

## GATED-BEAM DISCRIMINATOR

FOR FM AND TV LIMITER AND DISCRIMINATOR APPLICATIONS

### DESCRIPTION AND RATING

The 6BN6 is a miniature beam tube primarily designed to perform the combined functions of the limiter, discriminator, and audio-voltage amplifier in FM and intercarrier television receivers. Advantages inherent in this application of the 6BN6 include excellent performance, circuit simplicity, and ease of alignment. Additional applications of the tube include use as a limiter or as a sync-clipper.

Except for heater ratings and heater-cathode voltage ratings, the 3BN6 and 4BN6 are identical to the 6BN6. As a result of their controlled heater-warm-up characteristic, the 3BN6 and 4BN6 are especially suited for use in television receivers that employ series-connected heaters.

The 12BN6 is identical to the 6BN6 except for heater ratings.

### GENERAL

#### ELECTRICAL

Cathode—Coated Unipotential

|                                         | 3BN6 | 4BN6 | 6BN6 | 12BN6               |
|-----------------------------------------|------|------|------|---------------------|
| Heater Voltage, AC or DC                | 3.15 | 4.2  | 6.3  | 12.6 Volts          |
| Heater Current                          | 0.6  | 0.45 | 0.3  | 0.15 Amperes        |
| Heater Warm-up Time*                    | 11   | 11   | ...  | ... Seconds         |
| Direct Interelectrode Capacitances†     |      |      |      |                     |
| Grid-Number 1 to All                    |      |      |      | 4.2 $\mu\text{f}$   |
| Grid Number 3 to All                    |      |      |      | 3.3 $\mu\text{f}$   |
| Grid-Number 1 to Grid-Number 3, maximum |      |      |      | 0.004 $\mu\text{f}$ |

#### MECHANICAL

Mounting Position—Any

Envelope—T5½, Glass

Base—E7-1, Miniature Button 7-Pin

### MAXIMUM RATINGS

#### DESIGN-MAXIMUM VALUES

|                                         |                 |              |
|-----------------------------------------|-----------------|--------------|
| Plate-Supply Voltage                    | 330             | Volts        |
| Accelerator Voltage                     | 110             | Volts        |
| Peak Positive Limiter-Grid Voltage      | 60              | Volts        |
| DC Cathode Current                      | 13              | Milliamperes |
| Heater-Cathode Voltage                  |                 |              |
| Heater Positive with Respect to Cathode | 3BN6 4BN6 12BN6 |              |
| DC Component                            | 100             | ... Volts    |
| Total DC and Peak                       | 200             | 100 Volts    |
| Heater Negative with Respect to Cathode |                 |              |
| Total DC and Peak                       | 200             | 100 Volts    |

Design-Maximum ratings are limiting values of operating and environmental conditions applicable to a bogey tube of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

The tube manufacturer chooses these values to provide acceptable serviceability of the tube, taking responsibility for the effects of changes in operating conditions due to variations in tube characteristics.

The equipment manufacturer should design so that initially and throughout life no design-maximum value for the intended service is exceeded with a bogey tube under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, and environmental conditions.

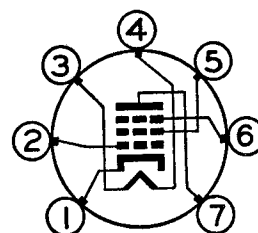
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**GENERAL ELECTRIC**

Supersedes ET-T874, dated 7-54

$\Delta$ Supersedes pages 1 and 2, dated 11-56.

### BASING DIAGRAM

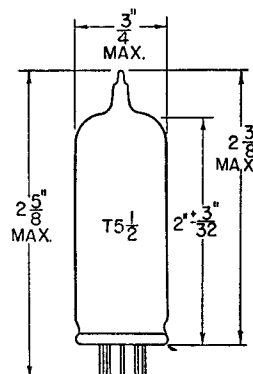


EIA 7DF

### TERMINAL CONNECTIONS

- Pin 1—Cathode, Focus Electrode, and Internal Shields
- Pin 2—Grid Number 1 (Signal or Limiter)
- Pin 3—Heater
- Pin 4—Heater
- Pin 5—Grid Number 2 (Accelerator)
- Pin 6—Grid Number 3 (Quadrature)
- Pin 7—Plate

### PHYSICAL DIMENSIONS



EIA 5-3

## CHARACTERISTICS AND TYPICAL OPERATION

### LIMITER-DISCRIMINATOR SERVICE (SEE CIRCUIT DIAGRAM)

|                                                                   |          |          |          |              |
|-------------------------------------------------------------------|----------|----------|----------|--------------|
| Input-Signal Center Frequency.....                                | 10.7     | 10.7     | 4.5      | Megacycles   |
| Frequency Deviation.....                                          | $\pm 75$ | $\pm 75$ | $\pm 25$ | Kilocycles   |
| Plate-Supply Voltage.....                                         | 85       | 285      | 270      | Volts        |
| Plate Voltage.....                                                | 63       | 122      | 121      | Volts        |
| Accelerator Voltage.....                                          | 55       | 100      | 100      | Volts        |
| Cathode-Bias Resistor (Variable) $\dagger$ .....                  | 200-400  | 200-400  | 200-400  | Ohms         |
| Plate Load Resistor.....                                          | 85000    | 330000   | 330000   | Ohms         |
| Plate Linearity Resistor.....                                     | 470      | 1500     | 1000     | Ohms         |
| Integrating Capacitor.....                                        | 0.002    | 0.001    | 0.001    | Microfarads  |
| Coupling Capacitor.....                                           | 0.25     | 0.01     | 0.25     | Microfarads  |
| Minimum Signal Voltage<br>for Limiting Action, RMS $\S$ .....     | 1.25     | 1.25     | 1.25     | Volts        |
| DC Plate Current.....                                             | 0.25     | 0.49     | 0.44     | Milliamperes |
| Accelerator Current.....                                          | 4.1      | 9.8      | 10       | Milliamperes |
| Input Signal Level<br>for AM Rejection Adjustment $\dagger$ ..... | 1.25     | 2.0      | 2.0      | Volts        |
| AM Rejection at Esig = 2.0 Volts, RMS.....                        | 31       | 20       | 25       | Decibels     |
| AM Rejection at Esig = 3.0 Volts, RMS.....                        | 30       | 29       | 30       | Decibels     |
| Total Harmonic Distortion.....                                    | 2.0      | 1.6      | 1.8      | Percent      |
| Peak Audio Output Voltage.....                                    | 6.0      | 16.6     | 16.8     | Volts        |

\* The time required for the voltage across the heater to reach 80 percent of its rated value after applying 4 times rated heater voltage to a circuit consisting of the tube heater in series with a resistance equal to 3 times the rated heater voltage divided by the rated heater current.

$\dagger$  Without external shield.

$\ddagger$  The cathode resistor should be adjusted for maximum AM rejection in the output of the limiter-discriminator stage at the specified signal level. AM rejection is measured with an applied signal containing 30-percent amplitude modulation and 30-percent frequency modulation.

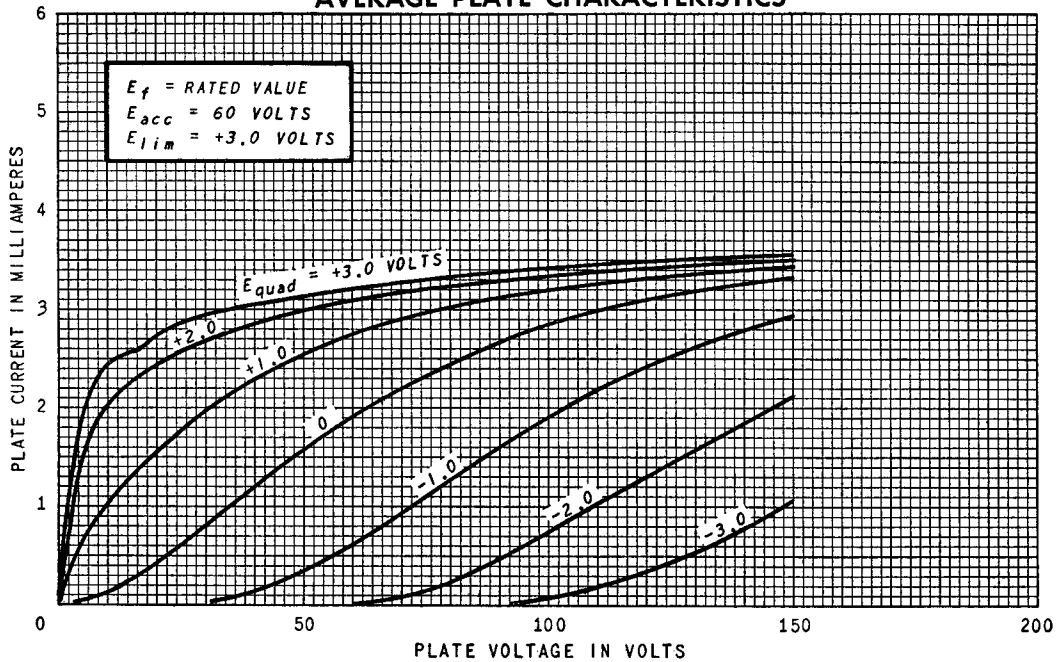
$\S$  At signal levels above specified value, limiting is within  $\pm 2$  decibels.

Adequate shielding between components of the limiter grid and the quadrature grid must be used to insure proper phasing of the voltage developed on the quadrature grid.

Standard de-emphasis requirements for FM are included.

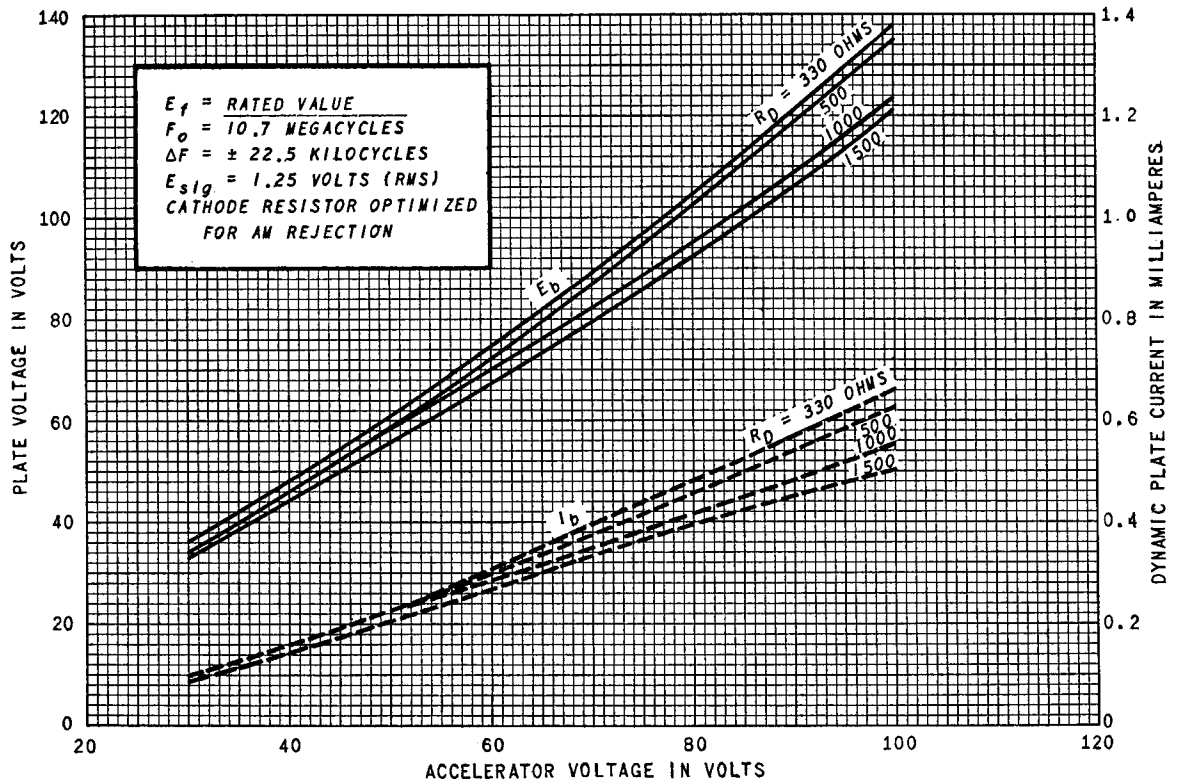
The Q of the quadrature grid circuit should be high enough to develop a minimum of 4 volts (RMS) signal with 2 volts (RMS) of the center-frequency signal applied to the limiter grid. It is recommended that the coil be shunted by a minimum of 10  $\mu\text{f}$ . The capacitance may be composed of tube input capacitance, stray capacitance, and distributed capacitance, as well as physical capacitance.

## AVERAGE PLATE CHARACTERISTICS

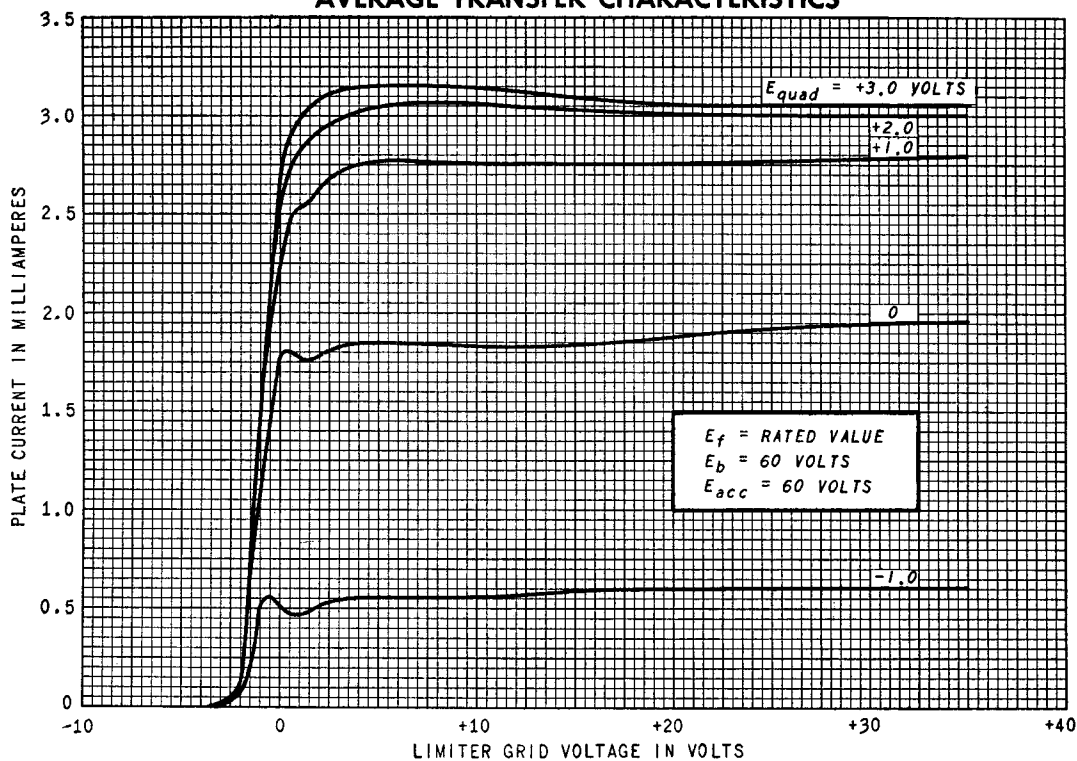


## OPERATION CHARACTERISTICS

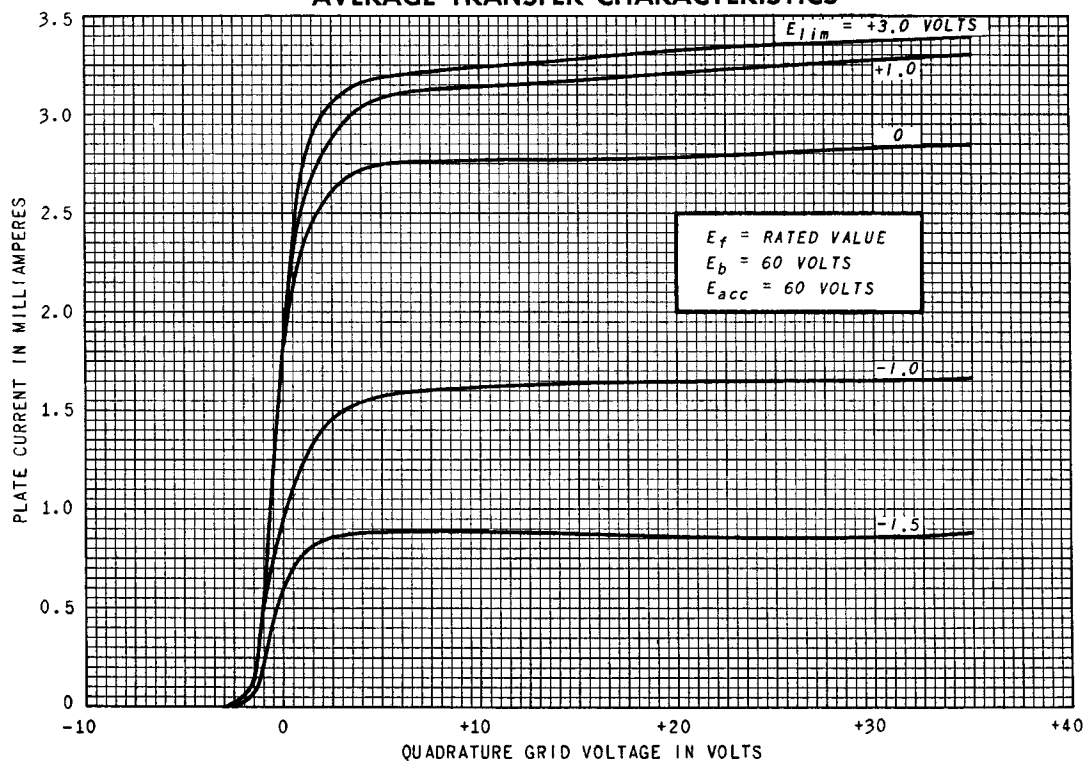
To obtain the optimum dial-tuning characteristic (a symmetrical discriminator response curve) in FM applications, it is essential that the ratio of plate current with no signal to plate current with an unmodulated signal should equal unity. After a value of accelerator voltage is chosen, the plate voltage applied to the tube should be chosen as indicated by the following graph in order to realize this unity ratio of plate current. The graph also shows the average dynamic plate current that is flowing under the specified plate and accelerator voltage conditions. The plate load resistor should be chosen to drop the plate supply voltage to the specified plate voltage.



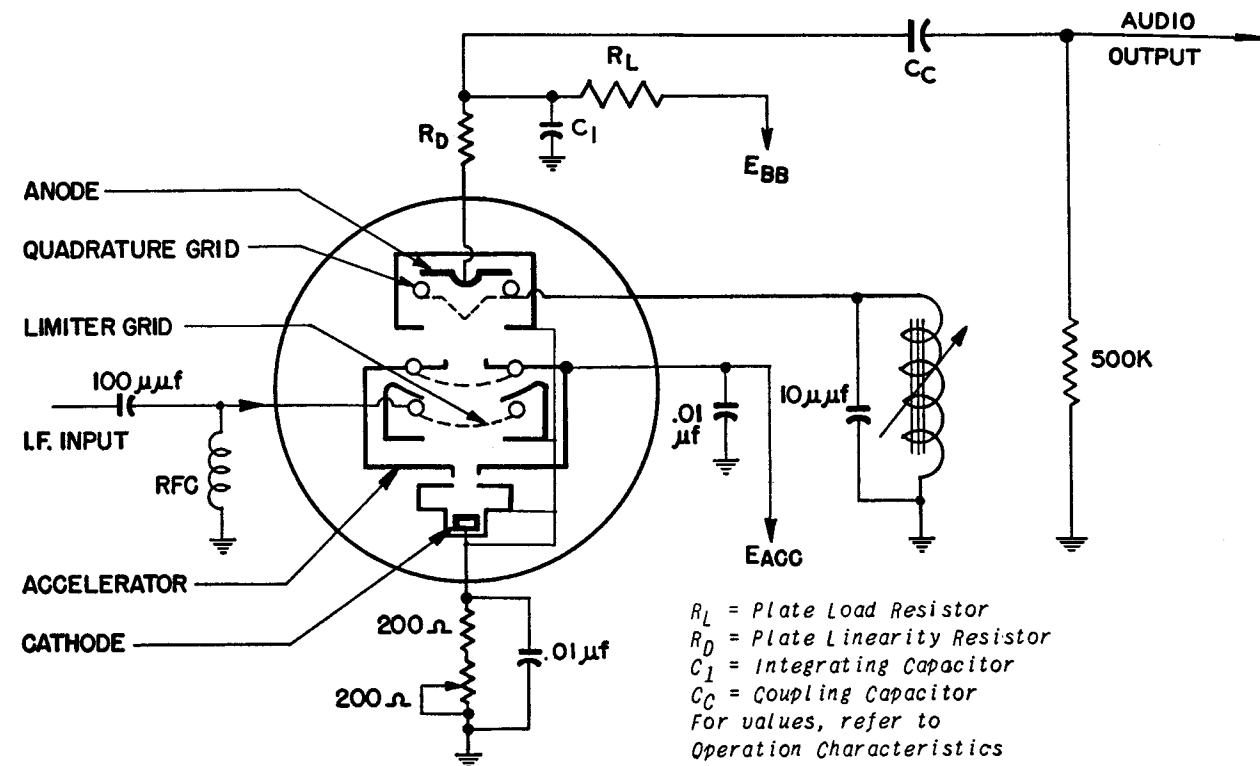
### AVERAGE TRANSFER CHARACTERISTICS



### AVERAGE TRANSFER CHARACTERISTICS



**SCHEMATIC DIAGRAM SHOWING TYPICAL CIRCUIT  
 AND INTERNAL CONSTRUCTION OF THE 6BN6**



**WAVEFORMS OF PLATE CURRENT**

$f$  = frequency of applied signal  
 $f_0$  = center-frequency of applied signal

