Hearing Aid Redesign: Test Plans

ELECTRICAL TESTING

Table of Contents:

Specification Summary:

Spec	Specification	Dir.	Units	Marginal	Ideal	Measured Value	Pass/Fail
S1	Lowest level of sound detected	min	dB	<60	<30	N/A	Fail
S2	Frequencies amplified	max	Hz	300-7000	85-8000	200-8000	Pass
S3	Maximum amplification	target	dB	85-95	90	16.9	Fail
S4	Levels of volume adjustment	max	levels	5	20	20	Pass
S5	Time to charge earpiece	min	minutes	<60	<30	N/A	Fail
S7	Connects to standard USB 2.0	target	yes/no	yes/no	yes	yes/no	Pass
S12	Battery life at max. Amplification	max	hours	>16	>48	Est. 3.5	Fail

Hearing Aid Redesign: Test Plans
EE 1: Switch Test

Date Completed – April 2nd, 2013

Performed By - Ron Dries

Specifications Tested

Specification	Description	Ideal	Marginal
S4	Levels of Volume Adjustment	20	5

Revision History

Revision	Description	Date
1	Document Created	03/14/13
2	Document Completed	5/7/13

Equipment

___ Switch
___ MC56F8006 Evaluation Kit
___ USB power cable
___ USB TAP cable

Sections

- Part 1 – Test Volume Up and Down Interrupt
- Part 2 – Test Next and Previous Mode Interrupt
- Part 3 – Test Standby Interrupt
- Part 4 – Test Functionality of each Button Press

Hearing Aid Redesign: Test Plans
EE 1: Switch Test

Date Completed- April 2nd 2013

Performed By - Ron Dries

Part 1 – Test Volume Up and Down

___ 1. Solder wires to the switch

___ 2. Connect the volume up and down switches to the designated input pins on the eval board

___ 3. Flash the switch test software onto the Eval Board

___ 4. Press the volume up button

___ 5. Observe the volume up LED turns on and off when the button is pressed

___ 6. Press the volume down button

___ 7. Observe the volume down LED turns on and off when the button is pressed

Summary of Data

Did the volume switches correctly interact with the eval board? Yes _X__ No _____

Testing Part 1 Sign Off - Ron Dries Date – 5/7/13

Hearing Aid Redesign: Test Plans
EE 1: Switch Test

Date Completed - April 2nd, 2013

Performed By – Ron Dries

Part 2 – Test Mode Next and Previous

___ 1. Solder wires to the switch

___ 2. Connect the mode next and previous switches to the designated input pins on the eval board

___ 3. Flash the switch test software onto the Eval Board (If needed)

___ 4. Press the mode next button

___ 5. Observe the mode next LED turns on and off when the button is pressed

___ 6. Press the mode previous button

___ 7. Observe the mode previous LED turns on and off when the button is pressed

Summary of Data

Did the mode switches correctly interact with the eval board? Yes _X___ No _____

Testing Part 2 Sign Off Ron Dries Date – 5/7/13

Hearing Aid Redesign: Test Plans
EE 1: Switch Test

Date Completed – March 24th 2013

Performed By – Ron Dries

Part 3 – Test Standby

___ 1. Solder wires to the switch

___ 2. Connect the standby switch to the designated input pins on the eval board

___ 3. Flash the switch test software onto the Eval Board (If needed)

___ 4. Press the standby button

___ 5. Observe the standby LED turns on and off when the button is pressed

Summary of Data

Did the standby switch correctly interact with the eval board? Yes _X___ No _____

Testing Part 3 Sign Off - Ron Dries Date - 5/7/13

Hearing Aid Redesign: Test Plans
EE 1: Switch Test

Date Completed – March 24th 2013

Performed By – Ron Dries

Part 3 – Test Switch Functionality

___ 1. Solder wires to the switch

___ 2. Connect all of he switches to the evaluation board

___ 3. Flash the hearing aid software to the evaluation board

___ 4. Press the volume up and down buttons

___ 5. While debugging the code observe that the volume variable goes up and down

___ 6. Press the mode next and previous

___ 7. While debugging the code observe the mode variable changes accordingly

___ 8. Press the standby button

___ 9. While debugging the code observe that the code appropriately goes into standby mode

Summary of Data

Did the switch function as intended? Yes __X__ No _____

Testing Part 4 Sign Off – Ron Dries Date - 5/7/13

Hearing Aid Redesign: Test Plans
EE 2: Speaker Test

Date Completed 5/3/2013

Performed By Conor Murphy

Specifications Tested

Specification	Description	Ideal	Marginal
S2	Frequencies Amplified	85 – 8000 Hz	300 – 7000 Hz

Revision History

Revision	Description	Date
1	Document Created	03/14/13
2	Document updated to completion	5/3/2013

Equipment

___ Speaker
___ Breadboard
___ Signal Generator
___ Signal Generator Test Leads

Sections

- Part 1 – Determine Min Input to Speaker
- Part 2 – Speaker Functionality: Lowest Frequency Heard
- Part 3 – Speaker Functionality: Highest Frequency Heard

Hearing Aid Redesign: Test Plans
EE 2: Speaker Test

Date Completed 5/3/2013

Performed By –Conor Murphy

Part 1 – Determine Min Input to Speaker

___ 1. Solder wires to the speaker

___ 2. Connect the speaker to VDD and GND

___ 3. Connect the data line of the speaker to the signal generator

___ 4. Set signal generator to a mid range frequency 1-2 kHz and lowest amplitude

___ 5. Observe if the speaker is outputting a tone, or sound

___ 6. If no sound heard up the amplitude a slight amount, 10mV,

___ 7. Keep repeating steps 5 and 6 until a sound can just be heard

___ 8. Vary frequency to observe the speaker output at this level but different frequencies

Summary of Data

Frequency (Hz)	**Amplitude ()**
80	50mV
200	50mV
1000	50mV
8000	50mV
15000	50mV

The speaker operates correctly, emitting a constant tone at the lowest possible input voltage from the signal generator. Attempts to use a low resistance voltage divider to sower the signal were unsuccessful, as the input impedance of the speaker was larger than the parallel resistance of the voltage divider. Due to the limited number of available components, and concerns over breaking pats, testing with higher resistor voltage dividers and a signal generator in high impedance mode was not performed.

Testing Part 1 Sign Off - Conor Murphy Date – 5/3/2013

Hearing Aid Redesign: Test Plans
EE 2: Speaker Test

Date Completed - 5/13/2013

Performed By - Conor Murphy

Part 2 – Speaker Functionality: Lowest Frequency Heard

___ 1. Solder wires to the speaker (Ensure this is correct from previous part)

___ 2. Connect the speaker to VDD and GND (Ensure this is correct from previous part)

___ 3. Connect the data line of the speaker to the Signal Generator

___ 4. Set signal generator to a mid range value 1-3 kHz and the amplitude found above

___ 5. Observe the speaker output

___ 6. Lower the frequency of the signal generator

___ 7. Repeat steps 5 and 6 until the speaker no longer produces an audible noise.

Summary of Data

Lowest Frequency Output by Speaker – 80Hz

Test was stopped before values below 80Hz were tested, due to concern of the device operating outside of maximum parameters

Testing Part 2 Sign Off - Conor Murphy Date – 5/13/2013

Hearing Aid Redesign: Test Plans
EE 2: Speaker Test

Date Completed – 5/3/2013

Performed By – Conor Murphy
Part 3 – Speaker Functionality: Highest Frequency Heard

___ 1. Solder wires to the speaker (Ensure this is correct from previous part)

___ 2. Connect the speaker to VDD and GND (Ensure this is correct from previous part)

___ 3. Connect the data line of the speaker to the Signal Generator

___ 4. Set signal generator to a mid range value 1-3 kHz and the amplitude found above

___ 5. Observe the speaker output

___ 6. Raise the frequency of the signal generator slowly

___ 7. Repeat steps 5 and 6 until the maximum rating of the speaker is reached or the ideal frequency is reached.

Summary of Data

Highest Frequency Output by Speaker - 15kHz

Test was stopped before values above 15kHz were tested, due to concern of the device operating outside of maximum parameters

Testing Part 3 Sign Off – Conor Murphy Date – 5/3/2013

Hearing Aid Redesign: Test Plans
EE 3: Sound Processing Test

Date Completed – 5/3/2013

Performed By –Ron Dries, Conor Murphy

Specifications Tested

Specification	Description	Ideal	Marginal
S2	Frequencies Amplified	85 – 8000 Hz	300 – 7000 Hz
S3	Maximum Amplification	90 dB	85-95 dB

Revision History

Revision	Description	Date
1	Document Created	03/14/13
2	Document Completed	05/07/13

Equipment

___ MC56F8006 Evaluation Kit
___ USB power cable
___ USB TAP cable
___ Matlab

Sections

- Part 1: Test sound processing algorithm on known signal from Matlab
- Part 2: Test sound processing with signal generator

Hearing Aid Redesign: Test Plans
EE 3: Sound Processing Test

Date Completed - 5/3/2013

Performed By – Ron Dries, Conor Murphy

Part 1 – Test sound processing with signal from Matlab

___ 1. Hard code signal into software

___ 2. Flash code onto evaluation board

___ 3. Set a break point after the signal is finished being processed before being output

___ 4. Run the code

___ 5. Take and plot the output of the sound processing algorithm in Matlab

___ 6. Compare the result to the initial signal

Summary of Data

Did the sound processing algorithm modify the signal? Yes _x___ No _____

Was the signal Amplified? Yes __x__ No _____

Are modifications to the algorithm needed? Yes _____ No _x_____

Testing Part 1 Sign Off _____Date_____

Hearing Aid Redesign: Test Plans
EE 3: Sound Processing Test

Date Completed _____

Performed By _____

Part 2 – Test Sound Processing with Signal Generator

___ 1. Attach signal generator to the ADC ports of the eval board

___ 2. Flash code onto evaluation board

___ 3. Set a break point after the signal is finished being processed before being output

___ 4. Run the code

___ 5. Observe that the ADC interrupt LED goes on when interrupt is generated.

___ 6. Take and plot the output of the sound processing algorithm in Matlab

___ 6. Compare the result to the initial signal

Summary of Data

Did the sound processing algorithm modify the signal? Yes _x___ No _____

Did the ADC interrupt Trigger Yes _x___ No _____

Was the signal Amplified? Yes _x__ No _____

Are modifications to the algorithm needed? Yes _____ No _____

Place Wave forms here

Testing Part 2 Sign Off _____ Date_____

Hearing Aid Redesign: Test Plans
EE 4: Microphone Test

Date Completed – 5/1/2013

Performed By - Conor Murphy, Ron Dries

Specifications Tested

Specification	Description	Ideal	Marginal
S1	Lowest Level of Sound Detected	< 30 dB	<60 dB

Revision History

Revision	Description	Date
1	Document Created	03/14/13
2	Document updated to completion	5/3/2013

Equipment

___ Directional Microphone
___ Omni-Directional Microphone
___ Breadboard
___ Oscilloscope
___ Oscilloscope Probes

Sections

- Part 1 – Microphone Functionality: Normal speaking voice
- Part 2 – Microphone Functionality: Whisper
- Part 3 – Measure the output of the microphone

Hearing Aid Redesign: Test Plans
EE 4: Microphone Test

Date Completed 5/1/2013

Performed By – Conor Murphy, Ron Dries

Part 1 – Microphone Functionality: Normal speaking voice Test

___ 1. Solder wires to the microphones

___ 2. Connect the microphones to VDD and GND

___ 3. Connect the data lines of the microphones to the Oscilloscope

___ 4. Talk at a normal speaking level (approx. 60 dB)

___ 5. Observe oscilloscope output to obtain a quantifiable measurement of the microphones

___ 6. Save capture of oscilloscope to verify that it can pick up normal speech

Summary of Data

No identifiable waveforms were generated when the microphone was tested with a normal speaking voice. It is believed that the microphone was not able to generate the current required to drive the input impedance of the oscilloscope. It is suggested that the microphone is tested with a JFET operational amplifier buffer at the output to stabilize the output waveform and allow the oscilloscope to record it.

Testing Part 1 Sign Off - Conor Murphy Date – 5/3/2013

Hearing Aid Redesign: Test Plans
EE 4: Microphone Test

Date Completed – 5/1/2013

Performed By - Conor Murphy, Ron Dries

Part 2 – Microphone Functionality: Whisper Test

___ 1. Solder wires to the microphones (Ensure this is correct from previous part)

___ 2. Connect the microphones to VDD and GND (Ensure this is correct from previous part)

___ 3. Connect the data lines of the microphones to the Oscilloscope

___ 4. Talk at a whisper(approx. 30 dB)

___ 5. Observe oscilloscope output to obtain a quantifiable measurement of the microphones

___ 6. Save capture of oscilloscope to verify that it can pick up speech at a whisper

Summary of Data

No identifiable waveforms were generated when the microphone was tested with a whisper speaking voice. It is believed that the microphone was not able to generate the current required to drive the input impedance of the oscilloscope. It is suggested that the microphone is tested with a JFET operational amplifier buffer at the output to stabilize the output waveform and allow the oscilloscope to record it.

Testing Part 2 Sign Off - Conor Murphy Date – 5/3/2013

Hearing Aid Redesign: Test Plans
EE 4: Microphone Test

Date Completed – 5/1/2013

Performed By – Conor Murphy, Ron Dries

Part 3 – Measure the output of the microphone

___ 1. Solder wires to the microphones (Ensure this is correct from previous part)

___ 2. Connect the microphones to VDD and GND (Ensure this is correct from previous part)

___ 3. Connect the data lines of the microphones to the Oscilloscope

___ 4. Talk at varying levels of speech

___ 5. Observe oscilloscope output to obtain a quantifiable measurement of the microphones

___ 6. Save capture of oscilloscope to verify that it can pick up speech at a whisper

___ 7. Record the max voltage levels of the microphones output to determine the operating range of the microphone. This is useful to not harm electronics later on in the system

Summary of Data

Place capture of microphone waveforms here to prove functionality at a whisper speaking level

Maximum voltage reading: Normal Level: _____

Maximum voltage reading: Low Level _____

Maximum voltage reading: High Level _____

Testing Part 3 Sign Off _____Date_____

Hearing Aid Redesign: Test Plans
EE 5: Battery Charger Test

Date Completed _____

Performed By –Eric Lew

Specifications Tested

Specification	Description	Ideal	Marginal
S5	Time to charge Earpiece	<30	<60
S7	Connects to Standard USB 2.0 Port	Yes	Yes/No
S12	Battery life at max Amplification	>48	>16

Revision History

Revision	Description	Date
1	Document Created	03/14/13
1.1	Changed to single battery and included Amplification test	03/29/13

Equipment

___ Battery Charger IC
___ Batteries
___ Breadboard
___ Multimeter
___ Boost Converter IC

Sections

- Part 1: Test Battery Charger for Correct Operation and Amplification

Hearing Aid Redesign: Test Plans

EE 5: Battery Charger Test

Date Completed _____

Performed By – Eric Lew

Part 1 – Test Battery Charger for Correct Operation

___ 1. Wire up the charger circuit on the breadboard

___ 2. Connect the battery

___ 3. Double check that the circuit is correct

___ 4. Apply the correct input voltage to the circuit

___ 5. Probe the circuit with the multimeter checking test point voltages

___ 6. Measure the battery during charging to see if is in fact charging

___ 7. Discharge the battery to simulate circuit operation.

___ 8. Repeat steps 4 – 7 for multiple charge cycles

Summary of Data

Did the battery charging circuit charge the battery? Yes _____ No __x__

Were we able to optimize the circuit at all? Yes ____ No _x__
If so what was optimized:

What was the time to charge the earpiece? N/A

Are we able to charge over USB 2.0? Yes _____ No __x___

Hearing Aid Redesign: Test Plans

Results:

The battery charger circuit did not charge the battery. When the USB power supply was connected to the circuit, the battery voltage was not increasing which indicates the battery charging circuit failed to charge the battery.

The most probable root of cause is with the circuit connected to the modulation pin. According to the BQ2000 datasheet, this pin controls when the circuit enters fast charge mode and thereby charge the battery. The transistors chosen for this circuit only serve for general purpose use and could result in unintended voltage drops through the circuit. They also could not be turning on at the proper gate voltages and therefore would not send the signal to the chip to tell the circuit to enter battery charging mode.

Recommendations:

For future iterations of this project, I recommend using the *BQ2002* battery charging chip since that is designed specifically for NiMH batteries. It contains similar data to the BQ2000 chip except that there is more information on the charge inhibit pin which is similar to the modulation pin in the BQ2000 and the supply voltage takes 5 volts which is ideal for USB since that runs on 5 volts as well.

Testing Part 1 Sign Off - Eric Lew Date_____

Hearing Aid Redesign: Test Plans

EE 6: Bandpass and Pre-Amplification Test

Date Completed – April 29, 2013

Performed By – Conor Murphy

Specifications Tested

Specification	Description	Ideal	Marginal
S2	Frequencies Amplified	85 – 8000 Hz	300 – 7000 Hz
S3	Maximum Amplification	90 dB	85-95 dB

Revision History

Revision	Description	Date
1	Document Created	03/14/13
2	Document Completed	05/07/2013

Equipment

___ INA333 Instrumentation Amplifier
___Passive Bandpass Filtering Circuit
___ Breadboard
___ Multimeter
___ Oscilloscope
___ Oscilloscope Probes

Sections

- Part 1 - Filtering and Filter Functionality
- Part 2 -Pre-amplification through INA333

Hearing Aid Redesign: Test Plans
EE 6: Bandpass and Pre-Amplification Test

Date Completed April 29th, 2013

Performed By – Conor Murphy

Part 1 – Filtering and filter functionality

___ 1. Measure Bandpass filter resistors and capacitor to ensure proper values

___ 2. Apply waveforms from 10Hz-10kHz and record the results

___ 3. Ensure that there is no loss between the desired frequencies, and that the signal output at ten times above and below he desired frequency has ~70% of the amplitude

Summary of Data

What values for the filter were used? RLow _10k_ Rhigh _10k_ CLow_80nF_ CHigh _2nF_

Were the desired frequencies able to pass? Yes_x_ No____

Did the signal show half-power loss at 10x and .1x the desired frequencies? Yes _x_ No ___

Were we able to optimize the circuit at all? Yes ____ No _x__
If so what was optimized: None needed

Testing Part 1 Sign Off - Conor Murphy Date – 05/07/2013

Hearing Aid Redesign: Test Plans
EE 6: Bandpass and Pre-Amplification Test

Date Completed April 29th, 2013

Performed By – Conor Murphy

Part 2 – Filtering and filter functionality

___ 1. Measure gain resistor to ensure proper values

___ 2. Wire up Pre-amplification circuit

___ 3. Ensure that power is being correctly provided to all necessary pins

___4. Apply a 10mV AC waveform to the input and measure the output.

Summary of Data

What values for the gain resistor was used? _2.1Kohms_

Was the desired amplified output produced? Yes___ No_x_

The INA333 did not produce an amplified output, and instead burnt out. Research into the INA333 amplifier revealed that the output voltage of the device was limited to be 50mV, instead of the .5V first believed. The INA333 could not produce the output waveform, and broke as a result.

Testing Part 2 Sign Off - Conor Murphy Date – 05/07/2013

Hearing Aid Redesign: Test Plans
EE 7: System Test

Date Completed _____

Performed By _____

Specifications Tested

Specification	Description	Ideal	Marginal
S1	Lowest Level of Sound Detected	< 30	< 60
S2	Frequencies Amplified	85 – 8000 Hz	300 – 7000 Hz
S3	Maximum Amplification	90 dB	85-95 dB
S4	Levels of Volume Adjustment	20	5
S7	Connects to USB 2.0 Port	Yes	Yes/no
S5	Time to Charge Earpiece	< 30	< 60
S12	Earpiece Battery Life at Max Amplification	> 48	> 16

Revision History

Revision	Description	Date
1	Document Created	03/14/13

Equipment

___ MC56F8006 Evaluation Kit
___ USB power cable
___ USB TAP cable
___ Directional Microphone
___ Omni-Directional Microphone
___ Speaker
___ Battery Charger Circuit
___ Switch
___ Filtering and Amplification Circuit
___ Oscilloscope
___ Oscilloscope Probes

Sections

- Part 1: Test for S1
- Part 2: Test for S2
- Part 3: Test for S3
- Part 4: Test for S4
- Part 5: Test for S7
- Part 6: Test for S5

Hearing Aid Redesign: Test Plans

- Part 7: Test for S12

EE 7: System Test

Date Completed _____

Performed By _____

Part 1 – Test for S1

___ 1. Flash the latest code to the evaluation board

___ 2. Connect all of the subsystems together

___ 3. Ensure batteries are charged, charger circuit is correct, and amplification and filtering is in place

___ 4. Check that the microphones and speaker are connected, as well as the switch.

___ 5. Place the microphones and speaker inside of the audiologist test equipment

___ 6. Run a low sound scenario on the audiologist test equipment

___ 7. Compare the result of the low sound scenario to that of a known good hearing aid

Summary of Data

Were we able to detect sound in the low sound scenario? Yes _____ No __x___

Are modifications to the algorithm needed? Yes _____ No ___x____

Place Result Graph he

Complete system tests were not performed due to an inability to receive a comprehendible signal from either microphone. Research and purchasing of alternative microphones need to be done before complete system tests can be performed.

Testing Part 1 Sign Off - Conor Murphy Date 5/14/2013

Hearing Aid Redesign: Test Plans
EE 7: System Test

Date Completed _____

Performed By _____

Part 2 – Test for S2

___ 1. Flash the latest code to the evaluation board

___ 2. Connect all of the subsystems together

___ 3. Ensure batteries are charged, charger circuit is correct, and amplification and filtering is in place

___ 4. Check that the microphones and speaker are connected, as well as the switch.

___ 5. Place the microphones and speaker inside of the audiologist test equipment

___ 6. Run a scenario that will test at the limits of the frequency ranges to see hearing aid response

___ 7. Compare the result of the scenario to that of a known good hearing aid

Summary of Data

Were we able to amplify the necessary frequencies? Yes _____ No __x___

Are modifications to the algorithm needed? Yes _____ No ___x____

Place Result Graph here

Complete system tests were not performed due to an inability to receive a comprehendible signal from either microphone. Research and purchasing of alternative microphones need to be done before complete system tests can be performed.

Testing Part 2 Sign Off – Conor Murphy Date – 5/14/2013

Hearing Aid Redesign: Test Plans
EE 7: System Test

Date Completed _____

Performed By _____

Part 3 – Test for S3

___ 1. Flash the latest code to the evaluation board

___ 2. connect all of the subsystems together

___ 3. Ensure batteries are charged, charger circuit is correct, and amplification and filtering is in place

___ 4. Check that the microphones and speaker are connected, as well as the switch.

___ 5. Place the microphones and speaker inside of the audiologist test equipment

___ 6. Set mode to max gain

___ 7. Run a scenario and observe the maximum gain of the hearing aid

___ 8. Compare the result of the scenario to that of a known good hearing aid

Summary of Data

Were we able to meet the maximum amplification? Yes _____ No ___x__

Are modifications to the algorithm needed? Yes _____ No ___x____

Place Result Graph here

Complete system tests were not performed due to an inability to receive a comprehendible signal from either microphone. Research and purchasing of alternative microphones need to be done before complete system tests can be performed.

Testing Part 3 Sign Off - Conor Murphy Date 5/14/2013

Hearing Aid Redesign: Test Plans
EE 7: System Test

Date Completed _____

Performed By _____

Part 4 – Test for S4

___ 1. Flash the latest code to the evaluation board

___ 2. connect all of the subsystems together

___ 3. Ensure batteries are charged, charger circuit is correct, and amplification and filtering is in place

___ 4. Check that the microphones and speaker are connected, as well as the switch.

___ 5. Place the microphones and speaker inside of the audiologist test equipment

___ 6. Run a scenario that will test at the limits of the frequency ranges to see hearing aid response

___ 7. Compare the result of the scenario to that of a known good hearing aid

Summary of Data

Were we able to amplify the necessary frequencies? Yes _____ No __x___

Are modifications to the algorithm needed? Yes _____ No ___x____

Place Result Graph here

Complete system tests were not performed due to an inability to receive a comprehendible signal from either microphone. Research and purchasing of alternative microphones need to be done before complete system tests can be performed.

Testing Part 4 Sign Off - Conor Murphy Date 5/14/2013

Hearing Aid Redesign: Test Plans
EE 7: System Test

Date Completed _____

Performed By _____

Part 5 – Test for S7

___ 1. Connect all of the subsystems together

___ 2. Ensure batteries are uncharged, charger circuit is correct, and amplification and filtering is in place

___ 3. Check that the microphones and speaker are connected, as well as the switch.

___ 4. Plug the USB Cable into the battery charger

___ 5. Measure the battery voltage as the charging begins

Summary of Data

Did the Batteries start charging? Yes _____ No _____

Did they hold a charge Yes _____ No _____

Complete system tests on the battery charger were not performed due to the recharging circuit not functioning. Research and purchasing of alternative recharger chips, as well as the designing of a new recharging circuit, need to be done before complete system tests can be performed.

Testing Part 5 Sign Off - Conor Murphy Date 5/14/2013

Hearing Aid Redesign: Test Plans
EE 7: System Test

Date Completed _____

Performed By _____

Part 6 – Test for S5

___ 1. Connect all of the subsystems together

___ 2. Ensure batteries are uncharged, charger circuit is correct, and amplification and filtering is in place

___ 3. Check that the microphones and speaker are connected, as well as the switch.

___ 4. Plug the USB Cable into the battery charger

___ 5. Measure the battery voltage as the charging begins, start timing

___ 6. When batteries are fully charged stop timing. Record time to charge

Summary of Data

Was the time to charge acceptable? Yes _____ No _____

What was the time to charge? _____

Complete system tests on the battery charger were not performed due to the recharging circuit not functioning. Research and purchasing of alternative recharger chips, as well as the designing of a new recharging circuit, need to be done before complete system tests can be performed.

Testing Part 6 Sign Off - Conor Murphy Date 5/14/2013

Hearing Aid Redesign: Test Plans
EE 7: System Test

Date Completed _____

Performed By _____

Part 7 – Test for S12

___ 1. Connect all of the subsystems together

___ 2. Ensure batteries are fully charged, charger circuit is correct, and amplification and filtering is in place

___ 3. Check that the microphones and speaker are connected, as well as the switch.

___ 4. Set hearing aid to a mode that will use the most power

___ 5. Measure the battery voltage and plug them into the hearing aid

___ 6. Start timing, and monitor the battery voltage

___ 7. When the batteries are fully drained stop timing

___ 8. Record the worst case battery life

Summary of Data

Was the battery life of the hearing aid acceptable? Yes _____ No _____

What was the battery life in this worst case? _____

Do changes need to be made to extend the battery life? Yes _____ No _____

If so list any possible changes here:

Complete system tests on the battery charger were not performed due to the recharging circuit not functioning. Research and purchasing of alternative recharger chips, as well as the designing of a new recharging circuit, need to be done before complete system tests can be performed.

Testing Part 7 Sign Off - Conor Murphy Date 5/14/2013

Hearing Aid Redesign: Test Plans

EE 8: Backup Battery System

Date Completed 4/30/2013

Performed By- Conor Murphy

Specifications Tested

Specification	Description	Ideal	Marginal
S12	Battery life at max. Amplification	<48	<16

Revision History

Revision	Description	Date
1	Document Created	5/3/2013
2	Document updated to completion	5/3/2013

Equipment

___ Backup Charger Board
___ Batteries
___ Breadboard
___ Multimeter

Sections

- Part 1: Test Backup Battery Charger Board for Correct Operation

Hearing Aid Redesign: Test Plans

EE 8: Battery Charger Test

Date Completed - 4/30/2013

Performed By – Conor Murphy

Part 1 – Test Battery Charger for Correct Operation

___ 1. Wire up the charger circuit on the breadboard

___ 2. Connect the batteries

___ 3. Double check that the circuit is correct

___ 4. Apply the correct input voltage to the circuit

___ 5. Probe the circuit with the multimeter checking test point voltages

___ 6. Ensure the circuit is providing the proper output voltage

___ 7. Apply a test load to ensure the circuit is able to supply enough current.

Summary of Data

Did the backup battery charger output the correct voltage? Yes _x__ No ____

Was the circuit able to provide enough current to the test load? Yes _ __ No __x__

The circuit was only able to provide ~20mA of current at 2V to the test load. It is believed that this is due to the inability of the single battery to provide enough current at the boosted voltage.

Hearing Aid Redesign: Test Plans

Testing Part 1 Sign Off - Conor Murphy Date – 5/7/2013