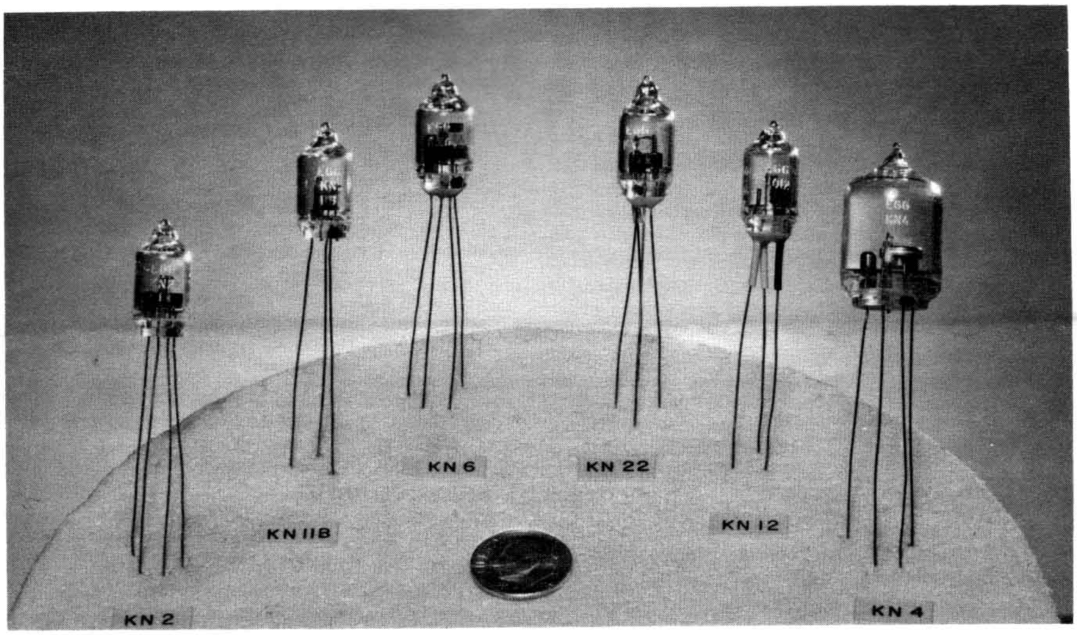
ELECTRO-OPTICS DIVISION

DATA SHEET K5500B-1

KRYTRONS — COLD CATHODE SWITCH TUBES



APPLICATIONS

Exploding Bridge Wire Systems for missile stage separation, motor ignition, arming and fusing

Nanosecond Pulse Generator

Radar Beacon Modulator

Trigger Transformer primary switch for triggering Xenon Flashtubes, Triggered Spark Gaps, Ignitrons and spark chambers

Gallium Arsenide Cell Switch

FEATURES

- Capability in radiation environments
- Reliable firing — no warm-up
- Conducts high peak currents
- High voltage hold-off
- Short delay time and low jitter
- Operation over wide temperature range
- Rugged and reliable
- Compact and light-weight

KRYTRON DESCRIPTION

The Krytron is a 4 element (grid, anode, cathode and keep-alive), cold-cathode, gas-filled switch tube designed to operate in an arc discharge mode conducting moderately high peak currents for short durations. Commutation is normally initiated by a positive pulse applied to a high impedance control grid; this grid structure encloses the anode except for a small opening at the top. It is through this small opening in the grid that conduction current must pass. This unique design allows the Krytron to hold off high voltages and still have a low tube drop during conduction. A column of ionized gas, appearing in a glow mode, and maintained by a keep-alive current, provides an initial source of plasma which produces short delay time. Krytrons are constructed with a rugged glass structure and pigtail leads for mounting into potted or fabricated assemblies where minimum package size is required. The environmental ratings shown substantiate the mechanical and electrical capabilities of the Krytrons.

ANODE OPERATING RANGE

The Anode Operating Range as shown under Specifications denotes a minimum value of voltage for a typical trigger voltage. By increasing this trigger voltage, the minimum anode operating voltage can be reduced further.

RECOVERY TIME

Recovery time is dependent on the peak current conditions and varies from several hundred microseconds at high anode peak currents to less than 100 microseconds at low anode peak currents.

PEAK CURRENTS

Peak currents specified are for typical pulse durations indicated. Increased peak currents can be achieved by decreasing the pulse width. Laboratory tests indicate that this is not necessarily a linear relatonship in that the pulse width should decrease faster than the increase in current, otherwise electrode damage can occur. Sputtering of the cathode and melting of the anode can occur when either the pulse width is too long or the peak current too great. Darkening within the glass envelope indicates sputtering of the cathode material and can result very quickly at high peak currents for long pulse widths. In determining pulse duration, the total on-time of the tube must be taken into account. Underdamped and oscillating currents may cause the tube to stay in conduction for a period longer than the maximum on-time allowed. Circuit design should be such as to permit minimum peak cathode currents of approximately 10 amperes for proper cathode conditioning throughout life. The Krytron is not designed to operate under DC cathode current conditions.

TRIGGERING

The grid of the Krytron is a high impedance element requiring very little trigger energy to cause commutation. The amount of the current required to cause grid to cathode breakdown is negligible. At the point of firing, the grid potential rises to approximately 80% of the applied anode voltage. If the tube is operated with capacitance coupling, grid leak resistance must be provided. (A typical value is 150K ohms). If the tube is transformer coupled the DC path is of adequate resistance.

Trigger pulse rise time has a decided effect on the commutation time of the tube; fast rising pulses of high peak amplitudes cause the Krytron to break down in a shorter than normal time due to the over voltage function. For example, when operating a Krytron at rated anode voltage, the delay time can be reduced 20 to 50% by increasing the peak trigger voltage from 300 to 1,000 volts.

SPRYTRONS (VACUUM KRYTRONS)

The Sprytron is a 3 electrode (anode, trigger and cathode) vacuum, switch tube that does not require any keep-alive current. The Sprytron is similar to the Krytron in both internal and external construction. KN-11B and 12 Sprytrons were developed to meet switching applications where high intensity radiation environments are encountered. The Sprytron is a hard vacuum switch tube which differs from low pressure gas-filled Krytron tubes in that it uses a special triggering device. The Sprytron initiates commutation in a manner different from the gas-filled Krytron. The trigger assembly is a lower impedance device as compared to the Krytron and emits a spark when pulsed with a potential of several hundred volts applied between the trigger probe and cathode. This spark then causes the electric field, existing between cathode and anode, to become interrupted, resulting in tube breakdown.

The Sprytron exhibits shorter delay times than the Krytron at lower anode potentials. Peak trigger voltages with rise times in the order of 0.3 microseconds are recommended.

ELECTRICAL

TUBE TYPE	VOLTAGE ANODE RANGE		MAX. PEAK CURRENT	PULSE DURATION	TRIGGER VOLTAGE	FIRING CHARACTERISTICS DELAY(3)	FIRING CHARACTERISTICS JITTER	KEEP-ALIVE CURRENT	TYPICAL LIFE DATA ANODE VOLTAGE	PEAK CURRENT	PULSE WIDTH	PULSES PER MIN.	TOTAL FIRINGS
Number	Min. VDC	Max. VDC	a	Typical µs	Min. (2) v	Max. µs	Typical µs	Typical µADC	VDC	a	µs	ppm	Number Operations
KRYTRONS													
KN-2(1)	300	4000	500	5	200	0.2	0.02	50	2000	40	1	6	1×10^7
KN-4	400	5000	2500	10	250	0.3	0.03	150	1200	270	6	1	25,000
KN-6(1)	700	5000	3000	10	250	0.25	0.03	50	2600	715	26	1	35,000
KN-6B	700	8000	3000	10	250	0.50	0.05	50	2800	715	28	1	35,000
KN-9	300	4000	500	5	200	0.2	0.02	50	1500	1	20	24,000	1.5×10^7
KN-22	400	5000	100	0.04	750	0.04	0.005	300	4000	80	0.04	3,000	2×10^7
SPRYTRONS													
KN-11B	200	2500	1500	1	200	0.3	0.05	0	350	200	1.5	1	2,000
KN-12	1000	5000	3000	1	500	1.0	0.3	0	2500	1600	1	1	500

(1) KN-2A and KN-6A are available with RTV potted base, silatube leads and alternate lead arrangement. (See Outline Drawings — Page 4) KN-6B is in development status; development models available.

(2) Minimum trigger is measured for an anode operating voltage of 1 KVDC.

(3) Delay time for Krytrons is measured at an anode potential of 3000 V with a 500 v peak trigger and 50 µa keep-alive current (KN-4 at 150µa). The KN-11B and KN-12 are 3 element tubes which have no keep-alive. The KN-11B delay time is measured at anode potential of 350 V and peak trigger voltage of 300 v. The KN-12 delay time is measured at anode potential of 2300 V and peak trigger voltage of 800 v. Sprytron trigger voltages were measured with a rise time of 0.3 µs (10-90% points).

MECHANICAL (SEE OUTLINE DRAWINGS — PAGE 4)

Type	KN-2, 6, 6B, 9, 11, 12, 22	KN-4
Bulb	T3	T5½
Base (with flexible leads)	Subminiature Button	Miniature
Mounting Method	KS-1 (Transistor) Socket	⅞"Grommet
Mounting Position	Any	Any

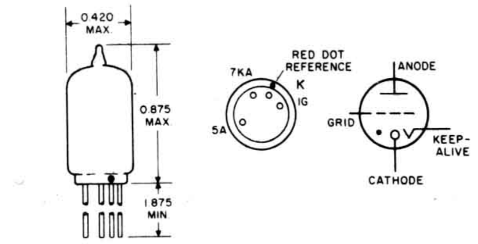
ENVIRONMENTAL

Temperature Range −65° to +74°C ambient with no significant change in delay or Jitter.

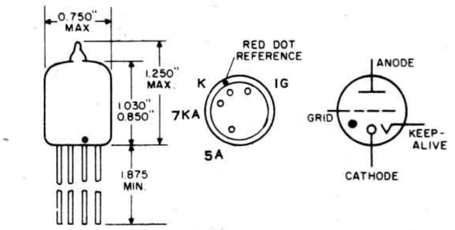
Vibration 10-80 cycles at 0.064 inch constant double amplitude displacement and 80-2000 cycles at 20 g.

Shock 250 g peak half sinusoid with base duration of 11 milliseconds, up to 3000 g peak half sine with duration of 1 millisecond.

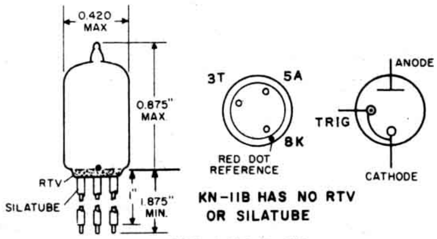
Acceleration 500 g.



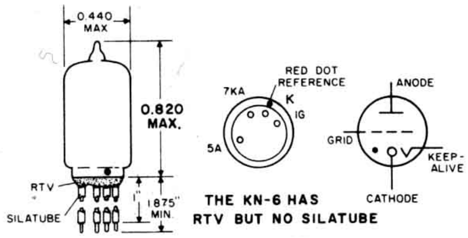
KN-2,9,22



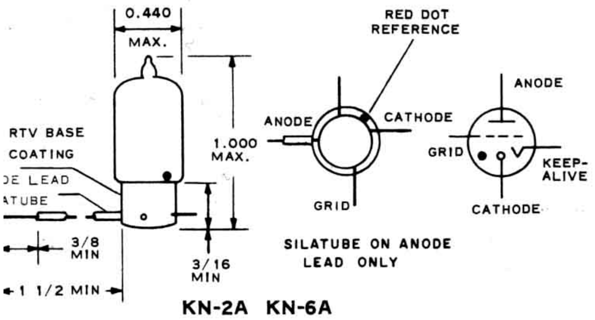
KN-4



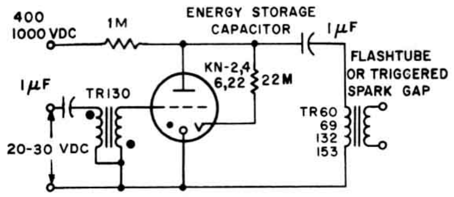
KN-11B & 12



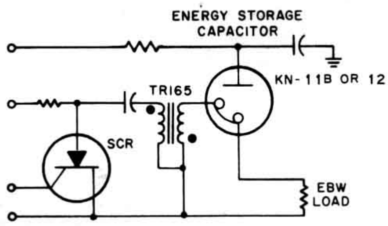
KN-6 & KN-6B



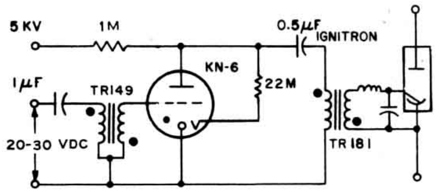
KN-2A KN-6A



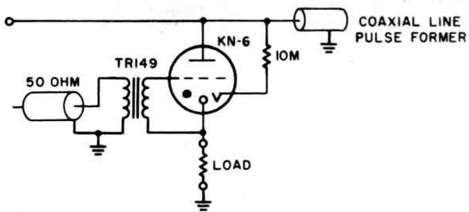
FLASHTUBE AND SPARK GAP TRIGGERING



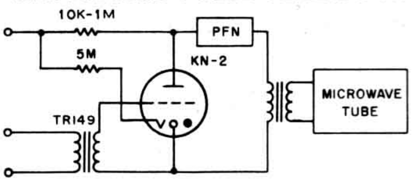
EXPLODING BRIDGE WIRE



IGNITRON TRIGGER



NANOSECOND PULSE GENERATOR



RADAR BEACON MODULATOR

NOTES

1. **Tube Symbols:**
   A – Anode   G – Grid   KA – Keep Alive
   T – Trigger for Sprytron   K – Cathode
2. Red dot indicates cathode lead.
3. All dwgs-pin circle diameter is .185" except KN-4.
4. KN-2,4,9, & 11B have no base insulation.
5. The KN-22 has RTV base and ¼" Silatube on anode only.
6. Use EG&G Trigger transformers TR-130,TR-131,TR-149, TR-157 and TR-165. (Data sheets available on request.)

All Data and Specifications Subject to Change Without Notice

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