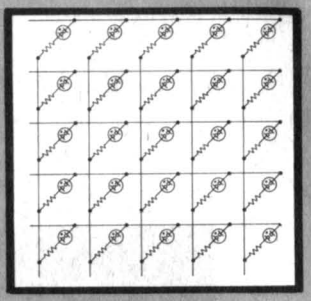
Signalite
APPLICATION NEWS
A General Instrument company



VOL. 2, NO. 5

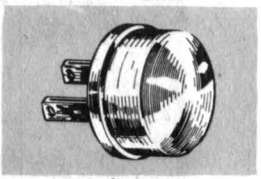
IN THIS ISSUE . . . THE COMPLEMENTARY USE OF NEONS AND TRANSISTORS . . . BY ED. BAUMAN, SIGNALITE CORPORATION

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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Providing Low Cost Reliability in Digital Voltmeters

by: Leonard M. Scholl

Project Manager Non-Linear Systems Inc.

Improving reliability in modern electronic circuitry almost invariably is reflected in substantially increasing costs. This does not have to be a basic rule of development, however, for if the design engineer knows how to take advantage of some of the properties of off-the-shelf products on the market, it may be possible to provide a high degree of reliability at surprisingly low cost.

An example of this approach to design is evident in the Model 484 Digital Voltmeter manufactured by Non-Linear Systems Inc. (Figure 1) The properties of neon glow lamps to absorb momentary surges of high voltage, to isolate un-

wanted signals or spurious noise, and to operate as off-on switches have been utilized in this unit to ensure its high reliability. The two circuits in which the neon glow lamps are installed are shown in Figures 2 and 3.

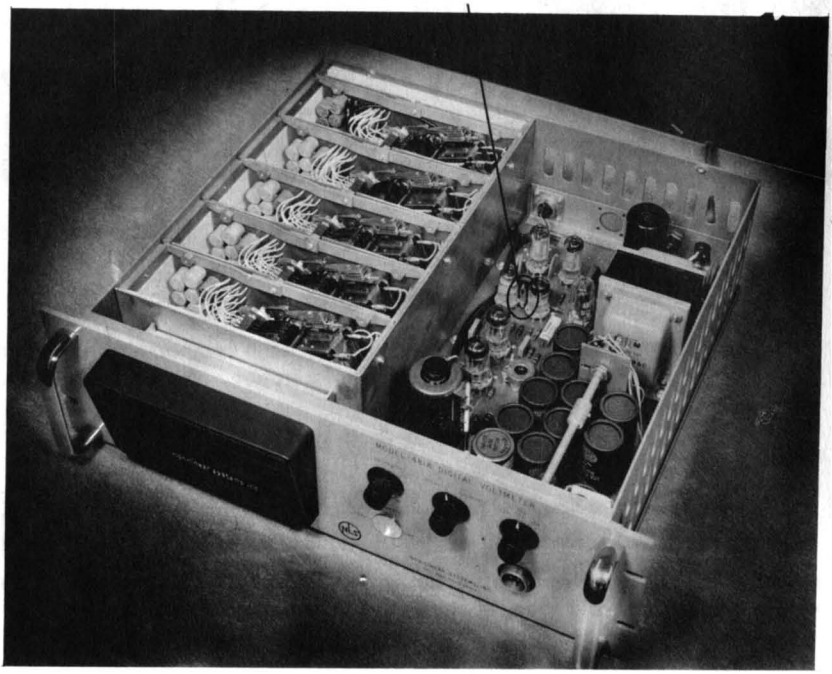
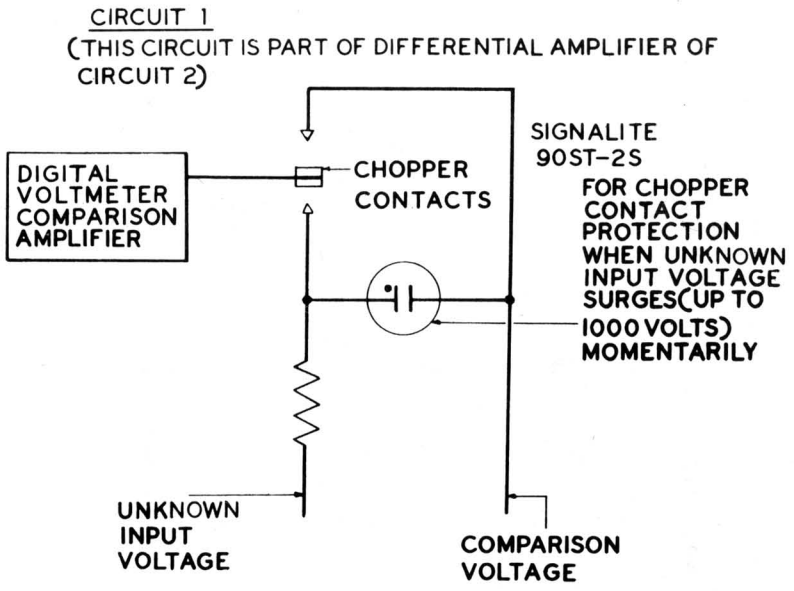


Figure 1 — In this exposed view of the Non-Linear Systems, Inc. digital voltmeter, the Signalite 90ST2S neon glow lamp in Circuit 2 (see Figure 3) can be seen between the thyratrons.

Circuit 1: (Figure 2)

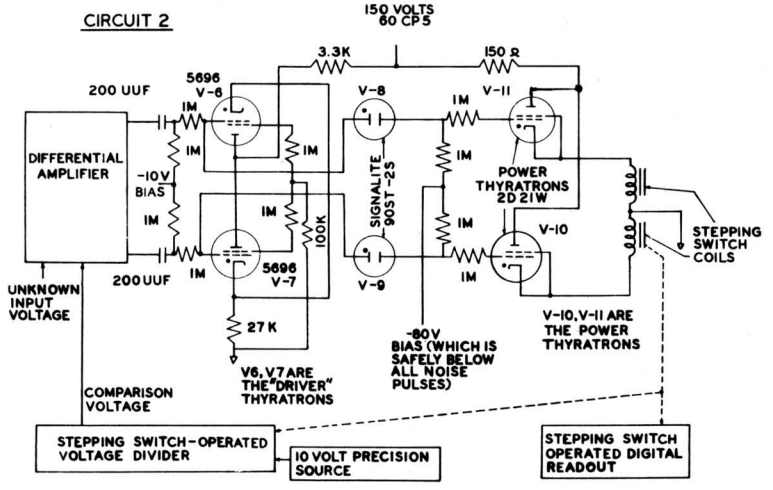
Here, a neon tube is used for chopper protection. It provides a by-pass for high voltages around chopper contacts. During range switching in digital voltmeters, momentary high voltages are often applied to chopper contacts, which would be burned if not protected. The lamps, produced by Signalite Inc., Neptune, N. J., do not affect digital voltmeter operation during normal measurements because they are effectively open circuited when extinguished.

All of the neon glow lamps used in the voltmeter are Signalite type 90ST2S. These lamps ignite when subjected to voltages between 94-106 vdc, and continue to operate while the voltage is 77-90 vdc. When the voltage drops to 75 vdc, the lamps will extinguish.



Circuit 2: (Figure 3)

Two 90ST2S Signalite lamps are used to reliably fire power thyratrons to pulse stepping switches. The driver thyratrons are set to be fired by an input of 1 millivolt to the amplifier. When ignited, these thyratrons exceed the breakdown voltage of the neon lamps, which ignite the power thyratrons. The power thyratrons are biased off by a high negative voltage to avoid being fired by noise pulses created by pulsing the stepping switches. Since they are such effective on-off switches, the 90ST2S lamps greatly simplify using a high negative bias voltage. The neon bulbs very effectively isolate the driver thyratrons and the amplifier from these noise pulses.



This circuit is part of the nulling amplifier (or "comparison" amplifier) of a digital voltmeter. Digital voltmeter operation is as follows: The digital voltmeter's voltage divider is operated by stepping switches, and creates a voltage (comparison voltage) equal to the unknown input voltage. The unknown voltage and comparison voltage are applied to the input of a differential amplifier whose output is connected to the driver thyratrons. Whenever the difference between the unknown and comparison voltages exceeds 1 millivolt, one set of thyratrons (V6 and V-11, or V9 and V10) "fire" and pulse the stepping switches until the stepping switch operated divider creates a comparison voltage equal to the unknown input (within ± 1 millivolt).

The Complementary Use of Neons and Transistors

Ed Bauman, Chief Engineer

A number of letters have been received concerning the use of neon glow lamps with transistors. Neon glow lamps are a natural component to use in transistor circuitry because of their low current requirements, absence of heat generated and long lifetimes. The A079 lamp has been specifically designed to be used with transistors and is shown in three of the circuits accompanying this discussion. Its characteristics are: Breakdown voltage 70 vdc maximum, maintaining voltage 55 vdc, design current 0.3 ma.

Normally, neon glow lamps require approximately 70 volts or more for ignition. However, in a transistor circuit, such as shown in Figure 1, it is possible to trigger the tube with extremely low voltages. In this case the transistor acts as a current amplifier. Voltages in the order of .3 volts or currents of .1 ma can operate neon lamps through the transistor.

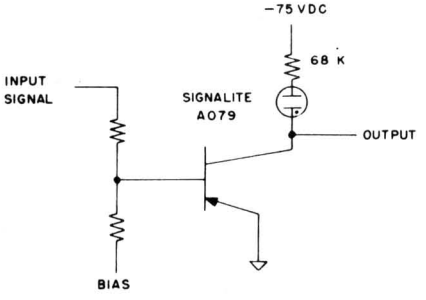


FIGURE 1. TRANSISTORIZED OUTPUT CIRCUIT AND INDICATOR

In this circuit the reverse bias applied to the base of the transistor in the absence of an incoming signal keeps the transistor in a cut-off condition. As a

result, no emitter to collector current flows. Because the A079 is also non-conducting the 75 vdc is prevented from being applied to the transistor. When an input signal is applied such as to cause a given current to flow in the same circuit, the transistor will change its condition from cut-off to saturation. This, then, allows current to flow from the emitter to the collector with only approximately a .6 volt drop. The A079 lamp is now on. The corresponding voltage drop of 55 volts is the maintaining voltage of the tube. The remainder of the voltage, 19.4 volts, appears across the resistor. This means that .3 ma is flowing through the lamp. The maximum voltage that will appear across the collector to base in transistor is less than 20 volts and this occurs only at the instant of cut-off.

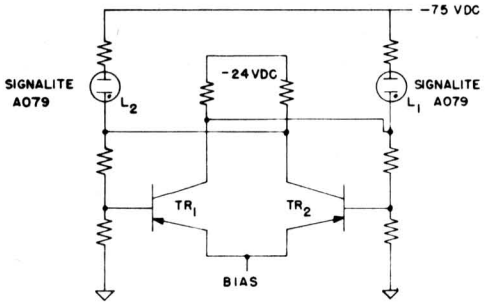


FIGURE 2. FLIP FLOP STATUS INDICATOR

Figure 1 represents the most common arrangement for a transistor operated indicator light. A typical application of this use is shown in Figure 2, a flip-flop status indicator. In this circuit it can be seen that when transistor TR_1 is "on", or saturated, indicator light L_1 is also on. At this time transistor TR_2 is "off". Its collector voltage is approximately 24 v. The resulting 51 volts (75 volts B+ minus the 24 v collector voltage) is below the 55 v maintaining voltage of the A079 lamp. Hence, lamp L_2 is off. When the flip-flop changes its condition by virtue of an external signal, TR_2 turns "on" and lamp L_2 turns on also through the process described above. TR_1 is then cut off and, with only 51 volts appearing across lamp L_1, it will go off.

In many cases the presence of an incoming signal represents a prime condition and the absence of such a signal represents the 0 or failure condition. In such cases the neon lamp can be turned on by the absence of a signal through transistor circuitry as shown in Figure 3. Conversely, the lamp can be turned off in the presence of an incoming signal.

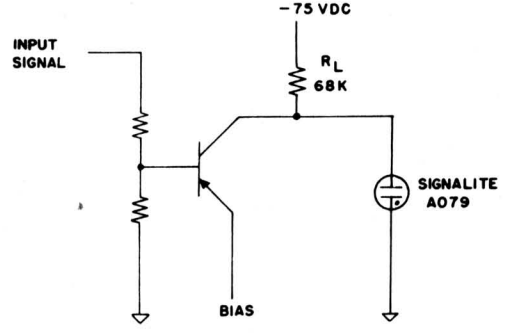


FIGURE 3. PRESENCE OF SIGNAL INDICATOR

When no signal is applied, the transistor is biased beyond cut-off and the A079 lamp is "on" because it *sees* the 75 volts applied through the 68K resistor, R_2. At this ume 55 volts appears from the collector to the base. Upon the application of an incoming signal, base current will flow and saturate the transistor. The collector to emitter drop is .6 volt, much below the maintaining voltage of the neon lamp. Consequently, the neon lamp turns off. In this case the maximum voltage which can appear across the transistor is equal to the ionization voltage of the A079, typically 70 volts. This circuit is common in logic applications where an indication is required of absence of a signal.

It is also possible to combine the bistable electrical characteristics of the neon lamp and its light generating characteristics with a transistor to perform the function of a memory with a low output impedance plus a status indicator lamp. A number of variations on this basic function, such as relaxation timers, etc., are, of course, possible.

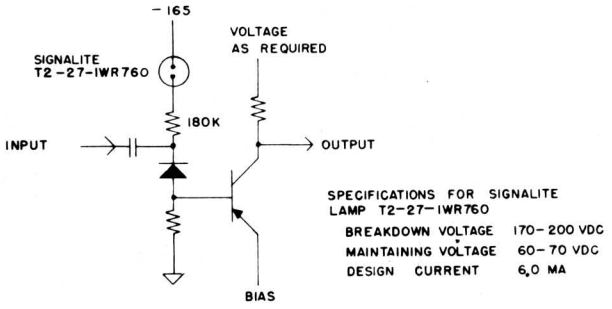


FIGURE 4. MEMORY CIRCUIT APPLICATION

In Figure 4 under normal circumstances, with no information stored, the neon lamp is off, no current flowing, and the transistor is biased beyond cut-off. The output voltage is equal to approximately the collector supply voltage. When a positive going pulse of 35 volts or more is applied to the input, it will cause the T2-27-1WR760 lamp to ignite and stay on. At this point 2 ma current will flow through the base circuit causing the transistor to saturate. The entire circuit is now in the primed condition. The neon lamp glows, indicating information is stored, and the output voltage is very low, .6 volt above bias.

It has not been our intention here to design any specific circuits, nor indicate the entire scope of uses for neon lamps in combination with transistors. If, from this brief discussion, you have any questions concerning this type of application we will be pleased to answer them. If you have any comments or suggestions regarding circuits with which you are familiar, or would like to see some phase of this subject discussed in greater detail, we would like to hear from you.

*

Answer to Can You Solve This: Vol 2, No. 4 .....

Dear Sir:

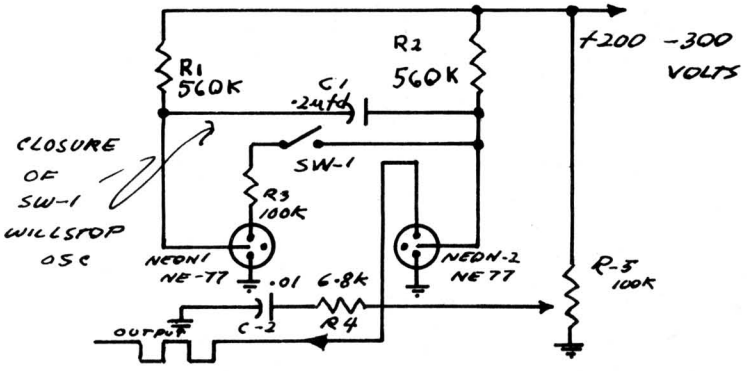
I would like to present my solution to Mr. Frenzel's problem in Volume 2, Number 4 of **Application News.**

(See Schematic.) This oscillator will supply a square wave at about 50 cps. The circuit is self-completing when stopped by the closure of SW-1.

Should Neon-2 be in conduction when SW-1 is closed, Neon-2 will continue to time out and turn on Neon-1. Neon-1 will then inhibit Neon-2, preventing the beginning of the next cycle.

Respectfully,

D. R. Jaster
Process Engineering
Automatic Electric Company



Ed. Note:

Suggest using LTG-27-2 lamps in place of NE 77's, because of closer tolerance on characteristics. Breakdown voltage anode to cathode: 160-180 vdc, cathode to center electrode: 90-114 vdc.

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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.

INDICATOR FOR SEQUENCE OF OPERATION

Dear Mr. Bauman:

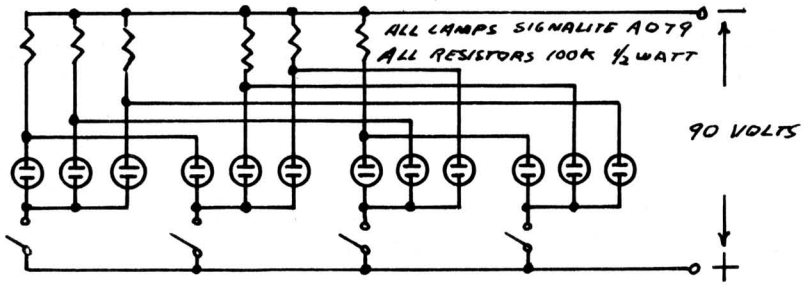
Mr. Shepard's circuit for testing a temperature regulator, on page 75 of Volume 2, number 4, of the SIGNALITE APPLICATION NEWS, was the inspiration for the enclosed proposed circuit for indicating the order in which four micro switches are closed.

The first switch to close will light all three of the lights associated with it. The second switch to close will find one of its lights in a circuit shared with an already-lit light, and thus, will be able to light only two of the lights associated with it. The third switch to close will likewise be able to light only one light

and there will be lights to be lit by the fourth switch to close.

Sincerely yours,

Theodore F. Koch, Res. Engr.
General American Transportation Corp.



SIGNALITE ALL ELECTRIC HOME

Dear Mr. Bauman:

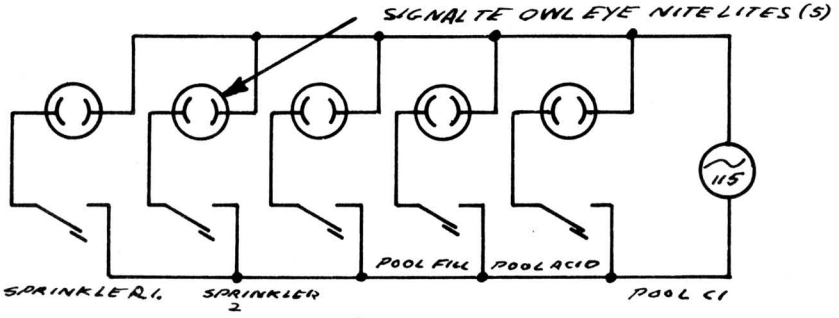
Enclosed you will find the Schematic for the "Memory Board" I have devised using Signalite Owl Eye Nite Lites.

Though not an exotic application for the glow lamps, I have arranged a "Memory-board" of lights to turn on for my Swimming Pool functions and lawn sprinklers to assure that they will be turned off before retiring for the night.

It is obvious that a certain amount of Memory is required on the part of the operator to turn on the Lites. However, once on they serve as a very effective device to assure that their respective functions do not continue longer than desired.

Sincerely yours,

RADIO CORPORATION OF AMERICA
L. S. Murphy
Power Supply Group



Ed. Note:

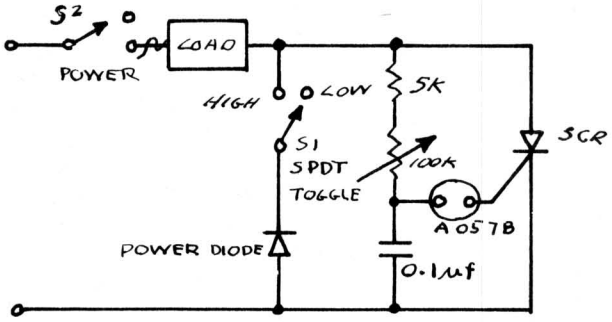
Good application — even though not many of us are lucky enough to have the problem.

FULL WAVE PROPORTIONAL CONTROL

Dear Mr. Bauman:

A very cheap 360° full wave proportional control is shown. This circuit is a modification of the half wave control appearing on Page 68, Vol. 2, #4 Signalite Application News. A power diode and an SPDT are added.

D. Weigand
Brookhaven National Laboratory

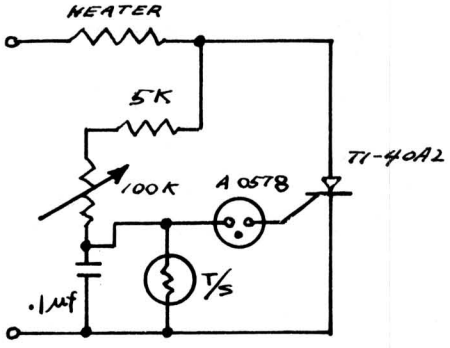


TEMPERATURE CONTROLLER w/ S.C.R.

Dear Mr. Bauman:

Substitute a thermistor for CDS cell on Page 70 & a temperature controller will be the result. Naturally, a suitable resistance network may have to be added to insure capacitor does not charge to lamp charge voltage for specific applications.

C. G. Crouse
C. B. Fall Company



Ed. Note:

Very good additional application of proportional controllers. Using a high resistance thermistor and mounting it inside the area to be temperature-controlled, the 100K pot can be set to maintain a specific temperature.

MORE ON FREQUENCY DIVIDERS

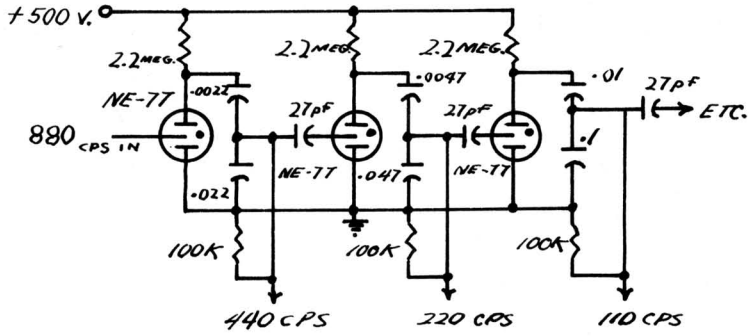
Dear Mr. Bauman:

Below is a circuit for a neon lamp frequency divider which I designed. Because of the high ignition voltage of the NE-77's, a 500 volt supply was necessary to achieve a reasonably linear sawtooth. In order to power the master oscillator and other auxiliary circuits from the same supply, it would be convenient to lower the voltage to about 250 volts. I believe this would be possible if the NE-77's were replaced by your 120TG-27-2 three terminal lamp. It would be appreciated if you could send me some samples of the above lamp so that I can verify if this is feasible.

I thoroughly enjoy the articles in "Signalite Application News" and look forward with enthusiasm to receiving each issue. By the way, are any copies of Volume 1 No. 2 still available? I seem to have missed receiving it somewhere along the line.

Very truly yours,

WABASH MAGNETICS, INC.
Keith L. Williams
Design Engineer



Ed. Note:

By using Signalite's 120TG-27-2 cold cathode triode instead of the NE-77's, the B+ voltage can be reduced to 200 vdc. Samples and back issues of Vol. 1, No. 2 mailed to you.

THE HANDYMAN'S DO-ALL

Dear Sir:

Enclosed is an interesting circuit. We have found it most useful in plant maintenance work, and feel that it could find a place in your application news.

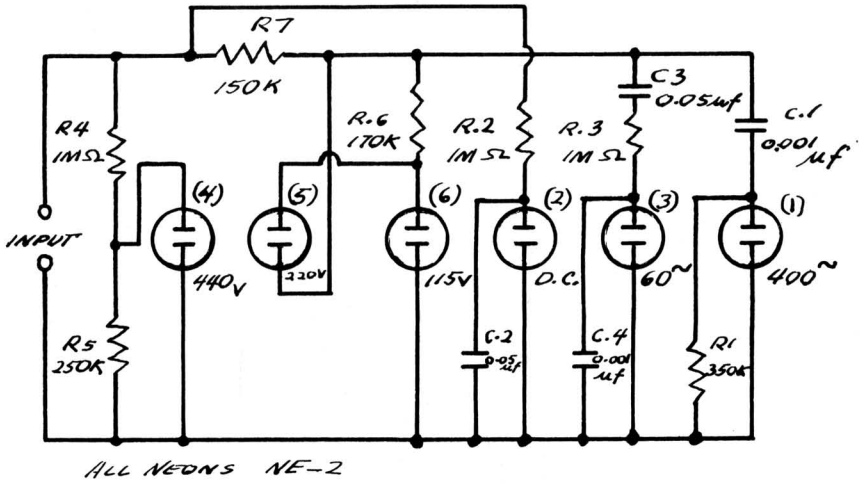
Circuit operation is as follows: for a D.C. input C1, C3 blocks lamp (1), (3), D.C. appears across C2 firing D.C. neon (2). Polarity of D.C. voltage is indicated by (2) electrode glow. At 400 cycles, divider C1, R1 prevents proper impedance to develop voltage sufficient to fire (1). Dividers R2, C2 and C3, R3, C4 prevent (2) and (3) from firing. At 60 cycles, divider impedance favors (3) and inhibits (2), (1).

Voltage regulation characteristics of neon lamps (5) and (6) limit voltage across frequency network to 145 v. This prevents applied 440 v from firing (3) (60 cycle) or (1) (400 cycle). At 110 v input, dividers R4, R5 and R6, R7 and (6) prevent impedance sufficient only to fire (6). At 220 v, voltage level is raised enough to fire both (5) and (6). At 440 volts (4), (5) and (6) fire.

All neon lamps are N.E. 2.

Very truly yours,

Lawson A. Shields
Electrical Properties Section
Clevite Corporation



Ed. Note:

Suggest using Signalite T2-27-1B100 lamp because of its close tolerance on breakdown and maintaining voltage. Specs for this lamp are: Breakdown 66-74 volts, maintaining 52-59 volts, to be operated at .5 ma.

INEXPENSIVE TONE GENERATOR

Dear Ed:

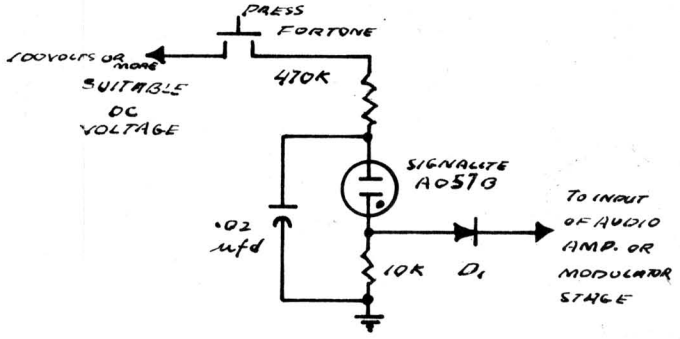
There may be a need for a simple and inexpensive tone generator to be incorporated into a phone transmitter for fast on-the-air tone identification.

The simple neon glow oscillator easily obtains operating power from a suitable DC source in the transmitter. The output is a diode coupled to the input

of the modulator stage; or if necessary, into an audio amplifier stage preceding the modulator.

Yours truly,

ELECTRONIC SPECIALTY CO.
Ronald J. Zenone
Electronic Engineering



Ed. Note:

We have supplied values for this circuit. Diode, D1, can be replaced by a capacitor.

*

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.

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Printed in U.S.A.

Signalite Incorporated
Neptune, N. J.