HY-3002/5948A-Replacement

Hydrogen Filled Triode Thyratron

Description

The HY-3002 is a hydrogen-filled, triode thyratron. The hydrogen gas fill facilitates reliable operation at a moderately-high voltage and very high pulse repetition rates when compared to similar deuterium-filled thyratrons. High pulse currents are achievable using only free or forced air convection cooling. The tube may be mounted by its mounting flange in any position.

Specifications

Absolute Ratings

(Maximums)(Nonsimultaneous)

epy, Peak Forward Anode Voltage *(Notes 1, 2 & 3)* .... 25 kv
ib, Peak Forward Anode Current *(Notes 4, 5 & 6)* .... 5 ka
ibx, Peak Reverse Anode Current *(Note 7)* .... 1 ib
epx, Peak Reverse Anode Voltage *(Note 8)* .... 20 kV
epy Min., Minimum Anode Supply Voltage .... 1 kV DC
tp, Anode Current Pulse Duration *(Note 5)* .... 10 µsec.
Ib, Average Anode Current .... 2.2 Adc
Ip, RMS Average Current *(Note 9)* .... 47.5 Aac
Pb, Anode Dissipation Factor (V x A x pps) *(Note 10)* 50x109
tr, Maximum Anode Current Rise Rate .... $1X10^{11}$a/sec

NOTE

The HY3002/5948A-REPLACEMENT is a HY3002 that incorporates a base plate adapter and extended anode rod connector designed to replace the original 5948A. The HY3002/5948A-REPLACEMENT is a ceramic tube that is much smaller in size, but performs electrically the same as the 5948A. See Figure 1 for the outline drawing. Also, please see Figure 2 for important electrical connection information.

A Typical Operating Condition *(Note 11)*

epy, Peak Forward Anode Voltage	10 kv
ib, Peak Forward Anode Current	1.0 ka
tp, Anode Current Pulse Duration	0.5 µsec.
Prr, Pulse Repetition Rate	4,000 Hz
Ib, Average Anode Current	2.0 Adc
Ip, RMS Average Current	45 Aac
Pb, Anode Dissipation Factor (V x A x pps)	45×10^9
tr, Maximum Anode Current Rise Rate	1×10^{10} a/sec

General Electrical Data

Ef, Cathode Heater Voltage (Vac)	6.3 ± 5%
If, Nom. Cathode Heater Current @ Ef = 6.3Vac, (Aac)	12.5
Er, Reservoir Heater Voltage, Nominal (Vac) *(Note 12)*	6.3
Ir, Nom. Reservoir Heater Current @ Er = 6.3Vac (Aac)	5.5
tk, Tube Warm-Up Time (Minimum Minutes)	5

Triggering Requirements

	MIN.	TYP.	MAX.
egy, Peak Open Circuit Trigger Voltage (Forward) (V)	500	750	1500
Zg, Driver Circuit Output Impedance (Ohms)	---	100	400
Driver Pulse Rise Time (ns)	---	100	150
Driver Pulse Width (µs)	1	2	---
Peak Reverse Grid Voltage (V)	---	---	400
Bias Voltage (Negative) (V)	---	---	300

Triggering Characteristics

	MIN.	TYP.	MAX.
Anode Delay Time (nS) *(Notes 13 & 14)*	---	---	500
Anode Delay Time Drift (nS) *(Note 14)*	---	---	150
Time Jitter (nS) *(Note 14)*	---	---	5

Notes

1. The dwell time at the peak anode voltage should be minimized in order to minimize prefiring. For operation at the rated epy, the dwell time must not exceed 10 milliseconds.

2. After thyratron anode current stops flowing and before voltage is reapplied to the anode, the anode voltage must stay between 0 and -500 volts for at least 10 µS to allow the gas to deionize.

3. This tube may be operated in air at up to 25 kv. Some of the more important derating factors that determine the safe operating voltage in air are the cleanliness of the tube's ceramic insulators, the rate of rise of anode voltage, the dwell time at the operating peak anode voltage, the pulse repetition rate, and ambient pressure, temperature, humidity and contaminant level. This tube may also be operated while immersed in an insulating gas or liquid.

4. The peak current capability of 5 ka applies to, short pulse (tp < 0.3 µs) duration applications.

5. The pulse width is measured on the discharge current waveform at the half peak current level.

Notes (cont.)

6. For anode current pulse widths greater than 0.3 microseconds but less than 10 microseconds, a useful formula for estimating the allowable peak current is ib = ib0 (3/tp)1/2 amps, where tp is the pulse width in microseconds, and ib0, the peak current rating at tp = 3 microseconds, is 1,500 amps for this tube.

7. This tube is not designed to conduct current in the reverse direction. The tube will have a tendency to cut-off conduction in the reverse direction but may not be able to stop reverse conduction if the reverse voltage across the thyratron is high enough. In the case where there is conduction in the reverse direction, the absolute value of the reverse peak current must be limited to no more than 10% of the peak value of the previous positive half cycle of the thyratron current waveform.

8. The reverse anode voltage shown applies for a previously nonconducting tube. Exclusive only of a spike not longer than 25 nanoseconds, the peak reverse anode voltage must not exceed 1 kv during the first 50 microseconds after conduction.

9. Ip is the true root mean square (RMS) current. For relatively rectangular shaped current pulses without a reverse current, the RMS anode current may be approximated as the square root of the product of the peak current and the average current.

10. Forced air or liquid immersion cooling should always be used in any situation where cooling by natural convection is insufficient to keep the temperature of the tube's envelope below 200°C. Typically, a room temperature air flow of 50 to 150 cfm directed into the anode cup will be sufficient. When the tube is cooled by immersion in a force-circulated liquid coolant, the anode dissipation factor may be tripled provided that the envelope temperature does not exceed 200°C.

11. Typical, simultaneous operating conditions other than the example shown in this data sheet might also be acceptable. The conditions shown herein produce a discharge current waveform of the peak forward anode current shown and no current reversal. The pulse width is measured at the half peak current level. The RMS current is approximated using the relationship shown in note 9. The average current is the product of the stored charge (in the pfn being switched by the thyratron) and the pulse repetition rate.

12. The optimum reservoir heater voltage is that which provides the best overall compromise among anode heating, anode voltage holdoff and holdoff recovery, anode current rise rate, and the tube's overall triggering characteristics. For most applications, the optimum reservoir heater voltage lies between 90% and 110% of the nominal value. Operation at voltages below 90% of nominal can result in permanent damage from anode overheating; operation at high reservoir heater voltages degrades anode holdoff and holdoff recovery, and can permanently damage the reservoir itself.

13. The anode delay time is measured from the 25% point on the rise of the unloaded grid voltage pulse to the 10% point on the rise of the anode current pulse.

14. Delay time, delay time drift and time jitter may be simultaneously minimized by applying the maximum grid drive voltage (egy) at a high rate of rise of voltage from a source of low impedance (Zg).

15. All data and specifications are subject to change without notice.

16. Data sheet origination date is shown on the front page. This data sheet becomes obsolete when more recent revisions are published.

FIGURE 1 Schematic

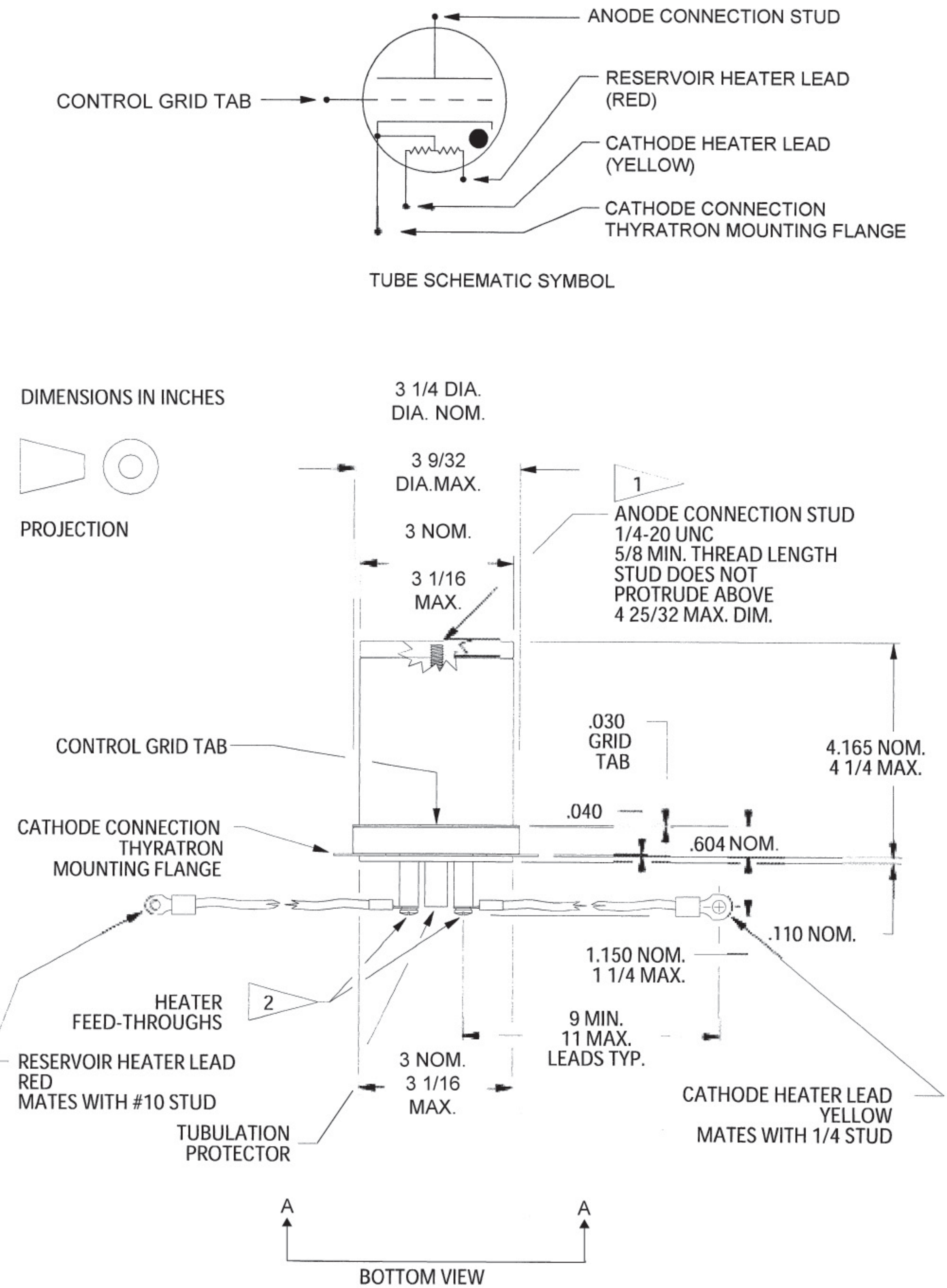
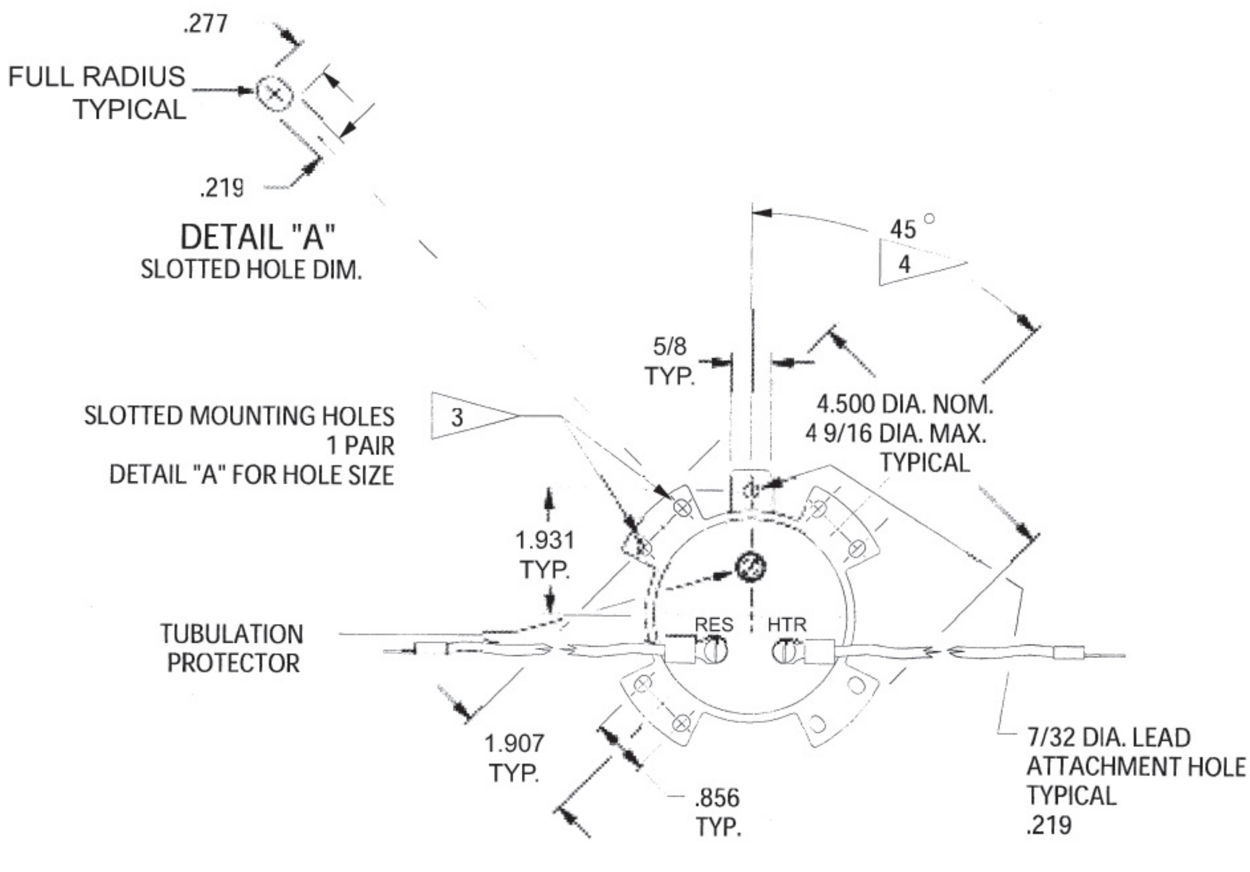


FIGURE 2 Bottom-view Schematic



VIEW A-A
BOTTOM VIEW

NOTES

1. DO NOT APPLY MORE THAN 35 INCH-POUNDS OF TORQUE TO THE ANODE CONNECTION STUD WHEN ATTACHING OR REMOVING THE ANODE LEAD.

2. CONTACT PERKINELMER APPLICATION ENGINEERING BEFORE DOING ANYTHING WITH THE SCREWS IN THE HEATER FEED-THROUGHS. THE TUBE HERMETIC SEAL MAY BECOME COMPROMISED IF EXCESSIVE TORQUE OR OTHER LOADS ARE APPLIED TO THE FEED-THROUGHS. PERKINELMER WILL GIVE YOU A PROCEDURE FOR REMOVING AND/OR REPLACING THE LEADS.

3. THERE ARE 4 PAIRS OF SLOTTED MOUNTING HOLES THAT ARE EQUALLY SPACED AROUND THE THYRATRON MOUNTING FLANGE AS SHOWN IN THE BOTTOM VIEW. DETAIL "A" GIVES THE DIMENSIONS OF EACH SLOTTED HOLE.

4. THE ANGULAR ORIENTATION OF THE TUBULATION, HEATER FEED-THROUGHS, AND GRID TAB WITH RESPECT TO THE SLOTTED MOUNTING HOLES IS AS SHOWN IN THE BOTTOM VIEW. THE ANGULAR ORIENTATION OF EACH OF THOSE ITEMS WITH RESPECT TO THE SLOTTED MOUNTING HOLES IS HELD TO WITHIN 10 DEGREES. THE ANGULAR ATTACHMENT OF THE HEATER LEADS IS ARBITRARY.

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