



**WYETECH  
LABS**

**Owner's Manual**

# **Sapphire**

Single ended triode (SET)  
monoblock amplifier



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## Introduction

Thank you for purchasing a Wyetech Labs amplifier. You are in possession of what we believe will become known as one of the best full range 300B amplifiers while maintaining the tradition of this tubes glorious mid-range that is stunning in its purity. This unit has been completely hand crafted using some of the same reliable and sonically neutral parts as is presently used in our other amplifiers.

Our goal was to design an amplifier around what is probably the most known and popular tube for audio use, namely the 300B. We have also chosen among all that is presently manufactured what we think is the best sounding 300B in the marketplace irrespective of price. We also were impressed with the reputation this tube has for reliability. This amplifier also uses another rugged 5687 NOS triode for the voltage & driver gain stages that complements and allows the 300B to perform at its best.

Using a wide bandwidth custom Hammond output transformer has allowed this design to overcome the short comings that a lot of other 300B amplifiers are noted for. You will be surprised to know that the bass is quick , fast and deep, while the highs are smoothly extended to 40 kHz.

Separate high voltage DC power supplies isolate the voltage/driver stages from the output stage, which in a single ended amplifier is a critical attribute.

Our self-biasing stages, while completely eliminating all adjustments, insure long term stability and reliable operation. As in our previous Onyx design, we have implemented what we call a quasi-parallel circuit design where each of the two output triodes have their own independent automatic biasing circuit. Only the plates are tied together to drive the output transformer. Although this doubles the amount of parts in the biasing circuitry that normally would be employed, it results in a purity of sound that one would normally associate when using only a single triode, such as is implemented in our Topaz design.

We also use filtered DC on the filament of the input / driver tube to keep hum and noise at a minimum. The 300B output filaments each have their own regulated DC 5 volt supply that negates the use of hum minimizing adjustments that inferior amplifiers use.

Further refinement can be found in the use of a delayed DC power sequencing that maximizes tube life by preventing cathode emission deterioration. Low frequency response has been greatly enhanced by using very large signal capacitors and wide bandwidth output transformers. These combined attributes reduce overall distortion at higher power levels and give an overall impression of a much more powerful amplifier than what the specifications would suggest.

Unlike solid state amplifiers, that when clipped sound extremely harsh, this amplifier can be pushed beyond its rating with little noticeable effect due to the tendency to compress when overdriven, which is much more benign than what normally occurs with solid state equipment.

## Design goals

### Audio circuits

We opted to keep the same circuit topology as that found in our more expensive Topaz amplifier, which is plate loaded single ended in all stages. For the signal and driver we use readily available low cost NOS (New Old Stock) triodes that were made in the USA and have met JAN (Joint Army Navy) military specifications. We chose the Full Music premium TJ gold mesh plate 300B's for their superior sound and reliability.

We use a custom Hammond output transformer designed to our specifications which resulted in a wide bandwidth with exceptionally deep low frequency response.

### Power supply

Single ended amps are more susceptible to power supply aberrations than push-pull amps. For this reason we have split the front end from the output by using completely separate power supplies. This eliminates power supply feedback non-linearity. To keep cost moderate and still uphold sound quality we opted for R-C filtering as opposed to the more expensive L-C used in the Topaz. (R = resistor, C = capacitor, L = inductor) We also use electrolytic capacitors with much larger storage capacity to make up for the loss in filtering when using resistors in lieu of inductors. The radiated heat is distributed inside the chassis, such that, it insures that the chassis runs only warm to the touch. The total power intake and heat dissipation is only 185 watts per channel, for an amplifier operating in pure class A1.

### Parts quality

We use precision quality parts throughout. Our printed circuit boards have a manually designed layout using computers to meet the needs of analog design which are radically different than digital or computer circuit design. We needed large signal and power traces and special footprints for parts like the tube sockets. This has resulted in short signal paths and more precise positioning of components on the board. We use wire wound silicone and ceramic high power resistors and computer grade electrolytic capacitors in our power supplies.

All wiring to the printed circuit boards is done with the use of screw down connectors. This is done for ease of repair should ever the need arise. We use a single oxygen-free copper (OFC) coax cable for the signal input wiring and Teflon coated silver plated OFC wire for the speaker connection and selector impedance switch wiring.

## Circuit Description

All stages operate in pure class "A1" single ended and contain automatic self-biasing circuitry. Our custom built Hammond output transformer has endowed this amplifier with very extended low and high frequency response. Each of the two output triodes are individually self-biased, with only the plates tied together in a quasi parallel configuration, which is nearly equivalent to having one high powered triode. Our 12 pound output transformer provides 18 Watts RMS per monoblock with solid bass and absolute stability into all low impedance loads. The output

windings can be toggled via two high current switches to allow selection of impedance for 2, 4, 8 or 12 Ohms. We employ no feedback of any kind due to the low distortion ultra-linear amplification stages employed in this design.

## **Power supplies**

Toroidal power transformer voltage input can be selected for 115V/230V 50-60 Hz operation via an internal toggle switch. Three output windings provide full-wave rectification using spike & noise suppression circuitry.

Separate DC power supplies provide total isolation between the INPUT and OUTPUT stages. These consist of a triple  $\pi$  (pi) filter for the 460 Volt output rail and a double  $\pi$  (pi) filter for the 400 Volt input & driver rail. The use of RC filter networks with very large electrolytic capacitors and wire wound power resistors provide an unparalleled ripple reduction and low noise operation.

Rectified and filtered DC provide the power for the input tube filament of the 1st and 2nd stage. The other two 300B output tube filaments each have their dedicated regulated DC floating power supply that eliminates the normally found hum adjusting potentiometer. This provides a very low noise floor that allow all subtle nuances in the music to be heard.

## **Mechanical Construction**

- Extremely rugged (14 gauge) all welded steel chassis further reduces any possibility of vibration induced signal aberrations.
- Highly polished brass handles allow for easy handling and accentuates the chassis styling.
- Gold plated brass holder with 3M rubber feet inserts also accentuates the styling as well as incorporating Sorbothane isolation between it and the chassis.
- Very high quality paint / primer coat and baked on finish enhance the artistry.
- A deep lavender color accentuates the satin black finish of the output transformer and toroid cover.
- A cast aluminum box is used to cover the power Toroid transformer to strengthen an already appealing look.
- Metalized TEFLON signal caps
- Shuguang 300B Treasure tubes with High Polymer Compound Carbon (HPCC)

## **Circuit board**

The components are mounted on a printed circuit board (PCB) which is made from FR4 glass epoxy with double sided copper traces and plated through holes. Both sides have a protective green solder mask. A silkscreen is printed in white showing the component layout and parts value. This PCB was designed manually in house. It has enlarged power and signal line traces to attain the best analog integrity that automatic routing circuit programs cannot attain. Our Printed Circuit Board program allows for an infinite varieties of traces and component layouts that can be developed into our own custom library parts. We have created a library of custom component layouts that are specifically suited to develop our Analog circuits. Wiring to the PCB

is attached via screw down crimp terminals to allow for ease of repair should the need ever occur where the board would need to be removed. We have reduced the signal path length to less than 6" on the PCB board. The final assembly of parts to the PCB is done by hand soldering of all components, which is superior to automated flow-soldering techniques, by allowing more solder on each and every joint.

### **Auto sequencing**

A time-delay relay provides extended tube life and proper power sequencing for stabilized circuitry on power up. The filament voltage is turned on for 45 seconds before applying the DC voltage power, after which the ready (green) LED comes on.

### **Power switch**

The power switch applies power to the automatic power up sequencing circuit

# Installation

## Unpacking

1. Remove top cover foam from box.
2. Remove box containing tubes, line cord & spare fuses.
3. Grab the Sapphire by the two handles and pull out from box
4. Leave remaining foam in place to facilitate repackaging if necessary.
5. Place the top foam and small box back in container and save the packaging.
6. Follow these procedures in reverse order if you need to ship this unit.

## Installing The Tubes

### 9-pin 5687WB tubes

Line up the tube pins to the socket and gently push while slightly rocking in a circular fashion until fully seated. (pins are no longer visible) Note: these sockets are very tight and take considerably pressure to insert. You must be very careful so as not to bend the pins. If pins get bent you must straighten using needle nose pliers.

### Output 300B tubes

The 300B tubes use a four pin socket consisting of two large and two smaller ones.

Place the 2 large pins over the large female sockets and the smaller pins over their corresponding smaller sockets. Wiggle slightly until you feel the pins mating properly. Then place pressure on top of tube and press straight down to seat.

When plugged in the tube filaments are in full view from the front and look like the inside of a toaster when lit up when using the TJ mesh plate tubes. A very pleasing sight to behold.

The Shuguang tubes require you to stand over them to view whether the filaments are lit up due their HP carbon coating.

To insert WATCH THAT THE TWO LARGE PINS INSERT INTO TWO LARGE HOLES. Wrong orientation will cause tube or amp damage which is not covered by the warranty.

### Removing 300B tubes

Don't handle the tube by its glass envelope when removing. Use the supplied white gloves to remove the tube. Carefully grip the base of the tube, while gently wiggling & pulling straight up to remove the tube from its socket.

### Warning

**Do not use this amplifier in the presence of small children unless it is beyond their reach. They will cause burns to any hands that touch them when turned on!**



## Installing the AC Power Cable

Connect the AC cord to the amplifier's IEC filter input connector. Ensure the power switch is in the off position and connect the AC plug to the wall outlet.

## Power Up

To power up place power switch in on position and wait for automatic sequence to complete. Once the green LED comes on you may begin to play music immediately.

This amplifier does not seem to require much warm up time for good sound reproduction, after the initial burn in period has been completed.

## Output Load Impedance Selector Switches

These switches allow selection between 2 and 16 ohm speakers. Four selections are possible – 2, 4, 8 and 12 Ohms. In general the best overall setting is usually what the speaker is rated for. The 12 Ohm position can be used to drive speakers rated at 12 Ohms and above.

Using a lower setting than the rating of the speakers increases the damping factor which may increase the performance depending on the speaker being used.

Each monoblock has two impedance switches, on either side of the amp.

- The left switch has markings of 8 – 2 in upper/rear position, and 4 – 12 in lower/front position.
- The right switch has markings of 8 – 12 in upper/rear position, and 4 – 2 in lower/front position.

Simply set each switch so that the numbers match your desired impedance.

Desired impedance (ohms)	Left switch	Right switch
2	Up (rear)	Down (front)
4	Down (front)	Down (front)
8	Up (rear)	Up (rear)
12	Down (front)	Up (rear)

## Input gain selection

Low = 20 dB, Normal = 25 dB, High = 30 dB

Normal gain is preset at the factory. To change you must remove the AC input cord to attempt removal of bottom cover.

## WARNING

**Do not attempt to change setting or open up bottom cover unless the amplifier has been turned off for at least 4 hours. The high voltage (up to 450 V DC) in the amplifier needs this time to discharge through the drain resistors in the unit.**

Low or Normal is selected via a toggle switch on the PCB board. Jumper must be in the IN position.

High is selected by moving the jumper as shown in diagram from the IN to the OUT position. Switch can be in either position for this setting.

## Periodic Maintenance

NOTE: A cloth made of soft cotton flannel is supplied with unit.

### Cleaning The Surfaces

A soft lint free 100% cotton flannel should only be used to wipe off surfaces. For finger prints or grease use only a soft cloth with a mild liquid hand soap and water, followed by a dry soft cloth to dry.

### Front end tubes ( 5687WB )

To remove tubes pull straight up while wiggling somewhat.

### Output tubes (300B)

To remove pull straight up while holding the tube from it's white ceramic which encases the glass envelope.

To install use a gentle push on top of tube should seat it firmly in place. If not you likely have not aligned the tube pins to the socket properly. Note that the 300Bs have two larger width pins and two thinner pins.

### Burn in procedure for new output tubes

If you receive these tubes directly from Wyetech Labs they will have already been tested and burned in. Otherwise, plug them in and play immediately. You may notice a subtle improvement over time, but nothing very dramatic, since these tubes do not need an extended burn-in period. If you have received these from an outside source then you should check the bias voltage using a voltmeter. The reading should be within 10% of 78 Volts DC.

### Diagnosing problems with output tubes

If you suspect that the useful life of your output tubes may be coming close to their retirement you can always measure the bias voltage using the test points provided. You need test leads with banana plugs on both ends. Insert negative lead in black test point. Insert positive lead in one of the blue test points and measure voltage.

- If voltage is below 70 Volts or above 90 Volts on any reading you probably should replace the tube. However, it may still perform well at these settings.
- Fuse blows just as the green LED comes on at power up time > can be caused by shorted output tube or defective fuse > first try replacing fuse.
- Any noise or other erratic behavior that occurs in only one channel. > swap all tubes between the two channels to see if problem moves to other channel.

### **Fuse rating**

The back of the unit says to replace fuse with 1.5 AMP MDL for 115V-60Hz or 0.75 AMP MDL for 230V-50Hz. Although this fuse rating will work for a dozen or so power ups, it will eventually blow due to fuse fatigue. We have provided the correct size fuse which should be slow-blow fuses to the following specifications. Spare fuses are supplied with unit.

2 amp MDL for 115V/60Hz and 1 amp MDL for 230V/50Hz operation

**WARNING:** Do not use a higher rated fuse than this otherwise you could void the warranty.

# Specifications

## Tube Complement

- 1 - Dual triode 9-pin base 5687WB JAN Military NOS - input / driver stage
- 2 - Triode 4 pin-base 300B Shuguang Treasure premium grade - output stage

## Frequency Response

+ 0 / - 1 dB > 11 Hz to 28 kHz

+ 0 / - 3 dB > 6 Hz to 43 kHz

## Input Impedance

	<b>Impedance</b>	<b>Gain</b>
<b>Low</b>	55 Kohms	20db > 1.28 VRMS for full output
<b>Normal</b>	50 Kohms	25db > 0.6 VRMS for full output
<b>High</b>	200 Kohms	30db > 0.38 VRMS for full output

## Absolute Phase

non-inverting (can be set to Invert at Factory)

## Power Output

18 Watts RMS per Channel

## Dynamic Headroom

music peaks up to 40 Watts

## Energy Storage

300 joules

## Universal Voltage Select

115/230 Volts 50/60 Hz

## Power Consumption

185 Watts per mono-block

## Weight (Net)

2 x 33 lbs. (30 kg)

**Weight (Shipping)**

2 x 38 lbs. (35 kg)

**Dimensions**

9.5" W x 16" L x 8.5" H

25 x 41 x 22 cm

## Warranty

To the original purchaser of this product for home use, Wyetech Labs warrants to repair or replace any part which proves to be defective through normal use, except external finishes and vacuum tubes (1 year), for a period of 5 years from the date of purchase. This warranty does not extend to any defect, malfunction or failure caused by misuse, abuse, or negligence on the part of the purchaser. Please read your Owners Manual carefully.

This is the only warranty expressed or implied and there are no other valid warranties and no one is authorized to assume any liability on behalf of Wyetech Labs or its representatives or impose any obligation on it in connection with the sale of any equipment other than as stated in this warranty and outlined above.

In no event will Wyetech Labs or its representatives be responsible or liable for other than is stated herein, such as incidental or consequential damage, interrupted operation or other causes.