Razik Ahmed and Stephen Hall
Harshad Desai
Lab 8

A) **Objectives**
1. Overview
   1.1. Objective: to layout an embedded system
   1.2. Roles and Responsibilities: Razik will do the software and Stephen will do the hardware. The clients are people that are bored of board games.
2. Function Description
   2.1. Functionality: to play Battleship
   2.2. Performance: current will be determined using the bench power supply which will help decide the battery
   2.3. Usability: Their will be two different modules each with a C32 microcontroller, 128 x 64 pixel graphical LCD screen, six buttons for user input, and 6 LEDs to signify a hit. The two modules will be connected via a serial cable.
3. Deliverables
   3.1. Reports: The reports for Labs 8 and 11 will be written
   3.2. Outcomes: Objectives, hardware and software design, and measurement data for Lab 8 and Lab 11
B) **Hardware Design** – Pages 2 - 7
C) **Software Design** – Requirements document already in Objectives
D) **Measurement Data**
   a. ~50mA measured current, ZigBee and sound shouldn't increase current much since they will be rare compared to the rest of the program. The current will actually be less once sleeping has been implemented
   b. Estimated cost: $125.84, Bill of Materials: page 8
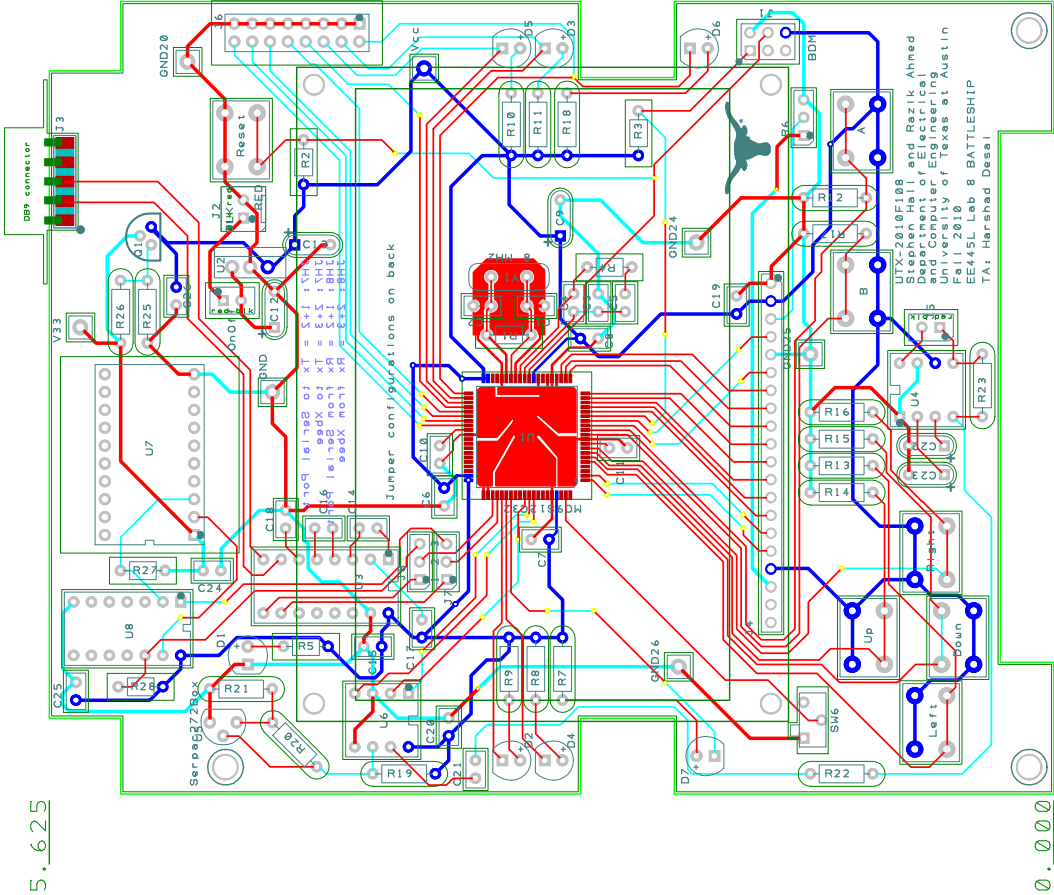E) **Analysis and Discussion** – None
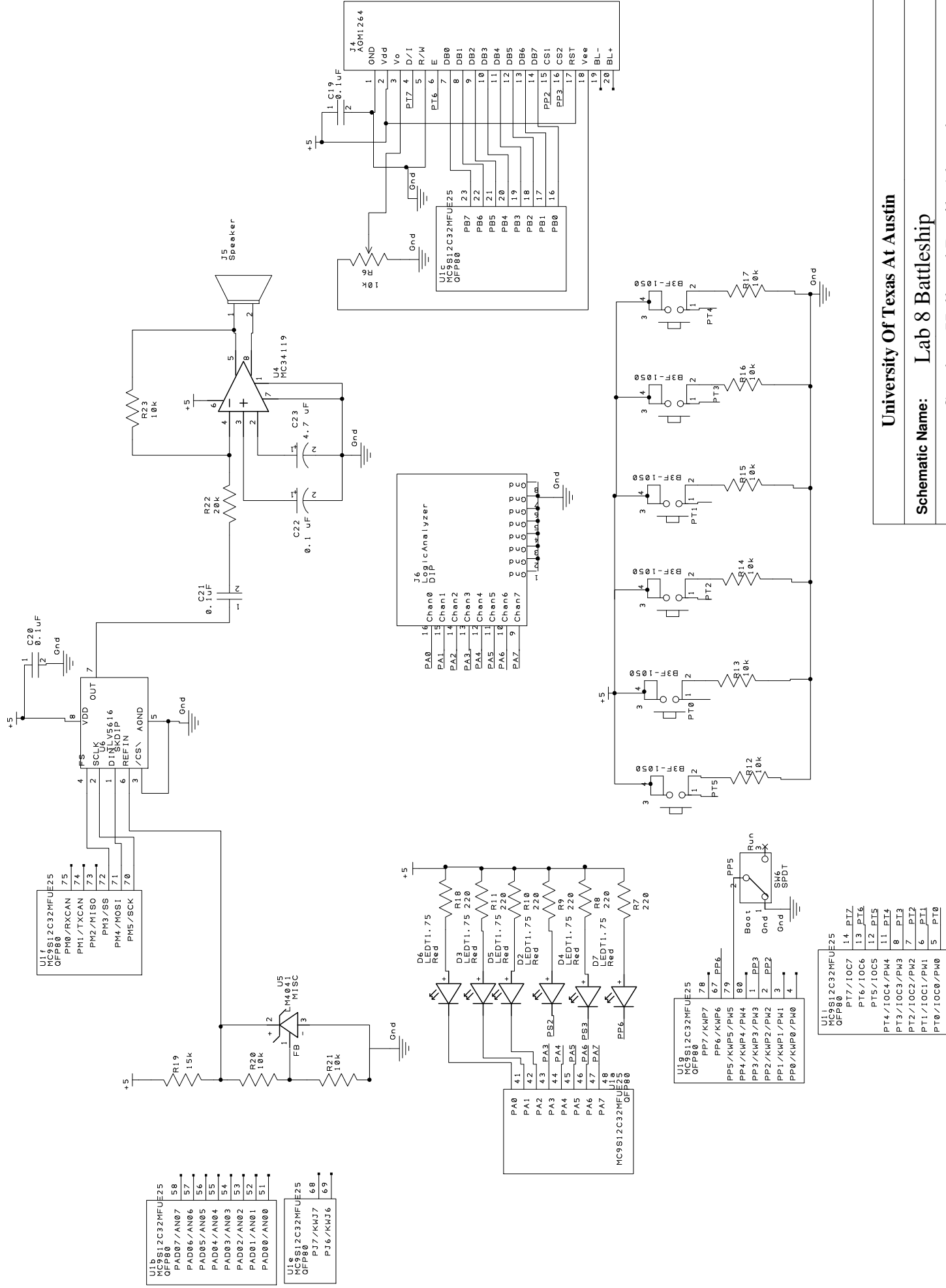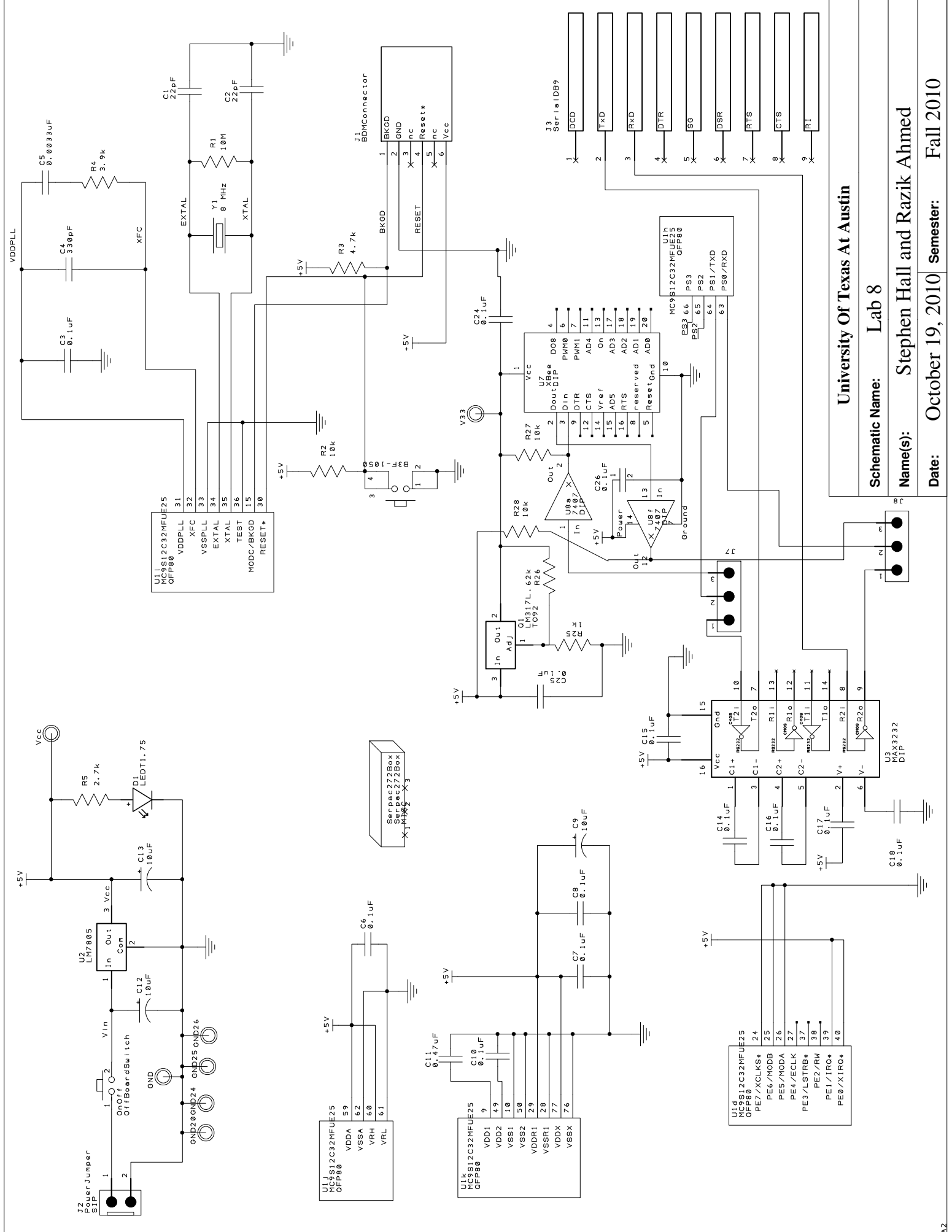
University Of Texas At Austin

Schematic Name:	Lab 8 Battleship
Name(s):	Stephen Hall and Razik Ahmed
Date:	October 19, 2010	Semester:	Fall 2010

C1 22pF
C2 22pF
C5 0.0033uF
R4 3.9k
VDDPLL
R1 10M
EXTAL
Y1 8 MHz
XTAL
C4 330pF
XFC
C3 0.1uF

J1 BDMConnector
BKGD
GND
nc
Reset*
nc
Vcc
BKGD
RESET

R3 4.7k
+5V

C24 0.1uF
+5V

J3 SerialDB9
DCD
TxD
RxD
DTR
SG
DSR
RTS
CTS
RI

U7 XBee Dout DIP
Vcc
Din
DTR
CTS
Vref
AD5
RTS
reserved
ResetGnd
DO8
PWM0
PWM1
AD4
On
AD3
AD2
AD1
AD0

U1h MC9S12C32MFUE25 QFP80
PS3 66
PS2
PS1/TXD
PS0/RXD
PS3
PS2

V33
R27 10k

C26 0.1uF
U8a 7407 DIP
Out
In
Power
U8f 7407 DIP
Out
In
Ground

R28 10k

R2 10k
+5V
B3F-1050
+5V

U1i MC9S12C32MFUE25 QFP80
VDDPLL 31
XFC 32
VSSPLL 33
EXTAL 34
XTAL 35
TEST 36
MODC/BKGD 15
RESET* 30

R26
LM317L .62k
Q1 LM317L TO92
In Out Adj
R25 1K
C25 0.1uF
+5V

J7
J8

U3 MAX3232 DIP
Gnd
T2i
T2o
R1i
R1o
T1i
T1o
R2i
R2o
Vcc
C1+
C1-
C2+
C2-
V+
V-
CMOS
RS232
C15 0.1uF
+5V
C14 0.1uF
C16 0.1uF
C17 0.1uF
C18 0.1uF
+5V
+5V

Vcc
R5 2.7k
D1 LEDT1.75
C13 10uF
U2 LM7805
In Out Con
Vin Vcc
C12 10uF
+5V
OnOff OffBoardSwitch
GND
GND20 GND24
GND25 GND26

J2 PowerJumper SIP

Serpac272Box X3
XT14452

C6 0.1uF
+5V
U1j MC9S12C32MFUE25 QFP80
VDDA 59
VSSA 62
VRH 60
VRL 61

C8 0.1uF
C9 10uF
C7 0.1uF
+5V

C11 0.47uF
C10 0.1uF
U1k MC9S12C32MFUE25 QFP80
VDD1 9
VDD2 49
VSS1 10
VSS2 50
VDDR1 29
VSSR1 28
VDDX 77
VSSX 76

+5V
U1d MC9S12C32MFUE25 QFP80
PE7/XCLKS* 24
PE6/MODB 25
PE5/MODA 26
PE4/ECLK 27
PE3/LSTRB* 37
PE2/RW 38
PE1/IRQ* 39
PE0/XIRQ* 40
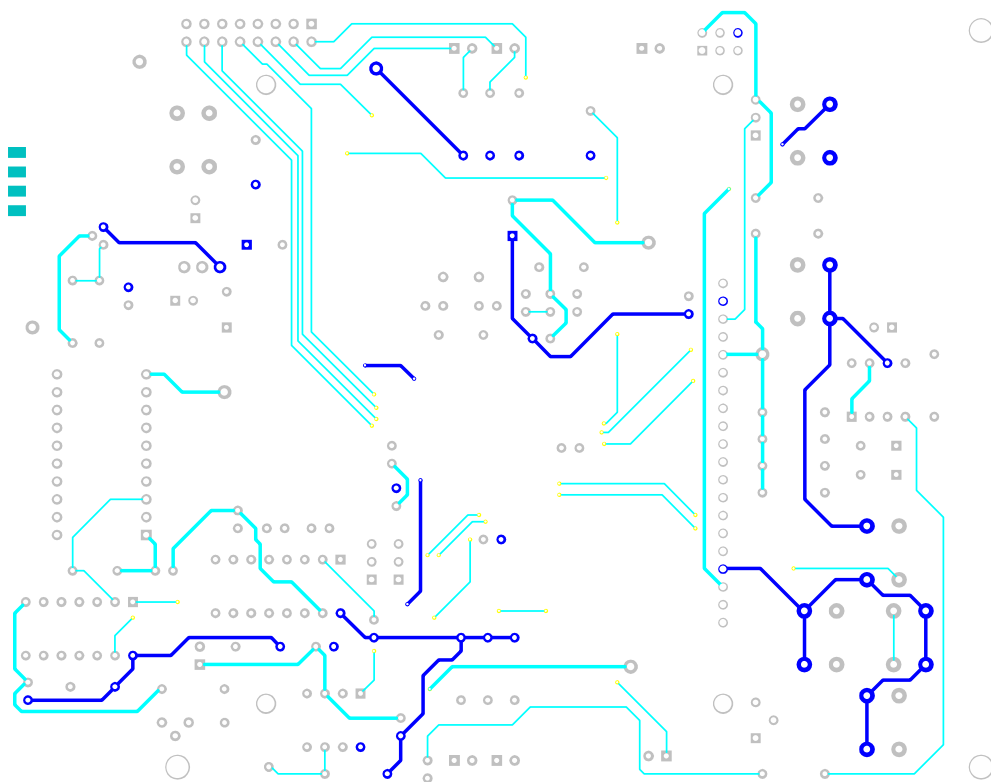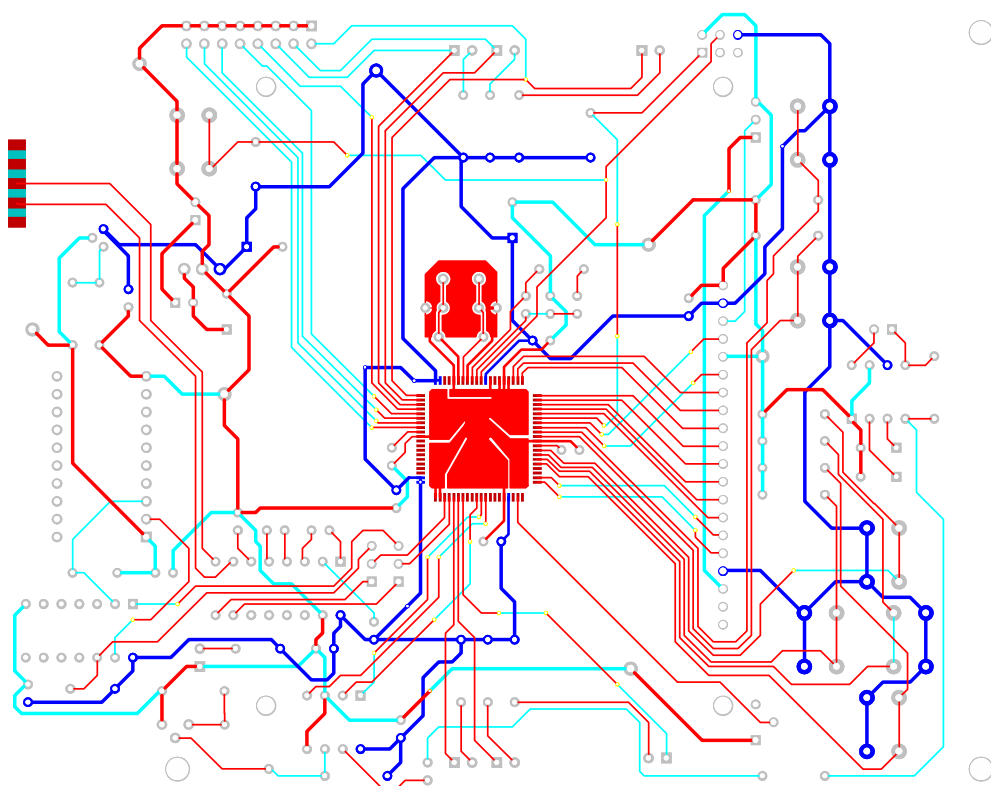
Fabrication Notes

1. Fabricate PCB in accordance with IPC-6012, Class 2; per IPC-6011.

2. Layer Stackup

   1. Top Silkscreen
   2. Top Soldermask
   3. Top Copper, plate to 1oz/ft^2
   4. FR-4 or equivalent
   5. Bottom Copper, plate to 1oz/ft^2
   6. Bottom Soldermask
   7. Bottom Silkscreen

3. Finish Thickness should be 0.062"

4. No internal routing

5. All holes shall be plated

REV 2010

Battleship
P/N: UTX-2010F108 REV A
DESIGNED AT THE UNIVERSITY OF TEXAS AT AUSTIN
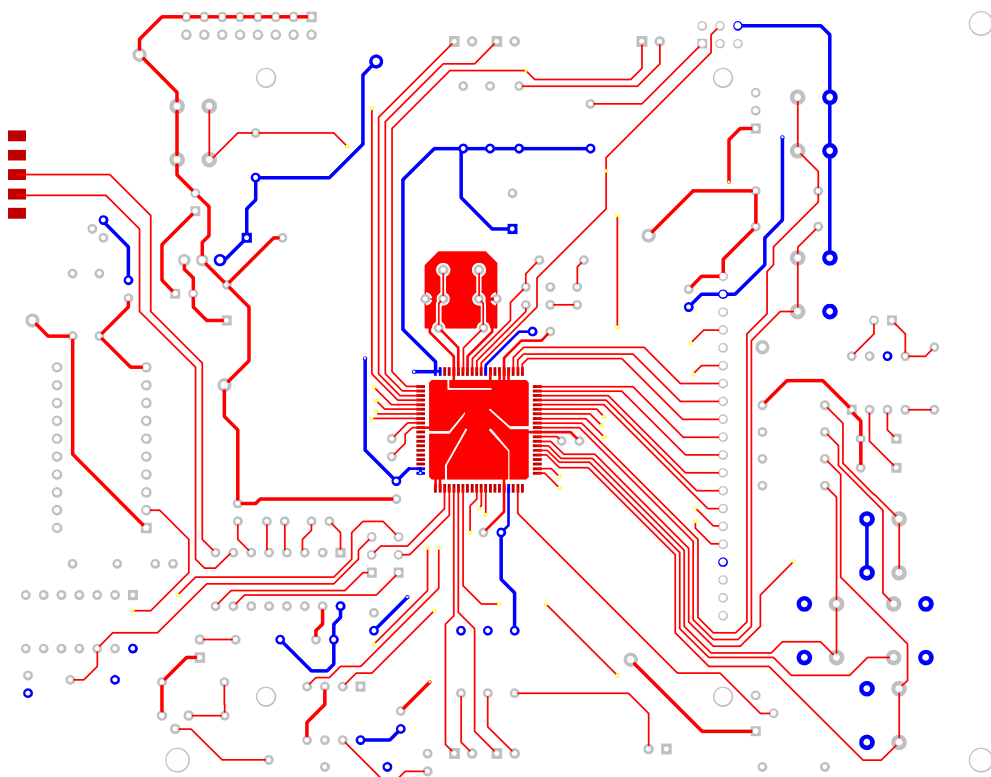
4.438

5.625

0.000

0.000

UTX-2010F108
Stephen Hall and Razik Ahmed
Department of Electrical
and Computer Engineering
University of Texas at Austin
Fall 2010
EE445L Lab 8 BATTLESHIP
TA: Harshad Desai

Battleship

| PART NO.: | REV: | DATE: | | |
| UTX-2010F108 | A | 11-04-2010 | | |

GERBER:
UTX-2010F108

DESIGNER: Stephen Hall
Razik Ahmed

Checked by TA: Harshad

Jumper configurations on back

Quantity	REF DES	Type	Description	Manufacturer	Mfg. P/N	Distributor	P/N	Unit cost	Cost	PCB Artist	Where to get it?	Inventory
1		ASM	Black case, 8" x 8" x 4"			BGMicro	CAS1007	$1.00	$1.00	CAS1007	Prof	
11		CAP	Ceramic, X7R, 20%, 0.1uF			Jameco	544921	$0.14	$1.54	Ceramic0.2	Prof	
1		CAP	Ceramic, Z5U, -20/+80%, 0.47 uF	Kemet	C320C474M5U5TA	Digikey	399-4309-ND	$0.40	$0.40	Ceramic	Prof	
1		CAP	Ceramic, Z5U, -20/+80%, 0.0033 uF	Kemet	C320C332M5U5TA			$0.40	$0.40	Ceramic	Prof	
2		CAP	Ceramic Z5U, -20/+80%, 22 pF			Jameco	15405	$0.03	$0.06	Ceramic	Prof	
1		CAP	Ceramic Z5U, -20/+80%, 330 pF			Jameco	15410	$0.03	$0.03	Ceramic	Prof	
3		CAP-Elect	Electrolytic 10uV 16V, 20%	Panasonic - ECG	ECE-A1CKA100	Digikey	P807-ND	$0.22	$0.66	Electrolytic	some	
1		CAP-Elect	Electrolytic 4.7uV 25V, 20%	Panasonic - ECG	ECE-A1EKA4R7	Digikey	P812-ND	$0.14	$0.14	Electrolytic	some	
1		CAP-Elect	Electrolytic 0.1uV 25V, 20%	Panasonic - ECG	ECE-A1EKA4R7	Digikey	P752-ND	$0.14	$0.14	Electrolytic	some	
1		CON	2-pin for TechArts power plug			AllElectronics	CON-242	$0.70	$0.70	PowerJumper	Prof	
1		CON	2-pin header			AllElectronics	SBH-2	$0.10	$0.10	Jumper2	Prof	
1		CON	2-pin jumper			AllElectronics	SBC-2	$0.27	$0.27	goes with SBH-2	Prof	
1		CON	Test point, black	Keystone Electronics	5001	Digikey	5001K-ND	$0.29	$0.29	testpoint	Prof	
1		CON	Test point, red	Keystone Electronics	5000	Digikey	5000K-ND	$0.29	$0.29	testpoint	Prof	
1		CON	DB9 serial connector, female, board mount			Jameco	15771	$0.65	$0.65	SerialDB9	Prof	
1		CPU	MC9S12C32MFUE25, 80-pin QFP	Freescale	MC9S12C128MFUE			$5.00	$5.00	MC9S12C128	Prof	8
1		CRYS	8 MHz crystal,50ppm,HC49/U			Jameco	14728	$0.59	$0.59	XTAL	Prof	
1		IC	78M05 500MA 5V TO-220	National	LM78M05	Jameco	192233	$0.19	$0.19	LM7805CT	Prof	
1		IC	RS232 driver	STMicroelectronics	ST232CN	Jameco	2001171	$0.58	$0.58	MAX3232	Prof	
1		IC	3-Terminal 1A Positive Voltage Regulator	Fairchild	LM7805	Digikey	rLM7805CT-ND	$0.65	$0.65	LM7805CT	www.digikey.com	
1		JACK	DC Power MALE 2.1mm			Jameco	101179	$0.55	$0.55	PowerJack	Prof	
1		LED	Green 2mA 5mm diffused	Avago Technologies	HLMP-4740	Digikey	516-1327-ND	$0.29	$0.29	LEDT1.75	Prof	
1		PCB	PCB plus shipping	Advanced Circuits		Advanced Circuits		$49.06	$49.06		http://www.4pcb.com/	
1		RES	Carbon 1/6W, 5%, 2.7K	Yageo	CFR-12JB-2K7	Digikey	2.7KEBK-ND	$0.02	$0.02	0.125Wresistor	Prof	
1		RES	Carbon 1/6W, 5%, 3.9K	Yageo	CFR-12JB-3K9	Digikey	3.9KEBK-ND	$0.02	$0.02	0.125Wresistor	Prof	
1		RES	Carbon 1/6W, 5%, 4.7K	Yageo	CFR-12JB-4K7	Digikey	4.7KEBK-ND	$0.02	$0.02	0.125Wresistor	Prof	
1		RES	Carbon 1/6W, 5%, 10K	Yageo	CFR-12JB-10K	Digikey	10KEBK-ND	$0.02	$0.02	0.125Wresistor	Prof	
1		RES	Carbon 1/6W, 5%, 10M	Yageo	CFR-12JB-10M	Digikey	10MEBK-ND	$0.02	$0.02	0.125Wresistor	Prof	
6		SW	B3F tactile push button switch	Omron Electronics	B3F-1052	Digikey	SW405-ND	$0.17	$1.02	B3F-1050	Prof	
1		SW	On/off power switch			BGMicro	SWT1010	$0.85	$0.85	BOXMOUNTBUTTON	some	
4		BAT	AA, 1.25V NMH, 2500mAh			BGMicro	BAT1102	$2.49	$9.96		tenergybattery.com	
6		RES	Carbon 1/4W, 5%, 10K	Yageo	CFR-12JB-10K	Digikey	10KEBK-ND	$0.02	$0.14	0.25Wresistor	Prof	
1		LCD	128x64 Graphic LCD	AZ Displays	AGM1264F	BGMicro	LCD1030	$9.95	$9.95	LCD1030	bgmicro.com	
1		XBEE	XBee 1mW Zigbee Module	Digi			WRL-08664	$22.95	$22.95			
1		XBEE	XBee Module Breakout Board	Digi			BOB-08276	$2.95	$2.95			
2		XBEE	Two 2mm 10 pin XBee Sockets	Digi			PRT-08272	$1.00	$2.00			
1		XBEE	0.1" 40 pin Break Away Headers	Digi			PRT-00116	$2.50	$2.50			
1		IC	MC34119, AUDIO LOW PWR 8-PDIP	Freescale	MC34119	Jameco	316865	$2.25	$2.25	MC34119	not free	
1		IC	TLV5616 12-bit DAC	TI	TLV5616	TI	TLV5616CP	$6.66	$6.66	TLV5616	free sample	
1		IC	LM4041CILPR shunt diode reference	TI	LM4041CILPR	TI	LM4041CILPR	$0.90	$0.90	LM4041	free sample	
1		BOX	Serpac 272 Electronic Enclosure	Serpac	272	Serpac	272	$0.00	$0.00	Serpac272Box	free sample	

| | | | | | | | | $125.84 | | Total Cost | | |