Determine why:

- Low efficiency: Possible feedback
- High efficiency: Feedback too low
- Low N: High feedback
- High N: Low feedback

- Horizontal deflection voltage gen.

*Sil-Rect 800 PIV - 1 Amp

**Horizontal Deflection Voltage Gen. Circuit**
VERTICAL DEFLECTION CIRCUIT
I. WIRES OF YORE:

A - DECELERATION - BLUE, YELLOW
B - ELECTRICAL FOIL - GREEN
C - GUN - WHITE, BLACK, RED
D - IGN - ORANGE
E - FIRST SHIV - GOLD, WHITE
F - TARGET - GRAY, SHIELDED AT GUN
G - BERN - YELLOW
H - ALL - PURPLE - NEG.
I - ALIG. - BROWN - POS.
RCA-7198 is a camera tube of the image-orthicon type designed primarily to provide reliable performance in television cameras for industrial or military service under adverse environmental conditions. It is capable of withstanding operating conditions involving severe shock and vibration, altitude up to 60,000 feet, wide-temperature range, and high humidity.

The 7198 has high sensitivity combined with spectral response approaching that of the eye, and very good resolution capability. The response of the 7198 covers the range from about 3200 angstroms to 6950 angstroms as shown in Fig. 1.

The target in the 7198 is designed to have low capacitance. Because of this feature, the 7198 has negligible microphonics due to movement of target and mesh with respect to each other and is capable of reproducing motion in low-light-intensity scenes with a minimum of smearing. When used with proper, low-noise amplifiers, the 7198 can produce signal information with illumination on the photocathode as low as 0.00001 footcandle. Under such low-illumination levels, the resolution is about 75 TV lines.

PRINCIPLES OF OPERATION

The 7198 has three sections—an image section, a scanning section, and a multiplier section—as shown in Fig. 2.

Image Section

The image section contains a semitransparent photocathode on the inside of the faceplate, a grid (grid No. 6) to provide an electrostatic accelerating field, and a target which consists of a thin glass disc with a fine mesh screen adjacent to it on the photocathode side. Focusing is accomplished by means of a magnetic field produced by an external coil, and by the proper selection of the photocathode voltage and grid-No. 6 voltage.

Light from the scene being televised is picked up by an optical system and focused on the photocathode which emits electrons from each illuminated area in proportion to the intensity of the light striking the area. The streams of electrons are focused on the target by the magnetic and accelerating fields.

On striking the target, the electrons cause secondary electrons to be emitted from the glass. The secondaries thus emitted are collected by the adjacent mesh screen which is held at a definite potential of two volts positive with respect to target-cutoff voltage. Therefore, the potential of the glass disc is limited for all values of light and stable operation is achieved. Emission of the secondaries leaves on the photocathode side of the glass a pattern of positive charges which corresponds with the pattern of light from the scene being televised. Because of the thinness of the glass, the charges set up a similar potential pattern on the opposite or scanned side of the glass.

The spacing between the target glass disc and the mesh in the 7198 is about fifty times greater than in a conventional image orthicon for TV broadcast service. This greater spacing reduces the capacitance between the glass disc and the adjacent mesh, with the result that the small photocurrent-produced image-charges produce higher voltages than would be obtained in a tube without the increased spacing. These higher voltages more effectively modulate the scanning beam at low light levels with consequent increase in ratio of reproduced signal to noise. Furthermore, the lower value of signal-storage capacitance reduces the tendency of moving objects to cause smearing which would otherwise normally occur at extremely low light levels. Movement of the target and mesh with respect to each other is a small percentage of the wide target-mesh spacing in the 7198 and, therefore, the possibility of target-assembly microphonics is reduced.
Scanning Section

The opposite side of the glass is scanned by a low-velocity electron beam produced by the electron gun in the scanning section. This gun contains a thermionic cathode, a control grid (grid No. 1), and an accelerating grid (grid No. 2). The beam is focused at the target by the magnetic field of an external focusing coil and the electrostatic field of grid No. 4.

Deflection of the beam is accomplished by transverse magnetic fields produced by external deflecting coils.

Alignment of the beam from the gun is accomplished by a transverse magnetic field produced by external coils located at the gun end of the focusing coil.

By proper adjustment of potentials including that of grid No. 5, the beam is caused to approach the target perpendicularly and with essentially zero velocity. The electrons stop their forward motion at the surface of the glass and are turned back and focused into a five-stage signal multiplier, except when they approach the positively charged portions of the pattern on the glass. When this condition occurs, they are deposited from the scanning beam in quantities sufficient to neutralize the potential pattern on the glass. Such deposition leaves the glass with a negative charge on the scanned side and a positive charge on the photocathode side. These charges neutralize each other by conductivity through the glass in less than 1/60 of a second.

The electrons turned back at the target form the return beam which has been amplitude modulated by absorption of electrons at the target in accord with the charge pattern whose more positive areas correspond to the highlights of the televised scene.

Multiplier Section

The return beam is directed to the first dynode of a five-stage electrostatically focused multiplier. This utilizes the phenomenon of secondary emission to amplify the modulated beam more than 500 times. The electrons in the beam impinging on the first-dynode surface produce many other electrons, the number depending on the energy of the impinging electrons. These secondary electrons are then directed to the second dynode and knock out more new electrons. Grid No. 3 facilitates a more complete collection by dynode No. 2 of the secondaries from dynode No. 1. The multiplying process is repeated in each successive stage, with an ever-increasing stream of electrons until those emitted from dynode No. 5 are collected by the anode and constitute the current utilized in the output circuit.

The effect of photocathode illumination on signal-to-noise ratio for a typical 7198 is shown in Fig. 5. The signal is defined as the peak-to-peak amplitude of the video current (large-area white to large-area black). The noise is defined as follows:

$$\text{RMS Noise Current} = \frac{1}{6} \sqrt{N_T^2 - N_S^2}$$

Where $N_T$ = peak-to-peak noise current as measured on a black scene

$N_S$ = peak-to-peak system current as measured with the beam of the camera tube cut off

Fig. 5 shows that signal-to-noise ratio of the output signal of the 7198 is approximately proportional to the square root of the highlight illumination of the scene. If the beam current is adjusted to just discharge the highest highlights of the scene being reproduced, the amount of signal current produced is nearly in direct proportion to the light intensity, while the noise varies as the square root of the scanning-beam current. The noise, therefore, is not a fixed quantity, but varies with the amount of scanning-beam current utilized or required. Because of this characteristic, the operator can choose parameters such that the 7198 will operate over a rather wide range of signal current or scene illumination without a direct proportional change in signal-to-noise ratio of the video.
signal. For this reason, the 7198 is particularly suitable for picking up extremely low light levels, but strict attention must be given to the set-up parameters affecting the amount of beam current utilized.

It can be seen that when the beam moves from a less-positive portion on the target to a more-positive portion, the signal-output voltage across the load resistor (R25 in Fig. 3) changes in the positive direction. Hence, for highlights in the scene, the grid of the first video amplifier stage swings in the positive direction.

**DATA**

**General:**

Heater, for Unipotential Cathode:
- Voltage (AC or DC) ... 6.3 ± 10% volts
- Current at 6.3 volts ... 0.6 amperes
- Direct Interelectrode Capacitance:
  - Anode to all other electrodes ... 12 μuf
- Spectral Response ... 5-10
- Wavelength of Maximum Response ... 4500 ± 300 angstroms
- Photocathode, Semitransparent:
  - Rectangular image (4 x 3 or 3 x 4 aspect ratio)
  - Useful size of ... 1.8" max. Diagonal
- Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

**Orientation of... Proper orientation is obtained when the vertical or horizontal scan is essentially parallel to the plane passing through center of faceplate and pin 7 of the shoulder base.**

**Focusing Method** ... Magnetic

**Deflection Method** ... Magnetic

**Overall Length** ... 15.20" ± 0.25"

**Greatest Diameter of Bulb** ... > 3.00" ± 0.06"

**Shoulder Base** ... Keyed Jumbo Annular 7-Pin End Base...

**Small-Shell Diheptal 14-Pin Base** (JEDEC Group 5, No. 81-5

**Operating Position** ... See Operating Considerations

**Weight (Approx.)** ... 1 lb. 6 oz.

**Minimum Deflecting-Coil Inside Diameter** ... 2.38"

**Deflecting-Coil Length** ... 5"

**Focusing-Coil Length** ... 10"

**Alignment Coil Length** ... 0.94"

**Photocathode Distance Inside End of Focusing Coil** ... 0.50"

**Maximum Ratings, Absolute-Maximum Values:**

**PHOTOCATHODE:**
- Voltage ... -650 max. volts
- Illumination ... 50 max. ft

**OPERATING TEMPERATURE:**
- Any part of bulb ... 71 max. °C
- Of bulb at large end of tube ... 20 max. °C
- Storage Temperature Range ... -65 to +71 °C

**TEMPERATURE DIFFERENCE:**
- Between image section and any part of bulb hotter than 7.5 max. °C

**GRID-No.6 VOLTAGE** ... -650 max. volts

**TARGET VOLTAGE:**
- Positive value ... 10 max. volts
- Negative value ... 10 max. volts
Vibration Tests. These tests are performed on a sample lot of tubes from each production run with no voltages applied to the tubes. The test will be made with at least 350 tubes from each production run for these tests (per the method of MIL-E-52724, par. 4.15.2.1) to 12 impact shocks of 30G, each shock impulse having a time duration of 1.1 ± 0.1 millisecond. The intensity is within ±10 per cent as measured with a filter having a bandwidth of 0.2 to 250 cycles per second. The maximum g is reached in approximately 5-1/2 milliseconds. The shock is applied in the following directions: a) vertically, perpendicular to longitudinal axis, 3 shocks in each direction; b) horizontally, perpendicular to longitudinal axis, 3 shocks in each direction. After shock tests, the tubes are operable and will have resolution of at least 525 lines as determined with an RETMA Resolution chart, or equivalent, with not more than 0.003 footcandle highlight illumination on the photocathode.

Temperature-Humidity Tests. These tests are performed on a sample lot of tubes from each production run with no voltages applied to the tubes. The tubes are subjected (per MIL-E-52724 (USAF), par. 4.4.1, Procedure 1) to relative humidities up to and including 95% at temperatures up to and including +75°C. Following this test the tubes are operable and there will be no picture streaking or other evidence of arcing when operated under the following conditions: a) target-supply voltage = 1750 volts; and anode voltage = 1850 volts. In addition, the leakage resistance determined separately between each of six specific diheptal-base pins (pins 5, 6, 7, 8, 9, and 10) and the 13 other diheptal-base pins tied together and grounded will be greater than 500 megs and when a voltage of 250 volts is applied between that specific pin and the others.

The maximum ratings in the tabulated data are established in accordance with the following definition of the Absolute-Maximum Rating System for ratings electron devices.

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its rated data, and should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in device characteristics.

The equipment manufacturer should design so that initially and throughout the period during which the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, grid voltage variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in device characteristics.

The ratio of each voltage is shown under Typical Operating Values.
Fig. 3 - Voltage-Divider Circuit for Type 7198 with Recommended Arrangement for Connecting the Focusing Coil and Alignment Coils.
deflecting, and alignment fields. Suitable support is provided for the tube and its sockets by the arrangement shown in Fig. 2.

Proper orientation of the annular socket with respect to the horizontal-deflecting field is essential, and is obtained when the plane which is perpendicular to the plane of the annular socket and which passes through the center of the annular socket and the center line between pins 3 and 4 of the annular base is at right angles or parallel to the horizontal scanning field. This orientation minimizes beat-pattern effects by placing the sides of the mesh holes at an angle of 45° with respect to the horizontal scanning lines.

The deflecting yoke and focusing coil used with the 7198 must incorporate means to prevent the magnetic field produced by the deflecting yoke from extending into the image section of the tube. Unless proper shielding is provided, crosstalk from the deflecting yoke into the image section will cause the electron image to "jitter". This jitter produces a loss of picture sharpness. It is common practice to enclose the focusing coil in a cylindrical magnetic shield. Additional shielding can be provided by fitting the inside portion of the focusing coil which is directly over the image section of the 7198 with a copper cylinder having a length of approximately 2-1/4" and a wall thickness of 1/32".

For the high dc voltages required by the 7198, two pulse supplies may be used. The plate voltage and current for the pulse supplies, the "B" supply should also provide an output current of 50 milliamperes for the focusing-and alignment coils and for the voltage divider which is used to supply the voltages for the electrodes in the scanning section of the 7198. Provision should be made for regulating the focusing-coil current.

A voltage-divider to provide the required operating voltages for the various electrodes of the 7198 is shown in Fig. 3. It is to be noted that the blocking capacitor C6 should be of sufficiently high quality so that its leakage current will not introduce disturbing effects into the picture.

The dc output of individual 7198's may have a range of 8 to 1. This range, therefore, must be considered in designing a voltage divider for the multiplier stages of the 7198. If the bleeder-resistor values are too high, the distribution of voltages applied to the dynodes will be upset by a 7198 with a dc output at the upper end of the range. As a result, there will be an abrupt drop in the ac output of the tube as the beam current is increased. When this drop occurs before the beam is at its optimum value, the ratio of signal to noise will be lessened, and compression of the signal information will result.

Resolution capability of the 7198 as affected by image-section temperature is shown in Fig. 8 and as affected by highlight illumination in Fig. 9.

It is necessary to use a video amplifier having sufficient bandwidth to utilize the resolution capability of the 7198. Even with a wide-band amplifier, the resolution may be limited in the image section by "cross-talk" caused by...
the scanning fields. Unless prevented by proper shielding from extending into the image section, these fields will cause the electron image on the target to move at the scanning frequency. As a result, the picture will lack definition.

Video gain can be controlled over a wide range by reducing the voltage on one of the multiplier dynodes. It is recommended that dynode-No.3 voltage be made adjustable to perform this gain-control function. However, in no case should the voltage of dynode No.3 be lower than that of dynode No.2 or higher than the normal dynode-No.3 voltage. With this system of video-gain control, there is no necessity for providing a gain control in the first stages of the associated video amplifier. Such a gain control would normally be required to prevent overload when a 7198 having a high signal output or high multiplier gain is used. When dynode gain control is used, the video amplifier should be designed to handle without distortion and without introducing appreciable noise into the signal a peak-to-peak signal-output current of 5 microamperes. The dynode-No.3 voltage can then be adjusted to produce a signal output of approximately 5 microamperes. When dynode gain control is not used, the video amplifier must be designed to handle without distortion peak-to-peak video signals as high as 10 microamperes.

A blanking signal should be supplied to the target to prevent the electron beam from striking the target during the return portions of the horizontal and vertical deflecting cycles. Unless this is done, the camera-tube return lines will appear in the received picture.

The blanking signal is a series of negative voltage pulses. The voltage between pulses must be constant to prevent fluctuation of the target voltage. During the blanking period, the full beam current without video-signal modulation is returned to the multiplier and its multiplied output flows through the load resistance. Excessive amounts of blanking voltage applied to the target will impair resolution, because during retrace the target is out of focus to the continuously flowing photocathode current. A desirable amount of target blanking is 6 volts peak to peak.

Normally, shading correction is not required with optimum adjustment of voltage on grid No.3 in order to obtain a uniformly shaded picture. However, sawtooth and parabolic waveforms of adjustable amplitude and polarity at both the vertical- and horizontal-scanning frequency may be provided for insertion in the video amplifier to aid in obtaining a flat background.
shading-correction signal should be introduced in the amplifier after clamping is performed, because clamping circuits will remove the vertical-frequency shading component if added previous to the clamp-circuit location.

Failure of scanning even for a few seconds may permanently damage the surface of the target. The damaged area shows up as a spot or line in the picture during subsequent operation.

To avoid damaging the 7198 during scanning failure, provision should be made to prevent automatically the scanning beam from reaching the target. The scanning beam can be prevented from reaching the target by (1) cutting off the scanning beam, or (2) making the target sufficiently negative. The scanning beam can be cut off by a relay which applies -115 to -125 volts bias to grid No. 1. The target can be made sufficiently negative by a relay which applies a bias of at least -10 volts to it. Either relay is actuated by a signal from a tube which in turn is controlled by a portion of the scanning pulse voltage developed across either the horizontal or the vertical deflecting coils, or both. It is important to insure that the horizontal scanning pulse and the vertical scanning pulse should each independently actuate the relay in case either one fails.

The operating temperature of any part of the glass bulb should never exceed 71°C, and no part of the bulb at the large end of the tube (image section) should ever fall below 20°C.
during operation. For best results, it is recommended that the temperature of the entire bulb be held between 35° and 45° C. Operation at too low a temperature will be characterized by the appearance of a rapidly disappearing "sticking picture" of opposite polarity from the original when the picture is moved. Operation at too high a temperature will cause loss of resolution and possibly permanent damage to the tube. The loss of resolution is caused by the decreasing resistivity of the target glass disc with increasing temperature. As a result, lateral leakage of the image charge occurs. Resolution is regained by waiting for the temperature to drop below 71° C. No part of the bulb should run more than 7.5° C hotter than the image section to prevent cesium migration to the target. Such migration will result in loss of resolution and in probable permanent damage to the tube. Like other photosensitive devices employing cesium, the 7198 may show fluctuations in performance from time to time. Strict observance of the above recommendations with respect to operating temperature will not completely eliminate these variations but will greatly improve the stability of the characteristics during the life of the tube.

When the equipment design or operating conditions are such that the maximum temperature rating or maximum temperature difference as given under Maximum Ratings will be exceeded, provision should be made to direct a blast of cooling air from the diheptal-base end of the tube along the entire length of the bulb surface, i.e., through the space between the bulb surface and the surrounding deflecting-coil assembly and its extension. Any attempt to effect cooling of the tube by circulating even a large amount of air around the focusing coil will do little good, but a small amount of air directly in contact with the bulb surface will effectively drop the bulb temperature. For this purpose, a small blower is satisfactory, but the blower and its mountings should be designed to prevent excessive vibration of the 7198 and the associated amplifier equipment. (See Vibration under Performance Data on page 4).

To keep the operating temperature of the large end of the tube from falling below 20° C, some form of controlled heating should be employed. Ordinarily, adequate heat will be supplied by the focusing coil, deflecting coils, and associated amplifier tubes so that the temperature can be controlled by the amount of cooling air directed along the bulb surface. If, in special cases, an image-section heater is required, it should fit between the focusing coil and the bulb near the shoulder of the tube, and be non-inductively wound.

A mask having a diagonal or diameter of 1.8 inches should always be used on the photocathode to reduce the amount of light reaching unused parts of the photocathode.

The optical system used with the 7198 should be of high quality and should incorporate control of the amount of light entering the television camera lens. This control may consist of an iris or an iris and suitable neutral-density filters. The entire optical system should have all inside surfaces finished in mat black to prevent internal reflections from reaching the photocathode. Under almost all conditions, the use of a lens shade is beneficial.

Operating Considerations

The 7198 has two complementary guides for inserting the tube correctly in the annular socket, i.e., the large pin (No. 7) on the annular base, and the white radial line on the face of the bulb.

Installation of the 7198 in the camera is accomplished by inserting the diheptal-base end of the tube through the coil assembly and then turning the tube until the annular-base pins, keyed by pin 7, can be inserted in the annular socket. Proper insertion aligns the white radial line on the face with center of the key-pin hole in the annular socket. The diheptal socket is then put on the 14-pin base.

The operating position of the 7198 should preferably be such that any loose particles in the neck of the tube will not fall down and strike or become lodged on the target. Therefore, it is recommended that the tube never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with base up makes an angle of less than 20° with the vertical.

Operating temperature considerations for the 7198 are covered under Camera-Design Considerations on pages 8 & 9.

Full-size scanning of the target should always be used during operation. Full-size scanning can be assured by first adjusting the deflection circuits to overscan the target sufficiently because the edge of the target ring to be visible in the corners of the picture, and then reducing the scanning until the edge of the target ring just disappears. In this way, the maximum signal-to-noise ratio and maxi- resolution can be obtained. Notice that overscanning the target produces a smaller-than-normal picture on the monitor.

Underscanning the target, i.e., scanning an area of the target less than its sensitive area, should never be permitted. Underscanning produces a larger-than-normal picture on the monitor. If the target is underscanned for any length of time, a permanent change in target-cutoff voltage of the underscanned area takes place with the result that the underscanned area thenceforth is visible in the picture when full-size scanning is restored.

During standby operation, the lens of the camera should always be closed or capped. An
effective method of performing the same end result is to cut off the photocathode voltage by means of a switch. The camera will instantly be ready for operation when the photocathode voltage is again turned on.

The light transfer characteristics of the 7198 change for different illumination levels (see Reference 6). The basic light transfer characteristic of the 7198 is shown in Fig. 4. The light values shown are applicable only for the indicated kinds of illumination incident on the photocathode. This curve is representative only for small-area highlights.

Sensitivity and Illumination. The image orthicon is a device exceeding in relative sensitivity most high-speed photographic film. When related to photographic film and compared at shutter speeds of 1/60 second which is the effective storage time of the image orthicon in a standard broadcast television system, the 7198 exposed with the highlights on the photocathode of 0.05 footcandle will have an equivalent ASA exposure index of approximately 7000. This equivalent film-speed rating can be used in conjunction with a photographic exposure meter set for a shutter speed of 1/60 second to determine the approximate light level or lens-stop setting necessary for operating the 7198 in a standard broadcast system.

The illumination on the photocathode of the 7198 is related to the scene illumination as follows:

\[ I_s = \frac{4f^2 I_{pc}(m+1)^2}{TR} \]

where

- \( I_s \) = scene illumination in footcandles
- \( f \) = f-number setting of lens
- \( I_{pc} \) = photocathode illumination in footcandles
- \( m \) = linear magnification from scene to target
- \( T \) = total transmission of lens
- \( R \) = reflectance of principal subject in scene

Except for very close shots, the linear magnification factor from scene to target may be neglected.

For example, assume that the lens is set at \( f:1.5 \), that it has a transmission \( T \) of 75%, that the photocathode highlight illumination is 0.0001 footcandle, and that the highlight reflectance \( R \) is 50%.

Then,

\[ I_s = \frac{4 \times 1.5^2 \times 0.0001}{0.75 \times 0.50} = 0.0024 \text{ footcandle} \]

Optimum resolution and best performance is obtained from the 7198 when the highlight illumination on the photocathode does not exceed 0.1 footcandle. It may not be possible to stop the lens down far enough to obtain this level of highlight illumination on the photocathode. When such a condition is encountered, the use of a Wratten neutral filter selected to give the required reduction in illumination is recommended. Such a filter with lens-adapter ring can be obtained at photographic supply stores.

The low illumination level utilized on the photocathode of the 7198 makes it necessary that no stray light from without or within the camera fall on the face of the tube. See optical system under Camera-Design Considerations.

Retention of a scene by the 7198, sometimes called a "sticking picture", may be observed if the 7198 is allowed to remain focused on a stationary bright scene, or if it is focused on a bright scene before reaching operating temperature in the range from 35° to 45° C. Often the retained image will disappear in a few seconds, but sometimes it may persist for long periods before it completely disappears. A persisting retained image can generally be removed by focusing the 7198 on a clear white screen and allowing it to operate with an illumination of about 1 footcandle on the photocathode until the retained image disappears.

To minimize retention of a scene, it is recommended that the 7198 always be allowed to warm up in the camera for 1/2 to 1 hour with the lens capped. Never allow the 7198 to remain focused on a stationary bright scene, and never use more illumination than is necessary.

Occasionally, a white spot which does not change in size when the beam-focus voltage is varied, may be observed in the center of the picture. Such a spot, especially if it is visible on the monitor with the camera lens capped, is probably an ion spot. If the spot begins to grow in size with continuous operation, the 7198 should be removed from service at once, and returned for re-processing. Continued operation of an image orthicon with an ion spot will eventually damage the target permanently.

SET-UP PROCEDURE

The set-up procedure for operating the 7198 is as follows: After the tube has been inserted in its sockets and the voltages applied as indicated under Typical Operating Values, allow it to warm up for 1/2 to 1 hour with the camera lens capped, and with grid-No.1 voltage adjusted to give a small amount of beam current. Make certain that the deflection circuits are functioning properly to cause the electron beam to scan the target. Adjust the deflection circuits so that the beam will "overscan" the target, i.e., so that the area of the target scanned is greater than its sensitive area. This procedure during the warming-up period is recommended to prevent burning on the target a raster smaller than that used for on-the-air operation. Note that over-
scanning the target results in a smaller-than-normal picture on the monitor.

With the lens still capped and the target voltage set at approximately 2 volts negative, adjust the grid-No.1 voltage until noise or a rough-textured picture of dynode No.1 appears on the monitor. Then adjust the alignment-coil current so that the small white dynode spots do not move when the beam-focus control (grid No.4) is varied, but simply go in and out of focus. During alignment of the beam, and also during operation of the tube, always keep the beam current as low as possible to give the best picture quality and also to prevent excessive noise.

Next, uncap the lens and open the lens iris partially. Focus the camera on a test pattern. The target voltage is then increased until a reproduction of the test pattern is just discernable on the monitor. This value of target voltage is known as the "target cutoff voltage". The target voltage should then be raised exactly 2 volts above the cutoff-voltage value, and the beam-current control adjusted to give just sufficient beam current to discharge the highlights.

Then adjust the lens to produce best optical focus, and the voltage on the photocathode as well as the voltage on grid No.4 to produce the sharpest picture.

At this point, attention should be given to the grid-No.5 and grid-No.3 voltage controls. Grid No.5 is used to control the landing of the beam on the target and consequently the uniformity of signal output. The grid-No.5 voltage control should be adjusted to produce a picture that has most uniform shading from center to edge with the lens iris opened to permit operation at the highest light level involved in the application. The value of grid-No.5 voltage should be as high as possible consistent with uniform shading. Grid No.3 facilitates a more complete collection by dynode No.2 of the secondaries from dynode No.1. The grid-No.3 voltage control should be adjusted to produce the maximum signal output.

Now with a test pattern consisting of a straight line centered on the face of the 719B, adjust the voltage on grid No.6 along with the voltage on the photocathode to produce a sharply focused straight line on the monitor. Improper adjustment of the grid-No.6 voltage control will result in the straight-line pattern being reproduced with a slight S-shape.

The above adjustments constitute a rough set-up of the 719B. Final adjustments necessary for the 719B to produce the best possible picture are as follows: With the lens capped, re-align the beam. Beam alignment is necessary after each change of the grid-No.5 voltage control and sometimes after each adjustment of the grid-No.3 voltage control.

With the camera operating at the desired illumination level, the beam current should be slowly decreased by adjusting the grid-No.1 voltage control to the point where the beam is just sufficient to discharge the highlights of the picture. Each change of scene illumination should be accompanied by appropriate changes in beam current and amplifier gain to obtain the best contrast and signal-to-noise ratio for each new scene condition.

REFERENCES

Information furnished by RCA is believed to be accurate and reliable. However, no responsibility is assumed by RCA for its use; nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of RCA.
Here are the "dos"--

1. Allow the 7198 to warm up prior to operation.
2. Hold temperature of the 7198 within operating range.
3. Make sure alignment coil is properly aligned.
4. Adjust beam-focus control for best usable resolution.
5. Determine proper operating point with target voltage adjusted to exactly 2 volts above target cutoff.
6. Cap lens during standby operation.

Here are the "don'ts"--

1. Don't force the 7198 into its shoulder socket.
2. Don't operate the 7198 without scanning.
3. Don't underscan target.
4. Don't focus the 7198 on a stationary bright scene.
5. Don't operate a 7198 having an ion spot.

The significance of each of the above "dos" and "don'ts" in obtaining optimum performance from the 7198 is explained in the preceding pages of this bulletin.
SOCKET CONNECTIONS
Bottom View

DIRECTION OF LIGHT:
PERPENDICULAR TO
LARGE END OF TUBE

WHITE INDEX LINE
ON FACE

SMALL-SHELL DIHEPTAL 14-PIN BASE

PIN 1: HEATER
PIN 2: GRID No.4
PIN 3: GRID No.3
PIN 4: INTERNAL CONNEC-
TION--DO NOT USE
PIN 5: DYNODE No.2
PIN 6: DYNODE No.4
PIN 7: ANODE
PIN 8: DYNODE No.5
PIN 9: DYNODE No.3
PIN 10: DYNODE No.1,
GRID No.2
PIN 11: INTERNAL CONNEC-
TION--DO NOT USE
PIN 12: GRID No.1
PIN 13: CATHODE
PIN 14: HEATER

KEYED JUMBO ANKULAR 7-PIN BASE

PIN 1: GRID No.6
PIN 2: PHOTOCATHODE
PIN 3: INTERNAL CONNEC-
TION--DO NOT USE
PIN 4: INTERNAL CONNEC-
TION--DO NOT USE
PIN 5: GRID No.5
PIN 6: TARGET
PIN 7: INTERNAL CONNEC-
TION--DO NOT USE
**NOTE 1:** ENDS OF PINS CHAMFERED 45°; FLAT ENDS 0.020" ± 0.010".

**NOTE 2:** PLASTIC COATING MAY INCREASE DIAMETER OF BASE SHELL TO 2.08" MAX. AND MAY INCREASE HEIGHT OF BASE SHELL BY 0.03" MAX.

**NOTE 3:** DOTTED AREA IS FLAT OR EXTENDS TOWARD DINEPTAL-BASE END OF TUBE BY 0.060" MAX.

**ANNULAR BASE GAUGE**

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flat-plate gauge with:

a. Six holes having diameter of 0.065" ± 0.001" and one hole having diameter of 0.150" ± 0.001". All holes have depth of 0.265" ± 0.001". The six 0.065" holes are enlarged by 45° taper to depth of 0.047". All holes are spaced at angles of 51°26' ± 5' on circle diameter of 2.500" ± 0.001".

b. Seven stops having height of 0.187" ± 0.001", centered between pin holes, to bear against flat areas of base.

c. Rim extending out a minimum of 0.125" from 2.812" diameter and having height of 0.126" ± 0.001".

d. Neck-cylinder clearance hole having diameter of 2.200" ± 0.001".
# R.F. CHOKE

## Sub-Miniature R.F. Choices

An extremely versatile series of iron core R.F. chokes designed to meet the industries' demand for high reliability, miniaturized components. The coils are ideally suited to network design, delay lines, and computer applications. Listed at 10 milliamperes maximum D.C. current they are more than satisfactory for most applications. The coils are impregnated with a moisture-resistant lacquer and when ordered with varnish can be fungus-proofed per MIL-V-141 using varnish per MIL-V-118.

They can also be encapsulated in epoxy taro m or form as Grade 1, Bass B of MIL-15303.

---

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Measurement Model 2606 A Meter</th>
<th>Inductance Minimum</th>
<th>Inductance Maximum</th>
<th>Frequency Minimum</th>
<th>Frequency Maximum</th>
<th>Tolerance</th>
<th>Frequency 10%</th>
<th>Frequency 5%</th>
<th>Diameter</th>
<th>Form Length x</th>
</tr>
</thead>
<tbody>
<tr>
<td>701476AP</td>
<td>10 µH</td>
<td>48</td>
<td>25 MHz</td>
<td>400</td>
<td>.013</td>
<td>3200</td>
<td>.156</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701176AP</td>
<td>15 µH</td>
<td>55</td>
<td>25 MHz</td>
<td>400</td>
<td>.025</td>
<td>4400</td>
<td>.181</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701477AP</td>
<td>22 µH</td>
<td>65</td>
<td>25 MHz</td>
<td>400</td>
<td>.038</td>
<td>5800</td>
<td>.213</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701478AP</td>
<td>50 µH</td>
<td>100</td>
<td>25 MHz</td>
<td>400</td>
<td>.070</td>
<td>9000</td>
<td>.241</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701479AP</td>
<td>1.2 µH</td>
<td>45</td>
<td>7.9 MHz</td>
<td>118</td>
<td>.072</td>
<td>400</td>
<td>.160</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701466AP</td>
<td>1.3 µH</td>
<td>47</td>
<td>7.9 MHz</td>
<td>102</td>
<td>.096</td>
<td>316</td>
<td>.168</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701467AP</td>
<td>1.8 µH</td>
<td>51</td>
<td>7.9 MHz</td>
<td>89</td>
<td>.096</td>
<td>400</td>
<td>.168</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701468AP</td>
<td>2.2 µH</td>
<td>53</td>
<td>7.9 MHz</td>
<td>87</td>
<td>.156</td>
<td>320</td>
<td>.160</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701469AP</td>
<td>3.7 µH</td>
<td>54</td>
<td>7.9 MHz</td>
<td>74</td>
<td>.156</td>
<td>236</td>
<td>.160</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701470AP</td>
<td>3.3 µH</td>
<td>40</td>
<td>7.9 MHz</td>
<td>66</td>
<td>.240</td>
<td>199</td>
<td>.150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701471AP</td>
<td>3.9 µH</td>
<td>33</td>
<td>7.9 MHz</td>
<td>61</td>
<td>.384</td>
<td>139</td>
<td>.150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701472AP</td>
<td>4.7 µH</td>
<td>43</td>
<td>7.9 MHz</td>
<td>53</td>
<td>.457</td>
<td>100</td>
<td>.150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701473AP</td>
<td>5.6 µH</td>
<td>41</td>
<td>7.9 MHz</td>
<td>49</td>
<td>.493</td>
<td>100</td>
<td>.150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701474AP</td>
<td>6.8 µH</td>
<td>39</td>
<td>7.9 MHz</td>
<td>49</td>
<td>.624</td>
<td>100</td>
<td>.150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701475AP</td>
<td>7.3 µH</td>
<td>35</td>
<td>7.9 MHz</td>
<td>44</td>
<td>.664</td>
<td>100</td>
<td>.150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701476AP</td>
<td>8.3 µH</td>
<td>37</td>
<td>7.9 MHz</td>
<td>41</td>
<td>.744</td>
<td>100</td>
<td>.150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701477AP</td>
<td>9.1 µH</td>
<td>41</td>
<td>7.9 MHz</td>
<td>39</td>
<td>1.15</td>
<td>75</td>
<td>.160</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701478AP</td>
<td>10 µH</td>
<td>41</td>
<td>7.9 MHz</td>
<td>37</td>
<td>1.61</td>
<td>75</td>
<td>.160</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701479AP</td>
<td>12 µH</td>
<td>33</td>
<td>2.3 MHz</td>
<td>19</td>
<td>1.61</td>
<td>75</td>
<td>.160</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701480AP</td>
<td>15 µH</td>
<td>32</td>
<td>2.3 MHz</td>
<td>14</td>
<td>1.92</td>
<td>75</td>
<td>.160</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701481AP</td>
<td>18 µH</td>
<td>32</td>
<td>2.3 MHz</td>
<td>12</td>
<td>2.58</td>
<td>75</td>
<td>.160</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701482AP</td>
<td>22 µH</td>
<td>31</td>
<td>2.3 MHz</td>
<td>13</td>
<td>2.98</td>
<td>75</td>
<td>.162</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701483AP</td>
<td>27 µH</td>
<td>49</td>
<td>2.3 MHz</td>
<td>12</td>
<td>3.64</td>
<td>75</td>
<td>.170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701484AP</td>
<td>33 µH</td>
<td>50</td>
<td>2.3 MHz</td>
<td>10</td>
<td>3.76</td>
<td>75</td>
<td>.170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701485AP</td>
<td>39 µH</td>
<td>48</td>
<td>2.3 MHz</td>
<td>9.3</td>
<td>3.86</td>
<td>75</td>
<td>.170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701486AP</td>
<td>47 µH</td>
<td>44</td>
<td>2.3 MHz</td>
<td>8.3</td>
<td>3.66</td>
<td>75</td>
<td>.170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701487AP</td>
<td>56 µH</td>
<td>42</td>
<td>2.3 MHz</td>
<td>8.4</td>
<td>3.64</td>
<td>75</td>
<td>.170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701488AP</td>
<td>63 µH</td>
<td>40</td>
<td>2.3 MHz</td>
<td>8.3</td>
<td>4.20</td>
<td>75</td>
<td>.170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701489AP</td>
<td>7.2 µH</td>
<td>38</td>
<td>2.3 MHz</td>
<td>7.2</td>
<td>4.56</td>
<td>75</td>
<td>.170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701490AP</td>
<td>82 µH</td>
<td>41</td>
<td>2.3 MHz</td>
<td>6.7</td>
<td>4.90</td>
<td>75</td>
<td>.185</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701491AP</td>
<td>9.1 µH</td>
<td>41</td>
<td>2.3 MHz</td>
<td>6.7</td>
<td>4.92</td>
<td>75</td>
<td>.185</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701492AP</td>
<td>100 µH</td>
<td>25</td>
<td>2.3 MHz</td>
<td>5.6</td>
<td>7.60</td>
<td>75</td>
<td>.185</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701493AP</td>
<td>120 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>7.2</td>
<td>8.10</td>
<td>75</td>
<td>.165</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701494AP</td>
<td>180 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>5.8</td>
<td>8.16</td>
<td>75</td>
<td>.165</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701495AP</td>
<td>200 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>5.2</td>
<td>8.16</td>
<td>75</td>
<td>.165</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701496AP</td>
<td>250 µH</td>
<td>49</td>
<td>790 kHz</td>
<td>2.7</td>
<td>10.3</td>
<td>75</td>
<td>.170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701497AP</td>
<td>350 µH</td>
<td>49</td>
<td>790 kHz</td>
<td>2.0</td>
<td>11.5</td>
<td>75</td>
<td>.170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701498AP</td>
<td>450 µH</td>
<td>49</td>
<td>790 kHz</td>
<td>2.0</td>
<td>11.5</td>
<td>75</td>
<td>.170</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701499AP</td>
<td>600 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>1.8</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701500AP</td>
<td>800 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.2</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701501AP</td>
<td>1000 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701502AP</td>
<td>1500 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701503AP</td>
<td>2000 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701504AP</td>
<td>3000 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701505AP</td>
<td>4000 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701506AP</td>
<td>5000 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701507AP</td>
<td>6000 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701508AP</td>
<td>7000 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701509AP</td>
<td>8000 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701510AP</td>
<td>9000 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>701511AP</td>
<td>10000 µH</td>
<td>40</td>
<td>790 kHz</td>
<td>2.0</td>
<td>13.2</td>
<td>75</td>
<td>.173</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Tolerance 0.1 to 1.0 µH ± 20%, 1.1 to 15 µH ± 10%, over 15 µH ± 5%*  
*Measured with leads 1/4" long from Q Meter binding posts*  

Continued on following page
### R.F. CHOKES

**Sub-Miniature R.F. Chokes**

Continued from previous page

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Measured Inductance, µH</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Measured Frequency, MHz</th>
<th>R.F. Resistance, Maximum</th>
<th>Milling Rating, Maximum</th>
<th>Maximum Winding Density</th>
<th>Form Length, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>70F120A1</td>
<td>1.00 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.4</td>
<td>24.0</td>
<td>75</td>
<td>225</td>
</tr>
<tr>
<td>70F122A1</td>
<td>1.25 µH</td>
<td>24</td>
<td>50</td>
<td>250 MHz</td>
<td>1.2</td>
<td>23.6</td>
<td>75</td>
<td>230</td>
</tr>
<tr>
<td>70F130A1</td>
<td>1.50 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.1</td>
<td>27.2</td>
<td>75</td>
<td>235</td>
</tr>
<tr>
<td>70F140A1</td>
<td>2.00 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.6</td>
<td>26.8</td>
<td>75</td>
<td>240</td>
</tr>
<tr>
<td>70F150A1</td>
<td>2.50 µH</td>
<td>40</td>
<td>70</td>
<td>250 MHz</td>
<td>2.5</td>
<td>20.0</td>
<td>75</td>
<td>250</td>
</tr>
<tr>
<td>70F160A1</td>
<td>3.00 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.5</td>
<td>25.0</td>
<td>75</td>
<td>255</td>
</tr>
<tr>
<td>70F170A1</td>
<td>3.50 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.5</td>
<td>24.0</td>
<td>75</td>
<td>260</td>
</tr>
<tr>
<td>70F180A1</td>
<td>4.00 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.5</td>
<td>23.0</td>
<td>75</td>
<td>265</td>
</tr>
<tr>
<td>70F190A1</td>
<td>5.00 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.5</td>
<td>22.0</td>
<td>75</td>
<td>270</td>
</tr>
<tr>
<td>70F200A1</td>
<td>6.00 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.5</td>
<td>21.0</td>
<td>75</td>
<td>275</td>
</tr>
<tr>
<td>70F210A1</td>
<td>7.00 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.5</td>
<td>20.0</td>
<td>75</td>
<td>280</td>
</tr>
<tr>
<td>70F220A1</td>
<td>8.00 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.5</td>
<td>19.0</td>
<td>75</td>
<td>285</td>
</tr>
<tr>
<td>70F230A1</td>
<td>9.00 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.5</td>
<td>18.0</td>
<td>75</td>
<td>290</td>
</tr>
<tr>
<td>70F240A1</td>
<td>10.0 µH</td>
<td>20</td>
<td>50</td>
<td>250 MHz</td>
<td>1.5</td>
<td>17.0</td>
<td>75</td>
<td>295</td>
</tr>
</tbody>
</table>

*All catalog items stocked in depth.*

Orders shipped the same day received.

See your distributor for quantity prices.

---

J. W. MILLER COMPANY
19070 REYES AVENUE
P.O. BOX 5825
COMPTON, CALIF. 90224

PRINTED IN U.S.A.