

INSTRUCTION MANUAL

Serial Number 27894

OSCILLOSCOPE CAMERA SYSTEM

**C-30A, C-32
Cameras & Accessories**



WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your TEKTRONIX Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the TEKTRONIX Field Office or representative in your area. This will assure you the fastest possible service. Please include the instrument Type Number or Part Number and Serial Number with all requests for parts or service.

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Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL-STD-12B and other standards of the electronics industry. Change information, if any, is located at the rear of this manual.

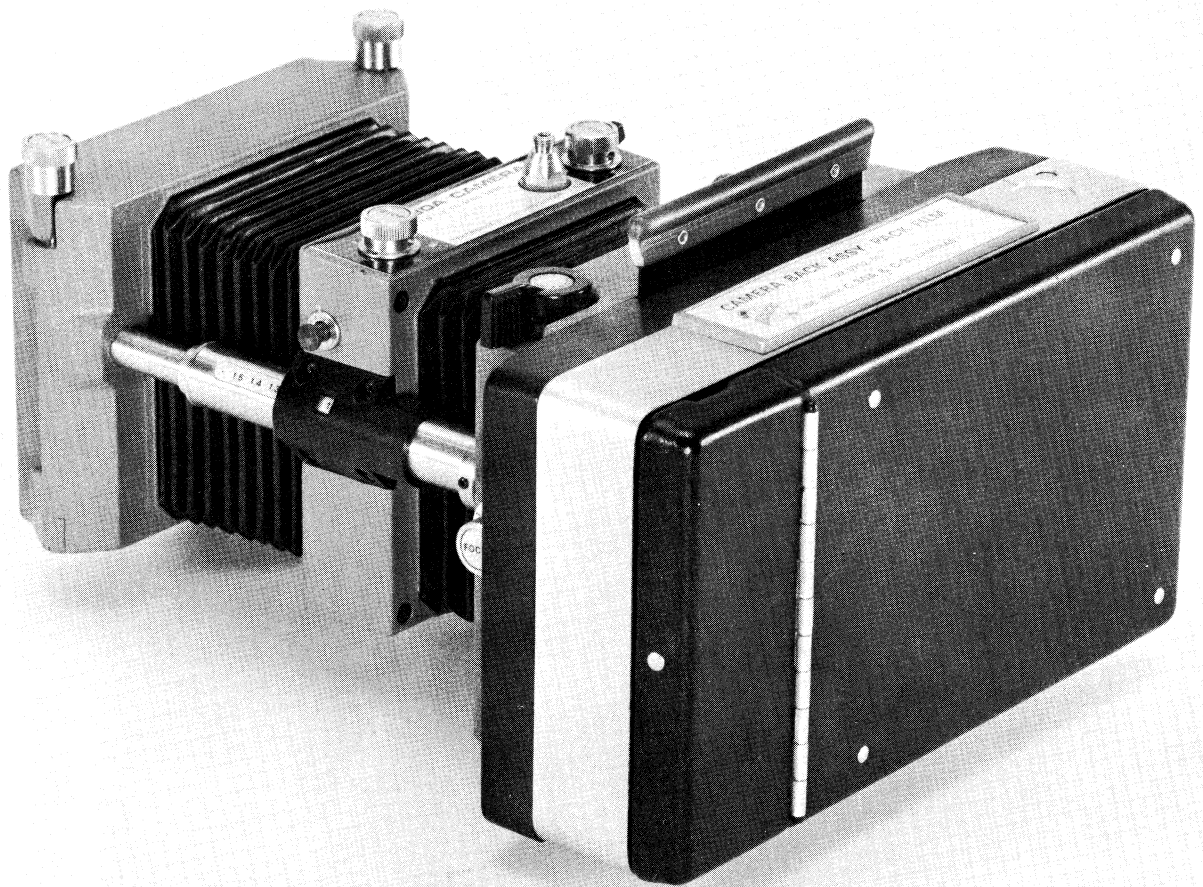


Fig. 1-1. Type C-30A Camera with Polaroid pack film back attached.

SECTION 1

CHARACTERISTICS

Change information, if any, affecting this section can be found at the rear of the manual.

General Description

The Tektronix Type C-30A Camera is specially designed for photographing oscilloscope displays. The optical system of the camera permits photographs to be made directly from the oscilloscope screen so the image is not reversed.

The camera provides many new convenience features, including slide-on type mountings with swing-away hinges so the camera can be swung out either to left or right for direct CRT display viewing.

The design of the Type C-30A Camera makes available a variety of object-to-image (MAG) ratios and allows the use of parfocal backs. The parfocal backs can be used with Polaroid¹ Land films or conventional films, in either sheet or roll film forms.

MAIN FRAME

Focusing

Focusing to compensate for slight differences between oscilloscopes (or for different MAG settings) is accomplished by means of a Focus knob on the left side. Once the Focus knob has been set, it may be locked in position with the Focus Lock knob, to prevent accidentally changing the Camera focus.

Mounting

The Type C-30A Camera is designed to mount directly to the Tektronix Type 422, 453, 453A, 454, 454A and 491. Refer to page 1-3 for additional adapters available for mounting the C-30A on other Tektronix oscilloscopes. (C-30A Option 1 requires removal of the corrector lens and use of a special adapter for mounting on these oscilloscopes, refer to the Option 1 insert for specific information.)

Optical System

Photographs are taken directly from the oscilloscope screen with no reversal. Object-to-image ratio may be varied from 1:0.7 to 1:1.5 in ten steps.

Viewing

The camera may be swung away from the CRT either to the left or right on its swing-away hinges to provide direct display viewing.

Size

See Fig. 1-2.

Weight

4 lbs., 13 oz. with Polaroid pack film back attached.

LENS

Lens (56 mm - f/1.9) and Shutter Settings

Both aperture (F stops) and shutter speed settings can be made from the top of the shutter box. X Synchronization contact connections are available on the bottom of the shutter box.

Shutter Speeds

(T), (B), and seven shutter speeds from 1 to 1/50 second.

f-Stops

1.9, 2.8, 4, 5.6, 8, 11 and 16.

MAG (Object-To-Image) Ratios

1 to 1.5, 1.4, 1.3, 1.2, 1.1, 1, 0.9, 0.85, 0.8 and 0.7.

CAMERA BACKS

Polaroid Land Pack Film Camera Back (122-0752-00)

Black-and-white or color film is available for the pack film back. Overall print size is 3 1/4 x 4 1/4 inches (maximum actual image size available is 7.3 x 9.5 cm). 100-Series Polaroid Land film packs should be used with this camera back.

Polaroid Land Roll Film Camera Back (122-0754-00)

Prints or transparencies in black and white or color prints may be obtained from a roll of film. Overall print size is 3 1/4 x 4 1/4 inches (maximum actual image size available is 7.3 x 9.5 cm). Only Polaroid Land roll film can be used with this back.

Graflok Camera Back (122-0755-00)

Any type of film holder which will attach to the 2 1/4 x 3 1/4 Graflok back can be used. The various attachments available will allow sheet or roll film of conventional types to be used. Maximum image size available is 2 1/4 x 3 1/4 inches.

¹Registered trademark of the Polaroid Corporation.

Characteristics—Type C-30A Camera

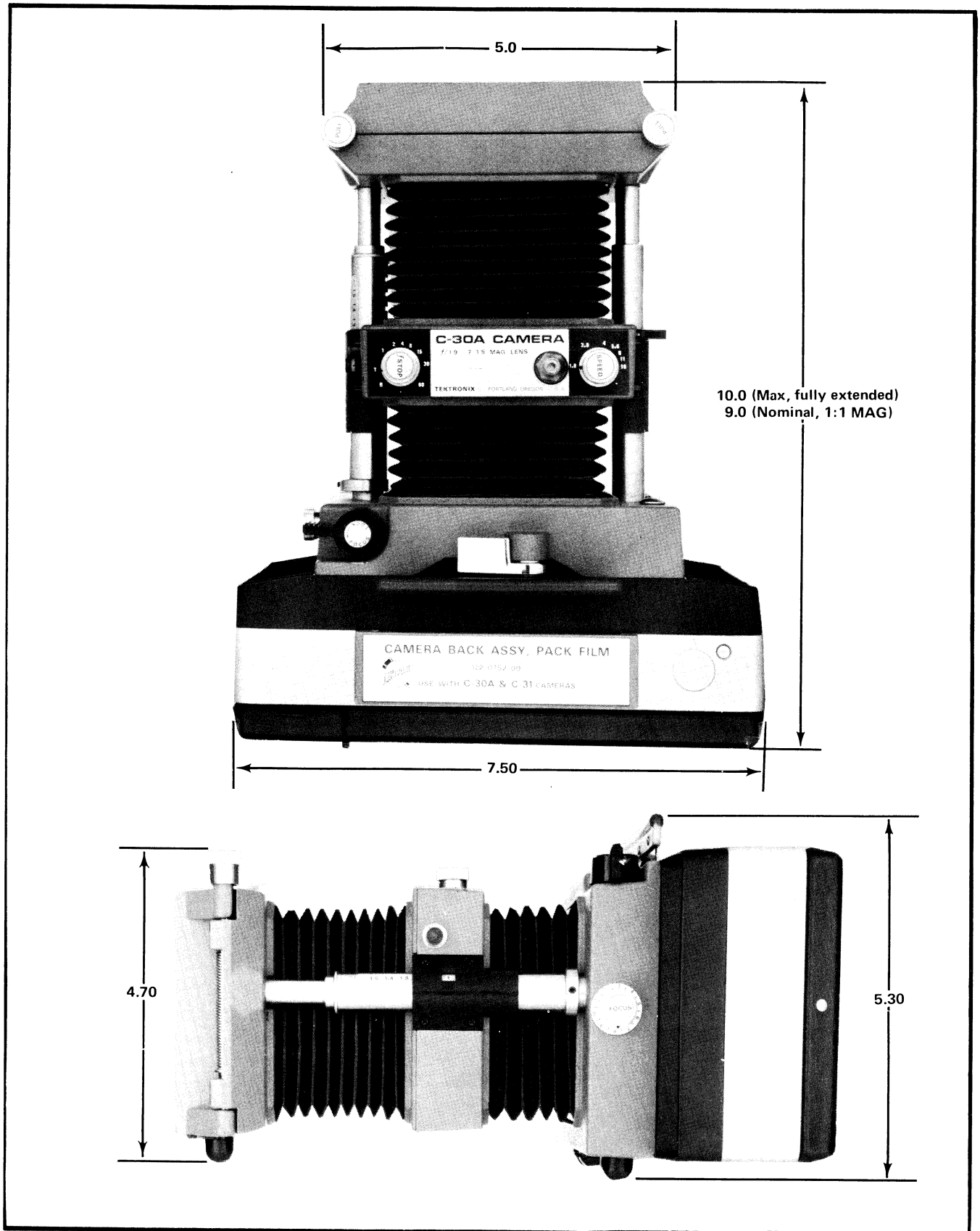


Fig. 1-2. Dimensions of the Type C-30A Camera with Polaroid pack film back attached.

CAMERA ADAPTERS²

Tektronix Part No.	Instruments used with
016-0241-00	310, 310A, 316, RM16, 317, RM17, and 360 oscilloscopes
016-0242-00	321 and 321A oscilloscopes.
016-0243-00	530, 540, 550, 580 oscilloscopes.
016-0244-00	560-Series oscilloscopes. ³
016-0248-00	Type 601 Storage Display Unit and Type 528 Waveform Monitor.
016-0301-00	432 and 434 oscilloscopes
	465 and 475 oscilloscopes

NOTE

Refer to the current Tektronix catalog for adapters for other instruments.

Optional Accessories

The use of a portra lens (Tektronix Part No. 016-0246-01) permits adaptation of the Type C-30A for some conventional camera work.

The depth of field when using the portra lens will vary with the f stop and magnification settings used. Generally, at f/1.9 there will be little depth of field; while at f/16, the depth of field is several feet. At a distance of 21 inches, a subject area 22 inches in diameter can be covered.

TABLE 1-1
Subject Area Covered With Portra Lens

Type C30A Object-to-Image (MAG) Ratio	Effective Magnification With Portra Lens	Total Distortion Percentage	Subject Area Covered
0.7	0.140	-2.7	22 inch diameter circle (380 in ²)
1.0	0.377	-2.3	8 x 10 inch rectangle (80 in ²)
1.5	0.770	-1.0	3.75 x 4.75 inch rectangle (18 in ²)

Portra lens, -7.25 diopters.

ACCESSORIES

SHUTTER ACTUATOR MODEL 3

The Shutter Actuator System Model 3 is a rotary solenoid-operated shutter release control. The Shutter Actuator has been designed to be used with the Tektronix Camera systems.

The Shutter Actuator System permits electrical triggering of the camera shutter. The remote trigger connectors of several Shutter Actuator Systems can be paralleled and remotely triggered from the same remote switching con-

²No camera adapter is required to mount the Type C-30A Camera on a Type 422, 453, 453A, 454, 454A oscilloscope, or a Type 491 Spectrum Analyzer.

³For Type 565 and RM565 oscilloscope use Tektronix Part No. 016-0243-00.

trol, thus allowing several camera shutters to be triggered simultaneously.

The power supply may be attached to the camera by either of two different mounting brackets, or it can be used without mounting on the camera by being placed close enough so the leads will reach.

Power Supply Mounting Bracket

Two different power supply mounting arrangements are available for use with the Type C-30A Camera system, depending upon the needs of the user. If several different types of camera backs are to be used interchangeably, order the Power Supply Mounting Bracket by Tektronix Part No. 407-0477-00. This bracket mounts directly on the camera itself. If only one type of camera back will be used, Power Supply Mounting Bracket 122-0713-00 can be attached directly to a Polaroid Pack Film or Roll Film back. This bracket will not, however, mount on the Graflok back.

ELECTRICAL CHARACTERISTICS

Power Supply

Line Voltage—115 (230) volts, 50 to 400 Hz, or 115 (230) volts DC.

Fuse— $\frac{1}{2}$ A slow-blow type for 115-volt operation, 0.3 A slow-blow for 230-volt operation.

Shutter Actuator

Input Voltage—115 (230) volts DC.

Solenoid Pull-In Peak Current—1 A for 115-volt operation, $\frac{1}{2}$ A for 230-volt operation.

Solenoid Holding Current—0.13 A for 115-volt operation, 0.067 A for 230-volt operation.

Power Requirement for Remote Trigger

A current of 25 milliamperes and a voltage between 24 and 28 VDC is required to energize each Shutter Actuator System. For each additional Shutter Actuator System triggered, an additional 25 milliamperes must be supplied.

System Delay

The shutter is fully open within 20 to 25 ms after the MOMENTARY-OFF-MAINTAIN switch has been operated, depending upon the type of shutter used.

MECHANICAL CHARACTERISTICS

Power Supply

Finish—aluminum box is finished in textured black vinyl paint. The front panel is anodized aluminum.

Dimensions— $4\frac{1}{16}$ inches long \times $3\frac{1}{8}$ inches wide by $3\frac{1}{8}$ inches deep.

Weight—approximately $15\frac{3}{4}$ oz.

Power Supply Mounting Brackets

Finish—cold rolled steel bracket is finished in black vinyl paint.

Characteristics—Type C-30A Camera

Shutter Actuator Solenoid

Finish—Die-cast case is finished in black. The name plate is anodized aluminum.

Dimensions—2½ inches long × 2⅛ inches × 1¾ inches deep.

Weight—approximately 10¾ oz.

NO. 1 ELECTRIC SHUTTER AND SPEEDCOMPUTER

The No. 1 Electric Shutter and Speedcomputer⁴ system consists of a solenoid-operated shutter and a unit containing a power supply and timing circuitry. The system has been designed so that the Electric Shutter replaces the existing mechanical shutter in the lens which is used with the C-30, C-30A and C-31 camera systems.

The Electric Shutter/Speedcomputer system permits electrical triggering of the camera shutter. It can also be used to trip more than one camera shutter simultaneously by connecting the required number of systems to one remote switching control.

The Speedcomputer is supplied in a small box which can be easily attached to the camera back (by using a mounting bracket) or the Speedcomputer may be set on an object near the camera.

ELECTRICAL CHARACTERISTICS

NOTE

In the following description, the below listed definitions and criteria established by the United States of America Standards Institute shall apply: Items 2.1 and 4.3 of the USA Standard PH3.32-1959; Item 3.1 of USA Standard PH3.18-1957.

**TABLE 1-1
Electric Shutter**

Characteristic	Performance Requirement
Synchronization	Internal; X-Type, as described in 3.1 of USA Standard PH3.18-1957
Action	Actuated by Speedcomputer
Actuation Voltage Initial Pulse	At least 120 VDC; at least 5 ms in duration
Holding Voltage	At least 20 VDC

**TABLE 1-2
Speedcomputer**

Characteristic	Performance Requirement
Output Voltage Initial Pulse	At least 120 VDC; at least 5 ms in duration
Holding Voltage	At least 20 VDC
Exposure-time Settings	Time (T), 4, 2, 1, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60 second and Bulb (B).
Exposure-time Accuracy	Within 20 % of exposure-time markings in a temperature range of 0°C to +40°C. (In accordance with item 4.3 of USA Standard PH3.32-1959.)
Synchronization	Determined by Electric Shutter (see Table 1-1).
Shutter-open Indication	Indicator light turns on when shutter blades are more than 80% open.
Remote Actuation	Accomplished by connecting pins A and C of J20 together or by supplying +27 VDC to pin A of J20; using pin B of J20 as ground.
Power Source Line Voltage	115 VAC ±10%. Can be converted for 230 VAC ±10%, operation.
Frequency	50 to 60 Hz
Power Consumption	16 W, with shutter open
Power Indication	Indicator light turns on if power is applied to instrument when ON-OFF switch SW 1 is ON.

**TABLE 1-3
Physical Characteristics**

Characteristic	Description
Finish: Electric Shutter	Die-cast aluminum finished with gray paint. The identification plate is anodized aluminum.
Speedcomputer	Aluminum case is finished with textured black vinyl paint. The front-panel is anodized aluminum.
Dimensions: Electric Shutter	1⅝ inches diameter × 2⅛ inch thick.
Speedcomputer	4½ inches long × 3⅛ inches wide × 3⅛ inches deep.

⁴Registered trademark of the Ilex Optical Company.

TABLE 1-4
Environmental Characteristics

Characteristic	Performance Requirement
Temperature Operating	0°C to +50°C
Non-operating	-40°C to +65°C
Altitude Operating	To 15,000 feet
Non-operating	To 50,000 feet. Refer to temperature characteristic for lowest allowable temperature.
Vibration Operating [†]	15 minutes in each of the three planes at 0.010 inch double amplitude. Vary frequency from 5 to 55 to 5 c/s in 1-minute cycles.
Shock: Operating	10 g's, 1/2 sine, 11 ms duration, 1 shock in vertical plane only. Guillotine-type shocks.
Non-operating	10 g's, 1/2 sine, 11 ms duration, 1 shock in each of 6 face plates. Guillotine-type shocks.
Humidity [‡]	5 cycles (120 hours) of MIL-STD-202C, method 106B. Omit freezing and vibration. Allow 24 hour post-test drying period at 25°C, ±5°C with a relative humidity of 20% to 80%.

TABLE 1-5
Electric Shutter

Characteristics	Information	
Solenoid Resistance	500 ohms, ±10% at 25°C	
Maximum Input Voltage Peak Value	140 V DC for not more than 5 ms	
Continuous	24 V DC	
Minimum Input Voltage To Open Shutter	45 V DC for a duration of 60 ms	
To Hold Shutter Open	18 V DC	
Opening Time	Mechanical shutter opening time to 100% light-transmission point at maximum aperture	Delay from input voltage application to fully open
120 V DC	5 ms	13 ms
100 V DC	6 ms	14 ms
80 V DC	6 ms	17 ms
60 V DC	10 ms	22 ms
45 V DC	15 ms	50 ms
Closing Time To 0% Light-transmission Point From Maximum Aperture		
30 V DC Holding Voltage	6 ms	
18 V DC Holding Voltage	6 ms	

[†]Electric Shutter and Speedcomputer mounted on a camera in a normal manner.

[‡]Applies to Speedcomputer only.

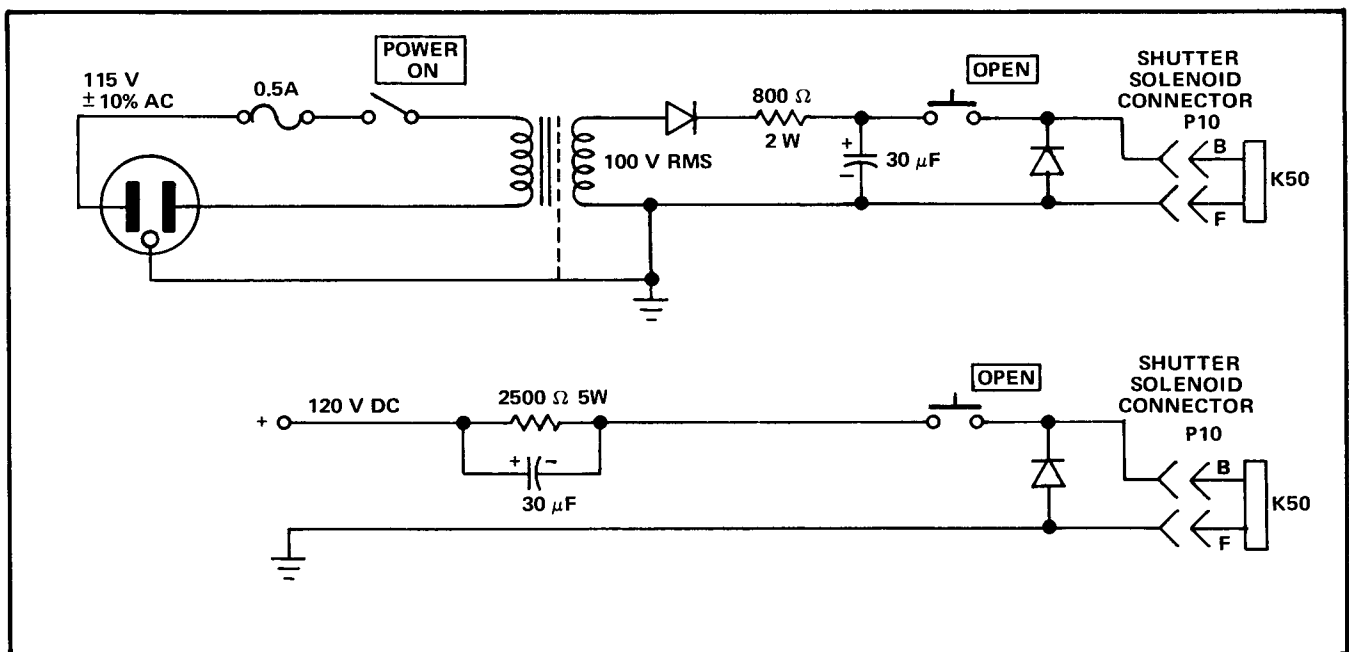


Fig. 1-3. Electric shutter solenoid power supply diagrams.

Supplemental Information

The following information applies to $f/1.2$, 1:15 to 0.7 (adjusted); Tektronix Part Number 122-0838-00.

The electric shutter is operated by a single solenoid against the spring tension of the shutter release mechanism. Power is required to open the shutter; removal of power allows the shutter to close. The solenoid is intended for operation from DC voltage only.

To obtain quick shutter opening, a brief pulse of up to 120 V may be applied. As soon as the shutter is open, the applied voltage may be dropped quickly to 24 V or less, to avoid overheating of the solenoid and possible damage to the electric shutter.

The recommended operating waveform is an opening pulse of 120 V, decaying on an rc time-constant of 15 ms to a holding voltage of 20 V. A circuit for deriving such a waveform is shown in Fig. 1-3.

NOTE

The power cord on Tektronix instruments may conform to either of the following two electrical codes:

<i>Conductor</i>	<i>USA (NEC) & Canada</i>	<i>IEC</i>
<i>Line</i>	<i>Black</i>	<i>Brown</i>
<i>Neutral</i>	<i>White</i>	<i>Light Blue*</i>
<i>Safety-Earth</i>	<i>Green w/yellow stripe</i>	<i>Green w/yellow stripe</i>

*Tinned copper conductor.

SECTION 2

OPERATING INSTRUCTIONS

Change information, if any, affecting this section will be found at the rear of the manual.

MAIN FRAME

Mounting the Camera

NOTE

To insure that the hinge pins will remain engaged in the camera adapter when moving the camera/oscilloscope combination about, screw one of the thumb screws (located in accessory package) into the bottom of each of the hinge pins after mounting the camera. Before either or both camera hinge pins can be lifted for swinging the camera out or removing it from the camera adapter, the thumb screw(s) in the bottom of the hinge pin(s) to be lifted must be completely removed.

To mount the camera on a Type 422, 453, 454 or 491 oscilloscope, unscrew and remove the foot from the supporting casting. Insert either the 6 x 10 or 8 x 10 division light seal and re-install the foot to hold the light seal in place. For most photographic work, any mesh or light filter should be removed from the oscilloscope.

The camera can be mounted to the oscilloscope by sliding the camera into the groove on the Type 422, 453, 454 or 491 oscilloscope bezel. The camera can be removed at any time by lifting the opposite hinge pin and swinging the camera away from the support casting, or the support casting may be detached from the camera by lifting both hinge pins simultaneously.

Slide on mounting has been incorporated to provide easy camera mounting or removal. If, however, a more secure attachment is needed it can be obtained by tightening the two set screws (mounting lock adjustments) located in the support casting with a $\frac{5}{64}$ hexagonal wrench.

To obtain access to the two set screws swing the camera away from the support casting or remove the camera completely. The two set screws are located in the half round boss on each side of the support casting next to the light seal groove.

The two set screws need only be adjusted slightly clockwise to lock the support casting into the oscilloscope bezel. To remove the support casting from the oscilloscope bezel, loosen both set screws by turning them counterclockwise until the support casting slides off the oscilloscope bezel.

Special Mounting Information

Special mounts (camera adapters) are used to attach the Type C-30A Camera to storage display units and oscilloscopes other than the Types 422, 453, 454, or 491. The camera adapters take the place of the normal graticule cover on most of these oscilloscopes and storage display units.

Mounting Camera Adapter 016-0269-01. Slide the camera adapter down over the instrument bezel until the rib on the upper inner part of the camera adapter engages the groove on the top of the instrument bezel. When the camera adapter and the instrument bezel are engaged push the bottom of the camera adapter in against the instrument. While holding the camera adapter against the instrument, engage the spring latch into the slot on the bottom of the instrument bezel and pull back on the latch lever until it snaps. Check that the camera adapter is firmly attached by pulling on it gently after it is mounted.

To remove the 016-0269-01 camera adapter, push on the latch lever at the bottom of the camera adapter to release the spring latch from the instrument bezel. Pull out slightly on the bottom of the camera adapter and slide the camera adapter up until it is free of the oscilloscope.

The camera can be attached to the camera adapter by lifting both camera hinge pins at the same time, aligning the camera and camera adapter halves of the hinges and then releasing the pins. The camera may be swung back from the camera adapter to either side by lifting the hinge pin on the opposite side; or it may be removed from the camera adapter completely by lifting both pins at the same time.

Mounting the 016-0248-00 Camera Adapter. Slide the camera adapter down over the instrument bezel until the rib on the upper inner part of the camera adapter engages the groove on the top of the instrument bezel. Push the bottom of the camera adapter in toward the instrument until a click is heard, indicating that the bottom latch on the camera adapter has engaged the instrument bezel. Check that the camera adapter is properly attached by pulling on it gently.

Operating Instructions—Type C-30A Camera

To remove the 016-0248-00 adapter, lift the plastic latch lever at the bottom center of the camera adapter and pull out on the bottom of the adapter at the same time. Slide the camera adapter up until the rib on the upper inner part of the camera adapter is disengaged from the groove on the top of the instrument.

The camera can be attached to the camera adapter by lifting both camera hinge pins at the same time, aligning the camera and adapter halves of the hinges and then releasing the pins. The camera may be swung back from the adapter to either side by lifting the hinge pin on the opposite side; or, it may be removed from the adapter completely by lifting both pins at the same time.

The small rubber gaskets accompanying the adapter are light seals; the placement of which is shown in Fig. 2-1, below.

Mounting the 016-0242-00 Adapter. Remove the graticule cover from the oscilloscope by removing the phillips head screw (321A only) located on the lower part of the cover, then lift out on the lower part of the cover and pull down. For most photographic work any mesh or light filters should be removed from the oscilloscope.

Check the oscilloscope external graticule for scratches and for cleanliness. Place the external graticule in the cutout on the oscilloscope so that the scribed side is toward the CRT and the illumination slots are down.

Engage the two ears on the top of the camera adapter into the top of the front panel, reversing the graticule cover removal procedure. After the camera adapter is in place, install the phillips screw to hold the adapter to the oscilloscope. Mount the camera by sliding it onto the groove on the camera adapter.

NOTE

It will be necessary to drill and tap a hole in the front panel of the Type 321 for a 4-40 phillips head screw. The special mounting adapter should be used as the template.

Mounting the 016-0243-00 and 016-0244-00 adapters on oscilloscopes. Remove the graticule from the oscilloscope by unscrewing the four knurled nuts.

Check the oscilloscope external graticule or CRT protector plate for scratches and be sure it is clean. Place the external graticule, on the graticule studs so that the scribed side is toward the CRT and the clear illumination slots are up.

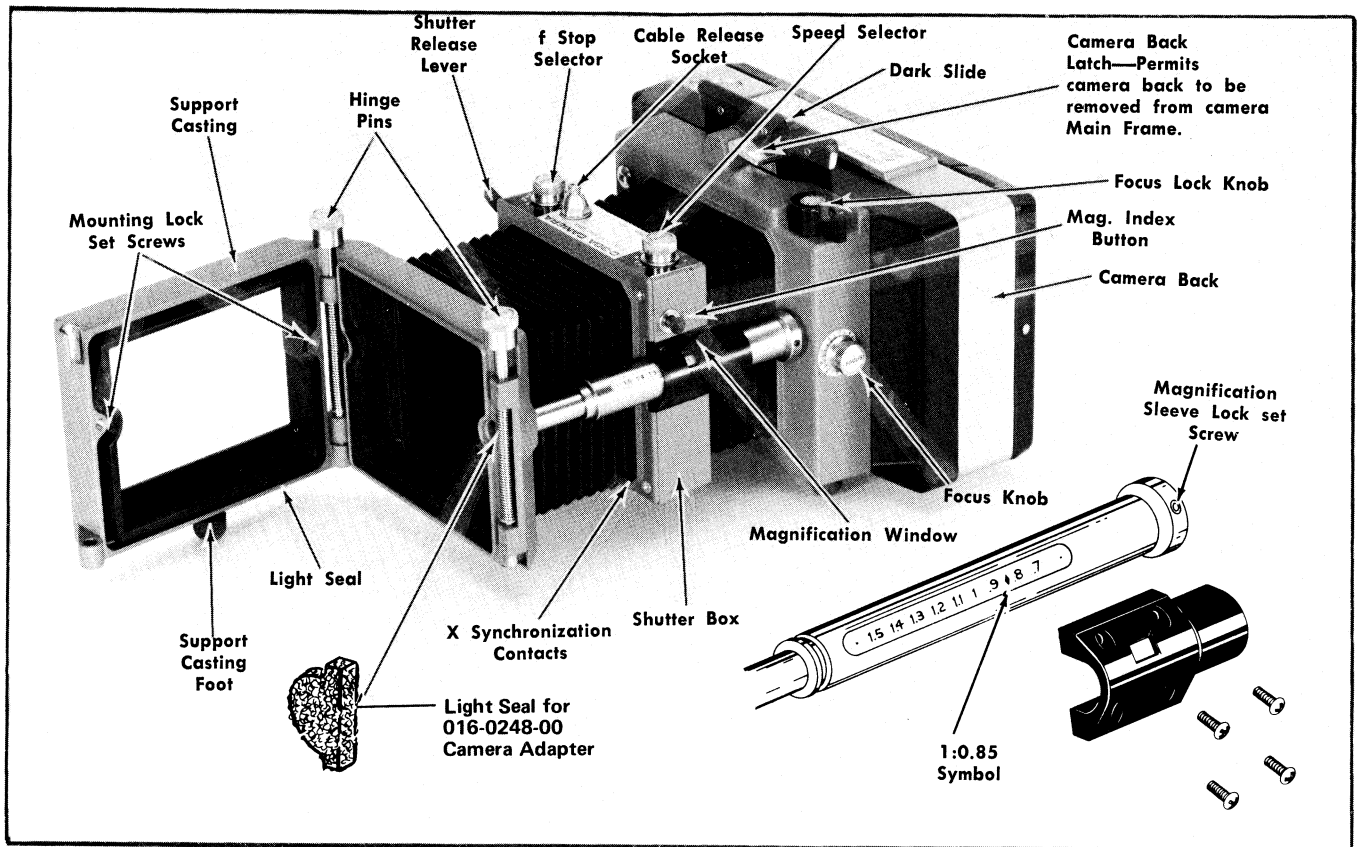


Fig. 2-1. Type C-30A Camera controls and functions.

Place the camera adapter on the graticule studs. Use the four graticule nuts supplied to attach the camera adapter to the oscilloscope. The new graticule nuts are slotted so that a screwdriver or coin can be used to tighten them. Make certain that the groove in the camera is oriented across the top and down both sides of the adapter. Mount the camera by sliding it into the groove on the camera adapter.

Mounting the 016-0301-00 Adapter. Slide the camera adapter down over the instrument until the rib on the upper inner part of the camera adapter engages the groove on the top of the instrument bezel. When the camera adapter and the instrument bezel are engaged push the bottom of the camera adapter in against the instrument. While holding the camera adapter against the instrument, engage the spring latch into the slot on the bottom of the instrument bezel and pull back on the latch lever until it snaps. Check that the camera adapter is firmly attached by pulling on it gently after it is mounted.

Remove the light seal flange ring screws (and clips on early cameras) and attach corrector lens holder using the flat head screws. Firmly seat the lens holder into the outer lens holder by using two fingers to push, at the same time, against opposite sides of the flange on the lens holder. Caution should be taken that the lens holder is seated completely into the outer lens holder and that there are no fingerprints on the lens.

Be sure to set camera magnification at 1:1 which with the corrector lens in the adapter will give an image ratio of 1:0.8. After corrector lens is mounted refocus the camera.

To remove the 016-0301-00 camera adapter, push on the latch lever at the bottom of the camera adapter to release the spring latch from the instrument bezel. Pull out slightly on the bottom of the camera adapter and slide it up until it is free of the oscilloscope.

The camera can be attached to the camera adapter by lifting both camera hinge pins at the same time, aligning the camera and camera adapter halves of the hinges and then releasing the pins. The camera may be swung back from the camera adapter to either side by lifting the hinge pin on the opposite side; or it may be removed from the camera adapter completely by lifting both pins at the same time.

LENSES

Adjusting the Lens Aperture

The f STOP selector (see Fig. 2-1) is used to select the lens opening. The dial is calibrated in f-stop numbers with a black dot to indicate the setting.

The lens setting to be used for a particular picture depends on several factors. Whenever possible, use of f-stop numbers lower than f/4 should be avoided if an external graticule is to be used. As in all cameras, the best depth of field is obtained at the smallest openings (largest f-stop numbers). This is important in all oscilloscope cameras since

the trace and an external graticule cannot simultaneously be brought into focus when the f-stop number is lower than f/4. In applications where an external graticule is used and it is necessary to use the lens aperture wide open, special techniques can be used to obtain a satisfactory picture with both the trace and the external graticule in focus. These techniques are described in Section 4.

Additional information on selecting lens aperture openings for particular applications is given in the Photographic Techniques section.

Selecting the Shutter Speed

The camera shutter speed is selected by means of the SPEED selector (see Fig. 2-1). Numbers shown on the dial are actually the reciprocals of the shutter speeds. For example, when the SPEED selector is set at 30, the shutter is open 1/30 second. As with the aperture setting, many factors determine the shutter speed used for a particular picture. Care must be taken that the right combination of lens opening and shutter speed is chosen. More information on selecting the shutter speed is contained in the Photographic Techniques section.

Releasing the Shutter

The SHUTTER RELEASE lever is located on the right side of the shutter box. When the SHUTTER RELEASE lever is pushed down, the shutter mechanism is actuated. In all positions of the speed selector except (T) and (B) the shutter mechanism operates independently of the time that the SHUTTER RELEASE lever is held down. In the (B) position of the SPEED selector, the shutter remains open as long as the SHUTTER RELEASE lever is held down. When the control is released, the shutter closes. In the (T) position of the SPEED selector, the shutter is opened the first time the knob is pressed. It is then necessary to depress the SHUTTER RELEASE lever a second time to close the shutter.

The shutter can also be operated using a shutter release cable, connected to the cable release socket located on top of the shutter box.

CAUTION

Do not attempt to force the SHUTTER RELEASE LEVER.

Setting Lens Object-to-Image (MAG) Ratio

Several object-to-image (MAG) ratios are available for use with the Type C-30A Camera.

On the left side of the shutter box and above the guide rod is the MAGnification button. Just below is a window indicating the object-to-image ratio of the Type C-30A.

To change the magnification ratio, depress the MAG Index button and slide the shutter housing along the guides until the desired image number appears in the window under the MAG Index button. Release the button, then gently move the shutter housing until it engages the detent for that particular image number.

NOTE

When setting the camera for an object-to-image ratio of 1:0.85 the number 0.85 will not appear in the window; instead, a \diamond will appear. DO NOT loosen the set screw which secures the mag-

Operating Instructions—Type C-30A Camera

nification sleeve lock ring. This is a factory adjustment used solely to compensate for lens magnification tolerances. The magnification sleeve lock ring is located adjacent to the rear casting on the left guide, i.e., the guide which has the image numbers imprinted on it.

It is necessary to refocus the camera after changing the object-to-image ratio. Focusing instructions for each type of Camera Back will be found under the heading Camera Back in this section.

CAMERA BACK

Mounting the Camera Backs

Lift up the camera back latch and slide the ledge on the bottom of the camera back into the slot at the bottom center of the camera Main Frame. Holding the camera back firmly against the Main Frame, press down on the camera back latch to lock the back on the camera.

NOTE

Be sure the dark slide is installed any time the camera back is removed from the camera. On the Polaroid Roll or Pack film backs, the dark slide is part of the back. On the Graflok back, the dark slide is normally part of the attachment that goes with the Graflok back. In either case, failure to have a dark slide installed before removing the back will probably result in loss of film.

Selecting the Camera Back

The choice of a camera back will depend primarily on the intended use for the photograph, how quickly you want the finished photographs, the area you wish to photograph, the magnification factor of the Lens and the size of the picture image desired. To obtain a negative for additional prints use of conventional film is quite satisfactory. The holders for conventional cut and roll film can be used only with the 2¼ x 3¼ inches Graflok back in place.

With any film, the film size must be at least equal the size of the image from the Lens. The image size will depend on the object-to-image (MAG) ratio of the camera Lens and on the size of the oscilloscope display. For example, the roll film back for 120 film which can record a maximum image size of 2¼ x 2¼ inches can be used with a Lens object-to-image (MAG) ratio of 1:05 and a 10-cm wide oscilloscope display. This is because the image of the display on the film is 5 centimeters wide and the long dimension of the film is about 5.72 centimeters. Thus, the long dimension of the film is at least 7.1 mm longer than the needed image area.

In actual practice, the film size should be at least 5 mm larger than the size of the image to allow for normal tolerances in the construction of the camera backs and for variations in the position of the film in the back.

GRAFLOK BACK

Focusing With a Graflok Back

Install the Graflok back and press the release button on the back (see Fig. 2-2). Set the Lens for maximum aperture (f/1.2) and set the SPEED selector on (T). Obtain a sharply focused trace on the CRT using the oscilloscope Focus and

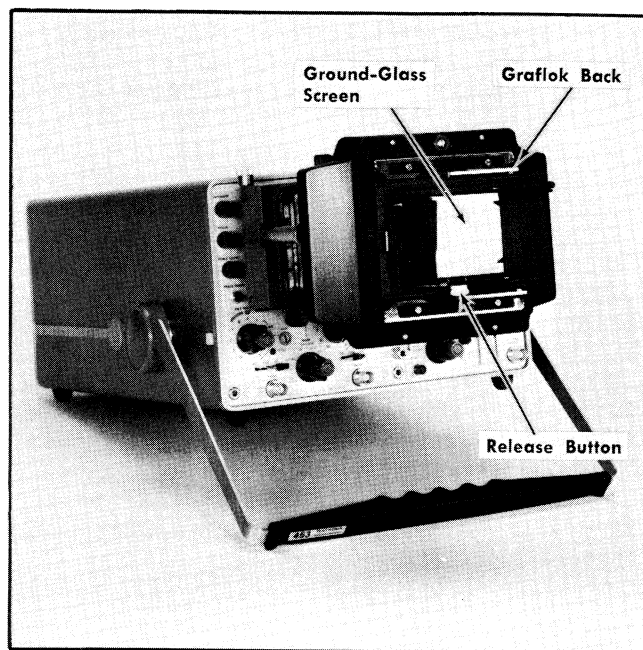


Fig. 2-2. The Graflok Back installed to permit focusing.

Astigmatism controls. Secure the camera in place on the oscilloscope. Open the camera shutter and observe the image on the ground glass screen of the Graflok back.

Turn the FOCUS LOCK knob fully clockwise, then adjust the FOCUS knob on the side of the camera Main Frame to produce a sharply focused image of the oscilloscope trace on the ground glass screen.

After focusing the camera, turn the FOCUS LOCK knob counterclockwise to insure that the camera focus cannot be changed accidentally.

The camera is normally focused on the oscilloscope trace, rather than the graticule, if an external graticule is being used, since it is usually most desirable to photograph the fine detail of the trace. Even with the camera focused on the oscilloscope trace, the focus of the external graticule will usually be quite satisfactory. The camera can, of course, be focused on the external graticule if desired.

CONVENTIONAL FILM HOLDERS

Loading the Sheet Film Holder

Sheet film is available in a variety of types. Some types of film require that the film holders be loaded in complete darkness while others permit the use of a safe light. See the instruction sheet with the film.

In loading the film holder, the dark slide (see Fig. 2-3) should be pulled out about half way. Place the silver side of the dark slide handle in the empty film holder to be loaded, towards the closest outside surface. Later, when the sheet of film has been exposed, turn the slide over so that the black side of the handle faces the outside when it is re-installed.

The following procedure should be practiced several times outside the darkroom before attempting to load the film holders in the dark.

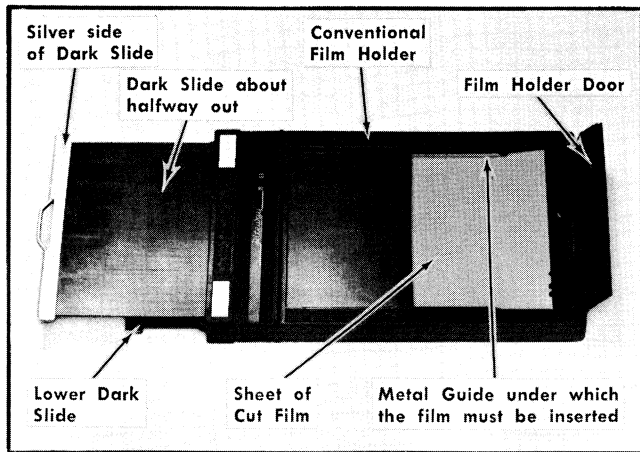


Fig. 2-3. Important points of film holder.

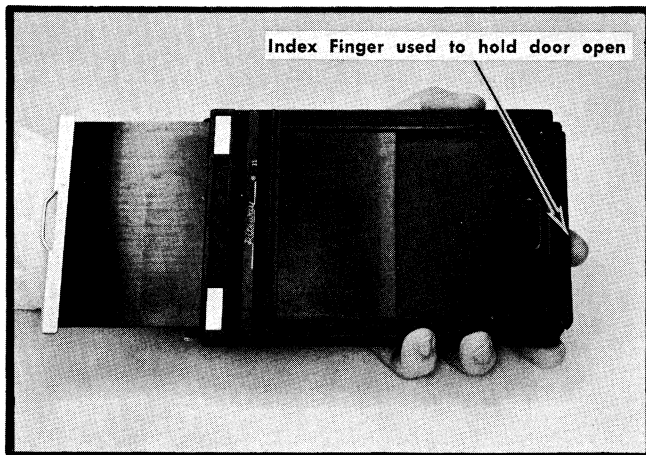


Fig. 2-4. Method used to hold film holder while loading the film.

Set the lighting conditions of the darkroom as described in the information sheet provided with the film. Now hold the film holder in your left hand with the side to be loaded up and the dark slide toward your body. The index finger

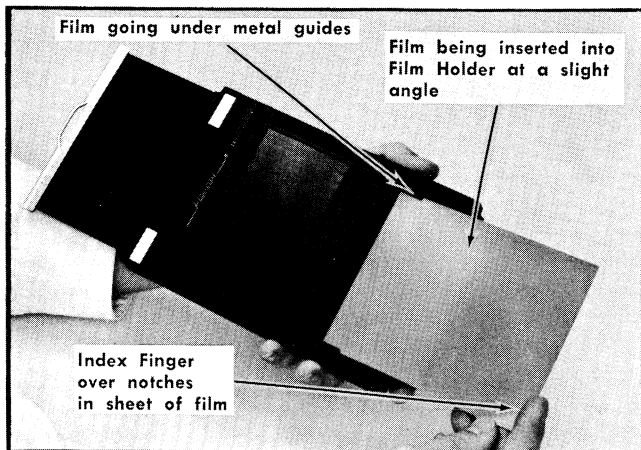


Fig. 2-5. Proper way to insert the film into the film holder. Note the position of the right index finger on the sheet of film.

of the left hand is used to hold the film holder door open. Refer to Fig. 2-4 for the method used.

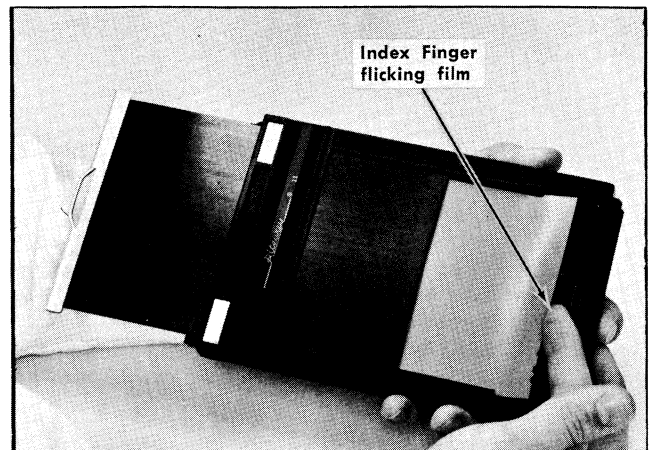


Fig. 2-6 Checking the sheet of film to insure that it has been inserted under the metal guides of the film holder.

With the right hand, hold the film so that the notches in the edge of the film are in the upper right corner. Fig. 2-5 shows the proper way to hold the film. In Fig. 2-5, note that the right index finger rests on the notches in the film. The film is inserted at a slight downward angle into the holder. Fig. 2-5 shows how the film must be inserted under the two metal guides inside the film holder. After the film is started under the metal guides, it should be shoved all the way forward in the holder (toward the body). If it is not, the complete image may not appear on the film.

When the film is inserted into the holder, the far end of the film should be given a flick to check that the film is under the film holder guides.

Close and hold the film holder in the closed position. Now push the slide all the way into the holder (toward the film door). The dark slide will slide into a slot in the film holder door when it is shoved in all the way, and the film holder will stay closed. One side of the film holder is now loaded.

The dark slide may now be locked in place by turning the right angle pin located on the end of the film holder toward your body.

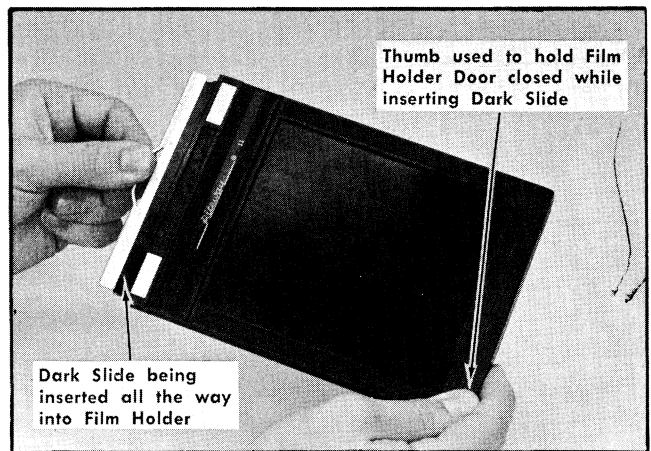


Fig. 2-7. Closing the film holder after loading the sheet of film. The film holder door is held closed with thumb while dark slide is installed.

Operating Instructions—Type C-30A Camera

Procedure Used to Expose Sheet Film

Obtain the desired waveform on the oscilloscope and focus the display with the Focus and Astigmatism controls. The camera should now be attached to the oscilloscope and the Graflok back attached to the camera.

Set the f STOP selector for the largest lens opening and the SPEED selector to the (T) position. Now depress the SHUTTER RELEASE lever to open the shutter. Open the ground glass viewing doors and check the focus of the camera.

Take the film holder with one hand, and with your free hand lift the hinged focusing panel on the Graflok back (see Fig. 2-8). Insert the film holder between the hinged focusing panel and the other part of the Graflok back. The side of the film holder to be exposed should be installed toward the camera lens.

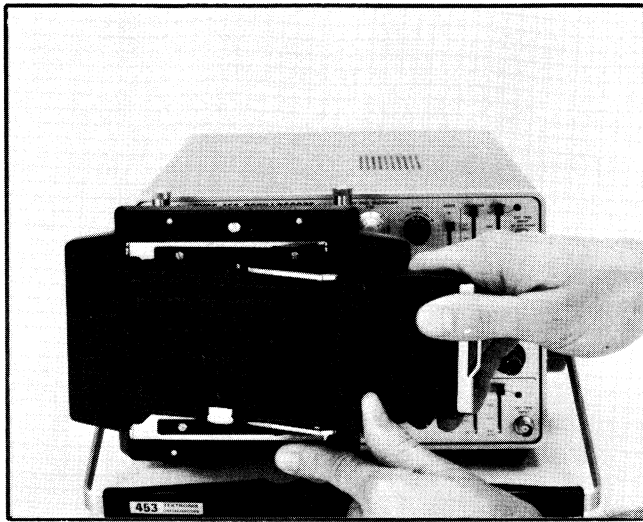


Fig. 2-8. Inserting the film holder in the Graflok back.

The film holder should be firmly shoved all the way into the Graflok back until the small ridge on the film holder is seated in the Graflok back. Give the film holder a slight tug to check that it is seated.

Close the shutter and set the f STOP selector and SPEED selector to the desired settings. Remove the dark slide from the side of the film holder facing the lens. Expose the film and replace the dark slide in the film holder so that the black side of the handle is toward the camera lens. The black side of the dark slide toward the nearest outside edge of the film holder, indicates exposed film.

To remove the film holder from the Graflok back, the hinged focusing panel must be lifted away from the camera slightly. With the hinged focusing panel lifted, take hold of the film holder, lift it slightly and pull outward.

To remove the sheet film from the film holder, reverse the loading procedure as described above.

Loading the Roll Film Holder

The sectional drawing (Fig. 2-9) may be used as a guide for loading the roll film holder. Fig. 2-10 shows the various parts of a 120 film size roll film holder. Make sure the dark slide is installed in the roll film holder before advancing the film for the first exposure.

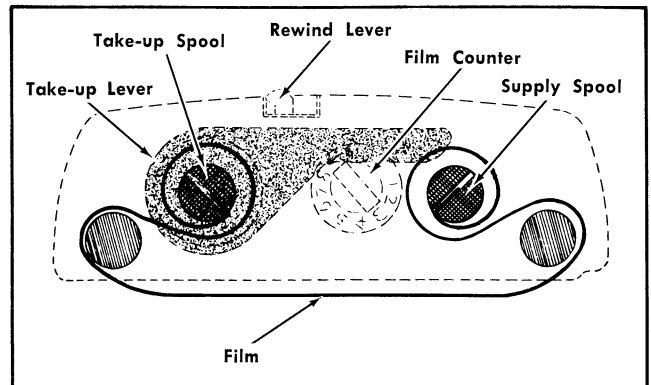


Fig. 2-9. Film threading path for a typical roll film holder.

Attaching the Roll Film Holder to the Graflok Back

The roll film holder should be loaded before installing it on the Graflok back. After the roll film holder is loaded and

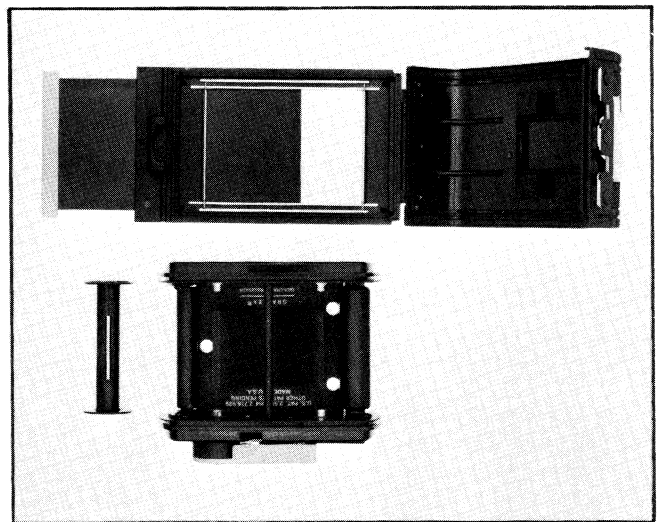


Fig. 2-10. Typical roll film holder apart, ready to load film.

the film advanced to the first exposure (dark slide still installed), it can be laid aside.

Install the Graflok back on the camera and install the camera on the oscilloscope.

Now place one thumb on each of the hinges for the hinged focusing panel (refer to Fig. 2-11). Press the hinges in toward the oscilloscope, and at the same time, slide the hinged focusing panel toward the side in which the film holder will be inserted. This procedure removes the hinged focusing panel from the Graflok back.

Slide the roll film holder onto the Graflok back. Sliding the roll film holder on will insure a light-tight seal. The small ridge on the roll film holder should fit into the slot in the Graflok back. This is the same type of locking used on the sheet film holders.

Operating Instructions—Type C-30A Camera

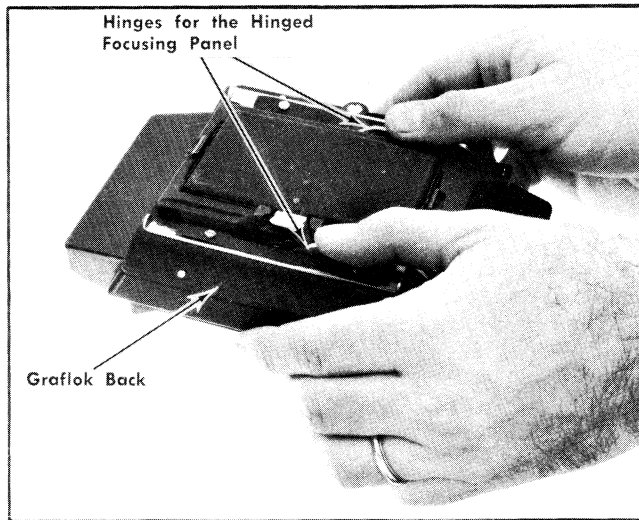


Fig. 2-11. Method used to remove the hinged focusing panel.

Hold the roll film holder on the Graflok back with one hand, using the other hand to engage the two slide locks.

One slide lock is located on each side of the long axis of the film (see Fig. 2-12).

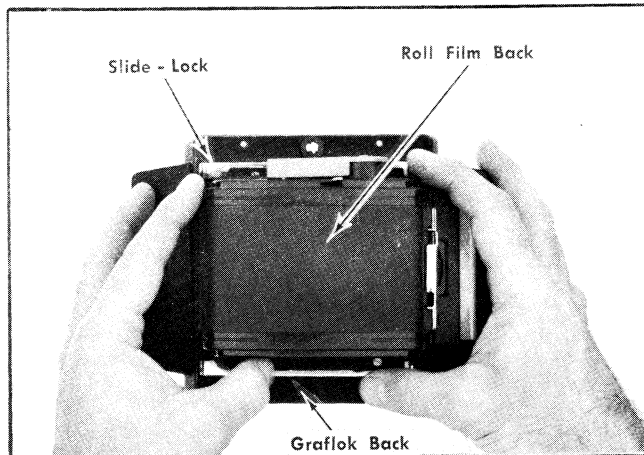


Fig. 2-12. Installing the roll film back on the Graflok back.

Exposing Roll Film

Obtain the waveform on the oscilloscope and focus it properly. The camera should already be in focus. If it is not, the hinged focusing panel must be reinstalled for focusing. Remove the dark slide from the roll film holder, set the SPEED selector and f STOP selector to the proper settings and take the picture.

To advance the film, press the film release lever and rotate the lever until it stops. The roll film holder is now ready for the next exposure.

POLAROID LAND ROLL FILM BACK

Focusing the Camera with the Focus Plate

To use the focus plate, open the Polaroid Land roll film camera back and insert the focus plate where the film normally rests.

To accomplish this, place the frosted side of the focus plate toward the camera lens and insert the two bottom ears inside the edge of the camera-back film compartment. With nothing more than finger pressure, gently press the upper mounting ears all the way into the film plane within the film compartment. The upper mounting ears will have to be compressed and the focus plate inserted into the film compartment at the same time. Fig. 2-13A shows the focus plate properly installed.

For best trace detail, focus the camera on the oscilloscope trace (the focus of the external graticule will usually be satisfactory). If less trace detail can be tolerated, the camera can be focused on the external graticule if desired.

Set the Lens for maximum aperture and the SHUTTER SPEED selector to T (time). Obtain a sharply focused trace on the CRT, then secure the camera against the oscilloscope. Open the camera shutter and observe the trace on the focus plate. When the split image focus plate (TEKTRONIX PN 387-0893-01) is used, observe the horizontal trace or graticule line in the center of the clear bi-prism spot. Adjust the Focus knob on the camera until the horizontal trace or graticule line is aligned with itself (see Fig. 2-13C). If a focus plate without the split image is used, adjust the Focus knob for a sharply focused trace or graticule line on the focus plate.

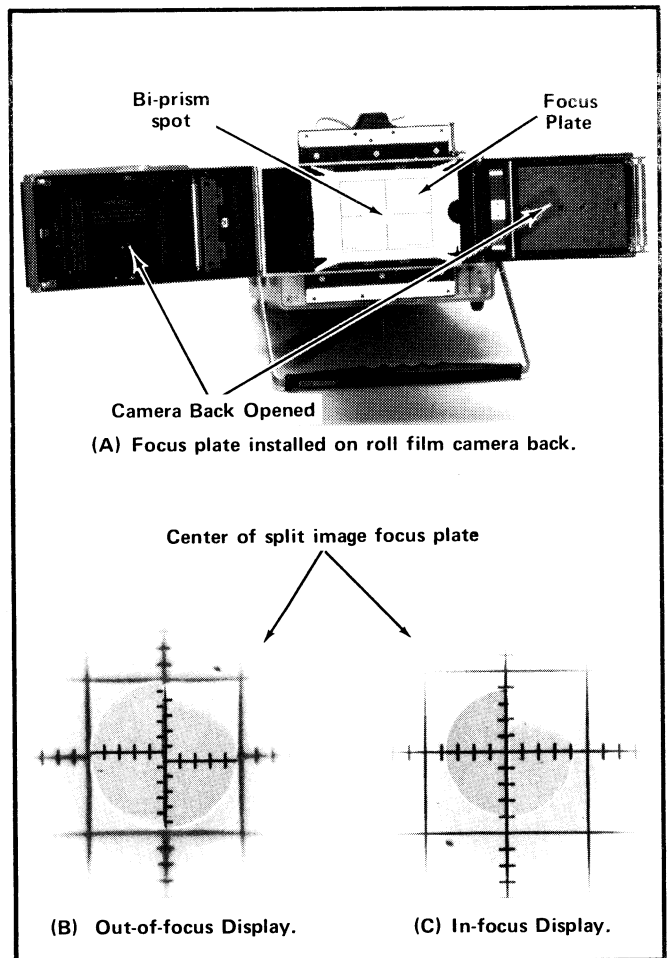


Fig. 2-13. Focus Plate installation and focus displays (Roll film camera back).

Operating Instructions—Type C-30A Camera

Loading and Exposing the Roll Film Back

When a new box of film is opened, the instruction sheet and print coater should be saved.

To open the camera back for loading, swing the latch lever out and down from the bottom of the camera back. Open the back cover fully and swing out the inner panel.

Remove the empty spool from the camera back. The processing rollers in the camera should be inspected and cleaned if necessary. A damp cloth may be used to clean the rollers. It is important to keep these rollers clean to spread the developer evenly between the negative and positive components of the film.

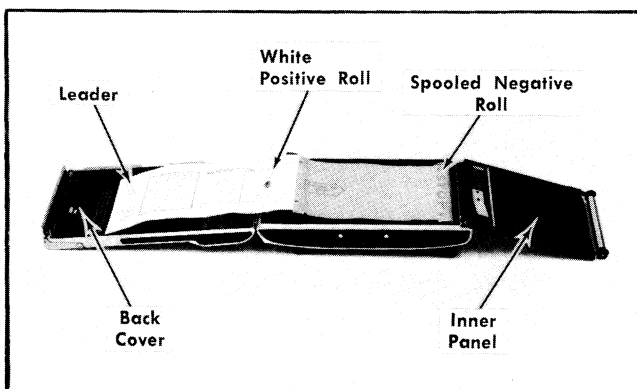


Fig. 2-14. The Polaroid Roll Film Camera Back opened for loading. The white positive roll is dropped in the well at the left while the spooled negative roll is dropped in the well at the right.

In the following procedure it is assumed that the camera back is lying face down on a table, with the dark slide protruding from the top (tripod socket hole toward you).

Remove the film rolls from the foil wrapper by tearing the wrapper at the indicated point. Break the first seal at the end of the roll. The film actually contains two rolls; a large white positive roll and a smaller spooled negative roll. In unwrapping the film, be careful not to break the seals on the top of the negative roll and the underside of the positive roll. Drop the rolls into the wells in the camera back as shown in Fig. 2-14.

Close the inner panel, bringing the film leader around the steel roller on the edge of the inner panel. Lay the

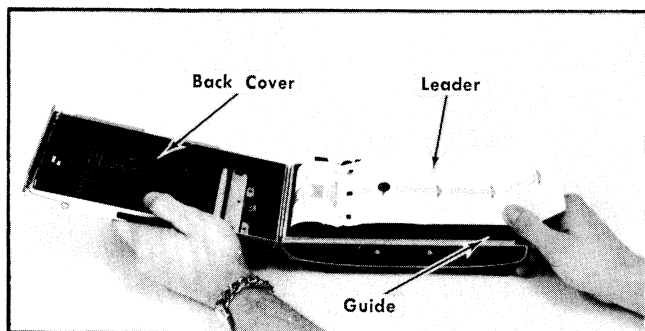


Fig. 2-15. The leader of the film roll must be brought around the roller on the inner panel. Care must be taken that the leader is aligned between the guides on the inner panel before the back is closed.

leader flat between the guides at the outer edge of the panel (see Fig. 2-15). Be sure that the white paper of the positive roll lies smooth and flat, not tucked into the well.

Close the back cover and hold it shut. Swing the latch lever all the way towards the bottom of the camera back to insure that both sides of the back cover will latch, then swing the latch lever to the locked position (towards the top of the camera back). There should now be a short tab of paper extending beyond the cutter bar of the camera back. The dark slide should be installed in the camera back to prevent exposing the first frame.

Hold the camera back and lift the cutter bar by raising up on the plastic edge. Once the cutter bar has been lifted it will remain in the up or unlocked position until it is pushed down. Pull the film leader out of the camera back until it comes to a firm stop. About 15 inches of the film leader must be pulled out before it will stop, in proper position for the first exposure.

Now lock the cutter bar with a gentle downward pressure. After it has latched you can tear the film leader off and discard it.

The camera back is now ready for the first picture. Mount the camera back on the camera Main Frame and make the proper shutter and lens opening settings. Remove the dark slide and take the picture. The number of exposures remaining on the roll is indicated on the film tab under the cutter bar.

Advancing and Developing Roll Film

Throw the red release switch in either direction to release the film. If you should throw it accidentally at any time, don't worry—no harm is done. Open the cutter bar by lifting the plastic edge, and take a firm on the film tab.

Pull the film tab straight out about 7 inches with a single motion. Pull it about as rapidly as you might pull down a window shade; not hard enough to pull the shade off the roll (or the film off the spool), but not slowly and hesitantly. Remember, the film will stop automatically.

NOTE

If the film tab will not pull easily, throw the red release switch again.

After you pull the film tab, press down and latch the cutter bar. Tear off and discard the excess paper.

Wait the recommended development time. Pulling the film tab has started development process and advanced the film into position for the next picture. Follow the instructions in the instruction sheet for development times under various conditions. Check the instruction sheet for exact development time. This time varies for different types of film, and even the development time for a particular film may change.

When the development time is up, slide back the latch on the print door and open the door. Lift the print out carefully, starting with the cutout. Don't let the print fall back on the damp negative. Close and relatch the print door.

Apply the print coater along the entire length of the print, including edges, borders and corners, with 6 to 8 firm overlapping strokes. For the last two or three pictures in each roll, press the coater down hard against the tab end of the print (not the image) for a moment to release extra liquid; then spread the liquid smoothly across the print.

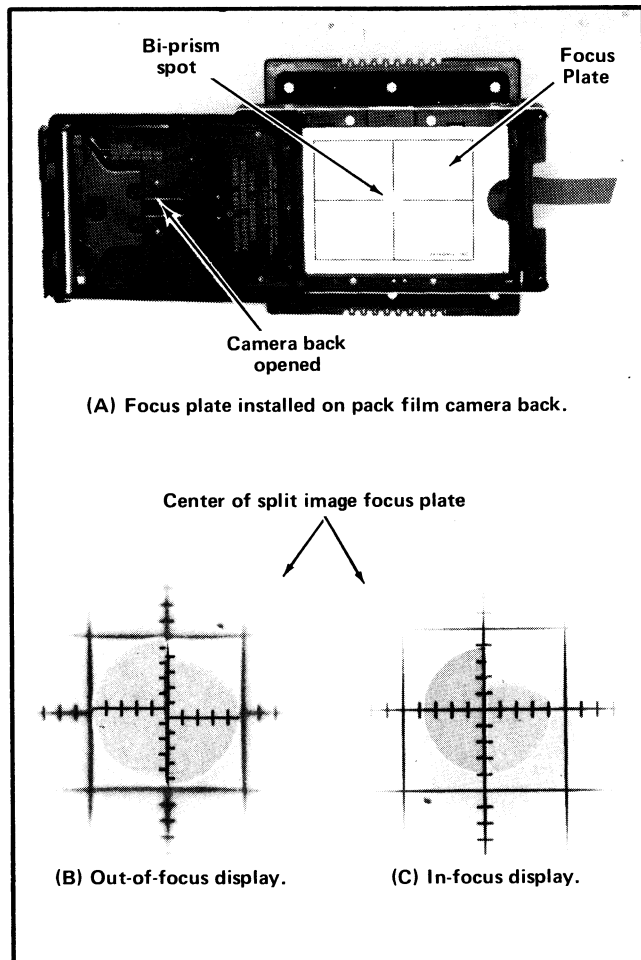


Fig. 2-16. Focus Plate installation and focus displays (Pack film camera back).

POLAROID LAND PACK FILM CAMERA BACK

Focusing the Camera with the Focus Plate

To use the focus plate, open the Polaroid Land pack film camera back and insert the focus plate where the film normally rests. To accomplish this, place the frosted side of the focus plate toward the camera lens, insert the left side under the door hinge and down next to the exposure window. With nothing more than finger pressure, gently press the focus plate in the direction of the hinge, at the same time press the focus plate all the way into the film plane (see Fig. 2-16A). The half-moon cutout in the opposite end of the plate provides a finger hole for easy removal of the focus plate.

For best trace detail, focus the camera on the oscilloscope trace, (the focus of the external graticule will usually be satisfactory). If less trace detail can be tolerated, the camera can be focused on the external graticule if desired.

Set the Lens for maximum aperture and the SHUTTER SPEED selector to T (time). Obtain a sharply focused trace on the CRT, then secure the camera against the oscilloscope. Open the camera shutter and observe the trace on the focus plate. When the split image focus plate (TEKTRONIX PN 387-0893-02) is used, observe the horizontal trace or graticule line in the center of the clear bi-prism spot. Adjust the FOCUS knob on the camera until the horizontal trace or graticule line is aligned with itself (see Fig. 2-16C). If a focus plate without the split image is used, adjust the FOCUS knob for a sharply focused trace or graticule line on the focus plate.

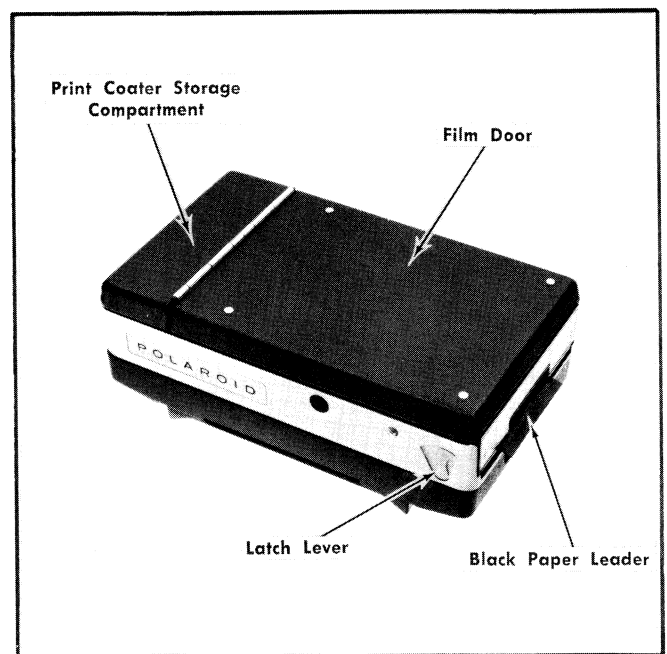


Fig. 2-17. Polaroid Land Pack Film Camera Back.

Loading and Exposing the Polaroid Land Film Back

When the film box is opened, the instruction sheet, film box, and print coater should be saved.

To open the camera back for loading, push the latch lever (on the bottom of the camera back near the tripod socket), counterclockwise. The door should open slightly. Now swing the door fully open.

Remove the empty film container from the camera back.

The processing rollers in the camera back should be inspected and cleaned if necessary. Directions inside the door indicate how to release the stainless steel rollers from their normal position in the camera back. A damp cloth may be

Operating Instructions—Type C-30A Camera

used to clean the rollers. It is important to keep these rollers clean to spread the developing reagent evenly.

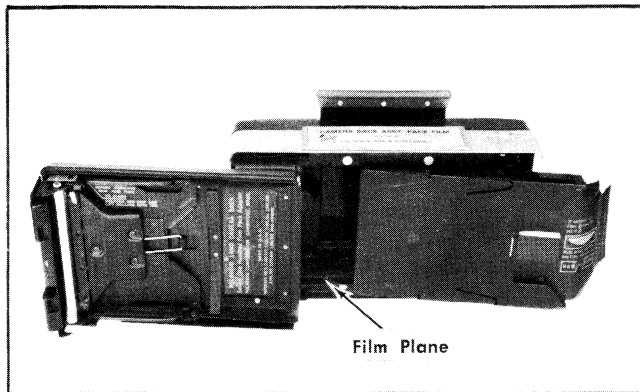


Fig. 2-18. Installing Film Pack into Camera Back.

In the following procedure it is assumed that the camera back is lying face down on a table, with the dark slide protruding from the top (tripod socket toward you).

Remove the film pack from the foil wrapper by tearing the wrapper at the indicated point. When you unwrap the film, be careful to handle the film pack by the edges only.

Insert the film pack under the back door hinge, and push it toward the hinge and down into the film plane until it snaps into place. Be sure that the indicated side of the film pack is correctly oriented toward the lens, or the dark slide in this case. The black paper leader should be allowed to hang over the right end of the camera back.

Close the door by squeezing it until both sides snap shut. Check that the black paper leader is now extending outside the camera back. The dark slide should be pushed in all the way.

Hold the camera back and pull the black paper leader all the way out. The camera is now ready for the first picture. If the dark slide is not pushed in all the way, the first exposure may be fogged.

Mount the camera back on the camera Main Frame and make the proper shutter and lens opening settings. Remove the dark slide and take the picture. The number of the negative ready for exposure is indicated on the white tab protruding from the camera back.

Advancing and Developing the Film

After taking the picture, pull the white tab all the way out. Pulling the tab does two things: first, it positions the positive and negative sheets together; and second, it causes the yellow tab (marked PULL) to pop out.

NOTE

Do not pull another white tab if a yellow tab is extending from the camera back. The white tab should be the only tab visible when it is pulled.

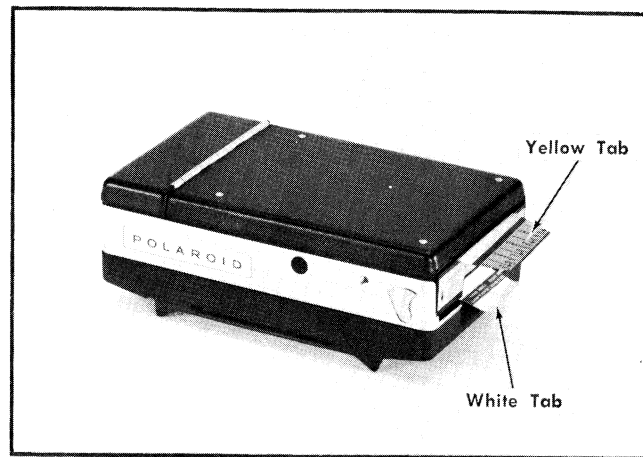


Fig. 2-19. Positive and negative sheets ready to be pulled out of camera back.

Next pull the yellow tab. This causes the positive and negative sheets to be pulled between and through the processing rollers, spreading the developing reagent between the two sheets to start the development process.

Pull the yellow tab completely out of the camera back in one smooth, fairly rapid motion. Pull about as hard and rapidly as you might pull down a window shade; not slowly and hesitantly.

Wait the recommended development time. Follow the directions in the instruction sheet for development times under various conditions. Check the instruction sheet for exact development time. This time varies for different types of film, and even the development time for a particular film is subject to change.

When the development time is up, peel the print away from the negative rapidly. Do not let the print fall back on the damp negative.

Coat each print as soon as possible after separating it from the negative.

Apply the print coater along the entire length of the print, including edges, borders and corners, with 6 to 8 firm overlapping strokes. For the last two or three pictures in each film pack, press the coater down hard against a non-image surface for a moment to release extra liquid; then spread the liquid smoothly across the print as before.

Storage of Print Coater

The print coater can be stored in the compartment just to the left of the film loading door (bottom of camera back towards you). To open compartment, take hold of the black cover area to the left of the hinge and lift up.

ACCESSORIES

Portra Lens

The portra lens is attached to the normal Type C-30A Lens by inserting the portra lens into the three plastic clips

located around the front of the normal lens. Access to the front of the camera lens is obtained through the opening in the support casting. When attaching the portra lens to the camera lens, the lettering on the portra lens must be facing away from the camera lens.

Shutter Actuator Model 3

Mounting Model 3 Power Supply and Mounting Bracket 407-0477-01.

Place the power supply in an inverted position with the front panel toward you, and remove the two bottom screws. Lay the mounting bracket on the supply so the narrow flat surface of the bracket (power supply base) is against the supply and the camera mounting slots are on the right. Line up the holes in the bracket with the two screw holes in the bottom of the power supply. Re-insert the two bottom screws through the slots into the power supply cabinet and tighten.

Power Supply Model 3 (box style) is mounted to the rear casting of the camera Main Frame. Loosen the two screws on the right-front of the rear casting (camera back is toward you). Slip the camera mounting slots, see Fig. 2-20, in the Power Supply Mounting Bracket under the screws as far as possible, then tighten the screws.

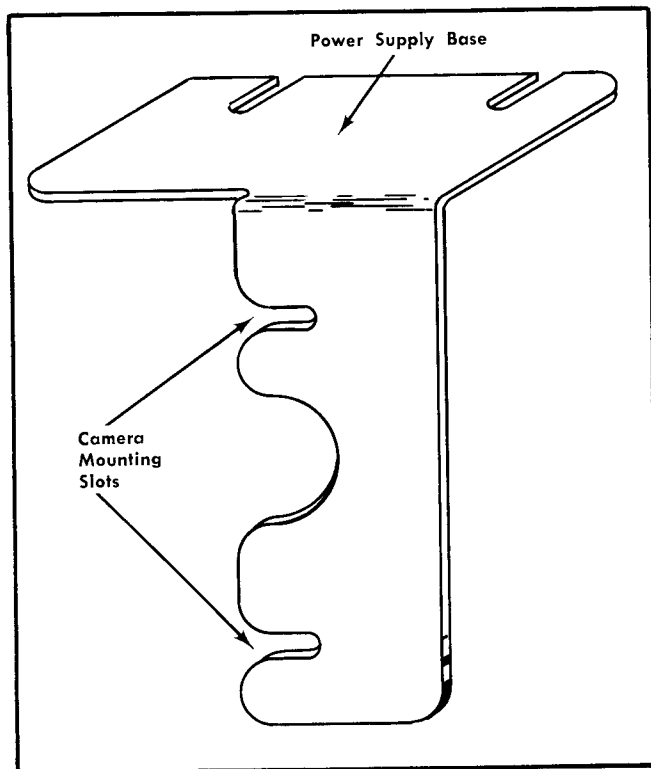


Fig. 2-20. Power Supply Mounting Bracket (407-0477-00) terminology.

Power Supply Model 3 and Mounting Bracket 122-0713-00

With the power supply inverted and the front panel toward you, remove the two bottom screws. Lay the mounting bracket on the supply so the flat surface of the bracket is

against the supply and the plastic knob is toward you. Line up the slots in the bracket with the screw holes in the power supply. Reinsert the two bottom screws through the slots into the power supply cabinet. Don't tighten the screws yet.

Power Supply Model 3 (box style) is mounted on a camera back by inserting the screw supplied with the mounting bracket through the proper hole in the bracket and into the tripod socket on the bottom of the camera back. Mounting holes are shown in Fig. 2-21.

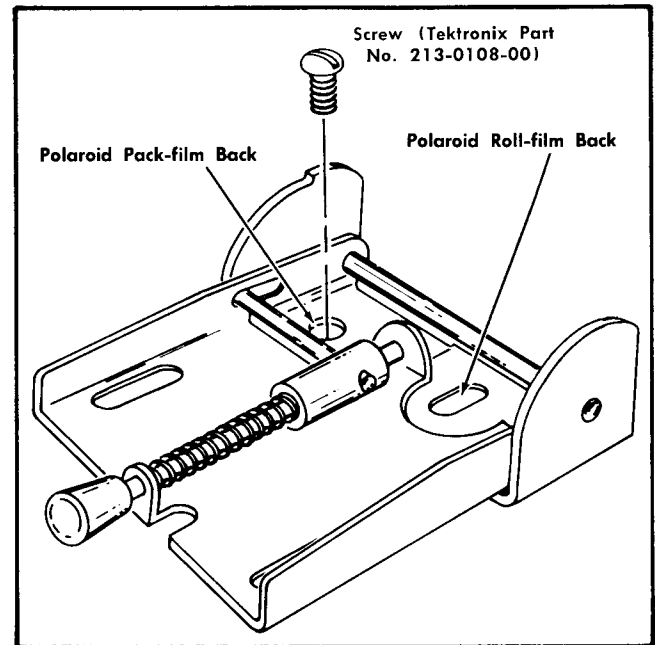


Fig. 2-21. Selecting proper mounting hole in Power Supply Mounting Bracket (122-0713-00).

After securing the power supply Mounting Bracket to the camera back, push the power supply toward the camera back until the rubber feet rest on the camera back. The two bottom screws holding the bracket to the power supply should now be tightened.

To open the camera back, pull the plastic knob under the Power Supply. This allows the Power Supply to swing out and down, clearing the camera back for opening. After the camera back is closed again, swing the power supply back into position. It will lock in place automatically.

Shutter Actuator Solenoid

Loosen both the Shutter Actuator solenoid set screws found between the main part of the body and the knurled nut. Loosen the set screws just enough so the knurled nut turns freely.

Align the Shutter Actuator solenoid on the shutter box directly above the cable release socket. Tighten the knurled nut to fasten the Shutter Actuator solenoid to the cable release socket or loosen the set screws and remove the knurled nut from the solenoid body. Then put the knurled nut on the cable release socket, and remount the Shutter Actuator body onto the knurled nut. Tighten one or both of the set screws that retain the knurled nut.

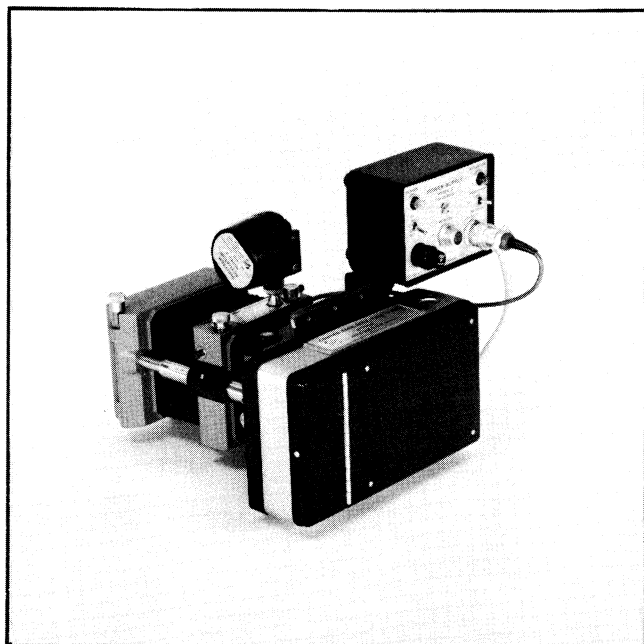


Fig. 2-22. Mounting the Shutter Actuator on the Type C-30A Camera using Power Supply Mounting Bracket (407-0477-00).

Operating Controls and Connectors

ACTUATOR (Indicator Lamp)	Lights when the Shutter Actuator solenoid is energized. The lamp will stay lit as long as the actuator is held energized. The lamp is an indicator that the shutter is open if the shutter is set on (B). The lamp is not, however, an indicator that the shutter is open if the shutter is set on (T).
ON-OFF POWER	Turns the line voltage to the power supply on or off. Indicator lamp lights when line voltage is applied to the power supply.
MOMENTARY- OFF-MAINTAIN	Causes the Shutter Actuator solenoid to be energized in the MOMENTARY or MAINTAIN positions. MOMENTARY is a spring return to OFF position while the MAINTAIN position allows the Shutter Actuator solenoid to be held in the energized position indefinitely.
REMOTE	Applying 24 VDC to the + and - pins of the REMOTE connector will energize an internal relay whose normally open contacts are connected across the MOMENTARY-OFF-MAINTAIN switch. The energizing of the internal relay causes its normally open contacts to close, which simulates holding the MOMENTARY-OFF-MAINTAIN switch in MOMENTARY position. As long as 24 VDC is applied to the + and - pins of the REMOTE connector the Shutter Actuator solenoid remains energized. Accepts male connector (Tektronix Part No. 131-0423-00).
Power Cord	The power cord to the power supply is permanently attached.

ACTUATOR 115 (230) VDC 1A (.5A) Receptacle into which the connector from the Shutter Actuator solenoid connects to obtain power to operate the Shutter Actuator solenoid.

Operating Shutter Actuator Model 3

NOTE

To prevent a misleading display on the oscilloscope, the leads of the Shutter Actuator system should not be interwound with the input leads to the oscilloscope. Maximum separation of the leads is recommended since there is a magnetic field present when the Shutter Actuator solenoid is energized.

Repetitive Waveforms

Mount the Shutter Actuator solenoid and power supply on the camera as described under Mounting, then mount the camera on the oscilloscope.

1. Connect the Shutter Actuator solenoid to the power supply and apply power, then set the SPEED selector to (B).
2. Energize the Shutter Actuator solenoid by turning the ON-OFF switch to ON and the MOMENTARY-OFF-MAINTAIN switch to MAINTAIN.
3. Focus the camera.
4. After focusing the camera, return the MOMENTARY-OFF-MAINTAIN switch to OFF.

To photograph a repetitive waveform using any shutter setting other than (T) or (B), first obtain a stable display of the desired waveform on the CRT. Then, with the Camera Back ready for exposure, push the MOMENTARY-OFF-MAINTAIN switch to MOMENTARY and release.

To photograph a repetitive waveform using a shutter setting of (T), the MOMENTARY-OFF-MAINTAIN switch must be pushed twice to the MOMENTARY position. The first time, the shutter will open. The second operation will close the shutter.

To photograph a repetitive waveform using a shutter setting of (B), the MOMENTARY-OFF-MAINTAIN switch must be held in the MOMENTARY position for the desired exposure time and then released.

Non-Repetitive Waveforms

Mount and focus the camera system as outlined above under Repetitive Waveforms.

When photographing a non-repetitive waveform using a shutter setting of (T), set the oscilloscope for single sweep operation to avoid display jitter. Push the MOMENTARY-OFF-MAINTAIN switch to MOMENTARY and release. Wait for the waveform to occur, then push the MOMENTARY-OFF-MAINTAIN switch to MOMENTARY again and release. This last action closes the shutter.

When using a shutter setting of (B) to photograph a non-repetitive waveform, set the oscilloscope for single sweep operation. Then set the MOMENTARY-OFF-MAINTAIN switch to MAINTAIN. After the waveform has occurred, the MOMENTARY-OFF-MAINTAIN switch is set to OFF to close the shutter.

NOTE

The Shutter Actuator System Model 3 may be left in the MAINTAIN (energized) position for an indefinite period without damaging the equipment.

#1 Electric Shutter and Speedcomputer

Mounting Speedcomputer and Mounting Bracket 407-0477-01

Place the Speedcomputer in an inverted position with the front panel toward you, and remove the two bottom screws. Lay the mounting bracket on the Speedcomputer so the narrow flat surface of the bracket (Speedcomputer base) is against the Speedcomputer and the camera mounting slots are on the right. Line up the slots in the bracket with the two screw holes in the bottom of the Speedcomputer. Re-insert the two bottom screws through the slots into the Speedcomputer cabinet and tighten.

The Speedcomputer is mounted to the rear casting of the camera Main Frame by loosening the two screws on the right-front of the rear casting (camera back is toward you). Slip the camera mounting slots, see Fig. 2-20, in the Speedcomputer Mounting Bracket under the screws as far as possible, then tighten the screws.

Mounting Speedcomputer and Mounting Bracket 122-0713-00

Grasp the Speedcomputer so that the front panel is toward you and the top of the Speedcomputer is down. With the Speedcomputer in this position, remove the two bottom screws. Lay the mounting bracket (see Fig. 2-21) on the Speedcomputer so the flat surface of the bracket is against the Speedcomputer and the plastic knob is toward you. Line up the slots in the bracket so they are over the holes in the Speedcomputer from which the two bottom screws were just removed. When the slots and screw holes are lined up, re-insert the two bottom screws through the slots into the Speedcomputer cabinet. Do not tighten the screws at this time.

The Speedcomputer is mounted on a camera back by inserting the screw supplied with the Speedcomputer mounting bracket through the proper hole in the bracket and into the tripod socket on the bottom of the camera back. The proper hole to mount the mounting bracket to the camera back is shown in Fig. 2-21.

After securing the Speedcomputer mounting bracket to the camera back, push the Speedcomputer toward the camera back until the rubber feet rest against the camera back. The two bottom screws holding the bracket to the Speedcomputer are now tightened.

When it is necessary to open the camera back, the Speedcomputer may be rotated out of the way. The Speedcomputer is unlocked from its operating position by pulling outward on the plastic knob. Keep the knob pulled out (away

from the camera back) and rotate the Speedcomputer out and down. Release the knob and allow the Speedcomputer to rotate into its down position. After the camera back is closed again, the Speedcomputer is rotated back to normal position by pushing it up and in toward the camera. The Speedcomputer locks into position automatically.

Operating Controls and Connectors

- POWER** Indicator lamp lights when line-voltage is applied to the Speedcomputer and the ON-OFF switch is in ON position.
- ON-OFF** Turns the line voltage to the Speedcomputer on or off.
- SHUTTER** Indicator lamp lights when the shutter blades are open. The lamp will stay lit as long as the shutter blades are open.

NOTE

If Electric Shutter fails to operate and POWER indicator lamp will not light, check fuse. The fuse is located inside the Speedcomputer case. Instructions for disassembly of the Speedcomputer will be found in Section 6.

- ACTUATE (Pushbutton)** Causes the solenoid in the Electric Shutter to be energized, thereby opening the shutter blades. In any speed setting except (T) the solenoid will automatically de-energize (shutter blades close) when the indicated (speed setting) time has passed. In the (T) position the ACTUATE pushbutton must be pushed twice, once to open the shutter blades and once to close the shutter blades.
- Speed** Knob that determines the time the shutter blades will remain open. In (T) the shutter blades can remain open for an indefinite time without any damage to the Electric Shutter or Speedcomputer.
- Remote (3 pin connector on side of actuator)** The action of pressing the ACTUATE pushbutton may be done remotely by either shorting pins A and C of the connector together momentarily, or by connecting +27 VDC to pin A of the connector using Pin B as ground. Accepts male connector (Tektronix Part No. 131-0423-00).
- Electric Shutter (6 pin connector on side of actuator)** Receptacle into which connector from the Electric Shutter connects to obtain power (J10, pins F and B) for the solenoid and to supply (via J10, pins D and E) shutter-blade position information (open or closed) to the Speedcomputer. It also supplies the switch connections (J10, pins A and C) to the X Sync Posts from the Electric Shutter.
- Power Cord** The power cord is permanently attached.
- X Sync Posts (2 pin connector on side of actuator)** An extension of normally open switch contacts in the shutter assembly. Contacts are open (off) when shutter blades are closed and closed (on) when shutter blades are opened.

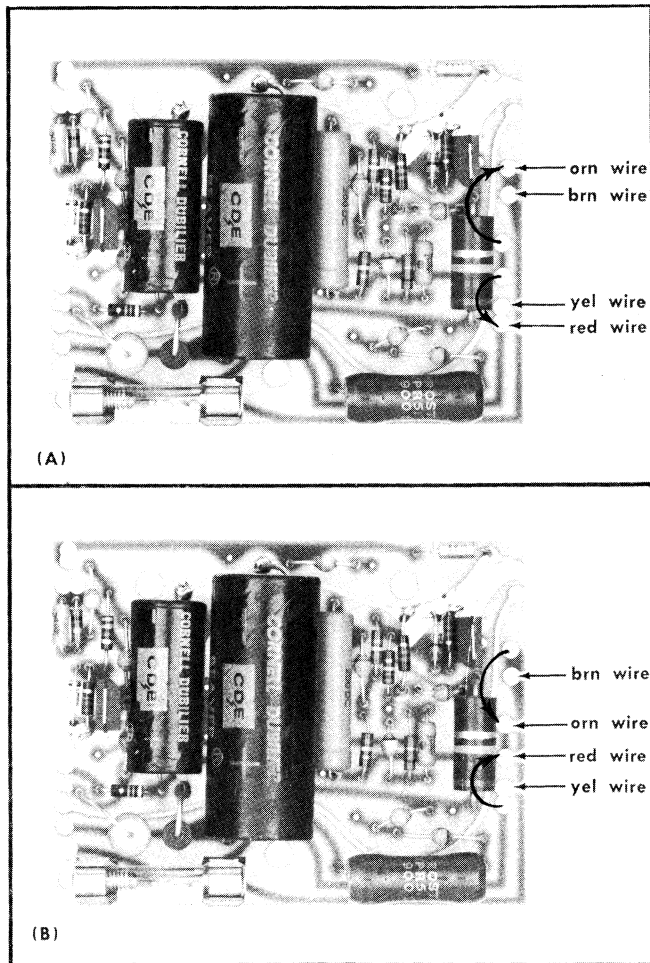


Fig. 2-23. Transformer primary connections for: (A) 105-130 VAC operation. (B) 210-260 VAC operation.

Power Transformer Line-Voltage Conversion

The Speedcomputer as shipped from Tektronix, Inc., unless otherwise ordered, will be wired for 105-130 volt AC operation. To change the Speedcomputer so it will operate on a 210-260 volt AC line voltage, refer to Fig. 2-23B. Fig. 2-23A illustrates how to convert the Speedcomputer back to 105-130-volt AC line voltage. Whenever the line voltage is changed, the fuse must also be changed, see electrical parts list for correct value.

Disassembly instructions for the Speedcomputer will be found in Section 6.

Operating Electric Shutter and Speedcomputer

NOTE

To prevent a misleading display on the oscilloscope, the leads of the Electric Shutter/Speedcomputer system should not be interwound with the input leads to the oscilloscope. Maximum separation of the leads is recommended since there is a magnetic field present when the Electric Shutter solenoid is energized.

Focusing with Electric Shutter

The aperture opening is controlled and selected in a normal manner. The shutter blades may be opened for focusing by setting the Speed switch on the Speedcomputer to (T) and pressing the ACTUATE pushbutton once to open the shutter blades and pressing it again, when finished focusing, to close the shutter blades.

Photographing Repetitive Waveforms

Mount the Electric Shutter and Speedcomputer on the camera as described under mounting, then mount the camera on the oscilloscope.

1. After connecting the Electric Shutter to the Speedcomputer, apply line voltage to the Speedcomputer, then set the Speed selector to T.
2. Open the shutter blades by pressing the ACTUATE PUSHBUTTON.
3. Focus the camera.
4. After focusing the camera, close the shutter blades by again pressing the ACTUATE pushbutton.

To photograph a repetitive waveform, using any shutter setting other than (T) or (B), first obtain a stable display of the desired waveform on the CRT. Second, with the camera back ready for exposure, push the ACTUATE pushbutton and release.

To photograph a repetitive waveform using a shutter setting of (T), the ACTUATE pushbutton must be pushed twice. The first time it is pushed, the shutter will open. The second operation will close the shutter.

To photograph a repetitive waveform using a shutter setting of (B), the ACTUATE pushbutton must be held in the pushed-in position for the desired exposure time and then released.

Photographing Non-Repetitive Waveforms

Mount and focus the camera system as described previously under "Photographing Repetitive Waveforms."

When photographing a non-repetitive waveform using a Speedcomputer Speed setting of (T), set the oscilloscope for single-sweep operation so that the display, when presented, will not have jitter. Push the ACTUATE pushbutton to open the shutter blades. Wait for the waveform to occur, then push the ACTUATE pushbutton to close the shutter blades.

When using a Speedcomputer speed setting of (B) to photograph a nonrepetitive waveform, set the oscilloscope for single-sweep operation. Then push the ACTUATE pushbutton in and hold it for the duration of the waveform. After the waveform has occurred, then release the pushbutton to close the shutter blades.

NOTE

In (T) the shutter blades can remain open for an indefinite time without any damage to the Electric Shutter or Speedcomputer.

SECTION 3

PHOTOGRAPHIC TECHNIQUES

Change information, if any, affecting this section will be found at the rear of the manual.

WRITING RATE

Writing Rate is a figure of merit which roughly describes the ability of a particular camera system mounted on a particular oscilloscope to photograph fast moving traces. The writing rate figure expresses the maximum spot rate (usually in centimeters per microsecond) which can be photographed satisfactorily.

The faster the oscilloscope spot moves, the dimmer the trace becomes. This is because the electron beam strikes each point on the phosphor coating for a shorter period of time. A camera system and oscilloscope with a high writing rate are required for photographing low repetition rate displays at the fast oscilloscope sweep rates.

Figure 3-1 shows one way to calculate writing speed. A single trace of a damped sinewave is displayed. The frequency of the damped waveform is such that the rapidly rising and falling portions of the first cycle or two fail to photograph. The writing rate of the system is found as follows: Starting from the left, find the first rapidly rising or falling portion of the damped sinewave that is photographed in its entirety. Let D represent the vertical distance in centimeters between the peaks connected by this portion. If D is three or more times as great as the horizontal distance occupied by one cycle (so that the horizontal component of velocity is small compared to the vertical component), the maximum writing speed in centimeters per microsecond is given approximately by:

$$\text{Maximum writing speed} = 3.14 Df$$

where f is the frequency of the damped wave in megahertz.

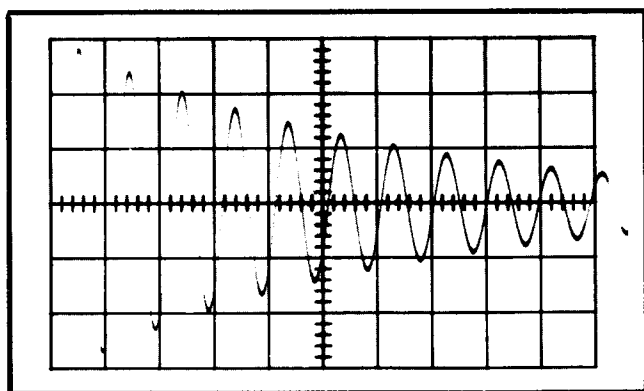


Fig. 3-1. A single-shot damped sinusoidal waveform which can be used to measure the maximum writing rate of an oscilloscope camera combination.

Absolute writing speed of an oscilloscope or camera is difficult to measure because so many variables are involved. Among the variables are the speed of the camera lens, the type of phosphor, the type of film, the CRT accelerating potential, the camera lens, and development time of the film.

It is possible to compare the effectiveness of two films by measuring their writing speeds under identical conditions. In other words, the more effective of the two films under those particular conditions can be chosen without being able to assign a specific value to either film.

The rated ASA speed of a film reveals little about its effectiveness in recording single oscilloscope traces. This is because ASA speed rating is measured for 1/50 second exposure to light of normal daylight and spectral characteristics, while the very short exposures of fast CRT traces are several orders of magnitude smaller and have different spectral distributions. There is usually some relationship between ASA rating and maximum writing rate, however. Thus it would be safe to assume that a film with a very high ASA speed rating would probably have a higher maximum writing rate than a film with lower ASA speed rating.

CRT SELECTION

There are a great number of phosphor types presently available to the purchaser of a cathode-ray oscilloscope. Each of these phosphors has certain advantages and disadvantages compared to the others. No single phosphor is best for all application. Of the many types of phosphors available, five are most commonly in use. They are P1, P2, P7, P11 and P31. Other phosphor types are usually restricted to special applications. Since the P1, P2, P7, P11 and P31 phosphors are most commonly used, information contained here will primarily concern them.

For low sweep rate or repetitive-sweep applications where a high writing rate is not required, practically any type of phosphor is satisfactory. It is only for single-sweep or low-repetition-rate applications at the fast sweep rates where selection of the CRT phosphor is important. In low repetition rate applications at the fast sweep rates, use of the proper phosphor can mean the difference between getting a good photograph and not getting one at all.

Probably the most important single characteristic of a phosphor for photographic purposes is the color of its emitted light. A blue or violet fluorescence has the highest actinic value and is most suitable for photographic work. In general, it can be stated that (all other things being equal) the shorter the wavelength of the visible peak emitted light, the better the phosphor for photographic applications.

TABLE 3-1
Common Phosphor Table

Phosphor Type	¹ Relative Photographic Writing Speed P11 used as the Standard	² Relative Brightness Representative of 10 kV Aluminized Screens P31 used as the Standard	Wavelength of Peak Radiant Energy	Decay Time in ms to 0.1% of initial value	Color	
					Fluorescence	Phosphorescence
P1	20% as fast	50% as bright	520 nanometers	95	Yellowish-green	Yellowish-green
P2	40% as fast	55% as bright	510 nanometers	120	Bluish-green	Yellowish-green
P7	75% as fast	35% as bright	450 nanometers	1500	Blue	Yellowish-green
P11	100%	15% as bright	450 nanometers	20	Purplish-blue	Purplish-blue
P31	50% as fast	100%	530 nanometers	32	Yellowish-green	Yellowish-green

¹To achieve the writing rate comparisons the shutter of the test camera was left open five seconds to make use of the available light.

²Taken with a Spectra Brightness Spot Meter, which incorporates a C.I.E. Standard Eye Filter.

Most users of oscilloscopes are concerned not only with photographing the oscilloscope trace but in observing it directly as well. For such applications it is important to have a phosphor which gives good results in both types of applications. This frequently results in the choice of a phosphor such as P2 or P31 where the emitted light has a large enough actinic value to give a good writing rate and also has sufficient persistence to permit easy viewing.

It has been observed that the P11 phosphor has the highest comparative writing rate of any common phosphor and is thus the best for photographic work. The medium short persistence of the phosphor is somewhat undesirable for general purpose work but the disadvantages of this are slight. Type P11 should be chosen whenever the ultimate in photographic ability is required. Type P11 emits a medium short-duration purplish-blue light.

TABLE 3-2
Polaroid Land Film Types

Film Types	Approximate ASA Rating	Overall Picture Size In Inches	Maximum Image Size In Inches and Centimeters	Remarks
47 ³	3000	3¼ × 4¼	2⅞ × 3¾ in. 7.3 × 9.5 cm	Panchromatic type. Paper print. Roll film only. High speed film with medium contrast.
107 ³	3000	3¼ × 4¼	2⅞ × 3¾ in. 7.3 × 9.5 cm	Panchromatic type. Film packs only. Paper print. Similar to Type 47.
410 ³	10,000	3¼ × 4¼	2⅞ × 3¾ in. 7.3 × 9.5 cm	Roll only. Panchromatic type. Paper print. Extra high-speed film good for extremely fast waveforms.
146L ³	125	3¼ × 4¼	2½ × 3⅜ in. 6.3 × 8.5 cm	Slower speed than Type 46L. Faster development time. Roll form. Positive transparency. High contrast.
46L ⁴	800	3¼ × 4¼	2½ × 3⅜ in. 6.3 × 8.5 cm	Roll form only. Yields positive transparency. Medium contrast. High speed. Panchromatic type.
48 ⁵	75	3¼ × 4¼	2⅞ × 3¾ in. 7.3 × 9.5 cm	Color film which yields a paper print. Available in roll form only. Requires no coating.
108 ⁵	75	3¼ × 4¼	2⅞ × 3¾ in. 7.3 × 9.5 cm	Color film which yields a paper print. Available in film packs only. Requires no coating.

³Development time 10 seconds.

⁴Development time 2 minutes.

⁵Development time 50-60 seconds.

Since the Type P2 and P31 phosphors appear to be best for combined general purpose and photographic applications, they are standard on most Tektronix oscilloscopes designed for extremely rapid sweeps. Other phosphors can be obtained on any of the Tektronix oscilloscopes.

FILM SELECTION

Selecting the Proper Film

For most oscilloscope work Polaroid Land film is likely to be most convenient, since it provides a complete picture almost immediately without having to develop an entire roll.

Table 3-2 (page 3-2) of Polaroid film types gives a brief outline of the available emulsions. The film recommended or films having equivalent characteristics may be used.

Table 3-3 (page 3-3) of conventional films gives a brief outline of the films available. Film recommended or films having equivalent characteristics may be used.

TABLE 3-3
Conventional Film Types

Manufacturer	Film Name	ASA Speed	Remarks
Eastman Kodak	Tri-X	400	High speed, medium contrast. Roll film.
	RS Pan	650	Similar to Tri-X, in sheet form.
	Royal-X Pan Recording	1250	Ultra-fast roll film with low contrast.
	Plus-X Pan	125	Medium speed film with good contrast. Both sheet and roll film.
	Panchromatic-X	64	Slow-speed, extremely fine grain and resolution. Both sheet and roll film.
Agfa	Isopan Record	1000	High-speed film with low contrast. Both sheet and roll film.
AnSCO	Super Hypan	400	Medium-speed film with medium contrast. Both sheet and roll film.

HELPFUL TECHNIQUES WITH FILM

Polaroid Land Film

CAUTION

Polaroid recommends that spray-on matte finishes not be used as a method of note marking on the self coating Polaroid Land film.

Several types of spray-on matte finishes are available which will enable you to make pencil or pen notes directly on the non-self coating Polaroid prints only. It can be obtained from any art or photo supply store.

Another method of note marking on non-self coating Polaroid prints is to use an ink eraser to rub the emulsion off

the areas to be written on. Pen or pencil is then used to write the data on the print.

For self coating Polaroid prints the above method is changed to rubbing the emulsion off the areas to be written on with a damp cloth, being careful that the emulsion area removed is remote from the waveform area.

Still another method is to scratch the desired data onto the print with a sharp pointed instrument. The data should be scratched onto the print before it is coated. If the data is to be scratched onto a self coating Polaroid print, it must be done within 10 to 15 seconds after the print is separated from the negative.

For greater contrast on Polaroid prints, use slightly longer development time. A decrease in development time, on the other hand, will normally increase writing rate; with, however, a consequent lowering of print contrast. Shorter time will sometimes bring up waveform details not otherwise visible.

A method which sometimes produces very good results with Polaroid Land films is prefogging. In prefogging, the film is exposed to a predetermined amount of light for a definite period. The intensity of the light and the period of the exposure are so chosen that the film is brought just to the threshold of being exposed. A lesser amount of light is then required to expose the film. The prefogging technique can produce an increase in maximum writing rate of two or more times depending on film types, film condition, the nature of the prefog light and other variables. Prefogging results in a slightly foggy background on the photographs and somewhat less contrast. This is sometimes a small price to pay for a large increase in writing rate.

Postfogging is very similar to prefogging. The difference is that the film is exposed to the controlled light source after exposure, rather than before. Postfogging produces very nearly the same increase in writing rate as prefogging.

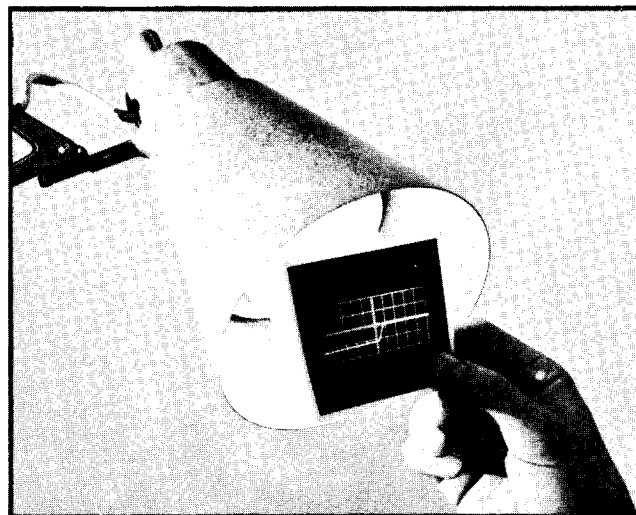


Fig. 3-2. Using transillumination to see otherwise invisible information.

Transillumination

While not strictly a means of improving writing rate, transillumination permits better viewing of information which

Photographic Techniques—Type C-30A Camera

is recorded on prints. In the technique of transillumination, the print is observed with a source of bright diffused light, such as a light bulb, directly behind the print (see Fig. 3-2). The light passing through the print brings out detail which would not otherwise be evident.

The transillumination technique will not work on Polaroid Type 107 or 108 films, since they have an opaque plastic base.

Conventional Film

The matte-finish sprays referred to previously are also good to coat standard prints and negatives for marking purposes. Remember that any mark on the negative may appear on the print. This suggests the idea of marking notes on the negative prior to printing.

The paragraphs on prefogging and postfogging Polaroid Land film apply equally well to conventional films.

To increase the contrast of conventional films, the film may be left in the developer longer or the temperature of the developer may be raised; however, this may result in increased grain and fog.

The transillumination technique can also be used with conventional-film negatives and prints.

Negative Film Development

Equipment Needed

The essentials for the development of negative film are listed below:

1. Developer (If speed or contrast is more important than grain, do not use a fine grain developer.)
2. Hypo (Rapid fixer is most convenient.)
3. Three trays made of glass, hard rubber, polyethylene, enameled steel, or stainless steel, or a development tank.
4. Thermometer
5. Graduated measure
6. Two containers made of glass, hard rubber, polyethylene, enameled steel, or stainless steel to store the chemicals. The containers should block light from reaching the chemicals. For long-term storage, use brown glass bottles.
7. Timing device (readable or audible in a dark room).

Additional equipment for easier development of negatives:

1. Stop-bath (Stops development and prevents contamination of Hypo.)
2. Hypo clearing agent (Allows a shorter wash period.)
3. Photo Flo (Stops water spotting and speeds drying.)
4. Film clips (or plastic clothes pins.)
5. Funnel

Procedure

Sheet and Roll Film. (Tank or Tray Development.) Mix the chemicals as directed. Once the chemicals are mixed

and at the proper temperature, pour each one into a separate tank or tray. If no stop-bath is available, substitute water in this tray.

Arrange the tanks or trays with the developer first, stop-bath or water second, and hypo last. Turn out the lights and be sure the room is light tight. Remove the film sheet from the film holder and attach a film clip to it; or undo the roll of film, remove the film from the paper backing, and attach a film clip to each end of the film roll.

Start the timing device and immerse the film in the developer. Agitate the film at 30-second intervals, being sure that the developer covers the complete image area of the film. If roll film is being developed, see-saw it back and forth through the tank for the period. Make sure all portions of the roll film receive the same time in the developer.

When the development time is up, switch the film to the stop-bath or water tank. Leave it in the stop-bath for about one minute. Roll film should be see-sawed back and forth through the stop-bath to insure that the stop-bath covers all areas of the film.

Remove the film from the stop-bath at the end of one minute and immerse it in the fixing bath. Roll film should be see-sawed back and forth through the hypo tank in such a way that all parts of the film come into contact with the hypo solution. The length of time in the fixer will depend upon the solution and the type of film. (See the directions packed with the film.)

Place the film in a container in the sink and allow running water to rinse it for about 30 minutes. The water in the container should have one complete change at least every five minutes.

If the hypo clearing agent is employed, use the following washing procedure:

1. Wash one minute in water.
2. Treat film with hypo clearing agent for 2 minutes.
3. Wash film in water for five minutes.

When the washing is complete, hang the film up to dry with the film clips. Make sure that the film touches nothing while it is drying. The film clips must not be clipped onto an image area.

Storage of Supplies

Conventional Film. Do not open a film package until it is to be used. The vapor tight packaging will protect the film against high humidities. Under high-humidity conditions, film should be exposed and processed as soon as possible. Do not store open packages of film in damp basements, ice boxes, or refrigerators because of the high humidities in these places. If it is necessary to refrigerate an open package of film, it should be placed inside a can or jar which can be tightly sealed to keep out the moisture.

If an open package of film has been stored in a relatively high humidity (above 60%) it should be dried before using, by means of a desiccating agent such as silica gel.

When storing film, the temperature in the area should be about 70°F. If a cool storage place is not available, the film may be stored in a refrigerator. Film may be stored

for 2 months at 75°F, 6 months at 60°F, and 12 months at 50°F. The relative humidity of the storage area should be from 40% to 60%. To avoid moisture condensation on cold film surfaces, the unopened packages of film should be allowed about 30 minutes to 2 hours to come up to room temperature before opening, after they have been removed from cold storage.

Open packages of film should be kept away from chemical fumes, x-ray, and radioactive materials. Open packages of film should also be in an area with a humidity between 40% and 60%, with 40% preferred. It is better to keep open film in an area of 80°F at 40% humidity than in an area of 65°F at 70% humidity.

The developed film should ideally be stored in an area with a temperature between 60°F and 80°F with a humidity not over 60%.

Polaroid Film. The wrappers on Polaroid film will protect it against humidity through the expiration date. Once the film is taken out of its wrapper in high relative-humidity areas, it must be exposed as soon as possible.

If it is necessary to store opened rolls of Polaroid Land film, approximately the same conditions apply as with conventional film.

Polaroid film can be used at temperatures from 40°F to 100°F. However, open film will keep longer in a temperature of 90°F at 50% humidity than it will in a tem-

perature of 70°F at 80% humidity.

Developing Solutions. After using the solutions, they should be poured into air-tight containers. The screw tops should be free from rust or other foreign material and have liners or gaskets. Cork and glass stoppers present sticking problems, and therefore should not be used.

Air is one of the worst enemies of photographic solutions. Oxidation of a solution may take place even in a tightly sealed container if the solution level is low. It is therefore advisable to store solutions in a container no larger than necessary.

The storage temperature of the solutions should be about 65°F to 70°F. Temperatures above this may cause rapid oxidation. On the other hand, too low a temperature (below 55°F) can cause the solutions to crystallize. Once a solution has crystallized, it may not be possible to redissolve the crystals. Repeated temperature changes shorten the life of solutions.

Most photographic solutions will remain good for about two months if they are stored in air tight containers of the right size and at a temperature of 60°F to 80°F. Each use of the solutions shortens the storage period.

All photographic solutions become weaker as they process additional film. All have a maximum amount of film area that can be run through them, after which they are considered of no further use. (See developer instructions.)

SECTION 4

PICTURE TAKING

Change information, if any, affecting this section will be found at the rear of the manual.

Photographing Repetitive Signals

The following procedure can be used as a guide to obtain an exposure.

1. Position the external graticule, if the oscilloscope has one, for the white lines.
2. Mount the camera adapter on the oscilloscope if the oscilloscope is other than a Tektronix Type 422, 453, 454, or 491.
3. Obtain the signal and adjust the controls for the desired display.
4. Attach the camera to the adapter and secure the camera against the oscilloscope.
5. Adjust the focus, astigmatism and intensity controls for a sharp trace.
6. Set the f-Stop selector for the largest lens opening (smallest f-stop number) and carefully focus the camera.

NOTE

When using an external graticule and both a clear trace and external graticule are desired, the camera should be focused halfway between the trace and the external graticule.

7. Set the Intensity between one-third and one-half clockwise, Scale Illumination three-quarters clockwise, SPEED selector to 1/25 second and f-STOP selector to f/5.6. The above control settings should be reasonably close for most film around 200 ASA and a waveform with a frequency near 1 kHz. For film with a 3000 ASA rating and a waveform with a frequency near 1 kHz, use a SPEED selector setting of 1/4 second and an f-STOP selector setting of f/5.6.

Photographing Single Sweep Displays

Single-sweep displays are formed when the oscilloscope spot sweeps across the screen only once. The actual exposure time is thus determined not by the shutter speed setting, but by the duration of the sweep plus phosphor persistence, provided the shutter is open sufficiently long. In one type of single-sweep photography, the graticule exposes the film for the time set by the shutter while the spot on the screen exposes the film for only the duration of the sweep. It is therefore not usually possible to adjust the trace and graticule for the same intensity and obtain good pictures, since the effective exposure times for the two are different.

Success in obtaining good photographs of single-sweep displays will come only with experience. A few tips, however may reduce the need for experimenting.

1. Use steps 1 through 6, under Photographing Repetitive Signals, to set up the camera.

2. Select a shutter speed which keeps the shutter open longer than the time of the event which is to be photographed.

3. Use the highest practical intensity without causing defocusing of the trace. Photograph fast areas of a display at the center of the CRT to make use of the light transmission characteristics of the lens. This prevents many defocusing problems caused by high intensity settings.

4. Where practical, use f-stops higher than f/4 if an external graticule is used. This permits both trace and external graticule to be in focus.

Since the shutter speed has already been determined, the quality of the photographic reproduction will depend largely on the selection of lens opening. In single-sweep applications make camera settings for the trace intensity and duration; graticule illumination cannot be used as a reference.

Picture Troubles

If the trace is too wide (defocused due to high light intensity) on the picture, this may be corrected by using a higher f-stop number or a faster shutter speed. If the defocused trace cannot be improved by using either a higher f-stop number or a faster shutter speed, the camera needs refocusing.

No Image on Picture

1. Use higher intensity and scale illumination settings.
2. Use a slower SPEED selector setting.
3. Set the f-STOP selector for a smaller number.
4. Leave shutter open for 5 seconds after trace occurs so as to integrate all display light possible.
5. Use a film with a higher ASA rating.
6. Prefogging or postfogging may help. Refer to the section on Photographic Techniques.
7. If Polaroid film is being used, try underdeveloping it, that is remove the print before the fully developing time has expired.

Light Streaks on Picture

1. Light leaks in bellows between shutter box and camera back. See your local Tektronix Representative about repair.

Picture Taking—Type C-30A Camera

2. Light seal between camera and oscilloscope faulty.
3. Dirty rollers in Polaroid Land camera back.
4. Polaroid Land film pack was handled too roughly during loading.

Fogging on Picture

1. Scale illumination control is set too high.
2. Light-struck or bad film.
3. Film exposed to light during loading.

Trace or External Graticule in Focus, But Not Both

1. Use f-stop numbers larger than $f/4$ when photographing an external graticule.
2. Camera needs to be refocused because of an object-to-image ratio change.

Some portions of photographed signal appear brighter than others

1. Use an exposure long enough to allow several sweeps to occur.

Eliminating Parallax and Focusing Difficulties

Tektronix oscilloscopes with the internal "no parallax" graticule and variable edge-lighting will have no parallax problems, and hence no focusing difficulties.

On some oscilloscopes the trace and graticule are not in the same plane, which results in some parallax. This also makes it impossible to obtain good focus simultaneously on both the trace and graticule at f-stop numbers below $f/4$. Both of these difficulties can be eliminated by either of two methods.

The first method involves double-exposing the film. First set up the oscilloscope display as usual and focus the camera on the trace. Turn the graticule intensity to minimum and make the first exposure of the trace only. Then turn up the graticule to its former brightness and set the camera lens for its smallest lens opening (largest f-stop number). Readjust the camera shutter speed to compensate for the smaller lens opening. Turn down the oscilloscope trace intensity and make a second exposure of the graticule only. The resulting photograph, due to the greater depth of field when making the graticule exposure, will have some parallax error between graticule and trace and will have both the graticule and trace in proper focus. Care must be taken in using this method that the position of the film for the second exposure is the same as for the first exposure.

The second method involves double exposing the film and refocusing the camera. First set up the oscilloscope display as usual and focus the camera on the trace. Turn the graticule intensity to minimum and make the first exposure on the trace only. Then turn up the graticule to its former brightness and refocus the camera on the graticule. Turn down the oscilloscope trace intensity and make a second exposure of the graticule only. The resulting photograph, due to refocusing between exposures, will have no parallax error between graticule and trace and will also have both the graticule and trace in proper focus. Care must be taken in using this method that the position of the film for the second exposure is the same as for the first exposure.

Effects of Camera Magnification on Exposure

The camera or lens object-to-image ratio is the ratio of the object size to the image size. For example, a 1:1 setting is one whose object is the same size as the image. The object-to-image ratio of the camera lens has a definite effect on the exposures obtained.

The object-to-image ratio affects the amount of light which will fall on a given point of the film. The smaller the image on the film, the greater the intensity of the light. Therefore the larger the object-to-image ratio, the less time required to obtain a good exposure on the film. With a 1:0.7 setting slightly less exposure time is required to photograph a display than with a 1:0.9 setting. The difference in the exposure time required between the various settings is so slight, however, that it can usually be ignored.

It is important to note that a slightly better writing rate can be obtained with a larger object-to-image ratio than with a small object-to-image ratio. Here again, the difference is fairly small unless there is a wide difference in the ratio.

Reciprocity

Decreasing the f-stop number by one unit (e.g. from $f/8$ to $f/5.6$) doubles the area through which light can pass and expose film in the camera. Theoretically such a decrease in the f-stop number requires that the exposure time be halved to produce the same exposure as obtained previously. This results in what is known as the Law of Reciprocity. The Reciprocity Law works quite well for medium intensity light at medium shutter speeds. It fails, however, for very short exposures from bright light or for very long exposures from dim light. The Reciprocity Law applies only for exposures in the range of approximately $1/250$ second to 1 second.

SECTION 5

OPTICAL AND ELECTRICAL DESCRIPTION

Operation of All Exposure-time Settings Except Time (T) and Bulb (B)

Change information, if any, affecting this section will be found at the rear of the manual.

C-30A

Magnification (Object-To-Image Ratio) Determination

The effective magnification of a lens (object-to-image ratio) in a given camera system depends on the lens focal

length and on the object and image distances. Thus, the lens magnification can be expressed by the equation:

$$M = \frac{f}{s - f} = \frac{s'}{s}$$

where M is the magnification, s is the object distance, s' is the image distance, and f is the focal length of the lens. The image distance is determined by the lens focal length

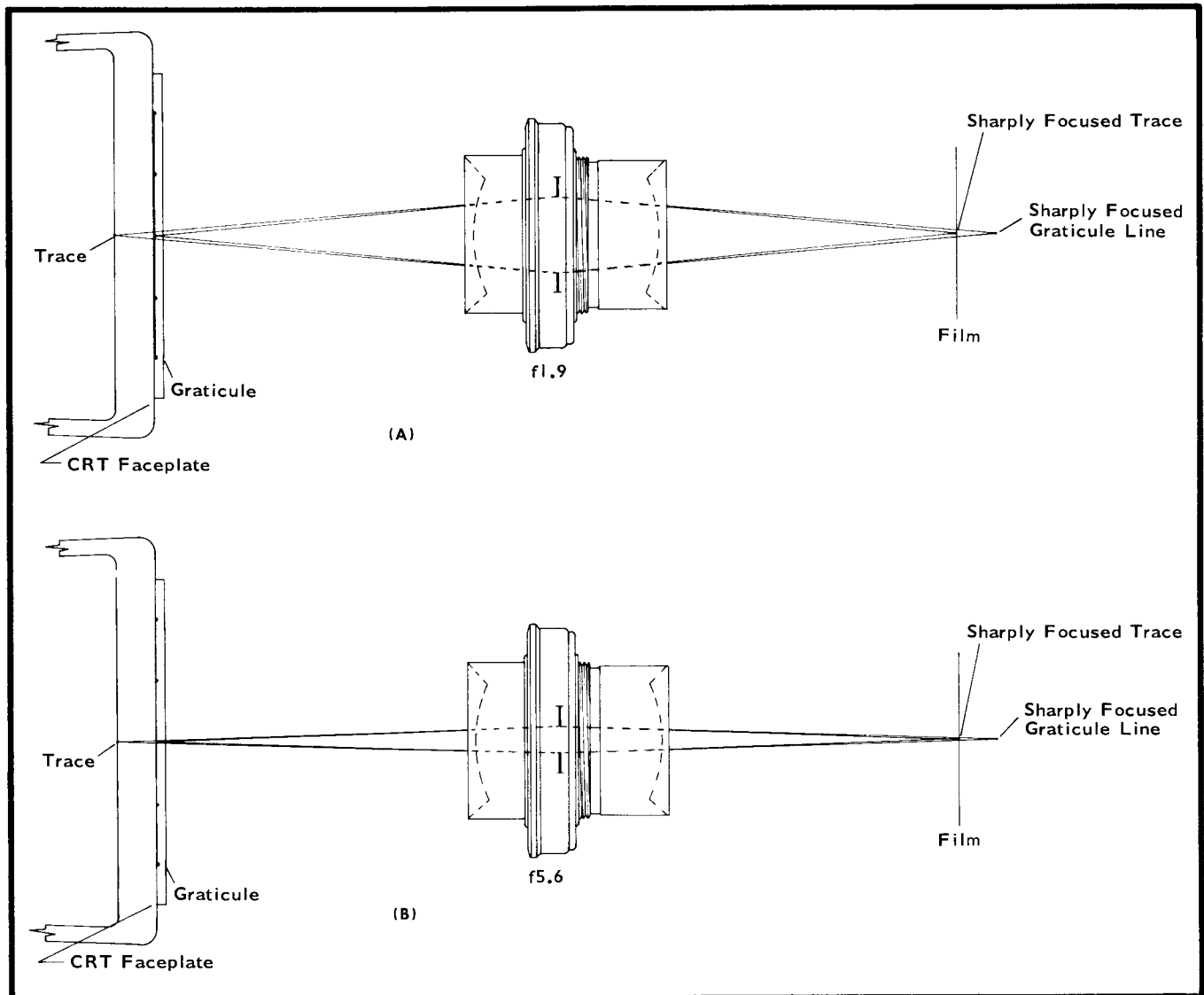


Fig. 5-1. Depth of field for different aperture settings. In (A), a small f-stop number permits light rays through the outer extremities of the lens to converge rapidly to focus on the film. When the object distance is changed slightly, the image on the film is defocused quite rapidly due to the sharp convergence of the light rays. In (B) the same lens is shown but with a larger f-stop number. Rays through the outer extremities of the lens now converge much more slowly to the image on the film. When the object distance is changed slightly the image is defocused much more slowly due to the slower convergence of the rays.

Optical and Electrical Description—Type C-30A Camera

and by the object distance as shown in the following relationship:

$$s^1 = \frac{sf}{s - f} = sM$$

f STOP Determination

The f-stop value for a particular camera lens system is found by dividing the focal length of the system by the diameter of the limiting aperture. Thus:

$$\text{f-stop value} = \frac{f}{a}$$

Where f is the focal length of the lens and a is the diameter of the limiting aperture. Two means are available for increasing the effective speed of a lens. These are (1) decreasing the focal length of the lens, and (2) increasing the diameter of the limiting aperture (decreasing the f-stop value).

Depth of Field and Parallax

One characteristic of all lenses is that as the f-stop value is decreased, the depth of the field for that lens is also decreased. This occurs whether the f-stop value is decreased by shortening the focal length or by increasing the diameter of the limiting aperture. This is demonstrated in Fig. 5-1. An $f/1.9$ lens aperture is shown in Fig. 5-1A. It can be seen that the rays from the object on the axis which pass through the extremities of the lens opening converge to form

a sharp image on the film. This means that if the object is moved slightly, the image will also be moved slightly away from the film plane as shown in the drawing. This results in a defocused image due to the wide divergence of the rays. Since a slight change in object distance results in the image being out of focus, the lens is said to have a low depth of field.

Fig. 5-1B shows the same lens with the aperture reduced. This results in a value of $f/5.6$ for the lens system. A construction similar to Fig. 5-1A shows that the light rays through the outer extremities of the lens now converge much more slowly to the film. Thus, it is possible to change the object distance by a much greater amount before the same degree of image defocusing occurs. The lens system of Fig. 5-1B thus has a greater depth of field than the lens system of Fig. 5-1A.

Depth of field is extremely important in lens systems designed to photograph oscilloscope displays. The low depth of field of an $f/1.9$ lens aperture means that extra care must be taken to properly focus the image. This characteristic makes it difficult to obtain proper focus simultaneously on two objects in different planes. Thus the oscilloscope trace when pictured with an external graticule (trace and graticule in two different planes) cannot be simultaneously brought into proper focus at f-stop values less than $f/4$. In order to increase the depth of field of the lens system sufficiently to focus both the external graticule and oscilloscope trace, it is necessary to increase the f-stop value of the lens by decreasing the size of the aperture. Whenever possible, the large f-stop values should be used.

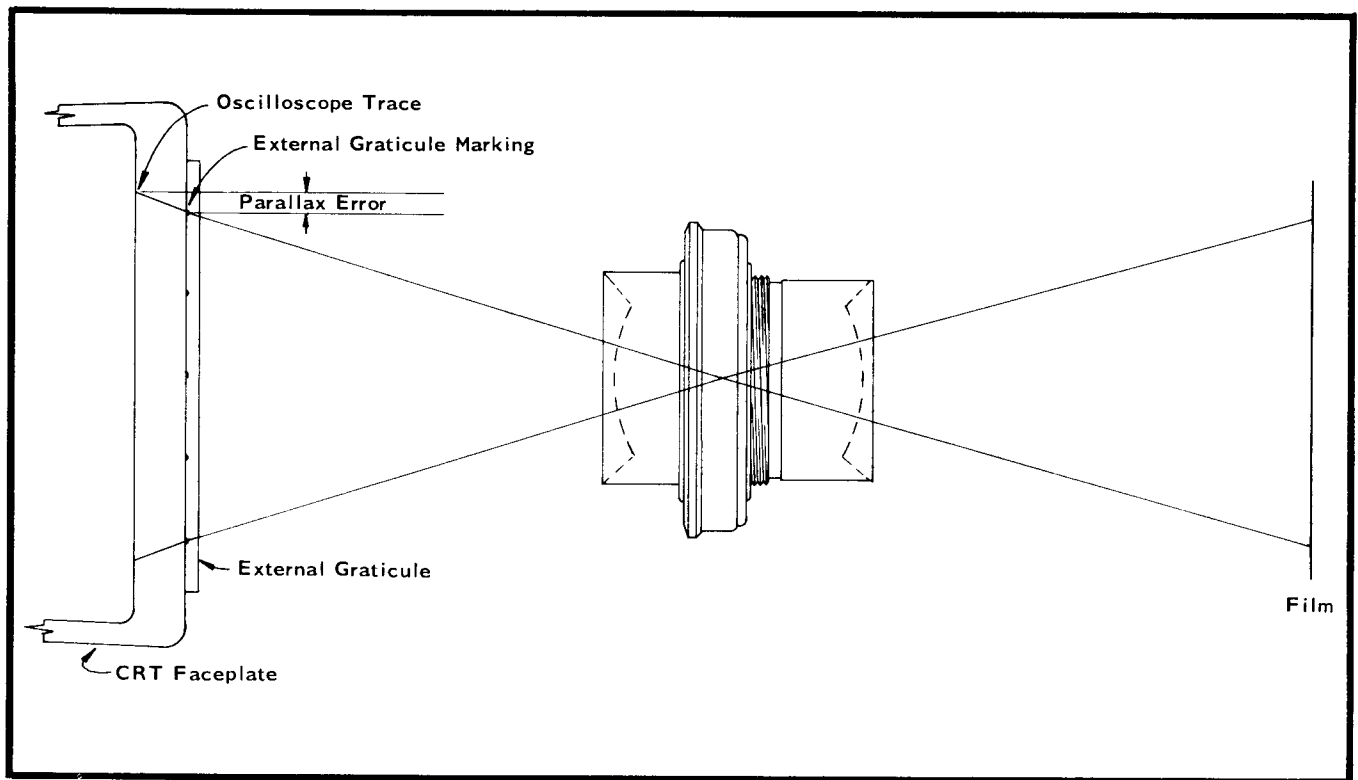


Fig. 5-2. The fact that the oscilloscope trace and external graticule lines are not in the same plane introduces a certain amount of parallax error as can be seen from the illustration. The oscilloscope trace is actually higher than the external graticule line; however, on the film both appear to be at the same level.

The characteristics by which the depth of field decreases as the f-stop value is decreased explains why the camera should be focused at the smallest f-stop values of the lens.

Fig. 5-2 shows another result of the external graticule being in a different plane than the oscilloscope trace. Because the trace is farther from the camera, parallax makes displayed signals appear reduced in size in both dimensions. This effect can be eliminated by using an internal graticule CRT, or compensated for by increasing the vertical and horizontal gain of the oscilloscope when using an external graticule CRT.

ACCESSORIES

SHUTTER ACTUATOR MODEL 3

Circuit Description

Line voltage is applied to a bridge rectifier made up of D2, D3, D4 and D5. The rectified output voltage is then applied to the Shutter Actuator solenoid via pins 1 and 3 of J19.

Closing SW9 causes the Shutter Actuator solenoid to start energizing. As the actuator energizes, its plunger trips SW19, thus connecting pins 1 and 6 of J19 together and causing B15 to light. After SW19 has been tripped, the current path for the actuator is through the parallel combination of R10, R11, R12 and R13 and pin 2 of J19. R19, R11, R12 and R13 reduce the DC output voltage of the power supply, allowing the actuator to remain energized indefinitely without damage from overheating.

D12 suppresses the arc which occurs as SW19 switches. Pin 4 of J19 connects the Shutter Actuator solenoid and power supply cases to the third wire ground.

#1 ELECTRIC SHUTTER AND SPEEDCOMPUTER

Circuit Description

Line voltage is supplied to the Speedcomputer via ON-OFF switch SW1 (see electrical diagram), fuse F1 and transformer T1. T1 secondary has two voltage outputs; the approximate 27-volt output which is rectified and filtered by D7 and C7. This supplies power to the actuate circuit. The approximate 160 volt output rectified and filtered by D2 and C2 supplies power to the timing circuit, POWER indicator and the SHUTTER indicator via pins D and E of J10. The approximate 160 volt output is also rectified and filtered by D1 and C1 to supply power to the shutter solenoid energizing circuit.

Initially, when the Speedcomputer is turned on, a positive voltage from the +160-volt supply is applied via R14, R17 and R27 to the gate of silicon controlled rectifier (SCR) D25, turning it on. SCR D15 is receiving anode voltage via shutter solenoid K50, but is not conducting since the only way its gate can get a positive signal is through ACTUATE switch SW14 or the remote actuate circuit.

Operation of All Exposure-time Settings Except Time (T) and Bulb (B)

The solenoid energizing circuitry for bulb (B) is the same as was described above for an exposure-time speed set-

ting except, that as long as the actuating circuit is supplied with +27 volts, transistor Q29 will be conducting. Q29 conducting will hold the voltage at the junction of R13 and D30 very close to ground thereby not allowing C21 to charge up sufficiently to fire B21.

The solenoid de-energizing circuit is the same as was described for exposure-time speed settings since, once the +27 volts to the actuating circuit is removed from Q29 it will turn off and C21 will charge toward +160 volts using R13 as the timing resistor.

Operation of All Exposure-Time Settings Except Time (T)

Actuating the circuit by either-(1) Pressing the ACTUATE button, (2) shorting pins A and C of Remote Actuate connector together, or (3) applying +27 VDC to pin A (use pin B for ground) of the Remote Actuate connector, causes a positive 27 volt initiating pulse to be applied to the gate of silicon controlled rectifier (SCR) D15 via R12-C12, D12 and R15, turning D15 on. At the same time D15 late is receiving a positive pulse, a pulse is also being sent toward the gate of D25 via R22-C22 and D22. This positive pulse, however, is shorted to ground via D21 and conducting SCR D25.

When D15 turns on, its anode voltage drops to a level near ground, creating a negative voltage drop. This negative voltage step is coupled through C17 to the anode of D25 and through D17 and R27 to the gate of D25 causing D25 to turn off. The negative voltage step is also applied to C21 via D21, giving C21 a negative charge.

With D15 conducting, a current path is completed from ground through D15, D10, shutter solenoid K50, R1, D1 and T1 back to ground. Energizing K50, causes the contacts of K50A to close and turn on the SHUTTER indicator B7.

Solenoid K50 remains energized until the charge across C21 (which can now charge toward 160 volts through D29 and the selected timing resistor) becomes large enough to fire neon lamp B21. The charge rate of C21 is controlled by timing resistors selected by SW30. Zener diode D38 limits the maximum charge across C21.

When B21 fires, a positive pulse is coupled via R25 to the gate of D25, turning it on. When D25 turns on, its anode voltage drops to a level near ground, creating a negative voltage step. This negative voltage step is coupled through C17 to the anode of D15 and through D11 and R15 to the gate of D15, causing D15 to turn off.

With D15 not conducting the current path for K50 is broken and the solenoid can not remain energized. As K50 de-energizes it causes the contacts of K50A to open and the SHUTTER indicator B7 extinguishes.

Operation of Time (T) Exposure-Time Setting

The solenoid energizing circuitry for time (T) is the same as was described above for an exposure-time speed setting, therefore only the solenoid de-energizing circuit will be described.

Optical and Electrical Description—Type C-30A Camera

After the desired shutter open time, the actuating circuit is again triggered (C21 cannot be charged to a plus voltage because R40 returns it to ground, therefore B21 can not fire) by one of the three methods already described, causing a +27 volt initiating pulse to be applied via R22-C22, D22 and R25 to the gate of SCR D25, turning D25 on. At the same time D25 gate is receiving a positive pulse, a pulse is also being sent toward the gate of D15 via R12-C12 and D12. This positive pulse, however, is routed to ground via D11 and conducting SCR D15.

When D25 turns on, its anode voltage drops to a level near ground, creating a negative voltage step. This negative voltage step is coupled through C17 to the anode of D15 and through D11 and R15 to the gate of D15, causing D15 to turn off.

With D15 not conducting the current path for K50 is broken and the solenoid can not remain energized. As K50 de-energizes it causes the contacts of K50A to open and the SHUTTER indicator B7 extinguishes.

SECTION 6

CAMERA SYSTEM MAINTENANCE

Change information, if any, affecting this section will be found at the rear of the manual.

GENERAL CARE OF THE CAMERA SYSTEM

The Camera System should be given the same care as other precision optical devices. Care should be taken in handling the various mechanisms to assure that they are not damaged. The equipment should be kept protected against dust when not in use.

Lenses

In order to obtain maximum use from your camera, the lenses must be kept clean. When lenses require cleaning, remove loose dust with a soft camel-hair brush. Fingerprints and other smudges can be removed with clean, high-quality lens tissue. Avoid scratching the lenses during cleaning.

NOTE

The front and rear lenses may be cleaned by attaching the cleaning materials to a long rod. The rod is then inserted through either the front opening or the back opening of the camera to reach the lens to be cleaned.

Do not attempt to disassemble lenses. The lens assemblies are sealed; therefore, dirt should not get on their inner surfaces.

Special lubricants have been added to the shutter during manufacture which makes further lubrication unnecessary during its lifetime. It is essential that neither oil nor graphite be used on the shutter, as either may ruin it. If the shutter acts in a sluggish manner, it may be the result of continuous wear or extreme environmental conditions.

Camera Back

The Polaroid film backs used with the Type C-30A Camera should be inspected after each batch of film is exposed and before more film is put in the camera. Any reagent on the rollers or other parts of the back should be removed immediately using a moist rag, since the reagent left on the rollers may ruin some of the pictures.

Electrical Visual Inspection

You should visually inspect the entire electrical instrument every few months for possible circuit defects. These defects may include such things as loose or broken connections, scorched wires or resistors, or broken terminal strips. For most visual troubles the remedy is apparent; however, particular care must be taken when heat-damaged components are detected. Overheating of parts is often the result of other, less apparent defects. It is essential that you determine the cause of overheating before replacing heat-damaged parts in order to prevent further damage.

COMPONENT REPLACEMENT

Light Leak Sealing

Some of the parts used in critical light leak areas of the camera have been sealed to adjoining parts with a black, pliable, non-hardening, weather stripping adhesive in place of any other light sealing material. If a light leak occurs or if one of the previously sealed parts is being replaced it is recommended that No. 2 Permatex¹, 3M² weather strip adhesive No. 8011, or a material with similar characteristics be used as a light sealing material.

Standard Parts

Many components in the instrument are standard electronic parts available locally. However, all parts can be obtained through your Tektronix Field Engineer or Field Office. Before purchasing or ordering, consult the parts list to determine the value, tolerance, and rating required.

Special Parts

Some parts are manufactured or selected by Tektronix to satisfy particular requirements, or are manufactured for Tektronix to our specifications. These and most mechanical parts should be ordered directly from your Tektronix Engineer or Field Office. See Parts Ordering Information preceding Section 7.

Soldering

WARNING

Disconnect the instrument from the power source before soldering.

Metal Terminals. When soldering metal terminals (e.g., interconnecting plug pins, switch terminals, potentiometers, etc.), ordinary 60/40 solder can be used. The soldering iron should have a 40- to 75-watt rating with an 1/8 inch wide chisel-shaped tip.

Observe the following precautions when soldering metal terminals:

1. Apply only enough heat to make the solder flow freely.
2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.
3. If a wire extends beyond the solder joint, clip the excess close to the joint.
4. Clean the flux from the solder joint with a flux-remover solvent to maintain good environmental characteristics.

Circuit Boards. Use ordinary 60/40 solder and a 15 to 30 watt pencil type soldering iron on the circuit boards. A higher wattage soldering iron may separate the etched wiring from the base material.

¹Registered trademark of the Permatex Company, Inc.

²Registered trademark of the Minnesota Mining and Manufacturing Company.

Camera System Maintenance—Type C-30A Camera

The tip should be made of copper and have a chisel or beveled shape, with a $\frac{1}{8}$ inch width. The tip of the iron should be clean and properly tinned for best heat transfer to the solder joint.

The following technique should be used to replace a component on a circuit board.

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board.

2. When the solder begins to melt, pull the lead out gently. This should leave a clean hole in the board. If not, the hole can be cleaned by reheating the solder and placing a sharp object such as a toothpick into the hole to clean it out. A vacuum-type desoldering tool can also be used for this purpose. If the removal is not accomplished in the first few seconds of heat application, go to another connection or wait a few minutes before reheating the connection. This is to avoid transferring too much heat to the substrate.

3. Bend the leads of the new component to fit the holes in the board. Insert the leads into the holes in the board so the component is firmly seated against the board (or as positioned originally). If it does not seat properly, heat the solder and gently press the component into place.

4. Touch the iron to the connection and apply a small amount of solder to make a firm solder joint; do not apply too much solder. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers or other heat sink.

5. Clean the area around the solder connection with a flux-remover solvent. Clip off any excessive lead length that protrudes through the board.

Disassembly of Speedcomputer

- Disconnect the power cord from its line voltage source.
- Remove all connections to Speedcomputer.
- Remove the three screws indicated in Fig. 6-1 from the rear of the speedcomputer case.
- Lift the front panel and its attached (upper) circuit board and power transformer out of the case.
- Remove the lower circuit board by lifting it out of the case.

Reassembly of Speedcomputer

- Reinstall lower circuit board in position being careful that no wires are pinched by the circuit board.
- Set the front panel with its associated upper circuit board and power transformer into the Speedcomputer case, dressing the wires and positioning the ornament ring as necessary for proper clearances.
- Reinstall the three screws removed in part c of the disassembly instructions.
- Reconnect the Electric Shutter and Speedcomputer.

Removal of No. 1 Electric Shutter from C-30A Camera

a. Release camera FOCUS LOCK knob and rotate the FOCUS knob in such a direction so as to extend the front bellows section as far as possible, then secure it in this

position with the FOCUS LOCK knob, see Fig. 6-2, items 1 and 2.

b. Remove the support casting adapter and camera back from the camera, see Fig. 6-2, items 14 and 15.

c. Place a $\frac{5}{16}$ inch open-end wrench on the flats of one of the support shafts and a $\frac{5}{32}$ inch hexagonal wrench in the head of the screw which secures the support casting to the support shaft, see Fig. 6-2, items 3 and 4.

d. Loosen and remove the two screws which secure the support casting to the support shaft using the procedure in step c.

e. Remove the three screws which hold the light sealing ring and three porta lens clips in place, see Fig. 6-2, items 5, 6 and 7.

f. Remove the four screws which hold the shutter housing cover to the shutter housing (one screw inside bellows), see Fig. 6-2, items 8, 9 and 10.

g. Remove the light sealing ring, three porta lens clips, o-ring and support casting-bellows-shutter housing cover assembly, see Fig. 6-2, items 7, 6, 11, 12, 13 and 19.

h. Press the MAG Index button and slide the shutter housing as far as possible toward the rear of the camera, see Fig. 6-3, item 1 and Fig. 6-2, item 10.

i. Grasp the shutter case and remove the lens retainer nut by reaching in through the rear of the camera with a spanner wrench, Tektronix Part No. 003-0627-00, see Fig. 6-3, items 2 and 3.

j. Before removing shutter case from shutter housing, the spur gear and knob positions should be noted to aid in reassembly, see Fig. 6-3, items 4 and 5.

k. Release the strain relief bushing from the shutter housing by squeezing it together and removing from the shutter housing at the same time, see Fig. 6-3, items 6 and 7.

l. Remove the shutter case from the shutter housing, see Fig. 6-3, items 2 and 7.

m. Remove the front and rear lens assemblies from the shutter case, see Fig. 6-3, items 8 and 9.

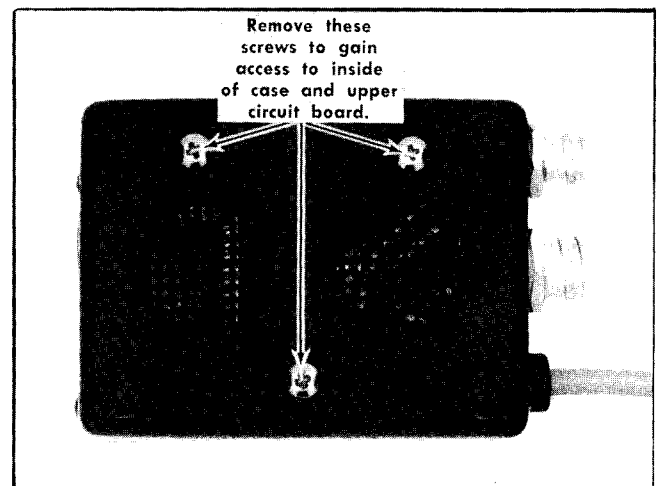


Fig. 6-1. Screw removal for Speedcomputer.

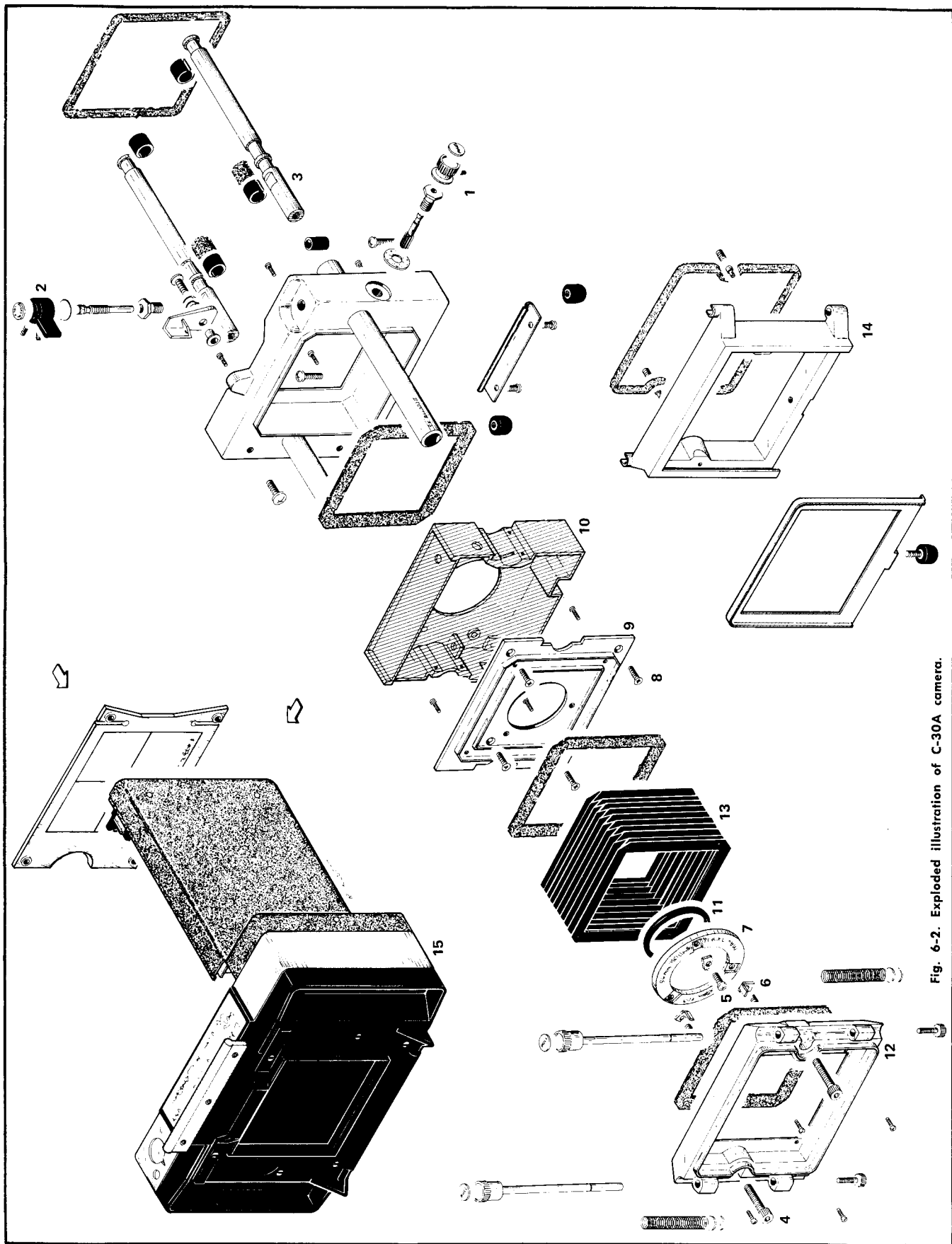
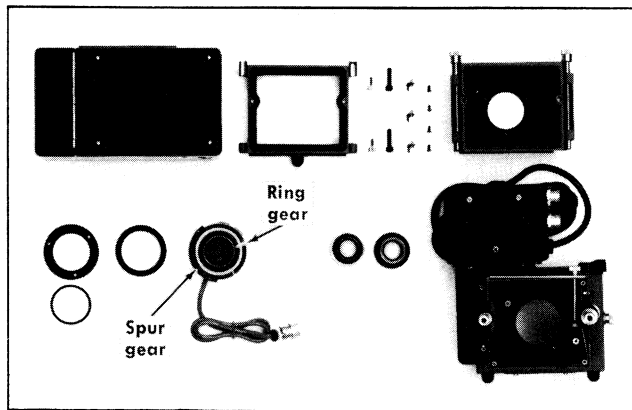
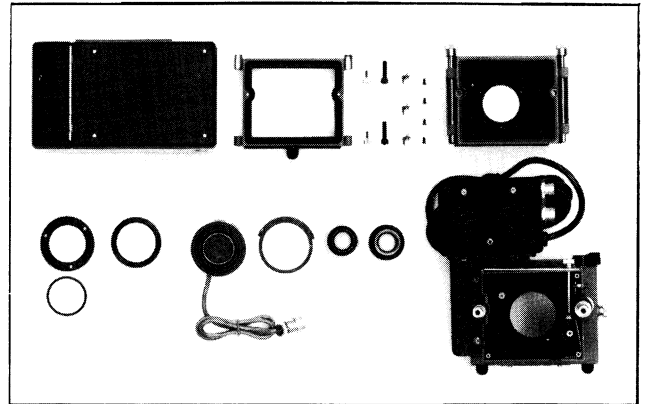


Fig. 6-2. Exploded illustration of C-30A camera.

No. 1 Electric Shutter Installation into C-30A Camera

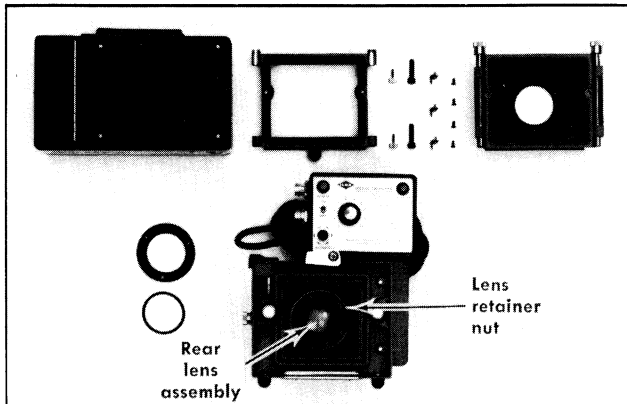
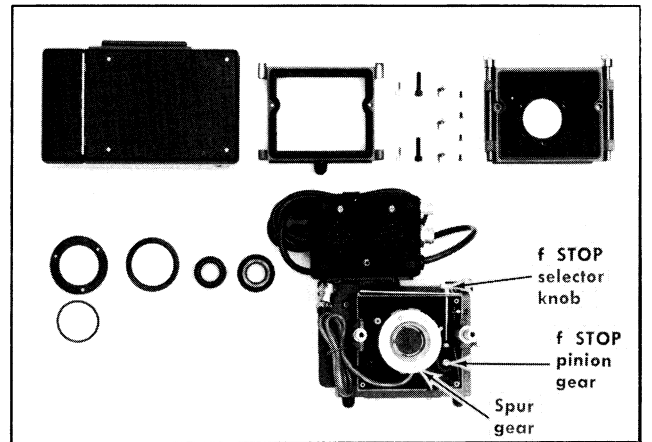


a. Install spur gear onto shutter case ring gear and engage it with the iris ring assembly as shown.

b. Set the shutter box f STOP selector to its highest number. Set the iris ring assembly on the electric shutter for the smallest aperture opening.

c. Install the shutter case into the shutter housing as shown. Install it through the front opening of the shutter housing, making sure the spur gear engages the shutter housing f STOP pinion gear.

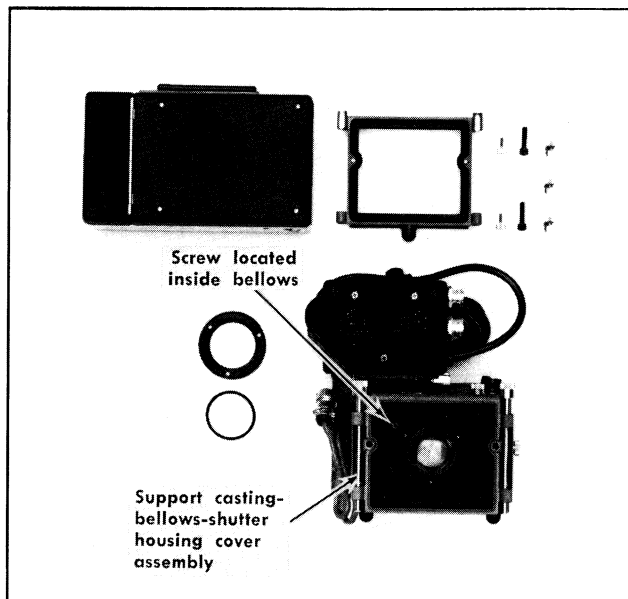
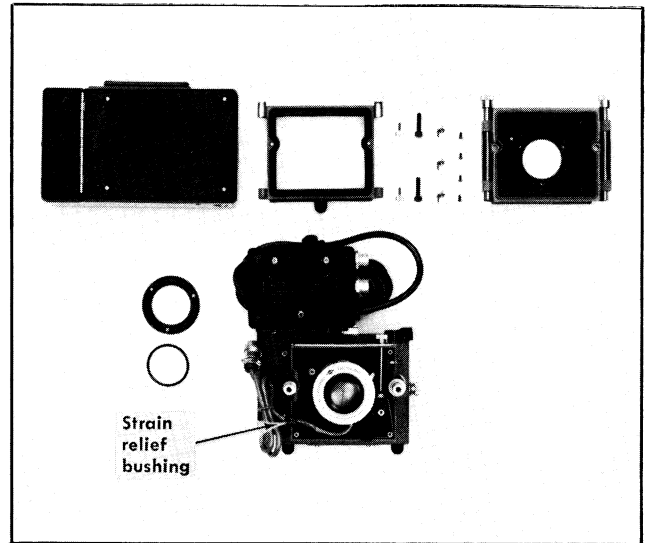
d. While holding the electric shutter in position, rotate the shutter housing f STOP selector through its range and observe that the range can be covered by the spur gear. If the range of the spur gear is not sufficient, reposition the electric shutter and repeat the first part of this step. The f STOP selector knob can be repositioned, if necessary, by using a $\frac{3}{64}$ inch hexagonal wrench.



e. Install the lens retainer nut onto the rear of the shutter by reaching in through the rear of the camera. Tighten the lens retainer nut with a spanner wrench, Tektronix Part No. 003-0627-00.

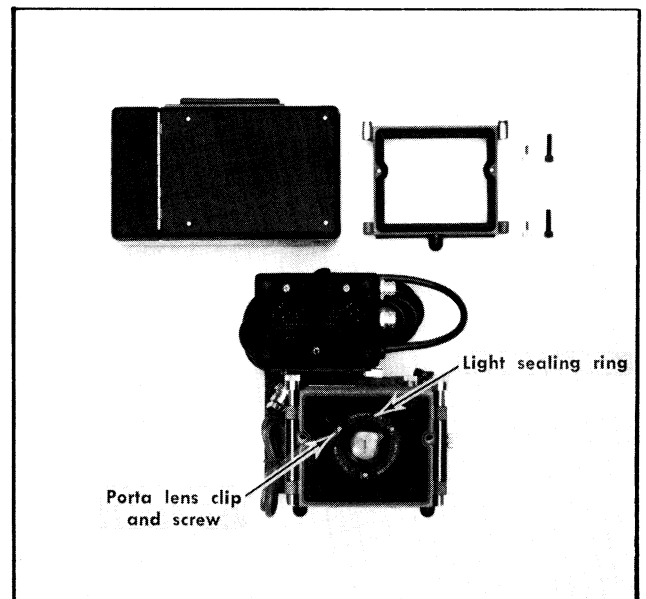
f. Install the front and rear lens assemblies into the shutter case.

g. Install the strain relief bushing into the shutter housing by squeezing it together and pushing it into the proper position at the same time.

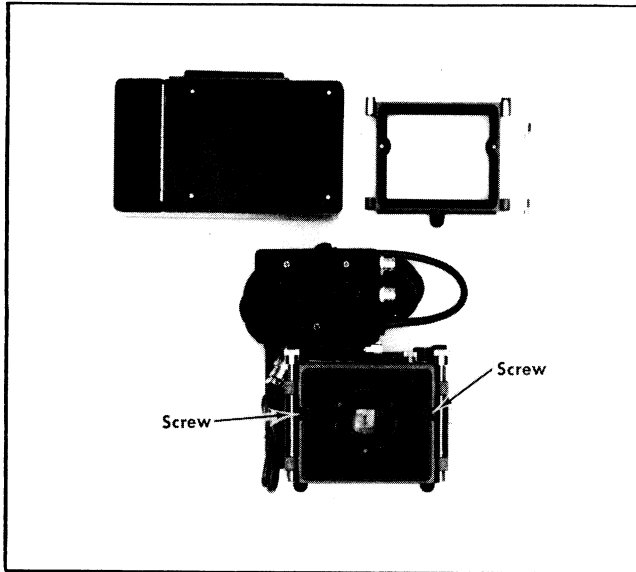


h. Position support casting-bellows-shutter housing cover assembly in position and fasten the shutter housing cover to the shutter housing with four screws (one screw inside bellows).

i. Install o-ring around front lens assembly then over o-ring place light sealing ring. Place the three porta lens clips in place and fasten the parts with three screws.



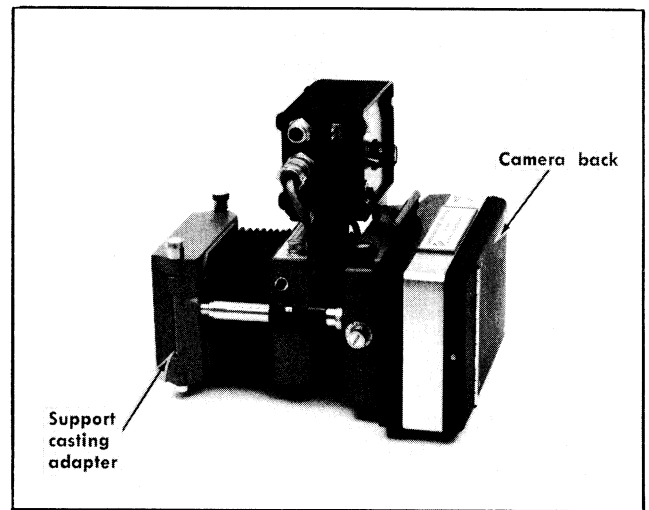
Camera System Maintenance—Type C-30A Camera



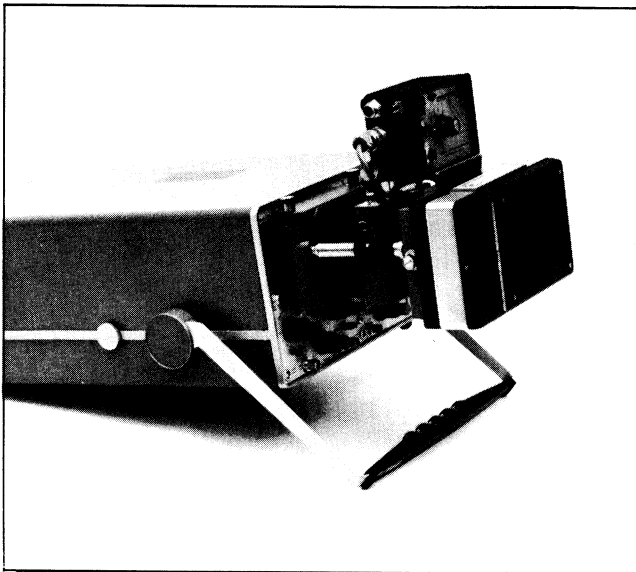
l. Install the support casting adapter and camera back into their respective positions.

j. Align the support casting over the longest support shaft and fasten it to the support shaft with a screw. Place a $\frac{5}{16}$ inch open-end wrench on the flats of the support shaft and a $\frac{5}{32}$ inch hexagonal wrench in the head of the screw, then tighten the screw.

k. Pull the short support shaft out to reveal the shaft flats and place a wrench on the shaft flats. Fasten the support shaft to the support casting in the same manner as described in step j.



C-30A Camera Realignment



a. Attach the camera to an oscilloscope.

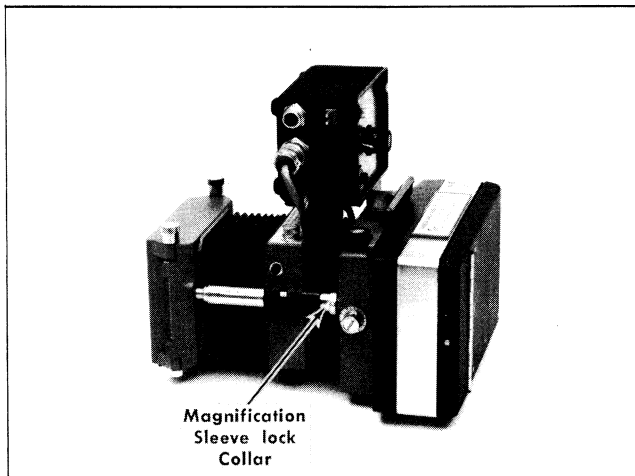
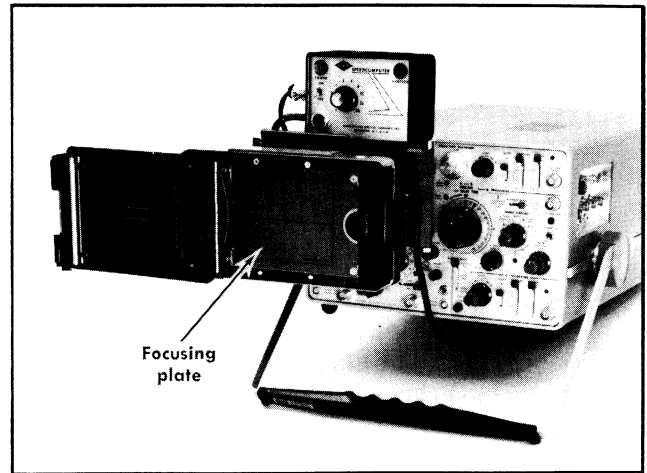
b. Obtain a sharply focused trace of known amplitude on the CRT using the oscilloscope Focus and Astigmatism controls.

Camera System Maintenance—Type C-30A Camera

c. Set the camera to a magnification setting, for example 1.

d. Install either a focusing plate in the film back or the Graflok back and focus the camera, then secure the focus position by using the FOCUS LOCK knob.

e. Measure the image size on the focusing plate or Graflok back and compare it to the original display size times the camera magnification ratio which was set.



f. If the image size is incorrect, loosen the magnification sleeve lock collar set screw and slide the camera toward the oscilloscope to increase image size or away from oscilloscope for decreased image size.

g. Tighten the magnification sleeve lock collar set screw. Release the FOCUS LOCK knob and focus the camera again.

h. Secure the focus position and repeat steps e through h of this procedure until the image size is correct.

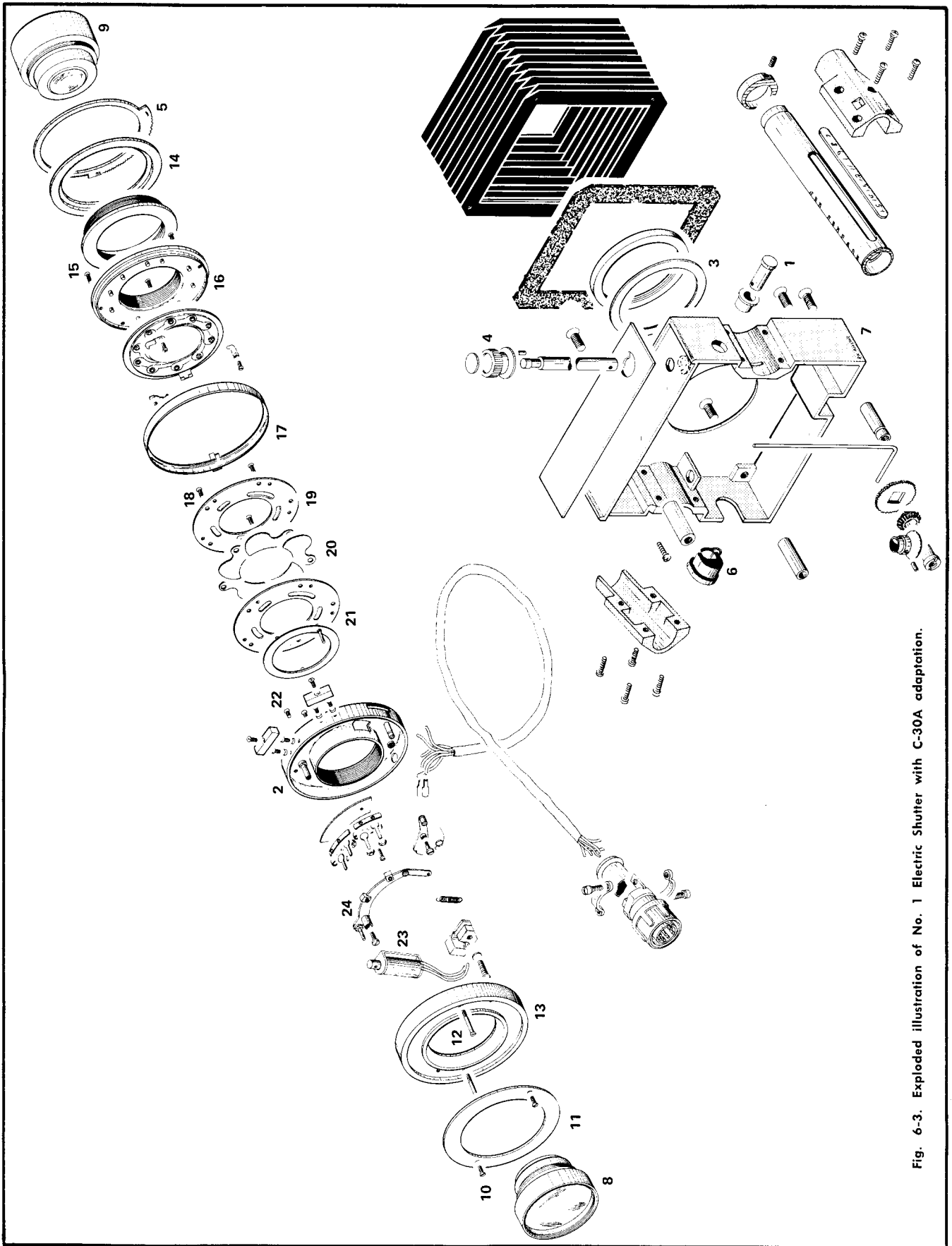


Fig. 6-3. Exploded illustration of No. 1 Electric Shutter with C-30A adaptation.

Disassembly of Electric Shutter

NOTE

When disassembling the shutter, lay the parts out in an orderly manner as they are removed. This will make reassembly easier.

Microswitch Repairs

- a. Remove electric shutter from camera.
- b. Remove two small screws from faceplate on the shutter and remove the faceplate, see Fig. 6-3, items 10 and 11.
- c. Remove two screws from shutter cover and remove the shutter cover, see Fig. 6-3, items 12 and 13.
- d. Perform necessary maintenance.

Solenoid Repairs

- a. Do parts a through c of Microswitch Repairs, then proceed with the following.

- b. Remove shutter case alignment washer, see Fig. 6-3, item 14.
- c. Remove three screws from back case cover and remove the back case cover, see Fig. 6-3, items 15 and 16.
- d. Remove iris ring assembly, see Fig. 6-3, item 17.
- e. Remove three screws from blade plate on the rear of the case assembly and remove blade plate, see Fig. 6-3, items 18, 19 and 2.
- f. Remove shutter blades and ring plate, see Fig. 6-3, items 20 and 21.
- g. Remove the two screws (from the rear of the case assembly) which hold the solenoid in place, see Fig. 6-3, item 22.
- h. Carefully lift the solenoid from the front of the master plate, taking care not to bend the drive lever assembly pin, see Fig. 6-3, items 23 and 24.
- i. Perform necessary maintenance.

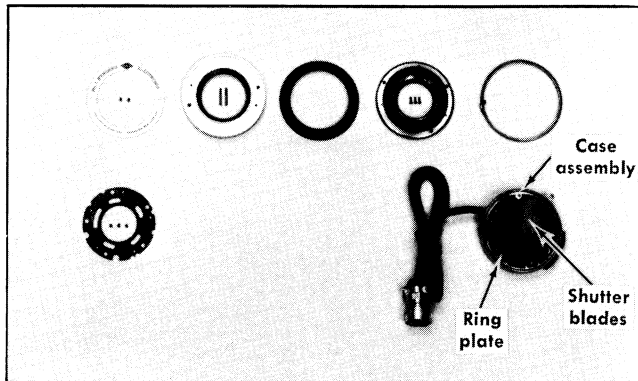
Camera System Maintenance—Type C-30A Camera

Reassembly of Electric Shutter

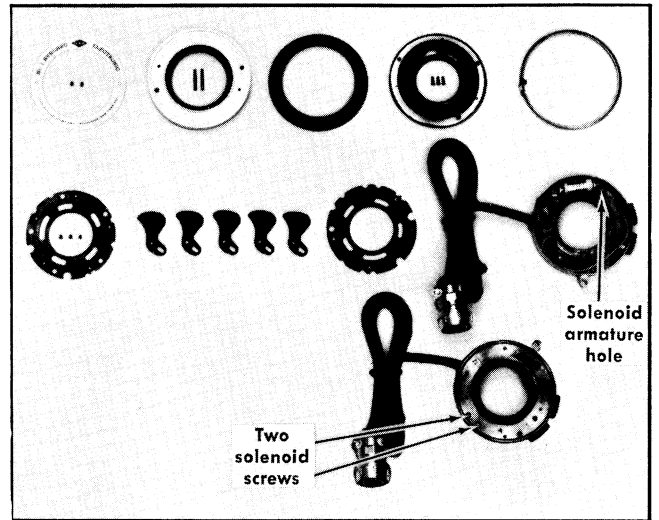
Perform parts a through f if solenoid repairs were made;

Assembly for Solenoid Repairs

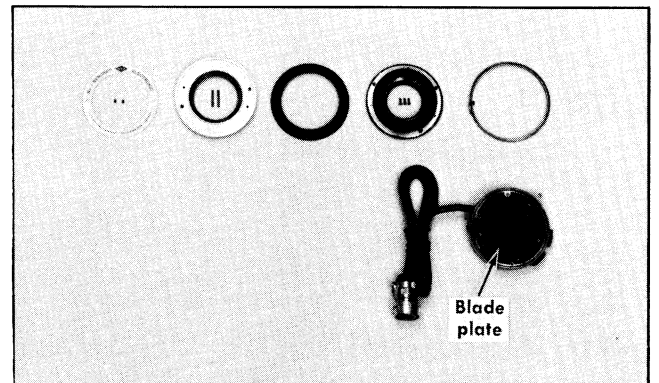
a. Install the solenoid onto the front side of the case assembly (engage drive lever assembly pin in solenoid armature hole) and fasten with two screws from rear side of the case assembly. If the solenoid leads are not soldered to cable, do it now. Refer to electrical diagram for wire color.



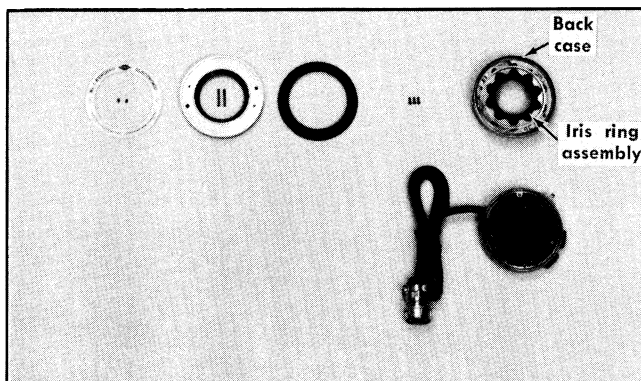
skip parts a through f and start with part g if only micro-switch repairs were made.



b. Install ring plate onto rear of case assembly with rear of case assembly up, then install shutter blades on pins as shown.

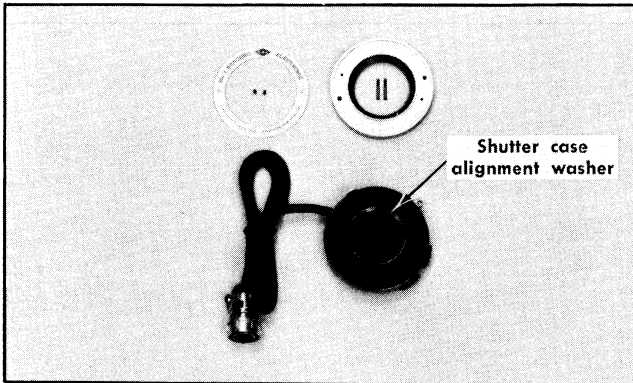
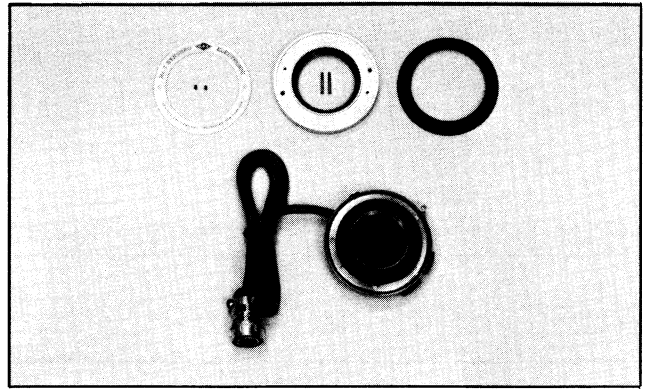


c. Install blade plate on top of shutter blades and secure with three screws. Check drive lever assembly movement for any binding.



d. Install iris ring assembly, as shown, onto back case, making sure to engage the iris ring assembly with the ring and leaf assembly.

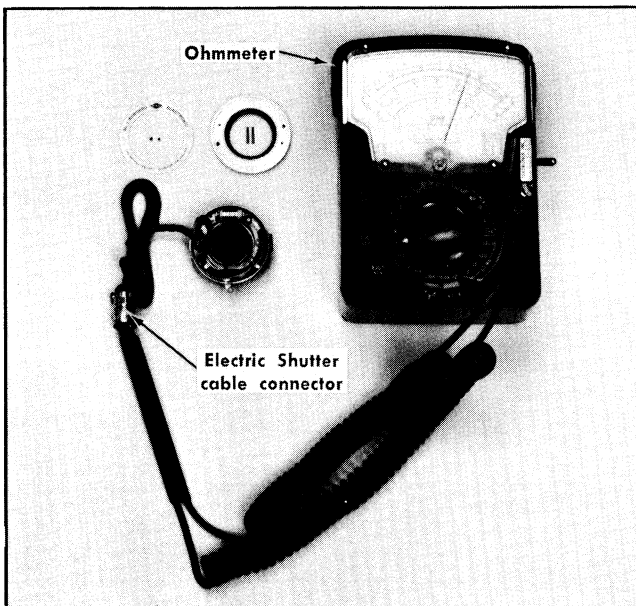
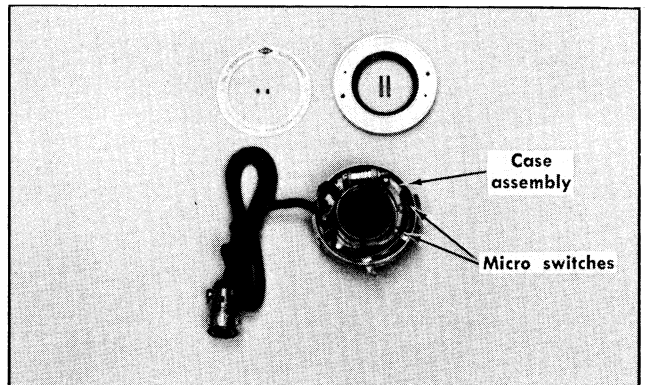
e. Install the iris ring assembly-back case over the blade plate on the rear of the case assembly. Fasten back case in place with three screws.



f. Place shutter case alignment washer in proper position as shown.

Reassembly for Solenoid and Microswitch Repairs

g. Turn shutter so top of case assembly is up, install and solder the microswitches to the cable if it has not been done. Refer to electrical diagram for wire color. Be careful of shorts in assembling microswitches to case assembly and wiring them to the cable.

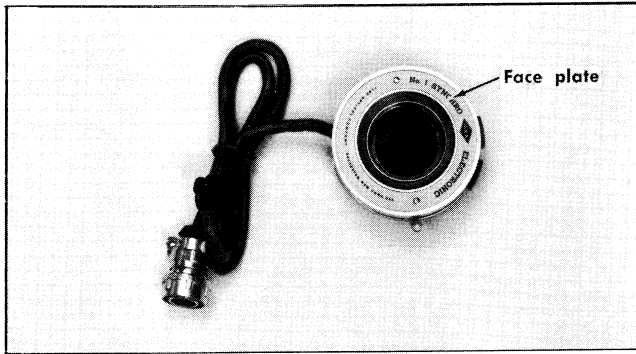
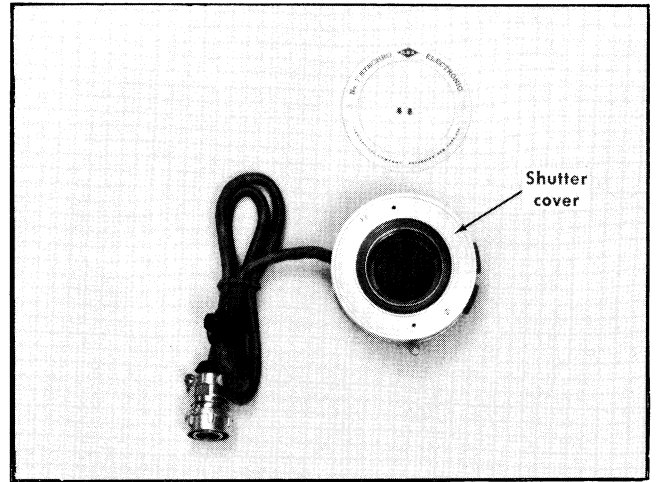


h. Connect an ohmmeter between pins A and C of P5 (Electric Shutter cable connector) and open shutter blades 80% by pushing the solenoid armature into solenoid. Check that microswitch K50B (X-Sync Posts switch) shows a short, if not, blend contact loop. Remove ohmmeter.

i. Connect an ohmmeter between pins D and E of P5 and again open the shutter blades 80%. Check that microswitch K50A (SHUTTER indicator lamp) shows a short, if not, blend contact loop. Remove ohmmeter.

Camera System Maintenance—Type C-30A Camera

j. Install shutter cover over the top of case assembly, positioning the cable wires as necessary for proper fit, and fasten with two screws.



k. Position faceplate on shutter cover and fasten with two screws.

l. Connect the Electric Shutter to Speedcomputer and check operation before installing in camera. Disconnect Electric Shutter after check.

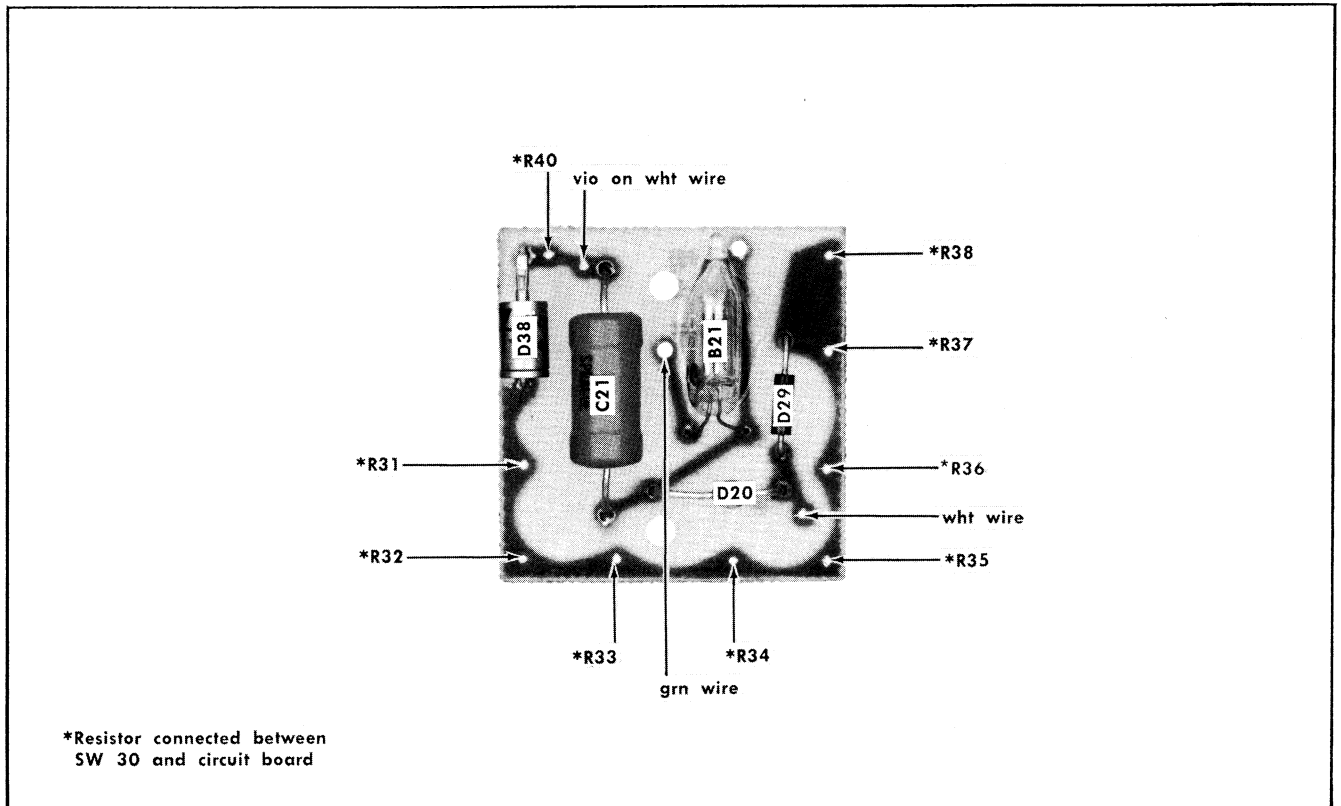


Fig. 6-4. Speedcomputer upper circuit board components and wire color codes.

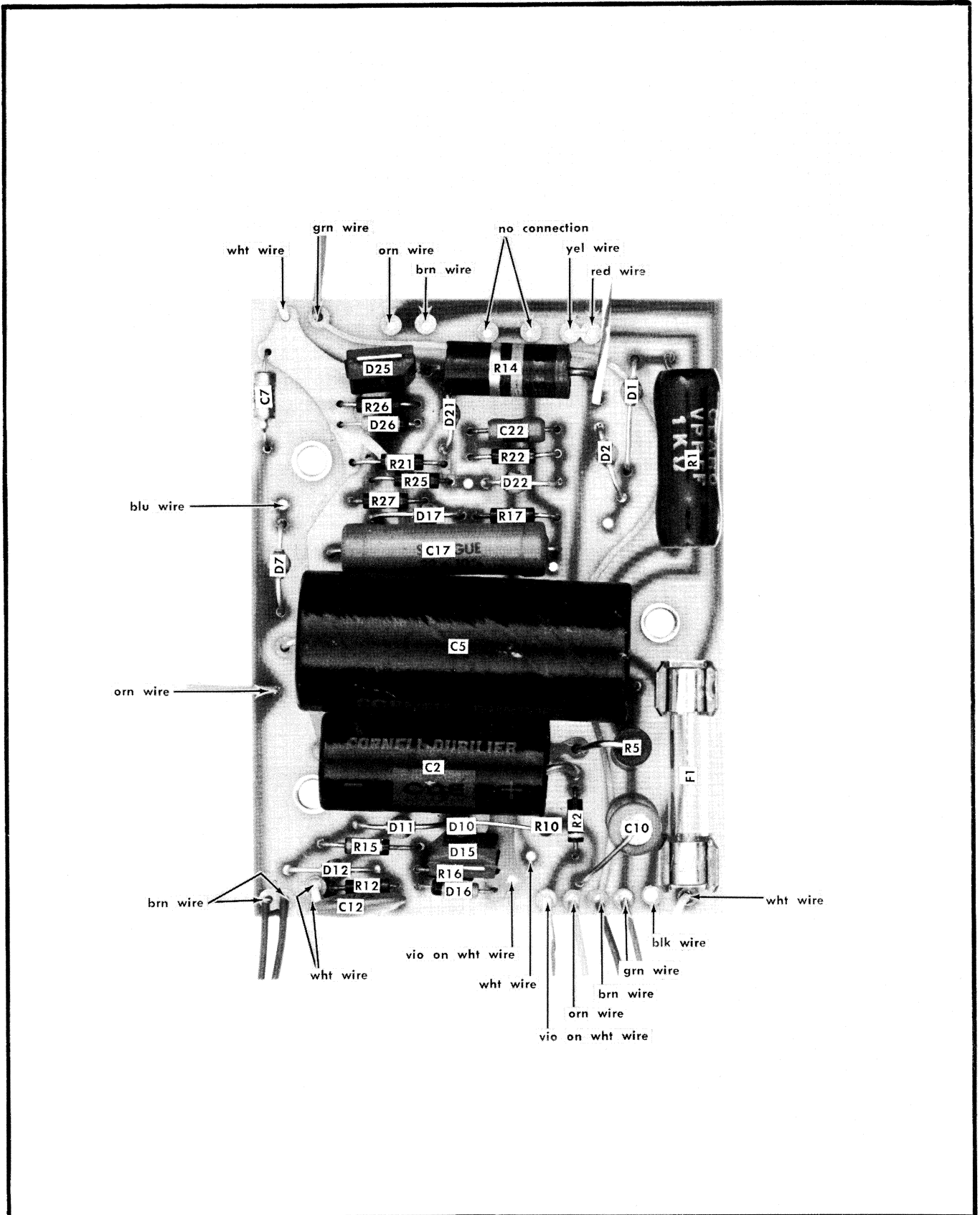


Fig. 6-5. Speedcomputer lower circuit board components and wire color codes.

PACKAGING

Original Packaging

If the camera is to be shipped for long distances by commercial means of transportation, it is recommended that the camera be repackaged in the original manner for maximum protection. The original shipping carton can be saved and used for this purpose. Figs. 6-7 and 6-8 illustrate how to repackage the camera and gives the part numbers for the packaging components if new items are needed.

Accessory Carrying Case

This is an optional accessory which will hold the camera and all standard accessories including extra film. Fig. 6-9 illustrates how to package the camera.

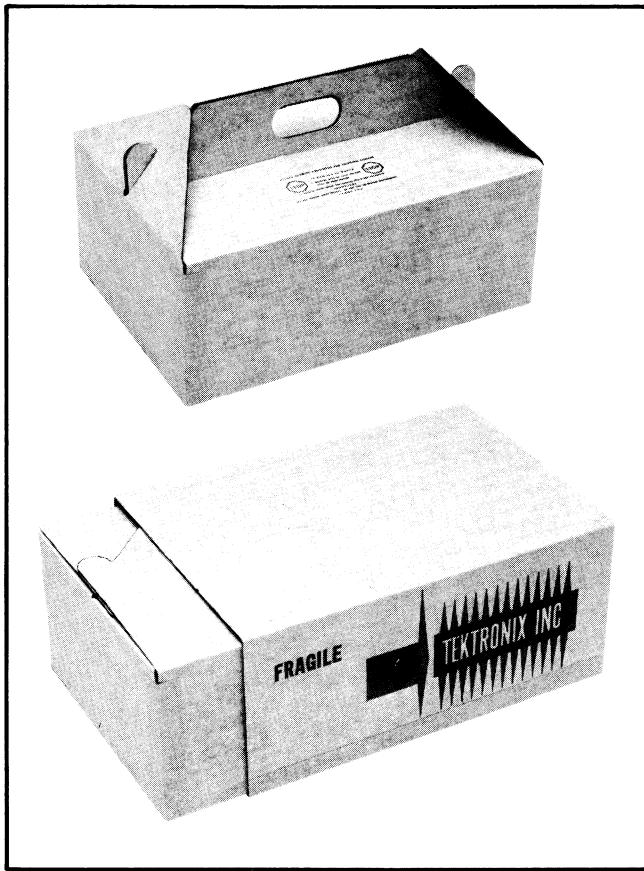


Fig. 6-6. Illustration of the convertible package; (A) for shipping by commercial carrier; (B) for use as a carrying case.

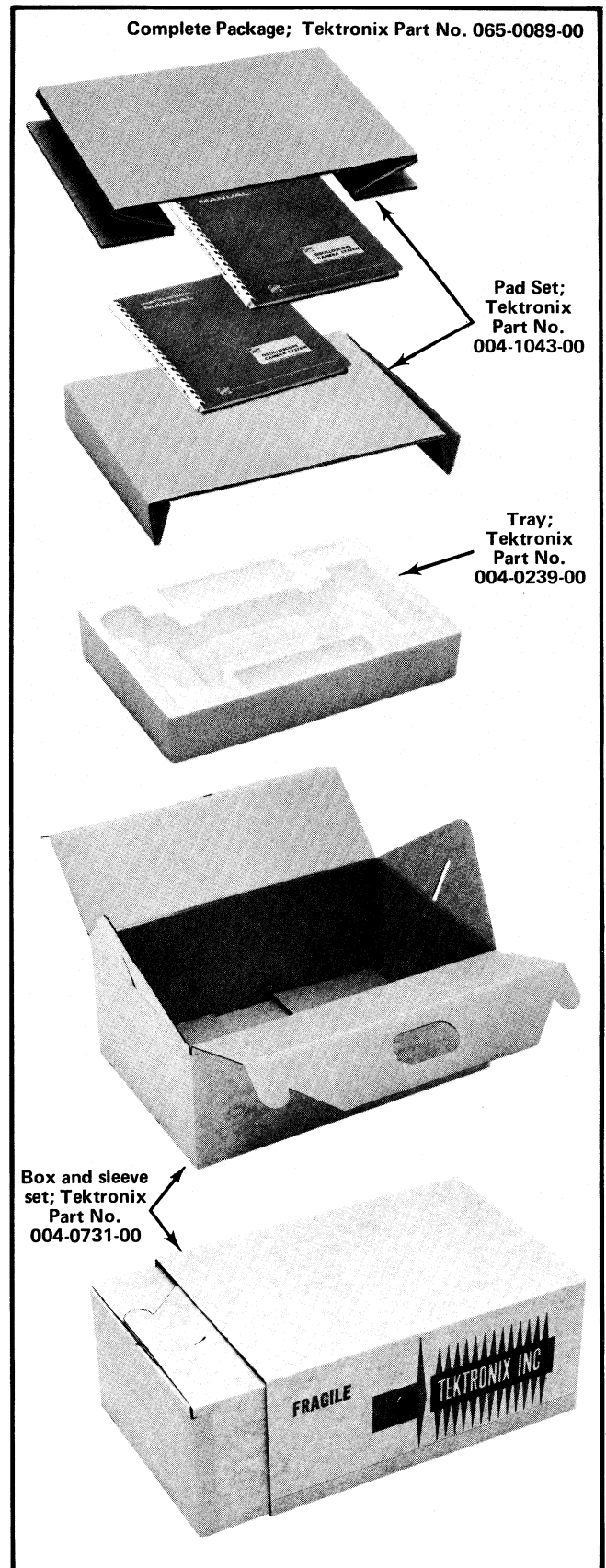


Fig. 6-7. Exploded view of packaging parts showing assembly and Tektronix part numbers for replacement purposes.

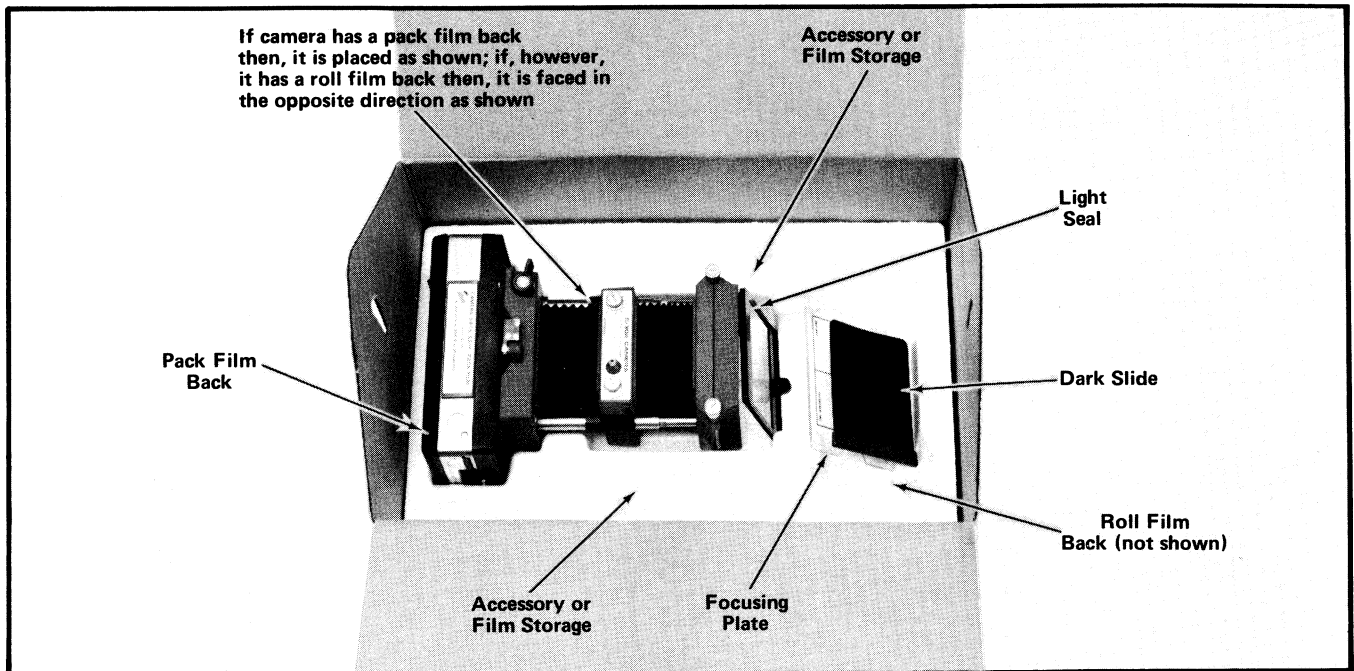


Fig. 6-8. Repackaging the camera in original packing for shipment.

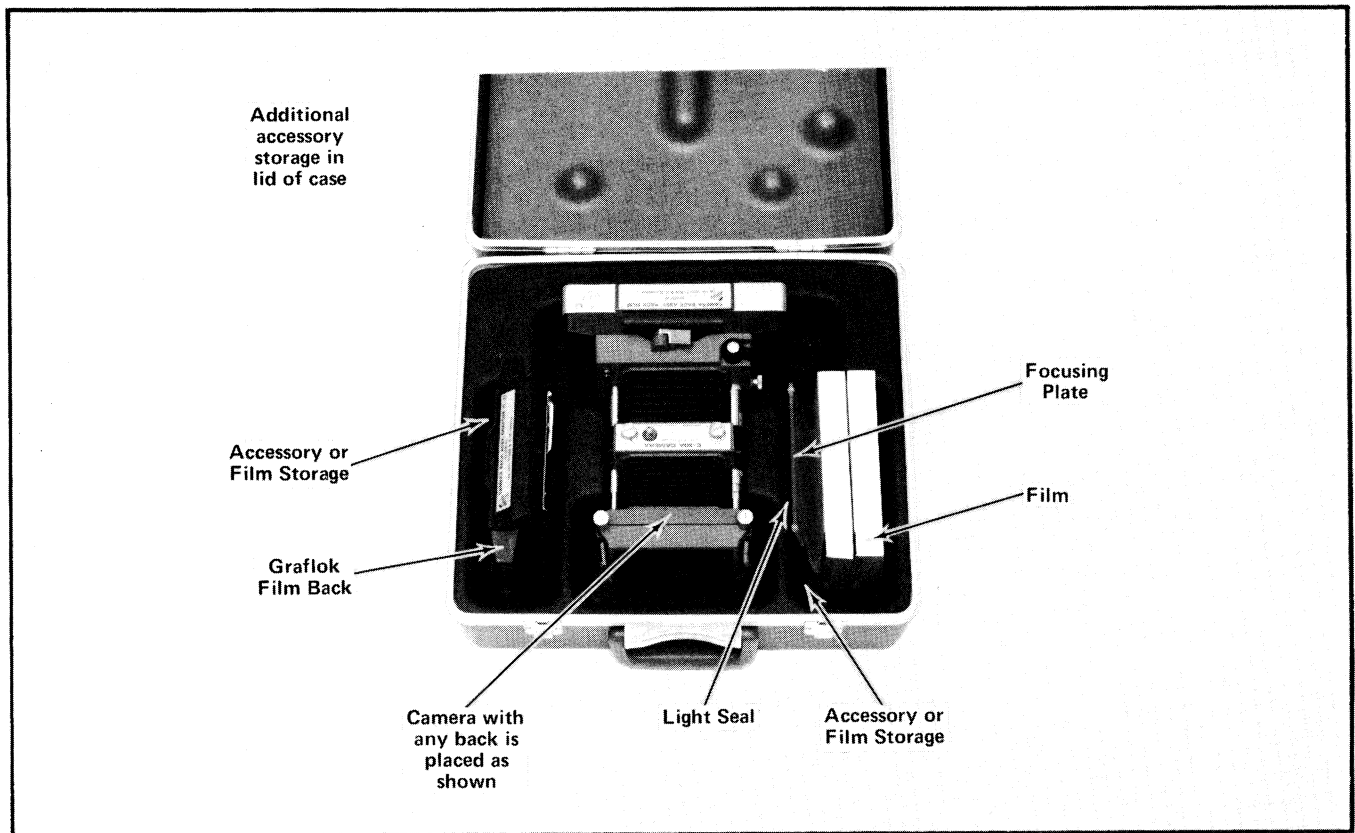


Fig. 6-9. Packaging the camera in the accessory carrying case.

PARTS LIST ABBREVIATIONS

BHB	binding head brass	int	internal
BHS	binding head steel	lg	length or long
cap.	capacitor	met.	metal
cer	ceramic	mtg hdw	mounting hardware
comp	composition	OD	outside diameter
conn	connector	OHB	oval head brass
CRT	cathode-ray tube	OHS	oval head steel
csk	countersunk	P/O	part of
DE	double end	PHB	pan head brass
dia	diameter	PHS	pan head steel
div	division	plstc	plastic
elect.	electrolytic	PMC	paper, metal cased
EMC	electrolytic, metal cased	poly	polystyrene
EMT	electrolytic, metal tubular	prec	precision
ext	external	PT	paper, tubular
F & I	focus and intensity	PTM	paper or plastic, tubular, molded
FHB	flat head brass	RHB	round head brass
FHS	flat head steel	RHS	round head steel
Fil HB	fillister head brass	SE	single end
Fil HS	fillister head steel	SN or S/N	serial number
h	height or high	S or SW	switch
hex.	hexagonal	TC	temperature compensated
HHB	hex head brass	THB	truss head brass
HHS	hex head steel	thk	thick
HSB	hex socket brass	THS	truss head steel
HSS	hex socket steel	tub.	tubular
ID	inside diameter	var	variable
inc	incandescent	w	wide or width
		WW	wire-wound

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial or model number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

SPECIAL NOTES AND SYMBOLS

- | | |
|-----------------|---|
| ×000 | Part first added at this serial number |
| 00× | Part removed after this serial number |
| *000-0000-00 | Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components. |
| Use 000-0000-00 | Part number indicated is direct replacement. |

SECTION 7

ELECTRICAL PARTS LIST

NO. 1 ELECTRIC SHUTTER

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
Bulbs				
B3	150-0040-00			Neon NE2H, assembly, translucent lens
B7	150-0041-00			Neon NE2H, assembly, amber lens
B21	150-0021-00			Neon NE76

Capacitors

Tolerance $\pm 20\%$ unless otherwise indicated.

C2	290-0431-00		4 μ F	PTM	250 V	
C5	290-0430-00		30 μ F	PTM	250 V	
C7	290-0267-00		1 μ F	Elect.	35 V	
C10	285-0572-00		0.1 μ F	PTM	200 V	
C12	285-0832-00		0.001 μ F	PTM	200 V	
C17	285-0892-00		0.47 μ F	MT	200 V	
C21	285-0572-00		0.1 μ F	PTM	200 V	
C22	283-0597-00		470 pF	Mica	300 V	10%

Semiconductor Device, Diodes

D1	152-0066-01		Silicon	400 V	0.75A	
D2	152-0066-01		Silicon	400 V	0.75A	
D7	152-0066-01		Silicon	400 V	0.75A	
D10	152-0066-01		Silicon	400 V	0.75A	
D11	152-0066-01		Silicon	400 V	0.75A	
D12	152-0066-01		Silicon	400 V	0.75A	
D15	151-0506-00		Silicon controlled rectifier, C106B			
D16	152-0025-00		Germanium 1N634			
D17	152-0066-01		Silicon	400 V	0.75A	
D20	152-0066-01		Silicon	400 V	0.75A	
D21	152-0066-01		Silicon	400 V	0.75A	
D22	152-0066-01		Silicon	400 V	0.75A	
D25	151-0506-00		Silicon controlled rectifier, C106B			
D26	152-0025-00		Germanium 1N634			
D28	*152-0185-00		Silicon		Replaceable by 1N4152	
D29	152-0066-01		Silicon	400 V	0.75A	
D30	152-0066-01		Silicon	400 V	0.75A	
D38	152-0417-00		Zener		1N3047B, 1W, 130 V, 5%	

Fuse

F1	159-0028-00		$\frac{1}{4}$ A 3AG Fast-Blo	115 V	
	159-0033-00		$\frac{1}{8}$ A 8AG Fast-Blo	230 V	

Electrical Parts List—Type C-30A

Connectors

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
J10	131-0425-00			Receptacle, electrical
J20	131-0424-00			Receptacle, electrical

Sync Posts

P5	122-0822-00			Sync Posts
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Transistor

Q29	151-0292-00		Silicon	PNP TO-92 TIS 100
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Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R1	308-0106-00		1 k Ω	5 W	WW	5%
R2	316-0473-00		47 k Ω	1/4 W		
R3	316-0473-00		47 k Ω	1/4 W		
R5	304-0473-00		47 k Ω	1 W		
R10	316-0150-00		15 Ω	1/4 W		
R11	316-0223-00		22 k Ω	1/4 W		
R12	316-0105-00		1 M Ω	1/4 W		
R13	316-0224-00		220 k Ω	1/4 W		
R14	306-0153-00		15 k Ω	2 W		
R15	316-0222-00		2.2 k Ω	1/4 W		
R16	316-0221-00		220 Ω	1/4 W		
R17	316-0274-00		270 k Ω	1/4 W		
R21	316-0562-00		5.6 k Ω	1/4 W		
R22	316-0105-00		1 M Ω	1/4 W		
R25	316-0223-00		22 k Ω	1/4 W		
R26	316-0562-00		5.6 k Ω	1/4 W		
R27	316-0274-00		270 k Ω	1/4 W		
R31			Selected			
R32			Selected			
R33			Selected			
R34			Selected			
R35			Selected			
R36			Selected			
R37			Selected			
R38			Selected			
R39			Selected			
R40	316-0824-00		820 k Ω	1/4 W		

Transformer

T1	122-0823-00			Transformer
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Switches

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Description
		Wired or Unwired		
SW1	260-0834-00			Toggle
SW14	122-0821-00			Lever
SW30	122-0820-00			Rotary
K50	122-0878-00			
K50A ¹				
K50B ¹				

ON-OFF
ACTUATE
EXPOSURE TIME
SOLENOID

Circuit Boards

122-0818-00	Complete Circuit Board (rear)
122-0819-00	Complete Circuit Board (front)

¹See Mechanical Parts List.

SECTION 8

MECHANICAL PARTS LIST

FIG. 1 FRAME-MOUNT & REAR FRAME ASSEMBLIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Q † Y	Description
		Eff	Disc		
1-	122-0762-00			1	ASSEMBLY, frame-mount
	- - - - -			-	assembly includes:
	016-0306-00			1	ADAPTER, camera assembly
-1	- - - - -			-	SEE STANDARD ACCESSORIES
	122-0928-00			1	ADAPTER, camera to oscilloscope
	- - - - -			-	adapter includes
-2	348-0048-00			1	FOOT, rubber, black
-3	426-0285-01			1	CASTING, support
-4	124-0178-00			1	STRIP, light seal
-5	377-0143-00			2	INSERT, locking
	- - - - -			-	mounting hardware for each: (not included w/insert)
-6	213-0006-00			1	SCREW, set, 8-32 x 3/16 inch, HSS
-7	426-0284-01			1	CASTING, support adapter
	- - - - -			-	mounting hardware: (not included w/casting)
-8	212-0573-00			2	SCREW, 10-32 x 0.750 inch, HSS
-9	214-0647-00	B020101	B020250	2	ASSEMBLY, hinge pin & knob
	214-0647-01	B020251		2	ASSEMBLY, hinge pin & knob
	- - - - -			-	each assembly includes:
-10	334-0966-03			1	TAG, knob (PULL)
	- - - - -			-	mounting hardware for each: (not included w/assembly)
-11	214-0626-00			1	SPRING
-12	210-1009-00			1	WASHER, flat, 0.200 ID x 0.312 inch OD
-13	354-0290-01			1	RING, retaining
-14	213-0204-00	XB020251		2	THUMBSCREW, 4-40 x 0.55 inch
-15	214-0752-00			2	GASKET, light seal
-16	354-0278-00	B010100	B025667	1	RING, light seal
	352-0342-00	B025668		1	HOLDER, lens
	- - - - -			-	mounting hardware: (not included w/ring)
-17	211-0008-00	B010100	B025667	3	SCREW, 4-40 x 1/4 inch, PHS
	211-0101-00	B025668		3	SCREW, MACHINE, 4-40 x 0.25, FLH STL
-18	214-0646-00	B010100	B025667X	3	SPRING, auxiliary lens retainer
-19	214-0659-00			1	GASKET, light seal
-20	214-0627-00			1	BELLOWS
	- - - - -			-	mounting hardware: (not included w/bellows)
-21	211-0123-00			8	SCREW, 1-72 x 0.188 inch, PHS
-22	200-0638-01			1	COVER, shutter housing
	- - - - -			-	mounting hardware: (not included w/shutter)
-23	211-0119-00			4	SCREW, 4-40 x 0.250 inch, 100° csk, FHS
-24	- - - - -			1	FRAME-LENS ASSEMBLY (see FIG. #2)
	122-0758-00			1	ASSEMBLY, rear-frame
	- - - - -			-	assembly includes:
-25	426-0570-00			-	ASSEMBLY, rear frame
	- - - - -			-	assembly includes:
	- - - - -			1	FRAME
-26	- - - - -			1	TUBE
-27	- - - - -			1	TUBE

Mechanical Parts List—Type C-30A

FIG. 1 FRAME-MOUNT & REAR FRAME ASSEMBLIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Q † Y	Description
		Eff	Disc		
1-28	366-0339-02			1	KNOB-FOCUS
	- - - - -			-	knob includes:
-29	213-0048-00			1	SCREW, set, 4-40 x 1/8 inch, HSS
-30	334-0966-02			1	TAG, knob (FOCUS)
-31	384-0371-00			1	SHAFT, focus control
	- - - - -			-	mounting hardware: (not included w/shaft)
-32	334-0970-00			1	TAG, focus knob index
-33	358-0279-00			1	BUSHING, focus control
-34	348-0187-00			2	FOOT, rubber, black
	- - - - -			-	mounting hardware for each: (not included w/foot)
-35	211-0565-00			1	SCREW, 6-32 x 1/4 inch, THS
-36	366-0340-02			1	KNOB-FOCUS LOCK
	- - - - -			-	knob includes:
-37	213-0126-00			2	SCREW, set, 6-32 x 1/4 inch, HSS
-38	334-0969-00			1	TAG, knob (FOCUS LOCK)
-39	210-1015-00			1	WASHER, spring tension, 0.254 ID x 0.500 inch OD
-40	384-0370-00			1	SHAFT, focus lock
	- - - - -			-	mounting hardware: (not included w/shaft)
-41	358-0280-00			1	BUSHING, focus lock
-42	200-0829-00			1	CAP, end, shaft
-43	214-0163-00			1	LATCH, camera back
	- - - - -			-	mounting hardware: (not included w/latch)
-44	358-0108-00			1	BUSHING, latch
-45	210-0044-00			2	LOCKWASHER, 0.230 ID x 0.375 inch OD
-46	212-0067-00			1	SCREW, 8-32 x 3/8 inch, THS
-47	344-0039-00			1	CLIP, camera back adapter
	- - - - -			-	mounting hardware: (not included w/clip)
-48	211-0065-00			2	SCREW, 4-40 x 3/16 inch, PHS
-49	211-0123-00			4	SCREW, 1-72 x 0.188 inch, PHS
-50	212-0067-00			2	SCREW, 8-32 x 3/8 inch, THS
-51	214-0752-00			1	GASKET, light seal, 1/8 x 3/16 x 15 inches long
-52	124-0178-00			1	STRIP, light seal
-53	384-0373-00			1	SHAFT, support, left
-54	252-0550-00			FT	SEAL, light, black velvet ribbon (1.5 inches)
-55	214-0624-00			2	BEARING, support shaft
-56	384-0372-00			1	SHAFT, support right
-57	252-0550-00			FT	SEAL, light, black velvet ribbon (1.5 inches)
-58	214-0624-00			2	BEARING, support shaft
-59	122-0752-00			1	ASSEMBLY, polaroid pack film back w/focus plate (see data sheet)

FIG. 2 FRAME-LENS ASSEMBLY-MECHANICAL-ELECTRICAL

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q					Description	
				y	1	2	3	4		5
2-	122-0763-00			1						ASSEMBLY, lens-frame
	- - - - -			-						assembly includes:
-1	380-0083-01			1						HOUSING, shutter
-2	361-0105-00			2						SPACER, housing, 0.187 inch OD
	- - - - -			-						mounting hardware for each: (not included w/spacer)
-3	211-0119-00			1						SCREW, 4-40 x 0.250 inch, 100° csk, FHS
	- - - - -			-						
-4	129-0080-00			1						POST, plastic, 1/4 diameter x 0.875 inch long
	- - - - -			-						mounting hardware: (not included w/post)
-5	211-0119-00			1						SCREW, 4-40 x 0.250 inch, 100° csk, FHS
	- - - - -			-						
-6	361-0096-00			1						SPACER, housing, 3/16 inch OD
	- - - - -			-						mounting hardware: (not included w/spacer)
-7	211-0119-00			1						SCREW, 4-40 x 0.250 inch, 100° csk, FHS
	- - - - -			-						
-8	214-0621-00			1						BEARING, shutter box housing, right side
	- - - - -			-						mounting hardware: (not included w/bearing)
-9	211-0118-00			4						SCREW, 2-56 x 0.250 inch, PHS
	- - - - -			-						
-10	166-0411-00			1						SLEEVE, magnification adjust
-11	214-0623-00			1						COLLAR, magnification adjust
	- - - - -			-						collar includes:
-12	213-0022-00			1						SCREW, set, 4-40 x 3/16 inch, HSS
-13	334-0967-00			1						TAG, magnification
-14	214-0635-00			1						BEARING, shutter box housing, left side
	- - - - -			-						mounting hardware: (not included w/bearing)
-15	211-0118-00			4						SCREW, 2-56 x 0.250 inch, PHS
	- - - - -			-						
-16	214-0752-00			1						GASKET, light seal
-17	214-0627-00			1						BELLOWS, camera
	- - - - -			-						mounting hardware: (not included w/bellows)
-18	211-0123-00			4						SCREW, 1-72 x 0.188 inch, PHS
	- - - - -			-						
-19	214-0655-00			2						CONTACT, electrical
	- - - - -			-						mounting hardware: (not included w/contact)
-20	386-0228-00			2						PLATE, mounting
-21	210-0259-00			2						LUG, solder, #2
-22	210-0405-00			2						NUT, hex., 2-56 x 3/16 inch
	- - - - -			-						
-23	366-0339-00			1						KNOB—SPEED
	- - - - -			-						knob includes:
	213-0048-00			1						SCREW, set, 4-40 x 1/8 inch, HSS
-24	334-0966-00			1						TAG, knob (SPEED)
-25	384-0369-00			1						SHAFT, shutter speed
-26	214-0619-00			2						GEAR, mitre driver
	- - - - -			-						mounting hardware for each: (not included w/gear)
-27	214-0660-00			1						PIN, straight

FIG. 2 FRAME-LENS ASSEMBLY-MECHANICAL-ELECTRICAL (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q					Description	
				†	Y	1	2	3		4
2-28	214-0615-00			1						GEAR, pinion
-29	214-0620-00			1						GEAR, mitre
	- - - - -			-						mounting hardware: (not included w/gear)
-30	358-0278-00			1						BUSHING, gear
-31	136-0225-00			1						SOCKET, cable release
-32	214-0612-00			1						PIN, socket, cable release
-33	366-0339-01			1						KNOB—F STOP
	- - - - -			-						knob includes:
	213-0048-00			1						SCREW, set, 4-40 x 1/8 inch, HSS
-34	334-0966-01			1						TAG, knob (F STOP)
-35	384-0379-00			1						SHAFT, mitre gear
-36	129-0081-00			1						POST, gear
	- - - - -			-						mounting hardware: (not included w/post)
-37	211-0119-00			1						SCREW, 4-40 x 0.250 inch, 100° csk, FHS
-38	214-0620-00			1						GEAR, mitre
-39	214-0618-00			1						GEAR, pinion
	- - - - -			-						mounting hardware: (not included w/gear)
-40	210-1012-00			1						WASHER, plastic, 0.117 ID x 0.720 inch OD
-41	211-0007-00			1						SCREW, 4-40 x 3/16 inch, PHS
-42	214-0610-00			1						SPRING, lock
-43	214-0746-00			1						LEVER, shutter release
	- - - - -			-						mounting hardware: (not included w/lever)
-44	211-0097-00			1						SCREW, 4-40 x 5/16 inch, PHS
-45	210-0851-00			1						WASHER, flat, 0.119 ID x 3/8 inch OD
-46	214-0611-00			1						SPRING, return
-47	358-0284-00			1						BUSHING, actuator lever
-48	214-0613-00			1						PIN, release
	- - - - -			-						mounting hardware: (not included w/pin)
-49	358-0277-00			1						BUSHING, pin
-50	334-1277-00			1						PLATE, instruction
-51	214-0617-00			1						GEAR, spur
	- - - - -			-						mounting hardware: (not included w/gear)
-52	211-0069-00			2						SCREW, 2-56 x 1/8 inch, PHS
-53	122-0711-00			1						ASSEMBLY, lens
	- - - - -			-						assembly includes:
	122-0724-00			1						SHUTTER
	- - - - -			-						mounting hardware: (not included w/assembly)
-54	214-1083-00			1						INSULATOR WASHER, 1.693 ID x 2.129 inch OD
-55	220-0442-00			1						NUT, lens retainer
-56	354-0277-00			1						RING, gear
-57	214-0616-00			1						GEAR, spur

FIG. 2 FRAME-LENS ASSEMBLY-MECHANICAL-ELECTRICAL (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Q † Y	Description
		Eff	Disc		
2-	122-0912-00			1	ASSEMBLY, lens-frame
-58	380-0083-02			1	assembly includes: HOUSING, shutter
-59	361-0105-00			2	SPACER, housing, 0.187 inch OD
-60	211-0119-00			1	mounting hardware for each: (not included w/spacer) SCREW, 4-40 x 0.250 inch, 100° csk, FHS
-61	129-0080-00			1	POST, plastic, 1/4 diameter x 0.875 inch long
-62	211-0119-00			1	mounting hardware: (not included w/post) SCREW, 4-40 x 0.250 inch, 100° csk, FHS
-63	361-0096-00			1	SPACER, housing, 3/16 inch OD
-64	211-0119-00			1	mounting hardware: (not included w/spacer) SCREW, 4-40 x 0.250 inch, 100° csk, FHS
-65	214-0621-00			1	BEARING, shutter box housing, right side
-66	211-0118-00			4	mounting hardware: (not included w/bearing) SCREW, 2-56 x 0.250 inch, PHS
-67	166-0411-00			1	SLEEVE, magnification adjust
-68	214-0623-00			1	COLLAR, magnification adjust
-69	213-0022-00			1	collar includes: SCREW, set, 4-40 x 3/16 inch, HSS
-70	334-0967-00			1	TAG, magnification
-71	214-0635-00			1	BEARING, shutter box housing, left side
-72	211-0118-00			4	mounting hardware: (not included w/bearing) SCREW, 2-56 x 0.250 inch, PHS
-73	214-0752-00			1	GASKET, light seal
-74	214-0627-00			1	BELLOWS, camera
-75	211-0123-00			4	mounting hardware: (not included w/bellows) SCREW, 1-72 x 0.188 inch, PHS
-76	366-0339-01			1	KNOB, F stop
-77	334-0966-01			1	knob includes: TAG, knob
-78	354-0290-00			1	RING, retaining
-79	384-0754-00			1	SHAFT, shutter
-80	214-0619-00			1	GEAR, mitre driver
-81	214-0660-00			1	mounting hardware: (not included w/gear) PIN, straight
-82	214-0613-00			1	PIN, release
-83	358-0277-00			1	mounting hardware: (not included w/pin) BUSHING, pin
-84	214-0615-00			1	GEAR, pinion
-85	214-0620-00			1	GEAR, mitre
-86	211-0119-00			1	mounting hardware: (not included w/gear) SCREW, 4-40 x 0.250 inch, 100° csk, FHS
-87	358-0278-00			1	BUSHING, gear

Mechanical Parts List—Type C-30A

FIG. 2 FRAME-LENS ASSEMBLY-MECHANICAL-ELECTRICAL (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Q † y	Description
		Eff	Disc		
2-88	358-0161-00			1	BUSHING, strain relief
-89	214-0610-00			1	SPRING, lock
-90	334-1399-00			1	PLATE, instruction
-91	354-0277-00			1	RING, gear mounting
-92	214-0616-00			1	GEAR, spur
	122-0838-00			1	ASSEMBLY, lens
	- - - - -			-	assembly includes:
	122-0835-00			1	ASSEMBLY, shutter
	- - - - -			-	assembly includes:
-93	122-0875-00			1	FACE PLATE
	- - - - -			-	mounting hardware: (not included w/face plate)
-94	122-0784-00			2	SCREW
-95	122-0867-00			1	COVER
	- - - - -			-	mounting hardware: (not included w/cover)
-96	122-0874-00			2	SCREW
-97	- - - - -			1	SOLENOID (see electrical parts list)
	- - - - -			-	mounting hardware: (not included w/solenoid)
-98	122-0787-00			2	SCREW
-99	122-0811-00			1	CLAMP, cable
	- - - - -			-	mounting hardware: (not included w/clamp)
-100	122-0879-00			1	SCREW
-101	210-0001-00			1	LOCKWASHER, internal, #2
-102	122-0881-00			1	LEVER, drive
	- - - - -			-	mounting hardware: (not included w/lever)
-103	122-0781-00			1	SCREW
-104	122-0873-00			1	SHAFT, extension
-105	122-0876-00			1	LEVER, focus
	- - - - -			-	mounting hardware: (not included w/lever)
-106	122-0877-00			1	SPRING, helical
-107	122-0851-00			1	SCREW
-108	211-0868-00			1	INSULATOR
	- - - - -			-	mounting hardware: (not included w/insulator)
-109	122-0782-00			1	SCREW
-110	122-0850-00			2	TERMINAL, lug
	- - - - -			-	mounting hardware for each: (not included w/terminal)
-111	122-0863-00			1	SCREW
-112	122-0865-00			1	BUSHING, sleeve
-113	122-0871-00			1	CONTACT, electrical
-114	122-0861-00			1	NUT, hex., plain
-115	122-0870-00			2	INSULATOR
-116	122-0850-00			2	TERMINAL, lug
	- - - - -			-	mounting hardware for each: (not included w/terminal)
-117	122-0864-00			1	SCREW
-118	122-0865-00			1	BUSHING, sleeve
-119	122-0861-00			1	NUT, hex., plain

FIG. 2 FRAME-LENS ASSEMBLY-MECHANICAL-ELECTRICAL (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q					Description	
				†	Y	1	2	3		4
2-120	122-0866-00			2						CAP
	- - - - -			-						mounting hardware for each: (not included w/cap)
-121	122-0848-00			1						SCREW
-122	122-0862-00			1						CASE ASSEMBLY
-123	122-0872-00			1						BLADE, ring assembly
-124	122-0853-00			1						RING, plate
-125	122-0883-00			5						BLADE, shutter
-126	122-0854-00			1						PLATE, blade
	- - - - -			-						mounting hardware: (not included w/plate)
-127	122-0849-00			3						SCREW
-128	122-0852-00			1						RING, iris
-129	122-0856-00			1						RING-LEAF ASSEMBLY
	- - - - -			-						mounting hardware: (not included w/ring-leaf assembly)
-130	122-0782-00			3						SCREW
-131	122-0859-00			3						CLAMP
-132	122-0880-00			1						CASE, back
	- - - - -			-						mounting hardware: (not included w/case)
-133	122-0860-00			3						SCREW
-134	122-0882-00			1						CABLE ASSEMBLY
	- - - - -			-						mounting hardware: (not included w/assembly)
-135	214-1083-00			1						INSULATOR WASHER, 1.693 ID x 2.129 inches OD
-136	220-0442-00			1						NUT, lens retainer

STANDARD ACCESSORIES

354-0279-00	1	RING, light seal (Type 422) (installed)
354-0280-00	1	RING, light seal (Type 453)
387-0893-01	1	PLATE, focus
387-0893-02	1	PLATE, focus
070-0808-02	1	MANUAL, instruction (not shown)

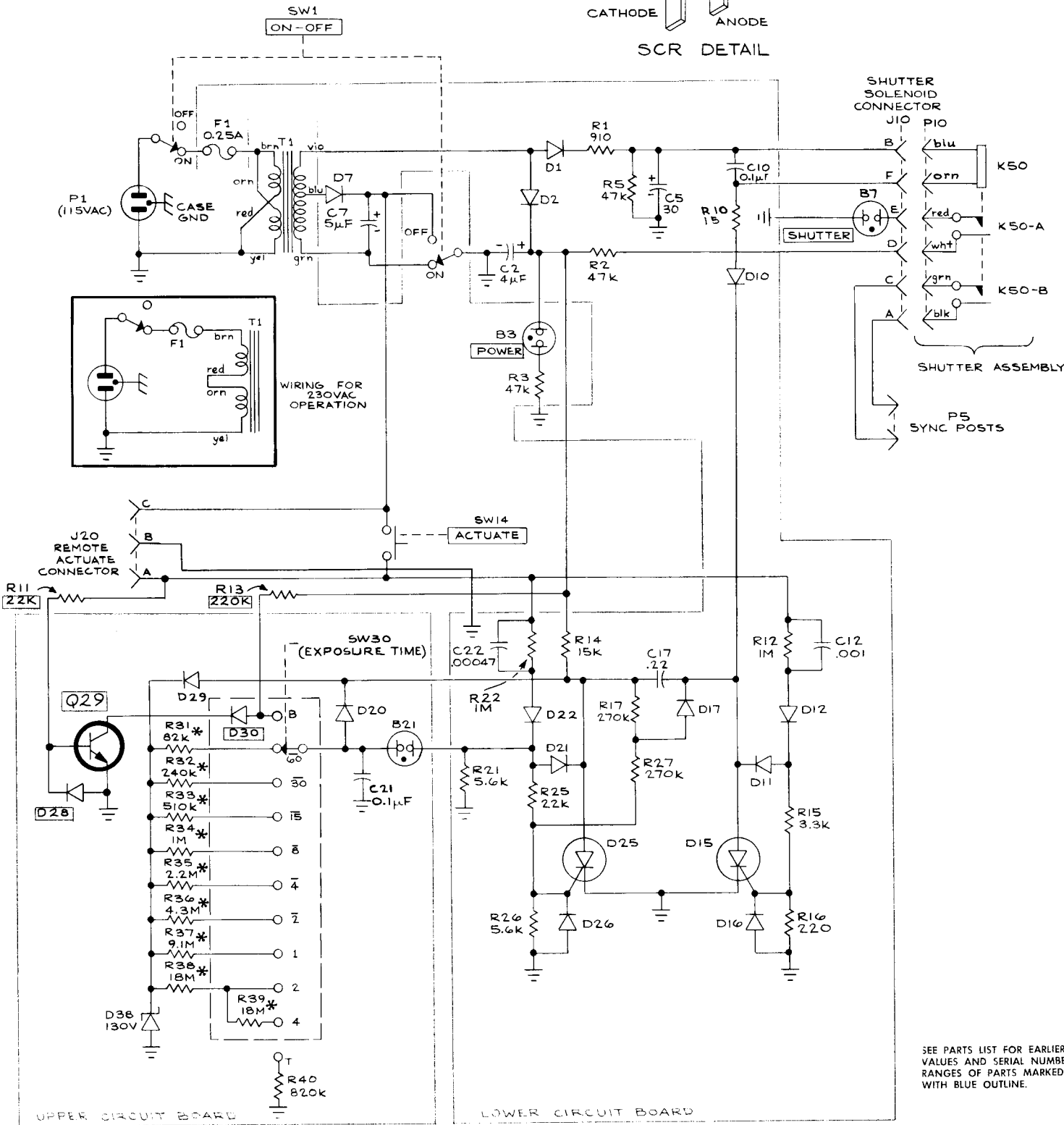
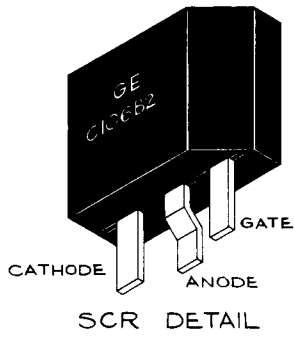
Mechanical Parts List—Type C-30A

FIG. 3 SPEEDCOMPUTER

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Disc	Q † y						Description
					1	2	3	4	5	
3-	122-0767-02			1						SPEEDCOMPUTER®, w/bulb position
	- - - - -			-						speedcomputer includes:
	131-0423-00			1						CONNECTOR, plug, 3 pin
	212-0069-00			2						SCREW, 2-56 x 1/8 inch, PHS
-1	122-0826-00			1						KNOB
-2	122-0825-01			1						PANEL, front
-3	122-0827-00			1						SUB-PANEL, w/posts
	122-0828-00			1						SUB-PANEL, w/o posts
-4	122-0829-00			2						POST
-5	150-0040-00			1						ASSEMBLY, bulb, neon, w/mounting hardware
-6	260-0834-00			1						SWITCH, ON-OFF
	- - - - -			-						mounting hardware: (not included w/switch)
-7	210-0562-00			2						NUT, hex., 1/4-40 x 5/16 inch
-8	210-0020-00			1						LOCKWASHER, internal, #12
-9	122-0821-00			1						SWITCH—ACTUATE, w/mounting hardware
-10	122-0820-00			1						SWITCH—EXPOSURE TIME, w/mounting hardware
-11	122-0819-00			1						ASSEMBLY, circuit board, front
	- - - - -			-						mounting hardware: (not included w/assembly)
-12	211-0017-00			2						SCREW, 4-40 x 3/4 inch, RHS
-13	150-0041-00			1						ASSEMBLY, bulb, neon, amber, w/mounting hardware
-14	- - - - -			1						TRANSFORMER
	- - - - -			-						mounting hardware: (not included w/transformer)
-15	122-0824-00			1						POST, tapped both ends
-16	210-0004-00			1						LOCKWASHER, internal, #4
-17	210-0408-00			1						NUT, hex., 6-32 x 5/16 inch
-18	210-0202-00			1						LUG, solder, SE #6
-19	211-0541-00			2						SCREW, 6-32 x 1/4 inch, 100° csk, FHS
-20	354-0239-00			1						RING, ornamental
-21	122-0818-00			1						ASSEMBLY, circuit board, rear
	- - - - -			-						mounting hardware: (not included w/assembly)
-22	211-0504-00			3						SCREW, 6-32 x 1/2 inch, THS
-23	122-0830-00			1						BOX
-24	348-0013-00			4						FOOT, rubber, black
-25	212-0069-00			2						SCREW, 8-32 x 1/4 inch, THS
-26	131-0424-00			1						CONNECTOR, 3 pin, female, w/mounting hardware
-27	131-0425-00			1						CONNECTOR, 6 pin, female, w/mounting hardware
-28	122-0822-00			1						SYNC POST
	- - - - -			-						mounting hardware: (not included w/post)
-29	210-0405-00			2						NUT, hex., 2-56 x 3/16 inch
-30	210-0001-00			2						LOCKWASHER, internal, #2
-31	210-0259-00			2						LUG, solder, #2
-32	161-0023-00			1						CORD, power, 3 conductor

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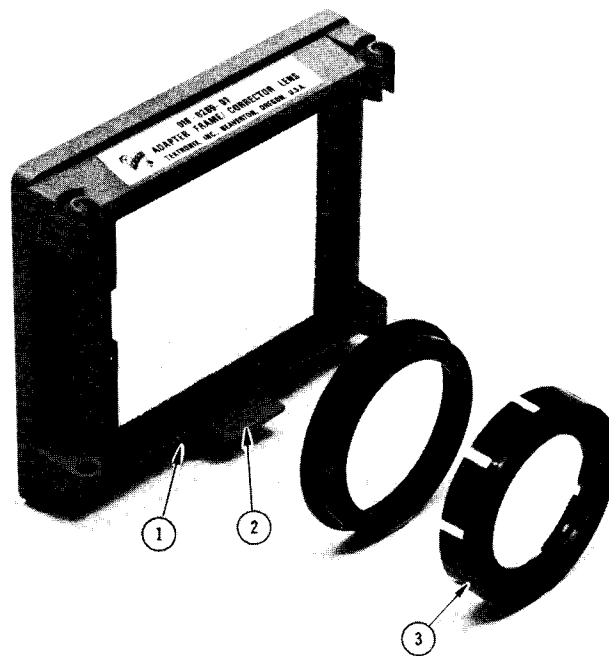
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

*DENOTES SELECTED PART

0370

ADAPTER, CAMERA TO OSCILLOSCOPE

OPTION 1



OPTION 1 adapts the C30A camera to the 432, 434, 465, and 475 oscilloscope.

Mounting Camera Adapter. Slide the camera adapter down over the instrument bezel until the rib on the upper inner part of the camera adapter engages the groove on the top of the instrument bezel. When the camera adapter and the instrument bezel are engaged push the bottom of the adapter in against the instrument. Then engage the spring latch (1) into the slot on the bottom of the instrument bezel and pull back on the latch lever (2) until it snaps. Check that the adapter is firmly attached by pulling on it gently after it is mounted.

Be sure to set camera magnification at 1:1 which with the corrector lens in the adapter will give an image ratio of 1:0.8.

Note: Other ranges of magnification may be used however refocusing may be required.

To remove the camera adapter, push on the latch lever at the bottom of the camera adapter to release the spring latch from the instrument bezel. Pull out slightly on the bottom of the camera adapter and slide it up until it is free of the oscilloscope.

Note: To adapt OPTION 1 to fit 422, 453, 454, and 491 Oscilloscope remove adapter subpart 016-0269-01 and the corrector lens. Use adapter 122-0928-00 and see manual Standard Accessories list for proper light seal (422, 453).

MECHANICAL PARTS LIST (016-0301-00)

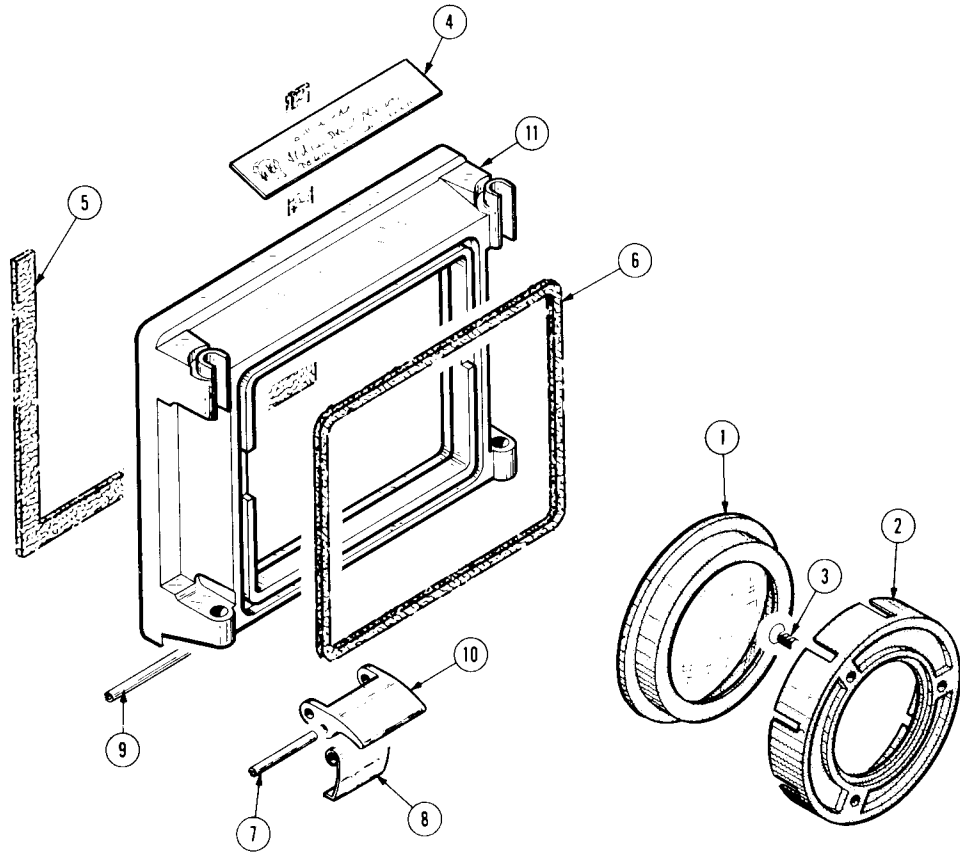


Fig. & Index No.	Tektronix Part No.	Serial/Model No.		Q † y	Description
		Eff	Disc		
	016-0301-00			1	ADAPTER KIT, camera to oscilloscope
	- - - - -			-	adapter kit includes:
1	352-0341-01			1	HOLDER, lens, w/lens
2	352-0342-00			1	HOLDER, lens, outer
3	211-0025-00			3	SCREW, 4-40 x 0.375 inch, 100° csk, FHS
	016-0269-01			1	ADAPTER, camera to oscilloscope
	- - - - -			-	adapter includes:
4	334-2103-00			1	LABEL, identification
5	122-0764-00			1	GASKET, light seal, 16 inches long
6	124-0178-00			1	STRIP, light seal, 15 inches long
7	214-1521-00			1	PIN, retaining, 0.094 OD x 1 inch long
8	214-1509-01			1	SPRING, latch
9	214-1534-00			1	PIN, retaining, 0.094 OD x 1.25 inches long
10	367-0143-01			1	HANDLE, latch
11	426-0722-03			1	FRAME SECTION

C-32 CAMERA SUPPLEMENT

Introduction

This supplement describes the differences between the C-30A and C-32 cameras. Only characteristics or features which differ from those pertaining to the C-30A are described.

SECTION 1 CHARACTERISTICS

General Description

The Tektronix Type C-30A and C-32 Cameras are specially designed for photographing oscilloscope displays. The optical system of the cameras permit photographs to be made directly from the oscilloscope screen so the image is not reversed.

The cameras provide many new convenience features, including slide-on type mountings with swing-away hinges so the cameras can be swung out either to left or right for direct CRT display viewing.

The design of the Type C-30A and C-32 Cameras makes available a variety of object-to-image (MAG) ratios and allows the use of parfocal backs. The parfocal backs which can be used with the camera provide use of Polaroid¹ Land Films or conventional films, in either sheet or roll films.

**TABLE 1
OPTICAL CHARACTERISTICS
C-32 LENS**

Characteristic	Performance Requirement
Maximum Relative Aperture At Infinity	f1.4
Focal Length	60.0 mm nominal
Coverage at Maximum Relative Aperture	At least 110.00 mm diameter in object plane
Magnification (Object: Image)	1:1.2, 1:1.1, 1:1, 1:0.9, and 1:0.85 within 5%. 1:0.9 magnification is denoted by ↓
Geometrical Distortion	0.2% or less as measured at a 1:1 magnification. 2% or less as measured at a 1:0.85 magnification

¹Registered trademark of the Polaroid Corporation.

Characteristic	Performance Requirement
Relative Illumination	Illumination at an angle of 25 degrees from optical axis of the lens to be at least 30% of the illumination at the optical axis
Photographic Resolving Power	
Center Pattern	At least 30 lines/mm
One Corner Pattern	At least 15 lines/mm

**TABLE 2
MECHANICAL CHARACTERISTICS
C-32 SHUTTER (f1.4 LENS)**

Characteristic	Performance Requirement
Speed (Normal) Range	1, 1/2, 1/5, 1/10, 1/25, and 1/50 second
Accuracy	Within 20% of exposure-time markings from 0°C to +40°C (In accordance with 4.3 of U.S.A. Standard PH 3.32-1959)
Relative Aperture (f-Number) Range	1.4, 2.0, 2.8, 4.0, 5.6, 8, 11, 16
Accuracy	Within 1/3 of APERTURE (f) setting
Synchronization	Internal; X-Type as described in 3.1 of U.S.A. Standard PH 3.18-1957

**TABLE 3
ENVIRONMENTAL CHARACTERISTICS**

The following environmental test limits apply when tested in accordance with the recommended test procedure. This instrument will meet all the performance requirements given

C-32 Camera Supplement

in this section following an environmental test. Complete details on environmental test procedures, including failure criteria, etc., may be obtained from your local Tektronix, Inc. representative or field office.

Characteristic	Performance Requirement
Temperature	
Operating	0°C to +50°C
Storage	-40°C to +55°C
Altitude	
Operating	15,000 feet
Storage	50,000 feet and -40°C
Vibration	
Operating (Mounted On Scope)	15 minutes along each axis at 0.010" within 0.002 (DA). 10 to 55 to 10 Hz in 1-minute sweeps. Three minutes at any resonant point, or if none, at 55 Hz.
Shock	
Operating (Mounted on Scope)	15 g's, 1/2 sine, 11 ms duration, 1 shock in each direction along 3 major axes, total to 6 shocks

TABLE 4
CAMERA ADAPTERS² (BEZELS)

Tektronix Part No.	Instruments Used With
016-0241-00	310, 310A, 316, RM16, 317, RM17 and 360 oscilloscopes.
016-0242-00	321 and 321A oscilloscopes.
016-0243-00	530, 540, 550, 580-Series oscilloscopes.
016-0244-00	560-Series oscilloscopes. ³
016-0248-00	Type 601 Storage Display Unit and Type 528 Waveform Monitor.

²No adapter required for mounting on Types 422, 453, 454 oscilloscopes or Type 491 Spectrum Analyzer.

³Types 565 and RM565 use Tektronix Part No. 016-0243-00.

Optional Accessories

The porta lens cannot be used on the Type C-32 camera.

SECTION 2

OPERATING INSTRUCTIONS

Setting Lens Object-to-Image (MAG) Ratio

Same as C-30A information, only the object-to-image (MAG) ratios are different.

NOTE

When setting the camera for an object-to-image ratio of 1:0.9 the number 0.9 will not appear in the window; instead a \blacktriangledown will appear.

The following list of C-32 mechanical camera parts supersedes the existing equivalent mechanical parts listed for the C-30A series cameras for those items which have a Fig. - item number.

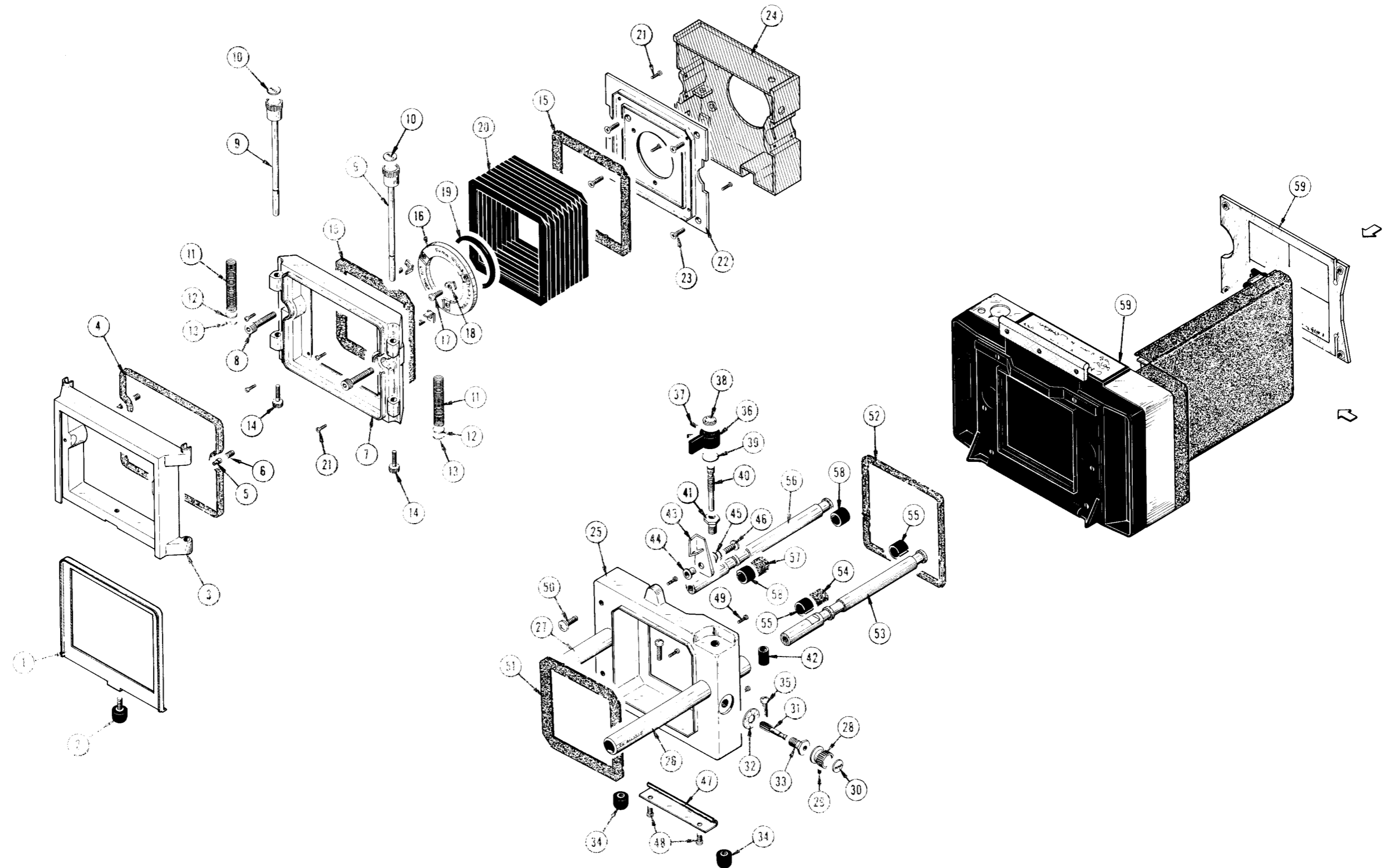
Any mechanical part in the C-30A series mechanical parts list not changed by the following list or specifically indicated for a particular camera is a common part of all C-30A series cameras.

Fig. 1-22	200-0638-03	1	COVER, shutter housing
Fig. 2-53	122-0947-00	1	ASSEMBLY, lens
	- - - - -		assembly includes:
	122-0724-01	1	SHUTTER
	2-67	166-0535-00	1 SLEEVE, magnification adjust
	2-70	334-1777-00	1 TAG, magnification
		122-0947-01	1 ASSEMBLY, lens
		- - - - -	assembly includes:
		122-0835-01	1 ASSEMBLY, shutter

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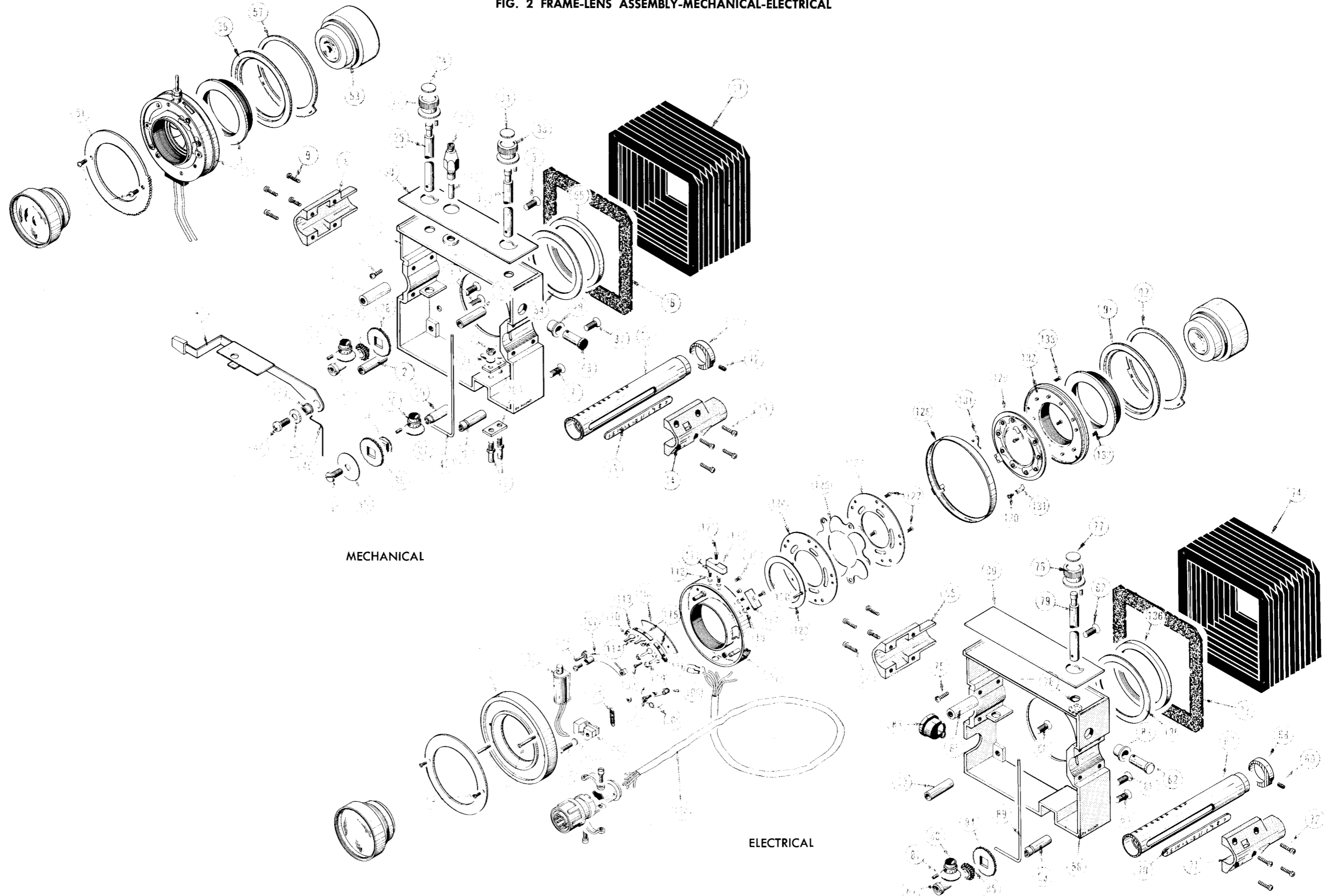
Fig. 1-16	352-0278-00	1	RING, light seal flange
	1-17	214-0646-00	3 SPRING, auxiliary lens re- tainer
	1-18	211-0008-00	3 SCREW, 4-40 x 1/4 inch, PHS
	1-19	214-0659-00	1 GASKET, light seal

FIG. 1 FRAME-MOUNT & REAR FRAME ASSEMBLIES



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FIG. 2 FRAME-LENS ASSEMBLY-MECHANICAL-ELECTRICAL



MECHANICAL

ELECTRICAL

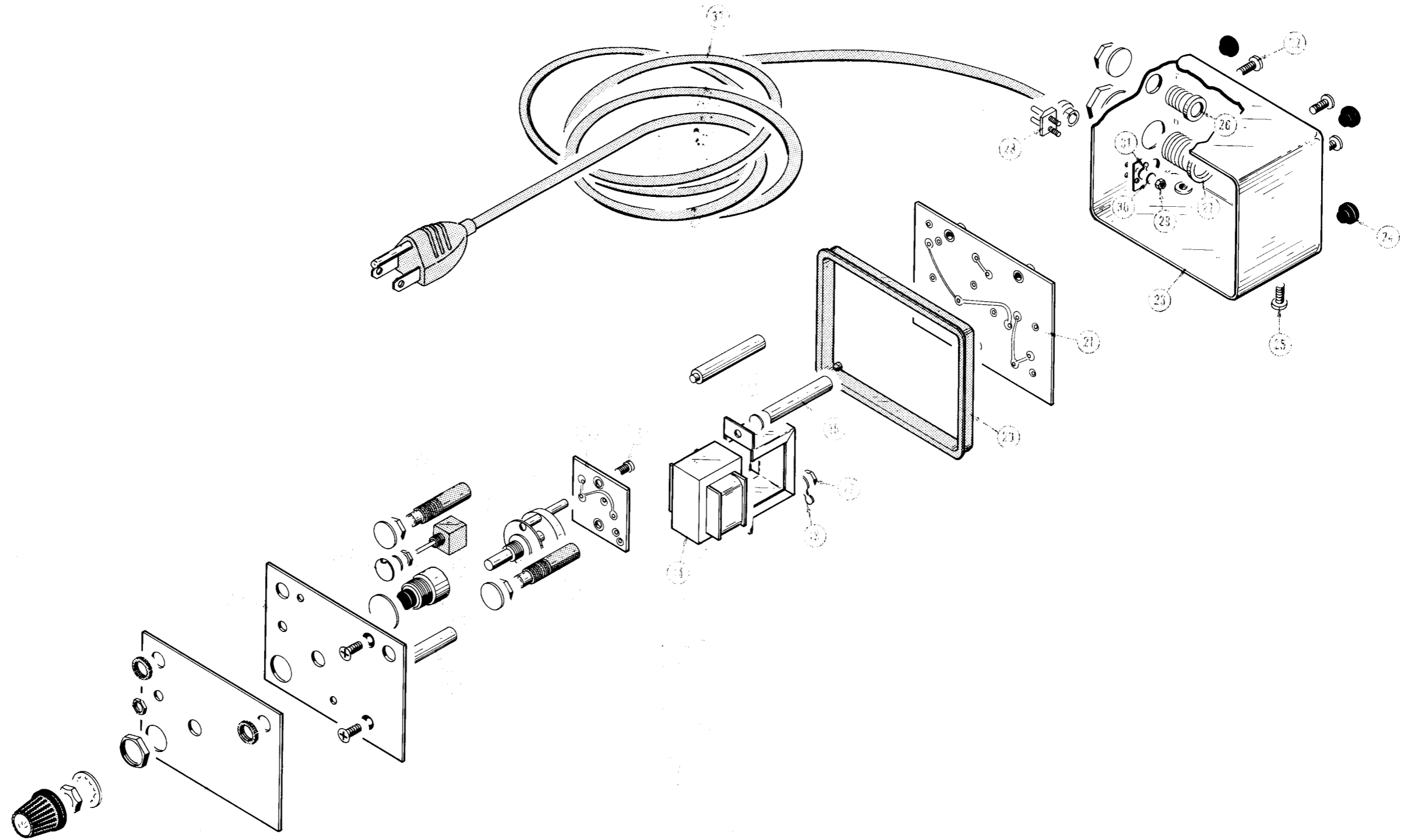
C-30A CAMERA OSCILLOSCOPE SYSTEM

+ (A)

FIG. 2

+

FIG. 3 SPEEDCOMPUTER



+ (A)

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FIG. 3