Signalite

APPLICATION NEWS

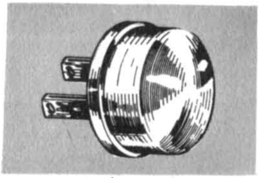
from the desk of

Ed Bauman, Chief Engineer

VOL. 2, NO. 6

Send Us Your Glow Lamp Application

The use of the neon glow lamp as a reliable circuit component has dramatically increased the need for application information. We are asking that you:



1) Send application examples—both general and specific
2) Send application problems or solutions to problems that we publish

A Signalite Owl Eye Nite Lite for the home will be sent free to each person who sends us an application, a problem or a solution.

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EVALUATING AND APPLYING NEON GLOW LAMPS

by Edward Bauman
Chief Engineer,
Signalite Inc.

Neon glow lamps, or perhaps more correctly cold cathode diodes, are becoming a product of increasing interest to electronic design engineers. Because of their versatility and ability to do a variety of jobs well and economically, they are finding increasing applications in electronic circuitry. Where formerly they were used almost exclusively as indicator lamps, they are now used as circuit logic elements, photochoppers, in memory circuits, voltage regulators and timers.

Unfortunately, the original neon glow lamp, which was designed for non-critical indicator uses in appliances, night lights, and other ornamental devices, was not intended for use in critical electronics circuits.

We say "unfortunately" because use of an indicator lamp in a critical circuit may jeopardize performance of the circuit, or may result in an inordinately high cost per unit because of wastage in finding lamps that meet and hold tight specifications. We have encountered manufacturers who were discarding 75% or more of a shipment of lamps during incoming inspection, making a relatively inexpensive component quite expensive. Add to this the cost of rework and field service to replace lamps that passed inspection but did not perform after installation, and the cost of this inexpensive component soars.

The picture, however, is not nearly as black as it might appear on the surface. Neon glow lamps can be produced to the close tolerances required by electronic specifications. It is now possible to specify lamps within narrow limits and expect them to perform as you would any other component in the circuit. Such lamps, however, are designed and manufactured under exacting standards and should not be confused with the more common indicator types. Contrary to some thinking in the industry, neon lamps designed as indicators cannot be aged into reliability for use as circuit components.

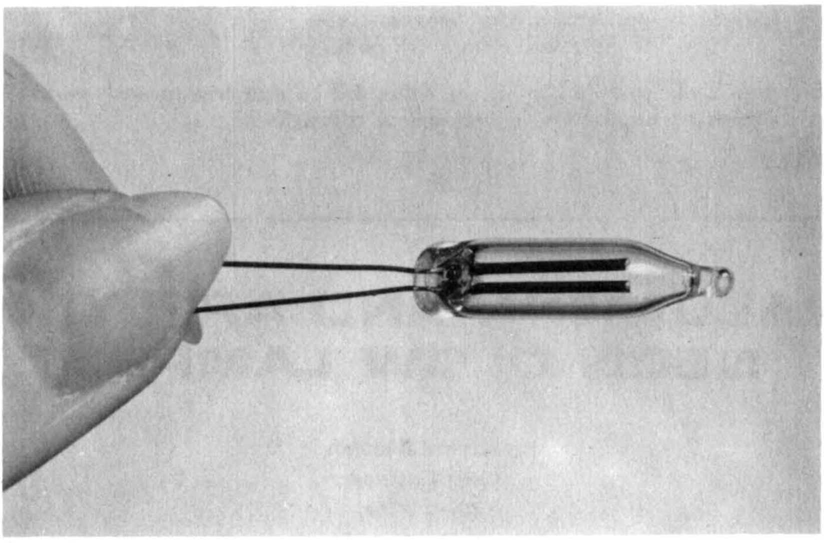

FIG 1

Important Parameters

The neon glow lamp consists of an anode and cathode housed in a glass container filled with rare gases. It breaks down or ignites, when subjected to a certain voltage, usually between 66 and 200 volts dc depending on design. Immediately after breakdown, the voltage across the lamp drops to a reduced level, usually between 48 to 80 volts dc. When the voltage is decreased below this maintaining level, the lamp ceases to conduct and abruptly extinguishes.

The current for neon lamps may vary from .1 milliamp to 10 milliamp. Lifetimes can be higher than 50,000 hours of continuous operation. Lamps meeting specific values within these ranges can be designed.

The amount of time it takes for the lamp to start conducting after application of the breakdown voltage is known as the ionization time. If the applied voltage is just equal to the lamp's specified breakdown voltage, this time may be hundreds of milliseconds. However, if the applied voltage is 30% or greater than the breakdown voltage, the ionization time may be as low as 10 microseconds.

An example of the performance specifications which are easily within reach, characteristic of the lamp shown in Figure 1, are: breakdown voltage 65 to 75 vdc, maintaining voltage 56 vdc ± .5 volt, design current 0.3 ma, and rated life of 7500 hours continuous operation. This particular lamp can be provided with a maintaining voltage at any level between 52 and 59 vdc, still maintaining the tolerance of ± .5 volt.

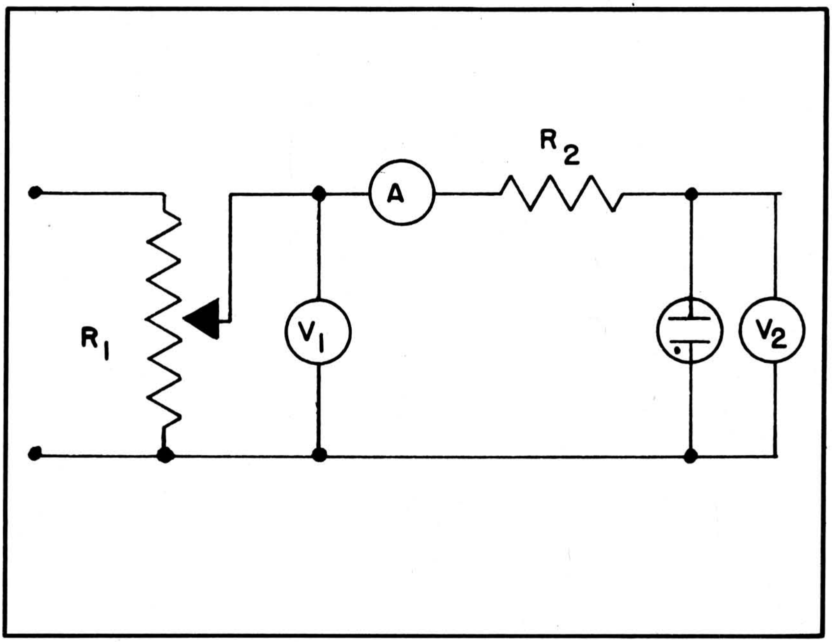

FIG 2

Measuring Parameters

The circuit for measuring standard glow lamp parameters is shown in Figure 2. With the lamp in the position shown, the potentiometer is turned up until the lamp ignites. At this point breakdown voltage is read on voltmeter, V_1. Then the pot is adjusted until the ammeter reads the design current of the lamp. At this point voltmeter, V_2, reads the maintaining voltage. Turning the pot down until the lamp extinguishes will show the extinguishing voltage on voltmeter, V_1. Ionization time is usually measured on a high speed oscilloscope.

All neon glow lamps require ballasting in the form of a resistor in series with the lamp. The value of the resistor depends on the applied voltage, current, and desired lamp characteristics.

Electrostatic and RF Effects

There are also external conditions which affect the operation of neon glow lamps. For example, the existence of an electrostatic field in the vicinity of the glow lamp will noticeably affect its performance. Such a field may decrease the rated breakdown voltage, and cause the lamp to ignite at levels significantly below normal. Electrostatic fields have no effect on maintaining voltage characteristics. High intensity radio frequency can cause the neon lamp to ignite with no applied voltage. These characteristics in themselves suggest other possible applications.

Other External Effects

Neon lamps exhibit a negative temperature characteristic, normally about 40 to 50 millivolts per degree Centigrade. In a voltage regulator this temperature coefficient may be as low as 1.5 millivolts per degree C. This change is small compared to zener diodes. The normal operating temperature specifications for electronic circuitry of $-60°F$ to $+165°F$ are perfectly acceptable to neons. The upper temperature limit not to be exceeded is 300°F.

Another factor that may affect the performance of glow lamps is the absence or presence of light. Normally, high levels of incident illumination tend to reduce the breakdown voltage level. This light effect, however, can be minimized or eliminated by the addition of a small amount of radioactive material during manufacture.

Light Output

Light output of neon lamps in circuit applications is usually not a matter of prime importance, except when being used with photocells. However, the fact that the lamp does glow when it is operating can be used as an indication of circuit operation, especially when inexperienced or untrained personnel are being used to monitor equipment operation. Also, since the glow in a direct current application is confined to the cathode, this characteristic can be used to determine polarity.

Light emitted by standard neon lamps generally averages about .06 lumens per milliamp. Meaningful measurement in this area is limited because conventional N.B.S. standards are about 1,000 times brighter than neon glow lamps. For certain applications high brightness lamps can be used which average about .15 lumens per milliamp. The light itself is confined mainly to the yellow and red regions of the spectrum, between 5200 and 7500 Angstroms. A band in the infrared region between 8200 and 8800 Angstroms is also emitted.

Accelerated Life Testing

The rated life for neon glow lamps is the length of operating time, expressed in hours, which produces certain specified changes in characteristics. In lamps used as circuit components, this characteristic is usually the breakdown and maintaining voltage. Because this change is a gradual process, accelerated life testing methods are not applicable to testing neon glow lamps. There are several reasons for this. First, the greatest changes in breakdown and maintaining voltages take place during the first 100 hours of operation. After this period, changes continue to take place but at a different rate. Second, the rated life is a function of lamp current. Running a lamp at currents above its design current causes heating of the emissive material. This, in turn, will generate sputtering of the material, changing its aging characteristics at a rate that is not reproducible or easily related to its life at normal usage. Consequently, any attempt to accelerate aging at higher currents will not be applicable to actual service. In fact, seasoning at high currents for relatively short periods of time usually produces a temporary change in characteristics which return to the original values after a period of rest.

Rated Life Expectancy

In most circuit applications, neon glow lamps are not on all of the time. In such applications only the time during which the lamp has current passing through it determines the useful life. If this period is a short duration, as in pulsing applications, the rated life will have to reflect the fact that the lamp's useful life is not being consumed while it is inoperative. In many applications, the actual rated life, i.e. calculated operation time of the lamp, will exceed by many times the estimated lifetime of the equipment or circuit in which the lamp is installed.

The life expectancy of a neon glow lamp, of course, depends on the operating conditions of the lamp. Running at higher currents, for example, results in shorter life expectancies than running at lower currents. If the lamp is installed in a circuit where it will be subjected to pulsing, the peak current, pulse wave shape and pulse duration all will have their effect on lamp lifetimes. Lifetimes may range from 1,000 to 50,000 hours of continuous operation. Operation on direct current rather than alternating current will shorten these figures, perhaps up to 50% in some installations, because of the fact that only one electrode is being used instead of both. As a rule of thumb, average circuit component neon lamps will have rated lifetimes in the area of 7,500 hours of continuous operation.

Application Assistance

All of the foregoing leads to one important conclusion regarding the application of neon glow lamps in electronic circuitry. Because of the wide variation in lamps, and because of the wide variation in conditions of application, it is extremely important to consult with the engineering group of the glow lamp manufacturer in the determination of the proper lamp to use in any given situation. Frequently, we have found that standard lamps are completely unsatisfactory for circuit component use, but with only minor design changes, they can be made to perform well. The cost of such changes, even the cost of designing a new lamp from scratch, is almost always relatively insignificant when viewed in terms of the job to be done, or the cost of other components in the system, or the cost of alternative ways to accomplish the task.

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Ed. Note:

Our lead article, Evaluating and Applying Neon Glow Lamps, appeared in the Nov.-Dec. 1964 issue of Evaluation Engineering magazine.

CAN YOU SOLVE THIS ? ?????

Gentlemen:

I have need for a circuit which will flash an indicator lamp from 1 to 600 cycles in a period of 1 to 6 minutes and then an indicator lamp stays on to indicate the end of the period. It is desirable that the total cycles be set in with one control and the total time set with another control so that the operator need not calculate cycles per minute, etc.

Very truly yours,
Sperry Phoenix Co.
C. G. Sutter

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YOUR GLOW LAMP APPLICATION FORUM

It is Signalite's policy to publish letters based on their intrinsic interest only. We do not necessarily agree with all comments and suggested uses and will upon occasion wait for your reaction before taking editorial space for ours.

Alarm Memory System

Dear Ed:

Neon lamps have come to the rescue in providing a simple answer to an alarm memory requirement. The problem arose when it was necessary to interlock several power supplies such that one failure would turn off all power to prevent equipment damage. An interlock system was devised which would shut down all power supplies simultaneously a few milliseconds after a particular supply failed. It was desirable to present an indication of which power supply had failed, causing the shut-down sequence.

Although the interlock system is still in the engineering stage of development, it is hoped that the enclosed Alarm Memory Circuit will provide the answer to our problem.

Circuit operation is as follows:

1) Depressing the START button will energize KC, providing primary power to all power supplies.

2) Assuming normal operation, K1, K2 and KN will energize, interlocking KC and disconnecting all neon lamps from the DC power buss.

3) To illustrate neon memory operation assume power supply #2 failure

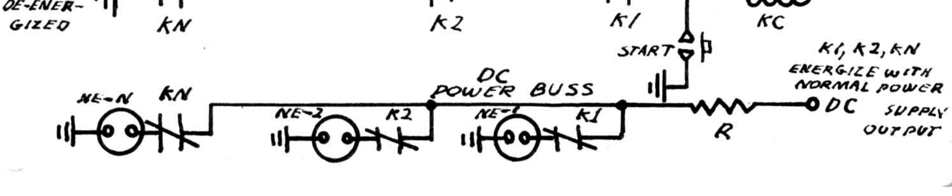
a. K2 de-energizes firing NE-2 and lowering the DC power buss to the maintaining voltage.

b. KC de-energizes removing primary power from all power supplies.

c. A few milliseconds later K1 and KN de-energize connecting NE-1 and NE-N to the DC power buss.

d. All power supplies are shut down and NE-2 announces that power supply #2 initiated the failure. NE-1 and NE-N will not light because the DC power buss voltage is well below their breakdown potential.

Sincerely yours,
C. J. Johnston
WESTERN ELECTRIC CO., INC.



Resistor R chosen so that when any one of the neon lamps are on, 2 ma will flow. Lamps are our LT2-27-1.

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Triangular Voltage Output

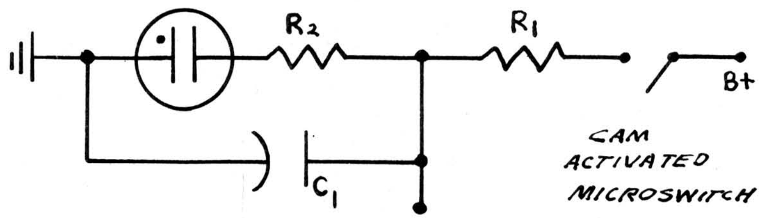
Gentlemen:

As for glow lamp applications, these components have been used extensively in operational amplifier circuits, with a good deal of success, in a similar configuration to the circuit description of using glow lamps as a coupling element for dc amplifier operations.

I am also proposing the following circuit format as the most ready and economic solution for generating a triangular voltage output under the prevailing conditions:

The cam activated microswitch can be readily replaced by any gating circuits as multivibrators, phantastrons, etc.

Very truly yours,
LOCKHEED ELECTRONICS CO.
H. Cook



Ed. Note:

F = rotational speed of cam activated switch. For triangular waveform $F = \frac{1}{T}$*, where* R_1C_1 *and* C_1R_2 *are approximately equal to T.*

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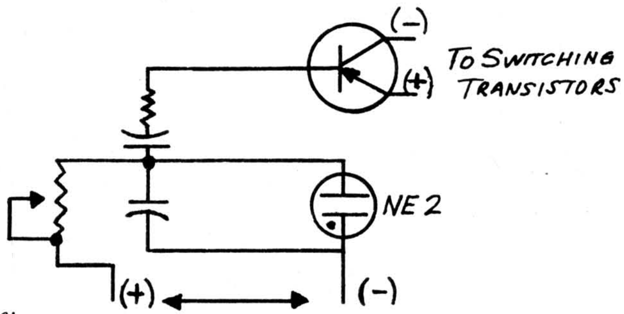
Frequency Drift Problem

Dear Sir:

I have used the enclosed figure for an R/C circuit using NE2 lamps but find after a few days' operations the frequency drifts, and the control must be quite constant.

V. B. Sanford



Ed Note:

Problem is caused by using an indicator lamp (NE-2) to do the job of a circuit component. The drift can be eliminated by using an A078 lamp (Specs: Breakdown voltage 66-74 vdc, maintaining voltage 50-60 vdc, design current 0.3 ma, leakage resistance 10,000 megohms min.) A further improvement would be using a 470-ohm resistor in series with the timing condensors.

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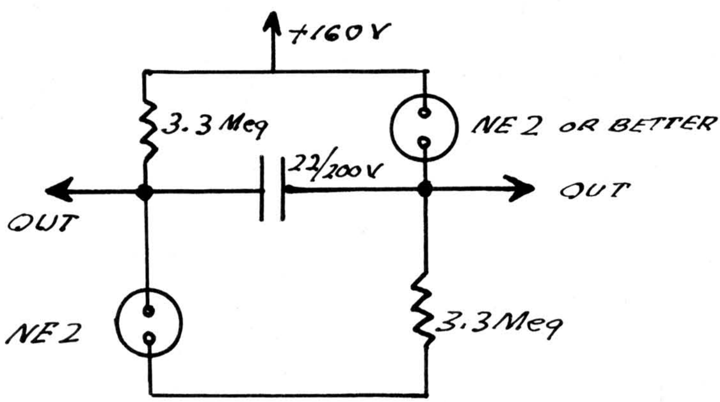
Saw Tooth Voltage

Dear Sir:

This configuration produces a differential saw tooth voltage of twice a single neon. Power supply ripple and noise is also reduced by the symmetrical output.

William Eisenreich
Medical Electronics, Inc.



Ed Note:

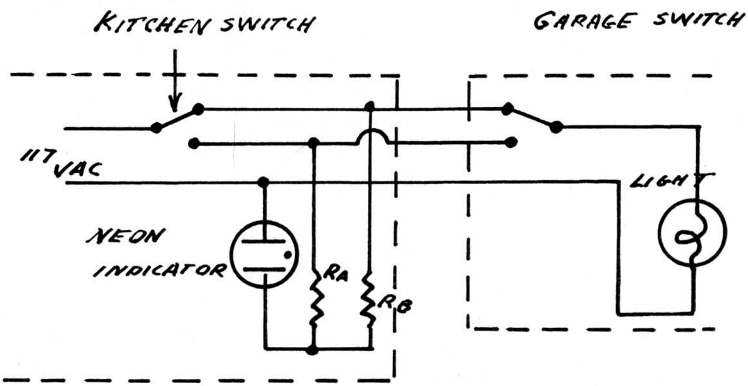
Operation would be improved with our TR-27-1R100 lamps.

Remote Indicator

Dear Sir:

This glow lamp application is in regard to the problem of indicating a circuit condition at its remote switching location when using "3-way" switches. For example, to indicate at the kitchen switch that the garage light is on or off. The circuit below is offered as a solution. $R_A = R_B =$ Normal series resistance for the Neon indicator selected. With both switches on the same line, both lights are "ON". With the switches on opposing lines, the two resistors form a voltage divider reducing the voltage across the lamp to less than its ignition potential, therefore, both lights are "OFF".

Yours truly,
MAGNETIC CONTROLS COMPANY
A. H. Koenig



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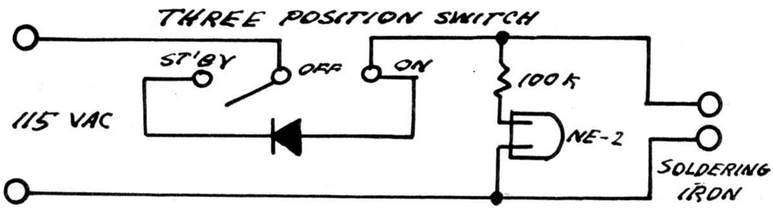
Extending Life of Soldering Iron

Dear Mr. Bauman:

The following circuit is suggested for a pencil type soldering iron tip saver. It would be practical when an iron is used infrequently but is hot when needed.



Both anodes will glow when full AC Voltage is applied, and only one anode will glow when half wave is applied in the standby position.

Yours truly,
W. D. Ameele
STROMBERG-CARLSON

Ed. Note:

For more distinctive indicator, use Signalite LT2-27-1 high brightness lamp with 30K resistor.

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If you have a circuit design problem involving the use of glow lamps, or have developed a circuit in which glow lamps are important for design and/or economic reasons, we would like to discuss your application in a future issue of this newsletter

Applications which in the opinion of Signalite have significant interest will also be brought to the attention of the editors of the leading technical publications for consideration as articles and featurettes. Your by-line and company credit will be given with your permission.

TWX 201-775-2255 Phone: 775-2490 (Area code: 201)

Printed in U.S.A.

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Neptune, N. J.

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