

Track Mate

Critical Design Review

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ECE 189 Fall 2012

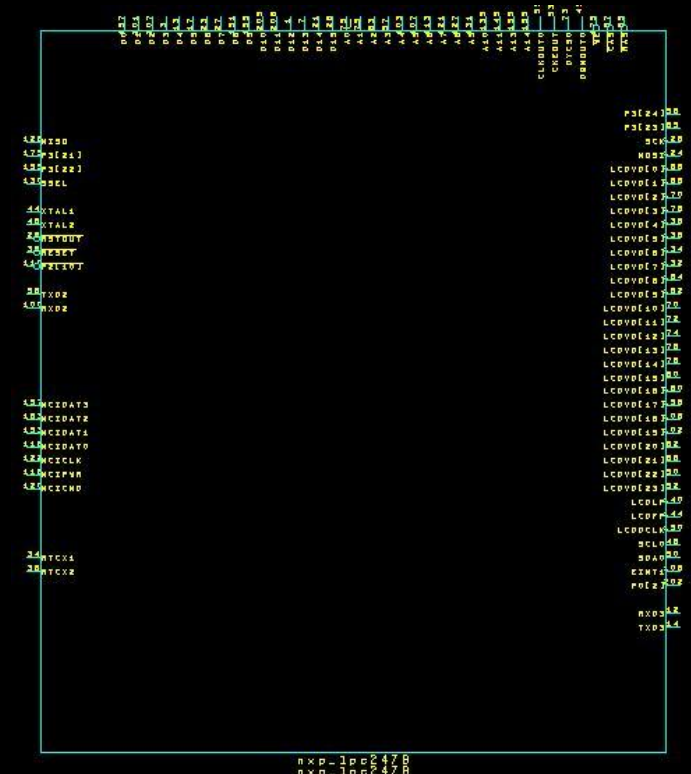
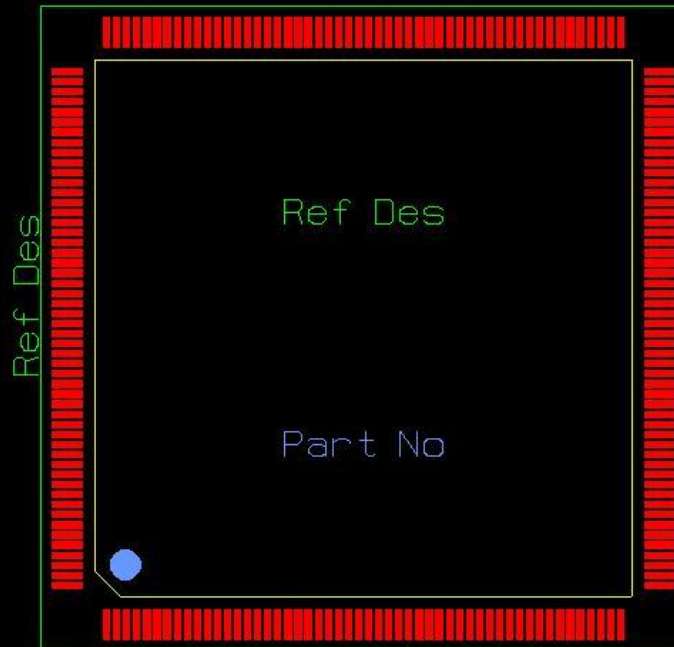
Features

Track Mate is designed to fulfill the needs of an athlete on the go. With its on-board GPS, Track Mate will be able to provide to the LCD display information such as distance traveled, average speed, and roughly the number of calories burned. By setting calorie or distance goals beforehand, it will also be able to give feedback on progress and inform the user when he or she has met his or her targets.

Audio feedback will be conveniently combined with Track Mate's secondary function: MP3 playback. Songs will be preloaded onto any SD card, which when inserted will allow the user to construct a playlist or set to shuffle. Basic MP3 player functionality such as play, pause, skip and volume control will be included as well.

Microprocessor: LPC2478

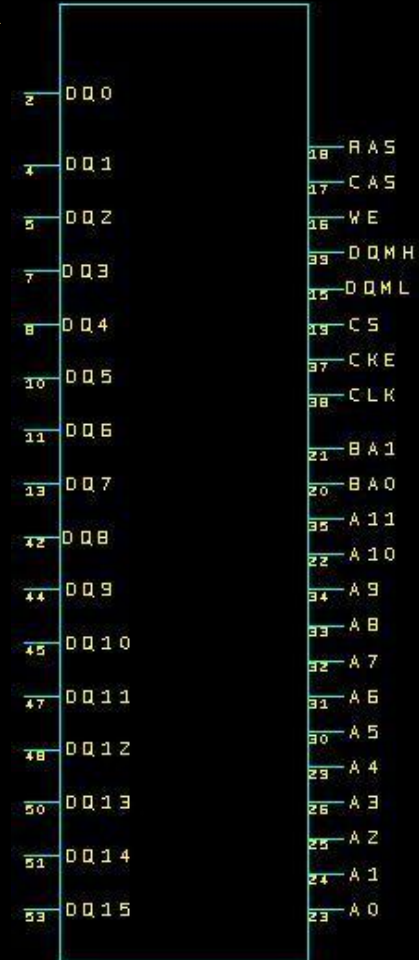
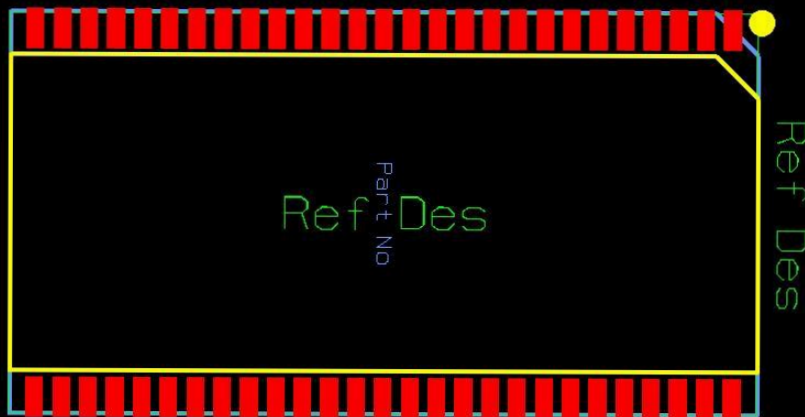
- ARM7 processor with 2 external clocks
- 512 kb on chip flash program memory
- LCD Controller with TFT support
- SD card memory interface
- SPI interface controller for audio decoding and LCD display
- RS-232 peripheral interface for GPS and programming the processor



SDRAM

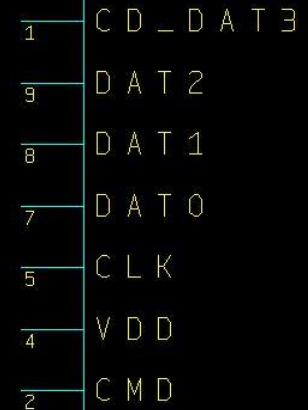
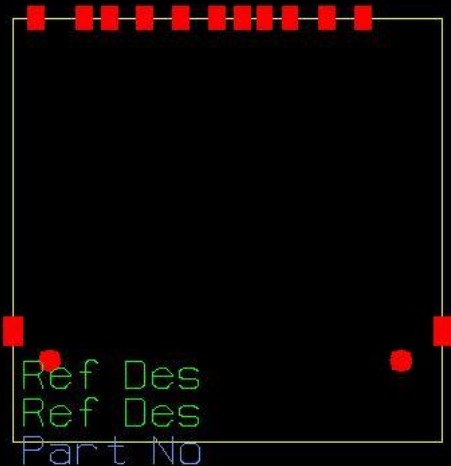
Micron Technologies MT48LC8M16A2P-7E:G TR

- 32MB x 4 Architecture
- 54 pin (400 mil) TSOP package
- 166 MHz Clock
- PC133 Data Rate



SD Card Reader

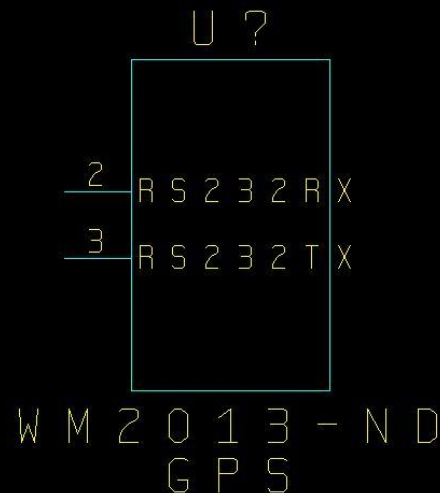
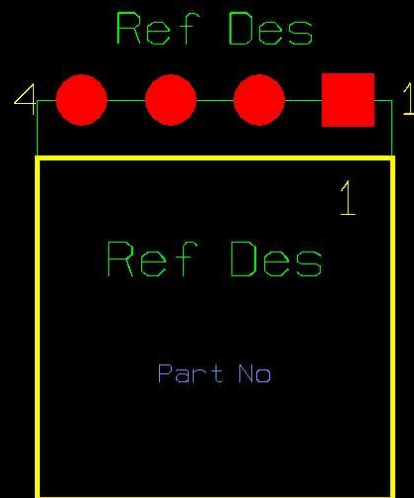
- Sparkfun PRT-11362
- 4-bit data bus
- Communicates with CPU SD/MMC interface.
- Is a Mixed type Edge Connector. It contains surface mount and through hole padstacks.



Specifics: GPS

PMB-648 GPS Module

- 20 parallel satellite-tracking channels
- Power: 3.3V DC @ 65mA
- Output: NMEA string
- Communications: RS-232 asynchronous serial @ 4800 bps
- Cold start: 42s (average)
- Hot start: 1s (minimum)
- Berg connector used to connect GPS module to processor



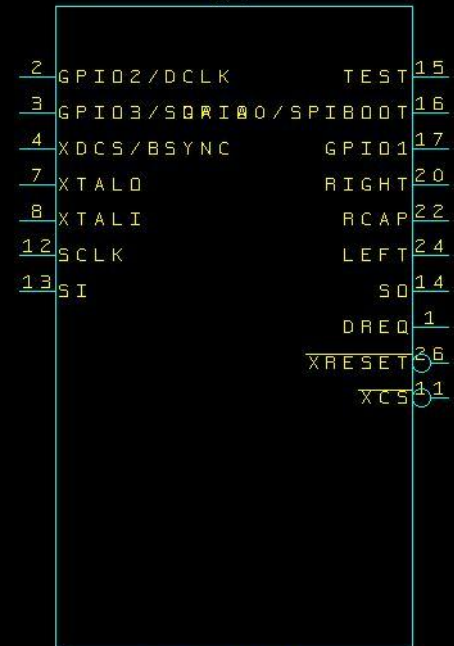
Specifics: Audio Decoding

VS1011e MP3 Audio Codec Chip

- SOIC-28 Chip
- SPI interface, multiplexed with display
- Operates with a single, off-chip, 12.88MHz clock
- 5 KiB Instruction RAM for user code and data
- 32-bit instruction words and 16-bit data words
- On-chip stereo DAC
- Shares 3.3V supply for digital operations
- Dedicated 2.8V supply for analog operations
- 4 GPIO Pins unused

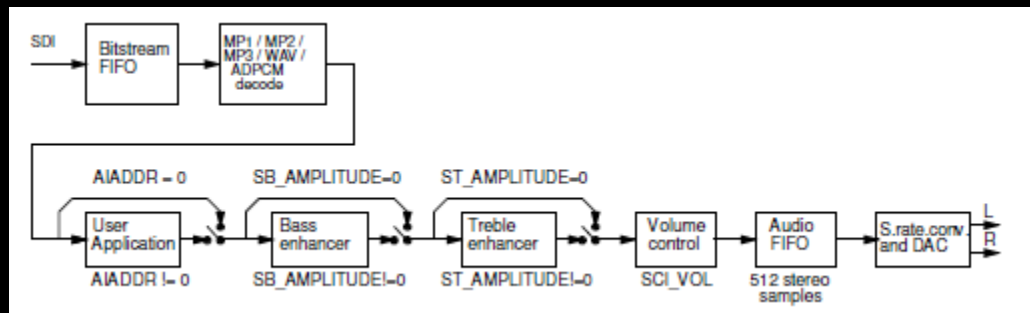
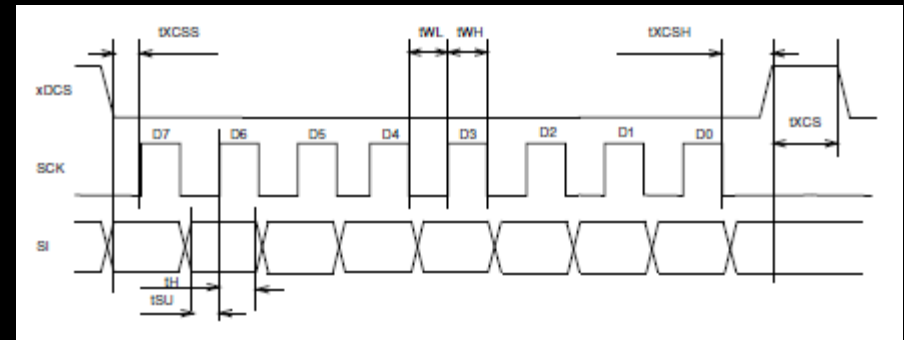
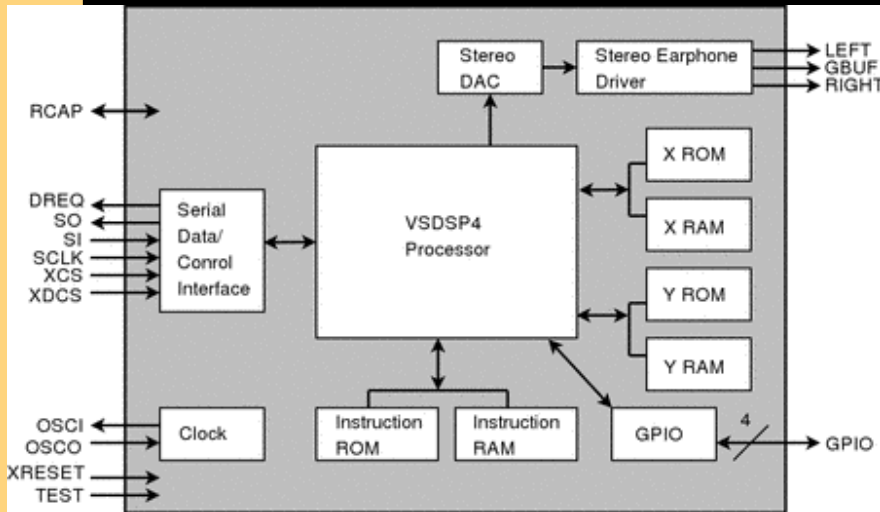


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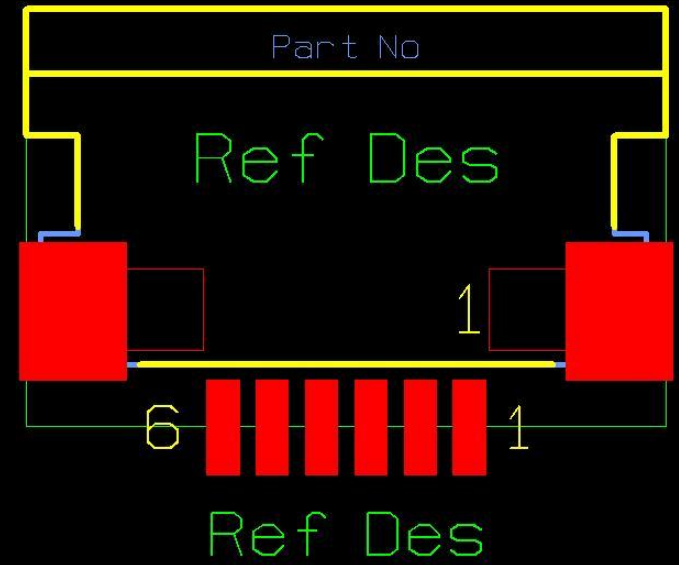
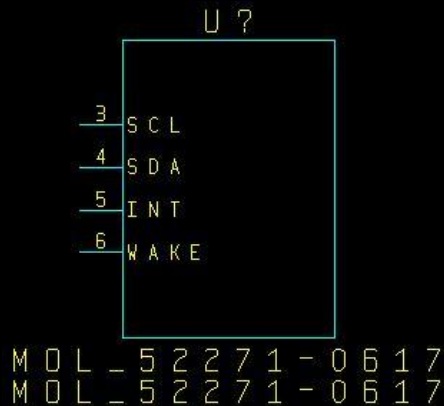
VS1011e
SOIC127P1030_28_D1790M

Audio Decoding (cont)



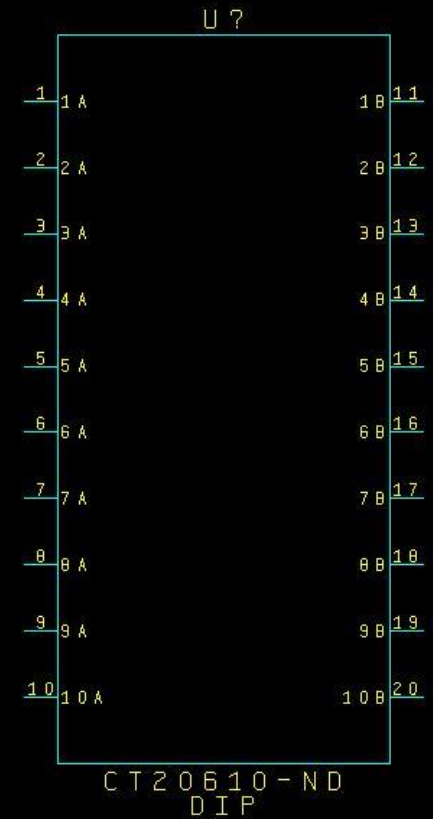
Touchscreen Connector

- Required Power: 3V Digital @ 6mA
- Two interrupt pins to communicate with the processor
 - /INT - Interrupt from touch panel to processor
 - /Wake - Interrupt from processor to touch panel
- I2C interface to transfer data to registers on the processor
- 5 groups of onboard registers to hold 12-bit X and Y position as well as an event flag and touch ID.
- Molex_52271-0617 connector used to mount to the PCB



10-pin DIP Switch

- Standard 2.54mm X 7.62mm DIP centers
- Operating temperature: -55°C - 85°C
- Used for testing purposes throughout the board such as controlling/invoking various features while debugging



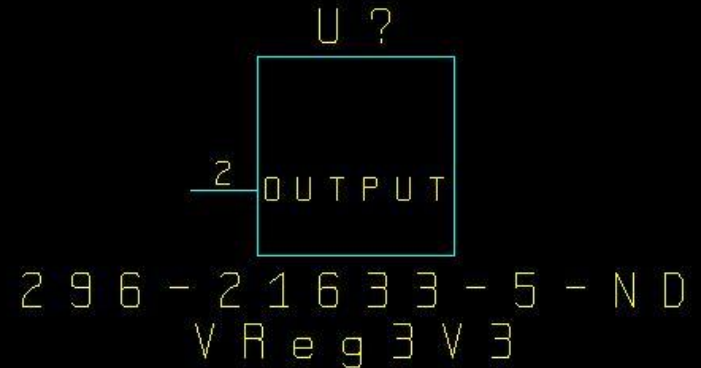
Audio Output Jack

- Operating temperature: $-25^{\circ}\text{C} - 85^{\circ}\text{C}$
- Maximum input current: 1A
- Used for the output of the MP3 decoder to any standard male headphone jack

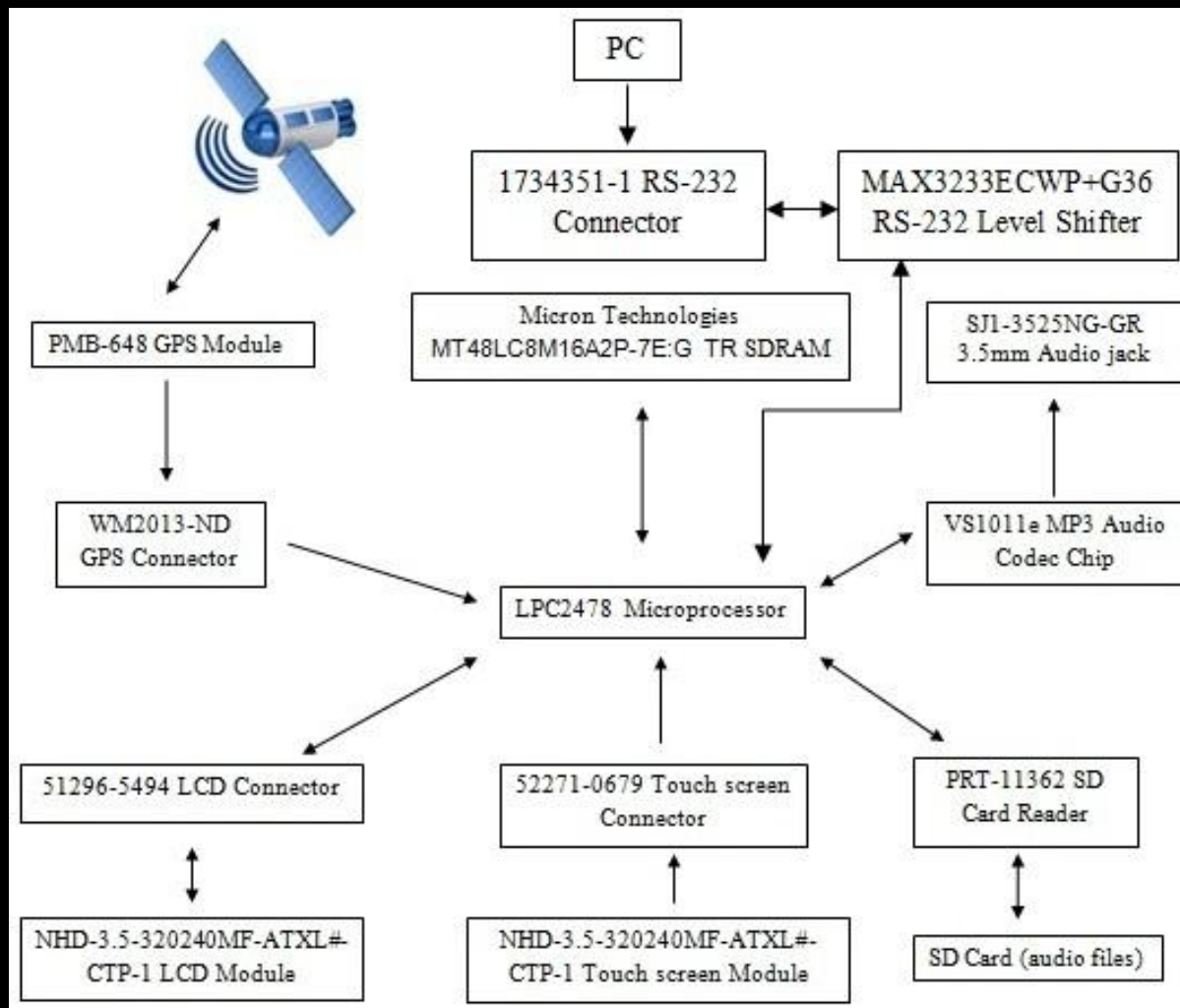


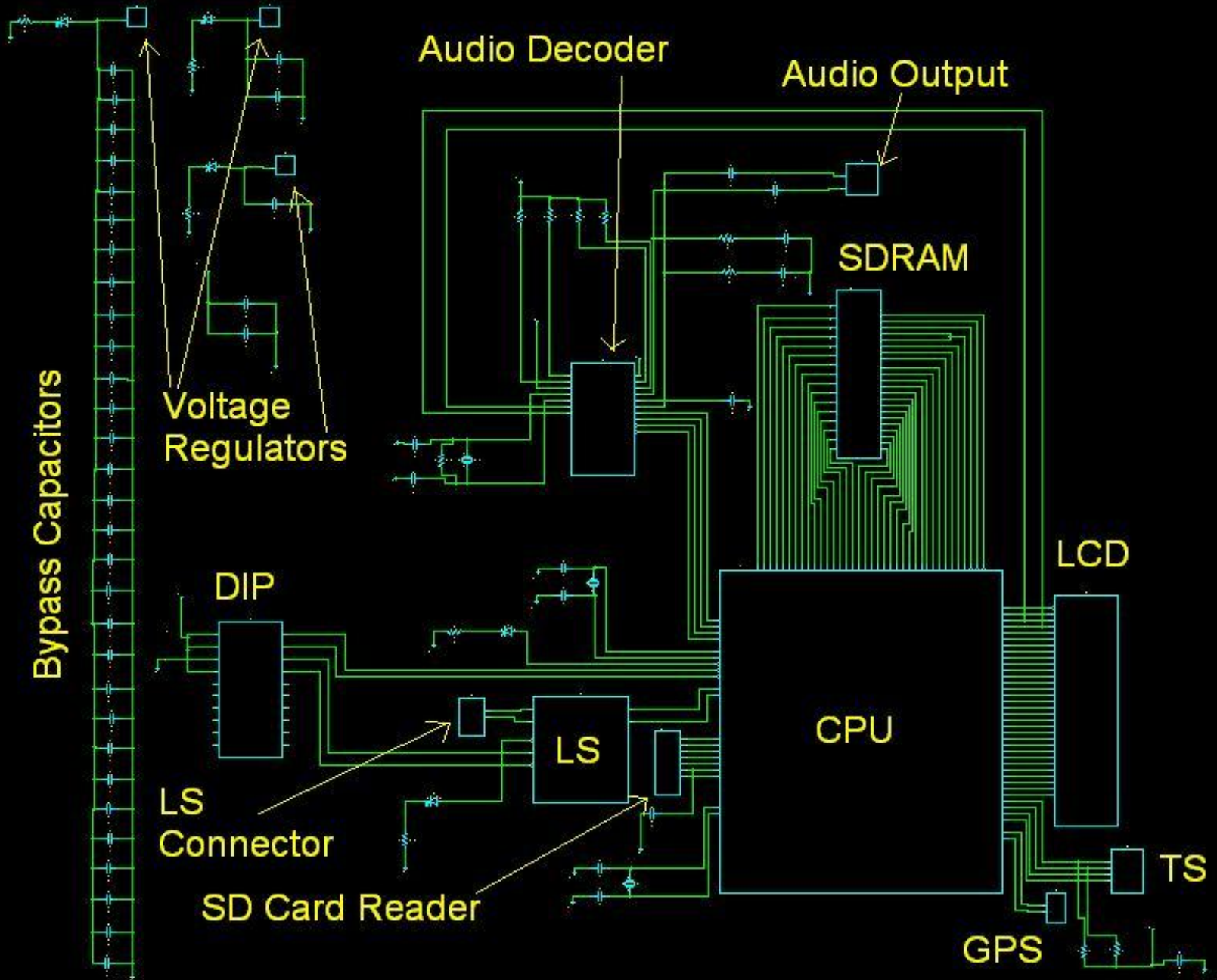
Voltage Regulators

- Voltage Regulator 6V to 3.3V @ 500mA(max)
 - GPS
 - Processor
 - SDRAM
 - LCD
 - RS-232 Level Shifter
 - Audio Decoder
- Voltage Regulator 6V to 2.8V @ 250mA(max)
 - Audio Decoder (Analog)
- Voltage Regulator 6V to 3V @ 100mA(max)
 - Touchscreen



High Level Block Diagram





Software Structure

- The NMEA data string that is sent to the microprocessor from the GPS module will have to be parsed to pull out the necessary information such as latitude, longitude and altitude. This data will then have to be sent to the LCD to be displayed. This information will also have to be used in the calculation of speed, distance and average calories burned which will also have to be displayed on the LCD screen.
- Software will have to be developed to take in real time data and compute different values that will be shown on the LCD display. The touch screen, depending on where it is touched, will store that value in a certain register that will be readable by the processor. Depending on that value different functions will be accommodated through C code.
- The SDRAM will be used to quickly access data on the SD card, particularly to the audio decoder. All basic functionality of an MP3 player will be coded using C for example: play, pause, skip, stop, volume adjust, menu display. etc. The RS-232 level shifter and connector will allow us to put code on the processor.

Software Structure (cont)

- Upon booting up the LCD will display a home screen with the following options:



Software Structure (cont)

- Pressing the GPS Screen button from the Home screen brings up the following display:



Software Structure (cont)

- Pressing the MP3 Screen button from the Home screen brings up the following display:



Software Structure (cont)

- Pressing the Options button from the home screen brings up the following display:



Test Plan

- Just about every pin we are using on the processor will have a test pin header attached
- LED's will be used to test power supplies as well as the reset state of the processor and the invalid state of the RS-232 Level Shifter.
- A 10-pin DIP switch will be used to manually reset individual devices as well we being used to implement a master reset for all the peripherals.



Bill of Materials

Ref Des	Part Number	Side	Description	Vendor	Unit Price	Quantity	Ordered/Received
CPU	LPC2478	Top	Processor	NXP	\$0.00		4 Rec
IC7	MAX3233ECWP+G	Top	RS 232 Level Shifter	Digikey	\$30.00		4 Orderered
IC6	1734351-1	Top	RS 232 Connector	Digikey	\$4.00		4 Ordered
	NHD-3.5-320240MF-ATXL#-CTP-1		LCD/Touchscreen	New Haven Display	\$44.50		1 Rec
IC1	51296-5494	Top	LCD Connector	Digikey	\$12.00		4 Rec
IC8	52271-0679	Top	Touchscreen Connector	Digikey	\$4.00		4 Ordered
	PMB-648 GPS module		GPS Module	Digikey	\$40.00		1 Rec
IC2	WM2013-ND	Top	GPS Connector	Digikey	\$0.25		4 Ordered
IC3	VS1011e	Top	Audio Decoder				4 Ordered
Y1	Ask Prof	Top	Crystal Processor				4 Ordered
Y2	ECS-122.8-20-46X	Top	CRYSTAL 12.288 MHZ 20PF	Digikey	\$0.46		4 Ordered
Y3	9HT11-32.768	Top	Crystal 32.768MHz (for RTC)	Digikey	\$1.77		4 Ordered
	KDZF-T	Top	SD Card				1 Ordered
IC4	PRT-11362	Top	SD Card Reader	Sparkfun	\$1.95		4 Ordered
IC5	MT48LC8M16A2P-TR	Top	SDRAM		\$20.00		4 Rec
VR1	296-21633-5-ND	Bottom	Voltage Regulator 6V to 3.3V @ 500mA(max)	Digikey	\$0.60		4 Ordered
VR2	497-6695-5-ND	Bottom	Voltage Reglator 6V to 5V @ 1A (max)	Digikey	\$1.11		4 Ordered
VR2	L4941BV	Bottom	Voltage Regulator 6V to 2.8V @ 250mA(max)]	Digikey	\$0.52		4 Ordered
VR2	MCP1702-2802E/TO	Bottom	Voltage Regulator 6V to 3V @ 100mA(max)	Digikey	\$0.49		4 Ordered
VR3	LP2950-30LPR	Bottom	Voltage Regulator 6V to 3V @ 100mA(max)	Digikey	\$0.49		4 Ordered
DIP	CT20610-ND	Top	10-Pin DIP Switch	Digikey	\$1.08		4 Ordered
C1-C2	445-4657-1-ND	Top	18pF Capacitor	Digikey	\$0.38 total		8 Ordered
	C0603C0G1E180J	Top					
C3-C4	445-4657-1-ND	Top	18pF Capacitor	Digikey	Included in above		8 Ordered
	C0603C0G1E180J	Top					
C5-C40, C47, C50	445-4654-1-ND		.1uF Bypass Cap	Inherited	Free		148 Rec
	C0603C0G1E130J		13pF Capacitor for RTC crystal	Digikey	\$0.54 total		8 Ordered

Bill of Materials (cont)

C43-44	445-1780-1-ND C0603C0G1H330J		33pF Capacitor for Audio Decoder	Digikey	\$0.24 total	8	Ordered
C45-C46	445-8465-ND FK20X7S1H106K	Top	10uF Capacitor for Audio Decoder output and power supplies	Digikey	\$0.97	20	Ordered
C48-C49			10nF capacitor for audio decoder output			8	Ordered
R1-R2		Top	Pullup Resistor LCD (100K)			8	Ordered
R3	P1.0MAGCT-ND ERJ-1GEJ105C	Top	Audio Decoder Resistor 1M Ohm	Digikey	\$0.10	4	Ordered
R4-R7	P100KAGCT-ND ERJ-1GEJ104C	Top	100k Ohm Pull-up, pull-down resistors	Digikey	\$0.03	At least 20, ordering 50	Ordered
R8-R9	P20AGCT-ND ERJ-1GEJ200C	Top	Audio Decoder 20 Ohm	Digikey	\$0.10	8	Ordered
LED1-LED5	751-1116-ND	Top	Test LEDs	Digikey	\$0.309 (for at least 10)	8	Ordered
R10-R14	P100AGCT-ND ERJ-1GEJ101C		Resistors for LEDs (100 ohm)	Digikey	\$0.10	8	Ordered
IC9	CP1-3525NG-GR- ND	Top	Audio Output	Digikey	\$1.01	4	Ordered



Questions or comments?