from RMA release #761, June 25, 1949

RCA

5823

GLOW-DISCHARGE TRIODE

Cold-Cathode, Miniature Type

TENTATIVE DATA

RCA-5823 is a cold-cathode, glow-discharge triode of the miniature type designed for use primarily as a relay tube for the "on-off" control of low-current electrical circuits. The discharge of this tube can be initiated by a very small amount of electrical energy applied to the starter-electrode circuit.

The 5823 requires no warm-up and consumes no stand-by power.

AVERAGE LIFE-EXPECTANCY CONSIDERATIONS

The 5823 will give excellent life performance in intermittent relay service. The average life expectancy of a tube of this kind is a function of frequency of "on" cycles, total duration of "on" periods, and peak value of cathode current. Varying any of these factors affects the average life expectancy. If a 5823 is operated on 60-cycle ac and triggered every cycle, its life is determined primarily by the number of starts which it can withstand and the peak value of the cathode current. In such service, the average starts-number expectancy is approximately 45,000,000. For dc, the same factors apply but the total duration of the "on" periods becomes increasingly important with reduced frequency of starts. For increased tube life with either ac or dc operation, the cathode current should be kept as low as possible.

DATA

General:

Cathode	Cold
Maximum Overall Length	2-1/8"
Maximum Seated Length	1-7/8"
Length from Base Seat to Bulb Top (excluding tip)	1-1/2" ± 3/32"
Maximum Diameter	3/4"
Bulb	T-5-1/2
Base	Small-Button Miniature 7-Pin
Mounting Position	Any

Maximum Ratings▲, *Absolute Values*:

For First-Quadrant Operation Only

PEAK ANODE AND STARTER-ELECTRODE VOLTAGE:		
Inverse	200 max.	volts
Forward	200 max.	volts
CATHODE CURRENT:		
Peak	100 max.	ma
Average*	25 max.	ma
PEAK STARTER-ELECTRODE CURRENT:		
With starter-electrode voltage positive	100 max.	ma
AMBIENT TEMPERATURE	-60 to +75	°C

Typical Operating Conditions:

For Relay Service with 60-Cycle AC Supply

AC Anode Supply Voltage (RMS)	117	volts
AC Starter-Electrode Voltage:		
Max. Peak Positive Pre-Firing Voltage	70	volts
Min. Peak Positive Triggering Voltage	35	volts
Min. Firing Voltage (Sum of In-Phase Instantaneous Pre-Firing Voltage and Instantaneous Triggering Voltage)	105	volts

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

For First-Quadrant Operation Only

	Note	*Min.*	*Av.*	*Max.*	
Anode Breakdown Voltage	1	200	290	-	volts
Starter-Electrode Breakdown Voltage	2	73	80	105■	volts
Required Transfer Current (DC or Instantaneous AC) for transition of discharge to anode at 140 volts peak	3	-	50	400■▲	μamp
Anode Voltage Drop	4	-	62	85■	volts
Starter-Electrode Voltage Drop	5	-	61	75■	volts
Deionization Time (Approx.)	6	-	500	-	μsec
Ionization Time (Approx.)	6	-	20	-	μsec

Note 1: With a variable dc anode voltage, dc starter-electrode voltage of 0 volts, anode-circuit series resistance of 3000 ohms, and starter-electrode series resistance of 50000 ohms.

Note 2: With dc anode voltage of 0 volts, variable dc starter-electrode voltage, anode-circuit series resistance of 3000 ohms, and starter-electrode series resistance of 50000 ohms.

Note 3: With a variable dc starter-electrode voltage, anode-circuit series resistance of 3000 ohms, and starter-electrode series resistance of 2 megohms.

Note 4: With dc anode voltage of 230 volts, dc starter-electrode voltage of 91 volts, dc cathode current of 50 milliamperes, anode-circuit series resistance of 3000 ohms, and starter-electrode series resistance of 50000 ohms.

Note 5: With dc anode voltage of 0 volts, variable dc starter-electrode voltage, dc starter-electrode current of 10 milliamperes, and starter-electrode series resistance of 3000 ohms.

Note 6: With instantaneous anode voltage of 185 volts, peak positive starter-electrode pre-firing voltage of 70 volts, peak positive starter-electrode triggering voltage of 50 volts, anode-circuit series resistance of 820 ohms, and starter-electrode series resistance of 100000 ohms.

▲ These ratings apply to the 5823 when it is operated from a power supply having a frequency of 60 cycles per second. If a contemplated application involves higher supply frequencies, please write, stating the proposed operating frequency, to the attention of Commercial Engineering Section, Harrison, New Jersey for information as to required changes in maximum ratings and characteristics.

* Averaged over any interval of 15 seconds max.

■ Maximum individual tube values during life.

INSTALLATION AND APPLICATION

The *base* pins of the 5823 fit the miniature 7-pin socket. The socket may be mounted to hold the tube in any position. *Make no connections to* *pins 2, 5, and 6.* Any potentials applied to these pins may cause erratic tube performance.

The *breakdown characteristic* of the 5823 in all quadrants is shown in Fig. 1. These curves describe the voltage conditions necessary for breakdown between any two of the electrodes of the 5823. The area between the inner and outer curves indicates the typical operating region of the tube throughout useful life. The inner curve shows the minimum positive and negative electrode values; the outer curve shows the maximum positive and negative electrode values; dashed sections indicate approximate values only.

RCA-5823 is recommended for operation only in that part of the breakdown characteristic designated by Quadrant I. Operation in Quadrant II is satisfactory but changes in tube ratings are necessary. Operation in Quadrants III and IV is not recommended, because the anode and starter electrode are not designed for efficient cathode operation; their use in this manner will result in unstable operation and shorter tube life. The information given for quadrants III and IV is of value to the equipment designer in that it indicates the need for precautions to be taken in order that the peak inverse voltage rating is not exceeded.

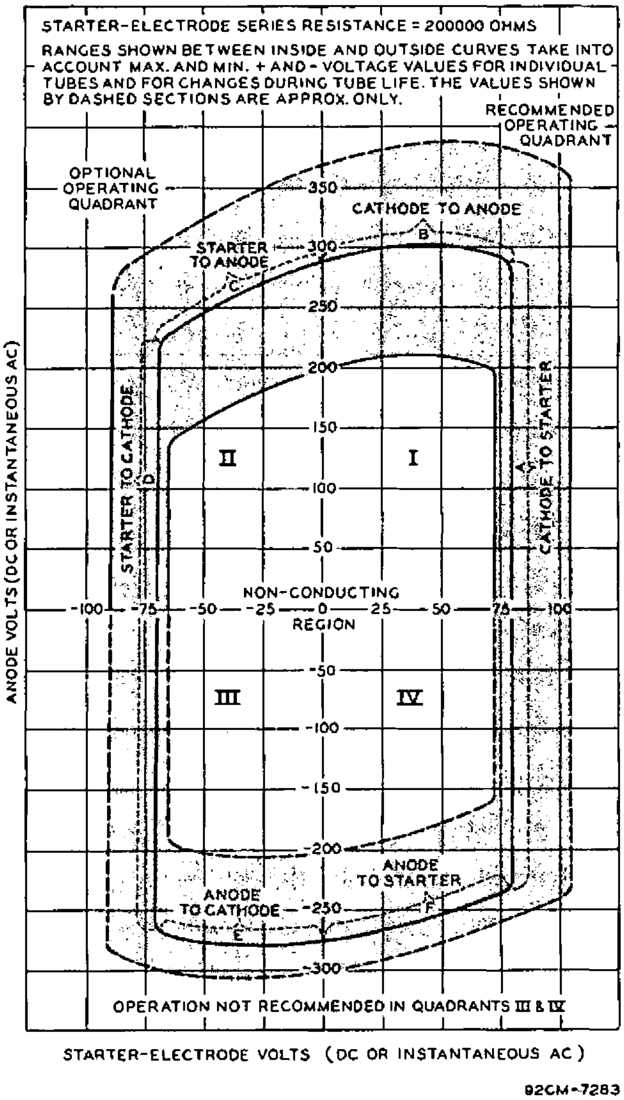


Fig. 1 - RCA-5823 Breakdown Characteristic For All Quadrants.

To obtain most satisfactory performance from the 5823, it is necessary to understand the significance of the *breakdown characteristic.* In the *non-conducting region,* the relation between the starter-electrode voltage and the anode voltage is such that breakdown does not occur. As the starter-electrode voltage is increased to a value near the edge of this region, breakdown occurs depending on the value of the associated anode

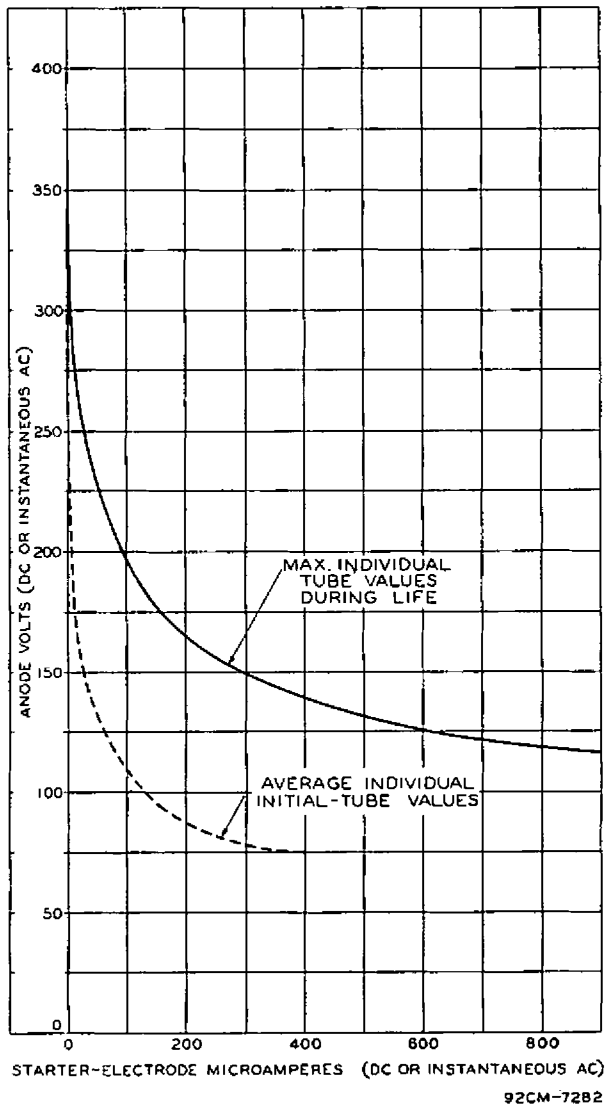


Fig. 2 - RCA-5823 Transition Characteristic.

voltage. The maximum or outside curves indicate what minimum triggering voltages should be used to insure operation of the 5823 at all times during useful life.

For operation of the 5823 in Quadrant I, the peak anode supply voltage and the peak positive starter-electrode pre-firing voltage must not exceed the minimum values indicated by the inner solid curve. A triggering voltage is applied to the starter electrode. This voltage must be in-phase with the pre-firing voltage and must be of sufficient magnitude to initiate a discharge between starter electrode and cathode. The minimum sum of these starter-electrode voltages is indicated by the outer solid curve. To transfer the discharge to the anode-cathode circuit, it is essential that adequate transfer current flow to the starter electrode, as shown in Fig.2. When the 5823 is operated with ac on both anode and starter electrode, the equipment designer should also refer to Quadrant III. The peak values of ac anode supply voltage and ac starter-electrode pre-firing voltage selected should not exceed the values given by the inside dotted curve of this quadrant. If it is desired to operate the 5823 with ac anode supply voltage and a positive dc starter-electrode pre-firing voltage, the equipment designer should be guided by the peak inverse rating as given by the minimum values of the inner dotted curve in Quadrant IV. For straight dc operation, the equipment designer should consider the same voltage limitations as given for ac operation but need not consider the peak inverse rating unless an inductive load is used. In this case the limitation on the peak inverse anode voltage rating is of importance because of the inductive kick-back voltage.

The *transfer characteristic* of the 5823, as given in Fig.2, indicates the minimum transfer-current requirements of the starter electrode for transition of the discharge from starter electrode to anode for any given anode supply voltage. From an equipment designer's standpoint, the maximum individual-tube values during life, as shown by the solid curve, are minimum starter-current requirements for satisfactory tube performance. The dashed curve gives the average individual-tube initial values. Fig. 2 shows that for each value of anode voltage there is a corresponding minimum value of starter-electrode current necessary to initiate the main discharge between cathode and anode. For example, with an ac anode supply voltage of 166 volts peak (117 volts rms), and an ac starter-electrode pre-firing voltage of 70 volts peak (50 volts rms), it follows from the curve in Fig.1 that the minimum required triggering voltage will be 35 volts peak. Under these conditions, Fig.2 shows that the minimum starter-electrode current required to transfer the discharge from the starter electrode to the anode will be 200 microamperes.

In Fig. 1, section C of Quadrant II shows the relation between anode voltage and starter voltage that is required for a discharge from starter to anode when there are no ions to assist the initiation of the discharge. In this section, the starter acts as a cathode with the result that the slope of section C is approximately 45 degrees. This discharge can occur with positive values of anode voltage, because the distance between the anode and the starter electrode is less than the distance between the anode and the cathode.

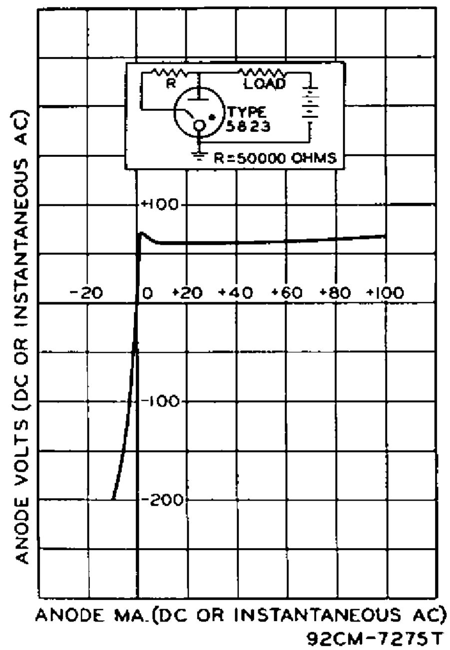


Fig.3 - RCA-5823 Average Anode Characteristic.

Section D shows the relation between anode voltage and starter-electrode voltage necessary for a discharge from starter to cathode when there are no ions to assist the initiation of this discharge. It should be noted that this discharge takes place between the same two electrodes as in Section A. However, under the conditions indicated in Section D, the starter acts as a cathode because it is negative with respect to the cathode.

Sections E and F show relations between anode volts and starter volts necessary to initiate a discharge from anode to cathode and from anode to starter-electrode respectively, when there are no ions to assist the initiation of these discharges. Under the conditions indicated in sections E and F, the anode acts as cathode.

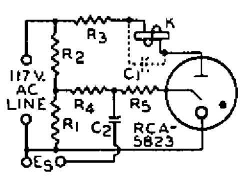
The *average anode characteristic* of the 5823 is given in Fig. 3. The curve shows that over the useful operating range, the anode voltage drop remains substantially constant at 62 volts. The curve also shows by its assymetrical shape, that the 5823 can be used as a rectifier. This feature is an advantage when the anode is supplied with ac power to operate a dc relay. When used as a rectifier, the 5823 has a maximum peak inverse anode voltage rating of 200 volts and a maximum peak cathode current as indicated in the tabulated data. Operation at values of dc cathode current less than 8 milliamperes is not recommended because of resulting instability.

The *maximum ratings* shown in the tabulated data are limiting values above which the serviceability of the 5823 may be impaired from the viewpoint of life and satisfactory performance. Therefore, in order not to exceed the absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by an amount such that the absolute values will never be exceeded under any usual conditions of supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

Fig.4 shows the 5823 in a typical ac-operated relay circuit. The pre-firing voltage supplied by the voltage divider (R1 and R2) is just below that required for tube conduction. A positive triggering voltage applied to the starter electrode develops a voltage across resistor R4 which, when added to the pre-firing voltage, causes the tube to breakdown. Resistors R3 and R5 are current-limiting resistors for the anode and the starter electrode.

Fig.5 shows the 5823 in a dc-operated locking relay. The pre-firing voltage is provided by the battery supply. A positive triggering voltage applied to the starter electrode develops a voltage across resistor R1 which, when added to the pre-firing voltage causes the tube to breakdown. The anode current energizes the relay which switches the supply voltage to the load. The load current must be sufficient to keep the relay energized. R3 and R2 are current-limiting resistors for the anode and the starter electrode.

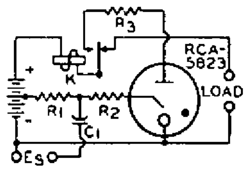
Fig.6 shows the 5823 in a dc-operated self-resetting relay circuit. The pre-firing voltage is provided by the battery supply. A positive triggering voltage applied to the starter electrode develops a voltage across resistor R1 which, when added to the pre-firing voltage, causes the tube to breakdown. Capacitor C2 which has been charged by the supply voltage through R2 will discharge through the tube and energize the relay winding until the voltage on the anode is insufficient to maintain tube conduction. Relay resets itself when capacitor C2 recharges through resistor R2.



C1: 2 to 8 μf, 250 volts: used if needed to prevent relay chatter
C2: 0.1 μf, 250 volts
Es: Triggering Voltage
K: Winding for high-resistance sensitive relay
R1: 5000 ohms, 1 watt
R2: 8200 ohms, 1 watt
R4: 10 megohms
R3,R5: Peak current-limiting resistor—value depends on desired operating conditions.

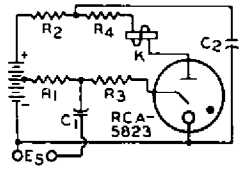
Fig.4 - Typical AC-Operated Relay Circuit Using RCA-5823

Devices and arrangements shown or described herein may use patents of RCA or others. Information contained herein is furnished without responsibility by RCA for its use and without prejudice to RCA's patent rights.



C1: 0.1 μf, 250 volts
Es: Triggering Voltage
K: Winding for high-resistance sensitive relay
R1: 10 megohms
R2,R3: Peak current-limiting resistor—value depends on desired operating conditions

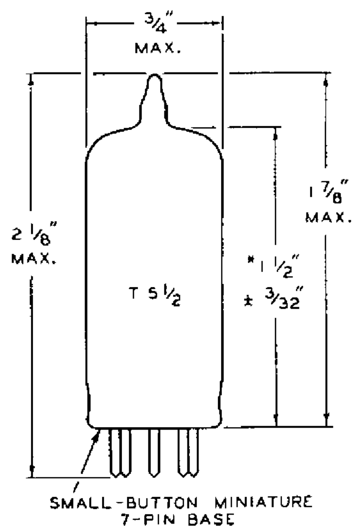
Fig.5 - Typical DC-Operated Locking Relay Circuit Using RCA-5823



C1: 0.1 μf, 250 volts
C2: 1.0 μf, 250 volts
Es: Triggering Voltage
K: Winding for high-resistance sensitive relay
R1: 10 megohms
R2: 1 megohm, 1 watt
R3,R4: Peak current-limiting resistor—value depends on desired operating conditions

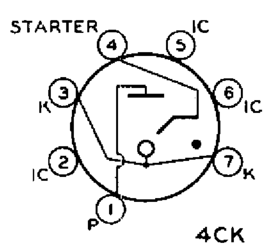
Fig.6 - Typical DC-Operated Self-Resetting Relay Circuit Using RCA-5823

DIMENSIONAL OUTLINE



* MEASURED FROM BASE SEAT TO BULB-TOP LINE AS DETERMINED BY RING GAUGE OF 7/16" I.D.

SOCKET CONNECTIONS
Bottom View



PIN 1: ANODE
PIN 2: INTERNAL CONNECTION—DO NOT USE
PIN 3: CATHODE
PIN 4: STARTER ELECTRODE
PIN 5: INTERNAL CONNECTION—DO NOT USE
PIN 6: INTERNAL CONNECTION—DO NOT USE
PIN 7: CATHODE