RAYTHEON

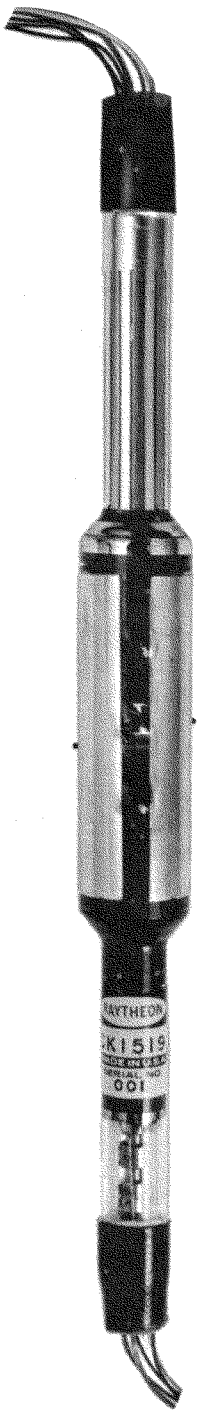
MINIATURE RECORDING STORAGE TUBE

CK1519

The CK1519 is a miniature 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 in airborne equipment, such as sonar, infrared and radar to television type presentation. This type of system yields a bright video display, with high resolution and adjustable automatic erasing. 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 if desired. Erasure of stored information can be carried out by either the reading or writing gun.



ELECTRICAL DATA

GENERAL CHARACTERISTICS

Gun Locations	Co–axial
Gun Type (Both Guns)	Tetrode High Resolution
Deflection (Both Guns)	Magnetic
Max. Deflection Angle (Both Guns)	20°
Focusing	Magnetic
Mounting Position	Any
Resolution	
TV lines per diameter (See Note 1)	850 TV lines typical
Output Capacitance	
(Collector and Write Decelerator to all other elements)	5 pf (approx.)
Erasing Technique	By Switching or Automatic

MECHANICAL CHARACTERISTICS

Seated Length	16½" Nominal
Bulb Diameter	1.5" Maximum
Neck Diameters	0.875" Maximum
Storage Assembly Buttons	JEDEC Type J1–22

ELECTRICAL CHARACTERISTICS

RATINGS – ABSOLUTE MAXIMUM VALUES (See Note 2)

Heater Voltage	6.3 ± 5% Volts
Anode Voltage (Either Gun)	4500 Vdc
Grid Voltage Positive (Either Gun)	0 Vdc
Write Control Grid Voltage Negative	–150 Vdc
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.

ELECTRICAL CHARACTERISTICS

RATINGS – ABSOLUTE MAXIMUM VALUES (Cont'd.)

Heater Cathode Voltage

Heater to Cathode Voltage	±125 Vdc
Write Collimating Lens Voltage	800 Vdc
Read Collimating Lens Voltage	800 Vdc
Read Decelerator Voltage	800 Vdc
Write Decelerator Voltage	1000 Vdc

NOTE 1: Resolution Versus Anode Potential at 50% modulation measured in the center of the storage area.

850 TV lines min.	4000V (Anode) Max.
600 TV lines min.	2500V (Anode)

NOTE 2: 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 –70 Vdc
G–2	450 Vdc
Anode	4000 Vdc
Collimating Lens (Vary for best scan shape and linearity)	±200 Vdc
Write Decelerator	700 Vdc
Collector	Variable – See Note 3.

READ GUN

Cathode Voltage	+400 Vdc
Cathode Current (nominal)	50 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) (See Page 5)	30 Vrms
G–2	900 Vdc
Anode	4000 Vdc
Decelerator	+1150 Vdc
Collimating Lens (Vary for best shading)	+800 to 1100 Vdc
Storage Screen	405 Vdc
Output Signal (Peak Level at Collector)	3 μa

NOTE 3: 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.) Also see special application notes for further information.

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.

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.

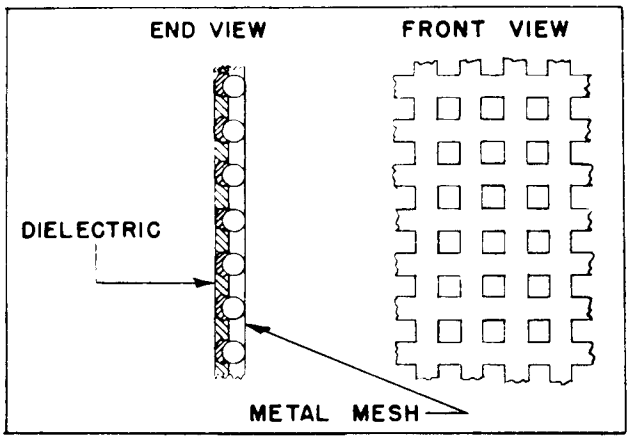


FIGURE 1
MAGNIFIED SECTION OF STORAGE SCREEN

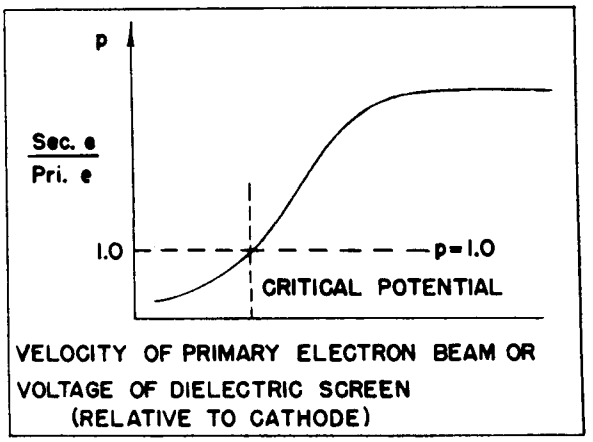


FIGURE 2
SECONDARY EMISSION CHARACTERISTIC OF RECORDING STORAGE TUBE DIELECTRIC

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 a more negative potential than read cathode and 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. Storage screen voltage should be separately adjustable between prime and read modes. Normally the prime voltage will be slightly lower than read voltage.

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.

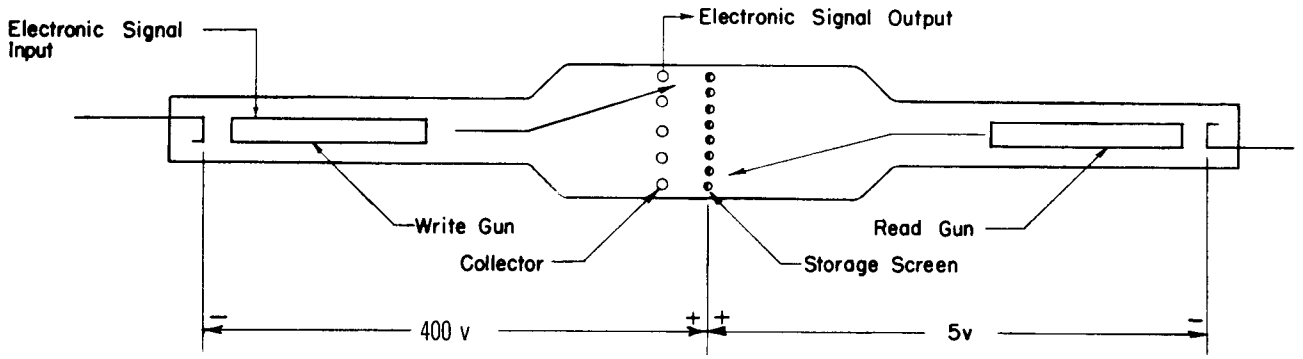


FIGURE 3
TWO GUN RECORDING STORAGE TUBE — SIMPLIFIED DRAWING

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.)

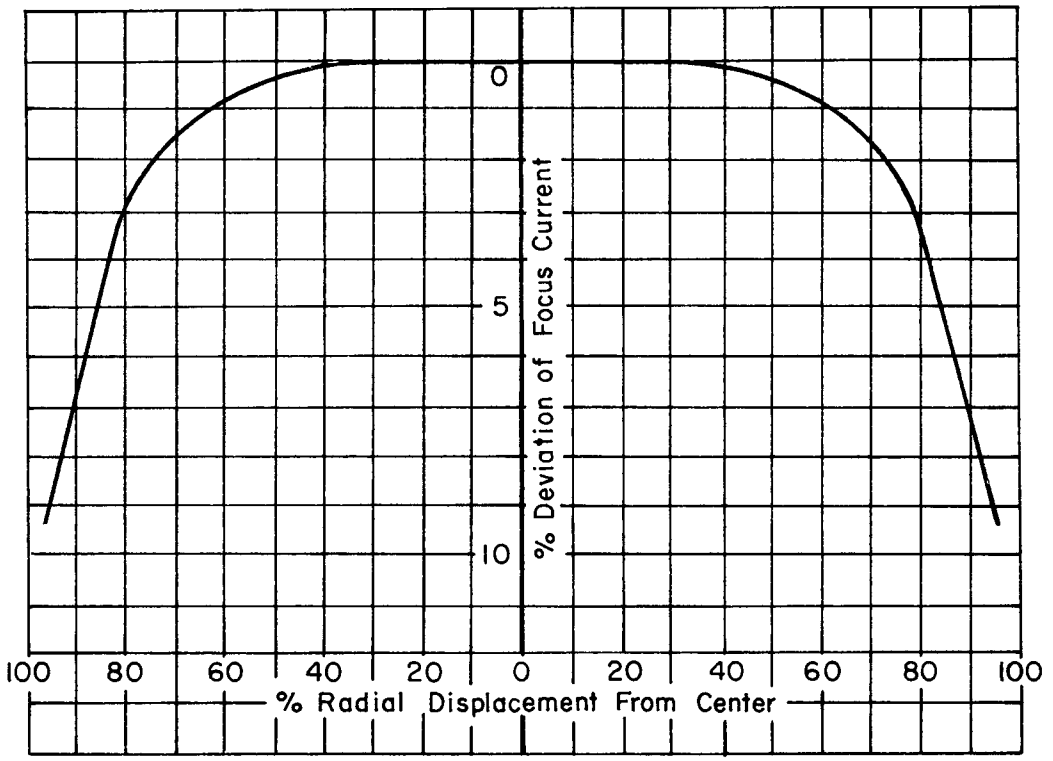


FIGURE 4
MAGNETIC DYNAMIC FOCUS CHARACTERISTIC

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. This can also be done with the read gun by operating the storage screen at +250 Vdc above read cathode. The collector must be negative by approximately 25 volts with respect to the read cathode. A prime cycle must follow.

SPECIAL APPLICATION NOTES: (See Figure 5)

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 beremoved 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. To adjust for proper RF drive, set read G1 bias for a read current of approximately 10 μadc with RF drive at zero. Increase RF drive until the read cathode current is approximately 50 μa.

VIDEO SEPARATION – A no–RF alternate method to the above is use of the secondary emission characteristic of the collector. This can be adjusted for a ratio of one–to–one by operating the write decelerator at approximately +20 Vdc above the collector. The writing signal is then cancelled automatically. Write decelerator to collector voltage should be variable between 0 volts and +30V for proper adjustment.

AUTOMATIC PRIME –(Controllable 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 – An electrostatic lens and deceleration screen are provided to collimate the beam as it arrives in the region of the storage screen. For optimum shading characteristics the reading and writing beams should arrive at the storage screen dielectric orthognally to it. The voltage on the lens 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 800 TV lines across the diameter and is obtainable when the minimum current for writing a fully modulated signal is employed with max. limit of anode potential 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. (Typical correction curves are shown in Figure 4.)

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.

TYPICAL SCHEMATIC

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

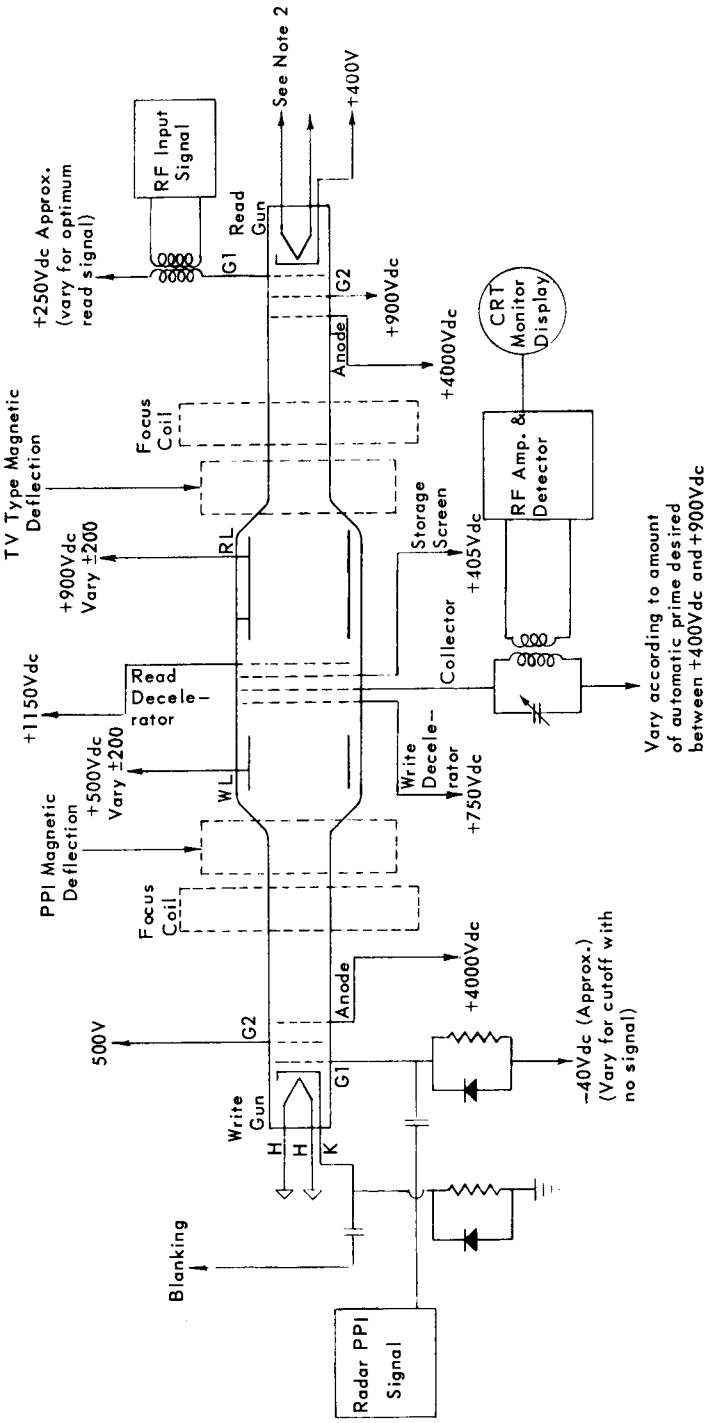


FIGURE 5

MINIATURE RECORDING STORAGE TUBE CK1519

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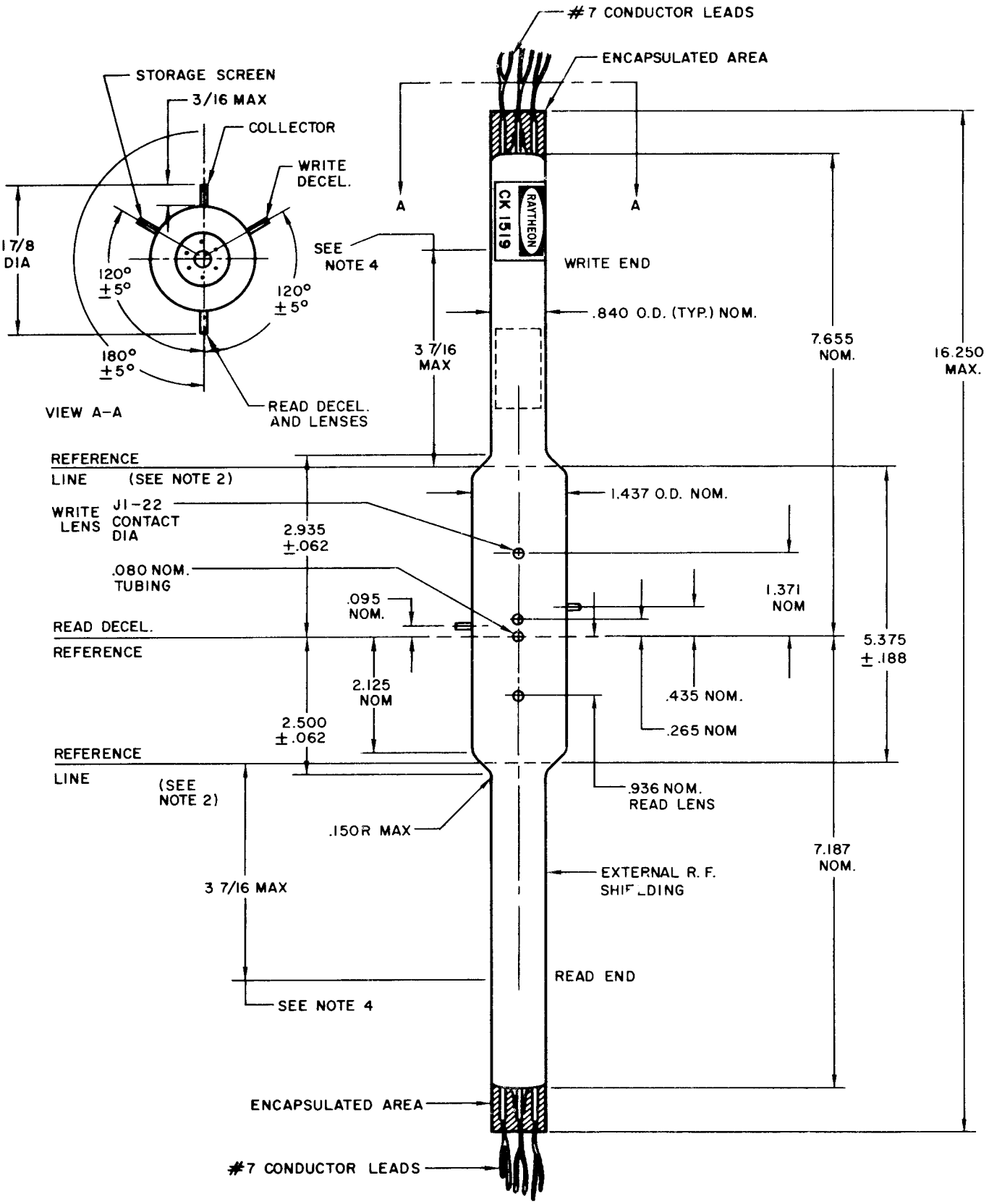

NOTES FOR CK1519 OUTLINE DRAWING ON PAGE SEVEN

1. Basing Color Code

Lead	Write End	Read End
H1	Brown	Brown
H2	Brown	Brown
Anode	Red	Red
G1	Green	Green
G2	Orange	Orange
K	Clear	White

2. Reference Line is determined by that point where a ring gauge .995–.000 + .003 I.D. and 1.500 long comes to rest on neck flare.
3. Aluminum R.F. shielding on Read End of tube.
4. Magnetic deflection yoke and focus coil should be mounted so that they do not fall beyond this dimension. Beam current and resolution can be seriously reduced if the focus coils are too close to the electron guns.
5. The air gap of the focus coil is adjacent to deflection yoke. The magnetic fields of both should not interact on each other. Follow yoke manufacturer's recommendations.