

ELECTRONIC TUBE REFERENCE

11BT11

Voltage Dual Triode Pentode electronic tube

CONSOLIDATED TECHNICAL DATA

3 SECTIONS

CONSTRUCTION

PENTODE-TRIODE-TRIODE

Duodecar television tube combining two general-purpose triodes with a sharp-cutoff pentode specifically intended for video amplification, integrating three receiver signal-processing stages in one envelope.

GENERAL CHARACTERISTICS

BASE DESIGNATION	12GS	BASE PINS	12
NOMINAL HEATER	10.7 V / 600 mA	PARALLEL HEATER	– / –
HEATING	Indirect	SERIES OPERATION	Not specified
CATHODE ARRANGEMENT	Separate cathodes	SECTION CONSTRUCTION	Dissimilar

SECTION RATINGS

SECTION1 Pentode	
PLATE RESISTANCE	51000 Ω
TRANSCONDUCTANCE	0.019 S
MAXIMUM PLATE VOLTAGE	165 V
MAXIMUM SCREEN VOLTAGE	165 V
MAXIMUM PLATE DISSIPATION	3.5 W
MAXIMUM SCREEN DISSIPATION	1.5 W
Sharp-cutoff video-amplifier pentode.	

SECTION2 Triode	
PLATE RESISTANCE	12500 Ω
TRANSCONDUCTANCE	0.0055 S
AMPLIFICATION FACTOR	69
MAXIMUM PLATE VOLTAGE	330 V
MAXIMUM PLATE DISSIPATION	1.5 W
<i>Triode Section 1 in source.</i>	

SECTION3 Triode	
PLATE RESISTANCE	7600 Ω
TRANSCONDUCTANCE	0.0053 S
AMPLIFICATION FACTOR	40
MAXIMUM PLATE VOLTAGE	330 V
MAXIMUM PLATE DISSIPATION	2 W
<i>Triode Section 2 in source.</i>	

11BT11 — Dissimilar Double Triode and Sharp-Cutoff Pentode Compactron

Overview

The **11BT11** is a multi-unit vacuum tube of the compactron (or duodecar) design, containing three electrically distinct active structures within a single T-9 glass envelope. It integrates a high- μ triode (Section 1), a medium- μ triode (Section 2), and a high-transconductance, sharp-cutoff, frame-grid pentode.

The tube is primarily designed for television receiver applications. The high-performance pentode section is specifically intended for video-amplifier service, while the two dissimilar triode sections are designed for general-purpose applications, such as voltage amplification, oscillation, or sync separation. The 11BT11 features a 12-pin button base and an indirectly heated cathode system with a controlled heater warm-up time.

Construction, Heater, and Pinout

The 11BT11 is housed in a T-9 glass bulb with a 12-pin button base (E12-70 designation) and conforms to the EIA 9-58 outline. It can be operated in any physical position.

Physical Dimensions

- **Maximum Diameter:** 1.188 inches
- **Minimum Diameter:** 1.062 inches
- **Maximum Overall Length:** 2.375 inches
- **Maximum Seated Height:** 2.000 inches
- **Minimum Seated Height:** 1.750 inches

Heater Characteristics

The tube utilizes coated unipotential cathodes. The heater is designed for series or parallel AC/DC operation with a controlled warm-up characteristic to ensure reliability in series-string television receivers.

Parameter	Value
Nominal Heater Voltage (AC or DC)	10.7 V
Nominal Heater Current	0.6 ± 0.04 A
Average Heater Warm-up Time	11 seconds

Heater-Cathode Voltage Ratings

- **Heater Positive with Respect to Cathode:**
 - DC Component: 100 V maximum
 - Total DC and Peak: 200 V maximum
- **Heater Negative with Respect to Cathode:**
 - Total DC and Peak: 200 V maximum

Terminal Connections and Basing

The 11BT11 uses the **EIA 12GS** basing diagram. The pin connections, viewed from the bottom of the base, are as follows:

Pin Number	Connection
1	Heater
2	Pentode Plate
3	Triode Grid (Section 2)
4	Triode Cathode (Section 2)
5	Triode Grid (Section 1)

Pin Number	Connection
6	Triode Cathode (Section 1), Pentode Grid Number 3 (Suppressor), and Internal Shield
7	Triode Plate (Section 1)
8	Pentode Cathode
9	Triode Plate (Section 2)
10	Pentode Grid Number 2 (Screen Grid)
11	Pentode Grid Number 1 (Control Grid)
12	Heater

Note on Electrode Independence: While Triode Section 2 and the Pentode section have fully independent cathodes (Pins 4 and 8, respectively), Triode Section 1 shares its cathode connection (Pin 6) with the Pentode's suppressor grid (Grid Number 3) and the tube's internal shield. This common connection must be accounted for in circuit design, particularly when biasing Triode Section 1.

Electrical Characteristics and Class A1 Operation

The three active sections of the 11BT11 exhibit highly distinct electrical properties, reflecting their specialized roles. The pentode section features a frame-grid construction that achieves exceptionally high transconductance (19,000 μ hos) at typical operating points. Triode Section 1 is a high- μ voltage amplifier ($\mu = 69$), whereas Triode Section 2 is a medium- μ unit ($\mu = 40$) with lower plate resistance.

Typical Operating Characteristics

Parameter	Triode Section 1	Triode Section 2	Pentode Section (Low Eb)	Pentode Section (Typical)
Plate Voltage	200 V	200 V	35 V	150 V
Grid-No. 2 (Screen) Voltage	—	—	100 V	100 V
Grid-No. 1 (Control) Voltage	—	—	0 V	—
Cathode-Bias Resistor	270 Ω	470 Ω	—	82 Ω
Amplification Factor (μ)	69	40	—	—

Parameter	Triode Section 1	Triode Section 2	Pentode Section (Low Eb)	Pentode Section (Typical)
Plate Resistance (Approx.)	12,500 Ω	7,600 Ω	—	51,000 Ω
Transconductance (gm)	5,500 μmhos	5,300 μmhos	—	19,000 μmhos
Plate Current (Ib)	7.1 mA	7.2 mA	54 mA	17.4 mA
Grid-No. 2 Current (Ic2)	—	—	13.5 mA	3.2 mA
Grid-No. 1 Cutoff Voltage	-5.5 V (at Ib = 50 μA)	-8 V (at Ib = 100 μA)	—	-6.6 V (at Ib = 100 μA)

Maximum Ratings and Circuit Values

The maximum ratings are established under the **Design-Maximum System**. These ratings represent limiting values of operating and environmental conditions that should not be exceeded under the worst probable circumstances.

Design-Maximum Ratings

Rating	Triode Section 1	Triode Section 2	Pentode Section
Plate Voltage	330 V	330 V	165 V
Grid-No. 2 (Screen) Voltage	—	—	165 V
Positive DC Grid-No. 1 Voltage	0 V	0 V	0 V
Plate Dissipation	1.5 W	2.0 W	3.5 W
Grid-No. 2 (Screen) Input	—	—	1.5 W

Maximum Circuit Values (Grid-No. 1 Circuit Resistance)

Bias Type	Triode Section 1	Triode Section 2	Pentode Section
Fixed-Bias Operation	0.5 M Ω	0.5 M Ω	0.05 M Ω (50,000 Ω)

Bias Type	Triode Section 1	Triode Section 2	Pentode Section
Cathode-Bias Operation	1.0 MΩ	1.0 MΩ	0.1 MΩ (100,000 Ω)

Interelectrode and Coupling Capacitances

Because the 11BT11 houses three high-gain stages in close proximity, internal shielding and direct interelectrode capacitances are critical design factors. The following values are measured **without an external shield**:

Direct Interelectrode Capacitances

- **Triode Section 1:**
 - Grid to Plate (1Tg to 1Tp): 1.9 pF
 - Input [1Tg to (1Tk + Pg3 + h + i.s.)]: 2.8 pF
 - Output [1Tp to (1Tk + Pg3 + h + i.s.)]: 2.0 pF
- **Triode Section 2:**
 - Grid to Plate (2Tg to 2Tp): 2.6 pF
 - Input [2Tg to (2Tk + 1Tk + Pg3 + h + i.s.)]: 4.6 pF
 - Output [2Tp to (2Tk + 1Tk + Pg3 + h + i.s.)]: 3.6 pF
- **Pentode Section:**
 - Grid-No. 1 to Plate (Pg1 to Pp): 0.13 pF
 - Input [Pg1 to (Pk + 1Tk + Pg2 + Pg3 + h + i.s.)]: 13 pF
 - Output [Pp to (Pk + 1Tk + Pg2 + Pg3 + h + i.s.)]: 4.6 pF

Inter-Unit Coupling Capacitances

- **Pentode Plate to Triode Plate (Section 2)** (Pp to 2Tp): 0.08 pF maximum
- **Triode Plate (Section 1) to Triode Plate (Section 2)** (1Tp to 2Tp): 0.19 pF maximum

Characteristic Curves and Design Interpretation

The published characteristic curves for the 11BT11 illustrate the performance capabilities and biasing requirements of each section:

Pentode Section Curves

- **Average Plate Characteristics:** Plotting plate current (I_b) and screen current (I_{c2}) against plate voltage reveals typical pentode behavior. At a screen voltage (E_{c2}) of 100 V, the plate current rises extremely sharply at very low plate voltages (below 25 V) and remains highly flat and independent of plate voltage across the rest of the operating range. Increasing the screen voltage to 150 V shifts the curves upward, significantly increasing the available plate current for a given control-grid bias.

- **Average Transfer Characteristics:** These curves plot plate and screen currents against Grid-No. 1 voltage. They show a sharp-cutoff characteristic, with plate current approaching zero near -6.6 V when the screen is at 100 V.
- **Transconductance vs. Grid-No. 1 Voltage:** The transconductance (g_m) curve rises steeply as the control grid bias approaches 0 V, demonstrating the high gain capability of the frame-grid design, which peaks at 19,000 μmhos under typical operating conditions.

Triode Section 1 Curves

- **Average Plate Characteristics:** The plate current curves for various grid voltages (from 0 V to -7.0 V) show typical high- μ triode behavior, requiring relatively small negative grid voltages to control plate current.
- **Average Characteristics vs. Plate Current:** At a plate voltage (E_b) of 200 V, the amplification factor (μ) remains remarkably constant near 69 across a wide range of plate currents (from 2 mA to 14 mA). Over this same range, the plate resistance (r_p) drops from approximately 25,000 Ω to 10,000 Ω , while the transconductance (g_m) rises from 2,500 μmhos to over 6,000 μmhos .

Triode Section 2 Curves

- **Average Plate Characteristics:** The curves for Triode Section 2 span grid voltages from 0 V to -10 V. The lower slope of these curves compared to Section 1 reflects its lower plate resistance and medium- μ design.
- **Average Characteristics vs. Plate Current:** At $E_b = 200$ V, the amplification factor (μ) is stable near 40. The plate resistance (r_p) is significantly lower than that of Section 1, dropping from about 15,000 Ω at low currents to approximately 6,000 Ω at higher currents, while transconductance (g_m) rises from 2,500 μmhos to nearly 7,000 μmhos as plate current increases toward 20 mA.

Technical Summary

The **11BT11** is a highly integrated compactron/duodecar multi-unit tube designed to consolidate multiple functions in television receivers. By combining a high- μ triode ($\mu = 69$), a medium- μ triode ($\mu = 40$), and a high-transconductance, sharp-cutoff frame-grid pentode ($g_m = 19,000 \mu\text{mhos}$) into a single T-9 envelope, it reduces chassis space and component count.

Its heater is optimized for series-string operation with a 10.7 V, 0.6 A rating and a controlled 11-second warm-up time. Designers must respect the shared cathode connection on Pin 6 (linking Triode 1's cathode to the pentode's suppressor grid and internal shield) and adhere to the design-maximum ratings, particularly the 165 V limit on the pentode plate and screen grid, to ensure reliable operation in video-amplifier and general-purpose television circuitry.

SOURCE OPERATING CONDITIONS

[SOURCE PDF](#)

1968 General Electric Co

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

1968 GENERAL ELECTRIC CO

Section 1 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	35 V	—
Plate Voltage	-55611 V	—
Plate Voltage	-55611 V	—
Screen Voltage	165 V	—
Screen Voltage	4 V	—
Plate Dissipation	4 W	—
ScreenDissipation	4 W	—
Plate Current	25 mA	—
Plate Current	-55611 mA	—
Plate Current	-55611 mA	—
Screen Current	13.5 mA	—
Transconductance	19000 uS	—
Transconductance	5500 uS	—
Transconductance	6 uS	—
Plate Resistance	51000 ohm	—
Plate Resistance	12500 ohm	—
Plate Resistance	30 ohm	—
Grid Voltage	50 V	—
Grid Voltage	100 V	—
Grid Voltage	-55611 V	—
Grid Voltage	-55611 V	—
Plate Voltage	150 V	AverageCharacteristics

PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Screen Voltage	100 V	AverageCharacteristics

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Current	17.4 mA	AverageCharacteristics
Screen Current	3.2 mA	AverageCharacteristics

1968 GENERAL ELECTRIC CO

Section 2 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	200 V	AverageCharacteristics

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Current	7.1 mA	AverageCharacteristics

1968 GENERAL ELECTRIC CO

Section 3 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Voltage	200 V	AverageCharacteristics

CHARACTERISTIC		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate Current	7.2 mA	AverageCharacteristics



SOURCE OPERATING CONDITIONS

1975 RCA RC30

[SOURCE PDF](#)

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

1975 RCA RC30

Section 1 · Pentode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	150 V	ClassA
Screen-grid voltage	100 V	ClassA
Cathode-bias resistor	82 ohm	ClassA
Plate current	17.4 mA	ClassA
Screen-grid current	3.2 mA	ClassA

1975 RCA RC30

Section 2 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	200 V	ClassA
Cathode-bias resistor	270 ohm	ClassA
Plate current	7.1 mA	ClassA

1975 RCA RC30

Section 3 · Triode

OTHER		
PARAMETER	PUBLISHED VALUE	CONDITION / NOTE
Plate voltage	35 V	ClassA
Cathode-bias resistor	470 ohm	ClassA
Plate current	7.2 mA	ClassA