

IC blocks for analog computers 96

\$1.00 A McGraw-Hill Publication

Color tv tint control made easy 102

August 4, 1969

Electronics markets—a midyear report 107

Electronics®

Triple trace scope

40-kilohertz scan

Precise color convergence

Fast comparator circuits



It's a GRrrrand Counter

Aye, that's what you'll think of our new counter. From its wee size to its big performance, the 1192 is new in every respect.

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You can select an 1192 with 5, 6, or 7 digits, with or without BCD output, and for bench or rack use. And if 32 MHz is not enough frequency range for you, add our new 1157-B scaler (same size) to the 1192 and zoom up to 500 MHz. The counter/scaler combination, the 1192-Z, has a common cabinet. There's more, lots more, to tell about the 1192; we'll gladly send you a free data sheet upon request.

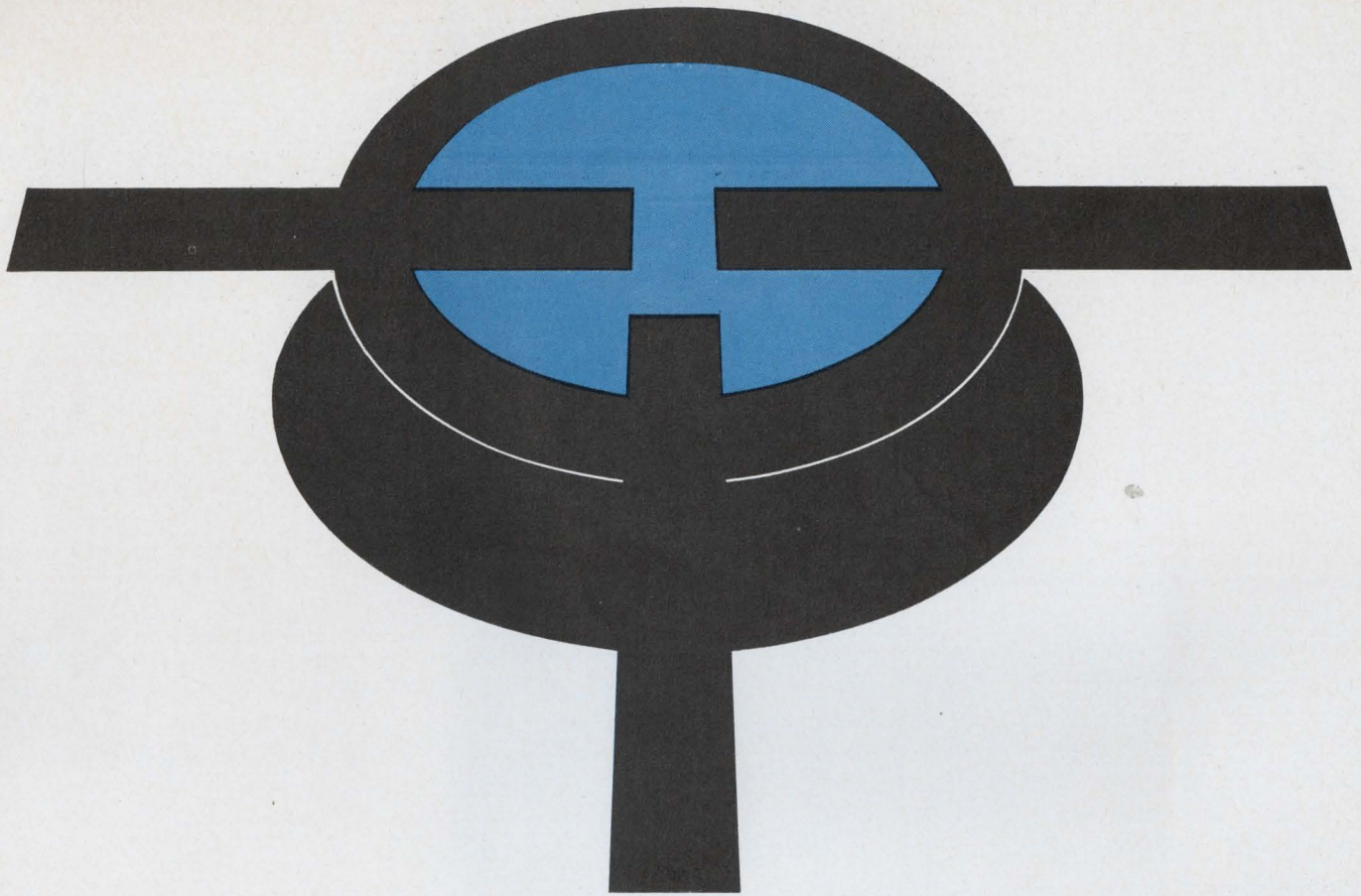
But the grandest part of all about the 1192 is the money you'll save when you buy one. Prices* range from \$575 for the 5-digit bench model without data output to \$845 for a 7-digit rack model with data output. You can add the scaler for another \$850. Imagine, a 500-MHz counter for as little as \$1425. Man, that's a real bargain. You can save quite a few more dollars by ordering two or more units and taking advantage of GR's quantity-discount plan. Discounts range from 3% for 2-4 units to 20% for 100 units.

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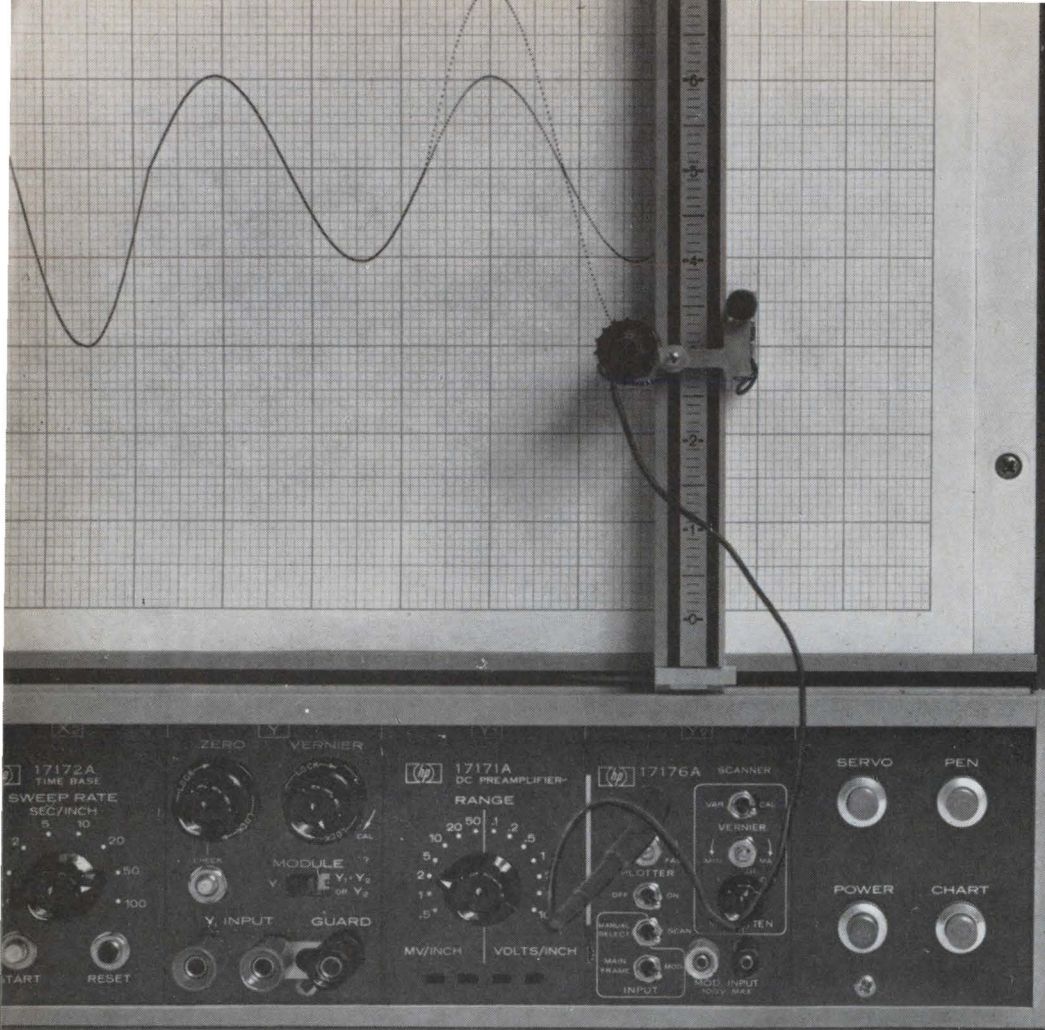
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04905



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Hewlett-Packard now offers you a new extra advantage in X-Y recording — the 17176A Dual-Trace unit — a new accessory for the world's first truly "plug-in" recorder, the 7004A. It lets you plot, with a standard recorder, two variables against a third — without the expense of a two-pen system.

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GRAPHIC RECORDERS

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Electronics

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Publisher: Gordon Jones

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Electronics: August 4, 1969, Vol. 42, No. 16

Published every other Monday by McGraw-Hill, Inc. Founder: James H. McGraw 1860-1948.
Publication office 99 North Broadway, Albany, N. Y. 12202; second class postage paid at Albany, N. Y. and additional mailing offices.

Executive, editorial, circulation and advertising addresses: McGraw-Hill Building, 330 W. 42nd Street, New York, N. Y. 10036. Telephone (212) 971-3333. Teletype TWX, N. Y. 710-581-4235. Cable address: MCGRAWHILL N.Y.

Subscriptions solicited only from those professionally engaged in electronics technology. Subscription rates: qualified subscribers in the United States and possessions and Canada, \$8.00 one year, \$12.00 two years, \$16.00 three years; all other countries \$25.00 one year. Non-qualified subscribers in the U.S. and possessions and Canada, \$25.00 one year; all other countries \$50.00. Air freight service to Japan \$50.00 one year. Single copies: United States and possessions and Canada, \$1.00; all other countries, \$1.75.

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Readers Comment

Clouding the picture

To the Editor:

Your newsletter concerning the performance of the Dants night-vision system [May 12, p. 75] is badly misleading. Unfortunately, it has stimulated a fairly large amount of work at considerable cost by systems manufacturers interested in the military market. Various companies have requested their technical staffs to reopen their thinking to confirm or deny the inference of your newsletter.

In general, one would never expect a tube with the characteristics of a lead-oxide vidicon or Oxicon to be compatible with high-quality, low-light-level performance because of the high target capacitance.

Lucien M. Biberman
Institute for Defense Analysis
Arlington, Va.

■ In a forthcoming issue of *Electronics*, Mr. Biberman will expand on some of the arguments concerning the application of various tv tubes in a signed article.

Credit where it's due

To the Editor:

You did a "spin-out" when it came to crediting the manufacturer of the multihead disk recorder used to read out the color signals in parallel format for the Apollo 10 mission [July 7, p. 114]. It was a standard recorder made by Data Disc Inc. that was used at NASA's Manned Spacecraft Center at Houston.

R.R. Troxell

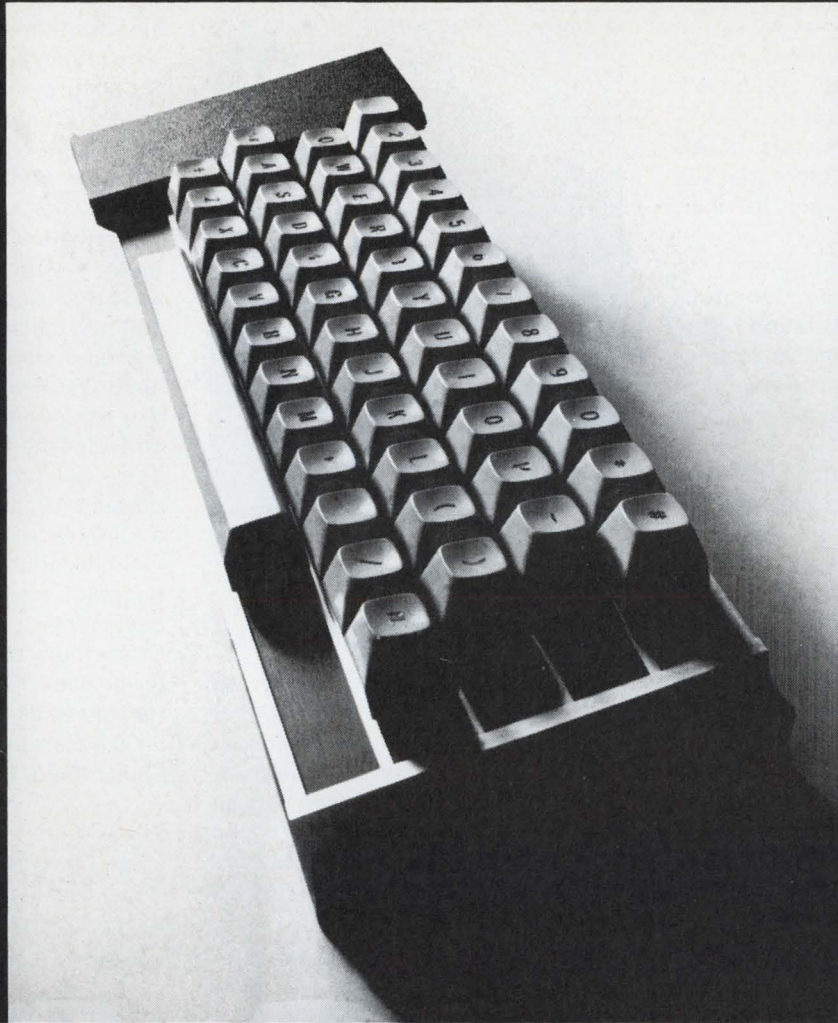
Data Disc Inc.
Palo Alto, Calif.

'Black-box' tariff

To the Editor:

Regarding the "black-box" tariff [April 14, p. 69], perhaps your readers aren't aware that Magnavox, too, is involved in this market. Magnavox developed such a device in 1965 and licensed Xerox to

If you have more brains than money...



If you could eliminate the semi-conductors from a computer, and still get the same performance, could you see some dollars saved? Could you see higher reliability?

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And we saved you money. The Synergistics Self Encoding Keyboard is only \$68 in quantity orders.

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Synergistics, Inc.

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Yes, I am interested in the Synergistics Self Encoding keyboard. Please send me:

- Additional technical information.
- Instructions for ordering one keyboard for evaluation, made to my layout specifications. Prices to be included.

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We have AC meters, lots of AC meters. We have AC meters that sell for more than \$4500—and for their job, they can't be beat.

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These instruments are packed with convenience features. Two of these meters have a built-in 100 kHz low-pass filter to take out unwanted high frequencies for low-level audio mea-



surements. You get fast response—a reading in less than 2 seconds after turn-on, and <2 seconds overload recovery. These instruments have an internal wideband ac amplifier, with an 80 dB gain—so we put an output on the back. With all these you can have the log scale uppermost for greater resolution in dB measurements.

Each HP-made taut-band suspen-

sion friction-free meter movement is individually calibrated to its scale for accurate readings over the entire range. Elimination of friction gives these meters excellent repeatability.

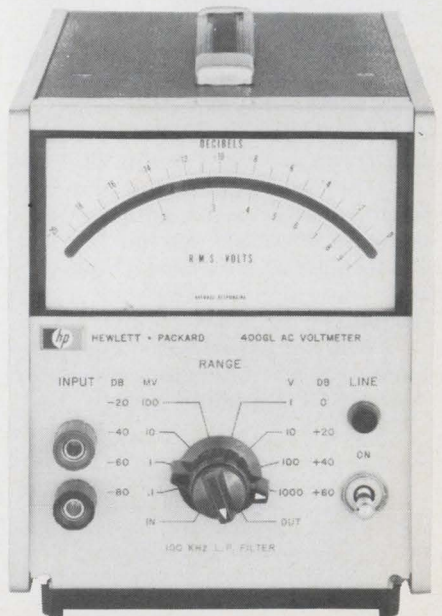
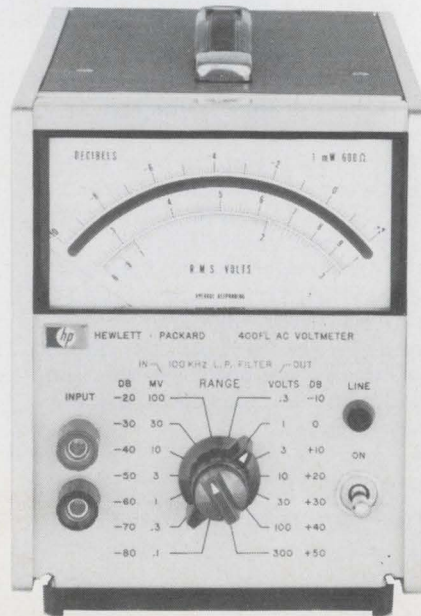
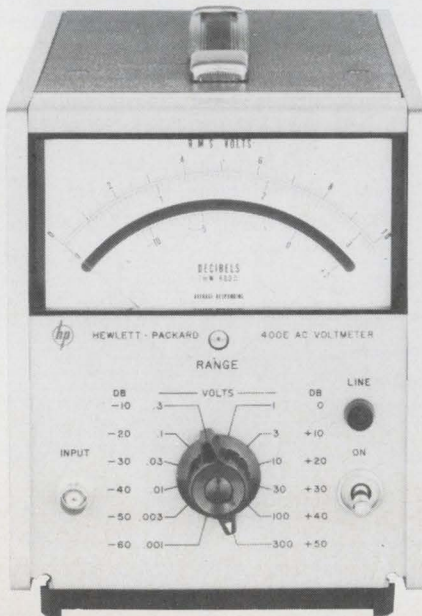
These, and more, are the features that assure reliable, day-in, day-out performance that gets the job done on time. If your problem is in sonar, acoustics, audio response, communications, calibration, ac to dc conversion and amplification—or any other application where precision ac voltage measurements are a must—then consider the HP 400 series carefully. They will fit your measurement requirements, leave your wallet fatter, and make your job easier and faster.

Check your HP catalog, starting on page 201, and choose the meter that best meets your measurement needs. Order today by calling the nearest HP order desk. For data sheets, write to Hewlett-Packard, Palo Alto, California 94304. Europe: 1217 Meyrin-Geneva, Switzerland. Price: \$275 to \$390.

099/18

HEWLETT  PACKARD

ANALOG VOLTMETERS



Readers Comment

market the unit. Xerox is now marketing its own unit and paying royalties to Magnavox.

Both companies are competing directly, but with compatible equipment—an influencing factor on the future facsimile market.

James R. O'Malley
Magnavox Systems Inc.
New York

Aeronautical, not aviation

To the Editor:

In mentioning the Ryan Aeronautical Co.'s landing radar on the Apollo 11 lunar module [July 7, p. 62], you inadvertently called the company Ryan Aviation. Moreover, the system isn't new. It was first tested in space on Apollo 9 and was used on Apollo 10 to measure the low point of the pass over the moon and to test lunar radar reflectivity.

Robert P. Battenfield
Ryan Aeronautical Co.
San Diego, Calif.

Out of the picture

To the Editor:

While it is true that the TelePrompTer Corp. was engaged in developing a subscription-tv system a number of years ago, the company no longer is actively engaged in this project and no longer can be counted among the would-be pay-tv entrepreneurs you cited

in your article [May 26, p. 123].

TelePrompTer presently is concentrating on cable-tv systems.

John R. Barrington
TelePrompTer Corp.
New York

Aesthetics, continued

To the Editor:

Regarding the use of standards, your reply to Mr. Soanes letter [July 7, p. 7] rather amazed me. While the use of standards is not mandatory, except in military documents, it is difficult to follow your reasoning as to "communicating better without them." Surely the IEEE and the EIA have the same problems of aesthetics and communication, yet they follow the standards in all their documents.

The important thing to remember is that the electrical and electronics industries spend large sums and many man hours to establish national and international standards. It is therefore discouraging to find a leading magazine unwilling to cooperate in promoting the standards.

Julian Loebenstein
General Instrument Corp.
Newark, N.J.

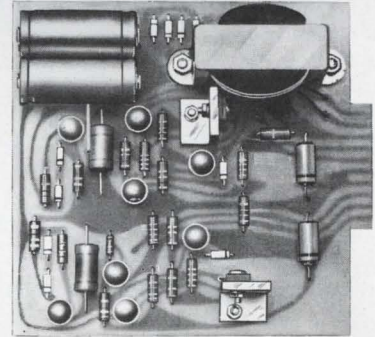
■ Mr. Loebenstein, like Mr. Soanes, is a member of the IEEE standards coordinating committee for letter and graphic symbols (SCC11), and is chairman of the committee for definitions and type designations (JS-7).

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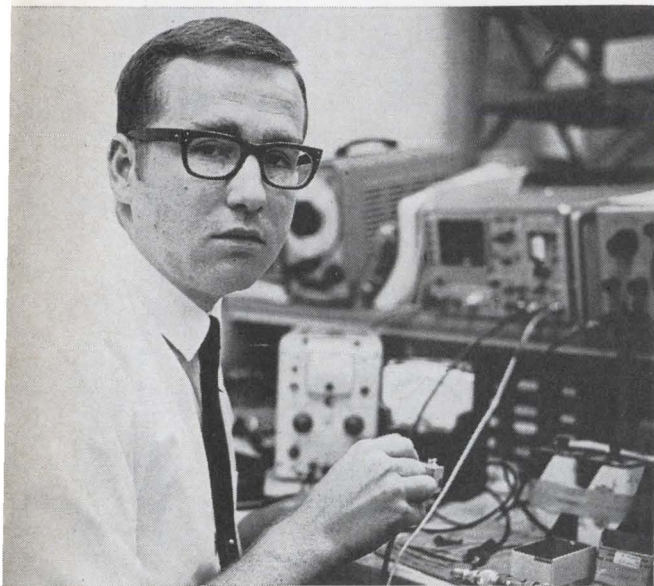
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Who's Who in this issue



McCormick

A change of scene from the Hoosier State to California appears to have agreed with Richard McCormick, whose article on Telonic's three-color scope appears on page 84. Holder of a master's degree from Purdue, McCormick joined the firm's Indianapolis labs in 1965, later transferring to the Laguna Beach facility.



Aiken

Strassler

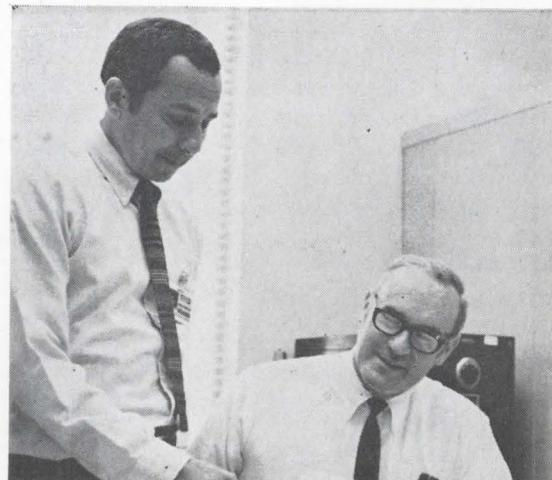
Joining forces on short notice, Eric Aiken, assistant managing editor, and David Strassler, market research manager, put together the report on the midyear state of the mart that begins on page 118. Strassler, who assembled the vital statistical data, has been with McGraw-Hill four years; he holds an M.A. from Brooklyn College. Aiken wrote the piece on the basis of detailed memos from department editors and field correspondents. A 10-year veteran of the business journalism field, he's worked at Douglas on the Thor, Nike Hercules, and Sparrow missile programs. Aiken also served as a radio/radar operator on DC-7 test flights. Inside cover photo was done by Bill Farrell.



McLin

Knauer

The two-man team of Paul Knauer and Gene McLin produced the article on Magnavox's automatic-tint control circuit for color television sets that starts on page 102. Knauer, chief engineer for color tv at the company, is a Purdue graduate and a Navy veteran. McLin training development manager for the service training department at Magnavox, is a graduate of the University of Evansville (Indiana) and has a varied background as a broadcast engineer.



Segarra

Perkins

Another twosome, Edwin Segarra and John F. Perkins, did the honors on the story about Raytheon's new analog control computer (page 96). Currently manager of the radar systems department at the company's Missile Systems division, Segarra is a CCNY graduate. Perkins heads the systems electronics group in Segarra's department.

EAGLE

*...where the
state of the art
is the standard
of the industry*



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Send for Bulletin 158

CG 300 OFF-DELAY Timer

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Send for Bulletin 159

NEW CE 400 PRECISION Delay Timer

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Send for Bulletin 126

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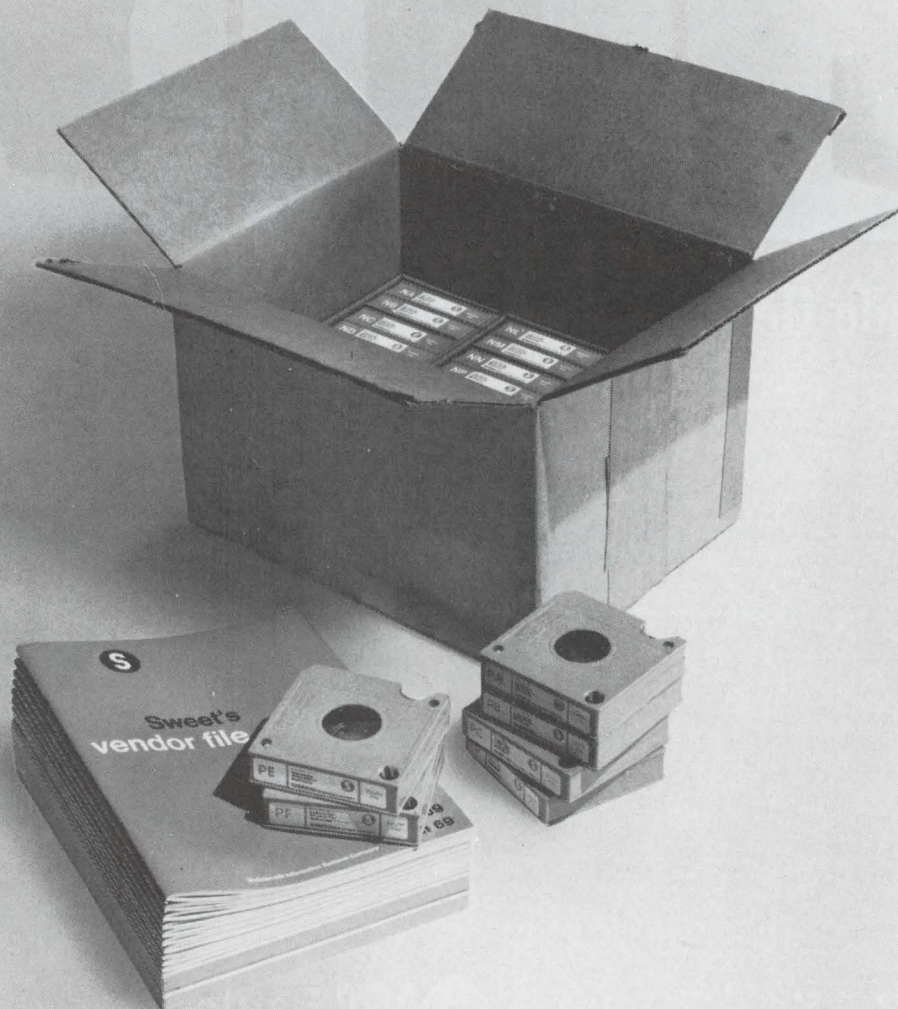
GW Eagle Signal Division
A GULF + WESTERN COMPANY

Davenport, Iowa 52803

The February update: 82,400 pages of product data

The April update: 95,100 pages of product data

The June update: 90,400 pages of product data





Every other month, Sweet's Microfilm System packages the data explosion

In 5 minutes, you can collect, index and file the data explosion. That's the amount of time you'll spend every other month putting the latest Sweet's Microfilm System update into the cartridge carousel. Essentially zero-maintenance; Sweet's has done all the work.

We mail about 30 cartridges in each bimonthly update of our product/vendor file. The *total* of current information is already more than three-quarters of a million pages. *More current information than contained in any other system... updated more often, more thoroughly, than any other system.*

A typical update will contain new and revised data from about 800 important industrial suppliers... 75% of them new to the file. For example we've recently added a 3500-page apparatus handbook... and lots of smaller but equally important firms too. And we keep them all up to date.

How could you possibly keep up with all this new data? Obviously, you can't. Sweet's can, with a simple plan and

a computer. The plan is simply that we don't charge anyone to get their data into our File. *So we get all their data, and new information as soon as it issues.*

Then a computer takes over, after we've thoroughly indexed the new data. A complete new index is printed out by computer for every update. Over 6,000 product entries, plus vendor index, speed you to the right information in minutes. (You'd have a terrible time finding data if we just issued supplemental indexes with the updates.) If you want a copy of the data you've found, our reader/printer delivers one in 6 seconds... *and the File remains wholly intact.* No data gets borrowed, and the cartridges easily go back into the carousel without filing confusion.

Sweet's Microfilm also has several other important data packages. Our MIL Specs file has all of them, complete, updated with a new index every month. Another package contains five important sets of MIL Standards. And, we've just added the ASTM Standards to the system, *exclusively.*

These standards are conveniently offered in four sections, with automatic updating every two months.

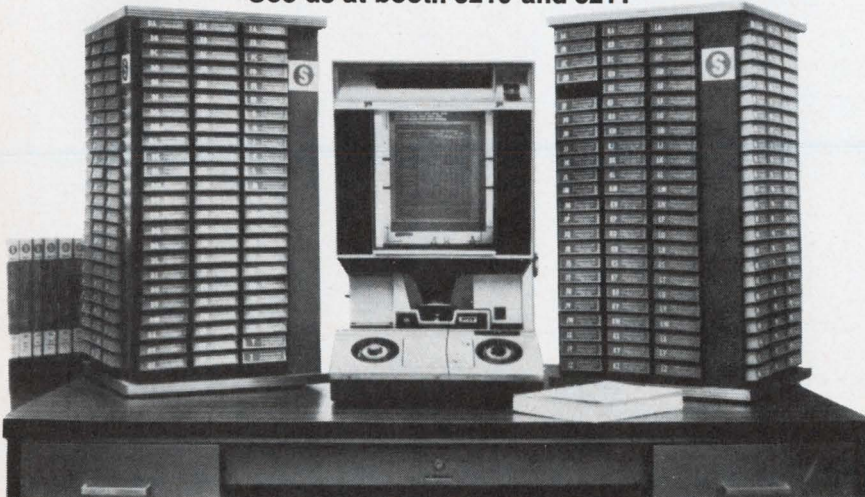
Now, Sweet's introduces a new data system: Characteristic Search. The capability is fast survey and comparison of product areas. The first segment, the six-volume Electronic Instruments Edition, will issue shortly. More than 35,000 electronic instruments have been described with up to 15 important parameters; manufacturer's data is in the Microfilm System for final reference if needed. Use the coupon to get information on this new system.

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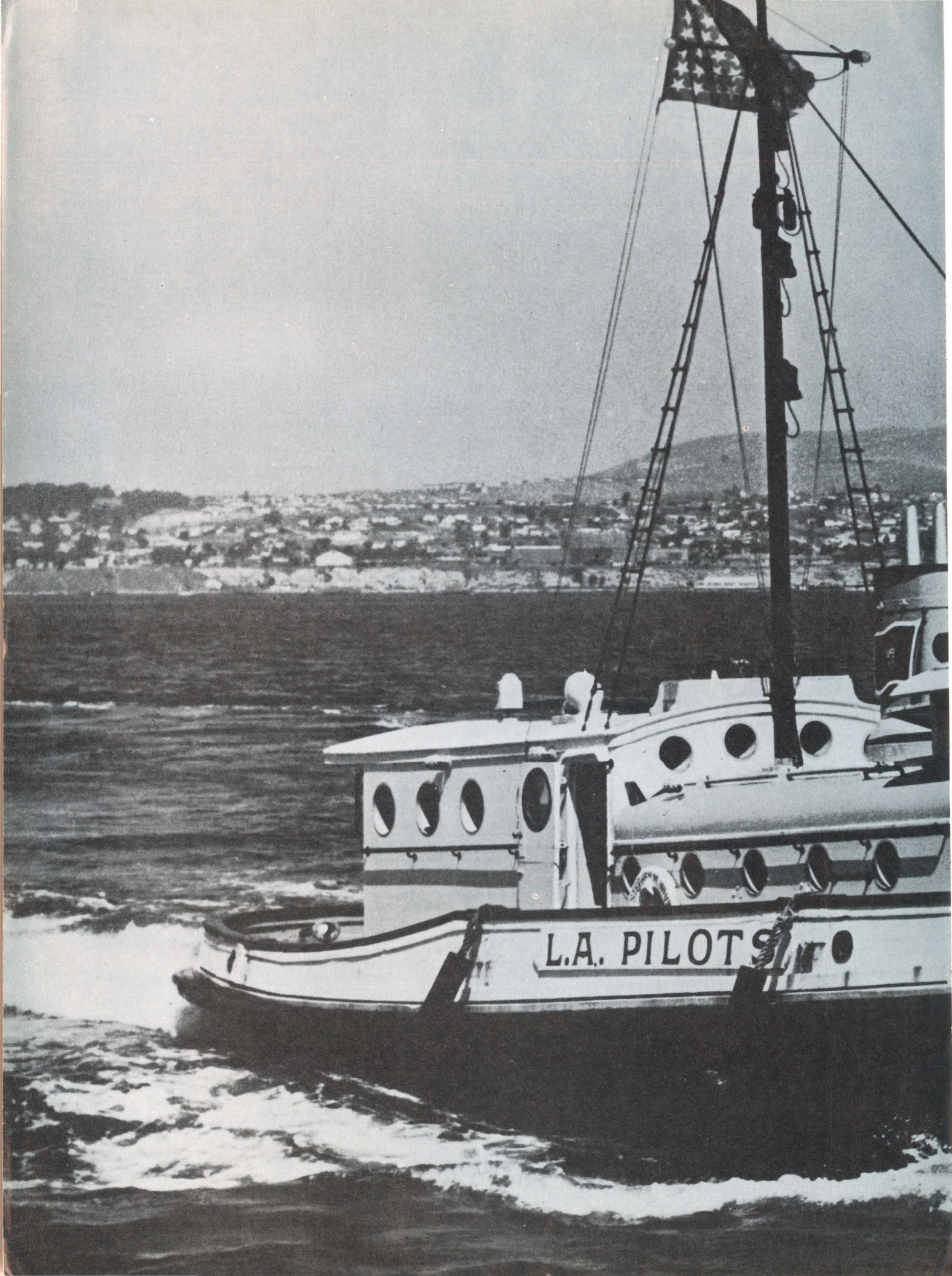
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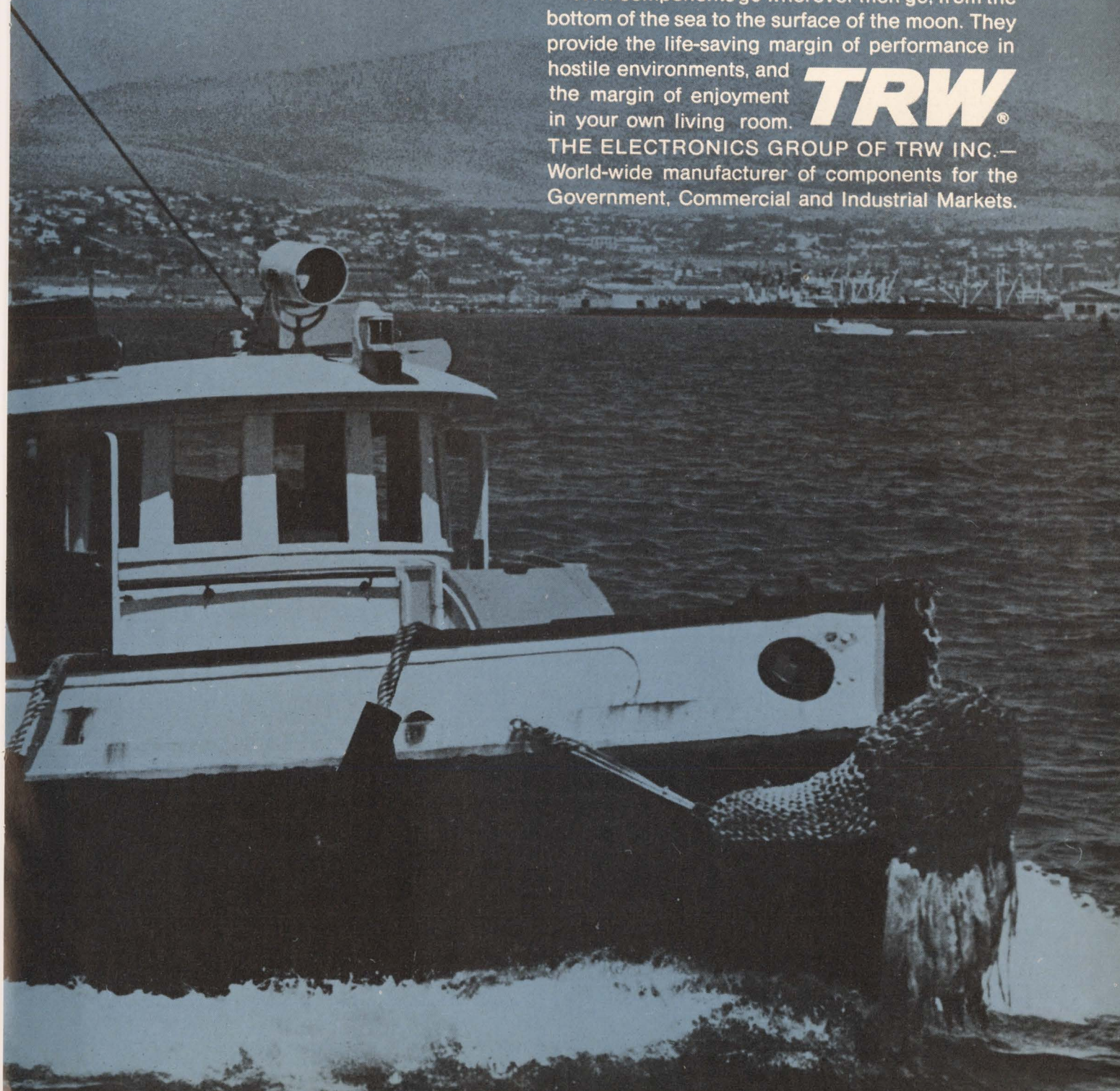
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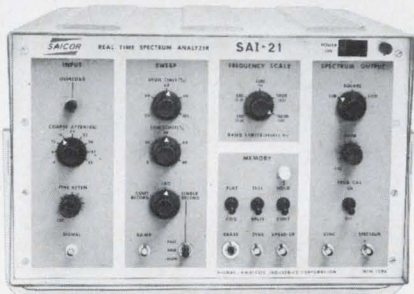
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Who's Who in electronics



RCA's Rajchman

The grand old man of memories, as Jan Rajchman is sometimes called, may not be so old after all. For one thing, on his birthday next week he'll be only 58. And for another, Rajchman, who has just been appointed staff vice president in charge of the Information Sciences group at RCA Laboratories, is still very much in the thick of new memory development.

Officially, Rajchman, in his new job, is responsible for directing "a number of exploratory ventures in the information sciences." But according to Rajchman, this can be interpreted specifically as developing an optical computer memory.

Optics ahead. It's no secret to Rajchman, or anyone else in the computer industry, that optics offer far denser information-packing capacity than present-day memory systems, including those of the semiconductor variety. The question is, however, what form such a memory would take and when it would be available.

Rajchman believes the industry will see its first optical memory in product form in the mid-1970's. "In the last two years we've made great progress. Now we believe that we've taken most of our concepts off paper and turned them into laboratory developments. The next stage is improving and refining what we've already done, and then we'll have to build our developments into a system. That's

the really monumental job," he says.

The latest development to come from Rajchman's group is a read/write, or erasable, hologram which has a potential density of 10^8 bits per square centimeter. Basically, Rajchman explains, it's a manganese bismuth-coated magnetic substrate, which when struck by laser light, changes magnetic direction at 1.5 light-wavelength intervals.

In its final form, according to Rajchman, the optical memory may well be used as a very large mass, or archival, memory in conjunction with the fast transistor memories.

Rajchman looks upon his new position (previously he was staff vice president for data processing research at the labs) as a combination of line and staff work. "In one sense, I'm sort of a salesman to upper management, but I'm also very closely tied to research."

Almost two years had passed more or less quietly at Litton Industries' Litcom division after it rose from the ashes of what was called the Westrex communications division. But four months ago, Herbert L. Robinson—Litcom president for only seven months—left suddenly. And for more than three months, while Litton searched for a successor to Robinson, an air of uncertainty settled over Litcom's Mel-

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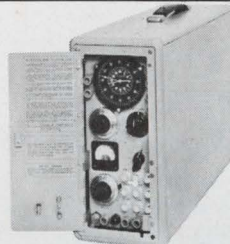
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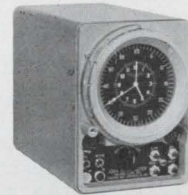
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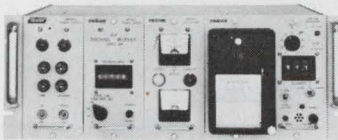
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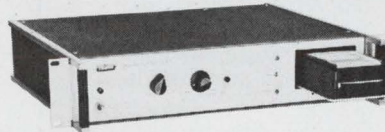
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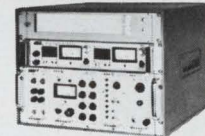


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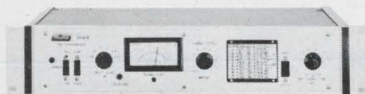


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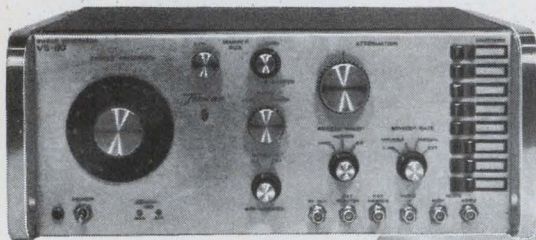
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well as in the popular laboratory/field model. Write for free descriptive literature with complete technical details.



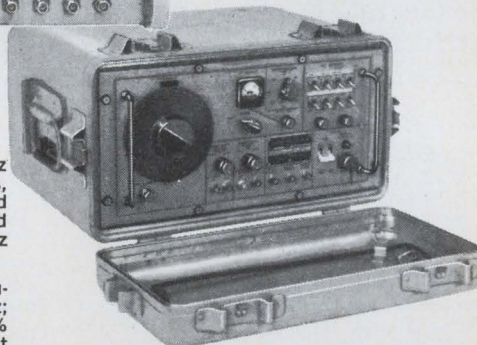
key specifications

LABORATORY UNIT

Frequency Range: 1 MHz to 1200 MHz in two overlapping, switchable bands, 1-300 and 290-1200. Can be centered on any frequency between 1 MHz and 1000 MHz and sweep up to 1200 MHz at maximum sweep.

Sweep Width: On the low band, continuously variable from 50 kHz to 300 MHz; on the high band, can be varied to 40% at 1000 MHz. Unit also has CW output mode for signal generator applications.

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Model VS-80 \$1550.00 Model VS-80 DH \$3050.00 (Combination Case)
Delivery is within four weeks maximum; in some cases models and accessories are available from stock.



Texscan CORPORATION

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Who's Who in electronics



Litcom's Norsell

ville, Long Island, plant.

With the appointment of Paul E. Norsell, 36, as president, optimism has returned.

Norsell who, unlike Robinson, comes to Litcom from another Litton division (he was vice president for engineering at the Data Systems division in Van Nuys, Calif.) feels confident that he can chart a steadier course than Robinson did. He knows what's expected of him because he's been with Litton for almost six years.

Systems. As explained by Norsell, Litcom is fast assuming the posture of a communications systems house selling such items as radios, high-powered r-f, loran and Omega equipment, as well as such interior communications gear as multiplexing systems. Neither the size nor the reputation of competitive firms—among them, RCA, Collins Radio, and Bendix—awes him.

Even the fact that most of Litcom's work is aimed at military markets at a time when many firms are trying to reduce the percentage of their military work does not worry Norsell. "We'll stick with military work," Norsell says confidently. He anticipates Litcom's making proposals for a number of long-term military programs including the on-again, off-again Awacs program.

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What to do about the headache of small "problem" parts? Make them yourself? That means a major investment in special machinery and skilled labor. If you already make them, how do you know somebody else can't make them for you more economically?

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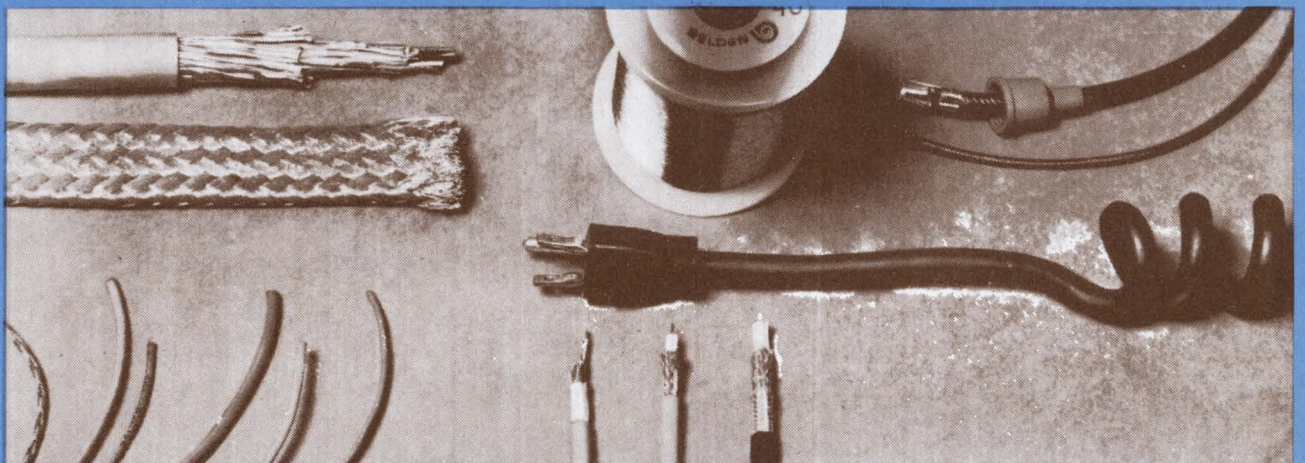
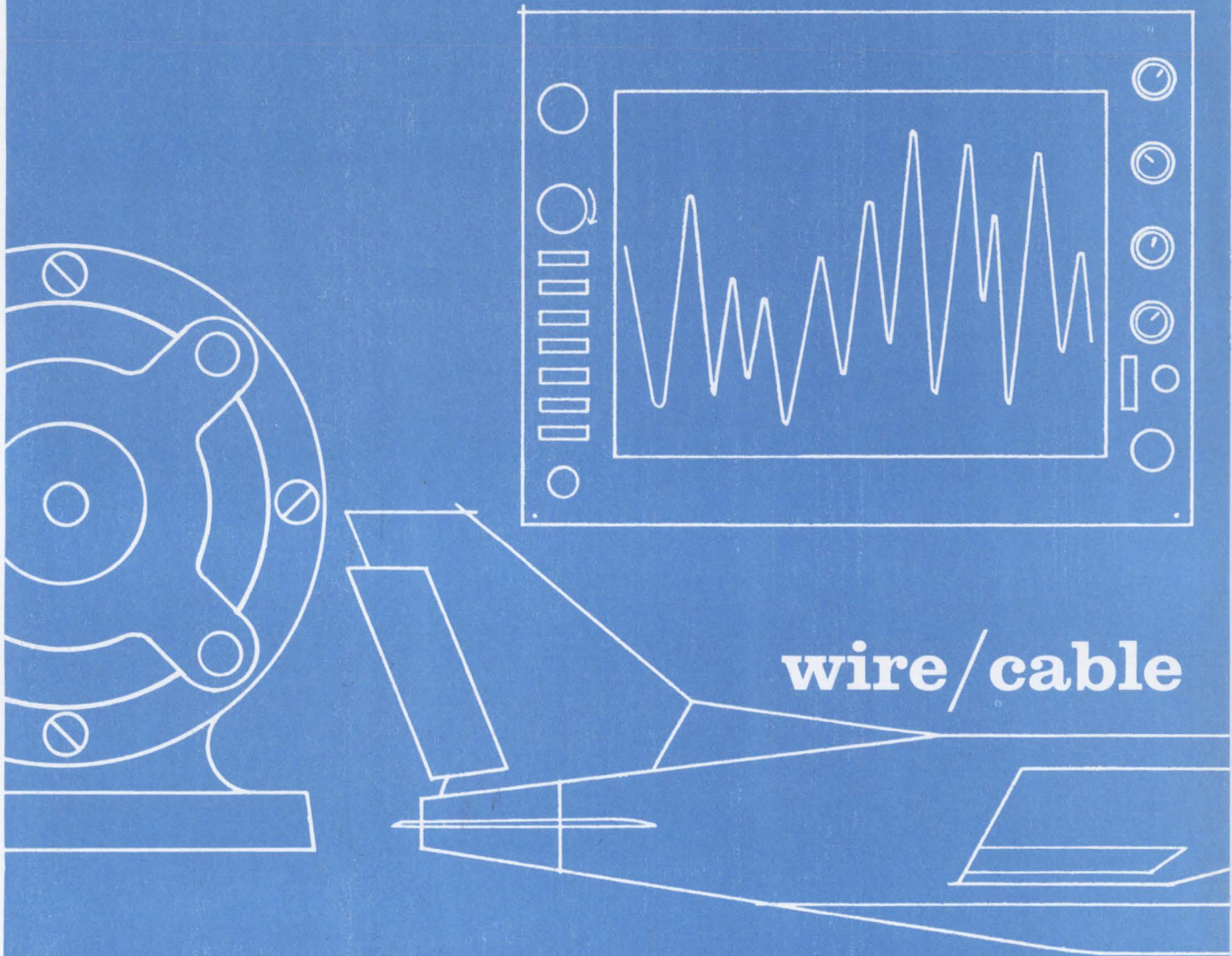
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what FMG can do for you. Send a blueprint; they'll do the rest.

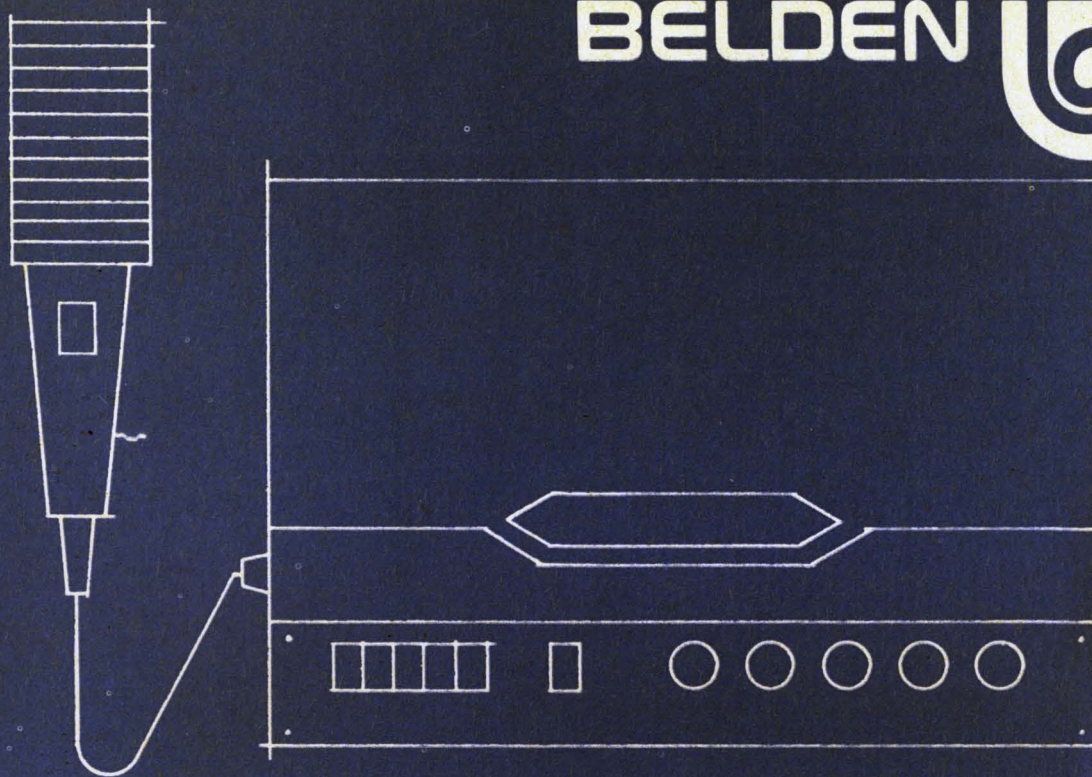
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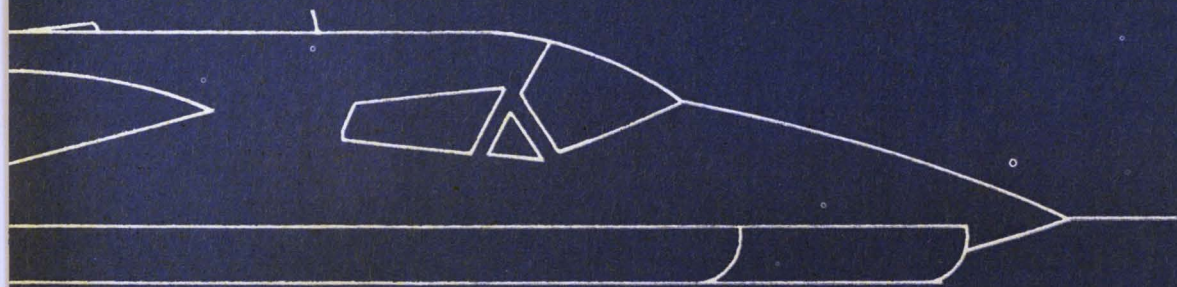
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idea into reality . . . well, we make all kinds of wire for all kinds of systems. Why not see what we can imagine for your product? Call or write: Belden Corporation, P.O. Box 5070-A, Chicago, Illinois 60680. And ask for our catalog, and the reprint article, "Key Questions and Answers on Specifying Electronic Cable."

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Meetings

Showing the way to strapdown guidance

While hardware for strapdown guidance will be evaluated in several papers at this month's Guidance, Control, and Flight Mechanics Conference, most of the papers will deal with flight mechanics and control concepts. The conference, sponsored by the American Institute of Astronautics and Aeronautics, will be held at Princeton University in Princeton, N.J., Aug. 18-20.

Three researchers from MIT's Instrumentation Laboratory will present results of an evaluation made on a strapdown package containing single-degree-of-freedom gyros in a digital torque-to-balance control loop. The three are J.P. Gilmore, R.A. McKern, and D.W. Swanson.

Real time. Two Raytheon engineers, J.B. Matthews and G.R. Taylor, will discuss the feasibility of a strapdown system that uses a gen-

eral-purpose computer. And in another paper, F.A. Evans and J.C. Wilcox of TRW Systems will describe a strapdown redundant-sensor package containing six gyros and six accelerometers. Sensor signals are processed in real time by a digital computer.

Another strapdown system will be described by P.G. Savage of Honeywell in a session on optical-and radar-guidance techniques. His system uses a laser phased-array seeker system for a homing missile. Also in this session will be a paper, by C.L. Wyman of NASA's Marshall Space Flight Center, describing a scanned-laser system with a random-access capability that can be applied to spaceborne radar and communications.

For information, contact Meetings Department, AIAA, 1290 Ave. of the Americas, New York, N.Y. 10019

Calendar

International Photoconductivity Conference; Stanford University, Palo Alto, Calif.; Aug. 12-15.

Western Electronic Show & Convention (Wescon), IEEE; Cow Palace & San Francisco Hilton Hotel, San Francisco; Aug. 19-22.

Symposium on Programming Languages Definition, Association for Computing Machinery; San Francisco; Aug. 24-25.

Defects in Electronic Materials for Devices, Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers; Statler-Hilton Hotel, Boston; Aug. 24-27.

ACM National Conference and Exposition, Association for Computing Machinery; San Francisco Civic Center; Aug. 26-28.

Cornell Biennial Conference on Engineering Applications of Electronic Phenomena, IEEE; Cornell University, Ithaca, N. Y.; Aug. 26-28.

Education and Training Technology International Convention, IEE; London, England; Sept. 2-6.

Electrical Insulation Conference, IEEE; Sheraton-Boston Hotel & War Memorial Auditorium, Boston; Sept. 7-11.

European Microwave Conference, International Symposium on Man-Machine Systems, IEE; St. John's College, Cambridge, England; Sept. 8-12.

Convention of the Society of Logistics Engineers; Cape Kennedy Hilton Hotel, Cape Kennedy, Fla.; Sept. 9-10.

Petroleum & Chemical Industry Tech. Conference, IEEE; Statler Hilton Hotel, Los Angeles; Sept. 14-17.

International Telemetry Conference, International Foundation for Telemetering, Sheraton Park Hotel, Washington, D.C.; Sept. 15-17.

Conference on Trunk Telecommunications by Guided Waves, IEE; London, England; Sept. 15-17.

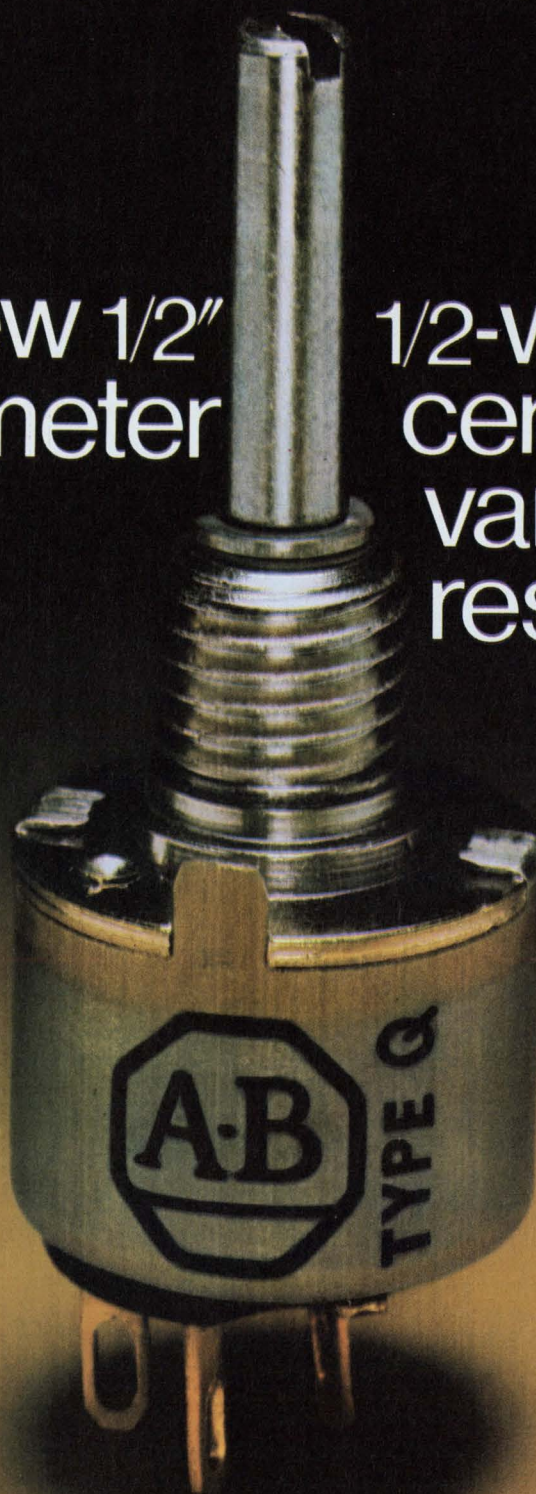
Solid State Devices Conference, IEE; University of Exeter, Exeter, Devon, England; Sept. 16-19.

Symposium on the Biological Effects

(Continued on p. 24)

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
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Meetings

(Continued from p. 22)

and Health Implications of Microwave Radiation, Biophysics Department of the Virginia Commonwealth University, Bureau of Radiological Health, Environmental Control Administration, and U.S. Public Health Service; Richmond, Va.; **Sept. 17-19.**

Annual Broadcasting Symposium, IEEE; Mayflower Hotel, Washington, D.C.; **Sept. 18-20.**

Joint Power Generation Conference, IEEE, American Society for Mechanical Engineers; Charlotte, N.C.; **Sept. 21-25.**

Annual Intersociety Energy Conversion Engineering Conference, IEEE, American Society for Mechanical Engineers; Statler Hilton Hotel, Washington, D.C.; **Sept. 21-26.**

Ultrasonics Symposium, IEEE; Chase Park Plaza Hotel, St. Louis, Mo.; **Sept. 24-26.**

International Electronics Conference, IEEE; Automotive Building, Exhibition Park, Toronto, **Oct. 6-8.**

Annual Conference of the American Institute of Ultrasound in Medicine; Winnipeg, Manitoba, Canada, **Oct. 6-10.**

IGA Group Annual Meeting, IEEE; Statler Hilton Hotel, Detroit, **Oct. 12-16.**

Annual Symposium on Switching and Automata Theory, IEEE; Waterloo, Ontario, Canada, **Oct. 15-17.**

International Symposium on Remote Sensing of Environment, The Center for Remote Sensing Information and Analysis; University of Michigan, Ann Arbor, **Oct. 14-16.**

Engineering Management Conference, IEEE; Montreal, Quebec, Canada; **Oct. 9-10.**

Joint Materials Handling Engineering Conference, IEEE, American Society of Mechanical Engineers; Sheraton Motor Inn, Portland, Ore.; **Oct. 27-29.**

Nuclear Science Symposium, IEEE; Sheraton Palace Hotel, San Francisco; **Oct. 29-31.**

International Electron Devices Meeting, IEEE; Sheraton Park Hotel, Washington; **Oct. 29-31.**

Northeast Electronics Research & Engineering Meeting (NEREM), IEEE; Sheraton Boston Hotel, War Memorial Auditorium, Boston; **Nov. 5-7.**

University Conference on Ceramic
 (Continued on p. 26)



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carbide capillary tube, ready for next bonding cycle. This extreme precision symbolizes the Tempress approach to every project... explains why it requires 11 months to train an operator for many Tempress production operations. Other Tempress products include automatic scribing machines, diamond scribes, diamond lapping points, and tungsten carbide probe contact needles.

Lead-bonding, Model DTN-1, at Union Carbide Electronics.



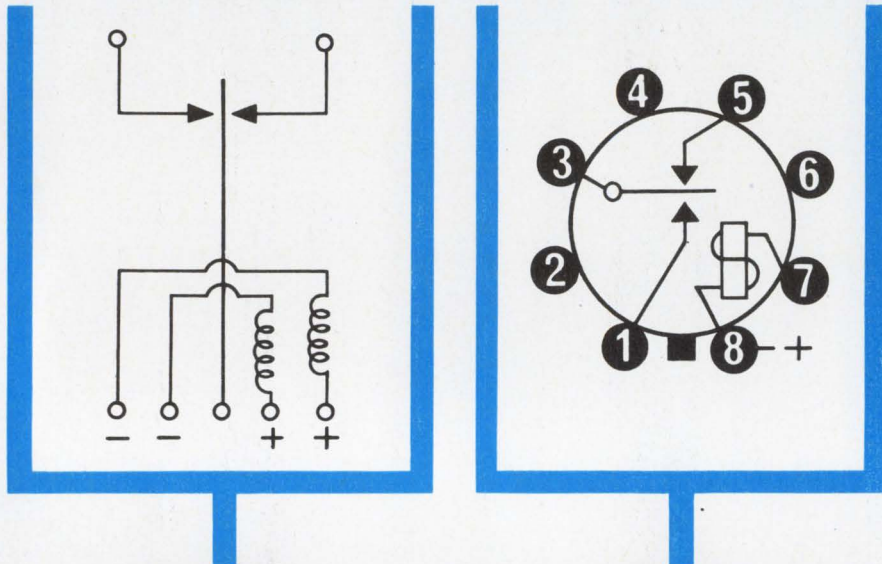
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Meetings

(Continued from p. 24)

Science, Dept. of Metallurgical and Materials Engineering, University of Florida; Nov. 10-14.

Symposium on Adaptive Processes, IEEE; Pennsylvania State University, State College; Nov. 17-19.

Fall Joint Computer Conference, IEEE; Convention Hall, Las Vegas; Nov. 18-20.

Commerce Laser Colloquium, Electronic Industries Association and the U.S. Commerce Department; Paris, France; Nov. 18-20.

Conference on Magnetism and Magnetic Materials, IEEE, American Institute of Physics; Benjamin Franklin Hotel, Philadelphia; Nov. 18-21.

Short courses

Automation in Electronic Test Equipment, New York University; Aug. 18-22. \$265 fee.

Science and Technology of Information Display, Polytechnic Institute of Brooklyn Graduate Center, Farmingdale, L.I., N.Y.; Aug. 19-29. \$375 fee for both parts.

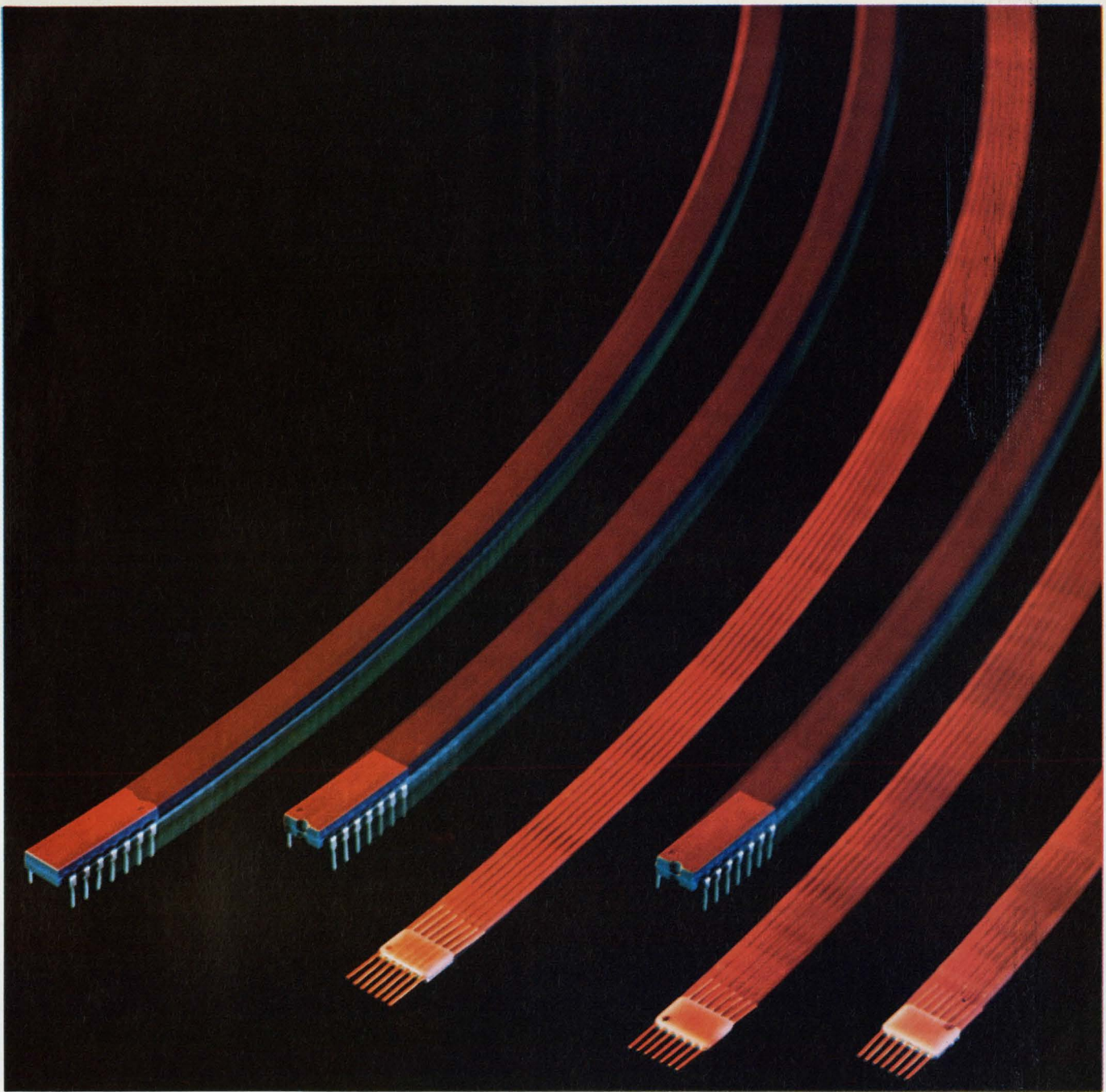
Computerized Electronics, School of Electrical Engineering, Cornell University, Ithaca, N.Y.; Aug. 26-28. \$16.50 fee.

Call for papers

International Solid-State Circuits Conference, IEEE; Sheraton Hotel, Philadelphia, Feb. 18-20, 1970. Oct. 17 is deadline for submission of abstracts and papers to Mr. L.D. Wechsler, General Electric Co., Electronics Park, Building #3, Syracuse, N.Y. 13201.

Transducer Conference, IEEE; National Bureau of Standards, Gaithersburg, Md., May 4-5, 1970. Nov. 1 is deadline for submission of summaries to Dr. Robert B. Spooner, IMPAC Instrument Service, 201 E. Carson Street, Pittsburgh, Pa. 15219.

Geoscience Electronics Symposium, IEEE; Washington, D.C., April 14-17, 1970. Dec. 1 is deadline for submission of abstracts to Mr. Ralph Bernstein, Chairman, Technical Program Committee, IBM Corp., 18100 Frederick Pike, Gaithersburg, Md. 20760.



Sprague Digital ICs. Illustration: Series 54H/74H in flatpack and DIP

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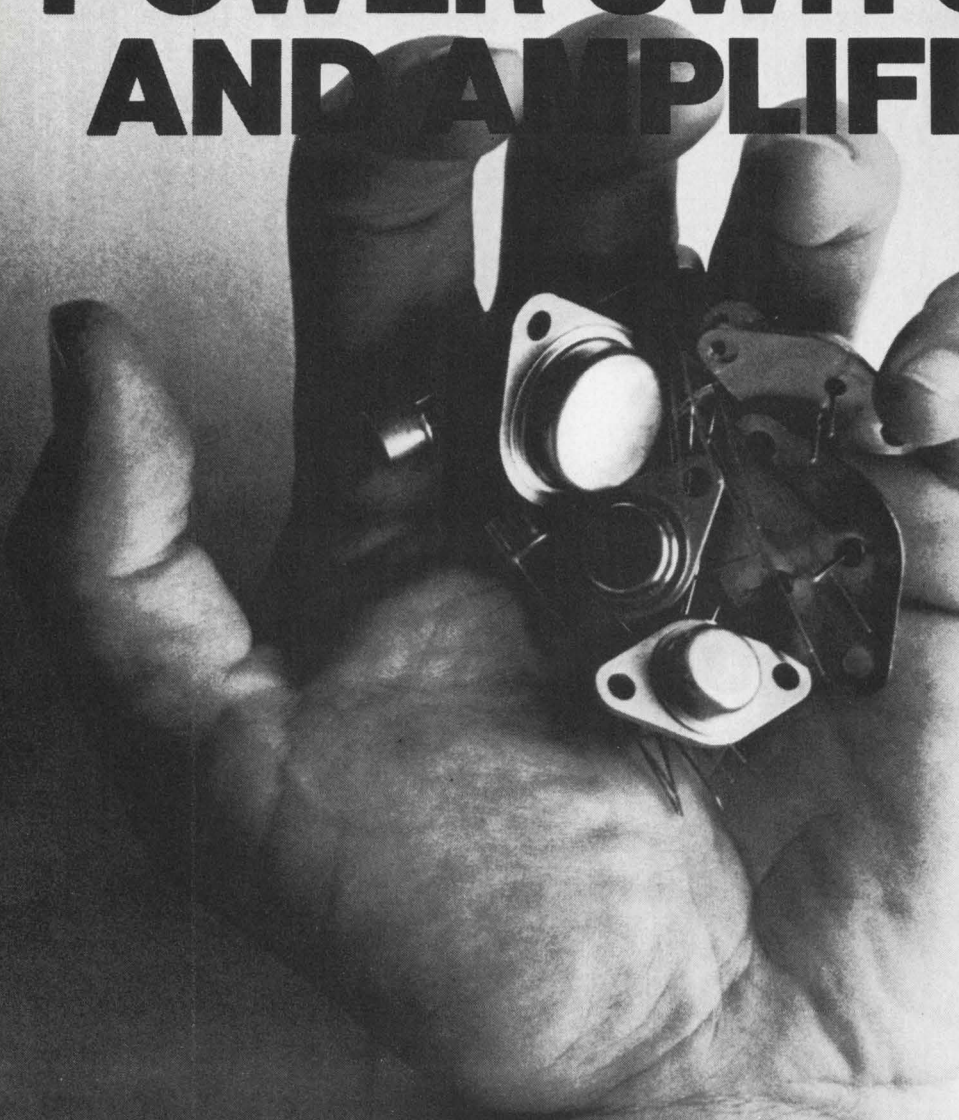
TYPICAL CHARACTERISTICS	GATES	FLIP-FLOPS
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	2N4398	2N3771
	2N4399	2N3772
TO-5	2N4234	2N4237
	2N4235	2N4238
	2N4236	2N4239
TO-66	2N3740	2N3054
	2N3741	2N3054
	2N4898	2N4910
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TO-3	2N3055	_____	TO-59	2N5337	_____	TO-66	2N3054	_____
	2N3232	_____		2N5338	_____		2N3441	_____
	2N3233	_____		2N5339	_____		2N3738	_____
	2N3234	_____		2N5729	_____		2N3739	_____
	2N3442	_____		2N5346	_____		2N4910	_____
	2N3713	_____		2N5347	_____		2N4911	_____
	2N3714	_____		2N5348	_____		2N4912	_____
	2N3715	_____		2N5349	_____		*2N5427	_____
	2N3716	_____		2N5477	_____		*2N5428	_____
	*2N3771	_____		2N5478	_____		*2N5429	_____
	*2N3772	_____	2N5479	_____	*2N5430	_____		
	*2N3773	_____	2N5480	_____				
	2N4913	_____	2N5730	_____				
	2N4914	_____						
	2N4915	_____						
	*2N5038	_____						
	*2N5039	_____						
	2N5067	_____						
	2N5068	_____						
	2N5069	_____						
*2N5301	_____							
*2N5302	_____							
*2N5303	_____							
2N5732	_____							
2N5734	_____							
TO-5	2N3439	_____	TO-61	2N2811	_____	TO-3	*2N3789	_____
	2N3440	_____		2N2812	_____		*2N3790	_____
	2N4300	_____		2N2813	_____		*2N3791	_____
	2N4877	_____		2N2814	_____		*2N3792	_____
	2N5336	_____		2N4301	_____		*2N4398	_____
			2N4301	_____	*2N4399	_____		
			2N5313	_____				
			2N5315	_____	TO-5	*2N4234	_____	
			2N5317	_____		*2N4235	_____	
			2N5319	_____		*2N4236	_____	
			2N5731	_____				
					TO-66	*2N3740	_____	
						*2N3741	_____	
						*2N4898	_____	
						*2N4899	_____	
						*2N4900	_____	

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Editorial comment

Advanced technology helps chart growth

Pessimists may interpret this year's modest increase in electronics dollar volume [p. 107] as heralding a flattening of the market in the next few years. Such a conclusion would be a mistake. Simple extrapolation of the numbers in the fast moving electronics business seldom works. And at best, prognostication is a risky business; the most advanced techniques can't account for all factors.

Electronics markets cannot be gauged just by looking at projected equipment needs. Too often, customers don't know what they "need" simply because they don't know what's available. Obviously, market prognosticators would do well to base their projections on where advanced materials and devices can be expected to be applied, for advanced technology has an important bearing on tomorrow's outlook. Therefore, projections made by semiconductor makers to guide their own businesses are a valuable barometer—even though semiconductors account for little more than 5% of the total market.

Texas Instruments, whose predictions are well regarded, forecasts not only growth in the over-all market, but possibly a bigger share for semiconductors (about 7% by 1972). The increased share would stem, in part, from the burgeoning semiconductor content of such systems as advanced radars and infrared mappers.

There are good reasons for TI's optimism. For one thing, device makers and equipment people will be working closer together to devise new higher-performance systems. This will result in an emphasis on customized devices. For example, a big market for emitter-coupled logic will be in large, long-term computer programs for which circuits will be custom tailored. And an important end use of MOS devices will be in customized applications: digital communications for the military, and office machines and calculators.

The expanding custom market will be reflected in a change in the way of doing business. Jack Kilby, head of TI's customer requirements center, says the trend towards custom devices could lead to decisions—made jointly by device and equipment people—to design and build entire receiver front ends instead of standard mixers. It follows that an increasing number of electronics products will require no more than a few hundred identical parts per year. Thus the proliferation of standard devices will be minimized; instead, a few well-known devices or techniques will be combined or permuted to meet the specialized needs. Four of the seven growth lines upon which TI is concentrating fit the custom pattern. They are optoelec-

tronics, advanced high-speed logic circuits (ECL), MOS circuitry, and medium scale IC's (TTL). (The others are single-diffused power transistors, computer diodes and diode arrays, and plastic-encapsulated transistors.) In the meantime, TI is moving toward the introduction of large-scale-integrated circuits, linear and microwave IC's, and semiconductor memories—product lines that also fit the custom pattern. These lines are expected to blossom in the 1970's.

Another important factor is the expanding industrial electronics market. An important development that helped open up this market was the plastic package; it started industrial users "thinking electronics." By the early 1970's, TI envisions the market for industrial semiconductors (for general purpose computers, instrumentation, and control systems, for example) at about \$270 million.

It seems certain that the future of electronics will not be a linear extension of the past. It will be accelerated by the application of today's advanced semiconductor and materials technology. ■

No doubt about Apollo fallout

Engineers and scientists will argue for years about the quality and quantity of fallout from the Apollo program. Ironically, the effect least open to question occurred not in the U.S., but in Japan. It was the booming sales of color-tv sets to Japanese consumers. Those Japanese who back in May were lucky enough to see the moon in color and the pre-dawn splashdown of Apollo 10 on color tv via Intelsat were enthralled. At that time the Mainichi Daily News reported that "millions of Japanese were glued to tv sets—and those not yet possessing color sets wished they had one—as they watched breathlessly for the Apollo 10 astronauts' safe return to earth." As a result of having had their appetites whetted by the amazing color transmissions from Apollo 10 and abetted by some extremely clever moon-oriented (Apollo 11) ad campaigns by Japanese set makers, the populace swarmed to set dealers, sending color-tv sales rocketing 80%.

Undoubtedly, the fallout's dollar value in far more significant areas, such as medical electronics monitoring techniques, will prove much harder to pin down. But in any event, it is difficult to argue with the statement by Ronald Philips, director of technology utilization for NASA: "There isn't any question that the [NASA-developed] technologies of the 1960's will be the realities of the 1970's." ■

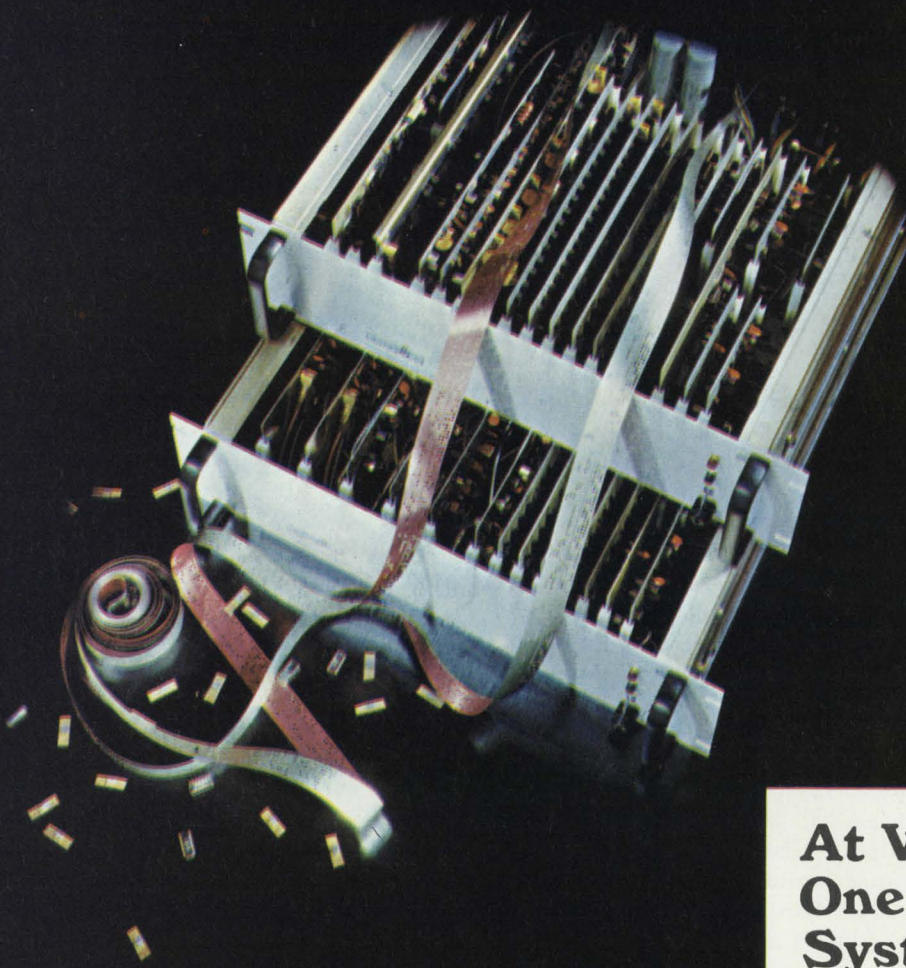
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Electronics Newsletter

August 4, 1969

Air Force eyes standardization for electro-optics

The Air Force is finally trying to standardize its approach to defining the performance of electro-optical and infrared sensor systems. Goals are to unify the terminology that's used, develop realistic performance criteria, and set up procedures for making repeatable measurements.

The lack of common language is a prime reason, many feel, for the lack of success in developing and deploying electro-optical systems, particularly low-light-level television.

Work on developing the standard is being done largely in-house at the Avionics Laboratory, Wright-Patterson Air Force Base, Ohio. Television, infrared and line-scanning systems are being tackled first, but radar systems will eventually be included.

The Air Force hopes to hold a series of seminars with industry, probably starting in the fall, to exchange ideas and help develop the standards.

TI gears up for LSI; first bipolar devices due this month . . .

The first complete production line for LSI arrays at Texas Instruments will be set up in the new Houston plant around November. Presently, TI's LSI work is in the developmental and pilot production stages, divided about evenly between Dallas and Houston. Ultimately all of it will be moved to Houston [*Electronics*, March 17, p. 36].

This month TI will begin introducing an off-the-shelf line of its bipolar, discretionary-wired LSI. First device to be announced will be a digital differential analyzer. TI is tentatively planning to bring out about one LSI array product a month over the next several months. In the works are five LSI device types including a 1,000-bit shift register.

The primary aim in announcing these standard LSI arrays is to get across to potential customers TI's position that it has the ability to supply arrays now. The company still sees at least 80% to 90% of the future LSI market as being custom-designed products. Its LSI product line is aimed primarily at giving customers something they can feel and touch. TI gets customer resistance when it has nothing to show—something the company went through in the early days of integrated circuits.

. . . as company farms out MOS technology abroad

Texas Instruments is taking an unusual step—for it at least—in moving its MOS technology overseas. Normally, TI waits until it has a product in volume production before moving the technology to its foreign plants. But in the case of MOS, TI isn't waiting because it sees a big overseas market developing very fast. The traditional two- or three-year gap between the U.S. and other countries in designing new semiconductor devices into hardware isn't happening with MOS.

Engineers from TI's European and Far East plants are already hard at work with the company's MOS people in Houston. They will be taking the technology back with them "in the coming year" to gear up for the anticipated overseas business.

TI expects about half of the MOS business by 1972 to come from overseas. It sees the total market exceeding \$150 million by that time, with about 70% coming in memory and custom logic devices for office machines and computers. It's this slice of the pie that's whetting TI's appetite. Company officials see the biggest MOS competition coming from the major semiconductor houses and the Japanese.

Electronics Newsletter

Sylvania to sell digital recorder?

What may be the world's fastest digital recorder is the object of negotiations between the developer, Sylvania Electronic Systems, and the potential buyer, Synergistics. The system uses a modulated helium-neon laser to store data in 36 channels on 8 millimeter microfilm. Data-transfer rate is from 0 to 10.8 megabits per second—and could range upward to more than 20 megabits per second in future units. It would have a photodiode readout.

A key application would be high speed, high density storage; 5,000 36-bit words per inch can be stored with the new system. This is as much as 90% more compact than magnetic tape.

As for why Sylvania is thinking of selling this recorder, the major potential market for the recorder appears to be in commercial computer peripheral equipment, and apparently Sylvania doesn't want to enter this field with just a single product.

Comsat considering eighth Intelsat 3

Failure of the latest Intelsat 3 to achieve orbit may turn out to be a blessing in disguise for TRW, builder of the \$7 million communications satellites for Comsat. Comsat recently ordered a seventh spacecraft because of earlier failures in the program, and may now end up buying yet another. The decision on whether to buy an eighth will probably be made later this month. Only six of the satellites were procured originally.

Comsat is now pushing to get its next Intelsat 3, the sixth attempt on the pad at Cape Kennedy in time for a September launch. The July 25 launch failed when the satellite didn't achieve a proper transfer orbit. Presently, only two of the five satellites launched are operating.

Fast Fourier unit boasts capacity of 30-odd channels

Computer Signal Processors Inc. is developing a faster, big brother to its CSS-3 fast-Fourier computer system [*Electronics*, April 14, p. 159]. Instead of building the new system, called the CSP-30, around a Varian 620I general purpose computer as it did on the CSS-3, the firm is developing its own processor. The emphasis is on getting as much speed as possible: TTL integrated circuits and five- to 12-layer printed circuits boards. The digital signal processor will also handle more data channels, about 30-odd compared with the earlier model's standard one channel.

A functioning machine should be completed by late September or early October. Software hopefully will be debugged by early 1970. It is expected to be priced at something below \$100,000. Two systems already have been sold.

Addendum

A new Saugus, Mass., firm, Solid State Technology, is about to come out with a radio alarm that uses neither battery nor line power. Based on a proprietary power system the company won't discuss, the alarm box generates its own power when a user opens the box's cover. It also won't give the power or range of the signal. Pressing a button releases the energy as a tone coded, 150 megahertz, frequency-modulated signal which identifies both the location and type of emergency. A single receiver console can handle up to 9,999 separate alarm boxes. The cost will be about \$1,000 per unit, according to the company, which hopes to carve out part of the fire alarm and roadside signaling systems market.

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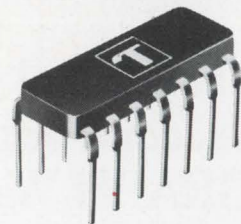


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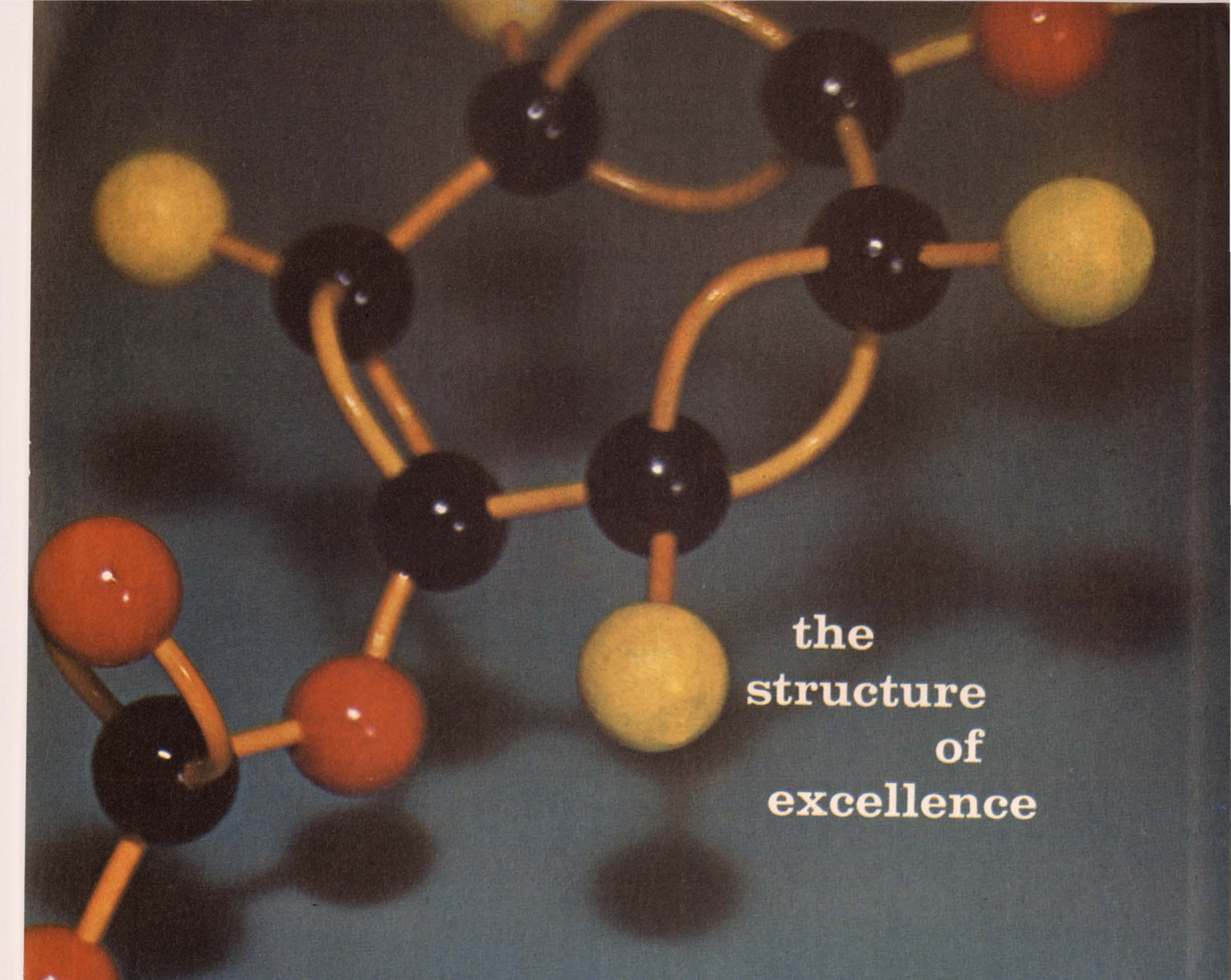
Ranging from basic gates to more complex functions such as adders, counters and shift registers, Transistron's family of TTL devices now numbers more than 450, including a broad range of Series I and Series II types.* This gives you breadth of choice virtually unmatched in the industry.

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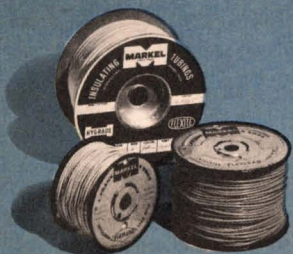
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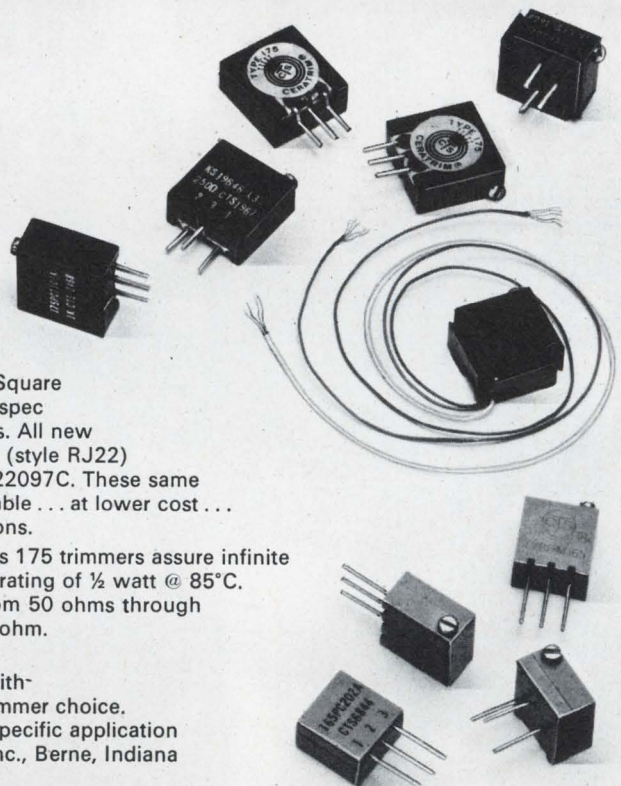
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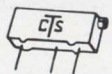





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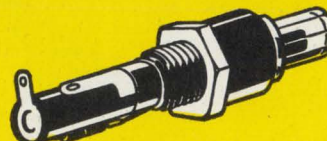


BUSS GBA- $\frac{1}{4}$ x 1 $\frac{1}{4}$ in. Visual-Indicating.

BUSS GLD- $\frac{1}{4}$ x 1 $\frac{1}{4}$ in. Visual-Indicating, Alarm-Activating.



BUSS ACH Aircraft Limiter, Visual-Indicating



HKA panel mounted holder, lamp indicating-signal activating, for $\frac{1}{4}$ x 1 $\frac{1}{4}$ in. BUSS GLD fuse.

$\frac{1}{4}$ to 5 amp.



BUSS MIC-13/32 x 1 $\frac{1}{2}$ in. Visual-Indicating, Alarm-Activating.

BUSS MIN-13/32 x 1 $\frac{1}{2}$ in. Visual-Indicating.



HLD panel mounted holder, visual-indicating, for $\frac{1}{4}$ x 1 $\frac{1}{4}$ in. BUSS GBA fuses (or GLD fuses)

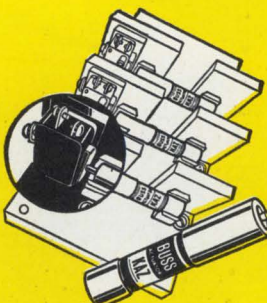
$\frac{1}{4}$ to 5 amp.



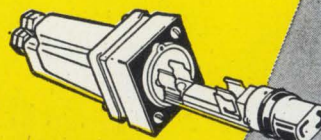
HPC-C panel mounted holder, visual-indicating, for 13/32 x 1 $\frac{1}{2}$ in. fuses.



FNA FUSETRON Fuse 13/32 x 1 $\frac{1}{2}$ in. slow-blowing, Visual-Indicating, Alarm-Activating. (Also useful for protection of small motors, solenoids, transformers in machine tool industry.)

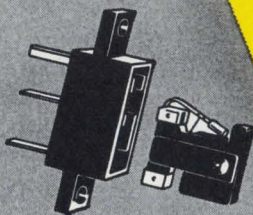


BUSS KAZ Actuator 13/32 x 2 in. Signal-Indicating, Alarm-Activating Device. Use to call attention to the opening of a fuse of 50 amp or larger. Can be mounted "piggy-back" on large fuse or in special block with micro-switch. Ask for Bulletin KAFS.

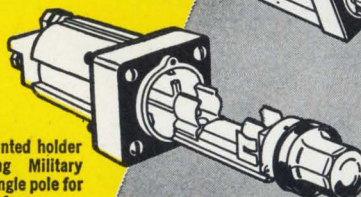


HGB-C panel mounted holder lamp indicating Military type FHL11U Single pole for $\frac{1}{4}$ x 1 $\frac{1}{4}$ in. fuses.

HGA-C panel mounted holder lamp indicating Military type FHL10U Two pole for $\frac{1}{4}$ x 1 $\frac{1}{4}$ in. fuses.

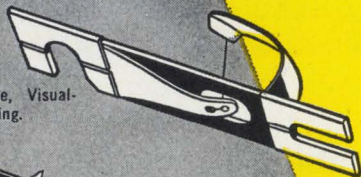


BUSS GMT and HLT holder, Visual-Indicating, Alarm-Activating.

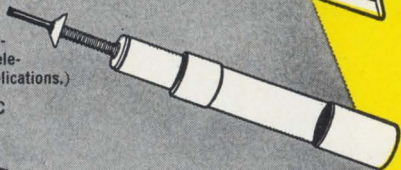


HGC panel mounted holder lamp indicating Military type FHL12U Single pole for 13/32 x 1 $\frac{1}{2}$ in. fuses.

BUSS Grasshopper Fuse, Visual-Indicating, Alarm-Activating.



BUSS Series 70. Visual-Indicating, Alarm-Activating. (Used in telephone and similar applications.)

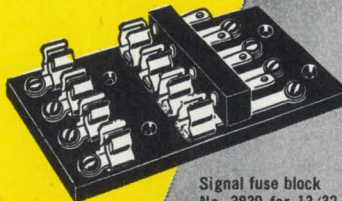


Ask for Bulletin 70S-C

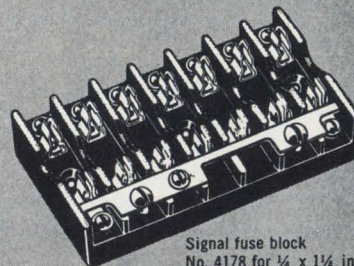


HKL panel mounted holder, lamp indicating, for $\frac{1}{4}$ x 1 $\frac{1}{4}$ in. fuses.

Write for BUSS Form SFB



Signal fuse block No. 3839 for 13/32 x 1 $\frac{1}{2}$ in. indicating fuse.



Signal fuse block No. 4178 for $\frac{1}{4}$ x 1 $\frac{1}{4}$ in. indicating fuse.

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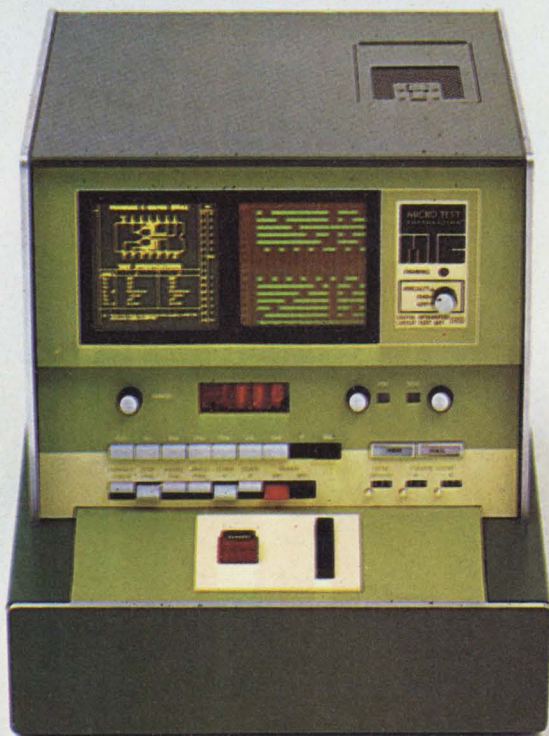
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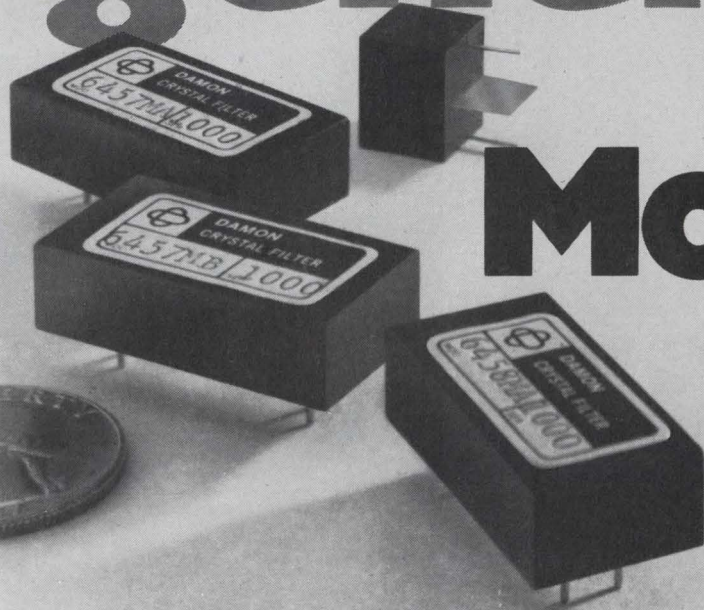


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DAMON ANNOUNCES...

A new 7-pole monolithic crystal filter line that surpasses those previously available in shape factor and spurious mode suppression. Provides performance comparable to the highest state-of-the-art currently available with discrete filters – yet incorporates all of the inherent advantages monolithics have over conventional multi-component configurations. Now Damon provides the best of both worlds: critical performance, superior temperature characteristics, improved aging, small size, and significantly lower price. All are available in hermetically-sealed metal cases within miniature rectangular packages ranging in size from 0.080 cu. in. to 0.274 cu. in. Immediate off-the-shelf delivery of evaluation quantities. Damon also offers a wide variety of computer-assisted designs, but these take a little longer. Damon/Electronics Division, 115 Fourth Ave., Needham, Mass. 02194, Tel: (617) 449-0800.

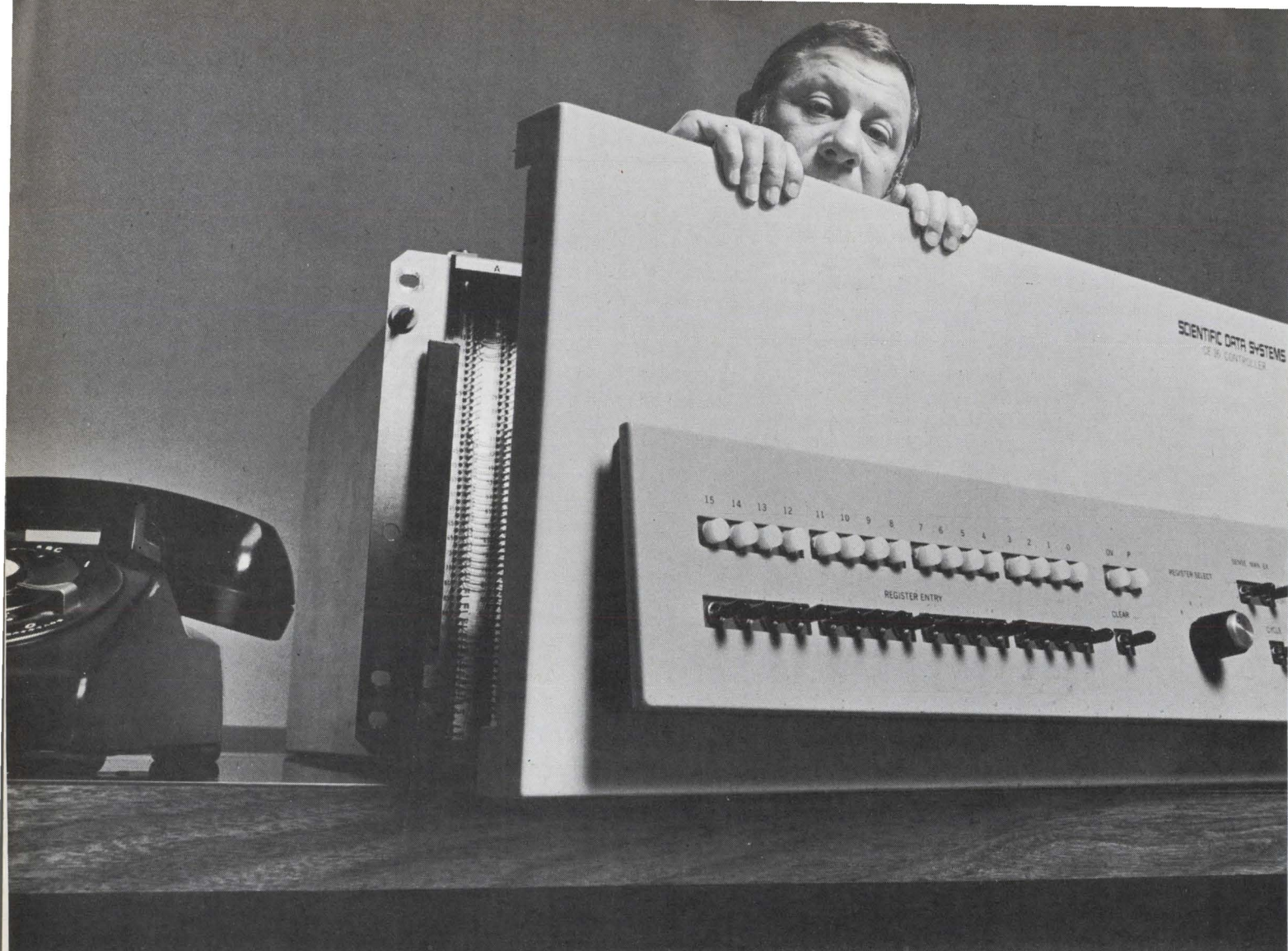
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"STANDARD" 7-POLE MONOLITHIC CRYSTAL FILTERS					CASE "A" 0.274 cu. in.	CASE "B" 0.080 cu. in.
Model No.	6457MA	6457MB	6458MA	6458MB		
Center Frequency:	10.7 MHz ± .7 KHz	10.7 MHz ± 1 KHz	21.4 MHz ± 0.7 KHz	21.4 MHz ± 1 KHz		
Bandwidth, 3 dB:	6 KHz min.	15 KHz min.	6 KHz min.	15 KHz min.		
Bandwidth, 60 dB:	18 KHz max.	40 KHz max.	18 KHz max.	45 KHz max.		
Ripple, Max.:	1 dB	1 dB	1 dB	1 dB		
Insertion Loss, Max.:	6 dB	6 dB	6 dB	6 dB		
Spurious Returns:	> 55 dB down	> 50 dB down	> 55 dB down	> 50 dB down		
Terminations (Resistive):	2.0 kilohms	5.1 kilohms	0.38 kilohms	1.3 kilohms		
Ultimate Atten.:	80 dB	70 dB	80 dB	70 dB		
Op. Temp. Range:	0°-60° C	0°-60° C	0°-60° C	0°-60° C		
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Just tell our 16-bit machines what you want done. The CE16 and CF16 will do it, because their "built-in programmers" (a comprehensive set of sophisticated instructions) let any engineer use them with ease. For example, the single instruction "scan memory" makes our machines compare a given number with the contents of the entire memory.

The CE16 and CF16 have 125 other heroic instructions that specify comprehensive maneuvers. So you give fewer instructions and use far less core memory than with any other small computer. Problem run times are shortened and Input/Output operations are simplified.

The CE16 and CF16 are designed to control and exchange information with a large number of external devices while doing related computation. Their "automatic I/O" enables them to talk back and forth between memory and a group of interrupting peripherals, in order of priority,

without needing attention from the on-going program.

Automatic I/O isn't a high priced option. Neither is a teletype, nor three priority interrupts, one of which is indefinitely expandable. They're all standard. The only thing you might pay extra for is speed. The CF16 can do a fully signed software multiply in 42 micro-seconds. But it costs a little more than the CE16 which takes 126 micro-seconds (which isn't bad) for the same job.

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SDS
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El Segundo, California

And now, aiming beyond the moon

Space stations and unmanned explorations of outer planets are high on NASA's list of goals for the next decade

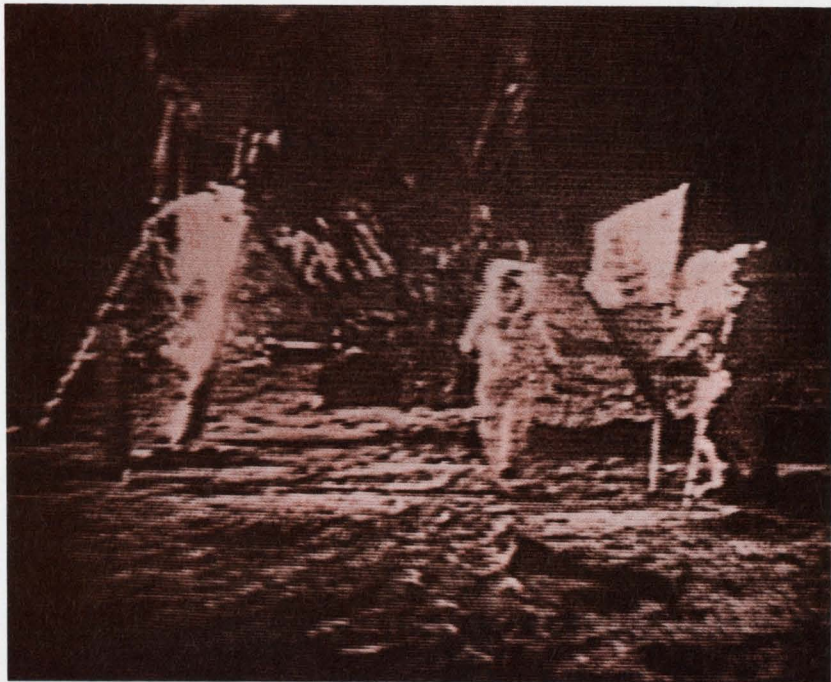
Even before it's incredibly successful Apollo 11 lunar mission had splashed down, NASA moved to capitalize on its new glory by disclosing plans to revitalize the slipped Apollo Applications Program with one major 1972 launch. By combining the Apollo telescope mount with its orbiting workshop into a single spacecraft, the agency not only encouraged industry interests but provided an interim answer to the question: What's next?

Though the final answer will come from the White House this fall following submission of the report of the President's special Space Task Group, NASA was promoting a favorable judgment by providing a public demonstration of its flexibility as well as an ability to economize on the battered Apollo applications effort.

Double shot. Both the Apollo telescope mount and the orbiting workshop will ride the same Saturn 5 booster; they'll be followed a day later by astronauts in an Apollo capsule. The astronauts will spend 28 days initially in the station, and an as yet unspecified number of revisits—lasting up to 56 days—will follow. The concentrated Apollo applications mission will use up NASA's committed manned-space money with the exception of a few lunar visits.

Meanwhile, NASA's long-term future is being assembled by the President's special group, which has until September 1 to deliver an outline on the proposed future of the agency. Composed of strong space advocates—Vice President Agnew heads it with NASA administrator Thomas Paine, Presidential science adviser Lee DuBridge, and Air Force Secretary Robert Seamans as voting members—the task group is expected to offer an

Lunar labors



How did the lunar electronics perform during the Apollo 11 mission? Pretty well, from all indications. For one thing, communications between the lunar surface and earth worked so well that RCA's umbrella antenna, which was to be set up only if the signal needed boosting, wasn't even used.

However, when the astronauts—as instructed—switched the LM's radar computer to its own power, the machine flashed its overload alarm. At that critical point, the flight controllers in Houston came close to aborting the lunar landing.

The jury still isn't in on the experimental packages left by the astronauts. The latest check of the passive seismic experiments package indicates that it is still producing usable data; however, the temperature of the unit was running high and its continued success was a day-to-day proposition.

As for the laser ranging experiment, a positive response was achieved by the Lick Observatory at Mt. Hamilton, Calif., but that was before the astronauts left the moon. However, there have been few bounces since, leading to speculation that the reflector may have fallen over, perhaps when the lunar module took off. The next try will be made by the McDonald Observatory at Ft. Davis, Texas, but not until the beginning of the next lunar night, early in August. Currently, the part of the moon where the reflector sits is moving into sunlight, causing enough noise (in the form of light) to smother a laser signal.

U.S. Reports

ambitious program for the next decade. Adding to bullish prospects for the report is the fact that NASA "task forces" have put together chapters of the report.

According to those close to the group, every attempt is being made to give the President a balanced report for him to use in charting a new course in space.

So as not to catch Congress off guard, members of the group's staff have been consulting with members of key Congressional committees on their recommendations. Nonetheless, the final decision on the contents of the report lies with the President, who seems to have Apollo fever himself. He recently predicted that by the year 2,000 people from earth would have visited "new worlds, where there is a form of life."

Sources in the White House say that four major project areas are being studied for the President's consideration. They are:

▪ **Shuttle splurge.** NASA would like to go ahead with its concept of a reusable manned space shuttle which would be used in conjunction with orbiting stations as well as on its own for earth resources, orbital astronomy, research laboratory, and manned lunar missions. General Dynamics, Lockheed, McDonnell Douglas, and North American Rockwell will deliver parallel studies in September. According to another study, prepared by the Institute for Defense Analysis, development costs would run to \$2.14 billion—each vehicle would run about \$40 million in production, and operating costs could run as high as \$1.5 billion.

Should a green light be given, NASA feels it can schedule initiation of final design and development in early 1972 with initial flight testing in 1974 and operations commencing in late 1975. Much data has been given to the space task group. And, both Air Force Secretary Seamans and NASA Administrator Paine are pushing for the shuttle.

▪ **Unmanned plunge.** NASA planners would like to boost the relatively low \$200 million to \$300 million a year now being spent on unmanned planetary exploration to

the \$800 million to \$900 million-a-year level by the mid-1970's and go over the billion-a-year level by 1980. (At the Office of Space Science and Applications, planners have discussed an idealized fiscal 1980 planetary budget which calls for \$800 million for the "outer" planets and \$400 million for the "inner" planets.)

Two Grand Tour missions to the outer planets, a Venus orbiter and "buoyant probe" mission, advanced solar orbiters and probes, several missions to Mercury, and planetary sample expeditions are among the ambitious lot of fly-bys, probes, and orbiters hoped for in the coming decade. The pacing item for all of this will be approval of the Grand Tour missions to the outer planets. NASA Administrator Paine and Presidential science adviser DuBridge have both expressed strong interest in the plan. Officials on the unmanned side at NASA concede that their grandiose plans will of necessity be tied to comparable plans of their manned counterparts. An historical point often raised: the Surveyor program was in financial trouble until it got irrevocably tied to the then emerging Apollo lunar-landing program.

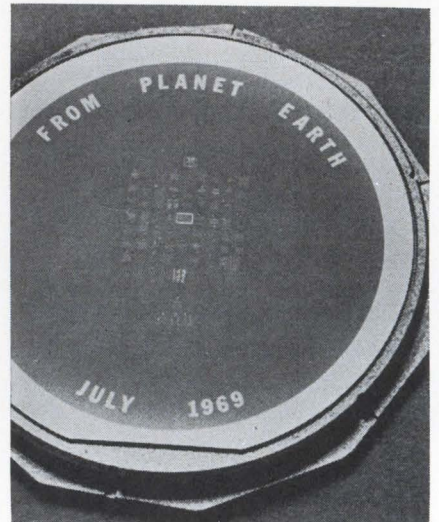
▪ **Space station spectacular.** With the Air Force's manned orbiting laboratory now off the boards and the once mammoth Apollo Applications Program now neatly consolidated, the U.S. is sorely in need of a grand manned scheme. NASA is moving quickly on its proposed national space station which it would like to launch in 1975 for a decade of operation [*Electronics*, June 23, p. 149]. The project would be costly and, in general, able to keep the space program in good health. Such a program would also give NASA the experience and technology needed to get on with manned interplanetary exploration after the 1970's. At present, it is acknowledged to be the program NASA would most like to get approval for in the next decade.

Not to be overlooked in assessing the possibilities for the station is that astronaut Frank Borman, who heads a special task group at NASA to boost the station concept,

has become a close associate of the President.

▪ **Applications additions.** Currently, NASA is spending about \$250 million a year on unmanned earth orbiting satellite programs. NASA would like to gradually double this total by the late 1970's as it initiates and broadens satellite programs in meteorology, earth resources, communications, engineering, broadcasting, and navigation and traffic control. The least costly of the possibilities, an expanded applications program, probably has the strongest chance.

Hello, moon



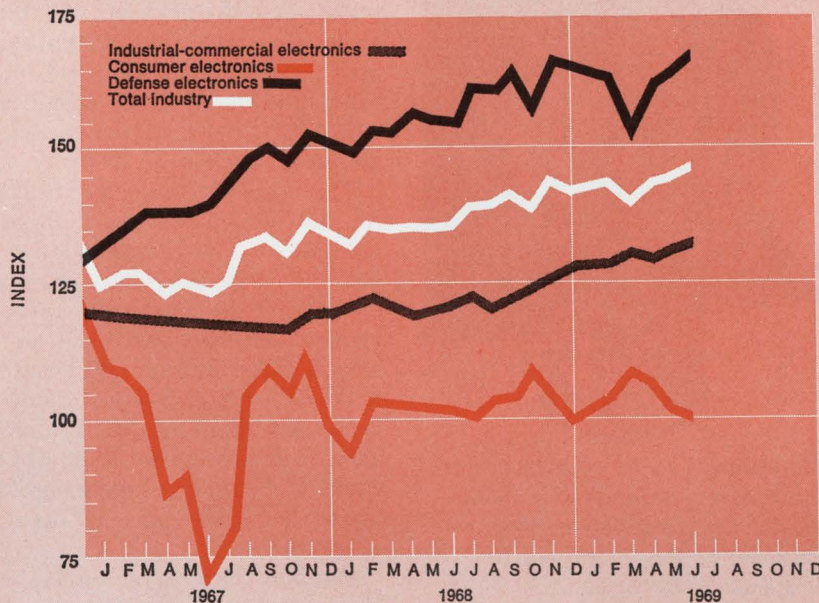
Compact. This is message disk for Apollo 11. It carries 87 messages at 1/200th size on a 1.5-inch disk of pure silicon.

After the moon—what? For the Sprague Electric Co. it could be information storage and retrieval, because when the firm got into the Apollo program at the last minute, it also may have gotten itself into a new market.

It all started when NASA requested messages from some 200 heads of state. The messages were to be reduced in size and left at Apollo 11's lunar module landing site. The usual vehicle for storing large amounts of text in small volume is microfilm, but it was apparent that microfilm wouldn't be able to withstand the radiation,

August 4, 1969

Electronics Index of Activity



Segment of industry	June 1969	May 1969*	June 1968
Consumer electronics	101.8	102.4	102.0
Defence electronics	168.8	165.4	154.4
Industrial-commercial electronics	133.9	132.1	122.8
Total industry	147.1	144.9	136.7

June's production index climbed to 147.1, up 2.2 points from the revised May figure and up a whopping 10.4 points from June 1968. Consumer production, however, was off slightly—0.6 point—from the previous month. But defense and industrial-commercial production took up the slack—defense rose 3.4 points, industrial-commercial climbed 1.8.

The drop in consumer production can be attributed, in part, to a sales sag in May. Compared with sales figures for May 1968, distributor sales to dealers of color-tv sets fell 16.1% and black-and-white receiver sales dropped 11.4%. Auto radios were down 18.6% and home radios were off 17.9%. Console phonograph sales, however, provided a bright spot with a 9.5% increase. Color sales for 1969's first five months were up 9.5%.

Indexes chart pace of production volume for total industry and each segment. The base period, equal to 100, is the average of 1965 monthly output for each of the three parts of the industry. Index numbers are expressed as a percentage of the base period. Data is seasonally adjusted.
*Revised.

heat, cold, and near total vacuum of the moon's surface.

Pass it on. NASA headquarters gave the problem to its Electronics Research Center in Cambridge, Mass., which turned to Sprague. Gene G. Mannella, the center's director of advanced technology, says it thought of Sprague because the center wanted to utilize the photo-reduction techniques inherent in integrated circuit construction, though at the time Mannella and others envisioned an etched roll of metal foil as a space- and weight-saving vehicle. With lunar freight rates running at \$22,000 to \$23,000 per pound, weight had to be low.

Early in the course of a three-week, \$7,000 effort, Sprague suggested that an etched silicon wafer carry the messages. According to Robert S. Pepper, Sprague's director of research, development, and engineering, a text reduced several hundred times and etched into a silicon dioxide coating on a silicon

substrate retains more than enough detail clearly to delineate the center of the loop in the letter "e". Steel or aluminum foil wouldn't have allowed such resolution (or as much contrast) because their surfaces are much rougher.

Pepper feels that no great technological breakthrough went into the moon wafer; "We work here daily with IC's having geometries in the micron range. By taking added care, we have been able to reduce printing almost the diffraction limit of the ultraviolet light used to expose our photoresist plates—at 400 times reduction, the line widths approach 0.25 to 0.50 micron."

Tough. Now Sprague feels it may have a salable product. The metal-packaged wafer sent to the moon turns out to be impervious to almost any wear and tear it might normally encounter, including fire and explosion, since silicon's melting point is greater than 1,400°C.

Not only is the silicon system permanent but it packs data more tightly than the best microfilm, Sprague claims. A 1.5-inch-diameter wafer recording typewritten copy at 12 characters to the (original size) inch and 60 lines per page can hold about 600,000 words at the 200:1 size reduction used for the NASA disk. With 400:1 reduction, with thin wafers, and by etching both sides of a wafer 7 mils thick, packing densities of 97.2 million words per cubic inch are achievable, Sprague claims.

Thus a few hundred such disks might be used to store corporate records as a sort of poor man's Iron Mountain repository. Already, a large insurance company is interested in what Sprague is now calling its Microperm process.

Coming up. Microperm records are read with optical comparators or microscopes. For fast optical data retrieval, handling techniques might be adapted from microfiche systems. Electron-beam readout

U.S. Reports

techniques might also be borrowed since they're more easily compatible with electronic data-processing and executive information systems.

Pepper feels that electron beams will probably be limited to the readout of information. "While it's theoretically possible to make higher resolution masks with electron-beam scanning, it doesn't look practical to me yet. I don't think the extra density would offset the extra cost and effort."

Manufacturing

Masked marvel

"Should Microelectronic Processing Be Done With Electron Beams?" That's the innocuous-seeming title of a Wescon paper to be given by Stephen Angello, a consultant for the Westinghouse Research Laboratories. The paper could revolutionize semiconductor masking operations.

William Hugle, president of Hugle Industries, the Sunnyvale, Calif., manufacturer of wafer-fabrication and semiconductor-assembly equipment, believes a masking machine incorporating the Westinghouse technique "will replace all the mask-making and masking equipment that now exists." Hugle has an exclusive agreement to manufacture and license the machine, which means it also has the not-too-easy task of making a production machine out of the Westinghouse development. William Hugle has guaranteed Westinghouse that his firm will complete its portion of the remaining development in less than 18 months.

No light. Electron beam projection is employed in a vacuum tube to transfer the mask image to a silicon wafer up to 2 inches in diameter. The mask is the photocathode, and the wafer is the anode. The wafer is coated with a resist material that is sensitive only to electrons and doesn't require the usual yellow light.

Angello explains that the simplest way to make the photocathode is to evaporate titanium over one face of a quartz window, trans-



The means. This is a feasibility model of the electron tube to be used with electron-beam masking machine developed by Westinghouse to be built and sold by Hugle.

mitting ultraviolet light at 2,537 angstroms. The mask pattern is etched into the titanium, leaving etched openings where photoelectrons are to be emitted. The titanium is next oxidized, becoming titanium dioxide—which is a good absorbent of ultraviolet light at 2,537 Å. Palladium 40×10^{-10} meter thick is evaporated over the cathode face, which now bears a pattern of photo-emissive metal that is precisely the integrated circuit geometry to be exposed on the passivated wafer.

Ultraviolet light shines evenly on the back of the quartz disk, causing areas coated with palladium to emit photoelectrons having energy of a few tenths of an electron volt. A 10-kilovolt electric field, 100 microamperes per square centimeter, speeds the electrons to the anode; parallel to the projection tube axis a magnetic field of 1,060 gauss—generated by solenoids outside the tube—focuses electrons from one cathode point on a corresponding spot on the anode.

Pow! The entire wafer can be flooded with electron beams, exposing all the resist, in only 1 or 2 seconds. Donald Pedrotti, Hugle's vice president for engineering, says the proprietary photore-sist can't be exposed by any kind

of light. A solvent, also proprietary, dissolves any of the resist that has been struck by electrons. The photoemissive metal mask (cathode) and wafer (anode) are 1 centimeter apart in the 3-inch-diameter image tube now used by Westinghouse. The tube is pumped to a vacuum of 10^{-5} torr or less.

The mask is projected full size on the silicon wafer, eliminating equipment and labor needed to cut and strip ruby liths. Also unneeded are the huge and expensive cameras required to make an enlarged mask at, say, 100 times actual size; step-and-repeat cameras; and mask aligners. Mask aligners alone can cost more than \$14,000 each, and a large semiconductor house can easily have as many as 10 of them.

William Hugle is understandably uncertain about the price of a machine that is possibly a year or more from completion; he estimates it will cost \$150,000 to \$250,000. But he points out that it could save almost \$150,000 in mask aligners alone, plus another \$150,000 for conventional mask-making equipment. Pedrotti predicts the electron-beam machine will cut the masking operation to about 5 seconds from 1 or 2 minutes and give better resolution—1 micron instead of the 2 microns of today's best optical projection techniques.

Companies

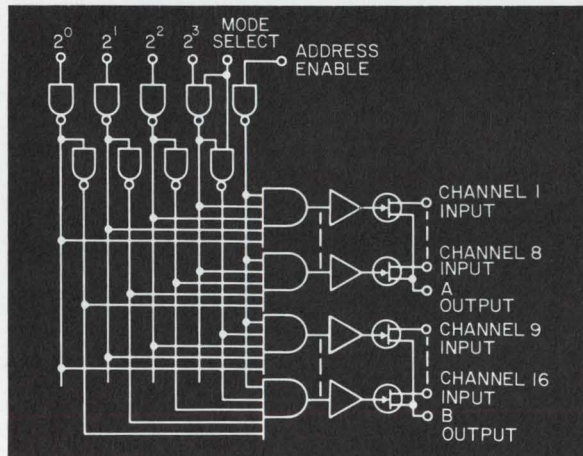
Expanding Novas

The Data General Corp. has a problem lots of companies would suffer gladly: growing pains. Having come up with what industry pundits figure is a good small computer, the Southboro, Mass., firm has proved that the machine is producible, and now sales are out-stripping estimates.

The company moved from organization to product announcement in only six months, and has moved into production just as quickly. Harvey P. Newquist, director of manufacturing, says that the first Nova computer was delivered in February, and that almost 60 have

new

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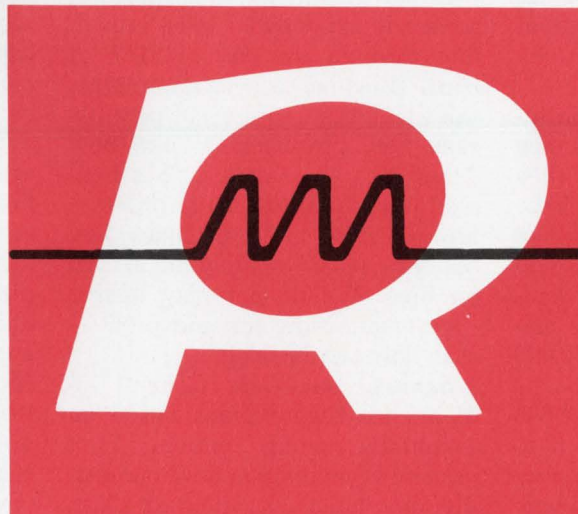
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Wrapping it up. Back panel of Data General's Nova computer being wirewrapped. This is final step in chassis construction; p-c boards are then plugged in and machine gets final check.

been shipped since. Production is now running at about a machine per day—and the rate is growing.

With 5,000 square feet of production area now in use, Newquist already foresees overflowing an additional unfinished 20,000-square-foot wing, and wants still another wing of the same size as soon as he can get it.

What happened. It seems that Data General's major premise—that small computer sales were limited by the industry's ability to produce—was correct.

Herbert J. Richman, marketing vice president, at one time figured that a list of 10 or 20 good customers, mostly original equipment manufacturers, would be a good year's work for calendar 1969. As of July 10, Data General had about 75, with 60% to 70% of them OEM's.

Last year, when Nova was introduced, Data General spokesmen were quietly—optimistically, they though—predicting sales of “maybe 200 machines in 1969.” Richman now estimates that the figure will be exceeded. Others in the company hint at more than 250 machines this year, and 1,500 to 2,000 in 1970.

Backlog now stands at about 800 Novas, and Richman expects it to grow to about 1,500 by September 1970. Thus, it's easy to see where

the squeeze is—in production capability—and why Newquist wants more space and people.

Salesmen. Several reasons are cited for Data General's fast growth, but OEM sales are most important. When you concentrate on OEM sales, “it's as if you employed a marketing organization eager to pay for the risk and overhead of selling your product,” says Allen Z. Kluchman, marketing director.

Kluchman foresees OEM's accounting for at least half the small-computer business for the next three years or so, and adds that demand will continue to exceed supply during that same three-year period.

In agreement, Richman predicts a “nearly exponential sales growth rate through the end of 1970 at least.” Richman is even altering his sales technique to prevent possible cash flow problems. “We're now demanding at least a 20% scheduled release on any large order. A firm ordering 100 machines had better be ready to apply the first 20 on time. We do not play banker—we want shipments and profits—cash flow, not backlog.”

Sailing. But Data General already has bigger plans based on eventually going public. First priority is production development. But simultaneously, Richman plans

to expand his overseas sales organization.

The company is already selling in Australia through an agreement with Fairchild, which acts as an OEM. Because of what Richman calls excellent sales in Canada, the firm plans to open an office there.

Data General may open offices in Common Market territory early next year. Until now, Richman has tried to stay out of Europe because of the difficulty of product support. He attributes much of the company's stateside sales success to such support.

Finally, the company already is budgeting for new product development. Data General's upcoming computer must be the worst kept corporate secret around, though no details about its capabilities or availability are given. Spokesmen say only that the new machine is to be a prestige model—and its code name, naturally, is “Supernova.”

Computers

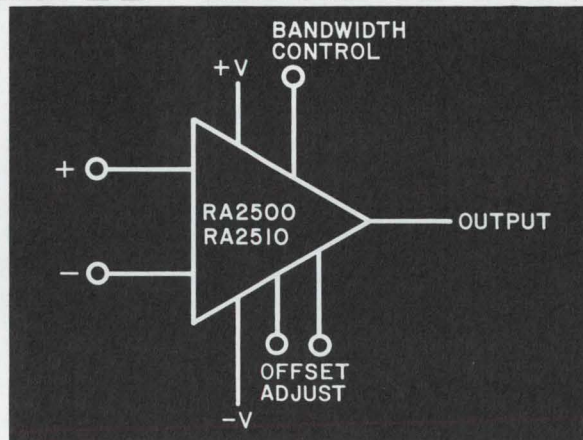
3-D guidance

Even before they deliver a development model of an air-to-surface missile guidance computer that's to cost no more than \$2,500 in production [*Electronics*, Nov. 25, 1968, p. 52], engineers at Bunker-Ramo's Defense Systems division have convinced their sponsor to consider a three-dimensional coaxial interconnection scheme for a preproduction version of the computer. The scheme would shrink the computer from 220 cubic inches to 67 cubic inches, and, because it could be batch fabricated, cut the price.

The sponsor is the Avionics laboratory at Wright-Patterson Air Force Base. Albert Goldstein, manager of Bunker-Ramo's data equipment department, says the computer probably would be mechanized with the same kind of medium-scale integrated metal oxide semiconductors it's getting from General Instrument. The IC's are being mounted on four double-sided circuit boards for the present version of the computer, which is

new

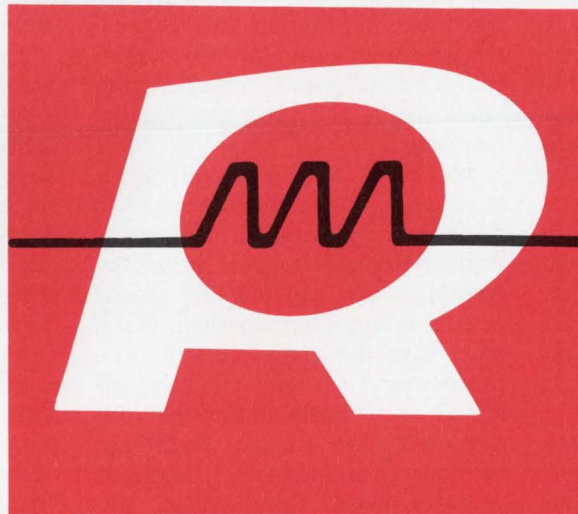
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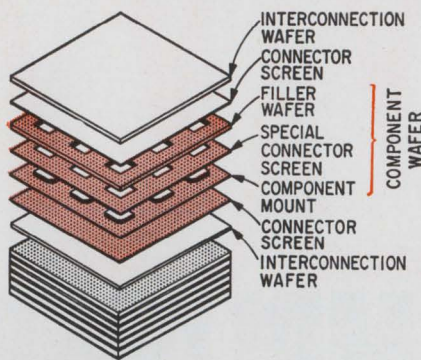
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Exploded. Intended for missile computer, arithmetic unit uses coaxial 3-D interconnection plan.

to be delivered to the Avionics lab next month.

Four chips. The associated bits of five different registers, and the associated logic to transfer signals among them, are put on one kind of chip. In addition, there is a full adder chip, a carry chip, and a central chip providing all the functions needed in the central part of the processor to interpret the instruction logic. The four will be carried over to the preproduction version, if it is funded; but the big change is in packaging, which has been in laboratory development at Bunker-Ramo for more than three years.

Howard Parks, director of the lab, won't discuss all the details of the 3-D coaxial scheme, but he's quick to point out that the interconnection method has been used previously to build a functioning 65-megahertz pseudo-random code generator.

Three basic wafers, thin slices of beryllium copper, are stacked to form the interconnection sandwich: a component wafer, bearing the MSI arrays, an interconnection wafer providing x-y plane interconnects, and a z-axis connector screen. The component wafer is made of three thinner wafers: a component mount wafer, a special connector screen, and a filler wafer. The last two have cutouts to accommodate the height of the package housing the array of wafers and interconnections.

This ceramic package replaces the conventional flatpack. Bunker-Ramo designed it with solder

bumps on the bottom, and it's joined to the component mount slice of the component wafer by using reflow soldering. The component wafer, itself, has no interconnection between arrays. The 44 leads from the MOS die are fanned outside the periphery of the ceramic housing to points where they can be picked up by z-axis "slugs" in the connector screen and fed to the interconnection wafer in its sandwich.

Thar's gold. Connector screens, placed on both sides of the three-layer component wafer, are fitted with gold bumps on the outside surface to provide the z-axis interconnection. These screens provide 400 pin connections in just 1/100 cubic inch. Interconnection wafers are then added to the sandwich and come in contact with the gold bumps on the connector screens. The interconnection wafer contains one or more levels of coaxial wiring—but no active components—providing the x-y plane interconnections in a manner similar to that used in multilayer boards. When the three basic wafers are pressed together, the ductile-gold bumps do their job and make the z-axis interconnections.

The processor portion of the computer in the mockup includes 54 MOS arrays on six component wafers; two more component wafers are used—one for the computer's hybrid-clock circuitry and one for the conventional IC's that provide the interface between the high-threshold MOS arrays and transistor-transistor logic outside the processor. There are eight interconnection wafers and 16 connector screens, one of which goes to the outside world. This 32-wafer stack forms the processor for the computer.

The input/output section needs a separate stack. Both it and the 2,048-word plated-wire memory Bunker-Ramo is suggesting for the computer can use the 3-D planar coaxial interconnect method. Goldstein says the complete systems—processor, I/O and memory, all joined to a motherboard for connection to the outside world—can be housed in the sharply reduced space of just 67 cubic inches.

Avionics

L-1011's flight plan

The problem: give buyers of the Lockheed L-1011 airbus the option of utilizing almost any existing form of navigation. The solution: use a modular system that, in its simplest form, will handle en route and terminal area navigation while, in its most complex form, providing both area and long-range inertial navigation. Lockheed-California reportedly is nearing a decision as to what firm will develop the system [*Electronics*, July 7, p. 33].

The L-1011 will be wired to accept any of three modules, as optional equipment, coupled to the autopilot. The simplest version will have dual general-purpose digital computers with a total memory of from 6,000 to 8,000 words. Primarily for overland flights, this version will have, in addition to the computers, dual controls and displays, and dual data-storage units into which en route VOR/DME (very-high frequency omnirange/distance-measuring equipment) station data can be entered on punched cards or magnetic tape, depending on customer needs.

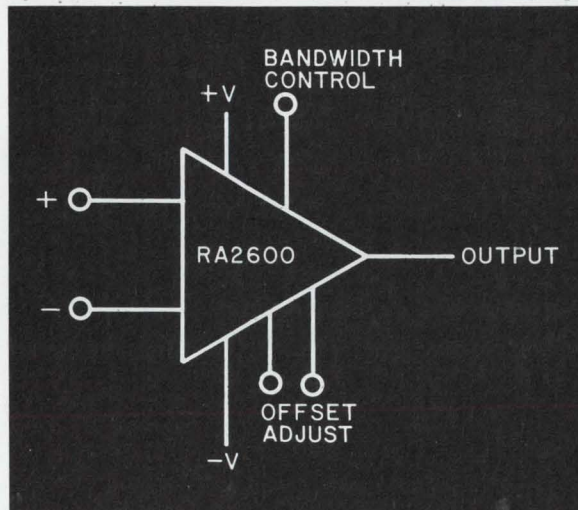
Fancy. The most sophisticated version will employ three advanced heading and attitude sensors—inertial platforms with their associated computers that "close the Schuler loop," says Wright—plus the two area-navigation computers. The platform computers will provide latitude and longitude, velocity, and drift angle (the difference between the aircraft's heading and the ground track) data.

Expected to be priced at about \$100,000, this version will provide long-range transoceanic inertial navigation plus area navigation cheaper than today's usual triple set of Arinc Characteristic 561 inertial navigation systems, according to Wright. Arinc 561 inertial systems don't handle area navigation.

A third version has two advanced inertial platforms (sensors of the HAS-2 type) and two area-navigation computers. Primarily for short overwater flights that are out of VOR station range, this version will

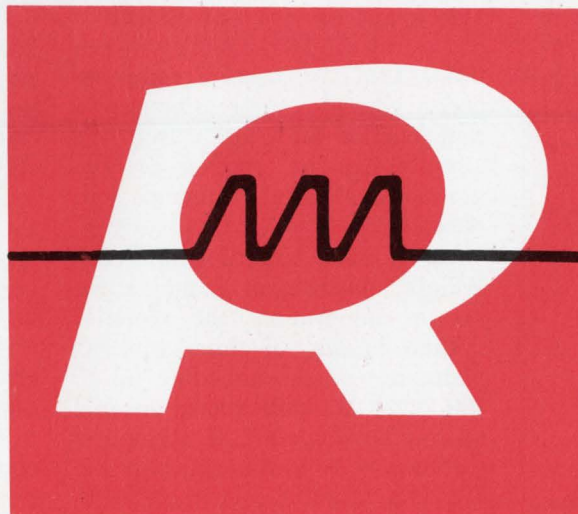
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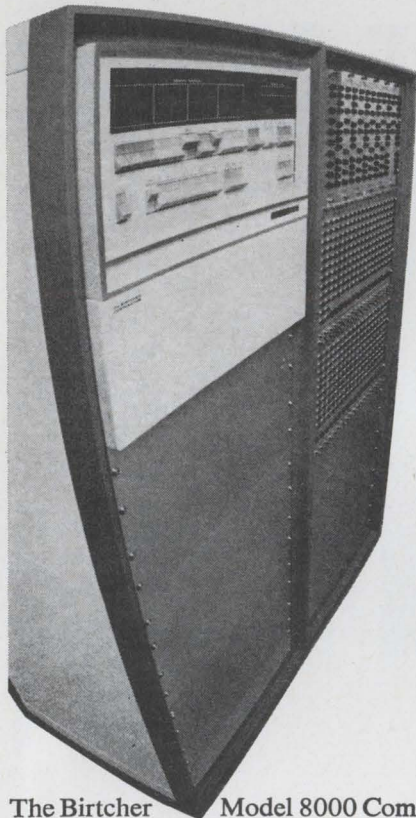
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enable the L-1011 to receive attitude reference of an inertial-grade system. Area navigation here is a bonus. Presently, aircraft on such flights use vertical and directional gyros in addition to Loran-position fixing.

Ground decision. Readers will feed VOR/DME data to the computers before takeoff. The terminal-flight plan will include any of the six to eight standard approach patterns now used at domestic airports, and won't be called up until the crew has been informed about terminal navigation conditions by the ground controller, who will also select which of the approaches is to be used.

Standard hold points are used in congested terminal areas; those hold points can be preprogrammed so that the plane will automatically hold at the waypoint. Or, the pilot can load the latitude and longitude of a hold point manually and orbit there until a controller orders him to resume his preloaded course.

Lockheed will offer three features as plus-in options: vertical guidance, automatic VOR/DME tuning, and a map display interface—although a moving map or cathode-ray tube display won't be provided initially in the L-1011. Vertical guidance is essentially computer control of letdowns from a preprogrammed point to the next preset point. Automatic VOR/DME tuning will ease the crew's workload, particularly in terminal areas, by eliminating manual tuning.

Other options will permit inputs from such hyperbolic-navigation systems as loran, Omega, and Decca, and provision for linking to a two-way digital data link between the L-1011's navigation computer and a ground-control computer so that location information from the aircraft can be verified on the ground and digital commands sent back.

Up to 500. According to Frank Wright, department manager for system integration, the modular system in any of three versions planned will accommodate up to 500 VOR/DME station locations and up to 500 waypoints. Heading and distance to VOR stations, plus the L-1011's altitude over the check-

points and its times of arrival, can be programed into the data storage unit, and filed with air traffic controllers.

Government

Keeping in touch

Despite John F. Kennedy's 1963 order calling for creation of a National Communications System (NCS), no one ever plugged the program in. To the contrary, there has been a "perpetuation" and "proliferation" of separate networks for accomplishment of "individual agency missions," according to the General Accounting Office (GAO). Thus the Congressional watchdog of federal spending says the time has come to make NCS a reality, taking away authority for the program from the Defense Communications Agency, with its conflicting interests, and turning it over to a restructured and strengthened White House Office of Telecommunications Management (OTM).

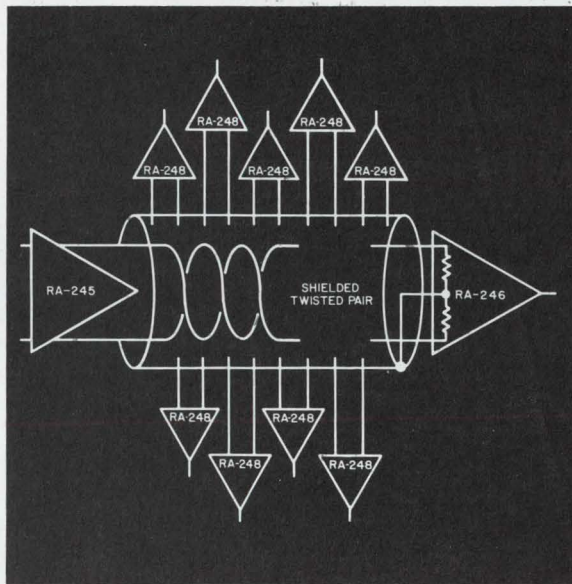
At stake are an estimated \$3 billion in annual Federal outlays for "a wide variety of communications equipment, research, development, and services" exclusive of another billion spent on nonconventional systems such as those inside weapons. Of the total, about \$1 billion goes for long-distance communications—principal area of NCS involvement—plus another \$2 billion for specialized systems such as those used by NASA and the Defense Department.

Good timing. The GAO always has had a good sense of timing. At a time when Pentagon power is under attack from all sides, the GAO urges it be stripped of NCS responsibility; when Federal spending cuts are being called for, the accountants see potential economies in consolidating Federal communications; and just as James D. O'Connell is about to retire as OTM director, a reorganization and strengthening of his office is recommended.

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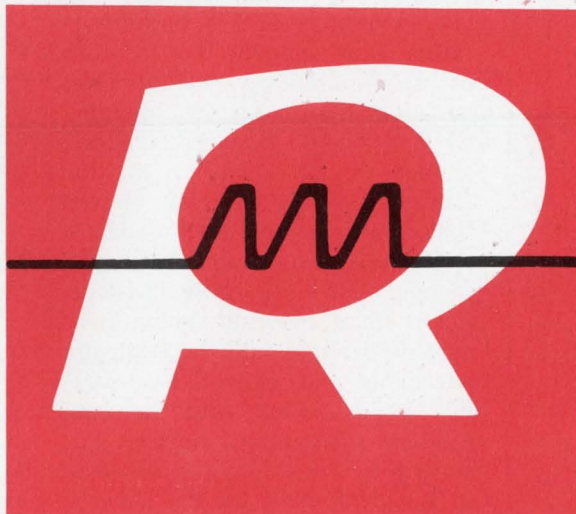
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600V		
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VE 68	1A	1.49
VS 647	2A	1.60
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spurred by the Pueblo disaster, when the system failed at nearly every level. In fact, the President learned of the seizure only after the ship was already in a North Korean port. That foul-up demonstrated to Congress that communications capabilities had not been significantly improved since the 1962 Cuban missile crisis—which prompted the call for creation of NCS. Implied in the GAO assessment is that Kennedy erred in naming his trusted defense secretary, Robert McNamara, as executive agent for NCS and naming the Defense Communications Agency as manager.

One of the first jobs of the NCS, for example, was to have been unification of civil and military weather-data communications systems. Despite a recommendation in November 1963 for development of a digital, automatic weather and warning-to-airmen system, McNamara's office delayed the program a full year by ordering further studies. "As a result," contends GAO, "interim improvement programs of the FAA, Air Force, Navy, and the Weather Bureau increased in scope to the extent that establishment of a single system . . . as originally proposed . . . was no longer desirable." The judgment: a Pentagon failure since "separate weather networks continue to be operated by the various Federal agencies."

Busy signal. Again, the Pentagon set up its own Defense Telephone Service for its Washington, D.C., outgoing calls—an operation with some 37,000 working lines and 87,000 extensions in 178 buildings—rather than employ the facilities of the nonmilitary Federal Telecommunications Service operated by the General Services Administration. A later analysis of the Pentagon phone operation showed that approximately 1,000 overflow calls were being routed over commercial lines in busy periods, rather than over the nonmilitary system. Then should the Pentagon automatic voice network (Autovon) be interconnected with the nonmilitary system? An answer was sought by including the question in an AT&T study for the Defense

Communications Agency, manager for NCS. The General Services Administration believes such an integration could save "millions of dollars a year," but adds that defects in the AT&T study plus a broadening of its scope are postponing a decision.

One of the most important specific issues still to be decided is the Kennedy Administration concept of NCS as an integrated trunk line system for nonsecure communications—"long haul, point-to-point communications which can serve one or more agencies." Such an integration effort was agreed to last year by 10 of the 11 participating agencies. The lone dissenter: the Defense Department.

Fresh approach. Since the major dissent to a National Communications System came from its manager, it is not surprising that the GAO now recommends a fresh approach to any interconnection of Federal communications—a look embracing the Atomic Energy Commission, FAA, State Department, NASA, Veterans Administration, and others beyond the Defense and General Services Administration systems.

In addition, GAO suggests that the Office of Telecommunications Management be upgraded in budget, stature, and responsibility and made responsible for NCS. One step would be to take the system out of the Office of Emergency Preparedness, and quadruple its budget to \$12 million.

If the Nixon Administration buys the recommendation, as it now seems likely to do, this would mean another boost in the power of the Executive branch. Yet communications specialists believe that this compromise must be made to achieve a working National Communications System.

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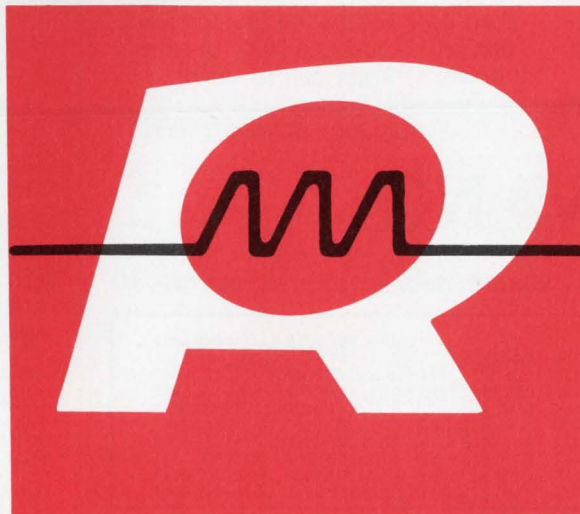
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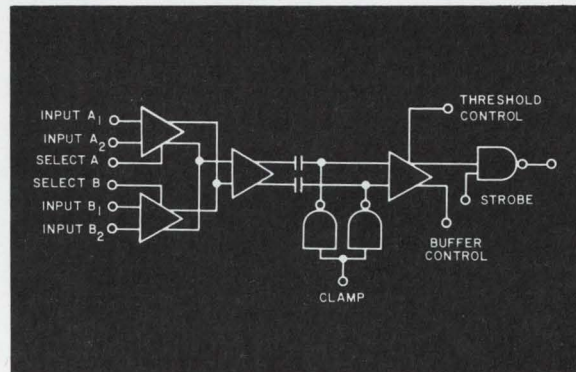
torquing inertial instruments is achieved by using a d-c square wave instead of a d-c current. Each half of a 50 cycles-per-second square wave, for example, is divided into 100 positive and 100 negative pulses, which can be varied in one-pulse increments. This permits the operator to take a surplus pulse from the positive side of the cycle and put it on the negative side. The pulse increments let him know, with great accuracy, how much current is being fed into the torquerers. An up/down digital counter with a variable time base was designed by the Itron Corp. to count the positive and negative pulses, and indicate the net pulsing. The use of digital techniques is said to eliminate hysteresis and drift associated with d-c current analog devices ordinarily used for torquing, and permits greater resolution.

Battle's over. The FCC has ruled that "urgent national requirements" warrant a crash program to complete a satellite communications earth station on Guam by November 1. Thus has the FCC settled the "Battle of Guam" in favor of RCA Global Communications and two other carriers despite the Communications Satellite Corp.'s opposition to the increased costs that will result—an increase it must share as half owner of the facility. RCA's teammates are ITT and Western Union:

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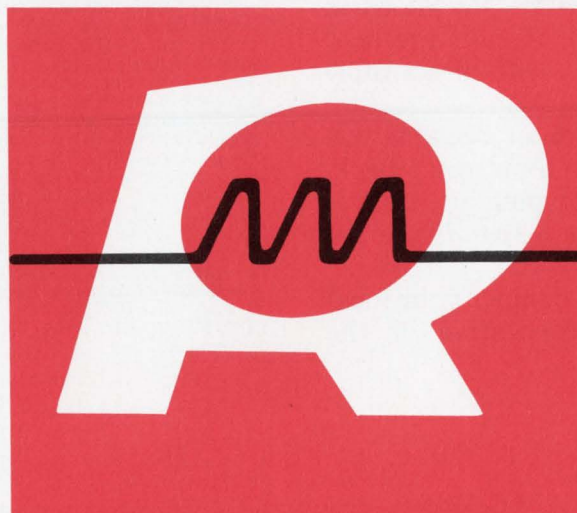
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Specifications

Model 6155 Measurement Modes: Frequency: 100 MHz (to 12.4 GHz with optional plug-in). Period: To 100 ns (to 1 ns or 10 ns with optional plug-in). Multiple Period Averages: 1 to 10⁸ in decade steps. Ratio: X/Y with X = 0 to 100 MHz and Y = 0 to greater than 1 MHz. Pulse Width & Separation: (To 1 ns or 10 ns with optional plug-in). Voltage & Current: (Optional plug-in). Scaling: By decades up to 10⁸. **Crystal Frequency:** 1 MHz. **Stability:** Better than 3 parts in 10⁸ per 24 hours. (5 parts in 10¹⁰ per 24 hours optional). **Output Frequencies:** 0.1 Hz to 10 MHz in decade steps selected by front-panel TIME BASE selector. **External Frequency:** 1 MHz, 1V rms into 1000 ohms required at rear-panel BNC connector. **Display:** 8 inline digits of glow-tube display, 9th digit optional. **Signal (X input) Sensitivity:** 100 mV rms. **Digital Output:** Fourline, 1-2-4-8 BCD output at rear panel. Output compatible with Beckman 1453 Digital Printer. **Power:** 115/230 Vac, 50 to 400 Hz, 80 W. **Size:** 5¼ in. high, 16¾ in. wide, 19 in. deep. **Weight:** 30 lbs. **Price:** \$2,450.

Model 606 Frequency Range: 1 MHz to 525 MHz. **Sensitivity:** 50 mV rms, 10 Volts rms (max.) or 50 Volts Peak. **Impedance:** 50 Ω. **VSWR:** ≤ 1.2. **Price:** \$525.

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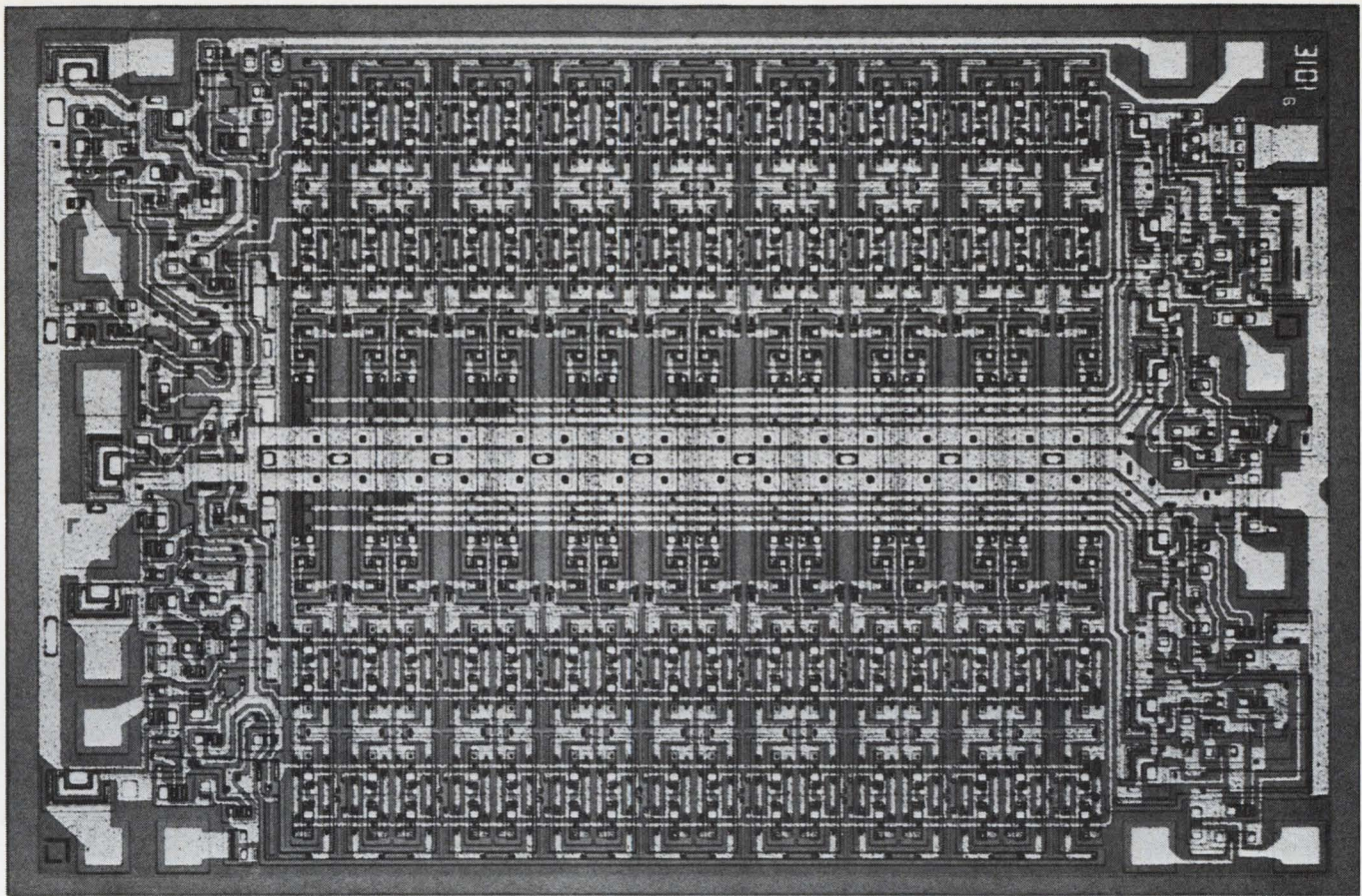
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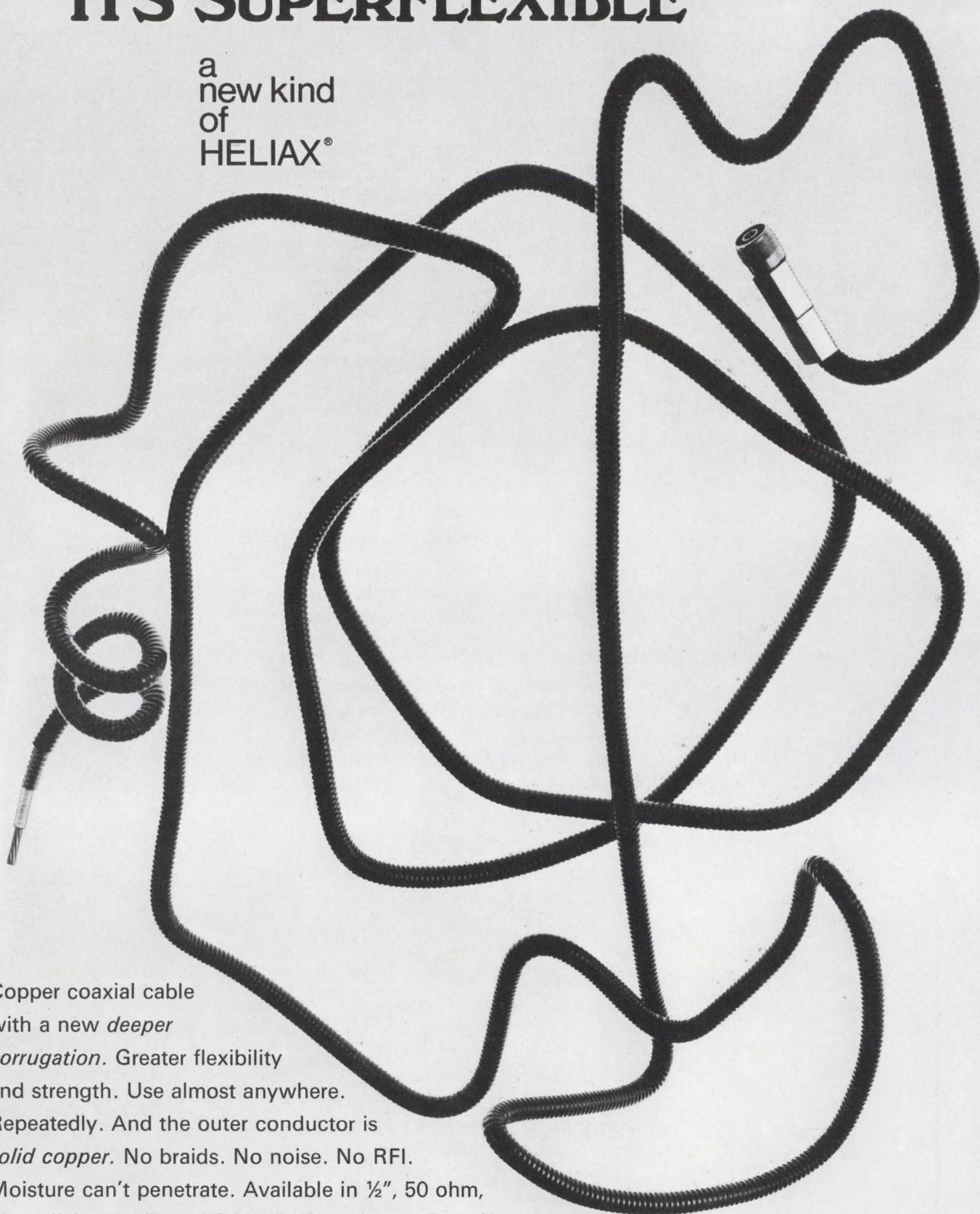
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Circle 68 on reader service card

Washington Newsletter

August 4, 1969

Philco to get DCA all-digital net award

Philco-Ford is about to be named winner of a two-part study for an all-digital defense communications system for the Defense Communications Agency (DCA). Teamed with IBM's Federal Systems division, Gaithersburg, Md., Philco will define under the first phase the requirements for what insiders call "the ideal system for the late 1970's."

In the second phase of the program, the team will identify the research, development, and hardware required to achieve the all-digital network by a process of evolution. The \$934,000 competitive contract gives the Philco-Ford/IBM team an inside track on future procurement, which could turn out to be one of the largest communications pacts ever made by the Defense Department.

Among the losers: AT&T, RCA, Sylvania, Honeywell, and Communications & Systems Inc. AT&T promoted the study within the DCA but wanted to do it on a sole source basis—an approach the Pentagon is reluctant to take in these sensitive times for military spending.

NASA to fill five top slots

NASA is expected to get around to filling five of its top spots, including the Number 2 job of deputy administrator, now that things are settling down following the successful Apollo 11 mission. A sixth slot—that of Apollo program director—will also need filling soon when Lt. Gen. Samuel C. Phillips returns to military service.

Though NASA administrator Thomas O. Paine and others have been interviewing potential candidates, the buildup to the lunar mission has prevented any final selections. Indeed, the agency is reportedly still awaiting receipt of a list of politically acceptable appointees.

In addition to deputy administrator, the following NASA administrator jobs are open: Offices of Industry Affairs, Advanced Research & Technology, Organization and Management, and Technology Utilization.

White House wants civilian for OTM post

The Nixon administration, according to authoritative sources, has definitely decided that it wants a civilian to succeed Gen. James D. O'Connell (USA-Ret.) as director of the White House Office of Telecommunications Management. In effect, the decision automatically rules out such highly-touted contenders for the job as Philco Ford's senior scientist Charles C. Mack, a retired Army colonel [*Electronics*, June 9, p. 76], as well as the more recently mentioned retired Lt. Gen. Harold Grant, who is now director of telecommunications policy in the Office of the Assistant Secretary of Defense. Also reported to be no longer in contention is Washington consultant Fred W. Morris.

Speculation on industry candidates for OTM now centers around General Electric's Richard P. Gifford, chairman of the comprehensive and highly-regarded spectrum engineering study put out last year by the Joint Technical Advisory Committee set up by the IEEE and the EIA.

However, the articulate general manager of GE's communications products department had previously indicated to associates that he has no interest in Government service, and there are no signs his attitude has changed, particularly in view of reports that he is destined for bigger things within GE.

Whatever civilian is tapped, the White House decision is but one more indication that the Administration is being swayed by recommendations

Washington Newsletter

of many Government and industry authorities that OTM be restructured, given increased authority, budget, and responsibilities for determining and coordinating Federal communications policy. Most recent of these recommendations comes from the General Accounting Office, fiscal watchdog for Congress [see p. 56].

U. S. ready to install road guidance system

The Federal Highway Administration's Bureau of Public Roads is moving ahead with its electronic route guidance system (ERGS) and is seeking bids for the initial installation.

ERGS, a navigation aid for motorists, would put induction loops in the pavement, a transcriber and a computer at each intersection, and a transceiver and display unit in each vehicle. At the start of a journey a driver would set his receiver for a destination.

The upcoming purchase will include equipment for 50 vehicles and 100 intersections in the District of Columbia for the first large-scale test.

The Bureau of Public Roads has already completed a nationwide code-book directory for the system. For its part, the Highway Administration is planning to make money available to states wishing to install ERGS in the early 1970's.

NASA to ask for ATS-G ideas . . .

Within a month NASA will ask for proposals for experiments to ride with the Applications Technology Satellite-G scheduled for launch in 1974. Proposals will be due in September with selection of experiments set for early next year.

ATS project officials say they are looking for "far out" or "highly experimental" ideas for ATS-G. As of now, the satellite is scheduled to carry an advanced L-band transponder for aeronautical experiments as well as direct television broadcast equipment.

Meanwhile, NASA has also begun advertising for scientific experiments for its Viking missions to Mars in 1973. Equipment to detect life and measure the Martian atmosphere, as well as remote orbiting measuring devices, are being sought. Bids for Viking experiments are due October 20.

. . . and provides for some planning

Later this year the space agency's Applications Technology Satellite Program Office will kick off a new program called Advanced Applications Flight Experiments (AAFE) which is intended to begin developing space applications experiments requiring long development periods.

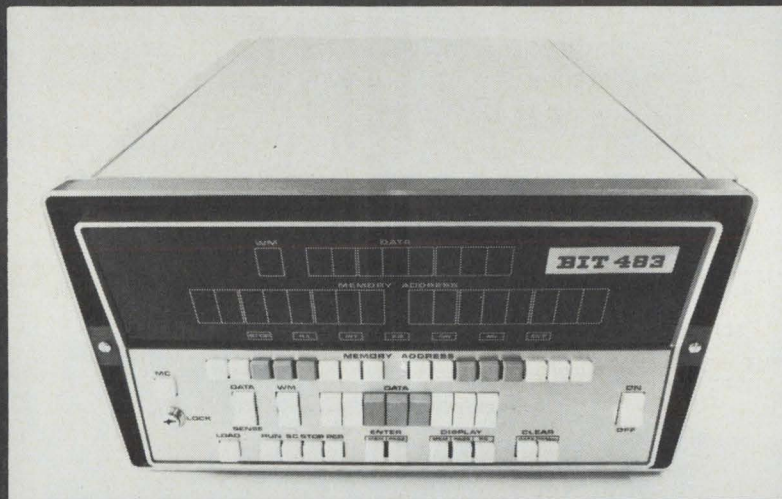
The idea will be to have researchers at work on a concept long before an assignment is made to a specific satellite. Although initially intended for the ATS program, AAFE may also be applied to other satellites such as future Nimbus or ERTS craft. Until now the procedure has been that requests for experiments go out only after a specific satellite program has gotten under way.

The AAFE program will be coordinated with the Office of Advanced Research and Technology as well as various NASA centers, as much of the work, at the beginning at least, will be done in-house.

Addendum

NASA has selected Aerojet General, Hughes, and GE to negotiate for an estimated \$5 million award for a wideband laser communications experiment for the ATS-F satellite. The winner will develop satellite and ground equipment for the experiment [*Electronics*, Dec. 23, 1968, p. 103].

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Circle 71 on reader service card

Unplug the computer

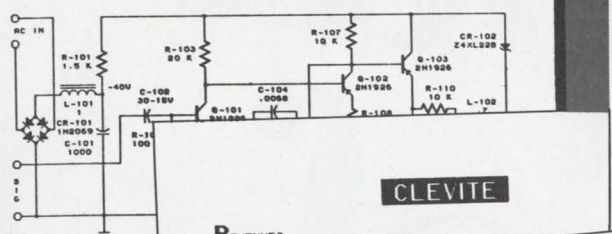
MONTHLY INVENTORY										WDFL	SERIAL	AP NO
TAG	AC	COST	ACQ. DATE	COST	CODE	MANUFACTURER	INV. CATEGORY	DESCRIPTION				4020
C7312	29	201	03-64	83.17	2	COLUMBIA		CABINET	4 DR LETTER FILE	00154L		10503
C7313	24	139	05-54	2,445.30	2	TENNEY		TEST CHAMBER	HIGH-LOW TEMP	100350		90492
C7314	24	139	05-54	25.95	2	LUMINITE		TEMP CHAIR		LA-212		90502
C7315	29	101	11-61	58.20	2	BALLANTINE		VOLTMETER	ELECTRONIC	00300H	00001121	90501
C7316	26	139	03-64	250.00	2	GEN RADIO		BRIDGE	IMPEDANCE TEST JIG	01650A		90501
C7317	26	139	03-64	495.00	2	FLUXE		OSCILLATOR	AUDIO	01311A		90501
C7318	26	139	03-64	40.99	2	BERKELEY		CABINET	FILE GRAY	00001268		90501
C7319	29	030	09-63	875.00	2	CONTINENTAL		VOLTMETER	DIFFERENTIAL	00000947		90501
C7321	26	140	03-64	701.05	2	UNIVERSAL		EMPT & TIMER	MODIFICATION	00001000	00021137	10501
C7322	26	140	04-64	1,087.50	1	HEAPNEY		SAM & FILE	SEE C5500 YEAR 1954	000191	00005303	10000
C7323	29	141	03-64	17,071.05	1	DOALL		PARTS MILLING	SEE C5500 YEAR 1953	00721A	00014410	30403
C7324	26	141	04-54	1,707.68	2	SELLER		SAN	CENTOUR MATIF			00501
C7325	26	143	05-64	5,441.00	1	NORTON		GRINDER	HANDEL STARTER & WDT	0630NS		00016
C7326	24	130	03-64	738.70	2	ATLAS PRESS		DRELL PRESS		0630NS		00009
C7327	26	175	12-63	10,016.98	1	BROWN & SHAR		CUTTER CHINDER	PLAIN	00154L	01817336	00501
C7328	26	180	12-63	121.20	1	CINCIN WILL		WHEELING MACH		00154L	01817340	00502
C7329	29	230	01-64	1,047.00	1	AMER CHAIN		WHEELING MACH		00154L	01817340	00502
C7330	29	230	01-64	1,810.00	1	IDEAL TOOL		BENCH TYPE DIE FILM		00154L	01817340	00502
C7331	29	230	01-64	890.00	1	ONEIL		HAND OPERATED		00154L	01817340	00502
C7332	29	230	08-64	181.00	1	COLLINS		BLACK GRANITF		00154L	01817340	00502
C7333	29	202	04-64	225.00	1			3/4 HP		002234	00020942	30502
C7334	24	050	04-64	183.90	2			3/4 HP		003101	00020942	30501
C7335	29	170	04-64	183.90	2			3/4 HP		15M7A	08-01590	20502
C7336	29	302	04-64	183.90	2			CARRIER ROUN				10502
C7337	29	302	04-64	183.90	2			IC KEY				10003
C7338	29	302	04-64	183.90	2					001314	0170720	10003
C7339	24	303	04-64	183.90	2					000043	00000362	10404
C7340	24	303	04-64	183.90	2					000043	00000368	90101
C7341	24	303	04-64	250.00	2					000043	00000368	90101
C7342	29	101	01-64	205.23	2	GOLD STAR		CABINET	ELECTRIC	000043	00000368	90101
C7343	29	101	01-64	58.29	2	1BH		TYPEWRITER	4 DR FILE GRADE A 10	000043	00000368	90101
C7344	29	101	03-64	58.29	2	STODCHREST		CABINET	WITH LIGHT	000043	00000368	90101
C7345	24	139	12-63	930.00	2	WHITFIELD		BENCH		999-PT	00701224	00003
C7346	29	101	01-64	58.29	2	WHITFIELD		BENCH		000100	00675108	10005
C7347	29	101	03-64	58.29	2	WHITFIELD		BENCH		000100	00675108	10005
C7348	24	139	12-63	930.00	2	WHITFIELD		BENCH		00803P	00000110	00504
C7349	29	200	12-63	447.63	2	TIME MASTER		VERTICATING MACH				
C7350	29	201	12-63	447.63	2	HEMINGTON		ADD'G	12-UNIT GREY			
C7351	26	030	05-64	875.00	2	FLUXE		VOLTMETER	12-UNIT GREY			
C7352	26	067	01-61	77.67	2			LOCKED				
C7353	29	067	01-61	77.67	2			LOCKED				

03/13/69-PRNTEFIL-PRINTA

In the time it takes a line printer to pound out one oversize page of printout...

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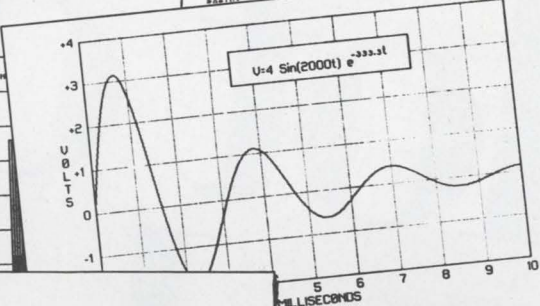
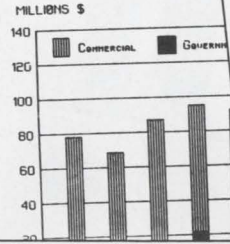


The above schematic is a graphical sophisticated CLEVITE 4800 has been created using have been overlaid automatically erasing the literature degrees of cal or hd

White not circuit is re literature degrees of cal or hd

This diagram is typed and light pen technique the CLEVITE 4800

REVENUES



ELEMENT VALUES (IN HENRYS, FARADS) FOR NORMALIZED SPEECH CIRCUIT CATEGORY FILTERS

ORDER	C1	L2	C3	B=2.75	C5	L6	C7	L8
1	1.414214	0.707107						
2	1.584893	1.232072	0.519655					
3	1.734994	1.192152	0.064271	0.404498				
4	1.874612	1.233384	1.030450					
5	2.092206	1.394097	1.214384	0.904821	0.338878			
6	2.304320	1.509533	1.379821	1.166622	0.789703	0.277279		
7	2.461501	1.593349	1.427443	1.259742	1.094442	0.686185	0.230104	
8	2.504342	1.613011	1.457859	1.370522	1.242905	0.954747	0.610272	0.210047

ORDER	C1	L2	C3	B=4.00	C5	L6	C7	L8
1	1.414213	0.707107						
2	1.649595	1.185145	0.527626					
3	1.874612	1.233384	1.030450	0.414142				
4	2.092206	1.394097	1.214384	0.904821	0.338878			
5	2.304320	1.509533	1.379821	1.166622	0.789703	0.288511		
6	2.461501	1.593349	1.427443	1.259742	1.094442	0.697611	0.2487	
7	2.504342	1.613011	1.457859	1.370522	1.242905	0.949204	0.621872	0.216688

ROBINS DRY NURSERY 4302 SCHULL ---291-8178 ROBINSON EDNA E 1408 W 110 ---421-8708
 ROBINSON DONALD W 3888 WALTON ---477-3128 ROBINSON EDW 1881 HILLVIEW ---231-8087
 ROBINSON E 8019 RIDGE ---786-4982 ROBINSON EDW 1348 E 82 ---821-1921
 ROBINSON HAROLD R 13700 FAIRVIEW ---688-4800 ROBINSON EDW 1348 E 82 ---821-2611
 ROBINSON J C 18804 SOUTHLAND ---381-8109 ROBINSON ELMER 10211 ROBINSON ---781-8818
 ROBINSON JOHN P 3887 METLHAM ---421-2414 ROBINSON EMMETT 3304 DECKER ---491-8917
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CLEVITE
 CORPORATION

June 1969

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 Cleveland, Ohio 44110

Mr. Harker:

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 20 UNITS HIGH BY 15 UNITS WIDE.
 20 UNITS HIGH BY 15 UNITS WIDE.
 SAME CHARACTERS ARE 4 UNITS WIDE.
 SAME CHARACTERS ARE 26 UNITS WIDE.
 THESE ARE 26 UNITS WIDE.

MODEL	SERIAL	SP NO	6080+
00194	00001	10003	
10030	00002	10002	
10052	00001	10001	
00300	00001121	90501	
01850A	00001	90901	
000038	00003888	00008	
000308	0000947	00011	
000100	00001	40901	
0000137	1090	90901	
0000303	0000303	30903	
00018619	00018619	30903	
000016	000016	40901	
00009	00009	90901	
000028	000028	20902	
00003888	00003888	00001	
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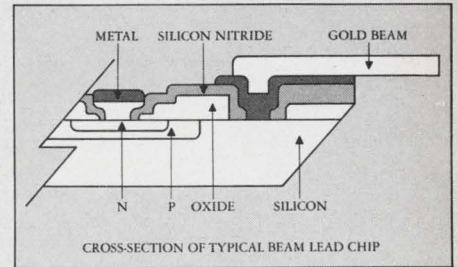
Everybody talks about beam lead.



Circle 77 on reader service card →

This is the dawning of the age of the leaded chip. In other words, sports fans, August is the month Raytheon uncorks beam lead, and the old semiconductor business will never again be the same.

- Simply meaning that now you can buy semiconductor chips with leads already formed and integrally attached. This lets you control packaging, save system assembly time and boost reliability.



- Take a for instance. With

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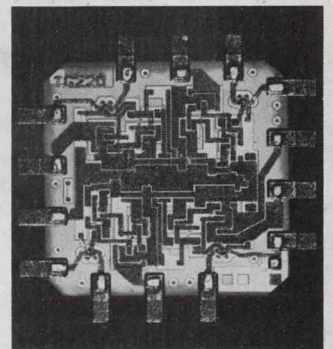
- And the chip stays healthier. Your operator can mash down on those little leads and cook them to a turn. The chip sits there, to one side of the action, calm, cool and uncracked.

- But there's more. Every beam lead chip sports a Silicon Nitride passivation coat to give it complete hermetic sealing at all junctions. Raytheon's wafer separation process exorcises that evil old chip-cracker, the scribe.

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But we deliver it.



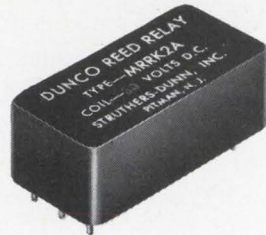
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RG220	Quad 2 input NAND gate	4.05
RG240	Dual 4 input NAND gate	4.05
RG200	Expandable single 8 input NAND gate	4.05
RG230	Quad 2 input OR expander gate	2.60
RF200	JK flip flop (AND inputs)	6.00
RF100	Dual JK flip flop (separate clock)	7.10
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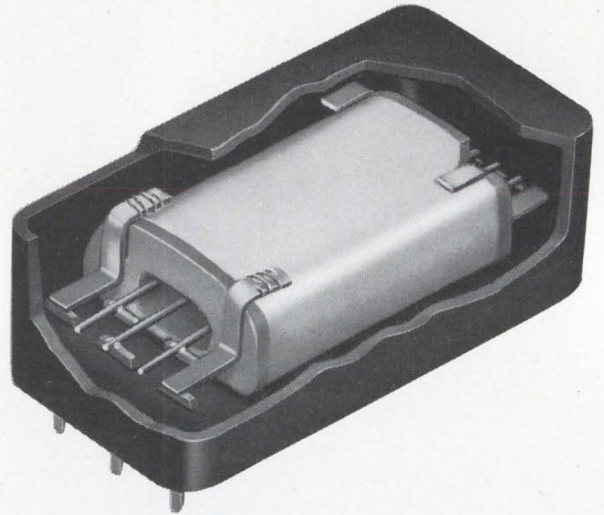
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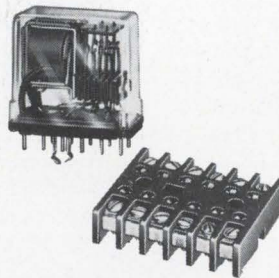
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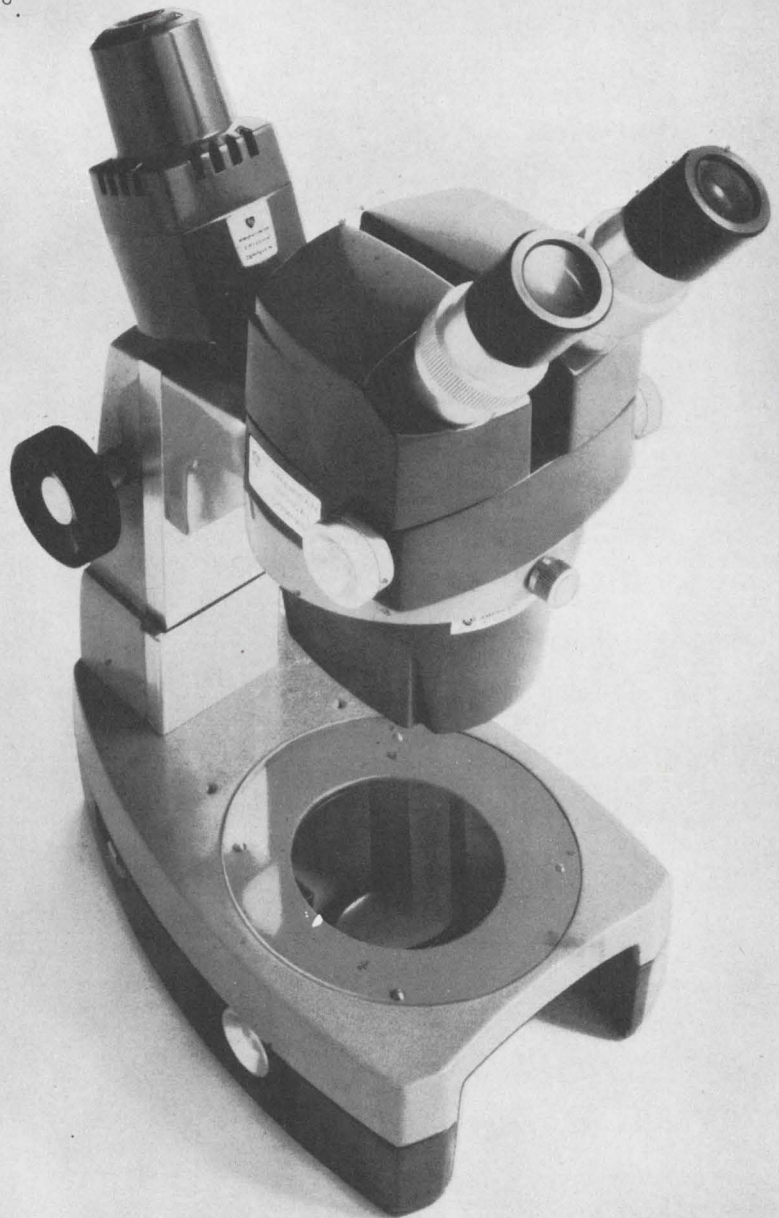
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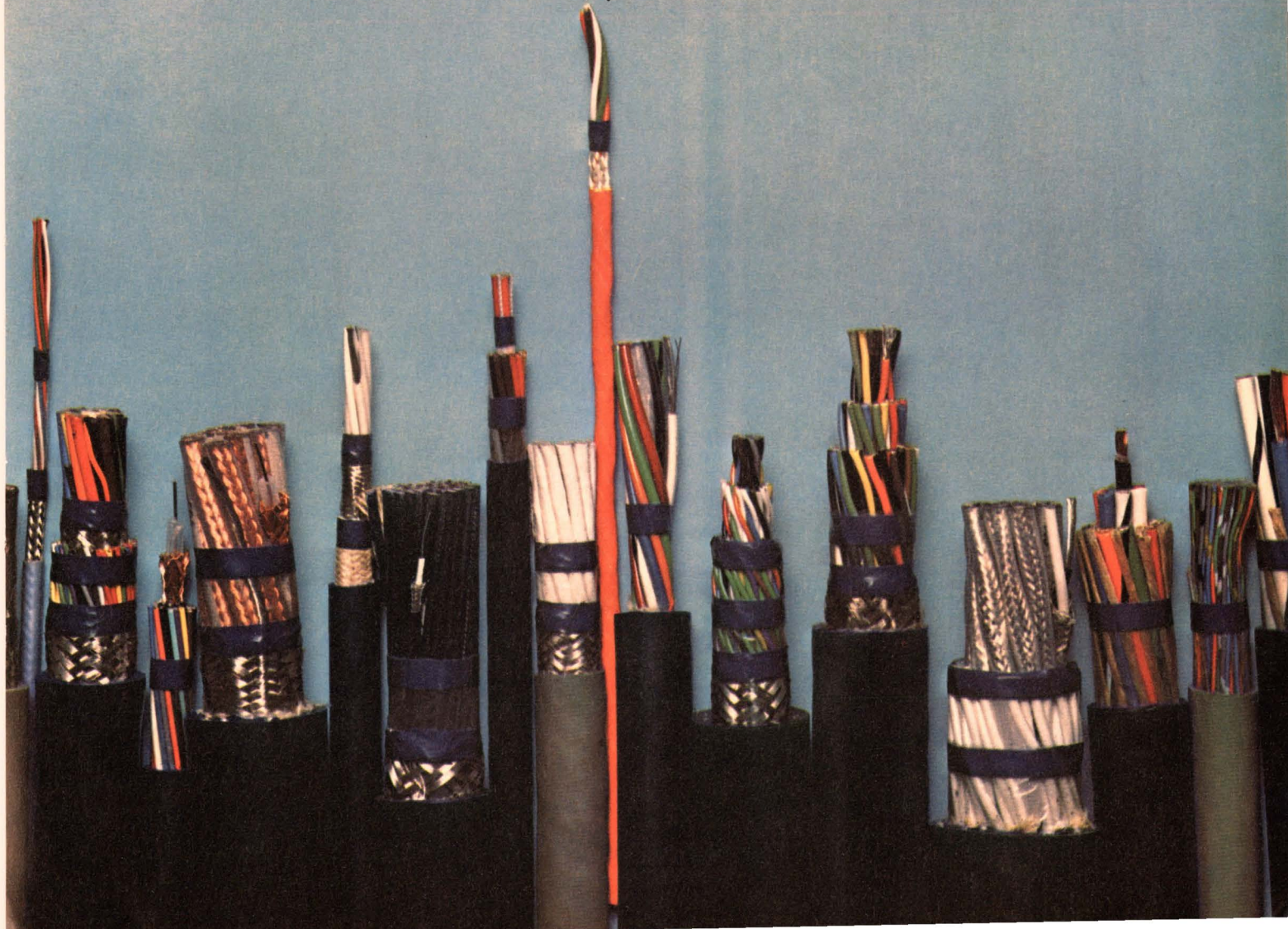
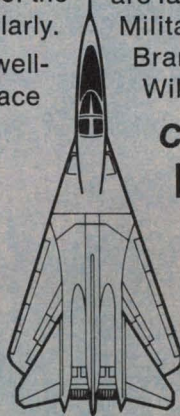
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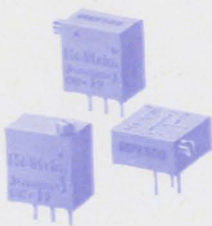
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Technical Articles

Oscilloscope's changing face—red, green and blue traces
page 84



Resolution and aim are the important considerations when designing a three-gun cathode-ray tube like those used in color television sets into a three-channel oscilloscope. In a new unit, built with this kind of crt, the three electron guns scan the screen and a logic network fires the right ones at the right times. The results are sets of green, red, and blue dots forming the

scope's traces. For good resolution there must be plenty of dots; display accuracy depends on convergence of the three electron beams. The multihued traces display a great deal of information that can be read and understood by professional engineers and laymen alike.

Building blocks are two-base hit for analog control computers
page 96

Analog computation may now prove preferable to digital techniques in control applications where 1% accuracy is acceptable. Raytheon has come up with an analog computer that promises to allow systems designers to take advantage of simpler and more straightforward methods. The machine works off just two basic modules—a function generator and a summing amplifier—built around monolithic linear IC's and discrete components on thick-film ceramic substrates.

Color tv gets badly needed face-lift
page 102

The changes in color hues that result when channels are changed or when cameras switch from live to taped coverage can be greatly minimized by a correction circuit in the receiver. A recently developed automatic-tint control, using gates controlled by the set's 3.58-megahertz oscillator and phase-shifting networks, senses color variations in the flesh-tone region and develops a correction signal to compensate for them in the chroma amplifier.

Electronics midyear markets report
page 107

Just past the halfway point, it looks like a pretty good year for the electronics industry. Defense and aerospace suppliers may be in for some disappointments during the period ahead as congressional budget cutters hack away at appropriations. Semiconductor houses, however, are rocketing along at a good clip as are concerns oriented toward industrial outlets. Computer makers and manufacturers of peripheral equipment are still riding a gravy train, and avionics outfits are eyeing lush new markets in traffic control. Consumer goods business is running at a high level, but producers are concerned about the rising tide of imports, particularly from Japan.

New slant on failure analysis

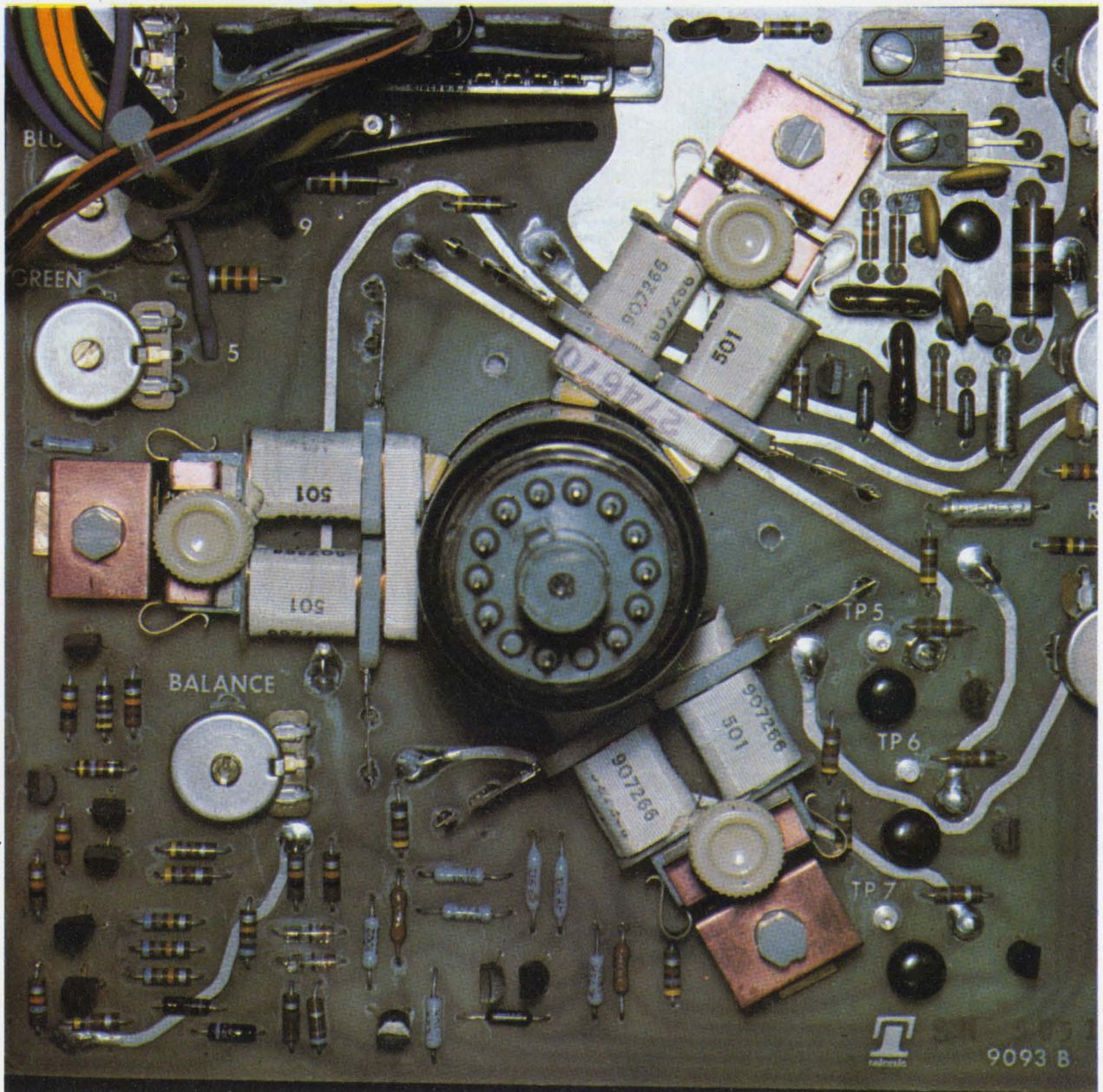
Coming

Having studied the matter, the Air Force has determined that when equipment breaks down as a result of the failure of a solid state component, the part in question has not, in many cases, been properly designed or inspected by the supplier.

By Richard E. McCormick

Telonic Industries Inc., Laguna Beach, Calif.

Oscilloscope's changing face



- ▶ Magnets converge the beams from a three-gun crt
- ▶ High-speed vertical scan intensifies resolution
- ▶ IC comparators provide 15-nsec response time

— *red, green and blue traces*

Effectively locked out of oscilloscopes because of the thorny problems of aim and resolution, color is at long last being ushered through the door. Providing the key is a three-gun cathode-ray tube, standard in color-television receivers, that serves as the scope's display element.

Much more than merely having a pretty face, a color scope delivers a meaningful message. It's red, green, and blue traces display a great deal of information distinctly. More importantly, the information can be read and understood by engineer and layman alike. This readability could lead to oscilloscopes having a broader range of applications in which laymen, rather than technicians, are involved.

The crt's electron guns fire through a shadow mask at phosphors on the tube's face, with the beam from one gun striking only the red phosphors, the beam from the second gun hitting only the green phosphors, and the third beam striking only the blue phosphors. A deflection coil aims the guns vertically, while a second coil scans the guns horizontally. The firing of the right guns at the right times, thus producing the traces, is controlled by logic circuitry.

Since the traces aren't continuous lines—they're sets of dots on a raster—a high-frequency vertical scan is needed to achieve an illusion of continuity. In the approach taken by Telonic Industries Inc., 40 kilohertz was chosen as the scan rate.

Three guns; one spot. If the color t-v tube (center) were left alone, its three electron beams wouldn't converge. But it's not alone. The trio of magnets surrounding the tube generate a continuously changing flux which ensures that the tube's electronic guns are always pointing at the same spot.

Three magnets, each having one winding for vertical-correction current and another for horizontal-correction current, are clamped onto the neck of the crt to position the beams precisely so that they converge.

Putting it together

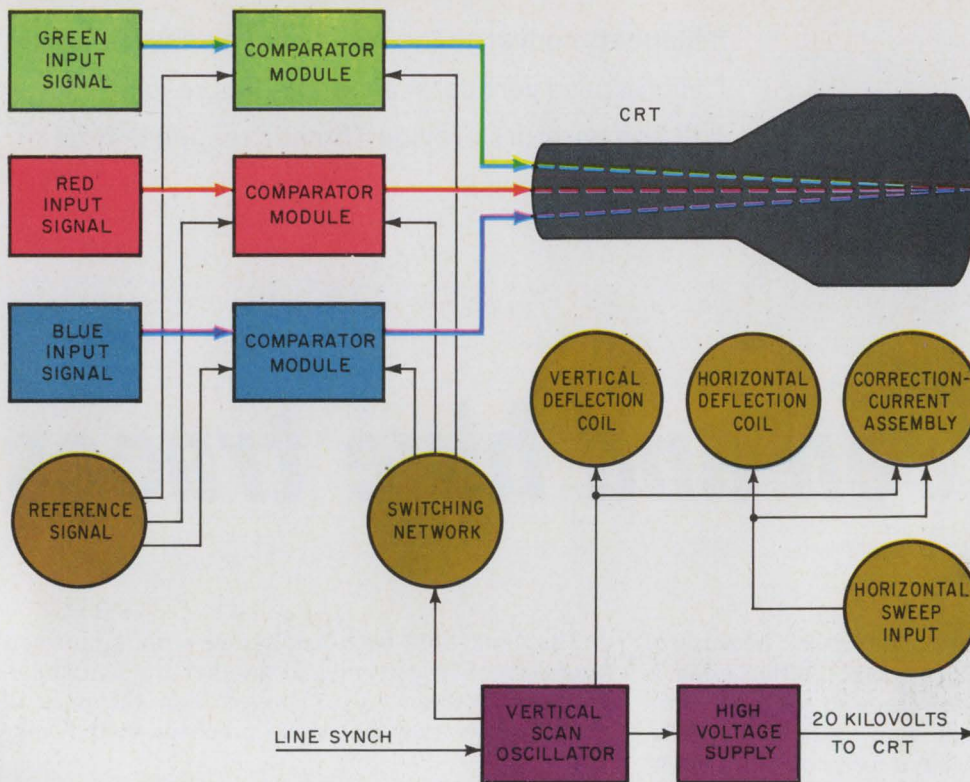
A power oscillator, phase-locked to the line frequency, generates a sinusoidal current in the vertical deflection coil. This current not only aims the electron beams, but also generates a beam-position voltage that is routed by a switching network to red, green, and blue comparator modules. These modules have pulse generators that trigger their associated guns. In addition to the position voltage, each module receives both a reference voltage and an input voltage from one of the three vertical channels.

During the downward vertical scan, each comparator turns on its pulse generator when the comparator's input voltage equals the position voltage. The gun then fires, producing a dot. Thus, three dots—red, green and blue—are generated in the downward scan. During the upward scan, the input voltage is ignored. In its place, reference voltages which are preset, are compared with the position voltage. Three more dots are then generated. As the beams are deflected horizontally, three input traces and three reference lines are plotted.

Since the vertical sweep is sinusoidal, the beams move up and down at a continuously changing rate. But because the comparators, not the scanning system, determine the position of the dots, the nonlinearity of the scan has no bearing on the linearity of the trace. Only the point-to-point spacing between dots differs for each adjacent pair of dots.

Enhancing resolution

But since resolution of raster-type displays depends on the distance between the dots, the determining factors are the horizontal-sweep speed, the input's frequency and amplitude, and the vertical-



Channels of color. The horizontal and vertical deflection coils aim the three guns in an up-and-down left-to-right scan. During the downward scan each module compares its channel's input with the position signal coming from the switching network; when the two signals are equal the pulse generator fires an electron gun, making a colored dot on the screen. During the upward scan the position signal is compared with the channel's reference signal, and when these two are equal another dot appears. The correction-current assembly converges the beams from the three guns.

scan frequency. The distance between adjacent dots is given by

$$(1/f_s)(v_h)(m^2 + 1)^{\frac{1}{2}}$$

where f_s is the scan frequency, v_h is the horizontal sweep and m is the slope of the displayed signal. The slope increases when the input's frequency or amplitude increases.

There are two ways of enhancing resolution—one by lowering the horizontal speed, the input's frequency, or the input's amplitude, and the second by boosting vertical-scan frequency. The former approach, however, reduces the display's capability, and, in turn, the scope's. Thus, it's best to take the latter approach, not that it is without a drawback.

Unfortunately, flyback-type scans usually used with magnetically-deflected crt's aren't practical for high-speed scans; large voltages, which lead to breakdowns, are induced across the vertical amplifier's output transistors during flyback. In this scope, a resonant circuit reduces the voltage requirement for these transistors. This circuit, the 40-khz oscillator on page 87, is essentially a closed-loop network. To achieve oscillation, a square wave from a switching amplifier passes through an impedance-matching filter to a high-Q tank circuit comprising the vertical-deflection coil in series with a tuning capacitor. With the square wave having an amplitude of 45 volts, the resulting deflection current, $i(t)$, is a 40-khz sine wave whose amplitude is about 0.7 amp.

It takes only 0.5 amp to deflect the beam to the

top or bottom of the 10-inch-high screen, so there's a 40% overscan. Therefore, only the linear portion of the sinusoidal scan is used.

The coil, whose inductance is 15 millihenrys, has a peak voltage across it of about 2.6 kilovolts because

$$\begin{aligned} v &= L \frac{di}{dt} \\ &= L \frac{d}{dt} (0.7 \sin \omega t) \\ &\cong 2,600 \cos \omega t \end{aligned}$$

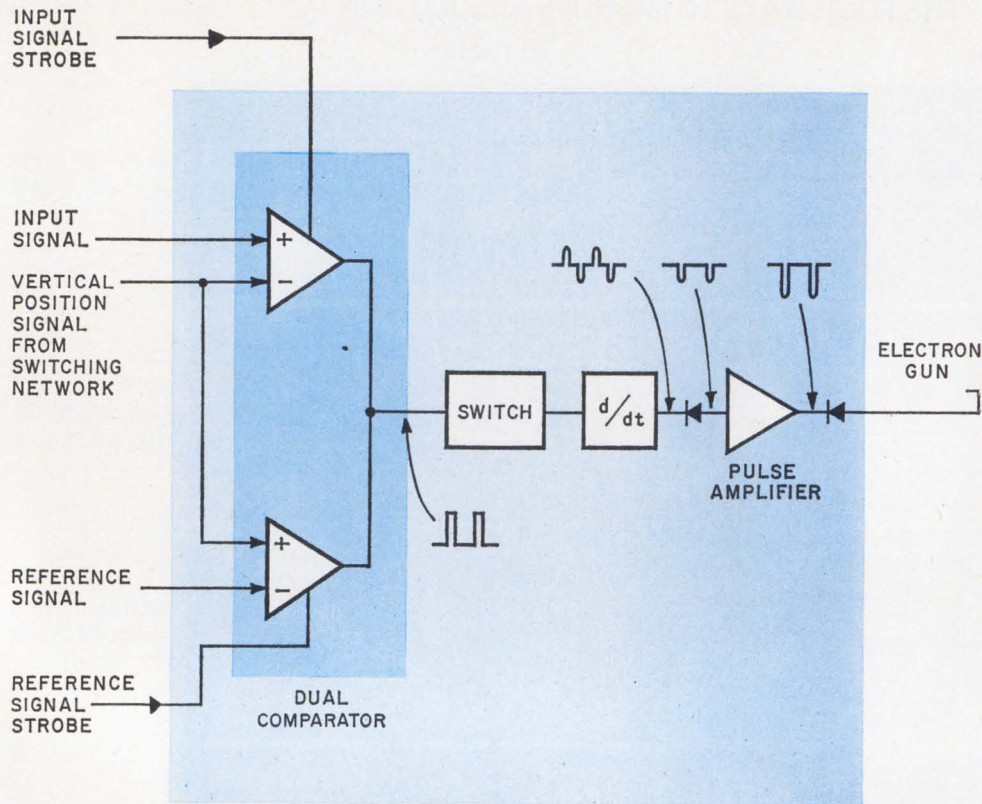
where

$$\omega \cong 80,000 \pi$$

With a 15-mh deflection coil, the tank circuit needs a capacitance of 1,200 picofarads. Any high-Q tank circuit can be used as long as the tuning capacitor maintains the proper resonant frequency.

Stabilization of the scan frequency is achieved with a phase-locked loop. A phase comparator looks at the phase of the oscillator's output and that of the line voltage, and generates an error voltage proportional to the difference. This error voltage drives a phase shifter that adjusts the oscillator.

The 40-khz figure is a nominal value for the scan frequency. In reality, this frequency is an exact multiple of the line frequency. Thus, if the line frequency is 60 hertz, the scan frequency is 36,240 hz (the 604th harmonic); if it's 50 hz, the scan frequency is 36,200 hz (the 724th harmonic).



Strobe control. Each of the scope's three channels has a module. Its key element is the dual comparator, an off-the-shelf integrated circuit. Strobe signals turn on one of the IC's comparators during the downward scan and the other comparator during the upward scan.

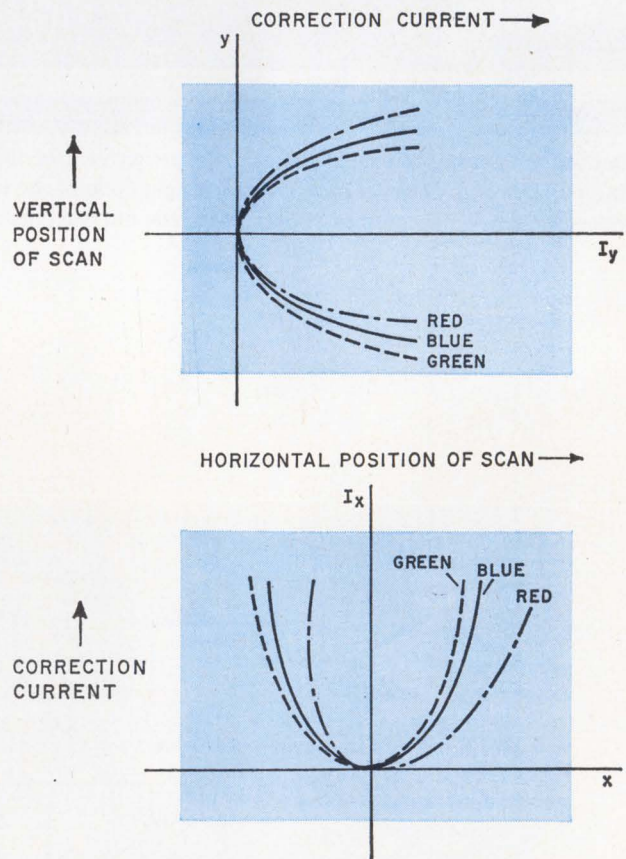
The reason that the vertical scan frequency is synched to the line frequency is to ensure that the display is stable when the horizontal sweep is also synched to the line, a common occurrence. Any low-amplitude high-frequency line transients are filtered out before the synchronous signal is generated.

One module per channel

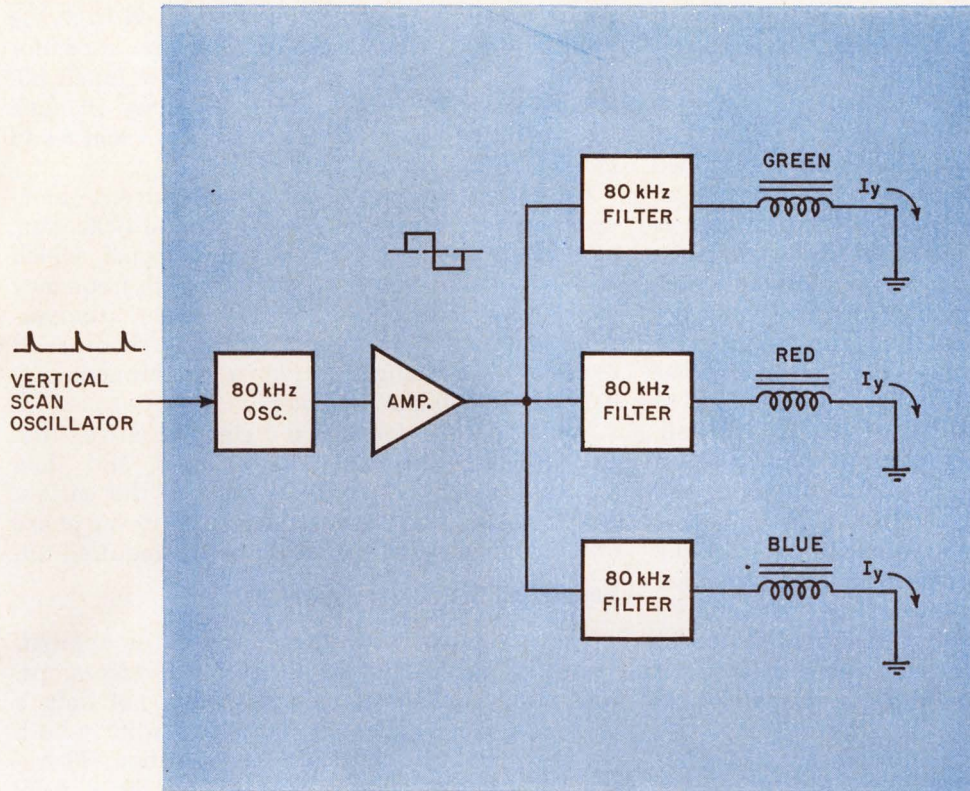
Although the channels produce different colors, the comparator modules are identical. Each has an integrated-circuit dual comparator and a pulse generator. One such module is shown above. Only 15 nanoseconds elapse between the time a comparator senses two voltages are equal and the time a pulse generator fires. This speed is necessitated by the 40-khz scan frequency.

To determine which of the IC's two comparators is connected to the output, a strobe is used. The voltage across the deflection coil switches the strobe between high and low logic levels at zero crossings of the coil's voltage. Since this voltage is 90° out of phase with the coil's current, the strobe is switched when the vertical scan is at its top or bottom. During the downward scan, the strobe line for the dual comparator is high, and the input voltage is compared with the position voltage; all reference information is ignored. During the upward scan, the strobe levels are reversed so that reference voltages are compared and signal information ignored. The comparator then drives a differentiator.

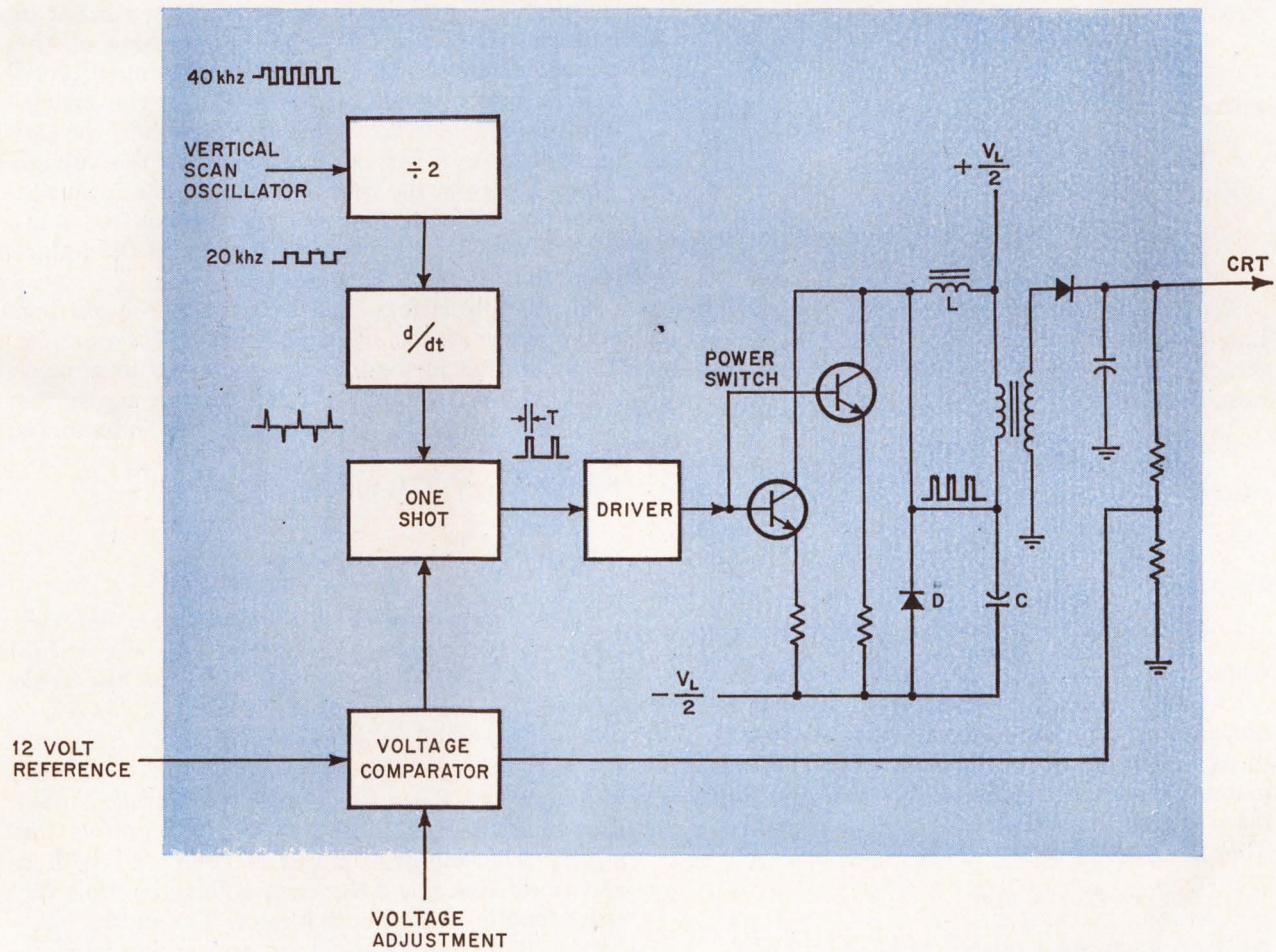
Negative spikes from the differentiator trigger a



Getting together. When the correction currents, which are functions of the scan's position, flow in the windings of the correction-current magnets the beams converge.



Getting the current.
The vertical convergence circuits generates the I_y for each of the channels.



Tube power. Regulated to within 50 volts, the power supply delivers up to 20 kilovolts to the crt's anode.

pulse amplifier, which applies an 80-nsec, 200-volt negative pulse to a cathode.

Convergence

The solution to the convergence problem lies with a trio of magnets whose fluxes are determined by correction currents. Each gun, positioned in an equilateral triangle about the axis of the tube, is tilted slightly toward the axis. Thus, each beam strikes the shadow mask at the precise angle necessary to illuminate phosphor of only one color. Because the guns are positioned off axis and because the beams converge at the shadow mask rather than on the screen, each beam reacts differently to the magnetic flux generated by the deflection coil. Without the magnets, the traces wouldn't overlap when the same signal is applied to the input terminals of three channels.

Since there are three magnets, one each for the green, red and blue guns, there are six correction windings in all. For every given point on the tube's scan, there's a specific amount of current that must flow into each winding. These currents, determined empirically, are plotted as functions of the vertical or horizontal position of the scan on page 88. Besides the magnets, the correction-current assemblies have networks that generate the correction currents.

The plots are tilted parabolas whose general equation is

$$I = K_1 r^2 + K_2 r$$

where

I = correction current

K_1, K_2 = constants

r = amount of vertical deflection y or horizontal deflection x

To generate correction current, vertical deflection is considered first. The vertical deflection is directly proportional to the scan signal and is described by

$$y = K_3 \sin \omega t$$

where

K_3 = constant

Therefore,

$$I_y = \frac{1}{2} K_1 K_3^2 - \frac{1}{2} K_1 K_3^2 \cos 2\omega t + K_2 K_3 \sin \omega t$$

where I_y is the vertical correction current.

The first term may be neglected since it can be included in a static convergence adjustment. K_2 turns out to be quite small and may be approximated by adding a phase-shift term, θ , to the primary correction signal.

Therefore,

$$I_y = A \cos (2\omega t + \theta) t$$

where A is constant related to K_1, K_2 and K_3 .

Providing this correction is a vertical conver-

gence circuit, on page 89. Pulses derived from the vertical scan synchronize an 80-khz oscillator whose output is applied to three series-tuned 80-khz filters. The Q and center frequency of each filter are varied to set the individual A 's and θ 's to get the desired values.

Generating horizontal-correction current, however, isn't quite as easy. The horizontal deflection, x , depends on the horizontal sweep signal, which in this scope may be any waveform with frequency components from d-c to 1 khz. Therefore, the vertical-correction network is inadequate because it requires an unchanging input—a synchronous signal from the 40-khz oscillator.

What does the job is a d-c coupled circuit that rectifies the horizontal sweep input and then shapes it to fit the parabolic form of the curves. Added to this shaped waveform is whatever phase of the original signal that achieves the required tilt.

Regulating the power supply

The crt requires an anode voltage of approximately 20 kv at a current of up to 500 microamps. Any change in anode voltage causes not only a change in display intensity, but also a shift in both the horizontal and vertical beam position. Therefore, the tube's anode supply, on pg. 89, is fully regulated against changes in line voltage or load current. The supply generates pulses across a pulse transformer's primary by establishing a current in an inductor, L , and then rapidly switching off the current source so that the inductor current is forced to flow into a small capacitor, C . As the energy from the inductor flows into the capacitor, the latter charges to a very high voltage and the voltage appears across the pulse transformer's primary. After one cycle, oscillation is damped out by a diode, D , and the circuit is dormant until the inductor current is again turned on.

The supply is regulated by varying the on time of the power switch. If the switch is on for a period, T , the current in the inductor increases to a maximum, $V_L T/L$, where V_L is the voltage across the coil; the energy E_L contained in the inductor is $\frac{1}{2} L I^2$.

Substituting $V_L T/L$ for I gives

$$E_L = \frac{V_L^2 T^2}{2L}$$

Since energy stored in a capacitor is $\frac{1}{2} C V_C^2$, where V_C is the voltage across the capacitor, it follows that $\frac{1}{2} (V_L^2 T^2 / L) = \frac{1}{2} C V_C^2$, and the peak voltage across the capacitor will be $V_L T / (LC)^{1/2}$.

Note that if all other factors are held constant, the peak voltage is directly proportional to T . And in this supply T is a function of the output. A one-shot multivibrator, pulsed at 20-khz, controls the switch. The supply's output is compared with a 12-volt reference, and the error voltage controls the pulse length of the multivibrator. The output may be adjusted from 12 to 24 kv, and is regulated to within 50 volts. ■

Designer's casebook

Designer's casebook is a regular feature in Electronics. Readers are invited to submit novel circuit ideas and unusual solutions to design problems. Descriptions should be short. We'll pay \$50 for each item published.

IC's take the "bounce" out of switches

By Victor Wintriss

Consultant, Norfolk, Va.

Transients from switch contact bounce cannot be tolerated in fast response circuits. Snap-action switches are the main offenders and are still very much in use today.

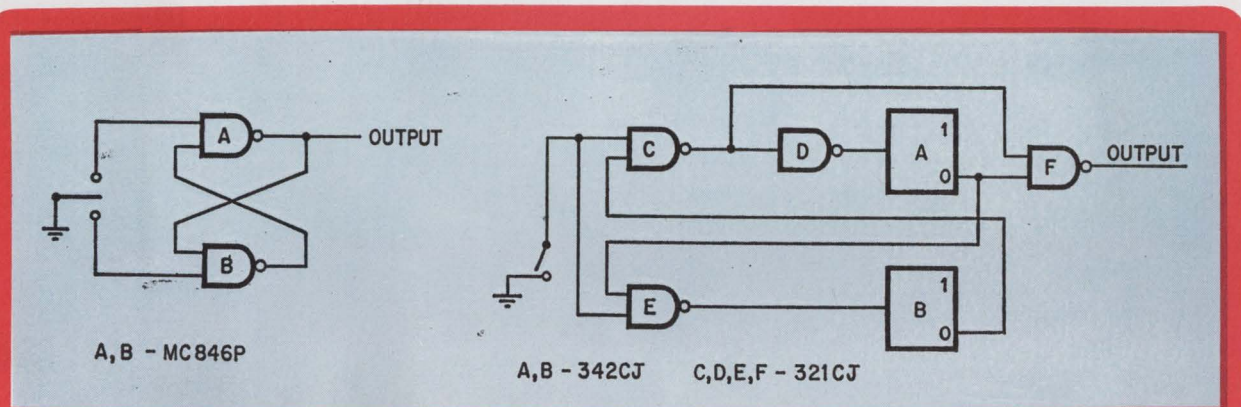
A simple method of eliminating bounce uses the NAND gate configuration shown on top. When the switch is moved to the contact forming B's input, B's output goes high. The high output of B is delivered to A's input and its output goes low.

A's low output immediately locks B's input low, inhibiting any further transients of the switch from triggering B.

The only drawback to this circuit is that it uses a single pole double throw switch while many applications may use single pole single throw switches. For this purpose, the circuit at the bottom will do.

When the switch closes, E goes low and the one shot multivibrator B delivers a logic-0 pulse to C's input. The pulse width should be wide enough to suppress any closing transients from the switch.

With C low, A cannot be triggered and F's output remains low. When the switch opens, and C's input goes high, A delivers a pulse that keeps the input to E low, preventing further triggering of B and keeping F's output high for the durations of A's pulse width, which should be long enough to suppress any opening transients.



No spikes. The NAND gate circuit configuration shown on top can be used to eliminate transients from contact bounce in single pole single throw switches. In applications requiring double throw switches, the monostable multivibrator circuit below can be used.

IC-size phase detector doesn't need any inductors

By A. H. Hargrove

Bendix Corp., Baltimore, Md.

A phase-sensitive detector circuit can be built without the usual need for tuned circuits or transformers. By eliminating the cumbersome transformers and inductors, the detector can be packaged as a micro-circuit and used with integrated circuits.

The circuit extracts phase and amplitude modulation data from 20-megahertz intermediate frequency signals. The wide bandwidth of the circuit

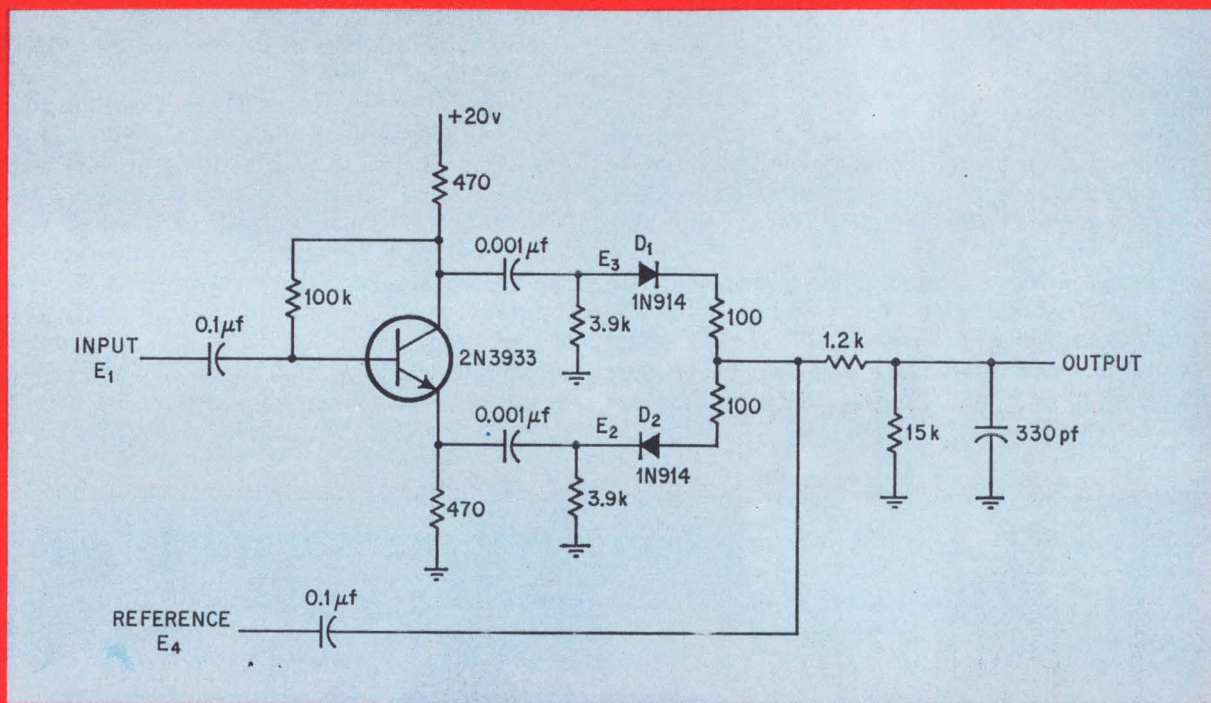
allows it to operate at frequencies up to 30 Mhz.

Transistor Q_1 acts as a phase splitter to incoming signals, delivering the signal to the anode of diode D_1 , and to the cathode of D_2 but 180° out of phase. The reference voltage E_4 is delivered to the opposite terminal of both diodes. A voltage proportional to the vector sum of the input signal E_1 and the reference signal is produced at the output.

When the input signal and reference voltages are in quadrature, the diodes produce equal and oppo-

site voltages yielding zero volts at the output. The maximum negative voltage is generated at the output when the signals are 180° out of phase. The maximum positive voltage appears when the signals are in phase. As the reference is shifted through 360° , the output follows a typical detector curve.

If a limiter is used to lower the input signal's amplitude, the output will be a function of phase angle only, otherwise, amplitude changes appear.



Splitting the scene. Incoming signals are transmitted to both diodes simultaneously but 180° out of phase. The reference voltage combines with the input signal by vector addition to produce the output signal. The circuit was designed to handle frequencies up to 30 megahertz.

Inverted transistor switches precision d-c voltage

By George R. Latham 4th

Hewlett-Packard, Loveland, Colo.

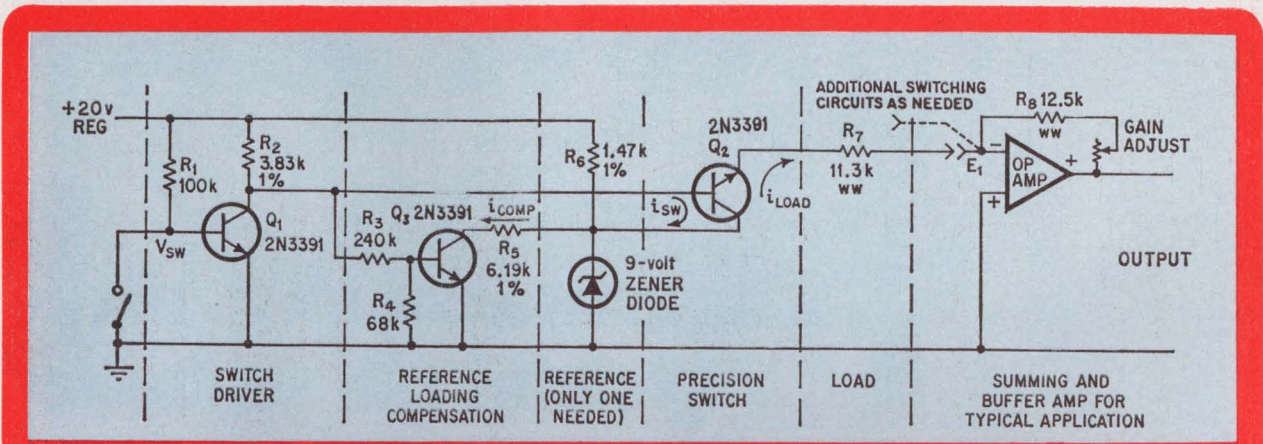
A transistor with the emitter and collector connections inverted overcomes inaccuracies caused by contact resistance in cheap switches. In fact, contact resistance as high as one kilohm has no effect

on the operation of a circuit using an inverted transistor.

With a well regulated power supply and a dropping resistor R_6 , a precision d-c test voltage is set up across the zener diode. The test voltage is switched on or off by Q_2 . R_7 acts as the load and can be used to feed a current summing junction such as E_1 . The connection of Q_1 in the inverted mode provides a collector-to-emitter saturation voltage, V_{ce} , that is about one half that of the normal mode connection, because the beta for the inverted mode is approximately unity. The base current i_{sw} is chosen to be 3 to 4 times the load current in order to minimize V_{ce} .

The switch Q_2 is controlled by Q_1 . When Q_1 is cut off, Q_3 and R_5 conduct causing a compensating current to flow, and the +20 volt source supplies base current through R_2 to turn on Q_2 . Additional switching circuits may be added whenever necessary so that decimal or binary voltages may be formed. By choosing $i_{comp} = i_{sw} - i_{load}$, an

inexpensive reference diode may be used in place of a low impedance active reference supply. Even though a typical 9-volt reference diode has an 18-ohm output impedance, the total current change through the diode is small due to the use of a compensating current. Thus high accuracy can be obtained economically.



Accurate and economical. The +20 volt regulated supply and R_6 set up an accurate reference voltage across the zener diode while Q_3 connected in the inverted mode acts as a low contact resistance switch. Because a compensating current is employed, an inexpensive zener diode may be used.

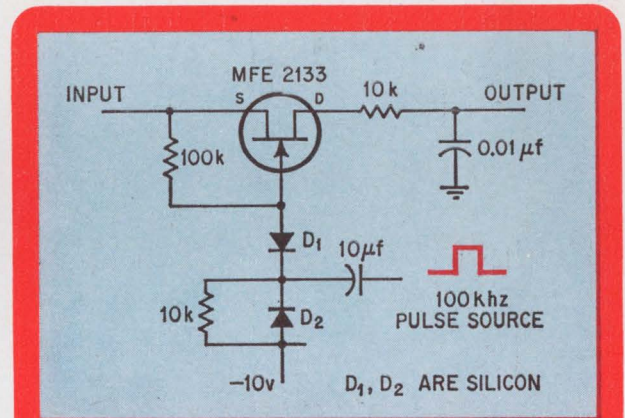
Pulse-train duty factor controls RC filter

By L. L. Hamilton

Catholic University of America, Washington, D.C.

The availability of inexpensive digital integrated circuits and nearly ideal field effect transistor switches enables great flexibility in the design of analog circuitry by using the duty factor of a pulse train to control the frequency selectivity of a resistance-capacitance filter. This is accomplished by switching a field effect transistor and thus varying the circuit resistance. This method offers several advantages over linear FET resistance control including less dependence on the properties of the FET and reduced temperature sensitivity.

The FET is driven by a pulse width modulated source. D_1 decouples the switching signal from the FET during the positive pulse. Since the FET is a depletion mode device, no forward bias is required on the gate. D_2 is used as a d-c restorer. If the proper d-c level were available from the pulse source, the 10-microfarad capacitor, 10-kilohm resistor and D_2 would not be necessary. Using the



Tunable. The FET, acting as an ideal switch, controls the effective resistance in the circuit thus determining the corner frequency, f_c , of the filter.

arrangement shown, the effective resistance in the circuit becomes inversely proportional to the duty factor t/T , where t is the on time and T is the period of the pulse train. As the duty factor is varied from 1 to 0, the effective resistance ranges from $R-10$ kilohms in the circuit shown—to infinity, thus giving continuous control of the filter's corner frequency, $f_c = 1/(2\pi R_{eff}C)$.

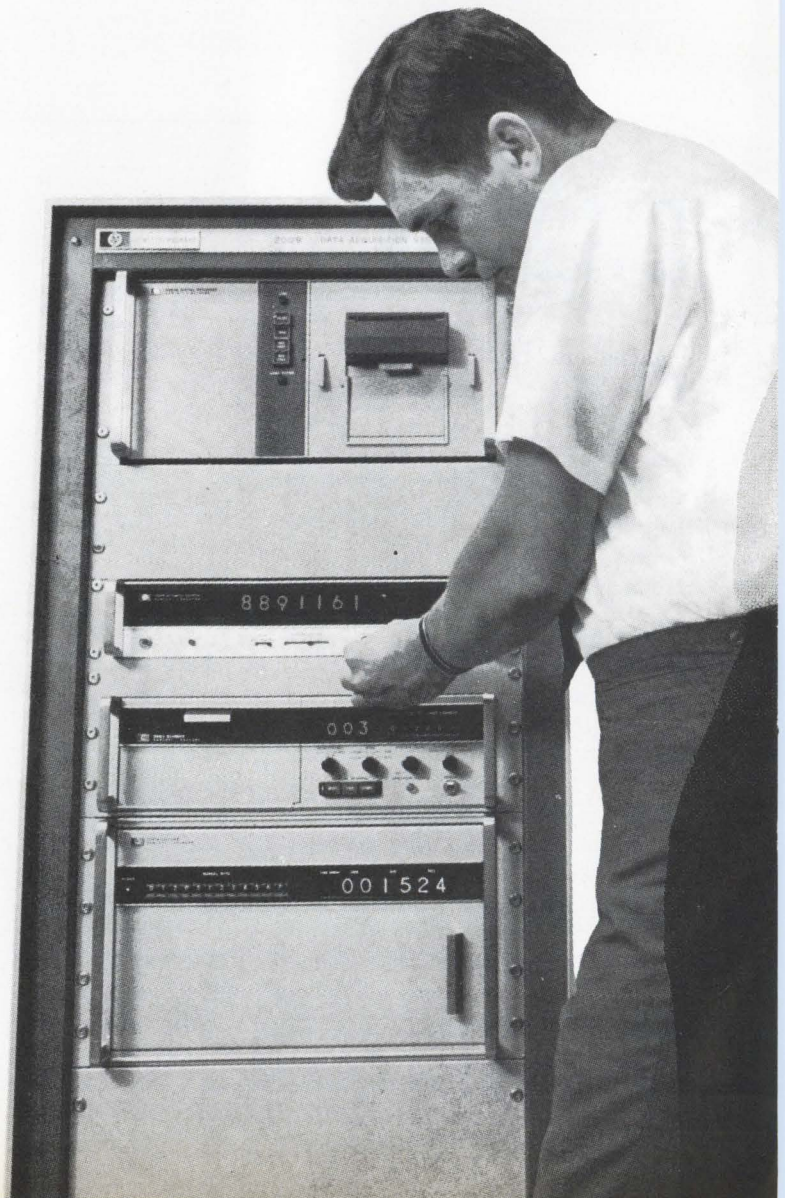
On the left you see the HP 5323A Automatic Counter at work in a system. On the right is our HP 5325B Universal Counter, making a hard test easy.

The counters could easily be reversed. Because both are programmable and with either of them you can count up to 20 MHz in a system or on your bench. The one you choose depends on what you need.

The Automatic Counter has automatic range selection from 0.125 Hz to 20 MHz. And it needs no switching from frequency measuring mode for high frequency measurements to period measuring mode for accurate low frequency measurements. That's because all measurements are made in the period mode, and internal

computing circuits invert the period measurements to frequency. Thus you get the speed and accuracy benefits of period measurements at low frequencies coupled with the convenience of direct readout in frequency at all frequencies. There's no accuracy penalty at any frequency. The 5323A has a score of other advantages built in. For instance, it can automatically measure the carrier frequency of pulsed signals. Some people buy the 5323A for bench and production line use because its simple, automatic operation and direct readout in frequency reduce errors, even with untrained users. It even keeps tabs on the user by refusing to display more digits than it should for a given measurement speed. For easy use in systems, it's programmable, of course.

These two counters make systems run smoother.



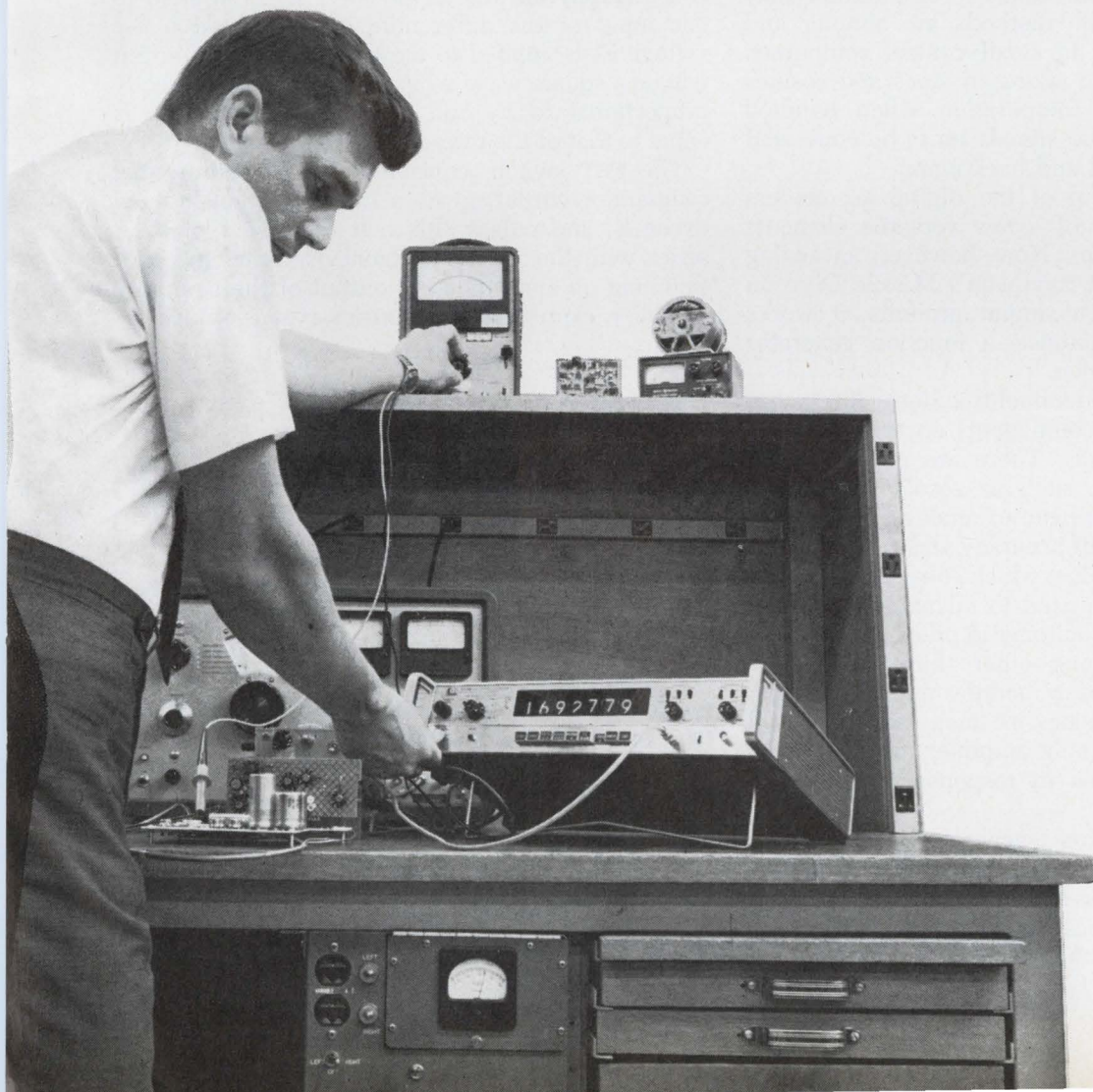
The Universal Counter is even more versatile but is less automatic. It will measure frequency to 20 MHz, time intervals from 100 ns to 10^s, and period, multiple period, ratio and multiple ratio. It will totalize input events or scale an input frequency. Time interval stop and start signals can be from common or separate inputs, with separate trigger-level, slope and polarity controls for each. And its very narrow trigger-level threshold band, less than 1.0 mV, prevents false counts when the trigger level setting is marginal. In addition, the Universal Counter generates two types of oscilloscope markers. These not only mark the start and stop points of a measured interval, but can also intensify the entire measured segment. For easy use in systems, it's

programmable, of course. The cost of this versatility for either system or bench use is \$2150 for the 5323A and \$1300 for the 5325B. Your local HP field engineer has all the details. So give him a call. Or write to Hewlett-Packard, Palo Alto, California 94304; Europe: 1217 Meyrin-Geneva, Switzerland.

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Circle 95 on reader service card

And tests run faster.



Building blocks are two-base hit for analog control computers

Using only a couple of basic elements, new machine offers efficiency and directness of analog computation, plus the reliability and simple logistics of digital techniques

By Edwin Segarra and John F. Perkins

Raytheon Co., Bedford, Mass.

Digital techniques may be first in the hearts of control-systems designers, but in cases where 1% accuracy is acceptable, analog computation may prove preferable. Such methods are simpler and more straightforward in small control computers. Multiplication and the taking of sines and cosines require a lot more computation when handled digitally; moreover, the signals must be converted from analog to digital and back again.

The essential appeal of the digital art centers on the repetitive use of a few versatile elements like gates and flip-flops. Now, however, an analog machine developed at Raytheon's Missile Division promises to appeal on similar grounds; it works off just two basic modules—a function generator and a summing amplifier.

The modules contain monolithic linear integrated circuits and discrete components on thick-film hybrid ceramic substrates. There are no electromechanical components, such as resolvers and potentiometers—long the bane of analog computation because of their lack of accuracy and reliability.

The Raytheon machine, which solves missile control equations, can be used to advantage on other projects—for example, automatic pilots and process control systems. Among other things, the computer's function-generator modules multiply, divide, and find reciprocals, sines, cosines, arc sines, and arc cosines. The summing amplifier modules operate on these functions in response to the basic control equations.

The basic function generator, as shown opposite, consists of a differential comparator, a field-effect transistor switch, and an operational amplifier. The multiplication operation, $E_x E_y = E_o$, is based on the idea that the d-c component of a

pulse wave is directly proportional to the amplitude of the wave multiplied by its pulse width x . If a precisely linear triangle wave E_A is applied to one input of the differential amplifier and a d-c voltage E_x is applied to the other input, the output will be a square wave whose pulse width is directly proportional to E_x and whose repetition rate is equal to that of the reference triangle wave.

The FET switch, controlled by the differential comparator output, gives a linear relationship between E_x and pulsewidth x . If the FET switch, in series with the E_y input signal, is connected to a summing op amp, then the output of the summing amplifier, expressed as a Fourier expansion, is:

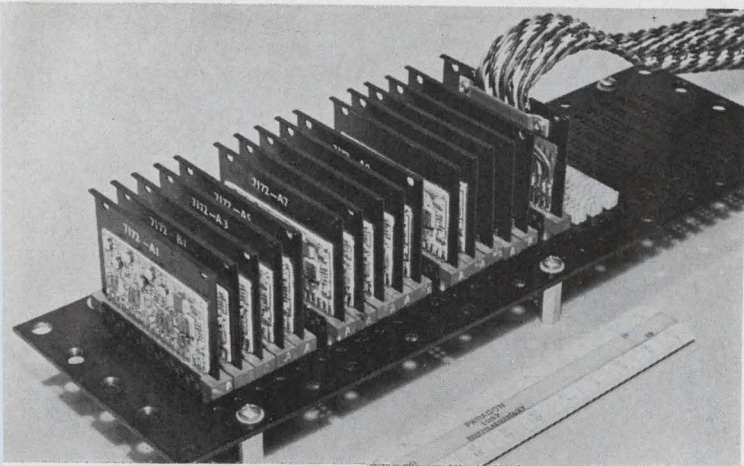
$$E_o = KE_y \left[\frac{x}{L} + \frac{2}{\pi} \sum_{n=1}^{\infty} \frac{(-1)^n}{n} \sin n\pi \frac{x}{L} \cos n\pi \frac{E_y}{L} \right]$$

K is the ratio R_f/R_{in} . The other terms are defined in the circuit diagram and waveforms as shown at the top, right, on the opposite page.

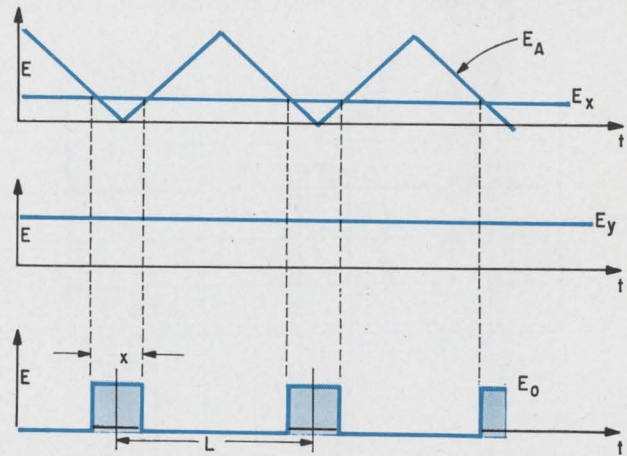
If the summing amplifier is designed to have an upper cut-off point at a rather low frequency, so that it acts as a low-pass filter to remove harmonics, the output signal will be proportional to the product of E_x and E_y :

$$E_o = KE_y \frac{x}{L} = K' E_y E_x$$

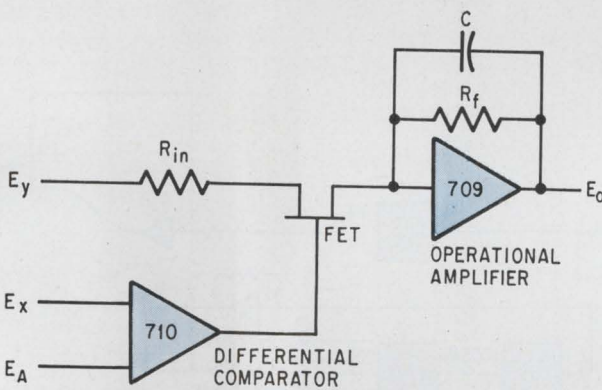
since x/L is proportional to E_x .



No moving parts. Instead of electromechanical components, missile-guidance computer uses hybrid analog circuits in "nafi" modules. Head-aim portion of computer is shown here.



Times table. To multiply quantities represented by E_x and E_y , a triangle wave is applied to the function generator, along with the multiplicands. The product is proportional to the shaded area under the output pulses.

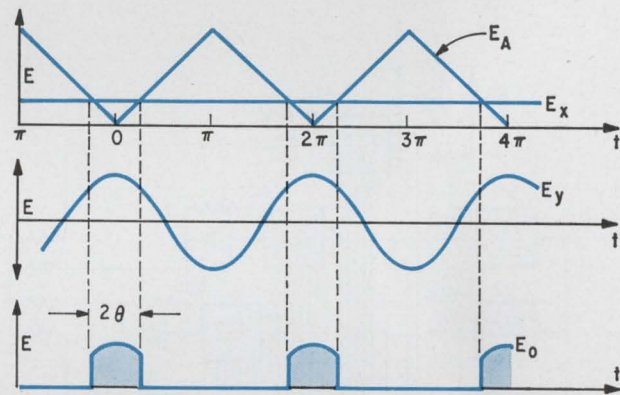


Simple versatility. One of two basic circuits in Raytheon's analog computer, the function generator can multiply, divide, provide sines and cosines, and determine inverse trigonometric functions.

The same configuration used for the multiplier-FET switch, differential comparator, and operational amplifier—can be used to generate trigonometric functions.

For example, to generate a d-c voltage proportional to $\sin \theta$, a triangle wave is applied to one of the differential comparator inputs and a d-c voltage proportional to the angle θ is applied to the other. The resulting waveform at the output of comparator is a periodic rectangular pulse whose width is directly proportional to θ , as shown in the lower right illustration.

The output is then used to turn the FET switch off and on. Since the d-c component of the chopped E_y signal is proportional to the area under the E_y waveform and to the pulse width and the pulse width is proportional to θ , the d-c output of the module is proportional to the integral of $E_y d\theta$. If



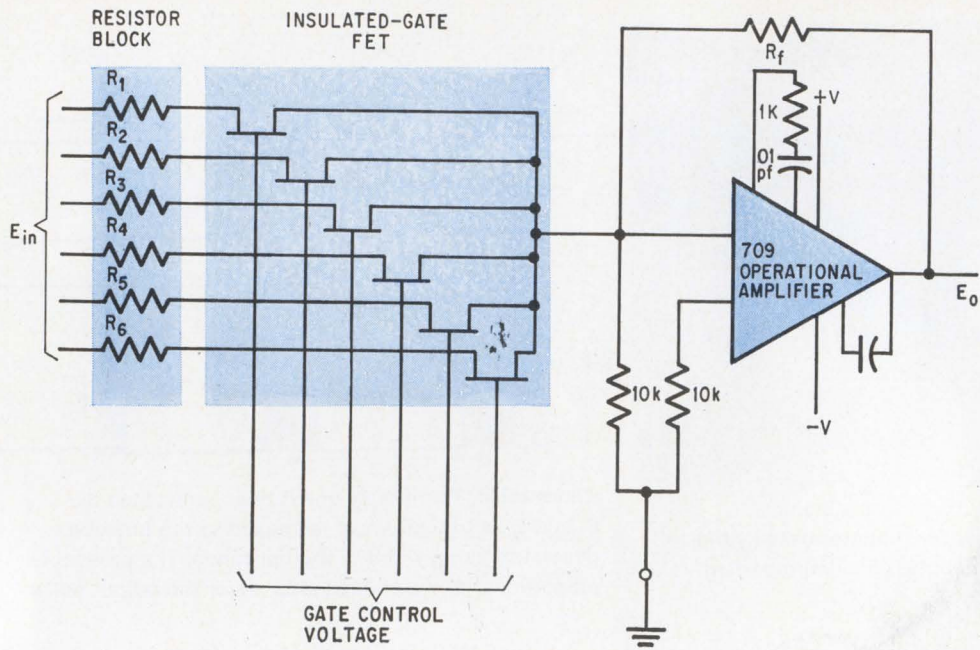
Sines of the times. To generate $\sin \theta$, the function generator requires a triangle wave, a signal E_x proportional to θ , and a cosine wave. Cosines can be generated by shifting zero crossover point.

E_y is a cosine wave, the d-c output is proportional to the integral of $\cos \theta d\theta$, or:

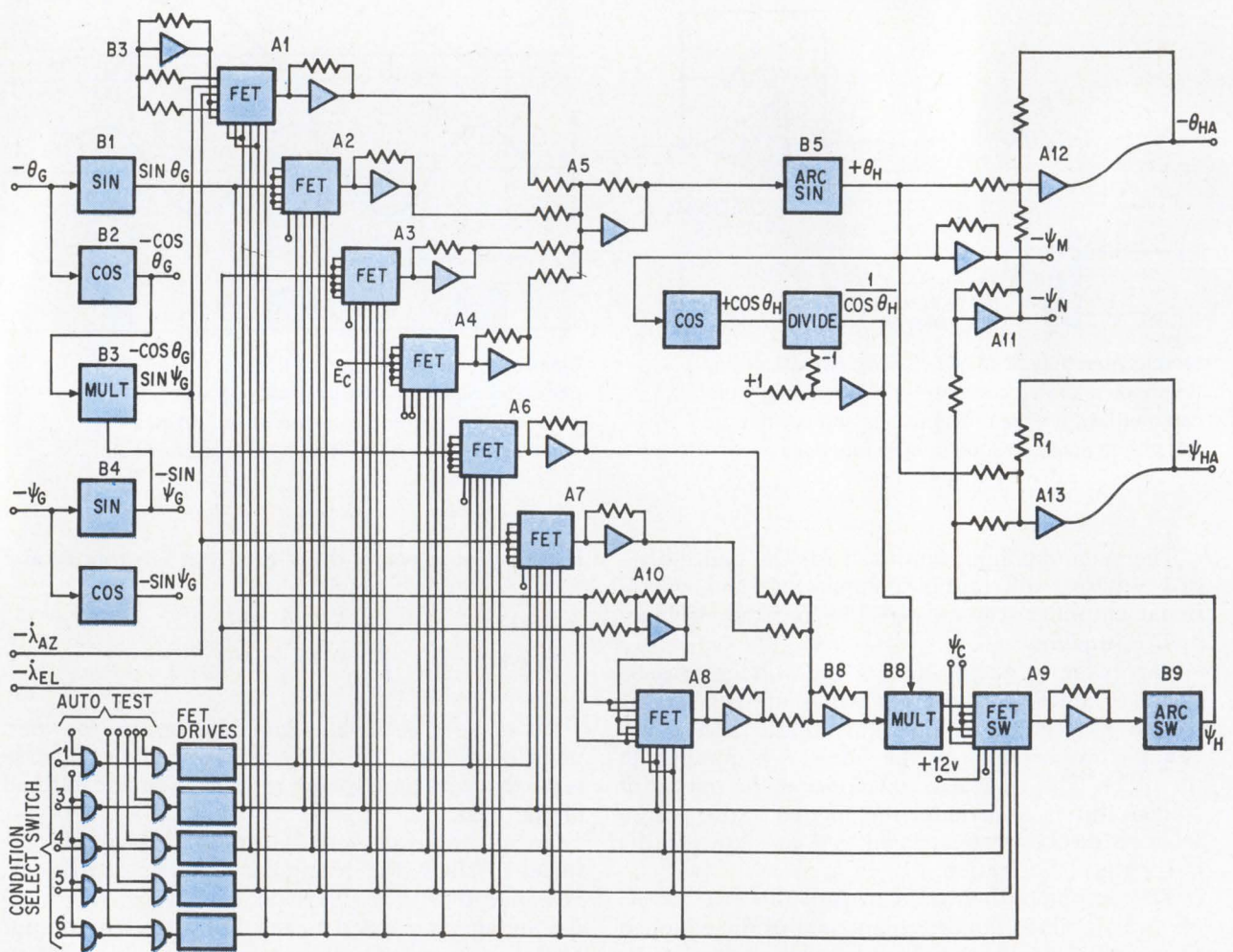
$$E_{o(dc)} = \frac{E_y}{2\pi} \int_{-\theta}^{\theta} \cos \theta d\theta = \frac{E_y}{2\pi} \sin \theta$$

To make the module generate $\cos \theta$, the zero point of the triangle wave is changed to coincide with the zero crossover point of the E_y input instead of the peak.

To generate $\arcsin \theta$ from a voltage proportional to $\sin \theta$, the triangular reference waveform is replaced with a precision sine wave; the $\sin \theta$ d-c voltage is applied to the E_x input. The output of the comparator is thus a series of pulses whose width is proportional to the angle θ . In the FET, the pulses are amplified by a constant d-c voltage E_y . The amplified pulses are integrated in the



Multichannel. The summing amplifier uses a six-channel FET switch with various input resistors to adapt to different sets of input conditions.



Two plus. The head-aim portion of the Raytheon computer typifies the building-block approach. With the two basic modules—function generator (prefix B) and summing amplifier (prefix A)—it calculates complicated trigonometric equations.

operational amplifier to produce an output voltage proportional to θ .

In analog computations, it often happens that the terms in a summed expression are measured under different conditions. In such cases, it's necessary to normalize the terms; this can be done by adjusting the ratio of feedback-to-input resistance. In other words, a multiple-input summing amplifier must be externally controllable to adjust for changed input conditions.

To this end the Raytheon summing amplifier consists of an integrated op amp, an integrated six-channel FET switch, and a thick-film resistor block, as shown at the left. The output voltage of the summing amplifier is:

$$E_o = - \left[\frac{R_f}{R_1} E_1 + \frac{R_f}{R_2} E_2 + \frac{R_f}{R_3} E_3 + \frac{R_f}{R_4} E_4 + \frac{R_f}{R_5} E_5 + \frac{R_f}{R_6} E_6 \right]$$

The voltage applied to the gate of each channel of the FET switch determines whether the channel is open or closed, so that any term in this equation whose associated FET is open equals zero. The values of the resistors are chosen to suit the function of the particular summing amplifier.

Raytheon has assembled its analog elements in a "head-aim" subsystem for a missile control computer to demonstrate the potential of the building-block technique. The subsystem, shown at the left, is similar to what might be used in an autopilot, for example, or, perhaps, in a process-control application involving gas flow.

The head-aim computer requires 13 gated-input amplifiers, nine function generators, and a wave-form generator that provides triangular-wave and sine-wave references—both at 5 kilohertz—for the function generators.

The computer solves two equations, as shown in the panel at the right; it must solve these equations for the five different sets of conditions that are shown. The resistor blocks can be switched in to represent each condition.

The diagram, shown on the next page, represents the θ_{HA} and ψ_{HA} equations as calculated by the computer for condition 3. In all cases, the computer values are well within the maximum permissible error range of $\pm 3.5^\circ$, even at the temperature extremes of -55° and $+125^\circ\text{C}$.

Part and parcel

There are three sources of error, and each can easily be minimized:

- Offset voltage at the output of the IC operational amplifiers. A 709 op amp was used in the first building-block circuits. More recent versions of this IC offer lower offset and lower variation of offset with temperature; offset voltage variation can be kept within ± 5 millivolts over the military temperature range.

Head-aim equations

$$\theta_{HA} = 0.707 [\theta_H - \psi_H]$$

$$\psi_{HA} = 0.707 [\theta_H + \psi_H]$$

where

$$\theta_H = \sin^{-1} [\sin \phi_{MO} (\cos \theta_G \sin \psi_G + 1.2\lambda_{AZ}) + \cos \phi_{MO} \sin \theta_G + \cos \phi_{MO} - 1.2\lambda_{EL} + E_C]$$

and

$$\psi_H = \sin^{-1} \left[\frac{1}{\cos \theta_H} \right] [-\sin \phi_{MO}$$

$$(\sin \theta_G + 1.2\lambda_{EL}) + \cos \phi_{MO} \cos \theta_G \sin \psi_G + \cos \phi_{MO} 1.2\lambda_{AZ}] + \psi_C$$

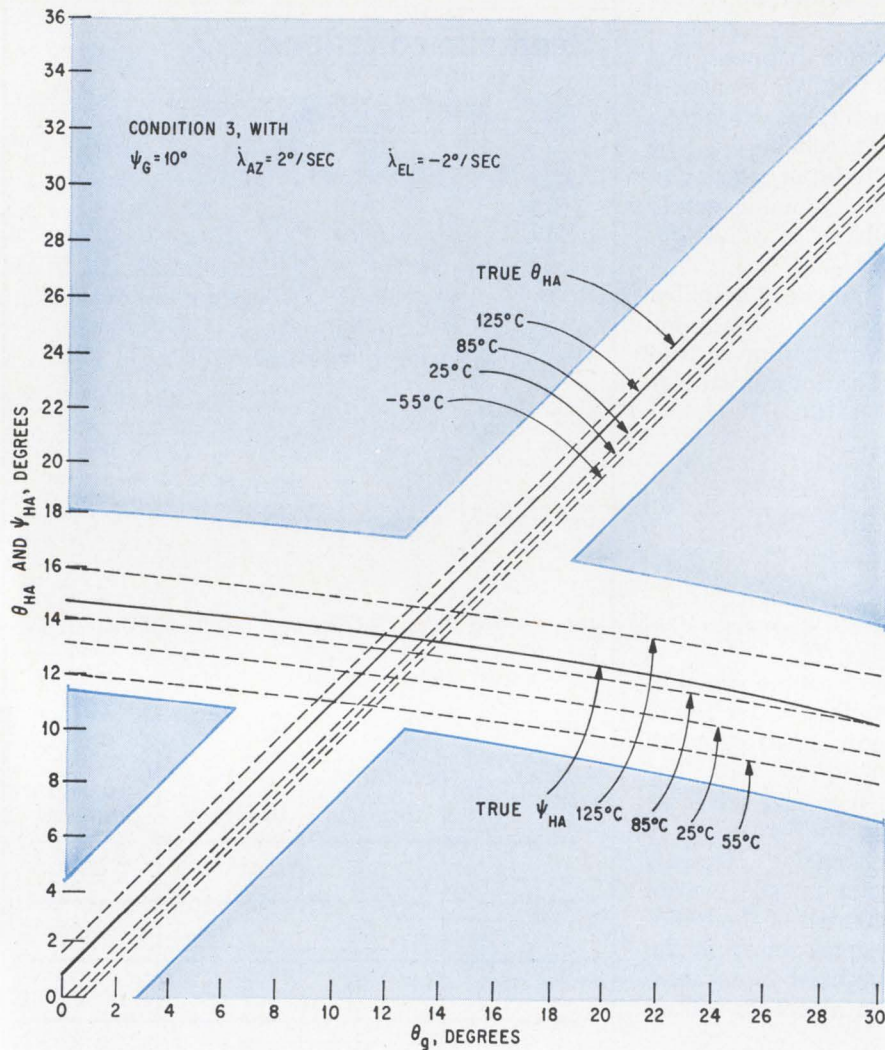
Condition	ϕ_{MO} , degrees	ϵ_C , degrees	ψ_C , degrees
1	0	0	0
2	49	3.50	-0.45
3	-49	3.50	+0.45
4	49	2.11	-2.42
5	-49	2.11	+2.42

- Scaling error due to resistor deviations. The discrete input and feedback resistors used in the prototype head-aim computer are $\pm 0.25\%$ -tolerance components with rather large temperature coefficients. The scaling error could easily be reduced, since $\pm 0.1\%$ -tolerance resistors with low temperature coefficients are readily available.

- FET scaling error. The FET resistance adds to the input resistance. However, by taking the FET resistance into account when the value of the input resistor is selected, the change in slope of the summing amplifier output will be no greater than 0.5% over a 100°C change in temperature.

The total computer error depends on the number of computer functions that are cascaded. Use of $\pm 0.1\%$ resistors and ± 5 -mv-offset op amps would yield peak errors of 0.6% for a full-scale output of 1 volt or 0.2% for a full-scale output of 5 volts.

The percentage error is primarily due to op amp offset when 0.1% resistors are used, and it is not



Performance. The dashed line represents the computer's output for the head-aim equations at several temperatures. The heavy lines in color represent the maximum permissible deviation per military specs from the true value. Values are well within the allowable $\pm 3.5^\circ$ limits.

a fixed quantity—it depends on the input-voltage range. The percentage error is expressed as:

$$\epsilon = \frac{\text{offset (volts)}}{\text{full-scale voltage}} \times 100$$

when resistor error is neglected.

To assess the total errors for a complete computer would require analysis of the number of functions, their types, and scaling. But it's safe to say that any single computation can be done well within 1% over the military temperature range.

That 1% error applies to voltages, and therefore to multiplication and summing. Trigonometric-function errors depend on the range of angles used. A 1% error in the sine, for example, can cause as much as 8° of error if the angle is near 90° .

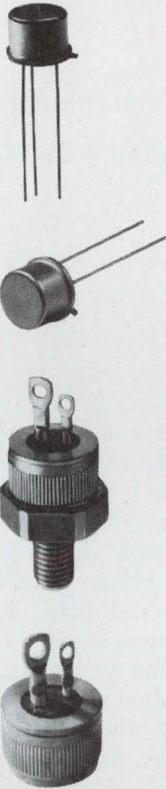
All the gated-input summing amplifiers used in the head-aim computer are identical except for the values of the input resistors, R_1 through R_6 ; all the function generators are identical except for input resistors R_1 through R_3 . A total of 56 discrete resistors, in 14 different values, is needed for the 13 summing amplifiers.

Power requirements are modest. The head-aim computer draws only 9.05 watts, and the entire missile guidance computer (also built from the two basic modules) consumes only 37.715 watts. Allowing 3 watts for the reference waveform generator and assuming a power-supply efficiency of 50% (a conservative estimate), the total power consumption is 60 watts.

The Raytheon analog computer can test itself automatically. The built-in test circuits use the same modules developed for the computer itself. Checks involve switching known values of the input variables into the machine and comparing the resulting output signals with reference voltages that represent hand-calculated levels.

At the moment, each module is in the "nafi" package developed by the Naval Avionics Facility, Indianapolis. This configuration centers on a 40-pin connector with an attached mounting surface. However, the basic ceramic modules measure only 1 inch by 2 inches—about $\frac{1}{3}$ the size of the nafi module. Obviously, if small size were crucial, some other packaging arrangement could be adopted to take advantage of the compactness of the Raytheon modules. ■

400 Hz RCA Triacs— ready to take over!



**120-V line operation and
200- and 400-V repetitive peak
off-state blocking voltages**

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Ask your local RCA Representative or your RCA Distributor for details. For preliminary technical data sheets to aid in your evaluation of these units for airborne controls applications, write RCA Electronic Components, Commercial Engineering, Section RN8-1 Harrison, N. J. 07029.

MAXIMUM RATINGS

0.5 A I_{rms}—In 3-lead modified TO-5			TA7615	400 V	press-fit
TA7654	200 V	10 mA I_{gt}	TA7616	200 V	stud
TA7655	400 V	10 mA I_{gt}	TA7617	400 V	stud
TA7656	200 V	25 mA I_{gt}	15 A I_{rms}—press-fit or stud		
TA7657	400 V	25 mA I_{gt}	TA7618	200 V	press-fit
2.5 A I_{rms}—2-lead modified TO-5			TA7619	400 V	press-fit
TA7671	200 V	25 mA I_{gt}	TA7620	200 V	stud
TA7672	400 V	25 mA I_{gt}	TA7621	400 V	stud
6 A I_{rms}—press-fit or stud			25 A I_{rms}—press-fit or stud		
TA7642	200 V	press-fit	TA7646	200 V	press-fit
TA7643	400 V	press-fit	TA7647	400 V	press-fit
TA7644	200 V	stud	TA7648	200 V	stud
TA7645	400 V	stud	TA7649	400 V	stud
10 A I_{rms}—press-fit or stud			40 A I_{rms}—press-fit or stud		
TA7614	200 V	press-fit	TA7650	200 V	press-fit
			TA7651	400 V	press-fit
			TA7652	200 V	stud
			TA7653	400 V	stud

RCA Thyristors

Color tv gets a badly needed face-lift

An automatic tint-control circuit cuts down the fluctuation in flesh colors by correcting phase errors before the chroma signal is demodulated

By Gene McLin and Paul Knauer

Magnavox Co., Fort Wayne, Ind.

Like a yo-yo on a string, a color-tv viewer has to get up constantly from his favorite easy chair to adjust the tint because of the fluctuations in the picture's flesh tones. These fluctuations—occurring principally when channels are changed or when cameras switch from live to tape—are more than a bother to viewers, they're a major headache to television engineers. And until now, no relief has been in sight.

But the picture is changing, and relief is indeed on the way—in the form of an automatic-tint control (ATC) circuit developed by engineers at the Magnavox Co. to correct phase errors. The circuit, which is included in some models of the set maker's 1970-line, may not always eliminate tint fluctuations completely, but it goes a long way toward reducing the ups and downs of viewers. And, hopefully, only Martians will be green-skinned, not humans. Magnavox' solution to the problem of how to compensate for the phase differences between one signal and another is to detect phase errors in the flesh tone region before the chroma signal is demodulated, and then correct these errors automatically. The ATC circuit does this by sensing the phase difference between a reference burst and the color signal, and then developing a correction signal to restore the desired hue. The correction signal is generated by two gates—a yellow gate and a red gate—and a 3.58-megahertz switch, which turns on the gates at the proper signal phase.

Besides the switch and gates, the ATC circuitry—above right in block diagram form—includes a separate ATC switch, four phase-shifting networks and a color preference control.

The chroma signal, picked off a bandpass amplifier, is simultaneously applied to the yellow gate and, after a phase shift, to the red gate. Each

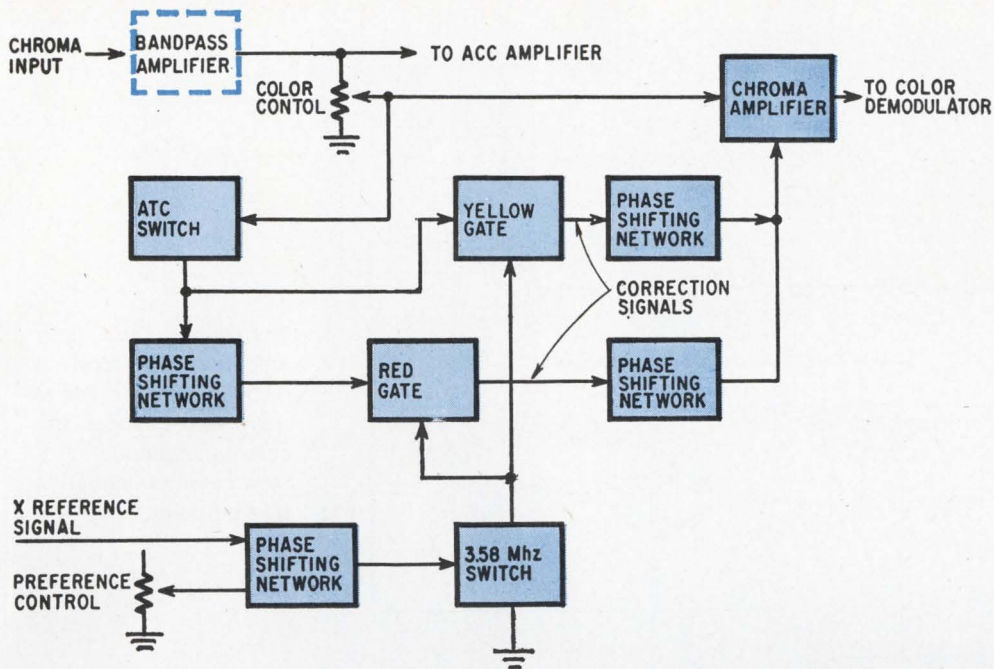
gate conducts when there's a chroma signal of a certain phase present and when the 3.58-Mhz switch is turned on by a reference signal, "X," from the tv set's 3.58-Mhz oscillator. A yellow chroma signal produces a maximum output from the yellow gate, but only a minimum output from the red gate. The opposite is true with a red chroma signal.

The yellow gate's output is phase shifted and applied to a chroma amplifier where it's combined with the original chroma signal to correct flesh tones that appear in the yellow or green areas. The red gate's output is also phase shifted, but in the opposite direction, and applied to the amplifier to correct flesh tones in the red or the magenta areas.

The changing colors

Regardless of hue, the chroma signal is a 3.58-Mhz sine wave voltage, as is the burst signal. The difference between one hue and another is established by the phase of their sine waves with respect to that of the burst signal. And since the positive peak of the reference burst sine wave is considered as 0° on a color-spectrum wheel, below right, different hues can be identified by the degree the positive peaks of their sine waves lead or lag the reference burst sine wave. Thus it can be seen that a yellow chroma signal, for example, lags the burst by 13° ; a magenta signal lags by 119° and a green chroma signal lags by 299° . Therefore, a chroma signal of 0° has a greenish-yellow hue and is in phase with the burst.

Since some colors—particularly blue and green—are dominant, they cover wide segments of the color wheel. Slight phase errors are barely noticeable in those signals. Flesh tones, however, cover



Phase shifting. Before demodulation, the chroma signal is phase corrected in the gating circuits to restore the desired preset flesh tone. The yellow gate signal is delayed about 90° , while the red gate signal is advanced about 30° . Both signals are inverted 180° by the chroma amplifier.

a very narrow range in the orange portion of the spectrum. Here, slight phase errors have a major impact on the color-tv picture. Critical setting of the tint control is therefore necessary for satisfactory reproduction of flesh color, which, from the viewer's point of view, determines the quality of his picture.

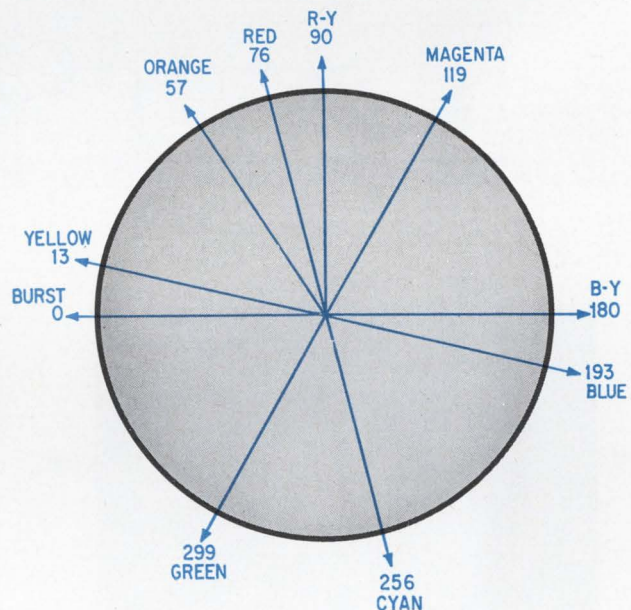
Flesh tones originate at a chroma-signal phase of 57° . When this phase, called the I vector, is moved closer to the burst phase, flesh tone takes on a greenish hue; shifted further away toward 90° , flesh tone becomes reddish. When the I vector is below 57° , the yellow gate generates a correction signal to bring the vector back to the ideal; when it's above, the red gate takes over to bring the vector back to 57° .

Viewer in control

Although the correction signals themselves are generated automatically, the amount of correction is under the control of the viewer who is provided with an ATC switch and a preference control. The setting of the preference control determines the hue of the flesh tone after correction.

The ATC switch operates in two positions, either full or partial. With the switch in the full position, colors that fall within approximately $\pm 30^\circ$ of the I vector receive 100% correction—all colors are placed at the position of the I vector. Partial positioning of the switch, however, will yield only 50% correction for colors falling within this $\pm 30^\circ$ range. The correction signal is then coupled to the chroma amplifier, which also receives the original chroma signal through the wiper arm of the color control.

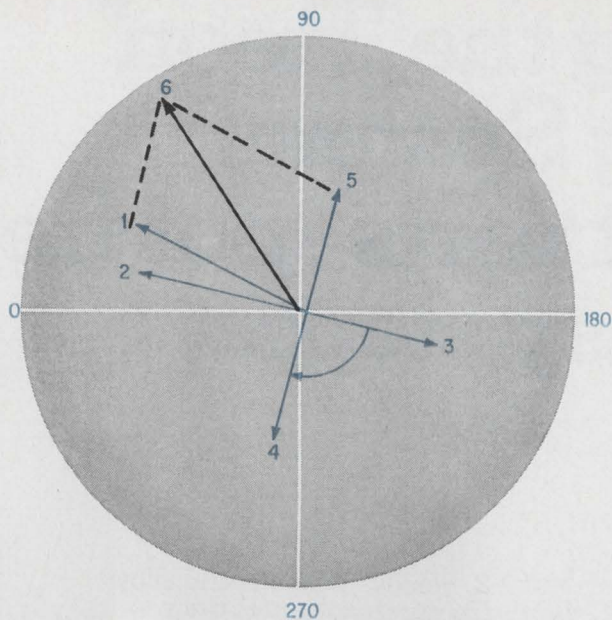
The setting of the color control determines both the amplitude of the original chroma signal and the amount of signal that is coupled to the red and yellow



Color spectrum. Any hue may be identified by the number of degrees it leads or lags the burst 0° reference.

low gates. As a result, changes in one automatically result in changes in the other, and the proper signal ratios are maintained. However, the amount of correction can be controlled by the ATC switch, which inserts one of two fixed amounts of attenuation in the signal path.

Forward bias for the gate transistors is obtained from a 20-volt power supply through respective 10-kilohm resistors and a diode. The diode, which is forward biased by the supply voltage, develops a 0.6-volt d-c drop. This voltage, insufficient to cause any appreciable amount of current to flow



Vectors

Phase shift(°)

1	27	Original chroma and signal input to yellow gate. Phase error is 30° toward yellow (57° - 30°).
2	13	Sample time of yellow gate
3	193	Yellow gate output (13° + 180°). Base signal at turn-on time determines amplitude.
4	283	Collector signal delayed 90°.
5	103	Chroma amplifier inverts vector 4 180°. This is the correction signal.
6	57	Resultant of vectors 1 and 5 added in chroma amplifier.

Correcting for yellow. For a 30° error, the phase of the yellow correction signal at the chroma amplifier is about 103°. The red signal phase is 343° at the same point.

through the gates, is then applied to the base of the gates. Only when the gates' emitters are connected to ground through the 3.58-Mhz switch will the gates conduct with a chroma signal. Thus the switch determines when the chroma signal will be sampled. And, the phase of the "X" or reference signal is what determines when the switch turns on.

The phase of the "X" signal is approximately 90° with respect to the burst signal. In the ATC circuit, top left, a phase shifting network—comprising capacitors, C_7 and C_8 , inductor L_7 and the preference control—advances the phase of the X signal to +13°. But this may be varied $\pm 30^\circ$ with the preference control, whose precise setting produces the desired flesh tone hue.

Because the switch conducts only on the positive half cycles of the X signal, the "on" time of the gates is relatively short. Also, the chroma signal at the base of the gates must be positive to produce a correction signal at the collector. Chroma signals between yellow and magenta, 13° to 119°, are positive-going during sample time and thus produce correction signals. Blue, cyan, and green signals, however, are in the negative portion of their cycles during sample time and their correction signals aren't produced.

The chroma signal is coupled directly to the yellow gate, and, after being advanced 90° in phase by capacitor C_6 and inductor L_4 , the signal is applied to the red gate.

Maximum output from the yellow gate is obtained with a yellow chroma input signal because the signal is at its positive peak just as the gate turns on at 13°. But at the red gate, the yellow signal produces little output because it is advanced in phase. Thus, when the red gate is turned on at

13° the chroma signal is passing through zero and cannot forward bias the gate.

Similarly, maximum output from the red gate is obtained with a reddish chroma signal having a phase angle of 103°. The phase is shifted 90° to 13°. Thus, the chroma signal is at its peak when the red gate turns on at 13°. Little output is produced from the yellow gate because the chroma signal is passing through zero when the yellow gate conducts at 13°.

A vector display on opposite page points up the phase relationships of the 10 bars in a demodulated color-bar pattern. The bars are 30° apart. At the collector of the yellow gate, the first bar produces the highest output. The outputs of the second and third bars are progressively lower. At the collector of the red gate, the outputs of the third and fourth bars are about equal; the outputs of the remaining bars are progressively lower. There is no appreciable output from either gate for the last five bars for blue, cyan, and green.

The red- and yellow-gate correction signals are inverted 180° and must be further shifted in phase before they are added to the original chroma signal. The yellow-gate signal is delayed about 90° by inductor L_2 and capacitor C_4 . The red gate signal is advanced in phase about 30° by capacitor C_5 and inductor L_3 . Both signals are again inverted 180° but this time in the chroma amplifier.

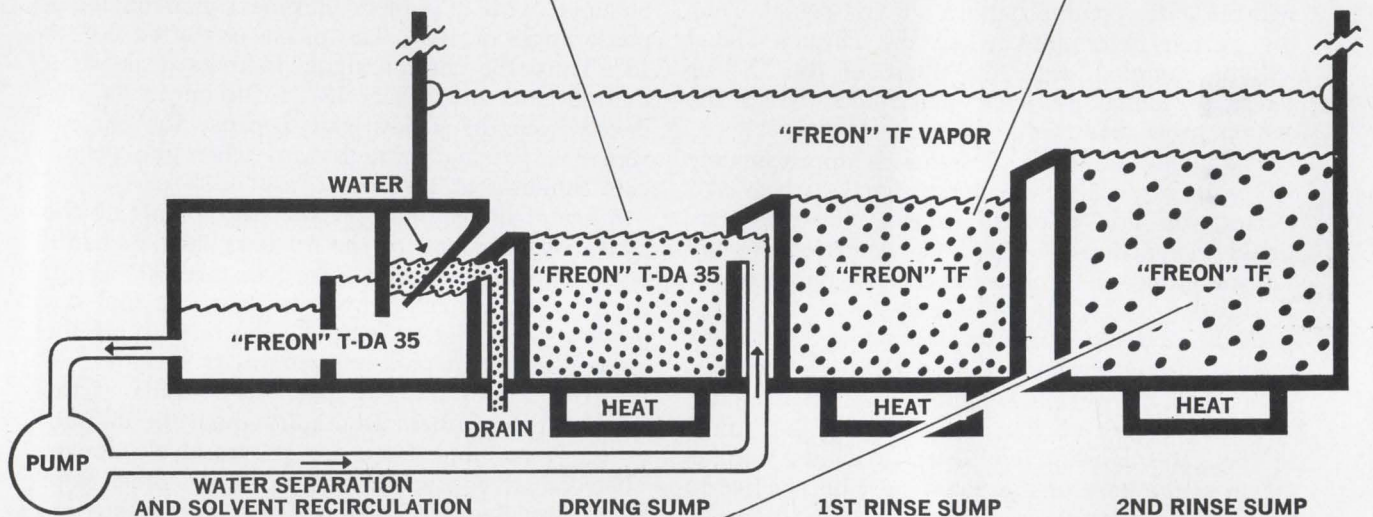
When flesh-tone hues shift from 57° toward yellow, the correction signal produced at 103° adds vectorially to the original chroma signal. When the ATC switch is at full, and the chroma error does not exceed 30°, the result is the ideal, 57°. When the hues shift toward red, the red-correction signal produced at 343° adds to the chroma signal to produce the ideal flesh tone. ■

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An Electronics
special markets report
August 4, 1969

At midyear business takes off in search of new heights

But external events, including Vietnam and inflation, will largely determine how high the electronics industry flies for rest of 1969





Silvan setting. Small, rugged two-way radios like this Handie-Talkie unit from Motorola are increasingly popular with communications users as diverse as lumber companies and law enforcement agencies.

● When and if managers get around to toasting 1969, they'll probably reach for beer, rather than champagne. Just past the halfway point, it looks like a good year but far from a great one for the U.S. electronics industry. On the basis of preliminary data for the first six months, electronics is still expected to be a \$25 billion business during 1969. This level represents a 6% or so improvement over the year-earlier performance, but 5% of the dollar gain is attributable to inflation.

Outlets directly or indirectly dependent on Government largesse have experienced rough going of late, and suppliers can look forward to more of the same. The voting public's disenchantment with, among other things, the war in Vietnam is triggering a shift in priorities atop Capitol Hill. Defense and aerospace contractors are getting decidedly the worst of it in skirmishes with politically sensitive budget cutters.

The FAA, long forced to subsist on short rations, may prove a bright spot in the Federal picture if a proposed \$5.6 billion program to overhaul the nation's airways and terminals gets off the ground. But prospects must still be rated iffy since new taxes will be required. On balance, there's little in the way of Government-funded efforts to take up the slack resulting from cutbacks in military and space allocations. Despite the enthusiastic lip service paid the application of advanced technology to pressing societal problems, partially as a result of the Adminis-

tration's struggle to brake inflation, only a few showcase projects have actually been underwritten. Over the longer run, the electronics and aerospace industries will play increasingly important roles in health, education, pollution control, urban renewal, and the like. But for the moment at least, pickings are slim.

The immediate outlook in the commercial, industrial, and consumer sectors is far rosier, albeit not without a few dark spots. Instrumentation houses, for example, have been hurt by the decelerating rate of gain in research and development outlays, but can look forward to a sizable pent-up demand for their wares. Industrial equipment suppliers, embracing integrated circuitry in a big way for the first time, are likewise hampered by such developments as continuance of the surtax and prospective suspension of the investment tax credit. But demand for their products and systems continues strong. In fact, within the next couple of years, the combined sales of industrial and commercial electronics concerns—including those of perennially prosperous computer makers—promise to exceed the total Government market—an eventuality that augurs well for the industry's future stability and profitability.

Consumers, notwithstanding a deteriorating stock market, inflation curbs, and tight money, continue to spend freely for electronic goods. The only problem from domestic producers' standpoints is that more of

Fundamentally, electronics is on solid ground as a result of semiconductor suppliers' achievements in integrated circuitry of all kinds

their purchases are labeled made in Japan. The industry as a whole is enjoying a far less favorable balance of trade, but the problem is acute in the consumer field.

Fundamentally, however, electronics is on solid ground as a result of semiconductor suppliers' remarkable achievements in integrated circuitry of all kinds. Market penetration continues to amaze even the most optimistic, and the best bet is that performance will outstrip projection by a wide margin for some time to come.

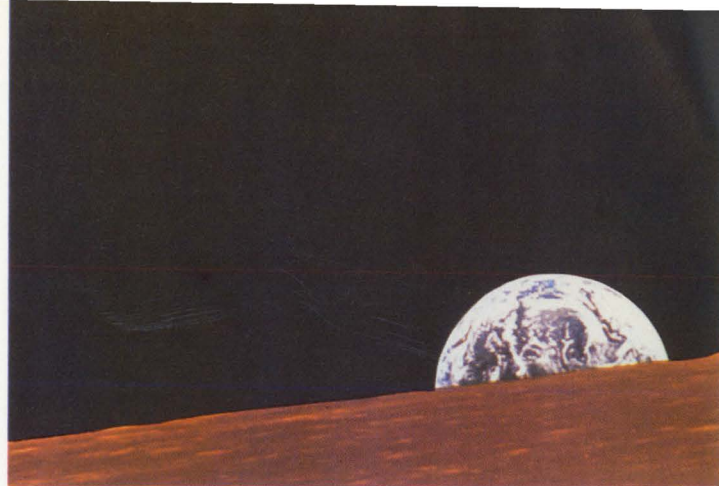
At the outset of 1969, Pentagon brass were looking forward to a year of transition during which R&D outlays would make an orderly transition from tactical to strategic projects. But a funny thing happened on the way to the Treasury. The Senate's Armed Service's Committee—headed by hawkish John Stennis (D., Miss.)—heavily edited the Pentagon's shopping list; the research, development, test, and engineering request was dropped 13% to around \$7.2 billion. The outlook in the House is equally bleak; representatives, pressed by constituents outraged by the war and well-publicized cost over-runs, are also in a mood to blue-pencil military procurement requests.

The prospective slashes in RDT&E allocations for aircraft, missiles, ships, and tracked vehicles come as a real shock to Pentagon planners. The defense dollar buys about 25% less than it did five years ago because of spiraling costs and systems' increasing complexity.

Prelude. Astronauts Armstrong and Aldrin, first men on the moon, practice collecting surface samples at Manned Spacecraft Center in Houston. Lunar module is in the background.



Sequence. Astronauts Stafford and Cernan aboard Apollo 10's lunar module saw this earth rise from the moon's farside highlands.



And the significance of the pruning goes far beyond threats to the Safeguard ABM (antiballistic missile)—a \$345.5 million item that squeaked through the committee by a 10-to-seven vote. Across-the-board cuts are going to hurt a lot of programs in a number of technologies. Moreover, it was evidently a miscalculation to assume, as many Pentagon strategists did, that economies achieved by “voluntarily” scrubbing the Air Force’s Manned Orbiting Laboratory and the Army’s AH-56A helicopter would mollify budget cutters.

The casualty list to date, in addition to MOL and the Cheyenne, encompasses 12 major programs. Left for dead or among the missing are such electronics-laden projects as SAM-D, the Army’s surface-to-air missile; the E-2C, an updated electronic intelligence and picket aircraft for the Navy; and an underseas long-range missile system. Among the gravely wounded are the Navy’s S-3A (VSX) antisubmarine warfare aircraft, the Air Force’s airborne warning and control system (AWACS), the advanced manned strategic aircraft (AMSA), and the Mark II avionics system for the ill-starred F-111.

An imponderable in the current outlook for military spending is the imminence of arms control talks between the U.S. and Russia. Upcoming negotiations promise to be different in kind from those that led to such past agreements as the atmospheric nuclear test ban treaty and the nonproliferation pact. In fine, both sides seem

sincerely interested in seeking a genuine freeze on further costly testing and deployment of offensive and defensive atomic weapons systems. At the moment, there’s no telling how far-reaching or definitive agreements might be. But assuming some sort of accord is worked out within the next few years, the impact on electronics and weapons-systems supplier’s would be substantial.

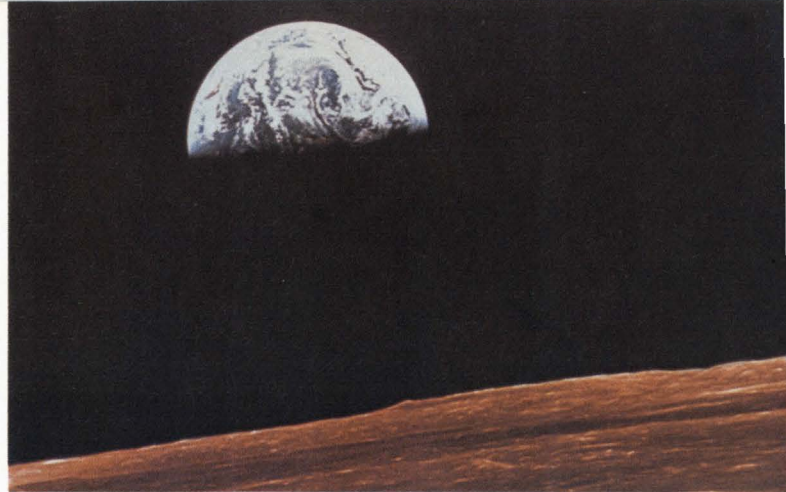
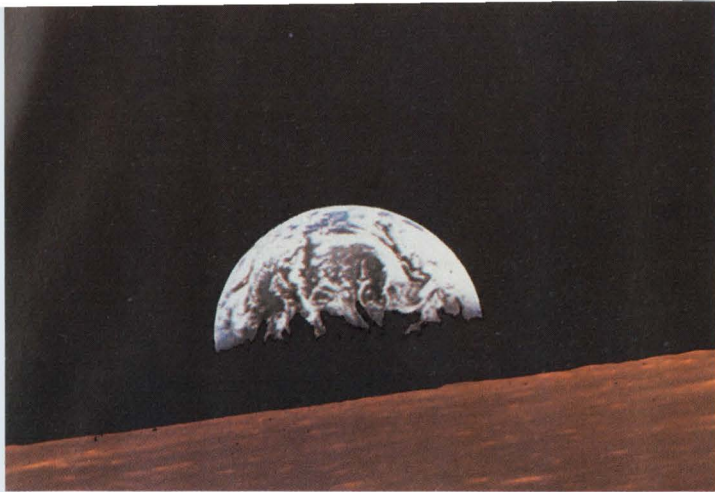
Space doesn’t appear to offer much promise as a hardware outlet over the intermediate term. Though Apollo 11 has gone to glory, planners at the National Aeronautics and Space Administration still must chart a course for the 1970’s—a task made no easier by the fact that the total space budget is in eclipse for the seventh straight year. Pending final adjustments, civilian and military agencies will have about \$5.6 billion in new obligational authority and \$5.7 billion to spend in fiscal 1970, which began July 1. This represents quite a comedown from, say, calendar 1966 when outlays reached \$7.7 billion.

NASA’s share of the pot is around \$3.8 billion, over 20% below the amount originally requested last fall. The space agency has dubbed its short ration for fiscal 1970 “a holding budget.” This may prove an optimistic assessment in light of requirements. Most of the money is already earmarked for Apollo flights, ongoing unmanned series of spacecraft, a few new unmanned starts, lunar exploration, and some facilities expansion. As a result, there’s precious little seed money for 1970’s projects.

Selected instrumentation markets*	In millions of dollars by quarters				
	1st	2nd	3rd	4th	Total
Spectrum analyzers	7.1	7.6	8.1	9.7	31.5
Signal generators	7.5	8.1	8.4	9.2	33.2
Sweep generators	4.0	5.0	6.2	7.1	22.3
Pulse generators	3.8	4.4	5.1	5.4	18.8
Oscillators	5.6	6.1	6.3	6.6	24.6
Waveform generators	3.3	3.4	3.6	3.7	14.0
Counters	8.7	10.2	9.6	9.9	38.4
Timers	19.8	21.2	19.0	23.9	83.9
Digital voltmeters	7.2	7.5	7.9	8.3	30.9
Impedance measuring equipment	7.3	7.8	8.3	9.0	32.4
Oscilloscopes (including access and plug-ins)	32.3	35.4	37.8	40.2	145.7
Recording instruments, digital & analog	12.4	13.3	13.7	14.0	53.4

*includes microwave

Selected computer markets	In millions of dollars by quarters				
	1st	2nd	3rd	4th	Total
Digital computers, except process control, total	1,215.0	1,275.0	1,225.0	1,265.0	4,980.0
Analog computers, except process control	15.8	17.4	16.9	18.3	68.4
Electronic readout (digital displays and crt's)	41.2	43.8	43.5	45.7	174.2
Character recognition equipment (optical, magnetic, etc.)	39.8	42.3	41.7	43.9	167.7
Core memories	12.4	13.1	14.1	15.2	54.8
Magnetic tape machinery	17.7	19.4	18.6	20.6	76.3
Magnetic drum memories	7.8	9.6	8.9	10.7	37.0
Magnetic disk memories	38.0	41.7	40.9	42.2	162.8



What's more, only modest amounts of what's to be spent will wind up in the coffers of electronics concerns.

Manned space-flight activities, for example, will take a \$2 billion chunk of the NASA budget. Most of this amount is earmarked for Apollo hardware and support. There is, however, \$135 million for the Apollo Applications Program. This scaled-down project now encompasses a 28-man space workshop, a telescope mount for solar astronomy studies, and working-mission studies.

Applications efforts are slated for around \$130 million. Of interest to aerospace and electronics companies are hardware allocations for Nimbus weather satellites E and F, two synchronous meteorological satellites, applications technology satellites F and G, earth resources technology satellites A and B, and orbiting solar observatory H. Launch vehicles, the bioscience program, and physics and astronomy programs will account for the rest of the funds coming to the Office of Space Science and Applications. The Office of Advanced Research and Technology is down for nearly \$280 million in fiscal 1970. But only about \$34 million will go for electronics.

Military space spending, which topped \$2 billion in fiscal 1969 will dip to about \$1.9 billion this year. The brass are not dismayed, however, privately estimating Pentagon space spending will reach \$3 billion within the next few years. The drop is largely attributable to cancellation of the Air Force's Manned Orbiting Lab-

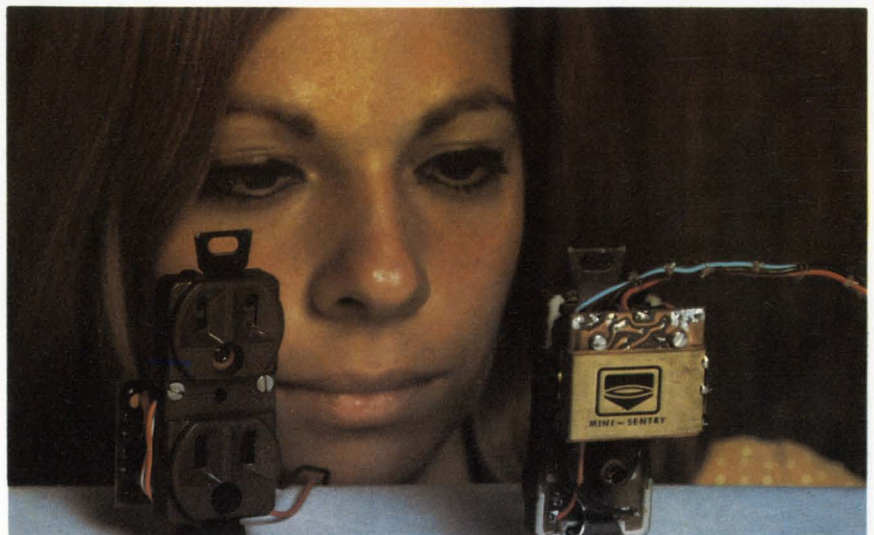
oratory program. Prior to MOL's demise, the armed forces expected to spend \$2.2 billion. It's well worth the industry's while to sweat out such interim setbacks since about 60% of the military space dollar goes for electronics. There's no official breakdown, but the estimate is reasonable in view of the service's interest in surveillance and reconnaissance. As it happens, there's almost \$160 million available for detection systems.

Another \$870 million or so will go for support, including range instrumentation, satellite detection and tracking, and control networks, as well as research and development. Set for the biggest percentage increase in funding is the defense satellite communications system, which now encompasses 24 spacecraft and 29 ground terminals around the globe. Outlays will go from \$71 million to \$149 million.

Elsewhere on the Federal scene, FAA approval of area navigation to relieve air traffic congestion and the possibility that Congress will establish a multibillion-dollar fund for developing airports and airways make the mid-year picture for avionics suppliers brighter than short-term indicators might suggest. Sales of general-aviation aircraft, which reached 6,880 units during the first six months of 1969, were 4% below year-earlier levels. And deliveries of commercial planes are at a virtual standstill as the airlines await the jumbo jets and airbuses.

But the Federal Aviation Administration's blessing of

Listening post. A flatpack linear IC drives gallium arsenide diode supplied by TI in this intrusion detection system offered by Laser Systems Corp. Diode emits modulated infrared beam received by silicon photodiode in a similar outlet across the room. System works with standard alarms.



In the picture. TTL is getting a workout in an increasing number of commercial and industrial applications. This alphanumeric generator uses MSI devices supplied by Texas Instruments.

Selected communications markets	In millions of dollars by quarters				
	1st	2nd	3rd	4th	Total
Land mobile	49.6	52.8	53.4	56.2	212.0
Microwave relay	30.4	32.4	31.3	33.7	127.8
Amateur equipment	7.3	8.7	7.8	8.8	32.6
Citizens band equipment	9.8	11.2	10.7	11.8	43.5
Facsimile	8.4	9.5	8.8	10.7	37.4
Telemetry	52.5	54.8	53.2	58.5	222.0
Modems	21.2	23.2	22.6	24.3	91.3

area navigation—belated though it may be—should generate a sizable outlet for a new type of avionics gear for both general-aviation and commercial craft. “The market will start slowly and then bloom, as was the case with transponders and distance-measuring equipment,” says Victor Kayne, vice president of the Aircraft Owners and Pilots Association.

Computer-based area-navigation equipment allows a plane to operate along almost any air route provided it's within range of very-high-frequency omnirange (VOR) ground stations. The advantage is a straight-line flight path; the pilot does not have to waste time dog-legging from one VOR station to the next. Moreover, area navigation systems can furnish vertical guidance, as well as horizontal position information, permitting instrument approaches at airports not equipped with ILS.

“We'll ship as many units as we can produce, probably several hundred this year,” says Gilbert F. Quinby, vice president, market planning at Narco Scientific Industries' Avionics division. The company offers a low-cost (\$2,855) set—basically a course-line computer—designed for general-aviation craft. Commercial airlines are keenly interested in area navigation. Eastern, Mohawk, Continental, American, and United, among others, have been flight-checking various configurations.

The potential of area navigation for the airlines is apparent in the fact that the ATA is already calling for

expanded use in a report issued last month. The organization's Air Traffic Control Systems Planning Group, which did the work, also recommends, among other things, early introduction of automatic digital communications into the air traffic control system to cut down on the voice messages cluttering the airwaves. Suppliers of digital gear got another boost in June when the data link subcommittee of the Airlines Electronic Engineering Committee met to consider a systems standard covering such parameters as data rate, modulation techniques, and error detection and correction schemes. Industry sources estimate that digital communications could be commercially operational as early as 1971.

But best of all, the Nixon Administration earlier this year made a dramatic proposal to establish a \$5.6 billion fund for developing airways and airports and reducing terminal congestion over a 10-year period. The aviation subcommittee of the Senate's Committee on Commerce is now holding hearings on enabling legislation. The program would be underwritten by higher taxes on passenger tickets, air freight, and fuel. If all goes well, some \$600 million would be invested in R&D, and \$250 million would be spent annually for new equipment, most of it electronic. The balance would be available for building new airports and improving old ones.

In a field keyed, but not tied, to Government outlays—instrumentation—producers were predicting steady but



Exception. Sales of commercial broadcast equipment are about even with year-earlier levels. But RCA reports the TK-44A color camera, which it began delivering recently, is moving briskly.



unspectacular sales increases for their wares at the start of 1969. Many, however, have been chagrined to find the rate of gain even more unspectacular than planned as the year unfolded. War priorities are still siphoning funds from Government-supported research activities, social programs, and advanced defense and space systems. Since instrument purchases can generally be deferred, demand has softened significantly. Continuation of the Federal income tax surcharge and prospective suspension of the investment tax credit, along with a drop-off in orders from foreign outlets, have added to the difficulties. As a result, companies are scrambling hard for the available business. But a handicap from the marketing standpoint is the paucity of compellingly innovative new products to tempt cash-strapped customers. The trend to versatile, computer-based systems should, however, provide a handsome payoff over the longer run.

Roger Swanson, director of marketing at Weston's Instruments division, says: "We anticipated market growth of 1% to 2%. Instead, outlets for (pointer-type) panel meters, portable units, and aerospace systems were off about 10% industrywide. Everyone—the Government, original-equipment manufacturers, and distributors—cut back. The surtax is getting a lot of the blame, but I don't see any connection. We do, however, expect things to pick up from here on out."

Myron Pogue, manager of marketing at Monsanto's

Electronic Instruments division, shares Swanson's optimism for the balance of the year, but he believes Administration tax moves have had at least a temporary impact on purchases. "The need for instruments is still there, however," he says. "Once people get over the shock, the market will recover again."

Among other things, the slowdown is attributable to the slackening pace of foreign sales because of European manufacturers' growing skills, according to Anthony Oliverio, vice president for sales at Keithley Instruments. To an extent, industry problems have been offset by price hikes, particularly on catalog items, he says. On balance, Oliverio is looking for a good year.

Congestion is beginning to account for a fair measure of the instrumentation field's current woes. At the IEEE show in March, for example, half a dozen companies unveiled new counters. And this month at Wescon, Dana Labs and General Radio, among others, will introduce new units; Monsanto will preview 5-digit and 9-digit counters with light-emitting diode displays.

The Laboratory oscilloscope market is likewise becoming crowded. Once the private preserve of Tektronix and Hewlett-Packard, this field is being eyed by Philips and Monsanto, which are readying 50-megahertz models for introduction. In the meantime, Tektronix is bringing out a whole new line of scopes, while H-P has come up with a 250-Mhz unit—the fastest lab unit available.

Computer makers during recent months—and years—have had things easier, contenting themselves with refinements, rather than innovations, on their fast-selling third-generation machines. Aside from the proliferation of bantamweight minimodels, most of the action's in peripherals. In this field, which is growing perhaps twice as fast as the main-frame business, there's been a spurt in low-cost crt displays with alphanumeric readouts.

From a business standpoint, the decision by the industry's colossus, IBM, to unbundle—sell software and support services separately from hardware—will have widespread, if immediately indeterminate, effects. Though the returns are not all in yet, it appears probable many of IBM's rivals will follow suit. One notable exception: Honeywell, which will stick with its pricing policies.

In memory technology, ferrite cores remain entrenched despite continuing improvements in plated wire and semiconductors. The cache concept, first implemented in IBM's System 360/85 machines early last year, promises to keep cores in the driver's seat for a while yet. A cache is a small fast unit storing data from locations most recently addressed. Since the processor is apt to want this information again, the cache greatly enhances systems performance. A number of computer makers are studying the possibility of using it in their machines.

Not so long ago time sharing was considered the wave of the future; at the moment, it's unquestionably a fact of life. The next step seems to be linking unlike machines into a versatile network as the Pentagon's Advanced Projects Research Agency is doing. Remote-access systems, going beyond time sharing to include systems with restricted language inputs, like Fortran-only and where the user's actions influence another's output—for example, airline reservation set-ups—are also on an upward track. Likewise, remote batch-processing installations in which users have quick, but not immediate, response



Long shot. Apollo 10's command and service modules are photographed from the lunar module shortly after separation in moon orbit.

Mission to Mars. Mariner series of spacecraft is designed to study the red planet's surface and atmosphere, establishing a basis for further searches for extraterrestrial life.

and cannot have independent and simultaneous use of the central processor, should continue to do well.

The computer boom is, of course producing an information explosion. One result is that terminal equipment in general and modems in particular are pacing the commercial communications market. Prior to the Carterphone decision, which permitted "foreign" attachments on phone lines, common carriers had a 95% piece of the modem action; lately, however, their share of this booming outlet has been closer to 65%. Annual volume, now around \$91 million, is expected to exceed \$155 million by 1972 as demand rises for digital systems.

Over the longer run, no more than 40% of the modem market is expected to be siphoned away from AT&T largely because of its extensive and unmatched service facilities. Another possible brake on independents' growth is the trend among major suppliers to build modems right into terminal systems.

In the meantime, AT&T's Picturephone, which can handle data, as well as voice and picture transmissions, has come through an initial check in which 40 sets were installed at Westinghouse. The results of this field test are being checked—a process which will take until mid-October. But a spokesman terms the Picturephone outlook "extremely favorable." Bell will, he says, be offering commercial service on a limited basis in metropolitan centers within two years.

Land-mobile sets continue to move well. By 1980, the number of licensed transmitters, now about 2.5 million, will have tripled according to FCC estimates. Law-enforcement applications will account for a growing share of sales. In February, for example, New York City ordered 2,230 two-way radio sets from Motorola for its police department. These units, which sell for \$700 each, are slightly larger than a pack of cigarettes and weigh less than a pound apiece.

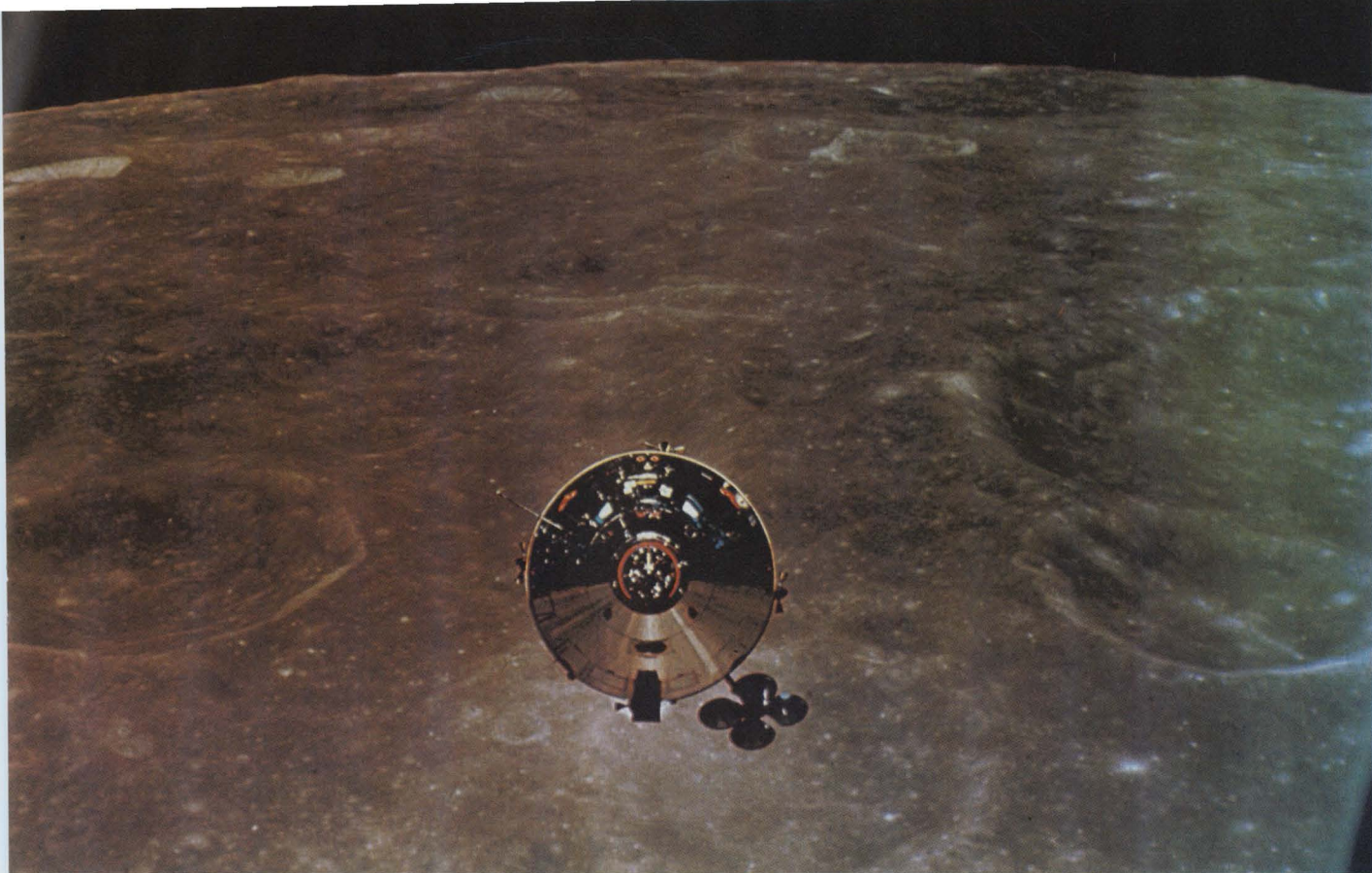
In another area of the commercial field, integrated circuits continue to make gains in process-control and machinery applications. Industrial designers are accepting IC's at a surprisingly rapid rate, and semiconductor houses may have to revise their market forecasts upward. One of the reasons for the surge is the MOS read-only memory which is easy to use. Gene Carter, MOS product manager at National Semiconductor, says, "If a guy can write a truth table, he can use an ROM." In effect, a tiny, fixed-program computer on a chip, the

ROM can control, for example, a milling machine, starting, stopping, and moving the cutting table.

The equipment designer supplies the IC manufacturer with the bit code for each address. The manufacturer programs the ROM accordingly by depositing metal interconnections on the chip; a gate electrode can be left open or closed depending on whether the bit it comprises is a 1 or a 0. Cost per bit for an MOS ROM is about 5 cents—low enough to entice designers in fields as diverse as construction equipment and displays.

Bipolar logic IC's are also on the best-seller list though controversy between advocates of high-level (15-volt) and low-level (5-volt) designs is still unresolved. Producers of high-level IC's like Amelco and Motorola claim greater noise immunity for their products and, hence, greater suitability for electrically noisy industrial environments. But such rivals as Fairchild and Texas Instruments say high-level logic is too expensive, contending that with easy and inexpensive shielding, low-level transistor-transistor logic can be noise-immune too.

Customers are giving aid and comfort to both sides. TTL shows every sign of becoming a workhorse in industrial control, and high-level logic continues to rack up enviable sales volume. "The growth of the market has been exponential," says Lane Garrett, a new products manager at Motorola, which goes both ways. "A year ago I made some economic predictions which I felt



were a little optimistic. But to date we're strictly on target, and the open orders are above expectations."

During the past six months, distributor sales of consumer electronics goods have also been growing at a fast clip. As it happens, however, the greatest gains were racked up by Japanese manufacturers; they've sold domestic importers twice as many television sets and 56% more radios, hi-fi components, and tape recorders, as well as 16% more radio-phono combinations than a year earlier. This invasion of a once-private preserve is causing deep concern among domestic manufacturers.

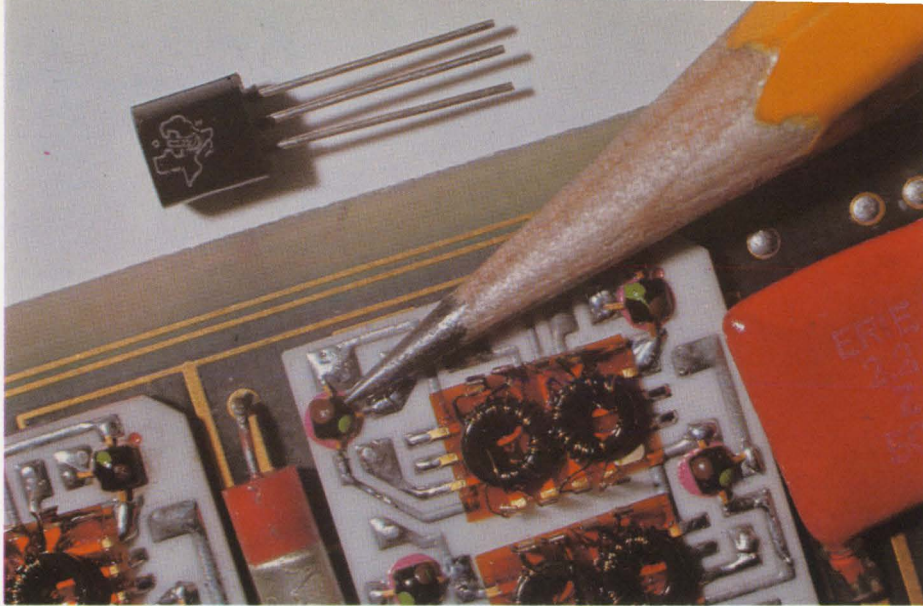
According to Masao Tsuchiya, executive director of the Electronic Industries Association of Japan, about 80% of the products displayed at the Consumer Electronics Show in New York during June were imports from Japan, or at least contained parts made in Japan. In addition, most of the American companies use Japa-

nese-made components or subassemblies in their wares. Tsuchiya does not consider the status quo unduly one-sided. "Importers and executives at some of your largest electronics companies have told me that agitation comes from only a handful of companies who want a protective shelter at the expense of both the consumer and the growth of the industry," he says.

"That's jawbone music," retorts Victor H. Pomper, president of H. H. Scott, a top hi-fi component maker. "The Japanese government, by direct action and by subterfuge, effectively protects its domestic market from foreign competition. Whether it's automobiles, electronics, or computers, they do not allow foreign competition or capital unless the Japanese industry so thoroughly dominates a given area that foreign competition would not be a significant threat."

On the home front all-solid-state color sets aren't

Selected consumer electronics markets	In millions of dollars by quarters				
	1st	2nd	3rd	4th	Total
Monochrome tv receivers	115.0	110.0	135.0	120.0	480.0
Color tv receivers	556.0	542.0	606.0	580.0	2,284.0
A-m and f-m radios	72.8	79.3	75.3	78.6	306.0
Auto radios	87.4	89.0	86.2	84.4	347.0
Automobile tape players	8.7	9.2	8.6	8.1	34.6
Phonographs, total	125.0	115.0	162.0	139.0	541.0
Tape recorders, audio	44.6	47.8	46.7	48.9	188.0
Tape cartridges	32.1	34.9	33.2	35.2	135.4



Closeup. Hybrid circuits are giving semiconductor suppliers and users a real run for their money these days. This one from TI is used in a Honeywell 8200 computer because of the high current-switching capability required for core driving.

expected to flood the market any time soon. Marketing men agree consumers aren't quite ready to ante up \$200 more to own one. As a result few top set makers are ready to tie up engineering talent on such a project. "Hybridization provides both performance and reliability without a premium," says Thomas H. Cashin, senior vice president at Sylvania. His opinion is shared by many industry colleagues. Nonetheless, for prestige several more firms, including Emerson Radio, will produce all-solid-state color sets in limited runs for next year's line. Clairtone Electronic, a Canadian outfit plans to invade the American market with a receiver next year.

And for the moment, electronic tuning has not lived up to its press clippings and won't replace standard switched systems for several years. Set makers contend cost is the big hurdle, but engineers point to the poor tracking performance of the tuner diodes as a big factor. Producers are now checking performance reliability against the higher costs involved with the hope of coming up with marketable configurations.

But failures in the realm of solid state are now more the exception than the rule. So far this year, dollar volume in integrated circuits is exceeding expectations, despite the depressing influence of military and space cutbacks, price reductions, and a disappointing linear market. The big reason is booming demand from the data processing industry, particularly suppliers of peri-

pheral equipment. Texas Instruments expects total industry sales next year of \$40 million in MOS IC's alone for small memories and terminal equipment.

TI's move in early June to slash prices on its 54/74 series of transistor-transistor logic precipitated similar reductions by other manufacturers. Despite the average 30% drop in unit prices for this family, market planners are confident larger orders will offset the revised loss.

Linear IC's have also suffered severe price erosion. Although unit volume is up sharply, total sales are up only a few percentage points. Moreover IC sense amplifiers are getting stiff competition from discrete devices, which computer makers, for example, prefer as an interface for core memories. The reason: IC's just haven't been able to match the performance of discrete components in this application.

But the longer term outlook is promising. National Semiconductor, for example, contends that price cutting made voltage regulators and op amps attractive for new equipment designs. Now that these designs are getting into production, demand will rise. For nine months, a source there reports, industry shipments of linear IC's hovered at just over 1.5 million units a month. But now, he says, it looks as though the market is finally taking off; shipments have risen to the two-million level during the last few months.

Softness in TTL and linear IC prices notwithstanding,



Best seller. Since the Carterphone decision, the hottest thing in the communications field has been modems. Among the units on the market is Ultronic's Series 2400 Data Pump, which receives and transmits synchronous digital data over voice-grade phone lines.

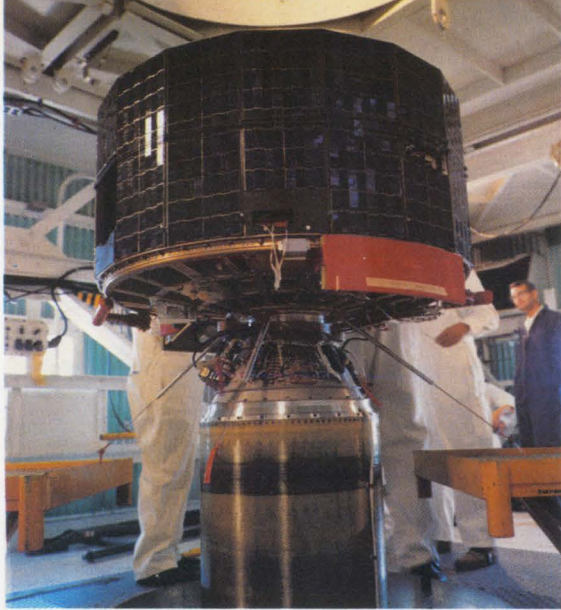
the average unit price for all IC's has remained firm at about \$1.35. One reason is that medium-scale integrated circuits have become accepted and established. And since MSI contains many more functional cells than standard IC's, it commands a correspondingly higher price. "Just about every system that's being designed today incorporates MSI," says Don Winstead, marketing manager at Signetics. He estimates that 15% of the IC packages in such systems contain MSI circuits. TI's market projections support his estimate; MSI will account for 45% of the total TTL dollar sales this year. And by 1972, the level will be around 65%.

MSI is no longer an exclusively custom-design business. Products such as adders, decoders, counters, memories (one of the fastest growing lines, according to TI), shift registers, and multiplexers are now catalog items. MOS LSI, on the other hand, may be shifting in the opposite direction. TI's marketing staff, for example, believes that MOS may turn out to be "a custom, sole-source situation because of high development costs."

Plastic IC's, which have been cheerfully accepted by industrial and commercial users, have proved a big factor in the upsurge in orders. Now, despite all the controversy, there appears to be some hope that such devices stand a good chance of eventually being accepted by the military. Recent data—from field use as well as lab tests—has "documented that the military temperature range

Selected components markets	In millions of dollars by quarters				
	1st	2nd	3rd	4th	Total
Capacitors, electrolytic	41.4	43.8	48.2	55.6	189.0
Capacitors, all others	58.5	62.9	64.0	69.0	254.4
Receiving tubes	52.3	55.8	58.9	60.0	227.0
High-vacuum tubes	14.6	15.5	15.0	14.6	59.7
Gas and vapor tubes	4.8	4.5	4.3	3.8	17.4
Microwave tubes (klystrons, magnetrons, TWT's)	25.2	24.3	23.5	21.6	94.6
Tv picture tubes, black-and-white	25.3	26.6	22.0	20.1	94.0
Tv picture tubes, color	187.4	198.0	208.6	204.0	798.0
Filters, electronic	12.2	13.0	13.8	14.5	53.5
Microwave ferrite devices	6.0	6.6	6.3	7.4	26.3
Fixed resistors	55.8	59.2	62.7	66.3	244.0
Potentiometers	40.0	41.2	43.0	44.6	168.8
Solid state relays	4.3	5.4	7.0	7.7	24.4
Electromagnetic relays	30.4	31.7	34.0	30.4	126.5
Optoelectronic devices	7.1	8.2	9.0	10.5	34.8
Rectifiers, solid state	31.1	29.4	27.2	24.3	112.0

Selected semiconductors markets	In millions of dollars by quarters				
	1st	2nd	3rd	4th	Total
Transistors, silicon	74.3	71.7	68.2	63.8	278.0
Transistors, germanium	16.7	15.9	14.3	13.5	60.4
Transistors, field effect	4.2	4.9	6.0	6.9	22.0
Germanium diodes	5.7	5.2	4.9	4.5	20.3
Silicon diodes	43.2	41.7	39.3	37.8	162.0
Thyristors	15.6	16.2	17.0	17.6	66.4
Tunnel & varactor diodes	2.3	2.6	2.8	3.3	11.0
Zeners	14.1	14.3	14.5	14.9	57.8
Monolithic linear IC's (less than 12 gates)	20.7	22.3	24.6	26.4	94.0
Monolithic digital IC's (less than 12 gates)	78.6	81.1	84.3	87.0	331.0
Monolithic IC's, MOS	7.6	8.7	9.3	10.1	35.7
Thick-film hybrid circuits	10.7	12.5	12.8	13.8	49.8
Thin-film hybrid circuits	7.4	7.9	8.2	8.5	32.0
MSI devices (12 to 100 gates)	24.0	27.8	29.1	32.1	113.0
LSI devices (100 or more gates)	1.3	1.7	2.1	2.5	7.6



Preflight. Tiros operational satellite undergoes final checks before successful launch earlier this year. Spacecraft is ninth in weather-watch series operated by the Environmental Science Services Administration.

has no adverse effect on the plastic," according to one industry source. Other observers agree, noting contractors are ready, willing, and able to use plastic IC's, but are inhibited by the services' opposition.

Hybrid IC's, which are winning an increasing number of sockets in consumer goods and industrial equipment, are fostering sizable new outlets for chip capacitors and resistors that can be bonded directly to substrates. The market, currently worth about \$8 million a year, could triple within the next 12 months or so, according to informed estimates. For example, Varadyne, which offers both chip capacitors and resistors plans to introduce passive hybrids in dual in-line packages for data processing and military systems. Other firms in one or both sides of this burgeoning business include Republic Electronics, the U.S. Capacitor Corp., Sage Electronics, and Allen-Bradley—all old-line suppliers of discrete devices.

Another component development that bears watching is a new tantalum nitride thin-film resistor from Western Electric. The patent-protected devices, available in a variety of values, are in production at the company's Winston-Salem, N.C. plant. (Western Electric is being pressed to license the development to other manufacturers.)

The ceramic-based component, produced with values from 100 ohms to 100 kilohms, is highly stable and corrosion resistant. Frequency response is equal to or better

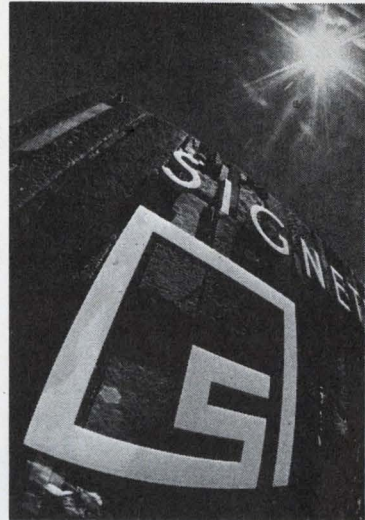
than most film-type units. For example, 1/8-watt devices, tested for more than 10,000 hours at 70°C showed only 0.02% resistance change for 500-ohm resistors and 0.11% change for values of 47 kilohms. By using a coplanar staple-lead arrangement, mounted on 0.25-inch centers, a density of more than 450,000 parts per cubic foot is possible. When power dissipation and costs are taken into account, these discrete resistors mounted on printed-wiring boards can compare favorably with either thick- or thin-film resistance networks.

Elsewhere in componentry, with companies like Texas Instruments, Motorola, RCA, Monsanto, and Hewlett-Packard now making light-sensing and light-emitting devices, demand for optical semiconductors is growing. These devices are being used in both discrete and monolithic units displacing mechanical relays, transformers, indicator lamps, brushless motors, and motor speed controls. TI estimates this market will be worth \$50 million in 1969, believing it could grow to \$300 million by 1973. In addition to large military outlets devices can also be applied in typewriter keyboards, automatic garage-door openers, photomultipliers, and alphanumeric. Because of intense demand and competition, manufacturers earlier this year were selling emitters for \$10 apiece; they're now targeting unit prices of \$3 to \$5. If this level is reached, new markets should open for electro-optic devices, notably in cars and heavy machinery. ●



Excelsior. Tiros operational satellite heads for near-polar, sun synchronous orbit; craft surveys global weather conditions once every 24 hours, returning data and pictures to ESSA stations in Alaska and Virginia.

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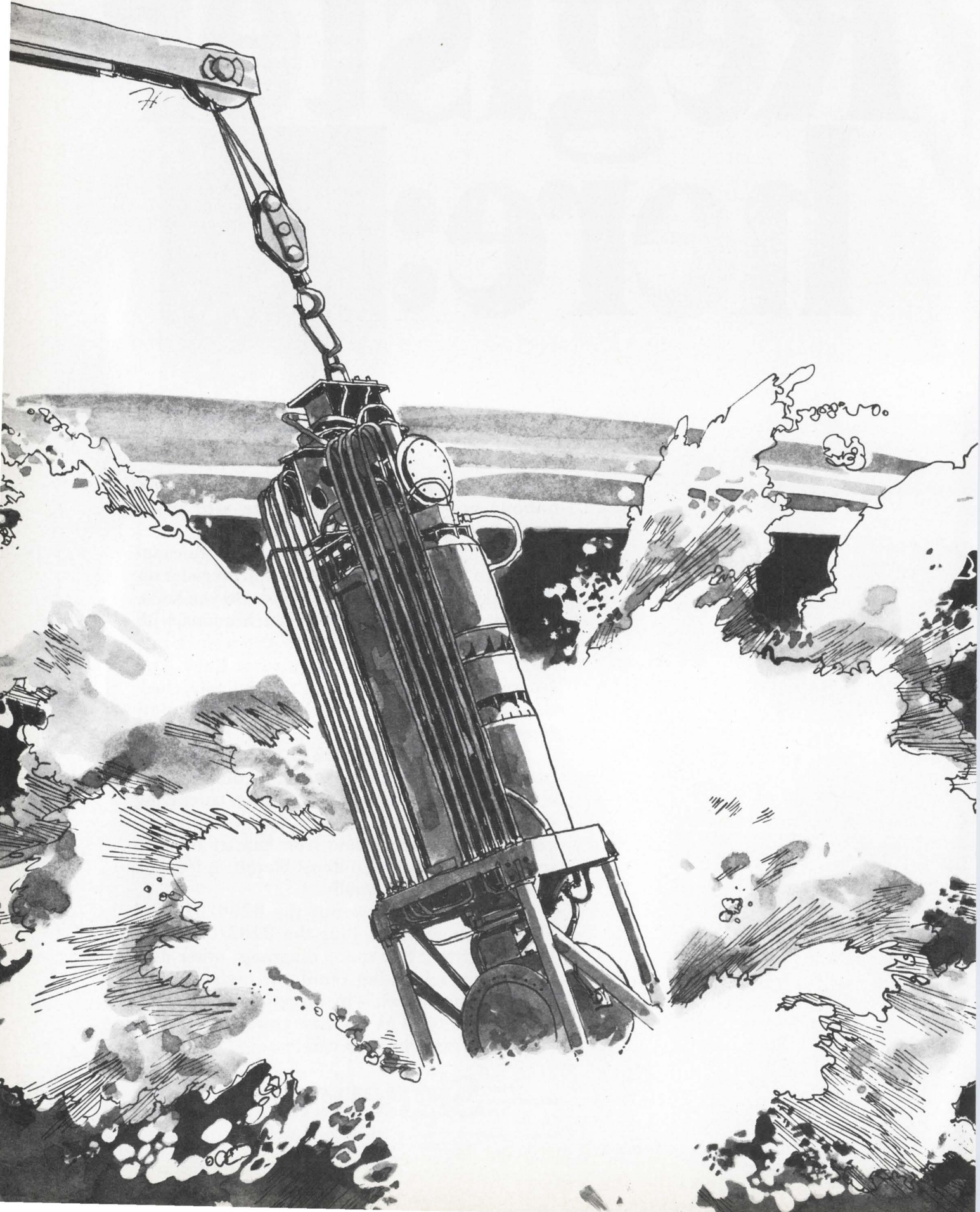
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THE UNDERSEA POWER PLANT THAT GETS ITS POWER FROM THE SEA ITSELF.

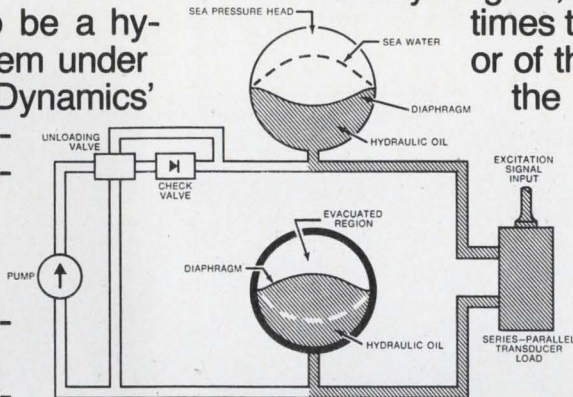


Man has been going to greater and greater depths beneath the sea in recent years. To explore, and to work. And he has become increasingly concerned with finding new means for probing so alien an environment.

One of his most urgent needs is a reliable source of high peak power that will work most efficiently under the sea.

One answer promises to be a hydraulic energy storage system under development by General Dynamics' Electronics Division. It harnesses the enormous pressure of the sea itself.

Sea pressure delivers 10,000 horsepower. Figure 1 is a simplified diagram illustrating the principle utilized in the deep-sea energy-storage concept.



The upper (transfer) vessel is a sphere partially filled with oil. A diaphragm separates the oil and the sea water, and the top of the sphere is open to the sea.

The lower sphere is a conventional pressure vessel which is evacuated. The hydraulic device to be powered by the energy storage system is placed between the upper and lower vessel.

The complete system is located at depth in the ocean. Upon demand of the hydraulic device, the hydrostatic pressure existing in the upper vessel forces the oil through the device into the evacuated vessel. The hydraulic pressure across the device is largely constant throughout the discharge, since the hydrostatic pressure of the sea does not change, and since the lower vessel pressure does not change significantly.

As an example, at a depth of 12,000 feet in the ocean, a six-foot diameter sphere used for the lower vessel could enable over 10,000 hp. of flow energy to be sustained for 10 seconds; a 10-foot diameter sphere would sustain this power level for one minute. Other power levels and vessel sizes are illustrated in Figure 2.

Recharging the system by evacuating the sea water from the filled vessel can be accomplished with the aid of a small pump, operated by a mere trickle of power fed by cable from the surface, or by a power source self-contained in the undersea work system itself.

Long life independent of discharge rates. The advantage of General Dynamics' new concept is that it meets the need for high power discharges over short intervals of time at low cost. And that it can be recharged over a time interval at the demand of the user.

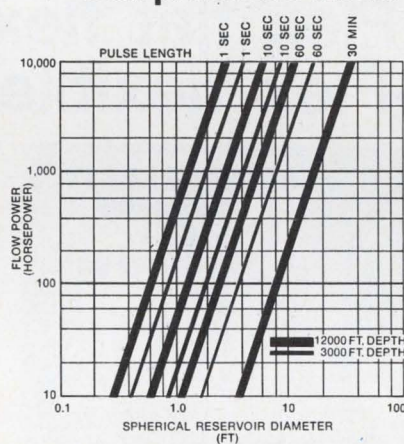
The system also shows promise of an extremely long life, regardless of the number of times this energy source is tapped, or of the rate of power delivery. In the much weaker electrochemical batteries that have had to be used in such applications, severe deterioration can take place after just a few cycles at high discharge rate.

A major role in opening depths to man's use.

Right now at General Dynamics, sonar and underwater communications have the highest priority for application of this hydraulic-to-acoustic power conversion technique.

But this concept may soon be assisting in the search for minerals and operating everything from beacons to underwater drills as man's exploration of the sea moves forward.

Sea pressure head energy storage systems



are just one example of our undersea work. General Dynamics builds nuclear submarines for the Navy, research and work submersibles, advanced sonar systems, microelectronic sonobuoy

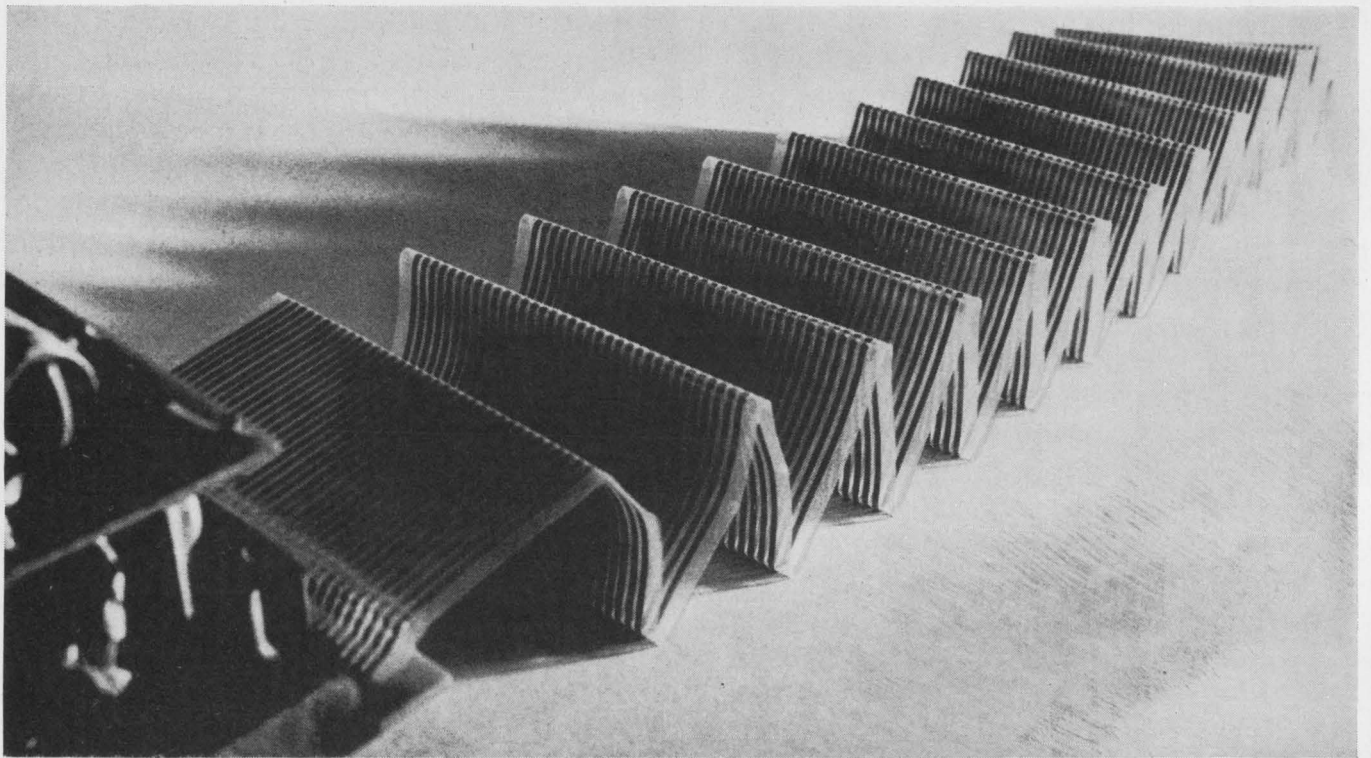
receivers, sonar calibration range systems, and ASW tactical displays. They all show what technology can accomplish when it's handed a problem. At General Dynamics we put technology to work solving problems from the bottom of the sea to outer space... and a good bit in between.

GENERAL DYNAMICS

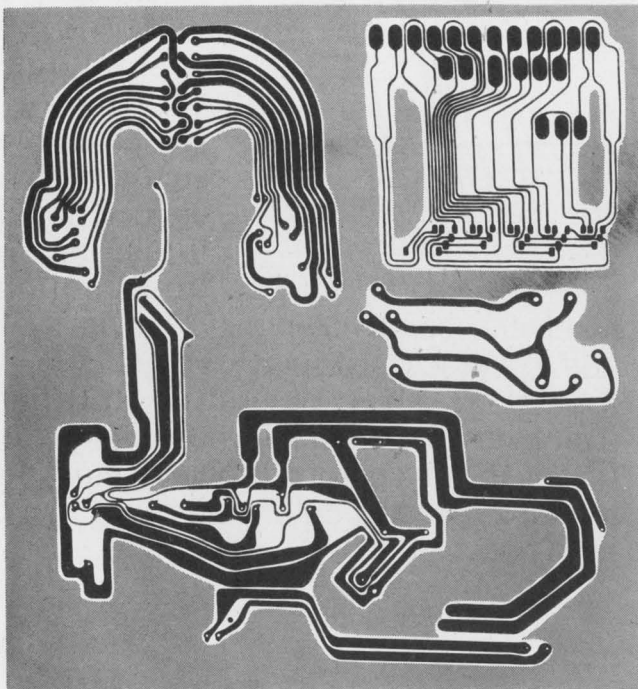
Additional technical information on the deep-sea energy storage system is available on request. Write: General Dynamics, Dept. 850, 1 Rockefeller Plaza, New York, N.Y. 10020.

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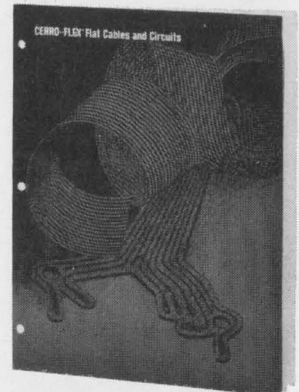


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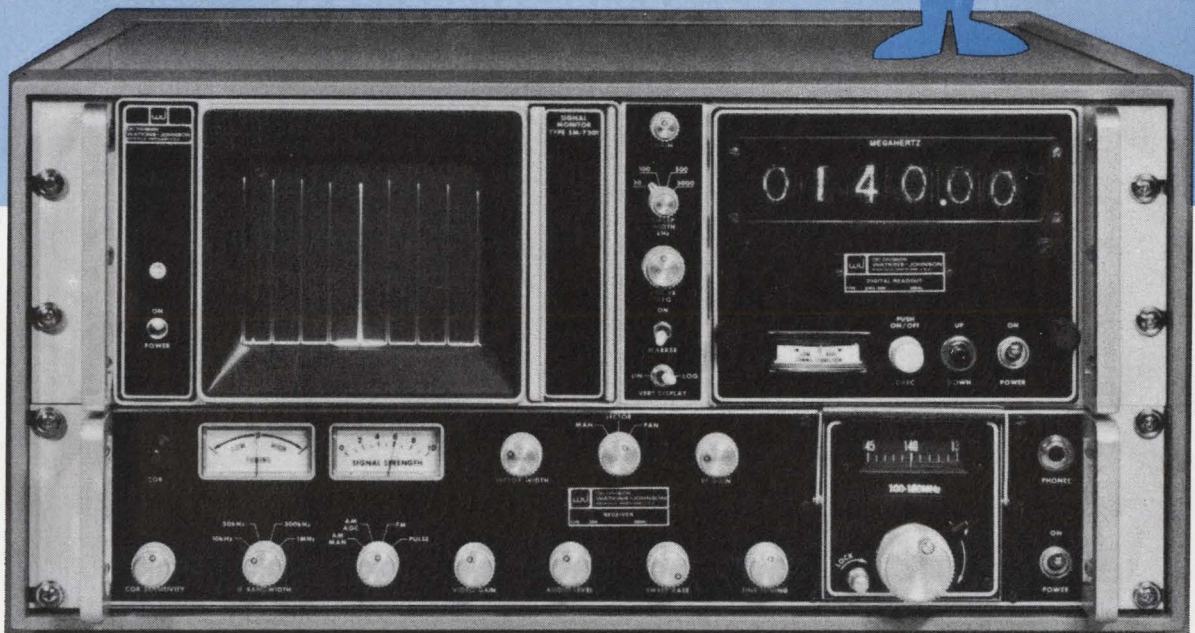
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The receiver covers the 30-300 MHz range with four plug-in tuners. RF preselection consists of four tuned circuits in two coupled pairs which are voltage tuned using varactors. These circuits provide a high order of IF and image rejection and reduce intermodulation for signals outside the RF passband. The RF amplifier consists of a dual gate MOSFET followed by a junction FET in a cascode configuration for maximum selectivity. This configuration also provides a high reverse isolation to the local oscillator signal which is typically less than one microvolt at the RF input. A double-balanced mixer provides improved intermodulation characteristics, IF rejection and local oscillator leakage.

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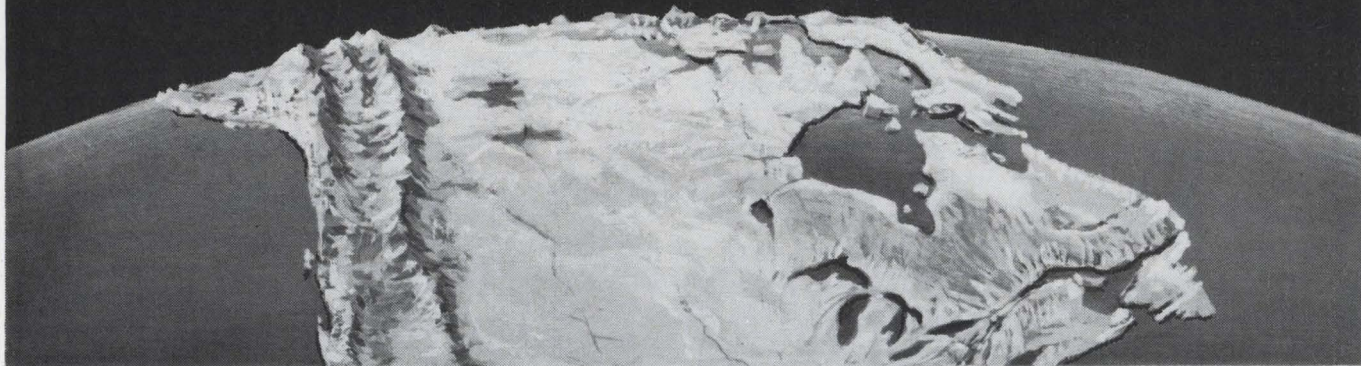
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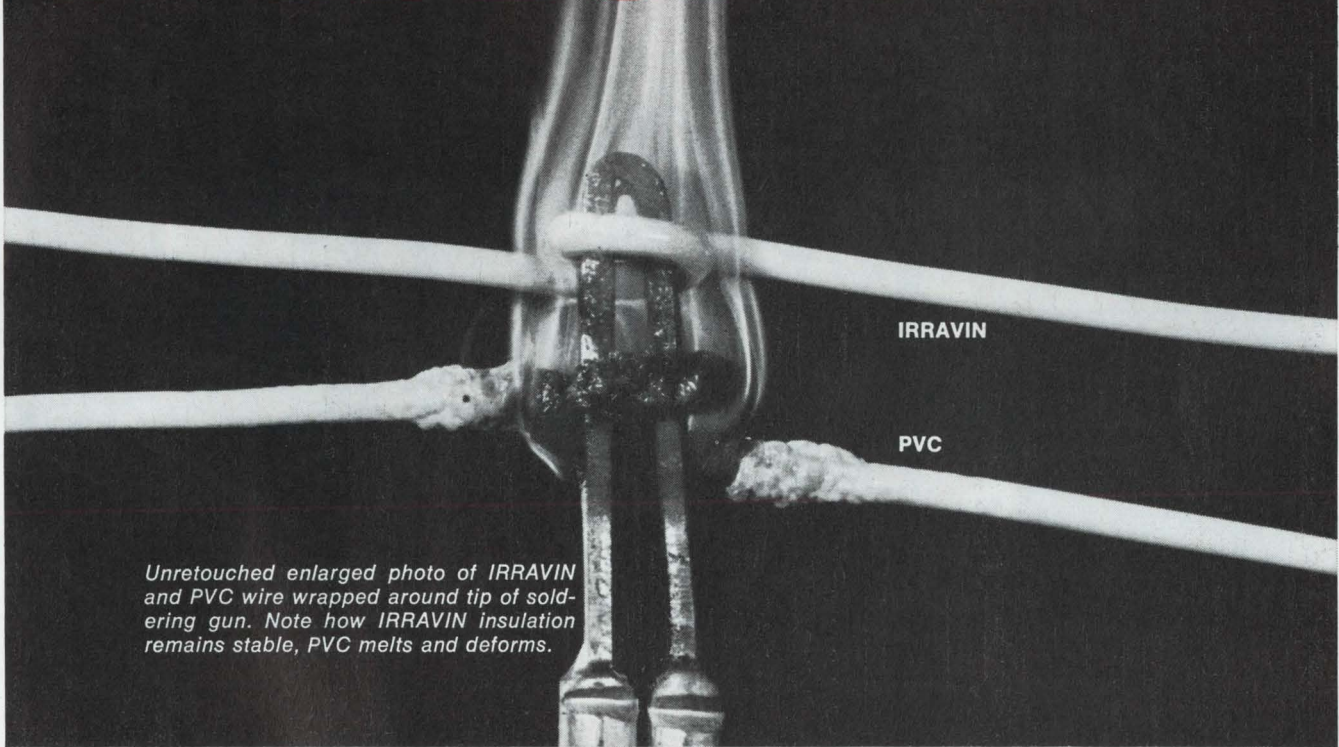
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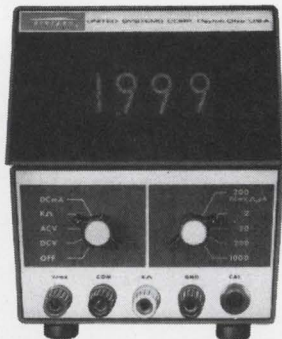
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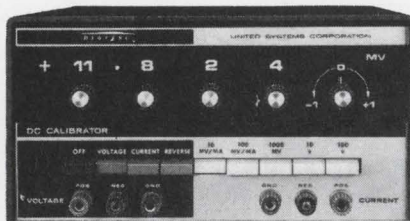
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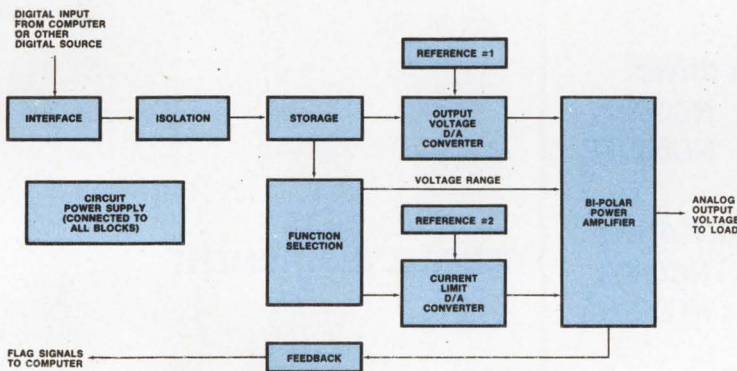
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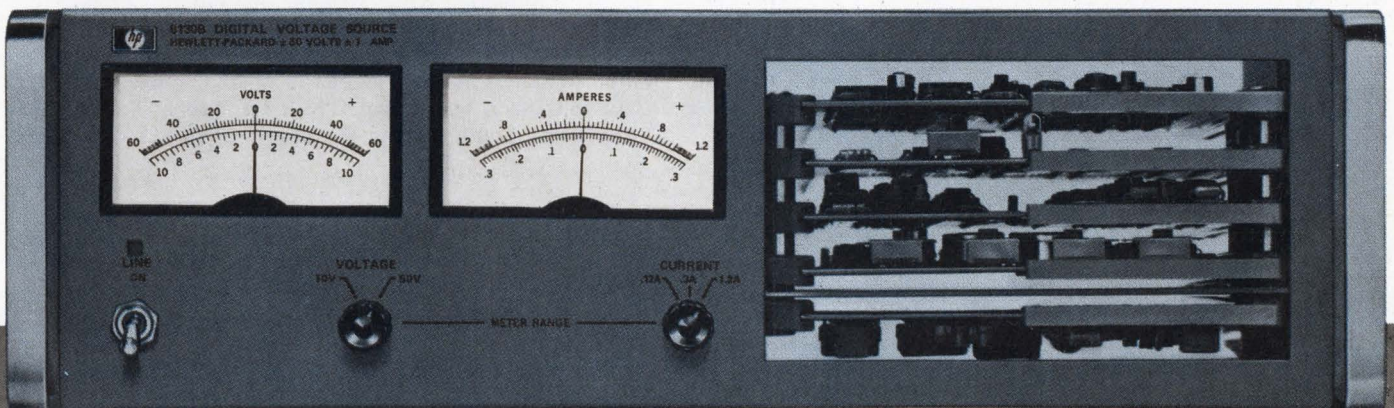
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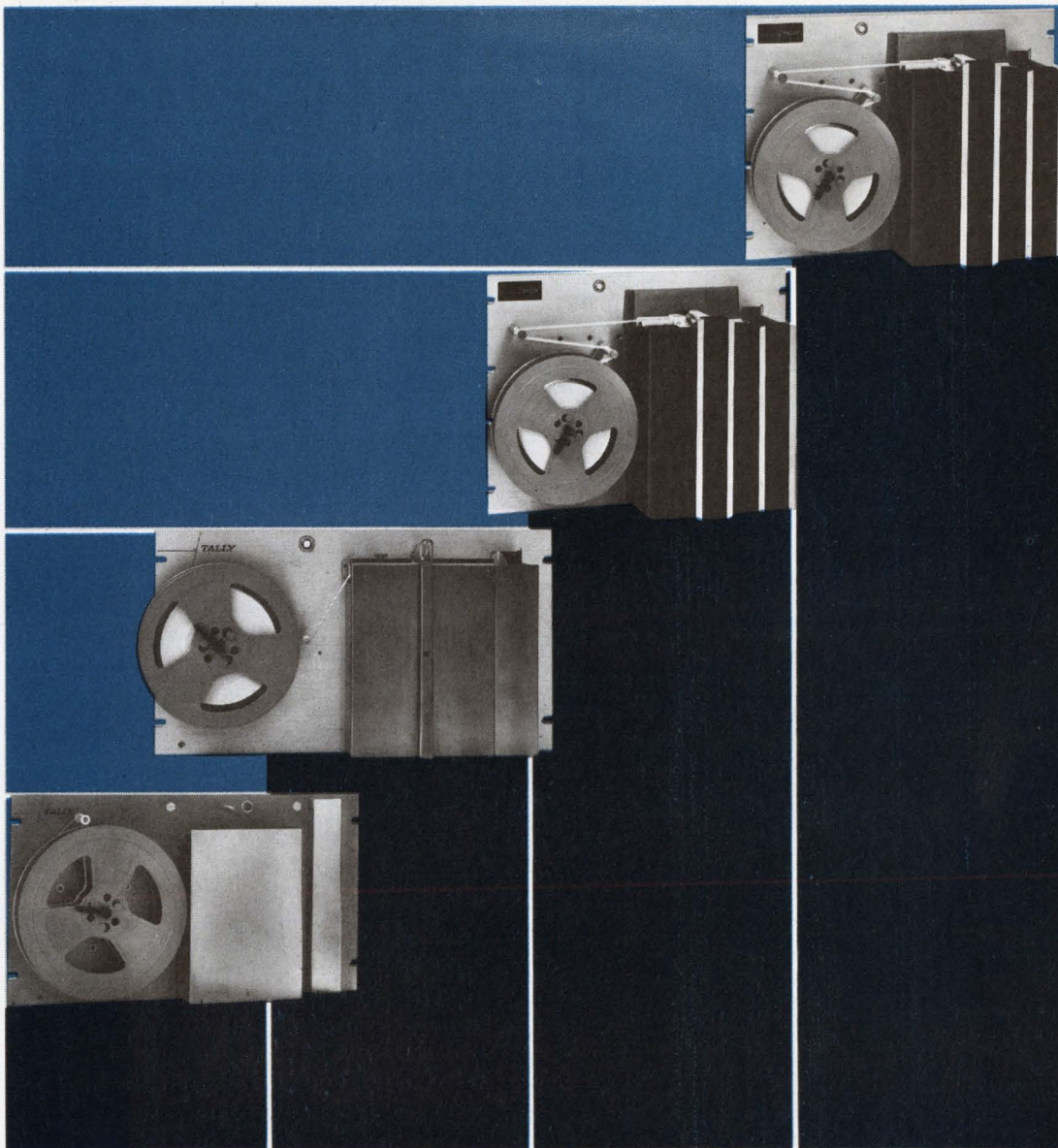
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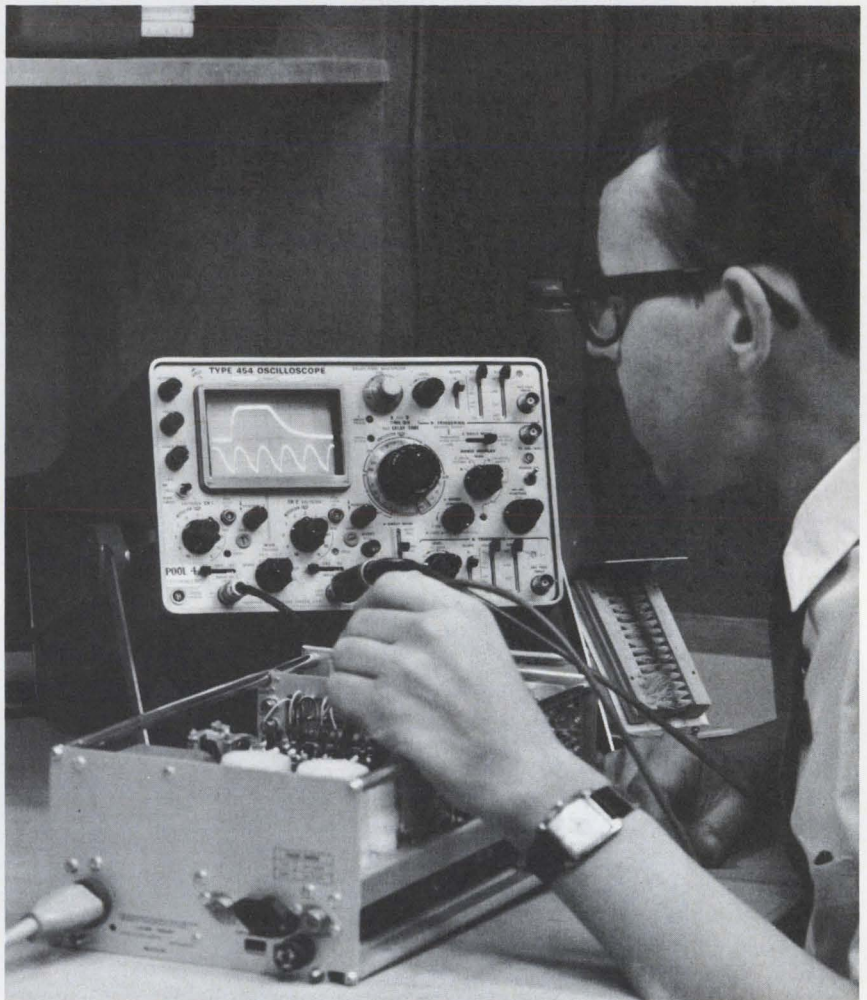
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Videofile puts lawmen in the picture

Los Angeles County Sheriff's Department installs automated information storage and retrieval system from Ampex to keep track centrally of its voluminous records

Documentary evidence, according to a story now making the rounds, proves that paperwork is a lot more likely to bury the country than the Russians. The situation does have amusing aspects, but it's no joke for those contending with current record levels.

The Los Angeles County Sheriff's Department, for example, has the staggering task of maintaining 18 million individual case, fingerprint, and photograph files that are increasing at a 13% annual rate. Not too surprisingly, the snowed-under agency, which has officers requiring up-to-the-minute information scattered throughout one of the nation's largest metropolitan areas, decided some sort of automated storage and retrieval help was required. After investigating the matter, it decided on Videofile, a sophisticated assemblage of hardware developed by the Ampex Corp. that's just now winning a secure foothold in commercial and government markets.

Essentially, Videofile is a computer-controlled system built from modular elements, including: high-performance cameras for input; tape for storage; tape transports for search; and display monitors and electrostatic printers for output. The hardware can be combined in a number of different ways to satisfy varying requirements. With Videofile, any document in a master file can be viewed on a television screen or electrostatically printed out in a matter of seconds by simply pressing a few buttons. Since the original is not removed, it's available for inspection by any other interested party. In addition, documents can be erased, relocated, or replaced electronically without disturbing the basic file.

When Ampex decided a few

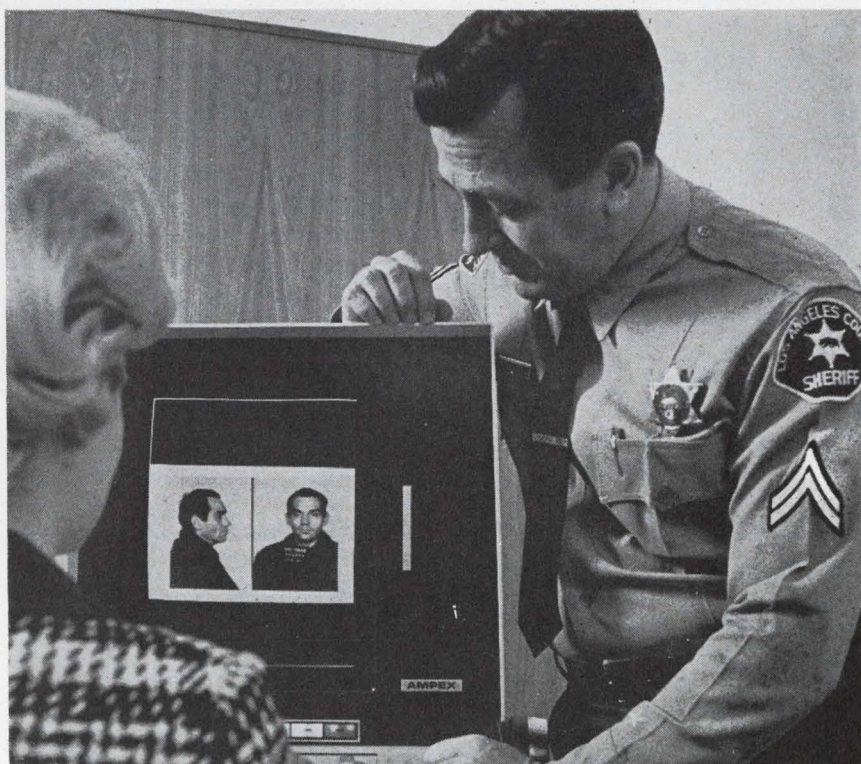
years back to get into the automated information storage and retrieval field, it seemed probable that in-house talents in magnetic tape recording, television, data processing, and related technologies would make development work easier than proved to be the case. "When we started, we thought that we could adapt existing equipment to a much greater extent than actually proved possible," says Charles Steinberg, general manager of the company's Videofile Information Systems division.

End and means

The transport on available video tape recorders, for example,

couldn't shuttle back and forth at the rate demanded by the system. The specified search rate is 380 inches per second, using 2-inch tape. A single reel might have 20 pounds of tape, twice the mass which high-speed digital transports normally have to handle. Acceleration from zero to 380 ips and comparable deceleration had to be achieved within 1.9 seconds. In addition, the transport had to be able to read digital addresses during the search.

In order to meet these design goals, Ampex had to combine the rotating-drum head technique developed for vtr's with the single-capstan, vacuum-chamber techniques used for digital tape record-



Mug shot. Los Angeles County Sheriff's Oracle system can make stored records, including identification photographs, immediately available.

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CERRO®

Files on parade

The investment of time, effort, and money required to develop an automated information storage and retrieval system is so great, the Ampex Corp. has made the initial market soundings virtually unchallenged. The company has had the basic tool—the video tape recorder—for over a decade, but only now, after sinking over \$8.5 million into R&D is it beginning to win any substantial sales acceptance for its Videofile system.

Last year, Ampex installed a system for handling waybills at the Southern Pacific Railroad. And this spring, it made the biggest single sale in Ampex's history when it signed up the Los Angeles County Sheriff's Department for a \$5.6 million system to handle law-enforcement records.

The division itself has grown from 100 employees to over 400 during the year it has been housed in its own building, a 100,000-square-foot facility in Santa Clara, Calif., a few miles south of the main Ampex plant. The marketing department alone now numbers 48—a far cry from the days when it consisted solely of Robert A. Miner, currently product marketing manager. The division is not yet profitable, but General Manager Charles Steinberg says that it will be within a year. And, he adds, by the mid-to-late 1970's, it will be generating sales of some \$300 million a year. (Ampex's total sales for fiscal 1969, which ended April 30, were \$280 million.)

Head start. Catching Ampex will not be easy, because a Videofile system is not simply a vtr with ancillary support gear. For example, the cost of the nine units in the Los Angeles system is only \$375,000; the rest of the money is for buffers, monitors, cameras, printers, and displays. Moreover, Ampex is gobbling up some big customers. It has booked \$18 million worth of orders since Videofile was introduced in May of 1966; the Los Angeles Oracle system is its eleventh sale.

Among the other customers are the Sandia Corp., which will use its system for engineering drawings; the American National Insurance Co. of Galveston, Texas; and American Republic Insurance, a Des Moines, Iowa, accident and health firm. There are also a number of Government agencies and commercial prospects that Ampex prefers not to discuss. In this category is the National Aeronautics and Space Administration, whose Huntsville, Ala., facility bought the first Videofile system for a parts reliability file. NASA never had the money to run the system, and has never used it, since the program for which it was intended was cancelled. "That was a real blow to us," Steinberg says candidly. "It hasn't helped our marketing." He is quick to add, however, that the system worked just as Ampex said it would.

ing equipment.

The camera was an equally thorny problem; it required much higher resolution than conventional video units since the documents it would be called upon to scan would not always be in the best of shape. Accordingly, Ampex devised a new vidicon with a two-inch target for the camera, which itself had 1,280 scan lines (15 frames per second), as against 525 for commercial broadcast equipment. Moreover, since the camera is normally operated by personnel who are not technically trained, it had to be extremely simple.

The monitor for the camera also had to be redesigned with dynamic focus on both axes to meet resolution specifications in the corners of the display.

In order not to tie up the transport while a document is being

printed out, Ampex developed a buffer system—basically a disk recorder that records an entire document in 1/15 second, and then plays it back into the printer in 3.2 seconds.

Stopgap

But the disk recorder is different from those commonly used as computer peripheral equipment. To eliminate head wear, these machines do not bring the recording head into contact with the disk. However, because of the high video bandwidth of the Videofile system (7.2 megahertz), Ampex could not use this technique. Minute changes in the gap between head and disk would affect the recording.

In the Ampex system, head and disk are kept in contact by a jet of air. The pressure is higher during the short record time, and lower

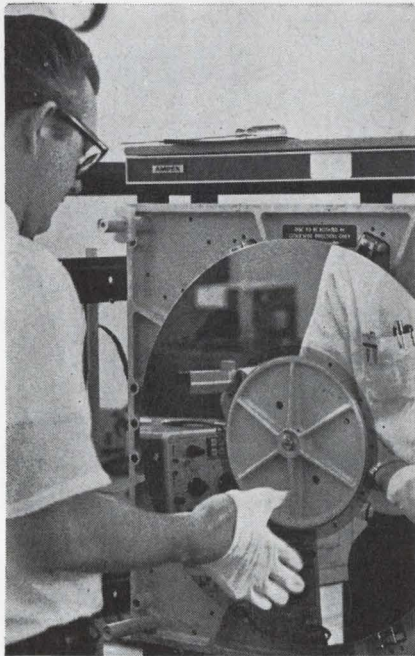
during the relatively long print time. Head life for any one track on the disk is 1,000 hours.

The company's buffer technique has already produced some commercial fallout; it is the heart of Ampex's stop-action video system that has made the instant replay popular on televised sports shows. Steinberg says that the camera, too, will undoubtedly be adapted into a hands-off unit for broadcast tv systems.

Even the printer is new design (although Honeywell uses a similar technique for its 1-megahertz oscillograph). The disk recorder drives a cathode-ray tube which has a fiber-optic face plate; hard copy, if required, is printed out on electrostatic paper.

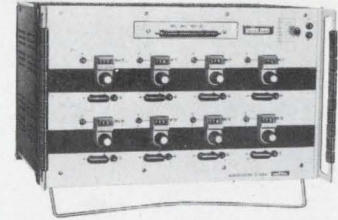
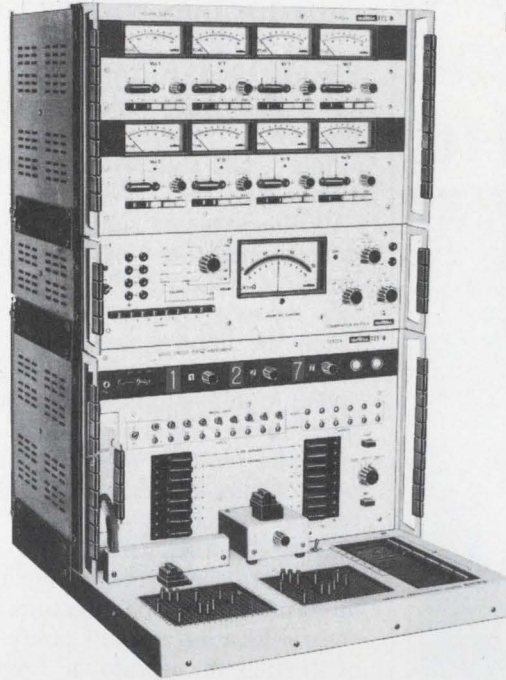
Case study

The \$5.6 million Videofile—dubbed Oracle for optimum record automation for court and law enforcement—that Ampex is selling the Los Angeles Sheriff is expected to cut record-keeping costs by 40%. It's designed to shave maximum retrieval times from a day or so to five minutes. Moreover, when the system is completely installed in mid-1971, the amount of floor space required for file storage will be reduced from 40,000 to 3,000 square feet, according to Capt. James C. White, of the Los Angeles Sheriff's Department Technical



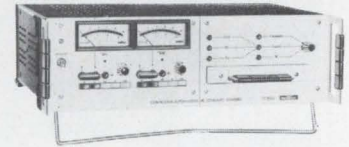
Test. Videotape transport is checked by technician on Ampex assembly line.

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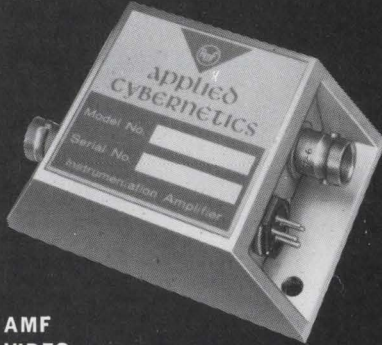
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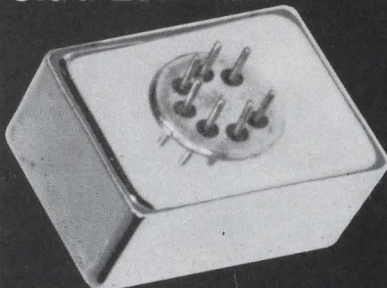
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ALEXANDRIA

... in the detective bureau, waiting time for files wastes \$10,000 a month ...

Services division. "About \$1.5 million will be saved each year in filing clerk salaries alone," says White. "The staff will be cut from 152 to 30."

White explains that the cost in delays with the present set-up is far greater than \$1.5 million, since this amount doesn't take into account the filing space to be saved and the time investigative officers spend tracking down a particular file. "In the detective bureau, for example, waiting time for files is now costing us about \$10,000 per month," he says.

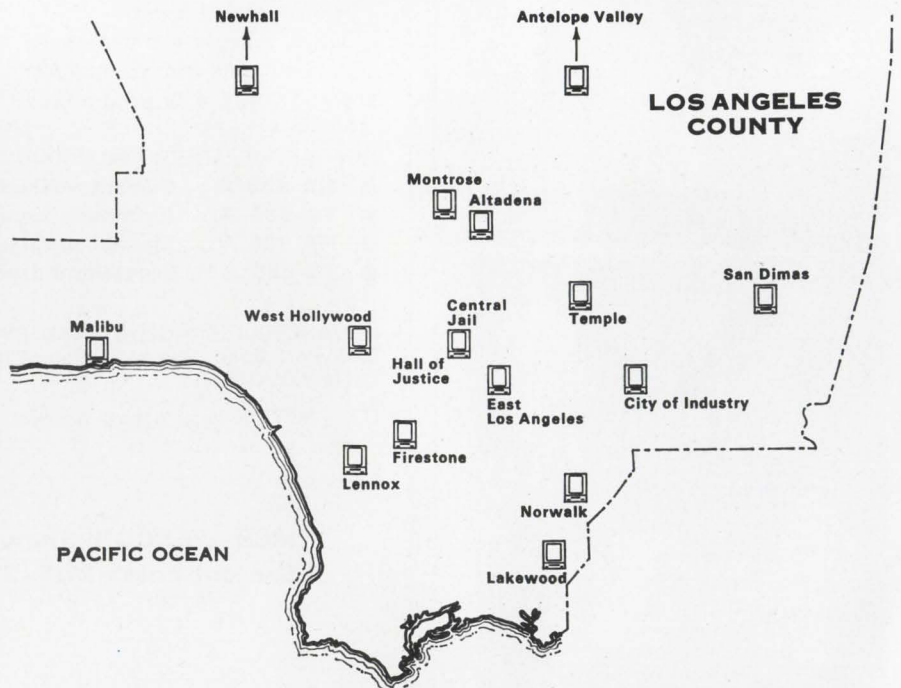
Give-and-take. Oracle will store law-enforcement records, including fingerprints and photographs at a central location in the County Hall of Justice in downtown Los Angeles. Filing consoles and television monitors located at 15 branch sheriff's stations will permit field officers to remotely put case reports, fingerprints, and other documents into the master file. Agents will also be able to retrieve documents from the master file for video display at any of the remote locations.

Equipment in the Hall of Justice will include two filing sections,

nine videotape transports, 21 video buffer sections, 36 television displays, two paper copy printers, and two system control sections. Outlying facilities are equipped with filing consoles and television displays. Microwave links for the system, including a relay station atop nearby Mount Wilson, will be constructed at an additional cost of about \$1.5 million. Maintenance chores will be handled by Ampex, on a contract basis, at a cost of \$44,000 per month.

The system, as installed, allows a 15% expansion of remote stations, and a 40% capacity boost for the central file without the need for additional equipment. About 380,000 new documents will be added to the file each month; current requests from various sources for file information average 100,000 per month.

Unfortunately, requirements covering the preservation of legal documents may prevent the best use of Oracle for some time to come, according to White. "We now have to keep most papers in a dead file for two years, and certain legal documents for a longer period of time, but we're trying to get legis-

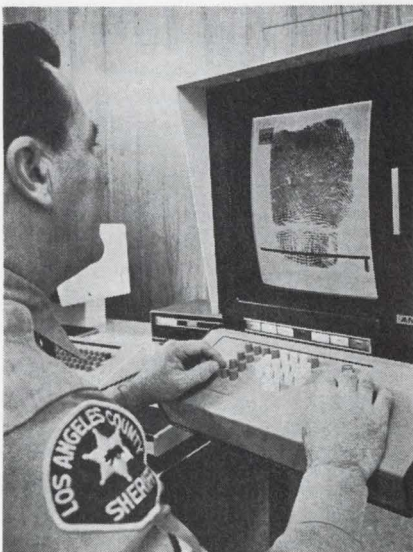


Network. Central file in Los Angeles Sheriff's Oracle system is downtown in Hall of Justice; 15 outlying stations have tv monitors and input gear.

lation passed in Sacramento that would eliminate some of these strictures," he says.

Dirty work. The possible loss of vital documents as a result of accidental tape erasure, fire, or other catastrophes will be guarded against in Los Angeles by making duplicates of master tapes and storing them at other locations. White concedes that erasure of tapes by accident or design "could result in the loss of some documents." But he points out: "The county is already losing a lot by misfiling now. I would estimate that the Videofile system is 150 times more secure than the set-up we have now."

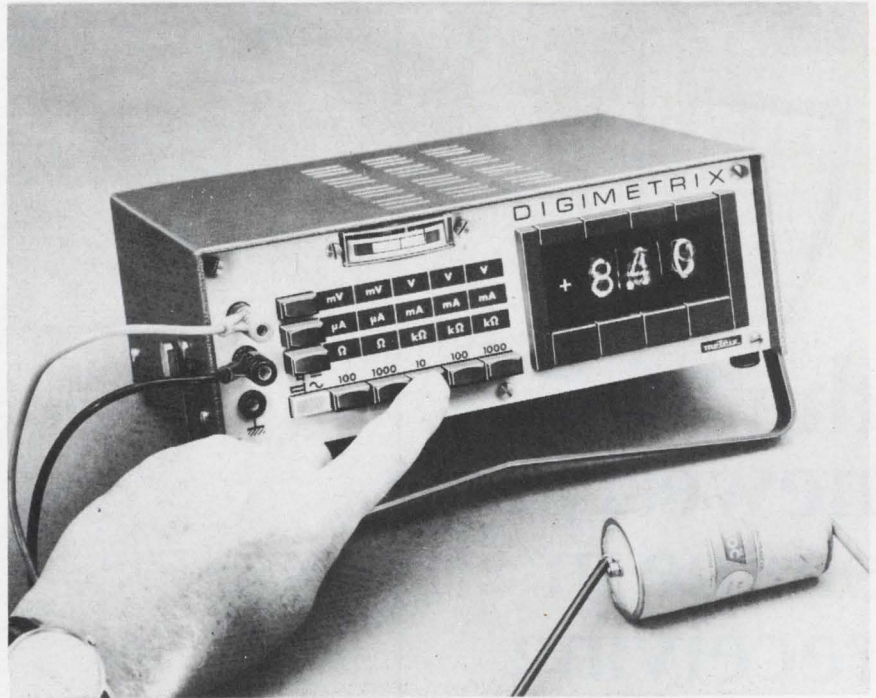
An Ampex source concedes that electronic doctoring of files is possible. But, he points out, it's likewise possible to tamper with written documents. And company officials who cite enough statistics on the economy's paperwork to fill more than a few tapes note that the Southern Pacific—the first commercial Videofile customer—is now destroying waybills once they're on tape. In any case, fewer employees will have access to Oracle than the current system which permits a person to simply go to a file and read it. The Videofile will provide additional security for intelligence, personnel, and administrative files by recognizing only those input



Clues. Fingerprints can be stored and retrieved by Oracle information system.

requests for information that originate from authorized video monitor locations.

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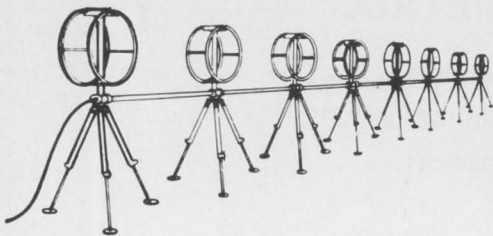
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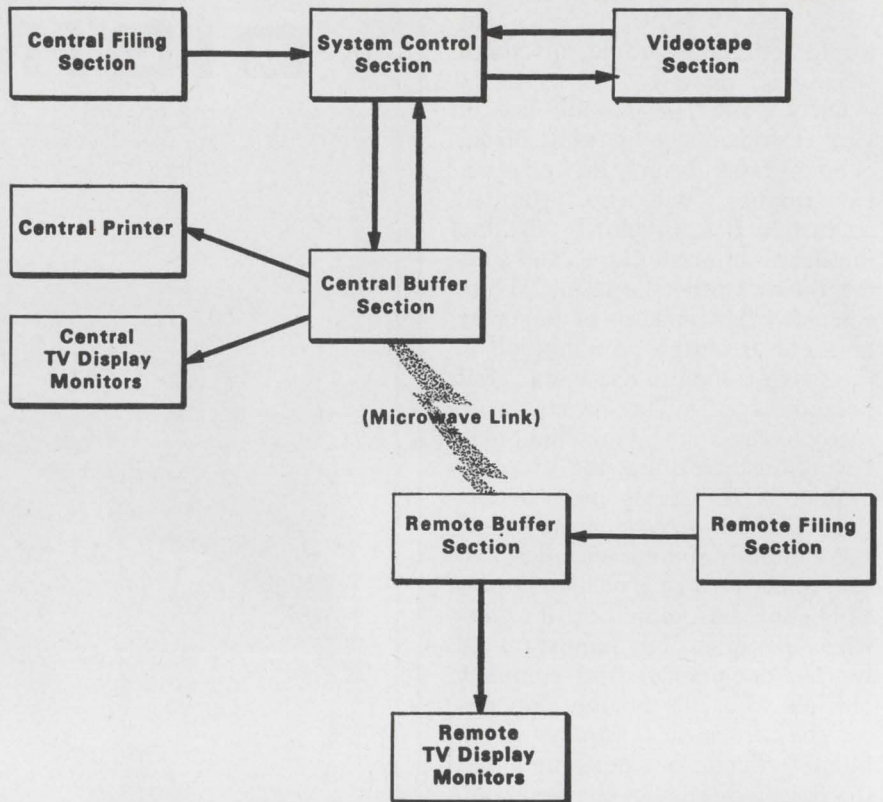
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Modus operandi. Block diagram illustrates how outlying station of the L.A. County Sheriff's Department will file and retrieve records, using Videofile.

White believes that other uses for the system will develop with use. Among them:

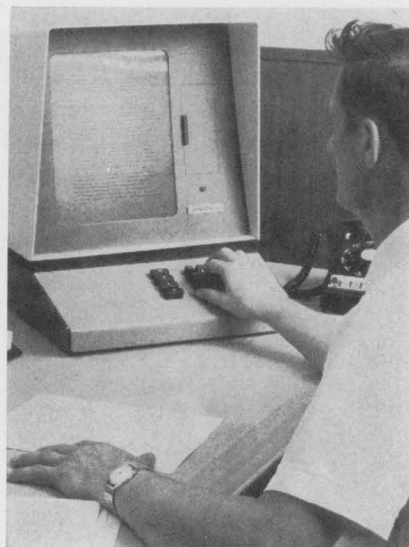
- Quicker identification of criminal suspects by using physical descriptions for composite photographs to retrieve "mug shots" from the file for viewing by the victim on a video display.
- Secure emergency communica-

tions during riots or civil disturbances when normal radio channels can't be used by using the system to display simple coded messages to and from outlying stations.

▪ Rapid filing of photograph negatives without making prints; reversing polarity on the video screen would permit immediate viewing.

Los Angeles County Sheriff Peter J. Pitchess says two additional stations will be added to the system in 1972. He predicts that Oracle will ultimately be expanded to include the courts as well as other local, state, and Federal agencies. Right now, other Los Angeles county departments are interested in the sheriff's installation. "But it may be that for a straight archival job the Videofile would be too expensive," says White. "It will, however, meet our special needs for a high-resolution, quick retrieval system."

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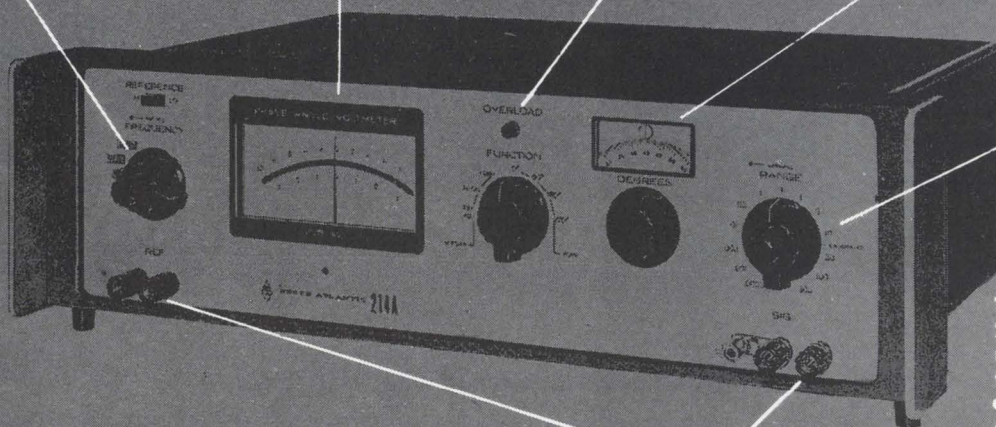
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EE's—names to conjure with

To keep their engineering and managerial talent happy, or at least content, electronics concerns devise elaborate series of job titles and hierarchies

By Peter J. Schuyten

Staff writer

New corporate status symbols—executive washrooms, reserved parking spaces, and dining room privileges are among the better known—are getting harder to come by. But Martin-Marietta may just have one—an executive barbershop. Top engineers and managers at the company's Orlando, Fla., plant have to pay for a clipping, but they have the satisfaction of knowing that their success becomes more visible with every snip of the shears.

Few electronics or aerospace companies have gone to the same lengths to provide their treasured

technical talent with such an obvious reminder of having made it. Nevertheless, most have taken the problem at least tacitly into consideration, devising ingenious series of job titles to cover their work forces.

This ploy is, however, not without problems. Many personnel experts admit the difficulties are akin to those involved with more obvious perquisites. Recognizing merit without offending the rest of the workaday engineering staff is a very tricky proposition. Further complicating matters is the fact that no two firms use pre-

cisely the same system of callouts. What at one company is a top technical slot spot, say senior engineer, might at another be simply the third of seven rungs on the corporate ladder as it is at the Lockheed Missile & Space Co. in Sunnyvale, Calif.

Moreover, an engineer cannot easily determine the status of colleagues at rival concerns. While technology, marketing, and even production facilities may be strikingly similar throughout, job titles are a very mixed bag indeed. It's especially tough on the personnel director who must decipher and

Bustle and a Peck

Many electronics companies, particularly the larger ones, are structured to the point where an engineer—no matter how brilliant or imaginative—must dance to the tune piped by the personnel department. At the same time, however, there's usually at least one story at these same concerns about the engineer who couldn't or wouldn't be stopped by formal guidelines on his way to management.

David B. Peck, now a vice president of planning and development at the Sprague Electric Co—a free-form sort of firm—offers a case in point. During his 25-year career there, he's held 10 different positions. And although he followed a dog-leg path to his present spot, Peck maintains that each one of the nine other jobs has proved valuable to everything he does in the tenth.

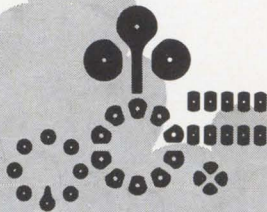
Starting out as an engineer, Peck proved adept at writing his own patents and soon became a patent engineer—a spot where he got his first management exposure.

In succession, Peck's next jobs were: chief services engineer, an administrative post in the company's research labs; contract administrator, where he prepared R&D proposals and negotiated and supervised the work; manager for new product development, more of a technical than an administrative assignment; chief engineer for electrolytic capacitors, a job that combined both technical and administrative responsibilities; and manager of the Special Products division.

At this point, Peck joined upper management, becoming vice president for special products and later vice president for engineering, subsequently moving on to his current spot. "Even though my present job is mainly administrative, I still do creative things involving new products and new concepts," he says. As for his next job, Peck says: "Maybe one of these days I'll find something I can do well and settle down."

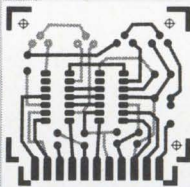


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interpret the entries on a prospective employee's resume to determine his qualifications.

Blanket coverage

There are of course, exceptions. A number of organizations, notably research laboratories, deliberately avoid visible trappings, using but one working title for the entire engineering force—member of the technical staff (MTS). A spokesman at RCA Laboratories, where this policy is practiced, says that engineers, especially those engaged in pure research work prefer not to compete for job titles. As a rule, he claims, they're willing to stake their professional prestige on achievement. The rewards, he adds, center largely on salary and publication of technical papers.

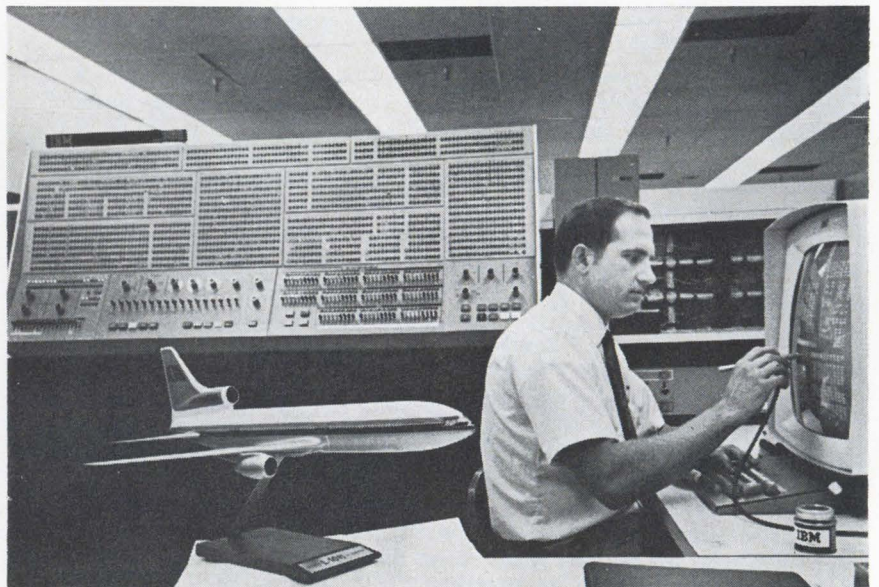
A source at Bell Telephone Laboratories, which also uses the MTS system, points out that companies prefer going this route when possible because it's easier to keep track of everybody. "And nobody's nose gets out of joint," he says.

The Mitre Corp., an Air Force affiliate in Bedford, Mass., is another firm that uses the MTS designations. However, a fledgling engineer signing on with the firm passes through two preliminary positions. Successively he's a technical aide and technical assistant before becoming a member of the technical staff; the process can take as long as five years to complete.

To the letter. The Watkins-Johnson Co., a Palo Alto, Calif., producer of microwave IC's, tuners, receivers, and instrumentation, has added a slightly different wrinkle to the MTS gambit. Every one of the company's engineers is a member of the technical staff. But there's a tagline—a letter from A to E—which designates not only the engineer's responsibility but also his salary range and, to some extent, his experience. Thus, a Watkins-Johnson MTS in the A grade would have the same responsibilities and make about as much as a junior engineer at a larger firm.

"The whole point of the set-up is to allow us as much flexibility as possible without at the same time demoralizing our staff by flaunting promotions," says a source.

Flexibility tends to be a function of size. As a rule, larger concerns are relatively more hidebound than smaller ones like Watkins-Johnson. However, the large firms generally offer the assurance of steady promotions based on seniority. In addition, there are what might be called two distinct ladders to the top—one for management and one for technical personnel. In theory at least, the engineer who wishes to stay strictly on the technical side can do so without losing the high salaries and prestige that usually are associated with management. "Let's face it," says a source at a large aerospace company. "A lot



Structured. At Lockheed, engineers' careers follow well-plotted paths; there are paths to the top on both the technical and managerial sides.

Separate paths

Most technology concerns have devised separate hierarchies for engineers and managers. Among the more representative is the Lockheed Missile & Space Co. of Sunnyvale, Calif. As is the case with many other firms, a beginner usually spends several years in a strictly engineering capacity before a decision is made as to which road he will follow. Graduate EE's start with the title of associate engineer, a level at which they're little more than apprentices or interns, according to a Lockheed source. From there, they progress to engineer and to senior engineer—a process that may take as long as six years.

At Lockheed, a senior engineer is considered a real journeyman capable of planning and working on major systems. In rare cases, he might even run an entire test program. As a rule, however, this kind of work is handled by the engineering specialist—the next position in the structure. Referred to by their specialties—for example, reliability engineering specialist or research engineering specialist—these men have about nine years experience and earn between \$12,000 and \$17,000 a year. This is a pinnacle, or leveling-off point, for most engineers. But it can also represent a way station for those going into management.

The first step along the management path is group leader. Supervisors in this category are responsible for between 12 and 15 people and make anywhere from \$13,000 to \$23,000 depending on the complexity and importance of the project. Department manager is the next rung at Lockheed; the engineer/manager heads a staff of 100 or more and earns as much as \$28,600. The top spot in the line is manager; responsibilities and authority vary with the importance and scope of the project as do salaries which range from \$18,700 to \$31,900.

Technical side. For the man who wants to stay in engineering the first step after engineering specialist is staff engineer—"a job that rates an office." Pay scales correspond to those for a group leader. Senior staff engineer is the next stop. Senior staffers are considered more expert in their area and report to a higher level of management than their staff colleagues. Salaries run as high as \$25,000.

At the highest levels on the technical side at Lockheed are the consulting engineer and senior consulting engineer; the top salary for the latter is \$32,000—about equal to wages for the top job on the management side. Men in this group usually hold Ph.D.'s.

of engineers either are not cut out for or don't want to go into management. But we've still got to give them some kind of incentive."

Separate tables

More often than not, however, there's a gap between theory and practice. An engineering manager at a medium-sized instrument maker with a dual title structure sums things up this way: "We preach separate but parallel, without always practicing it. While the salary range for so-called parallel positions may be the same, the boys in management somehow always seem to be at the high end of the range. The engineers are usually in the middle."

One good index of corporate flexibility is how frequently, if at all, engineers skip a rung on the hierarchical ladder. At Martin-Marietta, for example, neither technical nor managerial personnel can skip

a grade. The only way around this is for an engineer to leave for a job at another company and return at a higher level. However, says a company source, this has a negative effect on the morale of those "who are loyal and stay. It almost looks like a reward for cutting out; the practice is discouraged as much as possible." Incidents at Martin are relatively infrequent because it is the only company of its kind in Orlando, and an engineer seeking this kind of leap-frog advancement must be willing to go to the trouble of moving out of town and then back again.

Random action. At the other end of the spectrum are companies like the Sprague Electric Co. in North Adams, Mass., Keithley Instruments Inc., in Cleveland, and the Scam Instrument Corp. in Skokie, Ill., where skipping rungs is permitted and even encouraged. A Sprague source says: "A guy can

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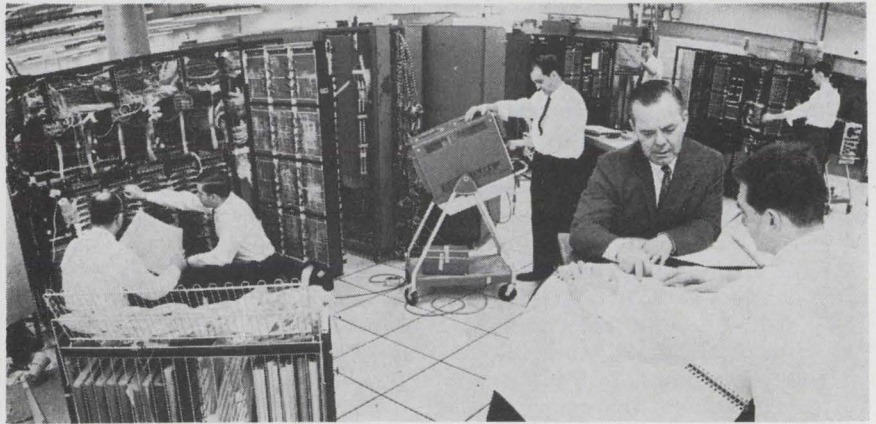
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sure as hell skip rungs on the way up; it's fairly common. Although we're a big company, we try to operate with the flexibility of a small one." In fact, Sprague, according to this man, has no formal rationale for its title scheme. Instead, procedures have developed haphazardly. "We've just never gotten around to sitting down and drawing up a chart," he says.

But one problem seems to crop up regularly in the case of engineers moving from one company to another. Often, they're not satisfied with new titles simply because they carried little, if any, status on the premises of their erstwhile employers.

Robert Bradley, vice president for engineering at Scam Instrument says, "Our hardest problem is relating our title structure to an engineer moving over from another company. We try to explain that

there are good opportunities at Scam, but engineers seem much more conscious of such details today—probably because titles are so marketable."

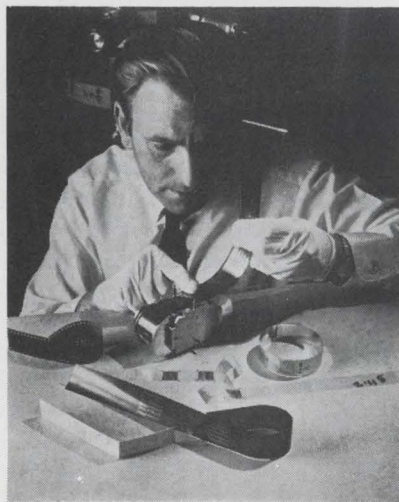
Send money

Most firms won't invent titles to satisfy newcomers. At least one company, however, has been known to hang the title systems engineer on recent arrivals frequently enough to defy the laws of chance. "It's an easy way to keep people at a company," says a personnel man.

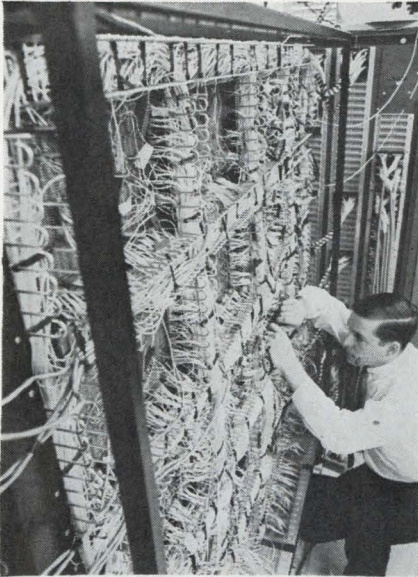
Another approach is outlined by a source at Litton's Data Systems division: "Generally we just use money. I can only recall four occasions in the past 10 years where we wanted a guy so badly that we dreamed up a phony title to get him."

Similar in kind is the problem encountered by firms bringing supervisory people from the outside. But here the difficulty is not so much in satisfying the newcomer with a title or money as it is keeping the people who'll work for him happy.

Lockheed-Georgia, for example, tries to maintain a policy of promoting from within by training back-up people for each supervisory engineering position. But it's sometimes faced with a situation where it has to bring in a new man. In such cases, the firm usually starts him off in a technical spot more or less equivalent to the supervisory job he will eventually fill. The idea is for him to absorb Lockheed procedures and methods, subsequently being transferred lat-



Rewards. Westinghouse is another firm with a fellowship program for engineers.



E pluribus. There have been only 36 IBM Fellows since the company began.

terally to the management side.

Hail fellow. Then, there are companies which reserve special titles for outstanding engineers. Perhaps the best-known example is the IBM Fellow. Appointed by the chairman of the board, an IBM Fellow is given total freedom to do such research as he pleases. The appointment is for a five-year period but can be renewed. The objective is to recognize outstanding achievements. But there's a practical aspect as well; the company believes that freeing exceptional engineers from supervisory restraints increases their productivity. There have only been 36 Fellows in the history of the company.

Other firms using the title fellow include RCA, Westinghouse, and Mitre. In the case of the latter concern, the designation is for an engineer who is on a leave of absence to continue his education and not for exceptional merit. Although it doesn't use the title fellow, Litton Data Systems also honors exceptional engineering merit with a title source at Litton says is roughly the equivalent—member of the senior technical staff. According to one company source, "These are people who are used internally as across-the-board consultants in their particular specialty."

Martin-Marietta also has a similar honor called principle staff engineer; only a dozen or so of 2,600 people at the company are accorded this honor. ■

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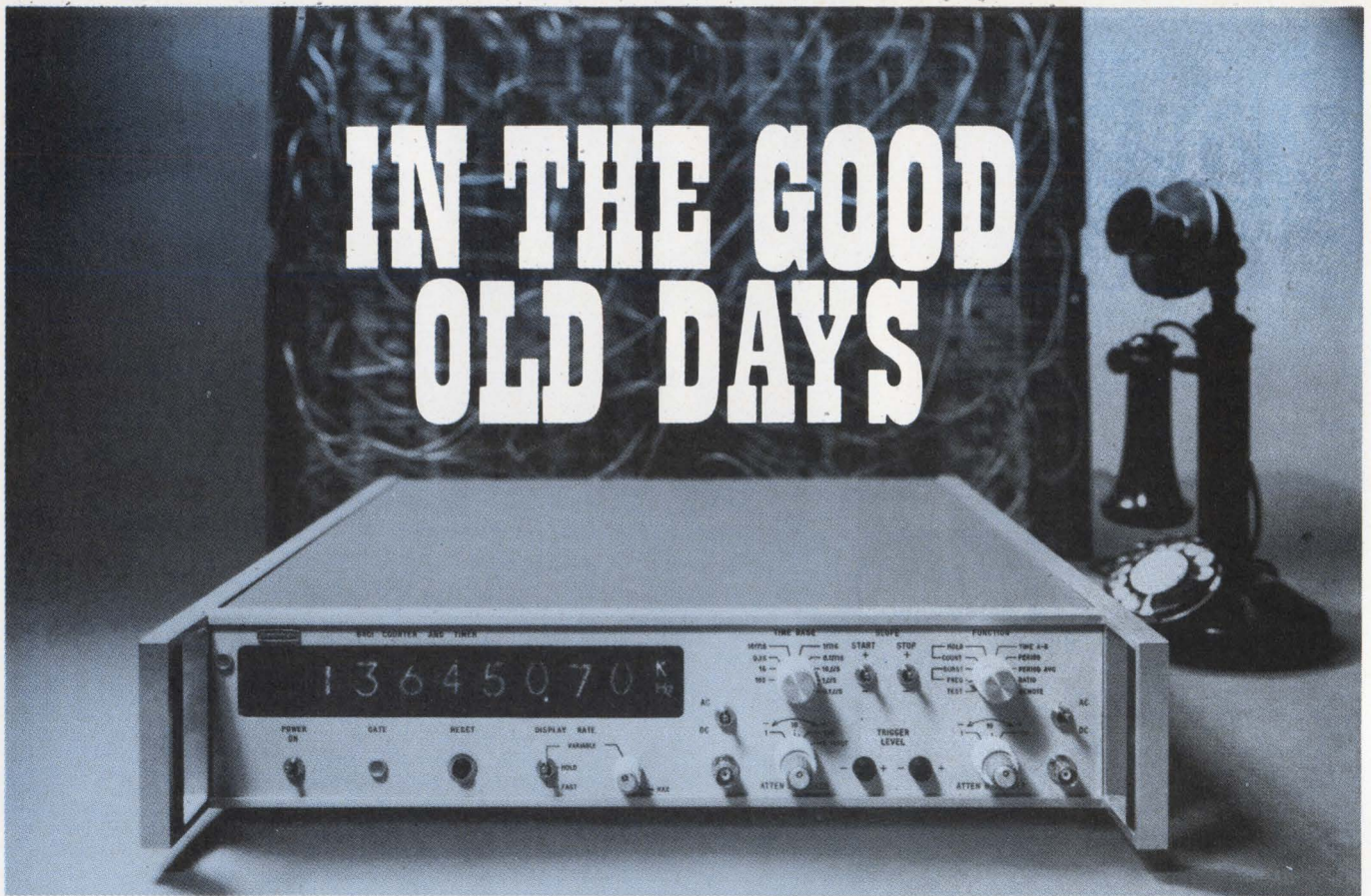
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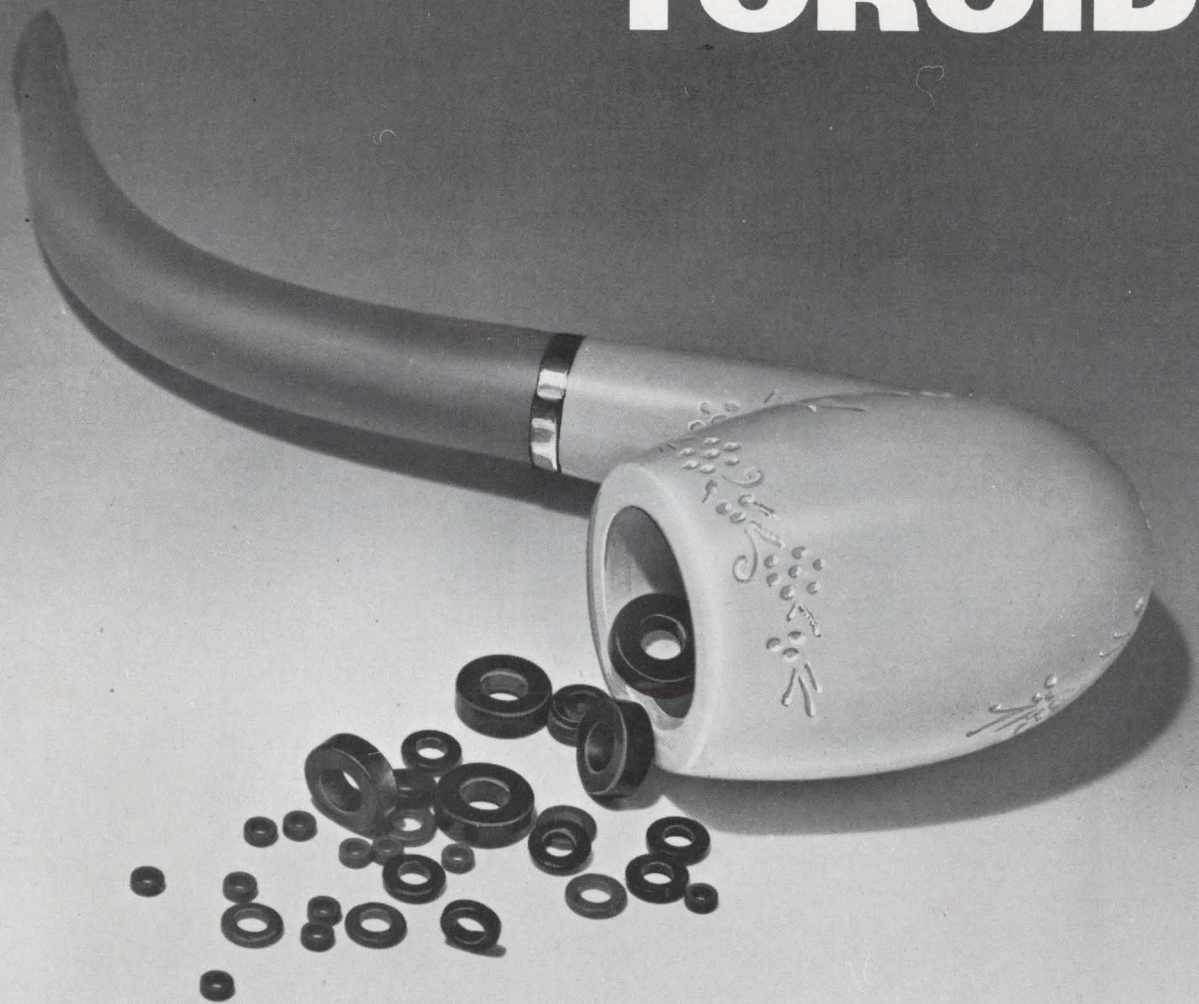
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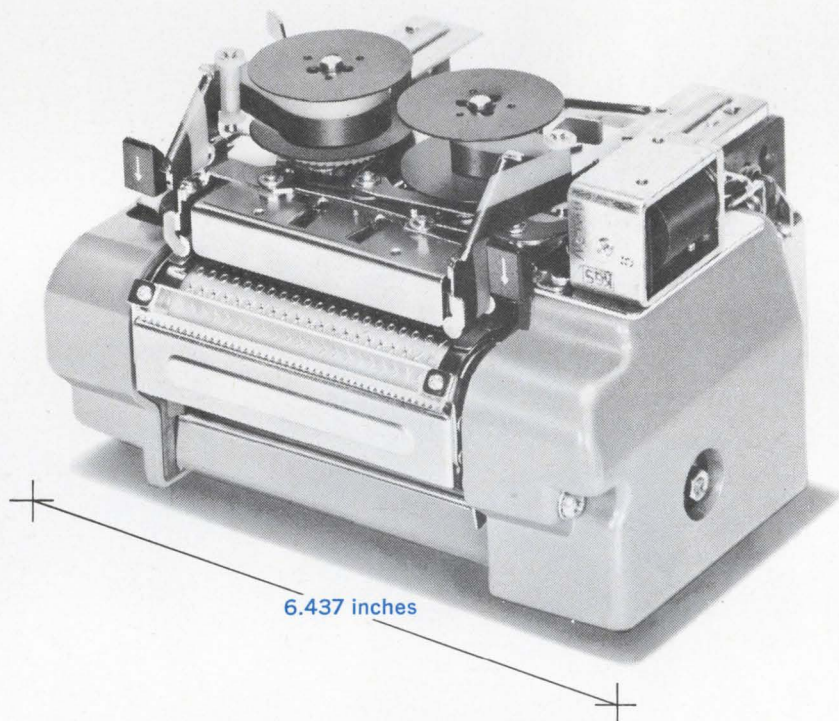


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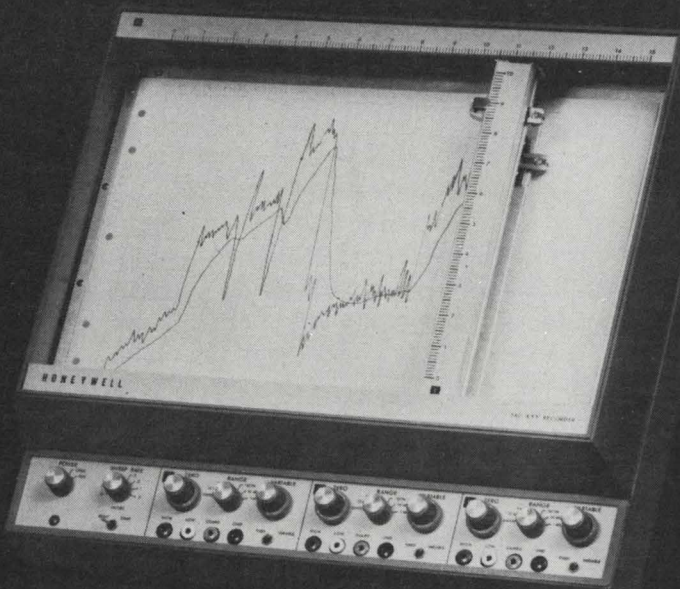
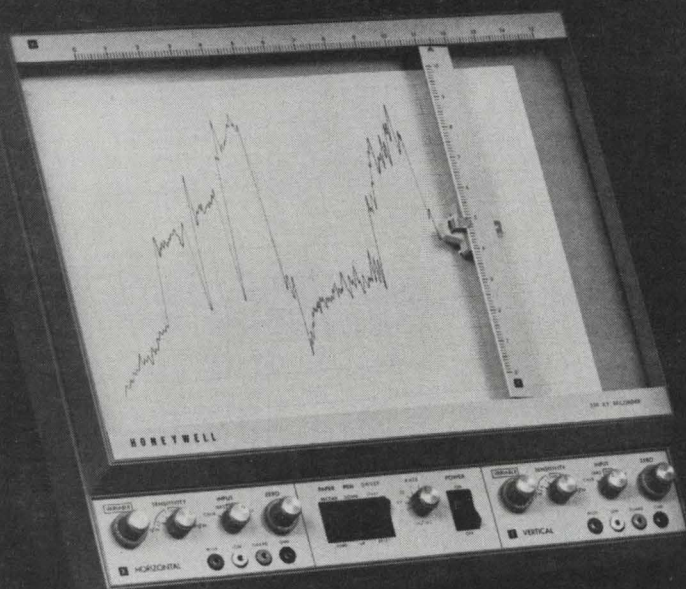
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For more information on either of these new X-Y recorders, write or call (collect) Roy Washburn, 303-771-4700, Honeywell Test Instruments Division, P.O. Box 5227, Denver, Colorado 80217.

Honeywell



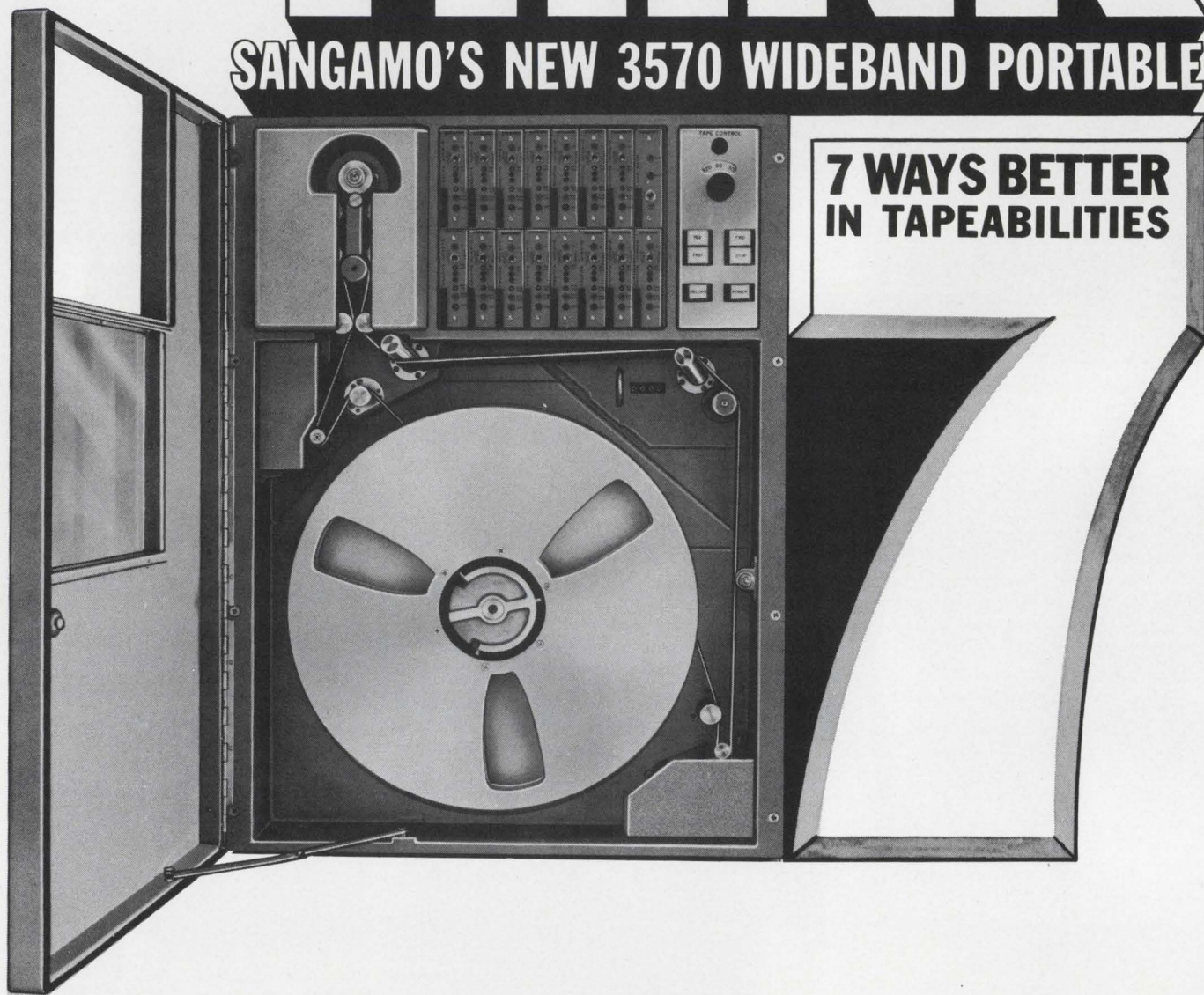
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Most tapeability per dollar!

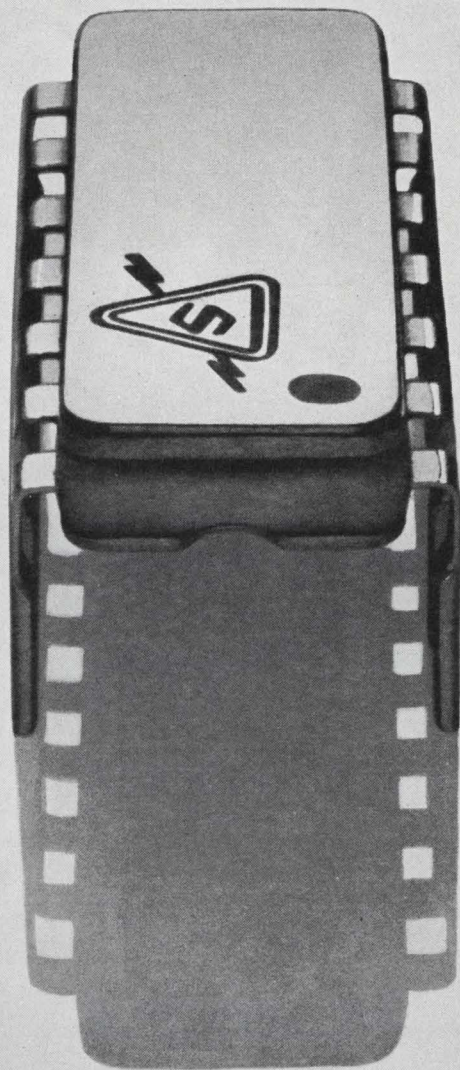
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DS69-2



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Model 4301



Model 4310



Model 4304

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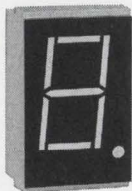
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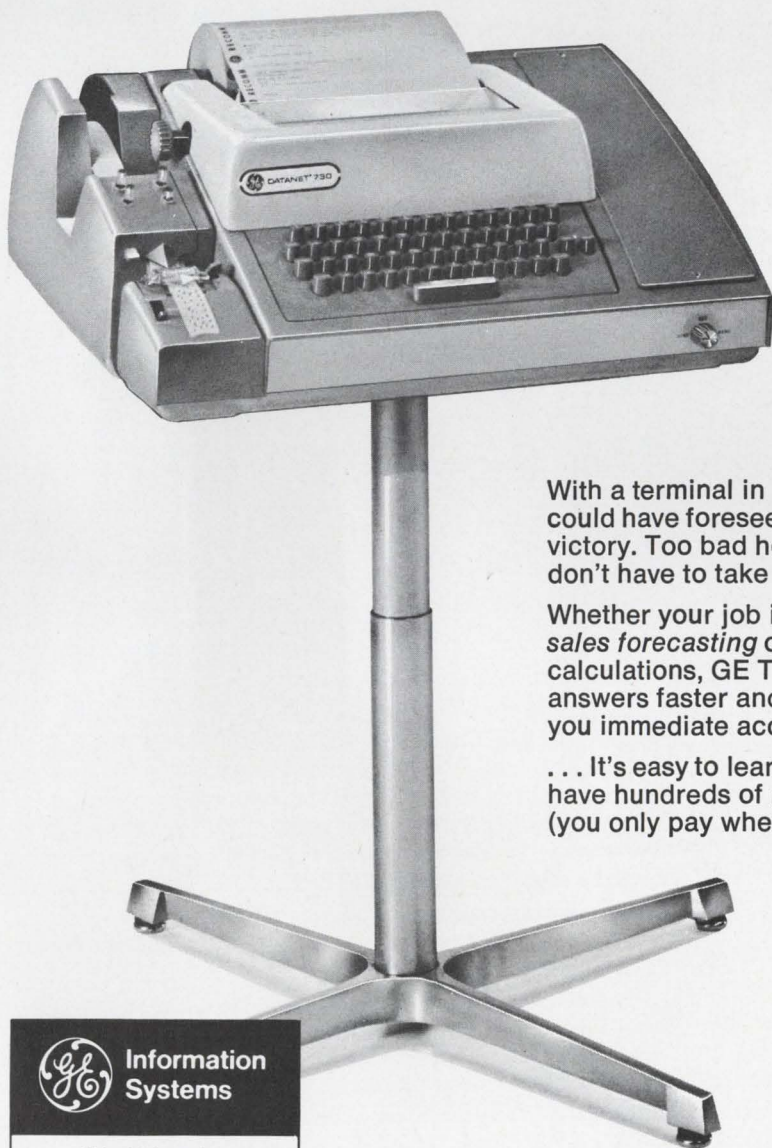
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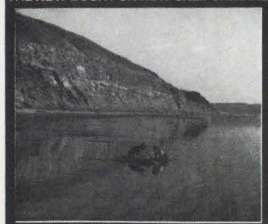
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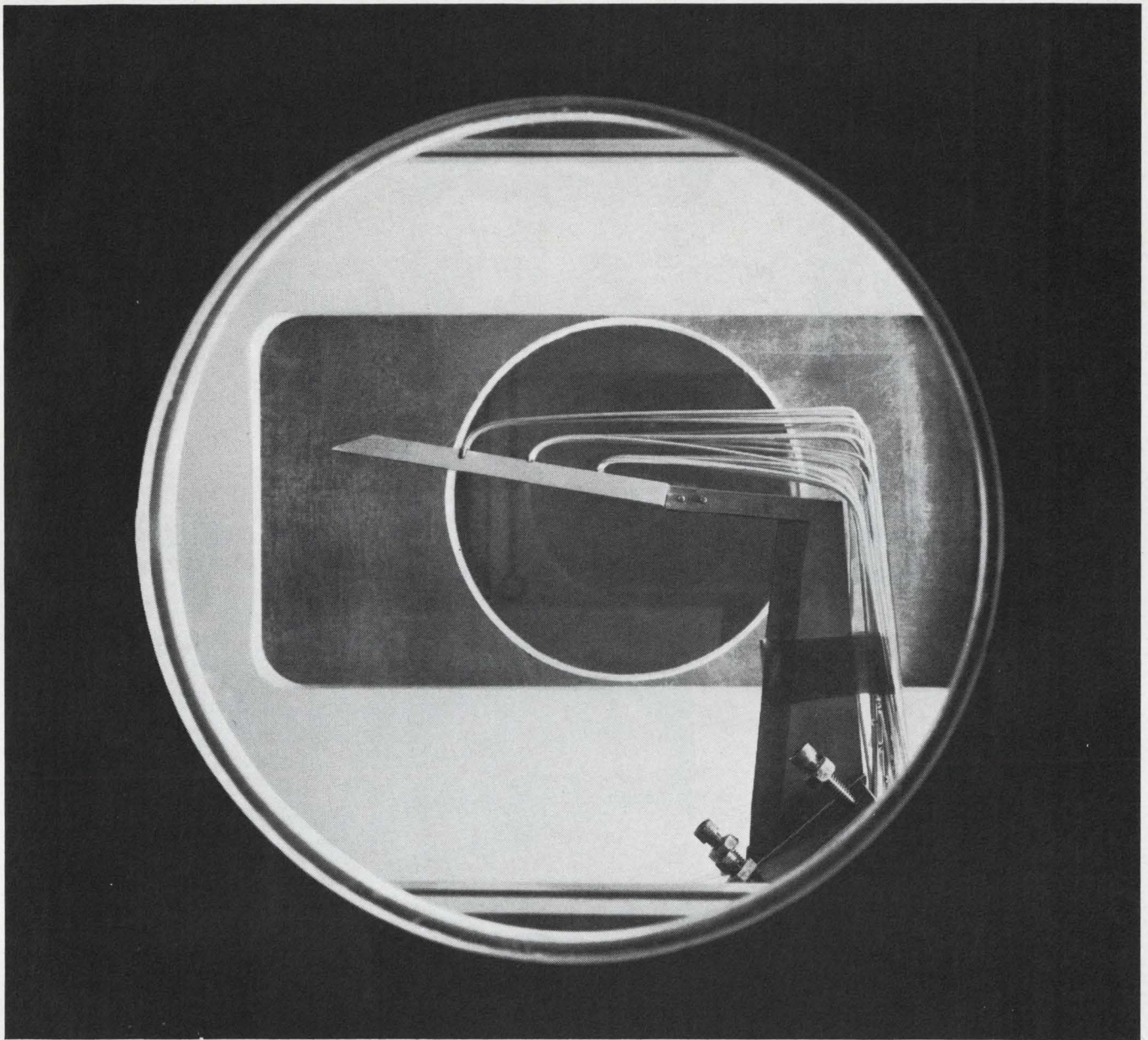
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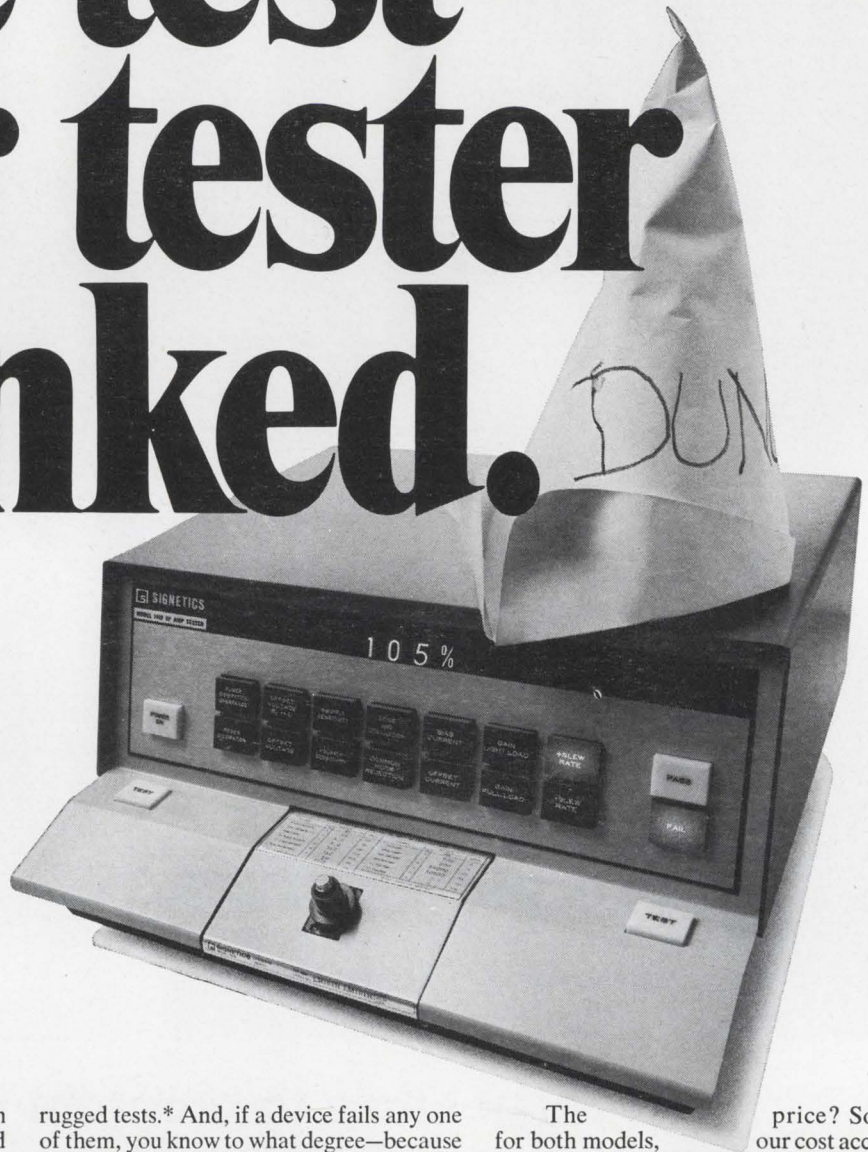
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Like the 1410, our 1420 is a snap to operate. You simply insert a program board, and push a button marked "test." Blink, blink, blink: the machine runs through 14

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Please, please do it.

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*The fearsome fourteen... 1) power consumption over-range (greater than 200%), 2) power consumption (less than 200%), 3) offset voltage (source resistance zero ohms), 4) offset voltage (source resistance programmed), 5) + supply sensitivity, 6) - supply sensitivity, 7) common mode rejection, 8) bias current, 9) offset current, 10) gain (programmed light load), 11) gain (programmed heavy load), 12) noise, oscillation, 13) + slew rate, 14) - slew rate.

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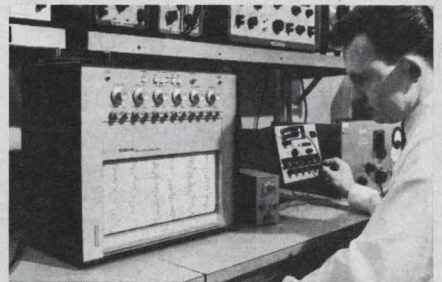
You can forget about recalibration problems, too. We took care of that little nuisance at the factory. So change those settings to your heart's delight. The Mark 260 will keep right up with you. And save you piles of time and piles of chart paper in the bargain.

That's what you get with a Mark 260. It's the go-anywhere, do-anything 6-channel recorder by Brush. At a price per channel that will surprise you.

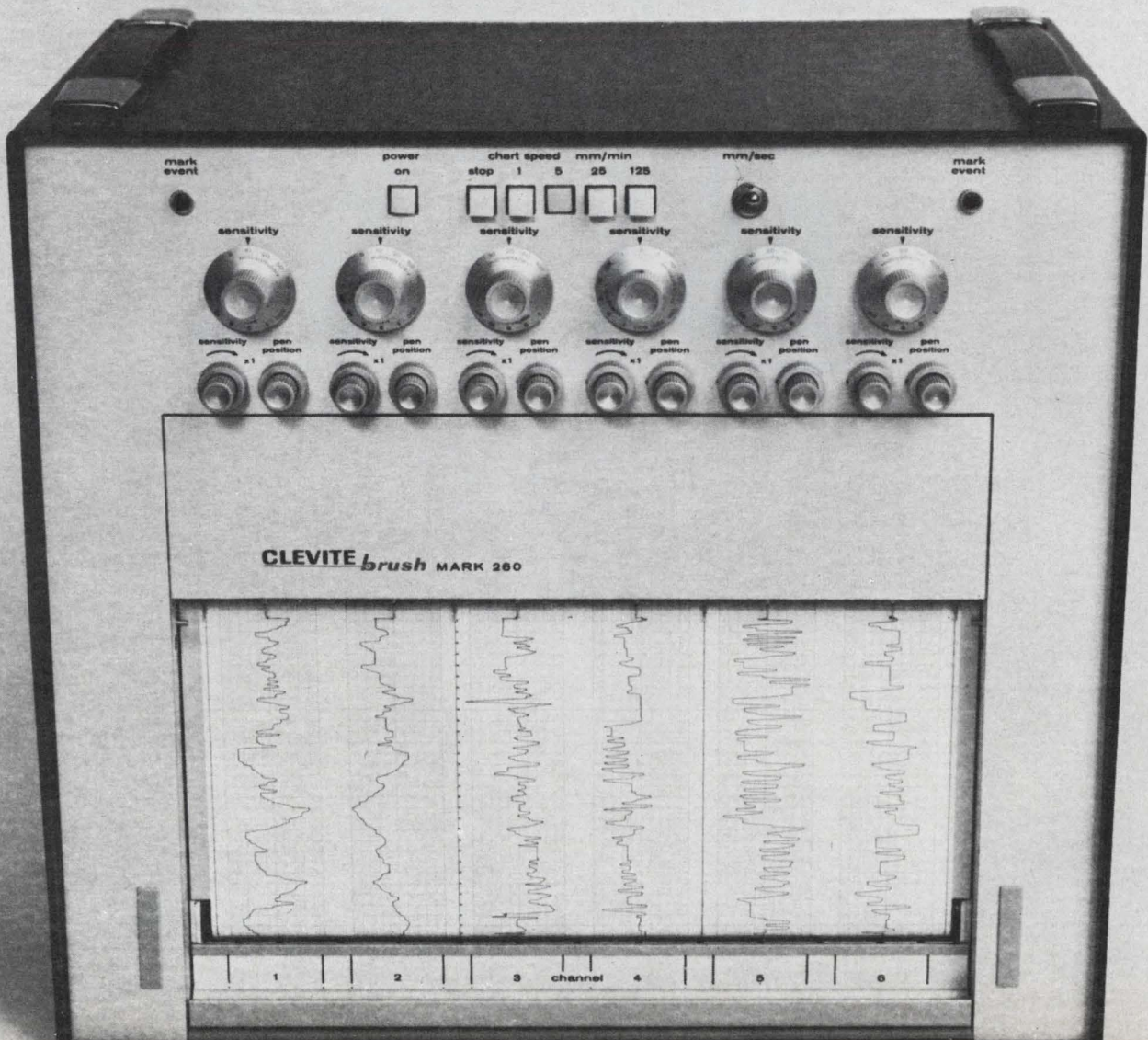
More facts. Less fuss, bother and cost.

Ask your Brush representative for a demonstration. Or write for Mark 260

Bulletin 942-2: Clevite Corporation, Brush Instruments Division, 37th and Perkins, Cleveland, Ohio 44114. We'll include one of the most comprehensive handbooks on signal conditioning you'll ever find.

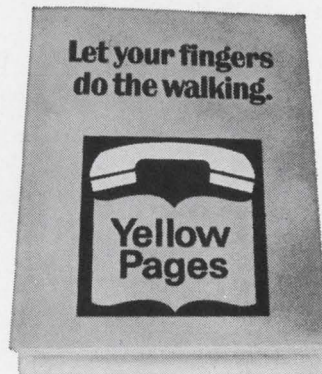


CLEVITE BRUSH



Marketing axiom number 1:


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Chances are you or somebody in your company uses the Yellow Pages regularly to buy supplies or services you need to do business. A study of just manufacturing firms alone proved 9 out of 10 buyers do. That's why the Yellow Pages is such a good place to reach business prospects with *your own* advertising. Sell where you buy. It's good business.

For electrical contacts, as in medicine,

It pays to go to a specialist

An illustration of a surgical team in an operating room. Several surgeons wearing masks and caps are gathered around a patient. One surgeon in the foreground is using surgical instruments. The scene is lit by a large overhead light fixture with multiple circular lamps.

A major operation requires a whole team of specialists. So too, it takes a team of specialists to design contacts. Configuration, materials, electrical performance, contact design and manufacture is complex. That's why Deringer believes it takes 100% concentrated effort to give our customers the best in electrical contacts, contact sub-assemblies and assemblies. Let Deringer be the doctor. Contact us today. We'll send one of our contact specialists right away.

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- Binary counters . . . 16-channel sequential/random access multiplexer . . . 1024-bit dynamic read-only memory, programmed to your bit pattern; off-the-shelf model is a sine look-up table.

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PHILCO 

Device	Description
pL4C07C pL4C07AC(1)	7-stage binary counter 7-stage binary counter
pL4G10C pL4G10AC(2)	Hex 2 input NOR + 2 inverters Hex 2 input NOR + 2 inverters
pL4G11C pL4G11AC(2)	Dual 4 input NOR + dual 5 input NOR Dual 4 input NOR + dual 5 input NOR
pL4G12C pL4G12AC(2)	Dual 9 input NOR Dual 9 input NOR
pL4S16C	16 channel multiplexer
pL5R32C	Dual 8/16-bit shift register
pL5R40C	Dual 20-bit shift register
pL5R100C	Dual 50-bit shift register
pL5R96C	Dual 48-bit shift register
pL5R128C pL5R128AC(3)	Dual 64-bit shift register Dual 64-bit shift register
pL5R250C pL5R250AC(3)	250-bit shift register 250-bit shift register
pL5R256C pL5R256AC(3)	256-bit shift register 256-bit shift register
pM1024C	1024-bit read-only memory

(1) Clock rate 500KHz (2) Clock rate 2MHz
(3) Clock rate 5MHz

If all systems aren't "GO"
after the computer's moved,
you know who's going to hear about it.

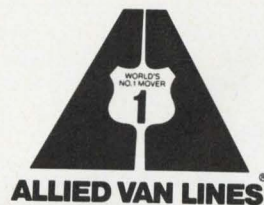


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Circle 159 on reader service card

You're Invited.....

Dear Sir :

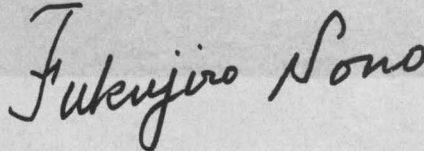
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We invite you to more closely examine TDK ferrites and other products at booth 5009 at WESCON '69 (from August 19th. through the 22nd.)

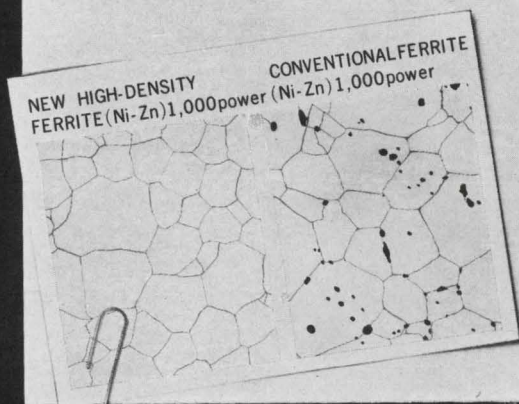
Most sincerely,



Fukujiro Sono

President

TDK ELECTRONICS CO., LTD.



Wescon '69 at the Cow Palace, San Francisco, August 19-22
TDK Booth: 5009, Science Systems and Communications area



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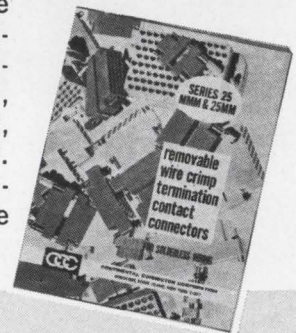
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Choose:

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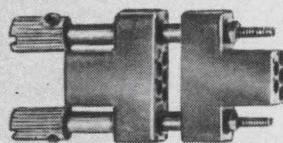
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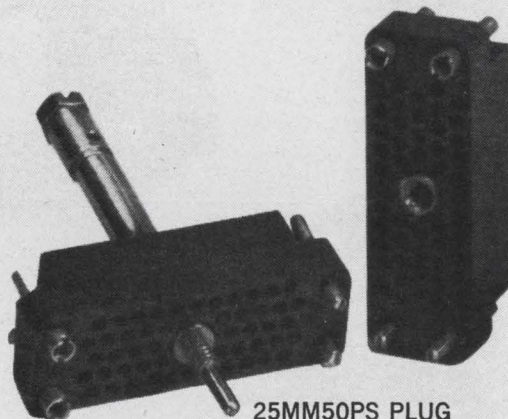


ILLUSTRATIONS ACTUAL SIZE

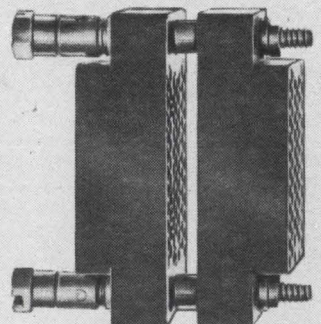
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MMM5PSK PLUG
MMM5SS SOCKET
WITH SCREWLOCKS



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CENTER SCREWLOCK



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Scopes to take product spotlight when curtain lifts for Wescon '69

Tektronix stresses improved readout, flexibility in new line; H-P unveils high-frequency model; Philips features low drift; Monsanto planning entry

It looks like the year of the oscilloscope. And nowhere will that be more evident than at the Cow Palace in San Francisco where Wescon will be held Aug. 19-22.

Tektronix Inc. will display a complete new family of scopes; the Hewlett-Packard Co., moving into the high-frequency end of the business, will show its 250-megahertz model [*Electronics*, July 7, p. 90]; Philips will exhibit a low-drift scope; and the Monsanto Company will talk about its entry into the commercial-oscilloscope business later this year.

The ubiquitous Tektronix type 545 oscilloscope, which is to be found at enough laboratory benches and test stations to make the company's rivals gnash their teeth with frustration, is about to become obsolete. In fact the whole line of Tektronix scopes, under development since the early 1950's, will be succeeded late this year by two new series that embody a redesign from the component level up. The new series, with plug-ins and ancillary gear, fall into four groups:

- The top-of-the-line 7000 series, including two mainframes and four horizontal and eight vertical plug-ins;

- The non-plug-in series 5000, embodied initially in a low-frequency (1 megahertz), dual-beam unit dubbed the R5030;

- Two cameras, the C-50 and C-51, which automatically select the proper shutter speed and f number for a given ASA film speed and scope luminance;

- Two probes—the 10X P6053, with a rise time of 1.2 nanoseconds or less, designed primarily for the 7000 series; and the slower, dual

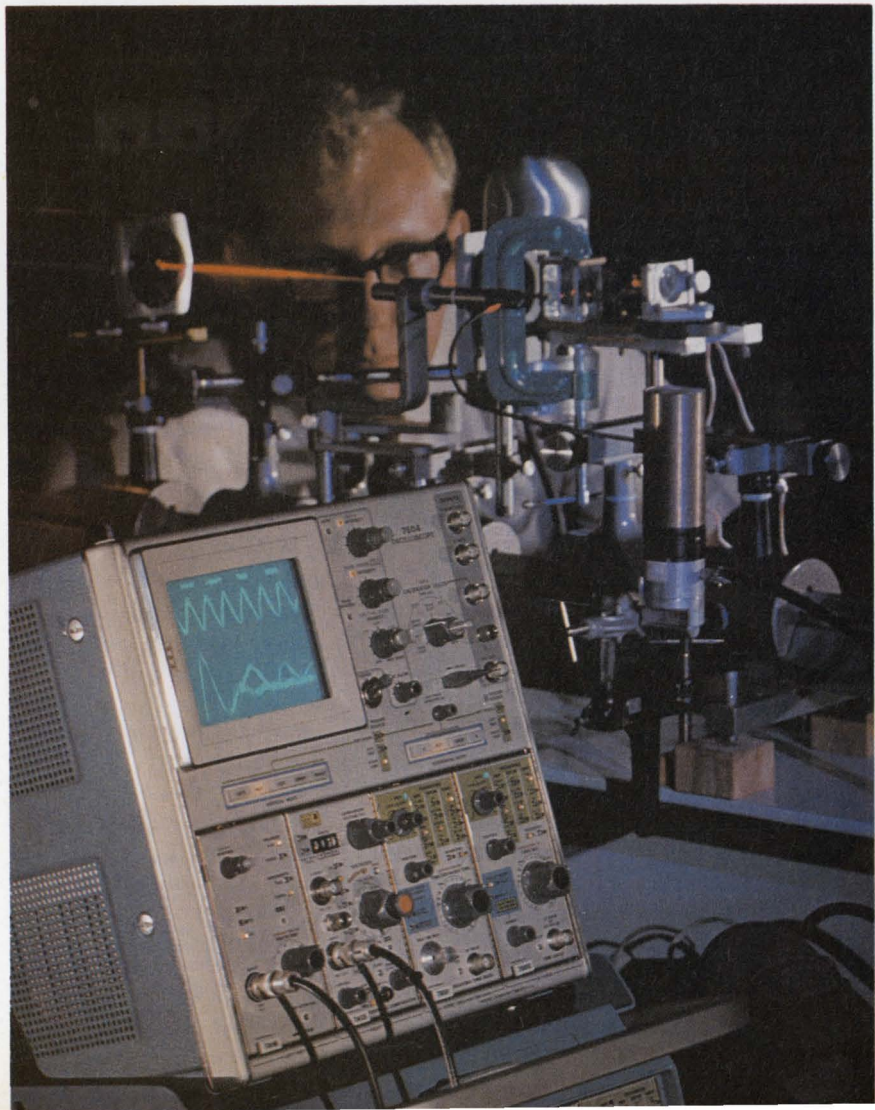
attenuation (X1 and X10) P6052, designed primarily for low-frequency scopes.

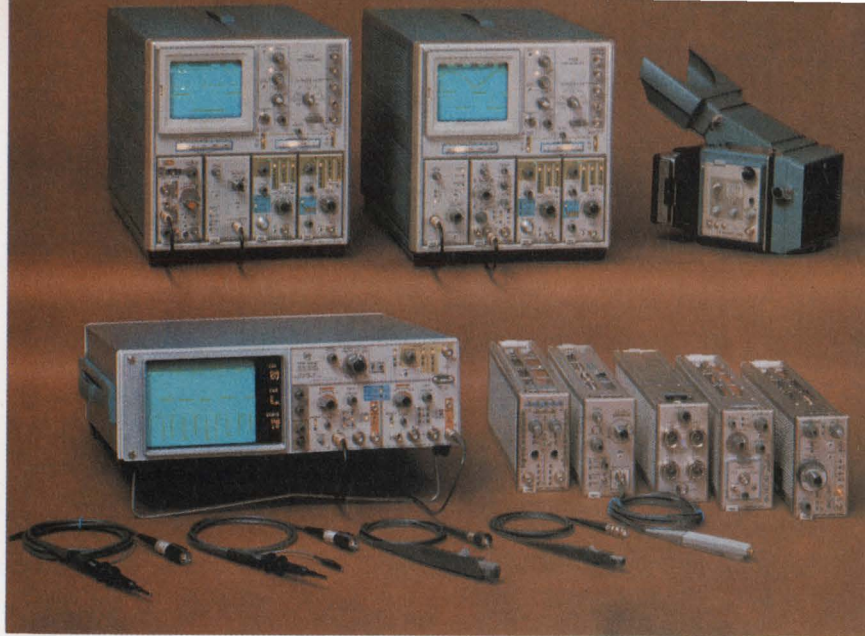
The top model, the 7704, will sell for \$2,500; the 7504, \$2,000; and the R5030, \$1,850.

All of the new mainframes provide parameter readout, so that Polaroid photos will carry their

own calibration. The 5030 has the same type of fiber optic readout that Tektronix introduced last fall in the type 576 curve tracer [*Electronics*, Oct. 28, 1968 p. 149]. The 7000 series mainframes have a time-shared cathode ray tube that can display two traces and put the parameters at the top of the screen

Experiment on display. Tektronix 7504 oscilloscope displays two traces during an experiment in light modulation at Pacific University.





Family gathering. The new line of Tektronix scopes includes two mainframes, plug-ins, cameras, and probes.

as well for the viewer.

New meaning. With the series, Tektronix introduces a new kind of catalog code, in which every number refers to a characteristic of the instrument. In the 7704 mainframe, for instance, the first digit notes that the scope accepts plug-ins, the second refers to vertical bandwidth (150 megahertz; the number 7 covers 150-300 Mhz), the third to special features and the fourth to the plug-in compartments.

In fact, Tektronix has gone to great lengths to code the instruments for easier understanding and use. The front panel is color-coded: salmon refers to current functions, grey to voltage, green to triggering, blue to mode, red to variables, and yellow to special functions.

The new scopes do not offer any spectacular improvement in performance. "Our biggest objective was to incorporate a number of new ideas that we couldn't put into the old series," says Oliver Dalton, manager of the conventional instruments group. Readout was one of those ideas; even more important was system flexibility. "Previous instruments had only one plug-in hole in the y axis," says Dalton. "Also, dual-trace scopes are big sellers, but the customer had only one or two dual-trace amplifiers. Now he has a complete choice of a combination of instruments, with current and voltage plug-ins, high speed, and increased sensitivity."

Some of the new instruments

outperform the old ones, but these improvements were part of a natural progression, Dalton says. Tektronix could not advance too fast and still serve its existing market, for which the present instrument line is obsolescent. The new instruments are generally the top end of a new line. "Functionally," Dalton says, "they replace all but the storage scope—but because of their relatively high price, they replace only the top of the line. In the future, we will place emphasis in three main areas: low price, new measurement capability (or the ability to make measurements easier), and higher performance."

Easy to use. The R5030 is a low-frequency instrument, but its features are in some ways as remarkable as those of its stablemates. It is a high-sensitivity (10 microvolt) scope designed for use by technicians not familiar with electronics—in mechanical and biomedical fields, for instance. The design goals were maximum display area and ease of operation, says Russ Fillinger, head of the group that designed it.

Because the scope operates at only 1 Mhz, Tektronix was able to use a big crt; it measures 6½ inches diagonally, and the graticule divisions are 1.27 centimeters wide, versus 1 cm on most scopes. Almost 50% of the usable area of the R5030's front panel is taken up by the crt face. "How many volts it takes to move the beam across

the face in a given amount of time is mostly a matter of power," Fillinger says. "I can find transistors that can swing a large number of volts; the 5030 takes 250 volts, side to side. At higher frequencies, we would have to do the same job with 50 volts."

More important to users not trained in electronics is the fact that the 5030 is triggered automatically. A peak-to-peak trigger circuit senses plus and minus excursions of the waveform and sets a level control at the same range. The circuit will trigger on either positive or negative slopes. A modification of a Schmitt trigger, it is contained in two integrated circuits built by Tektronix.

In house. Half of Tek's manufacturing capacity is now devoted to components, including IC's. The company builds all its own cathode-ray tubes, metal printed front panels, knobs and relays, three kinds of switches—lighted push-buttons, cams for multifunction switching, and a new push-push calibration switch—all printed circuit boards, coils, and special purpose IC's.

For the 7704, it developed a power supply that does not use a bulky iron coil transformer; in addition to saving weight (the unit weighs about 10 pounds, compared to 25 pounds for conventional types), the new power supply operates at 70% efficiency, versus 50% for transformer units.

These home-grown components have given instrument design engineers a great deal of freedom. Logic signals for the plug-ins, for instance, are generated by in-house integrated circuits.

Both series of scopes are designed for ease of use. The R5030, for instance, can operate in a YT mode, where the beam is driven vertically against time, or an XY mode; in the latter mode, all lights go out on the time section of the front panel, indicating that the user no longer has control over the time base. When a current probe is being used, none of the lamps on the grey voltage section of the front panel will light. The probes have identity buttons, so that if more than one is used, the proper trace can be indicated.

Holds the spot. The instrument has automatic focusing, to control

spot size. The focus control and intensity control pots are ganged in opposition on a single shaft; as grid drive increases, and tries to increase spot size, the focus control tries to decrease it, so that the spot size remains constant, while the intensity of the spot may vary.

The 7000 series accepts vertical and horizontal plug-ins on mainframes that contain the power supply, the calibrator, the crt, and the control circuits. Since the internal amplifier is dual channel and electronically switched, the units can combine two vertical channels. It can take a real-time plug-in and a sampling plug-in at the same time. Tektronix anticipates that the two

new mainframes will be the start of a whole new series of instruments; for instance, it will bring out a spectrum analyzer plug-in.

Deflection parameters are displayed by interrupting the trace in bursts of 200 microseconds per character. Characters are generated by five 65-mil square IC's, 10 symbols to a die. Like many Tek IC's, they are totally dissimilar from conventional character generators. Each die has 1,440 emitters that serve as a coordinate system to pick out the eight break-points required to generate a seven-stroke character. To trace out the whole figure, instead of producing a simple eight-dot dis-

play, Tek uses a resistive ladder network connected to the bases of the coordinate-forming transistors. By properly biasing the network, a point of maximum potential can be made to propagate along it, the position of which is controlled by an external scanning voltage.

Truly dual. The two sets of vertical deflection plates give true dual-beam operation, in either an alternating mode, in which the beam makes one sweep for each channel, or a chopped mode, in which one small segment of each channel is traced at a time.

Tektronix, Inc., P.O. Box 500, Beaverton, Ore. 97005 [303]

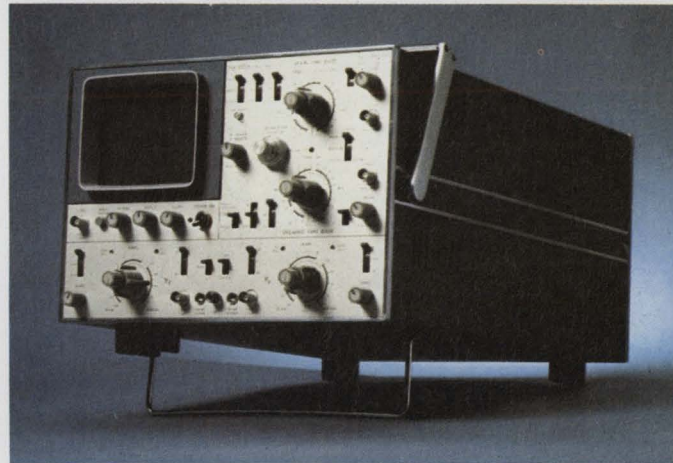
Chopper network fights scope drift

Traces on oscilloscopes are notorious drifters. Turn on a scope, center its trace, and then let the instrument alone. The trace starts moving slowly, usually imperceptibly, up or down until it's finally off the screen. The higher the sensitivity setting, the faster the trace disappears. Besides being annoying, this trace drift is a source of error.

Traces float away because of the drift of the d-c amplifiers that handle the scope's input. No such charge can be lodged against the two d-c amplifiers in the PM 3250, Philips Electronic Instruments' new dual-trace scope. A chopper-controlled network steadies the amplifiers to the point where the scope, according to Philips, is virtually drift free. By "virtually," Philips means that the 3250's traces move no more than a fraction of a millimeter in 24 hours.

Drift is one thing the 3250 can ill afford because of its sensitivity. The maximum is 200 microvolts per centimeter, and with this order of sensitivity any amplifier drift would send the trace flying off-screen.

When its sensitivity is in the μ volt range, the scope has a 5-megahertz bandwidth. If the selected sensitivity is 2 millivolts per cm or poorer, the bandwidth is 50 Mhz.



Steady. Dual-trace scope drifts no more than a fraction of a millimeter in a day, seldom requires adjustments to rebalance amplifiers.

Drift varies with sensitivity. When the scope user picks 200 μ volts, the trace drifts 1 mm in 24 hours. When the setting is 2 mv, the daily drift is 0.5 mm.

Because of its low drift, the 3250 doesn't need any screwdriver adjustments for amplifier balancing. Another control it doesn't have is "Astigmatism;" it's not needed because Philips engineers made sure that when the user changes the beam intensity, he doesn't throw it out of focus too.

Fans are not found in the 3250 either. The scope, since it draws only 50 watts, can cool itself by convection. Credit for the low power drain goes to field effect transistors and integrated circuits

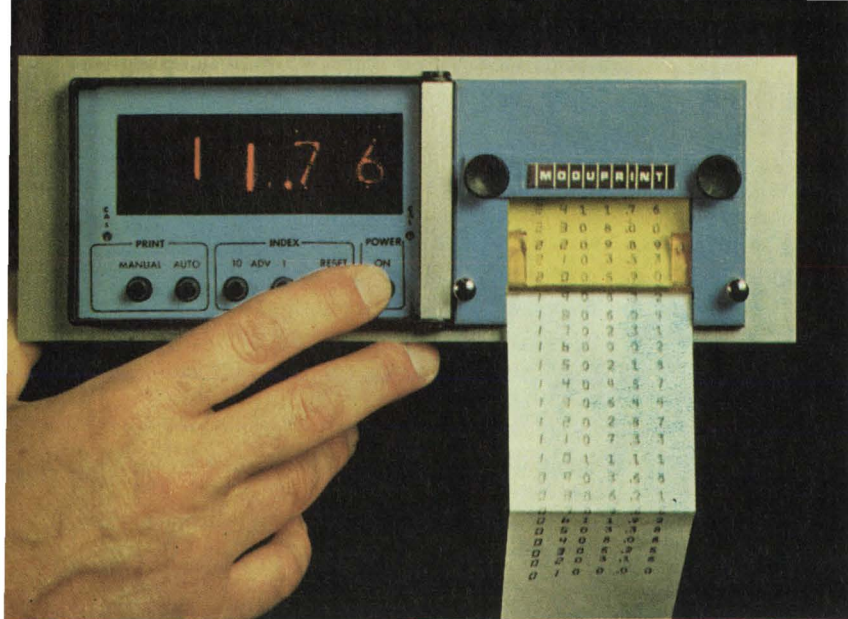
used in the scope.

"Where other people are still using transistors, we have IC's," says a Philips engineer, "and all the inputs have FET's."

A printed-circuit delay line applies a 50-nanosecond delay to input signals instead of the 160-nsec delay used in earlier vhf oscilloscope circuits. The shorter delay means that pulse leading edges can be displayed with minimum distortion.

The 3250's price is \$2,175. A few dozen scopes will be available this year, but delivery of large orders won't begin until January 1970.

Philips Electronic Instruments, 750 South Fulton Ave., Mount Vernon, N.Y. 10550 [304]



Show and tell. Combination of dvm and printer comes in portable or rack configuration for display and readout of repetitive measurements.

the job can be done by a technician. All that's involved is changing two resistors, moving a ground connection in the display-tube assembly, and changing two modules in the printer.

The dvm's accuracy is $0.1\% \pm 1$ digit, and its stability is ± 0.2 times the lowest digit per $^{\circ}\text{C}$ on the lowest voltage and current range. Meters set to one of the higher scales have a stability of ± 0.02 . Overloads of 100 times full scale don't damage the meter, and the 60-hertz rejection ratio is 20 db.

The printer's six columns consist of two for index numbers and four for data. Also printed on each line is a decimal point.

The printer works either manually or automatically. When the user pushes the MANUAL button, a pulse is sent to the print solenoid. When the AUTO button is down, the solenoid is fired after every encoding; the printer's maximum rate is three lines per second.

Also on the instrument's front panel are pushbuttons that reset and advance the index. And for those who don't want an index, Practical Automation has a PDM with a four-digit printer; price of this unit is \$500.

The PDM comes in either a half-rack package, in which the dvm sits beside the printer, or in a portable package in which the printer is on top of the meter. In a rack mount, the PDM is $3\frac{1}{2}$ by 8 by $8\frac{1}{2}$ inches; the portable package is a bit larger.

Practical Automation Inc., Trap Falls Road, Shelton, Conn. 06484 [310]

Printer, dvm in thrift pack

Free, one digital voltmeter with every printer you buy. That, in a sense, is the offer of Practical Automation Inc. Its PDM 611 is a $3\frac{1}{2}$ -digit voltmeter combined with a six-digit printer. The price of the whole package is \$550, about what a printer alone usually costs.

Credit for the low price goes solely to the printer. "The dvm is just a standard unit, no different than anybody else's," says Practical Automation's Maurice Teichner, "but I can turn out a printer every 15 minutes. Except for the screws, everything in it is stamped or molded."

Such talk could arouse questions

about the printer's reliability. But, says Teichner: "It's as rugged as any printer built; we'll guarantee it for half a million operations."

In keeping with its image of thrift, the PDM has no such frills as automatic ranging and polarity indication. In fact, a given instrument has only one range and accepts inputs of only one polarity.

The PDM's choice of ranges runs from 0.1999 volt to 199.9 volts and from 19.99 microamps to 199.9 milliamps.

Although Practical Automation suggests sending the instrument back to the factory for range-changing, the company agrees that

Associative memory on a chip

One of the drawbacks of semiconductor content-addressable or associative memories has been price. Although custom devices have been built, the memory cells were on one device, and the associated logic-word drivers, sense amplifiers, and match detectors—each required separate chips. Signetics Corp. has developed what it describes as the first integrated-circuit associative memory avail-

able as a standard product and marketed at a reasonable price [*Electronics*, Jan. 20, p. 44].

The company expects the memories to be used as an interface between low-speed main frame computer memories and high-speed buffer registers, addressing the main frame memory through the buffer. A typical application foreseen by Ury Priel, who designed the devices, is the generation of

data lists. The content-addressable memory can be presented a set of indicators that serve to identify the desired list, and have it dumped from the main memory into the buffer. The data can be read out from the buffer possibly 10 times faster than it could be from the main memory.

Two versions are available. The S8220 is intended for industrial temperature ranges from 0° to 75°C

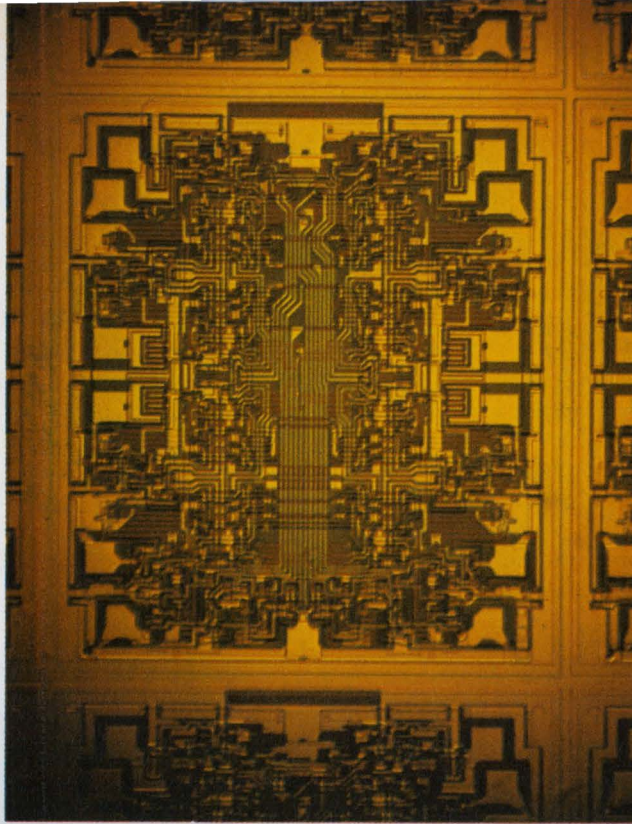
and will sell for \$13.31 in quantities of 100 or more; the S8222, designed for the full -55° to 125°C range, is priced at \$32 each for lots of 100 or more.

The two devices differ also in their associate delay times and power consumption. For the S8220, the typical associate time—the time required to detect a match or mismatch answer, depending on whether or not a like bit is stored within the memory cell—is 20 nanoseconds at 25°C and 5 volts. Maximum power dissipation is 590 milliwatts at 25°C and 5.25 volts.

The S8222 has a typical associate time of 35 nsec under the same conditions, but dissipates only 300 milliwatts maximum.

Both memories grew out of internal programs to develop advanced integrated subsystems, says Thomas McCarthy, advanced digital products supervisor. And even though each of the 90-by-100 mil chips contains about 100 gates, Signetics is describing them as medium-scale integrated devices. They combine all the formerly separate logic with the memory cells on one chip. Circuit structure is based on transistor-transistor logic designs, making the devices compatible with TTL and diode-transistor logic input-output levels.

Each of the 8-bit arrays incorporates the addressing logic and



All in one. Content-addressable memory, including the associated logic, is on single chip for high-speed data retrieval tasks.

eight identical memory cells organized as four words, each two bits long, expandable in both bits and words by interconnecting a number of the devices without the need for additional logic.

The units can also perform write-only and read-only functions. Both are available in either a 16-pin ceramic flatpack or a 16-pin

silicone plastic dual in-line package.

Typical readout time for the S8222 is 35 nsec at 25°C and 5-volt levels; write-in time under the same conditions is 80 nsec. For the S8220, readout time is 30 nsec and write-in time is 40 nsec.

Signetics Corp., 811 E. Arques Ave., Sunnyvale, Calif. 94086 [307]

IC's help simplify multimeter

Last March, the Data Technology Corporation introduced at the IEEE Show a $4\frac{1}{2}$ -digit voltmeter that had two principal advantages—low price (\$695) and small size ($3\frac{1}{4}$ inches high and a half-rack wide). Now the firm has put a $5\frac{1}{2}$ -digit multimeter into the same package, through extensive use of integrated circuits and simplified design.

In making basic d-c measurements, the model 370 is accurate to $\pm 0.0025\%$ of reading and $\pm 0.001\%$ full-scale. Without any options, it costs \$2,400. In accuracy, the company says, the $5\frac{1}{2}$ -digit machine that is closest has a rating of 0.003% of reading, ± 0.001 percent full-scale, and costs \$3,150



More to the inch. Through use of integrated-circuit logic, versatile $5\frac{1}{2}$ -digit voltmeter is built into a half-rack package.

without options; in price, the closest sells for \$2,450, has an accuracy of $\pm 0.005\%$ of reading, according to Data Technology Corp.

Seven options—including auto-

ranging, a-c volts measurement from one to 750 volts, ohms measurement from 100 ohms to 10 megohms with a resolution of one milliohm, and ratios to 0.99999:1—

bring the model 370 price to a total of \$3,790.

Binary coded decimal outputs and remote control are options that cost anywhere from \$150 to \$500 in other 5½-digit multimeters; these features are built into the model 370 at the basic price.

Everything but the power supply for the 5½-digit machine is newly designed, says technical director Stephen Ammann. Only six circuit boards are used in the basic d-c measuring machine, which covers the range from 100 millivolts to 1,000 volts in five steps.

Both transistor-transistor logic and diode-transistor logic IC's are used, which helps reduce the unit's size, and so does the use of the input amplifier as the integrating amplifier. Two separate amplifiers are normally required for these functions, and Ammann says Data Technology has eliminated a source of drift, error, and cost by combining these amplifiers.

For analog-to-digital conversion, the model 370 accomplishes self-zeroing by a feedback loop from the integrating amplifier to the zero detector, keeping all the instru-

ment's amplifiers at the most recent threshold to begin a new reading. Thus, the effects of drift on the amplifiers are cancelled after each reading.

Ammann points out that the self-zeroing feature eliminates the need for elaborate temperature control, such as Peltier cooling, to hold down the temperature drift of the input stages and the zero detectors.

Delivery time for small quantities of the model 370 is 60 days.

Data Technology Corp., 1050 E. Meadow Circle, Palo Alto, Calif. 94303 [312]

Calibrator booster reaches 1 kv Over range of 10 hz to 110 khz

More muscle—Calibrator, at top, has 10 times more range when connected to the amplifier (shown with its cover removed).



Who knows? The maker of your a-c voltmeter says that, when set on its 1,000-volt scale, the instrument has an accuracy of 0.1%. How do you check it? "Till now, there haven't been many calibrators that could deliver 1,000 volts; and at frequencies over 20 kilohertz, there hasn't been anything," says Fred Hanson, a design engineer at Hewlett-Packard Co.'s Loveland division. But, thanks in part to Hanson's design work, things have changed in calibration work.

About a year ago, HP introduced the 745A, a calibrator whose maxi-

mum output is 110 volts rms and whose frequency range is 10 hertz to 110 khz. Now the calibrator has a helper. The new 746A amplifier boosts the calibrator's maximum output to 1,100 volts rms and doesn't decrease the frequency range. The amplifier's price is \$2,000 (the calibrator costs \$4,500).

A pair of cables connects the two instruments. One brings the calibrator's output to the amplifier, and the other carries feedback and logic signals.

The 746A consists of a class A amplifier whose gain is 10, followed

by a buffer amplifier that is driven by a pair of follower amplifiers. Using a class A amplifier instead of transformers, says Hanson, precludes the generation of meter-mangling spikes.

All the voltage amplification is done by the class A stage; the rest of the circuitry boosts the output's current. When set between 100 hz and 110 khz, the 746A delivers 63 milliamperes; when below 100 hz, the output is a linear function of frequency. At 10 khz, the output is 6.3 milliamperes.

A resistive divider across the

... circuit checks unit during brief warmup ...

746A's output helps with the regulation. It picks off 1/1,000 of the output and sends this voltage back to the calibrator where it's compared with a voltage proportional to the voltage set by the user. The error signal adjusts the calibrator's output.

The result of this feedback control is that the amplifier's accuracy is 0.2% from 10 hz to 20 hz, 0.05% from 20 hz to 50 hz, 0.02% from 50 hz to 20 khz, and 0.05% from 20 khz to 110 khz. The total distortion is 0.05%, and if the line voltage changes 10%, the output changes 0.001%.

When voltages get into the kilovolt range, safety becomes a major design consideration. The 746A doesn't have interlocks because, says Hanson, "Interlocks are usually cheated anyway." Instead, the 746A's high-voltage areas have plastic covers with holes big enough for a probe but too small for a finger.

The amplifier warms up in 30 seconds. During this time, a logic circuit inside the amplifier checks the instrument out. If everything is alright, the circuit turns on the calibrator and flashes a "ready" light. Even then, the high voltage isn't available at the amplifier's output. For safety's sake, the user must push buttons, one on the amplifier and the other on the calibrator to get the high voltage.

When the calibrator-amplifier combination is set to the 1,000-volt range, the output can be set in 1-millivolt steps between 100 and 1,000 volts.

Specifications (745A/746A combined)

Range	Resolution
1 mv	0.1 to 1.1 mv in 1 nv steps
10 mv	1.0 to 11 mv in 10 nv steps
100 mv	10 to 110 mv in 100 nv steps
1 v	0.1 to 1.1 v in 1 μ v steps
10 v	1 to 11 v in 10 μ v steps
100 v	10 to 110 v in 100 μ v steps
1,000 v	100 to 1,100 v in 1 mv steps

Load capability

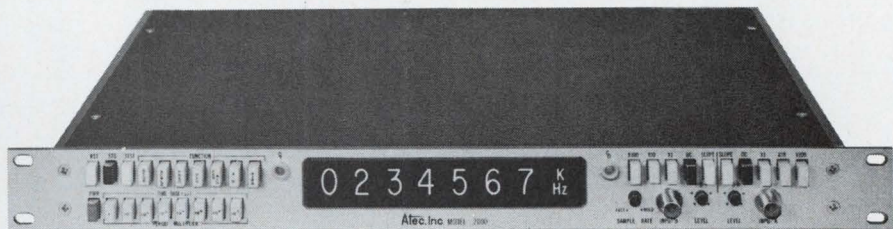
1,000 pf or 50 ma on 1 mv to 100 v ranges (50 ma allows 800 pf at 100 v, 100 khz)

1,000 pf or 63 ma on 1,000 v range (63 ma allows 100 pf at 1,000 v, 100 khz)

746A operating temperature 0 to 55°C

Hewlett-Packard Co., Loveland Div., 815 Fourteenth St., S.W., Loveland, Colo. 80537 [314]

Atec's new 12.5 MHz universal counter/timer measures Frequency, Time Interval, Ratio, Period, Multiple Period, and Totalizes. **That's quite a bit for \$850!**



Atec's new Model 2000 offers more performance for less money than any competitive instrument. Standard features include a 1 MHz crystal-controlled time base stable to one part in 10^8 /day, remote programming, and 1-2-4-8 BCD output. Options include display storage, oven-stabilized crystal, and additional digits (to seven). Modular plug-in design makes it simple to add options at any time.

Input sensitivity is 10 mV (DC to 5 MHz) and 30 mV to 12.5 MHz. Front panel height is only 1 $\frac{3}{4}$ inches.

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Op amp tester analyzes the no-go

For speed and high volume, go/no-go tests are fine, but most of the time engineers need to know why the no-go signal flashes thumbs down on a string of devices. An added complexity is the fact that devices like operational amplifiers must be given a dozen or more tests.

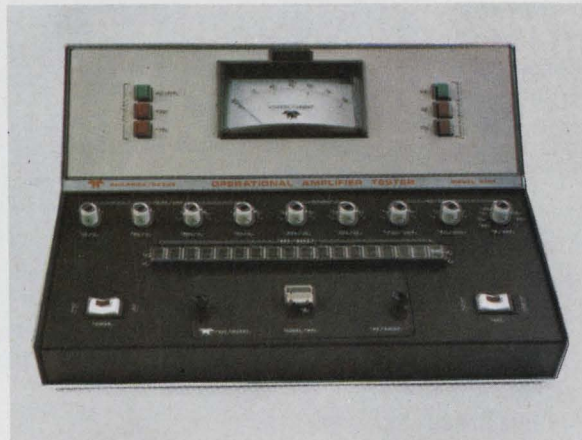
The Philbrick/Nexus Research's model 5104 automated op amp tester is designed to answer the speed/volume needs of quality control and quality assurance and give quick answers to the no-go question through provisions for fine tuning the test parameters every time the op amp fails to meet preset standards. In addition, every step the tester makes, as well as all of its test results, can be picked off and used for data logging, automatic running and handling, binning, oscilloscope display—even computer control.

The model 5104 automatically scans through 14 tests in about two seconds. It takes on both bipolar and field effect transistor devices and disregards their construction, whether discrete, hybrid or monolithic.

Analysis. The 5104's automatic testing is not only fast, it's considerate of the engineer who must pick up the pieces when the no-go light shines. Go or no-go decisions are made after each test. Thus, if an op amp fails test seven, say, the 5104 stops, the no-go lamp flashes, and the test results are displayed on a meter.

If he is in doubt, the engineer can call up the standard for a go indication with a "verify" button beside the meter panel. This way he can compare in engineering units—volts, amperes, or decibels, not percent readings as offered on some machines—the actual with the desired performance. At the same time he can verify test conditions to catch tester errors.

With the 5104 in this so-called "hold" mode, a trouble-shooting engineer can alter test parameters to see what's needed to make the device pass muster. Load resistance, common mode voltage, and output voltage swing can be ad-



Inspection tool. Tester not only screens out substandard op amps, but it helps quality-control engineers to determine why the devices are failing.

justed, and the resulting meter deflections can give an idea of just where the trouble is.

Although the 5104 would seem tailored to outgoing inspection applications, it's also designed for incoming tests. Fresh from the factory, it's equipped to check for gain, oscillation, common mode and power supply rejection, output voltage swing, common mode voltage, input offset voltage and current, input bias current, and current drain without an input present.

There also are three extra buttons that increase the flexibility of the 5104 to encompass almost any desired test. These can be connected to back panel terminals and used to add any tests the user might desire, or if multiplexed testing is used, to slip several added tests into the sequence of operations.

If, for example, a slew rate measurement is desired, it could be wired into the 5104's scanned test sequence through one of these push buttons. Then when the scan button is pressed, slew rate would be tested as part of automatic sequence. And like standard tests, slew rate also could be done separately by pressing the button assigned to it.

Outputs. Performance indicators also are piped to back panel terminals. Meter voltage, polarity, and scaling are available, making for easy data logging with a relatively slow printer. With this data is a code identifying each particular test, and the op amp's output

itself in case it's to be viewed on an oscilloscope.

Outputs for a clock, go and no-go indications, and a relay power supply ease interfacing with automatic handling equipment. And for added tests there is an input for the "advance" signal that the instrument needs in order to move to the next test.

A complete set of test selection lines is piped out to the back and would allow simple computerization of the 5104. But about the only value of computer control, the company points out, would be to allow fast selection among the several tests available.

Philbrick/Nexus plans to sell the 5104 for less than \$4500, about \$2,000 below its nearest competition. The lower price is the result of taking advantage of the modules already developed as part of P/N's product line. Also, P/N uses a relatively low cost analog meter instead of a digital readout and binary-coded decimal outputs, which would cost up to \$1,000 more.

Slew rate isn't included in the standard package, partly because P/N engineers figure that this is an infrequently needed measurement in the markets they aim to serve—QC and QA—and partly to keep the price down. A company spokesman says \$500 was cut from the price by foregoing slew rate measurement.

Delivery will take two months.

Philbrick/Nexus Research, Allied Drive, Dedham, Mass. 02026. [309]

IC's slim flight-line meter

Hauling a bulky digital multimeter from service point to service point can become a taxing chore. And small battery-operated multimeters generally lack the accuracy and versatility required in avionics and computer testing.

Engineers at Lear Siegler's Cimron division had field and flight-line engineers in mind when they designed the model 6453 battery-pack digital multimeter. The 4½-digit multimeter with interchangeable d-c and a-c measurement options weighs 10 lbs., and is 8¼ by 3½ by 12 inches. It measures d-c and resistance with an accuracy of ±0.01% full scale, ±0.01% of reading at 23°C, ±2 degrees. Reference stability using a compensated zener reference is 0.01% for 90 days. Low level d-c measurement down to 100 millivolts, optional on other low-priced instruments, is standard. Plus or minus voltage is automatically displayed, with autoranging for all functions. The basic instrument at \$985 includes five d-c ranges, 100 mv to 1,000 volts, with a 20% overrange.

Input resistance is high, 10,000 megohms at 10 volts. Common-mode rejection is 120 decibels at d-c, and 120 db up to 1 kilohertz. The measurement rate is 1 or 4 per second, with the rate selectable through a front panel control.

An optional a-c converter costs \$245 and has four a-c measurement ranges from 1 to 1,000 volts. Bandwidth is 50 hertz to 100 khz with maximum voltage ratings of 500 volts from 50 hz to 50 khz, and 250 volts from 50 khz to 100 khz. A-c



Traveler. Compact multimeter is portable and can be powered by a battery pack in field operations.

overrange is 10%. The temperature coefficient for a-c measurement is ±0.002% and input impedance is 1 megohm ±5% shunted at 100 picofarads. Absolute accuracy at 25°C ±5 degrees is 0.2% full scale at 50 hz to 20 khz; 0.5% full scale at 20 khz to 50 khz; and 1% full scale at 50 khz to 100 khz.

Five ranges of resistance measurement, from 1 kilohm to 10 megohms, can be added to the model 6453 as a \$185 option. An optional remote printout, using diode-transistor logic and selling for \$175, makes the instrument compatible with systems applications. All front-panel control and display functions of the model 6453 are remotely programmable.

The meter operates at 105 volts to 125 volts a-c, 60 cycles or 24 volts d-c. The battery pack, which has the same dimensions as the multimeter case or can be carried separately. Four rechargeable 6-volt, 8-ampere-hour lead-oxide batteries supply d-c power.

Company engineers say extended d-c battery pack operation is made possible through use of a Digivac phosphorous display tube that operates on 24 volts, with only 1½ volts on the cathode.

Approximately 80% of the instrument's circuits are monolithic IC's, and the rest are hybrid thin-film assemblies.

The number of calibration adjustments required has been reduced 50% over comparable units through the use of thin-film circuits in the input attenuator. Improved temperature stability attained by substituting hybrid circuits for discrete components is reflected in the unit's small number of calibration points—only five.

Settling time for the input amplifier is 150 microseconds. The quick reading capability stems from using the same amplifier as that in Cimron's more expensive models.

Delivery time is 30 days.

Cimron Division, Lear Siegler, Inc., 1152 Morena Blvd., San Diego, Calif. 92110 [308]

Heavy-duty bonding automated

High-power semiconductor devices require special considerations in wire bonding. Ultrasonic bonding is normally employed, and the large-diameter wire is often bonded to the power transistor or silicon-controlled rectifier die by a hand-held ultrasonic horn. Wire cutoff is frequently done manually. But

with the increasing demand for power devices, and particularly multi-chip power circuits, there is a need for automating the bonding process, says William Hugle, president of Hugle Industries, Inc. His company will try to fulfill that need with its newly developed model 1350 heavy-mil bonder.

Hugle says the machine is the first production tool to bond wires up to 10 mils in diameter to individual power devices. He also expects it to be a boon to users making hybrid thick-film circuits with power dice.

The basic machine bonds automatically or manually, and sells

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Precise Regulation — 25 ppm down to 1 microampere output.

Patented Guard Circuit — prevents leakage paths and voltage monitoring from degrading output.

Unlike many so-called "constant current" sources, the new CCB Series has the necessary high impedance, non-capacitive output. There is essentially no stored energy to dump, delaying response to programming or load changes. Patented Guard Circuit allows the output voltage to be monitored, externally, without degradation. Further, the new CCB Series permits you to preset current and voltage before connecting your load.

Two models are now available: the 6177B at 0-500 mA, 0-50V; the 6181B at 0-250 mA, 0-100V. Either can be remote programmed (resistance or voltage) with an accuracy of 1% or better.

Other operating features are: Transient recovery time of less than 200 μ sec for output recovery to within 1% following a full load change; programmed speed of less than 500 μ sec. from zero to 99% of programmed current output; resolution of 0.02% of the range switch setting; rms ripple less than 80 ppm of range.

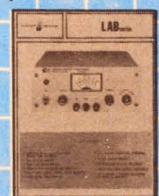
Both Constant Current Sources are 3½" high half-rack size, weighing 10 lbs., and are priced at \$425.00. For additional specifications, contact your local HP sales office or write: Hewlett-Packard, New Jersey Division, 100 Locust Avenue, Berkeley Heights, New Jersey 07922 . . . In Europe, 1217 Meyrin-Geneva.

HEWLETT  PACKARD
POWER SUPPLIES

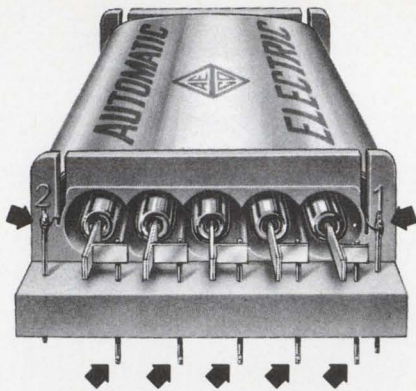
Additional Constant Current/Voltage Models
For Higher Current . . . less sophistication



3 MODELS
0 - 3A
Up to 50V



9 MODELS
0 - 3A
Up to 320V



Groov-Pin[®] Terminals Are Simpler... More Reliable... Lower in Cost

Groov-Pins rather than stamped or formed press-fit terminals are used in a new line of Correeds* developed by Automatic Electric Co., Northlake, Ill., a subsidiary of General Telephone & Electronics.

Here's why they are producing important savings for AE:

- Stamped or formed terminals require end-for-end and side-for-side orientation for assembly. Groov-Pins can be inserted from either end.
- Stamped or formed terminals need soldering projections for each connection. Groov-Pins can be soldered or welded anywhere.
- Groov-Pins also permit a simpler plastic mold for nylon relay coil forms. Hard-to-remove core pins and locking slots are eliminated.

If you design or make relays, connectors, or other hardware, find out how Groov-Pins can simplify your product and dramatically cut costs. Write to Groov-Pin Corporation, 1125 Hendricks Causeway, Ridgefield, N. J. 07657. Telephone (201) WH 5-6780.

Automatic Electric uses Groov-Pin terminals in its new Correeds. They are now available to AE's telephone company customers. Correeds have as many as 14 terminals, so a cost cut here means savings for the company. Groov-Pins lock in the Correed's coil form by a cold flow of nylon into three swaged grooves. Notches at both ends make it easy to wrap and solder leads from the Correed.

*Automatic Electric's name for Dry Reed Switch Modules

GROOV-PIN CORP.

FASTENER DIVISION



Powerful. Bonder can handle heavy wire for high-power semiconductors, has controls for either manual or automatic operation.

for \$4,800. Work holders for such packages as TO-5, TO-18 and TO-66 headers cost an additional \$150 each.

Both wire feed and cutoff can be done automatically by a pneumatic system under solid-state logic control. The wire is fed by a series of pressure rollers through plastic tubing to a set of pneumatically controlled jaws that break the wire after the bond is made.

The operator can set the machine to make one bond and break the wire, or she can do as many stitch bonds manually as she needs in sequence before she triggers the wire cutter. In the automatic mode, the wire is cut off every second bond. She can choose either to have a predetermined wire length fed out automatically or, by using a manual override button, determine the wire length herself. Motorized search-level positioning can be operated manually with finger-tip control, or can be done automatically. Both search positions are independently selectable.

With optional tooling, the machine can bond wire up to 20 mils thick. When bonding wires greater than 10 mils in diameter, problems

arise because the wire is too strong for conventional ultrasonic bonding tools. "You can't pull-break a 15-mil wire or you'll damage the power device," product manager Jan Anderson points out.

To overcome this problem, Hugel engineers worked with tool makers to develop a specially shaped tungsten carbide bonding wedge with cutoff assistance built into it. The wedge notches the wire to ease the job of the pneumatic jaws. The pivots on which the tool rides can be destroyed if the energy is transmitted through them rather than through the tool.

For these reasons, tools to handle wire greater than 10 mils are another \$150 option with the model 1350. And by buying an extra logic card and bonding head for the machine, the user can accommodate small-diameter wires—down to 1 mil. Hugel believes this \$698 option will be useful for laboratory or prototype work encompassing the range from 1 to 20 mils.

Delivery time for the standard 10-mil-wire bonder is approximately four weeks.

Hugel Industries Inc., 625 N. Pastoria, Sunnyvale, Calif. 94086 [311]

Nitride deposited uniformly

Silicon nitride passivation and metal oxide semiconductors are becoming increasingly intertwined because nitride lowers the threshold voltage of MOS devices. Makers of bipolar integrated circuits like nitride, too, principally for its protective properties.

But proponents of MOS are be-

coming disenchanted with the usual equipment employed to deposit nitride—horizontal epitaxial reactors or diffusion furnaces—because they're not happy with the uneven thicknesses of the passivation layers.

To solve the problem, Applied Materials Technology Inc. has de-

veloped two horizontal chemical vapor deposition reactors that uniformly deposit either silicon nitride or silicon dioxide—or both—on semiconductor wafers. The firm does it without the use of radio-frequency induction heating systems, which AMT president Michael McNeilly says create bothersome fields, take up twice the floor space, and cost \$10,000 to \$12,000 more than his company's AMN-710 and AMN-720. Both reactors use infrared heat sources, consisting of a series of high-intensity mercury halogen lamps.

McNeilly points out that the reactors are not intended for customers putting down oxide passivation layers alone, but for those depositing oxide-nitride sandwiches or nitrides alone. The company is billing the reactors as total passivation systems that will deposit oxides from silane and carbon dioxide at 900° C, or nitrides from silane and ammonia at 700° to 850° C to form the usual oxide-nitride sandwich employed with MOS devices.

The AMN-710 is considered a small-scale unit for a customer to use in developing his process. It accommodates 10 to 12 wafers two inches in diameter; the AMN-720 can handle 20 to 24 of the same-size wafers in each of two stations in a single run. The smaller, single-station machine sells for \$15,000; the AMN-720 for \$38,000 to \$48,000, depending on the degree of automation desired.

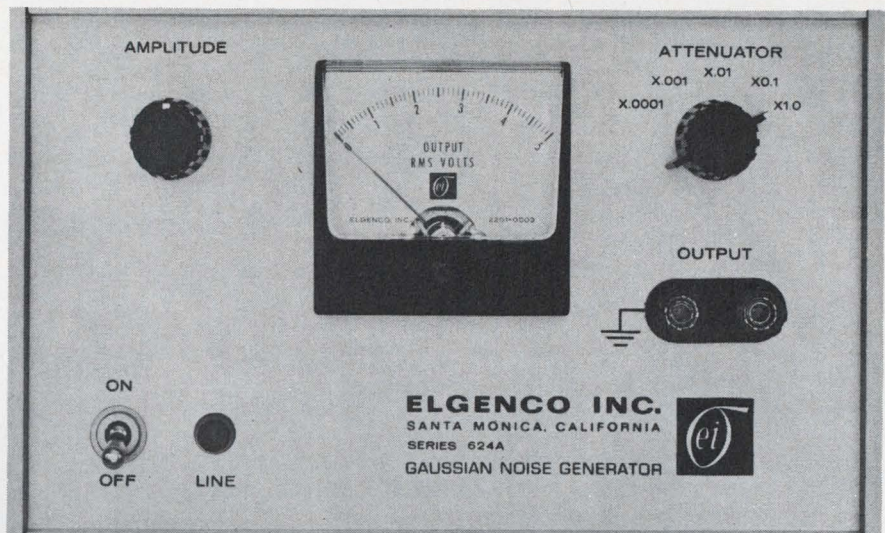
The larger machine will handle 100 to 150 two-inch wafers an hour, depositing nitride layers up to 1,000 angstroms thick. Oxides or nitrides can be grown in the same unit without taking the wafer holders out of the reactor station. Work stations of the AMN-720 can be operated simultaneously or independently, using the same heat source. To do this with an r-f deposition system would require a second power supply costing about \$20,000, according to McNeilly.

Further, the 720 can provide six independent temperature zones in which the temperature can be closely controlled.

Delivery time is 8-10 weeks.

Applied Materials Technology, Inc.,
2999 San Ysidro Way, Santa Clara,
Calif. 95051 [313]

ELGENCO 624A-12124 NOISE GENERATOR \$295



For your audio requirements, many obsolete vacuum tube noise generators can be directly replaced/updated with this solid state 5 Hz to 20 kHz Random Noise Generator at low cost and with improved characteristics. Delivery from stock. Other Noise Generators covering the range of DC to 30 mHz and Demo Models available. For name of nearest Sales Rep see EEM or contact Elgenco, Inc., 1550 Euclid, Santa Monica, Calif. 90404. Ph. 213-451-1635.

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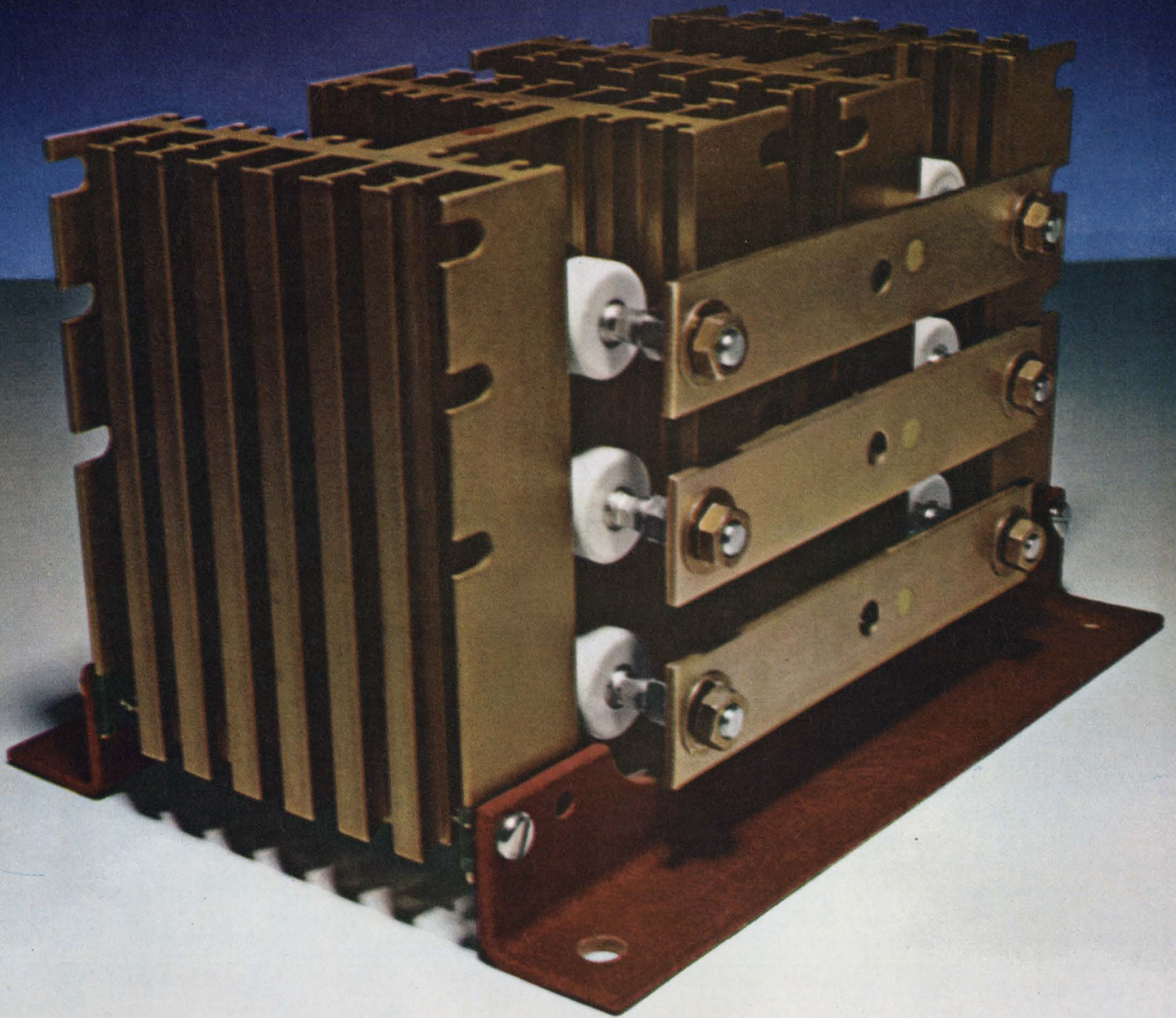
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Metal-vapor laser goes commercial

Spectra-Physics' helium-cadmium ion unit emits in blue and ultraviolet; air-cooled system is rugged, simple to operate; RCA to market similar product in fall

Product development of the metal-vapor laser took less than three years to accomplish.

The first of this new class of light amplifiers to go to market is a helium-cadmium ion unit developed by Spectra-Physics. It produces a brilliant blue 50-milliwatt beam at 4,416 angstroms and also an ultraviolet emission which the company claims is the shortest wavelength ever produced c-w. This is a 10-milliwatt beam at the 3,250-angstrom line.

The He-Cd laser, considered the first new type to be developed since the neodymium-doped yttrium-aluminum-garnet laser was introduced three years ago, is simple in operation, promises high reliability, and is expected to be relatively low in price eventually. Its only competitor in the blue and uv bands is the argon laser, that is cumbersome and less efficient.

The He-Cd device is expected to have initial applications primarily in photochemistry and biochemistry. Early work on this and other metal-vapor lasers was done at Bell Telephone Laboratories and at RCA, in addition to Spectra-Physics. RCA plans to announce the first in a family of metal-vapor lasers next month. It will have a 10-milliwatt output at 4,416 Å and 3,250 Å. RCA officials say they hope to extend the company's three-year warranty to these new lasers.

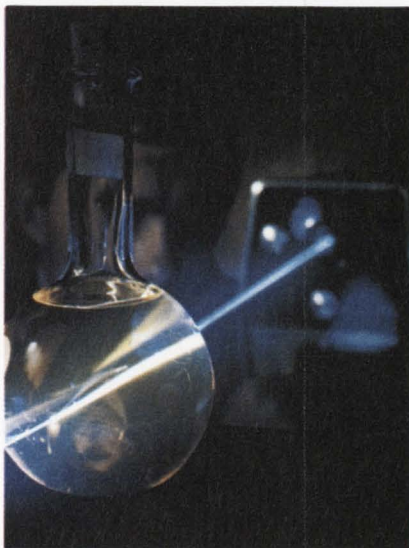
Rugged and easy to use, the Spectra-Physics system operates from a standard 115/230-volt 50/60-hertz power source and is designed for industrial applications as well as for the research laboratory. Efficiency is 0.2%; predicted lifetime is 3,000 hours. Much of the system was patterned after the firm's He-Ne laser.

Spectra-Physics began the search for an efficient c-w blue laser light source about two years ago. At that time, experiments with metal-vapor lasers (tin, zinc, and cadmium) at laboratories were revealing the potential of cadmium.

Air cooled. "We were looking for an air-cooled laser which could put out short wavelengths in the blue and uv regions," says Jon Tompkins, product manager. "We began thinking seriously of cadmium when researchers at the University of Utah reported cadmium's lasing

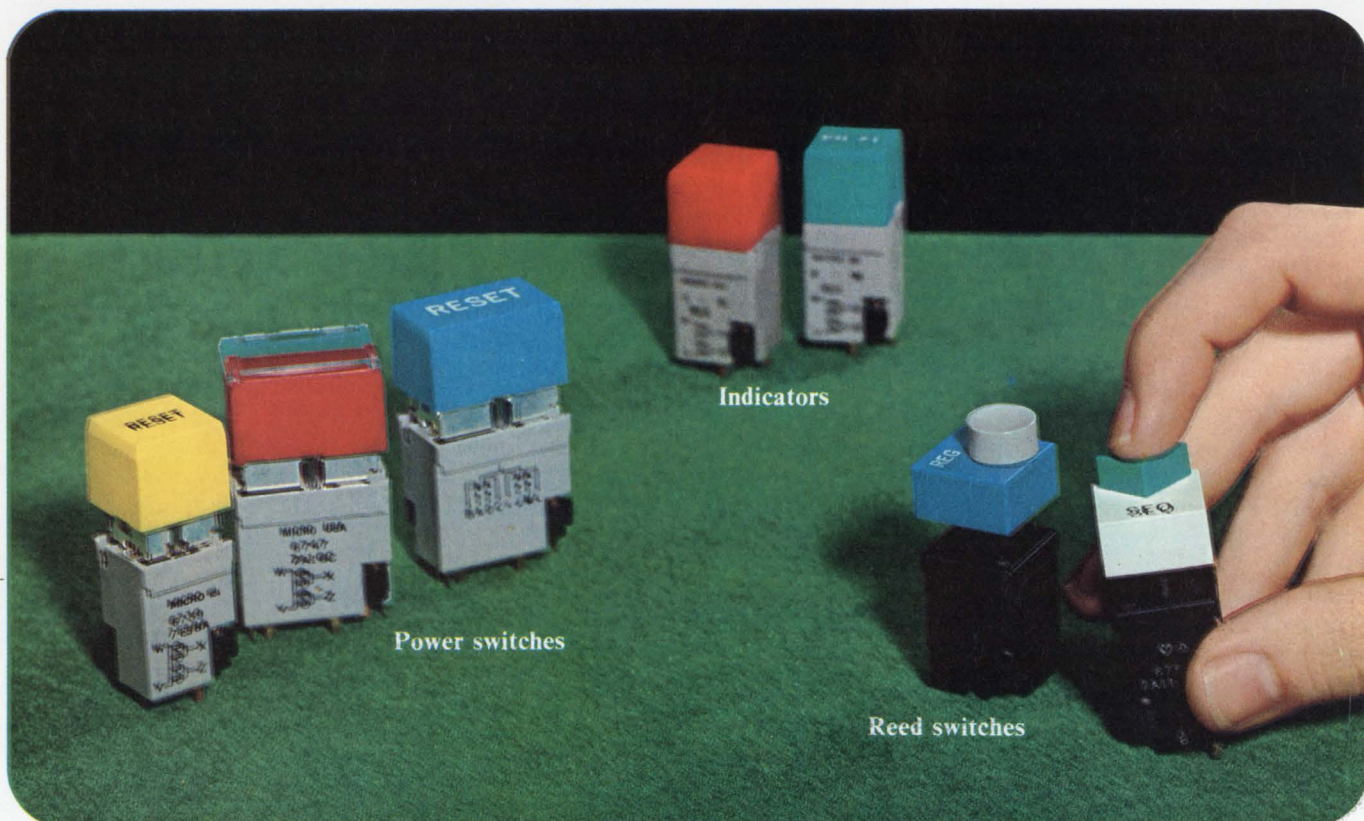
potential early in 1967. When we first decided to try cadmium we knew we could get the 4,416 Å to lase, but only after obtaining this wavelength did we realize the possibilities of the line at 3,250 Å. I think we were the first observers of this beam." The 3,250-Å line was first predicted by William Silvestro of Bell Labs.

Work with a cadmium laser continued at Bell Labs, Murray Hill, N.J. There scientists displaced cadmium "pellets" along the bottom of the tube and heated the entire



New blue. Beam from helium-cadmium laser strikes an organic solution in a flask, causing fluorescence. The metal-vapor system is expected to be used initially in biochemistry and photochemistry.

KB matrix-mount pushbutton line now offers the reliability of reed switches



A new reed keyboard switch has been added to the KB line of matrix-mounted pushbuttons. Now, hermetically sealed reed contacts offer full protection from contamination and provide extremely long life.

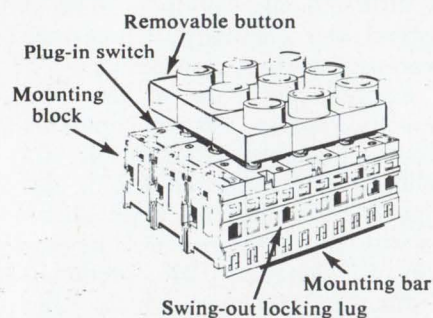
These new plug-in reed switches are highly versatile: a choice of momentary or alternate-action; 1, 2, 3 or 4-pole contact arrangements; turret terminals allowing either direct wiring, plug-in wiring to connector blocks, or mounting on printed circuit boards; optional alternate-action electric trip.

Besides the new reed switches, the KB line includes a variety of 5-amp power switches: lighted or unlighted, 2 or 4-pole contact arrangement, momentary or alternate-action. Also matching lighted indicators. Reed switches, power switches, indicators and spacers can be inter-mixed and arranged to suit your requirements. Choose from a variety of shapes, sizes, and colors of buttons and pushbars to fully customize the appearance of your panel.

The KB plug-in pushbuttons and matrix-mounting system provide unequalled flexibility in keyboard or

panel arrangement. You can assemble and wire a complete matrix at the bench. The box-girder matrix mounts in one panel cutout and requires no additional support.

For full details, call a Branch Office or Distributor (Yellow Pages, "Switches, Electric"). Or write for Bulletin 70.

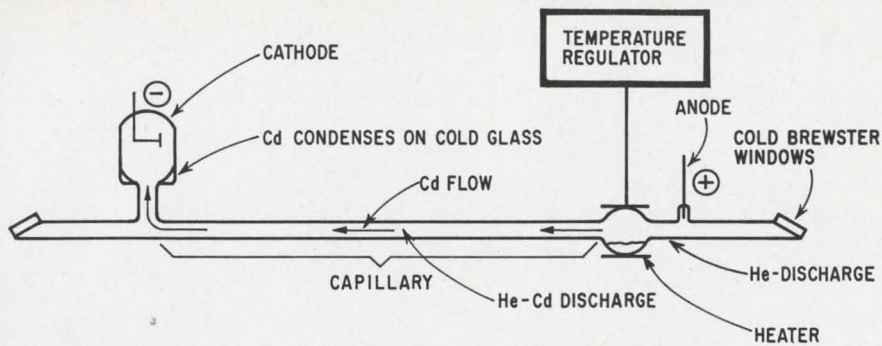


MICRO SWITCH

FREEPORT, ILLINOIS 61032

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Key technique. Regulation of temperature and voltage helps maintain a uniform metal vapor in capillary, the thin section of the tube.

tube in order to vaporize the cadmium and create lasing of the ion. However, as with most metal-vapor lasers, the major problem was that the rapid buildup of metal concentration gradients caused the beam to break down.

So, while the transitions in cadmium looked interesting, the problems associated with maintaining uniform distribution of vapor proved a major hurdle.

“Cataphoresis, the movement of particles with lower ionization potential toward the cathode, is proportional to the ion current,” Tompkins points out. “In large-diameter tubes, a back diffusion would cancel the cataphoresis effect and prohibit the buildup of large cadmium concentration gradients. But since the back diffusion is proportional to the tube diameter and small-diameter tubes are in fact the most convenient for use in lasers, this diffusion is almost insignificant compared to the cataphoresis. Consequently, the large gradient buildup quickly destroyed the proper mixing ratio for lasing.”

At the heart. The solution of this gradient problem came from S-P’s Dr. John Goldsborough with his successful development of a plasma tube about a year ago. This tube forms the heart of the new laser. Measuring 2.5mm in diameter, it uses special techniques to control the cataphoresis flow and thus maintain a uniform metal vapor throughout the discharge.

The cadmium is heated with a simple resistance heater at the anode and, once vaporized, flows through the tube and condenses on cold glass at an enlarged section of the tube near the cathode.

Two things are done to insure optimum concentration of the cad-

mium vapor in the laser’s capillary, the thin section of the tube. A regulator keeps the heated cadmium at the desired temperature, and the tube voltage is lowered as soon as the vaporized cadmium is present in the helium discharge.

As the heater works and cadmium begins to drop, thus reducing the output of the heater. The discharge maintains a high enough temperature in the plasma tube so no cadmium forms on the inside of the tube. The controlled flow of cadmium ions also reduces condensation on the Brewster windows.

Point the way. The short wavelengths point the way to several new laser applications. The 4,416 Å and 3,250 Å lines can be used in the field of microfluorescence. The lines can also be focused on extremely small areas, so more select samples can be used.

For biochemists doing cell experimentation, the uv line makes it possible to bombard specific chromosomes in the cell nucleus. The 3,250 Å line also widens the scope of photochemical experimentation because its energy is greater than the bonding energy in many organic compounds.

In the study of particle scattering, the shorter wavelengths are extremely efficient. The 3,250 Å line has a relative scattering efficiency almost 7 times greater than the argon-generated 4,880 Å line and more than 14 times that of the 6,328 Å wavelength put out by the He-Ne laser.

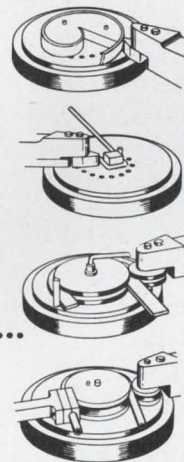
Production of the new laser is scheduled to begin this month, with first deliveries in the fall. The price is just under \$8,000.

Spectra-Physics, 1250 W. Middlefield Rd., Mountain View, Calif. 94040 [338]



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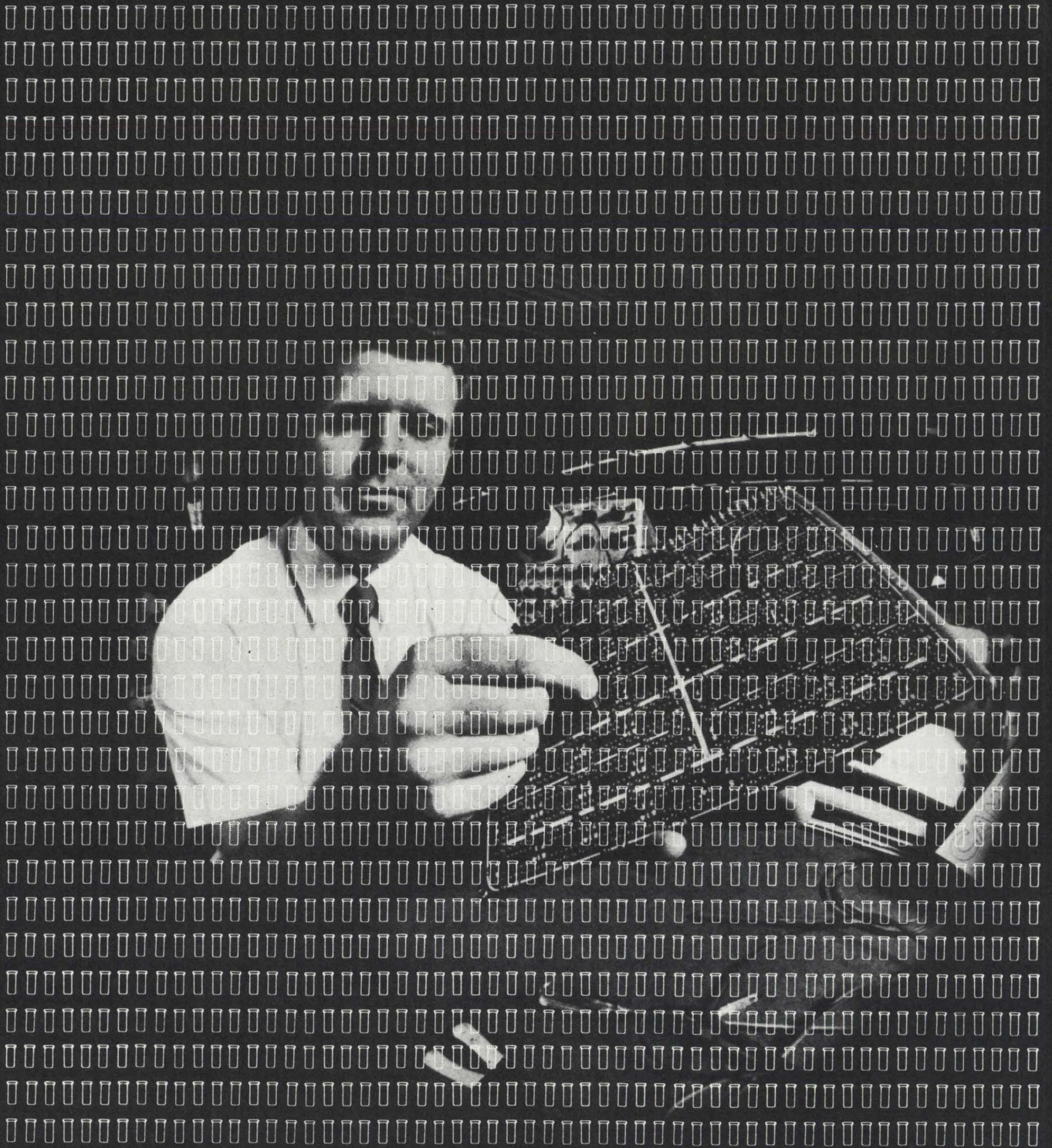
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And for at least another 32,607 trouble-free cycles, the fit will be exact . . . to sustain the electrical integrity of the connection. That's because this is a CAMBION Cage Jack. And even if you don't need to push it that far it's nice to know the proven reliability is always there.

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Phototransistor gives coupler high gain

Optical switch consisting of light-emitting diode and npn silicon planar unit isolates relay noise and spikes; molded plastic package keeps price down

Unwanted spikes, voltage transients, and ground currents are problems often encountered in switching circuits using digital integrated circuits and relays. One method for eliminating these problems is to use optically-coupled photoresistors and photodiodes. Since the circuits are optically coupled, relay noise and spikes are isolated and cannot be reflected

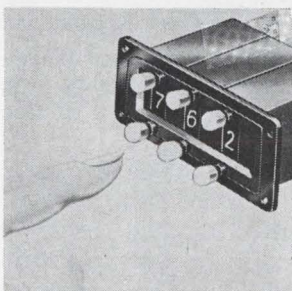
into other parts of the circuit.

Monsanto, which has been marketing both photodiodes and photoresistors, is expanding its product line to include a phototransistor pair. Called the MCT-1, it consists of a gallium arsenide light-emitting diode coupled by a light pipe to an npn silicon planar phototransistor.

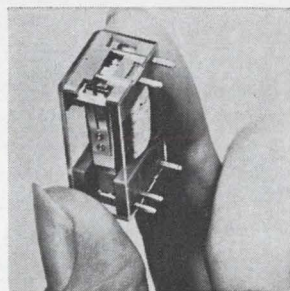
An electrical input signal drives the light-emitting diode which gener-

ates photons proportional to the input signal. The photons trigger the light-sensitive phototransistor, and this delivers an electric current at its output.

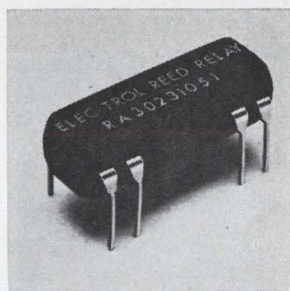
The advantage of using a phototransistor as the coupling element is the much higher current transfer ratio between the pair—30% as compared to 0.2% for a photodiode. The high built-in gain of the MCT-1



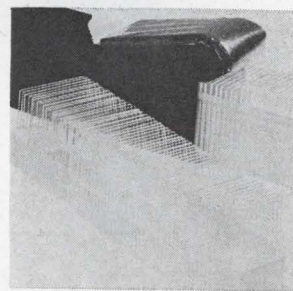
Add/subtract miniature push-button switch MPB/AS-27000 is for space-saving military and industrial uses requiring high reliability and long life (over a million operations). It comes in decimal, binary, and binary with complement outputs, and with internal lighting if desired. Special codes on request. Chicago Dynamic Industries Inc., 1725 Diversey Blvd., Chicago. [341]



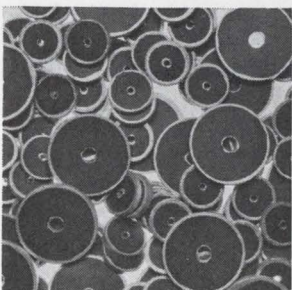
Relay AZ-530 requires less than 1/2 in. mounting height. Its high pressure spdt contact, rated for loads to 1 amp, enables it to switch capacitance or lamp loads with current spikes that would normally weld the contacts of reed relays. It has a sensitivity of 125 mw pull-in and insulation resistance of over 10^{11} ohms. American Zettler Inc., Randolph Ave., Costa Mesa, Calif. [342]



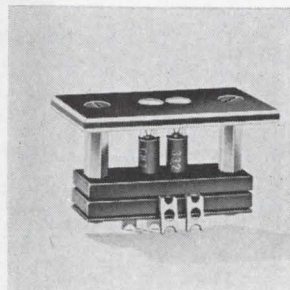
IC compatible reed relays are designed to be used with standard dual in-line packaging and flatpack techniques. They feature dual terminals for all inputs and outputs and total encapsulation to meet military environmental specifications with a temperature range of from -55° to $+85^{\circ}$ C. Switching speeds are faster than 500 μ sec. Elec-Trol Inc., P.O. Box 1, Saugus, Calif. [343]



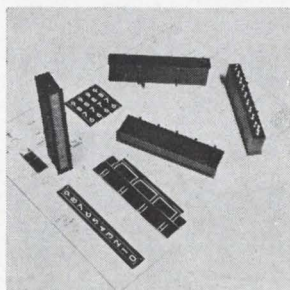
Micro-finish glass substrates for integrated circuit mask applications are flat within 20 μ in. per linear inch. Made of low expansion alumino-borosilicate glass, the substrates are suited for use with metal films such as chromium and can be thermally cycled to improve the glass-to-metal bond. Substrates cost \$5 each in sample lots. Corning Glass Works, Corning, N.Y. 14830 [344]



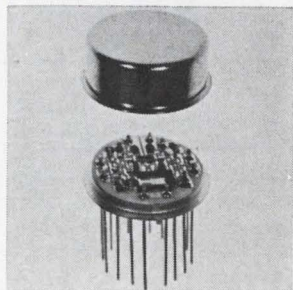
Feed-through, monolithic ceramic capacitor series VF-K1200 offers the filter designer a wide range of dielectrics and voltages. Capacitance range is 0.01 μ f to 1.5 μ f. Dissipation factor is less than 2.5%. Voltage range is 50 to 400 v d-c. Electrodes are silver (fuse bonded). Temperature range is -55° to 125° C. Varadyne Inc., 1805 Colorado Ave., Santa Monica, Calif. [345]



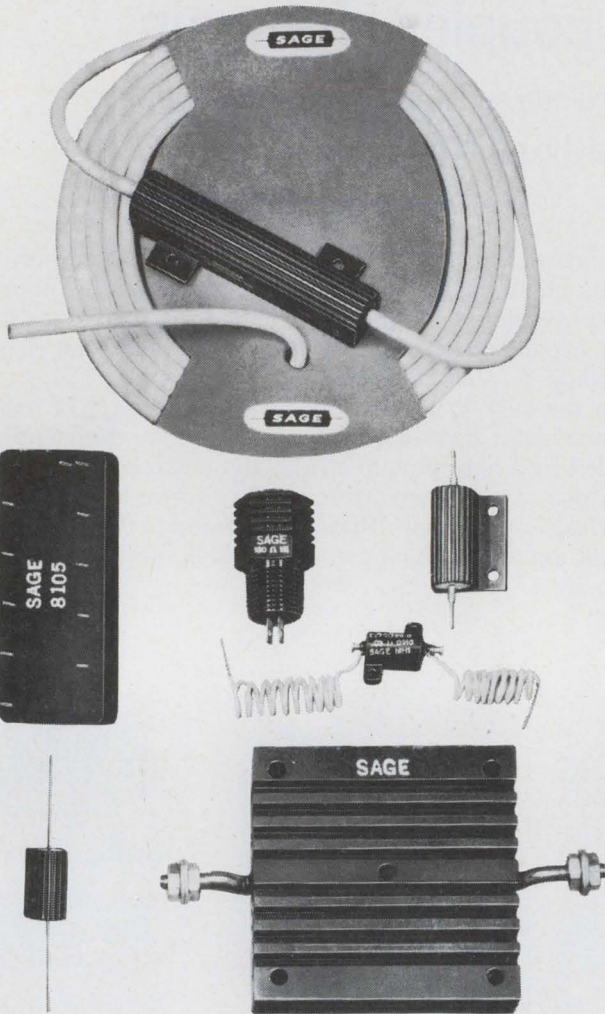
Multi-lamp strips provide multiple-indicator lamp panels for machine tool control, data display and other industrial applications. Actuated by individual power sources or connected in series with busses, the strips come with lamps mounted on 1/4-in. centers. Average cost for standard panels is \$1.50 per installed lamp. Sealectro Corp., 225 Hoyt St., Mamaroneck, N.Y. 10543 [346]



Digital strip indicators series 68020 are lighted readouts that display "0" through "9" in single or multiple decades. Units snap into panel cutouts and provide a built-in appearance. Light sources are T-1 1/4 flange based lamps, incandescent or neon (10 lamps per decade), which are front panel replaceable. Cartelli Technology Inc., 41-10 102nd St., Corona, N.Y. 11368 [347]



Precision ladder switch has a typical switching speed of 380 nsec. Miniaturized to fit two switches into a sealed TO-8 can, the hybrid circuits come in 8 basic types to meet a variety of requirements. Offset voltages are prebalanced to two ladder current ranges: 1.6 ma to 3.5 ma or zero to 1.6 ma. Maximum offset is ± 2 to ± 4 mv. Mepeco Inc., Morristown, N.J. [348]



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... optical unit can act as solid state relay ...

makes the circuit directly compatible with integrated circuits as well as transistors.

Isolation between input and output is 10^{11} ohms with 2,500 volts breakdown and 3-picofarad coupling capacitance. The pair switches between 2 and 12 microseconds depending on the load and collector current. The frequency range extends from d-c to 300 kilohertz, and output rise and fall times are typically 2 microseconds.

The optical switch can be used wherever high-speed isolation-switching functions must be performed. It can replace isolation transformers, couple IC logic elements such as DTL and TTL, serve as a link between analog to digital converters, or as a solid state relay.

Monsanto is offering the devices for prices ranging from \$20 each in small quantities to \$10 in quantities of 1,000 or more. The circuits are packaged in low-cost, high-volume molded plastic packages.

A similar unit is sold by Texas Instruments: The TIXL 101-103 sells for prices ranging from \$70 each in small quantities to \$20 in large quantities. The electrical specifications are similar to those of Monsanto but units are hermetically sealed.

The MCT-1 will be competing with optical switches that use incandescent lamps and cadmium cells. These devices are slower, decay rapidly from heat, and are not compatible with integrated circuits.

Specifications at 25°C

Light-emitting diode forward voltage	1.3 v typical 1.5 v max
reverse current	0.15 μ a typical 10 μ a max
Detector breakdown voltage collector to emitter emitter to collector	30 v min 7 v min 12 v typical
collector dark current	2 na typical 75 na max
Coupled d-c current transfer ratio	20% min 35% typical
bandwidth breakdown voltage	300 khz typical 2500 v min
LED to Detector resistance rise and fall time	10^{11} ohms typical 2 μ sec typical

Monsanto Electronic Special Products, 10131 Bubb Rd., Cupertino, Calif. [349]

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Weston Model 1290
\$204

Then there's our less expensive model.



Weston Model 1260
\$99.50

We brought out our 3½-digit compact DPM* just last March. It's the one that plugs into a panel slot only seven inches square, and pulls out for servicing or replacement. If you need the accuracy of 3½ digits, Model 1290 is still your best buy. But if you can settle for a digit less, you can have our new Model 1260 at less than half the price. Don't be fooled by the price tag, though... there's nothing "cheap"

about this 2½-digit version. Housed in the very same plug-in case and fully compatible with its more sophisticated brother, Weston Model 1260 offers 0.5% ±1 digit accuracy—with far greater resolution capability than mechanical movements provide. Full scale reading is 199, with 25% over and under-range capability, remote command signal and Weston's usual high rejection characteris-

tics. In addition to the convenience of front panel pluggability and circularly polarized viewing, we've included front panel calibration as a built-in bonus feature on the 1260. Write to the originators of the DPM. WESTON INSTRUMENTS DIVISION, Weston Instruments, Inc., Newark, N.J. 01774.

a Schlumberger company

WESTON®

Mixers have low intermodulation distortion

Three models of double-balanced units cover 10 khz to 1000 Mhz;
Schottky barrier diodes provide uniformity, low noise figure

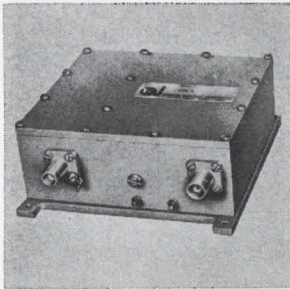
In the old days, nobody paid much attention to the r-f signals, says Robert Sproul, vice president and director of engineering at Lorch Electronics. "If a mixer did a good job of isolating the local oscillator's signal from the i-f output, everything was alright. The difference in frequency between the r-f and the i-f signals was so great, it didn't make much difference how much

of the r-f got through. But with the frequency schemes people are using today, you have to be able to keep the r-f out too."

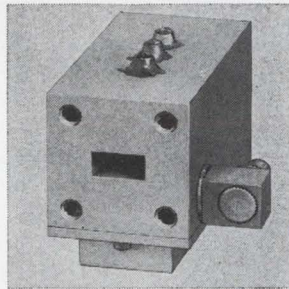
And that's what a double-balanced mixer does, isolate the i-f output from both the r-f and the i-f inputs. Sproul's company makes these mixers and at Wescon will show two new ones that feature low intermodulation distortion.

"The 217/218 has very low distortion and the 234/235 has extra low distortion," says Sproul. "We almost ran out of superlatives."

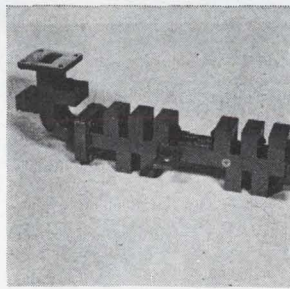
By "extra low," Lorch means that the 234/235 produces third order intermodulation distortion levels of -160 dbm for two tones of -30 dbm. And the corresponding distortion level for two 0 dbm tones is -70 dbm. The 217/218 series



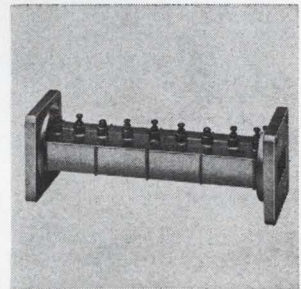
Solid state, crystal controlled pulsed r-f source model S-1001 is a 150-watt unit that covers a frequency range of 100 to 500 Mhz. Frequency stability is rated at $\pm 0.005\%$ and duty factor at 10% maximum. Unit operates from a $+28$ v d-c power supply and in a nominal temperature range from -40° to $+71^\circ$ C. Aerodyne Industries Inc., Willow Grove, Pa. 19090 [401]



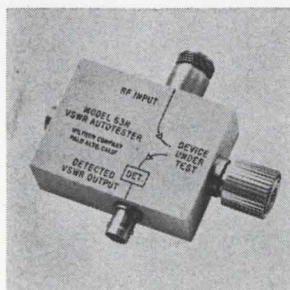
Millimeter diode switches series 750 are designed to operate in the 26.5-40 Ghz band. Spst and spdt types are available. Center frequency for the spst switch is 33 Ghz; bandwidth, $\pm 3\%$; insertion loss, equal to or less than 1 db; isolation, equal to or greater than 30 db; switching speed, 10 nsec; price, \$800. Control Data Corp., 400 Border St., East Boston, Mass. 02128 [402]



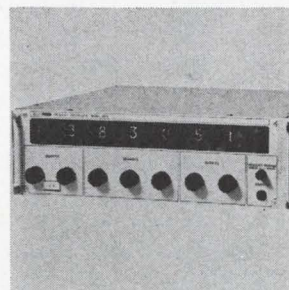
Waveguide band reject filter model FC-1383R consists of two 5-section resonators and one 2-section resonator. Pass band is 7,950 to 8,210 Mhz with phase linearity of $\pm 2^\circ$ maximum and insertion loss of 0.3 db max. Rejection at 7,986 to 8,004 Mhz is 25 db minimum. The unit measures approximately 12 inches long. Gombos Microwave Inc., 40 Webro Rd., Clifton, N.J. [403]



Waveguide and coaxial filters, series FW and FC respectively, are computer designed with precisely controlled phase characteristics. They are available in L through X band and as fixed tuned or tunable units. Model FW4-7.2 covers 7.2 to 8.5 Ghz. Model FCW-1.8 covers 1.8 to 2.3 Ghz. RHG Electronics Laboratory Inc., 94 Milbar Blvd., Farmingdale, N.Y. [404]



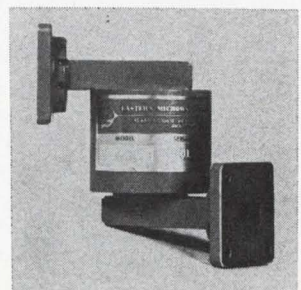
Vswr Autotester model 63N uses the APC-7 precision 7 mm r-f connector and covers the frequency range of 10 Mhz to 4 Ghz with 40 db directivity. The swept frequency vswr measuring range is 1.02:1 to 30:1 using the calibrated vswr oscilloscope gratitudes supplied with the bridge. Price is \$445; delivery, three weeks. Wiltron Co., 930 E. Meadow Dr., Palo Alto, Calif. 94303 [405]



Frequency synthesizer 300A provides stable, coherent signals at frequencies from 1 to as high as 12.4 Ghz. Frequencies can be selected manually by 7 digital switches. Tuning can also be digitally programmed by a 4-wire BCD ± 5 v input to each digit. Resolution is 10 khz. Power output is 15-30 mw min. in each of 4 bands. Micro-Power Inc., 25-14 Broadway, L.I.C., N.Y. [406]



R-f calorimeter 6070 measures power in 50-ohm coaxial systems up to 5,000 w with 3% typical accuracy. Units are available with 1 1/2 in. EIA flanged connectors. Power is quickly and precisely determined from input-to-output temperature differential at a constant flow rate. Vswr is 1.1 max. (d-c to 1 Ghz); 1.2 to 2 Ghz. Bird Electronic Corp., 30303 Aurora Rd., Cleveland [407]

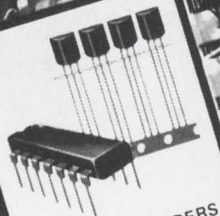


U-shaped, single channel X-band rotary joints series 13-4000 cover the frequency range of 7 to 10 Ghz. The terminations are standard WR-112 waveguide. A typical model, such as the 13-4001, operates over the 7 to 8 Ghz range with 0.20 db insertion loss and a vswr of 1.15:1. Peak power is 250 kw. Eastern Microwave Corp., 139 Swanton St., Winchester, Mass. 01890 [408]

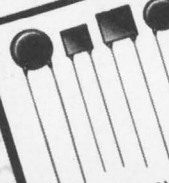
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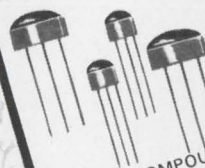
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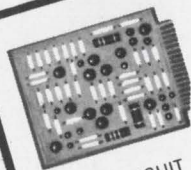
MOLDING POWDERS



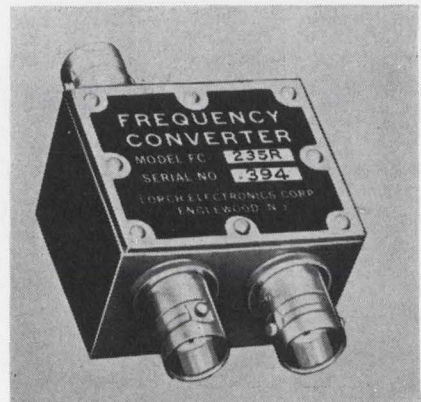
COATING POWDERS



CASTING COMPOUNDS



PRINTED CIRCUIT COATINGS



Good mix. Double-balanced mixer offers low distortion.

has a third order intermodulation distortion level of -145 dbm for two input tones of -30 dbm.

The 2-db compression point occurs at an input level of $+19$ dbm for the 234/235 series. And the 217/218 series reaches the 2-db compression point at $+12$ dbm.

Sproul says no other mixers of equivalent price have such low distortion. "Of course you can go to a FET mixer and do a lot better," he admits, "but that's a lot more money too." The 217/218 and 234/235 are made with Schottky diodes, and are priced at \$130 and \$200 respectively.

The two different model numbers refer to different packaging. The 217 and 234 have pins for plugging the mixer into a circuit board. The 218 and the 235 have connectors.

All four models have noise figures that vary between 6 and 9 db, depending on the frequency. Isolation depends on frequency too; for both r-f and i-f signals, the isolation ranges between 30 and 70 db.

The 217 and the 218 come in frequency ranges of 10 kilohertz to 100 megahertz, 200 khz to 500 Mhz, and 2 Mhz to 1,250 Mhz. The ranges of the 234 and 235 are 10 khz to 100 Mhz, 500 khz to 400 Mhz, and 2 Mhz to 1,000 Mhz.

Sproul feels that this company's new mixers will be of particular use in two areas because of their low susceptibility to intermodulation distortion. One area is in the front end of wide dynamic range receivers and the other is in frequency synthesizers.

Lorch Electronics Corp., 105 Cedar Lane, Englewood, N.J. 07631 [409]

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He-Ne laser gets fine-tuning jobs

Gas unit made to emit at 10,600 angstroms where it can inspect neodymium-doped glass laser rods and align oscillator-amplifier chains

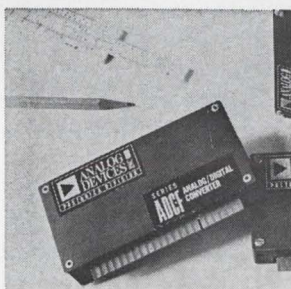
The closest thing to a workhorse among lasers is the helium-neon gas unit. Its power requirements are not demanding, it's easy to operate, and its continuous-wave output makes it useful in jobs from holography to ultrafine distance measurements. Plumbers depend on the He-Ne laser to align long stretches of pipe, and civil engineers use it to help drill straight

tunnels for transit projects.

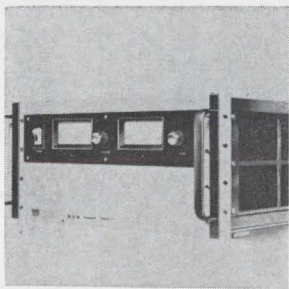
It is also used to align neodymium-doped glass lasers, but since these are tuned for 10,600 angstroms rather than the standard helium-neon line at 6,328 angstroms, the process is awkward and often inaccurate. This alignment problem has been eliminated by a new He-Ne laser that emits at 10,600 Å. Designated the model

101S, it was developed at the American Optical Co.

"The 101S is a laser for researchers," says its developer, Robert A. Wallace, senior research physicist. "Its wavelength will allow inspection for flaws, dopant concentrations, bubbles, and potential hot spots in Nd-doped laser rods. Its output also is at the proper wavelength for easy alignment of such



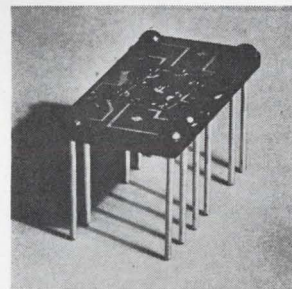
Analog-to-digital converter ADC-F combines successive approximation methods and single card modularity to achieve complete 10-bit conversions within 1 μsec. Differential linearity is within ±½ least significant bit, and relative accuracy is 0.05% for the 10-bit unit, 0.2% for the 8-bit version. Analog Devices Inc., Pastoriza Division, 221 Fifth St., Cambridge, Mass. [381]



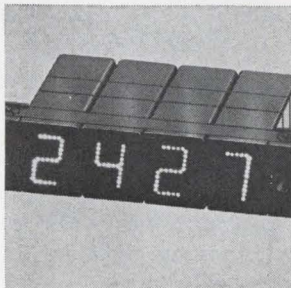
Three 10,000-w power supplies each measure 12½ x 20 x 19 in. Model SCR40-250 is rated 250 amps at 40 v adjustable to zero volts; model SCR50-200, 200 amps at 0-50 v; and model SCR100-100, 100 amps at 0-100 v. Inputs for all are 208, 220, or 480 v, delta or wye connected, 60 hz. Electronic Measurements Div. of Rowan Industries Inc., Oceanport, N.J. [382]



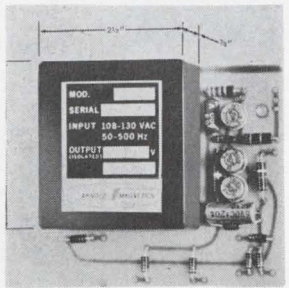
Parametric d-c power supply PDC incorporates the Paraformer which operates as a preregulator providing ¼% regulation to the basic d-c unit, as well as more than 60 db filtering. Units offer ±0.001 v line regulation, 25 μsec response time, 250 μv ripple, and complete transient suppression. Prices start at \$375. Wanlass Instruments, 1540 E. Edinger Ave., Santa Ana, Calif. [383]



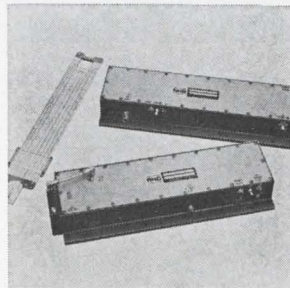
Seven segment light-emitting numeric is an all-semiconductor visible device for use in readouts. Called MAN-1, it is fabricated from red light-emitting Ga As phosphide. Each of the numeric's segments consists of two half segments in series which require only 3.4 v d-c at 0.02 amp for a typical brightness of 200 ft-lamberts. Monsanto Co., 10131 Bubb Rd., Cupertino, Calif. [384]



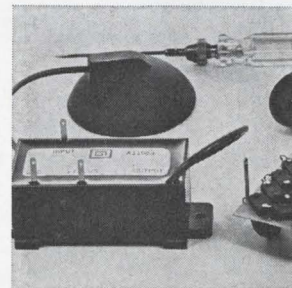
Fiber optic readouts series 900 are available with either solid state or incandescent light sources. They utilize a high intensity dot pattern which conforms to the latest human engineering standards. They are designed to meet the requirements of MIL-E-5400 and MIL-R-39027. Character size is 0.420 x 0.220 in. Master Specialties Co., 1640 Monrovia, Costa Mesa, Calif. [385]



Miniature power supply model PCA-5/500 is capable of mounting directly on p-c cards and contains an IC regulator for delivering highly regulated 5 v power to other circuitry. Total regulation is better than 0.05% for both line and load variations. Size is 2.5 x 2.5 x 9 in. Price is \$75 in small lots. Arnold Magnetics Corp., 11264 Playa Court, Culver City, Calif. 90230 [386]



Miniature, f-m transmitter-receiver combinations series MLT/MLR Mini-Link provide a basic microwave relay link capability for tv, wideband telemetry and multi-channel telephony. They are available at frequencies from 0.7 Ghz to 8.4 Ghz with transmitter output powers up to 4 w. Differential phase is ±0.5°. RHG Electronics Laboratory Inc., 94 Milbar Blvd., Farmingdale, N.Y. [387]

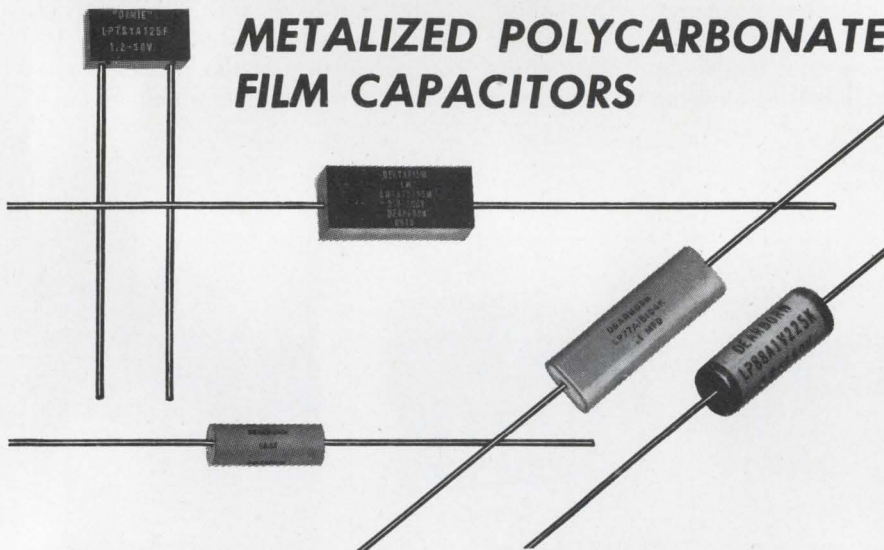


Voltage multiplier for color tv replaces the h-v rectifier tube in the horizontal deflection circuit. It delivers 25,000 v to the picture tube without radiating x-rays. Together with a proper flyback transformer, the output voltage wave shape is approximately sinusoidal with a width of 11 μsec at 15,750 hz. General Instrument Corp., 65 Gouverneur St., Newark, N.J. [388]

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Inspector. He-Ne laser at 10,600 Å is valuable optic-alignment tool.

complex optical cavities as found in Nd-laser oscillator-amplifier chains."

It was an oscillator-amplifier application that triggered development of the 10,600-Å He-Ne laser in the first place. A 10,600-Å He-Ne laser already has been used as a master oscillator in such chains. This makes possible a hybrid system having the modal purity and coherence length of gas lasers, coupled with the high power of glass systems.

Wallace adds that, formerly, "it was necessary to align these chains of mirrors, isolators and Nd-doped rods with the 6,328-Å red light of ordinary He-Ne lasers—then interpolate for fine adjustments because the wavelength was so far from neodymium's infrared wavelength. With 101S, it's a one-step job."

Building it wasn't that simple. There are two other strong lines near the desired 10,600-Å line, and they had to be blocked out; one is at 10,789 Å and the other at 10,844 Å. These are in addition to suppression of the 6,328-Å line.

The eventual solution came in the form of a pair of ultrasharp cutoff mirrors that form the ends of the 101S's optical cavity. They allow light at the undesired wavelengths to pass through while reflecting and relaying light at 10,600 Å.

Output power of the 101S is low—usually about 0.5 milliwatt—but ample for inspection and alignment. Minimum output is 0.25 mw, and the maximum is 1.0 mw.

Price is about \$3,500; delivery takes two to three months.

The American Optical Co., Mechanic St., Southbridge, Mass. 01550 [389]

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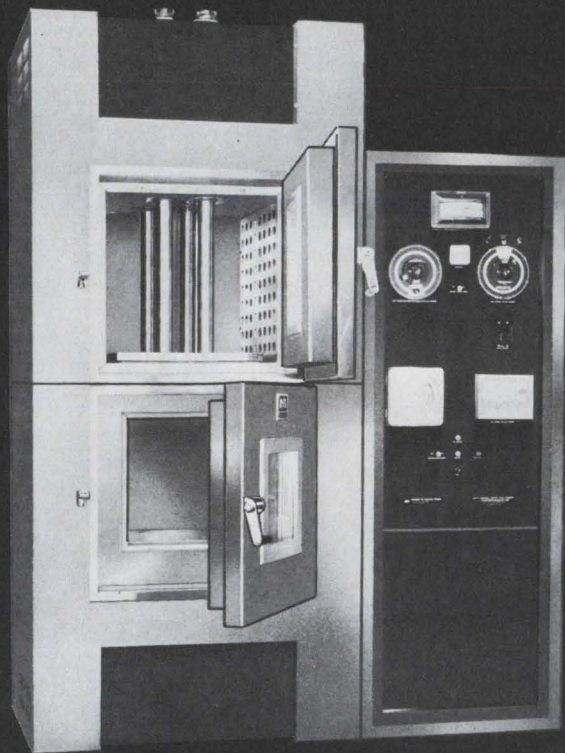
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IC's shrink digital printer's size, weight

Multifunction circuits also cut price of readout device for voltmeters, counters, and data acquisition equipment

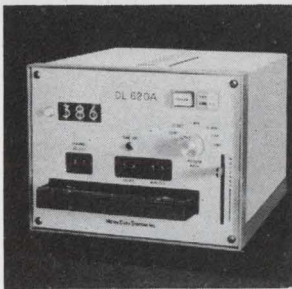
Multifunction integrated circuits have been applied to a digital printer intended for instrumentation applications, making it about one-tenth the size and weight and half the cost of similar printers.

The new unit, developed by California Electro-Scientific, will be shown at Wescon. It can be connected to any of a wide variety of digital readout instruments, such

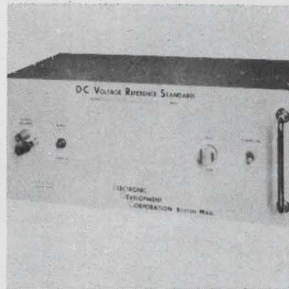
as voltmeters, frequency counters, and data acquisition equipment. It's available with a floating decimal point if desired, and with either positive or negative logic signals in either of two voltage ranges. The input data is binary-coded decimal in the 8-4-2-1 code.

The 12-digit version weighs four pounds and sells for \$920, as compared with 30 pounds and \$2,053

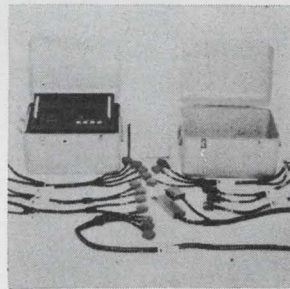
for an 11-digit Hewlett-Packard 562A or 50 pounds and \$1,645 for a 10-digit Franklin 800 printer. Each of the CES machines is also available with a smaller number of digits in its output; for a six-digit printout, the weights and sizes are respectively 3 pounds and \$660, 27 pounds and \$1,553, and 47 pounds and \$1,415. Regardless of the number of digits, the three printers' vol-



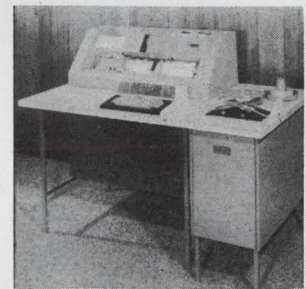
Digital recorder model DL620A contains a front panel presettable real-time clock; an 18-channel analog multiplexer; an analog to digital converter; a cartridge magnetic tape system with associated tape drive unit; plus all necessary logic and power supplies. System accuracy is 0.05% over 0° to 40° C. Metrodata Systems Inc., Box 1307, Norman, Okla. [421]



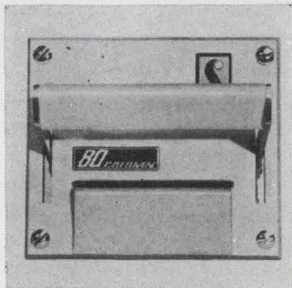
True digitally programmable millivolt calibrator model MV-100P is programmed from BCD logic signals. Various programs may be used, such as: punch tape, punch card, incremental magnetic tape readers, or key board. Full scale output voltage is 166.65 mv. Resolution is 10 μ v. Accuracy is \pm 0.015% of setting \pm 5 μ v. Electronic Development Corp., 423 W. Broadway, Boston 02127 [422]



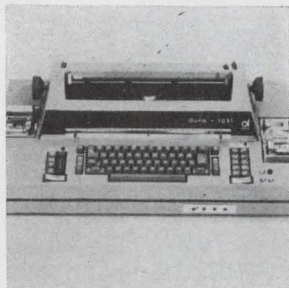
Computer simulator model CS-5001 provides manual operation and control of interface units when they are disconnected from the main digital computer. It consists essentially of six 16-bit registers, 3 addressable buffers, clock and control circuitry, 32 relay drivers, and 16 complementary word drivers. American Computer Technology Inc., Shirley Ave., Northridge, Calif. [423]



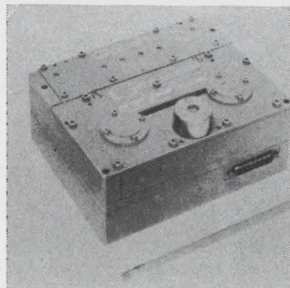
Tape-to-card converter called Edityper can be interfaced to the IBM 029 keypunch. It will convert BCD coded paper tape to Hollerith coded cards at a speed of 18-20 columns a second under program control. Alphanumerics are fix-wired, and codes indicating functions and programs can be plugged in by the user. Epsco Inc., 411 Providence Highway, Westwood, Mass. 02090 [424]



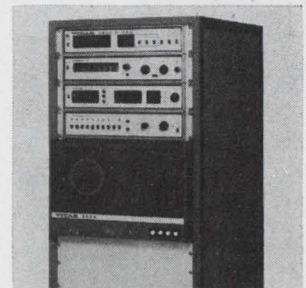
Static card reader Mark II is for 80-column tab cards. Misreads are completely eliminated because the unit includes a positive orientation and positioning system. It features remote sensing of the Hollerith code on the card, and closes full-wiping, switch contacts at every one of the 960 electrical cross-points. Sealectro Corp., 225 Hoyt St., Mamaroneck, N.Y. 10543 [425]



Data terminal 1051 bridges the gap between portable terminals with dial-up capabilities only and permanently located desk-structured, multiunit terminals providing automatic data transmission as well. The unit is compatible with 360 systems and can replace 360 data terminals or operate with them without software charge. Intercontinental Systems Inc., Palo Alto, Calif. [426]



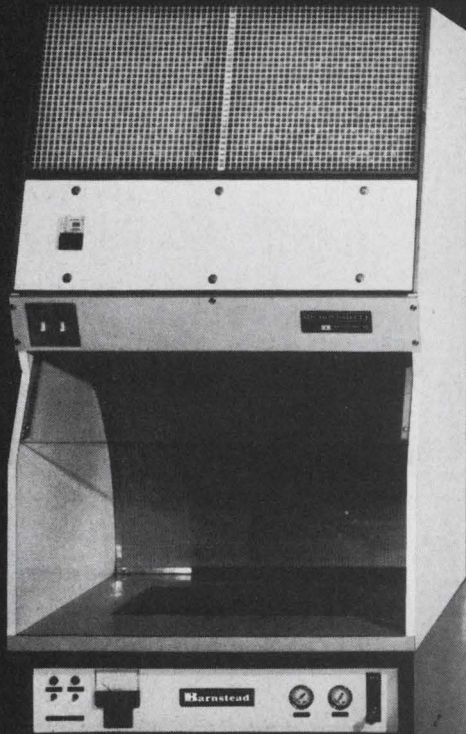
Magnetic tape recorder model 10-236 has operating environmental capabilities that suit it for limited space applications such as torpedoes and rockets. It features tape speeds from 7½ to 120 ips. It has a tape capacity of 300 ft of 1 mil Mylar instrumentation tape, and can accommodate ½-in. or 1-in. tape widths. Genisco Technology Corp., Compton, Calif. [427]



Automatic digital data acquisition systems series 5400 provide test and process data in ready-to-use computer-compatible form without need for intermediate manual data reduction steps. Up to 1,000 data-input channels are accommodated with scanners which expand in 10-channel increments. Prices start at \$4,500. Vidar Corp., 77 Ortega Ave., Mountain View, Calif. [428]

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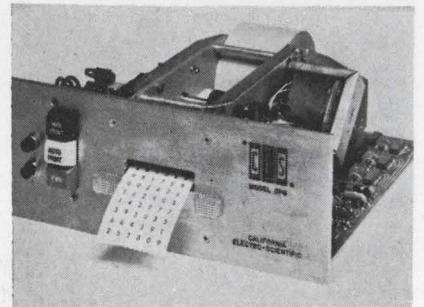
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umes are respectively 300, 3,300, and 1,950 cubic inches.

The small size and weight and the low cost are due largely to the use of multifunction IC's, all mounted on a single circuit board. Other improvements are in the mechanism that turns the print drum and in the use of 60-hertz alternating current to drive the drum, move the paper, and energize the printing solenoids. Thus the printer is free of large and expensive precision motors and direct-current power supplies.

The small printer can be combined in the same package with measuring instruments whose output it prints.

The printer is completely self-contained, requiring only a cable to the measuring instrument; the cable would contain four wires for each digit position printed, plus one wire for functions such as print command, paper advance (for blank spaces between successive



For the record. Small printer can be designed into a combined package with measuring equipment.

printouts) and data hold (to shut out new data inputs during a print cycle). In addition, one wire per digit position is required for the optional floating decimal point feature. Thus the cable could contain as many as 63 wires.

A single output line is printed in 400 milliseconds; the maximum print rate is thus $2\frac{1}{2}$ lines per second—somewhat slower than competitive machines. For continuous operation, the printer is limited to one line every five seconds, or to a burst of 50 lines at the maximum rate followed by an idle time of at least one minute. Faster operation presumably leads to overheating.

California Electro-Scientific, S. Grand Ave., Santa Ana, Calif. 92705 [429]

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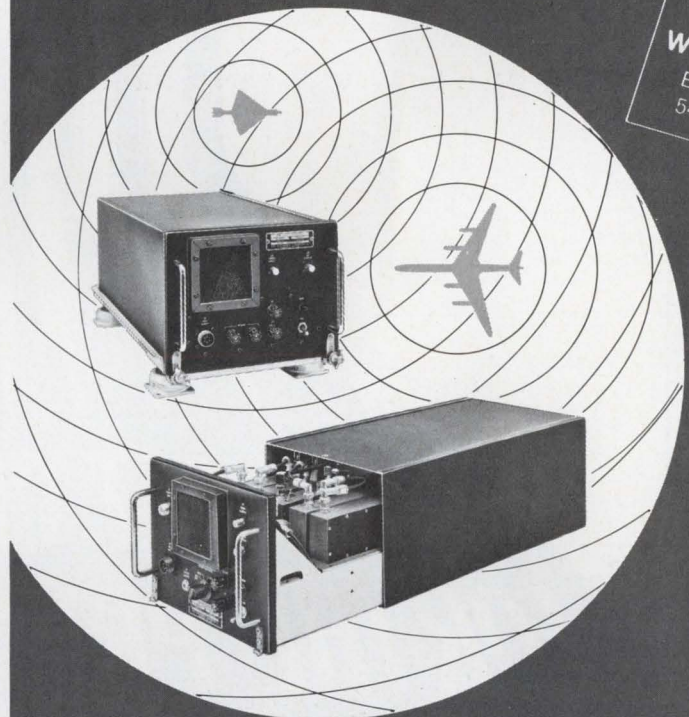
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Video i-f amplifier goes on a chip

Two-stage circuit with 53-decibel power gain opens the way for widespread use of IC's in black-and-white and color tv sets

Television-set makers say there are two main reasons why they're dragging their feet when it comes to replacing discrete components with integrated circuits: IC's still cost more than discretely, in spite of recent price slashing, and they generally don't perform any better. "Maybe the use of IC's is a good marketing ploy," says one engineer, "but we don't think that's a good

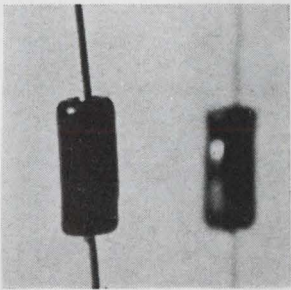
enough reason for a changeover."

Semiconductor producers aren't about to debate these points in the open, since the set makers are still their biggest customers. "They're coming around," says a Motorola Semiconductor spokesman. "They started with the sound section, and moved to the chroma demodulator. We're betting the video i-f amplifier will be next," referring specifi-

cally to his MC1352P.

Designed for use as the first and second video intermediate-frequency stages of a black-and-white or color tv set, MC1352P is an IC consisting of an automatic gain control section and an i-f signal amplifier that's subdivided into a bias and output section.

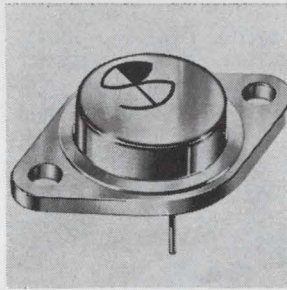
The agc section requires a gating pulse, a reference level, and a com-



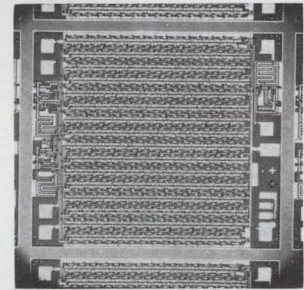
Hybrid hot-carrier diodes 5082-2810/11 have low junction capacitance (1.2 pf), high forward conductance (20-35 ma at 1 v), and low turn-on voltage (410 mv). These, plus near absence of recovery time, provide excellent rectification efficiency well into the microwave range. Piv is 20 v (2810) and 15 v (2811). Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif. [436]



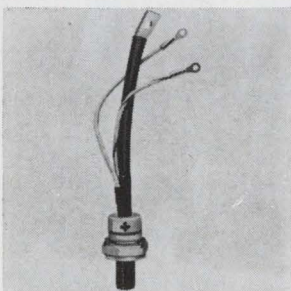
Planar p-i-n switching diode VSD-211 offers a typical switching speed of 10 nsec, and will operate over a wide dynamic range of r-f series resistance from 1.4 to 15,000 ohms. It will perform efficiently over a frequency range from 1 to 18 Ghz, depending upon r-f power and package parasitics. It operates from -65° to +175°C. Varian, Salem Rd., Beverly, Mass. [437]



Silicon high-power transistors with collector-emitter voltages up to 300 v come in the JEDEC TO-3 package. They feature power dissipation at 25° C of 350 w, extremely low saturation resistance (as low as 0.30 ohm) as well as low leakage currents and thermal impedance. Maximum collector current is up to 30 amps. Solid Power Corp., 440 Eastern Pkwy., Farmingdale, N.Y. 11735 [438]



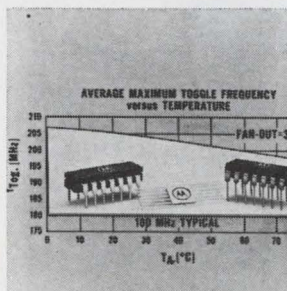
Dynamic MOS shift register EA1205 is a 256-bit device that utilizes a one-phase, 9-v, low input capacitance clock. At 1 Mhz operation, 4 packages of the EA1205 can be driven by less than 2 mw of one-phase clock power. Unit comes in TO-100 or hermetic dual in-line packages. Price (100-999, TO-100) is \$30 each. Electronic Arrays Inc., 501 Ellis St., Mtn. View, Calif. [439]



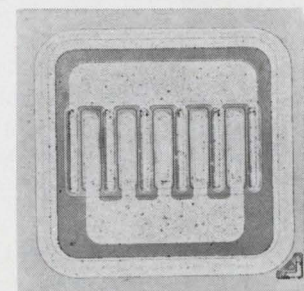
Silicon controlled rectifiers 2615 and 2605 will operate at a junction temperature of 150° C. The 2615 has a forward current of 200 amps rms and is rated at 125 amps half-wave average. The 2605 has a forward current of 275 amps rms and is rated at 175 amps half-wave average. Both have guaranteed dv/dt of 300 v per μ sec. Westinghouse Electric Corp., Box 868, Pittsburgh [440]



Plastic silicon rectifiers series R have piv's ranging from 200 to 1,000 v. Average rectified forward current is 1 amp at 100° C. Maximum d-c reverse current at piv is 2 μ a at 25° C, 100 μ a at 100° C. Maximum forward voltage at rated current is 1 v at 25° C. Maximum operating and storage temperature is -65° to +150° C. Scientific Components Inc., Linden, N.J. [441]



Master-slave type D flip-flop MC1034 toggles at rates in excess of 180 Mhz. It is for use in high speed counter and shift register applications. Both a direct set and a direct reset inputs are provided. Features include an output loading factor of 25, and a worst case maximum propagation delay of 6 nsec at -25° C. Motorola Semiconductor Products Inc., Phoenix. [442]

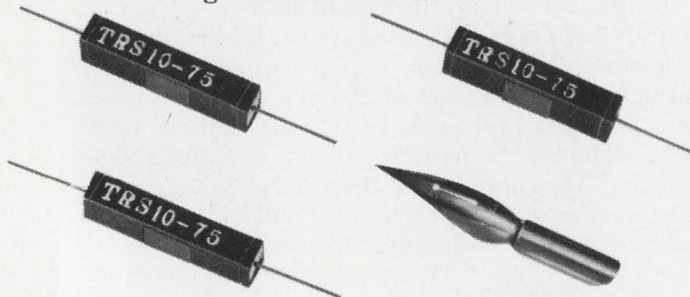


Pnp transistors 2N5455 and -6 are for saturated and nonsaturated switching uses. They have a turn-on time of 20 nsec max. and turn-off time of 30 nsec at this collector current. Switching times are excellent from 10 ma to 500 ma. Units feature 450 Mhz minimum frequency at 30 ma and 6 pf max. capacitance at 10 v. Fairchild Semiconductor, Mtn. View, Calif. [443]

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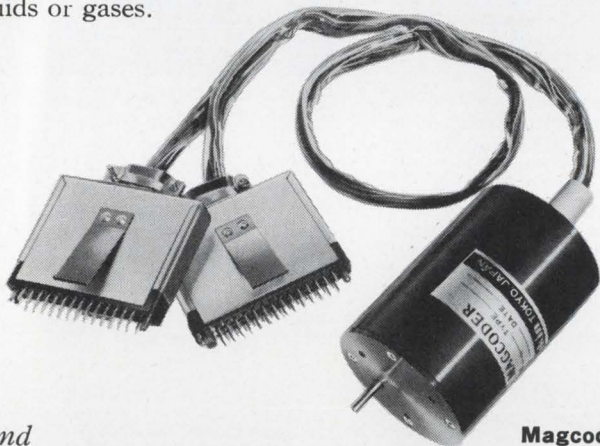


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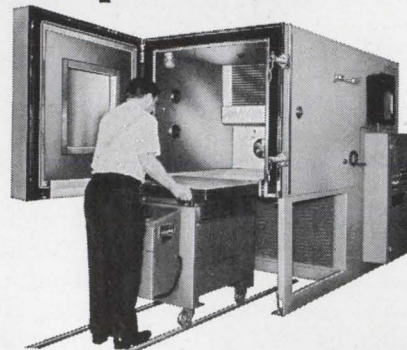
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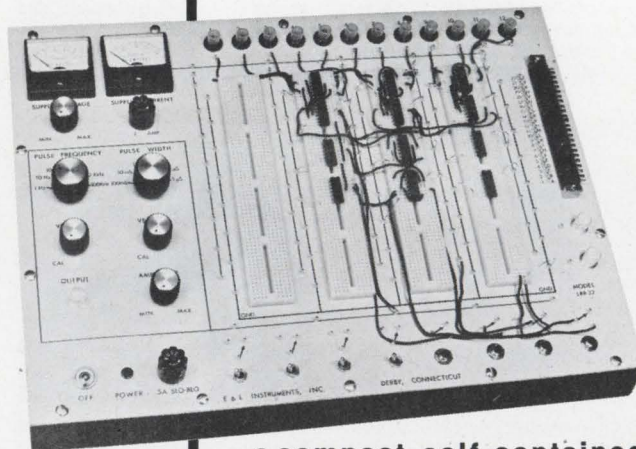
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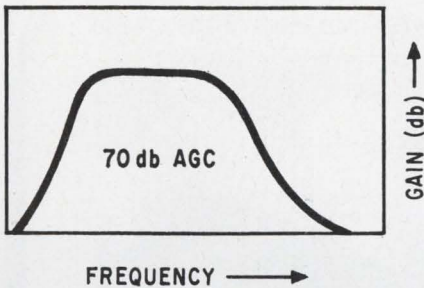
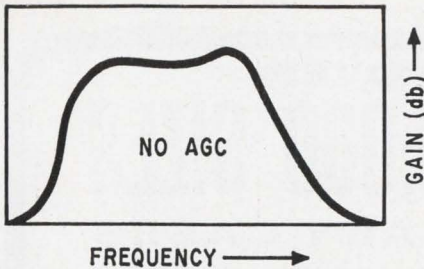


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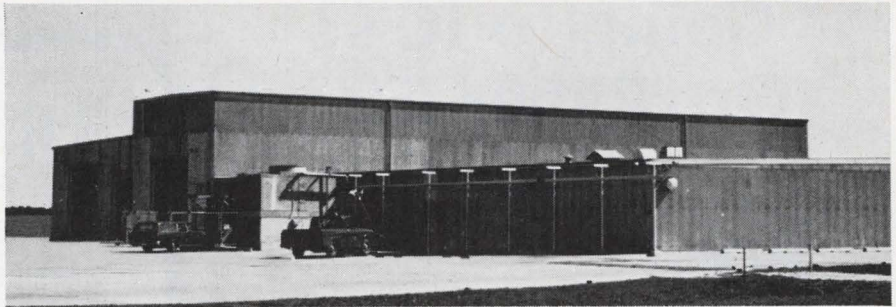
posite video signal for operation. For a particular video level and d-c reference setting, the gating section maintains the proper voltage across the external agc storage capacitor. The capacitor charge is delivered to the circuit coincidentally with the gating pulse. The amount of charge is determined by the video signal amplitude relative to the d-c reference level.

The i-f amplifier section input operates at constant emitter currents to maintain the input impedance independent of the agc action. The input signal can be applied either single-ended or differentially for a-c. The output amplifiers are fed from an active current source to maintain constant quiescent bias to hold the output admittance nearly constant. The collector voltage for the output amplifier is supplied through an external center-tapped tuning coil.

Typically, the MC1352P provides a power gain of 53 decibels at 45 megahertz, and has an agc range greater than 65 db. The output signal change for a 60 db i-f input signal change is 0.3 db, and the forward transfer admittance is 3 db down at 60 Mhz. Reverse transfer admittance is dominated by 1.0 micromho, typical.

The MC1352P is packaged in a dual-in-line plastic case and priced at \$2.75 in lots of 100.

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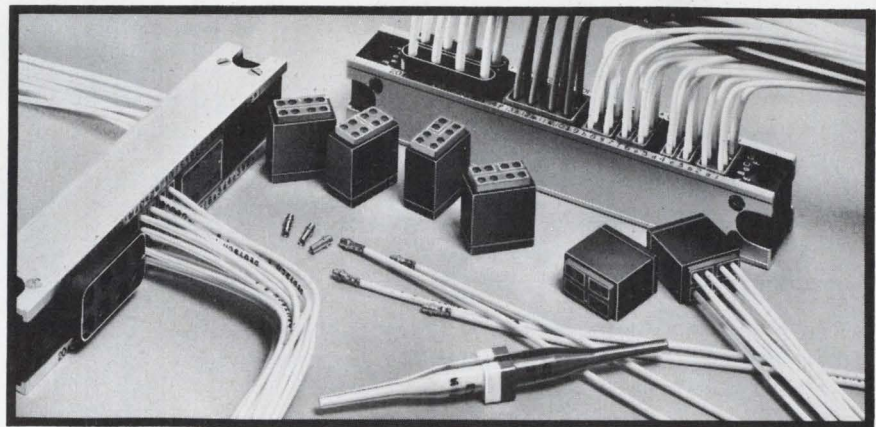
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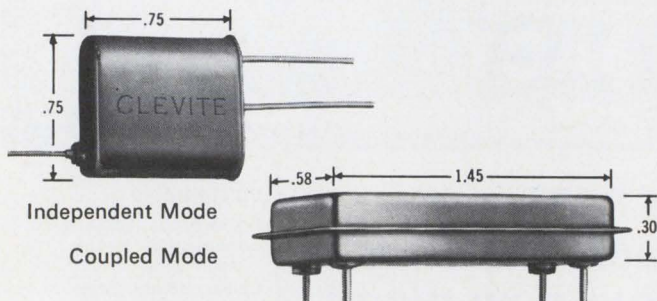
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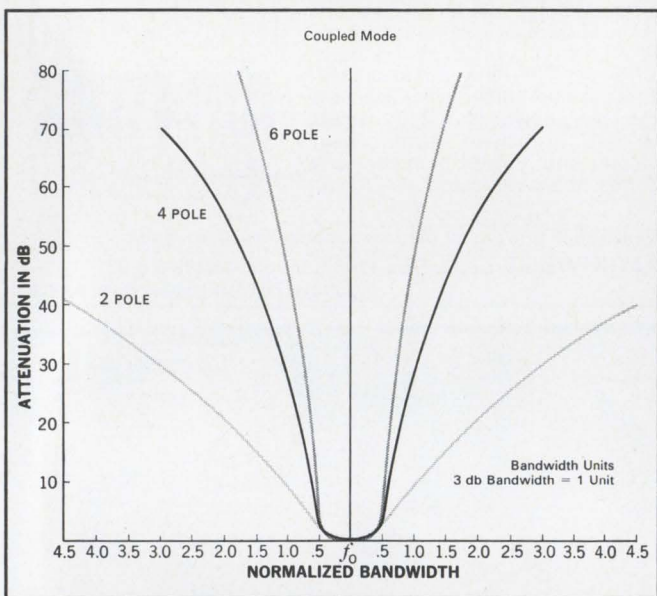
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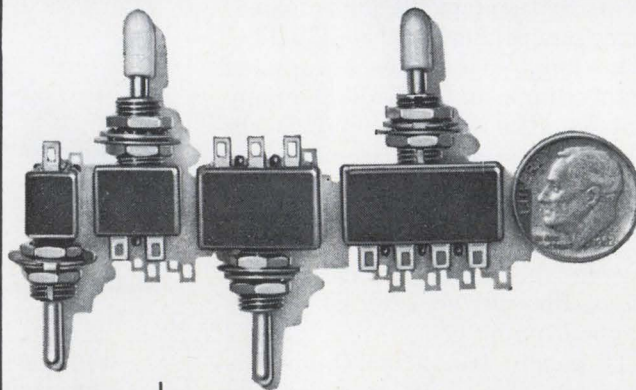
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New semiconductors

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Philco-Ford's tv market entry combines chroma demodulators, oscillator

A color-processing circuit for tv is the latest entry of Philco-Ford's microcircuits division in its push for a larger share of the consumer entertainment products market.

The monolithic integrated circuit, designated CP 1060-A, combines the functions of chroma amplifier, a 3.58 megahertz reference generator, buffer, and X and Z chroma demodulators on a single chip. All that's required for operation is a frequency-selective crystal and suitable inductive elements.

The IC can be hooked up in an automatic-phase-control loop, an injector-locked oscillator, or crystal-plus-amplifier reference system by choosing the appropriate external circuit components. And it provides a wide choice of demodulation angles, independent phase detection, and color reference phases.

Supplied in a 14-lead, dual-in-line package, the CP 1060-A operates with a supply voltage of 14-30 volts d-c, at 15 milliamperes. Operated in an APC loop, it provides a 12-volt peak-to-peak phase detector reference voltage, a 7-volt peak-to-peak color kill detector reference voltage, and a color difference output voltage of 5 volts, p-p. It also provides an oscillator frequency control of 300 hertz/volt, a pull-in range of ± 240 hertz, and a hold-in range of ± 350 hertz.

The CP-1060-A is now being produced in Lansdale, Pa., where the division in recent months has consolidated its domestic IC production facilities. However, the company says it plans to shift production of the circuit later to its IC plant in Taiwan.

Sample quantities of the CP 1060-A are available immediately from stock at \$1.50 each.

Microelectronics Division, Philco-Ford Corp., Lansdale, Pa. 19422 [445]

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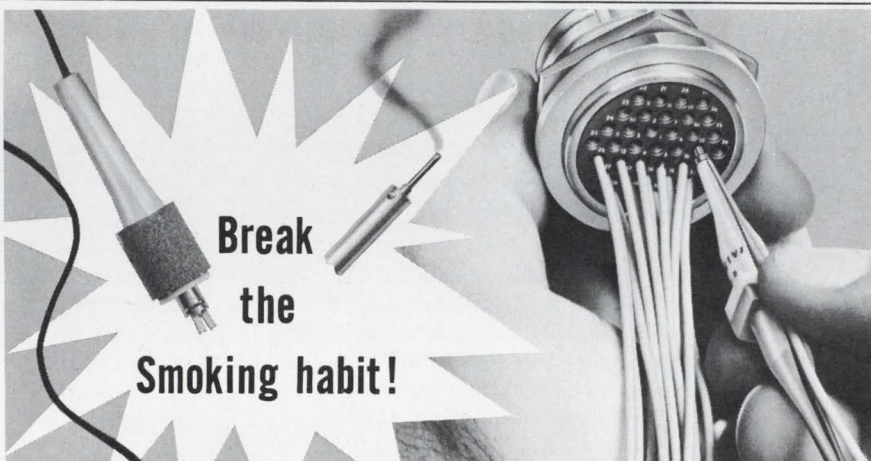
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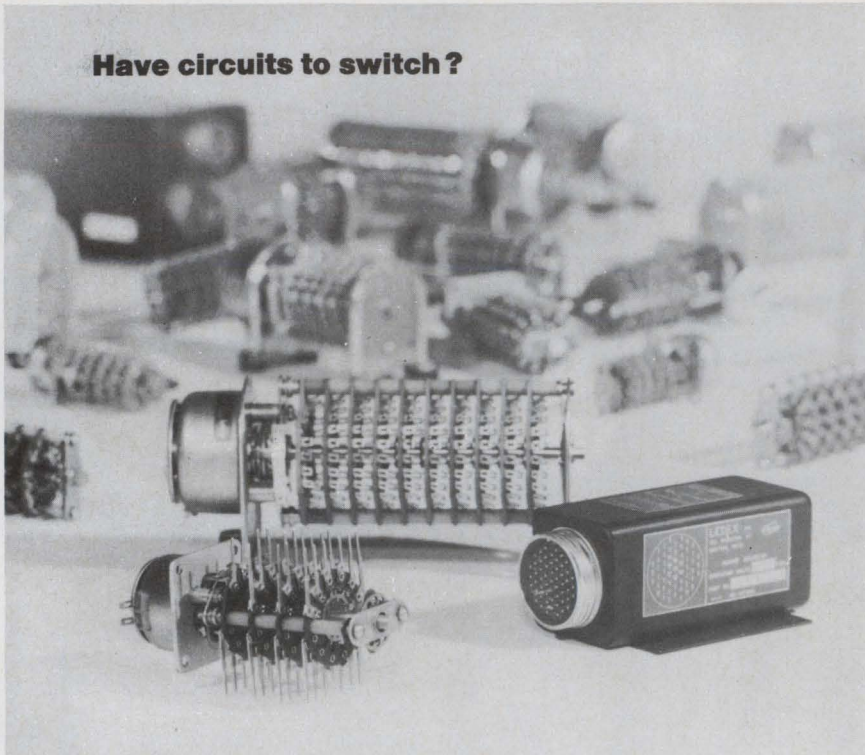
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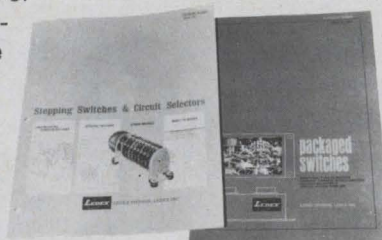
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New Books

Special region

An Introduction to the Theory of Microwave Circuits
K. Kurokawa
Academic Press Inc., 425 pp. \$19.50

Through a discussion of microwave circuit theory, this book, based on a first-year graduate text used in Japan, aims to present the reader with some basic ideas and mathematical techniques. Other branches of engineering and science should also find this information valuable.

The author defines the microwave region as the range of frequencies extending from 1 to 100 gigahertz. He also claims that the techniques of transmitting and controlling electromagnetic power, and the methods used to analyze it are quite different from the techniques used outside that range. At lower frequencies, for example, waveguide structures used at microwave frequencies are now impractical because of the extremely large structural dimensions required. And at frequencies above the microwave range—infrared or optical—the waveguides are impractically small.

In general, the author reasons that it's difficult to solve Maxwell's equations under appropriate boundary conditions. And even if a formal solution is easily gotten, interpreting the results can be so complicated that no useful information can be extracted from it. Moreover he approaches microwave circuits in much the same way as one would approach conventional circuit theory—where resistance, capacitance, and inductance are defined without actually specifying the physical structure or material used. First, the relations between voltage and current at each of the elements are clarified, then the properties of these elements in a complex network are analyzed as a combination of the effect each element contributes.

The microwave circuit framework includes any electromagnetic phenomena that can occur inside a hollow region surrounded by conducting walls; particular emphasis is placed on their effect on the various propagating modes of electromagnetic fields in the hollow

regions. However, electromagnetic waves in free space and those along a dielectric rod or coated wire are not discussed.

In chapter 1, several conventional circuit theory techniques that have particular relevance to microwave circuit theory are reviewed: the theory of transmission lines, bilinear transformations, and power waves. Chapter 2 reviews vector analysis and looks at the fundamental properties of electromagnetic fields. Chapter 3, after discussing the general theory of waveguides and waveguide modes, studies the eigenvalue problem in some detail taking into account the completeness of eigenfunctions. Chapter 4 examines resonant cavities using a similar eigenfunction approach, and in chapter 5, the various properties of waveguide junctions are analyzed using matrices.

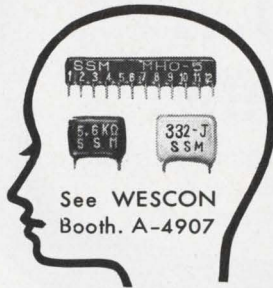
Chapter 6 discusses the coupling between traveling waves and the electromagnetic fields that exist in cavities, and presents some interesting applications of eigenvalues. Although the major emphasis of chapter 7 centers on the evaluation of the noise performance of linear amplifiers, the problems of unconditional stability and unilateral gain are also considered. In addition both negative-resistance parametric amplifiers and tunnel-diode amplifiers are studied. Chapter 8 discusses a circuit-theoretical analysis of electron beams that throws light on some properties of practical interest in most electron tubes, such as klystrons and traveling wave tubes. The last chapter on oscillators uses a simplified model to account for the nonlinearity of the device. It ends with a discussion of oscillator noise and of injection locking oscillators.

Recently Published

Signal Theory, L. E. Franks, Prentice-Hall, Inc., 311 pp., \$12.95

Geared to first year engineering graduate students with some knowledge of linear systems, probability, and random variables, this book presents a step-by-step development of the signal space concept and its application to practical engineering problems. It emphasizes the physical rather than mathematical interpretation of the concept, and delves into discrete signal representations, random-signal processes, integral transforms, and signal properties.

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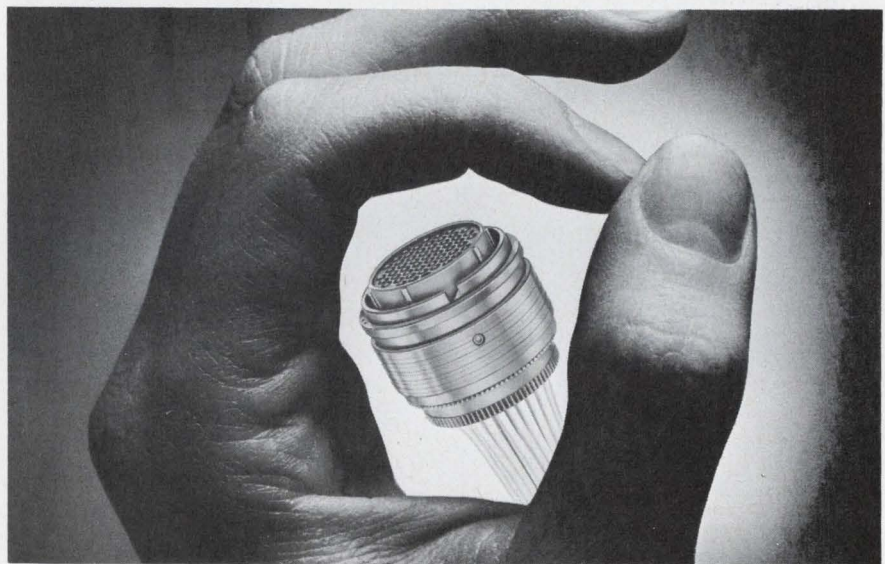
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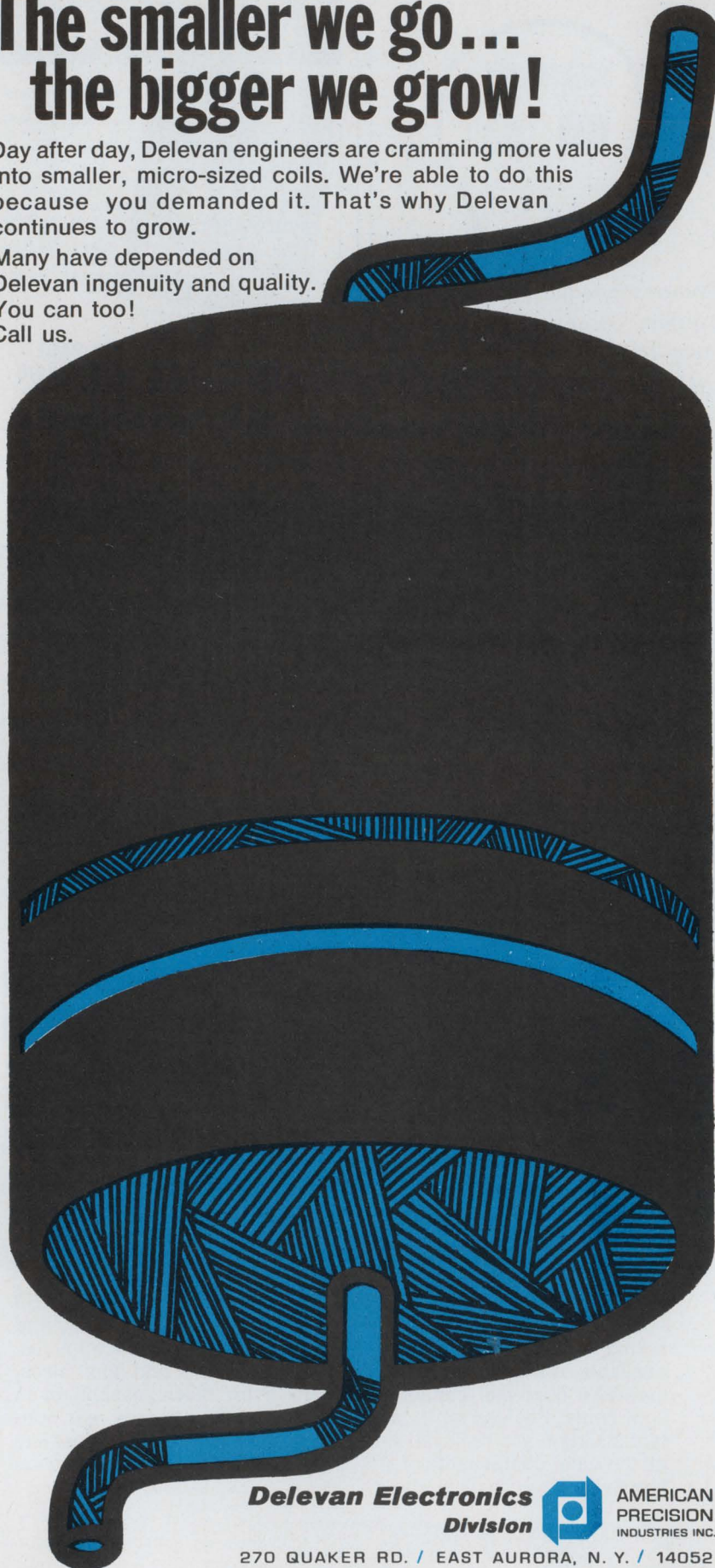
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Technical Abstracts

Clean up

An adaptive equalizer for tv channels
E. Arnon
Northern Electric Co.
Ottawa, Canada

Distortions on coaxial cable lines can mess up color tv signals. This is particularly true for longhaul cable systems (200 miles) which because of their time-varying nature cannot provide the flat response required to maintain high quality tv signals over the transmission distance. Manual equalizers could be used, but they have to be changed every time signals are switched to different routes. As a result they provide little help because adjustments must be made too frequently and take too long.

The solution—an automatic equalizer that consists of a transversal filter—which corrects for delay and amplitude distortions without need for human adjustments. It's applicable to any tv baseband channel and offers the possibility of high grade transmission at lower cost.

The equalizer works this way. At the transmitter a reference pulse is inserted once per frame in the tv signal. This pulse is locked to a 4.6 megahertz crystal oscillator.

The received reference-pulse waveshape is sampled at a rate of 9.2 Mhz; then each sampling point is compared with the corresponding stored reference level. And if the pulse height differs by more than 0.2%, equalizer circuits are activated to correct errors.

The equalizer corrects for both delay and amplitude distortions of 6 decibels, and phase distortions of 105 nanoseconds were reduced to 0.1 db and 8 nsec respectively. The equalizer is capable of handling distortions as large as 7.5 db and 200 nsec.

Actually the equalizer is a 20-tap, 10-megahertz delay line with each section consisting of an equalized length of cable and an isolation circuit to provide a tapping point. The Nyquist rate 1/9.2 Mhz is used to determine delay between adjacent taps—109 nsec. Wideband digitally controlled attenuators control the settings; high stepping rate and fast settling time are achieved by

SCIENCE/SCOPE

A new electronically-scanned airborne radar antenna, the U.S. Navy's first high-performance, X-band multimode, phased-array system, is now undergoing evaluation at Hughes. It has a 36-inch-diameter flat reflecting surface with 2400 radiating elements, and offers distinct advantages over mechanically-scanned gimballed antennas. It is designed for air-to-air search, multiple target tracking, terrain following and avoidance, and ground mapping.

A faster method for measuring the thermal insulating value of sandwich panels for portable shelters, developed recently at Hughes, cuts test time to only two to four hours instead of the three or four weeks previously required.

TV's "instant replay" technique is being used in a military design work study by Hughes engineers. They are using TV cameras to record the operation of command-and-control systems aboard U.S. Navy attack aircraft carriers. The video tape is edited to obtain the complete sequence of operations of various systems, then played back repeatedly for analysis. This enables the Hughes team to suggest improvements in both operating procedures and system design.

A multi-channel, crystal-controlled microwave source developed by Hughes makes it as simple to change channels on airborne data link, radar, and microwave communications systems as to change programs on a TV set. Twelve models are available in the frequency range of 800 to 9600 MHz, each with a choice of four (or even more) discrete frequencies. Modular, EMI-shielded construction permits .005% frequency stability and exceptionally low harmonics.

Safe landings in fog that normally would close an airport may be just around the corner. A Hughes-developed infrared imaging device called FLIR (Forward Looking Infra Red) turns the infrared scene ahead of the aircraft into a real-time display like a TV picture. Initial studies indicate that it may be possible to make safe landings when visibility is as short as 220 feet, depending on the nature of the fog, by using the FLIR in conjunction with existing ILS landing aids.

Hughes needs experienced engineers: Microcircuit, digital communication system analysis, computer systems, digital systems test, signal processing, circuit design, missile guidance & fuze, radar systems, SAF ordnance specialists, real-time and weapon system programmers. B.S. degree, two years related experience, U.S. citizenship required. Please write: Mr. J.C. Cox, Hughes Aircraft Company, P.O. Box 90515, Los Angeles 90009. Hughes is an equal opportunity employer.

A technique for cooling precision-regulated power supplies by immersing the circuits in a coolant has been developed by Hughes engineers. Total size is much reduced and there are no moving parts. The coolant isolates the circuits from airborne contaminants, damps vibration stresses, and has high dielectric strength. One power supply has operated without failure during a seven-year period of round-the-clock testing.

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Technical Abstracts

using solid state linear switches and transient compensating circuits.

Also, since a large number of active circuits that contribute to the over-all noise are used in the equalizer circuits, a special effort was made to minimize any noise build-up. The signal to total noise ratio achieved is 77 db.

Presented at the International Communications Conference, Boulder, Colo., June 9-11.

G-line revisited

Surface wave corridors
Theodore Hafner
Surface Conduction Inc.
New York

Renewed interest is expressed in the G-line, a single-wire transmission medium for sending and receiving communication signals along highways and railways. G-line is a practical tool capable of serving areas requiring broad bandwidth, large channel capacity, and freedom to expand without interference from other communications media. It has been described as a private wave space because it's essentially a nonradiating coaxial line with the outer conductor removed and therefore does not require regulation by the Federal Communications Commission.

Surface wave transmission can be explained by referring to a coaxial cable. If the diameter of the outer conductor of a coaxial cable is increased, the transmission line loss is reduced and at the same time some of the field lines between the inner and outer conductors return to the inner conductor without ever reaching the outer one. If the distance between the inner and outer conductors is made large enough, then all of the field lines will terminate along the inner conductor. Now, since the wave will be propagated only along the surface of the inner conductor, the outer conductor can be omitted for all practical purposes.

These surface wave transmission lines have the advantages of radio transmission and wire transmission of signals, with very few of their disadvantages. While coaxial cable



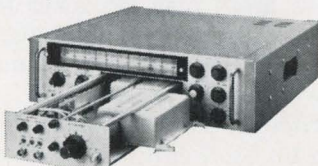
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Model 6151 shown with plug-in drawer capable of holding all dc to 1 Gc oscillators.

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Modulation for every application. Internal 1 KHz squarewave for reflectometer and SWR measurements and 1 KHz sine wave for amplifier response testing. Model 6151 also may be externally amplitude and frequency modulated.

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10 MHz - 1000 MHz	6151-1	\$140
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3. Oscillator Modules		
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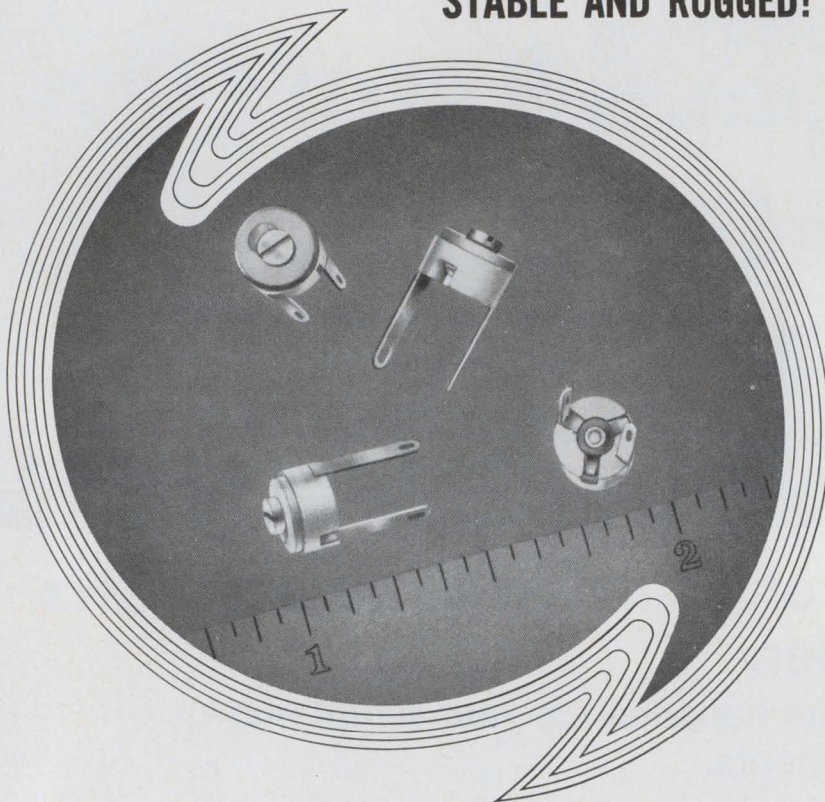
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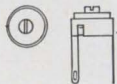
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Technical Abstracts

is free from FCC regulations, its high loss and narrow bandwidth still make it unattractive. Many amplifiers are required to counteract cable losses, and the over-all signal-to-noise ratio is decreased. Radio transmission, on the other hand, has lower loss and broader bandwidth than coaxial transmission, but it uses the public air space and is therefore controlled by the FCC. The G-line has a loss of approximately 8-10 decibels per mile at very high and ultra high frequencies and a bandwidth of at least 200 megahertz.

The field around a G-line can be extended to adequately cover a highway or railway. Any objects moving in the field will disturb it and the distance to that object can be determined. Because of these field properties, the G-line, in addition to acting as a low-loss transmission line, can sense the position and speed of nearby objects.

Presented at the International Communications Conference, Boulder, Colo., June 9-11.

Simple subtraction

Noise reduction in wideband atmospheric receiving systems
W.L. Taylor, H.M. Burdick, and L.W. Eichacker
Institute of Telecommunication Sciences
Boulder, Colo.

Low-frequency receiving systems operating in the range from a few hertz to several kilohertz are often bothered by interference from electric-field noises and harmonics from 60-hertz power lines. And electric noise fields may be generated by corona discharges, lightning, variations in the line current, and high power radio emissions.

There are several methods that can be used either individually or combined to increase the signal-to-noise ratios by 40 decibels or more. All of them do so by reducing the electric field noise in low frequency receiving systems.

One such method uses a noise-bucking circuit, consisting of a vertical electric antenna that responds to signals plus noise, and an electrostatic antenna that responds only to noise. The noise is



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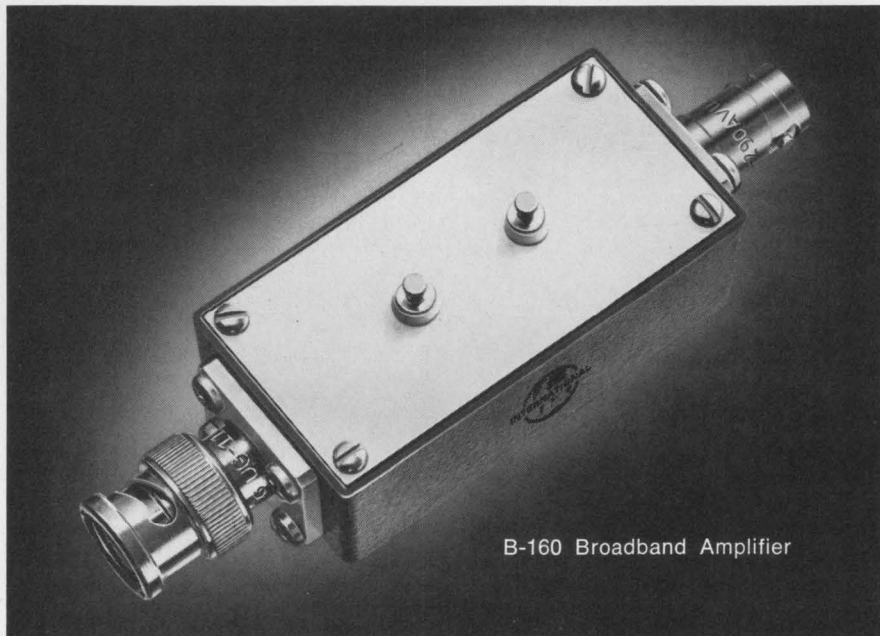
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Technical Abstracts

then subtracted from both the signal and the noise bucker circuits so that only the signal remains.

The vertical electric antenna used was a ¼-inch diameter monopole, 2 meters in length supported by a high input-impedance antenna coupler. The voltage at the base of the antenna was calculated to be 0.55 that of the vertical electric components for the radiation, induction, and electrostatic fields.

The electrostatic antenna was a 1-meter aluminum strip, 12 centimeters above a ground plane and 1 centimeter above a shielded antenna coupler input. The voltage supplied to the antenna coupler was 0.049 that of the electrostatic field component and 0.0038 that of the radiation and induction components.

Assuming the noise is composed of the electrostatic field E_v for the vertical antenna and E_e for the electrostatic antenna, then equal noise voltage is obtained when $0.55E_v = 0.049E_e g = 0.049E_v g r^3$ where g is the relative gain of the two antenna couplers and r is the distance ratio to the noise source for the two antenna systems, assuming that the electrostatic term varies as the inverse cube root of distance. With $r = 4$, $g = 0.175$ for the antenna coupler outputs to be equal. The electrostatic term of the noise can thus be canceled by the differential amplifier in the noise bucker.

Presented at the International Communications Conference, Boulder, Colo., June 9-11.

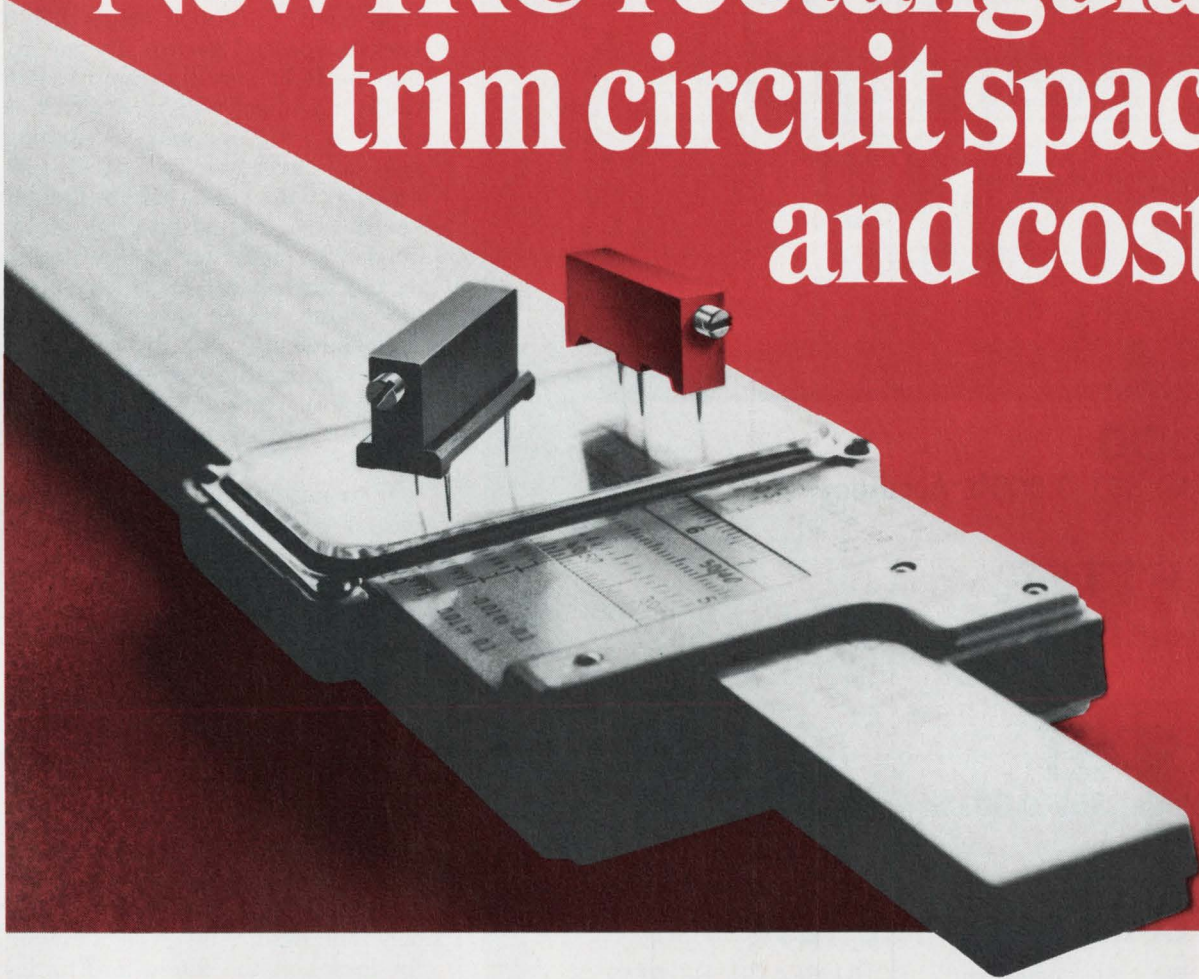
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Electronic color separation with laser light sources
D. Meyerhofer, A.W. Stephens and J.J. Walsh
RCA
Princeton, N.J.

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Now color separations can also

New IRC rectangular trim circuit space and cost



Metal Glaze and Wirewound types

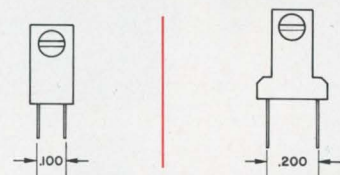
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Technical Abstracts

be produced photoelectrically using color scanners—high quality facsimile machines. These separate light from a scanned original into various spectral groups. By replacing the light sources now used in these machines with a laser, it is possible to increase scanning speeds, use lower sensitivity recording films, and obtain greater enlargement capability. A color correction computer in the facsimile machine drives an electro-optic modulator which modulates the light intensity; and by electronically pulsing the correction signal from the computer, a screened halftone image can be directly generated.

Increasing the radiance of the light source increases the speed of the scanning unit. A high temperature tungsten source will do the job but the tube life is drastically shortened by the higher temperature required. However, lasers with coherent light and essentially infinite radiance reduce this disadvantage. They are now becoming available with power supplies similar to those required for arc lamps, and with comparable efficiencies. The smallest lasers generally available produce about 1 milliwatt of coherent light. And even allowing for losses in the filters and optics the laser offers 100 times more power in a focused spot than the tungsten source.

The output of the conventional scanner is a continuous tone image. One subsequent processing step can be eliminated if screening is performed on the scanner and a halftone image produced. This requires dots of varying sizes to be exposed on a photographic film. Electronic modulation of dot size can best be accomplished by modulating the amplitude of a light pulse with a suitable energy density profile and exposing a high contrast film. Since high contrast films are not sensitive enough to be used with ordinary pulse modulated light that's currently available from a tungsten lamp, the necessity of using a laser as a source is again demonstrated.

Presented at the International Communications Conference, Boulder, Colo., June-9-11.

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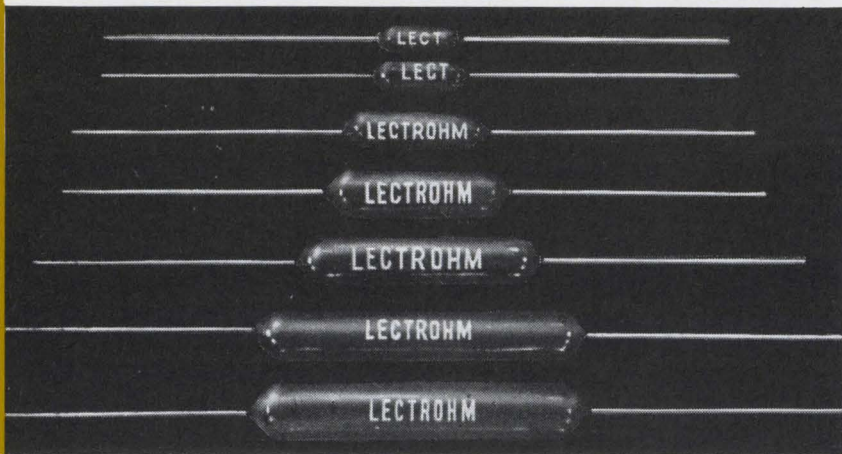


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New Literature

Pushbutton switches. Arrow-Hart Inc., 103 Hawthorn St., Hartford, Conn. 06106, has published a folder introducing Adapt-a-Switch lighted pushbutton switches, non-illuminated pushbutton switches, and indicators.
Circle 317 on reader service card

Capabilities brochure. Datatron Inc., 1562 Reynolds Ave., Santa Ana, Calif. 92705, has issued a 16-page capabilities brochure describing its range of data acquisition systems, timing instrumentation, testing services, and equipment [318]

D-c motors. Newman Co., Motor Division, 36-770 Cathedral Canyon Dr., Cathedral City, Calif. 92234. A two-page data sheet describes a new line of Marx d-c motors that feature low cost, small size, high torque, low voltage and immediate availability. [319]

Chemically created circuitry. Ansley Division of ACI Inc., Park Ave. and Ridge Rd., Perkasio, Pa. 18944, offers a 12-page brochure describing its complete capability for producing all types of chemically created circuitry. [320]

Magnetic tape system. Data Division, Genisco Technology Corp., 18435 Susana Rd., Compton, Calif. 90221. Portability in data recording is highlighted in a four-page brochure on the 10-126 magnetic tape system for severe environment applications. [321]

Resistor trimming bridges. Teradyne Inc., 183 Essex St., Boston, Mass. 02111. A 12-page brochure describes a line of resistor stop-and-test bridges specifically designed for use in the trimming of thick-film resistors. [322]

Removable contact connectors. Continental Connector Corp., 34-63 56th St., Woodside, N.Y. 11377. A data sheet covers a line of new microminiature connectors with wire crimp termination removable contacts. [323]

Silicone elastomer. Technical Wire Products Inc., 129 Dermody St., Cranford, N.J. 07016. Data sheet EMC-850 features the emi/rfi shielding, sealing, grounding and static discharge capabilities of a conductive silicone elastomer called Consil. [324]

Laser and maser modulators. LAD Electro-Systems Inc., 7 Commercial St., Hicksville, N.Y. 11801, has issued a data sheet describing laser and maser modulators that provide from 0.025 to 10,000 joules per pulse. [325]

Stepper motors. Haydon Switch and Instrument Inc., 1500 Meriden Rd., Waterbury, Conn. 06720. Bulletin 31300 describes a new line of two-wire stepper motors. [326]

TTL integrated circuits. Texas Instruments Inc., P.O. Box 5012, Dallas

New Literature

75222. An 80-page brochure provides data on three transistor-transistor logic IC series—the standard 54/74, the high-speed 54H/74H, and the low-power 54L/74L. [327]

Nickel cadmium batteries. NIFE Inc., Copiague, N.Y. 11726. Booklet AG-700 gives a technical analysis of the pocket plate nickel cadmium storage battery as applied to industrial standby service. [457]

Electronic console. Dunbar-Nunn Corp., 1108 Raymond Way, Anaheim, Calif. 92801. An illustrated six-page brochure describes the Unitrol electronic console for emergency vehicles. [328]

Digital data acquisition. Vidar Corp., 77 Ortega Ave., Mountain View, Calif. 94040. "How To Make Measurements Automatically" discusses the importance of data acquisition in various disciplines and the advantages of automatic data handling over chart recorder/visual/manual methods. [329]

Noiseless potentiometer. Clairex Electronics Inc., 1239 Broadway, New York 10001. A frictionless, stepless, heatless, and noiseless potentiometer is described in Vol. 5, No. 2 of Photocell Forum. [330]

Variable inductors. Sangamo Electric Co., P.O. Box 359, Springfield, Ill. 62705, has available an engineering handbook (bulletin 5104) covering the type NV-4 communications grade, variable inductors. [331]

Permanent-magnet d-c motors. Rotamec Inc., 6315 Arizona Pl., Los Angeles 90045, has released bulletin M300 illustrating and describing its line of Super 1¼ permanent-magnet d-c sub-miniature motors. [332]

Data sets. Lynch Communication Systems Inc., 695 Bryant St., San Francisco 94107, offers a product bulletin on the L2103A and L2103F solid state data sets. [333]

Advanced urethane system. Conap Inc., Allegany, N.Y. 14706, has issued technical bulletin P-127 containing complete information on the use of the Conathane EN-2 system for such applications as potting or encapsulating strain-sensitive devices and coating printed circuits. [334]

Transistor sockets. Robinson-Nugent Inc., 800 E. Eighth St., New Albany, Ind. 47150. Fabricated and molded transistor sockets are featured in a broad line catalog. [335]

Industrial electronics. Texas Instruments Inc., Box 5012, Dallas 75222. Twenty-two page bulletin CB-100 features a number of case histories that point out how industrial companies

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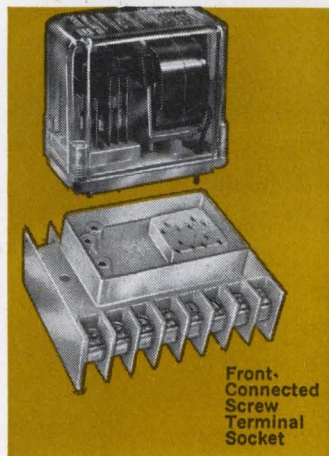
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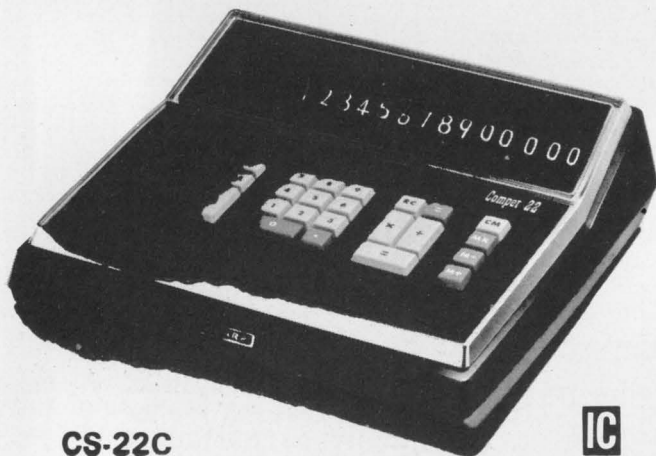
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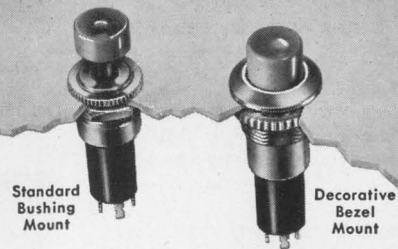
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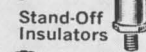
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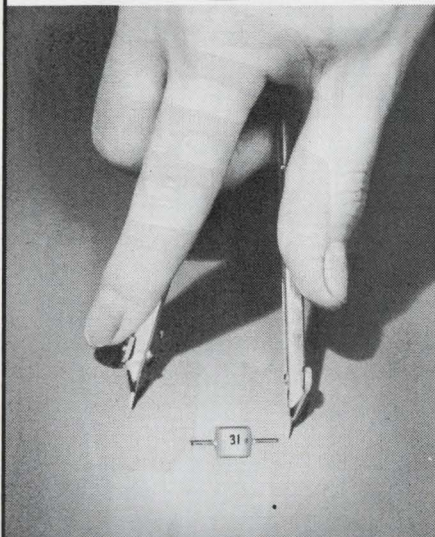


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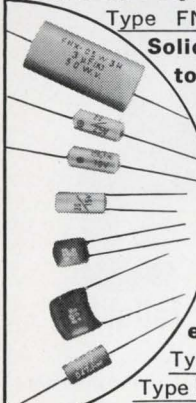
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New Literature

have dramatically improved their designs by using solid-state electronics. [466]

Rectifiers and diodes. Unitrode Corp., 580 Pleasant St., Watertown, Mass. 02172. Forty-page catalog C-159 covers a line of controlled avalanche, fused-in-glass rectifiers, zener diodes, and MIL-type devices. [336]

R-f power measurement. Bird Electronic Corp., 30303 Aurora Rd., Cleveland 44139. Short form catalog SF-69 lists nearly all the coaxial load resistors, absorption wattmeters, and directional wattmeters stocked by the company for r-f power measurement. [468]

D-c power supplies. Dressen-Barnes Electronics Corp., 250 N. Vinedo Ave., Pasadena, Calif. 91107, has available a short form catalog containing specifications, dimensions and prices on 631 d-c power supplies, overvoltage protectors and filters. [337]

Signal storage tube. Warnecke Electron Tubes Inc., 175 W. Oakton St., Des Plaines, Ill. 60018. A four-page brochure features the RW-6EM high resolution (2,000 tv lines), dual gun, electrical signal storage tube. [338]

Digitally controlled power. Hewlett-Packard Co., 1501 Page Mill Road, Palo Alto, Calif. 94304, offers a 22-page brochure dealing with the characteristics and applications of digitally controlled power sources. [446]

Coil winding service. James Electronics Inc., 4050 N. Rockwell St., Chicago 60618, has issued a facilities report detailing an automatic programmed coil winding service. [447]

Optical incremental encoder. Sequential Information Systems Inc., 66 Saw Mill River Rd., Elmsford, N.Y. 10523. A four-page product bulletin describes the company's optical incremental encoder series 25D. [448]

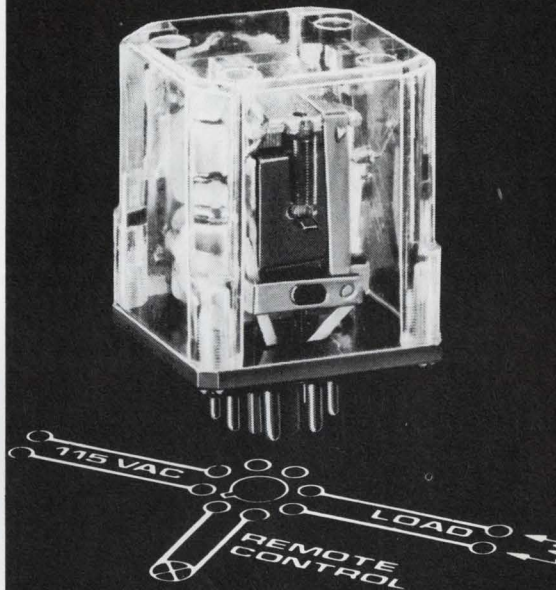
Ruggedized tape transports. Genisco Technology Corp., 18435 Susana Rd., Compton, Calif. 90221. Ruggedized tape transports for a wide variety of severe environment applications are described in a short form bulletin [474]

High-temperature inks. Aremco Products Inc., P.O. Box 145, Briarcliff Manor, N.Y. 10510. Product bulletin 530-534 is a single-page data sheet describing high-temperature and corrosion-resistant inks. [449]

High-power hybrids. Silicon Transistor Corp., East Gate Blvd., Garden City, N.Y. 11532, has released a four-page illustrated brochure on its diversified line of high-power hybrids. [450]

Coaxial cable delay lines. Phelps Dodge

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New Literature

Communications Co., 60 Dodge Ave., North Haven, Conn. 06473, has published a four-page catalog describing representative examples of coaxial cable delay lines. [477]

Analog computer. Astrodata Inc., 240 E. Palais Rd., Anaheim, Calif. 92803. A 16-page illustrated brochure describes the Comcor 550 analog computer. [452]

Quartz crystals. K-W Industries Inc., P.O. Box 508, Prague, Okla. 74864, has released a bulletin containing a list of quartz crystals in the range from 50 khz to 200 mhz. [453]

D-c/a-c converters. Carter Motor Co., 2711 W. George St., Chicago 60618. A complete line of d-c to a-c rotary converters is presented in a condensed catalog. [454]

Metalized polyester capacitors. Engineered Components Co., 2134 W. Rosecrans Ave., Gardena, Calif. 90249, offers catalog C/4-69 describing a line of 50-volt Flat-Pak, axial and radial lead metalized polyester capacitors. [455]

Laser optical components. Oriel Optics Corp., 1 Market St., Stamford, Conn. 06902. A 26-page catalog section on laser optical components includes a wide variety of precision substrates and high efficiency laser coatings. [456]

Clutches and brakes. Stearns Electric Corp., 120 N. Broadway, Milwaukee 53202. Fully assembled, ready to install electric clutches and brakes are described in 16-page bulletin 536. [485]

Remote batch computer service. Westinghouse Information Systems Laboratory, 2040 Ardmore Blvd., Pittsburgh, 15221. Four-page bulletin DB24-450 provides information on a problem-oriented remote batch computer service called RITS (Remote Input Terminal System). [458]

F-m/f-m telemetering modules. Solid State Electronics Corp., 15321 Rayen St., Sepulveda, Calif. 91343. A 40-page catalog describes f-m/f-m telemetering modules including voltage controlled oscillators, d-c amplifiers, d-c signal isolators, frequency to d-c converters, tone oscillators, pressure transducers, and laboratory telemetering system. [459]

Measurements survey. Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif. 94304. Application Note 93 is a comprehensive 60-page survey of measurements that can be made with the company's multichannel analyzers. [460]

Ceramic substrates. Bourns Inc., 3231 Kansas Ave., Riverside, Calif. 92507, has available a product bulletin on high

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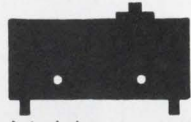
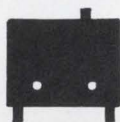
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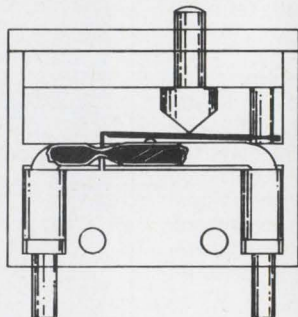
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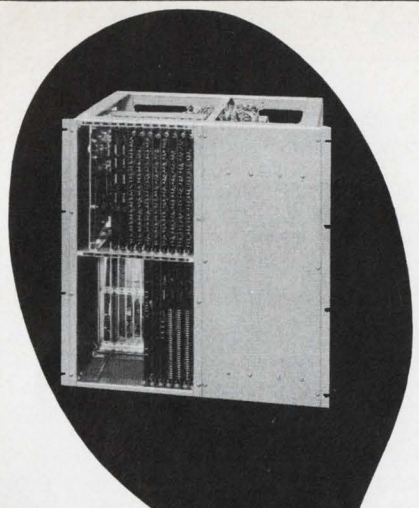
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New Literature

alumina ceramic substrates now being produced by the facility. [461]

Proximity voltmeter. Victoreen Instrument Division, 10101 Woodland Ave., Cleveland, Ohio 44104. A two-page data sheet highlights features of the model 5051 proximity voltmeter, in addition to providing complete specifications and useful engineering information. [462]

Miniature switches. Alco Electronic Products Inc., P.O. Box 1348, Lawrence, Mass. 01842, has released a 20-page catalog featuring an expanded line of miniature electronic switches and keyboard assemblies. [463]

High alumina ceramics. Diamonite Products Mfg. Co., Shreve, Ohio 44676, offers a new edition of "Standards of the Alumina Ceramic Manufacturers Association for High Alumina Ceramics". [464]

Log circuits. Analog Devices Inc., 221 Fifth St., Cambridge, Mass. 02142. A 12-page application note discusses logarithmic feedback principles and circuits for use with operational amplifiers. [465]

Thermal shock test. Blue M Engineering Co., 138th & Chatham St., Blue Island, Ill. 60406. Twelve-page brochure 693 describes the company's expanded line of thermal cycling and shock test equipment. [466]

Instrument knobs. Radial Controls, 2555 E. 55th Place, Indianapolis 46220. An eight-page catalog covering over 50,000 different instrument knobs includes dimensions, price and choice of color. [467]

Electromagnetic circuit protectors. Airpax Electronics, Cambridge, Md. 21613. Twelve-page bulletin 16E-16 describes an economical line of panel mount, single and multipole electromagnetic circuit protectors. [468]

Tape readers. The Superior Electric Co., Bristol, Conn. 06010. A four-page brochure illustrates and describes Slo-Syn photoelectric tape readers. [469]

Count controller. Automatic Timing & Controls Inc., King of Prussia, Pa. 19406, has issued bulletin 310 describing the series 310D impulse count controller [451]

Rear projection readout. Shelly Associates Inc., 111 Eucalyptus Dr., El Segundo, Calif. 90246. Bulletin 69-002 details the BDR-90 ultraminiature rear projection readout. [478]

Emi filters. Erie Technological Products Inc., 644 W. 12th St., Erie, Pa. 16512, has published a catalog sheet on the

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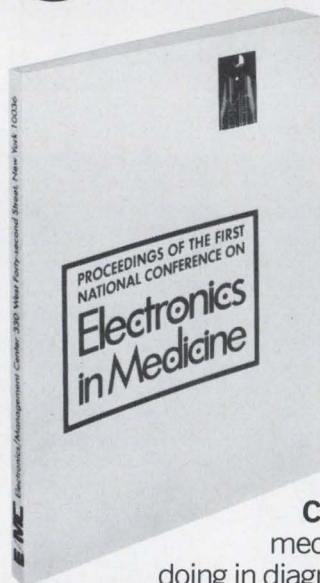
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New Literature

series 1211 hermetically sealed, miniature, low pass emi filters. [470]

Teletypewriter loop module. Quindar Electronics Inc., 60 Fadem Rd., Springfield, N.J. 07081. Product data sheet PDS-2-18 describes the QTL-8 teletypewriter loop module. [471]

Supervisory process control. The Foxboro Co., Foxboro, Mass. 02035. Bulletin L-29 describes the SPC/400, an inexpensive, supervisory digital computer control system. [472]

Insulated flat wire. Tapecon Inc., P.O. Box 4741, Rochester, N.Y. 14612. Data sheet IFW-119 covers insulated flat wire, its specifications, forms, and numerous applications. [473]

Quartz filters. Clevite Corp., 232 Forbes Rd., Bedford, Ohio 44146, has available a data sheet on its standard line of independent mode monolithic quartz Uni-Wafer filters. [482]

Precision switches. Cherry Electrical Products Corp., 1650 Old Deerfield Rd., Highland Park, Ill. 60035, offers its "Design Engineer's Precision Switch Selector Guide", accordion-folded to pocket size. [475]

Controlled environment systems. Bendix Automotive & Automation Co., P.O. Box 893, Dayton, Ohio 45401. Catalog IN-7103-669 covers Modulab controlled environment systems. [476]

Temperature sensors. Pennsylvania Electronics Technology Inc., 1397 Frey Rd., Pittsburgh, Pa. 15235. Technical data 68-9 describes the use of Positemp sensors for liquid level and temperature control. [477]

Wheatstone bridges. James G. Biddle Co., Plymouth Meeting, Pa. 19462. Bulletin 71-11 describes Wheatstone bridges for a wide range of high-resolution resistance measurement. [483]

Indicators. Beckman Instruments Inc., 2500 Harbor Blvd., Fullerton, Calif. 92634, has published an eight-page brochure on the modular series V-5A indicators, for use with transmitters to indicate process variables or measure vacuum, pressure, differential pressure, and temperature directly. [479]

Terminating sets. Lynch Communication Systems Inc., 695 Bryant St., San Francisco 94107, has available a product bulletin on the 2TN15 and 2TN16 coil-type, four-wire terminating sets. [480]

Miniature connectors. RF Components Division of Sealectro Corp., 225 Hoyt St., Mamaroneck, N.Y. 10543. A technical data sheet describes the SRM series of stainless-steel, gold-plated miniature connectors. [481]

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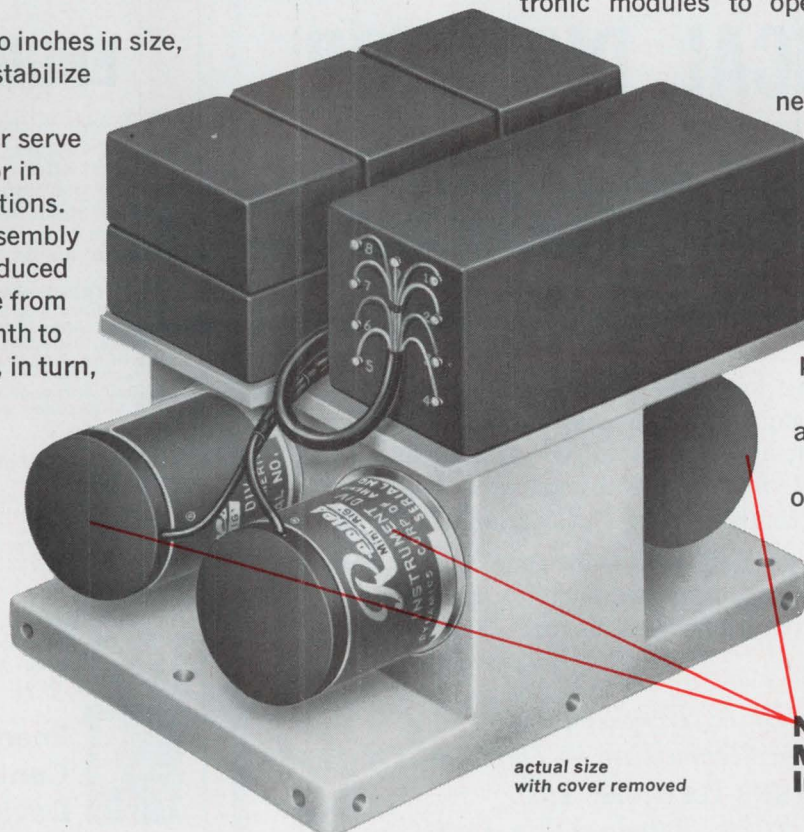
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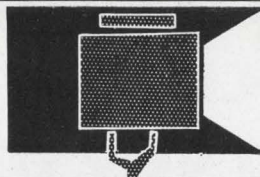
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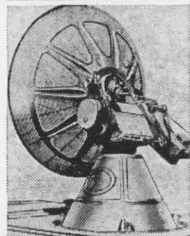
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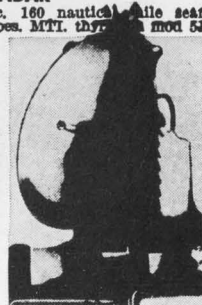
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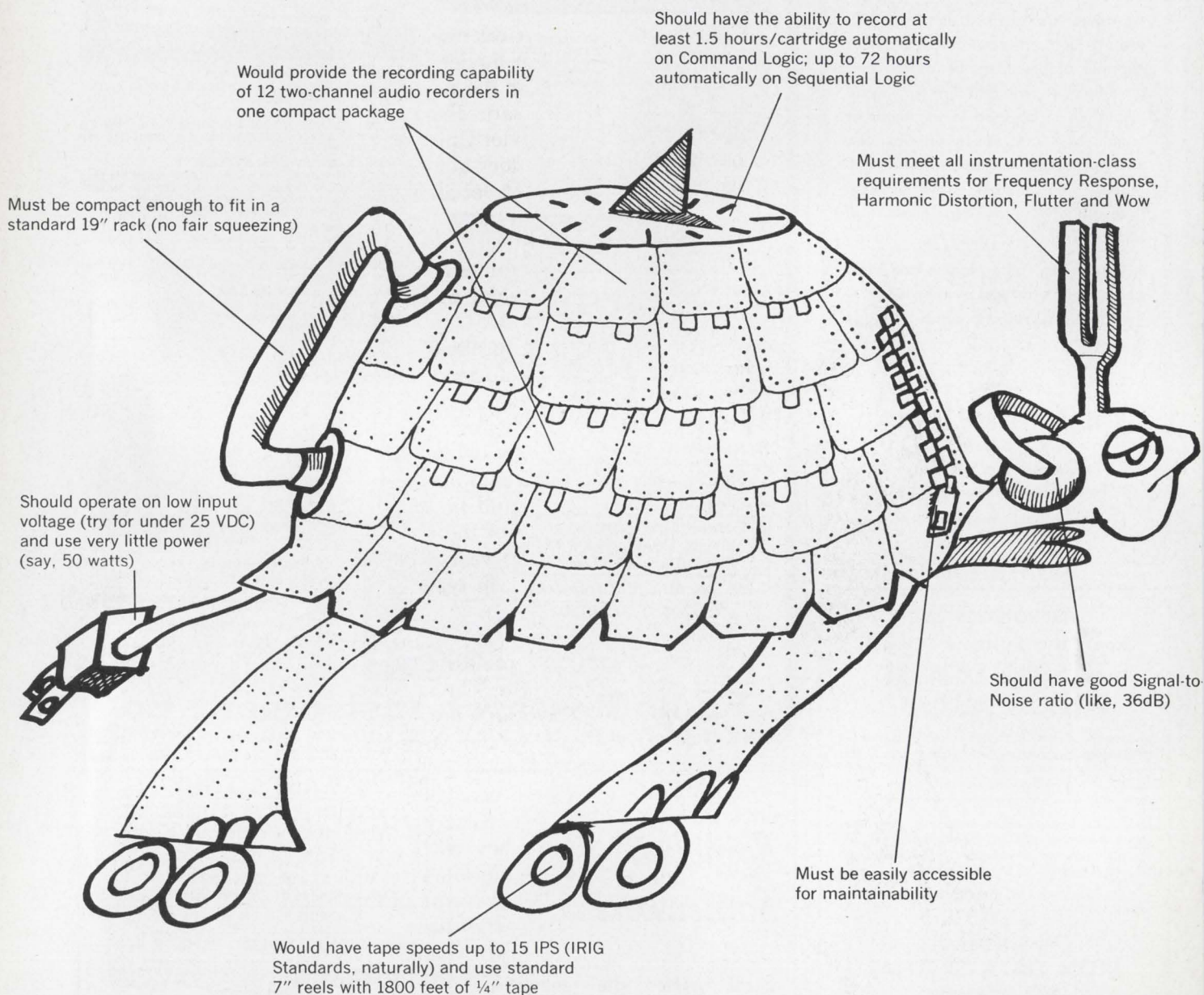
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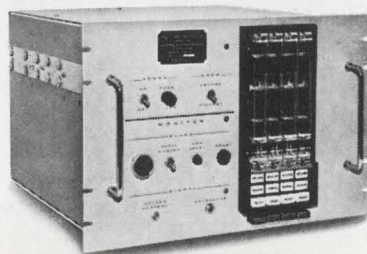
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Circle 226 on reader service card

The MTR-5000

International Newsletter

August 4, 1969

Soviet Union seeks to import color tv plant

Russia is shopping for a color television plant. The Japanese company, Sony, had been asked by the Soviet Union to set up an entire plant capable of making the sets for the newly consumer-products conscious Russians. Sony president Masaru Ibuka says the proposal was made during his recent trip to the Soviet Union. Ibuka says he turned down the request because his company does not have enough production capacity to meet its own needs at present, let alone export production equipment.

Separation first, marriage next?

Look for France's biggest electronics firm, Thomson-Brandt, to try for an out-and-out merger with the major French electrical equipment maker, Compagnie Generale d'Electricite.

The two recently signed a preliminary market-splitting agreement [*Electronics*, July 7, p. 185]. Informed sources say it eventually will be broadened to exclude competition altogether, with CGE turning over its sizeable—and lucrative—radio-tv production to Thomson-Brandt.

Government officials were fully behind the companies' plan to split the electronics and heavy electrical equipment markets. Now, they are saying privately that a full merger would be "desirable" and the "logical outcome" of the deal—and officials of the two companies don't exclude the possibility. A merger could take years to work out, or the firms could spring a surprise announcement, in typical French fashion, at any time.

Microwave oven sales begin to cook in Japan

A new price break, the third in less than a year, is heating up the Japanese microwave oven market. The latest cut in sales price, down to \$272 for a 550-watt unit, was made last week by the two biggest oven vendors, Hayakawa Electric Co. and Matsushita Electric Industrial Co.

Microwave cooking promises to follow the growth curves of stereo hi-fi sets, color television and air conditioners. In 1965, microwave oven production was a slim 3,000 units. Last year, 50,000 were made. At mid-year, sales for 1969 look as if they will reach 200,000 and the manufacturers are gearing up for sales up to half a million next year.

With volume production, microwave ovens from Japan are sure to spill over to export markets. Already Hayakawa is planning to go after the U.S. market. The company says its ovens have passed all the necessary tests, including Underwriters' Laboratories, Federal Communications Commission, and Public Health Service requirements, and should begin showing up in American stores by November.

Nordek may join electronics industry of four nations

Denmark, Finland, Norway, and Sweden may work together on research, development, and production of electronic equipment if a proposal in a draft treaty for a Nordic Economic Union, called Nordek, is accepted.

The treaty covers a wide range of economic, commercial and technical areas, including the creation of a Nordic Customs Union. Although there are some major points of disagreement, most observers feel that the prime ministers of the four nations will work out a compromise when they meet in October and that the Customs Union, at least, will be formed.

If the Customs Union is agreed upon, it would not affect import duties on electronic components and equipment. Since the Scandinavian area is dependent to a large degree on imported components, the Customs Union

International Newsletter

would make it simpler for foreign nations to do business. Customs and tariff paperwork would be reduced, and central warehousing could be established to serve the entire area.

The proposals for cooperation include studies to see just what—if any—joint efforts must be made to insure industry's making full use of electronics; the formation of a Scandinavian Institute for Electronic Technology; and the reorganization of the electronics industry itself through mergers and the creation of larger, better financed producers.

British fast memory development stalled

Now that International Computers Ltd. is the only reasonably certain outlet for the next generation of large, fast, British-made computer-memory stores, development of alternative fast stores is being cut back. **International Computers is apparently opting for the plated-wire store, which puts the Plessey Co. in line as the main—and possibly only—supplier** [*Electronics*, June 9, p. 201]. Standard Telephones and Cables Ltd. now has no plans to manufacture its 250-nanosecond destructive-readout waffle-iron store, despite its claimed advantages of low capital investment and high production yields. And Mullard Ltd. has shelved development work on its proposed 800,000-bit, 150-nanosecond magnetic thin-film store. Mullard says it simply sees no significant outlet for the store until the mid-1970's.

Spare the franc and spoil the market

French electronics markets will shrink this fall—and further still next year—thanks to a government “disinflation” program aimed at cooling the overheated economy and saving the franc. **The government is immediately blocking half of all unspent 1969 plant and equipment credits of state agencies—\$800 million in all—to be released only when inflationary pressures subside.** And President Georges Pompidou has vowed his 1970 budget will rise by only 6%, the smallest increase in a decade and no real increase at all if inflation continues.

This year's budget block will likely hit makers of measuring instruments and data processing equipment. An example: France's major research body, Centre National de la Recherche Scientifique, is having \$11.4 million lopped from its budget and says two-thirds will come from planned lab equipment purchases.

Makers of audio-visual and telecommunications equipment are breathing easy, though, since **the two priority sectors of education and telephone expansion are exempt from both this year's budget freeze and next year's belt-tightening.** And consumer electronics firms are cheered by Pompidou's resolve to increase neither taxes nor credit terms, in order to avoid social unrest. But plant investment will taper down. A government survey shows that industry plans to up its capital outlays next year by only 16%, against the whopping 26% jump expected this year.

ESRO expands launch program

It looks like there will be at least two more Western European satellites. **The European Space Research Organization plans to launch two more scientific satellites to follow the four due to be sent up in the next three years.** The first, set for mid-1974 will investigate cosmic rays. The second, more ambitious, will come a year later. It will park in stationary orbit and contain ten experiments from many European countries, ranging from electromagnetic field measurement to particle-flux sensing.

Odd batch of light-emitting diodes yields a bonus: negative resistance

Hayakawa's GND, made by a simple process, works at room temperature; inherently fast, the four-layered device offers wide range of applications

Serendipity is still an important element in electronic advances. In the latest triumph of accident over planning, engineers at Japan's Hayakawa Electric Co. stumbled onto a simple process for making negative-resistance light-emitting diodes that work at room temperature. Now the company is busily developing applications, ranging from optical computing circuits to communication devices that make use of what promises to be a cheap, versatile new component.

Actually, there may be more to serendipity in this case than mere accident. The manager of the Hayakawa division in which a negative resistance diode was found is Tadashi Sasaki, formerly plant manager at the Kobe Industries Corp., where the Esaki diode was discovered. At Hayakawa, he pushed to get a diode R&D project going in his industrial electronics division.

And, it was the presence of technicians and equipment capable of deciphering the perplexing test results that led to the discovery of the new diode.

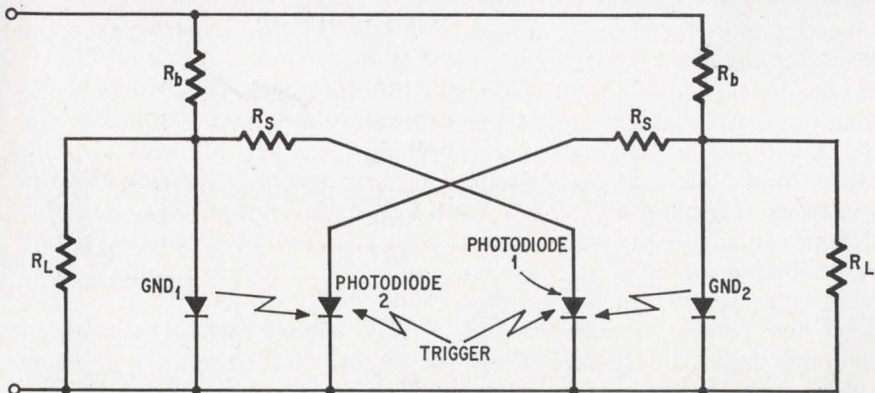
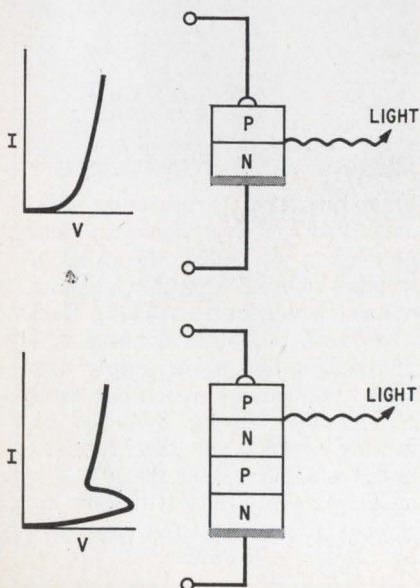
Process change. The new diode was discovered after engineers complained of strange displays on test oscilloscopes after a change in the production process for the company's gallium arsenide light-emitting diodes. Puzzled, they looked further, found that some diodes had been formed with four layers rather than the two they were supposed to have. And these layers were being produced in a single liquid epitaxial process using only one impurity—silicon.

Silicon can act as either a p-type or n-type impurity depending on process conditions. The engineers found that slight temperature changes in the process were causing the growth of a structure with

a 30 micron n-substrate, followed by a 5 micron p-layer, a 5 micron n-layer, and a 100 micron p-layer.

Naturally enough, Hayakawa is not releasing proprietary details, but it claims to have fully understood the process vagaries and can produce the desired characteristics with a high yield. The company has dubbed the new diode the GND, for gallium negative-resistance diode, and plans to unveil it at Wescon later this month.

Other devices of this general type include a p-i-n device developed by T. Yamamoto of Shizuoka University in 1964; a p⁺pn device developed by General Electric in 1964; a p⁺pn device developed by IBM also in 1964, which shows negative resistance at 77°K but not at room temperature; a p-n-n-p device developed by RCA in 1967, which gives laser radiation and a light output that isn't directly pro-



Accentuating the negative. In standard light-emitting diode, current rises with voltage. Hayakawa's device shows negative resistance area. Infrared radiation is emitted at the upper pn junction. Device is adaptable to use as a flip-flop because it can function as a light amplifier with inverting characteristics. In many circuits, the device operates in the same manner as a neon bulb.

portional to current; and a pnpnpn device developed by RCA last year that also gives laser radiation. The operation of devices having intrinsic or p^+ layers depends on the filling up of deep levels which is a relatively slow process.

Most of these devices have a conversion efficiency into infrared output one to two orders of magnitude lower than GND. And many of the devices require several processes for fabrication—for example, diffusion for IBM's device—in contrast with a single epitaxial process for the Hayakawa device.

Speedy. In addition to being simple to produce, the Hayakawa device is inherently fast and easy to design with. It operates by transistor action, a fast mechanism if parameters are correct. Infrared output amplitude at 9,000 angstrom units is about 50% higher than similar light emitting diodes without negative resistance when both are operated at the same power. GND has a high efficiency of two to three percent. The device is easy to use because it operates at room temperature, and because it does not operate by laser action. Thus its light output is strictly proportional to current over the operating range.

In harness. The device should be suitable for an extremely wide range of applications because of the combination of direct electrical input, infrared optical input through a phototransistor or photodiode, and electrical or optical output. When operated with optical input and either optical or electrical output, the circuit functions as a four-terminal circuit rather than as a two-terminal circuit like the Esaki diode or simple pnpn diode, and much greater circuit versatility is available.

Applications listed by Hayakawa include amplifiers, oscillators, logic circuits including flip-flops for use as memories and computer logic and pattern recognition, d-a and a-d converters, light switching elements, optical communications, optical displays including those teamed with new fluorescent materials that convert infrared to visible light, and optical computers.

Great Britain

Digital approach

It may be a decade before the next generation of aircraft instrument landing systems is in use, so there's still plenty of scope for improvement of present systems. And there's room for improvement because current ILS equipment uses analog techniques and has the usual drawbacks of analog hardware compared to digital equipment: the need for careful matching of components during manufacture and susceptibility to temperature variation, input signal variation, noise and drift with use.

To cut down these problems while leaving most of the existing equipment intact, Roy Thomason of the College of Aeronautics at Cranfield has developed a digital airborne ILS signal processor which will work with the existing ground transmission and aircraft instrument display equipment.

Digitizing. Thomason's ILS processor is a black box which, in principle, merely replaces the present analog black box in the aircraft. Thomason claims that his device is drift-free, unaffected by temperature, and insensitive to input signal variation and noise. In addition it is likely to be cheaper to build because, while component costs should be the same as for analog, manufacturing costs should be lower because there will no need for careful matching of components and signal channels. Further, it should be very much smaller and lighter.

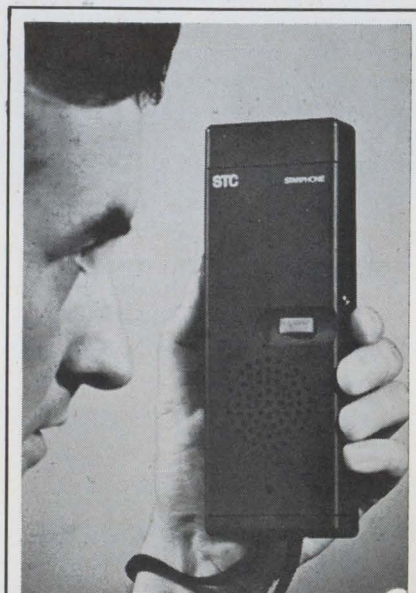
So far, Thomason has a workbench system operating and undergoing tests. He will start airborne tests in the fall. The first description of the system was presented last week at a conference on digital methods of measurement at Kent University.

The analog way. In present ILS systems, the airborne equipment compares 90 hertz and 150 hertz tones which are amplitude modulated onto a vhf carrier transmitted to the aircraft from the ground along the correct course line. The tones are filtered out of the composite signal with iron-cored filters,

the depths of modulation measured, and the outputs fed to a center-zero microammeter. If the modulation depth is the same, the aircraft is approaching down the center of the course line. Any difference will unbalance the microammeter and deflect the horizontal or vertical instrument pointer on the pilot's display. Accuracy requires that both signal channels maintain identical performance characteristics, and for precision, it is the filters which need the most careful attention. Losses must be identical over the input voltage and operating temperature range. The iron cores must therefore be thermally aged and selected before assembly.

In Thomason's digital system, the parallel channels and filters are discarded, and the difference information is derived directly from the composite demodulated input.

The composite input waveform is complex, but the difference in-



Small talk. The Starphone, by Britain's Standard Telephones and Cables Ltd., is called the world's smallest one-piece radio-telephone. ic's and solid-state switching hold size down, but big innovation is a pulsed long-life power supply that allows the use of a match box sized rechargeable battery. Switched on waiting reception, the receiver pulses on and off. It doesn't lock on permanently until it detects incoming signal. Thus, in standby, battery life is 8 hours.

formation is contained in less than 30% of it. The operative portion is a recurring minor rise and fall, with a mean peak height when the aircraft is on course center line and with a linear increase or decrease of peak height when the aircraft is off to one side or the other. Thomason uses this part of the waveform to produce a series of pulses proportional to instantaneous amplitude, feeding the pulses into a d-c output count-and-hold circuit, which in turn drives the conventional cockpit indicator. Thomason points out that because it uses less than 30% of the waveform compared with 100% in the analog system, the digital version gets a bonus improvement in signal-to-noise ratio.

Gauging the slope. In the rising portion of the waveform, the variation in slope is more pronounced than the variation in amplitude, so Thomason uses waveform slope to control pulse output. A clock-pulse generator feeds pulses into a J-K flip-flop. If the slope of the wave is increasing, the flip-flop passes an increasing proportion of its output through its positive output. If the slope is decreasing, an increasing proportion goes through the negative output. Only the positive-pulse output is counted for transmission to the count-and-hold circuit.

For the flip-flop to pass pulses through its positive output in proportion to the slope of the waveform, it is given a feedback signal corresponding to the signal amplitude at the last clock pulse. This signal is compared with the instantaneous incoming signal, and the error, positive or negative, determines which flip-flop output is connected.

Thomason has a long-term plan to take advantage of the digital output of his system to drive directly a new type of digital cockpit instrument consisting of a dot matrix of luminescent solid state diodes. Two straight luminescent lines, one horizontal and one vertical, crossing in the center of the matrix will show that the aircraft is on course center line. Movement of each line to a parallel position to right or left and above or below will indicate degree of deviation.

Canada

Telling volumes

In this jet age, it's a bit out of the ordinary when a railroad develops a cargo handling device and has airlines running to it with orders. That's just what happened, however, with an electronic volume measure developed by the Canadian National Railways.

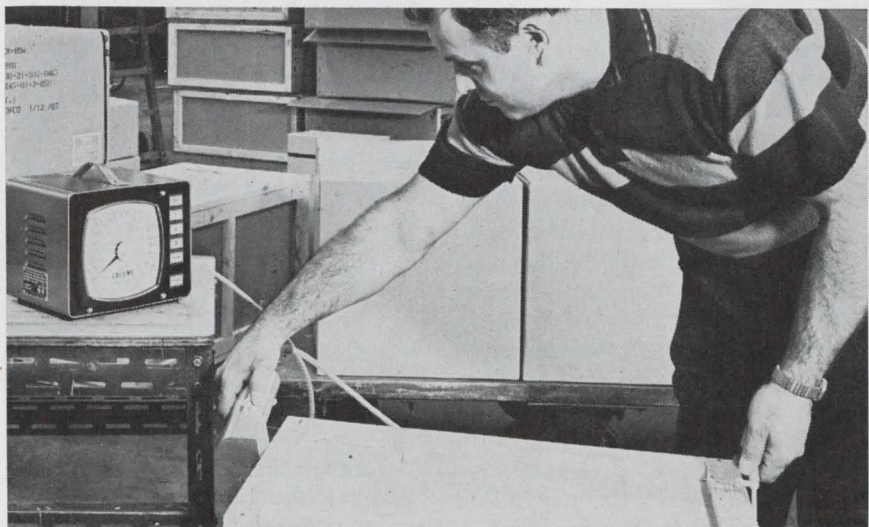
Canadian National, along with most other railroads, was losing money when large, but light-weight packages filled up its valuable box-car space because freight tariffs in Canada, like those in the United States, were based on weight only. The Canadian railroads decided to switch over to a combined weight and volume tariff that would give a better return on bulky shipments.

Almost immediately, however, they were faced with the need for something faster than a tape measure to give speedy three-dimensional measurements. Canadian National came up with an electronic tape measure that automatically integrates the three linear measurements and gives a visual readout of the calculated volume. Once representatives of Air Canada saw the device, now made under license by CAE Industries of Montreal, they ordered 30 units as part of a \$100,000 contract.

The device, which CAE calls the

Volumeter, has two main parts—a measuring probe and a display unit. The measuring probe contains a roll of nylon-covered steel wire 5 feet long. The probe is held at one edge of the package to be measured and the end of the wire pulled out to the opposite edge. The spool is connected to a potentiometer connected in a bridge circuit. The circuit's output is a voltage proportional to the logarithm of the length measured. When an operator presses a switch on the probe, the voltage is stored in a capacitor in the main unit. Each of the three dimensions has a capacitor which is filled sequentially by an automatic stepping relay circuit. When the third dimension has been recorded, the sequencer connects the three capacitors in series. The added voltages are proportional to the logarithm of the volume. In the original Canadian National version, this voltage was amplified and displayed using a logarithmic scale voltmeter calibrated in cubic feet.

Further Steps. The streamlined CAE version goes a couple of steps further. The company has added an analog to digital converter that drives a digital display. In addition, by pressing the appropriate pushbuttons, the operator gets a direct reading of the equivalent weight, based on either international air freight regulations, which



Automated tape measure. Uncoiling steel wire in hand-held probe turns potentiometer which delivers a voltage proportional to dimension.

call for a standard chargeable density of 8.9 pounds per cubic feet, or domestic regulations, which set a chargeable density of 6.9 pounds per cubic feet. The readout is four digit, with a decimal point after the third digit.

The instrument, which costs \$2500, can be readily incorporated into more elaborate systems. It has been used in conjunction with an electronic scale to determine actual density of shipments. And it may be possible to use the volume data to feed automatic bill generating and freight charge calculating equipment.

West Germany

Components booming

When Germany's economy turns up from a slump, it does so with a bang. A year or two ago the average company there was happy just to stay level. Now it looks as if everybody from Bonn to Berlin is going to be very disappointed if sales aren't up well over 10%. Half way through the year giant Siemens AG sees full year sales up about 20%. Medium-sized Standard Elektrik Lorenz AG predicts an 11% rise in profits.

While all parts of the electronics industry are cashing in on the boom, it's the components sector that is in the most ferment. The unexpectedly high demand for both consumer and industrial electronics is generating so much pressure that suppliers of components, both domestic and foreign, are forcing through major expansion plans.

Revised upwards. Semiconductor components are among the hottest selling devices with the total market likely to reach \$125 million this year—considerably higher than \$100 million most people had originally predicted for 1969. Consumption of integrated circuits alone could top the \$25 million mark, and is sure to rise at a 15 to 20% rate annually at least until the early seventies.

To cope with the expanding semiconductor market, manufacturers are feverishly setting up new factories or are enlarging existing

facilities. Siemens, for example, is currently adding a 6-story building containing nearly 65,000 square feet of floor space to its main semiconductor plant at Munich. The building has been set aside solely for activities in the IC field. Other companies, including AEG-Telefunken, Valvo GmbH, and Intermetall, an ITT subsidiary, are busy expanding production lines and equipping research labs. Texas Instruments Deutschland GmbH in June opened its second plant in Germany. Located at Ingolstadt, it will employ 500 people and turn out plastic-encapsulated transistors. And the company is spending \$2 million to enlarge its existing plant at Freising.

Knocking on the door. West Germany's semiconductor market is also bringing new companies to the scene. Fairchild Semiconductor, a major U.S. producer not yet manufacturing in Europe, intends to concentrate its European production and sales at a new complex in Wiesbaden. When completed in 1972, the 120,000 square-foot plant will house 1,000 employees making diodes, transistors, and IC's. Limited production will begin early next year.

What's more, Fairchild's erst-while partner is going into Germany. SGS Deutschland GmbH, a member of the Societa General Semiconduttore group of Milan, opened its first plant in Germany last month. "Because of the expanding Germany semiconductor market it's necessary to set up SGS Deutschland as the largest member of the group," says Renato Bonifacio, managing director of SGS. One quarter of the group's profits will come from sales by its German company. The new plant at Wasserburg has a production capacity of 22 million transistors and up to 2 million IC's a year.

Setting the stage

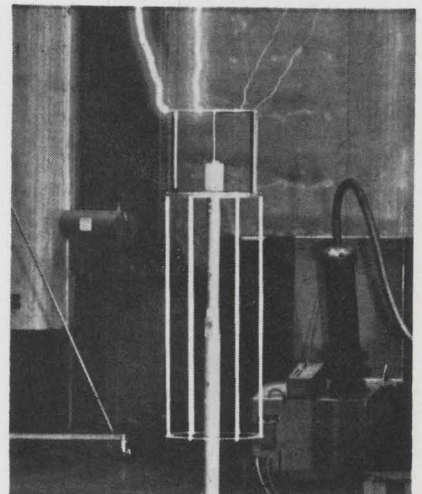
Transistorized antennas, a center of controversy on both sides of the Atlantic for more than two years, are finally headed for production.

Rhode and Schwarz, West Germany's big commercial communi-

cations and testing equipment maker, is readying an air-traffic-control antenna that incorporates a transistorized active stage. But Rhode and Schwarz may not be alone for long. Other companies are considering transistorized stages for both automobile-radio antennas and television antennas.

Called the Meinke antenna, the transistorized stage was developed in 1967 by the Institute for High-Frequency Research at the Technical University of Munich, which is headed by Hans H. Meinke. And almost from the outset, the Meinke antenna and other subminiature integrated antennas were caught up in a barrage of criticism. [*Electronics*, June 12, 1967, p. 145]. Some critics said the devices would suffer from cross modulation; others thought there would be degradation in signal-to-noise ratios; and still others said performance would be impaired because of lack of directivity.

Pushing ahead. Rhode and Schwarz has overcome these drawbacks real or imaginary, and is finishing tests on prototypes preparatory to serial production later this year. The company says results of tests thus far have been excellent. There is no degradation attributable to the active elements. Proof, according to the company, is the antennas low noise, good cross modulation behavior and insensitivity to atmospheric disturbances, including lightning.



A hit. Active antenna, under test here, finally heads for market.

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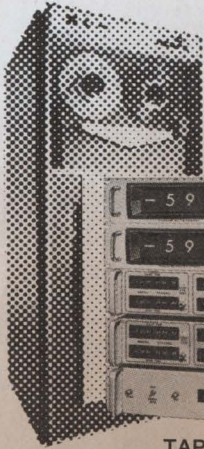
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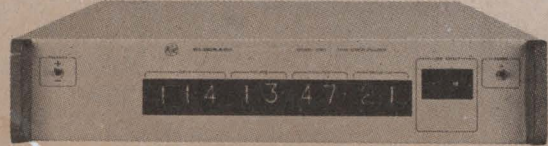
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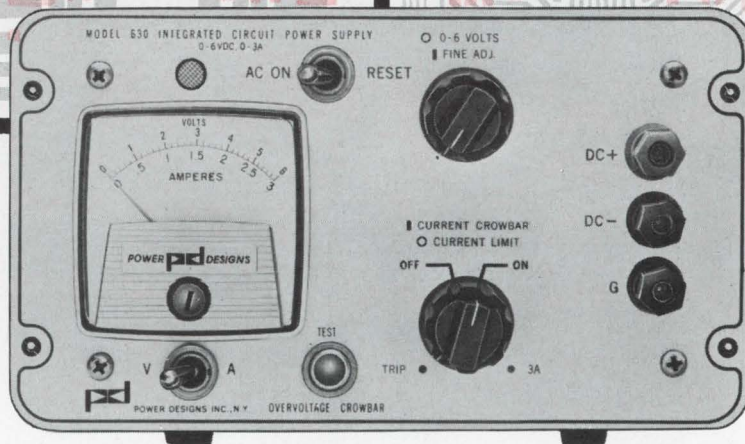
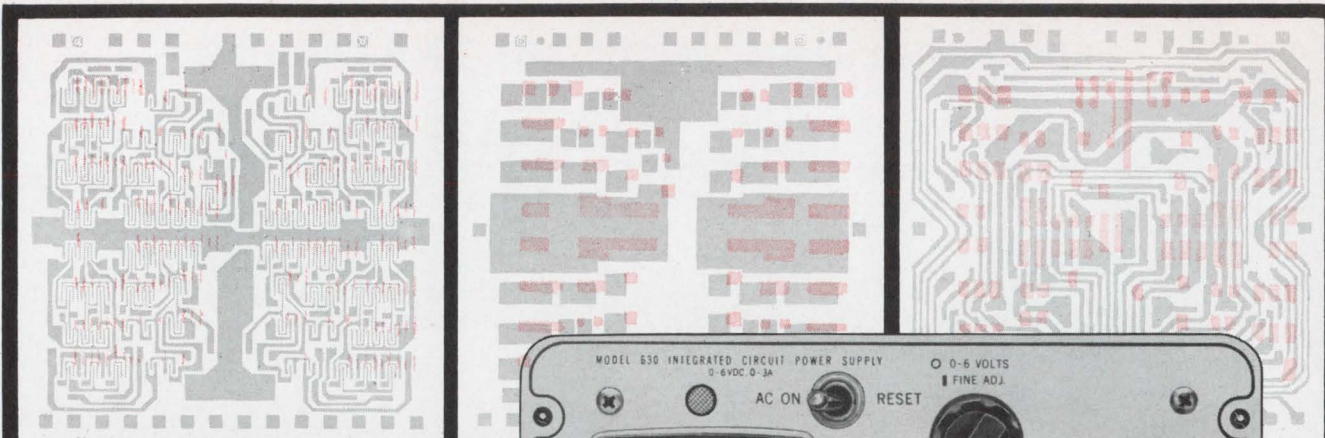
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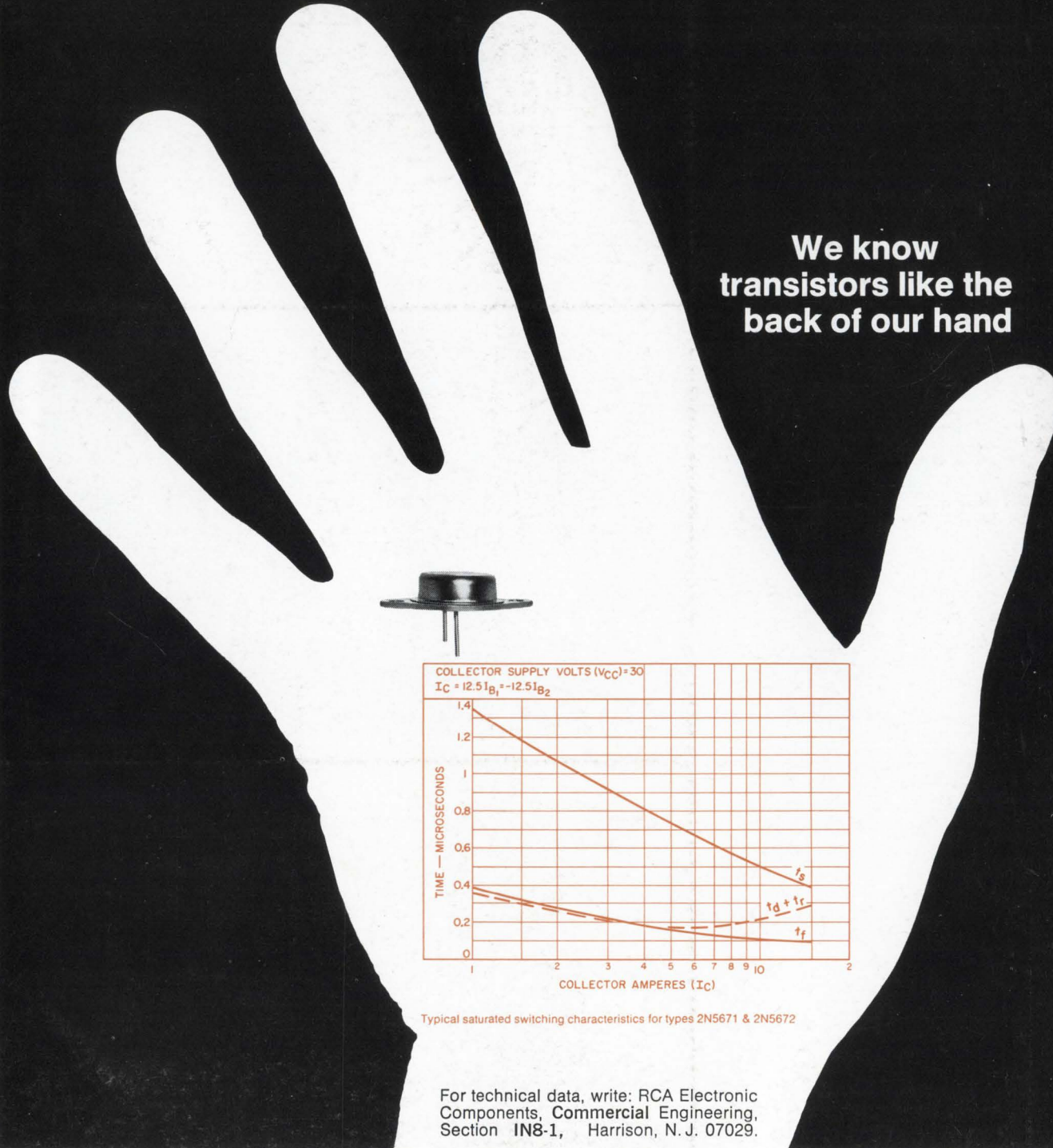
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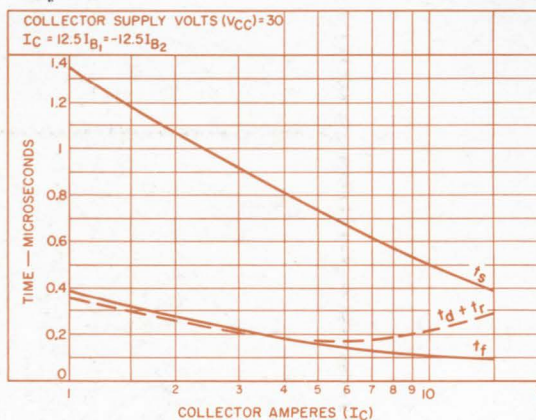
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