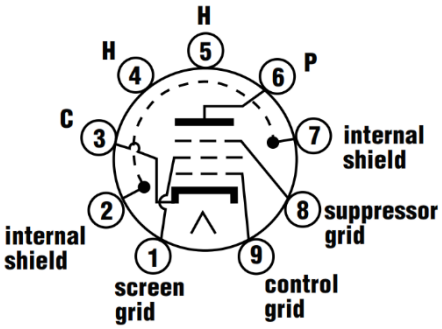
Current Equipment Type

TYPE: **CV4085 (Special EF86)** B9A LOW-NOISE AUDIO PENTODE

The original GEC CV4085 is a special quality version of the EF86 audio voltage amplifier made by the company which produced the famous British ***KT*** beam-tetrodes.

Even compared with the classic EF86s from Telefunken and Mullard, the CV4085 is considered the best of all the EF86s equivalents. The original tubes are now rare and expensive.



The Phædrus Audio CV4085 Supertube™ matches the dimensions and performance parameters of the CV4085 tube, in everything but maximum anode dissipation.[1] It is supplied as a standard B9A substitute device. It has a wide range of "plug-and-play" applications in: microphone preamplifiers; hi-fi equipment; and guitar amplifiers. In fact, almost anywhere a low-noise, low-distortion and zero microphony EF86 type pentode is required - see application notes.

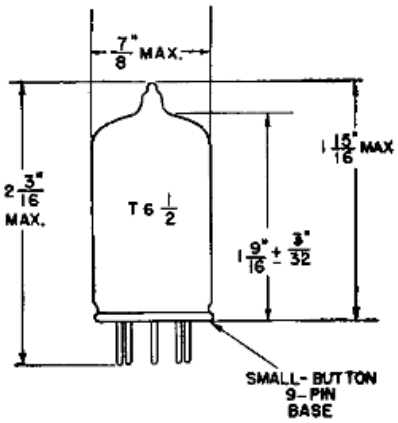
For more information contact: sales@phaedrus-audio.com

CV4085 Pentode* Supertube™ Technical Specifications

Heater voltage (current): 6.3V AC/DC (200mA)
V(a) abs. max: 500V
Vg2(Ig2): See ***Applications*** and ***Pin Tour***
g_m: 2mA/V
r_a: >2.5MΩ
***This device may not be operated as a triode**

1. Maximum anode dissipation is limited to 0.3W

PHYSICAL DIMENSIONS



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APPLICATIONS

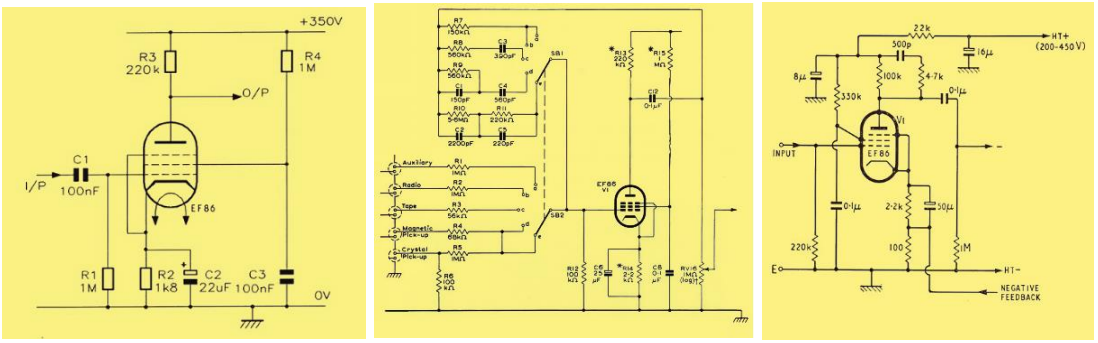


Figure 1 A, B & C – typical CV4085 (EF86) applications

Typical applications

Three example CV4085 (EF86) pentode circuit schematics are given above. The Phædrus Audio CV4085 (Special EF86) device is a suitable substitute in all these circuit arrangements. Contact sales@phaedrus-audio.com for more information and advice.

- **Circuit A is a typical guitar amplifier application with no negative feedback (see examples in Footnote. 2). The HT value and screen-dropper resistor is typical for these applications.**
- **Circuit B illustrates a typical "hi-fi" preamplifier application with the tube as the gain block in a virtual earth arrangement; the feedback voltage being returned to the control grid (see examples in Footnote. 3). HT voltages in preamplifiers are usually much lower than in guitar amplifier preamp's: sometimes below Mullard operating envelope (HT <150V).**
- **Circuit C illustrates a typical application as the first vacuum tube in a power amplifier in which the tube works as a differential amplifier of the voltage appearing between its grid and cathode pins (see Footnote. 4). The CV4085 was also used in microphone preamplifiers in this arrangement too.[5]**
- **Refer to the section *Pin Tour* if problems are experienced when substituting a Phædrus Audio CV4085 (Special EF86) device.**

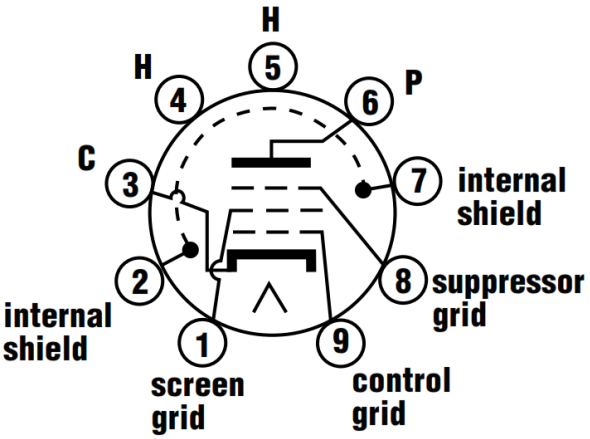
Noise and microphony

The specification for a NOS CV4085 (EF86) under conditions of an HT voltage of 250V and an anode load of 100 kΩ is for an equivalent input noise voltage of 2µV (RMS) in the frequency range 25 to 10kHz. The Phædrus Audio CV4085 (Special EF86) Supertube™ measures <1.5µV (RMS) under the same conditions. More importantly, tube microphony (the cause of feedback "howl" and "clang") is not present in the Phædrus Audio CV4085 (Special EF86) Supertube™.

Pin Tour

9. Control grid (g1)

The guaranteed value of grid current in the CV4085 was <400nA. The Phædrus Audio CV4085 easily matches this specification, thus grid resistors up to 100MΩ are possible. The Phædrus Audio CV4085 device supports virtual grid-leak bias as employed in the Mullard audio mixer reference deisgn (no cathode resistor, 10MΩ gid resistor).



8. Suppressor grid (g3)

The suppressor grid may be connected to ground or to cathode. It should not be left floating.

7 & 2. Internal shield

Mullard specified that the internal shield connections (pin 2 & 7) should always be connected directly to ground[1]. This seems to have been standard practice amongst studio and "hi-fi" applications. But some guitar amplifier manufacturers adopt the labour-saving dodge of looping the k, g3 connection to the shield on the tube base. This deprives the Phædrus Audio CV4085 device of its 0V reference which it requires for correct operation. Pin 2 or 7 of the Phædrus Audio CV4085 (they are internally connected) must be taken to 0V for correct operation. See Footnote. 6 for a "quick fix".

6. Anode (Plate)

This port is partially zener clamped for voltages above 400V to protect the Phædrus Audio CV4085 device from damage during circuit warm-up. Maximum anode dissipation is limited to 300mW.

4 & 5. Heater

The heater supply fufils no useful function in the Phædrus Audio CV4085 (Special EF86) device – it may be operated entirely without this supply. However, the correct heater load is included in the device as PSU ballast. Note that, just as with the original tube, the use of an unsuitable valve holder will result in a considerable increase in hum above the best attainable level due to inter-pin capacitance and leakage.

3. Cathode – DC conditions and negative feedback

Only the anode current flows in the cathode circuit in the Phædrus Audio CV4085 (Special EF86) device, so the voltage on the cathode bias resistor is always reduced compared with a thermionic device where the cathode current is the sum of the anode and screen currents. No compensation is required for this change – the anode current control does not rely on the back-bias in the cathode resistor.

The Phædrus Audio CV4085 (EF86) device supports negative feedback introduced into the cathode circuit as seen in power amplifiers and microphone preamplifiers (see Notes. 4 & 5). Similarly, the cathode resistor may be left unbypassed to provide local feedback.[7]

1. Screen grid (g2) - DC conditions and triode operation

In the Phædrus Audio CV4085 (Special EF86) device, quiescent DC conditions aren't modelled at the screen pin connection (pin 1). Instead, this port is a current programming pin and will always sit at around 7 volts. Current into this pin must not drop below 65µA. That's to say, ensure that,

(HT volts – 7 Volts) / Rg2 > 65µA.

In normal pentode operation, Mullard recommended that the screen grid resistance is 4 to 5 times the resistance of the anode (plate) load resistor, if this is observed (and it is in most pre-existing circuits) the condition for >65µA is easily fulfilled. Maximum current should not exceed the dissipation limit of the screen dropper resistor. For example, a 390kΩ dropper on a 400V HT will dissipate 0.4W.

The Phædrus Audio CV4085 device tube will not operate correctly in circuits in which the device AC gain is modulated by the screen-grid voltage. This includes a few tremolo circuits (the 1959 single-channel AC15 for example). The Phædrus Audio CV4085 device may not be operated as a triode by connecting the screen to the anode (plate).

Contact sales@phaedrus-audio.com **for more information and advice.**

Footnotes

1. **Valve Circuits for Audio Amplifiers. Mullard Ltd. 1959**
2. **GUITAR AMPS: Vox AC15/3 and above; Matchless DC 30 Series and others; Bad Cat *Black Cat* and others; Dr. Z; Blackstar Artisans; Ceriatone EF86 models.**
3. **Quad: 22 preamp (V1), Leak Point 1 preamp series (V1)**
4. **Leak TL/12 Plus (V1), TL/25 Plus (V1), Radford STA (& MA)12, 15, 25; Mullard: 20W (ultra-linear) amplifier - reference design (V1), Quad II V1 & V2.**
5. **EMI REDD.47 line amplifier (V1), Mullard: mixing preamplifier**
6. **A simple way to try a Phædrus Audio CV4085 in a socket in which the electrostatic shield is commoned with the cathode (and g3) is to short the cathode resistor by soldering a wire across it. This brings the whole shield, cathode, suppressor-grid network to 0V. The Phædrus Audio CV4085 does not require any volts on the cathode to operate correctly. This mod, of course, must be undone if an original tube is subsequently fitted.**
7. **Although, we do not know of any examples of commercial circuits where feedback is applied via an unbypassed cathode bias resistor.**