

TUNG-SOL[®] DIGIVAC S/G^{T.M.}

MAKES NEWS!

TUNG-SOL DIVISION/Wagner Electric Corporation

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One fumble, one touchdown for Tung-Sol fluorescent readouts

PROGRESS IN
DISPLAY DEVICES

**Progress
in
Design
and
Research**

EEE WAS LESS than enthusiastic about the seven-bar fluorescent readout, Digivac I, introduced by Tung-Sol just a few months ago (see "Two more contenders for readout throne," EEE, June 1968, pp. 26-28). Apparently, Tung-Sol wasn't overjoyed either. It dropped Digivac I, conceding that "Market study, customer reactions and our own research quickly obsoleted the device because of certain design considerations."

Unwilling to accept defeat of Digivac I passively, the company just introduced a second-generation readout, Digivac S/G, and this one really looks good. Like its predecessor, it's a seven-bar, single-plane readout in a vacuum-tube envelope. Unlike the earlier Digivac, a seven-triode, common-cathode tube, the S/G version (seven diodes with a common filament-cathode) requires no 250-V anode supply; it consumes less power; its structure is much simpler since there are no control grids, and it generates no emi.

The new tube can operate with a 12-V plate supply, which is lower, even, than the 20-V grid swing needed by the triode version. But with 25 V it gives a beautifully bright character. The filament takes only 1.6 V at 45 mA, which is a lot more impres-

sive than the 1.5 V at 360 mA required by the triode.

The price magnet

These features are attractive, but the major attraction may be the price. In 1000-up quantities, Digivac S/G costs only \$2.50, making it the lowest-cost readout tube on the market. That figure makes the \$8.50 tag on Digivac I look ridiculous and, more important, it beats the price of the lowest-cost Burroughs tube, the B-5750 with decimal points (\$3.95), and of Alco's Elfin, a seven-bar neon readout with decimal (\$2.99).

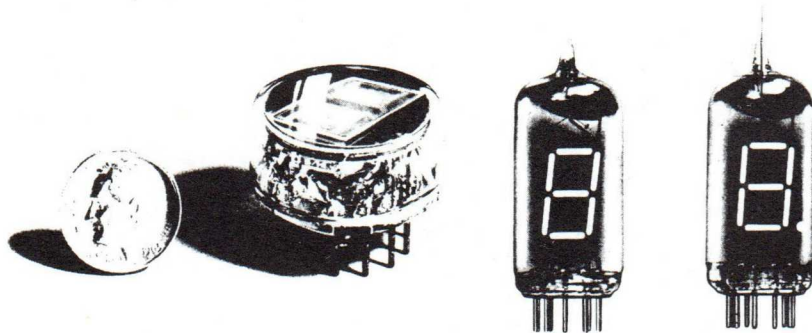
An optional decimal point in Digivac S/G boosts the 1000-up price to \$2.90. But the decimal-point version has a lead flying out of the top of the 9-pin miniature tube. Though many users may find it handy to retain 9-pin conveniences, others may find the flying lead awkward.

In quantities of 100,000, prices become even more attractive: \$1.95 without the decimal and "slightly more than \$2" with it.

Licking the logic problem

Without suitable decode logic and drive, any new readout faces a rough future. Tung-Sol learned this lesson with Digivac I. With Digivac S/G, the company offers

(Continued on page 20)



Tung-Sol's Digivac I (left) never made it. But the new Digivac S/G, with or without decimal point, has a string of extremely impressive features, not the least of which is the fact that it's the lowest-priced readout on the market. An IC logic and drive package offers low cost, low speed (unfortunately) and superb versatility.

(Continued from page 18)

an exceptionally versatile logic package, designed and made by General Instrument.

As one might expect, the GI package uses MTOS IC circuitry and, in quantities of 100,000, the price is beautiful — \$4. At 1000-up levels, the price is still handsome at \$16.

The logic is now available in a 24-lead, 1/4 × 3/8-in. flat pack.

Large quantities will soon be available in 24-lead dual-inline packages.

The logic has just about everything anybody could hope for except speed. Its up/down counter can accept a clock rate no faster than 500 kHz — which can rule it out of many applications.

Otherwise, the package is extremely versatile. It converts parallel BCD to seven-bar output.

Or it counts pulses — up or down. It stores a count and displays on command. It generates a carry signal for multi-digit displays. It provides zero-count and false-count indications, leading-zero blanking, decimal storage and start-count preset. That's a lot of logic in a small package at a low price.

For more information on the new Tung-Sol readout and GI logic/driver, circle 723.

TUNG-SOL MAKES THE DIGIVAC S/G READOUT THAT MAKES NEWS!

DECEMBER 1968
VOLUME 16, NUMBER 12

EEE

Economy readout tube outshines competitors

Single-plane alphanumeric device combines low power and high speed

A \$2 readout tube based on a simple design combines high intensity, low power consumption, high speed and long life.

Tung-Sol's Digivac S/G is a single-plane seven-bar segmented fluorescent readout. Each bar of phosphorescent material acts as an anode when actuated by a 10-to-40-volt dc signal voltage. Two barium-carbonate-coated tungsten wires, strung between the segments and the viewer, act as the cathodes. These two wires are almost invisible since their temperature is well below 700°C—only 45 mA at 1.6 volts ac or dc are needed to energize them.

Nix on gas ionization

The advantages of this new design go beyond the cost savings.

The conventional gas-ionization type readout tube does not offer a single-plane display. Its numerals are stacked atop one another from the front of the tube to the back, making for some loss of clarity at a distance. The Digivac's single viewing plane permits a viewing angle up to 150°. Whereas the two types of tubes have equally bright outputs, the Digivac's characters are blue-green in color and the gas-ionization tube's are red. Tung-Sol engineers say that their tube eliminates the parallax errors, "seasick," and "bloodshot eye" effects found in other types. And, it is visible at over 40 feet.

Since the luminosity is generated on the surface of identical segments, the characters are uniformly bright. The readouts operate at a high speed—lim-

ited only by the persistence of the phosphor.

The units can display all 10 numerals and thirteen letters. A decimal point is optional. They have a standard 9-pin socket base.

Less power to you

Electrically, the simplified design really reaps benefits. The maximum power required by the tube—the figure 8 plus a decimal point—is 280 mW. The comparable figure for other types of readout can be as much as 600 mW. Switching voltage requirement is 25 volts dc; other types require up to 170 volts. This makes the tube

ideal for battery operated equipment using a 1.5-volt D cell, or a 9-volt transistor battery. And, the Digivac is reportedly EMI emission-free.

As far as life is concerned, Tung-Sol engineers have tested the tube for over 3,000 hours thus far. It has suffered no degradation. They feel that the tube, life-wise, will be competitive since two factors contributing to potential failure, heat and voltage, are much lower in this tube than in competing tubes.

The logic of low power

Logic for the readout tube is supplied by a General Instrument designed MTOS chip. Packaged in a 24-lead flat pack, and available for about \$4, the chip consists of an up/down decade counter, storage register, decoder/driver and input, output and command terminals. The low power consumption of the tube makes the FET logic a natural.

The logic package incorporates count storage and display-on-command features. Provision is made for cascading multi-digit displays, zero count indication, leading zero blanking, preset or desired count start, decimal point storage, moving decimal point indication with outside logic, and false count indication.

The tubes are available for \$2.55 (\$2.90 with decimal point) in 1000-lots. At the 100,000-piece level, prices dip to below \$2. Tung-Sol Division, Wagner Electric Co., One Sumner Ave., Newark, N.J. 07104. Phone: (201) 484-8500.

Circle 305 on Inquiry Card

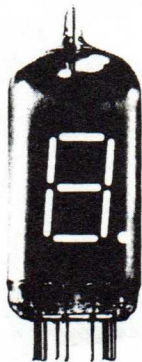


Figure eight. The eight and decimal point represents the tube's maximum power requirement—280 mW. The decimal segment is fed through the flying lead at the top. The tube stands 1.73 inches tall, exclusive of this lead.

TUNG-SOL MAKES THE DIGIVAC S/G READOUT THAT MAKES NEWS!

EDN

EXCLUSIVELY FOR DESIGNERS AND DESIGN MANAGERS
IN ELECTRONICS

MOS Drives Indicator Tubes
Diff-Amp Circuit File
Chart Selects 'Right' IF
Snap-Actions for Low Power

A CAHNERS PUBLICATION

JANUARY 15, 1969

TUNG-SOL MAKES THE DIGIVAC S/G READOUT THAT MAKES NEWS!

LOWER-VOLTAGE READOUT TUBES CAN BE DRIVEN BY MOS

ROBERT H. CUSHMAN, Eastern Editor

Latest challengers to the "Nixie" readout are two inexpensive multiple-anode CRT's that can be directly driven by many MOS and industrial logic families.

"Nixie"-type cold-cathode indicator tubes sell for as low as \$3.95 at the 1000-quantity level. Two new hard-vacuum, luminescent-anode indicator tubes, one by Tung-Sol Div. of Wagner Electric Corp., the other by Nippon Electric Co., Ltd., now are offered at the same or lower prices than the Burroughs "Nixie".

Tung-Sol quotes its tube at \$2.55 at the 1000 level and expects to go under \$2 for large-volume production orders. NEC is matching the "Nixie" price on low-volume orders, but expects to be competitive at the 100,000/yr level.

To EDN, however, the real selling point for these new tubes is not so much their low prices, but the ease

*Registered trademark of Burroughs Corp.

with which they can be driven directly from MOS and higher-voltage industrial-type logic families. These new low-voltage, low-current tubes can simplify displays. They need neither the 170V power supplies of the "Nixies" nor the 1/2A current of incandescent-lamp readouts.

A one-tube system fragment breadboarded by EDN (Fig. 1) indicates how the Tung-Sol unit can be directly driven by an existing logic family, the RCA complementary MOS. The logic's 12-15V power supply provided the anode power for the Tung-Sol tube (Fig. 2). Either a penlight battery or a small transformer will furnish the 1.5V, 72-mW excitation needed by the directly heated cathode. The multiple anode segments were driven by the MOS gates through a silicon-diode matrix (WC 227 diode arrays from the Westinghouse 200 DTL family). The diodes were arranged to choose the segments that formed the readout numerals.

At 15V, the upper limit on the RCA logic, display

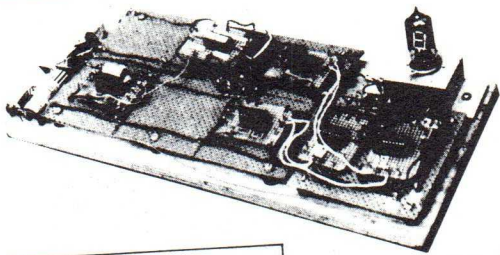


Fig. 1—Breadboard of MOS Driving an Indicator. This breadboard, constructed by EDN to become familiar with the Tung-Sol tube, showed that little additional circuitry is needed to drive these tubes, and that they do not constitute much of a power drain on the main system. For the photo, the shield around the indicator tube was removed.

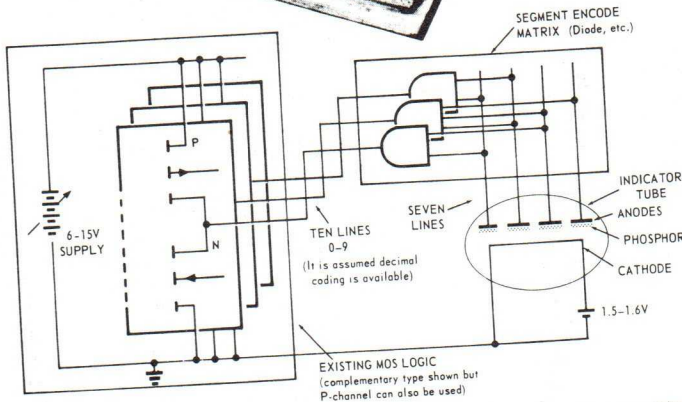
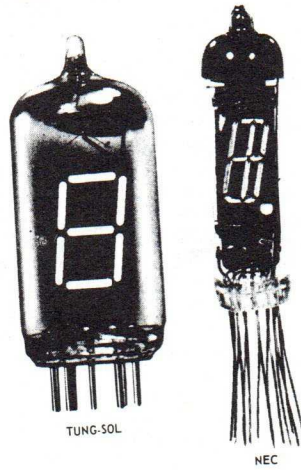


Fig. 2—Driving Indicators Directly from MOS. Any logic that has a 12V or more swing will drive the tube segments into useful light output. The current requirements—typically under a milliamperes—are inconsequential for most logic

families, even when all of the segments are being driven simultaneously to form an 8. The circuit fragment shown is from the EDN trial of one of the Tung-Sol tubes with RCA complementary MOS logic.



Design Features

turn-off. Normally, the 20V positive as the ON

strobe the tube ON, so the register can use the tube is used widely in comparing is feasible before registers are considered despite the strobing,

For example, the tubes must be driven at 50V, 100 Hz, and Tung-Sol similar levels.

The filament supply of the Tung-Sol tube is driven so that the current is driven between one of the logic gates. Unfortunately, the code to anodes is most any logic easily.

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Long-lead, type mm

0.5

3.95

Design/Functions/Digital 33

...the designer must consider

EDN January 15, 1969

All logic can be same IC family and should be connected between ground and B_v

POSITION 1

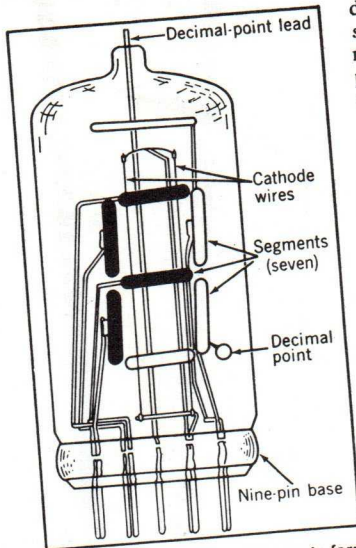
POSITION 2

Seven fluorescent sections form a clear alphanumeric display

All numerals and half the letters in the alphabet can be formed by only seven glowing green segments in a simple new vacuum tube. The new device is intended as a low-cost alternative to more complex display tubes, and it will be used in test equipment, control displays, and consumer electronics.

The Digivac S/G (second generation) readout tubes are produced by the Tung-Sol Div., Wagner Electric Corp. (Newark, N. J.). Each consists of seven diodes that form a planar array and a common cathode in a glass envelope. The anode elements, approximately 8 mm long by 1 mm wide, are coated with a special low-voltage phosphor. Highly visible slanting characters, 0.360 in. by 0.57 in., are formed within the miniature 1¾-in.-high tube.

Project aim. "We set out to develop a competitive, side-reading display tube that would be easier to read from a greater distance and would have wider viewing angles



Seven fluorescent anode segments form all numerals and half the alphabet. Digital MOS logic selects segments.

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than other tubes," says Ray Raago, a Tung-Sol senior project engineer. "The green phosphors and the planar construction did it. Speed is limited only by persistence of the phosphor."

"We discovered that customers wanted a readout tube that is able to operate in portable, battery-powered packs and use very little power," Raago explains. The Digivac will respond to signals in the 10- to 40-v ac range, but in order to get the high brightness, it is preferable for the signals to be at least 25 v, with a filament supply of 1.6 v ac or dc at 45 ma. Total power consumption with all segments is less than 280 mw.

"These specs make the Digivac a natural for integrated-circuit drivers," the engineer says, "so we worked along with General Instrument Corp. (GI, Hicksville, N. Y.) to come up with matching-field-effect transistor circuitry to drive the tube."

Decoders to match. Monolithic IC modules that decode logic and drive the Tung-Sol tubes are designed and available at GI. They are needed in cases where the appropriate switching logic is not available in the customer's circuitry.

The 24-lead circuits, which are able to count, store, and decode logic as well as drive the Digivac, are in ¼-in. by ¾-in., dual in-line packages. "Metalized-oxide silicon FETs that we call MTOS permitted us to compress 300 transistors into one small flatpack," reports Bill Whitehead, an applications engineer at GI's Microelectronics Div., "MTOS offer high-input impedance, high-packing density, and low-power consumption. Three packs would usually be needed to perform the same functions with bipolar logic. The IC logic driver modules require -13 and -27 v dc for their standard operation.

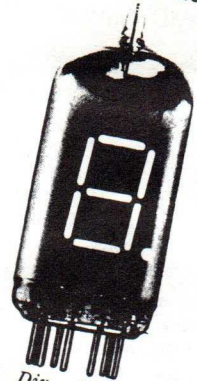
One more point. Another version of the Digivac has an additional

decimal-point element. Both use the standard 9-pin, miniature-tube base, but the decimal-point version has an additional lead in the top of the tube for the decimal-point logic.

Both readouts use an electron-optics scheme that obtains illuminating electrons for the anode elements from twin-coated cathodes 0.00039 in. dia., positioned in front of the array. The cathodes operate at a low temperature, less than 700 c, and thus are barely visible when emitting. Brightness of the characters can be increased by raising the anode voltage level.

The Digivacs will sell for around \$2 each and the IC logic drivers will sell for about \$4 each, when purchased in large quantities. (4.444; 4.56)

COMPONENTS Single plane readout works from battery



Tung-Sol Div., Wagner Electric Corp., One Summer Ave., Newark, N.J. Phone: (201) 484-8500. P&A: \$2.55 or \$2.90; stock.

Ideal for applications where information display must be in alphanumeric form, a second-generation Digivac readout tube operates from a battery supply with a maximum power consumption of only 280 mW. Performing without generating emi, the new tube requires a switching voltage of only 25 V dc.

The 7-segment fluorescent device can be driven by microcircuits to display 10 numbers and up to half the alphabet. It eliminates errors due to parallax with a single-plane readout that permits a 150° viewing angle.

Matching the spectral response of the human eye, characters are blue-green in color for optimum brightness. Since luminosity is generated on the surface of the phosphor-coated segments, characters are also uniform in brightness.

Each segment of the tube becomes an anode when it responds to a signal voltage of 10 to 40 V dc. The cathodes are two almost-invisible wires strung between the segments and the viewer. Cathode temperature is extremely low since energizing voltage is only 1.6 V, ac or dc, at 45 mA.

Initially, two versions are available, the DT1704A without decimal point display and the DT1705 with decimal. A matched MOS decoder/driver logic circuit is also available costing \$4 each in large quantities.

CIRCLE NO. 3:
ELECTRONIC DESIGN 22, October 24, 1971

TUNG-SOL MAKES THE DIGIVAC S/G READOUT THAT MAKES NEWS!

news REPORT

ALPHANUMERIC READOUT: better performance at much lower cost

An electronic alphanumeric readout that sells for about \$2.00 in 100,000 lots and \$3.95 in 1,000 quantities, yet performs better than comparable units costing considerably more, has been developed by Tung-Sol Division, Wagner Electric Corp., Newark, N.J. Key to the low cost: simplified design, lower production costs and improved quality. Offering high intensity, long life, high speed, and low power consumption, this second-generation Digivac S/G is designed for use in computer circuits, test equipment, process control, automotive instrumentation and consumer electronics. It can display all numerals and up to half the alphabet.

A matched LSI ic logic which counts, remembers, decodes and drives is available (\$4.00 in 100,000 lots and \$16.00 in 1,000 quantities) in a 1/4 x 3/8" 24-lead flat pack. Production quantities of this logic will be supplied in a dual in-line package.

Segmented characters are in eye-ease blue-green near the tube's front wall in a single viewing plane which permits a viewing angle up to 150° and eliminates parallax errors in addition to "seasick" and "bloodshot eye" effects. Since luminosity is generated on the surfaces of identical phosphor-coated segments, characters are uniformly bright. The readouts operate at very high speeds limited only by the persistence of the blue-green phosphor which of course, is infinitely faster than the

human eye response. Digivac S/G is EMI emission-free.

The LSI ic logic is a monolithic integrated MTOS (Metal-Thick-Oxide Silicon) circuit designed specifically as a matched logic for the Digivac S/G. The logic/driver ic consists of up/down decade counter, storage register, decode/driver, and appropriate input, output, and command terminals. Signal input to the counter can be in two forms: a BCD (binary coded decimal) signal or a pulse input. Decoding and amplification drive the proper bar segments of the Digivac.

Some features of the logic include count storage and display on command. Provision is made for cascading multiple-digit displays; zero count indication; leading zero blanking; preset or desired count start; decimal point storage; moving decimal point indication with outside logic; and false count indication.

Each bar of seven-bar segmented fluorescent readout is a phosphorescent material that becomes an anode when supplied with a signal voltage of 10 to 40 v dc. Two almost invisible wires strung between the segments and the viewer serve as cathodes. Cathode temperature is extremely low because only 45 milliamperes at



DT 1705A

1.6 v ac or dc are needed to energize them — important for ic circuits. Above model of Digivac S/G contains a decimal point segment fed through a flying lead in the top of the tube. Matched multi-purpose logic for the readout compares functionally to more expensive units and, in a small, lightweight configuration, does the job formerly requiring several small packages.

Manufactured by General Instrument Corp., the logic is packaged in a 1/4" x 3/8" 24-lead flat pack which contains over 300 FET's.

how it all happened or try, try again

In an attempt to broaden its growing share of the readout market, Tung-Sol developed over a series of devices suited to volume applications and also

electromechanica

active research and development program on electroluminescence going in the early 1960's. But poor life, low light output, and the need for a high-frequency power source led to the abandonment of research in this direction. These short-comings of electroluminescence still plague the industry.

Another attempt at supplying high-volume markets was a seven filament array configured as a segmented figure 8, mounted in a flat-faced Compactron tube envelope. Never marketed, this device gave birth to the trademarked Digivac. Nonetheless Digivac I, a device introduced at the IEEE show in 1961, was quickly obsolete by the results of market study, customer requirements for a simpler, lower cost readout device and a matching cost logic and driver to go with it. Development and research departments now call Digivac S/G.

circle 59 on inquiry

Tung-Sol's Newest Digivac Features \$2 Price Tag

NEWS

NEWARK, N.J.—In its latest bid for a larger share of the alphanumeric readout market, the Tung-Sol division of Wagner Electric Co. has introduced a new version of its Digivac S/G fluorescent readout tube that will sell for about \$2 in large quantities, compared with \$5.50 for the older version. Also available now is an MTOS IC logic package consisting of a decade up-down BCD counter, storage register, and decoder-driver for the Digivac. Developed and built by General Instrument Co., the logic package costs \$4 per Digivac stage in large quantity orders.

The development of the new tube, according to Rod Bell of Tung-Sol, was prompted by the complexity of the original design, which could never compete in cost with the commonly used gas discharge tubes, such as the Nixie.

The new Digivac is a seven-bar segmented fluorescent readout, operating as a diode. Each bar of phosphorescent material becomes an anode when supplied with a signal voltage of 10 to 40 vdc. The cathodes are near-invisible wires strung between the segments and the viewer. The earlier Digivac featured triode operation. Readout of up to 10 letters and 13 numerals are offered by the latest tube, against 10 letters and 11 numerals for its predecessor. Maximum power requirement (where figure "8" and decimal point are lighted) is 280 milliwatts, against 3 watts for the original Digivac. The older tube required a 250-volt anode potential, compared to a 27-volt supply for the new tube. Viewing angle for both tubes is said to be 150 deg and the company claims a 40-ft viewing distance for both readout devices.

NEW PRODUCTS

ALL-COLORS READOUT

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To make color play a functional role with the company's existing line of alphanumeric Digivac S/G displays, molecularly bonded filters provide any color in the visible spectrum and also white. The phosphors employed in the readouts are basically green, yet enough of the entire spectrum is present

to permit filtering, but not without some reduction in light. Digivac S/G consists of seven diodes with a common cathode sealed into a glass envelope. The anodes of each diode are in the form of a 1- by 8-mm bar of phosphorescent material all lying in the same plane near the tube's sidewall. A 10- to 40-volt signal excites the anode.—Tung-Sol Div., Wagner Electric Corp., Newark, N.J.

CONTROL ENGINEERING

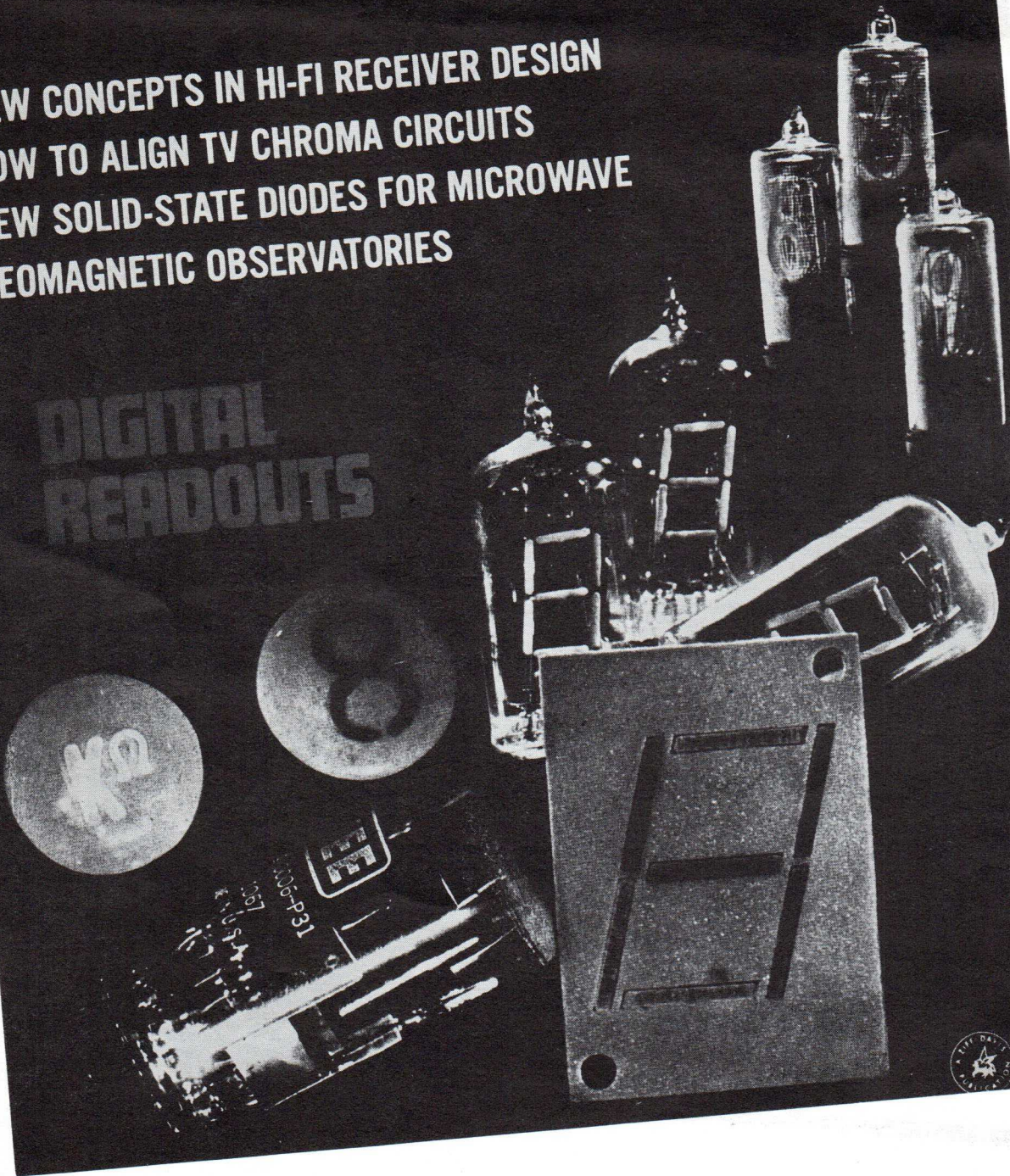
TUNG-SOL MAKES THE DIGIVAC S/G READOUT THAT MAKES NEWS!

Electronics World

FEBRUARY, 1969
60 CENTS

NEW CONCEPTS IN HI-FI RECEIVER DESIGN
HOW TO ALIGN TV CHROMA CIRCUITS
NEW SOLID-STATE DIODES FOR MICROWAVE
GEOMAGNETIC OBSERVATORIES

DIGITAL
READOUTS



TUNG-SOL MAKES THE DIGIVAC S/G READOUT THAT MAKES NEWS!

Choosing a Digital Display

By ROD BELL
 Director of Engineering
 Tung-Sol Division/Wagner Electric Corp.

Almost all new automated equipment needs digital displays. The problem is to choose a display which presents required data effectively, and at low cost.

THE development of automation techniques has brought about important changes in the field of data presentation. A few years ago, it was usually cheaper and easier to obtain data from the deflection of a pointer along a calibrated scale, or by other analog methods, and then have an operator translate the data into digital notation for record and computation. But within the past few years, great masses of already processed information have been readily available in digital form, so the trend has been to digital readout and, recently, more and more to electronic types.

Digital readout, the direct display of characters or coded equivalents, offers the following advantages as compared to analog readout (where input is measured in terms of some parameter such as angular displacement, as in a meter), and digital printout (where input is converted to printed characters, as in a teletypewriter).

Immediate comprehensibility. An in-line digital display requires no translation. It presents information conventionally whereas meter readings frequently involve verniers, multiple scales, logarithmic calibration, and other complications.

Dependability. Digital displays reduce chances of mechanical and human error. Electromechanical readouts sometimes malfunction, but electronic digital displays, on the whole, are as accurate as the information fed to them. They require no instrument calibration.

Speed. Many digital readouts register data as fast as the human eye can follow (about two counts per second). Furthermore, the characters snap into position, to prevent flinching. This is an obvious advantage over a rapidly fluctuating meter, or a slow printout device. And if faster presentation rates are necessary, there are readouts available which operate in milliseconds and microseconds, although these must be "stopped" by photography or special timing pulses.

Flexibility. Many digital readouts can be used as either counters or indicators, depending upon external switching arrangements. In addition to digits (0 to 9), some readouts display letters of the alphabet, full messages, and special

characters. Many incorporate dynamic alarms, and some accept, with slight modifications, a variety of inputs—pulses, parallel or serial binary codes, or straight "decimal" selection-switching.

Usually meters handle only one or two closely related units. But with proper switching, the same digital readouts can register widely differing units and symbols, for example, time, temperature, and baseball scores.

Appearance. Many of these devices are quite handsome,

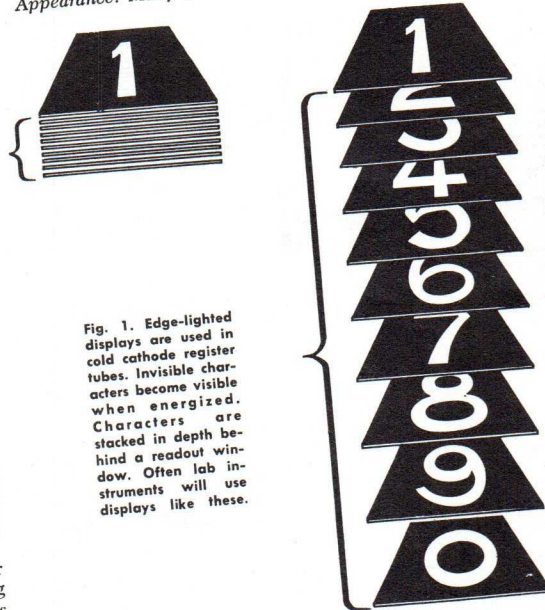


Fig. 1. Edge-lighted displays are used in cold cathode register tubes. Invisible characters become visible when energized. Characters are stacked in depth behind a readout window. Often lab instruments will use displays like these.

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ELECTRONICS WORLD

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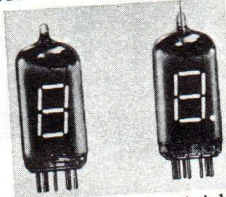
February, 1969

ELECTRONICS WORLD

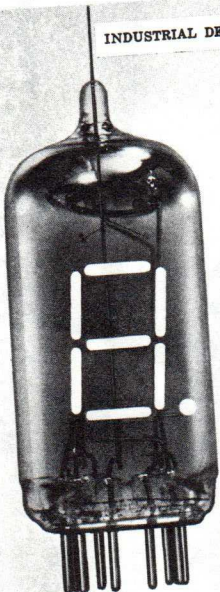
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Digital Displays In Any Color

The Digivac S/G is a low cost electronic alphanumeric readout that offers high intensity, long life, high speed, and low power consumption. It is even more useful because of its ability to display any color. Color can be functional, such as on a panel where several types of information are displayed; each type can be color coded. Phosphors used to provide the segmented display are basically green, but enough of the entire spectrum is present to permit filtering. Color selection involves trade-off between contrast and brightness. For example, original green is the brightest. Least bright is the red, best contrast is blue. Unit is seven-bar segmented fluorescent readout. Each bar of phosphorescent material becomes an anode when supplied with signal voltage of 10 to 40 v. The cathodes are two almost invisible wires strung between the segments and the viewer. Cathode temperature is low because only 45ma at 1.6 volts are needed to energize them. A matched LS1 1/C logic component counts, remembers, decodes, and drives.



INDUSTRIAL DESIGN/NOVEMBER 1968



New readout cuts cost
A new electronic alphanumeric readout that will sell for about \$2 in large quantities and performs better than comparable units costing much more has been announced by Tung-Sol Division, Wagner Electric Corporation. The reason for the low cost is a simplified design that permits lower production costs and, at the same time, improves the quality. Offering high intensity, long life, high speed and low-power consumption, the readout is ideal for use in computer circuits and many other applications where display of information in alphanumeric form is required. It can display all numerals and up to half the alphabet. The new Digivac S/G (Trademark, Wagner Electric Co.) is a seven-bar segmented fluorescent readout. Each bar of phosphorescent material becomes an anode when supplied with a signal voltage of 10 to 40 vdc. The cathodes are two almost invisible wires strung between the segments and the viewer and cathode temperature is extremely low. A second model contains a decimal point segment which is fed through a flying lead in the top of the tube. The

Circulation 90,000

electronic products

the magazine of products,
product application and selection



Vacuum fluoresce readout

Low-cost unit for low-level applications

THE DIGIVAC S/G™ seven-bar segmented vacuum fluorescent readout tubes can display 10 numerals (0 to 9) or 14 letters (A, C, E, F, G, H, I, J, L, O, P, S, U and Y).

Each bar of phosphorescent material becomes an anode when supplied with a signal voltage of 10 to 40 vdc. The cathodes are two almost invisible wires strung between the segments and the viewer. Cathode temperature is low because only 45 ma at 1.6 v a-c or d-c are required to energize them.

These readout tubes can be used in computer circuits and in test equipment, process control, automotive instrumentation and consumer electronics.

Two types are available — Model DT1704A without a decimal-point segment and Model DT1705A with a decimal-point segment that is fed through a flying lead in the top of the tube.

The segmented characters are formed in blue-green near the tube's front wall in a single viewing plane that permits an angle of view up to 150°.

Parallax errors, in addition to the "seasick" and "bloodshot eye" effects of gaseous type readout tubes, are said to be eliminated. Characters are uniformly bright since luminosity is generated on the surfaces of identical phosphor-coated segments. The tubes are also emi emission free.

Tubes have a seated height of 1.730" nominal and a maximum

New components

Readout tubes face a challenger

\$2 alphanumeric device, driven by \$4 MOS IC, fluoresces on low power

With a \$2 alphanumeric readout device and a \$4 integrated circuit to drive it, the Wagner Electric Corp.'s Tung-Sol division is trying to supplant the ubiquitous gas-ionization readout tube in test equipment, process controls, and computers. The cost is low enough,

Circle 161 on reader service card →

logic driver is MOS integrated circuit . . .

Sol engineers say, for their device to find its way also automobiles and appliances. It would give a direct digital display of miles per hour on a car's speedometer, or indicate the channel number in the varactor-tuned television that's reportedly just around the corner.

The readout unit, which Tung-Sol calls Digivac S/G, consists of

diodes with a common cathode, all sealed in a glass envelope. The anode of each diode is a phosphor-coated segment 8 millimeters long and 1 mm wide. When a segment is connected to a voltage of 10 to 40 volts d-c, it fluoresces in the blue-green portion of the visible spectrum. The cathode operates at only 1.6 volts, a-c or d-c, and 45 milliamperes; as a result, its temperature is low and the power supply need not be large.

Because the segments are on the same plane, problems common to gas-ionization readouts—changes in depth of focus and superposition of unlit characters over lit ones—are eliminated. The Digivac characters are more sharply defined, too, according to Tung-Sol, because they aren't surrounded by a layer of ionized gas.

GI circuit. Tung-Sol has accumulated 4,000 hours of life tests on the Digivac, and chief engineer Rodney Ball predicts a 100,000-hour life expectancy.

The IC driver is a monolithic metal oxide semiconductor circuit made by the General Instrument Co. especially for the Digivac. It consists of an up-down decade counter, a storage register, a decoder-driver, and input, output, and command terminals. The input signal can be in binary-coded-decimal or pulse-count form. In addition to leading-zero blanking, the circuit provides false-count indication. It's packaged in a 1/4-by-3/8-inch flat pack with 24 leads; GI will soon introduce a 14-lead version in a dual in-line package.

The seated height of the tube is 1.730 inches, and character size is 0.360 by 0.570 inch. A decimal point is optional at extra cost.

Tung-Sol division, Wagner Electric Corp., Newark, N.J. 07104 [350]

Electronics | October 28, 1968

diameter of 0.845". pin miniature. The characters slant to

Matched logic

Designed specifically for the Digivac S/G is a logic driver, manufactured by Tung-Sol. This driver consists of an up/down decade counter, a storage register, and appropriate command terminals.

Signal input can be in two forms: decimal signal or pulse-count. Decoding and driving place to drive the segments of the

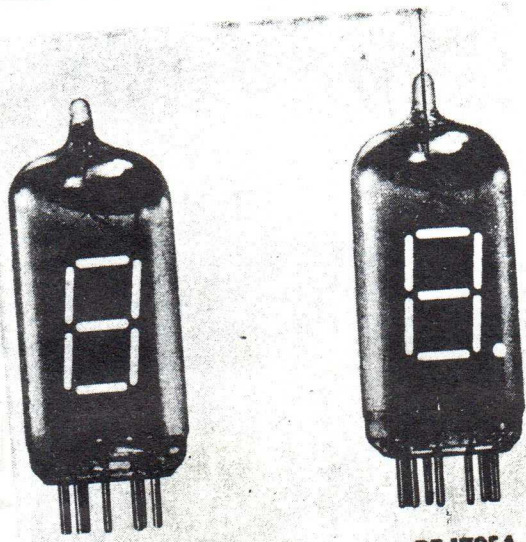
Features
count storage
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x 3/8" 24
line pack
—W. I.

Price: \$2.00 approx
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Ave., I
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Tel: (908) 741-1100



segmented eye-ease blue wall in a slant permits a viewing angle of up to 150 degrees and in addition "bloodshot eye" effects are eliminated. Characters are uniformly bright since luminosity is generated on the surfaces of phosphor-coated segments, characters are uniformly bright. For additional information, circle 101 on the reader service card.

166w electronic products • november



DT 1704A

DT 1705A

CAN MAKE POINT: This new readout tube by Tung-Sol is available with or without decimal point. Coupled to a General Instrument IC, the display is said to be low in cost.

Tung-Sol Display Tube Bows, Places Firm in Readout Field

NEW YORK.—The introduction last week of a low-cost alpha-numeric display tube placed Tung-Sol division, Wagner Electric Co., Newark, N. J., in contention for a share of the readout market.

Tung-Sol displayed a tube which, officials said, will sell for \$2.35 each without decimal point in 1000 lots, and for \$2.90 each with decimal point in 1000 lots.

Also developed as a logic/driver for the tube is a monolithic integrated MTOS circuit, produced by General Instrument Corp., Newark. As part of the readout package it will sell for about \$4 each.

Called the second generation Digivac S/G, Tung-Sol spokesmen said it was an advancement over a readout tube that the firm introduced in March at the I Triple E annual convention.

Besides low cost, James Emus, OEM sales manager, claimed high intensity, long life, high speed and low power consumption for the device. He said it will find a place in computer, calculator, digital voltmeter and consumer electronic applications.

Rodney Ball, chief engineer, said Digivac is a seven-bar segmented fluorescent tube readout. Each bar of phosphorescent material becomes an anode when supplied with a signal voltage of 10 to 40 vdc.

The cathodes are two, almost invisible wires strung between the segments and the viewer, he explained. Cathode temperature is low because 45 milliamperes at 1.6 vac or dc is used to energize it. The segmented characters are formed in blue-green near the tube's front wall in a single viewing plane.

The logic/driver IC consists of up down decade counter, storage register, decoder/driver, and appropriate input/output and command terminal.

Signal input to the counter can be in two forms: a binary coded decimal signal or a pulse input. Decoding and amplification take

place to drive the proper bar segments of the display tube.

William Whitehead, applications engineer for General Instrument, said the integrated circuit is packaged in a 1/4-inch x 3/8-inch, 24-lead flat pack. He said it contains over 300 FETs.

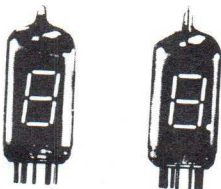
—By ADC

Digital Displays In Any Color

The Digivac S/G is a low cost electronic alphanumeric readout that offers high intensity, long life, high speed, and low power consumption. It is even more useful because of its ability to display any color. Color can be functional, such as on a panel where several types of information are displayed; each type can be color coded. Phosphors used to provide the segmented display are basically green, but enough of the entire spectrum is present to permit filtering. Color selection involves trade-off between contrast and brightness. For example, original green is the brightest. Least bright is the red, best contrast is blue. Unit is seven-bar segmented fluorescent readout. Each bar of phosphorescent material becomes an anode when supplied with signal voltage of 10 to 40 v. The cathodes are two almost invisible wires strung between the segments and the viewer. Cathode temperature is low because only 45ma at 1.6 volts are needed to energize them. A matched LS1 1/C logic component counts, remembers, decodes, and drives.

TUNG-SOL DIV., WAGNER ELECTRIC CORP., Dept. EE, One Summer Ave., Newark, N. J. 07104

Circle 4 on inquiry card



VACUUM FLUORESCENT READOUT

Typical driving power is 25 v for high brightness.

There's no gas in this vacuum readout device; it's really the simplest kind of CRT, and needs no complex power supplies.

Seven of these tubes go together as a bar segment readout, allowing green formation of numerals 0 to 9, with or without decimal,

or letters A, C, E, F, G, H, I, J, L, O, P, S, U, and Y. The seven diodes have a common cathode sealed into a glass envelope. The anode of each diode forms a segment about 8 mm long and 1 mm wide which is covered with fluorescent material (low-voltage phosphor).

Each segment responds to signal levels of 10 to 40 v dc (computer applications). Typical operation for high brightness would be about 25 v. Energizing voltage of the cathodes is only 1.6 vac or dc at 45 ma, so temperature is kept low. Model series: Digivac S/G.

••• Visibility of characters: over 40 ft. Price: \$2.90 each with decimal point or \$2.50 without, in lots of a thousand. A matched IC logic driver sells for about \$4 in large quantities, in a 1/4 by 3/8 in. 24-lead pack which contains over 300 FETs.

For additional information, write or telephone Tung-Sol Div., WAGNER ELECTRIC CORP., 1 Summer Ave., Newark, N. J. 07104. Area Code 201, 484-8500.

Circle #80 on PD&D postcard enclosed.

Second Generation Readouts

Seven-bar segmented vacuum fluorescent readouts are available with or without decimals. They can display all numerals and up to half the alphabet. A numerals and I/C logic which counts, remembers, decodes, and drives is also available. Tung-Sol Div., Wagner Electric Corp., One Summer Ave., Newark, N. J. 07104

Circle 705 on Free Service Card

AUTOMATION—December 1968

Low-cost computer readout

Electronic alphanumeric readout of simplified design sells for about \$2.00 in quantity. Unit can display all numerals and half the alphabet in computer circuits, test equipment, process control, instrumentation, etc. Easy-to-read, blue-green numerals are visible in 150-deg viewing arc. Tung-Sol.

INFORMATION RETRIEVAL NUMBER 78

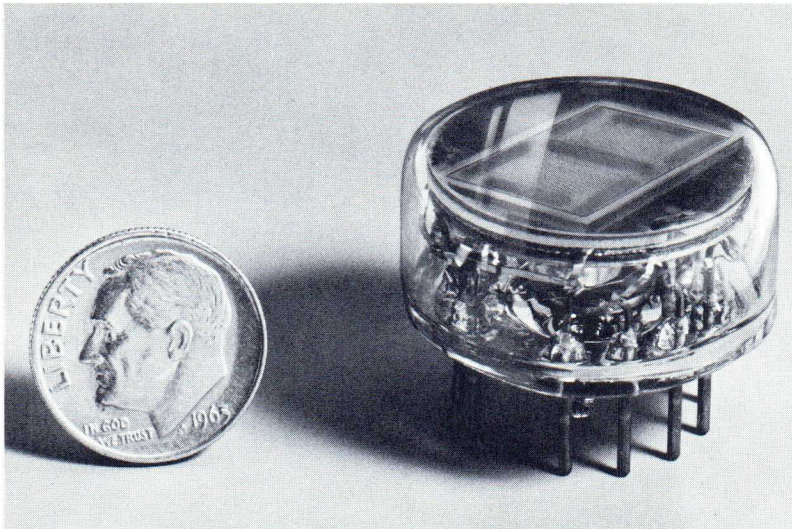
Purchasing Magazine

TUNG-SOL MAKES THE DIGIVAC S/G READOUT THAT MAKES NEWS!



DIGIVAC*

A SIGNIFICANT NEW READOUT DEVICE FROM TUNG-SOL*



The Tung-Sol glass envelope Digivac embodies advanced design features available in no other readout device. It combines the wide-angle "up front" viewing plane of projection types with the visibility, speed, versatility and low-power requirements of electron devices. In addition, it offers a host of other features never before combined in a single component.

Digivac is a high-legibility readout that provides the design / operating characteristics and purchasing economies you need for your advanced systems and equipment. Here's a dramatic new way to product improvement while staying cost-competitive.

CONSTANT VIEWING PLANE—All of the bright, segmented alphanumeric and symbolic characters are formed near the tube face—no parallax problems ever! Surer, quicker readings when split seconds count. Viewing distance in excess of 40 feet. Angles to 150°.

OPERATES AT HIGH SPEED—Because Digivac is an electron-controlled vacuum device, it can operate at very high speeds, limited only by the persistence of the phosphor. It responds to signal voltages of about 20 volts. Thus, Digivac is ideal for your computer applications!

REQUIRES ONLY LOW POWER—Because Digivac is a grid-controlled device, switching can be reliably achieved with very low voltages in a high-impedance circuit. This versatile device requires a minimum of actuating power.

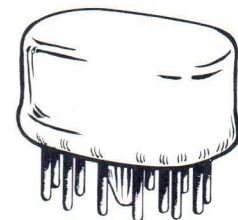
COST ECONOMIES—Comparable or lower in cost than other end-on devices. Lowers cost of logic circuitry through simplification and lower power requirements.

ISOLATION—There is no electrical connection between the input circuit and the anode circuit.

EYE-EASE GREEN CHARACTERS—New Digivac offers the most wanted character color—green—as standard. Custom colors are also available.

SMALLEST IN SIZE—Round version only .800" high when seated.

Rectangular and custom configurations will be available.



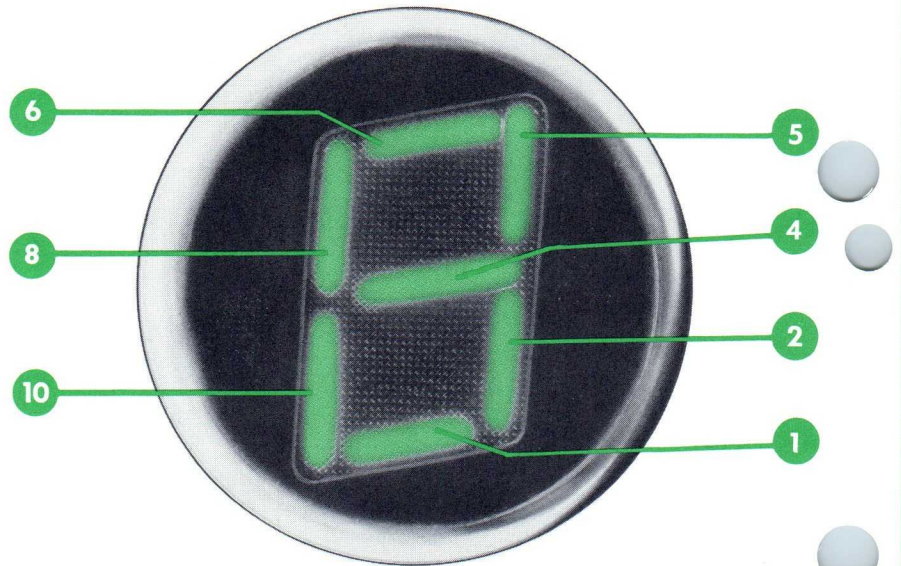
DIGIVAC DT1509A

7-BAR, SEGMENTED VACUUM FLUORESCENT READOUT

Digivac consists of seven triodes with a common anode and cathode sealed into a rugged glass envelope. The anode of each triode forms a segment approximately 8 mm long and 1 mm wide which is covered with fluorescent material. This material is a special Tung-Sol formulation and it ensures high-visibility characters. The diagram at right shows the pin connections that form the figure "8".

* * * *

If you use readouts for applications in test equipment, process control, computer display, consumer electronics, automotive and aircraft instrumentation, compare the new Digivac with any other available device. You will find its many features have substantially advanced the state of the art.



PIN CONNECTIONS

- | | | |
|------------|--------------------|-----------------------|
| 1. Segment | 5. Segment | 9. Anode |
| 2. Segment | 6. Segment | 10. Segment |
| 3. Heater | 7. Tied to Pin #12 | 11. Space Charge Grid |
| 4. Segment | 8. Segment | 12. Heater |

SPECIFICATIONS

Size: Seated height .800".
Diameter 1.125".

Base: 12-pin compactron.

Character Size: .400" x .600" — Slanting to right at 15°.

Viewing Plane: Constant — close to tube face.

Viewing Angle: 150°.

Brightness: Sufficient for viewing under high ambient light conditions.

Color: Green, peaking at 5200 Å — other colors on special request.

Characters: Standard alphanumeric—0 to 9, plus A, C, E, F, G, H, J, L, P, U, Y. Variable character intensity available.

Logic and Memory: To be supplied by Digivac users.

Mounting: Pins 1 and 12 horizontal for upright figures.
No RF shielding required.

Operating Conditions: $E_f = 1.5 \text{ VAC}$
 $I_f = 360 \text{ ma}$
 $E_b = 250 \text{ VDC}$
 $E_{\text{space charge}} = 30 \text{ VDC}$
 $E_{\text{co}} = -25 \text{ VDC}$

Maximum Rating: $E_f = 1.8 \text{ VAC}$
 $E_b = 300 \text{ VDC}$
 $E_{\text{space charge}} = 50 \text{ VDC}$

NOTE: All voltages measured in respect to pin #12.

Tung-Sol's experienced readout "professionals" are at your service to help you resolve design and applications problems.

For further information on new Digivac types or on the many other Tung-Sol readouts, contact your local sales office.

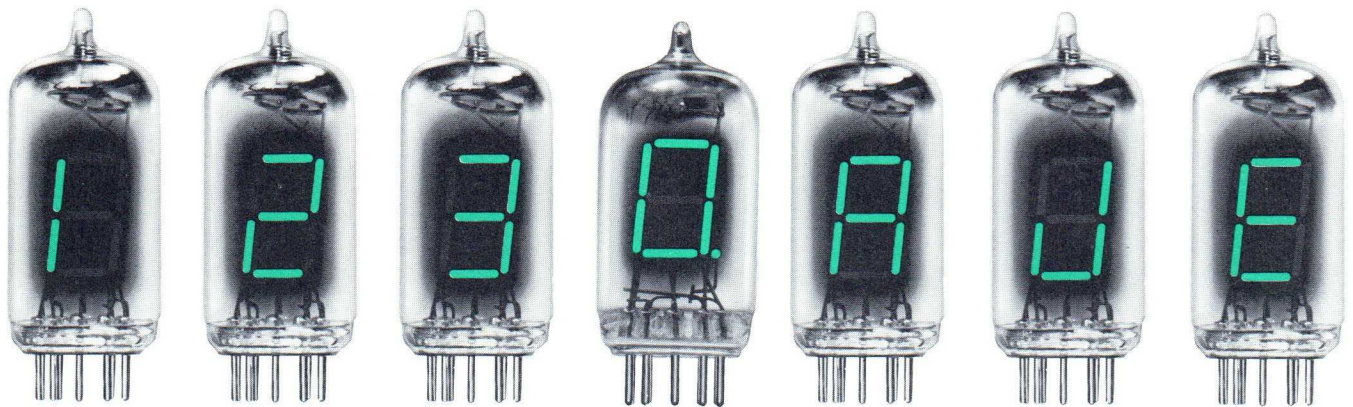
TUNG-SOL DIVISION
Wagner Electric Corporation

One Summer Avenue, Newark, N.J. 07104. Telephone: (201) 484-8500

NEW:

DIGIVAC S/G

NOW A SECOND GENERATION READOUT FROM TUNG-SOL



DIGIVAC S/G IS A NEW TYPE of low-cost seven-bar segmented vacuum fluorescent readout for low signal level applications. Even the most advanced systems can employ this side-display readout without compromising performance or reliability. In less sophisticated equipment, it can improve the readout function while remaining cost-competitive.

PARALLAX-FREE CHARACTER FORMATION All the segmented characters are formed near the tube sidewall in the same viewing plane. Since luminosity is generated on the surfaces of identical phosphor-coated segments, characters are of inherently uniform brightness. The wide, parallax-free viewing angle and visibility in excess of 40 feet mean *surer, faster readout when split seconds count!*

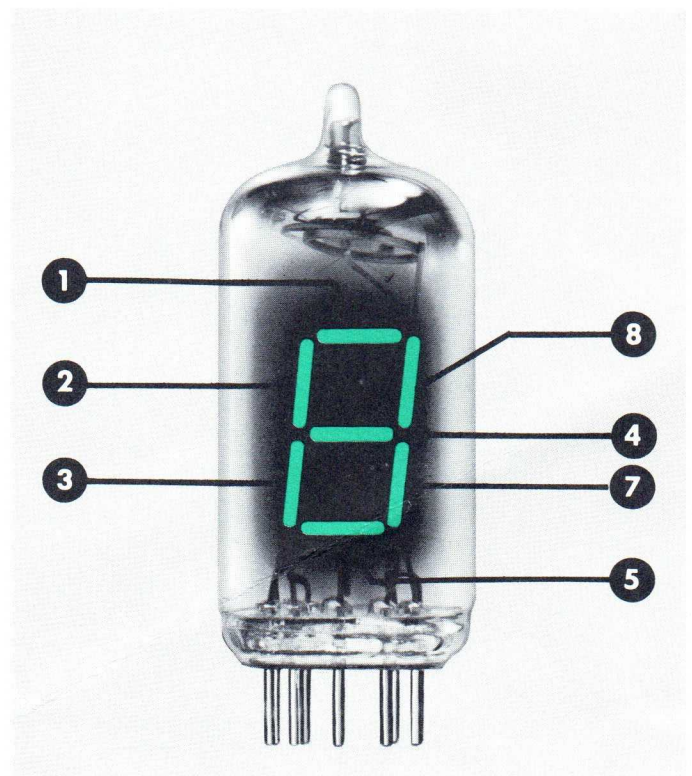
OPERATES AT HIGH SPEEDS Digivac S/G readouts operate at the very high speeds of electron-controlled devices . . . limited only by the low persistence of the new green phosphor. They respond to low signal levels of 10 to 40 VDC . . . *ideal for your computer applications!*

LOW POWER REQUIREMENT Digivac S/G can be switched reliably with voltages below 12 V, but typical operation for high brightness would be about 25 V. Energizing voltage of the cathodes is only 1.6 VAC or DC at 45 ma which, along with the low actuating power, means extremely low temperatures and long life. *Perfect for IC logic/driver and FET's!*

COST ECONOMIES The low voltage, low power requirements of Digivac S/G make it compatible with commercially available IC logic packages. The General Instrument Corporation's MEM5082 (flat pack) or MEM1056 (DIP) have been designed specifically to complement Digivac S/G. These packages include up/down counter, storage, decoder and driver in one 24 lead encapsulation. This provides versatility in minimum space and at minimum cost.

EYE-EASE GREEN CHARACTERS A new low-persistence phosphor is standard in the most wanted color.

SMALL SIZE, COMPACT Side readout format enables very compact horizontal arrays. Long, slanted numbers look better, read more accurately!



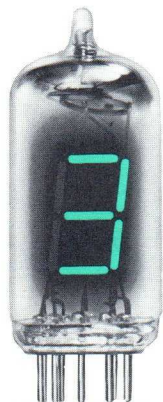
PIN CONNECTIONS—DT1704A*

Standard 9-pin base, with the following pin connections:

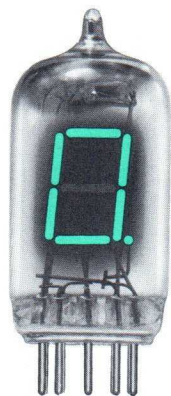
1. Segment	4. Segment	7. Segment
2. Segment	5. Segment	8. Segment
3. Segment	6. Filament	9. Filament

*DT1705C is same as above, but with a 10th pin connected to the decimal point anode.

DIGIVAC S/G VACUUM FLUORESCENT READOUT



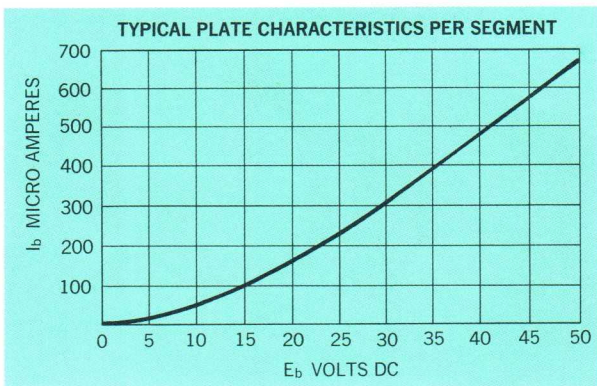
DIGIVAC S/G
Readout
DT1704A



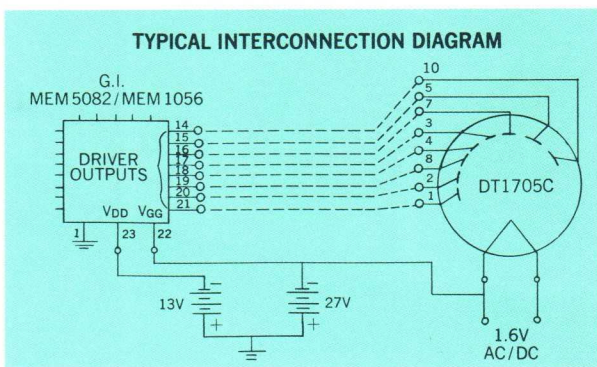
DIGIVAC S/G
Readout with decimal
DT1705C

Digivac S/G consists of seven diodes with a common cathode sealed into a rugged glass envelope. The anode of each diode forms a segment approximately 6½ mm long and 1 mm wide which is covered with fluorescent material. This material is a special low-voltage phosphor that assures high-visibility characters.

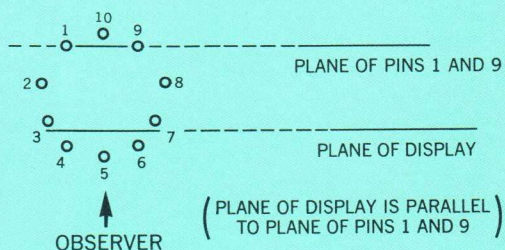
If you use readouts for applications in test equipment, process control, computer display, consumer electronics, automotive and aircraft instrumentation, compare the new Digivac S/G with any other available device. You will find its many features have substantially advanced the state of the art.



Current per segment will vary depending upon number of segments energized. Under maximum conditions (all segments energized) per-segment current with 25 volts applied, will not exceed 700 microamps.



DISPLAY ORIENTATION (TOP VIEW)



SPECIFICATIONS

Seated height: 1¾" NOM.
 Diameter: .845" max.
 Base: 9 pin miniature (DT1704A)
 10 pin miniature (DT1705C)
 (see "Decimal point:")
 Character size: .360" x .570" slanting to right at 8°
 Viewing plane: Single-plane character formation
 Brightness: Excellent definition under high ambient light condition. Brightness level can be varied with supply voltage.
 Color of display: Green

Characters: Standard 7 segmented alphanumeric—allows formation of numerals 0 to 9, or the following letters: A, C, E, F, G, H, I, J, L, O, P, S, U, and Y.
 Decimal point: Digivac S/G type DT1705C has internal decimal point anode. This anode is connected to pin number 10. A low-cost, 10-pin socket is available. Digivac S/G DT1704A does not have a decimal point.
 Typical operating conditions: E_f = 1.6 VAC or DC
 I_f = 45 ma @ E_f = 1.6 V
 E_{bb} = 25 VDC

Tung-Sol's experienced readout "professionals" are at your service to help you resolve design and applications problems. For further information on new Digivac types or on the many other Tung-Sol readouts, contact your local sales office.

TUNG-SOL DIVISION
WAGNER ELECTRIC CORPORATION

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