

ELECTRONIC TUBE REFERENCE

CONSOLIDATED TECHNICAL DATA

1AC6

1 SECTION
CONSTRUCTION
HEPTODE

Voltage Pentode or Tetrode (under 100V) electronic tube

Battery or receiving-tube frequency converter combining local-oscillator and mixer action for superheterodyne radio service. Its multi-grid structure provides frequency conversion while minimizing component count and, in battery types, filament power.

GENERAL CHARACTERISTICS

BASE DESIGNATION	7DH	BASE PINS	7
NOMINAL HEATER	1.4 V / 50 mA	PARALLEL HEATER	– / –
HEATING	Direct	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Similar

SECTION RATINGS

SECTION1 Heptode	
PLATE RESISTANCE	900000 Ω
TRANSCONDUCTANCE	0.0003 S
MAXIMUM PLATE VOLTAGE	90 V
MAXIMUM SCREEN VOLTAGE	90 V
MAXIMUM PLATE DISSIPATION	0.15 W
MAXIMUM CATHODE CURRENT	4 mA
Pentagrid converter. Transconductance is conversion transconductance.	

1AC6 — Miniature Battery Heptode Frequency Changer

A directly heated, seven-pin miniature heptode designed for frequency conversion in battery-operated receivers, offering high conversion conductance, low oscillator drive requirements, and automatic volume

Overview

The **1AC6** (also designated as the **DK92**) is a directly heated heptode, or pentagrid converter, designed primarily for use as a self-oscillating frequency changer in portable, battery-operated radio receivers. It is engineered to operate uniformly at frequencies up to 30 MHz.

Compared to older types such as the **1R5**, the 1AC6 features improved short-wave performance and reduced high-tension (H.T.) current consumption. A key design feature is the provision of separate external connections for the oscillator anode (Grid 2) and the screen grid (Grid 4). This separation allows the implementation of conventional oscillator circuits and yields significantly improved oscillator stability and performance.

Physical Characteristics and Pinout

The 1AC6 is constructed in a miniature glass envelope (T5 1/2 bulb) with a standard 7-pin miniature button base (B7G). The tube is designed to operate in any mounting position.

Physical Dimensions

- **Maximum Overall Length:** 54.5 mm (2-1/8 inches)
- **Maximum Seated Height:** 47.5 mm (1-7/8 inches)
- **Bulb Length (excluding tip):** 1-1/2 inches $\pm$ 3/32 inch
- **Maximum Diameter:** 19 mm (3/4 inch)

Base Connections

Two distinct pinout configurations are specified for the 1AC6, both utilizing the 7-pin miniature base.

Standard B7G Configuration

In the standard configuration, the electrodes are mapped to the seven pins as follows (viewed from the underside of the base):

Pin	Connection	Description
1	f- / g5	Filament negative / Grid 5 (Suppressor Grid)
2	a	Anode (Plate)
3	<u>g2</u>	Oscillator Anode (Grid 2)
4	g1	Oscillator Grid
5	g4	Screen Grid (Grid 4)

Pin	Connection	Description
6	g3	Control Grid / RF Input (Grid 3)
7	f+ / g5	Filament positive / Grid 5 (Suppressor Grid)

Alternative 7DH Configuration

An alternative configuration (designated under the JETEC 7DH scheme) maps the pins as follows:

Pin	Connection	Description
1	F- / G5	Filament negative / Grid 5
2	P	Plate (Anode)
3	<u>G2</u> , G4	Screen Grids (Grids 2 and 4 connected internally)
4	G1	Oscillator Grid
5	G3	Signal-Input Grid (Control Grid)
6	—	No connection
7	F+	Filament positive

Filament and Power Ratings

The 1AC6 features a directly heated, coated filament designed strictly for DC operation. The filament is highly efficient, minimizing current drain on portable battery supplies.

Parameter	Value
Nominal Filament Voltage	1.4 V DC
Filament Voltage Limits	1.1 V (minimum) to 1.6 V (maximum)
Nominal Filament Current	50 mA (0.05 A)

Maximum Ratings (Design Center Values)

To ensure reliable operation and prevent premature degradation, the operating conditions must be kept within the following absolute and design-center limits:

Parameter	Maximum Rating
Battery Voltage	90 V (Absolute maximum: 110 V)

Parameter	Maximum Rating
H.T. Supply Voltage	120 V
Anode (Plate) Voltage	90 V
Anode (Plate) Dissipation	0.15 W
Screen Grid (Grid 4) Voltage	90 V
Screen Grid (Grid 4) Dissipation	0.03 W
Oscillator Anode (Grid 2) Voltage	60 V
Oscillator Anode (Grid 2) Dissipation	0.2 W
Cathode Current	4.0 mA
Grid 3 Circuit Resistance (Rg3-f)	3.0 MΩ
Grid 1 Circuit Resistance (Rg1-f)	35 kΩ

Electrical Characteristics and Operating Points

The 1AC6 is typically operated as a self-oscillating frequency changer. Two primary operating points are specified, corresponding to nominal battery supply voltages of 67.5 V and 90 V (reduced by the negative bias of the receiver's output stage).

Typical Operating Conditions (Converter Service)

Parameter	Operating Point A (67.5 V Supply)	Operating Point B (90 V Supply)
Anode Voltage (Va)	63.5 V	85 V
Screen Grid (g4) Voltage	63.5 V	60 V
Screen Feed Resistor (Rg4)	0 Ω	180 kΩ
Control Grid (g3) Voltage	0 V	0 V
Oscillator Anode (g ₂) Voltage	30 V	30 V
Oscillator Anode Feed Resistor (Rg2)	22 kΩ	33 kΩ
Oscillator Grid Resistor (Rg1)*	27 kΩ	27 kΩ
Oscillator Grid AC Voltage	4 V rms	4 V rms
Anode Current (Ia)	0.70 mA	0.65 to 0.70 mA

Parameter	Operating Point A (67.5 V Supply)	Operating Point B (90 V Supply)
Screen Grid Current (Ig4)	0.15 mA	0.14 to 0.15 mA
Oscillator Anode Current (Ig2)	1.55 mA	1.60 to 1.65 mA
Oscillator Grid Current (Ig1)	130 μ A	100 to 130 μ A
Total Cathode Current (Ik)	2.5 mA	2.55 to 2.60 mA
Conversion Conductance (gc)	300 μ A/V	325 μ A/V
Plate Resistance (rp)	$\sim$ 0.9 M Ω	0.65 to 1.0 M Ω
Control Grid Bias for Cutoff**	-4 V (for gc = 3.0 μ A/V)	-6 V (for gc = 3.25 μ A/V)

Oscillator Section Characteristics

The characteristics of the oscillator portion of the heptode can be evaluated independently by connecting Grid 1 to the positive filament. Under these conditions, the mutual conductance and amplification factor of the oscillator triode section (Grid 1 acting as control grid, Grid 2 acting as anode) are as follows:

Parameter	Condition A (63.5 V Plate)	Condition B (85 V Plate)
Plate Voltage	63.5 V	85 V
Grid 4 Voltage	63.5 V	60 V
Grid 3 Voltage	0 V	0 V
Grid 2 Voltage	30 V	30 V
Grid 2 Current	2.2 mA	2.5 mA
Mutual Conductance (gg1-g2)	800 μ A/V (0.8 mA/V)	900 μ A/V (0.9 mA/V)
Inner Amplification Factor (μ g1-g2)	7.5	7.5

Interelectrode Capacitances

Interelectrode capacitances are measured without an external shield. The direct capacitances between the various electrodes are detailed below:

- **R.F. Input (cg3-all):** 7.5 pF
- **I.F. Output (ca-all):** 8.4 to 8.5 pF
- **Oscillator Input (cg1-all):** 3.9 to 4.0 pF
- **Oscillator Output (cg2-all):** 4.8 to 5.0 pF

- **Grid 1 to Grid 2 (cg1-g2):** 3.0 pF
- **Grid 2 to Grid 3 (cg2-g3):** 1.6 pF
- **Grid 1 to Grid 3 (cg1-g3):** 0.2 pF (maximum)
- **Grid 3 to Anode (cg3-a):** 0.36 to 0.4 pF (maximum)
- **Plate to Grid 1 (ca-g1):** 0.11 pF (maximum)
- **Plate to Grid 2 (ca-g2):** 0.3 pF (maximum)

Performance Curves and Behavior

The performance of the 1AC6 is highly dependent on the oscillator drive and the control grid bias. Analysis of the characteristic curves reveals several key operational behaviors:

Conversion Conductance and Noise vs. Oscillator Grid Current

- **Conversion Conductance (gc):** At a supply voltage of 85 V, gc rises rapidly from zero when there is no oscillator grid current ($I_{g1} = 0$). It reaches a broad peak of approximately 325 to 330 $\mu\text{A/V}$ when I_{g1} is between 100 μA and 200 μA . As the grid current increases further toward 350 μA , the conversion conductance gradually declines to approximately 230 $\mu\text{A/V}$.
- **Equivalent Noise Resistance (Req):** The equivalent noise resistance of the converter stage reaches its minimum value of approximately 40 k Ω when the oscillator grid current is optimized near 150 μA .
- **Anode Impedance (ra):** The internal plate resistance drops continuously as oscillator drive increases, falling from 2.5 M Ω at low grid currents down to 0.6 M Ω when I_{g1} reaches 300 μA .
- **Current Consumption:** Both the total cathode current (I_k) and the oscillator anode current (I_{g2}) rise steadily with increasing oscillator grid current. The cathode current plateaus at approximately 3.1 mA for I_{g1} values exceeding 150 μA .

Characteristics vs. Control Grid Bias (Vg3)

- **AVC Control and Cutoff:** Applying a negative bias to Grid 3 (V_{g3}) provides effective automatic volume control. As V_{g3} is swept from 0 V to -6 V, the conversion conductance drops exponentially from 325 $\mu\text{A/V}$ to approximately 3 $\mu\text{A/V}$. The exact cutoff point is sensitive to the screen grid (Grid 4) voltage; higher screen voltages shift the cutoff point more negative (ranging from -2 V to -7 V as Grid 4 varies from 30 V to 90 V).
- **Electrode Currents:** Both the anode current (I_a) and the screen grid current (I_{g4}) decrease exponentially toward zero as Grid 3 bias approaches -6 V. Conversely, the oscillator anode current (I_{g2}) increases from 1.6 mA to 3.0 mA over the same bias range, reflecting a redistribution of space charge within the tube.
- **Anode Impedance:** As Grid 3 becomes more negative, the anode impedance increases dramatically, rising from its nominal 0.65 M Ω to over 100 M Ω at -6 V bias.

Performance vs. Oscillator Voltage

When operating from an 85 V supply, the conversion conductance peaks broadly when the oscillator grid receives an AC drive voltage between 4 V and 5 V rms. Within this region, Grid 1 current increases

linearly with the applied oscillator voltage, while the plate resistance rises gradually from 0.8 M Ω to 1.2 M Ω across an oscillator drive range of 0 V to 8 V rms.



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1958 Brimar Radio Valve No 7

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

1958 BRIMAR RADIO VALVE NO 7

Section 1 · Heptode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	85 V	—
Plate Current	0.7 mA	—
Screen Voltage	60 V	—
Screen Current	0.15 mA	—
Oscillator Anode Voltage	30 V	—
Oscillator Anode Current	1.6 mA	—

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Conversion Conductance	325 μ S	—
Plate Resistance	650000 ohm	—
Operating Frequency Maximum	30 MHz	—



SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

195X General Electric Essential Characteristics

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

195X GENERAL ELECTRIC ESSENTIAL CHARACTERISTICS

Section 1 · Heptode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	63.5 V	Converter
Screen voltage	63.5 V	Converter
Grid voltage	0 V	Converter
Plate current	0.7 mA	Converter
Screen current	0.15 mA	Converter
Oscillator current	0.13 mA	Converter
Oscillator grid resistor	27000 ohm	Converter
Oscillator plate voltage	30 V	Converter
Oscillator plate series resistor	22000 ohm	Converter
Oscillator plate current	1.55 mA	Converter



SOURCE DATA APPENDIX

SOURCE OPERATING CONDITIONS

SOURCE PDF

1961 Ferranti Technical Handbook

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

1961 FERRANTI TECHNICAL HANDBOOK

Section 1 · Heptode

APPLICATION		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Application	Battery frequency changer	—

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Oscillator anode voltage maximum	60 V	—
Oscillator grid voltage	4 V	—



SOURCE DATA APPENDIX

1999 Philips 0-D

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

1999 PHILIPS 0-D

Section 1 · Heptode

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Filament voltage	1.4 V	Filament voltage 1.4 volts
Filament current	50 mA	Filament current 50 m amps
Plate to all other electrodes	8.4 pF	Plate to all other electrodes 8.4 uuF
Grid No.1 to all other electrodes	3.9 pF	Grid No.1 to all other electrodes 3.9 uuF
Battery voltage	90 V	Battery voltage 90 volts')
Plate voltage	80 V	Plate voltage 80 volts
Plate dissipation	0.15 watt	Plate dissipation 0.15 watt
Grid No	4 V	Grid No.4 voltage 90 volts
Grid No	90 V	Grid No.4 voltage 90 volts
Grid No.4 dissipation	0.03 watt	Grid No.4 dissipation 0,03 watt
Grid No	2 V	Grid No.2 voltage 60 volts
Grid No	60 V	Grid No.2 voltage 60 volts
Grid No.2 dissipation	0.2 watt	Grid No.2 dissipation 0.2 watt
Cathode current	4 mA	Cathode current 4 ma
Grid No	3 c	Grid No.3 circuit resistance 3 megohms
Grid No	3 megohms	Grid No.3 circuit resistance 3 megohms
Grid No.?! voltage at grid No.1	0.2 V	Grid No.?! voltage at grid No.1 0.2 volt
Filament voltage min	1 V	Filament voltage min. 1 volts
(grid No	1 c	(grid No.1 connected to +filament)
Plate voltage 63.5	85 V	Plate voltage 63.5 85 volts
Grid No	3 V	Grid No.3 voltage 0 0 volt
Grid No	0 V	Grid No.3 voltage 0 0 volt
Grid No	30 V	Grid No.2 voltage 30 30 volts

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Grid No	2 c	Grid No.2 current 2.2 2.5 ma
Grid No	2.5 mA	Grid No.2 current 2.2 2.5 ma
No	1 w	No.1 with respect to grid 800 900 micromhos
No	900 μ S	No.1 with respect to grid 800 900 micromhos
grid No	2 w	grid No. 2 with respect Te5 T.5
Anode voltage 1 63.5	85 V	Anode voltage 1 63.5 85 volts
Grid No	4 V	Grid No.4 voltage 63.5 60 volts
Grid No	60 V	Grid No.4 voltage 63.5 60 volts
Grid No.4 resistor 0	0.18 megohm	Grid No.4 resistor 0 0.18 megohm
Grid No.2 resistor 22,000	33 ohms	Grid No.2 resistor 22,000 33,000 ohms
Grid No	1 A	Grid No.1 A.C.voltage 4 volts,rms
Grid No.1 resistor 27,000	27 ohms	Grid No.1 resistor 27,000 27,000 ohms ©)
Plate current 0.70	0.65 mA	Plate current 0.70 0.65 ma
Grid No	4 c	Grid No.4 current 0.15 0.14 ma
Grid No	0.14 mA	Grid No.4 current 0.15 0.14 ma
Grid No	1.65 mA	Grid No.2 current 1.55 1.65 ma
Grid No	130 pa	Grid No.1 current 130 130 pamp
Cathode current 2.5	2.6 mA	Cathode current 2.5 2.6 ma
Conversion conductance 300	325 μ S	Conversion conductance 300 325 micromhos
(grid No	3 V	(grid No.3 voltage = 3.25 micromhos
(grid No	3.25 μ S	(grid No.3 voltage = 3.25 micromhos
{grid No	3 V	{grid No.3 voltage = 3'0 - micromhos
Plate resistance 0.9	1 megohm	Plate resistance 0.9 1.0 megohm
1) Based on a battery voltage of 6£7.5 or	390 V	1) Based on a battery voltage of 6£7.5 or 390 volts de-
Plate voltage	85 V	Plate voltage=85volts AT =
Grid No2 voltage	30 V	Grid No2 voltage =30volts /] p VARG g
Oscillator voltage	4 V	Oscillator voltage=4volts r.ms. fi/ // // 7 g
B Plate voltage	85 V	B Plate voltage =85volts > g
Grid No2 voltage	230 V	Grid No2 voltage=230volts ")
u Grid Nolresistor =27,0000hms A	1 A	u Grid Nolresistor =27,0000hms A 1 A /] i §
< g Supply voltage	85 V	< g Supply voltage =85volts

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
IR Plate voltage	85 v	IR Plate voltage=85votts y. §
~ '§ Grid No4 resistor	0.18 megohms	-- '§ Grid No4 resistor=0.18 megohms 4
13 Grid No3 bias	0 V	13 Grid No3 bias =0 volt ~ S

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate to grid KNo	1 mA	Plate to grid KNo.1 max. 0.11 upF
Plate to grid No	3 mA	Plate to grid No.3 maxe. 0.36 puF
Grid No.1 to grid No	3 mA	Grid No.1 to grid No.3 max. Ce2 ppPF
Grid No	1 c	Grid No.1 circuit resistance max.35,000 ohms
Grid No	35 ohms	Grid No.1 circuit resistance max.35,000 ohms
Filament voltage max	6 V	Filament voltage max. .6 volts