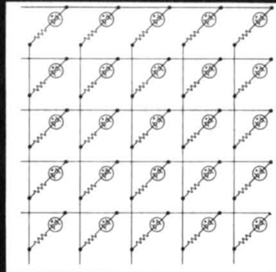
Signalite

APPLICATION NEWS

A General Instrument company



Vol. 6 No. 1 Signalite Inc., 1933 Heck Avenue, Neptune, N J 07753

RING COUNTERS FOR LINE OPERATION

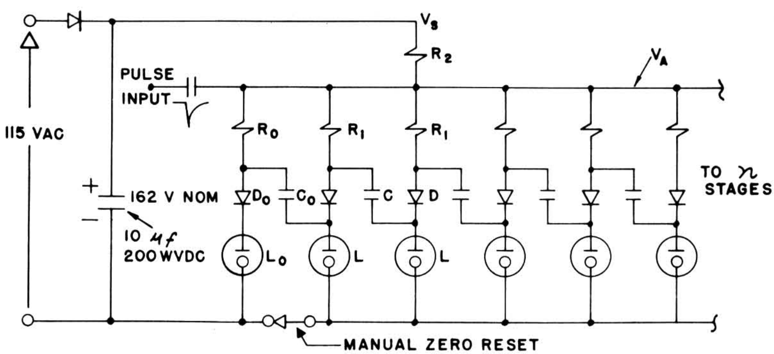
By: Frank McKendry
Signalite Incorporated

Ring counters can be and have been designed using two types of gas diodes. One design requires the use of close tolerance tubes and components and is generally sensitive to power supply variations. Another design makes use of what are called difference diodes and will be the subject of this article.

The name "difference diodes" comes from the fact that there is a large "difference" between the maintaining and the breakdown voltage of the unit. This is to insure that the firing voltage for any tube is never less than the maintaining voltage of any other tube. The tube we will consider for this purpose is the Signalite A257. This tube has the following tentative characteristics:

V_b	Breakdown Voltage	125 - 145 V
V_m	Maintaining Voltage	65 - 80 V
Design Current		2ma
Anode (+) Identified by green dot		
Ionization Time (25% over V)		<1m sec.

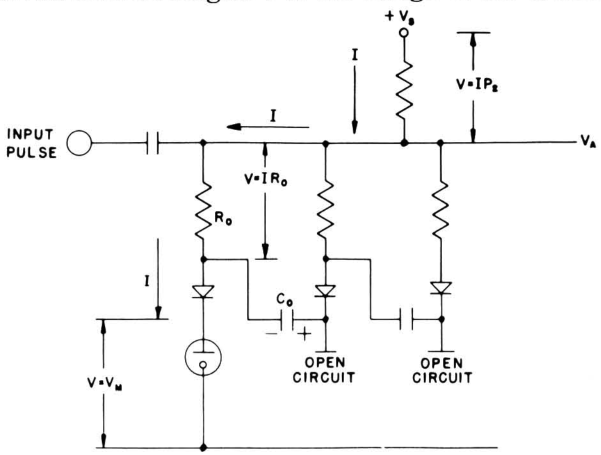
This counter is to be used on line voltage; therefore, the input voltage available is 115 volts RMS. Since dc will be required for the circuitry, rectification of the line will be accomplished with a half-wave rectifier indicated in Figure 1. It is assumed that the line can vary ±10 volts from 115 volts and the counter should still work. Thus, the dc voltage across the filter capacitor can vary ± 14 volts from 161 volts; i.e., Vdc = 161 ± 14 volts.



$R_1 = R_0 = 15K$
$R_2 = 33K$
D_1 = GI IN457 OR EQUIVALENT
C = C_0 = .001 MICRO FARAD
L = A 257, SIGNALITE

Figure 1: Basic circuit for neon lamp ring counter for use on 115 Vac line current.

The counter is composed of identical circuits coupled in a series manner The first stage involves components R_0, D_0, C_0, and L_0. Resistor R_2 is involved with all stages. For the design of the counter we must



$$I = \frac{V_S \quad V_M}{R_2 + R_0} = 2\text{ ma (TUBE DESIGN CURRENT)}$$

Figure 2: Voltage distribution on ring counter when lamp L_O (See Figure 1) is on.

consider the actions of various components and the various voltage distributions in the system. Assume that lamp L_o is on. The voltage distribution of the system is as indicated on Figure 2.

The voltage, V_A, which is the voltage across the other tubes, is

$$V_A = V_m + IR_o = V_m + \frac{(V_s \quad V_m)}{R_2 + R_o} R_o$$

Since V_A must be less than the minimum breakdown of any tube

$$V_A = V_m + \frac{(V_s \quad V_m)}{R_2 + R_o} R_o < V_f$$

and for the A257

$$V_m = \frac{(V_s \quad V_m)}{R_2 + R_o} R_o < 120 \text{ volts}$$

In a ring counter, when a pulse is received, it is desired that the indication move to the next position, for example, count if we associate numbers with each lamp. We therefore must provide a way to exceed the firing voltage, V_f, of the next lamp. Note that when lamp L_o is on, there is a voltage developed across $R_o = IR$. Since the voltage must be the same in all parallel circuits, the same voltage must appear across C_o and R, and capacitor, C_o will charge to $V_c = IR_o$ in the polarity indicated. (Figure 3). We are now ready to count. A negative pulse supplied

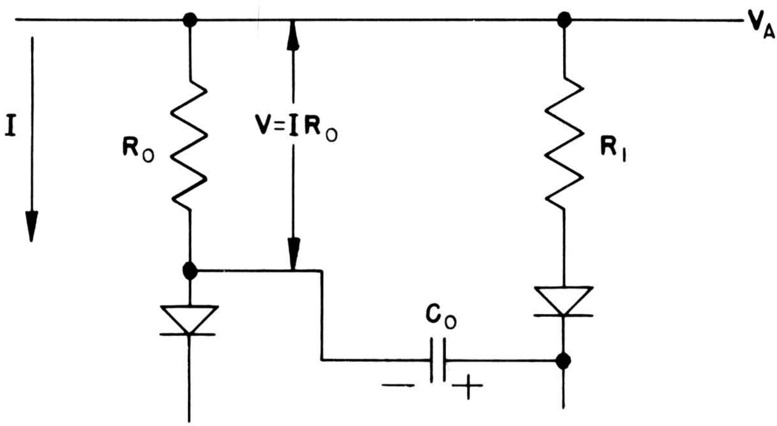


Figure 3: Capacitor charging in ring counter when lamp L_O is on.

to I of Figure 2 will turn off lamp L_o (this pulse will be discussed later). When L_o goes off, no current flows through R_o and therefore no voltage drop occurs. Keep in mind that the input pulse is still on the buss and is negative relative to the normal buss voltage. The capacitor that coupled in the negative signal now starts charging toward a more positive voltage as indicated in Figure 4.

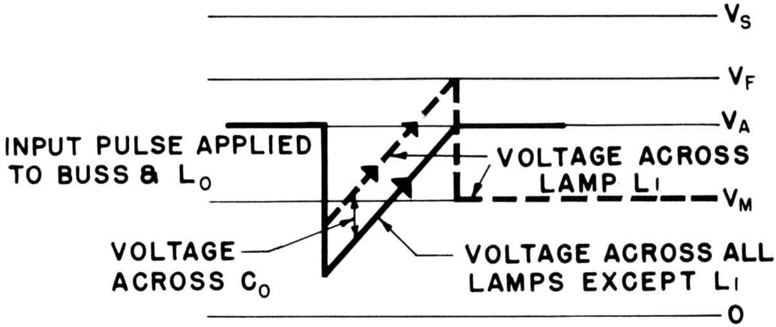


Figure 4: Effect of input pulse on neon lamps.

Notice that lamp L_1 sees $V_{Buss.} + V_C$ while all others see only $V_{Buss.}$ Lamp L_1 is therefore insured of firing before any of the other lamps can get to their firing voltage. This sequence continues for the various other lamps and components for each successive negative pulse applied to the buss (providing the frequency is not too great.)

To arrive at the most reliable design one has to consider several factors.

1. The input dc voltage and tolerance
2. Resistor values for R_2 and R_1 ($R_o = R_1$) and tolerances
3. The lamp parameters
4. The time constants

We know the following:

V_s (input voltage in dc) 161 ± 14 volts
V_f Breakdown voltage rating of the lamp 120-140 volts
V_m Maintaining voltage rating of the lamp
60-72 V nominal 66 v
Idc (Design Current of the lamp) 2ma

$$\frac{V_s \quad V_m}{R_1 + R_2} = 2ma$$

$$\frac{161 \quad 66}{2ma} = 49\ K = R_1 + R_2$$

161 Nom. Peak Line Voltage
66 Nom. Maint. Voltage

From the fact that when one lamp is on the buss must be at some voltage less than the *minimum* breakdown voltage of any other lamp, we can establish the drop across R_1 and R_2.

Let the buss be 98 volts $\frac{(\text{Nom } V_f - \text{Nom } V_m}{2} + V_m)$. Note that this this voltage is less than the minimum firing voltage (120v).

Then. $V_m + 2 \text{ ma } R_1 = 98$ volts

and $R_1 = \frac{98 \quad 66}{2\text{ma}} = 16$ K

and from the preceeding information:

$R_1 + R_2 = 48$ K

$R_2 = 32$ K

the worst case voltage on the buss is:

Maximum:

$$V_A = V_m + \frac{V_s \quad V_m}{R_1 + R_2} = R_1 = 106.3 \text{ volts}$$

Minimum.

$$V_A = V_m + \frac{V_s \quad V_m}{R_1 + R_2} = R_1 = 82 \text{ volts}$$

Note that the worst case voltage does not exceed the minimum breakdown or go below the maximum maintaining voltage rating of the lamp.

We must now consider the time constants of the circuit. The first ime constant involved is that of R_1 and C_O. Obviously, C_O must be fully harged to guarantee firing of the next lamp before the next negative pulse is applied to the rail. Thus, the repetition rate of the incoming pulses determines the maximum time constant. A capacitor is 99% charged after five (5) time constants. Therefore, $R_1 \text{ X } C_1 = 5T$ where $T = 1/p$ (p = number of pulses per second). Thus, for a 100 Hertz counter·

$$RC < 5 \text{ x } .01 < .05$$

$$C < .3\mu f \qquad R_1 = 15K$$

In general, one can design a counter for the maximum frequency that these gas tubes are capable of (about 2 kHz) select a capacitor, and not have to consider it further The capacitor (GI Type 107 or equivalent) sees only the rail voltage minus the maintaining voltage (about 50 volts) and is therefore a low voltage type.

The diodes used to prevent the charged capacitor from discharging prematurely are low voltage (about 50 V) silicon type which need handle only 2 milliamps in forward conduction (GI Type 1N457 or its quivalent).

When power is first applied to the circuit the lowest breakdown lamp will come on (actually more than one can come on due to ionization time delay). A manual zero reset switch can be indluded in negative return of all but the zero lamps. Power can be applied and the switch momentarily opened to set zero and to insure only one lamp is on. If several decades are to be used, the negative return of all but the zero lamps can be run to the source switch and all zeros can be set at the same time.

Pulses to be counted are capacitively coupled to the rail. The time constant of the input pulse has specific requirements. For rapid counting, the time constant should be not less than one-third (1/3) of the tube deionization time nor much more. Deionization time is defined generally as that time required, after removal of the input voltage, for the gas in the tube to get to a predetermined ionization level. Given in Figure 5 is a curve showing the recovery voltage vs time for the A257

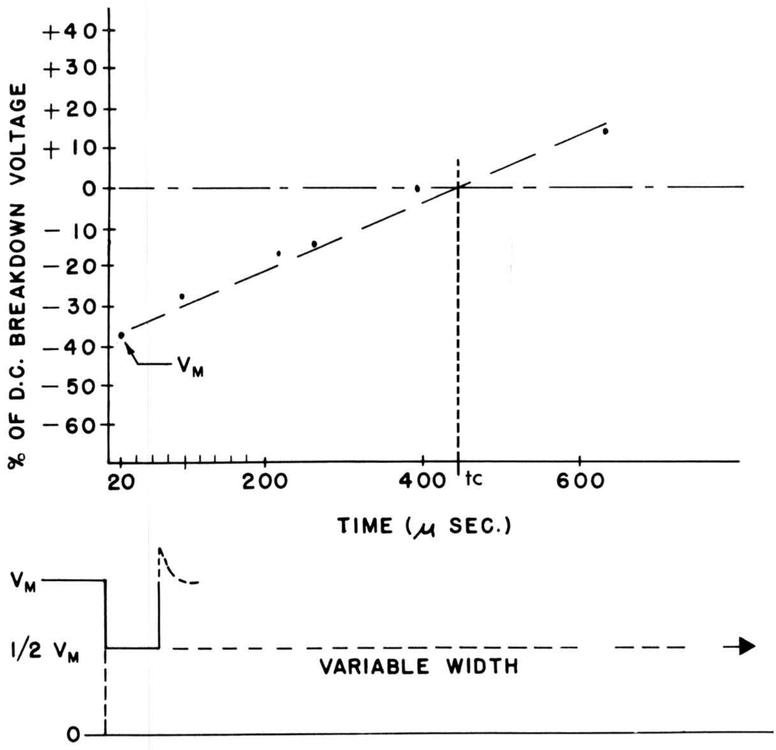


Figure 5: Deionization times of neon lamps vs per cent of breakdown voltage. This time depends on the shape of the turn off pulse. The curve shown here is applicable to a square wave pulse shown in the lower part of the figure.

This curve was obtained by driving the unit off to about 1/2 maintaining voltage with a square wave pulse of variable width. From the above it can be seen that an input pulse with a time less than tc will result in the same tube coming back on. For maximum speed, the curves of the input pulse and the deionization stand off voltage curve should track each other, or the input should be slightly slower, in time. Obviously, if the input pulse is longer than necessary to advance the counter, counting speed potential is reduced. Generally, an input pulse other than square will be used to drive the counter Under these conditions appropriate correction must be made to the deionization time effect on the stand-off voltage curve. Also, the deionization time is related to the voltage available to neutralize ions in the tube. The general shape of the curve is given in Figure 6.

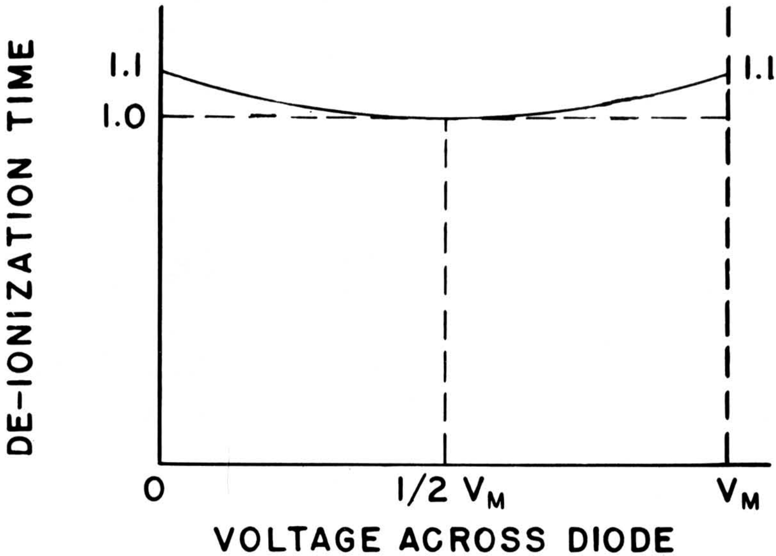


Figure 6: De-ionization time vs voltage across the gas diode for a square wave pulse.

Ring counters such as the one described here can be used in a variety of applications, including counting, sequencing, shift registers, timing, and others. No attempt has been made here to prescribe the circuitry for generating the pulses since this is generally a function of the end application. Other types of ring counters can, of course, be designed but the one discussed above is an economical and reliable approach which can be used up to 2 kHz. In addition, one of its major advantages is that it is relatively insensitive to power supply fluctuations.

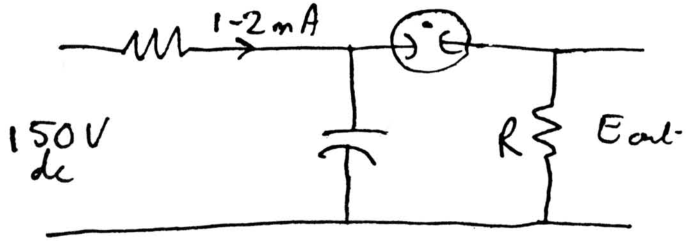
CAN YOU SOLVE THIS ? ?????

NEEDS VHF NOISE SOURCE

Dear Sirs.

I work at Racal Research Ltd. in Tewkesbury as a Designer, but unfortunately we do not have a suitable noise source, and I need one for measurements on my V H.F ham rig. I would like your comments on the following arrangement using a small indicator neon. I have seen that neon has a characteristic noise temperature of about 18,300 K, and for this arrangement to work this temperature must be independent of current. Is this so, and what is the exact temperature?

Here is the circuit.



For V H.F.the decoupling capacitor and resistor R wiring would, of course, be very short.

According to me·

$$E_{out} \quad (EMF) = \sqrt{4KTBR}$$

where T is this temperature of about 18,300 K. Will any corrections be needed at 500 MHz or higher?

Yours faithfully,
M. Mann, G8ABR

Ed. Note.

Any information our readers may have on this subject would also be appreciated by the editor

ANSWER TO CAN YOU SOLVE THIS. Vol. 5, No. 4

WHO STOPPED THE LINE?

Dear Sirs.

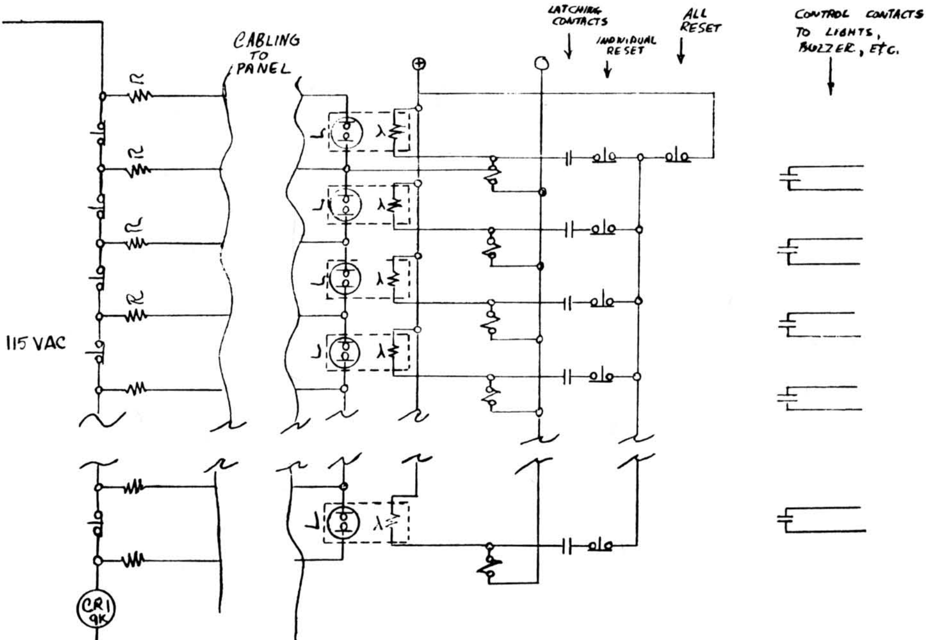
Enclosed is a solution to the problem presented by Mr P H. Fisher of Owens-Corning Fiberglass Corp. I believe the solution is fairly straightforward.

Operating any stop button will cause the neon associated with that button to be lighted by the 115 VAC. The neon will illuminate the photocell which will pick a relay which will latch itself until reset. The neon and photocell could be packaged in a lightproof tube similar to that described in your Vol 5, No. 1 issue of "Application News"

Resistors for current limiting with the neons are placed at the switches as a safety feature. The lines connected to the remote operator's panel are then current limited.

Display lights can be used to indicate which stop button has been pushed. A reset button can be furnished for each relay individually or one button can be used to reset all at one time by interrupting the supply voltage.

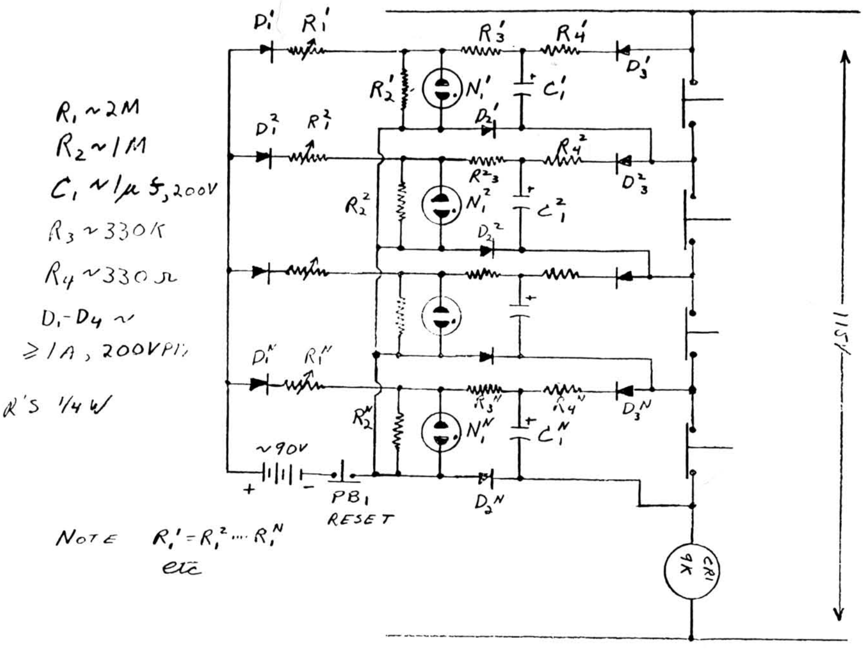
Please see enclosed diagram (below). Component values are left to the discretion of the engineer using the circuit.



Very truly yours,
John J. Long
Xerox Corp.

Dear Sirs.

When a pushbutton is depressed, C_1 is charged through D_3 and R_4 R_4 is a diode protector The voltage on C_1 is discharged through R_3, R_2, D_2 The discharge through R_2 raises the voltage across the lamp to firing potential Assuming that R_1 has been adjusted to apply a voltage just below firing potential on the lamp, the added "kick" provided by C_1's charge should cause the lamp to fire. Current through R_1 will keep it lit until the circuit is reset by PB-1 Diodes D_1 and D_2 are decoupling diodes to prevent one unit from firing the others. Specifically, D_2 prevents false firing due to pushing a stop button "down the line" The neon lamps used are non-critical, but if precision units are used, R_1 could be replaced with a fixed resistor The parts values shown are not necessarily the best values but are given to serve as a starting point for further experimentation.



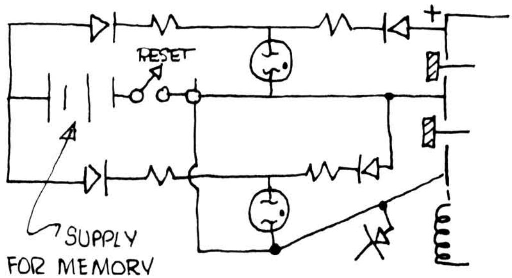
Yours truly,
Robert Yodlowski
Cornell University

Ed. Note.

If the switches were opened and closed when the line was negative, no indication would result. There is a small probability of this occurring, however

Resistors R_2^1 R_2^n, R_3^1 R_3^n, capacitor C_1^1 C_1^n and diode D_2^1 D_2^n are not really necessary and could be eliminated.

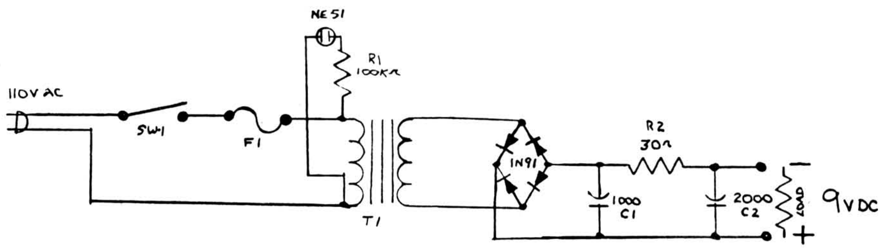
The following circuit is also suggested by the editor



TRANSISTOR RADIO PILOT LIGHT

Application News Editor

Here is a 9VDC circuit for powering a transistor radio that I've made up for a few of the people here at work using your NE51 to show power is on.



D. Cordes
Fairchild Recording Equipment Corp.

CHECKING RF TRANSMITTER GROUND

A neon glow lamp is very handy to determine whether an RF transmitter is properly grounded for its operating frequency With the transmitter on, hold one lead of the neon bulb in your hand, and touch the transmitter cabinet with the other lead. If the transmitter is improperly grounded the neon bulb will light. A high value series resistor must be used when checking out a high power transmitter.

Benedict Vitale
Patchogue, Long Island, N. Y

Return Postage Guaranteed

Signalite Incorporated
Neptune, N.J. 07753

BULK RATE
U. S. Postage
PAID
Dover N. J.
Permit No. 1

Drop Us A Line.

If you have an interesting application of neon glow lamps in your circuitry or a problem concerning the use of neon lamps, drop us a note telling about it Interesting letters will be published in a future issue of the **Application News**—and we will send you an Owl Eye Nite Lite for your home.

Applications which in the opinion of Signalite have significant interest will also be brought to the attention of the editors of leading technical publications for consideration as articles and featurettes. If you would like help in preparing your material for publication, just send us the facts and data. We will put it in the correct form for publication. Your by-line and company credit will be given with your permission.

For immediate technical application or circuit design assistance, you may contact Signalite directly at

TWX: 201-775-2255 *TEL: 201-775-2490*

• • • • •

For information about Signalite Neon Glow Lamps for circuit component and/or indicator applications, for specifications on lamps, for general information about Signalite and its products, call us at any of the following telephone numbers:

Phoenix, Arizona	(602) 254-6085	Albuquerque, N. Mex.	(505) 255-1638
Anaheim, Calif.	(714) 828-1344	Poughkeepsie, New York	(914) 471-1623
Los Altos, Calif.	(415) 948-7771	Rochester, New York	(716) 889-1429
Los Angeles, Calif.	(213) 274-8485	Syracuse (Liverpool), N.Y	(315) 472-7886
Denver Colorado	(303) 388-4391	Utica, New York	(315) 736-9195
Chicago, Illinois	(312) 777-2250	Charlotte, No. Car.	(704) 375-8958
Fort Wayne, Indiana	(219) 743-4411	Cincinnati, Ohio	(513) 521-2290
Indianapolis, Indiana	(317) 359-5374	Cleveland, Ohio	(216) 333-2585
Louisville, Kentucky	(502) 893-7303	Dayton, Ohio	(513) 298-9546
Baltimore, Maryland	(301) 484-3647	Portland, Oregon	(503) 292-8762
Benton Harbor Mich.	(616) 927-2041	Pittsburgh, Penna.	(412) 242-0100
Southfield, Mich.	(313) 358-2020	Dallas, Texas	(214) 528-6286
St. Paul, Minn.	(612) 488-7293	Houston, Texas	(713) 468-0232
St. Louis, Missouri	(314) 727-6123	Salt Lake City, Utah	(801) 466-8709
Kansas City, Missouri	(816) 763-3634	Seattle, Washington	(206) 682-7337
Neptune, New Jersey	(201) 775-2490	Scarborough, Ont. Can.	(416) 751-5980

St. Laurent, Que., Can. (514) 331-4884

Printed in U S A