



## VHT TUBE TESTER 2

### MONITOR YOUR OUTPUT TUBE PERFORMANCE

The VHT Tube Tester 2 provides two completely independent current-measuring tube tester sections. Simply plug your tubes into the adapters and then plug the included 8-pin octal-based adapters into your amp.

The two high-quality analog milliamp meters measure the tube's cathode current. You can use these measurements to observe your tube's real-time dynamic performance, see how well they're matched, adjust the bias, monitor your tube's performance as they age, check for unstable conditions, and more.

Additional test-pin jacks are provided for precise digital multi-meter measurements and analog meter calibration.

The VHT Tube Tester 2 is an affordable bench and road tool that lets you see how your output tubes are performing in real time, and whether it's time for replacement or a bias adjustment, etc. Get the most from your tubes — and amplifier — with a VHT Tube Tester 2.

#### SET UP

Setup is easy, simply unplug your output tubes and carefully plug them into the Tube Tester 2's adapters, then plug the adapters into your tube sockets.

Pay close attention to the tube's aligning guide pin, and be sure the adapters are aligned correctly with your tube sockets. (An incorrectly installed tube or adapter can cause serious damage to your amp and/or tubes.)

Some tubes may be a tight fit in the adapter. Tube pin diameter varies slightly between different tube manufacturers, and sometimes there will be some excess solder on the pin. For an easier fit, you can file-down excess solder with an ordinary fingernail file.

After the tubes and adapters have been properly secured, connect the adapter's banana plugs to the meter unit.

**Test-pin jacks:** For precise digital measurements and analog meter calibration, plug a DMM (digital multimeter) into the front panel test-pin jacks and set the DMM to its millivolt range; the test-pin jacks measure the voltage drop across a 1-ohm precision cathode resistor, 1 millivolt = 1 milliamp cathode current.

You can also plug the adapter's banana jacks directly into a DMM (set for milliamperes).

#### OPERATION

While other tube testers test your tubes externally, the truest and most relevant test is how your tubes perform in your amplifier.

The Tube Tester 2's high-quality analog meters provide a unique window into your tube's performance. Analog meters provide a much better view of your tube's *dynamic* response than digital meters (which are still useful for precise measurement of *stable* idle currents and voltages, and also for meter calibration).

After the tubes and adapters have been installed properly, power-up the amp as usual.

## **OPERATION, CONTINUED**

Observe the meters as the tubes warm up and slowly begin to draw current.

The meters will show a gradual rise in current until the tube idle current begins to stabilize.

(If the meters deflect in the negative direction, reverse the banana plug's polarity.)

If one of the tubes, or both, continue to draw current without stabilizing, this is a clue that the tube is defective (prone to "runaway"); it needs to be replaced.

**Do the two tubes rise at about the same rate, or does one tube rise faster than the other?**

Tubes with similar characteristics will warm-up at similar rates. An unusually fast warm-up rate can indicate a problem; it could be a tube problem or perhaps an amp problem.

**When the idle current stabilizes, how closely are they matched?**

The analog meters show 4 milliamps per division; a close/acceptable match is generally considered to be something less than a 10% difference between the two tubes.

With practice, you will learn to quickly recognize common tube problems such as runaway "red plating" as well as unstable conditions that cause unreliable operation.

## **MICROPHONICS TEST**

Tap the tubes and listen for microphonic rattles and rings while also watching the meter for unstable readings. (A doctor's rubber knee reflex hammer can be purchased cheaply on eBay, or a pencil with added eraser is also good, and a good alternative to the old-fashioned tried-and-true "fingernail flick.") Unstable meter readings indicate a tube with loose internal components; these tubes should be discarded.

## **BIASING**

After you've confirmed that your tubes are stable and the idle current is reasonably matched, you can use the Tube Tester 2 to adjust the idle current level (assuming your amp has an adjustable "fixed-bias" type circuit).

Simply put, "proper biasing" is any bias setting that sounds good to you without destroying the tubes. It is, after all, about tone, and tone is of course very subjective. Some people prefer a hot bias (high current), while some people prefer a colder bias (lower current). Fine-tune by ear, and season to taste, while always being aware of the tube's practical limits (its real-life maximum plate dissipation).

An output tube has a maximum plate dissipation rating; these generalized ratings were developed many decades ago, and they can be found in old tube manuals and reproduced online.

But tube manufacturing is different now; some currently manufactured tubes can easily exceed the old maximum ratings, while others don't measure up. So the old maximum plate dissipation ratings should be regarded as good guidelines rather than absolute limits. Your results may vary.

## **CALCULATING PLATE DISSIPATION**

To accurately calculate a tube's plate dissipation, you need to know the tube's plate voltage. This is the voltage between the tube's plate and its cathode (pin 3 and pin 8). You can measure this with a DMM, but you'll need to remove the chassis to access the tube's socket.

If this is not convenient, you can estimate; most amps with large octal (8-pin base) tubes (like 6L6 or EL34, for example) operate at around 400 to 475 volts on the plate, while smaller tubes like EL84s and 6V6 tubes will typically operate at lower plate voltages, around 350 volts or less if they're cathode biased.

## **PLATE DISSIPATION FORMULA**

Plate voltage x current = plate dissipation (watts)

Example: 450 volts plate voltage x 40 mA (meter reading) = 18 watts plate dissipation; this would be considered safe for an EL34 but dangerous for a 6V6.

Some cathode biased amps are known to routinely exceed the recommended maximum plate dissipation, so don't be surprised if your meter readings indicate plate dissipation approaching or exceeding the textbook maximum rating.

## PLATE DISSIPATION AND ADJUSTING THE BIAS

Fixed biased amps are typically biased below the maximum plate dissipation rating; typically between 50% to 75% of the maximum plate dissipation.

Each tube will have its own inherent capabilities, the tube will show you when its maximum plate dissipation has been exceeded — its plates will begin to glow orange/red (“red plating”). It’s wise to heed the tube’s “red plating” warning sign; “red plating” quickly leads to tube failure and destruction.

## TYPICAL GUITAR AMP VOLTAGE AND CURRENT MEASUREMENTS AND TUBE MANUAL MAXIMUM PLATE DISSIPATION RATINGS

EL84 = 12 watts	Plate voltage = 350 x 34 mA = 12 watts
6V6 = 14 watts	Plate voltage = 400 x 35 mA = 14 watts
6L6GB = 19 watts	Plate voltage = 450 x 42 mA = 19 watts
5881 = 23 watts	Plate voltage = 450 x 51 mA = 23 watts
EL34 = 25 watts	Plate voltage = 450 x 55 mA = 25 watts
6CA7 = 25 watts	Plate voltage = 450 x 55 mA = 25 watts
KT66 = 25 watts	Plate voltage = 450 x 55 mA = 25 watts
KT77 = 25 watts	Plate voltage = 450 x 55 mA = 25 watts
6L6GC = 30 watts	Plate voltage = 450 x 65 mA = 30 watts
7581 = 30 watts	Plate voltage = 450 x 65 mA = 30 watts
KT88 = 35 watts	Plate voltage = 450 x 78 mA = 35 watts
6550 = 35 watts	Plate voltage = 450 x 78 mA = 35 watts
6550A = 42 watts	Plate voltage = 450 x 93 mA = 42 watts

## CALIBRATING THE METERS

While testing tubes in an amp, plug a high-quality DMM into the test pin jacks and compare the DMM’s readings with the meter readings; adjust the meter’s calibrating screw to match the DMM reading.

## DYNAMIC TESTING

Plug an audio signal generator into your amp’s input and observe the meter’s response as the signal level is increased.

Many smart phone signal generator apps are available; all you need is a stereo-to-mono cable to connect your phone to your amp.

### Do the meters “track” the same as the signal level is increased?

Uneven dynamic tracking can indicate output tubes that have poor dynamic matching, or perhaps a poorly matched phase inverter/splitter tube, or perhaps other internal amp imbalances. A certain imbalance can be considered musical to some ears; again, it’s a matter of personal taste. Guitar accents can produce very dynamic pulses, confirm the signal generator’s dynamic response with guitar accents; punchy chords are a good way to observe the real-world dynamic response.

**Caution:** Exceeding the meter’s maximum level can damage the meters.

## FEATURES AND SPECS

Includes two standard 8-pin octal-base adapters with dual banana plugs.

Adapters accept all popular octal-base output tube types:

6V6, 6L6, EL34, KT66, KT77, KT88, 6550, etc.

Two high-quality 3” diameter metal and glass analog milliamp meters (100 mA max).

Additional test-pin jacks for external digital multi-meter connection.

Durable vinyl-covered wood cabinet.

Requires no external power.

Dimensions: Height: 5.25” (133mm), Width: 8.75” (222mm), Depth: 2.5” (63mm)



#### **LIMITED WARRANTY INFORMATION**

The Tube Tester 2 is warranted to the original purchaser to be free from defects in materials and workmanship for a period of five (5) years, excluding cables and meters, which are warranted for ninety (90) days from the original date of purchase.

The manufacturer shall, at its option, either repair or replace the defective unit if the unit is returned to the original place of purchase. If any returned unit is not defective within this warranty, the manufacturer shall so advise the purchaser and thereafter shall dispose of said unit in accordance with the purchaser's instructions and at the purchaser's cost. This warranty is not transferable by the purchaser.

The warrant shall not apply if the unit has been misused or damaged as a result of neglect, abuse, alteration, improper handling, unauthorized repair or modification, accident or causes external to the unit, such as, but not limited to excessive heat or humidity.

The manufacturer's sole and exclusive maximum liability for any claim by the purchaser shall not exceed the wholesale value of the unit. In no event shall the manufacturer be liable for any indirect, incidental, collateral, exemplary or consequential damages or losses arising out of the purchaser's purchase of this unit. The above limitations may not apply in some states (U.S.), international regions or countries.

#### **LEGAL DISCLAIMER**

Vacuum tube amplifiers contain potentially lethal voltages, under no circumstances shall VHT or any of its corporate affiliates be liable for any special, incidental or consequential damages, including but not limited to, death, injury or damages from the use of this device.