

Figure 1. Type 1544 Strobotac.

THE STROBOSCOPIC ILLUSION.

When the flashing rate of the stroboscope is either the actual speed or an integral submultiple of the actual speed of the observed object, a single stationary image results. When the flashing rate is near, but not at, such synchronism, a slow-motion replica of the actual motion appears. If the flashing rate is slightly below the speed of the observed object, then each successive flash occurs at a slightly later part of the cycle, and the apparent slow motion is in the same direction as the actual motion. If the flashing rate is slightly above the object speed, each successive flash occurs at a slightly earlier part of the cycle, and the apparent motion is in the reverse direction.

The optical illusion of slow or stopped motion is the basis of many important applications of the stroboscope. Of great significance is the fact that the apparent slow motion is an exact replica of the actual high-speed motion. Therefore, an irregularity in a machine's behavior that occurs only at high speeds will nevertheless be exposed in slow motion. This all-important function of slow-motion or stopped-motion visual observation is uniquely served by the stroboscope.

PURPOSE.

The Type 1544 Strobotac produces a bright flashing light over a wide flash-rate range to stop motion. It is well suited for use in industrial applications as an engineering or maintenance tool, as part of a photography setup, or as an aid in the classroom. Additionally, it is small, light, simple to operate and inexpensive.

Type 1544 Strobotac® (Electronic Stroboscope)

specifications

Flash Rate	180 fpm	3800 fpm
Duration ¹	4 μ s	6 μ s
Watt Seconds	0.16	0.6
Beam Candella ²	30X10 ⁶	4X10 ⁶
Beam Width ³	10°	10°

1. Measured at ½ peak-intensity points. 2. Measured with silicon photodetector 1 meter from lamp. 3. Measured at ½ intensity points.

External Trigger: Std. phone jack, operated by contact-closure, positive signal (> 2V peak), or GR 1536 Photoelectric Pickoff.

Trigger Delay: \approx 16 to 330 ms from application of external trigger; set by flash-rate control.

Sub-Mult Mode: Provides $\pm 0.1\%$ accuracy by synchronizing to submultiples of the line frequency.

Environmental: TEMPERATURE: 0 to 50°C operating, -40 to 75°C storage. Humidity: 95% RH at +40°C, (MIL-E-16400-4.5.4.6).

Power: 105 to 125 V, 50 to 60 Hz, 25 W max.

Mechanical: DIMENSIONS (wxhxd): 4.2X6.19X7.8 in. (107X157X198 mm). WEIGHT: 3.7 lb (1.7 kg) net, 5 lb (2.3 kg) shipping.

Catalog Number	Description
1544-9700	1544 Strobotac
1530-9410	Replacement Strobotron Flash Lamp

DESCRIPTION.

(Figure 1)

The 1544 features simple pushbutton control with a single knob to control the flash rate or delay time — no range switching is necessary. An uncalibrated dial indicates the approximate number of flashes per minute. Modes of operation are: NORMAL, LINE FREQUENCY submultiple, EXTERNAL SYNC DIRECT, and EXTERNAL SYNC DELAY. The light output is electronically compensated for relatively constant subjective brightness (as the flash rate decreases, the light intensity increases).

The instrument is housed in a high impact-plastic case that is shaped for comfortable hand-held operation. Alternatively, a threaded hole is provided for mounting on a tripod or a bail-type stand. The stand (supplied) doubles as a carrying handle or a bracket to hang the instrument in a convenient location.

MOUNTING.

A stainless-steel insert, which will accept a standard 1/4-20 tripod thread, is built into the bottom of the case for bail or tripod mounting. To tripod mount the stroboscopes remove the bail by turning its knob ccw. Screw the threaded end of the tripod pan head into the insert and hand tighten.

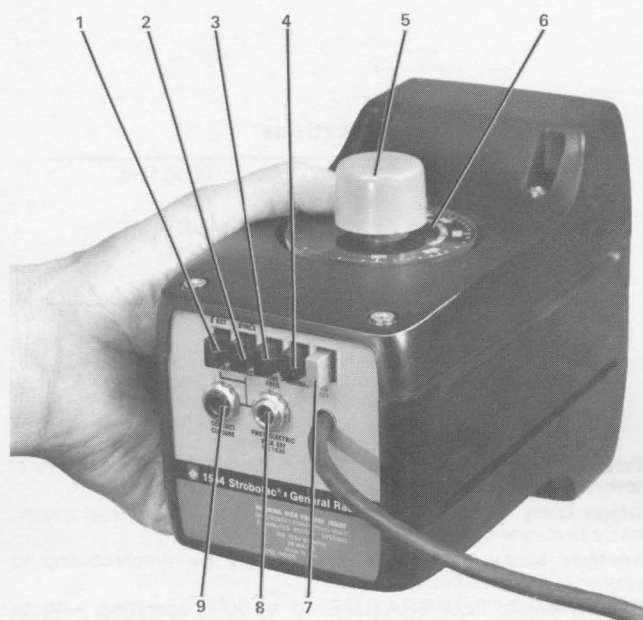


Figure 2. Rear view showing controls, connectors, and indicators.

CONTROLS, CONNECTORS, AND INDICATOR.

The controls, connectors, and indicator are listed and described in Table 1. Refer to the illustration of Figure 2.

PRELIMINARY CHECKS.

Refer to the trouble analysis section if any of these checks fail.

Normal Mode.

With the power connected, depress the ON-OFF and NORMAL buttons. Turn the flash-rate knob through its range — there should be no erratic action of the flash tube.

Line-Freq Mode.

Set the flash-rate knob to the high end and depress the LINE-FREQ submultiple button. The instrument is now synchronized with the line at 3600 flashes per min. Slowly turn the dial in a ccw direction. The flash rate will change to 3600/2, the first submultiple of the line frequency. Additional changes in the flash rate will be noticed as the dial is turned toward the low end. These step changes correspond to other submultiples of the line frequency. Do not expect the flash rate to change continuously in this mode.

External Sync.

Direct Mode. Depress the DIRECT button and connect a contact-closure device (such as a switch) to the rear-panel phone jack. The strobe should flash each time the device is activated.

Table 1
CONTROLS, CONNECTORS, AND INDICATOR

Fig. 2 Item	Name	Description	Function
1	EXT SYNC DELAY	On-off, pushbutton control	Selects EXT SYNC DELAY mode of operation. Refer to Item 5.
2	EXT SYNC DIRECT	On-off, pushbutton control	Selects EXT SYNC DIRECT mode of operation.
3	LINE FREQ	On-off, pushbutton control	Selects LINE FREQ mode of operation.
4	NORMAL	On-off, pushbutton control	Selects NORMAL mode of operation.
5	—	10-turn potentiometer (without stops)	Varies flash rate (180-3780 flashes/min) or delay time (approximately 16-330 ms).
6	—	Flash-rate dial, marked 500 to 3500	Indicates approximate flash rate per minute.
7	ON-OFF	On-off, pushbutton control	Turns instrument on or off.
8	PHOTOELECTRIC PICKOFF	Phone jack, mates with 1/4-in., Switchcraft Type 60, 3-conductor plug or equivalent	Accepts input from a signal source (+2 V peak) or GR 1536 Photoelectric Pickoff (or equivalent).
9	CONTACT CLOSURE	Phone jack, mates with 1/4-in., Switchcraft Type 40, two conductor plug or equivalent	Accepts input from contact closure device only.

Disconnect the contact closure device and connect the GR 1536 Photoelectric Pickoff (or equivalent) to the PHOTOELECTRIC PICKOFF jack. The strobe should flash each time the pickoff is activated. (Refer to the Type 1536 Photoelectric Pickoff Instruction Sheet for operating instructions.)

Delay Mode. Depress the DELAY button and adjust the flash-rate control for the maximum flash rate. Connect the 1536 Pickoff to the strobe as explained above. Activate the pickoff by passing a reflective object in front of the pickoff-head window — the stroboscope should flash immediately. Adjust the flash-rate control for the minimum rate and again pass the reflective object in front of the window — there should be a noticeable delay (≈ 330 ms) before the strobe flashes.

MODES OF OPERATION.

Normal.

In the NORMAL mode of operation, the stroboscopes will flash at a rate determined by the flash-rate control setting. Motion can be stopped by simply directing the strobe light on the moving object and turning the dial until a single or multiple image is obtained (see Figure 3).

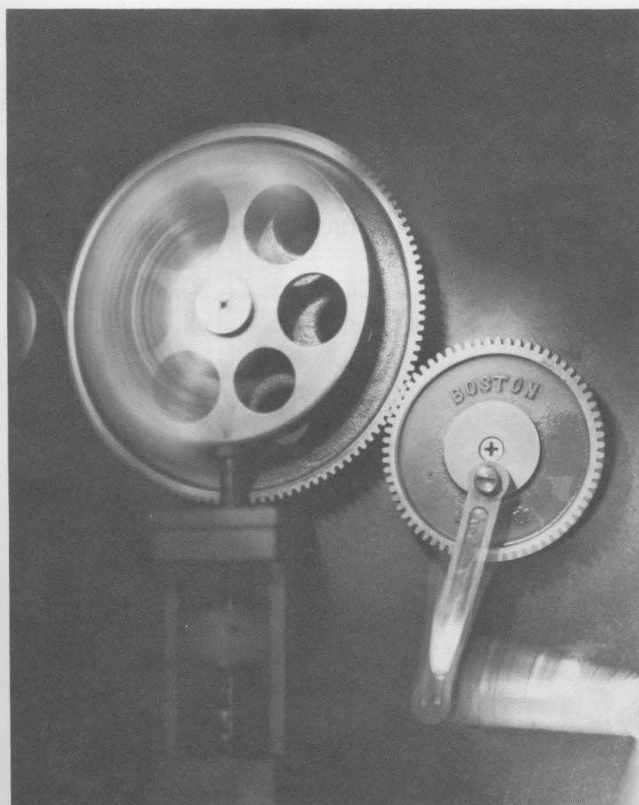


Figure 3. Stopped image of meshed gears.

When stopping the motion of an object, it is recommended that the dial be initially set to the high end. Then, slowly reduce the flashing rate until the object motion is stopped. Do not connect the GR 1536 Photoelectric Pickoff to the strobe when it is used in the NORMAL mode.

The dial markings are approximate indications of the flash rate. Following is a procedure that can be used to accurately calibrate the dial and is useful as a lab project for students or for special industrial applications:

- Fasten a disk to the shaft of a synchronous motor (such as the Bodine Electric Co. model no. NSY-12) and make a single mark on the outer surface of the disc.
- Cover the flash-rate dial of the stroboscopes with masking tape.
- Turn on the stroboscopes and the synchronous motor.
- Depress the NORMAL mode button and train the strobe light on the outer surface of the rotating disk.
- Turn the flash-rate dial fully cw (highest flash rate).
- Slowly turn the dial ccw until the first double image of the mark on the rotating disk appears. Mark this position on the flash-rate dial as 3600 rpm, using the mark on the instrument case as a reference.
- Continue turning in a ccw direction and mark the dial to correspond with Table 2.

This calibration may change with ambient temperature or line voltage. To recalibrate simply remove the masking tape and repeat the above procedure.

Table 2
FLASH-RATE DIAL CALIBRATION MARKS

Images	Revolutions Per Minute						
1	1800	900	600	450	360	300	200
2	3600	1200	720	514	400		
3	2700	1350	1080				
4	2400	1440	1028	800			
5	3000	2250	1500	1280			
6	2160		1543	1350			

Line Frequency Submultiple.

In the LINE FREQ mode the stroboscopes will flash at the fundamental (3600 fpm) or a submultiple of the line frequency ($3600/2, 3600/3, \dots, 3600/n$ fpm — where $n \approx 20$) with an accuracy equal to that of the line ($\approx 0.1\%$). The stroboscopes automatically switches from one submultiple to another as the flash-rate control is varied over its range — the flash rate does not vary continuously.

You can see and hear the flash rate change for the first 6 submultiples. However, the following procedure is a more accurate method.

a. Perform steps a, c, d and e listed in the *Normal* procedure, except depress the LINE FREQ button in step d. Two images of the mark on the disc should be seen 180° apart, which represents the fundamental frequency.

b. Rotate the flash-rate control ccw until a single image appears. This represents the 1st submultiple of the line frequency (3600/2 or 1800 fpm).

c. Continue turning the flash-rate control until the double image reappears. This is the 2nd submultiple 3600/3 fpm or 1200 rpm). Each successive image will alternate between a single and double image down to approximately the 20th submultiple.

The line freq mode is useful for applications requiring better accuracy than obtainable in the normal mode. For example, use this mode to determine the slip speed of motors in accordance with IEEE 112A and 114 as follows:

a. Mark the end of the shaft of a 1750 rpm induction motor.

b. Set the stroboscopes to the first submultiple of the line frequency and direct the strobe light on the shaft.

c. Notice that the mark appears to rotate (slip); count the revolutions per minute to determine the slip speed. To determine the actual motor speed, subtract the slip speed from 1800 rpm.

External Sync.

The EXTERNAL SYNC feature of the stroboscope is especially valuable when the motion of the object being observed varies or is erratic and when synchronization is desired. A special trigger circuit eliminates trigger-rate problems when the input rate exceeds 3780 fpm by automatically dividing down to the next integral submultiple within the instrument range.

The GR 1544 Strobotac has 2 EXTERNAL SYNC modes (DIRECT and DELAY). In the DIRECT mode, the instrument responds directly to an external trigger connected via the rear panel. In the DELAY mode, the instrument also responds to an external trigger but there is always some

delay ($\approx 16-330$ ms) between the application of the external trigger and the resulting flash. The delay range is controlled by the flash-rate control.

If a contact-closure device is used to trigger the stroboscope, noise, due to contact bounce, may cause erratic flashing. The circuit design in this instrument is such that noise occurring up to 15 ms after the initial contact closure will be filtered out. Information on how to increase the time constant of this filter can be obtained from our service department by special request.

Following are procedures for using the EXTERNAL SYNC modes:

Ext Sync Direct. The disadvantage of the NORMAL and LINE FREQ mode is that the object being observed may change speed, which will require resetting the flash rate. A method of overcoming this problem is to use the object being observed to trigger the stroboscope as follows:

a. Depress the POWER and EXT SYNC DIRECT buttons.

b. Connect the GR 1536 Photoelectric Pickoff to the PHOTOELECTRIC PICKOFF jack.

c. Position the pickoff relative to the object being observed so that trigger pulses are generated. (Refer to the 1536 instruction sheet.)

d. Direct the stroboscope light on the point of interest. Figure 4 (a) shows an example of stopped motion using the EXT SYNC DIRECT procedure.

Ext Sync Delay. This mode is useful where it is desirable to see stroboscopically any point of interest in the cycle of the object being observed as follows:

a. Perform steps a-d of the EXT SYNC DIRECT procedure with one exception — depress the EXT SYNC DELAY button in place of DIRECT.

b. Set the flash-rate control fully cw and slowly turn the control ccw.

Notice that you can make the stopped image appear any place in the cycle (see Figure 4 a, b, and c).

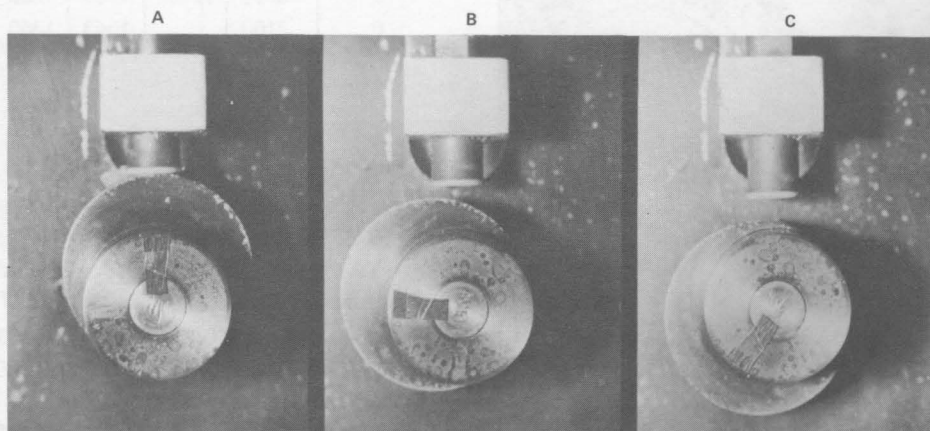


Figure 4. This sequence of photographs shows stopped images of a cam and follower. Positioning of the cam was accomplished by advancing the time-delay control to a new position for each photo.

NOTE

Be careful not to direct the stroboscope light at a reflective surface directly in front of the pickoff window. This causes erratic flashing in the DELAY mode only.

STROBES FOR PHOTOGRAPHERS.

GR stroboscopes are widely employed in single and multiframe photography. In general the camera used should have a "time" or "bulb" connection (for multiple exposure), an "X" synchronization connection (for single exposure), an adjustable aperture, a cable release, and a tripod mount. Polaroid film is recommended.

Following is a procedure for making a single-flash photograph using the EXT SYNC DIRECT mode:

- Find the guide number for the film speed used (see Figure 5).
- Measure the lamp-to-subject distance.
- Calculate the aperture setting using the following formula:

$$f/\text{number} = \frac{\text{Guide Number}}{1 + \text{lamp-to-subject distance (ft.)}}$$

- Adjust the camera aperture to the calculated setting.
- Depress the POWER and EXT SYNC DIRECT buttons of the stroboscope.
- Connect the CONTACT CLOSURE jack on the stroboscope to the shutter release on the camera. Use an adaptor cable with a standard, two-conductor phone plug on this end and the appropriate connector for the camera end.

The setup is now ready to make a single-exposure photograph.

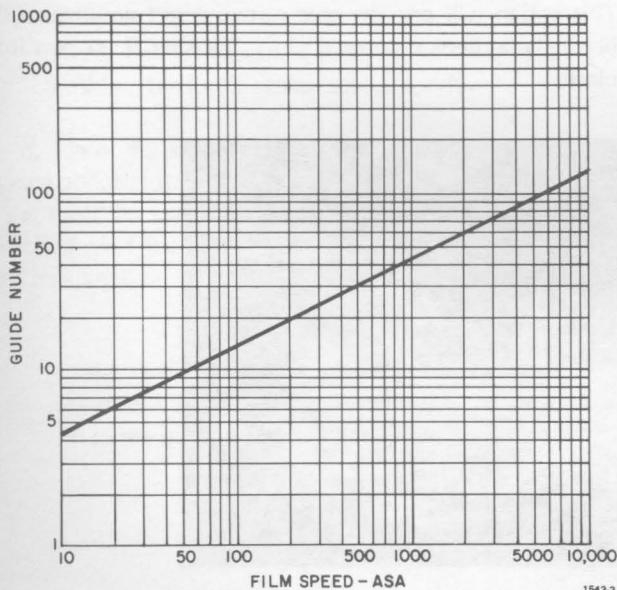


Figure 5. Guide-number chart.

Following is a procedure for making a multiple-exposure photograph using the LINE FREQ mode:

- Perform steps a and b of the single-flash procedure.
- Obtain the guide-number multiplier from Figure 6 and multiply it by the guide number.
- Calculate the aperture setting (with the formula in the single-flash procedure) using the corrected guide number. Adjust the camera accordingly.
- Estimate the strobe flash rate required to give the number of images desired and adjust the strobe accordingly.
- Adjust the camera shutter speed so that the shutter will remain open long enough for the desired number of images to be recorded on film.
- With the strobe flashing at the desired rate, release the shutter to take the multiframe photo.

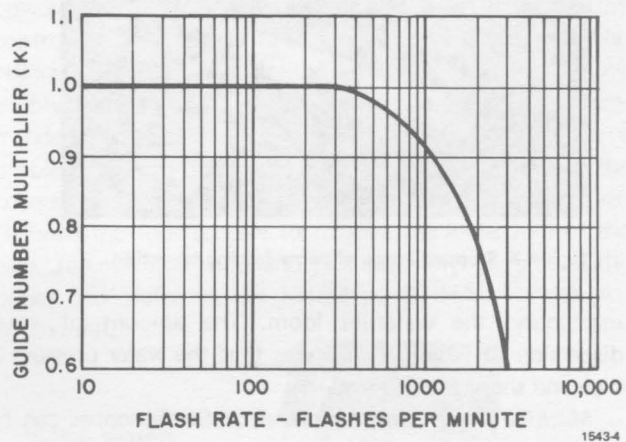


Figure 6. Guide-number correction for repetitive flashing.

OTHER APPLICATIONS.

Printing and Converting The operation of high-speed printing presses and converters can be checked easily by means of a strobe. Printing registration, ink or glue uniformity, water catch-up, and material stretch can all be checked without slowing or stopping the press. The strobe provides equally simple and valuable checks of other printing equipment such as folders (see Figure 7), blankers, box or bag making machinery, creasing and scoring equipment, coaters or laminators, slitters-rewinders, stitchers, and doctoring, embossing, and perforating equipment.

Textiles The high operating speeds in the textile industry make the strobe almost mandatory. Its versatility permits rapid checks on spindle operation, twist loss, travelers and twisters, pattern package, dobby head, harness cams and motion, shuttle flight and arm tension, boxing and picking, filling transfer and ringing-up bobbin ejection, hopper-stand setting, rapier action, filling transfer, and package in shuttleless looms, let-off and takeup, power-arm operation and adjustment, and condition, meshing, and running of gears.

The stroboscope has been successfully used to analyze the behavior of one of the newest pieces of textile

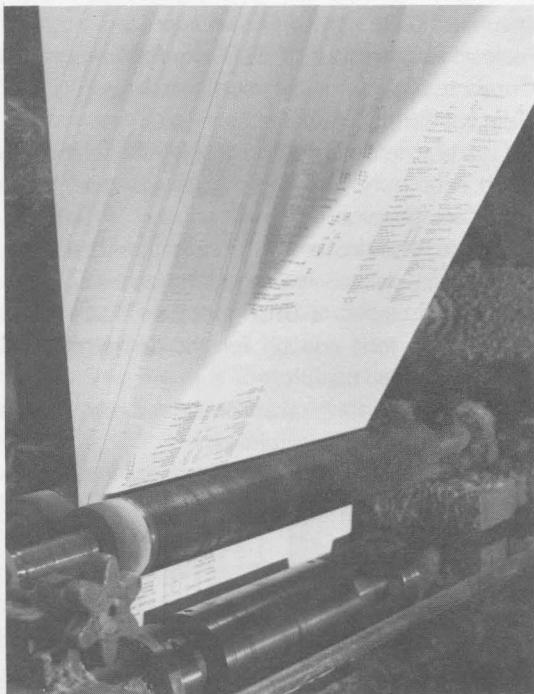


Figure 7. Stopped image of paper-folding operation.

machinery, the water-jet loom. The amount of water dispersion in Figure 8 indicates that the water pressure is high and should be reduced.

Machine Design and Maintenance Stroboscopes can be used to observe the slippage between two shafts or between a motor and belt, to measure motor slip speed in accordance with IEEE 112A and 114 (refer to the Line Frequency Submultiple paragraph), and to study the effects of cavitation on turbine blades or other hydraulic equipment. They can also be used in the design and checkout of appliances and production, handling, and packaging equipment or for studies of automobile wheel, motor, or chassis vibration.

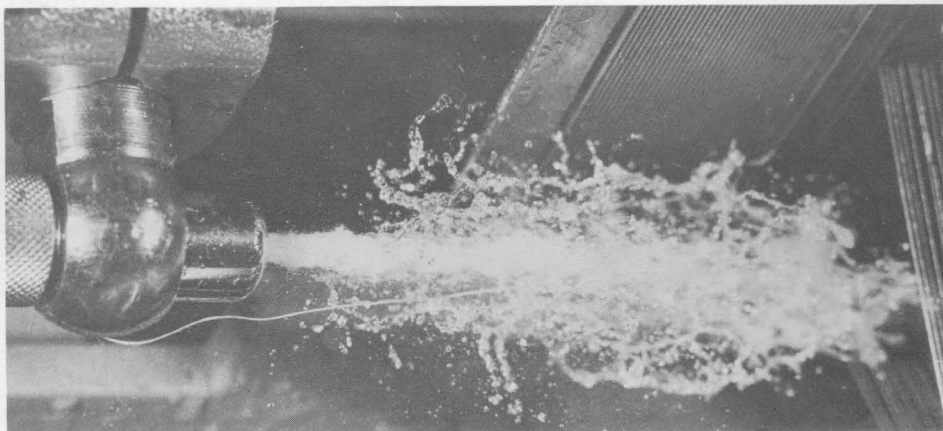


Figure 8. Stopped image of water-jet stream carrying filling to shed.

If you need more information, we have it in abundance: *A Primer of Stroboscopy* — free; a 20-page illustrated introduction to stroboscopy. *Using Stroboscopy* — free; a 16-page reprint with fundamental information on basic and advanced techniques of stroboscopy, especially the photographic aspects. *Strobotactics* — free; an informative periodic publication devoted to the latest techniques and instrumentation in the strobe field. *Handbook of High-Speed Photography* — \$1.00; a 92-page detailed discussion of strobe photography. The *Handbook of Stroboscopy* — \$2.00; a 117-page comprehensive work on stroboscopy tailored to your needs.

LAMP REPLACEMENT.

The following lamp-replacement procedure is recommended:

- a. Unplug the power cord.
- b. Loosen the case screws that are closest to the reflector by turning them 2 turns ccw.
- c. Insert the tip of a screwdriver blade in the reflector-cover slot shown in Figure 1.
- d. Snap the reflector cover out of the retaining slots by quickly rotating the screwdriver toward the rear of the instrument — do not be concerned about breaking the reflector cover.
- e. Carefully pull the lamp out of its socket.

To Install a Lamp:

- a. Insert the new lamp pins in the socket and carefully push the lamp inward until it seats firmly.
- b. Place one end of the reflector cover in the retainer slot in the bottom half of the case.
- c. Place the tip of a screwdriver blade in the other retainer slot.
- d. Rotate the screwdriver toward the reflector cover. This action will pry the case outward and simultaneously bend the reflector cover slightly, causing it to pop into place.

e. Check to see that the side panels are properly seated and then tighten the case screws.

f. Age the replacement lamp by operating the instrument for a minimum of one hour.

KNOB AND DIAL REMOVAL.

Use the following procedure to remove the FLASH RATE knob and dial:

a. Turn the knob ccw until the last mark on the low end of the dial aligns with the white mark on the case.

b. Grasp the knob firmly with the fingers close to the case and pull the knob straight away from the case — don't attempt to pry it off.

c. Remove the knob bushing by loosening the bushing setscrew with a 3/32-in. Allen wrench.

NOTE

To separate the bushing from the knob, if they should remain combined with the knob is removed, drive a machine tap a turn or two into the bushing to provide sufficient grip for easy separation.

d. Recheck the dial alignment and remove the dial by loosening its setscrew.

KNOB AND DIAL INSTALLATION.

To install a knob and dial assembly:

a. Place the dial on the larger shaft and align the marks mentioned in the removal procedure.

b. Tighten the dial setscrew.

c. Mount the knob bushing on the smaller shaft, keeping the end of the shaft flush with the outer surface of the bushing; tighten the setscrew.

NOTE

If the end of the shaft protrudes through the bushing, the knob cannot seat properly.

d. Place the knob on the bushing with the retention spring opposite the setscrew.

e. Push the knob in until it bottoms and pull it slightly to check that the retention spring is seated in the groove in the bushing.

NOTE

If the retention spring in the knob is loose, reinstall it in the interior notch with the small slit in the inner diameter of the wall.

ETCHED-BOARD MAINTENANCE.

(Figure 9)

WARNING

Potentially lethal voltages inside — this instrument should be serviced by skilled service personnel only.

The following procedure is recommended for opening the case:

a. Unplug the instrument *at least 3 minutes* before opening the case.

b. Remove the four case screws from the dial side of the instrument.

c. Separate the two halves of the case.

At this juncture the instrument comes apart with the power-supply board attached to the lower half and the control board attached to the upper half of the case. The reflector and backplate can be separated from the case by simply pulling them loose. Further disassembly is recommended for trained personnel only. However, once a problem has been isolated to a particular component, the covers will have to be removed to replace the component. Remove the four spacers to remove the lower half of the case; remove the knob and dial assembly to remove the upper half (refer to the KNOB AND DIAL REMOVAL procedure).

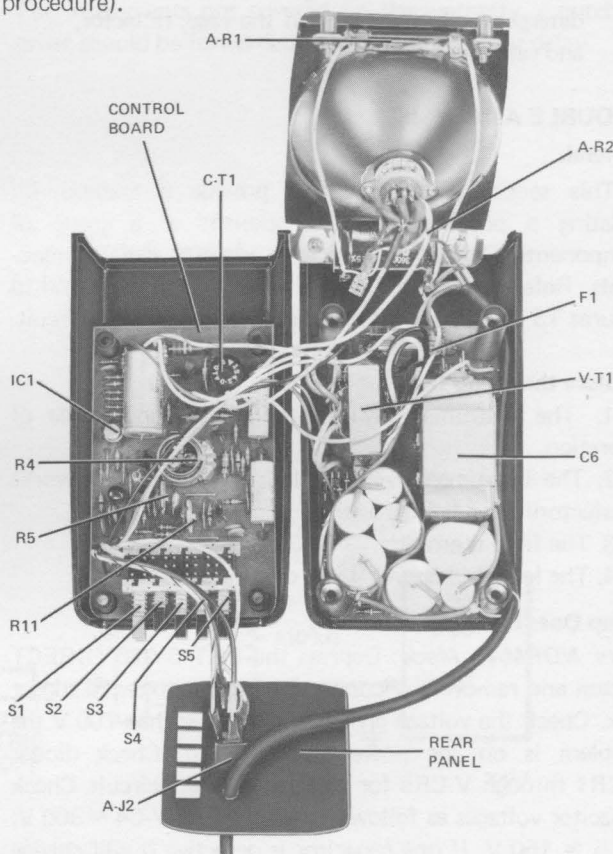


Figure 9. Interior view, showing the component side of the Control Board and the Power Supply Board.

Table 3
TEST EQUIPMENT

Item	Requirements	Recommended Type*
Oscilloscope	Dc to 450 kHz	Tektronix† 503
Photoelectric Pickoff	Operating rate: 63 pulses/s Requires: 3 to 25 V dc, 0 to 100 μ A	GR Type 1536
Battery	9 V	Burgess, 2U6
Isolation Transformer	115 V, 30 W	UTC Type R-72
Phone Jack	2 conductor	Littell-Jax Type 11
Resistor	100 k Ω , $\frac{1}{4}$ W	10% carbon
Multimeter	Measures resistance and dc voltage	Weston Analyzer Model 980

*or equivalent

†Reg. trademark, Tektronix Inc., Beaverton, Oregon

CLEANING.

CAUTION

Unplug the stroboscope 3 minutes before cleaning. Do not use an organic solvent. Use a damp NOT WET cloth or sponge with a mild soap or detergent solution to clean the case, reflector, and reflector cover.

TROUBLE ANALYSIS

General.

This section is intended to provide a method for isolating a problem to a component or a group of components. Refer to Figure 9 to identify major components. Refer to Figure 12 for a schematic diagram and to Figures 13 and 14 for a component layout of each circuit.

Replace the Lamp If:

1. The instrument will not flash on any mode of operation,
2. The instrument will not flash in the dark but works satisfactorily in a lighted area,
3. The flash is erratic,
4. The lamp holds over (i.e., continuous arc).

Lamp Does Not Flash:

In NORMAL Mode, Depress the EXT SYNC DIRECT button and remove any connections to the external trigger jack. Check the voltage on V-C6. If it is less than 700 V the problem is on the power-supply board. Check diodes V-CR1 through V-CR5 for an open or short circuit. Check capacitor voltages as follows: V-C1 through V-C4 \approx 300 V; V-C5 \approx 150 V. If one capacitor is defective it will change the voltage on all. The defective one will have the lowest voltage.

If the voltage on V-C6 is greater than 700 V, check the voltage at AT13 to be 150-180 V and AT17 25-35 V. If incorrect the following procedure is recommended:

- a. Depress the NORMAL button and check the voltage on C-C5 to be approximately 20 V.
- b. If the voltage is low, C-C5 may be defective; if it is missing C-VR1 may be short circuited.
- c. If the voltage in step b is present, check the anode of Q1 for a sawtooth signal of approximately 12 V. Replace Q1 if this signal is missing.
- d. If the signal in step c is present, check the anode of Q3 for a 150-V sawtooth signal. Replace Q6 if this voltage is low or missing. If the voltage is normal, the problem is in transformer T1.

In EXT SYNC DIRECT or LINE FREQ. If the instrument functions properly in NORMAL mode but not in EXT SYNC, check to see that the triggering device is functioning properly and that it is properly connected. If the problem still exists, trigger the instrument with a photoelectric pickoff and again with a contact closure. If it works satisfactorily with a contact closure but not with the pickoff, IC1 is probably defective.

If the strobe does not function properly with either input trigger device, depress the LINE FREQ button. Proper operation on this mode indicates that Q1 is defective; improper operation indicates that Q2 is defective.

In EXT SYNC DELAY. If the instrument functions properly in all other modes but fails in the EXT SYNC DELAY mode, check Q3, Q7, and Q8.

Instrument Blows Fuses.

If the stroboscope continuously blows fuses:

- a. Check the fuse value to be 1 A.
- b. Check for defective power supply components.

Calibration Procedure.

NOTE

The instrument should not have to be recalibrated unless it is damaged or a component has been replaced.

The recommended calibration procedure follows:

- a. Make the setup shown in Figure 10 and adjust the oscilloscope controls as follows:

TRIGGER SOURCE	INT
TRIGGER SLOPE	negative
SENSITIVITY	1V/CM
SWEEP TIME/CM	100 ms

- b. Set the flash-rate control to the maximum ccw position (min rpm). An oscilloscope pattern should be observed.

- c. Measure the period between the negative pulses generated by the photoelectric pickoff. It should be approximately 330 ms.

- d. Set the flash-rate control to the maximum cw position (max rpm) and again measure the period.

- e. Adjust R5 for $1/21^{\text{th}}$ of the period as measured in step d.

- f. Adjust R11 for a period of 16 ms.

The instrument is now calibrated to flash at rate of 180-3780 fpm.

WARRANTY.

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards, after examination by our factory, Regional Center, or authorized repair agency personnel, will be repaired or, at our option, replaced without charge, except for lamps that have given normal service.

FIELD SERVICE.

The two-year warranty stated above attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone our Service Department, giving full information of the trouble and of steps taken to remedy it. Be sure to mention the type number of the instrument.

Before returning an instrument to General Radio for service, please contact our Service Department or nearest Regional Center, requesting a "Returned Material" tag. Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

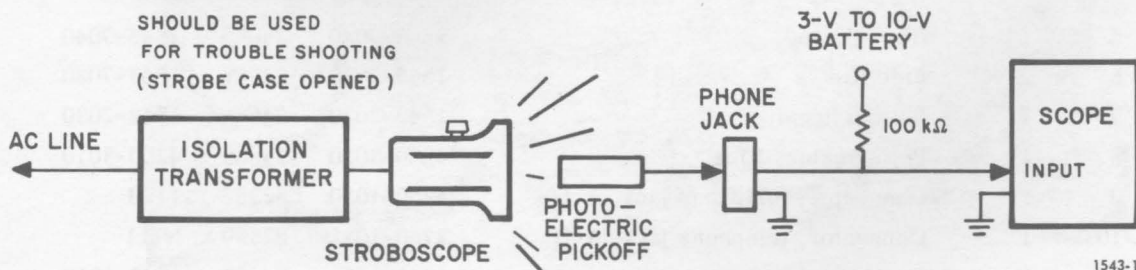


Figure 10. Calibration setup.

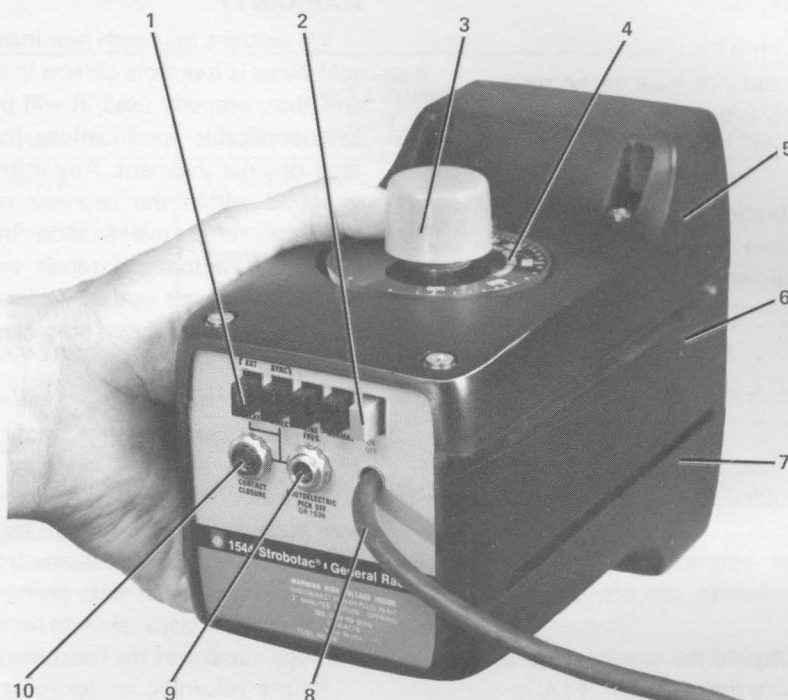


Figure 11. Mechanical parts — rear view.

MECHANICAL PARTS LIST

1544 STROBOSCOPE MECHANICAL PARTS LISTS

Fig Ref	Qnt	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
1	4	Pushbutton knob, black	0861-5988	71590	J52305
2	1	Pushbutton knob, gray	0861-5987	71590	J52304
3	1	Knob asm., inc. fastener	5520-5420	24655	5520-5420
4	1	Dial asm., FLASHES PER MINUTE (APPROX)	1543-1030	24655	1543-1030
5	1	Top housing	1543-7040	24655	1543-7040
6	2	Side pan	1543-7020	24655	1543-7020
7	1	Bottom housing	1542-2030	24655	1542-2030
8	1	Power cable, 10 ft.	4200-3010	24655	4200-3010
9	1	Connector, telephone jack, A-J2	4260-1050	82389	112B
10	1	Connector, telephone jack, A-J1	4260-1031	82389	N111
-	1	Stand asm	1543-1010	24655	1543-1010
-	1	Reflector cover	1543-8000	24655	1543-8000

ELECTRICAL PARTS LIST

1544 STROBOSCOPE (1544-4710 POWER SUPPLY BOARD V)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
CAPACITORS					
C1	Elect., 7 μ F +150-10% 375 V	4450-6168	90201	7 μ F +150-10%	
C2	7 μ F \pm 20% 375 V	1543-0420	24655	1543-0420	
C3 and					
C4	Elect., 35 μ F +150-10% 375 V	4450-6166	90201	20/000046339/01/00	
C5	Elect., 80 μ F +150-10% 200 V	4450-6167	90201	80 μ F +150-10%	
C6	Paper 2 μ F \pm 10% 1000 V	1543-0400	24655	1543-0400	
C7	Elect., 35 μ F +150-10% 200 V	4450-6154	83740	E, 35 μ F +150-10%	
C8	Elect., 495 μ F +150-10% 35 V	4450-6135	90201	20/000043910-01-01	
DIODES					
CR1 thru CR13		6081-1002	09213	1N3254	5961-082-3988
FUSES					
F1	1A Slo-Blo	5330-1400	82647	M20100L17-32	
RESISTORS					
R1	Comp., 1 M Ω \pm 5% 1/2 W	6100-5105	01121	RC20GF105J	5905-192-0390
R2	Comp., 15 k Ω \pm 5% 1/2 W	6120-3155	01121	RC42GF153J	5905-171-1976
R3	Comp., 27 Ω \pm 5% 2 W	6120-0275	01121	RC42GF270J	5905-279-1747
TRANSFORMERS					
T1		1544-0400	24655	1544-0400	

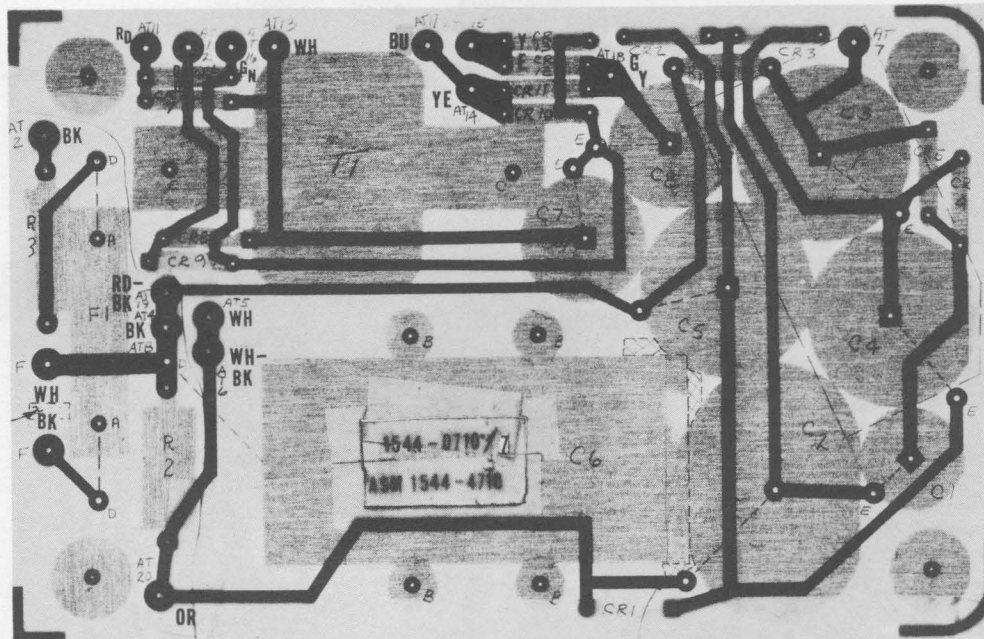


Figure 12. Power supply circuit-etched circuit diagram (P/N 1544-4710)

NOTE: Orientation: Viewed from foil side. Part number: Refer to caption. Symbolism: Outlined area = part; gray ckt pattern (if any) = parts side, black = other side. Pins: Square pad in ckt pattern = collector, I-C pin 1, cathode (of diode), or + end (of capacitor).

ELECTRICAL PARTS LIST

1544 STROBOSCOPE (1544-4700 CONTROL BOARD C)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
CAPACITORS					
C1	Mylar, .33 μ F $\pm 10\%$ 100 V	4860-7989	84411	663W, .33 μ F $\pm 10\%$	
C2 and					
C3	Ceramic, .01 μ F +80-20% 100 V	4401-3100	80131	CC61, .01 μ F +80-20%	5910-974-5694
C4	Mylar, .2 μ F $\pm 10\%$ 200 V	4860-7948	84411	663W, .2 μ F $\pm 10\%$	
C5	Elect., .495 μ F +150-10% 35 V	4450-6135	90201	20/000043910-01-01	
C6	Ceramic, .01 μ F +80-20% 100 V	4401-3100	80131	CC61, .01 μ F +80-20%	5910-974-5694
C7 and					
C8	Ceramic, 10000 pF +80-20% 500 V	4406-3109	72982	811, .01 μ F +80-20%	5910-977-5779
C9	Tantalum, 1.0 μ F $\pm 20\%$ 35 V	4450-4300	56289	150D105X0035A2	
C10 and					
C11	Ceramic, .01 μ F +80-20% 100 V	4401-3100	80131	CC61, .01 μ F +80-20%	5910-974-5694
C12 and					
C13	Ceramic, .01 μ F +80-20% 100 V	4401-3100	80131	CC61, .01 μ F +80-20%	5910-974-5694
CONNECTORS					
A-J1	Jack	4260-1031	82389	N111	
A-J2	Jack	4260-1050	82389	112B	
DIODES					
CR1	Type 1N3668	6083-1018	24446	1N3668	
CR6	Type 1N4009	6082-1012	24446	1N4009	5961-892-8700
CR11	Type 1N3254	6081-1002	09213	1N3254	5961-082-3988
CR12 thru					
CR18	Type 1N4009	6082-1012	24446	1N4009	5961-892-8700
INTEGRATED CIRCUITS					
IC1	Linear	5432-1004	12040	LM301A	
RESISTORS					
R1	620 Ω , $\pm 5\%$ 1/4 W	6099-1625	75042	BTS, 620 Ω $\pm 5\%$	
R2	3 k Ω , $\pm 5\%$ 1/4 W	6099-2305	75042	BTS, 3 k Ω $\pm 5\%$	
R3	43 k Ω $\pm 5\%$ 1/4 W	6099-3435	75042	BTS, 43 k Ω $\pm 5\%$	
R4	Comp. Dual Sht Pc, 1.0 M Ω $\pm 10\%$	6045-0440	01121	JT, 1.0 M Ω $\pm 10\%$	
R5	Comp., PC 10 k Ω $\pm 30\%$	6049-0336	71450	X-201	
R6	100 k Ω $\pm 5\%$ 1/4 W	6099-4105	75042	BTS, 100 k Ω $\pm 5\%$	
R7	10 Ω $\pm 5\%$ 1/4 W	6099-0105	75042	BTS, 10 Ω $\pm 5\%$	5905-809-8596
R8	1 M Ω $\pm 5\%$ 1/4 W	6099-5105	75042	BTS, 1 M Ω $\pm 5\%$	
R9	51 Ω $\pm 5\%$ 1/4 W	6099-0515	75042	BTS, 51 Ω $\pm 5\%$	
R10	3.6 k Ω $\pm 5\%$ 1/4 W	6099-2365	75042	BTS, 36 k Ω $\pm 5\%$	
R11	Comp. Pc 2.5 k Ω $\pm 30\%$	6049-0330	71450	X-201	
R12	6.8 k Ω $\pm 5\%$ 1/4 W	6099-2685	75042	BTS, 6.8 k Ω $\pm 5\%$	
R13 thru					
R15	5.6 k Ω $\pm 5\%$ 1/4 W	6099-2565	75042	BTS, 5.6 k Ω $\pm 5\%$	
R16	10 k Ω $\pm 5\%$ 1/4 W	6099-3105	75042	BTS, 10 k Ω $\pm 5\%$	
R17	1 K $\pm 5\%$ 1/4 W	6099-2105	75042	BTS, 1 K $\pm 5\%$	
R18	5.1 k Ω $\pm 5\%$ 1/4 W	6099-2515	75042	BTS, 5.1 k Ω $\pm 5\%$	
R19	510 k Ω $\pm 5\%$ 1/4 W	6099-4515	75042	BTS, 510 k Ω $\pm 5\%$	
R20	300 Ω $\pm 5\%$ 1/4 W	6099-1305	01121	RC20GF301J	5905-279-5481
R21	510 k Ω $\pm 5\%$ 1/4 W	6099-4515	75042	BTS, 510 k Ω $\pm 5\%$	
R22 and					
R23	2.4 k Ω $\pm 5\%$ 1/4 W	6099-2245	75042	BTS, 2.4 k Ω $\pm 5\%$	
R24	10 k Ω $\pm 5\%$ 1/4 W	6099-3105	75042	BTS, 10 k Ω $\pm 5\%$	
R25	1 k Ω $\pm 5\%$ 1/4 W	6099-2105	75042	BTS, 1 k Ω $\pm 5\%$	
R26	10 Ω $\pm 5\%$ 1/4 W	6099-0105	75042	BTS, 10 Ω $\pm 5\%$	5905-809-8596

ELECTRICAL PARTS LIST (Cont.)

1544 STROBOSCOPE (1544-4700 CONTROL BOARD C)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (Cont.)					
R27	2.4 k Ω \pm 5% 1/4 W	6099-2245	75042	BTS, 2.4 k Ω \pm 5%	
R28	27 k Ω \pm 5% 1 W	6110-3275	75042	BTS, 27 k Ω \pm 5%	
R29 thru					
R31	20 k Ω \pm 5% 1/4 W	6099-3205	75042	BTS, 20 k Ω \pm 5%	
R32	100 Ω \pm 5% 1/2 W	6100-1105	01121	RC20GF101J	5905-190-8889
R33 thru					
R36	10 k Ω \pm 5% 1/4 W	6099-3105	75042	BTS, 10 k Ω \pm 5%	
R37	300 Ω \pm 5% 1/4 W	6099-1305	01121	RC20GF301J	5905-279-5481
R38	5.1 k Ω \pm 5% 1/4 W	6099-2515	75042	BTS, 5.1 k Ω \pm 5%	
R39	10 k Ω \pm 5% 1/4 W	6099-3105	75042	BTS, 10 k Ω \pm 5%	
R40	10 Ω \pm 5% 1/4 W	6099-0105	75042	BTS, 10 Ω \pm 5%	5905-809-8596
R41	510 k Ω \pm 5% 1/2 W	6100-4515	75042	BTS, 510 k Ω \pm 5%	
SWITCHES					
	Pushbutton, Mult. 5 Sec	7880-2021	71590	PB-15	
TRANSFORMERS					
T1		1542-0410	24655	1542-0410	
TRANSFORMERS					
Q1		8210-1096	07263	2N3638	5961-912-9008
Q2		8210-1092	24454	2N3391A	
Q3 and					
Q4		8210-1047	24446	2N3414	5961-989-2749
Q5		8210-1210	17856	D13T1	
Q6		8210-1215	25227	RTJ0220	
Q7 and					
Q8		8210-1047	24446	2N3414	5961-989-2749

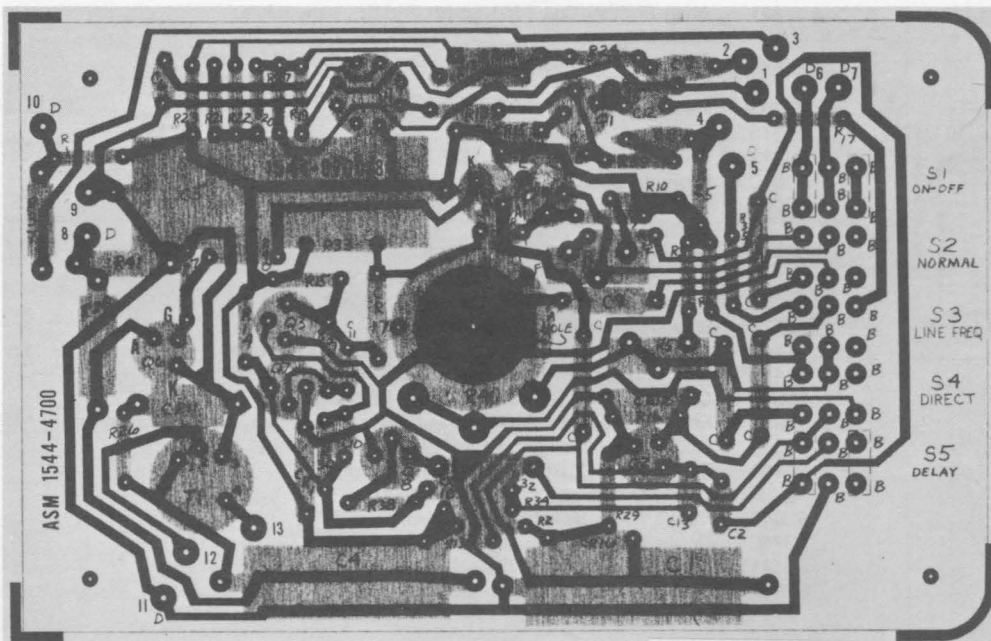


Figure 13. Control circuit-etched circuit diagram
(P/N 1544-4700).

NOTE: Orientation: Viewed from foil side. Part number: Refer to caption. Symbolism: Outlined area = part; gray ckt pattern (if any) = parts side, black = other side. Pins: Square pad in ckt pattern = collector, I-C pin 1, cathode (of diode), or + end (of capacitor).

ASSEMBLY PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
CAPACITORS				
A-C1 thru				
A-C6	Ceramic, 22 pF $\pm 20\%$ 4000 V	4428-3116	72982	858, 22 pF $\pm 20\%$
CONNECTORS				
P1	Mult Plug, 4 Contact	4220-4154	00779	1-480426-0
A-J1	Jack	4260-1031	82389	N111
A-J2	Jack	4260-1032		
POWER CORDS				
	Cable Power, Bk, 10 ft	4200-3010	24655	4200-3010
RESISTORS				
A-R1	Pwr, WW, 3.6 k Ω $\pm 5\%$ 40 W	6631-2365	80131	RW21, 3.6 k Ω $\pm 5\%$
A-R2	Pwr, WW, 3.6 k Ω $\pm 5\%$ 40 W	6631-2365	80131	RW21, 3.6 k Ω $\pm 5\%$
SOCKETS				
A-SO1	Tube, 9 Contacts	7540-3500	07233	121-11-10-026
TUBES				
A-V1	Strobotron	1530-9410	24655	1530-4010

FEDERAL MANUFACTURER'S CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1
(Name to Code) and H4-2 (Code to Name) as supplemented through August, 1968

Code	Manufacturer
00779	Amp Inc., PO Box 3608, Harrisburg, Pa., 17105
01121	Allen-Bradley Co., 1201 South 2nd St., Milwaukee, Wisc. 53204
07233	Cinch-Graphik, Div. of United Car Inc., City of Industry, Calif.
07263	Fairchild Camera, Mountain View, Calif.
07910	Cont Device Corp, Hawthorne, Calif.
09213	G.E. Semiconductor, Buffalo, N.Y.
12040	National Semiconductor, Danbury, Conn.
12065	Transition Electronic Corp., 144 Addison St., E. Boston, Mass.
24446	G.E., Schenectady, N.Y. 12305
24454	G.E., Electronics Comp., Syracuse, N.Y.
24655	General Radio Co., Concord, Mass. 01742
56289	Sprague Electric Co., N. Adams, Mass.
71400	Bussman (McGraw Edison), St. Louis, Mo.
71450	CTS Corp., 1142 W. Beardsley Ave., Elkhart, Ind. 46514
71590	Centralab, Inc., Milwaukee, Wisc., 53212
72982	Erie Technological Products Inc., Erie, Penn.
75042	IRC Inc, Philadelphia, Penn. 19108
80131	Electronic Industries Assoc., Washington, D.C.
82389	Switchcraft Inc., Chicago, Ill. 60630
82647	Metals & Controls Inc, Attleboro, Mass.
83740	Union Carbide Corp., New York, N.Y. 10017
84411	TRW Capacitor Div., Ogallala, Nebr.
90201	Mallory Capacitor Co., Indianapolis, Ind.

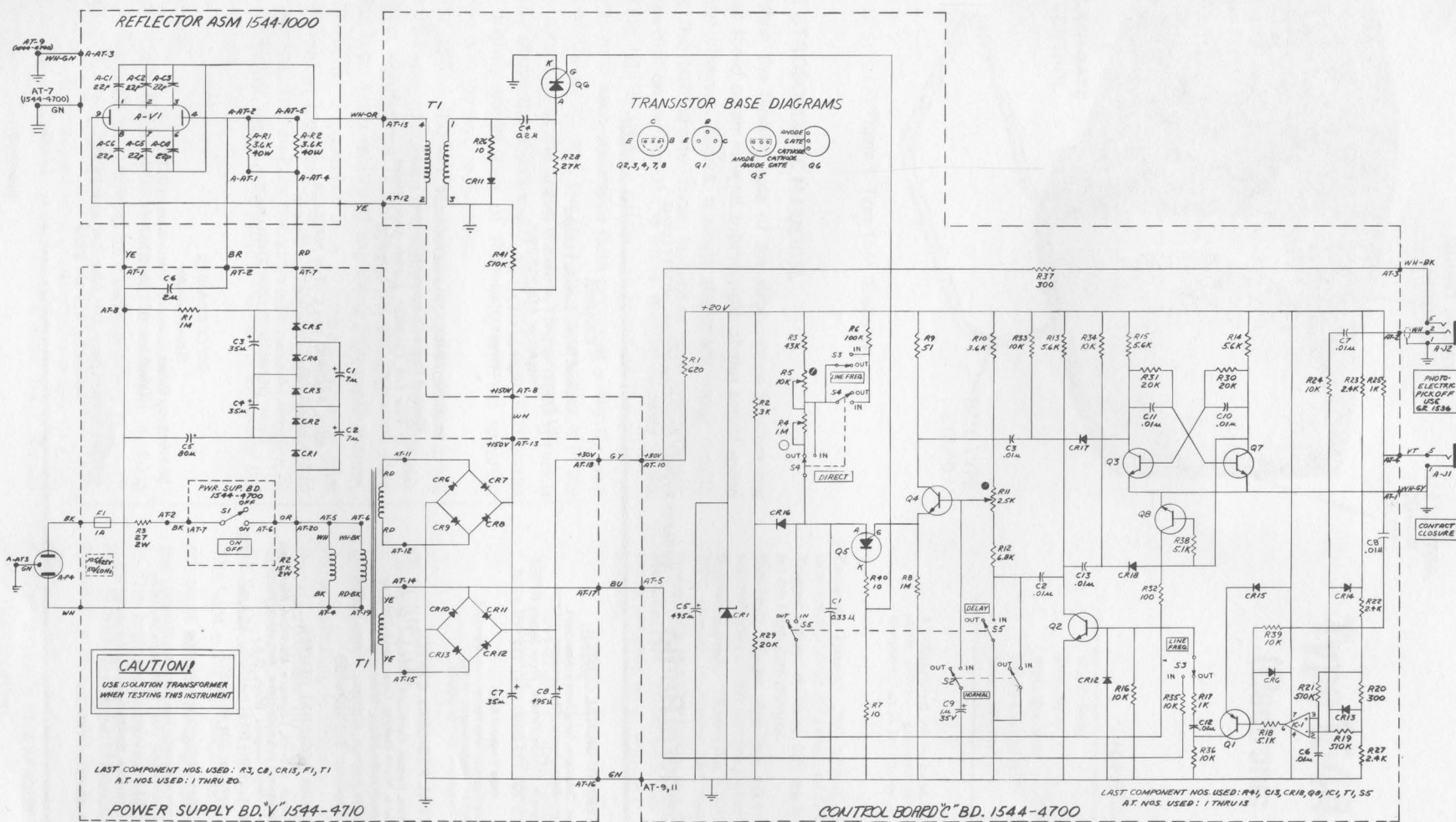


Figure 14. Type 1544 Strobotac schematic diagram.



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