

VISITRON

Phototubes



THE *Rauland* CORPORATION

CHICAGO 41, ILLINOIS

CATALOG NO. 546

Quality -- Like Character -- Endures

To select Visitron is to select the finest in the field of high sensitivity phototubes. Their uniformity, dependability and high sensitivity thru the years has brought recognized leadership to these quality phototubes. Efficiency and accuracy in performance are assured as the result of carefully controlled manufacturing methods developed by combining modern technical skill and production equipment with twenty years of engineering and production experience.

In 1925 when sound-on-film was in its early stages of development such pioneers as Dr. Lee DeForest used Visitron Tubes which, at that time, were the only phototubes manufactured on a commercial basis.

In 1930 Visitron Type "A" Red-Infra Red tubes were introduced, a product of long laboratory research. These were the first caesium-argon tubes to be placed on the commercial market. Supplementing these pioneering accomplishments, Visitron Phototubes are continually being improved and new sizes and types are constantly in process of development for varied applications.

The most recent addition to the famous Visitron line is a series of special blue-sensitive phototubes, developed and produced under patents owned exclusively by The Rauland Corporation. The outstanding feature of these new "B" series tubes is their increased sensitivity in the blue region of the Spectrum in comparison with similar tubes previously available on the market.

A third type of Visitron Phototube is the well established series of "C" type tubes having a peak sensitivity in the ultra violet region of the spectrum.

TYPES OF LIGHT-SENSITIVE DEVICES

There are three general types of electrical devices whose characteristics change when subjected to light variations:

1. Photo-conductive cells
2. Barrier-layer cells
3. Emission type cells

The photo-conductive or selenium cell is a device in which a thin layer of the metal, selenium, connecting two electrodes, alters its internal resistance in response to variations in light. Its characteristics are not suited to modern techniques because of its sluggish response to light changes, its fatigue when exposed to high light intensities and its drift in characteristics with time, temperature, long periods of exposure to light or polarizing voltage. It is notable for the fact that it was the earliest form of light-sensitive device.

The barrier-layer cell, sometimes called a photo-voltaic or self-generating cell, is a device which will cause a current to flow in an external load circuit when exposed to light, even though there is no other source of voltage in the circuit. The best known use of such cells is for rough measurements of light intensities such as exposure-meters for photography, or foot candle meters for studies of illumination. In such uses the precision required is not high and the convenience of a simple combination of meter and cell has great advantage.

This type of cell is not suited to precision measurement of light intensities because of instability of characteristics, or to reproduce rapidly changing light intensities encountered in sound-on-film work, because of the high internal capacity of the cell which is in parallel with the generated voltage.

This capacity causes serious reduction in output voltage at all frequencies above a few hundred cycles.

Visitron Phototubes are all of the Emission Type as distinct from barrier layer and selenium cells. The Emission Type of phototube is a device consisting of two electrodes in an evacuated transparent container having the property of changing the rate of current flow between cathode and anode in response to changes of illumination when a polarizing voltage is applied to the electrodes in the proper polarity. The balance of this pamphlet is devoted to a discussion of the basic characteristics of Emission Type phototubes in general and Visitron tubes in particular.

GEOMETRY OF PHOTOTUBES

The geometry of the Phototube is considerably different from that of a standard two element vacuum tube. In the Phototube, the large element which appears to be a plate is actually a cathode and is connected to the negative side of the polarizing voltage, while the collector wire (anode) is connected to the positive side. The reason why it is necessary to use such a large cathode in a Phototube is the fact that the major part of the energy which is effective in producing electrons in a Phototube is the energy contained in the light itself which shines on the cathode.

The anode wire is the positive element, corresponding to the plate in a conventional two-element vacuum tube. Because of the very low currents in the phototube this electrode can be small in area but should be relatively near all parts of the active surface.

SENSITIVITY TYPES

There are two major groups into which Visitron phototubes may be divided on the basis of intrinsic sensitivity.

- a. Vacuum
- b. Gas-filled

Each has distinctly different performance characteristics and different circuit requirements. They are, in general, not interchangeable and there is no reason to assume that the tube with the highest sensitivity is the best for a particular application. In addition to the major sensitivity groups which are in reality different kinds of tubes, obtaining their intrinsic sensitivity by quite dissimilar means, there are subdivisions of sensitivities within a group caused by small differences in processing, others by intentional variations in processing.

In order to supply phototubes with a more uniform sensitivity for each specific application, all Visitron tubes are selected as to sensitivity and classified into groups as indicated on the price list. All gas-filled Visitron tubes are selected and classified into five groups. All vacuum type tubes are grouped into four classifications.

The sensitivity range for each group is shown on the price list. In the case of group 1 tubes, only the minimum sensitivity is indicated. The maximum sensitivity varies for each type as shown in the characteristic tables. This maximum rating is given as a means of comparison to assist in selecting the proper tube type for applications where sensitivity of the highest order is desired.

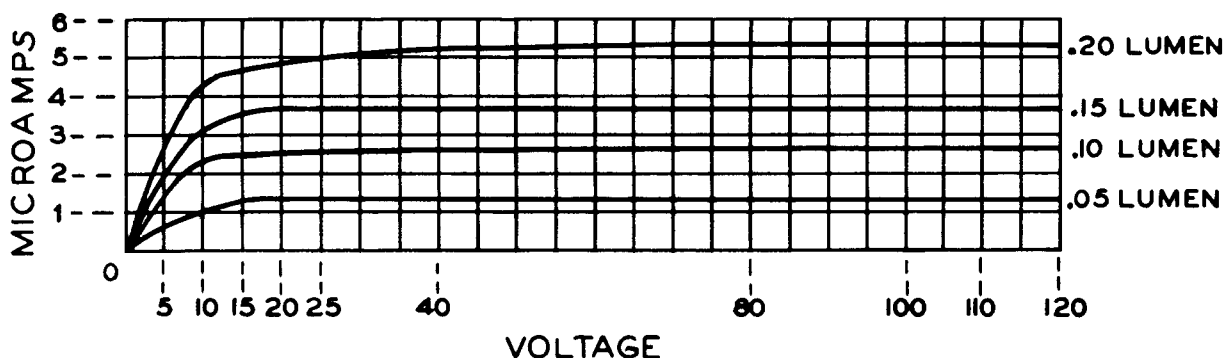


Fig. 1. Current-Voltage Curves For Visitron Vacuum Phototubes At Various Light Fluxes

a. VACUUM PHOTOTUBES

The vacuum phototube is the less sensitive and at the same time the most easily understood of the types mentioned. It consists of a photo-sensitive cathode and an anode in a highly evacuated bulb, usually glass. The photo-cathode usually has an area of $\frac{1}{4}$ to several square inches and may have any one of several photo-sensitive surfaces. The anode seldom has special treatment or preparation. It is ordinarily a single wire, either straight or bent into some simple form such as a rectangle or a spiral. When light falls on the cathode the light energy excites the atoms of the photo-sensitive material driving some of the electrons out of the surface of the material into the evacuated space surrounding it. Here these electrons, responding to the electrostatic field between anode and cathode, travel to the anode which is at positive potential with respect to the cathode.

The outstanding characteristics of the vacuum type phototube are:

1. Linear relationship between light input and current output.
2. The vacuum phototube is not easily damaged by accidental application of excess voltage.
3. For measurement purposes it is the preferred type of tube because it holds its characteristics unchanged over long periods of time.
4. Above saturation voltage, the sensitivity of the tube is virtually independent of applied voltage.

The curve shown in Fig. 1 is typical of all vacuum phototubes. It is easily seen how little effect applied voltage has on the current output, and how uniformly the output current increases with applied illumination.

b. GAS-FILLED PHOTOTUBES

Gas-filled phototubes have the same general appearance and same electrode structure as vacuum type phototubes. In the process of manufacturing gas-filled tubes, it is the usual procedure first to completely exhaust the tubes as if making high vacuum types, then to admit a measured quantity of an inert gas, usually argon, into the tube before sealing it off from the pumps. The purpose of the gas is to increase the sensitivity of the tube by ionizing. In this process of ionization an electron traveling from the cathode toward the anode collides with an atom of gas and knocks out an additional electron.

When these two electrons arrive at the anode instead of one, the current is obviously multiplied. The atom which was robbed of an electron became positive by deficiency of an electron and is attracted toward the cathode. If it strikes with sufficient velocity it may produce additional electrons which may further contribute to the ionization. Since these positive ions are very heavy they require a measurable length of time to reach the cathode. It is this time lag that is primarily the cause of poor high frequency response in a gas-filled phototube. The degree of ionization depends upon both the operating voltage and the applied light. Fig. 2 is a family of curves on a typical gas-filled phototube showing these relations. Since the degree of ionization depends upon both light and voltage, it is to be expected that the degree of high frequency attenuation will correspondingly be a function of both of these variables.

b. GAS-FILLED PHOTOTUBES (cont'd)

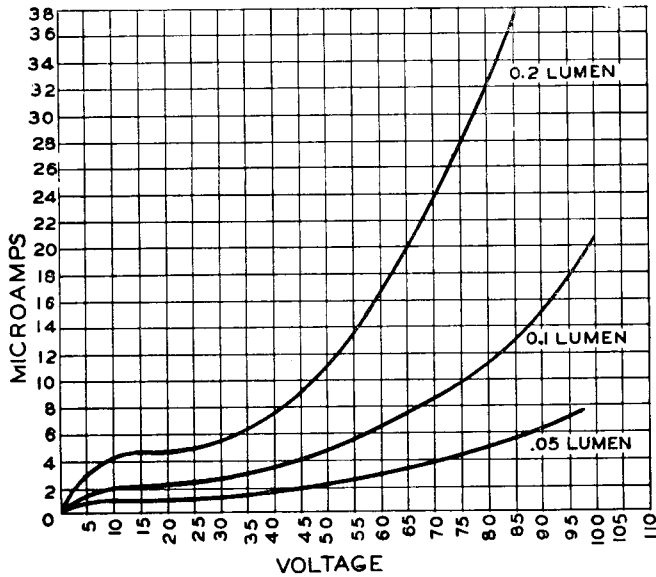


Fig. 2. Current-Voltage Curves For Visitron Gas Filled Phototubes At Various Light Fluxes

This fact can easily be checked by taking a response curve of a sound-on-film reproducer with the voltage below the maximum ionizing potential or "Glow Voltage" (say 25 volts) in which case the cell will show fidelity as good as a vacuum type cell, but at the higher voltage where ionization is contributing appreciably to the sensitivity, the high frequency response will suffer. A typical curve showing this effect is shown in Fig. 3.

The superiority of Visitron gas-filled phototubes for sound-on-film reproduction is the result of a studied program to obtain high sensitivities at low gas amplification ratios which results in better high frequency response. The general order of improvement is of practical rather than academic amount even when the sound track is a commercial film without special care in processing.

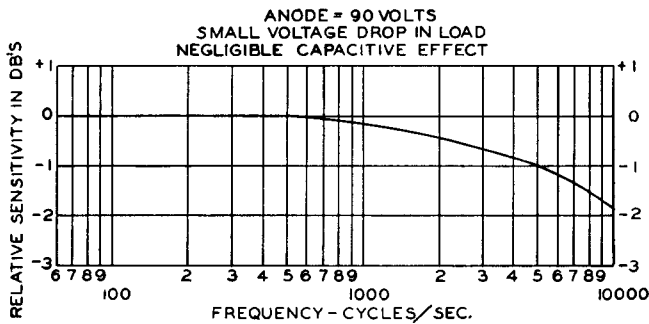


Fig. 3. Frequency Response Curve Of An Average Visitron Gas-Filled Phototube

If light is suddenly applied to, or removed from a gas-filled phototube, the current does not make its complete change instantly. This action is shown in Fig. 4. Here it is to be seen that there is an instantaneous change in current which can be attributed to the change in photo emission while the gradual change is due to ionization of the gas. From these considerations it is obvious that the ratio of total current shift to instantaneous shift is the same as the gas amplification ratio.

The outstanding characteristics of gas-filled phototubes are:

1. High sensitivity.
2. Non-linear relation between incident light and current output which, over a large part of the characteristic, is approximately square law.
3. Sensitivity is an important function of applied voltage and of light intensity.
4. In sound-on-film reproduction some degree of volume control can be obtained by shifting the applied voltage. (This is not a recommended practice because too often an operator will unintentionally turn the control up to the glow voltage point. A much better practice is to make the applied voltage fixed and use a conventional audio gain control.)
5. When working at high gas amplification ratio (high applied voltage) the characteristics are extremely unstable. In sound-on-film reproduction many extraneous interfering noises are generated in the phototube under this condition.

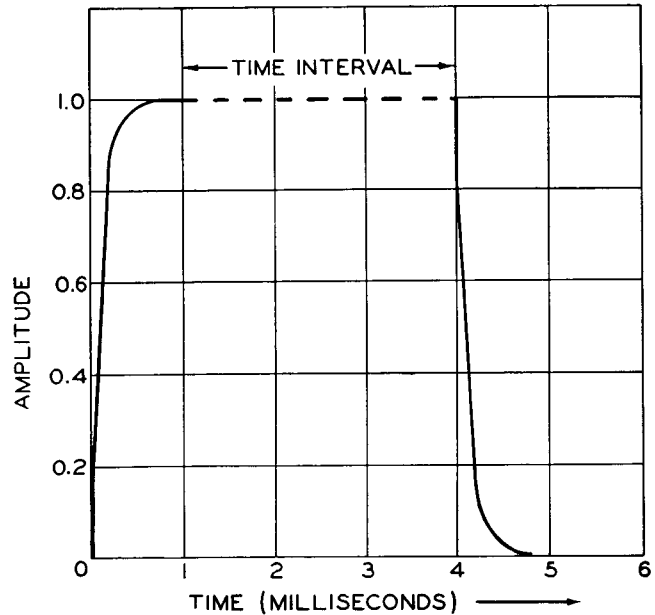


Fig. 4. Effect Of Time Lag In Gas-Filled Phototube

6. When working at high gas amplification ratios a surge in line voltage may increase the applied voltage enough to initiate a "glow discharge" which will seriously damage the tube unless stopped by reducing the voltage.
7. The "glow discharge" in the tube is in the nature of an "arc", having negative resistance characteristics. Unless there is enough positive resistance in series with the tube to limit the current, the tube will be destroyed almost instantly.
8. Inasmuch as the tube is susceptible to "glow discharge" there is a maximum supply voltage that should never be exceeded. (This maximum voltage is 90 volts for all Visitron gas-filled tubes.) Visitron phototubes excel in this characteristic because they have been made with an unusually high glow voltage.

SPECTRAL SENSITIVITY

The Visitron Phototubes are produced in three different types with respect to spectral sensitivity. These differ in the preparation of the light sensitive cathode and are identified by the suffixes A, B and C according to their spectral sensitivity. Fig. 5 and 6 show typical curves in which the relative sensitivity is plotted against wave length in angstrom units. It can be seen that "A" tubes have a peak sensitivity in the near infra-red region while the maxima of the "B" tubes is near the blue end of the visible spectrum. "C" tubes have a peak sensitivity in the ultra-violet region of the spectrum.

When the problem arises of choosing the most suitable type of cathode for a particular application of a phototube, it should be easy to decide from an examination of Figs. 5 and 6 which would be the most sensitive cell for any particular light source.

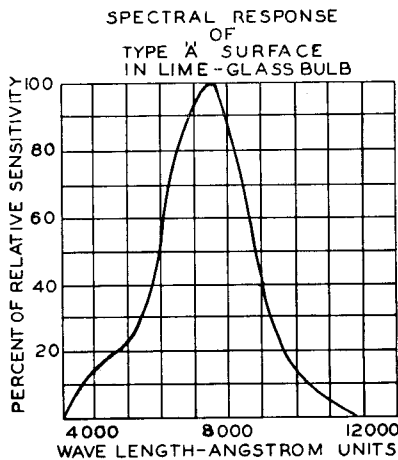


Fig. 5 Spectral Sensitivity Type "A" Surface Showing High Response In The Red And Infra-Red Region Of The Spectrum.

MEASURED SENSITIVITY

The usual factor of merit of a phototube is its sensitivity to light, which is measured in terms of its output current when exposed to standard illumination. The current is measured in microamperes while the standard illumination is measured in "lumens." The factor of merit is "microamperes per lumen."

By agreement among manufacturers the sensitivity measurement is made with only a fraction of the cathode area illuminated with a standard quantity of light. The measurement, therefore, represents the basic efficiency of the cathode. Because of the restricted size of the test spot, it is immediately apparent that the measured factor of merit, microamperes per lumen, will not be changed by increasing the area of the cathode.

The term "lumen" is based on the light of an incandescent lamp of specified color temperature and, therefore, the microamperes per lumen of a phototube is not an accurate indication of the sensitivity if light sources of different color and phototubes of different color sensitivity are compared. In the case of Visitron Phototubes this means that the sensitivity of types B and C is not much greater than that of type A when expressed in microamperes per lumen because of the deficiency of blue and ultra-violet light emitted by an incandescent lamp.

EFFECTIVE SENSITIVITY

The effective sensitivity of a phototube in use depends upon the efficiency of utilization of the light available. If all of it can be focused into a spot smaller than the effective area of the smallest cathode tested, all phototubes of the same "sensitivity" (microamperes per lumen) will give the same output. If the available light cannot be focused at all, or if the smallest spot into which it can be focused is larger than the cathode of the largest phototube tested, the output of each of a group of tubes all having the same "sensitivity" will be proportional to the area of the cathode, the largest cathode producing the greatest output, the smallest cathode producing the least output.

MECHANICAL CHARACTERISTICS

Some of the variations in phototubes arise from purely physical reasons, to fit in a particular space, to have a plate area sufficient to intercept all of a given light beam, or to intercept light from a particular direction, such as end view, side view (from one direction) or side view from all directions (360° pick-up). Most phototubes have a single base with conventional tube base pins. The style of base and number of pins is usually the manufacturers or the users option. In almost all cases, there are, for mechanical reasons, more pins than are required for circuit connections. (There are some exceptions, of course). In a few cases where high insulation resistance is required, one connection, usually the anode, is brought out to a top cap while the cathode is brought out to the base.

A further refinement in tubes for high insulation resistance is to bring the anode out to the top cap, the cathode to a pin on a ceramic base, and a guard ring on the glass around the cathode is brought out to a separate pin connected in the circuit to a point which will detour leakage currents around the cathode circuit, thereby preventing these stray currents from interfering with measurements. This additional high insulation resistance feature is incorporated in the manufacture of all Visitron anode cap type tubes.

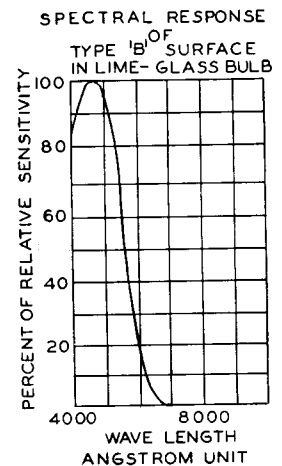


Fig. 6. Spectral Sensitivity Type "B" Surface Showing High Response In The Blue Region Of The Spectrum.

If the types shown on the following pages should not be found suitable for any special requirements, we would be prepared to consider manufacture of special tubes upon receipt of detail information regarding the proposed tube and the apparatus it is to be used with. This information should indicate the position, the area of the light beam and the maximum tolerances which can be allowed.

CLASSIFICATION OF VISITRON PHOTOTUBES

In order to simplify the ordering of Visitron Phototubes, the combination of the properties discussed above are denoted by a code of letters and numbers in the following manner:

1st two numerals indicate Physical Characteristics according to dimensions shown on drawings in this catalog. Example 51, 71.

1st suffix letter indicates
 "A" - Red Infra-red response
 "B" - Blue response
 "C" - Ultra Violet response

Additional suffix letters indicate
 "V" - Vacuum type (no letter required to indicate gas-filled. All Visitrons are supplied as gas-filled tubes unless order indicates "V" type)

"T" - With cap connected to anode.

Above letters are followed as to numeral, indicating classification as to sensitivity group. See price sheet for listings of group classifications.

HOW TO ORDER VISITRON PHOTOTUBES

Example - R58A-3 denotes a gas-filled tube with a type "A" (red infra-red) cathode with a sensitivity of 100 to 135 microamperes per lumen based on 2870°K light source and physical characteristics of the R58 series tubes as indicated on page 8.

R59TAV-3 denotes a vacuum tube with a type "A" (red infra-red) cathode with a sensitivity of 20 to 25 microamperes per lumen based on 2870°K light source and with an anode cap. This type number indicates physical characteristics of the R59 series tubes as indicated on page 9.

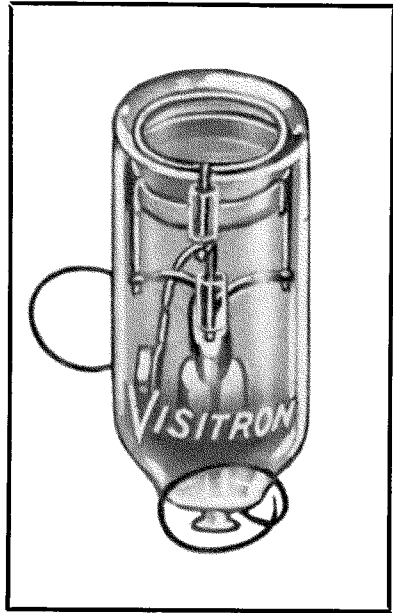
R71BV-2 denotes a vacuum tube with a type "B" (Blue) cathode with a sensitivity of 25 to 30 microamperes per lumen based on 2870°K light source and physical characteristic of the R71 series tubes as indicated on page 12.

R50 SERIES

This midget end view tube was designed for applications where space limitation is the controlling factor. Especially adaptable to extremely small electronic control devices.

Ideal in use of multiple phototube banks for controlling the moving pattern of electric signs.

This miniature tube fits perfectly with the compact designs of coin operated machines.



TYPE R50

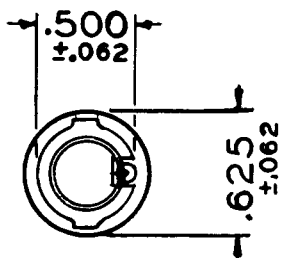
GENERAL CHARACTERISTICS

	R50A	R50AV
Cathode Surface	S1	S1
Cathode Size	.500" Dia.	.500" Dia.
Capacitance (Anode-Cathode)	2.5 MMF.	2.0 MMF.
Leakage Resistance (Min.)	1000 Meg.	1000 Meg.

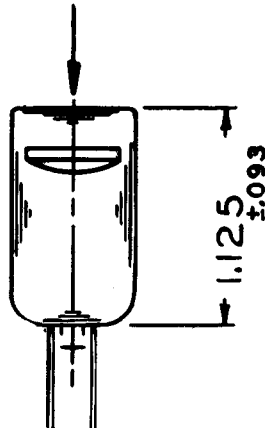
MAXIMUM RATINGS

	R50A	R50AV
Anode Voltage, Peak	90V	500V
Luminous Sensitivity	200 uA/L DC	35 uA/L DC
Luminous Sensitivity (25v)	30 uA/L DC	30 uA/L DC
Gas Amplification	10	---
Temperature, ambient	100°C	100°C

USABLE PLATE



DIRECTION OF LIGHT



VISITRON

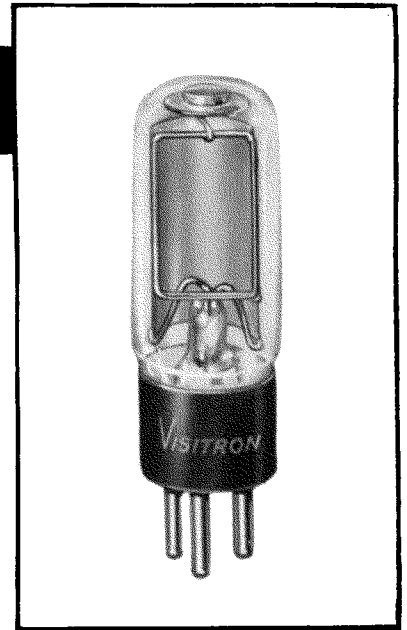
R51 SERIES

The rectangular anode of this tube offers no interference to the smallest of light sources, thus permitting a shadow-free cathode area. This particular Visitron is commonly used in portable 16 MM sound-on-film production equipment.

The R51 Series is supplied with two types of cathode surfaces, "A" type sensitive to infra-red and "B" type sensitive to blue.

The R51 blue sensitive Visitron phototubes have increased sensitivity to light sources predominating in blue radiation and a negligible sensitivity to infra-red radiation. This high sensitivity to blue radiation makes this tube particularly valuable for use in sound reproduction involving a dye-image sound track in conjunction with an incandescent light source. The R51B blue sensitive series are available on special order with non-hygroscopic ceramic bases.

The R51 Series is also available on special order with Corex D bulb for use in the ultra-violet region of the spectrum. These ultra-violet tubes are identified by the letter "C" (Example R51CV-2). Prices will be submitted upon application.



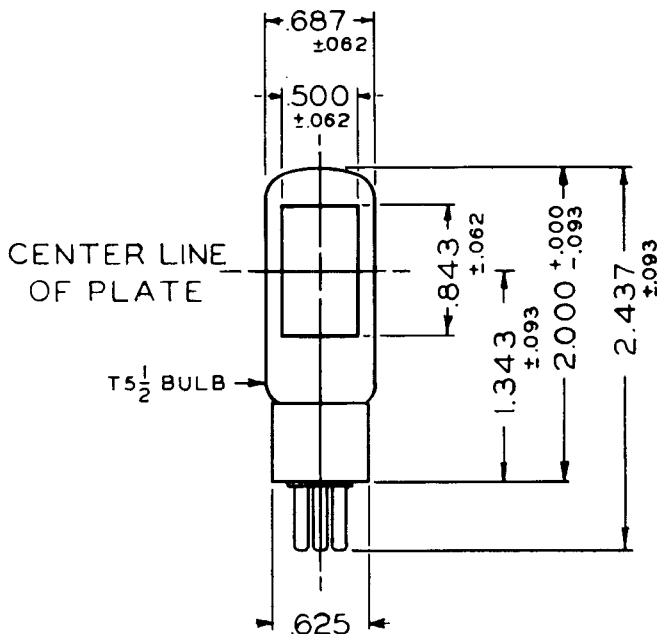
TYPE R51

GENERAL CHARACTERISTICS

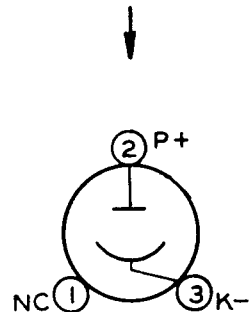
	R51A	R51AV	R51B	R51BV
Cathode Surface	S1	S1	S4	S4
Cathode Size	.843" x .500"	.843" x .500"	.843" x .500"	.843" x .500"
Capacitance (Anode-Cathode)	2.5 MMF.	2.0 MMF.	2.5 MMF.	2.0 MMF.
Leakage Resistance (Min)	1000 Meg.	1000 Meg.	1000 Meg.	1000 Meg.

MAXIMUM RATINGS

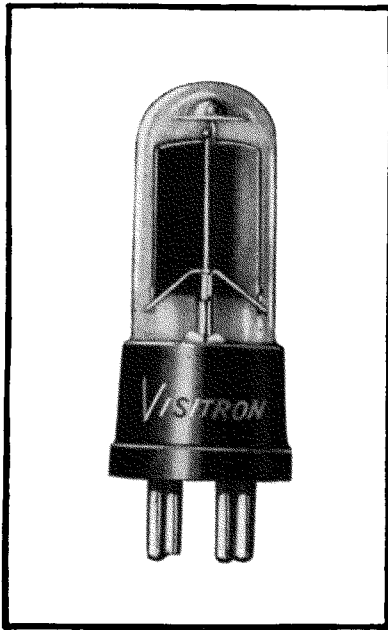
	R51A	R51AV	R51B	R51BV
Anode Voltage, Peak	90V	500V	90V	500V
Luminous Sensitivity	250 μ A/L DC	37 μ A/L DC	300 μ A/L DC	40 μ A/L DC
Luminous Sensitivity (25v)	35 μ A/L DC	35 μ A/L DC	40 μ A/L DC	37 μ A/L DC
Gas Amplification	12	- - -	10	- - -
Temperature, ambient	100°C	100°C	100°C	100°C



DIRECTION OF LIGHT



VISITRON



TYPE R58

R58 SERIES

A sturdy constructed tube designed to withstand shock and handling.

We recommend this tube to manufacturers developing new sound heads as the preferred type for use in portable 16 MM sound-on-film projection equipment.

The R58 series is exceptionally dependable when used in industrial electronic control equipment (such as counting, sorting, burglar alarms, smoke alarms, etc.)

R61 SERIES

The R61 Visitron phototube has the same general characteristics and maximum ratings as the R58 series but different physical characteristics. This tube is supplied with a five prong octal type base and a T9 bulb, dimensions are shown on drawing below.

The R61 series is supplied with two types of cathode surfaces, "A" type sensitive to infra-red and "B" type sensitive to blue.

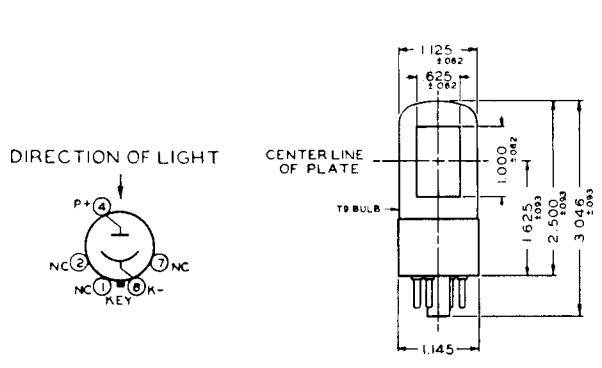
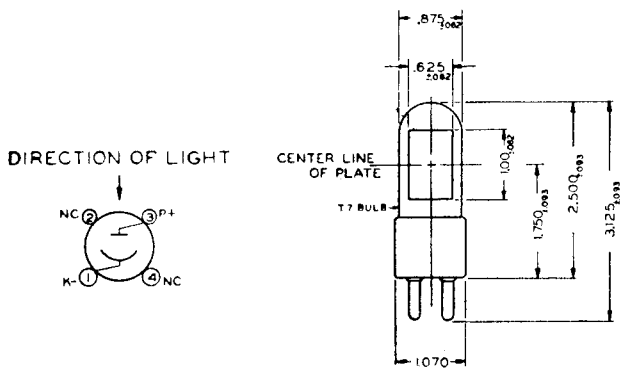
The exceptional high response to blue radiation and insignificant response to red radiation of the R61 blue sensitive tube makes it valuable in flame control work where it is desired that the tube respond to the flame and not to heated objects in it. The R61B series can be supplied on special order with non-hygroscopic ceramic bases.

GENERAL CHARACTERISTICS

	R58A	R58AV	R61A	R61AV	R61B	R61BV
Cathode Surface	S1	S1	S1	S1	S4	S4
Cathode Size	1.00" x .625"	1.00" x .625"	1.00" x .625"	1.00" x .625"	1.00" x .625"	1.00" x .625"
Capacitance (Anode-Cathode) ...	2.5 MMF.	2.0 MMF.	2.5 MMF.	2.0 MMF.	2.5 MMF.	2.0 MMF.
Leakage Resistance (Min)	1000 Meg.	1000 Meg.	1000 Meg.	1000 Meg.	1000 Meg.	1000 Meg.

MAXIMUM RATINGS

	R58A	R58AV	R61A	R61AV	R61B	R61BV
Anode Voltage, Peak	90V	500V	90V	500V	90V	500V
Luminous Sensitivity	225 uA/L DC	40 uA/L DC	225 uA/L DC	40 uA/L DC	250 uA/L DC	45 uA/L DC
Luminous Sensitivity (25v).....	40 uA/L DC	35 uA/L DC	40 uA/L DC	35 uA/L DC	40 uA/L DC	40 uA/L DC
Gas Amplification	8	- - -	8	- - -	8	- - -
Temperature, ambient	100°C	100°C	100°C	100°C	100°C	100°C



VISITRON

R59 SERIES

The R59 series tubes are widely used in theater sound projection equipment. This medium sized tube has long been prominent in 35 MM semi-portable systems. Its rugged dependability makes it exceptionally adaptable to industrial electronic equipment.

The R59 series is supplied with two types of cathode surfaces, "A" type sensitive to infra-red and "B" type sensitive to blue.

The blue sensitive Visitron tubes have a high response to blue radiation and insignificant response to red radiation. This tube will prove advantageous in sound reproductions involving a dye-image sound track in conjunction with an incandescent light source.

The R59 series is also available on special order with Corex D bulb for use in applications requiring response in the ultra-violet region. Among the many uses of this type tube are rapid and direct measurement of spectrum line intensities without recourse to photography and the measurement of ultra-violet intensities in biological and therapeutic work. These ultra-violet tubes are identified by the letter "C" (example R59CV-2). Price will be submitted upon application.



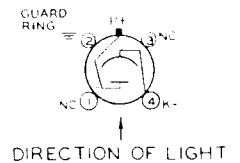
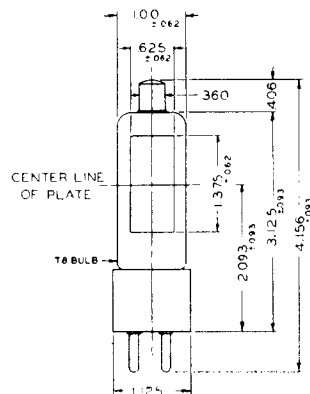
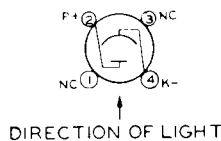
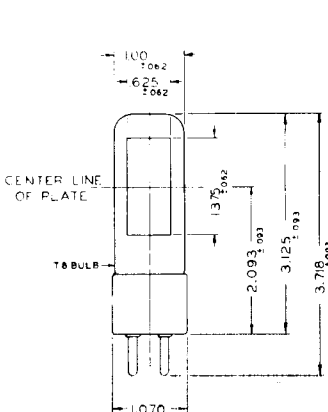
TYPE R59

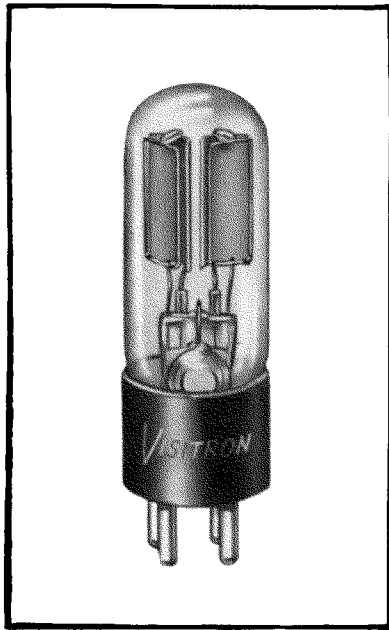
GENERAL CHARACTERISTICS

	R59A	R59AV	R59TA	R59TAV
Cathode Surface.....	S1	S1	S1	S1
Cathode Size.....	1.37" x .62"	1.37" x .62"	1.37" x .62"	1.37" x .62"
Capacitance (Anode-Cathode).....	2.5 MMF.	2.0 MMF.	< .8 MMF.	< .7 MMF.
Leakage Resistance (Min).....	1000 Meg.	1000 Meg.	1000 Meg.	1000 Meg.
	R59B	R59BV	R59TB	R59TBV
Cathode Surface.....	S4	S4	S4	S4
Cathode Size.....	1.37" x .62"	1.37" x .62"	1.37" x .62"	1.37" x .62"
Capacitance (Anode-Cathode).....	2.5 MMF.	2.0 MMF.	< .8 MMF.	< .7 MMF.
Leakage Resistance (Min).....	1000 Meg.	1000 Meg.	1000 Meg.	1000 Meg.

MAXIMUM RATINGS

	R59A	R59AV	R59TA	R59TAV
Anode Voltage, Peak.....	90V	500V	90V	500V
Luminous Sensitivity.....	225 uA/L DC	40 uA/L DC	225 uA/L DC	40 uA/L DC
Luminous Sensitivity (25v).....	40 uA/L DC	35 uAL/DC	40 uA/L DC	35 uAL/DC
Gas Amplification.....	8	- - -	8	- - -
Temperature, ambient.....	100°C	100°C	100°C	100°C
	R59B	R59BV	R59TB	R59TBV
Anode Voltage, Peak.....	90V	500V	90V	500V
Luminous Sensitivity.....	250 uA/L DC	45 uA/L DC	250 uA/L DC	45 uA/L DC
Luminous Sensitivity (25v).....	40 uA/L DC	40 uA/L DC	40 uA/L DC	40 uA/L DC
Gas Amplification.....	8	- - -	8	- - -
Temperature, ambient.....	100°C	100°C	100°C	100°C





TYPE R60

V VISITRON

R60 SERIES

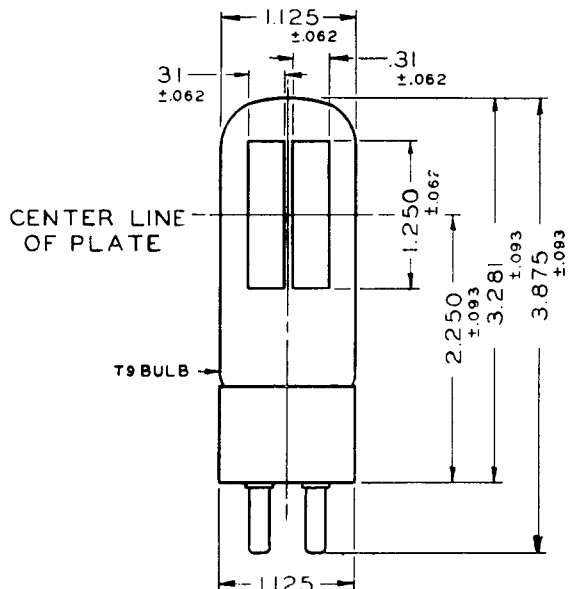
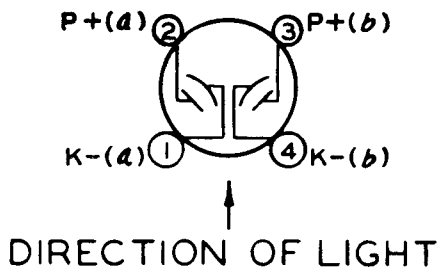
The R60 is a dual phototube with two cathodes and two anodes brought out to separate prongs. Designed primarily for dual sound track systems, it is also ideal wherever dual tube operation is required and space is a factor.

GENERAL CHARACTERISTICS

	R60A	R60AV
Cathode Surface.....	S1	S1
Cathode Size (each Cathode).....	1.250" x .310"	1.250" x .310"
Capacitance (Anode-Cathode).....	2.5 MMF.	2.0 MMF.
Leakage Resistance (Min).....	1000 Meg.	1000 Meg.

MAXIMUM RATINGS

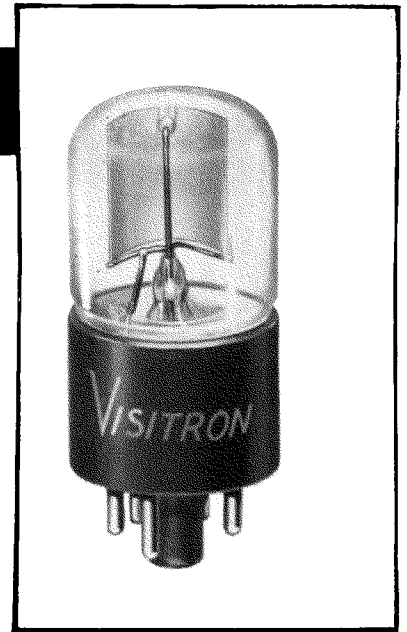
	R60A	R60AV
Anode Voltage, Peak.....	90V	500V
Luminous Sensitivity (ea. Cathode).....	175 uA/L DC	37 uA/L DC
Luminous Sensitivity (25v) (ea. Cathode).....	30 uA/L DC	35 uA/L DC
Gas Amplification.....	10	- - -
Temperature, ambient.....	100°C	100°C



VISITRON

R64 SERIES

A rugged, dependable tube in a short glass envelope. This tube is recommended for industrial light operated relay and measurement applications where space is a limiting factor.



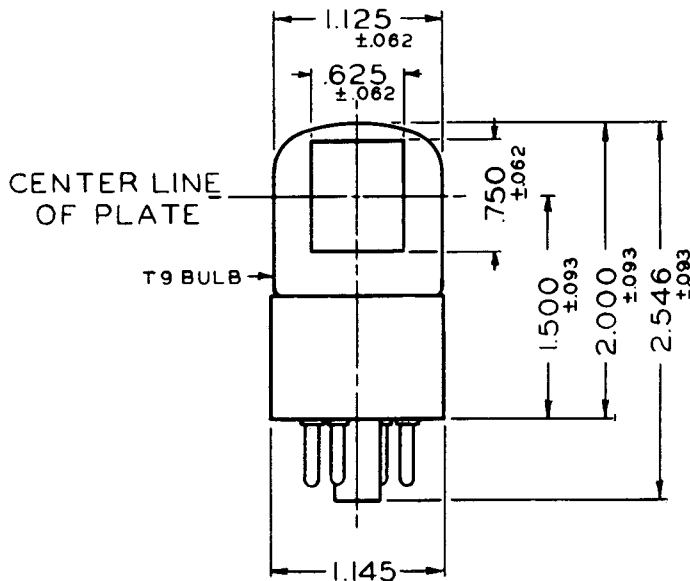
TYPE R64

GENERAL CHARACTERISTICS

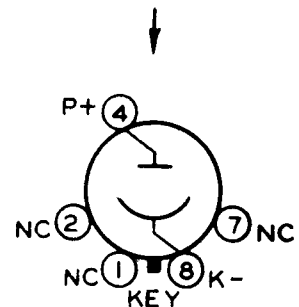
	R64A	R64AV
Cathode Surface.....	S1	S1
Cathode Size.....	.750" x .265"	.750" x .265"
Capacitance (Anode-Cathode).....	2.5 MMF.	2.0 MMF.
Leakage Resistance (Min).....	1000 Meg.	1000 Meg.

MAXIMUM RATINGS

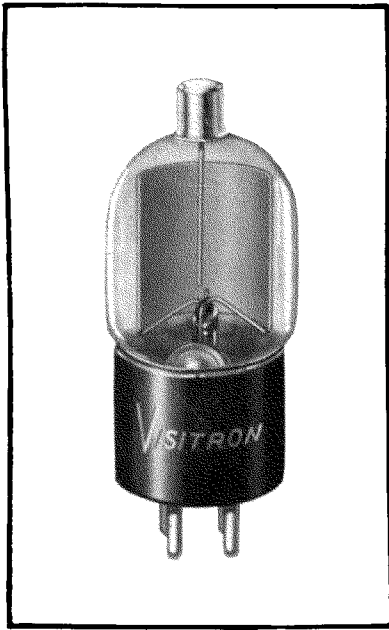
	R64A	R64AV
Anode Voltage, Peak.....	90V	500V
Luminous Sensitivity.....	200 uA/L DC	37 uA/L DC
Luminous Sensitivity (25v).....	35 uA/L DC	35 uA/L DC
Gas Amplification.....	10	--
Temperature ambient.....	100°C	100°C



DIRECTION OF LIGHT



VISITRON



TYPE R71T

R71 SERIES

One of the most commonly used Visitron phototubes of today, the R71 series is universally accepted as THE phototube to use where dependability and long trouble-free operation is desired. Recommended as ideal for sound-on-film applications. When used for this purpose this tube is exceptionally free from tube noises and microphonics.

The R71 tube is also used extensively in electronic control equipment for weighing, conveyor, illumination controls, smoke and turbidity measurement controls, safety devices, etc.

The R71 series is supplied with two types of cathode surfaces, "A" type sensitive to infra-red and "B" type sensitive to blue.

The exceptional high response to blue radiation and insignificant response to red radiation of the R71 blue sensitive tube makes it valuable in flame control work where it is desired that the tube respond to the flame and not to heated objects in it.

The R71 series is also available on special order with Corex D bulb for use in the ultra-violet region of the spectrum. These ultra-violet tubes are identified by the letter "C" (example R71CV-2). Prices will be submitted upon application.

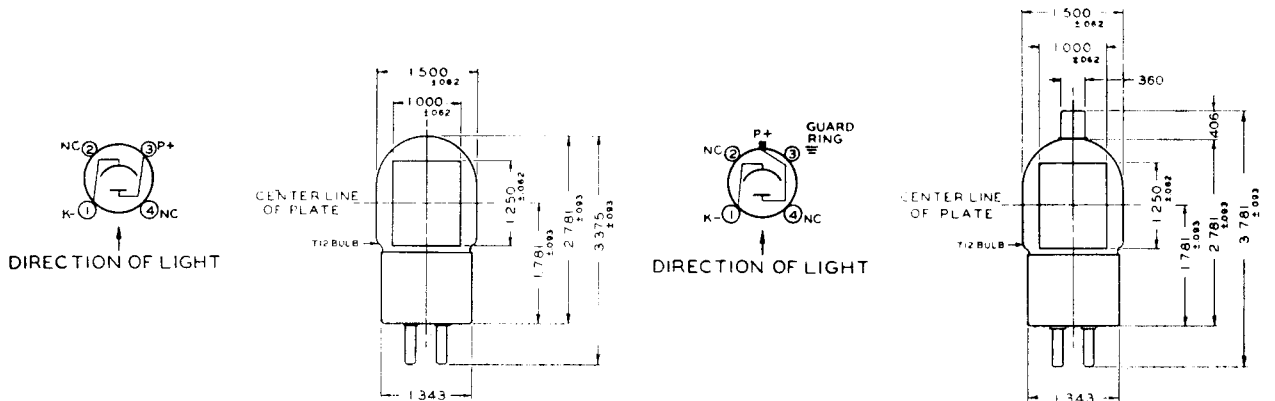
Series R71T tubes with anode cap are supplied with non-hygroscopic ceramic bases. The R71B series can also be supplied on special order with non-hygroscopic ceramic bases.

GENERAL CHARACTERISTICS

	R71A	R71AV	R71TA	R71TAV
Cathode Size.....	S1	S1	S1	S1
Cathode Surface.....	1.25" x 1.0"	1.25" x 1.0"	1.25" x 1.0"	1.25" x 1.0"
Capacitance (Anode-Cathode).....	2.5 MMF.	2.0 MMF.	< .8 MMF.	< .7 MMF.
Leakage Resistance (Min).....	1000 Meg.	1000 Meg.	1000 Meg.	1000 Meg.
	R71B	R71BV	R71TB	R71TBV
Cathode Size.....	S4	S4	S4	S4
Cathode Surface.....	1.25" x 1.0"	1.25" x 1.0"	1.25" x 1.0"	1.25" x 1.0"
Capacitance (Anode-Cathode).....	2.5 MMF.	2.0 MMF.	< .8 MMF.	< .7 MMF.
Leakage Resistance (Min).....	1000 Meg.	1000 Meg.	1000 Meg.	1000 Meg.

MAXIMUM RATINGS

	R71A	R71TAV	R71TA	R71TAV
Anode Voltage, Peak.....	90V	500V	90V	500V
Luminous Sensitivity.....	250 uA/L DC	40 uA/L DC	250 uA/L DC	40 uA/L DC
Luminous Sensitivity (25v).....	45 uA/L DC	37 uA/L DC	45 uA/L DC	37 uA/L DC
Gas Amplification.....	8	- - -	8	- - -
Temperature, ambient.....	100°C	100°C	100°C	100°C
	R71B	R71BV	R71TB	R71TBV
Anode Voltage, Peak.....	90V	500V	90V	500V
Luminous Sensitivity.....	300 uA/L DC	55 uA/L DC	300 uA/L DC	55 uA/L DC
Luminous Sensitivity (25v).....	50 uA/L DC	50 uA/L DC	50 uA/L DC	50 uA/L DC
Gas Amplification.....	8	- - -	8	- - -
Temperature, ambient.....	100°C	100°C	100°C	100°C



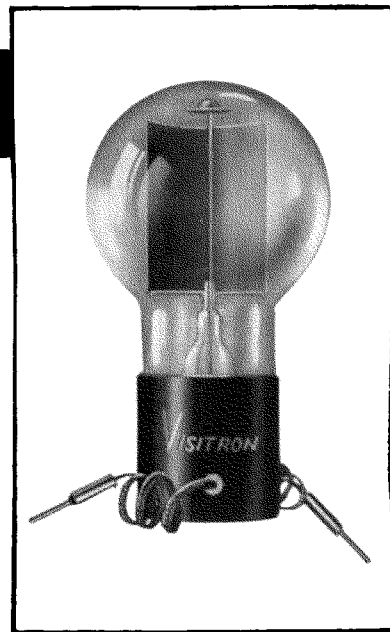
VISITRON

R79 SERIES

The Visitron R79 is a tube having an extra large cathode designed for a maximum area of light beam, commonly used in standard theatre projection equipment. A sturdy tube to give constant quality performance.

R78 SERIES

Identical to the R79 series in electrical and physical characteristics but equipped with a large four prong base instead of flexible leads.



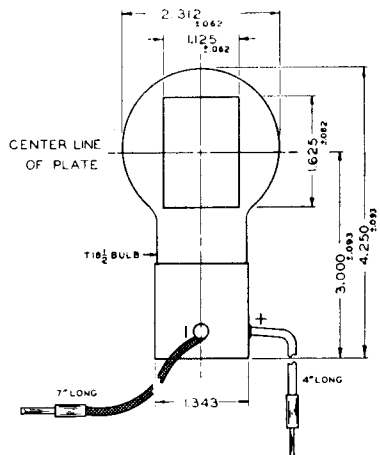
TYPE R79

GENERAL CHARACTERISTICS

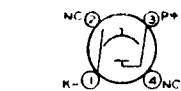
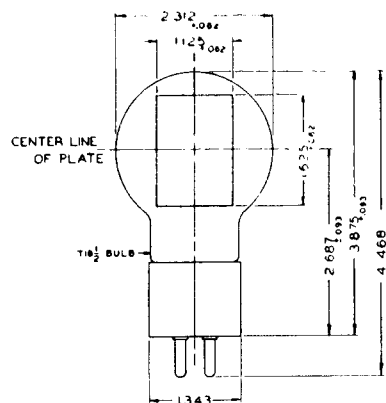
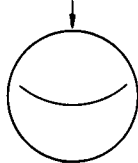
	R78A	R78AV	R79A	R79AV
Cathode Surface	S1	S1	S1	S1
Cathode Size	1.625" x 1.125"	1.625" x 1.125"	1.625" x 1.125"	1.625" x 1.125"
Capacitance (Anode-Cathode)	2.5 MMF.	2.0 MMF.	2.5 MMF.	2.0 MMF.
Leakage Resistance (Min)	1000 Meg.	1000 Meg.	1000 Meg.	1000 Meg.

MAXIMUM RATINGS

	R78A	R78AV	R79A	R79AV
Anode Voltage, Peak	90V	500V	90V	500V
Luminous Sensitivity	225 uA/L DC	40 uA/L DC	225 uA/L DC	40 uA/L DC
Luminous Sensitivity (25v)	40 uA/L DC	35 uA/L DC	40 uA/L DC	35 uA/L DC
Gas Amplification	8	- - -	8	- - -
Temperature, ambient	100°C	100°C	100°C	100°C

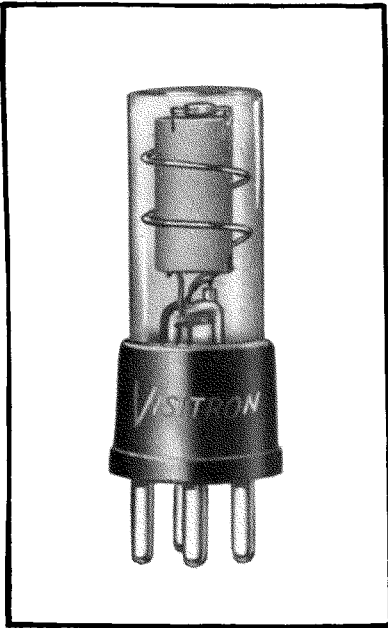


DIRECTION OF LIGHT



DIRECTION OF LIGHT

VISITRON



TYPE R85

R85 SERIES

A non-directional Visitron Phototube having a 360° pickup. Features an increased sensitivity due to utilization of all energy from the light source. Ideal wherever multi-directional applications are employed such as electronic operated target games, multiple beam burglar and fire alarms, etc.

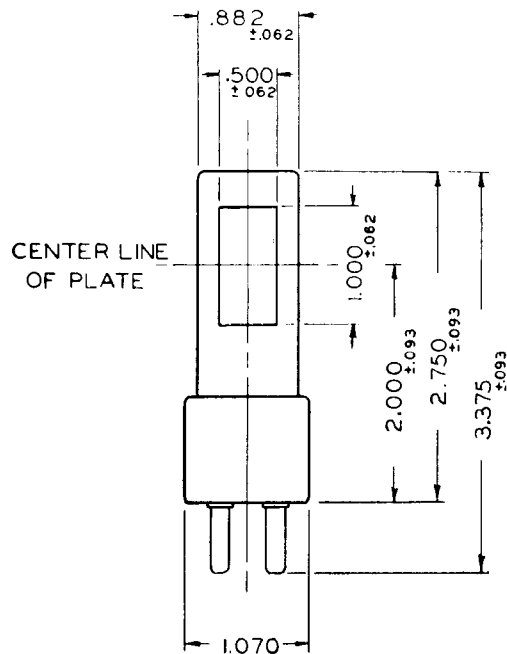
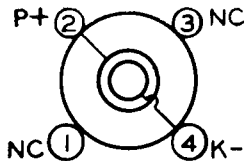
GENERAL CHARACTERISTICS

	R85A	R85AV
Cathode Surface.....	S1	S1
Cathode Size.....	1.000" x .500" (from 360°)	1.000" x .500" (from 360°)
Capacitance (Anode-Cathode).....	2.5 MMF.	2.0 MMF.
Leakage Resistance (Min).....	1000 Meg.	1000 Meg.

MAXIMUM RATINGS

	R85A	R85AV
Anode Voltage, Peak.....	90V	500V
Luminous Sensitivity.....	175 uA/L DC	40 uA/L DC
Luminous Sensitivity (25v).....	40 uA/L DC	37 uA/L DC
Gas Amplification.....	8	---
Temperature, ambient.....	100°C	100°C

DIRECTION OF LIGHT
360°



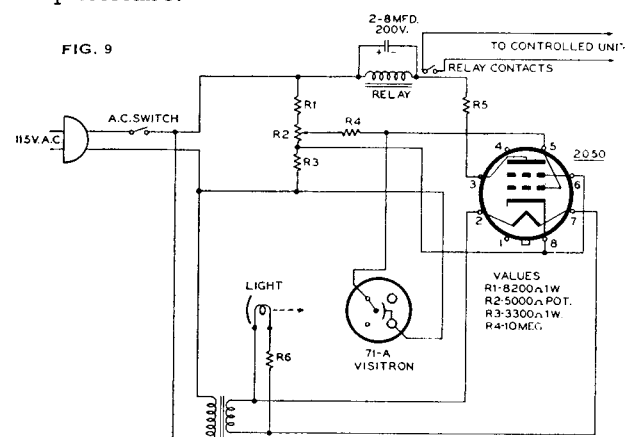
CIRCUIT APPLICATIONS

Phototubes are so versatile that the scope of their utility is limited largely by the ingenuity of the designing engineer. Whether they give dependable service or not depends on the application engineering. If proper consideration is given to ambient light changes, operating voltage, temperature, humidity, dirt, chemical dust or vapors, shock and vibration, Visitron Phototubes will give very long life, free from trouble, in any application.

AMBIENT LIGHT VARIATIONS: One of the most obvious agencies interfering with the proper operation of a phototube installation is variation in light intensity at the point where the phototube is located. The most obvious method of preventing variation in light intensity is to shield the phototube from all light except that coming through the zone where photoelectric control is desired, and to make the control

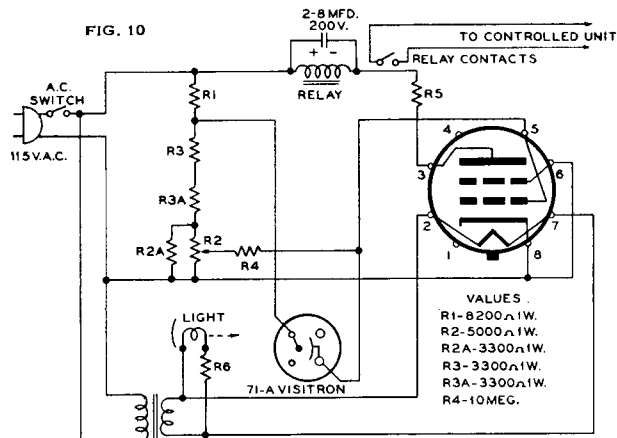
illumination strong enough to overcome interfering stray light. Figure 7 shows a very common method of excluding stray light. This consists of enclosing the cell in a light-tight box and allowing light to reach it only through a tube which restricts the angle through which light can reach the phototube. To cut down reflection within the tube, it should be given a dead black (dull) finish inside. A better method is to use a larger diameter tube with several diaphragms which are more effective in cutting down reflection. Such a unit is shown in Figure 8.

The method of obtaining high illumination is to make the light path as short as possible, to focus the light by means of lenses having high efficiency (large ratio of diameter to focal length), to reinforce the light by means of a reflector and by means of lamps of adequate wattage in a concentrated filament. If the illumination necessary to over-ride stray light conditions is very high, it may be necessary to use a filter at the phototube to reduce all light, desired as well as undesired, in order not to damage the phototube.

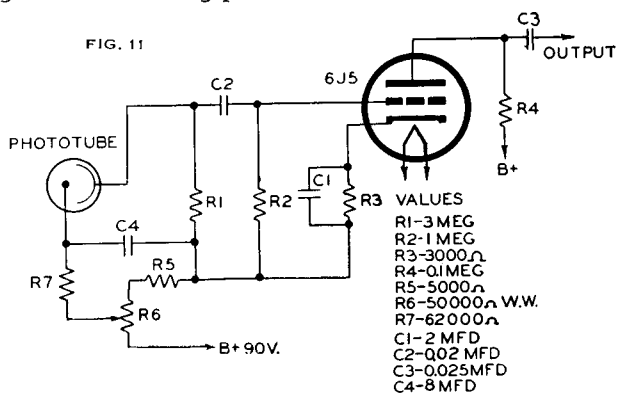


ACTUATE ON DECREASING LIGHT: Figure 9 is a very simple circuit, operating entirely from AC, which actuates a relay when the light falls below a certain level, which is adjustable. Typical uses for such a circuit are counting (up to several hundred per minute) intrusion alarms, door actuator, sign lighting control, automatic fountain actuator, annunciator, etc. The operation of the circuit is as follows: light falling on the phototube causes a current to flow in R_4 making the right hand end of this resistor negative with respect to the slider on R_2 . If sufficient voltage is developed the grid of the

Thyratron 2050 is negative with respect to its cathode and no current flows in its load circuit (relay plus resistor). When light is decreased the bias on the tube is reduced, the Thyratron ionizes, current flows in its load circuit closing the relay to perform useful work. Potentiometer R_2 adjusts the circuit to respond at different levels of illumination. The exciter lamp shown is a 32 candle power automobile headlight bulb. Resistor R_6 may be an actual resistor or may be the resistance of the hookup wires to drop the voltage to approximately $5\frac{1}{2}$ volts to prolong the life of the lamp. The transformer should be rated at 6.3 volts @ 5 amperes. The phototube is a Visitron 71-A gas filled tube. Vacuum type tubes are almost never used for such applications.



ACTUATE ON INCREASING LIGHT: Figure 10 shows a simple circuit actuated by an increase in light. Typical uses are: fire alarms, safety devices on machinery, garage door openers, etc. The action of the circuit is similar to that in figure 9 except that when current flows in the phototube it makes the right hand end of R_4 positive with respect to R_2 overcoming the negative bias on the Thyratron grid, and causing plate current to flow.



ACTUATE ON MODULATED LIGHT: Figure 11 shows a typical circuit for operation from modulated light. The most outstanding application for such a circuit is in sound on film. Additional uses are electronic organs, talking light beams and devices working from chopped light to overcome difficulties due to fluctuating ambient light. Only one stage of amplification has been shown. Additional stages will be required in accordance with the use of the device. The action of this circuit is as follows: Potentiometer R_6 adjusts the operating voltage on the gas filled phototube changing its gas amplification ratio and thereby its sensitivity. Capacitor C_4 and Resistor R_8 form a hum filter. The audio voltage is developed across R_1 and is coupled to the pre-amplifier tube through C_2 and R_2 in the conventional manner.

EQUIPMENT APPLICATIONS

A few of the problems solved with
VISITRON Phototubes

CONTROL

- Lighting Control
- Machine control
 - engraving, gas-flame, cutting
- Protective alarms
- Recorders
 - use of filters, etc.
- Temperature control
 - flame control, etc.
- Water control
 - level control, switch control for turning on, etc.

METERS

- Color analyzer
 - toast, chemicals, oils, fruits, etc.
- Densitometers
 - density of photographic films
- Photometers
 - surface fass of papers,
 - scattering of light, total light flux
- Pyrometers
 - color temperature of flames,
 - tungsten filament and other hot materials
- Smoke meters
- Spectrophotometer

COUNTING, SORTING, ETC.

- Sort and, or, count colored subjects
- Sort and, or, count objects by physical size

MANUFACTURING USES

- Automatic metal pouring in foundries
- Brightness rating of metal surfaces by reflected light (surface finish)
- Dust recorder and control of
- Detection of pinholes in tin plate
- Control of edges
- Bottle inspection
- Perforating of cards
- Inspect edges of razor blades
- Candy wrapper
- Gauging of piston rings
- Weighing

PHOTOGRAPHIC USES OF PHOTOTUBES

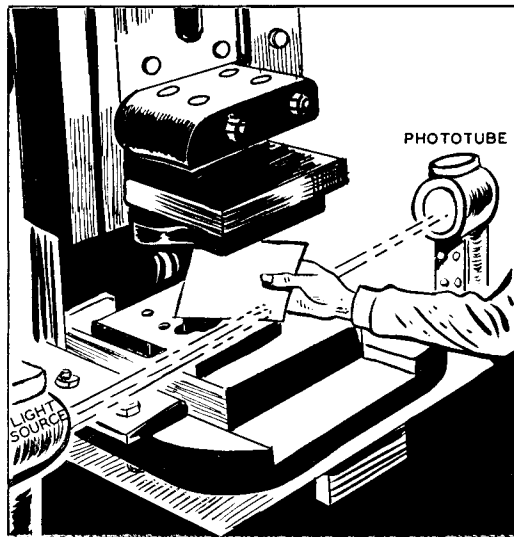
- Sound recording
- Calibrating stop values of lenses
- Exposure meters
- Flash camera
- Time-interval meter (speed)

SCIENTIFIC APPLICATIONS

- Cloud heights in daylight and densities
- Curve tracing devices

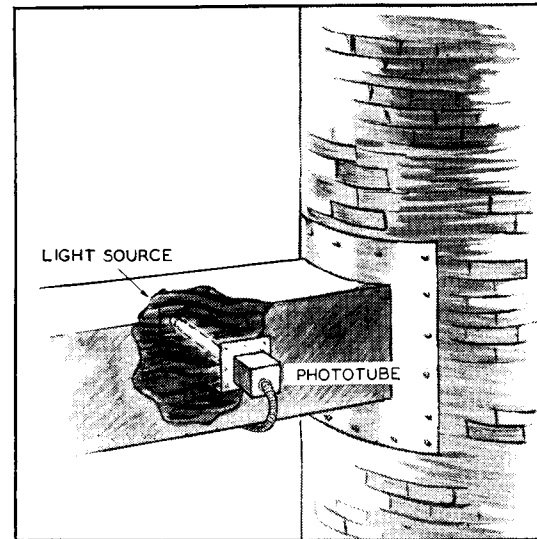
MISCELLANEOUS

- Air-conditioning safety device (fire damper release and method of preventing smoke from being recirculated into auditorium thru the air-conditioning system)
- Electronic area calculator
- Measure creep of metals
- Measure speed of projectiles, autos, horses, etc.
- Transparency tests
- Color comparators
- Guiding of astronomical telescopes
- Phono reproducer
- Automatic steering for boats



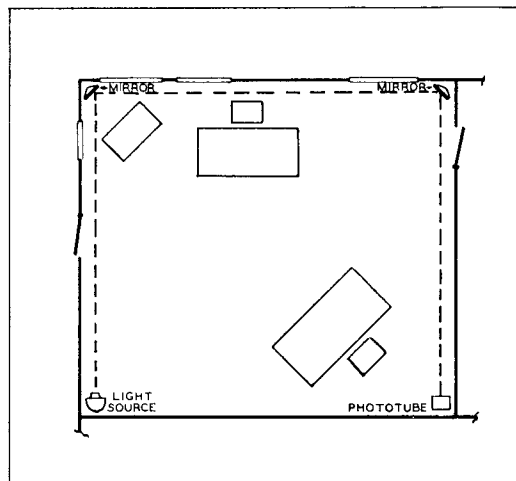
SAFETY

A light source and phototube housing placed across the opening of die and punch in hydraulic and other presses, automatically stops and reverses the action when operator places hands near the die, giving protection to life and limb.



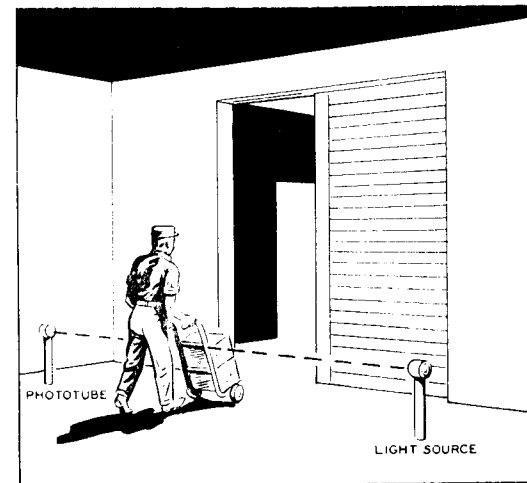
SMOKE ALARM

In this phototube application a predetermined density of smoke passing through a light beam placed across the smoke chamber activates the phototube sounding an alarm. This type of system pays for itself many times in resulting fuel saving.



BURGLAR ALARM

Photoelectric devices can be used to safeguard property against intrusion. Interiors or exteriors can be covered with invisible (black) light beams so that forced entry by a prowler will automatically set off an external alarm.



DOOR CONTROL

A light beam falling on the phototube automatically controls the opening and closing doors or gates. Factories, restaurants, garages, country estates, etc. find this phototube application an economical labor-saving device.

PHOTOTUBE COMPARISON CHART

Rauland Visatron	Cetron	RCA	GE	Raytheon	Sylvania	Westinghouse	Lumotron	W. E.
R50A								
R51A	CE36/CE25	927					G16	
R51AV	CE36V/CE25V							
R51B								
R51BV								
1P36/R58A	CE4			4GSM			G12	
R58AV	CE4V							
R59A	CE1	868/918		4GSM	868	WL-735	G9	
R59TA	CE11							
R59AV	CE1V					WL734		
R59TAV	CE11V	917	GL917					
1P37/R59B								
R59BV								
R60A	CE21	920	GL920				G18T	
R61A	CE30	930	GL930					
R61AV	CE30V							
R61B								
R61BV		929						
R62A								
R62AV								
R64A								
R64AV		925						
1P30/R71A	CE2			4GC	814A	WL-737	G6	
R71TA	CE13							
R71AV	CE2V							
R71TAV								
R71B								
R71BV								
1P33/78A	CE26							WE6A
1P31/79A	CE3			4G3-A	803A	WL738	G10	WE3A
R84A	CE23	923	GL923			WL741		
R84AV								
R85A	CE28	928						
R85AV								