



ELECTRONIC TUBE REFERENCE

10C14

Voltage - Triode (with diode, heptode or hexode) electronic tube

CONSOLIDATED TECHNICAL
DATA

2 SECTIONS
CONSTRUCTION
HEPTODE-TRIODE

Triode-heptode frequency changer for radio receivers, integrating a local oscillator and mixer in one envelope. Its 19 V, 100 mA heater particularly suits series-heater mains receiver designs.

GENERAL CHARACTERISTICS

BASE DESIGNATION	—	BASE PINS	9
NOMINAL HEATER	19 V / 100 mA	PARALLEL HEATER	— / —
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Dissimilar

SECTION RATINGS

SECTION1 Triode	
TRANSCONDUCTANCE	0.0032 S
MAXIMUM PLATE DISSIPATION	0.8 W
<i>Published ratings and characteristics promoted where clearly stated; identical repeated sections compressed when applicable.</i>	

SECTION2 Heptode	
MAXIMUM PLATE DISSIPATION	1.7 W
MAXIMUM SCREEN DISSIPATION	1 W
<i>Published ratings and characteristics promoted where clearly stated; identical repeated sections compressed when applicable.</i>	

10C14 — Triode-Heptode Frequency Changer

An indirectly heated, multi-unit vacuum tube containing separate triode and heptode structures, designed for frequency changer and intermediate-frequency amplifier applications in AM/FM receivers.

Overview

The **10C14** (also designated as the **UCH81**) is a triode-heptode multi-unit vacuum tube designed with separate electrode structures. It is primarily intended for use in AM/FM broadcast radio receivers operating on AC/DC power supplies. The device is optimized to function as a frequency changer for AM signals, utilizing the triode section as a local oscillator, or as an intermediate frequency (I.F.) amplifier for FM signals, with the heptode section configured accordingly.

Physical Characteristics, Heater, and Base Configuration

The 10C14 is housed in a glass envelope with a maximum overall length of 60.5 mm (2.375 inches) and a maximum diameter of 22.2 mm (0.875 inches). The tube has an approximate net weight of 0.5 oz, and a packed weight of 0.75 oz. It features a standard **B9A** nine-pin miniature base and can be mounted in any position without restriction.

The heater is designed for series-string operation in AC/DC receivers, drawing a constant current.

- **Heater Current (I_h):** 0.1 A
- **Heater Voltage (V_h):** 19.0 V
- **Calculated Heater Power:** 1.9 W (calculated as $19.0\text{ V} \times 0.1\text{ A}$)

The B9A base pin connections are arranged as follows (viewed from the underside of the base):

- **Pin 1:** Triode Grid (g_t) and Heptode Grid 3 (g_3) (internally connected)
- **Pin 2:** Heptode Control Grid (g_1)
- **Pin 3:** Cathode, Heptode Grid 5, and Internal Shield (k, g_5, s)
- **Pin 4:** Heater (h)
- **Pin 5:** Heater (h)
- **Pin 6:** Heptode Anode (a_h)
- **Pin 7:** Heptode Screen Grids (g_2, g_4)
- **Pin 8:** Triode Anode (a_t)
- **Pin 9:** Heptode Grid 3 (g_3) and Triode Grid (g_t) (internally connected)

The internal connection between the triode grid (g_t) and the heptode's third grid (g_3) simplifies external circuitry when the tube is operated as a self-oscillating mixer or frequency changer, as the local oscillator voltage is directly injected into the mixing structure.

Inter-electrode Capacitances

To ensure stable operation at radio frequencies, the inter-electrode capacitances are kept low. The capacitances, measured with holder capacitances balanced out, are specified as follows:

Capacitance Parameter	Triode Section	Heptode Section
Output Capacitance (c_{out})	2.1 pF	7.9 pF
Input Capacitance, Grid 1 ($c_{in(g1)}$)	2.6 pF	4.8 pF
Input Capacitance, Grid 3 ($c_{in(g3)}$)	—	6.0 pF
Grid 1 to Anode (c_{g1-a})	1.0 pF	< 0.006 pF
Grid 1 to Grid 3 (c_{g1-g3})	—	< 0.3 pF

Cross-section and inter-electrode coupling capacitances are also tightly controlled:

- **Heptode Grid 1 to Triode Grid + Heptode Grid 3 ($c_{g1-g3gt}$):** < 0.45 pF
- **Heptode Grid 1 to Triode Grid (c_{g1-gt}):** < 0.17 pF
- **Heptode Anode to Triode Anode (c_{ah-at}):** 0.2 pF

These low cross-capacitances minimize unwanted interaction between the local oscillator (triode) and the signal input (heptode) stages.

Maximum Ratings

The maximum ratings for the 10C14 are defined separately for the triode and heptode sections. These limits must be strictly observed to prevent premature failure or degradation of the device.

Rating Parameter	Triode Section	Heptode Section
Maximum Anode Dissipation ($p_a(max)$)	0.8 W	1.7 W
Maximum Screen Grids Dissipation ($p_{[g2](/tubes/G2)+g4(max)}$)	—	1.0 W
Maximum Anode Voltage ($V_a(max)$)	250 V	250 V
Maximum Screen Grids Voltage ($V_{[g2](/tubes/G2)+g4(max)}$) at $I_a = 7.6$ mA	—	125 V

Rating Parameter	Triode Section	Heptode Section
Maximum Screen Grids Voltage ($V_{[g2]}(/tubes/G2)+g4(max)$) at $I_a < 1$ mA	—	250 V
Maximum Mean Cathode Current ($I_{k(av)max}$)	6.5 mA	12.5 mA
Maximum Heater-to-Cathode Voltage ($V_{h-k(r.m.s.)max}$)	100 V*	100 V*

Note: The maximum heater-to-cathode voltage is measured with respect to the higher potential heater pin.

Electrical Characteristics and Typical Operating Points

The basic electrical characteristics of each section are evaluated under specific static conditions:

Triode Section Characteristics

- **Anode Voltage (V_a):** 100 V
- **Control Grid Voltage (V_{g1}):** -1.0 V
- **Anode Current (I_a):** 10 mA
- **Mutual Conductance (g_m):** 3.2 mA/V
- **Amplification Factor (μ):** 19

Heptode Section Characteristics

- **Anode Voltage (V_a):** 170 V
- **Screen Grids Voltage ($V_{[g2]}(/tubes/G2)+g4$):** 102 V
- **Grid 3 Voltage (V_{g3}):** 0 V
- **Control Grid Voltage (V_{g1}):** -2.2 V
- **Anode Current (I_a):** 6.2 mA
- **Mutual Conductance (g_m):** 2.3 mA/V
- **Inner Amplification Factor ($\mu_{g1-([g2]}(/tubes/G2)+g4)$):** 20

Application and Operating Modes

The 10C14 is designed to operate in two primary configurations within AM/FM receivers: as an R.F. or I.F. amplifier (typically for FM signals), or as an active AM frequency changer.

Typical Operation as R.F. or I.F. Amplifier (Heptode Section)

In this mode, the heptode section acts as a high-gain amplifier stage. The typical operating parameters are:

- **Supply Voltage (V_b):** 170 V
- **Anode Voltage (V_a):** 170 V
- **Screen Grids Series Resistance ($R_{[g2](/tubes/G2)+g4}$):** 18 k Ω
- **Initial Screen Grids Voltage ($V_{[g2](/tubes/G2)+g4}$):** 102 V
- **Grid 3 Voltage (V_{g3}):** 0 V
- **Control Grid Voltage (V_{g1}):** -2.2 V
- **Anode Current (I_a):** 6.2 mA (approximate)
- **Screen Grids Current ($I_{[g2](/tubes/G2)+g4}$):** 3.8 mA (approximate)
- **Mutual Conductance (g_m):** 2.3 mA/V
- **Valve Anode Resistance (r_a):** 0.6 M Ω
- **Equivalent Grid Noise Resistance (R_{eq}):** 8.8 k Ω
- **Grid 1 Voltage for 100:1 reduction of Mutual Conductance:** -28 V

Typical Operation as A.M. Frequency Changer

When configured as an AM frequency changer, the triode section operates as the local oscillator, injecting its signal into the heptode section via the internal connection between the triode grid and the heptode's third grid ($g3$). The operating parameters for both sections in this mode are:

Heptode Section (Frequency Changer):

- **Supply Voltage (V_b):** 170 V
- **Anode Voltage (V_a):** 170 V
- **Screen Grids Series Resistance ($R_{[g2](/tubes/G2)+g4}$):** 10 k Ω
- **Initial Screen Grids Voltage ($V_{[g2](/tubes/G2)+g4}$):** 102 V
- **Control Grid Voltage (V_{g1}):** -2.2 V
- **Anode Current (I_a):** 3.2 mA (approximate)
- **Screen Grids Current ($I_{[g2](/tubes/G2)+g4}$):** 6.8 mA (approximate)
- **Heptode Grid 3 and Triode Grid Current (I_{g3+gt}):** 200 μ A
- **Heptode Grid 3 and Triode Grid Leak Resistance (R_{g3+gt}):** 47 k Ω
- **Peak Heterodyne Voltage ($V_{(pk)het}$):** 12 V
- **Conversion Conductance (g_c):** 750 μ A/V
- **Valve Anode Resistance (r_a):** 0.9 M Ω
- **Equivalent Grid Noise Resistance (R_{eq}):** 70 k Ω
- **Grid Voltage for 100:1 reduction of Conversion Conductance:** -24 V

Triode Section (Local Oscillator):

- **Anode Voltage (V_a):** 103 V
- **Average Anode Current ($I_{a(av)}$):** 4.5 mA

Analysis of Characteristic Curves

The behavior of the 10C14 under varying operating conditions is illustrated by several families of characteristic curves:

Heptode Section Curves

1. **Conversion Conductance and Currents vs. Oscillator Grid Current:** At an anode voltage (V_a) of 250 V, a control grid voltage (V_{g1}) of -2 V, a screen grid resistance ($R_{[g2]}/(tubes/G2)+g4$) of 22 k Ω , and a grid leak resistance (R_{gt+g3}) of 47 k Ω , the conversion conductance (g_c) rises rapidly as the oscillator grid current (I_{gt+g3}) increases from 0 to approximately 150 μ A, peaking near 750 to 800 μ A/V. Beyond this point, g_c remains relatively flat up to 400 μ A. The screen grid current ($I_{[g2]}/(tubes/G2)+g4$) and anode current (I_a) remain stable across this range, while the oscillator grid voltage (V_{osc}) increases linearly with grid current.
2. **Control Grid Transfer Characteristics ($I_a, I_{[g2]}/(tubes/G2)+g4, g_c$ vs. V_{g1}):** With a heterodyne signal injected into grid 3, a supply voltage (V_b) of 250 V, and an anode voltage (V_a) of 250 V, the anode current (I_a) and screen grid current ($I_{[g2]}/(tubes/G2)+g4$) fall exponentially as the control grid voltage (V_{g1}) is made more negative. The conversion conductance (g_c) follows a similar curve, demonstrating the remote-cutoff (variable- μ) characteristic of the heptode section, which allows effective automatic volume control (AVC) or automatic gain control (AGC) without severe distortion.
3. **Mutual Conductance and Anode Current vs. Screen Grid Voltage:** The mutual conductance (g_m) and anode current (I_a) of the heptode section are highly dependent on the screen grid voltage ($V_{[g2]}/(tubes/G2)+g4$). At lower screen voltages (e.g., 50 V), the cutoff occurs at a much less negative grid voltage (around -15 V), whereas at higher screen voltages (e.g., 300 V), the cutoff is extended to beyond -70 V. This behavior is critical for designing AGC circuits where the screen voltage is derived via a series dropper resistor.

Triode Section Curves

1. **Transfer Characteristics (I_a, g_m vs. V_g):** The triode section's transfer curves show anode current (I_a) and mutual conductance (g_m) plotted against control grid voltage (V_g) for anode voltages of 100 V and 150 V. At $V_a = 100$ V, the anode current reaches approximately 10 mA at $V_g = -1$ V with a g_m of 3.2 mA/V. The cutoff is relatively sharp, reaching near-zero current around $V_g = -9$ V for $V_a = 100$ V, and around $V_g = -13$ V for $V_a = 150$ V.
2. **Anode Characteristics (I_a vs. V_a):** The triode's anode curves display anode current (I_a) as a function of anode voltage (V_a) for grid voltages (V_{gt}) ranging from 0 V to -16 V in 2 V steps. The curves exhibit typical triode behavior with a moderate plate resistance, showing a steady, nearly linear increase in anode current with increasing anode voltage for any given grid bias.

Technical Summary

The **10C14** ([UCH81](#)) is a versatile, high-performance triode-heptode frequency changer and amplifier designed for series-string AC/DC AM/FM receivers. Featuring a 19.0 V, 0.1 A heater and a standard B9A base, it integrates a medium-mu triode (typically used as a local oscillator) and a variable-mu heptode (used as a mixer or I.F. amplifier) in a single compact envelope. The internal connection between the triode grid and the heptode's third grid simplifies circuit layout and ensures efficient local oscillator injection. With robust maximum ratings, low inter-electrode capacitances, and excellent remote-cutoff characteristics, the 10C14 remains a classic example of highly integrated vacuum tube design for broadcast receivers.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1973 Mazda Valves Binder 2

Published test conditions and operating points. Values on this page are preserved as reported by this source.

1973 MAZDA VALVES BINDER 2

Section 1 · Triode

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater or filament voltage	19 V	Published nominal value
Heater or filament current	100 mA	Published nominal value
Transconductance	3200 μ S	Published operating characteristic

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum plate dissipation	0.8 W	Published maximum rating

1973 MAZDA VALVES BINDER 2

Section 2 · Heptode

CHARACTERISTICS		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Heater or filament voltage	19 V	Published nominal value
Heater or filament current	100 mA	Published nominal value

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Maximum plate dissipation	1.7 W	Published maximum rating

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