VOL. 18 NO.
Electronic Design 14
FOR ENGINEERS AND ENGINEERING MANAGERS
JULY 5, 1970

These engineers design laws. They are the only seven of their profession in Congress. Why did they trade their slide rules for campaign buttons? And has an engineering education helped or hindered their work as legislators? For the views of this elite group of U. S. Congressmen, turn to the story that starts on page 60.

Today, fast, low-cost pulses with variable rise and fall —tomorrow, a system!

HP's new, all-solid-state 1900 Pulse System gives you the best of two worlds. **For only $1195, you can get a 7 ns variable rise and fall generator,** right away. Then, as your needs and / or funds increase, plug-in capability allows you to get additional features, without having to buy a whole new generator.

Our basic package consists of a rate generator, a pulse shaping output, and a mainframe.

The 1917A pulse shaping output provides 10 V pulses with variable rise and fall times as short as 7 ns, **reversible polarity, and dc offset.** It takes up only half of a mainframe, and can handle rep rates of up to 25 MHz. A unique external-width function allows the 1917A to be used as a **pulse amplifier,** also, maintaining width and spacing of externally-supplied pulse trains.

The 1905A Rate Generator ("clock") is a quarter-size plug-in. It provides output triggers at repetition rates from 25 Hz to 25 MHz in six decade ranges. Rep rate can be determined internally, by external triggering, or by single-pulse push-button. **Gating feature allows pulse bursts.**

The 1901A Mainframe is a standard rack size unit, and contains power supplies that can be used to power other 1900-series plug-ins. **Built-in EMI and RFI shielding are standard.**

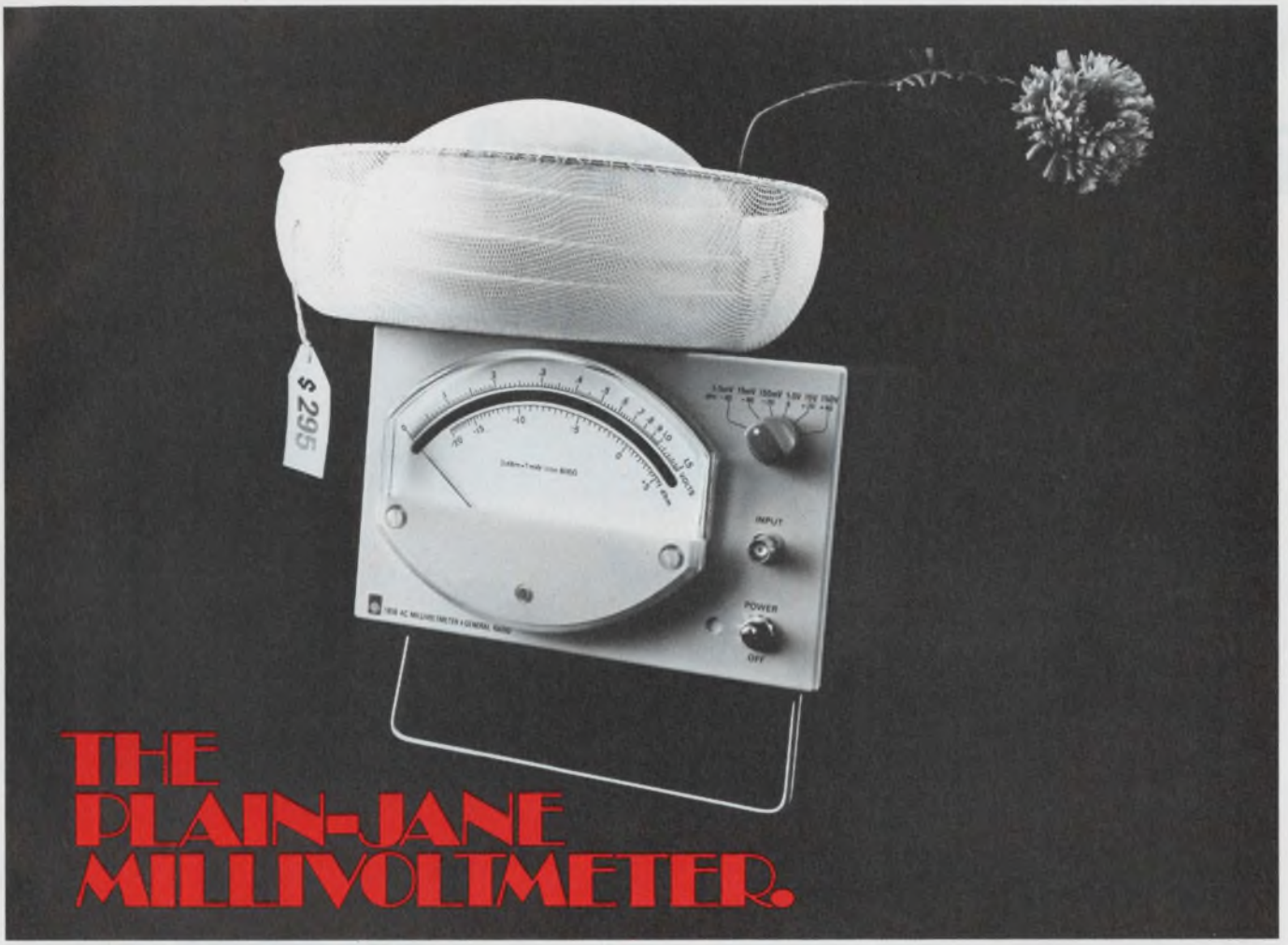
Price of this three-part package (including a blank plug-in) is only $1195. As your needs change, available plug-ins include a 350 ps output, **a 16-bit (RZ, NRZ) word generator,** variable delay generators, fan-in and fan-out generators, and optional analog programming—plus a high power pulse-shaping output (1 A, 50Ω) and mainframe.

Call your local HP field office for ordering. For further information on the HP 1900 Pulse System, see pp. 254-261 in your 1970 HP catalog, or send for our new free brochure on pulse generators. Hewlett-Packard, Palo Alto, California 94304. In Europe: 1217 Meyrin-Geneva, Switzerland.

HEWLETT hp PACKARD

SIGNAL SOURCES

INFORMATION RETRIEVAL NUMBER 112



THE PLAIN-JANE MILLIVOLTMETER.

The new GR 1808 AC Millivoltmeter is so plain it's almost ugly. The beauty of the 1808 lies in the engineered features that give it the plain look.

First of all, there's only one voltage scale and it's as easy to read as a yardstick. You can't read the wrong scale!

Look at the range switch – only six positions! Most voltmeters have twelve ranges and panels so cluttered they look like they belong in an SST, not on the bench. That's because most voltmeters have only a 3:1 meter range. The GR 1808 has a 10:1 range which halves the amount of range switching and means faster, easier, error-free readings for you. The meter is big, too – 6 inches of scale as compared to the usual 4½-inch varieties.

A point about stability – line-voltage variations cause absolutely no meter jitter or change of reading on any range.

Voltage measuring range is from 100 μV to 150 V from 10 Hz to 10 MHz. Basic accuracy is $\pm 1\%$ of reading, and input impedance is 10 MΩ shunted by 10 pF. A floating dc output is available for recording or for using the GR 1808 as an ac to dc converter for DVM's.

The features may be fancy, but there's nothing fancy about the price; only $295 in U.S.A.

For complete information, write General Radio, West Concord, Mass. 01781; Telephone (617) 369-4400.

In Europe: Postfach 124, CH 8034, Zurich, Switzerland.

GENERAL RADIO

INFORMATION RETRIEVAL NUMBER 4

Which 5-digit multimeter is your best buy?

The new S-D 7005 offers five-digit resolution and accuracy. Designed for top performance in actual laboratory use.

Price: $1,295.

S-D just introduced it.

Prove it to yourself. Ask these questions in evaluating any competitive DVM:

Does the basic DVM include **four dc ranges** from 1 V full scale to 1,000 V full scale?

Can all **optional functions** be added by means of individual cards at any time? (Auto-ranging, AC volts, DC millivolts, ohms, DC current and digital outputs?)

Is the **input impedance** greater than 10,000 megohms on 1 V and 10 V ranges? Is **feedback noise** at the input terminals less than 1 mV? Is full scale **response time** less than 400 millisecs?

Does the unit use **dual slope integration** for max noise immunity at line frequencies? Are **plug-in cards** used for easy maintainability of all measurement circuitry?

Does it have an **annunciator** to remind you what measurement you're making? Are its **digital outputs** compatible with both IC logic and discrete component logic?

The S-D 7005 offers all these features and more for just $1,295. Request technical data or a demonstration from your local Scientific Devices office or contact: Concord Instruments Division, 888 Galindo St., Concord, California 94520. Phone: (415) 682-6161. TWX: 910-481-9478.

SYSTRON DONNER

Another S-D instrument first! Electronic counters/Digital voltmeters/Pulse generators/Data generators/Time code generators/Sweep generators/Spectrum analyzers/Digital panel meters/Digital clocks/Signal generators/Oscillators / Laboratory magnets / Precision power supplies / Analog & analog-hybrid computers / Data acquisition systems.

INFORMATION RETRIEVAL NUMBER 5

VOL. 18 NO.
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FOR ENGINEERS AND ENGINEERING MANAGERS
JULY 5, 1970

NEWS

TECHNOLOGY

PRODUCTS

Departments

Cover: Designed by Art Director Clifford M. Gardiner and photographed by Henry Ries.

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RCA Solid-State Data for Designers

Low-power astable and monostable oscillators

COS/MOS IC's offer unique advantages in low-power astable and monostable oscillator circuits.

A new RCA Application Note (ICAN-6267) describes how COS/MOS IC's in multivibrator circuits:

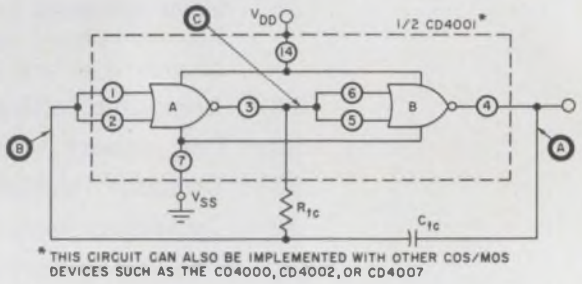
- offer large time-constants without the use of large capacitors
- operate at frequencies up to 1 MHz
- provide excellent frequency-stability over a broad operating-temperature range (−55°C to +125°C)
- permit simple circuit design—only two external components required
- consume only 10 nW @ V_{DD} = 10 V, f = 10 kHz

The schematic diagram (Fig. 1) is taken from the referenced application note and shows a typical astable multivibrator circuit using a CD4001 COS/MOS Gate. This circuit is implemented through the use of two of the gates in the COS/MOS IC plus the external capacitor and resistor incorporated to establish timing. Typical operation of the circuit is: multivibrator period approximately 0.6 ms with R_{tc} = 0.4 MΩ; C_{tc} = 1000 pF @ V_{DD} = 10 V. The voltage waveform for the circuit is shown in Fig. 2.

Application Note ICAN-6267 provides data on multivibrator frequency as a function of temperature and supply-voltage variations and includes information on nine circuits for astable and monostable oscillators built around COS/MOS IC's.

See your RCA Representative or RCA Distributor for price and delivery information on COS/MOS IC's.

For a copy of Application Note ICAN-6267, contact your RCA Sales Office or circle Reader Service No. **151** .



* THIS CIRCUIT CAN ALSO BE IMPLEMENTED WITH OTHER COS/MOS DEVICES SUCH AS THE CD4000, CD4002, OR CD4007

FIG. 1. ASTABLE MULTIVIBRATOR CIRCUIT DIAGRAM

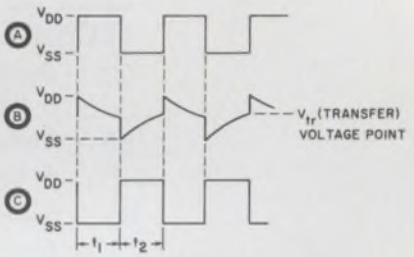


FIG. 2. VOLTAGE WAVEFORM FOR ASTABLE MULTIVIBRATOR

Thinking industrial applications? Think RCA Thyristors

There's good reason why RCA thyristors in stud and press-fit packages should be *foremost* in your mind, where industrial controls or power switching systems are your concern. Simply, RCA's broad line of SCR's and triacs provide the winning combination of quality, reliability, performance and availability for a myriad of key industrial applications. RCA has the right thyristor for the job—available now!

When you look closer, you'll find RCA is a key industrial supplier of SCR's and triacs for numerous types of industrial control equipment, motor controls, computer power supplies, heating controls, lighting controls, and power switching systems.

A broad line it is, when you consider, too, the wide selection of current ratings available from stock:

SCR's—10, 20, and 35 A

Triacs—10, 15, 30, and 40 A

Each unit is available in press-fit, stud, or isolated-stud packages. Families of RCA SCR's are rated 25 to 600 volts, and triacs are rated from 100 to 600 V—depending upon type and your requirements.

Circle Reader Service No. **152** .

300-A power circuit

The RCA developmental TA7628 is a single-package power circuit containing both the TA7629 driver and the TA7630 output module—a combination suitable for use as a positive or negative switch when driven from IC logic.

The TA7628 may be used as a motor control (5—10 hp); brushless commutator assembly (300 A DC), or a high current relay (300 A).

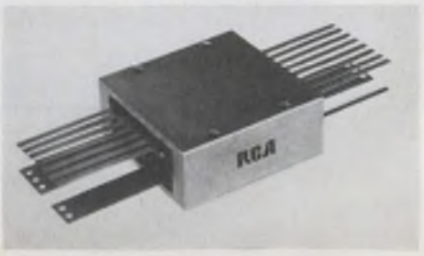
The TA7629 and TA7630 may each be purchased separately. The TA7629 provides 40-A switching capability from IC logic. The TA7630 affords higher current switching capability when suitably driven.

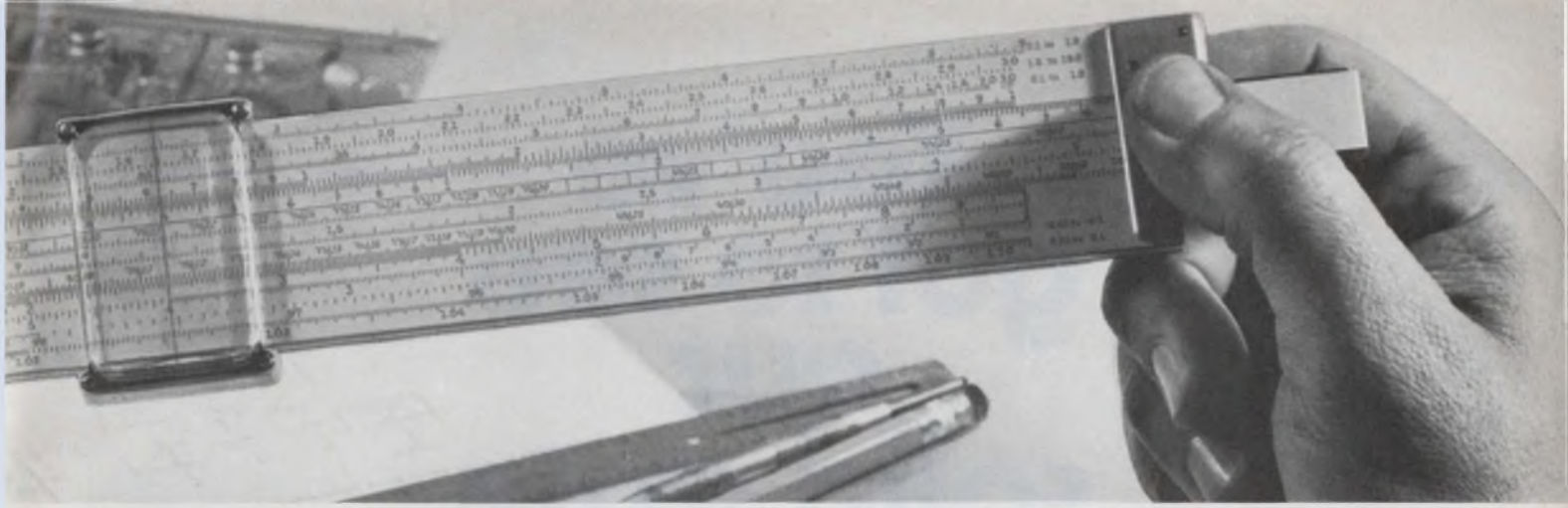
Each of these devices is obtained from basic array power modules which may be interconnected in a variety of ways to form such structures as:

- high current voltage regulators
- 4000-W inverters
- 50-A, 3-phase bridges

The basic array module used to form the TA7629 is the TA7631. It contains six 7-A and three 1.5-A n-p-n transistors; three 1.5-A p-n-p transistors; and 12 thick-film resistors. The basic array module used to form the TA7630 is the TA7632. It contains six 50-A transistors and six 50-A rectifiers. All components are electrically isolated from the case.

The TA7631 and TA7632 may be





purchased in unconnected form. Access is provided to the terminals of each internal device—permitting complete versatility in developing circuitry. These interconnections can readily be manufactured by RCA to fill your volume requirements.

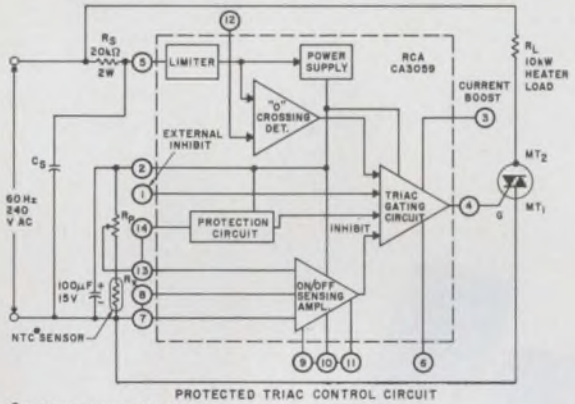
Circle Reader Service No. **153** .

IC Triac control circuit with built-in protection

An IC Thyristor Trigger, RCA's CA-3059, offers the power circuit designer significant advantages:

(a) Switching transients and RFI are reduced since the IC permits switching to occur only at zero supply voltage

(b) Built-in protection against sensor failure



PROTECTED TRIAC CONTROL CIRCUIT

*NEGATIVE TEMPERATURE COEFFICIENT

In the heater application shown here, the protection circuit removes power from the load if the sensor shorts or opens. To utilize the protection circuit, connect terminal 13 to terminal 14, as shown, and then:

Set the value of R_p and sensor resistance (R_X) between 2 kΩ and 100 kΩ. Hold the ratio of R_X to R_P within 0.25 and 4. If the ratio falls outside these limits, a resistor must be added, in series with the sensor or across the sensor, to provide a resistance ratio within this allowable range.

For Triacs specifically intended to operate with the CA3059, check RCA's 2.5- to 40-ampere, 100-600 volt series, Types 40693—40734.

Circle Reader Service No. **154** .

VERSAWATT: the stereophile's choice

Many "top-of-the-line" stereo manufacturers are studying the RCA 2N5494 silicon transistor—and other transistors of the VERSAWATT family—for use in their high-fidelity solid-state equipment.

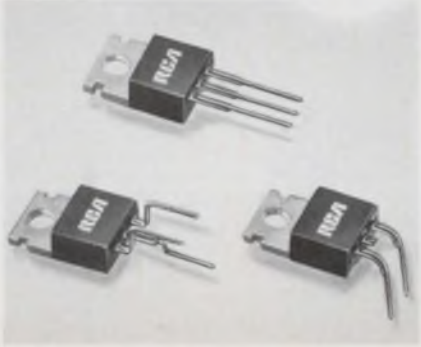
VERSAWATT TYPES FOR AUDIO APPLICATIONS

	watts	amperes
2N5296	4	1.0
2N5298	9	1.5
2N5490	16	2.0
2N5492	25	2.5
2N5494	35	3.0

Using the 2N5494 in the output of a quasi-complimentary symmetry circuit, one manufacturer finds this low cost, 3 A n-p-n transistor especially suited to audio amplifier applications. It has a low thermal resistance rating, and its current and voltage capability contribute to high performance. An added bonus: VERSAWATT transistors employ Hometaxial-base construction to provide freedom from second-breakdown problems.

VERSAWATT transistors are available in three basic configurations—straight lead (JEDEC TO-220 AB), TO-220 AA (direct replacement for TO-66) and a package with leads shaped for easy PC board mounting.

Circle Reader Service No. **155** .



High power GaAs Lasers for portable range finding devices

When a helicopter lands in a swirl of dust, the aircraft's safety may depend upon the pilot's ability to gauge distance between copter and ground.

A laser altimeter is only one device in which RCA TA7705 and TA7787 gallium arsenide (GaAs) lasers find application. They may be used in ship-docking instrumentation, anticollision devices, and many other portable ranging systems.

Since these GaAs laser diodes have short pulse duration and fast rise time ratings, equipment accuracy of a few inches is possible over a measured distance of a few feet to several hundred feet... allowing vital range resolution.

The TA7787 is unique! It is the largest single lasing chip available—55 mil source dimension. Minimum radiant power output is 60 watts at 100 PPS. The TA7705 is identical to the TA7787 except that its output is 40 W min. Drive current for both types is 250 A (typ); output pulse is 100 ns. Both units radiate at a center wavelength of 9050 angstroms.

The TA7705 and TA7787 are available in OP-12 coaxial stud packages. Why not design them into your portable ranging equipment?

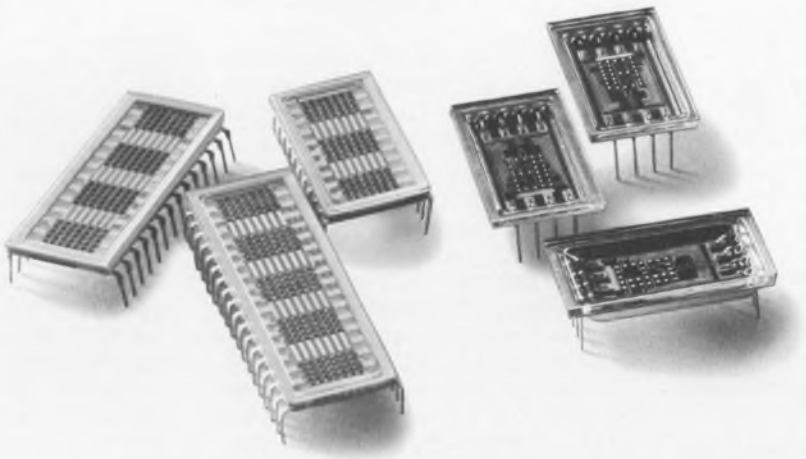
Pulsing circuit diagrams for these lasers are available upon request.

Circle Reader Service No. **156** .

For price and availability information on all solid-state devices, see your local RCA Representative or RCA Distributor. For specific technical data, write RCA, Commercial Engineering, Section 57G-5 /UM5, Harrison, N. J. 07029. In Europe: RCA International Marketing S.A., 2-4 rue du Lièvre, 1227 Geneva, Switzerland.

RCA

You've got to see our solid state displays to believe them.



New alphanumerics and numerics shown actual size.

So here's our "You've got to see them to believe them" sample offer.

HP offers very big rewards in numeric and alphanumeric solid-state displays:

IC compatibility — 5 volts or less eliminates the need for a separate high-voltage power supply.

5 x 7 dot matrix character — human-factor engineered to make false readings virtually impossible.

Long operating life — conservatively rated to give you a minimum of 10 years (MTBF) of brilliant service.

Small size — allows for the compact presentation of digital data.

Rugged construction — units are hermetically sealed and can withstand severe environmental conditions.

HP's new alphanumeric and numeric indicators are the finest displays you can buy. Single plane viewing provides greater than 120° of useful viewing angle. Both alphanumerics and numerics are end stackable with uniform spacing between the characters. Numerics include a decoder/driver as an integral part of each module to accept 4 line BCD input directly.

For a limited time, our alphanumerics are available in a 3, 4, or 5 unit package for just $20.00 per character; limit of one package per customer. The numerics are available for the low cost of $25.00 each; limit three per customer. These are the regular volume prices.

Fill out the coupon completely and mail it with a check or P. O. You'll be in for the brightest surprise any display ever gave you.

HEWLETT hp PACKARD

SOLID STATE DEVICES

01006

Tear out and mail to: Hewlett-Packard, HPA Division, 620 Page Mill Road, Palo Alto, California 94304

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____ ZIP_____

Alphanumerics (7100 Series) ☐ 3 character unit, $60.00 ☐ 4 character unit, $80.00 ☐ 5 character unit, $100.00

Numerics (7000 Series) ☐ Please send me_____numeric indicators at $25.00 per unit. (Limit 3.)

☐ Please send me complete information on your solid state displays.

Offer expires September 30, 1970/ Coupon *must* accompany order.

–where the priceless ingredient is care!

The sweet Heart Of The MODEM System

One call does it all

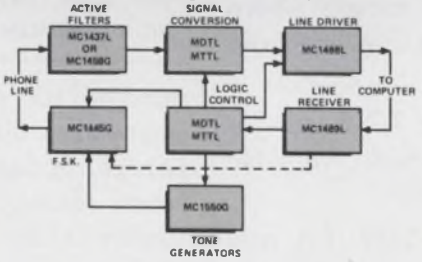
Dial Motorola for complete data about the industry's most complete line of "Dial-for-Data" MODEM circuits. There's an IC for every stage; and they're all available at cost-saving system prices.

RS-232C Line Drivers and Receivers . . . the first and only monolithic quads in the industry to meet this stringent EIA spec. They're designated MC1488L and MC1489L.

More importantly, because there's four in one package, you get more board space, lower package count. And, they're directly compatible with MDTL and MTTL logic circuits. Both types are available right now in the 14-pin dual in-line ceramic package.

Op Amps for Active Filters . . . to select specific audio tones from telephone lines. A dual op amp is the ideal element; and, your ideal choice would be the *MC1437L (a dual MC1709C)* or the brand new *MC1458G (a dual MC1741C)*. The latter is internally compensated for frequency response. Both devices cost considerably less than two single-package op amps and compare favorably with mechanical resonators or reed systems . . . and, of course, are much more reliable!

An RS-232C Integrated Modem System



Frequency-Shift Keyer . . . The MC1445G is a dual-input, logic-controlled video switch that can connect either of two tone generators to an output line. It also has a low-impedance emitter-follower output stage.

Tone Generators . . . The MC1550G is a high-frequency differential amplifier that makes an ideal, ultra-stable oscillator with built-in bias circuitry at little more than the cost of a transistor.

Digital Logic . . . MDTL or MTTL can be used to control the frequency-shift keyer and to perform other MODEM logic functions. Motorola offers a complete line in both families.

There's a Motorola IC for every MODEM stage; and, they're all available "off-the-shelf" . . . at cost-saving system prices:

Type	Function	Price (100-up)
MC1488L	Quad RS-232C Line Driver	$7.00
MC1489L	Quad RS-232C Line Receiver	$6.00
MC1437L	Dual (MC1709-type) Op Amp	$3.25
MC1458G	Dual (MC1741-type) Op Amp	$4.00
MC1445G/L	Dual-input F.S.K. Switch	$3.95
MC1550G	Differential Amplifier	75¢

If you're interested in complete data about integrated circuits for the complete MODEM system, simply Dial-for-Data . . . (602) 962-3161. Or write: P.O. Box 20912, Phoenix, Arizona 85036.

*MDTL, MTTL trademark of Motorola Inc.

MOTOROLA Integrated Circuits

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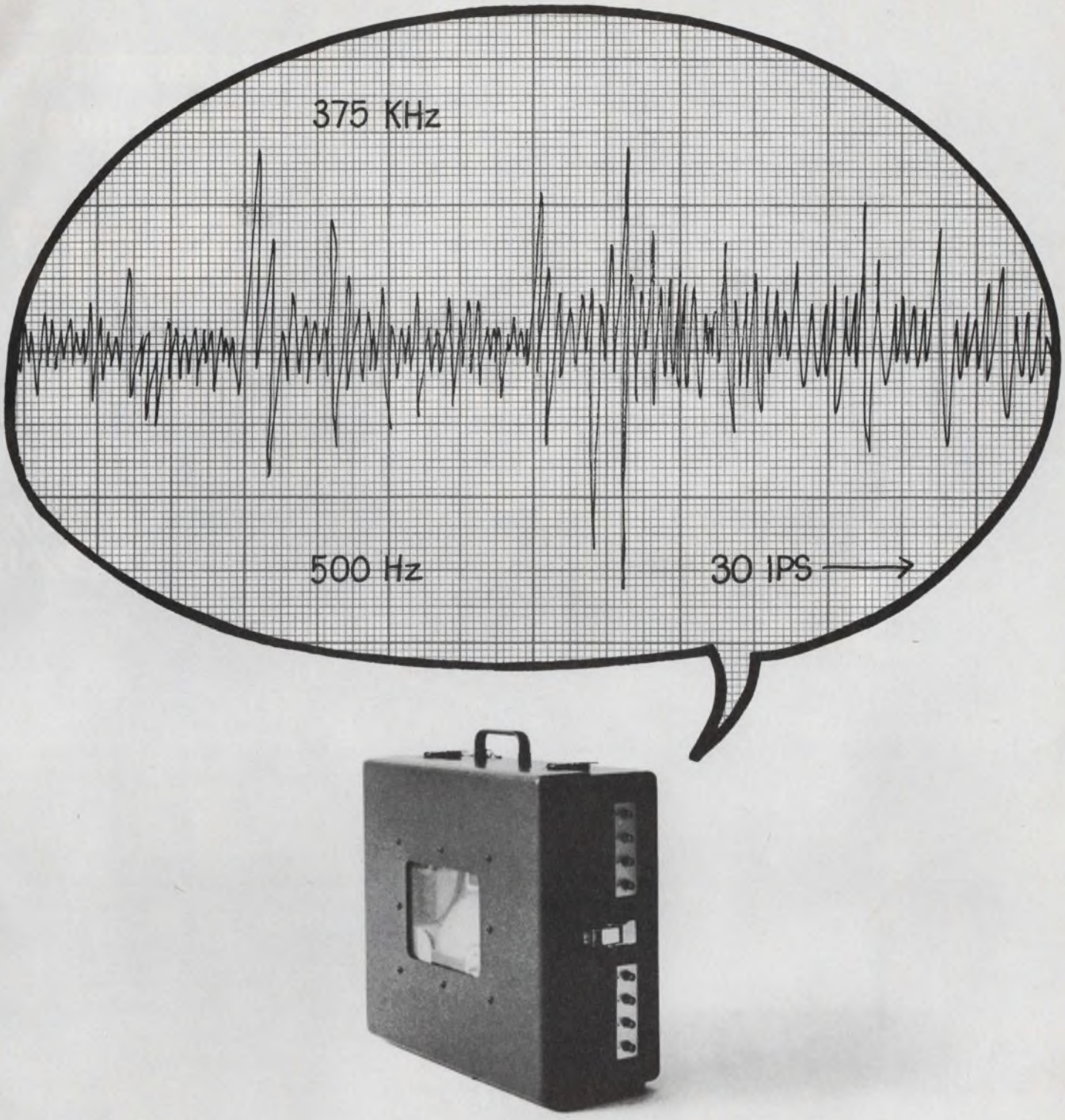

No other 28-lb. data recorder can make that statement.

Now available, our new 417 WB speaks wideband to the tune of 374.5K Hz at 30 ips. Of course it's not the only recorder that meets IRIG specs for wideband Group II. But it's the only one that weighs less than 50 lbs. (The 417 WB's 28 lbs. also includes its carrying case and self-contained battery, by the way.) And it's the only one small enough to fit under an airplane seat.

So, when you have to hit the trail for data, let the new 417 WB take a load off your back. And off your mind. It needs less maintenance and fewer adjustments than any other portable recorder. It ignores bumps, jolts, vibrations and odd mounting angles. It normally draws only 25 watts of power. It records on seven channels. And it matches large rack machines for accuracy.

But that's just a taste. For the full 417 WB story and spec sheet, write Mr. Fred Romer, Dept. 412-10, Lockheed Electronics Company, Plainfield, New Jersey 07061. Or call him at (201) 757-1600. He, too, speaks wideband.

Lockheed Electronics

A Division of Lockheed Aircraft Corporation

Trading off performance for cost in conversion equipment?

Stop!

Raytheon Computer just cut prices 33%

Now you don't have to make any cost/performance trade-offs in A-to-D and D-to-A conversion or interface equipment. We've taken the best price/performance ratio in the industry and made it even better. With price reductions from 15% to 50%.

So now you can pick from the industry's broadest line of conversion equipment. With ADC's. DAC's. Multiplexers. Sample-and-holds. All at new low prices. All available now. Off-the-shelf.

Take our 12-bit, multiplexed ADC. Case-mounted with 32 channels, this unit was a good buy for $3,640. The new price is only $2,300. Want more capacity? It's available with up to 256 channels. With savings to match.

Or choose our high performance 0.05% sample-and-hold amplifier card. It's yours for only $125. And That's a savings of more than 33%.

And we'll throw in wiring lists, test results, and technical manuals. Free. We'll deliver your conversion equipment and documentation cheaper and faster than you could do it yourself.

And, if your systems need computer power, try one of ours. Choose from a family of 16-bit machines. With cycle times from 900ns to 1.75μs, including our new 1.0μs 704 mini for under $10,000. All are software compatible with over 400 proven off-the-shelf programs.

Get the best price/performance bargain in the industry for your system, today. Call or write and ask for Data File E-188.

RAYTHEON

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The only thing Raytheon Computer does is your job. Cheaper.

Designer's Calendar

AUGUST 1970

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30	31					

For further information on meetings, use information Retrieval Card.

Aug. 25-28
Western Electronic Show & Convention (WESCON). (Los Angeles). Sponsors: IEEE, WEMA. WESCON Office, 3600 Wilshire Blvd., Los Angeles, Calif. 90005.

CIRCLE NO. 460

Aug. 30-Sept. 2
Electronic Materials Technical Conference (New York City). Sponsor: AIME. A. Reisman, IBM Corp., P.O. Box 218, Yorktown Heights, N. Y. 10598.

CIRCLE NO. 461

SEPTEMBER 1970

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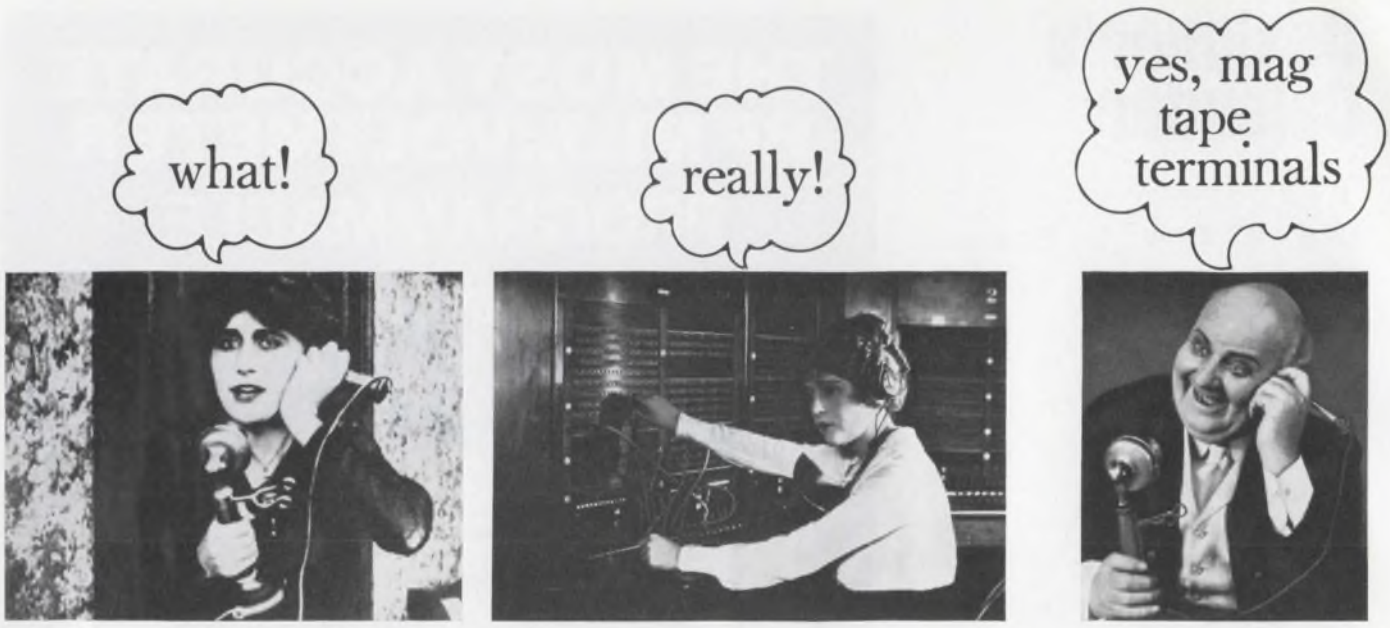
27	28	29	30			

Sept. 1-3
Association for Computing Machinery Conference (New York City). Sponsor: ACM. ACM 70, 1133 Ave. of the Americas, New York, N. Y. 10036.

CIRCLE NO. 462

Sept. 23-24
Electron Device Techniques Conference (New York City). Sponsor: IEEE. Mayden Gallagher, Hughes Res. Labs., 3011 Malibu Canyon Rd., Malibu, Calif. 90265.

CIRCLE NO. 463



It's true.

After helping a jillion feet of paper tape wind and unwind its way through communications systems everywhere, Teletype announces the addition of magnetic tape data terminals.

There are some basic advantages in both mediums. But as you are well aware, the medium that's right for a system depends a lot on the application criteria.

The new magnetic tape data terminals have many operational features that make life less complicated for the operator.

New, modular line of Teletype® 4210 magnetic tape data terminals.

For example, take a look at the tape cartridge, which was specifically designed for reliability required for data transmission.

Its vital statistics are: 3″ x 3″ x 1″.

It contains 100 feet of ½″ precision magnetic tape.

It will hold 150,000 characters of data, recorded at a density of 125 characters per inch. The equivalent of a 1000 foot roll of paper tape.

This means that your data is easier to store, easier to handle, easier to work with than ever before. And it's reusable.

Teletype is a trademark registered in the U.S. Pat. Office.

The units have a "fast access" switch which will move tape forward or reverse at a speed of 33 inches per second. A digit counter provides a reference point to help locate various areas of the tape.

Four ASCII control code characters can be recorded in the data format to aid character search operations. When the terminal's "search" button is pressed, tape moves at the rate of 400 characters per second until the control code selected is detected. Then the terminal stops the tape automatically.

A "single step" switch is also provided which enables you to move the tape forward or backward one character at a time. In editing or correcting tape, you can send a single character using this feature.

Also magnetic tape adds high speed on-line capability to low speed data terminals.

You can zip data along the line at up to 2400 words per minute. For example: Take a standard speed Teletype keyboard send-receive set, and a typical typist. Add a new magnetic tape unit to this combination and the on-line time savings can pay for the magnetic tape terminal in short order.

You can take better advantage of voice grade line speed capabilities.

An operator can prepare data for magnetic tape transmission using the keyboard terminal in local mode. Then send it on-line via the magnetic tape terminal up to 2400 words per minute.

These new modular magnetic tape data terminals offered by Teletype are perfectly compatible with model 33, model 35, model 37 and Inktronic® keyboard send-receive equipment.

Straight-through threading makes tape loading and unloading exceptionally easy.

They can send or receive at high or low speed. Or can be used independently as stand-alone terminals on-line.

If you would like to know more about this new line of Teletype magnetic tape data terminals, please write Teletype Corporation, Dept. 89-15, 5555 Touhy Avenue, Skokie, Illinois 60076.

Teletype 4210 magnetic tape data terminal with 37 keyboard send-receive set.

TELETYPE

machines that make data move

INFORMATION RETRIEVAL NUMBER 14

Built-in flexibility lets you choose:

- Arbitrary filter characteristics
- Single or multichannel processing
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INFORMATION RETRIEVAL NUMBER 15

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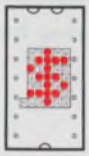

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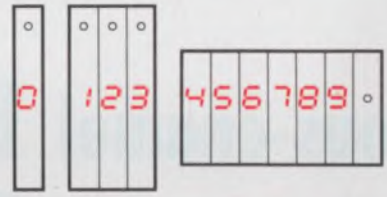
- Price: 1,000 quantities, $7.55.



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INFORMATION RETRIEVAL NUMBER 16

Highlighting
THE ISSUE

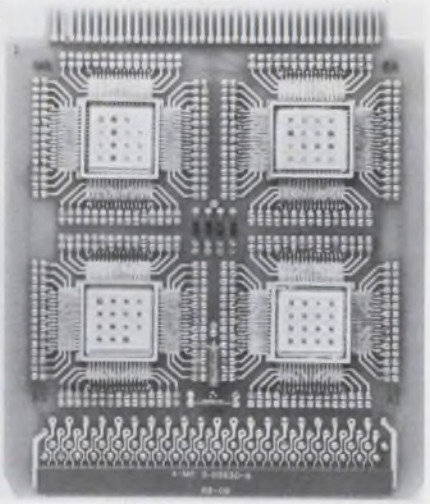
Nineteen seventy is one of those off election years when the President doesn't have to run for his political life. Congressional candidates will be running on the key issues, and it's never too early for us to find out how they're thinking—specifically on issues of special interest to the engineer.

Since it would be impractical to try to talk to every Congressman in Washington, we decided to limit our interviews to those members who have engineering backgrounds. We were surprised to find that, of the 535 seats in the U. S. Congress, only seven were filled by engineers.
Page 60

In a modular building-block system, a new series of programmable standard and custom-built digital filter assemblies features accuracies up to 24 bits at sampling rates up to 500 kHz.

Each assembly is composed of four basic components: adders, multipliers, shift-register delays and a memory. These basic components are combined into second-order building blocks (two poles and/or two zeros).

Assemblies can be combined or multiplexed in a number of ways to realize any number of any desired filter order functions.
Page 79



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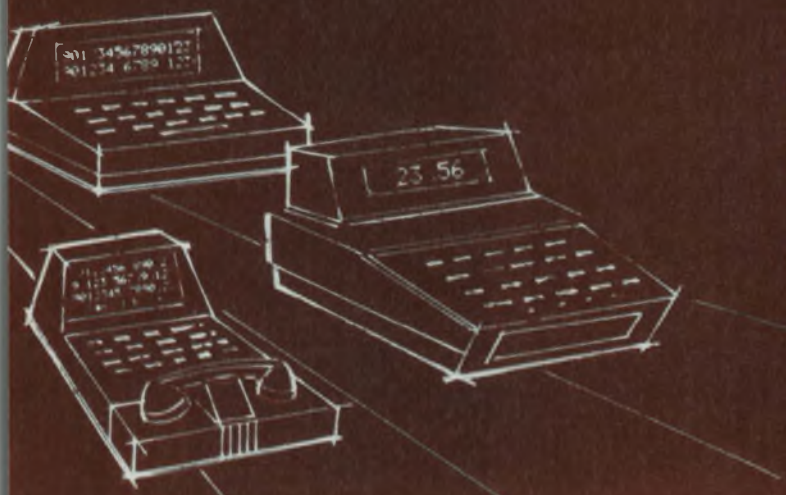
Page 25

SELF-SCAN™ alphanumeric panel displays

lowest cost readout system... and it's available now



SELF-SCAN panel displays combine everything you've wanted — including low cost — in 10 to 400 character alphanumeric readouts.

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News Scope

Magnetic domain memory going into production

The magnetic domain memory, an experimental computer development for several years, is moving out of the R&D stage to the production line.

Hughes Aircraft Co., developer of the Dynabit magnetic domain memory, has assigned an exclusive license for the manufacture of the device to Digital Development Corp. of San Diego.

Hughes announced the business arrangement at the annual conference of the IEEE's Computer Group, held in the Washington Hilton Hotel. The conference, titled "The Challenge of the 70s," was devoted almost entirely to an exploration of the fast growing computer peripheral field. Dynabit fits into this area as one of the newest entries in the auxiliary memory category.

Dynabit is a static, random-access memory based on controlled magnetic domain wall motion through a fine wire. According to John V. DiMatteo, public relations spokesman for Digital Development Corp., it is not suited for use as a main memory because it is too slow (1.0-ms typical cycle time), but it can compete with disc and drum auxiliary memories that require 5 to 100 ms.

DiMatteo says that Dynabit is very reliable because it is a completely static device. It can withstand high shock, vibration and temperatures from −80 to 200 C. No pricing has yet been announced, but the cost per bit is initially expected to be greater than that for disc or drum memory.

Dynabit can be used to store any number of bits, because it is a modular device that can be cascaded indefinitely. Production units are expected to be available during the last quarter this year.

The IEEE computer conference had a registration in excess of 1100 engineers—more than double the number attending the inaugural meeting last year in Minneapolis. Exhibitors were very impressed with the high technical qualifications of those who attended.

Dr. Lee DuBridge, science adviser to President Nixon, delivered the welcoming address at the conference luncheon.

21,000-W solar array being built for NASA

The largest solar-cell-array system for generating electric power on a spacecraft is being developed by engineers at NASA's Marshall Space Flight Center in Alabama.

The array will consist of two "wings," which will fold during launch and be exposed after the satellite reaches its orbital altitude. Each wing will contain 1200 square feet of solar-cell surface area, and together they will provide 21,000 W for about one hour during each orbit. This is enough power for five average houses, says NASA.

The power will be used to operate the Saturn Workshop and the Apollo Telescope Mount—the major components of the Skylab cluster.

A power-conditioning system will regulate Skylab's power to a nominal level of 28 V dc at about 4000 W.

The 18 solar cell panels of the Apollo Telescope Mount array will weigh 4000 pounds and charger-regulator-battery modules—one for each panel—will weigh 1980 pounds. While the final design of the Saturn Workshop has not been specified, NASA says that its solar panels will be wired to provide eight separate power sources.

The telescope component will orbit the earth at 250 miles—high enough above the atmosphere to give scientists a clear look at the sun.

The Saturn Workshop will contain 10,000 cubic feet of living and working space. Both components of the Skylab cluster will be launched separately in late 1972, according to the space agency.

Pacemaker users warned of radiation hazards

Electromagnetic interference put out by microwave ovens, electric shavers, auto ignition systems and TV sync generators may be serious enough to stop the hearts of persons with electronic pacemakers, the U.S. Bureau of Radiological Health and industry sources, have reported.

Industrial types of microwave ovens, such as are used by airlines and restaurants, can stop pacemakers at distances of up to 100 feet, according to James Fiala, president of the Microwave Heating Div. of EAS, Inc., Minneapolis. Other, less powerful equipment, he says, may cause malfunction and faintness of operation of pacemakers.

The problem with microwave ovens was spotlighted recently by a letter in the Journal of the American Medical Association, signed by five physicians. They pointed out in the May 18 issue that one patient had fainted near a microwave oven and that experiments had shown that the radiation caused the pacemaker to go into erratic action.

The problem involves both the type of pacemaker used as well as the condition of the rf seals on the microwave oven door. Edward Cheatham, engineering manager of pacemakers for Medtronics, Inc., Minneapolis, explains that there are two basic types of pacemakers: demand and asynchronous (constant beat).

The demand pacemaker, which increases the heartbeat with physical exertion, is the popular type. It has ac-coupled, high-impedance, sensitive amplifiers, which are more susceptible to electromagnetic interference than the electronics in the asynchronous units.

These pacemakers pick off a con-

tractional signal from the heart muscle, and when external radiation reaches the electrodes—particularly if it is synchronous with the heartbeat—the pacemaker can be blocked or its rhythm upset. The latest pacemakers have more shielding and filtering than the older models, but from some microwave ovens radiate a 1-Hz signal when the rf seals in the door become degraded through use or damage.

The present radiation standards call for leakage emission of no more than 10 mW per square centimeter, but tests have shown that it can be substantially higher.

Some of the demand pacemakers are sewn into the patient's chest, and if he operates a badly arcing brush type of electric shaver, or an electric drill close to his chest, it can affect his heartbeat.

Tough tape from Texas made of polymer alloys

By using high-performance polymer alloys instead of the common polyvinylchloride makeup of most magnetic tapes, a Texas company says it has achieved greater toughness than the best competitive product available.

The new magnetic tape, called Epoch 4, is also said to have better adhesion of the tape coating to its backing and improved recording characteristics. The developer, Graham Magnetics of Graham, Tex., is offering users a 20-year warranty against defects in the tape's materials and workmanship.

Mini-calculator rivalry intensifies in Japan

At least three Japanese electronics concerns have begun producing miniature calculators this year. The latest announcement comes from Sanyo Electronics, Ltd., in Osaka. Its new unit, which weighs 2.2 pounds and is smaller than a cigar box, not only can add, subtract, multiply and divide; it also can perform chain multiplication and division, mixed calculations, raising to a power and calculations by a constant.

The unit, called Sacom-Mini, has four MOS/LSI circuits that were developed by Sanyo through a technical agreement with General Instrument Corp. of Hicksville, N. Y. Other mini-calculators are being manufactured in Japan by the Micro Compet Div. of the Sharp Corp. and by Canon, Inc.

Honeywell a 'partner' in Japan's space effort

Honeywell, Inc., one of the first American companies to participate in the 1969 U. S.-Japan argeement for interchange of space technologies, has formed a company with Nippon Electric Co., Tokyo, to perform for the Japanese equivalent of NASA—the Japanese National Space Development Agency.

The first program expected to be undertaken by the new company is the development of guidance and stabilization systems for rockets that will launch Japanese communications satellites by 1975.

Honeywell and Nippon Electric have had cooperative arrangements for several years, with the Japanese company producing Honeywell avionics for the Japanese F-104 as well as Honeywell computers.

New wafer is expected to cut IC product costs

The availability of silicon on spinel epitaxial wafers has been announced, with predictions that it will lower the costs and improve the performance of MOS and other IC products.

Union Carbide Corp.'s Crystal Products Dept. in San Diego, developer of the new wafer, says it is a significant advance in semiconductor-on-insulating-substrate technology. David J. Valley, general manager of the department, predicts that spinel, a magnesium aluminate mineral, will replace silicon and sapphire as a substrate material in many applications. In addition, he says, spinel substrates will lead to new devices that at present are either economically or technically not feasible.

Potential applications include high-speed memories, precision thin-film monolithic devices and new photosensitive and thermal sensors.

The desirable properties of spinel as an insulating substrate include structural compatibility with the silicon film and high resistivity.

James J. Beeman, national sales manager for the Union Carbide department, reports the new wafers are available in development quantities. Made by the Czochralski, or pulled-from-melt process, the wafers are 1.25 inch in diameter by 0.020 inch thick, with a 2-micron single crystal silicon film. Union Carbide will sell spinel products in other forms—as grown boules and as cut wafers and polished wafers.

Beeman says a circuit combination of silicon on spinel epitaxial film active devices, with sputtered tantalum RC elements, would provide precision and stability. At the same time it would obviate the high cost and poor reliability associated with appliqued chips in hybrid circuits.

With present silicon ICs, high-precision resistors and capacitors of 0.1% or even 1% tolerance are not attainable because of their very high temperature coefficients.

Automated packaging seen on rise at Nepcon

An increased trend among component manufacturers toward automation was apparent at the National Electronic Packaging and Production Conference—Nepcon East—held last month in New York's Coliseum.

Conference Chairman Milton S. Kiver said, "Computer-aided packaging design is moving along with computer-aided circuit design." Another trend, Kiver noted, is that more companies are looking at in-house facilities for making their own ICs and hybrids. And, he said, job-shops are being set up to handle whatever part of the IC process that companies cannot do on their own, for example, masking.

Total attendance at the conference was better than 17,000 with about 350 companies occupying nearly 600 booths. Had economic times been normal, there would have been at least a third more attendance, Kiver said.


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INFORMATION RETRIEVAL NUMBER 20

Major advances in interconnection promised

Two techniques described at IEEE conference blend best features of multilayer and wire-wrap

John N. Kessler
News Editor

Circuit designers and suppliers hassled over the relative advantages of wire vs multilayer printed-circuit interconnections at the IEEE Eastern Electronics Packaging Conference. But amid the unresolved arguments, two new techniques were described that combine the features of multilayer with the fast turn-around and flexibility of wire interconnects.

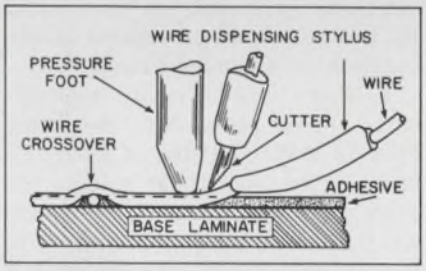
Ronald Morino, manager of manufacturing research at Photocircuits Corp., Glen Cove, N. Y., told conferees at the Massachusetts Institute of Technology in Cambridge that his company was "in the last stages of developing a Multiwire system for commercial use." The new technique consists of a numerically controlled machine that spits out 0.007-inch-diameter insulated wire with a built-in solder mask onto a circuit board containing an adhesive.

A computer-generated punched paper tape drives the numerically controlled machine that plots the paths and dispenses the wire. After the interconnection paths are plotted, termination points are formed by automatic drilling and metallization of holes through the wire paths. Components are soldered into these holes.

The polymide film insulation on the wires permits crossovers without danger of breakdown voltages. According to Morino, Multiwire circuits will provide the lowest cost when ordered in lots of 250 to 3000 parts with interconnection complexity of about 20 pins per square inch. The product looks much like a printed-circuit board.

3-tier multilayer system

The second new technique is being developed by Loral Electronics, New York City, and is based more on multilayer than on wire interconnect technology. Alan Chertoff, assistant chief engineer, and James J. Foti, manager of microminiaturization at Loral, described a three-tier multilayer system consisting of printed-circuit boards, substrates and chips. Each tier is topographically structured—multilayered in itself. The interconnect system is called QTA—Quick Turnaround. It is based on standardizing the internal layering of each multilayer tier and customizing the two outer layers.



The Multiwire technique uses a numerically controlled machine to spit out insulated wire onto a circuit board.

"We have sorted out the interconnections that remain the same for all designs from those that change for each design," Chertoff said. In this way we can batch-process the internal interconnections and produce thousands of them. The only thing that remains to do is to etch the outer surfaces."

Chertoff emphasized that the QTA system is highly adaptable for large-scale integration. What Loral calls the "master logic chip"—MLC—contains up to 150 elements and can be interconnected to higher-order assemblies, such as multilayer substrates and multilayer printed-circuit boards. "This three-tier packaging system is a viable alternative to the discretionary wiring approach to LSI," Chertoff said.

Foti, who presented the paper as co-author with Chertoff, described QTA as a "custom-universal interconnection network."

"With QTA," Chertoff explained later, "the design engineer can specify the number of printed-circuit boards he needs, the number of substrates, the number of chips. He reaches up on the shelf and takes what he needs. All the boards are pre-drilled. The etching of the outer surfaces can be done in two weeks."

Chertoff contended that if this were done for a conventional multilayer system, it would take "four months to get the boards, four to six months to get the substrates and about the same time to get the chips."

"In two weeks you can get a full LSI system with a price factor one-tenth of what it would normally cost," he said.

Two different animals

It is difficult to compare Multiwire with QTA. Morino emphasized that the two "are different animals." Chertoff pointed out that Multiwire is essentially a series operation, appropriate for relatively small numbers of systems. And Morino agreed, but he also pointed out that in instances where fast turnaround is most needed, the number of systems is most often going to be small.

Multiwire, if it fulfills its promise, will be highly adaptable for wiring together small components for relatively small runs, while QTA seems appropriate for LSI systems where the turnaround time is short.

From the standpoint of tooling and art work, Multiwire should reduce costs. "When you have high volumes," Morino said, "you usually have the lead time you need to prepare a production line. But when you want to put up a custom system and you have a three, four or five-week lead time, and you start at that time to design the board, the chances are that you need only a few of them."

(**Interconnections,** *continued*)

Morino pointed to two factors in determining which technique to use: one is quantity, the other is complexity.

"When you have a very simple interconnection where there are no stringent space requirements, the printed-wiring techniques—even in small quantities—are probably more economical," he said. "But when you have a very dense pattern, and you have to resort to a very precise artwork preparation to generate the interconnection you need, the cost of preparing the art work may run from several hundred to a few thousand dollars. If this is the case, if you need only a few pieces, it will pay to go Multiwire. Now let's say you have the same complex part, but you have to generate 10,000 pieces. In this case, if you amortize the art work costs—say $2000—over 10,000 pieces, the cost is only 50¢ per piece."

Multilayer vs wire debated

The question of multilayer vs wire for interconnections was discussed without resolution by a panel at last month's conference. Both techniques have been used to interconnect logic systems for such high-reliability projects as Apollo, according to L. David Hanley, deputy associate director of the Charles S. Draper Laboratories at MIT. He emphasized that both techniques were successful after many problems were worked out.

George Messner, director of research for Photocircuits, favored printed wiring. "Is there, after all, anything more efficient—in terms of volume, weight and cost—than a hole?" he asked.

Jack Fidian, eastern regional manager for Iotran International Inc., Sunnyvale, Calif., vouched for wire interconnects on the basis of economy. He said wire interconnections were the best way to make economical changes in a short time.

Future trends outlined

Design trends for tomorrow's electronic systems, as envisioned by another panel of experts at the conference, included these:

- There will be more sophisticated linear ICs. But the hitch here is cost; the use of such ICs cannot be justified unless the price goes way down. It is expected that cost competitiveness will be achieved by making linear ICs as replacements for complex circuitry.
- Hybrid forms will play an increasing role, especially in consumer applications, where, according to William Moyers, president of Microtronix Technology Inc., Mountainside, N. J., there will be a 1000% increase in communications needs in the next 10 years. The big advantage of hybrids is that they can be tailored to specific applications, and design changes can be made at much less cost than with monolithic ICs and multiple chip forms.
- Some of the first consumer ICs will be turning up in new cars this September, Moyers said. But the future market will also include ICs in appliance timing controls and in low-power (2-5 W) audio.
- The ancient art of weaving is being updated to make woven controlled impedance harnesses of cables, twisted pairs and single conductors. Edward Ross, vice president of the Southern Weaving Co., Mauldin, S. C., showed how various types of wire could be mixed and conductors "broken out" to connect to individual components or packs.

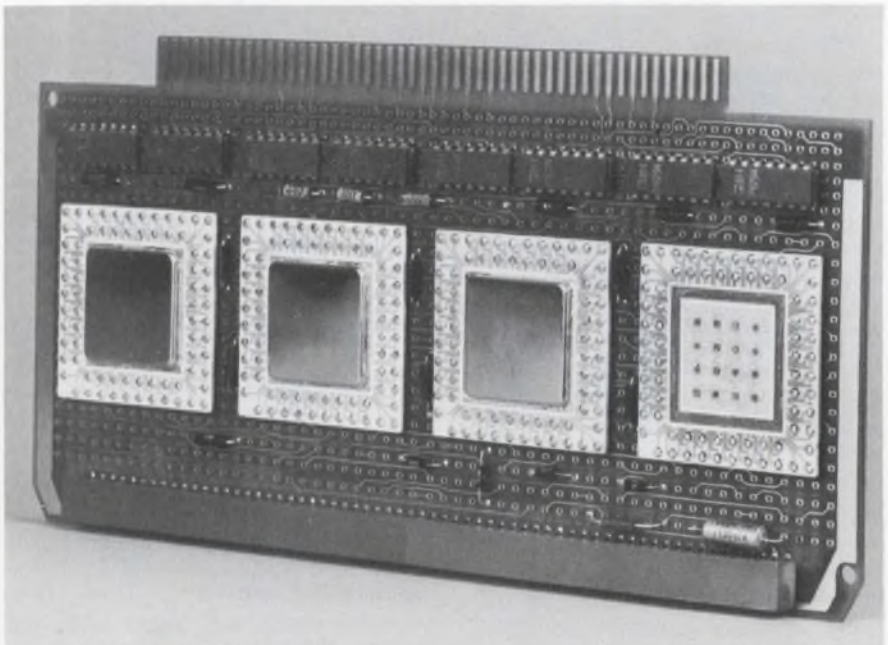
Evolutionary changes seen

The over-all technological trends in packaging in the 70s will be evolutionary Moyers told the conference, with solder and thermocompression bonds continuing to be used for a while.

The main interconnection techniques for ICs will continue to be beam leads, flip chips and the raising of conductor paths off the substrate by means of etching, Moyers said.

As the need for higher and higher packaging densities continues, and LSI systems become more widely used, the need for cooling systems will become more critical, the conference was told. In a paper on cooling techniques, Stanley A. Casazza of Raytheon Missile Systems Div., Bedford, Mass., explained that hot-spot power densities of 100 to 1000 W per cubic inch have become commonplace in advanced electronics.

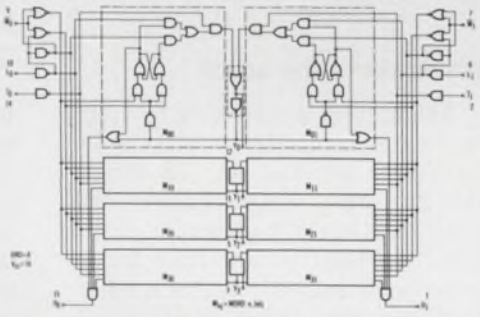
Since such semiconductors as germanium tend to degrade at about 120°F, cooling must be incorporated into the packaging design. Casazza outlined four basic cooling methods. ■■



QTA—Quick Turnaround—a three-tier system developed by Loral Electronics. Each tier of printed circuits, substrates and chips is topologically structured —that is, multilayered—in itself.

Introducing hardsoftware. Softhardware?

Signetics Content Addressable Memory



Two variations: High Speed 8220; Low Power 8222. Both monolithic arrays incorporate necessary addressing logic and eight identical memory cells organized as four words, each being two bits long. They offer associate, write-in only and read-out only function capability. Complexity: approximately one-hundred gates. Package: 16-pin.

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INFORMATION RETRIEVAL NUMBER 21

Disposable battery slated for Army manpacks

Soon Army field troops will be able to power their manpack radio transceivers with lightweight batteries that have twice the energy of batteries of comparable size and are cheap enough to throw away when they wear out.

Zinc-air units activated by water, the batteries are under development at the Army Electronics Command's Electronic Components Laboratory at Fort Monmouth, N. J. Companies that have contributed to their development include the Yardney Electric Corp., New York, N. Y.; American Cyanamid Co., Stamford, Conn.; the Electric Storage Battery Corp., Yardley, Pa.; Leesone Corp., Great Neck, N. Y.; and Gould Batteries, Inc., in St. Paul.

Particular progress has been made on two units: one a 10-ampere-hour 24-V, four-pound battery and one of twice that capacity weighing six pounds. The nominal energy densities are 60 watthours per pound for the smaller battery and 80 watthours for the larger.

High quality production costs would be in the $25 to $30 range, according to Carl A. Nordell, of the laboratory's Power Sources Div. To keep costs down, he says, noble metals are not used. Instead, a carbon-Teflon type of low-cost cathode is substituted. Compensation for the poorer voltage characteristics is made by the use of extra cells—22 instead of 20 for a 24-V battery.

Water starts the action

The battery is activated by pouring water into a tray—a container built with a filling slit for each of its 22 cells. Approximately 330 cubic centimeters of water, or 15 cm^3 per cell, is absorbed in 10 minutes or less. Air enters the battery through three rows of air intake and exhaust holes provided on each side. The unit cell stack is completely wired and slipped into the plastic battery box with a polyurethane foam lining.

KOH can substitute for water

"The design has shown promising electrical performance capability in two variations," Nordell says. "In one the anodes are impregnated with potassium hydroxide (KOH) as required for water activation, and in the other, the anodes are not impregnated and the battery is activated by adding a 35% solution of KOH.

"Although our present goal remains activation with water, we realize that KOH activation is practical and offers real advantages in terms of simplifying manufacturing, lowering cost, and eliminating the problem of supplying water at freezing temperatures."

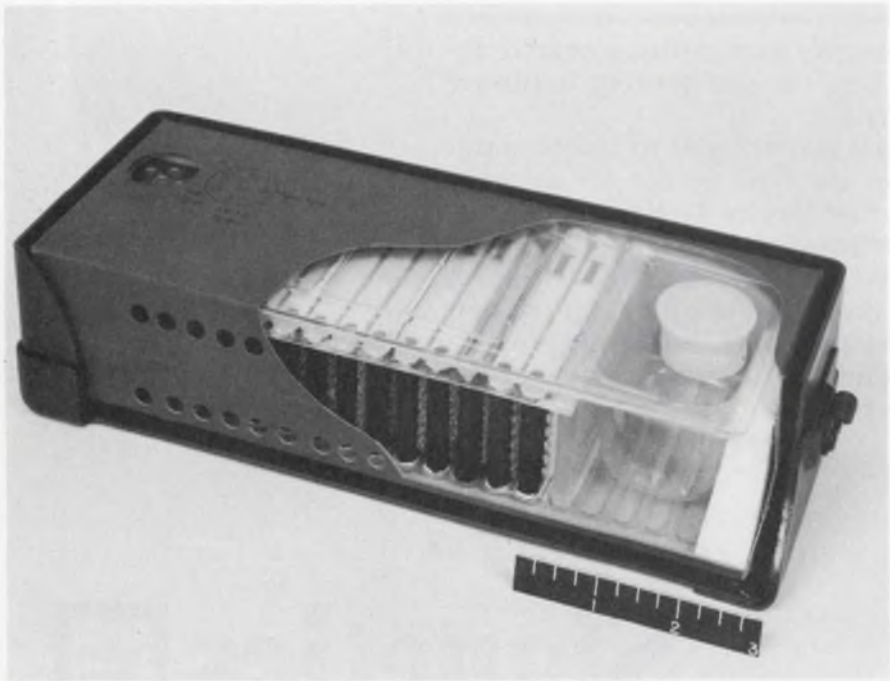
Nordell adds, "The main deficiency of the present KOH design results from the impregnation of the anodes after cell stack assembly. The voids in the cells become choked with solid KOH, and the subsequent absorption of water is slowed appreciably. Additional anode development could correct this problem and provide impregnated anodes which could be fully activated in the 10-minute period the Army requires."

Two-pound unit is under way

Work on a two-pound water-activated zinc-air battery has just been started for Fort Monmouth. Internally the battery consists of thirteen 11.6-ampere-hour cells, with the terminal connector assembly on one end and a combination reservoir and activation water-measuring device on the other.

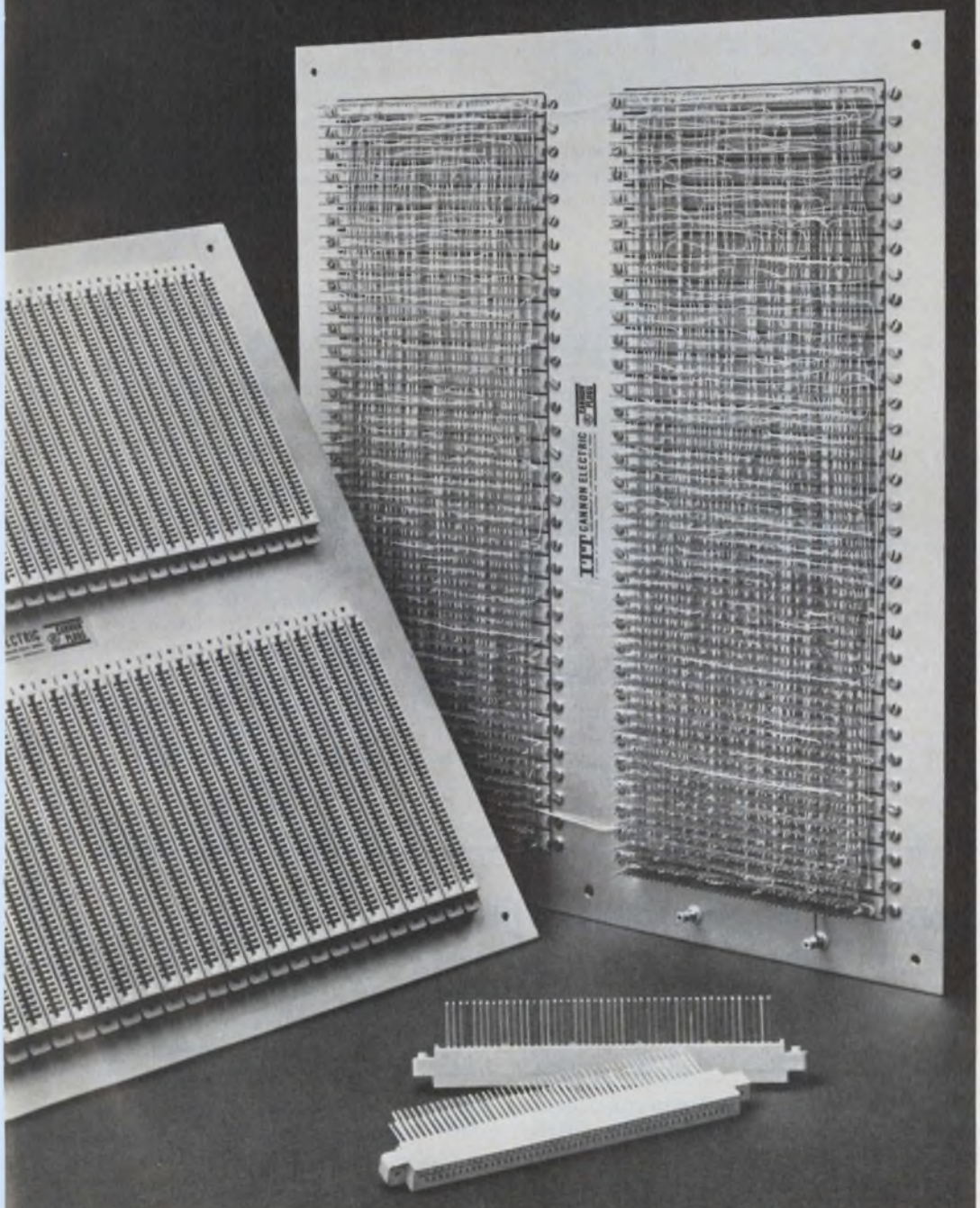
Intercell spacers provide cell support in addition to maintaining the required spacing necessary for air access.

The unit will be tested with the AN/PRC-25 radio. ■■



Disposable zinc-air battery, activated by water, will be tested with Army portable radio transceivers. The unit will cost $25 to $30.

THE LAST INTO THE BACKPLANE BUSINESS SHALL BE THE FIRST:



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CANNON ITT

Tiny network employs novel thick-film design

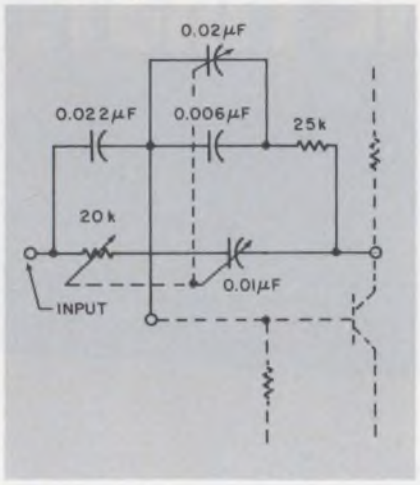
For the designers of $15 radios—who may think they have crammed just about everything feasible into their sets—Sprague Electric Co. has come up with an irresistible extra: an adjustable frequency/loudness network in a package no bigger than a volume control, but one that is reported to give the performance of the expensive and much more bulky Fletcher Munson network used in $1000 hi-fi sets.

J. H. Fabricius, manager of ceramic product development at Sprague in North Adams, Mass., says the new variable networks are combinations of thick films on a ceramic substrate. Prototypes produced by Sprague have adjustable capacitors of 0.01 and 0.02 μF, fixed capacitors of 0.022 and 0.006 μF, plus a 20 kΩ variable and a 25 kΩ fixed resistor (see figure)—all in the small package. The variable capacitances and variable resistance change with shaft rotation.

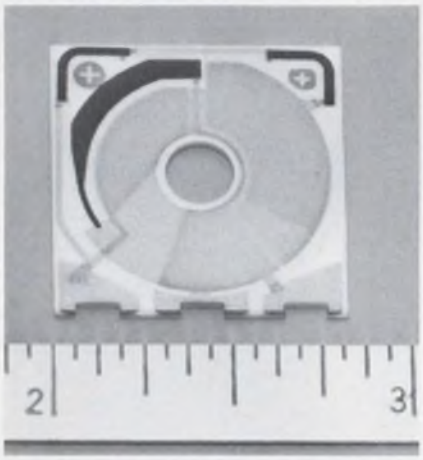
To develop this network, two problems were solved. First, high capacitances were provided on a 3/4-inch-diameter substrate area.

Second, a heretofore unachieved variation in capacity—from a few picofarads to 0.01 or 0.02 μF—were produced by a half turn or less of the control shaft.

The development effort began with the design of a 10 pF-to-0.01 μF variable capacitor. State-of-the-art thick-film technology, Fabricius says, readily provided enough capacity when dielectric materials, with constants ranging from 30 to 100 and capable of forming defect-free layers as thin as 0.0005 inch, were used. The capacitor element was formed on an alumina substrate by depositing films of metal, dielectric and metal—in that order.



Variable network is fabricated by Sprague Electric with thick-film techniques. Capacitor and resistor values change with shaft rotation.



The substrate supporting the new variable network. The variable capacitors are the upper segments, while the fixed are on the bottom.

But the tough problem was to obtain the incremental variation of capacitance. It was solved in two steps. First, the exposed, or top, metal layer of the capacitor was deposited as some 1600 discrete metal "islands," 5 to 10 mils on a side and with dielectric separation of 1 to 2 mils. For this segmented layer, a sweeping, sector contact had to be created.

It was here that the greatest contribution was made: A contact system was developed with negligible electrical resistance and with low shaft torque (3 to 4 inch ounces).

The contact element was formed of a fine-woven metal mesh backed by a silicone rubber pad and a spring-loaded washer. The fine weave provided several contact points for each island. Angular rotation of the contact sector varied the number of islands connected, as well as the output capacitance.

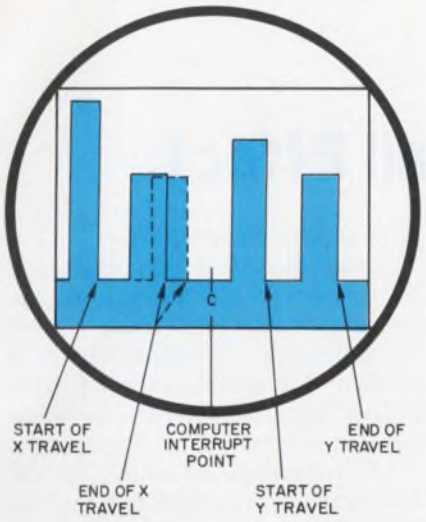
These same techniques were then applied to produce the variable networks of Sprague's device. (See figure and photo. The resistive elements appear black in the photo.)

Capacitors fabricated with the thick-film techniques used here are currently of low voltage and suitable for applications of from about 20 Hz to 100 kHz. ■■

Computer troubleshoots as it automates a process

Most automatic industrial control systems monitor only the input and output of a controller; so if there's a malfunction in some part of the system, the entire process must be shut down to allow troubleshooters to go to work. A new computer feature being offered by General Automation of Orange, Calif., gives operators real-time access to a memory register inside the computer. Switching, sequencing, positioning, timing and other parts of the total process can be checked while the system is in operation. Troubleshooting can be performed and preventive maintenance scheduled without shutting down the manufacturing process.

This feature, called the Autovue system, is being offered in General Automation's SPC-16, a 16-bit, 480-nanosecond minicomputer. The system requires an oscilloscope



Real-time examination of machine tool travel, the way Autovue might show it. Under normal conditions, the X and Y rate of travel would be the same (solid trace). Improper lubrication, a faulty bearing or dirt might cause the travel to be reduced (dashed line). Maintenance personnel could observe this and schedule service. The computer interrupt would stop the process automatically if the operation degraded to that point.

or other time-based display instrument to be connected to the console display register through a digital-to-voltage converter. The operator inserts digital patterns from memory (corresponding to the process under computer control) and displays the patterns on the scope. Thus portions of the process under control of the computer are viewed as time-based displays.

As Neal Young, product manager at General Automation puts it: "The Autovue allows a visual correlation between the process, program and computer without taking the computer off line or interrupting the process."

For example, in a computer-controlled chemical process plant, the opening and closing of valves might be indicated on the display. A template matching the ideal scope display pattern can be compared to the display representing the process. Extension of the time-base could indicate a faulty valve.

In a computer-automated machine tool, the scope display might be used to note time-based irregularities in X and Y travel while the machine is in operation. Any irregularities that exceeded an out-of-tolerance limit could trip a computer interrupt and stop the process. ■■

Frictionless transducer uses Hall Effect

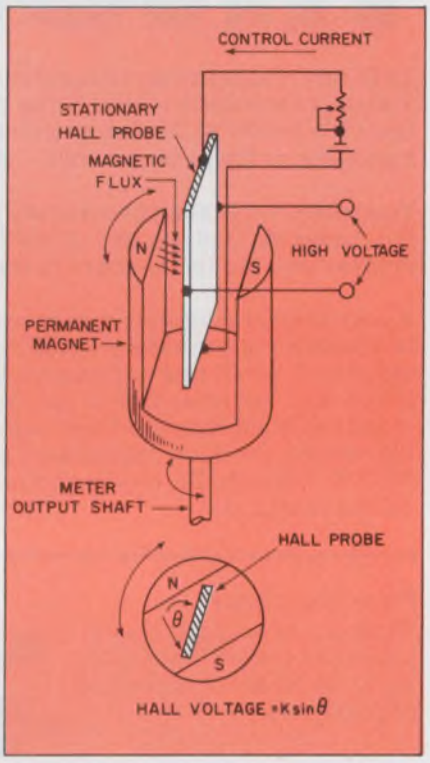
A transducer that operates on the Hall Effect principle produces an output voltage directly proportional to a small rotary shaft displacement. Since the output is electrical rather than mechanical, wear and tear on components is said to be drastically reduced.

The transducer was developed by an aerospace technologist, David Smith, at the National Aeronautics and Space Administration's Langley Research Center in Hampton, Va.

The principle of the transducer is applicable to any meter with a rotary shaft that responds to changes in physical magnitude.

The transducer transmits its output, as does any conventional mechanical-to-electrical transducer, by wire or telemetry to a terminal for display, storage or computer processing.

As shown in the schematic, a Hall probe (a plate of an appropriate conductor or semiconductor) is rigidly suspended between the poles of a permanent magnet fixed to the meter output shaft. With a constant control current supplied to contacts at the ends of the probe, the output voltage generated between contacts on the sides of the probe is directly proportional to the sine of the angular displacement of the meter shaft.



Transducer based on Hall Effect.

"Since the sine of the angle and its measure in radians rapidly approach equality for small angles, the voltage output and meter shaft rotation for angles ranging from 0 to 6° may be accepted as being directly proportional," NASA says.

"A voltmeter connected to the Hall transducer output can then be calibrated to give direct readings of meter shaft rotation on a linear scale extending over about ±6°."

With proper shaping of the magnetic field between the magnetic poles, or the use of a specially designed Hall probe, the voltage output linearity of the transducer can be extended to a much larger range of shaft rotations—approximately ±30°.

Where nonlinearity outputs are acceptable, the transducer can be used for measurement of angles up to ±90°.

A prototype has been built and tests are under way at the Langley Research Center.

Information on the rights for the commercial use of the transducer are being offered by NASA, Code GP, Washington, D. C. 20546. ■■

Direct sunlight can't damage new color TV camera

A color television camera that moon explorers can point directly toward the sun without damage and that is also sensitive to dim light has been developed by RCA's Astro-Electronics Div., Princeton, N. J.

The camera uses RCA's new Silicon Intensifier Tube, which, the company says, "has a brightness magnification never before achieved in a color TV camera."

Most TV tubes have a smooth imaging surface of photoconductive material that can be burned by bright light or damaged by vibration. The imaging surface of the Silicon Intensifier Tube consists of almost 400,000 individual silicon diodes, making it immune to extreme sunlight.

Color TV space camera withstands light from sun gun without damage.

The camera has a passive thermal control system that permits continuous operation on the moon. It operates from −250°F to +250°F.

Two cameras will be delivered to NASA this summer under a $196,500 contract. Each camera weighs 10 pounds and measures 4 by 6-1/2 by 16-1/2 inches, including the lens. The camera will transmit a 525-line picture at 30 frames per second.

The tube's low-light-level performance is better than that of silicon vidicon, RCA says. In fact "it is the best now available." ■■

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±15	14-16							OA15D0.5	
±12	11-13	0.750 @ 71°C 0.900 @ 55°C 1.1 @ 40°C	5.00	3.12	4.37	5	A1	OA12D1.1	149.00 Add $20 for overvoltage protection
±15	14-16							OA15D1.1	
±12	11-13	3.0 @ 71°C 3.5 @ 55°C 3.7 @ 40°C	5.00	5.25	6.00	11	C1	OA12D3.7	195.00 Add $20 for overvoltage protection
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Transient Response	Output voltage returns to within regulation limits within 50μsec in response to a 50% step change in load current.
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Weight	See table.
Mounting	Unit can be mounted in any position on either one of two sides. Mounting faces have threaded mounting holes.
Dimensions	H-W-L dimensions for individual models are given in the table.
Overload Protection	All models are inherently protected against overload and short circuits of any duration. No fuses or reset buttons are used — automatic recovery is electronically accomplished.
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Connector	Solder hook terminal header.
Construction	Modules are constructed of heavy gage aluminum with integral extruded heatsinks; color is black. Removable covers of perforated steel have a light gold enamel finish. Regulating circuitry is mounted on a PC board.
Output Impedance	DC — 1KHz 0.0001 R_L or 0.001 ohm max. 1-10KHz 0.0003 R_L or 0.01 ohm max. 10-100KHz 0.006 R_L or 0.3 ohm max. (whichever is greater). R_L = rated load.
Temperature Coefficient	Maximum .015% or 1mV/°C.

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Technology Abroad

Rapid growth reported in Israeli electronics

After Japan, what industrial country has one of the fastest growing electronics industries in the world? Answer: Israel.

Figures just released by the Government of Israel reveal that since 1960 the tiny industry there has been growing at an average annual rate of 17%. (The Japanese are out of sight, enjoying a 44% increase in factory sales in 1968 over 1969.)

Even more impressive is the fact that Israel's electronics output accounts for 8% of its Gross National Product—about $4.6-billion. In the advanced countries of the world, the electronics industry's share of the GNP is usually 2 to 3%.

Avner Tal, scientific consultant to the Government of Israel Investment & Export Authority, notes that most of the country's electronics output goes for defense needs. There's little left for export. There are now 4000 workers in the Israeli electronics industry, he said.

Electronic 'eyes' help run new supertanker

A 227,000-ton supertanker launched earlier this year at the Götaverken shipyard in Sweden has an advanced electronic system that continuously monitors 160 of the engine room's vital parameters. The parameters include engine pressures, temperature and propeller speed.

Developed jointly by Götaverken and Saab, the aircraft and car manufacturer, the equipment provides for indication, alarm and recording. Analog signals for all parameters are displayed on a compact central panel. By pressing one of the 160 buttons, the operator can read the desired parameter instantly in the appropriate units, kg/cm², degrees C, etc. Alarm signals are provided for parameters that do not require constant monitoring. A printer-readout for selected analog signals is also available.

Parisian movie camera runs on solar power

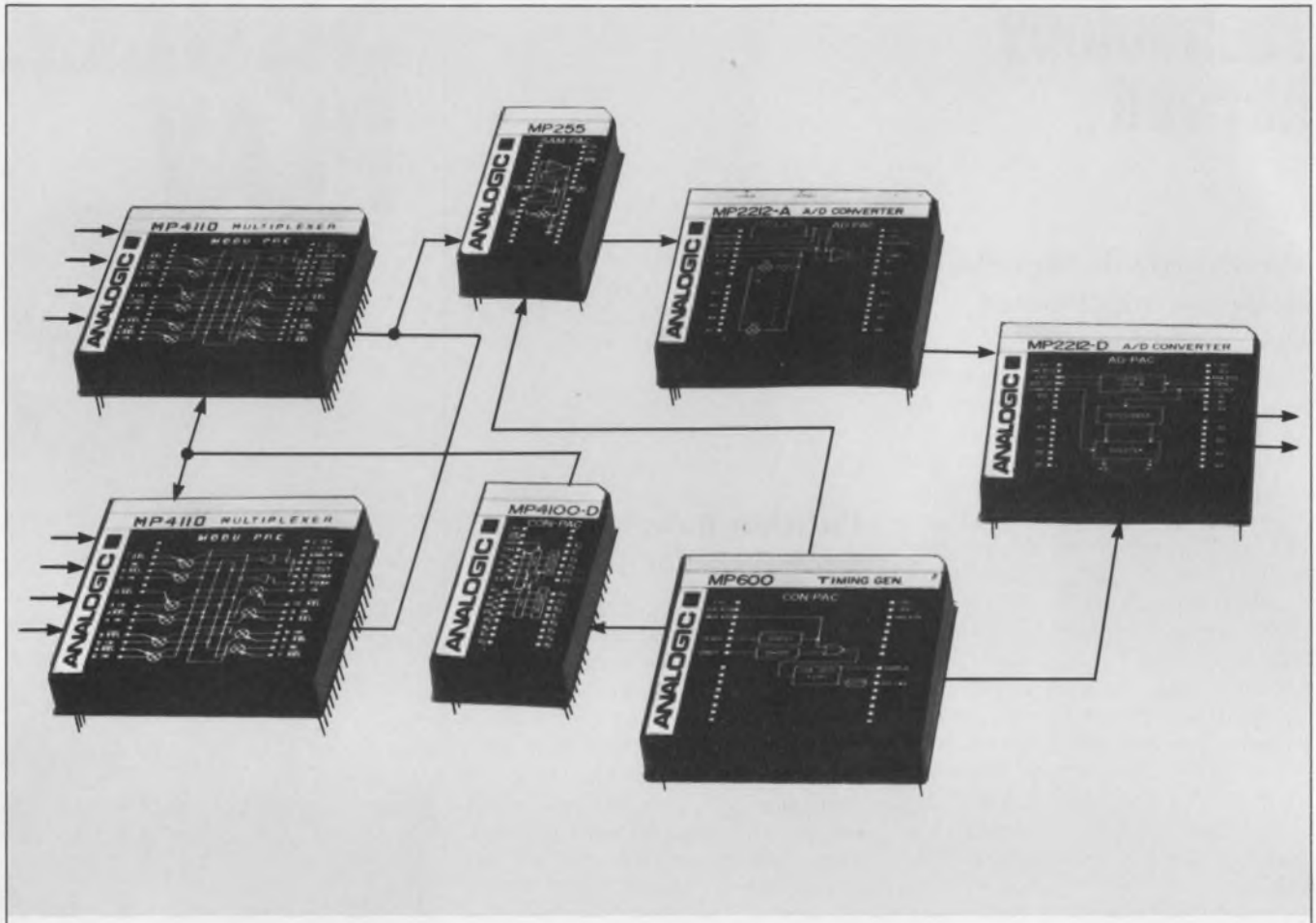
A solar-powered movie camera, with batteries that are recharged by built-in, flexible cadmium telluride solar cells, has been developed by La Radiotechnique Compelec of Paris. Several panels, each containing from 20 to 24, 15 × 18 mm solar cells, are attached to the surface of the camera housing. With normal sunlight of 1 kW per square meter, about 7 to 8 V and 30 mA is supplied by the solar cells—sufficient for recharging the movie-camera batteries.

'Noiseless' lamp built

Conventional discharge lamps, including fluorescent and mercury, sometimes create static that interferes with television and radio reception. Now Toshiba, in cooperation with the Japan Broadcasting Corp., has developed what it calls the world's first "noiseless" mercury lamp. The noise level has been reduced to 1/20th that of conventional lamps, Toshiba says.

ATS-1 telephony tested

The Australian Post Office and NASA are concluding tests this month with the ATS-1 satellite over the Pacific to determine the feasibility of using satellites for telephone service to thousands of subscribers in the remote "outback" regions of Australia.



ANALOGIC INTRODUCES

the first family

Analogic's new **Modupac**™ line is the first complete "building block" family of signal conversion modules. We've engineered them with fifth-generation techniques to handle virtually all A/D and D/A applications. They're available as independent single units, or in any combination. And they're easily interconnected to form all or part of a limitless range of systems. However you specify them, Analogic **Modupac**™ modules offer you the following advantages:

- ☐ Pre-system engineered for maximum performance and high M.T.B.F.
- ☐ Both electrostatically and electromagnetically shielded for complete freedom of module positioning . . . yet easily repairable.
- ☐ Standardized terminal arrangement insures ease of interconnection.
- ☐ Totally compatible with high-density, pluggable-card structures — 0.1″ pin spacing insures compatibility with "DIP" sockets.
- ☐ 3 plan sizes: 1″ x 2″, 2″ x 2″, and 2″ x 4″; most are 0.39″ high.

Function for function, Modupacs have the best price-performance ratio available.

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INFORMATION RETRIEVAL NUMBER 27

did you know?

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constant, constant, constant, constant, constant, constant, constant, constant...

Send in this coupon for free bulletin giving complete details on GE AC Voltage Stabilizer features, ratings and application data; or see your GE sales representative today.

* Output voltage is stabilized in less than 2 cycles for transient line drop of 30%.

GENERAL ELECTRIC

INFORMATION RETRIEVAL NUMBER 28

Section 413-35
General Electric Company
Schenectady, New York 12305

Please send me free bulletin GEA-7376 on AC Line Voltage Stabilizers.

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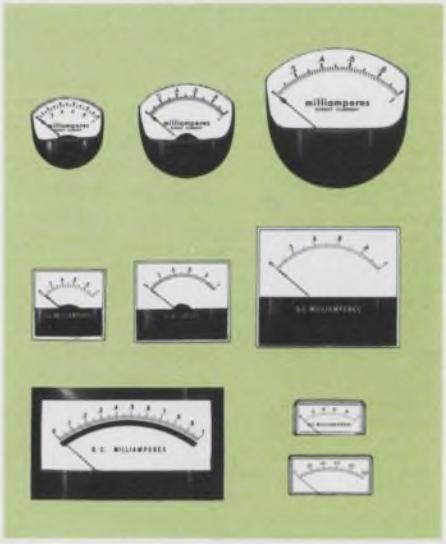
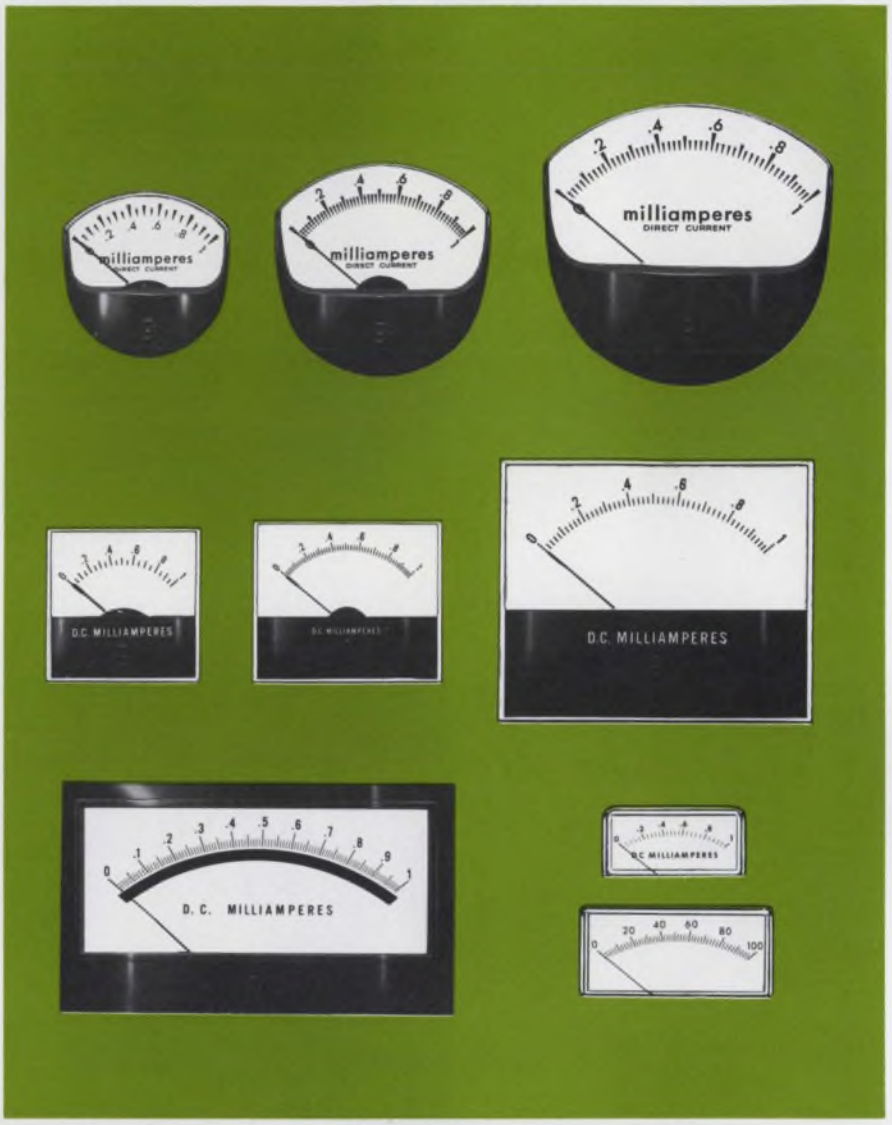


Honeywell's versatile line of precision meters.



Now that versatile line of precision meters is Jewell

Same plant. Same people. Same meters that were made popular by superior styling, design and quality. Only now they're Jewell. Everything else is the same—including the compact, frictionless movements and self-shielded, low-cost construction. So, when you need a meter for your application, the best place to find it is still Manchester, N.H. *Write for our spanking new catalog . . . or get in touch with our nearest sales representative, distributor or mod-center.*

Jewell JEWELL ELECTRICAL INSTRUMENTS, INC.
AGM DIVISION
Grenier Field, Manchester, N. H. 03105 • 603/669-6400

INFORMATION RETRIEVAL NUMBER 29

Washington Report

DON BYRNE, WASHINGTON BUREAU

B-1 avionics expected to be off-the-shelf systems

The $1.4-billion B-1 bomber contract has gone to North American Rockwell, but the half-billion-dollar avionics contracts for the airplane are still very much up for grabs. Although the Air Force has not said what it wants yet, an effort to cut cost overruns and hold the line on prices may be pointing the way to off-the-shelf electronics, updated to fit the needs of the bomber. This is expected to hold total spending for electronics at or below early estimates.

FAA tightening procurement procedures

While the Federal Aviation Administration will remain a lucrative market for R&D contracts (an estimated $600-million in the next 10 years) don't look for procurement contracts to follow R&D awards automatically, as in the past, unless the equipment performs well. Successful R&D bidders will have to prove that their production electronic equipment will work as well as that built under the R&D programs. Recent Congressional hearings and press criticism of the agency have stressed the poor delivery records of contractors whose costs have exceeded the original procurement contracts, and the agency is getting shy of such criticism.

Congress weighs entry into the computer age

The computer is going to Congress, but the how and when of its arrival will be determined by politics. The proposed Legislative Reorganization Act of 1970, scheduled for floor action soon, carries a provision in Title IV that would establish a Joint Committee on Data Processing. Practically every member of Congress agrees that computers are needed to handle the ever-increasing mountain of legislative data, files, mailing lists, federal grants and contracts, voting analyses, Congressional documents and scores of other jobs. But the disagreement is over who will run and control the system. The act calls for a joint House-Senate committee. Many members of the House feel that it should have its own system, because of the difference in scope of the two bodies; other members think the entire process should be run by the Library of Congress's Legislative Reference Service. Many Republicans are likely to oppose any computer system for at least two years, believing that installation of the machines would give the Democratic majority a leg up on the 1972 elections. The proposed Reorganization Act, while setting up the joint committee, would also establish a director of data processing at $40,000 a year—or just $2,000 less than a Congressman's salary. His assistant would be paid $36,000. Meanwhile the Clerk of the House of Representatives is proceeding with plans to let a contract for the study of just how House members would use computers. There are other undertones in the bill: Congressional committees and individual members would

no longer be at the mercy of such executive agencies as the Bureau of the Budget for information and research on which to base policy decision. And there is some belief that a properly equipped Appropriations Committee could take back the job of drafting the Federal Budget, something it gave up 50 years ago. While the argument boils, the old time-consuming, laborious and ineffective practices continue—the Senate, for instance, still pays its 4,500 employes in cash.

NASA moves toward establishing a moon base

The National Aeronautics and Space Administration has awarded a $320,000 contract to North American Rockwell Corp.'s Space Division in Downey, Calif., to study all aspects of establishing a base on the moon. The company was one of 18 aerospace contractors invited to submit bids on the 11-month study.

The North American team will define and analyze the kinds of lunar exploration missions that are desirable and possible. It will establish the major requirements for the missions and develop conceptual descriptions of the base itself.

Moon bases with and without orbiting lunar vehicles will be described, plus mobile systems for the moon's surface, both roving and flying.

NASA's Marshall Space Flight Center, Ala., will monitor the study.

Western Union bids to supply computer services

The Western Union Telegraph Co. has asked the Federal Communications Commission for permission to sell computer services to data-processing suppliers when the company's computers are not being used to switch messages.

Permission would result in FCC's waiving its preliminary determination that required companies furnishing data-processing services to do so through separate affiliated corporations.

Full utilization of its computers, Western Union contends, will permit lower costs to users of both communications and data processing.

In another move to expand, Western Union has already scored. FCC has granted it permission to buy the Bell System's Teletypewriter Exchange (TWX) Service. Cost of the system is approximately $90-million. Working capital will bring Western Union's total TWX investment to about $118-million.

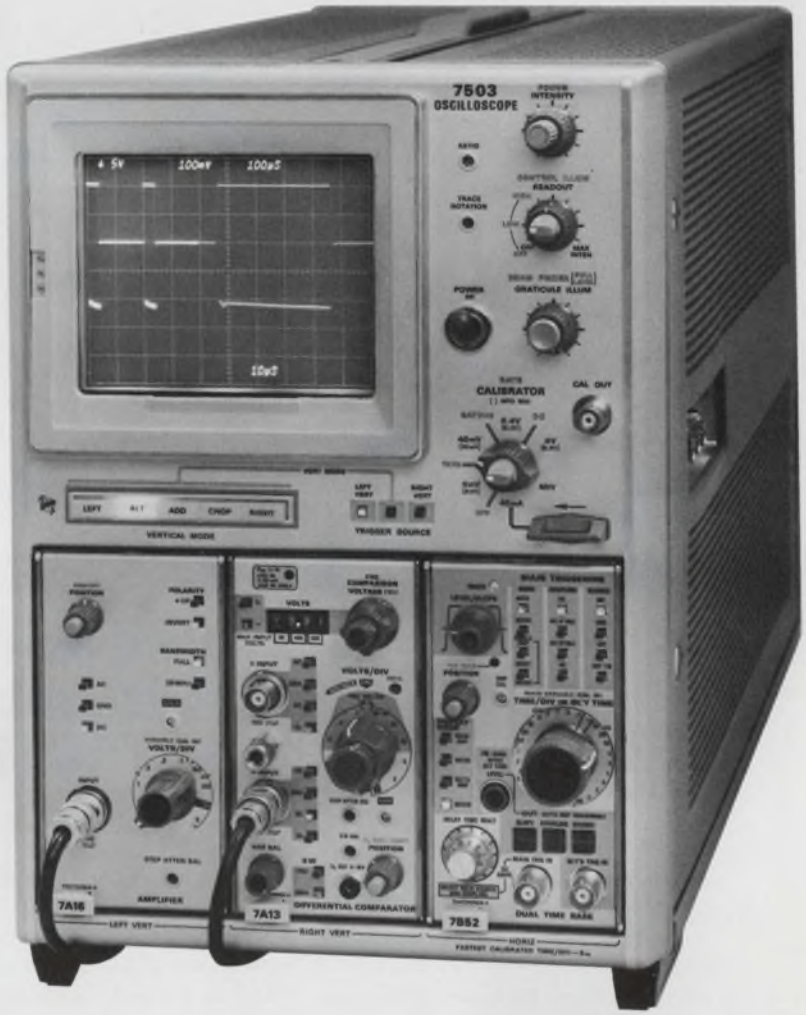
DCA to get 15 computer systems instead of 34

The Defense Communications Agency's long-awaited authorization for 34 new standardized computing systems—with an option to buy 53 more—has been cut. DCA will now get 15 systems for sure, with an option to buy 20 more at a later date.

Software, which is now handled locally at each of the agency's 16 IBM/360 computer centers, will be provided by a newly-created centralized office called the Joint Technical Support Activity in Washington, D.C.

Requests for proposals to bid on the computer contract will be issued soon by the Air Force Systems Command's Electronic Systems Div., Hanscom Field, Bedford, Mass.

tektronix®
expands the 7000 series



New Three-Plug-In Mainframe
New Dual Time Base Plug-In

A third mainframe and a fifth time base are added to the growing 7000-Series. The *NEW* 7503 THREE-PLUG-IN OSCILLOSCOPE offers bandwidths up to 90 MHz, depending on the plug-in selected. The *NEW* 7B52 Dual Time Base features four sweep modes: Main, Intensified, Delayed, and Mixed. The Mixed Sweep is CALIBRATED, allowing you to MEASURE . . . not just MONITOR.

Simultaneous measurements can be made by multiple plug-ins with widely different features. Some of the features of the fourteen plug-ins currently available are: dual-trace, 75 MHz at 5 mV/div (four-trace, 75 MHz with two units) • differential, 100,000:1 (100 dB) CMRR at 10 μV/div • differential comparator, 75 MHz at 1 mV/div and comparison voltage accurate to 0.1% • random or sequential sampling, 25-ps risetime (depending upon the sampling head) • two single-trace amplifiers, 90 MHz at 5 mV/div • current amplifier, 75 MHz at 1 mA/div.

For faster and easier measurements, Auto Scale-Factor Readout, which is exclusive to Tektronix, labels the CRT with time/div, volts or amps/div, invert and uncal symbols, and automatically corrects for 10X probes and magnifiers. All the data is on the CRT, where you need it, for faster measurements with fewer errors. And, looking into the future, the readout system is designed to meet needs other than of today's plug-ins.

The CRT display above is just one example of the flexibility and measurement ease that is YOURS when you use an oscilloscope that features Auto Scale-Factor Readout and dual vertical amplifier plug-ins. Pulse width, period, amplitude, and aberrations are all quickly measured in ONE display by applying the same signal to both amplifiers. With the 7B52 Time Base in the MIXED mode, two different sweep speeds are displayed simultaneously—the first 4 div at 100 μs/div, the last 6 div at 10 μs/div (the delay time multiplier control can be rotated to start the faster sweep at any point on the main sweep). The DC offset feature of the 7A13 Differential Comparator Amplifier is used to obtain the bottom trace. With a deflection factor of 100 mV/div, the pulses are effectively 100 divisions high, giving the resolution needed to detect aberrations and precisely measure pulse amplitude of −9.91 V (accurate to 0.1%).

For *even greater versatility,* 2 four-plug-in mainframes are available, the 7704 (150-MHz) and 7504 (90-MHz) Oscilloscopes. The 7000-Series does not require a full complement of plug-ins, you can start with only one horizontal and one vertical plug-in and add more as your measurement requirements change. When your plans call for the purchase of a new oscilloscope, evaluate the Tektronix 7000-Series . . . it's EXPANDABLE.

Your Tektronix field engineer will gladly demonstrate the complete VERSATILITY of the New Tektronix 7000-Series Oscilloscope System, in YOUR lab with YOUR signals. Contact him locally or write: Tektronix, Inc., P. O. Box 500, Beaverton, Oregon 97005. See your 1970 Tektronix catalog for complete specifications.

Prices of instruments shown:

7503 — 90-MHz, Three-Plug-In Oscilloscope	$1775
7A16 — 90-MHz, Single-Trace Amplifier	600
7A13 — 75-MHz, Differential Comparator Amplifier	1100
7B52 — Dual Time Base	900

U.S. Sales Prices FOB Beaverton, Oregon

Available through our new leasing plan.

Tektronix, Inc.

committed to technical excellence

INFORMATION RETRIEVAL NUMBER 31

FROM THE WAVE MAKERS:

THE FINEST IN VARIABLE ELECTRONIC FILTERS

New multifunction Tunable Filter, Model 3750.

Krohn-Hite pioneered the development of reliable, variable electronic filters. These filters can offer a variety of functions such as low pass, band pass, high pass and band reject in a single instrument. They also provide complete flexibility of adjustment for both high and low cutoff frequencies over a frequency range of six decades. Since both cutoff frequencies can be independently varied over wide limits, the center of the pass band or rejection band can also be placed at any desired frequency.

Since Krohn-Hite filters are active, they provide an overall gain of unity (no insertion loss). They offer very high input impedance, require no appreciable signal power and are not sensitive to the value of source impedance. Their low output impedance makes the frequency response independent of the load impedance. Lowering the load impedance merely reduces the maximum output voltage obtainable, due to maximum current limitation of the output stage.

Every Krohn-Hite filter provides a choice of Butterworth or Low Q (transient free) transfer characteristic. These filters represent the optimum practical approach to ideal filter characteristics, combined with versatility to give unsurpassed performance.

Yes, Krohn-Hite, innovators in filter design for over twenty years, is making waves again!

The table below lists all of the important features of the complete Krohn-Hite variable electronic filter line.

Frequency Range	Filter Model*	Function BP	Function BR	Function HP	Function LP	Add. Feature	Freq. Acc. %	Attenuation Slope db/octave	Hum and Noise (RMS)	Max. Attenuation	Output Volt/Amps (RMS)	3 db Points	Approx. Shipping Weight lbs/kgs	Price U.S.A. Only
.001 Hz – 99.9 kHz	3320			X	X	Batt. Op.	2%	24	0.5 mv	80 db	5v/50ma	dc – 1 MHz	24/11	$ 725
.001 Hz – 99.9 kHz	3322	X	X	X	X	Batt. Op.	2%	24/48	0.5 mv	80 db	5v/50ma	dc – 1 MHz	34/16	$1395
.001 Hz – 99.9 kHz	3340			X	X	Batt. Op.	2%	48	0.5 mv	80 db	5v/50ma	dc – 1 MHz	27/12	$1075
.001 Hz – 99.9 kHz	3342	X	X	X	X	Batt. Op.	2%	48/96	0.5 mv	80 db	5v/50ma	dc – 1 MHz	40/18	$2075
.01 Hz – 99.9 kHz	3321			X	X	Batt. Op.	2%	24	0.5 mv	80 db	5v/50ma	dc – 1 MHz	24/11	$ 635
.01 Hz – 99.9 kHz	3323	X	X	X	X	Batt. Op.	2%	24/48	0.5 mv	80 db	5v/50ma	dc – 1 MHz	34/16	$1225
.01 Hz – 99.9 kHz	3341			X	X	Batt. Op.	2%	48	0.5 mv	80 db	5v/50ma	dc – 1 MHz	27/12	$ 995
.01 Hz – 99.9 kHz	3343	X	X	X	X	Batt. Op.	2%	48/96	0.5 mv	80 db	5v/50ma	dc – 1 MHz	40/18	$1825
.02 Hz – 2 kHz	330B	X					5%	24	0.1 mv	80 db	10v/1ma		35/16	$ 595
.02 Hz – 20 kHz	3750	X	X	X	X	Batt. Op.	5%	6, 12, 18, 24	0.2 mv	80 db	10v/2ma	dc – 1 MHz	26/12	$ 850
.2 Hz – 20 kHz	3700	X				Batt. Op.	5%	24	0.2 mv	80 db	5v/1ma		19/9	$ 550
2 Hz – 200 kHz	3550	X	X	X	X		5%	24	0.2 mv	60 db	5v/10ma	.2 Hz – 3 MHz	15/7	$ 525
10 Hz – 1 MHz	3100	X					5%	24	0.1 mv	80 db	3v/10ma		17/8	$ 590
10Hz – 3 MHz	3103	X					5%	24	0.15 mv	80 db	3v/10ma		17/8	$ 640
20 Hz – 200 kHz	3500	X					10%	24	0.2 mv	60 db	5v/10ma		14/7	$ 395
20 Hz – 2 MHz	3200			X	X		5%	24	0.1 mv	80 db	3v/10ma	dc – 10 MHz	16/8	$ 450
20 Hz – 2 MHz	3202	X	X	X	X		5%	24/48	0.1 mv	80 db	3v/10ma	dc – 10 MHz	22/10	$ 795

BP – Band Pass BR – Band Reject HP – High Pass LP – Low Pass *Add suffix "R" for Rack mounting

For complete details, write: The Wavemakers: Krohn-Hite Corporation, 580 Massachusetts Avenue, Cambridge, Mass. 02139 U.S.A.

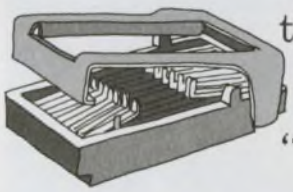
KROHN-HITE CORPORATION

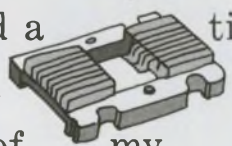
OSCILLATORS / FILTERS / AC POWER SUPPLIES / AMPLIFIERS

INFORMATION RETRIEVAL NUMBER 32

How the Wizard of Barnes saved the little bug.

ONCE UPON A TIME there was a little electronic bug. "I can flip-flop, I can gate, and do a lot of miraculous little numbers," he said modestly. "You see, however, people have a tendency to bend and break my arms and legs. Unintentionally, of course." "I see," said the Wizard. "I.C. is, in fact, what they call me," said the bug. "Ouch!" cried the bug, as the kindly Wizard broke one of his 14 arms. Unintentionally, of course. "Thanks Dummy, you just rendered a tiny, but vital portion of my electronic function useless."





"Sorry," said the Wizard, waving his magic wand. "I shall devise a magic carrier to protect you and the millions like you on your travels across the land. And a magic 'contactor' to see you safely through burn-in and test equipment. The cost is exceedingly low, too." "Sensational!" cried the bug. "You've saved my life. How can I ever thank you?" "Easy," said the Wizard, taking out his order pad.

Our Management man goes to Washington

Have you ever visited your Congressman in Washington? Or taken a ride on the Congressional subway to the Capitol Building? Or had your lunch at next to wholesale prices in the Old Senate Building? Our Management Editor, Dick Turmail, hadn't until he took part, recently, in a series of interviews in the nation's capital.

To gather data for the cover story on p. 60, Turmail talked to a number of Congressmen located in various House office buildings, including the Rayburn, Longworth, and Cannon.

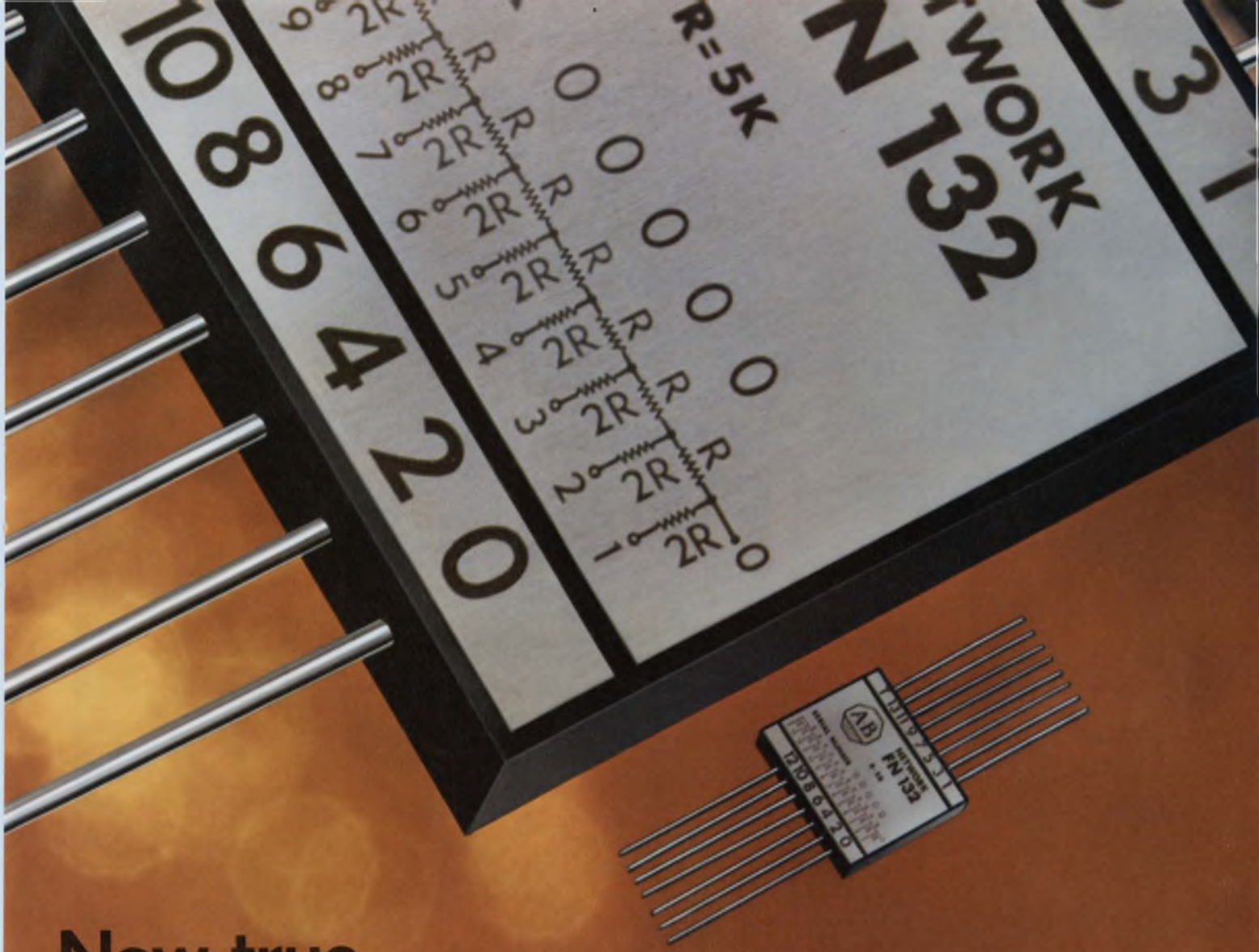
"To locate a legislator," Turmail says, "all you really need is his name. The building lobby guards supply the rest of the data—offhand."

"Congressman Ed Foreman of New Mexico moved yesterday, sir. He is now in Suite 1721," a Longworth Building guard replied to Turmail's query. He had neither paused in his answer nor checked a list. He has simply memorized the names, states, and suite numbers of 435 U. S. Representatives.

Although Congressional suites are similar in size and basic floor plan, each one displays the personality of its occupant. While some offices are festooned with state pennants and sports trophies, others might be mistaken for the local library. Most of the offices are staffed by pleasant people who seem happy to serve you.

A secretary on Sen. Mansfield's office staff was unhappy, however, when she was unable to supply a campaign button that Turmail had requested. "Oh," she said, "I'm sorry, but the Senator hasn't used a campaign button in his 28 years in Congress."

Management Editor Dick Turmail keeps posted on capital news while waiting for an interview in Washington.



Now true precision in thin film networks.

Resistance networks for A/D and D/A conversion, digital volt meters and numerical control systems demand extreme precision. Allen-Bradley can deliver. Precision that starts with a patented chromium-cobalt resistive material vacuum deposited on a substrate made to Allen-Bradley specifications. Precision based on exclusive computer drawn grids. Precision backed by extensive design and testing facilities. Precision on a continuing basis assured by Allen-Bradley's 14 solid years of experience.

Add the reliability of a single substrate, uniform temperature characteristics, much lower attachment costs and you see why Allen-Bradley thin film networks are the logical replacement for discrete precision resistors.

SELECTED SPECIFICATIONS

RESISTANCE RANGE	1K ohms to 2 megs, standard 25 ohms to 50 megs, special (Single substrate range – 10,000 to 1)
TCR LEVELS –55°C to +125°C	± 25 ppm/°C ± 10 ppm/°C ± 5 ppm/°C
TCR TRACKING	± 5 ppm/°C standard to ± 1 ppm/°C special
TOLERANCES	Absolute to ± .01% @ +25°C Matching to ± .005% @ +25°C
RESOLUTION	Line width and spacing to .0001 inch
ENDURANCE	Exceeds MIL-R-10509F Characteristic E Procedure: MIL-STD-202D

Investigate the superiority of Allen-Bradley thin film networks. Write: Marketing Department, Electronics Division, Allen-Bradley Co., 1201 South Second Street, Milwaukee, Wisconsin 53204. Export office: 1293 Broad St., Bloomfield, N. J. 07003, U.S.A. In Canada: Allen-Bradley Canada Ltd., 135 Dundas Street, Galt, Ontario. Several standard networks are available through your appointed A-B industrial electronic distributors.

ALLEN-BRADLEY

NEW DIMENSION ELECTRONICS

cure your logic testing headaches

Mellonics offers new automated diagnostic tools for detecting functional logic faults in sequential digital circuits. These computer programs have already cured test headaches in dozens of circuits, some with more than 400 logic elements.

Specifically, we have programs for: **Logic Simulation** which certifies design correctness; **Test Sequence Validation** which verifies that all potential functional faults in a logic design will be detected by your test procedure; **Automatic Test Sequence Generation** which produces a test procedure assuring that all testable functional faults in a logic design will be detected.

These services are economical and easy to use with guaranteed full data security. For more information contact Test Systems Marketing.

MELLONICS SYSTEMS DEVELOPMENT DIVISION
LITTON INDUSTRIES
1001 WEST MAUDE AVE., SUNNYVALE, CALIFORNIA 94086 (408) 245-0795

INFORMATION RETRIEVAL NUMBER 34

THIS

IS A RELAY

A MERCURY-WETTED RELAY THAT OPERATES IN ANY POSITION

Don't be fooled by the dual-in-line package. It's a Logcell® mercury-film relay that is completely compatible with DTL/TTL power driver IC's. It operates in any mounting position without contact bounce. And you can mount it into DIP-drilled printed circuit boards or DIP sockets without special handling.

Logcell relays are quiet, too. Thermal noise is less than 1 microvolt; AC noise is below instrumentation levels. Load switching range is 10^{-6} amperes to 1 ampere. And you can alternately switch low-level and power loads without contact degradation. Other features include bi-stable or mono-stable configurations, 0.05 ohms maximum contact resistance and an open-circuit resistance in excess of 10,000 megohms.

Looking for reliability? Logcell relays have been tested to billions of cycles. Shock and vibration resistance add dependability to airborne, marine and other mobile equipment.

Need fast operation? A 2.5 millisecond speed meets switching requirements in automatic test equipment, A/D and D/A converters, low-level multiplexers and other computer peripheral equipment where high speed and low noise are important.

Logcell DIP relays open new vistas of switching system operation and packaging. For more information, write Fifth Dimension, Inc., Box 483, Princeton, New Jersey 08540. Or call (609) 924-5990.

5-D FIFTH DIMENSION INC.

INFORMATION RETRIEVAL NUMBER 35

Letters

'Unsung hero' sings praises of the ME

Sir:

Having just read your survey, "Engineers Want More Challenges," in the May 24, 1970, issue (ED 11, p. 96), I have some comments.

Change "challenges" to "respect." Engineers have the respect of only intelligent management, which the survey indicates is lacking.

Also, your survey indicates that the electronics industry consists solely of electronics engineers. Unfortunately, most of management thinks so, too. But it is the mechanical engineer who is the unsung hero in the electronics field. Not only must he evolve designs into producible practicalities but he must contend with bad managers and egotisical EEs.

Remember, when it comes to the packaging of electronic devices, there is no such thing as an electrical part.

George Franklin

Scottsdale, Ariz.

Accuracy is our policy

It was incorrectly stated on page 32 of the June 21, 1970, issue (ED 13) that Duriron was developed by Engineering Development Corp. of Tempe, Ariz. Actually, Duriron was developed and first introduced in 1912 by the Duriron Co. of Dayton, Ohio. Furthermore, Duriron is but one of several materials which can successfully be used in a cathodic protection system.

In the Ideas for Design item, "Voltage Window Detector Provides Logical Output" (ED 10, May 10, 1970, p. 114) diode D_2 is shorted. The connection between the R_3/D_2 junction and D_3 should be removed.

GENERAL ELECTRIC wants to GIVE you an SCR

BECAUSE WE KNOW YOU'LL BE BACK FOR MORE

We're so confident that our C103 will meet your low current SCR needs that we'd like to give you one so you can try it in your circuit. Just fill out the coupon below and we'll send you, free, a new 800 ma SCR.

This new C103 features the same pellet structure as the performance-proven C106 (4-amp SCR).

Epoxy-encapsulated in the TO-18 plastic package, GE's C103 is available in peak reverse voltage ratings from 30 to 200 volts.

The C103 combines high surge capability (8 amps) with a low forward blocking current (1μA) and offers a very sensitive gate (200μA).

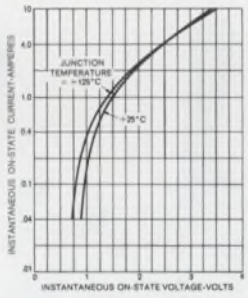
The C103 low-cost low current SCR is so versatile that it can replace more than 200 existing SCR's and is easily interchangeable in both package and electrical characteristics.

And because it's rugged, it's ideal for use in industrial and military as well as consumer applications such as motor controls, indicator drivers, off-the-line regulators for appliance and electronic equipment, light, heat and proximity detection, temperature and pressure control, counting or switching and as gate amplifiers for larger devices.

GE's C103 is now available from distributors' stock or in volume from the factory.

To get your sample C103 SCR, fill out the coupon below and present it (or mail it) to your authorized General Electric distributor.

For more information, write General Electric Company, Section 220-89, 1 River Road, Schenectady, N. Y. 12305. In Canada: Canadian General Electric, 189 Dufferin Street, Toronto, Ont. Export: Electronic Sales, IGE Export Division, 159 Madison Avenue, New York, N. Y. 10016.



C103 RATINGS

Peak reverse voltage	200 volts max.
RMS On-state current	0.80 amp. max.
Gate trigger current	200 μ amp. max.
Peak surge current	8.0 amps. max.
Peak reverse and off-state current	1.0 μ amp. max.

GENERAL ELECTRIC

FREE SCR SAMPLE

Present (or mail) this coupon to your authorized GE distributor (see listing on opposite page).

Attn: Industrial Sales Mgr. Please furnish 1 C103 SCR.

Rating: ☐ 30V ☐ 60V ☐ 100V ☐ 200V

Name_____

Firm:_____ Position:_____

Street_____

City_____ State_____ Zip_____

Distributor Name_____

Offer expires July 31, 1970

The magnificent seven.

Our seven basic AT toggle switch assemblies are made up of precision snap-action basics under a single toggle actuator.

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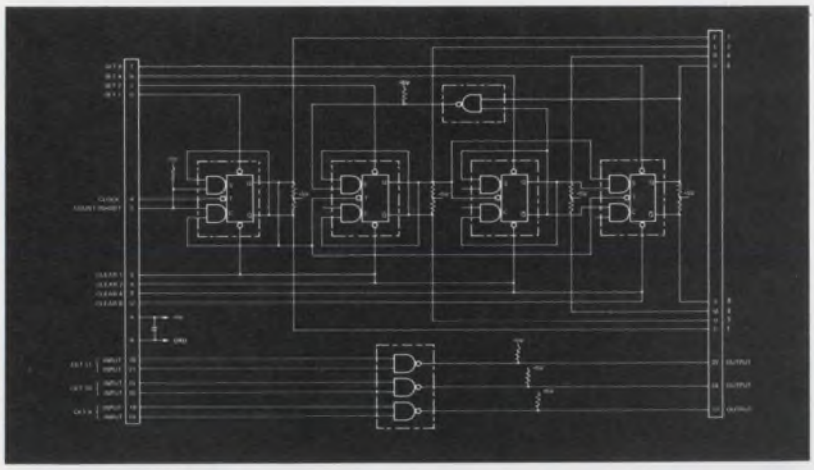

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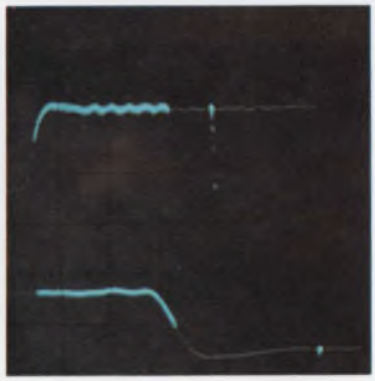

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EDITORIAL

How about a 'breadboard' to solve ecology crisis?

In the last few months we've been deluged with newspaper and magazine stories, television specials and oratory, all dealing with the "discovery" of a new crisis that mankind faces—environmental pollution. In the torrent of words, even elementary-school pupils have become aware of the word "ecology" and the fact that it is somehow threatened. But one thing has been overlooked: Before we can embark on a technological crusade to stem the threat, we need first to identify all of the problems. We need a sort of "breadboard model" from which we can pinpoint data before we can design solutions.

Dr. William B. McLean, technical director for the Naval Undersea Research and Development Center, San Diego, said recently: "We can all see many of the important survival test problems such as population density, energy requirements, pollution of the air, the sea and the earth by waste, insecticides and heat. I don't however believe that we are smart enough to see all of the important problems without some appeal to the experimental approach."

Dr. McLean proposes the establishment of closed communities "which must learn to survive within a limited environment with only basic chemical elements as raw materials."

"Such a procedure," he says, "will allow us to test solutions to waste processing, atmospheric control and energy conversion on a limited scale.

One such test setup, he suggests, is already indicated by our voyages to the moon: A minimum community could be set up on the lunar surface, using the basic raw materials there plus sunlight for the prime source of power. Another easier and less expensive site for a closed experiment, says Dr. McLean, is to carve caves out of the rock at the bottom of the ocean: The source of power in this case would probably be nuclear energy or the earth's thermal energy, with the ocean as the heat sink.

Far-fetched, maybe. But as engineers trained in using the scientific method and analytical approach to solving design problems, we can see sense in Dr. McLean's rather unique concepts. Before attacking man's ecological problems on a haphazard scale, we need much more data. Information on the problems arising in the closed-ecology concept and the solutions developed could supply this information.

RALPH DOBRINER

Synthesize logic with exclusive–OR ICs.

Decomposition maps provide a systematic approach to reduce the number of logic variables.

Logic circuits using exclusive-OR gates are difficult to synthesize by means of conventional Karnaugh maps. However, decomposition maps, which are similar to Karnaugh maps, can lead directly to exclusive-OR implementation, and thus help to decrease the count of integrated circuits needed for a given function.

While Karnaugh maps are examined for characteristic patterns of AND, OR and inversion, decomposition maps are investigated for simplification in terms of functions of fewer variables. The Karnaugh map is unique, but several decomposition maps can be drawn for a given function, and all are used in the synthesis. The best way to describe the procedure is to work through some examples.

Rearrange the Karnaugh map

For the logic function in Fig. 1a, the usual Karnaugh map synthesis would yield the map of Fig. 1b and the corresponding logic circuit of Fig. 2a.

By contrast, the decomposition maps take the variables and switch them around, so that all possible two-variable by two-variable maps are formed: AB vs CD, AC vs BD and AD vs BC, as seen in Figs. 1b, c and d. (One-variable by three-variable maps can also be drawn, but these are omitted here, since three variables cannot be related by an exclusive-OR.)

The map of Fig. 1d has two sets of two matching columns: 01 is the same as 10, and 00 is the same as 11. The rows of this map can be divided into two groups. The first group is 00, 01 and 10 —all identical—and the second group is 11.

To begin the decomposition procedure, the logic functions of the rows are written independently of the functions of the columns. The function that describes the columns of 01 and 10 of BC is $f_1 = \overline{B}C + B\overline{C} = B \oplus C$, the exclusive OR. There maining columns are inverse of f_1, $\overline{f}_1 = BC + \overline{B}\,\overline{C}$, The function for row 11 is $f_2 = A\,D$ while $\overline{f}_2 = \overline{A}\,\overline{D} + \overline{A}\,D + A\,\overline{D}$ covers the remaining rows.

After plotting f_1 vs f_2 on a one-by-one map, we find that the output is ZERO only when f_1 and f_2 are ZERO. This establishes that f_1 and f_2 are an OR combination. Therefore the results are $f = f_1 + f_2 = \overline{B}\,C + B\,\overline{C} + AD = B \oplus C + AD$, as shown in the logic circuit of Fig. 2b.

The synthesis procedure followed in the example can be formalized as follows: Plot all possible maps for the given function. Look for matching columns or rows and group them in sets. When there are only two sets, the function is decomposable. The best choice for decomposition is the map with the greatest number of matches. Designate one set of columns (or rows) of this map as f_1 and the remaining set of columns (or rows) as $\overline{f}_1$. Plot all possible three-variable maps of f_1 and the two remaining variables, of which f_1 is not a function. Now reduce the three-variable map, which has the most repetitions of columns or rows either directly or by using an auxiliary two-variable map. Sometimes steps can be omitted. The example skipped the three-variable map and went directly to the auxiliary two-variable map.

Exclusive-OR functions may be simpler

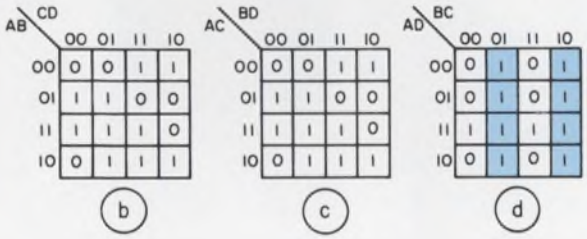
Another example of the procedure is shown for the function mapped in Fig. 3. The AB vs DC map (Fig. 3a) has two sets of matching columns: 01 is the same as 10, and 00 is the same as 11. First, designate f_1 to be columns 01 and 10: $f_1 = \overline{C}D + C\overline{D} = C \oplus D$. The function for the remaining columns, $CD + \overline{C}\overline{D}$, is $\overline{f}_1$. Now plot all possible three-variable maps, using f_1, A and B as the variables (Fig. 4). The map of Fig. 4b has three matching columns and can be reduced by designating column 11 as $f_2 = f_1B$. Plotting f_2 vs A on a two variable map (Fig. 4d) gives the transmission function $f = f_2A + \overline{f}_2\overline{A}$. Thus $f = f_2 \overline{\oplus}\, A$, where $\overline{\oplus}$ symbolizes the exclusive-NOR. If this expression is expanded, $f = [(C \overline{\oplus} D)B] \overline{\oplus}\, A$. The logic current is shown in Fig. 5a.

If the Karnaugh map of Fig. 3a had been used with only AND and OR gates, $f = \overline{A}\,\overline{B} + A\,B\,\overline{C}\,D$

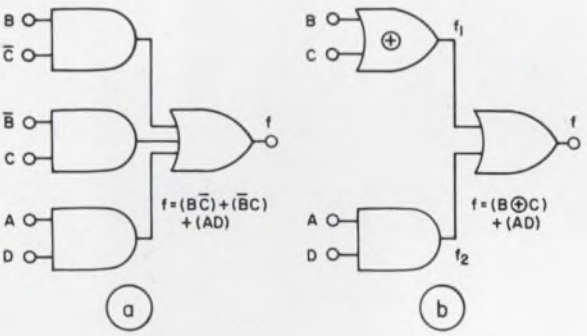
Bruce A. Twickler, Technical Staff Member, Mitre Corp., Bedford, Mass.

f(A, B, C, D)	ABCD	Decimal equivalent
0	0000	0
0	0001	1
1	0010	2
1	0011	3
1	0100	4
1	0101	5
0	0110	6
0	0111	7
0	1000	8
1	1001	9
1	1010	10
1	1011	11
1	1100	12
1	1101	13
0	1110	14
1	1111	15

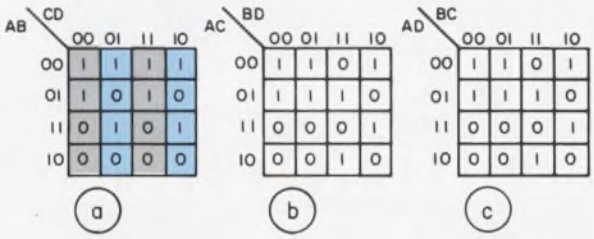
(a)



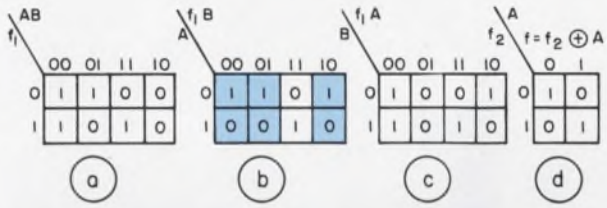
1. **The truth table** of a typical logic function "a" can be represented in the Karnaugh map forms: "b," "c," "d." The matching columns of "d" make it useful for decomposition.



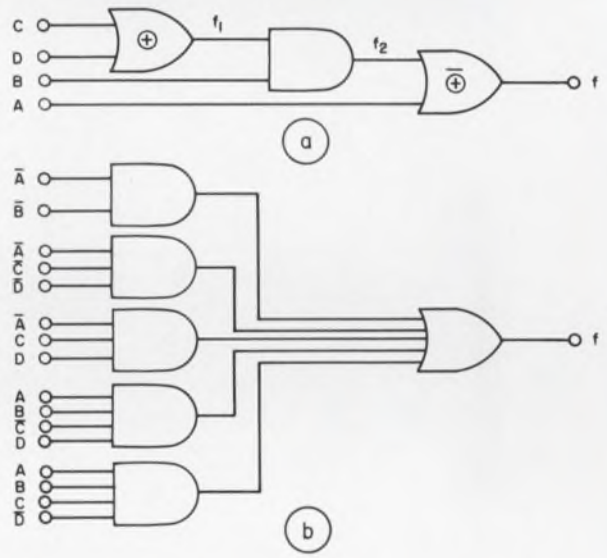
2. **The normal Karnaugh map synthesis** of the table of Fig. 1a results in the circuit "a." The exclusive-OR implementation reduces this to the circuit in "b."



3. **Three possible four-variable maps** can be drawn for a given logic function. The AB-CD map of "a" is chosen for additional study because it has two sets of matching columns.



4. **The map of Fig. 3a can be decomposed** into three maps of three variables each: "a," "b" and "c." There are three matching columns in "b" that permit further decomposition into the two-variable map of "d."



5. **The decomposition map** of Fig. 4d results in the circuit "a." The same logic derived with conventional methods gives the circuit of "b."

+ A B C $\overline{D}$ + $\overline{A}$ B C D + $\overline{A}$ B $\overline{C}$ $\overline{D}$. The circuit implementation of this equation shown in Fig. 5b uses many more gates.

If the function is not decomposable, a simple correcting function can be placed on the map. Then the AND of the complement of the correcting function, with the decomposable function, is formed. The correcting function is usually simpler than the original function, since it has "dont cares" for every zero on the decomposable map.

The number of decomposition maps increases with the number of variables.[1,2] For seven or more variables, a computer is necessary to generate the maps and to investigate decomposability. For large numbers of variables, the logic function usually can be implemented more economically with read-only memories. ■■

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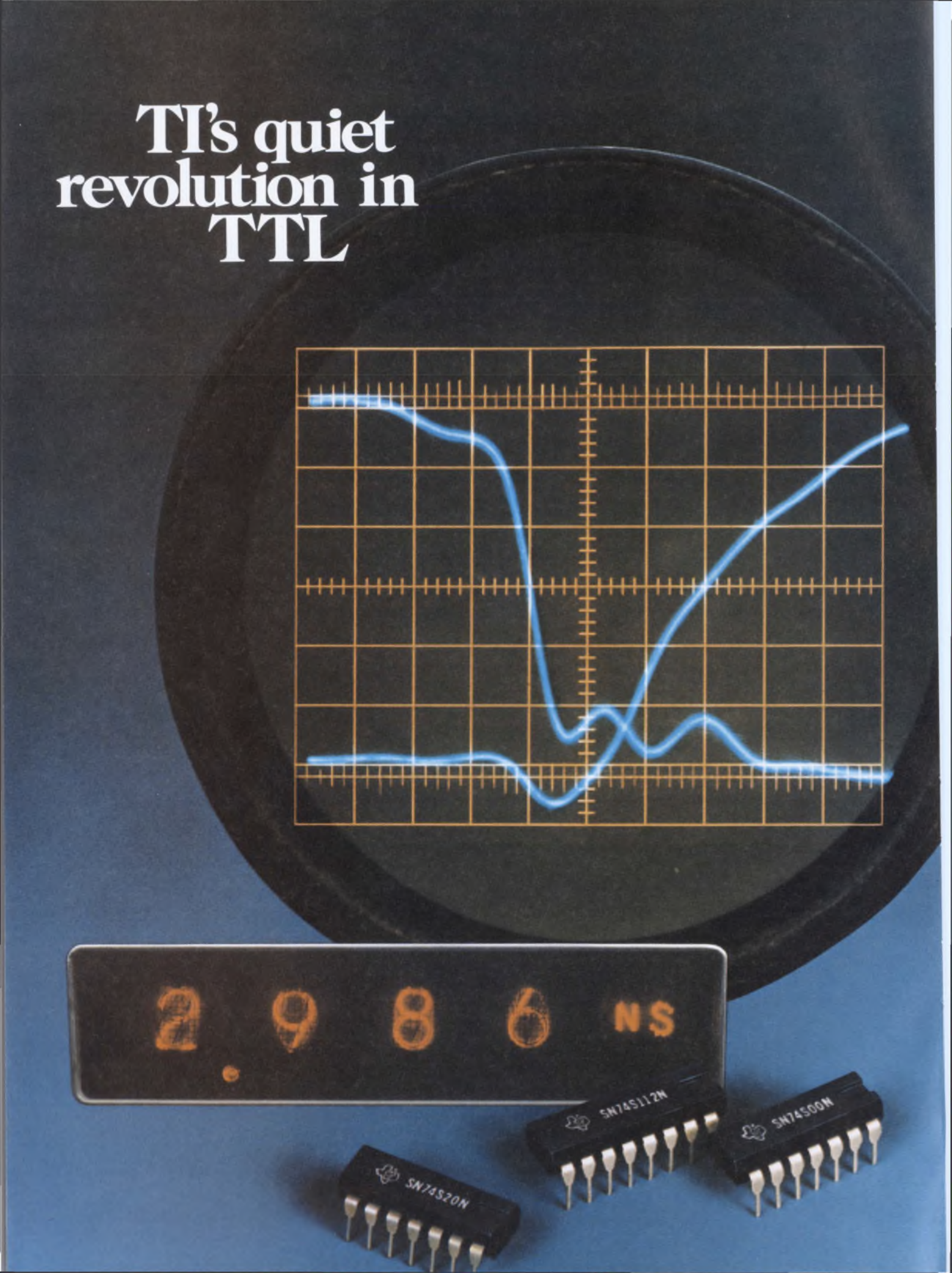
TI's quiet revolution in TTL



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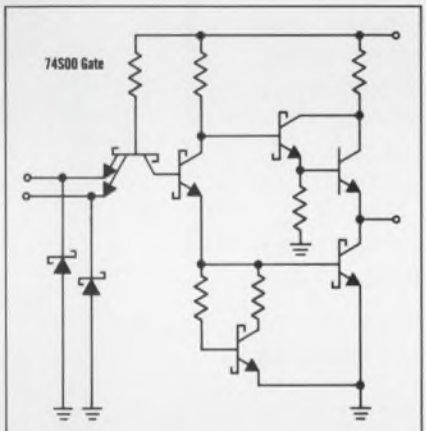
- Active pulldown network squares transfer curves and raises logical '1' output level.

*Texas Instruments has patented this technique in U. S. Patent number 3,463,975 titled "Unitary Semiconductor High Speed Switching Device Utilizing a Barrier Diode" issued August 26, 1969 (originally filed in 1964).



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More are coming in 1970. TI is developing 13 circuits in the revolutionary 54S/74S series, including other standard TTL gates (NANDs, AND, HEX inverter, AND-OR-INVERT), dual J-K and D flip-flops, as well as MSI counters and shift registers. Ceramic DIPs and flat packs will be available soon.

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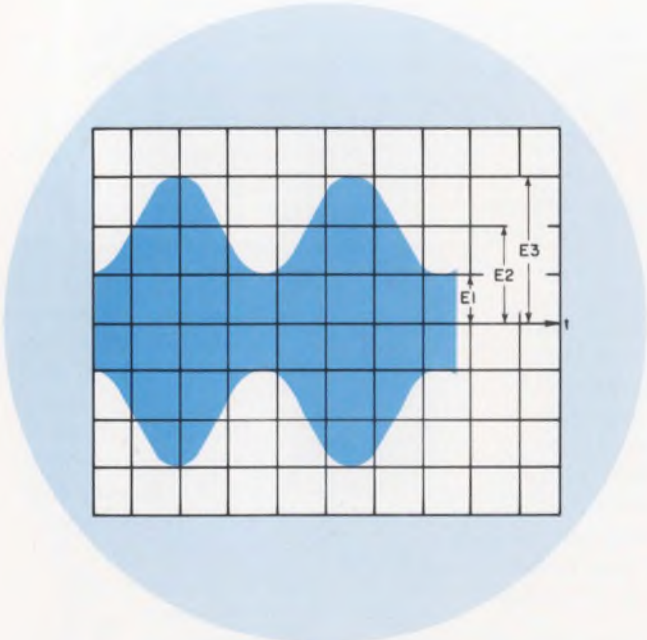
Time or frequency? Convert from one domain to the other with these graphs, and get more data from amplitude-modulated signals.

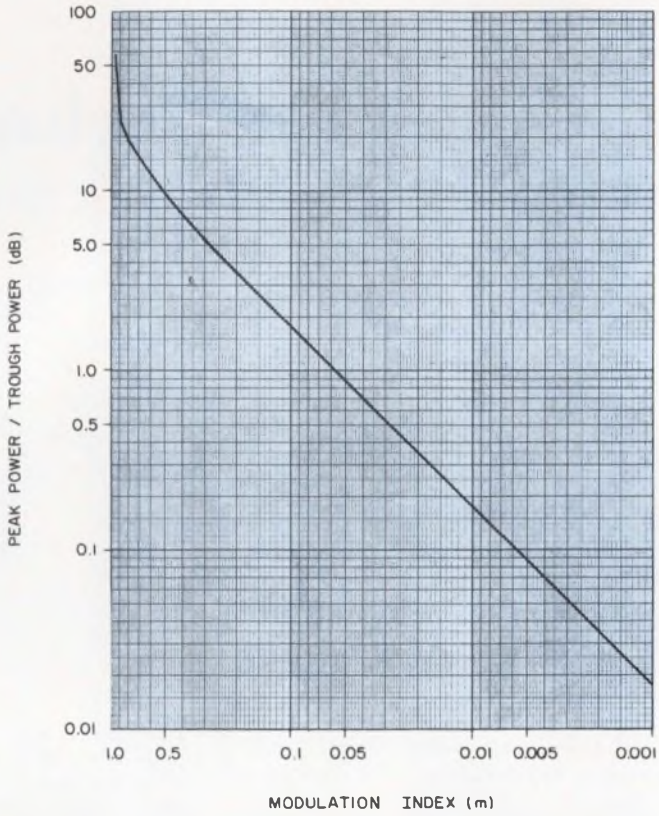
Although a frequency-domain measurement of an amplitude-modulated signal explicitly describes the signal's bandwidth, it's not of much help in determining the dynamic-range requirements of, say, an amplifier that has to handle the signal. Conversely a time-domain measurement gives the dynamic-range information easily enough, but does not explicitly describe the bandwidth.

Since it's not always possible to make both types of measurement on a particular signal, what's needed is a simple means for converting from one type of description to the other. The conversion is easily accomplished by using a pair of graphs that plot modulation index against an easily measured parameter for each type of display. The other parameters needed to describe the signal—carrier frequency and modulation fre-

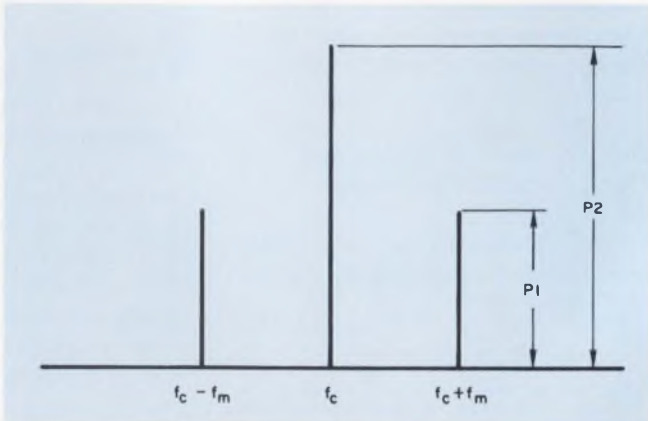
John M. Davis Jr., Research Assistant, Microwave Division, Hughes Aircraft Co., Los Angeles.



1. **Dynamic range information** is given explicitly in the time domain. Oscilloscope or power-meter measurements are particularly valuable at low-modulation rates when carrier and sidebands are very close together.



2. **When a power meter is used** to make time-domain measurements, this plot of peak-to-trough power ratio vs modulation index is a convenient tool. The power ratio is measured in decibels.



3. **Bandwidth data stares at you from the face** of a spectrum analyzer display. This frequency-domain measurement is probably the easiest to perform as long as the sidebands are clearly separated from the carrier.

quency—are easily read from either type of display.

Low rates in the time domain

For low-modulation frequencies, the AM sidebands are too close to the carrier to be measured with precision in the frequency domain. An oscilloscope display (Fig. 1) of the signal as a function of time is a better bet. Or, for extremely low rates, a power meter may be used. (It would be used, for example, to measure signal fading.)

Referring to Fig. 1, we see that the modulation index, m, is given by

$$m = (E_3 - E_1)/(E_3 + E_1). \quad (1)$$

If a power-meter measurement is made, the graph of peak-to-trough power ratio vs m (Fig. 2) should be used. Note that $E_3 = E_2(1+m)$, and $E_1 = E_2(1-m)$. The peak-to-trough power ratio is therefore

$$(E_3/E_1)^2 = [(1+m)/(1-m)]^2;$$

in decibels the ratio becomes 20 log $[(1+m)/(1-m)]$.

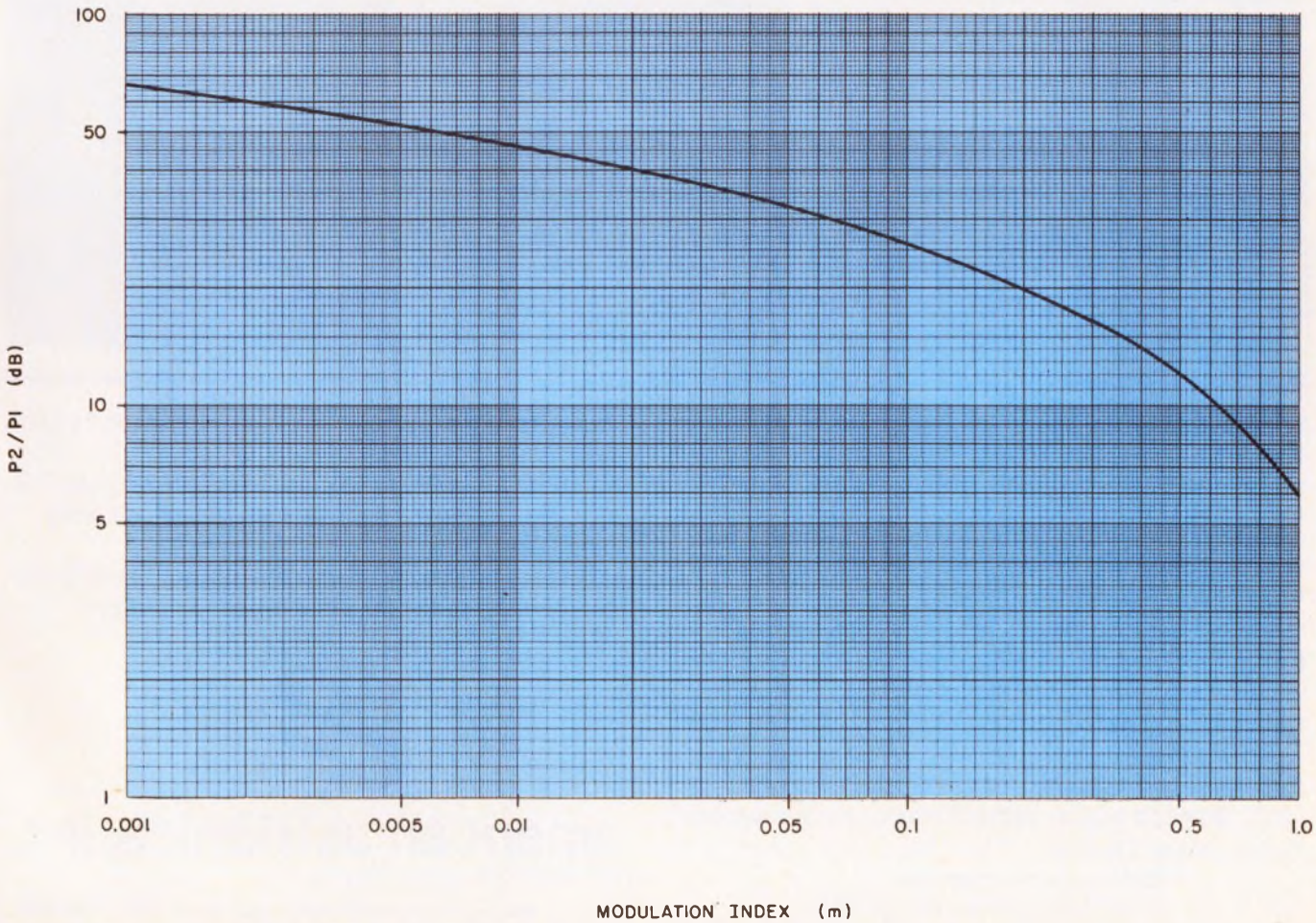
High rates in the frequency domain

For high-modulation rates, frequency-domain measurements are probably the easiest to make. A spectrum-analyzer display (Fig. 3) clearly shows the power of the carrier and the sidebands. To extract the mod index from this data, merely check the plot of carrier-to-sideband power ratio vs m (Fig. 4).

The amplitude modulated carrier is represented by $F(t) = \cos \omega_c t + (m/2) \cos (\omega_c - \omega_m)t + (m/2) \cos (\omega_c + \omega_m)t$, in which each sideband has voltage amplitude m/2. The power difference between the carrier and each sideband, in decibels, is 10 log $(m^2/4)$.

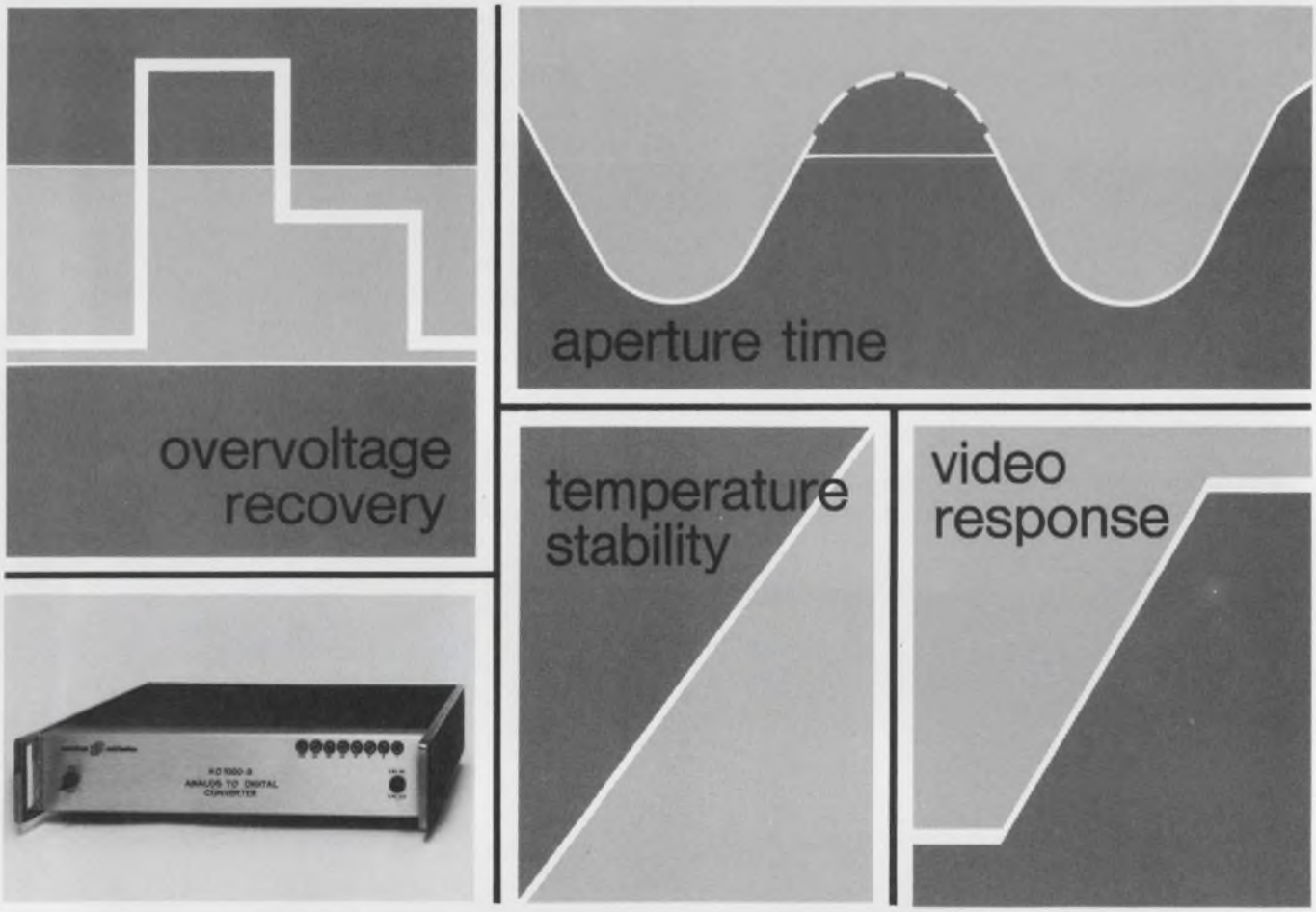
An example of the application of these graphs is in the specification of a limiter to reduce fading in a satellite communication system. The fading may be regarded as low-rate AM superimposed on the normal satellite FM wave. Let's say that the maximum expected fade is 5.3 dB and that we want to limit it to 0.1 dB. From Fig. 2, we see that 5.3 dB corresponds to an AM-mod index of 0.3. This, according to Fig. 4, means that the power of each of the sidebands is 16.5 dB below that of the carrier.

To reduce the fade to 0.1 dB, the mod index must be lowered to 0.006, corresponding to a sideband level 50.5 dB below the carrier. To achieve this performance, a limiter is required that can provide (50.5 − 16.5) = 34 dB of dynamic limiting. ■■



4. **Find m from frequency-domain data** with this plot of carrier-to-sideband power ratio vs modulation index.

A to D converter problems?



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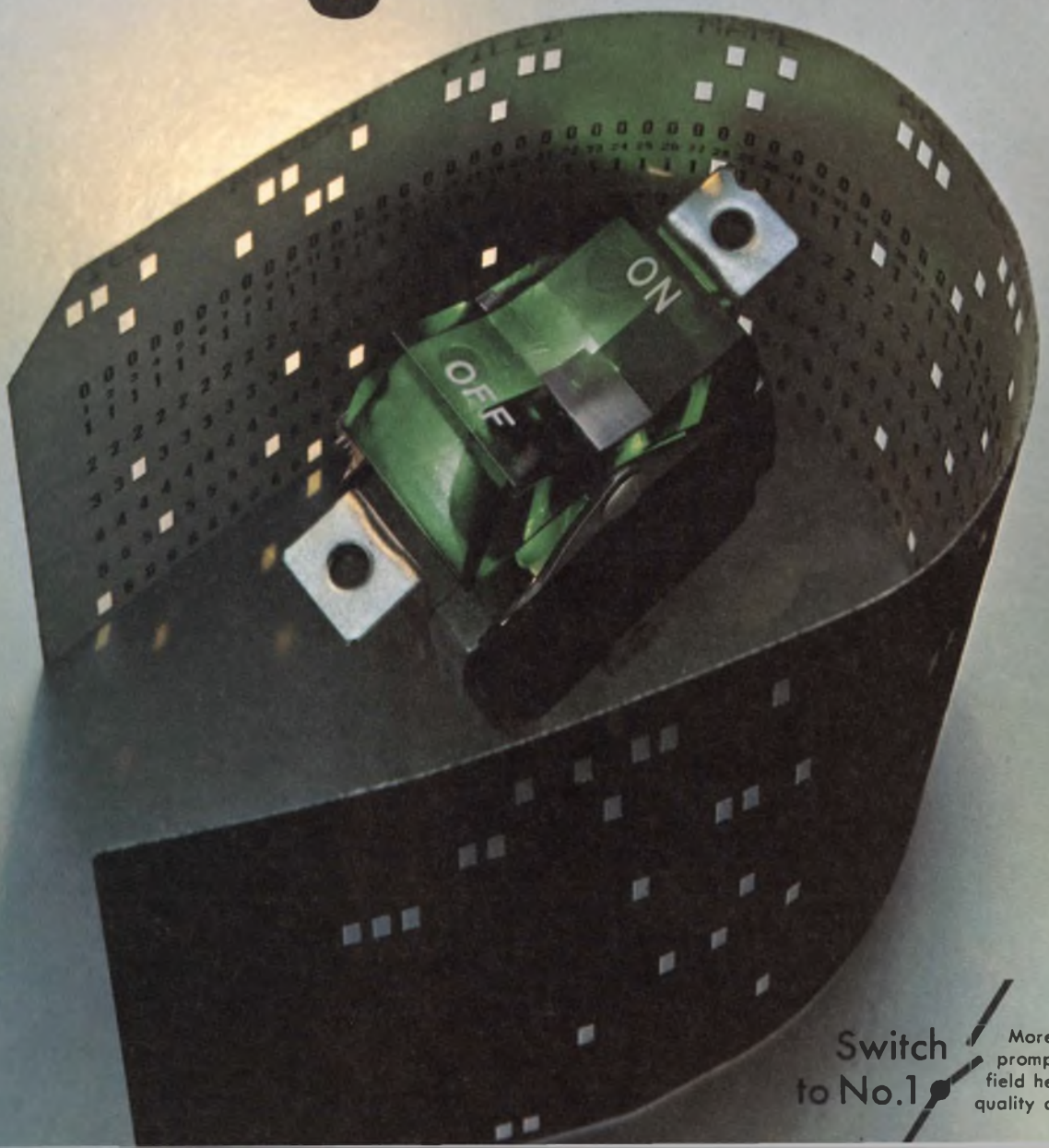
Enlightenment.



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How do they think on issues of importance to you? One point is clear - there is no stereotyped engineer in Congress.

Richard L. Turmail, Management Editor

Nineteen seventy is one of those off election years when the President doesn't have to run for his political life. With the Chief Executive on the sidelines, Congressional candidates will be running on the key issues. Although it's still too early for the pollsters to tell us how the challengers and the incumbents are running, it's never too early for us to find out how they're thinking on the more important issues—specifically those of special interest to the engineer.

Since it would be impractical to try to talk to every Congressman in Washington, we decided to limit our interviews to only those members who have engineering backgrounds.

The engineer as a legislator

Before deciding on that tack, we had no idea how many Congressmen we'd be seeing. As it turned out, most of those we interviewed were as surprised as we were to find that of the 535 seats in the U. S. Congress, only 1.3 per cent are filled by legislators who've had engineering training, experience, or both.

Two of 100 Senators, Mike Mansfield of Montana and Stuart Symington of Missouri, were manipulating slide rules before they were manipulating committees. Correspondingly, five members of the House of Representatives were drawing up designs long before they were drawing up bills, John M. Murphy of New York; Clarence E. Miller of Ohio; Ed Foreman of New Mexico; George E. Brown, Jr., and George P. Miller, both of California.

A breakdown of this group provides better insight into its makeup:

Affiliation: Democrats, 5; Republicans, 2.

Average age: 57 (average in Congress, 54).

Youngest: Ed Foreman (36).

Oldest: George P. Miller (79).

Veteran: 6 (Army, 4; Navy, 1; Army, Navy and Marine Corps, 1).

Engineer type: electrical, 2; mining, 1; civil, 4.

Other occupations: business or banking; public service; teaching.

It doesn't take a statistics expert to figure out that engineers are definitely in the minority in Congress. There are only seven in all. Except for law enforcement, medicine, science and the ministry, engineering is the least represented occupation in Congress. More frequently, members have been lawyers, businessmen or bankers, educators, farmers, and journalists.

Engineering—a help or a hindrance?

The engineers generally agreed that lawyers predominate in Congress not so much because they are versed in the law, but because they run for public office from the first day they hang up their shingle. Since lawyers can't advertise, becoming a candidate is one of the few ways they can publicize their abilities.

Whether or not they felt the need of a legal background when they first came to Congress, the engineer-Congressmen generally agreed that although a lawyer knows the law, the engineer knows how to think out a problem logically, even a legal one. Typical of the comments they offered to back up their belief that their engineering background has been helpful to them in Congress, is this one by Sen. Stuart Symington:

"I believe my experience in the electronics industry has been valuable to me throughout my service in the Senate. It has helped me to understand many of the more technical matters which come before the various committees on which I serve. In addition, it has aided me in making my recommendations as to defense and other federal projects designed to save the taxpayer money."

Rep. Clarence Miller of Ohio said that, when he first came to Washington, he had to do "a little adjusting" to fully understand the legal maneuvering that goes on in Congress. But he observed that his engineering background had taught him logical sequence. "That training," he said, "always helped me determine what should be done to solve any problem that would come up."

Rep. George P. Miller of California, although he claims to have no quarrel with lawyers, said, "We engineers are at a slight disadvantage be-

New York's Rep. John M. Murphy congratulates one of his appointees to Annapolis upon the officer's graduation.

As an engineer, Rep. Clarence Miller of Ohio had two electrical devices patented. He is shown in his Washington office.

A member of the House Committee on Armed Services, New Mexico Rep. Ed Foreman, center, inspects Camp Pendleton, Calif., with base commander Gen. D. J. Robertson, and Rep. Richard C. White of Texas.

California Rep. George P. Miller, second from right, chairman of the House Committee on Science and Astronautics, is shown with, from left, astronauts Armstrong, Aldrin and Collins after the first Apollo moon landing.

cause we think in straight lines, while lawyers tend to think in curves and circles."

No stereotyped engineers

What, if anything, do these seven members of Congress have in common, besides varying backgrounds in engineering? Have their careers operated, in their time, on a parallel course? To find out what makes the legislators tick, and how they think, we asked them:

- How did you get into Congress?
- From an engineering point of view, is the Safeguard antiballistic missile system feasible?
- Have you introduced any bills to help curb pollution?
- What would you do about the underemployment of engineers?
- Do members of the Administration have a solid feel for technology and where it's taking us?

What follows are the highlights of the answers:

Sen. Stuart Symington (D-Mo.)

Senate Committee membership: Armed Services; Foreign Relations; Aeronautical and Space Sciences; Joint Economic; Appropriations; Democratic Policy; and Democratic Steering.

Senator Symington came into public service in 1945 when he was appointed to the first of six successive high executive positions by President Harry S. Truman. He was the first Secretary of the Air Force. In 1952 he resigned the post of Administrator of the Reconstruction Finance Corporation and eventually decided to run for one of the Missouri Senate seats.

Symington said that he had studied metallurgy and electrical engineering by correspondence after he had earned an A.B. degree at Yale in 1923. He had started in business at the age of 14 as a machine-shop apprentice. From 1923, he was highly successful in radio and electronic manufacturing. He was so successful, in fact, that he was called upon to serve as president of the Emerson Electric Manufacturing Co. in St. Louis in 1937. He turned the company around from a loss to a profit. He also established one of the earliest profit-sharing plans in the country.

The Senator believes that employment in the engineering community would improve with the end of the Vietnam war. Since most of the research and development for weapons has been completed, the war is not stimulating the the economy. He thinks that the challenge to engineers now is to help us resolve our critical domestic problems, such as transportation, urban development and conservation.

As far as Symington is concerned, the military hasn't proved that the Safeguard antiballistics missile system is a feasible one. He believes that the Department of Defense research program responsible for the ABM project has been conducted by theory rather than by engineering methods. There have been too many cost overruns, and delays have been created, in his estimation, by a tendency to skip from research to production with not enough emphasis in between on engineering.

Sen. Mike Mansfield (D-Mont.)

Senate Committee membership; Chairman of Democratic Conference; Foreign Relations; Appropriations; Policy; and Steering.

Senator Mansfield is the only member of Congress to have served in all three branches of the military before he was 20 years old. He served in the Navy at the age of 14, then enlisted in the Army, and later in the Marine Corps. He returned to Butte, Mont., in 1922, to work for the next eight years in the mines and as a mining engineer. At that time he also attended Montana School of Mines in Butte.

Mansfield is the only one we talked to who denied that his experience in engineering had helped him in Congress. Part of the reason for this, perhaps, is that after he received both B.A. and M.A. degrees from Montana State University, he was a professor of Latin American and Far Eastern history at his alma mater.

In 1942 he was elected to Congress to serve five terms as a representative. He was elected to the Senate in 1952. In 1961, he was elected Majority Leader of the Senate and has been re-elected to that post each succeeding session to the present time.

Of the ABM system, Mansfield said, "The radar is vulnerable, because it's too large and too scattered." He further warns, "If the radar is hit, the whole system is out. The radar should be built on a smaller scale, be better protected, and be completely computerized.

"The military," he added, "is prone to move too quickly on such projects without having all the facts."

Rep. John M. Murphy (D-N. Y.)

House Committee membership: Interstate and Foreign Commerce; Merchant Marine and Fisheries.

Murphy came to Congress by way of the United States Military Academy at West Point, N. Y., where he majored in civil engineerng. Never actually employed as an engineer, Murphy served in the infantry in Korea for six years on the general staff. He was discharged as a captain in 1956 and organized a highly successful trucking firm in Staten Island, N. Y. Partly due to his success in business and partly because he was engaged in many public works, the Democratic Party in Staten Island asked him to run for Congress in 1962. He was elected and re-elected for the last three terms.

Of his engineering training, Murphy said, "It has given me a mental discipline to reason through to a conclusion—with no shortcuts—for every problem that comes up in Congress."

As to the question of whether or not the Administration has a solid feel for technology and where it's taking us, he said, "The government always has a problem getting top men because the men have to take a pay cut and there are conflicts of business interests."

Senator Symington of Missouri offers a word at a meeting of the Senate Foreign Relations Committee.

In Congress, Murphy has been a strong advocate of environmental-quality legislation. He spearheaded the drive for the Clean Air Act of 1965. In 1967 he succeeded in invoking the provisions of the Air Quality Act to reverse the tide of pollution in New York City. Far from satisfied with progress in this area, he says he continues to battle for strong and responsive antipollution controls and enforcement.

Rep. Ed Foreman (R-N. M.)

House Committee membership: Armed Services.

"I became interested in becoming a member of Congress," Foreman said, "when I became more and more concerned about the control and size of government, the high taxes and the red tape. I thought that it was up to me to do something about these problems."

Foreman graduated from New Mexico State University in 1955 with a B.S. degree in civil engineering. After a two-year tour of duty in the Navy, he served as company officer in land companies, farms and related businesses. Foreman was active in numerous social, civic, county and state organizations. In 1960, for example, he was the campaign chairman of seven counties for President Nixon and for Sen. John Tower of Texas. In 1962, Foreman was the youngest member elected to the 88th Congress. Although he

Montana Sen. Mike Mansfield opens a meeting of the Democratic Caucus composed of the Democratic Senate membership to discuss the legislative program. Shown are Senators Russell (Ga.), and Byrd (W. Va.).

was defeated later by Rep. Richard C. White of Texas, he was elected again to the 91st Congress as a Representative of New Mexico. He is the first individual in this century to be elected to the U. S. Congress from two different states.

Foreman said that the government needs more advice and help from engineers who've been taught a logical sequence of thinking.

"Government," he said, "needs less help from the consultant and more help and advice from the guys who've had to meet a payroll."

Rep. George E. Brown, Jr. (D-Calif.)

House Committee membership: Veterans Affairs; Science and Astronautics; Education and Labor; Foreign Policy; Environmental Affairs.

Brown was employed by the city of Los Angeles (except during service in World War II and while on leaves of absence) from 1940 to 1957 as a civil engineer, and in management of engineering personnel with the Department of Water and Power. While still a student at UCLA, where he earned a B.A. in physics, Brown was a power-station operator, and became a member of the International Brotherhood of Electrical Workers. For a number of years he served as a public member of the Mayor's labor Management Committee for Los Angeles. He was also busy in business and financial circles.

In 1954, Brown was elected a city councilman and Mayor of Monterey Park, and in 1958 was elected to the State Legislature as an Assemblyman. Four years later he was elected to represent California's new 29th Congressional District.

Brown suggested, in a speech given in Washington last year, that it is of extreme importance that the structure of local government be made "more efficient, administratively, so that the mayor (for example) can make decisions that are important" and "that the people have a greater voice in the policies under which he acts."

Rep. Clarence E. Miller (R-Ohio)

House Committee membership: Agriculture; Public Works.

Miller's career began in 1957 when he was appointed to fill an unexpired term as a member of the Lancaster, Ohio, City Council, and was elected to a full term in 1961. Two years later, Miller was elected Mayor of Lancaster. Highly praised for his work in that office, he was elected to the U. S. House of Representatives in 1966.

Prior to public service Miller was an electrical engineer employed by the Ohio Fuel and Gas Co. for 30 years. He has two patents, including: "Magneto Having Auxiliary Pole Piece," and "Remote Control and Alarm System for a Compressor Station and Compressor Engines Thereof."

Miller said that he thinks the ABM system is feasible because he has faith in the nation's ability to build it correctly.

He is working on a number of antipollution bills that he said would offer a tax break to those companies that would help curb water and air pollution.

Of his political philosophy, Miller said that it does not fall into any particular category. He believes in the individuality of man and that the community and state should make every effort to solve its problems before calling on the federal government for assistance.

George P. Miller (D-Calif.)
House Committee membership: Chairman of Science and Astronautics

"Civil engineering was equated with surveying when I was young," Miller said. "I surveyed railroads and property around Sacramento until I got my first engineering job as inspector of concrete construction and repair. We were building monolithic sewers at the time," he smiled.

He said that when there was no engineering work, he looked for a job in politics.

"To get elected to the state legislature in those days," Miller said, "all you needed was $20 and 20 names on a petition. The salary was $100 a month. I stayed for four years and quit in 1940. I just couldn't afford it. Now the legislators make $19,000 per year and $25 per diem when they're in session."

In 1941 Miller became Executive Officer of the California Division of Fish and Game, a position he occupied until he took his seat in Congress in 1945. He holds a degree in civil engineering from Saint Mary's College in California.

Referring to student dissenters who confronted him on clearing up pollution immediately in California, Miller said, "They just don't know what they're talking about. You pollute no matter what you do. These things take years to turn around."

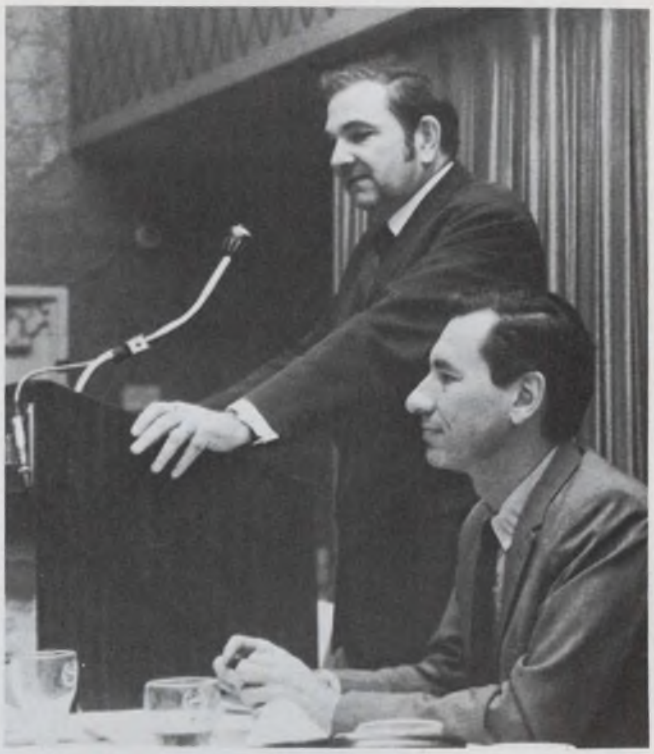
As an example he pointed out the problem caused by polluted streams in the San Joaquin Valley. "The Valley can't be drained," Miller said, "because the polluted water would stagnate San Francisco Bay the only real outlet for Valley streams." In his opinion, the only answer that makes any sense is reconstructed water—filter water that's used over and over again.

Of the ABM Miller said, "I think it's a feasible system because I have faith in our ability to build it. Even if the system is only 50% efficient, it's worth the building because it'll put us that much further ahead of our enemies."

Miller has been one of the primary backers of the space program. In 1967 he was the recipient of the Goddard Award, a trophy awarded annually for the greatest achievement to advance space flight programs contributing to U. S. leadership in astronautics. In 1970 he was given a similar tribute by the American Business Press.

What can you do for technology?

With a sizeable chunk of the national budget being meted out to technology each year, the engineer legislators mostly agree that it is incumbent on the engineering community to echo their opinions in the halls of Congress on matters that concern defense and space projects.



In a Washington speech, Rep. George E. Brown, Jr., of Calif., tells the SANE organization how academics can influence the Congress. The Director of SANE, Sanford Gottlieb, is shown seated.

Most of the legislators say that they rarely hear from the engineers of their constituency.

"They just don't seem to take time to write," said Representative Miller of Ohio.

Senator Symington hears from engineers only when the big technical projects such as the ABM are being discussed.

"It's so important," Representative Foreman said, "for engineers to participate in local government, particularly those who are in business for themselves."

"Engineers should be active in the community," Representative Murphy said, "on the school board, for example. They should go to hearings and speak with authority on technical issues. I don't hear from engineers," he said, "probably for the same reason I don't hear from dissenting engineering students—apparently, they're too busy to take the time."

Senator Mansfield's best advice for engineers is, "Tell the truth! If you think a system is good or bad, say so!" As the Seantor from Montana was called back to the floor for a vote, he further advised with a weary smile that, although more engineers should be heard in government, "They'll be a lot better off if they stay in engineering and not get into politics." ■■

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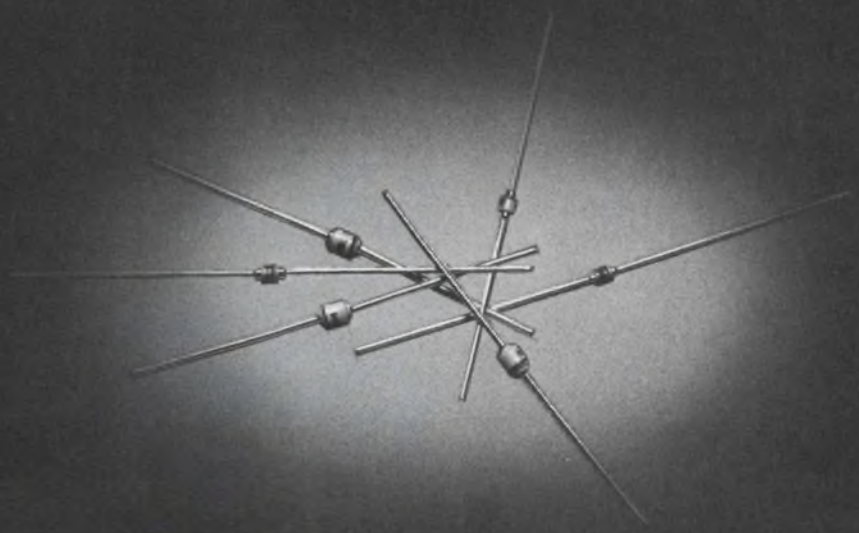

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INFORMATION RETRIEVAL NUMBER 54

Ideas For Design

Perform large-value factorial computations on a computer

Mathematical expressions involving the binominal coefficient $\binom{n}{k} = \frac{n!}{k!\,(n-k)!}$ are frequently encountered in probability theory problems or in error-detecting and correcting codes.

To compute $\binom{n}{k}$ directly requires computing three factorials. This can be time-consuming and cause overflow in computers for large value of n. A better method that prevents overflow unless the final answer itself causes overflow is as follows:

If $n \geq 2k$:

Start with $\binom{n}{1} = n$

Recursively compute $\binom{n}{j}$

for $j = 2, 3, 4, \ldots, k$. Then

$$\binom{n}{j} = \binom{n}{j-1}\left(\frac{n+1-j}{j}\right)$$

If $n < 2k$:

Initialize $I = 1$

Start with $\binom{k+I}{k} = \binom{k+1}{k} = k+1$

Recursively compute $\binom{k+I}{k}$

for $I = 2, 3, 4, \ldots, n-k$

$$\binom{k+I}{k} = \binom{k+I-1}{k}\left(\frac{k+I}{I}\right)$$

The time-sharing program in the figure is written in extended BASIC language. Computation of $\binom{9}{4}$, $\binom{11}{6}$ and $\binom{100}{70}$ are included. $\binom{100}{70}$ has the largest value of these binominal coefficients. To compute $\binom{100}{70}$ conventionally would have caused an overflow on the computer available. The new method computed it easily.

```
10 PRINT " N"," BINOMIAL"
20 PRINT " K"," COEFFICIENT"
30 PRINT
40 READ N,K
50 DATA 9,4
60 DATA 11,6
70 DATA 100,70
80 IF N<2*K THEN 180
90 LET B0=N
100 FOR J=2 TO K
110 LET B1=B0*((N+1-J)/J)
120 LET B0=B1
130 NEXT J
140 PRINT N,B1
150 PRINT K
160 PRINT
170 GO TO 40
180 LET L=N-K
190 LET S0=K+1
200 FOR I=2 TO L
210 LET S1=S0*(K+I)/I
220 LET S0=S1
230 NEXT I
240 PRINT N,S1
250 PRINT K
260 PRINT
270 GO TO 40
280 END
```

ⓐ

```
RUN
 N            BINOMIAL
 K            COEFFICIENT
 9             126.
 4
 11            462
 6
 100           2.93723E+25
 70
```

ⓑ

A listing of the program for computing the binominal coefficient is given in (a), and some examples of the results obtained are in (b).

Ronald Lambert, Design Engineer, General Electric Co., Utica, N.Y.

VOTE FOR 311

Improved IC fires SCRs used in auto ignition

An integrated circuit specifically designed for firing SCRs (Fairchild μA742) has become available. When connected as shown, it provides all of the desirable features for firing the SCR of a capacitor discharge (C/D) automobile ignition system.

The 742 IC has a built-in 21-V dc diode voltage regulator section. A current of approximately 10 mA is supplied from the C/D inverter through the dropping resistor R_{DR}. The 742 supply voltage will drop to zero while the SCR is on, but the 742 is designed for such operation. Sequential functioning is as follows:

1. During the dwell time when the distributor points are closed, pin 3 is more positive than pin 2. This biases a differential amplifier to trigger an internal thyristor "on" and charges the SCR firing storage capacitor, C_{st}, to approximately 19 V dc with a time constant of approximately 1 ms.

2. When the points open, the voltage at terminal 10 rapidly rises toward +12 V. At about +2 V an internal thyristor-transistor combination triggers on and dumps the C_{st} stored charge through an internal 10 ohm resistor into the external SCR firing gate, via terminal 11. This provides a peak current of nearly 2 A, which is adequate to fire any SCR likely to be used, yet

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Band-Pass Filters

PARAMETER	RANGE
Center Frequency	10 Khz-75 Mhz
Bandwidth	.01%-3% of C.F.
Phase Linearity	<±5%
Transient Overshoot	>40 db
Shape Factor	<1.25:1
Differential Phase Shift	<±2°
Group Delay Uniformity	<±5%

Band-Reject Filters

PARAMETER	RANGE
Center Frequency	10 Khz-35 Mhz
Reject Bandwidth	.01% to .5% of C.F.
Pass Bandwidth	Up to 100% of C.F.
Shape Factor	<1.8:1
Notch Rejection	>80 db
Insertion Loss	<0.5 db
Ripple	<0.25 db

Single Side-Band Filters

PARAMETER	RANGE
Center Frequency	10 Khz-35 Mhz
Pass Bandwidth	.01% to 2% of C.F.
Carrier Rejection	>40 db
Shape Factor Carrier Side	<1.15:1
Shape Factor Side-Band Side	<1.25:1
Insertion Loss	<3 db
Ripple	<1 db

DAMON

the energy available from C_{st} is low enough not to damage even the most sensitive SCR. During the C_{st} discharge, an internal inhibit action blocks the charging route of C_{st}.

3. When the voltage at terminal 10 reaches about 7 V, an internal zener diode allows an internal thyristor to fire, bringing the terminal 10 trigger voltage down to 1 V. This prevents false or repeated firing while the points are open.

4. The 12 V from the open points places the terminal 2-3 C_{st} charging system in an "inhibit state," preventing recharging of C_{st} while the points are open.

5. The firing of the C/D SCR dumps C_p into the ignition coil, firing the plug and simultaneously shorting the inverter, stopping its regenerative oscillations. At this time the voltage supply to the 742 drops below required internal active circuit operation levels, further assuring that C_{st} will not be recharged while the plug is firing. Oscillatory action of the coil and C_p attempt to reverse the current though the SCR and it turns off, allowing the inverter to restart.

Mechanical points usually make multiple contact during opening and closing. This problem is worst at very low (cranking) and very high speeds. Such "bounces" are normally separated by a few microseconds. Attempts to solve this problem account for most of the variety in published C/D ignition system circuits. The 742 firing action in the 1-2-3-4-5 sequence redundantly prevents such point bounce from causing multiple firing.

Reputable life studies establish the optimium distributor point current in the 0.25-to-0.5 ampere region; higher values cause erosion and pitting, while lower values are inadequate to keep the points clean.

One source of oily point coatings is crankcase vapor entering via the distributor shaft bearing. Thus minimum point current adequate to remove such coatings determines the value of R_1.

Point condition is not critical; points can develop a closed series resistance of more than 1 ohm and an open leakage path of lower than 100 ohms without firing malfunction. Exact dwell time is not important, because C_{st} accumulates adequate firing energy in less than 0.5 ms. However, crankshaft angle at distributor point opening remains significant for correct ignition timing. Timing checks and rubbing block lubrication are still needed.

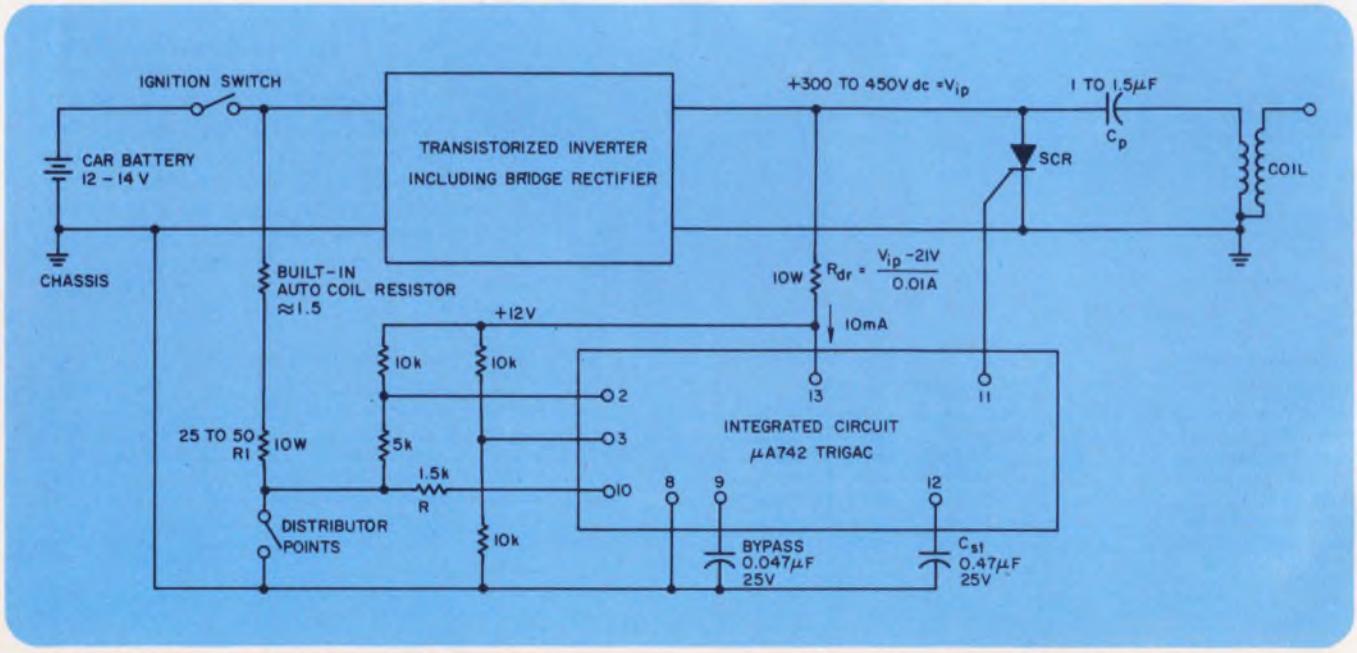
Use of the μA742 integrated circuit provides simple, low-cost firing with a minimum of external components.

Bibliography:

R. VanHouten & John C. Schweitzer, "A New Ignition System for Cars," *Electronics*, Oct. 5, 1965, p. 68.

W. L. Brown, Design Consultant, San Diego, Calif.

VOTE FOR 312



IC provides a peak current of 2 A, adequate to fire almost any SCR, yet the energy available from SCR firing storage capacitor, C_{st}, is low enough to prevent SCR damage.

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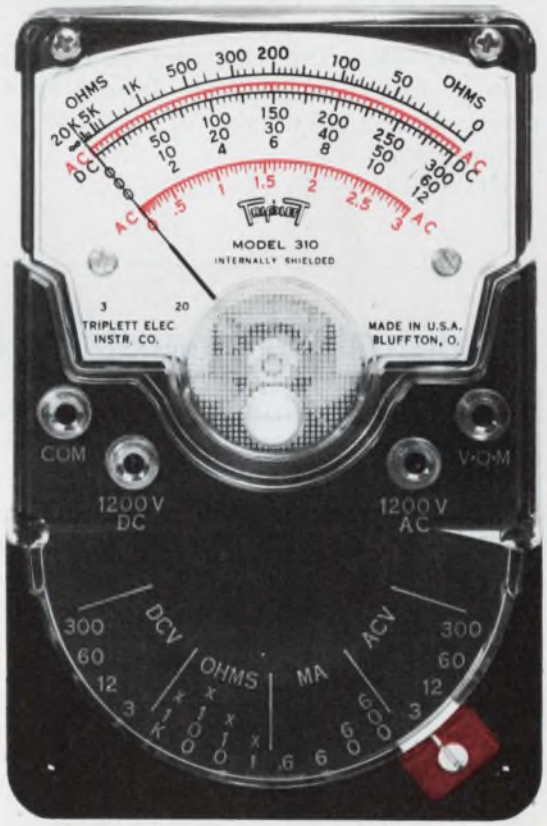
TRIPLETT

The World's most complete line of V-O-M's choose the one that's just right for you



1. Hand size V-O-M with provision for attaching AC clamp-on ammeter.
2. 20,000 Ohms per volt DC sensitivity 5,000 AC.
3. One selector switch minimizes chance of incorrect settings and burnouts.

Shown actual size

INFORMATION RETRIEVAL NUMBER 56

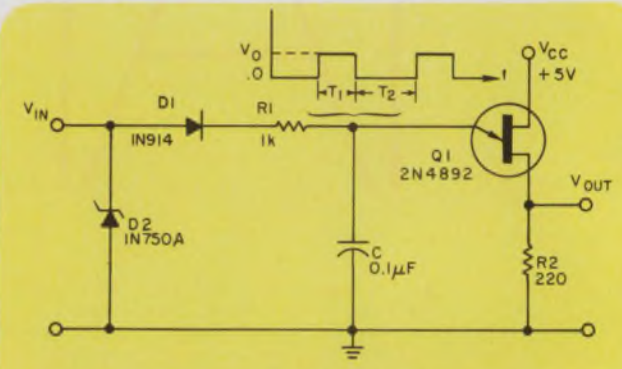
Divide-by-n counter uses unijunction transistor

The accompanying unijunction transistor (UJT) circuit is a simple counter that can be used as a divide-by-2, 3, 7, 13—or any number within the design limits. It simply charges a capacitor in steplike fashion until the UJT firing potential is reached, discharges the capacitor and starts the cycle again.

The input pulse length, T_1, and the time between pulses, T_2, determine the value of the circuit components. The base resistor R_2 is chosen first and should be less than 100 ohms for reasonable UJT temperature compensation. However, it must be large enough to give a sufficiently long output pulse when the capacitor discharges through it. The zener diode D_2 voltage V_z should be slightly less than the lowest input pulse amplitude so that all input pulses charge the capacitor in identical increments.

The capacitor must fully discharge during T_2, which should be about four or five time-constants long. This condition requires that $4R_2C = T_2$ or $C = T_2/4R_2$. The charging resistor R_1 must then be chosen to give the desired counting capacity. If n is the number of pulses to be counted in one cycle,

$$nT_1 = R_1C\,[-\ln(1-V_p/V_o)]$$



UJT counter uses zener diode to equalize input pulses. Capacitor C must be selected to allow complete discharge during pulse spacing period T_2. Component values are for a divide-by-7 counter.

where V_p is the firing potential of the UJT, and $V_o = V_z - V_{D1}$, the pulse voltage that the capacitor sees. Values shown are for a divide-by-7 counter with an input pulse rate of 10 kHz and a 20% duty cycle.

E. Lee Bell, Design Engineer, Sangamo Electric Co., Springfield, Ill. VOTE FOR 313

IC compatible monostable has wide linear range

This voltage-controlled monostable is compatible with low-voltage ICs and has excellent linearity. The circuit is similar to collector-coupled monostable design, the difference being that Q_3, along with the "hard" voltage source, V_B, provides a constant-current source to discharge the timing capacitor C. The constant current is

$$I_C = (\alpha_{Q3})\left(\frac{V_{CC} - V_{be\ Q3} - V_B}{R_3}\right).$$

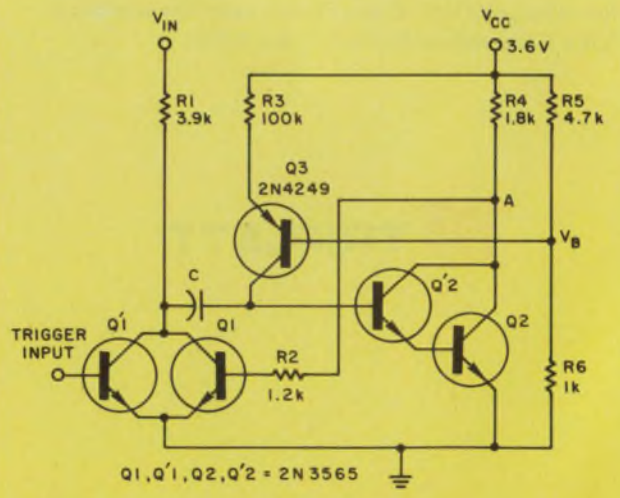
The quasi-stable state defined by the compound transists Q_2—Q'_2 is easily found to be of duration

$$T = \left[\frac{R_{BB}C}{\alpha_{Q3}}\right]\left[\frac{(V_{in} - V_{ce\ SAT\ Q1}) - (V_{be\ SAT} - V_{be\ CUT\ IN})_{Q2,Q'2}}{V_{CC} - V_{be\ Q3} - V_B}\right]$$

which is of the form

$$T = K\,V_{in} - T_o.$$

The deviations from linearity are due to transistor voltages V_{be}, V_{ce}, etc., varying nonlinearly with V_{in}. Poor linearity at low V_{in} is also due to difficulty in precisely locating the leading and



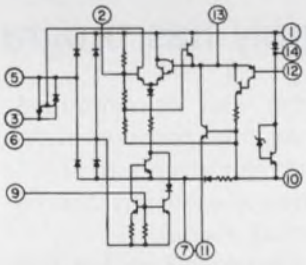
Constant-current source Q_3 discharges timing capacitor C in this monostable. Over the full input range (V_{in} = 0.2 to 25 V) linearity is ±1%.

General Electric's parade of power control IC's

Voltage, phase, temperature and threshold detector IC's for industrial control

General Electric—long a leader in power semiconductor devices—now offers a broad line of monolithic integrated circuits for power control tasks. Because they're monolithic, these devices provide better thermal coupling and stability. This means increased reliability which is essential to your industrial control applications.

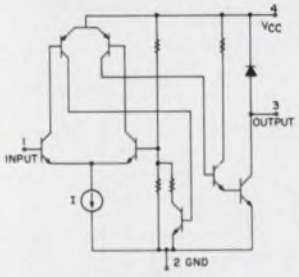
PHASE CONTROL



PA436—Phase-control

- controls loads up to 15A and 280V
- internal compensation for temperature and voltage changes
- induction motor speed control

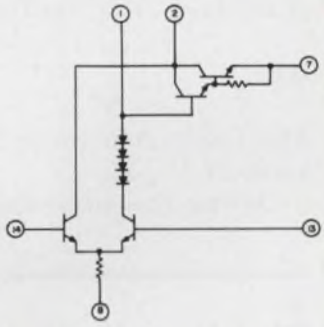
PRECISION THRESHOLD DETECTION



PA494—Threshold detector

- Schmitt trigger action
- 10% hysteresis
- low voltage operation (to 2.3V)
- high sensitivity (typ.1nA)

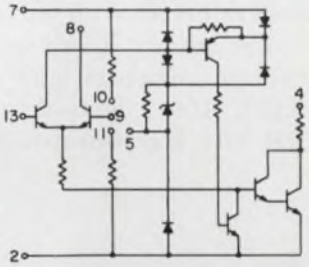
VOLTAGE REGULATION



PA264/PA265—
Five-watt voltage regulators

- 25- and 37-volt ratings
- 5-watt dissipation for on-card regulation
- Up to 1.25 amperes

TEMPERATURE CONTROL



PA424—Zero-voltage switch

- a-c line operation
- eliminates RFI
- triggers power triacs/SCR's

For more information about General Electric integrated circuits, call or write your GE sales representative or authorized distributor, or write General Electric Company, Section 220-87, Room C-2, Northern Concourse Office Bldg., North Syracuse, N.Y. 13212. In Canada: Canadian General Electric, 189 Dufferin Street, Toronto, Ont. Export: Electronic Sales, IGE Export Division, 159 Madison Avenue, New York, N.Y. 10016.

GENERAL ELECTRIC

INFORMATION RETRIEVAL NUMBER 57

falling edges of the output pulse. The power limit of V_{in} occurs when it approaches $V_{be\ Q1}$ and is about 0.3 V.

The upper linearity limit is caused by the incomplete recovery of the voltage at the base of Q_2 to $V_{be\ SAT\ Q2}$ and the collector voltage of Q_1 to V_{in}, when the next trigger pulse is applied. However, these recovery transients are short, providing good linearity up to 97% of duty cycle.

The upper limit for V_{in} is determined by BV_{ebo} of Q_2 because the initial OFF voltage appearing at the base of Q_2 (at the trigger pulse instant) is

$$V_{be\ SAT\ Q2} - |V_{in} - V_{ce\ SAT\ Q1}| ,$$

then

$$V_{in\ MAX} \leq BV_{ebo\ Q2} + V_{ce\ SAT\ Q1} + V_{be\ SAT\ Q2}.$$

The Darlington connection doubles the effective value of $V_{in\ MAX}$.

During the quasi-stable state, V_{CC}, R_4 and R_2 provide adequate base current for Q_1 to saturate up to $V_{in\ MAX}$. From these conditions R_1 can be obtained.

During that stable state it is required that

$$V_{be\ Q1} \leq V_{be\ CUT\ IN}\ (\approx 0.4\ V).$$

For a known V_{CC}, R_4 and R_2 can be obtained.

With a full range of V_{in} from 0.2 through 25 V, the linear range (±1%) is the order of 100:1. For the widest range, V_B is kept to a minimum; this value can be obtained from

$$V_B + V_{be\ Q3} = V_{ce\ Q3} + V_{be\ SAT\ Q2,\ Q'2}.$$

The output amplitude is a constant in the order of 1.7 V for the component values shown. It is obtained by superposition of the voltages V_{CC} and V_{beQ1}.

Victor C. Sobolewski, Research Student, The University of Adelaide, Adelaide, Australia.

VOTE FOR 314

Stable voltage supply has programmable output

A small dc-to-dc converter can be combined with two ICs to provide an inexpensive high-voltage supply that has good regulation and small temperature drift. In addition the output can be programmed with an external signal.

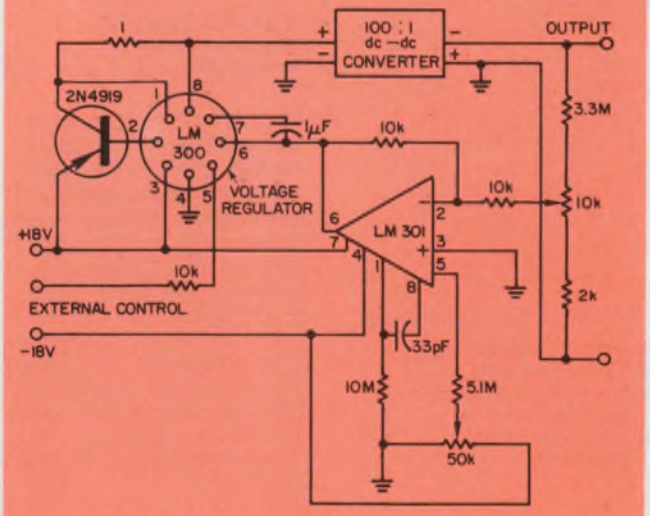
The supply shown in the figure uses an LM 300 voltage regulator and a Venus Scientific Model K15U 100:1 dc-to-dc converter. An IC op-amp LM 301 compensates for temperature drifts in the dc-to-dc converter and the voltage regulator; it also improves temperature stability.

By changing the output ground and the input polarity to the op amp, the designer can reverse the output polarity of the power supply. The output may be adjusted from about −400 V to about −1500 V with a 10-kΩ potentiometer. When the potentiometer is set for an output of −800 V, the output can be adjusted from −500 V to −1100 V by applying ±1.5 V through 10 kΩ to pin 5 of the voltage regulator.

For an output at −500 V, the line and load regulation are better than 0.1% for line voltages from 10 to 24 V and load currents from 100 μA to 1 mA. At this voltage, the temperature stability is 0.2%/°C from 20°C to 60°C.

L. E. Wood, Physicist, U.S. Dept. of Commerce, Boulder, Colo.

VOTE FOR 315



Op amp compensates for temperature drift in the dc-to-dc converter and voltage regulator. At an output of −500 V, temperature stability is 0.02%/°C from 20°C to 60°C.

VOTE! Go through all Idea-for-Design entries, select the best, and circle the appropriate number on the Reader-Service-Card.

SEND US YOUR IDEAS FOR DESIGN. You may win a grand total of $1050 (cash)! Here's how. Submit your IFD describing a new or important circuit or design technique, the clever use of a new component or test equipment, packaging tips, cost-saving ideas to our Ideas-for-Design editor. You will receive $20 for each accepted idea, $30 more if it is voted best-of-issue by our readers. The best-of-issue winners become eligible for the Idea Of the Year award of $1000.

Product Source Directory

Display Devices

This Product Source Directory covers numeric and alphanumeric display devices.

For each table, display devices are listed in alphabetical order by manufacturers name.

The following abbreviations apply to display devices

ina—information not available

req—request

n/a—not applicable

All notes used in this table are in letter series and defined at the end of the section. Manufacturers are identified by abbreviation. The complete name of each manufacturer can be found in the Master Cross Index below.

Abbrev.	Company	Information Retrieval No.
Amperex	Amperex Electronics Corp. Semiconductor & Microcircuits Div. Providence Pike Slatersville, R.I. 02876 (401) 762-9000	465
Burroughs	Burroughs Corp. Electronic Comp. Div. Box 1226 Plainfield, N.J. 07061 (201) 757-3400	466
H-P	Hewlett-Packard Co. 1501 Page Mill Rd. Palo Alto, Calif. 94304 (415) 326-7000	Contact local sales office
ICE	Integrated Circuit Electronic, Inc. Box 647 Waltham, Mass. (617) 899-0160	468
Monsanto	Monsanto-Electronic. Special Products 10131 Bubb Rd. Cupertino, Calif. 95014 (408) 257-2140	469

Abbrev.	Company	Information Retrieval No.
National	National Electronics Div. Varian Corp. P.O. Box 269 Geneva, Ill. 60134 (312) 232-4300	470
Pinlites	Pinlites Inc. 1275 Bloomfield Ave. Fairfield, N.J. 07006 (201) 226-7724	471
RCA	RCA Electronic Components 415 S. 5th St. Harrison, N.J. 07029 (201) 485-3900	472
Sylvania	Sylvania Electric Products, Inc. Electron Tube Div. Seneca Falls, N.Y. 13148 (315) 568-5881	473
Tung-Sol	Tung-Sol Div. Wagner Electric Corp. 630 W. Mt. Pleasant Ave. Livingston, N.J. 07039 (201) WY 2-1100	474

Display devices (numeric)

Manufacturer	Model	Character Size (Inches)	Viewing Distance (Feet)	Light Output ft-L	Supply Voltage (V)	Current (mA)	Notes	Price/Unit $
Amperex	ZM1020/22	0.6	25	200	170	2.5	ac	9.50
Amperex	ZM1000/5	0.55	25	200	170	2.5	cde	5.70
Amperex	ZM1200	0.4	ina	ina	175	9	cf	51.80
Amperex	ZM1005	0.551	ina	ina	170	6-20	ce	5.70
Burroughs	SSD 1000-0020	0.5	24	50	5-12, 250	650-135 30	gh	132
Burroughs	Super B-6091	0.8	38	200	170	2.5	a	19
Burroughs	B-4032	0.3	14	200	170	1	aj	19
Burroughs	B-5750	0.5	24	200	170	2.6	e	6.75
Burroughs	Large B-8091	1.4	65	200	170	4.5	a	22.50
Burroughs	B-5991	0.6	30	200	170	2	ak	15.75
Burroughs	B-5853	0.5	24	200	170	14	em	7.15
Burroughs	SSD 1000-0010	0.5	24	50	5-12, 250	140-75 30	gh	500
Burroughs	B-5092	0.6	30	200	170	2	a	15.75
Burroughs	B-4998	0.03	14	200	170	1.5	an	21.35
Burroughs	B-7037	2.0	100	200	170	5.0	e	26
Burroughs	B5855	0.5	24	200	170	14	em	7.15
ICE	D103	0.55	40	150	200	4.5	t	30.25
ICE	C103	0.55	40	150	200	4.5	t	44.55
ICE	PS103	0.55	40	150	200	4.5	t	44
ICE	CS103	0.55	40	150	200	4.5	t	55.55
ICE	D200	0.43	30	150	200	3.9	u	30.25
ICE	C200	0.43	30	150	200	3.9	u	43.50
ICE	DS200	0.43	30	150	200	3.9	u	43
ICE	CS200	0.43	30	150	200	3.9	u	53.50
ICE	D300	0.552	50	100	5	60	v	31.25
ICE	C300	0.552	50	100	5	60	v	48
ICE	D4000-3	0.62	40	150	27	45	w	49.50
ICE	D4000-4	0.62	40	150	27	45	w	66
ICE	D4000-5	0.62	40	150	27	45	w	82.50
ICE	U-4000-3	0.62	40	150	27	45	w	99
ICE	U-4000-4	0.62	40	150	27	45	w	132
ICE	U-4000-5	0.62	40	150	27	45	w	165
National	NL-7977/4032	0.31	14	ina	170	0.7-1.4	a	19
National	NL-934	2	100	ina	200	6-10	e	26.75
National	NL-863	2	100	ina	200	6-10	e	26
National	NL-7037	2	100	ina	200	6-10	e	26
National	NL-825	2	100	ina	200	4-7	a	45
National	NL-7094	2	100	ina	200	4-7	a	45
National	NL-887	1.375	65	ina	170	3-6	a	22.50
National	NL-8091	1.375	65	ina	170	3-6	a	22.50
National	NL-6034	0.808	38	ina	170	1.5-4	a	19
National	NL-8423/6091	0.808	38	ina	170	1.5-4	a	19
National	NL-821	0.808	38	ina	170	2-4.5	e	11
National	NL-807	0.808	38	ina	170	2-4.5	e	11
National	NL-907	0.61	30	ina	170	1.5-3	e	10.25
National	NL-906	0.61	30	ina	170	1.5-3	e	10.25
National	NL-905	0.61	30	ina	170	1.5-3	e	10.25
National	NL-904	0.61	30	ina	170	1.5-3	e	9.50
National	NL-908	0.61	30	ina	170	1.5-3	e	9.75
National	NL-903	0.61	30	ina	170	1.5-3	e	9
National	NL-902	0.61	30	ina	170	1.5-3	e	9.75
National	NL-901	0.61	30	ina	170	1.5-3	e	9.75
National	NL-900	0.61	30	ina	170	1.5-3	e	9
National	NL-848	0.61	30	ina	170	1.5-3	e	8.75
National	NL-843	0.61	30	ina	170	1.5-3	e	8
National	NL-842	0.61	30	ina	170	1.5-3	e	8.40
National	NL-841	0.61	30	ina	170	1.5-3	e	8.40
National	NL-8754/840	0.61	30	ina	170	1.5-3	e	8
National	NL-5442A	0.61	30	ina	170	1.5-3	e	8.40
National	NL-5441A	0.61	30	ina	170	1.5-3	e	8.40
National	NL-5440A	0.61	30	ina	170	1.5-3	e	8.40
National	NL-5442	0.61	30	ina	170	1.5-3	e	8
National	NL-5441	0.61	30	ina	170	1.5-3	e	8
National	NL-5440	0.61	30	ina	170	1.5-3	e	8
National	NL-5091	0.61	30	ina	170	1.5-3	a	15.75
National	NL-8421/5092	0.61	30	ina	170	1.5-3	a	15.75
National	NL-809	0.61	30	ina	170	1.5-3	a	17.35
National	NL-5992	0.61	30	ina	170	1.5-3	a	15.75
National	NL-8422/5991	0.61	30	ina	170	1.5-3	a	15.75
National	NL-918/5560	0.52	25	ina	170	1.2-2	e	17.75
National	NL-941	0.515	25	ina	170	2.3-5	e	7.15
National	NL-940	0.515	25	ina	170	2.3-5	e	7.15
National	NL-951	0.515	25	ina	170	2.3-5	e	7.15
National	NL-950	0.515	25	ina	170	2.3-5	e	7.15
National	NL-8502/4021	0.31	14	ina	120	0.7-1.4	a	33
National	NL-7009	0.31	14	ina	170	0.7-1.2	a	19
National	NL-4031	0.31	14	ina	170	0.7-1.2	a	19
National	NL-4998	0.31	14	ina	170	1.2-2	a	req

Display devices (numeric) 97

Manufacturer	Model	Character Size (Inches)	Viewing Distance (Feet)	Light Output ft-L	Supply Voltage (V)	Current (mA)	Notes	Price/Unit $
Pinlites	0640	5/16	20	7000	4	16.5		req
Pinlites	0850	0.5	20	4500	5	18		req
Pinlites	0630	5/16	15	1400	3	8		req
Pinlites	1050	5/8	30	3000	5	18		req
Pinlites	1250D	0.75	40	4000	5	43		req
Pinlites	0430	0.25	20	2000	3	8		req
Pinlites	0315	3/16	15	700	1.5	8		req
Pinlites	0650	5/16	20	4500	5	15		req
RCA	DR2000	0.6 x 0.35	ina	7000	3.5-5	24/seg	yz	2.95
RCA	DR2010	0.6 x 0.35	ina	7000	3.5-5	24/seg	yz	3.05
RCA	DR2020	0.6 x 0.35	ina	7000	3.5-5	24/seg	yz	1.75
RCA	DR2030	0.6 x 0.35	ina	7000	3.5-5	24/seg	yz	1.75
RCA	DR2100	0.4 x 0.23	ina	7000	3.5-5	24/seg	yz	3.20
RCA	DR2110	0.4 x 0.23	ina	7000	3.5-5	24/seg	yz	3.30
RCA	DR2120	0.4 x 0.23	ina	7000	3.5-5	24/seg	yz	2.00
RCA	DR2130	0.4 x 0.23	ina	7000	3.5-5	24/seg	yz	2.00
Sylvania	8843	0.57 x 0.36	1-10	200	25	90	ev	req

Display devices (numeric, solid-state) 98

H-P	5082-7000	0.27	15	200	5	100	rs	25/1k
H-P	5082-7200	0.1	5	200	1.6	5/seg	qr	7.05/1k

Display devices (alphanumeric) 99

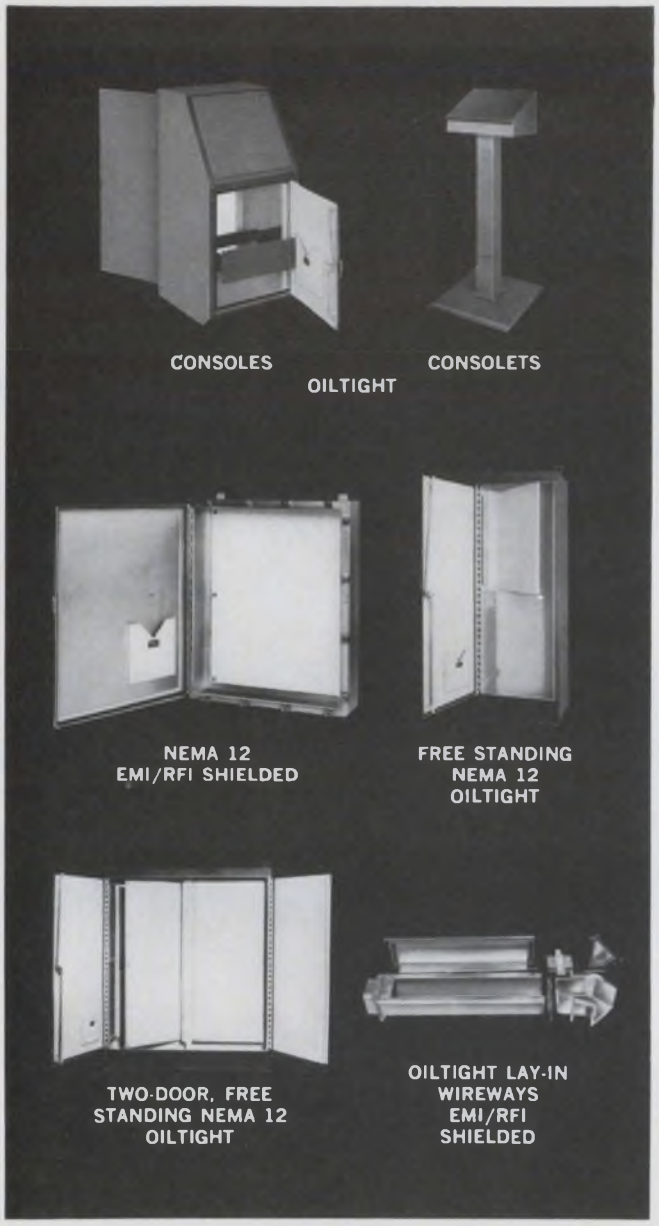
Manufacturer	Model	Character Size (Inches)	Viewing Distance (Feet)	Light Output ft-L	Supply Voltage (V)	Current (mA)	Notes	Price/Unit $
Amperex	ZM1001	0.55	25	200	170	2.5	bci	7.36
Burroughs	SSD1000-0030	0.5	24	50	5-12, 250	160-50 30	gh	165
Burroughs	medium B-8971	1.4	65	200	170	14	i	28.25
Burroughs	Large B-7971	2.5	100	200	170	21	ei	15.85
Burroughs	SSD 1000-0040	0.5	24	50	5-12, 250	700-150 30	gh	190
Burroughs	B-5971	0.6	30	200	170	12	a	30
Pinlites	43	0.25	20	2000	3	8		req
Pinlites	63	5/16	20	1400	3	8		req
Pinlites	64	5/16	10	7000	4	16.5		req
Pinlites	1050A	5/8	30	3000	5	18		req
Pinlites	12-50A	0.75	40	4000	5	43		req
Pinlites	65	5/16	20	4500	5	15		req
Tung-Sol	DT1704	0.57 x 0.36	40	225	25	0.5/seg		2.55/k

Display devices (alphanumeric, solid-state) 100

H-P	5082-7100	0.27	15	200	1.6	100	pr	30/1k
Monsanto	MAN2	0.35 x 0.25	ina	300	1.7	200	r	100
Monsanto	MAN1	0.27 x 0.187	ina	200	3.4	20/seg	rx	8.75
Monsanto	MAN3	0.115 x 0.066	ina	200	1.7	5/seg	qr	12.45

a. End view display
b. Displays +, −, X, Y, Z, N
c. Cold cathode
d. Includes decimal point
e. Side view display
f. Up to 14 digits available
g. 20-1 contrast ratio
h. 16 digits/unit character generator, drive electronics and bezel included
i. 15 segment
j. Miniature round nixie® tube
k. Standard rectangular nixie® tube
m. Timesharing application
n. Miniature rectangular nixie® tube
p. Complete alpha numeric capability
q. Monolithic
r. Solid state
s. Includes decoder driver
t. Cold cathode, gas filled
u. Seven segment neon, cold cathode
v. Seven segment incandescent readout
w. Seven segment fluorescent readout
x. Seven segment
y. Incandescent, segmented
DR2100 DR2110 DR2120
z. DR2000, 0-9; DR2010, 0-9 with decimal; DR2020, ±, and DR2130 numeral 1; DR2030, ±. Unlimited color filter capability

Hoffman's Pollution Solutions



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ELECTRICAL ENCLOSURES

INFORMATION RETRIEVAL NUMBER 58

How'd you like to get fixed up with a good looking model?

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Pseudo-Noise Transmission Test Set
that is!

This portable model will ride herd on your testing problems.
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Compatible with our Model 2000 Programmable Digital Printer for permanent record of all test data.
So why spend your time trying to trace a foul-up in your communications link-up when you can relax.

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ADVANCED TECHNIQUES IN DATA COMMUNICATIONS
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INFORMATION RETRIEVAL NUMBER 59

RATIO MOST SIGNIFICANT BIT:
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T.C. MATCH: 1 PPM/°C

10 bit and 8 bit ladder networks also available as standard units

Complete Data Available Upon Request

HyComp
146 MAIN STREET, BOX 250
(617) 897-4578 MAYNARD, MASSACHUSETTS 01754

INFORMATION RETRIEVAL NUMBER 60

New Products

Digital 24-bit filters sample up to 500 kHz

Rockland Systems Corp., 131 Erie St. East, Blauvelt, N.Y. Phone: (914) 359-1818. P&A: $5000 to $20,000; Fall of 1970.

Using building-block modules, the 4000 series of programmable digital filter assemblies features accuracies up to 24 bits at sampling rates up to 500 kHz.

Each assembly is composed of four basic parts: adders, multipliers, shift-register delays and a memory. These basic components are combined into second-order building blocks (two poles and/or two zeros).

Assemblies can be combined or multiplexed in a number of ways to realize any number of any desired filter order functions.

For instance, each filter assembly may be multiplexed among several inputs, or on one input for higher-order filter functions. Both a single input and several multiplexed inputs can also be used together.

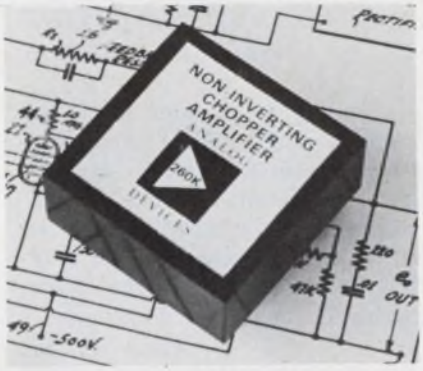
The use of recursive (poles and zeros) filter assembly structures permits the realization of extremely sharp frequency-domain cutoffs. Non-recursive structures can be used to give finite impulse response, precise linear phase and other special characteristics.

Sampling can be varied with either an internal clock or with an external clock via a front-panel connection.

Standard accuracies are 16 and 24 bits. Arbitrary arithmetic accuracies are also available. A/d and d/a conversion accuracies are limited to commercially available converter accuracies of 8 to 12 bits. Word lengths can be modified in four-bit bytes.

CIRCLE NO. 250

Chopper amplifier is non-inverting

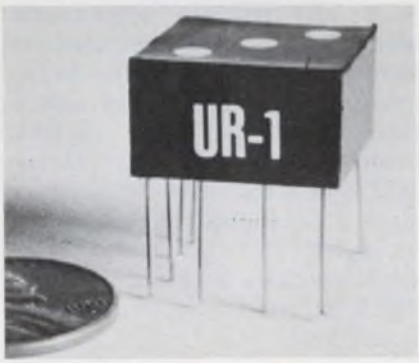


Analog Devices, Inc., 221 Fifth St., Cambridge, Mass. Phone: (617) 492-6000. P&A: $49 or $64; stock.

Because it is a non-inverting chopper-stabilized operational amplifier with an input impedance of 1000 MΩ, model 260 op amp can hold peak-to-peak noise to 0.4 μV and 4 pA. Two versions are available—one (the 260J) with a voltage drift of 0.3 μV/°C, and the other (the 260K) with a drift of 0.1 μV/°C. For both versions, offset voltage is 25 μV.

CIRCLE NO. 251

Miniature regulator can handle 100 V



Space Age Microcircuits, P.O. Box 426, Chatham, N. J. Phone: (201) 635-8484. P&A: $15; stock.

Featuring remote sensing and programmability, a miniature hybrid power supply regulator can stabilize dc voltages ranging from 1 to 100 V. Model UR-1 can handle very low currents, as well as currents in excess of 100 A when used with suitable external power transistors. Regulation is better than 10 mV for zero to full-load changes and 5 mV for input changes of ±10%.

CIRCLE NO. 252

High-speed amplifier gains out to 100 MHz

Optical Electronics Inc., P.O. Box 11140, Tucson, Ariz. Phone: (602) 624-8358. P&A: $57; stock.

Offering a slew rate of ±100 V/μs, the model 9694 general-purpose operational amplifier delivers a gain-bandwidth product of 100 MHz. Other features of the device include: a typical open-loop gain of 80 dB, a typical offset voltage drift of 20 μV/°C, and a typical bias current of 60 nA. Power dissipation is typically 210 mW, and output voltage is ±10 V.

CIRCLE NO. 253

Multiplier for $35 covers 1.5-MHz band

Burr-Brown Research Corp., International Airport Industrial Park, Tucson, Ariz. Phone: (602) 294-1431. P&A: $35; stock to 4 wks.

Costing only $35 in single-unit quantities, a new analog multiplier provides an accuracy of better than ±1% in all four quadrants, a bandwidth of 1.5 MHz, and a maximum supply rejection of ±100 mV/V. Model 4094/15C has less than ±2% amplitude error due to frequency effects up to 500 kHz and an output slew rate of 40 V/μs.

CIRCLE NO. 254

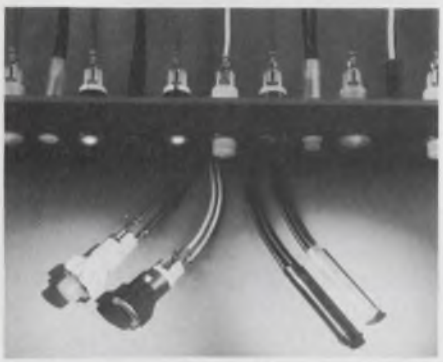
Readout tube for $27 displays 14 digits

Amperex Electronic Corp., a North American Philips Co., Semiconductor and Microcircuits Div., Slatersville, R.I. Phone: (401) 762-9000. Price: $27.

In only 7 in. of panel space, the Pandicon ZM1200 gas-filled cold-cathode readout tube displays 14 digits. The unit requires only 27 external connections instead of the 168 required for conventional readouts. Priced at $27, the tube offers floating decimal-point location.

CIRCLE NO. 255

Indicator lights snap into place

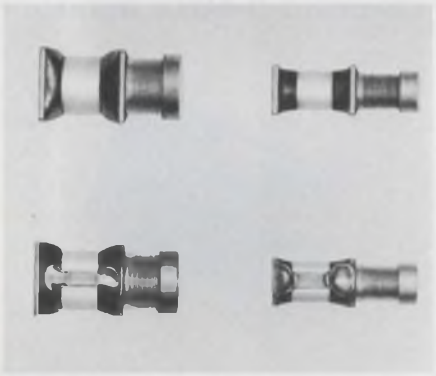


AMP Inc., Harrisburg, Pa. Phone: (717) 564-0101.

Completely pre-assembled, Ampillume nylon-encased neon and incandescent indicator lights snap into panels that are 0.032 to 0.062-in. thick. Standard lens styles include top-hat and flush versions. Available colors are natural, red, orange, yellow, blue, green, and purple. Life expectancy is 25,000 hours for the neon lights and 50,000 hours for the incandescent indicators.

CIRCLE NO. 256

Variable capacitors use chips as shunts

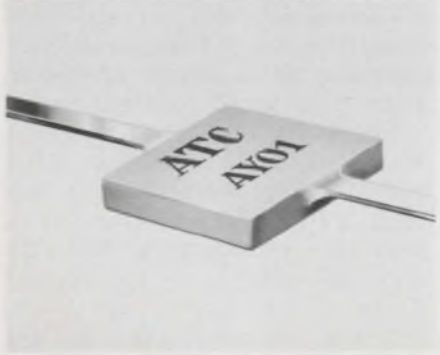


Johanson Manufacturing Corp., 400 Rockaway Valley Rd., Boonton, N.J.

Designed for uhf, vhf, microwave and stripline applications, series 505 variable capacitors are shunted with chip capacitors to improve Q, and current and capacitance capabilities. The variable capacitor with a chip in parallel is said to be a trimmable fixed device since it eliminates the need to trim by means of interchanging close-tolerance chips. Working voltage is 250 V dc, and insulation resistance is 10^6 MΩ.

CIRCLE NO. 257

Silicone capacitors achieve Q of 5000

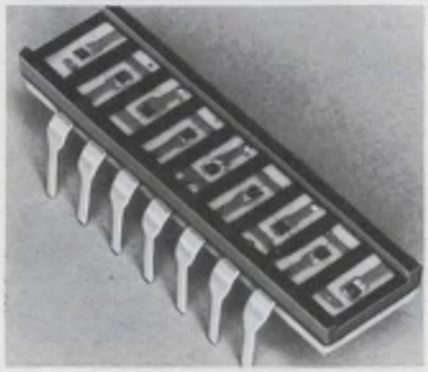


American Technical Ceramics, 1 Norden Lane, Huntington Station, N.Y. Phone: (516) 271-9600. P&A: 76¢; stock.

Encapsulated with a tough silicone epoxy body insulation, series ATC-AY01 capacitors provide a Q of greater than 5000 at 1 MHz. The units are 1/8-in. squares with silver ribbon leads. Capacitance values range from 0.5 to 470 pF and working voltage is 300 V dc. The units have a temperature coefficient of 95 ppm/°C.

CIRCLE NO. 258

Thick-film arrays use infrared LEDs

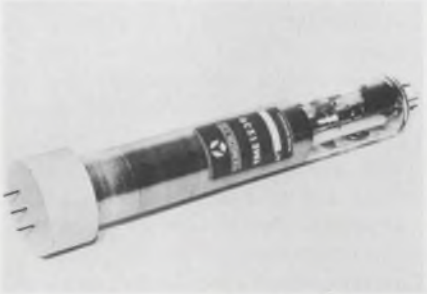


HEI, Inc., Jonathan Industrial Center, Chaska, Minn. Phone: (612) 448-3510.

Providing an infrared light for opto-electronic applications like paper-tape reading and shaft encoding, a new line of thick-film arrays use solid-state light-emitting diodes as the light source. Series LEA 400 arrays combine LEDs with thick-film packaging to provide small size, high reliability, long life, and low power requirements. They contain from 2 to 12 LEDs.

CIRCLE NO. 259

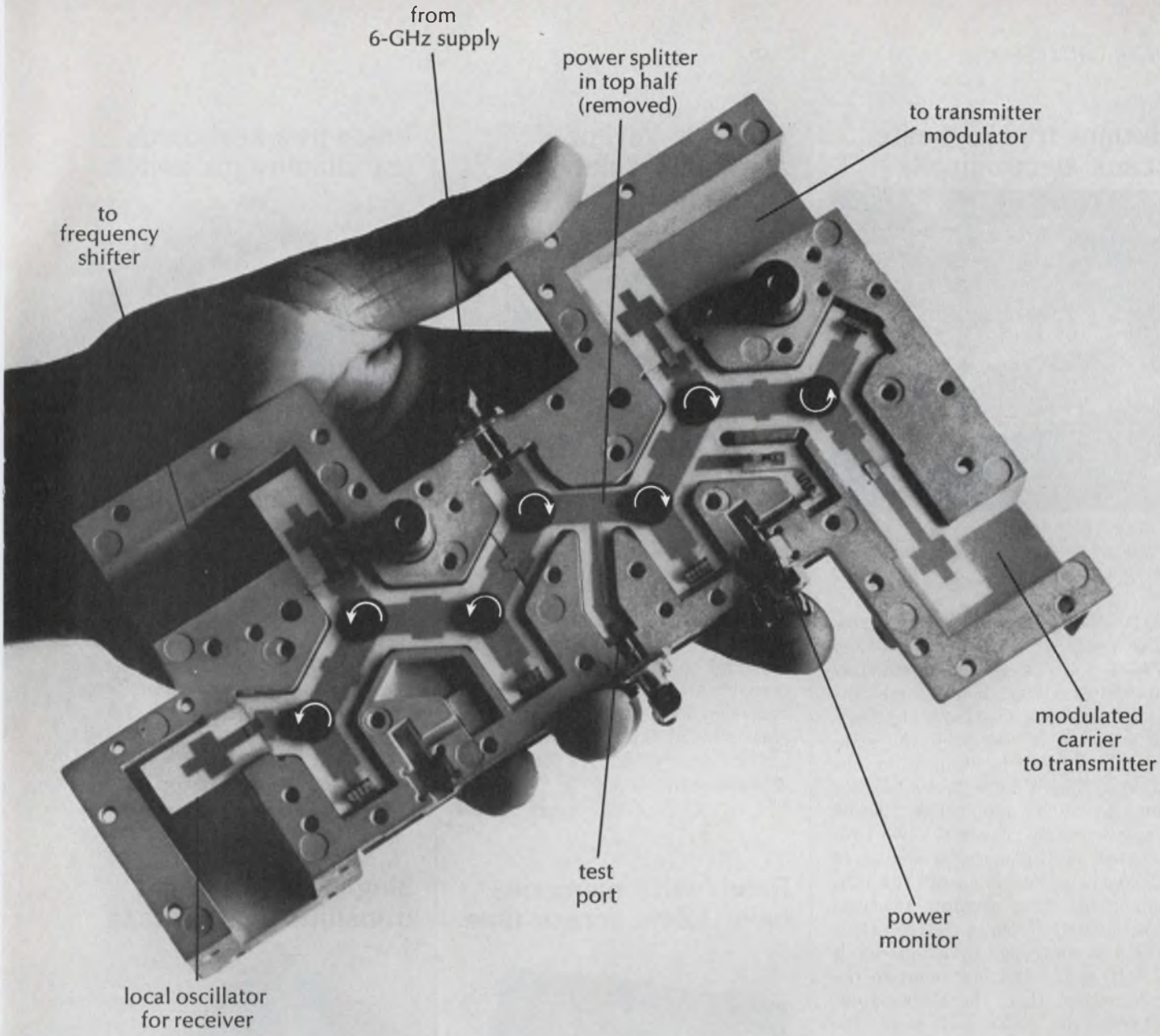
Silicon storage tubes hold image one month



Thomson-CSF Electron Tubes, Inc., 50 Rockefeller Plaza, New York, N. Y. Phone: (212) 245-3900.

Two new silicon-target storage tubes can store a full TV gray-scale image for 15 minutes with constant refreshing, and a black-and-white image for half an hour with the power on. If the power is turned off, storage capability is at least one month. Model 1238 provides 800-line resolution, while model 1239 has 1200-line resolution. The stored image can be edited.

CIRCLE NO. 260



Miniature crossroads for microwaves

At every repeater station of a microwave relay system, there's a microwave distribution network—a circuit assembly that combines, divides, and directs the signals of one transmission channel. It interconnects the waveguides with coaxial cables that distribute microwave power to frequency mixers, modulators, and amplifiers.

Now, engineers at Bell Laboratories' Allentown, Pennsylvania, location have developed an integrated-circuit version. This one structure, smaller than a cigar box, has only a tenth the weight and a fifteenth the volume of the previous assembly. And, it costs less.

The network is shown above with its top half removed. The paths for the microwave signals are "stripline"—small rectangular channels with a copper-strip center conductor, electrically much like coaxial cable. The conductor strip is plated over an evaporated thin gold film on a ceramic substrate. Terminations and resistors are made by depositing tantalum nitride on the substrate. The four cross-shaped stubs (at the ends of the stripline) are stripline-to-waveguide transducers.

The seven black disks on the center conductor are ferrite microwave circulators, three-port devices which let microwave power flow from any port to the next one in the indicated direction only. This controls signal flow and isolates circuitry. The power splitter in the conductor feeds the test port.

Bell Laboratories engineers and their colleagues at Western Electric carefully selected this combination of modern materials and the techniques for working with them—including precision aluminum die casting and tantalum and gold thin-film technology. Analytical studies defined the geometry of the various circuit components to meet the rigorous standards of long-distance communications. This resulted in a superior component for our radio relay system and, at the same time substantial reductions in cost, size, and weight.

From the Research and Development Unit of the Bell System:

Bell Labs

Bounce-free keyboard scans electronically

Cherry Electrical Products Corp., 1650 Old Deerfield Rd., Highland Park, Ill. Phone: (312) 831-2100. Price: $250.

Continuously scanning all possible codes every 256 μs, a 52-key ASCII-coded keyboard completely eliminates contact bounce since the code does not come from the keys. When a key is depressed, the scanning processed is stopped at the selected code. The keyboard encoder consists of an eight-page clocked ripple-through counter, two 16-channel multiplexers, a one-of-16 decoder, a monostable multivibrator, and gates. The counter operates continuously from a 1-MHz clock which is controlled by a four-input NAND gate. Any low input to the gate, other than the clock input, inhibits the clock and stops the counter at a particular eight-bit code.

CIRCLE NO. 261

Tape search system logs time codes too

Systron Donner Corp., 888 Galindo St., Concord, Calif. Phone: (415) 682-6161. Price: $3500.

Consisting of a time-code generator and tape search unit, the model 8154 tape search system can accept a serial time code input and search the recorded data during a preset time interval. As a time code generator, the system is a precise digital clock which also generates a serial modulated and dc level shift code for use in time indexing during data acquisition.

CIRCLE NO. 262

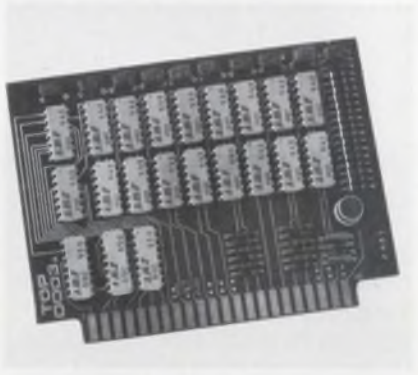
Numeric keyboard augments Teletypes

IDM Corp., 87 Pierce Rd., Watertown, Mass. P&A: $495; 6 wks.

An auxiliary numeric keyboard advances the speed and accuracy of data entered through Teletype and ASCII terminals. The compact portable unit is configured as a standard office calculator with terminal control keys. It attaches through a quick connect/disconnect provision leaving the main terminal keyboard fully operational. The unit's input is buffered for greater operator convenience.

CIRCLE NO. 263

Read/write memories have 12-ns access time



Advanced Memory Systems, Sunnyvale, Calif. P&A: $1230 or $1380; 3 to 4 wks.

Organized as 128 words by eight bits (model 1288E) or 128 words by nine bits (model 1298E), two new high-speed fully functional read/write memory cards offer typical access times of 12 ns. Both cards have a power dissipation of only 7 mW per bit. Inputs are fully buffered and unterminated emitter-follower outputs permit wired-OR operation for word expansion.

CIRCLE NO. 264

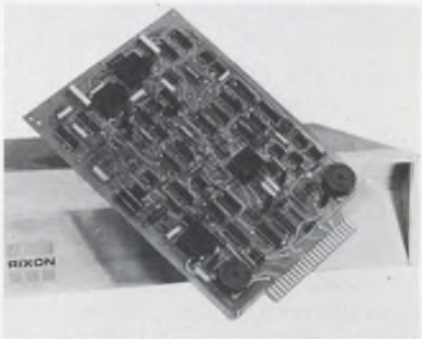
Noise-free keyboards use diaphragm switch

Datanetics Corp., 2828 Spreckels Lane, Redondo Beach, Calif. Phone: (213) 542-4355. P&A: $1 per position; 10 days.

Two new 16-position keyboards incorporate a wafer-thin (0.15 in.) elastic diaphragm switch configuration for long life and noise-free operation. They are available in both standard-key (model DC-16K) and low-profile touch (model DC-16P) versions. An integral PC-board plug mates with commercially available 18-pin connectors.

CIRCLE NO. 265

Single-card data set transmits 1800 bits/s

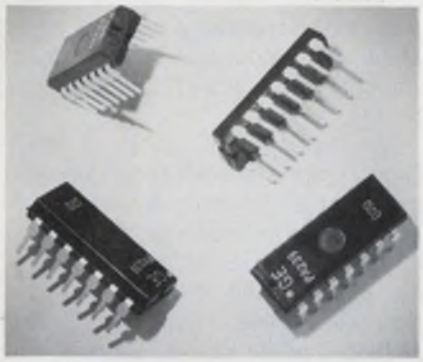


Rixon Electronics, Inc., div. of United Business Communications, Inc., 2120 Industrial Parkway, Silver Spring, Md. Phone: (301) 622-2121.

The FM-188 data modem, which operates at speeds up to 1800 bits per second, can be supplied in two different versions—as a single printed circuit card for OEM applications or as a full-duplex stand-alone modem in a compact desktop cabinet. The unit can be used on either the DDD network or on private leased lines.

CIRCLE NO. 266

Dual preamplifier needs but one supply

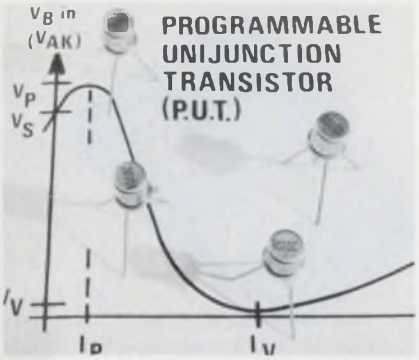


General Electric Co., Integrated Circuits Project, Northern Concourse Office Building, North Syracuse, N.Y. P&A: $3.42; 30 days.

Designed for amplifying low-level signals in low-noise applications, the PA239 dual preamplifier operates with only a single power supply and as few as two external components. It consists of two identically matched 68-dB-gain amplifiers fed from an internal power-supply filter. Power supply voltages can go to 16 V.

CIRCLE NO. 267

UJTs for only 53¢ come in TO-18 cans

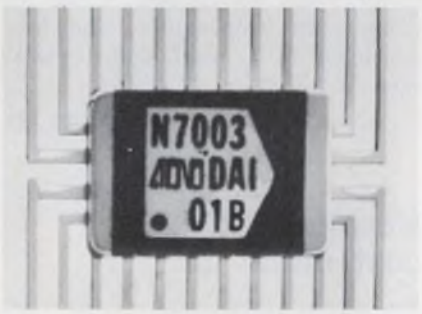


Unitrode Corp., 580 Pleasant St., Watertown, Mass. Phone: (617) 926-0404. P&A: 53¢; 2 to 3 wks.

Costing only 53¢ each in quantities of 100, a planar family of programmable unijunction transistors is now available in a hermetically sealed TO-18 package. Series U13T1 units are functionally equivalent to standard unijunction devices but have the added flexibility of programmable parameters. Primary applications are pulse, timing, and SCR trigger circuits.

CIRCLE NO. 269

10-bit current source is for d/a and a/d use

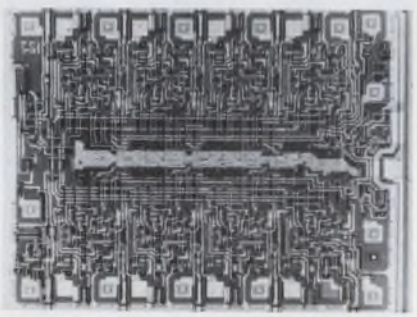


Precision Monolithics, Inc., 1500 Space Park Dr., Santa Clara, Calif.

The monoDAI-01B is a monolithic 10-bit precision current source for current-summing d/a converters that can also be used as a feedback element in successive-approximation a/d converters. The unit has a settling time of 150 ns and can operate from ±6 to ±15 V. Its absolute error is 0.2% of full scale, and output current is 2020 to 2080 μA. Operating temperature is −25 to +85°C.

CIRCLE NO. 268

TTL shift registers accept 32-MHz clock



Texas Instruments Inc., Components Group, P.O. Box 5012, Dallas, Tex. Phone: (214) 238-2011. P&A: $7.28; stock.

Two new eight-bit TTL MSI shift registers are the SN74198, a parallel-access left-shift/right-shift register, and the SN74199 a parallel-access type. Both circuits have 87 equivalent gates and a maximum input clock frequency of 32 MHz. Average power dissipation is only 47 mW per bit. Their operating temperature is 0 to 70°C.

CIRCLE NO. 270

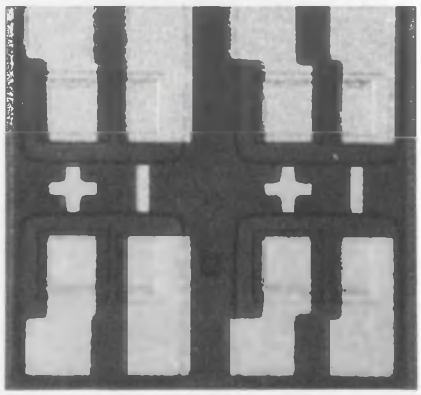
DIP opto-isolator can handle 1.5 kV

Monsanto Electronic Special Products, 10131 Bubb Rd., Cupertino, Calif. Phone: (408) 257-2140. P&A: $5.85; stock.

Supplied in a six-lead plastic dual-in-line package, a new opto-isolator provides a voltage isolation that exceeds 1500 V and an isolation resistance that is typically 100 GΩ. The MCT2 photo-transistor coupled pair also has a current transfer ratio of 35% and rise and fall times of 2 μs. Its base-emitter resistance can be varied externally.

CIRCLE NO. 271

Quad diode chips isolate to 1000 V



Dionics Inc., 65 Rushmore St., Westbury, N.Y. Phone: (516) 997-7474.

A new line of multi-diode chips for use in hybrid circuits contain four non-gold-doped 1N914 diodes, dielectrically isolated from each other and from the bottom of the chip, with more than 1000 V of isolation between individual diodes. Types 914-1QM, -2QM, -3QM have a 1-mV forward matched characteristic; types 914-1Q, -2Q, and -3Q have a characteristic of 30 mV.

CIRCLE NO. 272

Transistors in TO cans sell for 75¢ to 82¢

Fairchild Semiconductor, 313 Fairchild Dr., Mountain View, Calif. Phone: (414) 962-3563. P&A: 75¢ to 82¢; stock.

Metal-can equivalents of four popular plastic-packaged transistors, types 2N3903 through 2N3906, are now available for 75¢ to 82¢ in quantities of 1 to 99. Models FT3903 and FT3904 are npn general-purpose amplifiers and switches, while models FT9305 and FT9306 are their respective pnp complements. They come in TO-18 packages.

CIRCLE NO. 273

Stable 250-mW diodes sense −50 to +125°C

CODI Semiconductor, div. of Computer Diode Corp., Pollitt Dr., Fair Lawn, N.J. P&A: 50¢; stock.

Ideal for temperature monitoring and sensing applications, a new line of temperature-sensing diodes feature a power dissipation of 250 mW and an operating temperature range of −50 to +125°C. The devices have a stable forward characteristic that assures a stable temperature coefficient, which is linear with temperature. They are packaged in a single-ended metal case.

CIRCLE NO. 274

Hermetic SCRs cost under $1

Transitron Electronic Corp., 168 Albion St., Wakefield Mass. Phone: (617) 245-4500. P&A: 32¢ to 75¢; stock to 4 wks.

Aimed at the computer market, a new line of hermetically sealed TO-18 SCRs are now available for 32¢ to 75¢ in quantities of 1000. Series RTC02 units offer voltage ratings up to 200 V, a gate sensitivity of less than 1 mA, and a holding current of under 10 mA. They will handle 0.4 A rms at 80°C and have a maximum operating temperature of 125°C.

CIRCLE NO. 281

Pulse generator separates outputs

Hewlett-Packard, 1501 Page Mill Rd., Palo Alto, Calif. Phone: (415) 326-7000. P&A: $1925; August, 1970.

With its two independent channels that can be combined in common output, the model 8010A pulse generator can also perform as a complex waveform generator. Individual control of rise and fall transition times makes it possible to generate ramps, trapezoids, triangles, and rectangular waveforms. Also independently controlled are amplitude, offset, and delay.

CIRCLE NO. 276

Low-cost IC generator pulses out to 50 MHz

Data Dynamics Div., 240 Humphrey St., Englewood, N.J. Phone: (201) 567-5300. P&A: $475; stock to 3 wks.

Pulsing out to 50 MHz is the model 5102 pulse generator for TTL, RTL or DTL ICs. Single, gated and manually-generated pulses and square waves are available. The output level is adjustable from 0 to 6 V and the base-line offset is adjustable from 0 to 2 V. The output level and base-line offset voltages can be remotely programmed.

CIRCLE NO. 277

AM video detector takes 1-GHz carriers

Avantek, Inc., 2981 Copper Rd., Santa Clara, Calif. Phone: (408) 739-6170. P&A: $90; stock.

The UD-901 video detector provides AM detection and amplification of 1 kHz to 50 MHz modulation components on any carrier in the 100 to 1000 MHz passband. Tangential sensitivity is −50 dB when the unit is used by itself and can be improved with preamplification. Video gain is equivalent to 23 dB to provide up to 7 V of peak detected output voltage.

CIRCLE NO. 278

Uhf transistors give up to 2 W

Kertron Inc., 7516 Central Industrial Dr., Riviera Beach, Fla. Phone: (305) 848-9606. P&A: $9 to $10.50; 2 to 3 wks.

Operating at 12.5 V, the model 3TX620 uhf transistor is designed to deliver 1 W at 470 MHz with a minimum of 7-dB gain. The model 3TX621 uhf transistor puts out 2 W at 470 MHz and has a 6-dB minimum gain. Both devices are available in either a molded or ceramic package (models 3TX820 and 3TX821).

CIRCLE NO. 279

Binary varactor has two states

Siliconix Inc., 2201 Laurelwood Rd., Santa Clara, Calif. Phone: (408) 246-8000. P&A: $5.50; stock.

Designed for rf and microwave switching and tuning applications, the BV140 binary varactor is a variable-capacitance diode with two distinct capacitance states in the reverse direction. These two states are separated by a transition phase in which the capacitance is a rapid inverse function of the reverse bias voltage. Typically, the total voltage required to swing the device between 8.5 and 1.4 pF is only 7 V.

CIRCLE NO. 280

Evaluation Samples

Dry transfer patterns

JotDraft patterns are tough plastic dry transfer patterns for PC drafting methods. They are printed on see-through polyethylene strips so they can be precisely positioned before transferring. Once in position, a pattern is transferred with a ballpoint pen or burnisher in 3 to 5 seconds. Included are 1×, 2×, and 4× PC pad clusters, TO and DO case, and resistor outlines. Samples are available. Datak Corp.

CIRCLE NO. 282

PC-board interconnect

The Modu-Con terminal, a printed circuit board-to-board interconnect, is now available as a free evaluation sample. It is designed to press-fit into 0.049 to 0.052-in.-dia holes on printed circuit daughter boards, leaving an extended tapered male blade for insertion into corresponding-diameter holes on the mother board. This provides a wide variety of modular approaches in printed circuit packaging. The terminal adapts to modules with center-to-center spacings of 0.1 in. and to boards that are 1/32 to 3/32-in. thick. Malco Manufacturing Co. Inc.

CIRCLE NO. 283

Washers and spacers

About two dozen washers and spacers are included in a free evaluation sample kit. The assortment shows typical sizes and materials, both metallic and nonmetallic, for this universal type of hardware. Also available is a 48-page list of stock dies. Boker's, Inc.

CIRCLE NO. 284

Design Aids

Thermocouple tables

Recently published thermocouple temperature millivolt tables are available to aid users of temperature instrumentation and thermocouples. Fahrenheit and Celsius charts conveniently cover the temperature ranges from −300 to +3270°F and −200 to +1800°C, with their respective reference junctions at 75°F and 25°C. Eight thermocouple calibrations, J, Y, K, T, E, S, R and B, based on Instrument Society of America and National Bureau of Standards tables, are provided. Thermo Electric.

CIRCLE NO. 285

Relay chart

Several types of relays are conveniently listed with their characteristic features in a handy relay locator chart. These include subminiature, microminiature, blue-ribbon, latching and terminal-junction types. Listed are their operating characteristics, series designations, electrical and mechanical specifications and corresponding military part numbers. Units covered include 2pdt, 4pdt and 6pdt models. Deutsch Relay Div.

CIRCLE NO. 286

Audio recording guide

A handy reference guide to commonly used track configurations for audio recording is available in two formats: an 8-1/2-by-11-in. notebook-size chart or a 22-by-34-in. wall chart. The guide shows all configurations and dimensions generally used for the popular 1/4-in. tapes and 0.15-in. cassette tapes as well as 1/2, 1 and 2-in. studio tapes. Also provided in the guide are model number designations for recording heads that are applicable to each configuration. Nortronics Co., Inc.

CIRCLE NO. 287

Application Notes

Power supplies

A new 68-page handbook provides comprehensive data on power supplies and programming accessories. In addition, it includes revised language by which performance characteristics are described and adapts the recommendations of NEMA and the International Electrotechnical Commission to speak of the influence of the load on the power supply's stabilized output quantity such as the load effect. Application notes and a glossary are included. Kepco, Inc.

CIRCLE NO. 288

LC-filter monograph

A 10-page illustrated monograph on how to specify LC filters is available. Written for engineers, and based on extensive computer-aided filter design experience, it discusses a number of important specifications, including frequency response, impedance, passband ripple, shape factor, operating temperature range, packaging and environment. A two-page glossary of filter terms is provided for those not completely familiar with filter terminology. Cambridge Thermionic Corp.

CIRCLE NO. 289

Permanent magnet design

The "Do's and Don'ts of Permanent-Magnet Design" is the title of a handy 56-page booklet that discusses permanent magnets from their origin to their use in the design of circuits. It also includes tables of magnet properties, outline drawings of desirable and undesirable magnet shapes for design considerations, and a host of characteristic curves. A glossary of magnetic terms and symbols rounds out the discussion. Indiana General Magnet Products.

CIRCLE NO. 290

Data transmission

Wide-band vs narrow-band data transmission and how it affects supervisory control systems is discussed in a two-page application bulletin. It compares wide-band and multiple-channel narrow-band data transmission systems in terms of the need and time required for polling. It also discusses the interruption encountered when transmitting a station command, the adverse effect of differential delay distortion, and the consequence to system integrity with the loss of a channel. Quindar Electronics, Inc.

CIRCLE NO. 291

Thyristor rectifiers

The advantages, disadvantages and differences in performance of two basic thyristor circuits for three-phase controlled-rectification applications are listed and illustrated in a new brochure. The 12-page brochure compares the three-phase full-wave full-converter with the three-phase full-wave semi-converter circuit. Topics include rectification characteristics, delay angles vs system response, gate firing, double pulsing and inductive loads. Illustrations include circuit diagrams and curve traces of circuit responses. Westinghouse Electric Corp.

CIRCLE NO. 292

Chip capacitor book

The Ceramic Chip Capacitor Handbook is a handy 69-page handbook written to assist users of ceramic chip capacitors in their proper selection and application. Discussions include an introduction to chip capacitors, their design and manufacture, electrical properties, environmental characteristics and attachment and bonding techniques. An appendix follows with explanations of the piezoelectric effect, ion migration, and bonding effects. A glossary of capacitor terms is also included. San Fernando Electric Manufacturing Co., West-Cap Div.

CIRCLE NO. 293

New Literature

Scientific instruments

The latest edition of the 68-page Heath Scientific Instrumentation catalog is available. It is packed with instruments for industrial and academic laboratories such as the popular Malmstadt-Enke line, modular digital and spectroscopy systems, and chemical, biological and physical equipment. It also includes the regular Heath-kit line of instruments such as oscilloscopes, voltmeters, power supplies, generators, decades, transistor testers, impedance bridges and accessories. Heath Co.

CIRCLE NO. 294

Power supplies

A complete line of stock-delivery dc power supply modules including the latest miniaturized power supplies and rack assemblies is shown in a new six-page short-form catalog. The catalog is arranged to provide designers with the necessary specifications and prices for easy and proper power supply selection. ACDC Electronics Inc.

CIRCLE NO. 295

Connection systems

Completely revised and expanded to 16 pages, a guide describes how new contacts, staked and dip-soldered to perpendicular, parallel, or tandem PC boards, constitute a high-reliability low-cost connection system. The contacts are supplied with proper spacing for insertion in PC boards and are imbedded in disposable strips that facilitate installation. Elco Corp.

CIRCLE NO. 296

Instrumentation

Optical test instruments and data systems are outlined in a new series of data sheets. The equipment can make digital measurements of radiation and differential temperature from the far-infrared region to the ultraviolet. These systems can operate with or without an automatic on-line data processing calculator. Cintra Inc.

CIRCLE NO. 297

Data processing

"Stepping up Performance" is a 20-page catalog that describes 15 public electronic data processing training courses, and gives presentation schedules for major U. S. cities. Seminars and workshops described are presented at three levels: overviews of data processing for non-technical corporate executives, training in managerial and control techniques for data processing directors, and training in systems analysis and programming for technical personnel. Brandon Systems Institute.

CIRCLE NO. 298

Power supply kits

A new building-block concept in power supply design called "Power Kits" is described in a 12-page booklet. The concept involves putting together a series of major components and complete circuit specifications, which are designed to specific performance standards, for building power supply kits. Lambda Electronics Corp.

CIRCLE NO. 299

IC op amp applications

Two new application reports discuss the use of the SN72709 operational amplifier integrated circuit. Application report CA-149 describes in eight pages, two circuits which have logarithmic or exponential characteristics. Application report CA-151 covers in eight pages three methods of compensating amplifier frequency. Texas Instruments, Inc.

CIRCLE NO. 340

Metal film resistors

A 16-page designer's guide shows design engineers how to get the maximum benefit out of a line of ultra-precision high-stability metal-film resistors. The guide contains a chart showing the performance of typical metal film resistors within the limits specified by MIL-R-55182C and MIL-R-93. Airco Speer Electronic Components.

CIRCLE NO. 341

Semiconductors

A comprehensive 32-page guide to a line of semiconductors is available. It contains charts, diagrams and complete specifications for both standard and industrial semiconductors. Among the standard types included are germanium and silicon diodes and transistors and NTC resistors. The industrial types covered include silicon charge-storage varactors, magneto resistors, and Hall-effect devices. Siemens Corp.

CIRCLE NO. 342

Modular enclosures

A complete line of modular enclosures for electronic instrument systems is available in a 28-page catalog. Four different frame configurations are featured. These are straight-front, slope-front, wedge-front and slope-front-wedge styles. Also featured are a wide range of accessories such as doors, panels, bases and casters. Complete outline dimensions are given. Honeywell Inc.

CIRCLE NO. 343

Photo-sensitive cells

A complete listing of light-sensitive devices with typical characteristic curves is included in an illustrated catalog. The listing includes silicon cells, solar power modules, readout arrays, cell standards and selenium cells. Technical discussions cover the theories of operation, response characteristics and circuit applications. A multitude of curves and circuits is included. International Rectifier.

CIRCLE NO. 344

Product checklist

A highly simplified checklist that highlights essential information about resistors, capacitors, microcircuits and edge connectors is available. It is organized to give engineers and procurement officers instant access to basic data covering each component. Mepco, Inc.

CIRCLE NO. 345

Computer manual

A 660-page systems manual for the Raytheon 706 computer is available. It provides the basic information required for programming and using the 706 computer and features detailed information on the computer's organization, addressing, instruction repertoire and classes, software, and detailed specifications. Raytheon Computer.

CIRCLE NO. 346

Graphic art supplies

A complete catalog of graphic art supplies for the draftsman, engineer, artist, architect, student and designer is available. It contains such items as drawing instruments, triangles, drafting machines, scales, templates, and many others that are fully illustrated with descriptive literature. Plasticoid Products Inc.

CIRCLE NO. 347

Delay lines

A four-page brochure containing a series of lumped-constant delay lines is available. It includes general descriptions, applications, mechanical details, electrical specifications and outline drawings. Engineered Components Co.

CIRCLE NO. 348

Ceramic capacitors

The complete line of Mucon subminiature ceramic capacitors are described in a 12-page catalog. These units cover a full range of temperature coefficients with capacitance values as low as 0.5 pF. Republic Electronics Corp.

CIRCLE NO. 349

Television equipment

A new folder about a 1970-1971 line of closed-circuit television equipment and video tape recording equipment is now available. Panasonic VTR/CCTC.

CIRCLE NO. 350

Bulletin board

of product news
and developments

DUAL (Dynamic Universal Assembly Language), a practical software program, is a new machine independent processor for creating user languages. Able to define languages for specific or general applications, DUAL makes it possible to communicate with a computer in the user's jargon, or in terms which are intended for a particular application. It is immediately operational on most major computers and can be adapted to run on any new computer in only one or two months. Dual was developed by Proprietary Software Systems, Inc., Los Angeles, Calif. a sub. of Image Enterprises Inc.

CIRCLE NO. 351

BASIC computer language is now available for use with Digital Equipment Corp.'s recently introduced PDP-11 small computer. The new package requires only 4096 words of core memory.

CIRCLE NO. 352

Plated-wire memory elements are now available from Nemonic Data Systems, Inc., Denver Colo. This NW-100 plated wire is expected to find application in high-speed, non-destructive readout, random-access and read/write memories. For 15-in. lengths, the cost will be 10¢ per inch for 100,000 wires.

CIRCLE NO. 353

At the flick of a switch, a new microphone from Ingenuics, Inc., Gaithersburg, Md., can either accept or reject environmental sounds. Through its switchable distance-discriminating network, the microphone can uniformly pick up all sounds, both near and far — or it can respond primarily to near sounds while greatly suppressing those that are distant. The unit, which has a "T" shape, contains two cartridges whose outputs either add or subtract, depending on the operation mode.

CIRCLE NO. 354

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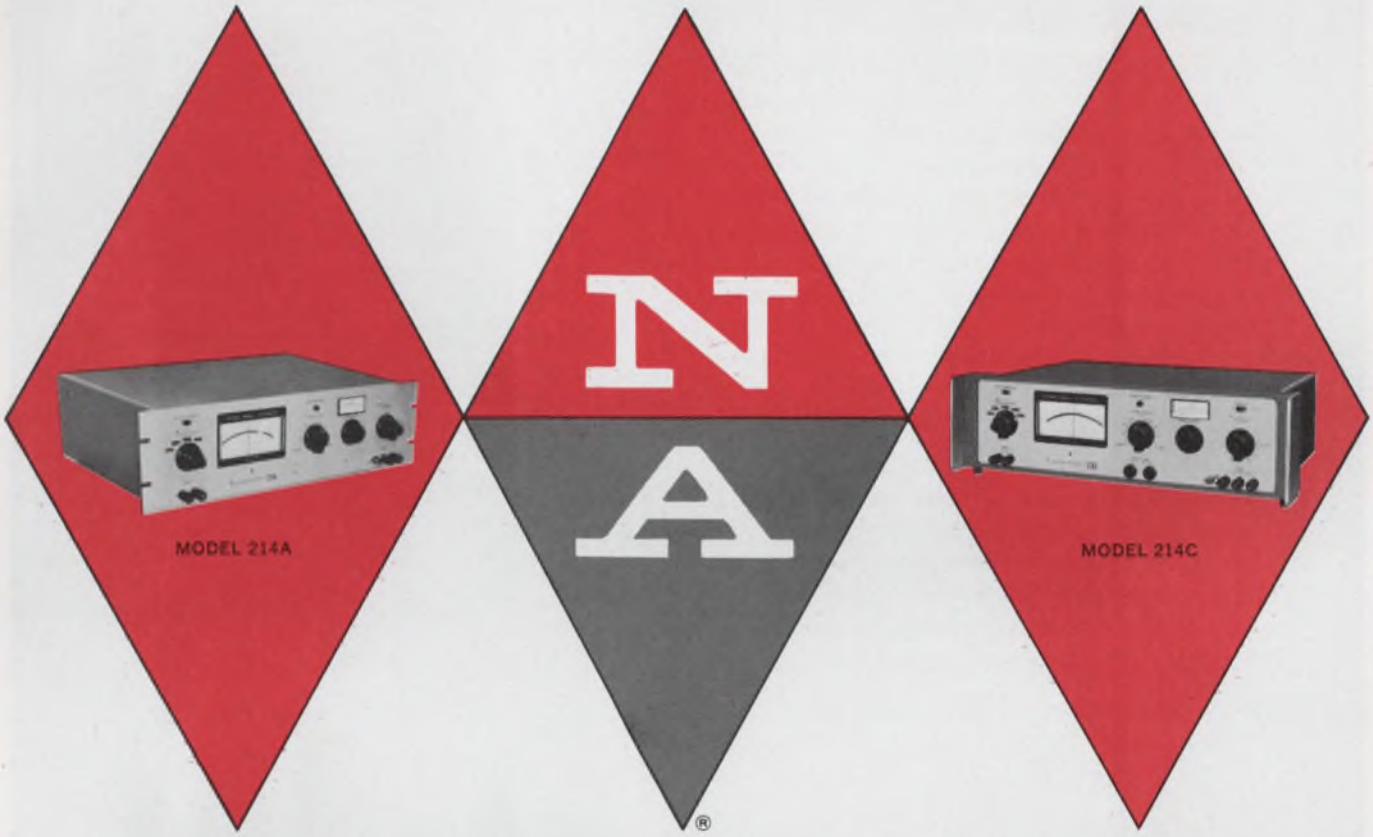
Advertisers' Index

OUR ANGLE: four frequency phase voltmeters



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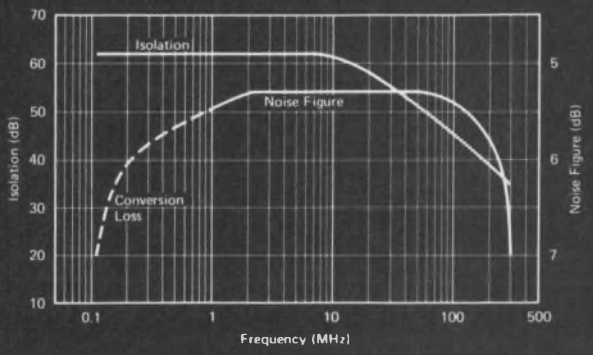
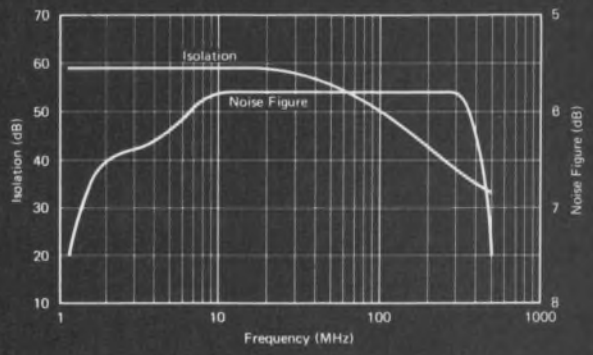
Need more information? Check the isolation and noise figure curves. Better yet, circle our number on the Reader Inquiry Card and we'll send you additional M6S and M6T data, plus a catalog of other RELCOM products. Or, call us collect. Ask a RELCOM sales engineer for your own evaluation unit. Delivery from stock.

Price: M6S $52.00 ea. 1–4 units
M6T $55.00 ea. 1–4 units

M6S



M6T



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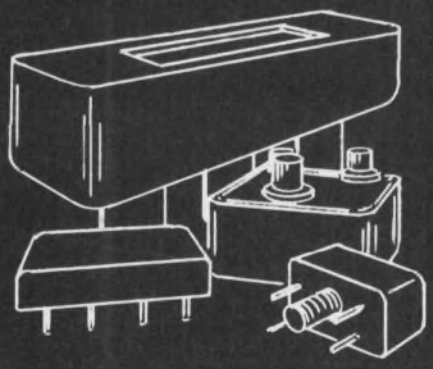

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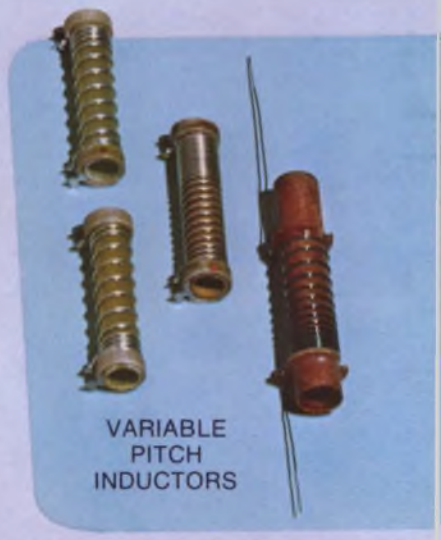

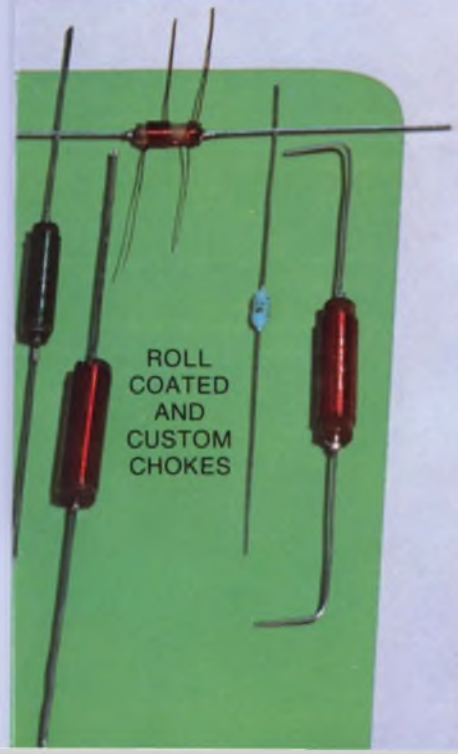

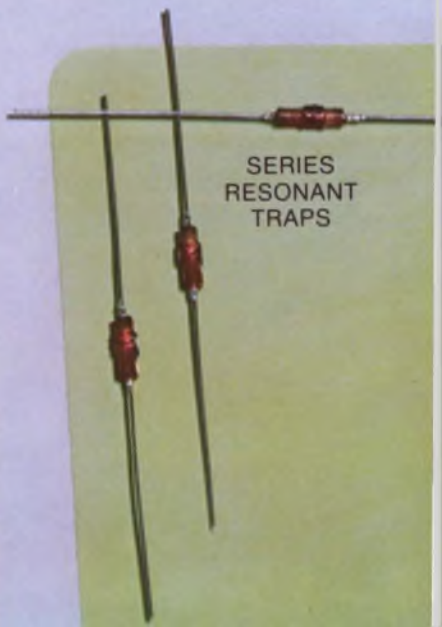

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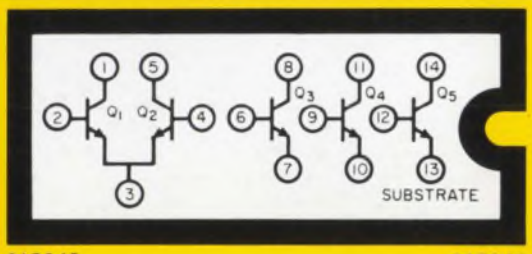

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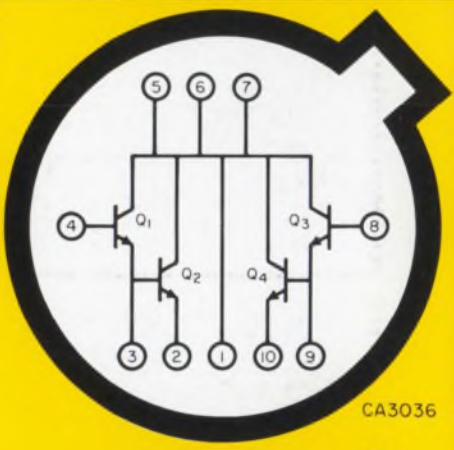
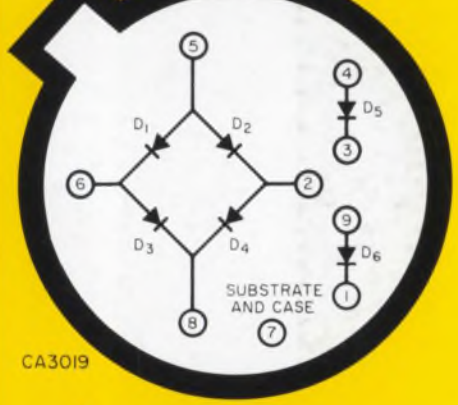


CA3036

Device Type	Package	Description	Technical Bulletin File No.	Price (1000-unit level)
CA3018	12-lead TO-5	Two isolated transistors and Darlington-connected transistor pair	338	$ .98
CA3018A	12-lead TO-5	Premium version of CA3018 (performance controlled)	338	1.35
CA3019	10-lead TO-5	One diode-quad, two isolated diodes	236	.98
CA3026	12-lead TO-5	Dual differential amplifier	388	1.25
CA3036	10-lead TO-5	Dual Darlington array	275	.89
CA3039	12-lead TO-5	Six matched diodes	343	.98
CA3045	14-lead DIL ceramic	Differential amplifier and three isolated transistors	341	1.50
CA3046	14-lead DIL plastic	Differential amplifier and three isolated transistors	341	.98
CA3049	12-lead TO-5	Dual independent differential RF/IF amplifiers	378	1.95
CA3054	14-lead DIL plastic	Dual independent differential amplifiers	388	1.25



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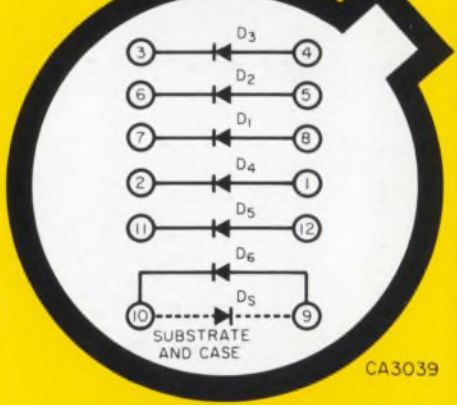

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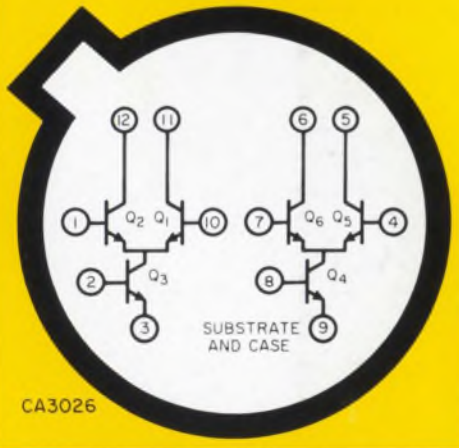

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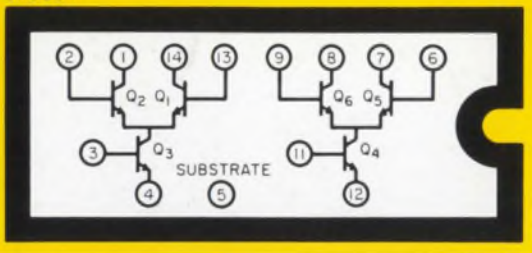

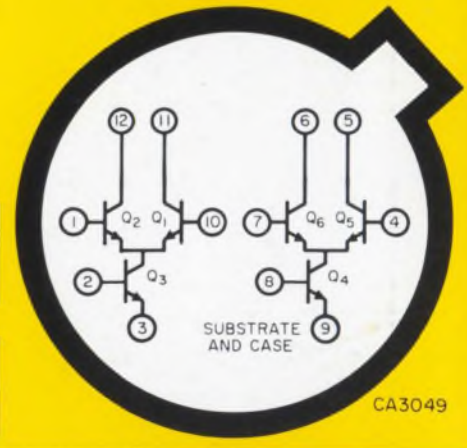

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