RAYTHEON

TECHNICAL INFORMATION SERVICE

# Technical Information

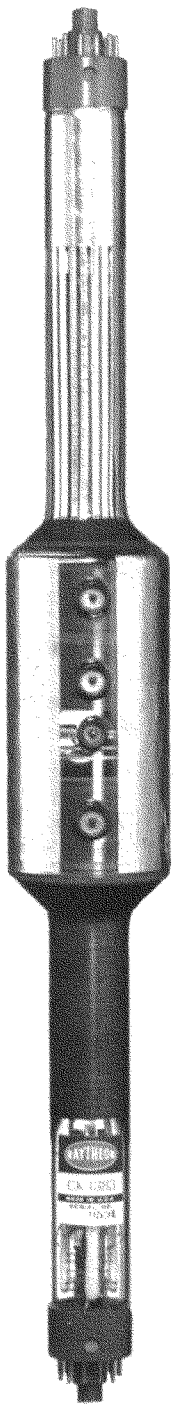
# CK1383

## RECORDING STORAGE TUBE

The CK1383 is a dual–gun cathode–ray recording storage tube capable of simultaneous writing and reading. It is an electronic input–electronic output storage device which combines high output signal with high resolution. The major application is scan conversion such as radar PPI to tele–vision type presentation. This type of system yields a bright video display, with high resolution and adjustable automatic priming or erasing, which may be used to generate target trails indicating elapsed time position. It is similar to the CK7702 except that no electrostatic focus elements are used. Stored signals can be held for a long period, read several thousand times, or erased in a fraction of a second if desired. The storage capabilities permit additional coherence of target information under conditions of high noise levels.

Both the writing and reading guns use magnetic deflection and magnetic focus. For uniform resolution over the storage surface, dynamic focus correction is recommended.

The design of the tube results in a wide dynamic range of gray shades, fast writing speeds, and selective erasure of the stored information is desired.



## ELECTRICAL DATA

### GENERAL CHARACTERISTICS

| | |
|---|---|
| Gun Locations | Co–axial |
| Gun Type (Both Guns) | Tetrode High Resolution |
| Deflection (Both Guns) | Magnetic |
| Max. Deflection Angle (Both Guns) | 30° |
| Focusing | Magnetic |
| Mounting Position | Any |
| Resolution (Magnetic Focus) | |
| TV lines per diameter | 1200 lines minimum |
| Output Capacitance | |
| (Collector and Write Decelerator to all other elements) | 19 pf (approx.) |
| Erasing Technique | By Switching or Automatic |

### MECHANICAL CHARACTERISTICS

| | |
|---|---|
| Seated Length | 22 ½" Nominal |
| Bulb Diameter | 3" Maximum |
| Neck Diameters | 1.450" Maximum |
| Bases (Both Ends) | Special High Altitude |
| Sockets (Both Ends – not supplied) | See Note 2 |
| Storage Assembly Buttons | JEDEC Type J1–22 |

### ELECTRICAL CHARACTERISTICS

RATINGS – ABSOLUTE MAXIMUM VALUES

| | |
|---|---|
| Heater Voltage | 6.3 ± 5% Volts |
| Anode Voltage (Either Gun) | 5200 Vdc |
| Grid Voltage Positive (Either Gun) | 0 Vdc |
| Write Control Grid Voltage Negative | –150 Vdc |

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## ELECTRICAL CHARACTERISTICS

### RATINGS – ABSOLUTE MAXIMUM VALUES (Cont'd.)

| | |
|---|---|
| Read Control Grid Voltage | –275 Vdc |
| Write Grid #2 Voltage | 500 Vdc |
| Read Grid #2 Voltage | 650 Vdc |
| Inter Screen Voltage (Between any pair) | 1000 Vdc |
| Grid Circuit Resistance | 0.5 Meg. |
| Heater Cathode Voltage | |
| Heater Positive | +10 Vdc |
| Heater Negative | –125 Vdc |
| Write Collimating Lens Voltage | 800 Vdc |
| Read Collimating Lens #1 Voltage | 800 Vdc |
| Read Collimating Lens #2 Voltage | 700 Vdc |
| Read Decelerator Voltage | 800 Vdc |
| Write Decelerator Voltage | 1000 Vdc |

NOTE: Except for heater rating and interscreen voltages, all voltages shown above are referenced to the respective gun cathode.

## TYPICAL OPERATING CHARACTERISTICS

Deflection drive must be applied to both guns whenever the tube is conducting to avoid damage to the storage assembly.

All Voltages except RF drive and read G1 with respect to write cathode.

### WRITE GUN

| | |
|---|---|
| Cathode Voltage | 0 Vdc |
| G–1 Cut–off | –20 Vdc to –50 Vdc |
| G–2 | 450 Vdc |
| Anode | 4500 Vdc |
| Collimating Lens | 400 Vdc |
| Write Decelerator | 800 Vdc |
| Collector | Variable – See Note 1. |

### READ GUN

| | |
|---|---|
| Cathode Voltage | +400 Vdc |
| Cathode Current (nominal) | 80 μA |
| G–1 Cut–off (with respect to Read K) | –100 Vdc to –250 Vdc |
| G–1 RF Drive (see Special Application Notes section on RF separation) | 30 Vrms See Note 3. |
| G–2 | 1000 Vdc |
| Anode | 4500 Vdc |
| Decelerator | 900 Vdc |
| Collimating Lens 1 | 900 Vdc |
| Collimating Lens 2 | 800 Vdc |
| Storage Screen | 405 Vdc |

NOTE 1: Gradual automatic priming is controllable by varying the value of collector voltage from 900 Vdc (for slow priming) down to 400 Vdc (for fast priming.)

NOTE 2: Sockets obtainable from Alden Products Co., 117 N. Main St., Brockton, Mass., part no. 212 FTSISL.

NOTE 3: To adjust for proper RF drive, set read G1 bias for a read cathode current of apprx. 10 $\mu$A dc with RF drive at zero. Increase RF drive until the read cathode current is apprx. 80 $\mu$A.

## PRINCIPLES OF OPERATION

When an electron beam strikes any material, secondary electrons are emitted. The quantity of secondary electrons emitted is a function of the velocity of the primary electron beam.

The secondary electron emitting surface in the Recording Storage Tube is a dielectric that has been deposited on a metal mesh or screen. Figure 1 illustrates this storage screen mesh. This screen has more than 2000 cross wires per diameter.

Figure 2 shows the characteristic curve for secondary to primary emission ratio for the dielectric material used. Since the velocity of the electron beam will be proportional to the voltage on the dielectric material the ordinate of velocity in Figure 2 can be voltage. The crossover, called critical potential, where the secondary to primary ratio is unity occurs at approximately 50 volts.

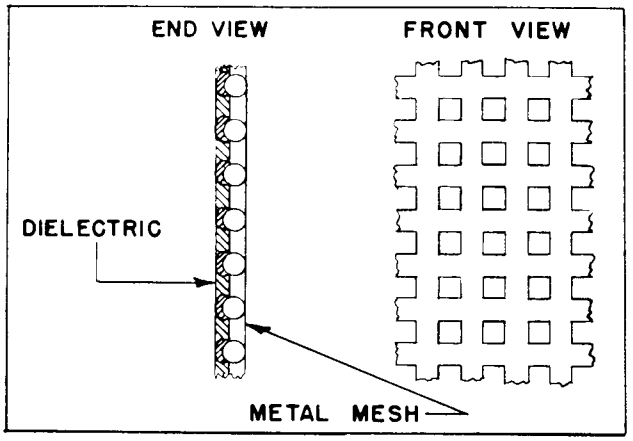


FIGURE 1
MAGNIFIED SECTION OF STORAGE SCREEN

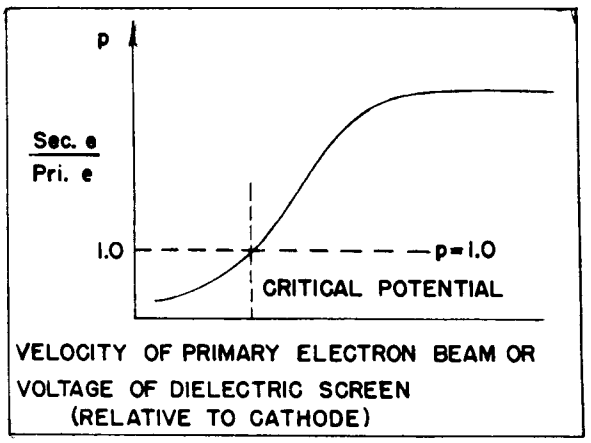


FIGURE 2
SECONDARY EMISSION CHARACTERISTIC OF RECORDING STORAGE TUBE DIELECTRIC

Using the secondary emission character shown by Figure 2, the dielectric screen surface can be discretely charged or discharged as a function of the potential on the metal screen and the position and magnitude of the primary electron beam.

The various modes of operation are described as follows:

PRIME – This is the basic form of erasure and prepares the storage screen for subsequent writing. It is accomplished by scanning the storage screen dielectric with an unmodulated beam. The storage screen mesh is operated at a voltage below critical potential and since the secondary to primary emission ratio is less than unity the dielectric surface can store electrons and become negatively charged to cathode gun potential. A total prime can be used if complete erasure of old patterns is desired or a partial prime can be used if it is desired to gradually decrease old signals in amplitude (e.g.: to generate target trails in radar). Selective priming of only part of the storage screen can be accomplished by only scanning the area where it is desired to erase previously stored information. Typical storage screen voltage for prime is +5 volts. Priming can be accomplished with either beam. When the writing beam is used for priming, the storage screen is switched to +5 volts above write cathode and the beam is turned on and scanned over the area to be primed.

When the read beam is used it is only necessary to switch the collector to or more negative than read cathode potential and the read beam is then scanned over the area to be erased. Under these conditions, the read beam primes the dielectric surface by reflection from the collector after it has passed through the storage screen. The read beam electrons recharge the dielectric surface.

WRITE – "Writing" of the charge pattern is accomplished by modulation of a scanning electron beam and operation at a storage screen voltage that yields a high secondary to primary emission ratio. This is any voltage above critical potential and is nominally 400 volts. Since during the prime mode the dielectric surface was negatively charged, the surface is discretely discharged towards the positive direction by the writing beam. As the modulated beam scans over the surface varying amounts of secondary electrons, depending on the instantaneous beam amplitude, are emitted at the surface and the stored pattern is established.

READ – Once a charge pattern has been written in, it can be read out by scanning the storage screen with an unmodulated beam. The storage screen is operated at 5 volts with respect to the reading gun cathode. Depending on the charged pattern the electron beam is therefore modulated as it passes through the storage screen to the collector element. By selecting the proper storage screen voltage the most negative areas of the dielectric (established by the prime mode) can completely cut off the electron beam from the collector and thus the "black" level is established. Various gray shades will appear in any areas where the dielectric is less negative.

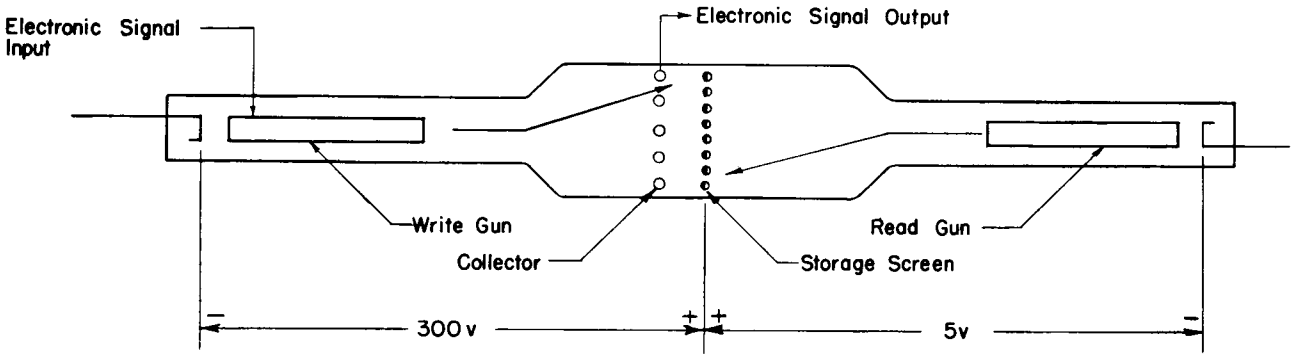


FIGURE 3
TWO GUN RECORDING STORAGE TUBE — SIMPLIFIED DRAWING

Simultaneous Write and Read modes are possible with the use of the two electron guns. This is desirable in most scan–conversion applications. Since two independent potentials can be maintained on the storage screen with respect to the two electron gun cathodes, the tube can be truly writing a charge pattern and reading it at the same time. (This is shown in Fig. 3.)

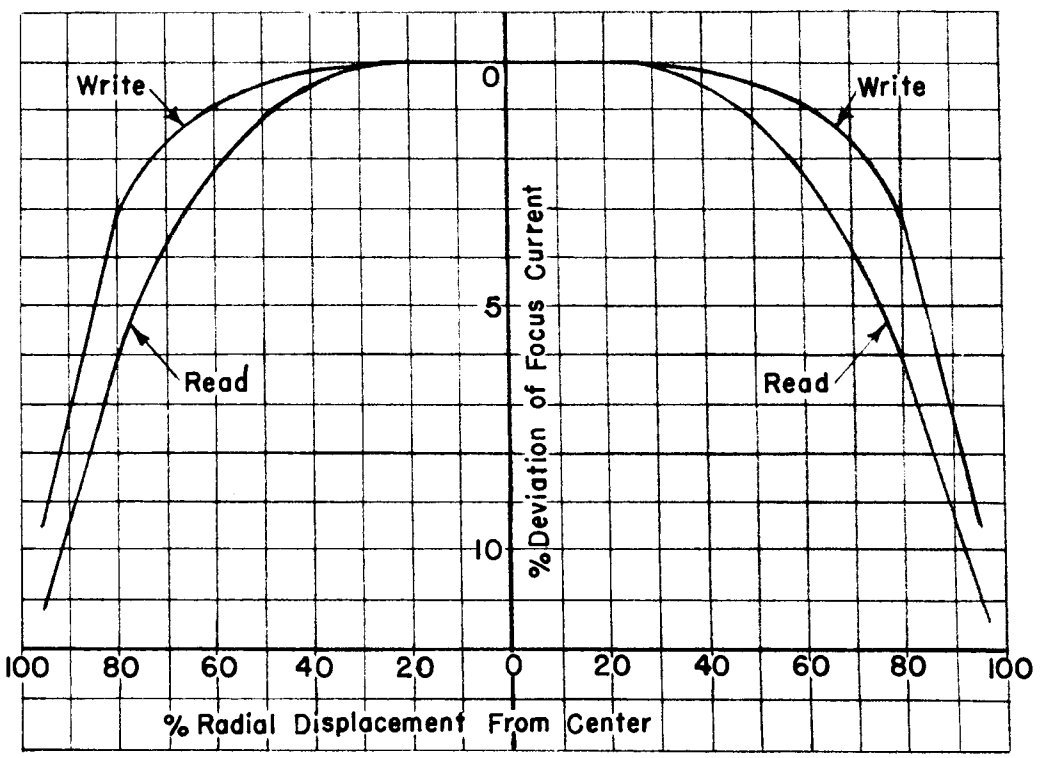


FIGURE 4
MAGNETIC DYNAMIC FOCUS CHARACTERISTIC

ERASE – Where total erasure is needed, it is frequently desirable to operate the tube in the positive erase mode. To accomplish this, the storage screen voltage is set at or above the value used for Write and the storage surface is scanned with an unmodulated electron–beam. This action discharges any stored pattern, bringing the whole storage surface to a uniform equilibrium potential. The tube must then be primed prior to subsequent writing.

SPECIAL APPLICATION NOTES: (See Figure 6)

RF SEPARATION – Since the collector intercepts the writing beam as well as the reading beam, a spurious output signal will result from the writing signal at the collector. This can be removed by cancellation techniques or by RF separation. RF separation is accomplished by modulating the read beam with insertion of an RF signal at the read gun control grid. As the RF read beam passes through the storage screen it is amplitude modulated by the stored charge pattern. This amplitude modulated signal then appears at the collector. The center frequency chosen is much higher than the highest write video frequencies and therefore a tuned circuit will reject the writing signal and accept only the read signal. This is amplified and typical amplitude–modulation detection re–establishes a read–out video signal with no writing signal. Typical RF center frequencies used are 30 mc and 50 mc.

AUTOMATIC PRIME – (Controlable erasure while reading) – During simultaneous writing and reading the tube can be operated at conditions that will allow either short or long storage of the charge pattern. It can also be variable for storage time between the two limits. Thus, in PPI to TV scan–conversion, target trails can be generated and the length of these trails are controllable by adjusting the storage time. This gradual automatic prime is obtained by varying the value of collector voltage from a high voltage for long storage (slow Prime) to a low voltage for short storage (fast Prime). The priming is accomplished by some of the read beam electrons between the collector and storage–screen dielectric returning to the dielectric to recharge it negatively in the specific areas where the negative charge was reduced by the written–in pattern.

COLLIMATION – Electrostatic lenses and deceleration screens are provided to collimate the beam as it arrives in the region of the storage screen. For optimum shading characteristics the reading and writing beam should arrive at the storage screen dielectric orthognally to it. The voltage on the lenses should therefore be adjusted for the most uniform background shading.

SHIELDING – Since any extraneous fields will cause unwanted deflection, it is recommended that good magnetic and electrostatic shielding techniques be used in the design of the tube mount.

RESOLVING POWER – The resolution of the storage tube at the 50% modulation level is usually in excess of 1200 TV lines across the diameter and is obtainable when the minimum current for writing a fully modulated signal is employed and the focus coils designed to minimize astigmatism. Resolution is also dependent on the orientation of the focus coil with respect to the gun, and the sharpness of focus across the storage screen. Therefore, for applications requiring optimum resolution, dynamic focusing is often needed.

STORAGE ABILITY – The length of time a tube will retain the stored information is a function of the operating conditions and varies inversely as the reading current. When reading with a low beam current at standard television repetition rate and scan, several thousand consecutive readings can be made without any appreciable deterioration of the stored signal. The tube is capable of storing information for many hours without appreciable change or deterioration when not reading.

FOCUSING TECHNIQUE – Raytheon type BM–411 focus coils (Figure 5) should be used. This provides a tickler coil for dynamic focus correction for optimum resolution across the diameter of the storage surface. Typical current correction curves are shown in Figure 4.

The focus coil mounting should be mechanically adjustable in all directions for proper positioning. A suggested mount is shown in Figure 7.

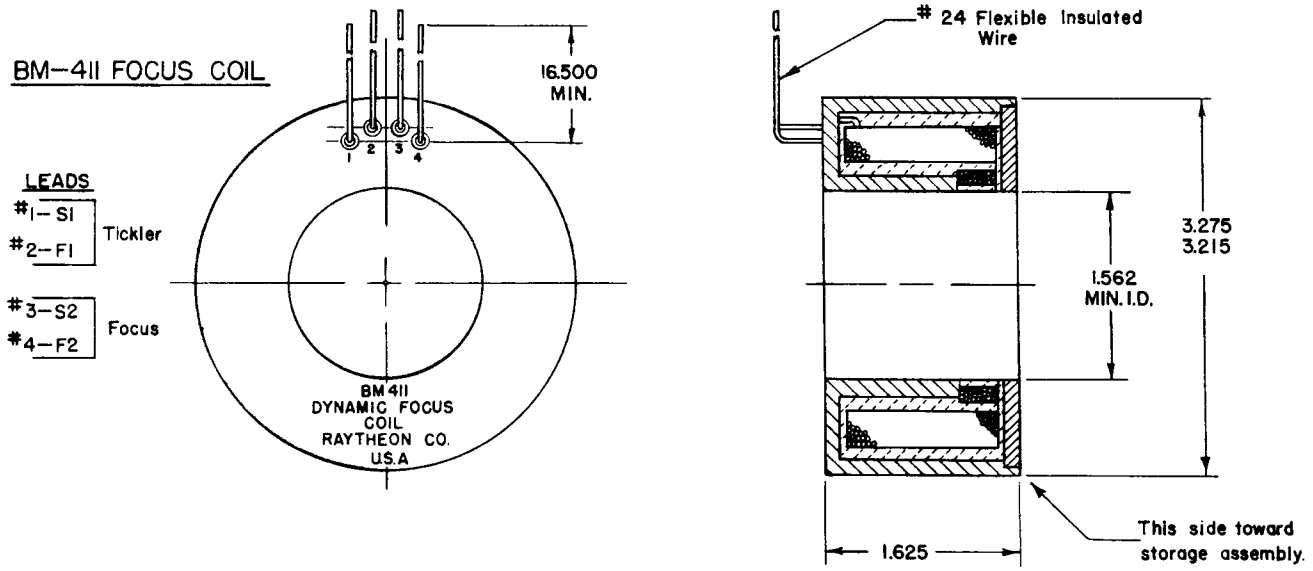


FIGURE 5

FOCUS COIL

Resistance – 6500 to 9000 ohms (at 20° C)
Max. Current – 25 madc
Voltage Rating – 250 V

TICKLER COIL

Resistance – 105 to 145 ohms (at 20° C)
Max. Current – 30mA RMS
Voltage Rating – 25 OV
Inductance – 45 Millihenries Approx.

NOTES:

1. For use with recording storage tubes and simulators.
2. Tickler coil is provided to permit dynamic focus correction. See Fig. 4.
3. When not required, the tickler coil may be left unconnected.
4. Shell material – annealed swedish iron or equivalent.

## TYPICAL SCHEMATIC

Radar PPI to TV Scan Conversion, Simultaneous Write and Read with automatic prime (erasure) and RF separation.

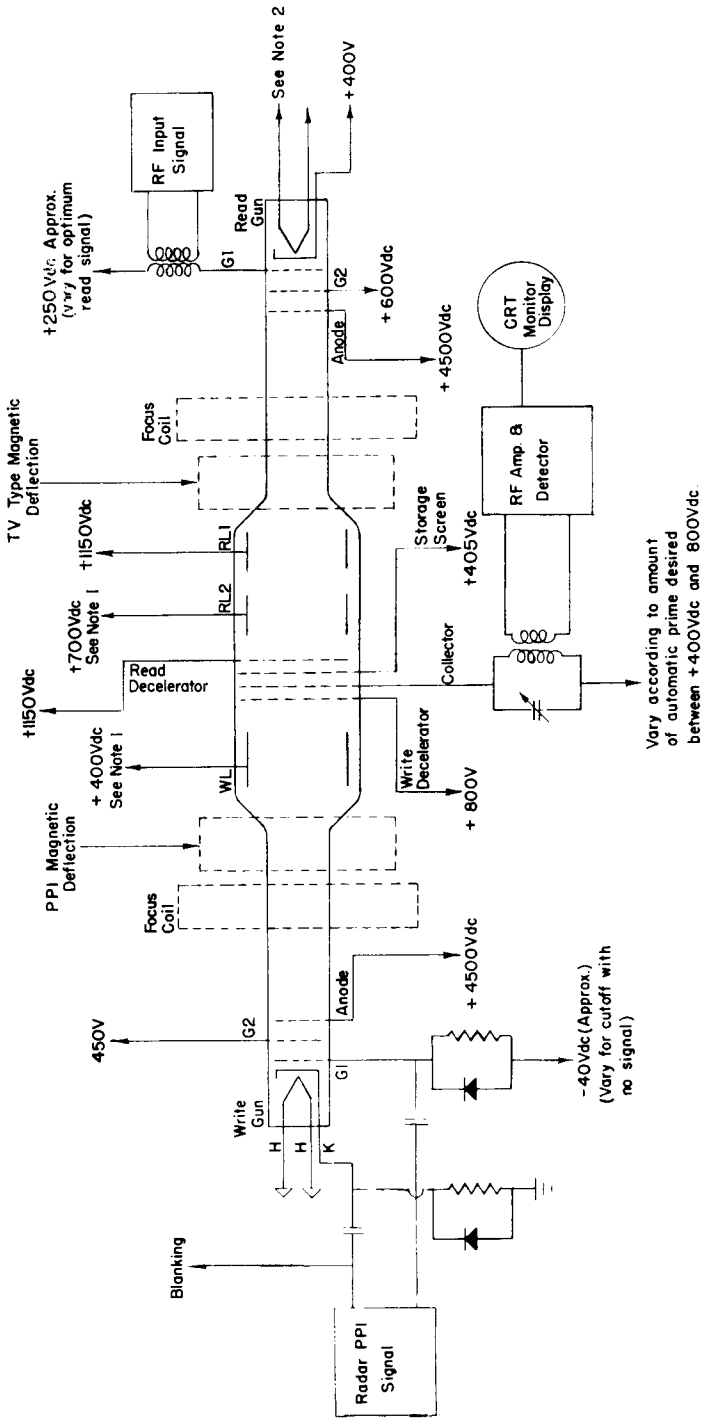


FIGURE 6

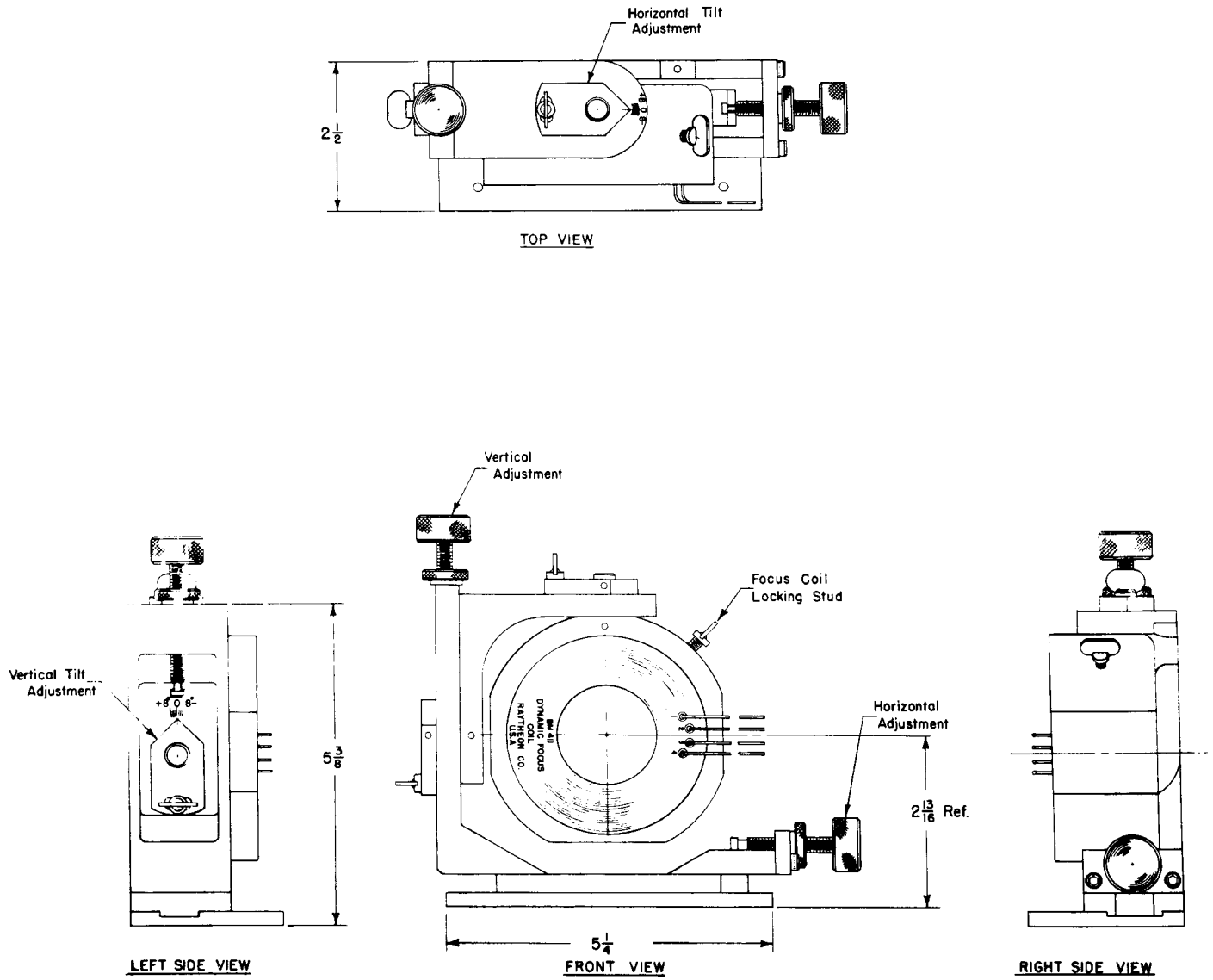


FIGURE 7

RECOMMENDED FOCUS COIL

MOUNTING ASSEMBLY

MECHANICAL OUTLINE

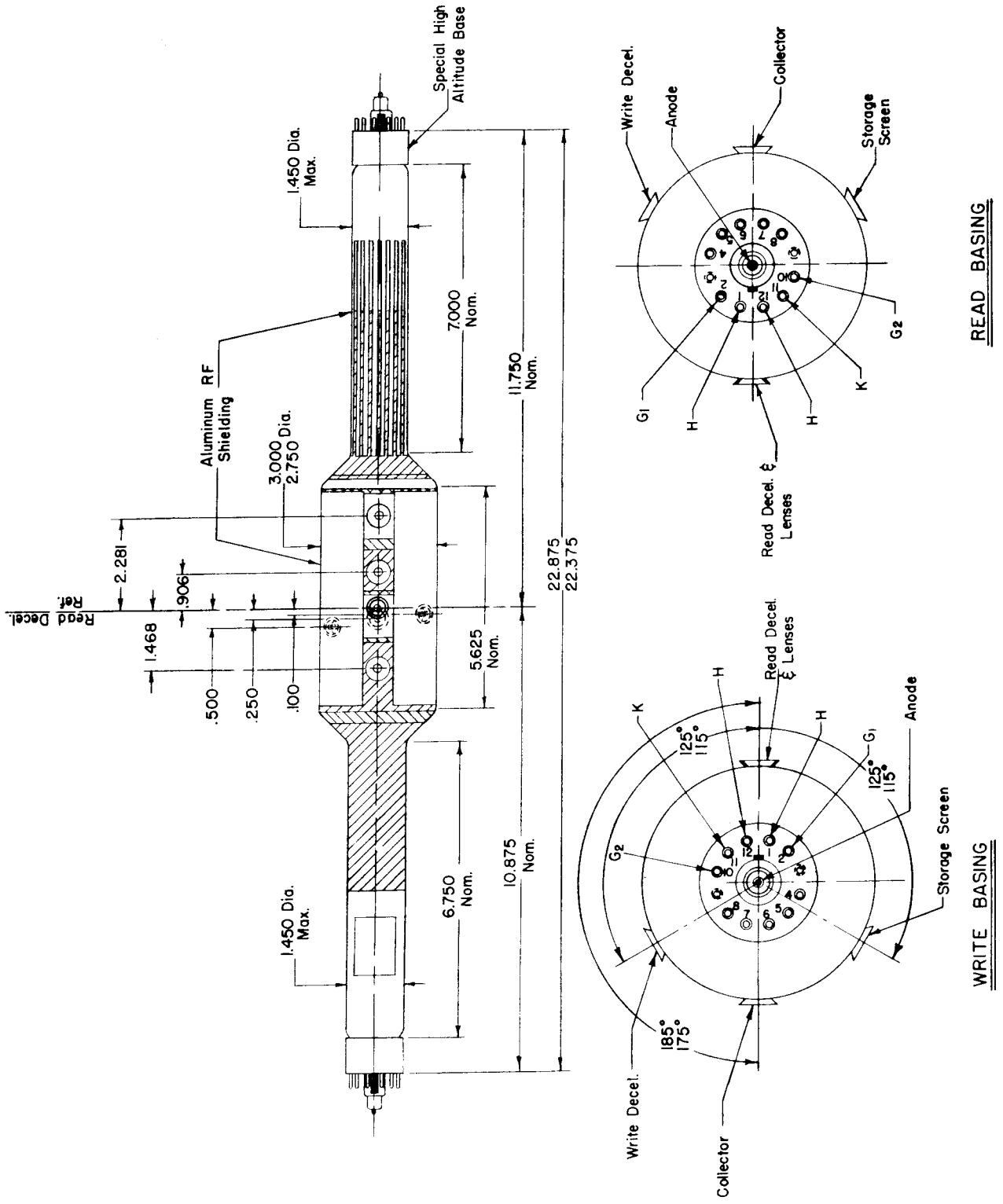


FIGURE 8