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APPLICATION NEWS

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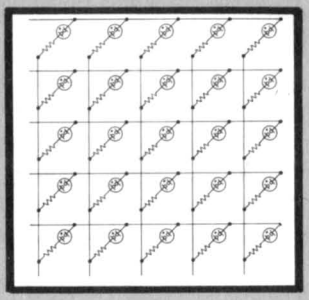


Vol. 10, No. 1 Signalite 1933 Heck Avenue, Neptune N J. 07753

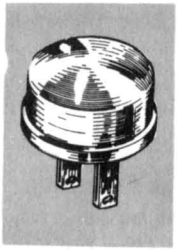
A STABILIZED VOLTAGE SOURCE USING NEON GLOW LAMPS FOR REFERENCE AND PROTECTION

By: Sheldon Rabin, Manager
Applications Engineering
Signalite

Most of today's electronic systems require the maintenance of precise voltage levels for proper operation. Fluctuations in power supply voltage can result, in severe cases, in catastrophic equipment failure and, in less serious cases, in malfunction of the equipment.

Since the degree of accuracy which the voltage regulator must provide varies in accordance with the function performed by the electronics, numerous methods have developed for providing the required regulation to the designer

Frequently, for example, the circuit design can be simplified with consequent savings in cost—if the design is based on utilizing a regulated voltage supply For many circuit applications, however, the degree of voltage control required by the system is so precise that commonly used devices such as standard neon glow lamps, originally developed for indicator applications, can not be employed. This has



Yours free . . . for telling us how you use or would like to use neon glow lamps and spark gaps.

You can get a free Signalite Owl Eye Nite Lite simply by sending us an application for neon glow lamps or spark gaps, a problem or solution on their use. Each reader will receive the Nite Lite whether or not his letter is used in the Application News. In addition, we welcome longer articles for feature treatment which we will also place in a leading technical magazine in your name.

necessitated turning to other relatively costly means, such as complex circuitry, large gas tube regulators or zener diodes for regulating the power supply where voltage regulation must be held within close limits.

A simple and inexpensive alternative to these choices is the family of neon glow lamps developed by Signalite whose precise operation and output makes them equally suitable as voltage regulators or reference voltage sources.

These small, easy-to-install cold cathode glow lamps can be used to provide predictable and reliable regulation to within ± 0.1 volts, maintaining their close tolerances for up to 30,000 hours of continuous operation. Relatively insensitive to vibration, shock or thermal cycling, these lamps exhibit very favorable characteristics for a stabilized voltage power source in the low milliamp range. Together with a high voltage transistor and current overload transistor, they can provide a very desirable type of power supply having the simplicity of a shunt regulator, and almost two magnitudes of stability better than a "raw" supply

Design considerations for such a power supply can be segmented into four basic parts (1) current and voltage input range; (2) the reference element and its current source, etc., (3) the pass transistor or darlington pair and its associated circuit components, and (4) the current limit transistor and its associated circuit components. See Figure 1.

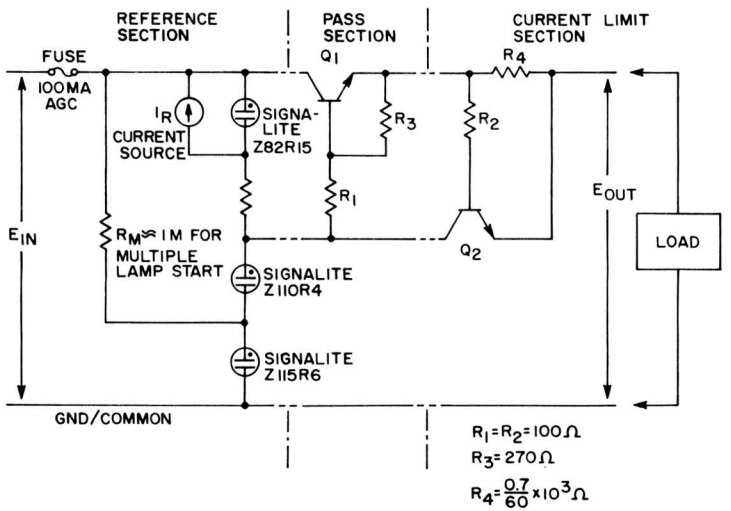


Figure 1
To insure that the maximum breakdown voltage of the V_R's is exceeded, one V_R is fed from a 1 megohm resistor, initially putting full input voltage on the non-ionized neon lamps.

If we start with a requirement for E_{out} of 225 volts, and a current requirement of 60 milliamps, all necessary parameters can be derived. Since the pass transistor is basically an emitter follower (the output

follows the input):

$$V_{CE} \approx 0.7 \text{ volts}$$
$$\text{and } E_{out} = V_R \quad 0.7 \text{ volts}$$

If $E_{out} \approx V_R$, and $0.7 \ll E_{out}$, we must find a 225 volt voltage reference. Using a minimum V_R current of 1.5 ma, a suitable combination is a Signalite voltage regulator neon lamp Z110R4 in series with a Signalite Z115R6, which sums to 225 volts. See Table 1

TABLE I

Signalite Type	Breakdown Voltage vdc	Reference Voltage		Temperature Coefficient	Typical Variation At 250 Hours
	(Typical)	vdc	ma	mv/°C	%
Z82R15	107	82 ±1	2.0	−2	< 0.5
Z11OR4	155	110 ±1	1.5	−9	< 0.4
Z115R6	145	115 ±1	1.5	+15	< 0.3

**Signalite Voltage Regulator and Reference tubes are available in many values from 82 volts to 143 volts reference voltage. See Signalite catalogue SF 4-1.*

With a maximum current of 3.0 ma, a reasonable current sink for the emitter follower can be provided, assuming room temperature. (A darlington combination can be used to insure worse case low temperature operation).

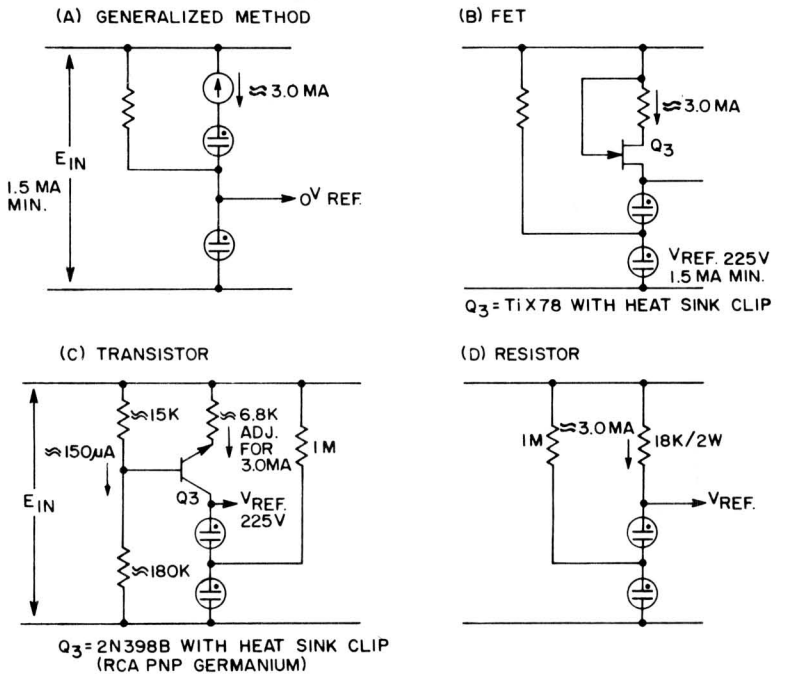


Figure 2
Four alternative methods for designing the reference section.

Assuming an input of 275 volts DC ± 10%, we see that our current source will have to drop, 50 volts ± 27.5 volts (275 225 = 50 volts, giving 77.5 ⟷ 22.5). In the worst case operation (see current limit section) power dissipation will be $77.5 \times 3.0 \times 10^{-3}$ or 0.24 watts.

An FET, a PNP transistor, or a resistor may be used, depending upon: (a) the required ripple reduction, (b) stability, and (c) simplicity required. In brief, an FET will provide the best of (a) and (b), but only median (c). The resistor is best at (c), and poor at (a) and (b). The transistor is median at (a), (b) and (c). Typical operating values are shown in Figure 2, keeping in mind that all three devices must handle the power dissipation specified above.

The pass transistor will ordinarily see 275 volts on the collector side and V_{EB} 225 volts on its emitter The base will see 225 volts from the reference.

The worst case dissipation will be $275 + 27.5 \times 70 \times 10^{-3}$, or 21.2 watts. This assumes a shorted output current limited to 60 ma. (The current limit knee is assumed to start at 60 ma and increase to 70 ma. See Figure 3). Under normal non-shorted output conditions, the dis-

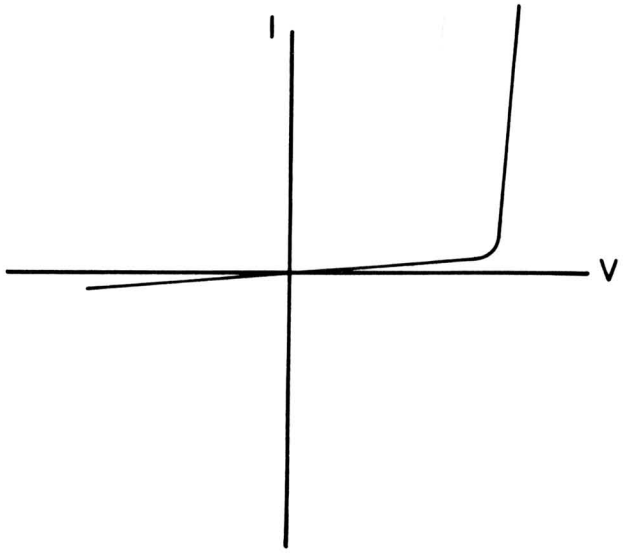


Figure 3
The current limit curve follows that of a forward-biased diode.

sipation will be $77.5 \times 60 \times 10^{-3}$ or 4.7 watts. The output transistor must have a suitable heat sink. (40 in^2 of 0.08" aluminum would be suitable up to 60° C ambient).

V_{CER} worst case should be 350 volts minimum. A 2N4240 will satisfy this case. If a darlington configuration is used, a 2N3439 can be used to drive the 2N4240. See Figure 4.

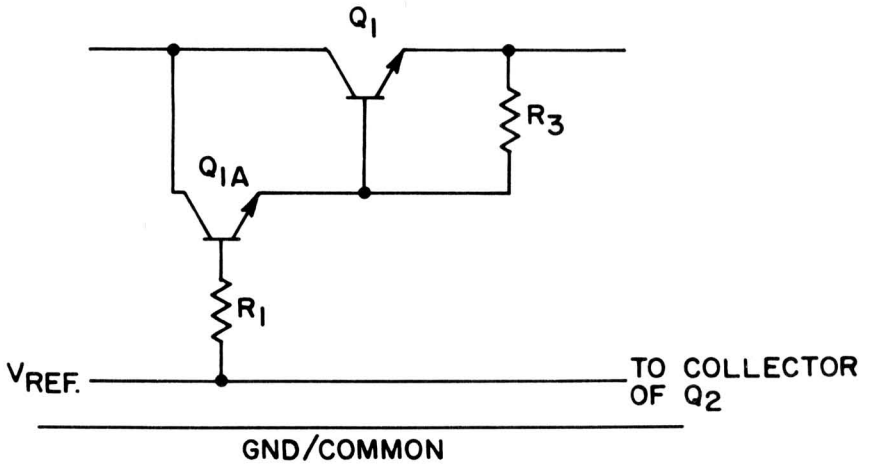


Figure 4
Darlington configuration.

CURRENT LIMITING

The current limit feature (transistor Q_3) depends upon the forward biased base to emitter voltage ($V_{EB}\,Q_3$) being exceeded. Assuming $V_{EB}\,Q_3$ to be 0.7 volts for a 60 ma "knee", R must be:

$$\frac{0.7 \times 10^{-3}}{60} \text{ or } 11.67 \text{ ohms.}$$

Tolerance considerations, therefore, dictate a 10 or 12 ohm (RETMA)

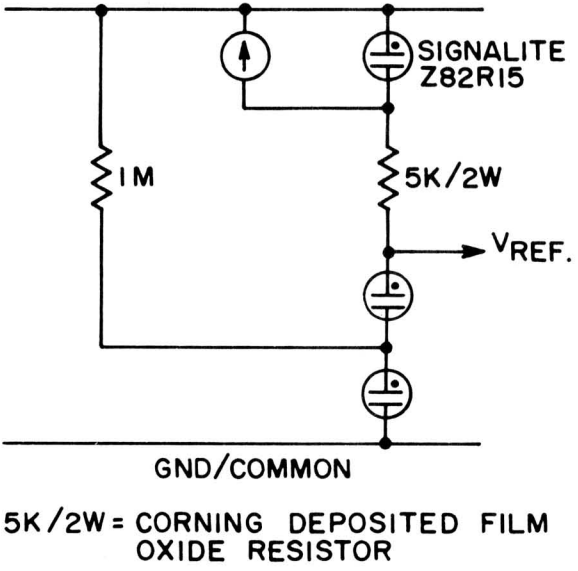


Figure 5
Current source protector.

resistor At currents less than the "knee", Q is off; there is no collector current.

As the "knee" is approached and exceeded, collector current is demanded from its source, $V_{Ref.}$ This takes the base of Q_2 toward zero, thereby forcing $V_E Q_3$ to follow, causing E_{out}, under shorted conditions, to go to zero. A 2N3439 may also be used for Q_3 (A word of caution. the current source must dissipate this worst case shorted condition. The parts specified will not!).

A Signalite voltage regulator, type Z82R15 in series with an 5K/2W Corning resistor paralleled with the current source will indicate a short and will keep the voltage across the current source at a safe level thereby preventing excessive dissipation. See Figure 5. The 100 ma fuse (Buss AGC 1/10A) will open (70 ma + 50 ma > 100 ma) protecting the power supply

In conclusion, this power supply with suitable scaling can help fill the void between an unstabilized source, and that presented by a highly regulated (high priced) power supply.

Bibliography: 1) RCA Transistor, Thyrisior and Diode Manual

2) Electronic Circuits Discrete and Integrated; Donald Schilling and Charles Belove; McGraw Hill Book Co.

3) Signalite Catalogue SF4-1

4) Applications of Neon Lamps and Gas Discharge Tubes, Edward Bauman, Carlton Press.

CAN YOU SOLVE THIS ? ?????

Gentlemen

I have a problem in the application of your neon indicators with which you may be able to help.

We have a three phase circuit feeding equipment, some of which in an emergency is desperately needed. Our emergency generator is a single phase system and for reasons of economy, we have provided switching which feeds the necessary equipment on the three phase circuit by merely applying power to the phase across which this vital equipment is connected.

To provide continuous monitoring of power on all three phases, we have installed neon glow lamps across each of the three phases. It was our intention that we could also use these lamps to indicate when two of the phases were out and power applied (by our emergency power source) to the remaining critical phase. Unfortunately, because

of transformer loads across the three phase circuit, all three lamps remain lit even though power is applied to only one of these phases.

Is there a method by which we can use these glow lamps to indicate only the phases on which power is applied? We have tried "load" resistors and series resistors in attempts to lower the voltage fed back by "autotransformer" action to no avail Any suggestions you may have wil be appreciated.

Sincerely

Otto R. Claus
WBAL-TV, Baltimore

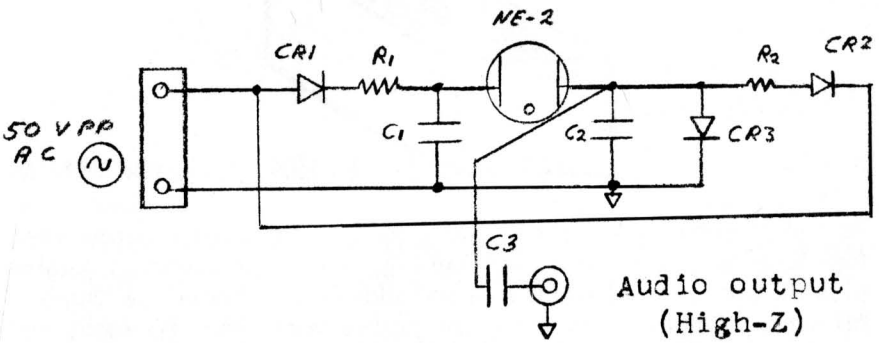
YOUR GLOW LAMP APPLICATION FORUM

ANSWER TO CAN YOU SOLVE THIS: VOL. 9, NO. 6

Dear Sir·

Regarding the question asked on page 453 of your Vol 9, No. 6 issue as to whether it is possible to produce a siren effect using only one neon lamp instead of two, I believe that I have a solution to this problem, however, I have not tested the idea although I see no reason why it would not work.

The circuit is drawn below·



The operation of this circuit is based upon the fact that a neon lamp is not sensitive to polarity, and can breakdown in either direction The time constant of R1-C1 is chosen to be long compared to that of R2-C2. Also C1 is picked to be at least ten times larger than C2. The combination of R1-C1 sets the wail time, while the R2-C2 conbination sets the nominal audio frequency CR3 would be necessary to allow a discharge path for C1 when the lamp breaks down from left to right. No such diode should be necessary for C2 since C1 is so much larger

it would look like a voltage source to C2. The value of the audio output capacitor C3 should be chosen to be one tenth the value of C2 so as not to affect the siren frequency

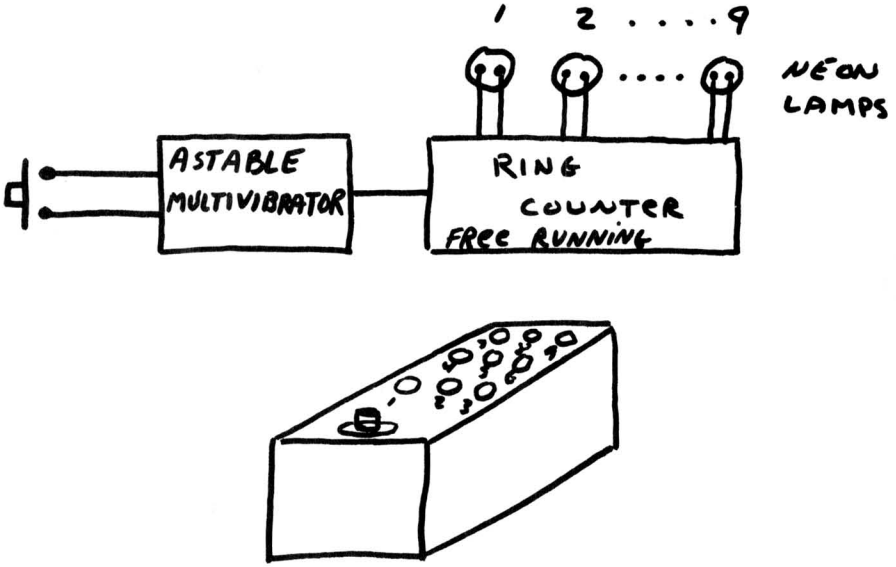
Sincerely,

Stuart J. Lipoff
Motorola Communications Division

FOR THE DO IT YOURSELF SANTA CLAUS

Gentlemen.

Here is an easily made children's game which also will help them learn to add. Push button switch triggers astable for predetermined period during which the ring counter steps through neon lights 1-9.



At end of period one light of series remains on (quasi-random when free running ring counter steps at high speed compared to astable period). Each child takes his turn and adds the number of "his" lamp to his score. Highest score after ten pushes wins. May be easily self contained in aluminum chassis box.

Sincerely,

Wentworth E. Potter
University of Minnesota

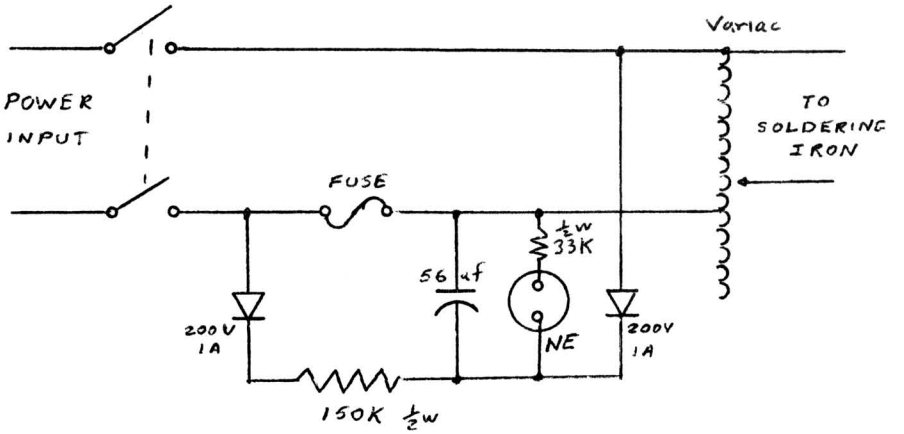
Ed. Note. See Vol. 6, No. 1 for information on the design of ring counter circuits.

"A LITTLE LIGHT..." MODIFIED

Dear Mr Dougherty·

Re· Vol 9, No. 3
"A Little Light Can Make A Big Difference"

I have been using a circuit which is a combination of Fig. 3 and Fig. 6. The neon in this circuit is lighted continuously with switch closed to the circuit. If the fuse blows, then the neon flashes indicating there is still power applied, but the fuse is blown. Following is the circuit diagram



This dual use takes up less panel space for many circuits.

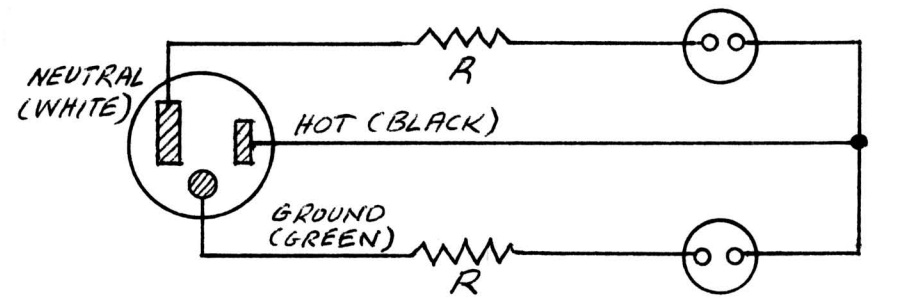
Very truly yours,

Victor K. Bailey
Eagle Machinery Company, Ltd.

HOUSEHOLD A.C. RECEPTACLE TESTER

Gentlemen

The following neon glow lamp application should be of interest to your safety minded readers. The circuit is for a *household AC*



receptacle tester With a little ingenuity the entire circuit can be constructed on the back of an ordinary 3-prong AC plug.

In operation, both neon lamps will glow if the receptacle is properly wired. However, if either the ground or neutral line is open or if the hot line and neutral line are reversed, then one or both lamps will be extinguished.

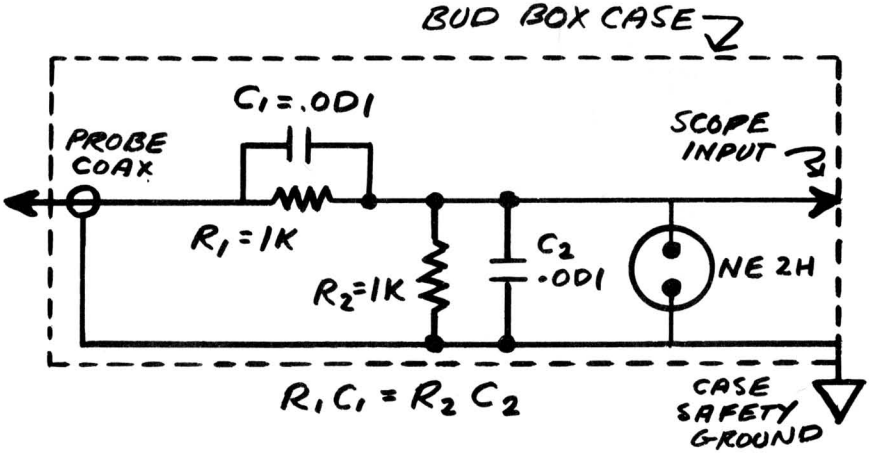
Very truly yours,

George R. Seylar
Applied Physics Laboratory

OSCILLOSCOPE INPUT PROTECTION

Gentlemen

Working with pulsed high-voltage supplies for transponders, we have in the past damaged the input capacitors to our oscilloscopes. The protective circuit (below) provides a 2·1 attenuation of the pulses



under normal conditions. However, under abnormal conditions, the NE2H will fire and protect the input as well as providing a visual indication of error

V J. Kaneski
Melpar Inc.

MEN TO TALK TO AT SIGNALITE . . .

We'd like to introduce two people who have recently joined Signalite's staff in positions which are likely to bring them into contact with you.

SHELLY RABIN, Manager of Applications Engineering

In this post Sheldon G Rabin is responsible for the design and modification of Signalite products for special applications and for providing technical assistance and engineering services to customers for all Signalite products.

Immediately prior to joining Signalite, Shelly was senior project engineer with Magnetic Analysis Corporation, Mt. Vernon, N.Y He has also held engineering design and development positions with North American Philips Company, Devenco Incorporated and Bell Telephone Laboratories.

Shelly, 34, holds a B.S. in Physics from City College of the City University of New York. He has written technical articles for trade journals such as *Electronics* and *EDN.* He is also the author of the lead article in this issue of SANS.

CARL APPLEGATE, Product Marketing Manager, High Energy Devices

Carlton C. Applegate has sales and marketing responsibility for Signalite's Uni-Imp®, Comm Gap, and standard spark gap transient protectors.

Prior to joining Signalite Carl was RF and Special Products Sales Manager at Fifth Dimension, Inc., Princeton, N.J Previous assignments were as Sales Manager with Wheelock Signals, Inc., and as Development Engineer and Sales Engineer with Rowan Controller Co.

Carl attended Southern Methodist University where he majored in mechanical engineering, and has completed American Management Association courses in sales, marketing, and supervisory management. He has written technical articles for trade journals such as *Electronic Products, EDN,* and *Electronic Engineer*

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Drop Us A Line .

If you have an interesting application of neon glow lamps or spark gaps in your circuitry or a problem concerning the use of these components, 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 interest.

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*

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For information about Signalite neon glow lamps, spark gaps, and other gas discharge products for circuit component and/or indicator applications, for specifications on Signalite components, or for general information about Signalite and its products, call us at any of the following telephone numbers:

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