



HEWLETT-PACKARD COMPANY / OPERATING AND SERVICE MANUAL

196A
OSCILLOSCOPE
CAMERA



OPERATING AND SERVICING MANUAL

MODEL 196A

SERIALS PREFIXED: 001-

OSCILLOSCOPE CAMERA

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Figure 1-1. Model 196A Oscilloscope Camera

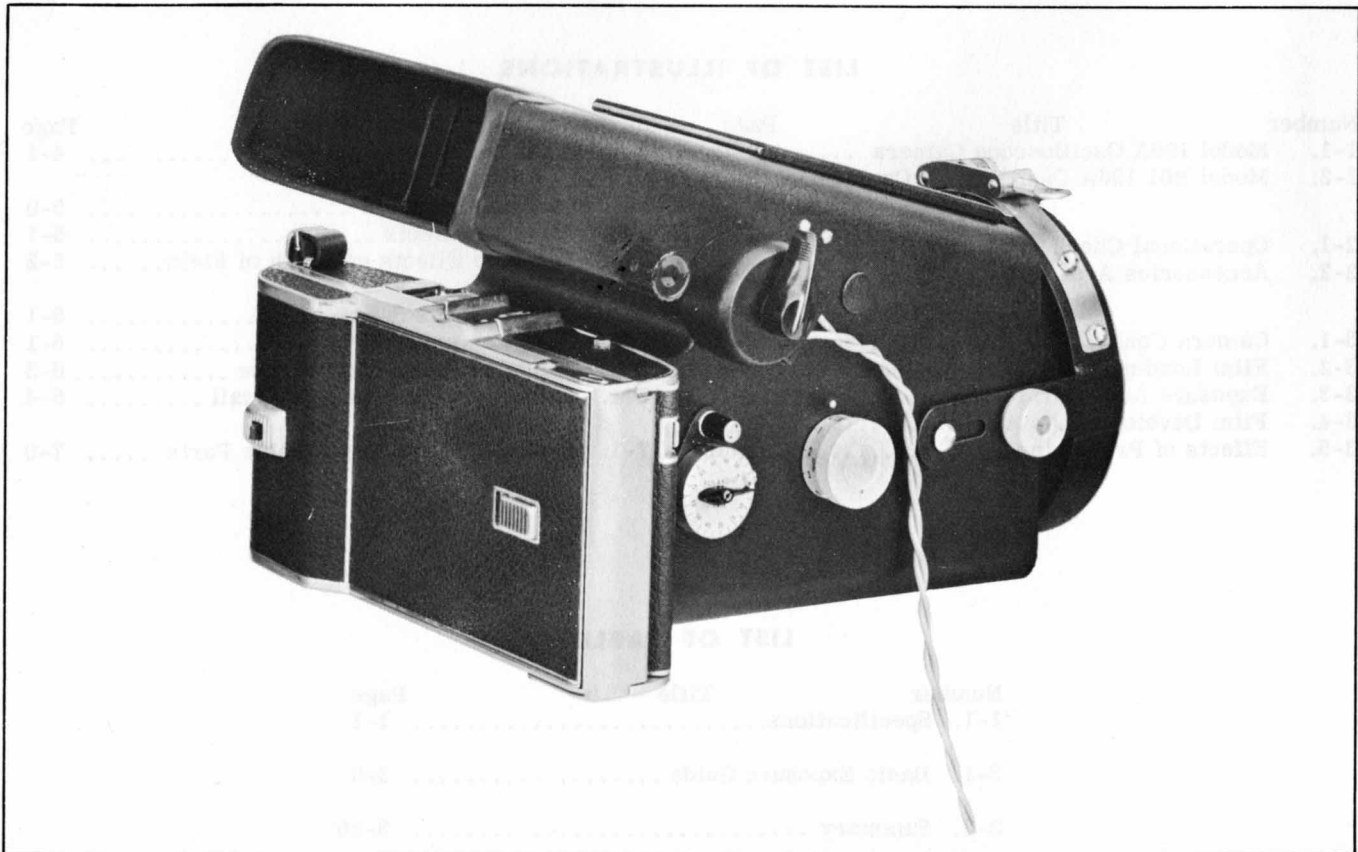


Figure 1-2. Model H01 196A Oscilloscope Camera

SECTION I

INTRODUCTION AND DESCRIPTION

1-1. INTRODUCTION.

1-2. SCOPE. This manual supplies operation and maintenance information for the Hewlett-Packard Model 196A Oscilloscope Camera. An operating instructions section (section III) and a print evaluation section (section IV) are included for the operator's use in evaluating many of the problems that occur in oscilloscope photography.

1-3. MODELS COVERED. There are two models covered in this manual: Model 196A, in which the shutter is manually operated (figure 1-1), and H01 196A (figure 1-2), in which the shutter may be either manually operated or remotely operated by actuating a relay in the camera. In the case of remote operation, an external Power source is required (see paragraph 3-10). With the exception of the shutter actuating system, these cameras are identical.

1-4. SERIAL NUMBER SYSTEM. Hewlett-Packard instruments use a two section, eight digit serial number (i. e. 000-00000). The first three digits are an identification number; the last five digits are the instrument serial number. If the identification number on the instrument does not agree with the identification number shown on the manual title page, there are differences between the manual and your instrument. These differences are described in "Manual Changes" sheets supplied with the manual.

1-5. DESCRIPTION.

1-6. GENERAL. The 196A Oscilloscope Camera is a high quality camera for use in permanently recording oscilloscope traces at all sweep speeds. The 196A has been designed so that when the camera nose is

mounted against the oscilloscope graticule, the camera will be in perfect focus on the trace. Image-to-object ratio is normally 0.9-to-1, allowing the entire 10 cm wide graticule to be photographed. A 1-to-1 ratio is available on special order, however, or may be obtained by modification in the field (see paragraph 6-13). Your Model 196A Oscilloscope Camera arrives fully assembled and, with the exception of film, ready for use. Film may be obtained at any photographic supply store. Use regular Polaroid® Land film types 42, 46L or 47.

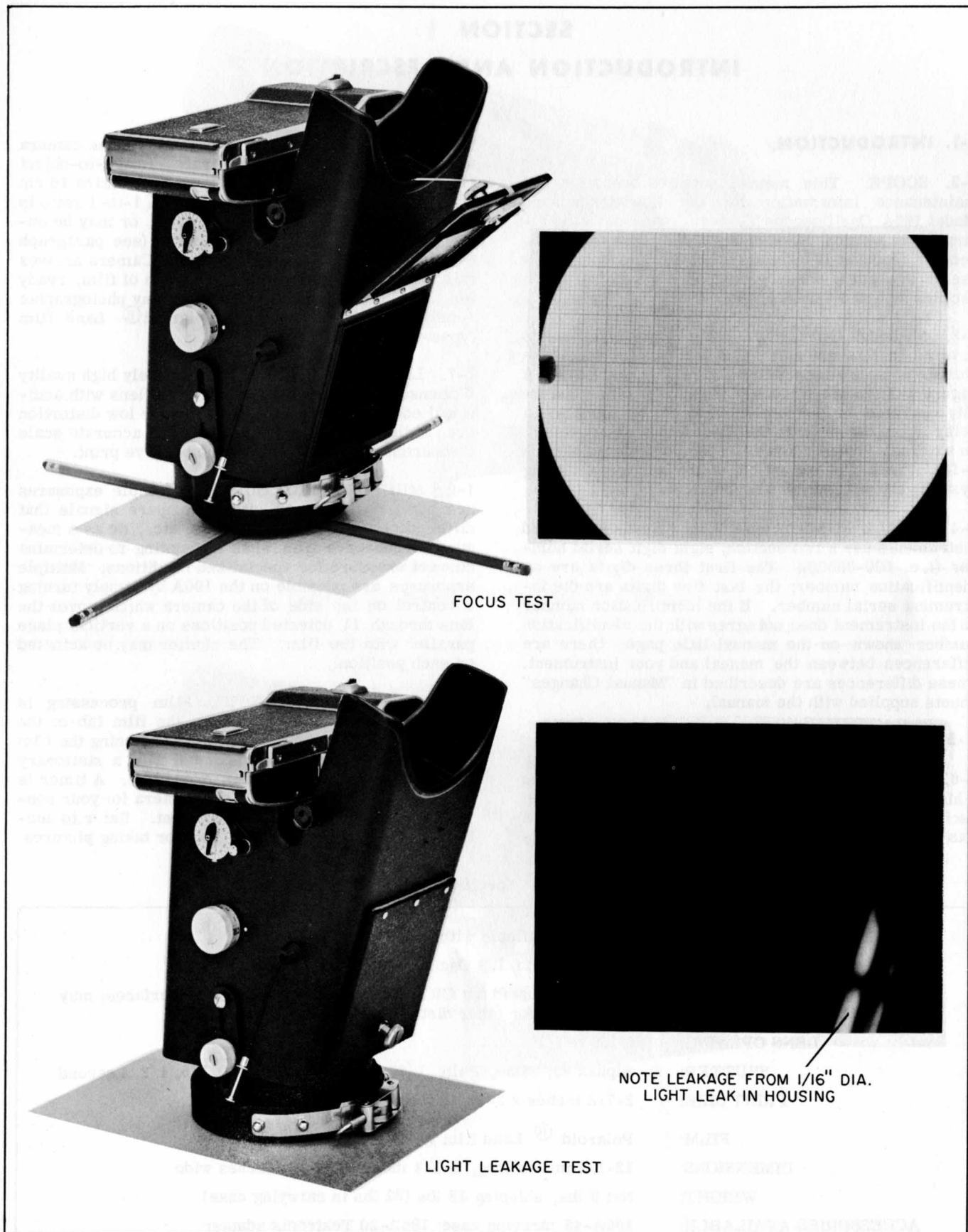
1-7. LENS. The 196A uses an extremely high quality Wollensak Oscillo-Raptar 75 mm f/1.9 lens with additional edge resolution, resulting in very low distortion even at the picture edge. This allows accurate scale measurements to be made on the positive print.

1-8. MULTIPLE EXPOSURES. Multiple exposures are often desirable to either compare signals that differ slightly during adjustments, etc., or as a measure to conserve film when attempting to determine correct exposure for specialized conditions. Multiple exposures are possible on the 196A by simply turning a control on the side of the camera which moves the lens through 11 detented positions on a vertical plane parallel with the film. The shutter may be actuated on each position.

1-9. FILM DEVELOPMENT. Film processing is automatically started by pulling the film tab on the right side of the camera back and advancing the film one frame. The 196A is designed with a stationary back to further simplify this procedure. A timer is provided on the right side of the camera for your convenience in timing film development. Refer to section III for complete instructions for taking pictures.

Table 1-1. Specifications

OBJECT-TO-IMAGE RATIO:	1 to 0.9; available with 1-to-1 ratio
LENS:	3 in. (75 mm) f/1.9 Oscillo-Raptar
FOCUS:	Factory adjusted for CRT face 5/16 inch behind front surfaces; may be adjusted for other distances
LENS OPENING:	f/1.9 to f/16
SHUTTER:	Alphax #3; Time, Bulb, 1/100, 1/50, 1/25, 1/10, 1/5, 1/2, 1 second
PRINT SIZE:	2-7/8 inches x 3-13/16 inches (7.3 cm x 9.6 cm)
FILM:	Polaroid® Land film types 42, 46L and 47
DIMENSIONS:	13-1/2 inches long, 9-1/4 inches high, 10 inches wide
WEIGHT:	Net 9 lbs, shipping 18 lbs (32 lbs in carrying case)
ACCESSORIES AVAILABLE:	196A-45 carrying case; 196A-20 Tektronix adapter



FOCUS TEST

NOTE LEAKAGE FROM 1/16" DIA.
LIGHT LEAK IN HOUSING

LIGHT LEAKAGE TEST

Figure 2-1. Operational Check

SECTION II

PREPARATION FOR USE

2-1. INCOMING INSPECTION.

2-2. **MECHANICAL INSPECTION.** Because of the fragile, expensive lens in your 196A Oscilloscope Camera, great care has been taken in packing to assure undamaged delivery. Despite these precautions, however, damage in shipment will sometimes occur. Upon receipt of your 196A, check the contents against the packing list and inspect the camera for any obvious damage received in transit. To facilitate reshipment, keep the packing material until an operational check has been made. Follow the procedure outlined in paragraph 2-3.

2-3. **OPERATIONAL CHECK.** Due to the many problems such as oscilloscope light leakage, and differences in trace intensity and focus that are often present in oscilloscope photography, and the specialized equipment necessary for a complete test, it is difficult to suggest a dependable method of performing a complete incoming performance check. The following procedure is suggested, however, as a means to check basic 196A operation. This check should be performed with normal room lighting. A complete adjustment procedure is given in section VI.

2-4. Check basic 196A performance as follows (refer to figure 3-1 for the location of parts mentioned in the following steps):

- a. Load the camera with Type 47 Polaroid® Land film (follow instructions in figure 3-2, Film Loading).
- b. Loosen the knurled locking screws on either side of the camera.
- c. Place a piece of dark paper on an absolutely flat surface that is large enough to accommodate the camera nose.
- d. Set the aperture to $f/1.9$ and the shutter speed control to one second (see paragraphs 3-8 and 3-9 for setting these controls).
- e. Place the camera nose-down on the paper and let the clamp ring slide down until it rests on the paper. Shut the lens access door and look in the viewer. If light is seen leaking between the camera nose and the paper it is probably due to dirt or other irregularities on the surface. Reposition the camera on the surface until no light is admitted. Shut the viewer door.
- f. Operate the shutter and develop the film (follow developing instructions given in figure 3-4). The picture should be totally black.
- g. Set shutter speed to $1/100$ and aperture to $f/4$.
- h. Place a piece of paper that has many sharp dark lines down on it (K & E graph paper #358-11 is good)

over a piece of white bond. Make sure the paper is lying absolutely flat.

i. Arrange four identical hexagonal pencils (about $5/16$ inch from flat to flat) in a circle as shown in figure 2-1. Slide the clamp ring back toward the camera itself and tighten the locking screws.

j. Put the camera nose down on the pencils. Open the lens access door and the viewer door.

k. Shine a 3-watt source of diffused light into the lens access door. Do not point the light at the lens. (A piece of tissue placed over a 3-watt trouble lamp makes a suitable diffused light source for this purpose.)

m. Actuate the shutter and develop the picture. The lines on the graph paper should appear well defined over the entire picture area (figure 2-1).

2-5. PREPARATION FOR RESHIPMENT.

2-6. If, after incoming inspection, damage is evident, repack the instrument in its original shipping container taking care to replace all pads in their original positions. If this packing is not available, the 196A should be packed in a strong container and surrounded by 6 to 8 inches of cushioning material designed specifically for package cushioning. Excelsior or other dust-producing material should not be used. The 196A carrying case, available as an accessory (figure 2-2) should provide sufficient cushioning for the camera. The carrying case should, however, be placed in a protective shipping container that conforms with the Uniform Freight Classification, and lined with additional sheets of cardboard.

2-7. STORAGE.

2-8. When storing this camera, as any high quality optical instrument, care should be taken to protect it from falls and sudden jars, from sharp changes in temperature and from excessive heat and moisture (see paragraph 2-9). Exposed glass surfaces should be protected from dust when not in use by using a lens cap or by keeping the camera in its carrying case.

2-9. ENVIRONMENTAL LIMITS.

2-10. The 196A may be operated or stored within wide environmental conditions. The following limits, however, should not be exceeded.

- a. Max. storage temperature (without film) 160°F .
- b. Min. storage temperature (without film) -20°F .
- c. Max. operating temperature 120°F .
- d. Min. operating temperature 20°F .

e. Maximum humidity 99% rh from 20°F to 120°F (50% rh above 120°F).


NOTE


Avoid operating or storing the camera under conditions of high humidity for any extended period.

f. The 196A has been tested at 25,000 feet altitude and found to produce satisfactory pictures. No checks have been made beyond this altitude.

2-11. ACCESSORIES AVAILABLE.

2-12. Two accessories are available for the 196A Oscilloscope Camera (figure 2-2):

a. Carrying Case. The 196A Camera Carrying Case,  stock number 196A-45, is well padded with plastic foam so that the camera will be fully protected against the shock encountered in normal use. It is also a suitable shipping container for the 196A, although we recommend that the case be protected by placing it in a shipping container lined with additional sheets of cardboard (see paragraph 2-5).

b. Tektronix Oscilloscope Adapter. The 196A Tektronix Adapter,  stock number 196A-20, allows the 196A to be used with most oscilloscopes that will not accept the 196A directly. The existing bezel should be removed and the Tektronix Adapter screwed on in its place.

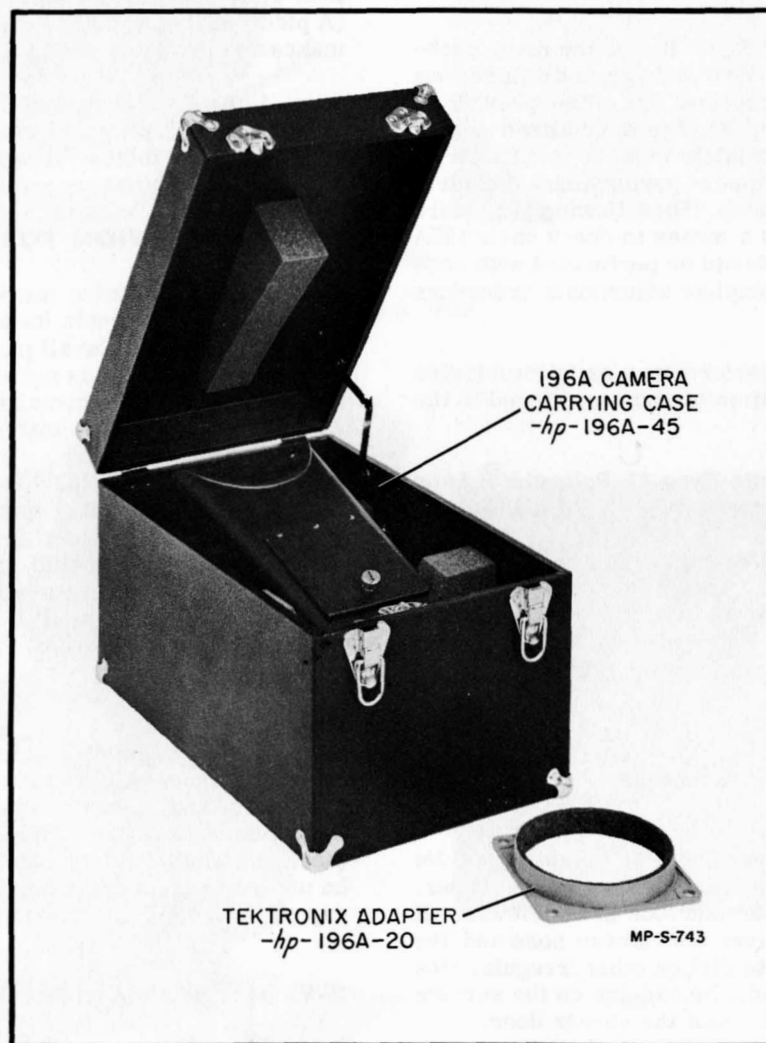


Figure 2-2. Accessories Available

SECTION III

OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. GENERAL. This section contains mounting and operating instructions for your 196A Oscilloscope Camera. Included in this section are suggestions for your use in evaluating and correcting any problems you may have in oscilloscope photography.

3-3. LENS. It is important that the lens be cleaned after use to prevent possible damage to the lens by corrosive skin acids during storage. For dust removal, a good method is either low pressure compressed air or the use of a camels' hair brush. The camels' hair brush is particularly effective if it is rubbed briskly on an article of clothing to generate a static charge, and then brushed lightly on the lens in one continuous motion. The dust should adhere to the brush when it is removed. For fingerprints or smudges, moisten the lens with the breath and wipe it clean with a piece of lens tissue. Stubborn smudges or grease spots will require a commercial lens cleaner. In any case, avoid undue pressure so as not to affect the polish of the lens.

3-4. MOUNTING INSTRUCTIONS.

3-5. The Model 196A is designed to fit all oscilloscopes using the standard 5-5/8 inch diameter bezel. The clamp ring assembly is designed to allow for variations of up to 3/4 inch in bezel depth permitting attachment to the principal types of oscilloscopes in use today. The 196A is carefully adjusted at the factory so that, when properly mounted on an oscilloscope it will be in focus on the trace. An inexpensive adapter (figure 2-2) for oscilloscopes that will not accept the 196A directly is available from your Hewlett-Packard sales office or from the factory. To mount the 196A, proceed as follows:

a. Loosen the thumbscrew on the toggle clamp and the knurled locking screws on either side of the clamp ring assembly.

b. Lift up on the thumbscrew to make sure the toggle clamp is unlocked.

c. Push the camera housing forward so that the camera nose is against the oscilloscope graticule. This is extremely important in preventing light leakage.

d. Slide the clamp ring forward to seat against the oscilloscope bezel shoulder.

e. Tighten the locking screws on either side of the clamp ring assembly.

f. Align the 196A so that the long dimension of the camera back is parallel to the sweep trace by using the edges on the viewing port as a reference.

g. Adjust the thumbscrew so that when it is pressed down to tighten the toggle clamp, the camera will be securely attached to the oscilloscope.

h. Lock the toggle clamp by pressing the thumbscrew down.

NOTE

When detaching or remounting the 196A to the same type oscilloscope, it is not necessary to loosen the locking screws or the thumbscrew. Simply lift up on the toggle clamp and remove the camera from the oscilloscope.

3-6. CAMERA CONTROLS.

3-7. GENERAL. The camera controls are described in figure 3-1. A lens access door is provided to permit easy adjustment of the aperture and shutter speed controls. Refer to paragraphs 3-15 through 3-21 for instructions concerning specific settings of all controls.

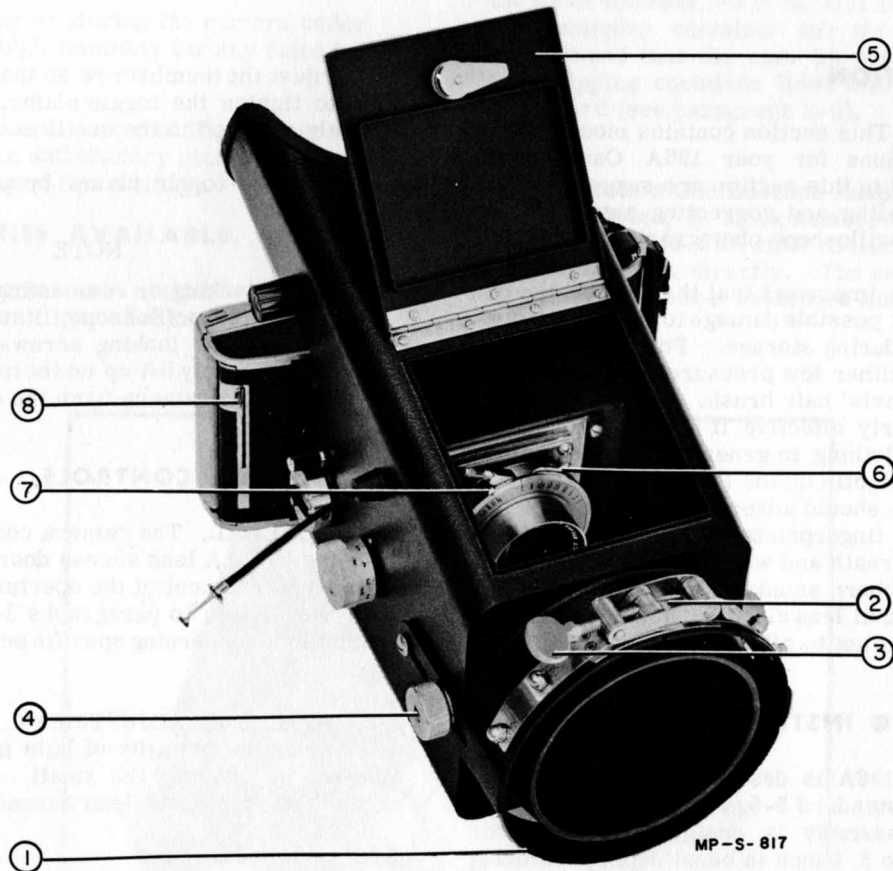
3-8. APERTURE ADJUSTMENT. This control, which determines the intensity of light falling on the film, is adjusted by moving the small, arrow-shaped lever around the edge of the lens assembly.

3-9. SHUTTER SPEED CONTROL. The shutter speed adjustment controls the length of time the shutter remains open and is adjusted by turning the knurled ring on the outer edge of the lens. In addition to automatically controlled speeds of 1/100, 1/50, 1/25, 1/10, 1/5, 1/2 and 1 second, there are two additional positions, "B" (bulb) and "T" (time). In "B" position, pressure on the shutter release will open the shutter; relieving the pressure will close the shutter. In "T" position, actuating the shutter release once will open the shutter, actuating it again will close the shutter.

3-10. SHUTTER RELEASE. There are two models of the 196A (figures 1-1 and 1-2) providing two different methods of actuating the shutter. One (Model 196A, figure 1-1) utilizes the conventional cable release system. The other (Model H01 196A, figure 1-2) utilizes a relay which may be either manually or electrically operated. Relays of several different voltage ratings are available.

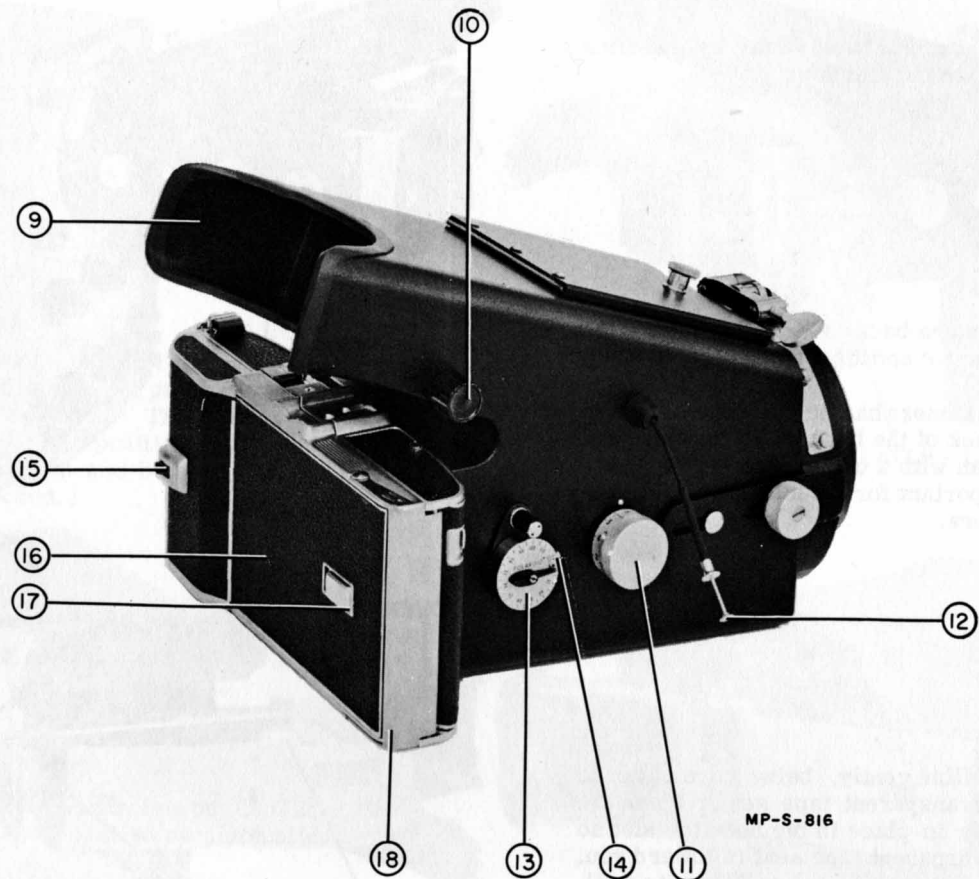
3-11. FILM LOADING.

3-12. Figure 3-2 gives complete film loading instructions. The camera may be mounted on the oscilloscope when loading the film. (For instructions on mounting the 196A on an oscilloscope, refer to paragraph 3-4.)



- | | |
|--|---|
| <p>1. Clamp Ring
Holds the camera to the oscilloscope bezel.</p> <p>2. Toggle Clamp
Holds or releases the clamp ring from the oscilloscope bezel.</p> <p>3. Thumb Screw
Adjusts the toggle clamp tension.</p> <p>4. Locking Screw
Used to lock the bezel clamp ring in the proper position. (One on each side)</p> | <p>5. Lens Access Door
Provides access to aperture and shutter speed controls.</p> <p>6. Shutter Speed Adjustment
Determines length of time shutter is open.</p> <p>7. Lens Aperture Adjustment
Determines the amount of light exposing the film at any given shutter speed.</p> <p>8. Latch Lever
Releases the camera back cover for film loading.</p> |
|--|---|

Figure 3-1. Camera Controls (Sheet 1 of 2)



- | | |
|---|---|
| <p>9. Viewer
Allows the operator to view the trace with the 196A mounted. (Closed before taking picture)</p> <p>10. Viewer Knob
Closes the viewer door.</p> <p>11. Multiple Picture Knob
Displaces the lens in relation to the film for multiple exposure.</p> <p>12. Cable Release
Actuates the shutter.</p> <p>13. Timer
Used to time the developing process.</p> | <p>14. Timer Start Button
Releases the timer.</p> <p>15. Film Release Switch
Releases the film for advancing the next frame.</p> <p>16. Picture Door
Provides access for removal of the positive print.</p> <p>17. Latch
Releases the picture door for removal of the positive print.</p> <p>18. Cutter Bar
Enables the operator to tear off the negative after the picture is taken.</p> |
|---|---|

Figure 3-1. Camera Controls (Sheet 2 of 2)

STEP 1

Unlock the camera back cover by swinging the latch lever out and down.

STEP 2

Open the camera back cover and swing out the bridge. Remove and discard the empty spool.

Note: If the camera has been used previously, wipe the back of the bridge and the two steel rollers clean with a damp cloth. This is extremely important for trouble-free operation of the camera.

STEP 3

Unroll the film gently, being careful not to break the transparent tape seal. Place the spool firmly in place in the negative slot so that the transparent tape seal is toward you. Place the positive (white) roll into its well.

STEP 4

Swing the bridge back into place.

STEP 5

Fold the leader around the steel roller. Lay the leader flat between the guides.

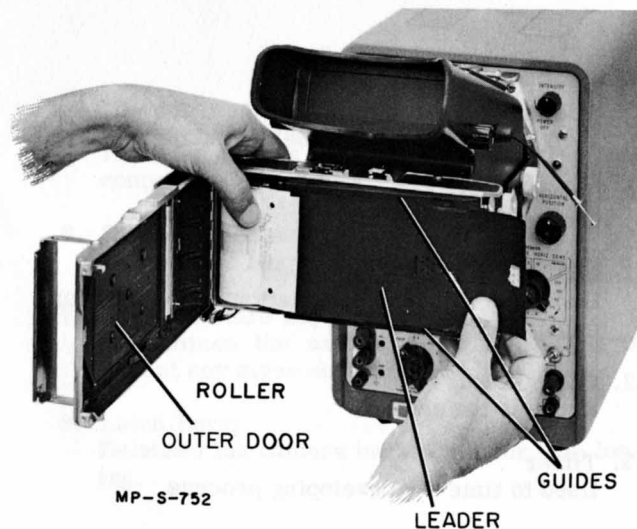
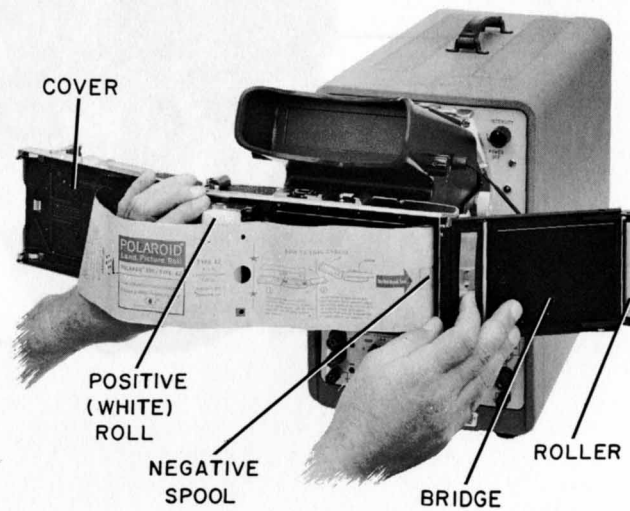
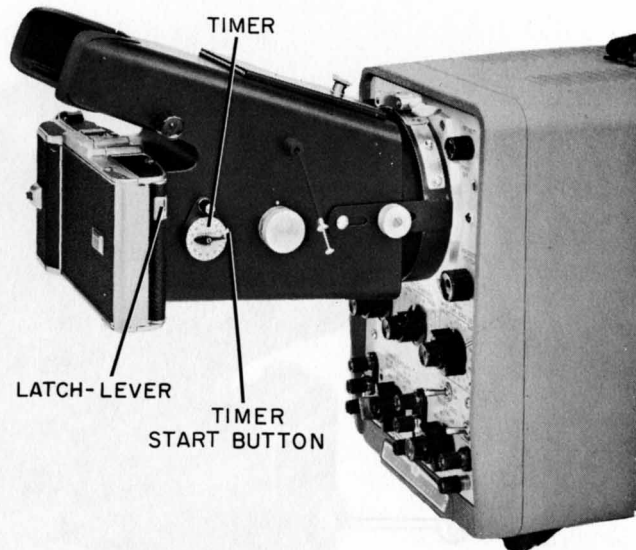
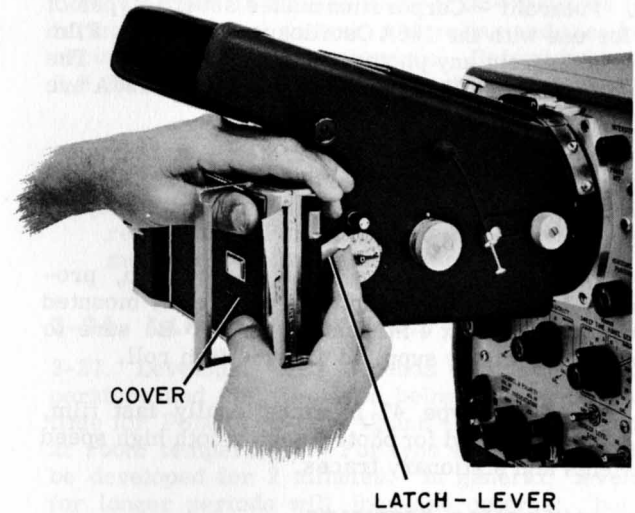


Figure 3-2. Film Loading (Sheet 1 of 2)

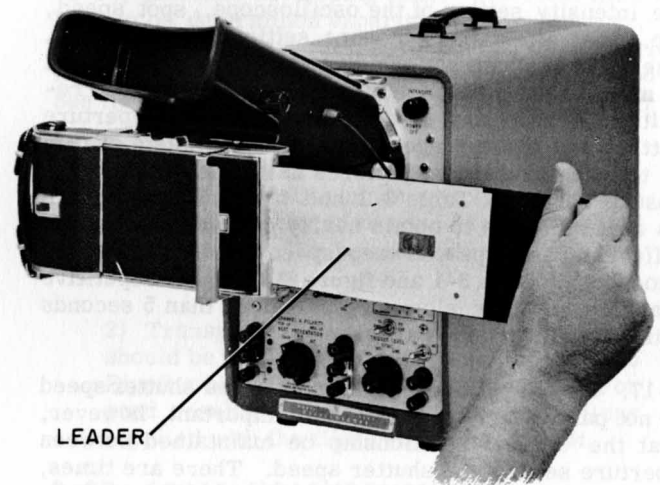
STEP 6

Close the cover.



STEP 7

Lock the cover by first swinging the latch lever down and applying pressure on the cover to engage the catch. Then swing the latch lever to the locked position. (Always be sure that both the top and bottom of the camera back are locked.)



STEP 8

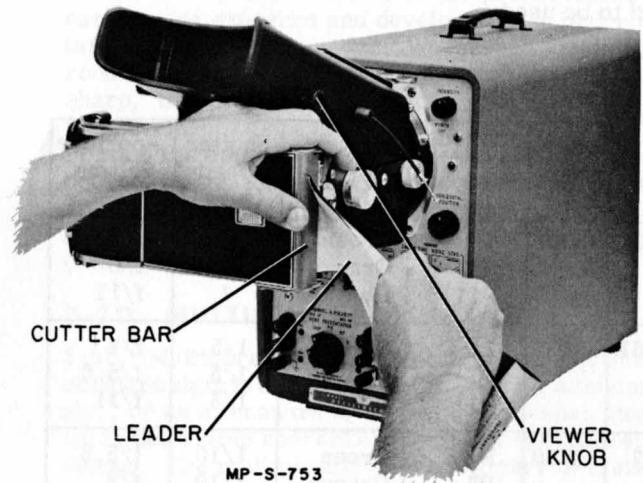
Pull the leader tab straight out until it clicks (about 14 inches) and stops automatically at the words:

STOP--PICTURE NO. 1

STEP 9

Snap the cutter bar shut, and while holding it there, tear off and discard the leader.

This completes the film loading operation.



Note: Before taking a picture, remove lens cap, and close the viewer and lens access doors.

Figure 3-2. Film Loading (Sheet 2 of 2)

3-13. FILM TYPES.

3-14. Polaroid® Corporation makes several types of film for use with the 196A Oscilloscope Camera. Film is available from any photographic supply store. The film types especially recommended for the 196A are listed below:

a. Type 42 -- A good film for steady state traces. This is the most economical film for oscilloscope photography, but it is not recommended for high speed transients.

b. Type 46L.-- This is a transparency film, producing a transparency which can be directly mounted for use as a 3-1/4 x 4 in. lantern slide. Be sure to follow all directions supplied with the film roll.

c. Type 47 -- Type 47 is exceptionally fast film, highly recommended for photographing both high speed transients and stationary traces.

3-15. EXPOSURE SETTINGS.

3-16. GENERAL. There are several variables (e.g., the intensity setting of the oscilloscope, spot speed, etc.) that affect the exposure setting of the camera. The exposure instructions given here are general, but in most cases will be sufficient to produce good results. A good way to determine the ideal aperture setting and shutter speed without undue waste of film is to take several test pictures using the multiple exposure control. Table 3-1 and figure 3-3 are given as a rough guide to obtain nearly correct settings for different film types, sweep speeds and oscilloscope phosphors. Table 3-1 and figure 3-3 are for repetitive traces only. For slow sweeps (more than 5 seconds total sweep time, see paragraph 3-19).

3-17. SHUTTER SPEED. In most cases shutter speed is not particularly critical. It is important, however, that the correct relationship be maintained between aperture setting and shutter speed. There are times, however, when shutter speed setting does become critical. The following situations dictate the shutter speed to be used:

a. When a very slow sweep speed is used. In this case the shutter must remain open to record one complete sweep and preferably five to ten sweeps if no drift or jitter is apparent.

b. When the signal contains drift or jitter. High shutter speed must be used here to reduce blurring.

c. When the signal is a non-repetitive transient (controlled or random) the camera shutter must be held open until the transient occurs.

3-18. APERTURE SETTINGS. The aperture setting, like shutter speed, is not critical except when the shutter speed is dictated by one of the conditions listed under paragraph 3-17. In that case, some specific aperture setting will be necessary in order to maintain the correct ratio between shutter speed and aperture setting. If the aperture is set between f/1.9 and f/5.6, the graticule should be exposed separately (paragraph 3-22).

3-19. Table 3-1 and figure 3-3 can be used to determine the approximate exposure settings required under varying conditions with repetitive traces. When only one sweep of a slow sweep presentation (over 5 seconds) is to be photographed, use an aperture setting of f/8 for type 47 film, and f/5.6 for type 42 film. Set the oscilloscope intensity for a sharp spot with no halo. Any point along any one diagonal line in figure 3-3 will give exactly the same exposure. Moving to any adjacent diagonal line will double or halve the exposure depending on whether you go to the right or left. To use table 3-1 and figure 3-3, proceed as follows:

- a. Decide which film type will be used (para.3-13).
- b. Determine the type of phosphor and filter on the oscilloscope.
- c. Using table 3-1, determine the basic shutter speed/aperture setting.
- d. Find the necessary oscilloscope sweep speed/cm.

Table 3-1. Basic Exposure Guide

Film Type	ASA* Index	Cathode Ray Tube		Shutter Speed (sec)	Aperture Setting
		Phosphor	Filter		
42	200	P1	Green	1	f/5.6
		P7	Orange	1	f/8
		P11	Blue	1	f/11
46L	800	P1	Green	1/5	f/4
		P7	Orange	1/5	f/5.6
		P11	Blue	1/5	f/11
47	3200	P1	Green	1/10	f/5.6
		P7	Orange	1/10	f/8
		P11	Blue	1/10	f/11

*ASA equivalent daylight exposure index

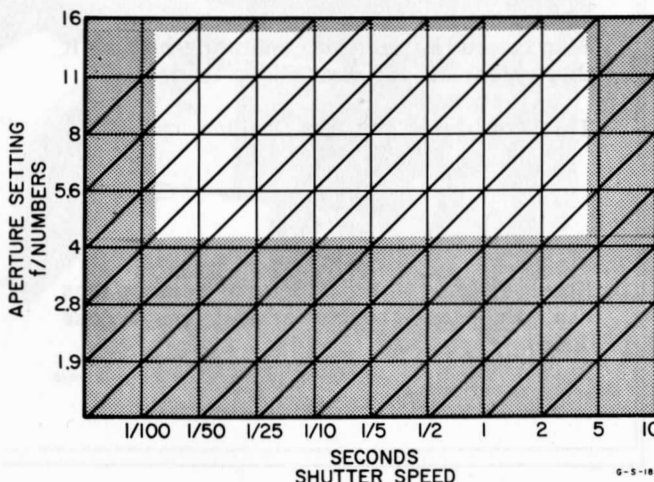


Figure 3-3. Exposure Adjustment Guide

e. Calculate total sweep time by multiplying sweep length in cm times sweep speed in sec/cm. Multiply the answer by 5 and this will be the minimum ideal shutter speed when no drift or jitter is present.

f. Find the basic aperture/shutter speed point in figure 3-3. Now go up or down that diagonal line until it intersects with the shutter speed closest to that found in step e. Follow the horizontal line at that intersection to find the new aperture setting.

3-20. INTENSITY SETTINGS.

3-21. Position your head against the 196A viewing port when making oscilloscope intensity and focus settings. A small change in intensity barely perceptible to the eye will produce the same result as changing the aperture settings two f/numbers. The intensity should be set so that no general glow or blooming is seen on the cathode ray tube. If this rule is followed, the data given in table 3-1 and figure 3-3 will prove of great help in the saving of film and time. There are specialized situations, of course, when details in fast rise times, etc., will want to be observed. In these cases, the intensity will have to be set somewhat higher.

3-22. GRATICULE EXPOSURE.

3-23. In some oscilloscopes, when using normal trace and graticule intensity, it will not be possible to illuminate the graticule enough to produce a satisfactory picture of both the trace and the graticule together. If you have this problem, there are two possible solutions:

a. Reduce the trace intensity and increase the exposure time (decrease shutter speed), leaving the graticule fully illuminated.

b. Using the exposure recommended in paragraph 3-19, take the picture of the trace with the graticule turned off. Then turn the trace intensity off and set the f/number between f/5.6 and f/16 (depending on graticule brilliance). Turn the graticule on, and expose it for about 5 seconds. This procedure is also recommended for long sweep speeds (above 5 seconds), where exposure of the graticule during sweep time would cause excessive graticule exposure.

NOTE

When an f/number below f/5.6 is used, the graticule should always be exposed separately as in part b above.

3-24. PARALLAX.

3-25. Due to the fact that the oscilloscope graticule lines are separated somewhat from the cathode ray tube phosphor, and the fact that the oscilloscope viewing angle differs from the lens angle, some parallax will exist. If it is necessary to have the trace positioned vertically in a particular area on the graticule (for making convenient scale measurements, etc.), the viewed trace will have to be offset. In most oscilloscopes, this distance is from 0.1 to 0.2 cm, that is, the viewed trace should be set 0.1 to 0.2 cm higher when viewed than it is desired on the finished print.

This distance will differ somewhat from oscilloscope to oscilloscope and from top to bottom of the graticule. Good practice is to take a few trial exposures to determine the exact amount of parallax and then keep a record of it for future reference. Refer to paragraph 5-5 for a complete description of parallax problems.

NOTE

Parallax will cause some error in scale measurements when the graticule is used as a reference. For maximum accuracy, make measurements near the picture center.

3-26. FILM DEVELOPING.

3-27. Developing time depends on the ambient temperature and the film type being used. Developing time for Polaroid® type 42 and 47 film is 10 seconds at room temperature. For type 46L, the film should be developed for 2 minutes. In general, developing for longer periods will increase contrast, but will also tend to render very faint traces invisible. When developing pictures at cooler temperatures (below 72°F), increase developing time. The ideal time will have to be determined experimentally. However, for type 47 film at temperatures around 30°F, a developing time of 40 seconds is a recommended starting point. See figure 3-4 for instructions on film developing.

NOTE

1) Polaroid prints made with type 42 and 47 film should be coated as soon as possible after exposure with the print coater supplied with each roll of film.

2) Transparencies made with type 46L film should be hardened after exposure in the #646 Dippit which is purchased separately. For good results, follow carefully all directions supplied with the film roll and the Dippit.

3-28. SCALE MEASUREMENTS.

3-29. Scale measurements on the print demand extra care during exposure and development in order to obtain maximum accuracy. Whenever possible, use reduced aperture size and long exposure to effect the sharp, thin line trace desirable. When making scale measurements using the graticule as a reference, keep in mind the limitations caused by the effects of parallax between the graticule and the oscilloscope trace. These effects can be minimized by making the scale measurements near the center of the oscilloscope presentation (see paragraph 5-5).

3-30. MULTIPLE EXPOSURES.

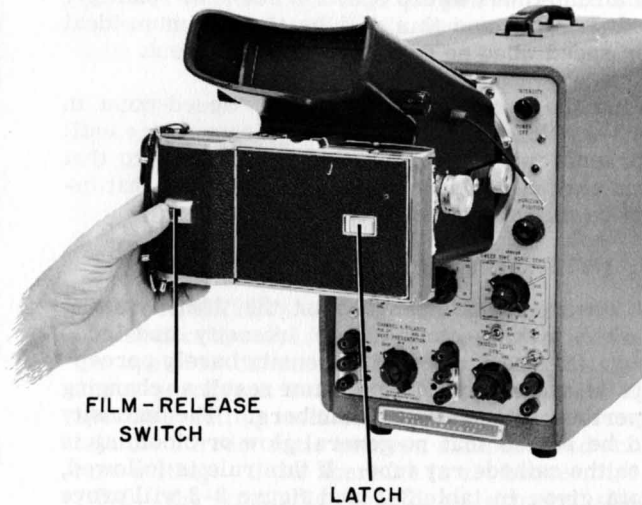
3-31. Multiple exposures are often desirable to either compare signals that differ slightly during adjustments, etc., or as a measure to conserve film when attempting to determine correct exposure for specialized conditions. The multiple picture knob (figure 3-1, sheet 2) moves the lens in relation to the camera back 1/2 cm for each of its 11 detented positions. The knob should be in the CTR position when the graticule is to be exposed. The graticule should be exposed only once during multiple exposures as explained in paragraph 3-22.

STEP 1

After making exposure(s), set the timer to the desired developing time (see paragraph 3-26). Do not start the timer until step 4.

STEP 2

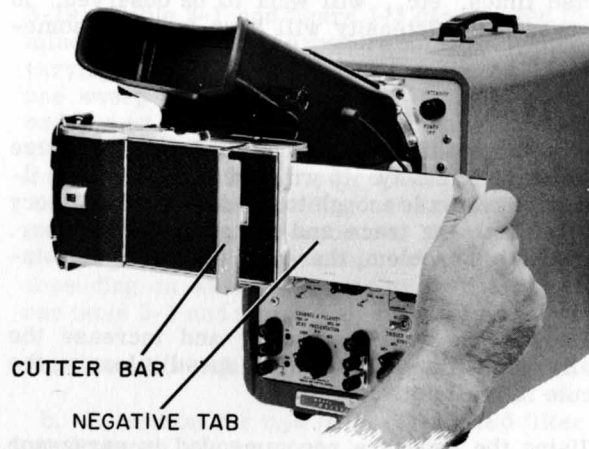
Snap the film release switch in either direction to release the film.



STEP 3

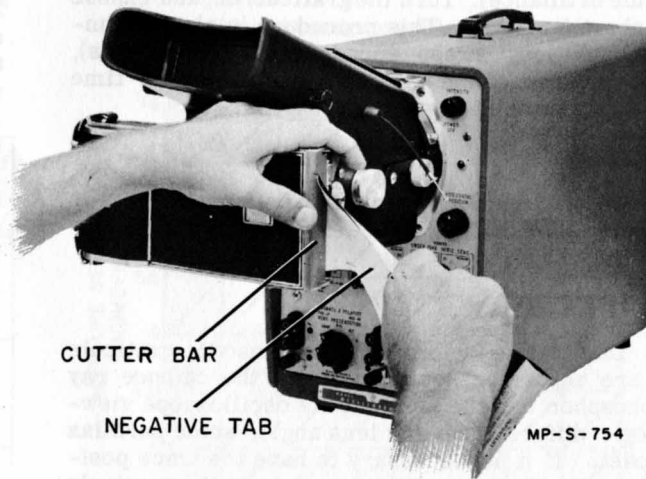
Lift the cutter bar, and pull the negative tab straight out with a steady, fairly rapid motion. Do not hesitate midway. The film advance will stop automatically. This starts the Polaroid® process, and automatically advances the film for the next exposure.

Note: Be careful not to pull the film tab on an angle. Doing so may damage the positive print (see paragraph 4-7).



STEP 4

Press the timer start button.



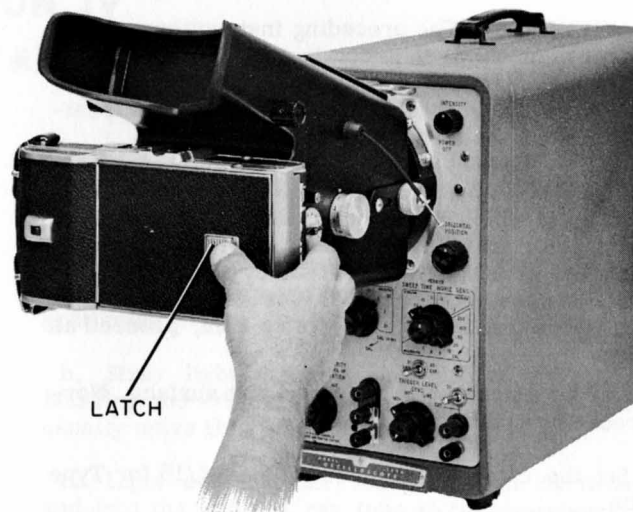
STEP 5

Hold the cutter bar down firmly with the thumb and tear off and discard the negative tab.

Figure 3-4. Film Developing (Sheet 1 of 2)

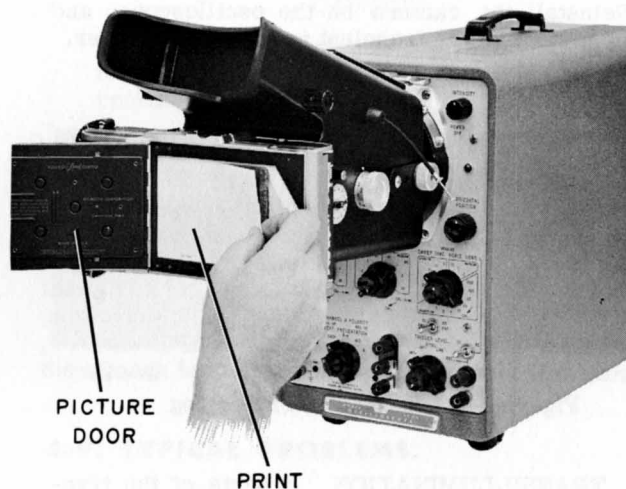
STEP 6

When the timer buzzing stops, open the picture door by sliding the latch to the left.



STEP 7

Remove the finished print starting with the cutout area on the right side of the positive print.



STEP 8

Close and lock the picture door.

STEP 9

Flatten the print by drawing it over a table edge. Coat the entire surface of the print using 6 to 8 overlapping strokes of the Print-coater supplied with each roll of film.

Note: 1) When taking transparencies (type 46L) be sure to treat them with #646 Dippit within an hour after removal from the camera. Follow directions supplied with the film and the Dippit carefully.

2) Wipe the back of the bridge and the two steel rollers clean with a damp cloth after the completion of each roll.

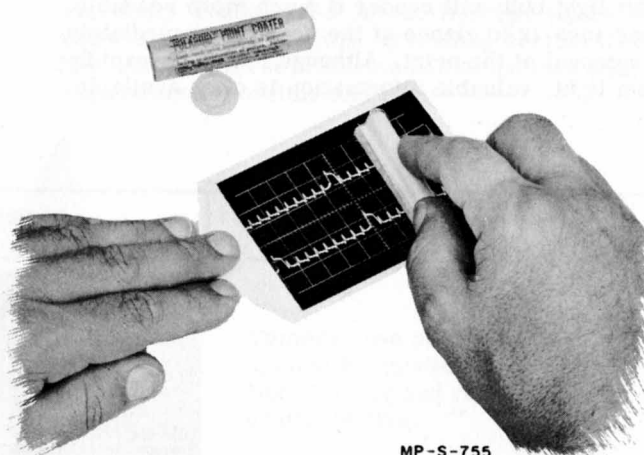


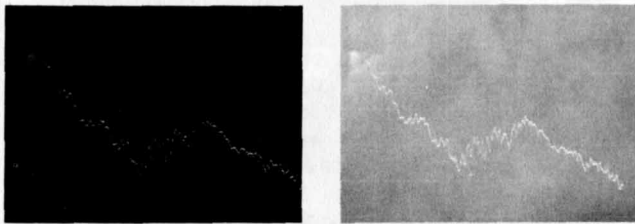
Figure 3-4. Film Developing (Sheet 2 of 2)

3-32. SPECIALIZED TECHNIQUES.

3-33. GENERAL. The preceding instructions will be sufficient in most cases to obtain good results in your oscilloscope photography. The recording of fast transients, however, will often require specialized treatment to render the trace visible.

3-34. PREFOGGING. Figure 3-5 shows the results of prefogging which is the controlled pre-exposure of the film prior to taking the actual picture. This increases the sensitivity of the film by a factor of 2 or 3, which makes this technique ideal for reproduction of high speed transients. To prefog film, proceed as follows:

- a. Lay a piece of white bond on a flat surface. Normal room light should be used.
- b. Set the camera lens for 1/100 at f/16 for Type 47 film.
- c. Hold the camera about 18 inches from the paper and actuate the shutter.
- d. Reinstall the camera on the oscilloscope, and take the picture of the transient in the usual manner.



MP-S-819

Figure 3-5. Effects of Prefogging

3-35. TRANSILLUMINATION. If parts of the transient are not readable on the print, holding it over a 100 watt light bulb will render it much more readable. Another idea is to glance at the negative immediately after removal of the print. Although it will fog rapidly in room light, valuable information is often available.

3-36. SUMMARY.

3-37. Table 3-2 gives a complete summary plus appropriate paragraph references for taking pictures with the 196A Oscilloscope Camera.

Table 3-2. Summary

Step	Procedure	Reference
1	Remove lens cap and inspect lens for dirt, smudges, etc.	par. 3-3
2	Install 196A on oscilloscope. Make sure camera nose is seated against the graticule.	par. 3-4
3	Determine the type of film needed	par. 3-13
4	Load film	fig. 3-2
5	Determine basic shutter speed/aperture setting	
6	Find required shutter speed and determine final aperture setting. Adjust these controls.	par. 3-15 to par. 3-19
7	Shut the lens access door	
8	Adjust oscilloscope intensity for comfortable viewing with no blooming. Set oscilloscope focus.	par. 3-20
9	Close viewer door and actuate shutter	
10	Develop picture for recommended time	par. 3-26 and fig. 3-4
11	Coat positive print	
12	Clean camera lens (if necessary) and replace lens cap	par. 3-3

SECTION IV PRINT EVALUATION

4-1. INTRODUCTION.

4-2. This section contains information for your use in correcting any problems you may have in oscilloscope photography. In each case, reference is made to the particular paragraph in section III that will offer more detailed instructions on how to prevent these difficulties.

4-3. FOGGING.

4-4. GENERAL. Fogging is the objectionable light area over either part of, or the whole print. Many different factors can be responsible for fogging, but in most cases they can be corrected with little difficulty. Two main causes are listed below.

4-5. INTERNAL SOURCES. Most cases of fogging stem from the oscilloscope itself. These problems can become difficult to control when time exposures are necessary. Some of the most common faults are given below.

a. Excessive brilliance can cause a general blooming of the trace which tends to light the entire screen. This can be easily corrected by lowering the oscilloscope intensity.

b. Low frequency light emitted from the cathode on an un-aluminized tube can cause considerable fogging, especially on time exposures. A blue filter placed either over the camera lens or on the graticule will be of some help for this type of fogging.

c. An unblanked oscilloscope can cause trouble, especially if it is being used for recording transients, since the spot remains visible until the transient occurs. This problem can be minimized by positioning the spot to a point just under the edge of the bezel, or if the bezel does not cover the edge of the cathode ray tube, the spot may be masked with a piece of tape.

4-6. LIGHT LEAKAGE. Light leakage is another cause of film fogging. Some common sources are listed below.

a. Improper mounting (paragraph 3-4) which does not permit the camera nose to seat tightly against the graticule.

b. Stray light entering the edge of the graticule. Masking the edge of the graticule with black tape will usually solve this problem.

c. Light entering the louvers of the oscilloscope and into the cathode ray tube to the phosphor. This is a more difficult problem, and is probably best solved by reducing the ambient light.

CAUTION

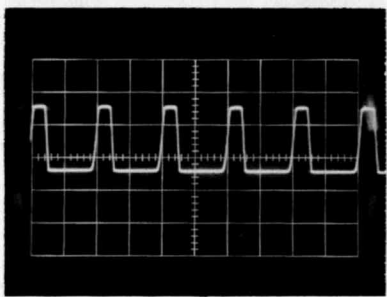
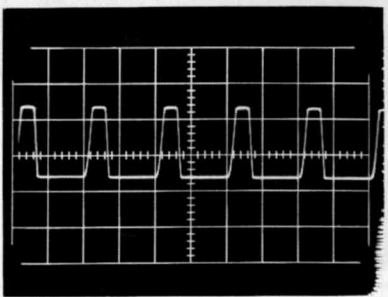
If black cloth shielding is ever used, be careful not to cut off the air circulation to the oscilloscope.

4-7. FILM TEARING.

4-8. Film damage due to tearing is usually caused by not pulling the negative tab straight while advancing the film. The tab should always be pulled in a straight line parallel with the long axis of the camera back. This procedure, in addition to care in keeping the inside of the camera back clean will prevent most film damage.

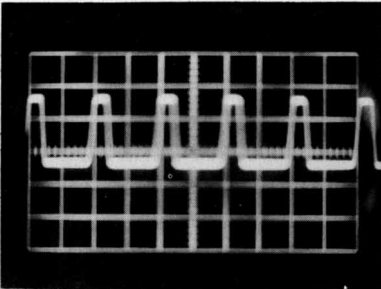
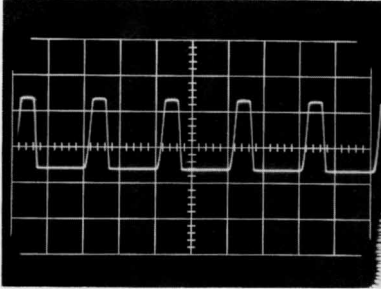
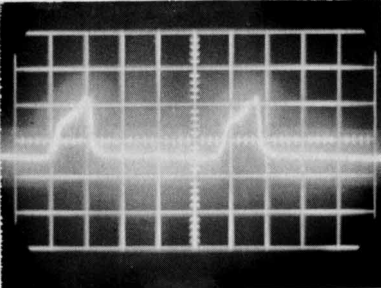
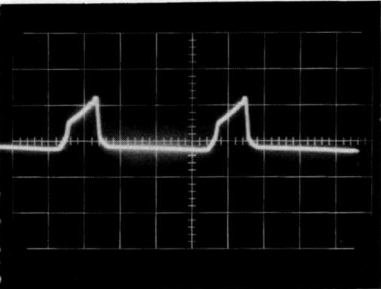
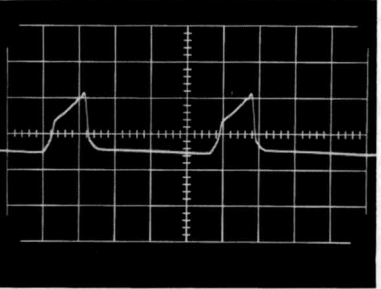
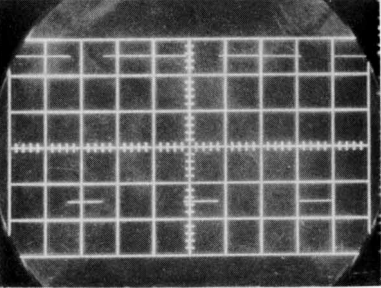
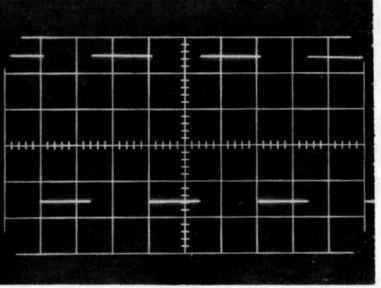
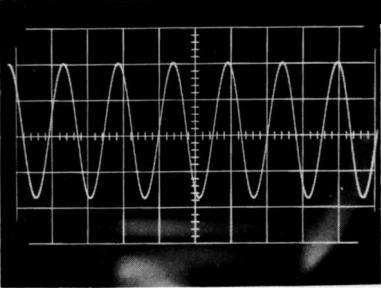
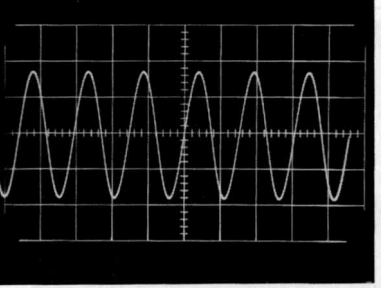
4-9. TYPICAL PROBLEMS.

4-10. Figure 4-1 illustrates many of the problems commonly encountered in oscilloscope photography. You will probably find that by reading section III carefully, many of these problems can be avoided with subsequent saving of time and film.

Picture Received	Picture Desired	Cause	Refer to Paragraph
		<p>Camera nose not mounted against the graticule. Note fogging and reduced graticule size.</p>	<p>3-4</p>

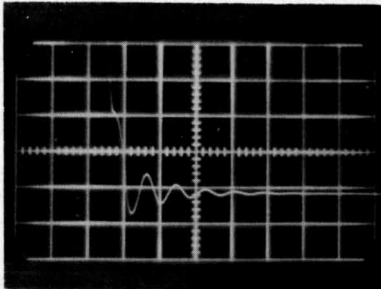
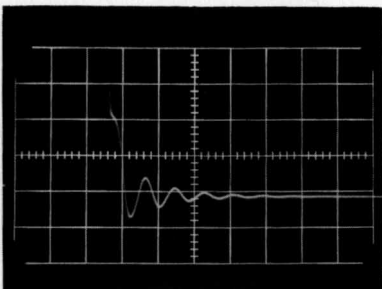
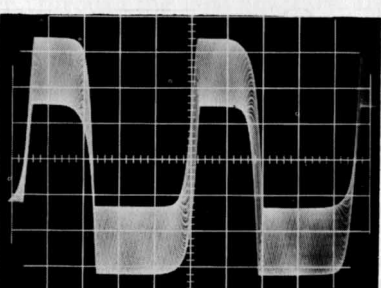
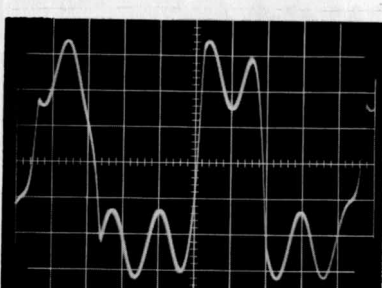
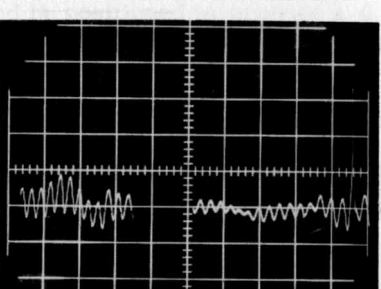
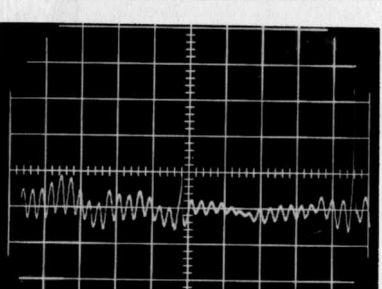
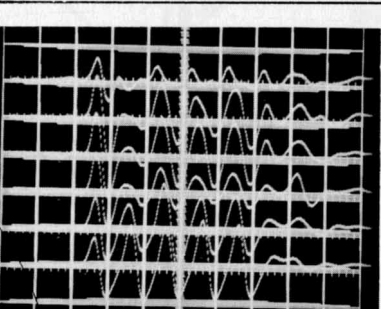
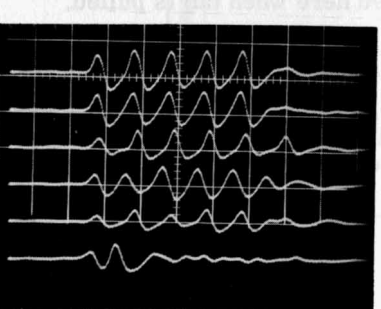
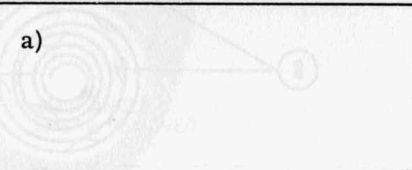
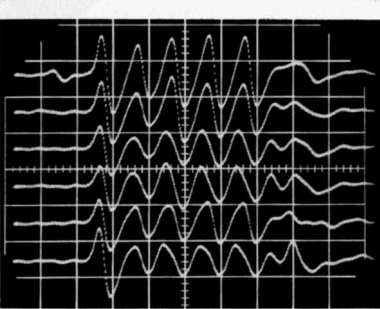
G-E-41

Figure 4-1. Print Evaluation (Sheet 1 of 3)

Picture Received	Picture Desired	Cause	Refer to Paragraph
		<p>Camera nose not mounted against graticule glass, and picture taken at low f/number.</p>	<p>3-4 & 3-18</p>
<p>a)</p>   <p>b)</p>		<p>a) Brilliance too high on both graticule and trace.</p> <p>b) Note deliberate under-exposure of same trace resulting in lack of detail.</p>	<p>3-20</p> <p>3-20</p>
		<p>Excessive graticule exposure caused by leaving graticule on during 8 second exposure of 0.5 cps square wave.</p>	<p>3-22</p>
		<p>Viewer port or lens access door left open.</p>	<p>Fig. 3-2 and Table 3-2</p>

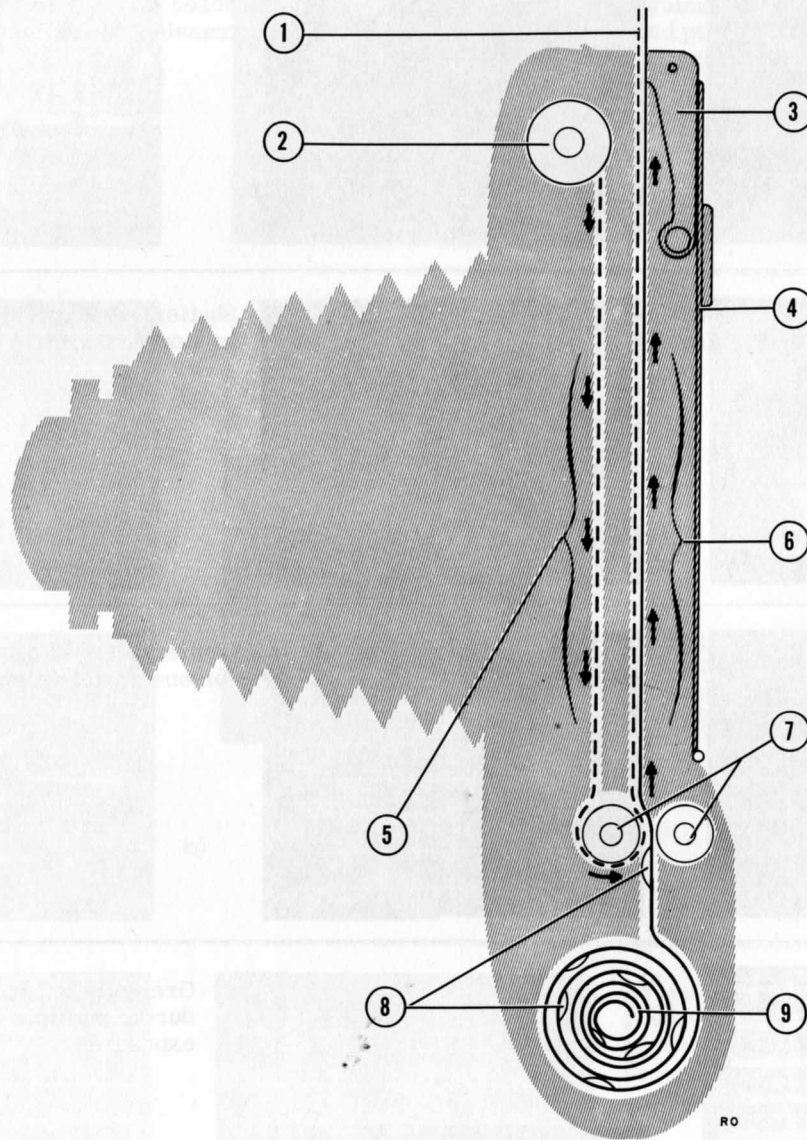
G-E-41

Figure 4-1. Print Evaluation (Sheet 2 of 3)

Picture Received	Picture Desired	Cause	Refer to Paragraph
		<p>Graticule and trace exposed together for fast transient at low f/number.</p>	<p>3-22 & 3-18</p>
		<p>Shutter speed too slow to stop drift.</p>	<p>3-17</p>
		<p>Shutter not held open for one complete sweep.</p>	<p>3-17</p>
 	<p>a)</p>   <p>b)</p>	<p>a) Graticule left on during multiple exposures.</p> <p>b) Graticule exposed with lens detent knob in the UP position instead of CTR.</p>	<p>3-22 & 3-30</p> <p>3-22 & 3-30</p>

G-E-41

Figure 4-1. Print Evaluation (Sheet 3 of 3)



1. Negative tab is pulled out and discarded.
2. Film roll.
3. Cutter bar.
4. Picture Door -- for removing positive print.
5. Film is exposed here.

6. Film is developed here when tab is pulled.
7. Rollers -- for spreading the developing reagent.
8. Pods of developing reagent -- for development of subsequent pictures.
9. Positive paper roll.

Figure 5-1. Camera Operation

SECTION V THEORY OF OPERATION

5-1. GENERAL.

5-2. The 196A Oscilloscope Camera uses Polaroid photography to record oscilloscope traces permanently on film. It has been designed to solve the problems involved with close up photography and low light levels. As in any other camera, a light source (the cathode ray tube) emits light which passes past the open shutter, through the lens aperture and onto the film. The negative is developed simultaneously with the positive using the Polaroid® Land process, and the print is removed from the back of the camera.

5-3. LENS.

5-4. The 196A uses a Wollensak Raptar f/1.9 lens with a focal length of 75 mm (focal length is basically the distance from the effective center of the lens to the image plane when the object viewed is at infinity). The lens has been especially corrected for use in oscilloscope photography to give minimum distortion, and is positioned to produce a 0.9:1 image to object ratio so that the full 10 cm wide oscilloscope graticule may be viewed on the 9.7 cm film. This is accomplished by making the effective distance from the lens to the film 0.9 of that from the lens to the oscilloscope trace. The lens may be adjusted on a line between the

film and the graticule to give a 1:1 image to object ratio. See paragraph 6-13 for an explanation and procedure for making this adjustment. The lens is also movable on a vertical plane parallel with the film to allow multiple exposures to be taken. An external control with 11 detented positions is provided for this adjustment.

5-5. PARALLAX.

5-6. Since the graticule lines are separated somewhat from the cathode ray tube phosphor in an oscilloscope, parallax problems will exist in oscilloscope photography. Parallax effects in the 196A come from two sources:

a. Those caused by the difference between the viewing angle (with the camera installed) and the straight on viewing angle with the camera off (figure 5-3, inserts C and A).

b. That caused by the difference in viewing angles between the camera lens and the eye, with the camera off (figure 5-3, inserts B and A).

5-7. The two effects interact to give the following typical results: An oscilloscope trace viewed with the

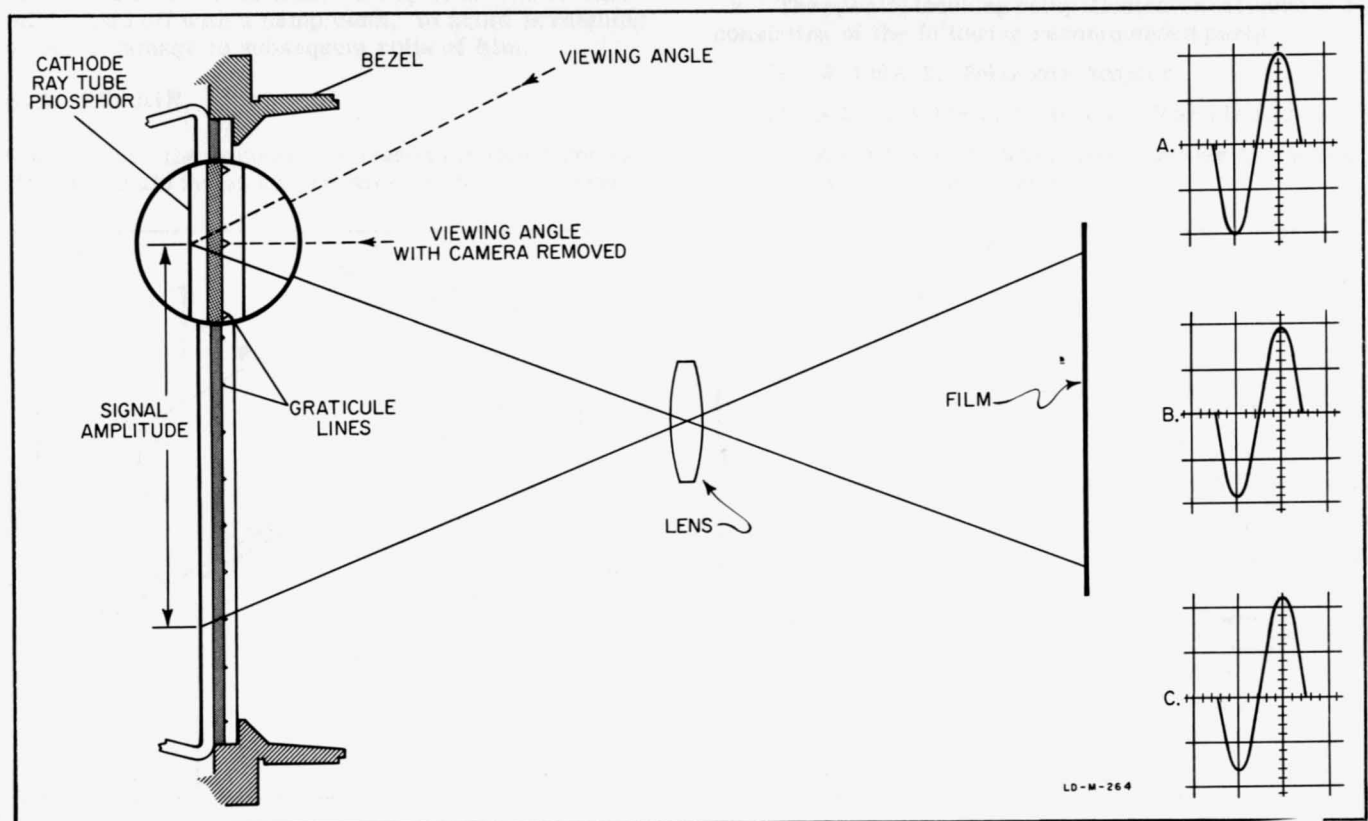


Figure 5-2. Parallax Effects

camera off (figure 5-3, insert A) will look like insert C with the camera in place, and will produce a picture on the film as in insert B. Parallax problems can be minimized by positioning the cathode ray tube against the oscilloscope bezel.

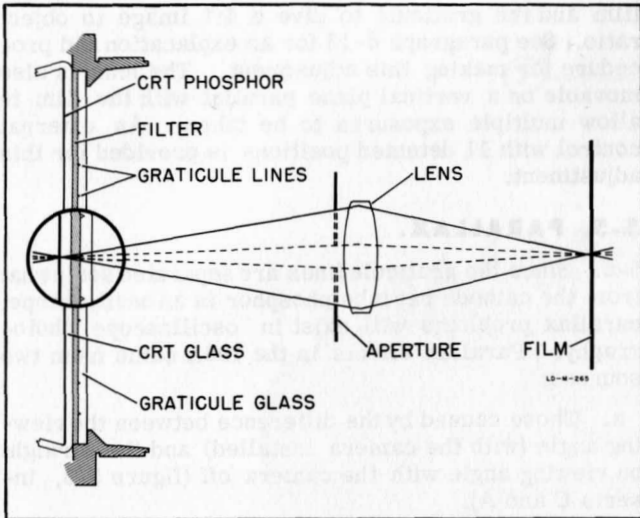


Figure 5-3. Aperture Effects on Depth of Field

5-8. DEPTH OF FIELD.

5-9. GENERAL. Depth of field (the range of object distances within which the image formed by the lens

on the film will be in focus) depends to a great extent on the aperture setting of the camera. In cases where it is important that both the graticule and the trace be in perfect focus, depth of field must be considered.

5-10. APERTURE EFFECTS. Aperture, the actual diameter of the lens opening, is described in terms of f/number which is the relationship between the focal length and the apparent diameter of the lens ($f/\text{number} = f/d$, when f = focal length of the lens and d = the apparent diameter of the lens). Figure 5-3 shows a typical oscilloscope bezel and demonstrates the effect of aperture size on depth of focus and depth of field. It should be fairly apparent from examination of figure 5-3 that because of the cathode ray tube phosphor and graticule separation, the aperture must be closed somewhat in order for both the graticule and the trace to be in focus at the same time. In the 196A, the aperture must be set to about $f/5.6$ or smaller (f/number 5.6 or higher) for both the graticule and trace to be in focus.

5-11. FILM PROCESSING.

5-12. After the film has been exposed, the operator pulls the negative tab on the right side of the camera. Rollers (figure 5-1) force the negative and the positive sheet together, breaking pods of developer (one for each exposure) and spreading this reagent between the negative and the positive sheet. After the developing period, the back access door is opened and the positive print is removed. The film meanwhile, has been automatically advanced one frame, and is ready for the next exposure.

SECTION VI

REPAIR AND ADJUSTMENT

6-1. MAINTENANCE.

6-2. **LENS.** With the exception of occasional cleaning, the lens should need no special maintenance. It is important, however, that the lens be cleaned after use. Refer to paragraph 3-3 for instructions on lens cleaning. The lens and shutter assembly are warranted for one year by Wollensak Optical Company, 850 Hudson Avenue, Rochester 21, New York. The lens should be returned to your Hewlett-Packard sales office or to the factory for service. In cases of emergency, consult the yellow pages in the telephone directory for Wollensak field repair service in your area. It is desirable that the lens be returned to its original camera since any other lens may require a focusing adjustment.

6-3. **CAMERA LUBRICATION.** No regular lubrication of any of the parts in the 196A is required. However, if there is noticeable binding in the lens guide or lens detent mechanism (figure 6-3, numbers 7, 9, and 10), a small amount of a lubricant such as Lubriplate should be applied.

6-4. **FILM HOUSING CLEANING.** The whole inside of the film housing should be inspected after each roll of film to see if any of the jellied reagent was spilled during the last roll of film. If so, it should be carefully wiped off with a damp cloth, to avoid scratching or other damage to subsequent rolls of film.

6-5. REPAIR.

6-6. Unless the camera is damaged through dropping, etc., it should require no repairs. However, if reason

for repair does occur, refer to figure 6-3 for the disassembly and assembly order of all parts. When ordering replacement parts, refer to figure 7-1 and the parts list.

CAUTION

The camera back is an integral assembly supplied by Polaroid Corporation. Field repair of this unit should not be attempted. If the camera back or the lens washers are loosened, the 196A will need complete re-adjustment using the special equipment listed in paragraphs 6-9 and 6-11. If malfunction is suspected, it would be a good idea to first complete the operational check in paragraph 2-3.

6-7. ADJUSTMENT.

6-8. **GENERAL.** The remainder of this section is devoted to refocusing and image-to-object ratio change procedures. These adjustments require special care and equipment and should not be attempted unless they become absolutely necessary.

6-9. SPECIAL EQUIPMENT REQUIRED.

6-10. In order to complete the following procedures, the following special equipment is required:

a. The special focusing setup illustrated in figure 6-1 consisting of the following recommended parts:

- (1) Φ 196A-20 Tektronix Adapter
- (2) A 6 x 6 x 1/8 inch piece of clear plexiglass
- (3) A 6 x 6 x 1/16 inch piece of amber plexiglass that has lines scribed on it

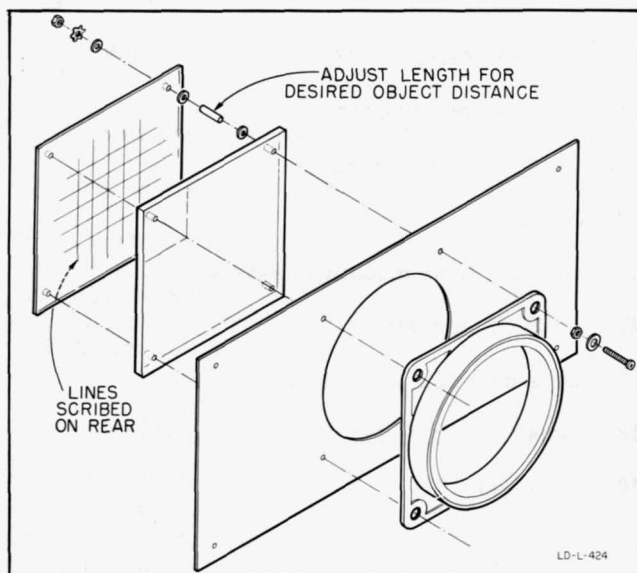


Figure 6-1. Special Focus Setup

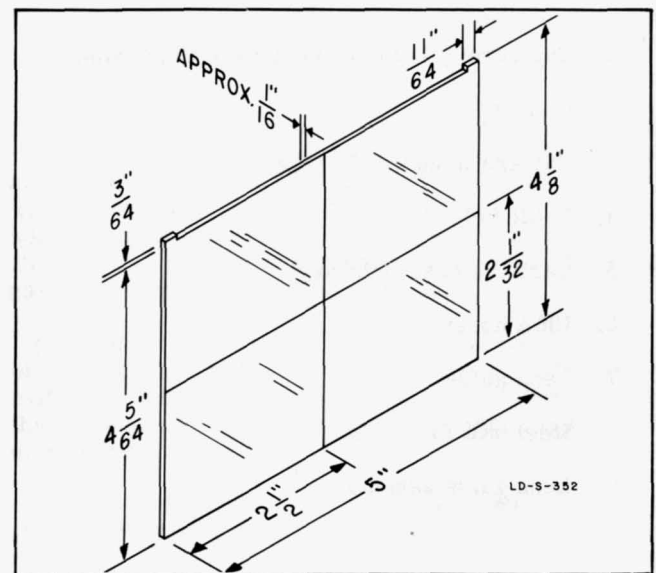
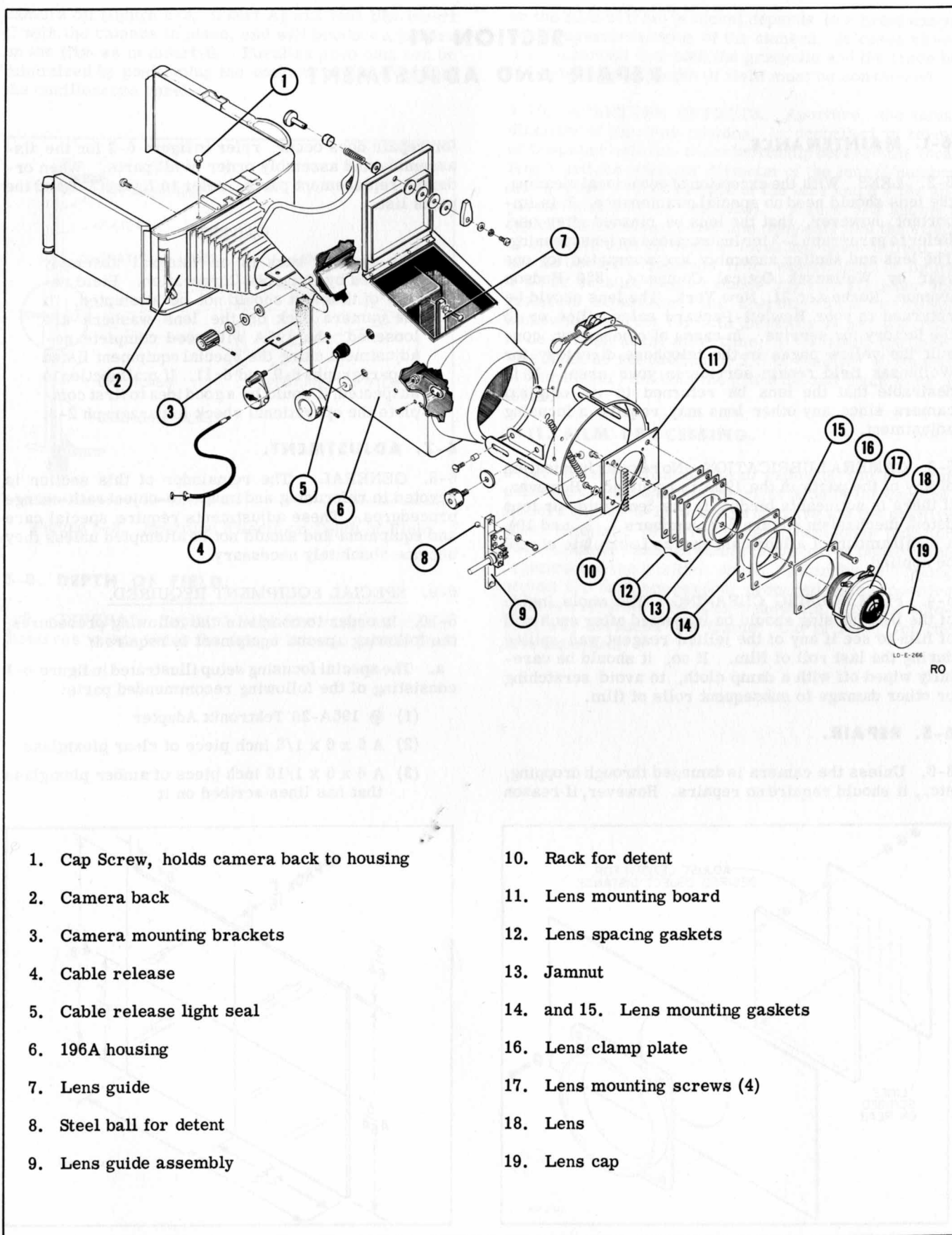


Figure 6-2. Lens Centering Plate



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- 1. Cap Screw, holds camera back to housing
- 2. Camera back
- 3. Camera mounting brackets
- 4. Cable release
- 5. Cable release light seal
- 6. 196A housing
- 7. Lens guide
- 8. Steel ball for detent
- 9. Lens guide assembly

- 10. Rack for detent
- 11. Lens mounting board
- 12. Lens spacing gaskets
- 13. Jamnut
- 14. and 15. Lens mounting gaskets
- 16. Lens clamp plate
- 17. Lens mounting screws (4)
- 18. Lens
- 19. Lens cap

Figure 6-3. Exploded View, Maintenance

- (4) A 7 x 15 in. (approximately) piece of 14-gauge aluminum that has been drilled for mounting with the Tektronix adapter (see figure 6-2)
- (5) Four #8 spacers; length determined by the desired object distance
- (6) Sixteen 1/4 in. ID x 9/16 in. OD flat washers
- (7) Four #8 external lockwashers
- (8) Four #8 x 1 in. phillips screws.

b. The special frosted plexiglass lens centering plate shown in detail in figure 6-2; all dimensions should be watched carefully.

6-11. TEST EQUIPMENT.

6-12. The following equipment is required to complete all adjustments in the following paragraphs. An alternate refocusing procedure requiring less specialized equipment is given in paragraph 6-18.

- a. Approximately seven (6 to 10) additional lens spacing gaskets (Ⓜ stock number 0905-0035).
- b. A three-power magnifying glass.
- c. The special refocusing setup described in paragraph 6-9 and figure 6-1.
- d. The special frosted plexiglass lens centering plate illustrated in figure 6-2.
- e. A 1/4-in. box wrench (Proto #1208 or equivalent).
- f. An oscilloscope, suitable for use with the 196A, with a graticule that can be illuminated.
- g. Audio signal generator such as Ⓜ Model 200CD or equivalent.
- h. A "stubby" phillips screwdriver (3-1/2 inch total length).
- i. Photographic ground glass plate, 4 x 5 inches.
- j. Four #8 x 1 inch phillips head screws.
- k. A centimeter scale.
- m. Square-wave generator (if oscilloscope does not have an internal square-wave calibrate signal), such as Ⓜ Model 411 or equivalent.

6-13. CHANGING THE IMAGE-TO-OBJECT RATIO.

6-14. GENERAL. The 196A is normally furnished with an image-to-object ratio of 0.9-to-1, since this allows a 10 cm wide graticule to be displayed on the 9.7 cm film. On special order, however, the 196A may be purchased with an image-to-object ratio of 1-to-1 without sacrificing any of the multiple picture provisions. The following procedure is given for your

convenience in making this change in the field. It is not always absolutely necessary to readjust the focus after this adjustment, although for very critical work readjustment is recommended (see paragraph 6-16).

6-15. PROCEDURE. To change the image-to-object ratio proceed as follows:

a. Detach the cable release from the shutter mechanism by unscrewing the knurled section of the cable release in a counterclockwise direction.

b. Remove the lens by unscrewing it in a counterclockwise direction. Place it on a clean surface with the lens cap on.

c. Unscrew the four screws that hold the lens clamp plate to the lens mounting board (figure 6-4). Leave the screws sticking through the lens mounting gaskets to help hold the whole assembly in one piece.

CAUTION

Do not disturb the placement order of the gaskets when they are removed. Place the gaskets and the lens jamnut as a group on a flat, clean surface.

d. Add seven of the lens spacing gaskets to the four gaskets already on the camera. Place the new gaskets between the first and second gaskets, counting from the lens mounting board (figure 6-4).

e. Using the four #8 x 1 inch screws, place the whole jamnut and lens gasket assembly back on the lens mounting board. Turn the screws until they just seat; do not tighten them yet.

CAUTION

Make sure the lens mounting gaskets (numbers 14 and 15 in figure 6-3) are kept next to the lens clamp plate to avoid warping of the lens mounting board.

f. Screw the lens into the jamnut until the jamnut begins to turn. Continue turning the lens and jamnut assembly until the $f/1.9$ notation on the lens lines up with the multiple picture shaft (until the cable release socket points toward the hole in the camera housing). Tighten the screws somewhat to compress the lens gaskets. Replace the cable release.

g. Connect a square wave source to the vertical input of the oscilloscope, and set sweep speed so that each half cycle is exactly 1 cm wide (the vertical portions of the trace are 1 cm apart) when viewed with the camera unmounted.

h. Mount the camera on the oscilloscope as per instructions in paragraph 3-4.

i. Open the camera cover and bridge and place the special plexiglass lens centering plate on the film plate. Be sure to place the frosted side toward the lens.

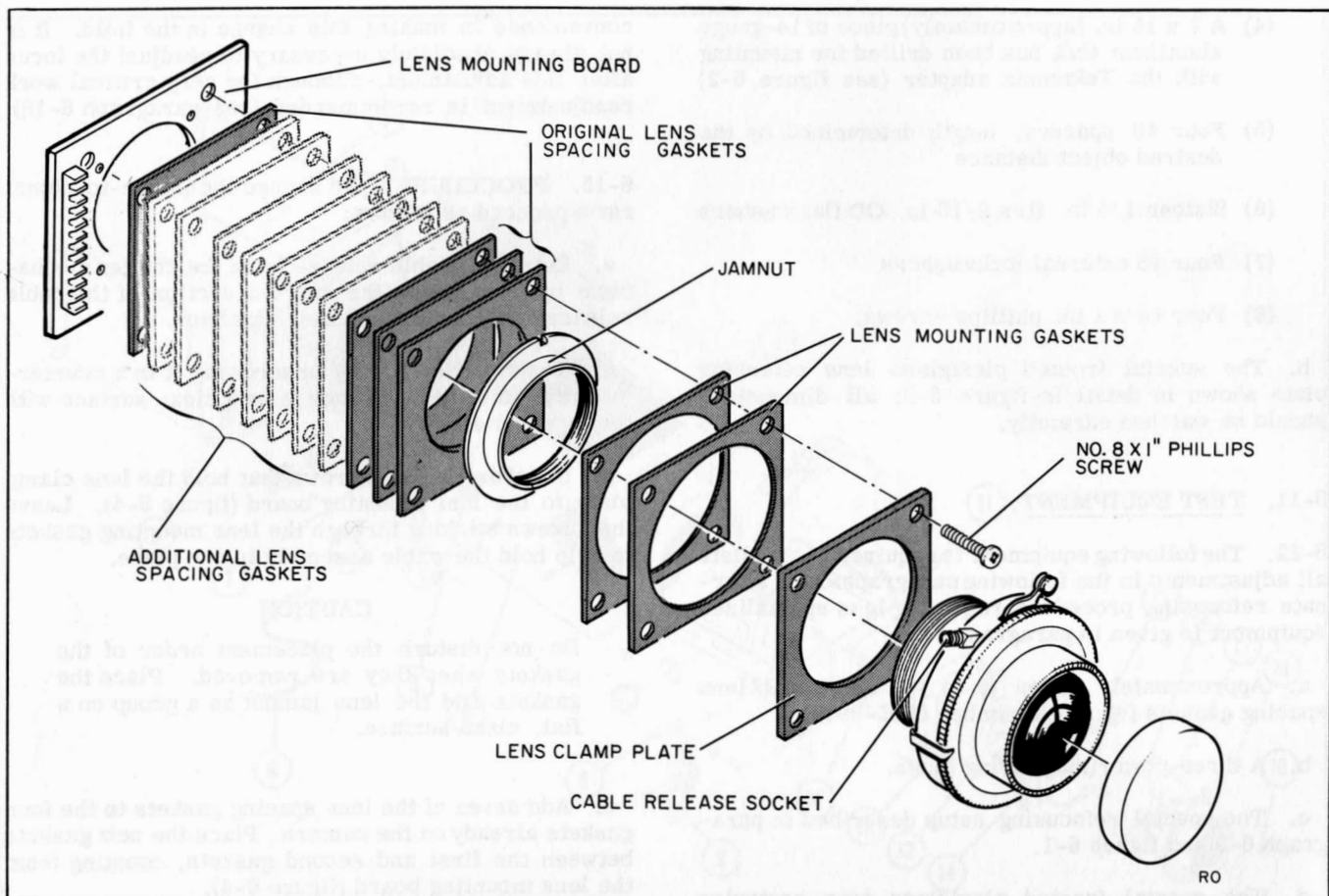


Figure 6-4. Image-to-Object Change Detail

j. Turn on the oscilloscope graticule to full brilliance and either reduce room lighting or place a black cloth over both your head and the camera. Adjust the oscilloscope brilliance until the trace can be easily seen on the frosted plate.

NOTE

1) Due to the separation between the graticule and the oscilloscope phosphor, the square wave will now appear shorter horizontally than the graticule. This is caused by parallax (paragraph 5-5).

2) Note that the graticule will not be in focus. This is because of the poor depth of focus with the large lens opening (paragraph 5-8). This will have no effect on the accuracy of the following adjustment.

k. Since, due to parallax, the oscilloscope presentation and the graticule as seen on the plexiglass plate will be a different horizontal size, you will have to decide whether you want the graticule or the oscilloscope presentation to be a perfect 1-to-1 ratio.

m. Measure the desired presentation with a centimeter scale. If a 1-to-1 ratio is desired, the lines

should be exactly 1 cm apart. If they are closer together than that, more lens gaskets must be added to correct the ratio. If the lines are wider than that, then one or more gaskets will have to be removed. In either case, steps a through k will have to be repeated until the desired ratio has been attained.

n. Working through the lens access door and using the stubby screwdriver, loosen the lens mounting screws just enough to allow a hindered movement of the lens-jamnut assembly.

p. Move the lens until the center of the graticule lines up with the cross hairs on the plexiglass plate.

q. Tighten the lens mounting screw evenly, working around the lens several times.

6-16. REFOCUSING.

6-17. GENERAL. The 196A Oscilloscope Camera is prefocused at the factory on a plane 3/8 inch from the camera nose, which is the standard combined thickness of the graticule, filter and cathode ray tube glass. Unless the camera has been dropped, or a non-standard lens-to-object distance is desired, the camera should never need refocusing. An alternate

focusing procedure, using less specialized equipment is given in paragraph 6-19.

NOTE

A change in lens-to-object distance from the normal distance of 3/8 inch from the camera nose will cause a change in image-to-object ratio. If it is desired to bring this ratio to an exact value refer to paragraph 6-13.

6-18. PROCEDURE. If malfocus is suspected, first check to see that the cathode ray tube is positioned against the graticule. If the focus still seems bad, perform the incoming check given in paragraph 2-3. It is extremely important that these factors be checked first, since refocusing is a difficult procedure. To refocus the 196A, proceed as follows:

a. Mount the camera on the special setup described in paragraph 6-9 and figure 6-1. Make sure the camera nose is against the plexiglass. The 100-watt diffused light source should be mounted so it shines through the amber plexiglass.

b. Set the aperture to f/1.9 and the shutter speed to "T".

c. Actuate the cable release once (the shutter should now be open).

d. Open the camera cover and bridge and place the piece of ground glass in the focal plane.

NOTE

Make sure the frosted side is toward the lens.

e. Turn on the diffused light source.

f. Using the 1/4-inch box wrench, loosen the four camera mounting screws (number 1 in figure 6-3).

g. Using the magnifying glass, look at the presentation on the ground glass in the upper left-hand corner. Move the camera-back slightly to find the area of best focus for that corner.

h. Tighten the camera mounting screw over that corner until it is just snug.

i. Now check the area in the right-hand bottom of the glass. Again, move this corner until it is in good focus. Recheck the upper left-hand corner to make sure it is still in focus.

j. Tighten the right-hand bottom camera mounting screw until it is just snug.

k. Check the bottom left and the upper right corners. If they are not in focus, rock the camera-back from upper right to bottom left slightly to find the area of best focus.

m. Recheck the focus on all four corners and tighten all four camera mounting screws securely.

6-19. ALTERNATE PROCEDURE. The following is an alternate procedure for resetting focus using less specialized equipment.

NOTE

This procedure should be used only to provide temporary settings until a more accurate setting is obtained using the procedure and equipment similar to that in paragraph 6-18.

a. Mount the 196A on an oscilloscope having the desired object distance.

b. Connect a 10 kc sine wave to the vertical amplifier, and adjust the sweep length so that there are four to six cycles per centimeter.

c. Set the aperture to f/1.9 and the shutter speed to "T." Actuate the cable release. The shutter should now be open.

d. Open the outer and inner doors and place the plexiglass or ground glass on the image plane.

NOTE

Make sure the frosted side is toward the lens.

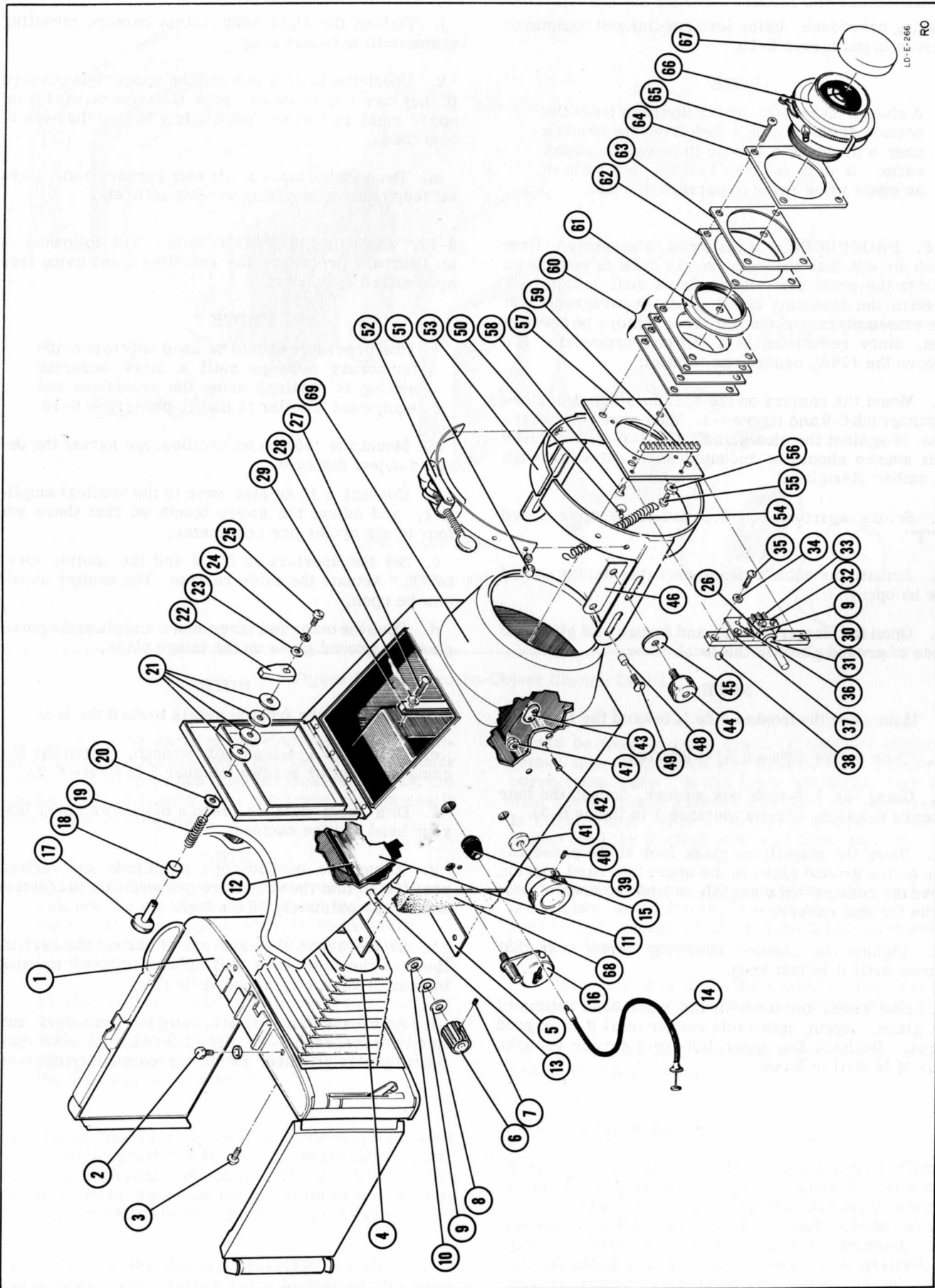
e. Using the 1/4-inch box wrench, loosen the four camera mounting screws (number 1 in figure 6-3).

f. Dim room light or place a black cloth over both your head and the camera.

g. Adjust the oscilloscope amplitude and vertical position so that the sine-wave presentation is centered and is approximately 10 cm high.

h. In the areas that are out of focus, the vertical lines of the sine wave will appear to "run" together instead of appearing as separate lines.

i. Adjust the camera back, using the procedure outlined in paragraph 6-18, steps f through m, until optimum focus is attained. Do not use the magnifying glass.



LD-E-266
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Figure 7-1. Exploded View, Replaceable Parts

SECTION VII REPLACEABLE PARTS

7-1. INTRODUCTION.

7-2. This section contains information for ordering replacement parts for the 196A Oscilloscope Camera.

7-3. Figure 7-1 is an exploded view of the 196A including numbered designators that are used for reference in table 7-1. Detailed information for parts used more than once in the instrument will be given opposite the first listing of that part. Detailed information in table 7-1 includes the following:

- a. Figure 7-1 reference number.
- b. Full description of the part.
- c. Manufacturer of the part in a five-digit code; see list of manufacturers in appendix.
- d. Hewlett-Packard stock number.
- e. Total quantity used in the instrument (TQ col).
- f. Recommended spare quantity for complete maintenance during one year of isolated service (RS col).

7-4. ORDERING INFORMATION.

7-5. To order a replacement part, address order or inquiry either to your authorized Hewlett-Packard sales office or to

CUSTOMER SERVICE
Hewlett-Packard Company
395 Page Mill Road
Palo Alto, California,

or, in Western Europe, to

Hewlett-Packard S. A.
Rue du Vieux Billard No. 1
Geneva, Switzerland.

7-6. Specify the following information for each part:

- a. Model and complete serial number of instrument.
- b. Hewlett-Packard stock number.
- c. Figure 7-1 reference number.
- d. Description.

7-7. To order a part not listed in table 7-1, give a complete description of the part and include its function and location.

Table 7-1. Replaceable Parts (Sheet 1 of 3)

Ref. Figure 7-1	Description	Mfr	Stock No.	TQ	RS	
1	Camera (less lens)	47904	1000-0004	1	0	
2	Screw, cap, hexagonal, stainless steel, 8-32 x 3/8", 1/4" across flats		0570-0036	4	2	
	Flat washer, brass-nickel plate, 1/4" OD, 11/64" ID, 0.018" thick (for cap screw #2)		3050-0063	4	2	
3	Screw, machine, round head, stainless steel, 6-32 x 3/16"		2360-0002	4	2	
4	Plate, bellows	28480	196A-41B	1	1	
5	Bracket, camera mounting	28480	196A-12D	2	2	
6	Knob, viewer door	28480	G-74C	2	1	
7	Setscrew, Allen head, stainless steel, 8-32 x 3/16", (for knobs)		3030-0001	6	3	
8	Flat washer, stainless steel, 7/16" OD x 1/4" ID		3050-0103	4	2	

Table 7-1. Replaceable Parts (Sheet 2 of 3)

Ref. Figure 7-1	Description	Mfr *	Ⓢ Stock No.	TQ*	RS*		
9	Compression washers, 9/16" OD x 17/64" ID, 0.013" thick	28480	M-29A	3	3		
10	Washer, same as #8						
11	Door Viewer	28480	196A-41A	1	0		
12	Screw, machine, flat head, brass, 3-48 x 1/4"		0525-0006	3	3		
13	Shaft, viewer door	28480	196A-37A	1	0		
14	Cable release	66346	1000-0005	1	1		
15	Rubber seal, cable release	70485	0400-0015	1	1		
16	Timer	47904	1010-0001	1	1		
	Screw, timer weld nut anchor (same as #42)						
	Weld nut (same as #43)						
17 thru 25	Latch, assembly lens access door (sold only as an assembly)	28480	1390-0018	1	1		
26	Collar, stop	28480	G-32J	1	1		
27	Screw, machine, round head stainless steel, Phillips drive, 6-32 x 5/8"		2360-0009	4	2		
28	Lockwasher, internal teeth for #6 screw, phosphor-bronze, nickel plated		2190-0007	4	2		
	Nut, stainless steel, nickel plated, 6-32 x 7/64", 5/16" across flats (for screw #27, not pictured)		2420-0001	4	2		
29	Guide, lens board (right)	28480	196A-110R	1	0		
30	Guide, lens board (left)	28480	196A-110L	1	0		
31	Pinion w/gear	28480	196A-24A	1	1		
32	Bearing	28480	196A-17A	1	1		
	Flat washer, phosphor-bronze, nickel plated, 3/8" OD x 0.26" ID, 0.01" thick (not pictured)		3050-0017	1	1		
33	Gear, multiple picture control, Part of #31						
34	Washer, same as #28						
35	Screw, same as #27						
36	Spring, leaf	28480	196A-91A	1	1		
37	Spacer, spring	28480	196A-47B	1	1		
38	Ball, steel, 1/8" diameter	76210	1410-0005	1	1		
39	Knob, lens detent		196A-95B	1	1		
40	Setscrew, same as #7						
41	Flat washer, grey felt, 1/2" OD x 1/4" ID, 1/8" thick		3050-0083	1	1		
42	Screw, machine, flat head, stainless steel, 4-40 x 3/16"		2210-0001	4	2		

* See introduction to this section

Table 7-1. Replaceable Parts (Sheet 3 of 3)

Ref. Figure 7-1	Description	Mfr *	hp Stock No.	TQ*	RS*		
43	Nut, weld	28480	196A-57A	3	3		
44	Screw, locking	28480	196A-44A-1	2	2		
45	Flat washer, brass, 17/64" ID x 15/16"OD		3050-0015	2	2		
46	Spacer, clamp ring	28480	196A-12C	2	1		
47	Nut, elastic stop, stainless steel, #10 x 24	84396	0590-0029	2	2		
48	Spacer, clamp ring	28480	196A-47C	2	2		
49	Screw machine, truss head, stainless steel, 10-24 x 1/2"		2990-0002	2	2		
50	Screw, machine, flat head, stainless steel, 6-32 x 1/4"		2370-0001	4	2		
51	Nut, cap, hexagonal, brass, nickel plated, 5/16" across flats, 9/32" overall thickness, 3/16" thread depth		0510-0110	4	2		
	Lockwasher, same as #28						
52	Clamp, toggle	28480	196A-12B	1	1		
53	Clamp, ring	28480	196A-12A	1	0		
54	Spring, extension	84396	1460-0073	1	1		
55	Screw, machine, truss head, stainless steel, 4-40 x 5/16"		2270-0001	1	1		
56	Nut, hexagonal, stainless steel, 4-40 x 1/16", 3/16" across flats		2260-0002	1	1		
57	Board lens mounting	28480	196A-41D	1	0		
58	Screw, same as #42						
59	Rack	28480	196A-24B	1	1		
60	Gasket, lens spacing, 2-3/4" square, 1/32" thick, 2" ID hole	78471	0905-0035	4	1		
61	Part of lens assembly (see #66)						
62	Gasket, lens mounting, 2-3/4" sq., 0.02" thick, 2-1/2" ID hole	78471	0905-0028	1	1		
63	Gasket, lens mounting, 2-3/4" sq., 1/32" thick, 2-1/2" ID hole	78471	0905-0036	1	1		
64	Plate, lens clamp	28480	196A-41C	1	0		
65	Screw, machine, binding head, Phillips drive, brass, nickel plated, 8-32 x 1/2"		2630-0003	4	2		
66	Assembly, camera lens	66346	1000-0003	1	0		
67	Lens cap (part of lens assembly)						
68	Cushioning, black polyurethane, 2" x 5" x 1/2"	85474	4208-0003	2	0		
69	Housing assembly, camera (includes lens access door and rubber channeling in- stalled around viewer port and camera nose)		196A-95A	1	0		

* See introduction to this section

APPENDIX

CODE LIST OF MANUFACTURERS (Sheet 1 of 2)

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 handbooks.

CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS
00334	Humidial Co.	Colton, Calif.	10646	Carborundum Co.	Niagara Falls, N.Y.	71313	Allen D. Cardwell Electronic Prod. Corp	Plainville, Conn.
00335	Westrex Corp.	New York, N.Y.	11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.	71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.
00373	Garlock Packing Co., Electronic Products Div.	Camden, N.J.	12697	Clarostat Mfg. Co.	Dover, N.H.	71450	Chicago Telephone Supply Co.	Elkhart, Ind.
00656	Aerovox Corp.	New Bedford, Mass.	14655	Cornell Dubilier Elec. Corp.	So. Plainfield, N.J.	71468	Cannon Electric Co.	Los Angeles, Calif.
00779	Amp, Inc.	Harrisburg, Pa.	15909	The Daven Co.	Livingston, N.J.	71471	Cinema Engineering Co.	Burbank, Calif.
00781	Aircraft Radio Corp.	Boonton, N.J.	16758	Delco Radio Div. of G. M. Corp.	Kokomo, Ind.	71482	C. P. Clare & Co.	Chicago, Ill.
00853	Sangamo Electric Co., Cap. Div.	Marion, Ill.	18873	E. I. DuPont and Co., Inc.	Wilmington, Del.	71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
00866	Goe Engineering Co.	Los Angeles, Calif.	19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.	71700	The Cornish Wire Co.	New York, N.Y.
00879	Carl E. Holmes Corp.	Los Angeles, Calif.	19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.	71744	Chicago Miniature Lamp Works	Chicago, Ill.
01121	Allen Bradley Co.	Milwaukee, Wis.	19701	Electra Manufacturing Co.	Kansas City, Mo.	71785	Cinch Mfg. Corp.	Chicago, Ill.
01255	Litton Industries, Inc.	Beverly Hills, Calif.	20183	Electronic Tube Corp.	Philadelphia, Pa.	71984	Dow Corning Corp.	Midland, Mich.
01281	Pacific Semiconductors, Inc.	Culver City, Calif.	21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.	72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
01295	Texas Instruments, Inc. Semiconductor Components Div.	Dallas, Texas	21335	The Fafnir Bearing Co.	New Britain, Conn.	72354	John E. Fast & Co.	Chicago, Ill.
01349	The Alliance Mfg. Co.	Alliance, Ohio	21964	Fed. Telephone and Radio Corp.	Clifton, N.J.	72619	Dialight Corp.	Brooklyn, N.Y.
01561	Chassi-Trak Corp.	Indianapolis, Ind.	24446	General Electric Co.	Schenectady, N.Y.	72656	General Ceramics Corp.	Keasbey, N.J.
01961	Pulse Engineering Co.	Santa Clara, Calif.	24455	G. E., Lamp Division	Nela Park, Cleveland, Ohio	72758	Girard-Hopkins	Oakland, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.	24655	General Radio Co.	West Concord, Mass.	72765	Drake Mfg. Co.	Chicago, Ill.
02286	Cole Mfg. Co.	Palo Alto, Calif.	26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.	72825	Hugh H. Eby Inc.	Philadelphia, Pa.
02660	Amphenol Electronics Corp.	Chicago, Ill.	26992	Hamilton Watch Co.	Lancaster, Pa.	72928	Gudemam Co.	Chicago, Ill.
02735	Radio Corp. of America Semiconductor and Materials Div.	Somerville, N.J.	28480	Hewlett-Packard Co.	Palo Alto, Calif.	72982	Erie Resistor Corp.	Erie, Pa.
02777	Hopkins Engineering Co.	San Fernando, Calif.	31173	G. E. Receiving Tube Dept.	Owensboro, Ky.	73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.	35434	Lectrohm Inc.	Chicago, Ill.	73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.
03705	Apex Machine & Tool Co.	Dayton, Ohio	37942	P. R. Mallory & Co., Inc.	Indianapolis, Ind.	73293	Hughes Products Div. of Hughes Aircraft Co.	Newport Beach, Calif.
03797	Eldema Corp.	El Monte, Calif.	39543	Mechanical Industries Prod. Co.	Akron, Ohio	73445	Amperex Electronic Co., Div. of North American Phillips Co., Inc.	Hicksville, N.Y.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.	40920	Miniature Precision Bearings, Inc.	Keene, N.H.	73506	Bradley Semiconductor Corp.	New Haven, Conn.
04062	Elmenco Products Co.	New York, N.Y.	42190	Muter Co.	Chicago, Ill.	73559	Carling Electric, Inc.	Hartford, Conn.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.	43990	C. A. Norgren Co.	Englewood, Colo.	73682	George K. Garrett Co., Inc.	Philadelphia, Pa.
04404	Dymec Inc.	Palo Alto, Calif.	44655	Ohmite Mfg. Co.	Skokie, Ill.	73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
04651	Special Tube Operations of Sylvania Electronic Systems	Mountain View, Calif.	47904	Polaroid Corp.	Cambridge, Mass.	73793	The General Industries Co.	Elyria, Ohio
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona	48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.	73905	Jennings Radio Mfg. Co.	San Jose, Calif.
04732	Filtron Co., Inc. Western Division	Culver City, Calif.	49956	Raytheon Mfg. Co.	Waltham, Mass.	74455	J. H. Winns, and Sons	Winchester, Mass.
04777	Automatic Electric Sales Corp.	Northlake, Ill.	54294	Shallcross Mfg. Co.	Selma, N.C.	74861	Industrial Condenser Corp.	Chicago, Ill.
05277	Westinghouse Electric Corp., Semi-Conductor Dept.	Youngwood, Pa.	55026	Simpson Electric Co.	Chicago, Ill.	74868	Industrial Products Co.	Danbury, Conn.
05624	Barber Colman Co.	Rockford, Ill.	55933	Sonotone Corp.	Elmsford, N.Y.	74970	E. F. Johnson Co.	Waseca, Minn.
05783	Stewart Engineering Co.	Soquel, Calif.	55938	Sorenson & Co., Inc.	So. Norwalk, Conn.	75042	International Resistance Co.	Philadelphia, Pa.
06004	The Bassick Co.	Bridgeport, Conn.	56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.	75173	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.
06812	Torrington Mfg. Co., West. Div.	Van Nuys, Calif.	56289	Sprague Electric Co.	North Adams, Mass.	75378	James Knights Co.	Sandwich, Ill.
07115	Corning Glass Works Electronic Components Dept.	Bradford, Pa.	59446	Telex, Inc.	St. Paul, Minn.	75382	Kulka Electric Mfg. Co., Inc.	Mt. Vernon, N.Y.
07137	Transistor Electronics Corp.	Minneapolis, Minn.	61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.	75818	Lenz Electric Mfg. Co.	Chicago, Ill.
07261	Avnet Corp.	Los Angeles, Calif.	62119	Universal Electric Co.	Owosso, Mich.	75915	Littelfuse Inc.	Des Plaines, Ill.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.	64959	Western Electric Co., Inc.	New York, N.Y.	76005	Lord Mfg. Co.	Erie, Pa.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.	65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.	76210	C. W. Marwedel	San Francisco, Calif.
07980	Boonton Radio Corp.	Boonton, N.J.	66346	Wollensak Optical Co.	Rochester, N.Y.	76433	Micamold Electronic Mfg. Corp.	Brooklyn, N.Y.
08718	Cannon Electric Co. Phoenix Div.	Phoenix, Ariz.	70119	Advance Electric and Relay Co.	Burbank, Calif.	76487	James Millen Mfg. Co., Inc.	Malden, Mass.
08792	CBS Electronics Semiconductor Operations, Div. of C.B.S. Inc.	Lowell, Mass.	70276	Allen Mfg. Co.	Hartford, Conn.	76530	Monadnock Mills	San Leandro, Calif.
09134	Texas Capacitor Co.	Houston, Texas	70309	Allied Control Co., Inc.	New York, N.Y.	76545	Mueller Electric Co.	Cleveland, Ohio
09250	Electro Assemblies, Inc.	Chicago, Ill.	70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.	76854	Oak Manufacturing Co.	Chicago, Ill.
10411	Ti-Tal, Inc.	Berkeley, Calif.	70563	Amperite Co., Inc	New York, N.Y.	77068	Bendix Corp., Bendix Pacific Div.	No. Hollywood, Calif.
			70903	Belden Mfg. Co.	Chicago, Ill.	77221	Phostron Instrument and Electronic Co.	South Pasadena, Calif.
			70998	Bird Electronic Corp.	Cleveland, Ohio	77342	Potter and Brumfield, Inc.	Princeton, Ind.
			71002	Birnbach Radio Co.	New York, N.Y.	77630	Radio Condenser Co.	Camden, N.J.
			71218	Bud Radio Inc.	Cleveland, Ohio	77634	Radio Essentials Inc.	Mt. Vernon, N.Y.
			71286	Camloc Fastener Corp.	Paramus, N.J.			

00015-5
Revised: 6 April 1961

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H4-1 Dated Oct. 1960
H4-2 Dated Oct. 1960

APPENDIX

CODE LIST OF MANUFACTURERS (Sheet 2 of 2)

CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS	CODE NO.	MANUFACTURER	ADDRESS
77638	Radio Receptor Co., Inc.	Brooklyn, N.Y.	84970	Sarkes Tarzian, Inc.	Bloomington, Ind.	98141	Axel Brothers Inc.	Jamaica, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.	85474	R. M. Bracamonte & Co.	San Francisco, Calif.	98220	Francis L. Mosley	Pasadena, Calif.
78283	Signal Indicator Corp.	New York, N.Y.	85660	Koiled Kords, Inc.	New Haven, Conn.	98278	Microdot, Inc.	So. Pasadena, Calif.
78471	Tilley Mfg. Co.	San Francisco, Calif.	85911	Seamless Rubber Co.	Chicago, Ill.	98291	Sealectro Corp.	New Rochelle, N.Y.
78488	Stackpole Carbon Co.	St. Marys, Pa.	86684	Radio Corp. of America, RCA Electron Tube Div.	Harrison, N.J.	98405	Carad Corp.	Redwood City, Calif.
78790	Transformer Engineers	Pasadena, Calif.	88140	Cutler-Hammer, Inc.	Lincoln, Ill.	98734	Palo Alto Engineering Co., Inc.	Palo Alto, Calif.
79142	Vaeder Root, Inc.	Hartford, Conn.	89473	General Electric Distributing Corp.	Schenectady, N.Y.	98925	Clevite Transistor Prod. Div. of Clevite Corp.	Waltham, Mass.
79251	Wenco Mfg. Co.	Chicago, Ill.	90179	U.S. Rubber Co., Mechanical Goods Div.	Passaic, N.J.	98978	International Electronic Research Corp.	Burbank, Calif.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.	90970	Bearing Engineering Co.	San Francisco, Calif.	99109	Columbia Technical Corp.	New York, N.Y.
80130	Times Facsimile Corp.	New York, N.Y.	91418	Radio Materials Co.	Chicago, Ill.	99313	Varian Associates	Palo Alto, Calif.
80131	Electronic Industries Association Any brand tube meeting EIA standards	Washington, D.C.	91506	Augat Brothers, Inc.	Attleboro, Mass.	99800	Delevan Electronics Corp.	East Aurora, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.	91637	Dale Products, Inc.	Columbus, Neb.	99821	North Hills Electric Co.	Great Neck, L.I., N.Y.
80411	Acro Manufacturing Co.	Columbus, Ohio	91662	Elco Corp.	Philadelphia, Pa.	99848	Wilco Corporation	Indianapolis, Ind.
80486	All Star Products Inc.	Defiance, Ohio	91737	Gremer Mfg. Co., Inc.	Wakefield, Mass.	99934	Renbrandt, Inc.	Boston, Mass.
80583	Hammerlund Co., Inc.	New York, N.Y.	91827	K F Development Co.	Redwood City, Calif.	99942	Hoffman Semiconductor Div. of Hoffman Electronics, Corp.	Evanston, Ill.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.	91929	Micro-Switch Div. of Minneapolis Honeywell Regulator Co.	Freeport, Ill.	99957	Technology Instruments Corp. of Calif.	No. Hollywood, Calif.
81030	International Instruments, Inc.	New Haven, Conn.	92196	Universal Metal Products, Inc.	Bassett Puente, Calif.			
81415	Wilkor Products, Inc.	Cleveland, Ohio	93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.			
81453	Raytheon Mfg. Co., Industrial Tube Division	Quincy, Mass.	93369	Robbins and Myers, Inc.	New York, N.Y.			
81483	International Rectifier Corp.	El Segundo, Calif.	93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio			
81860	Barry Controls, Inc.	Watertown, Mass.	93983	Insuline-Van Norman Ind., Inc. Electronic Division	Manchester, N.H.			
82042	Carter Parts Co.	Skokie, Ill.	94144	Raytheon Mfg. Co., Receiving Tube Div.	Quincy, Mass.			
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.	94145	Raytheon Mfg. Co., Semi- conductor Div.	Newton, Mass.	0000C	Connor Spring Mfg. Co.	San Francisco, Calif.
82170	Allen B. DuMont Labs., Inc.	Clifton, N.J.	94154	Tung-Sol Electric, Inc.	Newark, N.J.	0000D	Connex Corp.	Oakland, Calif.
82209	Maguire Industries, Inc.	Greenwich, Conn.	94197	Curtiss-Wright Corp., Electronics Div.	Carlstadt, N.J.	0000E	Fisher Switches, Inc.	San Francisco, Calif.
82219	Sylvania Electric Prod. Inc., Electronic Tube Div.	Emporium, Pa.	94310	Tru Ohm Prod. Div. of Model Engineering and Mfg. Co.	Chicago, Ill.	0000F	Malco Tool and Die	Los Angeles, Calif.
82376	Astron Co.	East Newark, N.J.	95236	Allies Products Corp.	Miami, Fla.	0000G	Microwave Engineering Co.	Palo Alto, Calif.
82389	Switchcraft, Inc.	Chicago, Ill.	95238	Continental Connector Corp.	Woodside, N.Y.	0000H	Philco Corp. (Lansdale Division)	Lansdale, Pa.
82647	Texas Instruments, Inc., Metals and Controls Div., Spencer Products	Attleboro, Mass.	95263	Leecraft Mfg. Co., Inc.	New York, N.Y.	0000I	Telefunken (c/o American Elite)	New York, N.Y.
82866	Research Products Corp.	Madison, Wis.	95265	National Coil Co.	Sheridan, Wyo.	0000K	Transitron Electronic Sales Corp.	Wakefield, Mass.
82893	Vector Electronic Co.	Glendale, Calif.	95987	Weckesser Co.	Chicago, Ill.	0000L	Winchester Electronics, Inc.	Santa Monica, Calif.
83148	Electro Cords Co.	Los Angeles, Calif.	96067	Huggins Laboratories	Sunnyvale, Calif.	0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
83186	Victory Engineering Corp.	Union, N.J.	96095	Hi-Q Division of Aerovox	Olean, N.Y.	0000N	Nahm-Bros. Spring Co.	San Leandro, Calif.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.	96296	Solar Manufacturing Co.	Los Angeles, Calif.	0000P	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.	96341	Microwave Associates, Inc.	Burlington, Mass.	0000R	Metro Cap. Div., Metropolitan Telecommunications Corp.	Brooklyn, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.	96501	Excel Transformer Co.	Oakland, Calif.	0000S	Moulton Electronics	San Carlos, Calif.
83821	Loyd Scruggs Co.	Festus, Mo.	97539	Automatic and Precision Mfg. Co.	Yonkers, N.Y.			
84171	Arco Electronics, Inc.	New York, N.Y.	97966	CBS Electronics, Div. of C.B.S., Inc.	Danvers, Mass.			
84396	A. J. Glesener Co., Inc.	San Francisco, Calif.						
84411	Good All Electric Mfg. Co.	Ogallala, Neb.						

THE FOLLOWING H-P VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

From: F.S.C. Handbook Supplements
H4-1 Dated Oct. 1960
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Revised: 6 April 1961





MANUAL CHANGES

CHANGES
01038-1

MODEL 196A

OSCILLOSCOPE CAMERA

Manual printed: 4-61
For Serials Prefixed: 001-

CHANGES INSTRUCTIONS:

Place the following list of addenda, errata, and production changes in front of the title page of the above instruction manual. Incorporate all errata into the manual. To adapt the manual to a specific instrument having one of the serial number prefixes listed below, apply all addendum and/or production changes listed under the appropriate serial prefix.

For instruments with Serials Prefixed 118-:

Since the film now produced by Polaroid Corporation requires only 10 seconds developing time, the 196A timer (-hp- Stock No. 1010-0001) is no longer necessary and has been removed.