Signalite
APPLICATION NEWS
A DIVISION OF GENERAL INSTRUMENT

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Signalite Inc., 1933 Heck Avenue, Neptune, N J 07753

FAILURE MONITOR FOR HEATING ELEMENTS

By Robert S. Lee
Hotwatt Incorporated

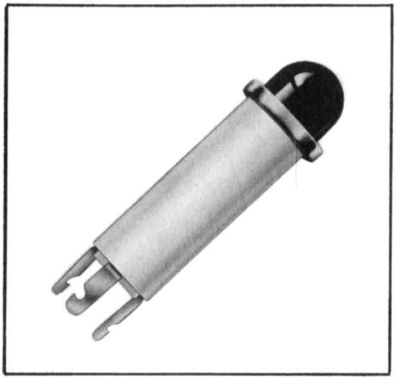

Figure 1
The Hotwatt heating element failure indicator cartridge containing a Signalite three-element neon glow lamp.

The increasing complexity of electronic equipment and the increasing dependence on electrical power in a modern industrial society places a great deal of trust in the faultless functioning of electrical equipment. When a failure does occur, it should ideally be readily identifiable as to cause and condition so that appropriate corrective action can be taken. The critical aspects of electrical power used to maintain operating temperatures, actuate controls and the like all depend on a continuous source of power and a reasonable service life of working components.

Any failure system used to monitor electrical and electro-mechanical functions should in themselves be simple and fault-free. It serves no purpose to design a fault sensing system into a piece of equipment if the fault system in itself is so complex that it requires constant maintenance or highly complex circuitry The best objective for fault sensing system design is to fabricate a monitor curcuit using as few active components as possible, and to choose exceptionally long service life components for those components that have to remain active.

The design technicians at Hotwatt, Inc. followed this failure design circuit philosophy precisely when called upon to design a monitoring system for electrical heaters. The need arose from a necessity to sense premature heater failure for critical production stages in industry that relied very heavily on the maintenance of heat at various stages in chemical manufacturing. The result is a system incorporating a specially designed heating element coupled to a fail-safe indicator assembly that would positively indicate heater element failure immediately.

The indicator unit, shown in Figure 1, is simple and reliable, and requires no maintenance or critical installation locations for operation.

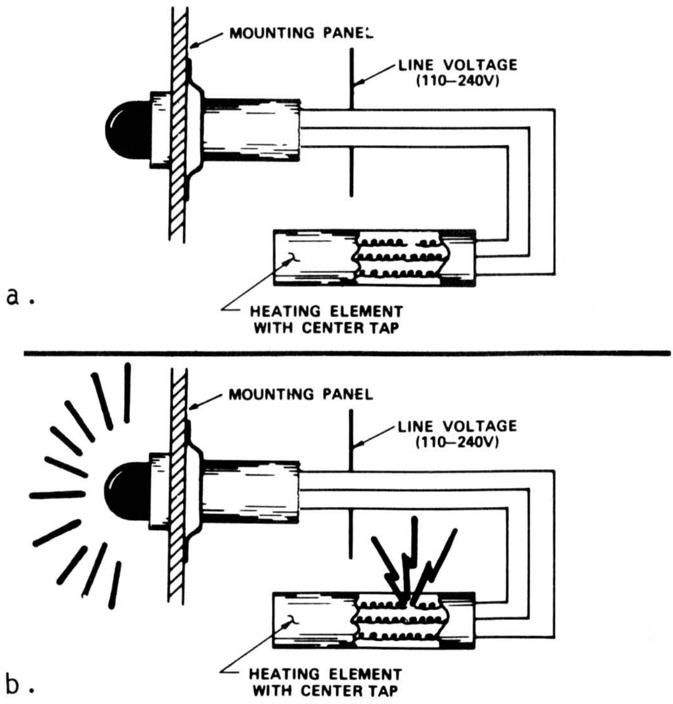

Figure 2:
The Hotwatt Fail-Safe System consists of a center-tapped heating coil assembly and the three-element indicator device. If a defect in one of the heating elements exists when the operating voltage is applied to the system, the indicator glows brightly.

The unit consists of a Signalite LTG-27-2 three-element neon glow lamp mounted within a plastic container and lens cap assembly Connection to the heating elements being monitored is accomplished by a simple three-conductor cable of any length. The indicator can be mounted on the equipment containing the heating elements, or may be remotely located closer to a central process monitoring system or control panel.

The heater assembly used in conjunction with Hotwatt Fail-Safe® indicator system is generally a cartridge type, being round, square, or rectangular, depending on the particular installation requirement. It is equipped with a common lead to both sides of a resistance circuit that forms a balanced bridge when coupled to the indicator assembly In any case where heater failure is encountered, enough voltage is generated in the resulting unbalanced bridge circuit to activate the neon lamp and make it glow Figure 2 represents the indicator connected to a defective heating coil assembly. Illustration (a) shows the system in the non-energized condition. Illustration (b) shows the system with energy applied. The heating element and three-element

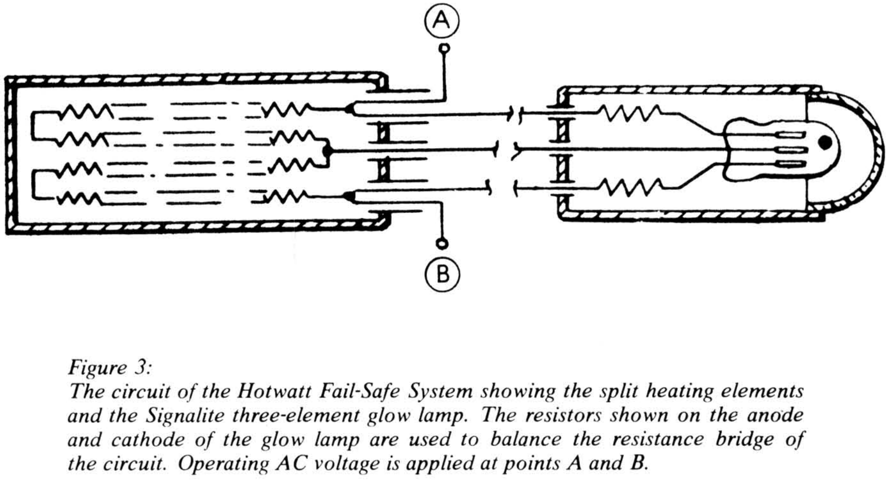

Figure 3:
The circuit of the Hotwatt Fail-Safe System showing the split heating elements and the Signalite three-element glow lamp. The resistors shown on the anode and cathode of the glow lamp are used to balance the resistance bridge of the circuit. Operating AC voltage is applied at points A and B.

lamp circuit is shown in Figure 3, and the resistance bridge circuit is shown in Figure 4.

The Signalite three-element lamp consists of an anode, cathode, and a trigger electrode. When connected to the circuit, the resulting AC voltage potential appearing between the anode and cathode is always higher than maintaining voltage but lower than the breakdown voltage of the 3-element glow lamp. The voltage appearing at the trigger electrode, however, is nominally one-half the anode to cathode voltage. Thus, the lamp is off in the normal circuit-energized condition. The indicator remains in this state as long as the heating elements

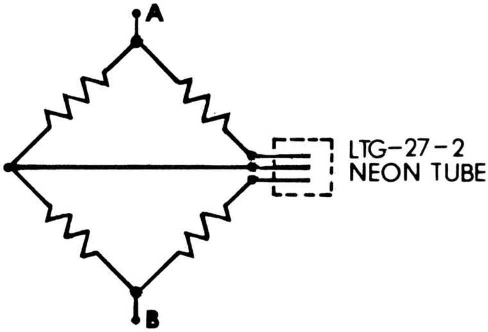

Figure 4.
The equivalent resistance bridge of the Hotwatt heating elements and indicator assembly.

remain operative. The resistors appearing on the anode and cathode leads in Figure 3 are used to effect a perfect balance in the resistance bridge circuit.

When a heating element failure occurs, the resistance balance established by the elements of the heater and glow lamp is upset, and voltage differences appear. Specifically, a fault in one or both of the heating elements causes the full AC input voltage to appear on the trigger electrode. This voltage level exceeds the ionization or breakdown voltage value for the three-element device, and the resulting ionization causes the lamp to fire between anode or cathode and the trigger electrode. The bright glow of the three-element device is readily recognized, and appropriate action is indicated.

The simplicity of the failure indicator circuitry using only one active component represents an ideal solution to reliable fault monitoring. Conventional monitoring devices using thermostats would not react immediately, and the heating assembly would cool down excessively before an accurate appraisal of the situation could be made. Use

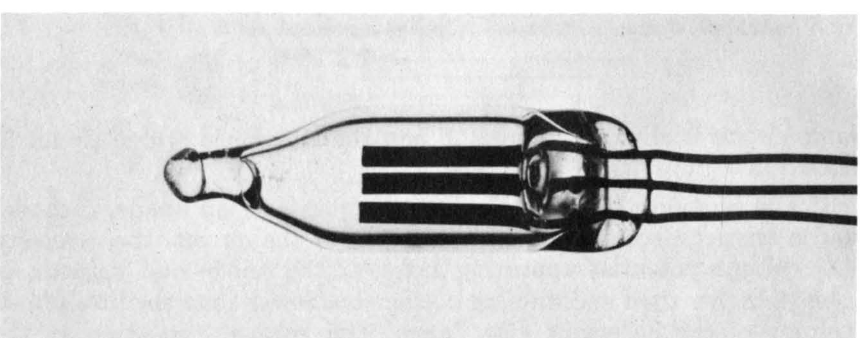

Figure 5.
A Signalite three-element neon lamp.

of a current indicating device on the heater element leads would indicate the heater failure immediately, but would require considerably more complex components and support circuitry than the patented Hotwatt design approach. Use of indicator lamps on the heating elements themselves would not allow the monitoring system to be conveniently located away from the heating system, or would require heavy gauge electrical cables to run from the indicator and control point to the heater

If the monitoring system requires more than a visual indication it may be combined with a relay arrangement to give an audible signal as well as the three-element glow lamp indication. In either case the resulting heater failure warning system is a practical, low cost function monitor that is completely reliable and requires no maintenance.

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SIMPLE BUT EFFECTIVE STROBE LIGHT CALIBRATION

By: Geoff Dendy
Application Engineer
Signalite

The increasing application of strobe light instruments in the electronic, mechanical and photographic trades has brought about a need for simple and effective means of strobe flash rate calibration. Devices used for calibration in the past have ranged from simple tuning forks of one fixed frequency to costly and complex electronic frequency standards with numerical readouts. In the first instance the tuning fork only provided one point of calibration, and in the second the cost of the equipment often exceeds that of the strobe instrument itself.

The answer to providing a simple means of strobe rate calibration can be found in a recent circuit developed by Signalite at the request of a strobe instrument manufacturer Since the device had to be simple to operate and read, a neon glow lamp was chosen as a direct visual indicator Rather than rely on a costly internal frequency standard that might cause more problems than the strobe circuit itself, the device was designed to key on the 60 Hz frequency standard of the 115 VAC line. The complete calibration circuit, shown in Figure 2, occupies very little space within the strobe instrument and uses commonly available components. It will give clear indications of flash rates at 60 and 120 pulses per second (pps), is readable to 30 and 240 pps, and requires no maintenance whatever.

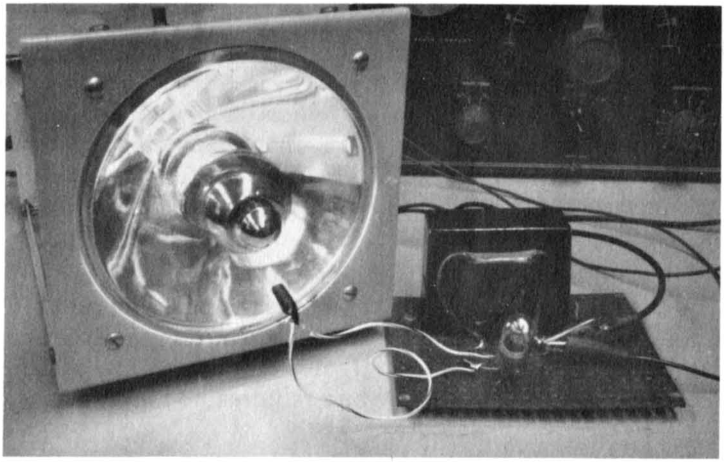


Figure 1:
A breadboard portotype of the strobe light calibration device. The photocell is shown placed against the strobe light lens. The neon glow lamp can be seen with one electrode illuminated, indicating a 60 pps flash rate.

Taking a closer look at the calibration circuit will show that it is basically a conventional neon lamp indicating circuit shunted by a photoelectric cell. The 47K resistor provides current limiting to the photocell and neon lamp, and isolates the components from possible high AC current damage during operation. The transformer shown in the Figure 1 prototype was used as a safety precaution during breadboarding to eliminate the possibility of electrical shock to the engineering technicians, and is not necessary for production models of the device.

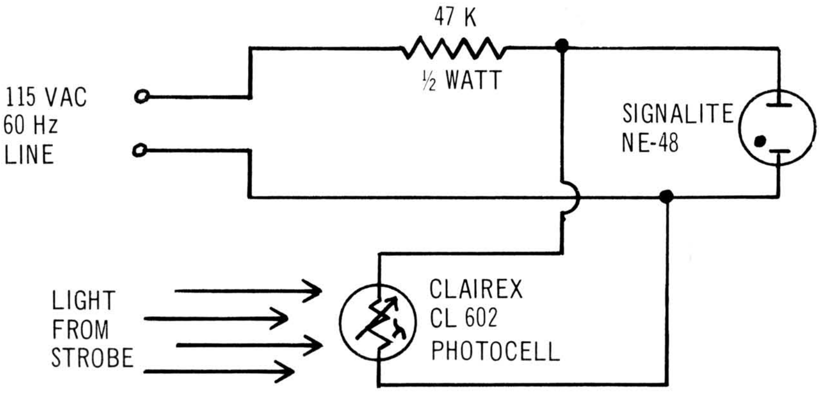


Figure 2:
The circuit for the strobe light calibration device.

A neon glow lamp is composed of two electrodes in a sealed glass envelope filled with a rare gas mixture. When subjected to a sufficiently high AC or DC voltage, the current flow causes the gas around the electrode to ionize and glow brightly If direct current is applied to a neon lamp, only one electrode will appear to glow However, in the case of alternating current, although both electrodes appear to glow, in actuality each electrode is blinking on and off alternately 60 times per second in time with the positive and negative peaks of the current flow This emission, keyed to the highly stable frequency standard of the AC line, is used by the calibration circuit as a reference rate for the strobe light.

The photoelectric cell connected in parallel with the neon glow lamp is used as a photoresistor which sharply decreases in resistance when subjected to a high intensity pulse of light from the strobe flash tube. When the photocell is in a low resistance state, it shunts enough of the current away from the neon lamp to prevent electrode firing, and the lamp remains dark for the particular moment in time.

To understand this relationship more fully, consider the circuit operation at 60 pulses per second of the strobe unit. The photocell is placed close to the flash tube such that the light pulses fall directly on its sensing surface. Each time the flash tube fires it causes a sharp decrease in resistance within the photocell. This decrease, when related to the 60 Hz sine wave of the AC line operating the neon lamp, can be illustrated by the drawings in Figure 3. The neon lamp does not fire instantly upon the upward swing of the sine wave cycle, but has to attain a firing voltage level, Vb, (Figure 3a before the electrode will glow As the second illustration, 3b), shows, before the time the lamp firing point is reached the photocell has reacted to light from strobe tube flash and clipped the voltage peak below the point where lamp ionization can take place.

At the 60 pps calibration point the photocell will be activated once for each ½ cycle of alternating current. Thus, it will clip the voltage to one of the two electrodes in the lamp preventing firing on every ½ cycle, and the other will appear to remain on. As the calibration point is approached either from above or below, the glow area will switch from one electrode to the other back and forth at a rate that directly reflects the amount of offset from exact synchronization. In other words if the strobe is flashing at 59 pulses per second, the glow will transfer from electrode to electrode at the rate of once per second.

When the strobe rate is increased to 120 pps and applied to the calibration circuitry the same photocell clipping effect takes place on the 60 Hz wave form, but it effects both the positive and negative peaks instead of just one. The result in neon lamp operation is that at

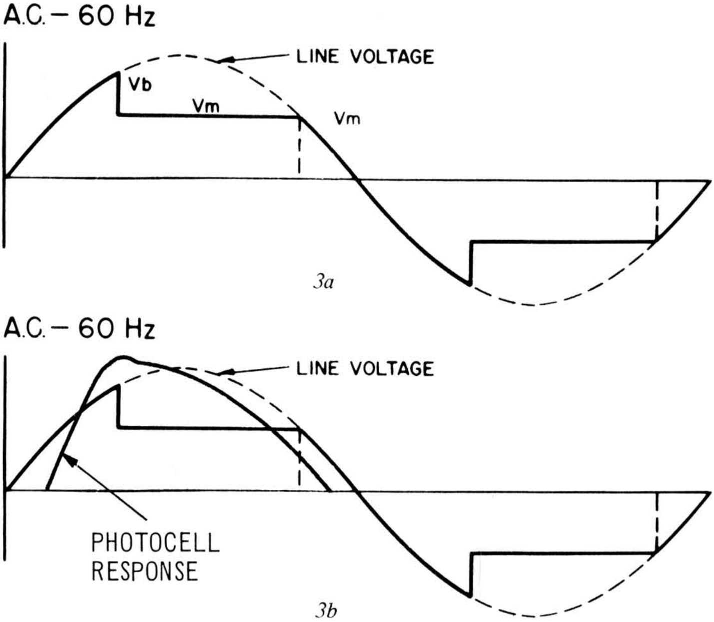


Figure 3:

exactly 120 pps of the strobe device, both neon electrodes will remain off. As the calibration point is approached the two electrodes appear to flash on and off simultaneously Once again the difference between the strobe flash rate and the calibration point may be determined by the rate at which the neon lamp flashes on and off.

The calibration circuit will respond to harmonic peaks as all frequency sensitive devices will, but clear definition between lamp electrode on and off functioning is a little harder to identify At 30 pps of the strobe light both of the electrodes will remain on, but one will be operating at reduced brilliance due to the alternate clipping effect of the photocell on every other sine wave peak. When 240 cycles is reached by the strobe unit the calibration lamp will appear extinguished, but once again the reduced overall brilliance of the electrodes as that point is reached can make it harder to recognize. In this latter case the photocell is reacting twice for every actual 60 Hz sine wave peak in the neon lamp.

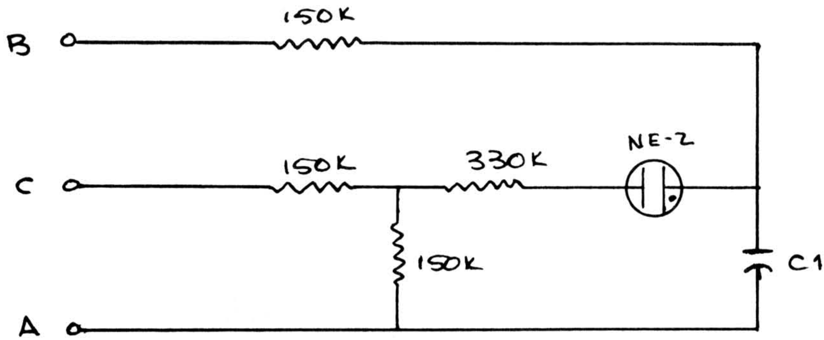
The calibration device designed by Signalite can be mounted within an existing strobe instrument, or can be housed separately in a small utility box for use with battery powered strobe units. In either case it is an inexpensive but reliable alternative to larger and more costly frequency rate sources, and a lot more versatile than a simple tuning fork.

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.

ANOTHER PHASE SEQUENCE INDICATOR

Gentlemen,

Seeing the phase sequence indicator submitted to Professor Simmons in a recent SANS issue reminded me of a phase indication circuit used many times in our laboratory for determining the phase relationship on 3-phase, 120 V lines.



The circuit shown contains three leads, A, B, C, which are to be connected to the three terminals of a 3-phase source. If a neon bulb lights, any two leads are interchanged until the neon extinguishes. The labeled leads then indicate the correct phase sequence.

By proper selection of capacitor value C1, the circuit may be used with any supply frequency The value of C1 for a 400 Hz. source is 4700 pf and for a 60 Hz. source is 0.033 uf

Sincerely,

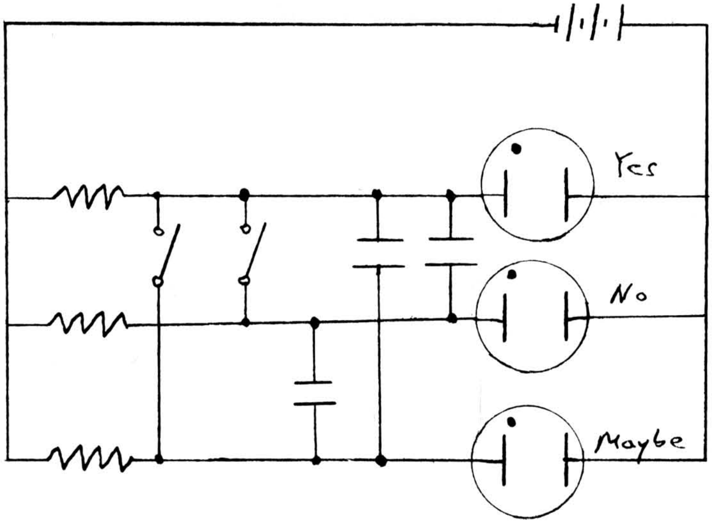
N D. Frederick
Senior Engineer
Aerojet-General Corporation

DECISION MAKER

Dear Sirs,

The following is a modification of the do-nothing-box that we call the decision maker; when the switch is closed, one bulb stays lit.

Lamps: NE-51 C 0.1 uf R — 2 Meg



SW's are DPST, either momentary or snap action.

Sincerely,

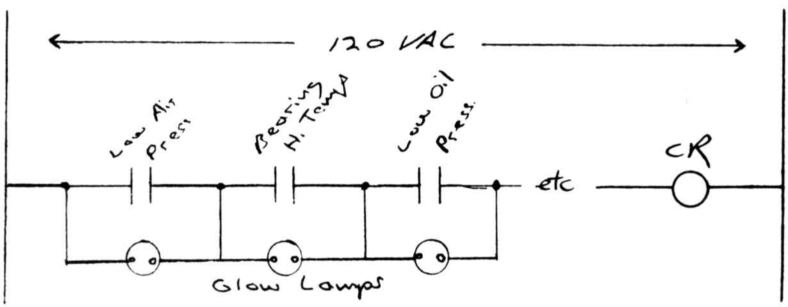
Peter Beck

Dover, New Jersey

LIGHT ON THE INTERLOCK

Gentlemen,

We have several refrigeration systems which have numerous interlocks in series which can shut down the compressor A neon glow lamp



across these interlocks signals the contact which opened the circuit.

Very truly yours,

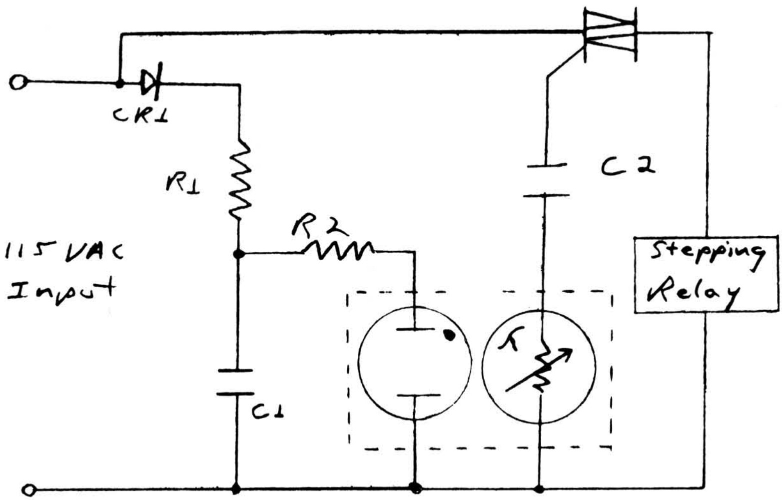
E. L. Sutton
Electrical & Instrument Engineer
Rohm and Haas Company

Ed. Note. Suggest lamp NE2H used for indicators. Some series resistance may have to be added to limit current within the lamps. The total series resistance should be approximately 30K ohms for 25,000 hour average life of the neons.

STEPPING THE RELAY

Gentlemen,

The following is a circuit used to effectively step a relay C1 charges with each half cycle thru R1 and CR1 When C1 reaches the firing voltage of the neon, C1 discharges thru R2 and the neon. The neon lights momentarily and the photocell resistance drops. The triac



gate current will now be sufficient to turn the triac on and energize the stepping relay C1 charges again and the sequence is repeated.

Sincerely,

W D. Verdugt
G-V Controls

Ed. Note. This is an effective way to activate a stepping relay. We suggest that a very fast photocell be used.

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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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