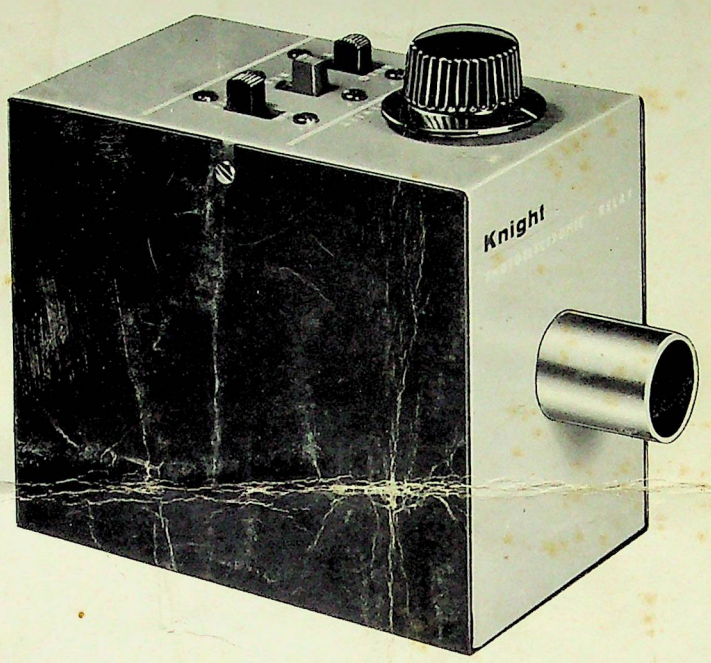


PHOTOELECTRONIC RELAY

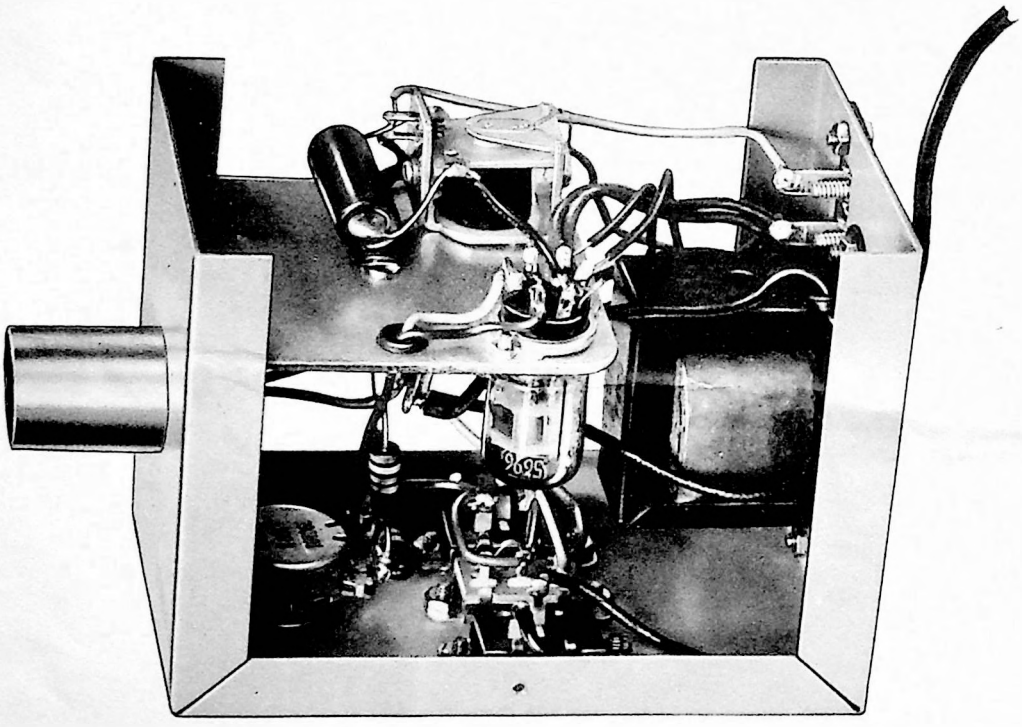
83 Y 702

ASSEMBLY MANUAL

A PRODUCT OF ALLIED RADIO · CHICAGO

knight-kit

PHOTOELECTRONIC RELAY



SPECIFICATIONS

RELAY:	Single pole, double throw. Maximum contact rating 1 ampere at 28 VDC. AC rating is about 50 V at 1.5 ampere into a non-inductive load.
ABSOLUTE SENSITIVITY:	250 milli-foot-candles
RELIABLE OPERATING DISTANCE WHEN USED WITH KNIGHT-KIT LIGHT SOURCE:	
NO FILTER	250 feet
RED FILTER	125 feet
MAXIMUM COUNTING RATE:	600 counts per minute
POWER AVAILABLE FOR OPERATING AN ALARM OR OTHER INDICATOR:	6.3 VAC at 0.6 amperes
TUBE COMPLEMENT:	5696 thyratron
PHOTO-CELL:	CL-3 cadium selenide
POWER REQUIREMENTS:	105 to 120 VAC, 60 cycles
POWER CONSUMPTION:	3 watts
DIMENSIONS:	5 x 3 x 5"
SHIPPING WEIGHT:	2½ lbs.

INTRODUCTION

The KNIGHT-KIT Photoelectronic Relay is an extremely sensitive electronically operated relay. By interrupting a beam of light, the relay can be used to actuate various electrical devices or controls. It will also operate from sources of light energy other than from the Light Source, such as daylight, incandescent or fluorescent room illumination, and radiant energy from molten metals.

CHECKING YOUR KIT

Before starting to build your Photoelectronic Relay, check each part against the parts list on page 15. This will help you to become acquainted with each part. If you are unable to identify some parts by sight, locate their pictures on the wiring diagrams.

CONSTRUCTION HINTS

The only tools necessary for building your Photoelectronic Relay are: A pair of long-nose, side-cutting pliers, a screwdriver, a setscrew driver, and a soldering iron. An additional tool that simplifies construction is a pair of diagonal cutters.

Study the pictorial diagrams and note how the parts are mounted. These pictorial diagrams show the actual location of all parts and wires. The schematic diagram shows how the parts are connected electrically and is helpful in understanding how the circuit works.

We recommend that the step-by-step instructions be followed exactly. DO NOT wire this kit from the pictorials or schematic alone as it must be assembled and wired in a definite sequence. Occasionally, several parts are mounted with the same hardware so be sure that you read each step all the way through before you do it.

Space is provided, for your convenience, to check off each step after you have completed it.

WIRING HINTS

Improperly soldered connections are often the cause of poorly functioning or inoperative equipment. A little care taken in wiring and soldering will be well rewarded with a professional looking and operating instrument. For this reason, we urge you to read the following paragraphs before proceeding with the assembly of your Photoelectronic Relay.

When connecting wires to a terminal, bend the end of the wire around the terminal and clamp it tightly with long-nose pliers. See Figure 1. This assures a good mechanical connection. Solder must not be used to supply mechanical strength—its only purpose is to assure a good electrical connection between two conductors.

The proper way to connect a component is illustrated in Figure 1. Pull the end leads of the part being mounted through the holes in the mounting terminals so that the part is tightly mounted. After the part is mounted, bend its leads around the mounting terminals and cut off the excess wire.

Leads on resistors, capacitors, and transformers are usually longer than needed. These leads should be cut to the proper length when the parts are wired in place. This will result in better operation and neater appearance.

Follow the pictorial diagrams closely. The unit will work best with the parts positioned as shown.

The soft tubing supplied is called "spaghetti." Spaghetti is used to cover the bare end leads of some of the parts. Whenever it is necessary to use some of this spaghetti, the exact length is given. The spaghetti must cover the entire lead where there is a chance it will touch another lead, a connection, or the chassis.

THIS KIT MUST BE *PROPERLY* SOLDERED!

WITHOUT GOOD SOLDERING, AN ELECTRONIC UNIT WILL NOT WORK . . . just as a suit of clothing will fall apart if the stitches are loose . . . no matter how excellent the material.

USE ENOUGH HEAT

This is the main idea of good soldering. The purpose of soldering is to join metal parts, making an UNBROKEN metal path over which electricity can travel. To do this you must apply enough heat to the metal surfaces to make the solder spread freely on them, until the contour (shape) of the connection shows under the solder. If the solder barely melts and forms a rounded ball, *you are not using enough heat*. If you do not use enough heat, there may be no electrical connection, although it appears soldered.

USE A 100-WATT IRON

A 100-watt soldering iron with a clean, chisel-shaped tip will supply the right amount of heat when used correctly. Notice how the iron is held in the picture. Heat the iron for 10 minutes before you start soldering. Keep the tip brightly coated with solder. When necessary, wipe the hot tip clean with a cloth. (If you use a soldering gun, be sure the tip reaches full heat before you solder.)

USE ONLY ROSIN CORE SOLDER

We supply the right kind of solder *(rosin core solder)* Do not use any other kind of solder! USE OF ACID CORE SOLDER, PASTE, OR IRONS CLEANED ON A SAL AMMONIAC BLOCK WILL RUIN ANY ELECTRONIC UNIT AND WILL VOID THE GUARANTEE.

HERE'S HOW TO DO IT . . .

1. Join bare metal to bare metal. Insulation must be removed.
2. Coat the tip of a hot iron with solder.
3. FIRMLY PRESS THE FLAT SIDE OF THE TIP OF A HOT IRON FLAT against the parts to be soldered together. Keep it there while you apply the solder BETWEEN THE IRON TIP AND THE METAL TO BE SOLDERED. Use only enough solder for it to flow over ALL the surfaces of the connection. Remove the iron.
4. DO NOT MOVE PARTS UNTIL THE SOLDER HARDENS. If you accidentally move the wires as the solder is hardening, apply your iron and reheat.

Compare your soldering with the pictures on this page. You have a good connection if your solder has flowed over all surfaces to be connected, following the shape of the surfaces. It should appear smooth and bright.

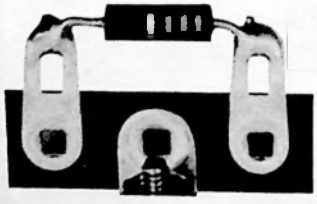
YOU HAVE NOT USED ENOUGH HEAT: If your connection is rough and flaky-looking, or if the solder has formed a round ball instead of spreading.

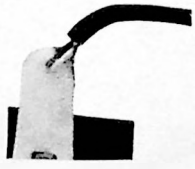
The difference between good soldering (enough heat) and poor soldering (not enough heat,) is just a few extra seconds with a hot iron FIRMLY applied. Remember, larger metal surfaces take a longer time to heat.

1. Join bare metal to bare metal

2. Press FLAT side of a HOT iron

3. Apply solder BETWEEN iron and connection





Compare your soldering with these pictures.

FIGURE 1. THE ONE-TWO-THREE OF GOOD SOLDERING.

HOW TO CARE FOR YOUR SOLDERING IRON

Your soldering iron is the key to good soldering since it supplies the essential ingredient—HEAT. If the tip is covered by a dirt (oxide) film, the iron will not be able to transfer its full heat. A new tip can be protected from film by coating it with solder the first time it is heated. An old tip should first be cleaned with a file until bare copper is exposed. Then solder-coat it like a new tip.

Never use the iron like a brush—soldering is not a paste-spreading operation. To get the most heat out of the iron, always press the iron firmly to the connection. Hold it so the greatest tip surface is directly in contact with the connection.

PARTS MOUNTING

SEE FIGURE 2.

So that you will be able to identify the screws during assembly, separate them into four groups. There are seven 6-32 x ¼" long, six 4-36 x ⅜" long, two 3-48 x ⅜" long, and two self-tapping #4 x ¼" long screws supplied with your Photoelectronic Relay Kit. It is important that you use the screws as stated in the instructions.

☑ Mount S-1, the ON-OFF slide switch. Position the terminals as shown in Figure 2. Use two 4-36 x ⅜" screws, small lockwashers, and matching nuts to mount S-1.

☑ In a similar manner, mount S-3, the spring return switch. Be sure to position the terminals as shown.

☑ Following the above instructions, mount S-2, the remaining slide switch.

☑ Mount R-4, the 100KΩ SENSITIVITY control, following the assembly instructions shown in Figure 3. Position the terminals of R-4 as shown in Figure 2.

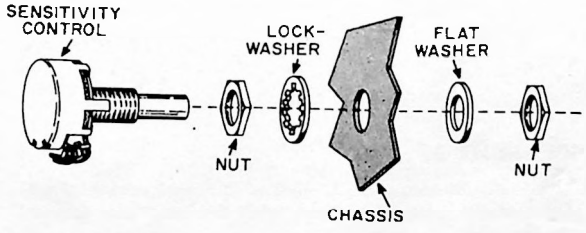


FIGURE 3. MOUNTING THE SENSITIVITY CONTROL

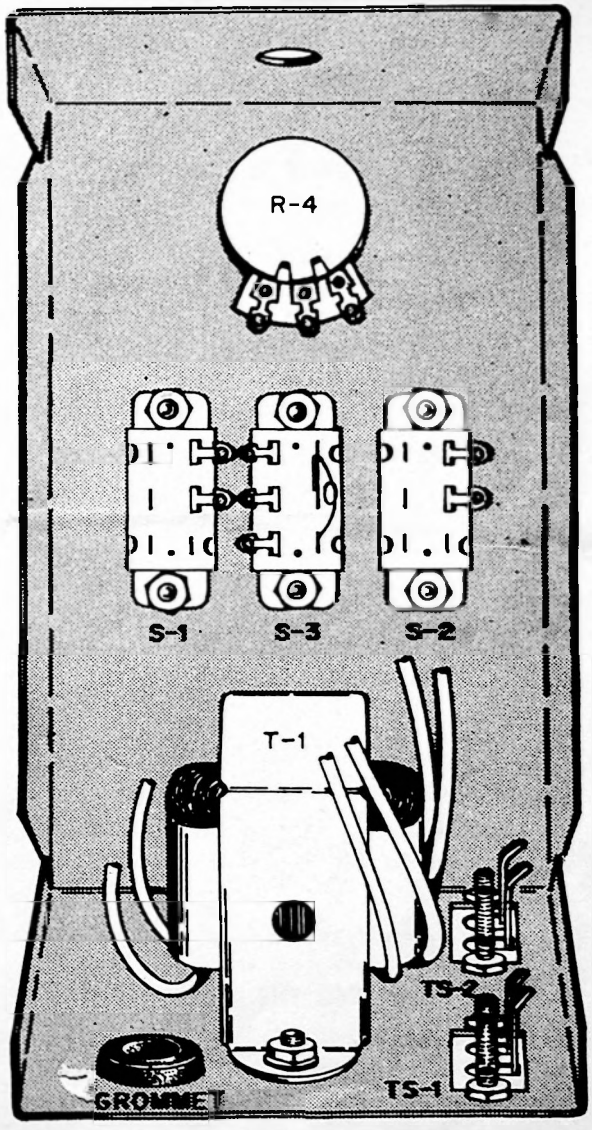
Note: TS-2 and TS-1 must be mounted FROM OUTSIDE the chassis.

☑ From the outside of the chassis, mount TS-2, a 2-screw terminal strip, with two 6-32 x ¼" screws, medium lockwashers, and matching nuts.

☑ In a similar manner, mount TS-1, the other 2-screw terminal strip.

☑ Mount T-1, the power transformer, with two 6-32 x ¼" screws, medium lockwashers, and matching nuts. The side with the two green and two red leads go next to the terminal strips.

☑ Install the large grommet.



MOUNT TS-1 AND TS-2 FROM OUTSIDE THE CHASSIS

FIGURE 2. PARTS MOUNTING INSIDE THE CHASSIS

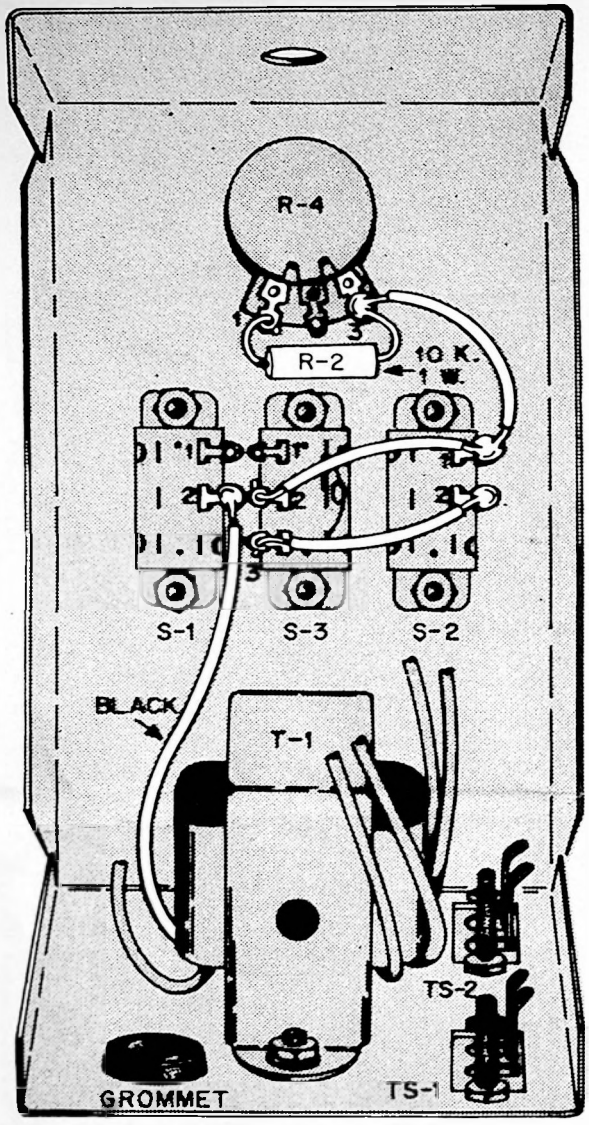


FIGURE 4. WIRING INSIDE THE CHASSIS

WIRING THE CHASSIS

SEE FIGURE 4.

- ☑ Connect, but do not solder, one lead of R-2, a 10KΩ 1 watt resistor marked with the color bands brown, black, orange, to terminal 1 of R-4. Connect, but do not solder, the other lead to terminal 3 of R-4.
- ☑ Solder one end of a red wire to terminal 3 of R-4. Connect, but do not solder, the other end to terminal 1 of S-2.
- ☑ Solder one end of a red wire to terminal 1 of S-2. Connect, but do not solder, the other end to terminal 2 of S-3.
- ☑ Solder one end of a red wire to terminal 2 of S-2. Connect, but do not solder, the other end to terminal 3 of S-3.
- ☑ Solder one of the black leads of T-1 to terminal 2 of S-1.

MOUNTING PARTS ON THE SUB-CHASSIS

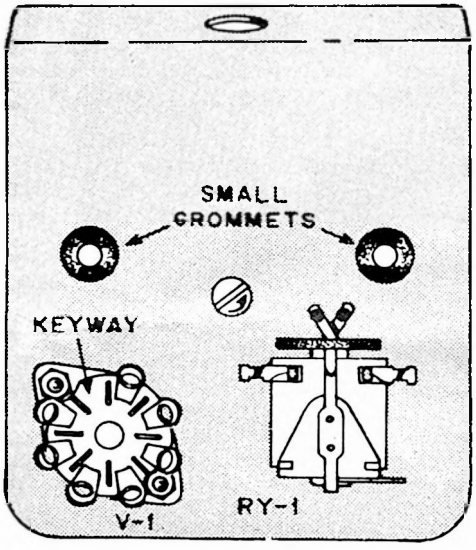


FIGURE 5. MOUNTING PARTS ON THE SUB-CHASSIS

SEE FIGURE 5.

The sub-chassis is an L-shaped piece of metal. Position it on the table like a tent, with the large side toward you.

- ☑ Mount RY-1, the relay, to the sub-chassis using the lockwasher and nut supplied with the relay.
- ☑ Mount the tube socket for V-1 to the sub-chassis. Position the keyway, the wide space between two of the pins, as shown. Use the two 3-48 x 3/8" screws and matching nuts to mount the socket.
- ☑ Install the two small grommets.
- ☑ Turn the sub-chassis over so that the large side lies flat on the table, as in Figure 7. Mount TS-3, a 5-terminal strip.

WIRING THE SUB-CHASSIS

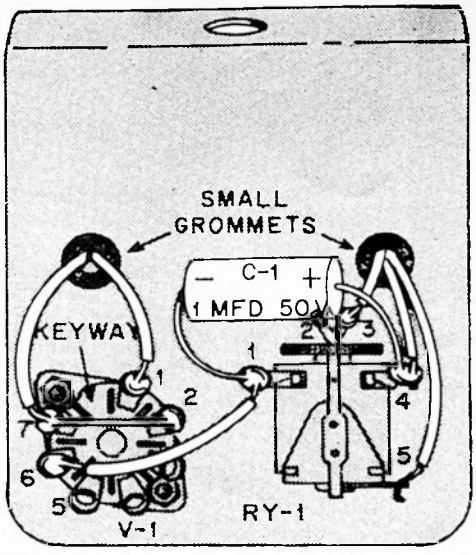


FIGURE 6. WIRING THE TOP OF THE SUB-CHASSIS

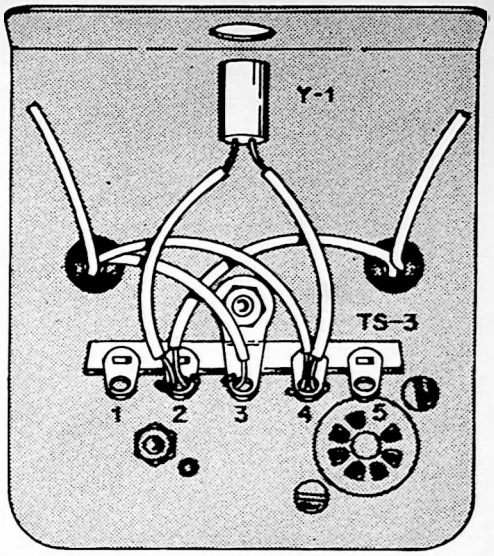


FIGURE 7. WIRING THE BOTTOM OF THE SUB-CHASSIS

SEE FIGURES 6 AND 7.

☑ Connect, but do not solder, the positive (+) lead of C-1, the 1 μfd 50 V electrolytic capacitor, to terminal 4 of RY-1. Solder the other lead of C-1 to terminal 1 of RY-1, leaving enough lead length to reach pin 6 of V-1. Then, place a 1" piece of spaghetti (the soft tubing supplied) on this lead. Solder this lead to pin 6 of V-1. Be sure the leads of C-1 clear the edge of the chassis.

☑ Solder one end of a yellow wire to pin 1 of V-1. Push the other end through the small grommet near V-1. Turn the sub-chassis over and connect, but do not solder, the other end to terminal 2 of TS-3.

☑ Remove about ¼" more of insulation from one end of a green wire. Thread this end through pin 7 of V-1, and then solder it to pin 2 of V-1. Solder pin 7 of V-1. Push the other end through the grommet near V-1. It will be connected later.

☑ Connect, but do not solder, one end of a yellow wire to terminal 5 of RY-1. Push the other end through the grommet near RY-1. Turn the sub-chassis over, and connect, but do not solder, the other end to terminal 3 of TS-3.

☑ Solder one end of a yellow wire to terminal 4 of RY-1. Push the other end through the grommet near RY-1, and then connect, but do not solder, it to terminal 4 of TS-3.

☑ Solder one end of a green wire to terminal 3 (lower terminal) of RY-1. Push the other end through the grommet near RY-1. It will be connected later.

SEE FIGURE 7.

☑ Put a 1½" piece of spaghetti on each lead of Y-1, the photo-cell. Connect, but do not solder, one lead of the photo-cell to terminal 2 of TS-3. Connect, but do not solder, the other lead to terminal 4 of TS-3.

ATTACHING THE SUB-CHASSIS TO THE MAIN CHASSIS

REFER TO FIGURES 8 AND 9.

☑ Attach the sub-chassis to the main chassis. Place the sub-chassis into the main chassis as shown in Figure 8. Then from the inside of the chassis, insert the retainer bushing through the holes in the main chassis and the sub-chassis. Now, screw the light shade on tightly.

☑ Insert Y-1, the photo-cell, into the retainer bushing.

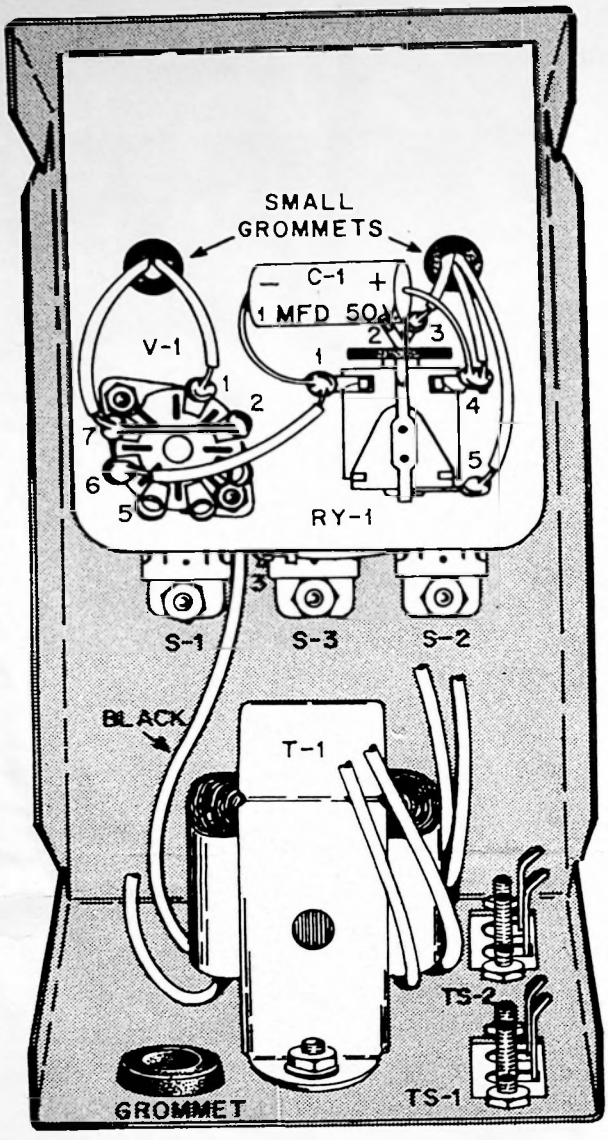


FIGURE 8. SUB-CHASSIS MOUNTING TO THE MAIN CHASSIS

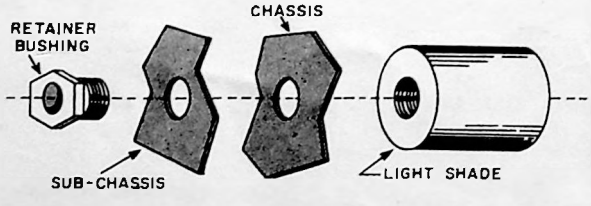


FIGURE 9. ASSEMBLY DETAILS OF THE SUB-CHASSIS MOUNTING

WIRING THE SUB-CHASSIS TO THE MAIN CHASSIS

POSITION THE CHASSIS AS SHOWN IN FIGURE 10.

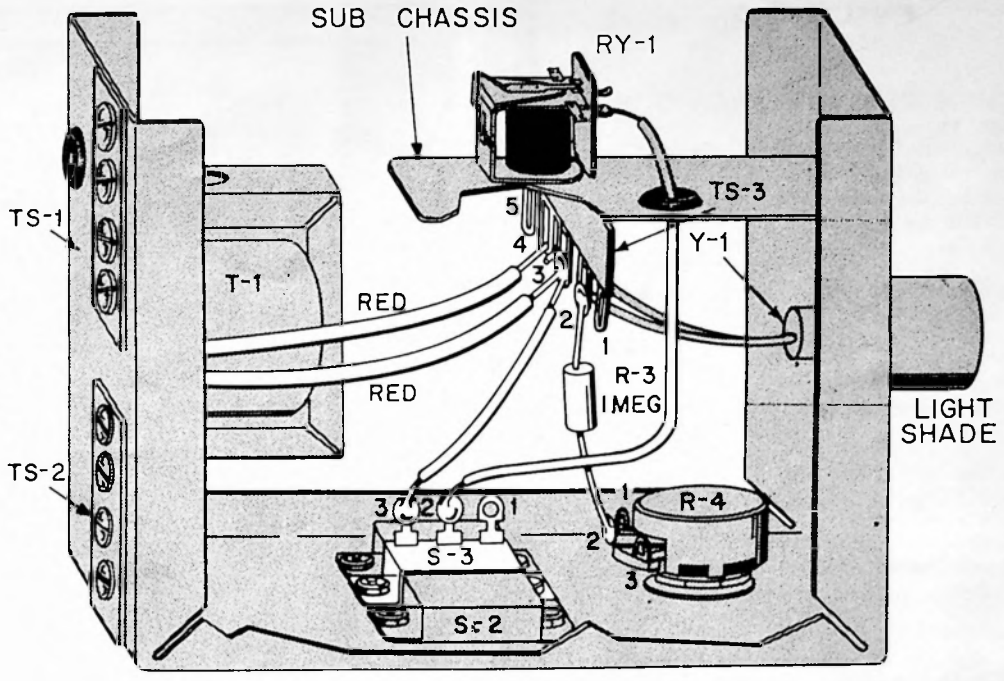
Notice that some of the previous wiring has been omitted for clarity.

- [ ] Connect, but do not solder, either of the red leads from T-1 to terminal 4 of TS-3.
- [ ] Connect, but do not solder, the other red lead from T-1 to terminal 3 of TS-3.
- [ ] Solder one end of an orange wire to terminal 3 of TS-3. Solder the other end to terminal 3 of S-3, the switch in the center.
- [ ] There is a green wire coming through the small grommet located near the relay. Solder the free end of this wire to terminal 2 of S-3.
- [ ] Solder one lead of R-3, a 1 megΩ resistor (brown, black, green), to terminal 2 of TS-3. Solder the other lead to terminal 2 of R-4.

POSITION THE CHASSIS AS SHOWN IN FIGURE 11.

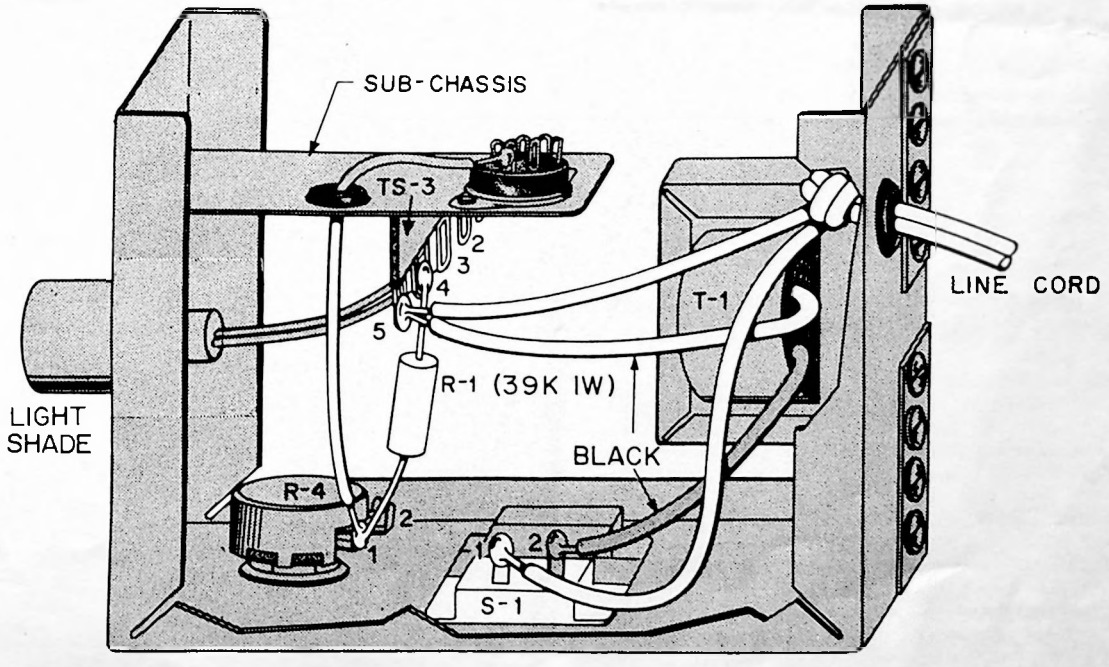
- [ ] Solder one lead of R-1, a 39KΩ, 1 watt resistor (orange, white, orange), to terminal 4 of TS-3. Connect, but do not solder, the other lead to terminal 1 of R-4.
- [ ] Solder the free end of the green wire coming through the small grommet near the tube socket to terminal 1 of R-4. DO NOT try to put this wire through the hole in the terminal. Wrap the end of the wire around the terminal.
- [ ] Connect, but do not solder, the remaining black lead from T-1 to terminal 5 of TS-3.
- [ ] Insert the end of the line cord through the grommet in the chassis. On the inside of the chassis, tie a knot in the line cord about 4" from the end. Split the two line cord leads back to the knot.
- [ ] Solder either of the line cord leads to terminal 5 of TS-3.
- [ ] Solder the other line cord lead to terminal 1 of S-1.

CAUTION: DO NOT TOUCH ANY OF THE WIRING WHILE THE PHOTOELECTRONIC RELAY IS PLUGGED INTO A POWER OUTLET.



SOME WIRING AND PARTS ARE NOT SHOWN FOR CLARITY.

FIGURE 10. FIRST WIRING OF THE SUB-CHASSIS TO THE MAIN CHASSIS



SOME WIRING AND PARTS ARE NOT SHOWN FOR CLARITY.

FIGURE 11. SECOND WIRING OF THE SUB-CHASSIS TO THE MAIN CHASSIS

FINAL WIRING

SEE FIGURE 12.

- [ ] Connect, but do not solder, either of the green leads from T-1 to pin 3 of V-1.
- [ ] Connect, but do not solder, the other green lead to pin 4 of V-1.
- [ ] Solder one end of a green wire to pin 3 of V-1. Solder the other end to terminal 1 of TS-2.
- [ ] Solder one end of a green wire to pin 4 of V-1. Solder the other end to terminal 2 of TS-2.
- [ ] Solder one end of an orange wire to terminal 5 of RY-1. Solder the other end to terminal 1 of TS-1.
- [ ] Solder one end of a yellow wire to terminal 2 of RY-1. Solder the other end to terminal 2 of TS-1.
- [ ] Install the 5696 thyratron tube in its socket.
- [ ] Place the knob on the shaft of the sensitivity control and tighten the setscrew.
- [ ] Install the cover and secure it in place with the two #4 sheet metal screws.

MOUNTING

Four holes are provided in the bottom of the cover for mounting the Photoelectronic Relay.

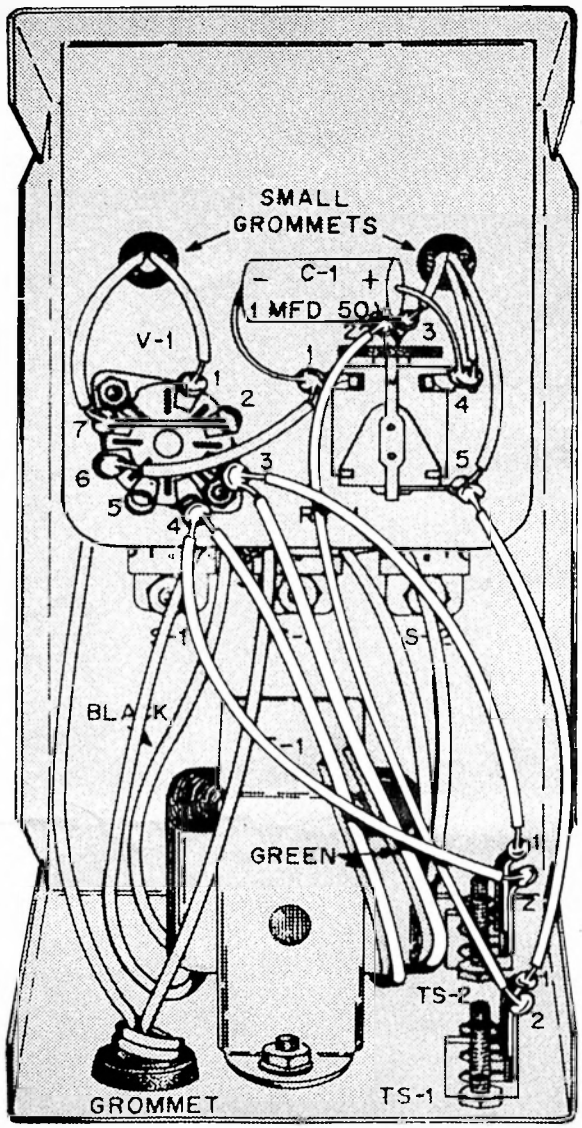


FIGURE 12. FINAL WIRING

HOW TO USE YOUR PHOTOELECTRONIC RELAY

CONTROLS

ON-OFF—This switch turns the AC power to the Photoelectronic Relay "ON" or "OFF."

AUTO-TRIP—With this switch in the AUTO position, the relay will reset automatically each time the beam is broken, and the alarm or other indicator will be actuated momentarily. This position is used for counting or announcing applications.

With the switch in the TRIP position, the alarm or other indicating device, will operate continuously once the beam is broken, until the relay is reset by using the RESET switch. The TRIP position is used for burglar alarm systems.

RESET—This switch is used to reset the relay when the Photoelectronic Relay is used with the AUTO-TRIP switch in the TRIP position.

SENSITIVITY—The farther clockwise this control is turned, the more sensitive the Photoelectronic Relay is to weak light.

RELAY TERMINALS—These terminals are used to complete the circuit between the indicator device and its power source.

6.3 VAC TERMINALS—These terminals supply 6.3 VAC at 0.6 amperes to operate an alarm, a bell, a light, or other indicating devices. DO NOT connect any indicating device to these terminals if it uses more than 0.6 amperes.

WHERE TO INSTALL

Locate the Photoelectronic Relay and the Light Source so that the light beam between them passes through the area to be guarded or supervised. A mirror can be used to reflect the light beam around corners or at angles to cover a greater area.

The total length of the beam (including any beam reflected by a mirror) between the Photoelectronic Relay and the Light Source should not exceed the following distances when the KNIGHT-KIT Light Source is used: 250 feet with white light (no filter), and 125 feet with the RED filter. These are the reliable operating distances in total darkness. A large amount of light in the room, other than that from the Light Source, will cause some reduction in the reliable operating distance.

Some applications of the Photoelectronic Relay may require infra-red (invisible) light. To get this invisible light, use a wratten No. 87C filter which is available at most photographic supply houses. The reliable operating distance with a wratten No. 87C filter is about 50 feet.

In a location where extraneous illumination is very high, try locating the units so that the photo-cell will *not* be pointed at the source of the extraneous light. For instance, if the extraneous light is coming from the ceiling, locate the Light Source lower than the Photoelectronic Relay so that the Photoelectronic Relay can be tilted downward.

HOW TO ADJUST THE LIGHT SOURCE

Turn the Photoelectronic Relay and the Light Source "ON". Temporarily remove the filter. Adjust the Light Source so the beam falls on the photo-cell. Replace the filter.

HOW TO ADJUST THE SENSITIVITY CONTROL

When the SENSITIVITY control is adjusted, room illumination should be the same as for actual operating conditions. For example, for a burglar alarm, eliminate any background light that will not be present when the photo-cell is in use.

Start with the SENSITIVITY control turned all the way to the left. Now slowly turn the control to the right until you hear the relay click. Set the control slightly to the right of this point for the lowest SENSITIVITY setting that will assure consistent, reliable operation of the relay. Do not set the control higher than necessary for consistent relay operation, or the relay may not respond to small, fast-moving objects.

In brightly lit rooms, or under daylight conditions, it may be necessary to restrict the amount of light entering the photo-cell before the SENSITIVITY control can be adjusted. This is true because the photo-cell is highly sensitive, as required for burglar alarm systems. To eliminate unwanted light, tie or paste a 12"-long tube, made of dull black paper, over the light shade. In extreme cases, cover over part of the end face of the photo-cell with black crayon.

APPLICATIONS OF THE PHOTOELECTRONIC RELAY

A Photoelectronic Relay has numerous applications, some of which we will discuss. Figures 13, 14, and 15 show several of the more common applications of the Photoelectronic Relay. Bear in mind that these illustrations are only typical (not intended to show prescribed methods of installation) and they can be revised to suit your own needs. The burglar alarm is very handy to protect valuables around the house or place of business. It will sound an alarm whenever an intruder interrupts the light beam. Many businesses make use of a Photoelectronic Relay to count items on a production line or a conveyor belt. A typical counter set-up is illustrated in Figure 14. The only additional equipment required is an electric counter. Another of the more frequent uses of a Photoelectronic Relay is illustrated in Figure 15. Here the Photoelectronic Relay is used as an electronic receptionist. For instance, an electronic receptionist can be used to announce the entrance of a customer to a busy attendant in the rear of a store or to prevent a doctor's privacy from being interrupted due to an absent receptionist. For this application, just connect a chime or a bell to the relay and power terminals. This same set-up can be used with a counter, in place of the chime, to count people passing through a doorway.

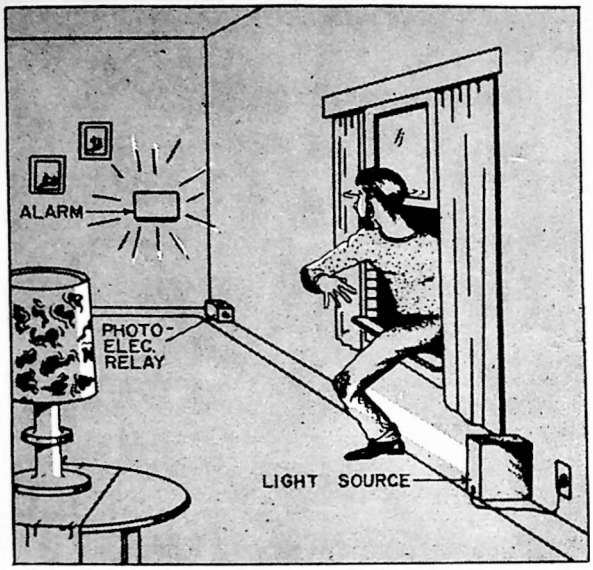


FIGURE 13. TYPICAL BURGLAR ALARM INSTALLATION

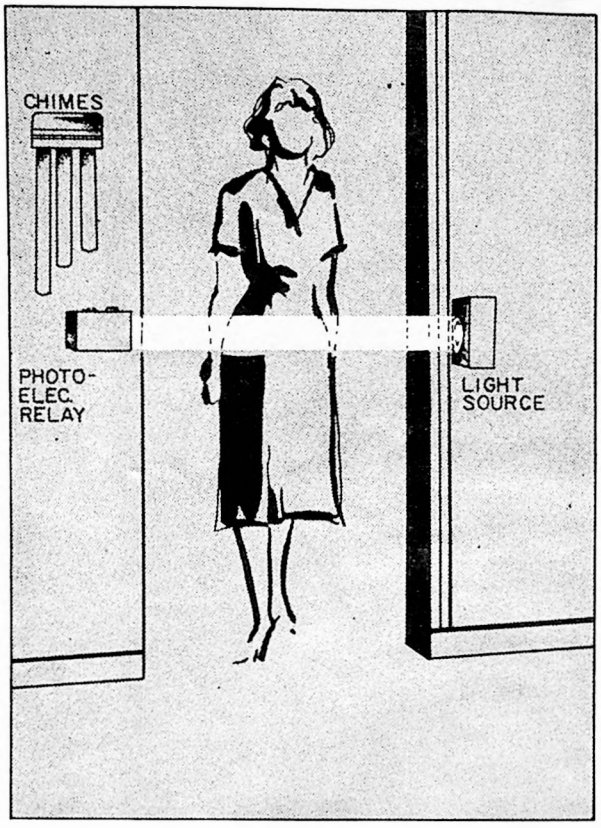


FIGURE 15. TYPICAL ANNOUNCER INSTALLATION

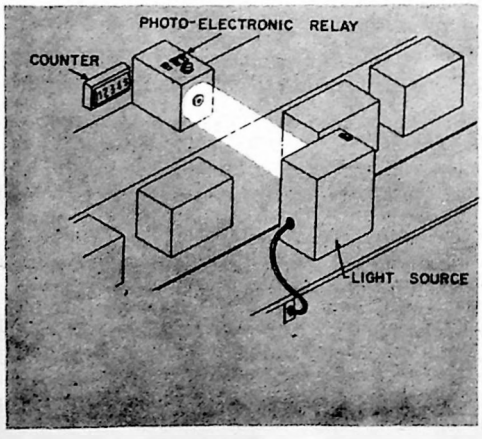


FIGURE 14. TYPICAL COUNTER INSTALLATION

Another application of a Photoelectronic Relay is a light control. To make the light control set-up, just point the Photoelectronic Relay with the SENSITIVITY control properly adjusted, toward the sky through a window. Whenever it becomes dark outside, the lights controlled by the Photoelectronic Relay will be turned on. The lights will be turned off whenever it becomes light outside. Note: The relay contacts in the Photoelectronic Relay are made to handle 28 VDC at 1 ampere (this rating in AC is about 50 V at 1.5 amp into a non-inductive load) or less. To control 110 V or 220 V lines, a power relay must be used between the power line and the Photoelectronic Relay.

By using the information presented, you should be able to adapt the Photoelectronic Relay to do many additional jobs. It can be used in practically any control application where the light beam can be interrupted by some object. Also, the Photoelectronic Relay can be used in many control applications where a light beam can be displayed on the photo-cell from a source, such as automobile headlights, daylight, ordinary room illumination, or radiant light energy from molten metals.

HOW TO USE THE RELAY AND 6.3 VAC TERMINALS

Any indicating device, alarm, or another relay that operates from 6.3 VAC and does not consume more than 0.6 ampere can receive its operating power from the 6.3 VAC terminals on the Photoelectronic Relay. If the device requires a different voltage rating or consumes more than 0.6 ampere, a separate power source will be necessary.

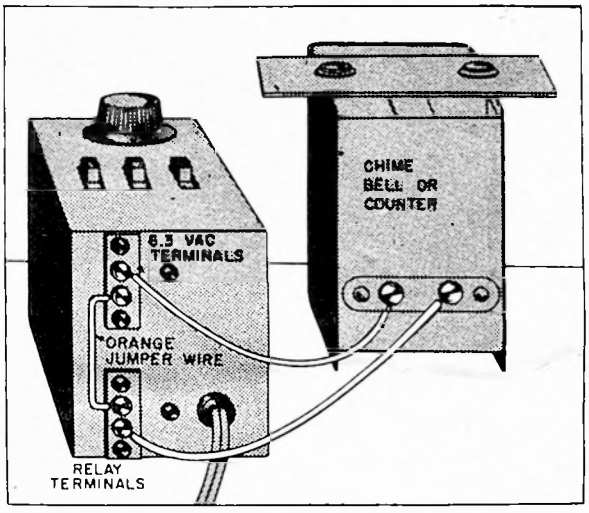


FIGURE 16. HOW TO CONNECT A DEVICE THAT IS TO RECEIVE ITS OPERATING POWER FROM THE PHOTOELECTRONIC RELAY

Figure 16 illustrates how to connect a controlled device that is to receive its operating power from the Photoelectronic Relay to the terminals on the Photoelectronic Relay. In this case, the orange wire (supplied with the kit) is connected between the lower 6.3 VAC terminal and the upper relay terminal. Connect the device to be controlled to the two remaining terminals.

Figure 17 illustrates how to connect a device that receives its operating power from an external source to the Photoelectronic Relay. Here, only the relay terminals on the Photoelectronic Relay are used.

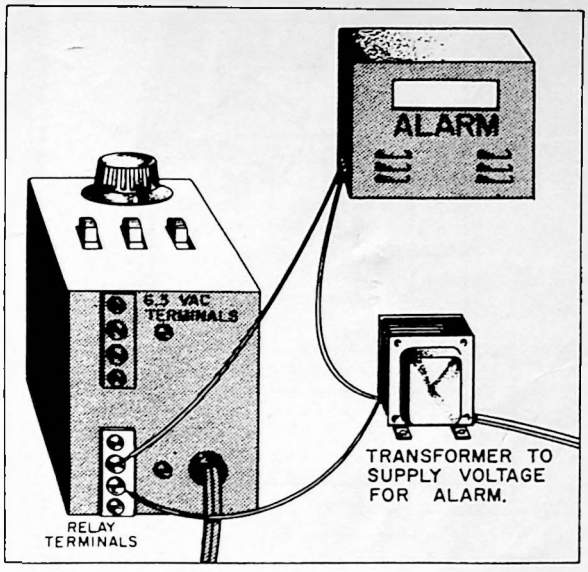


FIGURE 17. HOW TO CONNECT A DEVICE THAT REQUIRES AN EXTERNAL POWER SOURCE TO THE PHOTOELECTRONIC RELAY

The method of connecting a power relay, to control high voltages and currents, is illustrated in Figure 18. A 6.3 VAC power relay that draws 4 to 5 volt amperes or less can be powered from the 6.3 VAC terminals on the Photoelectronic Relay. Power relays that use other operating voltages or currents will require a separate power source.

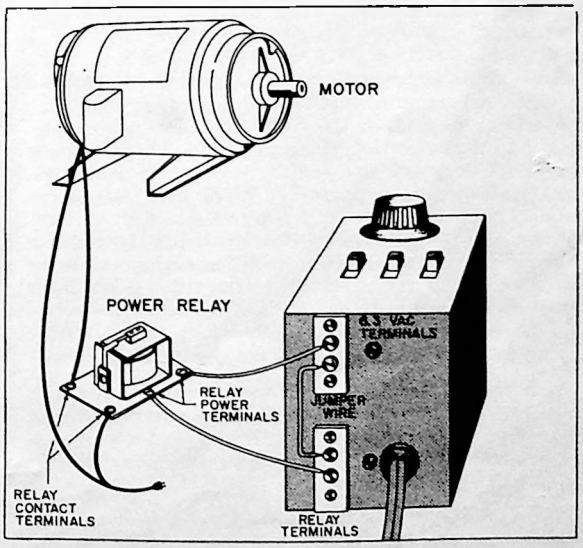


FIGURE 18. HOW TO CONNECT A POWER RELAY

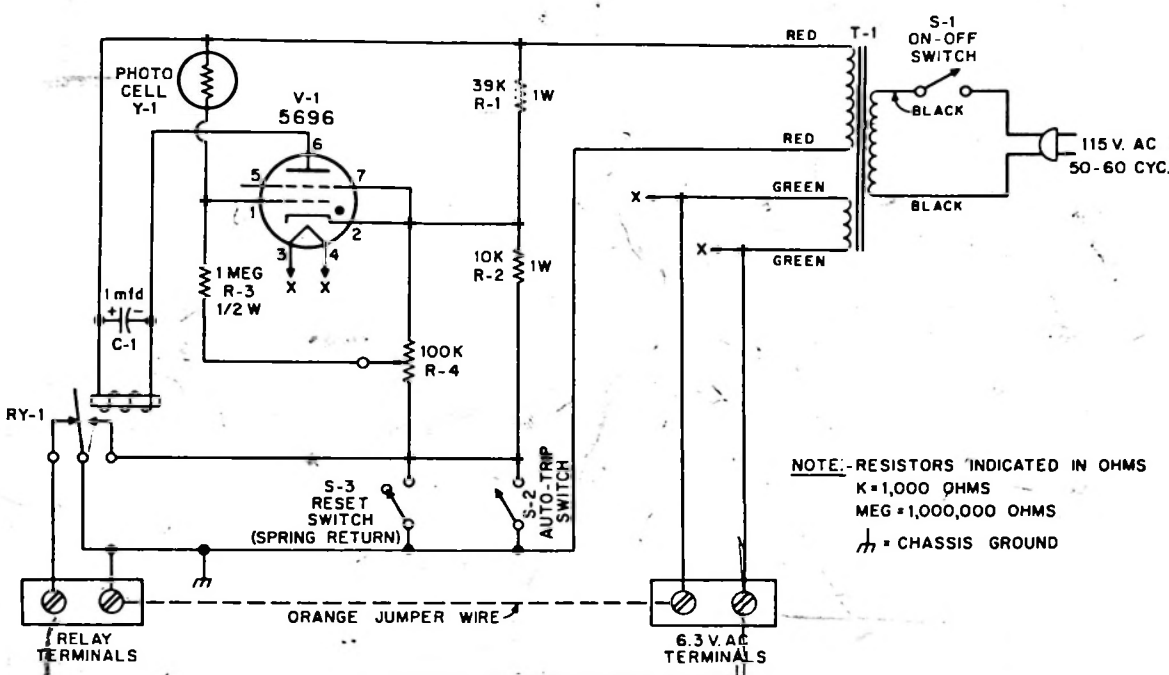


FIGURE 19. SCHEMATIC DIAGRAM

HOW IT WORKS

The Photoelectronic Relay is basically a thyratron (grid controlled gas rectifier) circuit. Voltages for operation are obtained from the line through an isolation transformer (T-1). AC voltages are applied to the grid, cathode and plate of V-1, the 5696 thyratron tube. V-1 during conduction acts as a half-wave rectifier. That is, it conducts only when the positive half of the cycle is on its plate. R-1, a 39KΩ resistor, and R-2, a 10KΩ resistor form a voltage divider to supply the cathode voltage. A portion of this cathode voltage is applied to the grid through R-4, the SENSITIVITY control, and R-3, a 1 megΩ resistor. The grid also receives a voltage through Y-1, which is a variable-resistance photo-cell. A variable-resistance photo-cell is one that changes resistance with varying light intensities. With a light shining on the photo-cell, its resistance is reduced causing the voltage on the grid to increase to the firing potential of the thyratron. Once the firing potential is reached, V-1 conducts heavily and energizes the relay. C-1 is connected across the relay to prevent it from trying to drop out when V-1 is not conducting.

With the light removed, the resistance of Y-1 increases reducing the grid voltages below the firing potential of V-1. With this condition, V-1 will stop conducting when the negative portion of the cycle is on its plate and the relay will be de-energized.

The cathode of V-1 is returned to ground through one set of the relay contacts which are paralleled by S-2 (AUTO-TRIP) and S-3 (RESET). Setting S-2 to the TRIP position prevents the cathode from returning to ground, whenever the light beam is broken. The RESET switch must be actuated to start V-1 conducting again. With V-1 conducting, the relay energizes completing the cathode circuit.

MAINTENANCE

After a period of time, the relay contacts may become tarnished and stick causing erratic operation. The contacts can be cleaned by rubbing them lightly with a coarse grade of ordinary paper or a very fine sandpaper. Do not use emery paper as it is conductive. Be careful not to rub the contacts too hard or the silver on them may be removed. Handle the relay contact arm carefully so the tension will not change.

The photo-cell can be tested by removing it from the circuit and measuring its resistance. The resistance will vary from a few thousand ohms under intense light to several hundred megohms (nearly infinite) in absolute darkness.

The thyratron can be checked for conduction by looking for a bluish glow inside the tube. The 5696 cannot be checked on most tube testers.

When a very strong light is used at close range, the relay may chatter. To prevent this chatter, reduce the intensity of the light.

Use in a brightly lighted room may cause erratic operation. To correct this, extend the light shade in front of the photo cell.

VOLTAGE CHART

Voltages Measured with Photo-cell Covered and Sensitivity Control Turned Fully Counterclockwise.			Voltages Measured with Photo-cell Exposed and Sensitivity Control Turned Fully Clockwise.	
PIN	AC	DC	AC	DC
1	0	—12	110	20 to 40
2	25	0	110	40
3	6.3*	—	6.3*	—
4	6.3*	—	6.3*	—
5	25	0	110	40
6	140	0	120	—14
7	25	0	110	40

Voltage Measurements Made with a VTVM from Point Indicated to Ground. *Measured Across Pins 3 & 4.

RESISTANCE CHART

PIN	Resistance in Ohms
1	1 meg
2	9KΩ
3	—
4	—
5	9KΩ
6	2.5KΩ
7	9KΩ

Measured from Point Indicated to Ground. Photo-cell Covered. Sensitivity Control Fully Counterclockwise.

Please order Me

PARTS LIST

Symbol No.	Description	Part No.
	CAPACITOR	
C-1	Electrolytic, 1 μfd 50 V	202010
	RESISTORS	
Note:	When ordering resistors, give part number and description.	
R-1	39KΩ, 1 W, 10%	304393
R-2	10KΩ, 1 W, 10%	304103
R-3	1 megohm, ½ W, 10%	301105
R-4	Sensitivity control 100KΩ linear taper	390101
	RELAY	
RY-1	Relay, single pole, double throw	190003
	SWITCHES	
S-1	SPST slide (on-off)	431005
S-2	SPST slide (auto-trip)	431005
S-3	SPDT spring return (reset)	431102
	TRANSFORMER	
T-1	Power Transformer	101319
	TERMINAL STRIPS	
TS-1	2-screw terminal strip	441201
TS-2	2-screw terminal strip	441201
TS-3	5-terminal strip	440501
	TUBE	
V-1	5696 thyratron	610044
	PHOTO-CELL	
Y-1	CL-3 cadium selenide	671000

Description	Quantity	Part No.
MISCELLANEOUS		
Bushing retainer, brass	1	470152
Chassis	1	462220
Cover, chassis	1	463302
Cord, AC line	1	802001
Grommet, ⅜"	1	830200
Grommet, ¼"	2	830001
Knob, control	1	764301
Lockwasher, control mtg.	1	582700
Lockwasher, #6	7	582300
Lockwasher, #4	6	582200
Light shade	1	470090
Nut, hex: 3/8-32	2	570841
Nut, hex: 6-32	7	570340
Nut, hex: 4-36	6	570230
Nut, hex: 3-48	2	570110
Sub-chassis	1	461324
Screw, machine: 6-32 x ¼"	7	560342
Screw, machine: 4-36 x ⅜"	6	560234
Screw, machine: 3-48 x ⅛"	2	560112
Screw, self-tapping: #4 x ¼"	2	562292
Socket, 7-pin miniature	1	501170
Washer, flat	1	580702
Manual, instruction	1	750207
WIRE AND SOLDER		
2" red wire	3	801002
3" orange wire	3	801003
4" yellow wire	4	801004
5" green wire	4	801005
#20 spaghetti tubing, 4"	1	812001
Solder, 20"	1	930004

TOOLS NEEDED FOR CONSTRUCTION

Allied Stock No.	Description	Price*
46N852	Soldering iron	$5.16
50N132	6" long-nose pliers	1.54
50N133	5" diagonal cutters	1.34
45N796	6" screwdriver	.72

ACCESSORY YOU MAY WANT

83Y703	Light source kit. With bulb and filter	6.75

*Subject to change

ALLIED'S SERVICE FACILITIES AND GUARANTEE

If the kit does not operate properly, we recommend the following:

Please write our Kit Department giving stock number and date of purchase of the kit. Also, describe fully what appears to be wrong. We may be able to determine a wiring error or a defective part.

This wired KNIGHT-KIT may be returned for inspection within one year after purchase for a special service charge of $2.50. Parts within the standard EIA 90-day warranty period will be replaced without charge for the parts. A charge will be made for parts damaged in construction or because of a wiring error, or for parts which are beyond the 90-day warranty period. After the one-year period, service charges are based on the length of time required to repair the unit, plus the cost of any parts required.

PLEASE NOTE: KITS BUILT WITH ACID CORE SOLDER, PASTE FLUX OR IRONS CLEANED ON A SAL AMMONIAC BLOCK ARE NOT ELIGIBLE FOR REPAIR OR SERVICE AND WILL BE RETURNED TO YOU NOT REPAIRED, AT YOUR EXPENSE.

Allied's service facilities are primarily for inspection and trouble shooting. Kits not completely wired, which require extensive work, will be returned collect with a letter of explanation.

If you return this kit, pack it well. To prevent damage in shipment, use a large enough carton so that cushioning material can be placed around the instrument. (Do not use the same carton in which kit was shipped.) Cushion it well and tightly. Mark it: FRAGILE—DELICATE ELECTRONIC EQUIPMENT. Send the kit prepaid and insured. We will return the repaired kit to you C.O.D. as soon as repairs are completed. If you wish to save C.O.D. fees, your advance remittance may be enclosed for standard repair charges plus transportation costs. Any excess remittance will be refunded.

The designs and components selected for KNIGHT-KITS represent over a quarter of a century of experience in kit development. Allied extends these firm guarantees on KNIGHTS-KITS:

> We guarantee that the circuits on all KNIGHT-KITS have been carefully engineered and tested.
>
> We guarantee that only high-quality components are supplied. All parts are covered by the standard EIA 90-day warranty. Any faulty components will be replaced prepaid and without charge if reported to us within the warranty period. We reserve the right to request the return of defective parts.

If your kit was damaged in a parcel post shipment, please write us at once, describing the condition in which the shipment was received. If your kit was part of a Railway Express shipment that was damaged in transit, please notify the Railway Express agent at once and then write us.

KNIGHT-KITS ARE YOUR BEST BUY THE FINEST ELECTRONIC EQUIPMENT IN KIT FORM. CREATIVE ENGINEERING AND USE OF PREMIUM QUALITY PARTS ASSURE SUPERIOR PERFORMANCE. THAT'S WHY KNIGHT-KITS ARE SOLD WITH THIS EXCLUSIVE GUARANTEE: *EVERY KNIGHT-KIT MUST MEET PUBLISHED SPECIFICATIONS OR WE REFUND YOUR MONEY.*

KNIGHT-KITS ARE "CONVENIENCE ENGINEERED" RESISTORS ARE CARD MOUNTED AND IDENTIFIED. WIRE IS PRECUT. SMALL PARTS ARE PACKAGED IN SEE-THROUGH PLASTIC BAGS. DETAILS SUCH AS THESE AND STEP-BY-STEP INSTRUCTION MANUALS MAKE KNIGHT-KITS EASIEST TO BUILD.

KNIGHT-KITS ARE THE FIRST CHOICE OF EXACTING BUILDERS OF ELECTRONIC KITS EVERYWHERE AND HAVE BEEN SINCE THE EARLY 20's. THERE IS AN OUTSTANDING KNIGHT-KIT AVAILABLE FOR EVERY REQUIREMENT. EACH IS A REWARDING ADVENTURE IN KIT CONSTRUCTION. YOU WILL BE PROUD TO BUILD AND OWN A KNIGHT-KIT.

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