59’ Fender Bassman

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Let me begin by saying that I have no business building a tube amp. I am a cellist who plays only a little bass. However, I am also an electrical engineer, so I was really attracted to the idea of working with a circuit and building something from scratch. Building this amp has been such a great learning experience and so much fun. I have learned about the practical side of implementing all of the circuit theory that has been crammed into my head. It isn't simply connecting things to the right place: you have to connect them to the right place in the right way. You need to consider EM field interferences and what might arc to where to set the whole thing on fire. The goal of this paper is to help any future students who are interested in completing a similar project and to keep good notes for myself so that I can maintain this spectacular amp over the years.

Getting Started:

This project started when I bought circuit for a 59' Fender Bassman on eBay. I liked the idea of putting the whole thing together from the ground up. I admit that at the time I had no idea what I was getting into. I was clueless as to just how many parts went into the whole thing. Once I had the circuit, I picked up a 4x10 custom-built replica '59 Bassman cabinet on eBay. I then went into class to learn what other parts I would need.

Parts List:

Part Description	Part number	Supplier	Qty	Price
Power Transformer	Hammond 290EX/291EX	Antique Electronics	1	72.85
OP Transformer	Fender Reissue - 036485	Antique Electronics	1	$51.95
Choke	125C1A (6L6 choke)(022099)	Antique Electronics	1	12.95
8-Pin Tube Socket	P-ST8-801	Antique Electronics	3	1.95x3
9-Pin Tube Socket	P-ST9-700	Antique Electronics	3	2.95 x 3
Weber Vst copper cap rectifier	WZ-34	Weber	1	22
Preamp Tube	3-12AX7 (Tungsol)	Tube Depot	3	45
Power Tubes	2-6L6GC (Tungsol)	Tube depot	2	40
Pilot Lamp Holder	P-L124P	Antique Electronics	1	2.95
Jewel	(P-L)	Antique Electronics	1	1.95
10k Bias Pot	R-V10KL-BP-FND	Antique Electronics	1	2.95
Chassis Kit	5F6	Weber	1	100
Jack socket	Switchcraft J12A (w/tip shunt) 3-term	prof	1	3
AC on/off toggle switch	P-H530	Antique Electronics	1	3.9
Fuse Holder	3AGC or S-H201(better)	Antique Electronics	1	1.95
3-prong 8' AC line cord and strain relief		Hardware Store	1	10
Chassis Bolts		Weber	3	2.4
Cabinet w/ Speakers		eBay	1	450
Carling SPST 2-pos toggle switch	P-H495/P-H494	Tyler	2	3.25
Knobs		Antique Electronics	6	14.95
220K MOX resistors		Antique Electronics	2	2
9/32'' Grommets		Hardware Store	4	0.98
washers		Prof	11	0.25
Light		Prof	1	1.25
Circuit Board		eBay	1	50
Total Cost:				**$896.53**

The Cabinet:

It turns out that the cabinet that I bought is not a "real-deal" Fender according to Professor Errede. However, it is of very good quality, with 4 Weber Alnico speakers which are tonally much better than the current-production Jensen P10R speakers that Fender equipped the reissue '59 Bassman with. The cabinet itself is made of soft pine (not hard yellow pine, like the originals), so I will need to take care not to dent it. The tweed work was very well done with the stripes oriented properly and lining up on adjacent pieces. It is lacquered and looks great. The handle is rubber as opposed to the original plastic handles. While the original handles look a bit more classy, they were known to break which could mean disaster for the amp. Needless to say, I'll be sticking with the sturdy rubber handle.

The cabinet came with a vinyl dust cover. It isn't the vintage style cover, but I don't see the need to get one. Having a dust cover is very important to keep dust from building up behind the grill cloth. Dust will build up on the speaker cones which could lead to damage to the speakers.

The Chassis:

Neither the circuit board nor the cabinet I ordered came with a chassis, so I had to order one separately. I ordered a 5F6 chassis from Weber Speakers. This chassis was exactly what I needed. The control circuit was a perfect fit; I didn't need to force the knobs to stick through. The surface is chrome and all the knobs and switches are labeled in white lettering. Numbers are printed on the chassis instead of on the knob just like the original '59 Bassman. I bought chicken head knobs to complete the vintage look. In a departure from the original look, I chose to use an amber pilot light jewel as opposed to the original red.

The chassis had a spot for a ground polarity switch like the original Bassman. However, this switch is only there to fill the hole in the chassis on my amp. This switch is supposed to be used to capacitively connect the 120 VAC line or neutral of the amp to chassis ground, which was useful in the days of 2-prong unpolarized AC line cords. However, using a modern 3-prong AC line cord, with the chassis held at earth ground, use of a ground polarity switching circuit is a bad idea, so I did not implement that on my amp.

The ’59 Bassman was a model that was designed before Fender used bright switches on their amps. Instead, there are four different inputs on the chassis. There are 2 “bright” inputs and 2 “normal” inputs. This does not mean that the amp was intended to be used with multiple instruments simultaneously. There are 2 inputs for each channel because one is a few decibels quieter than the other. The fact that there are 4 input jacks enables some tonal versatility, e.g. by connecting two diagonal input jacks with a short cable. For example, connecting normal 2 with bright 1 when playing into normal 1. Even using one input only, there is some interesting interference between the normal and bright channel, due to the common cathode of first gain stage of the amp, which causes some signal to be induced from one channel to the other channel, the effect can be heard by turning down the volume control on the input channel the guitar is plugged into and turning up the other, unused channel.

My chassis lacks the typical cover over the capacitor board, which is mounted on the back of the chassis. This is not a problem for functionality. However, no one should ever stick their hand back behind the chassis while the amp is in use. If they touched a lead on the cap board, they would risk a zap of over 400 volts!

The chassis did not have the necessary holes to mount the circuit board, so I had to drill those myself (with some help). Because I drilled the holes at such an early stage of the project, I was not able to visualize how everything would fit together. Near the end of the project, I realized that one of the input jacks would not fit because one of the large capacitors was in the way. Luckily it was an easy problem to resolve. I simply removed that capacitor and re-mounted it on top of the capacitor it was in parallel with.

The Circuit:

I made a few minor modifications to the circuit, but I didn’t do any modifications to an extra effect such as reverb. On the capacitor board, I replaced the original resistors with 2 Watt metal oxide resistors. Metal oxide resistors are preferred for this high voltage part of the circuit because they do not catch fire. However, they needed to be mounted a little bit raised off of the board because they need to be able to dissipate heat.

Other components that I replaced were the 120pF and 47pF ceramic disc capacitors with silver mica capacitors of the same ratings. Silver mica capacitors are known to have a better audio quality than the ceramic disc type of capacitor. These capacitors help to achieve a nice bright sound. The 47 pF

capacitor was not installed on the board, but rather soldered directly to the phase inverter tube socket to shorten the signal path.

A 1Ω resistor was added in between the cathode (pin 8) of each power tube and the connection to ground. Again, 5% tolerance 2 Watt metal oxide resistors were used. The purpose for adding these resistors is that it enables measuring the quiescent DC current in each power tube, since V = IR and R = 1 Ohm. The voltage across these resistors can easily be measured to obtain the DC current flowing though the power tube. This feature proved handy for the next mod I discuss.

I did a small mod by adding a 10k bias pot in series with R41, which was changed from 56kΩ to 47kΩ. The addition of this pot allowed me to "fine-tune" the power tube grid bias of my amp. The current through each of the power tubes (a matched pair) was measured and then the 10K bias pot was adjusted to achieve 25 milliamps of current/power tube. I could adjust it to as high as 35 milliamps if I wanted it to run hot.

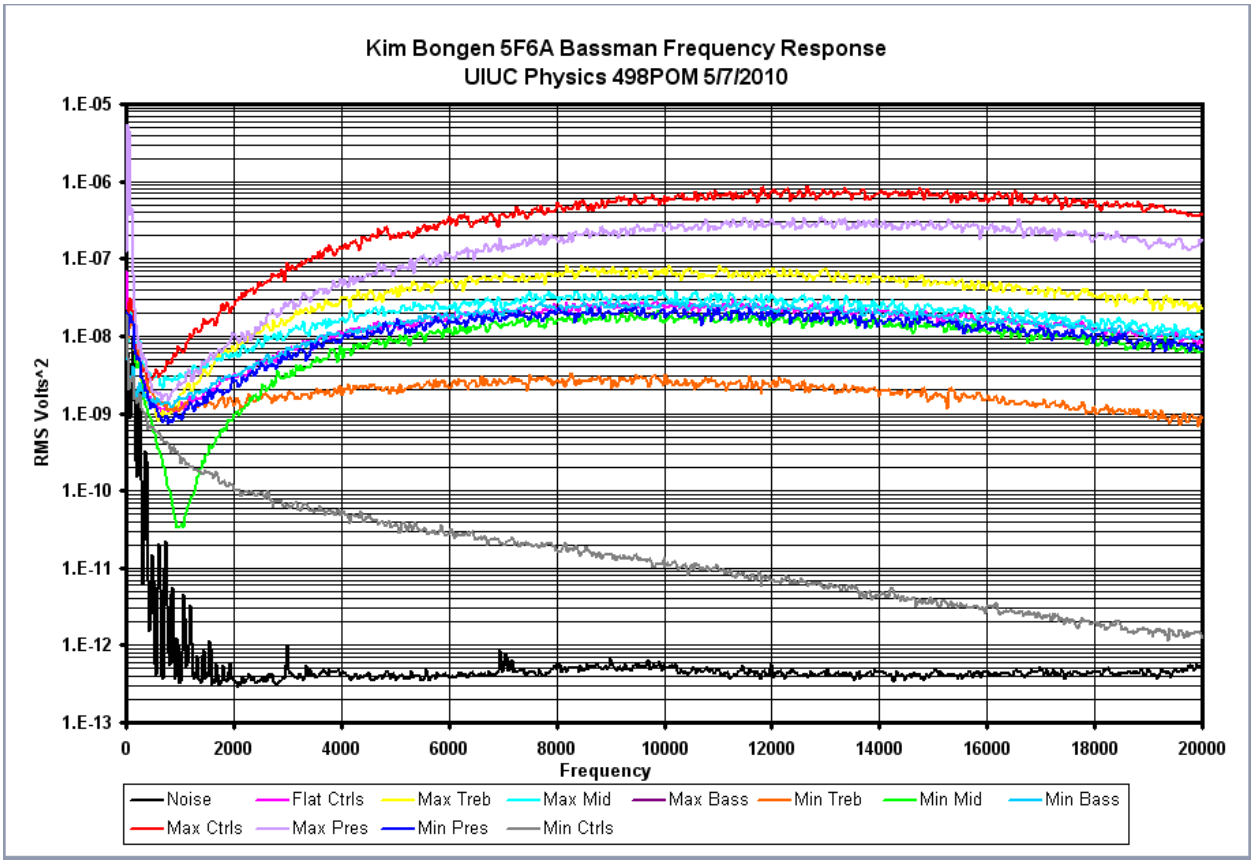
An important step in ensuring the quality of my amp was to fix cold solder joints. We noticed cold solder joints on the volume control pots of the control pc board when we turned on the amp for the first time and could hear intermittent connections when the control board was wiggled. After resoldering these bad solder joints, the problem was gone.

The tubes that I chose were the traditional 12AX7's for the preamp tubes, and a matched pair of 6L6's for the power tubes. I will be able to use EL34's if I want to since I connected pins 1 and 8 on the power tube sockets. I used a Weber WZ-34 copper cap rectifier because it is more robust than a GZ-34/5AR4 tube rectifier, but it mimics the behavior of a tube rectifier unlike other solid state rectifiers. I will not be able to use a tube rectifier for this amp because the Hammond tweed Bassman power transformer I bought does not have the 5.0 Vac secondary winding necessary to support a tube rectifier.

I was lucky enough to be given steel preamp tube covers for my preamp tubes. Steel tube covers are not manufactured anymore, so they are highly prized. They provide better shielding than the modern aluminum covers and do not develop a layer of oxide. To provide further shielding for my amp, I will also attach a piece of sheet metal on the inside of the back cover board to have a complete metal case around the circuitry.

Frequency Response:

The frequency response of the amp is shown below for different control settings, and was measured using an HP3562-A spectrum analyzer, taking 1% of the signal output from the amp's speaker jack. All the settings are roughly similar other than amplitude. The setting with a striking difference is maximum presence which attenuates the low frequencies rather than high



Mounting the Chassis in the Cabinet:

The '59 Bassman cabinet I bought had never been used, so I needed to drill holes in the top in order to attach the chassis. We marked holes by holding the chassis upside down on top of the cabinet and aligning it before making marks on the top of the cabinet for the bolt holes in the cabinet. The bolts I used were ordered from Weber Speakers. Any bolts of the right size can be used, but these bolts are the original style chrome pan head.

In addition to the 2 usual bolts, a third was attached to a square 90^{o} bracket mounted on one of the top through-bolts of the output transformer. This adds a little more security against the chassis ever falling out of the cabinet.

Using and Maintaining the Amp:

When turning on the amp, I should allow it to warm up in standby for a few minutes to warm up the tubes. Also, due to the inrush current limiter in my circuit board (a negative temperature coefficient 2-lead device), this causes the B+ voltage to creep up slowly over time. When turning off the amp, I should turn the power switch to off and leave the standby switch on to let the voltage in the circuit dissipate. I should also always unplug the amp from the wall power when it is not in use.

I should always store the amp in a low humidity setting with a comfortable temperature. I should also clean the connections occasionally to avoid oxidation.

Conclusion:

I loved building this amp, and I love how it sounds! I guess all I have to do now is learn to play guitar!