Test Plan v0.1

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1b	Verify detection of contact and initial brainwaves after the device is attached to the head.
2b	Verify detection of sleep stage accumulation and user wakeup.
3b	Verify device powers down on loss of head contact.
4b	Verify battrey life requirements.

	Test Author:	Julia Filipchuk	***Test ID:***	1	
	Test Case Name:	Verify small signal amplification through amplifier stages.	***Type:***	☑	White Box
	Description:	Generate a small intensity signal to test the amplification range of the device circuits. We will use a function generator in combination with a voltage divider to generate peak to peak signals of ~1uV and ~20uV. Check amplification is 23 after AD620 stage, 598 (23*26) after stage 1, and 15548 (23*26*26) after stage 2 filter/amplifier. [' 1.0µ', expect, ' 23.0µ', ' 0.598m', ' 15.5m'] [' 20.0µ', expect, ' 0.46m', ' 12.0m', ' 311.0m']		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Device with function generator connected to attenuated input. Function generator outputing a sin wave at 30 Hz. Scope available for signal verificaiton. Power supply for board power.			

Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Enable power to board.	Check supplied current is reasonable.	☐	☐	
2	Connect to attenuated input 1.	N/A	☐	☐	
3	Measure output of AD620.	Expect ~23µV peak-to-peak signal strength.	☐	☐	
4	Measure output of stage 1 filter.	Expect ~598µV peak-to-peak signal strength.	☐	☐	
5	Measure output of stage 2 filter.	Expect ~15.5mV peak-to-peak signal strength.	☐	☐	
6	Connect to attenuated input 2.	N/A	☐	☐	
7	Measure output of AD620.	Expect 0.46mV peak-to-peak signal strength.	☐	☐	
8	Measure output of stage 1 filter.	Expect 12.0mV peak-to-peak signal strength.	☐	☐	
9	Measure output of stage 2 filter.	Expect 311mV peak-to-peak signal strength.	☐	☐	
	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	2	
	Test Case Name:	Verify frequency response through filter/amplifier stages.	***Type:***	☑	White Box
	Description:	Generate a range of input frequencies to test frequency response. High pass cut-off frequency is 0.16Hz. Low-pass cut-off frequency is 47 Hz. Expect 0.5 of Vpp at cut-off frequencies. With two filter stages 1/sqrt(2) *1/sqrt(2) = 0.5 total attenuation.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Device with function generateo connected to attenuated input 2. Power supply connected to board. Output voltage constant. Scope at output of stage 2 filter.			

Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Enable power to board.	Check supplied current is reasonable.	☐	☐	
2	Connect to attenuated input 2.	N/A	☐	☐	
3	Generator frequency to 47 Hz.	Output voltage is ~50% of 311mV (156mV).	☐	☐	
4	Generator frequency to 20 Hz.	Output voltage is ~100% of 311mV..	☐	☐	
5	Generator frequency to 0.16 Hz.	Output voltage is ~50% of 311mV (156mV).	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	3	
	Test Case Name:	Verify bias removal from reference probe.	***Type:***	☑	White Box
	Description:	Verify bias is removing noise via the reference probe. Use the function generator a noisy wave and mirror of that same noise. Use the noise as the reference probe.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Device board with external power supply. Probes connected to head with earclip to bias. Output of filter stage 2 to scope. Function generator channel 2 attached to bias.			
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Disconnect earclip.	View output on scope as baseline.	☐	☐	
2	Connect earclip.	Verify output on scope improves as noise is removed.			
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	4	
	Test Case Name:	Verify visible muscular and brain waves through scope.	***Type:***	☑	White Box
	Description:	Verify visible electromyography (EMG) muscular response and electroencephalogram (EEG) brain waves through amplifier stages.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Device board with external power supply. Probes connected to head with earclip to bias. Output of filter stage 2 to scope.			
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Verify baseline waves on scope.	Baseline should be int mV range with only low frequencies.	☐	☐	
2	Conduct Forehead scrunch.	Notice EMG signal on the scope.	☐	☐	
3	Conduct Forehead scrunch.	Notice EMG signal on the scope.	☐	☐	
4	Conduct Forehead scrunch.	Notice EMG signal on the scope.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	5	
	Test Case Name:	Verify ADC sampling.	***Type:***	☑	White Box
	Description:	We will verify sampling data correctly with the ADC. We will generate an input wave and record the sampled signal. Check the recorded signal has expected values.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Beaglebone board with external power supply. Input into ADC connected to funct			
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Generate input sin 0-3V @ 30Hz.	N/A	☐	☐	
2	Record 30s.	Recording should have benn created.	☐	☐	
3	Compare recording to input.	Recording should match input.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	6	
	Test Case Name:	Test input impedance of probes using a known working system.	***Type:***	☑	White Box
	Description:	Test probes are able to measure data on a working system. We will use the OpenBCI system to verify probes are usible to record brain signals.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Connect probes to OpenBCI system and earprobes. Probes on forehead with earclip attached.			
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Observe recording on OpeBCI system.	Confirm brainwaves are detectible with probes.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	7	
	Test Case Name:	Verify the sound notification component.	***Type:***	☑	White Box
	Description:	Use a test program to generate the range of tones we will use for the device. Confirm all are heard clearly.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Device with speaker circuit connected. External power supply to board.			
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Start tone test program.	N/A	☐	☐	
2	Wait for next tone.	Confirm contact tone plays.	☐	☐	
3	Wait for next tone.	Confirm ready tone plays.	☐	☐	
4	Wait for next tone.	Confirm error tone plays.	☐	☐	
5	Wait for next tone.	Confirm disconnect tone plays.	☐	☐	
6	Wait for next tone.	Confirm wake-up tone plays.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	8	
	Test Case Name:	Verify the detection of contact by the device.	***Type:***	☑	White Box
	Description:	Verify detection of contact by capacitive touch to the device. Utilize a test program that plays a tone when contact is detected past a threshold. Test condition with simulated sweat as well as a clean forehead. Test for no false positives in a cloth bag.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:				
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Turn on device.	No tone is played after 1 minute.	☐	☐	
2	Place device on forehead.	Device makes notification tone within 1 second.	☐	☐	
3	Remove device.	N/A	☐	☐	
4	Spray salt water on forehead.	N/A	☐	☐	
5	Place device on forehead.	Device makes notification tone within 1 second.	☐	☐	
6	Place device into bag. Shake.	No tone is played after 1 minute.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	9	
	Test Case Name:	Verify detection of brain waves, sleep stages, and accumulation	***Type:***	☑	White Box
	Description:	Use a recorded sleep session into our sleep stage detection algorithm. Play into the device and expect sleep stages to match. Verify sleep stages accumulate total sleep and wake is triggered.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:				
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Run algorithm on recorded file.		☐	☐	
2	Before sleep data.	Brainwaves but not sleep detected. Wake detected.	☐	☐	
3	At sleep.	Stage N1 detected.	☐	☐	
4	At deeper sleep.	Stage N2 detected.	☐	☐	
5	Later.	Accumulation of N1, N2 stages trigger wake-up.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	10	
	Test Case Name:	Verify device records detected brainwaves during a session.	***Type:***	☑	White Box
	Description:	Test if data recording of detected brainwaves functions.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Device must have room on SD card.			
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Connect device to head.	Hear signal device is connected.	☐	☐	
2	Record 40 seconds.	N/A	☐	☐	
3	Scrunch forehead 10 times.	N/A	☐	☐	
4	Record 40 seconds.	N/A	☐	☐	
5	Stop recording.		☐	☐	
6	View recored file.	File should exist on SD card.	☐	☐	
7	View data.	Scrunches should be visible as spikes.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	11	
	Test Case Name:	Verify charging of battery via micro usb connection.	***Type:***	☑	White Box
	Description:	Test if battery can be charged in the system.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Device.			
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Discharge battery.	Measured voltage under rated 3.6 v indicating ~10% charge.	☐	☐	
2	Connect to power.	Battery starts charging.	☐	☐	
3	Wait for 1h.	No fire. Device is still on.	☐	☐	
4	Disconnect power.	Device still on.	☐	☐	
5	Measure battery voltage.	Measured voltage above 3.7 V indicating > 60% charge.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	12	
	Test Case Name:	Verify case water resistance.	***Type:***	☑	White Box
	Description:	Place in a moist tupperware with a moisture test strip inside. Spray with a spray bottle 3x. Leave overnight.		☐	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Case with out main board but with all external connections.			
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Place Test Strip Inside.	Test strip is unactivated (dry).	☐	☐	
2	Close case.	No gaps on case.	☐	☐	
3	Spray 3x with water.	N/A	☐	☐	
4	Close in tupperware container.	N/A	☐	☐	
5	Wait 24 hours.	N/A	☐	☐	
6	Check if test strip has been activated.	Test strip should signal that himidity was low.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	1b	
	Test Case Name:	Verify detection of contact and initial brainwaves after the device	***Type:***	☐	White Box
	Description:	In order to test correct device positioning we will have a user place the device on the forehead. Audible confirmation if in contact and brainwaves in threshold. Audible alert if contact but the brainwaves are undetectable or under threshold.		☑	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Charged device with clean probes.			

Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Place on head.	Listen for contact confimation tone within 10 seconds.	☐	☐	
2	Wait.	Listen for brainwave confirmation tone within 40 seconds.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	2b	
	Test Case Name:	Verify detection of sleep stage accumulation and user wakeup.	***Type:***	☐	White Box
	Description:	Verify core functionality of device. User will take a nap with the expectation that device will take them.		☑	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Charged device with clean probes. Second person to wake user. Tired main device user.			

Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Place device on forehead.	Contact tone.	☐	☐	
2	Device is ready.	Confirmation tone.	☐	☐	
3	User goes to sleep.	N/A	☐	☐	
4	Wait ~20+ minutes.	Device plays wakeup tone after ~10-20 minutes asleep.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	3b	
	Test Case Name:	Verify device powers down on loss of head contact.	***Type:***	☐	White Box
	Description:	Check the device powers off after removing from head contact.		☑	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Breadboard/Solder	***Time:***		
	Test Setup:	Connect device to head and allow it to start recording.			
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Remove device from head.	N/A	☐	☐	
2	Verify power is off.	Power off within 30 seconds.	☐	☐	
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	Result:				

	Test Author:	Julia Filipchuk	***Test ID:***	4b	
	Test Case Name:	Verify battrey life requirements.	***Type:***	☐	White Box
	Description:	Run device on battery for 3 days. Using it for wake-up 6 times.		☑	Black Box
	Tester Name:		***Date:***		
	HW/SW Version:	Manufactured Board in Case	***Time:***		
	Test Setup:	Device in case with strap. Charge device fully. Clean electrodes.			
Step	***Action***	***Expected Result***	***Pass***	***Fail***	***Comments***
1	Wait until sleep.	N/A	☐	☐	
2	Place on forehead.	Device beeps within 30 seconds indicating ready.	☐	☐	
3	Fall asleep.	Device wakes you up in ~20 minutes from you falling asleep.	☐	☐	
4	Place device in bag.	Device is silent.	☐	☐	
5	Wait ~12 hours. Repeat 1-5.		☐	☐	
6	Wait ~12 hours. Repeat 1-5.		☐	☐	
7	Wait ~12 hours. Repeat 1-5.		☐	☐	
8	Wait ~12 hours. Repeat 1-5.		☐	☐	
9	Wait ~12 hours. Repeat 1-5.	Device still functions after 6 uses in 3 days.	☐	☐	
	Result:				