

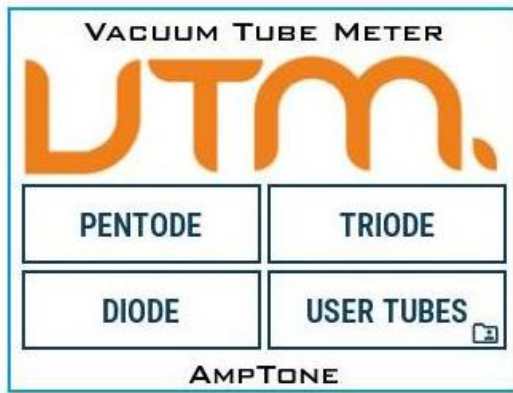
User manual

UTM

VACUUM TUBE METER

by AmpTone, Poland

START Screen



PENTODE – list of pentode and beam tetrode tubes from the internal database.

TRIODE – list of triode tubes from the internal database.

DIODE – measurement screen for rectifier tubes.

USER TUBES – list of user-defined tubes.

PENTODE, TRIODE Screen

Selection of a tube from the internal database.

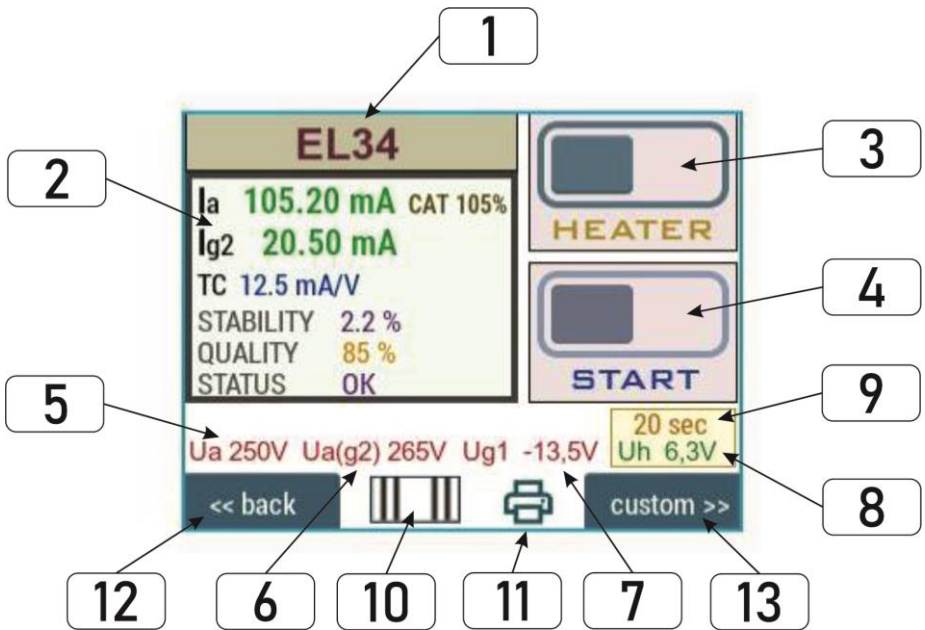
PENTODE:

EL84	6V6	6L6
6L6GC	EL34	6CA7
KT66	KT77	KT88
KT120	EF86	
<< back		

TRIODE:

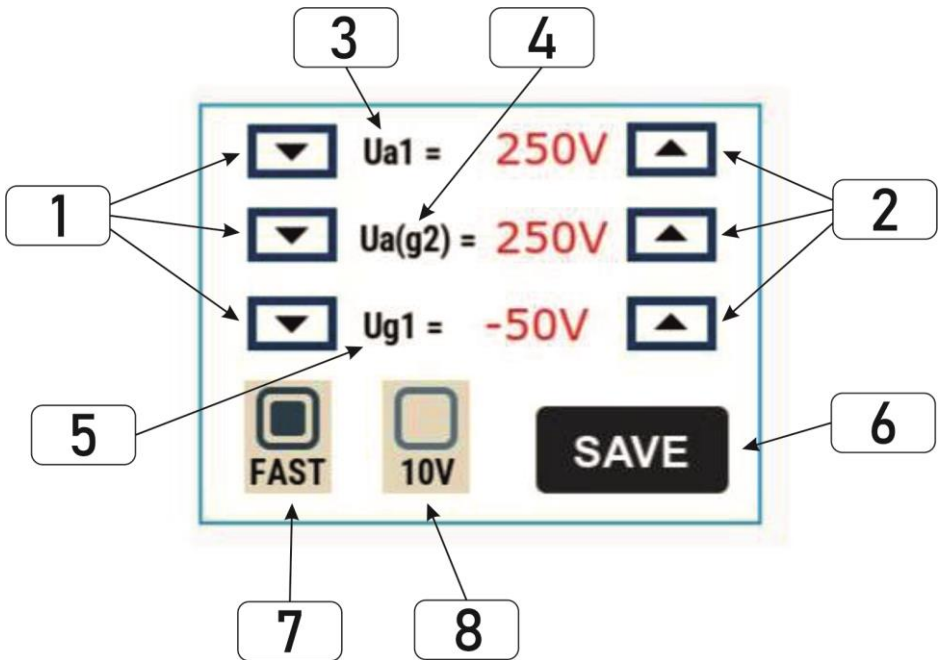
12AX7	12DW7	12BH7
12AU7	5751	ECC99
12AT7	ECC88	6SN7
12AY7	6SL7	6n2p
<< back		

MEASUREMENT Screen



- 1 - Selected tube name,
- 2 - measurement results field,
- 3 - heater ON button,
- 4 - start measurement button,
- 5 - set anode voltage,
- 6 - set screen grid voltage (or second triode anode voltage),
- 8 - heater voltage,
- 9 - preheat time setting,
- 10 - go to MATCH screen,
- 11 - print label,
- 12 - back button,
- 13 - enter custom voltage setup.

CUSTOM Screen



- 1 – Decrease voltage,
- 2 – increase voltage,
- 3 – anode voltage,
- 4 – second triode anode / screen grid voltage,
- 5 – grid voltage (G1),
- 6 – save buton,
- 7 – FAST mode (fast/slow adjustment),
- 8 –voltage step selection.

USER TUBES

USER TUBE LIST	
300B	T 250V 250V -50V 5V

<< back [EDIT] [ADD NEW]

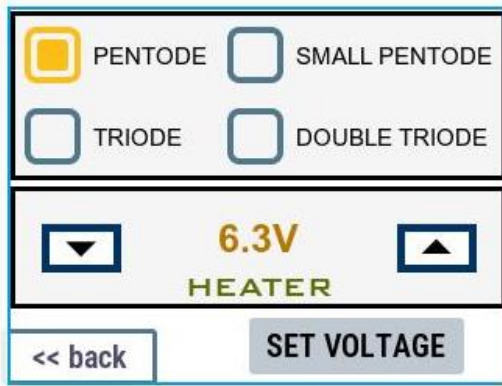
List of user-defined tubes stored in memory (max 10).

To add a tube:

- press ADD NEW
- complete the setup process

[A]	▼	▲	+
[1]	▼	▲	+
300B			⏮ ×
<< back RESET SAVE NAME			

Tube and filament voltage selection screen:



☒ PENTODE ☐ SMALL PENTODE
☐ TRIODE ☐ DOUBLE TRIODE

 6.3V
 HEATER

Initial voltage selection screen:



 $U_{a1} =$ **250V**

 $U_{a(g2)} =$ **250V**

 $U_{g1} =$ **-50V**

Editing:

- select tube → go to measurement → press BACK
- use RESET to clear name
- confirm with SAVE NAME

300B	T 250V 250V 5V
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Example Measurement 12AX7.

Step 1 – select from the main menu:

A rectangular button with a black border and the word "TRIODE" in blue capital letters.

Step 2 – choose the tube from the device database:

A rounded rectangular button with a black border and the text "12AX7" in black capital letters.

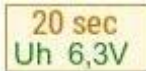
Step 3 – insert the tube into the socket; the red indicator will light up,

Step 4 – on the MEASUREMENT screen, press the button:



The preheating time of the tube depends on the selected field/button.

In this case, it is set to 20 seconds.

A small rectangular display with a yellow background. It shows "20 sec" in orange text and "Uh 6,3V" in green text.

If you select this field, a window will appear allowing you to choose the preheating time, after which the meter will start the measurement

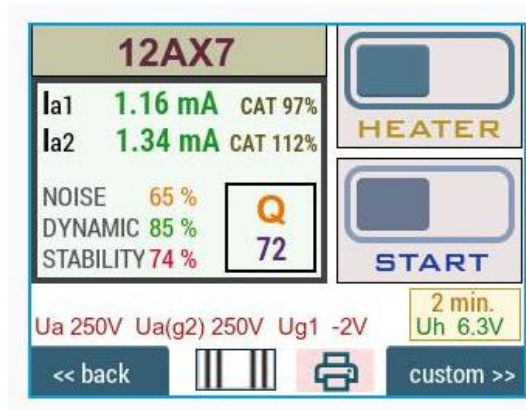


It is also possible to start the heater manually using the HEATER button.



More information about the tube warm-up process is provided later in this manual.

Results:



Ia1 **1,16mA** – anode current (triode 1),

97% – % value vs datasheet,

Ia2 **1,34mA** – anode current (triode 2),

112% – % value vs datasheet,

NOISE – **65%** (orange) - acceptable noise level.

DYNAMIC – **85%** (green) - good dynamic matching.

STABILITY – **74%** (red)

Total tube quality rating Q – 72

Example Measurement EL34.

Step 1 – select from the main menu:

PENTODE

Step 2 – choose the tube from the device database:

EL34

Step 3 – insert the tube into the socket; the red indicator will light up,

Step 4 – on the MEASUREMENT screen, press the button:



The preheating time of the tube depends on the selected field/button.

In this case, it is set to 20 seconds.

20 sec
Uh 6,3V

If you select this field, a window will appear allowing you to choose the preheating time, after which the meter will start the measurement



It is also possible to start the heater manually using the HEATER button.



More information about the tube warm-up process is provided later in this manual.

Results:



Ia 87,34mA – anode current,

87% – % value vs datasheet,

Ig2 22,62mA – screen grid current,

TC 12,7 mA/V – transconductance.

STABILITY – ±1,4% – moderate stability.

QUALITY – 85% – efficient, good quality.

STATUS – OK – meets the measurement criteria.

Tube Warm-Up Time - Recommendations

To obtain reliable and repeatable measurement results, the tube should reach stable operating conditions before starting the measurement.

Recommended warm-up times:

- minimum: approximately 2 minutes
- recommended: 5 minutes
- for long-unused tubes: longer warm-up may be required

Why it matters

During the first minutes of operation:

- cathode emission increases as temperature rises,
 - anode current (I_a) may change,
 - transconductance (gm) is not yet stable,
 - parameters may drift over time.
-

Important

Measurements performed too early may:

- underestimate anode current (I_a),
 - overestimate instability (STABILITY / GM STABILITY),
 - lead to incorrect tube evaluation (e.g. UNSTABLE or BAD).
-

Practical tip

For a quick check, a measurement can be performed after a shorter warm-up time.

However, for accurate evaluation and tube comparison, full warm-up is strongly recommended.

It is also possible to start the heater in advance using the HEATER button and begin the measurement after the appropriate warm-up time.

MATCH Screen

After selecting the button:



You'll be taken to the 'MATCH' screen, where your most recent measurement results are displayed.

Stores recent measurements.

- CLOSE – save result.
- CLEAR LIST – delete all.

Parameters:

- I_a – anode current.
- I_{g2} – screen grid current.
- g_m – transconductance.
- Δg_m – deviation.
- STATUS – tube conditio.

Max entries: 20

	la	Is(g2)	gm	Δgm	STATUS
1	104.0	16.5	12.9	2.0	OK
2					
3					
4					
5					
6					
7					
8					
9					

CLOSE
MATCHING
CLEAR LIST

MATCHING – tube selection

The MATCHING function is used to automatically select tubes with the most similar electrical parameters.

After measuring multiple tubes and adding them to the list (using the MATCH button), the device analyzes the results and identifies the best-matched pairs. The matching process is based mainly on comparing anode current (I_a) and transconductance (g_m).

For dual-section tubes (e.g. triodes), both sections are taken into account, ensuring more accurate pairing.

The MATCHING result is displayed as a list of tube pairs with a percentage difference value (Δ). The lower the Δ value, the better the match.

QR Code – Measurement Result



The device allows generating a QR code containing the basic measurement results of the tested tube.

The code can be scanned using a smartphone or a label printer application.

After scanning, the QR code provides a compact text representation of the measurement, which can be used for:

- quick tube identification,
- storing measurement results,
- printing labels (e.g. via Niimbot app),
- archiving or further analysis.

QR Code Content

The QR code contains a simplified set of measurement data, optimized for reliable scanning:

For triodes / double triodes:

- anode current (I_a)
- transconductance (g_m)

For pentodes:

- anode current (Ia)
- transconductance (gm)
- tube condition status

Note:

The HC (High Current) status indicates that the measurement was performed at a higher-than-recommended anode current. In such conditions, the stability result may be degraded and should not be used as a primary indicator of tube quality.

QR Code Limitations

The QR code contains a shortened version of the data to ensure:

- fast and reliable scanning,
- compatibility with various devices,
- stable display on the device screen.

Full measurement details are available directly on the device display.

Usage Tips

- For accurate evaluation, perform measurements at operating points close to the tube's datasheet conditions.
- At high anode currents, natural instabilities may occur due to tube characteristics.
- For best results, scan the QR code from a short distance (a few to several centimeters) under good lighting conditions.

Examples:

Ia: 102mA gm:12.8mA/V
st:±1.5% 'OK'

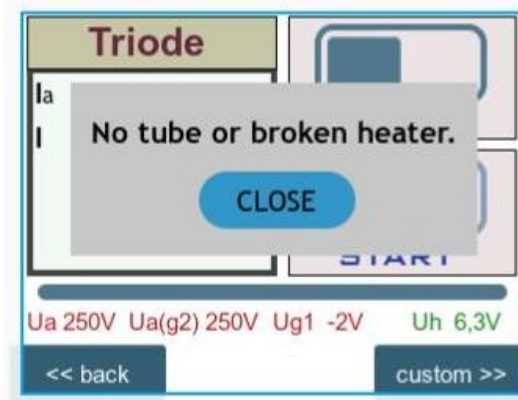
Ia:1.1/1.2mA gm:2.0mA/V
s:75 n65

Additional Messages

SHORT / OVERCURRENT – short circuit or overload detected



Heater error – no tube or broken heater circuit



TRIODE – Parameter Description

NOISE — Tube Noise Performance

NOISE describes the level of electrical noise generated by the tube at a given operating point, taking into account:

- the absolute noise level ($\mu\text{A RMS}$),
- and its relation to the operating current.

It is a measure of signal quality, not just current level.

Noise varies over time and depends on factors such as cathode temperature and grid condition.

How it is calculated:

- RMS noise of the anode current is measured for each section
- the ratio of noise to DC current is calculated
- the result is stabilized (median filtering) to reject spikes and transient disturbances
- the final score is a hybrid evaluation including:
 - relative noise,
 - absolute noise (to prevent falsely “quiet” high-current tubes).

How to interpret the result:

The higher the percentage, the quieter the tube.

NOISE	Interpretation
80–100%	Very low noise, ideal for audio applications ("LOW NOISE")
40–79%	Moderate noise, acceptable for most uses ("ACCEPTABLE")
< 40%	High noise, not recommended for audio ("NOISY")

NOISE is not based on a single sample — the system automatically filters short-term spikes to provide a representative and stable result.

DYNAMIC — Dynamic Matching of Tube Sections

DYNAMIC describes how similarly both sections of a tube (e.g. a dual triode) respond to changes in operating conditions.

The parameter includes not only current values, but also changes in characteristics (transconductance gm) and measurement stability.

It represents the real operating balance of the tube, rather than a static match at a single point.

How it is calculated:

- changes in anode current between sections are compared
- consistency of transconductance (gm) is evaluated
- stability and repeatability of the measurement are taken into account
- the result is scaled to a 0–100% range

How to interpret the result:

The higher the percentage, the more similar the behavior of both sections under real operating conditions.

DYNAMIC	Interpretation
90–100%	Very high consistency (excellent dynamic matching)
70–89%	Good matching (sections behave similarly)
40–69%	Moderate matching, noticeable differences
< 40%	Significant asymmetry of characteristics

STABILITY — Anode Current Stability

STABILITY indicates how consistently a tube maintains its anode current during a series of consecutive measurements under the same operating conditions.

It evaluates short-term current variations and helps identify irregularities in the tube's electrical behavior during testing.

How is it calculated?

The tester records the anode current over several consecutive samples and analyzes the variation between the measured values relative to their average. Filtering and median-based processing help reduce the influence of individual measurement disturbances.

The resulting variation is used to determine the STABILITY score.

How to interpret the result

A higher STABILITY score indicates more consistent anode current readings, while a lower score indicates greater variation during measurement.

Note: STABILITY measures short-term anode current consistency. It does not measure matching between the two triodes, which is evaluated separately by DYNAMIC. It also does not directly indicate the tube's overall condition or noise level.

.STABILITY	Interpretation
1–2%	Very high stability
2–5%	Good stability
5 – 10%	Moderate stability
< 5%	Low stability — significant current variations

QUALITY — Overall Tube Rating

QUALITY is a single value summarizing the overall performance of the tube.

It combines noise, stability, and matching in proportions reflecting real-world audio applications.

QUALITY is intended for quick comparison between tubes.

Important:

A low value in a single parameter does not necessarily mean the tube is unusable.

It may simply indicate that the tube is better suited for certain applications than others.

How to interpret the result:

QUALITY	Interpretation
85–100	Excellent
70–84	Very good
55–69	Good
40–54	Marginal
< 40	Poor / heavily worn

PENTODE – Parameter Description

GM STABILITY — Transconductance Stability

This parameter describes the variation of transconductance (gm) during the measurement.

It is expressed as a percentage deviation ($\pm\%$).

How to interpret the result:

< 1%

Very stable operation (high repeatability)

1–3%

Moderate stability (acceptable for most applications)

> 3%

Unstable operation (results may be unreliable)

QUALITY — Tube Performance

QUALITY describes the overall condition of the tube based on the measured transconductance (gm) and its consistency with expected values.

The parameter is expressed as a percentage (0–100%).

How to interpret the result:

90–100%

Very good tube (full performance).

70–89%

Good, functional tube.

< 70%

Degraded performance (wear or weak parameters).

STATUS — Tube Condition

STATUS indicates the basic operational correctness of the tube based on key measurement parameters.

It is a logical evaluation — if any condition is not met, the tube is not considered fully functional.

Possible results:

OK

The tube meets all criteria and is suitable for use.

UNSTABLE

Unstable transconductance (gm). Tube parameters vary over time — measurement results may be unreliable.

GAS

Gas detected in the tube (excessive grid current). The tube is defective.

INVALID

Transconductance (gm) measurement is invalid or could not be performed correctly.

BAD

Low performance (weak emission or poor parameters). The tube operates, but below a useful level.

SMALL PENTODE – Parameter Description

GM STABILITY — Transconductance Stability

This parameter describes the variation of transconductance (gm) during the measurement.

It is expressed as a percentage deviation ($\pm\%$).

How to interpret the result:

< 1%

Very stable operation (high repeatability)

1–3%

Moderate stability (acceptable in practice)

> 3%

Unstable operation (possible influence of noise, microphonics, or internal instability)

QUALITY — Tube Performance

QUALITY describes the overall condition of the tube based on the measured transconductance (gm).

For small-signal tubes, this parameter is secondary — the most important factor is noise (NOISE).

How to interpret the result:

90–100% - Very good performance

70–89% - Good, functional tube

< 70% - Degraded performance (wear or weak parameters)

STATUS — Tube Condition

STATUS indicates the basic operational correctness of a small-signal tube based on transconductance (gm), stability, and gas detection.

For tubes such as EF86, criteria are adapted to their characteristics (high sensitivity, higher susceptibility to noise and microphonics).

Possible results:

OK

The tube meets the criteria and is suitable for use.

HC

HC is not a direct indicator of tube quality.

It reflects operating conditions during measurement and must be interpreted in the context of the selected operating point.

UNSTABLE

Transconductance (gm) is unstable. Parameters vary over time — results may be unreliable.

GAS

Clear gas effect detected (excessive grid current). The tube is defective.

INVALID

gm measurement is invalid or cannot be performed.

BAD

Very low performance (significant wear).

NOISE — Noise Level

This parameter describes the intrinsic noise level of the tube, which is especially important in audio applications (preamplifiers, microphone inputs).

The evaluation is based on signal analysis over time.

How to interpret the result:

QUIET

Very low noise — ideal for high-sensitivity audio circuits

OK

Acceptable noise level — suitable for most applications

NOISY

Elevated noise level — not recommended for audio use

DIODE - Rectifier Quality Evaluation

Practical quality thresholds:

$\leq 10 \%$

- very good rectifier,
- normal emission difference,
- fully functional

➡ Status: **OK**

10 % – 25 %

- noticeable difference between anodes
- often indicates:
 - uneven wear
 - early degradation of one section
- still usable, but not ideal

➡ Status: **Asymmetry / Weak**

> 25–30 %

- one anode significantly weaker
- possible causes:

- poor cathode contact
- worn section
- increased ripple in power supply

➡ Status: **Bad rectifier / Strong asymmetry**

> 50 %

- effectively half-wave rectification,
- very high ripple,
- unacceptable in audio equipment.

➡ Status: **FAIL**

Selecting a Balance Triode

BALANCE — Internal symmetry of a dual triode

BALANCE describes how well both halves of a dual triode are matched within a single tube.

This is especially important in circuits such as phase inverters, where both halves must operate symmetrically.

In the VTM meter, balance is evaluated dynamically using the DYNAMIC parameter, supported by comparison of anode currents and stability analysis.

Key parameters affecting balance

• **DYNAMIC** — primary parameter

Describes how similarly both halves respond to changes in operating conditions (signal behavior).

• **Anode current (I_{a1} vs I_{a2})**

Indicates static matching at the operating point.

• STABILITY

Ensures both halves behave consistently over time.

How to interpret balance

A tube is considered well balanced when:

- $\text{DYNAMIC} \geq 85\%$
 - I_{a1} and I_{a2} difference is small (typically $< 5-10\%$)
 - STABILITY is at an acceptable level ($\geq 70\%$)
-

Practical note

In phase inverter circuits, dynamic matching (DYNAMIC) is more important than equal current alone.

A tube may have similar I_a values but different dynamic behavior, which can degrade signal symmetry.

Balance classes (QR label)

A — very well balanced

Ideal for applications such as phase inverters. Provides excellent signal symmetry.

B — well balanced

Suitable for most applications. Can be used as a phase inverter, though not optimal.

C — poorly balanced

Significant mismatch between halves. Not recommended for inverter use.

Tube Matching – measurement label (triode)

Tube matching describes how well two tubes are matched for operation in the same circuit (e.g. push-pull stages or stereo channels).

Unlike BALANCE (which applies to a single tube), matching compares parameters between different tubes.

Key parameters

- Anode current (I_a)

Tubes should operate at similar current under the same conditions.

- Transconductance (g_m)

The most important parameter for gain matching.

Differences in g_m directly affect signal balance.

- STABILITY

Tubes should have similar stability behavior.

- NOISE (for audio applications)

It is recommended to use tubes with similar noise levels (e.g. QUIET + QUIET).

Data used for matching (from label)

- anode currents (I_{a1} / I_{a2})
- transconductance (g_m)
- balance class (A / B / C)

Matching procedure

1. Select tubes with the same balance class (recommended: A or B)
 2. Compare average anode current (I_a):
→ difference should be minimal (recommended $< 10\%$)
 3. Compare transconductance (g_m):
→ difference should be as small as possible (recommended $< 10\%$)
-

Matching evaluation

Very good match:

- I_a difference $< 5\%$
- g_m difference $< 5\%$

Good match:

- I_a difference $< 10\%$
- g_m difference $< 10\%$

Poor match:

- large differences in I_a or g_m
 - different balance classes (e.g. A + C)
-

Important note

Balance class (A/B/C) describes the quality of a single tube.

A matched pair cannot be better than the weakest tube.

Technical note

In practical triode matching, the most important parameters are transconductance (g_m) and anode current.

The amplification factor (μ) is derived from these values and is not used directly for matching evaluation.

Example

Tube 1:

$I_a = 1.2 / 1.3 \text{ mA}$ $g_m = 1.6 \text{ mA/V}$

S85 N65 inv A

Tube 2:

$I_a = 1.1 / 1.2 \text{ mA}$ $g_m = 1.5 \text{ mA/V}$

s79 n70 inv A

→ Very well matched pair (differences < 5%)

Tube Matching – measurement label (pentode)

Tube matching describes how well multiple tubes are electrically matched for operation in the same circuit (e.g. push-pull stages).

Unlike double triodes, only a single structure is evaluated — therefore matching is based on comparing key electrical parameters at the same operating point.

Key parameters for comparison

- Anode current (I_a)

Tubes should operate at similar anode current under the same test

conditions.

Differences in current lead to imbalance and may increase distortion.

• **Transconductance (gm)**

The most important parameter for pentode matching.

It defines tube gain and directly affects how evenly tubes operate in the circuit.

• **ST (stability)**

Represents transconductance stability (Δgm over time).

Tubes with similar stability provide more predictable operation.

• **STATUS**

Tubes should have status OK.

Tubes marked as GAS, UNSTABLE, BAD, or INVALID should not be used for matching.

Matching criteria

Very good match:

- I_a difference < 5%
- gm difference < 5%
- similar stability (ST)

Good match:

- I_a difference < 10%
- gm difference < 10%

Poor match:

- large differences in I_a or gm
- differences in stability
- different tube status

Example:

Tube 1: $I_a = 48 \text{ mA}$, $g_m = 11.5 \text{ mA/V}$

Tube 2: $I_a = 46 \text{ mA}$, $g_m = 11.2 \text{ mA/V}$

→ I_a difference $\approx 4\%$

→ g_m difference $\approx 2.6\%$

Result: good match — suitable for push-pull operation.

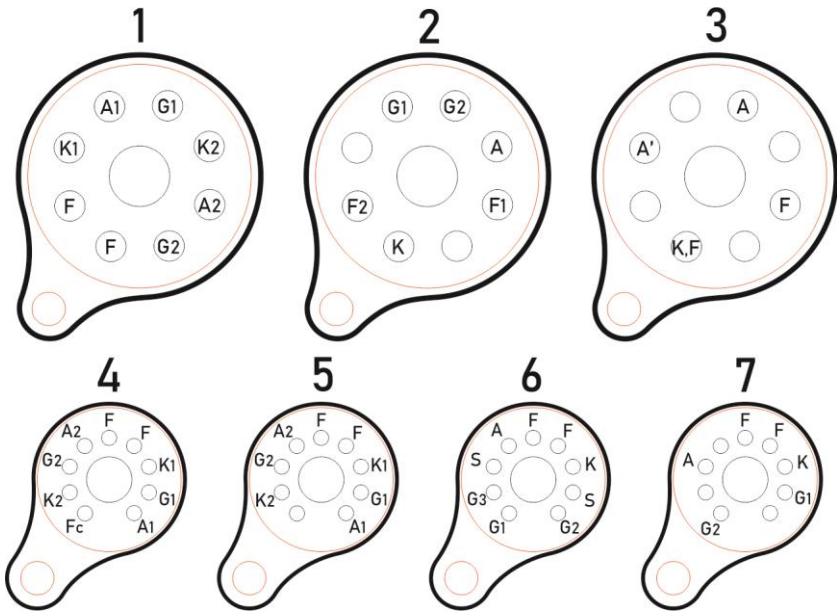
Matching is performed at a single, controlled operating point. In practice, this provides very good consistency for most applications.

However, under different operating conditions (e.g. higher plate voltage), tube differences may increase.

For best results, use tubes with good emission (high g_m) and similar parameters.

Worn tubes (low g_m) may behave less consistently under different operating conditions, even if they appear matched during measurement.

Tube Socket Pin Description



A – anode

K – cathode

G1 – control grid

G2 – screen grid

G3 – suppressor grid

F,F – heater

1 – OCTAL 8-pin socket, for dual triodes
(e.g. 6SN7, 6SL7).

2 – OCTAL 8-pin socket, for power pentodes
(e.g. EL34, 6V6).

3 – OCTAL 8-pin socket, for rectifier tubes (e.g. 5Y3, GZ34).

- 4 – NOVAL 9-pin socket, for small-signal dual triodes (e.g. 12AX7, 5751), with heater connected to pins 9 and 4–5
- 5 – NOVAL 9-pin socket, for small-signal dual triodes (e.g. ECC88, 6n2p), with heater connected to pins 4–5.
- 6 – NOVAL 9-pin socket, for small-signal pentodes (e.g. EF86, EF83).
- 7 – NOVAL 9-pin socket, for power pentodes (e.g. EL84, 6p14p).

Technical Specification

Power supply: 19.5V / 5A

Connector: 2.1 mm / 5.5 mm

Anode voltage range (Va1): 50V – 430V

Step: 1V

Maximum anode current: 180 mA

Resolution: 0.01 mA

Screen grid / second anode voltage range (Va2 / G2): 50V – 430V

Step: 1V

Maximum current: 180 mA

Resolution: 0.01 mA

Control grid voltage range (G1): 0.1V – 50V

Step: 0.1V

Available heater voltages:

4V, 5V, 6.3V, 10V, 13V, 17V

(Max current: 2.5A)

Additional Notes

The touchscreen can be operated using either a finger or the included stylus.

The stylus is recommended for precise input, especially in the USER TUBES section.

Measurement of tubes not directly supported by the device (due to socket limitations) is possible using appropriate adapters (socket + base).

For example, a 300B tube can be measured using socket no. 2.



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