Signalite
APPLICATION NEWS
from the desk of

Ed Bauman, Chief Engineer

Vol. 5, No. 1

REGULATING VOLTAGE TO VIDICON TUBES

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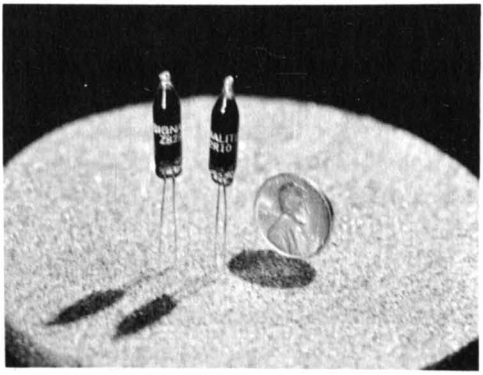
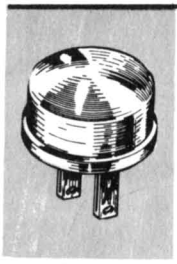


In an operating room the patient is undergoing microsurgery to correct his hearing. Using miniature instruments the surgeon can only see what he is doing through a powerful microscope. In the observation gallery are a handful of student surgeons intent on watching the oper-



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

You can get a free Signalite Owl Eye Nite Lite simply by sending us an application for neon glow lamps, 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.

ating surgeon's techniques on a large television screen. Never before was it possible to teach these techniques by actual observation.

The technological progress made in the development of industrial television since the first systems were made available commercially more than ten years ago has resulted in direct observation of many areas and processes which previously could not be seen, or could not be observed safely, or which required many eyes to do the observing. In the scene described above, a small television camera is mounted on the microscope to project what the surgeon sees to an audience. On the television monitor the magnification is 1800 times with no loss in resolution. Such resolution is the key to the rapid increase in the application of industrial television.

Today industrial television is being used to monitor industrial processes remotely, to observe the mixing of dangerous chemicals, to see in places where it is not possible for a human to enter, such as blast furnaces, to act as guards, watchmen and even bank tellers. Industrial television cameras are mounted in railroad freight yards exposed to all weather conditions, vibration and shock. They are mounted in nuclear reactors and cyclotrons to check alignment while the unit is accelerating.

In all of these applications two qualities are paramount—reliability and stability. A television camera located at some distant location cannot readily be serviced if it should break down. An image on the monitor which jumps, becomes fuzzy or indistinct, or can not hold brightness tends to defeat the purpose of the system.

We regret to announce the death of Edward Bauman, our Vice President for Engineering. Ed, whom many of you have come to know through the pages of this newsletter, passed away on February 8, 1967 after a brief illness.

Today's industrial television cameras are capable of 700 to 1000 line resolution. In a closed circuit system this resolution is maintained. Such systems make extensive use of microcircuitry, silicon transistors, and other solid state advances which have enabled design engineers to educe the size significantly and at the same time to improve the reliability.

One of the areas important to preserving the stability of the system is regulation of the voltages on the vidicon tube. Any variation in voltage to the control grid, the accelerating grid, the focusing grid or the decelerator grid will result in an imperfect picture. (Figure 1) For example, the electron beam, which is scanning at frequencies of 15,750 cps horizontally and 60 cps vertically, produces a signal voltage which varies in direct proportion to the amount of light incident on the light-sensitive layer on the signal electrode. If this voltage varies as a result of instability within the system rather than the image on the signal electrode, the output will not be a true representation of the scene under observation. It is of extreme importance, therefore, that the electrical adjustments on the camera, and more specifically, the vidicon, do not change under short duration changes in line voltage or aging of components.

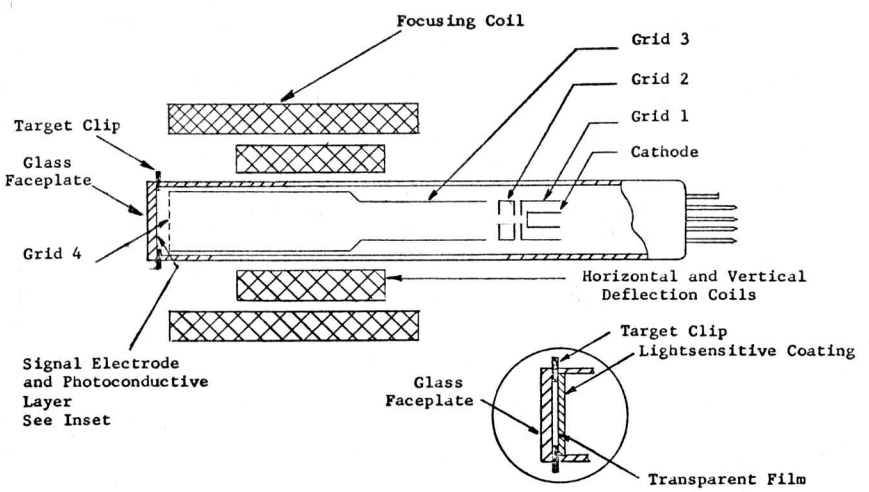


Figure 1: Diagram of typical vidicon showing arrangement of grids and coils.

Years ago when industrial television cameras had resolutions of about 350 lines, precise regulation was not as important. In fact, many cameras had no provision for voltage regulation at all. As the resolution increased, various methods for regulation were incorporated. Earlier forms of regulation included transistorized power supplies, regulated transformers, large gas tube regulators and zener diodes.

The transistorized regulated power supply consisted of a low voltage d-c to high voltage d-c converter in which the high voltage was compared to a reference voltage. The error voltage was amplified and fed back to a series voltage regulator which fed the input transistors of the d-c to d-c converter. This circuitry, however, was complex and costly. The coupling of the various loads to the power supply results in an interaction which adversly affects the regulation. While the semiconductors used are reliable, the fact that a large number of components were required reduced the mean time between failure.

The regulating transformer is large and heavy. It regulates only against input line voltage changes leaving the system subject to internal variations of load. And it is not applicable to portable television cameras.

The large gas tube regulators, in addition to being large, did not have the regulation required by the vidicon. Occasionally, they exhibit jump voltage characteristics which can not be tolerated in high resolution cameras. When all possible is being done to miniaturize the camera, the size of these tubes is a disadvantage. They, too, are comparatively expensive.

Zener doides had been tried by Fairchild, but they, too, fell short of the performance required by the camera. For a camera that may be subjected to a wide range of environmental conditions, temperature extremes in particular, the relatively poor temperature coefficients of zeners could not be tolerated. The tolerance of the low cost zeners (±20%) was too wide for the vidicon, and the high voltage, close tolerance units are too expensive in as competitive a market as we face today.

The method currently being used for regulation in all Fairchild industrial and military television cameras is the subminature voltage regulator produced by Signalite Inc., Neptune, N.J. (Figure 2) These regulators, which are an advanced development of neon glow lamps, regulate to within one volt over the current range, and exhibit very low temperature coefficients. They are small enough to meet our miniaturization requirements, reliable and low in cost.

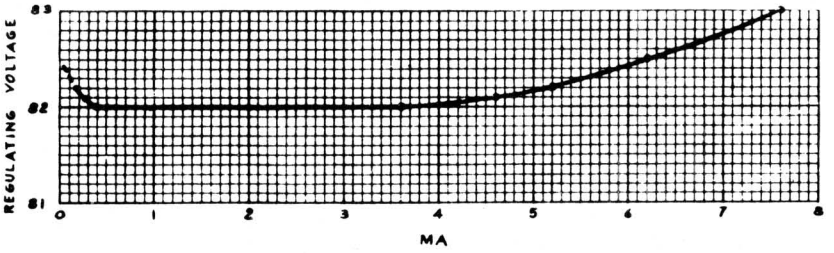


Figure 2:

Subminiature gas discharge voltage regulators, showing typical regulation curve for an 82 volt regulator.

In the television camera, the voltage to each of the four grids in the vidicon is regulated separately. (Figure 3) Grid #1 is the beam control and operates at a voltage of 0 to 130 volts. This grid forms the electron emitted from the electron beam which is used to scan the light-sensitive layer of the signal electrode. If the voltage level changes here in one direction, the picture will be lost completely, if it changes in the other direction, defocusing will occur and clarity will be lost in the center of the picture.

Grid #2 is the accelerator which operates at 350 volts.

Grid #3 is the focusing electrode and Grid #4 is the decelerator. The decelerator is a fine mesh screen located adjacent to the photoconductive layer and is connected to Grid #3. Its purpose is to cause the electrode beam to approach the target perpendicular to all sections on the surface. Both Grid #3 and Grid #4 operate at 700 volts.

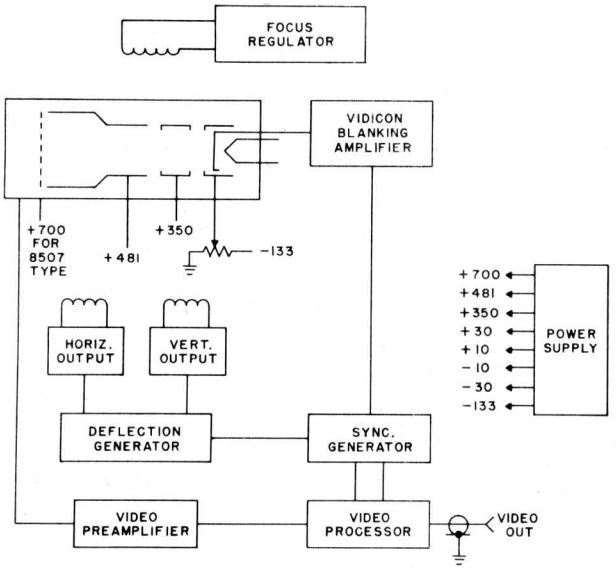


Figure 3: Block Diagram of the TC950 industrial television camera

The power supply for the TC950 industrial television camera consists of a high voltage power supply for the vidicon tube and a low voltage power supply for the transistorized circuitry.

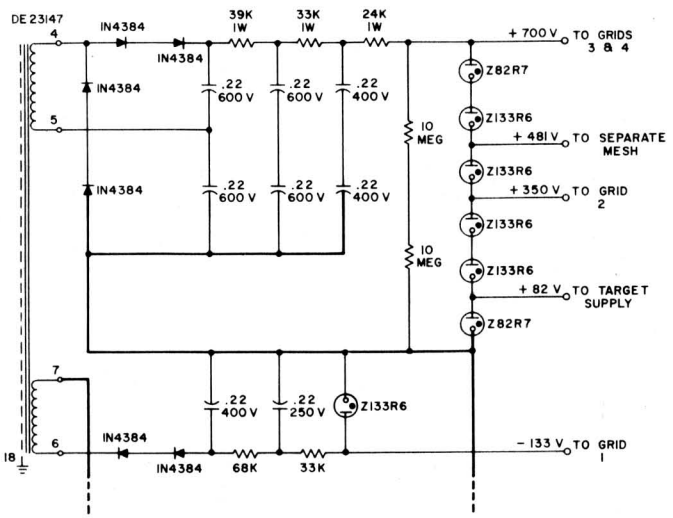


Figure 4: Power supply for the TC950 industrial television camera

TABLE 1

TYPICAL CHARACTERISTICS OF 3 COMMON TYPES OF VOLTAGE REGULATORS

CHARACTERISTICS	Large Gas Tube Reg. Type VR90	Zener Diode 91V, 1W Low Tol.	Zener Diode 91V, 1W High Tol.	Submin. Gas Tube Regulator Z91R2
Regulation Tolerance	±3%	±20%	±5%	±1%
Approximate Temperature Coefficient	-15 mv/°C	135 mv/°C		-3.5 mv/°C
Approximate size	ST12 Tube	DO 7 to TO3 can, or lug type to 1-1/2" L. by 1/2" D		T-2 Bulb 1-1/16" Long.
Reliability (Life)	2,000 hours	30,000 hours		30,000 hours
Stability	May exhibit jump characteristics	Excellent		Excellent
Voltage Range	3%	2%		1%
Current Range	5-40 ma	.25 to 7 ma		.25 to 7 ma
Shock & Vibration Tolerance	Must be isolated from vibration & shock	Good		Good
Installation	Socket	Solderable leads		Solderable leads
Mounting Position Restrictions	Must be upright in certain applications	None		None

Line voltage (117 va-c) is applied to the primary of the transformer. The positive high voltage vidicon power supply consists of a secondary (terminals 4&5) which supplies approximately 350 va-c to a voltage double rectifier system. This voltage doubler supplies approximately 1100 volts to the R-C filter network. The output of the filter is pure d-c and is fed to the series string of subminiature voltage regulators.

The highest positive voltage output supplied through the voltage regulators is +700 volts. This voltage is then dropped through a series arrangement consisting of one ZR82R7 and one Z133R6 voltage regulator. The output at this tap is +481 volts. Voltage is then further reduced by the drop of one more Z133R6 to +350 volts. The positive voltage is finally dropped once again to +82 volts through another series arrangement of two Z133R6 voltage regulators.

The vidicon grid power supply consists of a secondary (terminals 6 & 7) which supplies 230 va-c through a half-wave rectifier and R-C filter network and is then applied to the Z133R6. This regulates the output to Grid #1 of the vidicon. This output voltage is –133 volts.

The +700 volt output voltage is supplied to Grids 3 & 4 of the vidicon. This voltage is regulated to ±0.7%. The +481 volt output is used where the vidicon has a separate mesh and is held at ±0.7%. The +350 volt output is supplied to grid 2 of the vidicon and is regulated to within +1.1%. The 82 volt output is used for the target supply and is held at +1.2%. The negative 133 volts supplies the beam control potentiometer for Grid 1 and is regulated to within ±1.3%.

The remainder of the power supply consists of a +30, a +10, a –10, and a –30 volt regulated power supply for the various transistorized circuitry. This circuitry consists of full wave rectifiers, filter networks and standard series transistor regulators.

Congratulations to Marvin Willrodt of Hewlett-Packard Co. whose article on "Binary to Decimal Decoding System Using Neon Lamps and a Photoconductor Matrix" appeared in the Nov./Dec. issue of *Information Display*.

Also, congratulations to A. B. Cistola, IBM Space Guidance Center, for his article "Neon Tube Staircase Generator Performs Two Jobs" which appeared in the December 26 issue of *Electronics*.

Both of there articles were prepared originally for *Signalite Application News*.

"USEFUL TO ANY ELECTRONIC ENGINEER..."
—*ELECTRONIC DESIGN*

Did you happen to notice the review of Ed Bauman's book, Applications of Neon Glow Lamps and Gas Discharge Tubes, in the Jan. 18, 1967 issue of *Electronic Design?* Here are some of the things it said:

> "The book should be useful to any electronic engineer. . . it can very well serve as a general reference in applications of neon glow lamps and gas discharge tubes."

You can get a copy from Signalite for only $2.95 plus 25¢ postage and handling. (N.J. residents add 9¢ for state sales tax.) Order your copy today.

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.

MONITORS MICROWAVE FIELD PATTERN

Dear Mr. Bauman:

Here is an application of neon glow lamps that we used recently.

We took 100 NE-2 lamps and placed them in a grid pattern on a sheet of styrofoam plastic and inserted this into an electronic oven to monitor field patterns. By varying power levels and distributing devices we were able to get a fairly accurate picture of any 'hot' or 'cold' spots in the oven. The frequency of the oven was 2450 magehertz.

Thank you very much for my 'subscription' to the Signalite News.

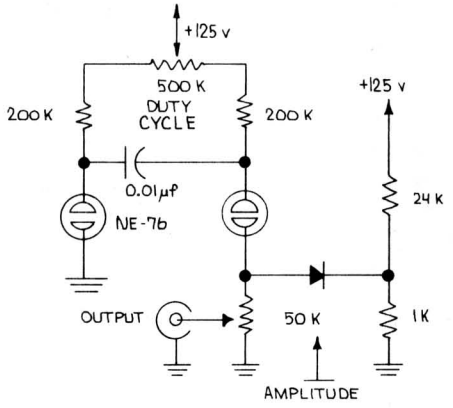
Jerry C. Sutton
Senior Microwave Tech.
STD Research Corporation

Ed. Note: Our T2-24-1 would give excellent service in this application.

SQUARE WAVE GENERATOR

Dear Mr. Bauman,

. I have an application to relate. The following is a square wave generator with variable amplitude output, and variable duty cycle:



Output Rep. Rate: 455 μ-sec.
Duty Ratio Adjustable from about 25% to 75%
Amplitude adjustable from 0 volts to about 5 volts P - P

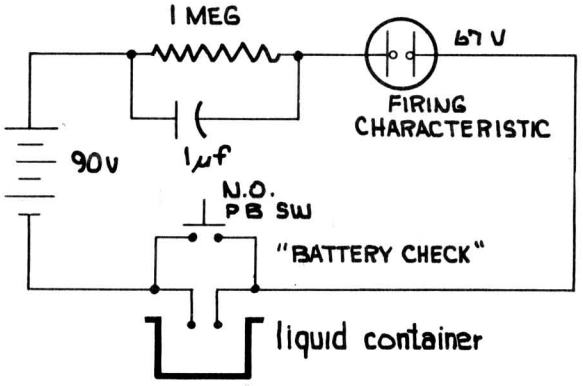
Sincerely yours,
Duane W. Moore
General Electric Computer Equipment

Ed. Note. To improve the reliability of this square wave generator we recommend using Signalite's T2-27-1R100. This lamp contains a radioactive additive to improve its stability of operation. It has a breakdown rating of 66-74 vdc and a maintaining voltage rating of 52-59 vdc.

SIMPLE LIQUID LEVEL INDICATOR

A simple liquid level indicator and warning system can be built using neon glow lamps in applications where the liquid is nonflammable. For example, if it is desired to know when a rain barrel is filled with water, the following circuit could be used.

When water reaches the electrodes, the neon lamp will flash once a second. Since the load on the battery is negligible, its life will approximate normal shelf life. A normally open pushbutton switch across the electrodes provides a convenient "Battery Check" indication.



Yours truly,
Paul E. Mix
Pemco Electronics

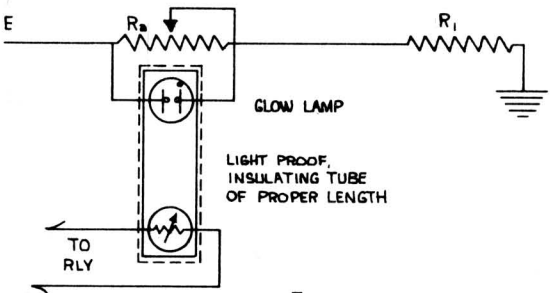
Ed. Note:

Our type A079 lamp would work well in this application. It has a maximum breakdown voltage rating of 70 volts, design current of 0.3 ma, and a rated life of 7500 hours at continuous operation. Under the intermittent operation described here, the lamp should last indefinitely.

LOW COST, ADJUSTABLE, HIGH VOLTAGE, CURRENT ALARM AND CONTROL

Gentlemen:

(Here is a suggestion) for Signalite Application News.



Value of R_a such that $\frac{E}{R_a} = \text{Max I}$

Relay can: 1 Disconnect power at primary
2. Short out H V
3. Sound alarm

Robert C. Hale
Applications Engineer
Industrial Electronic Rubber Co.

Ed. Note: We suggest using a high brightness type neon lamp such as our LT2-24-1 for this application with a photocell.

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) 254-8889	Neptune, New Jersey	(201) 775-2490
Los Altos, Calif.	(415) 967-8998	Albuquerque, N Mex.	(505) 256-0884
Los Angeles, Calif.	(213) 274-8485	Cincinnati, Ohio	(513) 521-229[illegible]
No. Miami, Florida	(305)PL1-5566	Cleveland, Ohio	(216) 333-258[illegible]
Chicago, Illinois	(312) 777-2250	Columbus, Ohio	(614) 488-973[illegible]
Indianapolis, Indiana	(317)FL9-5374	Dayton, Ohio	(513) 298-9546
Fort Wayne, Indiana	(219) 743-4411	Portland, Oregon	(503)CA2-7337
Louisville, Kentucky	(502) 893-7303	Seattle, Washington	(206)MU2-7337
Detroit, Michigan	(313) 862-2225	Scarborough, Ont. Can.	(416)PL7-3253

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