VOLUME 3200A

1/83

CARAMATE
3100 - 3200

SERVICE INSTRUCTIONS

TELEX®

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SECTION I GENERAL INFORMATION

A. INTRODUCTION

This manual has been prepared as a guide for service and maintenance of the CARAMATE 3100 & 3200 PROJECTORS. Obvious procedures are not stated.

B. PRINCIPLES OF OPERATION

The CARAMATE 3100 PROJECTOR is a front screen projector utilizing 2 x 2 slides. The CARAMATE 3200 PROJECTOR is a front screen projector utilizing 2 x 2 slides synchronized with a monaural tape program.

The visual program of the 3200 projector is synchronized to the audio by using a monaural track cassette on which the control pulse is recorded on tracks 3 and 4. The audio is recorded on tracks 1 and 2.

1. DRIVE CLUTCH

When the main power switch is on, torque from the motor, thru the neoprene drive belt, to the pulley and worm gear (not illustrated) will drive the cam worm gear (Figure 1-1)

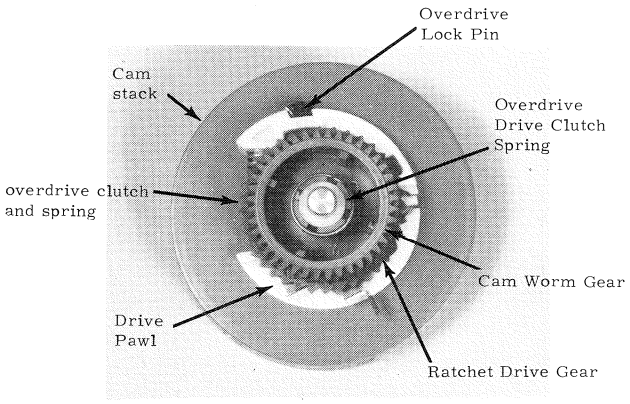


Figure 1-1. Drive Clutch.

In Idle condition, the cam worm gear is driven, but drive clutch spring allows it to slip on its shaft. The drive pawl is held "open" by the escapement lever (Figure 1-2) and the cam stack does not turn.

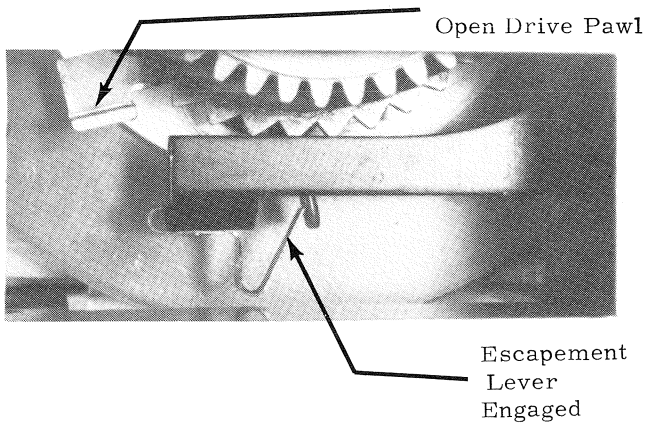


Figure 1-2. Drive Clutch in Idle Condition.

In Drive condition, the escapement lever, linked to the solenoid, is pulled to release the drive pawl which swings "closed" (Figure 1-3) to engage the ratchet drive gear. Now the cam worm gear, coupled thru the overdrive clutch and its lock pin, turns the cam stack one revolution or one slide change cycle.

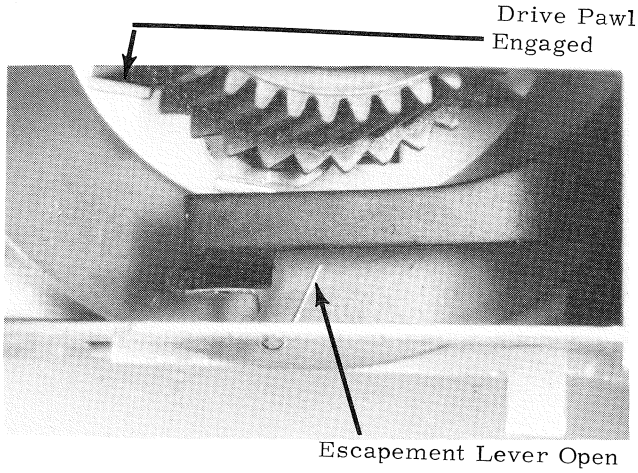


Figure 1-3. Drive Pawl in Drive Condition.

A jammed slide or tray will obstruct lever movement and cause a binding load on the cam stack. In this case, the overdrive clutch releases at its lock pin (Figure 1-1) to complete the cycle to the idle condition without damage and to hold this condition until the jam is cleared.

NOTE: Timing of cams, levers or drive gears is not required by this mechanism.

2. SELECT SLIDE OPERATION

a. Electrical

Electrically, the select operation is the simplest function since it does not use any of the transistor logic circuits. Contact is made through the power supply to the continuous duty solenoid which is held in as long as the button is depressed.

b. Mechanical (Figure 1-4). Mechanically, two events occur and at the same time. The solenoid is energized which pulls the escapement allowing the select pawl to drop. The select pawl will now catch the drive pawl, after the cams rotate 180°, and hold it released as long as the select button switch is closed to energize the solenoid.

The select button presses the select arm to pull the link and select lever forward so that the cam follower pin is disengaged, inactivating the tray index. The slide lifter and tray detent will function to lift the slide and allow the slide tray to rotate manually.

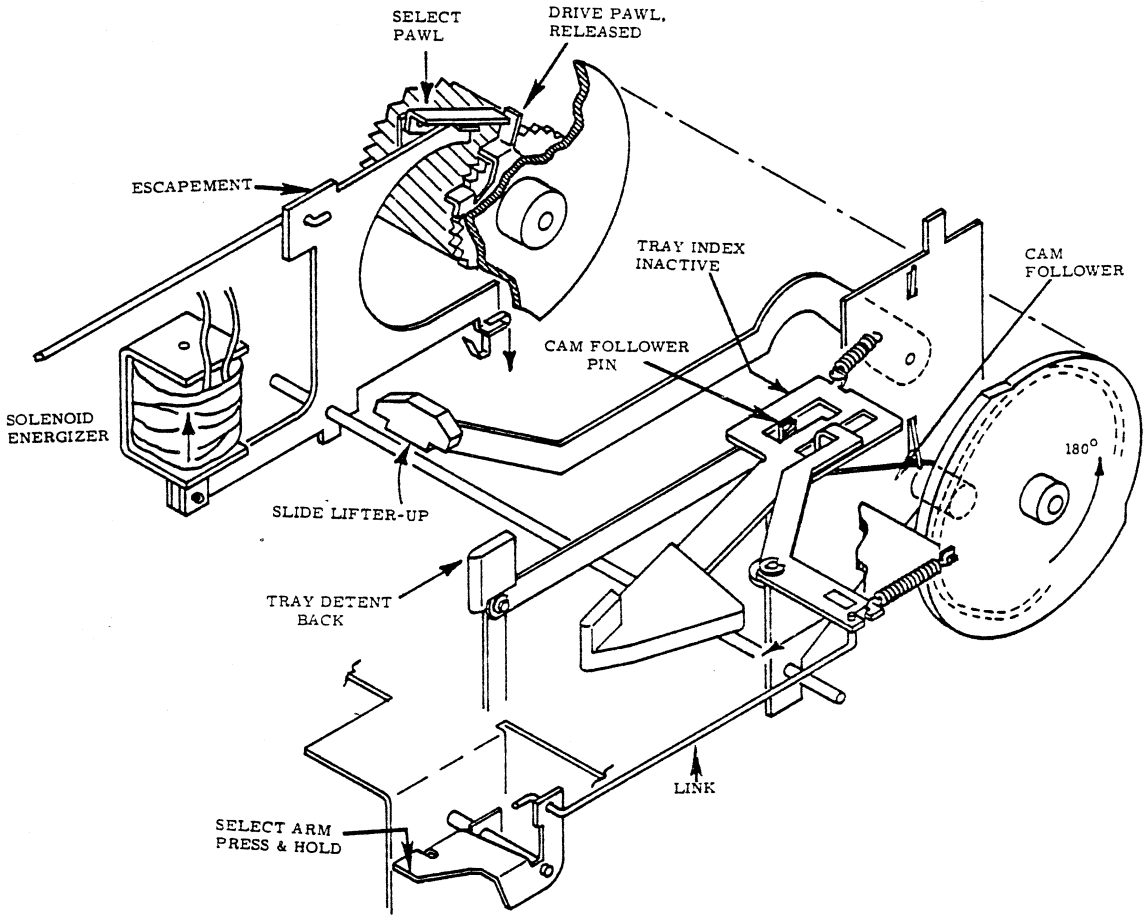


Figure 1-4. Select Operation. (Hold Position).

3. ADVANCE OPERATION

a. Electrical

Electrically, the solenoid, controlled by the logic circuit, pulls in for only 120 milliseconds to release the mechanical drive. See Circuit Description Section IV, B.1 Manual Advance.

b. Mechanical

Mechanically, the drive clutch(Figure 1-1) is released(Figure 1-3). The cams rotate to drive the Tray index arm forward (Figure 1-5). The tray index pin guides along the "front V" of the front/ rear cam to advance the slide tray to the next slide.

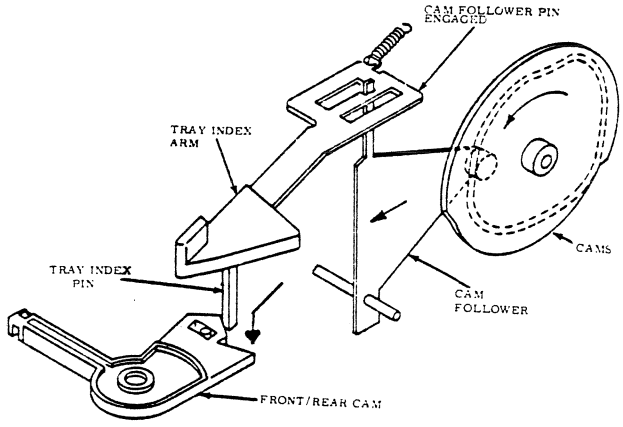


Figure 1-5. Advance Operation

4. REVERSE OPERATION

a. Electrical

Electrically, the solenoid, controlled by the logic circuit, pulls in and holds for 400 milliseconds to release the mechanism drive and position the front/rear cam. For logic details, See Section IV, B.2 Manual Reverse.

b. Mechanical

Mechanically, the drive clutch (Figure 1-1) is released(Figure 1-3). Then the cams rotate 120° while the solenoid holds the front/rear cam back for 400 milliseconds(Figure 1-6). The cam follower pin drives the tray index arm and its pin forward to guide along the "Rear V" of the front/rear cam to reverse the slide tray rotation to the previous slide.

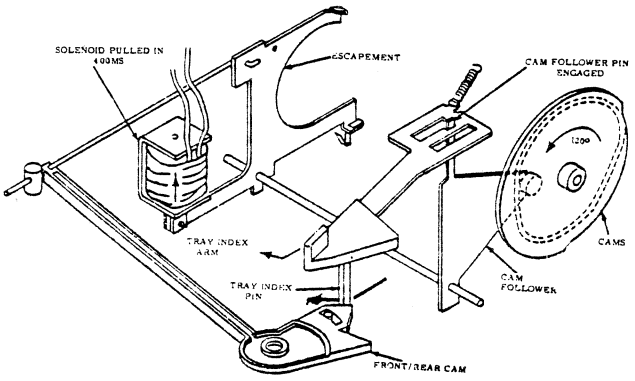


Figure 1-6. Reverse Operation

5. DETENT (Slide Tray Lock).

The detent locates and locks the slide tray slot over the mechanism slide guides assuring that the slide will drop by gravity into the project position.

The cam, cam follower and levers provide drive to the detent. The cam assembly is designed so that the detent locks the tray until the lifter is up and the slide 80% within its tray slot. Then the detent pulls back until the tray is indexed. The detent locks the tray before the lifter drops the next slide. There is no adjustment.

6. SHUTTER AND SLIDE CLAMPS (Figure 1-7)

The cam follower lever controls shutter closure and cams face clamps open. Coil springs control the face and edge clamps and provide a lever override.

Operation - the slide is registered toward the center by the edge clamp. At this time the slide, in the gate, releases the latch (1)... this allows springs to pull cam follower (2) and open shutter blades (3). At the same time, the slide face clamps are spring loaded against the slide.

When the slide is ejected, the cam follower is driven up to close shutter blades and open side clamp. The face clamps are closed until the slide is about 80% up and in the tray. Then the cam follower cams the face clamps open and holds to receive the next slide. If there is no next slide, the cam follower drops a bit to close face clamps and latch on the edge clamp.

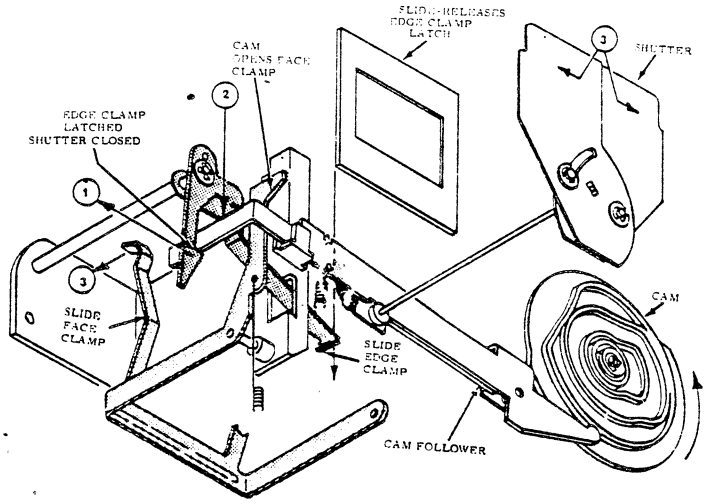


Figure 1-7. Shutter and Slide Clamp Operation

C. SPECIFICATIONS

Width:	Height:	Depth:	Weight:
13.650"	5.70"	13.160"	18 pounds
34.7 cm	14.48cm	33.4 cm	8.2kg

OPTICAL SYSTEM: 125mm. 5" F/3.2 Sestar lens. The 3200 will accept all Kodak Carousel* and Ektagraphic* curved field and flatfield lenses.

PROJECTION LAMP:

Type	Code ANSI	Lampswitch Position	Relative Brightness	Average Life in Hours
Standard	"ELH" 300 watt	"Lo"	70%	125
p/n 44295-P3	120 volt	"Hi"	100%	35
Long Life	"ENH" 250 watt	"Lo"	50%	500
Local Purchase	120 volt	"Hi"	65%	175

AMPLIFIER: 3200 — 5 watt RMS continuous, with total harmonic distortion less than 5%

SPEAKER: 3200 — 3" x 5"(7.69cm x 12.85cm) oval, base mounted for 360 degress sound dispersion.

SPEAKER JACK :3200 — Standard $\frac{1}{4}$" (6.25mm) jack. Use an 8 ohm impedance external speaker. For headset usage: 8-2000 ohm impedance headset should be used.

POWER REQUIRED:

DOMESTIC 120V- 60 Hz.	INTERNATIONAL 220/240V- 50Hz	OPTIONS
3230	3234P	Front only / Sound, Auto Focus
3130	3134	Front only/ Silent, Auto Focus
3260		Front only/ Sound, Auto Focus- Dissolve

SLIDE ACCEPTANCE: Will accept all transparencies mounted in 2 x 2 slides meeting the ANSI Standard PH3.43(1977) specifications

Size	Thick Slides	Thin Slides
Size	2.000" to 1.969"	1.988" to 1.957"
Thickness	0.126" to 0.055"	0.055" to 0.040"
Flat within	0.126"	0.083"

Will accept all circular slide trays and stackload devices manufactured for use with the Kodak Carousel* projector.

(Note:*A Trademark of the Eastman Kodak Company)

TAPE DECK: The 3200 accepts all compact cassettes. Rewind time is approximately 95 seconds for a C-60 cassette. Forward tape speed is 1.875 ips (4.80 cm/s) and is mechanically governed. Auto-Stop at the end of tape travel is signaled by a lighted tape indicator. A single function lever controls all modes of tape transport. For sound/slide synchronization the tape cassette should be prerecorded and pulsed in accordance with ANSI Standard PH 7.4 and proposed IEC Standard.

AUDIO LEVEL: -4 db referenced to 250 nWb/m at 315 Hz.

ADVANCE PULSE: Frequency: 1000 Hz. ±5% (Slide advance pulses on tracks 3 and 4. Audio program on tracks 1 and 2. Tape plays in one direction only.)

Spacing: minimum of 1.5 seconds between start of one pulse and start of adjacent pulse.

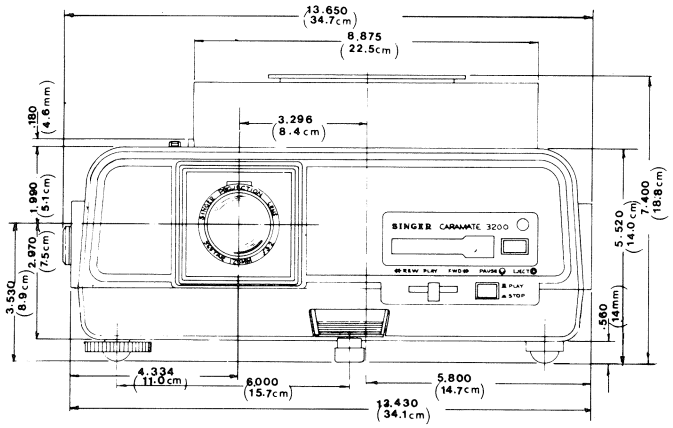
STOP PULSE: Frequency: 150 Hz ±5% (Stop Pulses recorded on tracks 3 and 4).

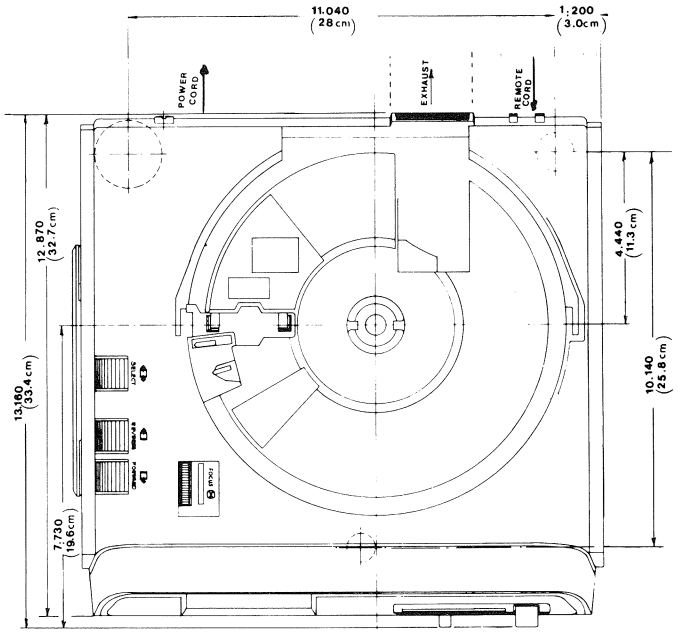
Spacing: 2.0 seconds minimum between end of stop cue and start of recorded material.

PULSE DURATION:
(Advance & Stop) 0.45 ±0.07 seconds

PULSE LEVEL:
(Advance & Stop) -6 db ± 3 db referenced to 250nWb/m at 315 Hz.

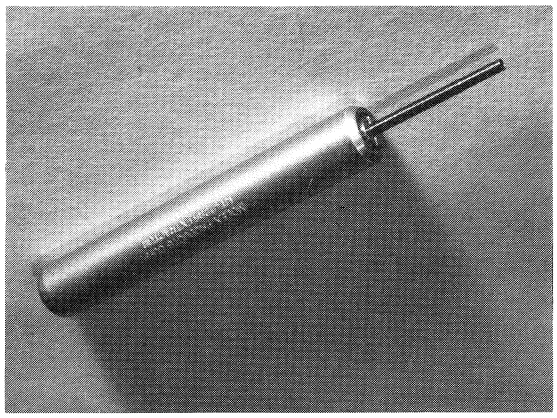
EXTERNAL DIMENSIONS
(All dimensions are in inches with metric equivalents given parenthetically)





D. TOOLS

Molex Extractor # HT-2285
19-708 Alignment Slide
19-711 Test Tapes (SS-345)
19-714 Torque Cassette, Hartak # X-87
Head Alignment Cassette -(Local Purchase)
Tape Head Demagnetizer - (Local Purchase)
Slide Tray with Slides - (Local Purchase)
General Hand Tools
Multimeter
Oscilloscope
VTVM
Tool Kit (SS-363)
Torque Wrench (G17-38000)
Electric Drill Chuck having 3/8 x 24 Thread



Molex Terminal Extractor # HT-2285

E. MATERIALS

Materials required are listed in the following table. The stock numbers of the material available from Singer Education Systems are included. If no number is given, the product is commercially available and not supplied by Singer Education Systems.

39479-P9 DC-44 Light consistency silicone grease (Dow Corning Corp., Midland, Michigan), 2 oz.

39479-P16 Extreme Pressure Lube #3 (Evans Product Co). 4 oz.

39479-P1 Glyptal 7526 (Blue) General Electric Co., Schenectady, N. Y.

39479-P2 Glyptal 1276 (Clear) General Electric Co, Schenectady, N. Y.

46464-P1	Tape, 3 M Co. #4416, 9 yd roll.	Local Purchase	Plastic Cleaner
Local Purchase	Denatured(Isoproyl) alcohol	Local Purchase	Glass Cleaner
Local Purchase	Benzine	Local Purchase	Cotton swabs
Local Purchase	Dry Neolubé (Huron Industries, Port Huron, Michigan)	Local Purchase	Pipe cleaners

F. ACCESSORIES

Cat. No. 3290	Hard Carrying Case
Cat. No. 3290S	Hard Carrying Case (w/speaker)
Cat. No. 3295	Remote Control Cord (12 ft.)

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SECTION II PREVENTIVE MAINTENANCE

A. UNIFORM SCREEN ILLUMINATION-MIRROR ADJUSTMENT

1. Visually inspect the screen illumination by inserting an empty slide to trip the shutter and project the light onto a screen. If the illumination is not even side-to-side and top-to-bottom, the lamp mirror will reqúire adjustment.
2. Use a normal focal length projection lens (about 5") and move the lens out to the end of its focusing rack. Position an index card in front of the lens and observe the dark filament spot in respect to the center of the circle illumination.
3. Turn the lamp "OFF".
4. Open the lamp door.
5. Horizontal adjustment is made by loosening the horizontal locking screw. Place a tip of a flat screwdriver blade in the fine adjustment slot and swing the mirror mounting plate.
6. Vertical adjustment is made by turning the vertical screw in or out to change the tilt of the mirror.
7. Close and secure the lamp house door after each adjustment and inspect the dark filament that is to be centered in the illuminated circle.

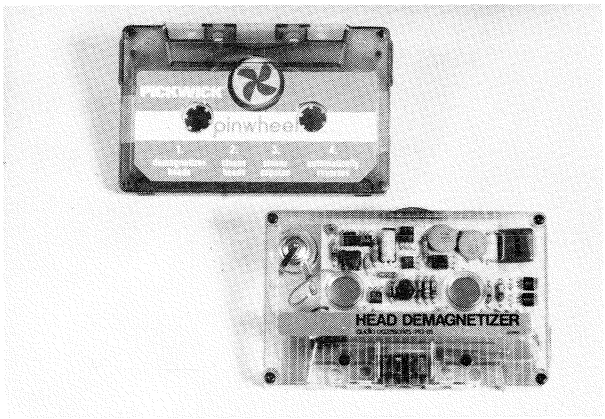
B. RECORDING AND PLAYBACK HEADS

To clean the recording or playback heads, use a commerical head cleaning cassette or moisten a clean cotton swab with denatured (ISOPROPYL) alcohol only. DO NOT use any sharp objects that will scratch or mark the head.

Push the cassette trap door open with a pencil or other blunt instrument and push in on the tab of the cassette ejecting slide until the cassette holder drops down into position. (This tab extends down from the top of the cassette holder about halfway back into the holder, almost directly above the take-up reel.) Hold the trap door open and clean the tape head, capstan and pinch roller with a cotton swab moistened with isopropyl alcohol. (It is easier to clean the capstan and pinch roller with the tape deck runing. However, care should be taken that the cotton does not come loose and wrap around the capstan and pinch roller. Removal of the tape deck from the projector will be then necessary to correct this problem.

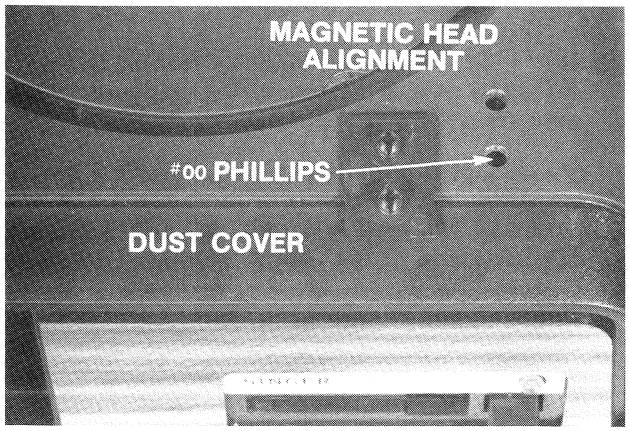
C. DEMAGNETIZE TAPE HEAD

Demagnetize tape playback head using T. D. K. HD-01 or equal head demagnetizer.

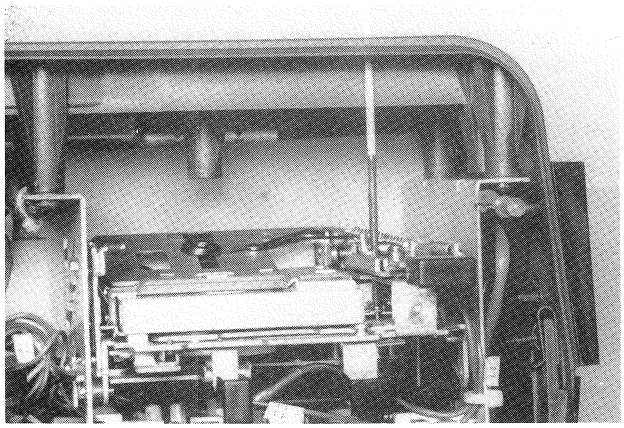


D. ALIGNMENT OF THE TAPE HEAD AZIMUTH

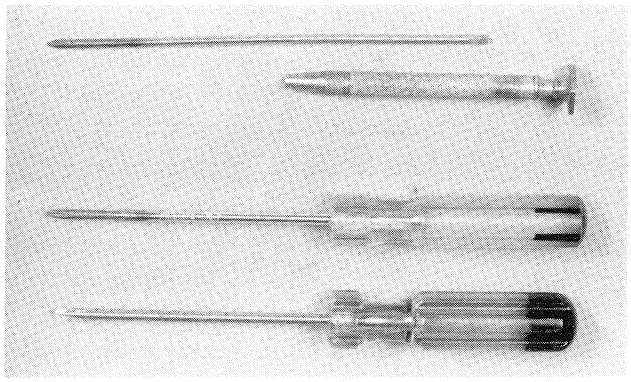
To adjust the azimuth of the tape head, lift the dust cover, insert a No. 00 Phillips screwdriver, 3" long straight down through the front hole.



The screwdriver, Straight down, will pass through a chassis hole and directly into the tape head azimuth screw. Using a 6.3 KHZ azimuth tape in the tape recorder, adjust for maximium output. The most accurate adjustment will be made with a meter clipped across an 8 ohm dummy load or external speaker plugged into the speaker jack.



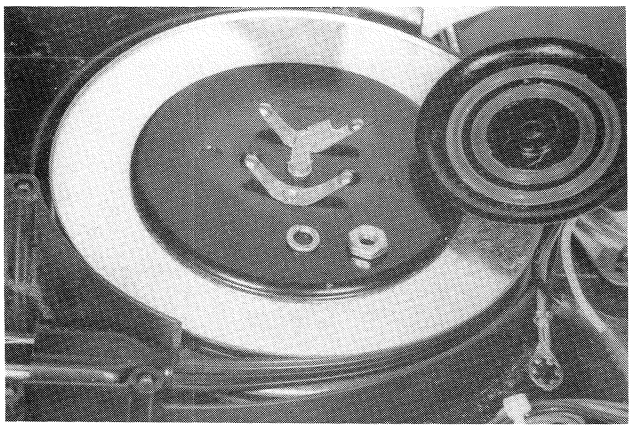
A screwdriver to make this adjustment may not be available. #0 Phillips screwdriver can be modified by turning the end diameter to .100" diameter (2.5mm) or a jewelers screwdriver may be modified by making a special tip about $4\frac{1}{2}$" long by .100" diameter.



E. RETRACTABLE POWER CORD REEL

If the power cord fails to retract, it could be that the wiper contact is too high or there may be friction on the center post screw.

a. Disassemble as shown and apply 1 or 2 drops of light oil on the center post.
b. Add a flat washer about .020" thick under the contact plate if necessary for better rewind.



F. SLIDE LIFTER HEIGHT

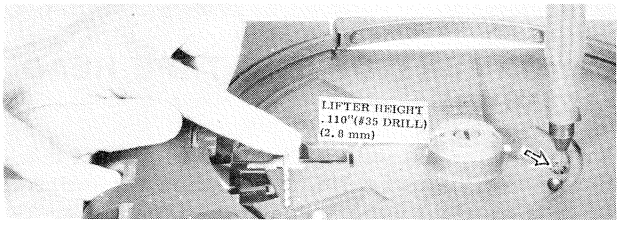
1. Remove the dust cap which is located opposite the slide gate on the top of the projector. This exposes the adjustment screw.

2. Press and hold the SELECT button.

3. Place a .110" diameter (No. 35) drill beside the lifter pad on the end of the slide lifter arm.

4. Using a .050" hex wrench, turn the screw until the lifter pad is flush with the top of the drill. Do not turn this screw over 3 turns in either direction during this adjustment.

5. Check rotation with loaded trays of 80 and 140 slides. If the lifter is too high, the 140 tray could rotate roughly. In this case, reduce the height and recheck both trays.



Alternate Method

1. Place a loaded 80 slide tray on the projector.

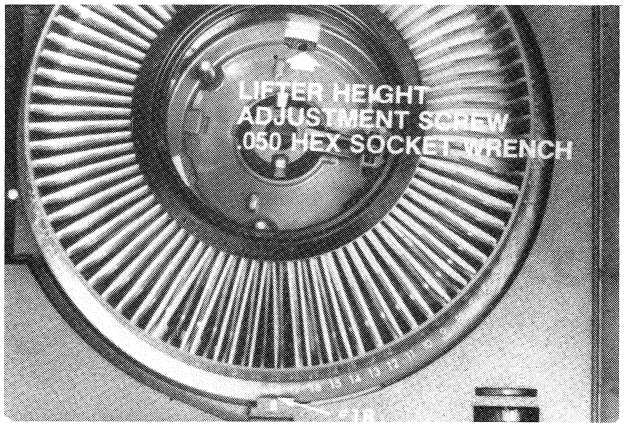
2. Depress the SELECT button and turn the slide tray to the No. 18 slide.

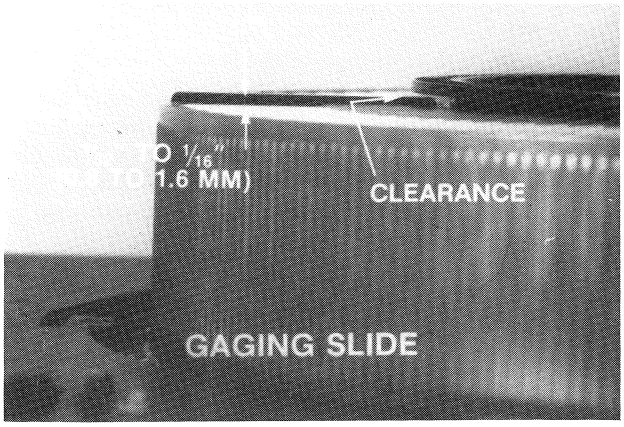
3. Holding the SELECT button depressed, turn the slide lifter adjusting screw with your tool through the slot in the slide tray until the No. 18 slide is approximately 1/16" above the adjacent slides.

4. The No. 18 slide should not touch the locking ring. If the slide touches the locking ring, a clicking noise will be heard during normal operation.

5. Remove the hex wrench. Hold the SELECT button and rotate the slide tray. The tray should turn freely with no hang up.

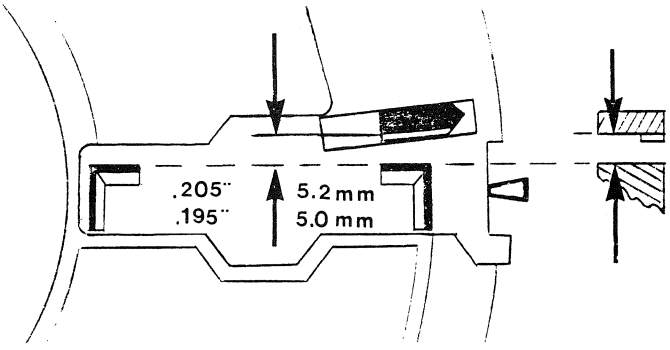
6. Check rotation with loaded trays of 80 and 140 slides. If the lifter is too high, the 140 tray could rotate roughly. In this case, reduce the height and recheck both trays.





G. DETENT ARM ALIGNMENT

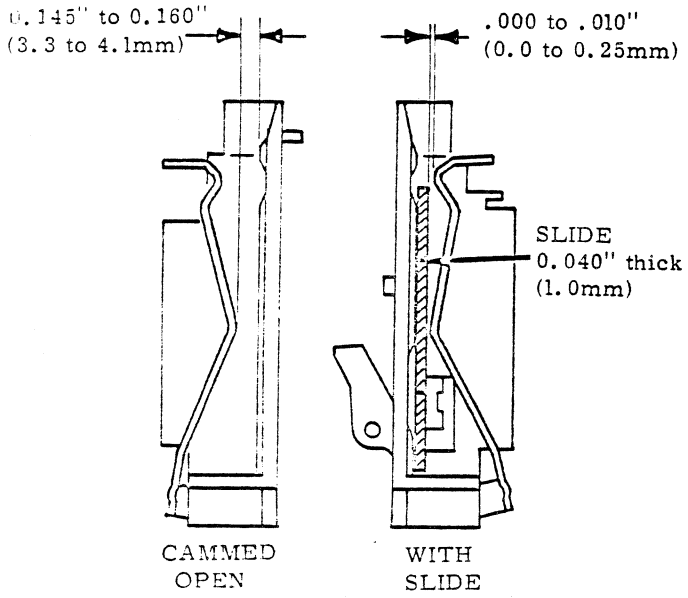
Use feeler gages to check the clearence between the detent finger and slide guide.
Adjust by finger pressure on the detent finger or lower on its vertical arm.



Detent Arm Alignment

H. FACE CLAMPS

Check slide face clamps as dimensioned below. The "Cammed Open" dimension can be measured when the "Select" button is depressed.



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SECTION III MECHANICAL ADJUSTMENTS AND SPECIFICATIONS

A. AUTO-FOCUS

The Auto-Focus feature automatically maintains a correctly focused projected image once this image is established by the operator of the projector. It does this by continuously monitoring the distance between the slide film plane and a Sensor which is connected to the projection lens through a series of clutches. If anything happens to change this distance, such as the surface of the slide "popping" from the heat of the projection lamp or variations in slide mountings, etc., the Sensor "sees" the change and sends a command to electronic circuitry to drive a motor which moves the sensor and lens back to the original, manually established distance from the film plane. Thus the projected image is maintained in focus.

The Auto-Focus mechanism is designed for use with standard, open frame slide mounts. It may operate erratically with glass slide mounts. This is due to the reflective nature of the glass surface of these mounts. It is therefore suggested that the Auto-Focus switch be turned "OFF" when projecting glass mounted slides.

The Operational Check provides a means to determine whether the Auto-Focus mechanism is in need of adjustment.

The Adjusting Procedure establishes the correct limits of movement or range of vision for the Sensor.

The "Null" Adjustment establishes the maximum Sensor travel approximately .023" beyond what is considered to be the worst possible slide mount and film buckle condition. (Figure 1) This insures that the Sensor has sufficient travel to track virtually any slide.

CHECKING SENSOR RANGE OF VISION

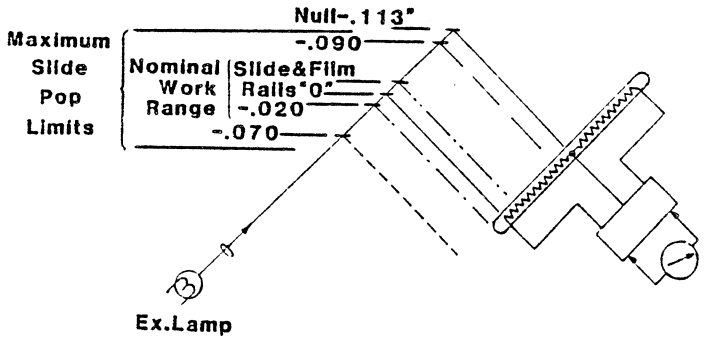


Figure 1. Null Position

Considering that the popular slide mount is .040" thick, the slide film plane will be nominally .020" behind the film rails (Figure 2). From this .020" film position, the range of vision of the Sensor should be .070" back and .090" forward of the film plane. These limits should encompass most variations of mount thickness and film buckle.

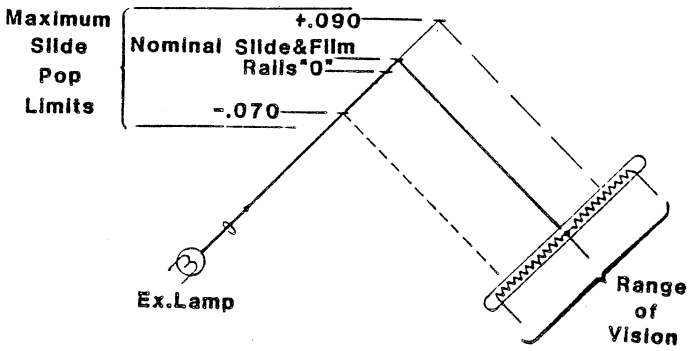


Figure 2. Focused On Film

Note: Films that have extreme buckle or curve may require manual or remote focus adjustment to achieve the best overall focus due to the unusual film surface conditions. Remounting slides exhibiting these characteristics may alleviate this problem.

1. MATERIAL

Materials required to check and adjust the Auto-Focus mechanism are as follows:

a. 80 slide tray with slides.

b. Auto-Focus tool/gauge kit SS-363

c. Torque wrench G17- 38000.

d. Electric drill chuck having 3/8 X 24 thread. (e.g. Sears #9GT2975)

e. General hand tools.

2. OPERATION CHECK

a. Load an 80 slide tray with slides in various types of mounts (DO NOT USE GLASS MOUNTS). It is suggested that every other slide be inserted backward, and every ninth slide be one whose surface has been bent, creased or otherwise distorted (this is to check the Auto-Focus mechanism for "runaway").

b. Turn the projector "ON", operate the Lamp switch to "HI" and make sure the Line (Mains) voltage is maintained at 120 volts AC ±1/2 volt throughout this check.

c. Install the tray on the projector and project the first slide.

d. Operate the Auto-Focus switch "ON" and allow the Auto-Focus mechanism time to react (the manual focus wheel will move when the Auto-Focus mechanism is making its adjustments).

e. When the manual focus wheel stops moving, manually focus the projected image for the sharpest picture.

f. Turn the Automatic Timer "ON" and adjust it to change slides at 4 or 5 second intervals.

g. Each slide should come into focus, and no change of focus should have occurred when the #1 slide reappears on the screen at the end of the test.

h. The Auto-Focus mechanism should not "run away" when focusing on the bent or creased slides.

j. If the projector fails step g.above, the Auto-Focus slip clutches must be serviced. Refer to the instructions under Auto-Focus Slip Clutch Servicing.

k. If the projector fails step h above, the Auto-Focus Exciter Lamp and Sensor must be serviced as instructed under Auto-Focus Mechanism Adjustments.

3. AUTO-FOCUS MECHANISM ADJUSTMENTS

Checking Auto-Focus Runaway

Auto-Focus tool/gauge kit SS-363 will be required to make the following tests and adjustments. Tools and gauges referenced in these instructions are part of this kit unless otherwise noted.

a. Turn the projector "ON" and operate the Lamp switch to "HI".

b. Make sure the Line (Mains) voltage is 120 volts AC ±1/2 volt for all Auto-Focus Mechanism Adjustments.

c. Insert the Red test gauge (45706 + 090) and turn the Auto-Focus switch "ON". Allow time for the auto-focus to come to rest, and manually focus the target hole for a sharp image.

d. Turn the Auto-Focus switch "OFF", remove the Red test gauge and insert the Yellow test gauge (45706 - 073)

e. Turn the Auto-Focus switch "ON".

f. The Auto-Focus **must not** focus on the Yellow gauge.

g. If the Auto-Focus attempts to focus on the yellow gauge, remove the gauge and perform the AUTO-FOCUS EXCITER LAMP ADJUSTMENT and the EXCITER LAMP"Ghost"IMAGE ADJUSTMENT and and the AUTO-FOCUS "NULL" ADJUSTMENT.

h. If the Auto-Focus does not attempt to focus on the Yellow gauge, turn the Auto-Focus switch "OFF", remove the Yellow gauge and insert the White alignment slide (19-712A). Continue with CHECKING AUTO-FOCUS TRACKING (RANGE OF VISION).

4. CHECKING AUTO-FOCUS TRACKING (Range of Vision)

a. Make sure the Auto-Focus switch is "OFF" and the White alignment slide (19-712A) is in the projector.

b. Turn the Auto-Focus switch "ON" and allow the Auto-Focus to come to rest (the manual focus wheel stops moving). Manually focus the target hole for a sharp image.

c. Turn the Auto-Focus switch "OFF", remove the White alignment gauge (19-712A) and insert the Red test gauge (45706 + 090).

d. Turn the Auto-Focus switch "ON". The Auto-Focus must focus sharply on the target hole.

e. Turn the Auto-Focus switch "OFF", remove the Red gauge and insert the Blue gauge (45706 - 020).

f. Turn the Auto-Focus switch "ON" and make sure the Auto-Focus produces a sharply focused target hole.

g. Turn the Auto-Focus switch "OFF", remove the Blue gauge, reinsert the White alignment gauge (19-712A), turn the Auto-Focus switch "ON" and make sure the Auto-Focus produces a sharply focused target hole.

h Turn the Auto-Focus switch "OFF", remove the White gauge, insert the Yellow gauge (45706 - 070), turn the Auto-Focus switch "ON" and make sure the Auto-Focus produces a sharply focused target hole.

j. If the Auto-Focus does not react to this series of test gauges, in this sequence, perform the Auto-Focus Exciter Lamp Adjustment and the Auto-Focus "Null" Adjustment.

5. AUTO-FOCUS EXCITER LAMP ADJUSTMENT

a. Turn the projector "OFF", insert the White alignment slide (19-712A) with the parallel lines running vertically, and remove the projection lens.

b. Tip the projector upside down and remove the projector base and front bezel.

c. With the projector still upside down, hold the shutter blades fully open by hooking one end of a rubber band under the shutter blade actuator pin which protrudes through the shutter blades, and the other end of the rubber band over the upper housing rear tab.

d. Turn the projector "ON". (The Lamp switch must be left "OFF" to prevent overheating and damage to the shutter blades.

e. The projected image of the exciter lamp filament, resembling a straightened or flattened "S" (occasionally a sideways "V"), must appear between the two vertical lines on the test slide.

f. To adjust, loosen the two screws which hold the exciter lamp lens housing to the projector. Move the entire lens housing until the "S" image falls between the two vertical lines on the test slide.

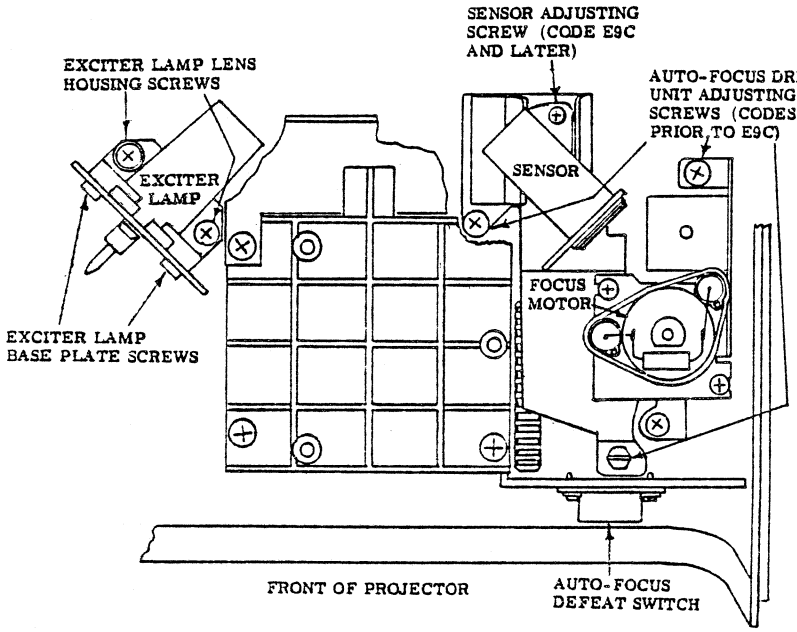


Figure 3. Exciter Lamp Housing

g. Tighten the lens housing screws.

Note: The "S" ("V") image should be quite clearly defined. A general halo of light around the "S" ("V") is acceptable. However, if a "ghost" or secondary "S" ("V") image can be seen to the right of the main image, (as viewed with the projector upside down), the exciter lamp must be adjusted within its lens housing.

h. If the Auto-Focus exciter lamp has been adjusted, the Auto-Focus "Null" adjustment MUST BE MADE.

6. EXCITER LAMP "Ghost" IMAGE ADJUSTMENT

a. Loosen the two small screws which hold the exciter lamp in the lens housing. (Figure 3)

b. Slide the exciter lamp base plate to either side (generally to the left) until the main filament image and the "ghost" image are superimposed. (It may be helpful to deliberately move the base plate all the way to the right to force the "ghost" image to appear and then move the base plate to the left until the two images are superimposed as described above.)

c. Tighten the exciter lamp base plate screws and recheck the adjustments made in steps e through h under AUTO-FOCUS EXCITER LAMP ADJUSTMENT above.

7. AUTO-FOCUS "Null" ADJUSTMENT (SENSOR Alignment)

a. Before adjusting Auto-Focus "Null", perform the Auto-Focus Exciter Lamp Adjustment.

b. Remove the White alignment slide (19-712A) and insert the "Null" gauge (45706 + 113).

c. Make sure the projector is "ON" and maintain the Line (Mains) voltage at 120 volts AC ±1/2 volt.

d. Turn the Auto-Focus switch "ON" and allow the focus motor to move the Sensor all the way back toward the "Null" gauge. When the Sensor is as far back as it will go, the focus motor should stop driving.

(1) If the motor does not stop driving, the "Null" adjustment is incorrect. Proceed to step e.

(2) If the motor stops driving, push the top of the "Null" gauge slightly toward the back of the projector. The motor will start to drive again but the Sensor should not move.

(3) Release the "Null" gauge so it returns to its rest position.

(4) The motor should stop driving and the Sensor should not move.

Note: If the Sensor moves either in step 2 or 4, the "Null" adjustment is incorrect. Proceed to step e.

(5) If all the requirements of this step are met, skip step e and proceed directly to step f.

e. Adjust the Auto-Focus Sensor until the requirements of step d are satisfied. (Figure 3)

(1) For production codes starting E9C - The Sensor Lensmount Assembly is movable. Loosen the screw in the slotted hole of the Sensor Lensmount which holds it to the base. (This screw is accessible with a #0 phillips screwdriver below the back edge of the P/C board.) Swing the Sensor Lensmount Assembly to the point where the requirements of step d are satisfied.

(2) For production codes prior to E9C - It is necessary to move the complete Auto-Focus Drive Unit. Remove the P/C board mounting screws and lift the board but DO NOT disconnect any of the plugs. Slightly loosen the three Drive Unit mounting screws and move the entire assembly within the screw hole limits until the requirements of step d are satisfied. Reassemble the P/C board.

f. Turn the Auto-Focus switch "OFF".

g. Insert the Red test gauge (45706 + 090) and turn the Auto-Focus switch "ON". Allow time for the Auto-Focus to come to rest.

h. Turn the Auto-Focus switch "OFF".

j. Remove the Red test gauge and insert the Yellow test gauge (45706 - 073).

k. Turn the Auto-Focus switch "ON".

m. The Auto-Focus must not react to the Yellow gauge.

n. If the Auto-Focus reacts to the Yellow gauge, replace the Exciter Lamp (45765-G1) and/or Lensmount (45761-G1) and repeat AUTO-FOCUS EXCITER Lamp adjustment and the EXCITER LAMP "Ghost" IMAGE ADJUSTMENT and AUTO-FOCUS "NULL" ADJUSTMENT.

o. If the Auto-Focus does not react to the Yellow gauge, turn the Auto-Focus switch "OFF", remove the Yellow gauge and insert the Blue gauge (45706 - 020).

p. Turn the Auto-Focus switch "ON" and make sure the Auto-Focus reacts to the Blue gauge.

q. Turn the Auto-Focus switch "OFF", remove the Blue gauge, insert the White gauge (19-712A), turn the Auto-Focus switch "ON" and make sure the Auto-Focus reacts to the White gauge.

r. Turn the Auto-Focus switch "OFF", remove the White gauge, insert the Yellow gauge (45706 - 073) and turn the Auto-Focus switch "ON".

s. The Auto-Focus motor should drive the Sensor toward the front of the projector but should stop before the Sensor reaches the limit of its movement in this direction.

t. If the Auto-Focus does not react to this series of test gauges, in this sequence, replace the Exciter Lamp (45765-G1) and/or Lensmount (45761-G1) and/or Auto-Focus Mechanism (45735-G7) and repeat AUTO-FOCUS EXCITER LAMP ADJUSTment and the EXCITER LAMP "Ghost" IMAGE ADJUSTMENT and AUTO-FOCUS "NULL" ADJUSTMENT.

u. When all the requirements for the Auto-Focus Exciter Lamp and "Null" adjustments are met, reassemble the front bezel, base and projection lens and recheck the AUTO-FOCUS RUNAWAY and TRACKING per the previous procedure.

B. REMOVAL OF DRIVE UNIT

To remove the Drive Unit, the Power Supply Circuit Board and the Projection Lens Lower Housing and Wiring Harness Tray must be removed first.

1. Remove the screws, retainer clip and washer from each end of the jack shaft.
2. Remove one hex head screw from the front and two screws from the back of the auto focus drive bracket.
3. Lift the drive unit from the projector.

The sensor must slide smoothly in its track with only about 4 oz. of pressure. Wipe the guide rails with a hard paste wax. Caution should be used when disassembling because the spring will eject the plastic guide button that could be lost.

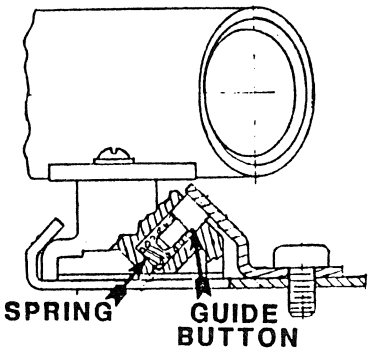


Figure 5. AUTO-FOCUS SENSOR GUIDE BUTTON

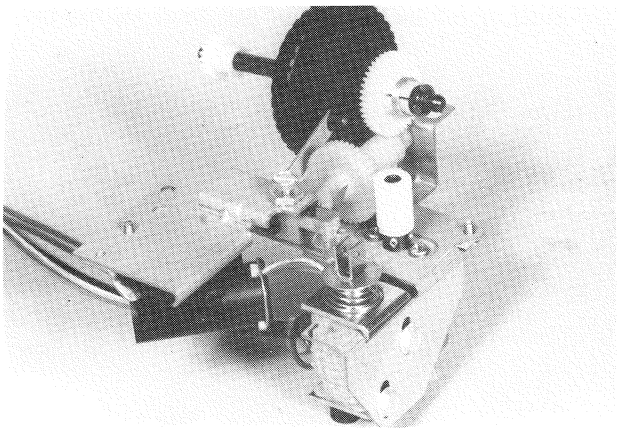


Figure 4. AUTO-FOCUS DRIVE MECHANISM

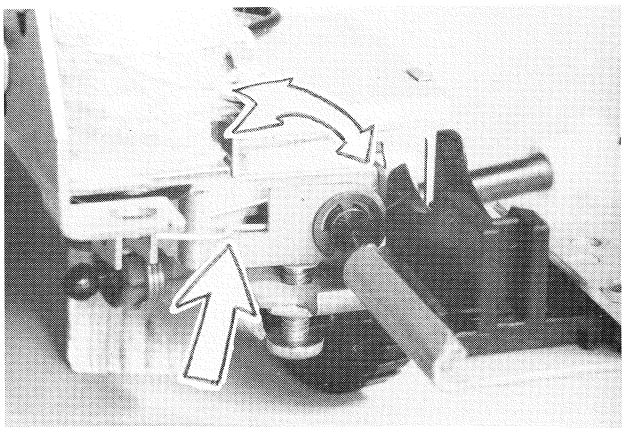


Figure 6. AUTO-FOCUS BRAKE

The Sensor Brake is applied whenever the projector is focused from the Remote Control. TheBrake is applied by the Brake Solenoid which rocks the Cam Lock Lever against the Sensor Link to hold the Sensor stationary while the Focus Motor moves the lens to the desired focus position.

C . BRAKE ADJUSTMENTS

1 When relaxed, the cam lock should have .003" to .008" between the cam and the sensor link. Adjustment is made with the hex head screw and lock nut below the cam.

2. When energized, the spring should lift off the cam .005" to .020" and lock the sensor link. Adjustment is made by moving the solenoid.

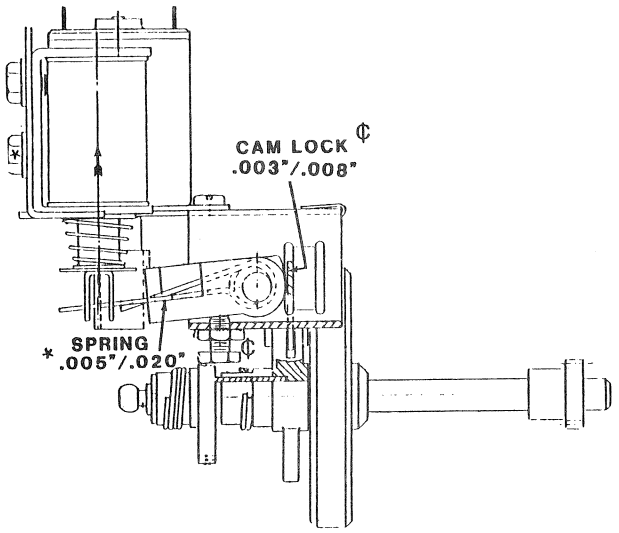


Figure 7. AUTO-FOCUS BRAKE ADJUSTMENTS

D . AUTO-FOCUS SLIP CLUTCH SERVICING

Checking Torque of Focus Gear Clutch

1. Thread the G17-38000A Torque Adapter (part of Tool Kit SS-363) into any standard electric drill chuck having a 3/8" x 24 thread, and clamp the drill chuck on the end of the Jack Shaft(Figure 8).

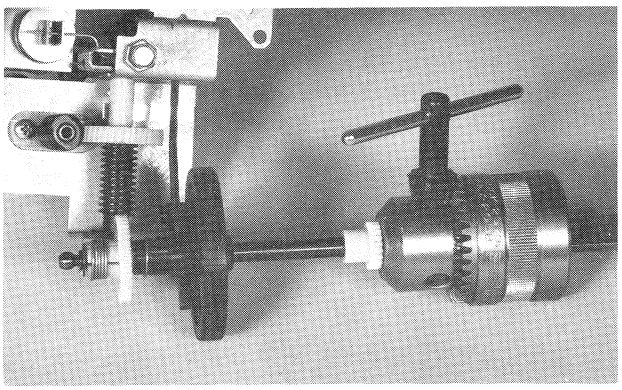


Figure 8. Jackshaft with Drill Chuck Attached

2. Attach the Torque Wrench #G17-38000 (not part of Tool Kit SS-363) to the G17-38000A Adapter (Figure 9)

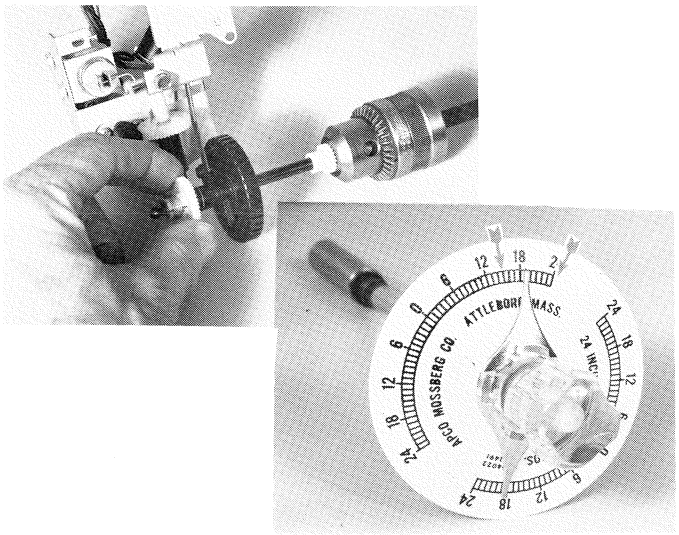


Figure 10. Measuring Focus Gear Clutch Torque

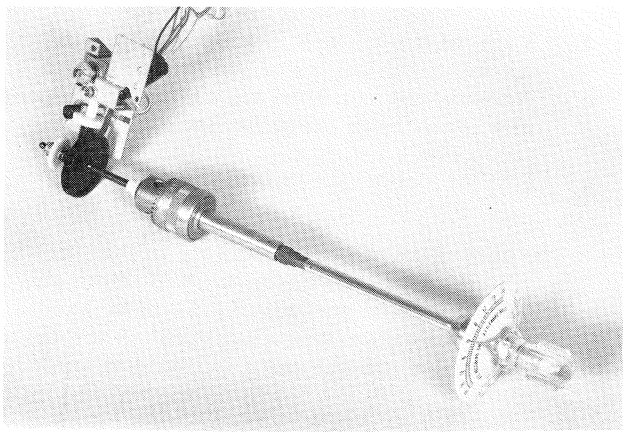


Figure 9. Torque Measurment w/Gage G17-38000

3. Grasp the Focus Gear (Figure 10) and turn the Torque Wrench until the Focus Gear Clutch starts to slip. The Torque Wrench should read 15 - 20 inch/ounces. (This reading must be obtained when turning the torque wrench both clockwise and counterclockwise.)

4. If this requirement cannot be met, change the Focus Gear Clutch Springs #46014-P1 and #46015-P1 (Figure 11) and recheck step 3 above.

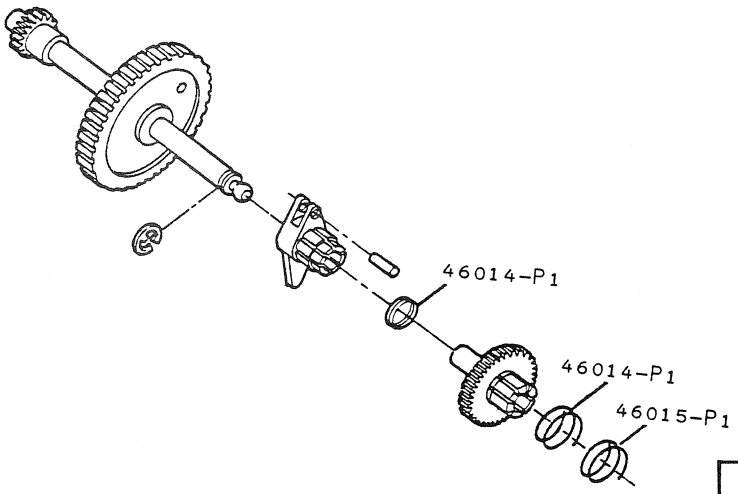


Figure 11. Clutch Springs

E. Checking Torque of Sensor Drive Clutch

1. Thread the G17-38000A Torque Adapter (part of Tool Kit SS-363) into any standard electric drill chuck having a 3/8" X 24 thread, and clamp the drill chuck on the end of the Jack Shaft (Figure 8).

2. Attach the Torque Wrench #G17-38000 (not part of Tool Kit SS-363) to the G17-38000A Adapter (Figure 9).

3. Grasp the Crank (Figure 12) and turn the Torque Wrench until the Sensor Drive Clutch starts to slip. The Torque Wrench should read 4-8 inch/ounces. (This reading must be obtained when turning the torque wrench both clockwise and counterclockwise.)

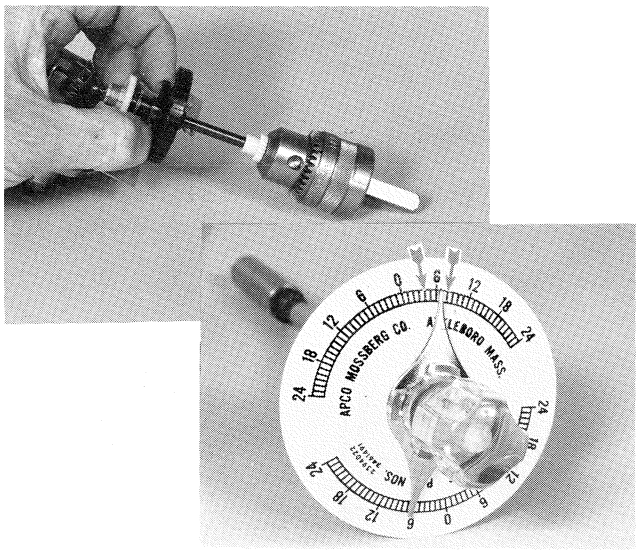


Figure 12. Measuring Sensor Drive Crank Clutch Torque

4. If this requirement cannot be met, change the Sensor Drive Clutch Spring #46014-P1 (Figure 11). and recheck step 3 above.

F. ADJUSTING AUTO-FOCUS MECHANISM GEAR MESH

1. After assembling the Auto-Focus Mechanism to the upper housing with the three screws and the retainer plate on the right end of the jack shaft (as viewed from the front of the projector with the upper housing upside down), the height of the left end of the jack shaft must be checked with the "Go-No Go" Gauge #G1-SK2761.

2. Rest the end of the Gauge on top of the upper housing boss at the end of the jack shaft (Figure 13).

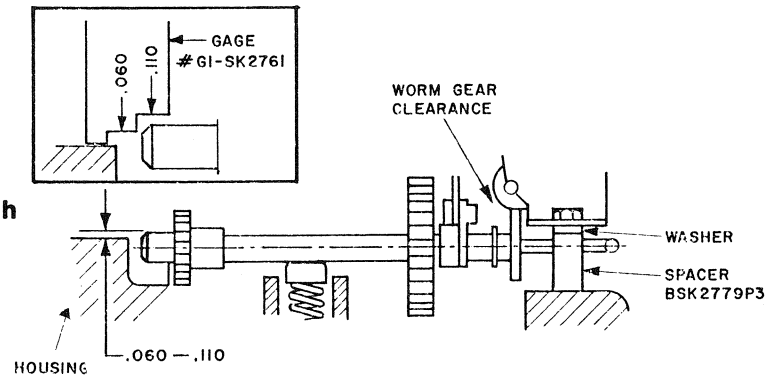


Figure 13. Using Jack Shaft Gage and Adjustment

3. The end of the jack shaft should pass under the .110" step on the Gauge ("Go"), but should not pass under the .060" step on the Gauge ("No Go").

4. Add or remove washer #41846-P2 as required under the front of the Auto-Focus Mechanism Bracket as shown in Figure 13 to achieve this requirement.

5. Install the Washer (or Retaining Bracket) and screw to hold the left end of the jack shaft down.

G. INDEX GUIDE SPRING 45344-P2

Assemble spring as illustrated in Figure 14. below. The straight spring terminal must bear against the mechanism plate - form at "step down" if necessary. Be sure that the plastic guide pin on the bottom of the index arm is positioned between the spring terminals.

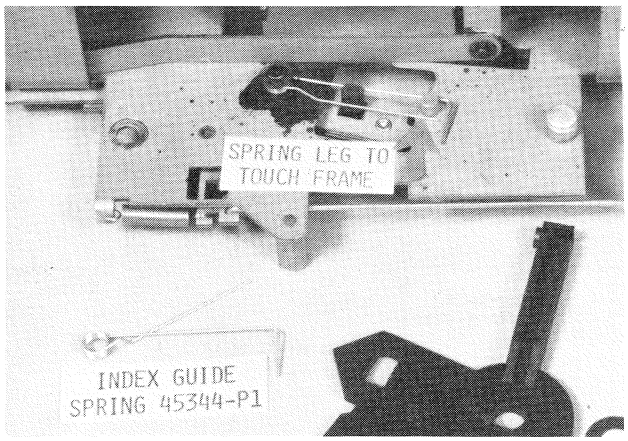


Figure 14. Index Guide Spring 45344-P2

H. FRONT-REAR CAM ADJUSTMENT

With the mechanism relaxed, the front/rear cam will rest against the stop pin...the link to the solenoid will be pushed to the right as illustrated. In this condition, check, and adjust if necessary, the clearance between the adjustment nut and the extended arm of the front/rear cam. Snap the front/rear cam several times and recheck to be sure that the 0.005" to 0.020" clearance is holding (Figure 15).

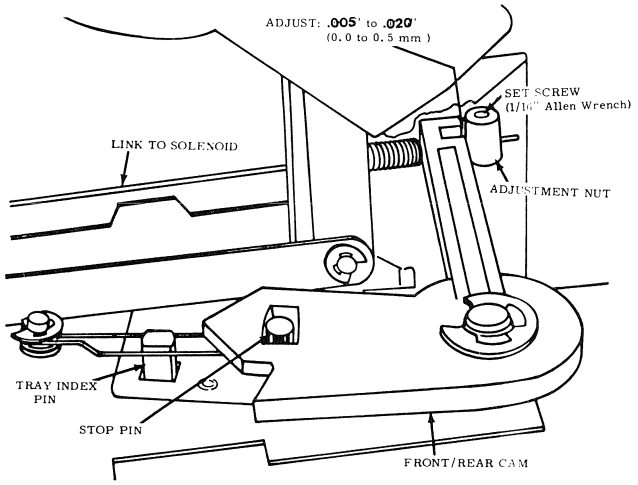


Figure 15. Front/Rear Cam Adjustment

J. SOLENOID ADJUSTMENT

The solenoid, position for reverse operation is adjusted after the advance operation is verified

(1) Energize the 12VDC solenoid or press the armature in by inserting a thin blade tool through a hole in the top mechanism plate.

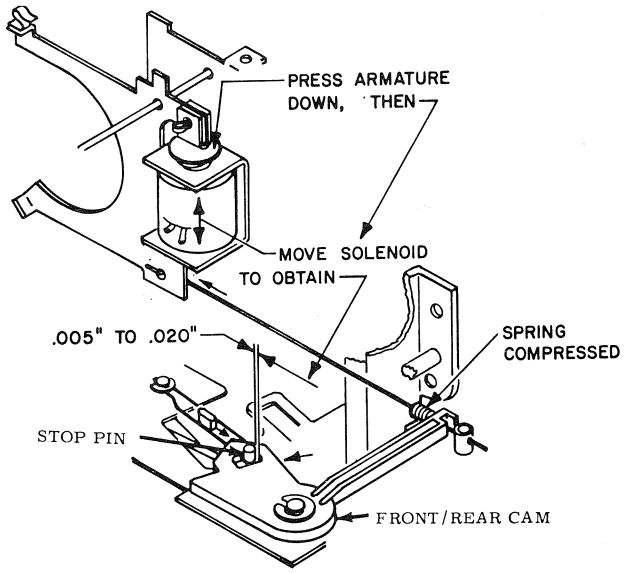


Figure 16. Solenoid Adjustment

(2) Observe the stop pin clearance and back edge of the slot in the front/rear cam. This clearance must be .005" to .020" (0.1 to 0.5mm) (Figure 16).

(3) Move solenoid up to decrease pin clearance if necessary. This will cause the tray index arm pin to follow the rear "V" of the front/rear cam.

K. SLIDE FACE CLAMP ADJUSTMENT

Check slide face clamps as dimensioned below. The "cammed open" dimension can be measured when the "Select" button is depressed.

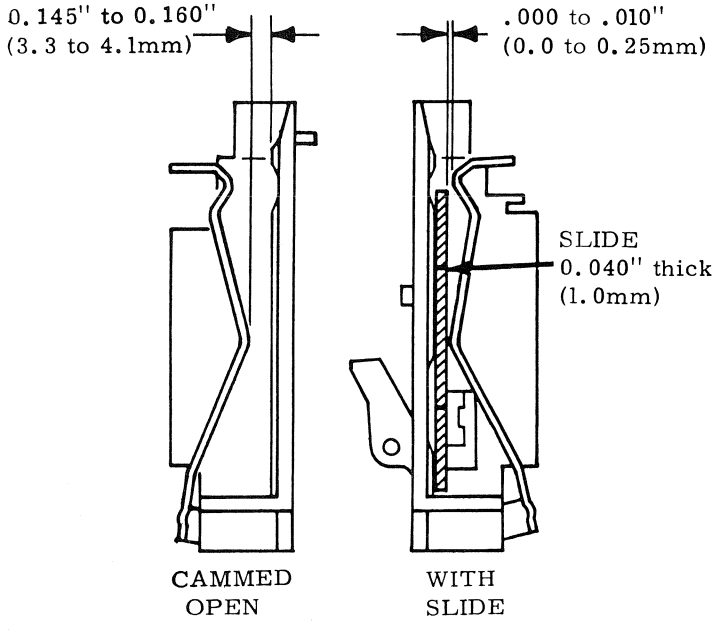


Figure 17. Slide Face Clamp Adjustment

L. REMOVAL OF SLIDE MECHANISM FROM PROJECTOR

1. When removing the slide mechanism from the projector, there are several major operating areas. It is advisable to serarate the screws, hardware, and parts of each area by using a muffin tin or egg carton. This will keep the parts in their respective groups.

(2) The wires should be redressed and tied in tight bundles as originally manufactured. A stray wire could drag against the shutter blades and cause a problem after the projector is completely reassembled. Other stray wires could cause other problems.

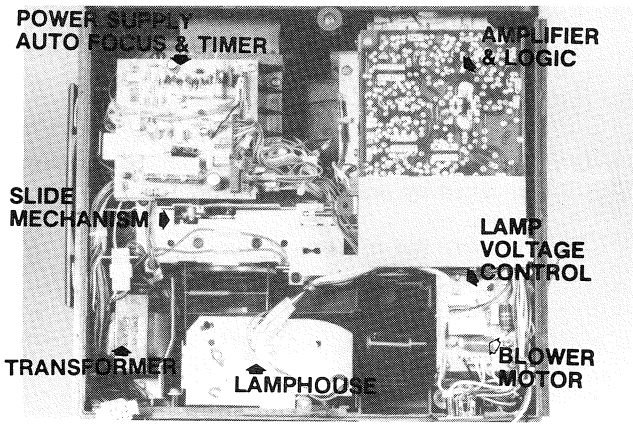


Figure 18. Major Operating Areas

(3) Remove the auto focus mechanism and sensor as instructed previously.
(4) Remove the amplifier board and tape deck.
(5) Unhook the drive belt.
(6) Unplug the connector at the right end.
(7) Remove the 3 screws, 1 at each end and one in the center of the mechanism. Notice that there are several green ground wires terminated on the mechanism. Note their position because it will be very important that they be repositioned.

(8) When removing the mechanism assembly, do not brush the plastic condenser lens. Marks on this lens **will project** as dark spots on the rear screen. After the three mounting screws and the drive belt have been removed, press in on the slide tray locator pin (outside of top) and tilt the mechanism forward away from the plastic condensor lens, as the mechanism is lifted out.

Figure 19. Wire Dress

M. MECHANISM REASSEMBLY

To hold select pawl in position while mechanism is turned over for reassembly, snap a rubber band around the mechanism and over the select pawl. Be sure to remove rubber band after the mechanism is secured.

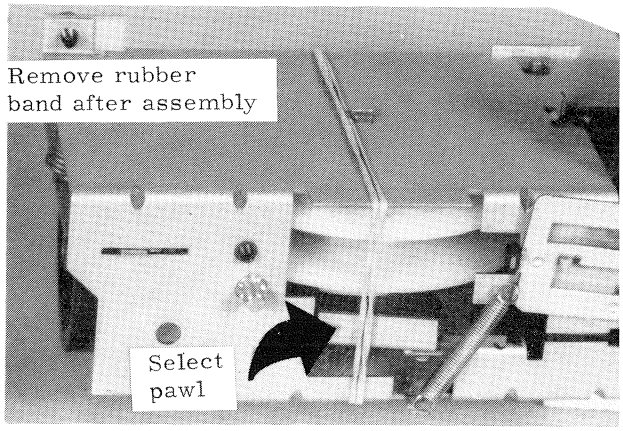


Figure 20. Holding Select Pawl

N. MOTOR REPLACEMENT

(1) Remove the amplifier board and tape deck.
(2) Remove the voltage control board.
(3) Loosen the lamp switch and swing it inside of the projector.
(4) Remove the voltage control board support, secured by one screw at each end of the base.
(5) Remove the motor.

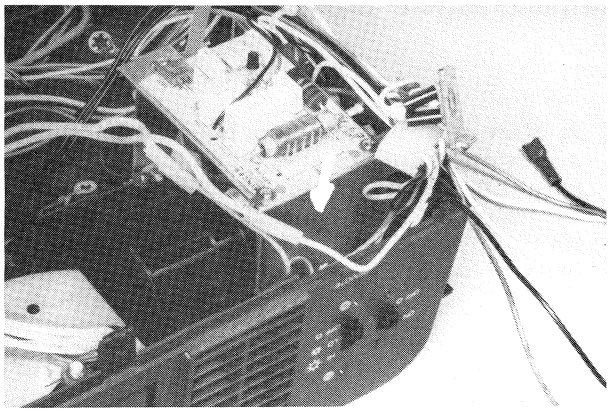


Figure 21. Motor Replacement

TABLE OF CONTENTS

SECTION IV -CIRCUIT DESCRIPTION

A. ADVANCE CUE DETECTION CIRCUITS (3230)

The 1000 Hz advance cue pulses recorded on tracks 3 and 4 of the magnetic tape are picked up by the second channel of the tape head (H-1, Ch. 2) and fed into the cue preamplifier consisting of (Z-2A) and (Z-2B) (Figure 4-1).

The amplified cue pulses are then fed into the 1000 Hz filter circuit consisting of (Z-2C) and (Z-2D). This circuit will respond to only 1000 Hz signals when the Sensitivity and Tuning are adjusted properly by means of (VR-1) and (VR-2) respectively (Figure 4-1).

The output of the 1000 Hz filter circuit (Pin 10 of (Z-2D) is a relatively undistorted 8.4 volt peak to peak (3v. RMS) 1000 Hz Sine Wave. This output is fed into the Tray Control Logic circuits consisting of (Z-3A), (Z-4), (Z-5) and (Q-5) (Figure 4-2).

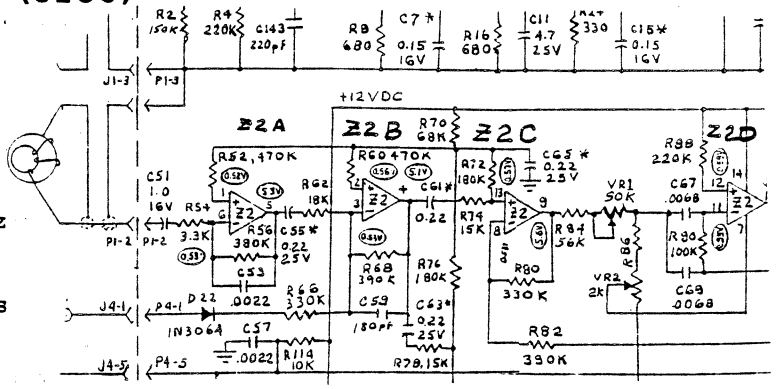


Figure 4-1. Advance Cue Detection Circuits

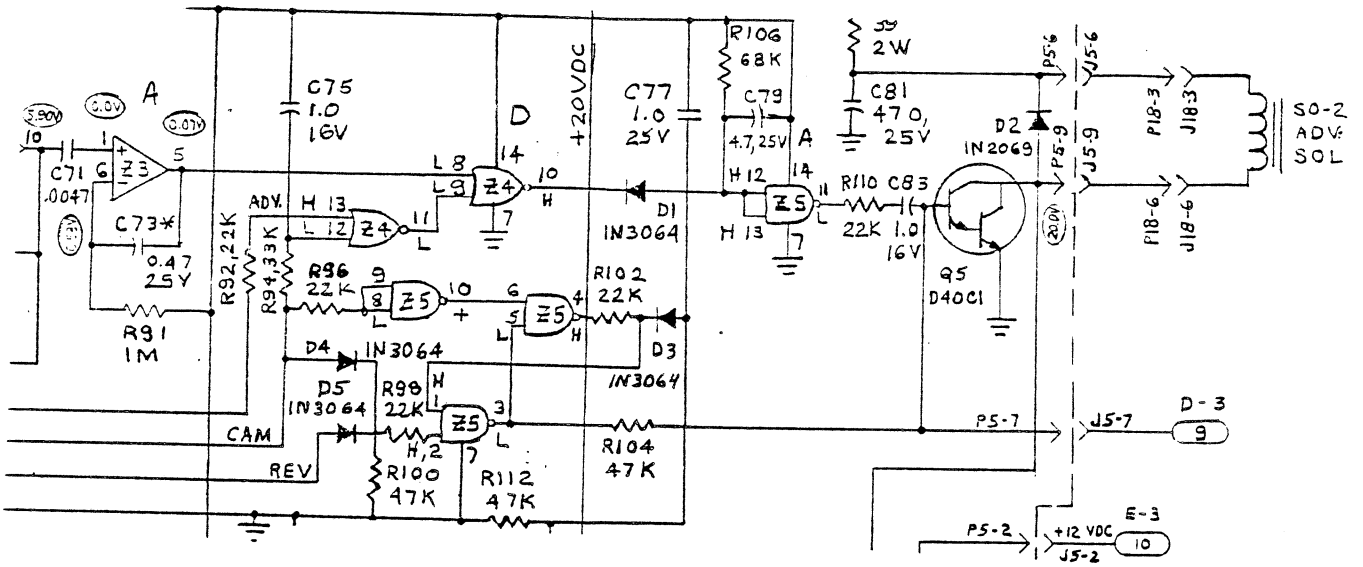


Figure 4-2. Tray Control Logic Circuits

B. TRAY CONTROL LOGIC CIRCUITS (3230)

The output from the 1000Hz Filter, Pin 10 of (Z-2D), in the3230 Models is fed into an advance ramp detector (Z-3A) causing its output to gradually increase. This positive voltage is recognized by NOR GATE (Z-4D) as a logic high causing it to conduct and produce a logic low at its output, Pin 10.

This low promotes conduction through (D-1) and (R-106) causing a logic low on pins 12 and 13 of NAND GATE (Z-5A).

NAND GATE (Z-5A) now stops conducting and a logic high appears at its output, Pin 11. (NAND GATE (Z-5A) is wired so it actually functions as an inverter in this circuit). This high is immediately coupled through (R-110) and (C-83) to the base of transistor (Q-5) causing(Q-5) to conduct through the tray advance solenoid (SO-2).

The solenoid now operates engaging the clutch in the tray advance mechanism and allowing the mechanism to advance one slide, (Figure 4-2).

The advance mechanism will advance only one slide regardless how long the 1000 Hz advance pulse is sustained at the input of the cue detection circuits (Figure 4-1 and 4-2). This is due to the charging action of (C-83). As stated, the logic high which appears at Pin 11 of (Z-5A) is coupled to the base of (Q-5) through (R-110) and (C-83). However, as soon as (Q-5) starts conducting, (C-83) starts charging through the emitter base circuit of (Q-5). After 120 milliseconds, (C-83) will charge to a point where the positive voltage on the base of (Q-5) is not positive enough to substain conduction thru (Q-5) and (Q-5) shuts off. The tray advance solenoid releases and the engaged clutch on the tray advance mechanism continues through one cycle and clutches again.

If the 1000 Hz cue signal is sustained continuously, the logic high remains on pin 11 of (Z-5A), (C-83) remains charged, (Q-5) remains cut off, and the tray advance solenoid remains released. This condition will not change until the 1000 Hz cue signal is removed allowing the logic voltage to go low again at pin 11 of (Z-5A) and permitting (C-83) to discharge. This prepares the circuit to react to the next 1000 Hz cue pulse. (See Figure 4-3).

The 120 millisecond timing is critical to insure that the slide tray advances rather than reverses. If the tray advance solenoid is held operated too long, it will condition the front/rear cam so the index arm moves the slide tray in reverse rather than advance.

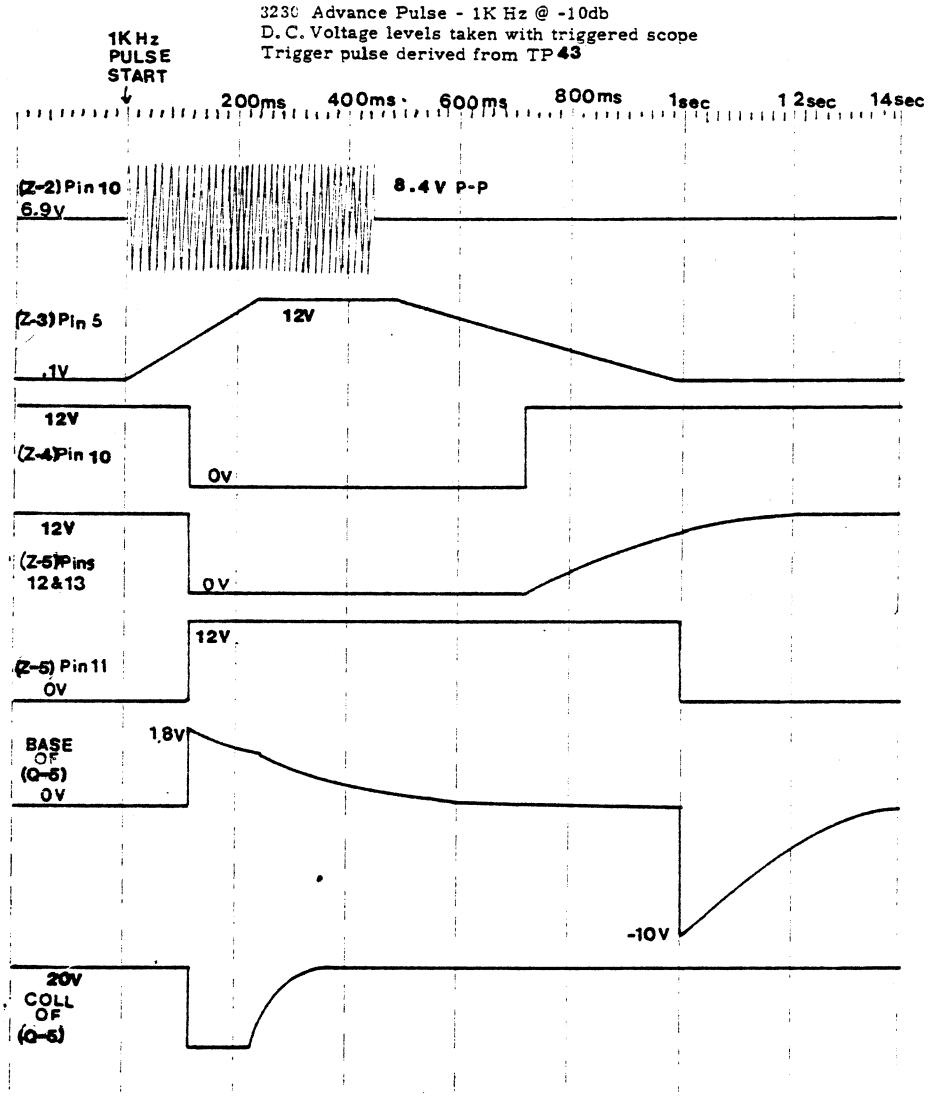


Figure 4-3. 3230 ADVANCE PULSE WAVEFORMS

1. MANUAL ADVANCE (3230)

The logical starting point in a discussion of the manual advance feature is to call attention to the logic condition of pins 12 and 13 of NOR GATE (Z-4C). Pin 12 is held at a logic low by the ground connected to it through the normally closed contacts of the mechanism cam switch (S-9) and (R-94). Pin 13 is held at a logic high by the +12 Volt supply connected to it through (R-92) and (R-114). The output of this NOR GATE under these conditions is a logic low (0 volts). This logic low is also felt at pin 9 of (Z-4D). Since pin 8 of (Z-4D) is also at a logic low, the output at pin 10 of (Z-4D) is a logic high (Figure 4-4).

When the manual advance button on the upper left hand side of the projector or on the hand held remote control is depressed, a ground is connected to the junction of (R-114 and (C-57). This ground is coupled to pin 13 of (Z-4C) through (R-92). This means that the logic high which was on pin 13 has now become a logic low and (Z-4C) stops conducting since pin 12 is also at a logic low. A logic high (+12 volts) now appears at pin 11 of (Z-4C) and at pin9 of (Z-4D). (Z-4D) now starts to conduct and the logic high originally on pin 10 of (Z-4D) now becomes a logic low. This low is coupled to pins 12 and 13 of (Z-5A) through (D-1) as described in the discussion on advancing with a 1000 Hz cue pulse. The remaining sequence of events in (Z5A), (R-110), (C-

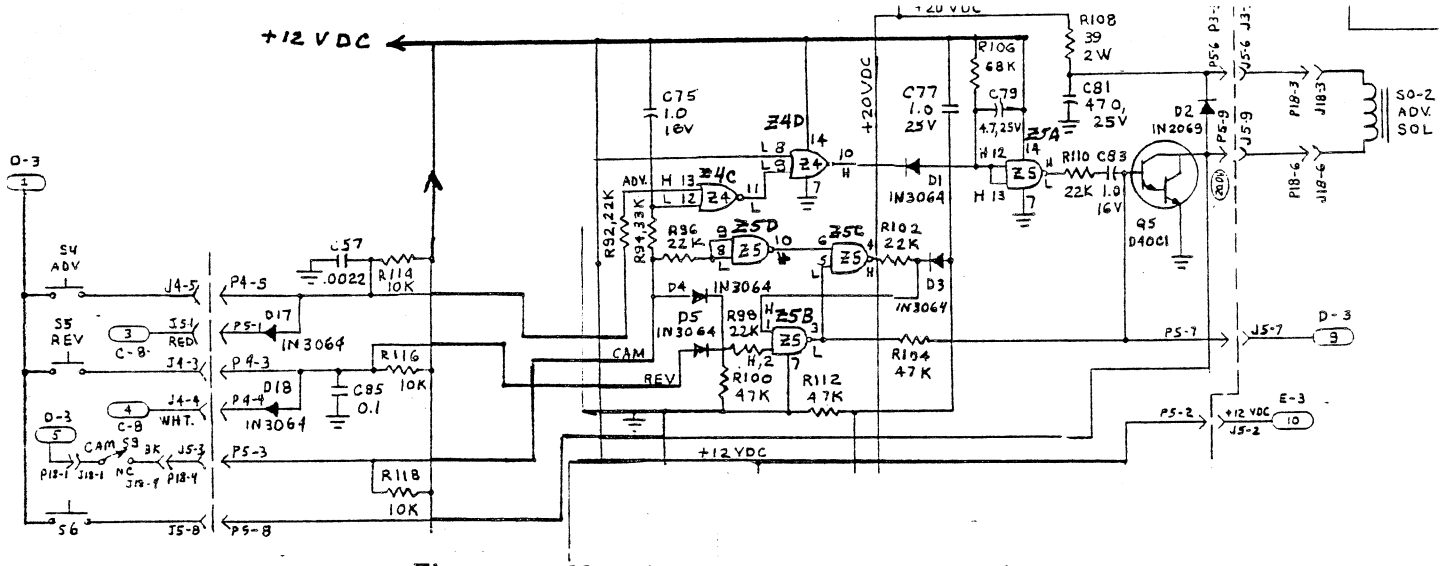


Figure 4-4. Manual Advance and Reverse Circuits

83), (Q-5) and (SO-2) is identical as when a 1000 Hz cue pulse is used to advance a slide. (See Figure 4-2 and related circuit description).

One difference exists between advancing with a 1000 Hz cue pulse and advancing with manual advance buttons. Advancing with a 1000 Hz cue pulse will result in only one slide advance per pulse regardless how long the pulse is sustained. Advancing with either manual advance button will result in continual slide advancing if the button is held depressed. This is due to the action of the advance mechanism cam switch (S-9) and NOR GATE (Z-4C).

As stated previously, depressing the advance button places a logic low on pin 13 of (Z4C) causing it to stop conducting and starting the series of logic voltage changes which results in a slide change. If the button was held depressed and nothing else happened, (C-83) would eventually charge, as in the case when advancing with a 1000 Hz cue pulse, and only one slide would advance. However, about 400 ms after the tray advance solenoid operates, the cam switch (S-9) is opened by the advance mechanism cam. This impresses a logic high (+12V) through (R-118) and (R-94) on pin 12 of NOR GATE (Z-4C) causing it to conduct and produce a logic low at its output, pin 11. This low is also impressed on pin 9 of (Z4D) and couples with the low already on pin 8 of (Z4D) to stop it conducting. A logic high thus appears at pin 10 of (Z4D) and is coupled to pins 12 and 13 of (Z5A) (Figure 4-4), producing a low at pin 11 of (Z5A). This allows (C83) to discharge to its normal state when no advance signal of any kind is present. Thus (C83) is conditioned to react to the next advance signal.

With the advance button held depressed, this signal appears when the advance mechanism cam rotates enough to allow the cam switch (S-9) to close again. This closure puts a ground (Logic Low) on pin 12 of (Z4C). Coupled with the low still on pin 13 of (Z4C) because of the depressed advance button, this low on pin 12 causes (Z4C) to stop conducting. A high appears at its output causing a low at the output of (Z5A), which in turn causes (Q5) to conduct through solenoid (SO2) engaging the clutch on the advance mechanism to advance another slide. This sequence of events will continue as long as the advance button is held depressed. When the advance button is released, the original logic high reappears on pin 13 of (Z4C) causing it to remain conducting and in turn holding (Z4D) shut off to await the next signal. (See Figure 4-5 for manual advance waveforms).

2. MANUAL REVERSE

Three NAND GATES (Z5B), (Z5C) and (Z5D) are used in connection with the manual reverse function of the CARAMATE 3230. Both (Z5B) and (Z 5C) function as NAND GATES while (Z5D) is wired as an inverter by tying its two inputs together. (Figure 4-4). When power is initially applied to the circuit board, (C77) charges through (R112) and impresses a positive pulse on pin 1 of (Z5B) through (D3). (Figure 4-4). At the same time a positive 9 volts is impressed on pin 2 of (Z5B) by the +12 Volt power supply conducting current through (R100), (D5) and (R116). These two positive voltages represent logic highs and cause (Z5B) to conduct producing a logic low at its output, pin 3. This low is coupled to pin 5 of (Z5C) forcing it to remain turned off to produce a logic high (+12V) at its output, pin 4. This high is coupled back to pin 1 of (Z5B) and together with the high on pin 2 of (Z5B) holds (Z5B) in its conducting condition, sustaining the logic low at its output which in turn holds (Z5C) cut off and prevents (Q5) from conducting through (SO2). This action serves two functions:

a. Establishes the proper condition for (Z-5B) and (Z-5C) to function properly for manual reverse.

b. Prevents the projector from cycling one slide in reverse when it's first turned on.

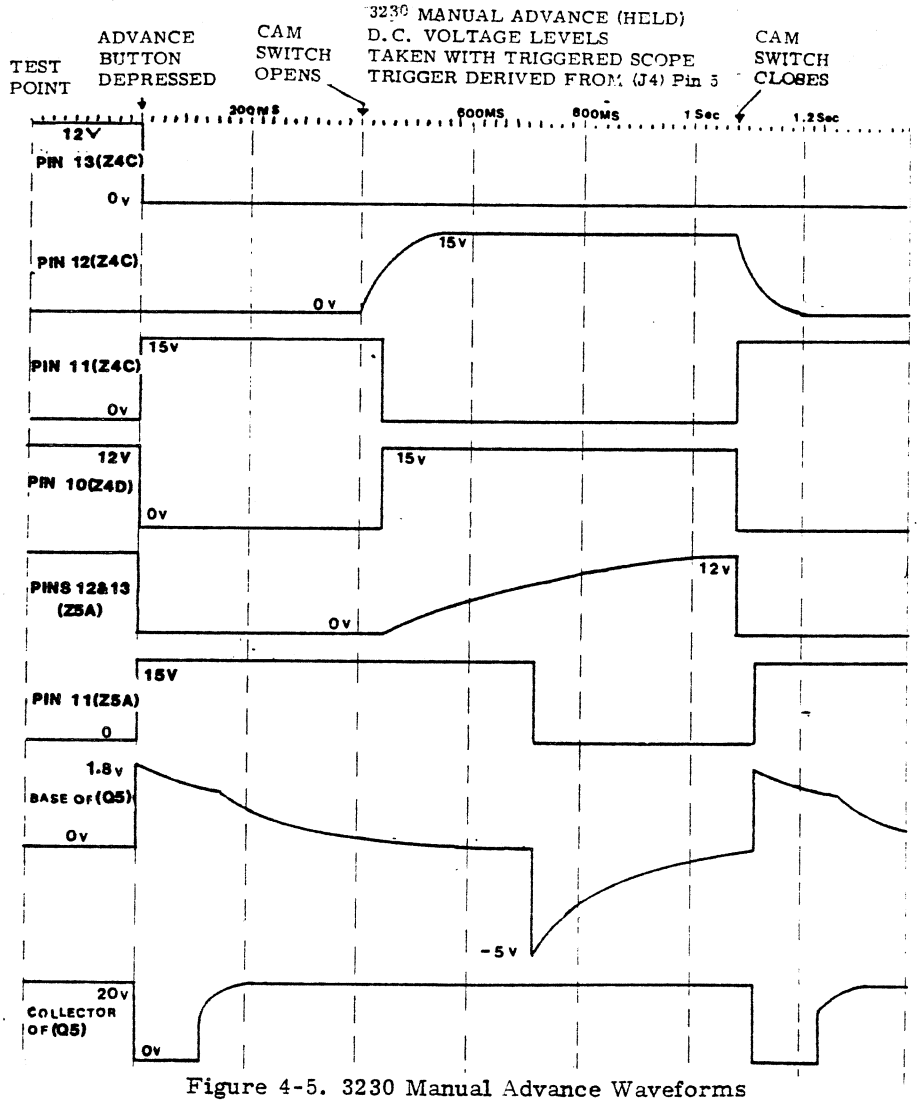


Figure 4-5. 3230 Manual Advance Waveforms

(Z-5D) is conditioned by the ground (Logic Low) applied to pins 8 and 9 through the normally closed contacts of the advance mechanism cam switch (S-9). The output of (Z-5D) is therefore a logic high (+12V) which is coupled to pin 6 of (Z-5C).

Depressing the reverse button on the upper left hand side of the projector or on the hand held remote control puts a gound on the junction of (C-85) and (R-116). This results in stopping current flow through (R-100) and D-5). The voltage on Pin 2 of (Z-5B) thus disappears and Pin 2 is connected to ground through (R-98) and (R-100). This changes the logic condition on Pin 2 from high to low and stops (Z-5B) from conducting. A logic high now appears at Pin 3 of (Z-5B) and is coupled to Pin 5 of (Z-5C) and also to the base of (Q-5) through (R-104). This high causes (Q-5) to conduct for approximately 400ms through the tray advance solenoid (SO-2). The solenoid thus operates and allows the tray advance clutch to engage and start through a tray advance cycle. The 400ms conduction time for (Q-5) is necessary so the front/rear cam will be properly conditioned to cause the index arm to move the slide tray in reverse rather than forward.

The 400ms conduction time for (Q-5) is established by (Z-5C), (Z-5D) and the advance mechanism cam switch (S-9). As mentioned above, the logic high at the output of (Z-5B) when the reverse button is depressed, appears on pin 5 of (Z-5C) as well as the base of (Q-5). Coupled with the logic high already on Pin 6 of (Z-5C) this high causes (Z-5C) to conduct and produce a logic low at its output. This low is coupled back to pin 1 of (Z-5B) and holds (Z-5B) cut off with the result that the logic high remains at the output of (Z-5B) to keep both (Z-5C) and (Q-5) conducting.

Approximately 400ms after the tray advance solenoid operates, the contacts of the advance mechanism cam switch (S-9) open. This removes the ground from pins 8 and 9 of (Z-5D) and allows the (+12V) power supply to conduct current through (R-100), (D-4) and (R-118). A +9 Volts now appears on pins 8 and 9 of (Z-5D) and pin 2 of (Z-5B). This

+9 Volts represents a logic high and causes (Z-5D) to conduct resulting in a logic low at its output, pin 10. Pin 6 of (Z-5C) now also goes to a logic low condition and (Z-5C) stops conducting to produce a logic high at its output, pin 4. This high is coupled back to pin 1 of (Z-5B) and, together with the high impressed on pin 2 by the open cam switch causes (Z-5B) to conduct. A logic low now appears at the output of (Z-5B) and is coupled to the base of (Q-5) and to pin 5 of (Z-5C). Thus (Q-5) stops conducting, the tray advance solenoid releases and (Z-5C) is held cut off. The advance mechanism clutch will finish its cycle and release with the result that the projector will have moved the slide tray one slide in reverse.

If either manual reverse button is held depressed, the entire cycle described above will repeat itself when the contacts of the advance mechanism cam switch (S-9) close and reestablish the ground on pin 2 of (Z-5B) and pins 8 and 9 of (Z-5D). (See Figure 4-6 for manual reverse waveforms).

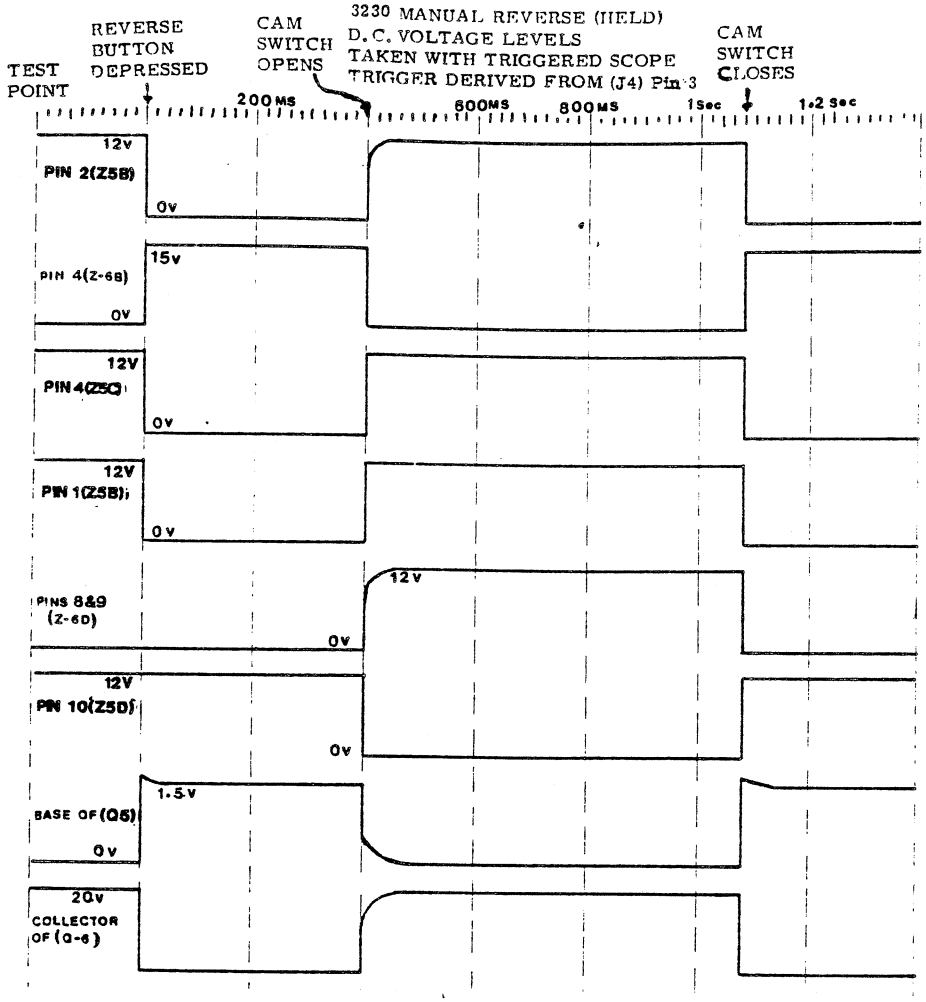


Figure 4-6. 3230 Manual Reverse Waveforms

3 SELECT (3230)

Depressing the select button connects a ground to the collector of (Q-5) which provides a conduction path for the tray advance solenoid (SO-2). The solenoid will thus remain operated as long as the select button is held depressed. Figure 4-4). The continuously operated solenoid operates a mechanical linkage which prevents the advance mechanism clutch from remaining engaged through a complete cycle of slide advance. This linkage releases the clutch as soon as the slide lifter reaches its uppermost position. The select button also disengages the index arm so the slide tray will not advance or reverse.

C . END-OF-TAPE DETECTOR

The End-of-tape detector circuit consists of transistors (Q9), (Q10), and (Q11), Diode (D10), End-of tape L.E.D. (D19) and the tape deck spindle switch (S8), mounted under the take-up spindle on the tape deck (Figure 4-7).

With a tape cassette in the projector and either the Play, Rewind or Forward button depressed, tape is transported through the projector, the take up spindle rotates and the spindle switch (S-8) initiates a signal which keeps (Q-11) shut off and prevents the end-of-tape L.E.D. (D-19) from lighting.

Since the spindle switch (S-8) continuously opens and closes when the take-up spindle rotates, it applies a square wave which fluctuates between ground and +.8 Volts to the base of transistor (Q-9). The result of this is the turning of (Q-9) off and on to produce an amplified, slightly distorted square wave at its collector. This square wave is rectified by (D-10) and a square wave greatly reduced in amplitude but riding on a positive D.C. Voltage (+.7V), is applied to the base of (Q-10). (Q-10) is now biased to operate close to saturation and the small amplitude square wave applied to its base either allows it to conduct to saturation (positive going portion of square wave) or to reduce its conduction (negative going portion of square wave). When (Q-10) conducts at saturation, the voltage at its collector is very low - about +.06 Volts D.C. This voltage holds (Q-11)cut-off and the end-of-tape L.E.D. (D-19) is prevented from lighting. When the negative portion of the square wave appears at the base of (Q-10) and reduces its conduction, its collector Voltage immediately jumps to about +.2 volts D.C. and then gradually increases to about +.6 volts D.C. because of the charging action of C-119). However, neither voltage is sufficient to bring (Q-11) out of cut-off. At this point in time the positive portion of the square wave appears at the base of (Q-10) and forces it into saturation, reducing the collector voltage and holding (Q-11) cut off. So as long as tape is transported through the machine, (Q-11) is held cut-off and the end-of-tape L.E.D. cannot light. (See Figure 4-8 for end of tape detector waveforms).

When the end of the tape is reached, either in a forward or reverse direction, the take-up spindle stops and the spindle switch ceases applying the square wave to the base of (Q-9). The signal disappears from the collector of (Q-9) and the base of (Q-10) and the voltage on the base of (Q-10) drops. The voltage on the collector of (Q-10) immediately increases to +.2 Volts D.C. and then gradually increases due to the charging action of (C-119). Now, however, since there is no signal present, (C-119) continues charging to allow the voltage on the connector of (Q-10), Base of (Q-11) to go past +.6 volts.

When the voltage reaches approximately 1.2 volts D.C. (Q-11) conducts through the end-of-tape L.E.D. (D-19) causing it to light.

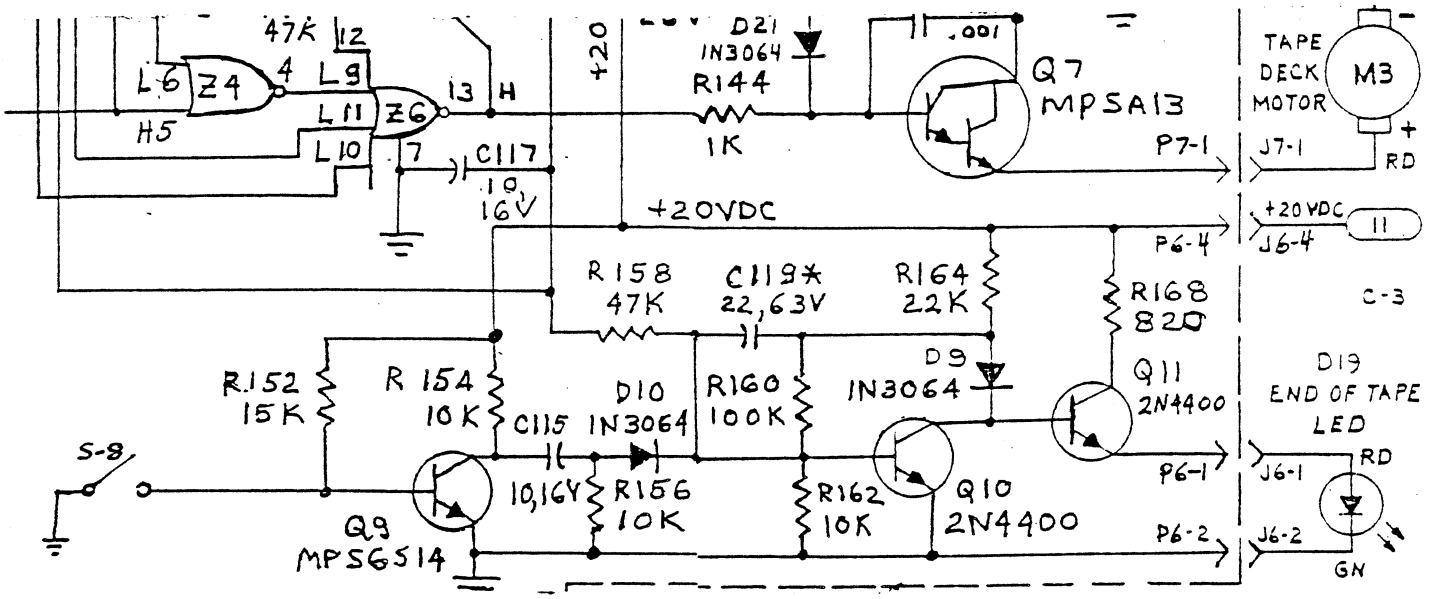


Figure 4-7. End of Tape Detector

D . STOP PULSE DETECTION CIRCUIT 3230

The Stop Pulse Detection Circuit consists of the 150Hz filter (Z-3B) and (Z-3C) and the Stop Ramp Detector (Z-3D) (Figure 4-9). This circuit is identical to the 1000Hz filter circuit (Z-2C) and (Z-2D) and the advance ramp detector (Z-3A) except it is tuned to 150Hz rather than 1000Hz. (See Section IV, Para .A and Figure 4-1).
The output of this circuit is a gradually increasing positive voltage which will eventually turn on NOR GATE (Z6B) Described under Tape Drive Control Logic circuits.

The 150 Hz Stop Pulses Recorded on Channels 3 and 4 of the magnetic tape are picked up by the second channel of the tape head (H-1), (Ch. 2) along with the 1000Hz advance pulses and are fed into the Cue preamplifier (Z-2A) and (Z-2B) (Figure 4-1). The

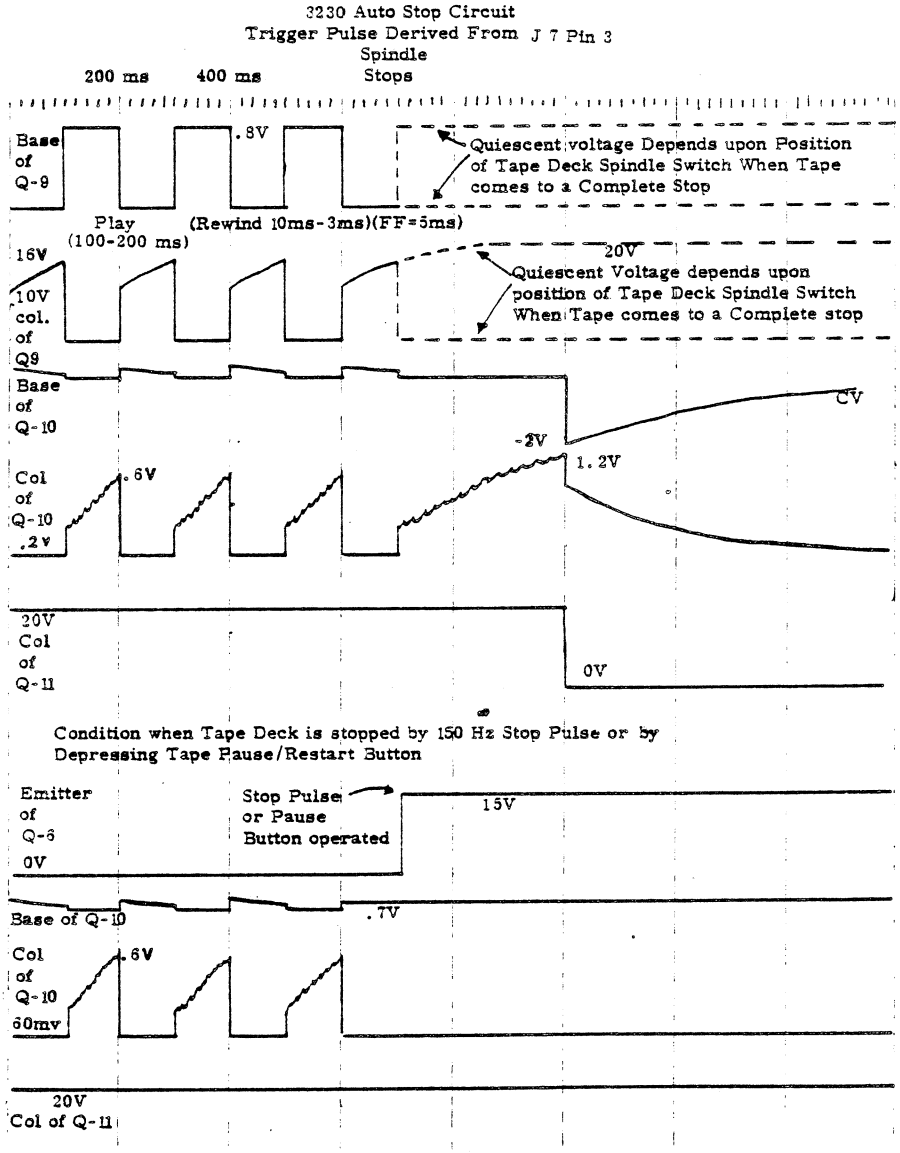


Figure 4-8. 3230 END-OF-TAPE DETECTOR CIRCUIT WAVEFORMS

output of the Cue Preamplifier is fed through (R-74) and (C-61) to the 1000Hz filter where the advance pulses are detected and also through (C-63) and (R-78) to Pin 13 of (Z-3B) where the Stop pulses are detected. When a stop pulse is present on the tape, the 150 Hz filter recognizes it and produces an output at Pin 10 of (Z-3C) which causes (Z-3D) to produce its positive going output and subsequently turn on NOR GATE (Z6B) (See Figure 4-10 for waveforms).

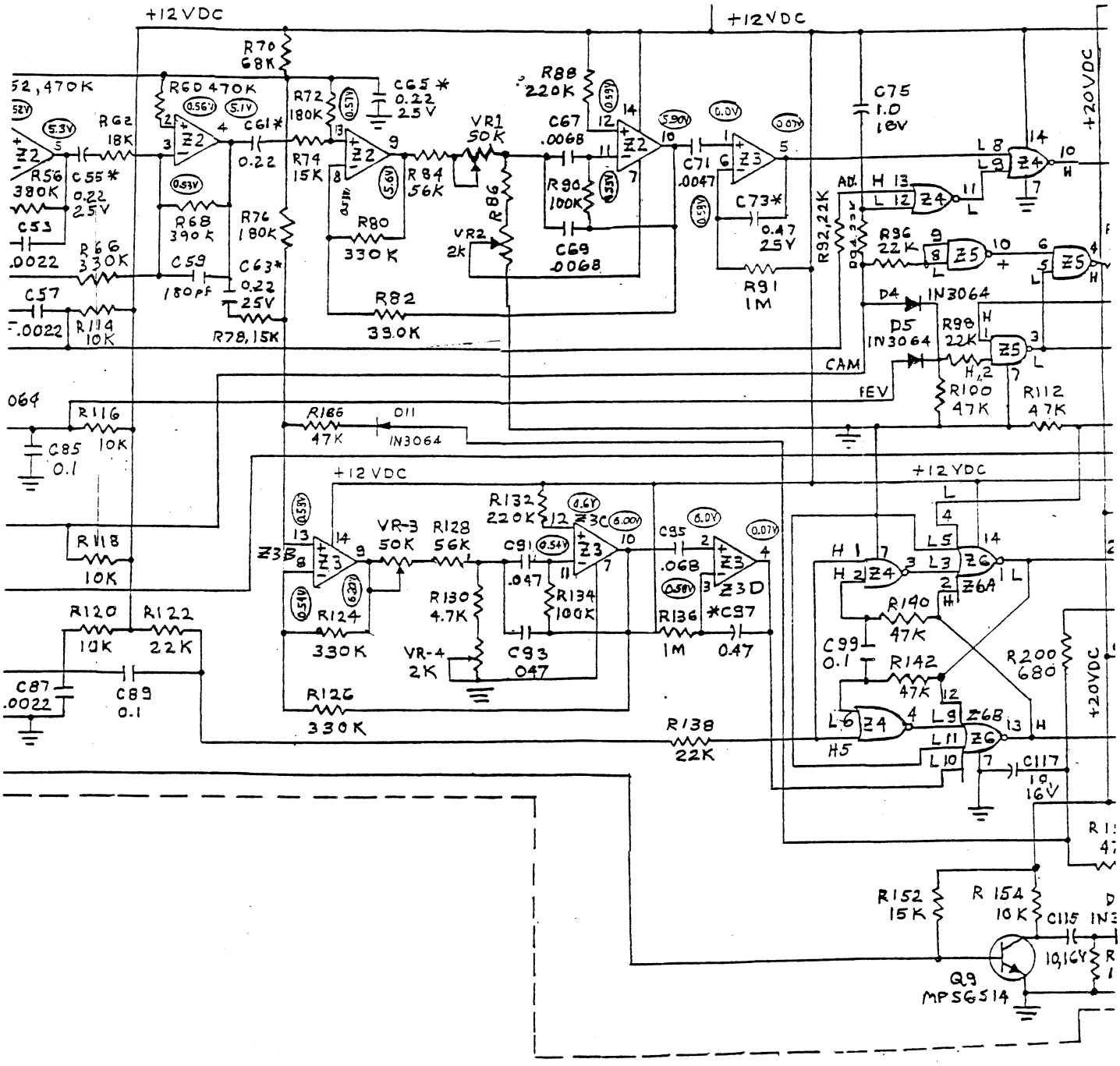


Figure 4-9. Stop Pulse Detection Circuit

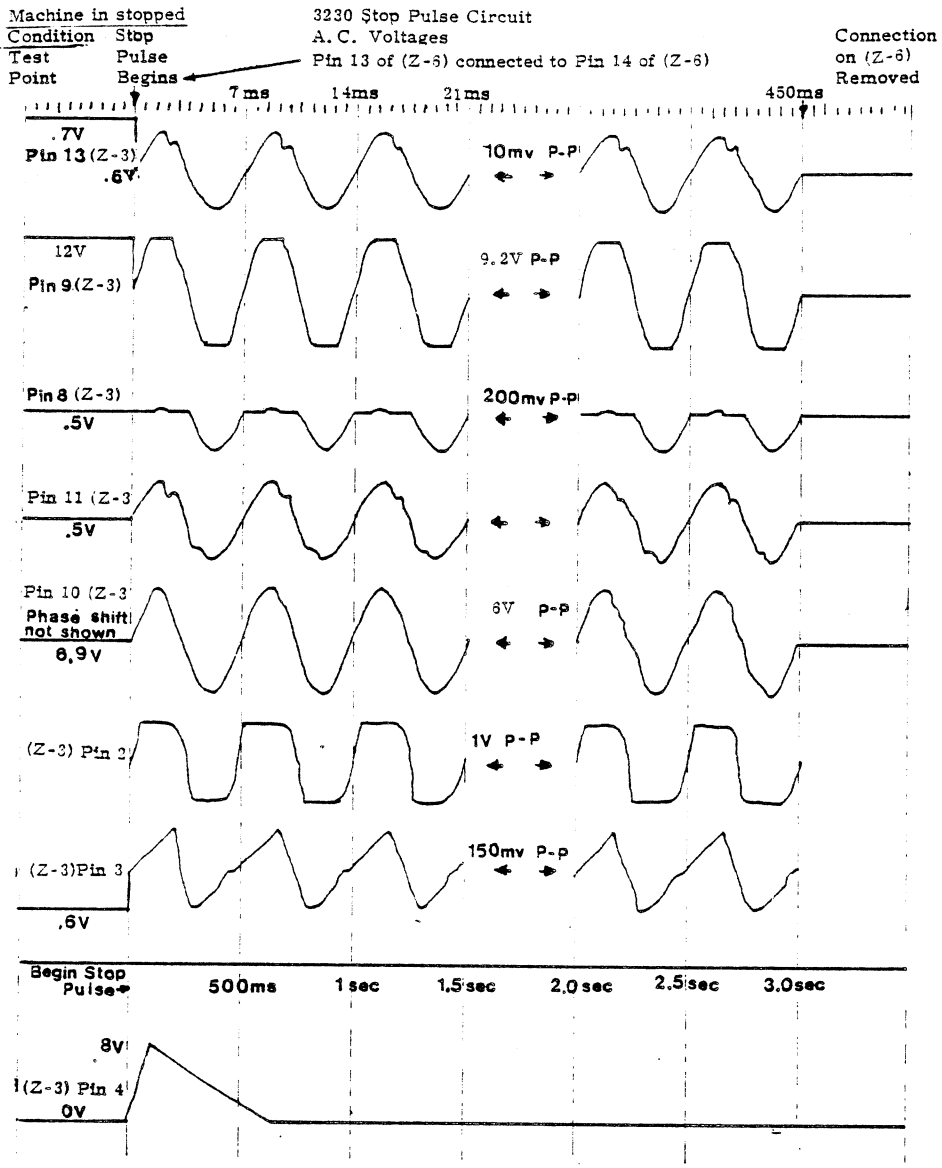


Figure 4-10. 3230 Stop Pulse Circuit Waveforms

E. TAPE DRIVE CONTROL LOGIC CIRCUIT (3230)

The Tape Drive Control Logic Circuit is used in conjunction with the Stop Pulse Detecting Circuit and the Tape Pause Restart Button to stop and start the tape drive motor (M-3) (Figure 4-11).

The heart of this circuit is the Bistable Multivibrator or "Flip-Flop" circuit (Z-6A) and (Z-6B). When power is initially applied to the projector this multivibrator must be conditioned to allow the tape drive motor (M-3) to run. This is accomplished by applying a positive pulse developed across (R-112) by (C-77) charging through it, to Pin 4 of NOR GATE (Z-6A). This logic high produces a logic low at the output of (Z-6A), Pin 1), which is coupled back to Pin 12 of (Z-6B). Together with the lows already on Pins 9, 10 and 11 of (Z-6B) this low holds NOR GATE (Z-6B) cut off and guarantees a logic high at its output, Pin 13. The base of (Q-7) and Pin 2 of (Z-6A) are now held at a high and both conduct allowing the tape deck motor to run and maintaining a low at the output of (Z-6B), Pin 1 respectively.

Now when a 150 Hz Stop Pulse is introduced into the projector, the Stop Ramp Detector (Z-3D) produces its positive output at Pin 4, which turns (Z-6B) on and produces a logic low at its output, Pin 13. This low cuts off both (Q-7) and (Z-6A). The tape deck motor now stops running and the output of (Z-6A) goes high. Coupling this high back to Pin 12 of (Z-6B) keeps this NOR GATE conducting and holds its output low to keep (Q7) cut off and the tape deck motor stopped. (Figure 4-11

The high on Pin 1 of (Z-6A) is also connected to the base of (Q-6) causing it to conduct through the red light emitting Diode (D-20) located on the control panel next to the "Tape Pause/Restart Button".

The diode now lights to indicate that the tape deck motor has been stopped.

Due to its conduction, a positive voltage appears at the emitter of (Q-6) which performs two very important functions, First, it is connected through (D-7), (R-200) and (R-158) to the base of (Q-10) to keep (Q-10) conducting. Second it is connected through (D-7), (R-200), (R-166) and (D-11) to Pin 13 of (Z-3B) to force it into saturation. With the tape deck motor stopped, it is necessary to keep (Q-10) conducting to prevent the End-of-Tape L.E.D. (D-19) from lighting. When the tape transport is restarted by depressing the "Tape Pause/ Restart Button" and (Q-6) stops conducting (C-117) holds the base of (Q-10) positive momentarily until the tape transport comes up to speed and the tape deck spindle switch supplies the proper signal to keep (Q-10) conducting (Figure 4-11). (See End-of-Tape Detector Section IV, Para. C.)

The purpose of forcing (Z-3B) into saturation is to prevent it from immediately responding to 150 Hz Stop Pulses when the tape transport mechanism is restarted. When the tape transport is restarted, (C-117) holds (Z-3B) saturated momentarily until the tape transport comes up to speed. This insures that, in the event an unusually long stop pulse had been recorded on the tape, the tape transport will not immediately stop as soon as it's restarted due to the remainder of this long pulse passing the tape head after restarting.

Restarting the tape transport after it has been stopped by a Stop Pulse is accomplished by depressing either the "Tape Pause/Restart" button located on the control panel of the projector or the "Pause/Restart" button on the hand held Remote Control. This action puts a ground at the junction of (C-89) and (R-120) and couples a negative pulse, due to the charging action of (C-89), through (R-138) to pin 1 of (Z-4A) and pin 5 of (Z-4B) (Figure 4-11) (Z-4B) is not affected by this pulse since a high remains on Pin 6. However, (Z-4A) is turned off since Pin 2 is also low, and a positive pulse is transmitted from its output, Pin 3, to Pin 3 of (Z-6A). The output of (Z-6A), Pin 1, now goes low, turning off (Q-6) and (Z-6B). L.E.D. (D-20) goes out and the output of (Z-6B), Pin 13 goes high, holds (Z-6A) on and turns (Q-7) on to allow the tape deck motor to run. Depressing either Pause/Restart button again will momentarily turn (Z-4B) off and Reverse the condition of (Z-6A) and (Z-6B) to stop the tape deck motor and light (D-20) again. (See Figure 4-12 for waveforms).

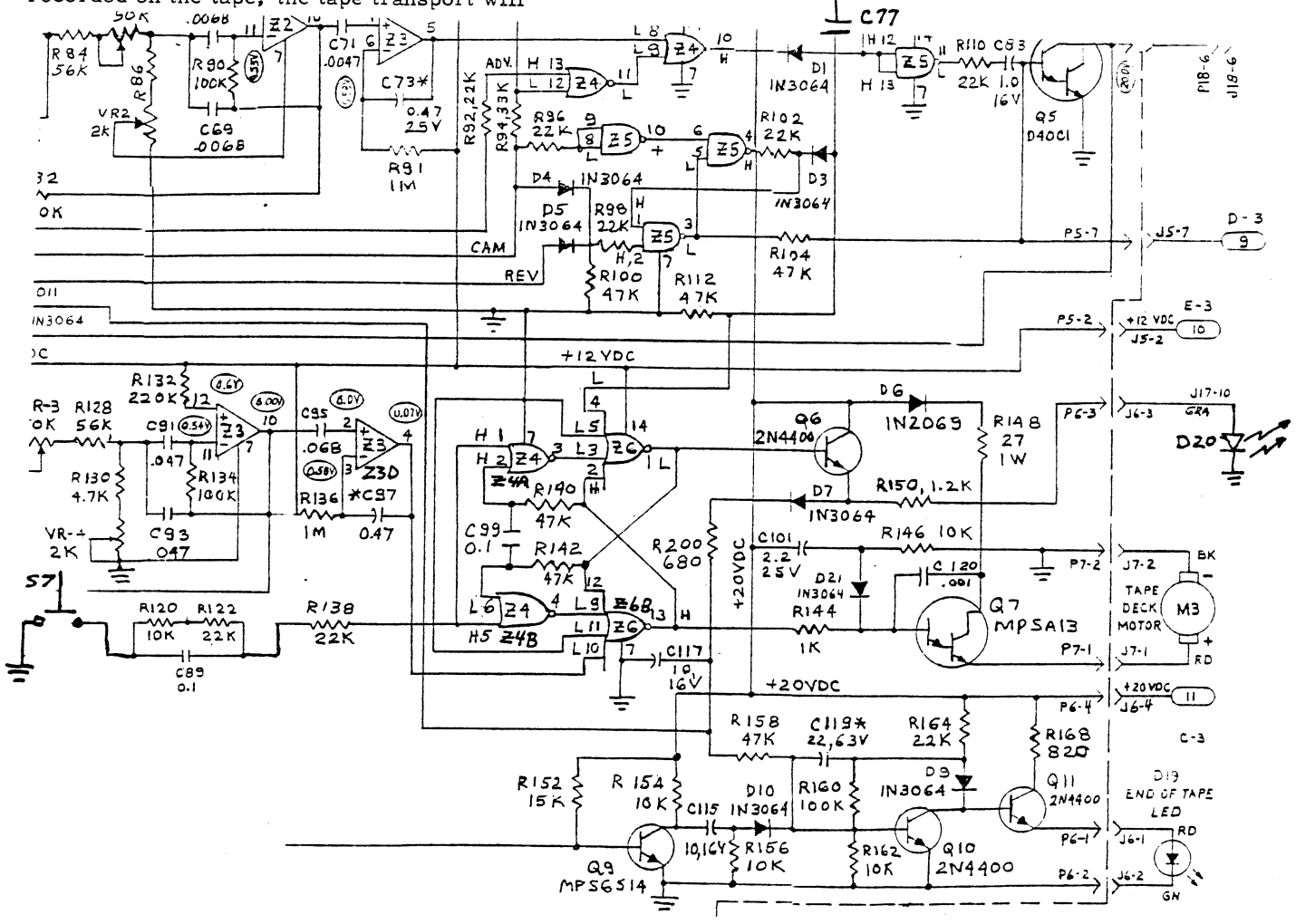
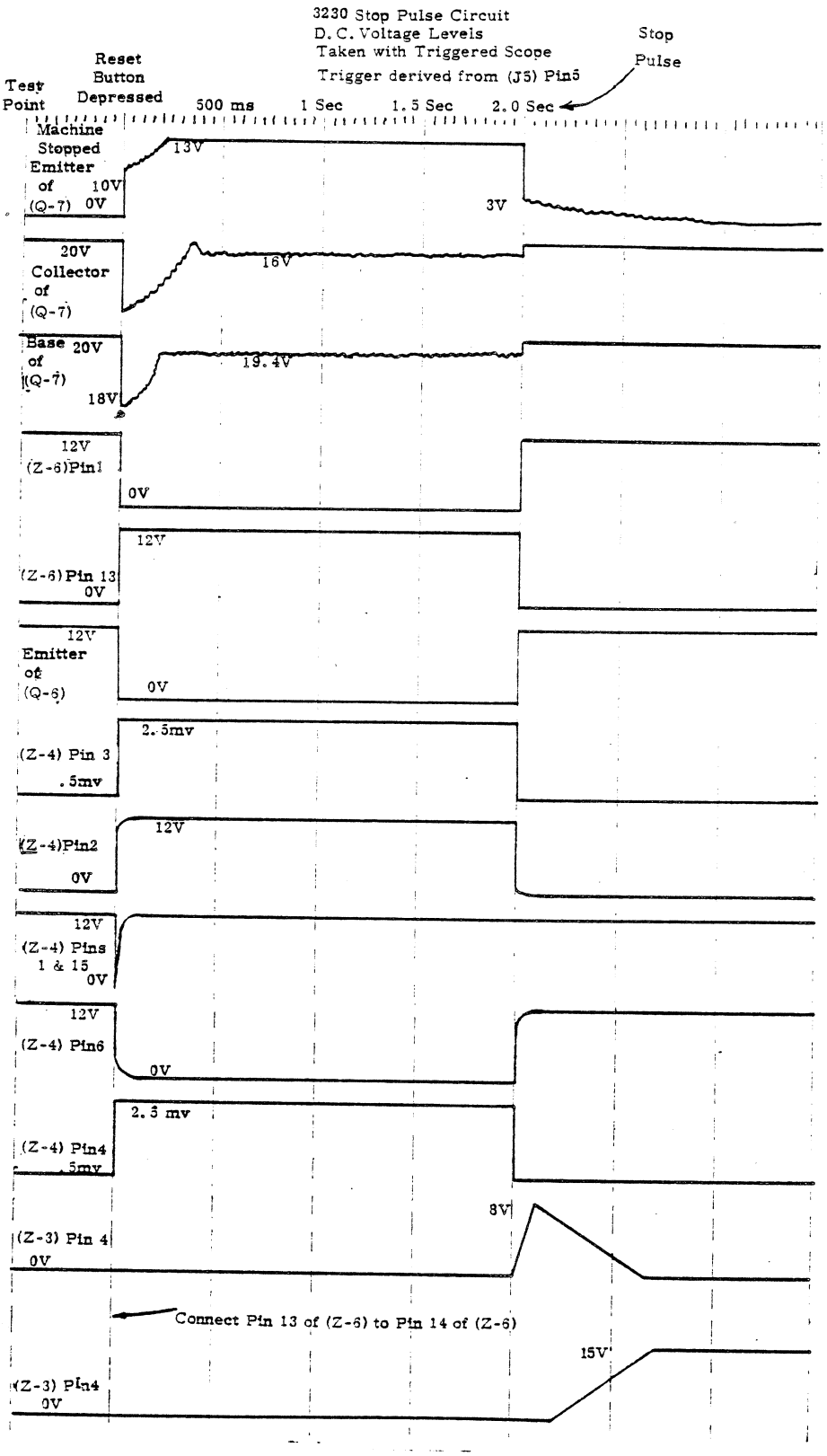


Figure 4-11). Tape Drive Control Logic Circuit



Figire 4-12. 3230 STOP PULSE CIRCUIT WAVEFORMS

F. PROJECTION LAMP REGULATOR CIRCUIT

The projection lamp regulator circuit in the Caramate 3130 and 3230 projectors is an AC regulator which maintains a constant light output from the projection lamp over wide variations of input or line voltage. (108 to 132 volts AC). This circuit is unique in that it does not govern the peak voltage supplied to the projection lamp, but rather it governs how long the lamp will conduct during one complete cycle of input voltage. Thus, the RMS or effective voltage supplied to the lamp is regulated and maximum lamp life results by eliminating overheating of the lamp due to high line voltage.

The key components in the circuit are Transformer (T1) two Zener diodes (D200) and (D202), capacitors (C204) and (C201) resistor (R204), bilateral switch (Q200) and triac (Q202). (Figure 4-13)Through a step up winding in it primary, the transformer increases the line voltage (to approximately 131 volts when the line voltage is 120 volt and applies it to the Lamp Regulator circuit which regulates it to a constant 120 volts True RMS for the pro jection lamp (with the lamp switch in Hi).

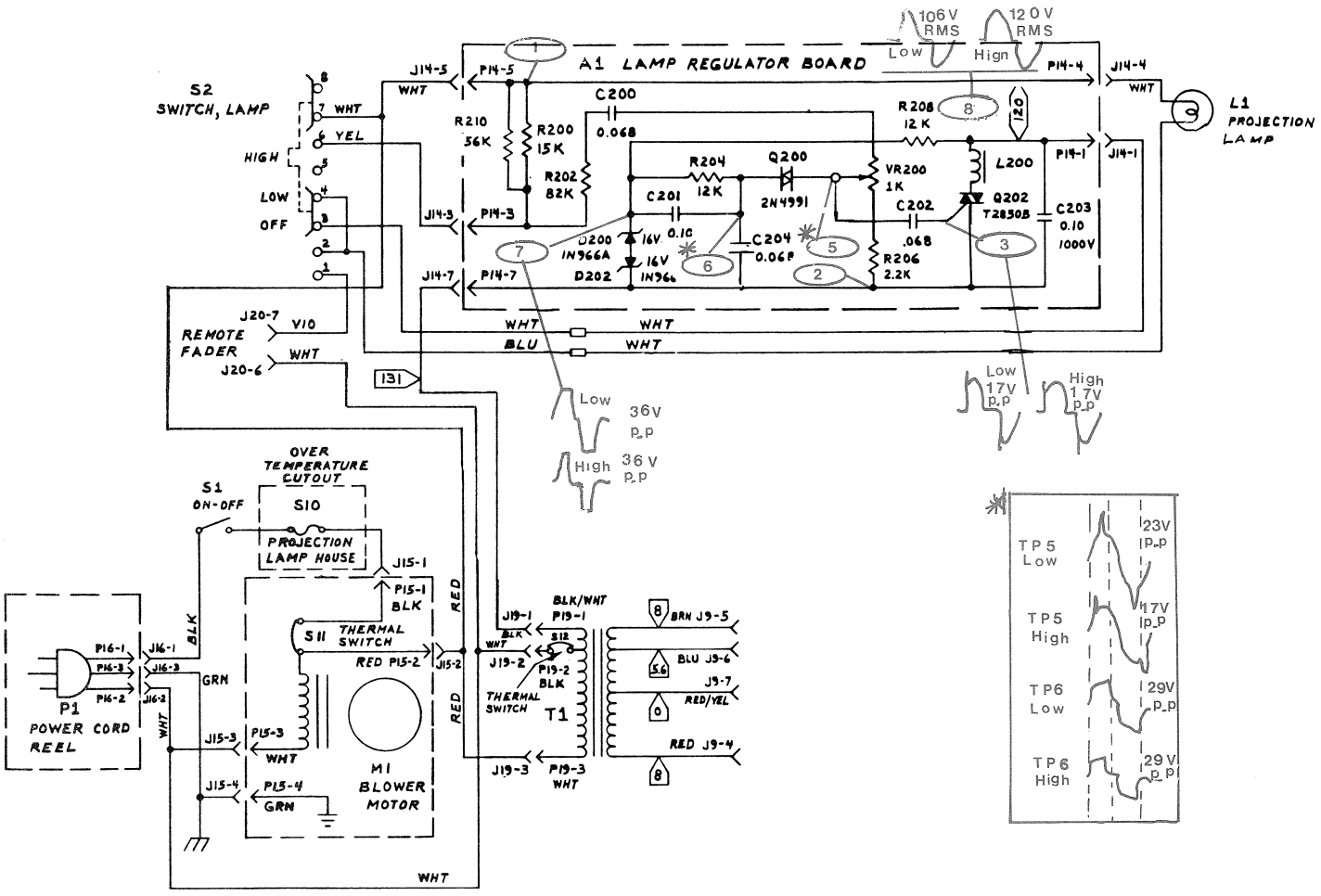


Figure 4-13. PROJECTION LAMP REGULATOR CIRCUIT

The bilateral switch senses a voltage difference existing between test points 5 and 6 and will conduct when this difference reaches 6 to 10 volts. It can conduct in either direction depending upon the polarity of the input voltage. When it conducts, it sends a triggering pulse through (C202) to the gate of the triac, test point 3, turning the triac on and allowing it to conduct. Once triggered, the triac can also conduct in either direction depending upon the polarity of the input voltage. Since the triac is in series with the projection lamp, it governs when current is allowed to flow through the lamp. The circuit is designed to delay the conduction of the triac by delaying the conduction of the bilateral switch. In other words, the input voltage will have already proceeded through part of its cycle before the bilateral switch turns on and allows current to pass through the projection lamp. The result is that the total heating effect (RMS voltage) on the lamp filament is controlled by controlling the length of time that current is allowed to flow through this filament.

The delay in conduction of the bilateral switch is created by referencing test points 5 and 6 to two different voltage variation rates. The voltage variation at test point 5 follows the AC input voltage polarity and rate of change. However, the voltage variations at test point 6 are governed by the two Zener diodes and the resistor-capacitor combination (R204), (C204) and (C-201). the input voltage swings either positive or negative, the Zener diodes, connected back to back, establish either a positive or negative 16 to 18 volt reference at the junction of (D200), (C201), and (R204). Capacitor (C204) charges through (R204) toward this reference voltage at a constant rate established by the time constant of these two components. This means that after an initial rise of a few volts, the voltage at test point 6 increases gradually toward the 16 to 18 volt reference. This controlled rate of rise of voltage at test point 6 is the key to delaying the conduction of the bilateral switch and subsequently to the delay of conduction of current through the lamp. (See lamp regulator wave forms (Figure 4-14).

The voltage at test point 5 is established by the voltage divider network (R206), (VR200), (C200), (R202), and (R200). As previously mentioned, this voltage follows the input voltage polarity and rate of change. However, the rate of change of the voltage at test point 6 is controlled by the charging curve of (C204) as it charges through (R204). In other words, it takes longer for the voltage to rise at test point 6 than it does for the voltage to rise at test point 5. This results in a delay before the voltage at test point 6 is 6 to 10 volts higher than the voltage at test point 5. (Remember that higher in this case means that the voltage at test point 6 must be either 6 to 10 volts more positive or 6 to 10 volts more negative than the voltage at test point 5 as determined by the polarity of the input voltage.) Thus, when the voltage at test point 6 finally rises to a value high enough to cause (Q200) to conduct, part of the input voltage cycle has already been completed. Now (Q200) finally conducts and the pulse created on the gate of (Q202) through (C202) causes it to conduct allowing current to flow through the projection lamp for the remaining portion of the input voltage

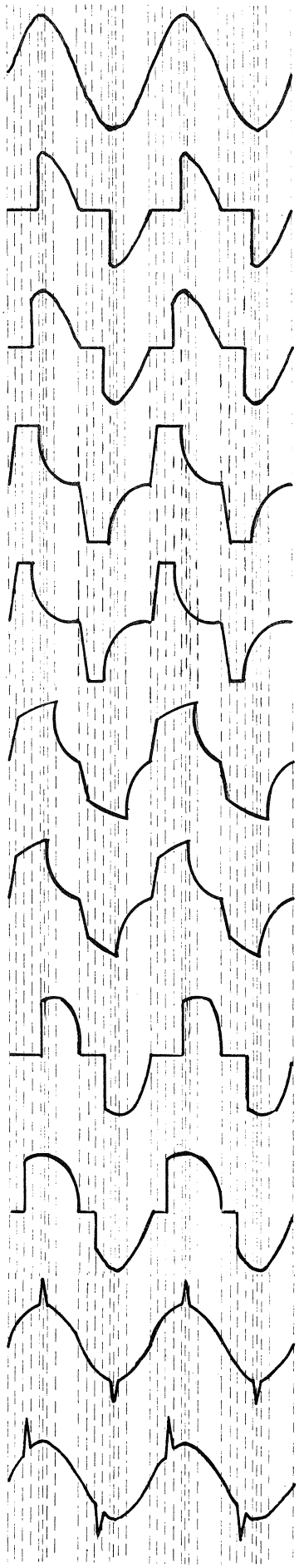


Figure 4-14. LAMP REGULATOR WAVEFORMS

alternating time. The total heating effect on the lamp filament is thus controlled since the lamp does not conduct through the entire input voltage alternating time.

When the input voltage returns to 0 volts AC, the triac turns off and the projection lamp stops conducting (momentarily). However, at this point the AC voltage input starts through the other half of its alternating time, and the above cycle is repeated with the opposite polarity. The overall result is that the projection lamp has current passing through it during only a portion of the positive alternating time and negative alternating time of the input voltage. Thus the RMS or effective voltage delivered to the projection lamp is less than the RMS or effective voltage available from the AC voltage input.

The lamp switch (S2) controls the high and low output of the projection lamp by changing the AC reference voltage at test point 5. This reference voltage is higher when the lamp switch is in the low position and lower when the lamp switch is in the high position. The voltage reference is changed by switching (R200) in and out of the circuit by either opening or closing the connection between contact 6 and 7 of the lamp switch. In the high position, (R200) is in the circuit, and in the low position (R200) is shorted out.

When the lamp switch is in the low position, the higher AC reference voltage at test point 5 dictates that the voltage at test point 6 must also be higher in order to establish the 6 to 10 volt difference required to cause the bilateral switch (Q200) to conduct. Since the charging rate of (C204) is constant, it will take longer to reach the voltage required at test point 6 to cause this conduction than if the voltage at test point 5 was lower. This means that the bilateral switch will conduct at a later point in time with reference to input voltage. If conduction through (Q200) is delayed longer, the triac (Q202) will also be turned on later and the projection lamp will conduct during a smaller portion of the input cycle. The heating effect on the lamp filament will be less and the lamp brilliance will be decreased.

When the lamp switch is in the high position, the lower voltage reference at test point 5 will allow (Q200) to conduct at an earlier point during the input voltage cycle since voltage at test point 6 does not have to go as high to reach the 6 to 10 volts required to start the bilateral switch conducting. Since (Q200) starts conducting earlier, the triac (Q202) will also conduct earlier and current is permitted to flow through the projection lamp earlier causing a greater heating effect in the lamp filament. Accordingly, the lamp brilliance will be increased.

Potentiometer (VR200) is provided in the circuit to make it possible to adjust the exact operating voltage of the projection lamp. The adjusting procedure is covered under Electronic Adjustments and Specifications.

If the input or line voltage increases, the voltage at test point 5 will increase proportionately and the bilateral switch (Q200) will remain turned off until the voltage at test point 6 rises sufficiently to turn it on. Thus the projection lamp will conduct for a shorter period of time when the input voltage rises, and the RMS voltage delivered to the projection lamp effectively remains the same. If the input voltage is reduced, the voltage at test point 5 goes down and (Q200) will be turned on sooner, allowing the projection lamp to conduct for a longer period of time, effectively maintaining the RMS voltage the same. Once again, the regulation of this circuit is governed by the fixed charging rate of capacitor (C204) through resistor (R204) and the reference voltage maintained by Zener diodes (D200) and (D202).

G. SLIDE INTERVAL TIMER-(3230)

The slide interval timer consists of (Z9), (Q300), (S3), (VR8) and other associated capacitors and resistors. This circuit is very basic and is used to advance the slide tray one slide at a time at a predetermined interval continuously variable from approximately 2 to 20 seconds with the adjustment of (VR8), the slide interval timer control. (Figure 4-15).

Turning on the timer switch (S3) applies 12 volts DC to the integrated circuit (Z9) and the timer output transistor (Q300). A negative, 40 millisecond pulse immediately appears on pin 3 of (Z9) which is coupled to the base of (Q300) through (R304). This negative pulse causes (Q300) to conduct and produce a positive, 40 millisecond pulse at its collector. The positive pulse is in turn coupled through (R306), (P10-9), (J10-9), J5-7), and (P5-7) to the base of transistor (Q5) momentarily turning it on and allowing it to conduct through the advance solenoid (S0-2). (S0-2) operates momentarily and allows the slide advance mechanism to advance one slide.

At the same time that the timer circuit is putting out the positive pulse on the collector of (Q300), capacitor (C310) is rapidly charged from ground through the circuitry of (Z9) between pins 1 and 7 and through (R300).

After producing one 40 millisecond pulse, the timer chip (Z9) resets itself and (C310) starts to discharge through (R300), (R302) and (VR8). The rate of discharge is governed by the time constant established by (C310), (R300), (R302) and (VR8).

Since (VR8) is a variable resistance, a variable time constant is possible which produces a variable time delay between the changing of slides.

As capacitor (C310) discharges through the above-mentioned resistors, the voltage at pins 2 and 6 of the timer gradually rises from 5 volts to 9 volts. When the voltage reaches 9 volts, (Z9) is again triggered to produce another negative, 40 millisecond output pulse at pin 3. This pulse, in turn, causes (Q300) to conduct again for 40 milliseconds and produce another positive, 40 millisecond pulse at its output. This

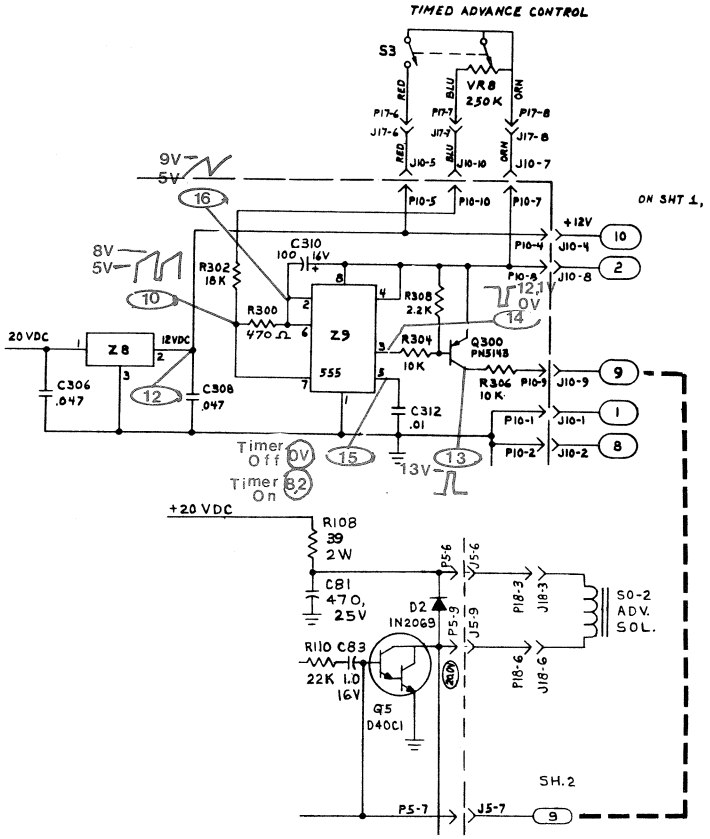


Figure 4-15. SLIDE INTERVAL TIMER (Model 3230)

causes (Q5) to conduct again and advance another slide. In the meantime, (C310) is again charged through (Z9) and (R300) and the cycle begins again when (Z9) resets itself.

Since the time interval between slide changes is a function of the setting of (VR8), a longer delay between slide advances may be achieved by rotating the timer control knob in a clockwise direction, inserting a larger portion of (VR8) in series with (C310) thus increasing the time constant of the circuit(Figure 4-16).

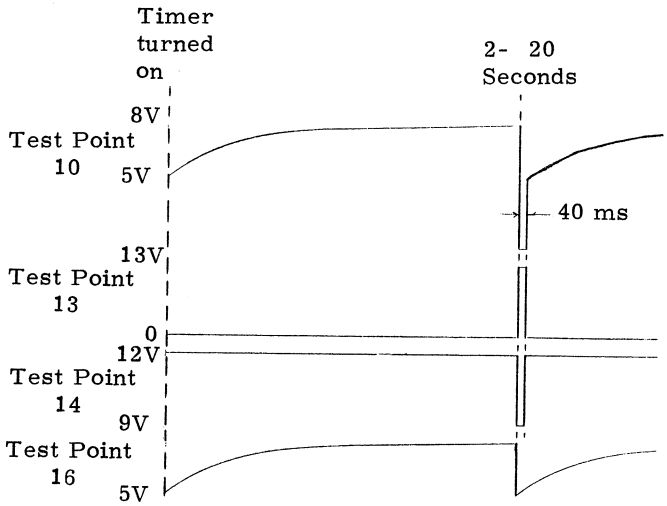


Figure 4-16. SLIDE INTERVAL TIMER (Model 3230) WAVEFORMS

H. SLIDE INTERVAL TIMER(3130)

The slide interval timer in the Model 3130 varies considerably in circuitry from that found in the Model 3230. It consists of capacitor (C-6), resistor (R-11), potentiometer (VR-1), switch (S-4), and the timer resetting NOR-GATE and diode, (Z-1) and (D-3) respectively. (Figure 4-17).

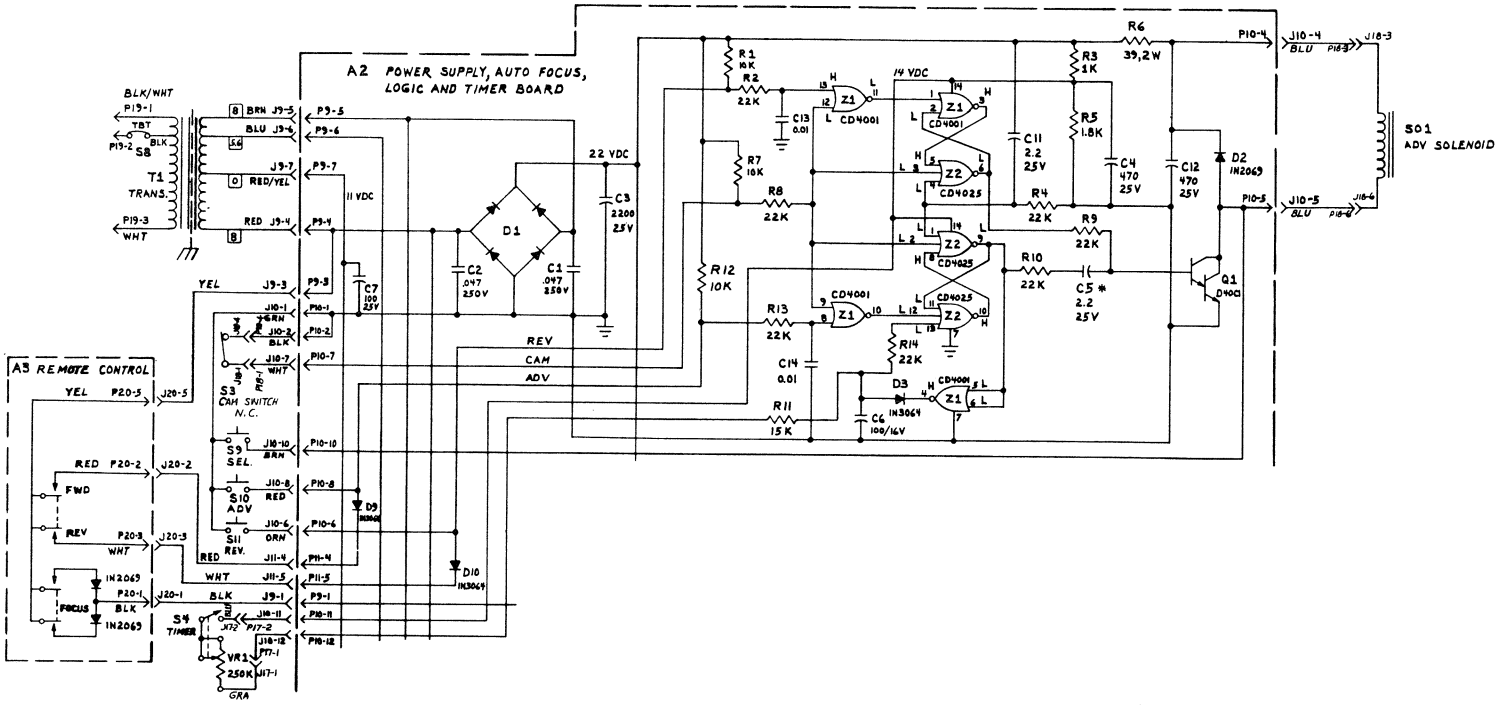


Figure 4-17. SLIDE INTERVAL TIMER (Model 3130)

When the timer switch (S-4) is turned on, 14 volts DC is applied to (VR-1). Capacitor (C-6) begins to charge through (R-11) and (VR-1) to this voltage. The positive voltage across (C-6) is coupled through (R-14) to pin 13 of NOR-GATE (Z-2). As this capacitor continues to charge, the positive voltage felt on pin 13 of (Z-2) is eventually recognized by this NOR-GATE as a logic high. (Z-2) begins to conduct and the logic condition at its output, pin 10, changes from the high to a low. This low is coupled to pin 8 of (Z-2) and coupled with the logic lows already on pins 1 and 2 of this NOR-GATE turns this portion of (Z-2) off.

The logic low at its output, pin 9, now becomes a logic high which is coupled to the base of (Q-1) through (R-10) and (C-5) causing (Q-10) to momentarily conduct and advance one slide by activating the advance solenoid (SO-1).

The logic high on pin 9 is also coupled to pins 5 and 6 of NOR-GATE (Z-1), causing it to conduct and produce a logic low at its output, pin 4. This provides a discharge path for (C-6) through (Z-1) and (D-3). (C-6) now discharges and a low appears on pin 13 of (Z-2) once again. However, a logic high still appears on pin 11 of (Z-2) and will hold it in its conducting state unless another action causes this to change. The other action is initiated by the opening of the cam switch, (S-3). When the cam switch opens, a logic high appears on pin 2 of (Z-2) causing it to conduct and produce a logic low at its output. This low is coupled to pin 11 of (Z-2) and coupled with the logic lows already on pins 12 and 13 shuts that portion of (Z-2) off to produce the logic high at its output, pin 10, once again. The circuit has now been reset and the capacitor, (C-6) again starts to charge to repeat the cycle.

The charging rate of (C-6) is determined by the time constant established by (C-6), (R-11), and (VR-1). Since (VR-1) is a variable resistor, the time constant of this circuit is continuously variable, and the interval between slide changes is variable between approximately 2 to 20 seconds.

J. REMOTE STOP/RESTART CIRCUIT

The remote stop/restart circuit is designed to simulate the same thing which takes place when the stop/restart switch (S-7) on the side of the projector is depressed. When the stop/restart switch is depressed, ground is placed at the junction of (C-87), (C-89) and (R-120). This causes a logic low to appear momentarily at pin 5 of (Z-4) which results in the stopping of the tape deck motor (M-3). (Figure 4-19).

Depressing the remote stop/restart button applies an AC signal through (C-320) and (R-320) to the junction of (D-320) and (D-322). The negative portion of this AC signal is removed by (D-320), and the positive portion is passed by (D-322) to the base of (Q-320). This positive voltage allows (Q-320) to conduct and reduces the voltage on its collector from 12 volts to about 4 volts. This voltage reduction is also felt at the junction of (C-87), (C-89), and (R-120) and is recognized on pin 5 of (Z-4) as a logic low. The result is the stopping of the tape deck motor (M-3). (See Remote Stop Waveforms, Figure 4-18).

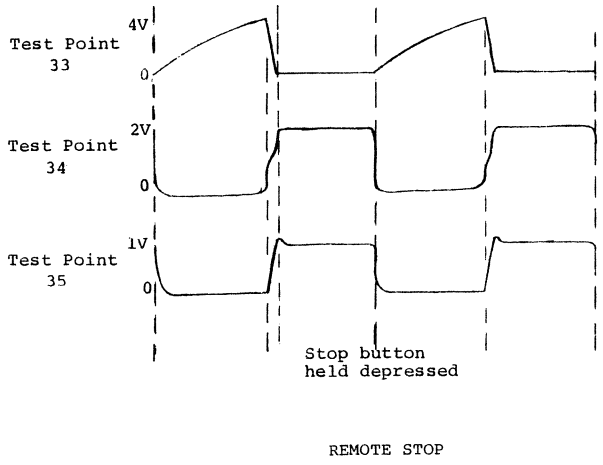


Figure 4-18. REMOTE STOP WAVEFORMS

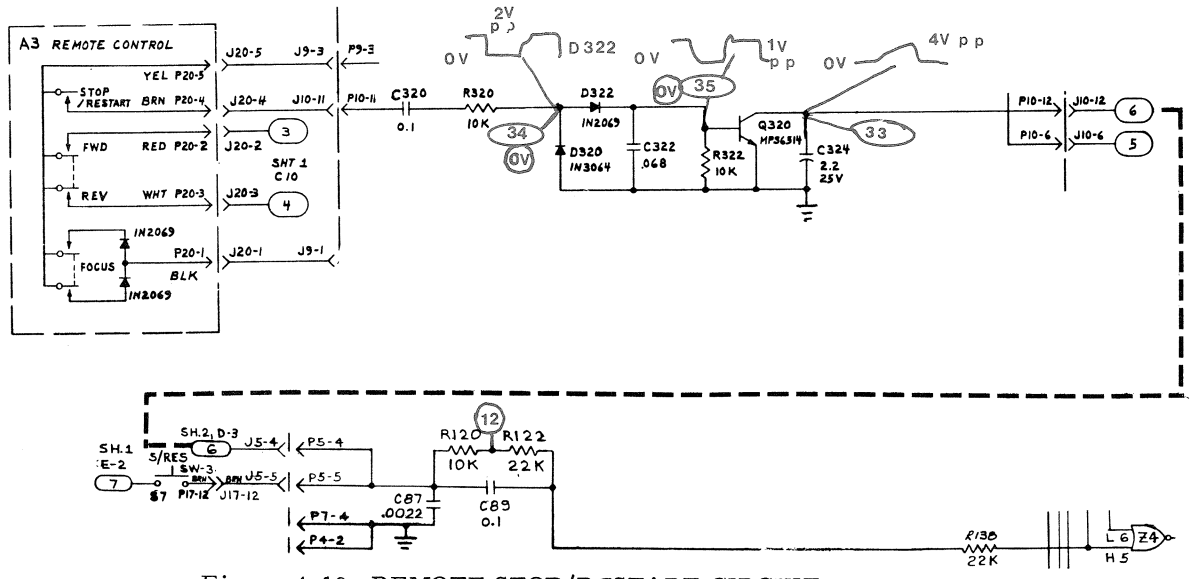


Figure 4-19. REMOTE STOP/RESTART CIRCUIT

K. AUTO-FOCUS CIRCUIT DESCRIPTION

The Auto-Focus circuit automatically maintains a correctly focused projected image once this image is obtained by the operator of the projector. It does this by continuously monitoring the distance between the slide film plane and the projection lens. If anything happens to change this distance, such as the slide "popping" from the heat of the projection lamp or variations in slide mountings, etc. the circuit recognizes these changes and automatically adjusts the lens to compensate for them.

A 5.6 volt AC exciter lamp is mounted off to the side of the slide, between the slide and the lens, and it directs a beam of light toward the front surface of the slide.(Figure 4-20). A sensor is mounted on the opposite side of the slide, between the slide and the lens, and it detects the infrared portion of the light beam reflected from the surface of the slide. If the correct distance exists between the slide film plane and the projection lens, the reflected light beam strikes the sensor at its center and a condition of equilibrium exists resulting in no movement of the projection lens. However, if the distance between the slide film plane and projection lens changes, the light beam no longer strikes the sensor at its center and a voltage is developed by the sensor which causes the auto-focus motor to run in the correct direction to reestablish both the projection lens and the sensor at the correct distance from the slide film plane.

The voltage developed by the sensor is an AC voltage. It is fed into pin 3 of the operational amplifier (Z-10) and amplified. It is then rectified by (D-352) and only the negative portion of it is fed to the base of (Q-340). From the emitter of (Q-340), this negative pulse is fed to the gate of the triac (Q-342). The triac now compares this negative pulse with the phase of the 5.6 volt AC reference voltage at test point 30. (This reference voltage is, of course, fed through (R-374) to the triac.)

If the film plane is too close to the projection lens, the negative pulse on the gate of the triac will be in phase with the negative portion of the reference voltage and the triac will conduct in one direction to produce a voltage across (R-374) which is negative at the top and positive at the bottom. The focus motor will thus run in a direction to cause the projection lens and sensor to move away from the slide.

If the film plane is too far away from the projection lens, the negative pulse on the gate of the triac will be out of phase with the positive portion of the reference voltage and the triac will conduct in the other direction to produce a voltage across (R-374) which is positive at the top and negative at the bottom. The focus motor will now run in the other direction and move the projection lens and sensor toward the slide.

The Sensor produces these phase relationships because it is connected across the secondary of transformer (T-1) with its center tap connected through (R-356) to the center tap of the

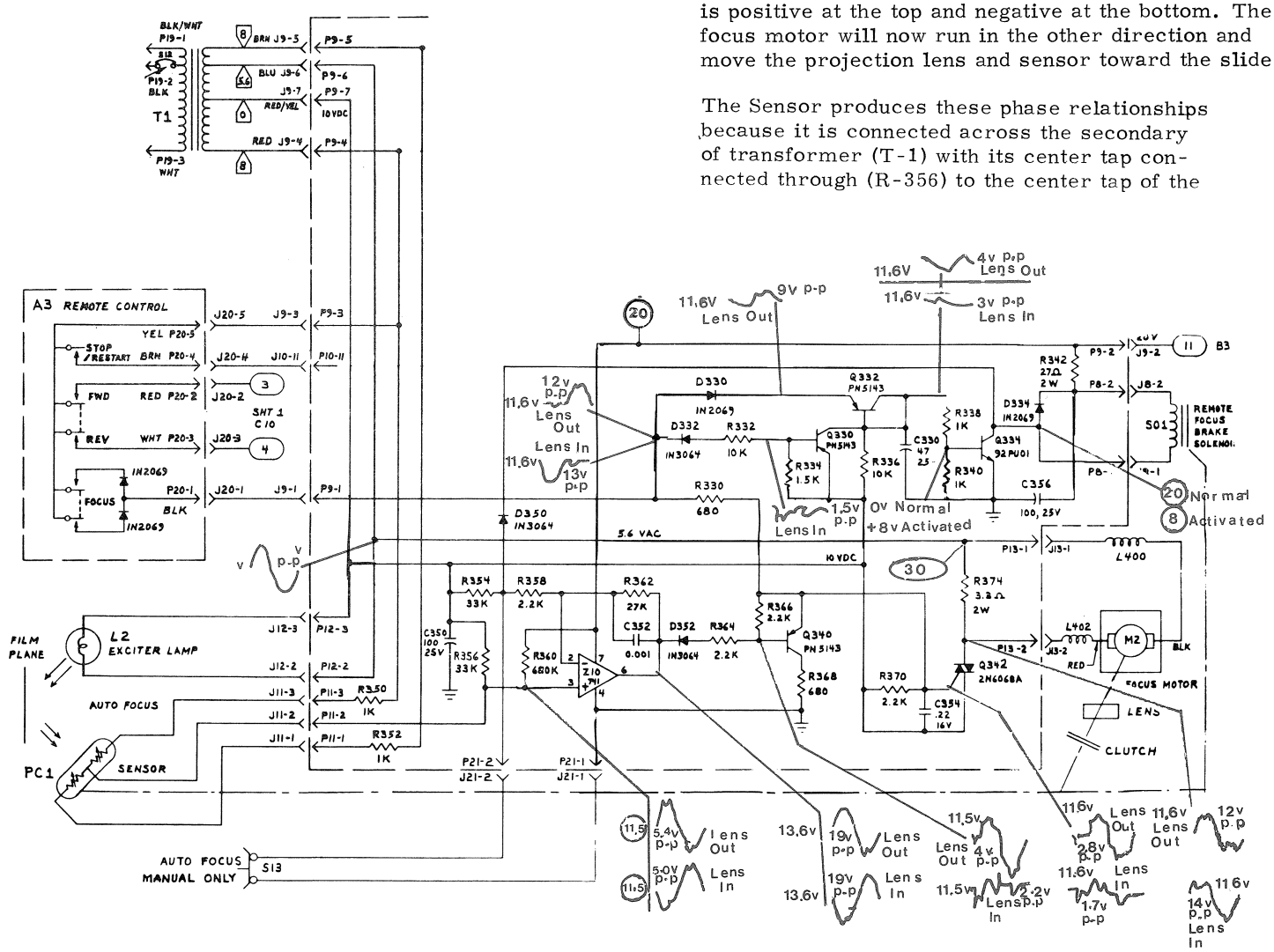


Figure 4-20. AUTO-FOCUS AND REMOTE FOCUS CIRCUITS

transformer. Thus each end of the sensor is 180° out of phase with the other end, with one end in phase with the 5.6 volt AC reference voltage. If one side of the sensor conducts, the AC signal it produces and feeds to pin 3 of the operational amplifier (Z-10) will be in phase with the 5.6 volt AC reference voltage. If the other side of the sensor conducts, the AC signal produced will be 180° out of phase with the reference voltage. Since only the negative portion of the sensor voltage is passed by (D-352), this negative pulse will be either in or out of phase with the reference voltage at test point 30. The triac will thus conduct in whatever direction is dictated by that phase relationship. By studying the the auto-focus waveforms, these phase relationships can be seen. (Figure 4-21).

Note: The voltage developed across (R-374) is not a pure DC voltage. Rather it is a pulsating DC voltage, the polarity of which is determined by the direction of conduction of (Q-342) as described above.

When auto-focusing is not desired, the circuit is turned off by the operating the auto-focus "ON /OFF "switch to the off position (this switch is located on the top of the projector above the lens). This places a ground on pin 2 of (Z-10) through (R-358) which prevents (Z-10) from responding to any signal generated by the sensor. All focusing is then accomplished manually or from the remote control. When the auto-focus ON/OFF switch is in the ON position, the ground is removed from pin 2 of (Z-10) allowing (Z-10) to respond to sensor signals.

L. REMOTE FOCUS CIRCUIT DESCRIPTION

Remote focus in machines with auto-focus is accomplished by supplying the trigger pulse for triac (Q-342) from two diodes located in the hand held remote control. (Figure 4-20). These diodes are placed in the circuit alternately by the remote focus button, one providing a positive trigger pulse on the gate of the triac to move the projection lens out and the other providing a negative pulse on the gate to move the projection lens in. (See remote focus waveforms.) (Fig.4-22).

When the projector is focused from the remote control, the auto-focus sensor is locked in position while the projection lens is being focused so the sensor is always positioned correctly when the projected image is in focus. The remote focus brake solenoid accomplishes this by operating a clutch which prevents the sensor from moving. The brake solenoid (SO-1) is operated when (Q-334) conducts due to the conduction of either (Q-330) or (Q-332). When the projection lens is moved in by the remote focus button, (Q-330) conducts, and when the lens is moved out, (Q-332) conducts.

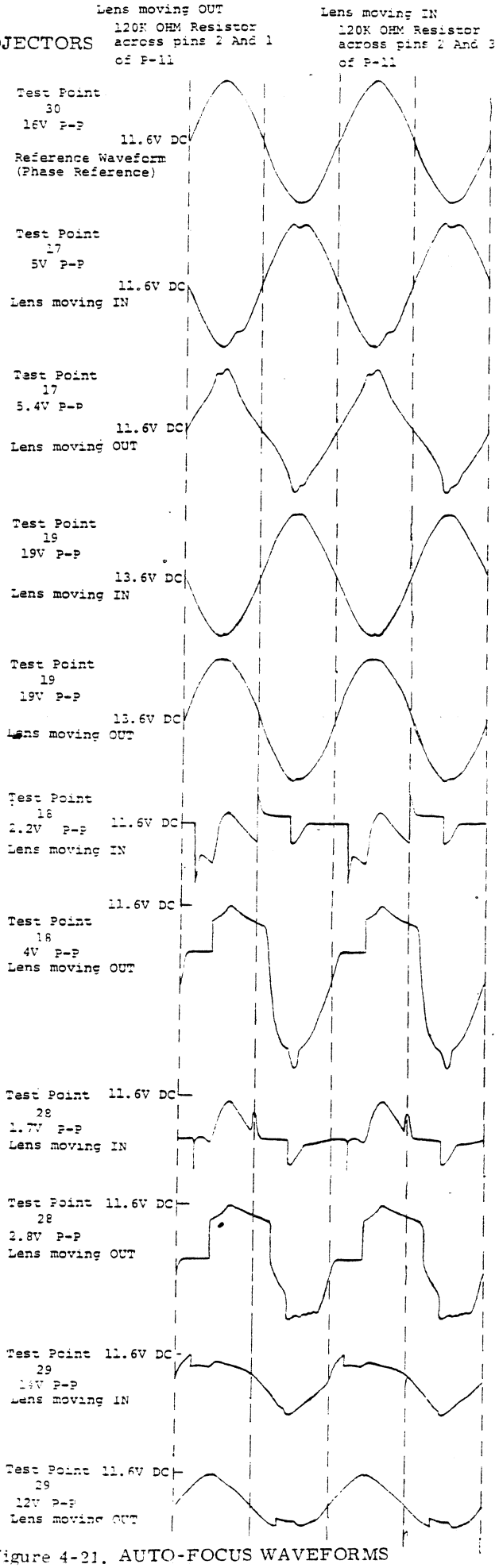


Figure 4-21. AUTO-FOCUS WAVEFORMS

In addition to operating the remote focus brake solenoid to hold the auto-focus sensor in place, the conduction of (Q-334) also shuts down (Z-10) so it will not respond to any voltages sent to it by the auto-focus sensor while the projector is being focused by the remote focus button. When (Q-334) conducts, the voltage at its collector drops to about 8 volts and this reduced voltage is coupled through (D-350) and (R-358) to Pin 2 of (Z-10). This reduced voltage produces the same result as switching the auto-focus ON-OFF switch to the OFF position. When the remote focus button is released, the voltage on pin 2 of (Z-10) returns to about 12 volts and (Z-10) will once again respond to voltages coupled to it from the auto-focus sensor.

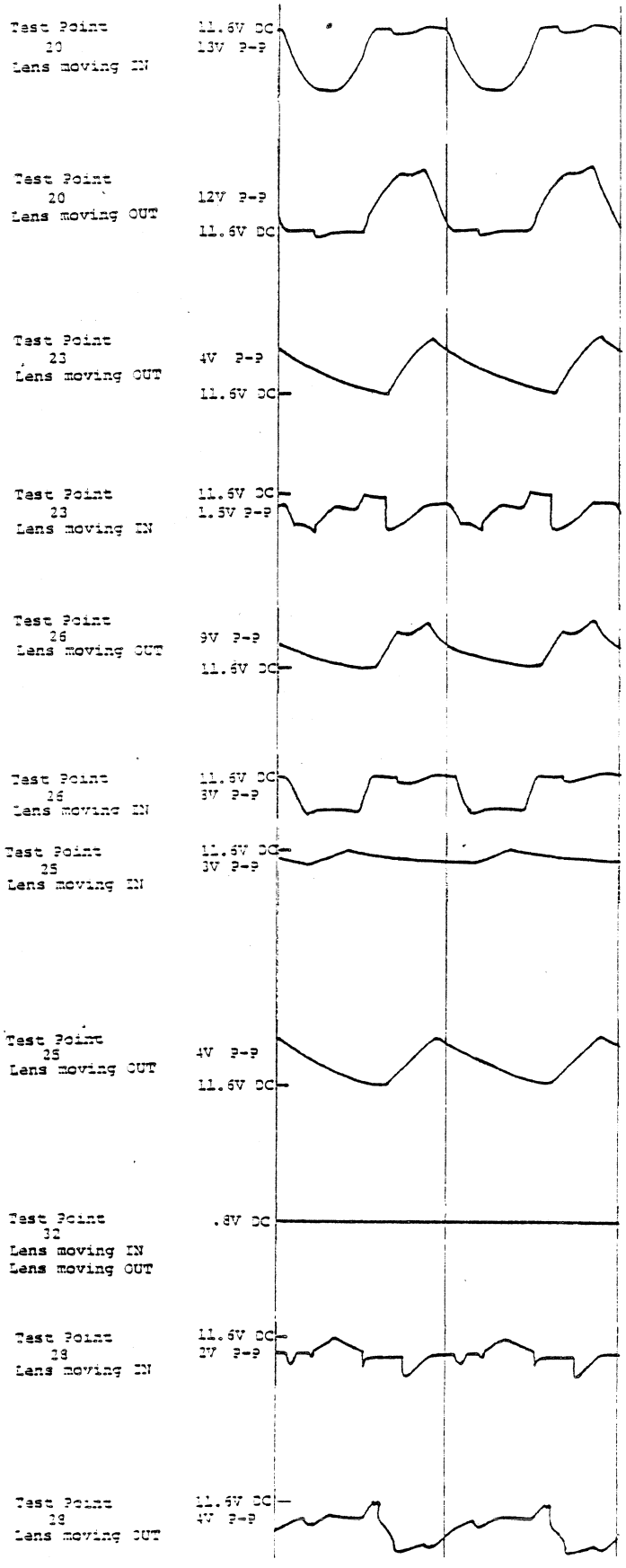
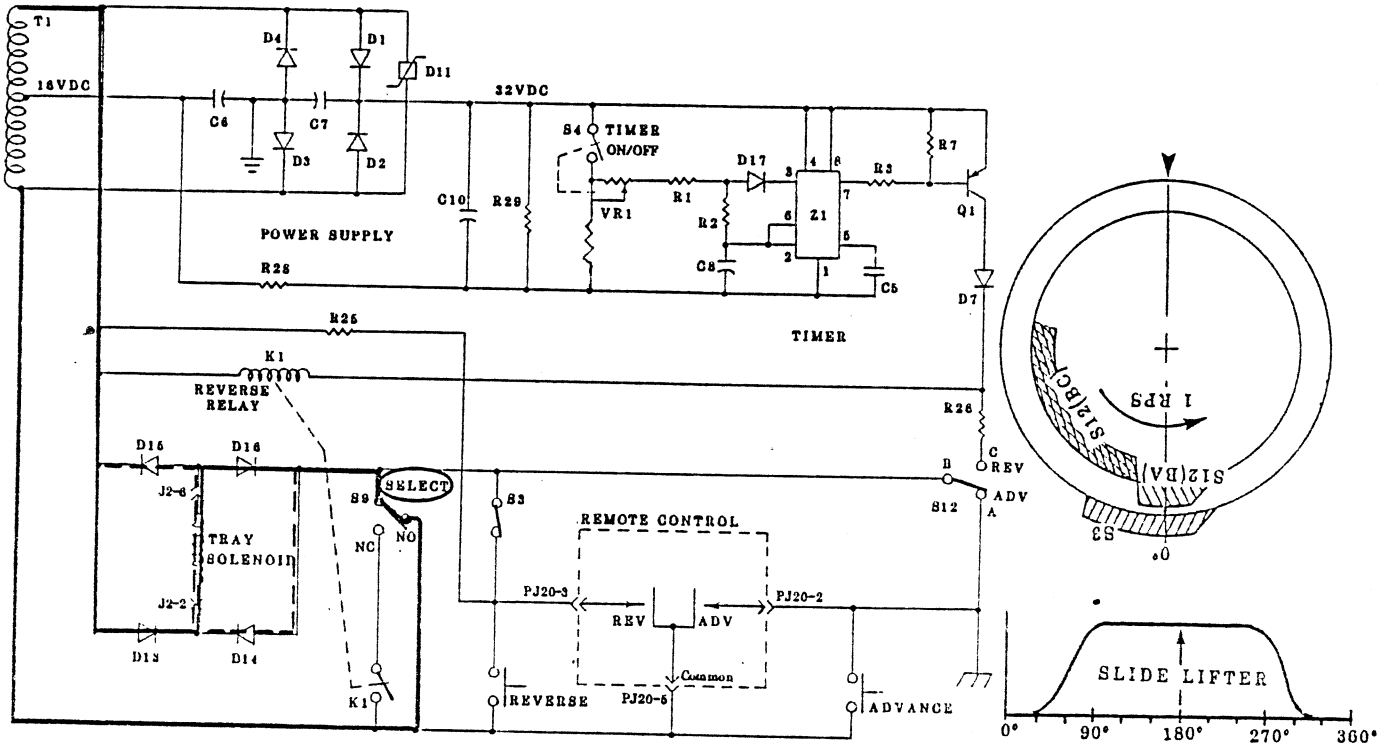


Figure 4-22. REMOTE FOCUS WAVEFORMS

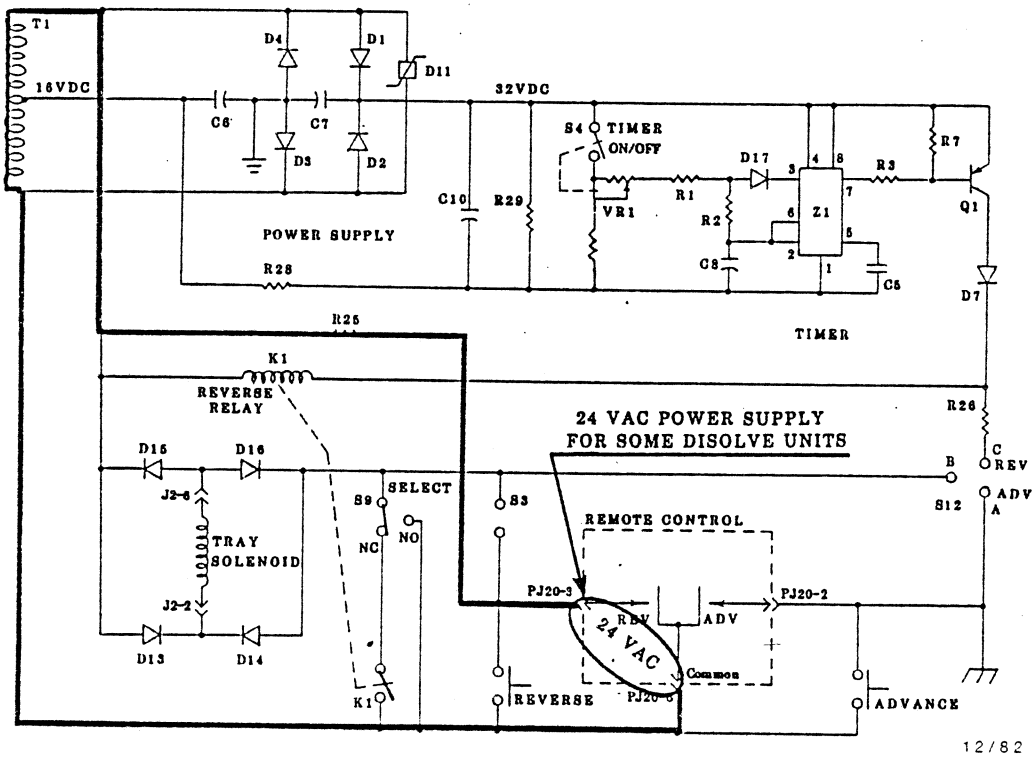
MODEL 3120 CIRCUIT DESCRIPTION

SELECT

Pressing the Select button mechanically closes the N. O. contacts on the Select Switch (S-9) completing the Tray Solenoid circuit through the Bridge Rectifier (D13 through D16). The operated Solenoid moves the Slide Mechanism Escapement to allow the Drive Pawl to engage the Cam Stack and start the Slide Mechanism through its Select cycle. The Solenoid remains operated while the Select button is held depressed causing the Escapement to disengage the Drive Pawl from the Cam Stack when the Cam has rotated 180°, the point where the Slide Lifter is all the way up in its travel. The Index Arm is prevented from moving the Slide Tray either Forward or Reverse by a linkage mechanically operated by the Select button.



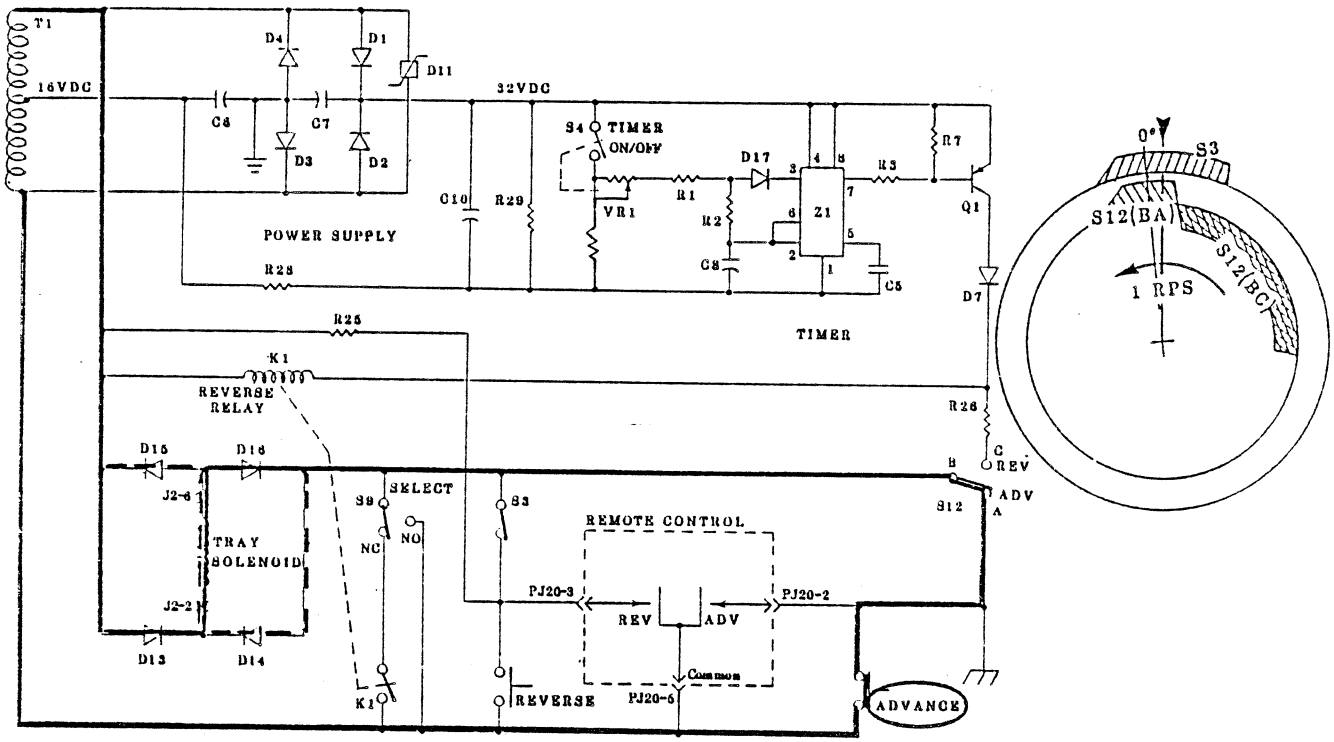
24 volts AC is supplied through a 150 ohm, 5 watt resistor across pins 5 and 3 of the remote control socket. This voltage is used by some Remote Controllers as their power source.



SLIDE ADVANCE

Pressing the Advance button completes the Tray Solenoid circuit through the A-B contacts of Cam Switch (S-12) and the Bridge Rectifier (D-13 through D-16). The operated Solenoid moves the Slide Mechanism Escapement to allow the Drive Pawl to engage the Cam Stack and start the Slide Mechanism through its Advance cycle. After the Cam Stack has rotated 12°, the A-B contacts of (S-12) open and the Tray Solenoid releases to restore the Front/Rear Cam back to the Front position so the Index Arm will advance one slide.

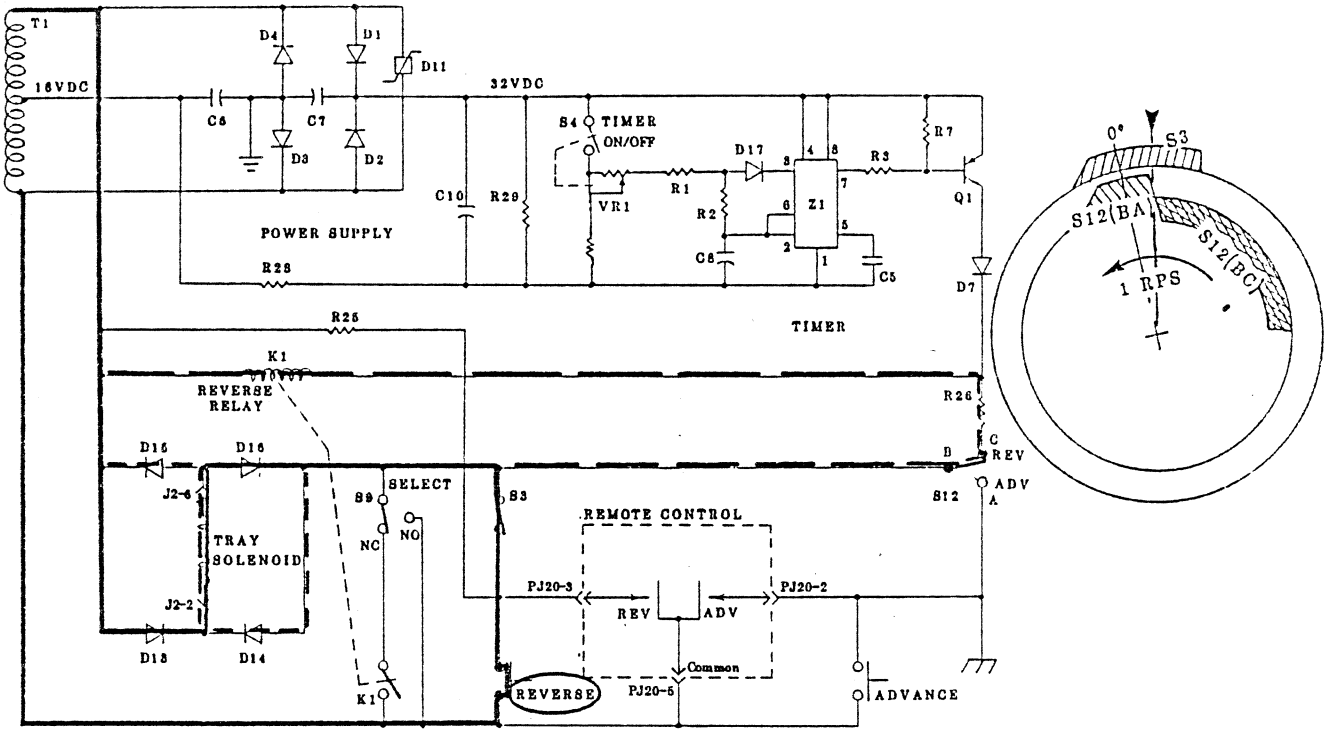
Note: The A-B contacts remain open until the Cam Stack has rotated 350°, at which time they close putting a ground through Cam Switch (S-3) and pin 3 of the Remote Control connector. This ground serves as a supervisory signal for some dissolve controllers to signal when the Slide Mechanism has completed its cycle.



SLIDE REVERSE

Pressing the Reverse button operates the Tray Solenoid through Cam Switch (S-3) and Bridge Rectifier (D-13 through D-16). The operated Solenoid moves the Slide Mechanism Escapement to allow the Drive Pawl to engage the Cam Stack and start the Slide Mechanism through its Reverse cycle.

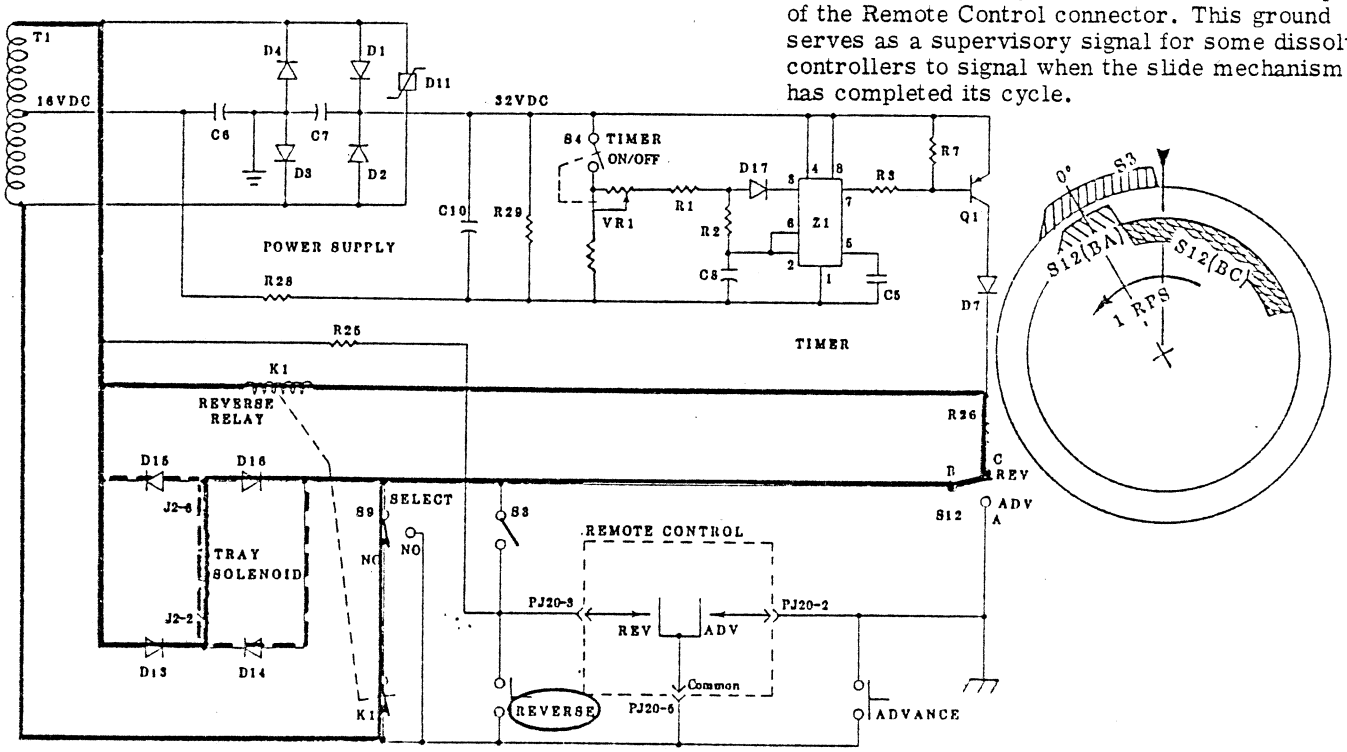
The Reverse button must be held down until the Cam Stack has rotated 12° to insure the operation of the Reverse Relay through the B-C contacts of Cam Switch (S-12) which close at the 12° point of rotation (approximately 33ms). The operated Relay holds itself and the Tray Solenoid operated through the N. C. contacts of the Select Switch (S-9) until the B-C contacts of Cam Switch (S-12) open at 102° of Cam Stack rotation.



The additional holding time for the Tray Solenoid is necessary in the Reverse mode to insure that the Front/Rear Cam is positioned in the Rear position when the Slide Tray Index Arm engages it.

The Reverse button may be released any time after the Reversing Relay operates and the projector will still complete the Reverse function properly. In the event that the Reverse button is held down throughout the Reverse cycle, the Cam Switch (S-3) opens after 25° of Cam Stack rotation and remains open until 350° of rotation to insure that the circuit will reset itself when the B-C contacts of Cam Switch (S-12) open.

Note: When the B-C contacts of Cam Switch (S-12) open at 102° of Cam Stack rotation, no contacts of (S-12) are closed until the Cam Stack has rotated 350°. At this point, the A-B contacts close again and remain closed until the Cam Stack has rotated 12° into the next Advance or Reverse cycle. The closing of the A-B contacts puts a ground through Cam Switch (S3) out of pin 3 of the Remote Control connector. This ground serves as a supervisory signal for some dissolve controllers to signal when the slide mechanism has completed its cycle.

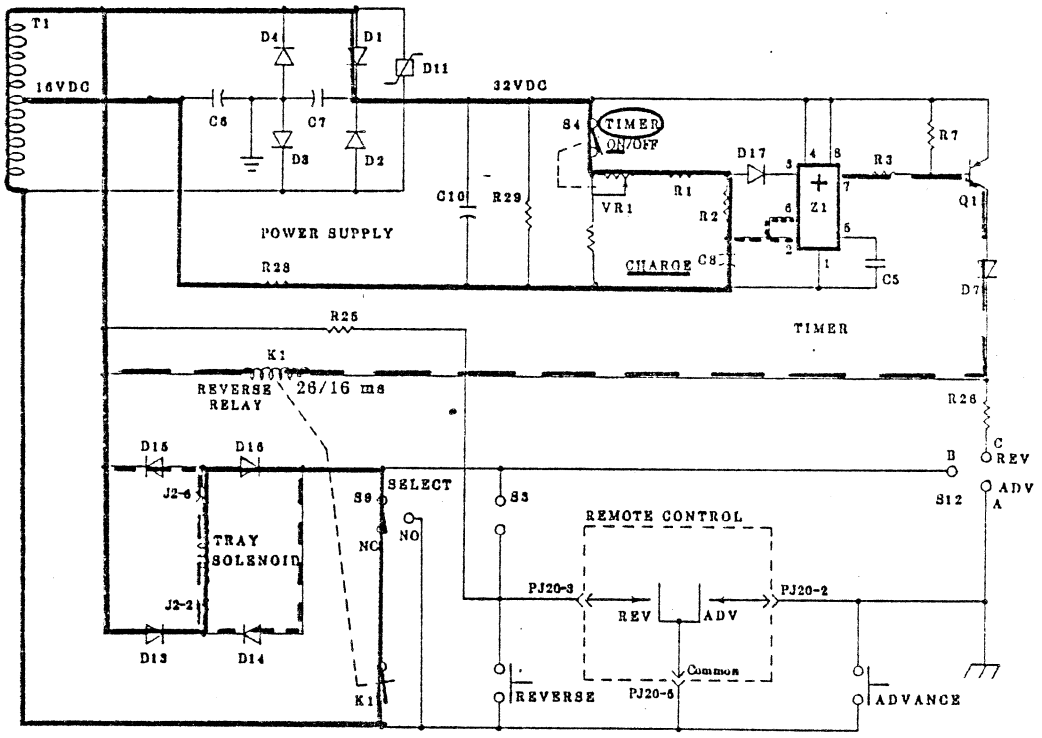


TIMER OPERATION

Turning the Timer ON/OFF Switch ON allows capacitor (C-8) to charge through (R-28), (R-2), (R-1) and (VR-1) Eventually pins 2 and 6 of the Timer Chip (Z-1) will become positive enough to trigger the Timer Chip to produce a low voltage at pin 7 which is coupled to the base of Transistor (Q-1) causing it to conduct.

The conducting Transistor causes the Reversing Relay (K-1) to operate through (D-7), (Q-1), (D-2) and (T-1) closing its contacts to operate the Tray Solenoid and start the Slide Mechanism through its cycle. The Slide Mechanism does not move the Slide Tray in Reverse since the Reversing Relay is held operated by the Timer Pulse for only about 26ms - not enough time to hold the Front/Rear Cam in position for reverse movement of the Index Arm.

Once the Timer Chip fires to give the low output from pin 7, it resets itself and starts through another cycle. This continues as long as the timer ON/OFF Switch remains ON. The cycle time of the Timer circuit is determined by the setting of the Slide Interval Timer Control (VR-1).



REMOTE CONTROL OPERATION

The Advance and Reverse buttons on the Remote Control are connected in parallel with the Advance and Reverse buttons on the projector.

The projector can be made to advance slides by putting a momentary closure (26ms) on the Reverse control line (PJ20-3).

TABLE OF CONTENTS

SECTION V

ELECTRONIC ADJUSTMENTS AND SPECIFICATIONS

A PROJECTION LAMP VOLTAGE ADJUSTMENTS (Models 3130 and 3230)

Before adjustment is made, it is advisable to check the waveform at test point 7 with an oscilloscope. * (For this measurement, test point 2 is the reference for the oscilloscope common lead.)(See Figure 5-1).

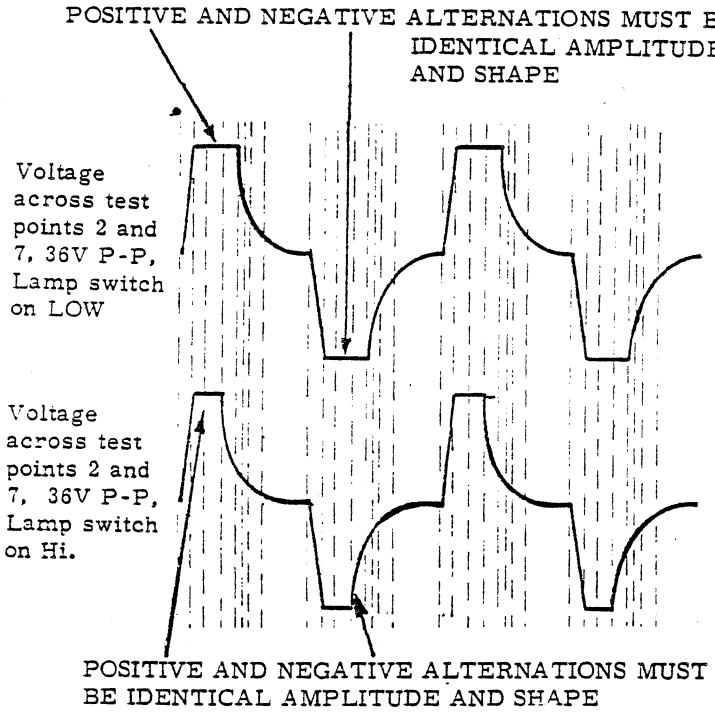


Figure 5-1.

REQUIREMENT

The positive alternation of this waveform must look exactly like the negative alternation as to amplitude and shape. If this is not true, the regulator circuit may not regulate properly. Change (D200) and/or (D202) to meet this requirement. (This results in maintaining (D200) and (D202) as a matched pair.)

Adjustment is made as follows:

1. Connect a True RMS voltmeter between test point 1 and 8. (See note below). *
2. Set Lamp switch on Hi position.
3. Set the line voltage at 120 VAC ±.5V
4. Adjust (VR200), located on Lamp Regulator circuit board, for 118-120 volts True RMS.
5. Move Lamp switch to Lo position.
6. True RMS meter should read 105V-111.9V True RMS.

NOTE: (VR-200) may be adjusted to any lamp voltage between 118V and 120V to achieve the above requirements.

7. If above requirements cannot be met:
   a. Check value of (R206). If it is a 2.7K ohm resistor, change it to a 2.2 K ohm resistor and try steps 2 through 5 again.
   b. If performing step 7a above does not bring the circuit within specifications, check for a 56K ohm resistor (R210) connected in parallel with (R200). If (R210) is there, try clipping it out. If it is not there, try adding it and go back to steps 2 through 5.

NOTE: A meter designed to measure True RMS MUST be used to make this adjustment. Voltage readings taken in this circuit with meters not so designed will be totally inaccurate since these meters are incapable of measuring True RMS nonsinusoidal waveforms.

IF YOU DO NOT HAVE A TRUE RMS METER IN YOUR SHOP, DO NOT TRY TO ADJUST THE LAMP VOLTAGE.

The whole purpose of having a regulated lamp supply is to guarantee proper lamp life by preventing the RMS voltage supplied to the lamp from going too high. Unknowingly setting the lamp voltage too high, because of error introduced by a meter incapable of measuring True RMS, defeats this purpose.

e.g. Lamp life is decreased by at least 20% if the True RMS voltage supplied to the lamp is as little as 2 volts too high. An RMS voltage 4 volts too high decreases lamp life at least 35%, etc.

* The common or reference probe of the oscilloscope or meter MUST NOT be grounded.

A grounded common probe could cause damage to the test equipment or to the projector.

A brief listing of meters which are designed to measure True RMS is offered below. Other meters are also available for this purpose.

Manufacturer	Model
Data Precision	248
Data Precision	258
Data Precision	2480R
Keithley	179
Systron-Donner	7141A
Fluke	8010A
Fluke	8921A
Ballantine	3036A
Kontron	4020
Simpson	467

NOTE: If the advance and stop cue circuits in the Caramate 3300 under consideration are in definite need of adjustment, this Section will provide the necessary details for doing so. However, if the projector seems to be functioning properly and is only in need of checking, refer to Step Level Evaluation Tests, Section E.

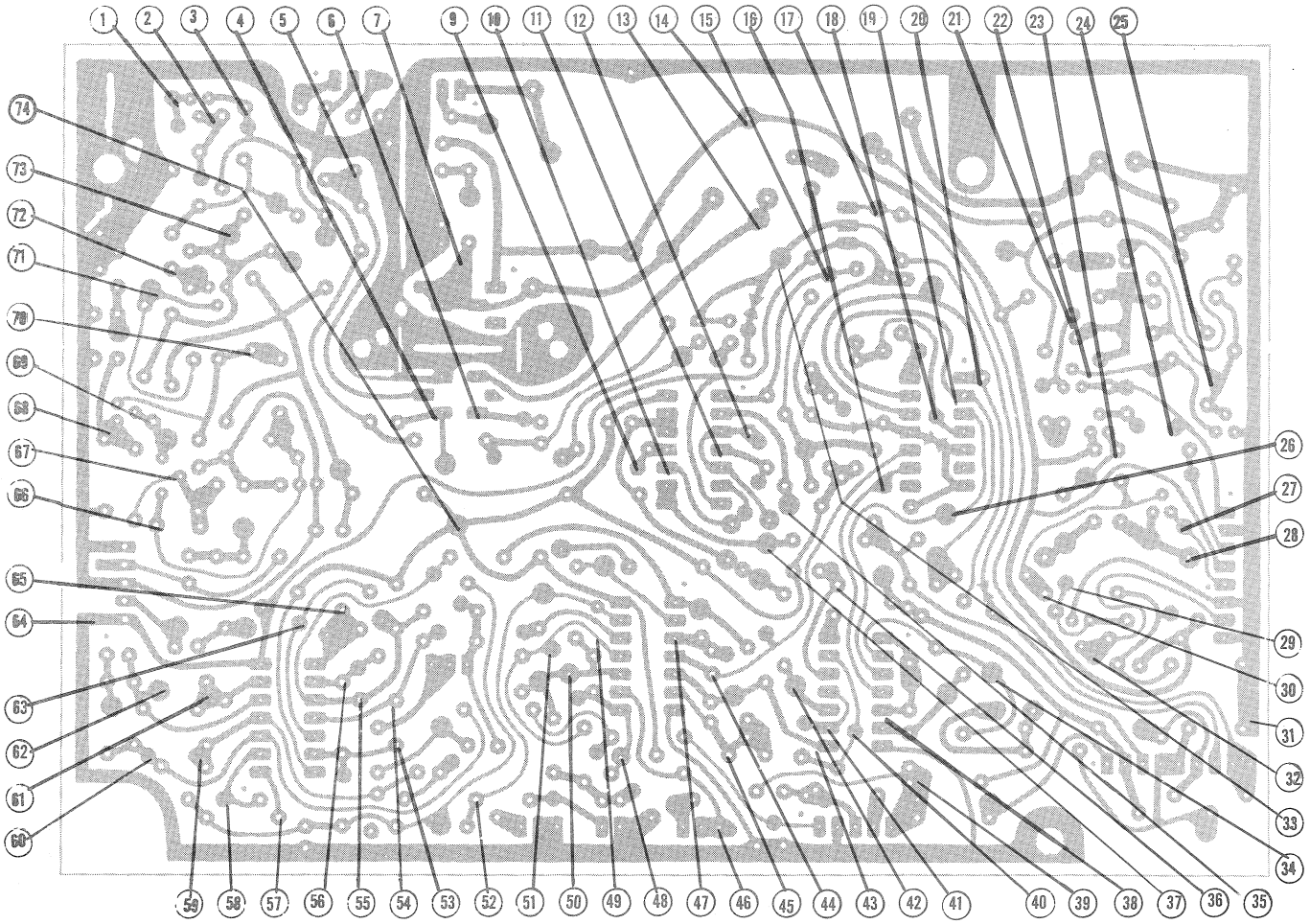
B ADVANCE CUE PULSE TUNING AND SENSITIVITY-1000 Hz (Models 3230 and 3260)

1. Connect an AC VTVM or an oscilloscope between ground (Test Point 64) and the output of the 1000 Hz filter circuit (Test point 55).

2. Operate the "ON/OFF" switch on the rear of the projector to "ON".

3. Insert Singer Education Systems Test Tape (SS 345C) into the tape deck.

Note: The first $3\frac{1}{2}$ minutes of recorded information on this tape are continuous 50 Hz signals which will have no affect on Caramate 3200 projectors.



The next three minutes of recorded information is a continuous 1000Hz signal recorded at -10db on tracks 3 and 4. This signal is used for adjusting the advance cue pulse tuning and sensitivity on the Caramate 3200 Projectors.

4. Adjust the sensitivity Potentiometer (VR-1) for a minimum reading on the VTVM or Oscillscope connected in step 1.

5. Adjust the tuning Potentiometer (VR-2) for a maximum reading on the VTVM or Oscilloscope.

6. Adjust the sensitivity Potentiometer (VR-1) for a reading of 3 volts RMS (8.4 volts peak to peak) on the VTVM or Oscilloscope.

7. If the Stop Pulse feature is functioning properly and not in need of adjustment, rewind the tape. Depress the "Eject" button, remove the tape and proceed to Step Level Evalution Tests, Section Otherwise, proceed with Stop Cue Pulse Tuning and Sensitivity, Section C.

C STOP CUE PULSE TUNING AND SENSITIVITY (Models 3230 and 3260)

1. Immediately following the three minutes of continuous 1000 Hz signal recorded on tracks 3 and 4 of the test tape (SS 345C) are two minutes of a continuous 150 Hz signal recorded at -10 db on tracks 3 and 4. This signal is used for adjusting the stop cue pulse tuning and sensitivity on the Caramate 3200 projectors.

2. Operate the "ON/OFF" switch on the rear of the projector to "OFF".

3. Connect the VTVM or Oscilloscope between ground (Test point 64) and the output of the 150 Hz filter circuit (Test point 50).

4. Connect a jumper from the output of the Tape Drive Control Logic Circuit (Test point 19) to the +12 supply voltage (Test point 74).

5. Operate the "ON/OFF" switch on the rear of the projector to "ON".

6. Adjust the sensitivity Potentiometer (VR-3) for a minimum reading on the VTVM or Oscilloscope connected in step 3.

7. Adjust the tuning Potentiometer (VR-4) for a maximum reading on the VTVM or Oscilloscope.

8. Adjust the sensitivity Potentiometer (VR-3) for a reading of 2 volts RMS (6 volts peak to peak) on the VTVM or Oscilloscope.

9. If no further tests are to be made, rewind the Test Tape. Depress the "EJECT" button on the front of the machine. Remove the test tape and proceed to Step Level Evaluation Tests, Section E. Otherwise Proceed to Audio Tests and Requirements Section D.

10. Remove the jumper installed in step 4

D AUDIO TESTS AND REQUIREMENTS (Models 3230 and 3260)

1. Immediately following the two minutes of continuous 150 Hz signal recorded on tracks 3 and 4 of the test tape (SS-345C) are two continuous signals of 1000 Hz @ -6db & 150 Hz @ -6db, each about 20 to 30 seconds long, recorded on tracks 3 and 4 of the test tape. These are reference signals which correspond to the ANSI Standard Nominal Level for Advance & Stop pulses. Caramate 3200 projectors should advance once during the 1000 Hz signal and stop during the 150 Hz signal. If restarting is attempted, the projector will immediately stop again and will continue doing so until the entire 20 seconds of 150 Hz has finally passed by the tape head with this stopping and starting action.

2. Connect the AC VTVM or Oscilloscope to the tip and sleeve connections of the speaker jack (J-1) .

   NOTE: A test speaker or dummy load may be used for these tests by plugging it into the speaker jack and connecting the test equipment across it,

3. Immediately following the 20 seconds of the 150 Hz recorded on tracks 3 and 4 are 5 reference signals of 20 second duration recorded on tracks 1 and 2. They are 150 Hz @ -6db, 1000 Hz @ -6db, 315 Hz @ -4db, 50 Hz @ -10db and 50 Hz @ -6db.

4. The 150 Hz signal will have no significant affect on the audio circuits.

5. The 1000 Hz signal at -6db should be audible from the speaker and an undistorted output of 6.4 volts RMS (18 volts P-P) should be obtainable by varying the volume and tone controls.

6. The third signal of 315 Hz @ -4db is the ANSI Standard Reference Level for audio. It should be audible from the speaker and able to produce an undistorted output of 6.4 volts RMS (18 volts P-P) with the adjustment of the volume and tone controls.

7. The fourth and fifth signals of 50 Hz will also have no affect on the audio circuits.

8. Rewind the tape, depress the "EJECT" button on the front of the projector and remove the tape from the projector.

E STEP LEVEL EVALUATION TESTS (Models 3230 and 3260)

1. Insert Singer Education Systems test tape (SS-345A) into the tape deck.

2. The first two signals are 10 second reference signals recorded on tracke 3 and 4 which provide an immediate check of the advance pulse circuits. Caramate 3200 projectors should advance once with each of these two 1000 Hz advance signals.

   If desired, a quick check of the advance circuits can be made at this time by making all test connections specified in the Advance Cue Pulse Tuning and Sensitivity 1000Hz, Section B.

3. The next 10 seconds of recorded information is a 315 Hz signal recorded at -4db on tracks 1 and 2. This is the ANSI Standard Reference Level for audio. If desired, a quick check of the audio circuits can be made at this time by making all test connections specified in the Audio Tests and Requirements, Section D.

4. The next information is a series of 1000 Hz pulses, each 440 milliseconds long but decreasing in level, recorded on tracks 3 and 4. There are three pulses recorded at -3db, three at -9db, three at -12db and so on in 3db steps down to- 30db. These pulses are followed by another three pulses at -3db. The Caramate 3200 Projectors should advance one slide on all pulses through the -18db or -21db levels but should not from -24db to -30db.

5. Refine the adjustment on the sensitivity potentiometer (VR-1) to achieve this requirement. This may require rewinding and playing this tape several times and adjusting the sensitivity potentiometer in increments until this requirement is met.

6. Following the 1000 Hz pulses at -3db, fifteen pulses are recorded which check the machine's marginal operating characteristics. These are three "Long-Strong" pulses of -3db for 520 milliseconds, three nominal level-short duration pulses of -6db for 380 milliseconds and three " Short-Weak" pulses of -9db for 380 milliseconds, followed by six pulses, three of 950 Hz at -10db for 380 milliseconds and three of 1050 Hz at -10db for 380 milliseconds, which check the bandwidth of the 1000 Hz cue pulse detecting circuitry. Caramate 3200 projectors should advance once for each of the fifteen pulses.

7. The next 15 pulses are 150 Hz and are used to check the sensitivity and bandwidth of the Stop Pulse Detecting Circuitry ONLY (the projector will not advance with these pulses). The first 3 pulses are "Long-Strong" pulses of 150Hz at -3db for 520 ms. These are followed by 3"Short -Weak" pulses of 150 Hz at -9db for 380 ms. Following these are 3 pulses of 150 Hz at -30db for 520 ms. After these are 3 pulses of 142 Hz at -10db for 380 ms.and 3 pulses of 158 Hz at -10db for 380 ms. Caramate 3200 projectors should stop on each of these pulses except the three 150 Hz pulses at -30db for 520 ms.

8. The next three signals on this tape are 1000 Hz at -10db, 150 Hz at -10db and 150 Hz at -6db, each 20 to 30 seconds in duration, recorded on tracks 3 and 4. These signals may be used for checking and adjusting the advance and stop circuit according to Sections B and C respectvely of these instructions.

9. The last two signals are ANSI Standard Reference signals of 315 Hz @ -4db recorded on tracks 1 and 2 and 1000 Hz @ -6db recorded on tracks 3 and 4. These may be used for a final verification of the audio and advance circuits respectively.

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SECTION VI. TROUBLESHOOTING

Before troubleshooting the CARAMATE 3100 and 3200 PROJECTORS, make sure the following conditions exist.

There are no loose or missing screws or parts that are binding because of misalignment or lack of lubrication.

The tape deck will transport a general purpose cassette without binding or damaging tape (3230 & 3260) (This will insure against damaging an expensive test tape).

The tape head is clean and demagnetized. (3230 and 3260)

The azimuth adjustment is correct. (3230 and 3260)

The tape contains the proper cue pulse frequencies. (3230 and 3260)

Evaluation tape SS 345A has been played to determine the approximate operating condition of the projector (see description of test tape, Section V. Para. E)

When all of the above conditions are verified and the machine still exhibits trouble, consult the following.

A. TROUBLE AND REMEDY CHARTS

The purpose of the following table is to list commonly encountered troubles and to indicate corrective repairs and adjustments. Disassemble only as far as needed for repair. Electrical troubleshooting will be facilitated by referring to the Troubleshooting Aid Charts and the Wiring and Schematic diagrams.

The table is divided into two sections. Section One covers Projector Electrical Problems, while Section Two covers Projector Mechanical Problems. The Schematic Diagram indicates typical AC signal and DC bias voltages for cases requiring more extensive circuit analysis.

TROUBLE	PROBABLE CAUSE	REMEDY
1. PROJECTOR, ELECTRICAL		
(a) All functions inoperative	Circuit breaker shut off or tripped (Line fuse blown)	Turn circuit breaker on (Replace line fuse)
	Power switch defective	Replace
	Power cord defective	Replace
	Connector loose or disconnected	Reconnect
	Thermal cutoff, in fan motor or lamp housing defective	Replace
	Thermal cutoff open due to overheating	Check operation of fan motor, Check for air flow obstruction, Check for high line voltage.
(b) Lamp does not light	Defective lamp	Replace
	Defective lamp board component	Replace Q 202 (All Models) Replace Q 200, D 200 and D 202 (3130 & 3230) Replace D 200, Z 200 (3260)
	Defective lamp switch	Replace
	Connector loose or disconnected	Reconnect

TROUBLE	PROBABLE CAUSE	REMEDY
(c) No audio, all other functions O.K. (3230 and 3260)	Defective board component	Insert 315 Hz Test Signal from Test Tapes, Trace signal with an Oscilloscope or VTVM. Replace defective component.
	Defective speaker	Replace
(d) No audio, no advance or stop. Lamp and blower O.K. (3230 and 3260)	Azimuth out of adjustment	Adjust (refer to Section II, Para. D.)
	Tape head dirty	Clean
	Blown fuse in transformer	Replace
	Defective cassette	Replace
(e) Tape not being transported (3230 and 3260)	Stop circuit activated	Push restart button
	Pause button activated	Release Pause button
	Defective board component	Replace
	Defective cassette	Replace
	Loose or defective connector	Replace
(f) Low audio output (3230 and 3260)	Azimuth out of adjustment	Adjust (Refer to Section II, Para. D)
	Volume control dirty or defective	Clean or replace
	Defective board component	Insert 315 Hz Test Signal from test tapes, trace signal with oscilloscope or VTVM. Replace defective component.
	Defective tape head	Replace
	Bad Connection	Clean or repair
(g) No advance from cue pulses on tape, audio O.K. (3230 and 3260)	Azimuth out of adjustment	Adjust (Refer to Section II, Para. D)
	Cue pulses wrong frequency	Check for proper cue pulse frequency
	Tape head dirty	Clean
	Defective board component	See troubleshooting aid chart.
(h) No tone control (3230 and 3260)	Tone/Volume control plug reversed	Remove plug from board, turn plug around and plug back in.
	Azimuth out of adjustment	Adjust (Refer to Section II, Para. D)
	Defective tone control	Replace
(j) Slide tray remains in select	Defective board component	Replace (Q-5), (Z-5)(3260 &3230) Replace (Q-1), (Z-2)(3130)
	Mechanical bind in slide advance mechanism	Repair

TROUBLE	PROBABLE CAUSE	REMEDY
(k) Slides advance at random	Audio recorded on both sides of tape	Use tape with audio recorded on one side only and cue pulses on the other side.
(m) No stop from cue pulse on tape, audio seems O.K. (3230 and 3260)	Azimuth out of adjustment	Adjust (Refer to Section II, Para. D)
	Tape head dirty	Clean
	Defective board component	See troubleshooting chart
(n) Noisy audio (3230 and 3260)	Tape head dirty or scratched	Clean or replace
	Tape head requires demagnetization	Demagnetize tape head
	Tape head connections open or intermittent	Repair
2. PROJECTOR MECHANICAL	Dirty volume control	Clean
(a) Screen illuminated when no slide is in projector	Shutter out of adjustment	Adjust
	Shutter spring missing	Replace spring
(b) Screen is not illuminated when slide is in projector, projection lamp O. K.	Shutter dirty	Clean
	Shutter not opening	Check springs for operation interference.
(c) Screen illumination weak or low	Projection lens, mirror or projection screen dirty.	Clean
	Projection lamp mirror out of adjustment	Adjust
(d) Projected image not centered on screen	Defective lamp	Replace
	Defective slide, not dropping	Remount slide
(e) Projector does not cycle	Solenoid out of adjustment	Adjust (refer to Section III, Para J.)
	Clutch spring broken	Replace
	Slides jammed	Replace (Slide mounting)
	Slide clamp interference at top of frame	Adjust (Refer to Section III, Para K.)
	Detent arm out of adjustment	Adjust
(f) Slide tray will not rotate manually when select is depressed	Lifter out of adjustment	Adjust (Refer to Section II, Para. F)
(g) Slide tray will not advance	Index arm jammed	Adjust forward or reverse cam (Refer to Section III, Para H)
	Tray defective	Replace
	Defective board component	Refer to troubleshooting charts.
(h) Projector continues to cycle	Solenoid misaligned	Adjust (Refer to Section III, Para. J)

TROUBLE	PROUBLE CAUSE	REMEDY
(j) Wow or flutter (3230 and 3260)	Cassette defective	Test with another cassette. Replace if necessary
	Pinch roller surfaces dirty	Clean
	Flywheel or pinch roller bearings dirty	Clean
	Dirty capstan, rotates slowly	Clean
	Pinch roller spring defective	Replace
	Drive rollers worn or nicked	Replace
	Drive belt loose or worn	Replace
(m) Cassette tape damaged by unit (3230 and 3260)	Take-up torque low	Replace tape deck assembly
	Rollers gummy or dirty	Clean
	Defective slide	Replace slide
(n) Auto-focus inoperative	Defective exciter lamp	Replace lamp (L2)
	Auto-Focus switch off	Turn switch on
	Defective board component	(Z-10, (Z-3), (Q-340), (Q-5), (Q-342), (Q-6), (D-352), (D-8), (D-350), (D-7), (Q-334), (Q-4) Numbers in parentheses refer to 3130
	Defective Focus motor	Replace motor (M-2)
	Defective sensor	Replace focus mechanism with rebuilt mechanism
(o) Auto-focus runs away	Auto-Focus sensor and/or exciter lamp out of adjustment	Adjust (Refer to Section III, A)
	Auto-Focus brake out of adjustment	Adjust (Refer to Section III, C)
	Auto-Focus sensor link bent	Straightenand adjust (Refer to Section III, A)
	Defective board component	Replace Q-334, (Q-4), Q-342, (Q-6), Z-10, (Z-3) Numbers in parentheses refer to 3130
	Defective exciter lamp	Replace lamp
	Defective sensor	Replace focus mechanism with a rebuilt menhanism
(p) Auto-Focus Sluggish	Auto-Focus gear mesh improperly set	Adjust (Refer to Section III, F)
	Auto-Focus brake out of adjustment	Adjust (Refer to Section III, C)
	Defective Auto-Focus motor	Replace motor (M-2)
	Jackshaft clutch springs too tight	Check and/or Replace (See Section III, D)

TROUBLE	PROUBLE CAUSE	REMEDY
(q) Auto-Focus erratic	Focus motor leads reversed	Unplug motor leads and reverse them
	Defective board component	Replace Z-10, (Z-3), Q-342, (Q-6), Q-340, (Q-5), D352, (D-8) (Numbers in parentheses refer to 3130)
	Defective Sensor	Replace Focus mechanism with a rebuilt mechanism
(r) Remote focus drifts after focusing	Remote focus brake solenoid not operating	Adjust or replace solenoid, Replace Q-334, (Q-4), D-334, (D-6), Q-330, (Q-3), Q-332, (Q-2), D-330, (D-4) D-332, (D-5) (Numbers in parentheses Refer to 3130)

B. TROUBLESHOOTING AID CHARTS

The Troubleshooting Aid Charts are included as a logical approach to a Troubleshooting procedure. They are by no means the final word on how troubles should be traced, but they are designed to eliminate as much duplication of effort as possible. Simply follow the direction of the arrow describing the condition existing during any given test. Suggested component replacement represents components most likely to fail. If following arrows results in a closed loop, then trouble most likely exists in that circuit and further testing of other components in that circuit is recommended.

1. Place the projector upside down, remove the five screws around the perimeter of the upper housing, the four screws from the bottom of the lower housing (three screws in the 3130), lift the lower housing up at the rear of the projector and slide the lower housing toward the rear of the projector while lifting up to remove the lower housing.

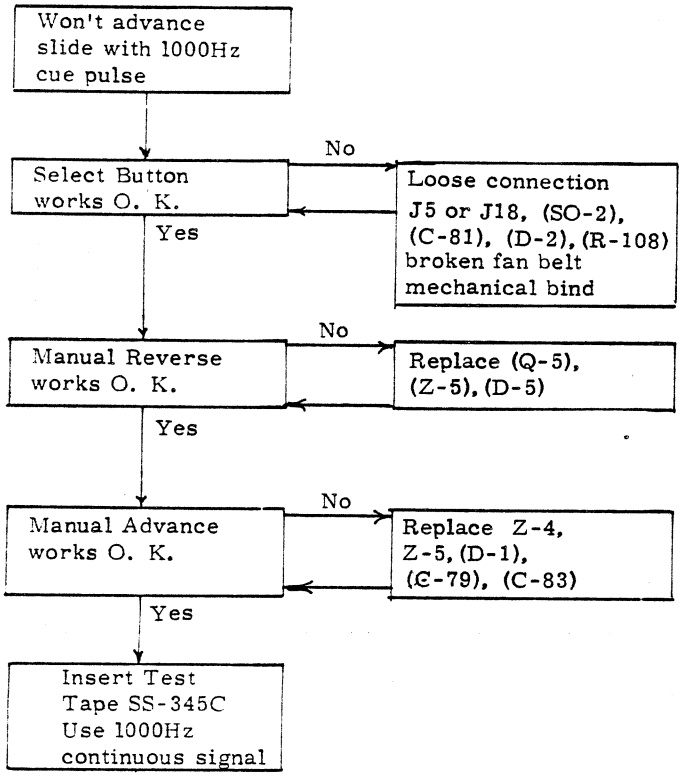
2. Make sure all plugs and connectors are making good contact.

3. Verify that all DC supply voltages are correct on the circuit boards. Refer to the test point charts at the end of this section.

Model	Test Points			
	Ground	+ 20 volts	+ 10 volts	+ 12 volts
3130	14*	9*	44*	
3230 and 3260	27*	9*	31*	12*
	64**	14**		74**

* On the power supply board.
** On the audio and logic board.

EXAMPLE

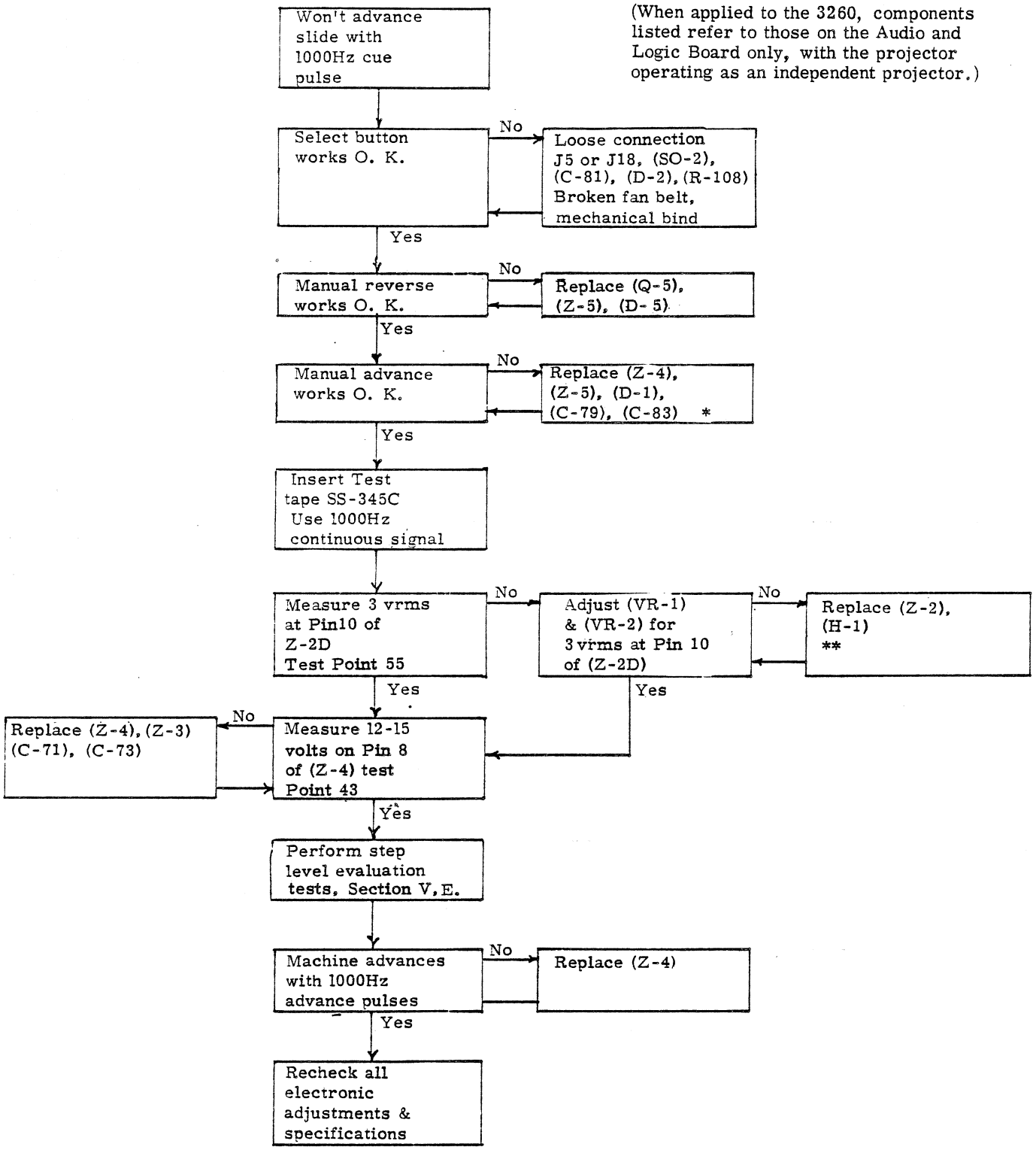


Test	Condition	Action Required
Select Button Works O.K.	No	Check for Loose Connectors, Broken Belt, Mechanical bind or component failure
Select Button Works O.K.	Yes	Go on to manual Reverse works O.K.
Manual Reverse Works O.K.	No	Replace one at a time (Q-5) (Z-5), D-5)
Manual reverse works O. K.	No	Continue testing in manual reverse circuit

Consulting the trouble and remedy chart will also assist in locating troubles.

3230 and 3260 Troubleshooting Aid Chart

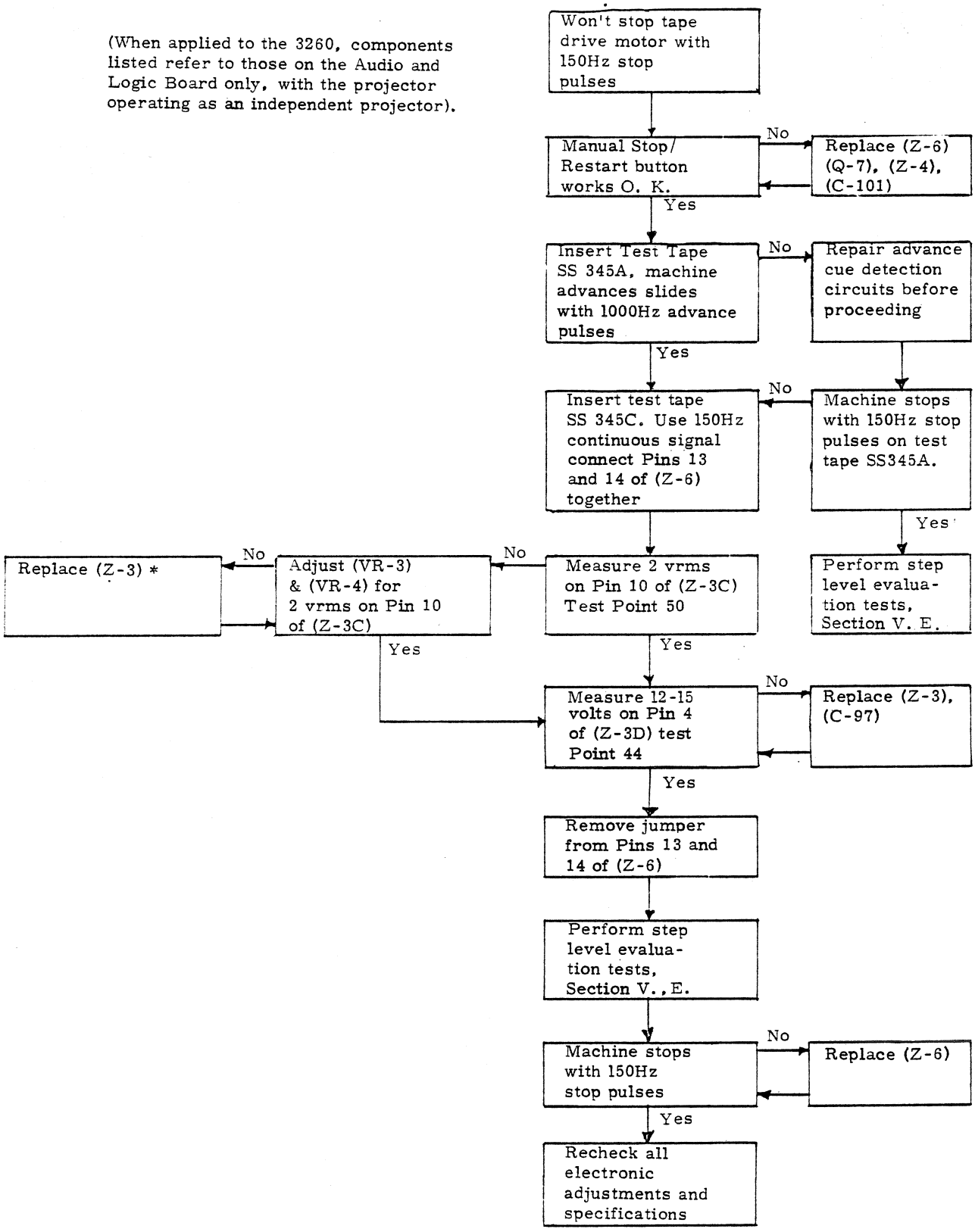
(When applied to the 3260, components listed refer to those on the Audio and Logic Board only, with the projector operating as an independent projector.)



*On 3260, also replace (Z-5), (Z-13) and (Z-1) on the Dissolve Control Board.
**On 3260, also replace (Z-6) on the Cue Record Control Board.

3230 and 3260 Troubleshooting Aid Chart

(When applied to the 3260, components listed refer to those on the Audio and Logic Board only, with the projector operating as an independent projector).



*On 3260, also replace (Z-6) on Cue Record Control Board.

C- TROUBLESHOOTING THE IMAGE 2 - Model 3260

The IMAGE 2, Model 3260 dissolve master projector, is a Caramate 3230 projector with dissolve master control circuitry and the ability to record advance and stop cue pulses. In troubleshooting the projector, it is suggested that it be operated as an independent projector first (Standard Operation). This will verify the majority of the circuitry and allow use of the troubleshooting tables and Aid Charts for the 3230 and 3260.

1.COMMON COMPONENT LISTING

The following is a list of components, by location, which are common to independent operation and dissolve operation. If the projector functions normally as an independent projector, these components can be eliminated as a source of trouble in dissolve operation unless otherwise specified in the tables or charts.

a. Tape Head

b. Tape Deck

c. Forward, Reverse and Select Buttons

d. Automatic Slide Interval Timer

e. Volume Control

f. Tone Control

g. Pause /Restart Button

h. Speaker Jack

j. Auto-Focus Sensor and Exciter Lamp

k. Transformer

l. Blower Motor

m. Speaker

n. Projection Lamp

o. Audio and Logic Board Components

All Components are common

p. Power Supply, Auto-Focus and Timer Board Components.

All components are common

q. Dissolve Control Board Components

(Z-13) is common.

r. Cue Record Control Board

(Z-6), (R-23), (R-24) are common

s. Master Lamp Dimmer Board

(Q-202), (R-202), (R-204), (L-201), (C-203) are common

2. QUICK CHECK OF THE DISSOLVE AND CUT LOGIC CIRCUITS OF THE IMAGE 2 Model 3260

a. Connect a meter or oscilloscope between pin 1 of the J-K Flip-Flop, (Z-4), on the dissolve control board and ground. Adjust the meter or scope range switch to read 12 volts.

b. Connect a second meter or scope between pin 15 of (Z-4) and ground and set the range switch to read 12 volts.

c. Connect the Dissolve Slave Adapter to the Image 2 and the slave projector.

d. Plug both projectors into the power source and turn them on, turning the Image 2 on first and the slave projector second.

e. The meter connected to pin 1 of (Z-4) should read a logic low (0 to .5 volts) and the same should be true of the meter connected to pin 15 of (Z-4).

f. Set the dissolve rate control on the Dissolve Slave Adapter for a relatively long dissolve rate.

g. Press the Advance button on the side of the Image 2 .

h. The meter connected to pin 1 of (Z-4) should go to a logic high (approximately 12 volts) and the meter connected to pin 15 should remain low.

j. Before the dissolve is complete, press the Advance button again.

k. The meter connected to pin 1 of (Z-4) should remain high and the meter connected to pin 15 of (Z-4) should also now go high.

m. Before the dissolve is complete, again press the Advance button.

n. The meter connected to pin 1 of (Z-4) should now go low and the meter connected to pin 15 should remain high.

o. Before the dissolve is complete, again press the Advance button.

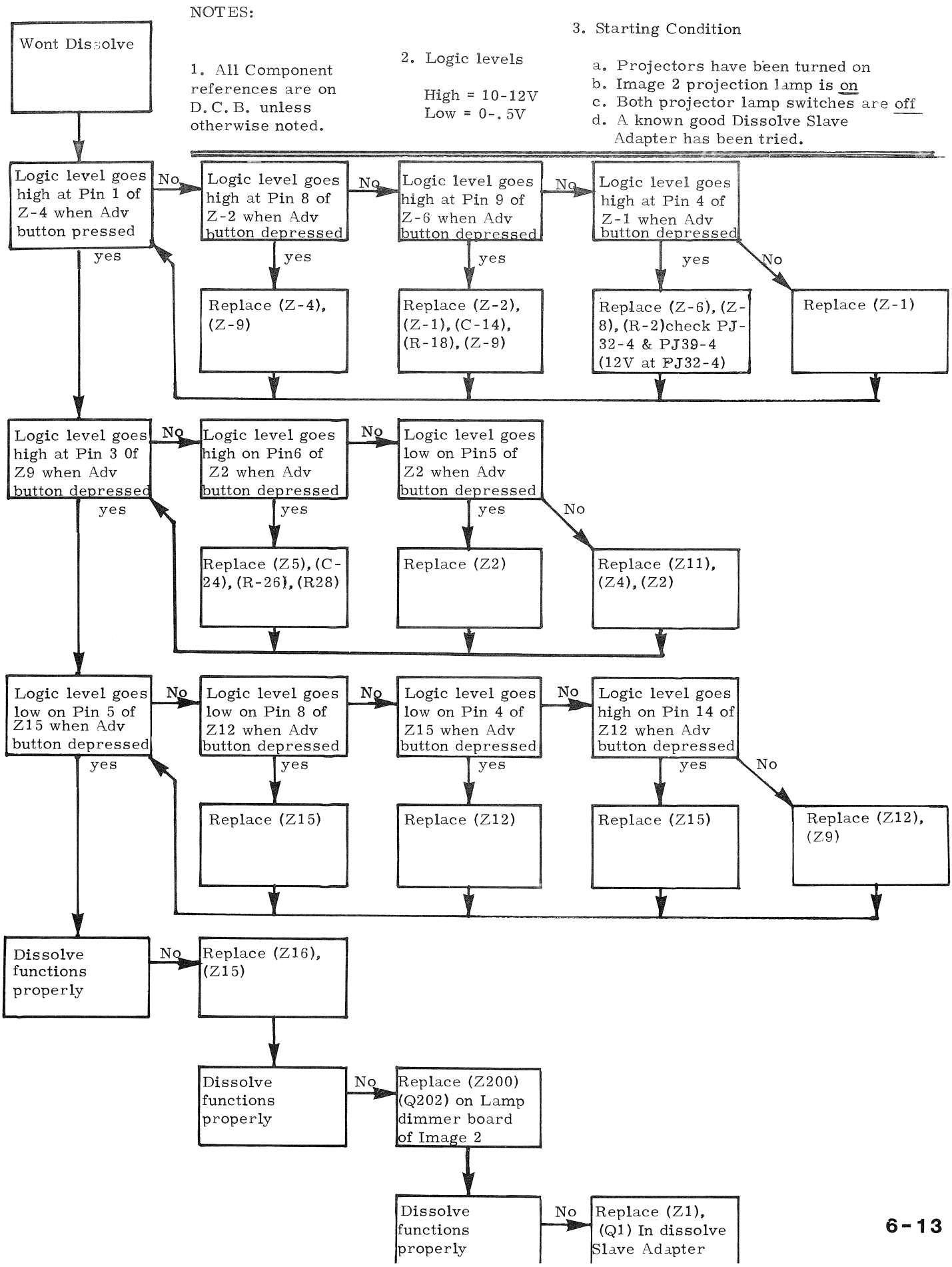
p. The meter connected to pin 1 of (Z-4) should remain low and the meter connected to pin 15 of (Z-4) should remain high. Further pressing the Advance button while a dissolve is in process will sustain this logic condition.

q. If the above logic conditions are verified, the operation of (Z-1A), (Z-1B), (Z-6A), (Z-2A), (Z-9A), (Z-4A) and (Z-4B) is correct and any trouble experienced will be found in other components.

3. DISSOLVE TROUBLE AND REMEDY

TROUBLE	PROBABLE CAUSE	REMEDY
1. Image 2 projection lamp stays lit continuously.	Lamp switch is in Lo or Hi position	Turn Lamp switch OFF
	Lamp Dimmer Board failure	Replace (Q-202), (Z-200)
	Dissolve Control Board failure	Replace (Z-16), (Z-15), (Z-12)
2. Slave projector lamp stays lit continuously.	Lamp switch is on	Turn lamp switch OFF
	Dissolve Slave Adapter failure	Replace (Q-1), (Z-1)
	Dissolve Control Board failure	Replace (Z-16), (Z-15), (Z-12)
3. Dissolves rapidly back and forth with cue pulse.	Cue pulse too long	Use tape with cue pulses no longer than 520 ms
4. Image 2 advances before dissolve is complete.	Dissolve Control Board failure	Replace (Z-5), (R-2)
	Bad connection between DSA and Image 2	Check PJ-32 and PJ-39 and circuit boards in Image 2 and DSA for cold solder joints and/or bad connections
5. Image 2 won't advance after dissolve.	Dissolve Control Board failure	Replace (Z-13)
6. Slave projector won't advance after dissolve.	Dissolve Control Board failure	Replace (Q-1), (Z-11), (Z-13), (Z-16), (C-38)
	Dissolve Slave Adapter failure	Replace (Z-2), (Q-2)
7. Slave projector won't reverse	Dissolve Slave Adapter failure	Replace (Z-3), (Q-3), check cord for broken wire
8. Dissolve Cut inoperative	Dissolve Control Board failure	Replace (Z-3), (Z-4), (D-10)
9. Cuts but won't initiate new dissolve.	Dissolve Control Board failure	Replace (Z-6), (Z-5), (Z-8), (Z-7), (Z-11), (Z-2), (Z-3), (Z-14), (Z-9)
10. Operates in Cut mode continuously.	Dissolve Control Board failure	Replace (Z-3), (Z-4), (Z-2), (Z-11), (Z-14), (Z-7), (Z-1), (Z-13)
11. Dissolves and immediately Cuts without another dissolve command.	Dissolve Control Board failure	Replace (Z-9), (Z-4)
12. Won't record advance and/or stop pulses..	Record switch defective	Replace record switch
	Cue Control Board failure	Replace (Z-6), (Q-2), (Z-2), (Z-5), (Z-1), (Z-10)
13. Records pulses of wrong duration.	Cue Control Board failure	Replace (Z-3), (Z-1), (Z-2), (Z-4), (Z-5), (Z-7), (Z-8), (Z-9)
	Dissolve Control Board failure	Replace (Z-15)
14. Cue record ready light fails to operate properly.	Cue Control Board failure	Replace (Z-4), (Q-1), (D-21), (R-26)
15. Won't erase cue pulses.	Cue Control Board failure	Replace (C-4), (C-5), (R-10), (R-12)
	Erase head defective	Replace erase head

4. TROUBLE SHOOTING AID CHART



D. TRANSFORMER FUSE LINK

Electrical safety requirements of UL and CSA require an internally fused transformer. Replacement of the fuse link is permitted if the identical fuse is used and the repaired unit is Hi-pot tested (Dielectric breakdown) after repair.

(1). Use a Buss fuse link #LKB-3 available from Singer Education Systems as Part No. SS-359.

(2). Carefully cut through the outer insulation between the power wire connections of the transformer to uncover the fuse. Figure 6-1. Transformer Fuse - link replacement.

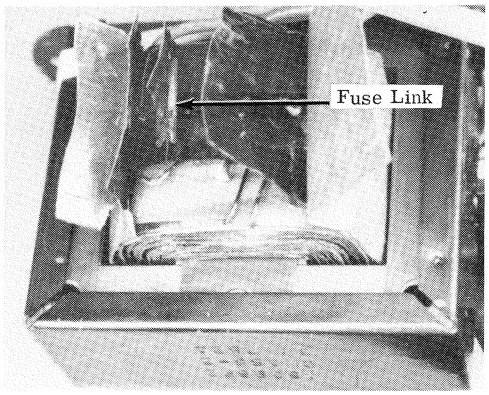


Figure 6-1. Transformer Fuse Link Replacement

(3). Remove the defective fuse and replace with an LKB-3 fuse.

(4). Place the insulation in its original position over the fuse and secure with glass filament tape.

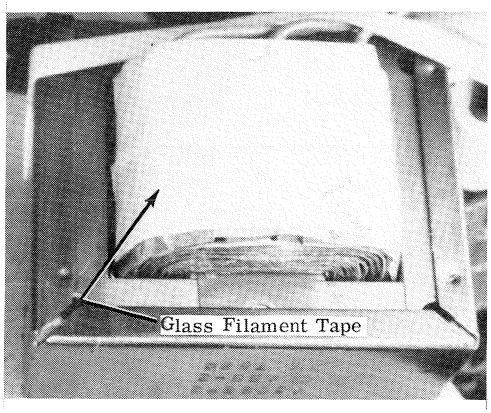


Figure 6-2. Transformer Wrap After Repair.

E. SHUTTER SERVICE

If shutter or slide clamps fail, check four control springs (Figure 6-3 & 6-4).

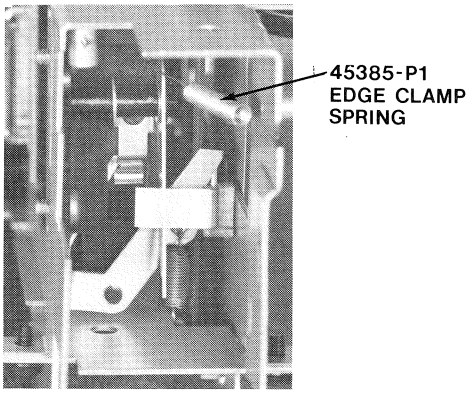


Figure 6-3. Slide Clamp Springs.

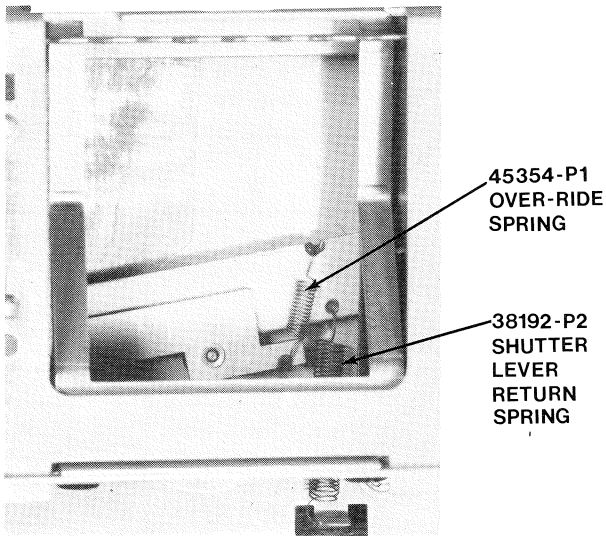


Figure 6-4. Cam Follower Lever Springs.

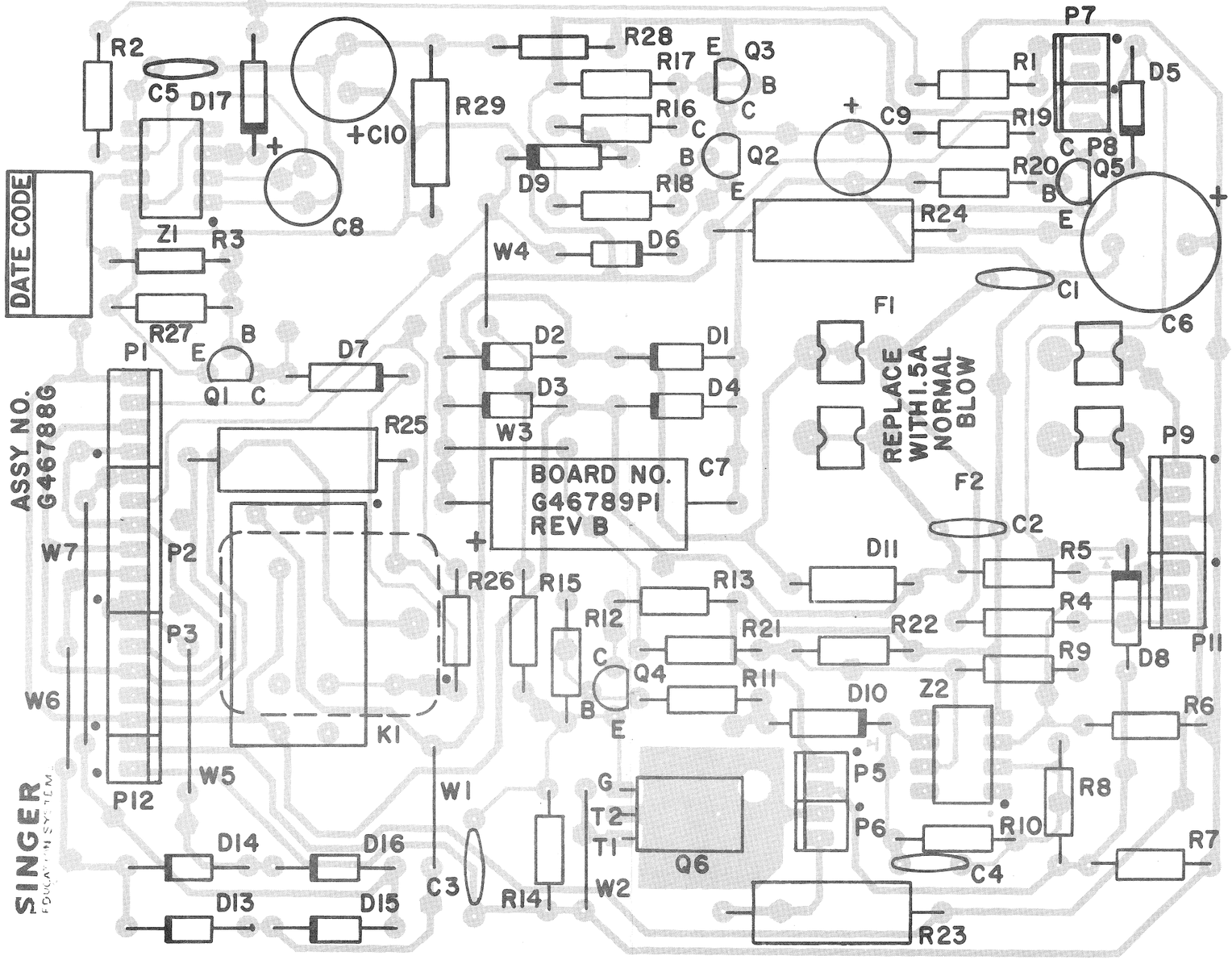


Figure 6-5. CIRCUIT BOARD ASSEMBLY (Model 3120)

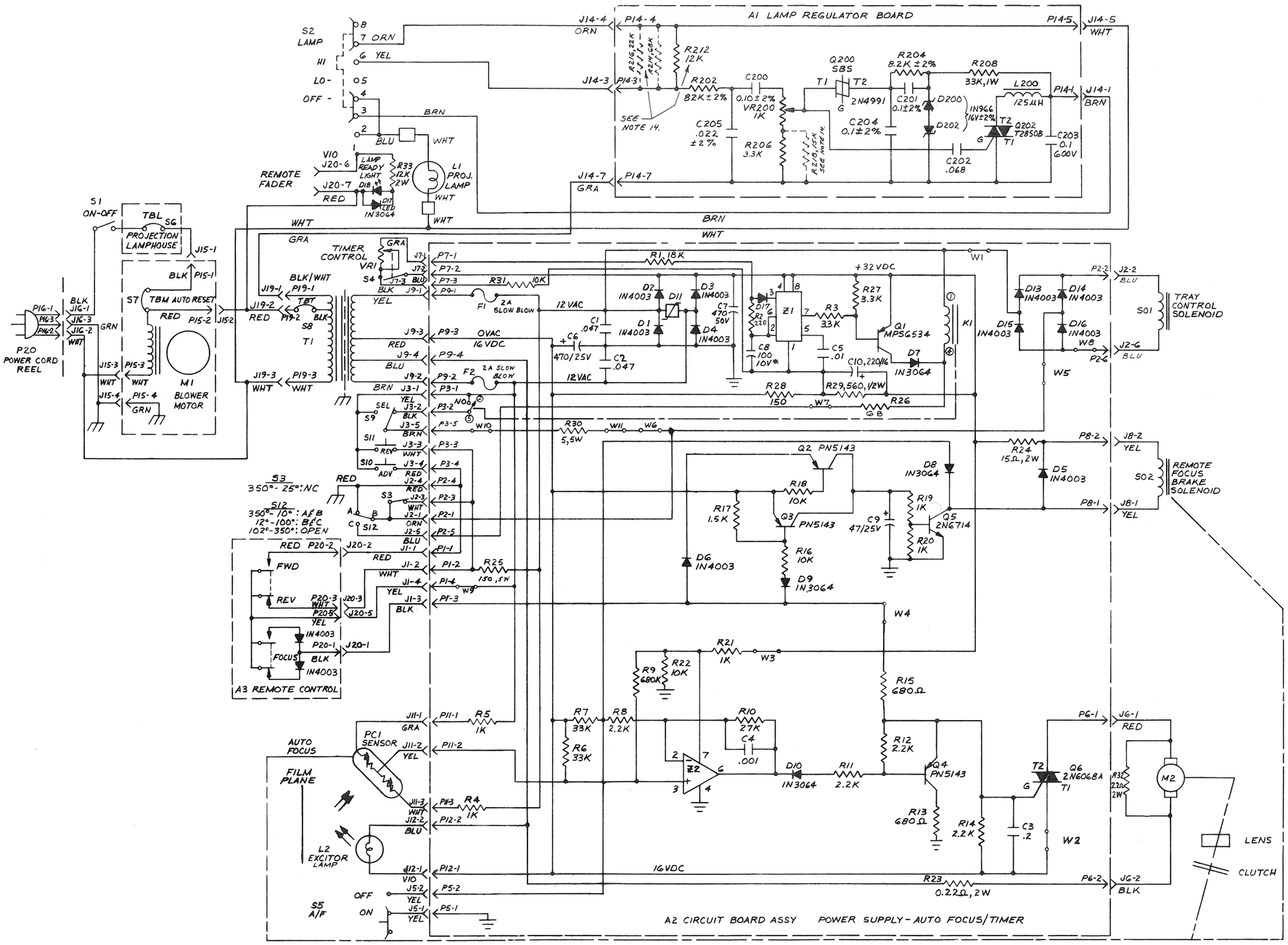


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Figure 6-6. PROJECTOR SCHEMATIC DIAGRAM (Model 3120)

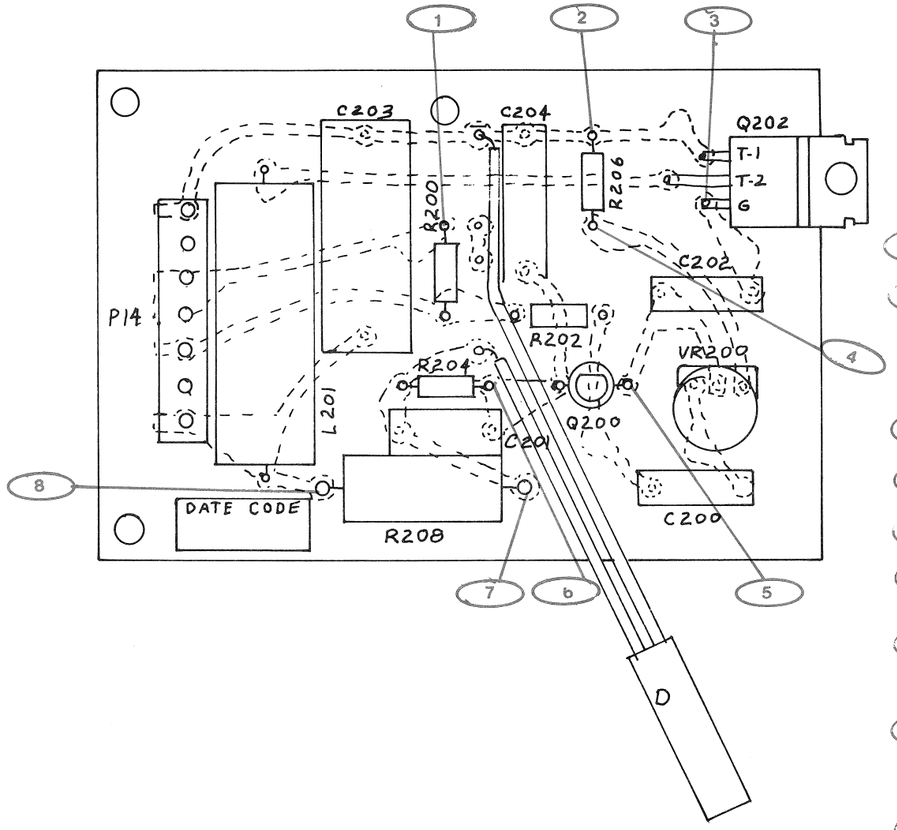


Figure 6-7. LAMP REGULATOR BOARD ASSEMBLY, (Model 3130)

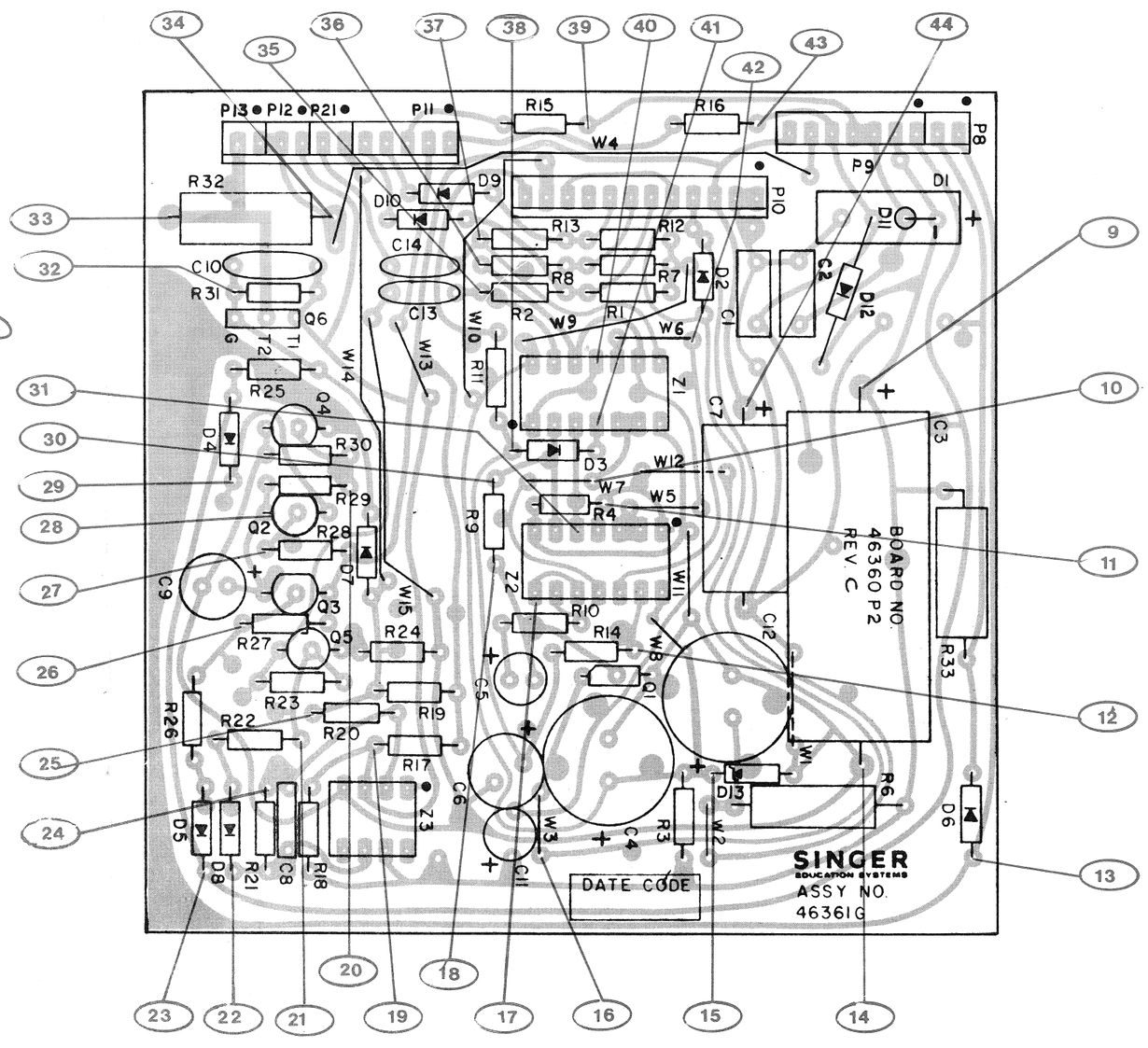
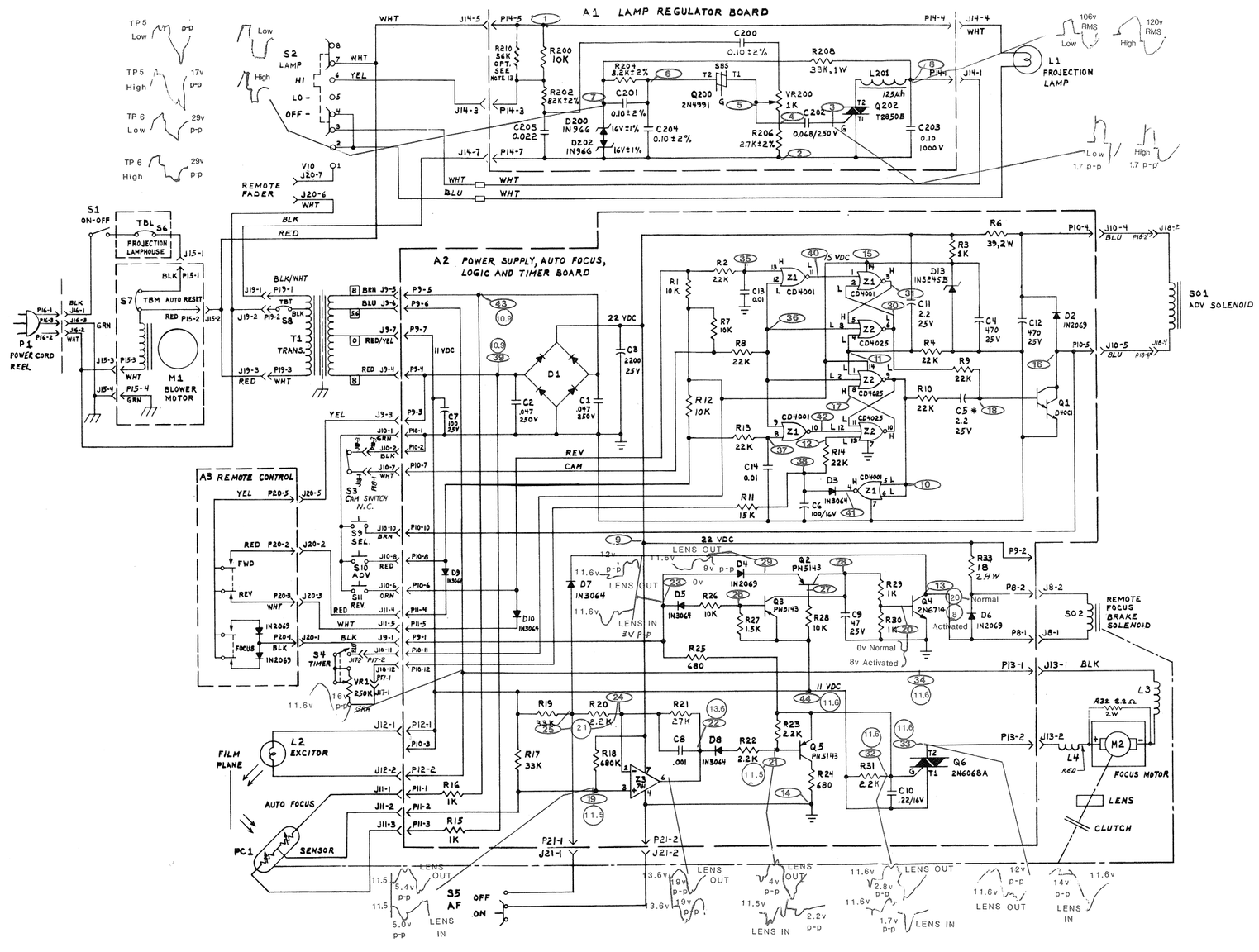


Figure 6-8. BOARD ASSEMBLY, Power and Logic (Model 3130)



1. All resistor values are in ohms. Tolerance ± 5%, Dissipation 1/4 watt.
   Capacitor values are in microfarads.

2. Values are nominal RMS to ground with 120volts RMS line
   Values are RMS point to point.

3. Denotes test point

4. Denotes nominal DC voltage measured with a VTVM to ground with no signals present or supervisory buttons or switches operated unless otherwise noted.

5. All oscilloscope patterns taken using DC input and Line Sync.

6. Oscilloscope patterns for test points 19, 21, 22, 32 and 33 taken with a 120K ohm resistor across either pins 2 and 3 of P-11 (Lens moving in) or pins 2 and 1 (Lens moving out). Resistors up to 270K ohms will cause the auto-focus circuit to function but readings will be proportionately lower and waveforms may change shape slightly.

7. Oscilloscope patterns for test points 13, 20, 23 and 26 through 29 taken with remote focus button operated in each of its two positions.

8. Lens out and Lens in denotes movement of lens to achieve proper focus.

9. Lamp voltage is measured across test points 1 and 8. Reading Readings given are true RMS values and must be taken with a True RMS meter.

10. All AC voltages and waveforms in the lamp regulator circuit with the exception of the one in note 11, are with test point 2 as the reference.

11. (R-210) may or mey not be removed to achieve 105V-119V RMS when Lamp switch (S2) is in Low position. See ELECTRONIC ADJUSTMENTS AND SPECIFICATIONS.

12. (R-206) may be 2.2K ohms See ELECTRONIC ADJUSTMENTS ADJUSTMENTS AND SPECIFICATIONS.

Ungrounded Common Probe.
SEE ELECTRICAL ADJUSTMENTS AND SPECIFICATIONS.

Figure 6-9. PROJECTOR SCHEMATIC DIAGRAM (Model 3130)

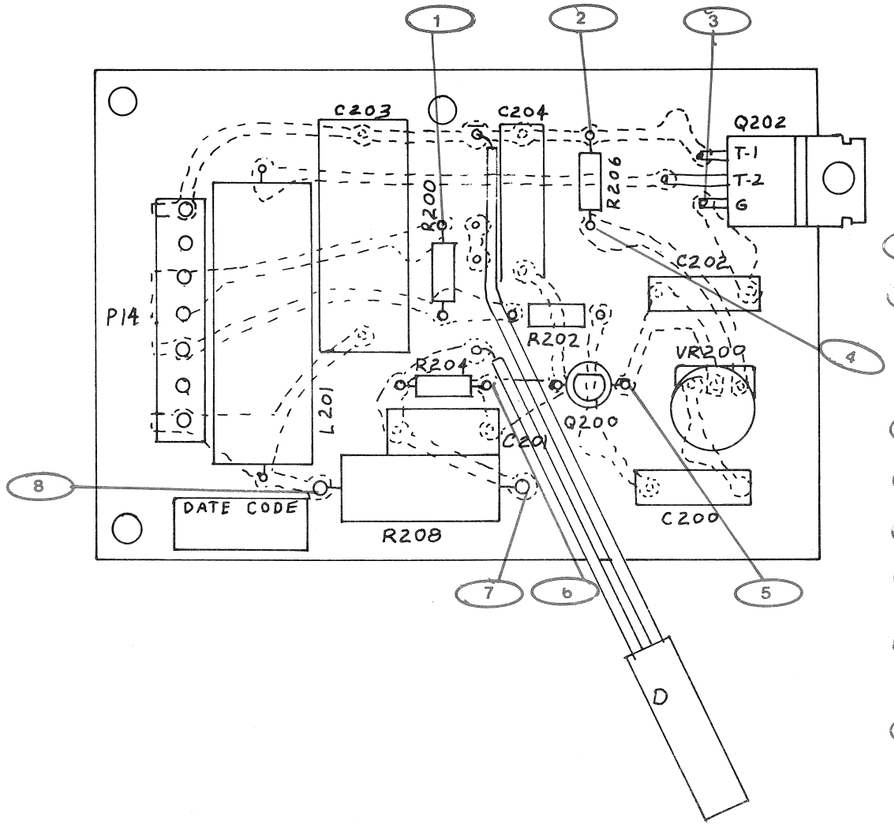


Figure 6-10. LAMP REGULATOR BOARD ASSEMBLY, (Model 3134)

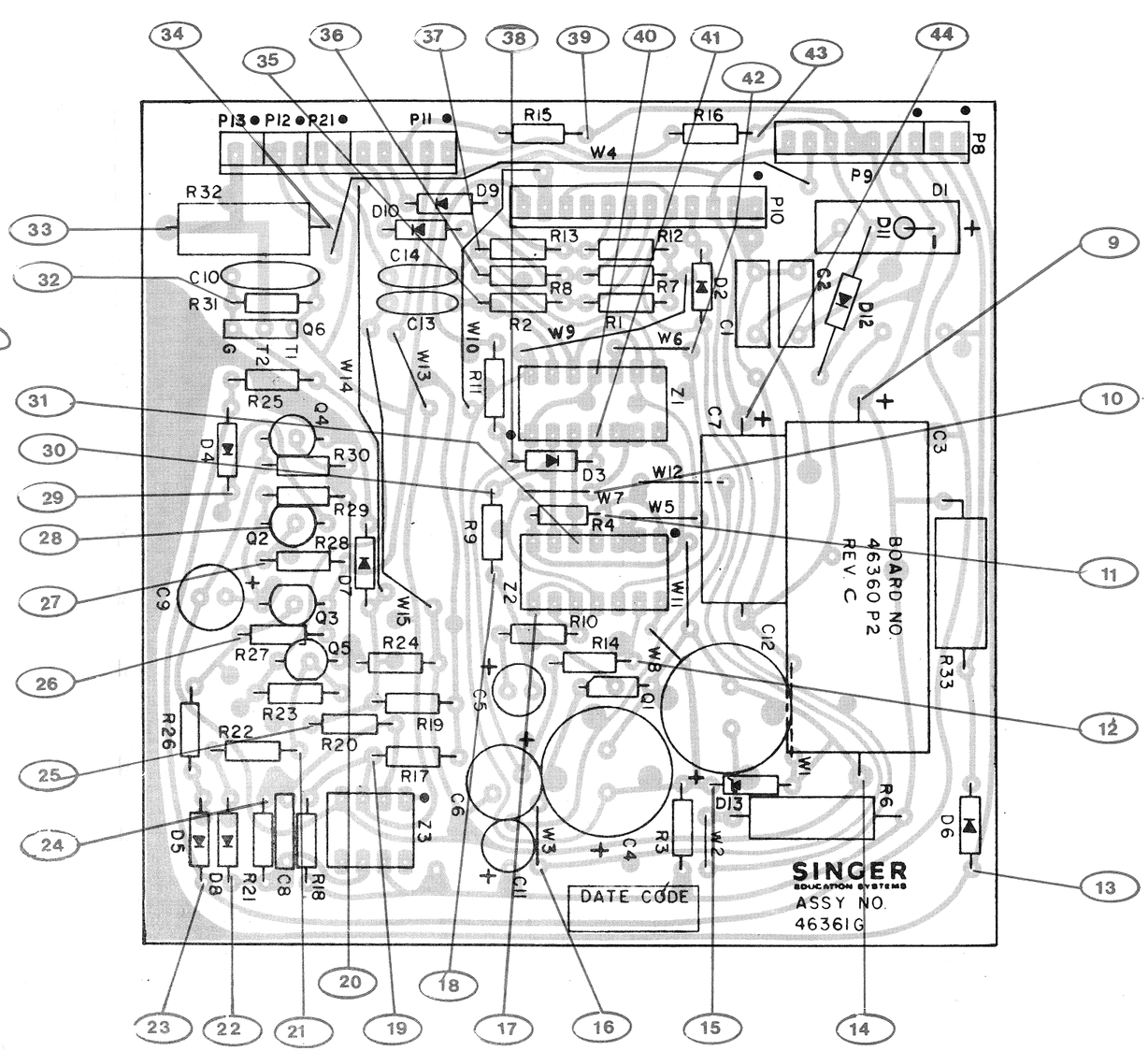


Figure 6-11. BOARD ASSEMBLY, Power and Logic (Model 3134)

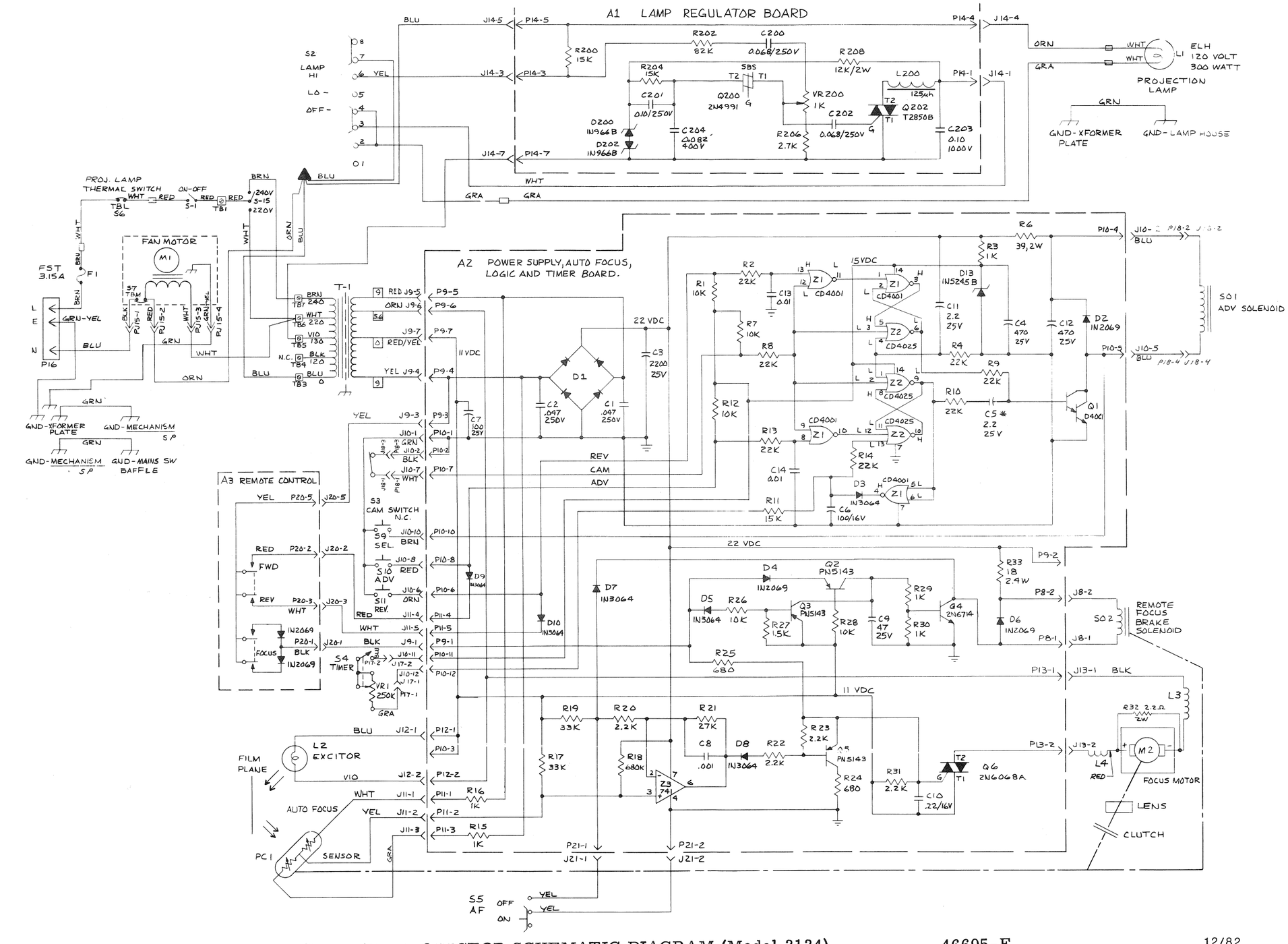


Figure 12. PROJECTOR SCHEMATIC DIAGRAM (Model 3134) 46695-E 12/82 **6-21**

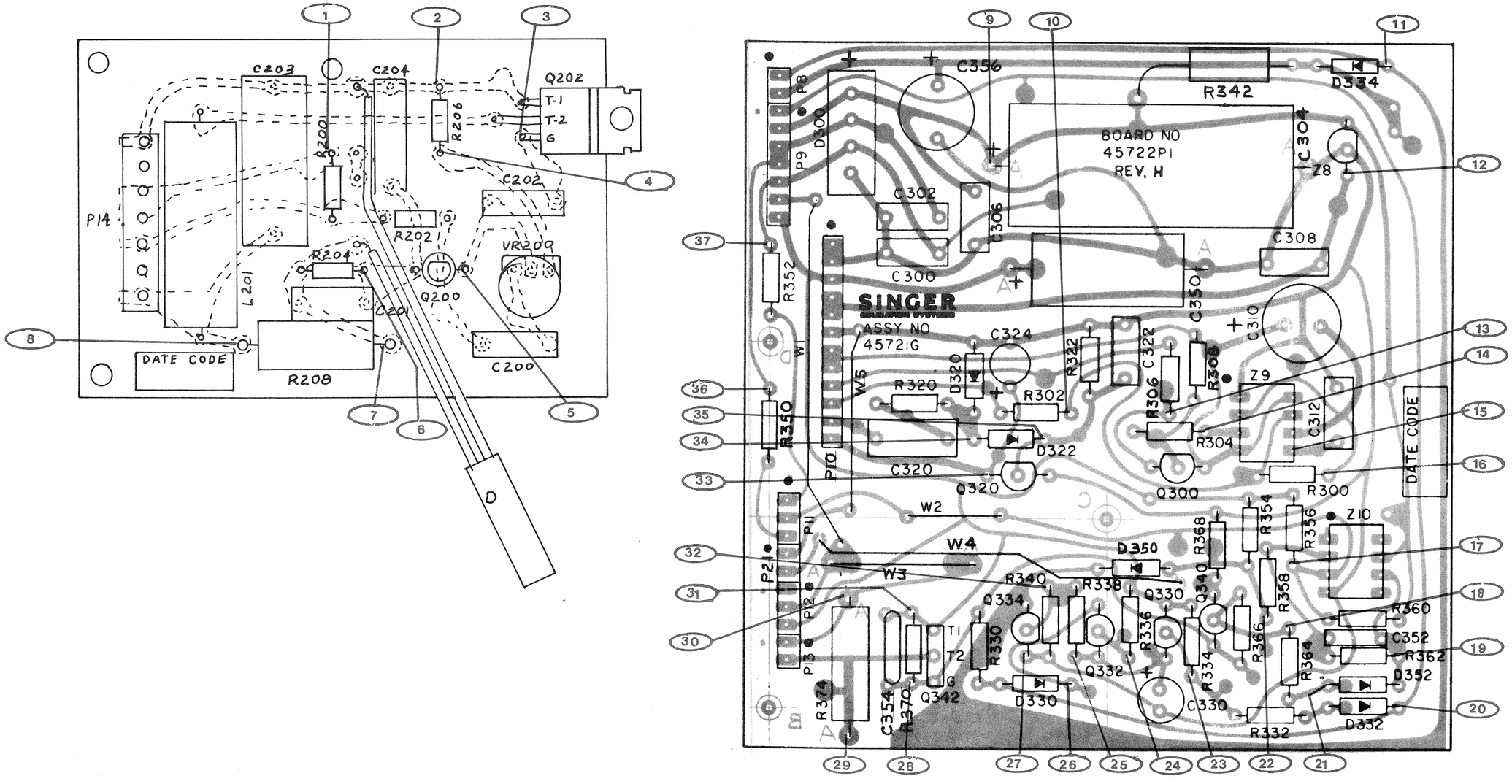
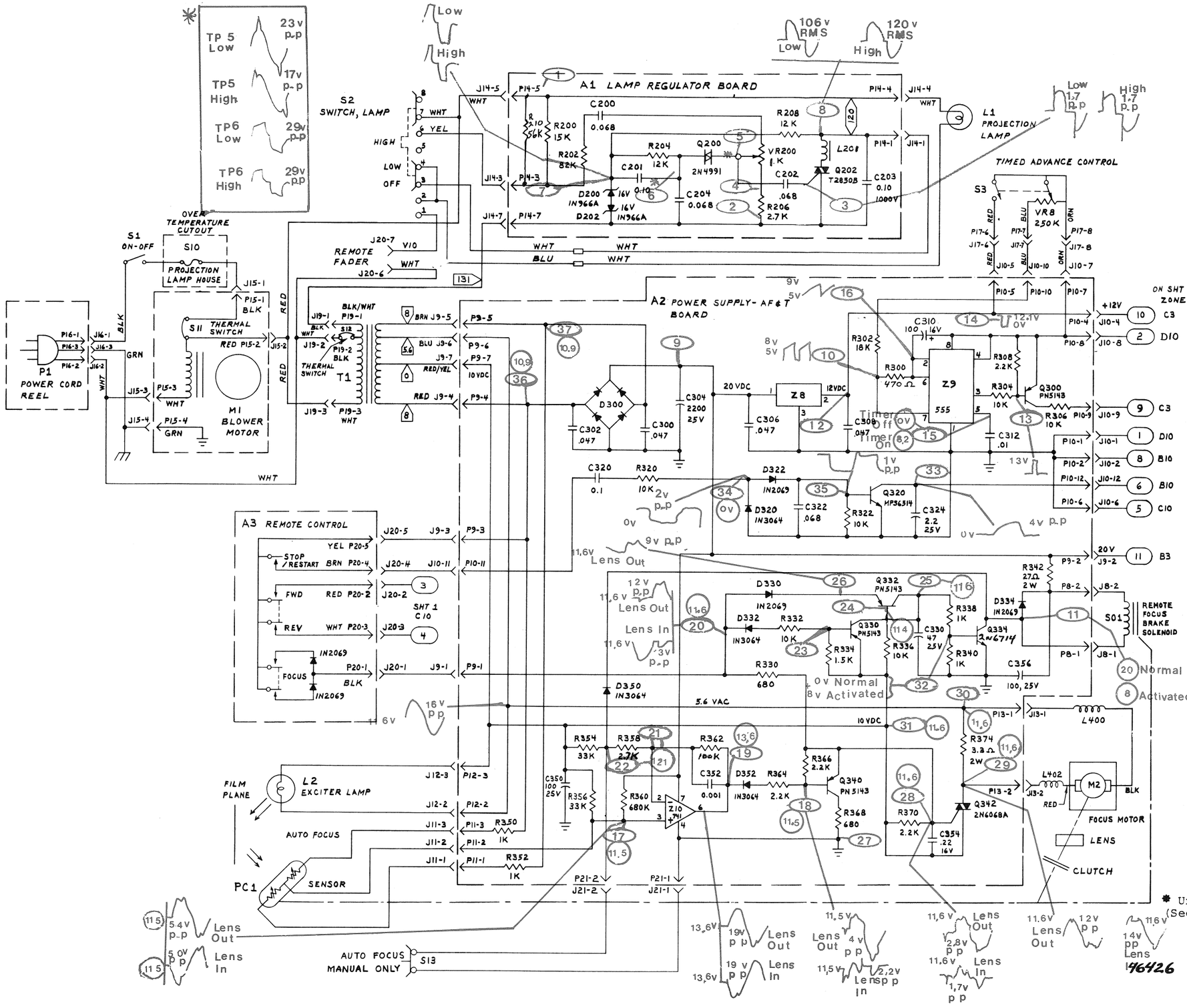


Figure 6-13. LAMP REGULATOR BOARD ASSEMBLY (Model 3230)

Figure 6-14. POWER SUPPLY AND AF-T BOARD ASSEMBLY (Model 3230)



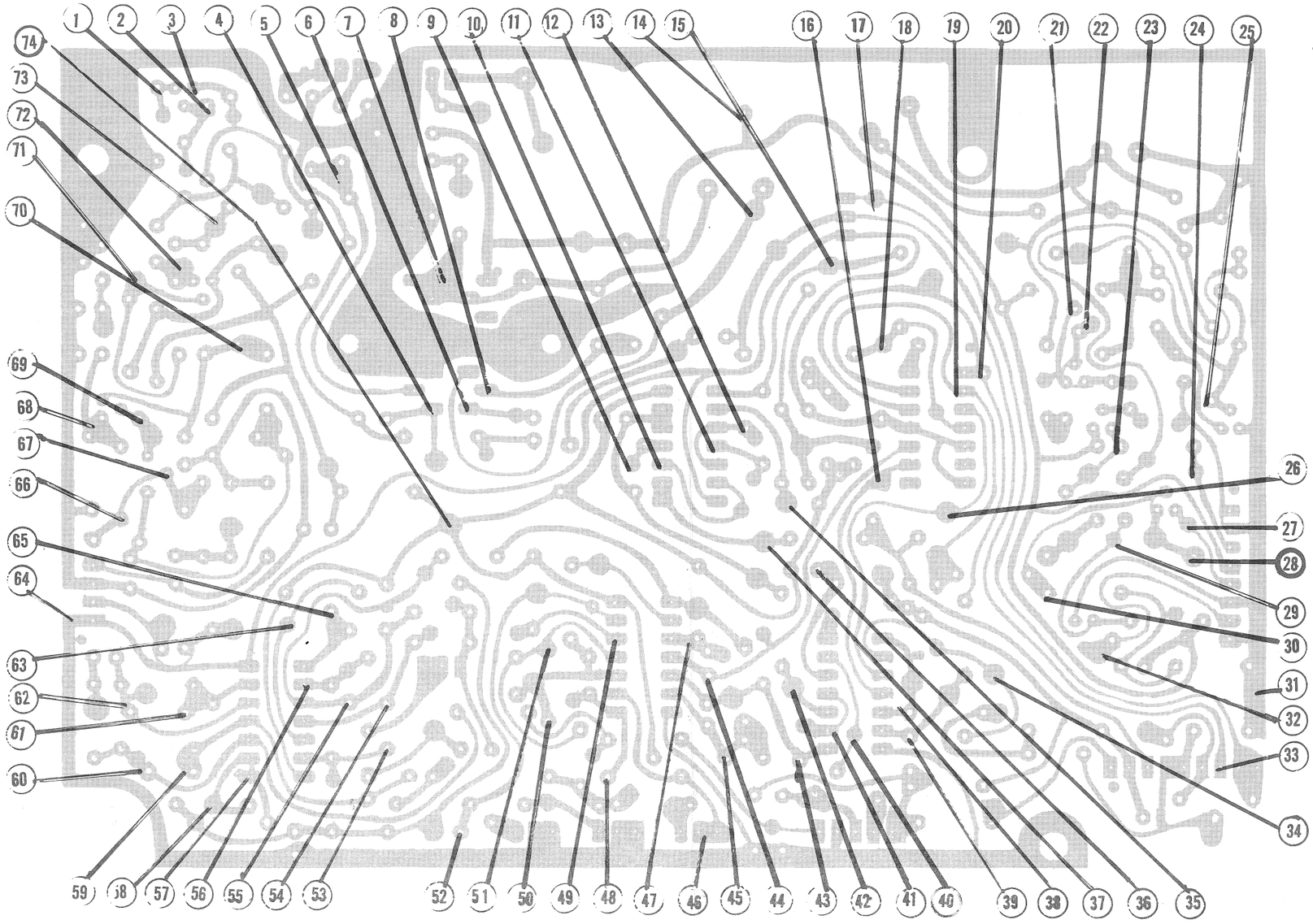
1. All resistor values are in ohms. Tolerance ±5%, dissipation 1/4 watt. All capacitor values are in microfarads.
2. ⏥ Values are nominal RMS to ground with 120 volts RMS line.
   ⬡ Values are RMS point-to-point.
3. ⬭ Denotes test point.
4. ○ Denotes nominal DC voltage measured with a VTVM to ground with no signals present or supervisory buttons or switches operated unless otherwise noted.
5. All oscilloscope patterns taken using DC input and LINE sync.
6. Oscilloscope patterns for test points 10 and 13 through 16 taken with timer turned on using a very slow sweep rate on the oscilloscope.
7. Oscilloscope patterns for test points 33 through 35 taken with remote stop/restart button depressed.
8. Oscilloscope patterns for test points 17 through 19, 21, 22 and 27 through 29 taken with a 120K Ohm resistor across either pins 2 and 3 of P-11 (lens moving IN) or pins 2 and 1 (lens moving OUT). Resistors up to 270K Ohms will cause the auto-focus circuit to function but readings will be proportionately lower and waveforms may change shape slightly.
9. Oscilloscope patterns for test points 11, 20, 23 through 26, and 32 taken with remote focus button operated in each of its two positions.
10. LENS OUT and LENS IN denote movement of lens to achieve proper focus.
11. Lamp voltage is measured across test points 1 and 8. Readings given are TRUE RMS values and must be taken with a TRUE RMS meter.
12. All AC voltages and waveforms in the lamp regulator circuit, with the exception of the one in note 11, are with test point 2 as the reference.
13. (R210) may or may not be removed to achieve 105V - 111.9V RMS when Lamp switch (S2) is in Low position. See ELECTRONIC ADJUSTMENTS AND SPECIFICATIONS
14. (R206) may be 2.7K Ohms See ELECTRONIC ADJUSTMENTS AND SPECIFICATIONS

✱ Ungrounded Common Probe. (See electrical Adjustments and Specifications)

96426

Figure 6-15. PROJECTOR SCHEMATIC DIAGRAM (Power Supply AF-T Lamp Reg.) Model 3230) Stage I

Prior to Code K9C



46008

Figure 6-16. Audio & Logic Circuit Board Test Points

Prior to Code K9C

1. All resistor values are in ohms, tolerance ±5%, dissipation 1/4 watt. All capacitor values are in microfarads unless other wise specified.

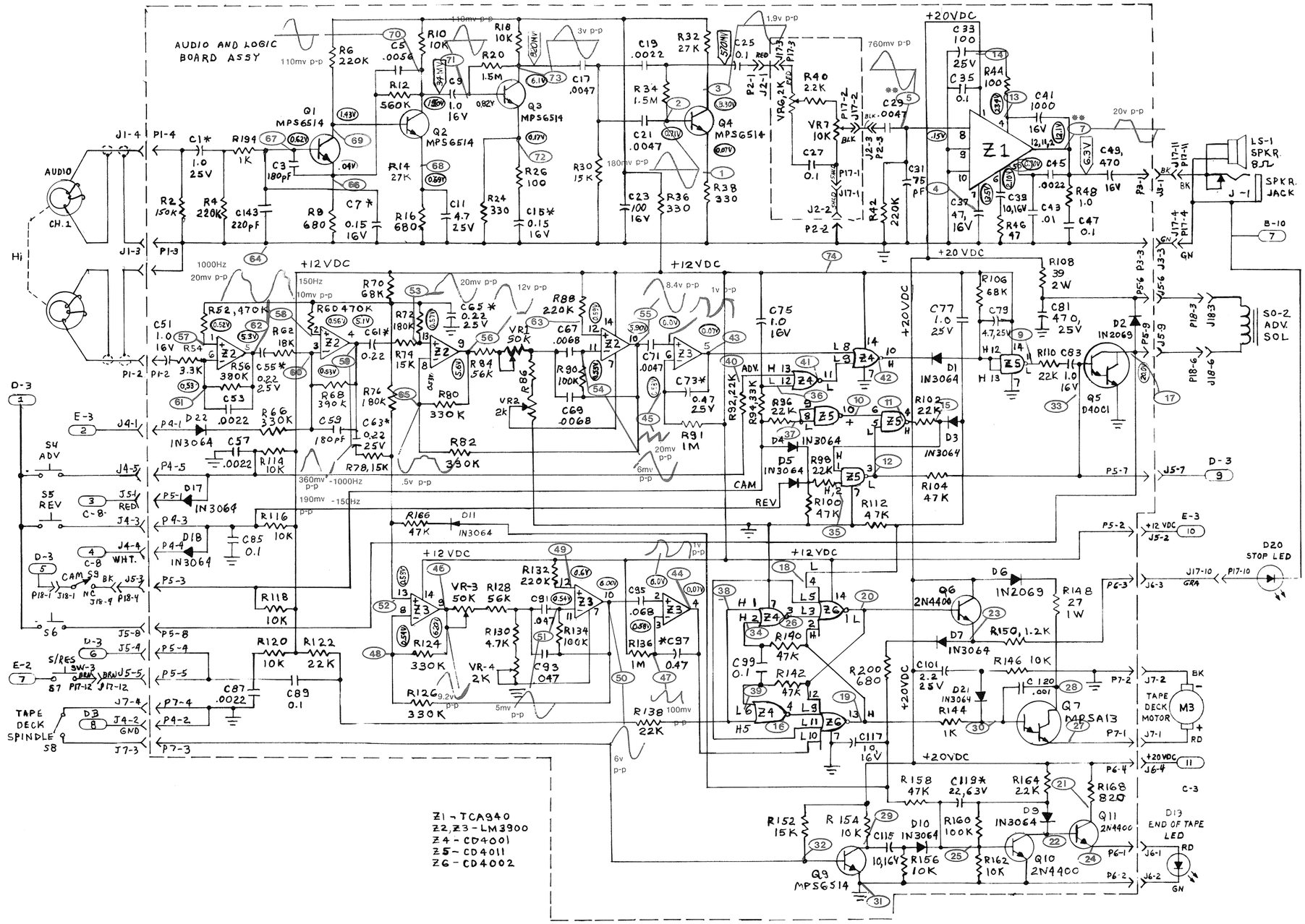
2. * Denotes Low Leakage capacitor.

3. ** Volume Control Maximum

4, Audio measurements taken with a 315 Hz Tape Recorded at -4 db running in the projector.

5. Advance Cue Pulse measurements taken with a 1000 Hz Tape Recorded at -10 db running in the projector on channels 3 and 4.

6. Stop Cue Pulse measurements Taken with a 150 Hz Tape Recorded at -10 db running in the projector on channels 3 and 4, and pins 13 and 14 of Z-6 connected together.



Prior to Code K9C

Figure 6-17. PROJECTOR SCHEMATIC (Audio & Logic) Model 3230) Stage II

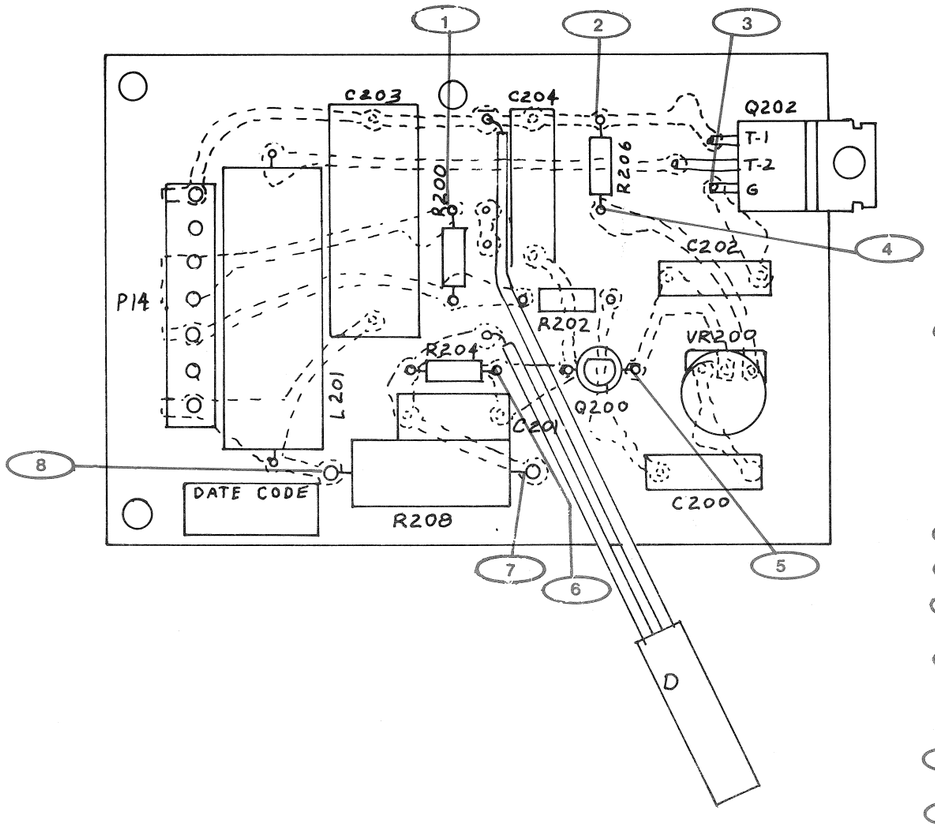


Figure 6-18. LAMP REGULATOR BOARD ASSEMBLY (Model 3230)

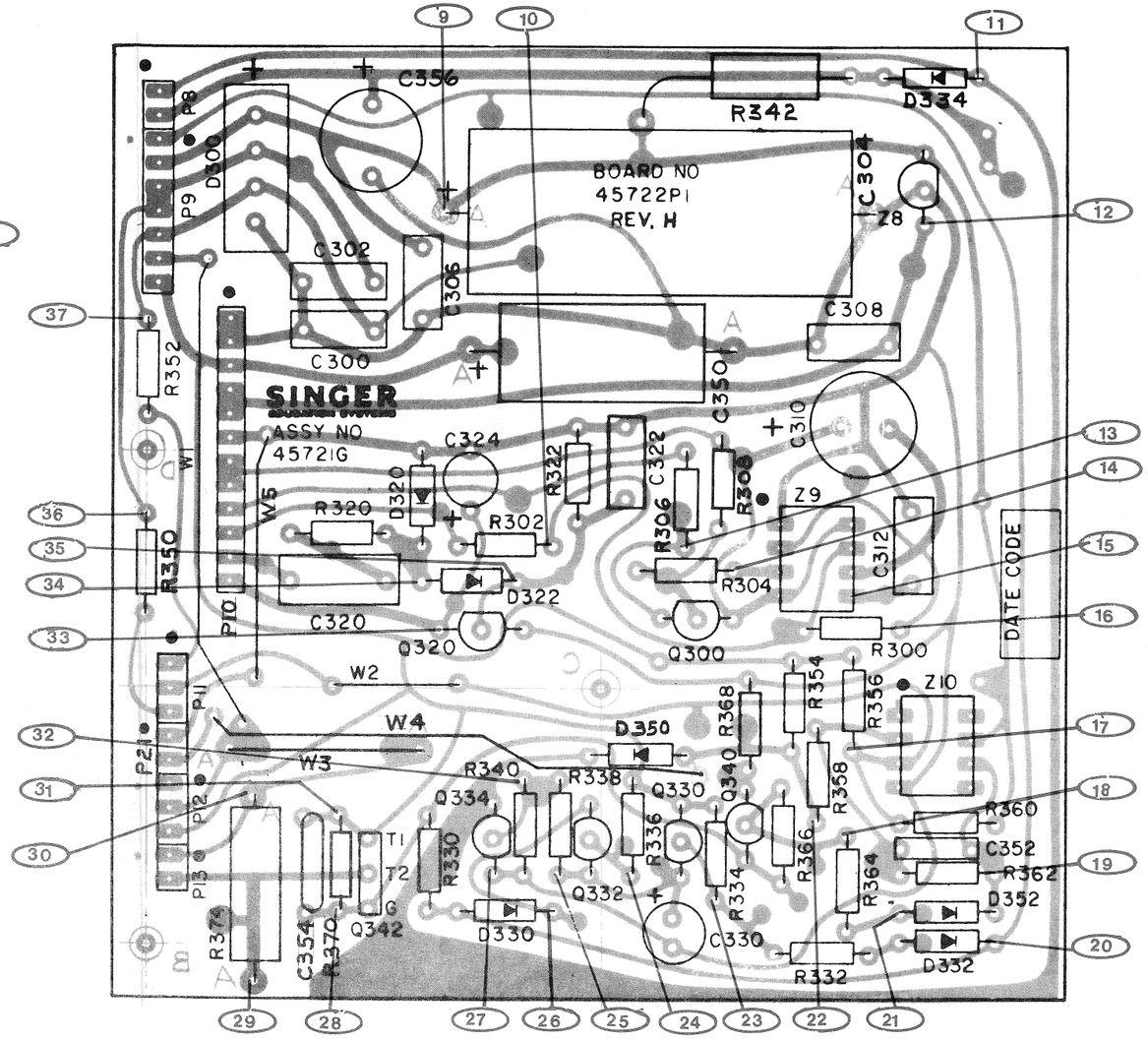
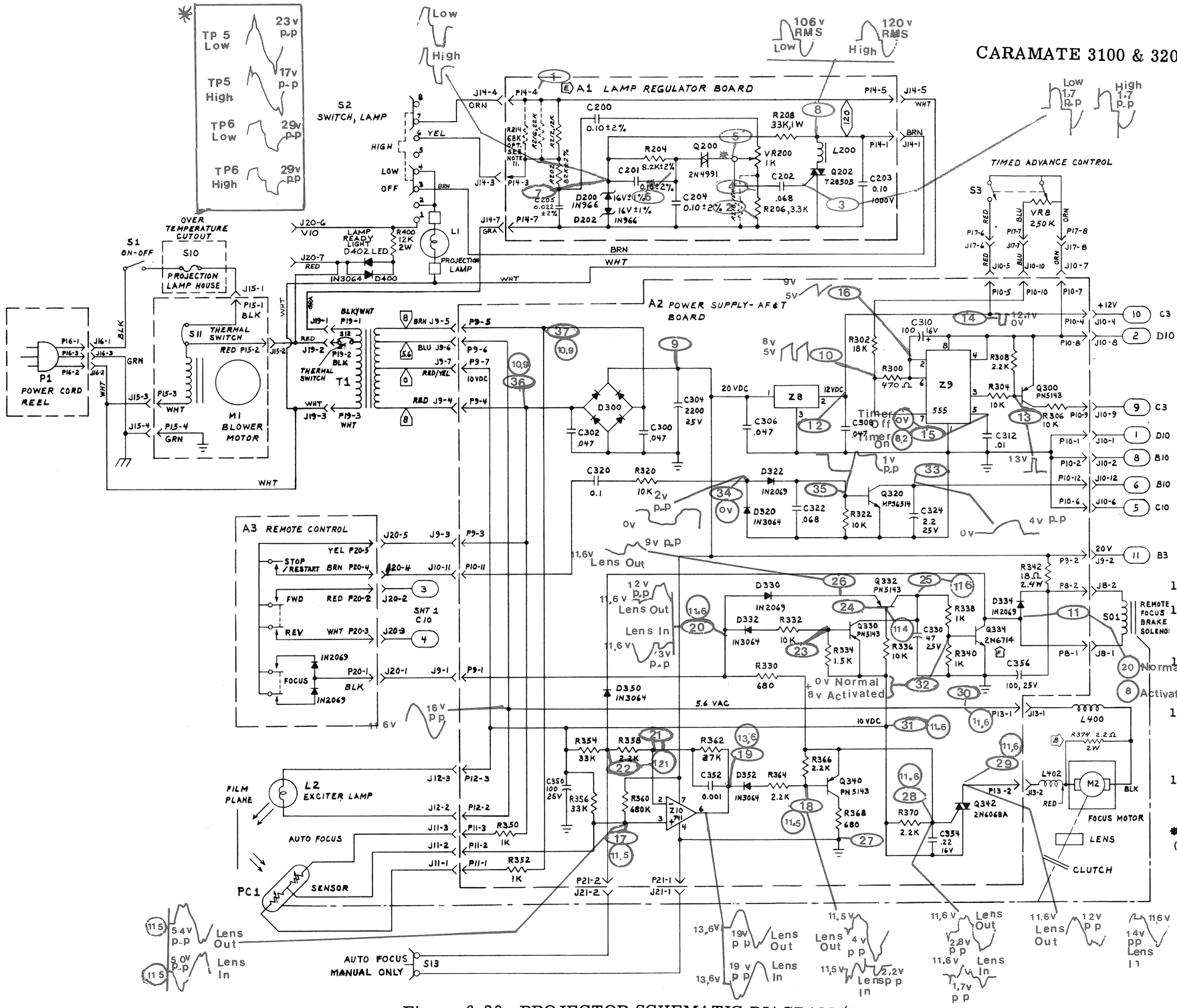


Figure 6-19. POWER SUPPLY AND AF-T BOARD ASSEMBLY (Model 3230)

CARAMATE 3100 & 3200 PROJECTORS



2. Values are nominal RMS to ground with 120 volts RMS line.
3. Values are RMS point-to-point.
4. Denotes test point.
5. Denotes nominal DC voltage measured with a VTVM to ground with no signals present or supervisory buttons or switches operated unless otherwise noted.
5. All oscilloscope patterns taken using DC input and LINE sync.
6. Oscilloscope patterns for test points 10 and 13 through 16 taken with timer turned on using a very slow sweep rate on the oscilloscope.
7. Oscilloscope patterns for test points 33 through 35 taken with remote stop/restart button depressed.
8. Oscilloscope patterns for test points 17 through 19, 21, 22 and 27 through 29 taken with a 120K Ohm resistor across either pins 2 and 3 of P-11 (lens moving IN) or pins 2 and 1 (lens moving OUT). Resistors up to 270K Ohms will cause the auto-focus circuit to function but readings will be proportionately lower and waveforms may change shape slightly.
9. Oscilloscope patterns for test points 11, 20, 23 through 26, and 32 taken with remote focus button operated in each of its two positions.
10. LENS OUT and LENS IN denote movement of lens to achieve proper focus.
11. Lamp voltage is measured across test points 1 and 8. Readings given are TRUE RMS values and must be taken with a TRUE RMS meter.
12. All AC voltages and waveforms in the lamp regulator circuit, with the exception of the one in note 11, are with test point 2 as the reference.
13. (R210) may or may not be removed to achieve 105V - 111.9V RMS when Lamp switch (S2) is in Low position. See ELECTRONIC ADJUSTMENTS AND SPECIFICATIONS
14. (R206) may be 2.7K Ohms See ELECTRONIC ADJUSTMENTS AND SPECIFICATIONS

* Ungrounded Common Probe. (See electrical Adjustments and Specifications)

Starting Code K9C

Figure 6-20. PROJECTOR SCHEMATIC DIAGRAM (Power Supply AF-T Lamp Reg.) Model 3230) Stage I

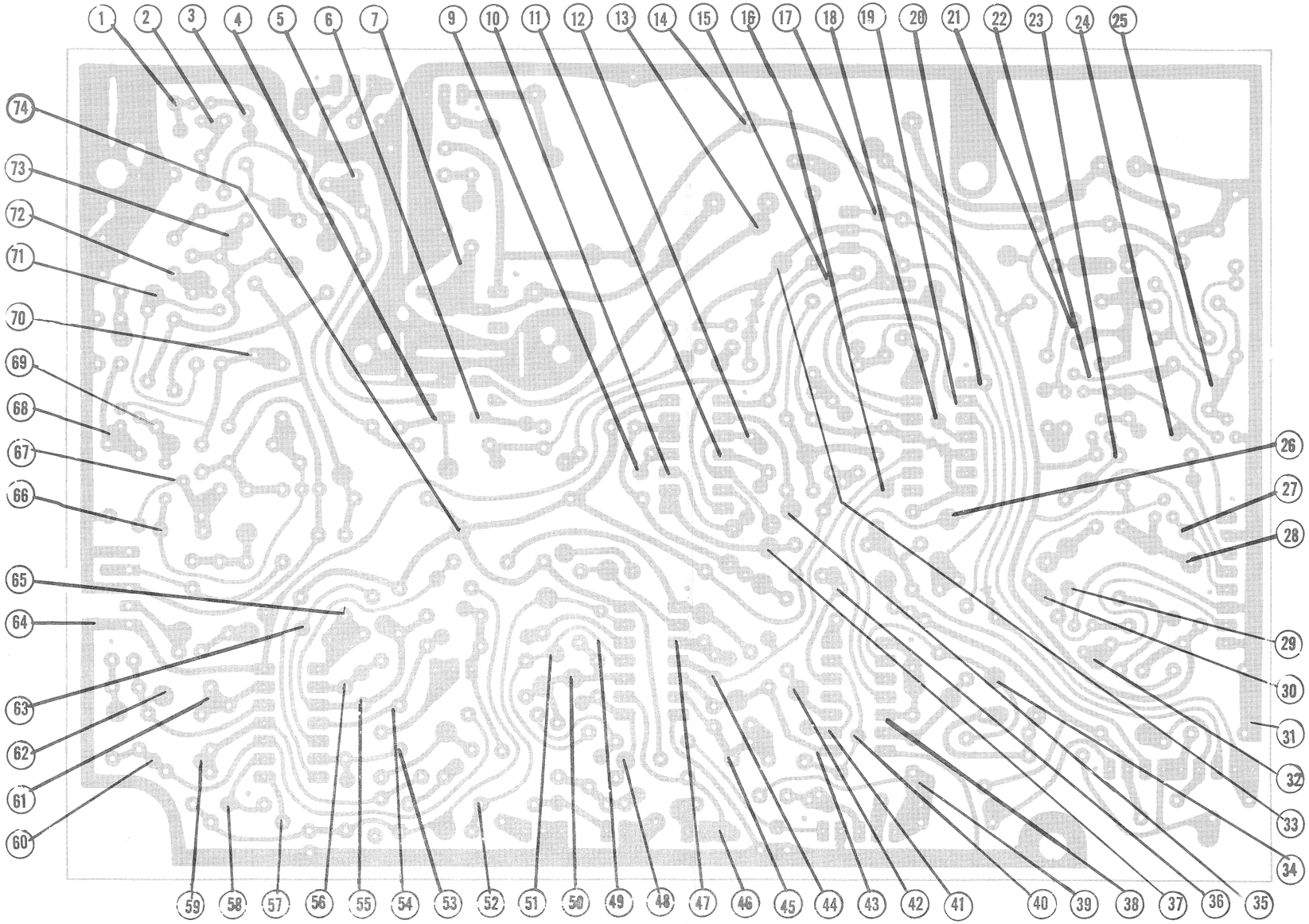


Figure 6-21 Audio & Logic Circuit Board Test Points

1. All resistor values are in ohms, tolerance ±5%, dissipation 1/4 watt. All capacitor values are in microfarads unless other wise specified.

2. * Denotes Low Leakage capacitor.

3. ** Volume Control Maximum

4. Audio measurements taken with a 315 Hz Tape Recorded at -4 db running in the projector.

5. Advance Cue Pulse measurements taken with a 1000 Hz Tape Recorded at -10 db running in the projector on channels 3 and 4.

6. Stop Cue Pulse measurements Taken with a 150 Hz Tape Recorded at -10 db running in the projector on channels 3 and 4, and pins 13 and 14 of Z-6 connected together.

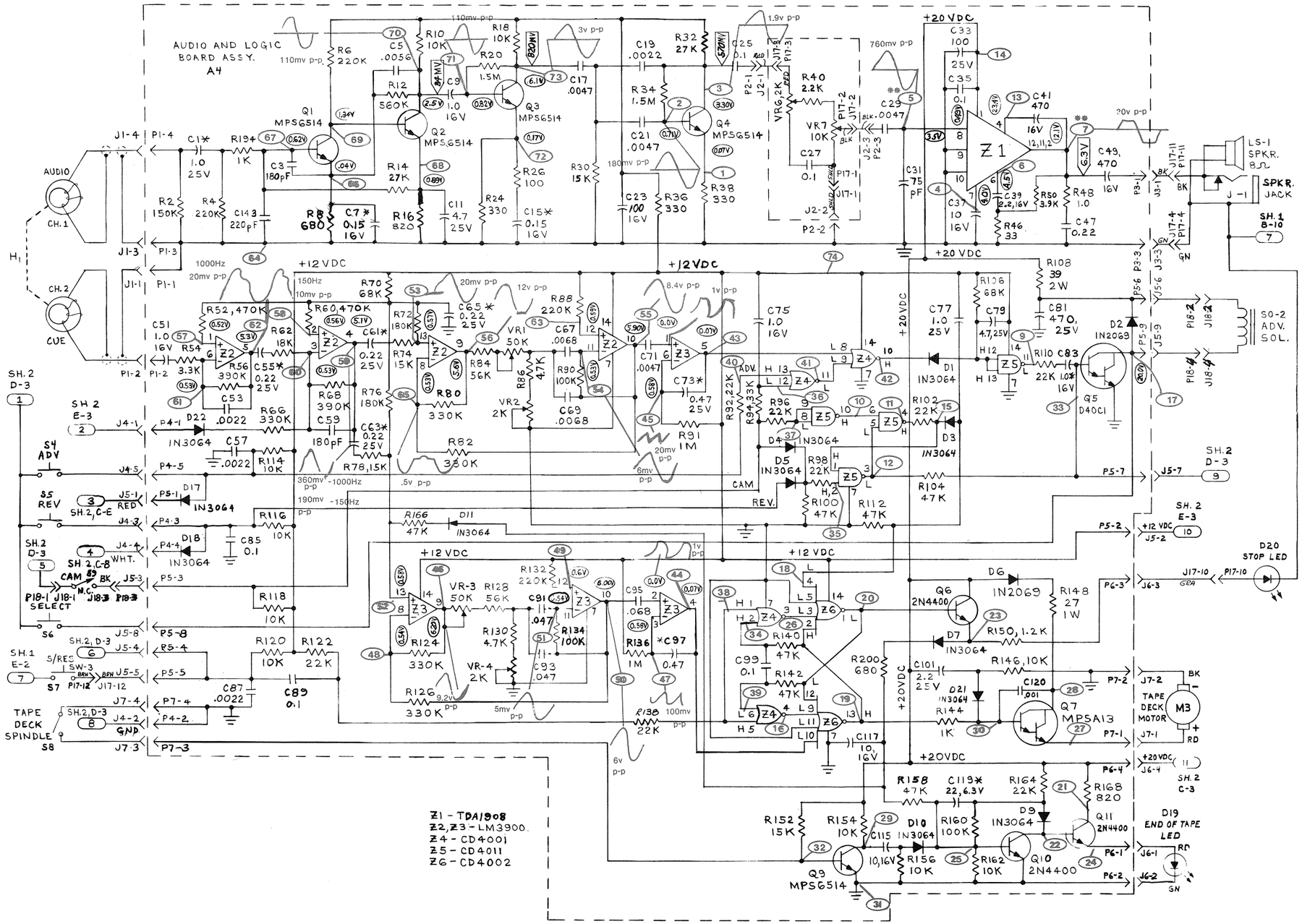


Figure 6-22. PROJECTOR SCHEMATIC DIAGRAM (Audio & Logic) Model 3230 Stage II Starting Code K9C

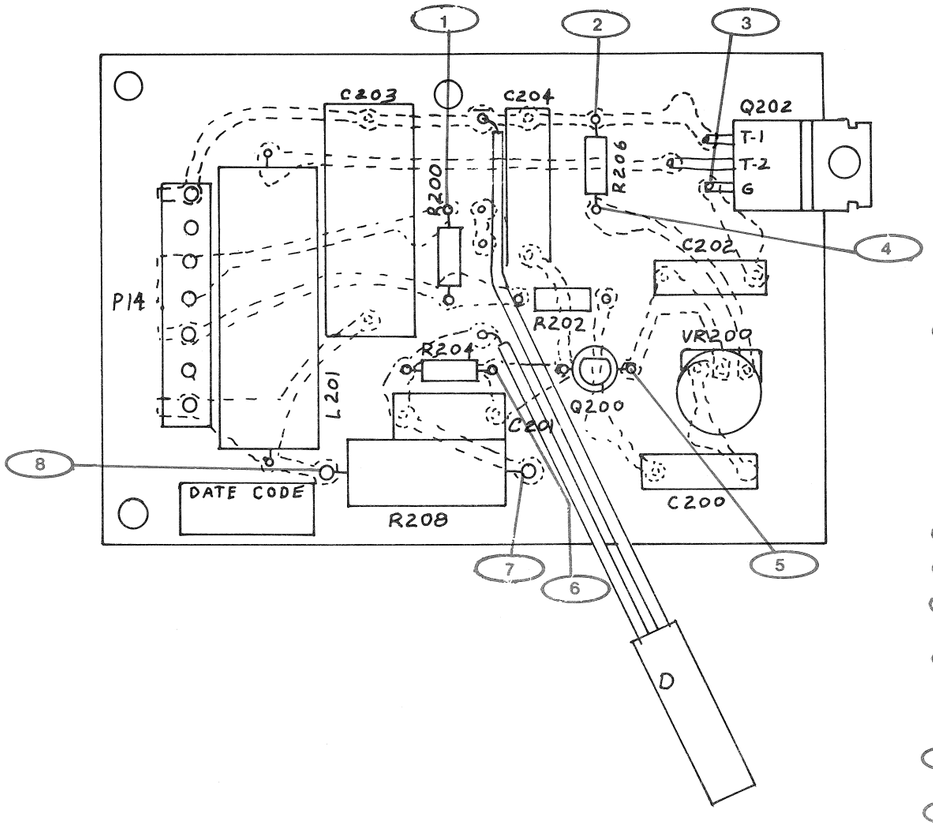


Figure 6-23. LAMP REGULATOR BOARD ASSEMBLY (Model 3230)

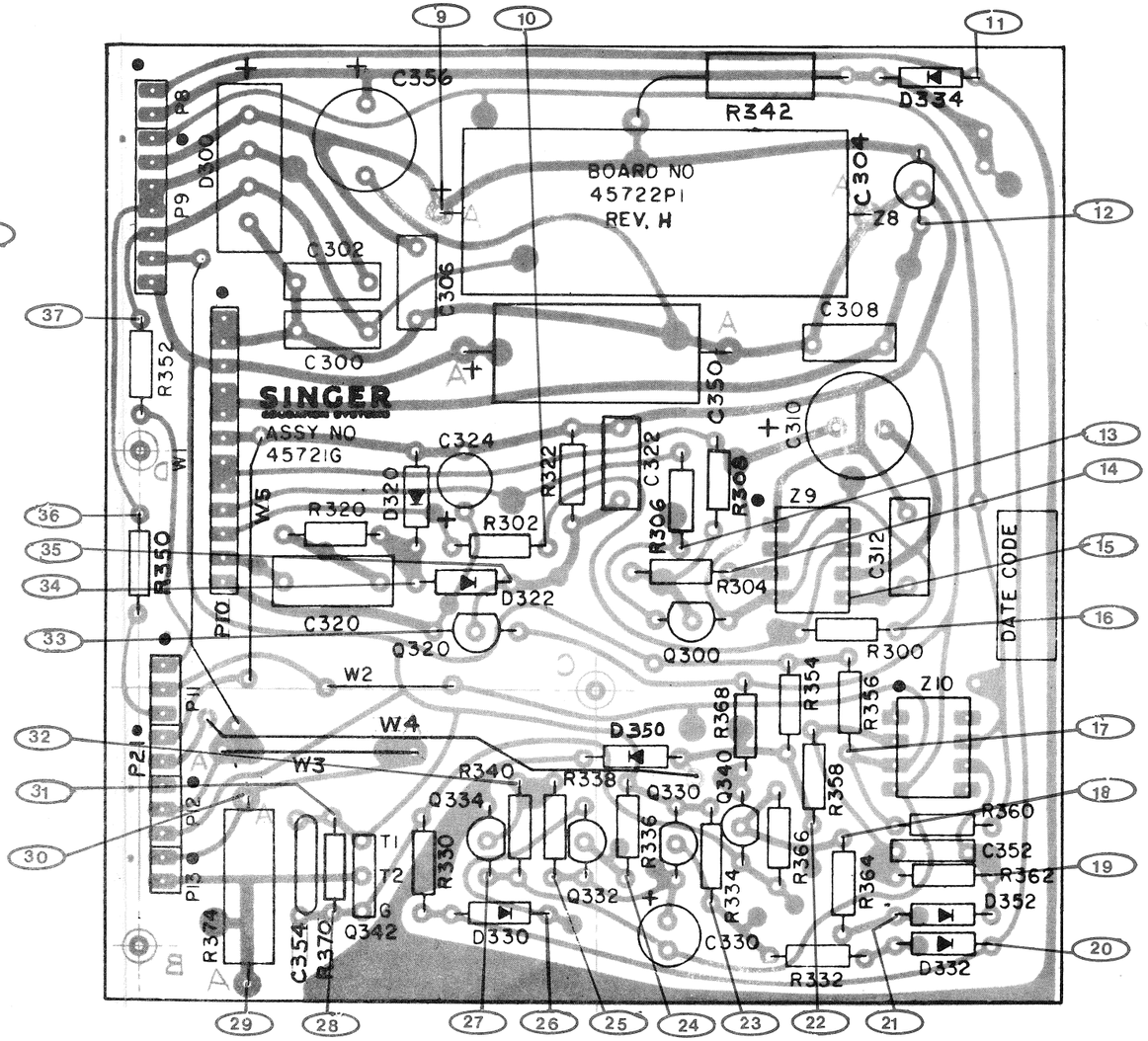


Figure 6-24. POWER SUPPLY AND AF-T BOARD ASSEMBLY (Model 3230)

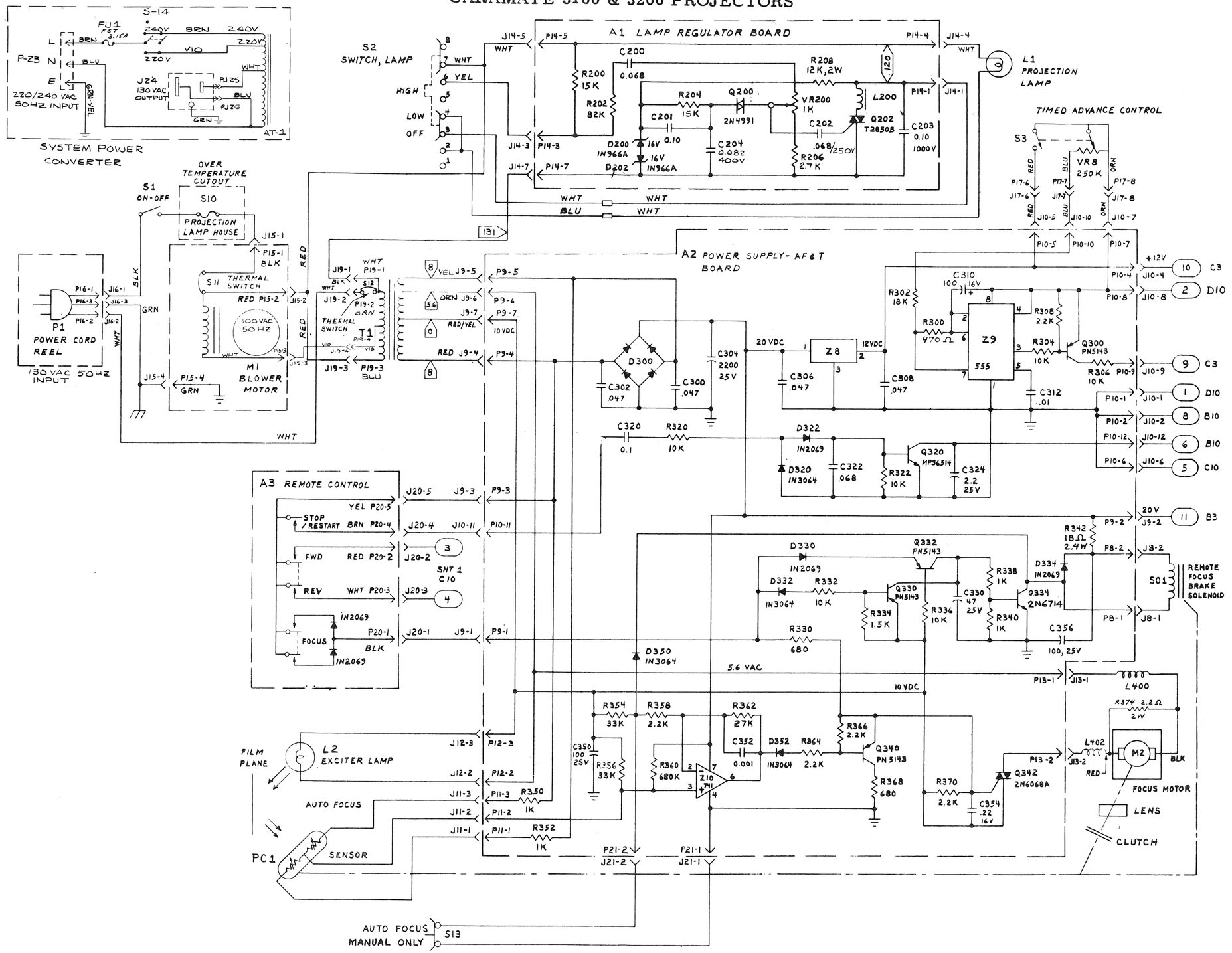


Figure 6-25. PROJECTOR SCHEMATIC DIAGRAM (Model 3234) Stage I

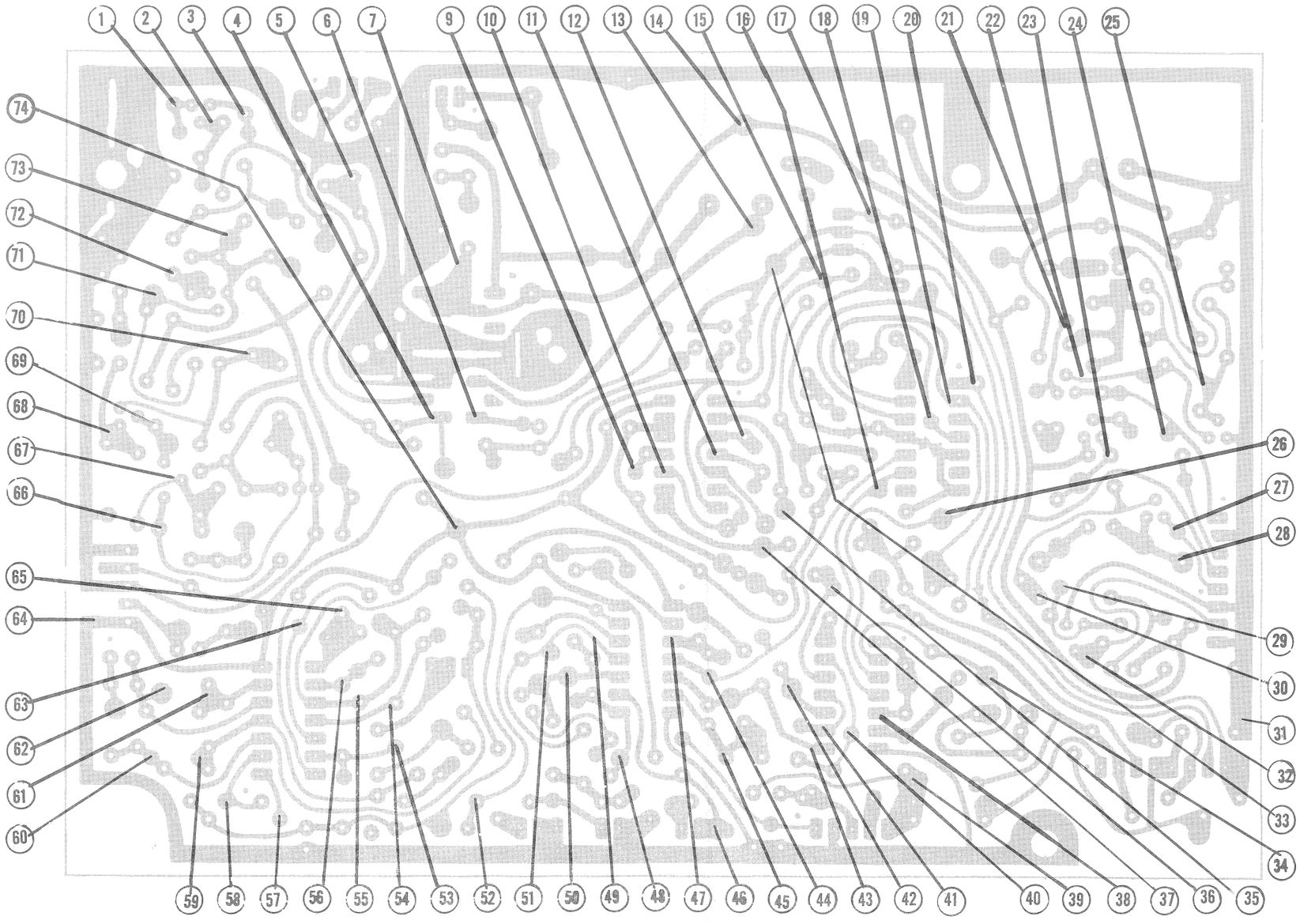


Figure 6-26. Audio & Logic Circuit Board Test Points

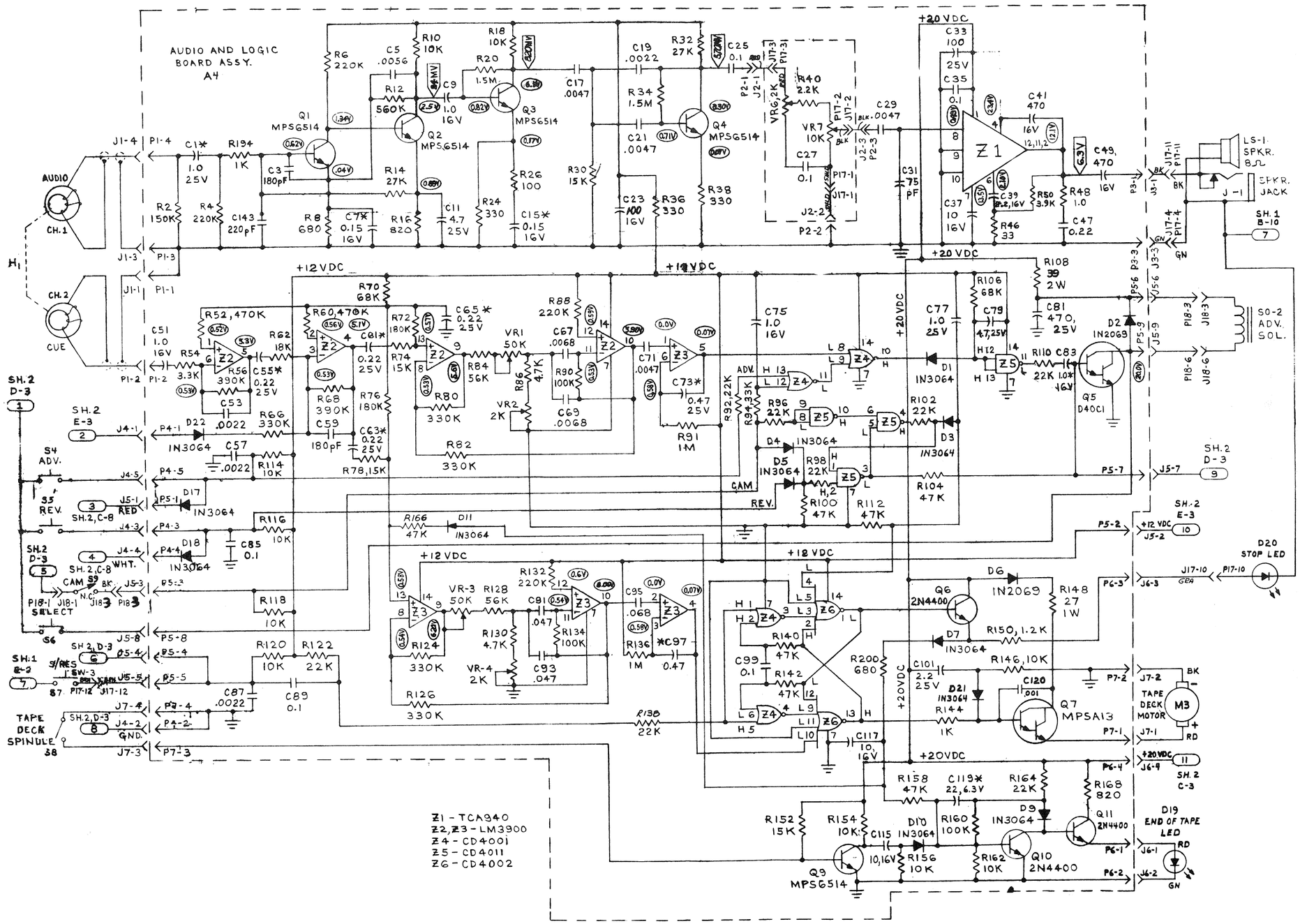


Figure 6-27. PROJECTOR SCHEMATIC DIAGRAM (Model 3234) Stage II 46718-C

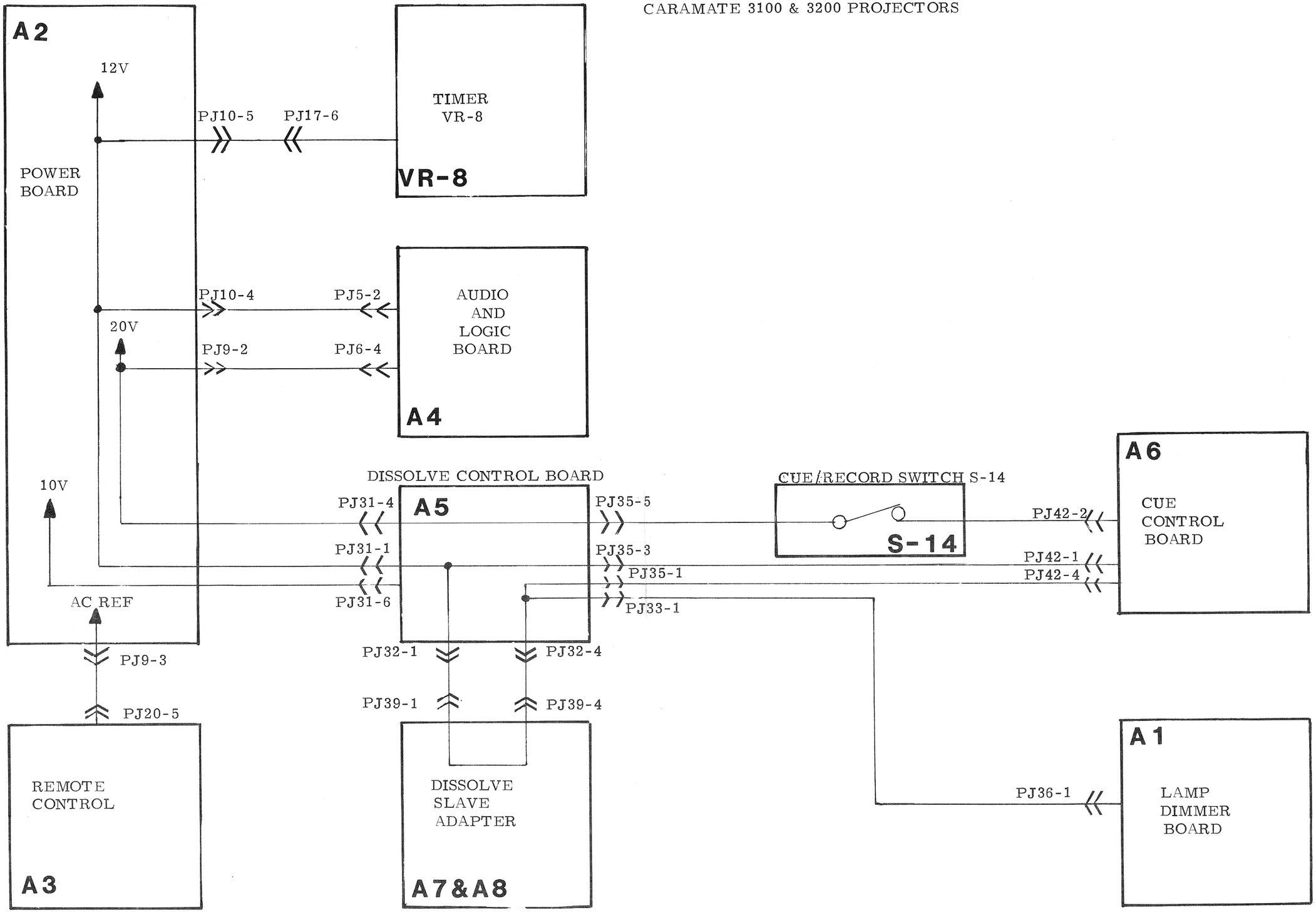
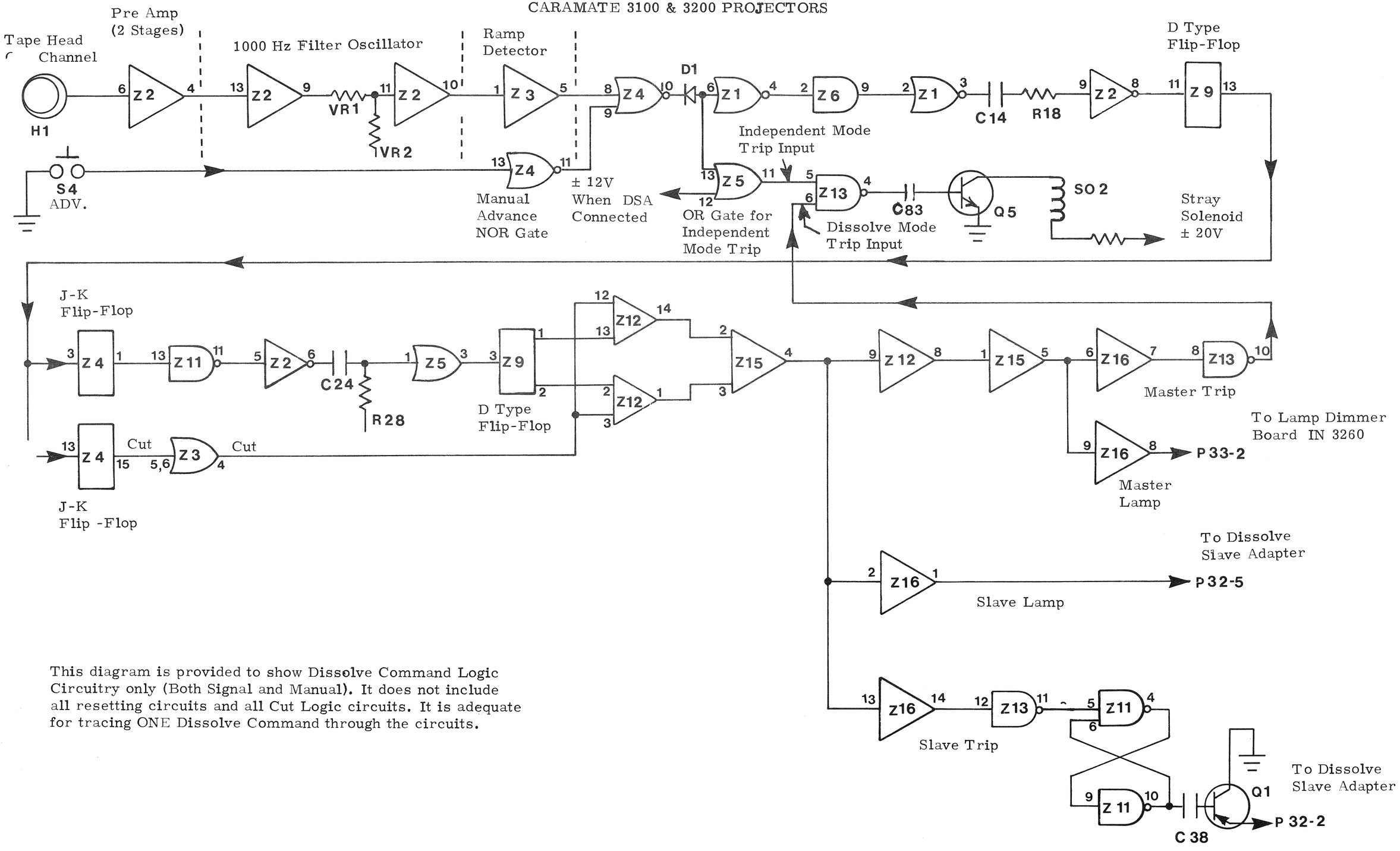


Figure 6-28. BLOCK DIAGRAM OF POWER DISTRIBUTION (Model 3260)



This diagram is provided to show Dissolve Command Logic Circuitry only (Both Signal and Manual). It does not include all resetting circuits and all Cut Logic circuits. It is adequate for tracing ONE Dissolve Command through the circuits.

Figure 6-29. DISSOLVE COMMAND BLOCK DIAGRAM (Model 3260)

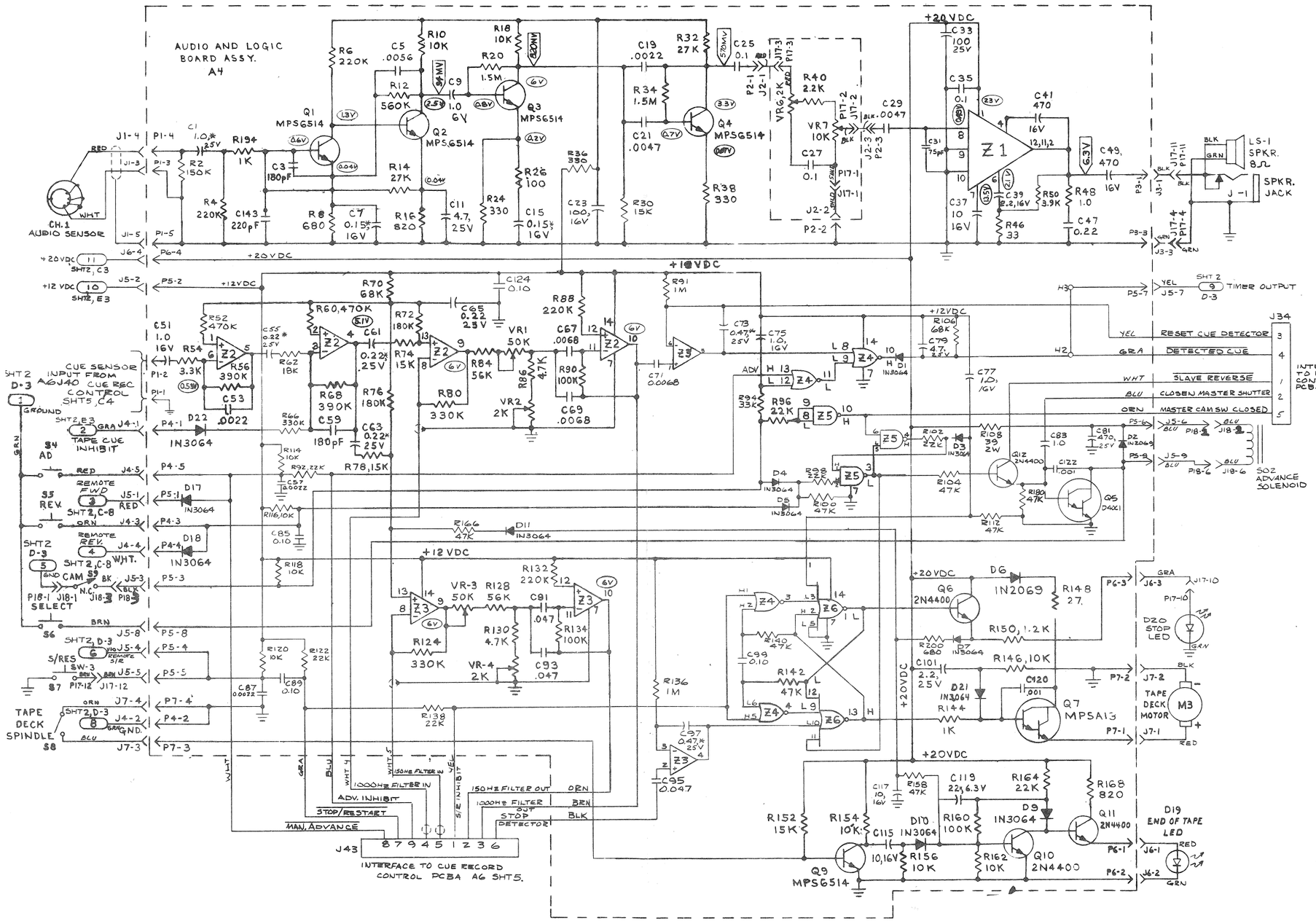
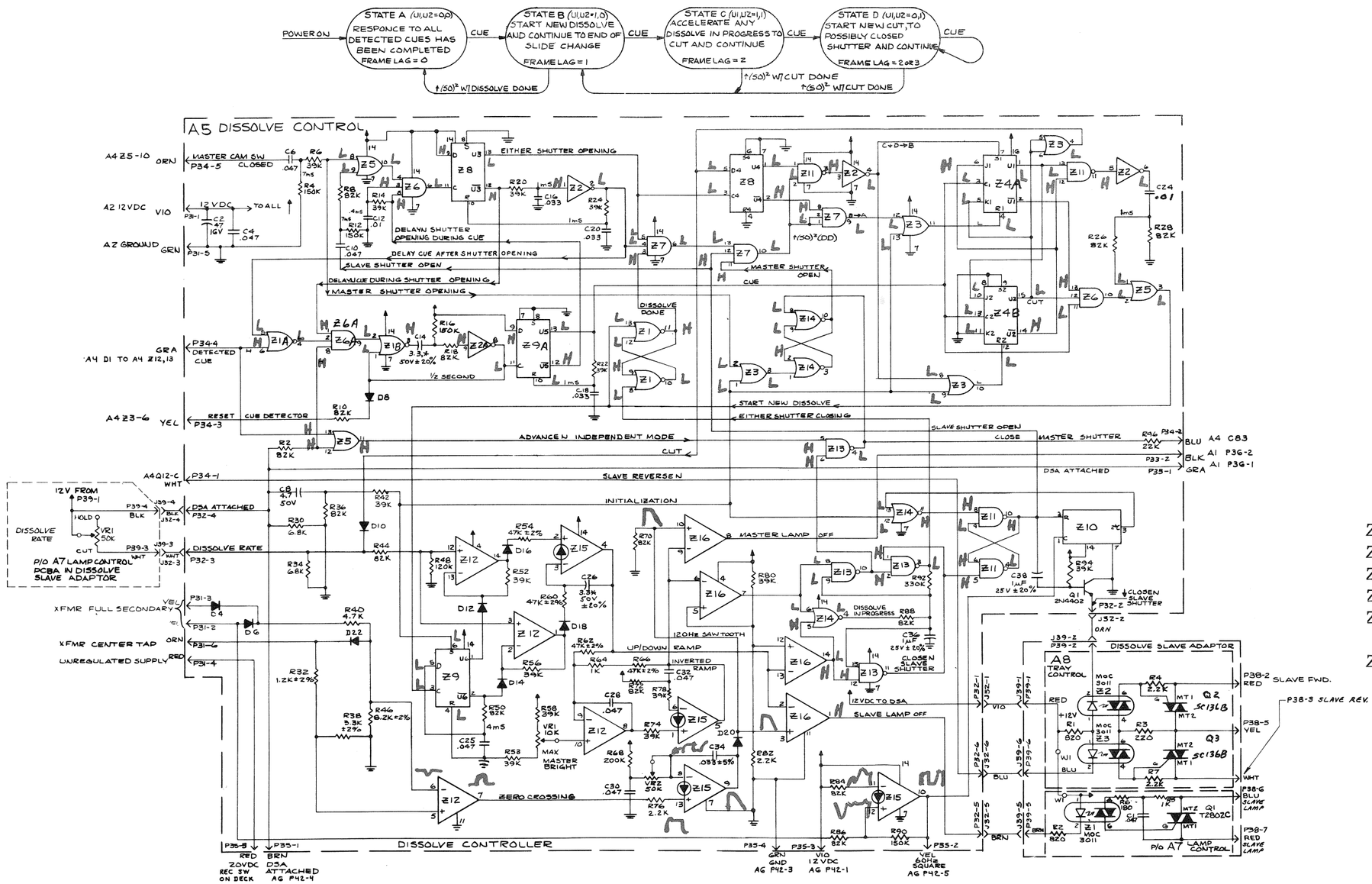


Figure 6-30. PROJECTOR SCHEMATIC (Audio & Logic) Model 3260 46622-F 12/82



1. Special ACRONYMS used:
↑(SO)² A shutter just opened with other shutter open.
DSA: Dissolve Slave Adapter.
N : Suffix on word of signal
LABLE- Lable is active when signal voltage is near ground.
FRAME LAG: Number of properly spaced cues detected minus number of shutter openings. openings.

2. I.C. Identifications

Z1, 14	4001	4 x 2 NOR
Z2	4069	6 INV
Z3	4071	4 x 2 OR
Z4	4027	2 J-K FF
Z5	4071	4 x 2 OR
Z6	4073	3 x 3 AND
Z7	4073	3 x 3 AND
Z8	4013	2 D FF
Z9	4013	2 D FF
Z10	4024	7 Bit CNTR
Z11	4011	4 x 2 AND
Z12	LM324	4 OP AMP
Z13	4011	4 x 2 AND
Z14	4001	4 x 2 NOR
Z15	LM 3900	4 NAMP
Z16	LM 324	4 OP AMP

3. Logic levels indicated are the starting logic levels when the IMAGE 2 is being used as a Dissolve Master and the IMAGE 2 and Slave Projector have been turned on in the proper sequence.

Figure 6-31. PROJECTOR SCHEMATIC DIAGRAM (Dissolve Control) Model 3260

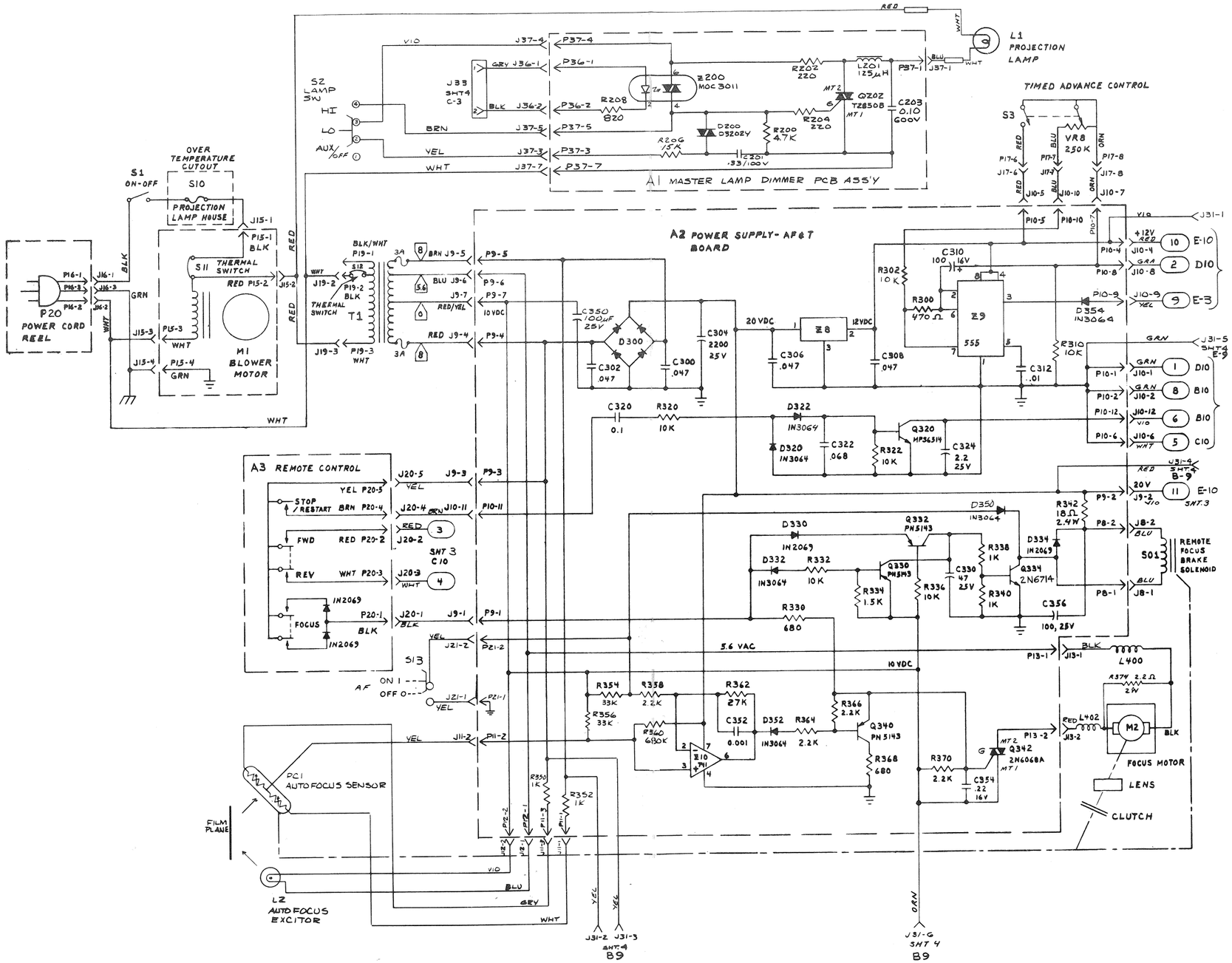


Figure 6-32. PROJECTOR SCHEMATIC DIAGRAM (Power Supply AF-T-Lamp Control) Model 3260 46622-F

1. I.C. IDENTIFICATION

Z1: 4081 , 4 x 2 AND
Z2: 4011 , 4 x 2 NAND
Z3: 4040 , 12 Bit Counter
Z4: 4001 , 4 x 2 NOR
Z5: 4023 , 3 x 3 NAND
Z6: 4053 , 3 x DT Switch
Z7: 4071 , 4 x 2 OR
Z8: 4001 , 4 x 2 NOR
Z9: 4011 , 4 x 2 NAND
Z10: 4001 , 4 x 2 NOR

2. Connecting Dissolve Slave Adapter inhibits manual advance NOR GATE (24) through (Z-7) (Z-4), (Z-5) and (Z-6).

3. Record switch inhibits manual advance NOR GATE (24) through (Z-7) (Z-4), (Z-5) and (Z-6).

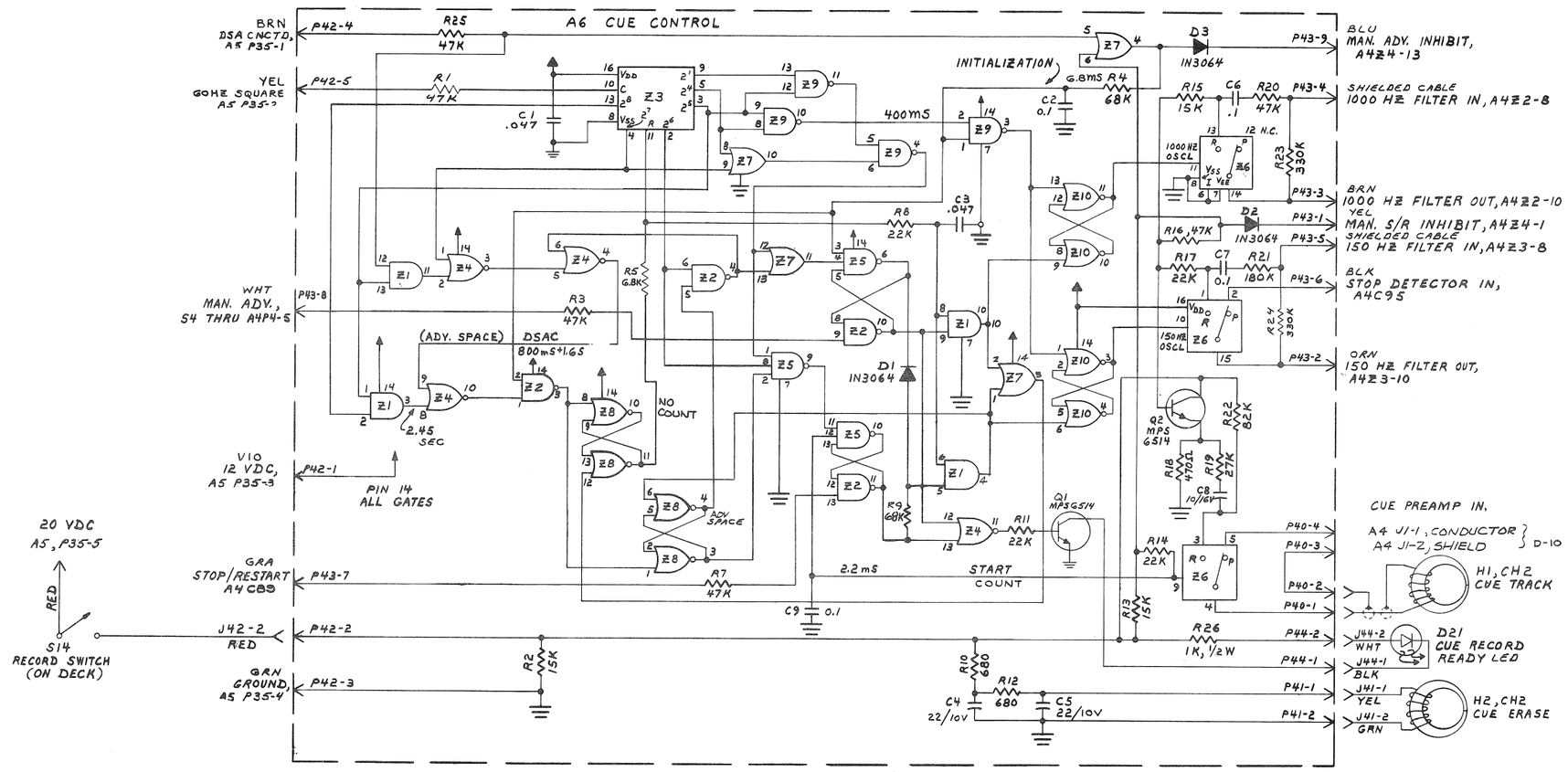


Figure 6-33. PROJECTOR SCHEMATIC DIAGRAM (Cue Control) Model 3260 46622-F

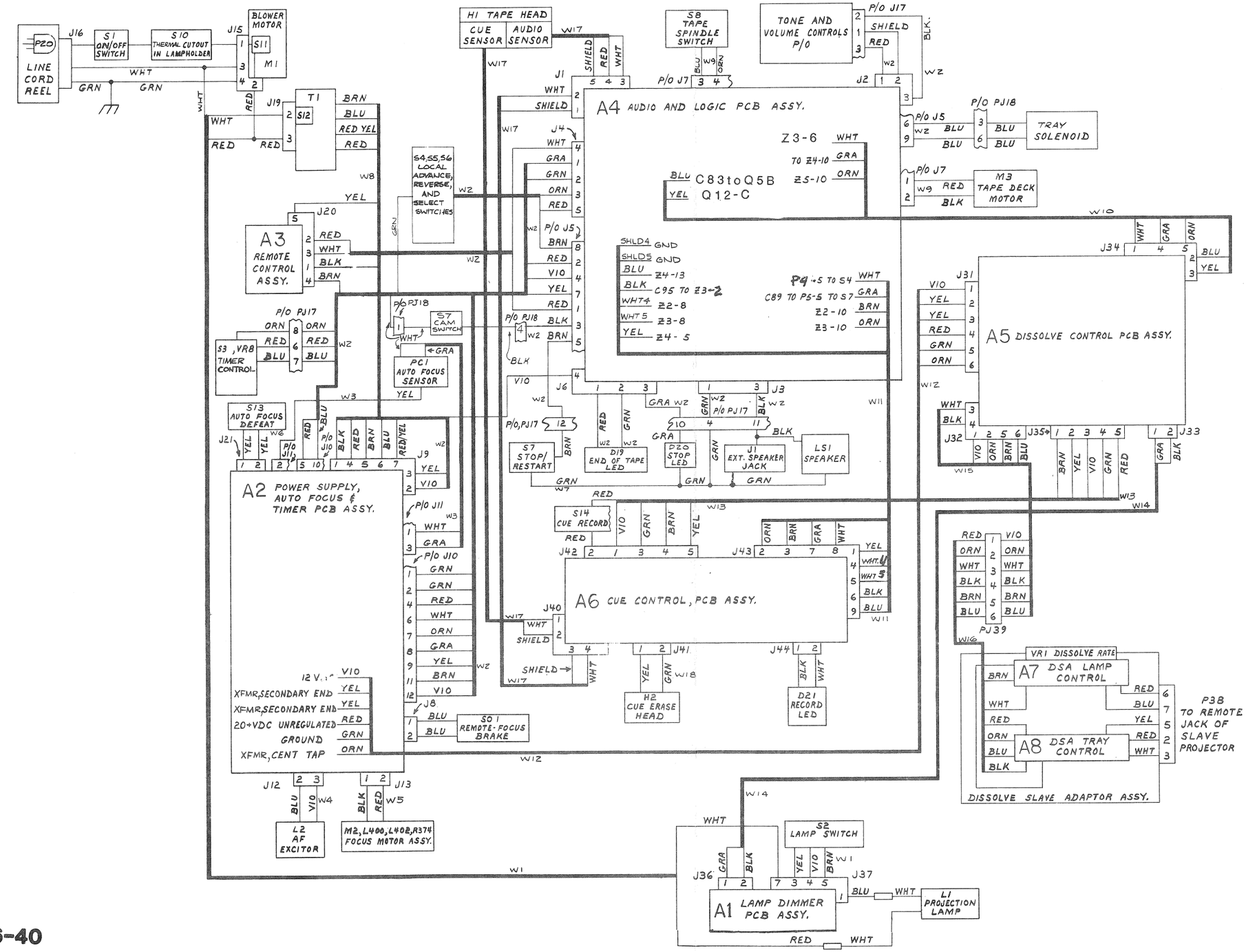


Figure 6-34. PROJECTOR SCHEMATIC DIAGRAM (Circuit Board Interconnections) Model 3260 46622-F

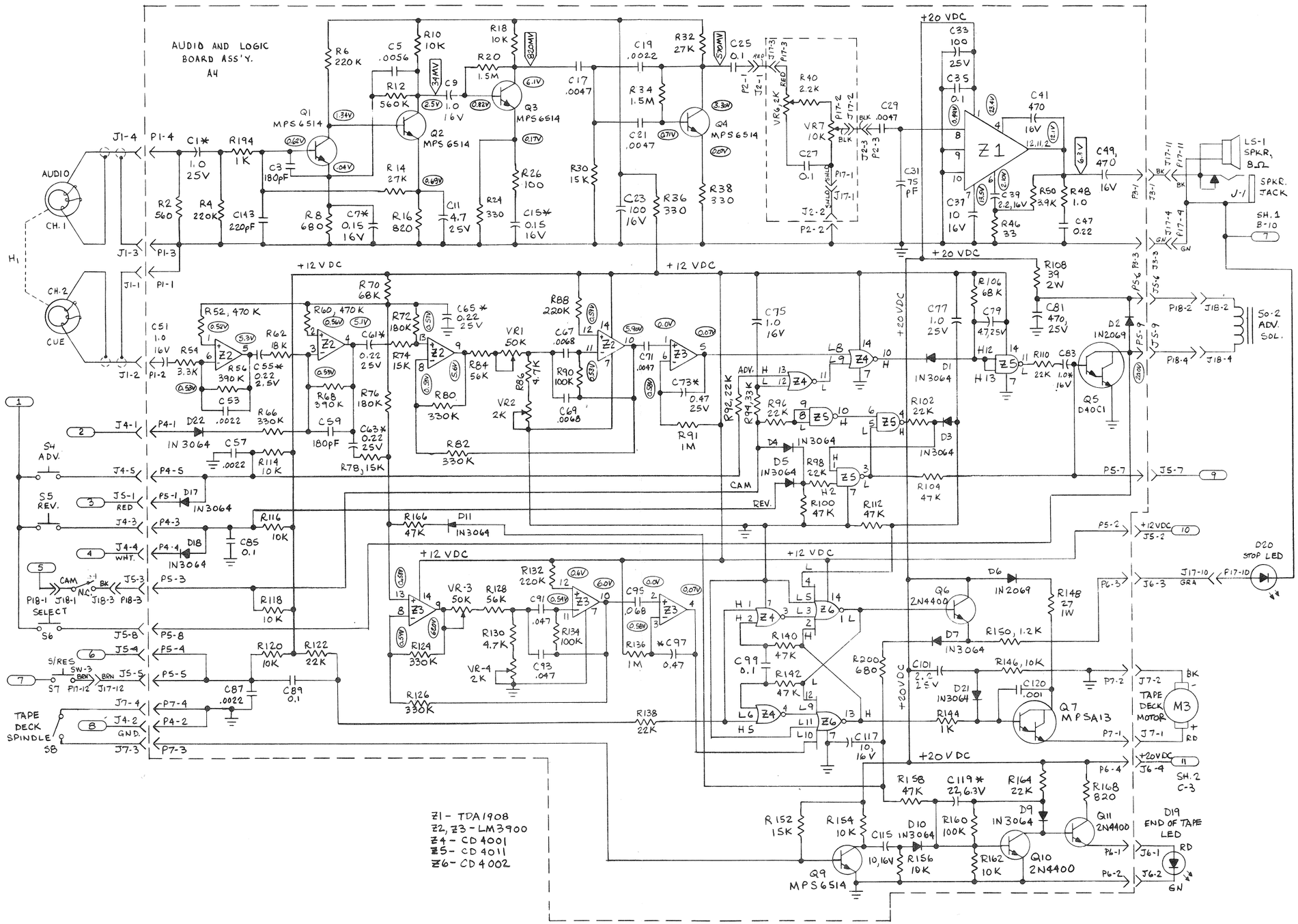


Figure 6-35. PROJECTOR SCHEMATIC DIAGRAM (Stage I) Model 3224 46842- B

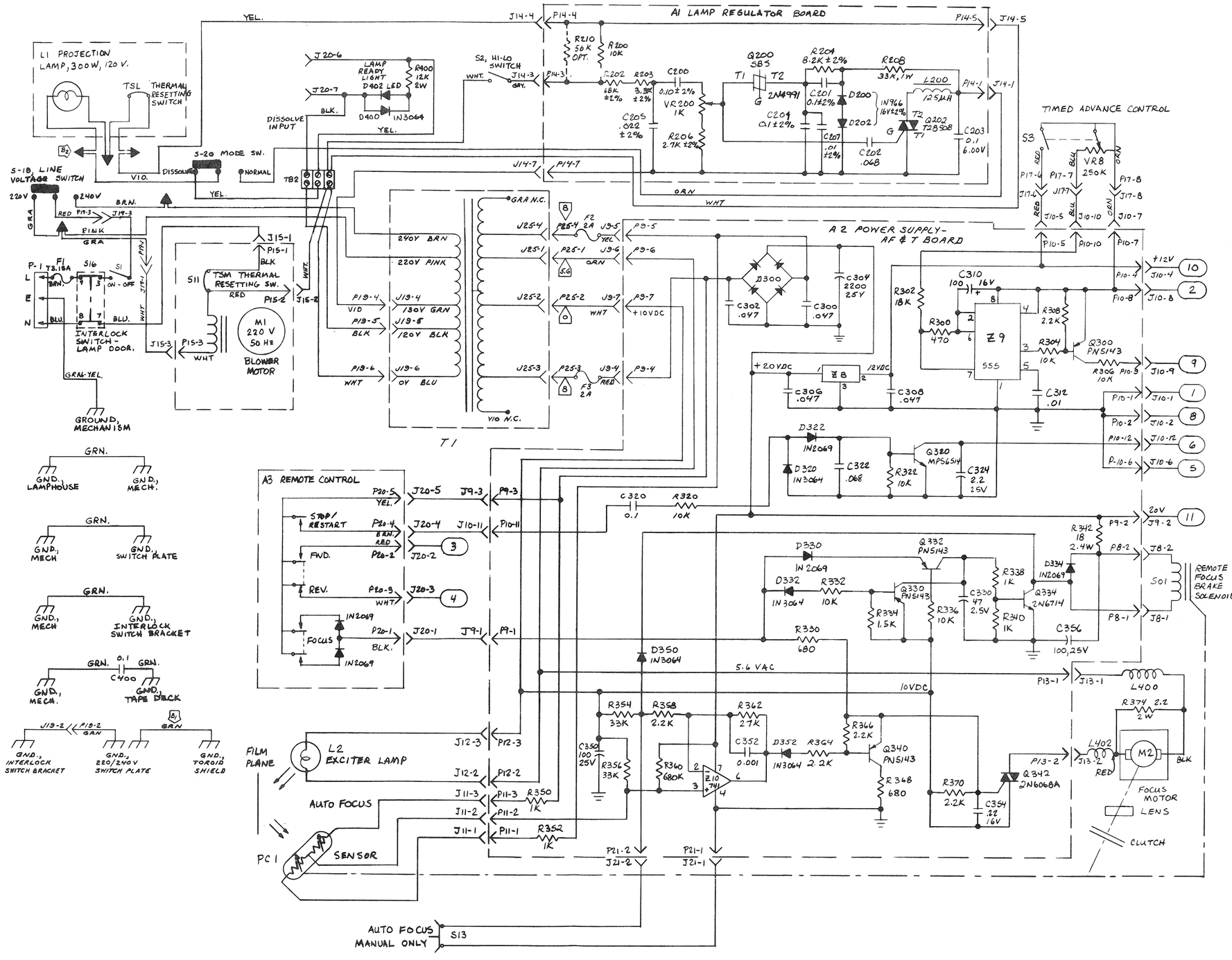


Figure 6-36. PROJECTOR SCHEMATIC DIAGRAM (Stage II) Model 3224 46842- B

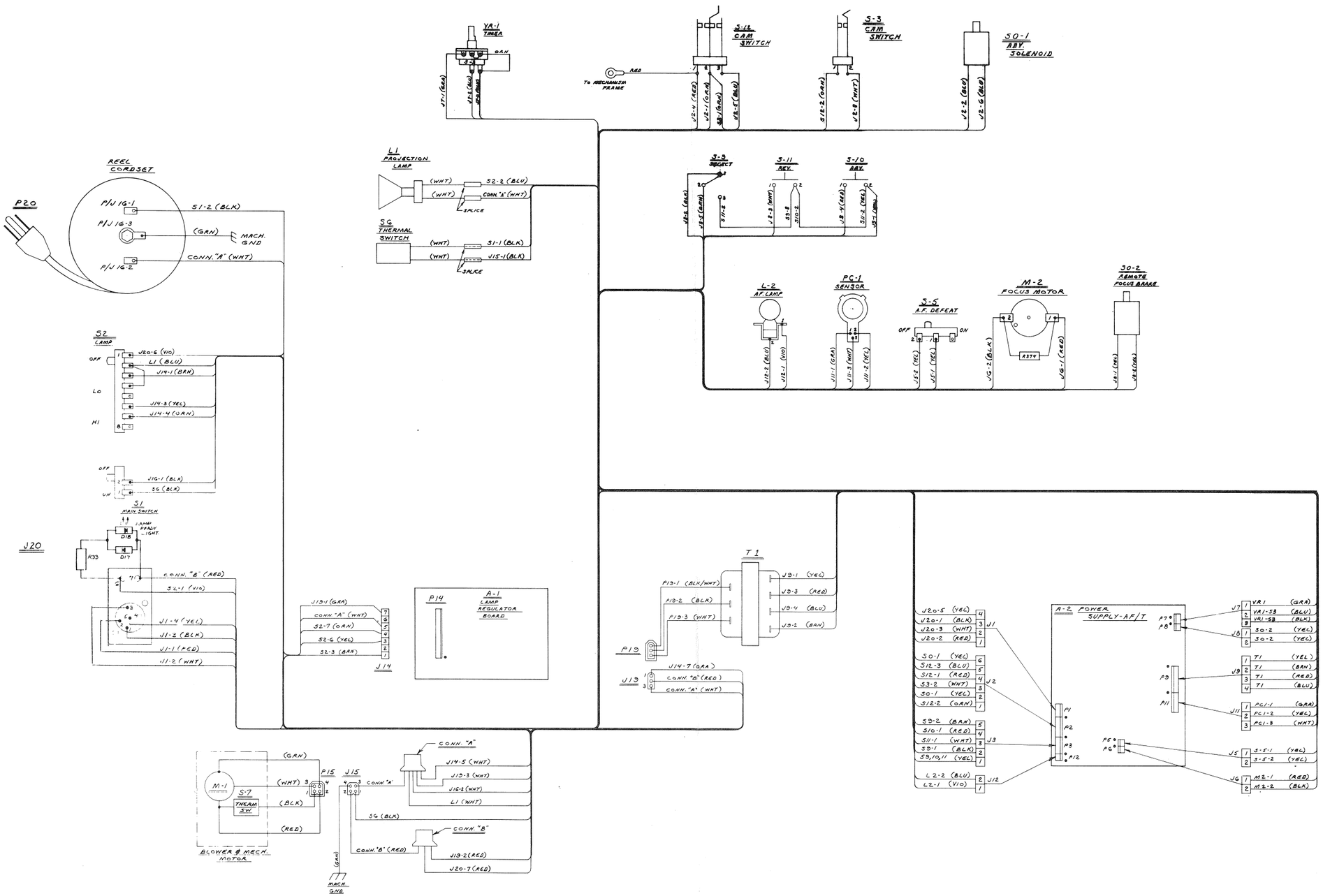


Figure 6-37. PROJECTOR WIRING DIAGRAM (Model 3120)

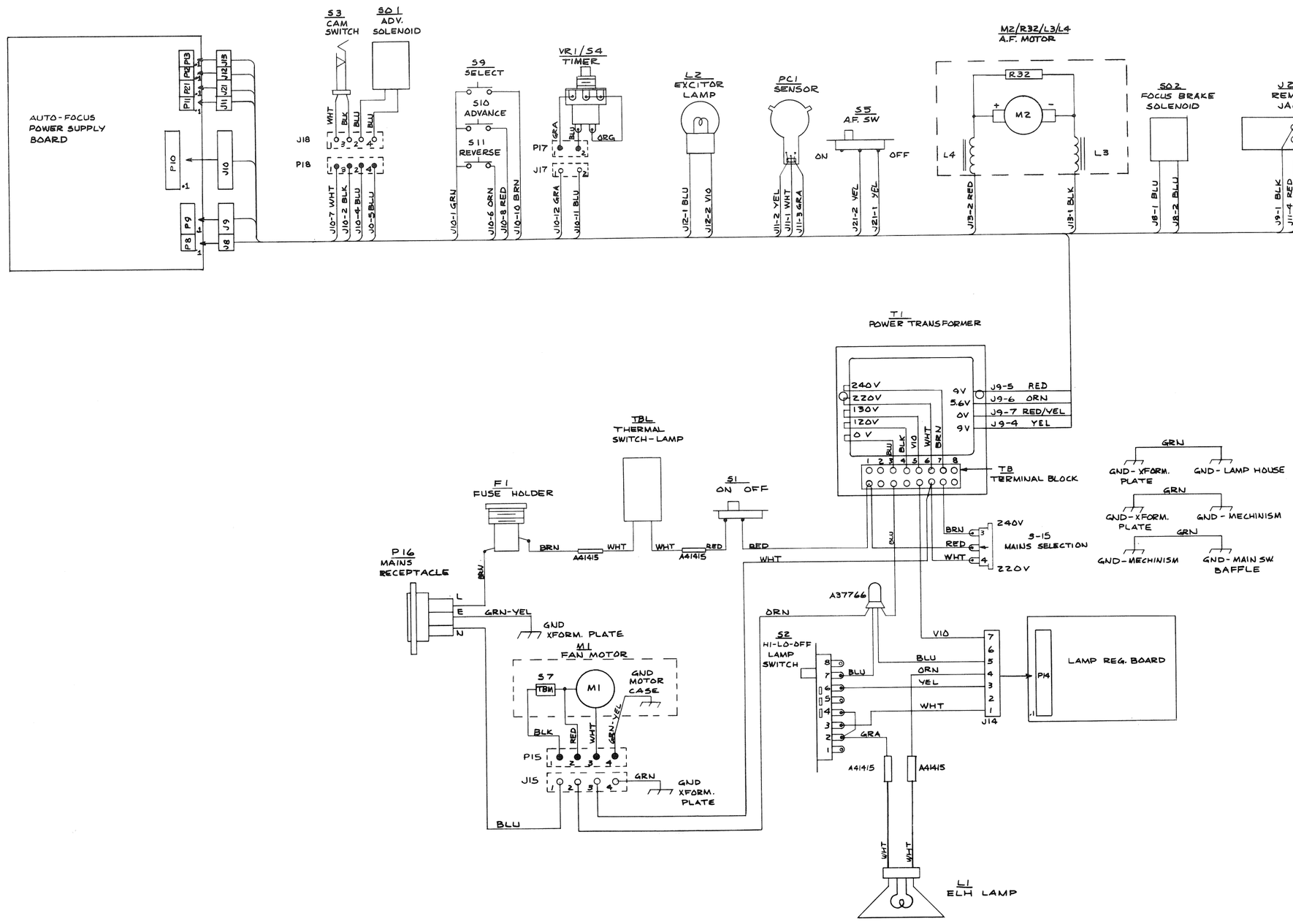


Figure 6-38. PROJECTOR WIRING DIAGRAM (Model 3134)

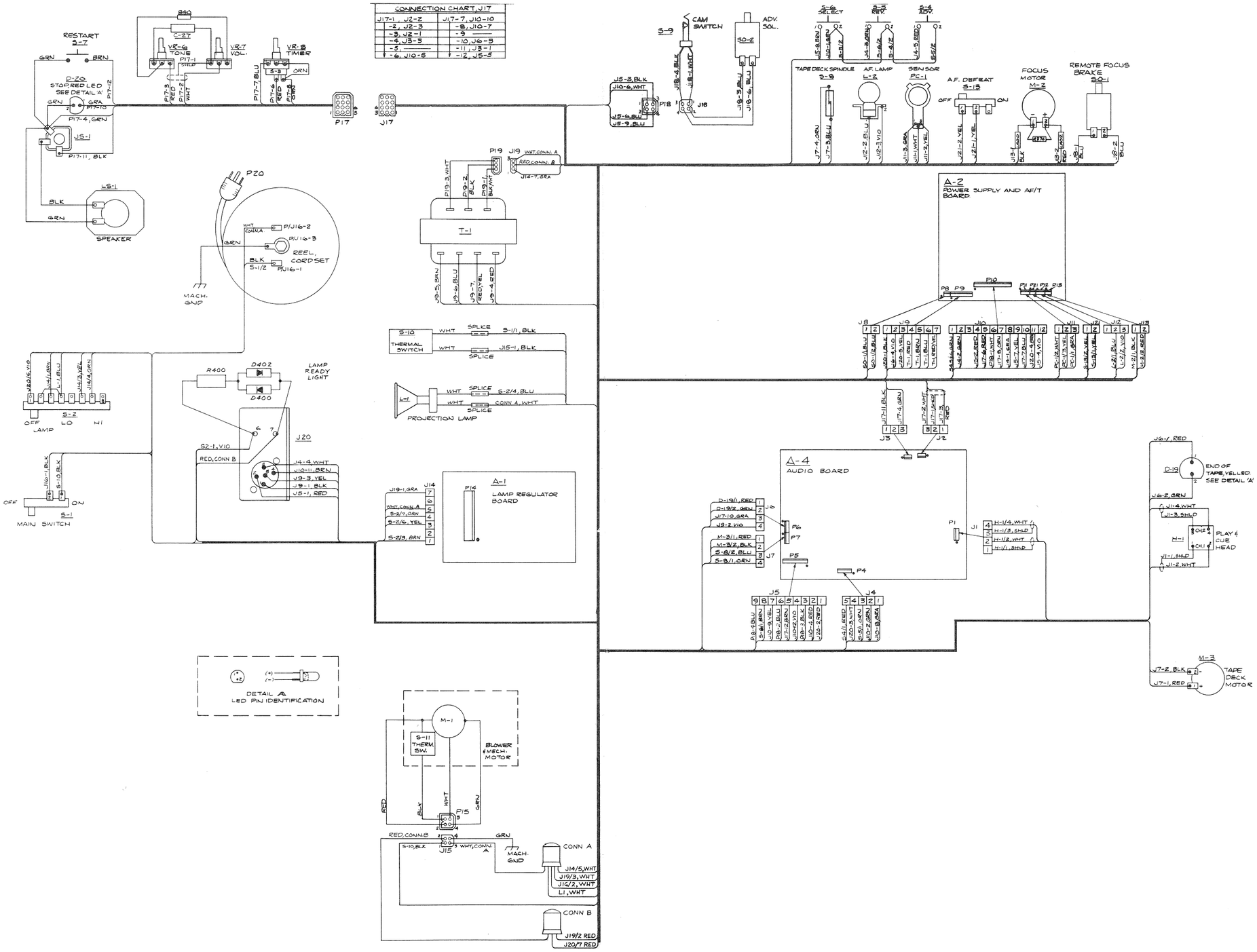


Figure 6-39. PROJECTOR WIRING DIAGRAM (Model 3230)

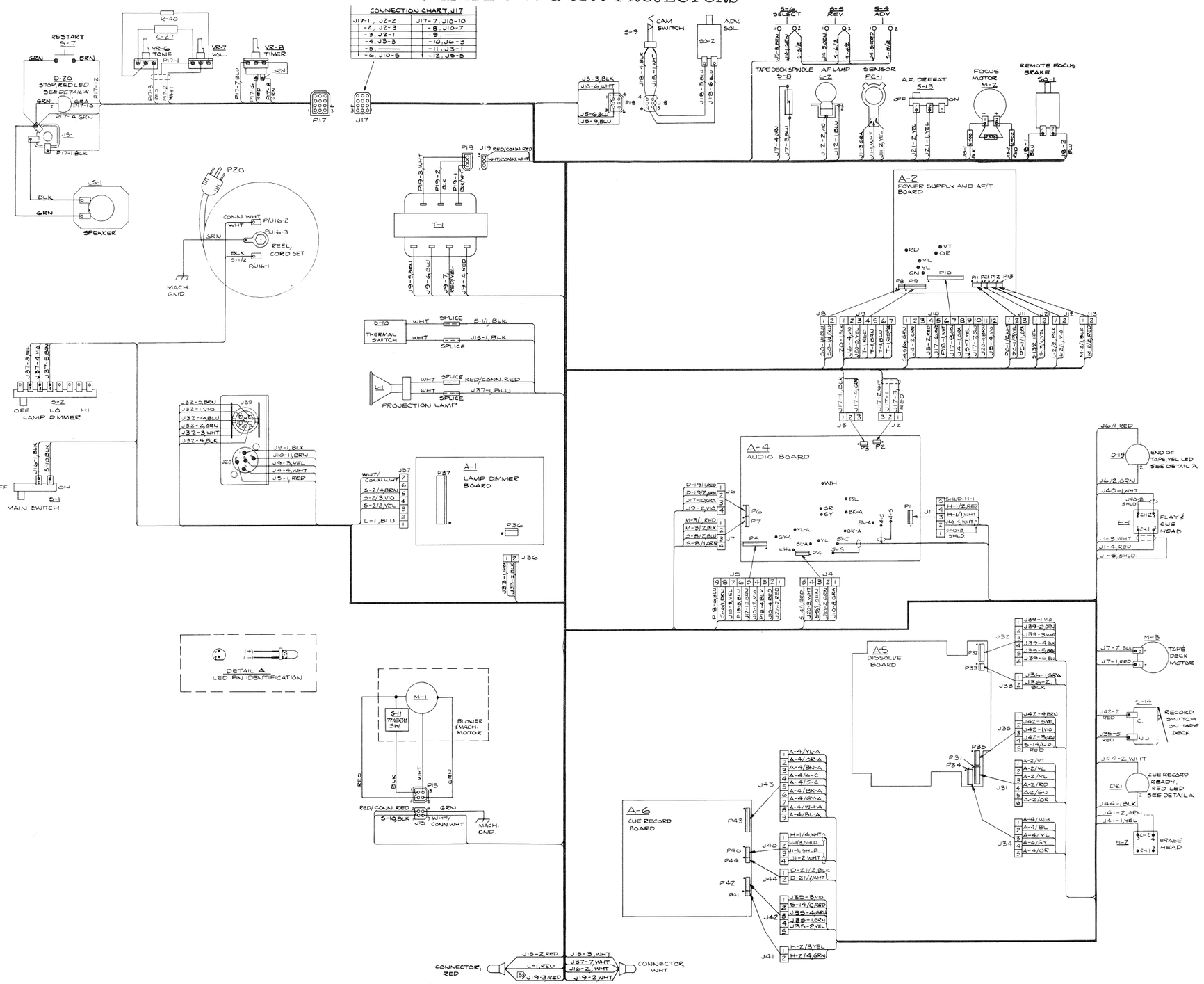


Figure 6-40. PROJECTOR WIRING DIAGRAM (Model 3260)