

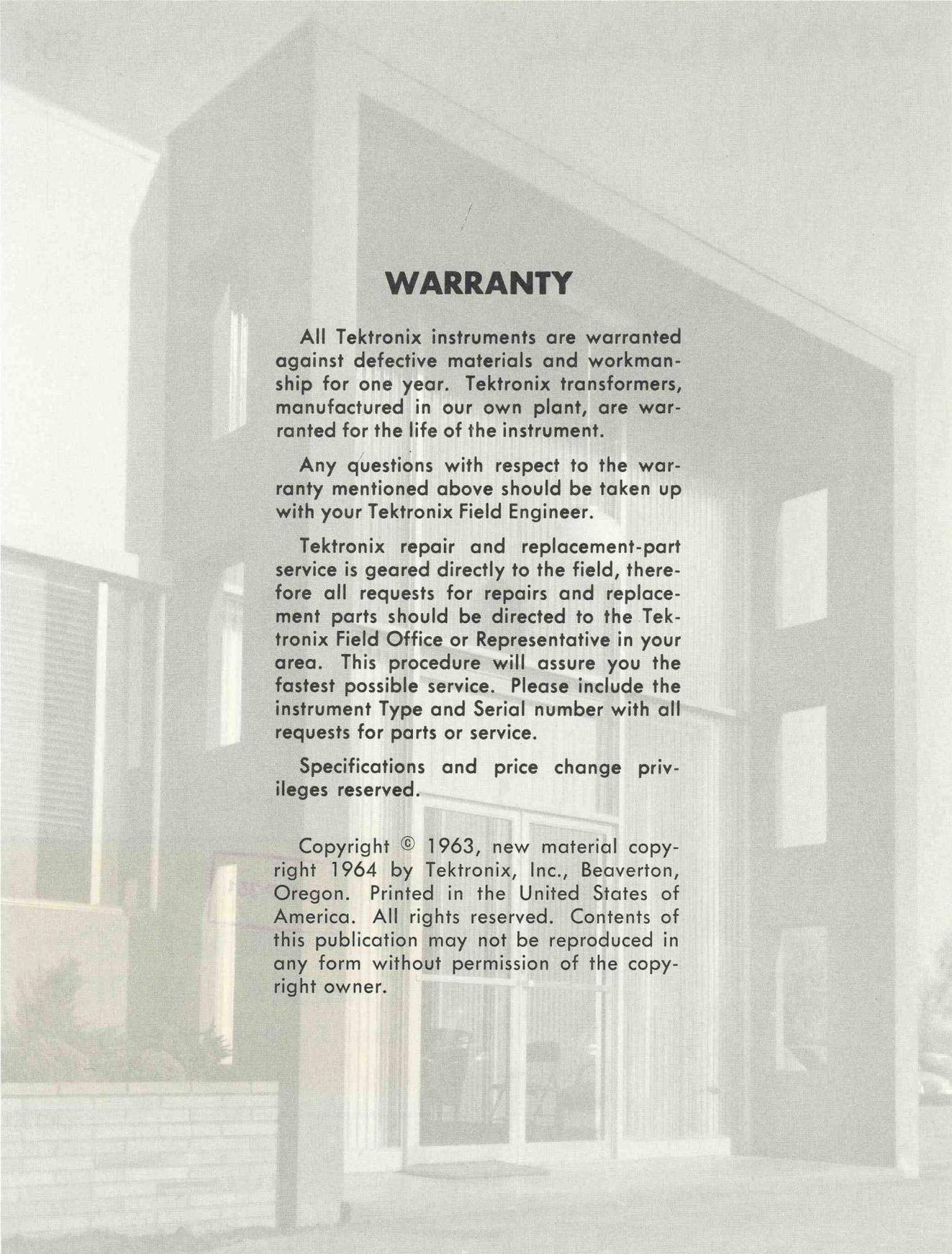
INSTRUCTION MANUAL

Serial Number 854



Tektronix, Inc.

S.W. Millikan Way ● P. O. Box 500 ● Beaverton, Oregon ● Phone MI 4-0161 ● Cables: Tektronix
070-383



WARRANTY

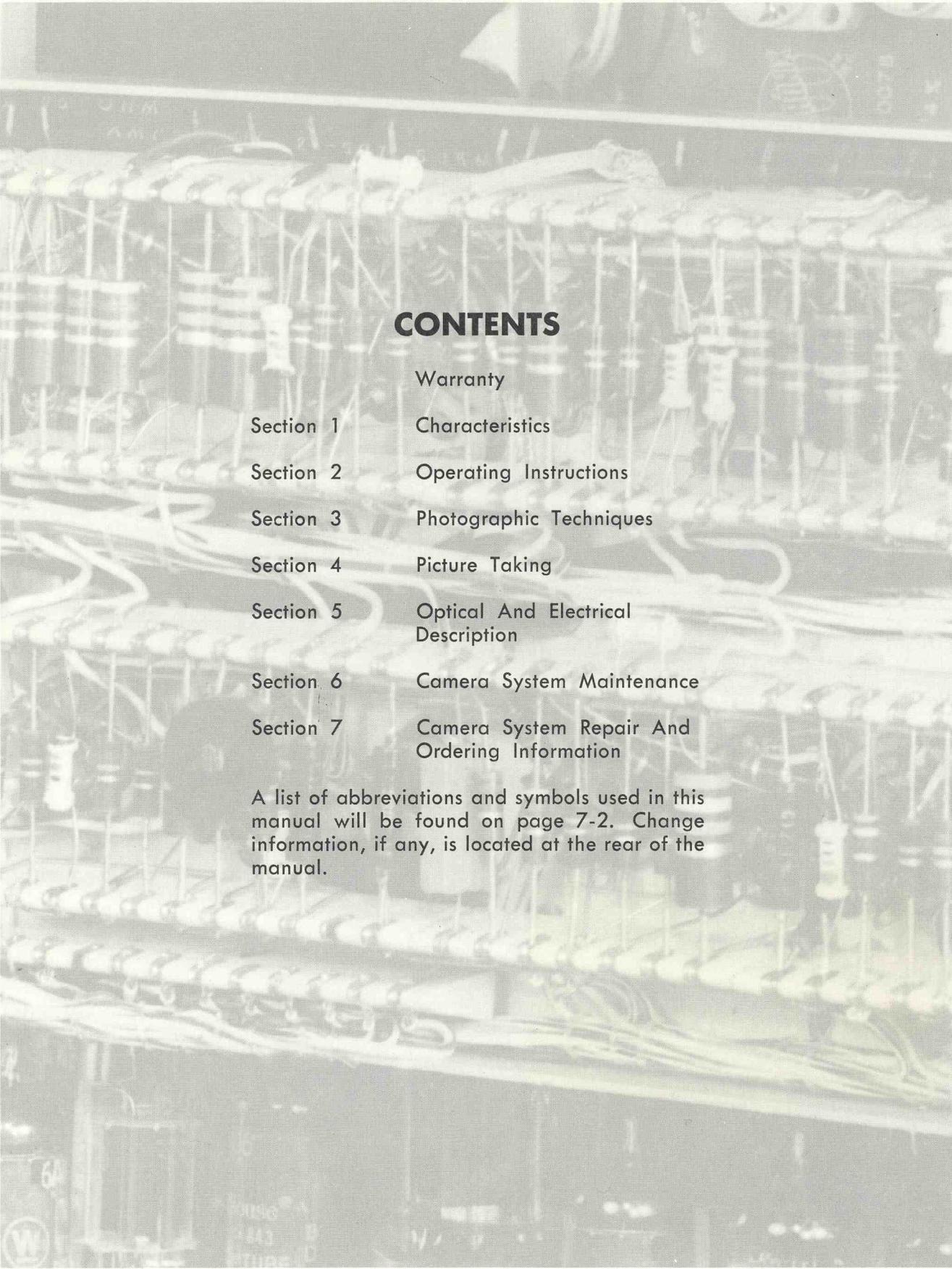
All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

Specifications and price change privileges reserved.

Copyright © 1963, new material copyright 1964 by Tektronix, Inc., Beaverton, Oregon. Printed in the United States of America. All rights reserved. Contents of this publication may not be reproduced in any form without permission of the copyright owner.



CONTENTS

Warranty

- Section 1 Characteristics
- Section 2 Operating Instructions
- Section 3 Photographic Techniques
- Section 4 Picture Taking
- Section 5 Optical And Electrical Description
- Section 6 Camera System Maintenance
- Section 7 Camera System Repair And Ordering Information

A list of abbreviations and symbols used in this manual will be found on page 7-2. Change information, if any, is located at the rear of the manual.



Camera System

SECTION 1

CHARACTERISTICS

General Description

Tektronix Cameras have been specifically designed for photographing oscilloscope displays. The optical system of the camera permits displays to be simultaneously viewed and photographed. Photographs are made directly from the oscilloscope screen so the image is not reversed. The viewed image is undistorted and is also not reversed.

The Cameras provide many new convenience features. Lift-on mounting is used so that the camera can easily be mounted or removed. Swing-away hinges allow the camera to be swung out of the way when not in use. The Viewing Hood on the C-12, C-19 and C-27 provides comfortable viewing with or without glasses. The Rotating Slide Adapter allows any of the parfocal film-holding backs used with it to be locked in any of nine detented positions. All Camera backs can also be rotated in 90-degree increments so that the long axis of the film will be parallel or perpendicular to the trace, as desired.

Several interchangeable lenses can be used with the camera when a rear casting is used. The wide range of object-to-image ratios and maximum apertures permit you to select the lens which is just right for your application.

Parfocal backs which can be used with the camera allow you to make photographs on Polaroid* Land or conventional film, in either sheet or roll film forms.

MAIN FRAMES

Information applicable to all Main Frames

Focusing

Focusing to compensate for slight differences between oscilloscopes is accomplished by means of a Focus Knob on the main Camera frame. Once the Focus Knob has been set it may be locked in position with the Focus Knob Lock. This will prevent accidentally changing the focus of the camera.

Mounting (C-12, C-13 and C-19)

Graticule covers are available for mounting the camera on Tektronix 5-inch oscilloscopes. The special graticule covers have a hinged fitting to support the camera. The hinged fitting allows the camera to be easily swung in or out of the operating position.

Mounting (C-27)

Graticule covers are available for mounting the camera on all Tektronix oscilloscopes except those with three-inch CRTs. Graticule covers are also available to fit the camera to most Hewlett-Packard and DuMont oscilloscopes. All the graticule covers have hinged fittings to allow the camera to be easily swung in or out of the operating position. The camera may also be lifted completely off the graticule cover when desired.

*Registered trademark of the Polaroid Corporation.

C-12 (122-635)

Optical System

Photographs are taken directly from the oscilloscope screen through a beam-splitting mirror. There is a two-mirror system for observation of the oscilloscope display with minimum parallax between viewed and photographed displays. Maximum CRT area which can be viewed and photographed: 8 cm vertical; 10 cm horizontal.

Transmission Characteristics of Beam-Splitting Mirror: Transmission of light through beam-splitting mirror to camera lens is nearly constant at approximately 65% for all visible light frequencies.

Viewing Hood

The Viewing Hood can be used by persons with or without glasses.

Size

Approximately 12 inches high, 14 inches deep, and 7 inches wide. (Measurements taken without Viewing Hood or Bezel.)

Included Accessories

- 2 Instruction Manuals 070-383
- 1 Viewing Hood 337-411
- 1 Cable Release 122-586

C-13 (122-609)

Optical System

Photographs taken directly from oscilloscope screen with no reversal. Maximum CRT area which can be photographed: 8 cm vertical; 10 cm horizontal.

Viewing

The Viewing Door may be opened for direct viewing of the waveform.

Size

Approximately 7 inches high, 8 inches deep, and 7 inches wide. (Measurements taken without Bezel.)

Included Accessories

- 2 Instruction Manuals 070-383
- 1 Cable Release 122-586

Characteristics—Camera System

C-19 (122-636)

Optical System

Photographs taken directly from oscilloscope screen (no beam-splitting mirror is used). Two-mirror system is used for observation of the oscilloscope display. Maximum CRT area which can be photographed: 8 cm vertical; 10 cm horizontal. Maximum CRT area which can be seen through Viewing Hood: 5 cm vertical; 10 cm horizontal.

Viewing Hood

The Viewing Hood can be used by persons with or without glasses.

Size

Approximately 12 inches high, 14 inches deep, and 7 inches wide. (Measurements taken without Viewing Hood or Bezel.)

Included Accessories

- 2 Instruction Manuals 070-383
- 1 Viewing Hood 337-411
- 1 Cable Release 122-586

C-27 (122-676)

Optical System

Photographs taken directly from oscilloscope screen (no beam-splitting mirror is used). Parallax type viewing is used for observation. Maximum CRT area which can be photographed: 10 cm vertical; 10 cm horizontal. Maximum area which can be seen through Viewing Hood: 7 cm vertical; 10 cm horizontal. The Main Frame can be attached to the oscilloscope in any of four directions: Viewing Hood on top (0°), bottom (180°), left side (270°), and right side (90°).

Viewing Hood

The Viewing Hood can be used by persons with or without glasses.

The Viewing Hood and Tunnel section may be slipped off the Main Frame if desired. The Viewing Door in the Main Frame keeps the camera light-tight.

Size

Approximately 7⁷/₈ inches high, 7¹/₄ inches deep, and 7¹/₄ inches wide. (Measurements taken without Viewing Hood and Tunnel or Bezel.)

Included Accessories

- 2 Instruction Manuals 070-383
- 1 Viewing Hood 337-411
- 1 Viewing Tunnel 337-604
- 1 Cable Release 122-586

LENSES

Lens and Shutter Settings

Both lens and shutter settings can be made from the side of the camera without removing or unlatching the camera from the oscilloscope.

Shutter Speeds

Alphax No. 1 Shutter—(T), (B), 1/10, 1/25, 1/50, 1/100, and 1/200. X Synchronization.

Alphax No. 3 Shutter—(T), (B), 1, 1/2, 1/5, 1/10, 1/25, 1/50, and 1/100. X Synchronization.

Ilex (Elgeet) No. 3X Universal Shutter—(T), (B), 1, 1/2, 1/5, 1/10, 1/25, 1/50, and 1/100. X Synchronization.

REAR FRAMES and ROTATING SLIDE ADAPTER

Standard (122-591)

The Rear Frame is used with the Rotating Slide Adapter (122-602) to allow the Camera Backs to be mounted. This combination allows any of the standard Camera Backs, except the Type 350, to be rotated in 90-degree steps. The long axis of the film can be either parallel or perpendicular to the trace.

The nine indentations of the standard Camera Backs permit the Camera Back to slide to any of nine positions. The position of the Camera Back is indicated by number on the Rotating Slide Adapter.

The Rear Frame and Rotating Slide Adapter is not needed if a Type 350 Camera Attachment is to be used.

TABLE 1-1

Lens Stock No.	Type	Max. Aperture	Focal Length	Object-to-Image Ratio	Shutter
122-547	Oscillo-Raptar	f/1.9	75 mm	1:0.7	Alphax No. 3 or Ilex (Elgeet) No. 3X Universal
*122-550	Oscillo-Amaton	f/4.5	75 mm	1:0.7	Alphax No. 1
122-549	Oscillo-Raptar	f/1.9	75 mm	1:0.5	Alphax No. 3 or Ilex (Elgeet) No. 3X Universal
122-608	Oscillo-Raptar	f/1.4	88 mm	1:1	Alphax No. 3
122-548	Oscillo-Navitar	f/1.9	75 mm	1:0.9	Alphax No. 3 or Ilex (Elgeet) No. 3X Universal
122-662	Oscillo-Navitar	f/1.3	80 mm	1:0.5	Ilex No. 3X
122-692	Oscillo-Navitar	f/1.9	75 mm	1:0.85	Alphax No. 3 or Ilex (Elgeet) No. 3X Universal

* Shutter Actuator Model 1 cannot be adapted to Alphax No. 1 shutter.

Power Supply Frame (016-231)

The Power Supply-Frame is used with the Rotating Slide Adapter (122-602) to allow the Camera Backs to be mounted. This combination allows any of the standard Camera Backs, except the Type 350, to be rotated in 90-degree steps. The long axis of the film can be either parallel or perpendicular to the trace.

The nine indentations on the standard Camera Backs permit the Camera Back to slide to any of nine positions. The position of the Camera Back is indicated by number on the Rotating Slide Adapter.

The Power Supply Frame and Rotating Slide Adapter is not needed if a Type 350 Camera Attachment is to be used.

CAMERA BACKS

Polaroid Land Roll Film Camera Back (122-603)

Prints or transparencies in black and white or color may be obtained from a roll of film. Picture size in most cases is 3 1/4 x 4 1/4. Only Polaroid Land roll film can be used with this back.

Polaroid Land Pack Film Camera Back (122-671)

Black-and-white or color film is available for the Pack Film Back. Picture size is 3 1/4 x 4 1/4. 100-Series Polaroid Land Film Packs should be used with this camera back.

Included Accessories

- 1 Instruction Manual

Graflok (122-604)

Any type of film holder which will attach to the Graflok back can be used. The various attachments available will allow sheet or roll film of conventional or Polaroid Land types to be used. Maximum image size available is 4 x 5 inches.

Graflok (016-233)

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

350 Camera Attachment (350)

The Type 350 Camera Attachment (35 mm Camera Assembly) will mount on any of the Main Frame Assemblies (Viewing Assemblies). Standard 35 mm film cassettes will fit the film supply holder. In normal operation film is taken up on an open spool and after exposure, is rewound into the original cassette before removal. However, film can be taken up in a closed NR type cassette, for removal without rewinding.

The Type 350 will accept either standard 20 or 36 exposure films, or cassettes may be bulk loaded.

The Type 350 produces a 20 x 20 mm image for each exposure; therefore it is possible to obtain approximately 30 exposures on a 20 exposure roll and approximately 55 exposures on a 36 exposure roll. Do not attempt more than 34 exposures on a 20 exposure roll nor more than 58 exposures on a 36 exposure roll.

The "automatic" advance feature of the Type 350 Camera Attachment will allow a sequence of pictures to be taken with no break needed to advance the film to each new frame. The spring motor automatically advances the film one frame each time the SHUTTER RELEASE LEVER is depressed. A full winding of the spring motor will transport approximately twenty to thirty-five frame advances. The exact number of frames transported by the fully wound motor varies because of differences in cassette design among film manufacturers.

Included Accessories

- 1 Focus Magnifier 122-640
- 1 Instruction Manual
- 1 Take-up Spool 122-663

Optional Accessories

- Type TR Bulk-Loading Cassette 016-221
- Type NR Take-up Cassette 016-222

BEZELS

Main Frame	Stock Number	Oscilloscope Style
C-12 C-13 C-19	016-226	For oscilloscopes having 5 inch round CRT's*.
C-12 C-13 C-19	016-217	For oscilloscopes having 5 inch rectangular CRT's. (560 series)
C-12 C-13 C-19	016-229	For some models of Hewlett-Packard oscilloscopes. See your local Field Engineer or Tektronix Representative.
C-27	016-225	For oscilloscopes having 5 inch round CRT's.
C-27	016-224	For oscilloscopes with 5 inch rectangular CRT's with 8 x 10 cm grati-cules. Will also fit some TV oscillo-scopes.
C-27	016-223	For oscilloscopes with 5 inch rec-tangular CRT's with 6 x 10 cm grati-cules.
C-27	016-228	For most models of Hewlett-Packard Oscilloscopes. See your local Field Engineer or Tektronix Representa-tive.
C-27	016-227	For some models of DuMont oscillo-scopes. See your local Field Engineer or Tektronix Representative.

*The Type 519 comes equipped with a Bezel.

Characteristics—Camera System

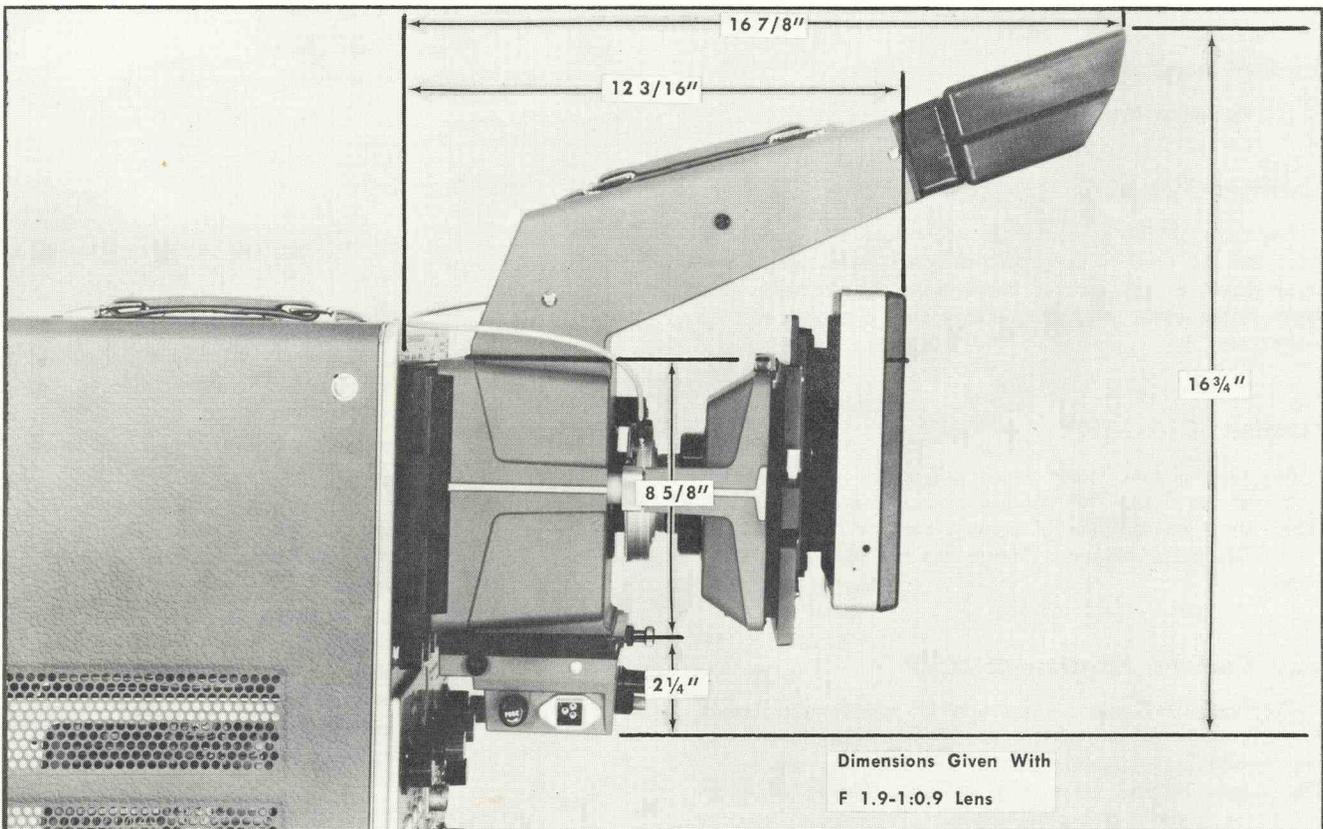
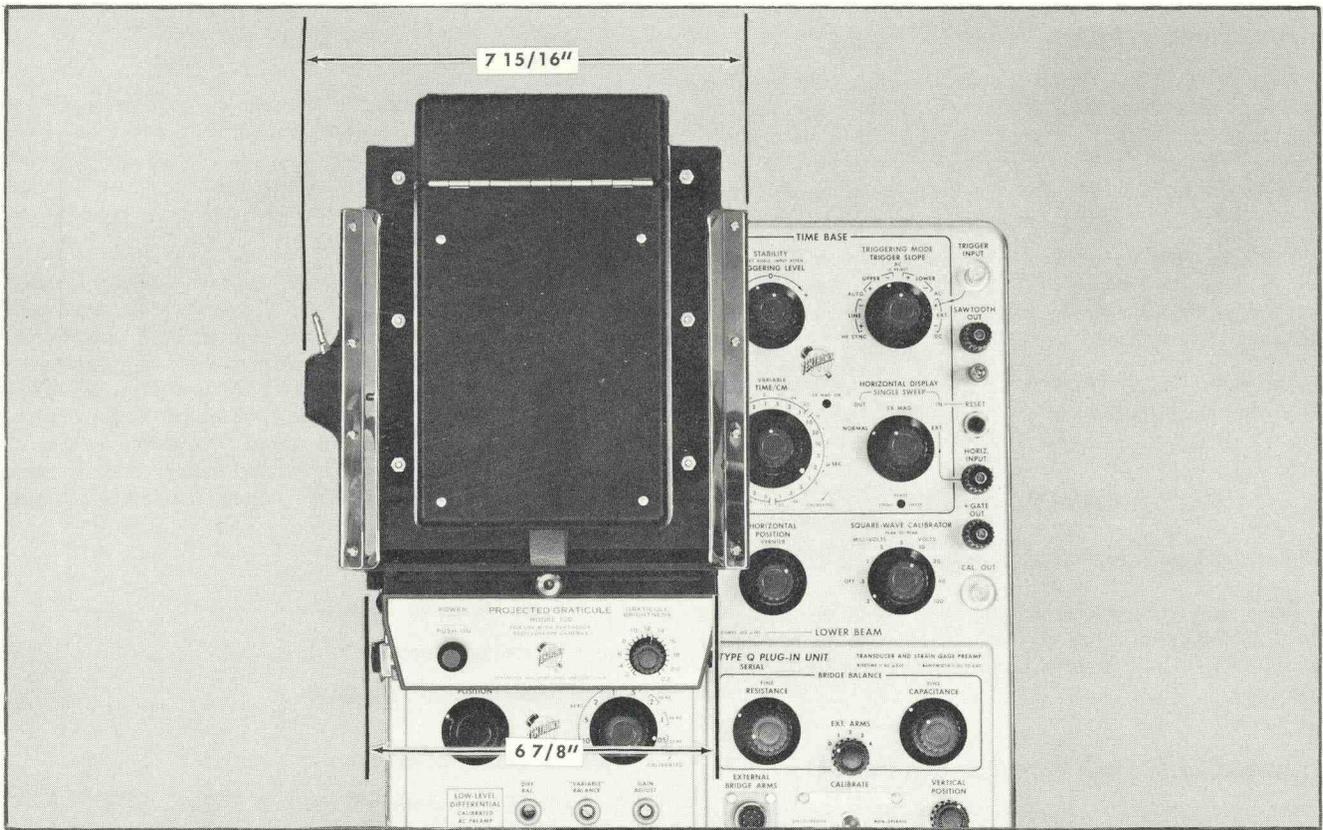


Fig. 1-1. Dimensions of a typical camera system.

Included Accessories

4 Special Graticule Nuts with screwdriver slot.

ACCESSORIES**Projected Graticule (016-204)**

The Projected Graticule can be used only with the C-12 or C-13 Main Frames. The Projected Graticule eliminates the parallax problems which exist between the trace and the external graticule. If the Projected Graticule is used with the C-13, a beam-splitting mirror must be added to the Main Frame. Your local Field Engineer can assist you in obtaining this modification.

The Projected Graticule is designed so the Graticule Film may be changed quickly. The Graticule Film used may be one purchased from Tektronix or one made by you. See the Optional Accessories list for additional types of Graticule Films.

Additional Graticule Slides are available in amber, green or blue. By using amber, green, or blue colored Graticule Slides to match colors of graticule lines and trace, it is easier to balance the light intensity of the trace to that of the graticule lines for good exposures.

Some of the Graticule Films available for the Projected Graticule have clear strips above and below the graticule image. These clear strips permit you to write data about the waveform on a strip of translucent paper and insert it along with the Graticule Film into the Graticule Slide. Clamps in the Graticule Slide will hold the strip of translucent paper in place over the clear spaces. The exposures made will show both the waveform and the data which has been written on the translucent strip of paper.

External Voltage Output

An output of 6 volts ac at 0.08 amps is available from the phone jack on the right side of the unit.

Power Requirements

Line Voltage—normally 117 volts, 50-60 cycles. Can be obtained for 234 volt, 50-60 cycle operation.

Power—nominally 5 watts at 117 volts, 60 cycle line.

Fuse—1/10 amp slow-blowing type for 117 volts. 1/16 amp slow-blowing type for 234 volts.

Mechanical Characteristics

Finish—photoetched, anodized front panel.

The die cast Power Supply box is finished in blue vinyl, with black trim.

Dimensions—See Figure 1-1.

Weight—4 $\frac{1}{4}$ pounds.

Accessories Included:

1—Power cord 161-015

1—3 to 2 wire adapter 103-013

1—Graticule Film, 4x10 cm with write-in area and short minor lines 331-117

1—Graticule Film, 6x10 cm with write-in area and short minor lines 331-111

1—Graticule Film, 8x10 without write-in area, but with full minor lines 331-119

1—Graticule Mask, 4x10 cm 331-118

1—Graticule Mask, 6x10 cm 331-116

1—Instruction manual

Optional Accessories**Graticule Slide:**

Amber window 122-669

Blue window 122-667

Green window 122-668

Graticule Film:

4x10 cm with write-in area and full minor lines 331-120

4x10 cm Risetime Graticule with short minor lines 331-121

4x10 cm Risetime Graticule with full minor lines 331-122

4x10 cm with write-in area and short minor lines 331-117

4x10 cm Risetime Graticule (similar to internal graticule design) with short minor lines 331-136

6x10 cm with write-in area and full minor lines 331-123

6x10 cm Risetime Graticule with short minor lines 331-124

6x10 cm Risetime Graticule with full minor lines 331-125

6x10 cm with write-in area and short minor lines 331-111

6x10 cm Risetime Graticule (similar to internal graticule design) with short minor lines 331-137

8x10 cm without write-in area, but with short minor lines 331-126

8x10 cm without write-in area, but with full minor lines 331-119

10x10 divisions (570 type) with write-in area and short minor lines 331-127

10x10 divisions (570 type) with write-in area and full minor lines 331-128

525 type without write-in area 331-130

555 type with write-in area and short minor lines 331-131

Graticule Mask:

4x10 cm 331-118

6x10 cm 331-116

10x10 divisions (570 type) 331-129

Characteristics—Camera System

Shutter Actuator Model 1 (Non-holding Type) 016-205

The Shutter Actuator Model 1 input is a solenoid-operated shutter release for use with the camera system. The solenoid actuates the camera shutter approximately 15 to 20 milliseconds after a manually impressed pulse is initiated from the Shutter Actuator Model 1 Power Supply.

The Shutter Actuator Model 1 unit permits remote shutter release of one oscilloscope camera or simultaneous shutter release of several oscilloscope cameras by paralleling the complete Shutter Actuator Model 1 units or by paralleling solenoids so they operate off a single power supply. It may also be used with time-delay or time-lapse equipment for photographing time-related phenomena.

The operation of the Shutter Actuator Model 1 unit compares to a standard shutter release cable press and release action. A single depression of the MANUAL TRIGGER switch, on the power supply, opens or closes the shutter on the (T) setting; momentarily trips the shutter in all other speed settings, including (B).

Shutters

Will operate with Alphax No. 3, Ilex (Elgeet) No. 3X Universal, or Alphax No. 4 shutters only.

Time Lapse

Approximately 15 to 20 milliseconds between pulse initiation and shutter release.

Recovery Time

Approximately two seconds between pulses.

Power Requirements

Operates on either 117 V or 234 V, 50 or 60 cycle line-voltage. Depending upon the line voltage and the shutter to be operated, one power supply can operate several solenoids (refer to the table below).

TABLE 1-2

Shutter Type	Line Voltage			
	130 260	120 240	110 220	100 200
Alphax 3	7	6	5	4
Ilex (Elgeet) #3X Universal	5	4	3	2
Alphax 4	5	4	3	2

Included Accessories

1 Instruction Manual

Shutter Actuator Model 2 (Holding Type)

The Shutter Actuator System Model 2 is a rotary solenoid-operated shutter release control. The Shutter Actuator has been designed to be used with Alphax No. 3 and Ilex (Elgeet) No. 3X Universal shutters.

The Shutter Actuator System permits electrical triggering of most Tektronix oscilloscope camera shutters. It can also be used to trip more than one camera shutter simultaneously, through the use of more than one Shutter Actuator System tied to the same remote switch.

The power supply is available in two different types of housing, a Rear Frame housing and a separate small box style. The Rear Frame housing is intended to mount in place of the normal Rear Frame of the Tektronix camera system. Since the Rear Frame for the camera is not used with the Type 350 Camera Attachment, and since the Rear Frame type power supply is not easily moved from one camera to another, a box style power supply may be attached to the Type 350 camera back, the Polaroid roll film back, and the Polaroid pack film back by using the Power Supply Mounting Bracket (Tektronix Part No. 122-713), or the power supply may be set on an object near the camera.

The same Shutter Actuator solenoid is used with either style power supply.

Power Requirements

Power Supply

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

Fuse— $\frac{1}{2}$ (0.3) amp slow-blow type.

Shutter Actuator

Input Voltage—115 (230) volts dc.

Peak Current—1 ($\frac{1}{2}$) amp.

Holding Current—0.13 (0.067) amp.

System Delay

The length of time for the shutter to become fully open after the MOMENTARY-OFF-MAINTAIN switch has been operated is approximately 20 to 25 milliseconds, depending upon the type of shutter used.

Mechanical Characteristics

Power Supply

Power Supply Frame (016-231 — 115 v); (016-237 — 230 v)

Finish—die-cast Rear Frame is finished in textured blue vinyl paint. The two control panels are photo-etched, anodized aluminum.

Dimensions— $6\frac{3}{8}$ inches long \times $8\frac{1}{2}$ inches wide \times $3\frac{5}{16}$ inches deep.

Weight—1 lb., $13\frac{3}{4}$ oz.

Power Supply Model 2 (016-230 — 115 v); (016-236 — 230 v)

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

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

Weight— $15\frac{3}{4}$ oz.

Power Supply Mounting Bracket (122-713)

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

Shutter Actuator Solenoid (016-218 — 115 v); (016-235 — 230 v)

Finish—die-cast case is finished in black. The name plate is photo-etched and anodized aluminum.

Dimensions— $2\frac{1}{2}$ inches long \times $2\frac{1}{16}$ inches wide \times $1\frac{3}{4}$ inches deep.

Weight— $10\frac{3}{4}$ oz.

Accessories Included:

- 1 Instruction Manual

“STANDARD” CAMERA PACKAGES

The standard camera packages include a complete camera except for the Bezel. The Bezel selection for a particular Main Frame is determined by the style of CRT on your oscilloscope.

C-12

Components of “standard” package.

Lens—f/1.9-1:0.95—122-548

Camera Back— $3\frac{1}{4} \times 4\frac{1}{4}$ Polaroid Land Camera—122-603 roll film or 122-671 pack film

Focusing method—Focusing Plate—387-460 roll back or 387-893 pack film back

Main Frame — C-12 — 122-635

Rear Frame — 122-591

Rotating Slide Adapter — 122-602

Included Accessories

- 2 Instruction Manuals 070-383
- 1 Cable Release 122-586
- 1 Viewing Hood 337-411
- 1 Rod with foot 385-153 and 348-048

C-13

Components of “standard” package.

Lens — f/4.5-1:0.7 — 122-550

Camera Back— $3\frac{1}{4} \times 4\frac{1}{4}$ Polaroid Land Camera — 122-603 roll film or 122-671 pack film

Focusing method—Focusing Plate—387-460 roll back or 387-893 pack film back

Main Frame — C-13 — 122-609

Rear Frame — 122-591

Rotating Slide Adapter — 122-602

Included Accessories

- 2 Instruction Manuals 070-383
- 1 Cable Release 122-586
- 1 Rod with foot 385-153 and 348-048

C-19

Components of “standard” package.

Lens—f/1.9-1:0.5 — 122-549

Camera Back— $3\frac{1}{4} \times 4\frac{1}{4}$ Polaroid Land Camera — 122-603 roll film or 122-671 pack film

Focusing method—Focusing Plate—387-460 roll back or 387-893 pack film back

Main Frame — C-19 — 122-636

Rear Frame — 122-591

Rotating Slide Adapter — 122-602

Included Accessories

- 2 Instruction Manuals 070-383
- 1 Cable Release 122-586
- 1 Viewing Hood 337-411
- 1 Rod with foot 385-153 and 348-048

C-27

Components of “standard” package.

Lens—f/1.9-1:0.85 — 122-692

Camera Back— $3\frac{1}{4} \times 4\frac{1}{4}$ Polaroid Land Camera — 122-603 roll film or 122-671 pack film

Focusing method—Focusing Plate—387-460 roll back or 387-893 pack film back

Main Frame — C-27 — 122-676

Rear Frame — 122-591

Rotating Slide Adapter — 122-602

Included Accessories

- 2 Instruction Manuals 070-383
- 1 Cable Release 122-586
- 1 Viewing Hood 337-411
- 1 Viewing Tunnel 337-604
- 1 Rod with foot 385-153 and 348-048

SECTION 2

OPERATING INSTRUCTIONS

MAIN FRAME

Mounting the Camera (Refer below for special cases)

A special mount (Bezel) is used to attach the camera to the oscilloscope. The Bezel takes the place of the normal graticule cover on the oscilloscope.

To mount the camera first remove the graticule cover from the oscilloscope by unscrewing the four knurled nuts. For most photographic work it is recommended that any light filters also be removed.

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

Remove the Bezel from its package and place it on the graticule studs. Use the four graticule nuts supplied to attach the Bezel 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 hinge fittings of the Bezel for the C-12, C-13 and C-19 are to the left. The camera can now be put in place by engaging the hinge pins on the camera frame with the hinge fitting on the Bezel. The camera can be removed at any time by simply lifting it off the Bezel. The hinge system permits the camera to be moved against the oscilloscope screen or swung away.

The Mounting Latch on the camera frame is used to lock the camera to the Bezel. Before fastening the Mounting Latch, be sure to remove the plastic dust cover from the opening at the front of the camera body. Then swing the camera against the Bezel and lock it by raising the Mounting Latch until snug.

Special Mounting Information

C-12, C-13 and C-19

The Type 519 Oscilloscope comes equipped with a C-12, C-13, C-19 type camera mount which will accept the hinge pins on the Main Frame. The graticule assembly of the Type 519 cannot be properly fitted into any normal Bezel for the cameras.

C-27

To stack the C-27 Main Frame on stacked rackmount oscilloscopes, with 7 inch high front panels, it is necessary to face the Viewing Hood to the right. If the rackmount oscilloscopes are not mounted closely together, the mounting position of the C-27 Main Frame is not critical.

To change the mounting position of the C-27 it is necessary to reposition the frame support bracket. To do this, remove the four button-headed screws from the outer corners of the Main Frame. Grasp the hinge pins and Mounting Latch and carefully work the frame support bracket

loose from the remainder of the Main Frame. Rotate the frame support bracket to its new position and gently push it into the Main Frame of the C-27. Push it into the Main Frame until the frame support bracket is firmly against the remainder of the Main Frame. If the frame support bracket will not go completely into the Main Frame check to see that the Mounting Latch assembly and hinge pins are lined up with the proper cutouts in the Main Frame casting. If the Mounting Latch assembly and hinge pins do not line up with the cutouts it is likely that the frame support bracket has been turned over.

After installing the frame support bracket into the Main Frame, reinstall the four button-headed screws into the holes near the outer corners of the frame support bracket and tighten securely. Before mounting the C-27 Main Frame onto the Bezel, check to see that the three D-shaped (light seals) pieces of foam plastic in the Main Frame have not been moved out of position. If they have been disturbed they can be stuck back into position with a small amount of rubber cement.

Using the Viewing Hood of the C-12 and C-19

The viewing system uses a two-mirror system which allows you to view the oscilloscope display at a right angle to the display. This is the same view the camera lens sees, so there is a minimum of parallax between the observed and photographed display.

The Viewing Hood allows persons either with or without glasses to observe the display. When the Viewing Tunnel is not being used, the Viewing Door should be closed to prevent light from entering. If the door is left open, a reflection of the open door may appear on the photograph. When you are observing the trace, light will be sealed out if your face is pressed against the rubber of the shield.

Using the Viewing Hood of the C-13

The C-13 has a door on the top of the Main Frame which allows a 6 x 10 cm area of the CRT to be viewed. When the Viewing Door is not being used it should be closed to prevent light from entering.

Using the Viewing Hood of the C-27

The C-27 uses a parallax type viewing system which allows a 7 x 10 cm area of the CRT to be viewed. The Viewing Tunnel and Hood may be removed from the Main Frame and the knurled nut on the handle assembly loosened to allow the handle to be folded down to provide a smaller camera.

The Viewing Hood can be used by persons with or without glasses. The Viewing Door should be closed when not viewing a display. If the door is left open or not adequately covered, a reflection of the open door may appear on the photograph.

Operating Instructions—Camera System

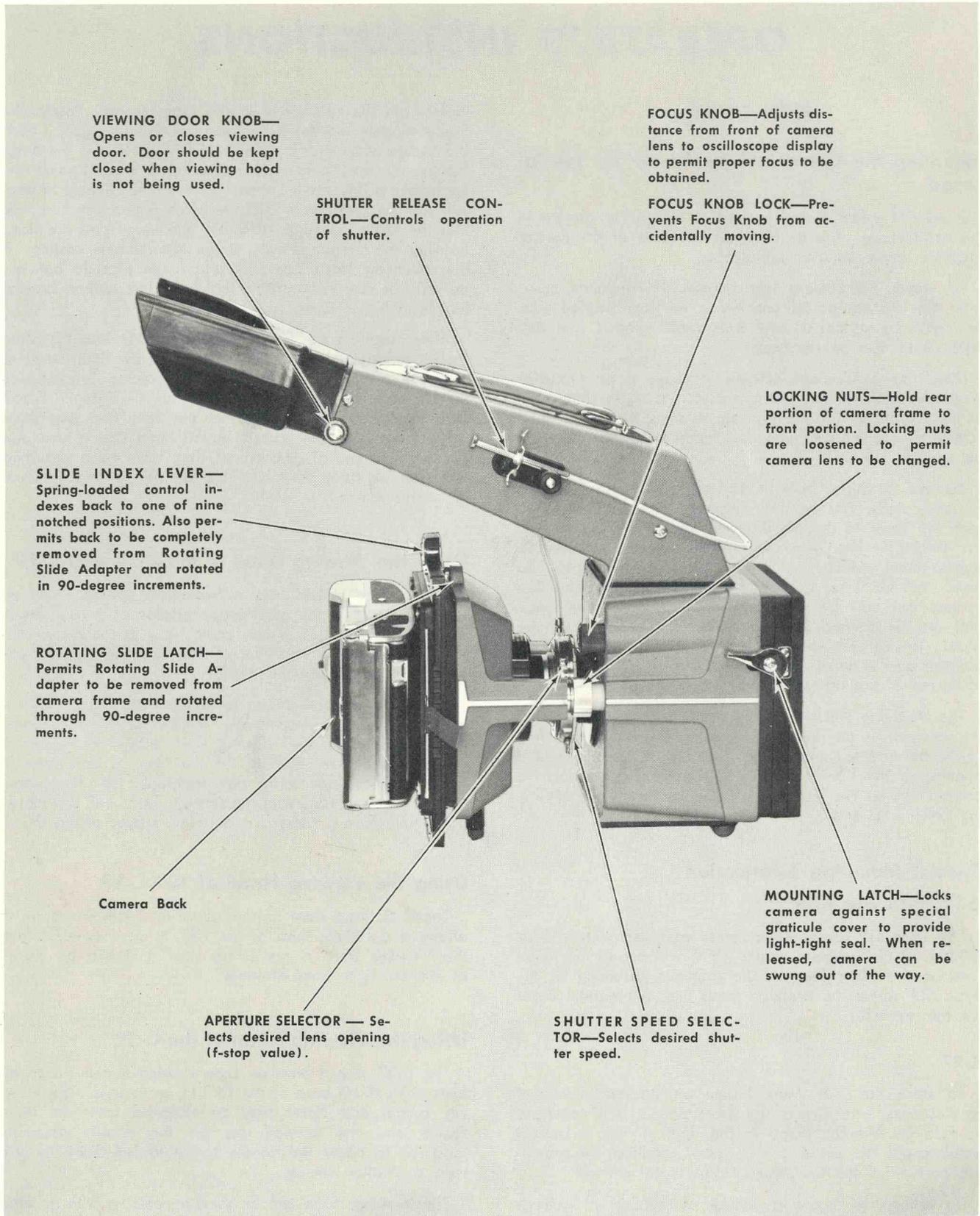


Fig. 2-1. Camera System operating controls and their functions.

LENSES

Adjusting the Lens Aperture

The APERTURE SELECTOR (see Fig. 2-1) is used to select the lens opening. The dial is calibrated in f-stop numbers with a small pointer to indicate the settings.

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. 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 because the trace and graticule cannot simultaneously be brought into focus when the f-stop number is lower than $f/4$. In applications where it is necessary to use the lens wide open, special techniques can be used to obtain a satisfactory picture with both the trace and graticule in focus. These techniques are described in Section 4 of this manual. A Projected Graticule Attachment is available which will produce a virtual image of the graticule in the same plane as the trace. This makes it possible to obtain proper focus of both the trace and the graticule at the widest lens openings.

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

Selecting the Shutter Speed

The camera shutter speed is selected by means of the SHUTTER SPEED SELECTOR (see Fig. 2-1). Numbers shown on the SHUTTER SPEED SELECTOR are actually the reciprocals of the shutter speeds. For example, when the SHUTTER SPEED SELECTOR is set at 25, the shutter is open $1/25$ 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 so that the desired results may be obtained. More information on selecting the shutter speed is contained in the Photographic Techniques section of this manual.

Releasing the Shutter

The SHUTTER RELEASE CONTROL is located on the right side of the camera in a special holder. When the SHUTTER RELEASE CONTROL is pressed, the shutter mechanism is actuated. In all positions of the SHUTTER SPEED SELECTOR except (T) and (B) the shutter mechanism operates independently of the time that the Shutter Release Control is held in. In the (B) position of the SHUTTER SPEED SELECTOR, the shutter remains open as long as the SHUTTER RELEASE CONTROL is held down. When the control is released, the shutter closes. In the (T) position of the SHUTTER SPEED SELECTOR, the shutter is opened the first time the control is pressed. It is then necessary to press the SHUTTER RELEASE CONTROL a second time in order to close the shutter.

The shutter can also be operated without using the cable release by using the lever at the left side of the lens assembly. The lever is raised to actuate the shutter mechanism.

CAUTION

Do not attempt to force the SHUTTER RELEASE LEVER. When the SHUTTER SPEED SELECTOR is set at (T), the release lever will not return to the closed position the first time the lever is actuated. Attempting to force the lever to the closed position will damage the shutter mechanism. Raise the lever a second time to close the shutter.

Changing Lenses

Several lenses can be used with the camera. All except the Elgeet type can be changed by following the procedure outlined below: (See Fig. 2-2).

1. Install the Dark Slide in the camera back.
2. Disconnect the cable release from the lens assembly.
3. Simultaneously unscrew the Lock Nuts holding the rear and front portions of the camera frame together.
4. Remove the rear portion of the camera frame and unscrew the lens assembly.
5. After checking the new lens for cleanliness, screw it into place on the frame and reverse the above procedure to complete re-assembly.
6. Adjust the Lock Nuts so the front of the lens seats against the front of the camera frame. Do not excessively tighten the Lock Nuts, as it may impair shutter operation. After changing lenses, minor re-focusing of the camera may be necessary.

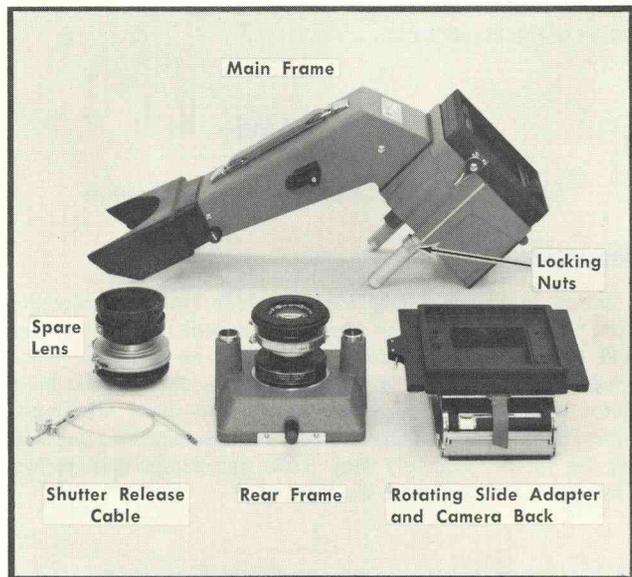


Fig. 2-2. Components described in changing the screw-in style of lens.

Special Information for Elgeet Lenses

Figure 2-3 shows details of installation of an Elgeet lens.

In changing Elgeet lenses, after installing the Dark Slide in the camera back, the Rotating Slide Adapter must be removed. This is done by lifting the Rotating Slide Lever and lifting out the Slide Adapter Assembly.

Operating Instructions—Camera System

After removing the rear of the camera frame as previously explained, reach in through the back of the rear frame and unscrew the metal locking ring which holds the Elgeet lens in place. Once the locking ring has been removed, the lens assembly can be lifted out from the back.

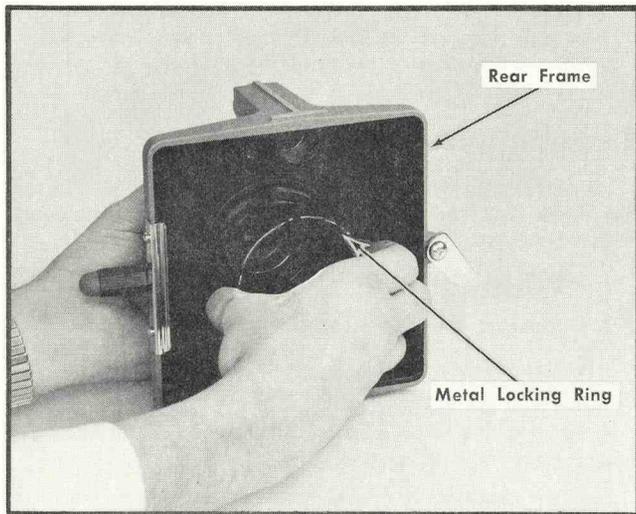


Fig. 2-3. Removing the metal locking ring from an Elgeet lens.

To install the new lens assembly, the above procedure should be reversed. The metal locking ring should be screwed hand tight after the lens assembly is seated in place.

Again, minor re-focusing may be necessary after installation of the Elgeet lens.

REAR FRAME

Standard and Power Supply Frame

Mounting

Install the desired lens into the Rear Frame. Screw the Locking Nuts toward the Main Frame until the Rear Frame will slide onto the supports far enough for the lens to be snug against the Main Frame. Tighten the two Locking Nuts onto the Rear Frame simultaneously until they are finger tight. If the Locking Nuts are tightened excessively, pressure on the shutter assembly may make the shutter inoperative. The camera should now be focused.

ROTATING SLIDE ADAPTER

Mounting the Camera Backs

Lift up the ROTATING SLIDE LATCH and slide the ledge on the bottom of the Rotating Slide Adapter into the slot on the Rear Frame. Press the top of the Rotating Slide Adapter up against the Rear Frame and press down on the ROTATING SLIDE LATCH to lock the Rotating Slide Adapter into place. The Rotating Slide Adapter can be placed on the Rear Frame to permit either vertical or horizontal sliding of the Camera Backs.

Early Type Rotating Slide Adapter

When the Rotating Slide Adapter is in place, pull out the Slide Indexer and give it a half turn. This holds the indexer out and permits the desired Camera Back to be slid onto the tracks of the Rotating Slide Adapter. Be sure to hold onto the Camera Back until you have given the Slide Indexer another half turn and permitted it to drop into place. The Slide Indexer prevents the Camera Back from coming completely out of the Rotating Slide Adapter but does permit the backs to be indexed to the desired position by means of the nine notches in the back.

The Dark Slide should be left in the film back until the back has been placed in the proper position and a check made that the shutter is closed. The Dark Slide should be put into place before removing either the lens or the Camera Back since failure to use the Dark Slide will result in the fogging of one or more film frames.

Later Style Rotating Slide Adapter

When the Rotating Slide Adapter is in place, press down on the SLIDE INDEX LEVER. While holding down the Slide Index Lever insert the desired Camera Back onto the tracks of the Rotating Slide Adapter. Be sure to hold onto the Camera Back until the Slide Index Lever has been released and the Camera Back has been firmly locked in place.

The Camera Back may be positioned in any one of nine positions by pressing the SLIDE INDEX LEVER and moving the Camera Back to the desired position. The various stops of the Camera Back have been numbered—this number will appear in a small hole of the Slide Adapter Assembly.

It is a good idea to leave the Dark Slide in the Camera Back until the back has been properly seated on the camera. The Dark Slide should also be used whenever the Camera Back is changed if either back contains film.

CAMERA BACKS

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 photograph, how large an area you wish to photograph, on the magnification factor of the particular lens used, and the size of the negative desired. If you want to obtain a negative from which a number of prints can be made, either Types 55 P/N film (which comes in Polaroid Land 4x5, only) or conventional film is quite satisfactory. Both the Polaroid Land 4x5 Film Holder and the holders for conventional cut and roll film are used with the Graflok Back in place.

With either Polaroid Land or conventional films, the size of the film used by the selected back must be at least as large as the image from the lens. This will depend on the object-to-image ratio of the camera lens and on the size of the oscilloscope display. For example, the roll film back for 120 or 620 film would probably not be used with a 1:0.9 lens and a 10 cm wide oscilloscope display. This is because the image of the display is 9 centimeters wide and the long dimension of the film is only about 8.25 centimeters. Thus at least 7.5 mm would be cut off of the photograph.

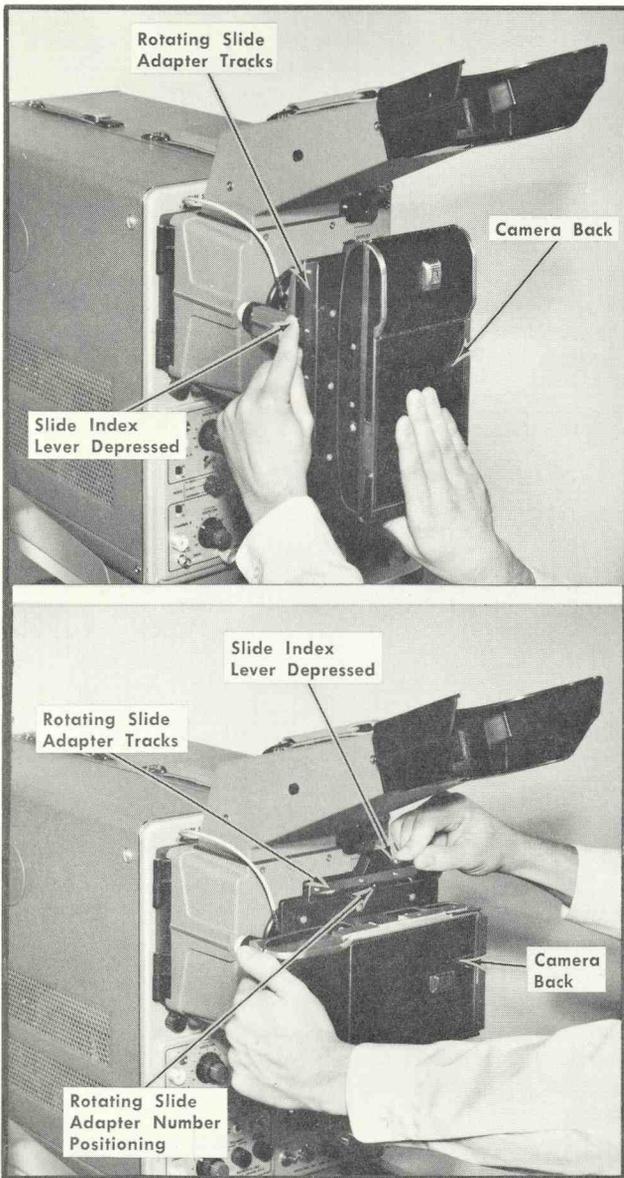


Fig. 2-4. (a) Shows the Rotating Slide Adapter installed to permit vertical sliding of the Camera Back. (b) Shows the Rotating Slide adapter positioned for horizontal sliding.

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

Selecting the Position of the Camera Back when using Rotating Slide Adapter.

The Camera Back can be rotated in 90-degree increments in either of two ways. First, the Rotating Slide Adapter can be rotated by lifting the ROTATING SLIDE LATCH. This permits the tracks on the Rotating Slide Adapter to run either vertically or horizontally. This in turn allows the Camera Back to slide either way. The Camera Back itself can also be rotated by sliding it off the Rotating Slide Adapter, rotating it, and sliding it on the Rotating Slide Adapter in the new position. If either of these methods is used, you must

place the Dark Slide into the Camera Back before rotating the Camera Back in order to prevent exposing the film.

For most applications involving only a single exposure per frame, it will normally be most convenient to install the Rotating Slide Adapter so that the tracks run horizontally. The SLIDE INDEX LEVER can be either on top or bottom as desired. Either the long or the short axis of the film can be made to run parallel with the trace by rotating the Camera Back itself.

When more than one exposure per frame is required, you will probably want to install the Rotating Slide Adapter so that its tracks run vertically. This will permit the film back to move vertically and allow more than one trace to be photographed on a film frame. Again the Camera Back can be installed with the long axis of the film either parallel or perpendicular to the trace.

GRAFLOK BACK

Focusing With a Graflok Back

Install the 4x5 Graflok Back and press the release button on the back (see Fig. 2-5.) Set the lens for maximum aperture ($f/1.4$, $f/1.9$, etc. depending on the lens) and set the SHUTTER SPEED SELECTOR on Time (T). Obtain a sharply focused trace on the crt using the oscilloscope FOCUS and 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. Release the FOCUS KNOB LOCK and adjust the FOCUS KNOB on the Main Frame to produce a sharply focused image of the oscilloscope trace on the ground glass screen.

The camera is normally focused on the oscilloscope trace rather than the graticule 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 graticule will usually be quite satisfactory. The camera can, of course, be focused on the graticule if desired.

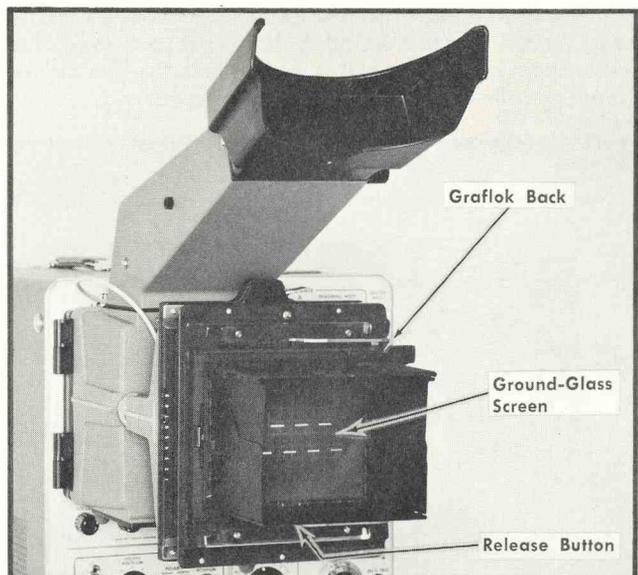


Fig. 2-5. The Graflok Back installed to permit focusing.

CONVENTIONAL FILM HOLDERS

Loading the Sheet Film Holder

4 x 5 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; it will state whether a safe light can be used or not.

In loading the Film Holder the Dark Slide (see Fig. 2-6) 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 reinstalled.

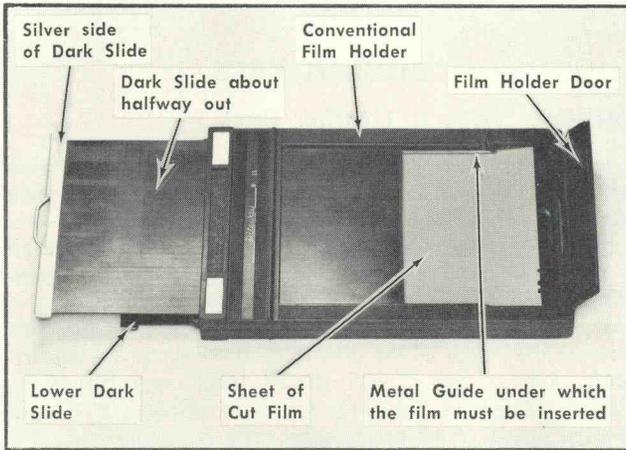


Fig. 2-6. Important points of Film Holder.

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

Set the lighting conditions of the darkroom as described in the information sheet which came with the film. Now hold the Film Holder in your left hand with the side which is to be loaded up and the Dark Slide toward your body. The index finger of the left hand is used to hold the Film Holder Door open. Refer to Figure 2-7 for the method used.

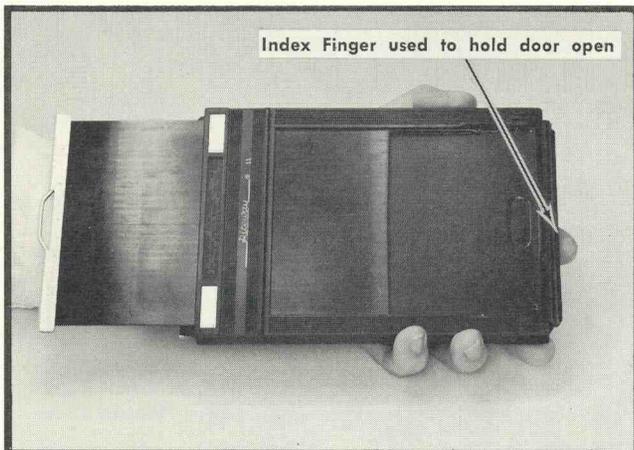


Fig. 2-7. Method used to hold Film Holder while loading the film.

With the right hand hold the film so that the notches in the edge of the film are in the upper right corner. Figure 2-8 shows the proper way to hold the film. In Figure 2-8 it should be noted that the index finger of the right hand is resting on the notches in the film.

The film is inserted at a slight downward angle into the holder. In Figure 2-8 it can be seen 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 the film is not shoved all the way forward the complete image may not appear on the film.

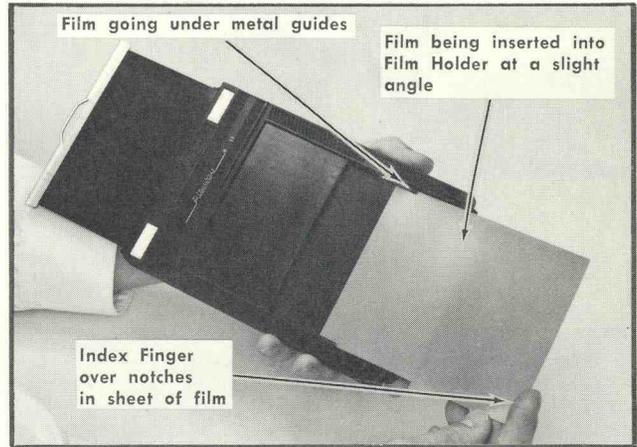


Fig. 2-8. Proper way to insert the film into the Film Holder. Note the position of the right index finger on the sheet of film.

When the film is inserted into the holder, the far end of the film should be given a flick with the index finger of the right hand. This will indicate whether the film is under the film holder guides or not. Now that the film is properly installed in the Film Holder, the Film Holder Door may be closed.

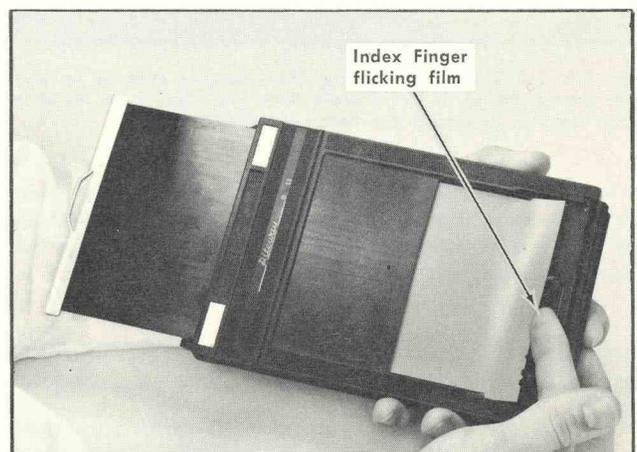


Fig. 2-9. Checking the sheet of film to insure that it has been inserted under the metal guides of the Film Holder.

Release the index finger of the left hand from holding the door open and with the right thumb close and hold the door 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 all the way into the holder. One side of the Film Holder is now loaded. The Film Holder Door will remain closed by itself once the Dark Slide has been inserted all the way.

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. 2-10. Closing the Film Holder after loading the sheet of film. The Film Holder Door is held closed with thumb while Dark Slide is installed.

Procedure Used to Expose Sheet Film

On the oscilloscope, obtain the desired waveform and with the FOCUS and ASTIGMATISM controls focus the display. The camera should now be attached to the oscilloscope and the Graflok Back attached to the camera.

Set the APERTURE SELECTOR for the largest lens opening and the SHUTTER 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.

Now with one hand take the Film Holder and with your free hand lift the Hinged Focusing Panel on the Graflok Back (see Fig. 2-11). 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.

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. Test to see that the Film Holder is seated by giving it a slight tug.

Close the shutter and set the APERTURE SELECTOR and SHUTTER 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 and lift it slightly and pull outward.

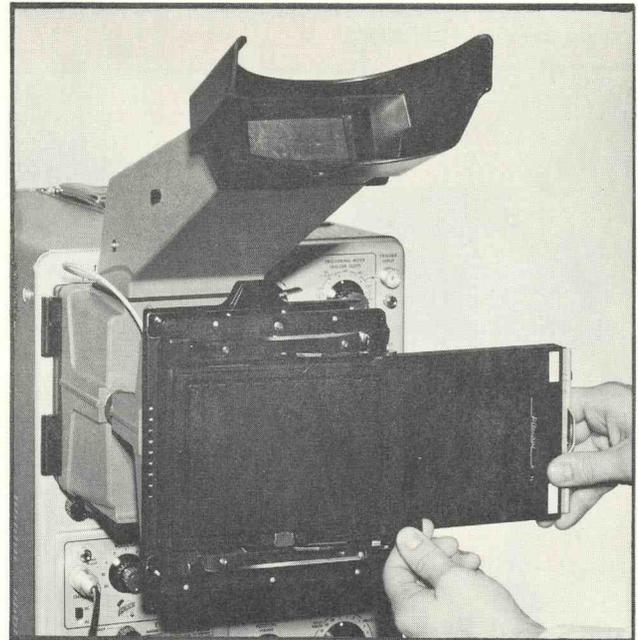


Fig. 2-11. Inserting the Film Holder in the Graflok Back.

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

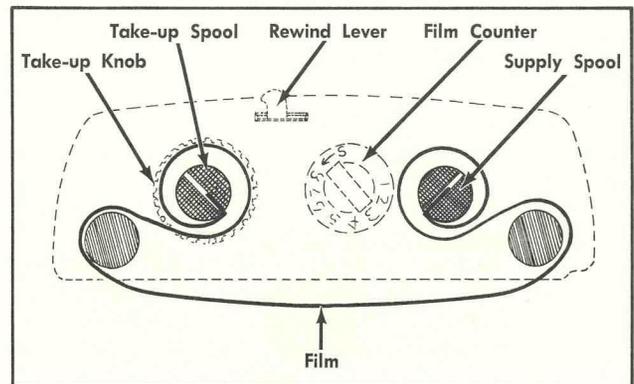


Fig. 2-12. Film threading path for a typical Roll Film Holder.

Loading the Roll Film Holder

If the directions for loading the Roll Film Holder have been lost, the sectional drawing (Fig. 2-12) may be used as a guide. Figure 2-13 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.

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

Operating Instructions—Camera System

and 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.

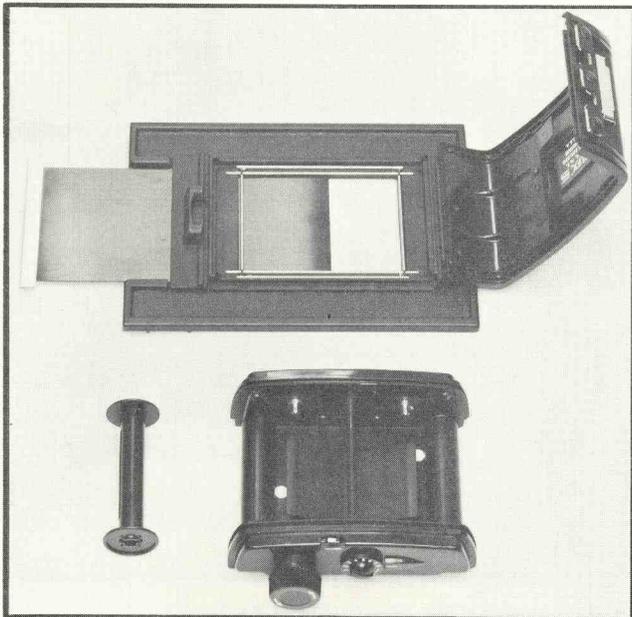


Fig. 2-13. Typical Roll Film Holder apart, ready to load film.

Now place one thumb on each of the hinges for the Hinged Focusing Panel (refer to Fig. 2-14). 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 would be inserted. The above procedure will remove the Hinged Focusing Panel from the Graflok Back.

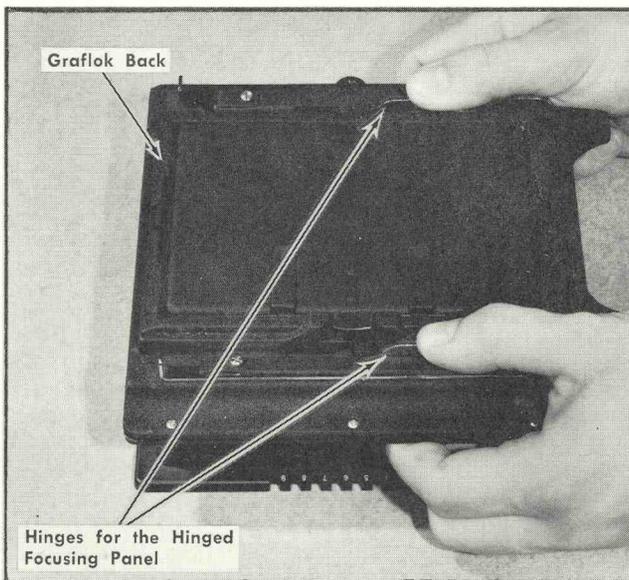


Fig. 2-14. Method used to remove the Hinged Focusing Panel.

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.

With one hand hold the Roll Film Holder on the Graflok Back and use the other hand to engage the two Slide-Locks.

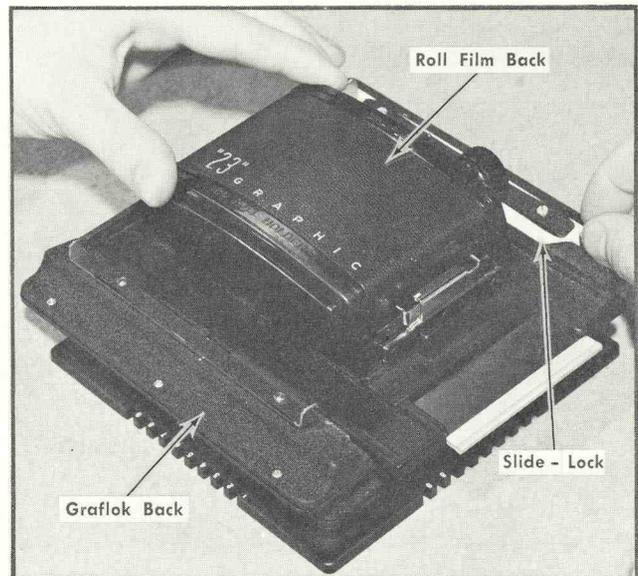


Fig. 2-15. Installing the Roll Film Back on the Graflok Back.

One Slide-Lock is located on each side of the long axis of the film (see Fig. 2-15).

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 and set the SHUTTER SPEED SELECTOR and APERTURE SELECTOR to the proper settings and take the picture.

To advance the film press the Film Release Lever and turn the knob until it stops. The Roll Film Holder is now ready for the next exposure.

POLAROID LAND 4 x 5 FILM HOLDER

Attaching the Polaroid Land 4 x 5 Film Holder to the Graflok Back

Install the camera on the oscilloscope to be used and attach the Graflok Back to the camera. The waveform should now be obtained and focused properly with the oscilloscope controls. Check the camera focus with the aid of the ground glass in the Graflok Back.

To insert the film holder in the Graflok Back, lift the Hinged Focusing Panel and slide the film holder between the Hinged Focusing Panel and the rest of the Graflok Back. The film holder should be inserted so that the PROCESSING ARM is facing away from the Lens (see Fig. 2-16).

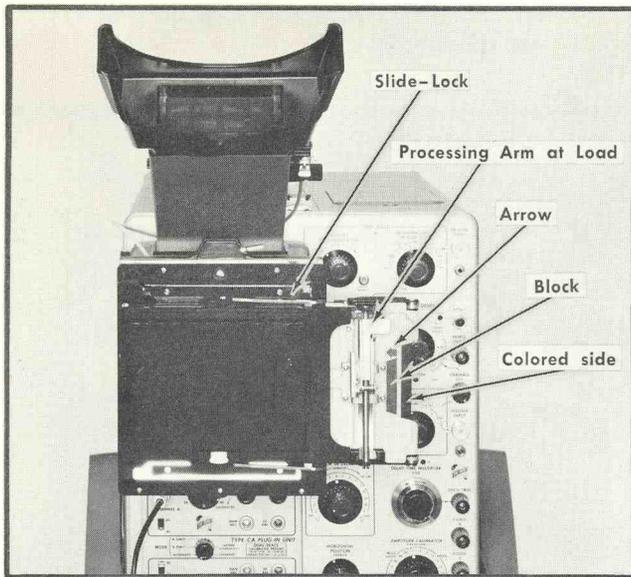


Fig. 2-16. Polaroid Land 4 x 5 Film Holder properly installed in the Graflok Back. With the film packet properly installed, it should be as shown.

When the film-holder has been shoved all the way into the back, give a small tug outward to see if the unit is firmly locked in the Graflok Back. There is a small ridge on the holder which will engage in a slot in the Graflok Back. Now lock the film holder in place by engaging the Slide-Locks into the slots in the film holder (refer to Fig. 2-16).

NOTE

The weight of this film holder makes it advisable to use the Slide-Locks in addition to the spring back to prevent light leaks and to hold the film holder securely.

Inserting and Exposing the Polaroid Land 4 x 5 Film Packet

When inserting the film packet, the PROCESSING ARM on the Polaroid Land Film Holder must be in the LOAD (UP) position. Before inserting, check the film packet for the proper side toward the Lens. The packet should be inserted into the film holder so that the colored block and the arrow are on the side of the film packet that faces you (away from the lens).

Hold the film packet at about its center and insert the metal capped end into the holder. Push the film packet gently (without buckling) into the film holder. After the metal capped end has been pushed past the rubber roller you should shift your hold to the far end (colored block and arrow end) of the packet.

NOTE

Do not press on the pod area of the film packet. The pod contains developing chemicals and premature rupture will damage the picture.

The packet should be pushed into the film holder until it stops. When the film packet is inserted all the way into

the film holder the arrow and the colored block should just show. Refer to Figure 2-16.

Now set the SHUTTER SPEED SELECTOR and the APERTURE SELECTOR to the proper settings for the picture. When you are ready to take the picture, gently pull the film packet envelope out of the holder until it stops. The envelope acts as a dark slide. A slight resistance will be felt as the envelope detaches from the metal end cap as you start to pull the envelope out of the film holder. To avoid fogging the negative, the envelope should not be withdrawn for a longer period of time than necessary.

Make your exposure as you would normally. The ASA rating of the film along with other directions will be found inside the film box. When the film packet envelope is pulled out for an exposure, take care not to bend the envelope out of its natural position. Such a bend could cause light leaks.

After the exposure has been made, reinsert the envelope all the way into the film holder. Using the colored block and arrow, the envelope may be checked to insure that it all the way inserted. If the envelope will not reinsert all the way, withdraw it and try again. Forcing of the film envelope can cause buckling and creasing of the print.

The picture may now be developed right away or at a later time. If ambient humidity is high, development should not be delayed.

Developing the Film Packet

How to Develop the Picture Immediately. After the envelope has been reinserted into the film holder, swing the PROCESSING ARM on the Polaroid Land 4 x 5 Film Holder to the PROCESS (DOWN) position. This will cause the processing rollers to come together. Now when you pull the packet out of the film holder, the rollers will crush the pod and spread the developing reagent between the positive and negative sheets inside the packet.

To start development of the film packet, pull the film packet all the way out of the film holder with a confident and fairly rapid motion. A slight resistance will be encountered as the metal cap enters the rollers, but keep right on pulling without hesitation. The picture is now developing. Refer to the directions packet with the film for the recommended development time.

Extremes of pulling speed should be avoided in pulling the film packet out of the film holder to start development. A slow, inching pull may cause mottle or streaks to appear on the print, while too fast a pull may result in an uneven spread of the developing reagent.

Care should be taken to prevent the film packet from bending or buckling during the development time. If possible, the film packet should be laid on a flat surface. Once the film packet has been pulled out to start development, the PROCESSING ARM should be thrown to the LOAD (UP) position. The film holder may now be reloaded for the next picture.

How to Remove the Finished Picture. After the recommended development time, remove the envelope of the film packet by hooking the tips of your fingers under the edge of the metal cap while you give the envelope a mod-

Operating Instructions—Camera System

erate tug with the other hand, from the colored block and arrow end. Use the finger tips only, and let the thumb rest along the edge of the metal cap. Do not try to pry off or bend the metal cap.

Now peel the picture away from the negative. Take the white sheet in one hand, the brown paper and negative in the other, and peel them apart rapidly. Do not let the print fall back on the damp negative. Black-white pictures should be coated as soon as possible, using print coaters supplied with each box of packets. Follow coating instructions found on the instruction sheet in the film box.

If Type 55 P/N Polaroid Land film has been used, the brown paper should be removed from the negative as soon as possible. From the negative also remove the metal cap, developer pod and the black paper tab. The negative must now be washed in water or a solution of sodium sulfite and then dried. Refer to the instruction sheet in the film box for complete directions.

How to Remove Exposed Film Packet for Later Development. Occasionally you may want to expose a series of pictures without developing each one right away. Here's how to remove the film packet without developing.

After exposing the negative and reinserting the envelope all the way, make sure the PROCESSING ARM is in the LOAD (UP) position.

Push the RELEASE LEVER on the far end of the film holder (end away from loading end) as far down as it will go (about $\frac{3}{8}$ inch) and hold it down. Briskly pull the film packet out of the film holder. Do not let go of the RELEASE LEVER until the film packet is completely out of the film holder.

To identify the exposed but unprocessed packets, bend over one corner (away from the metal cap). This will prevent mix-ups when shooting fast.

How to Develop Exposed Film Packets at a Later Time. With the PROCESSING ARM in the LOAD (UP) position, insert the exposed packet into the film holder as described previously. Make sure the packet is fully inserted into the film Holder. Swing the PROCESSING ARM to the PROCESS (DOWN) position and proceed to develop your pictures in the manner outlined above.

POLAROID LAND ROLL FILM BACK

Focusing the Camera with the Focusing Plate

To use the Focusing Plate, the Polaroid Land Camera Back must be opened and the Focusing Plate inserted where the film normally rests. Figure 2-17 shows the Focusing Plate properly installed.

When installing the Focusing Plate, 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 into the film compartment. The Upper Mounting Ears will have to be compressed and inserted into the film compartment at the same time.

NOTE

For the Focusing Plate to operate properly, the frosted side must be towards

the camera Lens and flush with the normal film position.

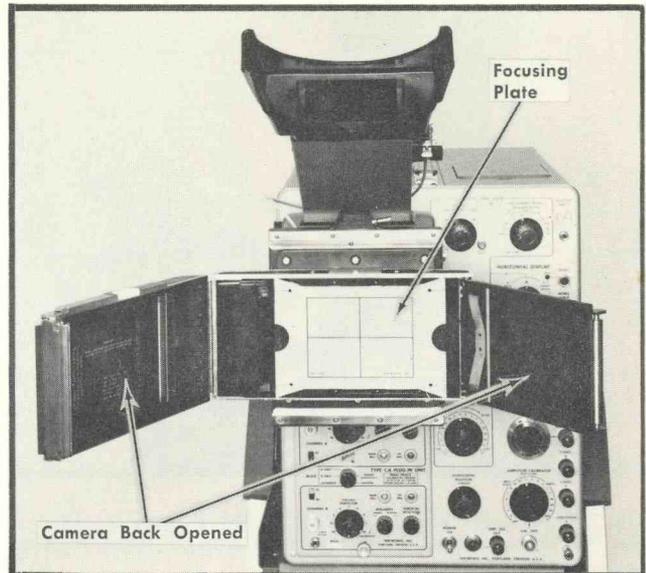


Fig. 2-17. Focusing Plate placed in the proper position for focusing.

When focusing the camera be sure to set the Lens for maximum aperture ($f/1.4$, $f/1.9$, etc. depending on the Lens) and set the SHUTTER SPEED SELECTOR on (T). Obtain a sharply focused trace on the crt using the oscilloscope FOCUS and ASTIGMATISM controls. Then secure the camera in place on the oscilloscope. Open the camera shutter and observe the image on the Focusing Plate. Adjust the FOCUS KNOB on the camera to produce a sharply focused image of the oscilloscope trace on the Focusing Plate.

The camera is normally focused on the oscilloscope trace rather than the graticule 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 graticule will usually be quite satisfactory. The camera can, of course, be focused on the graticule if desired.

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. The back should have opened slightly. Now swing the back cover out until it is fully open. Inside the camera back body you will now see the Inner Panel. Swing the Inner Panel to its fully opened position.

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.

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 right side (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. When you unwrap the film, be careful not break the tape 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 Figure 2-18.

Now close the Inner Panel, bringing the film leader around the steel roller on the edge of the Inner Panel. Lay the leader flat between the guides at the outer edge of the panel (see Fig. 2-19). Be sure that the white paper of the positive roll lies smooth and flat, not tucked into the well.

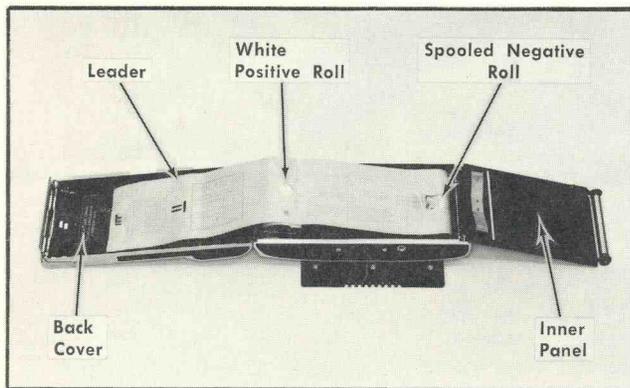


Fig. 2-18. The Polaroid Roll Film Camera Back opened for loading. The white positive roll is dropped in the well at the left while the spooled negative roll is dropped in the well at the right.

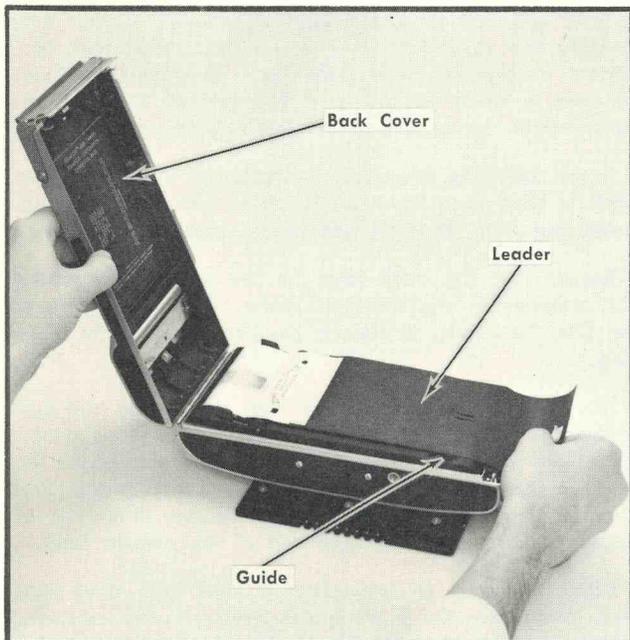


Fig. 2-19. The leader of the film roll must be brought around the roller on the inner panel. Care must be taken that the leader is aligned between the guides on the inner panel before the back is closed.

Close the back cover, and squeezing it tightly shut, pick up the camera back. Swing the LATCH LEVER all the way towards the bottom of the camera back. This will insure that both sides of the back cover will latch. Now 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 now be installed in the camera back. If it is not, the first picture may be exposed.

While holding the camera back with your left hand, lift the Cutter Bar with your right hand. The Cutter Bar is lifted 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 film leader must be pulled out before it will stop, but this will occur automatically when the film is in the proper position for the first exposure.

Now lock the Cutter Bar with a gently 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 Rotating Slide Adapter 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 the 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 grip on the film tab.

Pull the film tab straight out about 7 inches with a single motion. Pull it about as hard and 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. It is important for you to 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. Then close and relatch the Print Door.

Operating Instructions—Camera System

Coat each black-and-white print as soon after removal from the back as possible. First remove the curl by drawing the print face up over a straight edge, such as the edge of the Cutter Bar.

When using the Print Coater apply 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.

POLAROID LAND PACK FILM CAMERA BACK

Focusing the Camera with the Focusing Plate

To use the Focusing Plate, the Polaroid Land Pack Film Camera Back must be opened and the Focusing Plate inserted under the film normally rests. Refer to the paragraphs under "Loading and Exposing the Polaroid Land Film Pack" for directions on how to open the camera back. Figure 2-20 shows the Focusing Plate properly installed.

When installing the Focusing Plate, insert the two ears under the door hinge and down next to the exposure win-

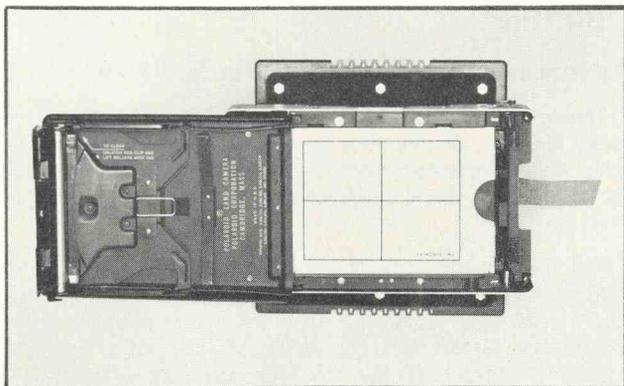


Fig. 2-20. Focusing Plate installed in Pack Film Camera Back.

dow. With nothing more than finger pressure, gently press the Focusing Plate in the direction of the hinge, at the same time pressing the Focus Plate in toward the film plane. The half-moon cut-out in the opposite end from the ears provides a finger hole for easy removal of the Focusing Plate.

NOTE

For the Focusing Plate to operate properly, the frosted side must be towards the camera Lens and pressed all the way into the film plane.

When focusing the camera be sure to set the Lens for maximum aperture ($f/1.4$, $f/1.9$, etc. depending on the Lens) and set the SHUTTER SPEED SELECTOR on (T). Obtain a sharply focused trace on the CRT using the oscilloscope FOCUS and ASTIGMATISM controls. Then secure the camera in place on the oscilloscope. Open the camera shutter and observe the image on the Focusing Plate. Ad-

just the FOCUS KNOB on the camera to produce a sharply focused image of the oscilloscope trace on the Focusing Plate.

Loading and Exposing the Polaroid Land Film Pack

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

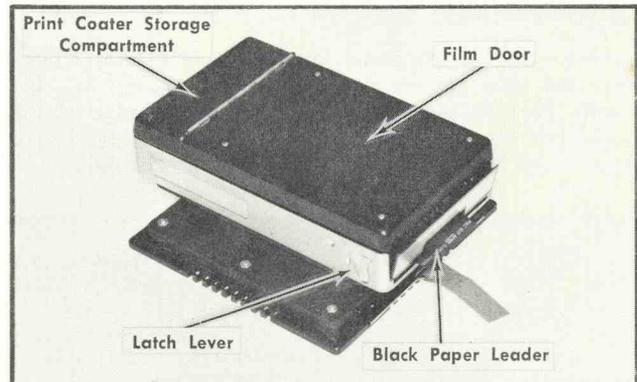


Fig. 2-21. Polaroid Land Pack Film Camera Back.

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 have opened slightly. Now swing the door out until it is fully open.

Remove the empty film container from the camera back by lifting up and pulling it out from under the door hinge.

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

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 right side (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. Make sure the black paper leader is now extending outside the camera back. The Dark Slide should be pushed in all the way.

While holding the camera back with your left hand, pull the black paper leader all the way out. The camera

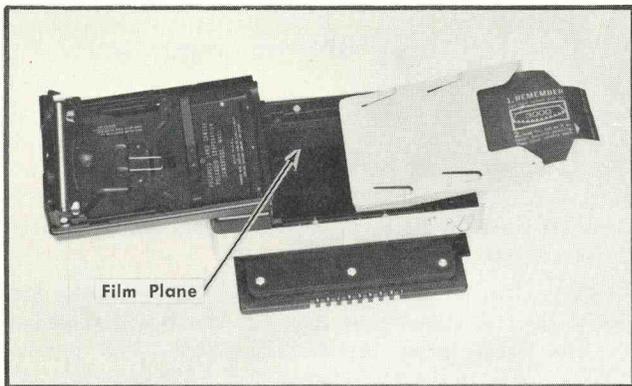


Fig. 2-22. Installing Film Pack into Camera Back.

is now ready for the first picture. If the Dark Slide has not been pushed in all the way, the first exposure may be fogged.

Mount the camera back on the Rotating Slide Adapter 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 which extends from the camera back, all the way out. Pulling the white 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.

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.

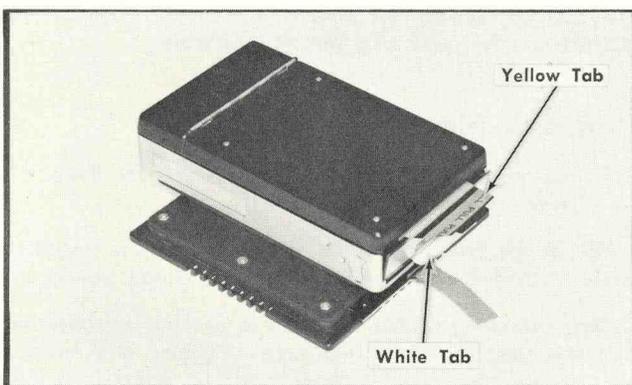


Fig. 2-23. Positive and negative sheets ready to be pulled out of camera back.

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. It is important for you to 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. Prints may be coated by sticking the back of the print to the sticky area on the film box, then using the Polaroid Print Coater (see instructions on film box).

When using the Print Coater apply 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 the compartment, grasp the black cover area to the left of the hinge and lift up. If the compartment is difficult to open, pry with your fingernails between the black cover and the aluminum casting on the left side of the body.

TYPE 350 CAMERA ATTACHMENT

Mounting the Type 350

First screw the two Locking Nuts (see Fig. 2-24) in toward the Main Frame as far as possible. Insert the supports of the Main Frame into the two cups provided for them in the casting of the Type 350. Screw the Locking Nuts toward the Type 350 until the nuts are holding the Lens Barrel of the Type 350 snugly against the Main Frame. Moderate finger pressure will provide adequate holding.

Check to see that the O-ring light seal is correctly positioned in its groove.

Selecting the Position of the Camera Back when using Type 350.

The Camera Back may be rotated so that the film will run from the left to right, right to left, top to bottom or bottom to top.

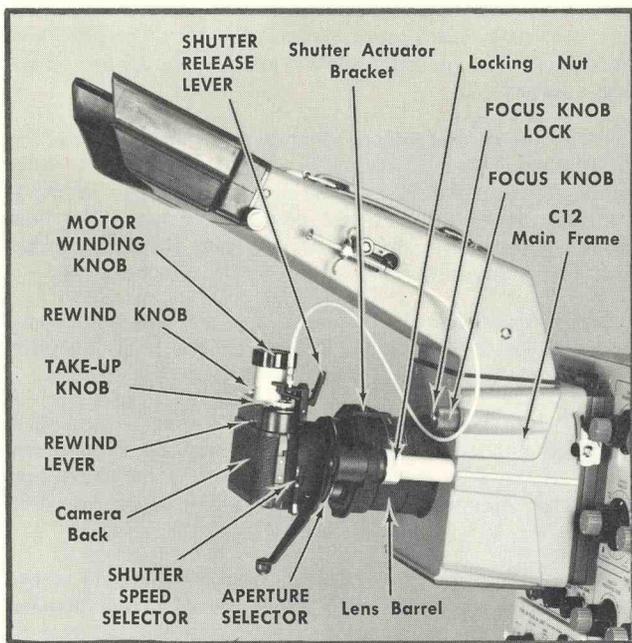


Fig. 2-24. Type 350 Camera Attachment mounted on a C-12 Main Frame.

To rotate the film from the horizontal running position to the vertical, it is necessary to loosen the camera from the Main Frame. It is not necessary to remove the Type 350 entirely from the Main Frame. It only needs to be loosened enough to allow the O-ring to slip when the camera is turned.

Next loosen the screws (use a $\frac{1}{16}$ inch allen wrench) which will be found in the center top and bottom of the bracket which attaches the Type 350 to the Main Frame. Now turn the camera in a counterclockwise direction (as seen from the rear of the camera) until the camera back is in a vertical position.

If it is desired to have the film "read" vertically from top to bottom, it will be necessary to rotate the camera in a clockwise direction to the vertical film running position. To rotate the camera back clockwise, it is necessary to first remove the Shutter Actuator Bracket. The rotation, after removal of the bracket, is the same as that for counterclockwise rotation.

Small white index marks will be found on the bracket which attaches the Type 350 to the Main Frame. These index marks indicate when the camera is in the straight vertical or horizontal position. The index mark on the bracket should line up with the index mark for APERTURE SELECTOR, when the camera is in the proper position. Retighten the screws when the camera is in position.

The two Locking Nuts on the Main Frame Assembly should now be tightened to hold the Type 350 snugly against the Main Frame.

To rotate the Camera Back to the horizontal position the same procedure as above may be used.

Focusing with the Type 350

Swing the Main Frame away from the oscilloscope and obtain a stable display on the oscilloscope. Use the FOCUS

and ASTIGMATISM controls to obtain the best trace focus. Swing the Main Frame back into position against the oscilloscope, and latch.

Set the SHUTTER SPEED SELECTOR to (B) and depress the SHUTTER RELEASE LEVER. While holding it down, shift the REWIND LEVER to the red dot. This will lock the shutter open. Set the APERTURE SELECTOR to f/1.9. Open the camera back by pulling out the bar on the left side of the camera.

Take the Focusing Magnifier supplied with the Type 350 and insert the frosted-glass end into the opening behind the lens. Now loosen the FOCUS KNOB LOCK on the FOCUS KNOB of the Main Frame and, while observing the image through the Focusing Magnifier, adjust the FOCUS KNOB until the image is sharp and clear.

The Type 350 may be focused on either the trace, the graticule or halfway between the trace and graticule. If the camera is focused halfway between the trace and graticule, the pictures will show both the trace and graticule clearly if f-stops from 4 to 16 are used.

Loading 35 mm Film.

Open the camera back by pulling out on the bar found on the left side of the camera. Push the REWIND LEVER as far left as possible before proceeding. The REWIND KNOB if extended, is retracted by turning the knob counterclockwise.

Now install the new film cassette with the projection on the cassette toward the bottom of the camera. The top (flat) end of the cassette must be inserted first. Pull the film leader toward the take-up holder.

When a take-up spool is used, turn the TAKE-UP KNOB until the spring on the take-up spool is toward the rear of the camera. Insert the film between the spring and the core of the take-up spool.

Now turn the TAKE-UP KNOB until the perforated part of the film toward the top of the camera engages the sprocket wheel. Close the camera back and advance the film two frames with the SHUTTER RELEASE LEVER. The film is now in position for the first exposure.

With your fingernail turn the knurled wheel on the right side of the camera until the Film Counter reads 0. Then turn the MOTOR WINDING KNOB until fully wound. The camera is now ready for the first exposure.

Rewinding Film

To rewind, place the REWIND LEVER under the R, i.e., as far right as the lever will go.

Lift up the TAKE-UP KNOB and give it a turn clockwise while holding it up. It will now remain in this position.

Now rotate the REWIND KNOB in a clockwise direction (this automatically causes the knob to extend and engage the cassette) and continue winding until a resistance is felt. This indicates that the film is rewound. The Camera Back must now be opened and the film leader disengaged from the take-up spool.

Unloading Film

Open the Camera Back by pulling the bar on the left side of the camera out. Then retract the REWIND KNOB by turning it counterclockwise. Remove the film leader from the take-up spool by pulling on the leader until it tears out of the hook on the take-up spool.

After the film has been unloaded it is well to check that the REWIND LEVER is in the far left position and that the TAKE-UP KNOB has been engaged into the slot of the take-up spool.

NR Cassette

The NR cassette is a light-tight cassette which may be used in the take-up holder in place of the take-up spool. With the NR cassette it is not necessary to rewind the film after the last exposure is made. It will allow a small number of exposures to be made and developed.

In loading the Type 350, the new film cassette is installed just as outlined in the loading instructions. The take-up spool is then removed by lifting up on the TAKE-UP KNOB and pulling the spool out. Now remove the cover pieces and the NR cassette and insert the film leader between the spring and the core of the NR cassette. Reassemble the cassette and install it in the take-up holder. The slotted end of the NR cassette must be toward the top of the camera. After the NR cassette is installed the TAKE-UP KNOB should be turned until it engages the slotted part on top of the NR cassette.

To unload the Type 350, open the Camera Back as explained in the unloading instructions, after the desired number of exposures have been obtained plus two more. The film is then cut in two with the exposed film in the NR cassette being developed, while the film remaining in the film supply cassette has a new leader formed on it and is rethreaded into another NR cassette or take-up spool.

Miscellaneous Information

If fewer than 20 or 36 exposures are needed, they may be obtained one of two ways. The first is by bulk loading the number of exposures wanted into a cassette. The Type 350 is then used with the take-up spool and the rewind process. The second way is to load a standard 20 or 36 exposure cassette into the film supply holder and to equip the take-up holder with a NR cassette. By use of the NR cassette the number of exposures wanted may be taken, then two or more exposures run through the camera. After this, without rewinding, the camera back may be opened and the film cut off. The remaining film from the film supply cassette may then be fed onto another NR cassette or take-up spool. The exposed film in the NR cassette is then developed.

To prevent an accidental exposure being made, the REWIND LEVER may be set under the red dot. Do not push it any further to the right (camera in horizontal position) as this is the rewind position.

With the REWIND LEVER set under the red dot the SHUTTER RELEASE LEVER cannot be depressed. On the other hand, if the SHUTTER SPEED SELECTOR has been set to (B), the SHUTTER RELEASE LEVER depressed and the

REWIND LEVER set under the red dot, the result will be that the shutter will stay open until the REWIND LEVER is removed from under the red dot. This method will allow time exposures to be made with the Type 350.

If the camera is to be operated from a distance, either a cable release or Shutter Actuator Model 2 should be used. The cable release is connected to the threaded hole on the top part of the SHUTTER RELEASE LEVER. If the Shutter Actuator Model 2 is used, the solenoid part is mounted on the Shutter Actuator Bracket so that the plunger will contact the SHUTTER RELEASE LEVER. The box style power supply may then be mounted to the camera using the tripod mounting hole on the bottom of the Type 350. See Shutter Actuator Model 2 information in this section.

On the left side (camera in horizontal position) of the camera and on top of the REWIND KNOB will be found a film reminder. The U is for reversal type film while the N is to denote negative film. The red dot on the REWIND KNOB is set to indicate the ASA or DIN speed of the film so that proper exposure settings may be set.

BEZELS

Rectangular CRT Bezel 8 X 10 CM (560 Series), All Main Frames

A hard-plastic insert in the bezel provides an ambient light seal for the glass-envelope rectangular CRT, but it must be removed before attaching the bezel to an oscilloscope using a ceramic-envelope rectangular CRT.

CAUTION

Failure to remove the plastic insert before installing the Bezel on an oscilloscope using a ceramic-envelope CRT can cause dangerous pressure to be exerted against the CRT face plate.

The plastic insert may be easily removed from the Bezel by using a small blunt tool. Viewing the Bezel from the camera side, insert the tool through the small opening near the center opening in the Bezel and apply enough pressure to release the ears on the plastic insert.

The plastic insert can be reinstalled into the bezel if it is desired to use the Bezel on a glass-envelope CRT.

ACCESSORIES

Projected Graticule

Mounting the Projected Graticule on the Main Frame

In mounting the Projected Graticule on the C-12 remove the Camera Back, Rear Casting and Lens as a unit. Turn the Main Frame on its side and remove the plate on the bottom of the Main Frame by unscrewing the two rubber feet and two screws. Pull the plate away from the Main Frame making sure to remove the gasket with the plate. Save the plate and two rubber feet for later use.

Remove the Projected Graticule from its shipping package and pull the Graticule Slide out of it. Turn the Knurled Nut found between and above the POWER PUSH ON and

Operating Instructions—Camera System

GRATICULE BRIGHTNESS controls, counterclockwise until you are able to slide the Main Frame bracket forward and off the remaining part of the Projected Graticule. Place the Main Frame bracket over the hole in the bottom of the Main Frame, so that the Knurled Nut is facing the rear of the camera assembly, and the felt on the bracket is against the Main Frame.

Insert four screws for the Projected Graticule into the Main Frame bracket and screw the bracket tightly against the Main Frame. Slide the remaining part of the Projected Graticule back onto the Main Frame bracket and turn the Knurled Nut clockwise until the nut is snug. Do not tighten the Knurled Nut excessively.

The bottom part of the Projected Graticule (Power Supply and Light Pipe) should be installed or removed when the Main Frame is not mounted on an instrument.

Reinstall the Camera Back, Rear Casting and Lens unit onto the Main Frame. Install the proper Graticule Film into the Graticule Slide and install the slide into the Projected Graticule.

External Graticule

Before mounting the camera Bezel onto the oscilloscope the removal of the external graticule should be considered. If the external graticule is left in place, the graticule lines may show up on the exposed picture as shadows cutting the trace. On the other hand, if the graticule is removed the waveform alignment must be done through the Viewing Tunnel of the Main Frame since there won't be any reference lines when the Main Frame is swung away from the oscilloscope.

CAUTION

If the external graticule is removed an implosion shield such as an unrulled graticule should be installed in front of the CRT. Failure to install a shield may result in serious injury to operating personnel.

In either case above, the SCALE ILLUM control must be turned to extinguish the graticule lamps.

In swinging the camera away from the oscilloscope with Projected Graticule mounted on the Main Frame, the power cord for the Projected Graticule will contact the side panel of the oscilloscope or a rubber bumper on the Projected Graticule will connect with the feature strip of the oscilloscope to prevent damage to either instrument. Do not force the camera to swing any closer to the oscilloscope than it will go easily.

Graticule Slide

Hold the Graticule Slide so the outside end (end with a long bar) is in your left hand and the clips of the slide are on top. Take the Graticule Film in your right hand with the dull side up and the notch in the upper left corner. Insert the Graticule Film in the clips near the outside end of the Graticule Slide. Buckle the Graticule Film in the middle by pushing on the right end of the graticule with your thumb. Allow the graticule to slide flat again while guiding it under the spring clamps near the inside end of the holder. Push the Graticule Film towards the right bot-

tom corner of the Graticule Slide until it is snugly in the corner. If no write-in area is to show in the pictures, the Graticule Mask should be installed on top of the Graticule Film. The Mask is installed in the Graticule Slide in the same manner as the Graticule Film.

With the proper graticule in the slide, insert the slide (noting that the side so marked should be down) into the Projected Graticule with the spring clamps on top.

To add data to your pictures, first remove the Graticule Mask, then add the data using either translucent paper, a grease pencil, or a sign pen. If translucent paper is to be used, it should be cut into a strip the same width as the clear window in the Graticule Film. On this strip of paper write the data that is to appear on the picture. Take the strip of paper and turn it over so that the writing is toward the Graticule Film. With the paper in this position insert each end of it under a spring clamp on the Graticule Slide.

To apply data with a grease pencil or a sign pen it is necessary to turn the Graticule Slide over so that the Graticule Film is on the bottom. On the plastic surface over the clear windows in the Graticule Film write the data from left to right, making sure that the outside end of the Graticule Slide is on your left. The top write-in area will be the top of the picture. Turn the Graticule Slide over and insert it into the Projected Graticule.

Graticule Slides are available with amber, blue or green plastic in them. The colored holders have the effect of producing a colored graticule. Among the uses for a colored slide are:

1. To make the graticule color more closely match the phosphor for exposure determination.
2. To make the graticule color contrast more sharply with the trace for clarity.
3. To color-code pictures for easier identification when color film is used.

Graticule Vertical Positioning

The graticule image of the Projected Graticule can be positioned to move the image on the CRT up and down about 0.100 inch from a mechanical center position on the face of the CRT. This positioning is accomplished by turning the Knurled Nut on the Projected Graticule. (The same nut used to secure the bottom part of the Projected Graticule to the Main Frame.) This adjustment is very useful for aligning the graticule with the useable vertical scan area of the CRT.

Operation of Front-Panel Control

To illuminate the Projected Graticule it is necessary to first connect the power cord to the unit and then to a source of proper line voltage. With power applied to the unit, push the button marked POWER PUSH ON. The red button on the switch should now glow. Turn the GRATICULE BRIGHTNESS control clockwise while observing the graticule image through the viewing system of the Main Frame. The scale of the GRATICULE BRIGHTNESS control is calibrated in photographic steps, i.e., moving the GRATICULE BRIGHTNESS control from 16 and 17 increases the light intensity of the Projected Graticule by a factor of X1.4 (1/2 f-stop).

Power Requirements

Unless otherwise indicated, this instrument is connected for 117-volt operation. To connect the instrument for 234-volt operation, remove the red and blue transformer leads from the power connector and switch respectively. Solder the red and blue leads together, insulating the connection with a suitable material.

To convert the instrument from 234 volts to 117 volts disconnect the red lead from the blue lead. Connect the red lead to the power connector along with the yellow lead. The blue lead is connected to the switch along with the black lead.

Table 2-1 shows lead connections for 117- and 234-volt operation.

TABLE 2-1

Wire Color	117-Volt Connections	234-Volt Connections
Black	Connects to switch	Connects to switch
Blue	Connects to wire above and switch	Connects to red lead
Yellow	Connects to power connector	Connects to power connector
Red	Connects to wire above and power connector	Connects to blue lead

Shutter Actuator Model 1

Equipment Connections

When the oscilloscope and camera are set up for the desired display, prepare the Shutter Actuator Model 1 for operation as follows:

1. Connect the remote trigger leads as desired.
2. Screw the solenoid into the cable release mount on the shutter. With some lenses on the Type C-27 it will be necessary to rotate the lens 90° and remove the Viewing Hood and Tunnel before attaching the Solenoid.
3. Insert the phone plug from the solenoid into the OUTPUT jack on the panel of the Power Supply.
4. Connect the Power Supply unit to the power line.
5. Turn ON the POWER switch. The instrument is now ready for operation.

Repetition Rate

The solenoid-energizing capacitor requires approximately three seconds to completely re-charge, but a full charge is not required for operation of the unit. It is recommended that triggering of the Shutter Actuator Model 1 be spaced at least two seconds apart.

Shutter Delay

The length of time required for the camera shutter to become fully open after the TRIGGER switch has been operated is approximately 15 to 20 milliseconds, depending primarily on the type of shutter used.

Normal Exposure

To operate the camera shutter on a short exposure using the timing mechanism of the shutter:

1. Set the SHUTTER SELECTOR and the APERTURE SELECTOR as desired.
2. Position the film for exposure.
3. Press the MANUAL TRIGGER button (or Remote Trigger switch), then release it. The shutter will open when the button is pressed, remain open for the preset exposure time, then close.

Time Exposure

To operate the camera shutter on an exposure of longer duration than provided by the shutter timing mechanism:

1. Set the SHUTTER SELECTOR at (T) and the APERTURE SELECTOR as desired.
2. Position the film for exposure.
3. Press the MANUAL TRIGGER button (or Remote Trigger switch), then release it. The shutter will open when the button is pressed and will remain open when the button is released. Leave the shutter open for the desired exposure time.
4. Press the MANUAL TRIGGER button and release it. The shutter will close when the button is pressed and remain closed when the button is released.

NOTE

(B) setting of the shutter should not be used with Shutter Actuator Model 1. The solenoid cannot be kept in an energized state by the power supply due to the fact that the actuating signal from the trigger circuit is in the form of a pulse. Therefore when the SHUTTER ACTUATOR control is set at (B), the Shutter Actuator Model 1 will open the shutter, then allow it to close immediately. The shutter open-time will be uncalibrated, with the duration depending on the amount of charge stored in the actuating capacitor and upon the mechanical speed action of the solenoid and the shutter.

Multiple Shutter Operation

For simultaneous operation of more than one camera shutter, Model 1 Shutter Actuators may be parallel-connected in the following ways:

1. Connect the Remote Trigger terminals of two or more Power Supply units in parallel, operating from a common trigger switch.
2. Connect two or more solenoid units in parallel, operating from a single Power Supply unit.

IMPORTANT

The number of solenoids that can be operated from a single Power Supply unit depends on the power-line voltage. See Table 2-2.

Operating Instructions—Camera System

3. Connect Power Supply units and solenoids in parallel, using both of the previous methods.

Instructions given for single Actuator operation also apply for units wired in parallel.

TABLE 2-2

Shutter Type	Line Voltage			
	130 260	120 240	110 220	100 200
Alphax #3	7	6	5	4
Illex (Elgeet) #3X Universal	5	4	3	2
Alphax #4	5	4	3	2

Power Requirements

Unless otherwise indicated, this instrument is connected for 117-volt operation. To connect the instrument for 234-volt operation, remove the jumper wires between terminals 1 and 2, 3 and 4. Connect a jumper wire between terminals 2 and 3.

Shutter Actuator Model 2

Mounting

Power Supply Frame (016-231 — 115 v); (016-237 — 230 v)

Refer to Rear Frame information in this section.

Power Supply Model 2 (016-230 — 115 v); (016-236 — 230 v) and Power Supply Mounting Bracket

Grasp the power supply so that the front panel is toward you and the top of the power supply is toward the ground. With the power supply in this position, remove the two BHS screws. Lay the mounting bracket on the supply so that the flat surface of the bracket is against the supply and the plastic knob is toward you. Line up the slots in the bracket so that they are over the holes in the power supply from which the two BHS screws were just removed. When the slots and screw holes are lined-up reinsert the two BHS screws through the slots into the power supply cabinet. Do not tighten the screws at this time.

Power Supply Model 2 (016-230 — 115 v); (016-236 — 230 v) With Power Supply Mounting Bracket Attached

Power Supply Model 2 (box style) is mounted on a camera back by inserting the screw supplied with the Power Supply 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 Power Supply Mounting Bracket to each camera back may be found in Figure 2-25.

After securing the Power Supply Mounting Bracket to the Camera Back, push the power supply toward the Camera Back until the rubber feet rest against the Camera Back. The two BHS screws holding the bracket to the power supply are now tightened.

When it is necessary to open the Camera Back, the power supply may be rotated out of the way. The power supply is unlocked from its position by pulling back the plastic knob.

Keep the knob pulled back (away from the Camera Back) and rotate the power supply out and down. Release the knob and allow the power supply to lock into its swung out position. After the Camera Back is closed again, the power supply is rotated back to normal position by pushing the power supply up and in toward the camera. The power supply locks into position automatically.

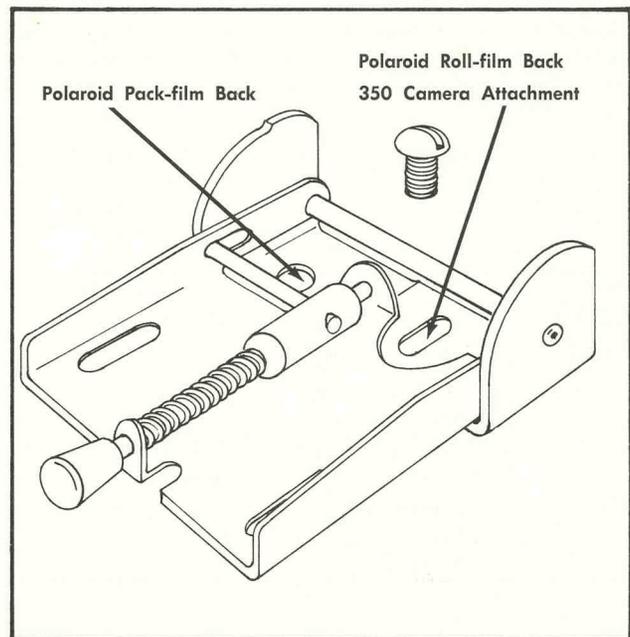


Fig. 2-25. Selecting proper mounting hole in Power Supply Mounting Bracket.

Shutter Actuator Solenoid (016-218 — 115 v); (016-235 — 230 v) Using Lens and Rear Frame

Remove the cable release from the shutter. Now take the Shutter Actuator solenoid and loosen both of the hex socketed screws found between the main part of the body and the knurled nut. The hex socketed screws should be loosened only enough to allow the knurled nut to turn freely.

Hold the Shutter Actuator solenoid directly above the cable release connector on the shutter. Turn the knurled nut to screw the Shutter Actuator solenoid onto the shutter or, as an alternative method, loosen the hex socketed screws enough to permit the knurled nut portion to be removed from the Shutter Actuator solenoid body. The knurled nut portion is then screwed onto the shutter. After screwing the knurled nut portion onto the shutter, remount the Shutter Actuator body onto the knurled nut. If the Shutter Actuator body will not remount onto the knurled nut portion, refer to the note below. After remounting the Shutter Actuator body onto the knurled nut, one of the two hex socketed screws used to retain the knurled nut must be tightened. The second hex socketed screw can be tightened if accessible, however, one screw is adequate to secure the knurled nut.

NOTE

It may be necessary to partly rotate the Lens to allow the Shutter Actuator solenoid to be mount-

ed. The slight unscrewing of the Lens should not exceed $\frac{1}{2}$ turn. This small amount will not materially affect the object-to-image ratio of the Lens but will affect the focus of the camera, therefore, the camera will have to be refocused. When it is necessary to rotate a Lens of the type that is mounted with a locking ring, the locking ring may be loosened slightly and the lens rotated 180° . A Lens using the locking ring will not show any change in the object-to-image ratio or focus after the Lens rotation.

CAUTION

If the camera system is to be subjected to shock in excess of 10 G for 10 to 20 milliseconds, the Shutter Actuator solenoid should be removed from the shutter. Failure to remove the Shutter Actuator solenoid will cause damage to the shutter.

Special Instructions for Ilex (Elgeet) No. 3X Universal Shutters

The Shutter Release Lever, on early lenses using the Ilex (Elgeet) No. 3X Universal shutter, can come in contact with the knurled nut that attaches the Shutter Actuator solenoid to the shutter. This interference will prevent operation of the shutter. To correct this difficulty, bend the Shutter Release Lever to provide clearance between it and the knurled nut. Care should be exercised in bending the Shutter Release Lever to ensure that it is bent only enough to obtain clearance between it and the knurled nut and that the Shutter Release Lever has free operation over its full travel.

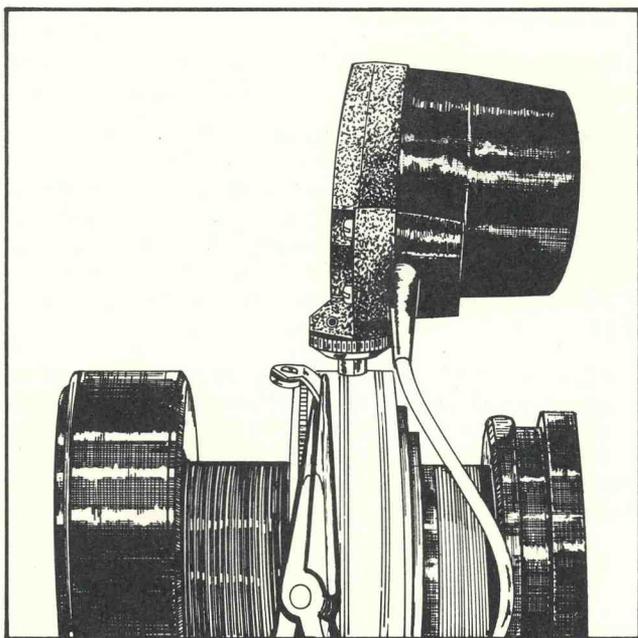


Fig. 2-26. Placing of long nose pliers prior to bending Shutter Release Lever on Ilex (Elgeet) No. 3X Universal shutter.

To bend the Shutter Release Lever, grip it with long nose pliers adjacent to the shutter housing, see Figure 2-26. Bend the Shutter Release Lever over the long nose pliers using finger pressure only.

Type 350 Shutter Actuator Solenoid Bracket

Remove the button-headed screws and washers from the Shutter Actuator solenoid. Mount the Shutter Actuator solenoid so that the knurled nut is toward the Shutter Release Lever of the Type 350 camera. Attach the Shutter Actuator solenoid to the Shutter Actuator Bracket. Do not tighten the screws.

With the Shutter Actuator solenoid loosely mounted, energize the Shutter Actuator solenoid and adjust the forward and back travel from the Shutter Release Lever until the Shutter Actuator plunger causes the Type 350 camera shutter and advance mechanism to function properly. With the Shutter Actuator solenoid in this position, tighten the button-headed screws with a hex wrench.

De-energize and re-energize the Shutter Actuator solenoid several times to insure that the Shutter Actuator solenoid has been properly positioned. If necessary, loosen the button-headed screws and adjust the position of the Shutter Actuator solenoid until operation is satisfactory.

CAUTION

Do not position the Shutter Actuator solenoid so far forward on the bracket as to prevent the plunger from extending to its full travel. Preventing the plunger from fully extending will cause damage to the Shutter Actuator solenoid and power supply.

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 **not** an indicator that the shutter is open if the shutter is set on (T). The lamp is, however, an indicator that the shutter is open if the shutter is set on (B).
- ACTUATOR lamp** mounted on the Power Supply Frame (016-231 or 016-237) can be remotely located. To remotely locate the lamp, unplug the neon assembly and jury rig an extension cord.
- MOMENTARY-OFF-MAINTAIN** Causes the Shutter Actuator solenoid to be energized in the MOMENTARY or MAINTAIN positions. The 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.
- ON-OFF** Turns the line voltage to the power supply on or off.
- POWER** Indicator lamp that lights when line-voltage is applied to the power supply.
- Power Cord** The power cord to the power supply is permanently attached. In the case of the Power Supply Frame, this allows the power cord connection to be made light tight.

Operating Instructions—Camera System

REMOTE 115 (230) VDC + and — Pin Jacks Shorting the + and — pin jacks together causes the Shutter Actuator solenoid to energize. It is possible by connecting a switch between these two pin jacks to energize the Shutter Actuator solenoid from a remote location.

WARNING

When the ON-OFF switch is ON, the MOMENTARY-OFF-MAINTAIN switch is OFF and the line-power and the Shutter Actuator solenoid are connected to the power supply; LETHAL VOLTAGE appears between the REMOTE 115 (230) VDC + and — pin jacks.

ACTUATOR 115 Receptacle into which the connector from the Shutter Actuator solenoid connects to obtain power to operate the Shutter Actuator solenoid.

Operating Shutter Actuator Model 2

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. Apply line voltage to the power supply after connecting the Shutter Actuator solenoid to the power supply, then set the Shutter 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. Using the proper focusing method for your camera system, 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. Second, 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 switch is operated to MOMENTARY, the shutter will open. The second operation will close the shutter.

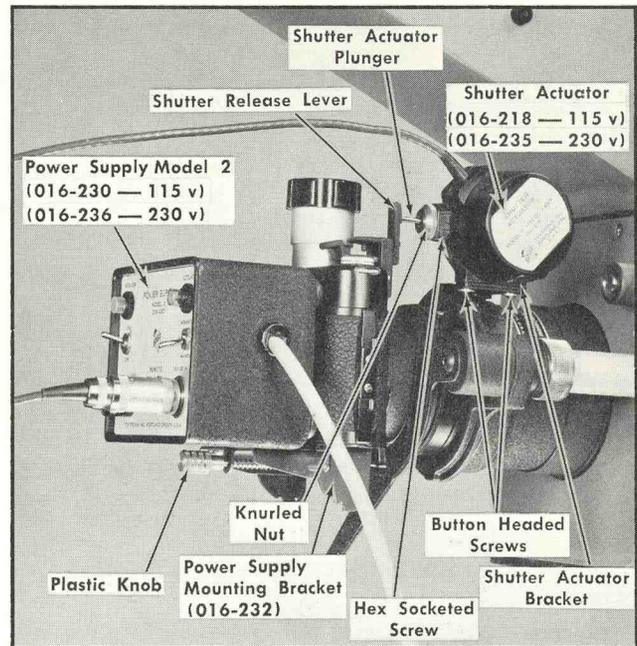


Fig.227 Mounting the Shutter Actuator on the Type 350 camera.

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 so that the display, when presented, will not have 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 2 may be left in the MAINTAIN (energized) position for an indefinite period without damaging the equipment.

SECTION 3

PHOTOGRAPHIC TECHNIQUES

CAMERA-OSCILLOSCOPE CONSIDERATIONS

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 which have a high writing rate are required for low repetition rate displays at the fast oscilloscope sweep rates.

Figure 3-1 shows one way in which writing rate can be calculated. A single trace of a damped sine wave 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 sine wave which is photographed in its entirety. Let D represent the vertical distance in centimeters between the peaks which are 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 rate in centimeters per microsecond is given approximately by:

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

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

It is inadvisable to speak of the absolute writing rate of any oscilloscope or camera, because so many variables are involved. Among the variables which must be considered

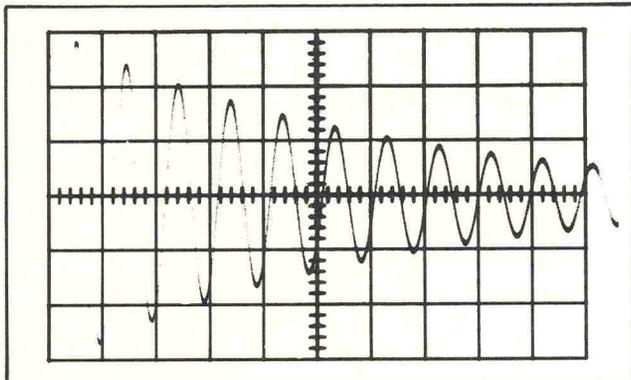


Fig. 3-1. A single-shot damped sinusoidal waveform which can be used to measure the maximum writing rate of an oscilloscope-camera combination.

are the speed of the camera lens, the type of crt phosphor, the type of film, the crt accelerating potential, the camera optical arrangement, the object-to-image ratio of the camera lens, and development time of the film.

It is possible to compare the effectiveness of two films by measuring their writing rate under the same conditions. In other words, you can determine which of the two films is the more effective under those particular conditions without being able to assign a specific value to either film.

The rated ASA speed of a film doesn't tell you much about its effectiveness in recording single oscilloscope traces. This is because the 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 various 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 a lower ASA speed rating.

CRT SELECTION

Selecting the CRT Phosphor

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. There is no one phosphor which is best for all applications. Of the many types of phosphors available, five are most commonly in use. They are the 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 the ones most commonly used, information contained in this portion of the manual will primarily concern these phosphors.

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 thus is most suitable for photographic work. In general, it can be stated that (for 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	Writing Rate. P11 used as the Standard.	*Relative Brightness Representative of 10 kv aluminized screens.	Wavelength of Peak Radiant Energy.	Decay Time in mSEC to 10% of initial value.	Color	
					Fluorescence	Phosphorescence
P1	35% as fast	128	5240 angstroms	23	Yellowish Green	Yellowish Green
P2	85% as fast	238	4500 and 5200 (major) angstroms	.33	Green	Green
P7	70% as fast	128	4650 angstroms	.330	Greenish Blue	Yellow
P11	100%	100	4500 angstroms	.300	Blue	Blue
P31	90% as fast	284	5050 angstroms	.265	Green	Green

* Taken 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 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 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 blue light.

Since the Type P2 phosphor appears to be best for combined general purpose use and photographic applications, it is standard on most Tektronix oscilloscopes. Type P11 is standard on some Tektronix oscilloscopes where extremely rapid sweeps make it possible to obtain maximum benefit from the advantages of this phosphor. Other phosphors can be obtained on any of the Tektronix oscilloscopes.

FILM SELECTION

Selecting the Proper Film

For most oscilloscope work you will find Polaroid Land film the most convenient. This film permits you to see the picture very soon after taking it and makes it unnecessary to expose part or all of the film before developing it.

The following table of Polaroid film types gives a brief outline of the available emulsions. The films recommended or films having equivalent characteristics may be used.

TABLE 3-2
POLAROID LAND FILM TYPES

Film Type	Approximate ASA Rating	Picture Size	Remarks
47*	3200	3 1/4 x 4 1/4	Panchromatic type. Paper print. Roll film only. High speed film with medium contrast.
107*	3000	3 1/4 x 4 1/4	Panchromatic type. Film Packs only. Paper print. Similar to Type 47.
410*	10,000	3 1/4 x 4 1/4	Roll only. Panchromatic type. Paper print. Extra high speed film good for extremely fast waveforms.
46L†	800	3 1/4 x 4	Roll form only. Yields positive transparency. Medium contrast. High speed. Panchromatic type.
146L*	125	3 1/4 x 4	Slower speed than type 46L. Faster development time. Roll form. Positive transparency. High contrast.
52*	200	4 x 5	Sheet form only. Panchromatic type. Yields paper print. Good general purpose film.
55P/N**	50	4 x 5	Positive paper print and reproducible negative. Sheet form. Panchromatic type. High resolution negative.

TABLE 3-2 (Cont'd)

Film Type	Approximate ASA Rating	Picture Size	Remarks
57*	3200	4 x 5	Panchromatic type. Sheet form only. Paper print. Equivalent of Type 47 in sheet form.
48††	75	3¼ x 4¼	Color film which yields a paper print. Available in roll form only. Requires no coating.
58††	75	4 x 5	Color film which yields a paper print. Available in sheet form only. Requires no coating.
108††	75	3¼ x 4¼	Color film which yields a paper print. Available in Film Packs only. Requires no coating.

* Development time 10 seconds.

† Development time 2 minutes.

** Development time 20 seconds.

†† Development time 50-60 seconds.

The following table 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.
	R S Pan.	650	Similar to Tri-X, in sheet form.
	Royal-X Pan Recording	1250	Ultra-fast roll film with low contrast.
	Royal-X Pan	1250	Same as Royal-X Pan Recording, in sheet form.
	Plus-X Pan.	125	Medium speed film with good contrast. Both sheet and roll film.
	Panatomic-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.
Anso	Super Hypan	400	Medium speed film with medium contrast. Both sheet and roll film.

Helpful Techniques with Film

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 Polaroid prints. It can be obtained from any store handling art or photographic supplies.

Another method of note marking 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. This method will not work on the plastic base films.

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 right 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 type, 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 a small price to pay for a large increase in writing rate, however.

Additional information on prefogging will be found later in this section under the paragraphs headed "Prefogging with Projected Graticule".

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

Miscellaneous Uses for Projected Graticule

Making Custom Graticules, Waveforms, etc.

It is possible to display custom graticules, check points or custom forms using the Projected Graticule.

A picture of the graticule, waveform or check points is taken from an oscilloscope or drawing. The image on the picture must be the same size as you wish to display on the CRT. If the graticule or waveform is taken with an oscilloscope camera, the camera should be equipped with a 1:1 object-to-image ratio lens.

Polaroid prints must first be coated on the image side and allowed to dry. The one-hundred series or colored Polaroid film will not work for this application since it is on a plastic base. If a conventional print is to be used it is best to use one with a glossy finish.

Take the conventional or Polaroid paper print and rub light machine oil on the back side (side without the image) with a paper towel, cotton pad, etc. After the oil has been rubbed completely over the backside of the image area, coat the back of the print with a Polaroid print coater, or

Photographic Techniques—Camera System

plastic spray. Do not use a print coater to coat the image side of a Polaroid print after it has been used to coat over the oil.

Cut the paper print to fit in place of the Graticule film. The Graticule film can be used as a template to do this. The paper print must now be inserted into the Graticule Slide face down (image against plastic window in the slide). The slide is then installed and the Projected Graticule used in the normal manner.

Prefogging with Projected Graticule

The Projected Graticule can be used as a light source to effect prefogging of films for cases where extremely high writing rate is required. Data on the exact control settings for the Projected Graticule and camera lens for the various films are available from your local Tektronix Field Engineer or Representative.

Transillumination

While not strictly a means of improving writing rate, transillumination permits you to better see information which 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 otherwise not be evident.

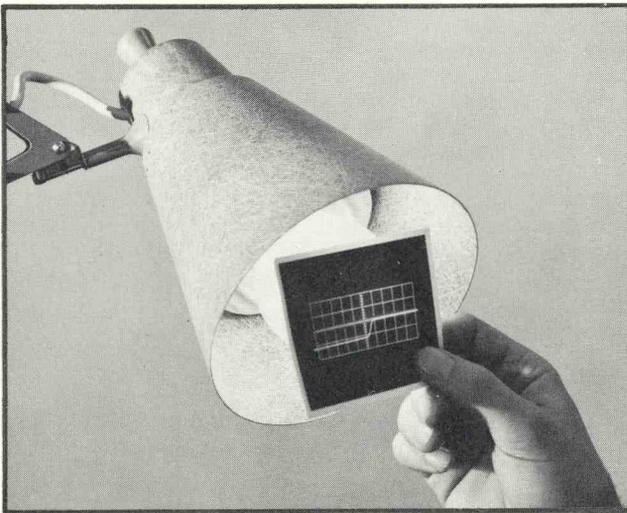


Fig. 3-2. Using transillumination to see otherwise invisible information on the print.

Conventional Film

The matte finish spays referred to above are also good to coat standard prints and negatives on which you wish to mark. Remember that any mark on the negative may appear in the print. This suggests the idea of marking notes on the negative prior to printing.

The paragraphs under Polaroid Land film, on prefogging and postfogging, 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 be used with conventional film negatives and prints. It is a method by which you may see information that might not ordinarily be seen. Refer to the paragraph on transillumination.

Negative Film Development

Equipment Needed

The bare 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 most convenient.)
3. Three glass, hard rubber, polyethylene, enameled steel, or stainless steel trays or a development tank. (A daylight loading tank for 35 mm film is a very convenient item.)
4. Thermometer
5. Graduated measure (Kitchen measuring cup will work.)
6. Two containers 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 (Must be readable or audible in a dark room if one is used.)

Additional equipment which will ease the development of the negative film:

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 (Plastic clothes pins will do.)
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, then 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 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 development 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 into 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 hypo clearing agent is used, the washing procedure in the paragraph above becomes:

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 using 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.

35 mm Daylight Tank Development. Daylight tank development allows 35 mm film in cassettes to be loaded into the tank and developed in normal room light.

Load the film into the tank as per instructions accompanying the tank. Mix the developer, stop-bath (if one is to be used), and fixer. Remove the empty cassette from the daylight tank. Pour the developer into the tank and start the timing device. Agitate the film at 30-second intervals throughout the development time.

At the end of the development time pour out the developer and pour in the stop-bath or water. Allow the stop-bath or water to remain in the tank one to two minutes. During this time agitate the film several times.

When the time is up pour out the stop-bath or water and pour in the fixer. Leave the fixing bath in the tank for the recommended time, agitating the tank at one minute intervals during the time.

Pour out the hypo when the time is up and loosen the cover on the tank. Allow running water to wash the film for about thirty minutes. (See above for procedure used when hypo clearing agent is used.) Be sure that the water is at the proper temperature and that a total water change in the tank occurs every five minutes.

Connect a film clip to one end of the film and remove it from the daylight tank. Hang the film up to dry in a dust-free place, making sure that it touches nothing. By connecting a film clip to the bottom end of the film, it can be kept from curling up.

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 desirable 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 storage area should be from 40% to 60% relative humidity. 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 with a humidity not over 60%.

Developing Solutions. When you are through 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 cause photographic solutions to have shorter life.

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).

Polaroid Film. The wrappers on Polaroid film will protect it through the expiration date against humidity. 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 or packets of Polaroid Land film, approximately the same conditions apply as with conventional film.

Photographic Techniques—Camera System

Polaroid film can be used at temperatures from about 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 temperature of 70° F at 80% humidity.

Polaroid 4 x 5 film packets are quite sensitive to humidity. The packets can be damaged rapidly when exposed to a hu-

midity above 75%. To protect the packets, insert them into the plastic bag packed with the film immediately upon removing the foil wrapper. Fold over the end of the bag several times to keep out the moisture.

In high humidity areas the 4 x 5 film packet should be exposed and developed within 15 minutes after it is removed from the bag.

SECTION 4

PICTURE TAKING

Photographing Repetitive Signals

The following procedure can be used to obtain an exposure for both Polaroid and conventional film.

1. Position the external graticule for white lines.
2. Mount the camera Bezel on the oscilloscope.
3. Obtain the signal and adjust the controls for the desired display.
4. Attach the camera to the Bezel and secure the camera against the oscilloscope with the Mounting Latch.
5. Adjust the FOCUS, ASTIGMATISM and INTENSITY controls for a sharp trace.
6. Set the APERTURE SELECTOR for the largest lens opening (smallest f-stop number) and carefully focus the camera on the trace or halfway between the trace and graticule.

NOTE

If both a clear trace and graticule are desired then the camera should be focused halfway between the trace and graticule.

7. Set the INTENSITY to midrange, SCALE ILLUM three-quarters clockwise, SHUTTER SPEED to 1/5 second and APERTURE SELECTOR to f/5.6. The above control settings should be reasonably close for most film around 400 ASA and a waveform with a frequency near 1 kc. For film with a 3000 ASA rating and a waveform with a frequency near 1 kc use a SHUTTER SPEED of 1/5 second and an APERTURE SELECTOR setting of f/5.

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 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 amount of experimenting required.

1. Use steps 1 through 6, under Photographing Repetitive Signals, to set up the camera.
2. Select a shutter speed which is of a longer time than the event which is to be photographed.
3. Use the highest practical intensity without causing defocus of the trace.

4. Where practical use f-stops higher than f/4. This will permit both trace and external graticule to be in focus.

It should be remembered that since the shutter speed has already been determined, the selection of lens opening will determine how well the trace photographs. In single-sweep applications you must make your camera settings for the trace intensity and duration. You cannot use the graticule as a reference.

Picture Troubles

If the trace is too wide (defocused) on the picture, this may be corrected by either using a higher f-stop number or a faster shutter speed. It is possible to adjust the APERTURE SELECTOR for any opening, even one between the marked numbers. The SHUTTER SPEED SELECTOR, however, must be set to a marked number.

No image appears on the picture.

It is likely that the Dark Slide is still in the camera back.

Image just barely appears on a picture.

1. Use higher INTENSITY and SCALE ILLUM settings.
2. Use a slower SHUTTER SPEED setting.
3. Set the APERTURE SELECTOR for a smaller f-stop number.
4. Use a film with a higher ASA rating.
5. Prefogging or postfogging may help. Refer to the section on Photographic Techniques.

Picture seems to be cut by dark lines.

1. Dust cover still in Main Frame.
2. If Projected Graticule is used, the external graticule is still in place.

Fogging on pictures.

1. Viewing Door has been open allowing the graticule or CRT to reflect light.
2. SCALE ILLUM control or GRATICULE BRIGHTNESS control of the Projected Graticule is set too high.
3. Light-struck or bad film.

Either trace or graticule in focus with the other out of focus.

Use f-stop numbers larger than f/4 or the Projected Graticule attachment.

Picture Taking—Camera System

Some portions of photographed signal appear brighter than others.

Use an exposure which is long enough to allow several sweeps to occur.

Eliminating Parallax and Focusing Difficulties

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

The fact that on some oscilloscopes the trace and graticule are not in the same plane 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 where necessary 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 down the graticule intensity to minimum and make the first exposure of the trace only. Then turn up the graticule to its former brightness and refocus the camera on the graticule. Turn down the oscilloscope trace and make a second exposure of the graticule only. The resulting photograph, due to refocusing between exposures, will have no parallax 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.

The second method involves the use of the Projected Graticule attachment. Here a virtual image of the graticule is projected on the oscilloscope screen in the same plane as the trace. Photographs taken will therefore have no parallax between the trace and graticule and both will be properly focused.

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 lens 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 of the lens, the less time required to obtain a good exposure on the film. With a 1:0.2 lens slightly less exposure time is required to photograph a display than is required with a 1:0.9 lens. The difference in the exposure time required with the various lenses is so slight, however, that they can usually be ignored. There is less than one camera stop difference between a 1:1 and the 1:0.2 lens used in the Type 350 Camera Attachment.

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.

Precautions for High Ambient Light Photographic Work

When the camera system is used in areas of high ambient light, (such as outdoors in bright sunlight) some special precautions should be taken to insure good results. Make certain that the Viewing Hood Door is closed (or that your face blocks the light) before taking the picture. Allow sufficient time after the door is closed to permit phosphorescence of the crt screen to decay.

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. The law fails, however, for very short exposures from bright light or for very long exposures from dim light. It is only for exposures in the range of approximately $1/250$ second to 1 second that the Reciprocity Law can be used.

SECTION 5

OPTICAL AND ELECTRICAL DESCRIPTION

MAIN FRAMES

C-12

Optical System

The viewing system used in the Main Frame consists of a Viewing Hood and two mirrors. Light from the oscilloscope screen strikes the beam-splitting mirror where a portion of the light is transmitted to the camera lens and another portion is reflected to the second mirror.

A virtual image of the oscilloscope display is formed by the beam-splitting mirror. The virtual image acts as the object for the second mirror surface. The second mirror then forms a virtual image which is viewed by the observer. Due to the 45-degree arrangement of the beam-splitting mirror, the observer views the oscilloscope display as though he were looking directly toward the oscilloscope screen on a line perpendicular to the screen. This orthogonal view is full size but the image appears approximately 20 inches away. In all cases the lens is considerably closer to the oscilloscope screen. The difference in the two distances produces a small amount of parallax between the viewed and photographed images. The small amount of parallax can usually be ignored.

C-13

Optical System

The viewing system of the Main Frame consists of a Viewing Door, which when raised allows part of the CRT display to be viewed. The lens photographs the waveforms directly from the CRT with no mirrors in the light-ray path.

C-19

Optical System

Two viewing mirrors permit the oscilloscope display to be observed through the Viewing Hood. The mirrors, however, do not interfere in any way with the light-ray path to the lens.

C-27

Optical System

The viewing system of the Main Frame consists of Viewing Door, Viewing Tunnel and Viewing Hood. The CRT display is viewed at an angle resulting in some parallax of the viewed display. The lens, however, photographs the display directly with no parallax.

LENSES

Aperture Selection

There are basically 4 different lenses which are available for the Camera System. They are the low-cost f/4.5, the

general-purpose f/1.9, the high-speed f/1.4 and the extra high-speed f/1.3.

Of the four lenses, the low-cost f/4.5 has the smallest maximum aperture. Although not as fast as the other two lenses, it is well suited for applications where the oscilloscope trace is moderately bright. These applications include work involving repetitive signals and work at slow sweep rates. The three lens elements used in the lens system produce a high degree of lens correction.

The general-purpose f/1.9 lens has a much greater maximum aperture than the f/4.5 lens and is used in applications where a very fast lens is required. This includes single-sweep applications at the fast oscilloscope sweep rates. The f/1.9 lens is approximately $5\frac{1}{2}$ times as fast as the general-purpose f/4.5 lens. The lens system was specifically designed for oscilloscope applications. The high amount of correction designed into the lens system provides faithful reproduction of the oscilloscope display on the film of the camera.

The high-speed f/1.4 lens is intended for applications involving extremely dim oscilloscope traces. The f/1.4 lens is approximately $1\frac{1}{2}$ times as fast as the f/1.9 lens and $8\frac{1}{4}$ times as fast as the f/4.5 lens. This lens includes a high degree of correction to produce images which are faithful reproductions of the original oscilloscope display. It also has been designed specially for oscilloscope applications. The focal length of the f/1.4 lens is slightly different from the other two types, being 88 mm instead of 75 mm.

The extra high-speed f/1.3 lens has been designed for single sweep photography of very fast sweep rates. The f/1.3 is approximately 5 times as fast as the f/1.4 lens and 12 times as fast as the f/4.5 lens. This lens was specially designed by Tektronix for extremely fast oscilloscope waveforms.

All the lenses provide negligible distortion of the image. Their essential differences are in their ability to photograph extremely dim traces such as those produced in single-sweep applications at the highest sweep rates.

REAR FRAMES AND ROTATING SLIDE ADAPTER

The physical length of the various lenses is quite different. In order to allow for this and also to compensate for manufacturing tolerances, a special lens mounting system is used. This mounting system consists of the supports protruding from the front portion of the camera frame and the two Locking Nuts. The supports and the Locking Nuts permit lenses of virtually any reasonable length to be installed in the camera.

The various lenses used with the camera system are installed in appropriate lens mounts which give the proper object and image distances and thus the desired object-to-image ratio. The lens mount automatically assures the proper image distance, when the lens assembly is installed in the Rear Frame. The proper object distance is then automatically obtained when the camera is focused.

All of the Camera Backs used with the camera system provide the same image distance. This means that any two backs

Optical And Electrical Description—Camera System

can be interchanged without affecting either the magnification of the lens system or the focus of the image.

ACCESSORIES

Shutter Actuator Model 1

Circuit Description

The solenoid unit screws directly into the cable-release mount on the shutter*, and the cord from the solenoid plugs into a jack on the panel of the Power Supply unit. A 350-volt pulse from C610 in the Power Supply energizes the solenoid, causing the actuating bayonet to operate the shutter. A spring in the solenoid unit immediately returns the bayonet to its normal position.

The Power Supply unit contains the power transformer and the triggering circuit of the instrument. The transformer primary consists of two windings, permitting operation on either 117 volts (parallel-connected) or 234 volts (series-connected).

One secondary winding of T601 supplies six volts ac for operation of the pilot light and the switching relay. The other secondary winding delivers 250 volts ac which operates through the diodes to charge capacitor C610 to 350 volts, when the relay is in its normal position. The capacitor is kept at full charge until the trigger switch is operated, clos-

***Use only the following shutters: Alphax #3, Ilex #3X, Alphax #4.**

ing the discharge circuit. The leak resistor R610 discharges C610 when the instrument is not in use.

Relay K610 is electrically triggered either by depressing the MANUAL TRIGGER switch, SW610, or by closing the remote circuit connected to the REMOTE TRIGGER terminals. When the relay is triggered, C610 discharges through the output circuit, energizing the solenoid.

Shutter Actuator Model 2

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. R10, R11, R12 and R13 reduce the dc output voltage of the power supply to allow the actuator to remain energized indefinitely without damage.

D12 has been installed to suppress the arc which will occur when SW19 switches. Pin 4 of J19 grounds the Shutter Actuator solenoid and power supply cases to the third wire ground.

SECTION 6

CAMERA SYSTEM MAINTENANCE

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 covered when not in use to prevent dust accumulating on or in it.

Main Frames

The mirrors used in the Main Frames require a minimum of maintenance. Normally the only thing required is to keep the mirrors clean. The mirrors can be cleaned in the same manner as the lenses. A soft camel-hair brush can be used to remove loose dust after which fingerprints and smudges can be removed with clean, high-quality lens tissue.

NOTE

The mirror in the Viewing Tunnel may be cleaned by attaching the cleaning materials to a long rod. The rod is then inserted through the Viewing Door opening.

Lenses

In order to obtain maximum use from your camera, care should be taken that the lenses are kept clean and are properly installed in the instrument. When lenses require cleaning, the entire lens assembly can be removed from the camera by first loosening the Locking Nuts, then separating the rear of the camera from the front and finally unscrewing the lens from the rear of the camera frame. When replacing the lens, do not force the parts together. If the parts are mated properly, they will fit together easily.

Loose dust on lenses should be removed with a soft camel-hair brush. Fingerprints and other smudges can be removed with clean, high-quality lens tissue. Be careful that you do not scratch the lenses when cleaning them.

Do not attempt to disassemble the lenses. The lens assemblies are sealed, therefore dirt should not get on the inner surfaces of the lenses. Each lens is individually adjusted at the factory to obtain the correct magnification factor. If the lenses are disassembled and then reassembled, the magnification factor of the lens will probably be altered.

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 sluggish it may be the result of continuous wear or extreme atmospheric conditions. Dust should present no problems since the shutter is sealed inside the lens system.

Camera Backs

Polaroid film backs used with the Camera System 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. If reagent is left on the rollers of the back, it 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, damaged banana jacks, 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

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 Field Engineer or Field Office. See "Camera System Repair and Ordering Information" at the front of Section 7.

Soldering

Special silver-bearing solder is used to establish a bond to the ceramic terminal strips in Tektronix instruments. This bond may be broken by repeated use (especially if ordinary tin-lead solder is used) or by excessive heating. We recommend solder containing about 3% silver. Silver-bearing solder is usually available locally or may be purchased in one-pound rolls through your Tektronix Field Engineer or Field Office. Order by part number 251-514.

Soldering to Ceramic Strips

1. Use a wedge-shaped soldering iron tip about 1/8-inch wide. This will allow you to apply heat directly to the solder in the terminal without touching the ceramic, thereby reducing the amount of heat required.

2. Maintain a clean, properly tinned tip.

3. Use a hot iron for a short time. A 50- to 75-watt iron with good heat storage and transfer properties is adequate.

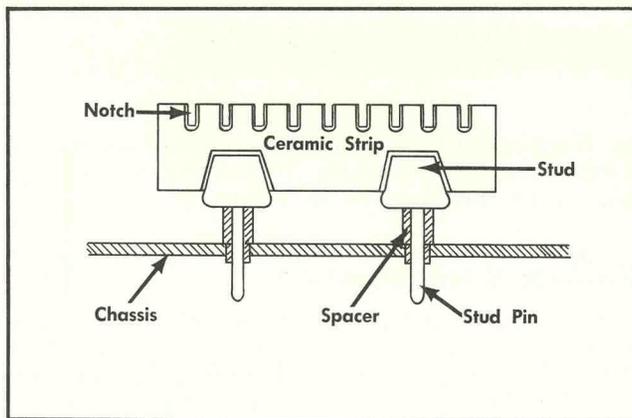


Fig. 6-1. Ceramic strip assembly.

4. Avoid putting pressure on the strip with the soldering iron or other tools. Excessive pressure may cause the strip to crack or chip.

Soldering to Etched Circuit Board

The etch-wired circuit boards have been constructed of the finest materials using the best construction techniques known. Each compartment hole is "through plated" to the opposite side of the board, giving it unusual strength and resoldering durability. Components can be removed and replaced on the circuit board numerous times with no fear of lifting the etched circuit from the glass laminate.

1. Use a 50- to 75-watt soldering iron with a small wedge-shaped tip.

2. Use needle nose pliers to grip the component lead next to its body before applying heat.

3. Apply heat and lift the lead out of its mounting hole.

When installing a new component, bend the leads to match the length and position of the leads of the removed part. It may help to heat the mounting hole solder to a liquid state and shake out the excess.

Tin the prepared leads of the new part, then heat the mounting hole and install the new part.

Do not apply excessive heat. Use sufficient heat, however, along with a small amount of new solder, to establish a full flow clean joint.

Ceramic Terminal Strips

Figure 6-1 shows an assembled ceramic terminal strip. Replacement strips with studs attached are supplied under a single part number and spacers under another number. The original spacers may be reused if undamaged.

Usually, a strip can be pried out of the chassis or pulled out with a pair of pliers. In some cases, you may choose to use a hammer and punch to drive out the studs from the opposite side of the chassis.

When the damaged strip has been removed, place new or used (but undamaged) spacers in the chassis holes. Then carefully force the studs of the new strips into the spacers until they are completely seated. If necessary, use a soft-faced mallet, tapping lightly directly over the stud area of the strip.

SECTION 7

CAMERA SYSTEM REPAIR AND ORDERING INFORMATION

Ordering Information

Replacement parts and additional camera system assemblies may be purchased from or through your local Tektronix Field Office or Tektronix Representative. Be sure your order contains the following information; assembly name, serial-manufacture or model number (if available), and part number. Any questions concerning an order should be taken up with your Tektronix Field Engineer or Representative.

If a part you have ordered has been replaced with a new or improved part, you will be notified before a replacement is made. Tektronix Field Engineers are informed of such changes.

Part Repairing

Contact your Tektronix Field Engineer or Representative. He will make the necessary arrangements to have the part repaired.

Using the Parts List

Each page contains part of the following information:

1. Mechanical Illustrations
2. Mechanical Parts
3. Electrical Diagram
4. Electrical Parts

Example One. You wish to order a f/1.9-1:0.7 Lens. First, turn to the sheet labeled Lenses and find the f/1.9 Lens illustration. Second, check the mechanical parts list and find the 1:0.7 ratio listed along with the Tektronix Part Number for this Lens.

Example Two. Replacing a light bulb in the Projected Graticule. First, determine the circuit number of the light bulb by referring to the electrical diagram on the Projected Graticule page. Second, locate the circuit number in the electrical parts list and obtain the light bulb type and Tektronix Part Number.

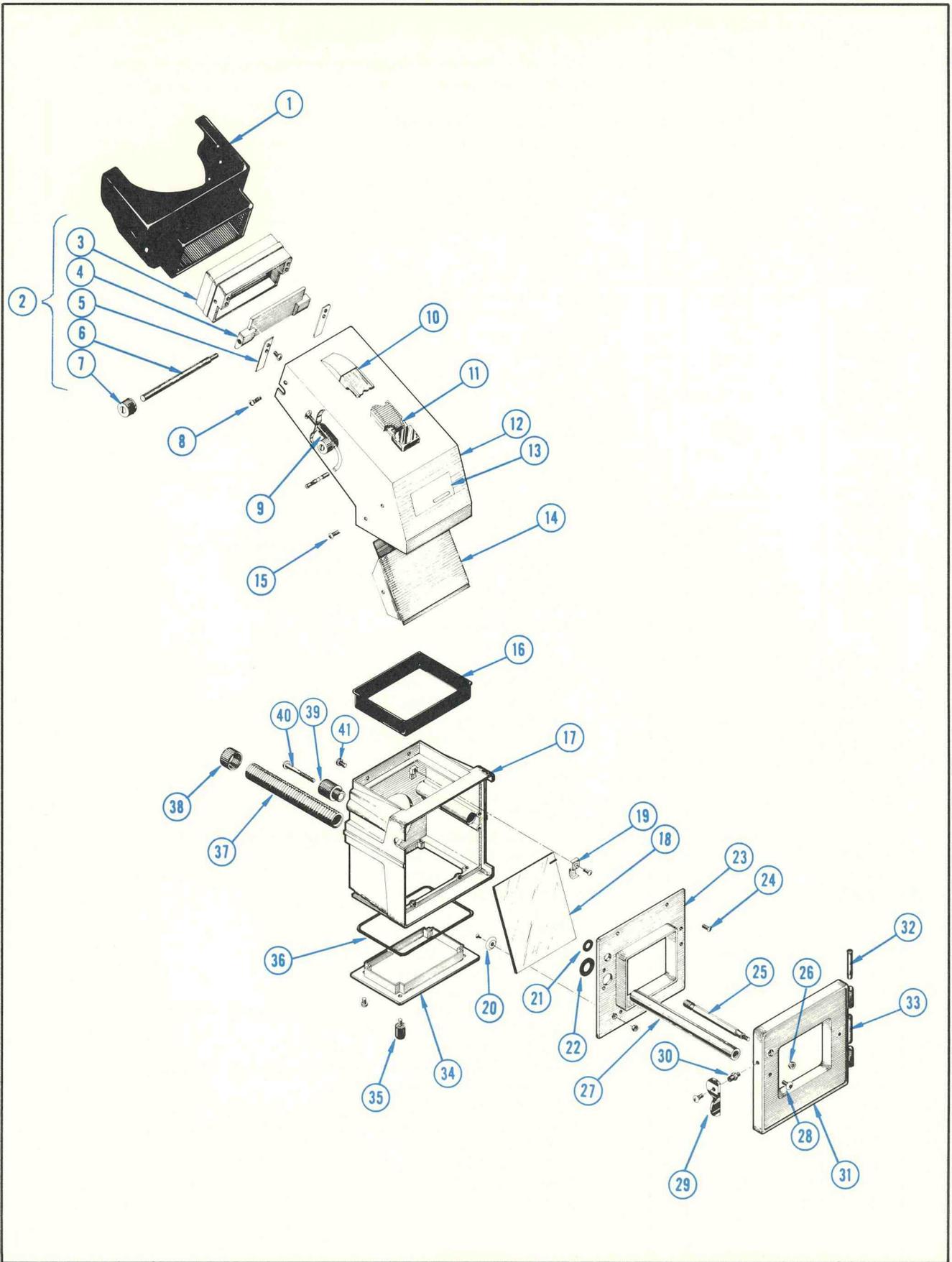
ABBREVIATIONS AND SYMBOLS

a or amp	amperes	mm	millimeter
BHS	binding head steel	meg or M	megohms or mega (10 ⁶)
C	carbon	met.	metal
cer	ceramic	μ	micro, or 10 ⁻⁶
cm	centimeter	n	nano, or 10 ⁻⁹
comp	composition	Ω	ohm
cps	cycles per second	OD	outside diameter
crt	cathode-ray tube	OHS	oval head steel
CSK	counter sunk	p	pico, or 10 ⁻¹²
dia	diameter	PHS	pan head steel
div	division	piv	peak inverse voltage
EMC	electrolytic, metal cased	plstc	plastic
EMT	electrolytic, metal tubular	PMC	paper, metal cased
ext	external	poly	polystyrene
f	farad	Prec	precision
F & I	focus and intensity	PT	paper tubular
FHS	flat head steel	PTM	paper or plastic, tubular, molded
Fil HS	fillister head steel	RHS	round head steel
g or G	giga, or 10 ⁹	rms	root mean square
Ge	germanium	sec	second
GMV	guaranteed minimum value	Si	silicon
h	henry	S/N	serial number
hex	hexagonal	t or T	tera, or 10 ¹²
HHS	hex head steel	TD	toroid
HSS	hex socket steel	THS	truss head steel
HV	high voltage	tub.	tubular
ID	inside diameter	v or V	volt
incd	incandescent	Var	variable
int	internal	w	watt
k or K	kilohms or kilo (10 ³)	w/	with
kc	kilocycle	w/o	without
m	milli, or 10 ⁻³	WW	wire-wound
mc	megacycle		

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

C-12 MAIN FRAME



Parts List—Camera System

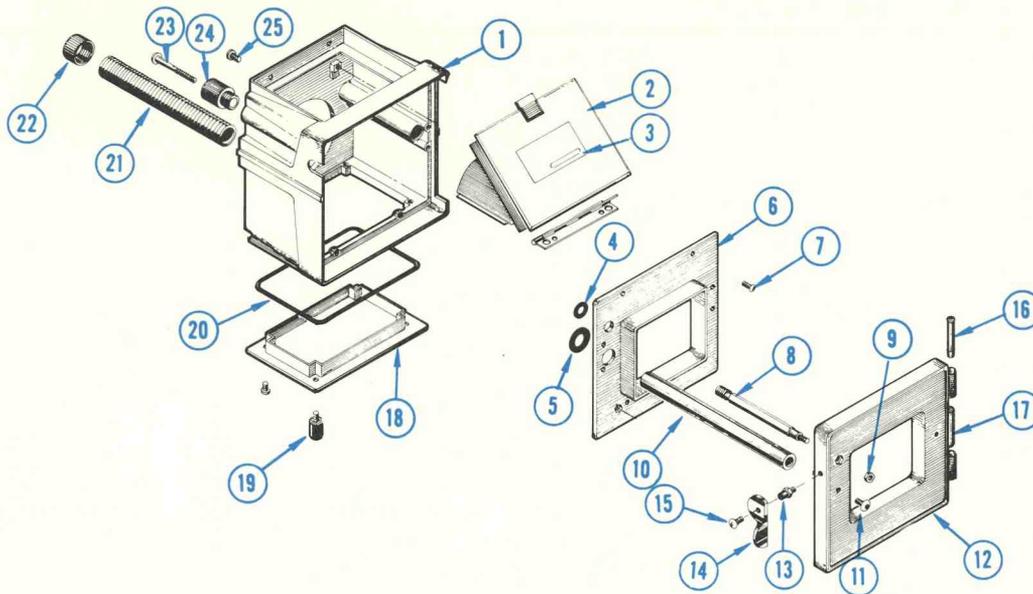
C-12 MAIN FRAME

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1-41	122-635			1	ASSEMBLY, main frame
	- - - -			-	Includes:
1-15	122-563	101	1897	1	ASSEMBLY, viewing tunnel
	122-589	1898		1	ASSEMBLY, viewing tunnel
	- - - -			-	Includes:
1	337-411			1	SHIELD, viewing hood, rubber
2	122-588			1	ASSEMBLY, occluder
	- - - -			-	Includes:
3	426-115			1	FRAME
4	337-409			1	SHIELD, door
5	344-042			2	CLIP, spring
	- - - -			-	Mounting Hardware: (not included w/clip)
	213-080			4	SCREW, thread cutting, 4-24 x 9/16 inch, FHS
6	384-579			1	ROD, shaft
7	366-123			1	KNOB, occluder
	334-819			1	TAG, occluder knob
8	213-085			2	SCREW, thread cutting, 6-20 x 5/16 inch, THS
9	122-587			1	ASSEMBLY, cable release (See Page 7-46)
10	367-029	101	1897	1	ASSEMBLY, handle
	- - - -			-	Includes:
	367-019			1	HANDLE, grip
	381-156			2	BAR, handle
	214-116			2	LINK, handle
	346-011			1	STRAP, handle
	213-045			2	SCREW, self-tapping, 4-40 x 5/16 inch, PHS phillips
	- - - -			-	Mounting Hardware: (not included w/handle)
	212-507			2	SCREW, 10-32 x 3/8 inch, BHS
	210-010			2	LOCKWASHER, steel, internal, #10
11	367-011	1898		1	ASSEMBLY, handle
	- - - -			-	Includes:
	343-073			2	COVER, clamp, chrome
	211-504			4	SCREW, 6-32 x 1/4 inch, BHS
	210-006			4	LOCKWASHER, steel, internal, #6
12	337-410	101	1897	1	SHIELD, viewing tunnel
	337-523	1898		1	SHIELD, viewing tunnel
13	334-799			1	TAG, name plate
	334-679			1	TAG, serial number insert
14	122-515			1	MIRROR, viewing tunnel
	406-667			1	BRACKET, mirror
	- - - -			-	Mounting Hardware: (not included w/bracket)
15	212-069			2	SCREW, 8-32 x 1/4 inch, THS
16	214-168			1	GASKET, light seal, rubber
17-41	122-570			1	ASSEMBLY, front
	- - - -			-	Includes:
17	- - - -			1	CASTING, front
18	122-533	101	210	1	MIRROR, dichroic, beam-splitting
	122-561	211		1	MIRROR, dichroic, beam-splitting
19	344-041			2	CLIP, mirror retainer
	- - - -			-	Mounting Hardware For Each: (not included w/clip)
	211-005			1	SCREW, 4-40 x 1/8 inch, BHS
20	210-919			2	WASHER, mirror positioner, nylon
	- - - -			-	Mounting Hardware For Each: (not included w/washer)
	211-070			1	SCREW, 2-56 x 1/4 inch, OHS
21	214-171			1	GASKET, light seal, focus shaft, felt
22	214-170			1	GASKET, light seal, support rod, felt
23	337-490			1	SHIELD, light seal, front
24	211-105			8	SCREW, 4-40 x 3/16 inch, FHS
25	384-580	101	2257	1	ROD, shaft, focus
	384-600	2258		1	ROD, shaft, focus

C-12 MAIN FRAME (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
26	210-412			1	NUT, hex, brass, 1/4-28 x 7/16 inch
27	- - - -			2	ROD, support
28	- - - -			2	SCREW
29	367-020			1	HANDLE, latch
	- - - -			-	Mounting Hardware: (not included w/handle)
	212-068			1	SCREW
30	355-067			1	STUD, latch
31	- - - -			1	CASTING, support
32	214-164			1	PIN, top hinge
33	214-165			1	PIN, bottom hinge
34	200-271			1	COVER, bottom
	- - - -			-	Mounting Hardware: (not included w/cover)
	211-574			2	SCREW, 6-32 x 3/8 inch, FHS phillips
35	348-036	101	3893	2	FOOT, rubber, blue
	348-048	3894		2	FOOT, rubber, black
36	354-113			1	GASKET, light seal, "O" ring
37	- - - -			2	BEARING, support rod
38	- - - -			2	NUT, draw
39	366-122	101	2257	1	KNOB, focus
	366-186	2258		1	KNOB, focus
40	214-251	X2258		1	SCREW, lock
41	211-574			6	SCREW, 6-32 x 3/8 inch, FHS phillips, chrome
	200-274			1	DUST COVER (not shown)

C-13 MAIN FRAME

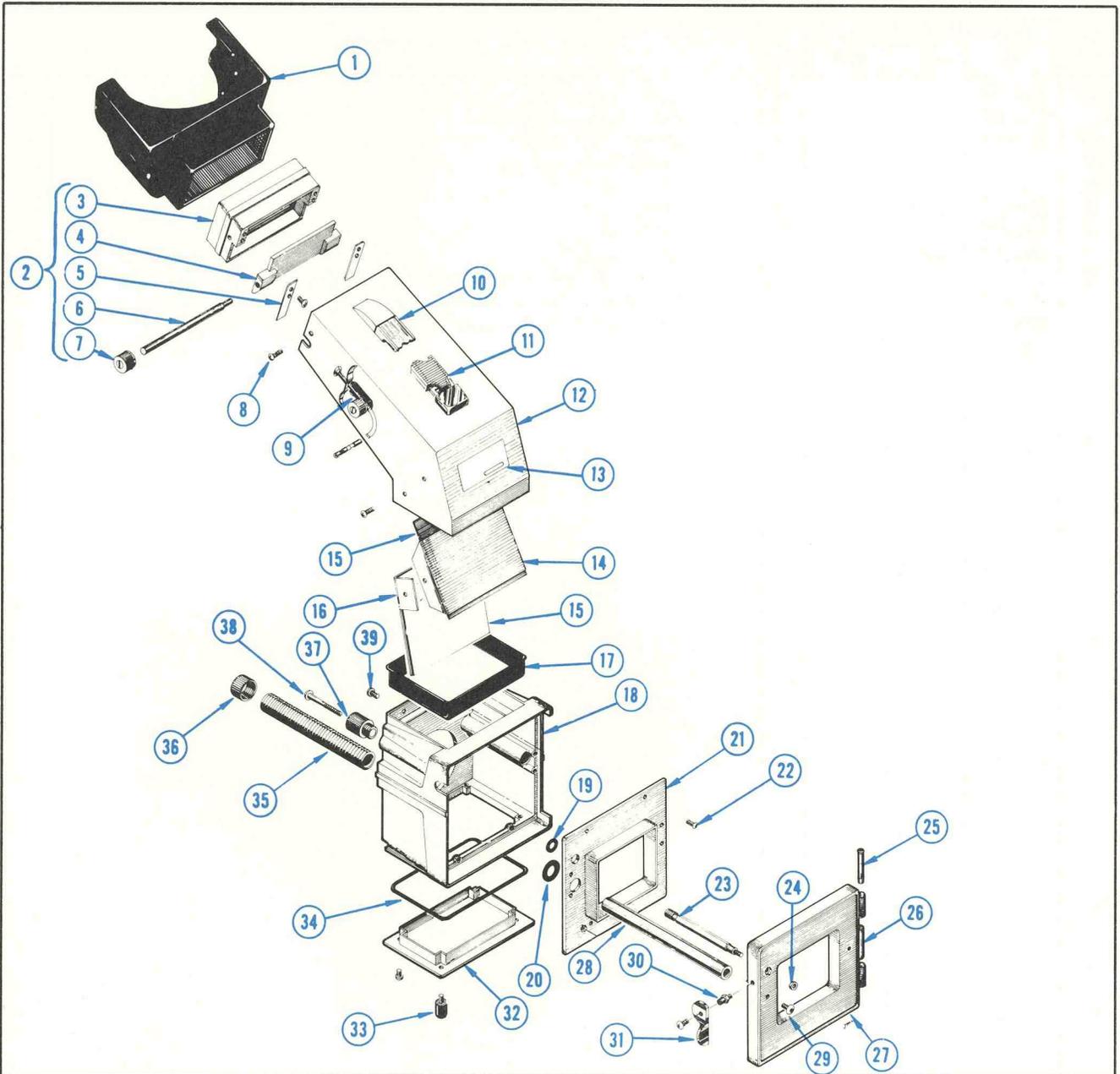


REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1-25	122-564	101	353	1	ASSEMBLY, main casting
	122-609	354		1	ASSEMBLY, main casting
	- - - -			-	Includes:
1	- - - -			1	CASTING, front
2	200-315	101	353	1	COVER, top
	200-481	354		1	COVER, top
	406-968	X354		1	BRACKET, light seal
	337-569	X354		2	SHIELD, side
	214-330	X354		2	SPRING, cover
	210-405	X354		6	NUT, hex, 2-56 x 3/16 inch
	211-001	X354		4	SCREW, 2-56 x 1/4 inch, RHS
	211-069	X354		2	SCREW, 2-56 x 1/8 inch, PHS
	211-079	X354		2	SCREW, 2-56 x 3/16 inch, PHS phillips
3	214-331	X354		1	SPRING, cover
4	214-171			1	GASKET, light seal, focus shaft
5	214-170			1	GASKET, light seal, support rod
6	337-490			1	SHIELD, light seal, front
7	211-066			8	SCREW, 4-40 x 1/4 inch, FHS phillips
8	348-580	101	177	1	ROD, shaft, focus
	384-600	178		1	ROD, shaft, focus
9	210-412			1	NUT, hex, brass, 1/4-28 x 7/16 inch
10	- - - -			2	ROD, support
11	- - - -			2	SCREW
12	- - - -			1	CASTING, support
13	355-067			1	STUD, latch
14	367-020			1	HANDLE, latch
15	212-068			1	SCREW, 8-32 x 5/16 inch, THS phillips, chrome
16	214-164			1	PIN, top hinge
17	214-165			1	PIN, bottom hinge
18	200-271			1	COVER, bottom
	- - - -			-	Mounting Hardware: (not included w/cover alone)
	211-574			2	SCREW, 6-32 x 3/8 inch, FHS phillips, chrome

C-13 MAIN FRAME

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
19	348-036			2	FOOT, rubber, blue
	348-048			2	FOOT, rubber, black
20	343-013			1	GASKET, "O" ring
21	- - - -			2	BEARING, support rod
22	- - - -			2	NUT, draw
23	214-251	X178		1	SCREW, lock
24	366-122	101	177	1	KNOB, focus
	366-186	178		1	KNOB, focus
25	211-575			1	SCREW, 6-32 x 3/8 inch, FHS phillips, chrome
	122-587			1	ASSEMBLY, cable release (See Page 7-46)
	200-274			1	DUST COVER (not shown)

C-19 MAIN FRAME



REF. NO.	PART NO.	SERIAL/ MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1-39	122-636			1	ASSEMBLY, main frame
	- - - -			-	Includes:
	122-567	101	287	1	ASSEMBLY, viewing hood
1-16	122-590	288		1	ASSEMBLY, viewing tunnel
	- - - -			-	Includes:
1	337-411			1	SHIELD, viewing hood, rubber
2	122-588			1	ASSEMBLY, occluder
	- - - -			-	Includes:
3	426-115			1	FRAME
4	337-409			1	SHIELD, door

C-19 MAIN FRAME (Cont'd)

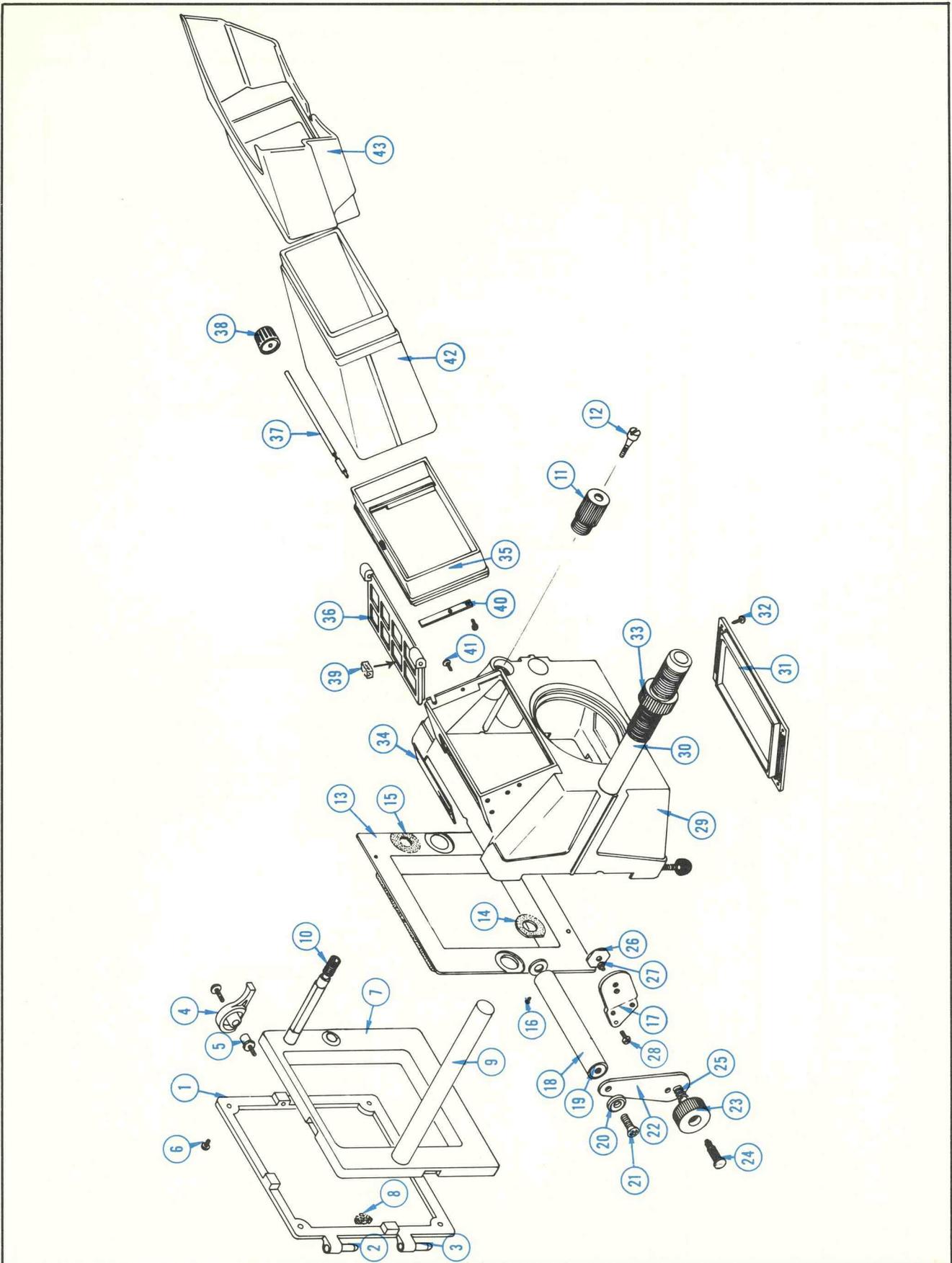
REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
5	344-042			2	CLIP, spring
	- - - -			-	Mounting hardware For Each: (not included w/clip)
	213-080			2	SCREW, thread forming, 4-24 x 9/16 inch, FHS
6	348-579			1	ROD, shaft
7	366-123			1	KNOB
	334-819			1	TAG, occluder
	253-044			RL	TAPE, polyurethane sponge, 3/8 x 1/2 inch
8	213-085			2	SCREW, 6-20 x 5/16 inch, THS
9	122-587			1	ASSEMBLY, cable release (See Page 7-46)
10	367-029	101	287	1	ASSEMBLY, handle
	- - - -			-	Includes:
	367-019	101	287	1	HANDLE, grip
	381-156	101	287	2	BAR, handle
	214-116	101	287	2	LINK, handle
	346-011	101	287	1	STRAP, handle
	213-045	101	287	2	SCREW, thread forming, 4-40 x 5/16 inch, PHS
	- - - -			-	Mounting Hardware: (not included w/handle)
	212-507	101	287	2	SCREW, 10-32 x 3/8 inch, BHS
	210-010	101	287	2	LOCKWASHER, steel, internal, #10
11	367-011	288		1	ASSEMBLY, handle
	- - - -			-	Includes:
	343-073	288		2	COVER, clamp, chrome
	211-504	288		4	SCREW, 6-32 x 1/4 inch, BHS
	210-006	288		4	LOCKWASHER, internal, #6
12	337-459	101	287	1	SHIELD, viewing hood tunnel
	337-524	288		1	SHIELD, viewing hood tunnel
13	334-786			1	TAG, name plate
	334-679			1	TAG, serial number insert
14	406-708			1	BRACKET, upper mirror
	- - - -			-	Mounting Hardware: (not included w/bracket)
	212-069			2	SCREW, 8-32 x 1/4 inch, THS
15	122-562			2	MIRROR, viewing hood
16	406-709			1	BRACKET, lower mirror
	- - - -			-	Mounting Hardware: (not included w/bracket)
	212-069			2	SCREW, 8-32 x 1/4 inch, THS
17	214-168			1	GASKET, light seal
18-40	122-564			1	ASSEMBLY, front casting
	- - - -			-	Includes:
18	- - - -			1	CASTING, front
19	214-171			1	GASKET, light seal, focus, felt
20	214-170			1	GASKET, light seal, support rod, felt
21	337-490			1	SHIELD, light seal, front
22	211-105			8	SCREW, 4-40 x 3/16 inch, FHS
23	384-580	101	301	1	SHAFT, focus
	384-600	302		1	SHAFT, focus
24	210-412			1	NUT, hex, 1/4-28 x 7/16 inch
25	214-164			1	PIN, top hinge
26	214-165			1	PIN, bottom hinge
27	- - - -			1	CASTING, support
28	- - - -			2	ROD, support
29	- - - -			2	SCREW
30	355-067			1	STUD, latch
31	367-020			1	HANDLE, latch
	- - - -			-	Mounting Hardware: (not included w/handle)
	212-068			1	SCREW, 8-32 x 5/16 inch, THS
32	200-271			1	COVER, bottom
33	348-036	101	603	2	FOOT, rubber, blue
	348-048	604		2	FOOT, rubber, black
34	354-113			1	GASKET, light seal, "O" ring

Parts List—Camera System

C-19 MAIN FRAME (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
35	- - - -			2	BEARING, support rod
36	- - - -			2	NUT, draw
37	366-122	101	301	1	KNOB, focus
	366-186	302		1	KNOB, focus
38	214-251	X302		1	SCREW, lock
39	211-574			6	SCREW, 6-32 x 3/8 inch, FHS
	200-274			1	DUST COVER (not shown)

C-27 EXPLODED VIEW



Parts List—Camera System

C-27 EXPLODED VIEW

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1-45	122-676			1	ASSEMBLY, MAIN FRAME, C-27
1	122-716			1	ASSEMBLY, support frame rotator (See Ref. #6)
	- - - -			-	Includes:
2	214-397			1	PIN, top hinge, 1/4 inch diameter
3	214-398			1	PIN, bottom hinge, 1/4 inch diameter
4	367-020			1	LATCH, front, 1 1/2 inches x 1/2 inch
	- - - -			-	Mounting Hardware: (not included w/latch alone)
5	355-067			1	STUD, latch
	212-068			1	SCREW, 8-32 x 5/16 inch, THS
6	- - - -			-	Mounting Hardware: (not included w/assembly)
	211-584			4	SCREW, 6-32 x 1/4 inch, button head socket
7-9	122-715			1	ASSEMBLY, support housing frame
	- - - -			-	Includes:
7	426-213			1	FRAME, support housing
8	134-072			3	PLUG, light seal
	252-549			YD	NYLON, velvet ribbon, black (23 inches)
9	384-577			2	ROD, support, 5/8 inch diameter, 7 inches long
	- - - -			-	Mounting Hardware For Each: (not included w/rod alone)
	211-072			1	SCREW, 5/16 x 3/4 inch, button head socket
10	384-626			1	ROD, shaft, focus
	- - - -			-	Mounting Hardware: (not included w/rod)
	210-455			1	NUT, hex, 1/4-28 x 3/8 inch
11	366-186			1	KNOB, focus control, 3/4 inch diameter x 1 3/8 inches long
12	214-251			1	LOCK, focus, 5/16 diameter x 1 5/32 inches long
13-16	122-718			1	ASSEMBLY, shield, light seal (See Ref. #16)
	- - - -			-	Includes:
13	337-603			1	SHIELD, light seal, styrene
14	214-170			1	GASKET, light seal, support rod
15	214-171			2	GASKET, light seal, focus rod
	252-550			FT	TAFFETA, velvet ribbon, black, (18 inches)
16	- - - -			-	Mounting Hardware: (not included w/assembly)
	211-105			8	SCREW, 4-40 x 3/16 inch, FHS
17-28	122-720			1	ASSEMBLY, handle (See Ref. #28)
	- - - -			-	Includes:
17	407-006			1	BRACKET, handle
18	162-032			FT	TUBE, blue, shrink on type, 7/16 inch ID (5 inches)
19	381-238			1	BAR, handle, 9/16 inch diameter, aluminum rod
	- - - -			-	Mounting Hardware: (not included w/bar alone)
20	210-969			2	WASHER, handle, 5/8 inch diameter
21	212-561			2	SCREW, 12-24 x 1/2 inch, oval head
22	214-429			1	ARM, handle, steel
23	366-272			1	KNOB, handle
24	355-097			1	STUD, handle, 3/8 inch, steel
25	214-428			1	SPRING, handle, stainless steel
26	220-417			1	NUT, lock, handle, hex, 3/4 inch
27	355-096			1	STUD, index, handle, 1/4 inch diameter
	- - - -			-	Mounting Hardware: (not included w/assembly)
28	211-565			3	SCREW, 6-32 x 1/4 inch, THS

C-27 EXPLODED VIEW (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
29-34	122-714			1	ASSEMBLY, frame, front casting
	- - - -			-	Includes:
29	426-211			1	FRAME, front casting
30	166-220			2	TUBE, bearing support, aluminum
31	200-547			1	COVER, bottom
	- - - -			-	Mounting Hardware: (not included w/cover alone)
32	211-541			4	SCREW, 6-32 x 1/4 inch, FHS
33	210-542			2	NUT, draw
	334-829			1	TAG, metal, blank insert
34	334-877			1	TAG, name
35-41	122-717			1	ASSEMBLY, occluder (See Ref. #41)
	- - - -			-	Includes:
35	426-216			1	FRAME, light shield
36	337-602			1	SHIELD, door, styrene
37	384-625			1	ROD, light shield
38	366-123			1	KNOB, light shield
39	253-045			RL	TAPE, polyurethane sponge, 3/8 x 1/4 inch thick, 2 pieces, 5/8 inch
40	344-042			2	CLIP, spring, light shield
	- - - -			-	Mounting Hardware For Each: (not included w/clip alone)
	213-088			2	SCREW, thread forming, #4 x 1/4 inch, PHS
41	- - - -			-	Mounting Hardware: (not included w/assembly)
	213-085			2	SCREW, 6-20 x 5/16 inch, THS
42-43	122-719			1	ASSEMBLY, viewing tunnel and hood
	- - - -			-	Includes:
42	337-604			1	SHIELD, viewing tunnel, rubber
43	337-411			1	SHIELD, viewing hood, rubber
	122-587			1	ASSEMBLY, cable release (not shown) (See Page 7-46)

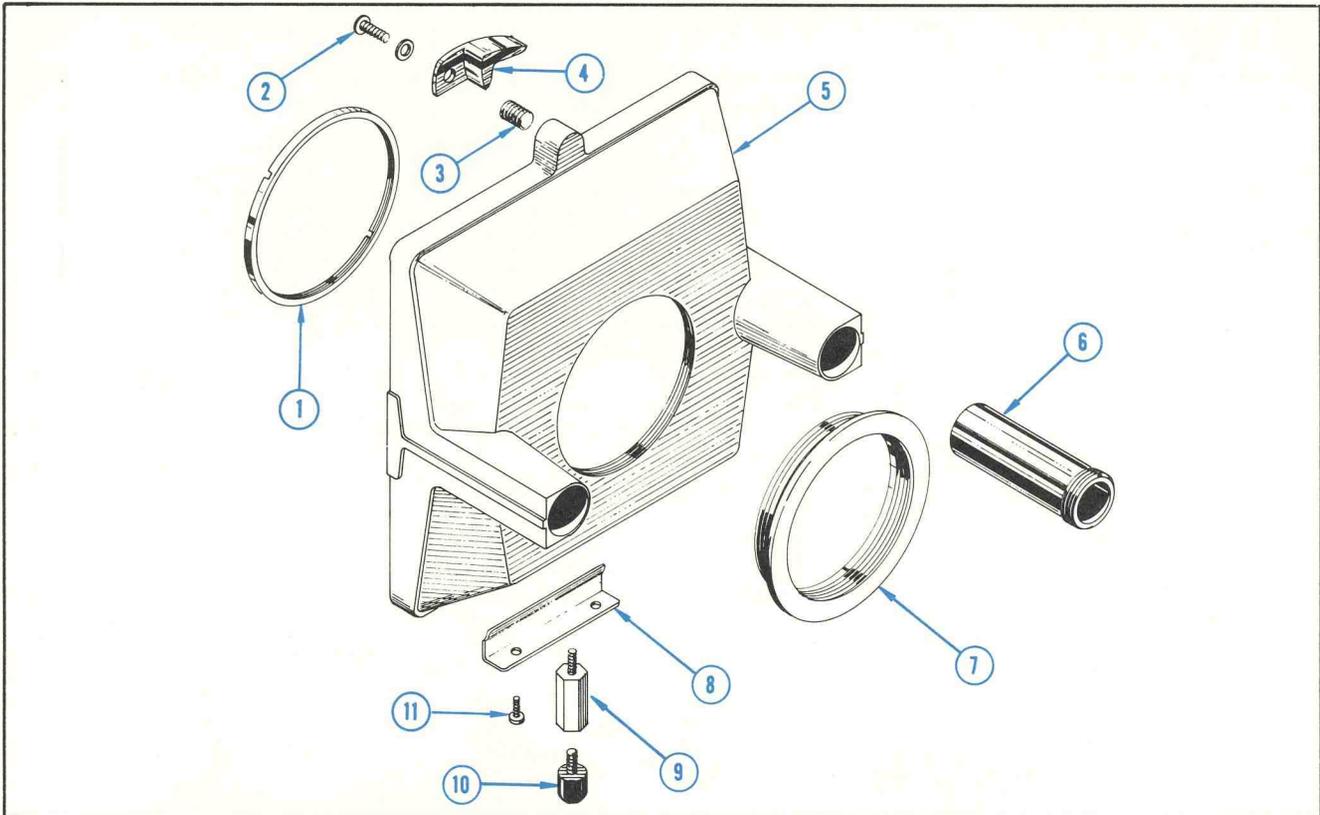
LENSES



LENSES

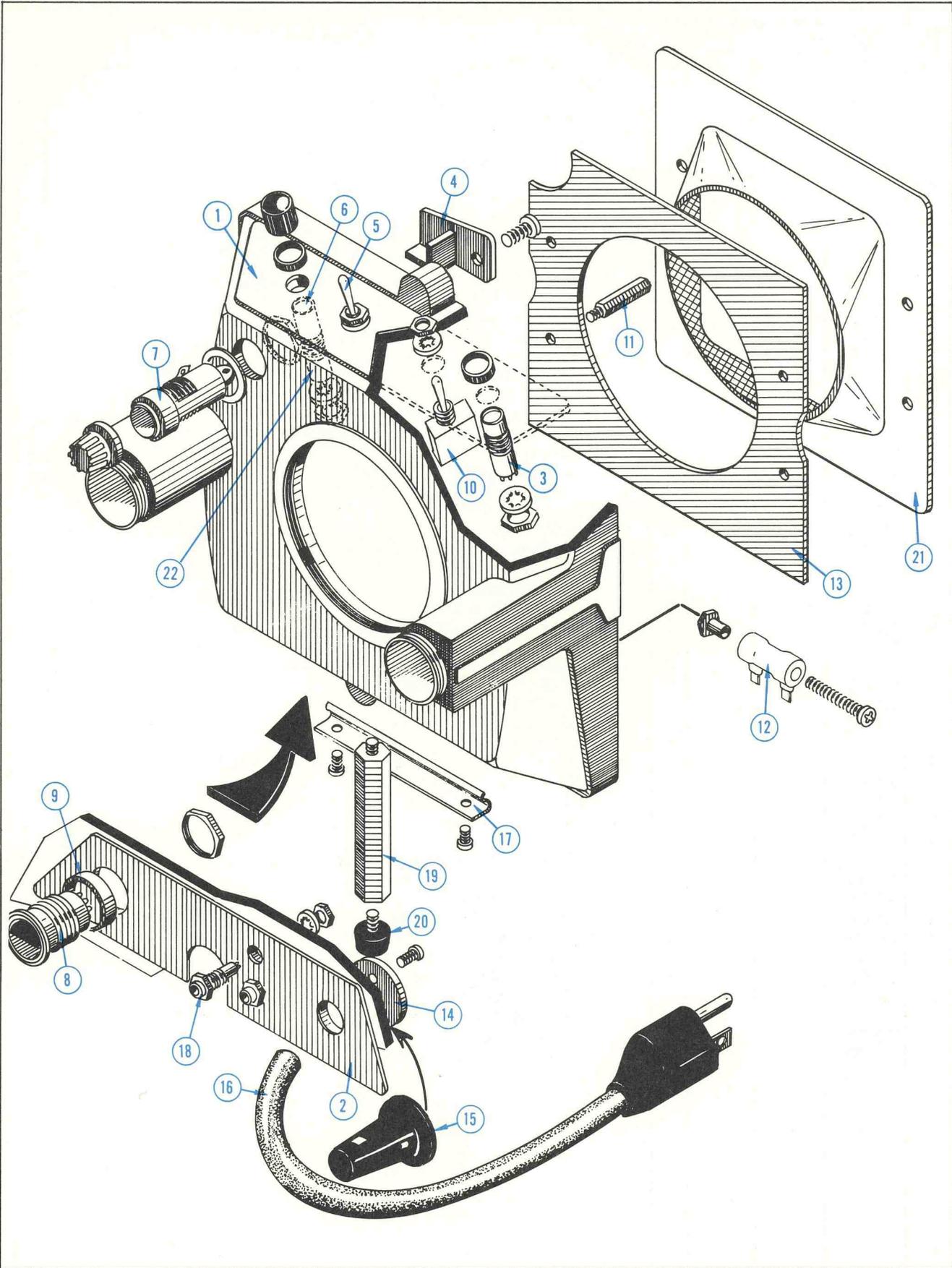
REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	122-662			1	LENS, assembly, f/1.3-1:0.5
	- - -			-	Includes:
	354-111			1	RING, lens spacer, rubber
2	122-549			1	LENS, assembly, f/1.9-1:0.5
	- - -			-	Includes:
	354-111			1	RING, lens spacer, rubber
3	122-692			1	LENS, assembly, f/1.9-1:0.85
	- - -			-	Includes:
	354-111			1	RING, lens spacer, rubber
4	122-608			1	LENS, assembly, f/1.4-1:1
	- - -			-	Includes:
	354-111			1	RING, lens spacer, rubber
5	122-547			1	LENS, assembly, f/1.9-1:0.7
	- - -			-	Includes:
	354-111			1	RING, lens spacer, rubber
6	122-548			1	LENS, assembly, f/1.9-1:0.9
	- - -			-	Includes:
	354-111			1	RING, lens spacer, rubber
7	122-550			1	LENS, assembly, f/4.5-1:0.7
	- - -			-	Includes:
	354-111			1	RING, lens spacer, rubber

STANDARD REAR FRAME



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1-11	*122-565	101	4799	1	ASSEMBLY, rear casting, C-12
	122-591	4800		1	ASSEMBLY, rear casting, C-12
	122-565	101	149	1	ASSEMBLY, rear casting, C-13
	122-591	150		1	ASSEMBLY, rear casting, C-13
	122-565	101	848	1	ASSEMBLY, rear casting, C-19
	122-591	849		1	ASSEMBLY, rear casting, C-19
	122-591			1	ASSEMBLY, rear casting, C-27
	- - - -			-	Includes:
1	- - - -			1	RING, securing
2	212-067			1	SCREW, 8-32 x 3/8 inch, THS
	210-044			1	LOCKWASHER, steel
3	358-108			1	BUSHING, latch
4	214-163			1	LATCH
5	- - - -			1	CASTING, rear
6	- - - -			2	BUSHING, bearing lock
7	- - - -			1	RING, lens mount
8	344-039			1	CLIP, camera back adapter
9	385-153	101	7331	1	ROD, extended foot, C-12
	385-177	7332		1	ROD, extended foot, C-12
	385-153	101	599	1	ROD, extended foot, C-13
	385-177	600		1	ROD, extended foot, C-13
	385-153			1	ROD, extended foot, C-19
	385-177			1	ROD, extended foot, C-27
	10	348-036	101	3493	1
348-048		3494		1	FOOT, rubber, black, C-12
348-036		101	275	1	FOOT, rubber, blue, C-13
348-048		276		1	FOOT, rubber, black, C-13
348-036		101	603	1	FOOT, rubber, blue, C-19
348-048		604		1	FOOT, rubber, black, C-19
348-048				1	FOOT, rubber, black, C-27
11	211-065			2	SCREW, 4-40 x 3/16 inch, PHS

SHUTTER ACTUATOR MODEL 2 POWER SUPPLY FRAME



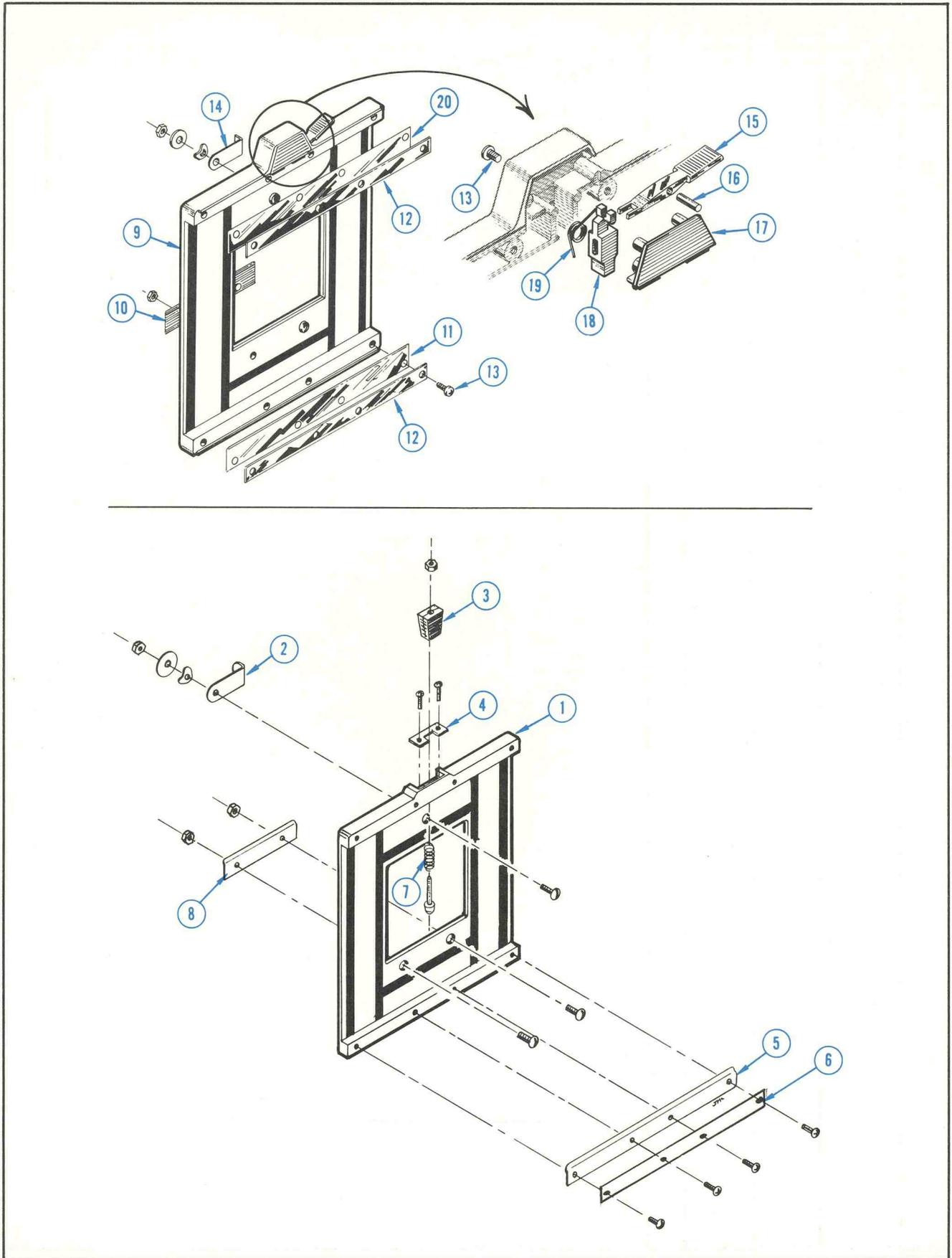
SHUTTER ACTUATOR MODEL 2 POWER SUPPLY FRAME

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
	016-231			1	ASSEMBLY, POWER SUPPLY FRAME, 115 V
	061-237			1	ASSEMBLY, POWER SUPPLY FRAME, 230 V
	- - - -			-	Each Assembly Includes
1	333-832			1	PANEL, top, 115 V
	333-885			1	PANEL, top, 230 V
2	333-833			1	PANEL, bottom, 115 V
	333-886			1	PANEL, bottom, 230 V
3	150-040			1	BULB, assembly, neon
	- - - -			-	Mounting Hardware: (not included w/bulb)
	210-590			1	NUT, hex, $\frac{3}{8}$ -32 x $\frac{7}{16}$ inch
	210-978			1	WASHER, flat, $\frac{3}{8}$ ID x $\frac{1}{2}$ inch OD
	210-012			1	LOCKWASHER, internal, $\frac{3}{8}$ x $\frac{1}{2}$ inch
4	214-163			1	LATCH, camera back
	- - - -			-	Mounting Hardware: (not included w/latch)
	358-108			1	BUSHING, latch
	210-044			2	LOCKWASHER
	212-067			1	SCREW, 8-32 x $\frac{3}{8}$ inch, THS phillips
5	260-614			1	SWITCH, toggle, MOMENTARY-OFF-MAINTAIN
	- - - -			-	Mounting Hardware: (not included w/switch)
	210-046			1	LOCKWASHER, internal tooth
	210-940			1	WASHER, $\frac{1}{4}$ ID x $\frac{3}{8}$ inch OD
	210-562			2	NUT, hex, $\frac{1}{4}$ -40 x $\frac{5}{16}$ inch
6	150-039			1	BULB, assembly, neon
7	352-076			1	HOLDER, fuse
	- - - -			-	Mounting Hardware: (not included w/holder)
	- - - -			1	NUT, fuse holder
	210-873			1	WASHER, rubber
8	131-339			1	CONNECTOR, 6 pin
9	361-073			1	SPACER
10	260-613			1	SWITCH, toggle, ON-OFF
	- - - -			-	Mounting Hardware: (not included w/switch)
	210-046			1	LOCKWASHER, internal tooth
	210-940			1	WASHER, $\frac{1}{4}$ ID x $\frac{3}{8}$ inch OD
	210-562			2	NUT, hex, $\frac{1}{4}$ -40 x $\frac{5}{16}$ inch
11	384-627			4	ROD, spacer shield
12	- - - -			-	Mounting Hardware For Each Resistor: (not included)
	211-544			1	SCREW, 6-32 x $\frac{3}{4}$ inch, THS
	210-478			1	NUT, hex, $\frac{5}{16}$ x $\frac{21}{32}$ inch
13	388-598			1	BOARD, etched circuit
14	214-443			1	COLLAR, cable relief
	- - - -			-	Mounting Hardware: (not included w/collar)
	211-097			2	SCREW, 4-40 x $\frac{5}{16}$ inch, PHS
15	200-578			1	COVER, cable relief
16	161-023			1	CORD, power, 3 conductor
17	344-039			1	CLIP, camera back
	- - - -			-	Mounting Hardware: (not included w/clip)
	211-065			2	SCREW, 4-40 x $\frac{3}{16}$ inch, PHS
18	136-187			2	SOCKET, 1 pin, black
	- - - -			-	Mounting Hardware For Each: (not included w/socket)
	210-046			1	LOCKWASHER
	210-583			1	NUT, hex, $\frac{1}{4}$ -32 x $\frac{5}{16}$ inch

SHUTTER ACTUATOR MODEL 2 POWER SUPPLY FRAME (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
19	385-177			1	ROD, extended foot
20	348-048			1	FOOT, camera back
21	337-647			1	SHIELD
	- - - -			-	Mounting Hardware: (not included w/shield)
	211-565			4	SCREW, 6-32 x 1/4 inch, THS
22	136-164			1	SOCKET, lamp
	- - - -			-	Socket Includes:
	210-413			1	NUT, hex, 3/8-32 x 7/16 inch
	- - - -			-	Mounting Hardware: (not included w/socket)
	210-590			1	NUT, hex, 3/8-32 x 7/16 inch
	210-978			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch

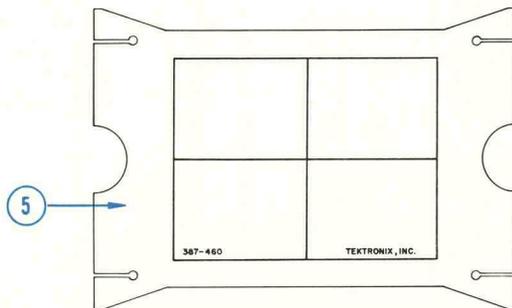
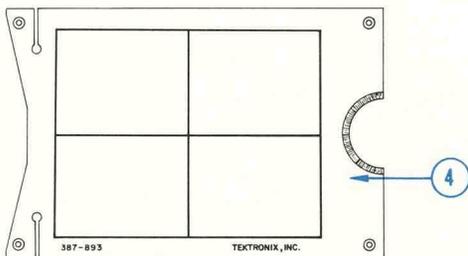
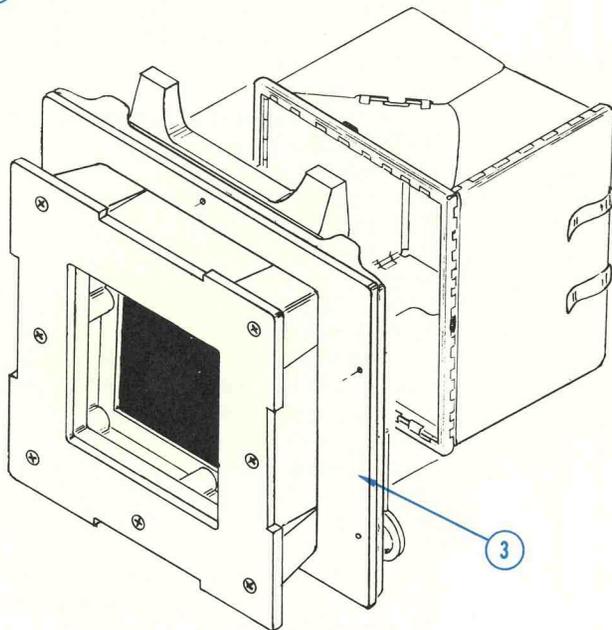
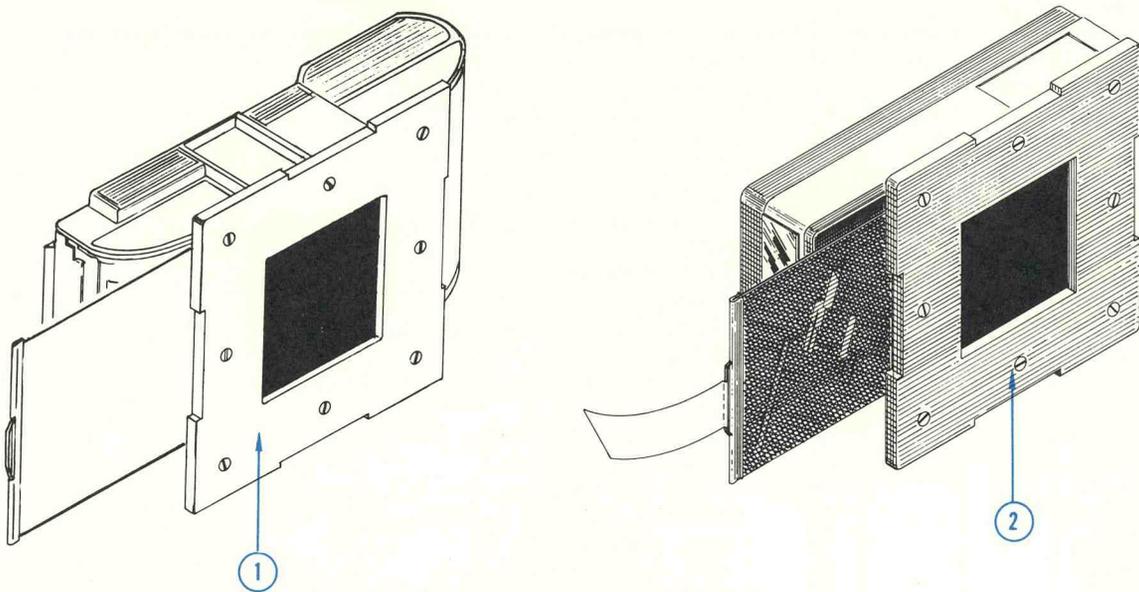
ROTATING SLIDE ADAPTERS



ROTATING SLIDE ADAPTERS

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1-8	122-566	101	3585	1	ADAPTER, rotating slide, C-12
	122-566	101	212	1	ADAPTER, rotating slide, C-13
	122-566	101	567	1	ADAPTER, rotating slide, C-19
	- - - -			-	Includes:
1	- - - -			1	FRAME
2	344-037			1	CLIP, mask
	- - - -			-	Mounting Hardware: (not included w/clip)
	211-008			1	SCREW, 4-40 x 1/4 inch, BHS
	210-044			1	LOCKWASHER, steel
	210-851			1	WASHER, steel, flat, 4L
	210-406			1	NUT, hex, brass, 4-40 x 3/16 inch
3	366-121			1	KNOB, slide lock
	- - - -			-	Mounting Hardware: (not included w/knob)
	214-169			1	PIN, slide lock
	210-405			1	NUT, hex, brass, 2-56 x 3/16 inch
4	387-354			1	PLATE, cover, slide lock
	- - - -			-	Mounting Hardware: (not included w/plate)
	211-069			2	SCREW, 2-56 x 1/8 inch, PHS phillips, chrome
5	344-044			2	CLIP, spring, slide
6	344-040			2	CLIP, slide spring retainer
	- - - -			-	Mounting Hardware For Each: (not included w/clip)
	211-079			4	SCREW, 2-56 x 3/16 inch, OHS phillips, chrome
7	214-167			1	SPRING, slide lock
8	344-038			1	CLIP, mask retainer
	- - - -			-	Mounting Hardware: (not included w/clip)
	211-007			2	SCREW, 4-40 x 3/16 inch, BHS
9-19	122-602	3586		1	ADAPTER, rotating slide, C-12
	122-602	213		1	ADAPTER, rotating slide, C-13
	122-602	568		1	ADAPTER, rotating slide, C-19
	122-602			1	ADAPTER, rotating slide, C-27
	- - - -			-	Includes:
9	- - - -			1	FRAME
10	344-038			1	CLIP, mask retainer
	- - - -			-	Mounting Hardware: (not included w/clip)
	211-008			2	SCREW, 4-40 x 1/4 inch, OHS phillips, chrome
	210-406			2	NUT, hex, brass, 4-40 x 3/16 inch
11	344-078			1	CLIP, spring, slide, bottom
12	344-040			2	CLIP, slide spring retainer
	- - - -			-	Mounting Hardware For Each: (not included w/clip)
	211-079			4	SCREW, 2-56 x 3/16 inch, PHS phillips, chrome
13	344-037			1	CLIP, mask
	- - - -			-	Mounting Hardware: (not included w/clip)
	211-007			1	SCREW, 4-40 x 3/16 inch, OHS phillips, chrome
	210-044			1	LOCKWASHER, steel
	210-851			1	WASHER, steel, flat, 4L
	210-406			1	NUT, hex, brass, 4-40 x 3/16 inch
15	214-249			1	LEVER
16	214-285			1	PIN, lever
17	200-425			1	COVER, detent
18	214-250			1	PIN, slide lock
19	214-286			1	SPRING
20	344-077			1	CLIP, spring, slide, top

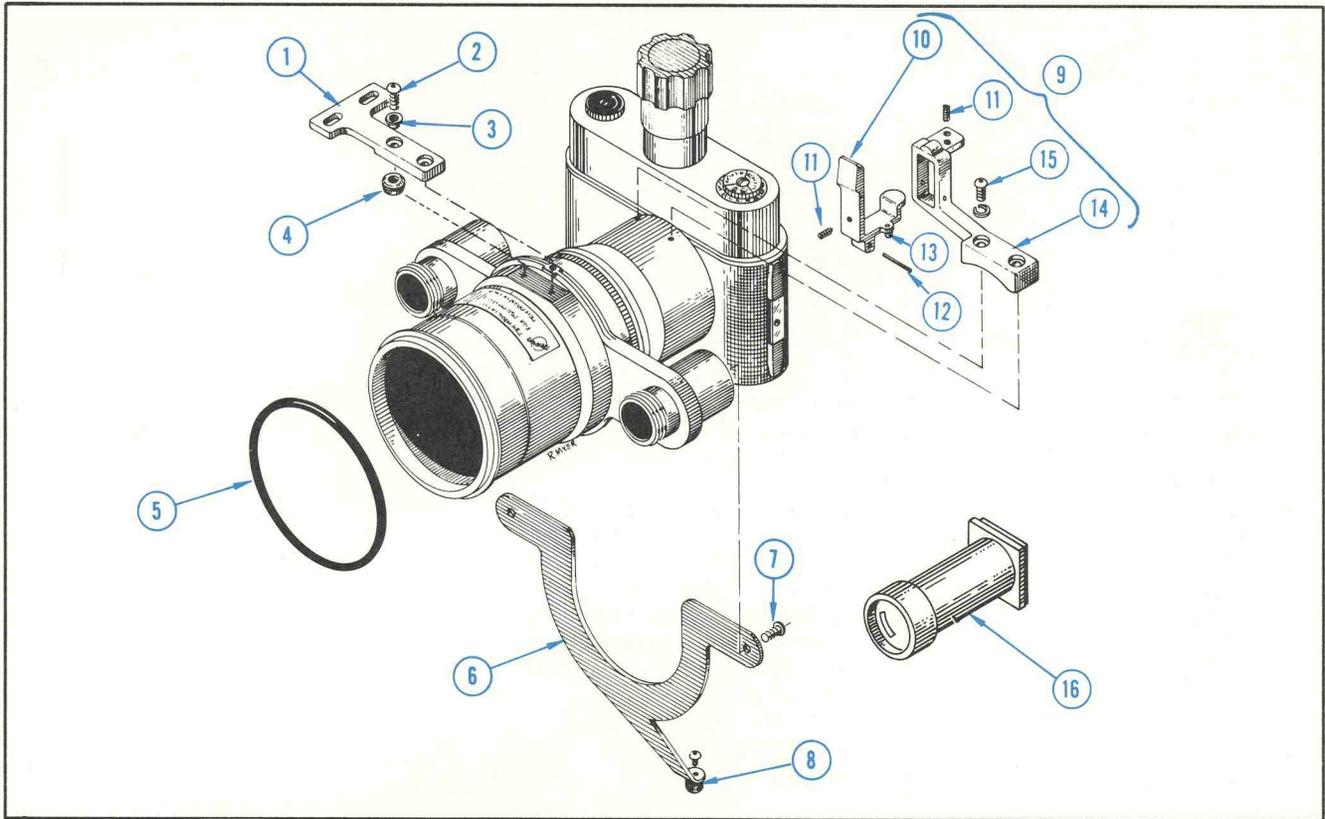
FILM BACKS & FOCUSING PLATES



FILM BACKS & FOCUSING PLATES

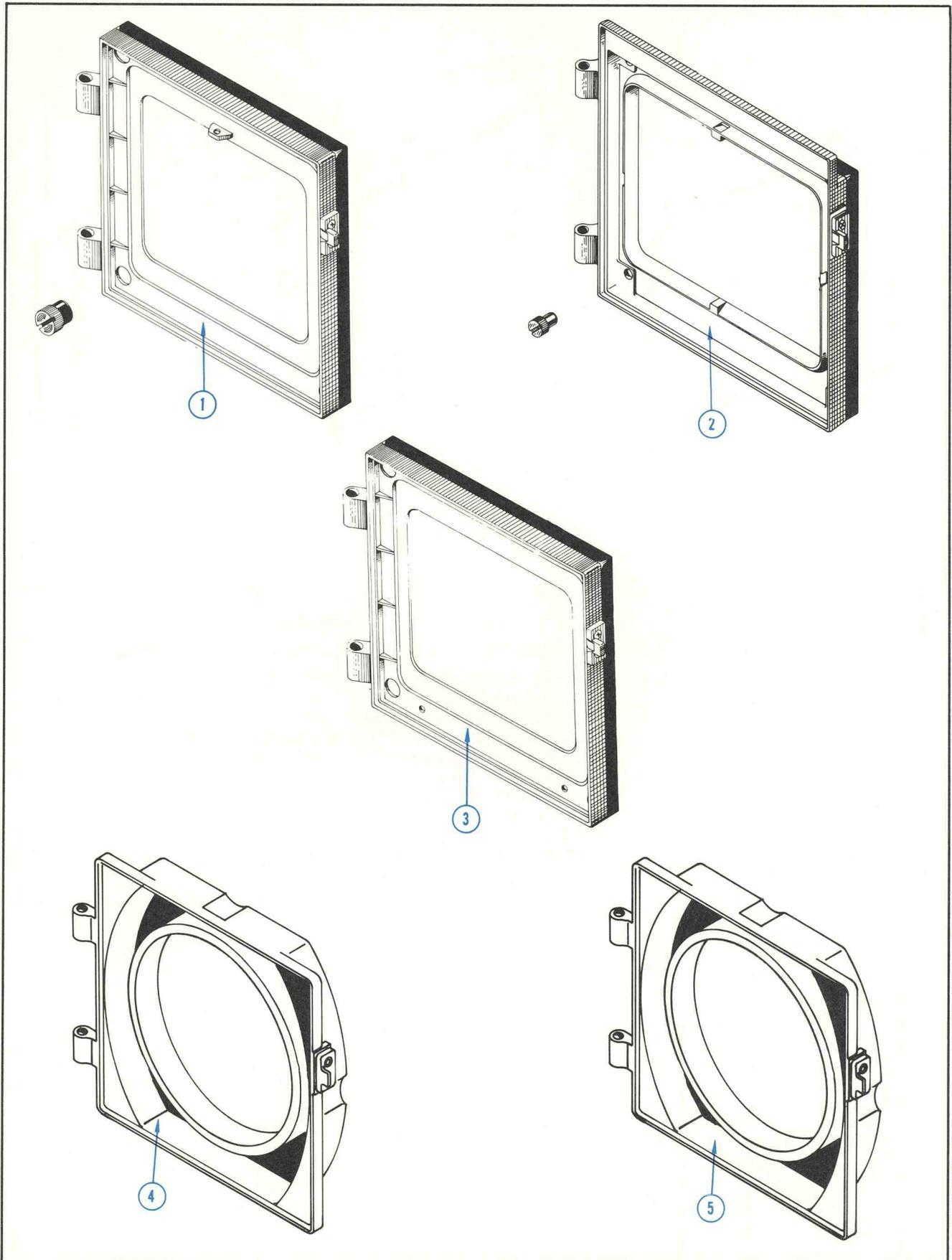
REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	122-556	101	3585	1	ASSEMBLY, Polaroid back, C-12
	122-603	3586		1	ASSEMBLY, Polaroid back, C-12
	122-556	101	212	1	ASSEMBLY, Polaroid back, C-13
	122-603	213		1	ASSEMBLY, Polaroid back, C-13
	122-556	101	567	1	ASSEMBLY, Polaroid back, C-19
	122-603	568		1	ASSEMBLY, Polaroid back, C-19
	122-603			1	ASSEMBLY, Polaroid back, C-27
	- - - -			-	Includes:
122-597			1	DARK SLIDE	
2	122-671			1	ASSEMBLY, Polaroid packback, C-12
	122-671			1	ASSEMBLY, Polaroid packback, C-13
	122-671			1	ASSEMBLY, Polaroid packback, C-19
	122-671			1	ASSEMBLY, Polaroid packback, C-27
	- - - -			-	Includes:
122-597			1	DARK SLIDE	
3	122-557	101	3585	1	ASSEMBLY, Graflok back, C-12
	122-604	3586		1	ASSEMBLY, Graflok back, C-12
	122-557	101	212	1	ASSEMBLY, Graflok back, C-13
	122-604	213		1	ASSEMBLY, Graflok back, C-13
	122-557	101	567	1	ASSEMBLY, Graflok back, C-19
	122-604	568		1	ASSEMBLY, Graflok back, C-19
	122-604			1	ASSEMBLY, Graflok back, C-27
	- - - -			-	Includes:
122-510			1	HOOD, focusing	
4	387-893			1	FOCUSING PLATE
5	387-460			1	FOCUSING PLATE

350 CAMERA ATTACHMENT

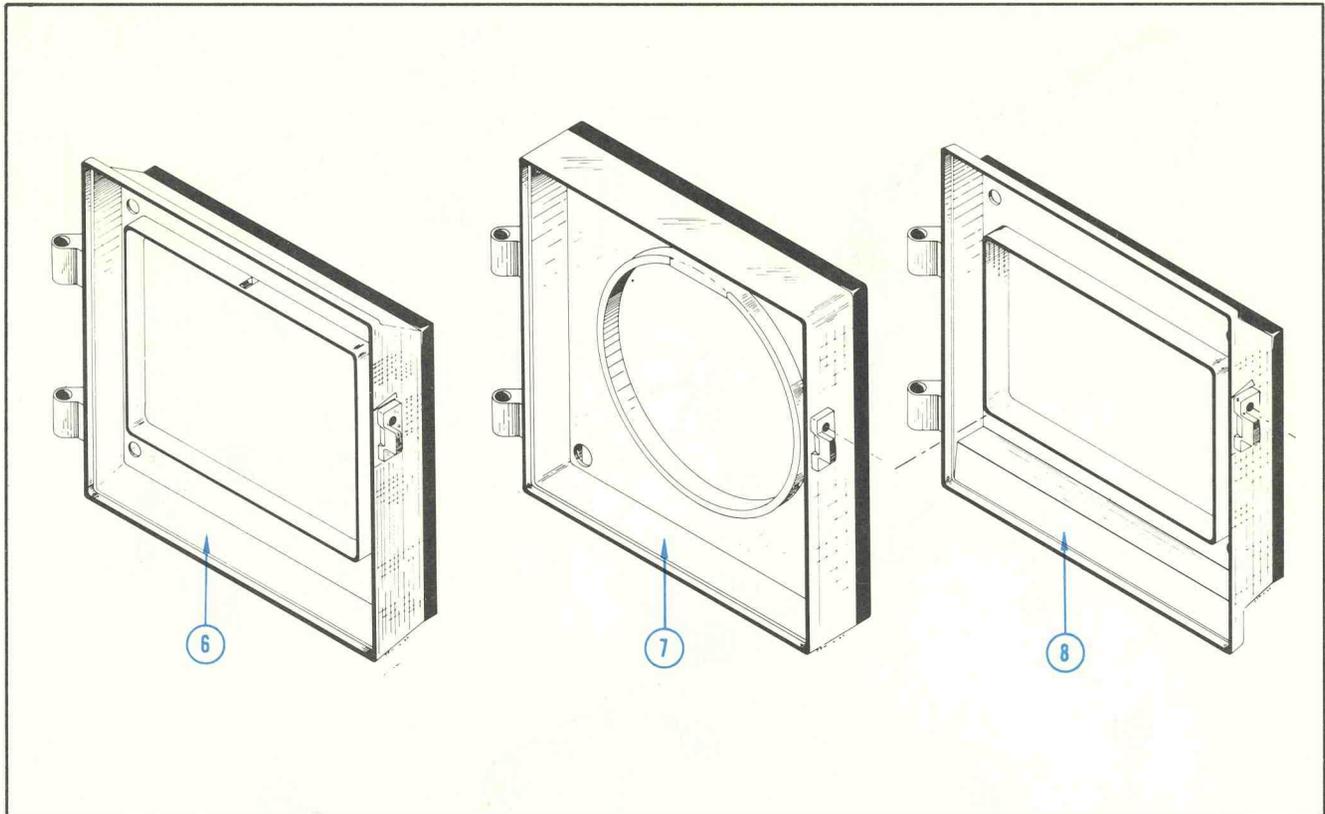


REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
	122-630			1	ASSEMBLY, camera
	- - - -			-	Includes:
1	122-634			1	BRACKET, solenoid mounting
	- - - -			-	Mounting Hardware: (not included w/bracket)
2	211-098			2	SCREW, 4-40 x 3/8 inch button head socket
3	361-062			2	SPACER
4	348-002			2	GROMMET, rubber, 1/4 inch
5	354-111			1	RING, lens spacer, rubber
6	406-942			1	BRACKET, foot, steel
	- - - -			-	Mounting Hardware: (not included w/bracket)
7	212-564			2	SCREW, 10-32 x 1/4 inch button head socket
8	348-025			1	FOOT, rubber
	- - - -			-	Mounting Hardware: (not included w/bracket)
	211-584			1	SCREW, 6-32 x 1/4 inch button head socket
9	122-641			1	ASSEMBLY, shutter trigger
	- - - -			-	Includes:
10	122-617			1	LEVER, release
11	213-126			2	SCREW, set, 6-32 x 1/4 inch HSS
12	214-345			1	PIN, drive, 1/16 inch diameter x 5/8 inch
13	214-342			1	PIN, plunger button
14	122-625			1	BRACKET, release
	- - - -			-	Mounting Hardware: (not included w/bracket)
15	211-098			2	SCREW, 4-40 x 3/8 inch button head socket
	210-007			2	LOCKWASHER, steel, #5 spring
16	122-640			1	ASSEMBLY, magnifier

MOUNTING BEZELS

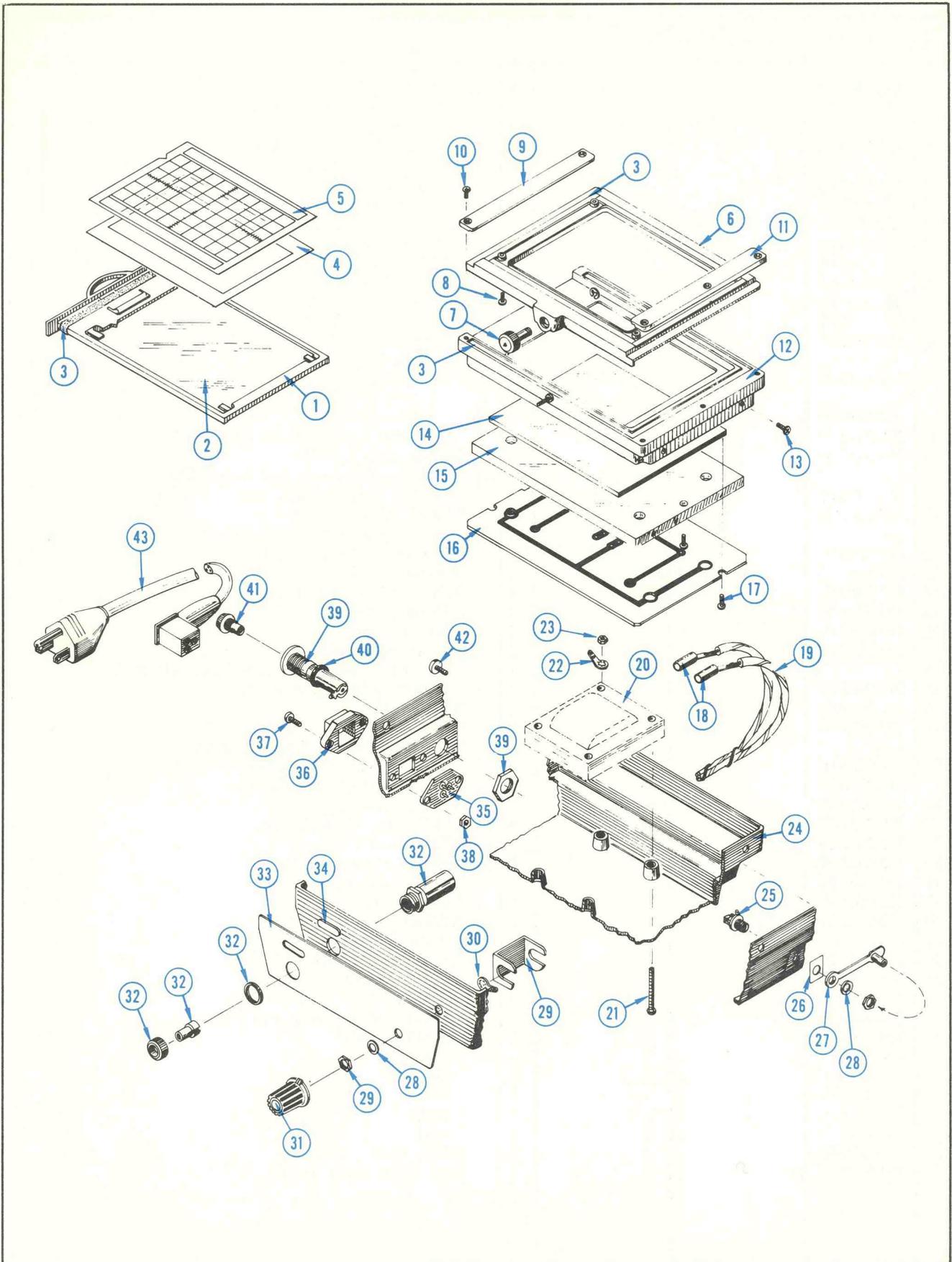


MOUNTING BEZELS



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	016-229			1	ASSEMBLY, camera adapter to oscilloscope made by Hewlett-Packard Co.
-	-			-	
2	016-217			1	ASSEMBLY, camera adapter to 4 x 5 inch rectangular tube
3	016-226			1	ASSEMBLY, camera adapter and holder for polarized viewer
4	016-227			1	ASSEMBLY, camera adapter, C-27 to oscilloscope made by DuMont oscilloscope
-	-			-	
5	016-228			1	ASSEMBLY, camera adapter, C-27 to oscilloscope made by Hewlett-Packard Co.
-	-			-	
6	016-224			1	ASSEMBLY, adapter, camera, 8 x 10 cm for C-27
7	016-225			1	ASSEMBLY, adapter, camera, 10 x 10 cm, for C-27
8	016-223			1	ASSEMBLY, adapter, camera, 6 x 10 cm for C-27

PROJECTED GRATICULE



PROJECTED GRATICULE

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
	016-0204-00			1	ASSEMBLY, projected graticule, 117 v
	016-0234-00			1	ASSEMBLY, projected graticule, 234 v
	- - - - -			-	Each includes:
1	122-0659-00			1	GRATICULE, slide assembly
	- - - - -			-	Includes:
	122-0657-00			1	SLIDE, graticule
2	122-0658-00			1	WINDOW, slide
3	252-0549-00			YD	NYLON, velvet ribbon, black
4	331-0116-00			1	MASK, graticule, 6 x 10 cm
	331-0118-00			1	MASK, graticule, 4 x 10 cm
5	331-0111-00			1	FILM, graticule, 6 x 10 cm
	331-0117-00			1	FILM, graticule, 4 x 10 cm
	331-0119-00			1	FILM, graticule, 8 x 10 cm
6	122-0643-00			1	ADAPTER
	- - - - -			-	Includes:
7	122-0644-00			1	NUT, adjustment
	- - - - -			-	Mounting Hardware: (not included w/nut)
	334-0219-00			1	RETAINER
8	213-0123-00			4	SCREW, 6-32 x 3/8 inch, FHS
9	122-0647-00			1	SPRING, slide
	- - - - -			-	Mounting Hardware: (not included w/spring)
10	213-0078-00			2	SCREW, 4-24 x 3/8 inch, FHS
11	122-0661-00			1	SPRING, slide, 3 hole
	- - - - -			-	Mounting Hardware: (not included w/spring)
	213-0078-00			3	SCREW, 4-24 x 3/8 inch, FHS
12	122-0646-00			1	HOUSING, slide
13	211-0565-00			4	SCREW, 6-32 x 1/4 inch, THS
14	122-0646-00			1	DIFFUSER, light
15	122-0650-00			1	LIGHTPIPE
16	122-0654-00			1	BOARD, lamp mounting
	- - - - -			-	Mounting Hardware: (not included w/board)
17	211-0079-00			4	SCREW, 2-56 x 3/16 inch, PHS
18	131-0330-00			2	RECEPTACLE, pin
19	179-0819-00			1	CABLE
20	- - - - -			-	Mounting Hardware For Transformer:
21	211-0585-00			4	SCREW, 6-32 x 1 inch, PHS
	210-0006-00			3	LOCKWASHER, internal, #6
22	210-0202-00			1	LUG, solder, #6
23	210-0407-00			4	NUT, hex, 6-32 x 1/4 inch
24	122-0656-00			1	BOX, control
25	136-0094-00			1	SOCKET, miniature, w/nut
26	334-0869-00			1	TAG, counter output
27	122-0660-00			1	PLUG, counter jack
28	210-0940-00			2	WASHER, steel, 1/4 inch ID
29	- - - - -			1	Rheostat bracket w/nut
30	210-0223-00			1	LUG, solder, 1/4 inch ID
31	366-0225-00			1	KNOB, charcoal
	- - - - -			-	Includes:
	213-0020-00			1	SCREW, set 6-32 x 1/8 inch, HHS
32	260-0581-00			1	ASSEMBLY, switch
	- - - - -			-	Includes:
	- - - - -			1	SWITCH
	- - - - -			1	NUT
	- - - - -			1	LENS
	- - - - -			1	NUT
33	333-0778-00			1	PANEL, front
34	334-0829-00			1	TAG, metal, blank insert

PROJECTED GRATICULE (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
35	136-167			1	SOCKET, 3 pin
	- - - -			-	Mounting Hardware: (not included w/socket)
36	380-047			1	HOUSING, 3 pin socket
37	211-512			2	SCREW, 6-32 x 1/2 inch, FHS
38	210-457			2	NUT, keps, 6-32 x 5/16 inch
39	352-010			1	HOLDER, fuse, w/nut
40	210-873			1	WASHER, rubber
41	200-582			1	CAP, fuse holder
42	348-048			1	FOOT, rubber
43	161-015			1	CORD, power, 8 feet

PROJECTED GRATICULE ELECTRICAL PARTS LIST

Ckt. No.	Tektronix Part No.	Description	S/N Range
----------	--------------------	-------------	-----------

Bulbs

B1	150-036	Incandescent, #345	Pilot Light
B2	150-029	Incandescent, #349	Graticule Light
B3	150-029	Incandescent, #349	Graticule Light
B4	150-029	Incandescent, #349	Graticule Light
B5	150-029	Incandescent, #349	Graticule Light

Fuses

F1	159-048	1/10 Amp, Slo-Blo, 117 v operation, 50 and 60 cycle
F1	159-051	1/16 Amp, Slo-Blo, 234 v operation, 50 and 60 cycle

Resistor

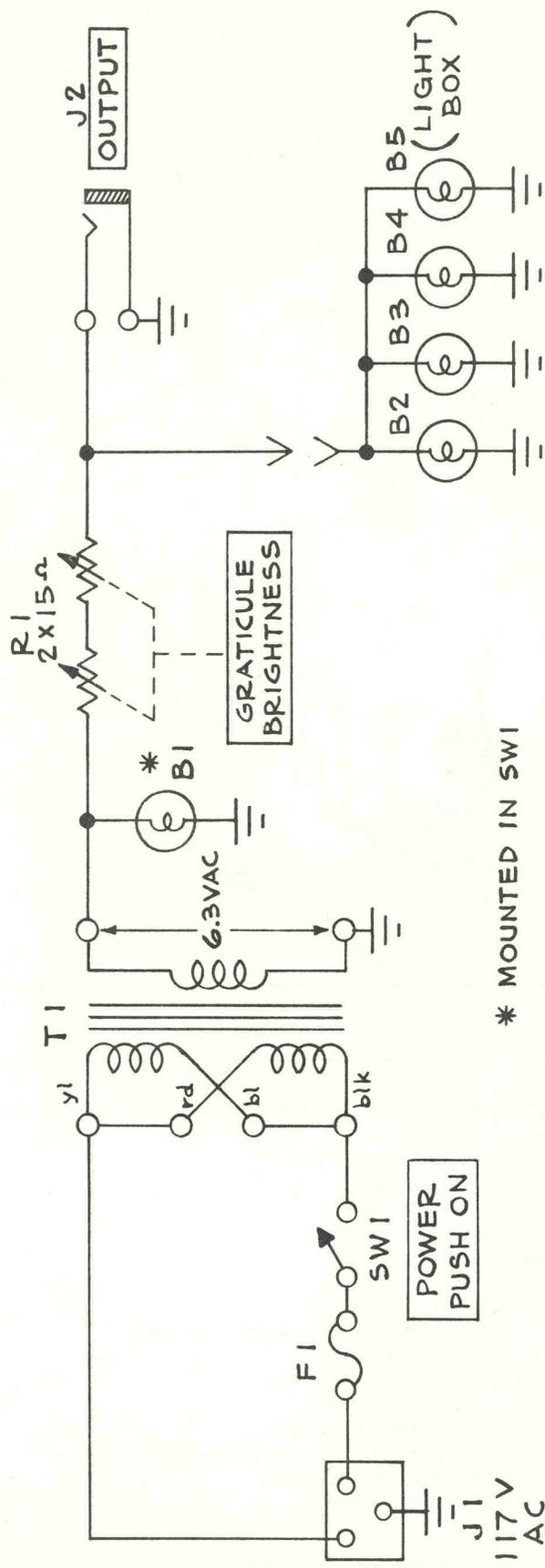
R1	311-427	2 x 15 Ω	12.5 w	Var	WW	GRATICULE BRIGHTNESS
----	---------	----------	--------	-----	----	----------------------

Switch

	Unwired	Wired		
SW1	260-581		Push-Button	POWER

Transformer

T1	*120-328	Power
----	----------	-------

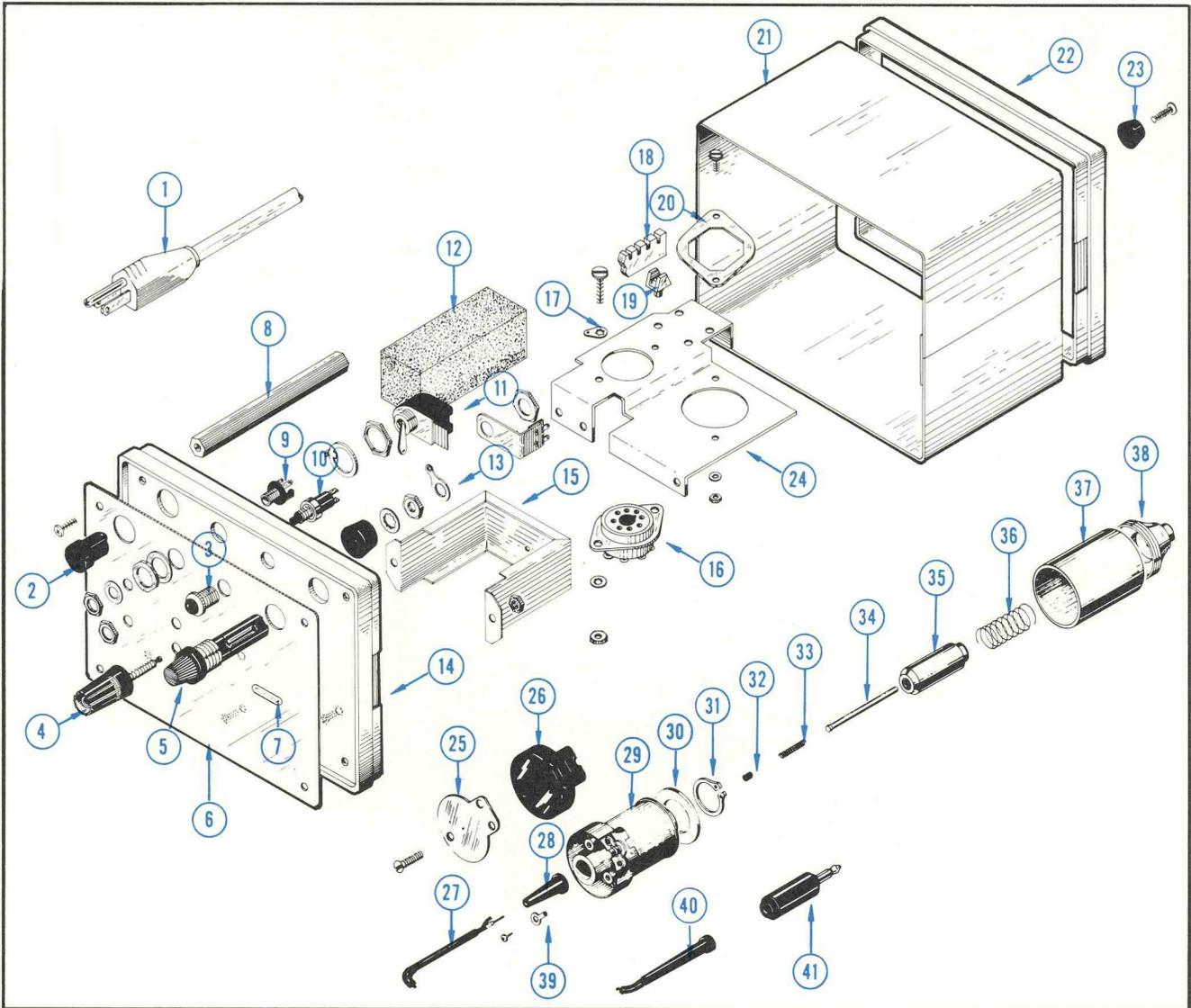


* MOUNTED IN SW1

763

PROJECTED GRATICULE

SHUTTER ACTUATOR MODEL 1 POWER SUPPLY & SOLENOID



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1-24	016-213			1	SHUTTER ACTUATOR POWER SUPPLY
-	-			-	Includes:
1	161-015			1	CORD, power, 20 ga., 8 feet
2	358-161			1	BUSHING, strain relief
3	136-047			1	SOCKET, light, red jewel
-	-			-	Includes:
-	-			1	BRACKET
-	-			1	NUT
4	129-036			1	POST, binding
-	-			-	Mounting Hardware: (not included w/post)
-	358-036			1	BUSHING, nylon
-	210-010			1	LOCKWASHER, internal #10
-	210-445			2	NUT, hex, 10-32 x 3/8 inch
-	129-055			1	POST, binding, red (not shown)
-	-			-	Mounting Hardware: (not included w/post)
-	210-010			1	LOCKWASHER, internal #10
-	210-445			2	NUT, hex, 10-32 x 3/8 inch
5	352-014			1	HOLDER, fuse

SHUTTER ACTUATOR MODEL 1 POWER SUPPLY & SOLENOID (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
6	333-691			1	PANEL, front
	- - - -			-	Mounting Hardware: (not included w/panel)
	211-071			4	SCREW, 4-40 x $\frac{3}{8}$ inch, PHS phillips
7	334-679			1	TAG, metal, serial number
8	384-588			3	ROD, spacer
9	136-094			1	SOCKET, miniature jack
	- - - -			-	Mounting Hardware: (not included w/socket)
	210-940			1	WASHER, $\frac{1}{4}$ ID x $\frac{3}{8}$ inch OD
	210-583			1	NUT, hex, $\frac{5}{16}$ inch
10	260-247			1	SWITCH, push button
	- - - -			-	Mounting Hardware: (not included w/switch)
	210-465			1	NUT, hex, $\frac{1}{4}$ -32 x $\frac{3}{32}$ inch
11	260-134			1	SWITCH, toggle
	- - - -			-	Mounting Hardware: (not included w/switch)
	210-473			1	NUT, switch, $\frac{15}{32}$ -32 x $\frac{5}{64}$ inch
	210-902			1	WASHER, flat
	354-055			1	RING, locking, switch
	210-414			1	NUT, hex, $\frac{15}{32}$ -32 x $\frac{9}{16}$ inch
12	348-047			1	CUSHION, relay
13	210-206			2	LUG, solder, long
14	200-350			1	COVER, top
	- - - -			-	Mounting Hardware: (not included w/cover)
	211-038			2	SCREW, 4-40 x $\frac{5}{16}$ inch, FHS
15	406-129			1	BRACKET, transformer mounting
	- - - -			-	Mounting Hardware: (not included w/bracket)
	211-538			2	SCREW, 6-32 x $\frac{5}{16}$ inch, FHS phillips
	210-457			2	NUT, keps, 6-32 x $\frac{5}{16}$ inch
16	136-013			1	SOCKET
	- - - -			-	Mounting Hardware: (not included w/socket)
	211-534			2	SCREW, 6-32 x $\frac{5}{16}$ inch, PHS
	210-006			2	LOCKWASHER, internal #6
	210-407			2	NUT, hex, 6-32 x $\frac{1}{4}$ inch
17	210-202			1	LUG, solder
18	124-149			2	STRIP, ceramic, $\frac{3}{4}$ inch x 7 notch
	- - - -			-	Each Includes:
	355-046			2	STUD, nylon
	- - - -			-	Mounting Hardware For Each:
19	361-007			2	SPACER, nylon
20	386-255			1	PLATE, capacitor mounting
	- - - -			-	Mounting Hardware: (not included w/plate)
	211-033			2	SCREW, 4-40 x $\frac{5}{16}$ inch, RHS
	210-004			2	LOCKWASHER, internal #4
	210-406			2	NUT, hex, 4-40 x $\frac{3}{16}$ inch
21	380-031			1	HOUSING, wrap-around
22	200-309			1	COVER, box
23	348-037			4	FOOT, rubber
	- - - -			-	Mounting Hardware: (not included w/foot)
	211-012			4	SCREW, 4-40 x $\frac{3}{8}$ inch, BHS
24	406-749			1	BRACKET, power supply
	179-603			1	CABLE HARNESS (not shown)
25-41	016-211			1	SHUTTER ACTUATOR SOLENOID
	- - - -			-	Includes:
25	334-805			1	TAG, name
	- - - -			-	Mounting Hardware: (not included w/tag)
	211-015			3	SCREW, 4-40 x $\frac{1}{2}$ inch, RHS
26	200-351			1	COVER, coil form, black
27	175-068			FT	CABLE, coax, 50 Ω , 48 inches

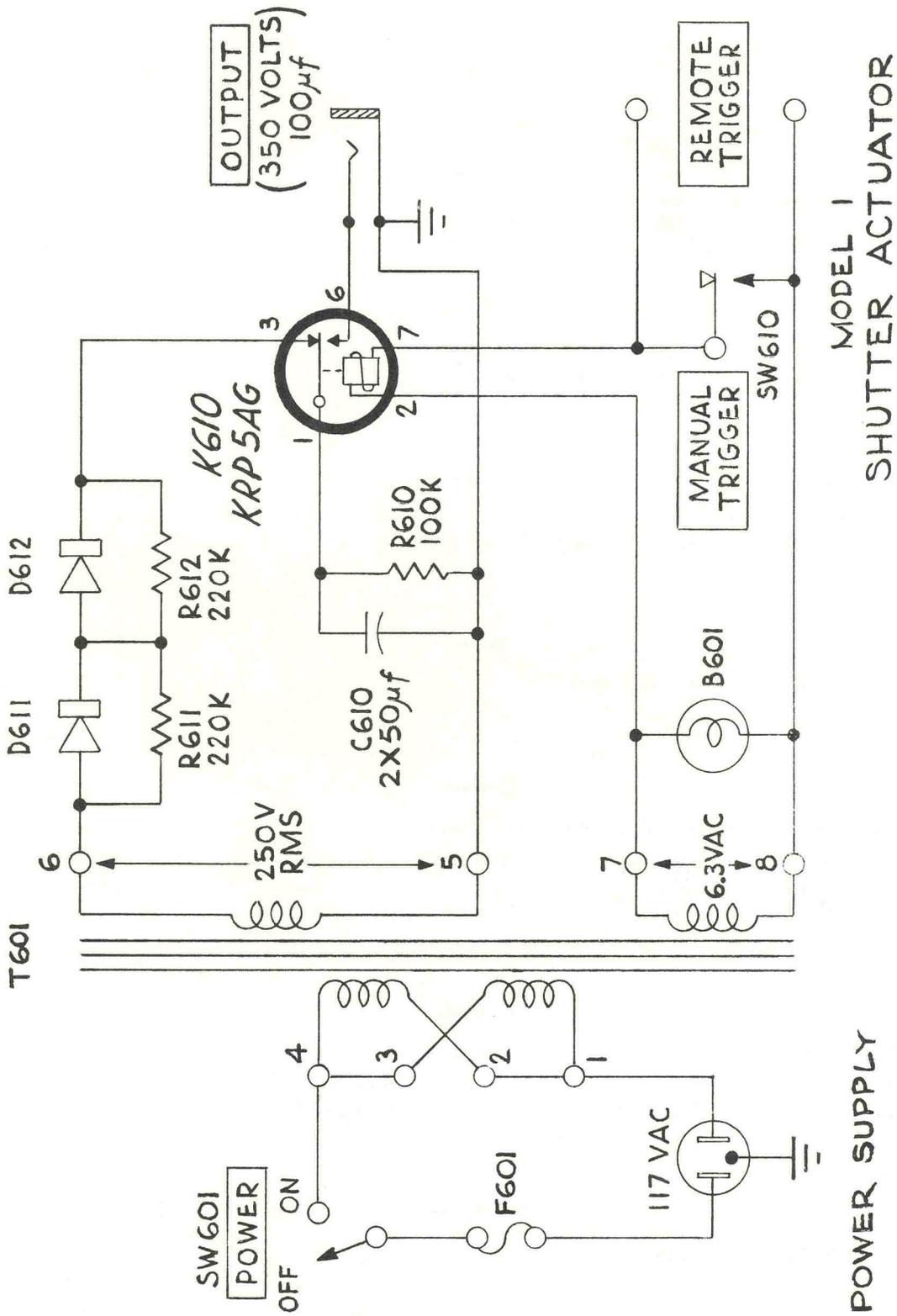
Parts List—Camera System

SHUTTER ACTUATOR MODEL 1 POWER SUPPLY & SOLENOID (Cont'd)

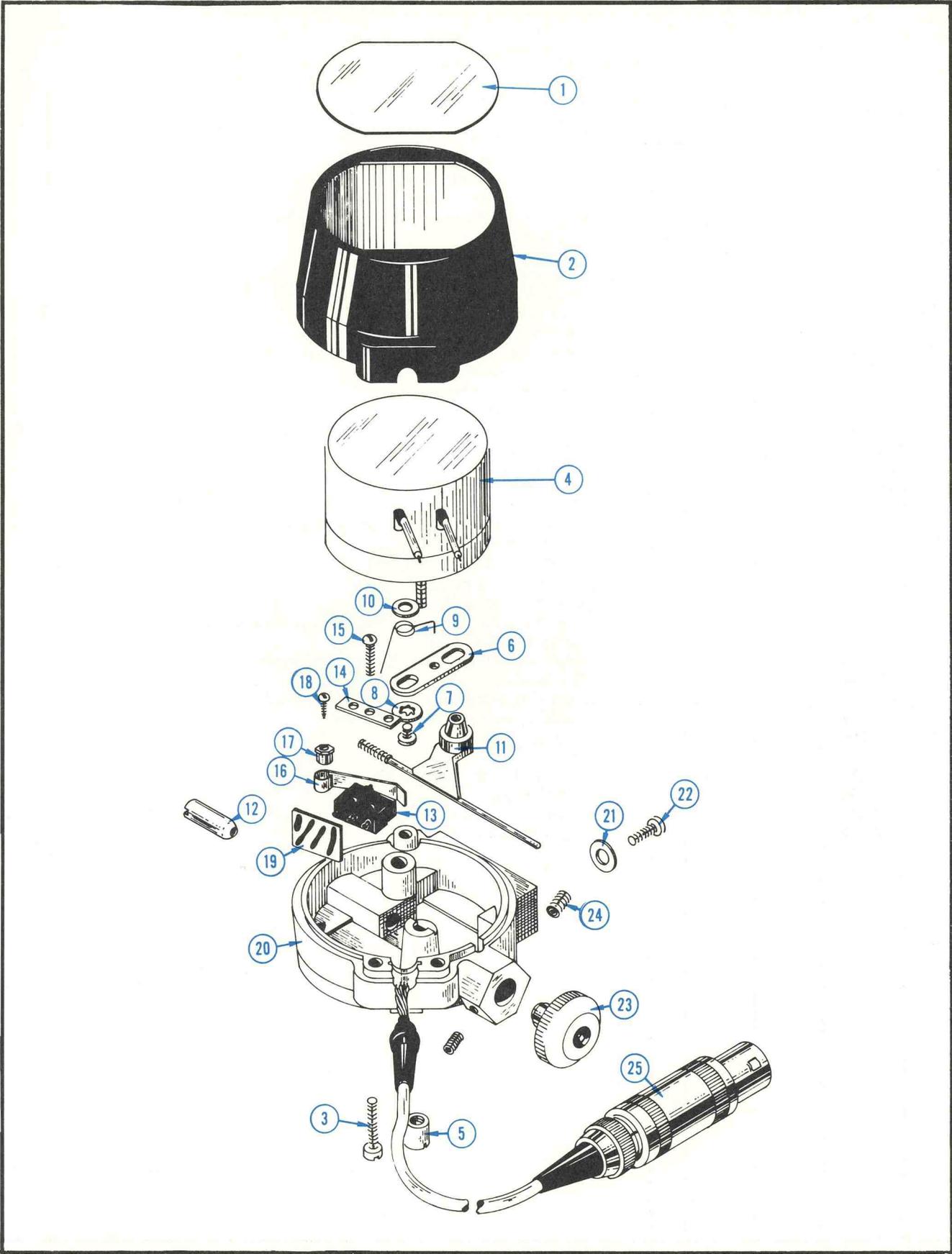
REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
28	200-352			1	COVER, strain relief, cable, 3/4 inch long
29	108-239			1	COIL, fixed, 4500 turns, 820 μh
	- - - -			-	Includes:
	210-215			2	LUG, pee wee
	213-055			2	SCREW, 2-56 x 3/16 inch PHS
30	210-950			1	WASHER
31	354-158			1	RING
32	213-005			1	SCREW, set, 8-32 x 1/8 inch, HSS
33	214-224			1	SPRING, return
34	214-223			1	PLUNGER, delrin
35	276-531			1	CORE, steel, 1.187 inches long
36	214-225			1	SPRING, shock
37	380-038			1	HOUSING
38	200-399			1	CAP, camera solenoid
39	210-215			2	LUG, pee wee
40	200-353			1	COVER, strain relief, cable, 1 5/8 inches long
41	134-051			1	PLUG, miniature

SHUTTER ACTUATOR MODEL 1 ELECTRICAL PARTS LIST

Ckt. No.	Tektronix Part No.	Description	Model No.
Bulb			
B610	150-018	Incandescent, #12	
Capacitor			
C610	290-163	2 x 50 μ f EMT	450 v
Diodes			
D611	*152-047	Replaceable by 1N2862	
D612	*152-047	Replaceable by 1N2862	
Fuses			
F601	159-044	0.2 Amp, Slo-Blo, 117 volt operation	
F601	159-048	0.1 Amp, Slo-Blo, 234 volt operation	
Relay			
K610	148-018	6 v AC SPDT	
Resistors			
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.			
R610	306-104	100 k	2 w 5%
R611	301-224	220 k	$\frac{1}{2}$ w 5%
R612	301-224	220 k	$\frac{1}{2}$ w 5%
Switches			
	Unwired	Wired	
SW601	260-134		Toggel POWER
SW610	260-247		Push-Button MANUAL TRIGGER
Transformer			
T601	*120-237	Power	



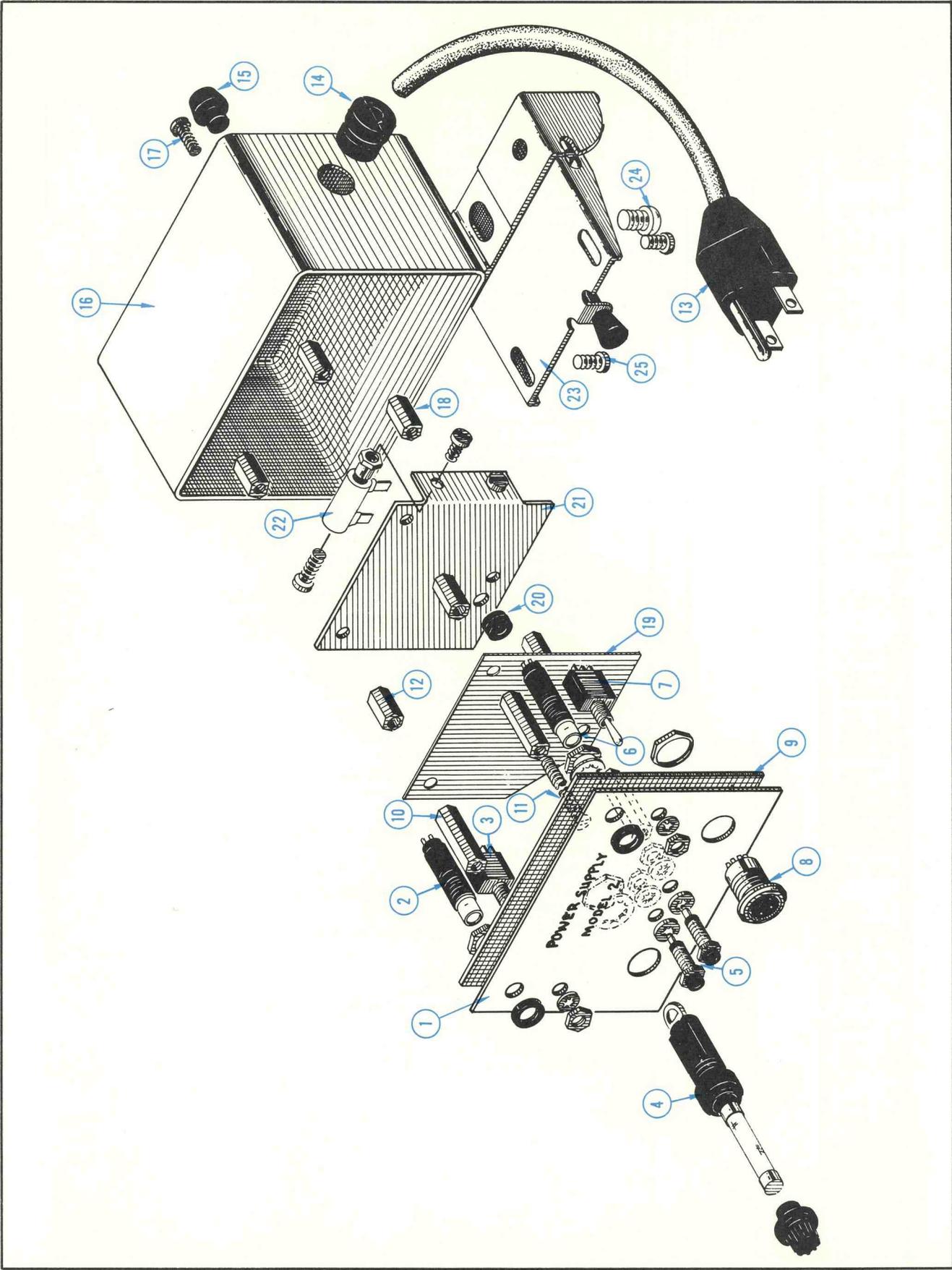
SHUTTER ACTUATOR MODEL 2 ROTARY SOLENOID



SHUTTER ACTUATOR MODEL 2 ROTARY SOLENOID

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
	016-218			1	ASSEMBLY, ROTARY SOLENOID SHUTTER ACTUATOR, 115 V
	016-235			1	ASSEMBLY, ROTARY SOLENOID SHUTTER ACTUATOR, 230 V
	- - - -			-	Each Assembly Includes:
1	334-895			1	TAG, name plate, 115 V
	334-937			1	TAG, name plate, 230 V
2	200-581			1	COVER, rotary solenoid
	- - - -			-	Mounting Hardware: (not included w/cover)
3	211-061			3	SCREW, 4-40 x 1/2 inch, Fil HS
4	- - - -			-	Mounting Hardware: (not included w/solenoid)
5	214-444			2	NUT, securing
6	387-943			1	PLATE, arm actuator
	- - - -			-	Mounting Hardware: (not included w/plate)
7	211-007			1	SCREW, 4-40 x 3/16 inch, BHS
8	210-004			1	LOCKWASHER, internal, #4
9	214-446			1	SPRING, rotary solenoid
10	210-973			1	WASHER, .225 ID x .012 inch, brass
11	214-445			1	PLUNGER, pin assembly
12	214-447			1	PLUNGER, actuator
13	260-612			1	SWITCH, micro
	- - - -			-	Mounting Hardware: (not included w/switch)
14	387-942			1	PLATE, ground
15	211-107			2	SCREW, 1-72 x 5/16 inch, RHS
	210-052			2	WASHER, split, #1
16	214-449			1	SPRING, actuator
	- - - -			-	Mounting Hardware: (not included w/spring)
17	358-240			1	BUSHING, pivot
18	211-107			1	SCREW, 1-72 x 5/16 inch, RHS
19	388-600			1	BOARD, etched circuit
20	426-238			1	HOUSING, solenoid
	- - - -			-	Mounting Hardware: (not included w/housing)
21	210-956			2	WASHER, #4, steel
22	211-098			2	SCREW, 4-40 x 3/8 inch, button head socket
23	214-448			1	NUT, revolving
	- - - -			-	Mounting Hardware: (not included w/nut)
24	213-004			2	SCREW, set, 6-32 x 3/16 inch, HHS
25	175-298			1	ASSEMBLY, cable
	- - - -			-	Includes:
	131-338			1	CONNECTOR, cable, 6 pin
	200-580			1	COVER, cable relief, long
	175-299			FT	CABLE, 7 conductor, twisted (23 inches)
	200-579			1	COVER, cable relief, short

SHUTTER ACTUATOR MODEL 2 POWER SUPPLY



SHUTTER ACTUATOR MODEL 2 POWER SUPPLY

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
	016-230			1	ASSEMBLY, SHUTTER ACTUATOR POWER SUPPLY, 115 V
	016-236			1	ASSEMBLY, SHUTTER ACTUATOR POWER SUPPLY, 230 V
	- - - -			-	Each Assembly Includes:
1	333-850			1	PANEL, front, 115 V
	333-884			1	PANEL, front, 230 V
2	150-040			1	BULB, assembly, neon
	- - - -			-	Mounting Hardware: (not included w/bulb)
	210-590			1	NUT, hex, 3/8-32 x 7/16 inch
	210-978			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
3	260-613			1	SWITCH, toggle, ON-OFF
	- - - -			-	Mounting Hardware: (not included w/switch)
	210-046			1	LOCKWASHER, internal tooth
	210-940			1	WASHER, 1/4 ID x 3/8 inch OD
	210-562			2	NUT, hex, 1/4-40 x 5/16 inch
4	352-076			1	HOLDER, fuse
	- - - -			-	Mounting Hardware: (not included w/holder)
	- - - -			1	NUT
5	136-187			2	SOCKET, 1 pin, black
	- - - -			-	Mounting Hardware For Each: (not included w/socket)
	210-046			1	LOCKWASHER, internal tooth
	210-583			1	NUT, hex, 1/4-32 x 1/6 inch thick, double chamfer
6	150-041			1	BULB, assembly, neon
	- - - -			-	Mounting Hardware: (not included w/bulb)
	210-590			1	NUT, hex, 3/8-32 x 7/16 inch
	210-978			1	WASHER, flat, 3/8 ID x 1/2 inch OD
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
7	260-614			1	SWITCH, toggle, MOMENTARY-OFF-MAINTAIN
	- - - -			-	Mounting Hardware: (not included w/switch)
	210-046			1	LOCKWASHER, internal tooth
	210-940			1	WASHER, 1/4 ID x 3/8 inch OD
	210-562			2	NUT, hex, 1/4-40 x 5/16 inch
8	131-339			1	CONNECTOR, 6 pin
9	387-961			1	PLATE, sub-panel
	354-239			1	RING, ornamental (not shown)
10	361-075			3	SPACER, hex, stud mounting
11	179-934			1	CABLE HARNESS, chassis (not shown)
12	361-077			3	SPACER, hex, middle
13	161-023			1	CORD, power, 3 conductor
14	358-161			1	BUSHING, strain relief
15	348-013			4	FOOT, rubber
16	202-130			1	BOX, power supply
	- - - -			-	Mounting Hardware: (not included w/box)
17	211-504			3	SCREW, 6-32 x 1/4 inch, BHS
18	361-076			3	SPACER, hex, .650 inch long, bottom
19	388-602			1	BOARD, etched circuit
20	348-002			1	GROMMET, rubber, 1/4 inch
21	407-044			1	BRACKET, resistor mounting
22	- - - -			-	Mounting Hardware For Each Resistor: (not included)
	210-478			1	NUT, hex, 5/16 x 2 1/32 inch
	211-504			1	SCREW, 6-32 x 1/4 inch, BHS
	211-544			1	SCREW, 6-32 x 3/4 inch, THS

SHUTTER ACTUATOR MODEL 2 POWER SUPPLY (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
23	122-713			1	ASSEMBLY, power supply mounting bracket (See Ref. #24)
	- - - -			-	Includes:
	214-479			1	SPRING, mounting bracket
	214-480			1	PIN, guide
	214-481			1	PIN, hinge
	214-482			1	PIN, locking
	384-327			1	ROD, hinge release
	407-057			1	BRACKET, mounting
	407-058			1	BRACKET, hinge
	213-108			1	SCREW, 1/4-20 x 3/8 inch, RHS
24	- - - -			-	Mounting Hardware: (not included w/assembly alone)
25	212-069			2	SCREW, 8-32 x 1/4 inch, THS

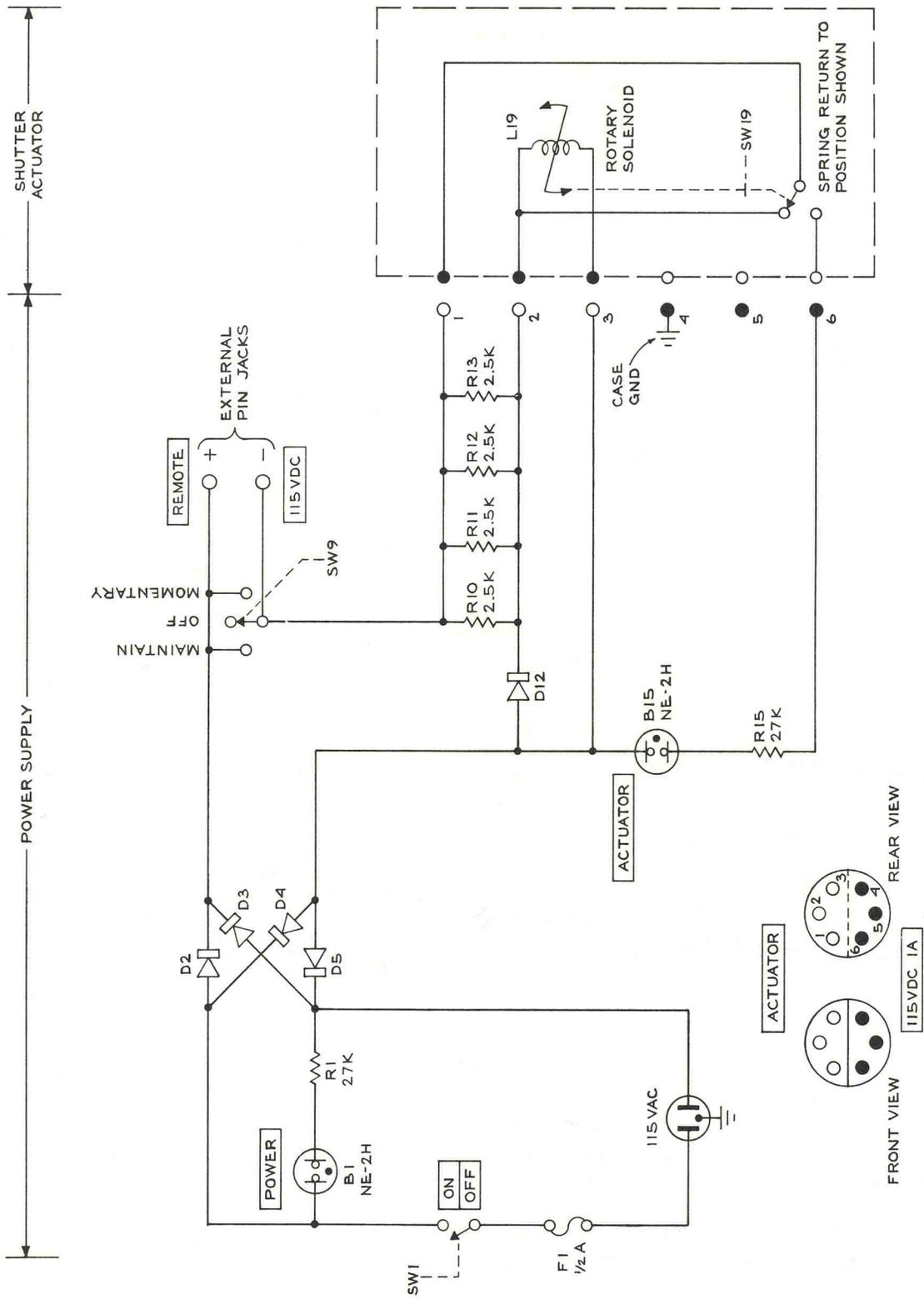
Parts List—Camera System

SHUTTER ACTUATOR MODEL 2 ELECTRICAL PARTS LIST
(115-VOLT)

Ckt. No.	Tektronix Part No.	Description	Model No.
Bulbs			
B1	150-040	Neon NE-2H POWER	
B15*	150-039	Neon NE-2H ACTUATOR	
B15**	150-041	Neon NE-2H ACTUATOR	
Diodes			
D2	152-066	Silicon 1N3194	
D3	152-066	Silicon 1N3194	
D4	152-066	Silicon 1N3194	
D5	152-066	Silicon 1N3194	
D12	152-066	Silicon 1N3194	
Fuse			
F1	159-032	.5 Amp 3AG Slo-Blo	
Inductor			
L19	119-032	Rotary Solenoid (Actuator)	
Resistors			
Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.			
R1	302-273	27 k	$\frac{1}{2}$ w
R10	308-120	2.5 k	5 w
R11	308-120	2.5 k	5 w
R12	308-120	2.5 k	5 w
R13	308-120	2.5 k	5 w
R15	302-273	27 k	$\frac{1}{2}$ w
			WW
Switches			
	Unwired	Wired	
SW1	260-613	Toggle ON-OFF	
SW9	260-614	Toggle MOMENTARY-OFF-MAINTAIN	
SW19	260-612	Push (Actuator)	

*Appears only in POWER SUPPLY FRAME (Part No. 016-231).

**Appears only in POWER SUPPLY (MODEL 2) (Part No. 016-230).



CMD
1064

MODEL 2
115V SHUTTER ACTUATOR SYSTEM

Parts List—Camera System

SHUTTER ACTUATOR MODEL 2 ELECTRICAL PARTS LIST
(230-VOLT)

Ckt. No.	Tektronix Part No.	Description	Model No.
----------	--------------------	-------------	-----------

Bulbs

B1	150-040	Neon NE-2H POWER	
B15*	150-039	Neon NE-2H ACTUATOR	
B15**	150-041	Neon NE-2H ACTUATOR	

Diodes

D2	152-066	Silicon 1N3194	
D3	152-066	Silicon 1N3194	
D4	152-066	Silicon 1N3194	
D5	152-066	Silicon 1N3194	
D12	152-066	Silicon 1N3194	

Fuse

F1	159-029	.3 Amp 3AG Slo-Bl	
----	---------	-------------------	--

Inductor

L19	119-043	Rotary Solenoid (Actuator)	
-----	---------	----------------------------	--

Resistors

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

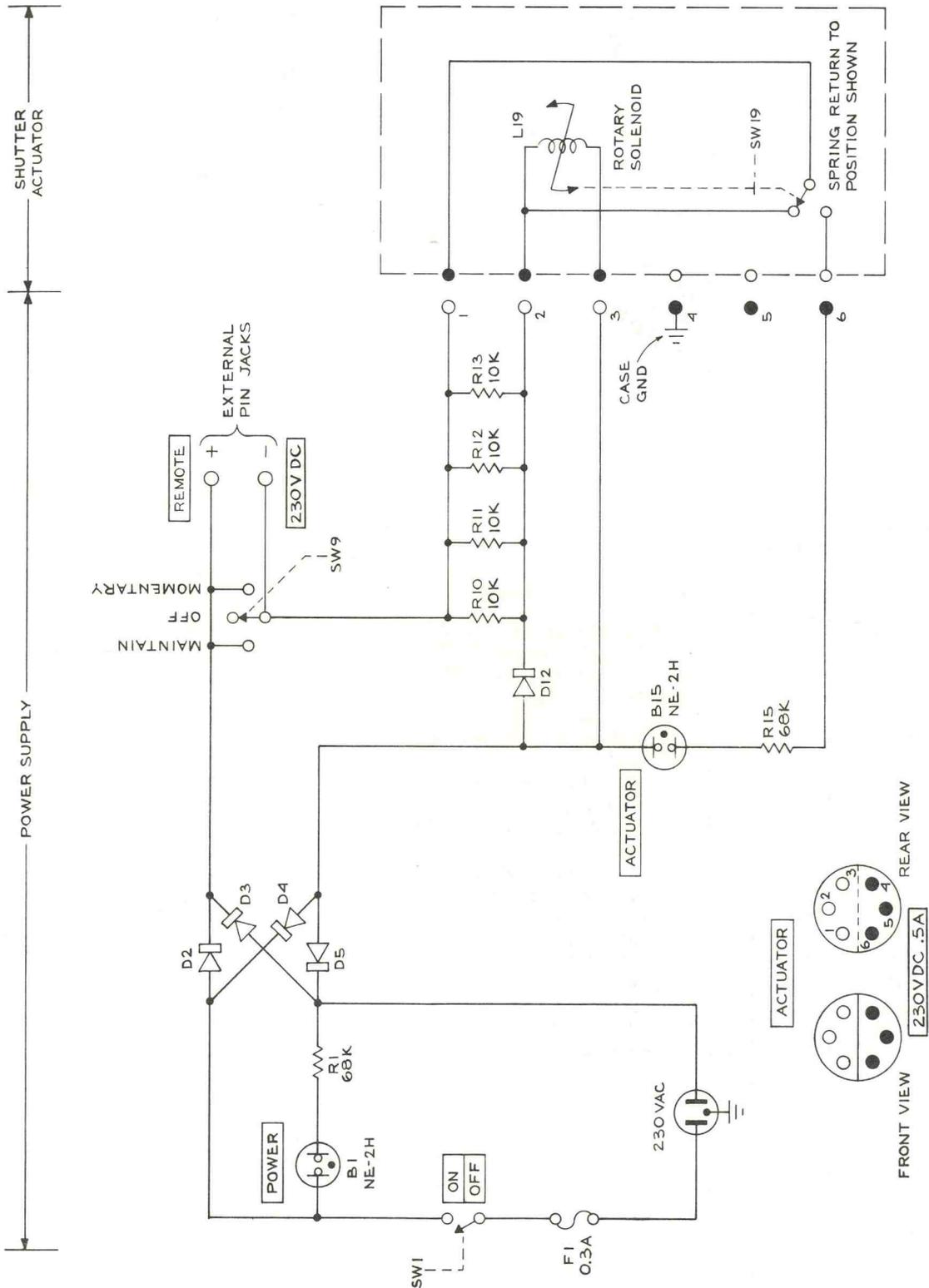
R1	302-683	68 k	1/2 w	
R10	308-008	10 k	5 w	WW
R11	308-008	10 k	5 w	WW
R12	308-008	10 k	5 w	WW
R13	308-008	10 k	5 w	WW
R15	302-683	68 k	1/2 w	

Switches

	Unwired	Wired	
SW1	260-613		Toggle ON-OFF
SW9	260-614		Toggle MOMENTARY-OFF-MAINTAIN
SW19	260-612		Push (Actuator)

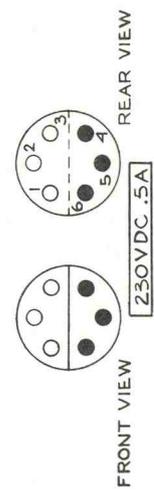
*Appears only in POWER SUPPLY FRAME (Part No. 016-237).

**Appears only in POWER SUPPLY (MODEL 2) (Part No. 016-236).

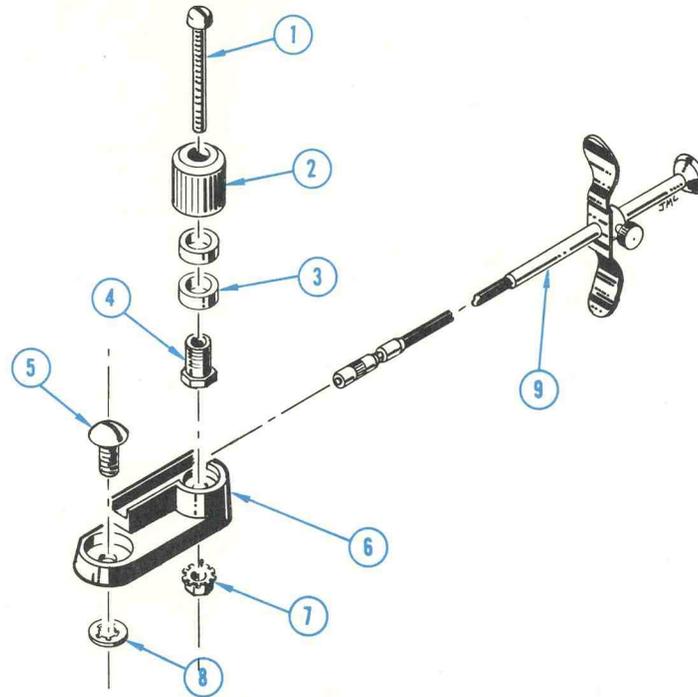


CMD
1064

MODEL 2
230V SHUTTER ACTUATOR SYSTEM



CABLE RELEASE



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1-8	122-587	X1334		1	ASSEMBLY, adapter, C-12
	122-587	X150		1	ASSEMBLY, adapter, C-13
	122-587	X176		1	ASSEMBLY, adapter, C-19
	122-587			1	ASSEMBLY, adapter, C-27
	- - - -			-	Includes:
1	211-517			1	SCREW, 6-32 x 1 inch, BHS
2	366-176			1	KNOB
3	210-844			2	WASHER, neoprene
4	358-179			1	BUSHING
5	213-108			1	SCREW, aluminum, 1/4-20 x 3/8 inch, RHS, black
6	204-118			1	BODY
7	210-457			1	NUT, keps, steel, 8-32 x 5/16 inch
8	210-046			1	LOCKWASHER, steel
9	122-513	101	1333	1	CABLE, C-12
	122-586	1334		1	CABLE, C-12
	122-513	101	149	1	CABLE, C-13
	122-586	150		1	CABLE, C-13
	122-513	101	175	1	CABLE, C-19
	122-586	176		1	CABLE, C-19
	122-586			1	CABLE, C-27

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.



Tektronix Oscilloscope Camera System

TEXT CHANGES

Page 1-2 -- Right-hand column - Remove "Lens and Shutter Settings" title from above the accessory list.

Table 1-1 - Focal Length for Lens Stock No. 122-662 should read 80 mm.

Page 1-7 -- Left-hand column - C-12, "Components of 'standard' package." - Change "Lens" as follows:

Lens---f/1.9-1:0.9 -- 122-548

Page 2-18 -- Left-hand column - Shutter Actuator Model 2 - Change "Power Supply Frame" title as follows:

Power Supply Frame (016-231 - 115 v); (016-237 - 230 v)

PARTS LIST CHANGES

Page 7-6 -- Ref. No. 1-25 - Remove

122-564 101 353 1 ASSEMBLY, main casting

Change next line as follows:

122-609 1 ASSEMBLY, main frame

Pages 7-4, 7-7, 7-9, and 7-13 -- Change "122-587, ASSEMBLY" as follows:

Page No.	Ref. No.	Part No.	Qty.	Description
7-4	9	122-587	1	ASSEMBLY, cable release adapter (See Page 7-46)
7-7	25	122-587	1	ASSEMBLY, cable release adapter (not shown) (See Page 7-46)
7-9	9	122-587	1	ASSEMBLY, cable release adapter (See Page 7-46)
7-13	43	122-587	1	ASSEMBLY, cable release adapter (not shown) (See Page 7-46)

Page 7-35 -- Switches - Change SW601 as follows:

SW601 260-134 Toggle POWER

