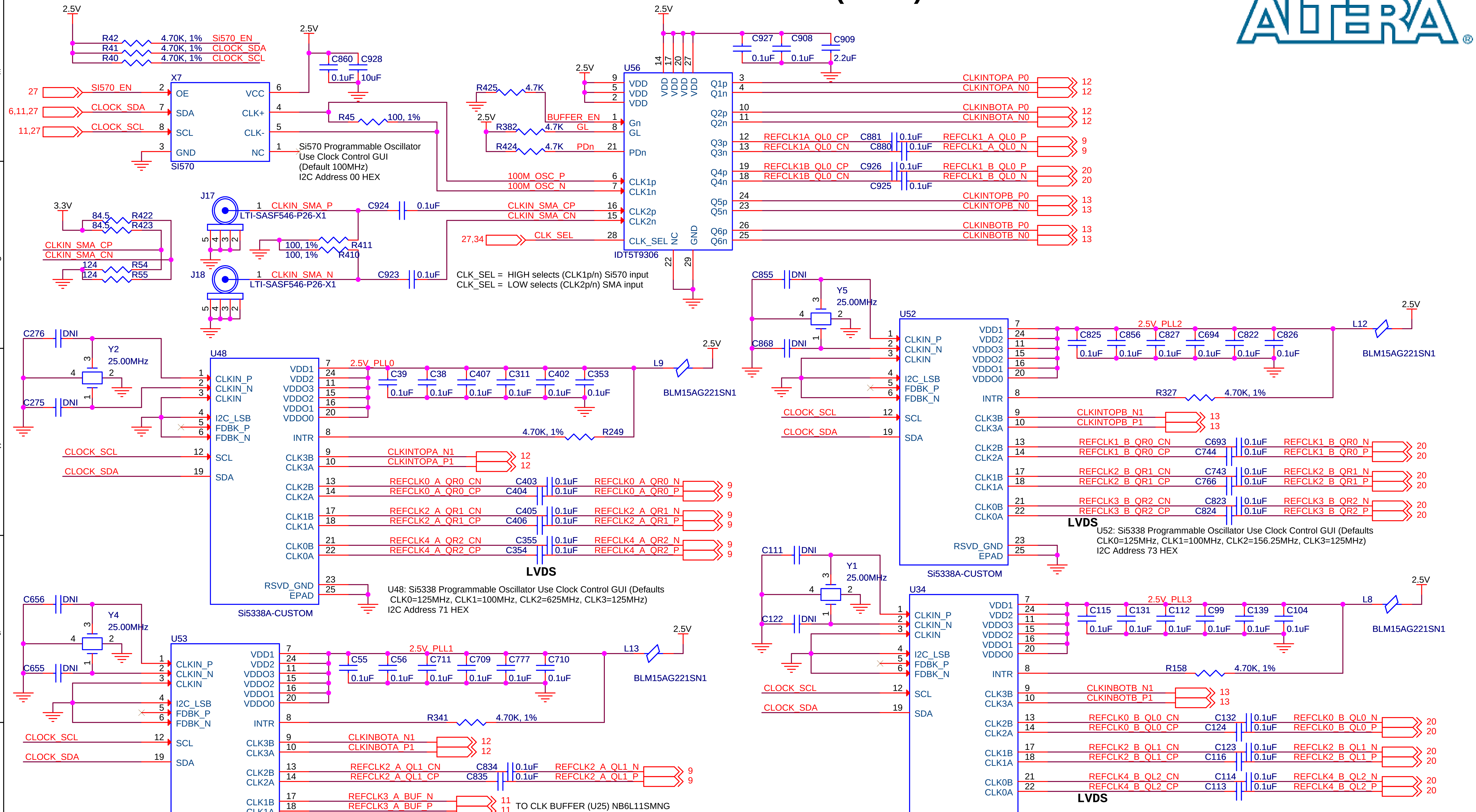
Arria V GX Transceivers and Power (FPGA 1)



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board	
Size: B	Document Number: 150-0320804-B1 (6XX-44096R)	Rev: B
Date: Tuesday, July 31, 2012	Sheet 9 of 46	

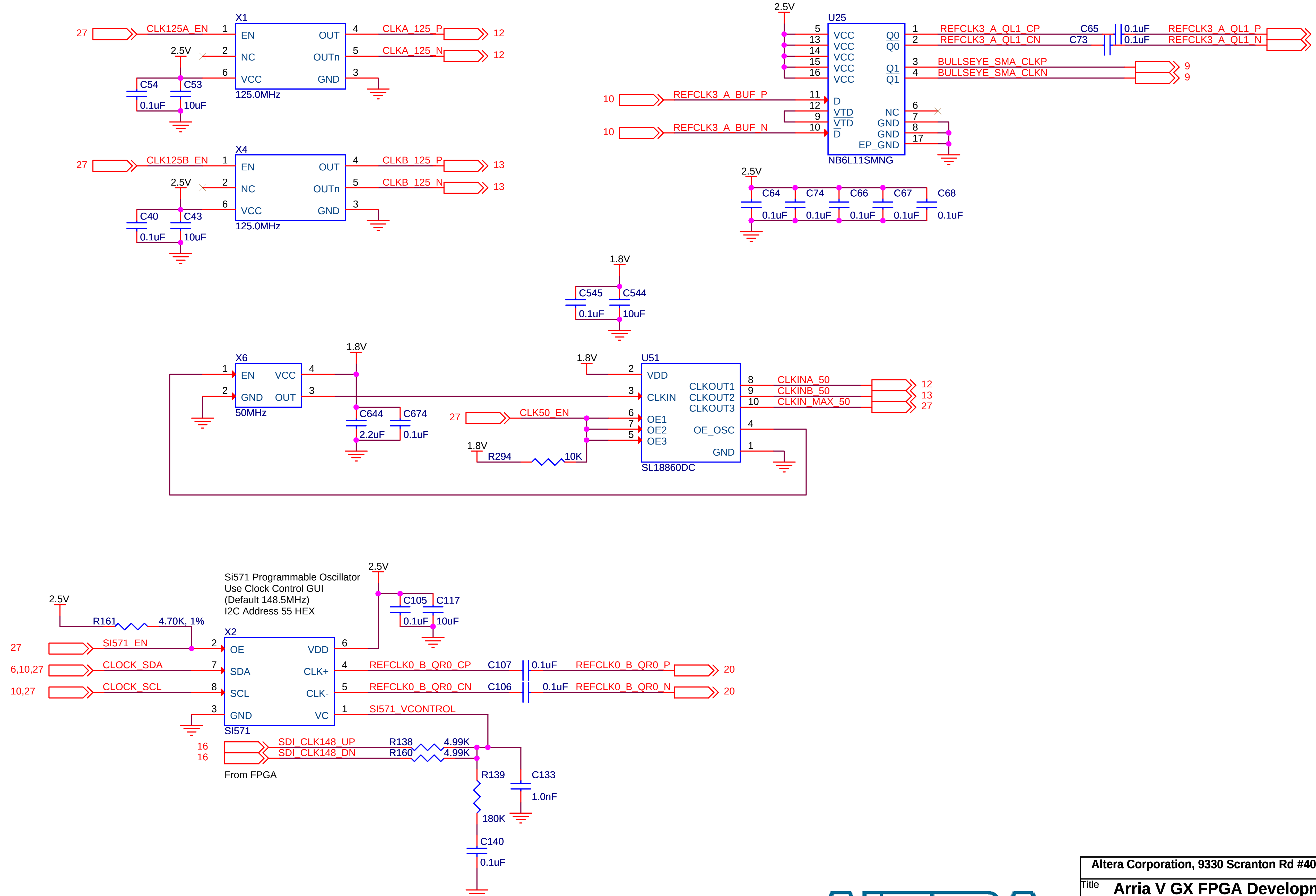
Clocks/Oscillators (1 of 2)



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board		
Size B	Document Number 150-0320804-B1 (6XX-44096R)		Rev B
Date: Tuesday, July 31, 2012		Sheet 10 of 46	

Clocks/Oscillators (2 of 2)



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 11 of 46

Arria V GX Clocks (FPGA 1)

ALTERA®

Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board	
Size B	Document Number 150-0320804-B1 (6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012	Sheet 12 of 46	

Arria V GX Clocks (FPGA 2)

ALTERA

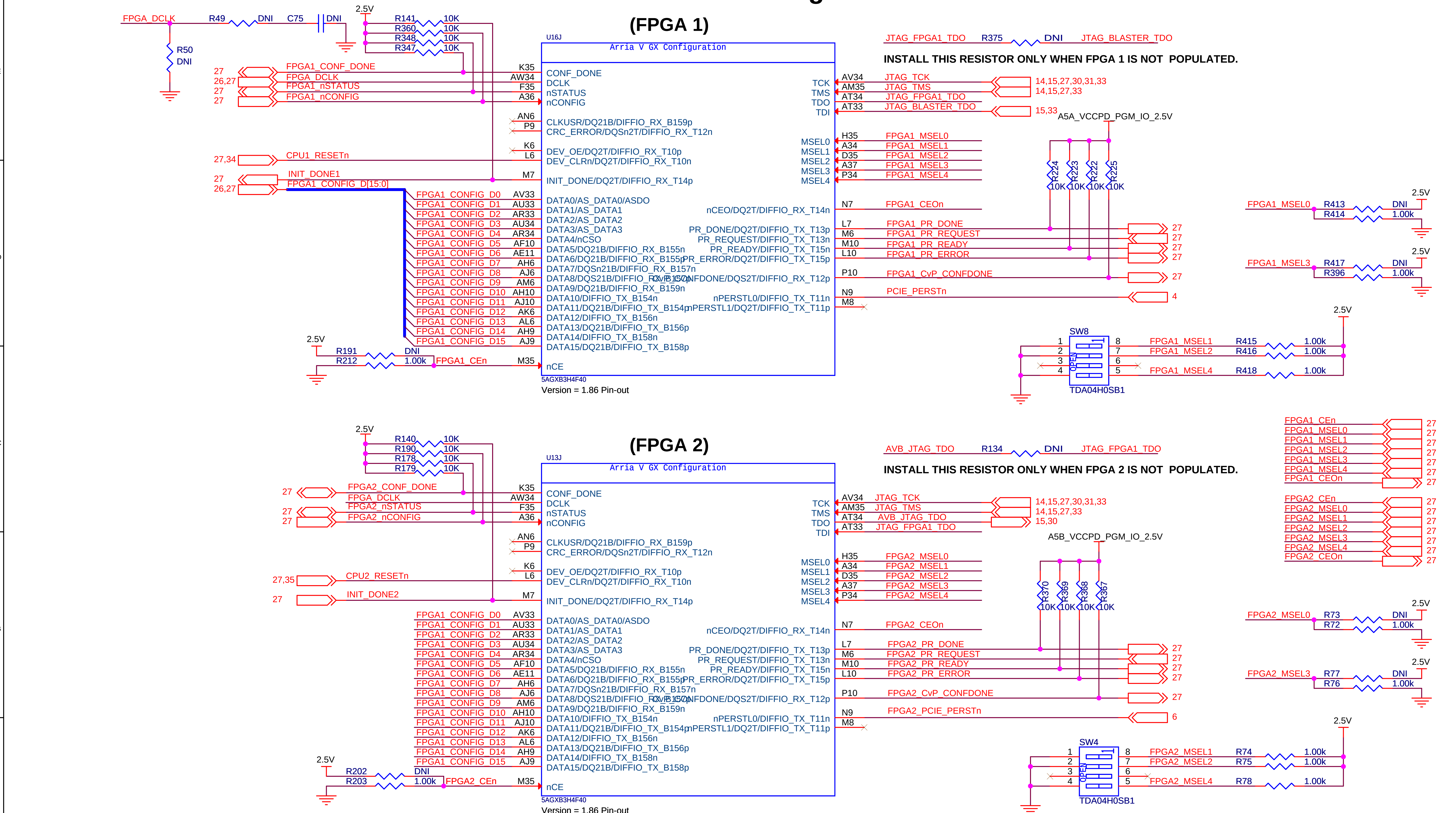
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 13 of 46

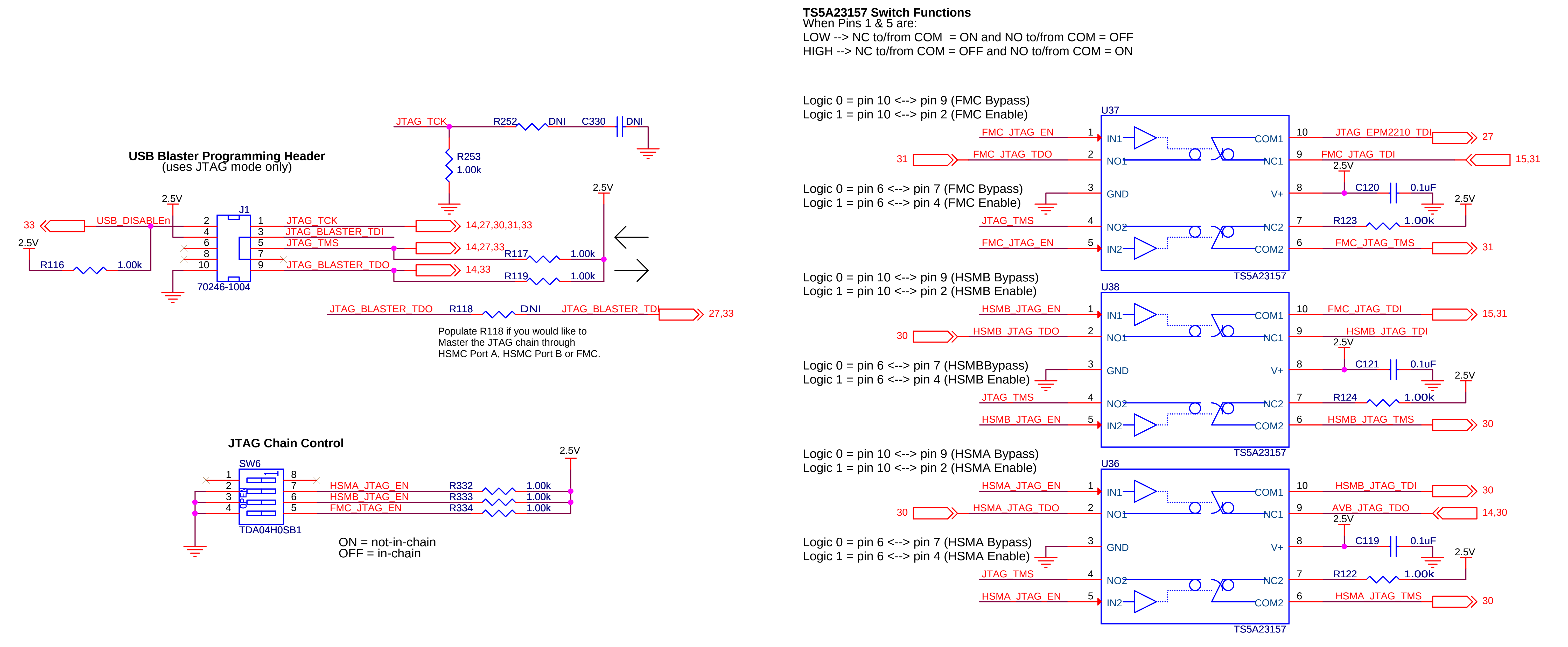
Arria V GX Configuration



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board	
Size B	Document Number 150-0320804-B1 (6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012	Sheet 14 of 46	

JTAG



ALTERA

Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

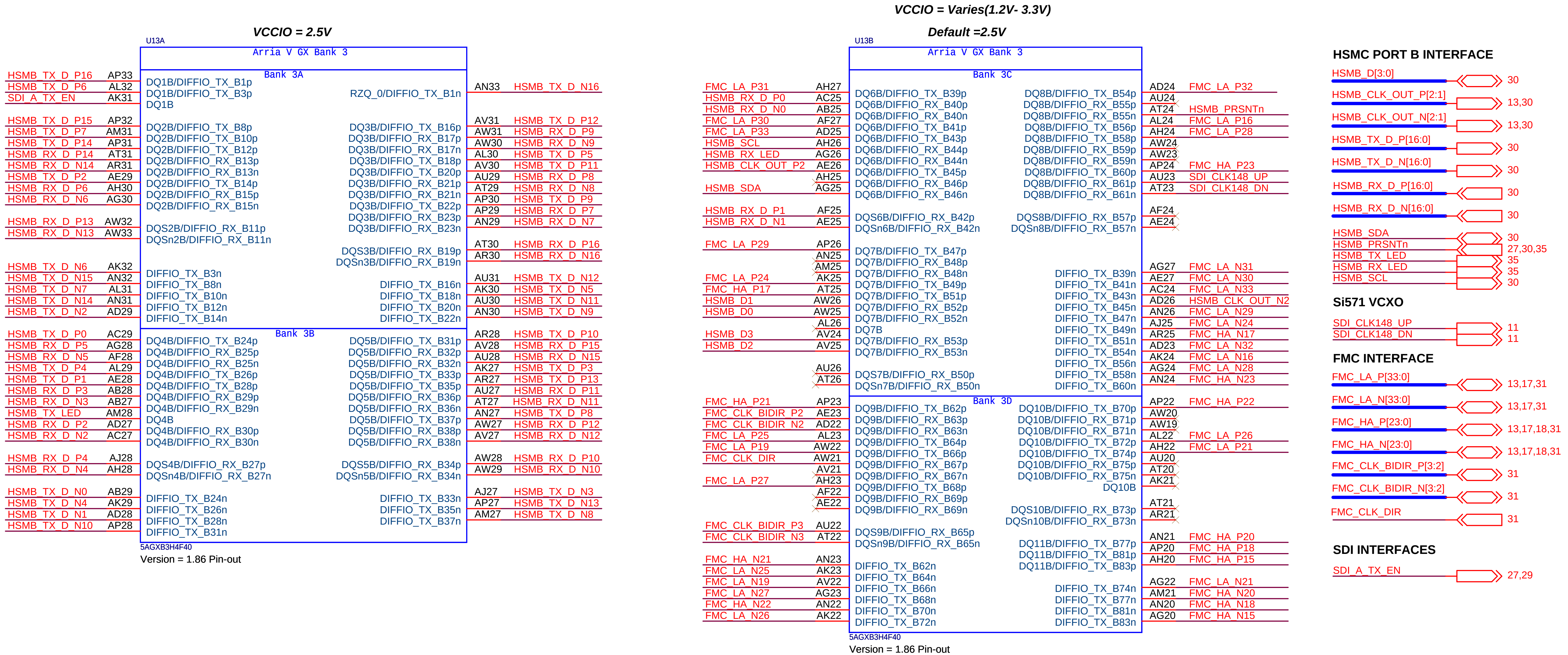
Title: Arria V GX FPGA Development Kit Board

Size: B | Document Number: 150-0320804-B1 (6XX-44096R) | Rev: B

Date: Tuesday, July 31, 2012 | Sheet 15 of 46

Arria V GX FPGA 2, Bank 3

NOTE: HSMB, SDI AND FMC CAN ONLY BE USED AT THE SAME TIME WHEN A5_VCCIO_FMC = 2.5V

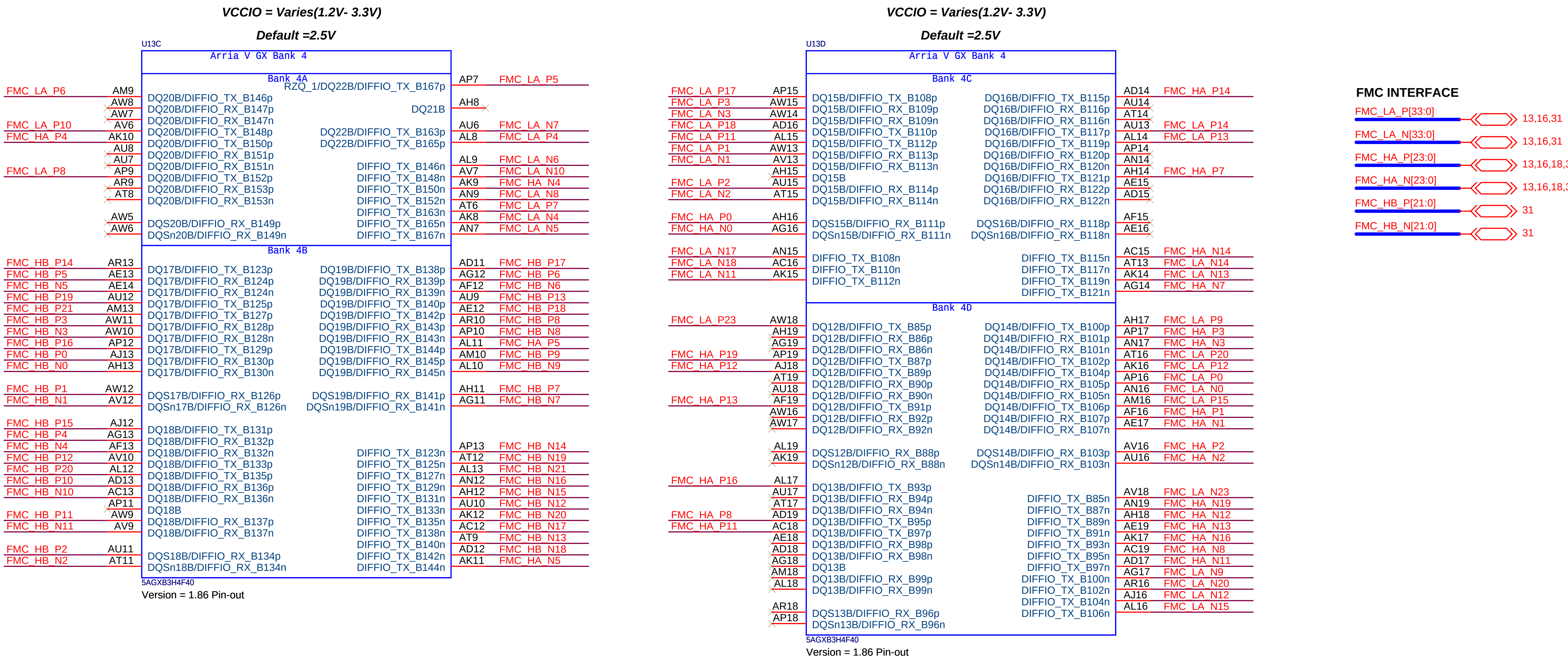


ALTERA

Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121			
Title	Arria V GX FPGA Development Kit Board		
	Copyright (c) 2012, Altera Corporation. All Rights Reserved.		
Size B	Document Number 150-0320804-B1 (6XX-44096R)		Rev B
Date: Tuesday, July 31, 2012	Sheet 16 of 46		

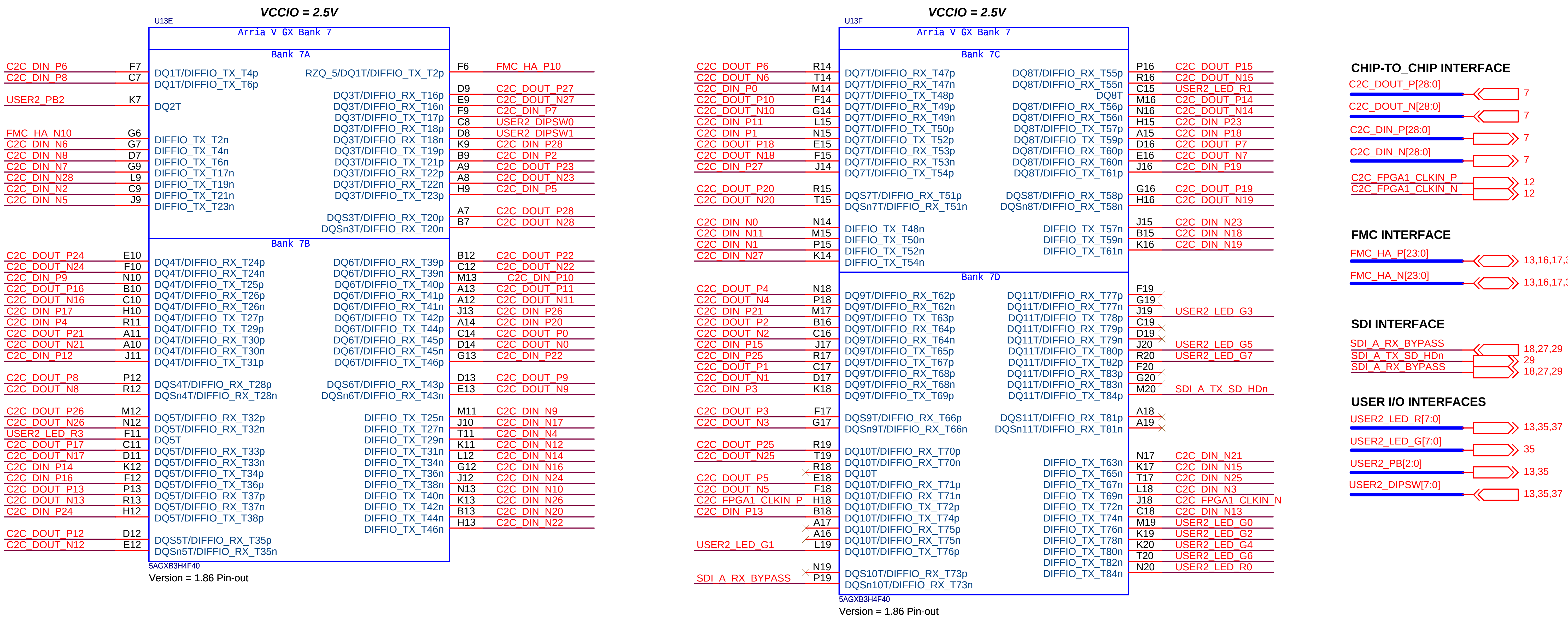
Arria V GX FPGA 2, Bank 4

NOTE: HSMB, SDI AND FMC CAN ONLY BE USED AT THE SAME TIME WHEN A5_VCCIO_FMC = 2.5V



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121			
Title	**Arria V GX FPGA Development Kit Board**		
Size B	Document Number 150-0320804-B1	(6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012		Sheet 17 of 46	

Arria V GX FPGA 2, Bank 7



ALTERA®

Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board	
Size B	Document Number 150-0320804-B1 (6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012	Sheet 18 of 46	

Arria V GX FPGA 2, Bank 8

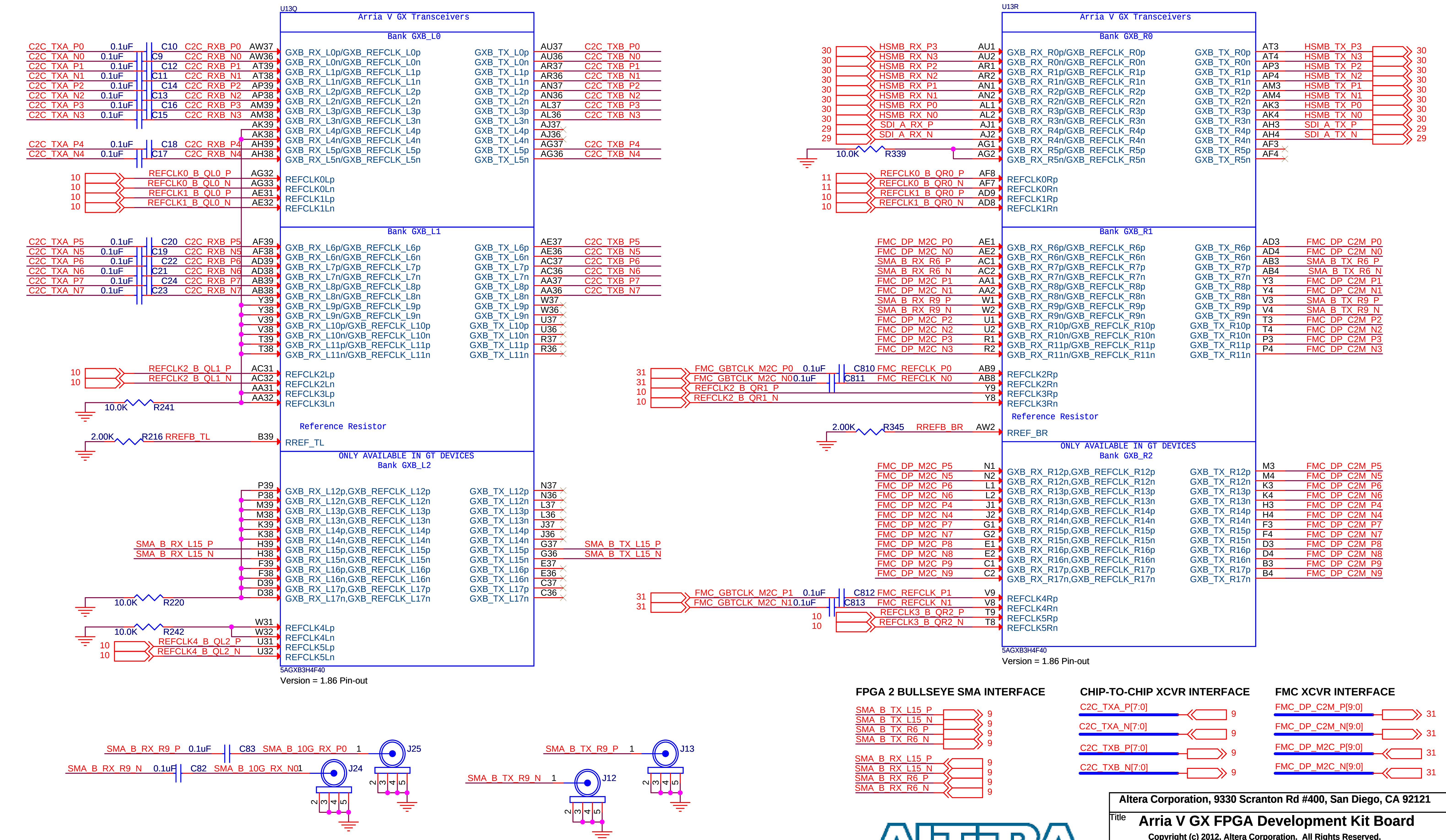
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 — Sheet 19 of 46

Arria V GX Transceivers and Power (FPGA 2)



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

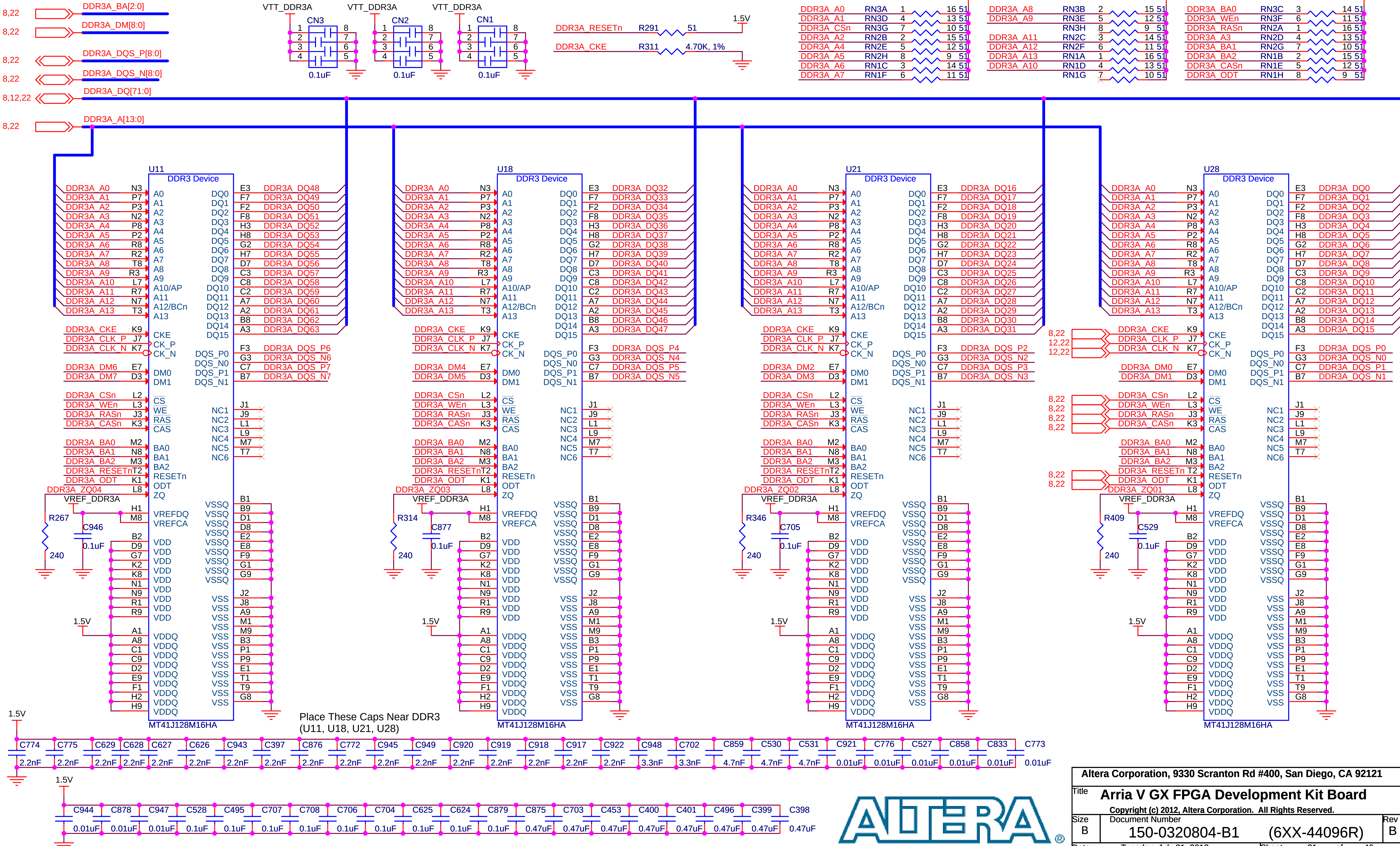
Title: Arria V GX FPGA Development Kit Board

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 20 of 46

DDR3A For FPGA 1, (x72 devices) - Part 1 of 2

Uses Soft Controller

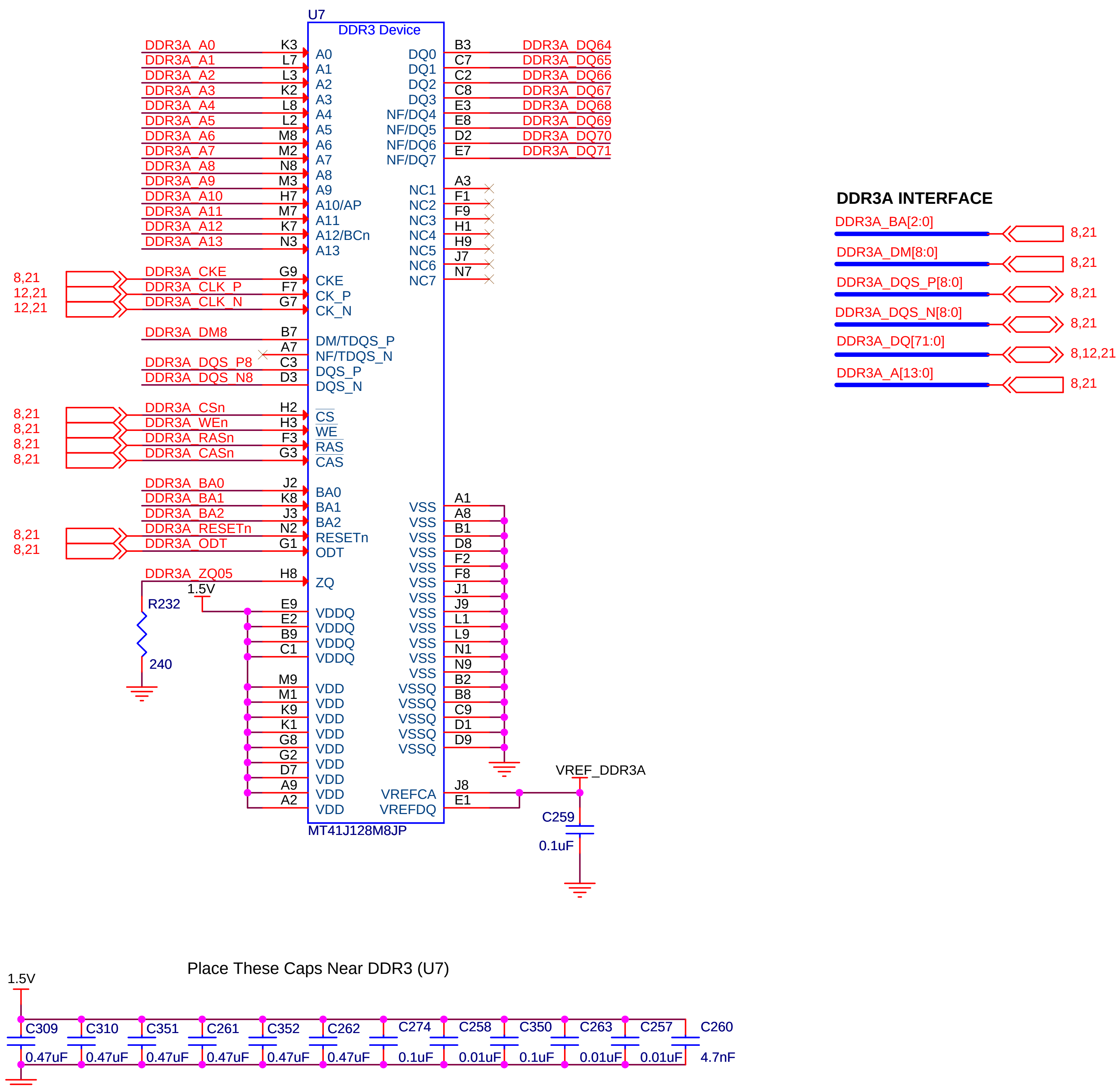


Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board
	Copyright (c) 2012, Altera Corporation. All Rights Reserved.
Size	B
Document Number	150-0320804-B1 (6XX-44096R)
Rev	B
Date:	Tuesday, July 31, 2012
Sheet	21 of 46

DDR3A For FPGA 1, (x72 devices) - Part 2 of 2

Uses Soft Controller



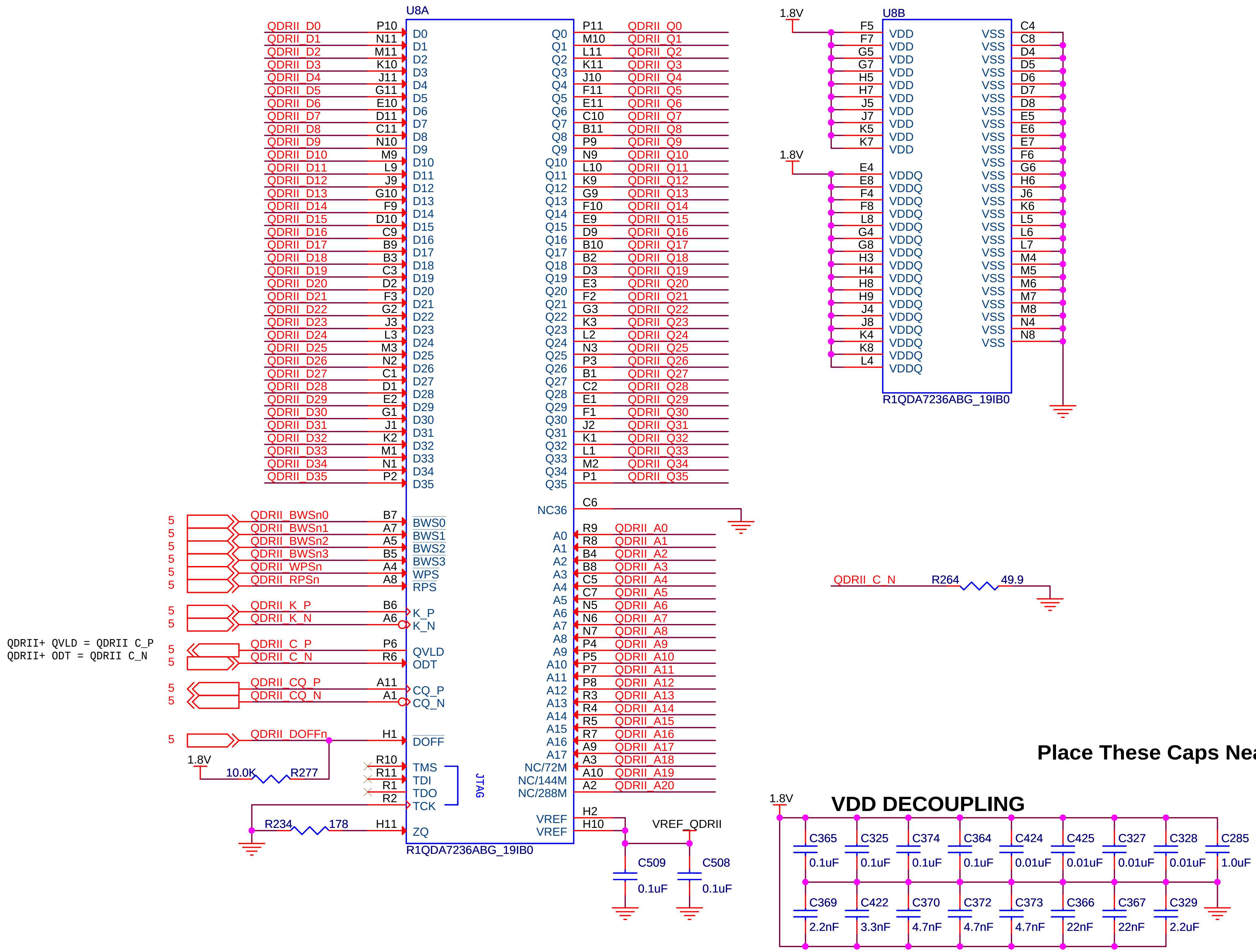
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012

QDRII+



Altera recomends to use external termination for QDRII/+ address and command signals. In this case external termination was not used, because simulations showed that with the short trace length and a point to point connection the external temination was not necessary. As a result since there is limited board space external termination is not used.

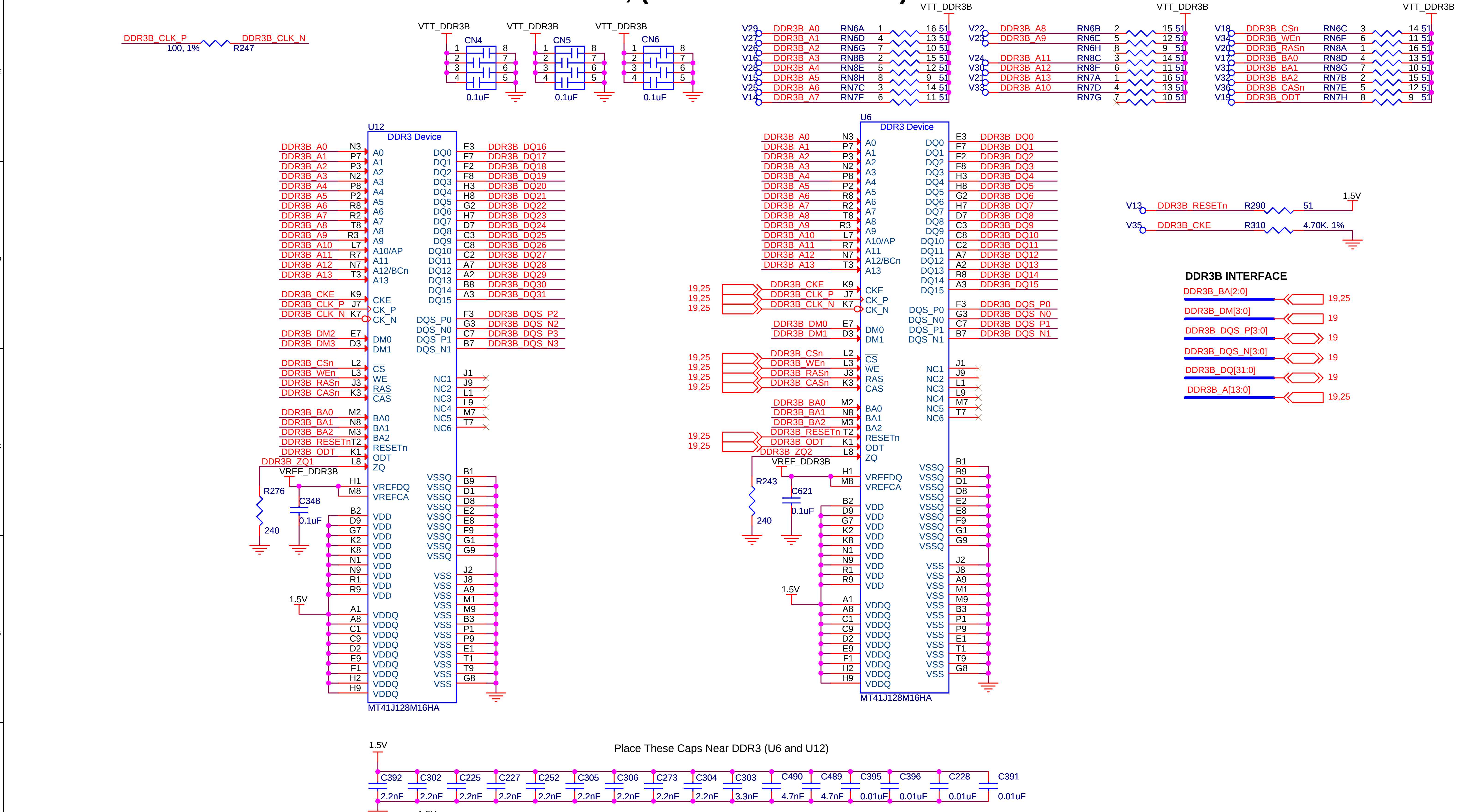
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: Arria V GX FPGA Development Kit Board

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

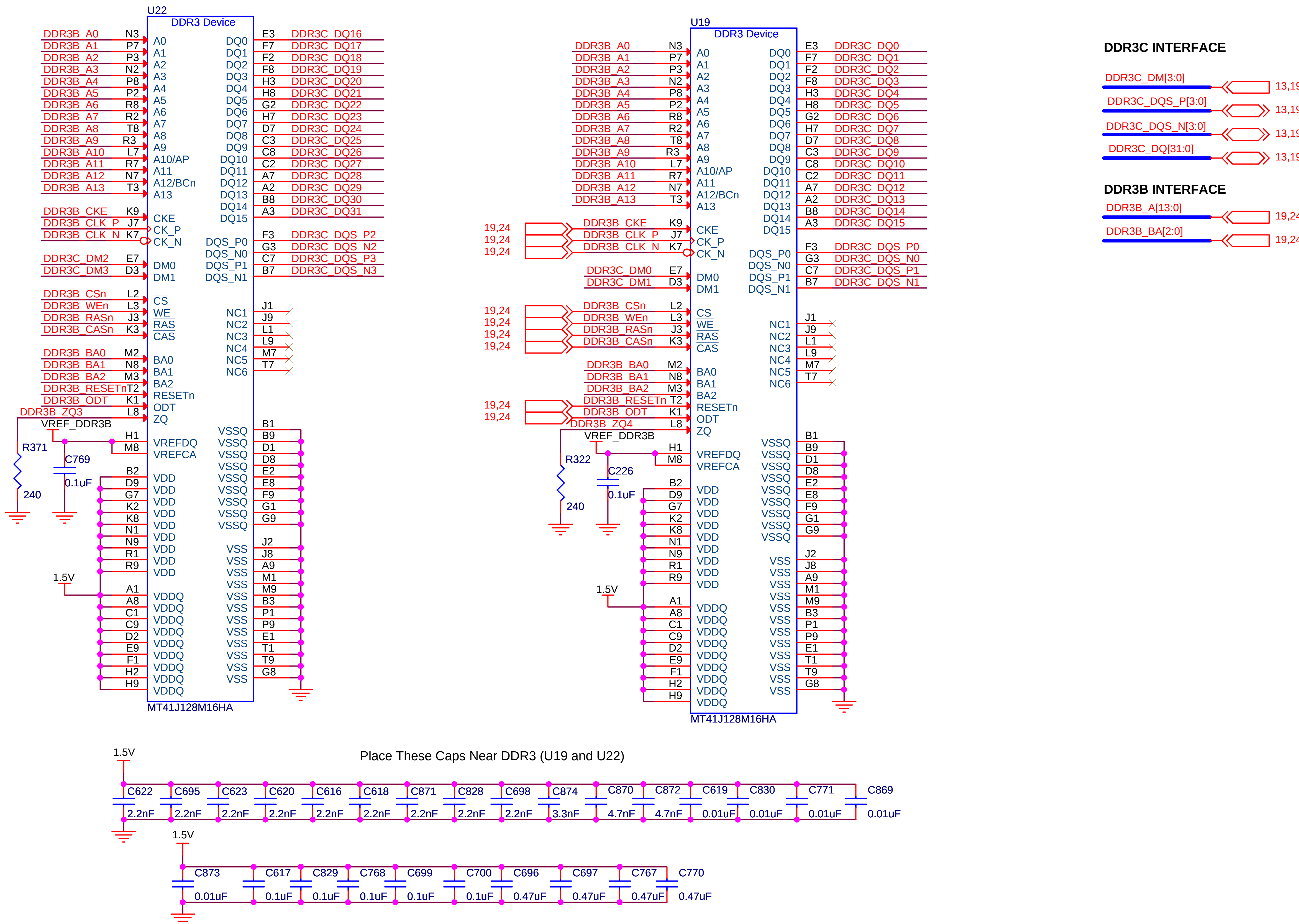
Date: Tuesday, July 31, 2012 Sheet 23 of 46

DDR3 For FPGA 2, (x32 Hard IP devices)



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121	
Title	**Arria V GX FPGA Development Kit Board**
Size: B	Document Number: 150-0320804-B1 (6XX-44096R)
Rev	B
Date:	Tuesday, July 31, 2012
Sheet	24 of 46

DDR3C For FPGA 2, (x64 Using Soft Controller Option)



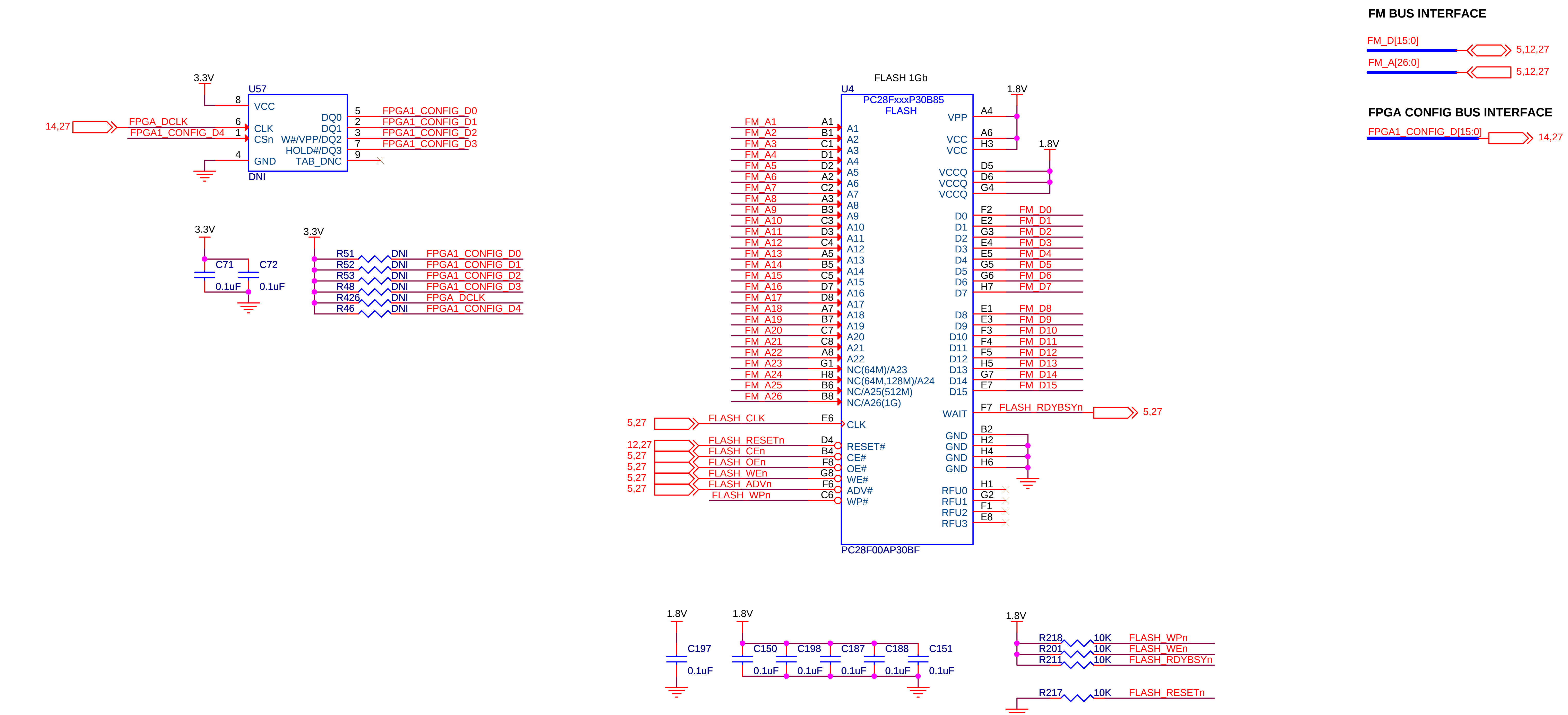
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: Arria V GX FPGA Development Kit Board

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

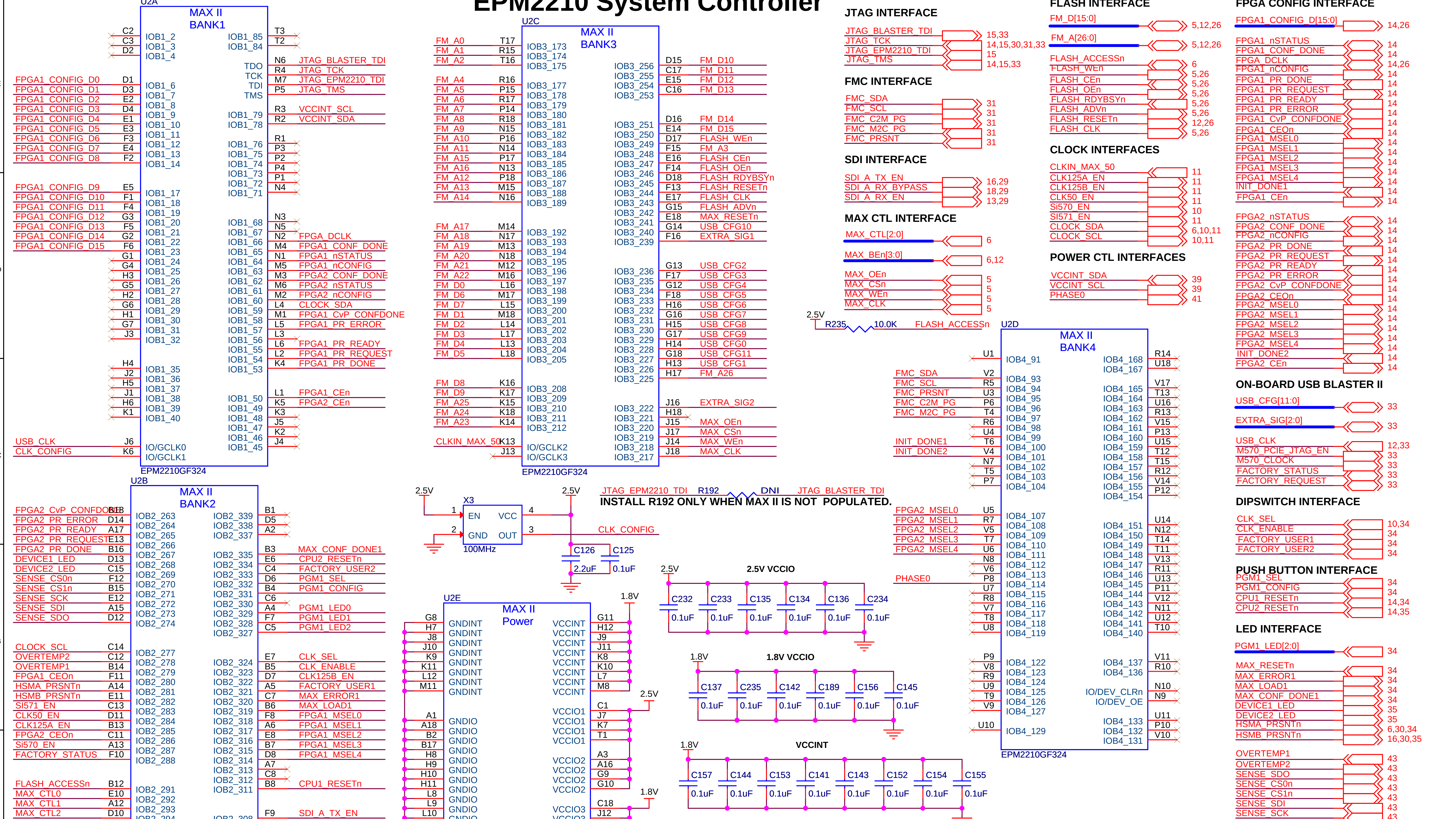
Date: Tuesday, July 31, 2012 | Sheet 25 of 46

FLASH



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121			
Title	Arria V GX FPGA Development Kit Board		
	Copyright (c) 2012, Altera Corporation. All Rights Reserved.		
Size B	Document Number 150-0320804-B1	(6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012		Sheet 26 of 46	

EPM2210 System Controller



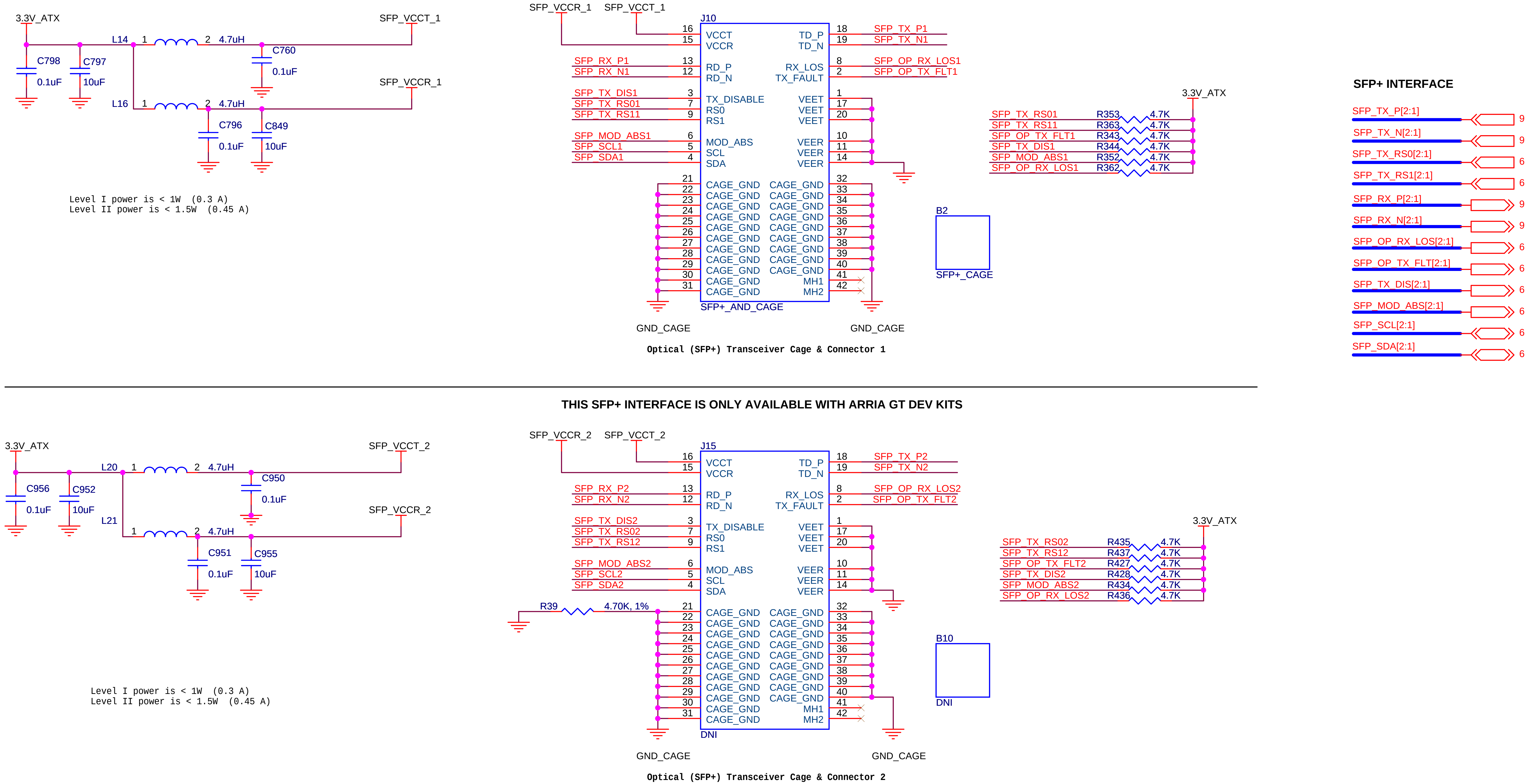
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: Arria V GX FPGA Development Kit Board

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 27 of 46

Small Form Factor Pluggable Plus (SFP+) Connector



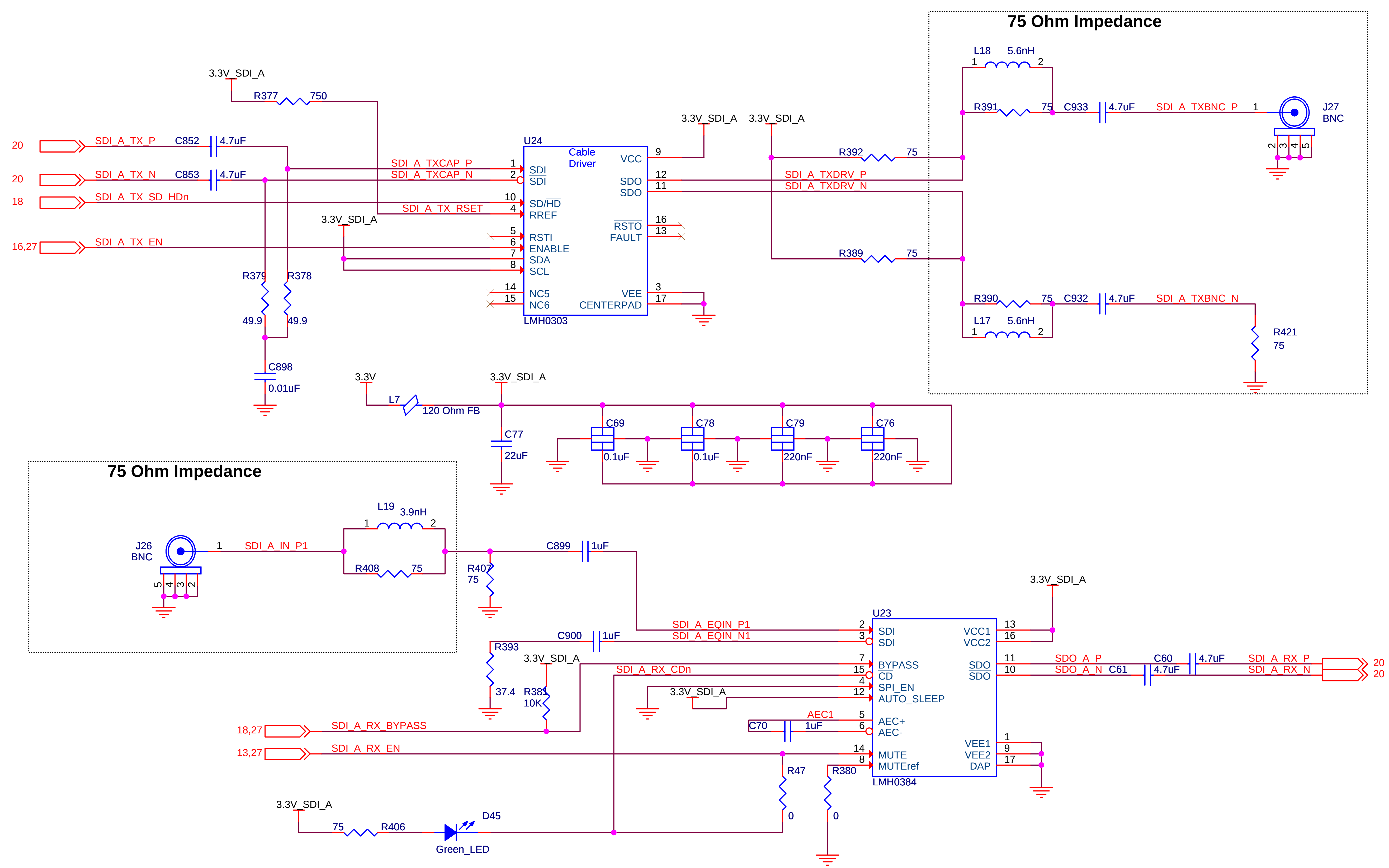
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 28 of 46

SDI Cable Driver, Equalizer, and SMB



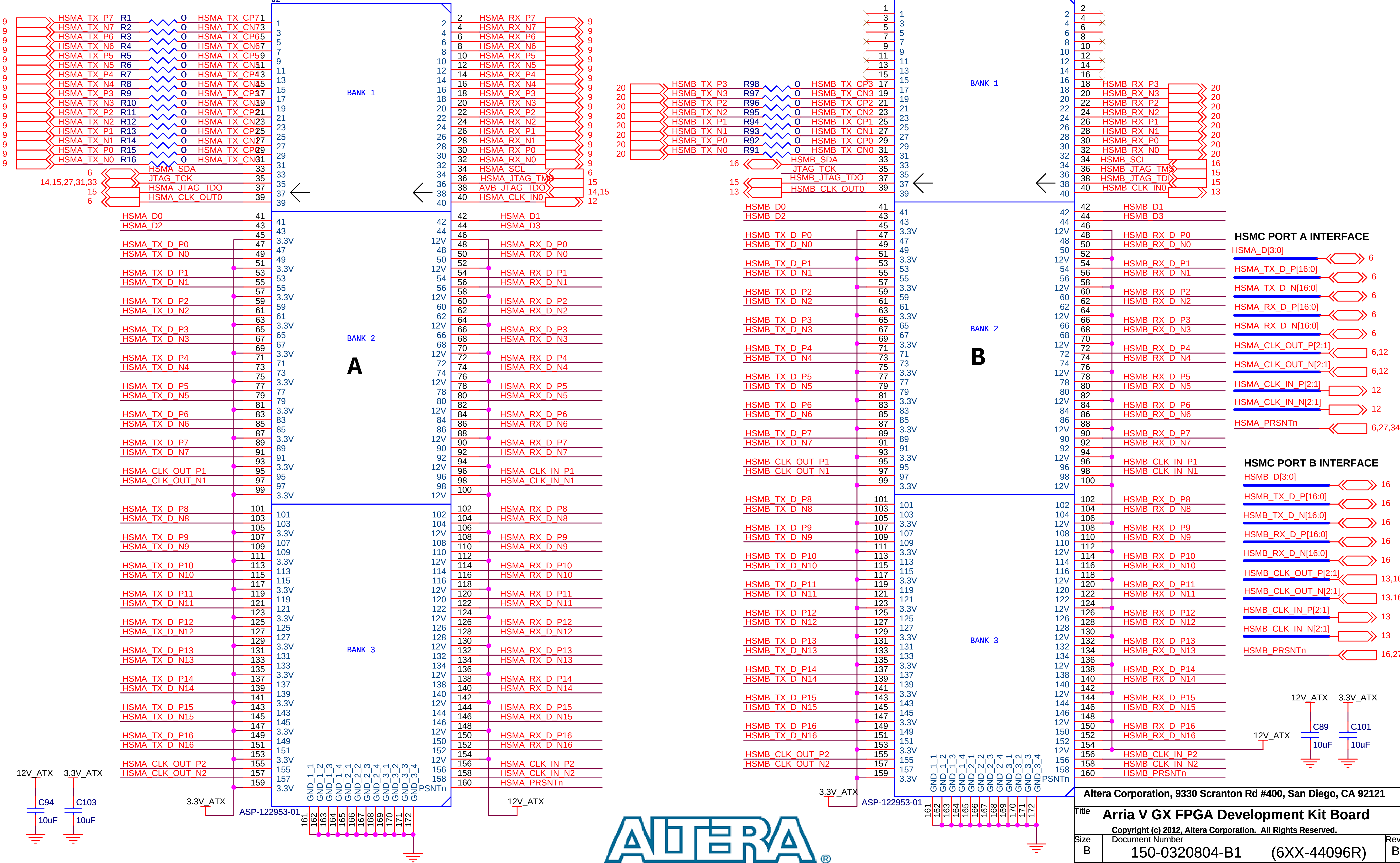
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: Arria V GX FPGA Development Kit Board

Size: B | Document Number: 150-0320804-B1 (6XX-44096R) | Rev: B

Date: Tuesday, July 31, 2012 | Sheet 29 of 46

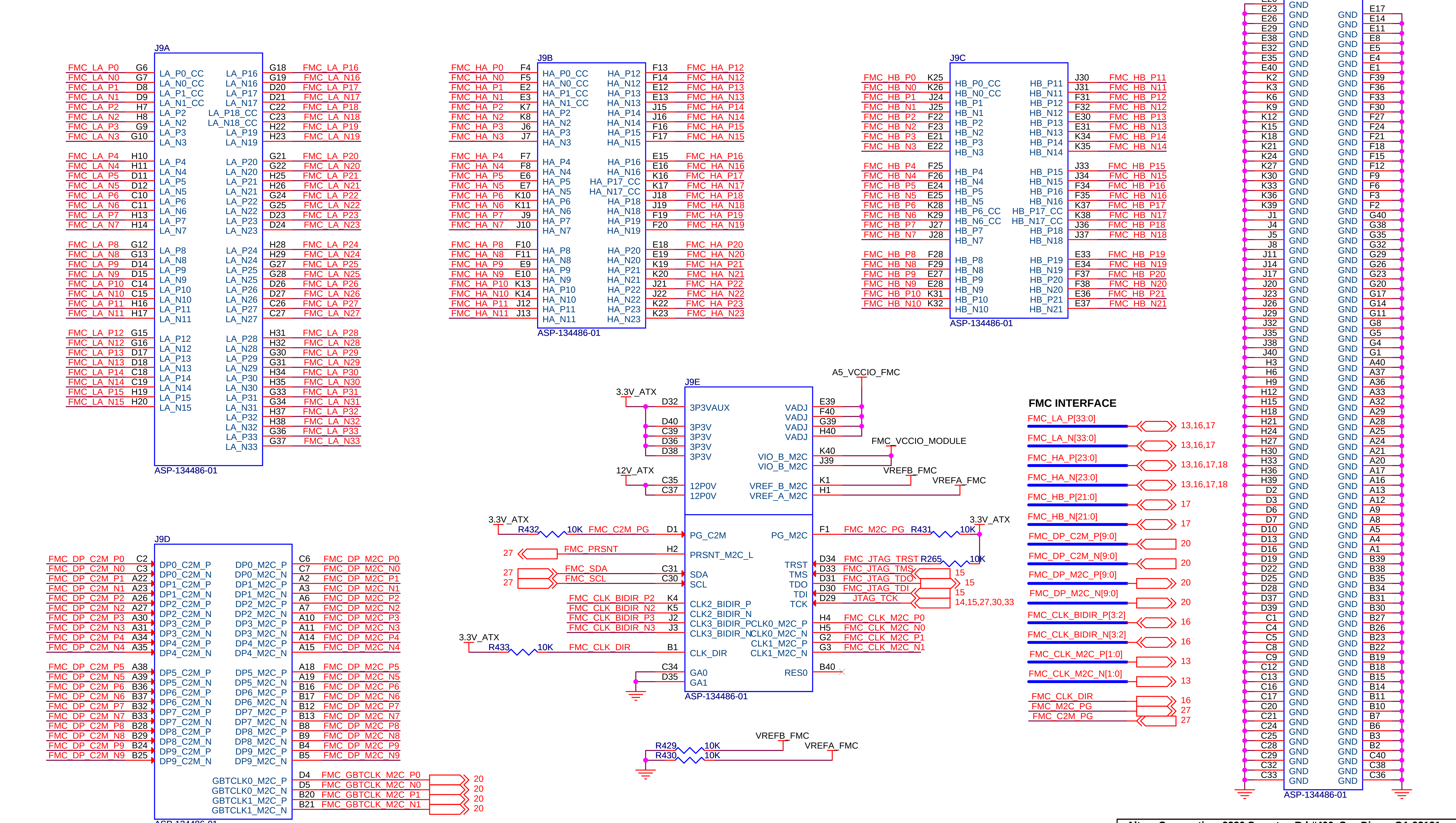
HSMC Port A & Port B



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board	
Size B	Document Number 150-0320804-B1 (6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012	Sheet 30 of 46	

FMC



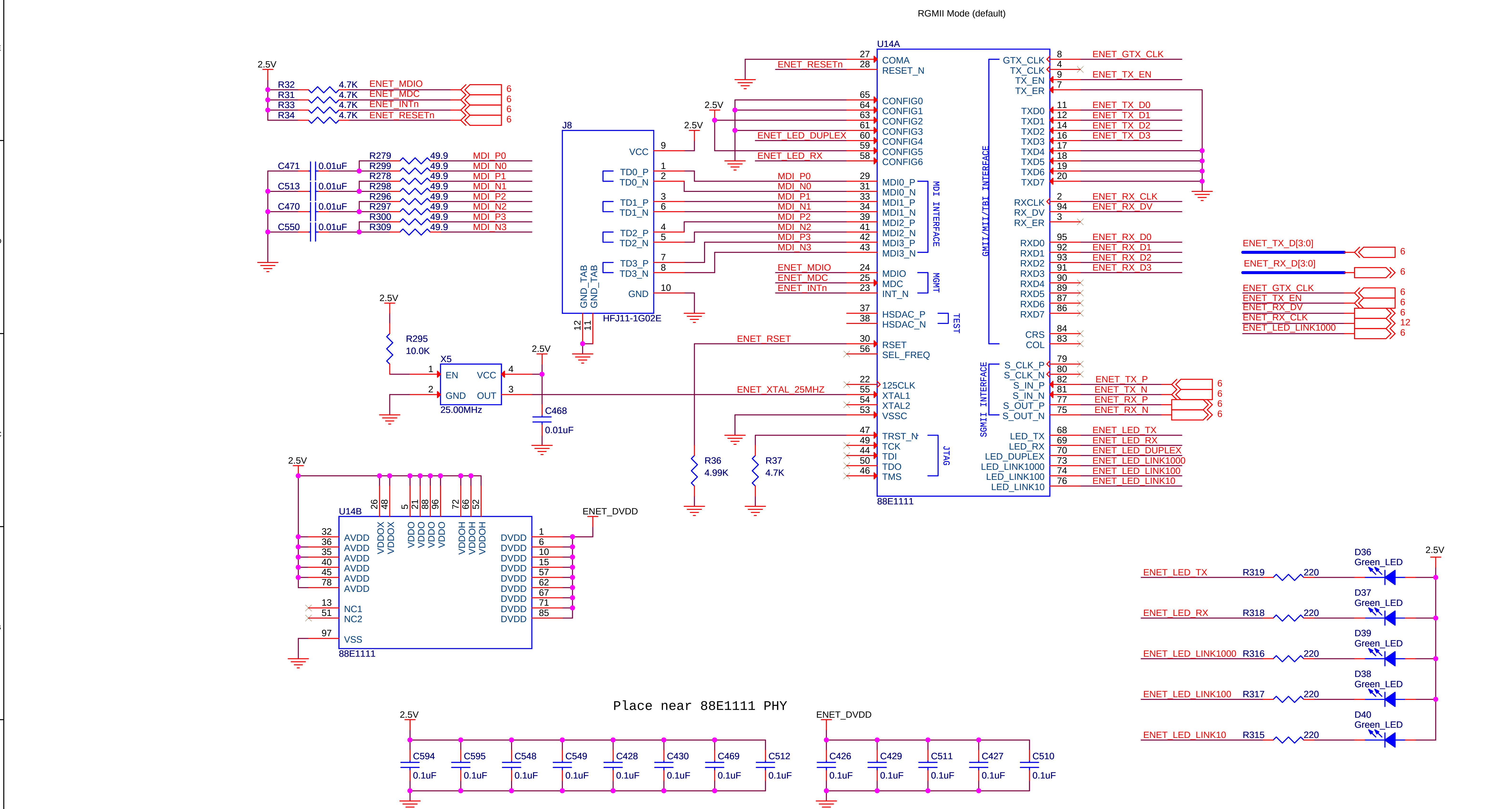
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 31 of 46

10/100/1000 Ethernet



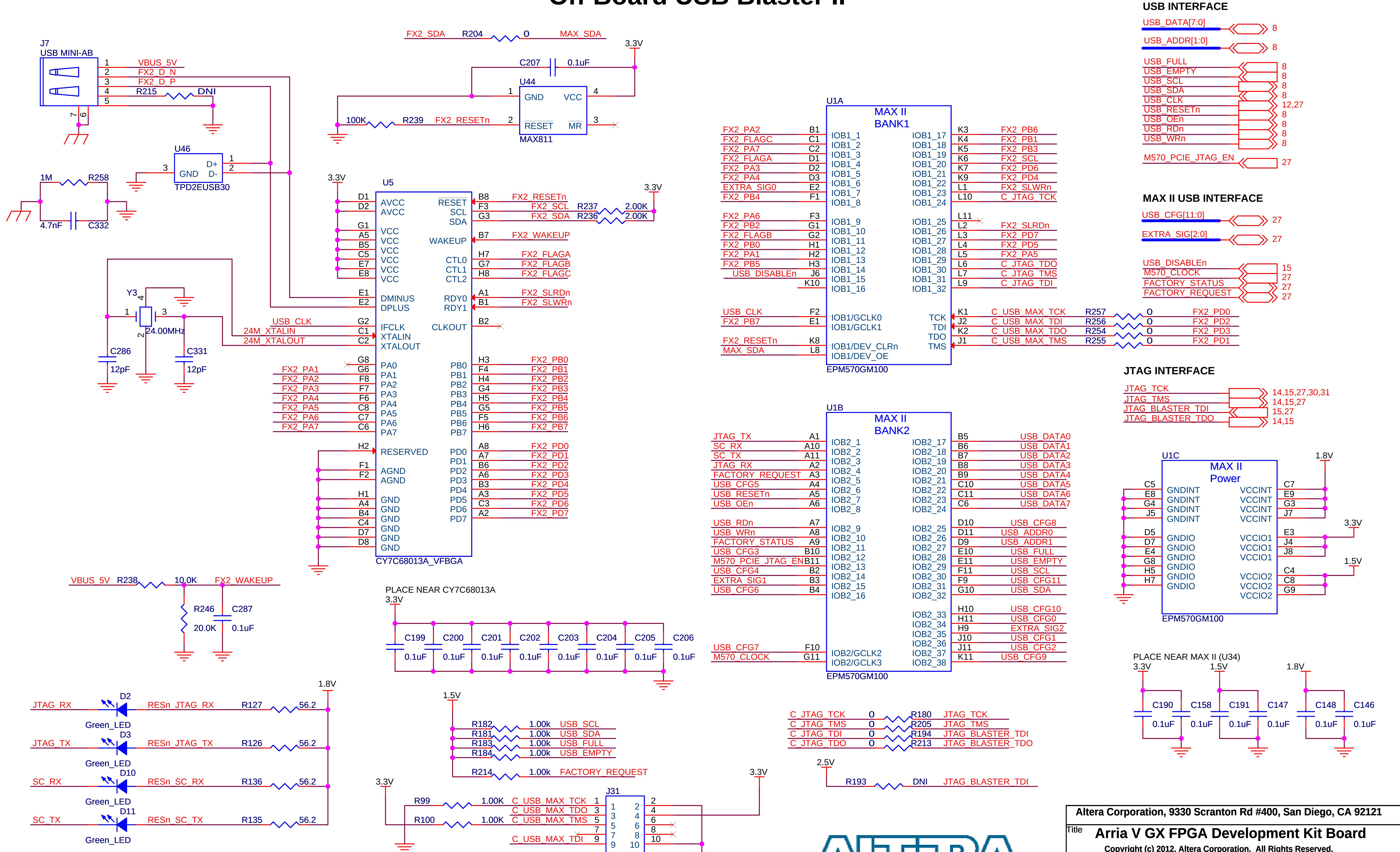
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 32 of 46

On-Board USB Blaster II

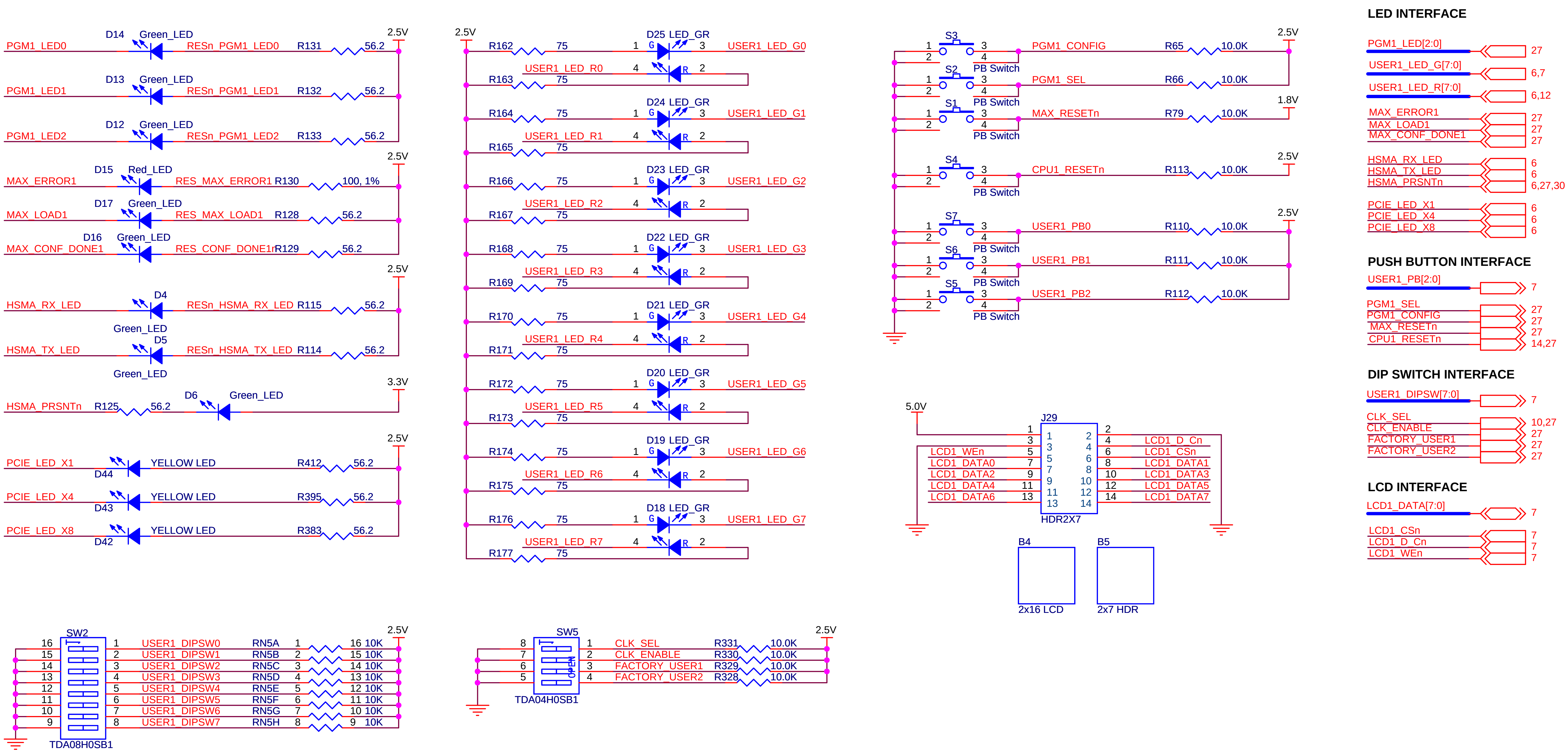


ALTERA

Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board		
	Copyright (c) 2012, Altera Corporation. All Rights Reserved.		
Size B	Document Number 150-0320804-B1	(6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012	Sheet 33 of 46		

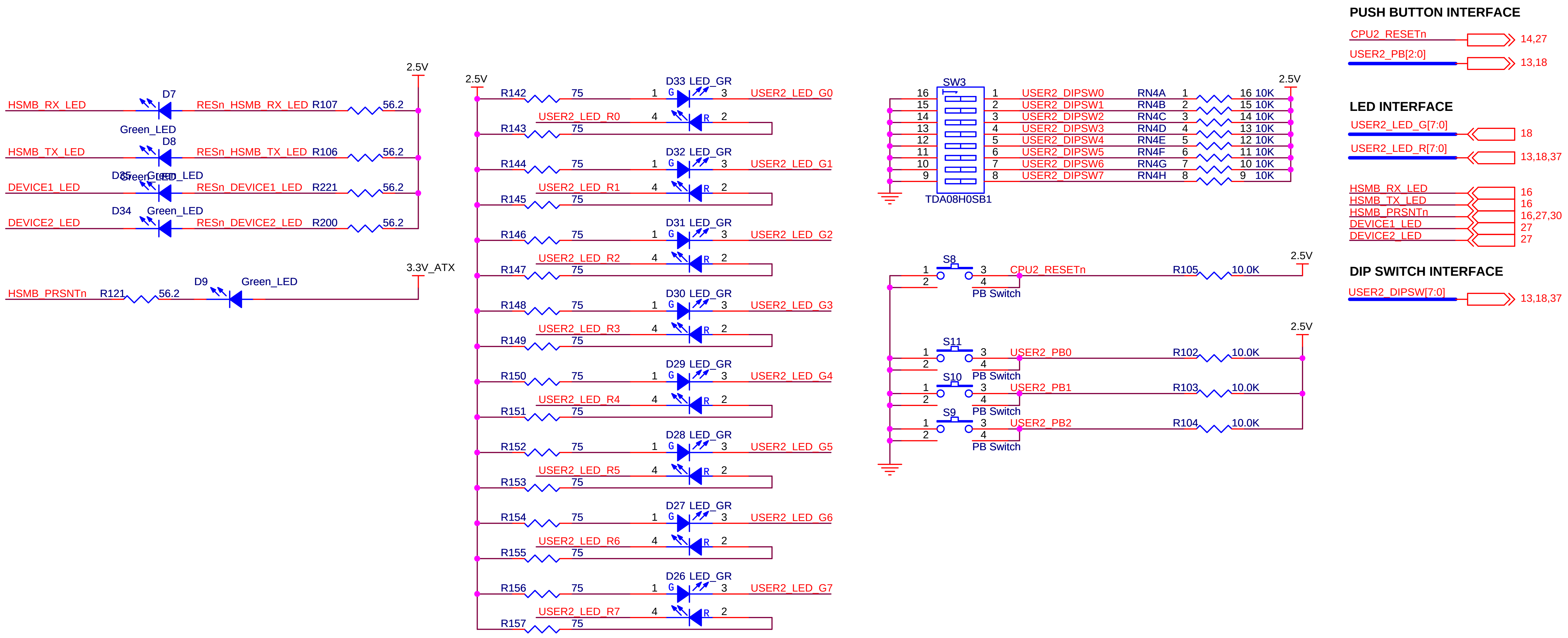
User I/O - (For Arria V GX FPGA 1)



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title	Arria V GX FPGA Development Kit Board	
Size B	Document Number 150-0320804-B1 (6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012	Sheet 34 of 46	

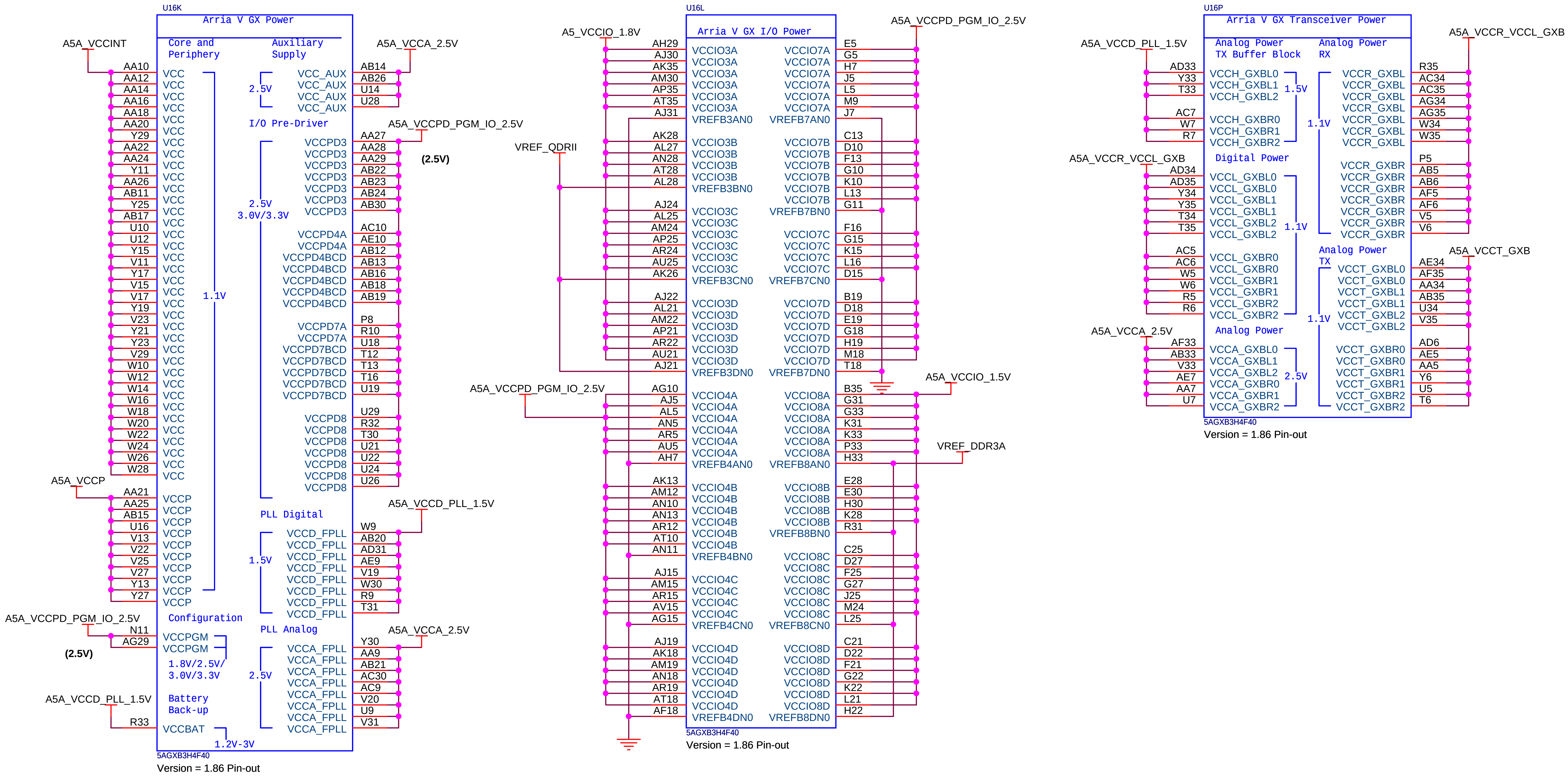
User I/O - (For Arria V GX FPGA 2)



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

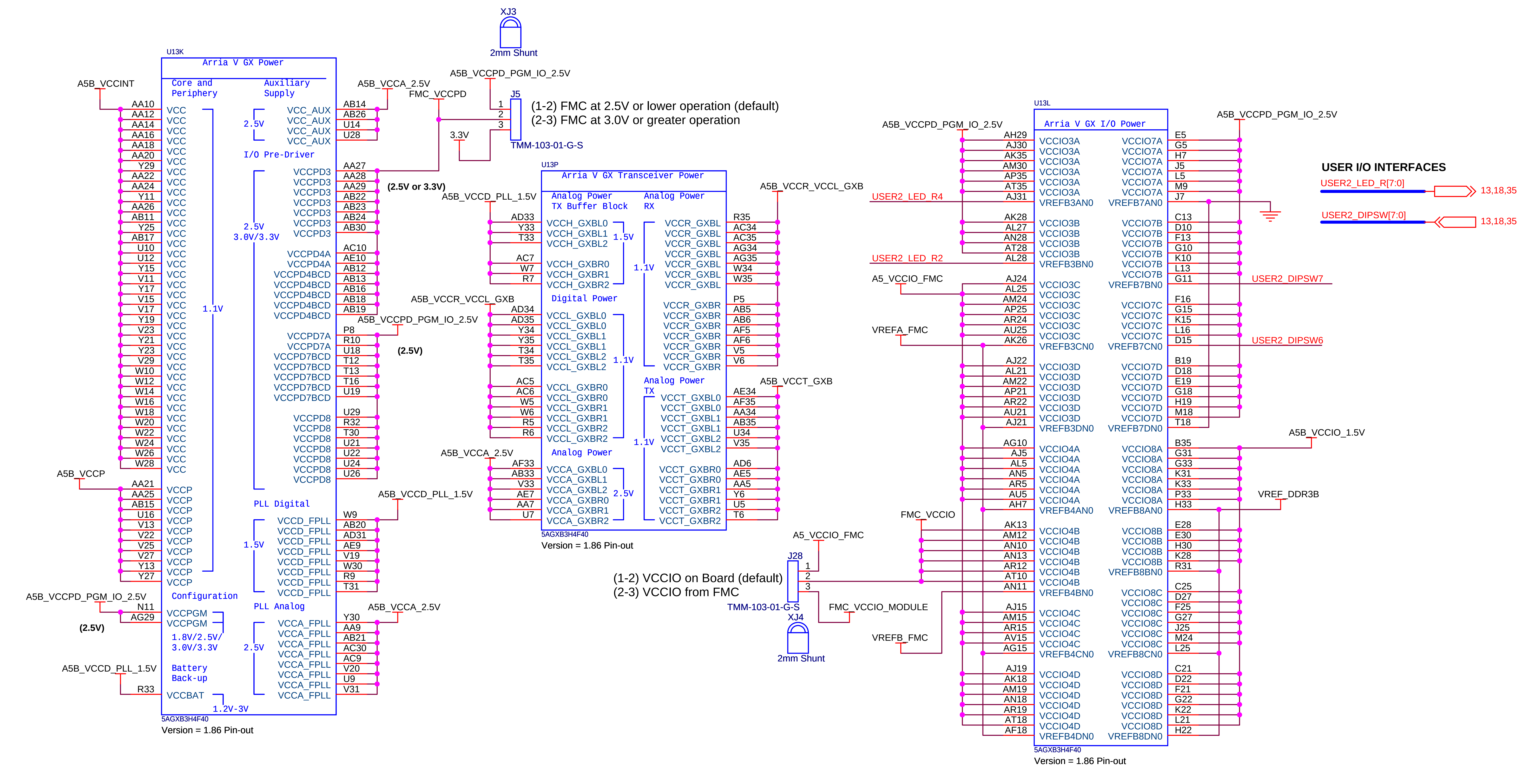
Title	Arria V GX FPGA Development Kit Board	
Size B	Document Number 150-0320804-B1 (6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012	Sheet 35 of 46	

Power - Arria V GX Power (FPGA 1)



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121			
Title	Arria V GX FPGA Development Kit Board		
	Copyright (c) 2012, Altera Corporation. All Rights Reserved.		
Size B	Document Number 150-0320804-B1	(6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012		Sheet 36 of 46	

Power - Arria V GX Power (FPGA 2)



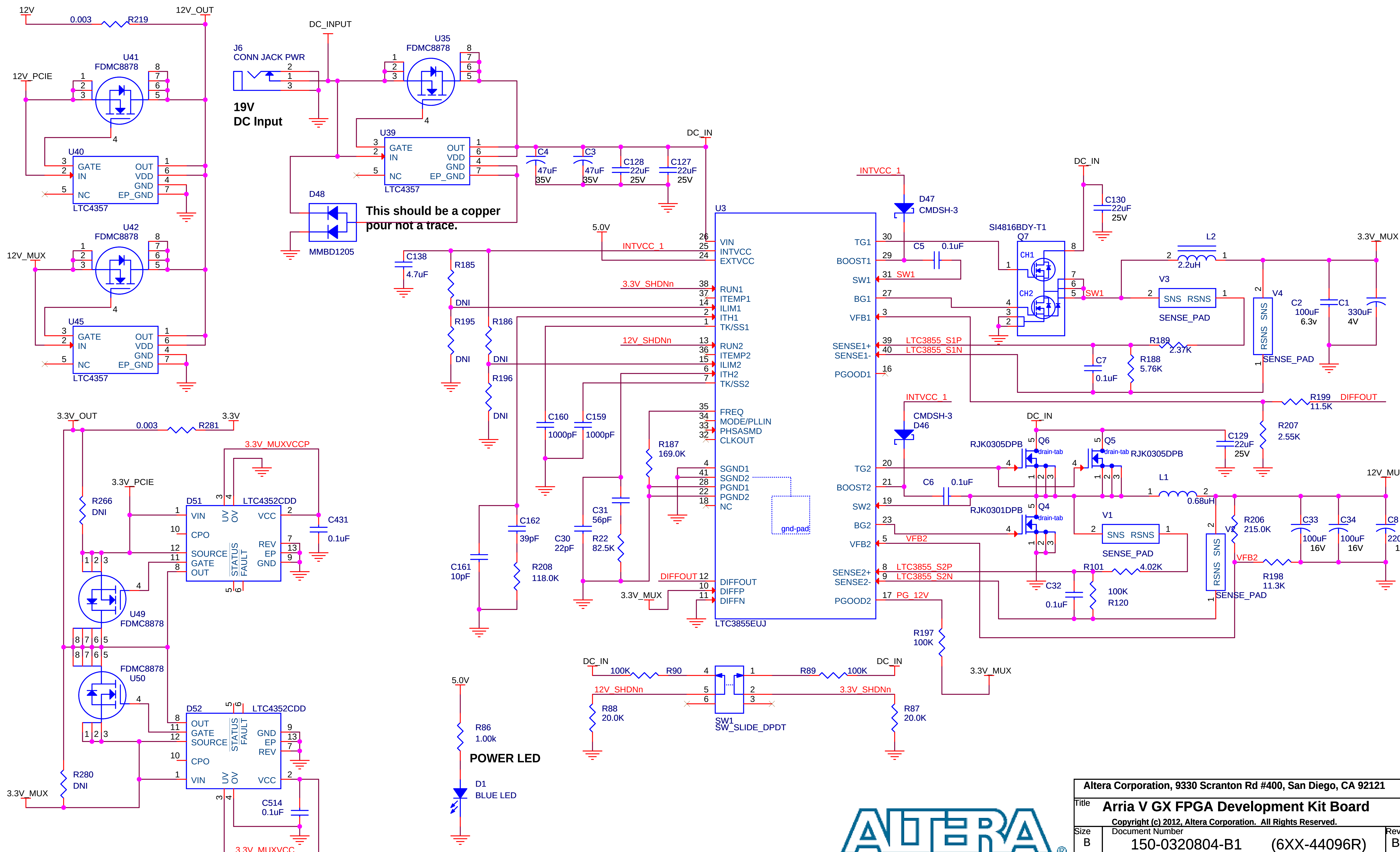
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size: B | Document Number: 150-0320804-B1 (6XX-44096R) | Rev: B

Date: Tuesday, July 31, 2012 | Sheet 37 of 46

Power 1 - DC Input & 12V, 3.3V Output



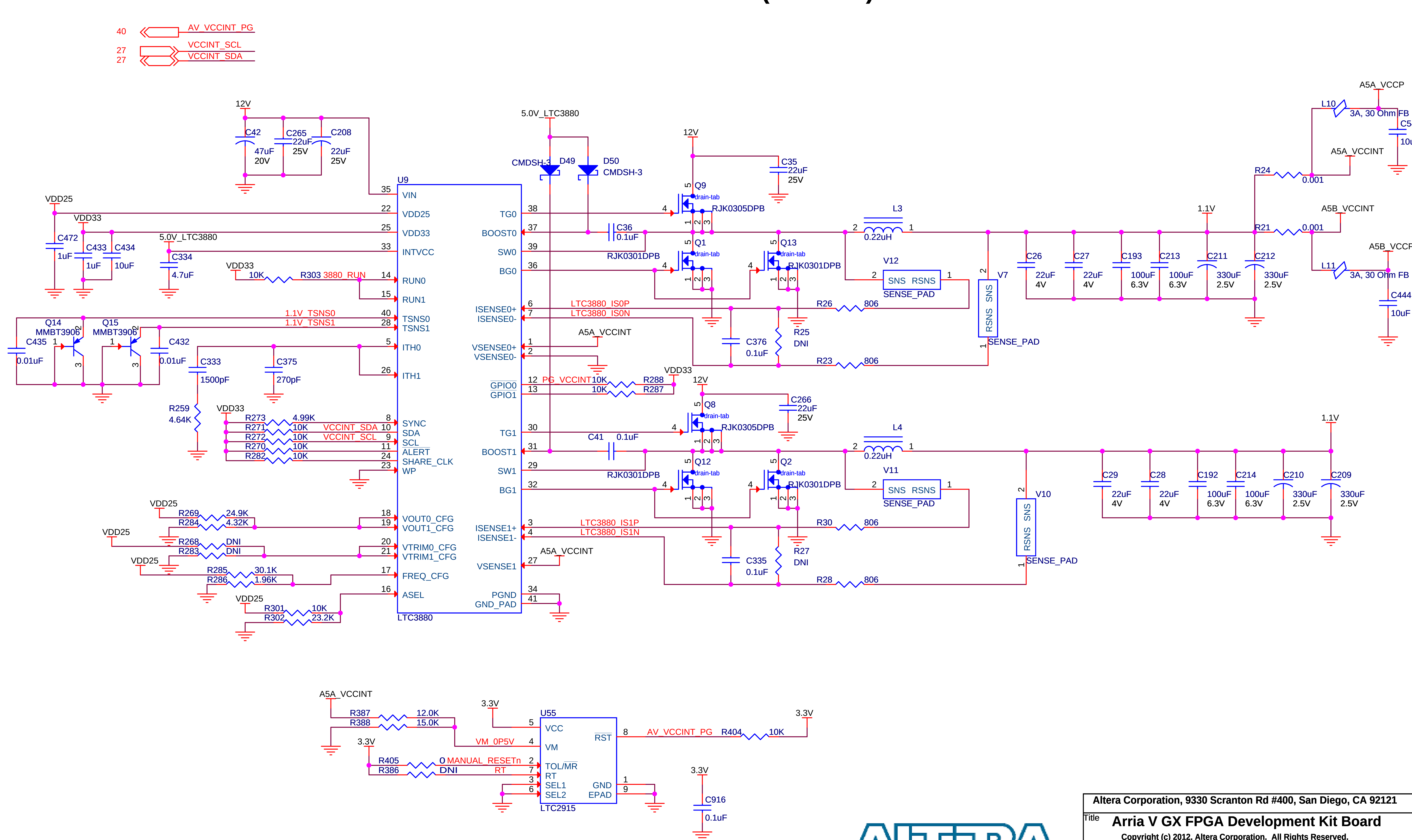
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 38 of 46

Power 2 - 1.1V (VCCINT)



ALTERA®

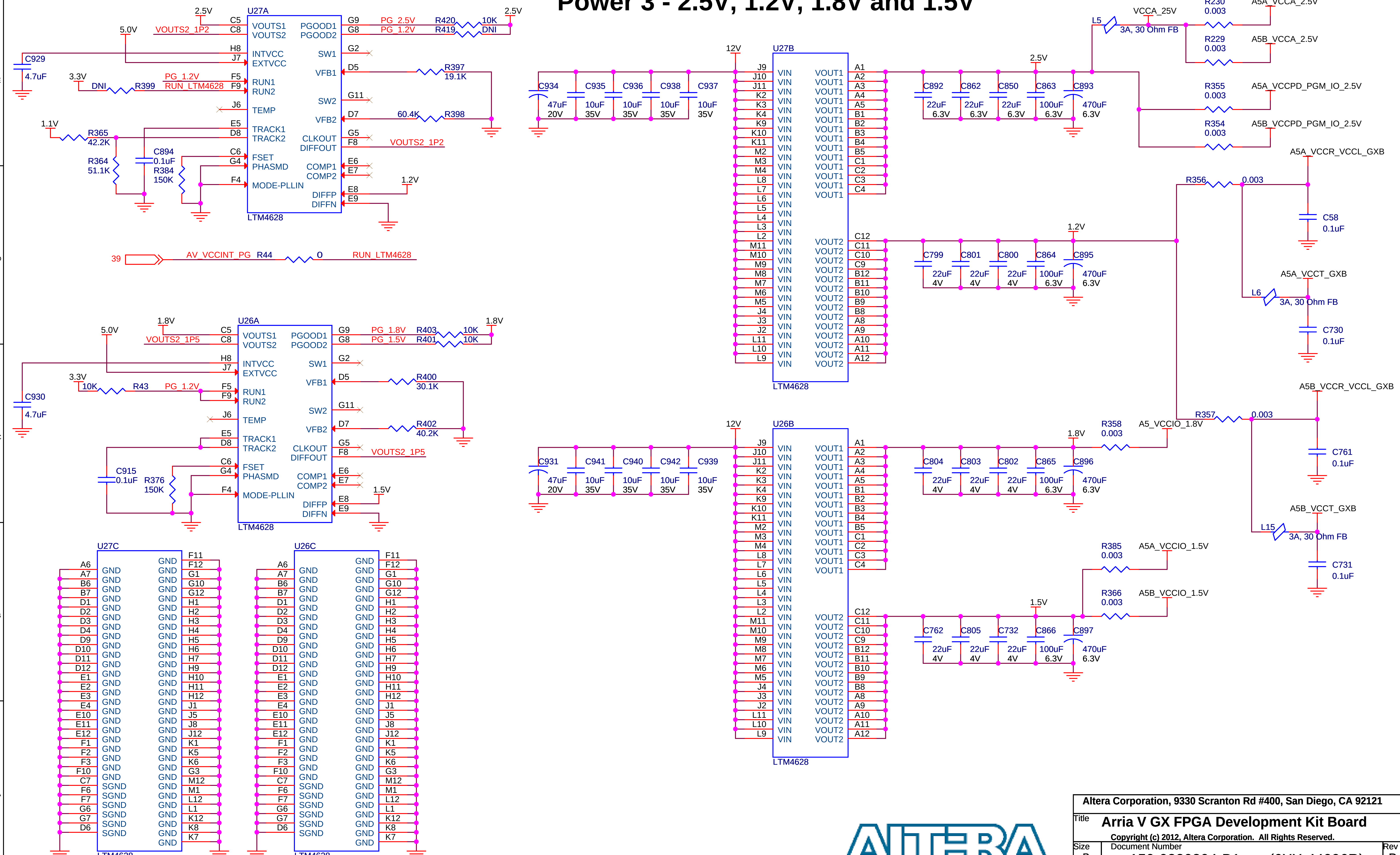
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 — Sheet 39 of 46

Power 3 - 2.5V, 1.2V, 1.8V and 1.5V



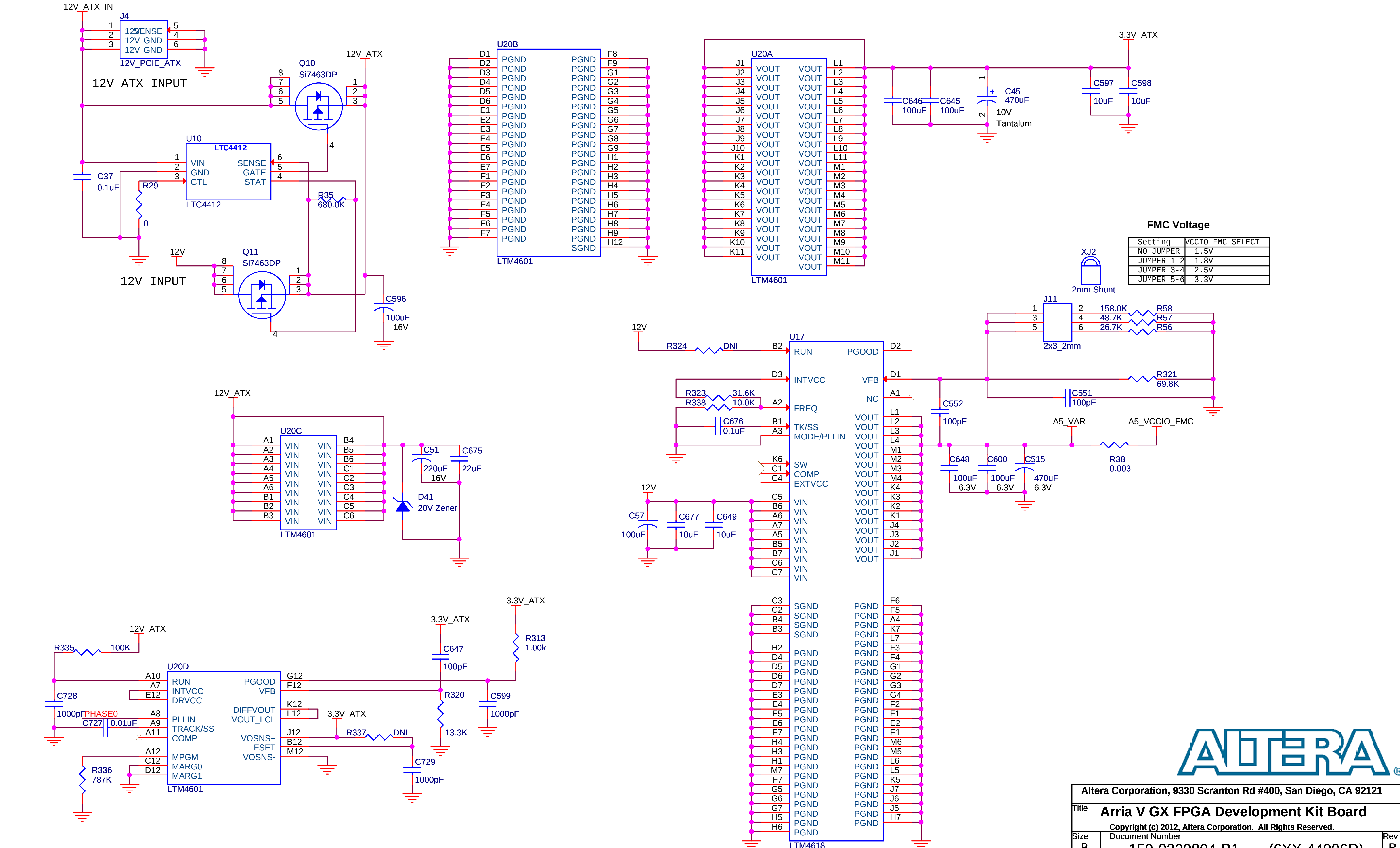
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 40 of 46

Power 3 - 3.3V_ATX and FMC Variable



FMC Voltage

Setting	VCCIO FMC SELECT
NO JUMPER	1.5V
JUMPER 1-2	1.8V
JUMPER 3-4	2.5V
JUMPER 5-6	3.3V

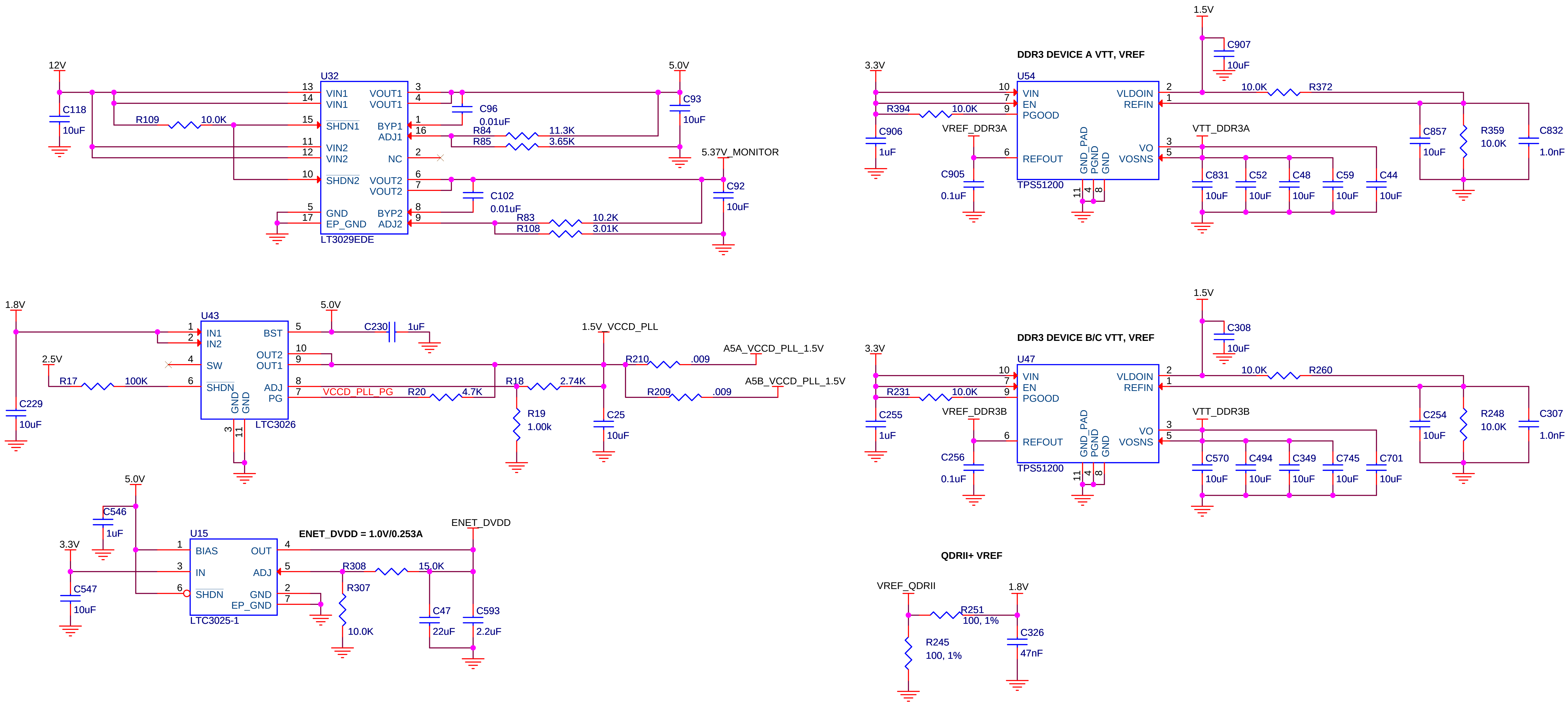
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

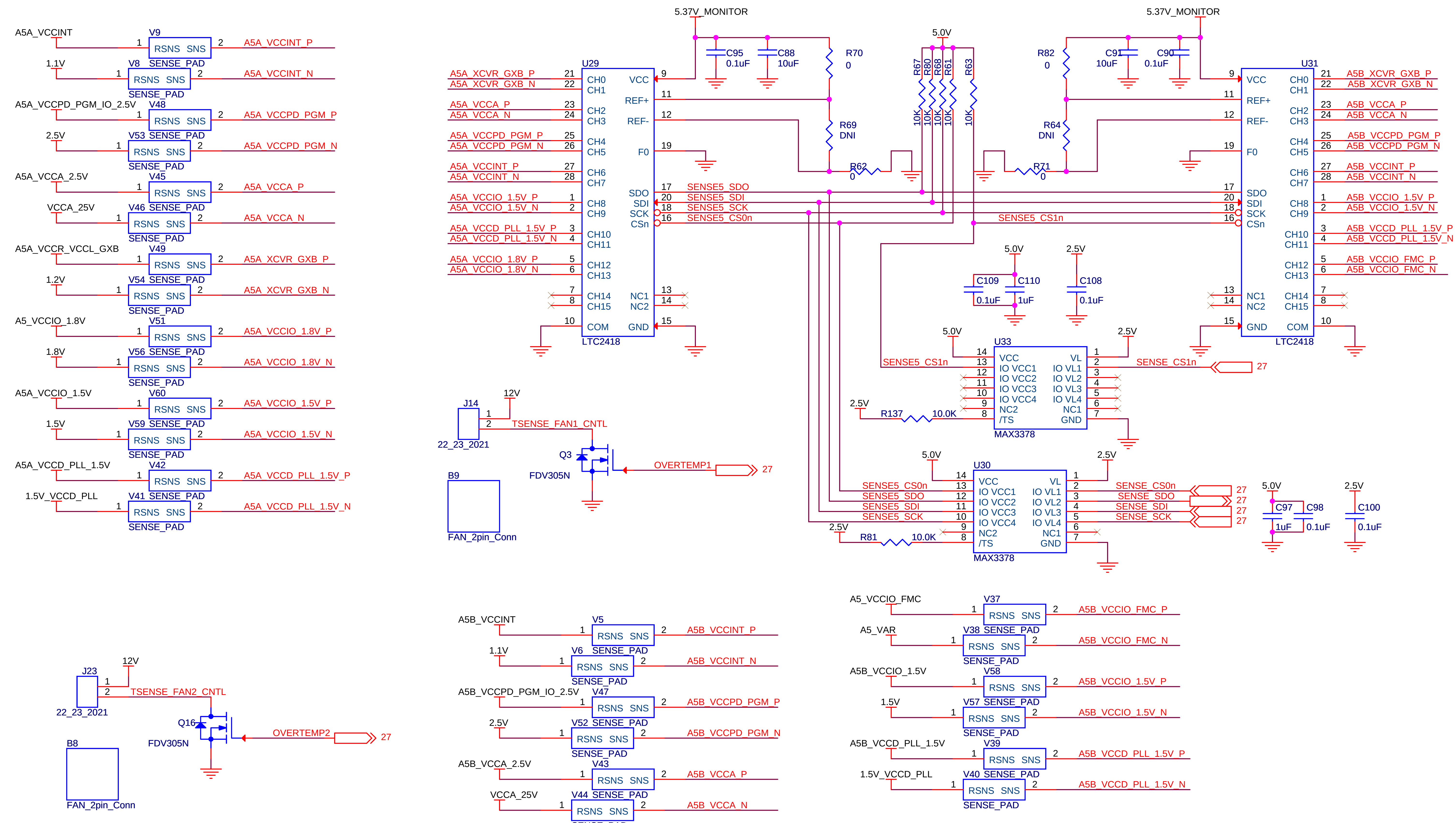
Date: Tuesday, July 31, 2012 Sheet 41 of 46

Power 4 - Linear Regulators



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121			
Title	Arria V GX FPGA Development Kit Board		
Size B	Document Number 150-0320804-B1	(6XX-44096R)	Rev B
Date: Tuesday, July 31, 2012		Sheet 42 of 46	

Power 6 - Power Monitor



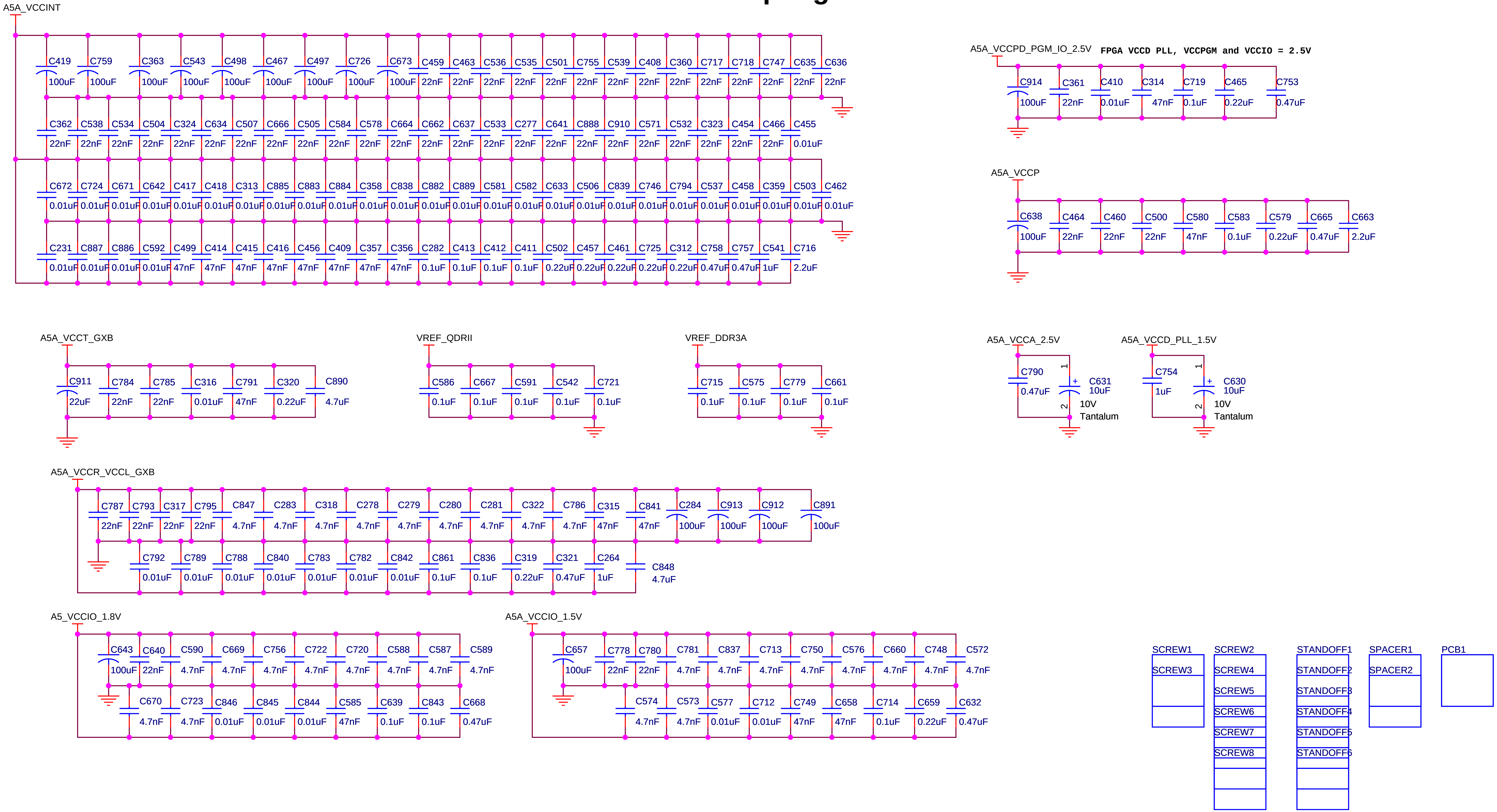
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 43 of 46

Decoupling - FPGA 1



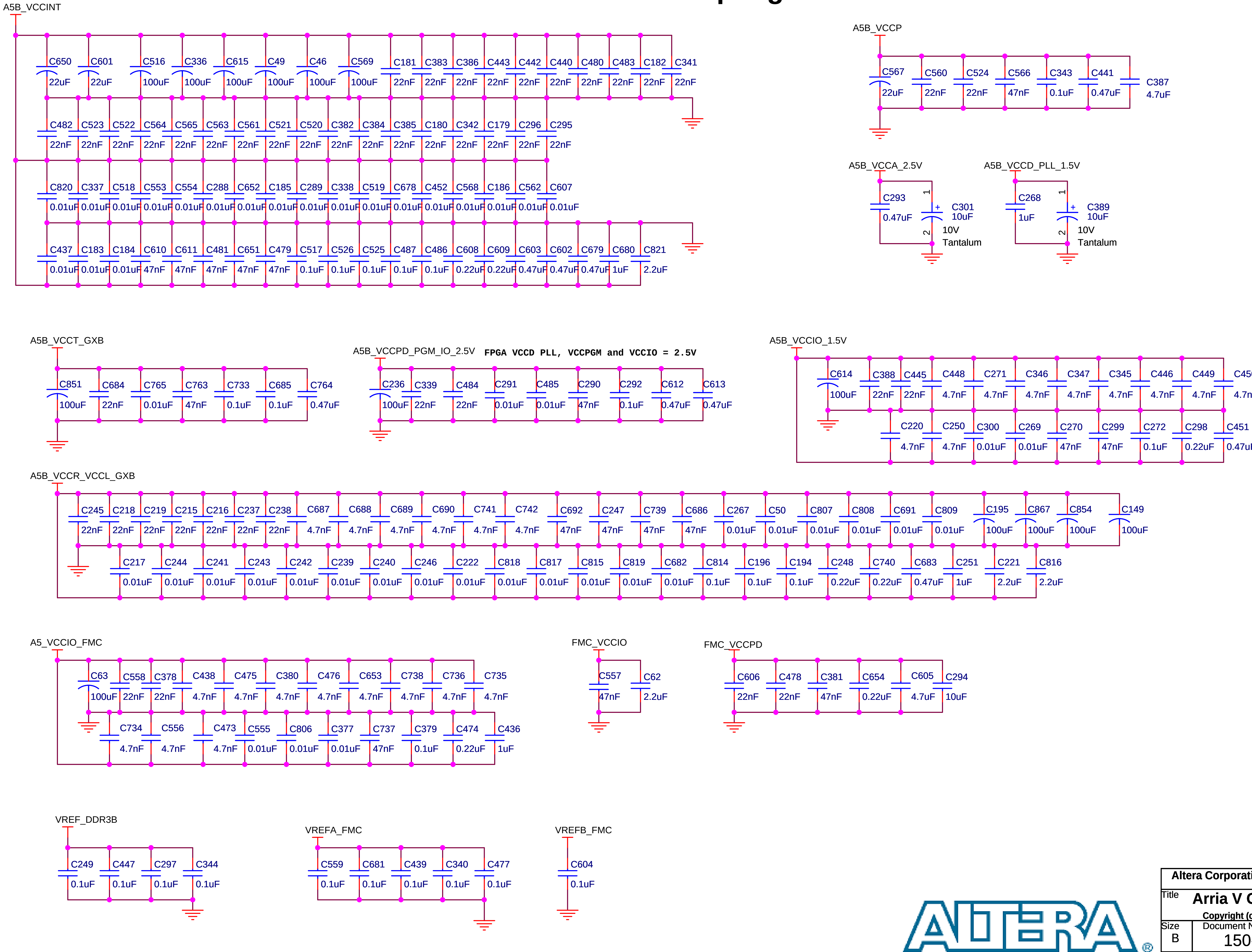
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 44 of 46

Decoupling - FPGA 2



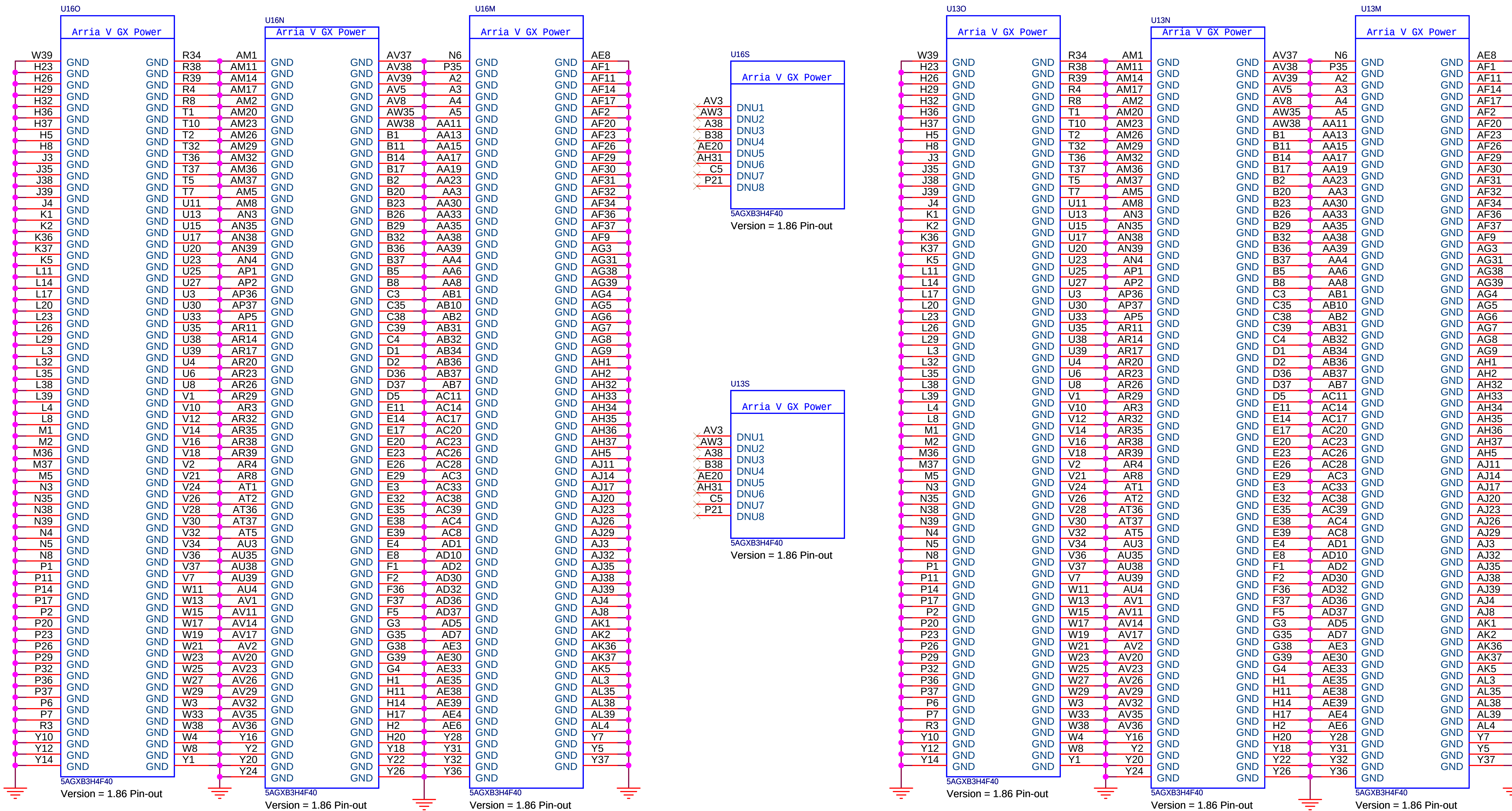
Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 45 of 46

Power - Arria V GX Ground Power



Altera Corporation, 9330 Scranton Rd #400, San Diego, CA 92121

Title: **Arria V GX FPGA Development Kit Board**

Size	Document Number	Rev
B	150-0320804-B1 (6XX-44096R)	B

Date: Tuesday, July 31, 2012 Sheet 46 of 46