

Fermi National Accelerator Laboratory

## **Main Injector Electronics**

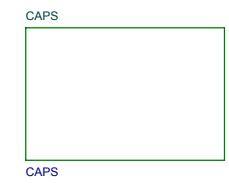
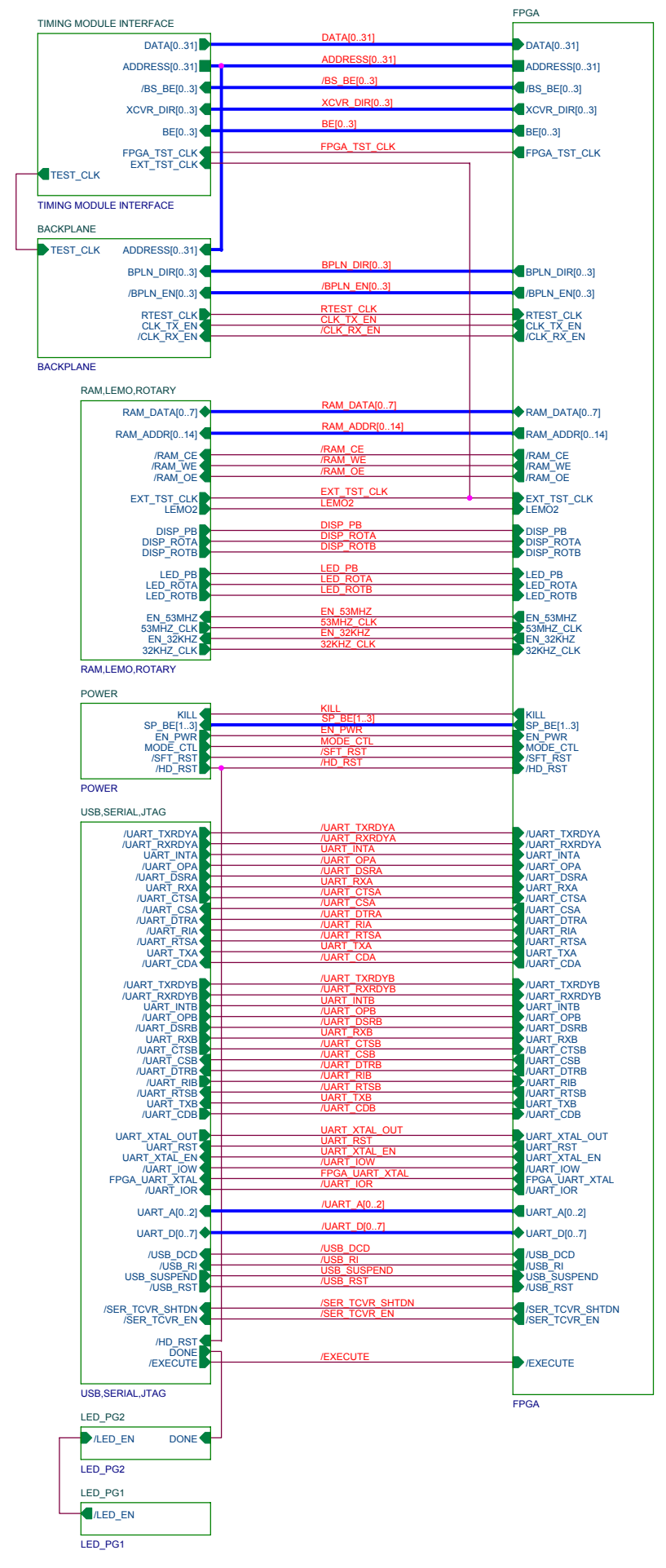
### **Electrical Schematic of the Beam Position Monitor Transition Board Control Module**

Date: April 1<sup>st</sup>, 2006

Revision Date: January 8<sup>th</sup>, 2007

Stefano M Rapisarda, Neal G Wilcer

**Document # Beam-doc-2154-v1**



MI BPM TB Control Module HARDWARE CHANGES

- 1) R38 should be replaced by a 0 Ohm Resistor.  
After LED daughter board assembly a 140 Ohm axial lead resistor should be placed in series to D19.
- 2) If R59 and R61 are not available to not install either of them.  
Place a direct connection (wire) between U34-pin3 (VCCA) and U34-pin1 (VCC3).
- 3) C327 should be replaced by a 220pF capacitor.
- 4) Cut the trace leading to U30-Pin4 at U30.
- 5) Place a 50 Ohm resistor across C323 (output of U28, 2.5 Volt regulator).
- 6) Reverse Resistors used to set output voltage of U31 (1.2 Volt regulator).  
R52 should be 3.57 KOhm (54H). R55 Should be 4.99 KOhm (68H).
- 7) Reverse Resistors used to set output voltage of U33 (1.2 Volt regulator).  
R57 should be 5.1 KOhm (512). R58 Should be 1.37 KOhm (14H).
- 8) Do not install U37 and U39.  
Connect directly U37-Pin1 to U37-Pin6.  
U37-Pin4 will be connected to the rotary encoder with a wire in modification #9.  
Connect directly U39-Pin1 to U37-Pin6.  
U37-Pin4 will be connected to the rotary encoder with a wire in modification #9.
- 9) Modifications are required before installing the rotary encoders due to error in footprint.
  - a) Cut top trace running to pin 2 on PCP.
  - b) Put kapton tape over pin 3 hole on top side of PCB.
  - c) Bend pin 3 of rotary encoder towards rear of switch.
  - d) Solder black wire wrap wire (about 3") to pin 3 of rotary encoder.
  - e) Install rotary encoder
  - f) Solder other end of black wire wrap wire to pin 4 pad of associated MAX6817, U39 for RSW2 and U37 for RSW1.
- 10) Do not install U42 (UART).
- 11) X3 should be placed in a socket.
- 12) R91 and R92 should be 4.7 KOhm (instead of 330Ohm).
- 13) R100, R101, R102, R103 and R107 should be 68 Ohm (instead of 330Ohm)
- 14) Place solder bridge on Data31 of J5.
- 15) Cut trace on the bottom of the board attached to pin16 of display daughterboard.  
Cut the trace on both sides of ground via shorting the trace.  
Remove R31. Jumper R31-pin2 to R33-pin2.

\*\*\* Caution \*\*\*

Changes in (16), (17) and (18) are not compatible with firmware revision dated before September 2, 2006. They allow to implement TB module addressing and readback.

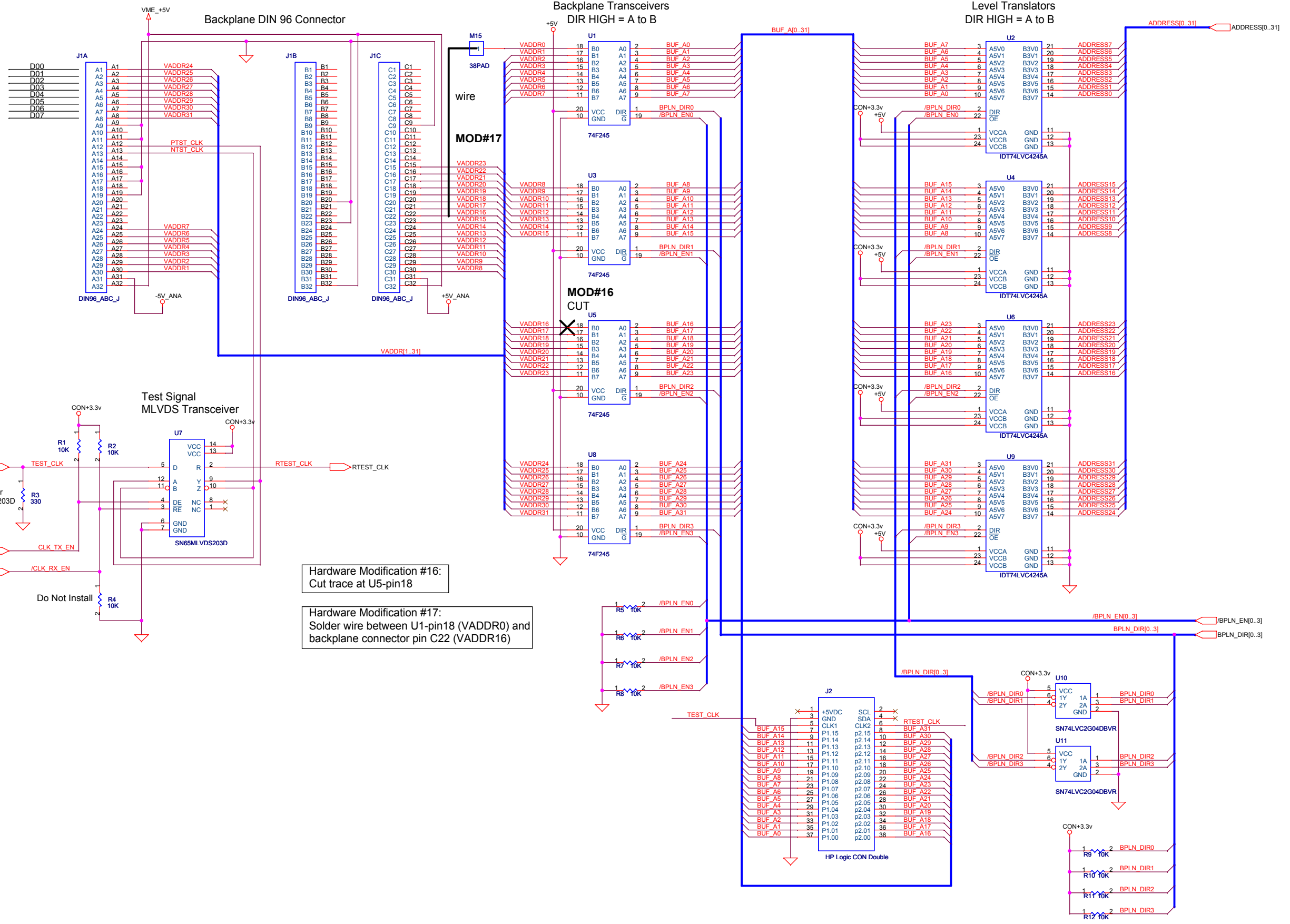
- 16) Cut trace at U5-pin18.
- 17) Solder wire between U1-pin18 (VADDR0) and backplane connector pin C22 (VADDR16).
- 18) Update firmware with revision dated after September 2, 2006.

MI BPM TB Control Module OPTIONAL HARDWARE CHANGES

- 1) OPT#A: Reflow FPGA.
- 2) OPT#B: Add components positioned at Q4 and Q5 to enable external test signal input (LEMO EXT2) and test signal monitoring (LEMO EXT1). It requires firmware revision of December 13, 2006 or later.

TOP

Title			BPM Transition Board Control Module		
Size	Document Number			Rev	
C	Beam-doc-2154			A	
Date:	Tuesday, January 09, 2007	Sheet	1	of	10

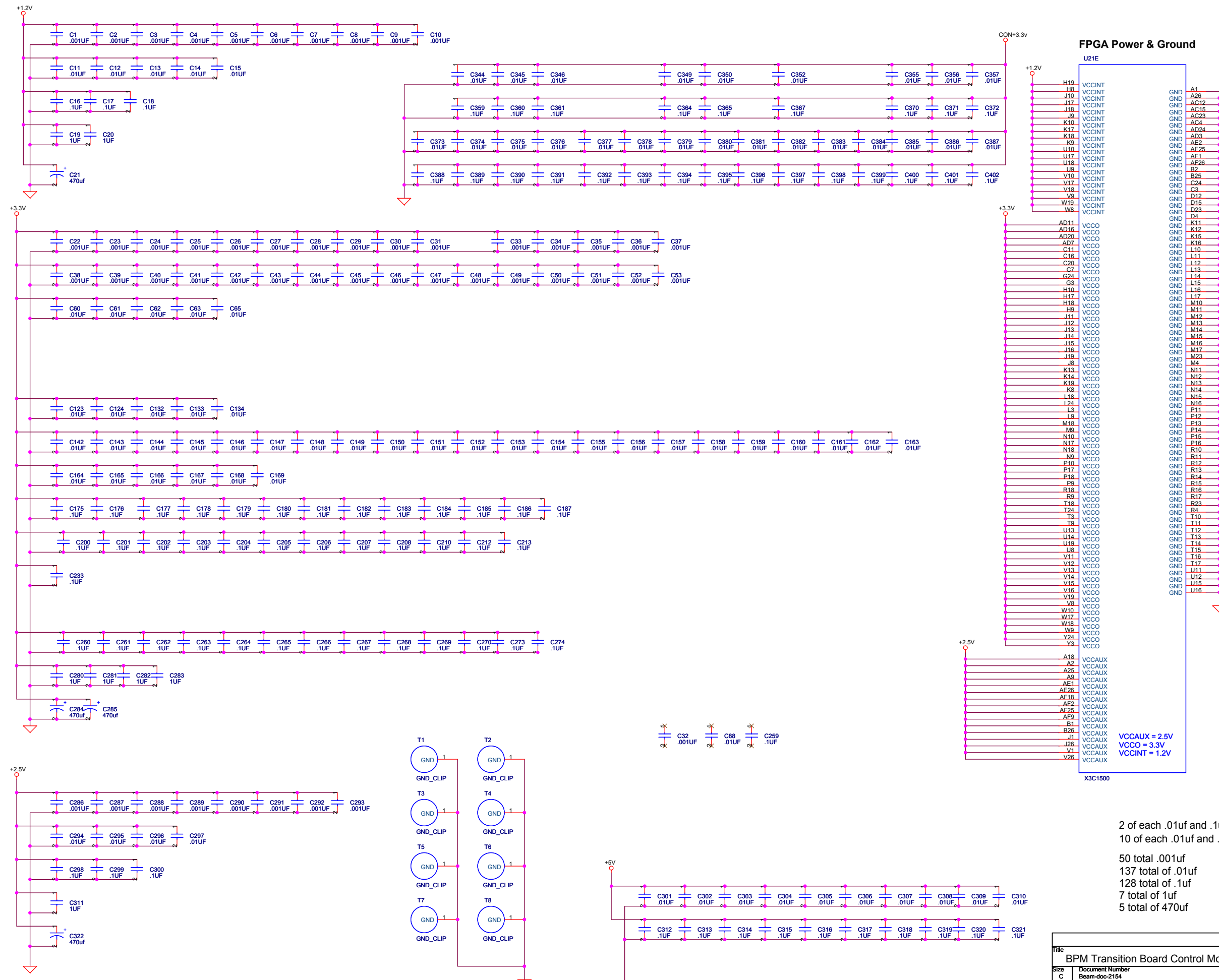


Hardware Modification #16:  
Cut trace at U5-pin18

Hardware Modification #17:  
Solder wire between U1-pin18 (VADDR0) and  
backplane connector pin C22 (VADDR16)

**BACKPLANE**

Title		
BPM Transition Board Control Module		
Size	Document Number	Rev
C	Beam-doc-2154	A
Date:	Tuesday, January 09, 2007	Sheet 2 of 10



**FPGA Power & Ground**

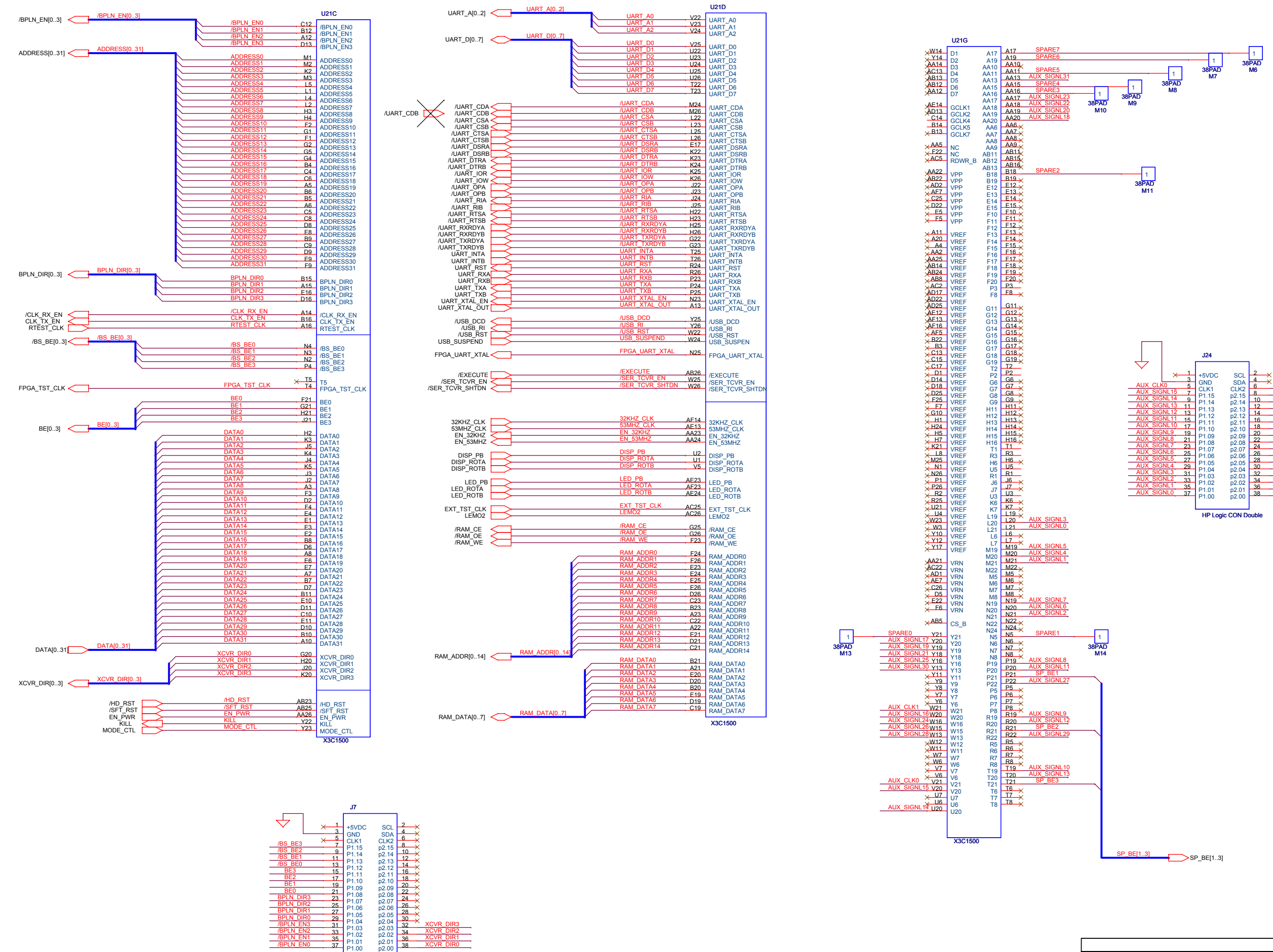
U21E

H19	VCCINT	A1
H8	VCCINT	A26
J10	VCCINT	AC12
J17	VCCINT	AC15
J18	VCCINT	AC23
J8	VCCINT	AC4
K10	VCCINT	AD3
K17	VCCINT	AD24
K18	VCCINT	AD3
K9	VCCINT	AE2
K10	VCCINT	AE25
U17	VCCINT	AF1
U18	VCCINT	AF26
U9	VCCINT	B2
V10	VCCINT	B25
V17	VCCINT	C24
V18	VCCINT	C3
V9	VCCINT	D12
W19	VCCINT	D15
W8	VCCINT	D23
	VCCINT	D4
	VCCO	K11
AD11	VCCO	K12
AD16	VCCO	K15
AD20	VCCO	K16
AD37	VCCO	L10
C11	VCCO	L11
C16	VCCO	L12
C20	VCCO	L13
C7	VCCO	L14
G24	VCCO	L15
G3	VCCO	L16
H10	VCCO	L17
H17	VCCO	M10
H18	VCCO	M11
H8	VCCO	M12
J11	VCCO	M13
J12	VCCO	M14
J13	VCCO	M15
J14	VCCO	M16
J15	VCCO	M17
J16	VCCO	M23
J19	VCCO	M4
J8	VCCO	N11
K13	VCCO	N12
K14	VCCO	N13
K19	VCCO	N14
K8	VCCO	N15
L18	VCCO	N16
L24	VCCO	P11
L3	VCCO	P12
L9	VCCO	P13
M18	VCCO	P14
M9	VCCO	P15
N10	VCCO	P16
N17	VCCO	R10
N18	VCCO	R11
N8	VCCO	R12
P10	VCCO	R13
P17	VCCO	R14
P18	VCCO	R15
P9	VCCO	R16
R18	VCCO	R17
R9	VCCO	R23
T18	VCCO	R4
T24	VCCO	T10
T3	VCCO	T11
T9	VCCO	T12
U13	VCCO	T13
U14	VCCO	T14
U19	VCCO	T15
U8	VCCO	T16
V11	VCCO	T17
V12	VCCO	U11
V13	VCCO	U12
V14	VCCO	U15
V15	VCCO	U16
V16	VCCO	
V19	VCCO	
V8	VCCO	
W10	VCCO	
W17	VCCO	
W18	VCCO	
W9	VCCO	
Y24	VCCO	
Y3	VCCO	
A18	VCCAUX	
A2	VCCAUX	
A25	VCCAUX	
A9	VCCAUX	
AE1	VCCAUX	
AE26	VCCAUX	
AE18	VCCAUX	
AE2	VCCAUX	
AE25	VCCAUX	
AE9	VCCAUX	
B1	VCCAUX	
B26	VCCAUX	
J1	VCCAUX	
J26	VCCAUX	
V1	VCCAUX	
V26	VCCAUX	

**CAPS**

2 of each .01uf and .1uf for 1.8V
10 of each .01uf and .1uf for 5V
50 total .001uf
137 total of .01uf
128 total of .1uf
7 total of 1uf
5 total of 470uf

Title		
BPM Transition Board Control Module		
Size	Document Number	Rev
C	Beam-doc-2154	A
Date:	Tuesday, January 09, 2007	Sheet 3 of 10

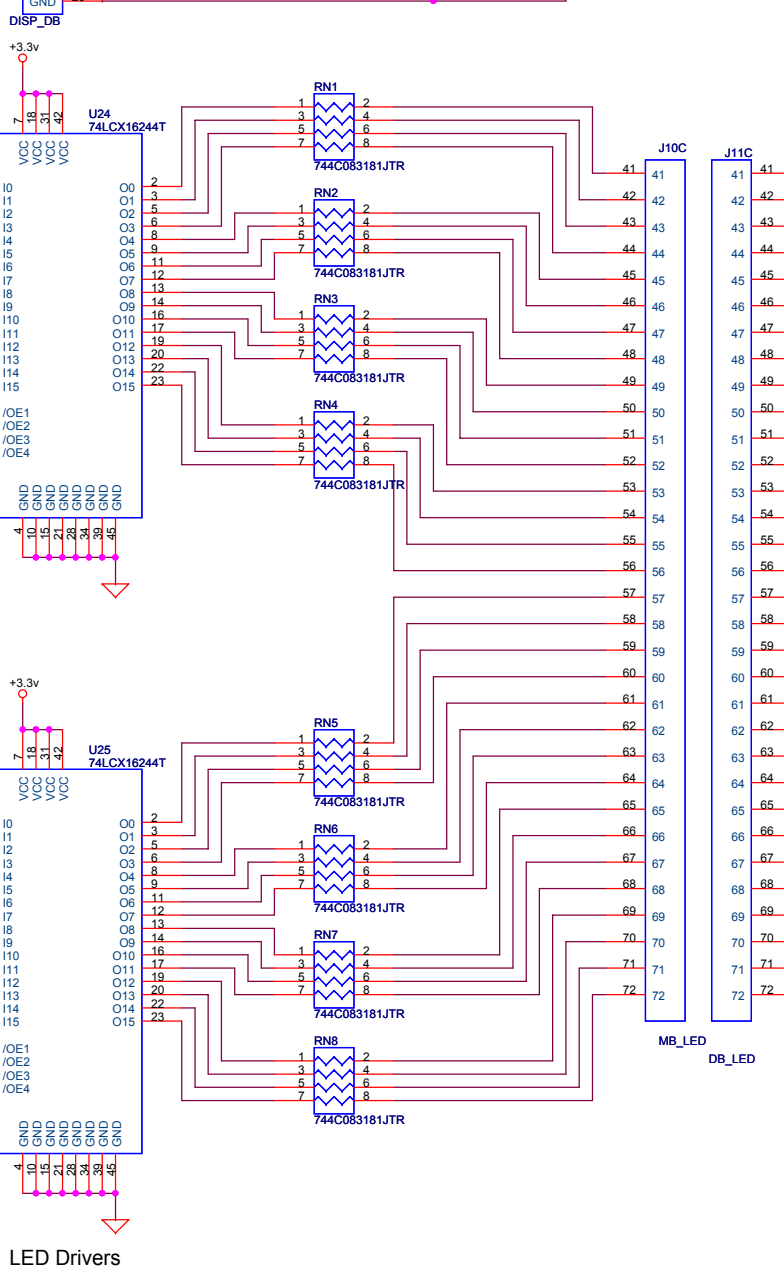
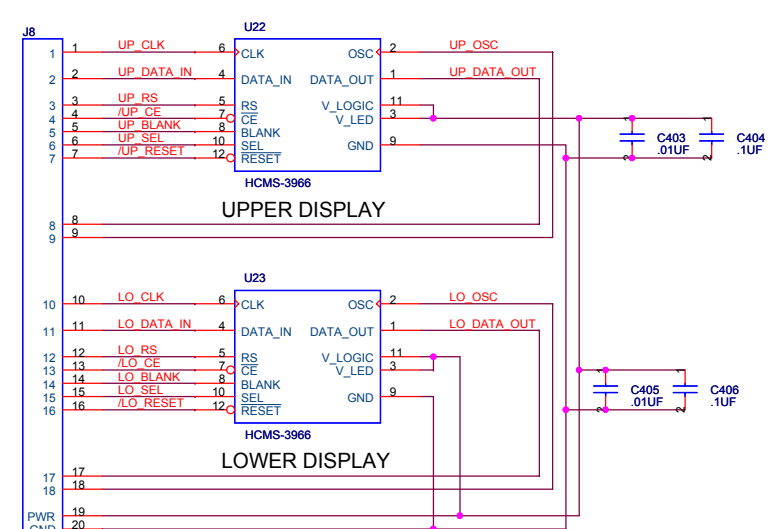
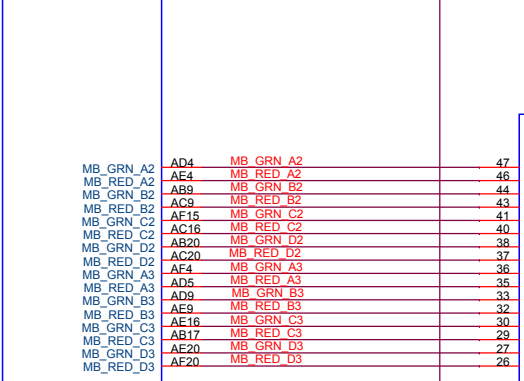
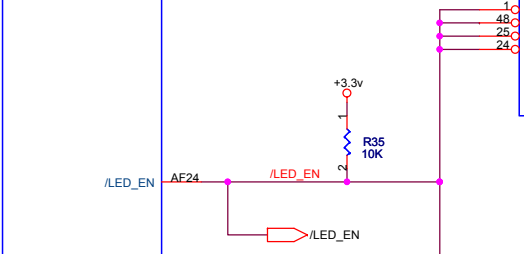
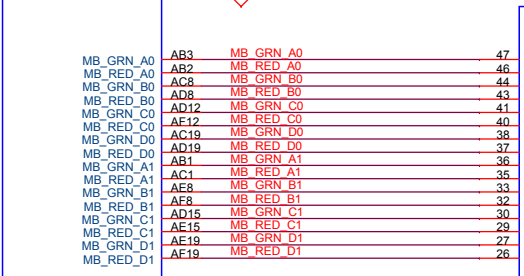
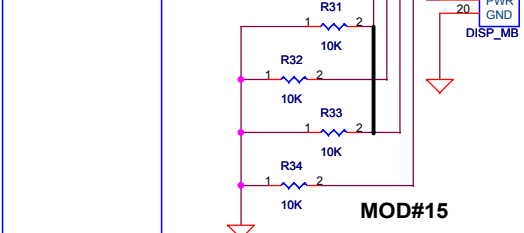
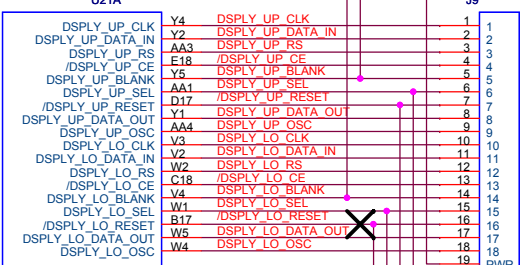


FPGA

Title		
BPM Transition Board Control Module		
Size	Document Number	Rev
C	Beam-doc-2154	A
Date:	Monday, January 08, 2007	Sheet 4 of 10

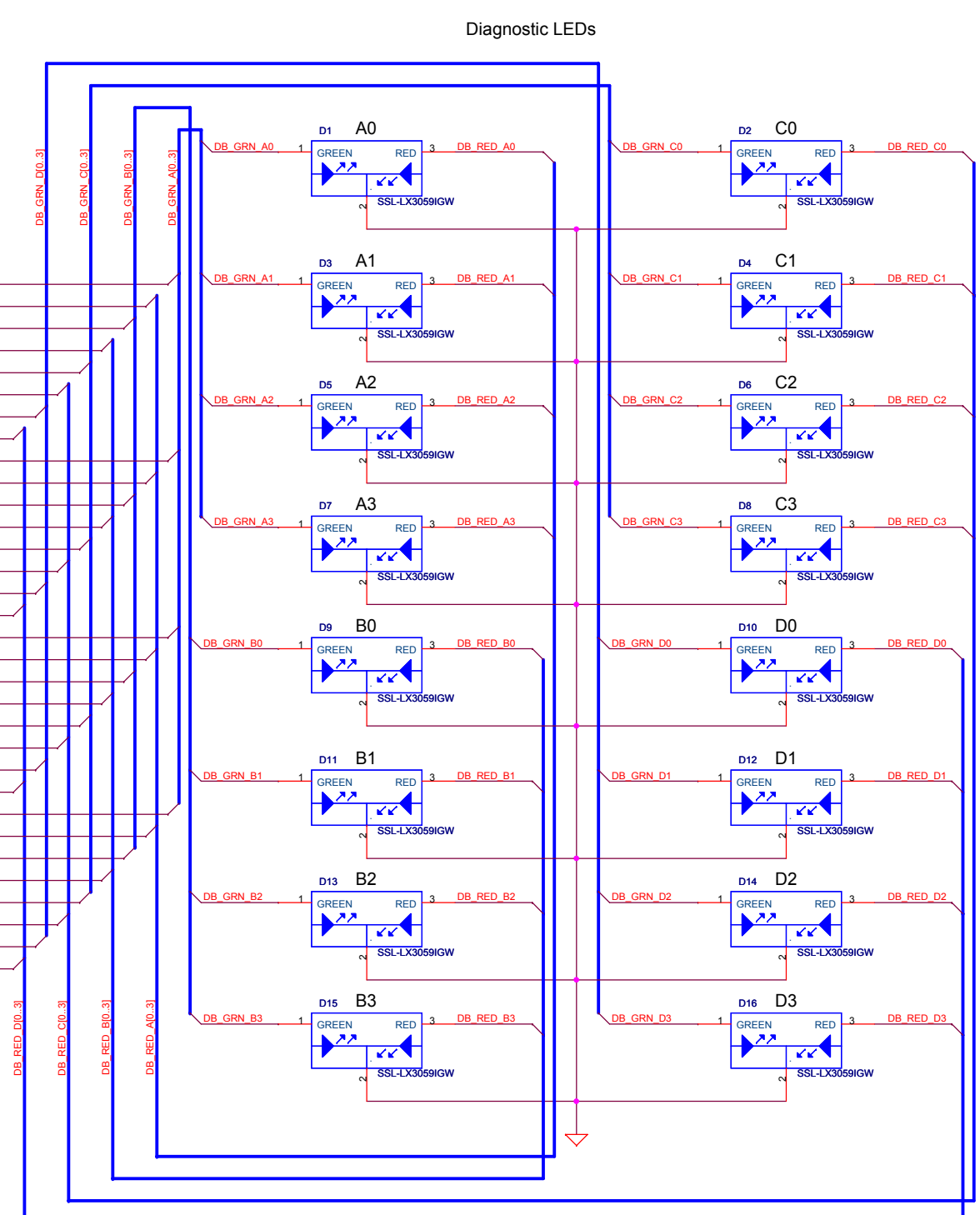


**FPGA**



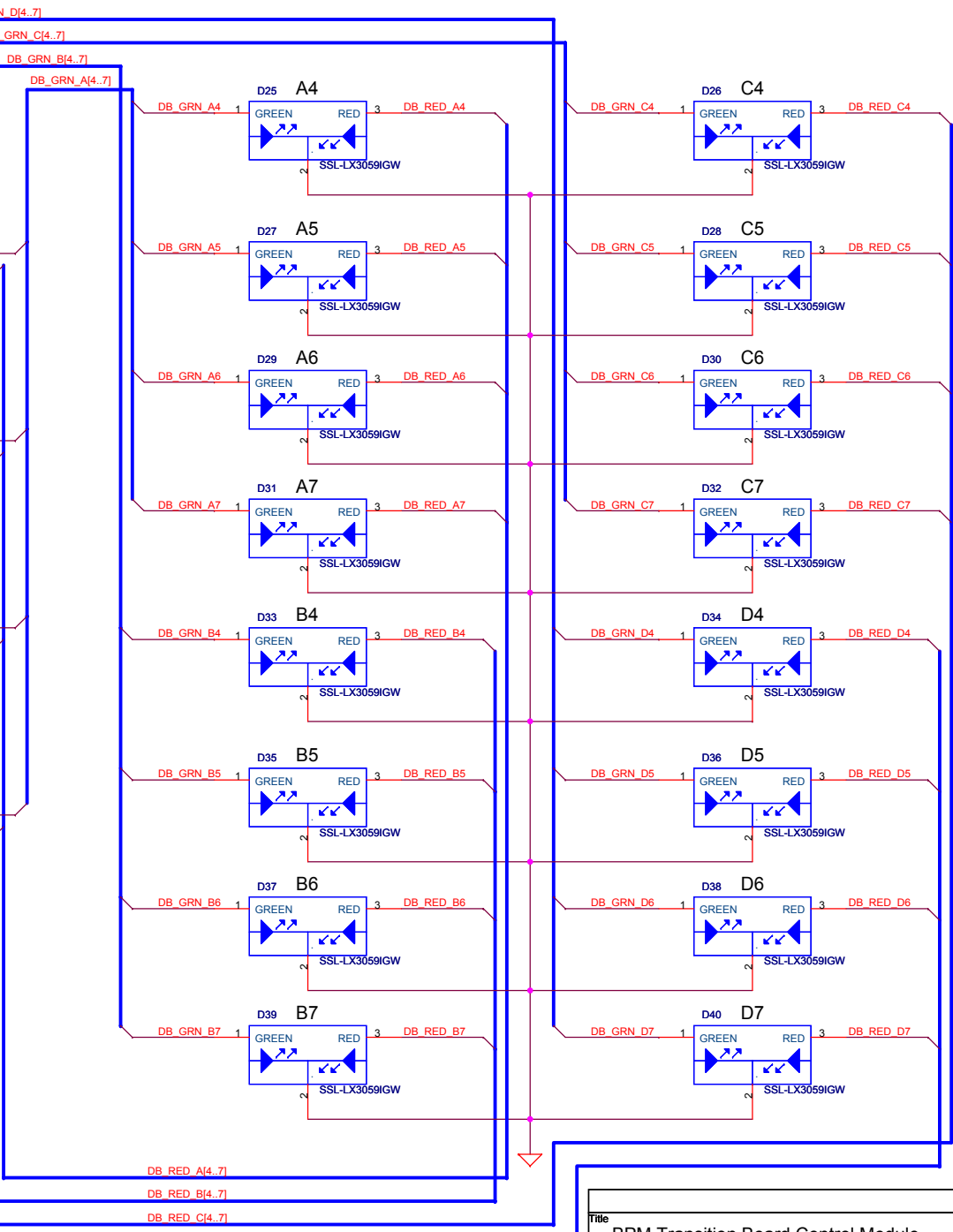
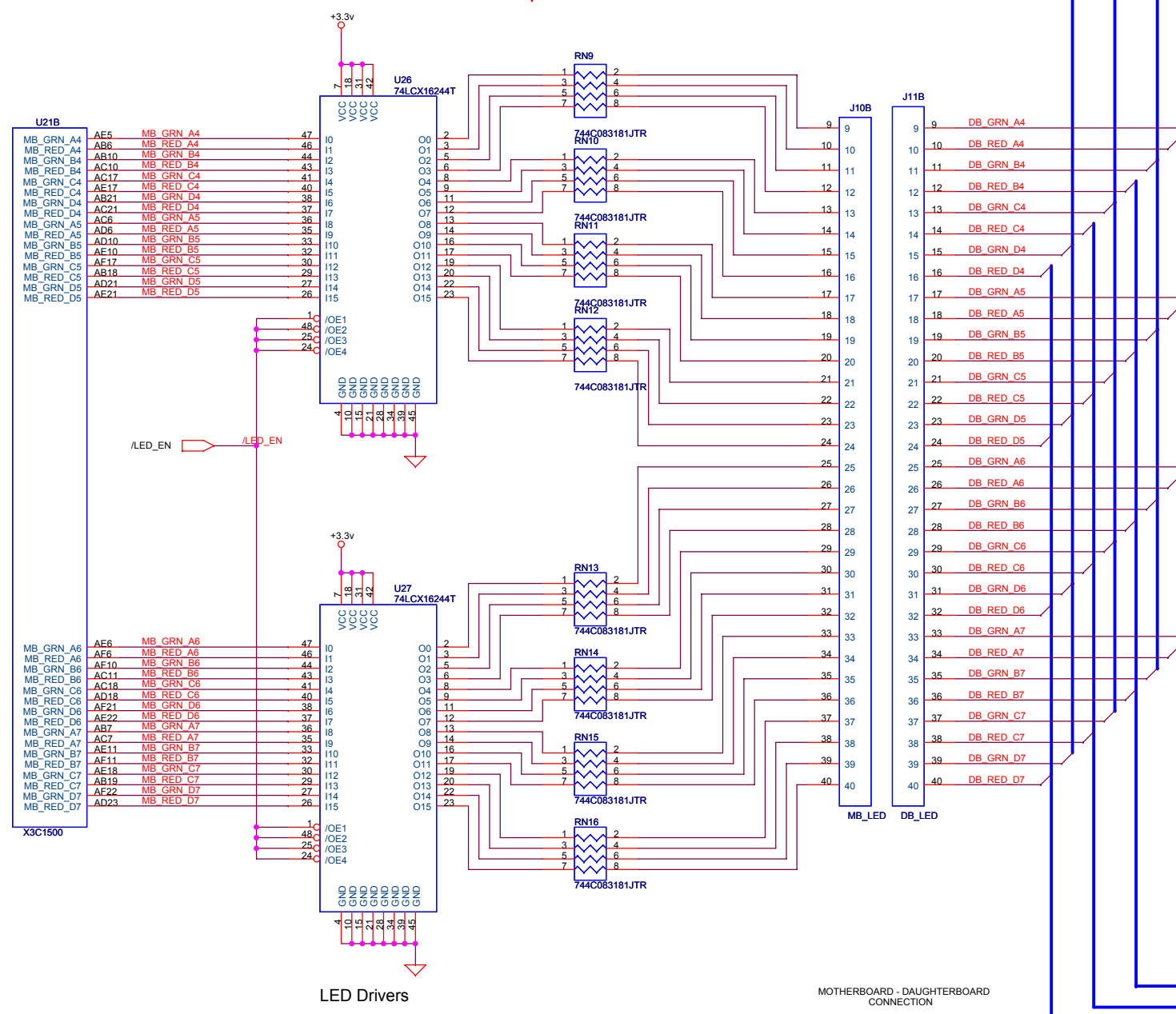
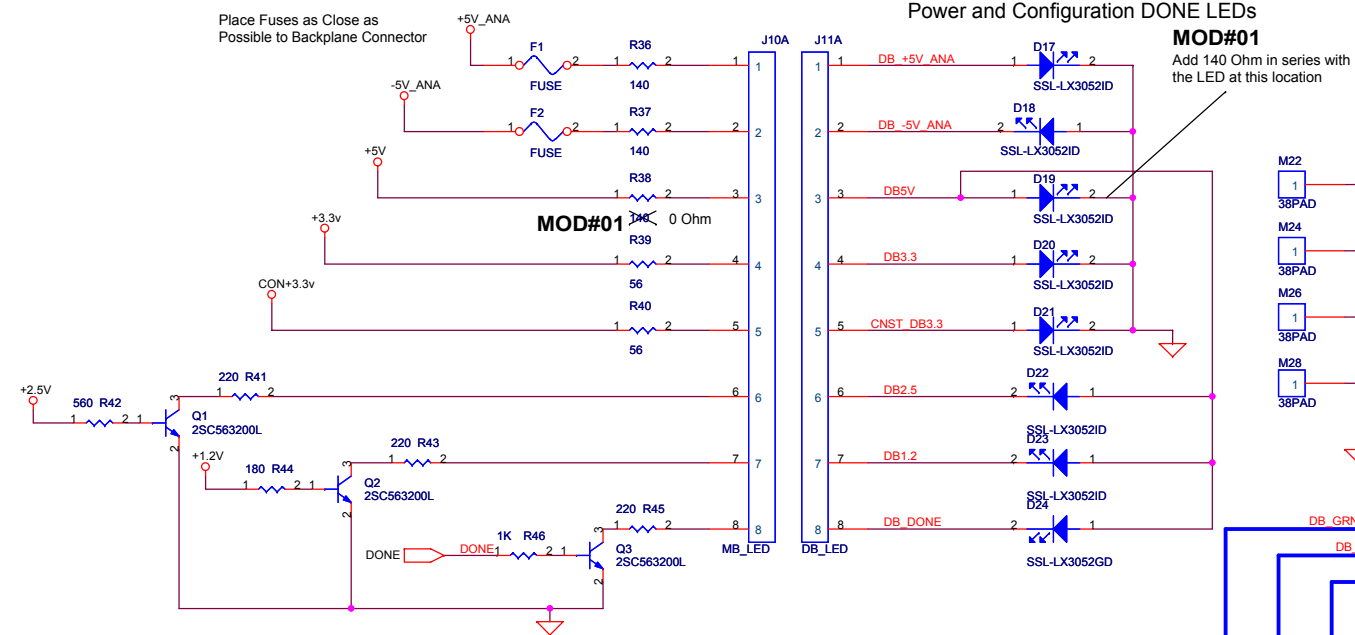
**Hardware Modification #15:**  
Cut trace on the bottom of the board attached to pin16 of display daughterboard. Cut the trace on both sides of ground via shorting the trace. Remove R31. Jumper R31-pin2 to R33-pin2.

**NOTE:**  
there is a mismatch between the schematic signal names and the LED signals used for the pin assignments in the FPGA Project UCF file. The UCF assignment (and the names used in the VHDL) reflects the position of the LED in the front panel. The schematic names are not consistent with the LED position on the front panel.



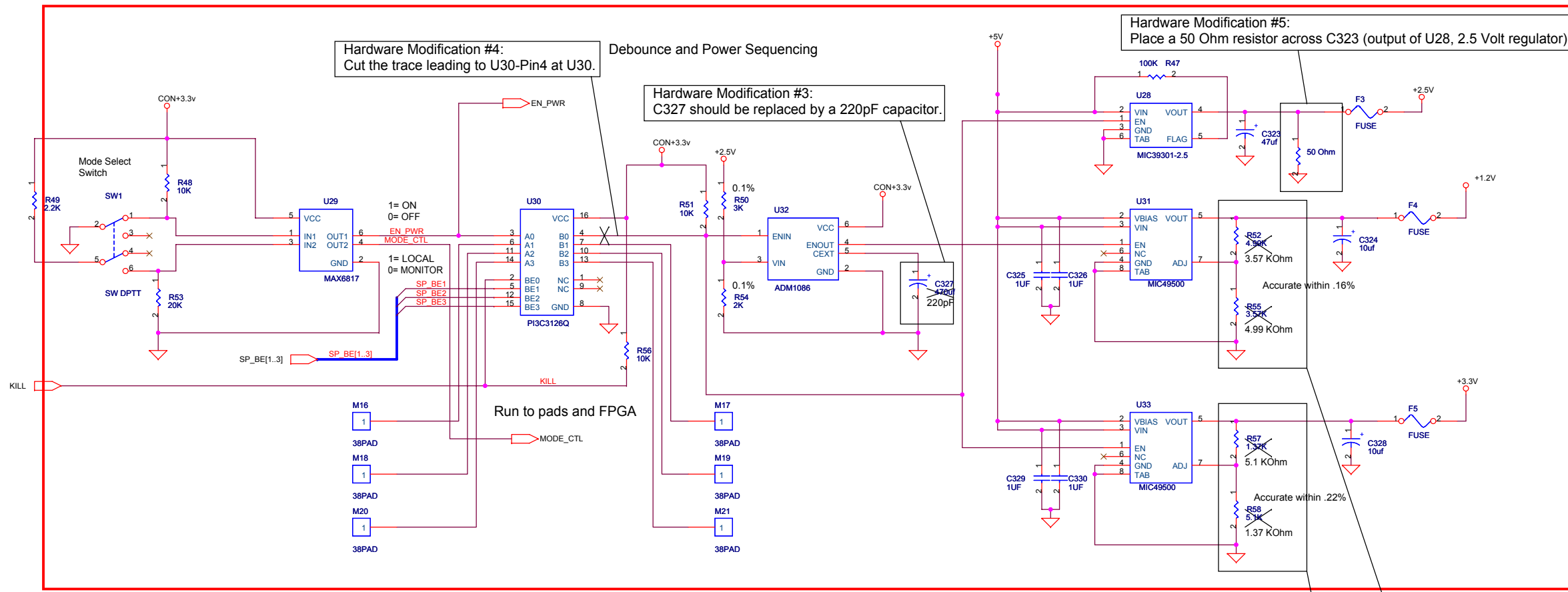
Note: Be sure to create copper GND area for backside of LED DB

Title		
BPM Transition Board Control Module		
Size	Document Number	Rev
C	Beam-doc-2154	A
Date:	Tuesday, January 09, 2007	Sheet 5 of 10



Title			BPM Transition Board Control Module		
Size	Document Number		Rev		
C	Beam-doc-2154		A		
Date:	Tuesday, January 09, 2007	Sheet	6	of	10

LED\_PG2



Hardware Modification #4:  
Cut the trace leading to U30-Pin4 at U30.

Debounce and Power Sequencing

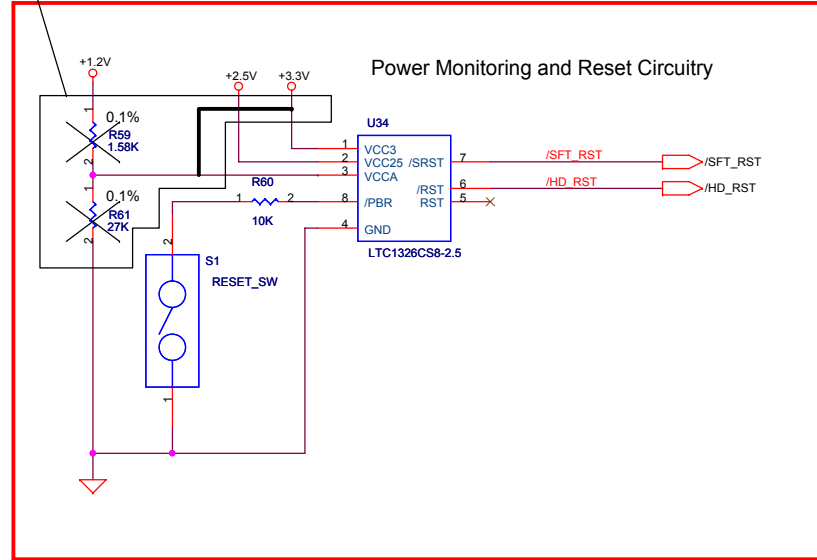
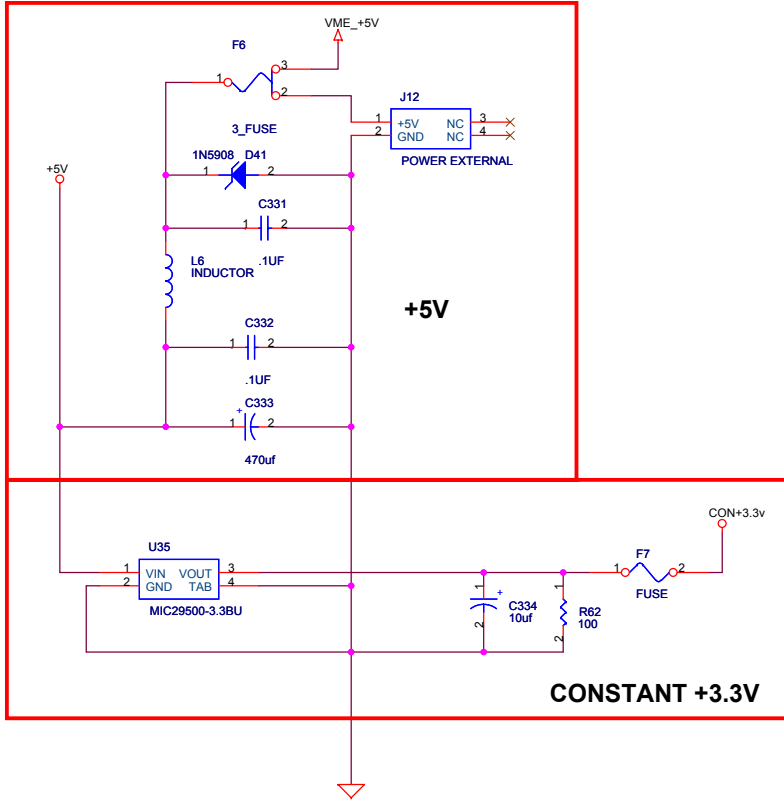
Hardware Modification #3:  
C327 should be replaced by a 220pF capacitor.

Hardware Modification #5:  
Place a 50 Ohm resistor across C323 (output of U28, 2.5 Volt regulator)

Hardware Modification #7:  
Reverse Resistors used to set output voltage of U33 (1.2 Volt regulator).  
R57 should be 5.1 KOhm (512). R58 Should be 1.37 KOhm (14H).

Hardware Modification #6:  
Reverse Resistors used to set output voltage of U31 (1.2 Volt regulator).  
R52 should be 3.57 KOhm (54H). R55 Should be 4.99 KOhm (68H).

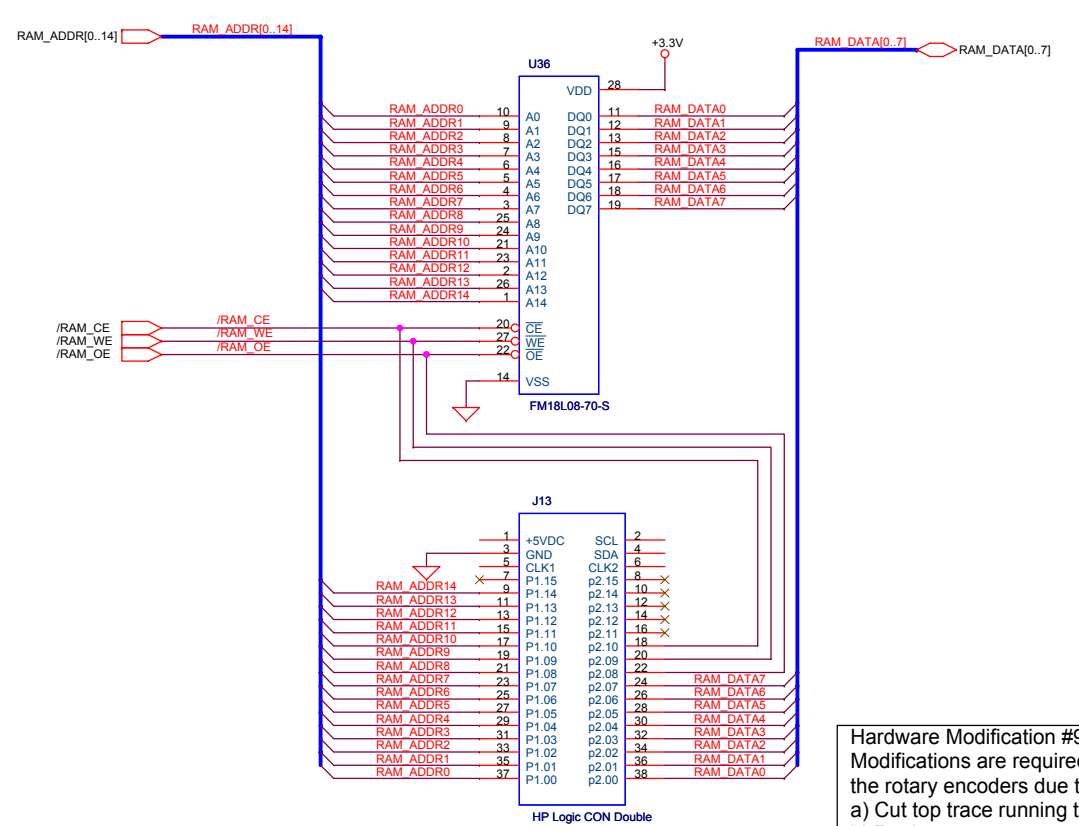
Hardware Modification #2:  
If R59 and R61 are not available to not install either of them.  
Place a direct connection (wire) between U34-pin3 (VCCA) and U34-pin1 (VCC3).



POWER

Title			BPM Transition Board Control Module		
Size	Document Number	Rev			
C	Beam-doc-2154	A			
Date:	Tuesday, January 09, 2007	Sheet	7	of	10

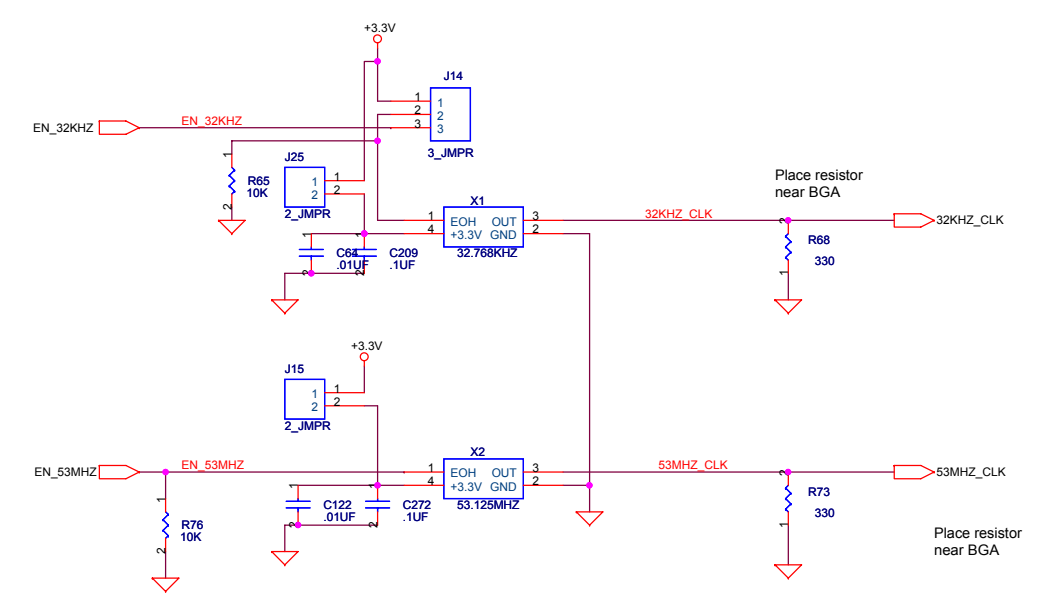
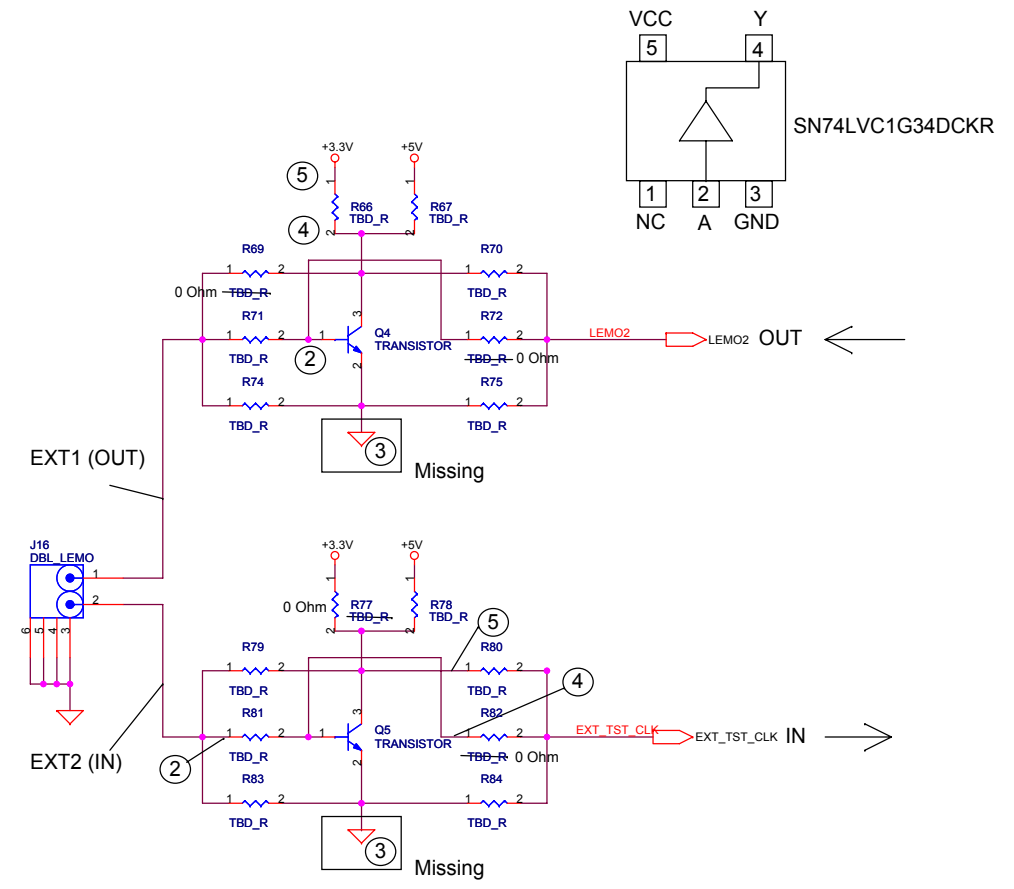
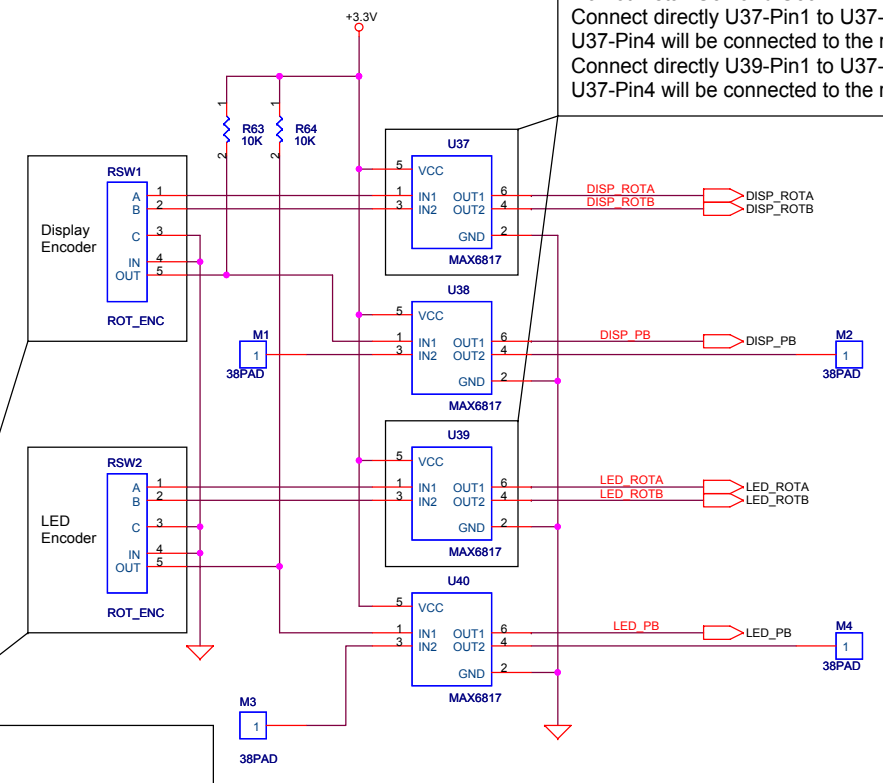




**Hardware Modification OPT#B:**  
 Add components positioned at Q4 and Q5 to enable external test signal input (LEMO EXT2) and test signal monitoring (LEMO EXT1).  
 It requires firmware revision of December 13, 2006 or later.

**Hardware Modification #9:**  
 Modifications are required before installing the rotary encoders due to error in footprint.  
 a) Cut top trace running to pin 2 on PCP.  
 b) Put kapton tape over pin 3 hole on top side of PCB.  
 c) Bend pin 3 of rotary encoder towards rear of switch.  
 d) Solder black wire wrap wire (about 3") to pin 3 of rotary encoder.  
 e) Install rotary encoder  
 f) Solder other end of black wire wrap wire to pin 4 pad of associated MAX6817, U39 for RSW2 and U37 for RSW1.

**Hardware Modification #8:**  
 Do not install U37 and U39.  
 Connect directly U37-Pin1 to U37-Pin6.  
 U37-Pin4 will be connected to the rotary encoder with a wire in modification #9.  
 Connect directly U39-Pin1 to U39-Pin6.  
 U39-Pin4 will be connected to the rotary encoder with a wire in modification #9.

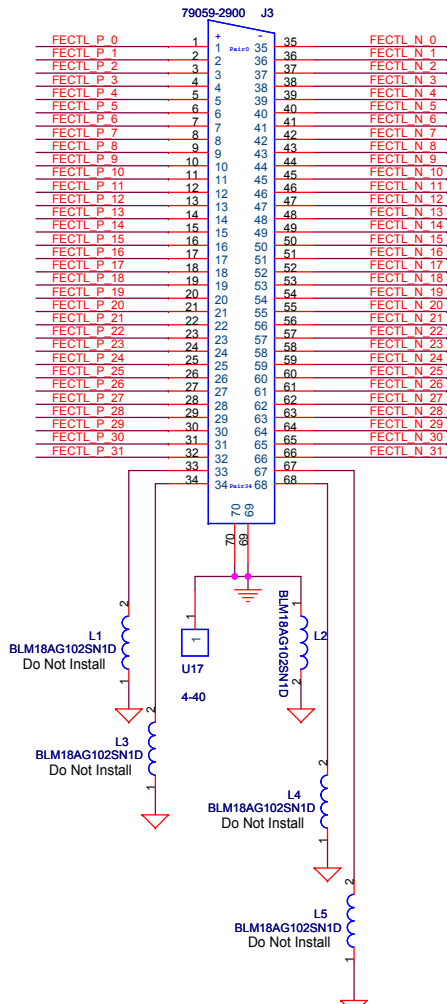


**RAM,LEMO,ROTARY**

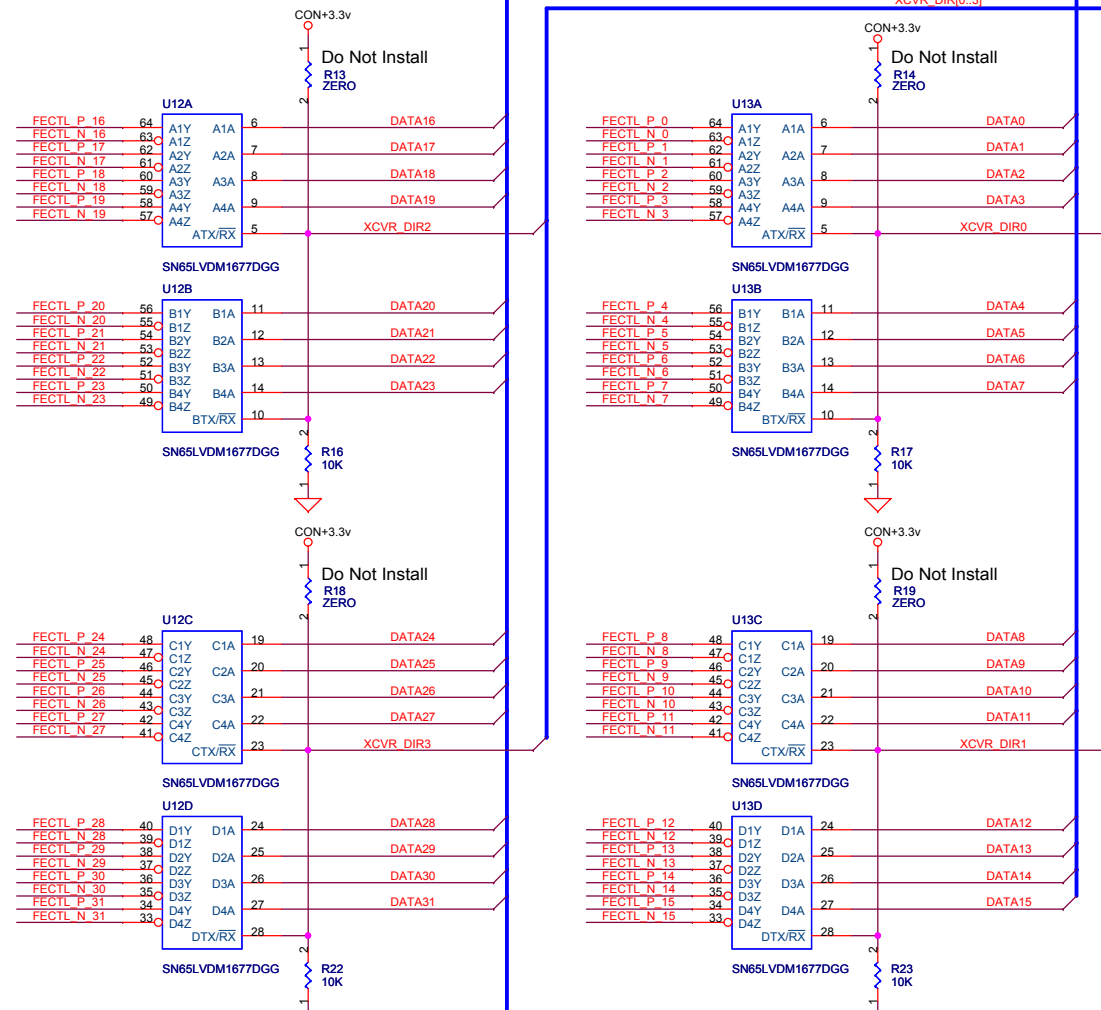
Title BPM Transition Board Control Module		
Size C	Document Number Beam-doc-2154	Rev A
Date Tuesday, January 09, 2007	Sheet 8	of 10

**Timing Module  
Cable Connector**

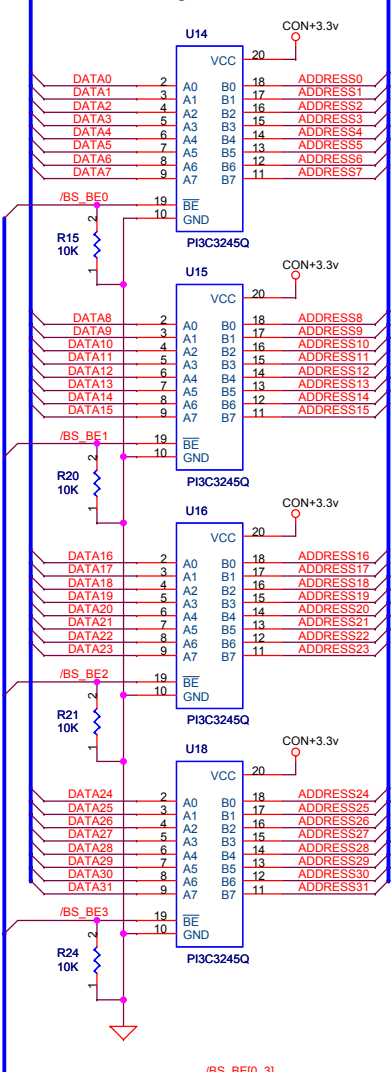
Note: Place Copper Areas to allow option to connect GND to shield.



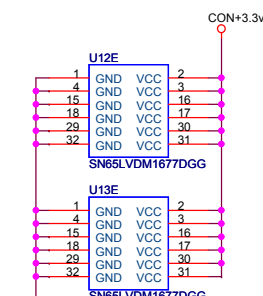
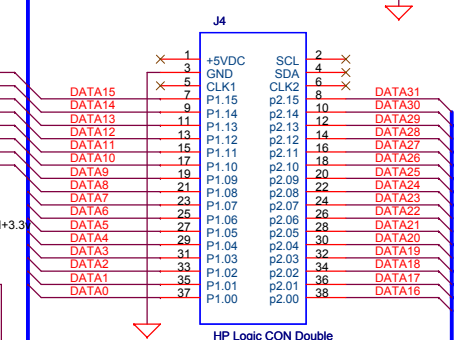
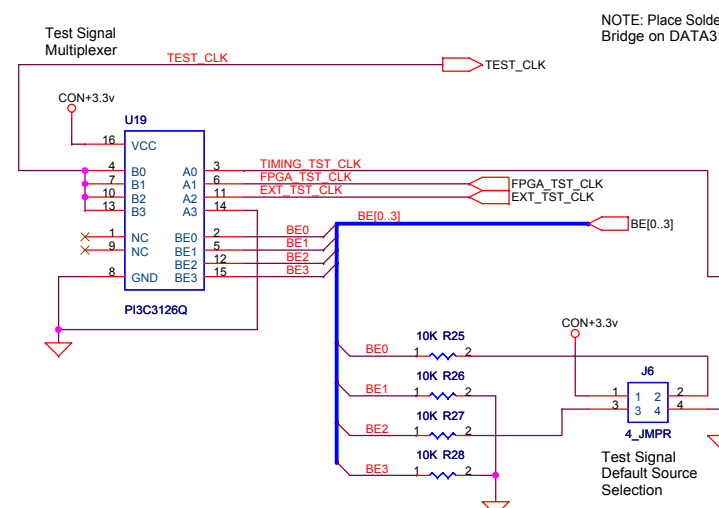
**Timing Module Interface  
LVDS Transceivers**



**Pass Through  
Analog Switches**

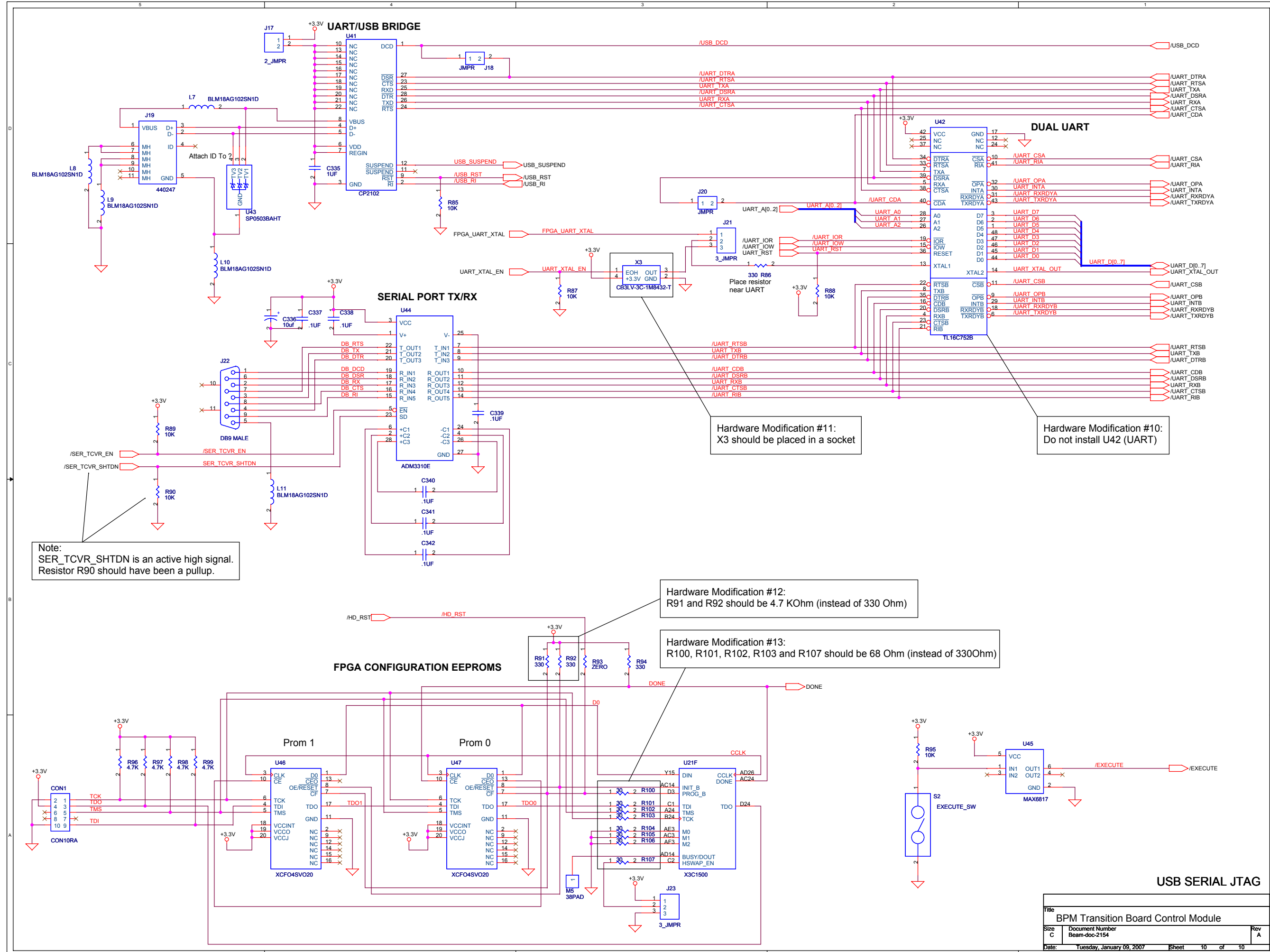


**Hardware Modification #14:  
Place Solder Bridge on DATA31**



**TIMING MODULE INTERFACE**

Title		
BPM Transition Board Control Module		
Size	Document Number	Rev
C	Beam-doc-2154	A
Date:	Tuesday, January 09, 2007	Sheet 9 of 10



Note:  
SER\_TCVR\_SHTDN is an active high signal.  
Resistor R90 should have been a pullup.

Hardware Modification #11:  
X3 should be placed in a socket

Hardware Modification #10:  
Do not install U42 (UART)

Hardware Modification #12:  
R91 and R92 should be 4.7 KOhm (instead of 330 Ohm)

Hardware Modification #13:  
R100, R101, R102, R103 and R107 should be 68 Ohm (instead of 330Ohm)

Title		
BPM Transition Board Control Module		
Size	Document Number	Rev
C	Beam-doc-2154	A
Date:	Tuesday, January 09, 2007	Sheet 10 of 10