TUNG-SOL

DIODE

MINIATURE TYPE

COLD CATHODE

ANY MOUNTING POSITION

GLASS BULB

BOTTOM VIEW

SMALL-BUTTON MINIATURE
7 PIN BASE
580

THE 5651WA IS A MINIATURE TWO ELECTRODE INERT-GAS-FILLED, COLD CATHODE, GLOW DISCHARGE DIODE FOR USE AS A VOLTAGE REFERENCE TUBE IN ELECTRONIC REGULATED SUPPLIES. IT HAS AN OPERATING VOLTAGE OF 86 VOLTS OVER A CURRENT RANGE OF 1.5 TO 3.5 MILLIAMPERES. THIS TUBE IS IDEALLY SUITED FOR APPLICATIONS IN WHICH SUDDEN FLUCTUATIONS MUST BE KEPT BELOW 5 MVOLTS OVER THE ENTIRE RANGE AND WHICH REQUIRE VERY LOW OPERATING VOLTAGE DRIFT AND LONG LIFE. THE 5651WA FEATURES HIGH SHOCK AND VIBRATION RATINGS AND WILL "STRIKE" AT LOW VOLTAGES IN THE ABSENCE OF LIGHT.

ELECTRICAL DATA

CATHODE

MECHANICAL DATA

MOUNTING POSITION
ANY

MAXIMUM OVERALL LENGTH
2 1/8 INCHES

MAXIMUM SEATED LENGTH
1 7/8 INCHES

MAXIMUM DIAMETER
3/4 INCH

BULB
T-5 1/2

BASE
7 PIN E7-1 SMALL-BUTTON MINIATURE

NET WEIGHT (APPROX.)
0.3 OUNCES

MAXIMUM SHOCK RATING
450 G/1 MS

MAXIMUM VIBRATION RATING (D=0.88" @ 50 CPS)
10 G

RATINGS

MAXIMUM DC OPERATING CURRENT
3.5 MA.

MINIMUM DC OPERATING CURRENT
1.5 MA.

AMBIENT TEMPERATURE RANGE
-55 TO +150 °C

ALTITUDE
60 000 FEET

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ADDITIONAL TESTS TO INSURE RELIABILITY
RANDOMLY SELECTED SAMPLES ARE SUBJECT TO THE FOLLOWING TESTS

SHOCK: 30° HAMMER ANGLE IN NAVY, FLYWEIGHT, HIGH IMPACT MACHINE (450G/SEC)

FATIGUE: 25 CPS, 0.08" TOTAL DISPLACEMENT FOR 32 HOURS IN EACH OF
3 MUTUALLY PERPENDICULAR PLANES (2.5 G)

POST SHOCK AND FATIGUE LIMITS:
IONIZATION VOLTAGE (MAX.) 115 VDC
REGULATION (1.5 TO 3.5 MA) 82 TO 90 VDC
TUBE VOLTAGE DROP (1.5 AND 3.5 MA) (MAX.) 3.0 VDC

STABILITY LIFE TEST (14 HOUR):
END POINT: CHANGE IN TUBE VOLTAGE DROP FROM
INITIAL VALUE @ IB=2.5 mA (MAX.) 200 mVDC

SURVIVAL RATE LIFE TEST (1000 HOURS):
END POINT: CHANGE IN TUBE VOLTAGE DROP FROM
INITIAL VALUE @ IB=2.5 mA (MAX.) 500 mVDC

INTERMITTENT LIFE TEST: END POINTS (500 HOURS)
CHANGE IN TUBE VOLTAGE DROP FROM
INITIAL VALUE @ IB = 2.5 mVDC (MAX.) 1.5 VDC
TUBE VOLTAGE DROP 82 - 90 VDC
REGULATION (MAX.) 3.0 VDC
IONIZATION VOLTAGE (MAX.) 115 VDC
END POINTS: (1000 HOURS):
TUBE VOLTAGE DROP 82 - 90 VDC
REGULATION (MAX.) 3.2 VDC
IONIZATION VOLTAGE (MAX.) 115 VDC

EQUIPMENT DESIGN AND RANGE VALUES

<table>
<thead>
<tr>
<th>MIN.</th>
<th>AVG.</th>
<th>MAX.</th>
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<tbody>
<tr>
<td>DC ANODE SUPPLY VOLTAGE IN DARKNESS</td>
<td>115A</td>
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<tr>
<td>DC ANODE SUPPLY VOLTAGE IN LIGHT</td>
<td>115A</td>
<td>---</td>
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<tr>
<td>ANODE BREAKDOWN VOLTAGE</td>
<td>---</td>
<td>106</td>
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<tr>
<td>TUBE VOLTAGE DROP (1) AT 1.5 MA.</td>
<td>82</td>
<td>84.5</td>
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<tr>
<td>TUBE VOLTAGE DROP (2) AT 3.5 MA.</td>
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<td>86.0</td>
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<tr>
<td>REGULATION</td>
<td>---</td>
<td>0.8</td>
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<tr>
<td>VOLTAGE JUMPB</td>
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<td>0</td>
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<tr>
<td>VOLTAGE REPEATABILITYC</td>
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<td>0.01</td>
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<tr>
<td>OSCILLATION (AURAL CHECK)</td>
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<td>---</td>
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<tr>
<td>NOISE</td>
<td>---</td>
<td>0</td>
</tr>
<tr>
<td>LEAKAGE CURRENT (EB =50V, RP=3000Ω)</td>
<td>---</td>
<td>0</td>
</tr>
<tr>
<td>GENERATED PLATE VOLTAGE (WHEN VIBRATED AT 40 CPS, 45G, RP=10000Ω, IB=2.5mA (MAX))</td>
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</tr>
<tr>
<td>MAXIMUM SHUNT CAPACITOR</td>
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</tr>
<tr>
<td>SERIES RESISTOR</td>
<td>D</td>
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</tr>
<tr>
<td>MAXIMUM CURRENT THROUGH INTERCONNECTED LEADS</td>
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NOTES

A. To assure starting throughout tube life, the supply voltage should not be less than this value.

B. The maximum voltage fluctuation at any current level within the operating current range.

C. Tube is cycled one minute on and one minute off for five cycles. \( i_B = 2.5 \text{ mADC} \). Readings are taken initially and at the end of each "on" period.

D. Sufficient series resistance must be used to limit the current to a maximum of 3.5 mA at the highest anode supply voltage and to limit the current to a minimum of 1.5 mA at the lowest anode supply voltage.

APPLICATION NOTES

Voltage reference tubes are often confused with voltage regulator tubes. While a reference tube is a regulator tube, it is a special form of regulator tube, in which current range and regulation is sacrificed to provide voltage repeatability and temperature stability and to minimize voltage jump and long term drift.

The voltage regulation characteristic of a reference tube is not independent of the tube current. Therefore the 5651WA should be run from a constant source such as a VR tube, a pentode, or a simple series regulator. Practical circuits are given in Figures 1, 2, and 3.

If so desired, "input and output" connections to either the anode or cathode can be made to different internally connected pins, so that the circuit will be broken upon the removal of the tube from its socket. Unused pins should not be used for circuit tie points as voltage on these pins may cause erratic behavior of the 5651WA or even form unwanted circuit connections through gas breakdown. The tube should be shielded if it is to be used in strong RF or magnetic fields.

Many circuits utilizing the 5651WA or its prototype, the 5654, are to be found in the Handbook, Preferred Circuits, Navy Aeronautical Electronic Equipment (NAPAER 16-1-519). This is available from the Superintendent of Documents, US GOVT. PRINTING OFFICE, WASHINGTON 25, D.C. at $1.75.