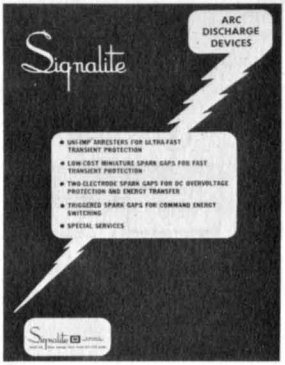
Signalite
APPLICATION NEWS
A DIVISION OF GENERAL INSTRUMENT



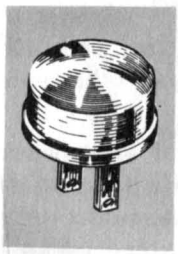
Vol. 9, No. 6 Signalite 1933 Heck Avenue, Neptune, N J. 07753

PROTECTING CATV SYSTEMS FROM SURGE CURRENTS

By: James C. Herman
Development Engineer
Jerrold Electronics Corporation

The utilization of solid state integrated circuit high frequency amplifiers in Community Antenna Television Systems (CATV) should be regarded as one of the more important technological breakthroughs of this decade. The application of these circuits to highly reliable RF amplifiers in a network of pole-mounted or subterranean coaxial cables has brought multiple-channel full color telecasts to broad segments of rural communities for the first time, and has eliminated poor signal quality and interference common to television reception in urban centers. Present CATV systems, which include the use of two-way transmission both to and from subscribers, are providing additional means of communication other than television entertainment between users and their community.

The basic CATV system (Figure 1) consists of several discrete parts. At a prominent point, often a mountain top, a master array of antennas is aimed at the desired distant TV transmission towers. The antennas



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.

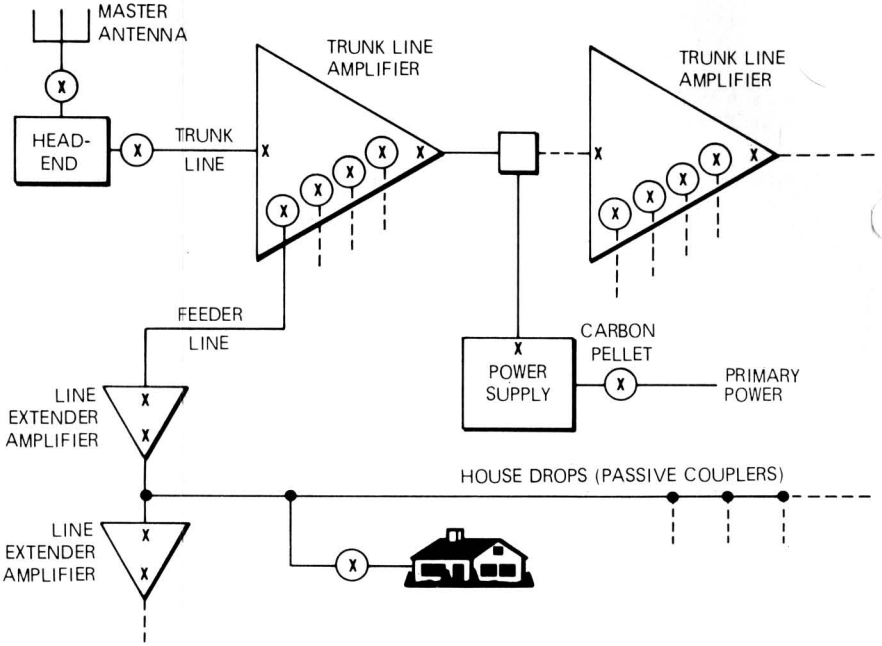


Figure 1
A basic CATV system block diagram. Location of Comm Gap surge protectors in the CATV system are indicated by "x"· other optional surge protectors should be located in areas where the circled "x" appears.

are connected to rack-mounted amplifiers, signal processing and automatic gain control (AGC equipment, all designed to process the received signal in a pure form and eliminate snow, ghosting, and aeroplane flutter from the TV video signals.

From this point, called the "head-end" in CATV terminology, the signals are sent along a main coaxial RF cable called the "trunk line" At various points along this trunk line additional amplifiers, called "trunk amplifiers", are used to amplify the signals and to split the signals into as many as four additional cables, called "feeder lines"

These feeder lines, possibly incorporating their own amplification "line extender amplifiers", are brought along main geographic areas to be served and these lines may be branched off by directional couplers into separate cables serving individual streets. Each subscriber is connected to this street via "drop-line" cables coupled to the system by a passive coupler and tap unit "pressure tap" that provides RF isolation between the subscriber's TV set and those of all other subscribers.

Power to the system amplifiers is supplied by local area power supplies that transform the available 110 or 220 volt 60 Hz line voltage into a lower voltage; 30 or 60 volts depending on the system operator's choice. One power supply feeds several trunk and line extender ampli-

fiers in common through the coax cable extending between them. Individual high-pass filter networks within the amplifiers separate the low frequency 60 Hz power from the high frequency RF signals.

To be most effective, all components in a CATV system must be inherently reliable and operate at maximum efficiency without continual maintenance. Cablecasting systems produced today are designed to meet stringent performance requirements under widely differing environments and operating conditions, so they will provide a good return in terms of service life and investment to the owner

Because the typical CATV system is exposed to the elements and is powered from existing electrical services, it is subject to spurious surge voltages caused by surge currents which, if unchecked, would be destructive to the many component parts of the system. Amplifiers in the system, of which there may be literally hundreds in remote locations, are high gain, low noise solid state RF amplifiers operating from 5 to 300 MHz, and are particularly sensitive to impulse-type voltage surges. If these amplifiers are to remain operative over long periods of time, they must be protected from such surges in a way that will safely, effectively, and repeatedly, dissipate the undesirable disturbance before it can cause a failure.

Voltage surges result from a variety of causes. The most commonly recognized natural source is lightning, but potential differences between storm cloud charges and earth can also be troublesome. The close proximity of high voltage electrical lines, sudden damage to an electric power pole, and power line switching transients, also can induce destructive surges into the CATV system.

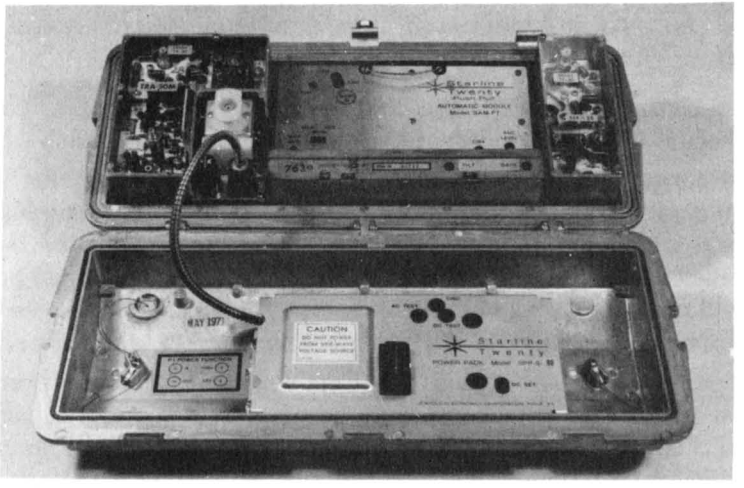


Figure 2
An inside view of a Jerrold Starline Twenty Push-Pull CATV amplifier with quick change plug-in amplifier and power converter modules in place. The unit features internal surge protection in the form of Signalite Comm Gaps.

Partial lightning protection and surge current protection are accomplished in the coax cable by proper and periodic grounding of the outer shield of the cable. But the main problem of unwanted transients and surge currents arises from the voltage differential created between the coaxial shield and the coaxial center conductor when large currents flow in the shield.

Protection against surge currents in active CATV equipment, such as the Jerrold Electronics Starline Twenty® series of amplifiers shown in Figure 2, is accomplished by using Signalite Comm Gap® surge arresters at various points in the amplifier circuitry. Where passive elements are used in the CATV system, such as the originating antenna

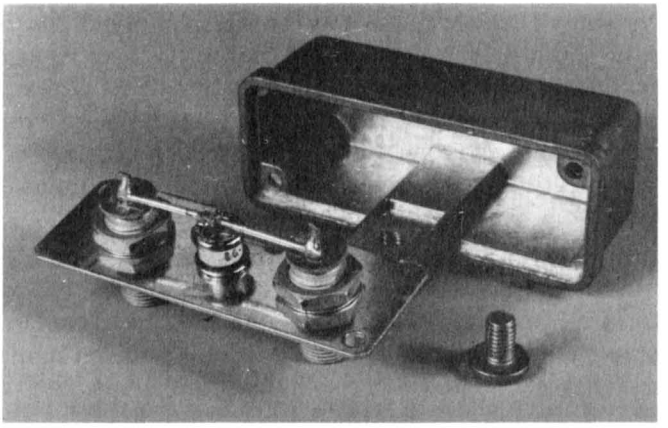


Figure 3
An internal view of the Jerrold LGB-6 Grounding Block showing a surge arrester connected between the RF feed-through and case ground. Grounding blocks are used typically at the subscriber house drop location.

system or the individual house drop terminals, so-called "Line Grounding Blocks" (Figure 3) incorporating the Comm Gap are used.

The surge arrester is basically a high current, fast action switch that reacts to steep wavefronts typical of high voltage surges. The device dissipates voltage by the creation of an arc discharge between two precisely spaced internal electrodes. The electrodes are self-healing, and will withstand tens of thousands of high current discharges before any appreciable change in operating characteristics takes place.

When placed in a typical RF CATV circuit, the surge arrester represents a high impedance component with a typical capacitance of 2pF Thus, it has little, if any, effect on the normal RF amplification and distribution process in the system. When a voltage surge exceeds the rated firing voltage of the arrester, 145 volts in the case of the Signalite CG-145 Comm Gap, the voltage path through the arc discharge represents a very low impedance and dissipates the surge

or transient to ground before it can damage sensitive components in the system. Repeated current loads up to 5,000 amperes can be safely dissipated by the arrester.

The Signalite device offers several advantages to surge protection as compared to conventional air gaps or carbon block type of protectors. The small size of the CG-145 permits its use directly in the circuit where possible, and within compact fixtures where circuit enclosure is not desired. It comes with or without leads, and can be soldered in place or held by a clip arrangement. The rated striking voltage of 145 volts permits a reasonable voltage margin for the 30/60 volt 60 Hz power supply, and yet is low enough to react long before surge current levels can reach equipment-damaging levels.

The graph in Figure 4 shows the relationship between voltage surge and time. The magnitude of a voltage surge such as this appearing within a CATV amplifier is sure to cause permanent circuit damage and a resulting equipment outage. The small dotted line at the base of Figure 4 shows how the Signalite CG-145 device limits the surge voltage to safe levels and at a very fast rate. The nominal reaction time for a surge arrester of this type to a standard 150 volt/u-sec wave is from 1.5 to 3 microseconds, even though a 3 microsecond maximum time interval is shown.

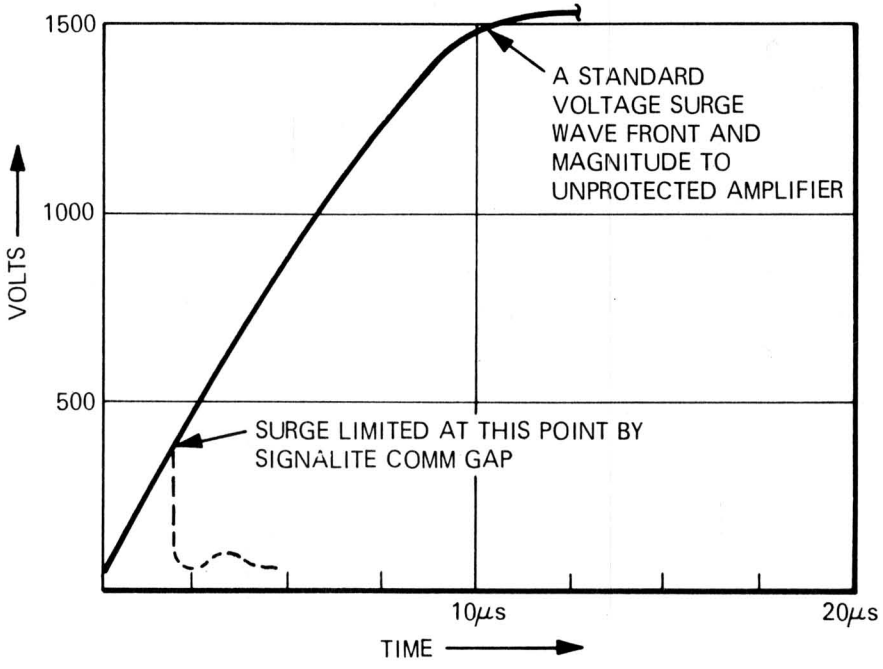


Figure 4
A comparison between (industry standard) a surge voltage that can appear at the input to an unprotected amplifier and to a protected amplifier.

The Signalite CG-145 Comm Gap in the CATV amplifiers is installed between the coax cable center conductor and ground. In practice the Comm Gap is wired in series with filter networks within the amplifiers which are used to separate the 60 Hz power supply current and the 5-300 MHz RF signal, as shown in Figure 5. Since the undesirable

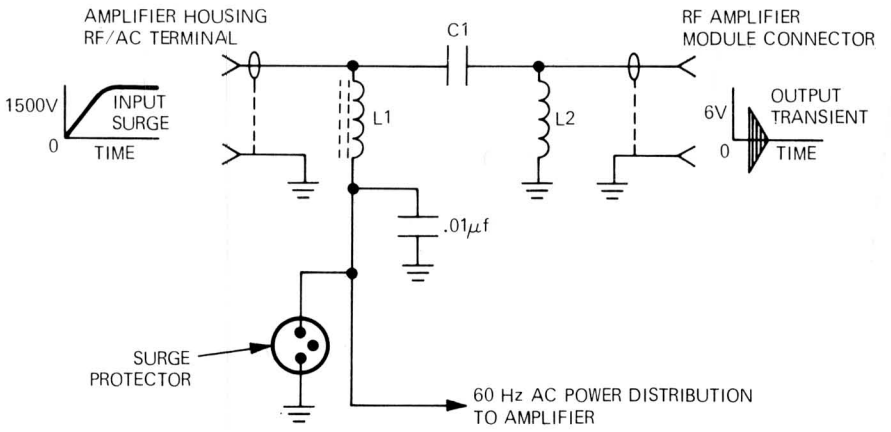


Figure 5
Typical amplifier transient dissipation circuitry used at every occupied amplifier input and output terminal within the amplifier housing. The inductors L1 and L2 and capacitor C1 form a Pi high pass filter which separates high frequency RF signals from the low frequency 60 Hz power supply current and low frequency surges. Surge currents are dissipated to ground by the surge protector at the base of L1.

surges consist of low frequency components, they pass through the inductor and are dissipated by the Comm Gap to ground. The inductor/surge arrester circuit is duplicated at the input and output of the amplifier. The illustration in Figure 6 shows the surge arrester installed within an amplifier chassis.

Providing surge protection to the system through the amplifier 30/60 volt transformer power supplies is accomplished in a similar with a Comm Gap again connected between coax center conductor and ground. The use of a Comm Gap protects from overvoltage surges that could exceed the primary to secondary winding rating of the transformer It also eliminates AC line surges from coming in through the power supply to the rest of the system in areas where large inductive loads are switched in and out of the AC power source. Figure 7 shows the interior of a power supply with the protective cover removed from the RFI shielded terminal box to show the location of the installed Comm Gap.

Where the system coax cables are brought to a building (house drop to subscriber or where internal means of equipment surge protection have not been provided, one of several accessories containing a surge

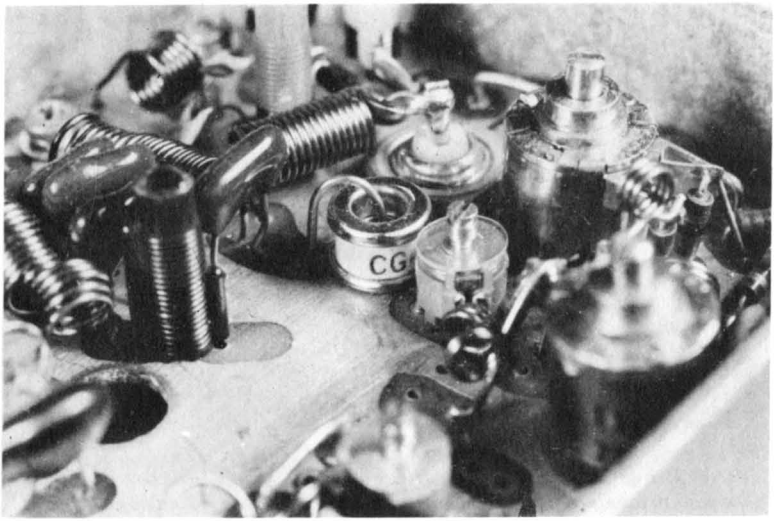


Figure 6
Close up view of a Signalite CG-145 Comm Gap wired within a CATV feeder line amplifier module. The inductors adjacent to the gap are part of a high-pass low-pass filter used to separate RF from the AC power supply current and low frequency surges.

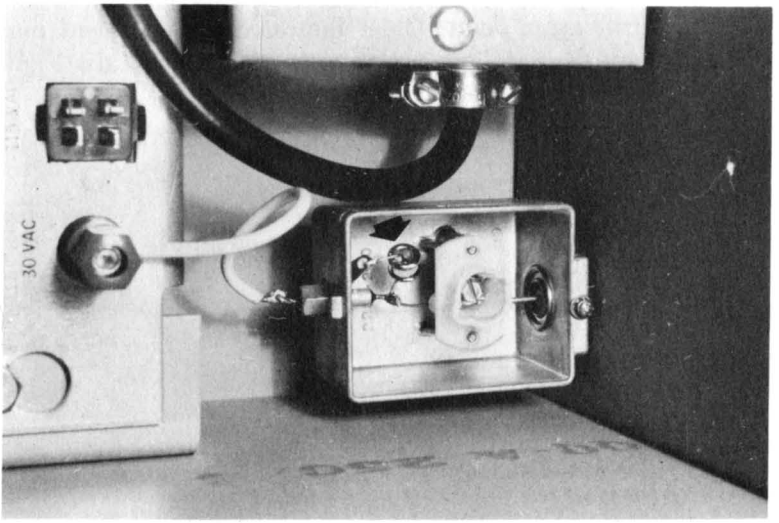


Figure 7
Surge voltage protection is also afforded the primary to secondary power supply station output. The Comm Gap is located in the small RFI shielded compartment within the power supply (arrow).

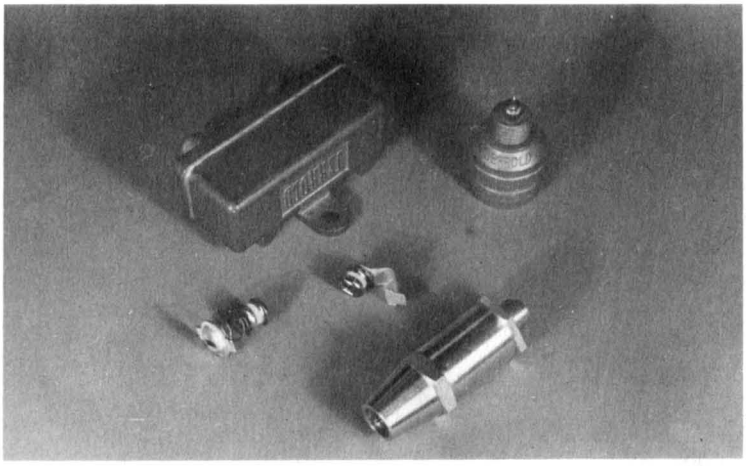


Figure 8
Several Jerrold surge protection devices containing surge arresters for use at termination points, at the head-end and house drops, and for updating existing unprotected CATV equipment.

arrester may be used. These devices are shown in Figure 8.

The importance of surge protection throughout a CATV system has become more obvious now after several years of actual field operation New equipment, like the Jerrold Starline Twenty series of two-way amplifiers, is designed with internal surge protection at input and output ports and optional protection provisions for protection at each distribution termination point. Older unprotected equipment may be accorded the same degree of protection with add-on hardware (Figure 9)

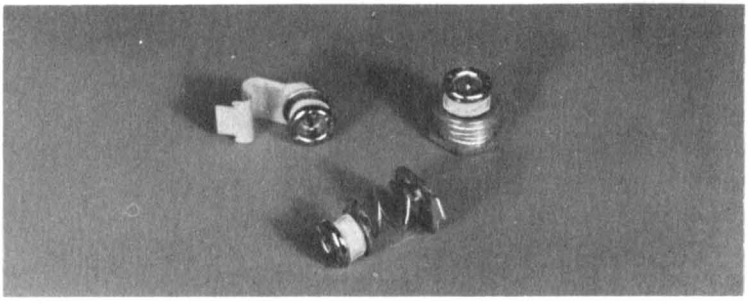


Figure 9
Available add-on hardware for Jerrold amplifiers is recommended to provide surge protection in existing systems in those systems which utilize older equipment built without such protection.

from the head-end on down to the individual subscriber line drops. Failure to use adequate surge protection soon appears in terms of frequent line outages, loss of capital equipment, and heavier demands on maintenance schedules.

GOT A PROBLEM IN GLASS?

As a result of our work with neon lamps and surge arresters, Signalite has developed expertise and high speed machinery in the technology of glass forming, high speed glass handling, and metal to glass sealing. If you have a problem and would like help in the design and fabrication of glass parts, perhaps we can help. Contact our Applications Engineering Department.

We are also expert in resistance welding small gauge wire (we routinely weld resistors on the leads of lamps), crimping, heat shrink insulation of assemblies, and encapsulation. Again, maybe our Applications Engineers can give you just the answer you need.

CAN YOU SOLVE THIS? ?????

Dear Editor:

There are circuits available for producing a siren effect using two or more neon glow lamps. I should ike to see a circuit using only one neon glow lamp to produce a siren (or wail) effect. The simpler the better. Can such a circuit be designed? Have I overlooked an existing circuit?

Yours truly,

Louis Berkowitz
Randolph, Mass.

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.

CORRECTION: WE DROPPED A CAPACITOR

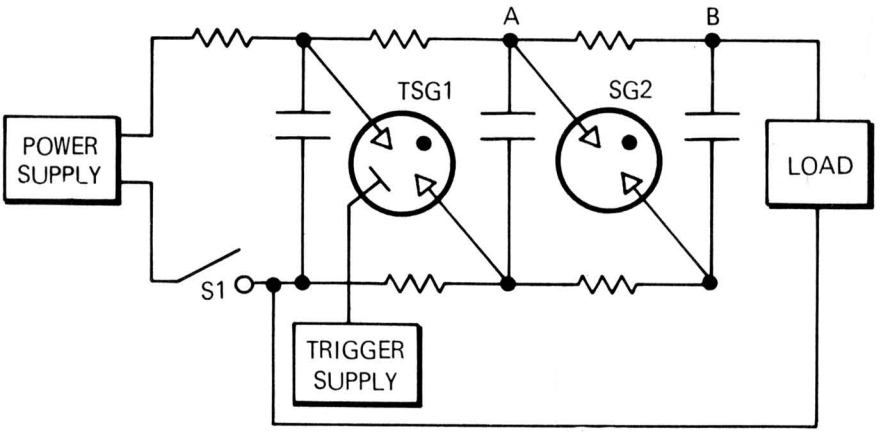
Dear Sir·

In the Marx Generator circuit shown on page 429, Fig. 11 of Signalite Application News Vol 9, No. 4, you omitted the capacitor

from the center leg between the two spark gaps.

Edward Brown, Engineer
Kilovolt Corporation

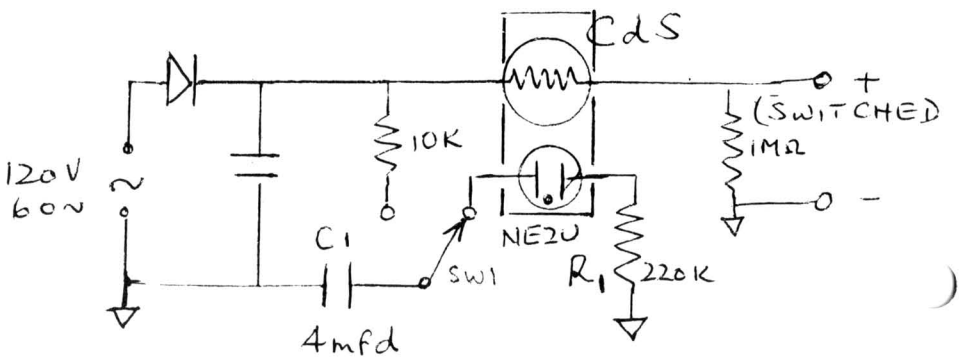
Ed. Note
Several of our readers called our attention to this omission. Thank you. The correct circuit is produced below



SHORT TERM TIMER

Gentlemen,

Needing a simple timer which would turn on B + for a few seconds, I came up with the following circuit which may interest you.



Upon depressing SW1 (s.p.d.t. push-button) C1 charges to B + On releasing, the NE2U lights and activates the CdS cell Timer period ends when the charge on C1 falls below the neon's maintaining voltage and the CdS reverts to its high resistance state. The cell and the lamp

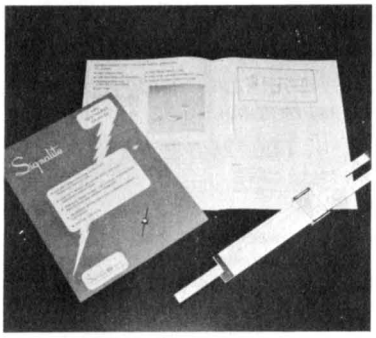
are glued together with transparent cement (Duco) and the whole assembly is dipped n black paint. The 1M ohm resistor "swamps" any dark-current leakage of the CdS.

Sincerely,

William Beckett
St. Petersburg, Florida

Ed Note R1,C1 can be adjusted to give any desired period (refer to Vol 5, No. 3 for design information).

CATALOG ON ARC DISCHARGE DEVICES OFFERED



A new, fully-illustrated catalog describing the complete line of Signalite gas-filled arc discharge devices applicable as circuit components, circuit protectors, & high current transfer switches is now available from Signalite. The 8-Page publication contains specifications and design features of the Uni-Imp (zero reaction time) surge arrestors, subminiature low-voltage surge arresters, two-electrode spark gaps and triggered spark gaps.

The new brochure details application considerations such as life expectancy, circuit insertion values, test data, and physical characteristics of each type of device in separate sections. Model and operating range data is compiled in quick-reference chart form to facilitate component selection. Detailed mechanical drawings giving dimensions and wire lead layout are also included.

The Signalite Arc Discharge Devices catalogs are prepunched to fit into a standard 8½ x11" loose leaf 3-ring binder. For individual copies of the catalog, contact Signalite, 1933 Heck Avenue, Neptune, New Jersey 07753.

Return Postage Guaranteed

H. Ulmor
.U INCORPORATED
P.O. Box 1007
Oceanside, Calif. 92054

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

Signalite DIVISION OF GENERAL INSTRUMENT CORPORATION
1933 HECK AVENUE, NEPTUNE, NEW JERSEY 07753

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*

● ● ● ●

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:

Scottsdale, Arizona	(602) 947-4297	Kansas City, Missouri	(816) 763-3634
Los Altos, Calif.	(415) 948-7771	Albuquerque, N. Mex.	(505) 255-1638
Glendale, Calif.	(213) 247-6190	Neptune, New Jersey	(201) 775-2490
Denver, Colorado	(303) 388-4391	Rochester, New York	(716) 586-2030
Atlanta, Ga.	(404) 758-7496	Charlotte, N.C.	(704) 375-8958
Chicago, Illinois	(312) 593-0200	Cincinnati, Ohio	(513) 521-2290
Fort Wayne, Indiana	(219) 432-5591	Cleveland, Ohio	(216) 333-2585
Kokomo, Indiana	(317) 453-6868	Dayton, Ohio	(513) 298-9546
Indianapolis, Indiana	(317) 359-9283	Lafayette Hill, Pa.	(215) 825-3177
Louisville, Kentucky	(502) 893-7303	Pittsburgh, Pa.	(412) 242-0100
Baltimore, Maryland	(301) 484-3647	Bristol, Tenn.	(615) 968-4195
Waltham, Mass.	(617) 890-8040	Dallas, Texas	(214) 528-6286
Grand Rapids, Mich.	(616) 451-8901	Houston, Texas	(713) 468-0232
St. Joseph, Mich	(616) 983-7337	Seattle, Washington	(206) 782-1600
Southfield, Mich.	(313) 358-2020	Waukesha, Wisc.	(414) 786-6330
Minneapolis, Minn.	(612) 854-4270	Toronto, Ont., Can.	(416) 763-4133
St. Louis, Missouri	(314) 872-3183		

PRINTED IN U.S.A