

## PART V

# Adapting Your *KODAK EKTAGRAPHIC* Slide Projector

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### INTRODUCTION

*KODAK EKTAGRAPHIC* Slide Projectors have a long history of being adapted for out-of-the-ordinary projection requirements. This part of *The Source Book* covers in detail the wiring and operation of the internal electrical controls for all current *EKTAGRAPHIC* III and *EKTAGRAPHIC* Slide Projectors so that your modifications will be based upon a better understanding of the electrical and mechanical characteristics of these projectors.

Eastman Kodak Company does not offer special modification services, nor does it recommend them. Such modifications may invalidate the projector warranty or the Underwriters Laboratories, Inc. (UL) and Canadian Standards Association (CSA) approvals.



This radiograph of an *EKTAGRAPHIC* Slide Projector visually summarizes the purpose of this part of *The Source Book*—to provide you with a wealth of information about our projectors.

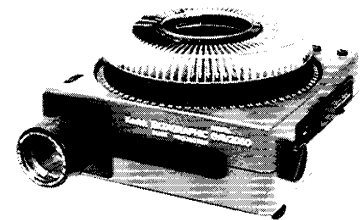
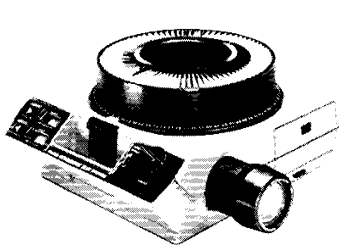
## SLIDE PROJECTOR WIRING AND INTERNAL OPERATION

This information is intended to assist you in connecting a variety of external controls to your *KODAK EKTAGRAPHIC III* or *EKTAGRAPHIC* Slide Projector, or to modify your projector for particular uses.

An analysis of the operation of the internal electrical components will be provided in detail for three slide projector models:

Each model represents the "top-of-the-line" in its own grouping, and each one is equipped with more sophisticated features and controls than other models in its line (with the exception of a few minor, nonelectrical features—i.e., the III AT Projector does not have a built-in viewing screen).

At all times, your projector should be operated within the voltage range and frequency specified in the operator's manual. The use of voltages other than those specified generally will cause damage.



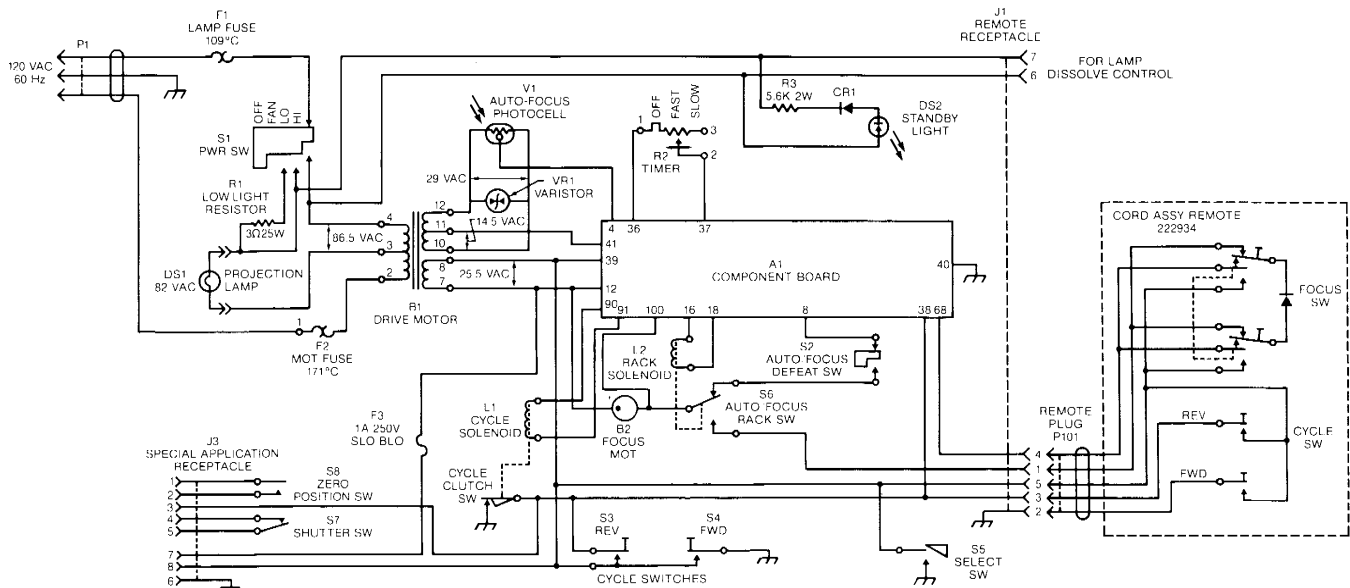
- *EKTAGRAPHIC III AT Projector*
- *EKTAGRAPHIC Slide Projector, Model AF-2*
- *EKTAGRAPHIC Slide Projector, Model S-AV2050*

### KODAK EKTAGRAPHIC III AT Projector

**NOTE:** All component references for the III AT Projector relate to the schematic diagram below.

#### Schematic and Reference List KODAK EKTAGRAPHIC III AT Projector

- |                                      |   |  |  |
|--------------------------------------|---|--|--|
| <b>A-1</b> Component Board           | <b>J-1</b> Remote-Control Receptacle      | <b>L-2</b> Combination Relay and Clutch Solenoid | <b>S-4</b> Forward Slide Change Cycle Switch |
| <b>B-1</b> Mechanism Motor           | <b>J-3</b> Special-Application Receptacle | <b>R-2</b> Variable Electronic Timer Resistor    | <b>S-5</b> Select Switch                     |
| <b>B-2</b> Permanent-Magnet DC Motor | <b>J-5</b> Special-Application Receptacle | <b>R-3</b> Current-Limiting Resistor             | <b>V-1</b> Photo Cell                        |
| <b>DS-1</b> Projection Lamp          | <b>J-5</b> Special-Application Receptacle | <b>S-1</b> Main Power Switch                     | <b>VR-1</b> Varistor                         |
| <b>DS-2</b> Standby Light            | <b>L-1</b> Cycle Solenoid                 | <b>S-2</b> Autofocus On/Off Switch               |  |
| <b>F-1</b> Lamp Thermal Fuse         |   | <b>S-3</b> Projector Reverse Switch              |  |
| <b>F-2</b> Motor Thermal Fuse        |   |  |  |
| <b>F-3</b> Internal Fuse             |   |  |  |



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The main power switch (S-1 PWR SW) is shown in the OFF position. As the switch is moved progressively to the right from the OFF position detent, it performs the following functions:

**FAN detent:** Power is supplied to the mechanism motor (B-1 DRIVE MOTOR) that drives the fan and the slide-change mechanism, and it also (through secondary windings) provides low-voltage isolated power for the remote control and focus, and for the special-application receptacle (J-3 SPECIAL-APPLICATION RECEPTACLE).

In addition, power is supplied to the lamp-circuit access contacts on the remote-accessory receptacle (J-1 REMOTE RECEPTACLE) at the rear of the projector, by means of a tap on the motor primary. (The open circuit voltage at the motor tap is approximately 86.5 V with 120 V across the entire primary, but this drops to 82 V under the load of the lamp.)

**LOW detent:** The same conditions exist as in the FAN position except that the lamp-circuit contacts of receptacle J-1 are connected through resistor R-1. Power supplied to the projector lamp (DS-1) is reduced to approximately 71 V, reducing light output approximately 30 percent and increasing lamp life to about three times rated life expectancy.

**HIGH detent:** Conditions are the same as for LOW except that the lamp circuit access contacts of receptacle J-1 are connected together, and 82 V is supplied to the lamp.

The lamp circuit access is primarily for use with external circuit control by the *KODAK EKTAGRAPHIC* Programmable Dissolve Control, Model 2, or dissolve controls and programming devices made by other manufacturers. Connecting the two contacts through a switch, resistor, or rheostat permits external projection lamp control when the function switch is in the FAN position. The dropping resistor is not in the circuit. Note that power is supplied from within the projector to avoid the possibility of operating the lamp with the fan switched off. Any control device should be capable of handling the load of a 3.66 A tungsten lamp at 82 V.

A thermal fuse (F-1 LAMP FUSE) is mounted just in front of the projector lamp module, toward the center of the projector, where it can be seen by removing the lamp module. If the area overheats, the temperature-sensitive element in the fuse will melt and open the power circuit for the entire projector. A second thermal fuse (F-2 MOT FUSE) is mounted adjacent to a winding of the motor-transformer (B-1 DRIVE MOTOR) and will shut off the motor if it overheats. *The opening of either fuse is a positive indication that some abnormal condition needs to be corrected.*

**IMPORTANT: Check the projector and the operating conditions thoroughly before replacing a fuse and using the projector again.**

Replacement of either fuse requires partial disassembly of the projector, a procedure that should be done *only* by a qualified technician such as found at your nearest Kodak Regional Equipment Service Center.

The forward slide-change cycle switch on the projector is S-4 (S4 FWD). There is a switch with the same function on the remote control. When pressed, either switch will energize the cycle solenoid (L-1 CYCLE SOLENOID), which operates the cycle lever. The switches control alternating current which is rectified by a bridge circuit on the component board (A-1 COMPONENT BOARD), so the solenoid operates on direct current.

The cycle lever releases a spring clutch that engages the slide-change mechanism. The cycle-clutch switch is formed by the combination of the cycle lever and the spring clutch. As soon as the contact between the cycle lever and the spring clutch is broken, the clutch switch opens, de-energizing the solenoid and returning the lever to its normal position. In addition to releasing the clutch, the cycle lever provides two pivot points for the indexer lever that drives the slide tray forward or inreverse. If the cycle lever is returned to its normal position immediately after being actuated (as when the cycle clutch switch de-energizes the solenoid), the forward pivot is used. When the solenoid and the cycle lever remain actuated, the indexer lever pivots at the alternate point and the tray is driven in reverse.

The reverse switch on the projector is S-3 (S3 REV), and there is a parallel switch on the remote control. They operate in the same manner as the forward switches except that they bypass the cycle clutch switch so that the solenoid and cycle lever remain actuated and the direction of the tray is reversed.

**NOTE:** For reliable reverse operation, the reverse contact should be maintained for at least 70 milliseconds. An extremely short reverse-circuit closure can result in a forward cycle, but this is not a reliable method of cycling the projector. It is possible to obtain cycling with less closure than the time given above; however, those specified provide greater reliability. To avoid multiple cycling, maximum closure should be no more than 750 milliseconds (0.75 seconds) for either forward or reverse.

The select switch (S-5 SELECT SW) operates like the forward slide change switch, except that it is mechanically coupled to the mechanism in such a way that the tray is not moved. As long as it is held down, the slide-change mechanism is halted in midcycle with the slide lift lever raised, so the tray can be turned manually. When the switch is released, the mechanism completes the cycle, lowering the slide-lift lever (and any slide it supports) into the gate. If the select lever is operated when the main power switch is off, the slide lift lever is raised mechanically, the locator lever is withdrawn from the tray, leaving the tray free to turn manually. When the select lever is released, the slide-lift lever lowers, and the locator lever again locks the tray in position.

In earlier *EKTAGRAPHIC* Slide Projectors, shutting off the current to the cycle solenoid L-1 would result in

an inductive pulse which could cause arcing, shortening the life of the cycle clutch switch, and possibly feeding a pulse into electronic equipment connected to the projector. In *EKTAGRAPHIC* III Projectors, the problem is reduced significantly because of the dc solenoid, plus a resistor-capacitor (R-C) circuit in the component board to further control switching current in the clutch contact.

B-2 is a permanent-magnet dc motor that operates the automatic and remote-focus mechanisms. It contains varistors that control electromagnetic interference (EMI) which might otherwise cause noise in some audio systems, and possibly cause erratic operation of projector-control equipment. For automatic focus maintenance, a small opening is provided in the wall just ahead of the lamp module in the projector: about  $\frac{1}{16} \times \frac{3}{8}$  inches (1.5 x 10 mm). Some of the infrared (plus a small amount of visible) radiation passes through this slot. A mirror-lens combination forms an image of the slot at the center of the front surface of the slide. The image is reflected onto a photo cell (V-1 AUTO-FOCUS PHOTOCCELL). The cell is center-tapped. When the beam of light results in a balanced resistance on both halves of the photocell, the motor is not driven. However, if the slide surface moves slightly, the reflected light beam will move also. This unbalances the circuit and, through the component board circuit (A-1), drives the motor until balance is restored. That happens when the lens carriage has been moved forward or backward to maintain the distance between the lens and the slide surface, and thus also to maintain focus. The varistor (VR-1) protects the photo cell from electrical "spikes" that might damage it.

The autofocus on/off switch (S-2) permits turning off the autofocus function without disturbing the remote-focus control.

The manual focus knob is used to position the lens within the lens carriage. It does not move the lens carriage or turn the focus motor, because of a friction clutch.

An unusual switch is used in the remote focus assembly. Mechanically, it is simpler than the schematic diagram indicates. The two "switch leaves" attached to the terminals of the diode are independent. One leaf operates when the focus is moved in one direction, and the other operates when the lever is moved in the opposite direction. This arrangement is the same as on models of *EKTAGRAPHIC* and *EKTAGRAPHIC* III Projectors that have remote focus, but not automatic focus. In the schematic diagram, the other (lower) leaves involved in the focus circuit are shown linked mechanically to the upper focus leaves. When either focus leaf is operated, the connection between the lower leaf and the unused focus leaf is broken. Therefore, when the focus switch is used, two switch contacts are maintained; the third is open; the fourth is closed. Two functions are served:

- Direct current is supplied through the component board assembly to a combination relay and clutch solenoid (L-2). Through its relay function, L-2 switches

the focus motor from the automatic-focus circuit to the remote-focus circuit. The clutch function of L-2 locks the focus-motor-drive clutch so that the focus motor will move the lens within the lens carriage (as does the focus knob) without moving the automatic focus components.

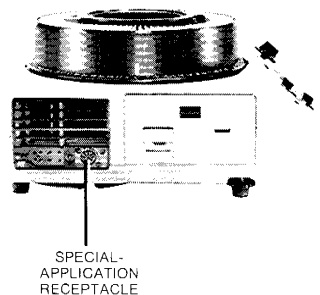
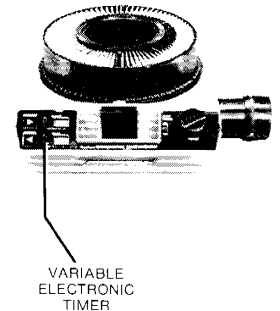
- The diode between the leaves of the remote focus switch provides pulsating dc to the focus motor to drive it in either direction, depending on which direction the lever is moved.

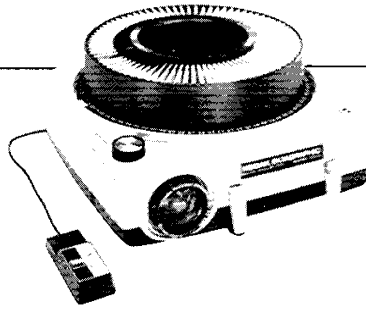
The variable electronic timer resistor (R-2) is part of a conventional capacitor charge-discharge timing circuit on the component board. It provides continuously adjustable advance cycling from about 3 to 22 seconds. The sliding contact does not continue to make contact with the resistance element beyond the fast end of the element, turning the timing circuit off. The timing circuit triggers a solid-state switch (SCR) that is connected between the forward and common of the remote-control circuit. The circuit is essentially the same as that in the *KODAK* EC Automatic Timer, Model III.

The standby light (DS-2) is a green light-emitting diode (LED), in series with a diode and current-limiting resistor (R-3) across the lamp-control contacts in the remote-control receptacle (J-1). It lights when voltage appears across these terminals, indicating that the projector is receiving power and that the projection lamp (DS-1) is ready to light as soon as it is switched on through the remote receptacle (or by moving the main power switch to LOW or HIGH). When the projection lamp is lighted at less than full brightness (as on LOW, or when controlled by a dimmer), the standby light will be lighted less brightly.

The special-application receptacle (J-5) provides access to circuits and components in the projector for connection to external control or other devices. The zero-position switch is operated by a sensing lever at the tray index point on the projector. It is open when the tray is at the zero position, or when no tray is on the projector. It is closed by the skirt on the tray whenever the tray is at a position other than zero. The shutter switch is operated by the shutter mechanism of the projector, and is closed when the shutter is closed, and open when the shutter is open. Thus, this switch is closed for about 0.8 second during each forward or reverse change cycle; and also at any time the shutter is latched closed because there is no slide in the gate. The current being switched by either switch should be limited to 3 A and 30 V ac, maximum.

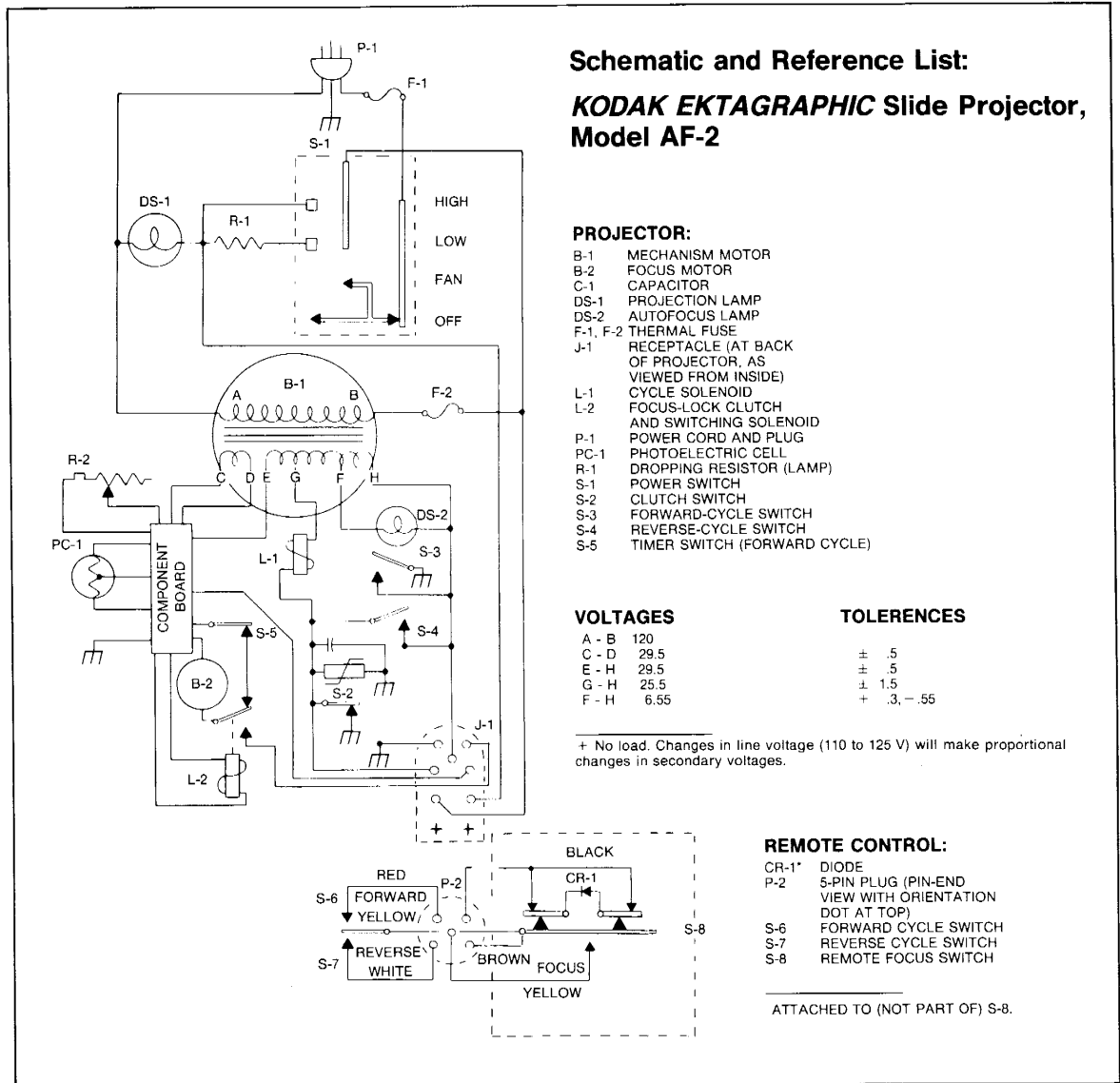
The power provided at terminals 7 and 8 of the special-application receptacle is 25.5 V ac, supplied by the remote control secondary winding of the drive motor (B-1). To prevent an electrical overload, this circuit is protected by an internal fuse (F-3) rated at 1 A. However, we recommend that power drawn continuously from this outlet be limited to  $\frac{1}{2}$  A.





## KODAK EKTAGRAPHIC Slide Projector, Model AF-2

**NOTE:** All component references for the Model AF-2 Projector relate to the schematic diagram below.



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The main power switch (S-1) is shown in the OFF position. As the switch is moved progressively upward from the OFF position detent, it performs the following functions:

**FAN detent:** Power is supplied to the mechanism motor (B-1) that drives the fan and the slide-changing mechanism, and that also (through a secondary winding) provides low-voltage isolated power for the remote control and focus systems. In addition, power is supplied to the lamp-circuit-access contacts on the remote-accessory receptable (J-1) at the rear of the projector.

**LOW detent:** The same conditions exist as in the FAN position except that the lamp-circuit-access contacts of receptable J-1 are connected through resistor R-1. Power supplied to the projector lamp (DS-1) through the resistor is approximately 12.5 volts less than the line voltage; light output of the lamp is approximately 70 percent of rated value, and lamp life is about three times normal expectancy.

**HIGH detent:** Conditions are the same as for LOW except that the lamp-circuit-access contacts of receptacles J-1 are connected together, and they supply full line voltage to the lamp.

The lamp-circuit access is intended primarily for use with the external circuit of the *KODAK EKTAGRAPHIC* Programmable Dissolve Control, Model 2, or dissolve controls and programming devices made by other manufacturers. Connecting the two contacts through a switch, resistor, rheostat, or other control device will permit the projection lamp to be switched or controlled when the function switch is in the FAN position. The dropping resistor is not in this circuit. Note that power is supplied from within the projector to avoid the possibility of operating the lamp with the fan switched off. Any control device used should be capable of handling the load of a 2.6 A tungsten lamp at 125 V.

A thermal fuse (F-1) is mounted on a small wafer between the lamp and back panel of the projector. If the projector lamphouse area overheats, the temperature-sensitive element in the fuse will melt and open the power circuit for the entire projector. A second thermal fuse (F-2) is mounted adjacent to a winding of motor-transformer (B-1) and will shut off the motor if it overheats. The opening of either fuse is a positive indication that some abnormal condition needs to be corrected. Check the projector and the operating conditions thoroughly before replacing a fuse and using the projector again.

**NOTE:** Replacement of either fuse requires partial disassembly of the projector, a procedure that should be attempted *only* by a qualified technician, such as found at your nearest Kodak Regional Equipment Service Center (listed on the inside back cover).

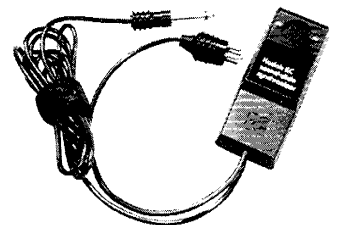
S-3 is the forward slide-change cycle switch on the projector. S-6 is the forward slide-change cycle switch on the remote-control unit. When actuated, either switch will energize the cycle solenoid (L-1), which operates the cycle lever. The cycle lever releases a spring clutch that engages the slide-changing mechanism. The clutch switch (S-2) is formed by the combination of the cycle lever and the spring clutch. As soon as the contact between the cycle lever and the spring clutch is broken, the clutch switch opens, de-energizing the solenoid and returning the lever to its normal position. Ordinarily the solenoid operates on low-voltage alternating current, but it can also be operated satisfactorily on pulsating direct current (as when the projector is cycled by a *KODAK EC* Sound-Slide Synchronizer). In addition to releasing the clutch, the cycle lever provides two pivot points for the indexer lever that drives the slide tray forward or in reverse. If the cycle lever is returned to its normal position immediately after being actuated (as when S-2 deactivates the solenoid), the forward pivot is used.

When the solenoid and the cycle lever remain activated, the indexer lever pivots at the alternate point and the tray is driven in reverse.

S-4 and S-7 are the reverse switches on the projector and remote control respectively. They operate in the same manner as the forward switches (S-3 and S-6) except that they bypass the clutch switch (S-2) so that the solenoid and cycle lever remain activated and the direction of the tray is reversed. For reliable reverse operation, the reverse wire should be closed to the common for at least 200 milliseconds. An extremely short reverse circuit closure can result in a forward cycle, but this is not a reliable method of cycling the projector. The required length of such a closure (for forward cycling by the reverse wire) will vary from one projector to another and will also change as the projector ages. It is possible to obtain cycling with less closure than the time given above; however, those specified provide greater reliability. To avoid the possibility of multiple cycling, maximum closure should be no more than 750 milliseconds (0.75 second) for either forward or reverse.

The clutch switch (S-2) serves a secondary function when the projector is controlled by the *KODAK EC* Sound-Slide Synchronizer. The synchronizer circuit includes a silicon-controlled rectifier (SCR) that acts as a forward cycle switch when the unit detects an actuation signal from a tape recorder. When S-2 is opened, the current flow through the SCR (as well as through L-1) is broken, and this allows the SCR to revert to a nonconductive state in the absence of a continuous actuation signal.

When current is cut off from cycle solenoid L-1, an inductive pulse is created that may cause arcing at the switching point—usually at the clutch switch S-2 (for forward actuation) or at the control switch (for reverse actuation).



In the circuit shown, a varistor and capacitor are used to control arcing and thus prolong the life of the contacts. They also reduce any "pulse" that might be picked up by sensitive amplifiers or other electronic circuits.

B-2 is a permanent-magnet dc motor that operates the automatic and remote focus mechanisms. It has varistors to control electro-magnetic interference (EMI) which otherwise might be heard as noise from sensitive audio amplifiers, or might cause erratic operation of the projector-control equipment.

The manual focus knob is used to position the lens within the lens carriage, but it does not move the lens carriage or turn the focus motor, because of a friction clutch.

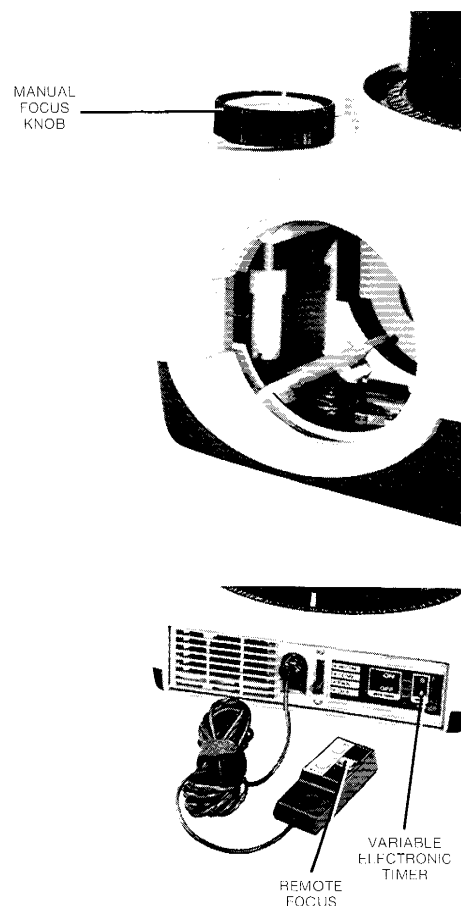
An unusual switch form is used in the remote-focus switch. Mechanically, this switch is much simpler than the schematic diagram indicates. The two switch leaves attached to the terminals of the diode are independent. One leaf operates when the focus lever is moved in one direction, and the other operates when the lever is moved in the opposite direction. This arrangement is the same as on other models of *EKTAGRAPHIC* Slide Projectors that have remote focus, but not automatic focus. In the schematic diagram, the other (lower) leaf involved in the focus circuit is shown linked mechanically to the standard focus leaves. When either focus leaf is operated, the connection between the lower leaf and the unused focus leaf is broken. Therefore, when the focus switch is used, two switch contacts are maintained; the third is open; the fourth is closed. Two functions are served by this arrangement:

- Direct current is supplied through the component board assembly to a combination relay and clutch solenoid (L-2). Through its relay function, L-2 switches the focus motor from the automatic focus circuit to the remote-focus circuit. The clutch function of L-2 locks the focus motor drive clutch so that the focus motor will move the lens within the lens carriage (as does the focus knob) without moving the automatic-focus lamp bracket.
- Diode CR-1 provides pulsating dc to the focus motor to drive it in either direction (depending on which direction the remote-focus lever is moved and which way the diode is oriented in the ac remote control focus-motor circuit). Paralleling the forward and reverse switches on *KODAK EC* Remote Controls is permissible, since they are normally open switches. However, the focus switches should not be paralleled.

An analysis of the switch contacts will show that a short will result if the focus switches are paralleled, and one of the focus levers is activated. If you want remote controls paralleled (for instance, at the front and back of a room), the focus and focus-lock wires can be omitted at one outlet, special controls can be built which will have only normally open switches for focus, or the remote controls can be modified by taking them apart and carefully bending the focus leaves of the switch so they do not touch either the top or bottom fixed contact when it is in rest position.

With the modification, two or more of the *EC* Remote Controls can be used in parallel with no problems—but each control must have the center switch leaf modified (bent, so they do not touch) as indicated above.

The variable electronic timer (R-2) is a conventional capacitor charge-discharge timing circuit that is controlled by a variable resistor on the back of the projector. This provides continuously adjustable advance cycling from about 4 to 15 seconds. The timing circuit triggers a solid-state switch (SCR) that is connected between the forward and common of the remote-control circuit and conducts momentarily to change slides. (The circuit is essentially the same as that in the *KODAK EC* Automatic Timer, Model III.)



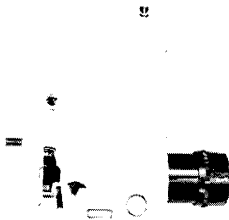
## KODAK EKTAGRAPHIC Slide Projectors—Elapsed Times

Sophisticated multi-image presentations are generally controlled by electronic programming devices and minicomputers. Such presentations must be carefully planned to achieve the desired effect on the audience. However, before the planning of the program can begin, the operational sequence of the projectors should be studied. When such data are available, special effects, such as dissolves, projector start and stop, and other projection modes can be properly programmed for maximum visual effect on the screen.

The following information will help you to plan the programming of your audiovisual show so that you can produce the best screen effects possible.

**NOTE:** The "Elapsed Time" for each "Action" in the table below is an approximation and may vary somewhat with adjustment of the individual projector, and with such variables as voltage, temperature, weight of the loaded slide tray, age of the projector, and so forth.

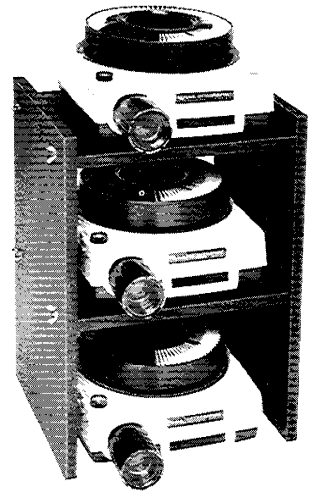
## KODAK EKTAGRAPHIC Slide Projectors



Elapsed Time (Milliseconds)	Action
0	Cam stack begins rotation when clutch contact lever is pulled from contact with clutch spring.
120	Indexer starts toward lugs on tray bottom; shutter starts to close.*
150	If select button is being held down, indexer movement stops and indexer snaps back to rest position and remains there.
160	Shutter fully closed; slide lever starts upward; registration lever starts to retract.
170	Indexer stops moving outward.

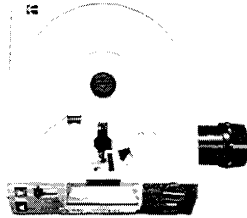
200	Registration lever fully retracted.
230	Pressure pad starts to open.
320	Locator starts to move out from between tray lugs.
330	Pressure pad completely open.
360	Indexer starts moving again; slide lever fully up.
420	Locator fully out from between lugs.
430	Indexer starts to move tray forward (or reverse).
500*	If select button is being held down, cams stop rotating.
560	Locator starts to return to tray lugs.
580	Indexer stops moving tray; starts to return to rest position.
590	Slide lever starts down.
630	Locator is fully back in position between lugs.
820	Slide lever fully down.
850	Registration lever starts moving in.
870	Pressure pad starts to close.
890	Shutter starts to open; registration lever is fully in.
900	Pressure pad is fully closed.
920	Indexer is completely returned to the rest position.
950	Shutter fully open.
1000	Cycle complete; cam rotation stops.

\*If the select button is depressed, only the indexer assembly is affected until the cam stops rotating at the half-cycle position. Then, when the button is released, the rest of the cycle is completed (with the indexer remaining in the rest position).



(CONTINUED)

## KODAK EKTAGRAPHIC III Projectors—Elapsed Times



Elapsed Time (Milliseconds)*	Action
0	Electrical signal to commit.
10	Cam stack released.
25	Shutter starts to close.
45	Indexer starts toward tray.
80	Indexer snaps back (manual select) and registration lever starts to retract.
110	Indexer stops.
140	Shutter fully closed.
145	Slide-lift lever starts to lift slide.
160	Registration lever fully retracted.
290	Pressure pad starts to open.
330	Pressure pad fully open.
335	Slide-lift lever fully up.

340	Locator starts to retract and indexer resumes motion.
360	Indexer contacts tray.
410	Locator fully retracted.
560	Cam stack stops rotating (manual select)
580	Locator starts to return.
590	Indexer stops moving tray.
620	Slide-lift lever starts to lower slide.
650	Locator fully engaged.
820	Registration lever starts to move in.
855	Slide-lift lever fully down.
870	Pressure pad starts to close.
880	Registration lever fully engaged.
890	Pressure pad fully closed and shutter starts to open.
910	Indexer returned to rest.
965	Shutter fully open.
1000	Cycle complete.

\*The elapsed time intervals listed above were obtained by using a high-speed video camera and were rounded off to the nearest 5 milliseconds.

### “We the Creators”

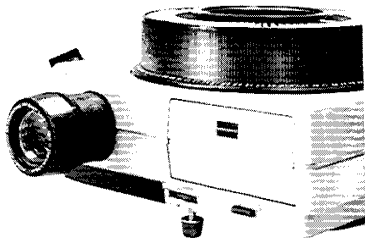
**Q** What is the greatest number of projectors you've used in a multi-image show?

**A.** More than 20 projectors have been used for special occasions. However, 18 EKTAGRAPHIC III Projectors are used to present a show entitled “We the Creators,” produced for Kodak by Alden Butcher Productions of Los Angeles and available for rent. Over 900 representational and abstract slides appear in this 8-minute multi-image tribute to audiovisual professionals. The projectors are arranged in three banks of six each with a 3-to-1-screen format with center-



screen overlap. AVL playback equipment and a 4-channel reel-to-reel tape deck are required. Shown above is a full-screen panorama from the show photographed directly from a 6 x 18-foot front-projection screen. For more information, contact Eastman Kodak Company, Motion Picture and Audiovisual Markets Division, Dept. 641, 343 State Street, Rochester, NY 14650.

## How to Deactivate the Projector's Dark-Screen Shutter



The dark-screen shutter was added to *EKTAGRAPHIC III* and *EKTAGRAPHIC* Slide Projectors as a convenience to users so that opaque (dark or blank) slides won't be needed for a dark screen during audiovisual presentations. The shutter prevents projector lamp light from reaching the screen and reflecting into the eyes of the audience. It is actuated when the projector is on and the gate is empty (no slide).

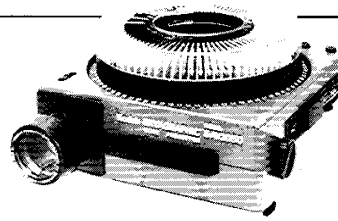
Some people prefer to deactivate the dark-screen shutter of their projectors because they need to see the projection beams when programming a multi-image show.

Eastman Kodak Company offers no service for deactivating the dark-screen shutter. However, it can be done in the following way:

- Locate the metal linkage (or finger) that latches the shutter closed when no slide is in the gate. With the projection lens pointed away from you, the link is on the right outside of the shutter. It catches the shutter to hold it closed, and it releases when the pressure pad opens to admit a slide, which allows the spring-loaded shutter to pop open.

**NOTE:** Opening the pressure pad opens the shutter; cycling the projector closes it.

- Unplug the projector. With a pair of long-nose pliers, reach into the gate area of the projector and bend the link *up* enough so that it releases the shutter. *Be careful not to bend the link in a direction that will cause it to interfere with adjacent moving parts.*
- Plug in and turn the projector on. Check the shutter action by cycling the projector several times. Projector lamp light should now come through the lens when a slide is *not* in the gate.



## KODAK EKTAGRAPHIC S-AV2050 Slide Projector

**NOTE:** All component references for the S-AV2050 Slide Projector relate to the schematic diagram on page 111.

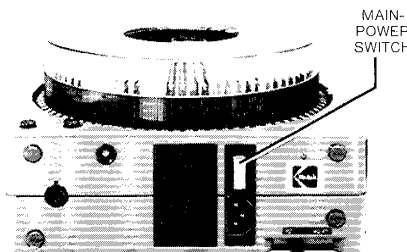
### Internal Electrical Controls

The *KODAK EKTAGRAPHIC S-AV2050* Slide Projector is delivered with a detachable 3-wire power cord that has a 3-prong plug to fit the grounded power outlets found in the U.S. and Canada, and on the other end a 3-contact European standard connector that fits the plug on the back of the projector. When plugged into a grounded outlet, it provides an automatic safety ground for the projector chassis.

If the projector is to be used where other types of power outlets are found, a 3-wire grounding power cord with a local-format plug on one end and the projector-fitting European connector on the other can usually be obtained locally. If you use an adapter instead, choose one that will provide a grounding connection for the projector, as well as operating power. A third approach involves cutting off the U.S. plug and installing a local one.

**NOTE:** This modification should be done only by a qualified electrician who can make the proper connections.

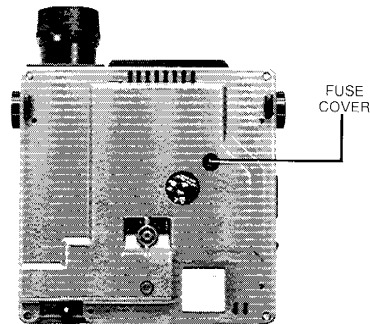
The main power switch (b) is shown in the off position. Depending on the position of the lamp-control switch and external connections to the 12-connector receptacle, the projection lamp may turn on with the projector when the main power switch is turned on.



The thermal overload switch (c) is located inside the projector near the lamp. If the projector overheats, this cutout shuts off power to the projector. Although the switch resets automatically once the projector has cooled, the cause of the overheating should be found and corrected.

The fuse (a) will open if a short or other circumstances cause the projector to draw too much

current. This is a slow-blowing fuse (KODAK Part No. 4516091), accessible through the bottom of the projector. For operation on the lower voltage ranges, 110 or 130 V, a 3.2 A slow-blowing fuse should be used. *Check for the proper fuse before the projector is turned on.* If the 1.6 A fuse is used on the low-voltage ranges, it will burn out as soon as the lamp is turned on. If the 3.2 A fuse is used on the high-voltage ranges, it will not provide as much protection as would the 1.6 A fuse (KODAK Part No. 225185).



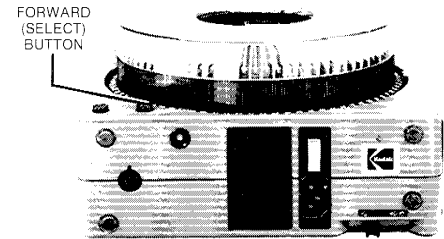
The power is supplied to the transformer and the main motor. The transformer provides the proper voltage for the various circuits by means of different connections selected by setting the main voltage-selector switch. This switch, located on the bottom of the projector, should be set for the voltage to which the projector will be connected—*before the projector is plugged in and turned on.* The instruction manual gives information on the ranges covered by each switch position.

The main motor turns the ventilating fan attached to its shaft and the gears that drive the slide-change mechanism. The cams that perform the slide-change operations are coupled to the drive train by a ratchet clutch, actuated by a solenoid. When the forward contacts are closed—by a button on the remote control or by a button on the projector—the solenoid remains activated until the cycle is complete, at which time a cam opens a switch to shut off the solenoid, releasing the clutch.

The forward button—on the projector, but not on the remote control—can also serve as a select button. If the projector forward button is held down, it interrupts the change cycle at midpoint through an additional switch operated by the cam stack. At that time, the tray can be turned manually to any position, after which the forward-select button can be released. The completion of the change cycle will advance the tray one more position forward, counterclockwise. *Thus, if slide 40 is wanted, the advance-select button should be released with the tray set at 39.* To return the tray to zero position, set the tray at 80 and release the button.

The reverse cycle is initiated by closing the contacts operated by the reverse button on the remote control or on the projector. This activates a reverse solenoid (f),

which determines that the slide tray transport lever will move the tray in reverse, clockwise. The reverse solenoid also operates a switch which activates the clutch solenoid (i), engaging the cam stack to make the slide change.



The single tray-transport lever on the S-AV2050 Projector performs the functions of both the locator lever and the index lever on North American Kodak projectors. That is, it locks the tray in position while slides are being lowered into the gate, raised into the tray, or projected, and it also moves the tray forward or backward.

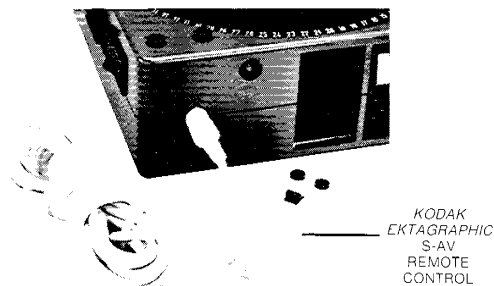
Electrical control of the shutter position is achieved by means of the reverse solenoid. The shutter in this projector (as well as in the Model S-AV2030 Projector) is located between the lamp and the gate, rather than between the gate and lens as in North American projectors. In normal slide change, the shutter, operated mechanically by a cam, closes to prevent light from reaching the screen during slide change. The shutter is coupled to the cam stack and the reverse solenoid in such a way that either one can close the shutter; it remains closed as long as either one calls for it to be closed. Contacts on the 12-contact socket, on the side of the projector, provide external electrical control of the shutter. Connecting the contacts activates the reverse solenoid, but disables the reverse-solenoid switch that activates the clutch solenoid. The result is that the shutter will close, but the clutch will not operate. This allows you to flash an image on and off the screen for testing or special effects.

This feature, together with the zero-positioning switch, makes possible an automatic-return-to-zero control for the S-AV2050 Projector. The zero-position switch lever is located under the index tab, beside the projector gate. When the tab is pressed down by the skirt of a slide tray, it closes the double-pole single-throw zero-position switch. When the tab is not pressed, the switch remains open—indicating that the tray is at the zero position, or that there is no tray on the projector.

As in North American EKTAGRAPHIC III and EKTAGRAPHIC Slide Projectors, there is a registration lever that provides repeatable horizontal registration of the screen image. This lever, at the inner side of the projector gate, pushes each slide to the outside of the gate; mechanically coupled to this lever is the slide-sensor switch that is open when the lever is held

against the edge of a slide, but closed when the lever has entered the gate without encountering a slide. The switch contacts are connected to the 12-connector socket on the side, and can be used for detecting the end of a slide series, by the absence of a slide in the gate. A special slide with a notch at the registration lever position can be used to permit the switch to close while cutting off light to the screen.

Remote focusing requires a separate accessory, the *EKTAGRAPHIC S-AV Remote Control*.

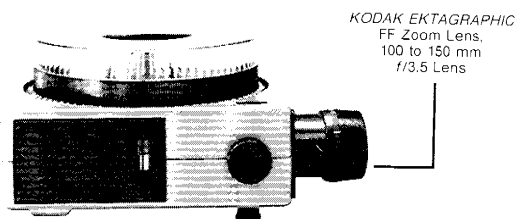


A double-pole double-throw center-off switch in the S-AV Remote Control connects direct current to the low-voltage dc permanent-magnet EMI-suppressed remote-focus motor in the projector. For use with lenses having a spiral-focusing groove, the motor drives a circular gear, and an eccentric connector on the gear moves a lever on which is located the lens-positioning pin.

**NOTE:** Although the remote-focus switch controls the polarity of the current to the motor, and thus the direction of motor and gear rotation, lens movement will reverse itself when the focus switch is held long enough in either position.

Even though the motor and gear continue to rotate in the same direction, the eccentric connector will move through a 0- or 180-degree relationship with the lever, and lever movement will change 180 degrees causing the lens-positioning pin and the lens to reach the end of their travel in one direction and reverse themselves. Because of this, the remote-focus motor can be used for minor lens movement only, about  $\frac{1}{8}$  inch (3 mm), and rough focusing must be done by turning the lens barrel manually.

The motor also drives the focus thumb wheel and the attached pinion to focus North American rack-focus lenses (such as the *KODAK EKTAGRAPHIC FF Zoom Lens, 100 to 150 mm f/3.5 lens* shown here).



### External Electrical Controls

The S-AV2050 Projector has receptacles for two different external control plugs, and these may be used independently or simultaneously.

The 6-pin receptacle on the back of the projector accepts a 6-pin plug, MAB 6/DIN 45322, such as the one on the projector remote control. All six pins are functional. The sixth pin, compared with the five-pin EC Remote Control used on U.S. and Canadian projectors, is required because the remote-control circuit for the S-AV2050 Projector operates on direct current. There is one common wire, a second wire for forward slide tray cycling, a third for reverse cycling, and three more wires to permit reversing the low-voltage direct current so the focus motor can be operated in both directions.

The connections on the receptacle are:

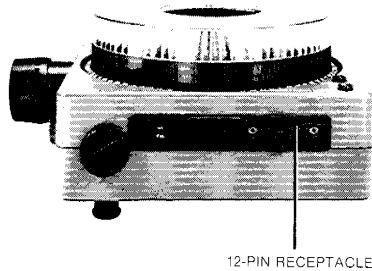
1. Slide Reverse (when closed to 3).
2. Slide Forward (when closed to 3).
3. Common (plus 20 V).
4. Focus Motor
5. Focus Motor
6. Negative (0 V).

- Connecting 3 to 4 and 5 to 6 will run the focus motor in one direction.
- Connecting 3 to 5 and 4 to 6 will run the focus motor in the opposite direction. Switching capacity required for slide change in either direction, or the focus motor, is about  $\frac{1}{2}$  A.

Terminals 3 and 6 can be used as a source for dc power for such things as external relays, pilot lights, and so on. The power is pulsating (full wave rectified), dc, approximately 20 V, and the power drawn should not exceed 750 mA, (0.75 A), or an internal fuse (F2, fast acting, 1.25 A), might blow. Replacing this internal fuse requires removal of the projector bottom to gain access to the fuse clip, located on a circuit board at the front corner opposite the lens side of the projector. Only a technician familiar with the internal workings of the projector, and its disassembly and reassembly, should attempt to replace this fuse.

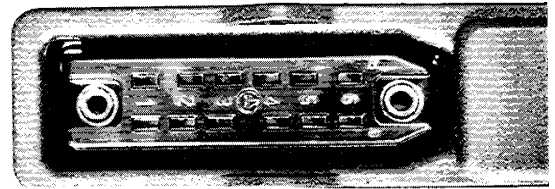
### Twelve-Pin Receptacle

The 12-pin receptacle at the side of the projector accepts a 12-blade plug (J2), DIN 41622, such as *KODAK* CAT No. 141 4937.



12-PIN RECEPTACLE

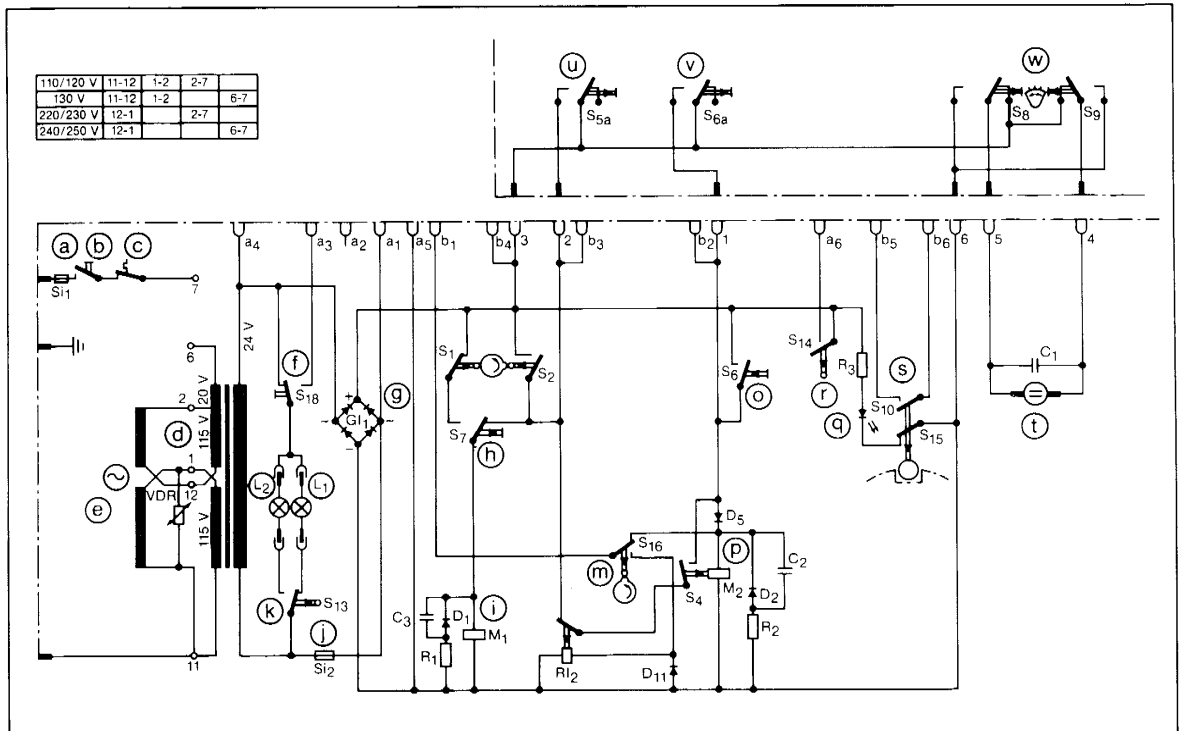
12-PIN RECEPTACLE (CLOSE-UP)



## Schematic Diagram Reference List: *KODAK EKTAGRAPHIC S-AV2050* Slide Projector

### Wiring Diagram

- |   |  |
|---|--|
| a) Mains fuse                                   | m) Switch for snap change  |
| b) Mains switch                                 | o) Reverse slide change  |
| c) Thermal overload                             | p) Reversing solenoid for forward/reverse slide change and snap change |
| d) Voltage selector                             | q) LED for zero-position   |
| e) Shaded pole motor                            | r) Zero reset switch in slide gate                                     |
| f) Switch for internal or external lamp control | s) Slide tray zero-position switch                                     |
| g) Rectifier                                    | t) Focusing motor  |
| h) Forward slide change and select              | u) Remote control forward  |
| i) Clutch solenoid                              | v) Remote control reverse  |
| j) Secondary fuse                               | w) Remote control focusing   |
| k) Switch for lamp changeover                   |  |
- L1 Lamp in Circuit  
L2 Spare lamp



The connections on the 12-pin receptacle are

- **a 1** Common, 24 V ac (lamp current; isolated from the power line).
- **a 2** Not used (no connection).
- **a 3** For external lamp control (dissolve, lamp switching, etc). Connects to “a 1” to turn lamp on; “a 3” is “live” only when the INT-EXT lamp switch on the side of the projector is in the EXT position. The lamp current is approximately 10.5 A, so approximate switching and current capacity is required. Total resistance added between “a 1” and “a 3” for lamp switching should not exceed 0.1 ohm when the lamp is fully on.
- **a 4** Can be used with “a 1” to supply 24 V ac to an external device. Do not exceed a 750 mA, 0.75 A, load.
- **a 5** 0 V dc. Same as “6” on the 6-pin receptacle at the back of the projector.
- **a 6** Gate slide-sensing switch; can be used to initiate automatic return to zero or detect end of program by absence of slide in gate.
- **b 1** Operates shutter. Connect to “b 4” to close shutter by operating reverse solenoid without activating slide change.
- **b 2** Same as “1” on back receptacle. Initiates reverse slide change when closed to “b 4.”
- **b 3** Same as “2” on back receptacle. Initiates forward slide change when closed to “b 4.”
- **b 4** Same as “3” on back receptacle. Common for forward and reverse slide change circuits, plus 20 V dc, pulsating. Can be used with “a 5” to provide approximately 20 V dc, 750 mA maximum for external use.
- **b 5** Zero-position switch. Single-pole single-throw normally open. Connects to “b 6” when tray on projector is not at zero position. No contact when tray is in zero position or no tray is present.
- **b 6** Zero-position switch.

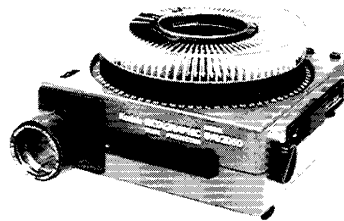
The zero-position and slide-detection switches built into the projector must be used only for low voltage and low current. They have enough capacity to control slide advance and reverse functions, but must never be used for switching the projection lamp current directly or for switching line voltage. Such functions, if controlled by these switches, must be performed through isolating relays having contact capacity sufficient to handle the current and/or voltages involved. With the exception of lamp switching (“a 1” and “a 3”), values in circuits connected to the back and side receptacles should be

limited to 750 mA and 30 V maximum. Any equipment connected to the projector should have UL requirements for class 2 photographic equipment. When the zero-position switch is closed and the projector is turned on, an LED (light-emitting diode) is lit on the back of the projector, indicating the tray is at zero.

The remote-control circuits of the S-AV2050 Projector are floating; that is, they are not grounded to earth ground or the chassis. The 12-pin plug that fits the side connector can be used to provide a ground to the chassis of the projector by using the two round pins supplied with it for assembly. Insert these into the round holes at either end of the banks of flat connector pins.

The remote-control circuits of the S-AV2050 Projector should *not* be connected in parallel. (Under some circumstances such parallel connection is permissible with North American projectors.) If it is necessary to cycle two or more S-AV2050 Projectors together, use isolating contacts.

## Electric Current Abroad



**Q. I realize that the *EKTAGRAPHIC* Slide Projector, Model S-AV2030 and Model S-AV2050, are “world travelers.” But I want more information on various countries’ electrical requirements for using slide projectors overseas. Is there such a source?**

**A.** Yes. “Electric Current Abroad” (1984 Edition, Stock No. 003 008 00193-9) is a publication of the U.S. Government Printing Office, Washington, DC 20402. This booklet lists by country and city the following information:

- Type of current (alternating or direct)
- Frequency (hertz-per-second)
- Number of phases
- Nominal voltage
- Number of wires to a commercial or residential installation
- Frequency stability

## CORDS, PLUGS, AND RECEPTACLES

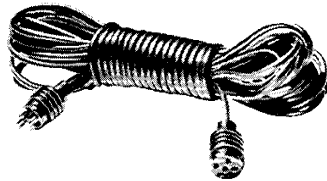
Some applications for *KODAK EKTAGRAPHIC* Slide Projectors made in North America require the interconnection of specialized control devices with one or more projectors. To reduce the possibility of improper electrical connections, which could result in damage to your slide projectors, you should use cords, plugs, and receptacles specifically designed for the projector. While these are not always standard commercial components, they are available either as accessories sold by suppliers of Kodak products or as parts (identified by part numbers) that can be ordered through electronics suppliers or directly from:

Eastman Kodak Company, Parts Services,  
800 Lee Road, Rochester, NY 14650  
Phone (716) 724-7278.

The following descriptions will help you identify the items needed for installation.

### Remote Control Cord and Cable Specifications

The *KODAK EC* Remote Extension Cord (25-foot) (*KODAK CAT* No. 140 1363) is available from dealers selling Kodak products. It extends the range of the 12-foot (3.7 metre) *EC* Remote Control cord and contains 5 No. 22 wires.



Depending on the remote-control capability, a slide projector will require one conductor for common, one for forward, one for reverse, and either one or two for focus.

Many types of cables and cords can be used, but the ones you select should have wires that are color-coded or otherwise identified.

Solid wires can be used for permanent installations; stranded wire should be used when flexibility will be required.

Recommended Wire Size		
Maximum Cable Length feet (metres)	Conductor Size (AWG)	Diameter (millimetres)
65 (19.8)	24	0.5
100 (30.5)	22	0.6
160 (48.8)	20	0.8
250 (76)	18	1.0
400 (122)	16	1.2

### Projector Receptacle for *KODAK EKTAGRAPHIC* Remote Control Cords

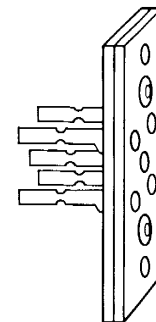
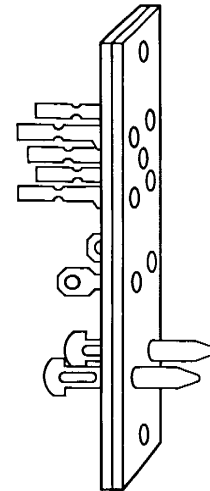
In a permanent projection installation where a remote control panel is used, one of the receptacles below can be installed at the point at which the projector remote-control cord is connected.

#### Eight- and Nine-Contact Receptacles

*KODAK* Part No. 185631 (as shown)

*KODAK* Part No. 185651 (without pins in bottom--used in projectors with attached power cords.)

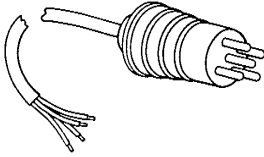
**CAUTION: The bottom four contacts of the 9-contact receptacle may carry line voltage and lamp current.** Any wires connected to them should therefore be adequate for 5 A of current and will need insulation adequate for 125 V. All wiring should conform to good practice and any special local code or other requirements.



#### Five-Contact Receptacle

*KODAK* Part No. 188747

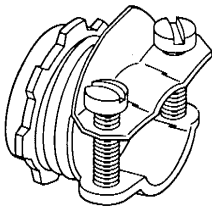
**Twelve-foot (3.7 metre) Cord for KODAK EC Remote Control Cord Assemblies; cord with plug only; without switch assembly; terminates in bared wires.**



- KODAK Part No. 181376  
3-wire cord (as in KODAK EC-1 Remote Control)
- KODAK Part No. 169826  
4-wire cord (as in KODAK EC-2 Remote Control)
- KODAK Part No. 185630  
5-wire cord (as in KODAK EC-3 Remote Control)

**Cable Clamp**

Used to mount round molded plugs to an electrical-outlet box or control panel. Standard cable clamp, such as Thomas and Betts No. 3300, is available from electrical supply houses.



**Plugs and Sockets**

Many standard plugs and sockets (Cinch-Jones, Amphenol, Eby, etc) with a contact rating of approximately 0.5 ampere or greater, can be used in pairs but will not mate with standard EKTAGRAPHIC Projector plugs and receptacles.

A few plugs or sockets, however, will mate satisfactorily with EKTAGRAPHIC Projector plugs and receptacles. Examples are the Eby 119-5M plug and the 119-5F saddle-mount socket.



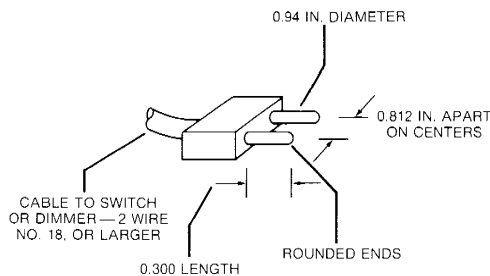
Pin length on the 119-5M plug is not exactly the same as on the EKTAGRAPHIC Projector plugs, but it will mate with corresponding EKTAGRAPHIC Projector receptacles; and the 119-5F socket will receive EKTAGRAPHIC Projector 5-prong projector plugs. Eby connectors can be obtained from:

- J. T. Simpson, 188 Elizabeth St., NY, N.Y. 10012, industrial electronics suppliers. (Also available from J. T. Simpson are Eby connectors mounted on wall plates, for use in conference rooms or auditoriums.)
- In quantity from the distributor, Eby Sales Company, 148-05 Archer Ave., Jamaica, NY 11435.
- From Radio Shack is a suitable plug without a wire (Radio Shack Catalog No. 274-1210), a plug with a 1-foot wire attached (Catalog No. 270-041), and a chassis mount socket (Catalog No. 274-1212).

**Custom-Made or Locally Fabricated Plug (For Access to Lamp Circuit of North American-made KODAK Slide Projectors)**

This custom-made plug inserts into the 2-hole receptacle directly under the 5-hole receptacle that accepts the KODAK EC Remote Control. If the 2 pins are shorted together or connected by means of a switch, the lamp circuit will go to HIGH when the projector switch is in the FAN position. (With the EKTAGRAPHIC Slide Projector, Model AF-2K, the circuit will go to LOW.) The plug body must be insulated for line voltage, and it must not interfere mechanically with other plugs connected to the receptacle. Dimmers or switches used with the new plug must have minimum ratings to handle the projection lamp voltage and load.

**IMPORTANT:** The power provided for the new plug is from the internal circuit of the projector. Do not connect the pin wires to an external power source.



One suitable plug can be obtained from Radio Shack (Catalog No. 274-342), in a set of six 2-pin plugs and sockets. You must insert this plug carefully to avoid breaking the plug body, since the pin spacing is slightly less than 0.312 inch (7.9 millimetres) on centers.

## Plugs and Remote Extension Cables for KODAK EKTAGRAPHIC Slide Projectors, Model S-AV2030 and Model S-AV2050

### 6-Pin DIN Plug

The 6-pin receptacle on the back of the S-AV2030 and S-AV2050 Projectors accepts a 6-pin plug, MAB 6/DIN 45322, such as the one on the projector remote control. All six pins are functional. The sixth pin, compared to the 5-pin remote control used on U.S. and Canadian KODAK Projectors, is required because the remote-control circuit for the S-AV2030 and S-AV2050 Projectors operates on direct current. There is one common wire, a second wire for forward slide-tray cycling, a third for reverse cycling, and three more wires to permit reversing the low-voltage direct current so the focus motor can be operated in both directions.

### Twelve-pin DIN Plug

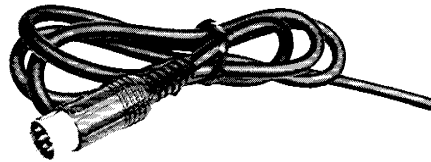
The 12-pin receptacle at the side of the S-AV2050 and S-AV2030 Projectors accepts a 12-blade plug, DIN 41622, such as KODAK CAT No. 141-4937.

### S-AV Remote Control Extension Cable

A remote extension cable is available that is compatible with the S-AV Remote Control used on Models S-AV2050 and S-AV2030. It is the KODAK CAROUSEL Remote Control Extension Cable, 4 metres (13 ft), KODAK Part No. 7863N.

### Eight-Pin Male Plug for 8-Contact Special-Applications Receptacle on EKTAGRAPHIC III Projectors

This is an 8-pin male plug cord assembly for the 8-contact special-applications receptacle on the projector, KODAK Part No. 205339; also available as Type MAS-80S, CAT No. 930 298-117, from Rye Industries, 125 Spencer Place, Mamaroneck, NY 10543, and from Marshall Electronics, Inc., PO Box 2027, Culver City, CA 90230.



### Eight-Contact Special-Applications Receptacle on EKTAGRAPHIC III Projectors

Eight-contact special-applications receptacle—with KODAK Part No. 204722 (supplied along with grille assembly); also available as Type MAS EI8S), CAT No. 930396-100, from Rye Industries; also available from Marshall Electronics, Inc.

## USING EKTAGRAPHIC PROJECTORS IN TELEVISION MULTIPLEXING SYSTEMS (SELECTING THE LENS AND LAMP)

KODAK EKTAGRAPHIC III and EKTAGRAPHIC Slide Projectors, when equipped with a KODAK EKTAGRAPHIC FF Lens, 178 mm  $f$  3.5 and an extended barrel, provide acceptably uniform illumination over the area of a 35 mm slide that is scanned by most television film cameras. However, since the projectors also provide approximately ten times the illumination required by such formats, they are generally modified with some light-attenuating arrangement to adjust the projector light output to that of other projectors providing input to the same television camera. Use of either the 175-hour ENH lamp (in Models E-2 through AF-2K) or the 200-hour EXY lamp (in EKTAGRAPHIC III Projectors) will reduce the light output of these projectors.

### Using Inconel Alloy-Coated Filters

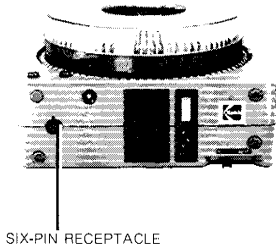
To further reduce the light output of these projectors, we recommend that you place a neutral-density filter in front of the projection lens and that you also use an iris diaphragm to make minor illumination adjustments. Inconel alloy-coated filters are recommended for this application because gelatin filters absorb the projection lamp heat and can warp.

The iris diaphragm should not close to a diameter less than  $1\frac{1}{4}$  inches (32 millimetres); about 1.4 inches (36 millimetres) is best to produce evenness of illumination and to avoid creating a depth of focus in the projector that will permit imaging of the dark central zone of the lamp reflector. Such a condition is observable as uneven illumination across the scanned area, usually darker in the center than on the edges.

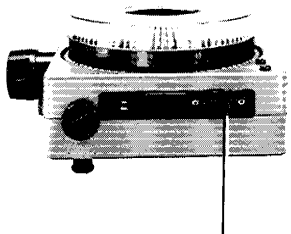
A gelatin filter can be used to color balance a projector if you position the filter so that the Inconel alloy-coated filter is situated between the projection lamp and the gelatin filter. This arrangement permits only attenuated light to pass through the gelatin filter with little possibility of heat buildup.

The amount of filtering required will depend on the characteristics of the projection multiplexing system and the brightness of the projector lamps. These two factors provide the input to the television camera. The following table shows the amount of light transmission of gelatin filters with densities of 0.01 through 2.00:

Density	% Transmission	Density	% Transmission
0.01	97	0.60	25
0.10	80	0.70	20
0.20	63	0.80	16
0.30	50	0.90	13
0.40	40	1.00	10
0.50	32	2.00	1



SIX-PIN RECEPTACLE



12-PIN RECEPTACLE

One source of iris diaphragms for the projection lens is Edmund Scientific Co., 101 East Gloucester Pike, Barrington, NJ 08007. They have a diaphragm (Stock No. 30,118) that has a maximum opening of about  $1\frac{5}{8}$  inches (42 mm) and a minimum opening of  $\frac{1}{16}$  inch (2 mm). This could be used for fine adjustment when the projector light sources are being balanced, but as indicated above, the minimum aperture should not be as small as the diaphragm permits, or uneven illumination will result.

There are no provisions on the 178 mm lens for attaching either the diaphragm or a filter holder. You will need to glue the attachments to the lens barrel with epoxy glue or employ a filter holder that will fit the lens and hold the iris diaphragm, Inconel alloy-coated filter, and color-correction filter.

### Sources of Nickel Alloy-Coated Filters

Sources	Densities of Stock Filters		Sizes
Baird Atomic, Inc. 125 Middlesex Turnpike Bedford, MA 01730	0.01 0.1 0.2 0.3 0.6 0.7	0.8 1.0 1.2 1.3 1.6 2.0	51 x 51 mm
Bausch & Lomb, Inc. 1400 N. Goodman St. Rochester, NY 14609	0.7 1.0 1.3	0.3 0.6 0.9 1.2	2-inch (51-millimetre) diameter 3-inch (76-millimetre) diameter 2 x 2 inches (51 x 51 millimetres)
Eastman Kodak Company Special Products Sales USAD, Elmgrove Plant Rochester, NY 14650	Available in most densities up to 4.0		Available in sizes up to 10-inch (254-millimetre) squares and circles on either glass or quartz
Special Optics Box G-T Little Falls, NJ 07424	0.01 0.1 0.2 0.3 0.6 0.7	0.8 1.0 1.2 1.3 1.6 2.0	2 x 2 inches (51 x 51 millimetres)

\*One source of a suitable filter holder is the Tiffen Manufacturing Co., 71 Jane St., Roslyn Heights, NY 11577.

## VENTILATION AND NOISE CONTROL

Most of the inquiries Kodak receives about projector ventilation and noise control concern the use of slide projectors in front- and rear-projection enclosures, blimps to muffle projector noise, cabinets to house a projector that must operate continuously for extended periods, and so on. The following information should answer most of these questions and will be very useful if you plan to install a slide projector in a booth or projection room.

Most electrical energy consumed by tungsten projection lamps is converted into heat. No more than about five percent of the energy used by these lamps leaves a slide projector as light. Additionally, much of the energy used by programmers, dissolve controls, and lighting rheostats becomes heat. When this happens in a projection enclosure, the elevated temperature can shorten the normal operating life of your slide projectors.

### Ventilation of Small Enclosures

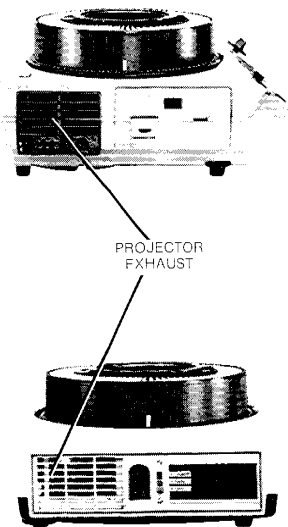
*KODAK EKTAGRAPHIC III* and *EKTAGRAPHIC Slide Projectors* incorporate fans or blowers to move fresh air through heat-producing areas of the projector. If the air supply or exhaust is blocked, the projector will overheat. Too many projection cabinets permit little or no air intake and exhaust, and the projector merely recirculates heated air inside the cabinet. The resultant overheating can often damage both the slides and the slide projector.

An air intake opening *at least* equal in area to the slide projector air intake *plus* an exhaust port of the same size *must* be provided in a projection cabinet. In addition, the cabinet air intake and exhaust opening should be adjacent to the respective projector openings. You should install a filter over cabinet air intakes, if the atmosphere contains quantities of dust and dirt. In some cases, the slide projector may not have enough power to pull sufficient air through a filter for proper cooling: small, quiet fans equipped with filter boxes are available for this purpose. There are various models capable of moving about 50 to 600 cubic feet (approximately 1.5 to 18 cubic metres) of air per minute. Even a *confined* space, such as a study carrel, may limit proper projector ventilation. For example, if you place a *KODAK EKTAGRAPHIC Slide Projector* with its back against the side of a carrel shelf, the exhaust will be partially blocked and the projector may overheat. (A projector backed into a corner may also cause warm airflow back under the projector to intakes where it may be recirculated.) To avoid these situations, place a spacing device (such as a block of wood) on the shelf to keep the projector exhaust at least 2 inches (51 mm) from the side of the carrel.

As discussed earlier, thermal fuses on the motors and in the lamp compartments of *EKTAGRAPHIC Slide Projectors* are designed to prevent dangerous overheating. These fuses should *never* be removed or bypassed. The fact that such fuses do not open (thus shutting off the projector) does not mean, however, that the projector is not overheating. Restricted airflow or other conditions can cause the temperature of the projector to rise well above normal without the danger of fire and without causing the thermal fuses to open. Such overheating will shorten motor life and may also reduce lamp and slide life.

### Ventilation of Projection Rooms or Booths

The same ventilation principles apply, but on a larger scale, when you install slide projectors in a projection room or booth. In such an area, adequate ventilation is needed not only for the projectors but also for the maximum number of occupants. Although a filtered intake fan is usually sufficient for a small cabinet, *both* forced exhaust and filtered power intake may be necessary in booths and large rooms. Ideally, these areas should be air-conditioned; while fans and filters can circulate fresh, dust-free air, efficient air conditioning can do this and control humidity as well.



## Providing Positive Pressure

Whenever possible, the filtered air-intake system should maintain a slightly positive pressure in the projection room or booth. That is, air should be *forced in* rather than pulled out. The air pressure at the intake should at least equal the pressure at the exhaust. If air is exhausted faster than it is supplied by the intake system, dust and dirt may be sucked into the projection area through unfiltered openings—the space under doors and around window casings, slits and gaps in partitions, and so on.

Although it seldom happens, it is possible to overventilate an area. Excessive cooling of tungsten-halogen lamps can lead to interruption of the halogen cycle and a shortened lamp life. High-speed streams of unfiltered air can also carry quantities of dust and dirt into slide projectors and onto the slides.

## Amount of Ventilation Required

A heating or air-conditioning engineer or consultant can calculate ventilation and heat disposal requirements on the basis of room occupancy and electrical requirements. However, the engineer may need to know from you the total amount of heat generated by the slide projectors, as well as any additional audiovisual equipment. This heat is governed largely by the wattage of equipment components that will be used in combination. Thus, if two slide projectors are available but only one is used at a time, there is no need to provide cooling or ventilation for two projectors. On the other hand, if the two projectors are used simultaneously but only for a few minutes or seconds out of an hour, it is not necessary that you provide ventilation and cooling for both projectors. However, if both are consuming maximum power (even though one is not actually projecting), ventilation for both must be supplied.

## Determining the Amount of Heat Produced

To compute the heat produced per hour by any piece of audiovisual equipment, the power consumption (watts, kilowatts, or amperes) must be converted to Btu's (British Thermal Units). The power rating can usually be found on the nameplate of the AV equipment. For example, the *EKTAGRAPHIC* III Projector uses a total of 400 watts. Multiply 400 by 3.4 (each watt the projector uses generates 3.4 British Thermal Units) and the heat output is 1,360 Btu's per hour.

In the following examples, these facts are necessary for the calculations of Btu's:

- 1 kilowatt (1000 watts) generates approximately 57 Btu's (60,000 joules\*) per minute or about 3400 Btus (3608 kilojoules) per hour.
- 1 watt (0.001 kilowatt) generates about 3.4 Btu's (3608 joules) per hour.
- To convert amperes to watts, multiply amperes by voltage (either the power source operating voltage or the maximum required voltage as stated on the equipment nameplate).

### Examples:

- Component uses 
$$\begin{array}{r} 700 \text{ W} \\ \times 3.4 \\ \hline 2380 \text{ Btus generated per hour} \end{array}$$

or

$$\begin{array}{r} 0.7 \text{ kW} \\ \times 3400 \\ \hline 2380 \text{ Btus generated per hour} \end{array}$$

- Component power requirement—110 to 125 volts ac, 3 amps

$$\begin{array}{r} 3 \text{ A} \\ \times 125 \text{ V} \\ \hline 375 \text{ W} \\ 375 \text{ W} \\ \times 3.4 \\ \hline 1275 \text{ Btus generated per hour} \end{array}$$

One cubic foot (0.03 cubic metre) of air per minute should be circulated in the projection area for each 10 W of power used by a projector. When calculating the total heat load for the projection room or booth, remember to include (besides the audiovisual equipment) such things as lights, rheostats, and the number of people that will occupy the room during a slide presentation.

Ventilation, although extremely important, is only one of the many factors you should consider in the design of a projection area. Before you begin construction, be sure to check your local building codes for specifications on the type of wiring required, the use of fireproof building materials, and soundproofing.

\*1 Btu equals approximately 1055 joules.