Princeton Thermionic
Fullerwell 36 User's Manual

Thank you for the purchase of your Princeton Thermionic Pure Tube guitar amplifier!
This document explains how to feed and care for your new amp.

ABOUT THE FULLERWELL 36 1x12" COMBO AMPLIFIER

The Fullerwell 36 (like its little brother, Fullerwell 18) is a 2-channel guitar amplifier with a British channel and an American channel. The British channel is a Plexi-inspired voice, including Treble, Middle, and Bass EQ controls in addition to the Gain control and a dedicated Master Volume control. The American channel is based on one of the most famous and lush-sounding circuits, the Tweed 5E3. These two channels each have a high gain input jack and a low gain input jack. The high gain jack is a little hotter and is especially useful for lower output vintage style single coil pickups. The low gain jack is great for hotter wound modern pickups, in particular overwound humbuckers. Both channels flow through a long-tail pair phase inverter before going on to the output section. The preamp section is powered by three military-grade, low-noise/high output CV4004 tubes. The output section is comprised of a matched quad of EL84 tubes, and a GZ34 rectifier tube provides clean, high voltage DC power. The cabinet is 100% void-free Baltic Birch, with many custom covering and speaker grill options. The speaker is a 12" Celestion Creamback, with a wide variety of alternative options available. An optional -30dB attenuation module can also be added for full cranked tube tone at lower speaker volumes. 36 Watts of musical power make the Fullerwell 36 a great amp for gigging clubs.

QUICK START GUIDE

1) Set front panel POWER switch in the OFF position
2) Set front panel STANDBY switch in the “STANDBY” mode
3) Set all rotary tone controls on the top panel to 12:00 (clock face)
4) Set VOLUME controls at just above minimum, around 7:00 (clock face)
5) Plug the included power cable from the amp’s rear panel MAINS cable inlet to your wall power
6) Plug your guitar into the upper input on the right of the top panel, using a ¼” instrument cable
7) Switch front panel POWER switch in the “ON” position for 30 seconds to allow tubes to warm up
8) Switch front panel STANDBY switch to “ON” mode
9) ROCK!

SPECIFICATIONS

MODEL: Princeton Thermionic Fullerwell 36

TYPE: Top Control 1x12 Combo Cabinet with Fullerwell Pure Tube Circuit

INPUT POWER: 120VAC, 60Hz

INPUT SIGNAL IMPEDANCE: 100kΩ

OUTPUT IMPEDANCE: 4Ω, 8Ω and 16Ω

POWER AMP OUTPUT: 36W/18W into 8Ω @ < 10% THD, 80Hz - 8kHz

SPEAKER: 8Ω, 12", Celestion Neodymium G12

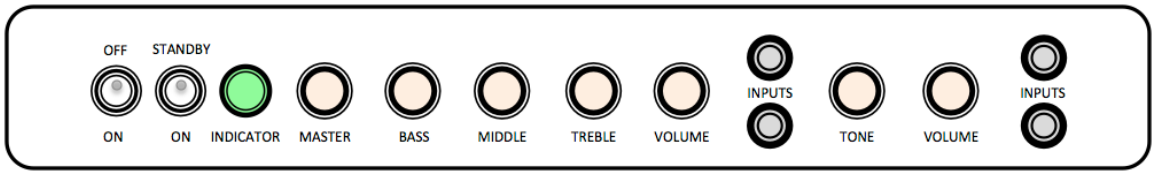
DIMENSIONS:
HEIGHT: 20 in (51 cm)
WIDTH: 24 in (61 cm)
DEPTH: 9 in (23cm)

WEIGHT: 39 lb. (18 kg)

OPTIONS:
1) Also available as a head (no speaker), 2x12" combo, and 2X10" combo.
2) Many custom finishes available; please inquire directly.
3) Custom handmade -30dB attenuator module for loud tone yet quiet volume.
4) Many speaker options available, alnico to ceramic to neo; please inquire directly.
5) A buffered active FX loop may be added upon request.

Princeton Thermionic amplifiers are custom handmade instruments.
Product specifications are subject to change without notice.
Any such changes would normally be improvements.

TOP PANEL CONTROLS



From left to right:

1) **POWER** two-way toggle switch powers the amp on and off. With the toggle switch in the DOWN ("ON") position, the amp is on. In the UP position, the amp is OFF.

2) **STANDBY** two-way toggle switch applies high voltage to the vacuum tube plates (and screen grids) during use of the amp. To ensure long tube life, first power the unit on with the STANDBY toggle switch in STANDBY position for approximately 30 seconds. You can then switch to DOWN ("ON") to use the amp. With the toggle switch in the UP position, the amp is in STANDBY mode. In the DOWN position, the amp is in OPERATE mode. Taking a break between sets at a gig? Leave the amp powered ON and in STANDBY during the break.

3) **INDICATOR LAMP** will illuminate when the amp is powered by turning the front panel POWER toggle switch to the ON position. If INDICATOR LAMP does not light up, check your power cable connections, and then the fuse on the rear of the unit.

4) **MASTER VOLUME** sets the overall volume level of the Plexi channel of the amp.

5) **BASS** adjusts low frequencies in the Plexi channel.

6) **MIDDLE** adjusts the midrange frequency response in the Plexi channel.

7) **TREBLE** adjusts the high frequency response in the Plexi channel.

8) **VOLUME** sets the overall gain and distortion level of the Plexi channel of the amp.

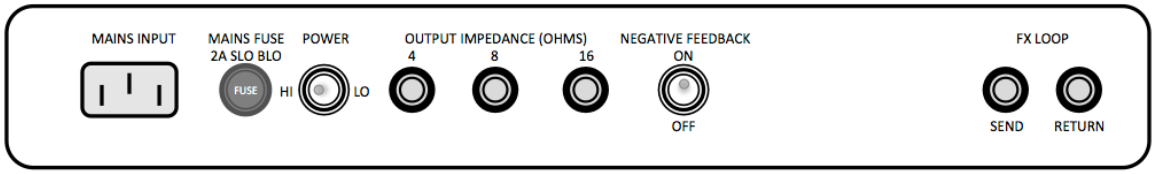
9) **PLEXI INPUT** ¼" jacks for instrument cables. Plug your guitar in here for the Plexi Channel. The UPPER input is higher gain, whereas the LOWER input is lower gain.

10) **TONE** adjusts the frequency balance for the Tweed channel. At counter-clockwise settings, the tone has more bottom end and less treble. At clockwise settings, the tone has less bottom end and more treble.

11) **VOLUME** sets the overall volume and gain of the Tweed channel of the amp.

12) **TWEED INPUT** ¼" jacks for instrument cables. Plug your guitar in here for the Tweed Channel. The UPPER input is higher gain, whereas the LOWER input is lower gain.

REAR PANEL CONTROLS



From left to right:

1) **MAINS INPUT** IEC cable inlet – plug the IEC power cable into this inlet to power your amplifier.

2) **MAINS FUSE** is used to protect your amplifier from voltage spikes or excessive current draw. Replace only when necessary with 2A Slo-Blo fuse.

3) **POWER** two-way toggle switch cuts the power output of the power amp in half, from 36W to 18W.

4) **OUTPUT JACKS** ¼" speaker cable jacks. 4 Ohm, 8 Ohm and 16 Ohm jacks are provided. Use the ¼" speaker cable to connect your speaker to the amplifier using these jacks. The standard setup includes an 8-Ohm speaker connected to the 8-Ohm jack. If you add an external speaker cabinet, ensure that you use the appropriate additional jack for the impedance of your cabinet.

NOTE – never turn your amplifier to OPERATE mode ("ON" position on STANDBY) without connecting the speaker lead to the amplifier. Failing to do so WILL damage your amplifier!

5) **NEGATIVE FEEDBACK** two-way toggle switch adds or defeats negative feedback in the power amplifier. UP engages negative feedback, which will tighten the response of the amp, increase headroom while decreasing breakup and harmonic content. DOWN defeats the negative feedback, which eases the transition to breakup, and increases the bandwidth of the power section.

6) **(OPTIONAL) FX LOOP** actively buffered FX send & return jacks

TUBE COMPLIMENT AND BIAS ADJUSTMENT

From left to right:

V1 – CV4004 (12AX7/ECC83)	…Input gain stage Tweed and Plexi channels
V2 – CV4004 (12AX7/ECC83)	…Plexi channel second gain stage and tone stack cathode follower
V3 – CV4004 (12AX7/ECC83)	…Phase inverter for both channels
V4 – EL84 (6BQ5)	…Output Tube for 36 Watt operation only (Full power)
V5 – EL84 (6BQ5)	…Output Tube for 36 Watt and 18 Watt operation (Full & 1/2 power)
V6 – EL84 (6BQ5)	…Output Tube for 36 Watt and 18 Watt operation (Full & 1/2 power)
V7 – EL84 (6BQ5)	…Output Tube for 36 Watt operation only (Full power)
V8 – GZ34 (5AR4)	…Rectifier Tube

The Fullerwell Amplifier is cathode-biased and requires NO BIAS ADJUSTMENT when installing new power tubes. With cathode bias, the amp automatically biases itself!

Princeton Thermionic amplifiers are fitted at the shop with the highest quality Mullard vacuum tubes.

FREQUENTLY ASKED QUESTIONS

Can I substitute different tube types?
In the preamp (V1-V3), you can try 12AT7s, 12AU7s, 5751s without any harm; the design is optimized for 12AX7s, which are therefore the only recommended tube in the preamp positions. We fit Mullard CV4004 tubes standard, which are a military grade 12AX7 with awesome sonic qualities. In the power amp (V4-V7), you must use EL84 tubes. A GZ34 tube is required in the rectifier socket. We fit Mullard EL84 tubes and a Mullard GZ34 tube as standard components.

Do I need to use a matched and balanced phase inverter tube?
While it is not necessary, we do fit a balanced, low noise, low microphonics Mullard CV4004 tube with matched triodes as the standard V3 component. Radically unbalanced tubes, such as the 12DW7, are not recommended because the channel mixing occurs within the phase inverter in this amplifier, so a reasonable balance is desirable. However, any regular 12AX7 type tube may be used here, even if the triodes are not perfectly matched.

I've read that the components used in the amplifier are really important. What is inside my amplifier?
This is a custom, handmade audio amplifier, built in the old school traditions. We use the highest quality, best-sounding parts available, sourced globally. For example, the transformers are made in the USA by **Heyboer**; The electrolytic capacitors are made in Germany by **Fischer & Tausche**; the signal capacitors are self-healing polyester film/foil capacitors made in the USA by **Mallory**; the tube sockets are high quality Micalex by **Belton** in South Korea; the potentiometers are premium from **Alpha** in Taiwan, the jacks are by **Cliff Electronic Components** in the UK; the signal resistors are military-specification, precision metal film by **Dale** in the USA; the bias capacitors are by **Sprague** in the USA; and the power resistors are high wattage by **Ohmite** (Brown Devils) in the UK; the screen resistors are the premium reduced mass wirewound type by **Draloric** in Germany. We use the traditional point-to-point turretboard method of component mounting rather than modern, cheaper PCBs. Our turretboards are the heaviest-duty FR4/G10 glass epoxy boards available, custom fabricated for us by **Hoffman** in the USA. We also use heavy gauge, Teflon insulated, military specification, aerospace grade, silver-plated copper hookup wire from **Alphawire** in the USA throughout the circuit. One exception is the input lines from the input jacks to the first preamp tube grids – for these sensitive lines we use special copper shielded low noise wire from **Mogami** in Japan. We use new production vacuum tubes by **Mullard** in Russia.

Is this amplifier Class A or Class AB? And which is better?
This amp operates in Class AB. There has been a lot of marketing hype over the years by a variety of manufacturers regarding Class A vs. Class AB. To keep it simple, think of operating class this way: In Class A operation, current always flows through the plate of each tube. In class AB operation, current flows through the tube plates part of the time only, and the tubes take turns handling different sections of the input cycle. A benefit of Class AB is the circuit can produce more power. The Fullerwell is biased so that current flows in each plate for more than half of the cycle but less than the entire cycle, resulting in full, rich harmonics and lush musical tone.

Is this amplifier single-ended or push-pull?
This amp employs a push-pull topology. This is why the circuit includes a phase inverter tube (V3). Push-pull is more efficient and powerful than single-ended designs.

How is this amplifier biased?
This amp is cathode-biased, rather than fixed-biased. The bias voltage is developed across a pair of huge 12-Watt Ohmite Brown Devil wirewound resistors, paired with a giant 100-Volt Sprague Atom electrolytic capacitor. Cathode biasing adjusts the bias of the EL84 output tubes automatically, so you never have to pay a tech fee to adjust the bias when changing the output tubes, as you might with a fixed-bias amp. It also allows you to try out a wide variety of output tube brands, even unmatched sets if you like.

What is your background – why are you qualified to build handmade amplifiers?

I had taken electronics courses in school, and I was familiar with high voltage from building light show systems and running lights and sound for some bands and DJs in New England during the 1980s. My older brother founded an electronics company originally called Rocklight Engineering and I helped him build, install and operate lightshow and audio gear for bands and clubs. His company grew into a leading theatrical supply company, The Production Advantage. He showed me how to use the tools of the trade -- multimeter, oscilloscope, variac, heatsinks, and how to solder components properly. We made some crazy strobe lights out of Navy aircraft landing lights. We set up keyboards to control the par lamps and fog machines -- all solid, heavy gauge, handwired stuff. Occasionally we'd chase each other around his workshop with charged Sprague electrolytic capacitors zapping each other. There was a memorable trip to the ER to flush some errantly squirted tube cleaner out of an eyeball. Ahh, the good old days...

…then, in 2018 I retired from a career on Wall Street and wanted to spend more time playing guitar. I decided to get back into building electronics with tube amps and effects pedals. The original concept I had was to build a "Tweed-style Tone Monster" the compact portable size of a 1980s Fender Super Champ, the 18 Watt tube amplifier I played in my rock bands during high school (Back in those days I scratch built a talkbox out of an Electro-Voice horn driver and some UV fluorescent plastic tubing, in an aluminum enclosure that I TIG welded). So I put together a nice little electronics shop in my buddy's barn. I started Princeton Thermionic with a two-channel 18 Watt 1x12 combo in 2018 (the Denim Deluxe) – this was the first Fullerwell circuit. In 2019 I also built a new talkbox and a couple of custom overdrive pedals. In 2020 I added a bigger, beefier 36 Watt version of the Fullerwell, which found immediate demand among local area guitarists in New Jersey, Pennsylvania and the tri-state area.

Can I service the amp myself?

You can change tubes, but be sure to let them cool down before grabbing them, no reason to burn your fingers! You can also replace the 2 Amp Slow-Blow fuse on the rear panel if it blows due to some external electricity spike. Other than that, we recommend returning the amp to us, or to a qualified local tube amp technician, for any other service. **There is extremely high voltage inside the chassis, even when the amp is unplugged or turned off. This high voltage can kill you.** There are no user-servicable parts inside the amp. So why take a chance of dying?

What is this "Hendrix Jumpering Trick" I've heard about?

This amp has 4 input jacks. You can plug in one guitar, two guitars, three guitars, or four guitars simultaneously. Or a guitar and a keyboard. Or a guitar and a harmonica. Or a guitar, a keyboard and a harmonica… You can also plug in one guitar and a short instrument cable jumpered across the two channels to cascade the guitar signal through both channels at the same time. This gives a fat, lush tone. For example, plug your guitar into the Plexi channel Hi Gain input jack and run a 6" instrument cable from the Plexi channel Lo Gain input jack to the Tweed channel Hi Gain input jack. Wow! This was a trick used in the '60s and '70s by some of the all-time rock legends to produce gorgeous thick tones – it's like playing through 2 differently voiced amps at the same time and can sound quite stunning. Start by turning up the Tweed channel volume control until a desired tone is achieved. Then bring up the Plexi channel volume control to add more sizzle into the sound. Or, try plugging your guitar into the Tweed channel Hi Gain input jack and run the jumper cable from the Tweed channel Lo Gain input jack to the Plexi channel Hi Gain input jack. The tonal possibilities are only limited by your imagination.

Does the half-power switch change the output tubes from operating as pentodes to operating as triodes?

No. The EL84 output tubes are pentode tubes, with 5 internal elements. We have found that these tubes provide the richest tone and most colorful harmonics when they are operated as designed, using all 5 elements to amplify the sound completely. Some other amplifier designs include a "pentode/triode" switch that reduces the output of the tubes by effectively severing some of the internal tube elements. In our experience, tone suffers and amplifiers sound "flat" when pentode tubes are run in triode mode. So our half power switch always runs the output tubes in pentode mode, and instead cuts out 2 of the 4 EL84s completely when "Lo" power mode is selected. The circuit is designed to automatically adjust the impedance of the cathode resistors to maintain the proper bias in both "Hi" (full) and "Lo" (half) power

modes. The result is that the complete Fullerwell tone is maintained in both 36-Watt and 18-Watt operation, and the amp is slightly louder in 36-Watt mode.

Running in half-power makes the amp a little bit quieter, but doesn't make it a lot quieter. I want to play late at night without disturbing the neighbors. But I want the sound of the cranked amp; I like that distorted output tube tone the best. What can I do?
We offer an optional hand made attenuation module that will soak up to -30 decibels off the final signal going to the speaker without affecting the tone. It fits nicely into the cabinet and plugs between the speaker jack and the speaker. This module also offers an additional external speaker out jack so you can use an external cabinet for a stereo effect or as a "mini-stack".

How should I mic this amp for stage use with a PA, and for studio recording?
You can mic this amp just as you would with any other combo amp. For example, many sound engineers like to record these tone machines by putting a microphone in front, slightly off axis of the speaker to get a crunchy, bluesy tone. Or they move the microphone to be centered directly in front to get an upfront rock tone. One method we really like for a HUGE sound is to record using two microphones, one in front of the speaker, as above, and a second microphone behind the speaker. The second signal will be out of phase, so be sure to reverse this microphone's phase at the console's preamp. We like Sure SM57 microphones for this setup.

I have a Weber WZ34 Copper Cap rectifier; can I use it in this amp instead of a GZ34 tube?
Yes. Weber Copper Cap Rectifiers are solid-state rectifier replacement devices for use in place of vintage tube rectifiers. The WZ34 emulates the forward conduction resistance curve of the GZ34 tube. It also has linear in-rush current limiting to simulate the warm-up of a tube rectifier, however, it is in the 1 to 2 second range, rather than the 7 to 9 seconds of a typical rectifier tube. The Copper Cap emulates a tube rectifier without using any filament power. This energy savings means that the power transformer may run cooler and last longer. Copper Caps are designed to last the lifetime of the amp when used properly. You might find the tone of the amp is slightly different with the WZ34 than with a GZ34 tube. Use whichever of these rectifiers you prefer.

Does this amp offer an effects loop for my pedalboard?
Yes. We recommend running high-gain pedals such as fuzz and overdrives between the guitar and the input jack. Then the amp offers a wonderful adjustable wet/dry mix that is especially well suited for time-based pedals: **Modulation** (such as phase shifter, tremolo, chorus, flanger, rotating speaker simulator, etc.), **Delay** (analog, digital, tape, etc.) and **Reverb**. To employ this option, plug your guitar (with any high gain pedals) into the Plexi channel Hi Gain input jack and run an instrument cable from the Plexi channel Lo Gain input jack to your pedalboard input; from the pedalboard output, run another instrument cable to the Tweed channel Hi Gain input Jack. You can blend the wet and dry signals by using the volume controls for each channel. Or swap the channels: plug your guitar into the Tweed channel Hi Gain input jack and run an instrument cable from the Tweed channel Lo Gain input jack to your pedalboard input; from the pedalboard output, run another instrument cable to the Plexi channel Hi Gain input Jack. We can also install an optional, buffered, active FX loop on the rear panel.

Why is the circuit called the "Fullerwell"?
The Fullerwell circuit includes an American, Tweed '50s style channel and a British, Plexi '60s style channel. Fullerton, California was the birthplace of Leo Fender's original amplifiers and Jim Marshall's first shop was at 76 Uxbridge Road in Hanwell, London. **Fuller**ton plus Han**well** = **Fullerwell.** It's our way of paying homage and respect to two of the true pioneers of Tube Amplifier design.

Are you experienced?
Not necessarily stoned, but beautiful.