# 3D22-A
# GAS THYRATRON

NEGATIVE-CONTROL TETRODE TYPE

*Supersedes Type 3D22*

## GENERAL DATA

**Electrical:**

Heater, for Unipotential Cathode:

| | Min. | Av. | Max. | |
|---|---|---|---|---|
| Voltage | 5.7 | 6.3 | 6.9 | ac or dc volts |
| Current at 6.3 volts | - | 2.6 | 2.85 | amp |

Cathode:

| | | |
|---|---|---|
| Minimum heating time prior to tube conduction | 30 | sec |
| Maximum outage time without reheating | 3 | sec |

Direct Interelectrode Capacitances (Approx.):[o]

| | | |
|---|---|---|
| Grid No.1 to anode* | 0.1 | μμf |
| Grid No.1 to cathode, grid No.2, base shell, and heater | 8.5 | μμf |
| Anode to cathode, grid No.2, base shell, and heater | 4.6 | μμf |

Ionization Time (Approx.):

| | | |
|---|---|---|
| For conditions: dc anode volts = 100, grid-No.1 square-pulse volts = +100, and peak anode amperes during conduction = 8 | 0.5 | μsec |

Deionization Time (Approx.):

| | | |
|---|---|---|
| For conditions: dc anode volts = 125, dc grid-No.1 volts = -200, grid-No.1 resistor (ohms) = 1000, and dc anode amperes = 0.8 | 150 | μsec |
| For conditions: dc anode volts = 125, dc grid-No.1 volts = -14.8, grid-No.1 resistor (ohms) = 1000, and dc anode amperes = 0.8 | 400 | μsec |

Maximum Critical Grid-No.1 Current:

| | | |
|---|---|---|
| For conditions: ac anode-supply volts = 460 (rms), and average anode amperes = 0.8 | 0.8 | μamp |
| Anode Voltage Drop (Approx.) | 10 | volts |

Grid-No.1 Control Ratio (Approx.):

| | |
|---|---|
| For conditions: grid-No.1 resistor (megohms) = 0 to 0.1, grid-No.2 resistor (megohms) = 0, and grid-No.2 volts = 0 | 150 |

Grid-No.2 Control Ratio (Approx.):

| | |
|---|---|
| For conditions: grid-No.1 resistor (megohms) = 0, grid-No.2 resistor (megohms) = 0 to 0.1, and grid-No.1 volts = -3 | 650 |

[o] Without external shield.

* With all other electrodes and base shell connected to ground.

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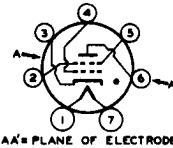
**Mechanical:**

| | |
|---|---|
| Mounting Position | Any |
| Maximum Overall Length | 4-5/8" |
| Maximum Seated Length | 4" |
| Maximum Diameter | 2-3/8" |
| Weight (Approx.) | 5 oz |
| Bulb | T-16 |
| Base | Medium-Metal-Shell Giant 7-Pin with Bayonet (JETEC No. A7-17) |
| Basing Designation for BOTTOM VIEW | 7BV |

Pin 1 – Heater
Pin 2 – Grid No.2
Pin 3 – Cathode
Pin 4 – Grid No.1



AA' = PLANE OF ELECTRODES

Pin 5 – Grid No.2
Pin 6 – Anode
Pin 7 – Heater

## RELAY AND GRID-CONTROLLED RECTIFIER SERVICE

**Maximum Ratings,** *Absolute Values:*

| | | |
|---|---|---|
| PEAK ANODE VOLTAGE: | | |
| Forward | 650 max. | volts |
| Inverse | 1500 max. | volts |
| GRID-No.2 (SHIELD-GRID) VOLTAGE: | | |
| Peak, before tube conduction | -100 max. | volts |
| Average#, during tube conduction | -10 max. | volts |
| GRID-No.1 (CONTROL-GRID) VOLTAGE: | | |
| Peak or DC, before tube conduction | -200 max. | volts |
| Average#, during tube conduction | -10 max. | volts |
| CATHODE CURRENT: | | |
| Peak | 8 max. | amp |
| Average# | 0.8 max. | amp |
| Fault, for duration of 0.1 second max. | 30 max. | amp |
| AVERAGE GRID-No.2 CURRENT# | +0.1 max. | amp |
| AVERAGE GRID-No.1 CURRENT# | +0.05 max. | amp |
| PEAK HEATER-CATHODE VOLTAGE: | | |
| Heater negative with respect to cathode | 100 max. | volts |
| Heater positive with respect to cathode | 25 max. | volts |
| AMBIENT-TEMPERATURE RANGE | -75 to +90 | °C |

**Maximum Circuit Values:**

| | | |
|---|---|---|
| Grid-No.1-Circuit Resistance | 2 max. | megohms |

# Averaged over any interval of 30 seconds maximum.



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## SPECIAL PERFORMANCE TESTS

*Made in conformance with indicated sections of MIL-E-1B Specifications dated 2 May 1952*

**4.9.19.2 (F-66) High-Frequency Vibration:**

The tube is rigidly mounted on a table vibrating with simple harmonic motion at a frequency of 50 ± 2 cps with a fixed amplitude of 0.040" ± 0.0025" (total excursion is double the amplitude). Maximum acceleration is 10g. No voltage is applied during vibration. Tube is vibrated for 10 minutes in such manner that table motion is along shortest line between anode and cathode. This test will not cause tube to be inoperative.

**4.10.19 (F-64) Thyratron High-Voltage Operation:**

| | *Min.* | *Max.* | |
|---|---|---|---|
| *Grid-No.1 Supply Voltage (1)* . . . . . | -4.4 | -9.2 | volts |

This test is made after two light taps with a felt hammer (similar to type used for noise tests) in direction from cathode to anode under the following conditions: heater voltage of 6.3 volts rms, anode supply voltage of 500 volts rms, grid No.2 tied to cathode, load resistance of 2000 ohms, and grid-No.1 circuit-resistance of 2 megohms. Tube conduction is indicated by an oscilloscope connected between anode and cathode and ceases when the grid-No.1 supply voltage is increased negatively within indicated range.

| | | | |
|---|---|---|---|
| *Grid-No.1 Supply Voltage (2)* . . . . . | -4.4 | -9.2 | volts |

This test is made as for Grid-No.1 Supply Voltage (1), except that the taps are made in direction from anode to cathode.

| | | | |
|---|---|---|---|
| *Voltage Difference* . . . . . | - | 1 | volt |

The difference between the value of grid-No.1 supply voltage in the first and second grid-No.1 supply voltage tests will not exceed the specified value.

## OPERATING CONSIDERATIONS

Sufficient *anode-circuit resistance*, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

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## GRID-CONTROLLED RECTIFIER CIRCUITS

### DC Voltage Control

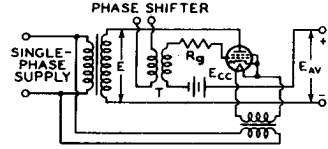


FIG. 1 HALF-WAVE SINGLE-PHASE

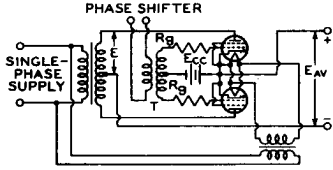


FIG. 2 FULL-WAVE SINGLE-PHASE

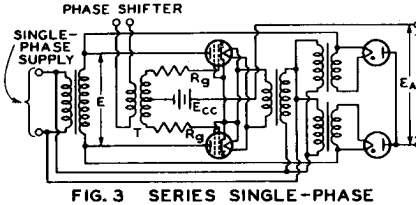


FIG. 3 SERIES SINGLE-PHASE

### AC Voltage Control

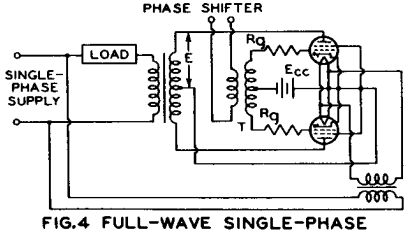


FIG.4 FULL-WAVE SINGLE-PHASE

NOTES

92CL-8596

T = PEAKING TRANSFORMER

IN FIG. 3, THE RECTIFIER TUBES MAY BE 3D22-A's USED AS DIODES. THE 3D22-A IS USED AS A DIODE BY CONNECTING GRIDS №2 AND №1 TO CATHODE (PIN 3)





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## GRID-CONTROLLED RECTIFIER CIRCUITS

### Numerical Relationships Among Electrical Quantities

$E$ = Trans. Sec. Voltage (RMS)
$E_{av}$ = Average DC Output Voltage
$E_{bmf}$ = Peak Forward Anode Voltage
$E_{bmi}$ = Peak Inverse Anode Voltage
$E_m$ = Peak DC Output Voltage
$E_r$ = Major Ripple Voltage (RMS)
$f$ = Supply Frequency
$f_r$ = Major Ripple Frequency

$I_{av}$ = Average DC Output Current
$I_b$ = Average Anode Current
$I_p$ = Anode Current (RMS)
$I_{pm}$ = Peak Anode Current
$P_{ac}$ = Load Volt-Amperes
$P_{al}$ = Line Volt-Amperes
$P_{ap}$ = Trans. Pri. Volt-Amperes
$P_{as}$ = Trans. Sec. Volt-Amperes

$P_{dc}$ = DC Power ($E_{av} \times I_{av}$)

*Note: Conditions assumed involve sine-wave supply; zero voltage drop in tubes; no losses in transformer and circuit; no back emf in the load circuit; and no phase-back.*

| RATIO | Fig. 1 | Fig. 2 | Fig. 3 | Fig. 4 |
|---|---|---|---|---|
| **Voltage Ratios** | | | | |
| $E/E_{av}$ | 2.22 | 1.11 | 1.11 | – |
| $E_{bmi}/E$ | 1.41 | 2.83 | 1.41 | 1.41 |
| $E_{bmi}/E_{av}$ | 3.14 | 3.14 | 1.57 | – |
| $E_m/E_{av}$ | 3.14 | 1.57 | 1.57 | – |
| $E_r/E_{av}$ | 1.11 | 0.472 | 0.472 | – |
| $E_{bmf}/E$: | | | | |
| *Resistive Load* | 1.41 | 1.41 | 1.41 | 1.41 |
| *Inductive Load*■ | 1.41 | 2.83 | 1.41 | 1.41 |
| **Frequency Ratio** | | | | |
| $f_r/f$ | 1 | 2 | 2 | – |
| **Current Ratios** | | | | |
| $I_p/I_{av}$ | 1.57 | 0.785 | 0.785 | – |
| $I_b/I_{av}$ | 1 | 0.5 | 0.5 | – |
| *Resistive Load* | | | | |
| $I_{pm}/I_{av}$ | 3.14 | 1.57 | 1.57 | – |
| $I_{pm}/I_b$ | 3.14 | 3.14 | 3.14 | 3.14 |
| *Inductive Load*■ | | | | |
| $I_{pm}/I_{av}$ | -- | 1 | 1 | – |
| **Power Ratios** | | | | |
| $P_{ac}/I_b E_{bmf}$ | -- | – | – | 1.57 |
| *Resistive Load* | | | | |
| $P_{as}/P_{dc}$ | 3.49 | 1.74 | 1.24 | – |
| $P_{ap}/P_{dc}$ | 2.69 | 1.23 | 1.24 | – |
| $P_{al}/P_{dc}$ | 2.69 | 1.23 | 1.24 | – |

■: See next page.

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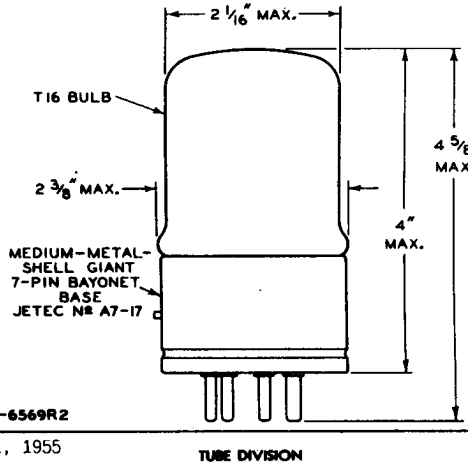
| RATIO | Fig. 1 | Fig. 2 | Fig. 3 | Fig. 4 |
|---|---|---|---|---|
| **Power Ratios (Cont'd)** | | | | |
| *Inductive Load*■ | | | | |
| $P_{as}/P_{dc}$ | — | 1.57 | 1.11 | – |
| $P_{ap}/P_{dc}$ | — | 1.11 | 1.11 | – |
| $P_{al}/P_{dc}$ | — | 1.11 | 1.11 | – |

■ The use of a large filter-input choke is assumed, except for the circuit in Fig. 4.

| CIRCUIT Single-Phase | MAX. TRANS. SEC. VOLTS (RMS) E | APPROX. DC OUTPUT VOLTS TO FILTER $E_{av}$ | MAX. DC OUTPUT AMPERES $I_{av}$ | MAX. DC OUTPUT WATTS TO FILTER $P_{dc}$ | MAX. AC OUTPUT VOLT-AMPERES $P_{ac}$ |
|---|---|---|---|---|---|
| **Fig. 1 Half-Wave** | 460 | 205 | 0.8 | 165 | – |
| **Fig. 2 Full-Wave:** | | | | | |
| Resistive Load | 460 | 410 | 1.6 | 660 | – |
| Inductive Load | 230 | 205 | 1.6 | 330 | – |
| **Fig. 3 Series** | 460 | 410 | 1.6 | 660 | – |
| **Fig. 4 Full-Wave** | 460 | – | – | – | 800 |



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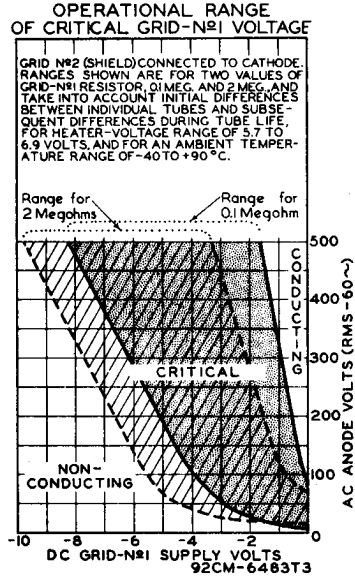




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RCA

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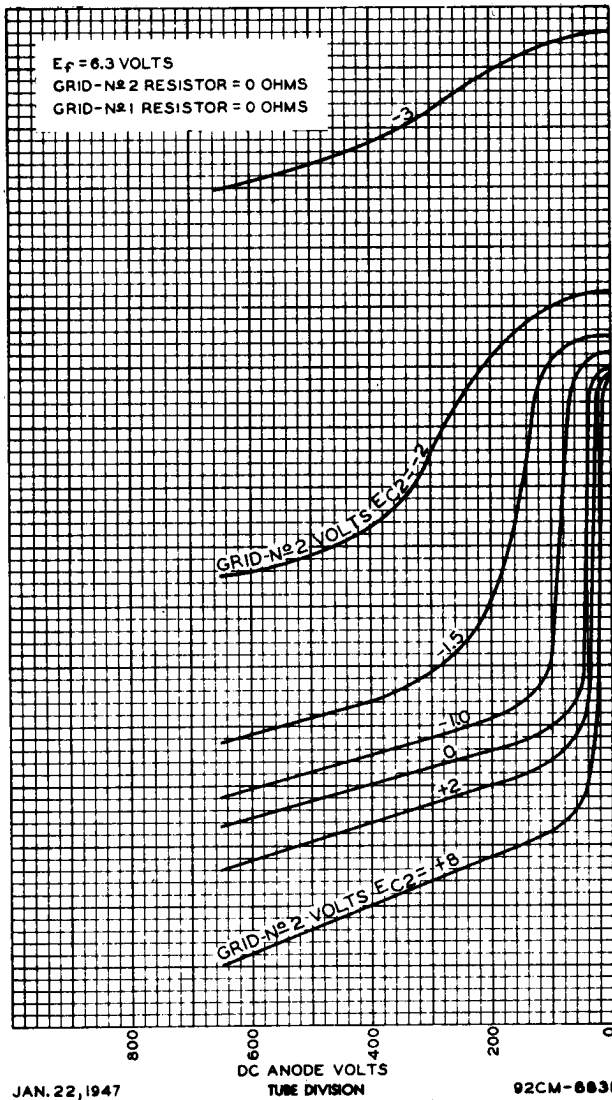
## AVERAGE CONTROL CHARACTERISTICS



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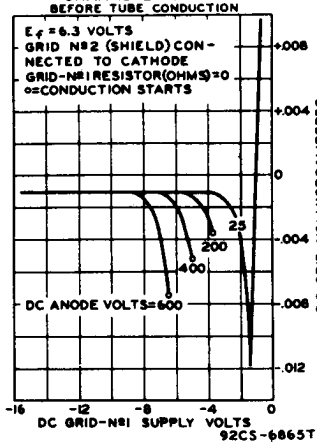
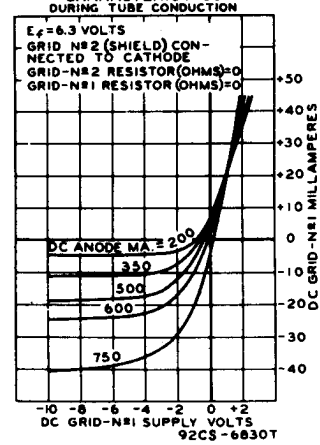
## CHARACTERISTIC CURVES

AVERAGE GRID-N°1 CHARACTERISTICS
BEFORE TUBE CONDUCTION




AVERAGE GRID-N°1 CHARACTERISTICS
DURING TUBE CONDUCTION



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