Vortex 2 Real-Time Voice Changing Module
Cyclo-Vocoder Version

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This document explains how to setup your Vortex 2 voice amp, operate it correctly, and use all the features available on the unit.

This package includes:
1) Programmed Vortex 2 voice effects board + interface board
2) 1/8" remote pushbutton cable
3) 1/8" stereo output cable
4) 9V 6AA battery holder
5) hard shell VHS case enclosure

You can also use the following compatible equipment with your voice amp (equipment listed is not all inclusive):

1) Amplified speaker (Radio Shack #277-1008C)   **(GOOD)**

2) Radio Shack PA amp or Newton PA amp from xtremegadget.com

(BETTER)

3) JBL OnTour Ipod speakers

(BEST)

1) Tie-clip electret mic (Radio Shack #33-3013)   **(GOOD)**

2) Directional electret microphone with boom   (Radio Shack #33-3012)
                                                                (BETTER)

3) Nady HM-5U or HM-20U directional headset boom microphone **(BEST)**

SECTION A. - OVERVIEW

Your voice amp transforms your voice in real time to sound like a cylon warrior – transforming your voice using vocoder filter bank technology and shifting your voice effect up/down in pitch, so it replicates the effect heard in the original series.

This Vortex 2 voice changer also features several innovations not found in any other voice amp in its class:

1) 16-bit CD quality output and DSP technology w/ real-time synthesis vocoder.
2) Stereo output – voice + sound fx on left channel, chorus sound fx on right channel
3) Different pitch settings to fine tune your voice effect.
4) Push-to-talk mode, enables voice output and disables external audio fx so you can talk at will.
5) Auto VOX mode automatically disables external sound fx while talking.
6) Digital voice output volume control
7) 6' remote pushbutton cable to control all the boards features with a single fingertip
8) Tunable onboard voice compressor – compression ratios of 1:1 up to 15:1
9) Compatible with all Radio Shack type amplified speakers, OnTour JBL speakers, xtremegadget Newton, etc
10) Uses any electret mic – board even supplies phantom mic power

The voice board will run off any DC power supply from 6V-18V. A 9V battery is sufficient to use, but may not last long. Use alkaline batteries or lithium batteries for added life. You can also use a 6AA battery pack for extended costuming sessions. *When the batteries are getting low, you will start to hear a high-pitched whine emanating from the speaker.* This is your cue that the batteries need replacing soon!

NOTE: Handle your board as you would any piece of delicate electronics! Do not get it wet and do not handle it without grounding yourself first! Even a static shock can destroy the delicate components on the board. I suggest when installing the board, insulate it with non-static foam, hot glue, or other material. Handle the board around its edges when moving it. We are not responsible for boards that are rendered useless by improper handling.

If you are not familiar with static electricity handling procedures, please refer to ESD procedures. Basic information on ESD can be found here: http://en.wikipedia.org/wiki/Electrostatic_discharge

This unit contains very sophisticated software that requires you to follow the setup procedures in order to get the best performance from the voice amp. PLEASE READ!!!
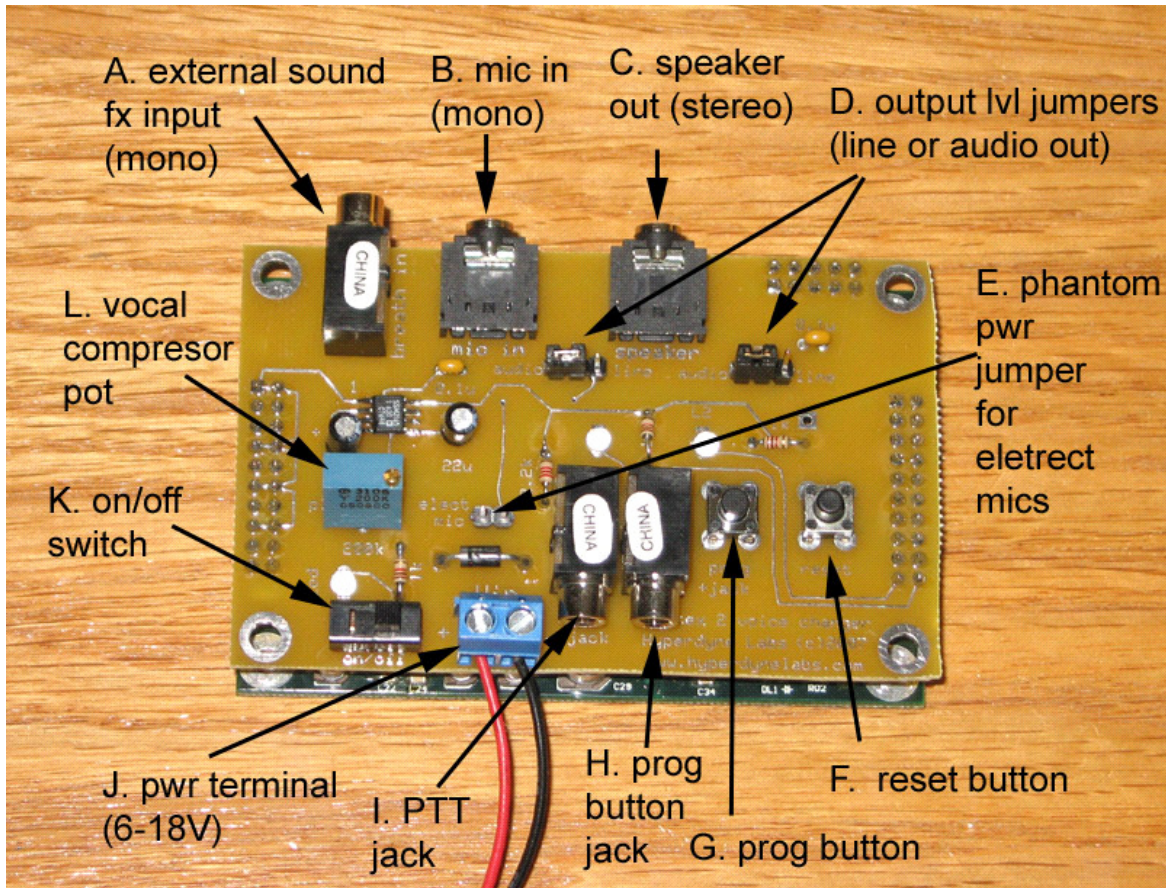
BOARD DIAGRAM

VORTEX 2
Real-Time Voice Changing Module

2.2"

1"

3.4"

dims are in inches
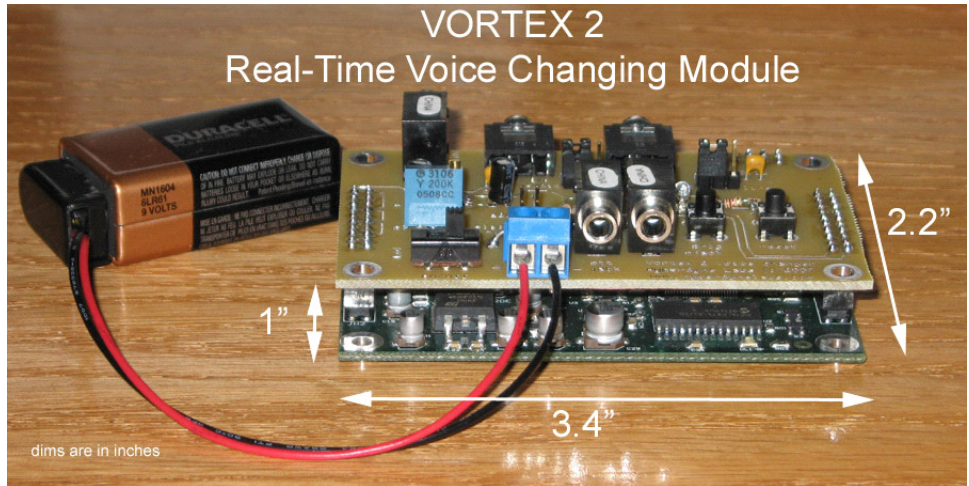
The dimensions of the Vortex 2 module are (not including battery or cables): 3.4" L x 2.2" W x 1" H.

The Vortex module consists of two boards, the upper INTERFACE board and the lower PROCESSING board. The two boards are sandwiched together using header pins. The boards must not be separated, as both are necessary for proper operation!

Here is a picture of the Vortex 2 unit with all of the major parts listed on the INTERFACE board.

A. external sound fx input (mono)
B. mic in (mono)
C. speaker out (stereo)
D. output lvl jumpers (line or audio out)
E. phantom pwr jumper for eletrect mics
L. vocal compresor pot
K. on/off switch
J. pwr terminal (6-18V)
I. PTT jack
H. prog button jack
G. prog button
F. reset button

A. External sound effects input jack – 1/8" mono input jack for an external eye warble sound or other sound effect.
B. Mic input jack – 1/8" mono input jack for microphone.
C. Output jack – 1/8" stereo output jack for voice and sound fx output. Connect to an external amp/speaker.
D. Output level jumpers – Selects line-level or audio level output mode.
E. Jumper to enable phantom power for non-powered electret mics
F. Reset button – for rebooting system
G. Programming button – Allows user to change board settings and features
H. Programming jack – 1/8" mono jack that accepts remote pushbutton cable so user can remotely change board settings and features (operates the same as prog button).
I. PTT jack – 1/8" mono jack that controls push-to-talk feature. Can be used with remote pushbutton cable.
J. Power terminal block – Accepts 6-18V DC power source. Polarity: + on left, - on right
K. On/off switch
L. Vocal compressor pot – Turning pot screw changes the amount of compression applied to mic input

There are also 3 LEDs on the Vortex module for power and status.
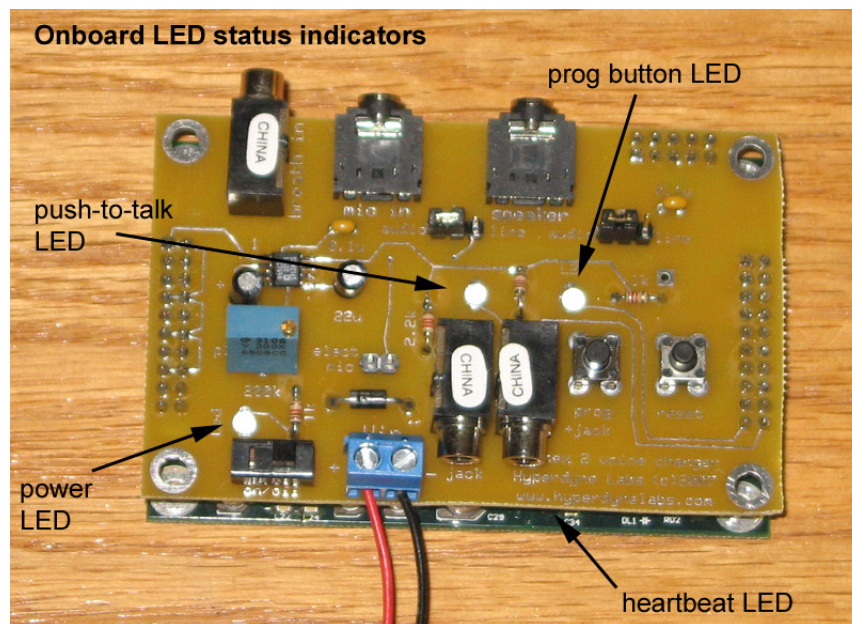
- When PTT mode is enabled, the push-to-talk LED will light up when the mic is "open". The LED will go off when the mic is "closed".
- When PTT mode is disabled, the PTT LED will light up when your voice surpasses the auto VOX threshold.
- The programming LED will light up each time you depress the programming button. When no button presses are detected within 1 sec, the board will update the feature selected and blink this LED to let the user know the EPROM memory onboard has been updated.
- The power LED lights when the board has power and is on.
- The heartbeat LED is located on the lower PROCESSING board and blinks once per sec. if the board is operating properly.

SECTION B. – BASIC SETUP AND OPERATION

Microphone setup:

Plug in your microphone and amplified speaker using an 1/8" cable. If you already own a Radio Shack amplified speaker (#277-1008C or the common black PA speaker), you can use this with your unit. You may have to dial down the output volume in order to avoid too much feedback. See Section C on how to do this.

If you are using an electret mic that **DOES NOT** have an external battery (like a computer mic), you will have to use the shorting terminal to enable power to the electret mic. See the below pic for details on how to do this. If you have a mic that has an external battery and on/off switch (similar to Radio Shack #33-3012 or #33-3013), you can leave the 2 gold pins on the board disconnected. By shorting these two gold pins together, you are providing power to the mic.
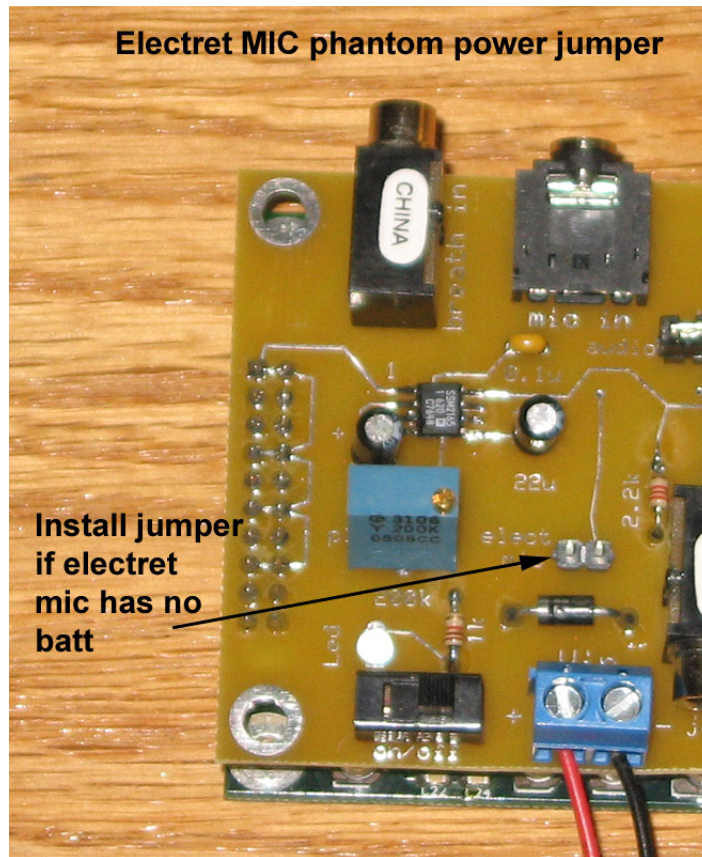

NOTE: A condenser mic will not work with the board, as the output will be too low for you to hear.
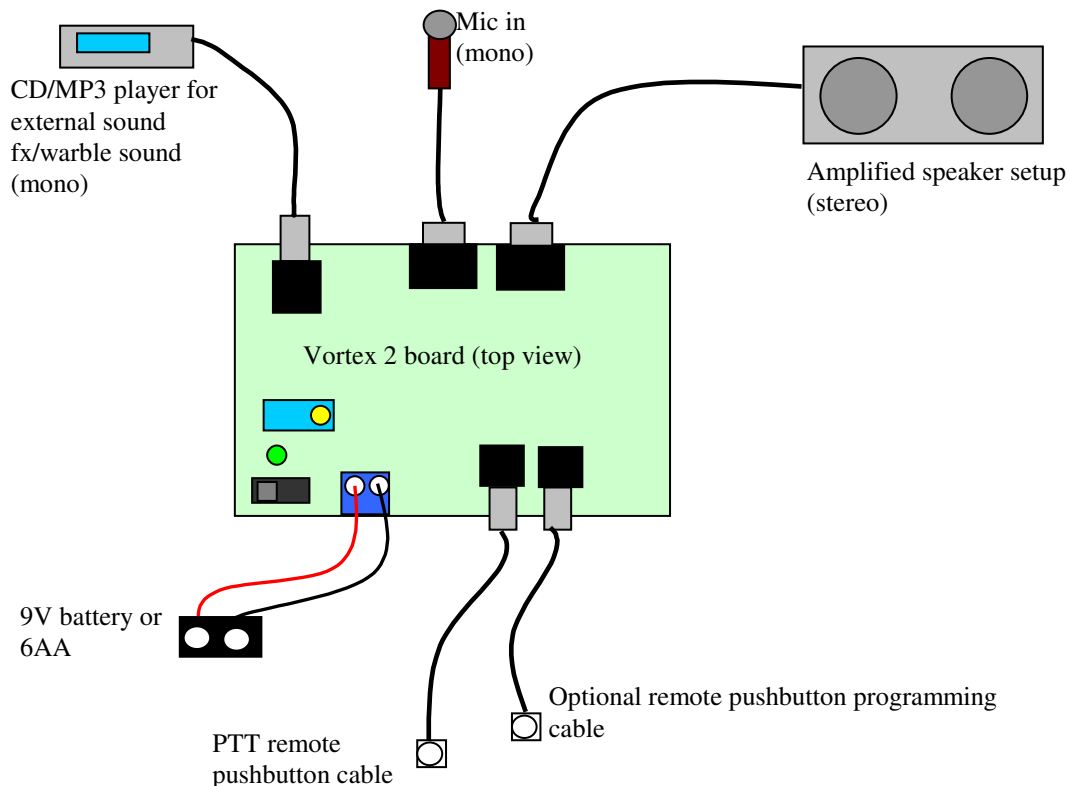
The output level jumpers on the board allow you to select one of two output levels – line out or audio out. By default the audio output level is selected. Move the jumpers over the 2 pins to select the output level you would like to use.

Line out is a lower level output and is better suited for equipment that needs a lower level input. Audio level is good for most amplified speakers and preamp type equipment. The below diagram shows the jumper positions to select each output level (filled-in circles denote jumper over those pins).

Audio level selected

Line level selected
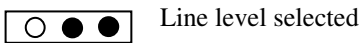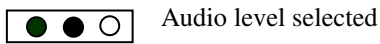
Hooking all the components up:

Here is a diagram of how to connect up all the different jacks to your equipment.

Mic in
(mono)

CD/MP3 player for
external sound
fx/warble sound
(mono)

Amplified speaker setup
(stereo)

Vortex 2 board (top view)

9V battery or
6AA

Optional remote pushbutton programming
cable

PTT remote
pushbutton cable

SECTION C. – CHANGING BOARD SETTINGS AND OPERATION

This section outlines how to change any of the settings for the board.

The voice amp has 6 functions that are controlled by the onboard pushbutton. These functions are included to help mitigate feedback and to enable different features. The programmable settings are:

1) PTT enable/disable
2) Enable/disable external sound effect mixed in with voice
3) Change the amount of pitch applied to voice
4) Enable/disable the auto VOX circuit for controlling the external sound fx output
5) Change output volume (digital)
6) Change auto VOX threshold for external sound fx cutoff
7) Reset all saved parameters to default

NORMAL OPERATING MODE

When you turn on the unit, the voice changer becomes active. When you talk the unit will automatically vocode your voice through a proprietary filter bank and pitch your voice up or down. This will make your voice sound like a cylon! The amount of pitch shift and vocoder parameters were carefully researched and calibrated to match the actual voice effect.

Cylons also talked in a very monotone voice. Try this as well and speak very clearly. The vocoder effect works best when you annunciate each word slowly and clearly. Fast talking will make you very difficult to understand. You will find that by fine tuning your own voice, you can achieve the spirit of the cylon speech much more readily. Perfecting these intricacies will transform your voice effect from good to great!

The onboard programming pushbutton (or using the remote cable w/ button) allows you to set up and use the features of the board. When the unit is installed on your costume, you can use the remote programming pushbutton to enable/disable features of the board.

Each feature on the board is triggered by pressing the programming button the desired number of times. Below is a table outlining each feature.

NOTE: If any of the settings are changed, they are automatically saved in EPROM memory, which is not lost after powerdown. Thus you only need to change the setting once, and the unit will remember your settings upon each powerup.

Number of programming button presses	Voice board feature	Default setting
1x	Enable/disable Push-to-talk function (PTT). Enabled = must use PTT button to open mic Disabled = mic always opened	Disabled
2x	Enable/disable external sound effect passthrough	Enabled
3x	Change pitch setting (10 available settings). Table Auto wraps after 10th setting is hit.	Mid pitch
4x	Enable/disable auto VOX playback of external sound effect	Disabled
5x	Change output volume gain (in dB). Table of values: -12dB, -6dB, 0dB, +6dB, +12dB	0dB
6x	Change VOX auto threshold for external sound fx cutoff (8 available settings)	Lowest
8x	Reset EPROM back to default vals	

Setting 1: Push to talk (PTT) mode enable/disable

Pushing the button 1x toggle the PTT mode on and off. PTT mode is off by default. When PTT mode is off, the mic is always opened. The PTT mode disables the mic output so you will only be able to talk through the speaker when you press the remote pushbutton and hold it in. Now the mic will open and allow you to talk.

When you release the button in PTT mode, the mic is automatically closed.   PTT mode is best used if you are experiencing too much feedback and need to mic to close after talking, or if you just want absolute control of when the mic opens and closes (can be used for secure comm also). Pushing the programming button 1x again will disable PTT mode.

NOTE: When the mic opens in PTT mode the external sound effect will be disabled as well. This allows you to have maximum voice volume without the external sound fx interfering. If you prefer to have the sound fx always mixed in with your voice (for example the eye "warble" sound), you can disable PTT mode which will keep the mic open and mix in the external sound fx.

TIP: The PTT trigger is run off the second 1/8" jack on the board labeled "PTT jack". This jack is right next to the programming cable jack. You can connect your remote pushbutton cable to this jack if you plan to use the PTT mode in your costume. Also, the PTT LED will go on whenever you press the PTT pushbutton while PTT mode is enabled. This will allow you to see when the mic is opened and closed.

Setting 2: Enable/disable external sound effect mixed in with voice

You can easily add a background or other sound effects that will be mixed in with your voice. For cylons the eye warble sound is the most obvious choice.

The Vortex 2 board has an input jack that allows you to input an outside sound from a CD player, MP3 player, computer sound card, etc. When you connect your source to this input jack, it will be mixed in with the mic input voice.

For best quality, your transformed voice plus the mixed sound effect is output on the **left channel** of the stereo output. The **right channel** contains only the sound effect input from an external source, and it has been digitally delayed by 20ms.

TIP: The combination of the L and delayed R external sound fx allows you to connect up a stereo speaker and create a pseudo-stereo echo effect! Using both channels, the external sound effect will appear more mechanical and give a slight echo, increasing the presence of the sound effect coming out of your stereo speakers.

If you only have one speaker, you can use a stereo combiner to mix both sounds into one output, use a 2nd speaker for the chorus sound effect, or just use the left channel into a single speaker to get the voice + sound effect.

You can enable or disable this external sound effect by pressing the programming pushbutton 2x. The default setting is "on", so any sound piped through the input jack will be mixed in with your transformed voice.

TIP: Be sure to tweak the volume on your external playback device so it sounds best coming out of the Vortex unit. Too much volume will swamp the input and cause it to sound crackly and distorted. If this happens turn down the external volume or turn down the voice gain (setting 5 below).

Setting 3: Changing pitch setting

There are 10 different settings to help match your voice to right pitch of the cylon vocoder voice. If the default setting does not give your vocoded voice the proper shift, you can use the remote button cable to increase the pitch up to 10 settings. The pitch wraps around after 10 presses so you can search for the best effect using your voice with the board.

Setting 4: Enable/disable auto VOX for external sound effect

Pressing the programming button 4x will enable and disable the auto VOX feature for playback of the external sound effect. This feature is useful if you are not using PTT mode, but would still like the external sound effect to cut off automatically while you are talking. Enabling this feature will do that for you. When the mic hears any activity above a preset VOX threshold, it will automatically turn off the external sound fx. When the mic input drops in volume once again, the unit will pass the external sound through the speaker again. The default value is "disabled", which means the external sound is always output (if it is enabled via setting 2).

NOTE: You can tell if the auto VOX is picking up any mic activity by observing the PTT LED. When you are not in PTT mode, this LED will light when your voice volume passes the VOX threshold (see Setting 6).

Setting 5: Changing output volume gain

Pressing the programming button 5x will change the output volume of your voice. If you are using a different speaker setup, this feature will allow you to increase or decrease the output volume to better match your input amplifier expectations. The volume table has values of -12dB, -6dB, 0dB, +6dB, +12dB. The default setting is 0dB (no gain).

Every time you change the output volume (by pressing the button 5x), the volume advances through the table one setting at a time. If your voice is distorting too much, popping, or sounds bad try to lower the output volume. If you are having trouble hearing the speaker output, try increasing the output volume.

NOTE: This setting does not affect the sound fx volume on the L or R channel, as you should change that volume input using the external source's volume control.

Setting 6: Changing the auto VOX threshold for external sound effect

Pressing the programming button 6x will increase the VOX voice threshold. This is also known as the squelch point. When you talk into the mic, you voice volume must surpass this threshold before the external sound effect is automatically disabled (see Setting 4). This is used in conjunction with Setting 4, as enabling Setting 4 will activate the VOX threshold logic.

The higher the VOX threshold setting, the more voice volume you need to trigger the auto breath cutoff per Setting 4. The default setting is the lowest VOX threshold. If background noise is cutting the external sound effect in and out, increment this setting by one level and try again. There are 8 VOX threshold values you can cycle through, each one is higher than the last one. After the last value is selected, the next VOX threshold change cycles back the lowest in the table. This way you can cycle through all values to find the best threshold for your mic.

NOTE: You can tell if the auto VOX is picking up any mic activity by observing the PTT LED. If you blow into the mic with PTT mode disabled, this LED will light up when the mic input surpasses the current VOX threshold. The LED will go off when no voice input is detected. If the LED is always on then your mic is too sensitive and you should try and increase the VOX threshold. If the LED is never on, the VOX threshold may be set too high or you may have a faulty mic, input jack, etc.

Setting 8: Reset all settings to default

Pushing the button 8x will reset all the saved settings back to their default values. If you ever want to reprogram the user settings for your board (as outlined in Section C), or just go back to the default settings, this feature allows you to do that.

BUTTON PROGRAMMING NOTE: Every time a new setting is saved to EPROM, the board will blink the programming LED briefly to inform you the save was successful.

# SECTION D. – VOICE COMPRESSOR FEATURE AND TROUBLESHOOTING

Below is a pic of all the tunable potentiometers on the board, with their functions listed.

NOTE: The potentiometer on the board requires 20 full turns in order to span the entire range.

Changing voice compression:

The mic input goes through a voice compressor. A compressor makes all of your words the same volume, resulting in a more "in your face" effect. If you have ever listened to a movie commercial, the announcer that has a very pronounced voice with equal volume for all words. This is a good example of vocal compression.

To increase compression, turn the pot screw clockwise. To decrease it, turn the pot counter-clockwise. The below pic shows this:
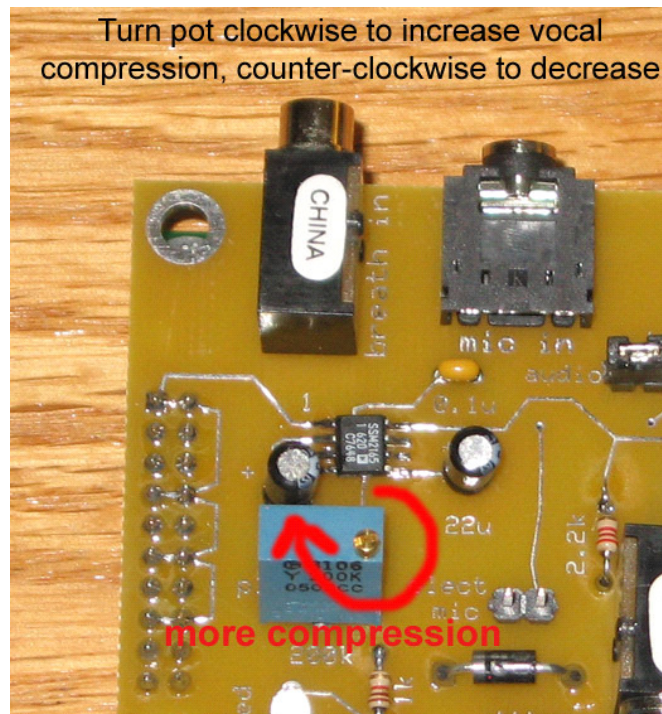
More compression results in softer spoken words receiving more gain, making them sound louder. Loudly spoken words are gained down some. There is also a limiter, which limits the output of the mic. So if you yell into the mic,

the output is well behaved and still discernable. A vocal compression of 1:1 is equivalent to normal speaking. A maximum vocal compression of 15:1 provides a large amount of vocal gain, giving the"in your face" effect. More compression is also good if the mic is farther from your mouth than normal. If the mic is far away, then the compressor will amplify the mic signal more. The correct amount of compression can also make your words more legible to outsiders, since volume between all words is maximized.

To increase the compression, turn the screw on the compression pot clockwise as shown. This will increase the compression from 1:1 up to 15:1. So, each turn of the screw will give you an increase of around 1x:1. Turning the screw counterclockwise will decrease compression.

NOTE: If you have set the vocal compression very high, a side effect is more feedback howling. This is because the gain of the mic on low level signals is greatly amplified, causing more feedback to happen when the mic is open and you are not talking. This is a tradeoff that needs experimentation to get right. If you are experiencing way too much feedback, then back off the vocal compression until it subsides or opt for using the PTT mode.

TIP: If you want to hear the effect of different compression settings, connect the Vortex 2 speaker output to your computer's sound card input. You can record several vocal passages using several different compression settings. You will be able to hear the difference in vocal volume over your passage by playing back the different recordings.

Mic placement issues

For the tie-clip mic (Radio Shack #33-3013), I have found it best to place it right under your lower lip. This gives you maximum sensitivity and loudness. Experimentation will give the best results. If you use the boom mic (#33-3012), the headset is more comfortable and can be worn under your helmet. The boom mic also has a unidirectional mic, which will help reduce feedback. The tie-clip mic has an omnidirectional mic, which gives better voice pickup but increases potential feedback. You will get more voice gain with the microphone right in front of your lips. So if the output voice is not loud enough, an easy solution is to try and bend the mic boom so the mic tip is as close to your lips as possible!

Feedback troubleshooting

If you are having problems with feedback, you will have to try one or more of the following:

1) Use PTT mode
2) Move the mic farther away from the speaker
3) Turn the volume down on the amplified speaker
4) Turn down the vocal compression - a 1:1 compression will result in less feedback.
5) Use a directional microphone, such as the Radio Shack boom mic model #33-3012

TIP: The closer the mic and speaker are, the worse this feedback is. Even if you eliminate feedback in this extreme case, the slightest movement of your head will cause a new feedback path. As the speaker and mic are separated, you will have more "leeway" in your head movement before feedback ensues.

This unit has its own natural feedback attenuator. If you turn up the speaker volume too much, or move the mic too close to the speaker, you will begin to hear a strange reverberant type noise. You must lower the volume or place the speaker farther away from the mic. Otherwise you risk having the unpleasant sounds continue, which is known as feedback.

Feedback is caused by the output of the speaker being picked up by the mic, and that sound amplified over and over, until the amplifier "howls" or otherwise makes unpleasant noises. You should experiment where to place the speaker and mic in order to find the "sweet spot" in your setup. The anti-feedback mechanism in the software can only handle a certain amount of feedback. You must remember that feedback always exists. Physical placement of the mic and speaker are the main variables in combating feedback. Feedback also increases when you put a helmet on your head, so some trial and error is necessary to find the best configuration and mic/speaker placement. Using the

boom mic will also help with feedback since it is a unidirectional mic. The easiest way to combat feedback is to lower the volume until it disappears. Also, separating the mic and speaker will reduce feedback immensely.

Also, as a stopgap measure for complete feedback mitigation you can close the mic and open it manually by enabling PTT mode. This feature rids of any feedback that you would normally hear when the volume is up too loud or if the mic were constantly "open".

Remember, feedback is always there, it is just a matter of how much you can attenuate it. Feedback is also directly proportional to volume, so the more you turn up your speaker, the more feedback you will experience. Our Vortex voice amp is the only unit capable of tackling difficult feedback paths by using advanced algorithms.

PROTECTING THE UNIT

If you are mounting the unit inside your helmet, **you want to make sure you do not get it wet**. That includes condensation, sweat, etc. These things can short out the board and render it inoperable. A good way to protect the board is to use epoxy, hot glue, or even heat shrink wrap. If you boards gets wet or stops operating, turn it off and let it air dry completely before turning it back on. You can also mount the boards inside a plastic project box to protect them.
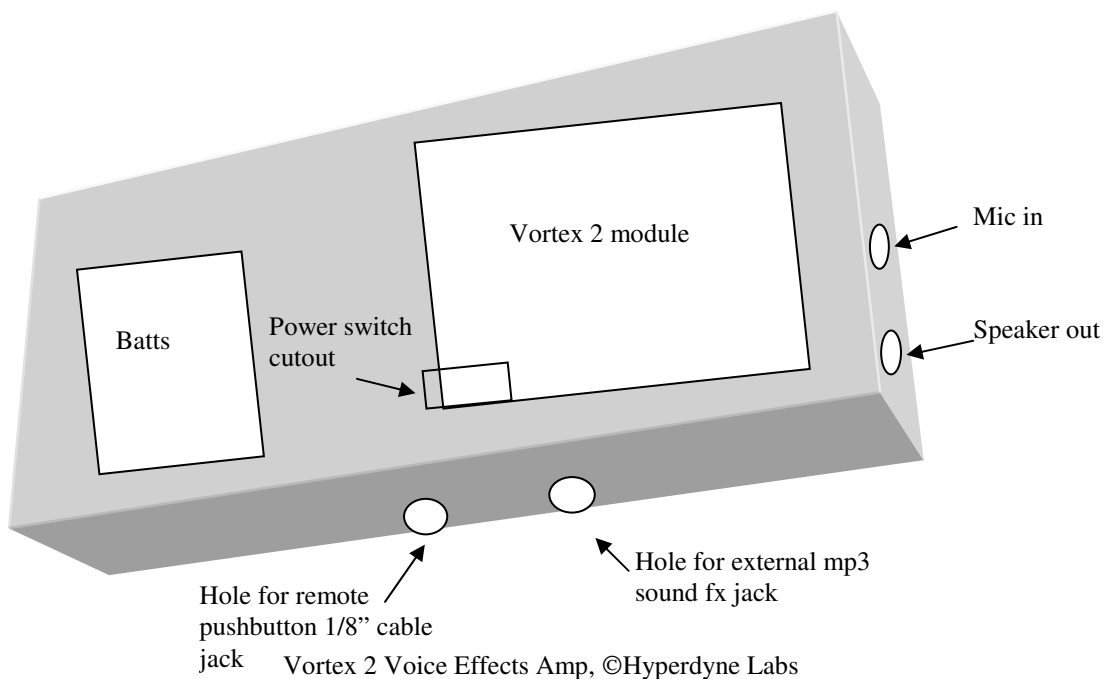
TIP: A good idea is to also use a pack of dessicant inside the project box to absorb and moisture that makes it way into the box.

TIP: Radio Shack project box #270-1803 (box dims are 5x2x2.5") is one enclosure that will house the unit. You can also use the slim line hard shell VHS tape case to store all the electronics and batteries.

Example mountings:

Your Vortex 2 board will fit in a hard shell VHS plastic tape case with room to spare. You can hot glue or mount the boards in the case. This will protect them, and also allow you to mount the entire package on a belt, underneath a cape, etc. You can cut the case with an exacto knife, dremel, drill, etc. The batteries can also be housed in the case so everything is contained.

VHS TAPE CASE INSTALL

Vortex 2 module

Mic in

Batts

Power switch cutout

Speaker out

Hole for remote pushbutton 1/8" cable jack

Hole for external mp3 sound fx jack

TROUBLESHOOTING FAQ

Q: I am experiencing more feedback than my previous system, why?
A: *Feedback for one system is not the same for a different system. Since the gain for different boards is not constant, feedback can increase/decrease for a given speaker/mic configuration you have set up. That is the nature of feedback. If you want to reduce feedback, try repositioning the speakers and mic, turn down the compressor until you have a 1:1 gain, and use a directional microphone. Feedback is a direct function of gain, which includes the compressor gain, the speaker gain (volume), system gain, and distant between mic and speakers.*

Q: My mic is not working, why?
A: *Make sure if you have an UNPOWERED electret mic, makes sure that the 2 header pins are shorted together using the provided shorting block as shown before. If you are using a Radio Shack powered mic, you must remove the shorting block from the 2 header pins.*

Q: I am trying to tune the compressor on the board but am not hearing any significant changes?
A: *When you are tuning the board using the onboard potentiometers, be aware that to go from one end to another, you must turn the pot screw 25 times! So if you are going from max compression to a 1:1 compression, try turning the pot 25 times (full rotations) and then test again. If you are fine tuning the board, try to turn the pot 4 rotations at a time. You should start to hear incremental changes in the voice effect. Turning the pot 1-2 times wont really make much of a difference.*

Any questions, email: hyperdyne@hyperdynelabs.com if you are having difficulties setting up the unit. Good luck and enjoy!!!!