The Epic Cube

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List of functions:

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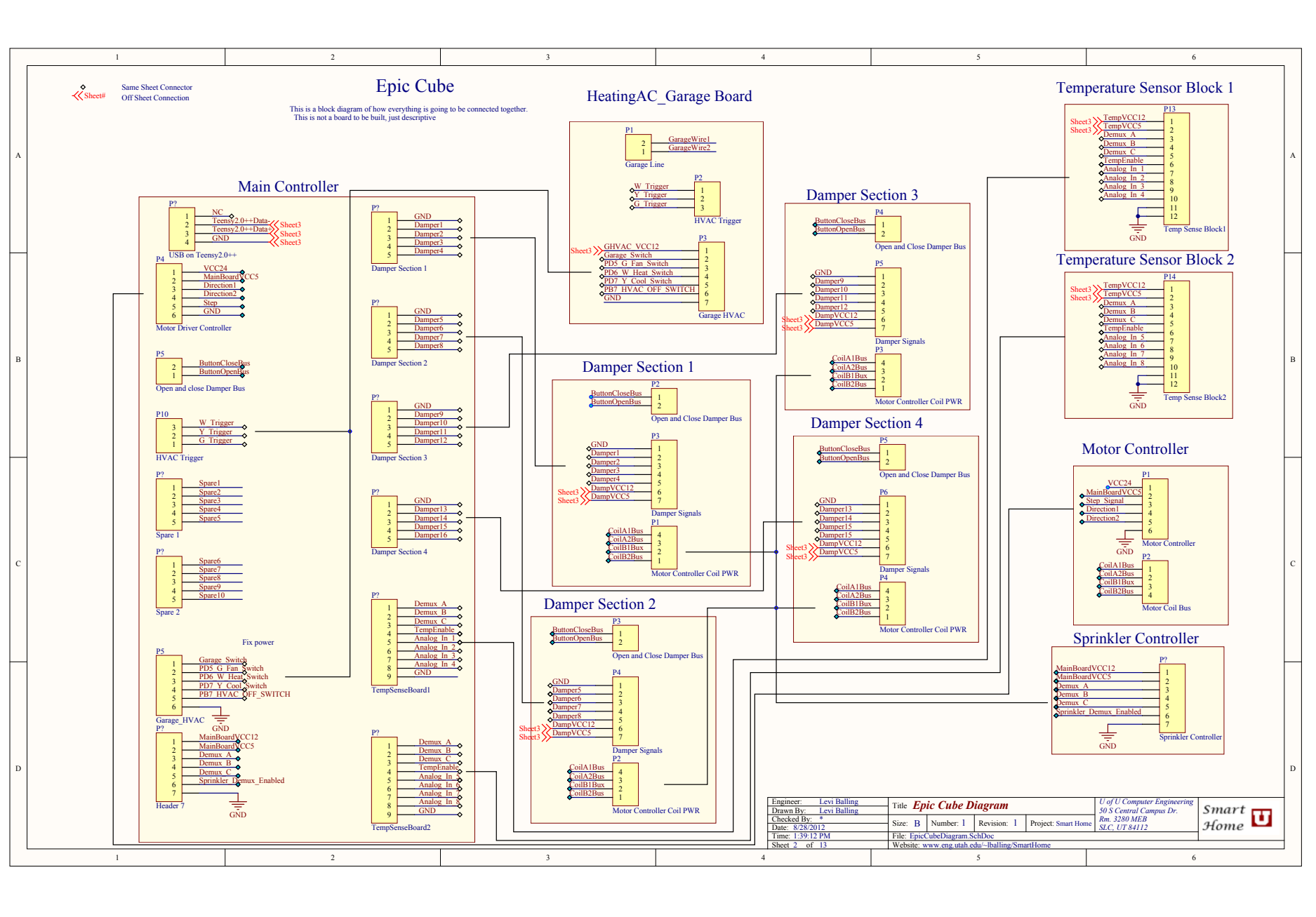
- Garage Door Control
- Air Conditioning and Heating Control
- 16 x Vent Damper Motor Drivers
- Wireless Communication
- 8 x Microphone Inputs for Voice Recognition
- 8 x Interrupt Buttons for Specific Microphone Use
- Baby Monitor listening
- 8 x Output Specific Speakers
- 5 x 12VDC PWM Fan Controllers
- 6 x Station Sprinkler Controller

Engineer: Levi Balling	Title: *The Epic Cube*				*U of U Computer Engineering*
Drawn By: Levi Balling					*50 S. Central Campus Dr.*
Checked By: *	Size: B	Number: 1	Revision: 1	Project: Smart Home	*Rm. 3280 MEB*
Date: 8/28/2012					*Salt Lake City, UT*
Time: 1:38:47 PM	File: TheEpicCube.SchDoc				
Sheet 1 of 13	Website: www.eng.utah.edu/~lballing/SmartHome				

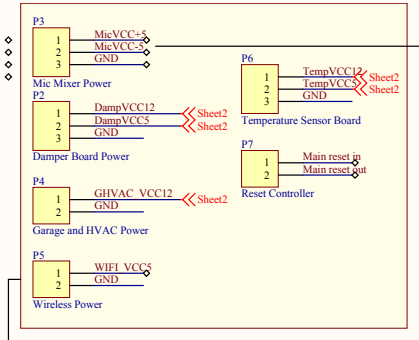
Smart Home


Sheet#
Same Sheet Connector
Off Sheet Connection
Epic Cube
This is a block diagram of how everything is going to be connected together.
This is not a board to be built, just descriptive
Main Controller
P?
NC
Teensy2.0++Data-
Teensy2.0++Data+
GND
Sheet3
USB on Teensy2.0++
P4
VCC24
MainBoardVCC5
Direction1
Direction2
Step
GND
Motor Driver Controller
P5
ButtonCloseBus
ButtonOpenBus
Open and close Damper Bus
P10
W_Trigger
Y_Trigger
G_Trigger
HVAC Trigger
Spare1
Spare2
Spare3
Spare4
Spare5
Spare 1
Spare6
Spare7
Spare8
Spare9
Spare10
Spare 2
Fix power
Garage_Switch
PD5_G_Fan_Switch
PD6_W_Heat_Switch
PD7_Y_Cool_Switch
PB7_HVAC_OFF_SWITCH
Garage_HVAC
GND
MainBoardVCC12
MainBoardVCC5
Demux_A
Demux_B
Demux_C
Sprinkler_Demux_Enabled
Header 7
GND
Damper Section 1
GND
Damper1
Damper2
Damper3
Damper4
Damper Section 2
Damper5
Damper6
Damper7
Damper8
Damper Section 3
Damper9
Damper10
Damper11
Damper12
Damper Section 4
Damper13
Damper14
Damper15
Damper16
TempSenseBoard1
Demux_A
Demux_B
Demux_C
TempEnable
Analog_In_1
Analog_In_2
Analog_In_3
Analog_In_4
GND
TempSenseBoard2
HeatingAC_Garage Board
P1
GarageWire1
GarageWire2
Garage Line
P2
W_Trigger
Y_Trigger
G_Trigger
HVAC Trigger
P3
GHVAC_VCC12
Garage_Switch
PD5_G_Fan_Switch
PD6_W_Heat_Switch
PD7_Y_Cool_Switch
PB7_HVAC_OFF_SWITCH
GND
Garage HVAC
Damper Section 1
P2
ButtonCloseBus
ButtonOpenBus
Open and Close Damper Bus
P3
GND
Damper1
Damper2
Damper3
Damper4
DampVCC12
DampVCC5
Damper Signals
P1
CoilA1Bus
CoilA2Bus
CoilB1Bus
CoilB2Bus
Motor Controller Coil PWR
Damper Section 2
P3
Open and Close Damper Bus
P4
GND
Damper5
Damper6
Damper7
Damper8
DampVCC12
DampVCC5
Damper Signals
P2
Motor Controller Coil PWR
Damper Section 3
P4
Open and Close Damper Bus
P5
GND
Damper9
Damper10
Damper11
Damper12
DampVCC12
DampVCC5
Damper Signals
P3
Motor Controller Coil PWR
Damper Section 4
P5
Open and Close Damper Bus
P6
GND
Damper13
Damper14
Damper15
Damper15
DampVCC12
DampVCC5
Damper Signals
P4
Motor Controller Coil PWR
Temperature Sensor Block 1
P13
TempVCC12
TempVCC5
Demux_A
Demux_B
Demux_C
TempEnable
Analog_In_1
Analog_In_2
Analog_In_3
Analog_In_4
GND
Temp Sense Block1
Temperature Sensor Block 2
P14
TempVCC12
TempVCC5
Demux_A
Demux_B
Demux_C
TempEnable
Analog_In_5
Analog_In_6
Analog_In_7
Analog_In_8
GND
Temp Sense Block2
Motor Controller
P1
VCC24
MainBoardVCC5
Step_Signal
Direction1
Direction2
GND
Motor Controller
P2
CoilA1Bus
CoilA2Bus
CoilB1Bus
CoilB2Bus
Motor Coil Bus
Sprinkler Controller
P?
MainBoardVCC12
MainBoardVCC5
Demux_A
Demux_B
Demux_C
Sprinkler_Demux_Enabled
GND
Sprinkler Controller
Engineer: Levi Balling
Drawn By: Levi Balling
Checked By: *
Date: 8/28/2012
Time: 1:39:12 PM
Sheet 2 of 13
Title Epic Cube Diagram
Size: B
Number: 1
Revision: 1
Project: Smart Home
File: EpicCubeDiagram.SchDoc
Website: www.eng.utah.edu/~lballing/SmartHome
U of U Computer Engineering
50 S Central Campus Dr.
Rm. 3280 MEB
SLC, UT 84112
Smart Home

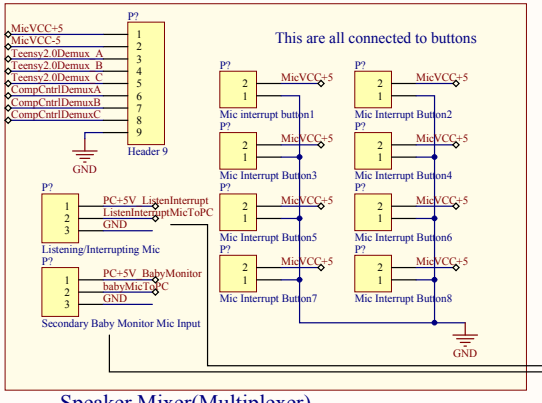
The Epic Cube Diagram 2

Power Supply Board

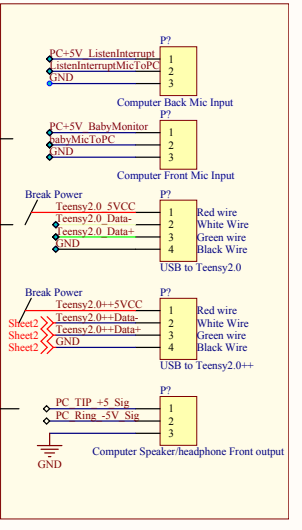
Most of the GND connections will remain unconnected



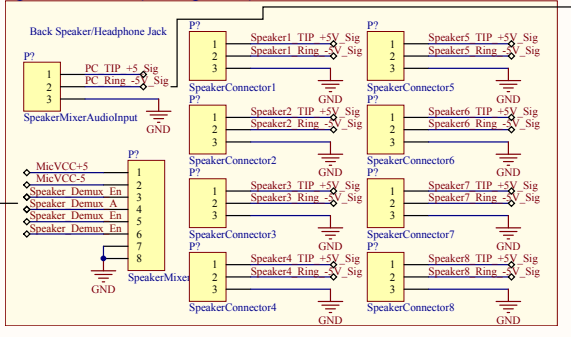
Microphone Mixer



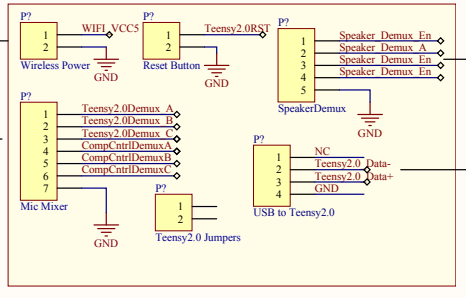
Computer I/O



Speaker Mixer(Multiplexer)



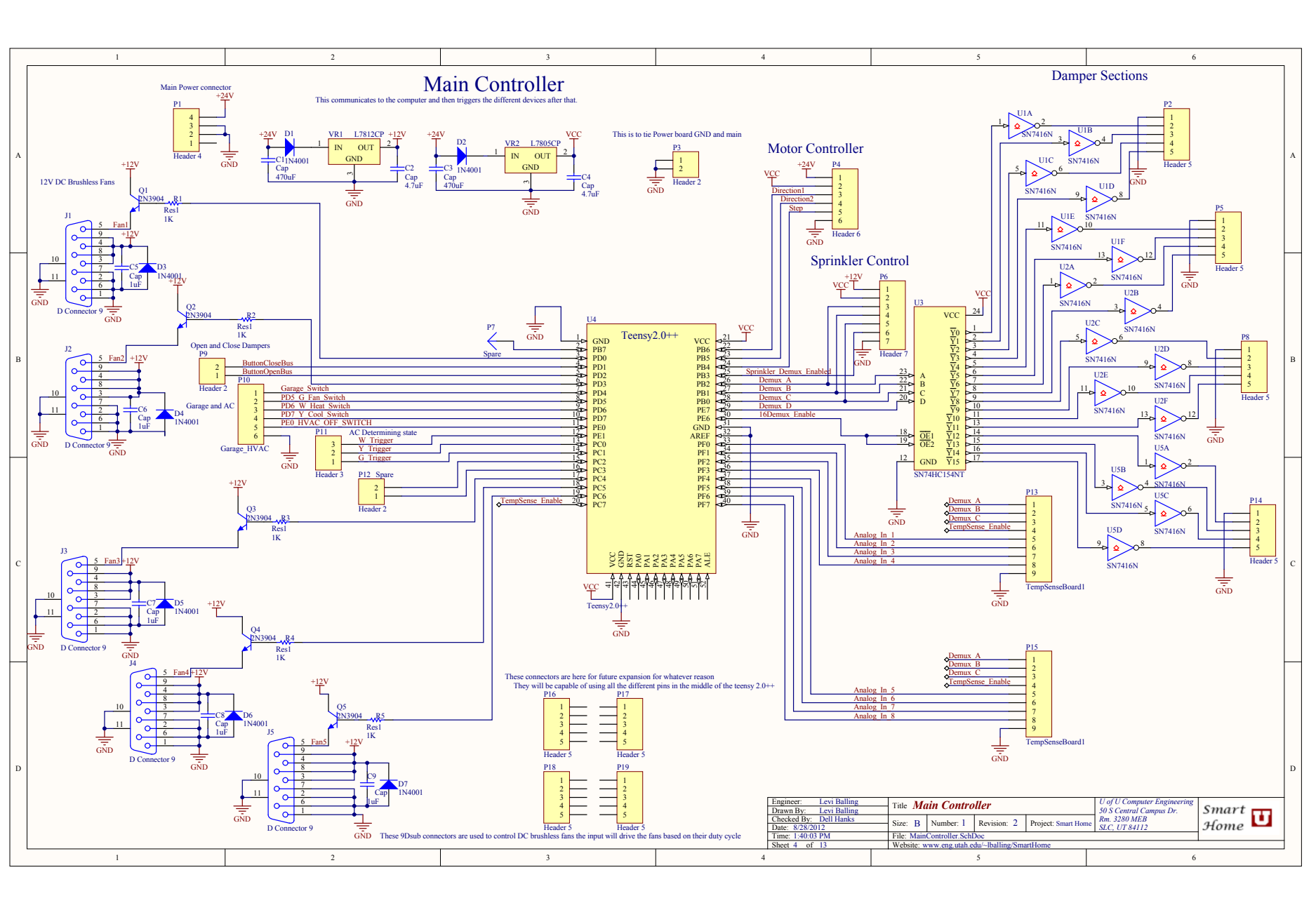
Wireless Communication



Engineer: Levi Balling	Title: Epic Cube Diagram				U of U Computer Engineering 50 S Central Campus Dr. Rm. 3280 MEB SLC, UT 84112
Drawn By: Levi Balling	Size: B	Number: 1	Revision: 1	Project: Smart Home	
Checked By: *	File: EpicCubeDiagram2.SchDoc				
Date: 8/28/2012	Website: www.eng.utah.edu/~lballing/SmartHome				
Time: 1:39:39 PM					
Sheet 3 of 13					

Main Controller

This communicates to the computer and then triggers the different devices after that.



Engineer: Levi Balling	Title: Main Controller				U of U Computer Engineering 50 S Central Campus Dr. Rm. 3280 MEB SLC, UT 84112
Drawn By: Levi Balling	Size: B	Number: 1	Revision: 2	Project: Smart Home	
Checked By: Dell Hanks	File: MainController.SchDoc				
Date: 8/28/2012	Website: www.eng.utah.edu/~lballing/SmartHome				
Time: 1:40:03 PM					
Sheet 4 of 13					

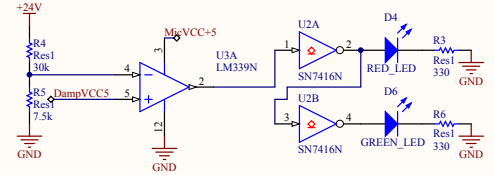
POWER SUPPLY BOARD

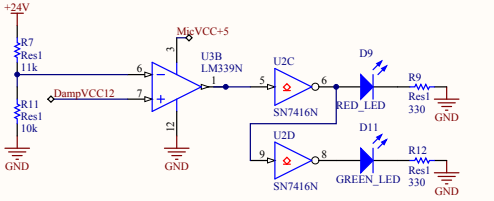
This Board will provide power to the rest of the Epic Cube(power is supplied by a 24V 4.5A power supply)

Voltage good = Green LED on
Voltage bad = Red LED on

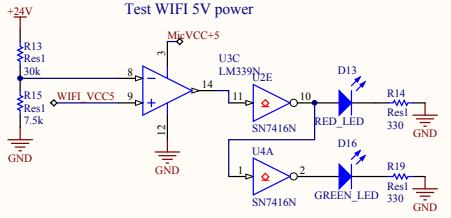
12V test is if the voltage is greater than 11.42V
5V test is if the voltage is greater than 4.8V

Test Damper Voltage

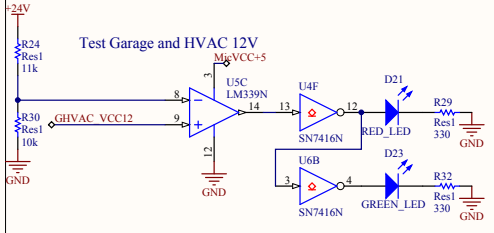




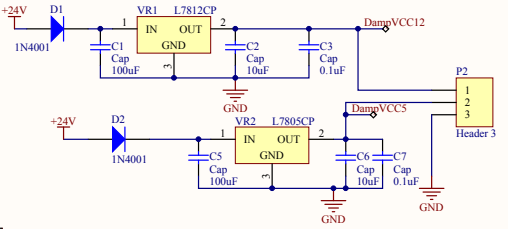
Test WIFI 5V power



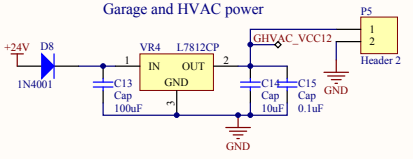
Test Garage and HVAC 12V



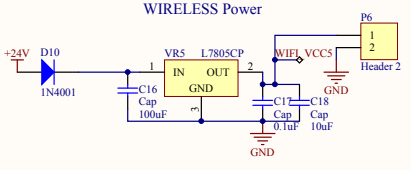
Damper Board Power +5V and +12V



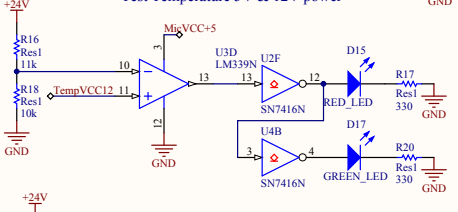
Garage and HVAC power

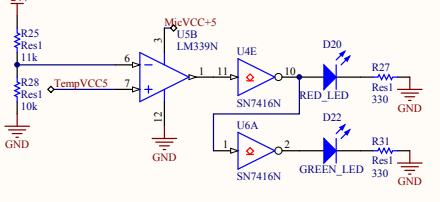


WIRELESS Power

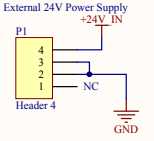


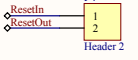
Test Temperature 5V & 12V power



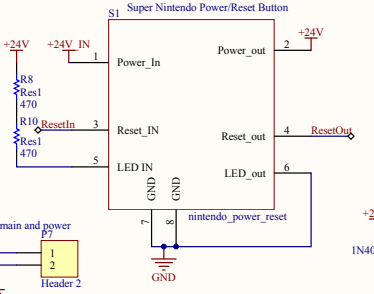


External 24V Power Supply





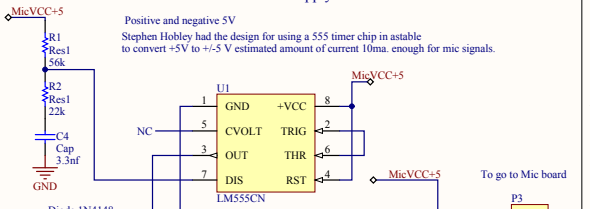
Super Nintendo Power/Reset Button

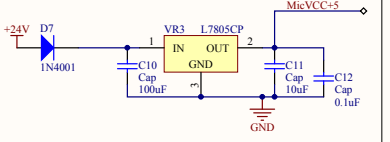


Mic Power Supply

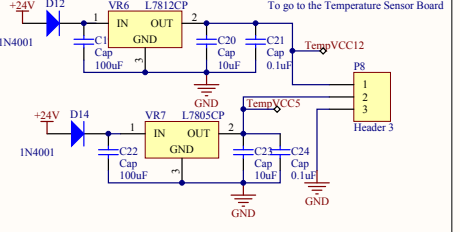
Positive and negative 5V

Stephen Hobley had the design for using a 555 timer chip in astable to convert +5V to +/-5 V estimated amount of current 10ma. enough for mic signals.

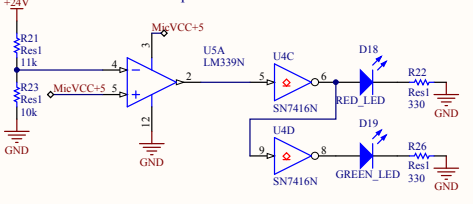




Temperature Sensor Power

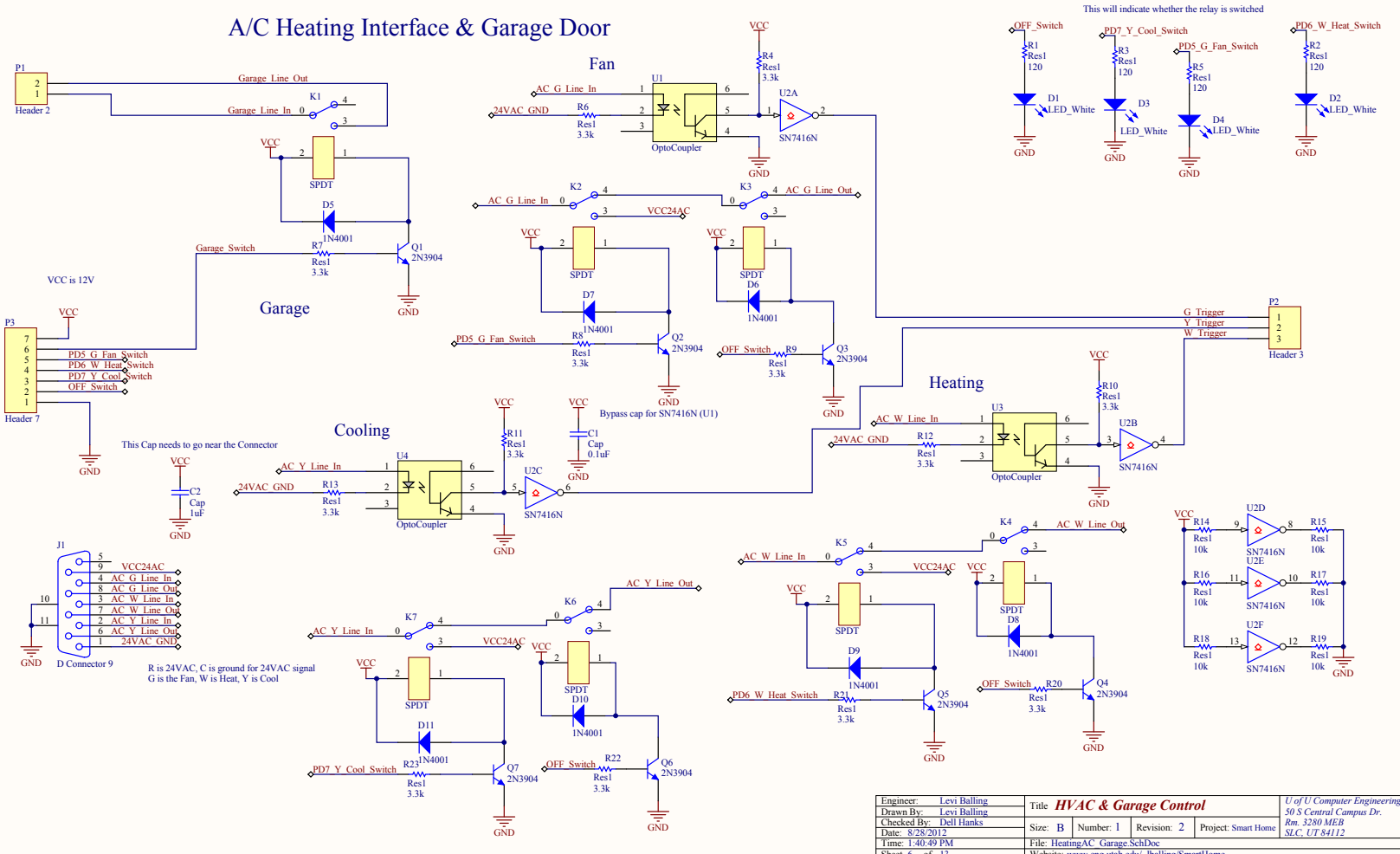


Test Mic +5V power



Engineer: Levi Balling	Title: **Epic Cube Power Supply**				U of U Computer Engineering 50 S. Central Campus Dr. Rm. 3280 MEB Salt Lake City, UT
Drawn By: Levi Balling	Size: B	Number: 1	Revision: 1	Project: Smart Home	
Checked By: *	File: PowerAndFanBoard.SchDoc				
Date: 8/28/2012	Website: www.eng.utah.edu/~lballing/SmartHome				
Time: 1:40:24 PM					
Sheet 5 of 13					

A/C Heating Interface & Garage Door

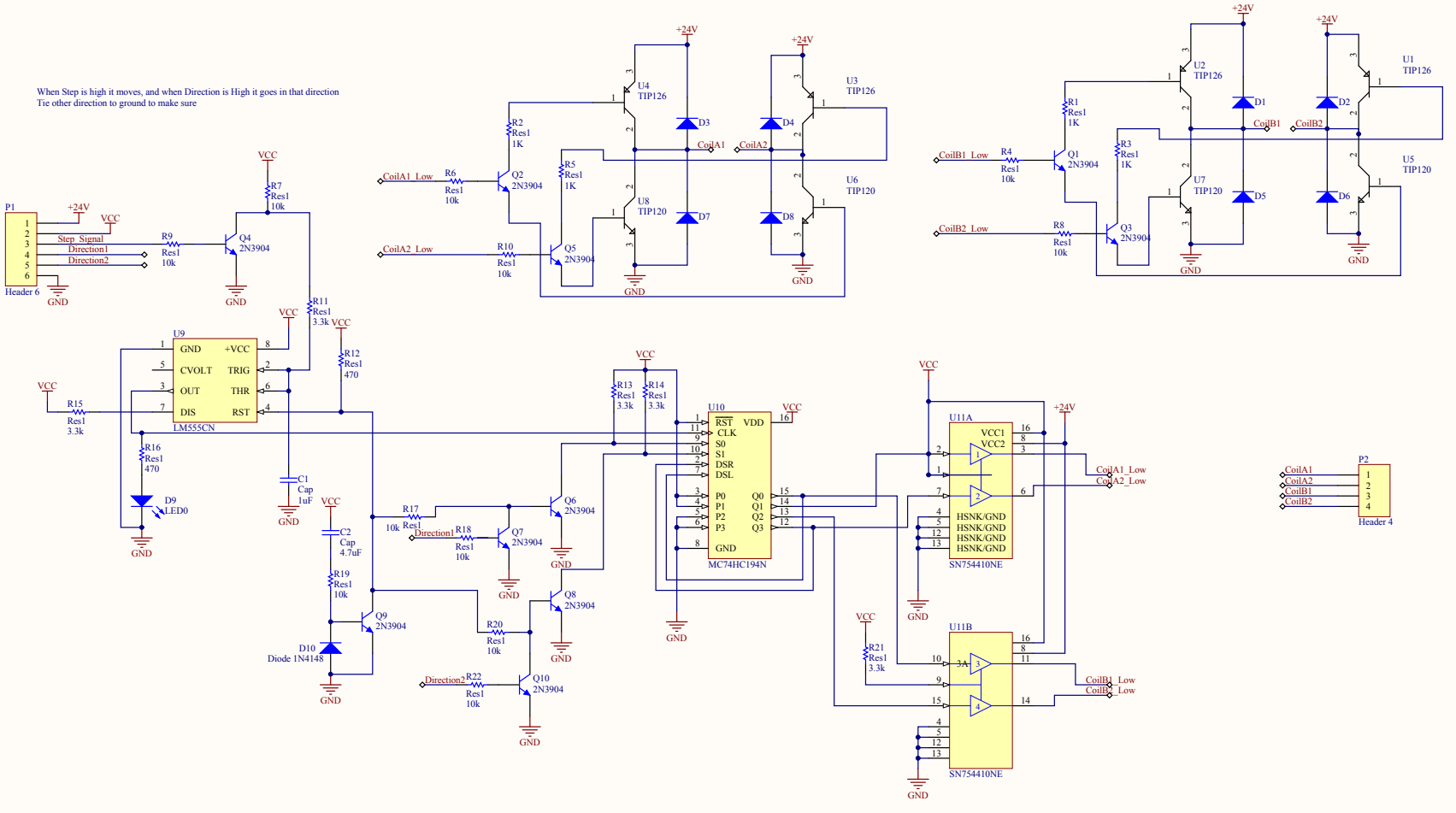


Engineer: Levi Balling	Title: **HVAC & Garage Control**				*U of U Computer Engineering*
Drawn By: Levi Balling	Size: B	Number: 1	Revision: 2	Project: Smart Home	*50 S Central Campus Dr.*
Checked By: Dell Hanks					*Rm. 3280 MEB*
Date: 8/28/2012	File: HeatingAC_Garage.SchDoc				*SLC, UT 84112*
Time: 1:40:49 PM	Website: www.eng.utah.edu/~lballing/SmartHome				Smart Home
Sheet 6 of 13					

Bi-Polar Stepper Motor Driver

This Board will control the bi-polar stepper motor with a range of 0.5 to 5 amps (provided you put heat sinks on)

When Step is high it moves, and when Direction is High it goes in that direction
Tie other direction to ground to make sure



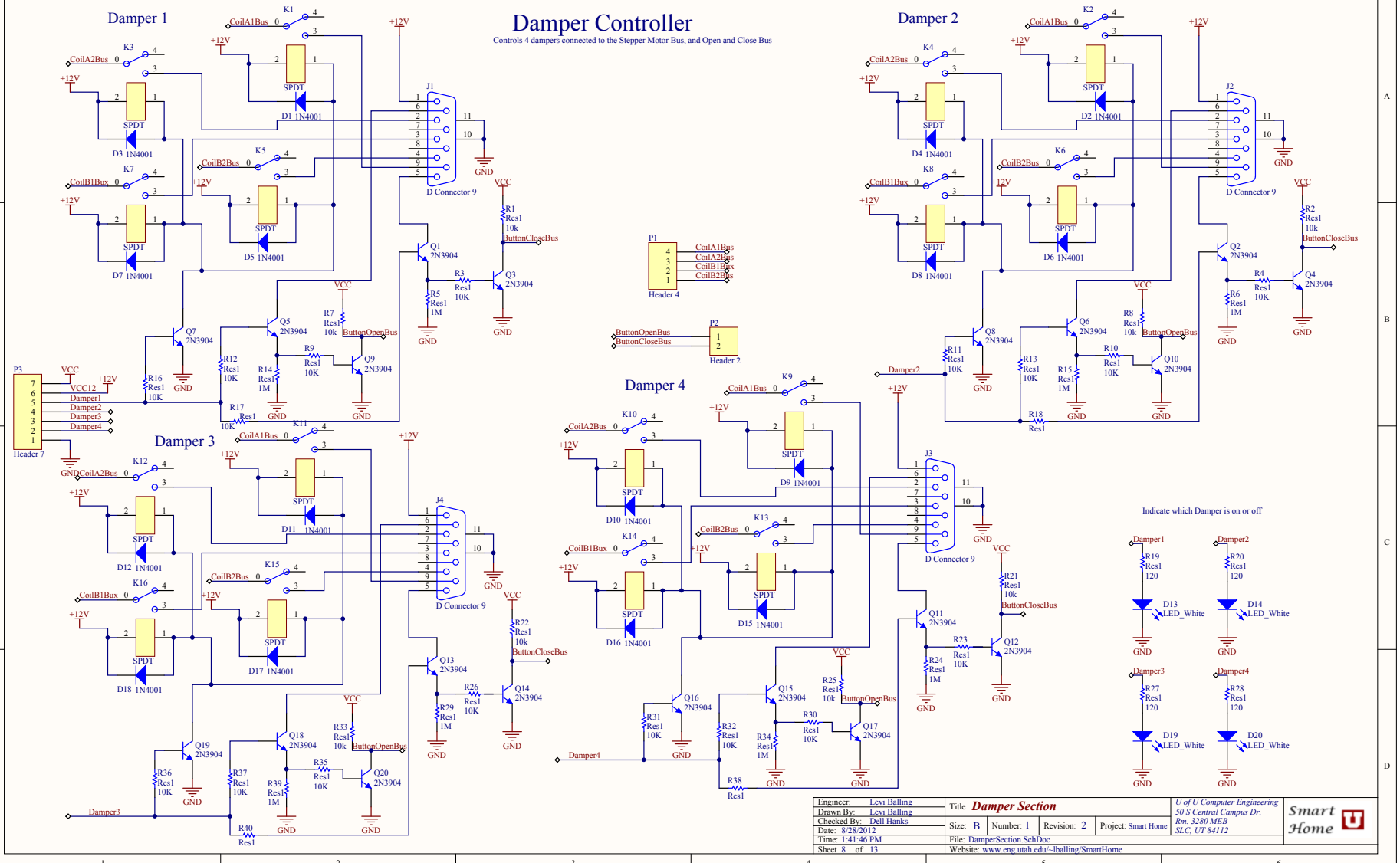
This Motor Controller was outlined heavily from http://home.cogeco.ca/~rpaisley4/Bipolar.html

Engineer: R. Paisley, L. Balling	Title: **Bi-Polar Stepper Motor Driver**		*U of U Computer Engineering*
Drawn By: Levi Balling	Size: B	Number: 1	Revision: 1	Project: Smart Home	*50 S Central Campus Dr.*
Checked By: Dell Hanks					*Rm. 3280 MEB*
Date: 8/28/2012					*SLC,UT 84112*
Time: 1:41:15 PM	File: MotorController.SchDoc				
Sheet 7 of 13	Website: www.eng.utah.edu/~lballing/SmartHome				

Smart Home

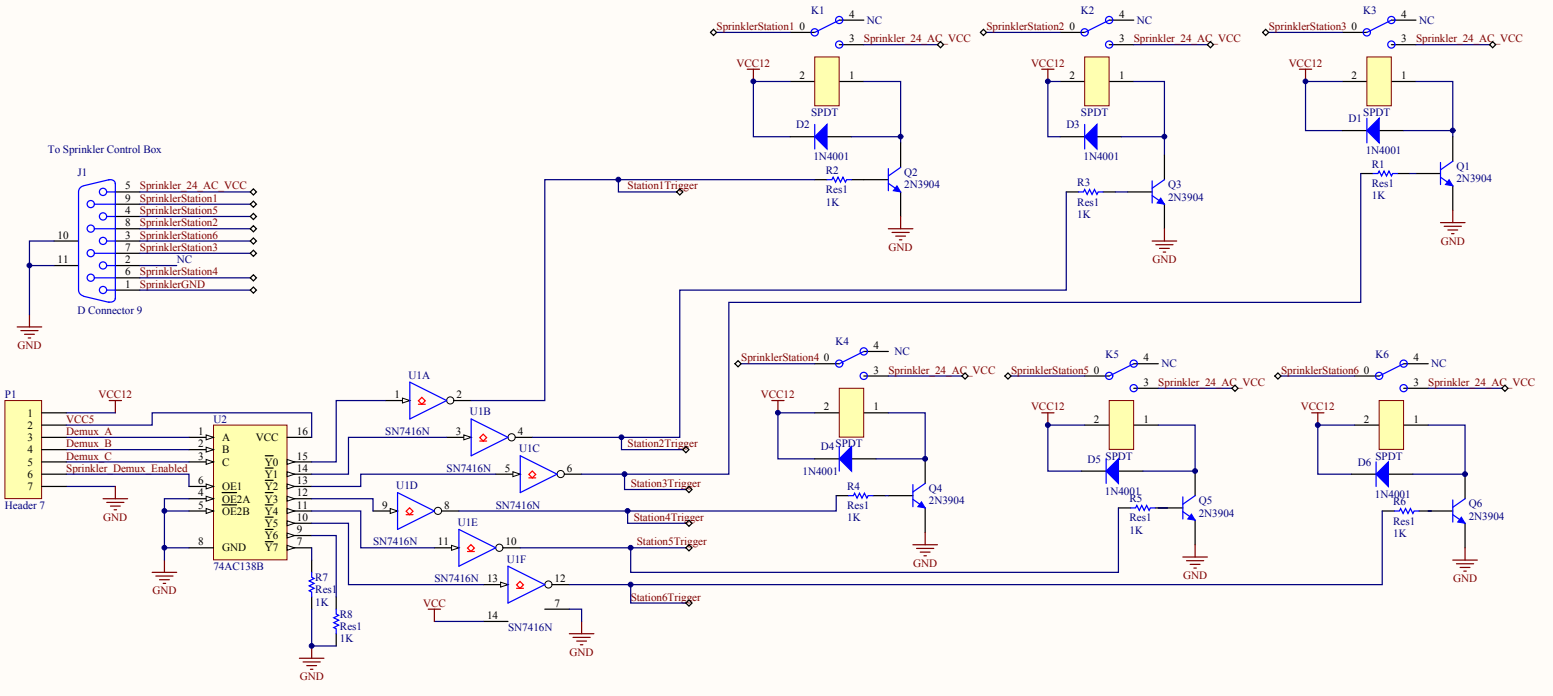
Damper Controller

Controls 4 dampers connected to the Stepper Motor Bus, and Open and Close Bus

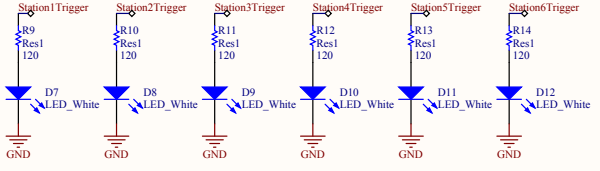


Sprinkler Controller

This board will control 6 Sprinkler Stations



Relay Indication

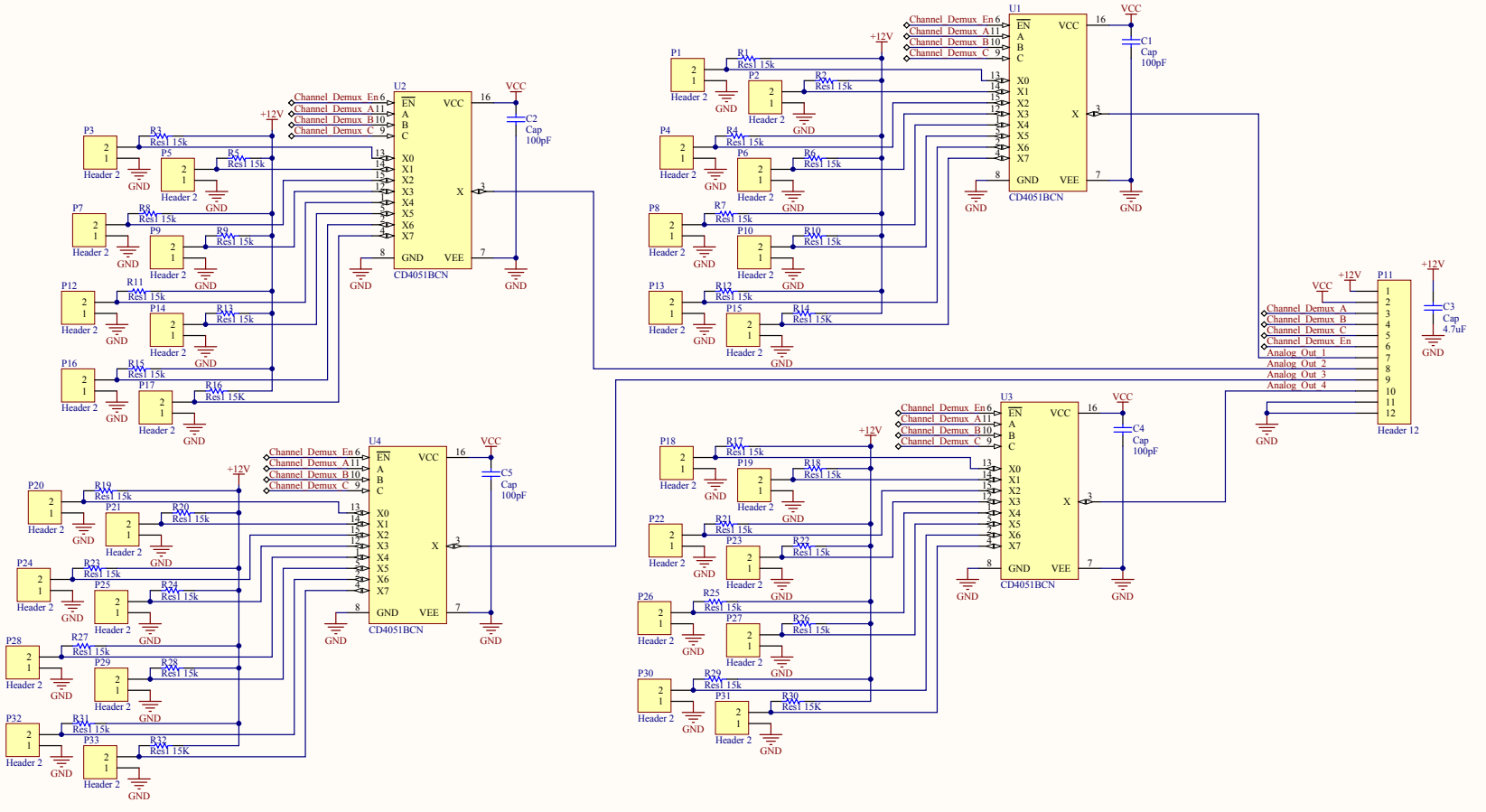


Engineer: Levi Balling	Title: *Sprinkler Controller*				*U of U Computer Engineering*
Drawn By: Levi Balling					*50 S. Central Campus Dr.*
Checked By: *	Size: B	Number: 1	Revision: 1	Project: Smart Home	*Rm. 3280 MEB*
Date: 8/28/2012					*Salt Lake City, UT*
Time: 1:42:17 PM	File: SprinklerBoard.SchDoc				
Sheet 9 of 13	Website: www.eng.utah.edu/~lballing/SmartHome				

Smart Home

Temperature Sensor Controller

This board will Take temperature samples from 32 locations
This system uses 10k thermistors that will be measured on the teensy analog input



Engineer: Levi Balling	Title: *Temperature Sensor Controller*				*U of U Computer Engineering*
Drawn By: Levi Balling					*50 S. Central Campus Dr.*
Checked By: *	Size: B	Number: 1	Revision: 2	Project: Smart Home	*Rm. 3280 MEB*
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Time: 1:42:37 PM	File: TemperatureSensorBlock.SchDoc				Smart Home
Sheet 10 of 13	Website: www.eng.utah.edu/~lballing/SmartHome				

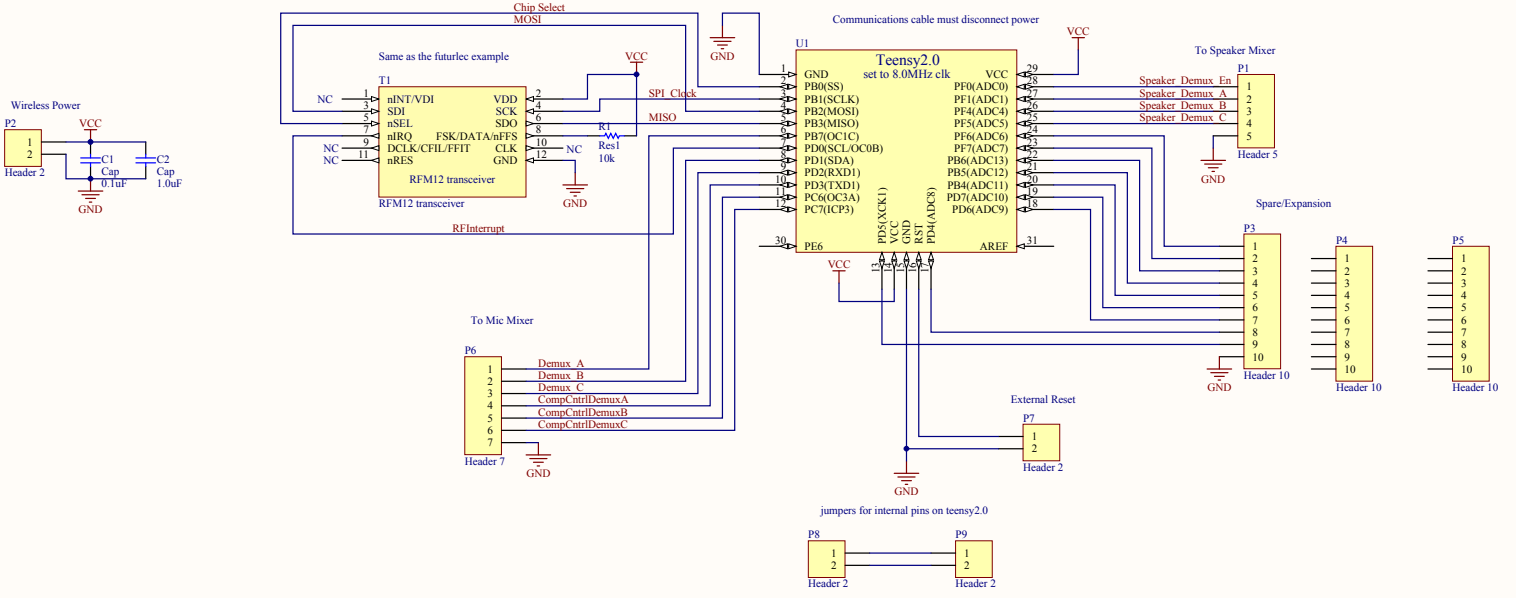
Wireless Communication Controller

This board will control a Mic Mixer system, Speaker Mixer System, and communicate wirelessly to other RF modules

Teensy 2.0 needs to be configured to run at 8MHz, this is the min PLL frequency for the RFM12 chip
Frequencies of the RFM12(using 8Mhz)

	Frequency	Antenna length(half/quarter)
315 MHz band, 2.5KHz step	248.19MHz	22.6/11.3
433 MHz band, 2.5KHz step	344.19MHz	16.31/8.158
868 MHz band, 5KHz step	703.61MHz	7.98/3.99
915MHz band, 7.5KHz step	720.57MHz	7.79/3.89

corner to corner of PCB is 8.48 in
a whip antenna will reach 30+M indoors



Engineer: Levi Balling	Title: **Wireless Communication Controller**				*U of U Computer Engineering*
Drawn By: Levi Balling					*50 S. Central Campus Dr.*
Checked By: *	Size: B	Number: 1	Revision: 1	Project: Smart Home	*Rm. 3280 MEB*
Date: 8/28/2012					*Salt Lake City, UT*
Time: 1:43:01 PM	File: WirelessCommunications.SchDoc				
Sheet 11 of 13	Website: www.eng.utah.edu/~lballing/SmartHome				

Smart Home

Microphone Mixer

VCC = +5V

This mic mixerwill be controlled using a teensy 2.0

need to disable all other mics but the one being pressed

need to be able to port any specific mic to the input of another mic jack

The Pre-amp was used from www.hobby-hour.com

Pull down to gnd, this chip will always be enabled.

Use Shielded Cat5, or coax

if the input from the button turns high
We then change enable the other demux

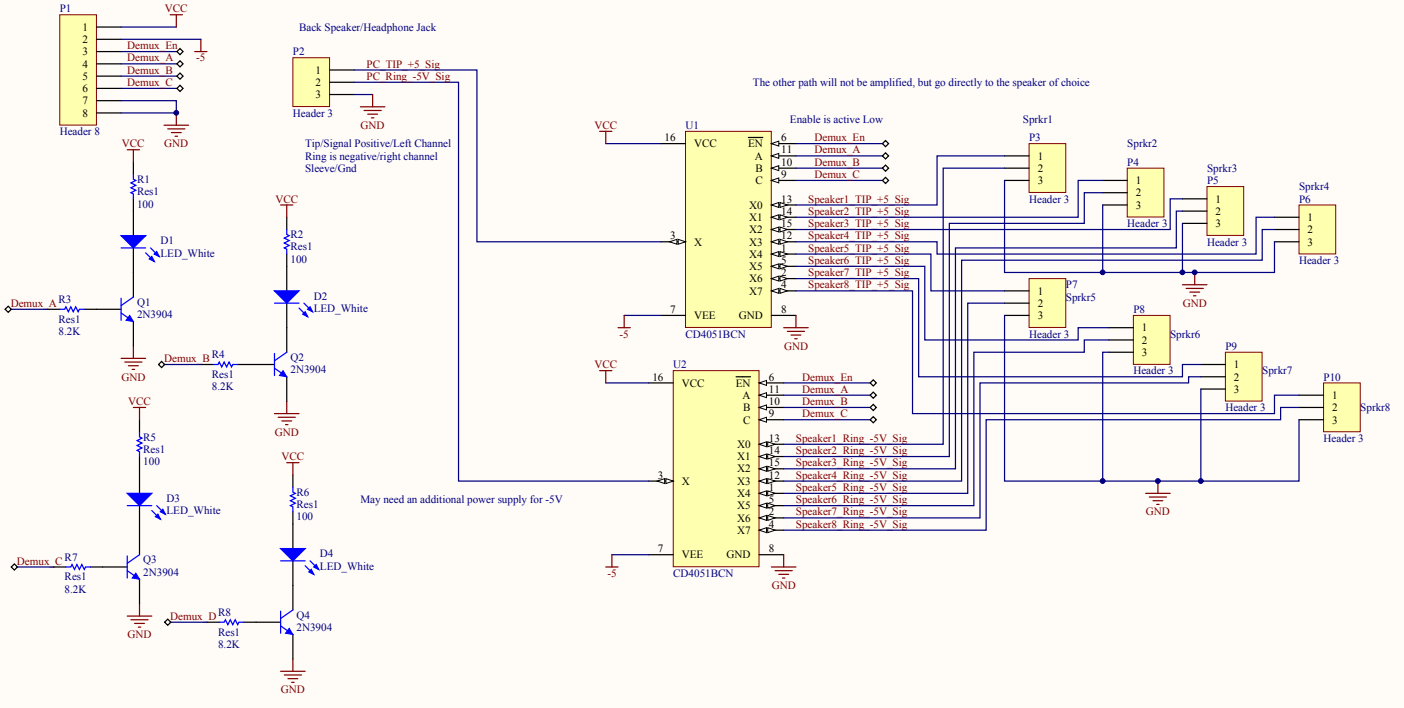
just to make sure that the signal is strong getting to the IC

Engineer: Levi Balling	Title: Microphone Mixer
Drawn By: Levi Balling	Size: B Number: 1 Revision: 1 Project: Smart Home
Checked By: *	U of U Computer Engineering, 50 S Central Campus Dr. Rm. 3280 MEB SLC, UT 84112
Date: 8/28/2012	File: MicMixer.SchDoc
Time: 1:43:25 PM	Website: www.eng.utah.edu/~lballing/SmartHome
Sheet 12 of 13	

Speaker Mixer

We aren't going to supply specific power to speakers. They will have their own

demux into 2 options 1: single speaker 2: all speakers with amplifier
simple SPDT relat will work



Engineer: Levi Balling	Title: **Speaker Mixer**				*U of U Computer Engineering*
Drawn By: Levi Balling					*50 S. Central Campus Dr.*
Checked By: *	Size: B	Number: 1	Revision: 1	Project: Smart Home	*Rm. 3280 MEB*
Date: 8/28/2012					*Salt Lake City, UT*
Time: 1:43:58 PM	File: SpeakerMixer.SchDoc				Smart Home
Sheet 13 of 13	Website: www.eng.utah.edu/~lballing/SmartHome				