OK, let's get started with our Board of Chuckie (BoC) DMX tutorial.

Recently, I switched over to DMX to run my Skeleton Quartet that I call Sindy Skinless and the Decomposers. It GREATLY reduced the wiring needed, improved the stability of the servos and made setting up and tearing down a 10 minute job as opposed to over an hour in the past. I eliminated lots of equipment and wiring and really simplified the entire setup.

To get started, first, you need to know what you will need to make a DMX system work. I will say that there are MANY different ways to do this, but I will focus on using Brookshire Software's VSA program as the DMX controller, rather than buying expensive stand-alone equipment.

With VSA, you can control servos, individual LEDs, or full lighting systems all within the same program with an easy-to-understand interface and minimal external equipment. Unless you plan to incorporate video into your VSA routines that is controlled by the program, you will not need anything more than the Hobbyist Version.

The DMX servo controller board I chose to use is the BoC from Skulltronix. There are other choices, but to my knowledge, not too many. I know of another one which was designed and built by a member of Halloween Forum. It is called the Medusa Board.

The Medusa board does come with a manual, but since I have not used it, I will not be a whole lot of help with anyone who wants to go that route. I hear that they do provide excellent customer service with the Medusa board, so I'm sure you would get up and running soon if that is your choice.

The reason that I chose the BoC board (They are both the same price) was because I needed a board with at least 14 servo outputs per board. The BoC provides 16 outputs. The Medusa only has 8 servo outputs. For my specific purposes, I would have needed to buy twice as many Medusa boards to do the same thing as BoC boards. I needed 5 BoC boards, but would have needed 10 Medusa boards and my budget did not allow that. If your needs for servo outputs are more modest than mine, you might benefit from some of the other features the Medusa offers that the BoC does not. It has 8 LED Dimmers and 8 general purpose digital outputs. These are switches that can be connected to relays to turn on or off anything you want. The BoC has only 3 LED Outputs specifically made for common anode tricolor LEDs. The Medusa has 8 individual LED outputs that can run 8 Separate LEDs or a couple common cathode tricolor LEDs.

OK, moving on. First, you need to know what other equipment you will need.

Here's a list:

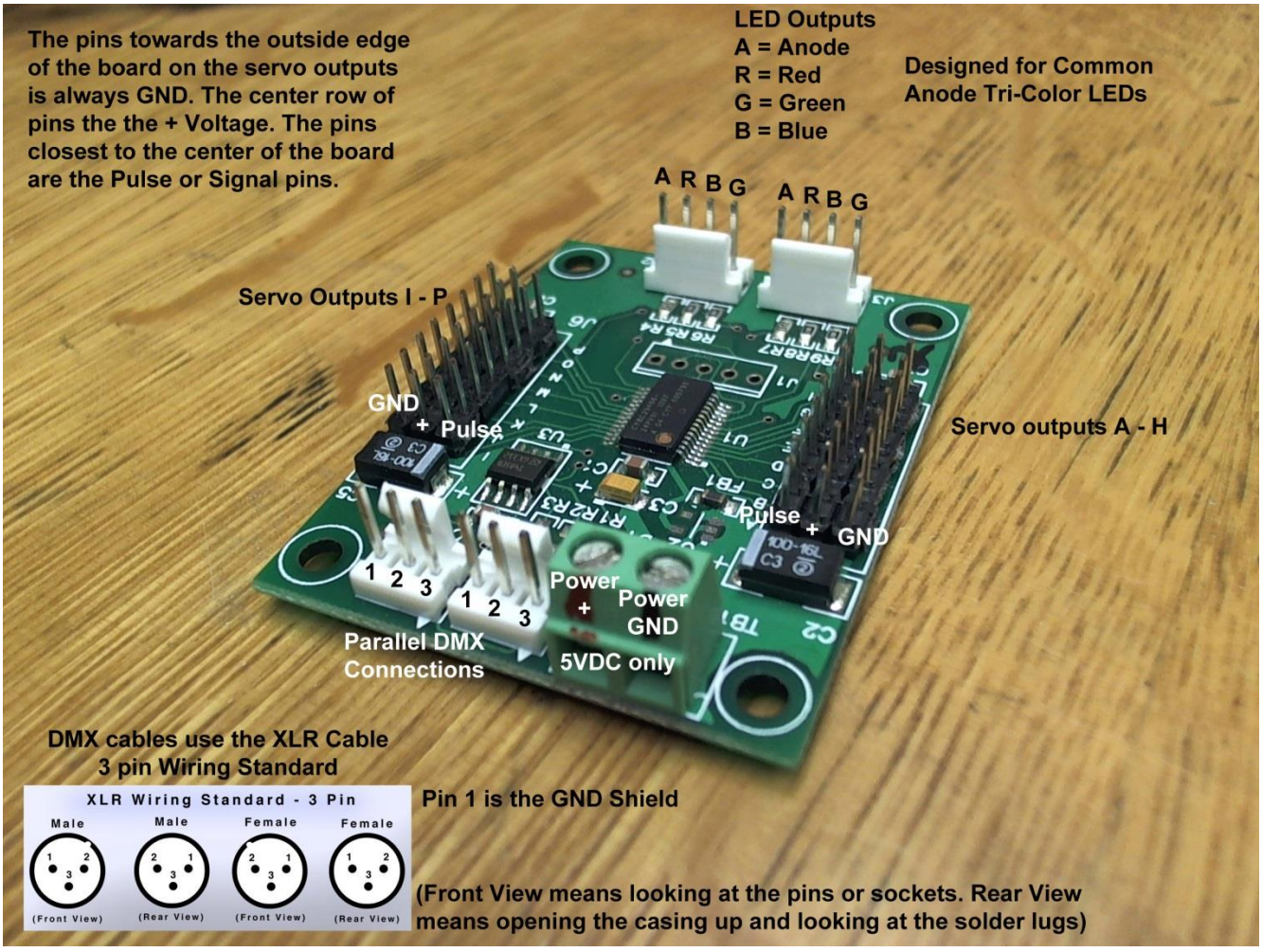
1. You will need a DMX 512 interface.
   The one that VSA works with is the EntTec OpenDMX USB interface pictured here:

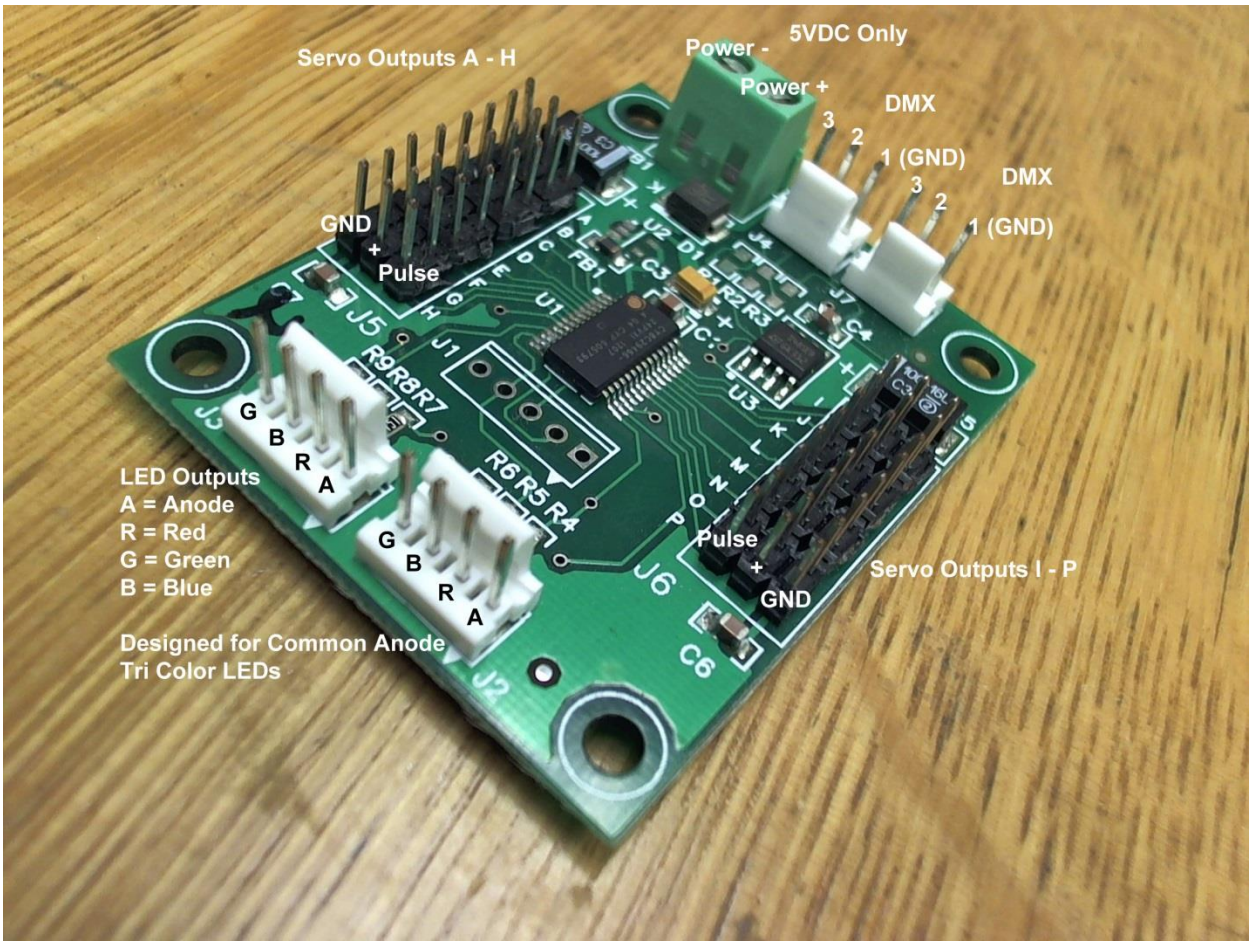
2. You will also need a 5pin to 3pin DMX adapter like this one:

3. Then, you will need as many DMX cables as you will need to connect however many cards you have together. You will need one longer cable to go from the above adapter (Which will be right by your computer) to reach your first prop. If you only have one prop, then that's all the cables you will need. If you have more than one prop, you daisy-chain them together. So you need a cable long enough to reach from the first prop to where your second prop is and so on. I will cover how to connect the cables to the BoC card a bit later. I have heard from others doing this that you can use cheaper, standard XLR cables instead of special DMX cables. These would be ordinary microphone cables. In most cases this might work fine if there isn't a lot of other wiring or power cables mixed in that could affect the cables carrying the DMX signal. Again, this has worked for some people, but is not recommended as DMX cables are shielded better and you could end up getting interference which could give you unpredictable results. I opted for purchasing DMX cables and not taking the chance. You can get your DMX cables just about anywhere. They are all over eBay or anyplace that sells DJ, musician, or Theater equipment will have them.
4. You will need a DMX terminator. At the end of the line, you need a terminator, so that you don't get wacky unexpected results. I have heard from others as well as Jerry Jewel at Skulltronix that the terminator is most-likely not needed unless you are experiencing issues. So most of the time you'll be fine without one, but you never know, and they're pretty cheap so I just went ahead and bought one. You can get these just about anywhere as well. The links I provide are only one source just in case you don't want to do your own research. They don't all look exactly the same but as long as it's a 3 pin DMX terminator, you're fine. The one I listed had the best price I could find.

5. OK, now you need the DMX servo controller board. Again, I chose the BoC which was specifically designed to operate a 3 axis skull with LED eyes and has quite a few extra outputs for things like moving arms or any other servo-driven thing you want to incorporate into your scene. Below are some images of the BoC board that I purchased and I have labeled all the parts so that you know how to hook up what and in what order. There is very little documentation on the BoC as it was developed for Skulltronix use only in their skulls. Enough people wanted to buy them, that they make them available, but they did not make a comprehensive manual to explain everything you need to know to use it. The main advantages over using a board like this instead of the

Lynxmotion SSC-32 servo controller board that I used to use is that you don't have to worry about how far away your prop is from your computer. With DMX, you can have your prop 300 feet away or more with no signal loss. With the SSC-32 you started having servo jitters and issues once you got past 15 or 20 feet. Since all the wiring is done inside each prop, connecting them together is simple with only one three connector cable (The DMX Cable) going in and two power wires. If you have more than one prop, then there is also a DMX cable going out to the next prop, but only one wire that goes from your computer to the scene. The downside that I have seen is that you need to buy one card for every prop. For me that was 5 $90.00 cards which replaced a single $40.00 SSC-32 board. That's a considerable amount to pay, but I am glad I did it. For someone with only a single prop, it will cost you just $50.00 more to go DMX than to use the SSC-32 board, once you have the Enttec open and other extras. There are extra costs to working either way, so if you are starting from scratch, it probably won't add up to much more to decide to go DMX from the get go. If you already have a complete SSC-32 system, then you will be scrapping a lot of what you already paid for and replacing it with new things as I have listed above, but in my opinion, it's worth it. I do ramble a lot, don't I? Here are some pictures of the BoC board as promised:





Now I will tell you the parts that are not in the instructions online for the BoC, but that you need to now in order to make them work. First, here's how you connect your DMX cables to the BoC board. You will notice that there is no XLR connector on the board. Look at the first picture. What I did was to buy a 10 foot long DMX cable for each board. I cut the cable in half. Then I separated the wires and prepared to crimp pins on the wires. To do this on your own, you will need the following things:

1. A crimping tool

2. Pins

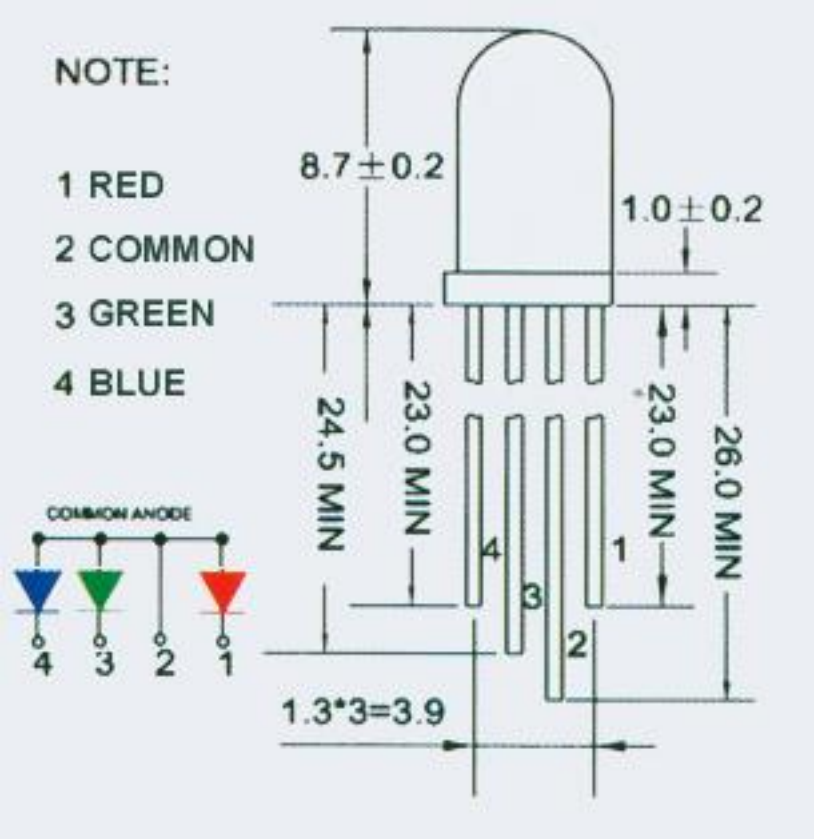
3. A housing that mates to the pins on the BoC.

You need to crimp the pins onto the ends of the two wires that you separated out of the cut end of the DMX cable. Make sure you strip the end of the wire first. Just enough to fit the pin on. Do not crimp over the insulation. You will not make an electrical connection. Then crimp your 3rd pin on the end of the braided shielding (bare ground wire) that is exposed. You can place a piece of shrink wrap over the bare wires first, but since the other two wires have insulation, it's not really necessary. Then slide the pins into the housing in the correct order. To determine this, use an ohm meter to figure out which wire that you have crimped pins on goes to either pin 2 or pin 3 on your connector. Use the chart in the first picture. Take the Male cable end and compare it to the image that says Male (Front View) those are the pin numbers. We already know that pin 1 is the Ground or shield, that is the wire that has no insulation around it. Slide that pin into the housing so that it makes contact with the pin on the BoC board that I have labeled #1. These are parallel inputs so it doesn't matter which one the input is on or which one the output is on. Now whichever one you have identified as either pin 2 or 3, slide that into the housing so that it connects to the appropriate pin on the BoC board and put the last pin in the remaining spot. If you are unsure about which image on the chart you should be looking at, I have labeled the pins in a Male XLR connector in the picture below:

Do the same thing to the other end of the cable you cut in half, only this time measure to find pin 2 or 3 by using the Female Front View image on the chart. OK, OK….I'll post another simplified picture:

Now you have connected the board to these two DMX cable ends which will mate up with the other cables you have purchased and you now have a quick and easy way to connect up and disconnect your props. Plug your terminator into the last connector at the end of your daisy-chain no matter how many are in the chain. If you don't want to buy the crimping tool and the parts I have linked to, you can use shrink wrap and just solder the wires to the pins if you want to do it ghetto style.

6. You will need a 5VDC power supply to run the BoC. It can be the same power supply that powers your servos. It must not be more than 5VDC. You can separate the power for the BoC board and your servo power if you want. I did it because I wanted to send 6VDC to my servos, but can't use more than 5VDC on the BoC. Later, I will show you how to separate the power. For now, we will assume that you have found a 5VDC power supply with a high enough current output (in amps) to drive all the servos you need to drive. As a rule of thumb, allow ½ an amp (500mA) for each servo you want to power. If you are running 10 servos, you want a 5VDC power supply with a 5 Amp output. If you don't want to go out and buy a power supply, use an old one out of a desktop computer. They all have 5VDC outputs (Any Red and Black wire) and plenty of current at the outputs. If you don't know how to power up a computer power supply, look for a green wire on the main plug that goes into the motherboard. Cut that wire and any one of the black wires and tie them together. That is the switch that turns on the power supply. Again, refer to the picture of the BoC board above to see where to connect the power and make sure you get the polarity correct. Use a meter if you're not sure. Connecting it backwards has the same effect as flushing $90.00 down the toilet.
7. Lastly, if you are using LEDs for eyes (or for any other purpose) you will want to hook those up to the BoC with the two 4 pin connections on the opposite side of the board. This board is designed to operate two common anode Tri-color LEDs. One on each output. You do not need to add any resistors or use a special power supply for the LEDs. All that is built into the board. The two outputs are just for convenience because most people are using this for LED eyes and there are 2 of them. The LEDs can not be controlled independently. There are just two sets of pins that are available from the same single output. You can dim the eyes up and down, Strobe them, Mix the colors, anything you want. Referring back to the pictures, I have labeled what each pin goes to on the LED. The pin outputs are not in the same order as the legs that come off a tri-color LED. The order that an LED legs are as follows:



The LED outputs of the BoC board reverse pins 1 and 2 and also reverse pins 3 and 4. It will not work if you connect up an LED directly to the pins without changing the order. If you want to add wire and plugs to run to your LED you can use this part to mate up to the pins on the BoC board:

This housing uses the same pins as the 3 pin one noted earlier in this tutorial.

Once you have connected at least one LED and a few servos, you can start the next step which is programming the BoC board.

To understand why you have to program the servo controller board, you have to understand a bit about how DMX works. As mentioned all your boards (As many as you will ever need) get hooked together in a daisy-chain. The single stream of information flows to and through every board all at the same time. It contains commands for every servo and LED output you have, but each servo has a specific address and each card has a specific range of addresses. So even though the first card is receiving information needed by the 4th card to move a servo, the 1st card ignores it because it was programmed to only listen for commands within its address range.

So this brings us to the Skulltronix BoC Configurator. It is special software developed just for the BoC and SoC boards. Download it and install it.

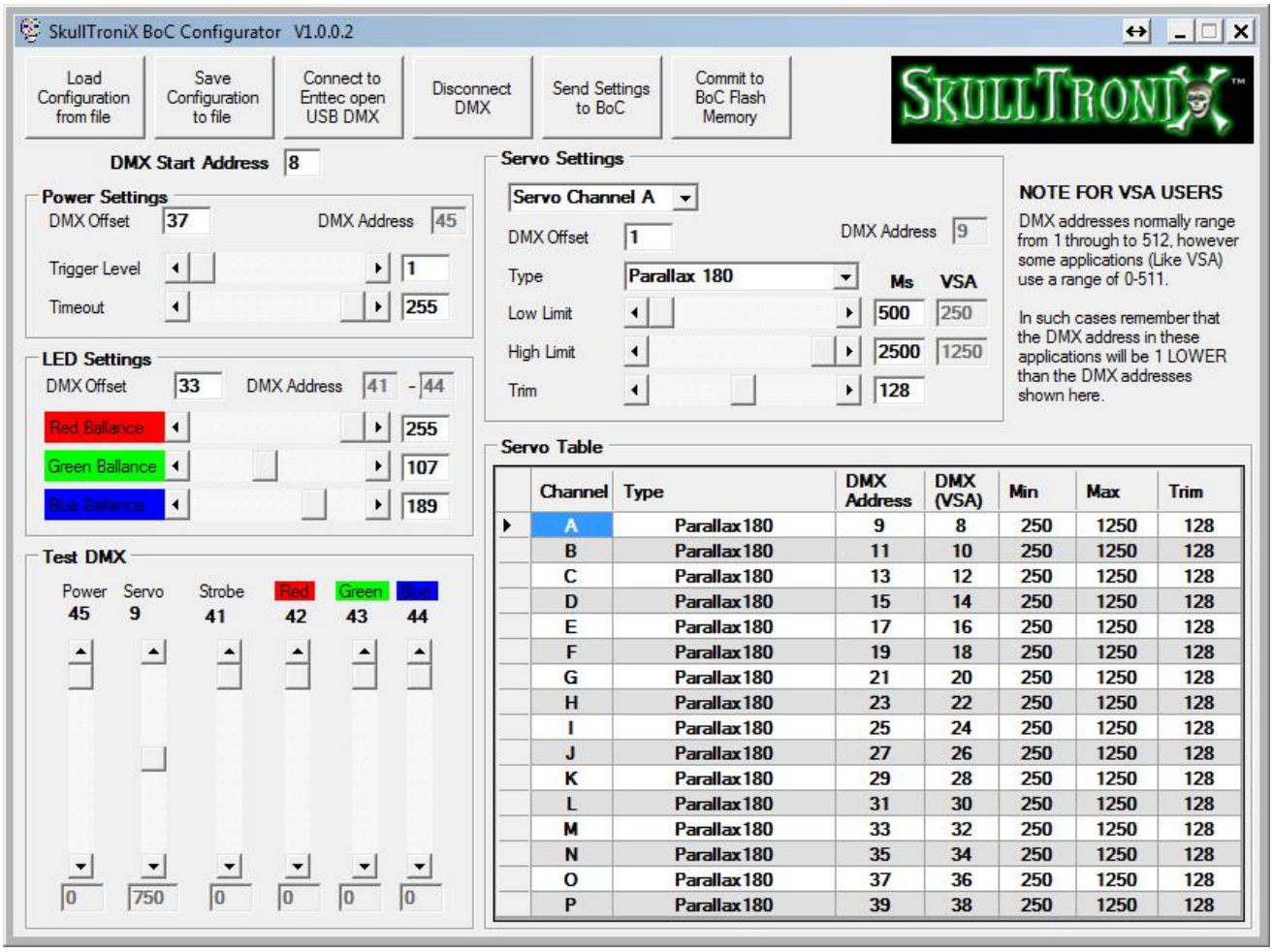
Before running it, make sure you have the EntTec Open DMX interface plugged into your computers USB slot, you have one of your cards connected to the DMX output as described above with the DMX cable you cut in two and added plugs to. You are going to program one card at a time. Once they are programmed, you can daisy-chain them and they will all work in harmony. To make things easier, I created an excel sheet and made the first column all consecutive numbers. You can make 2 columns of numbers if you want. The first to reflect the actual DMX address, and the second to reflect the address to enter in VSA. For whatever reason, VSA's first address is 0, but DMX goes from 1 to 512. That means that VSA is 0 to 511. Every DMX address you assign will be one lower in VSA. If you set a particular servo to be on DMX address 40. You would access it at address 39 in VSA. Just one of those things. Then starting at DMX address 9, you can list your First servo. It can be whatever servo you want. If you are running a skull, let's say that the first servo would be the Jaw Servo. For each servo, you need to use 2 DMX addresses. So your second servo would be at address 11. And so on. I will attach an excel sheet that you can use as an example. You don't HAVE to do this, but I found it a good reference while programming and setting up the VSA file. I would often get confused as to whether I'm using the DMX number or the VSA number and I could refer to this chart and see what I did wrong, and keep it all straight.

DMX – VSA Number Chart

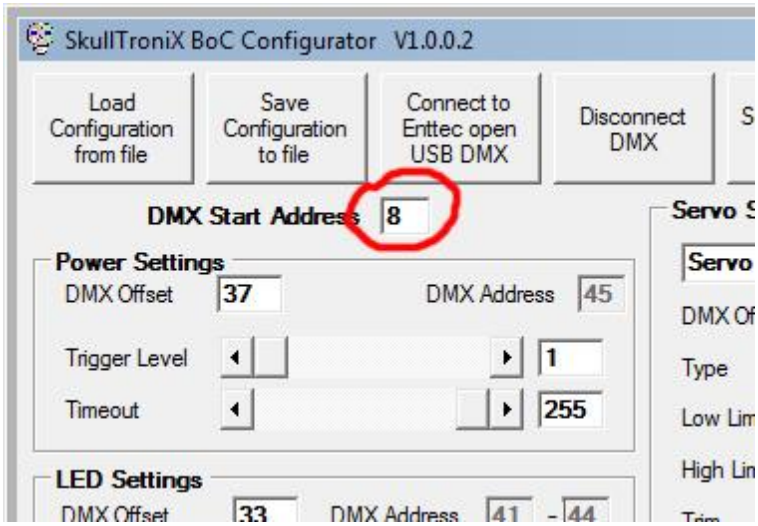
You also need to know that on a BoC board, the first 8 addresses are reserved for the board's internal functions, so you can't program anything at address 1 through 8. (That's 0 through 7 in VSA)

Confused yet?

It will all be clearer soon. So here is a screenshot of what the configurator should look like when it opens up if you have everything connected and powered up. That will be the EntTec, the 5 pin to 3 pin adapter, the DMX cable you cut in half bringing the DMX signal into the BoC board, the other half of that same cable at the output with a terminator attached to it (If you decided to get the terminator) and a 5VDC power source with enough mperage to drive all your servos attached with correct polarity to the BoC.

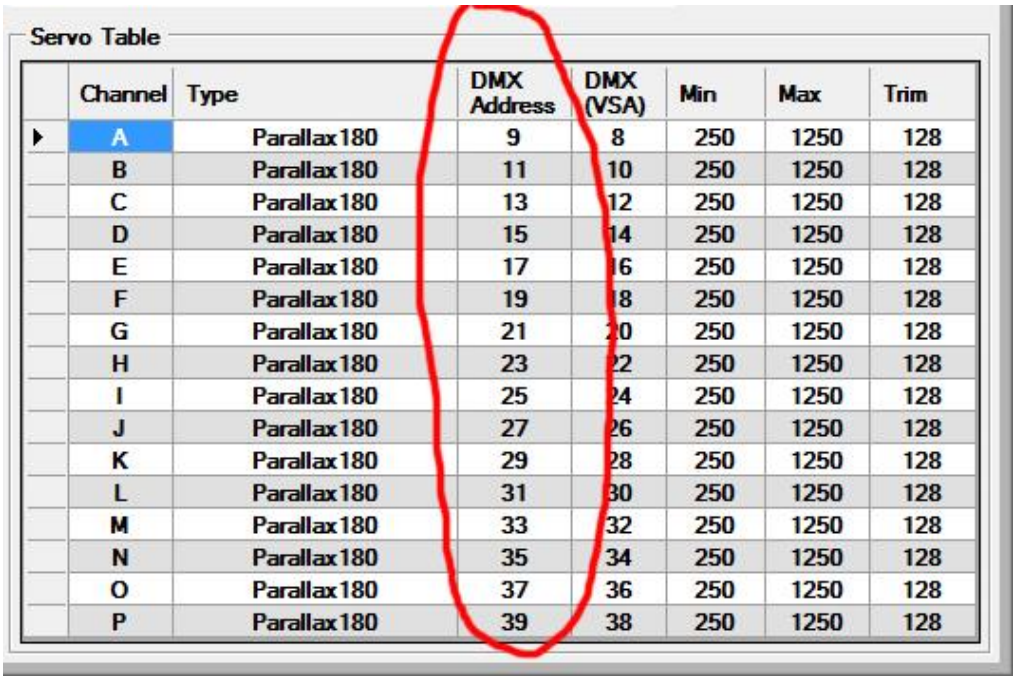


The above picture is ALMOST the way it comes by default. I have only made two changes to it, which I will explain shortly. Now I can show what you can do with this software. First, Click the button across the top that says “Connect to EntTec Open USB DMX”. You will get a message that tells you that you are connected. Click OK. Then make some changes to the settings. I start by changing the start address to 8. This is because the first 8 DMX addresses (0 -7) are reserved for the BoC board. This means that you skip over those first 8 addresses and start with DMX address 9 and nothing gets screwed up. Here’s where to find that setting:



Changing that will update all the other addresses on the board so the servos now start at 9 instead of 1. So far, I am only talking about DMX addresses so as not to get too confusing. We’ll worry about the VSA addresses when we get to the VSA programming part.

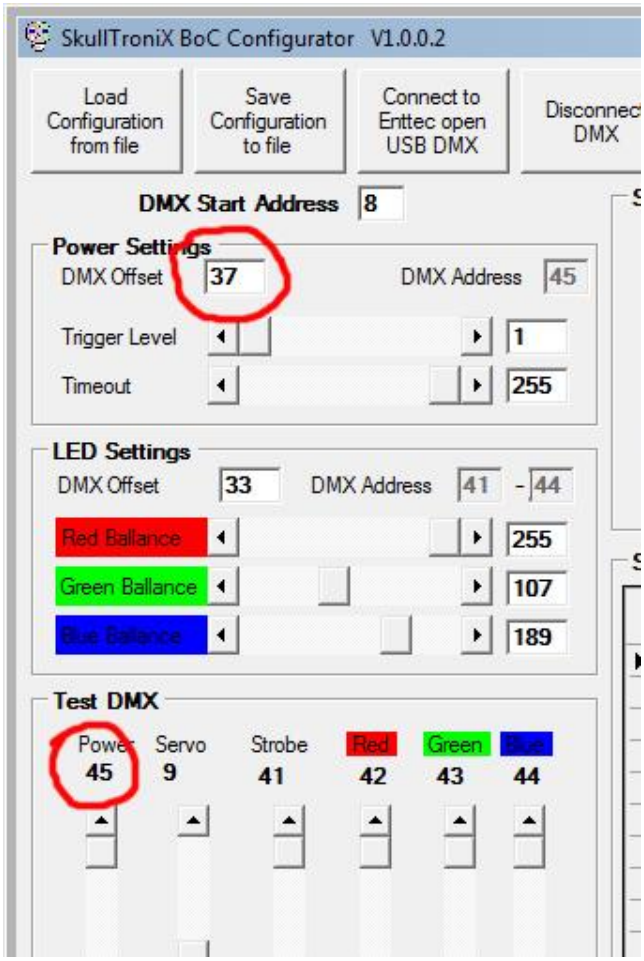
As you can see by the DMX addresses listed here, everything has updated and now you see the first DMX address of 9 for servos.



Channel	Type	DMX Address	DMX (VSA)	Min	Max	Trim
A	Parallax180	9	8	250	1250	128
B	Parallax180	11	10	250	1250	128
C	Parallax180	13	12	250	1250	128
D	Parallax180	15	14	250	1250	128
E	Parallax180	17	16	250	1250	128
F	Parallax180	19	18	250	1250	128
G	Parallax180	21	20	250	1250	128
H	Parallax180	23	22	250	1250	128
I	Parallax180	25	24	250	1250	128
J	Parallax180	27	26	250	1250	128
K	Parallax180	29	28	250	1250	128
L	Parallax180	31	30	250	1250	128
M	Parallax180	33	32	250	1250	128
N	Parallax180	35	34	250	1250	128
O	Parallax180	37	36	250	1250	128
P	Parallax180	39	38	250	1250	128

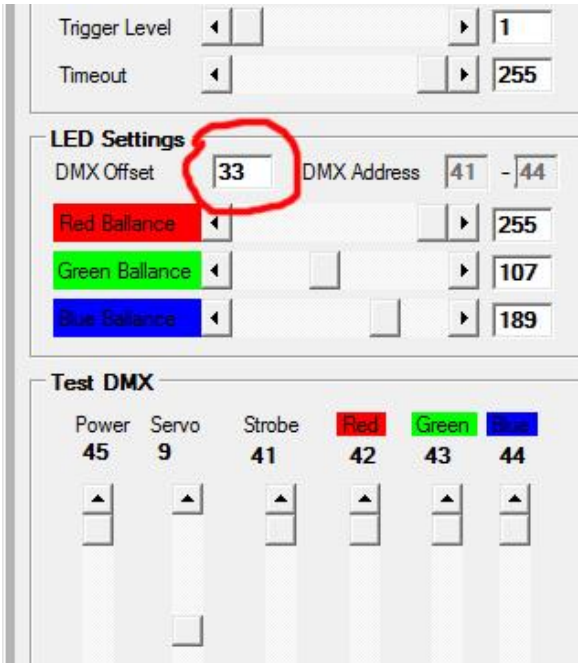
Notice that each servo (A – P) is allotted 2 DMX addresses. This is required for full resolution of servo motion which makes them move smoother. The second servo is at 11, then 13 and so on. If you go back to our excel chart you will see that these all match up and it should be making a little more sense now.

The second change I made was to change the Power Settings to 37.



When I do that, you will see the 'Power' slider at the bottom in the 'test DMX' section will change to 45. This is an address that does not conflict with any other address that you could use on the board. This is an important setting. You have to have an address assigned to Power and in VSA it must be set to 0 for 'ON' or the board will not run.

It appears that by default, the LED Settings DMX Offset is set to 33. That's good because there are 32 addresses assigned to the servos. (2 for each servo. 16 servos) So by setting the offset to 33, it bumps up the Strobe, Red, Green, and Blue channels to addresses above the ones reserved for servos.



The last servo starts at address 39. Look over at the servo table in the DMX Address column for servo 'P'. That servo uses 2 addresses, so the next available address is 41. That's the strobe setting, so it's just where we want it.

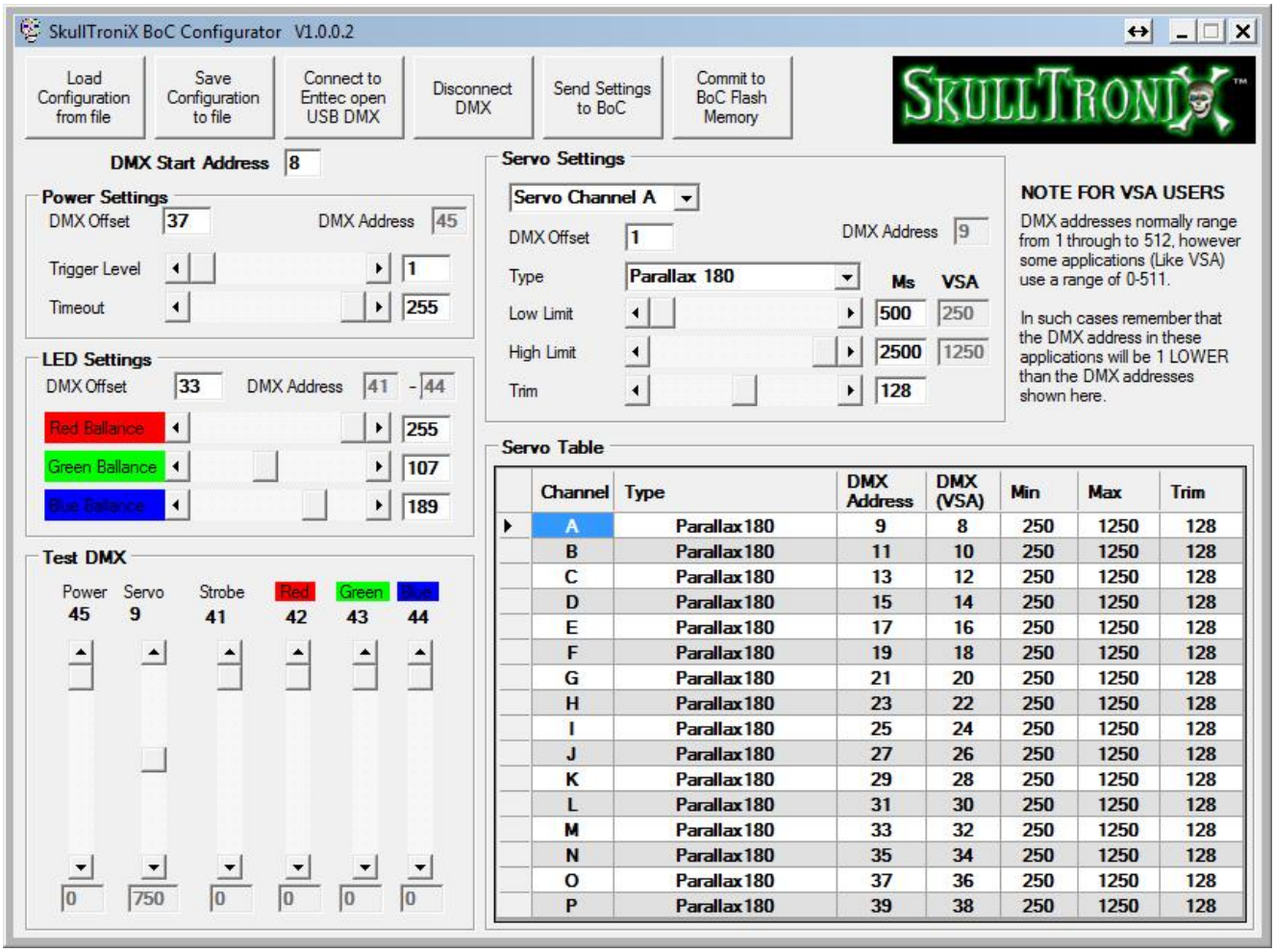
The LED and Power settings each use only 1 DMX address, so they can be consecutive as you see above.

There are other offsets that you can change, but if you are using just one board, there is no need. You could program the board right now as is, and you would have everything you need and room for expansion.

Looking back on your excel sheet, you will see that there are a lot of servo 'available' slots. If you never plan to use those slots, you can save DMX addresses (You only get 512 of them) by setting your LED Settings DMX Offset to a lower number. Play around with that and see what you get. In your excel sheet, we are only using the first 6 servos. That's A through F. So, if you had a lot of cards daisy-chained together and you thought you might run out of DMX addresses because you have a massive number of servos, (Remember each servo takes up 2 addresses, so 200 servos would use up 400 DMX addresses) you might want to change the LED Settings DMX Offset to 13 and the power Settings DMX Offset to 17. That would make your strobe start at 21 and put the power at 25.

You will notice that servo G already has DMX address 21. This is not a problem unless you actually are using a servo at that address. Then there will be conflicting signals being sent to that channel. However, if the only thing you put on DMX address 21 ids the LED strobe, that's the only information that gets sent, and there's no conflict.

If you have less than 30 or 40 servos, there's really no reason to try and conserve DMX addresses. If that's the case for you, I would set it up as shown below with these exact settings:



There is more that this program can do, and maybe I'll get into advanced programming later, but this is all you need to know right now to start working in VSA. The main thing this can do is set absolute servo limits right here in the programming of the BoC board. You can set it so that a specific servo can never go beyond 1000 for example. Whatever you tell it to do in VSA, it will never exceed 1000. This is handy if you have a servo that can damage itself or your prop if it gets turned too far. Doing this will idiot-proof the system so that you can't accidentally send the servo too far and break something while you are working in VSA. For now, we'll go with this, because you can also set servo limits in VSA just like always.

In order to program your first BoC, first (after clicking the 'Connect Enttec open USB DMX' as instructed before) click Send Settings to BoC.

Now you can test these settings by moving the servos and Lighting the LEDs you have connected using this interface.

Always make sure that the 'Power' slider is all the way up and the value under it is '0'. It has to be set to 0 for the board to turn on.

To move a servo, first go to the servo table and click on the servo letter you want to test. Once that letter is highlighted (as letter 'A' is in the image above), go over to the 'Test DMX box and move the 'Servo' slider up and down. This will move the servo you selected as you move the slider.

To test your LEDs, first set the 'Strobe' slider all the way down. It should read '255' under the slider. That setting allows you to adjust the individual colors as you want and allows you to bring each color up to its maximum possible intensity.

The strobe settings are as follows:
0=LED off.
1-127= Varying strobe speeds from slower to faster
128-255= Varying total intensity of whatever mix of colors you have from lowest to maximum.

So with the Strobe set to 255, you can play with the three color sliders to dim them up or down, and/or mix colors. Have fun with that!

After testing all your channels by connecting extra servos to all the servo outputs you plan to use, or, just taking one servo and moving it from output to output, and playing with your LEDs, you are ready to permanently program the board.

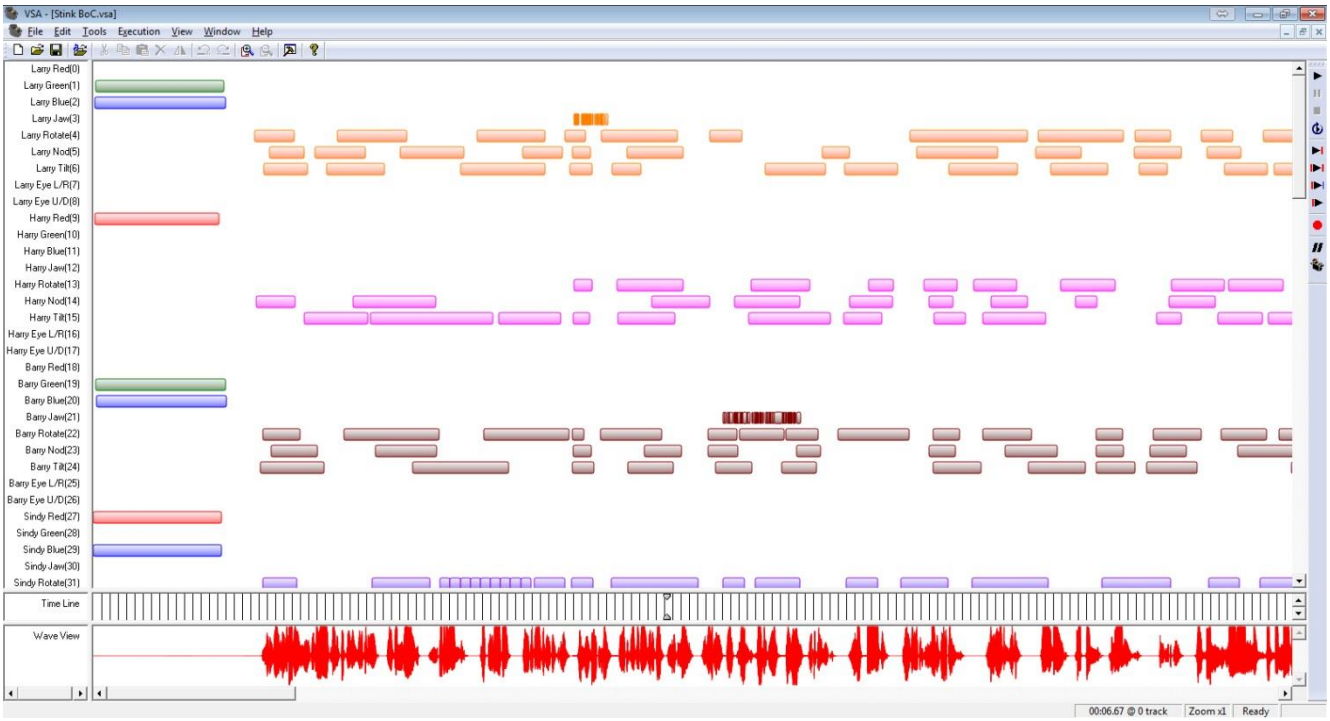
Permanently is a bad word. You can always re-program it at any time, but what I mean is after you hit the 'Commit to BoC Flash Memory' button and wait for it to do its thing, the board will remain programmed even after the power is removed until you decide to reprogram it.

OK, then. You are now ready to make your first VSA program for a DMX board!

For purposes of this tutorial, we will assume that you already have a copy of Brookshire software's VSA program. We will use the Hobbyist version that sells for about $80.00.

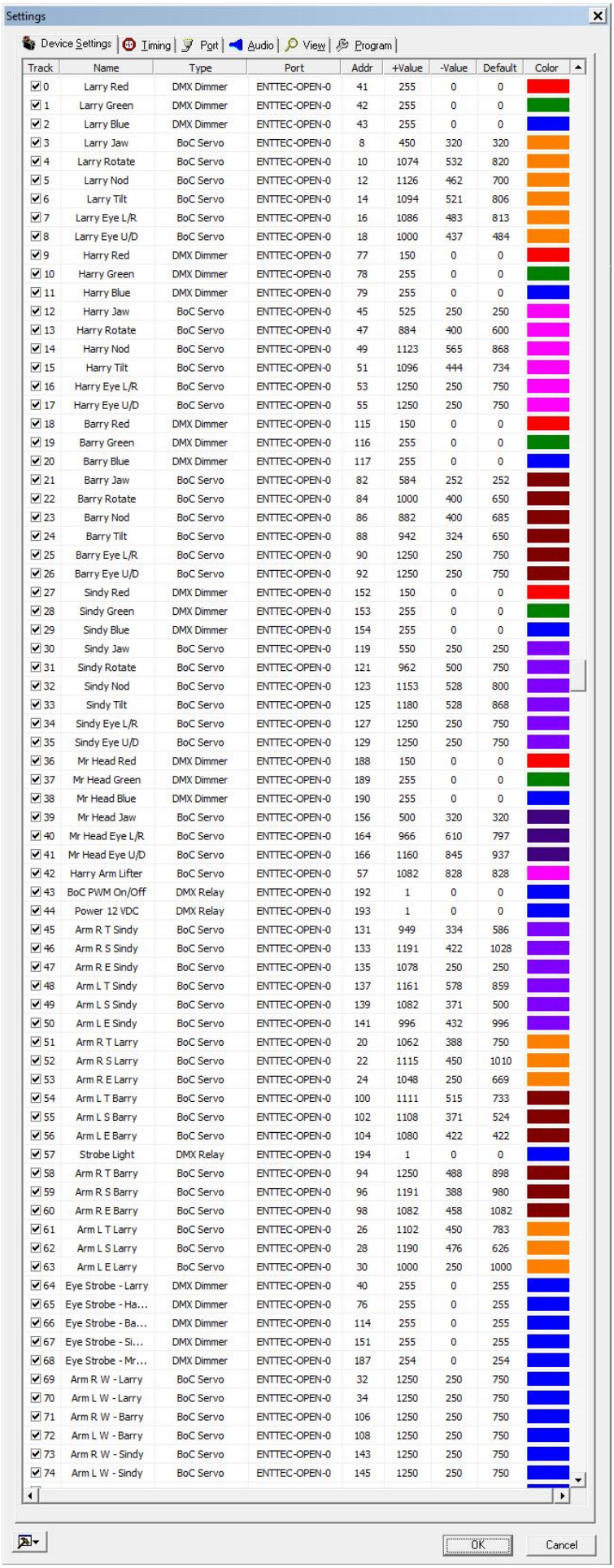
Since I already have set up my Skeleton Quartet using DMX and the BoC board I will use screenshots of one of my own routines and show you those settings and how they work with my BoC settings. It should be fairly simple to understand.

Let's start with a screenshot of the main VSA screen:



This is what the first portion of one of my songs looks like in VSA (looking only at the first 31 devices.) Looks pretty standard, probably like any one of your routines. If you use a program like MonkeyBasic's 'TrackSkull', your routines will look different. They will look more like solid lines for each track that you recorded that way. This is because that program takes a reading of what every position looks like every few milliseconds and makes that an event, even if there is no change. So each line is filled with thousands of tiny events back to back. It ends up doing the same thing, but will look different than a routine which was programmed manually. For the purposes of this tutorial, it really makes no difference which way you choose to create your routines since we will be focusing mostly on the settings section. That's what I'm going to show you next.

Below is the list of all my settings in VSA minus the settings for DMX LED Stage lighting that I just added this year. That is outside the scope of this tutorial, so to avoid confusion, they haven't been added. Get ready, this is a long list, but here it is. It should be helpful if you are still having issues understanding what DMX addresses are and how they relate to VSA and what it means when we say that each servo uses up 2 DMX addresses. Here goes:



Track	Name	Type	Port	Addr	+Value	-Value	Default	Color
0	Larry Red	DMX Dimmer	ENTTEC-OPEN-0	41	255	0	0	
1	Larry Green	DMX Dimmer	ENTTEC-OPEN-0	42	255	0	0	
2	Larry Blue	DMX Dimmer	ENTTEC-OPEN-0	43	255	0	0	
3	Larry Jaw	BoC Servo	ENTTEC-OPEN-0	8	450	320	320	
4	Larry Rotate	BoC Servo	ENTTEC-OPEN-0	10	1074	532	820	
5	Larry Nod	BoC Servo	ENTTEC-OPEN-0	12	1126	462	700	
6	Larry Tilt	BoC Servo	ENTTEC-OPEN-0	14	1094	521	806	
7	Larry Eye L/R	BoC Servo	ENTTEC-OPEN-0	16	1086	483	813	
8	Larry Eye U/D	BoC Servo	ENTTEC-OPEN-0	18	1000	437	484	
9	Harry Red	DMX Dimmer	ENTTEC-OPEN-0	77	150	0	0	
10	Harry Green	DMX Dimmer	ENTTEC-OPEN-0	78	255	0	0	
11	Harry Blue	DMX Dimmer	ENTTEC-OPEN-0	79	255	0	0	
12	Harry Jaw	BoC Servo	ENTTEC-OPEN-0	45	525	250	250	
13	Harry Rotate	BoC Servo	ENTTEC-OPEN-0	47	884	400	600	
14	Harry Nod	BoC Servo	ENTTEC-OPEN-0	49	1123	565	868	
15	Harry Tilt	BoC Servo	ENTTEC-OPEN-0	51	1096	444	734	
16	Harry Eye L/R	BoC Servo	ENTTEC-OPEN-0	53	1250	250	750	
17	Harry Eye U/D	BoC Servo	ENTTEC-OPEN-0	55	1250	250	750	
18	Barry Red	DMX Dimmer	ENTTEC-OPEN-0	115	150	0	0	
19	Barry Green	DMX Dimmer	ENTTEC-OPEN-0	116	255	0	0	
20	Barry Blue	DMX Dimmer	ENTTEC-OPEN-0	117	255	0	0	
21	Barry Jaw	BoC Servo	ENTTEC-OPEN-0	82	584	252	252	
22	Barry Rotate	BoC Servo	ENTTEC-OPEN-0	84	1000	400	650	
23	Barry Nod	BoC Servo	ENTTEC-OPEN-0	86	882	400	685	
24	Barry Tilt	BoC Servo	ENTTEC-OPEN-0	88	942	324	650	
25	Barry Eye L/R	BoC Servo	ENTTEC-OPEN-0	90	1250	250	750	
26	Barry Eye U/D	BoC Servo	ENTTEC-OPEN-0	92	1250	250	750	
27	Sindy Red	DMX Dimmer	ENTTEC-OPEN-0	152	150	0	0	
28	Sindy Green	DMX Dimmer	ENTTEC-OPEN-0	153	255	0	0	
29	Sindy Blue	DMX Dimmer	ENTTEC-OPEN-0	154	255	0	0	
30	Sindy Jaw	BoC Servo	ENTTEC-OPEN-0	119	550	250	250	
31	Sindy Rotate	BoC Servo	ENTTEC-OPEN-0	121	962	500	750	
32	Sindy Nod	BoC Servo	ENTTEC-OPEN-0	123	1153	528	800	
33	Sindy Tilt	BoC Servo	ENTTEC-OPEN-0	125	1180	528	868	
34	Sindy Eye L/R	BoC Servo	ENTTEC-OPEN-0	127	1250	250	750	
35	Sindy Eye U/D	BoC Servo	ENTTEC-OPEN-0	129	1250	250	750	
36	Mr Head Red	DMX Dimmer	ENTTEC-OPEN-0	188	150	0	0	
37	Mr Head Green	DMX Dimmer	ENTTEC-OPEN-0	189	255	0	0	
38	Mr Head Blue	DMX Dimmer	ENTTEC-OPEN-0	190	255	0	0	
39	Mr Head Jaw	BoC Servo	ENTTEC-OPEN-0	156	500	320	320	
40	Mr Head Eye L/R	BoC Servo	ENTTEC-OPEN-0	164	966	610	797	
41	Mr Head Eye U/D	BoC Servo	ENTTEC-OPEN-0	166	1160	845	937	
42	Harry Arm Lifter	BoC Servo	ENTTEC-OPEN-0	57	1082	828	828	
43	BoC PWM On/Off	DMX Relay	ENTTEC-OPEN-0	192	1	0	0	
44	Power 12 VDC	DMX Relay	ENTTEC-OPEN-0	193	1	0	0	
45	Arm R T Sindy	BoC Servo	ENTTEC-OPEN-0	131	949	334	586	
46	Arm R S Sindy	BoC Servo	ENTTEC-OPEN-0	133	1191	422	1028	
47	Arm R E Sindy	BoC Servo	ENTTEC-OPEN-0	135	1078	250	250	
48	Arm L T Sindy	BoC Servo	ENTTEC-OPEN-0	137	1161	578	859	
49	Arm L S Sindy	BoC Servo	ENTTEC-OPEN-0	139	1082	371	500	
50	Arm L E Sindy	BoC Servo	ENTTEC-OPEN-0	141	996	432	996	
51	Arm R T Larry	BoC Servo	ENTTEC-OPEN-0	20	1062	388	750	
52	Arm R S Larry	BoC Servo	ENTTEC-OPEN-0	22	1115	450	1010	
53	Arm R E Larry	BoC Servo	ENTTEC-OPEN-0	24	1048	250	669	
54	Arm L T Barry	BoC Servo	ENTTEC-OPEN-0	100	1111	515	733	
55	Arm L S Barry	BoC Servo	ENTTEC-OPEN-0	102	1108	371	524	
56	Arm L E Barry	BoC Servo	ENTTEC-OPEN-0	104	1080	422	422	
57	Strobe Light	DMX Relay	ENTTEC-OPEN-0	194	1	0	0	
58	Arm R T Barry	BoC Servo	ENTTEC-OPEN-0	94	1250	488	898	
59	Arm R S Barry	BoC Servo	ENTTEC-OPEN-0	96	1191	388	980	
60	Arm R E Barry	BoC Servo	ENTTEC-OPEN-0	98	1082	458	1082	
61	Arm L T Larry	BoC Servo	ENTTEC-OPEN-0	26	1102	450	783	
62	Arm L S Larry	BoC Servo	ENTTEC-OPEN-0	28	1190	476	626	
63	Arm L E Larry	BoC Servo	ENTTEC-OPEN-0	30	1000	250	1000	
64	Eye Strobe - Larry	DMX Dimmer	ENTTEC-OPEN-0	40	255	0	255	
65	Eye Strobe - Ha...	DMX Dimmer	ENTTEC-OPEN-0	76	255	0	255	
66	Eye Strobe - Ba...	DMX Dimmer	ENTTEC-OPEN-0	114	255	0	255	
67	Eye Strobe - Si...	DMX Dimmer	ENTTEC-OPEN-0	151	255	0	255	
68	Eye Strobe - Mr...	DMX Dimmer	ENTTEC-OPEN-0	187	254	0	254	
69	Arm R W - Larry	BoC Servo	ENTTEC-OPEN-0	32	1250	250	750	
70	Arm L W - Larry	BoC Servo	ENTTEC-OPEN-0	34	1250	250	750	
71	Arm R W - Barry	BoC Servo	ENTTEC-OPEN-0	106	1250	250	750	
72	Arm L W - Barry	BoC Servo	ENTTEC-OPEN-0	108	1250	250	750	
73	Arm R W - Sindy	BoC Servo	ENTTEC-OPEN-0	143	1250	250	750	
74	Arm L W - Sindy	BoC Servo	ENTTEC-OPEN-0	145	1250	250	750	

Browse through the above picture and notice that the device number and the Address really have nothing to do with each other. Device numbers are just a way to group devices that are part of the same unit together, like all the servos in one character's head for example. Later on, I have all the servos for that character's arms grouped together in a different section.

If I were doing this over again from scratch, I might have decided to group everything that relates to a particular character all together. LEDs, head servos, arm servos, even the stage lighting that aims at that character. In my case, it wasn't done this way, because I started simply with just head servos. A couple years later, I added moving arms, but only Sindy got a pair of moving arms that year. The two guys that weren't holding up Mr head just got one arm each that moved. The ones to the outside. The following year, I gave them both 2 arms each. Each time I made a change, I didn't feel like going back and rearranging the order of every old existing routine, so new parts that got added ended up being tagged on the end. It makes it a little harder to follow, but that's why I did it. Essentially, I was just lazy. If I had the foresight, I would have anticipated future expansion and left extra unused device tracks in-between each character so the grouping would have been better as I expanded. You can take that hint from me as you design what your new routine template will look like.

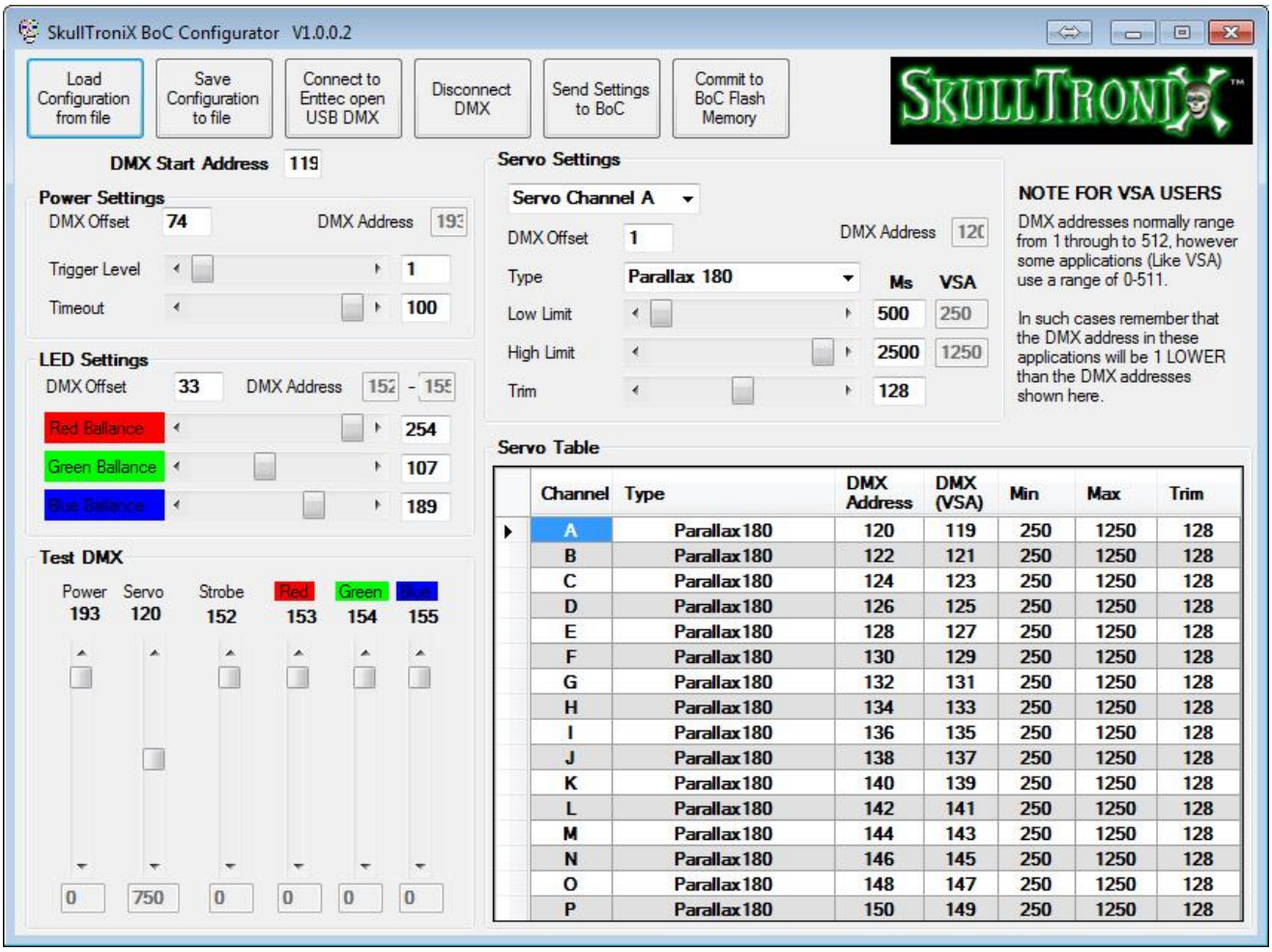
Enough of that. Now, I am going to focus on one small section of the above list of settings. This should clear things up as I will show you the settings, then the configuration file for the BoC and you can make sense of the whole DMX address thing. Here are the VSA settings for everything that has to do with Sindy's character (plus a few extra channels):

☑ 27	Sindy Red	DMX Dimmer	ENTTEC-OPEN-0	152	150	0	0
☑ 28	Sindy Green	DMX Dimmer	ENTTEC-OPEN-0	153	255	0	0
☑ 29	Sindy Blue	DMX Dimmer	ENTTEC-OPEN-0	154	255	0	0
☑ 30	Sindy Jaw	BoC Servo	ENTTEC-OPEN-0	119	550	250	250
☑ 31	Sindy Rotate	BoC Servo	ENTTEC-OPEN-0	121	962	500	750
☑ 32	Sindy Nod	BoC Servo	ENTTEC-OPEN-0	123	1153	528	800
☑ 33	Sindy Tilt	BoC Servo	ENTTEC-OPEN-0	125	1180	528	868
☑ 34	Sindy Eye L/R	BoC Servo	ENTTEC-OPEN-0	127	1250	250	750
☑ 35	Sindy Eye U/D	BoC Servo	ENTTEC-OPEN-0	129	1250	250	750
☑ 36	Mr Head Red	DMX Dimmer	ENTTEC-OPEN-0	188	150	0	0
☑ 37	Mr Head Green	DMX Dimmer	ENTTEC-OPEN-0	189	255	0	0
☑ 38	Mr Head Blue	DMX Dimmer	ENTTEC-OPEN-0	190	255	0	0
☑ 39	Mr Head Jaw	BoC Servo	ENTTEC-OPEN-0	156	500	320	320
☑ 40	Mr Head Eye L/R	BoC Servo	ENTTEC-OPEN-0	164	966	610	797
☑ 41	Mr Head Eye U/D	BoC Servo	ENTTEC-OPEN-0	166	1160	845	937
☑ 42	Harry Arm Lifter	BoC Servo	ENTTEC-OPEN-0	57	1082	828	828
☑ 43	BoC PWM On/Off	DMX Relay	ENTTEC-OPEN-0	192	1	0	0
☑ 44	Power 12 VDC	DMX Relay	ENTTEC-OPEN-0	193	1	0	0
☑ 45	Arm R T Sindy	BoC Servo	ENTTEC-OPEN-0	131	949	334	586
☑ 46	Arm R S Sindy	BoC Servo	ENTTEC-OPEN-0	133	1191	422	1028
☑ 47	Arm R E Sindy	BoC Servo	ENTTEC-OPEN-0	135	1078	250	250
☑ 48	Arm L T Sindy	BoC Servo	ENTTEC-OPEN-0	137	1161	578	859
☑ 49	Arm L S Sindy	BoC Servo	ENTTEC-OPEN-0	139	1082	371	500
☑ 50	Arm L E Sindy	BoC Servo	ENTTEC-OPEN-0	141	996	432	996

If you're not sure what I mean by the device names for devices 45 – 50, I will explain. The R's and L's are for Right and Left. T stands for 'Twist' which refers to the servo at the top of the arm which allows the arm to swing out to the side and back. S stands for the servo at the shoulder, and E stands for the servo at the Elbow. In the big list, you will also see at the very bottom, some W's. These are for servos in the wrists. I don't have these yet, but I am planning to add them for next year with any luck. Channel 44 that says 'Power 12 VDC runs a relay that turns on and off a 12VDC power supply. I used to use that before going DMX. I don't use it anymore, but never took it out of the system. I assigned a DMX address to it in case I want to use it for something else later on. That way I have an extra relay to turn something on or off if I want to use it. Channel 42 runs a large, high torque linear servo I got from Servo city where I get most of my servos.

That linear servo is what lifts up the arms that hold the extra skull (Mr. Head) that pops up to make wise-cracks and generally be annoying. Channel 43 is a special channel. I discovered this when I got all my BoC boards I couldn't get any of them to do a thing . They wouldn't turn on. After a call to Jerry Jewell at Skulltronix, I discovered that there is a special DMX address that you need to set called 'Power'. You see it in the 'Test DMX' section of the BoC Configurator. You need to assign a DMX address to that as described earlier in this tutorial, and set it up in VSA as a DMX Relay. In my settings above you see that I have default set as 0 for that channel which means that as soon as the VSA routine starts, it sends a 0 out to that DMX address. When it gets a 0, the board sees it and turns on. Without that, it does nothing. At the end of the routine, the 0 goes away and the board shuts down. What this does for you is it releases all the pulses going to your servos and they relax. (Analog servos only. Digital servos continue to hold position.) It doesn't shut down power to the board or even power to the servos, but it does stop sending pulse commands so that the servos stop holding position. This helps increase the lifespan of your servos over time. If you set the default to a 1 instead of 0 that means your servos will not be active by default. To get them to turn on, you would have to create a VSA event on that channel and change the state from 1 to 0. Then the servos would become active. For me, this did not make sense, as I want all my servos active the whole time during a routine, so I just set the default to 0 and never enter anything in the timeline on that channel. It stays at 0 for the whole routine, and goes off when it's done, just as I would want it to. So you need that DMX address set, and you need to have VSA tell it to be 0, but you don't need to add anything in your VSA programming beyond that. If you had a scene that had a lot of lighting effects and a minute or so into the routine, a servo had to come on for a few seconds and then shut off, it would make sense to make the default 1 and only change it to a zero just before the servo comes on, then change it back to a 1 after the servo was done. That would save a lot of time that the servo didn't need to be activated and would increase its life. Built into the BoC board is a feature that shuts down the pulses as though you had commanded it with a 1 after about a minute and a half of non-activity. This time is adjustable in the BoC Configurator and is just another servo-saving feature built into the board. I left the time out at its default and it worked fine for me.

Ok, I said I would show you the matching BoC configuration for the VSA section I showed you above, so here it is:



This is the actual configuration that I am currently using for the Sindy character in my singing quartet. Things to notice are my starting address, Power Setting DMX offset and LED Settings DMX offset. They are high because this is not the first character in my list, and they need higher DMX addresses. What is different here from using multiple SSC-32 cards is that with Multiple SSC-32 cards, you change the port, but the addresses are always the same. 0 to 31 per card. The first card might be on COM1 and the second on whatever other COM port is created when you plug in your USB to Serial adapter. With DMX, you never reuse the same address, even if it's on a separate card. I have 5 cards. In the DMX universe, there are 512 possible addresses. In a straight daisy-chain configuration, you can have as many as 32 different devices in that daisy-chain, but combined, there are still only 512 addresses. A good explanation of all of this can be found here.

So, there is only one DMX address of, for example, 120. In my example the DMX address is for the jaw servo for Sindy and it STARTS at DMX address 120 and uses 2 DMX addresses, So even though you don't have to tell it to, it uses address 120 and 121. This means that DMX address 121 is not available for anything else, and your next available DMX address is 122. Look up at the BoC configuration and you will see that servo B (Sindy Rotate in my case) Starts at address 122 and also uses 2 addresses. The second address does not need to be listed anywhere, it just can't be used for anything else. This is just for servos. The LEDs and power addresses only use a single address as mentioned earlier in this tutorial. Something else you don't see in the small section of VSA settings is the "Strobe " channel. In the BoC configuration, you see this in the "Test DMX" section as DMX address 152. When I first wrote my earlier VSA routines, I built my own LED dimmer/mixer and it did not have a 'Strobe' channel. Rather than re-order all my devices so the strobe channel could be near the 3 color channels, I put all the strobe channels together further down the list. If you refer back to the full settings image, you can see the

strobe settings starting at device number 64. Since we're there, let's talk about the Strobe settings, what they mean, and what they do. In my routines, I really don't utilize this feature much, but you can make the eyes flash like a strobe light by adjusting the settings. The strobe channel can also be used to dim the LEDs down, but that can also be done with the individual color channels. Let's say you mixed your colors together and found the perfect shade. You can keep that mix, and fade the whole mix up or down by just adjusting the Strobe channel to a number between 128 and 255. 128 is the lowest and 255 is full brightness. A setting of 0 means that the LED is off and settings between 1 and 127 control the rate at which they strobe from slow to fast. I found the strobe effect on LEDs in a skulls eye to be fairly unnatural. Not that it's natural for a skull to have eyes at all, or that if they did have eyes, it would be natural for them to light up and change color, but you know what I mean. Maybe not. I found the effect distracting. Let's leave it at that. Your opinions may vary. In my programming, I set all the strobe channels to have a default of 255. That means that all individual color channels for that LED can go up to full brightness if you set them to. I never put any events in the 'Strobe' channel and just let it be at 255 the whole time. I can mix the colors and dim them up and down using the individual colors, and since they don't tend to vary much or often within my routines I just adjust them that way. Feel free to experiment and use whatever method works best for you. Another reason for me personally to just set and forget the strobe channel is that I already had 30 routines all programmed to use the 3 color channels for everything before I had a 'Strobe' channel. To utilize this new channel, I would have had to go back and reprogram everything I did. That's more likely the real reason I don't use it.

And now for the elephant in the room.

You will see that NONE of the DMX addresses in the BoC Configuration screenshot match the addresses I use in VSA. DMX protocol is, as stated, 512 addresses. These go from 1 to 512. In the DMX universe, there is no 0. VSA, on the other hand uses addresses that start at 0. They do not conform to the DMX standard. So with DMX, the first possible address is 1 and in VSA, the first possible address is 0. To make them compatible, you need to translate. If you are using DMX address 10, that is the 10^{th} possible address in the DMX universe. In VSA, it still means that you want the 10^{th} possible address, but because they start at 0, it translates to address 9. So if you set the address to 9 in VSA, it will control whatever device is set to listen to DMX address 10.

Another thing you will notice about the VSA settings is that the Device type you use makes a difference. Converting an old VSA routine that used an SSC-32 into a new routine that uses the BoC is not easy and involves several steps, but can be done. I converted all 30 of mine over in a single day. I won't go into that here, unless there are people out there that need to do that. Let me know and I can show you how and post it here.

VSA fully supports the BoC board and has a specific setting for BoC servo. For eye LEDs or any LED device like stage lighting, you use the basic DMX Dimmer setting. This is for the three colors as well as the strobe channel. For the special 'Power' channel we discussed earlier, you need to set the device to a DMX Relay.

These settings are what you need even if they are all controlling different things on a BoC board. The BoC uses special settings for servos, but utilizes standard DMX protocol for LED dimming and the DMX relay channel. By the way, the DMX relay channel is built into the BoC board. There is nothing to connect to it. All you have to do is to choose what available DMX address you want it to be, (Doesn't matter what you choose) and then program it in VSA to have a zero sent to that address. (One address lower in VSA, of course)

It's hard to believe, but I think I covered everything I set out to cover. Following these instructions should get you up and running in DMX once you buy the equipment and cables you need. If I have forgotten to cover

something, please call me out on it, and I will go over the details, and as always, please don't hesitate to ask questions, correct me if I made a mistake, and add other tidbits of knowledge or experience you may have.