

- 65 Testing big semiconductor memories poses problems
- 68 The Japanese threat to U.S. computer dominance
- 107 Digital-IC models for computer-aided design: Part 2

Electronics®

EUROPE'S MARKETS
ENERGY CRISIS PERILS GAINS

1420 080120 AELCA/ MA110
CS OSBORNE JR
1202 W AVENUE H11
LANCASTER CA
93534

Burroughs panel displays help you sell your products

"The SELF-SCAN[®] panel display provides a CompuWriter[®] feature never before available. . . now an average typist can set quality typography with ease because the SELF-SCAN panel displays each character and function as she keyboards so that she can verify or make corrections by individual character, word, or complete line. Burroughs panel displays DO help you sell your product." — Mr. John Peterson, Vice President, Domestic Marketing, for Compugraphic Corporation, 80 Industrial Way, Wilmington, Massachusetts 01887.

Helping you to sell your product helps us sell our product. That's why Burroughs family of panel displays is designed to provide the most pleasing, most readable character available today. Whether your application is for 8, 16, 32, 80, or 256 alphanumeric characters, Burroughs SELF-SCAN panel displays provide an economical approach to your readout requirement plus offer the extra advantage of adding aesthetic quality to your product.

Ask a Burroughs salesman to drop by and demonstrate his terminal in a briefcase. His SELF-SCAN panel display demonstrator is our best salesman.

*Write or call
Burroughs Corporation,
Electronic Components
Division, Box 1226,
Plainfield, N.J. 07061
(201) 757-3400*



SELF-SCAN PANEL

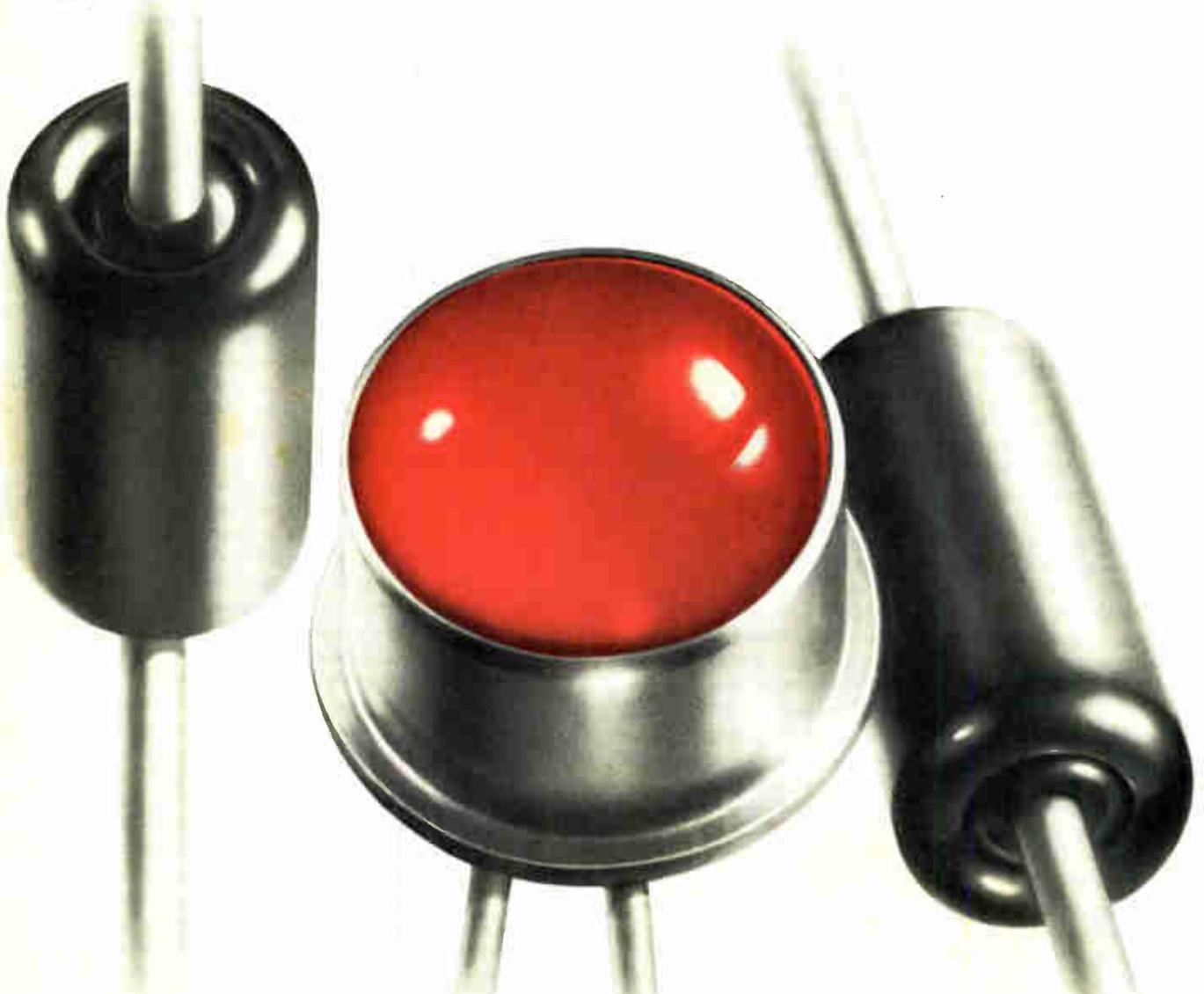
Burroughs



Only Burroughs manufactures NIXIE[®] tubes, SELF SCAN[®] panel displays and PANAPLEX[™] numeric panel displays.

Circle 900 on reader service card

SURPRISE!



MIL-qualified LEDs, PINs and Schottkys right off the shelf.

Now HP can offer you military-qualified LED lamps, PIN diodes and Schottky diodes right from stock. Our LEDs are just right for applications needing a brilliant, long-life indicator. Our PIN diodes are ideal for attenuating and our Schottkys are designed for high level detection, switching or gating. In addition to military-qualified devices, HP provides standard high reliability test programs, patterned after MIL-S-19500, for many more products. For more information, contact your nearby HP field engineer.

TYPE	PART NO	GOV'T DESIGNATION	MIL SPECIFICATION
SCHOTTKY	5082-2800	JAN/JANTX 1N5711	MIL-S-19500/444
PIN	5082-3001	JAN/JANTX 1N5719	MIL-S-19500/443
LED LAMP	5082-4420	JAN/JANTX 1N5765	MIL-S-19500/467

01334

HEWLETT  PACKARD

Sales and service from 172 offices in 65 countries.
1501 Page Mill Road, Palo Alto, California 94304

**more than batch...
more than timeshare...
less than \$170,000***

**Hewlett-Packard's 3000.
The New
Multiprogramming
Multilingual Computer.**

Full system capability from multiple interactive terminals. For your new brochure call (408) 257-7000, Ext. 3000.

Or write

HEWLETT  PACKARD

Sales and service from 172 offices in 65 countries.
1501 Page Mill Road, Palo Alto, California 94304

22408 *Domestic USA Price Only.

- 29 **Electronics review**
MEDICAL ELECTRONICS: An electronic link to the visual cortex, 29
FIBER OPTICS: Simple coupler taps fiber-optic cables, 30
GOVERNMENT ELECTRONICS: NSF starts R&D incentives project, 31
ORGANIZATIONS: Electronics groups fight for energy, 31
HOLOGRAPHY: USAF funds dental laser holography, 32
MICROWAVES: H-P designs receiver for educational TV, 34
NEWS BRIEFS: 34
MATERIALS: Silicon shortage won't cripple wafer output, 36
CONSUMER ELECTRONICS: Advent puts TV on a big screen, 38
- 53 **Electronics International**
WEST GERMANY: MNOS memory uses silicon-on-spinel, 53
AROUND THE WORLD: 53
- 65 **Probing the News**
MEMORIES: 4,096-bit memories pose testing problems, 65
COMPUTERS: Some see Japanese effort as threat, 68
European manufacturers told they must unite, 71
GOVERNMENT ELECTRONICS: Agencies spur technology transfer, 74
- 81 **Special Report: European markets**
Overview, 81
West Germany, 82
United Kingdom, 85
France, 88
Italy, 90
The Netherlands, 91
Sweden, 92
Spain, 94
Belgium, 95
Switzerland, 97
Denmark, 97
Norway, 99
Finland, 99
Market Forecast Chart, 101
- 107 **Technical Articles**
CIRCUIT DESIGN: IC models, part 2: TTL flip-flops, 107
DESIGNER'S CASEBOOK: No-ladder d-a converter has 5-V supply, 113
Dc restorer for video use offers ultra-stability, 114
Regulator for standby supply handles large load currents, 115
ENGINEER'S NOTEBOOK: Logic circuit gauges phase difference, 119
Liquid crystals isolate electrical short circuits, 120
Regular stereo amplifier can be variable ac source, 121
- 125 **New Products**
IN THE SPOTLIGHT: Logic scope handles 5-MHz data rate, 125
Process gives promise of low-cost FET op amps, 128
DATA HANDLING: Line of tape decks aimed at OEMs, 131
COMPONENTS: Capacitive keyboards are priced low, 135
PACKAGING & PRODUCTION: Wafer prober rides on air, 137
SUBASSEMBLIES: Hybrid switch drivers are shelf items, 141
MATERIALS: 144
- Departments**
Publisher's letter, 4
Readers comment, 6
40 years ago, 8
Meetings, 20
Electronics newsletter, 25
Washington newsletter, 49
Washington commentary, 50
International newsletter, 55
Engineer's newsletter, 122
New literature, 145

Highlights

The cover: European outlook sunny, unless . . . 81
Before the oil cutbacks, European electronics markets seemed set for another good year—and that could still happen. Color TV, computers, and communications will star as before, but the dollar's dwindling value means competition with U.S. products will be stiff.

Foldout chart on page 101 presents country-by-country market analyses in dollar terms.

Wanted: faster tests for 4k MOS memories, 65
Testing an MOS memory by comparing every cell with every other cell takes an impossible 40 seconds on the new 4,096-bit devices. Vendors, users, and test-equipment manufacturers are experimenting with less time-consuming alternatives.

Simple computer models of flip-flops, 107
Component-by-component descriptions of digital ICs are unnecessary in computer-aided design since much shorter models based on functionally equivalent circuits will produce accurate results. Two flip-flops are the subject of the second in the five-part series, "Digital-IC models for computer-aided design."

New logic scope does much more, much better, 125
First introduced last spring, oscilloscopes that display sequences of logic states instead of waveforms have already bred a second generation. Latest instrument is asynchronous, has dual-threshold detectors, handles 50-MHz data rates.

And in the next issue . . .
Electronics' 16th annual forecast of the U.S. markets . . . a new kind of gas-discharge display . . . how to select the best method of measuring fast waveforms.

EDITOR-IN-CHIEF: Kemp Anderson

EXECUTIVE EDITOR: Samuel Weber

MANAGING EDITORS: Lawrence Curran, *News*;
Arthur Erikson, *International*

SENIOR EDITORS: John Johnsrud,
H. Thomas Maguire, Laurence Altman
Ray Connolly

ART DIRECTOR: Fred Sklener

ASSOCIATE EDITORS: John N. Kessler,
Howard Wolff, Gerald M. Walker

DEPARTMENT EDITORS

Aerospace: William F. Arnold
Circuit Design: Lucinda Mattera
Communications & Microwave:

Lyman J. Hardeman
Components: Joel DuBow

Computers: Wallace B. Riley

Consumer: Gerald M. Walker

Industrial: Alfred Rosenblatt

Instrumentation: Michael J. Riezenman

Military: Ray Connolly

New Products: H. Thomas Maguire

Packaging & Production: Stephen E. Grossman

Solid State: Laurence Altman

Special Issues: Harry R. Karp

COPY EDITORS: Margaret Eastman,
Everett C. Terry

ASSISTANT EDITOR: Marilyn Offenheiser

ART: Charles D. Ciatto, *Associate Director*
Patricia Cybulski, *Assistant Director*

PRODUCTION EDITOR: Arthur C. Miller

EDITORIAL SECRETARIES: Janet Annunziata,
Julie Gorgoglione, Penny Roberts

FIELD EDITORS

Boston: Gail Farrell

Los Angeles: Paul Franson (Mgr.)

Midwest: Larry Armstrong (Mgr.)

New York: Alfred Rosenblatt (Mgr.)

San Francisco: George Sideris (Mgr.)

Judith Curtis

Washington: Ray Connolly (Mgr.)

William F. Arnold

Frankfurt: John Gosch

London: Michael Payne

Paris: Arthur Erikson

Tokyo: Charles Cohen

McGRAW-HILL WORLD NEWS

Director: Walter A. Stanbury

Bonn: Robert Ingersoll;

Brussels: James Smith;

London: Marvin Petal;

Milan: Peter Hoffmann, Andrew Heath;

Moscow: Axel Krause;

Paris: Michael Johnson, Richard Shepherd;

Stockholm: Robert Skole;

Tokyo: Mike Mealey

PUBLISHER: Dan McMillan

ADVERTISING SALES MANAGER: Pierre J. Braudé

ADVERTISING SALES SERVICE MANAGER:
Wallis Clarke

BUSINESS MANAGER: Stephen R. Weiss

CIRCULATION MANAGER: George F. Werner

MARKETING SERVICES MANAGER:
Tomlinson Howland

As we have done for nine years now, we fielded a sizable team of *Electronics* reporters and McGraw-Hill World News correspondents to pull out the facts and figures for the 24-page market report that starts on page 81. Our team stays about the same size from year to year—about a dozen—and so does the number of market estimates we make—a hefty 1,200 or so for equipment items and 1,000 for components.

But the number of people who actually contribute to the effort continues to grow. "Each time around, we find that more companies and more people have learned that it's to their advantage to give us inputs," says team leader Arthur Erikson, our Paris-based International Managing Editor. Erikson is the organizing talent behind the European report—and behind a lot of the coverage. While covering the Berlin radio and TV show, he caught the excitement about video disks—and himself—in a mirror (right).

"It's traditional in Europe to keep business information largely secret," explains Erikson, "but some executives are willing to break with tradition when they realize they can analyze our consensus estimates a lot more intelligently if they know that one set of figures—their own—went into the pool."

All told, some 200 sources supplied inputs for this year's survey. Inputs ranged from a single product category for a single country from small companies all the way up to just about everything for a country from a trade association or government agency. Most often, though, the questionnaires we use to get inputs come back with figures for related groups of products.

"After a first round of visits in the fall to get people to contribute estimates and to talk with them about what's in store, we have much followup to do to chase down promised questionnaires that weren't ready earlier," Erikson goes on.

Even telexes about questionnaires get lost. Queried whether a Telex to a source at a big company had been



delivered, the operator replied: "You better resend because you sent the Telex into a computer, and we did not get it because you used a wrong procedure." As yet, no response from the computer, although I am sure it has all the answers.

The quest for the market-dimension numbers is backed up by reporting by our on-the-spot correspondents. They were John Gosch (West Germany), Michael Payne (United Kingdom), Richard Shepherd (France), Andrew Heath (Italy), Robert Skole (Sweden), Dominic Curcio (Spain), James Smith (Belgium), Laura Pilarski (Switzerland), and Martin Schultz (Finland).

December 20, 1973 Volume 46, Number 26
93,177 copies of this issue printed

Published every other Thursday by McGraw-Hill, Inc. Founder: James H. McGraw 1860-1948. Publication office 1221 Avenue of the Americas, N.Y., N.Y. 10020; second class postage paid at New York, N.Y., and additional mailing offices.
Executive, editorial, circulation and advertising addresses: Electronics, McGraw-Hill Building, 1221 Avenue of the Americas, New York, N.Y. 10020. Telephone (212) 997-1221. Teletype TWX N.Y. 710-581-5234. Cable address: MCGRAWHILL N.Y.

Subscriptions limited to persons with active, professional, functional responsibility in electronics technology. Publisher reserves the right to reject non-qualified requests. No subscriptions accepted without complete identification of subscriber name, title, or job function, company or organization, including product manufactured or services performed. Subscription rates: qualified subscribers in the United States and possessions, Canada, and Mexico \$8.00 one year, \$12.00 two years, \$16.00 three years; all other countries \$25.00 per year, except Japan \$50.00 per year and Brazil \$40.00 per year, including air freight. Limited quota of subscriptions available at higher-than-basic rate for persons outside of field served, as follows: U.S. and possessions and Canada: \$25.00 one year; all other countries \$50.00. Single copies: United States and possessions and Canada, 1.00; all other countries, \$1.75.

Officers of the McGraw-Hill Publications Company: John R. Emery, President; J. Elton Tuohig, Executive Vice President-Administration; Gene W. Simpson, Group Publisher-Vice President; Senior Vice Presidents: Ralph Blackburn, Circulation; Walter A. Stanbury, Editorial; John D. Hoglund, Controller; David G. Jensen, Manufacturing; Gordon L. Jones, Marketing; Jerome D. Luntz, Planning & Development.
Officers of the Corporation: Shelton Fisher, President; Wallace F. Traendly, Group President, McGraw-Hill Publications Company and McGraw-Hill Information Systems Company; Robert N. Landes, Senior Vice President and Secretary; Ralph J. Webb, Treasurer.
Title registered in U.S. Patent Office; Copyright ©1973 by McGraw-Hill, Inc. All rights reserved. The contents of this publication may not be reproduced either in whole or in part without the consent of copyright owner.

Subscribers: The publisher, upon written request to our New York office from any subscriber, agrees to refund that part of the subscription price applying to copies not yet mailed. Please send change of address notices or complaints to Fulfillment Manager; subscription orders to Circulation Manager, Electronics, at address below. Change of address notices should provide old as well as new address, including postal zip code number, if possible, attach address label from recent issue. Allow one month for change to become effective.

Postmaster: Please send form 3579 to Fulfillment Manager, Electronics, P.O. Box 430, Hightstown, N.J. 08520.

**If you want
a systems power supply for
your system, one that you can
plug and unplug with ease,
look into**

KEPCO

OPS-II

for an uncommitted
amplifier

CC

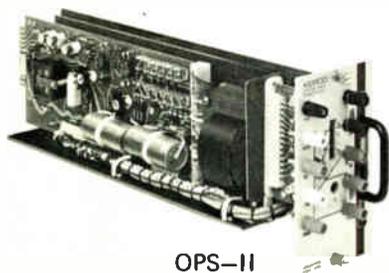
for stabilized
current

PCX-MAT

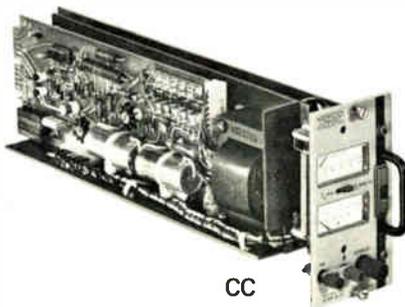
for stabilized
voltage

**These three groups, all approximately
20 watts in six voltage ranges,
0-7 to 0-100V, are produced in
a one-sixth rack format—
really skinny supplies**

And they really do plug in—riding on guides to mate with a connector carrying source power and control signals and d-c output—yet, on that one-sixth width panel we've got two meters, 10-turn control, on/off switching, pilot, etc. (The OPS has a 10-terminal patch board for "doing your own thing".) There is a 3-unit rack housing and a 6-unit housing, (both 5¼" high x 19" wide) or you can choose between several bench-top housings. There is a digital programmer in compatible format too.



OPS-II



CC

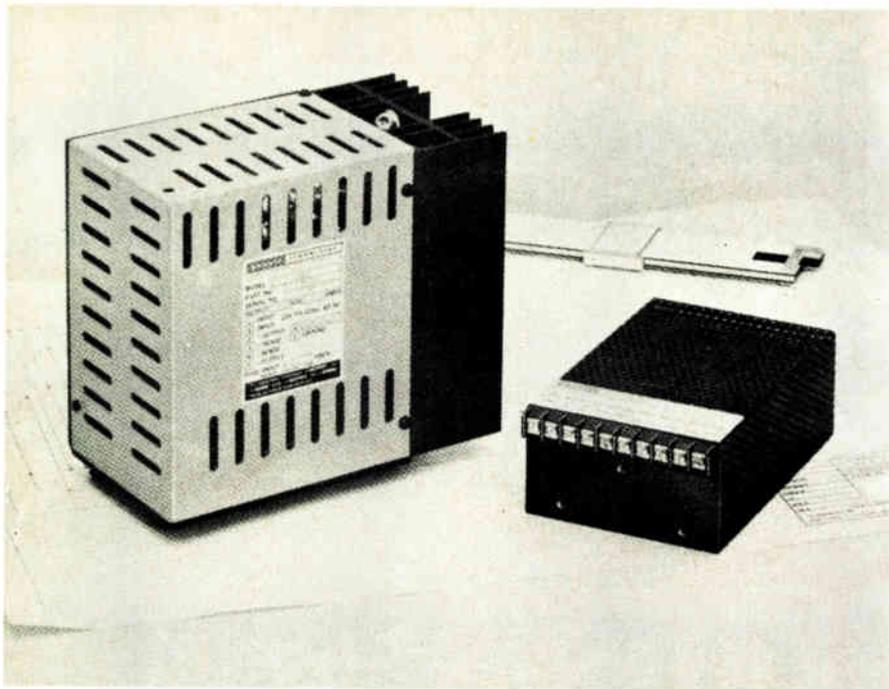


PCX-MAT

KEPCO®

Ask your Kepco man for details about the Kepco plug-in system supplies. If you don't know who he is, call (212) 461-7000 collect, or write Dept. AD-14 and we will be glad to direct you to the skinniest power supplies around.

KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, N.Y. 11352 • (212) 461-7000 • TWX = 710-582-2631 • Cable: KEPCOPOWER NEWYORK



Reduce Your Power Supply Size and Weight By 70% for \$49

A new way has been found to substantially reduce power supply size and weight. Consider the large power supply shown at left in the above photo — it uses an input transformer, into a bridge rectifier, to convert 60 Hz to 5 volts DC at 5 amperes. This unit measures 6½" x 4" x 7½" and weighs 13 pounds. It sells for \$170 in small quantities. For just \$49.00 more, Abbott's new model Z5T10, shown at right, provides the same performance with 70% less weight and volume. It measures only 2¼" x 4" x 6" and weighs just 3 pounds.

This size reduction in the Model Z5T10 is primarily accomplished by eliminating the large input transformer and instead using high voltage, high efficiency, DC to DC conversion circuits. Abbott engineers have been able to control the output ripple to less than 0.02% RMS or 50 millivolts peak-to-peak

maximum. This design approach also allows the unit to operate from 100 to 132 Volts RMS and 47 to 440 Hertz. Close regulation of 0.15% and a typical temperature coefficient of 0.01% per degree Centigrade are some of its many outstanding features. This new Model "Z" series is available in output voltages of 2.7 to 31 VDC in 9 days from receipt of order.

Abbott also manufactures 3,000 other models of power supplies with output voltages from 5 to 740 VDC and with output currents from 2 milliamps to 20 amps. They are all listed with prices in the new Abbott catalog with various inputs:

- 60 AC to DC, Regulated
- 400 AC to DC, Regulated
- 28 VDC to DC, Regulated
- 28 VDC to 400 AC , 1 ϕ
- 24 VDC to 60 AC , 1 ϕ

Please see pages 581-593 of your 1973-74 EEM (ELECTRONIC ENGINEERS MASTER Catalog) for complete information on Abbott Modules.

Send for our new 56 page FREE catalog.

abbott transistor

LABORATORIES, INCORPORATED
general offices

5200 W. Jefferson Blvd./Los Angeles 90016
(213) 936-8185 Telex: 69-1398

INCORPORATED
eastern office

1224 Anderson Ave./Fort Lee, N.J. 07024
(201) 224-6900 Telex: 13-5332

Readers comment

On Northrop's acquisitions

To the Editor: "Top management develops strategy aimed at penetrating new markets" [*Electronics*, Oct. 25, p.115] incorrectly states that a potential Northrop Corp. acquisition must not be unionized for fear that a foothold would be established in the "non-union parent corporation." This is simply not true.

A number of Northrop employees are members of bargaining units, including employees who were represented when their firms were acquired by Northrop. A few examples are the International Association of Machinists, representing personnel at our worldwide Wilcox Inc. facility in Kansas City; the United Auto Workers at our Precision Products department in Norwood, Mass.; and the United Brotherhood of Carpenters and Joiners of America at Northrop Architectural Systems Inc., in Los Angeles.

George C. Chalmers
Northrop Corp.
Palos Verdes Peninsula, Calif.

IC code is ambiguous

To the Editor: I suggest that IC manufacturers develop a date-coding symbology different from the current four-digit code giving year and week of manufacture. If this is not done, a package made in the 10th week of 1974 will be marked 7410, in addition to the actual part number. Many of these numbers will be misinterpreted as meaning TTL triple three-input NAND gates. On more than one occasion, I have been asked to classify ICs with part numbers like 7227 or 7313.

Fred U. Rosenberger
Washington University
St. Louis, Mo.

Crediting the employer

To the Editor: For my Engineer's notebook, "Storing two constants instead of just one" [Nov. 8], the by-line should have shown that my current employer is Lockheed Electronics Co., Industrial Technology division, Azusa, Calif.

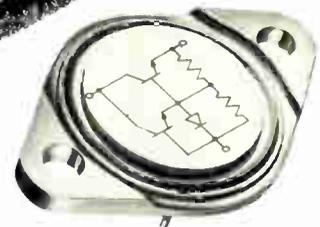
Jerome Snaper
VQ-2 Fleet Post Office
New York, N.Y. 09501

What would a power supply designer want to know about TRW's new Darlington family?

We asked our sales and applications engineers. And they said we should tell you 5 things:

1. It operates up to 450 Volts.
2. It offers fast switching — 250 Nsec.
3. It operates up to 25 Amps continuously.
4. It costs under \$5.00 (in quantity).
5. It is immediately available, in quantity, right off the distributors' shelves.

They assured us those five facts were enough to get any power supply designer pretty excited about our new Darlington. Were they right? Signify in the usual manner—casting your vote at the nearest office of any authorized TRW distributor. Or call John Powers, collect, at (213) 679-4561; or write TRW Semiconductors, an Electronic Components Division of TRW, Inc., 14520 Aviation Blvd., Lawndale, California 90260.



TRW® SEMICONDUCTORS

These products are available through the following authorized distributors:

Almo Electronics
Bell Industries
Cramer Electronics Inc.
De Mambro Electronics

Eastern Radio Corp.
Electronics Marketing Corp.
Elmar Electronics Inc.
Hall-Mark Electronics Corp.

Harvey-Michigan Inc.
Liberty Electronics
Powell Electronics
Pytronics

Semiconductor Concepts Inc.
Summit Distributor
R. V. Weatherford Co.
Westates Electronics Corp.

40 years ago

From the pages of Electronics, December, 1933

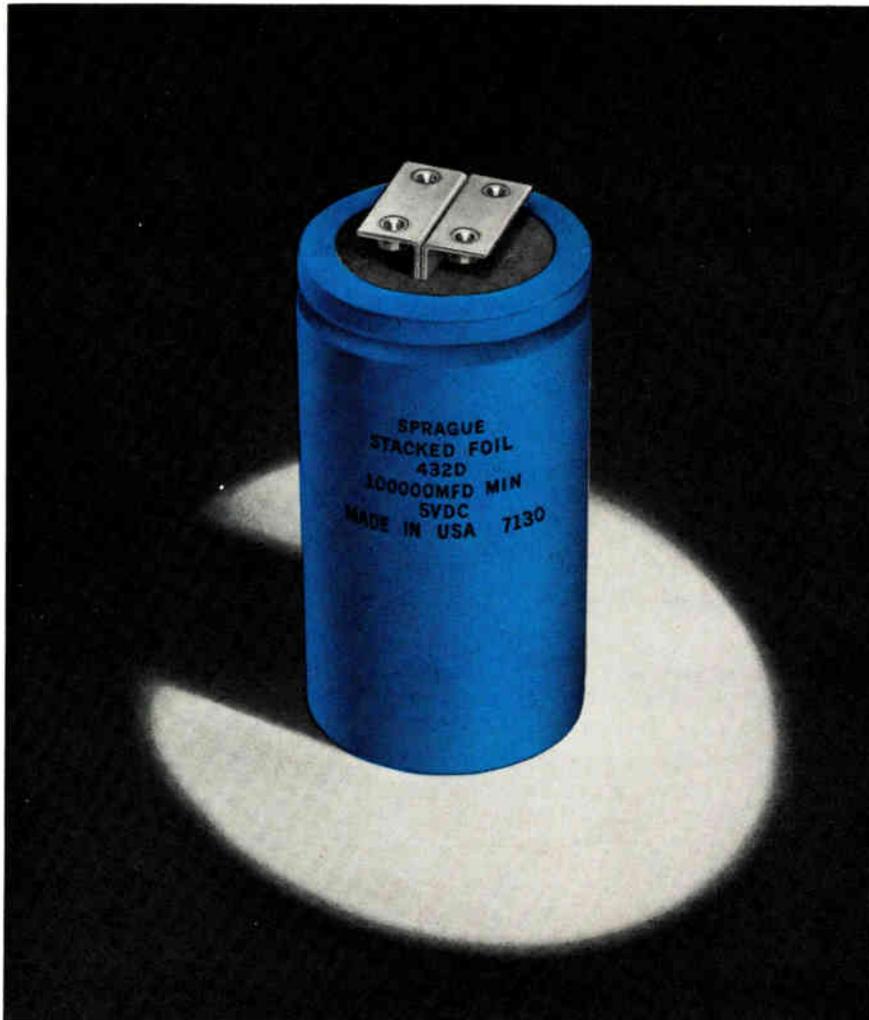
CRTs for oscillographs

The field of application of cathode ray oscillographs is daily being enlarged to include new uses in laboratory measurements and industrial engineering study. The common faults of cathode ray tubes have been short life, non-uniformity, insufficient brilliance of pattern, poor control of brilliance, and most of the tubes required critical adjustment.

In studying the above difficulties, it was apparent that the choice between a high-vacuum tube and an inert-gas-filled tube should be given first consideration. In a gas-filled tube, positive ion bombardment of the oxide-coated cathode shortens the life of the tube considerably. It should be mentioned also that the oxide-coated cathode is desirable because of its low-operating temperature, which reduces the possibility of light from that source conflicting with the fluorescent pattern.

By evacuating the tube to a pressure of about 10^{-5} mm. mercury, a relatively high vacuum results in which positive ion bombardment of the cathode is minimized. Gas filling presupposes the use of the gas as a focusing means to confine the beam to a pencil of electrons . . .

Methods of deflecting the beam.
The beam of electrons as accelerated out of the electron gun and focused on the screen may be deflected either by magnetic or electrostatic fields. To move the spot vertically and horizontally over the screen, it is necessary to apply two fields whose forces are at right angles. These separately applied fields of force may be magnetic, or electrostatic, or a combination of the two. It is possible to deflect in both directions magnetically with the fields applied at the same point along the electron trajectory. It is, however, more difficult to obtain a distortionless pattern with electrostatic deflection in both directions when the fields are applied at the same point, but it is quite simple to deflect first in one direction and then the other by displacing the deflection plates along the length of the bulb neck.



Stacked...with beautiful curves!

(stacked-foil construction with ultra-low impedance, ultra-low ESR, ultra-low inductance)

Revolutionary new Type 432D COMPULYTIC® Aluminum Electrolytic Capacitors offer capacitance values to 100,000 μ F with equivalent series resistance of typically less than 0.001 ohm and inductance of only 1 nH in a 3" x 5 5/8" case. This same capacitor will handle 93 amperes of ripple current at 65 C and 1 kHz.

Impedance limits at 10 kHz are as low as 0.001 ohm with typical values of only half of the specified limits.

Now available in two additional smaller case sizes for space-saving applications in smaller-wattage power supplies, with typical impedance of five milliohms.

Terminals are ideal for use with laminated-bus power distribution systems found in modern EDP equipment, where the low ESR and impedance of Compulytic capacitors help insure continued operation of logic circuits even during momentary power outages.

Sprague Type 432D Capacitors are available in nine voltage ratings from 5 to 50 volts d-c, and are designed for operation over the temperature range from -40 to $+85$ C.

For complete technical data, write for Engineering Bulletin 3443 to: Technical Literature Service, Sprague Electric Co., 35 Marshall St., North Adams, Mass. 01247.



THE BROAD-LINE PRODUCER OF ELECTRONIC PARTS

A flexcircuit for the new Mustang II

We did it for Ford.

Ford Motor Company hopes for big things for the 1974 Mustang II, with consumer acceptance equal to or better than the original Mustang.

It's a quality engineered, totally new automobile. And part of its quality, though unseen, lies in the Schjeldahl flexible circuit used behind its attractive and functional instrument cluster.

This new flexcircuit was engineered to accommodate multi-plane design with errorless connections. At the same time, possible future circuitry needs for safety standard items such as ignition interlock systems and additional warning lights were provided.

Flexcircuitry may be the answer to your electronic design problem too. It's now six years old with Ford Motor Company. And they've proven that it will do the job like nothing else could, along with reducing manufacturing costs.

Schjeldahl did it for Ford.

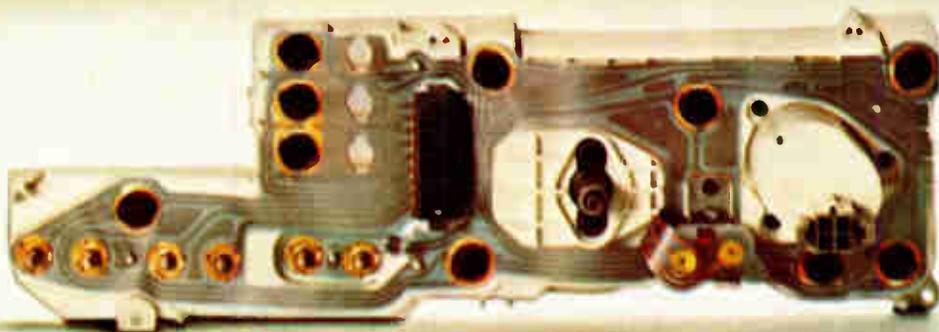
 **Schjeldahl Company**

Electrical Products Division
Northfield, Minnesota 55057
Phone: (507) 645-5633

The state of the art people in volume flexible circuits



MUSTANG II

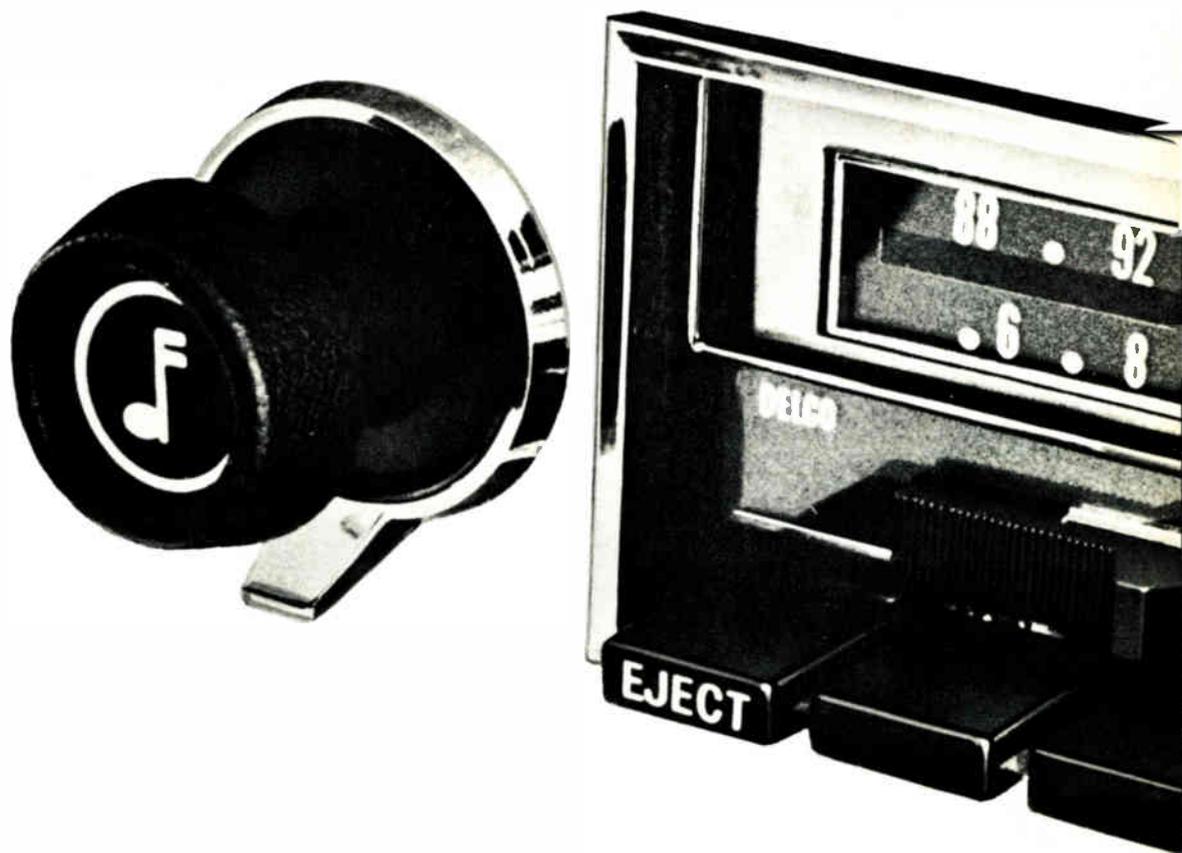


And we can do it for you.

Circle 9 on reader service card

©1973 GTS Co.

**OUR POWER
SEMICONDUCTORS
ARE SO GOOD
WE USE THEM OURSELVES.
20,000 TIMES A DAY.**



That's the rate at which Delco Electronics supplies a variety of products for GM cars.

Under one roof we design and manufacture complete systems, including the power semiconductors that help make those systems work. This can mean a lot to you. Here's why:

We know the requirements and standards that must be met to produce over 20,000 systems a day. We know what it means to deliver on time, to meet our own production schedules. And we know the importance of component quality in assuring reliability of the end product.

Our semiconductor devices are used

in the Delco AM radios, AM/FM radios and stereo tape systems we produce for GM cars. They are also used in the GM high-energy ignitions systems, I.C. voltage regulators, alternators, and in the new combination front seat/shoulder belt interlock systems you find in all the 1974 GM cars.

And all the capabilities that go into Delco semiconductors can work for you, too.

There are select distributors with stock on hand strategically located coast to coast. For the distributor nearest you, phone

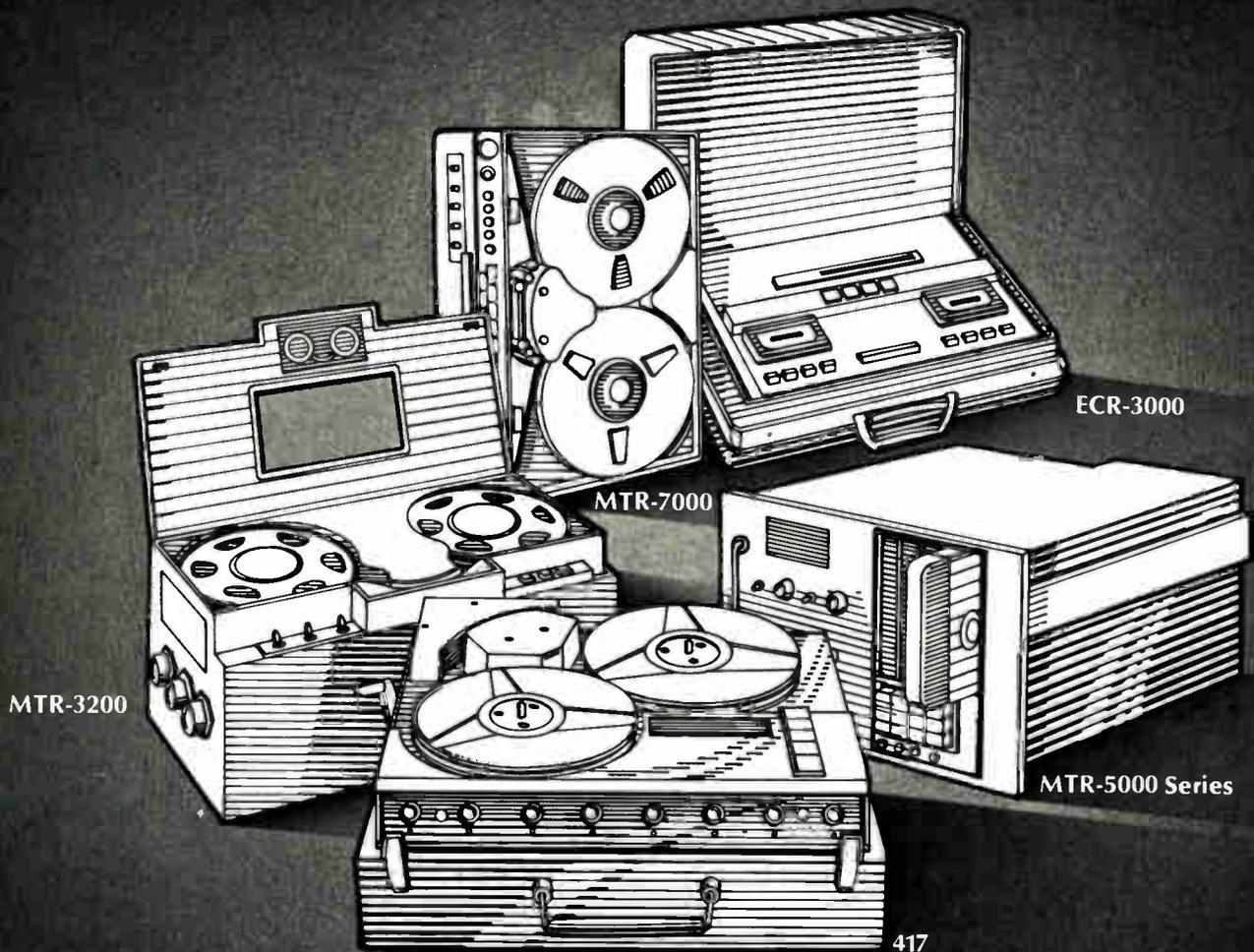
your closest Delco Electronic regional sales office: Kokomo, Ind. (317) 459-2175, El Segundo, Cal. (213) 640-0518, Union, N.J. (201) 687-3770.



DELCO ELECTRONICS



Division of General Motors Corporation



We build recorders that let you know what's going on in the world.

For years, Lockheed has been known for building advanced, custom recorders for space use. In fact, Lockheed has more recorders in space than any other manufacturer.

Now, since acquiring the recorder product line of Leach Controls Division, Lockheed has expanded its technological competence in deep space and satellite applications. And is also able to offer an expanded range of recorders for earthbound application:

417 — Lightweight, rugged and compact enough to fit under an airplane seat. Wide or intermediate band. Operates in any position.

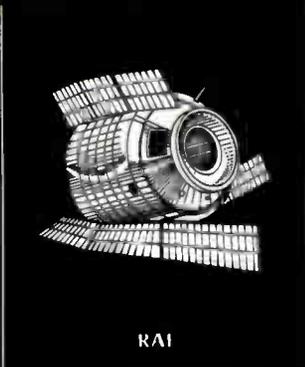
MTR-3200 — High environment recording of aircraft and missile flight tests, shipboard and other severe environmental applications.

MTR-7000 — 7 or 14 track over 800HZ to 2 MHz. 10½" reel. Available in 14" reel in the MTR-7100.

MTR-5000 Series — A family of audio frequency



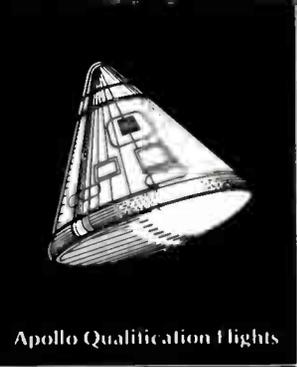
Mariner Mars 9



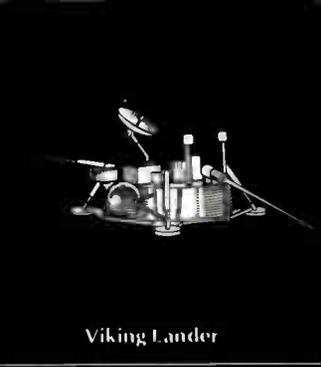
RAI



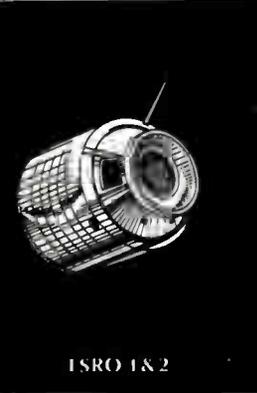
Mariner Mars 7



Apollo Qualification Flight 15



Viking Lander



ISRO 1&2



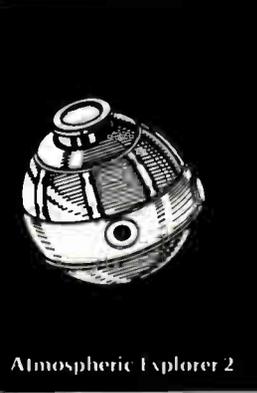
ISIS



IRIS



OSO



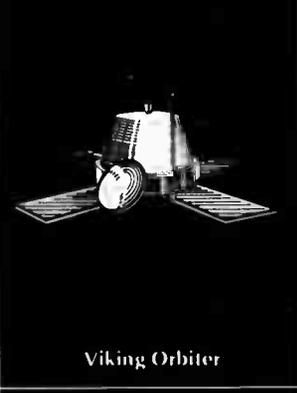
Atmospheric Explorer 2



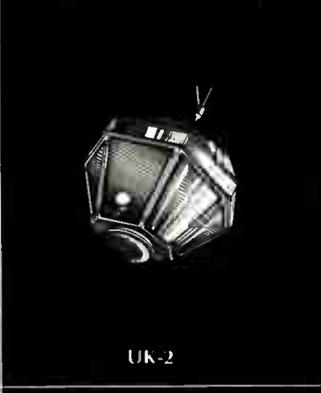
Mariner Venus/Mercury 10



Apollo Command Modules



Viking Orbiter



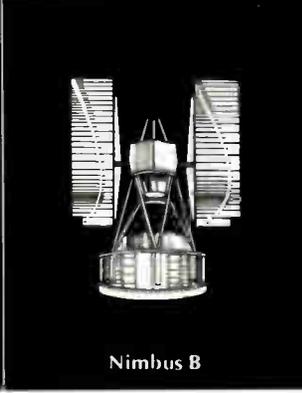
UK-2



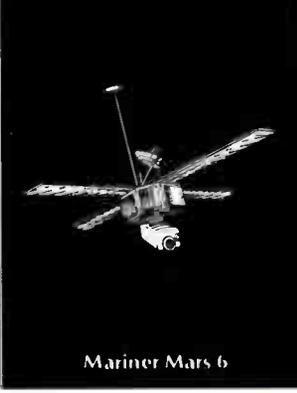
Atmospheric Research-Japan



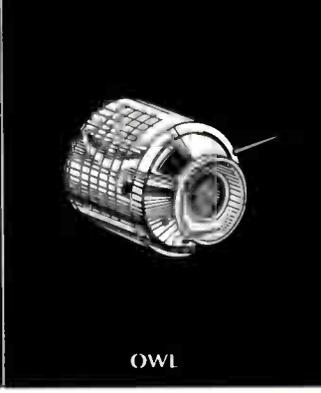
Apollo Lunar Module



Nimbus B



Mariner Mars 6



OWL

And out of it.

recorders. 4 and 12 cartridge units. Long-term, continuous monitoring or high-channel count.

ECR-3000 — Small, multi-channel courtroom recorder. Accurate, continuous recording. Operators do not need special training.

So, no matter what your recording needs, on earth or out of it, in controlled or hostile environments, check with Lockheed. We probably can give you exactly what you're looking for.

For more information, contact R. L. Major at Lockheed Electronics, Azusa, California 91702. Or call him collect at (213) 334-8211. Telex: 710-997-9541.

Our European representatives are: PTK, Cologne; Technitron, Rome; BDL, Paris; LAIAG, Geneva.

Lockheed Electronics.

Circle 13 on reader service card

FREE Engineering Handbook from RCL Electromagnetic Delay Lines

Including Dual-In-Line
(DIP)



NEW

'74

EDITION

Terms...engineering definitions... test methods ... how to specify delay lines ... characteristics of various types... specifications ... they're all included in this concise, easy-to-read handbook...yours for the asking.

**LUMPED CONSTANT ...
DISTRIBUTED CONSTANT
... VARIABLE**
all three types are covered in this reference handbook.

RCL

RCL ELECTRONICS, Inc.,

General Sales Office:

Seven Hundred
South Twenty First Street
Irvington, New Jersey 07111

People

This time around,
Czerwinski is boss

When Stan Czerwinski received his EE, he headed for TRW's Pacific Semiconductors Inc. in Lawndale, Calif. In the 10 years he's been at TRW, he has worked in several divisions. But now he has returned to the company's semiconductor operation—no longer a green engineer. This time he's in charge.

As the new general manager of TRW Semiconductors, Czerwinski takes over a company best known



Solid push. Stan Czerwinski aims to increase TRW's share of semiconductor sales to auto, TV and industry markets.

for its rf power transistors. In this fast-growing field that includes CATV, mobile radio, and microwave, TRW finds a situation unlike that in most semiconductor markets: "performance is the key—not price. Our customers want better parts, and that's more important to them than cost."

Sights set. Czerwinski intends to maintain this business, but he also has his sights firmly set on huge, price-conscious markets—automotive, industrial, and television. "We have products that are superior to those now being used in these applications, but they can't compete unless the price drops," and Czerwinski intends to make costs drop so that he can serve these markets.

"We want to increase productivity to make our high-voltage Darlingtons and other power devices attractive to the general market." In achieving these goals, his experience as director of marketing at TRW Electronic Components divisions and TRW's heavy involvement in Detroit should help him. TRW recently set up a special marketing effort in automotive electronics to unify some efforts in the wide offerings of TRW—from coils and cables to capacitors, connectors, resistors, circuit boards, and high-performance semiconductors.

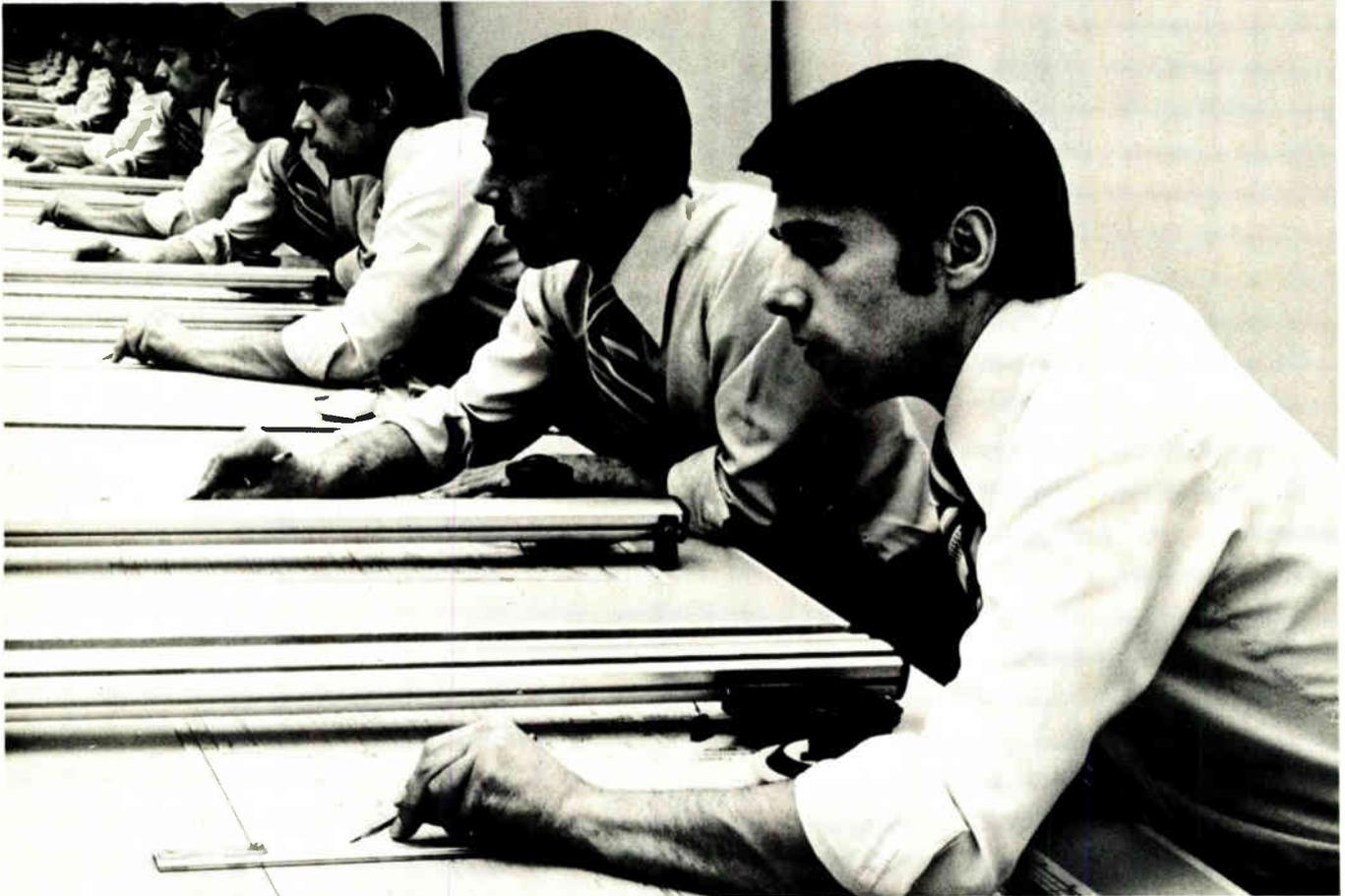
Czerwinski is looking at other semiconductor areas, as well—TRW holds basic TTL patents, and is now making SUHL TTL for a limited number of customers. Czerwinski says flatly, "I expect to get into some new areas like LEDs and LSI." But for now, he feels his biggest job is to maintain the company's position in the expanding communications market, in view of increasing competition from aggressive new firms. He also is trying to convert management and attitudes at TRW Semiconductor from that of a small intuitively run company to the planned, controlled, and organized operation of a large firm.

Forster set out to
found a firm—and did

Is America still the land of opportunity for the immigrant? It is for Englishman-turned-American J. Neil Forster, president, lawyer, and founder last August of Ad·Lin Corp., Norwood, Mass.

The idea for Ad·Lin (which stands for analog-digital linear) has been the driving force behind Forster since he was a teen-age apprentice draftsman in London. Forster came to the U.S. when he was 21 years old. "And the reason I came over was to found my own company," he says. His goal was to establish a business base in the circuit-module field upon which to build an instrument and data-acquisition-systems company. Forster has sales and marketing experience in mod-

How to multiply your draftsmen's time.



Shortcuts from Kodak turn drafting hours into minutes—on job after job.

Routine redrawing chores take a lot of valuable board time. Kodak can show your draftsmen how to restore drawings, make revisions, and handle repetitive elements—without redrawing. You'll save hours of drafting time and save money, too.

It's easy, because it's done photographically! We'll explain how to do it and help you select the proper Kodagraph films and papers for your particular work. And we can show you how, with an automated Kodak

processor, you can get reproductions back to your draftsmen faster, to save even more time.

There are other ways that Kodak can help multiply your draftsmen's efficiency. Microfilming your drawings will make them more accessible, save filing space, provide security, and give you other benefits, too.

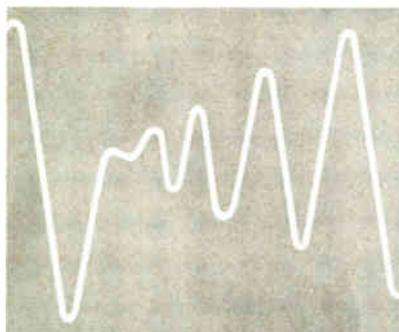
Get the details.

For additional information write: Eastman Kodak Company, Business Systems Markets Division, Dept. DP909, Rochester, N.Y. 14650.

Kodak products for drawing reproduction.

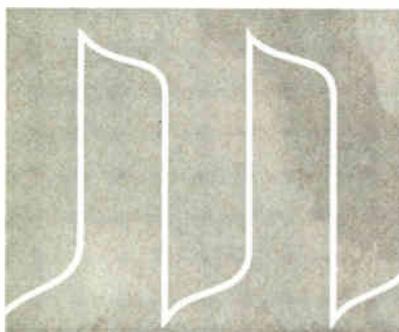


Pulse withstand capacitors for colour T.V.



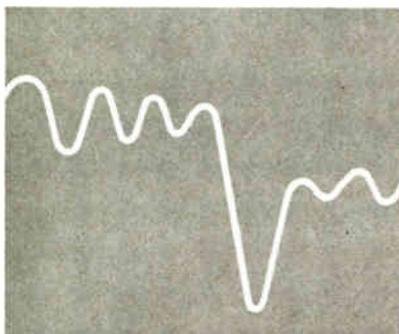
WIMA FKP 1

Polypropylene film and extended foil electrode capacitors encapsulated in cast resin. Self-healing properties. Suitable for sharp-edged or short rise time pulses in thyristor deflection circuits.



WIMA MKC 10

Metallized polycarbonate capacitors. Particularly suitable for stringent pulse and surge conditions. Low power factor at high frequencies. Self-healing properties. Plastic case design.



WIMA MKP 10

Metallized polypropylene capacitors in plastic cases. Self-healing properties. Suitable for both high current and pulse circuits owing to low dielectric losses.

- Other special capacitors in metal cases.
- One year successful field experience in equipment by leading manufacturers.
- Suitable for advanced solid-state equipment.
- For professional electronics.



WILHELM WESTERMANN

Spezialfabrik
für Kondensatoren
D-68 Mannheim 1
Fed. Rep. of Germany
Augusta-Anlage 56
P. O. Box 2345
Tel.: (621) 40 80 12

Write for our new catalogue.

People

ules from earlier work at Analog Devices and Teledyne Philbrick. Ad-Lin markets a broad line of adjustment-free high-performance multiplier/divider modules.

Today, at the age of 39, Forster enjoys his company's position as the smallest in the competition. "When a company is very big, it can't readily respond to the need of its smaller customers who need specialized work. That is where a fellow like me can come in and take up the slack," he explains. "When you're small and less formalized than the others, you can really determine what you're marketing next."

Ju-jitsu. Being a small company is not a blessing in these times of shortages, but Forster has managed to overcome that obstacle with his "financial ju-jitsu." "I pay my suppliers on the spot," he says. "I pay so fast that they love to see me in the door."

Forster concedes that the competition in the module field is fierce, but he notes that, once established, companies rarely go out of business. "There's room for others in this field, even though it is an emotional, cut-throat business," he says. But Forster prepared himself well for the hazards of business.

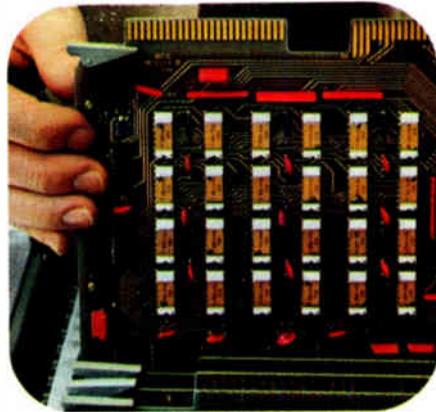
After obtaining a BSEE in 1969 from Northeastern University night school, Forster decided that a law degree would be the next practical building block for his future enterprise. He geared his legal training to a business environment and gained practical experience by participating in litigation in the electronics area under the wing of a practicing attorney. One thing Forster lacks is a "good dose of financial education. So I'll probably get that the hard way," he says.

Determined. J. Neil Forster, Ad-Lin chief, studied nights to win his BSEE and LLB.





THE HEWLETT-PACKARD COMPUTER DESIGNED SPECIFICALLY FOR THE SYSTEMS USER.



USE HP'S SUPPORTED FIRMWARE. OR MICROPROGRAM YOUR OWN SOLUTION.

- EXTENDED ARITHMETIC INSTRUCTIONS
- FLOATING POINT HARDWARE
- DUAL-CHANNEL DIRECT MEMORY ACCESS
- CRYSTAL-CONTROLLED PROGRAMMABLE TIME-BASE
- PARITY CHECK WITH INTERRUPT
- POWER-FAIL PROTECT WITH AUTOMATIC RE-START
- MEMORY PROTECT
- TWELVE I/O CHANNELS
- COMMUNICATIONS CONTROL INTERFACE
- A 16K, 16-BIT MEMORY (EXPANDABLE TO 32K)

THE FEATURES WANTED MOST ARE STANDARD ON THE 2100S.

Hewlett-Packard Computers. More features for your systems dollar.

Find out for yourself. Call your local HP office.
Or write

HEWLETT  PACKARD

Sales and service from 172 offices in 65 countries.
1501 Page Mill Road, Palo Alto, California 94304

A sample batch of the year's top numbers.

SCHOTTKY ON THE DOUBLE.



One-stop TTL shopping for 74S MSI, SSI...

At Schottky, you can get all the products you need in one place. The whole line is Schottky logic—meaning every high speed TTL function is Schottky.

And you get it where you want it, whether you need a full inventory directly from our factory, or a complete 2000-up in stock, or a complete 2000-up in stock, or a complete 2000-up in stock...

You can make the most out of your money by buying Schottky TTL. It's the only TTL that's Schottky logic. It's the only TTL that's Schottky logic. It's the only TTL that's Schottky logic...

Commuting 74S Schottky TTL gives you the advantages of Schottky TTL. It's the only TTL that's Schottky logic. It's the only TTL that's Schottky logic. It's the only TTL that's Schottky logic...

...and now optimized 82S MSI too.



Of course the 82S MSI has everything with 74S logic directly operating in the same design environment as all 74S Schottky TTL with the added advantage of driver replacement without changing fan-out rules.

74S-82S Schottky TTL. Just one call to one of our distributors, right in your area. And Schottky puts it on the line. You too.

The growing use of 82S TTL with high speed TTL for all applications. The 82S TTL is the only TTL that's Schottky logic. It's the only TTL that's Schottky logic. It's the only TTL that's Schottky logic...

World's Best Bipolar RAMs



Over 200 million Schottky RAMs are in use in computers, communications, and other high speed systems. Schottky RAMs are the only RAMs that are Schottky logic. They are the only RAMs that are Schottky logic. They are the only RAMs that are Schottky logic...

Part No.	Capacity	Access Time	Power
74S100	1K	100ns	100mW
74S101	2K	100ns	100mW
74S102	4K	100ns	100mW
74S103	8K	100ns	100mW
74S104	16K	100ns	100mW
74S105	32K	100ns	100mW
74S106	64K	100ns	100mW
74S107	128K	100ns	100mW
74S108	256K	100ns	100mW
74S109	512K	100ns	100mW
74S110	1M	100ns	100mW

INSTANT 883

Schottky puts 5400 SSI and MSI Class B housed-in parts on the shelf at Hamilton/Avnet.

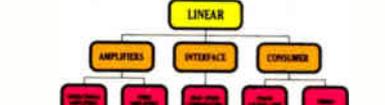


And thanks to the instant 883, you can get all the products you need in one place. The whole line is Schottky logic—meaning every high speed TTL function is Schottky.

Instant 883 is the name of our Schottky RAMs. It's the only RAM that's Schottky logic. It's the only RAM that's Schottky logic. It's the only RAM that's Schottky logic...

Hamilton/Avnet is the only distributor that's Schottky logic. It's the only distributor that's Schottky logic. It's the only distributor that's Schottky logic...

Economy: First Class



82S TTL is the only TTL that's Schottky logic. It's the only TTL that's Schottky logic. It's the only TTL that's Schottky logic...

82S TTL is the only TTL that's Schottky logic. It's the only TTL that's Schottky logic. It's the only TTL that's Schottky logic...

FREE



Pick up a FREE MCB SELECTION SLIP SHEET and get yourself the best MCB in the industry. On one side, you choose a function, on the other, you choose a number. It's that easy. It's that easy. It's that easy...

Integrated Circuits

SIGNETICS CORPORATION



"Where advanced technology is just part of the service."

Main Office and Manufacturer's Plant:

811 E. Arques,
Sunnyvale, Cal. 94086
(408) 739-7700

AUTHORIZED DISTRIBUTORS

ARIZONA

Phoenix: Hamilton/Avnet Electronics
2615 S. 21st Street . . . (602) 275-7851
Phoenix: Kierulff Electronics
2633 East Buckeye Road (602) 273-7331

Put more into your lines, tie into your neighborhood distributor.

CALIFORNIA

Culver City: Hamilton Electro Sales
10912 W. Washington . . . (213) 870-7171
El Monte: G. S. Marshall
9674 Telstar Avenue . . . (213) 686-0141
Los Angeles: Wesco Electronics
5650 Jillson Street . . . (213) 685-9525
Mountain View: Hamilton/Avnet Electronics
340 E. Middlefield Road, (415) 961-7000
Palo Alto: Wesco Electronics
3973 E. Bayshore Road . . . (415) 968-3475
San Diego: Hamilton/Avnet Electronics
8917 Complex Dr. . . . (714) 279-2421
San Diego: Cramer Electronics
8975 Complex Dr. . . . (714) 565-1881
San Diego: Kierulff Electronics
8797 Balboa Avenue . . . (414) 278-2112
Sunnyvale: Cramer Electronics
720 Palomar . . . (408) 739-3011



A telephone call to your distributor is one of today's best bargains.



CANADA

Downsview, Ontario: Cesco Electronics
24 Martin Ross Ave. . . . (416) 661-0220
Downsview, Ontario: Cramer Electronics
920 Alness Ave. Unit 9 . . . (416) 661-9222
Montreal, Quebec: Cesco Electronics
4050 Jean Talon West . . . (514) 735-6393
Montreal, Quebec: Hamilton/Avnet
935 Montee des Liesses . . . (514) 735-6393
Ottawa, Ontario: Hamilton/Avnet Electronics
880 Lady Ellen Place . . . (613) 725-3071
Ottawa, Ontario: Cesco Electronics
1300 Carling Avenue . . . (613) 729-5118

COLORADO

Denver: Hamilton/Avnet Electronics
5921 N. Broadway . . . (303) 534-1212
Denver: Cramer Electronics
5465 E. Evans Place at Hudson . . . (303) 758-2100

Integrated Circuits — Distributors (Cont'd)

CONNECTICUT

Hamden: Arrow Electronics
295 Treadwell Street . . . (203) 248-3801
Georgetown: Hamilton/Avnet Electronics
643 Danbury Road . . . (203) 762-0361
North Haven: Cramer Electronics
35 Dodge Avenue . . . (203) 239-5641

FLORIDA

Hollywood: Hamilton/Avnet Electronics
4020 N. 29th Ave. . . . (305) 925-5401
Hollywood: Schweber Electronics
2830 N. 28th Terrace . . . (305) 927-0511
Orlando: Hammond Electronics
911 W. Central Blvd. . . . (305) 241-6601

Signetics takes a back seat to no one in ECL 10K. Call us on it.

GEORGIA

Atlanta: Schweber Electronics
4126 Pleasantdale Road, Suite 14 . . . (404) 449-9170
Norcross: Hamilton/Avnet Electronics
6700 Interstate 85 Access Road, Suite 2B . . . (404) 448-0800

SCHOTTKY ON THE DOUBLE.
Promote the telephone, call your distributor.

ILLINOIS

Elk Grove: Schweber Electronics
1380 Jarvis Ave. . . . (312) 593-2740
Elmhurst: Semiconductor Specialists
195 Spangler Ave., Elmhurst Industrial Park . . . (312) 279-1000
Schiller Park: Hamilton/Avnet Electronics
3901 N. 25th Ave. . . . (312) 678-6310

INDIANA

Indianapolis: Semiconductor Specialists
P.D. Box 41630, Weir Cook Airport . . . (317) 243-8271

Dip into 0.15% AQL, with Signetics SUPR DIP digital circuits.

KANSAS

Lenexa: Hamilton/Avnet Electronics
37 Lenexa Industrial Center . . . (913) 888-8900

MARYLAND

Hanover: Hamilton/Avnet Electronics
7255 Standard Drive . . . (301) 796-5000

Rockville: Pioneer Washington Electronics
1037 Taft Street . . . (301) 424-3300

Rockville: Schweber Electronics
5640 Fisher Lane . . . (301) 881-2970

Here's a direct line to the shelves of your Comparator Supermarket.

MASSACHUSETTS

Burlington: Hamilton/Avnet Electronics
185 Cambridge St. . . . (617) 273-2120

Needham Heights: Kierulff Electronics
14 Charles Street . . . (617) 449-3600

Newton: Cramer Electronics
85 Wells Avenue . . . (617) 969-7700
Waltham: Schweber Electronics
213 Third Avenue . . . (617) 890-8484

Integrated Circuits — Distributors (Cont'd)

MICHIGAN

Livonia: Hamilton/Avnet Electronics
12870 Farmington Rd. . . (313) 522-4700
Detroit: Semiconductor Specialists
25127 W. Six Mile Rd. . . (313) 255-0300

MINNESOTA

Minneapolis: Semiconductor Specialists
8030 Cedar Ave., South . . . (612) 854-8841
Edina: Hamilton/Avnet Electronics
7683 Washington Avenue, South . . . (612) 941-3801

MISSOURI

Hazelwood: Hamilton/Avnet Electronics
392 Brookes Lane . . . (314) 731-1144

NEW YORK

Buffalo: Summit Distributors
916 Main Street . . . (716) 884-3450
Farmingdale, L. I.: Arrow Electronics
900 Broad Hollow Road . . . (516) 694-6800
Rochester: Schweber Electronics
999 Buffalo Road . . . (716) 328-4180
Syracuse: Hamilton/Avnet Electronics
6500 Joy Road . . . (315) 437-2642
Westbury: Schweber Electronics
Jericho Turnpike . . . (516) 334-7474
Westbury: Hamilton/Avnet Electronics
70 State Street . . . (516) 333-5800

JAN/Hi-Rel ICs.

Use? Buy? Specify?

Your distributor qualifies.

NEW MEXICO

Albuquerque: Cramer Electronics
137 Vermont, N.E. . . . (505) 265-5767

NORTH CAROLINA

Greensboro: Hammond Electronics
2923 Pacific Avenue . . . (919) 275-6391

NORTHERN NEW JERSEY

Cedar Grove: Hamilton/Avnet Electronics
218 Little Falls Road . . . (201) 239-0800
Saddlebrook: Arrow Electronics
285 Midland Avenue . . . (201) 256-7331

No-Hitch Schottky Comparators. So easy to shop by telephone.



SOUTHERN NEW JERSEY AND PENNSYLVANIA

Moorestown: Arrow/Angus Electronics
Pleasant Valley Road . . . (609) 235-1900

Mt. Laurel, N.J.: Hamilton/Avnet Electronics
113 Gaither Dr., East Gate Industrial Park . . . (609) 234-2133

Cherry Hill, N.J.: Milgray-Delaware Valley
1165 Marlkrass Rd. . . . (609) 424-1300

INSTANT 883.

Consult this page for instant 883 and JAN IC's

Integrated Circuits — Distributors (Cont'd)

CENTRAL NEW JERSEY AND PENNSYLVANIA

Somerset, N.J.: Schweber Electronics
43 Belmont Drive . . . (201) 469-6008

OHIO

Beechwood: Schweber Electronics
23880 Commerce Park Road . . . (216) 464-2970

Cleveland: Arrow Electronics
23945 Mercantile Rd. . . . (216) 464-2000

Cleveland: Pioneer Standard Electronics
4800 E. 131st Street . . . (216) 587-3600

Dayton: Hamilton/Avnet Electronics
118 Park Road W. . . . (513) 433-0610

Kettering: Arrow Electronics
3100 Plainfield Rd. . . . (513) 253-9176



OPTIMIZED PROMs and ROMs:



call for optimized service.



TEXAS

Dallas: Hamilton/Avnet Electronics
4445 Sigma Road . . . (214) 661-8661

Dallas: Cramer Electronics
2970 Biystone Ave. . . . (214) 350-1355

Houston: Component Specialties
7315 Ashcroft, Suite 113 . . . (713) 771-7237

Houston: Hamilton/Avnet Electronics
1216 West Clay Street . . . (713) 526-4661

☆☆☆ 555: ☆☆☆

The timer of 1001 uses. Promote the telephone shopping habit.

☆☆☆ 555: ☆☆☆

UTAH

Salt Lake City: Alta Electronics
2280 S. Main St. . . . (801) 486-7227

Salt Lake City: Hamilton/Avnet Electronics
647 W. Billins Rd. . . . (801) 262-8451

One-stop shopping: call your distributor for total TTL needs.

WASHINGTON

Bellevue: Hamilton/Avnet Electronics
13407 Northrup Way . . . (206) 746-8750

Seattle: Cramer Electronics
5602 6th Ave., South . . . (216) 762-5722

Your distributor brings the world to your door . . . with Bipolar ROMs and RAMs.

Off the shelf switches your shelf or ours



SNAP-IN SLIMSWITCH

- Eliminates the need for mounting holes and hardware.
- .315" (8mm) wide for greater panel density and improved readability.
- Assembles and mounts without tools.
- Life, over 1,000,000 detent operations.



ECONOMY MINISWITCH

- Sealed against dust and fluids.
- Back panel mounted.
- No tools needed for assembly.
- Dozens of output code options.

your shelf

If you use a lot of digital switches with a lot of different options, and you're trying to guess months ahead how many of each configuration you need, consider stocking our switches yourself. Digitran's Series 23000 SNAP-IN SLIMSWITCHES and Series 29000 ECONOMY MINISWITCHES are so quick and easy to assemble that anyone can do it without using tools.

Just buy switch modules with all the output codes and number of dial positions you use, then order end brackets and a selection of our simple to install assembly straps. You can then assemble all the standard or special switch assemblies you need, even if you wait 'til the day before you need them to put them together.

our shelf

We stock both products at our factory. Our distributors (26 of them) also stock both series on their shelves. So you can usually get just what you want already assembled from us or one of our distributors. There's no extra charge to assemble your Series 23000 or 29000 switches.

But, whether you use our shelf or yours, buy Digitran's Series 23000 SLIMSWITCHES and Series 29000 ECONOMY MINISWITCHES and save time, money and headaches.

There is a Digitran authorized distributor and a sales engineering group in your area. Call them or send for details about the new SNAP-IN SLIMSWITCH and ECONOMY MINISWITCH today.

More Digitran products are shown on pages 1148 and 1149, Vol. 2 of your 1973-74 EEM Directory.

**MORE SWITCHES FROM THE
DIGITRAN[®]
COMPANY**
Division of Becton, Dickinson and Company [B] [D]
855 South Arroyo Parkway / Pasadena, Ca. 91105
Phone: (213) 449-3110 TWX 910-588-3794

Meetings

Winter Consumer Electronics Show: EIA Consumer Electronics Group, Conrad Hilton Hotel, Chicago, Ill., Jan. 10-13, 1974.

Reliability and Maintainability Symposium: IEEE, Biltmore, Los Angeles, Calif., Jan. 29-31.

International Solid State Circuits Conference: IEEE, University of Pennsylvania, Marriott Hotel, Philadelphia, Feb. 13-15.

Computer Conference (Comcon): IEEE, Jack Tarr Hotel, San Francisco, Feb. 26-28.

Aerospace and Electronics Systems Winter Convention (Wincon): IEEE, Marriott Hotel, Los Angeles, March 12-14.

Zurich Digital Communications International Seminar: IEEE, Swiss Federal Institute of Technology, Zurich, Switzerland, March 12-15.

International Convention (Intercon): IEEE, Coliseum and Statler Hilton Hotel, New York, March 25-29.

Carnahan Conference on Electronic Crime Countermeasures: IEEE, Univ. of Kentucky, Lexington, April 17-19.

International Reliability Physics Symposium: IEEE, MGM Grand Hotel, Las Vegas, Nev., April 2-4.

International Optical Computing Conference. IEEE Computer Society, Zurich, Switzerland, April 9-11.

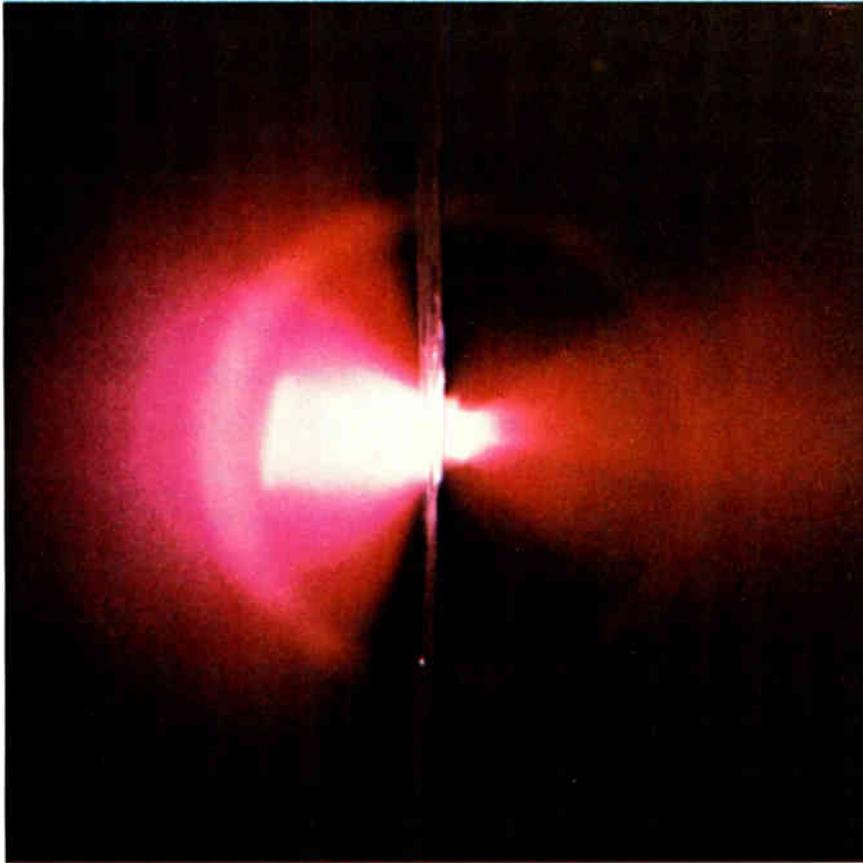
Optical and Acoustical Micro-Electronics: IEEE, Commodore Hotel, New York, N.Y., April 16-18.

International Circuits and Systems Symposium: IEEE, Sir Francis Drake Hotel, San Francisco, April 21-24.

Communications Satellite Systems Conference: IEEE, International Hotel, Los Angeles, Calif., April 22-24.

Pittsburgh Conference on Modeling and Simulation: Instrument Society of America, University of Pittsburgh, Pa., April 24-26.

PULSED LASER MEASUREMENT RESULTS IN MINUTES!



The TEKTRONIX R7912 Transient Digitizer represents orders of magnitude improvement in high speed transient measurements. It allows you to make your laser measurements quickly and easily—such measurements as checking switch-out effectiveness, looking for multi-modes, checking pumped amplifiers, and measuring effects on targets. One such target measurement is the study of particles generated from a plasma like that shown in the photo above.

Fast transient measurements can be viewed rapidly—with no need for photographs—whether your laser is running at a few pulses per second or single shot. The R7912 can be configured for direct viewing or for computer analysis. For repetitive signals (low or high rate), the TV mode offers large bright displays. For single transients, the digital display controller provides for viewing a refreshed display of the waveform on a monitor. For computer analysis, the PDP-11 interface allows waveform manipulation and measurement with Tektronix developed software.

The R7912 offers you the following measurement capabilities:

Analog Bandwidth:

1 GHz at 4 V/DIV
500 MHz at 10 mV/DIV

Resolution:

320 by 400 lines
512 by 512 addressable points

Writing Rate:

8 DIV/N sec—Digital Mode
30 DIV/N sec—TV Mode

Sampling Rate (effective):

10 psec (100 GHz) or slower

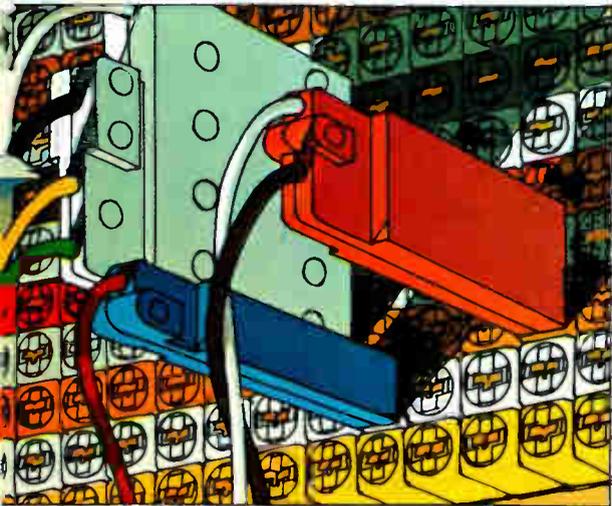
Investigate the TEKTRONIX R7912 Transient Digitizer, it can make your pulse laser measurements easier and quicker. To obtain a copy of "New ways to see Fast Transients" and/or pertinent application notes, contact your Tektronix Field Engineer, use the reader service card, or write to Tektronix, Inc., P.O. Box 500A, Beaverton, Oregon 97005. Phone: 503/644-0161. In Europe: Tektronix, Ltd., Guernsey, C.I., U.K.




TEKTRONIX®
committed to
technical excellence
**SYSTEMS
DIVISION**

Growing with the

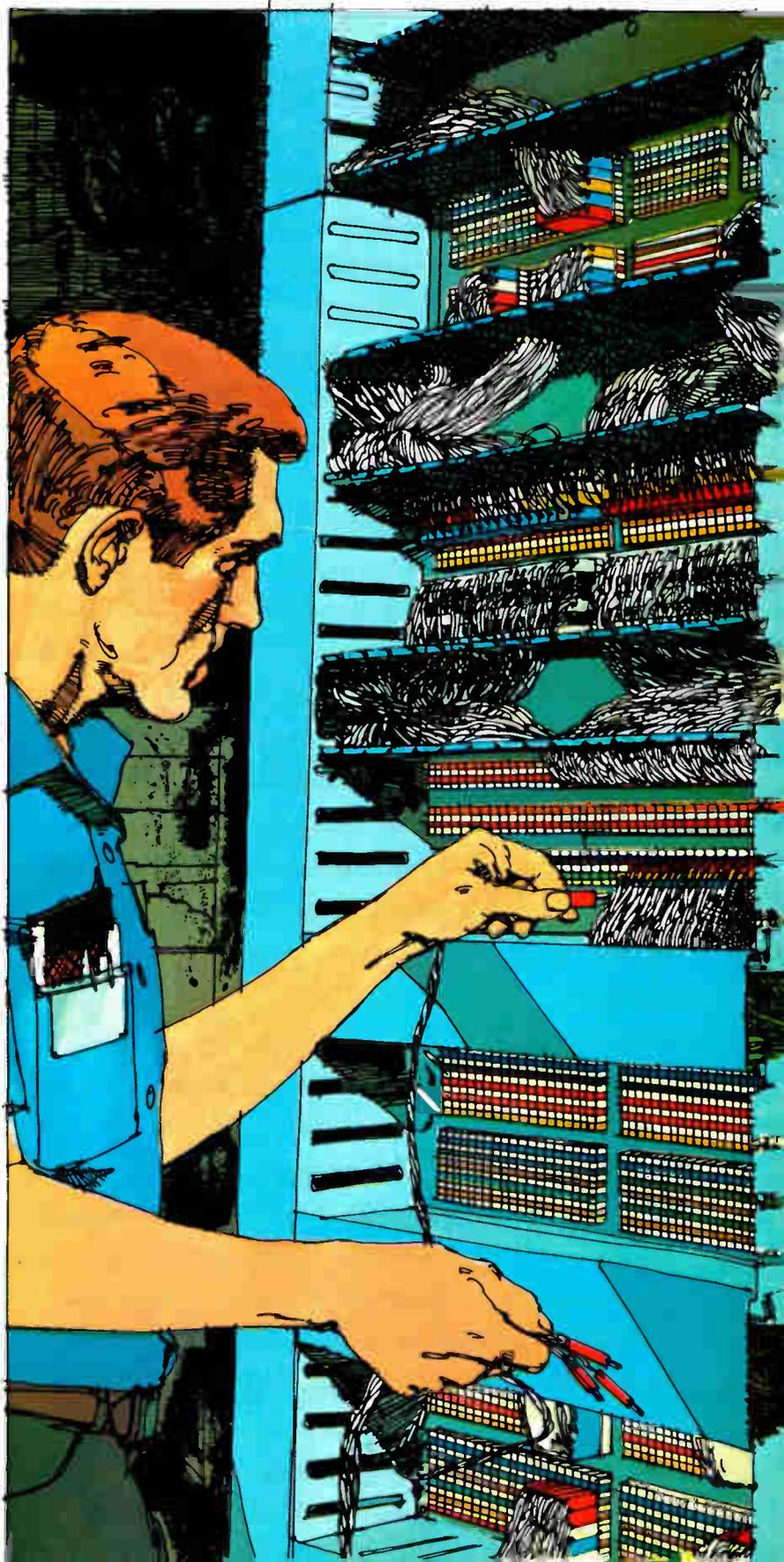
Amphenol's new telephone connector system saves space, saves time, saves material.



It's called Circuit Concentration Bay (CCB) and was first used to alleviate the problem of overcrowded distributing frames in a major Colorado telephone company central office. More than five miles of cable were actually eliminated in this installation. Floor space requirements were reduced by 80 per cent.

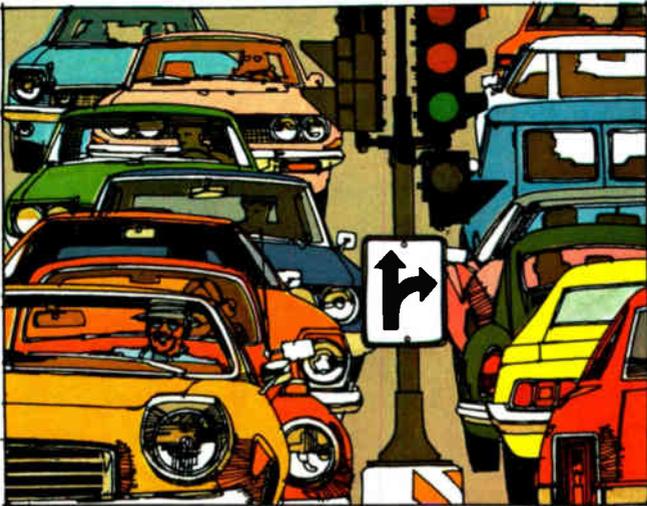
As more and more phone companies gain experience with CCB, it is also becoming clear that the savings in labor are at least as great as the space savings. Instead of the tedious, time-consuming job of hand soldering each connection, the craftsman uses color-coded miniature patchcords to complete circuits in about one-twentieth the time. And circuit interruptions found in normal distributing frames are virtually eliminated.

The savings in space, materials and labor due to Amphenol's CCB system are adding up to tremendous cost reductions and improved service for phone companies across the country.



new electronics

Amphenol connectors help a mini-computer control a 70,000 vehicle intersection.

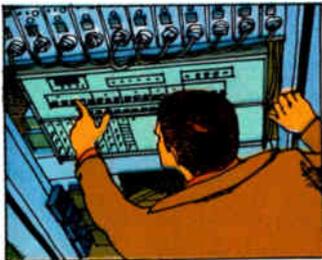


A sophisticated traffic control computer was installed last year to tame an unusually busy intersection in Campbell, California.

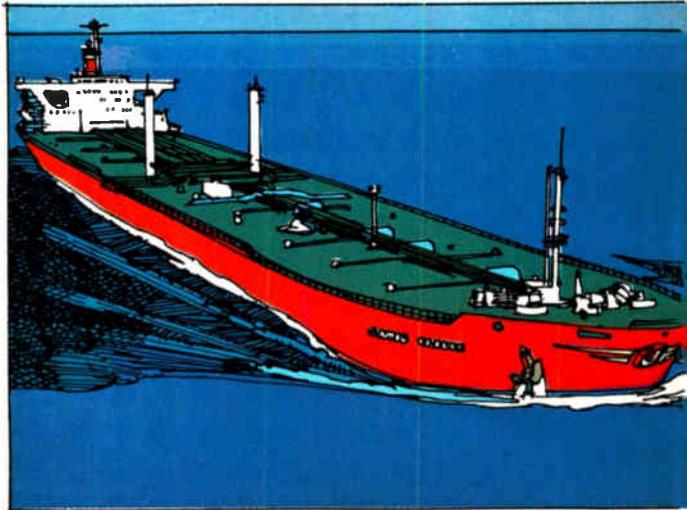
Environmental problems are tough because the controller is located right at the intersection. It must remain unaffected by temperature variations between 0 and 120°F. and by voltage variations of plus or minus 10 per cent. It must perform faithfully for years to come.

That's why Amphenol's 5015 series connectors were selected. Our "Old Vet" has a service record in tough environmental conditions that no one can match. Some "Old Vets" are in service after over 30 years on the job.

That's important to Campbell, California because their traffic controller has a lot of work ahead of it.



Amphenol digital turns-counting dials help load a ship by computer.



Unless a ship's cargo is distributed just right, stresses can cause extensive hull damage. So proper load distribution is critical. That's why one of the world's largest shipbuilders

has developed an electronic cargo distribution computer. It presents cargo placement and hull stress information continuously.

The Swedish manufacturer selected Amphenol dials for this computer because they're so easy to read. A magnifying window significantly enlarges the numerals and vernier scale, and digital readout is angled to the perpendicular for easy viewing from all positions.

Easy readability of the computer input devices is essential because a misread digit, when fed into the computer, could cause a disastrous error in loading.



**BUNKER
RAMO**

AMPHENOL

For more information, contact these manufacturing/sales facilities. United States: Amphenol Sales Division, 2875 S. 25th Av., Broadview, Il. 60153 Canada: Amphenol Canada Ltd., 44 Metropolitan Rd., Scarborough, Ont. Great Britain: Amphenol Ltd., Thanet Way, Tankerton, Whitstable, Kent, England West Germany: Amphenol-Tuchel Electronics GmbH, 8024 Deisenhofen bei Munchen, West Germany France: Usine Metallurgique Doloise, 92a98 Avenue de Gray, 39100—Dole, France Australia: Amphenol Tyrec Pty. Ltd., 10-16 Charles St., Redfern, N.S.W. 2016, Australia India: Amphetronix Ltd., 105 Bhosari Industrial Area, Box 1, Poona 26, India Japan: Daiichi Denshi Kogyo K.K., 20, 3-Chome, Yoyogi, Shibuya-ku, Tokyo, Japan 151

Circle 23 on reader service card

Pulse handling:
there's more to
resistors than
resistance.

If you're really
serious about cost,
be serious about quality.

Experience shows that Allen-Bradley fixed composition resistors can withstand far greater pulse energy levels than resistors manufactured by some other technologies.

For example, a pulse equivalent to the energy from the rapid discharge of a 10 μ f capacitor charged to 600 volts (1.8 watt-seconds) will have an insignificant effect on Allen-Bradley 1/4 watt resistors.

This performance is characteristic of the hidden values built into all Allen-Bradley composition resistors by our exclusive hot molding process. Quality that can make important differences in your design and procurement decisions.

Ask your Allen-Bradley distributor for "7 ways to tell the dif-

ference in fixed resistors." Or write: Allen-Bradley Electronics Division, 1201 South Second Street, Milwaukee, WI 53204. Export: Bloomfield, NJ 07003. Canada: Allen-Bradley Canada Limited, Cambridge, Ontario. United Kingdom: Jarrow, County Durham NE32 3EN.

A-B Type	Rated Watts	Pulse Energy Capability Watt-Seconds	Equivalent Energy Source
BB	1/8	0.45	2 μ f @ 670 volts
CB	1/4	1.8	10 μ f @ 600 volts
EB	1/2	6.4	32 μ f @ 630 volts
GB	1	16	32 μ f @ 1000 volts
HB	2	44	32 μ f @ 1650 volts

EC70



Double-drift Impatt of silicon opens way to pulsed systems

A new Impatt diode structure—a ring-shaped, silicon, double-drift mesa diode—developed by Hewlett-Packard's HPA division in Palo Alto, Calif., could trigger changes in microwave and millimeter-wave-system design concepts by making high-power silicon Impatts available and solid-state pulse systems practical.

Bert Berson, R&D section manager, stresses the pulse power of the new diodes because, heretofore, Impatts have been operated only in continuous-wave modes, at power levels up to around 1 watt at X band. Even at that modest level, the conventional single-drift Impatt is considered to be the most powerful solid-state oscillator and amplifier in production.

But HPA's first production units give average pulse powers of 3 w and peak powers of 12 w at X band (10 GHz) or 10 w at Ku band (16.5 GHz). Peak powers of developmental types range from around 25 w at 13 GHz to around 5 w at 38 GHz. The powers of cw types are less spectacular, but still far above those of conventional Impatts—1.3 w and 2.3 w in developmental single devices. Berson expects to get 5 w in the future.

Equally significant, the pulsed types run at efficiencies ranging from 12% at X band to near 5% at Ka band (38 GHz), and the cw types run around 10%. This compares with 6% or 7% for conventional silicon Impatts. That means, Berson says, that systems with small direct-current and battery power supplies are practical. Operating voltages range from 50 to 150 volts and currents from 200 milliamperes to about 2 amperes, depending on power-frequency tradeoffs.

Unlike gallium-arsenide Impatts, such as Raytheon's, some of which have also achieved high power levels, the double-drift diodes can be made by any firm with well-controlled silicon processing technology, he says.

FCC rule could boost business microwave market

A surge in the market for less expensive, lower-frequency microwave radio equipment is the result expected from a ruling by the Federal Communications Commission that permits local and business-area users access to frequencies below 10 gigahertz. Business-radio users operating long-haul systems are given access to the 2- and 6-GHz bands, criteria are also established for bandwidth, interference, and antennas. Until now, businesses have been restricted in the types of traffic they could transmit and to frequencies above 10 GHz, which require more expensive equipment.

Fairchild to go Isoplanar with all C-MOS families

Fairchild Camera & Instrument Corp. plans to produce all three types of MOS with Isoplanar dielectric isolation, says Thomas Longo, vice president of the Digital Products group, Mountain View, Calif. An Isoplanar C-MOS family, which will be introduced early in 1974, will be directly interchangeable with RCA 4000 C-MOS devices, but operate at higher performance levels, Longo claims. He adds that, late in 1974, Isoplanar n-channel LSI circuits will be in production. The firm has already announced p-channel Isoplanar products. [*Electronics*, Dec. 6, p. 35].

National cuts C-MOS prices, aims at data market

National Semiconductor Corp. plans to expand the market for its 74C C-MOS family by cutting prices 10% this month and by orienting several upcoming MSI circuits toward the data-acquisition and processing-equipment markets, which hardly have been touched by C-MOS, says Robert Bennett, product manager. He says the primary C-MOS market now is portable instruments. The price cuts, which went into effect Dec. 17, will make C-MOS more competitive with TTL and are justified by increased production volume, says Bennett.

For the data-acquisition and processing market, **National is introducing this month a 4-bit adder, a 4-bit comparator, and a 64-bit static RAM. A 256-bit RAM is to follow in a few months.** National now produces some 35 types of 74C C-MOS devices. Bennett plans to be in production by the end of 1974, with most of the 15 additional types to be C-MOS replacements of widely used TTL MSI functions.

Active antenna covers wide band

Linking a miniature antenna element and a proprietary wideband amplifier, Adams-Russell Co. of Waltham, Mass., **has come up with an active communications antenna featuring extremely wide bandwidth coverage.** Also, the company claims its amplifier has "extraordinarily good linearity" with low noise and negligible intermodulation problems.

Designed for receiving applications below 50 megahertz, standard models will cover the spectrum from 10 kilohertz to 108 MHz in three overlapping bands. All models are broadband with 50 ohms output impedance across the full band, with all frequencies simultaneously available. The antenna was developed for the Army, and Adams-Russell expects most sales will be to the military and government. Much of the first 36-unit production run will be sold to the Army and to a European customer.

Varian to market disk mini systems

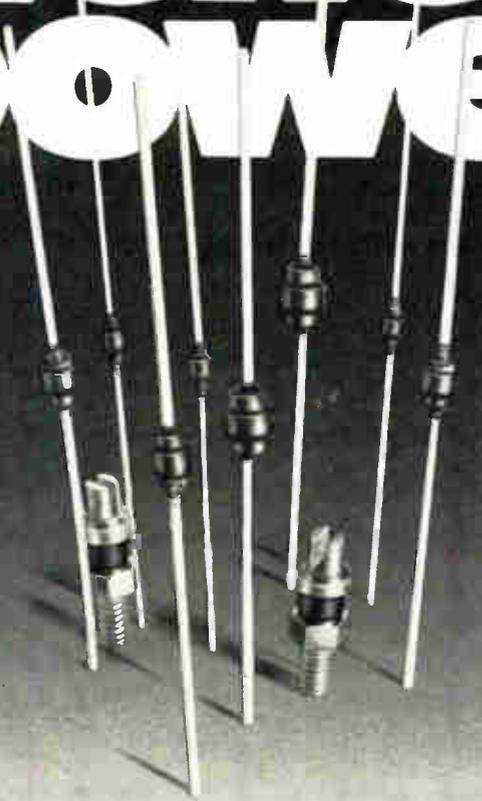
Another major minicomputer company is joining General Automation as a competitor in the disk-based, real-time operating system business dominated by Digital Equipment Corp. **The new entry is Varian Data Machines, which will announce soon five general-purpose, real-time and batch-processing systems with disks, all based on the company's V-73 and new V-72 and V-74 minis.**

Prices range from \$36,300 for the 72/one batch system with 32,000 bytes, disk, and TTY, to \$115,000 for the 74/fifty—which Varian calls a "PDP-11/50 killer"—with 128,000 bytes of main storage, a 29-megabyte disk, and numerous other peripherals.

Addenda

A study of IC packaging indicates that, though cost balance still favors offshore assembly when using conventional wire bonding, **automated gang bonding techniques plus changing world conditions will tend to bring IC assembly back to the U.S.** John Salzer of Darling and Alsobrook, a Los Angeles consulting firm, finds that the true cost of offshore wire-bonded assembly of a representative MSI device in a plastic encapsulated DIP is 48 cents compared to 61.5 cents in the U.S. However, gang-bonding techniques such as soldered flip-chip (58.6 cents in the U.S.) and soldered inverse beam leads (59.7 cents) tend to reduce the differential as reduced assembly labor somewhat compensates for higher chip cost. . . . Motorola has closed its computer-aided design center in Lexington, Mass., after a year of disappointing operation.

Zener power



Unitrode hi-rel zeners give you more surge protection... up to 2500 watts for 100 μ s.

That's the surge capability of our popular 6 watt series which is equal to or greater than conventional 50 watt types. Unitrode 1 watt, 1.5, 3, 5, 6 and 10 watt zeners will all give you more in a smaller, more rugged device. And most series are available up to 400 volts.

Unitrode also provides compact custom molded assemblies of zeners in series/parallel arrangements to meet any surge requirement. These unmatched capabilities are achieved through Unitrode's unique fused-in-glass construction. A silicon wafer is bonded directly between the terminal pins, eliminating the whisker.

A sleeve of hard glass is then fused to the exposed silicon surface resulting in a voidless, monolithic structure that exceeds the environmental requirements of MIL-S-19500. The 1.5 watt 1N4461 series is available as JAN and JANTX devices to MIL-S-19500/406 and the 5 watt 1N4954 series is available as JAN and JANTX devices to MIL-S-19500/356. And Unitrode can really service these specs. Shipment is from inventory. Send for your free zener data packet containing specification sheets and prices on our complete line of high surge capability zeners.



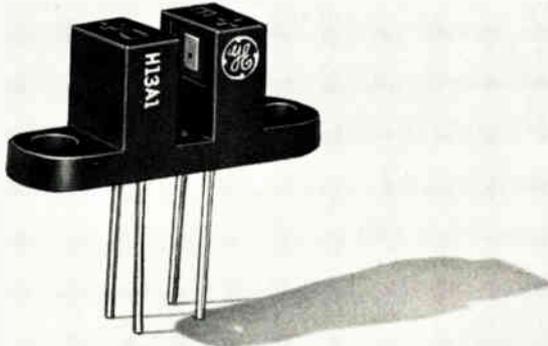
UNITRODE

Unitrode Corporation Dept. 23Y, 580 Pleasant Street, Watertown, Mass. 02172, U.S.A.

Unitrode Sales Representatives: **ALA.**, Huntsville, 20TH CENTURY MARKETING INC. (205) 772-9237; **ARIZ.**, Scottsdale, FRED BOARD, ASSOC. (602) 994-9388; **CAL.**, Burlingame, BROOKS TECHNICAL GROUP (415) 347-5411, Escondido, ANDREW ELECTRONICS SALES (714) 743-3015, Sherman Oaks, UNITRODE CORP. (213) 783-1301; **COL.**, Littleton, SIMPSON ASSOC., INC. (303) 794-8381; **CONN.**, Hamden, COMPAR NEW ENGLAND (203) 288-9276; **FLA.**, Boca Raton, CONLEY & ASSOC. INC. (305) 395-6108, Oviedo, CONLEY & ASSOC. INC. (305) 365-3283, Tampa, CONLEY & ASSOC. INC. (813) 933-3183; **ILL.**, Chicago, CARLSON ELECTRONICS SALES CO. (312) 774-0277; **MO.**, Baltimore, DANIEL & COMPANY (301) 825-3330; **MASS.**, Newton Highlands, COMPAR NEW ENGLAND (617) 969-7140; **MICH.**, Detroit, RATHSBURG ASSOCIATES, INC. (313) 882-1717; **MINN.**, Minneapolis, CHARLES E. BOHLIG CO. (612) 922-7011; **MO.**, St. Louis, CARLSON ELECTRONICS SALES CO. (314) 991-0262; **N.Y.**, Clifton, N.J., COMPAR NEW YORK, INC. (201) 546-3360, Albany, COMPAR ALBANY, INC. (518) 489-7408, Endwell, COMPAR ALBANY, INC. (607) 723-8743, Fairport, COMPAR ALBANY, INC. (716) 271-2230, Liverpool, COMPAR ALBANY, INC. (315) 471-3356; **N.C.**, Burlington, P. J. NAHSER, INC. (919) 226-8053; **OHIO**, Cincinnati, BAEHR, GREENLEAF & ASSOC., INC. (513) 891-3826, Cleveland, BAEHR, GREENLEAF & ASSOC., INC. (216) 221-9030, Columbus, BAEHR, GREENLEAF & ASSOC., INC. (614) 486-4046, Dayton, BAEHR, GREENLEAF & ASSOC., INC. (513) 426-5485; **PENN.**, Willow Grove, DANIEL & COMPANY (215) 674-3850, Pittsburgh, COVERT & NEWMAN CO. (412) 563-0303; **TEX.**, Houston, SEMICONDUCTOR SALES ASSOC. (713) 461-4197, Richardson, SEMICONDUCTOR SALES ASSOC. (214) 231-6181; **UTAH**, Salt Lake City, SIMPSON ASSOC., INC. (801) 521-3622; **WASH.**, Bellevue, N.E.M.C.O. (206) 747-6863; **CANADA**, Downsview, Ontario, KAYTRONICS LTD. (416) 638-5511, Montreal 267, Quebec, KAYTRONICS LTD. (514) 487-3434.

Circle 27 on reader service card

OPTOELECTRONIC DESIGNERS CHOICE



INTERRUPTER MODULES

4 new models require no contact pressure, offer high reliability, compatibility with integrated circuits

H13A1, H13A2 FOR HIGH SPEED

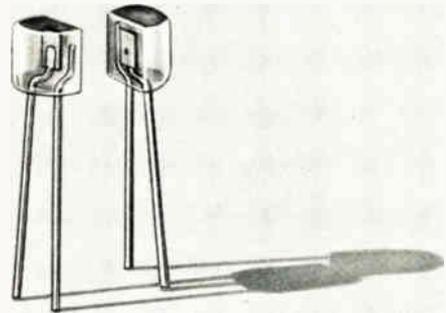


- min $I_O = 200\mu\text{A}$ at $I_F = 20\text{mA}$
- $5\mu\text{sec } t_{ON}, t_{OFF}$
- \$1.35*

H13B1, H13B2 FOR GAIN



- min $I_O = 2.5\text{mA}$ at $I_F = 20\text{mA}$
- \$1.45*



MATCHED LED/DETECTOR PAIR

2 new TO-92 configured gallium arsenide LED / detector pairs offer low cost, side looking packages

H17A1 LED/TRANSISTOR DETECTOR



- min $I_O = 50\mu\text{A}$ at $I_F = 20\text{mA}$ ($d = .125''$)
- $5\mu\text{sec } t_{ON}, t_{OFF}$
- \$1.25*

H17B1 LED/DARLINGTON DETECTOR



- min $I_O = 1\text{mA}$ at $I_F = 20\text{mA}$ ($d = .125''$)
- \$1.35*

*Suggested resale price 1,000 lot quantities

TYPICAL APPLICATIONS

- Shaft encoders
- Tachometers
- Counters
- Position sensing
- Key boards
- Level sensing
- Limit switch and micro switch replacement

For more information, contact your authorized GE distributor, any GE Electronic Components Sales office, or write on company letter-head to:

GE Semiconductor Products Department
Electronics Park, Bldg. #7, Mail Drop #49
Syracuse, N.Y. 13201

GENERAL  ELECTRIC

An electronic link to the visual cortex may let blind 'see'

Experiments conducted at the University of Utah use minicomputers to simulate 'sight'

Putting sight back into the eyes—literally—of blind people is the ambitious goal of an artificial-vision program at the University of Utah. Already, with electrodes implanted in their brains, some blind patients at the Institute for Biomedical Engineering there have seen light patterns generated by a simulated "eye." Further down the road is the implantation of sensors directly into the eye and their linkage to the brain electrodes.

In tests of the system, light patterns, called phosphenes, have been successfully stimulated with a pulse-generation and control system. For convenience and safety, two computers are used in the experiment setup: a Digital Equipment Corp. PDP-11 computer and CRT display simulates the light sensors, and a PDP-8 computer and stimulation-driver circuitry actuate electrodes implanted in a patient.

William H. Dobelle, associate director of the project, feels that, once the proper stimulation parameters—such as pulse width and intensity—are determined, a practical camera and data control and storage system should be a relatively straightforward design problem using present IC technology. For example, the eye imager could be either an MOS image-array chip or a charge-coupled device. Complementary-MOS logic would provide the current sources, while a one-chip micro-



Patterns. A blind patient can draw patterns displayed on a CRT shown at the rear and sent to his brain via electrodes implanted in his visual cortex. A DEC GT Graphics-40 System controls the setup. Associate director of the project is William Dobelle (center).

processor and some in-house-designed n-channel circuits would be used to implement the remaining portions of this system.

The embedded image sensors could be operated by the eye muscles and the miniature control circuits could be worn simply on the eyeglass frame. Total power for the system is expected to be less than 6 watts.

Other work. The first visual prosthetic device was implanted in 1967 by Giles Brindley, professor of physiology at the Institute of Psychiatry in London. Since then, Brindley and Peter Donaldson, also of the institute, have developed other approaches.

Brindley's system uses a small cable to connect electrodes in the visual cortex to receivers placed in a rubber shell under the scalp. The receivers respond to frequencies in the 5-to-10-megahertz range. These are,

in turn, driven by a battery of oscillators via inductors, which can be hand-held or fitted into a helmet. When the electrodes are stimulated, patients report "seeing" phosphenes, which can be combined in an array to form patterns.

The biggest current problems, Dobelle admits, are with the electrodes. Because wires penetrating the skin pose an unacceptable threat of infection, the Utah project, too, would use an rf coupling to connect the external circuits to the electrodes. What's more, packaging of the items is critical. With the biologic environment extremely corrosive, even microscopic defects or pinholes in the coating used to insulate chips could present a serious contamination.

Dobelle points out that only about 10% of the blind can actually read braille, which is not only limited to alphanumeric characters but

is quite expensive to transcribe. The implanted electrode system would add another dimension, permitting the blind to see for mobility as well as for obtaining transcribed information. □

Fiber optics

Simple coupler taps fiber-optic cables

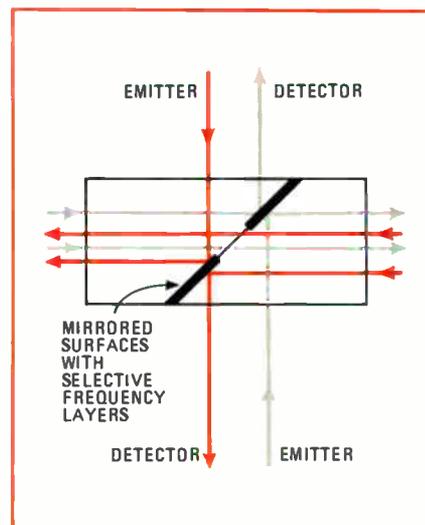
A simple optical coupler may provide a practical means of tapping bundles of multimode fiber-optic cable used to transmit electrical signals in aircraft. Developed at the Naval Electronics Laboratory Center (NELC), San Diego, Calif., the coupler results in signal loss of 4.5 decibels, says Henry Taylor, research physicist in the Electro-optics Technology division at NELC. Taylor expects to reduce losses to 3 dB, which he says would permit communications at 5 megabits per second through 15 coupler-equipped terminals in a 150-foot cable without a repeater—a practical system for future aircraft.

Bell Laboratories, Murray Hill, N.J., is also one of several firms developing experimental low-loss cou-

plers, but these have been for smaller-diameter single-mode fiber-optic pipes of the type more adaptable to long-haul telephone transmission.

The NECL coupler is made by diagonally slicing a small glass block, polishing and silvering the diagonal cuts to make a mirror part-way across the cut, and reassembling the block. If light from a cable is focused on one end, a small portion is reflected from the silvered surface and moves perpendicular to the axis, where it can be detected by a photodiode. Most of the light, however, continues through the coupler to the other end, where it reenters the fiber-optic cable. To introduce data, a light-emitting diode shines perpendicular to the other side of the block onto the other side of the silvered area.

For two-way communications, different-colored LEDs could be used, with multilayer interference mirrors that selectively reflect or transmit the desired light. In practice, infrared light has been used, with LEDs and silicon p-i-n detectors. Semiconductor lasers would provide higher power levels, and avalanche detectors would provide better sensitivity, says Taylor. A light output of 2 or 3 milliwatts is desirable, he adds, but present semi-



In and out. In the optical coupler developed at the Naval Electronics Laboratory Center, San Diego, losses are about 4.5 dB.

conductor lasers can't provide that. Present LEDs are capable of 50-megabit data rates, but the Naval lab has been using only 5 megabits with simple digital pulse-coded modulation.

The main advantage of the fiber-optic cables for the military is their immunity to radio-frequency signals and their containment of the transmitted signals in the cables. In ground-communications systems, this greatly increases transmission security. Optical cables also eliminate crosstalk, and they are resistant to electromagnetic interference from equipment on an aircraft and even electromagnetic pulses generated by nuclear blasts.

The other advantage, and one more commonly mentioned in commercial uses, is the weight and space savings of the cables resulting from their very large bandwidth. Again, this is most important if the cables need shielding, as they would for military uses.

Taylor points out that the bandwidth becomes especially vital if high-rate electronic countermeasures, sensors, or displays must be distributed around the aircraft. A single cable might be enough for fighters, says Taylor, and three cables are enough to handle communications in an aircraft of the complexity of an Air Force's B-1 bomber. He has also looked at fly-by-wire

Fiber-optic cabling comes into view

As military interest in fiber-optic communications increases, Corning Glass Co., Corning, N.Y., is expected to market low-loss multimode fiber cabling early next year. These links will include the input light-emitting diodes and the output photodetectors as part of a single cable. At Wright-Patterson Air Force Base, Ohio, Capt. Douglas Lockie, who is in charge of electromagnetic interference for the F-15, says optical cables could have as large an impact on aircraft electronics as the transistor or integrated circuit. And at the Naval Avionics Facility in Indianapolis, Ind., project leader Rodney Katz expects his group to develop aircraft demonstration systems using fiber optics early in 1974. Amphenol is making these connectors, and Corning is supplying the fibers.

Some of the advantages of fiber-optic cables include: greatly reduced size, weight and cost; electrical isolation that eliminates grounding and ground loops; reduced constraints for impedance-matching; and easy coupling to common logic via available light sources and detectors. What's more, they allow high channel-to-channel isolation, easy interchangeability with electrical cable, and greatly reduced electromagnetic interference. Corning feels that it has solved one of the major limitations on the technique: durability of the fiber optics. And prices are dropping.

applications for the A-7 attack aircraft and says that an unusually high data rate doesn't appear to be necessary.

The Naval laboratory is concentrating on aircraft at present, and shortly expects to retrofit an A-7 with point-to-point fiber-optic cables.

Ships are said to be more of a problem because of the size and large number of cables required. The Navy has installed simpler systems on ships, including a secure telephone link using fiber-optic cables on the cruiser USS Little Rock, flagship of the 6th Fleet, and a secure TV link on the carrier USS Kitty Hawk. □

Government electronics

NSF starts R&D incentives project

A prototype ultrasonic medical scanner is the immediate goal of a \$3 million National Science Foundation experiment. But the big goal of the project is to find out how companies can be prodded into developing and marketing new technologies without too much government intervention or money.

By offering industry both standard specifications and facilities amounting to the \$3 million for clinical evaluation, NSF officials hope that companies will want to spend their own R&D funds—knowing that an expensive clinical trial period won't make the investment risky, according to Arley T. Bever, deputy director of the experimental R&D incentives program.

The timetable of the \$3 million scanner program calls for industry to produce a prototype unit within two years and a marketable product within five, Bever says. The scanner experiment is one of several underway at NSF, the National Bureau of Standards, and the National Aeronautics and Space Administration to encourage the transfer of technology into the market [see p. 74].

Domestic instrument makers who

Electronic organizations begin round 1 in industry's fight for energy

Electronics industries organizations are both speaking out on matters of energy policy and advising their members on how best to cut back on electricity use voluntarily.

Two of the first to act were the Palo Alto, Calif., based Semiconductor Equipment and Materials Institute Inc., and WEMA, which testified early this month at a fact-finding meeting of the California Public Utilities Commission in San Francisco. Structuring the testimony for SEMI was its newly formed semiconductor industry committee, while at WEMA energy-policy efforts will be funnelled through the dozen-or-so-member California energy policy committee, which began forming only last week. John C. Beckett, government relations manager of Hewlett-Packard Co., Palo Alto, is chairman.

The Electronics Industries Association, Washington, D.C., is cranking up a select energy panel—no chairman or members yet—that will collect "the necessary data regarding energy needs within the industries, as well as the effect of materials shortages," according to an EIA spokesman.

And in New York, the National Electrical Manufacturers Association, whose joint committee on energy is already a year old, has already taken a look at those shortages via a survey of its 540 members. The results show an impending "disaster," declares the man who put them together, with companies already reporting layoffs and predicting production cutbacks in the months ahead.

"It's the worst situation we've ever seen," he continues, with shortages ranging from fabricating materials—such as aluminum, steel, and zinc—to conductive materials—copper, lead, silver—and insulating materials, such as the petrochemicals used in electric utility transformers, resins used to cover copper wire, and mica and porcelain.

Both SEMI and WEMA may already have scored some important points in their testimony before the

utilities commission. The gist of what they had to say was that Bay-area semiconductor firms could be crippled by energy cutbacks to below 1972 levels. They cite how much they had expanded during 1973, and they fear the so-called "rolling blackouts," which would shut off electricity entirely in designated areas for periods of hours.

Following the testimony, Vernon Sturgeon, president of California's Public Utilities Commission, declared that electric-power cuts to semiconductor companies would occur "only as a last resort. More hearings will be held in Los Angeles in January before a final plan is drawn up for cutting back on power use and allocating the state's resources. But before cutbacks are mandated, industry organizations through their energy committees are also trying to pass the word as to how members can cut back their use of power on their own.

Lobbying and other attempts to influence legislative and governmental opinion will continue. Of particular interest in California are bills before the legislature to establish a state energy czar, who would, in part, rule on appeals from any mandated energy cutbacks. Attorney Thomas Skornia of SEMI is helping draft a model appeals procedure to be submitted to the legislature in January. SEMI is also appealing to the Federal Power Commission to allow increased deliveries of natural gas to the West Coast by El Paso Natural Gas Co. A 1972 ruling had cut back on deliveries to the area.

Perhaps the biggest industry-wide airing of energy problems will come at EIA's spring conference next March in Washington, which will probably be very different from the meeting the year before. At that time, Sen. Henry Jackson (D., Wash.) chairman of the Interior and Insular Affairs committee and member of the Joint Committee on Atomic Energy, was the banquet speaker—and found his audience largely indifferent to his concern over the then-impending energy crisis.

want to participate in the program should register with NSF by the end of January, Bever says. About 30 days later, NSF will sponsor a specification-design-review conference for the participating companies and issue final specifications 30 days later. Since the program is designed to provide Government help without restricting normal marketing activities, the companies will be responsible for their own R&D efforts and for obtaining their own patent rights.

Encouragement. "If we can speed up clinical evaluation with Government money so the equipment can be used and meet a major need, perhaps we can encourage non-Federal R&D investment," Bever says. The scanner was chosen as a test instrument because "present equipment isn't sufficiently good enough to be used without the doctors having to fiddle with it," he says. And, "manufacturers aren't willing to take the R&D risk to develop it."

What NSF has in mind is a solid-state, automated unit that, like present units, uses ultrasonic waves to provide a transverse sectional view of the body. Current manually operated units are used primarily to complement X-ray studies in diagnosing ailments of the kidneys and brain, and in place of X-rays to determine the position of a fetus [*Electronics*, Sept. 13, p. 99]. The NSF scanner would be designed to probe patients' abdominal areas and extremities. Although some scanners are being developed abroad, domestic versions now on the market suffer from several problems—such as inadequate gray-scale definition and inability to portray some tissues, Bever says.

The unit that NSF proposes would use a minicomputer to perform the signal processing. The transmitted power would come from a transducer supplying a pulsed-focused ultrasonic beam, providing less than 0.5 milliwatt per square centimeter of time-averaged ultrasonic power with a peak power not exceeding 500 mw/cm² in a very short duty cycle of 1 in 1,000.

NSF also would like the scanner to have a video-tape-recording capa-

bility that would yield patient information now only available through exploratory surgery. Bever says that NSF has been promised cooperation by the Food and Drug Administration, which would get added jurisdiction over medical devices under pending legislation. The Veterans Administration is participating in the project by providing the clinical testing facilities for the scanner. □

Holography

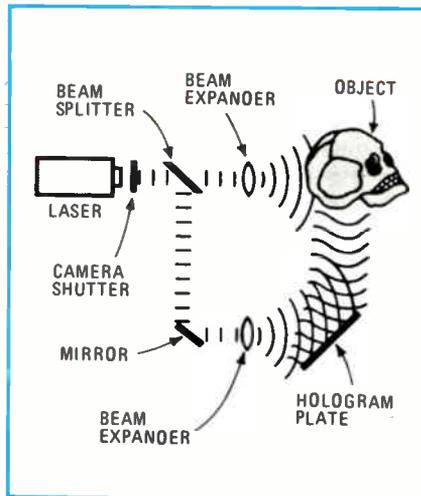
USAF funds dental laser holography

The U.S. Air Force is evaluating proposals to develop a prototype laser-holographic dental-examination unit, which promises another dimension to fight tooth decay and other dental ailments.

Although two years might be needed to test the concept, the service is likely to release the design once verified so that it can be used by non-military dentists, according to Dr. Bruce R. Altschuler, dental officer on the research staff of the School of Aerospace Medicine, Brooks Air Force Base, Texas.

The service declined to give funding or timing details on the development, but Dr. Altschuler says that

Next time, the teeth. Basic arrangement of apparatus for exposing holograms.



the system, using a two-frequency, solid-state cw ruby laser, would place in a patient's mouth not very much more equipment than is used now in intra-oral photography—a couple of mirrors and a holographic plate. The rugged, easy-to-operate ruby laser would not harm patients either through heat or radiation build-up, he says, adding that fears by some about using lasers that way could be overcome through education and explanation.

Many advantages forthcoming. Dr. Altschuler says three-dimensional oral photography, which he calls holodontography, have several advantages over present methods. For one, new holograms could record changes and be used for consultation without the patient having to be present. What's more, it would aid in forensic dentistry and record storage because contour holograms of teeth could be used like fingerprints for identification and for a national file, similar to the FBI's fingerprint file.

He adds that diagnosis could be improved because contour holography—by recording medically administered heat changes in a patient's mouth—would signal the more rapid heat buildup of infected areas. Then, too, the manufacture of crowns and bridges could be made more accurate by feeding contour holograms to a computer that would direct a precision lathe to make castings. The approach could lead to performing stress analysis on various orthodontic aids so that a dentist could choose the one compatible with a patient's dental makeup, provide a basis for developing three-dimensional X-ray pictures, and be used in security systems based on toothprints.

Dr. Altschuler says his group has been working on the idea for 2½ years. To bench-test the technical bases for his proposed applications, he used a 50-milliwatt Spectra-Physics gas laser for his source and a skull as his subject. Among his other work, he is developing computerized three-dimensional radiographs.

The dental holograms can be viewed with any low-cost, low-

an unbeatable combination... 350 MHz and 1ns/div in a portable!

Dual trace, 350 MHz bandpass, high writing speed, 5 mV/div to full bandwidth and 1 ns/div sweep together with many operator conveniences assure fast accurate high-speed oscilloscope measurements. This combination is now available in a portable—the 485 from Tektronix. It weighs just 24 pounds, allowing you to move it in the lab and shop, or you easily take it with you on installation and repair jobs.

HIGH-SPEED MEASUREMENTS WITH SELECTABLE INPUT IMPEDANCE

Full capability 50 Ω and 1 M Ω measurements are available at your fingertips. The 5 mV/div deflection exists to the full bandwidth of 350 MHz in 50 Ω , and 250 MHz in 1 M Ω . The 50 Ω input is protected against the inadvertent application of excessive signal strength. When it happens, you simply press the reset.

SINGLE-SHOT FAST PULSE RECORDING

If your application involves high-speed single shot phenomena, an optional P11 CRT phosphor and the TEKTRONIX C-31 Camera allow you to record on film at 6.0 div/ns. Use of the Writing Speed Enhancer substantially increases this speed.

ACCURATE TIME RESOLUTION MEASUREMENTS

In many of today's pulse applications, accurate time measurements are vital. An unmagnified sweep speed of 1 ns/div permits time resolution measurements in the vicinity of 200 picoseconds. This high-speed accuracy combined with horizontal sweep switching present time measurement capability unheard of in a portable oscilloscope.

BONUS FEATURES

Some of the operator conveniences are: A-external trigger view, delayed sweep, automatic scale factor read-out, horizontal sweep switching, A-trigger hold-off, bandwidth limit, beam finder, frequency selectable fast-rise calibrator, automatic focus, and battery operation with the TEKTRONIX 1105.

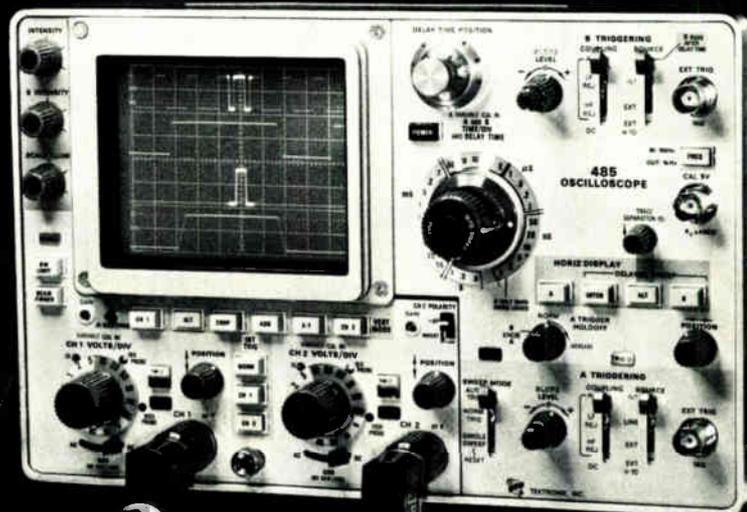
Full realization of these many ease-of-operation features can only be gained through actual hands-on experience. Your local Tektronix field engineer has a 485. Call him for a personal demonstration.

If you'd like additional literature, write Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97005. In Europe, write Tektronix Ltd., P.O. Box 36, St. Peter Port, Guernsey, C.I., U.K.

485 Oscilloscope\$4200



TEKTRONIX®
committed to
technical excellence



Electronics review

power laser, says Dr. Altschuler. But, because vibrations cause problems in taking holograms, especially with low-power lasers, he prefers the more rugged ruby laser for the prototype system. □

Microwaves

Early receiver idea suits educational TV

If all the plans for educational-television broadcasts from satellites mature throughout the world, the demand for tens of thousands of ground receivers could dwarf most other microwave markets. This development would force companies seeking market shares to develop low-cost, mass-produceable microwave circuits.

That is why Hewlett-Packard Co., Palo Alto, Calif., has decided to get in on the ground floor by taking a contract to develop a receiver for the Federation of Rocky Mountain States, an educational-TV group headquartered in Denver, Colo. And that is why H-P's project engineer, James Hall, decided to buck the prevailing trend in microwave receiver design. Hall is responsible for the prototype, which was recently delivered to Westinghouse Electric Co., Baltimore, Md.

Westinghouse is a prime contractor for terminals being developed for the Rocky Mountain group. Field trials of the system will probably begin in January. With the aid of the National Aeronautics and Space Administration, the Rocky Mountain group is engineering the ground network for the health-education telecommunications experiments to be conducted with the ATS-F satellite. The experiments are sponsored by NASA, the Department of Health, Education, and Welfare, and the Corporation for Public Broadcasting.

H-P's contract calls for the production of 130 receivers at a cost of about \$2,000 each—a figure that includes R&D costs. Even so, Hall says the price is already competitive with

News Briefs

Sperry introduces new radar sensor

Sperry Rand expects wide use in automotive applications for its new radar sensor, called Bards, for Baseband Radar Detection Sensor. Instead of transmitting an rf-carrier signal like most radars, it emits a train of short, unipolar pulses, each lasting several hundred picoseconds. It detects them by means of amplitude-threshold and -averaging techniques. The company says the range resolution of the sensor is less than 1 foot.

General Instrument to acquire Regitel

General Instrument Corp. has agreed in principle to the acquisition of the business and assets of American Regitel Corp., San Carlos, Calif., which makes point-of-sale equipment and is a subsidiary of Motorola, Inc.

GI, itself a maker of POS systems, will swap stock for the 576,205 shares of the one third of Regitel common stock not owned by Motorola. The owners of the non-Motorola stock will receive 0.173 share of GI stock for each Regitel share, or \$3 worth of GI stock. In addition, Motorola, which will divest itself of its two-thirds interest, will receive about 5,000 shares of GI.

Poland awards contract to Westinghouse

The People's Republic of Poland has awarded Westinghouse Electric Corp. a \$10 million contract to design, equip and put into operation a power-semiconductor manufacturing facility near Warsaw. Slated to begin operation in about three years, the new plant will produce a minimum of 200,000 thyristors and rectifiers per year. Both the U.S. Department of Commerce and NATO have approved agreements covering power-semiconductor-technology licensing and the supply of U.S.-built equipment, which Westinghouse is still in the process of selecting.

AT&T to apply for DUV permits

The American Telephone and Telegraph Co. will soon file a petition with the Federal Communications Commission for go-ahead to operate its digital data service between New York and Boston [*Electronics*, June 19, 1972, p.35]. The service will for the first time make use of the Bell System's data-under-voice, or DUV, technology. If all goes well, according to Bell, the initial DUV circuits will go into operation in early 1974.

Metric conversion software available

A bilingual software program that enables computers to produce customary non-metric measurements on drawings of products designed to the metric system will soon be offered to industry for an estimated \$500 each by the National Bureau of Standards. Developed by Caterpillar Tractor Co., the program prints a conversion table for the metric measurements used on each computer-generated drawing for administrative or inventory-control purposes.

Health bureau tightens X-ray standards

The Bureau of Radiological Health closed an apparent loophole in the X-ray diagnostic equipment standard, to become effective Aug. 1, 1974, by requiring that units made after that date contain only parts certified for compliance. This will prevent new units from being assembled from parts that don't meet the standard. The bureau also gave a five-year grace period for used units but insists that replacement parts must meet the new standard.

Addenda

Union Carbide has invested \$6 million at two locations for new production equipment producing specialized components and materials. The company says this will, for example, increase production of solid tantalum capacitors by 45% and monolithic ceramic capacitors by 250%. . . . International Liquid Crystal has added a 30,000-square-foot facility. The company hopes to double its current production of 50,000 displays a month and claims a backlog of \$6 million in orders now.

THE 577 CURVE TRACER....

A NEW WAY TO MEASURE COMPONENT CHARACTERISTICS.

For years the Tektronix Curve Tracers have been meeting the exacting measurement needs of the semiconductor industry. The same measurement techniques can be applied with equal success to electronic components such as: switches, relays, connectors, incandescent lamps, fuses, gas discharge devices, small motors, capacitors, inductors, resistors and transformers.

One unique advantage of the curve tracer is its ability to reveal non-linear resistance. When you think of it, all resistances are non-linear if viewed over a large range of current or voltage. Often this nonlinearity is of critical importance. While an ohmmeter yields only a single, fixed point on the resistance curve, the 577/177 plot current versus voltage at any desired level. Or, it plots the resistance over a wide range of input levels.

The 577/177 measures dynamic resistance from less than 0.001Ω to over $1,000,000 \text{ M}\Omega$. This means that you can measure the low resistance of circuit board runs, connectors and closed con-

tacts; or the high resistance between circuit board runs, adjacent connectors and open contacts.

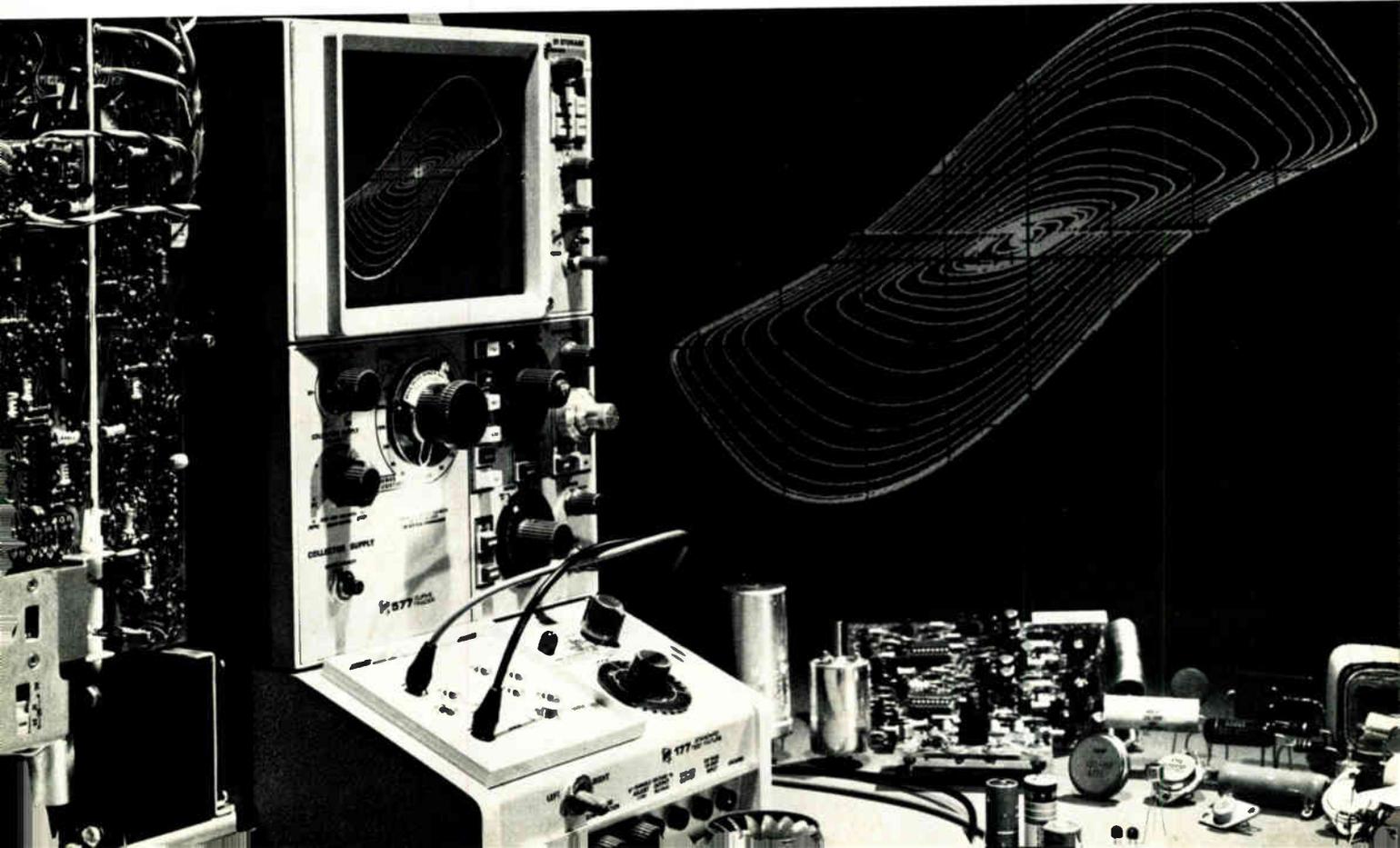
The movement of a relay armature in the magnetic field generates a forward voltage on closing, and a back voltage on dropout. Relay coil resistances, pull-in voltage, pull-in current, dropout voltage and dropout current can all be viewed on a single display using the 577/177 with CRT storage.

577/177 with storage module D1 . . \$2300

Let us help you make your measurements. To see this curve tracer, call your local Tektronix field engineer; he'll be glad to demo one for you. If you prefer, for additional information write Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97005. In Europe, write Tektronix Ltd., P.O. Box 36, St. Peter Port, Guernsey, C.I., U.K.

For a demonstration circle 34 on reader service card

Circle 35 on reader service card



NEED CRYSTAL OSCILLATORS



BULOVA OFFERS A FULL LINE

for Prototypes or Large Run
Industrial or MIL Spec



PCOXO'S HIGH STABILITY

Highest Stability — achieved by housing a high precision oscillator and an AGC circuit in a stable D.C. proportionally controlled oven.



TCXO'S TEMPERATURE COMPENSATED

Highly Stable—temperature compensated by a voltage variable capacitance diode and a thermister network.



COMPUTER CLOCK

Compatible with DTL or TTL loads
—for P.C. board mounting.

We've a set of Technical Bulletins and Application Notes waiting for you. To get yours call or write:

BULOVA

Electronics Division
Bulova Watch Company, Inc.
61-10 Woodside Avenue
Woodside, N.Y. 11377

In a rush? Call 212 335-6000, Ext. 632

Electronics review

conventional down-converter receivers, and Hall contends that the price should drop sharply in mass production.

The design is the microwave counterpart of a tuned radio-frequency (trf) receiver—a design rarely used since the early days of radio. In a trf system, the entire amplifier chain operates at the same rf frequencies as the first preamplifier stages. This eliminates the local oscillator and down-converter of conventional microwave receivers, improves the noise figure, and permits

most of the receiver to be built with identical amplifiers. The latter is most important in a microelectronic design, since it allows volume production of the ICs, reducing their average cost considerably, Hall points out.

Parameters. The receiver is divided into two big hybrid ICs and one printed-circuit assembly. The first hybrid contains two broadband amplifiers, each with a gain of 30-decibels, provided by four HP22 transistors, and a bandpass-filter network that can be switched to ei-

Silicon cuts won't cripple wafer output

Manufacturers of semiconductor products and silicon wafers are looking for alternate sources of polycrystalline silicon in the wake of the word that Dow Corning Corp., Midland, Mich., will cut its customers requests for the material some 40% in the first half of next year. But so far there's no evidence that the situation is critical, especially for wafer makers.

Dow Corning acknowledges that delays in getting a new plant on stream are at the heart of the problem. However, while Gerald Ziarno, marketing manager for semiconductor products, concedes that the delay will hurt customers a little, he is quick to add that most customers "admit that the demands they had stated for 1974 included a little inventory building." He believes the company will be able to make up for the first half shortage in the third and fourth quarters.

Other major suppliers are in Europe and Japan, with one of them, Wacker Chemical Corp., probably accounting for more than any other. A New York spokesman for the West German firm says that there is little hope that Wacker can pick up the slack in the first half of the year.

Nevertheless, a better measure of the impact on the semiconductor business of the Dow Corning delay is its effect on wafer makers who supply the semiconductor industry. Galamar Industries Inc., Palo Alto, Calif., a leading supplier, is minimizing that effect. Daniel Martin, vice president for operations, says the company will still get more polycrystalline material from Dow-Corn-

ing than it did in the first half of this year, even with the cutback. Martin points out that because of inventories on hand and purchases from Wacker, Galamar's wafer output will be down only about 5% in the first half.

Siltec Corp., a Menlo Park, Calif., wafer maker, sees other ways around the problem. Judy Gontang, marketing administrator, says Siltec is trying to arrange exchange of wafers for silicon with semiconductor manufacturers who make polycrystalline silicon. The firm also has ingots in stock that are less than standard diameter, and expects to sell wafers made from them.

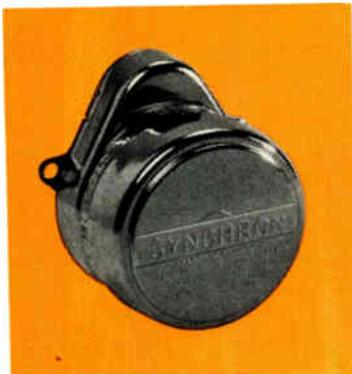
Semiconductor manufacturers are attempting to minimize the effect on them of the Dow Corning difficulty. A Texas Instruments official says that if Dow Corning meets its revised commitments, TI will not be impacted except that it will have to reduce its silicon sales to other semiconductor makers. Motorola, Fairchild and National Semiconductor sources are also downplaying the impact. Motorola, like TI, makes "a major share" of its silicon material in house, a spokesman says, and doesn't anticipate a silicon shortage at the Semiconductor Products division next year. A Fairchild official points out that the Semiconductor division anticipated a shortage 18 months ago, and undertook process controls that have achieved a wafer and die yield improvement of 15%, and a National source doesn't expect "a serious effect on operations in 1974" as a result of a silicon shortage.

Only one of these synchronous motors



is a genuine Synchron[®] Motor.

Synchron motors are made in five major styles. Speeds from 900 rpms to one revolution per week. Torque from 8 through 98 oz-in at one rpm. Hundreds of output options.



Look alike's aren't perform-alikes.

Not by a mile. And once a motor is installed in your product, who cares what it looks like? As long as it does its job, is trouble-free and lasts a specified time.

But how do you know which of the three will perform the best? Do you gamble and just pick one, assuming they're all about the same? Hardly. You specify the one that's made by a company that's just as interested in how well the motor performs as you are . . . who will stand by it 100% . . . who will deliver it when you need it . . . at a fair price.

But most of all, from a company dedicated to helping you solve your problems with the best product made. The motor on the left is the one we're talking about. It's the genuine Synchron.

Call or write for complete Synchron motor specifications and the name of your Hansen representative.

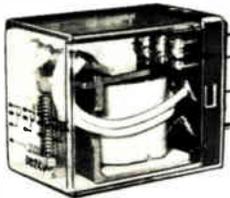
MALLORY



HANSEN MANUFACTURING CO.
a division of P. R. MALLORY & CO. INC.
Princeton, Indiana 47870

We make every Synchron motor as if our name were on your product.

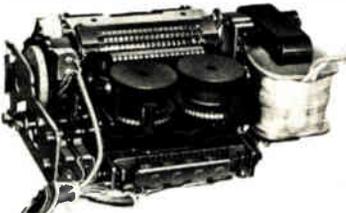
CONTROL—precise
SIZE—fits
SUPPLY—fast
PRICE—fine



Miniature
Relay Type
MPM-100

- Available for various voltages AC & DC.
- Both 4PDT and DPDT contact switching requiring minimum driving power is available.
- Highly economical.
- Incorporates anti insulation fatigue device which prevents short-circuits.
- Uses UL-approved resin bobbin.

Digital Line Printer LP-108



- Compact size with simplified mechanism.
- Up to 18 columns.
- 14 characters per column.
- High reliability.
- Red/black printing.
- Print rate of 2.5 to 3.0 lines/sec.
- Low cost



Miniature
Motor Timer
Type UT-500

- Smart surface design. Plug-in type terminal.
- Economical due to simplified pointerless mechanism.
- Available in a variety of types ranging from 10 seconds to 24 hours, surface-mounted or flush-mounted.

Whichever way you take the measure of TEC control instruments you're getting top value. They work longer; give you more reliable performance for your money.



TOKYO ELECTRIC CO., LTD.

14-10, 1-chome, Uchi-Kanda, Chiyoda-ku,
Tokyo, Japan

Electronics review

ther of two satellite channels (2.566 and 2.667 gigahertz). The preamplifier is mounted outside of the housing on a small, glass-fiber disk antenna made by Prodelin Inc., of Hightstown, N.J. It is connected to the "indoor" portion of the receiver through a coaxial cable that doubles as a dc power line to the preamplifier. A simple filter-capacitor network was designed to separate the rf and dc.

Avoids clipping signals. The indoor IC contains two identical 30-dB rf amplifiers and a similar 25-dB amplifier that is part of a limiter-discriminator stage. The limiter is also an unusual design. Instead of clipping the fm-broadcast signals to remove noise, it detects the a-m output, which contains the noise and feeds it back through a wideband automatic gain-control loop to an a-m modulator at the input of the fifth rf amplifier, which cancels the a-m noise. The technique provides more than 30 dB of noise suppression, Hall reports.

Signal processing. After the fm signal has been discriminated, it goes to the pc board. There, the video signals are amplified for viewing on a school's TV sets. Also, audio programs, which the satellite will transmit on four subcarriers, are demodulated.

Hall stresses that quality was not sacrificed in the drive to keep costs down. The rf amplifiers and filter networks are thin-film circuits on sapphire substrates, and other passive networks are thin films on ceramic substrates—circuits similar to those H-P uses in microwave instruments. The amplifier and network

substrates are assembled on the baseplates of microwave packages as two large hybrid ICs, and the audio and video circuitry on the pc board are of studio quality, Hall adds.

Hall reports the receiver has a noise figure of 4.2 dB maximum over the outdoor temperature range of -50°C to $+50^{\circ}\text{C}$. Typical noise figure is 3.7 dB, compared with 8 or 9 dB for down-converter receivers of similar price. He explains that the design avoids the problem of either driving a weak rf signal down cables as long as 100 ft or of keeping an inexpensive local oscillator stable outdoors.

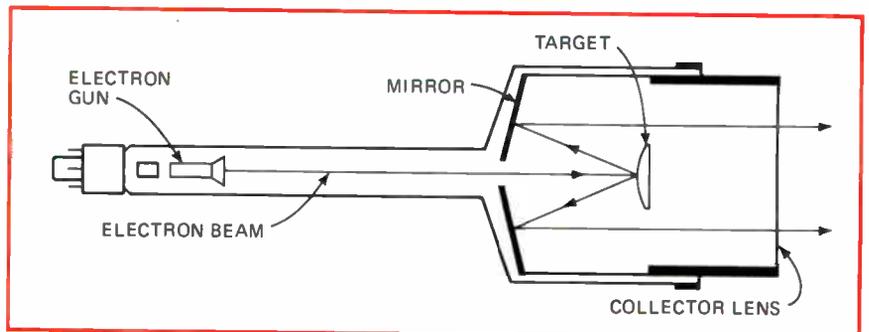
At last report, ATS-F was scheduled to be launched in April into a stationary orbit over North America. Some 21 educational and health organizations—from Alaska to Appalachia—are expected to use the satellite for about a year. Then, the satellite is to be parked over India for use there. □

Consumer electronics

Advent puts TV on the big screen

By putting the projection optics inside each of three color electronic tubes, the Advent Corp., Cambridge, Mass., has developed a large-screen color-TV system that does away with the shadow masks, color dots, and lattices usually required. Its VideoBeam projector has a screen measuring 68 by 51 inches,

Two in one. The LightGuide tube developed by Advent for its large-screen-TV system creates the image with an electron beam and projects it onto a screen.



Centralab perspectives

FOR USERS OF ELECTRONIC COMPONENTS

DISTRIBUTOR PRODUCTS



CENTRALAB

Electronics Division
GLOBE-UNION INC.

5757 NORTH GREEN BAY AVENUE
MILWAUKEE, WISCONSIN 53201

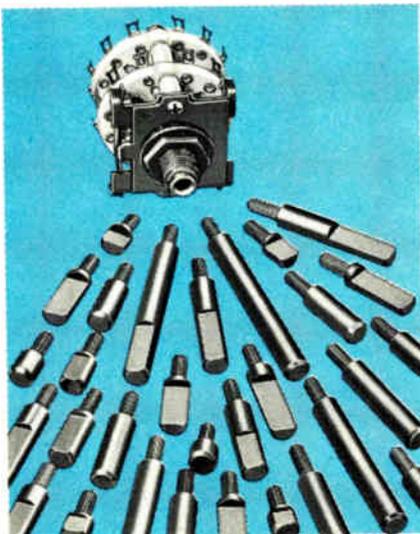
New Selectashaft Rotary Switch program corrects industry shortcoming.

Users of custom rotary switches can now get delivery within days, thanks to this new field assembly program offered by participating Centralab Distributors.

If it's taking you several weeks or even months to get delivery of custom rotary switches, you'll want to look into a new field assembly program pioneered by Centralab and available from their Selectashaft™ Distributors.

The thrust of the program is to ship orders of custom rotary switches within hours of their receipt. Eliminated are lengthy factory delays and special factory set-up charges.

Customers are finding the scope of Selectashaft switches indeed awesome. More than 100,000 combinations of miniature and subminiature



Custom switch assemblies with more than 100,000 combinations are available in days from Centralab Selectashaft Distributors.

switches are available, filling 95% of user needs.

The program enables you to select the exact length front shaft,

exact shaft end details, and the exact shaft flat angles required. You can choose from 92 types of rotary switches for field assembly by the Distributor to your choice of three .250 inch diameter shaft styles: plain round, .218 inch flat, or .156 flat configurations. The shafts themselves are offered in 24 sizes from .687 inch to 2.375 inches long from the mounting surface. Shaft flat angles can be specified in increments of 15°.

The Selectashaft Distributor program has been underway barely a year, and both Distributors and customers agree it meets a definite shortcoming that previously existed. In that short span, the number of participating distributors has grown to make the benefits of Selectashaft rotary switches available nationwide — on a local basis.

For complete product and price information, contact the Centralab Selectashaft Distributor nearest you. Or write Centralab Distributor Products, Dept. SAS-2. 

CALIFORNIA

Elmar Electronics Inc.
Mountain View 94041
415/961-3611

Fisher/Brownell, Inc.
Los Angeles 90061
213/532-2170

Fisher/Brownell, Inc.
Santa Clara 95050
408/244-6182

Kierulff Electronics Inc.
Los Angeles 90022
213/685-5511

Milo of California
San Diego 92111
714/292-0900

R.P.S. Electronics
Los Angeles 90015
213/748-1271

FLORIDA

Electronic Equipment Co.
Miami 33142
305/871-3500

Hammond Electronics
Orlando 32802
305/241-6601

INDIANA

Radio Distributing Co., Inc.
South Bend 46624
219/287-2911

Ra-Dis-Co, Inc.
Indianapolis 46202
317/637-5571

MASSACHUSETTS

Electrical Supply Corp.
Cambridge 02138
617/491-3300

MICHIGAN

RS Electronics
Detroit 48227
313/491-1012

MINNESOTA

Gopher Electronics Co.
St. Paul 55113
612/645-0241

NEW YORK

Peerless Radio Corp.
Lynbrook, L.I. 11563
516/593-2121
Summit Distributors
Buffalo 14202
716/884-3450

NORTH CAROLINA

Kirkman Electronics
Winston-Salem 27108
919/724-0541

OHIO

Esco, Incorporated
Dayton 45403
513/226-1133

Pioneer-Standard Electronics
Cleveland 44105
216/587-3600

Stotts-Friedman Company
Dayton 45402
513/224-1111

PENNSYLVANIA

Cameradio Company
Pittsburgh 15222
412/391-7400

Herbach & Rademan, Inc.
Philadelphia 19134
215/426-1700

Philadelphia Electronics Inc.
Philadelphia 19107
215/568-8288

TEXAS

Harrison Equipment Inc.
Houston 77004
713/224-9131

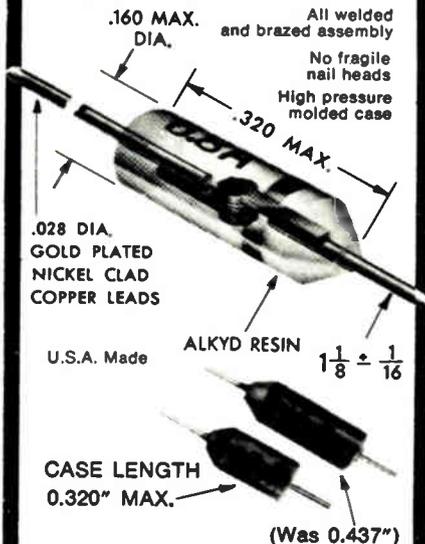
Texas Instruments Supply
Dallas 75235
214/238-6811

Southwest Electronics Inc.
Houston 77036
713/782-3060

WASHINGTON

Aimac/Stroum Electronics
Seattle 98108
206/763-2300

NEW SHORTER CASE! SCHAUER 1-WATT ZENERS



**SAME LOW PRICES FOR
1% TOLERANCE ZENERS
ANY VOLTAGE
FROM 2.0 TO 18.0**

Quantity	Price Each
1-99	\$1.07
100-499	.97
500-999	.91
1000-4999	.86
5000 up	.82

IMMEDIATE SHIPMENT
Send for rating data and
20%, 10%, 5% and 2%
tolerance prices.

Semiconductor Division

SCHAUER

MANUFACTURING CORP.

4514 Alpine Ave., Cincinnati, Ohio 45242
Telephone 513/791-3030

Electronics review

and the price—\$2,495—is competitive with the Sony Corp. projection-TV introduced last year.

VideoBeam consists of a receiver-projector and a separate screen. The TV picture is created by the electron beam inside each of three Light-Guide tubes. What travels to the screen is the light reflected from mirrors in each of the three tubes, one each for red, blue, and green.

The tubes use Schmidt optics, originally developed for wide-angle telescopes, but not used inside an electron tube before. The electron beam is projected over an angle of 15° onto a 3-inch curved aluminum target, coated with a single phosphor for the desired color. The image is reflected back into the tube to a curved mirror behind the phosphor, which in turn reflects the image forward onto the screen through a corrector lens. The total optical system has a speed of $f/6.8$ and collects about one third of the available light.

Advent president and founder, Henry E. Kloss, claims that having the optical element in a fixed position within the tube results in a more precise image and requires no alignment of the optics or mechanical adjustment after production. But projection distance cannot be changed; it is fixed at eight feet, with an inch of tolerance.

Advent feels that this inconvenience is more than offset by other features of the system. By eliminating the need for shadow masks, color dots, or lattices that intercept the electron beam as much as 4/5 of the time in conventional color sets, the VideoBeam provides higher efficiency and a brighter picture, Kloss says. Vertical interlace has also been maintained, eliminating segmentation of the raster into color dots or stripes.

Controls. The VideoBeam has the familiar controls of color, tint, contrast, and brightness, but it also has controls usually seen only on studio monitors. A true-black-level control gives 100% dc restoration, preventing "gray out" in a sharp contrast between black and white areas. Light-to-black transitions are sharpened by a true-aperture-correction

Liquid Rivets, Bolts, Nails, Staples, Etc.

One drop goes a long way in fastening almost anything to almost anything.

Metals, for instance. And plastics. And ceramics. And rubber.

Eastman 910[®] adhesive bonds fast, too. Almost instantaneously. With only contact pressure.

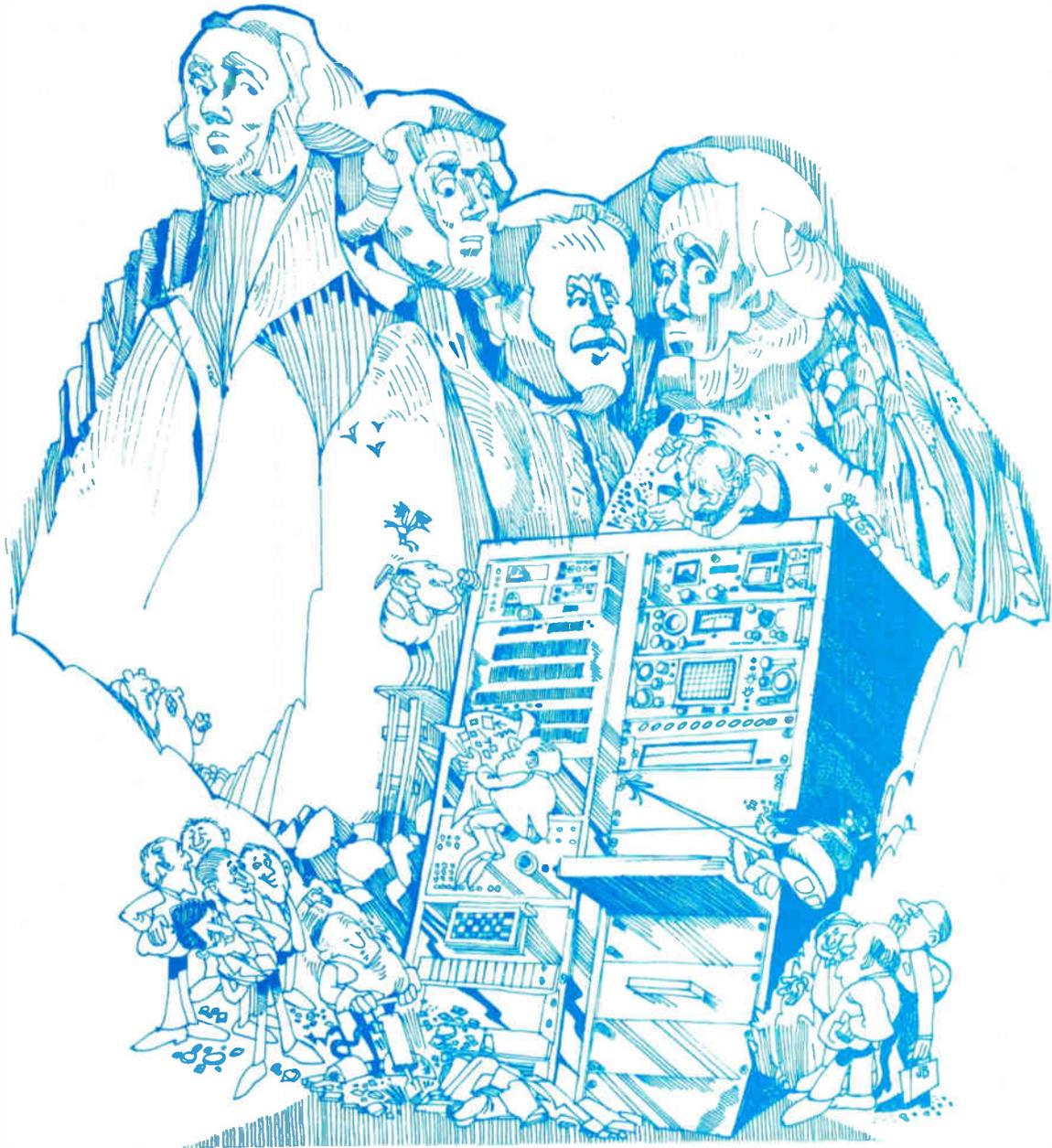
Tensile strength? Up to 5,000 psi at room temperature.

New Eastman 910 MHT and THT grades hold when the heat is on. Even over 400°F.

For further data and technical literature, write: Eastman Chemical Products, Inc., Kingsport, Tennessee 37662.



From modules to monuments



Major integrated Range Timing Systems are monuments to man's ingenuity and skills; to the user for his conception and utilization and to the builder for his design experience.

Whether your timing need be for a module or a monument — a digital clock or a computer-integrated range timing system — it has been designed by DATUM Instrumentation

Specialists. Every instrument, from the simplest to the most sophisticated, is a monument to engineering excellence and is performance engineered.

For Time Code Equipment of any type, DATUM is your best bet. Find out for yourself: call us, or send for our complete catalog today.



Model 9100-'200'
Time Code Generator



Model 9200-'200'
Time Code Reader



Camera Timing
Amplifier



IRIG Line Amplifier

DATUM, INC. Timing Division ■ 1363 South State College Blvd. ■ Anaheim, California 92806 ■ 714/533-6333 ■ TWX 910/592-1289

Compare Mox to whatever resistor you're using now.

Our Metal Oxide Resistors offer you:

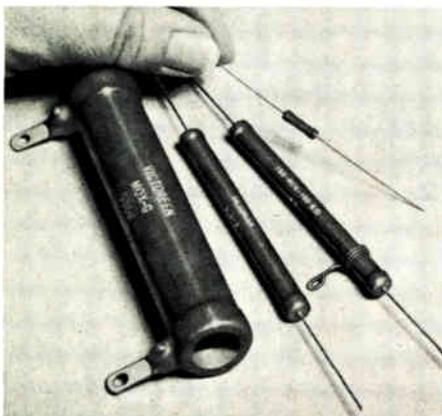
- Small Size ■ Maximum Reliability
- Low Temperature Coefficient
- High Stability
- High Voltage Capability

Set a comparable MOX Resistor beside the wire wound or metal film resistor you're using now. Chances are you'll find ours smaller, giving you greater design possibilities for ultra-critical applications. Our precision? As good as ± 0.5 per cent. With stability to match, both on the shelf—less than 0.1 per cent drift per year—and off—as little as 1 per cent drift under full load in 2000 hours. MOX Resistors withstand extreme environmental conditions; the effects from temperature cycling are negligible; and they have voltage capabilities far in excess of wire wound and metal film resistors.

We offer you a complete MOX Series to choose from, and we keep them stocked for prompt delivery.

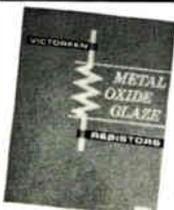
Mini-Mox—Miniature high voltage resistors with ratings as high as 5 KV and dissipations to 1 watt. Available with 100 ppm TCR. Compare with bulky metal film types.

Maxi-Mox—Rated at 2.5 watts and 7.5 Kv per lineal inch. Available in 1-5" lengths in 1" increments. Approximately $\frac{1}{2}$ size of film resistors with equivalent ratings. Compare with metal films with inflated voltage ratings.



Divider-Mox—Single units with one or more taps. Ratios as high as 10,000:1. Input voltages to 37.5 Kv. Output voltage stability ± 0.5 per cent over temperature extremes. Compare design advantages with discrete resistors.

Power-Mox — High voltage, high power resistors with hollow cores for more efficient heat dissipation. Voltages to 45 Kv. Wattages to 45 watts in 70°C air ambient. Compare with voltage limited wire wound resistors.



MOX FACTS and Technical Data Sheets are available from: Victoreen Instrument Div. of VLN Corp. 10101 Woodland Avenue, Cleveland, Ohio 44104. Telephone: 216/795-8200

DMA 681



Expertise in high voltage.

Electronics review

control. An internal crosshatch generator allows the user to adjust fine-color convergence—one switch projects a white grid, and three others control the focus and static convergence of the red, green, and blue images.

Previously, the optical systems for projecting TV images onto screens were located outside the projection tubes. Advent developed the Light-Guide design as a practical system for sale to home users who might not be inclined to adjust a complex optical system.

The big picture. The screen uses a highly reflective Kodak-developed aluminum surface that is five times more reflective than the conventional beaded screen, according to Advent.

The screen, plus the efficiency of the LightGuide tubes, results in a brightness of more than 20 foot-lamberts on axis. Thus, the picture can be viewed in ambient light, although the best viewing is in a darkened room.

The sound is beamed to the screen from an acoustic speaker, which is driven with a low-distortion 5-watt amplifier.

Kloss notes that the user should get as good an antenna as possible, since any ghosts or blurring are greatly magnified on the screen. Three antenna inputs are provided, one 75-ohm unbalanced and two 300-ohm balanced for vhf and uhf. The set also includes video inputs by way of the antenna terminals or a direct input that bypasses the rf stage to allow connection of any video playback medium. An external video recorder can record a broadcast via a video output jack. Audio input and output jacks are also included.

Kloss says that he first got the idea for the set from an article by J.H.O. Harries, of Harries Electronics Corp., Ltd., Bermuda [*Electronics*, Dec. 14, 1962, p. 33] proposing a \$300 color-TV set that needs less power than a regular color set needs to create an electron beam. Kloss felt this efficient light use could be applied to projection TV and spent the next 11 years exploring the possibility. □

Variable compression
mica capacitors:

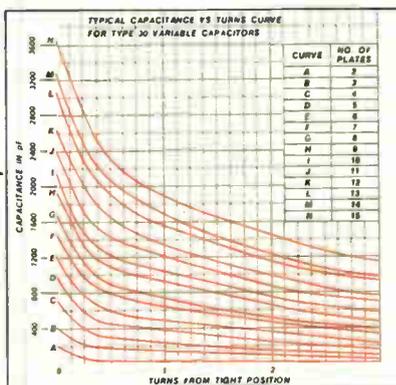
Small, Inexpensive, Wide-range, Go-anywhere Capacitance Packages

(Try 'em . . . you'll like 'em!)

Do you need a capacitor you can adjust from 1400 to 3055 pF (or almost *any other* range down to 0.9 to 7.0 pF)? As small as $\frac{3}{16}$ " x $\frac{1}{32}$ "? That mounts by *any* method, in *any* location, including PC applications? That has a high Q, smooth adjustment and, low inductance, excellent thermal stability and resistance to shock, vibration and humidity?

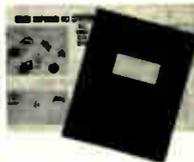
And that you can buy in quantity, off the shelf, typically for 15¢ each?

It will pay you to look into El-Menco variable compression mica trimmers and padders—the "old reliables" whose highly developed characteristics and extremely wide line today make them the capacitors of choice in hundreds of state-of-the-art communications, instrumentation, audio and military electronics equipment. For example: in RF, oscillator and FM antenna circuits . . . HF bias (tape) from 85 to 95 kHz . . . phase control circuits . . . compensation for other components . . . SSB 2.0 MHz channel strips. And perhaps one of these possibilities gives you an idea: coax cable line termination, pulse transmission, an equalizing/matching network, a low-Q tone generator, or padding in a TV circuit, power supply or home appliance.



WRITE FOR COMPREHENSIVE TECHNICAL DATA:

a recent technical article reprint
and a 29-page set of data sheets
are yours for the asking.
Send request directly to:

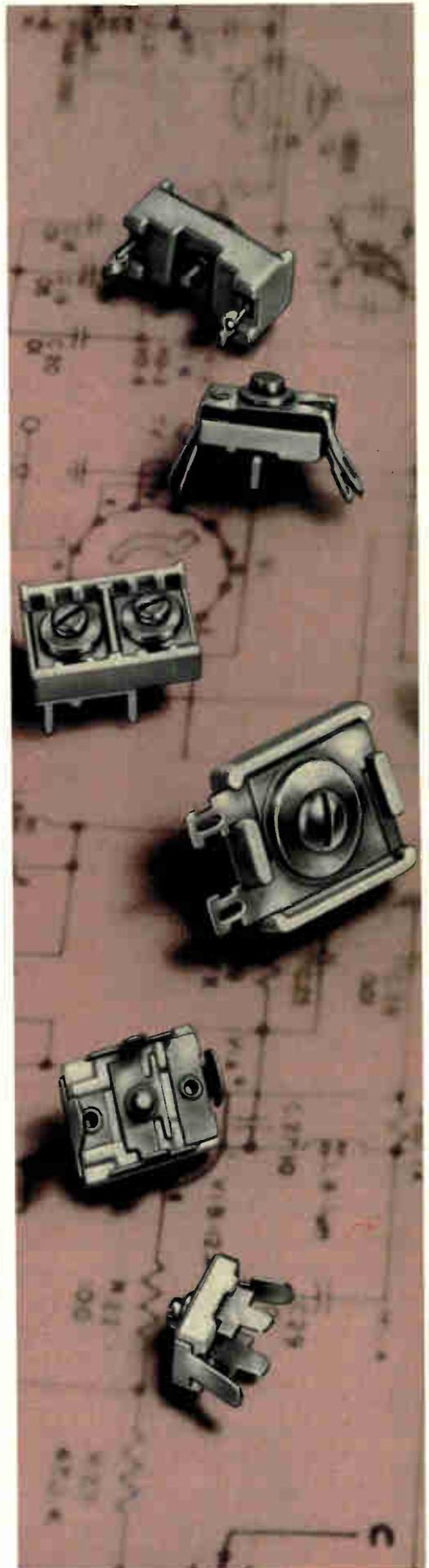


THE ELECTRO MOTIVE MFG. CO., INC.

Willimantic, Conn. 06226

West Coast: Collins and Hyde Co.

Nationwide: Arco Electronic Distributors



**TRW makes
electronic components for
telephones and
mobile communications and
automobiles and
computers and
television sets and
instrumentation and
aircraft and missiles
and...**

So?

So...

We are one of the few companies producing *both* high-volume and high-technology electronic components for today's growth industries.

Only a company that can cut a broad swath across the fields of all major electronics users has the cross-over capability in manufacturing to handle all your needs, whatever they are.

We are that kind of company. We can give you what you need. High-technology, high-volume —or both. Because we specialize in both, and in a big way. We make over 300 different kinds

of electronic components for the major OEM's in all the major industries. We have the technology and production savvy—plus the sheer size—to be the source for whatever you need.

Perhaps we already make it in one of our 30 plants. Certainly, we *can* make it, even building a new plant if necessary. As we have for others.

In short, we can do more for you precisely because we do so much for so many others in such a range of industries. And because we are TRW.

TRW ELECTRONIC COMPONENTS

10880 Wilshire Blvd., Los Angeles, CA. 90024

Connectors • Resistors • Semiconductors • Capacitors • Motors • Functions and Assemblies • PC Boards • Potentiometers • Transformers • Coils and Inductors • Wire and Cable

Prices reduced over General Electric Solid

Now you can not only get immediate delivery on these bright visible SSL's...you can also save money. For example, the SSL-22 and SSL-22L's are only 25¢ each in 10,000-lamp quantities. Contact your GE SSL distributor or your local GE representative today for price details.

When you specify GE SSL's you also gain other important advantages.

GE construction gives you these basic advantages:

First, General Electric uses GaP material in its SSL's because it gives you advantages over GaAsP material.

For example, GaP is more efficient. About 5-10 times more efficient in converting energy into light. This higher efficiency permits either generation of more light at the same low current level (under 25mA) or the use of lower power inputs to produce the same amount of light. This means GaP lamps provide more light and may eliminate the need for current drivers often required with GaAsP lamps.

GaP lamps also give more light output because light is emitted from the entire chip,

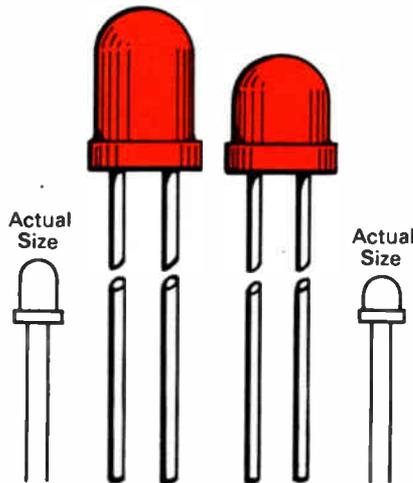
not just from the "P" side as do the GaAsP lamps.

Another construction feature is the GE patented reflector. It reflects the light output emitted from the bottom side of the GaP pellet. This increases the amount of light delivered by the lamp at least 20%.

Take exclusive guarantees, for example. Because of GE's design and construction features, we offer these guarantees: 100% lamp inspection at rated current for light output and forward voltage; reverse voltage at 10µA is 3 volts or greater for visible GaP lamps, and 2 volts or greater for GE's gallium arsenide infrared lamps. Power output of every infrared lamp is also guaranteed to be within published min-max range. GE will refund your purchase price or provide

replacements for returned lamps not meeting published specifications.

Then take service. GE is a full-line lamp manufacturer so OEM application service is available not only for SSL's but also for all your other lamp needs. GE backs up your distributor's service advice with lighting applica-



GE SSL Electronic Distributors by State:

Carlton-Bates Company
6821 Scott Hamilton Drive
Little Rock, AR 72209

Brill Electronics
610 East 10th Street
Oakland, CA 94600

Cramer Electronics, Inc.
17201 Daimler Street
Irvine, CA 92705

Cramer Electronics
720 Palomar Avenue
Sunnyvale, CA 94086

Electronic Supply Wholesale
Radio & Electronic Supplies
2486 Third Street
Riverside, CA 92507

Elmar Electronics
2288 Charleston Road
Mt. View, CA 94043

G. S. Marshall Company
9674 Telstar Avenue
El Monte, CA 91731

Hamilton/Avnet Electronics
Division of Avnet, Inc.
10912 West Washington Blvd.
Culver City, CA 90230

Hamilton/Avnet Electronics
340 East Middlefield Road
Mt. View, CA 94040

Kierulff Electronics, Inc.
2585 Commerce Way
Los Angeles, CA 90040

Western Electromotive
8467 Stellar Street
Culver City, CA 90230

Zack Electronics
1444 Market Street
San Francisco, CA 94102

Barnhill Five, Inc.
1170 S. Sheridan
Denver, CO 80226

Electronics Parts Company
1277 Broadway
Denver, CO 80203

Hamilton/Avnet Electronics
1400 West 46th Avenue
Denver, CO 80211

Hammond Electronics
911 West Central Avenue
Orlando, FL 32802

Schweber Electronics
2830 North 28th Terrace
Hollywood, FL 33020

Lykes Electronics Corp.
Div. of Jackson Electronics
1135 Chattahoochee Avenue, NW
Atlanta, GA 30325

Cramer Electronics
1911 South Busse Road
Mt. Prospect, IL 60056

Hamilton/Avnet Electronics
3901 Pace Court
Schiller Park, IL 60176

Newark Electronics
500 North Pulaski Road
Chicago, IL 60624

Schweber Electronics
1380 Jarvis Avenue
Elk Grove Village, IL 60007

Semiconductor Specialists, Inc.
195 Spangler Road
Elmhurst, IL 60126

Graham Electronics Supply Co.
133 South Pennsylvania Street
Indianapolis, IN 46204

Semiconductor Specialists, Inc.
P. O. Box 41645
Weir Cook Airport
Indianapolis, IN 46241

Hamilton/Avnet Electronics
3500 West 75th Street
Prairie Village, KS 66208

Cramer Electronics, Inc.
85 Wells Avenue
Newton Center, MA 02159

Gerber Electronics
852 Providence Highway
Dedham, MA 02026

Hamilton/Avnet Electronics
185 Cambridge Street
Burlington, MA 01803

Schweber Electronics
213 Third Avenue
Waltham, MA 02154

Hamilton Electro Sales
7255 Standard
Hanover, MD 21076

Schweber Electronics
5640 Fisher Lane
Rockville, MD 20852

Hamilton/Avnet Electronics
400 Brookes Lane
Hazelwood, MO 63042

L Comp
1520 Tanny Street
North Kansas City, MO 64116

40% on all red State Lamps (LED's)!

tion engineers in most major cities. They offer you guidance on the lamp type that is best, both technically and economically, for your specific application.

GE also offers dependability. We specify and control all lamp parts from raw materials to finished product. Mechanized manufacturing helps assure product dependability and uniformity of performance from lamp-to-lamp. We have a new plant on-stream ready to serve you, devoted exclusively to manufacturing solid state lamps. So you can count on GE as a source for continued service and availability.

For the name of your local GE SSL distributor, check below. He will gladly give you delivery details, the new low prices, and your free copy of our new Solid State Lamps catalog. (Order #3-3358, dated October, 1973).

Or contact GE directly. Call John Hall collect at (216) 266-2400. Or write General Electric, Miniature Lamp Products Department, #4454-M, Nela Park, Cleveland, Ohio 44112.

Free. Brand-new Solid State Lamp catalog, #3-3358.

Full of helpful up-to-date information on SSL Lamps (LED). Ask for your free copy, updated October, 1973.

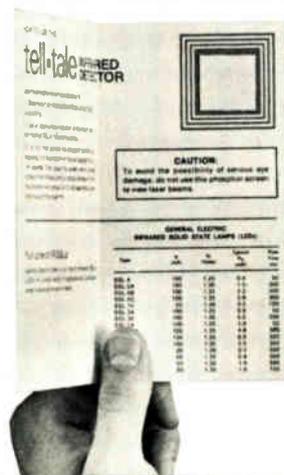


Special offer— New Tell-Tale Infrared Detector

If you work with infrared SSL Lamps (LED), you're sure to get a lot of use from GE's unique Tell-Tale Infrared Detector...handy for checking, installing, or aligning opto coupled devices or systems.

This one-square-inch phosphor screen converts the invisible infrared energy into a visible image. It can be used to determine if an infrared Solid State Lamp (LED) is operating and to get an approximate indication of the beam pattern from an SSL or the external optics.

Don't wait—get your Tell-Tale Infrared Detector now for only \$1.75—it's another exclusive available from GE. Order as many as you need today from your distributor or direct from GE. Please send check or money order.



Olive Industrial Electronics, Inc.
6662 Olive St. Road
St. Louis, MO 63130
General Radio Supply Co.
600 Penn Street
Camden, NJ 08102
Schweber Electronics
44 Belmont Drive
Somerset, NJ 08873
Cramer New Mexico, Inc.
137 Vermont NE
Albuquerque, NM 87108
Cramer Electronics
6716 Joy Road
East Syracuse, NY 13057
General Electric Supply Company
600 Jefferson Road
Rochester, NY 14623
Hamilton/Avnet Electronics
222 Boss Road
Syracuse, NY 13211
Milgray Electronics
191 Hanse Avenue
Freeport, NY 11520
Rochester Radio Supply Co., Inc.
140 West Main Street
Rochester, NY 14614

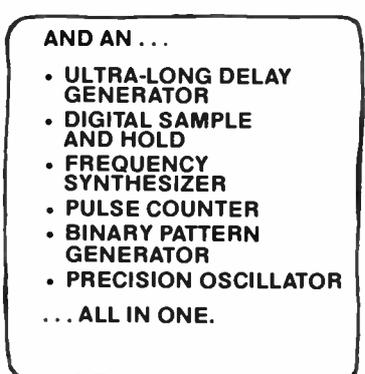
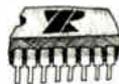
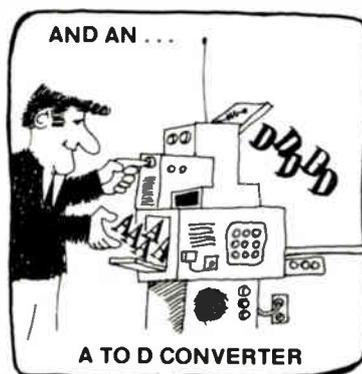
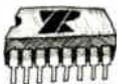
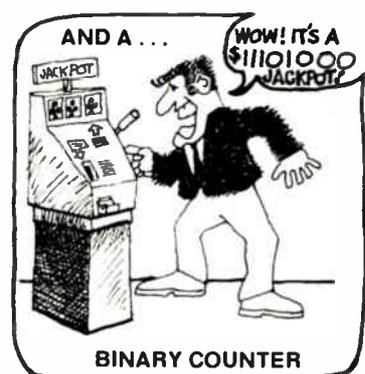
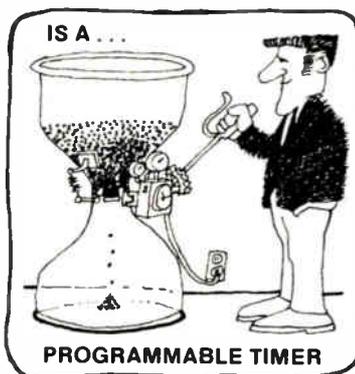
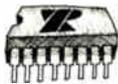
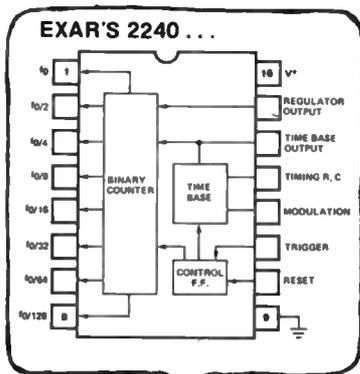
Rome Electronics, Inc.
108 Spring Street
Rome, NY 13440
Schweber Electronics
999 Buffalo Road
Rochester, NY 14624
Schweber Electronics
Jerico Turnpike
Westbury, NY 11591
Standard Electronics, Inc.
3519 Union Road
Cheektowaga, NY 14225
Southeastern Radio Supply Co.
414 Hillsborough Street
Raleigh, NC 27603
Electronics Marketing Corp.
1150 West Third Avenue
Columbus, OH 43212
Hughes/Peters, Inc.
4865 Duck Creek Road
Cincinnati, OH 45227

Hughes/Peters, Inc.
481 East 11th Street
Columbus, OH 43211
Pioneer Standard Electronics
4800 East 131st Street
Cleveland, OH 44105
Pioneer/Dayton
1900 Troy Street
Dayton, OH 45404
Rem Electronics
264 West Market Street
Warren, OH 44481
Schweber Electronics
23880 Commerce Park
Beachwood, OH 44122
Oil Capitol Electronics Corp.
708 South Sheridan
Tulsa, OK 74115
Almo Electronics
Roosevelt Blvd. & Blue Grass Rd.
Philadelphia, PA 19114

Semiconductor Specialists, Inc.
538 Alpha Drive
Pittsburgh, PA 15238
Electra Distributing Company
1914 West End Avenue
Nashville, TN 37203
Harpe Electronics, Inc.
1845 Central Ave
Chattanooga, TN 37408
Hamilton/Avnet Electronics
2403 Farrington
Dallas, TX 75207
Hamilton/Avnet Electronics
1216 West Clay
Houston, TX 77019
Sterling Electronics Corp.
2875 Merrell Road
Dallas, TX 75229
Sterling Electronics
4201 SW Freeway
Houston, TX 77027
Newark Electronics, Inc.
259 Crossroads Square
Salt Lake City, UT 84115
Almac/Strom Electronics
5811 6th Street
Seattle, WA 97108

GENERAL  ELECTRIC

THE FIRST OF THE BIG COUNT TIMERS



Exar's new XR-2240 counter/programmable timer solves so many tough problems that designers will unanimously agree that it's really the universal timer.

With its unique combination of analog and digital timing methods, you can now replace inadequate and complex assemblages of monolithic and electromechanical timers with the much simpler XR-2240. As a bonus, you get greater flexibility, precision operation, and a reduction in components and costs for most applications.

Because of built-in programmability, you can also use the XR-2240 for frequency synthesis, electronic music synthesis, digital sample and hold, A to D conversion, binary counting and pattern generation, and more.

With a single XR-2240 you can now generate pre-

cision time delays programmable from $1RC$ to $255RC$, a range of microseconds to 5 days. By cascading only two XR-2240 timers, you can extend the maximum delay by a factor of 2^N , where $N = 16$ bits, resulting in a total delay of 3 years!

The XR-2240 operates over a 4V to 15V supply range with an accuracy of 0.5% and a 50 ppm/°C temperature stability. It's available in either a 16-pin ceramic or plastic dual-in-line package for military or commercial applications. Prices start at \$3.00 in 100 piece quantities.

For the more conventional timing applications, look to our other timers: the XR-220/230 timing circuit and the XR-2556 dual timers. Call or write Exar, the timer leader, for complete information.

EXAR SPEAKS YOUR LANGUAGE



EXAR INTEGRATED SYSTEMS

750 Palomar Sunnyvale, California 94086 (408) 732-7970 TWX 910-339-9233

EXAR DISTRIBUTORS Semiconductor Concepts: Woodland Hills: (213) 884-4560 Hauppauge, L. I.: (516) 273-1234 EEP Corporation: Culver City (213) 838-1912 Intermark Electronics: Sunnyvale: (408) 738-1111 San Diego: (714) 279-5200 Santa Ana: (714) 540-1322 Denver: (303) 963-8284 Seattle: (206) 767-3160 Graham Electronics: Indianapolis: (317) 634-8202 Lafayette: (317) 742-4006 Ft. Wayne: (219) 742-4346 Cincinnati: (513) 733-1661 Radio Electric Service Co.: Baltimore: (301) 823-0070 Gerber Electronics: Dedham: (617) 329-2400 Yankee Electronics Supply: Londonderry: (603) 625-9746

DOD/NBS program to push IC reliability

First requests for proposals are expected to be issued in early 1974 by the National Bureau of Standards, with more expected in fiscal 1975, to kick off a new five-year program that will have significant repercussions for the semiconductor industry. **The program, prompted by Defense Department concern, aims to improve the reliability of integrated circuits by furthering production automation.** The goal is to define automated processes for digital monolithic ICs with some emphasis on MOS and bipolar devices, but the initial RFPs will cover methods to measure process control. Called ARPA/IC/NBS (advancement of reliability, processing and automation of integrated circuits with NBS), **the program is funded by DOD's Advance Research Projects Agency at a "30-man-year level"** and is expected to grow, says the agency.

Navy may divert in-house R&D to industry

A Navy study that could result in more research and development contracts for industry at the expense of the service's 10 in-house laboratory operations should be completed by winter's end, says David S. Potter, the service's new assistant secretary for R&D. Potter, an ocean scientist who took office in September from the General Motors' Allison division, told a December meeting of the National Security Industrial Association that the laboratories now employ 28,000 people and consume more than \$1 billion a year exclusive of test and engineering operations. **He strongly hinted that some of them may be consolidated and others cut back in size,** and he added that he believed more of the work now performed in-house by the Navy "should be put to industry to keep engineering operations together."

LEAA muddled over police transceivers

Want to produce a low-cost, high-performance transceiver for police patrolmen? If the answer is yes, contact the Law Enforcement Assistance Administration which finds itself in this dilemma: **after it funded two companies to develop prototype hardware as a preliminary to manufacturing the radios commercially, the companies indicate they don't want to** [*Electronics*, Oct. 11, p. 47]. GTE-Sylvania quit the commercial business to concentrate on military communications, and Martin Marietta remains noncommittal about its production plans, even though it has completed the prototype contract, LEAA says. Complicating things further, **the agency isn't sure it even has the data rights to the companies' designs that would let it rebid a small production contract.**

GSA reopens plans for government telephone centers

After rethinking its plans to install and operate its own telephone centers in Federal building complexes [*Electronics*, May 24, p. 53] **the General Services Administration has issued requests for proposals, due back Dec. 31, for a system in Syracuse, N.Y.,** and indicates that other systems could follow. Respondents may bid on either a five- or 10-year period for one of three provision options: sell and maintain the equipment, rent with a purchase option, or rent without a purchase option. GSA had shelved its Government phone interconnect program after a Chesapeake and Potomac Telephone Co. tariff would have prohibited economical operation of a proposed Middle River, Md., center.

Justice for communications?

There is news both good and bad for manufacturers of computer and communications terminals from the U.S. Department of Justice. The good news is that Justice is beginning to move toward an antitrust action against American Telephone & Telegraph Co., having issued an eight-page civil investigative demand for documents of AT&T and five associated Bell System companies on the subject of interconnection of customer-provided terminals to the telephone network. The bad news is that the demand—less forceful than a court order or subpoena—suggests that final resolution of the antitrust issue in the courts could take several years.

At stake is the success or failure of Federal Communications Commission moves to extend competition for new private-line communications services beyond the scope of the Bell System. Also at stake is the issue of whether or not there is a single interstate telephone network over which the FCC has jurisdiction, rather than multiple intrastate services subject to individual state-by-state regulatory chaos.

Baker's views

The fact that Justice Department is coming down firmly on the side of competition, however cautiously at first, is evident in the remarks in Washington earlier this month of Donald I. Baker, the deputy assistant attorney general for antitrust. He recently employed a long-standing political tool to express his views on the issue of competition in regulated industries such as communications without commenting on the merits of impending litigation: he delivered a lawyerly lecture on the subject. Using the platform of the Practising Law Institute, Baker addressed himself to the issue of communications competition generally. "It would be inappropriate for me not to make clear the fundamental antitrust interest in having the innovative work of the FCC carried forward free of any private restraints which may violate the antitrust laws," he declared. "We must move ahead, not be rolled back."

Twain's dog

To illustrate the absurdity of Bell System legal arguments that the attachment of customer-provided terminals approved by the FCC Carterfone decision of 1968 applies only to interstate—not intrastate—services, Baker makes an obvious point: "This sounds all right until you realize that the telephone network does not exist in two nice separate parts, one interstate and one local. To ban customer-provided terminal

equipment for intrastate purposes is, in effect, to ban it for all purposes."

He then goes on to destroy the AT&T premise by citing the case of Mark Twain's oafish character Pudd'nhead Wilson vs The Dog. Wilson, complaining to friends about a small, angry dog, declared his wish to own half the animal. Asked why, he responded, "Because if I did, I'd kill my half." Unless the FCC has Federal preemption over the whole interconnection dog, Baker believes the telephone system and its using public will be treated "as if it were Pudd'nhead Wilson's dog." AT&T's taking the interconnection issue to the states, he adds, is "a particularly clear example of a regulated monopoly trying to thwart a sound public policy in favor of competition."

Baker's most telling argument against AT&T comes not on points of law, however, but on a matter of policy. He startled his audience by labeling as "highly suspect" the Bell contention that higher-priced, noncompetitive services subsidize low rural and residential rates. "If we really are going to subsidize rural and residential users," Baker declared, "let's do so directly out of the public treasury so that we can see precisely who is getting what and how much it is costing the rest of us."

A new advocate

Even though such ideas are unlikely to become Government policy soon, they are disturbing to the telephone companies when advanced in public forums by a ranking Justice Department attorney. Such statements are signs of an increasingly widespread reaction against AT&T's calls for more monopoly and less competition.

Equally upsetting to the Bell System empire is Baker's belief that regulation by commission often fails in its goals by stifling innovation. "Regulated enterprises generally do not want to compete; and they are generally able to influence, if not always control, the appointees to the regulatory commission responsible for a particular industry. This has been true at both the Federal and state level, and perhaps even more true at the state level."

Communications equipment makers and users who want competition in private-line services may have a new advocate. Baker's contention that a competitive open market "not only encourages the development of new technology, but provides for its use without long drawn-out legal battles" is sweet music to those who would compete with Bell. —Ray Connolly

BARGAINS GALORE on LEDs from DIALIGHT

DIALIGHT DISTRIBUTORS

ARIZONA
Moltronics of Arizona,
Inc.
602-272-7951

CALIFORNIA
Western.
Electromotive
213-870-7621
Bell Electronics Corp.
415-323-9431
Fisher/Brownell
408-244-6182
Richey Electronics, Inc.
213-875-2862
Westates
Electronics Corp.
213-341-4411

COLORADO
Meter Master
Instrument Corp.
303-722-5766

FLORIDA
Hammond
Electronics, Inc.
305-241-6601

ILLINOIS
Newark Electronics
312-638-4411

INDIANA
Graham Electronic
Supply, Inc.
317-634-8486
Radio Distributing Co.
219-287-2911

MARYLAND
Pioneer Washington
Elect. Co.
301-424-3300
Radio Electric
Service Co.
301-823-0070

MASSACHUSETTS
Cramer Electronics,
Inc.
617-969-7700
DeMambo Supply
Co., Inc.
617-787-1200
Gerber Electronics, Inc.
617-329-2400
Sager Electrical
Supply Co.
617-542-2281

MICHIGAN
RS Electronics
313-491-1000

MINNESOTA
Gopher Electronics Co.
612-645-0241

MISSOURI
Lcomp-St. Louis, Inc.
314-647-5505

NEBRASKA
Scott Electronic Supply
402-434-8308

NEW JERSEY
Federated Electronics
201-376-8900
Resco Electronics
609-662-4000

**NEW YORK
METROPOLITAN
AREA**
Arrow Electronics,
Inc.
516-694-6800
Harvey Radio Co.,
Inc.
516-921-8700
Melville Radio Corp.
914-592-7100
Peerless Radio Corp.
516-593-2121

NEW YORK STATE
Summit Distributors,
Inc.
716-884-3450

NORTH CAROLINA
Hammond
Electronics of
Carolina, Inc.
919-275-6391

OHIO
Pioneer-Cleveland
Div.
Pioneer-Standard
Electronics
216-587-3600
Stotts-Friedman Co.
513-224-1111
Sun Radio Co., Inc.
216-434-2171

PENNSYLVANIA
Almo Electronics
Corp.
215-676-6000
George D. Barbey Co.
215-376-7451
Cameradio Co.
412-288-2600

TEXAS
Harrison Equipment
Co., Inc.
713-224-9131

UTAH
Standard Supply Co.
801-355-2971

WASHINGTON
Almac/Stroum
Electronics
206-763-2300

WISCONSIN
Parts Mart Corp.
414-276-4160

CANADA
Saynor Electronics Ltd.
416-445-2347
L. A. Varah Ltd.
604-736-9252

FEATURES:

High luminous intensity

Low cost

Low power consumption

IC compatible

Vibration/shock resistant

Solid state reliability

Life measured in years

Wide viewing angle



Dialight's high brightness 521-9200 LED is an intense large area light source that has this typical luminous intensity:
@ $I_F = 20 \text{ mA}$ $I_0 = 2.0 \text{ mcd}$.

APPLICATIONS:

Panel lighting • Circuit-status indicators • Back lighting of annunciators • Alpha-numeric displays • Automobile dashboards • Appliances • Desk-top calculators • Housewares



9¢

Quality LEDs are 9¢ each when purchased in million piece quantities



21¢

LEDs from 100 to 999 are only 21¢ each.

17¢



If you need LEDs from 1000 to 9999, Dialight has them for 17¢ each.

28¢



Even if you only need LEDs from 1 to 99, Dialight has them for 28¢ each.



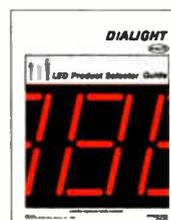
16¢

Quantities from 10,000 are a low 16¢ each and Dialight can fill your order today

FREE!

With this coupon you can get a free LED sample. Send this coupon to your nearest Dialight distributor or give him a call.

FREE!



Ask for free LED Product Selector Guide. 60 pages of LEDs: discretes, indicators, displays, fault indicators, opto-isolators, etc.

DIALIGHT

Dialight Corporation, A North American Philips Company
60 Stewart Avenue, Brooklyn, N.Y. 11237 (212) 497-7600

IN CASE OF POWER FAILURE, DIAL (714) 565-1155. COLLECT.



You'll be in the perfect frame of mind to talk to us about our Elgard Uninterruptible Power Sources. When we tell you they can provide up to ten minutes of reserve power instantaneously or that they supply 40 db line transient reduction and $\pm 2\%$ voltage regulation you'll be interested. You'll probably even buy one.

Of course if you'd rather not wait for a power failure, call us now. While you can still see the phone.

Circle 52 on reader service card

Elgard Uninterruptible Power Sources are available in .5kVA, 1kVA, 2.5kVA, 5.0kVA and 10kVA models. They supply up to ten minutes of instantaneous reserve in case of power failure; and they have self-contained, maintenance-free batteries. Ideal for IBM Systems 3 and 7, DEC PDP/8, PDP/11, and Data General Super Nova. Priced from \$1,895.



ELGAR

8225 Mercury Court, San Diego, CA 92111
Phone (714) 565-1155

Nonvolatile memories are based on silicon-on-spinel

Researchers at Siemens AG have developed several versions of fully decodable and reprogrammable metal-nitride-oxide-silicon memories that combine the advantages of nonvolatile information storage and complementary-MOS techniques. The new devices are based on the so-called ESFI—for epitaxial silicon film on isolators—technology. This Siemens-developed technique is similar to the silicon-on-sapphire approach but uses spinel instead of sapphire.

In contrast to memories in bulk silicon, ESFI-based MNOS memories have the advantage that the storage matrix and the decoder can be integrated on a single chip without requiring isolation wells. Furthermore, because of the drastic reduction of parasitic capacitance—a result of using isolating substrates—the new memories have short access time. They are comparable with those of bipolar types.

Plus. Another advantage is that parasitic effects between two adjacent silicon islands cannot occur, because the silicon film between the transistors is etched away. Finally, the substrate region of each memory transistor can be contacted separately and used to write or erase the information in the element.

The Siemens research team, headed by Karl Goser, has developed three experimental versions of these new memories to prove the applicability of the ESFI technique for such devices. Each version consists of a fully decoded two-by-two storage array.

The first version of the memory has the substrate regions of the memory transistors not contacted, and its operation is analogous to MNOS memory arrays in bulk silicon. The decoder is built in complementary-MOS technology.

In the second version, the substrate regions are connected in rows. The information can therefore be

written or erased with voltage pulses of one polarity only. The decoder can be built in single-channel technology, which results not only in a higher packing density but also in a slower operating speed.

The third version, the most important one, has its substrate regions connected in columns so that, similar to core memories, simultaneous writing and erasing can be used. Since the information in each memory element can be written or

erased without changing the information in the other elements, this version lends itself to building an MNOS random-access memory.

Goser believes that with such MNOS memories, using 4,096 bits, would require a chip area of approximately 16 millimeters square. It would have an access time of around 80 nanoseconds. Writing and erasing would be accomplished with voltage pulses about 1 microsecond long. □

Around the world

Plasma display panel grows larger

Fujitsu is making progress on its plasma display panels. After having a small panel—128 by 128 addressable points—on the market for a year, it now has prototypes of a larger—512 by 512 points—model up and operating. It first announced the models 2½ years ago [*Electronics*, *Electronics International*, May 10, 1971], and production of the larger version—which measures 30 by 30 centimeters—should start in about a year.

To demonstrate capabilities, Fujitsu has developed a computer-aided instruction system using the prototype panel for both graphic and alphanumeric information plus superimposed rear projection from standard color slides. Alphanumerics use a seven-by-nine dot matrix for display of Roman alphabet, Japanese kana syllabary, numerals, and assorted symbols.

Electronic control saves gas at stops

A Swiss electronics firm is coming out with a system that helps drivers cut gasoline consumption considerably without sacrificing mileage or driving convenience. Easy to install on almost any make of car, the Startomatic system stops and starts the engine at stop lights and other idling times. Just that much time out can shrink gasoline consumption by 10% under ordinary city-driving conditions. The system is a development of E. Jucker Relaisbau, a 35-man Zurich-based company specializing in relays and industrial-electronic devices. The Startomatic system sells in Switzerland for \$65.

Pushing the dashboard-mounted button cuts off power to the ignition coil and stops the engine. A switch installed at the gas-pedal linkage engages the starter motor. The system, which keeps tabs on starter rpm, disengages the starter when the engine fires.

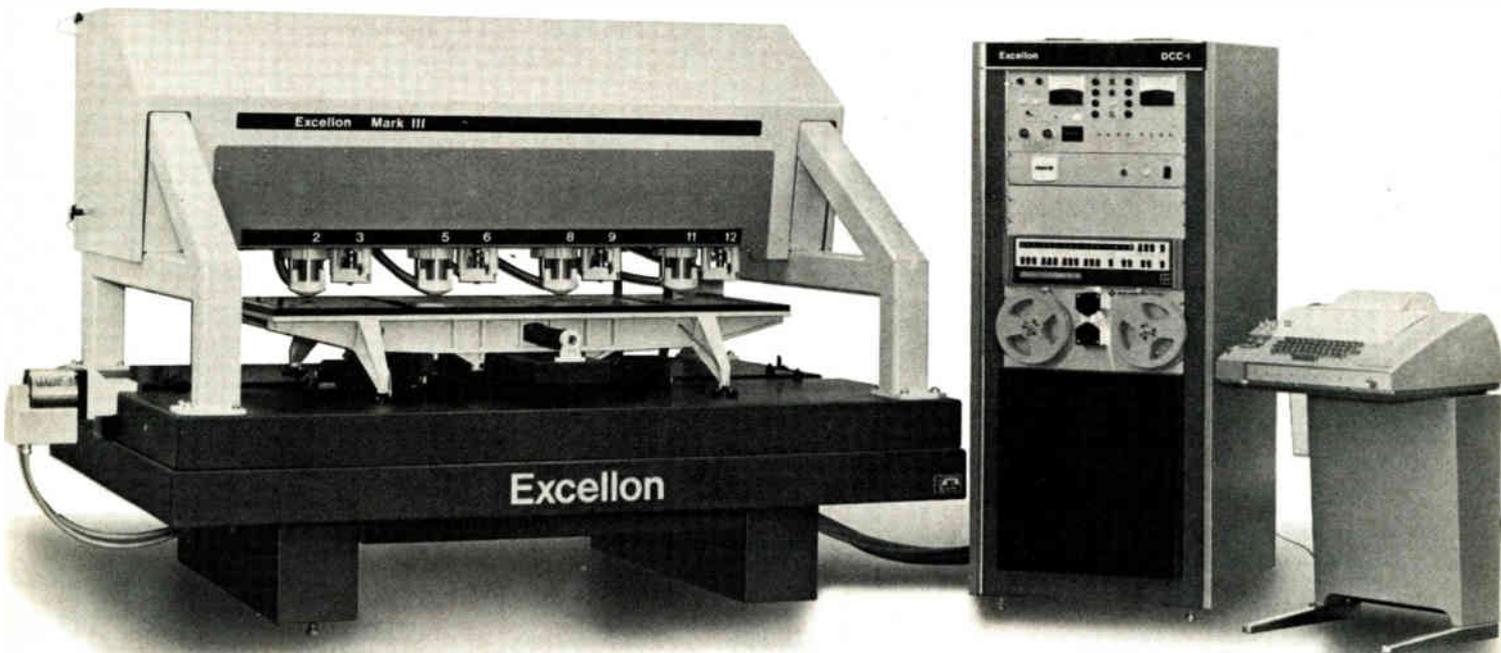
ESRO acts to build two satellites

The European Space Research Organization has awarded contracts to build its first two applications satellites. One spacecraft, an experimental communications repeater, will be built by the consortium of European space companies known as MESH. The prime contractor is Britain's Hawker Siddeley Dynamics Ltd., and major partners are AEG-Telefunken and ERNO in Germany, Aeritalia and Selenia in Italy, Saab-Scania in Sweden, and Engins Matrain France. The other spacecraft, a weather satellite, will be made by the Cosmos consortium, of which France's Société Nationale Industrielle Aérospatiale is prime contractor. Other major members are Siemens and Messerschmitt-Bolkow-Blohm in Germany, ETCA in Belgium, GEC-Marconi Electronics Ltd. in Britain, and Selenia in Italy.

Proven Performance.

Computer:	General Automation SPC-12/20. Step and repeat, mirror image, automatic rewind. Handles variety of formats.
Spindle feed rate:	20-250 ipm. Accuracy to within 2% of setting. Stroke limit adjustable, 0.001-in. increments.
Table travel speed:	400 ipm each axis. Computer-driven, high-torque, high-speed, low-inertia servo motor gives instant acceleration.
Drill hit rate:	200/min. Quality holes on 1/4-in. movement with 3-high stacks and 0.002 chip load.
Spindle motor speed:	15,000-45,000 rpm electric motors; 15,000-60,000 rpm liquid-cooled, frequency-controlled motors; 30,000-80,000 rpm air-bearing frequency-controlled motors.

The Excellon Mark III. Nobody's equalled it yet.



The Excellon Mark III is the most advanced p.c. drilling system in the industry today.

We've had more than our share of advances over the years. The fact is, when we added up the knowledge we've gained from our successes (and failures), we had all the makings of a major breakthrough.

The magnificent Mark III, for instance.

World-wide, the Excellon Mark III is giving unequalled performance with highest production rates possible . . . at the lowest hole costs possible, with high accuracy and clean, smear-free holes.

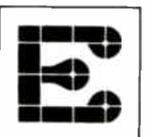
It has no competition because nobody's equalled it yet. Call or write Dick Hogan, Sales Manager. His number is (213) 325-8000.

Excellon Automation

A Division of Excellon Industries
23915 Garnier Street
Torrance, California 90505
Phone: (213) 325-8000

Telex: 67.45.62 Cable: Excellon Torrance

Excellon Sales and Service in ENGLAND • FRANCE • SCANDINAVIA • W. GERMANY • HOLLAND • AUSTRALIA • HONG KONG • TAIWAN • JAPAN



Thomson Brandt-CGE dispute threatens Unidata computer combine

The two largest French electrical and electronics groups—Thomson Brandt and Compagnie Générale D'Electricite—are ending their market-sharing agreement. **The result will be an open battle for the French telephone market, which so far has been out of bounds for Thomson-Brandt.** It will also lead to a bitter argument over investment financing for the new computer line to be developed by the French-Dutch-German Unidata combine, to which both belong.

First target for the Thomson-Brandt group will be the telephone-transmission business. **Secondly, but later, it may even try to compete with CGE for the electronic-switching business.** CGE is threatening to counterattack by moving back into the consumer-electronics business (which it mostly gave up to Thomson in 1969) and into the professional-electronics sector.

At the same time, both groups are threatening to withdraw from a joint company that holds the majority 64% in Compagnie Internationale pour L'Informatique (CII). Each says it will pull out if the other does not share the burden of financing the \$230 million development program over the next six years. To resolve the differences, the Minister for Industrial and Scientific Development, Jean Charbonnel, is expected to referee negotiations over the next few weeks.

Thomson-CSF seeks larger share of West German pie

In an effort to increase its share of West Germany's lucrative components market to 8% from 5%, **France's Thomson-CSF is concentrating all of its German sales activities in a single subsidiary—Munich-based Thomson-CSF GmbH.** By the middle of this year, the 160-man Munich affiliate had already taken on responsibility for sales of ceramic capacitors and ferrites, until then handled by German firms. And starting Jan. 1, Thomson-CSF GmbH will also take over the marketing operations of Sescosem, the French company's Semiconductor division, which had its own outlets. Europe-wide, Thomson says that it has 8% to 9% of the continent's components business. This puts the French company in the number 4 spot behind Philips Gloeilampenfabrieken, Siemens AG, and ITT.

Britain nears decision on TV data service

A national television information service to beam alphanumeric data to the home screen is becoming a real possibility in Britain. **One of the major obstacles—which of two technical formats to use—is expected to be resolved early next year.** However, the Ministry of Posts and Telecommunications would have to license the service—in effect giving the government the last word.

The British Broadcasting Corp. and the Independent Broadcasting Authority have come up with technically incompatible experimental systems that employ unused lines in the 625-line picture format. [*Electronics*, Electronics International, May 24]. The BBC is experimenting with lines 13 and 14, IBA with line 16. **The plan now is to combine best features of each approach.** TV set makers, through their trade organizations, are also involved in discussions.

U.S. cash registers ring at Munich computer show

Systems 73, the computer fair held in Munich last month, exceeded sales expectations of American exhibitors by far. A preliminary assessment by the U.S. Department of Commerce, which organized the American exhibit, **indicated an off-the-floor sales volume of about \$148 million for the 69 U.S. hardware producers represented.** That's more than twice the volume American companies logged at Systems 71.

Commerce Department officials say that 60% of this year's business was in peripheral equipment, 25% in computer-aided special systems, and the remaining 15% in data-transmission gear, single terminals, and leasing contracts. The exhibition, which Commerce Department people consider Europe's leading user-oriented computer show, **also proved to be a good place for establishing contact with potential Eastern European customers.**

France's 'Stradivarius' satellite radar nears completion

The French military is completing a new satellite-tracking radar with a range of 1,200 kilometers. Known as Stradivarius, the radar is being assembled by the Centre D'Electronique De L'Armement (Celar) at its research center in Rennes, Brittany. **Controlled by an IBM 370/135 computer, the system has been under development for more than seven years and is expected to be fully functional within six months.** The 90-ton scanner can cover between one-quarter and one-third of the globe and can theoretically be used to track missiles as well as satellites. The radar hardware has been built by Thomson-CSF.

British firm claims 40 dB SQ separation

A small British audio-engineering company at Cambridge, Connaught Equipment Ltd., has breadboarded a quadraphonic decoder that it claims will decode the CBS matrix sound (SQ) material to more than 40 dB separation between the four channels. Makers of other decoders for SQ claim up to 35 dB, but 40-dB separation is the main advantage of SQ over the rival quad coding, a discrete technique known as CD4.

This 40 dB separation should help matrix broadcasting against the discrete approach because for broadcasting, discrete requires twice the channel space. The decoder will be on two ICs, one of which has been made so far. Total harmonic distortion is said to be 0.02%. Connaught will show the breadboards at the Consumer Electronics Show in Chicago from Jan. 10 to 12, if patenting processes have been completed by then.

SAAB developing onboard computer for ESRO birds

Saab-Scania has unveiled an on-board computer being developed as a prototype for ESRO satellite computers that offers high speed and large memory capacity while requiring little power. The Swedish firm is doing the work under a \$350,000 contract and **expects its first model to fly aboard ESRO's scientific satellite to be launched around 1977.**

The computer will have a memory of up to 64,000 words of 16 or 32 bits each and have an addition speed of 2.8 microseconds. Only 5 watts will be required for the computer itself, and it will weigh 6 to 7 pounds with memory. The computer will be built up either in redundant modules or in multiprocessor configuration containing bus controller, processor, memory bank, direct-access memory, command adapter, telemetry adapter, interface buffer, and power supply. Saab-Scania expects to have a prototype delivered by next October.

Leading the way

Leaders have to be born, then made. The Philips mini-computer was conceived when we discovered that mini-computers bought for our systems were using our components. Today you can get the benefit of that discovery. With hardware design perfectly matched to components, then proved in our systems. Plus software packages that had to be right to make our own system work properly. On top of that you get the benefit of worldwide organization that's there wherever your systems go. On price, too, we've got nothing to impress you. There's a lot to be said for a mini-computer company that isn't just a mini-computer company. Full details are at the end of your phone.

Chinese compass
date unknown

Philips P860 M series plus points

- Memory capacity from 4K to 16K words. Conversion down to 100 nanoseconds.
- 16 hardware registers for efficient processing.
- Multiplex channel with 15 subchannels, plus DMA.
- Up to 6 interrupt lines on a local area level.
- Easy interfacing.
- O.M. quantity discount up to 10%.



Philips mini-computer, circa 1973.

- Apeldoorn 05760 30123 • Brussels 02 193900 • Copenhagen 0127 2222 • Essen 02141 236001
- Helsinki 9017271 • London 01 730 3416 • Milan 02 643 6541 • New York 212 697 3600 • Oslo 02679380
- Paris 01 702 2991 / 01 734 7759 • Stockholm 08635000 • Tokyo 034355211 • Toronto 416752 1980 • Zurich 01 4422 11

Philips considers your reputation



Data
Systems

PHILIPS

Circle 57 on reader service card



Who has the broadest line of Potentiometers?

It stands to reason that we wouldn't ask the headline question unless we were certain of the answer.

And we are. Unquestionably, the answer is **BOURNS**

Compare catalogs if you like. You'll find over 12,000 model/terminal/resistance combinations offered in our **TRIMMER POTENTIOMETER** section. Single-turn and multi-turn . . . round, square and rectangular — BOURNS has them all, in wirewound or cermet models.

No need to look elsewhere for a complete line of **PRECISION POTENTIOMETERS**. Check the precision section of the Bourns catalog. Over 20 different standard bushing mount models are displayed, including the unique **KNOBPOT®** integral dial/potentiometer family. If you have servo-mount requirements, or need "something special" . . . our fully staffed custom design and manufacturing organization is at your service. Promptly.

More? You bet.

Bourns popular "SPACE SAVER" line of cermet **CONTROLS** are finding wide acceptance in cost-conscious consumer and industrial applications. You can expect to see exciting developments in this line.

Our cermet and composition open frame **VARIABLE RESISTORS** are super for budget PC board applications. They're priced as low as 10¢ in production quantities. They're from Bourns, so you can count on cost-effective quality and service . . . even at such low prices.



When you think of variable resistive components . . . look no farther than your Bourns Master Catalog. It's your supermarket of quality, cost-effective resistive components.



TRIMPOT PRODUCTS DIVISION • 1200 COLUMBIA AVE., RIVERSIDE, CALIF. 92507

When we say Brand-Rex Vylink™ wires



Vylink is the Brand-Rex trade name for its tough irradiated PVC insulated wire and cable. A thermosetting material, it has superior heat resistance, is unaffected when accidentally touched by a solder iron and has outstanding cut-through, abrasion and chemical resistance – all in addition to vinyl's inherent non-flammability (it meets UL's FR-1 requirements), high dielectric strength and insulation resistance.

Five important processing and operating characteristics of Vylink and conventional PVC insulated wires are compared in the following panels. Test procedures and Vylink's properties are detailed in Brand-Rex specification BR-790. Write for your copy to Brand-Rex Company, Willimantic, Conn. 06226. Tel. (203) 423-7771

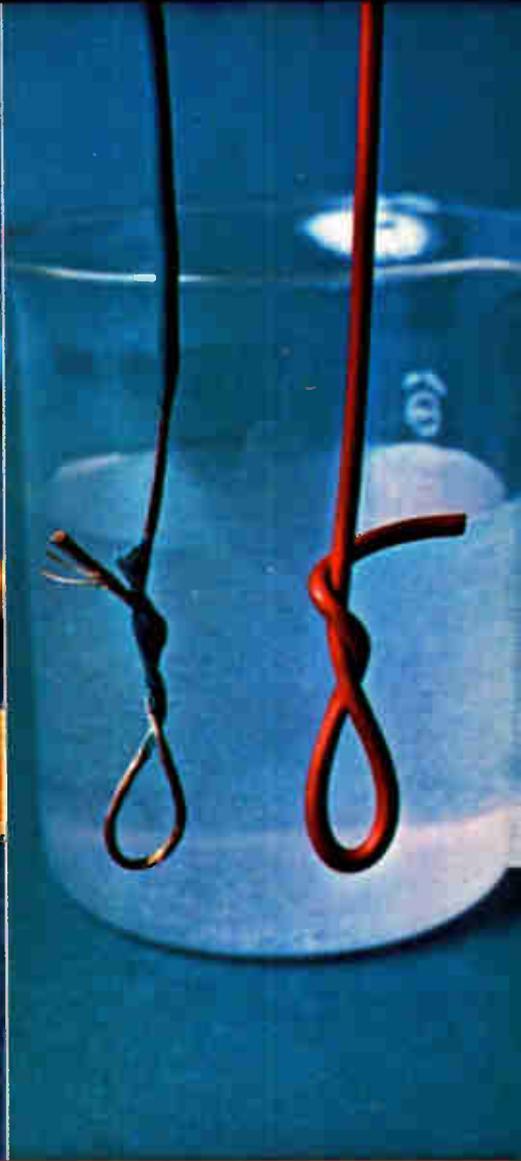
Heat Resistance

After 96 hours at 350°F, Vylink is unaffected, conventional PVC flows. Vylink wire provides far greater protection against current overloads and high temperature environments. It is recommended for shrink-tubing and wave solder cable terminations where wires are exposed to heat guns or solder baths – an excellent low-cost substitute for the premium-priced "high temperature" wires usually used in this application.

Solder Resistance

When a weighted solder iron (1½ lbs. force) is applied to the wire surface, conventional PVC insulation melts almost instantly. Vylink, though it may exhibit slight surface discoloration, shows no substantial change – even after several minutes. Regardless of method – hand gun, solder dip, wave soldering – Vylink insulation will neither shrink back nor melt. Shorts due to soldering are avoided. Circuit integrity is assured.

and cables are tough, we prove it.



Cut-through Resistance

The relative resistance of *Vylink* and conventional PVC insulated wires to penetration may be demonstrated by applying a 90° V cutting edge attached to a weighted plunger perpendicularly to samples of each. To have the specimens cut through in the same length of time, *Vylink* wire must be subjected to at least 5 times the weight. This extra toughness makes thinner insulation walls possible without compromising physical properties. The result — lighter weight, smaller diameter, but equally reliable, cable.

Abrasion Resistance

In this test, a predetermined weight presses a conventional PVC wire sample against a moving 400 grit, aluminum oxide abrasive tape until the insulation has been worn away and conductor exposed. By comparison, more than half the insulation remains when the same amount of tape abrades *Vylink* insulated wire under identical conditions. This toughness permits the use of thinner insulation which UL recognizes by rating 6½ mil wall *Vylink* wire at 125 volts (UL Style 1472).

Chemical Resistance

Electronic bombardment of the specially formulated *Vylink* compound causes a change in the molecular structure and transforms this PVC material from a thermoplastic to a thermosetting plastic. *Vylink*, like all thermosets is generally inert to chemicals and solvents. When *Vylink* and conventional PVC are boiled for two hours in MEK (methyl ethyl ketone), a good solvent for vinyls, *Vylink* is virtually unaffected; conventional PVC is completely dissolved.

Test wire conducted on 16 (26/30) AWG with 1/32" insulation

BRAND-REX

4,000 solutions in search of a problem.

BRAND-REX, A PART OF AVCO INCORPORATED
Circle 81 on reader service card

“Augat’s interconnection system appeared to have more advantages for use in the AN/TPX-42A Air Traffic Control System.

“Our extensive testing confirmed it.”

Robert A. Mesard, Group Leader
Transportation Systems Division
A I L Division of Cutler Hammer.

"When work began on the AN/TPX-42A, we started looking for an interconnection system that offered high reliability and design flexibility, without sacrificing lower initial costs or low field maintenance.

"Our program staff ran detailed reliability and cost analyses of the four basic interconnection systems under consideration: P.C. boards, multi-layering, welded wire-stitching, and wire-wrapped plug-in panels.

"The system meeting all of our requirements was wire-wrapped plug-in panels. We compared several manufacturers of socket panels and selected the Augat panel based on overall quality, range of products, and their willingness to respond to our needs.

"Our findings were incorporated into our proposal to the Air Force. But as the wire-wrapped plug-in panel concept was comparatively untried in U.S.A.F. equipment, they requested additional testing. So we ran a series of in-depth reliability and stability studies and tests as part of our systems qualification and reliability demonstration program.

"After 13,200 test hours, we experienced no mechanical failure or intermittence with the Augat system.

"Electronic Systems Division of U.S.A.F. accepted these findings and approved the Augat system.

"We now have used substantial production quantities of Augat panels without a single contact failure."

Augat first pioneered the socket-panel concept in 1965, and the exclusive precision-machined tapered-entry contact has made Augat the reliability standard for the plug-in interconnection industry.

A I L's record of not a single contact failure is one of the reasons why Augat supplies more panels than all

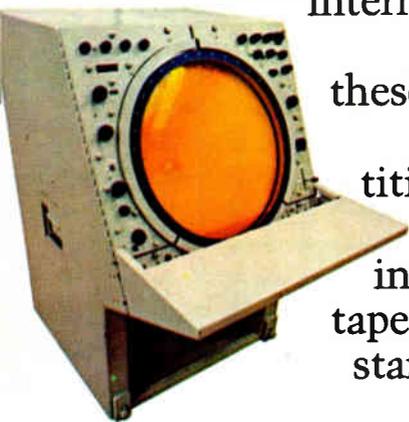
other manufacturers combined.

As the world's leading manufacturer of wire-wrapped panels and other IC interconnection products, Augat is ready and willing to help with all your interconnection requirements.

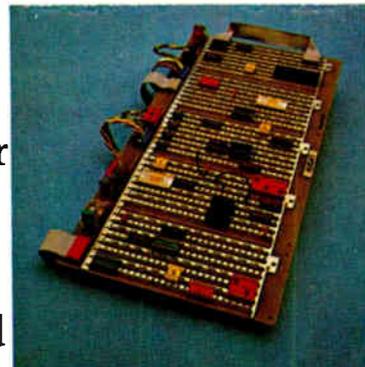
Call or write today for free brochure and complete product information. Augat, Inc., 33 Perry Ave., Attleboro, Massachusetts 02703. Represented and distributed internationally.



Robert A. Mesard



The AN/TPX-42A



Augat I.C. Socket Panel

Plug into Augat®. A I L did.

Buying a function generator isn't a big deal.



Using one every day is!

Because there's not much difference in function generator prices, there is often a tendency to specify the "name" brand. But **handle-ability** can be an essential factor. When a basic signal-source goes into your lab, consider first the **day-to-day efficiency** of the instrument and its **effect on the real cost of ownership**.

For example, with sweep width a critical factor in testing network frequency response or developing a response plot, INTERSTATE's F34 allows you to precisely dial the controlled starting and end points. This, coupled with a Sweep Limit Indicator that won't let you dial an invalid output, puts it miles ahead of Wavetek's 134 for accuracy and ease-of-use.

This, and many other human engineering and price/performance differences that exist between the two function generators reflect INTERSTATE's continuing concern for the user, and are factually catalogued in our FREE specifier guide. Check the number below to receive it, or for more direct information, call John Norburg, (714) 772-2811.



"THE \$495 COMPARISON:
INTERSTATE F34, WAVETEK 134 FUNCTION GENERATORS."

 **INTERSTATE
ELECTRONICS
CORPORATION**
Subsidiary of A-T-O Inc.

U.S. HEADQUARTERS: Dept. 7000, Box 3117, Anaheim, CA. 92803; OVERSEAS SALES OFFICES: AUSTRALIA, Parameters Pty., Ltd.; BELGIUM-LUXEMBOURG, Regulation-Mesure S.P.R.L.; FINLAND, Havulinno Oy; FRANCE, Tekelec Airtronic, S.A.; ITALY, Tekelec Airtronic; ISRAEL, Radat International Company Ltd.; JAPAN, Asahi & Co., Ltd.; NETHERLANDS, Tekelec Airtronic, N.V.; NEW ZEALAND, David J. Reid, Ltd.; REPUBLIC OF CHINA, Bons International Co., Ltd.; SPAIN, Telco, S.L.; SWEDEN, M. Stenhardt AB.; SWITZERLAND, Traco Trading Co., Ltd.; UNITED KINGDOM, Euro Electronic Instruments, Ltd.; WEST GERMANY, Tekelec Airtronic GMBH; CANADA, Radionics, Limited. TWX U.S.A. 910-591-1197 TELEX U.S.A. 655443 & 655419

Probing the news

Analysis of technology and business developments

4,096-bit memories pose test woes

Vendors, users, and manufacturers of test equipment, faced with prospect of 40-second n^2 tests, are looking for something different

by Wallace B. Riley, Computers Editor

If you liked the challenge of developing tests for the 1,024-bit p-channel MOS memories, then you're going to love the problems coming with the new 4,096-bit models.

The new testing problems concern users, vendors, and test-equipment makers. Users must make an incoming inspection on the chips they buy, because they can't expect vendor testing to anticipate the exact conditions of their application. And makers of test equipment are obliged to provide testers of maximum usefulness to both users and vendors. In fact, a spokesman for Macrodata Corp. of Woodland Hills, Calif., a leading manufacturer of memory testers, maintains that makers simply won't be able to test 4,096-bit chips adequately, leaving the bulk of the testing to the user.

But testing problems multiply along with the number of bits. Consider the classic test for semiconductor memories, the galloping-pattern test, or Galpat. With Galpat, every cell is compared with every other cell, to determine what happens when addresses are changed

quickly in all possible ways. That's not a bad idea with 1,024-bit memories—but with 4,096-bit versions, on the other hand, the additional test time involved makes Galpat unacceptable. The result is an effort to find worst-case test patterns.

Galpat, and similar tests known collectively as n^2 tests, might also be supposed to uncover interactions between cells that are physically adjacent on the chip. They're not too reliable for this purpose because they don't address the adjacent cells fast or often enough. However, one reason for using them to test for the adjacency interaction is that the cells are not necessarily arranged in numerical order. Without a chip map, the user can't establish which cells are next to which. And the manufacturer is often reluctant to turn over his chip map, because it may disclose a design innovation.

With the Intel 1103 p-channel MOS array of 1,024 bits—the most widely used semiconductor memory (with the possible exception of IBM's proprietary design)—which has a typical cycle time of 600 nano-

seconds, the n^2 test takes over 2.5 seconds just for the sequencing. For a 4,096-bit chip, at 600 ns, the test would take 40 seconds. When thousands of chips have to be tested, that kind of time becomes prohibitive.

Thomas L. Palfi, director of component development at Advanced Memory Systems Inc., Sunnyvale, Calif., says his company's 6004 read-write memory, with 4,096 bits, can be tested in only 8 seconds, including 2 seconds for dc tests. When the 6004 went into production early in 1974, the test time was only about 3 seconds. Palfi explains that AMS starts testing a memory chip with the simplest possible pattern, then uses it in memory systems and runs failure analyses. As these analyses identify failure modes, the basic chip pattern is modified.

Only at the start. At AMS the n^2 patterns are used only during preliminary development tests "when you don't know what to look for." It stretches the test time to over a minute. With the pattern now used in production tests of the 6004, one pass at 8 seconds is repeated several

Scrutinizing memories. This installation of Macrodata MD-100 test systems is doing high-speed work at Advanced Memory Systems.



Probing the news

times at various power-supply voltage levels.

According to Palfi, the major test problems can be solved with simple patterns that exercise the decoder circuits, measure their effects on the storage cells that are adjacent to the decoders, and identify tiny localized defects within the array. The decoder circuits are more likely to be pattern sensitive than the cell array, because of insufficient pre-charging or the presence of a charge residue in some circuits (MOS decoder circuits won't simply turn on and off like bipolar decoders). Furthermore, the column and row line drivers at the decoder outputs may tend to charge and discharge the row and column of cells next to them—although, Palfi says, the four-transistor flip-flop cell that AMS uses is much less sensitive to this than the one- and three-transistor cells that other companies use.

Experience. Four to six test patterns are usually adequate to test the 6004, and they require far fewer than n^2 steps. "Once you've burned your fingers a few times, you know what to look for," says Palfi.

It's generally agreed that one important consideration in testing the 4,096-bit n-channel memories is their use of a single clock. "To optimize at the system level you must minimize clocks," says Brian Croxon, section head for MOS main memory at Honeywell Information Systems Inc., Billerica, Mass. The single clock in the 4,096-bit memory is advantageous in system terms, and to a certain extent it's advantageous in testing because it reduces the number of combinations that must be tried in a test. But, because it removes one of the control parameters, it reduces flexibility and the amount one can learn about the memory being tested. "Perhaps less testing will be done on 4,096-bit memories, because there will be less to find out from them," he says.

Keiji Muranaga, senior systems analyst at the Systems Technology division of Fairchild Camera and Instrument Corp., Palo Alto, Calif., says today the trend is toward "march" patterns, in which an array is first loaded with 1s that are then

replaced, one at a time, with 0s. For an array of n cells this requires $2n$ steps. Other common patterns take up to $9n$ steps. An extreme case, testing for charge injections into the junctions, requires $n^{3/2}$ steps— $32n$ for a 1,024-bit chip, $64n$ for a 4,096-bit chip—but that's still less than n^2 .

At Intel, test engineers are still developing programs for the 2107 n-channel memory with 4,096 bits [*Electronics*, July 19, p.29]. Presently, they're running tests with several redundant patterns as the production line gets up to speed. By the time high-volume production is attained, minimal patterns will have been worked out, and Intel expects that the chip will take substantially less than four times as long to test as the 1103. This is in part from the chip's larger capacity, in part because of its slower speed (950-ns cycle time), and in part because of longer dc and refresh tests.

A major user of semiconductor memories is Burroughs Corp., which has its Electronic Memory Systems Organization at Piscataway, N.J. Burroughs inspects 100% of its incoming memory packages, many of which are Intel 1103s. When Burroughs first began using semiconductor memories, it used Galpat; but now it has discontinued that pattern. "We've concluded that we can't afford the time to perform our 100% test using any patterns proportional to n^2 ," says J. Reese Brown Jr., technical staff consultant at Burroughs. "There are patterns other than Galpat that will do the job just as efficiently and in less time."

Repertoire. Some of the tests that Burroughs uses include cross-nearest-neighbor-disturb, column-disturb-refresh, and sets of all-1s, alternating 1s and 0s, and a checkerboard pattern. Cross-nearest-neighbor-disturb tests each cell in the array in turn, writing a bit in that cell and a bit of opposite polarity in each adjacent cell in a "cross" pattern, and then testing the original bit for any proximity disturbances. Brown says that this seems to be a worst-case test for arrays in general.

Column-disturb-refresh tests the chip's ability to retain data for the refresh period. It writes 1s in a column of cells, then repeatedly writes

a 0 in one cell of that column during the full refresh interval (2 milliseconds at 70°C, longer at lower temperatures, corresponding to a minimum of several thousand cycles per column). The test is repeated for each column. Brown says that different 1103-type designs are sensitive to this test, but he isn't sure that any available 4,096-bit chips are.

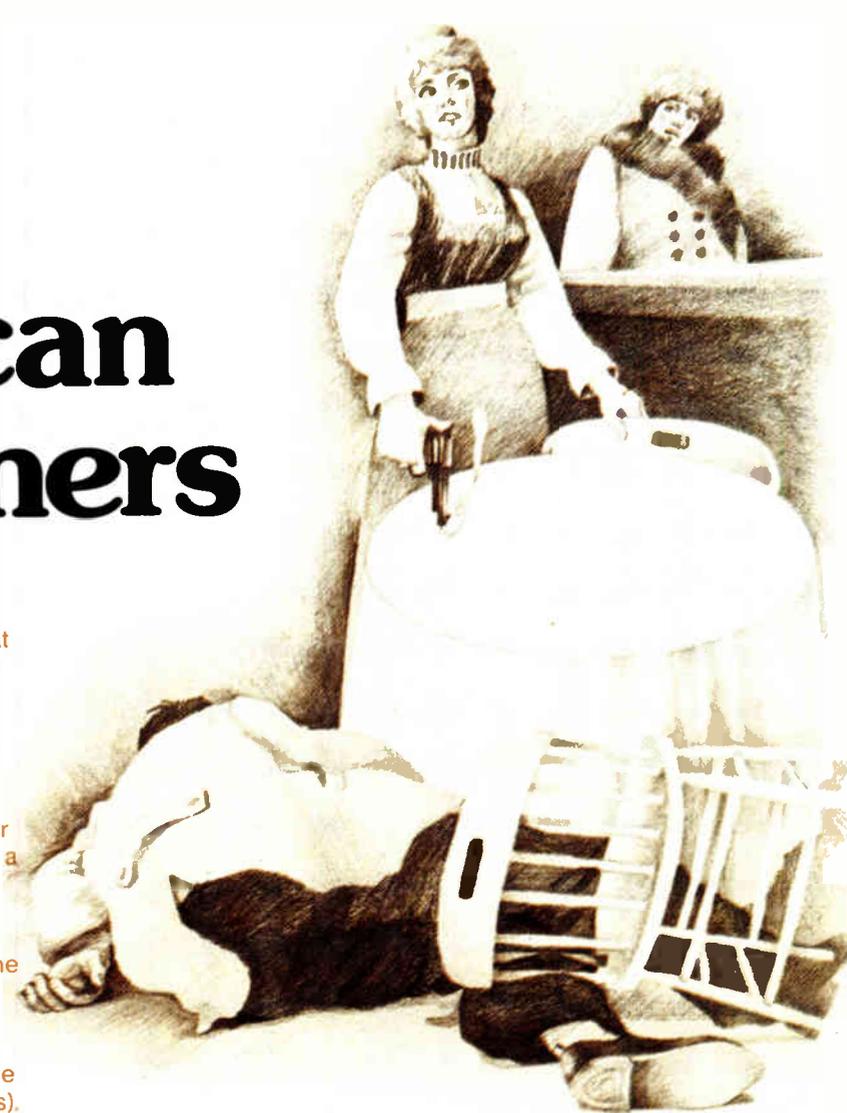
Plan ahead. "The key to testing any array," Brown says, "is to examine the internal circuitry and internal layout, and to try to anticipate problems due to internal coupling and internal voltages. Then you create a pattern that is worst-case for that design."

Honeywell's Croxon was the first to use the three-transistor inverting cell, now used in 4,096-bit memory chips produced by Microsystems International Ltd., Toronto, Canada [*Electronics*, Dec. 18, 1972, p. 97] and by American Microsystems Inc., Santa Clara, Calif. In this cell, if a charged capacitance represents a binary 1 and a discharged capacitance represents a 0, these designations are reversed with every refresh cycle—requiring every column to include an extra unaddressable dummy cell that keeps track of which designation is which. At any point, the output of any cell is the logical exclusive OR of its contents and that of the dummy cell.

Another 4,096-bit memory that presents a unique problem is the model from Mostek Corp., Carrollton, Texas. It has multiplexed inputs, which permits its mounting in a smaller package with fewer external connections—only 16 pins, compared with other vendors' 22-pin packages. "None of the testers I've seen have the capability to handle multiplexed inputs," says Brown of Burroughs, although his company has added external circuitry to one of its machines so that it can handle multiplexing. However, the 16-pin package has an advantage: it can be used directly in conventional automatic handling equipment.

Brown sums up the testing problem in one sentence: "The more complex 4,096-bit parts will be more difficult to analyze for worst-case patterns, there will probably be more worst-case patterns, and they'll be more subtle, than is the case for the 1,024-bit memories." □

Great American Two-timers



You already know most of the great American two-timers. There was Scarlett and Rhett, Frankie and Johnny, Bob and Carol and Ted and Alice.

And now this country has the Dual 555 Timer, emerging as one of the all-time great two-timers.

Known as the D555, this dual timer has two independent 555 type timers on a single chip. A 14-pin DIP two-timer to save you both board space and money. Instead of using two 555's, you could be using one D555. It costs only \$1.50 for the commercial version, 100-up.

And it two-times your design pleasure, with time delays set by an external R-C network and highly accurate time delays (from microseconds to hours). Or use it as an oscillator. The free-running frequency and duty cycle of each section are accurately controlled with two external resistors and one capacitor. And the outputs can source or sink 200mA, which is enough to drive relays or indicator lamps.

It also has better matching and tracking characteristics than the old discrete two single-timer approach, is compatible with TTL, DTL and ECL (which is more than anyone can say about Frankie and Johnny), and runs on any supply voltage from 4.5V to 18V.

The D555 is activated by triggering an internal flip-flop with a falling waveform. Once activated, the circuit is immune to additional triggering during the timing cycle. A reset terminal is provided in case the timing cycle must be interrupted.

Which all means that history won't play havoc with your imagination. You can shape the course of time to your liking—in sequential timing, frequency division, pulse shaping, clock pattern generation and hundreds of other timely applications.

To learn more about the world's new Two-Timer, call Teledyne. Or a rep or distributor. History will reward you.

 **TELEDYNE**
SEMICONDUCTOR

1300 Terra Bella Avenue Mountain View, California 94043
(415) 968-9241 TWX: 910-379-6494 Telex: 34-8416

Computers

Penetration of Japan increases

But U.S. National Research Council foresees Japanese entry into worldwide markets coming before 1975

by Ray Connolly, Washington bureau manager

Except for uncounted numbers of minicomputers, Japan had 17,255 computers installed and operating on March 31, an increase of 34.7% from last year, and valued at \$5.16 billion. Most were made in Japan, except for a significant market share of very large and very small machines with foreign labels.

The statistics, compiled by the Japan Electronic Computer Co., shows that foreign computers—a category that includes those made in Japan by foreign-controlled companies like IBM Japan—had 65% of the market for very large machines, those valued at more than \$2 million. As for very small computers valued between \$20,000 and \$40,000, foreign brands accounted for 48.6% of total sales and more than half the installations.

Such trends are disturbing to the Japanese, according to U.S. Government officials familiar with the statistics. Foreign computers have been increasing their market share in Japan during the past two fiscal years, rising 5.6% last year to the March 31 level of 46.8% of the installations. Moreover, there is the fact that increasing usage of minicomputers—defined as processors with a maximum 4,096 words of memory and value of less than \$20,000—is causing a decline in the rate of increase in the number of other computer deliveries. Most of the minicomputers represent foreign technology—mostly from America.

To remain competitive in its own market, Japan is pushing hard to accelerate the development of its own computer industry under the guidance of the Ministry of International Trade and Industry [*Electronics*, Nov. 22, p. 96]. But an in-

depth look at the Japanese computer industry prepared in the U.S. sees that effort as a real threat to American dominance of the world's computer markets and perhaps even its own. The study, by the National Research Council, says, "The Japanese intend to, can, and will make a full-scale entry into the world's computer markets—particularly the big markets of the U.S. and Western Europe—by or prior to 1975."

The NRC's computer technology/resources panel concludes further that Japan "will be able to offer the full spectrum of machine sizes, and a full complement of peripheral gear, fully contemporaneous in hardware, software, and system adaptation to use. We believe the equipment will be of high quality and reliability, easy to maintain, and very competitively priced."

Unimpressed. But Japanese familiar with the 18-month American study, which runs to 130 pages, are quick to minimize it. Still, their differences with the U.S. view of Japan and their own are matters of degree. For example, MITI's Kazuo Fujimoto, head of the Electrical and Electronic Machinery division, believes the report, as a whole, overrates the Japanese computer industry. While he does not believe that Japanese computer technology will catch up with that of the U.S. in the next five to 10 years—or even in the foreseeable future—Fujimoto does see Japanese computer exports concentrated in minicomputers for the present, mostly OEM equipment shipped as part of a plant. For the next few years at least, Fujimoto says, Japan's computer priority is to maintain a 50% share of its domestic market or greater.

Yujiro Degawa, Nippon Electric's executive vice president and Computer division director, comes on somewhat stronger. "I can't conceive of the Japanese computer industry advancing into world markets across the board by 1975 or before," says Degawa. But, he adds, "It is possible there will be partial entry into world markets with some computers that have features that make them competitive with foreign computers."

As for the American judgment that Japan will catch up in a decade or less, Degawa says "the enormous amount of capital" required to make computers probably rules that out. While he concedes that Japanese government outlays for research are increasing, Degawa notes they are almost negligible, compared to those of the U.S. But, like Fujimoto, he doesn't foreclose increased exports.

Degawa's ultimate judgment of his nation's future in computers has a distinctly chauvinistic ring, however. "If the pace of technical progress in Japan is rapid," he concludes, "it will be the fruit of the exertion and diligence of the Japanese people."

Progress. While some U.S. computer-industry observers believe the Japanese can make a legitimate case about some overstatements in the NRC study, they note that the latest statistics on installations show that the Japanese have been diligent. Also, figures in the NRC report—using data compiled by a joint U.S. Government-industry technical team in July 1972, in "a detailed, on-the-ground survey of the entire Japanese computer industry"—are holding up. Japanese installations

are rising sharply and seem likely to reach the NRC's estimated value of \$10 billion by 1975.

Moreover, the report sees Japan's computer progress keyed to its diligence in licensing "on very advantageous terms" new technology imported from the West, mostly the U.S., much as it licensed transistors and other developments earlier.

Only successful technology has been imported, the study points out, and the royalties run from 1% to 5% of production. The U.S. cost to create the technology, on the other hand, has been about 15% of production, "and not all of it turned out well." With this technology in hand, Japan has been able to concentrate its efforts on "improved processes, reduced cost, and higher quality. In the years 1950-1968, Japan entered into 10,000 license agreements, while only 2,000 flowed in the opposite direction. This import of technology was particularly prominent in the computer field, where five of the six major industrial groups in Japan then manufacturing computers had joint-venture agreements with U.S. counterparts."

Interests. On the subject of Japanese R&D, the council acknowledges that the U.S., with its investment of 3% of gross national product, is still far ahead of Japan's 1.5% of a smaller base. Yet the NRC makes two qualifying points. First, it argues that government-sponsored R&D is on the increase in Japan, while it has been waning in the U.S. More important, however, is its contention that "Japanese R&D differs qualitatively quite sharply from that in the U.S. Only 10% is at all basic in nature. Another 20% is exploratory, but definitely applications-oriented. The large 70% is aimed at improvements in the whole manufacturing process, which will result in cost reductions, productivity increases, and augmented reliability. Automation of process looms very large in the manufacturer's eye, and process-control computers are a prominent part of the computer industry's output."

Barring a continuing downturn in the Japanese economy—a research council estimate that the subsequent energy crisis may prove off the mark—the study offers these assessments of specific technologies and

products in the Japanese computer drive:

■ **Peripheral equipment:** Japan appears to have the technology and capability to produce equipment comparable to anything in the U.S., but it may not yet be cost-competitive. Nevertheless, it forecasts that in this important market area—up to 70% of system costs—"the Japanese may soon be able to outstrip the U.S. in performance, quality, and cost."

■ **Minicomputers:** In an area where the U.S. has managed to seize an increasing share of Japan's rapidly growing domestic market, the country now has about 20 of its own manufacturers, and output is rising sharply. This is the market Japan is said to be most anxious to recapture—machines it defines as those costing less than \$14,000. "Since the construction of a minicomputer is a logical extension of the desk-calculator technology," the report notes that Japan's dominance in that world market leads to the "surmise that the existing desk-calculator sales, marketing, and service organization throughout the world may

well be utilized for the export of minicomputers."

■ **Medium-scale:** Domestic industry growth is much further along in Japan than any other category. It not only had 70.7% of installed computer value in March 1973, but was increasing that share. Deliveries of Japanese-made medium-scale machines in the preceding six months accounted for 79%, while imports had slipped to 21%.

■ **Large-scale:** In big machines, foreign makers—including IBM Japan—had close to two-thirds of the domestic Japanese market in March, but the share is slipping. In the council's judgment, detailed data on large systems indicates that most of the domestic growth is occurring at the low end of the large-machine spectrum and that the U.S. makers are still supplying the really large systems. However, the report questions whether this will remain true following the introduction of Dendenkosha Information Processing System—DIPS for short—and the machines developed by the National Computer Project [*Electronics*, Nov. 22, p. 100]. □

Endangered species? This scene of workers busily assembling American computers may be threatened by Japanese advances into the worldwide markets, says a U.S. report.



Our competitors yelled, "Paper Tiger!"



The MD-500 Digital Test System may be interfaced with customer wafer probers or handlers.

Until they heard our MD-500 ROAR!

Last year, when we introduced our MD-500 as the world's finest and most versatile digital test system, our competitors said it was all on paper. But now the praise from our customers is drowning out the noise from our competitors, and the MD-500 is a working reality.

The MD-500 is in the field today, both at home and abroad. It provides a capability that permits DC parametric testing either independently or simultaneously with high speed functional tests. It tests MOS and bipolar devices at data rates up to 10 MHz. It tests random logic chips for CPU's, for calculators, for communications, for seat belt interlocks, for digital clocks and watches, etc. And it tests RAM's, ROM's, shift registers — and both synchronous and asynchronous devices.

The MD-500 offers the user the ultimate in random logic testing because of Macrodata's unique design em-

ploying a 10 MHz processor-controlled RAM data buffer memory. Also, the software system offers multi-station operation — up to two parallel stations and up to four active test stations, plus a test compiler station. Programs can be compiled on line while other stations are testing, without test interruption. Software capabilities also include histograms, Schmo plots, and distribution diagrams.

So what have we got to roar about? Plenty. Here is a digital test system with capabilities far beyond those of other existing systems — one equally at home for use in engineering characterization, incoming inspection, or on the production line. But, more important, the MD-500 is already out in the hands of the customers proving daily that it is a real tiger!

Send for your free copy of the full-color MD-500 brochure.

Macrodata



Macrodata Corporation, 6203 Variel Avenue, Woodland Hills, California 91364, Phone: (213) 887-5550, Telex: 65-1345
Sales Offices: Northern California Area Tel. (408) 735-9580 • Southwestern Area Tel. (213) 644-3611 • West/Central Area — Denver Tel. (303) 934-5505 •
Scottsdale Tel. (602) 947-7841 • Albuquerque Tel. (505) 299-7858 • Dallas Tel. (214) 231-2573 • Houston Tel. (713) 621-0040 • Minneapolis Area Tel. (615)
636-1770 • Chicago Area Tel. (312) 455-5100 • Cleveland Area Tel. (216) 481-8333 • New York and New England Area Tel. (914) 962-7797 • Southeast Area
Tel. (205) 883-0140 • International: West Germany — Munich Tel. (0811) 34 56 00 Telex: (841) 521-5969 • Milan, Italy Tel. 871-988/899-248 Telex: (843)
34314 • Sweden and Norway — Stockholm Tel. (08)-380-370 • Switzerland and Austria — Bern Tel. (031) 22 44 81 Telex: (845) 33172 • Tel Aviv, Israel Tel.
25 55 69 • Tokyo, Japan Tel. (03) 985-5266 Telex: (781) 272-2171 • Buckinghamshire, England Tel. High Wycombe (0494) 36 3 81 Telex: (851)837238

Computers

European makers told to unite

Common Market computer report says first step should include buy-at-home program and cooperation with governments on new applications

by James Smith, McGraw-Hill World News

Members of the European Common Market have been told that by the 1980s, the only way they'll be able to compete with U.S. computer companies, particularly IBM, is to build a powerful all-European combine. The warning came from the Economic Community's commission in a 35-page report [*Electronics*, Dec. 6, p. 65] that is drawing generally favorable comment from European computer manufacturers. The commission's suggestions center heavily on a buy-European policy by various national authorities and cooperation on new applications between national governments and European industry. Ultimately, the commission would like some progress toward shaping various government-supported programs into an all-Community effort, but, in the interim, it proposes that the Community finance short-term development efforts by European firms in certain key areas.

While the report concedes that cooperation between European and U.S. companies is one way to end the competition gap, it leaves no doubt that the commission is after an all-European grouping with few or no American ties. There is room for a new European competitor to IBM and its U.S. fellows in a market that's growing some 20% annually, the commission argues.

Long haul. The report fosters no illusions that an all-European grouping can develop in the short term, or that close cooperation can be arranged in the near future on central-processing units. The authors also sidestep the question of whether there should be an eventual fusion of production facilities by computer companies or simply a

single range of hardware. They strongly imply, however, that production linkups will be necessary if the European industry is to remain healthy in the face of U.S. domination.

Although the commission praises the Unidata tie of Philips, Siemens, and Compagnie Internationale pour l'Informatique [*Electronics*, March 1, p. 68] as a step in the right direction, it warns that Unidata is still too small to provide viable competition against the giants. Unidata has

8% of the European market, compared to 7.5% for British producer ICL, 13% for Honeywell-Bull, and 55% for IBM, according to the commission. It puts the minimum level for profitability at 5% to 8% in Europe and still more on the world market. Altogether, European companies have only a 6% share of the world market, the commission says.

The report also estimates that unit production costs diminish by 15% for each doubling of market share. This means Unidata's costs

Views from the companies vary

Although European industry's reaction to the EEC's computer-consolidation report, by and large, appears favorable, it still reveals considerable divergences in company viewpoints. Views differ on the desirability of compatibility with IBM equipment. While compatibility is no longer a technical problem for the computer industry, as the Honeywell-GE linkup shows, the commission observes that it is still a vital commercial matter for such companies as International Computers Ltd., which has 40% of the British market. Compatibility with IBM would simply expose the British firm to direct competition, says the commission. By contrast, for CII and Siemens, compatibility with IBM is essential because the U.S. company has 60% of the public sector in France and West Germany.

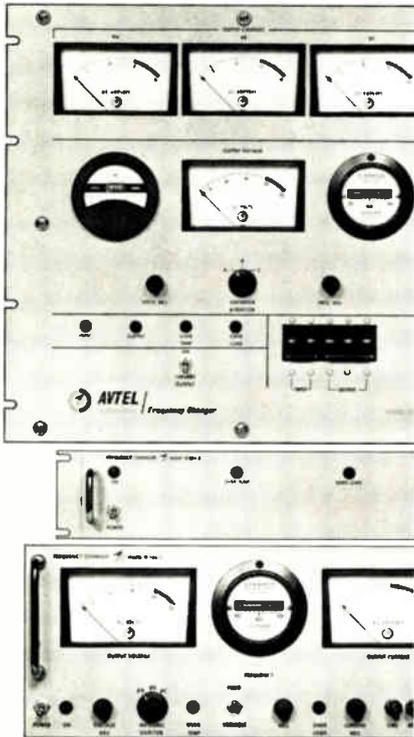
Brian Murphy, an official at ICL, praises the medium-term collaboration on peripherals with companies other than IBM as "a most sensible path to cooperation." But he warns that collaboration on mainframe development can only come about "if Unidata stops copying IBM architecture."

Murphy underlines one point on developing applications software packages that can be used on different types of computers: "If it's done in higher-level languages, that's fine. But the only major market at the moment is in government fields that are socially desirable but don't have commercial potential. However, the commercial market will develop."

A Siemens computer man praises in principle the commission's proposals, but said it is highly unlikely that collaboration will come about in the near future. "Once we have learned to cooperate among ourselves [in Unidata], then we might think about taking on other partners," he said.

L.E. Grossman, deputy director of Philips-Electrologica, another Unidata partner, is somewhat more optimistic. Grossman says that individual technology is becoming less important in relation to the need to pool resources. But he notes that the rationalization of production and other operations within Unidata itself could take three or four years. "Ultimately, there has to be a fusion of European production facilities," Grossman thinks.

solid state fre- quency convert- ers



Compact, Efficient, Reliable, Quiet. Avtel's Solid State Frequency Converters offer many performance and installation advantages when compared with rotating motor-generators or even other solid state approaches. And you get the lowest cost-of-ownership consistent with quality performance.

The next time you need 50 or 400 Hz power and only have 60 available, call Avtel. Standard models available in 50, 60 or 400 Hz outputs from 50, 60 or 400 Hz inputs in power levels from 500 VA, to over 500 KVA.

Avtel also manufactures solid state Uninterruptible Power Systems (UPS).



1130 East Cypress St. • Covina, Calif. 91724
(213) 331-0661

Probing the news

are about double those of IBM. If IBM's unit costs are rated 100 on an index basis, ICL would rank 220, Siemens 290, and CII 300, according to commission calculations. IBM's U.S. competitors would rank 175 on the scale.

Leasing urged. The commission also observes that European companies have relatively low leasing revenues. This handicaps their financing of R&D and limits their ability to provide service to customers. The report suggests possible help in this area by setting up a European leasing company. Although the commission leaves little doubt about its ultimate aim of promoting a single group capable of producing competitive CPUs, it concedes that two rival European groups will probably exist over the next three or more years. These are Unidata and ICL-Nixdorf/Telefunken, but they are not named in the report. The authors also urge the various member states agree on some sort of long-term Community computer policy under which it could coordinate the national plans, such as France's and Germany's, which come up for renewal about 1975.

Although the English approach is not as structured as those on the continent, the commission encourages the channeling of national financial aids to local industries into a single Community-wide policy. Thus far, cooperation between governments and exchange of technology have been extremely touchy subjects in the Community and have helped cause the breakdown of previous commission efforts to force a computer linkup.

Start small. To remedy the situation, the commission proposes initial short-term projects in such related markets as components, peripherals, external memories, and software. These projects might also receive Common Market financial aid by means of Community industrial-development contracts, a device that the commission had urged previously as a means of subsidizing technology developed by small- and medium-size firms.

The commission also suggests the development-contract concept be

broadened to cover more ambitious programs for computer systems. And, even though the problems of the semiconductor industry will be the subject of a separate study, the report notes that the European industry is entering a crucial phase with the development of new technologies such as large-scale integration and uses of optical memories. An important R&D effort should be undertaken in these areas, the commission says.

In addition, the commission wants to develop a software market based on programs that are transferable from one type of machine to another. The commission observes that, despite official unbundling by IBM, which is by far the most important software company, programs still remain associated with hardware. Besides financial help for such "bridgware" programs, the commission urges greater effort, especially by national governments, to fix common norms for both hardware and software.

Other areas. The commission also recommends that governments and public authorities cooperate in such data-applications as environmental control; meteorology; control systems for air, marine, and land traffic; customs and commercial statistics; and education, as well as in certain essentially national interests as social security, hospital and sanitary systems. Other joint-application efforts could aim at upgrading information on such of the community's weak industries as shipbuilding, aeronautics, and textiles, which must also be made more competitive.

Ironically, lack of adequate European hardware and software bases has frustrated the commission's own efforts to buy European and has served to underline the need for strengthening European companies. European computer firms were simply not competitive when the community asked for bids on a data system for its joint research center at Ispra in Italy some years ago. What's more, CII machines that are intended to replace IBM equipment at the Common Market's offices in Luxembourg are still not operating efficiently, mainly for lack of adequate software, and the result has been an embarrassment. □

All computers should be this simple.



for sale of course, and are backed by service with over 1500 technicians in 365 cities in the U.S.A. and Canada. They're for lease too. Starting at about \$20-a-week.

Proof is in the using.

Nobody has ever let you try a computer before, without making you buy it first. With all the complexity it just didn't make sense. The Uncomputers herald a new era, bringing "try it before you buy it" to the computer industry. In any of our 365 cities in the U.S.A. and Canada we'll let you use an Uncomputer for a week, free. And with no obligation, of course. That's not a lot of time. But with a computer this simple, it's enough. Just return the coupon or call your local man from Monroe.

For a long time it's been possible to make powerful computers small. What hasn't been so simple is to take all that computer power and make it easy to use. That's what the Uncomputers are all about.

Imagine all the horsepower of a room full of second generation computer hardware...simultaneous equations, hundreds of registers, symbolic logic, thousands of program steps...all of it together in a package that fits on the corner of a desk. And designed even with peripherals so that anybody who understands algebra or trigonometry or even simple arithmetic can make it work with just a little common sense.

Uncomputers with a library of hundreds of programs covering engineering, science, statistics and business just so you don't have to re-invent the wheel. But every Uncomputer is a self-contained system, capable of creating its own programs on little magnetic cards the size of your driver's license.

Powerful isn't expensive.
The Uncomputers are

Vest Pocket programs.
We're offering the

- Gentlemen, I'm interested. Call for an appointment.
- Please send complete information by return mail.

Name _____
 Business Name _____
 Address _____ Business Phone _____
 City _____ State _____ Zip _____

E 12

Monroe.
The Calculator
Company.

Orange, New Jersey 07051

Government electronics

Technology transfer stirs again

Programs of National Science Foundation, National Bureau of Standards aim to turn R&D into products with less cost to government

by William F. Arnold, Aerospace Editor

A few years ago, the Nixon Administration talked about a Technological Opportunities program in which Government would become a big partner in spurring needed civilian research and development. But when the bill climbed past \$50 billion the idea evaporated. Now the Administration is on a new tack and has charged the National Science Foundation and the National Bureau of Standards with discovering mechanisms for speeding R&D concepts into marketable items without entering the marketplace or paying for most of the development.

Under the Experimental Tech-

nology Incentives Program, the National Bureau of Standards has \$7 million each for fiscal years 1973 and 1974 to try and work with other Government agencies in encouraging technological advancement. The National Science Foundation has about \$25 million over two fiscal years to fund a series of Government-industry experiments under its Experimental Research and Development Incentives Program. One project is to fund clinical testing of a computerized ultrasonic medical scanner (see p. 31). And, even the old NASA Technology Utilization Office (\$4.5 million in fiscal 1974) is

thinking of reordering its attempts to get space technology into use.

Whether or not Government can shepherd a relatively few million dollars into replacing billions remains to be seen, but Government planners are investigating new approaches to counter a threatening trend: the rate of technological change in the U.S. is not accelerating as fast as that of Western Europe or Japan.

The aim of the programs is to conduct experimental studies on what works and why, explains Richard T. Penn, deputy director of NBS's program, adding that "the NASA and Defense Department programs haven't been massively successful." Once what works is known, the Government can "generate knowledge on 'how to,'" he says.

Elaborating, Arley T. Bever, deputy director of the NSF effort, says the programs will try out, on a limited basis, those approaches the "Government might use later on a larger scale." He believes that it's important that participating companies show commitment by using their own funds in the projects.

Leader. The NBS approach is to find out if "Government can use its purchasing power to be a leader in stimulating R&D," says Penn. He indicates he believes that the Government can "use its aggregate purchasing power to push R&D already completed but not out" by buying in such quantities that it will become profitable for companies to produce new items commercially. One example affecting the electronics industries is expected to be revealed shortly when the Veterans Administration announces a large purchase of biomedical equipment for its

A suitcase with fallout in it

One prescription for expeditiously getting R&D into the marketplace might be to combine commercially available components with devices produced under NASA contract and add corporate ingenuity. This is what happened at SCI Systems Inc. of Houston, which produces a portable emergency medical services package called Telecare. The system enables paramedical personnel, under radio supervision from a doctor, to aid a patient. The \$10,000 unit is designed to provide crucial immediate aid until a victim can be moved to an ambulance. "There wasn't any direct money from NASA for this," explains Craig A. Castle, marketing manager for biomedical systems. "They bought a suitcase with fallout technology in it."

The 40-pound unit contains a respiratory resuscitation system, 15-minute oxygen supply, a defibrillator, a basic pharmaceutical pack, an electrocardiogram display, telemetry system, and a semiautomatic indirect blood-pressure-measurement system. The communications-telemetry system is produced by General Electric's Communications division in Lynchburg, Va., and SCI developed the blood-pressure-measurement system for NASA's Skylab program. Options include an electroencephalogram that can remotely detect brain waves. That instrument was derived from a sleep-analyzer that SCI also developed for Skylab.

The company has sold 31 Telecare units to the city of Houston and reports that other communities express interest. The multiplexed communications system uses the ambulance's system as a repeater.



field hospitals and clinics, Penn says. NBS also is working with the General Services Administration, the Government's civilian purchasing department, toward buying products that help conserve energy.

The rules. Regulation is another area that affects technology change, Penn says. His group has talked with the Consumer Product Safety Commission to see if, in setting regulations, it can "take into account the impact on future technology." The NBS would like to see a requirement for automatic periodic review of regulations "so they don't restrain technological advancement," he says. Also contacted were the Interstate Commerce Commission, the Federal Power Commission, the Federal Railroad Administration, and the Urban Mass Transportation Administration.

Small business is another area where Government can help technological advance. Since "the small inventor is no longer the power he once was," Penn says, the NBS has talked with the Small Business Administration to change its procedures "to let them fund high-technology firms which aren't always very large." As the SBA "is traditionally run by bankers and accountants, the small guy never gets his."

Also getting under way is the National Science Foundation's R&D incentives program, a bundle of various experimental projects attempting to bring together Government, industry, and academic institutions. Like the NBS, the foundation also is concerned about the small inventor; through a private-sector office it's working with the problems of the private entrepreneur and small R&D companies trying to get off the ground.

In addition to the ultrasonic scanner experiment, the NSF has provided \$1 million each to three innovation centers at MIT, Carnegie-Mellon University, and the University of Oregon, so that they can bring together administrators, academics, and entrepreneurs to solve special problems. Another university project, aimed at dispelling the notion in industry that universities can't perform useful research, is at North Carolina State, helping that state's furniture industry.

To bring the latest technology to

local governments, the foundation is inaugurating an experimental urban-technology system to be managed by the not-for-profit Public Technology Inc. of Washington, D. C. The five-year effort will place a technology extension agent in 36 governments to act as a go-between and broker between political jurisdictions and technology centers.

Joint participation, in which companies perform their own R&D with

some government help, could be a winner for both sides. NASA has had success, and the Maritime Administration is finding it an efficient way to stretch Federal R&D cash and get industry cooperation.

In addition to the Telecare portable emergency medical aid (see "A suitcase with fallout in it"), NASA has been able to get several techniques ready for commercial use, including a lung monitor. □

CMOS/LSI SUBSYSTEMS CAN HELP YOU IMPROVE PRODUCT PERFORMANCE AND SLASH PRODUCTION COSTS.



WE CAN HELP, TOO.

That's our business—helping our customers extend their design and manufacturing capabilities to include the most advanced semiconductor technologies.

Whether your product can be improved through the application of CMOS/LSI subsystems, the high precision of Bipolar linear circuits — or a combination of both — our people have the proven knowledge and access to the industry's most advanced processing equipment. This combination of skills and facilities just might enable us to help reduce your system costs.

Our customers choose to work with us because of the harmony and mutual integrity which characterize the close working relationship we feel is essential to doing a proper job.

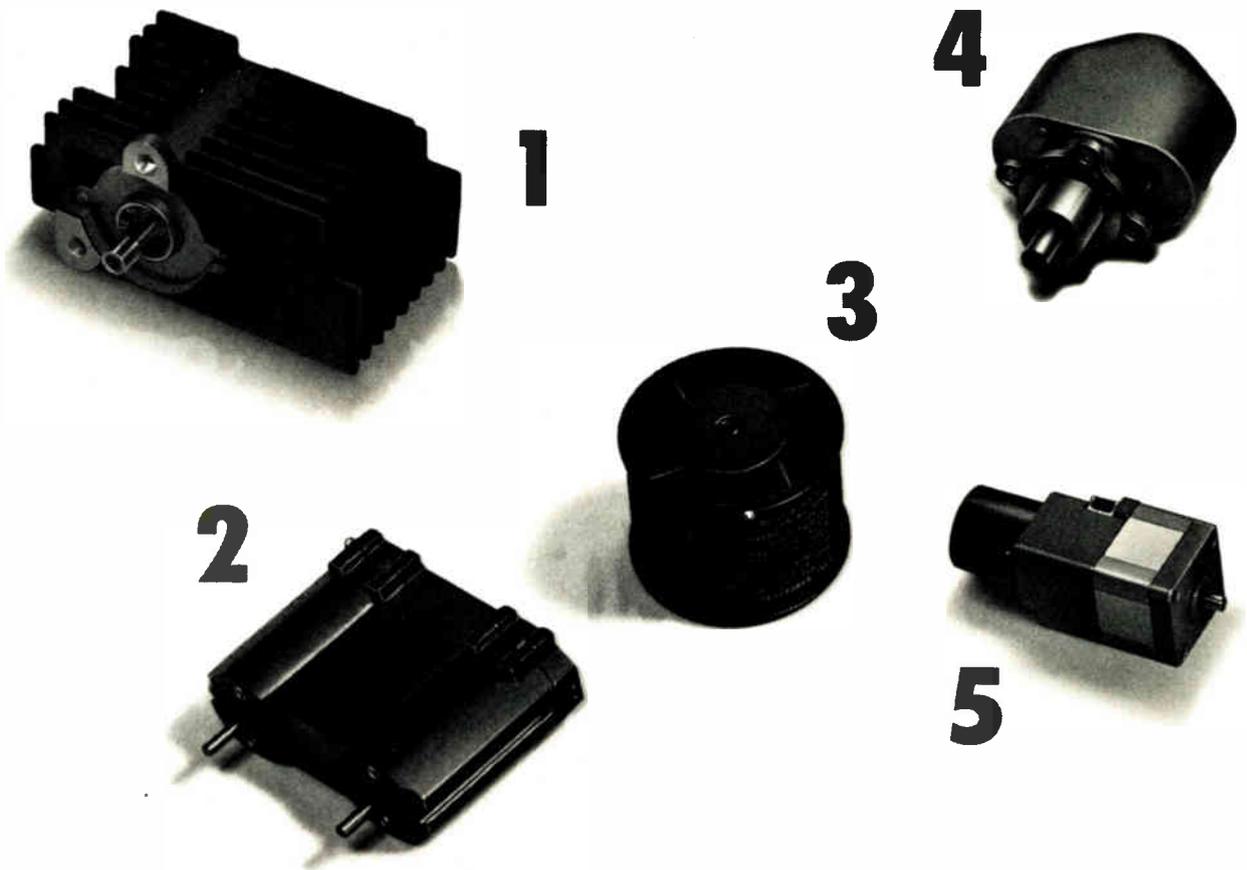
We've helped develop some of the industry's most sophisticated integrated circuits for high-volume production, including High-Density CMOS (CMOS utilizing two separate layers of interconnect) and precision Bipolar ICs incorporating high-value thin-film resistors.

If you feel your products might benefit from the application of these advanced techniques, you should know more about us. Give us a call or drop us a line today. Call, write, or circle reader service number 245 today. If we can't help, we'll say so.

MICRO POWER SYSTEMS

3100 Alfred Street, Santa Clara, CA 95050, Phone: (408) 247-5350, TWX: 910-338-0154
Japan: Yas Kanazashi, 21 Mori Bldg., 2-2-5 Roppongi, Minato-ku, Tokyo, Phone: 586-0471

Move your product with TRW/Globe



You can dramatically increase the efficiency of your powered product by asking TRW/Globe to combine multiple motion functions in one compact package, as you see here.

We'll not only get you maximum power per cubic inch; we'll eliminate the costs of second assembly and parts inventory. And we'll deliver your prototype in short order.

These examples demonstrate that, though there may be many manufacturers of motors, TRW/Globe has a unique capability to produce motion packages:

1. Integrally cast heat sink enables this high torque drive for a banking terminal carriage to operate

at 30% above normal power levels. Speed is accurately stabilized so system can operate open loop.

2. Cassette drive avoids assembly costs plus the problem of aligning the output shafts. Center to center distance on shafts is matched to standard Philips cassette.

3. TRW/Globe designed this blower to fit available space in an already-designed transceiver, and helped determine the system's air flow resistance.

4. Fin control motor for the Mark 46 torpedo operates in a "bang bang" mode, performs under severe environments, and has actually been reduced in cost since the 1960's.

more efficiently motion packages



5. Drive for a serial printer indexes the printing ball horizontally, provides feedback through a tach generator, and accommodates vertical indexing through the hollow shaft.

6. Fin control motor for the Standard missile performs under high impact loads, yet sells for 15-20% under the next bidder.

7. Torquer for the Maverick "super smart bomb" positions each axis of its camera platform and develops 17.5 in. oz./amp. Brake, slip clutch, and position pot are also in the same motion package.

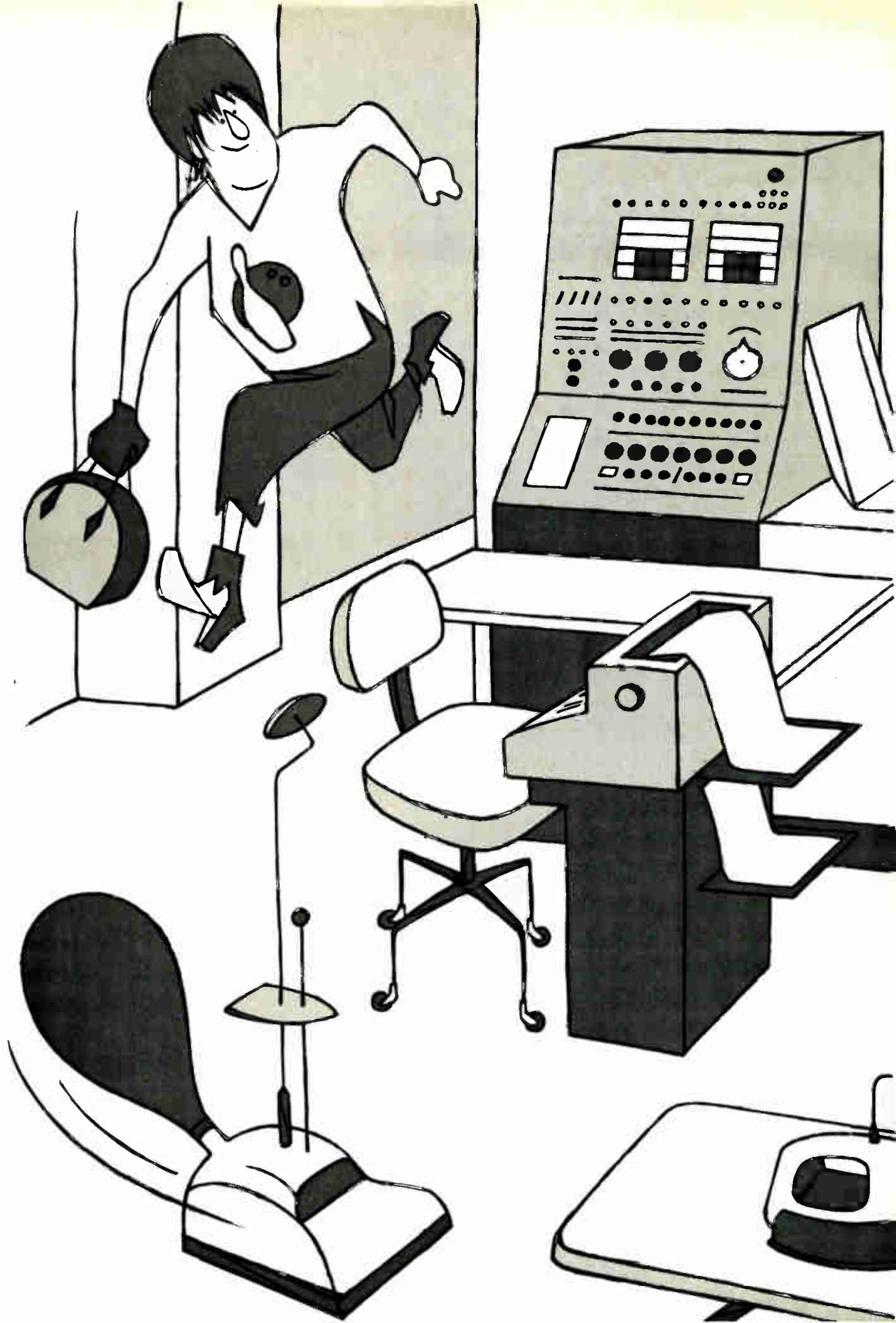
8. Rotary actuator for switching bands on a military transceiver includes motor, gearing, slip clutch, limit switches, and brake in minuscule space.

9. Drive for a computer tape reader assures smooth motion even though torque changes constantly. An encoder for the optical tachometer is part of the device.

10. In this drive for a facsimile scanner, hysteresis synchronous motors assure that both transmitter and recorder are synchronized.

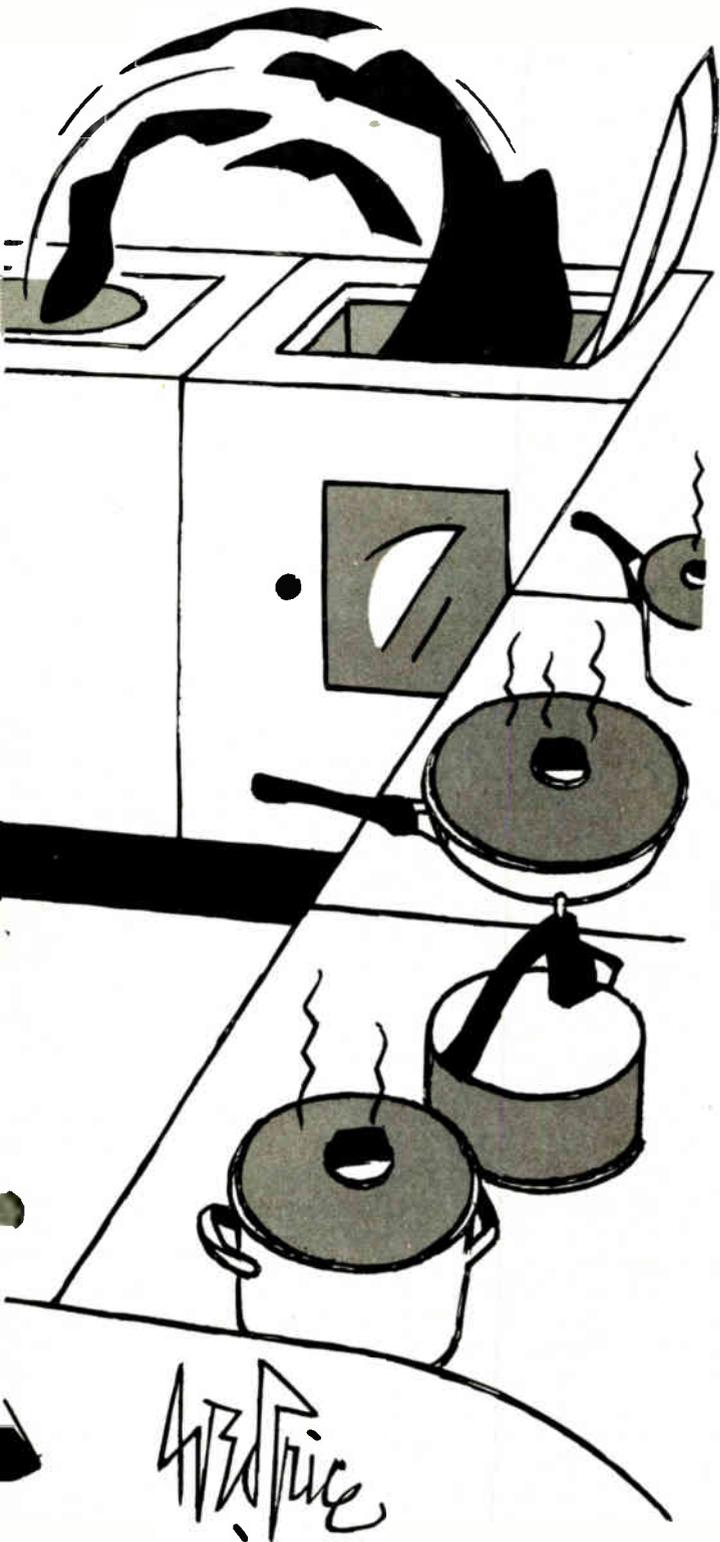
Think "motion packages" rather than motors, and call TRW/Globe Motors, an Electronic Components Division of TRW Inc., Dayton, Ohio 45404 (513-228-3171).

TRW GLOBE MOTORS



HOME SWEET HOME.

A new \$10-billion Electronics Technology Marketplace coming up?



Look twice.

Marshall McLuhan's Electronic Age complete with electronic home, is no longer tomorrow.

True, all the evidence is not yet in place.

But the state of our art already goes well beyond controls for major appliances.

Its fulfillment lies in total home-management/communications systems that will ultimately include functional takeover of:

- interior climate control
- fire, rain and intruder monitoring
- two-way participating entertainment systems
- shopping, billing and banking
- educational electronics

And, look for technology and the energy crunch to make the office-at-home concept a near-term reality.

A lot of systems engineering and marketing in residential design is what's needed now. And it's starting to take place. The catch is, many of your traditional customers in residential equipment will be the last to get the message. Remember the electro-mechanical calculator?

Your new customers, for the present, will be difficult to identify. But one thing is certain. Wherever they are, here and abroad, those who count will be scouring *Electronics* for technical and marketing ideas and new suppliers.

We're committed to accelerating the development of the Electronics Technology Marketplace for years to come. To become part of the exploding ETM, become part of "The Source." Where the market is being made rather than simply commented upon.

Electronics 
IS THE SOURCE. 

Need a highly stable function generator? Digital synthesizer? Digital phase generator?



Get all three in the GF106

which outperforms all others, while saving money in offering: Square, Sawtooth, Triangle, Squared Sine, outphased sine signals / Crystal-driven / Constant output level and phase throughout the range. / Three simultaneous outputs / Burst operation / Full programmability (option) / Automatic Frequency Scanning (option) / 0.001 Hz to 100 kHz Frequency Range. / Accuracy: 0.0001%.

AUSTRALIA : Warburton Franki, CHATSWOOD NSW
 ■ BELGIUM : F.R.T., LILLE ■ CANADA : I.R.C., SCARBOROUGH ■ DENMARK : Hans Orgreen, KROGSHOJVEJ ■ WEST DEUTSCHLAND : Enatechnik, HAMBURG ■ FINLAND : Nores OY, HELSINKI ■ GREAT BRITAIN : E.F.M. - Dynamco, ANDOVER ■ ITALY : Telav, MILANO ■ ISRAEL : Monsef, HAIFA ■ NETHERLANDS, Inelco, AMSTERDAM ■ NEW ZEALAND : AWA, WELLINGTON ■ NORWAY : Rodland & Rellsmo, OSLO ■ SPAIN : I.E.P., MADRID ■ SOUTH AFRICA : Hans Pollack, JOHANNESBURG ■ SWITZERLAND : Memo AG, ZURICH ■ UNITED STATES : New York (201) 673-2500, Philadelphia (215) 673-5600, Baltimore (301) 796-5600, Atlanta (404) 436-5169, Orlando (305) 894-9863, Huntsville (205) 837-5778, Seattle (206) 622-0177, San Francisco (408) 268-2600, Dayton (513) 252-5627, Chicago (312) 398-1420, Minneapolis (612) 925-1883, Dallas (214) 363-5291, Denver (303) 427-5299, Salt Lake City (801) 571-0129, Albuquerque (505) 281-5602, Phoenix (602) 939-6757, Los Angeles (213) 789-0418.

SCHNEIDER ELECTRONICS

3 Hazel Street Peabody, Mass 01960
 tel. : (617) 535 56 20

SCHNEIDER ELECTRONIQUE

MESURE - CALCUL - VISUALISATION
 27-33, rue d'Antony, 94150 Rungis, France.
 Tél. 686.76.10. Télex : SHNEDEL 20419 F

- West Germany 82*
- United Kingdom 85*
- France 88*
- Italy 90*
- The Netherlands 91*
- Sweden 92*
- Spain 94*
- Belgium 95*
- Switzerland 97*
- Denmark 97*
- Norway 99*
- Finland 99*



WESTERN EUROPEAN MARKETS,

THOUGH CLOUDED BY ENERGY CRISIS, MAY EXPAND 12%

Equipment markets should grow to just under \$18 billion in 1974, as consumer electronics still leads in the figures with \$6.4 billion in sales forecast; computers to climb most, up 16% to 5.7 billion

EUROPE'S MARKETS

□ Year-end celebrations are particularly pleasant for business forecasters, who usually have behind them the crucial job of predicting what's in store for the year ahead. This year, though, forecasters will be hustling back to their charts and computers almost before the last shout of Happy New Year dies out.

Last month's cutback of oil deliveries to Europe by the Arab petroleum-producing countries means that all economic forecasts for 1974 and the years after will have to be reworked. No one yet can really say how much the cutback in energy supplies will hurt business growth throughout Western Europe. Sound assessments can't be made until the Arab producers turn the oil back on with some sort of stability. Even then, there will be further puzzlement, particularly about how high prices will go for raw materials.

The direct effect of the crisis on electronics producers won't be as telling as the effects reflected back through their customers. There could be surprises, not all of them bad. Sales of color-TV sets spurted in West Germany in late November, and dealers say the cause was the ban on Sunday driving, which kept people home.

It will be months more, very likely, before the real impact of West Europe's energy troubles starts to surface. By and large, electronics companies will go into 1974 with substantial backlogs to bolster them, a vestige of this year's boom. Sales should stay high during the first six months. But as Jan F.G. Lamet, head of the planning department at Philips Gloeilampenfabrieken, pointed out even before the bad news about oil, "We are being very careful about the second half of 1974."

This fall, as usual, *Electronics* sent its reporters out through Western Europe to take its annual reading of the outlook for the year ahead. They came back with a forecast of just under \$18 billion for 1974 equipment markets in the 12 countries surveyed. If that's right, the industries' sales will wind up 12% above 1973's \$16 billion. However, the gain is not as impressive as it first looks—the market figures are bloated by the inflation that has distorted Western Europe's economies. Throughout this report, market sizes are based on factory sales prices for domestic equipment and cost-insurance-freight for imports. Dollar figures for both 1973 and 1974 were calculated at the exchange rates shown on the foldout chart.

Consumer electronics, as before, tops the list of money earners. Sales of TV sets, radios, and the like should run around \$6.4 billion next year. That's a rise of only 10% over this year's \$5.8 billion, and the reason is a calmer hue for color-TV sales. Last year, West Europeans bought some 4 million color-TV sets, shooting the market up better than 50%. This year's spurt will top 35%. Next year, color-TV sales will slow to a more "normal" 15% rise, according to the *Electronics* survey.

Computer makers now consider their cruising climb as about 15% a year. *Electronics'* forecast points to a slightly better increase in altitude than that: a 16% rise to \$5.7 billion (rentals are figured on an "if sold" basis). Minicomputer sales curves will show a much higher angle of attack, around 30% in some countries.

Attempts to pare down the massive market share of IBM in computers—so far of little avail—will no doubt continue. Unidata, the combine put together by Philips, Siemens AG, and the Compagnie Internationale pour l'Informatique, will go into the year bolstered by the X-0, the Unidata combine's first joint machine. Herman de Clerq, who heads the Siemens subsidiary in Belgium, maintains that "Unidata will have a multiplying, not just an additive effect."

Communications-equipment makers can count on a steady rise of about 12% to \$3.5 billion. As an executive at Philips Telecommunicatie Industrie puts it: "There's no way there could be a slump in telecommunications." Heavy spending for telephone networks is what's behind the rise. Most of the equipment money goes for cable, electromechanical switching systems, and subscriber sets. But the share for electronics grows each year. Sales of carrier equipment figure to get past \$900 million next year, and semielectronic switching systems are expected to climb to nearly \$200 million. Industrial electronics and instrument markets look so-so at best for 1974 in most countries. European producers will have to hustle harder than ever because dollar devaluations have made U.S. hardware highly competitive.

As for components makers, they've been running full blast all through 1973 and should keep up the pace for the next six months, at least. Delivery delays are stretched way out, and the order backlogs at some companies, in fact, add up to a year's output. Components makers, cautious about capacity, will be watching the moves of color-TV makers in West Germany and Britain very carefully to spot early signs of any possible implosion. All told, components markets covered by the *Electronics* survey add up to slightly over \$6 billion in 1974, a rise of 10% over this year's figure. Semiconductor sales passed the \$1 billion level this year and seem headed to \$1.26 billion in 1974, with integrated circuits contributing some 35% of the total.

West Germany

From Schleswig-Holstein to the southern reaches of Bavaria, consumers' purses are bulging as never before. But business in Germany has started to slow down in response to the anti-inflation program laid down this year by the coalition government of Chancellor Willy Brandt. Already, there've been layoffs in such key industries as textiles and building construction. Cutbacks in the length of work weeks have already started in some industries and there's even a threat of plant shut-downs in some cases. Above all looms the specter of an energy crisis.

There'll be a lot less bustle next year in the kingpin

This year's dollar is not the same as last year's dollar. What's more, changes in the dollar's value vary a lot from country to country. Straight comparisons between figures in this year's report with figures from previous years, then, are deceptive. Anyone who wants to make historical comparisons should convert estimates back into local currency at the rates listed on the charts.

WEST GERMAN ELECTRONICS MARKETS FORECASTS
(IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	5,421.4	5,958.5
Consumer products	1,982.3	2,159.1
Computers	1,847.0	2,045.9
Communication	837.6	925.3
Industrial electronics	436.5	470.2
Test and measuring equipment	131.6	139.0
Medical electronics	186.4	219.0
Components	1,998.3	2,165.0

Exchange rate: \$1 = 2.45 marks

entertainment-electronics market. "Spectacular" is how most radio and television set makers size up 1973 sales. Next year, most feel, business will be merely "good". The 1974 rating holds for communications-equipment makers and computer makers. Prospects for producers of instruments and industrial electronics, though, verge on "poor" and could turn out worse if the energy crisis becomes crippling. But all told, equipment-electronics markets in West Germany should add up to \$5.96 billion in 1974, according to the *Electronics* annual forecast, which is based on inputs this fall from dozens of West German companies. That's 10% more than the \$5.42 billion logged this year (throughout this report, dollar figures have been calculated on a single exchange

Throngs. Crowds at West Berlin's radio and TV exhibition check out latest consumer products, such as these Blaupunkt car radios.



rate for both 1973 and 1974: 2.45 marks to the dollar in the case of West Germany).

But the 1972 Christmas-buying binge will carry through 1973, anyway. West Germans this year have carted home more than 1.6 million color sets—roughly 400,000 more than last year. With that push, sales of entertainment electronics equipment surged to almost \$2 billion. For many a company, this has been the best year ever.

Things won't be quite the same in 1974, however. The pinchpenny mood that has caught on among many consumers is bringing an end to the ballooning growth of the past two years. Sales of entertainment electronics should rise roughly 9% to \$2.16 billion, *Electronics*' survey shows. At first glance, that doesn't seem too bad, but it's a far cry from the 18% growth realized this year, point out market watchers like Manfred Beinder of the ITT subsidiary Standard Elektrik Lorenz AG (SEL).

Color sets, as always, will be the mainstay. Marketing experts at companies like Grundig AG, Graetz GmbH, and Saba-Werke generally agree that between 1.8 million and 1.9 million color sets will be sold next year. That adds up to just over \$1.0 billion in factory sales—half the country's business in entertainment electronics.

It's still essentially a big-set, big-ticket market, but portable color receivers made their debut this year. Some 25,000 sets with screens of 14 inches or smaller were sold this year, estimates Wieland A. Liebler, marketing research manager at Saba. Next year's figure could go to 40,000, he says. Table models with screen from 20 to 22 inches also have found a modest market niche. Liebler thinks they'll go from 55,000 sets this year to between 60,000 and 70,000 in 1974.

As for the sets themselves, little that's startling is in view. Two main trends—more integrated circuits in receivers and more standard-size receivers with remote control—probably will continue during 1974. Controls with wires linking them to the set, though, may start to wane. Some 15% of sets in use now have them, and that is their saturation point, says Johanna von Ronai-Horvath, head of market research for Graetz GmbH and Schaub-Lorenz GmbH, both ITT companies. There's still plenty of market elbow room for ultrasonic controls however; they're still several years away from their saturation point of 20%.

Black-and-white set sales will backslide as usual, but not too much. The demand was unexpectedly high this year—some \$310 million worth. *Electronics*' survey pegs the 1974 market at \$292 million, down a scant 6%. What's keeping the monochrome business better than expected is mainly replacements. But "Gastarbeiter," the workers from abroad, are also keeping the market propped up. Saba's Liebler says that foreign workers this year bought more than 300,000 monochrome sets.

And radios are far from stagnant in most categories—table models, portables, radio recorders—producers anticipate rising sales. Stereo equipment and car-radio sales, particularly, will be strong. But manufacturers should forget about quadraphonic systems, though, until there's a common standard, and prices come down.

Next year, a new item will start tempting well-heeled West German consumers, when Telefunken-Teldec will kick off its video-disk system (TED). TED will retail for

EUROPE'S MARKETS

about half the price of a 26-inch color set in West Germany. Each TED disk, which carries 10 minutes of color programming will sell for \$4 to \$10, depending on number of copies made, royalties, artist fees, and the like. Initially, the TED system will be marketed only in German-speaking areas of Western Europe.

It's hazardous to say how big TED sales will be the first year, but for the long term, Telefunken officials predict TED sales will follow much the same progression as did color-TV sales. That would mean that, by the end of 1978 or so, about 10% of West Germany's roughly 22 million households will have TED players.

However, well before 1978, TED will be competing with Philips Gloeilampenfabrieken's video long-play system (VLP). The Dutch company presumably will have its video disk player on the market by the middle of 1975.

Computers cool down

"What's happening now in the German computer market is what's been going on in the United States for years," says Peter Feuser, marketing manager at Diebold Deutschland GmbH, the computer consultant. "The EDP business here has started to follow general economic cycles." Previously, Feuser maintains, computer makers could count on moving onward and upward almost regardless of general economic conditions. *Electronics'* forecasts reflect the changing character of the market. They put factory sales, with rentals counted as "if sold," at just under \$2.05 billion. That's 10% higher than this year's estimated \$1.85 billion, but well under the 15% or better growth that computer people consider normal.

The poorest performers among computers will be the medium-size machines. Many are losing out to intelligent terminals tied into large computers with monthly system rentals of 80,000 Deutsche marks (roughly \$32,000) or more. Small systems will do well, and sales of minicomputers figure to be brisk. Wilhelm Kister, a sales manager at Digital Equipment GmbH, predicts a 30% rise for minis next year. Along with established markets, minis are making headway in such new fields as production monitoring, plant-data collection, and environmental control. A market innovation next year in West Germany, Kister says, will be the application of minicomputers to control power distribution.

Producers of instruments and industrial-electronics gear face pretty much the same problems as general-purpose computer makers. Business men are cutting back on plant investments, and that points to a lean 1974. Dieter Gann, marketing manager for electronic instruments at Hewlett-Packard GmbH in Böblingen, predicts that the 1974 market will grow at 6% to 8%, a bit more slowly than this year's rate of 8% to 9%. *Electronics'* survey turned up a 1974 rise of 6% in the market for test and measuring equipment, up from \$131 million in 1973 to \$139 million next year. For industrial electronics, a gain of something like 8% seems likely. As for instruments, Günter A. Holzmann, assistant sales director at Rohde & Schwarz, predicts an above-average rise

for inexpensive equipment. Sales of medium-price instruments will stay more or less flat, he believes, and those of expensive systems will decline.

Strong call for communications

The 30 or so West German companies active in communications hardware have little to worry about next year. The post office, the largest single buyer of communications hardware in Germany, has yet to pin down a detailed budget for fiscal 1974. But officials at the Ministry of Post in Bonn say next year's expenditures for telecommunications should be "at least the same as this year's." Most equipment makers believe post office outlays for all types of communications will run 4% to 5% higher than the \$2.5 billion earmarked for 1973. In addition to the post office, there are other customers in both government agencies and the private sector. All told, communications-equipment makers can look forward to a market of \$925 million in 1974, according to the survey. That's 10%-plus over 1973's \$838 million.

In this near-billion-dollar 1974 market, such new-generation electronic telephone gear as computer-controlled exchanges and digital-transmission systems won't amount to much. However, the post office has an electronic switching system in mind, and the EWS-1 hardware is well along in development by a four-firm group headed by Siemens AG. Three EWS-1 systems should be ready for field trials next year. That puts the program behind schedule by as much as two years. "It won't be until 1976 or 1977," says a post office official, "that we will see the EWS in regular use."

Communications business is also coming from West Germany's Federal Agency for Air Traffic Safety, which is setting up a network of new radar stations for controlling traffic in the upper airspace. The big gainer in this project is AEG-Telefunken with its SRE-LL radar system. And 1974 communications business will also be coming from West Germany's Federal Railways, which is pushing expansion of its own radio links. These links, for communications between train operators and track-side control centers, now extend over several hundred miles of rail lines. The Railways wants to accelerate installation of systems along its right of way. Again, AEG-Telefunken is a major contractor in this work.

Smooth sailing for semiconductors

With the country's producers of consumer electronics geared up for merely a good year, West German components suppliers can't fare badly. The queues of customers clamoring for order allocations, though, should quiet down during 1974. And toward the end of the year, components salesmen may have to start hustling hard again. The market, according to *Electronics'* forecast, will edge up about 8% to a level of \$2.17 billion. This year's spurt, in comparison, was better than 20%.

Semiconductor producers figure to run well above the over-all 8% gain predicted for components. The consensus forecast sets the market at \$486 million, some 17% better than this year's figures. Many marketers expect more than that. Dirk G. Vogler, of Texas Instruments Deutschland GmbH, says there's been no appreciable letup yet in demand and that order backlogs for many devices still run three months and more. Vogler



Control. The third air-traffic-control radar installation in West Germany will eventually be hooked up to the Eurocontrol ATC system.

predicts that next year's semiconductor market will increase by at least 20%. For integrated circuits, *Electronics*' survey points to a 30% spurt next year, with MOS devices speedily gaining ground on bipolar devices.

One set of semiconductor customers to watch, everyone agrees, is the auto makers. But their business isn't piling in as fast as many had at first expected. Gerhard Liebscher, director of marketing services at the IIT-Semiconductor group's Intermetall GmbH, predicts the auto industry's 1974 semiconductor demand will rise less than 10% higher than this year's \$22 million. For one thing, Robert Bosch GmbH's new fuel-injection system requires only one third as many components as did its predecessor. For another, automobile production next year is expected to stagnate, or at best, rise only moderately. For the long term the auto industry's potential as a big semiconductor customer depends primarily on the Bundestag. If seat-belt laws and exhaust-emission standards go into effect, the West German automotive semiconductor market could well be worth \$160 million in 1980. If not, it'll barely be \$50 million, Liebscher says.

United Kingdom

Most Britons think, if you can believe the public opinion polls, that Prime Minister Edward Heath's Tory government hasn't done too badly at running the economy recently. The sentiment isn't surprising. More than anything else, it was British consumers who kept the country's economy expanding in real terms by some 5% during the first half of the year. Better still, the boom has at last spawned a round of plant investment.

All told, then, Heath's statisticians should get above \$150 billion for the country's gross national product for

1973. Nominally, this figure is some 15% over 1972's GNP, but only 3% to 4% of the rise is real expansion.

A round of plant investments generally keeps a country's economy headed upward for at least a year. But there's turmoil around the world, and British business depends heavily on international trade. Worse, the energy and raw materials Britons need to keep their economy humming are largely imported so that, for instance, if the Arabs throttle the flow of oil to Europe, Britain's should-be expansion next year won't be.

But if there's a return to normalcy in oil supplies, Britain can count on something like a gain of 3% of 4% again next year, plus a generous dollop of inflation. And the country's electronics markets should move up a little more than 10% to \$3.23 billion, according to *Electronics*' annual survey. Entertainment electronics, still far and away the biggest sector, figures to turn a little lackluster in 1974. But computer makers have a surge in sight, the survey shows, and industrial electronics producers could mark up their best gains in years. (Nearly all the inputs on which the forecasts are based, it must be pointed out, predate the year-end energy crisis. And throughout this article, market sizes in dollars are based on a constant rate of \$2.45 to the pound sterling.)

Color it how?

Television set makers will have much to party over at year-end. They've had a sensational year: some 2.6 million color-TV sets went into the hands of consumers or the rental companies that dominate the market. In money terms, the year's spurt was a breathtaking 40%, to \$857 million from last year's \$600 million. In late fall, to be sure, concern arose over the considerable stocks the rental companies had built up. But set makers nonetheless expect they'll need their second wind in 1974. Factory sales of color-TV sets should edge up slightly to just over \$900 million, according to *Electronics*' survey.

Although they still have a whopping home market to carry them, set makers will start significant switches in color technology next year. So far, Britain has been the last bastion of the big 90° picture tube. But the 110° tubes common on the Continent will start turning up in U.K.-made large sets in 1974. All makers except Pye Ltd. are starting 110° production with top-of-the-line 26-inch sets and will follow with 22-in. versions later. At Pye it's the other way around.

So far, all tubes smaller than 22 in. have been imports, but later in the year Thorn will start making RCA's 90° precision in-line tube in a 20-in. version for new small British sets. This should help domestic manufacturers break the stranglehold that Japanese producers have on the U.K. market for small color sets. This year they landed 275,000 sets, and next year Sony plans to produce 18-in. transistor sets in Britain.

Turning from tubes to chassis, the number of integrated circuits in sets is creeping up. Philips Electrical Ltd. has 10, Thorn has nine, and the average is seven or eight. Most chips are industry standards, but some are specials. A strong move to thick film is also evident.

To no one's surprise, big-set black-and-white TV sales continue to backslide. But portables are holding their own wonderfully well, and so the monochrome market's decline next year won't be too bad: a slide to \$122 mil-

EUROPE'S MARKETS

lion from this year's level of \$142 million. Technologically, the monochrome event of the year looks like the mid-1974 debut of a 2-in. pocket set with all circuitry integrated. The pioneer here is Sinclair Radionics Ltd., best known for its pocket calculators.

Tuning out television, the entertainment markets most likely to succeed in 1974 are "unit audio"—hi-fi and mid-fi if you prefer—and car tape players. John O'Neill, marketing director of Pye Ltd., estimates audio sales at around 1.9 million units next year, up from 1.7 million this year and 1.0 million last year. Philips marketing men expect automobile tape players and radio/players in 1974 will bounce up to \$66 million from this year's \$46 million. In contrast, the market for video playback units continues to dawdle.

Computers follow orders

United Kingdom computer makers went into 1973 convinced they'd make a comeback after the 1972 slump. And they did. An upturn in orders across the board this year indicates a bulge in deliveries next year. *Electronics'* survey pegs the data-processing market, including electronic calculators, at \$715 million, up 17% from the estimated 1973 level of \$612 million.

Computer makers next year will deliver a good part of their hardware to new users who are taking complete new systems. But undoubtedly the big money will come from upgradings of existing systems. That points primarily to a pickup for peripherals—more data-storage gear, particularly big packs of 50 or 60 megabytes; more data entry and display systems, with video terminals gaining on teletypewriters; and more key-to-disk equipment. Minicomputers or even additional central processors are being tacked on more and more to handle the housekeeping in large data-processing systems.

Perhaps more important for the long haul, a trend toward building systems around multiple minis instead of a single processor of equal power may have started. At London's Gatwick Airport, for example, baggage and passenger movement is controlled through two Arcturus minis in parallel. One, with 32 kilobits of main memory and disk, handles the housekeeping, while the other, with 8,192 bits of memory, processes the data and controls the peripherals. Each machine has its own backup, an expensive-looking proposition at first

glance. A closer look, says Arcturus sales manager Roger Deakin, shows that four minis are cheaper than a single big machine and much easier to program.

Minis are also moving in on conventional numerical-control systems for machine tools, reports Dave Seale, managing director of Micro Computer Systems Ltd., makers of the Minic computer. Seale maintains that computer control is actually cheaper than conventional NC for all but simple two-axis applications—and adds that his business is trebling annually.

Business is booming for calculator makers in Britain, too. Soundest segment is the relatively simple office desk calculator, priced at \$200 to \$400. "A year ago a company bought one per office," says a distributor of Hitachi machines, "now they buy one per desk." The Japanese companies, first into the market, lead the field, but there'll be room for everybody through 1974.

Meanwhile, producers of point-of-sale equipment hope to boost the number of their points of sale. Most installations in Britain so far are for evaluation, but equipment makers expect to see some full-fledged schemes going into service next year. American companies like Pitney Bowes, Singer, and NCR will provide almost all the hardware, but a simple British electronic terminal from Gross Cash Registers Ltd. also will be among the contenders.

Industry's ups and downs

Industrial electronics producers, who in recent years have envied the giddy rise of the entertainment electronics sales figures, can now look with some satisfaction at their sales curves. The upturn this year was marked, and until the energy crisis threatened, they had prospects of a further gain of about 14% for 1974. *Electronics'* survey, made in the fall, pegged this year's market at \$168 million and forecasts a rise to \$193 million.

The market won't get anywhere near that, of course, if the Arab countries cut oil supplies for any length of time. But oil or no, the expected pattern of industrial-electronics markets for 1974 should hold. Since big-system users like steel makers and oil companies won't be buying much, the growth will come from smaller installations. Honeywell Ltd., for example, says its industrial-control systems in Britain usually cost customers less than \$250,000. The company's controls business shot up 20% this year and seems poised for a further 25% gain next year. Working, too, in the favor of industrial electronics producers is the pervasiveness of their technology. Electronic controls pop up all the time where they never were before on production machines.

Instrument makers have been having it better in 1973, too, after two poor years. Just about all categories of test and measuring instruments moved up this year, and the sector overall should gain a modest 8.5% next year to carry the market to \$90 million. Instruments used mainly in production and maintenance figure to sell better than those most often found in laboratories. And almost certainly sales of automatic test equipment (TE) will spurt. Marconi Instruments, one heavyweight in the field, says its sales of ATE gear tripled this year, and none of Marconi's competitors admits to less than 50% growth. The market is mainly for tape-controlled checkers of printed-circuit boards for industrial and

BRITISH ELECTRONICS MARKETS FORECASTS
(IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	2,940.9	3,233.9
Consumer products	1,475.1	1,590.6
Computers	612.2	715.2
Communications	578.8	619.0
Industrial electronics	168.0	192.7
Test and measuring equipment	83.4	90.0
Medical electronics	23.4	26.4
Components	1,148.9	1,250.3

Exchange rate: \$1 = 41 pence (£1 = \$2.45)



Rolling out. First of 35 transportable electronic telephone exchanges left Plessey this year for delivery to the British Post Office.

communications equipment. But gains are also in store for computer-based systems that can wring out avionics and complex military gear. Marconi-Elliott Avionic Systems, British Aircraft Corp., Hawker-Siddeley Dynamics, and Honeywell are the main purveyors here.

As always, communications-equipment makers can count on hefty, steadily rising spending by the British Post Office to keep them in bread and butter. There's a big pot of jam to go with this in the current boom for mobile radios, and added sweets will come from avionics, radar, and space markets. Altogether, it comes to \$579 million this year for communications and \$619 million next, according to *Electronics'* survey.

In the bread-and-butter sector, something like \$50 million went for semielectronic telephone switching equipment this year, and close to \$60 million is earmarked for 1974. A good part of the gain will come from increasing production of TXE-4, the new semi-electronic large local exchange. TXE-4 uses reed-relay switches with hard-wired logic control and core storage. The bulk of remaining electronic switching investment is in TXE-2, the established small local exchange.

Some \$70 million will be spent on expanding cable and microwave trunk transmission facilities. The outlay includes the cost of the first 100 miles of 60-megahertz, 18-pair coaxial telephone line between Birmingham and Manchester. In the spring the newest and largest transatlantic cable, Cantat-2, will start operation, and by year-end, capacity of the 30-mile microwave link to France will be almost doubled to 3,800 channels.

Meanwhile, the mobile-radio boom goes on, and engineering effort is concentrated on easing production problems. To this end, Pye Telecommunications Ltd.'s new receivers will be built of modules that plug into a motherboard, eliminating most soldered connections. It is also probable that digital techniques for automatic routing and classification of messages, already being tried by the police, will be taken up more widely.

Avionics makers are reasonably happy about next year, in spite of Concorde's doubtful prospects. Unexpected orders from China for Hawker Siddeley civil

transports, production of Jaguar fighters, Nimrod maritime patrollers, Harrier vertical-take-off strike fighters, and various military helicopters will keep existing avionics lines rolling. Enough development work is around, particularly for the projected British-German-Italian multirole combat aircraft (MRCA), to keep R&D teams occupied. Some of the R&D breaks new ground, in digital controls for engines and autopilots, fly-by-wire controls, and frequency-agile long-range marine search radars, for example.

For radar scanner makers, the home market will continue much as this year. That means a steady military workload, mostly transportables and missile controllers, plus routine updating of the civil network. Event of the year will be a new private-venture 3-d radar system from Plessey Co. And, of course, installation and commissioning of the big IBM 9020-D-based air-traffic-control system at London Airport will continue.

In space, a lot of activity will occur early next year: in January the first British-built military satellite, Skynet II, will be launched, in February, a technology satellite and in March a scientific satellite will follow. Skynet builder Marconi Space and Defense Systems Ltd. has a backup vehicle to work on, and there's another scientific satellite on the drawing board. But next year will see the British space effort diverted increasingly into European projects not yet well-defined.

Curious conditions for components

Components makers in Britain don't expect they'll have any trouble next year finding buyers for all the products they can turn out. Even if color-TV makers merely keep working at their 1973 level, which they actually plan to surpass, their suppliers probably won't make much progress in cutting down the present dangerously long delivery times—dangerous because profits fall when prices are negotiated months before delivery and material costs skitter up meanwhile. But ambitious investment to increase capacity may turn out a mistake in a few years' time.

The market, though, is there. *Electronics'* survey

EUROPE'S MARKETS

shows 1974 sales rising to \$1.25 billion, an improvement of 11% over the estimated 1973 market of \$1.15 billion. As elsewhere, semiconductors will move up sharply. The forecast for discretely tops \$150 million, with integrated circuits adding another \$100 million. Hybrids now are turning up in all sorts of mass-produced equipment, producing a market growth of 20% to 25% yearly.

High growth is also on tap for MOS memories. Next year, Britain's leading computer maker International Computers Ltd. (ICL) will for the first time build more main store in MOS than in cores. Also expanding fast: consumption of calculator chips and LED displays. Complementary MOS, too, should appear in industrial and communications hardware next year.

France

French industrialists are hailing 1973 as a vintage year. And the word from the boardrooms of France's electronics producers about this year's results is just as enthusiastic. As they drove into the last quarter of the year, Thomson-Brandt, the country's largest electronics maker, announced that sales were running 25% ahead of 1972. Down to the smallest companies, it's been mainly a year of coping with bulging order backlogs.

This year's business boom in France has proved so strong, in fact, that it surprised even finance minister Valéry Giscard d'Estaing. His planners had plotted a 6.6% growth in real terms for the year; the actual figure will run just under 7.5%—more growth than the economy can safely handle. So for 1974, d'Estaing wants to hold growth of the GNP down to 5.5% and cut the rise in retail prices to 6.7% from this year's 7.7%. The flexible price controls in effect this year could well stiffen into price freezes for consumer durables like TV sets and radios. Other threats come from the possibility of strikes and work slowdowns and, above all, the oil crisis.

But as long as business conditions stay reasonably normal, the electronics industries have the promise of two good years back to back. Almost nothing can check the fast rise of color-TV sales. Plant investment is on the rise, and new plants these days are larded with electronics. Finally, there's no end in sight yet to the heavy spending the government has pledged to upgrade the telephone network. All told, then, French electronics markets could move up nicely to \$3.34 billion next year, a solid 15% above this year's \$2.91 billion. (These forecasts are based on *Electronics*' annual survey, made in the fall. Dollar figures for France for both 1973 and 1974 are calculated at 4.30 francs to the dollar.)

Concern about components

A paradox exists in the prospects for components. Next year's market is poised for a satisfying 11% boost to \$1.15 billion, *Electronics*' survey suggests—but many suppliers are uneasy about late 1974. Delivery times are stretched out as never before. For example, Olivier Garreta, managing director of Thomson's Sescosem semiconductor division, explains: "Last year we could deliver within six to 12 weeks. Now, deliveries are up to

five or six months and even longer—up to nine or 12 months in some cases."

Such delivery delays are doubly dangerous. They tempt equipment producers to double or even triple orders, and that tempts components suppliers to add capacity to handle business that really doesn't exist. Then comes overcapacity, and, should a major market start to sag, oversupply could be followed by chaotic price cutting. It happened in 1971, and it could happen again. "Color-TV sales in Britain and Germany are rising at a rate too fast to last, and when they slow, there will be problems," warns Raymond Genêt, economic studies director at RTC-La Radiotechnique Compelec, a company in the Philips group. Genêt foresees a danger in a sudden flood of components into France if British or German color-TV set makers run into setbacks.

Technology also contributes to the roller-coaster effect. French set makers this year switched massively from the old 90° color tubes to 110° tubes, which need more complex deflection circuits. What's more, to make sure their new chassis would work right, set makers played it safe and designed lavishly with passive components. That, to a considerable extent, is what's behind the spurt by passives this year, say Jean-Philippe Dauvin and Jacques Lorre of the Bureau d'Information et de Prévisions Economiques (BIPE). But as color-TV set makers trim their designs, the market for passives should grow only about 10% in 1974, they add.

Semiconductors, to no one's surprise, are expected to fare better. *Electronics*' survey spots the market at \$212 million, up a satisfying 16% over the 1973 estimated market of \$182 million.

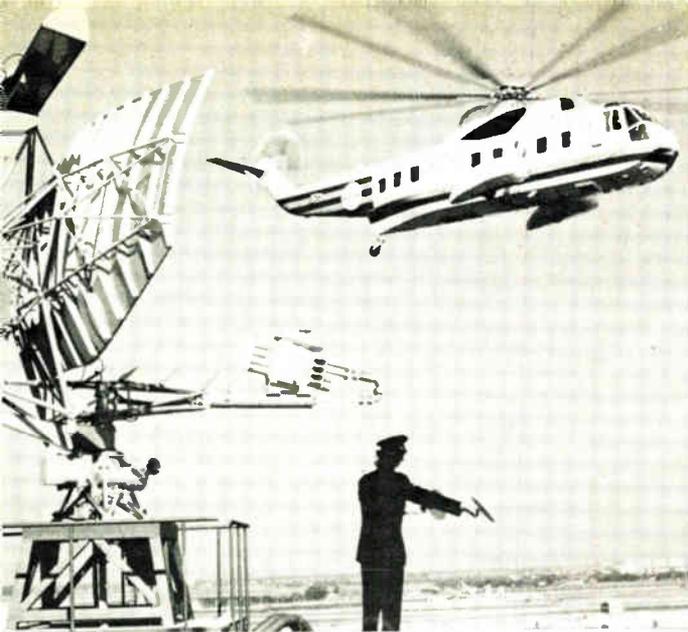
There's controversy, though, over how discrete devices and integrated circuits will share this total. The survey predicts a gain next year for discretely of 8%, lifting their market figure to \$126.5 million. As Sescosem's Garreta says, "Products like power diodes, thyristors, and power transistors are just as strong as integrated circuits." RTC's Genêt, however, won't be surprised if sales of discretely level off—or even drop—next year, while ICs soar some 30%.

Whatever happens, set makers should continue to be voracious consumers of components next year. They have turned out some 650,000 color receivers this year and may get past the 900,000 mark next year—in money, a leap up to \$372 million in 1974 from this year's estimated \$302 million—and have at least another two or three years before they'll have to worry about

FRENCH ELECTRONICS MARKETS FORECASTS
(IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	2,907.0	3,336.4
Consumer products	839.5	942.3
Computers	964.7	1,122.5
Communications	756.9	884.4
Industrial electronics	153.3	175.1
Test and measuring equipment	109.4	120.0
Medical electronics	83.2	92.1
Components	1,034.7	1,154.1

Exchange rate: \$1 = 4.3 francs



Landing. Airfield radar system is one step in Thomson-CSF's move away from dependence on military orders and toward civil market.

saturation. That's good because the other two key categories in entertainment electronics look sluggish. Black-and-white TV sales will edge off slightly from this year's \$160 million, and radio sales hover around \$133 million both this year and next.

Computers: programed for growth

Ostensibly, the computer market is set for another year of solid growth. Before the oil crisis, market experts figured there'd be a spurt of at least 15%. *Electronics'* survey puts the gain at 16%—to \$1,123 million from this year's \$965 million. Maxime Bonnet, marketing director at Honeywell-Bull, predicts the greatest growth will come from the top and bottom of model ranges. Terminal sales, as elsewhere, are rising above the average.

If there's a downturn, however, the newly launched Unidata triumvirate of Philips, Siemens, and France's own *Compagnie Internationale pour l'Informatique* (CII) may suffer most. Unidata is strongest in the weakest-looking area of the market—medium-size machines. What's more, the Siemens machines are hampered by their Deutsche-mark price tags, which makes them expensive in France. The German machines, nonetheless, have been a mainstay for Unidata so far in the French commercial market. (CII, of course, has a preferred position for government business.)

Point-of-sale equipment is also beginning to take off. Recently, Singer Business Machines sold \$6 million worth of electronic terminals and small computer systems to the *Nouvelles Galeries* department-store group. The Carrefour hypermarket—supermarket-type shopping center—chain has ordered about \$400,000 of similar equipment for a new center opening next June.

Like the country's set makers, France's communications-equipment producers can count on a solidly propped market for the next few years. The Ministry of Postes et Télécommunications, which runs the country's telephone system, this year budgeted about \$9 million for experimental electronic and semielectronic exchanges. Next year, the figure will be doubled. In 1975, some 5% of the budget for exchange hardware will go for electronics, and by 1985, the split should be half for



Lined up. Ready to battle Philips, Thomson-Brandt, and ITT, Grundig color-TV sets await assembly at company's new French plant.

electronics and half for conventional crossbar gear.

Meanwhile, as the switching bonanza builds up, there are other nuggets to be panned. Edouard Guignonis, sales director for Thomson-CSF, notes a new flurry in microwave links in France. Usually, the company exports about 90% of its microwave sales. Next year, thanks to orders from the P&T and the state-run broadcasting organization ORTF, the split will be 50-50.

But that is only a minor part of Thomson-CSF's business. The company's mainstay is military electronics, where real growth is nil, or next to it. Henri Batlle, who heads up the economic studies section for the *Fédération Nationale des Industries Electroniques* (FNIE), predicts the rise of military markets at 7% to 10%. Christian Loeffler, though, points out that inflation sops up at least 7% of any nominal growth in military business. Loeffler is director of electronics and radar activities at the ITT subsidiary, *Le Matériel Téléphonique*.

The avionics makers can no longer count on much of a lift from civil-aircraft programs. They had high hopes that the supersonic transport Concorde, the short-haul Mercure, and the medium-range A-300 Airbus would bring new business to offset slowing military orders. But Concorde may have had its *coup de grace* from the Arab oil producers and dwindling value of the dollar has made U.S. aircraft too much of a bargain for airlines to buy the Mercure and the A-300.

The outlook for military-equipment makers is not wholly bleak, nonetheless. There is growing talk in Paris of a new ground-to-air missile to match the Soviet SAM-6, which has proved so successful in the latest round of the Middle-East war. But it will no doubt come too late to help 1974 business. Too late also will be the new French fighter aircraft—the so-called ACF (*avion de combat français*)—and the RITA computer-controlled tactical battlefield-communications system, which should provide big contracts when production starts in 1976 or 1977.

But Thomson-CSF and the other big electronics firms in France obviously can't prosper on military business alone. All are looking for new markets. Guignonis points to road-traffic control and visual teaching aids as two of

EUROPE'S MARKETS

many sectors where his company has hopes. One of the major obstacles to quick development is the propensity for long bureaucratic wrangles between government agencies over who should handle the development. "The Ministry of Education has not even got to the budget stage yet," says Guignonis of the chances for teaching aids.

Both Thomson-CSF and Electronique Marcel Dassault (EMD) have great expectations for the traffic-control market. They are looking for sales of TV cameras, traffic-counting sensors, and information-display systems, together with computerized control and monitoring systems. But the 1973 government budget for the sector was only \$12 million, and it still remains to be seen how much of the nearly \$550 million allocated for next year's superhighway program will go to electronics.

Meantime, Thomson-CSF will joust with LMT in the brand new market for car telephones. Paris will have about 5,000 lines open by the end of next year, and similar radio systems will be installed in the major provincial cities. Selling at around \$2,500 each, the units are good business if the companies can persuade the P&T to offer them enough lines.

Italy

During 1973, a sweet smell of success reminiscent of the "miracle years" wafted through the Italian economy. It now seems as if the country's output of goods and services will add up to \$114 billion for the year, better by slightly more than 5% in real terms than the 1972 result.

The "Autunno Caldo" of 1969 ended the miracle, and an "Inverno Freddo" caused by the West European energy shortage could possibly jell next year's growth. However, if Italy's volatile labor force erupts in a rash of strikes, the upturn will evaporate. Even so, business has been so good this year that economists with an optimistic bent say that growth of the gross national product can continue to be good next year.

The look-good economy has rubbed off onto the electronics industries, to be sure. This year's markets for assembled equipment reached an estimated \$1.12 billion according to *Electronics'* annual survey. The 1974 level is pegged at \$1.29 billion. Unless the economy falters, computers—particularly small computers—should do

very well. Telecommunications-equipment makers are headed for steady growth as usual; components makers will be all right as long as the color-TV boom continues in other countries. But, since color has yet to come to Italy, no further explanation is needed as to why entertainment electronics is the suffering sector.

(All forecasts in this article are based on inputs received mainly before Arab producers began cutbacks in oil deliveries. Dollar figures for both 1973 and 1974 were calculated at a rate of 565 lire to the dollar.)

Call for communications

"As long as people keep dialling telephones, the telecommunications market will grow," asserts Aldo Calderelli, vice president, Europe, for General Telephone & Electronics Inc. Only 18 Italians out of 100 have telephones so far, so there's a lot of market left. The goal is to get the waiting list down to less than 200,000 subscribers, at a rate of 1 million new lines a year. But SIP, the government telephone agency, is three or four years away from that goal; to reach it, the agency has to spend nearly \$6 billion in the five years ending 1977.

Not all the customers are splurging like SIP, but communications-equipment markets are expected to total \$268 million next year, up some 14% over the estimated \$230 million for 1973. The gains aren't across the board, however. Paolo Mastalli, who works in the planning department of Telettra S.p.A., points out that the 14% to 15% increase in orders for carrier equipment usual in past years now is falling off to about 5%.

The big money is still going for electromechanical crossbar equipment, but semielectronic exchanges are starting to find a market. This year's deliveries were something like \$8.8 million, and the figure next year should go to \$15 million. The big jobs at the moment are a Metaconta exchange in Rome by ITT's FACE-Standard and an AKE-13 in Naples by LM Ericsson. SIP, which also has begun experiments with a fully electronic small exchange, hopes to have several hundred lines in trial service next year.

Broadcast-equipment producers, though, are still waiting for a call from the official radio-TV organization, RAI. From \$56 million in 1967, RAI's outlay for equipment dwindled to \$10 million last year and something like \$5 million this year. When RAI gets straightened out, look for some big catch-up spending. Pierluigi Parola, who's responsible for telecommunications at CGE-FIAR, says RAI will have to spend some \$3.5 million merely to replace obsolete low-power repeaters.

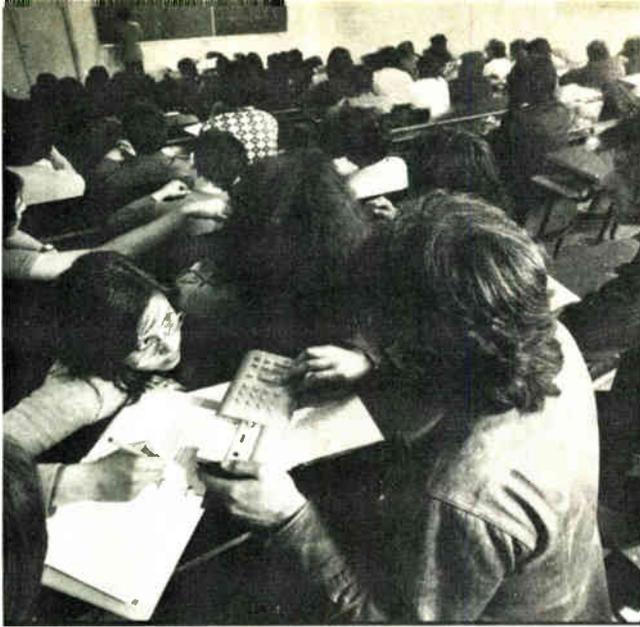
Military markets leave much to be desired, too, since the government is squeezing its budget. Avionics producers will benefit next year from a scheduled build of 40 F-104 Starfighters. They'll help sustain the Italian air force until deliveries start on the multirole combat aircraft (MRCA), now being developed jointly by West Germany, Great Britain, and Italy. Military business still dominates at Selenia S.p.A., the Italian heavy-weight in marine radar, air-traffic control, and weapons systems. But the company's sales of telecommunications and automation hardware are stepping out 25% yearly, a little more than twice the growth rate for military hardware.

Italian computer makers have been finding new cus-

ITALIAN ELECTRONICS MARKETS FORECASTS
(IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	1,120.3	1,288.0
Consumer products	259.2	280.6
Computers	451.3	539.6
Communications	230.2	267.6
Industrial electronics	104.3	114.0
Test and measuring equipment	39.8	45.9
Medical electronics	35.5	40.3
Components	337.1	381.4

Exchange rate: \$1 = 565 lire



In print. Olivetti counts on bolstering its already strong "professional" calculator position with electrostatic-printout models.

tomers this year almost as effortlessly as the pigeons in Milan's famed Piazza del Duomo find tourists to throw them peanuts and corn. And since sales to established customers haven't been bad at all this year, the market bounced up to \$451 million, according to *Electronics'* survey. This fall, before the energy crisis made any sort of prediction hazardous, the 1974 market seem poised to spurt another 20% to \$540 million.

The new customers flocked in largely because the government initiated an added-value tax (IVA in the Italian acronym) in January. Renato Levrero, a market researcher at Honeywell Information Systems Italia, predicts that at least 500 new companies will come into the market next year. And, says Geoffrey Marshall, who distributes Datapoint products in Italy, "Business is so good that right now, a large sales force is probably more important than the price of the computer."

Although he doesn't gainsay the success of mini-computers, Lorenzo Bosio maintains that big computers are doing well, too. Bosio, commercial director at the Univac division of Sperry Rand, says big-machine sales are coming from a change in the market structure.

For calculators, though, the question is still how fast. And the answer is fast enough for solid growth. Up north in Ivrea, where Ing. C. Olivetti & Cie. is headquartered, desk calculators are considered a booming field. *Electronics'* survey backs up the view, predicting a rise in electronic machines next year to \$66 million from this year's \$58 million. Olivetti has about three quarters of the Italian market for "professional" desktop calculators and expects to strengthen itself with a couple of new four-function machines introduced this fall. Along with a striking design, the machines have an unusual electrostatic printout. Marisa Bellisario, who heads the company's planning department, says, "Nineteen-seventy-four will be our year to introduce new systems." Olivetti is well along in development with a whole family of business-oriented computers—terminals integrated with accounting computers—based on MOS technology. The first two models will make their debut in 1974, and the rest of the family will follow in 1975.

Like suppliers throughout Western Europe, the im-

mediate problem for Italian components makers is simply filling orders. Most have order books that will carry them well into 1974—if not all the way through. "Orders for some discrete devices for 1974 have recently been doubled," reports Sergio Minoretti, marketing vice president at General Instrument Europe. If there's no hitch, components sales in Italy next year should bounce up some 13% to some \$381 million, according to *Electronics'* survey. The telecommunications producers continue to absorb a lot of expensive components, and there's a considerable rise in sight for production of color-TV sets—nearly all of them for export.

That's what has suppliers anxious. If the color markets start to sag in West Germany and Britain, the Italian components industry will be doubly hit. Their direct sales to set makers abroad could plummet, and so could their sales to set makers producing for export. But with the left-wing parties now so vociferous an element of the Italian political scene, the chances for color TV look exceedingly slim.

Meanwhile, SGS-ATES, doubled its diffusion capacity this year, and now it plans to triple it. The company has already begun to manufacture the first of a range of some 60 COS/MOS devices, second-sourcing RCA's series.

The Netherlands

In the tulip-bulb auctions at the town of Hillegom on the North Sea Coast some 16 miles southwest of Amsterdam, the auctioneer has a sort of clock that he sets at an impossibly high price for the lot of bulbs he's selling. Then he starts the price-clock counting down. The winning bidder is the first person who signals that he'll buy at the price then showing on the clock.

Dutch economy watchers face a roughly similar situation in figuring how much the country's output of goods and services might grow next year. This year, the GNP bounced up 13% nominally, but that figure must be slashed down to 5% to account for inflation. At year's end, the outlook for 1974 was a slowdown to 4% in real growth. But until they have time to assess the full impact of the oil crisis—the Arab producers slapped a boycott on crude-oil shipments to Holland last month—a lot of economists have started their growth clocks edging downward. Until the oil starts flowing back into Rotterdam, no one knows where to stop the clock.

It will take a while for the energy crisis to work its way back through the economy. Before the crisis clouded their crystal balls, Dutch marketeers foresaw a good year ahead. Very strong markets in computers and communications equipment, coupled with continued high sales of color-TV sets, pointed to a gain of better than 15% in factory sales of electronics equipment. The figures from *Electronics'* survey: \$750 million this year, \$878 million in 1974. (All dollar figures in this article were calculated at an exchange rate of 2.45 guilders to the dollar. Inputs on which estimates are based predate the oil boycott.)

It's no news that for Holland the term "electronics industries" and "Philips Gloeilampenfabrieken" are almost synonymous. So there's no question about where the big orders are going for new-generation telecommunications hardware, which sizes up as the fastest-

EUROPE'S MARKETS

growing major market for electronics in the Netherlands next year. *Electronics*' survey predicts a 30% spurt to some \$112 million. William Scherer, who handles relations with industrialized countries for Philips Telecommunicatie Industrie BV in Hilversum, says he sees no way that there could be a slump in telecommunications in Western Europe. That view is doubly true for Holland.

Up at the North-Holland hamlet of Burum, a 93-foot Intelsat antenna dish shares a pasture with the cattle. An observer might conclude that inauguration of the Intelsat-4 ground station in September by Queen Juliana was the big event this year for Dutch telecommunications.

But much more important for the long run was a letter that the Netherlands Postal and Telecommunications Services put out in May. It flatly states that from now on the Dutch network will order stored-program control (SPC) exchange equipment as much as possible. That means a flood of orders for Philips PRX exchanges, which the Dutch post office has made the standard for local exchanges of 2,000 lines or more "in large areas of the Netherlands."

The post office cut over the first PRX exchange in Utrecht a little over a year ago. By 1976, the agency expects to have 500,000 lines working through 75 PRX exchanges; by 1980 the total should be 200 exchanges. At roughly \$200 per line, it adds up to a lot of market. And there's more in sight. The post office plans to move to fully electronic time-division/pulse-code-modulation (SPC-TDM/PCM) trunk exchanges in the 1980's. The first trial exchange should be ready by 1975.

It all adds up to admirable long-term prospects for Philips' exchange business in Holland. But the home market alone never satisfies Philips. The company already has orders for two 2,000-line PRX installations for the telephone network on the Isle of Jersey. And Philips appears to be a strong contender for a share of the whopping market that's ahead in Brazil. Telecommunications authorities there have decided to shift to space-division SPC exchanges, and the needs in Brazil are 1 million lines a year for at least a decade.

After communications, computers are expected to show the best growth next year in Holland. *Electronics*' survey puts the market next year at some \$262 million.

DUTCH ELECTRONICS MARKETS FORECASTS
(IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	749.5	878.2
Consumer products	303.2	345.1
Computers	212.8	262.4
Communications	83.8	112.4
Industrial electronics	78.8	81.0
Test and measuring equipment	50.2	55.2
Medical electronics	20.7	22.1
Components	191.3	202.6

Exchange rate: \$1 = 2.45 florins

That's about 23% above the estimated \$213 million for 1973. Everybody in the business will be keeping an eye this year on Unidata, the computer combine of Philips, France's CII, and West Germany's Siemens. Unidata hopes to whittle down IBM's market share throughout Western Europe, and Holland is a test market of sorts.

Philips has kept its minicomputer lines outside the Unidata deal, apparently with good reason. A lot of people think that minicomputers will turn in gains well above the over-all market gain. "I get the feeling that a lot of computer users want to switch to batches of minis rather than typing terminals to a large central computer," says Jan Schapers, sales manager for Hewlett-Packard's Benelux operation.

Hewlett-Packard, it must be said, doesn't sell big computers. But H-P has a couple of impressive new systems to talk about. One has 13 technical colleges tied into four HP-2000-F time-sharing systems with a total of 125 terminals among them; the colleges use them to teach basic computer science and mathematics. H-P also scored last year in Holland with "instant-invoicing" systems for the Makro cash-and-carry chain of stores.

As for consumer electronics, that sector is still at the top of the Dutch rankings for market size. The forecast for 1974 is a \$345 million market for TV receivers, radios, tape recorders, and hi-fi equipment. But that's up from an estimated \$303 million this year—less than 15%. As elsewhere in Europe, color TV is the market mainstay, and hi-fi equipment is gaining. According to the survey, hi-fi hardware next year will pull more guilders into the cash registers than black-and-white TV.

Sweden

After a couple of hardtack-and-herring years, Swedish businessmen in 1973 found their way back to the smorgasbord. Consumers at home haven't been spending lavishly, to be sure, but export business turned so good this year that production records have gone by the board in major industries like metalworking, automobiles, and shipbuilding.

Unless the oil crisis makes world trade crumble like trod-on hardtack, the Swedes expect to rack up next year something like the 25% surge in exports they managed this year. That alone would ensure a good 1974. The Social Democrats plan to make it better. They have in mind a \$600 million "economic package" aimed largely at bettering social welfare services, but sure to spur domestic demand.

But even optimistic forecasters can always find at least one "if." For Sweden next year, the "if" is the outcome of the current round of contract negotiations between the unions and the employers' association. If they go reasonably smoothly, electronics markets seem set for a gain of 11% or so in 1974. *Electronics*' survey points to factory sales of just over \$700 million next year. This year's estimated sales were \$639 million. The markets deemed likely to grow most are computers and industrial electronics. Components makers have an all-right outlook. Communications-gear producers and defense electronics makers are up against the government's hold-the-line stance on budgets.

To be sure, military electronics will get a boost from



File. Sweden's budget does not have much for new weapons systems, but one new piece of armament is laser-guided ground-to-air missile.

the \$20 million contract AB Bofors has to develop a manpack, laser-guided, ground-to-air missile for the Swedish army. But there are questions about Sweden's largest defense project, the Viggen aircraft. At year-end it looked as if the production rate might be cut from the current 32 planes a year to 24. Also up in the air was funding for an air-to-air missile that the plane's builder, Saab-Scania AB, has under development. To add to Saab-Scania's worries, the prospects for selling Viggens to Australia and Holland, which looked bright last summer, have now faded. (Dollar figures in this article were calculated at a rate of 4.2 kroner to the dollar for both 1973 and 1974. Inputs on which estimates are based predate the November oil crisis.)

Color TV tops out

Swedes were the first to take to color TV heartily, but after three years of heavy buying, their ardor is cooling somewhat. Sales climbed to 300,000 sets this year from the 1972 figure of 250,000. The market will hover close to 300,000 sets for the next couple of years, figure market watchers like Ulf Tidics of Svenska Philips. The prospect doesn't faze the country's two set makers much. The plateau is a high one and both—Philips and Luxor AB—are doing well in export markets.

As for black-and-white TV, there's general agreement

that sales will continue to dwindle. The Radio Dealers' Association ciphers the decline from 110,000 monochrome sets this year to something like 100,000 next. Hi-fi equipment, then, seems far and away the growth leader in entertainment electronics. The survey spots a 20% gain next year, to \$43 million from an estimated \$36 million this. But with color TV nearly flat and monochrome declining, the sector as a whole next year will advance only 6%, according to the survey.

Cassette TV could provide the next market surge, for there are signs the Swedes may be forerunners there, as they were in color TV. Nils Treving, head of a cassette-TV company owned by two large publishing groups, says that the Swedish market for cassette-TV equipment was about \$2.5 million dollars in 1973, and will be between \$5 million and \$10 million in 1974. He estimates that if Teldec's video disks succeed when introduced in West Germany next year, they will quickly arrive in Sweden. The market could rise to almost \$2 million within a year.

Computer makers will have plenty of new programs to cope with next year, too. The sector seems set to soar something like 25% or better. *Electronics'* survey forecasts a sensational climb to \$175 million next year from this year's \$138 million.

Minicomputers will abound in the order books next year, but it's the big systems that get touted most. One big reason: the Swedish government's appetite for computers is far from sated. Its spending for EDP is running about \$25 million annually, reports Lennart Nordstom, head of computer procurement for Statskontoret, the state agency for administrative development.

The new year will also see a major move into electronic cash-register operations by Hugin Kassaregister, a company owned by a giant Swedish consumer cooperative. The country's other cash-register maker, the Litton subsidiary Sweda AB, has had electronic systems available for almost two years. The Hugin system, which will be installed first in a co-op department store in 1974, will use a Philips P800 minicomputer.

Another company taking a new tack in electronics is

SWEDISH ELECTRONICS MARKETS FORECASTS (IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	638.6	707.3
Consumer products	285.9	301.2
Computers	138.4	174.8
Communications	99.9	108.4
Industrial electronics	66.4	73.2
Test and measuring equipment	20.6	22.1
Medical electronics	27.4	27.6
Components	180.6	196.8

Exchange rate: S1 = 4.2 crowns

EUROPE'S MARKETS

Facit AB, the office-machine maker that merged with household-appliance maker Electrolux last year. The first hardware to result from the Electrolux-Facit marriage is an electronic control system, perhaps the most advanced of its kind, designed to operate a large number of industrial robots and related production and transport equipment.

Anyone wondering how Swedish components makers judge the outlook for their markets can get a solid indication at Järfälla in the northern suburbs of Stockholm. There, construction workers are making plenty of overtime rushing to finish a new plant for HAFO, the semiconductor subsidiary of ASEA, itself a big electrical equipment producer.

HAFO doesn't figure to be the only Swedish MOS producer for too long. RIFA, a subsidiary of telecommunications giant LM Ericsson, started producing TTL in a big way this year (on a license from National Semiconductor) and is thinking about going into MOS memories. RIFA's major outlet is LM Ericsson, obviously, but half its production goes to outsiders.

RIFA, HAFO, and the non-native suppliers of semiconductors can look for a strong market in 1974, according to *Electronics'* survey. Solid-state products look as if they'll bounce up some 25% in 1974 to just under \$28 million. As elsewhere, the spurt will be much higher for ICs, something like 50%.

Spain

Time was when European economists looked at Spain mainly as a sunny agricultural land south of the Pyrenees where a lot of people spent their vacations. That's mostly changed. Hordes of tourists still flock there, but economists now see Spain as Western Europe's fastest-growing, fastest-industrializing economy.

This year, the country's output of goods and services moved up about 7.5% in real terms to top \$50 billion. Industrial production advanced even more impressively—12%. The drive to industrialize, in fact, has come on so well that the Spanish government has talks under way with the nine-nation European Economic Community for a full-fledged free-trade agreement.

The fast industrialization may well continue at almost its customary pace in 1974, most business watchers



Upbeat. Noise levels went up as Swedish factories set production records, so Svenska Radio developed noise dosimeters.

think. And with it, the economy overall seems headed for a real-term gain of something like 6% next year, very likely better than in any other West European country.

The effects of oil shortages elsewhere, however, could work their way back to Spain, although the country so far has no serious worries about its own oil supply. Like its neighbors, though, Spain has inflation, and this year's figure was a record-breaking 12%. Along with this danger, there's always the possibility of upheaval should the 37-year reign of Generalissimo Francisco Franco end. But unless 1974 turns out tumultuous, electronics markets in Spain should bound upward. *Electronics'* survey pegs next year's market at some \$730 million, a burst upward of 20% over the estimated 1973 figure of \$600 million. Computers and industrial hardware are down for the greatest growth. But consumer markets will be sluggish unless color TV comes officially to Spain next year, which could happen. (Throughout this article figures in dollars have been calculated at the rate of 57 pesetas to the dollar.)

Talking over the new look

Franco's government has some ambitious plans for expanding the country's electronics/telecommunications industries. They are down in the economic plan to hit \$1.3 billion sales yearly by 1975. Minister of Industry José Marie Lopez de Letona is determined there'll be plenty of Spanish capital involved and plenty of technology brought in by any foreign companies he lets set up inside this fast-growing market.

Although irreverent industrialists dub Lopez de Letona "Spain's industry czar," businessmen will have a say in deciding the new look. An electronics industries' trade group, *Asociacion Nacional de Industrias Electrónicas (Aniel)*, has been organized and should be in action next year. Aniel's president, Juan Luis Heredero Marti, says the association must first obtain a common front among its three constituent groups: set makers, professional equipment producers, and components makers. Heredero himself heads Barcelona-based Piher SA, the largest Spanish-owned components firm, but Aniel's board of six directors spans all interests. As yet, Aniel hasn't taken an official position on either color TV or the government's plan to set up a computer-producing firm in Spain.

At year-end, the Instituto Nacional de Industria (INI)

SPANISH ELECTRONICS MARKETS FORECASTS
(IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	603.8	729.2
Consumer products	178.4	208.5
Computers	199.1	263.3
Communications	156.5	173.3
Industrial electronics	29.9	36.6
Test and measuring equipment	13.2	15.5
Medical electronics	26.7	32.0
Components	100.3	113.7

Exchange rate: \$1 = 57.0 pesetas



Adding up. Cahue Industrial SA, Spain's sole portable-calculator maker, has done so well that others are eyeing the market.

was examining joint-venture proposals from four foreign-computer makers. The idea is to set up a firm that can handle the country's needs for medium-size computers. Bidders are Japan's Fujitsu, Britain's International Computers Ltd., West Germany's Nixdorf, and the new Unidata combine—France's CII, Siemens of Germany, and Philips of the Netherlands.

If Fujitsu's offer turns out the winner, it will confirm the conviction held by many that Japan hopes to get into Europe via the Iberian peninsula. Matsushita Electrical Industrial Co. already has moved into Spain. It bought an 80% holding this fall in Anglo Española del Electricidad, a TV-set maker.

The winning candidate, presumably, will have as one partner Telesincro SA of Barcelona, Spain's sole native computer maker. The company has been doing all right so far with its bookkeeping computers. But on its own Telesincro couldn't build up to "European" stature for a long time. Lopez de Letona is in a hurry to get the joint-venture, tentatively titled Empresa Nacional de Ordenadores (ENO), going. The Spanish market for computers is zooming: *Electronics'* survey predicts 1974 business—with rentals counted as "if sold"—will top \$260 million, up an eye-opening 30% over this year.

These totals include electronic calculators, where Cahue Industrial SA, best known as the producer of Vanguard TV sets, has had considerable success with a moderately expensive \$300 calculator and a bare-bones \$100 eight-digit, four-function unit. "We'll add a 12-digit portable with memory and two desk models to the line in 1974," says Alberto Farrés, Vanguard's export director.

The clear sailing for computer suppliers has set makers in Spain envious. Their prospects next year depend mainly on when, if—and to a lesser extent with what system—full-scale color-TV broadcasts start. Test transmissions have been going on since last year's Olympic Games, and what few viewers there are now get some 10 hours weekly. These broadcasts use the West German PAL system, but the French government has been carrot-and-sticking the Franco government to change to Secam. There's the possibility that the government will adopt both: PAL for vhf transmissions and Secam for uhf. Set makers shudder at the idea.

Still, there's some hope that colorcasts will begin officially in July. If they do, the consumer electronics mar-

ket should spurt mildly during 1974. If they don't, there'll be stagnation. Sales of black-and-white TV, which set the tone of the entertainment electronics business when there's no color, can't seem to get off a plateau of 650,000 to 700,000 units yearly. But that's understandable since the saturation is about 65%.

The only movement in the monochrome market, then, is a rise in the share of small-screen sets. The word from Philips Iberia is that 12-inch "tinyvision" sets alone are gaining between 7% and 10% a year at the expense of big screens. Sets with screens of 17 in. and under accounted for about a third of sales in 1973, estimates a marketing expert at Iberia Radio SA. He figures their share will rise to 50% next year.

Components makers can count on good growth next year. *Electronics'* survey puts the 1974 market at \$114 million, up from an estimated \$100 million this year. If color-TV broadcasts start, Luis Roiz Noriega, an associate director at Copresa SA, feels that components output will shoot up 30% to 40%.

Color or no at home, Piher has moved to insure its 1974 sales figures have a bright hue. The company long has been selling its resistors and trimmers in the U.S. Next month it will become the first Spanish electronics company ever to set up shop in the U.S. with a carbon-film resistor plant in the Boston area. "By the end of 1974," says marketing director Javier Garcia-Nieto, "our American plant will be turning out 3 million resistors a day."

Belgium

Belgium is a small kingdom, but that doesn't bother the 10 million or so Belgians much because their country lies at the crossroads of Western Europe. Brussels has been established as the capital of the nine-nation European Economic Community and the European headquarters of the International Telephone and Telegraph Corp., which some observers classify almost as a sovereign state. And the Belgian countryside is fairly well filled with plants of big international companies, including Burroughs, ITT, Philips, RCA, Siemens, Sprague Electric, Sylvania, and Westinghouse.

International though the roster of companies working in Belgium has become, the country's economy has remained almost in lockstep with neighboring West Germany and the Netherlands. Both of those countries forecast a slowdown in the growth pace for the over-all

BELGIAN ELECTRONICS MARKETS FORECASTS (IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	498.8	569.6
Consumer products	148.3	174.5
Computers	135.2	152.3
Communications	121.6	141.3
Industrial electronics	61.6	66.5
Test and measuring equipment	19.0	20.8
Medical electronics	13.1	14.2
Components	160.3	202.2

Exchange rate: \$1 = 37 francs

EUROPE'S MARKETS

output of goods and services next year, and the 1974 outlook for Belgium is similar.

Belgian industry ran full blast this year, and the gross national product grew a lusty 6.2%. Before the Arab oil-producing countries boycotted Holland and cut back crude supplies to other West European countries, economists had pegged that growth rate as a peak in the cycle and had predicted a downturn that would drop next year's figure to something like 4.5%. Energy problems will accelerate the decline in growth, but how much, no one can estimate yet.

Meanwhile, Belgian electronics markets will ride on the momentum built up this year. Before the crisis, prospects looked excellent. *Electronics'* survey turned up a 1974 forecast of close to \$570 million for sales of Belgian equipment. That's nearly a 15% rise over the roughly \$500 million estimate for 1973. And, although cutbacks in energy supplies will curb them to some extent, Belgian markets for consumer goods and communications equipment look particularly strong. After years of going nowhere, military electronics should be on the rise next year. Finally, the recent influx of equipment-producing plants obviously will help components sales. At year's end, the order books were full enough to ensure a good 1974. (All dollar figures in this article were calculated at the rate of 37 francs to the dollar. Inputs on which forecasts are based predate the cutback in oil deliveries to Western Europe.)

The number of television-set makers in Belgium has dwindled in recent years as smaller producers have fallen by the wayside. But the output by the giants has climbed steadily, and next year it will spurt, mainly because Philips has transferred color-TV production from Holland to Belgium. The word is that the Philips subsidiary in Bruges, Compagnie Belge de Radio et de Television (CBRT), will boost color-TV output from this year's 190,000 or so to close to 300,000 sets next year. Carad SA, which is part of the British Thorn group, will triple production to 45,000 sets next year, industry people estimate, and the Belgian independent, Cobar

Clean up. Computer center in Brussels and waterway monitoring stations start pollution fight that spells rise in industrial-gear sales.



Electronic NV, will go to 80,000 from this year's 50,000. When production from a few small independents is added, the total amounts to roughly a 7% jump next year to some 450,000 sets.

A lot of this output is earmarked for export, but plenty of color sets will find their way into Belgian households. The market this year ran about 170,000 units and should go to 195,000 in 1974. By 1975, some predict, the market will level off at around 200,000 sets. As Herman de Clerq, managing director for Siemens in Belgium, puts it, "What we thought was a temporary boom for the Olympics last year has continued."

Cable TV to thrive

Whatever the level, one thing is sure. The expensive multistandard sets that Belgians had to buy so they could pick up the offerings of the television networks in neighboring France, Luxembourg, the Netherlands, and West Germany are on the way out. That's because cable television is coming on strong, making Belgium the European leader in the field. Out of about 3.5 million families in the country, 2 million live in regions that already have cable systems or are about to get them.

Cable-TV experts estimate that Belgium's 40 CATV companies have spent some \$150 million on systems so far and that a like amount will go for new systems. Between 35% and 40% of the money goes for electronics hardware. The biggest spender in sight is the big power utility, Sociétés Reunies d'Energie du Bassin, de l'Escaut (EBES), which will spend \$50 million to bring cable TV to 250 communities around Antwerp.

Cable TV appears to be such a big business, in fact, that RTT, the government telecommunications agency, wants a piece of the action. It has taken over the microwave links set up by the private cable companies to feed programs to their distribution centers. Next year, RTT will build a backbone CATV net that will bring West German programs all the way to Ostend, and British programs picked up there all the way back to Liege.

Meanwhile, RTT will continue to upgrade its existing telephone and telegraph networks. RTT is strong on semielectronic switching and expects to cut over 15 to 20 computer-controlled exchanges next year. Most of them will be Metaconta types from the ITT subsidiary in Antwerp, Bell Telephone Manufacturing Co. Scheduled during the year also are introduction of automatic radiotelephone service and a switch to seven-digit telephone numbers for the entire country. As if all this weren't enough, RTT will put its "orange phones" into service. These are table-top pay phones that are expected to become ubiquitous. RTT put a 200-band data-transmission network into service this fall and has been running facsimile trials during the year.

With RTT on the go, then, the outlook for communications-equipment producers is all right. *Electronics'* survey spots the market at some \$141 million for 1974, a gain of 16%, and orders for military equipment will help boost business. The Belgian air force has ordered 33 Franco-German Alpha jets, a trainer and close air-support aircraft. The deal presumably includes production of some security-classified electronic equipment by the Belgian aircraft maker Sabca SA.

Sabca also has a contract to supply laser-guided-mis-

sile systems for the Belgian army's Leopard tanks. The system uses a computer made under license from Hughes Aircraft, and Sabca produces the hardware in collaboration with two other firms. Société Belge d'Optique et d'Instruments de Precision (OIP) is handling the optics, and Compagnie Belge de Laser (CBL), the laser. Sabca will also produce firing simulators and training aids for the system. Eventually, the companies hope to supply the other European Leopard users.

The Belgian army also plans to buy, if it can get the money, some \$12.5 million worth of Eperviers, a guided reconnaissance drone developed by the Philips affiliate Belge de Lampes et de Matériel Electronique. The buy would be spread over three years and would put the first Eperviers in the hands of the army in early 1975.

As for computers, the expected gain looks about normal for Western Europe. The *Electronics*' survey puts the Belgian market at slightly above \$152 million for 1974—about 13% higher than this year's figure.

Switzerland

From Aarau to Zurich, the normally thrifty Swiss are watching their budgets more than ever these days. What one economist terms "disastrous good times" have settled in, and inflation strains everyone's finances.

At year's end, it looks as if Switzerland's output of goods and services for 1973 has moved up to some \$44 billion—a 13% rise that represents a real growth of 4.5% to 5%. That's strong growth, of course, but most citizens were worrying about the other 8.5% or so as they went in early December to vote on keeping their government's anti-inflation program another two years.

Anti-inflation program or no, most economists expect next year will bring much the same mix of growth and inflation. However, there's one worrisome catch. The industries that carried the economy this year—chemicals, precision machinery, and timepieces—all depend heavily on exports—and the energy crisis.

Otherwise, "adequate" is how many a businessman sizes up 1974. And adequate is about right to describe next year's outlook for electronics markets. They'll move up to just over \$470 million, *Electronics*' survey forecasts. That's just under 10% better than the \$430 million estimated for 1973. (All dollar figures in this article were calculated at the rate 3.05 francs to the dollar for both 1973 and 1974).

Computers are expected to show the way, with a

spurt from \$155 million this year up to \$176 million next—and this despite credit restrictions that keep some customers out of the market and tend to turn potential buyers into renters. A gain is in sight, too, for consumer electronics, mostly from color TV.

Communications-equipment producers, though, face a flat year. Their major customer, the Swiss postal and telecommunications administration (PTT), expects to wind up with its 1974 budget cut some 15% below this year's. Avionics producers have been waiting for years for the government to start buying a batch of new jet fighters for the country's defense forces. But to save money the government isn't deciding.

Even with its budget cut, the PTT remains a big spender. Some ambitious projects, like fully automating the postal checking system and putting a good part of the phone network under computer control, have been postponed. But there's a solid \$400 million earmarked for telecommunications hardware and cables.

The \$13 million Intelsat IV station will have its official start in 1974. The year will also see preparations for upgrading the main north-south cable to 60-megahertz, 10,800-channel operation in 1975, as well as work on a data transmission net that uses pulse-code-modulation on twisted pairs. Development will continue, too, on a PCM switching system that the PTT hopes to have operating by the late 1970s. Standard Radio AG, Siemens Albis AG and Hasler AG are working on the project.

Unless the answer can be expressed in hours, minutes, and seconds, Swiss watchmakers don't respond freely to requests for information, and precise figures about electronic-watch production are hard to come by. Educated guessers say that the dominant producer, Ebauches Electronics SA, turned out at least two million movements this year. Next year's figure is expected to be 50% higher, and more will be quartz types.

Ebauches has shown the prototype of an all-electronic watch with an electrochromic display. An all-electronic version with a liquid-crystal readout has also been developed by Brown, Boveri and Cie. BBC's field-effect material provides a dark-on-light display needing only a 1.5-volt battery to power it.

As elsewhere in West Europe, components suppliers will go into 1974 with heavy order backlogs, which should carry the components market in Switzerland up 13% to some \$140 million. Industrial electronics, by contrast, is in for a flat year. Plant investment has slowed in some key industries like pharmaceuticals, glass and cement. "The next three years will be very hard," sighs Guido Oswald, manager of Honeywell AG.

Denmark

Even the little mermaid that graces Copenhagen's harbor would shiver if she contemplated the list of economic inflictions that Denmark suffers. Like all nine Common Market countries, Denmark's economy is plagued by inflation and an energy crisis. Like the unluckier members of the nine, Denmark has to put a minus sign in front of the totals for foreign trade. And the Danes have an acute labor shortage.

Denmark joined the Common Market only this year, and getting inside the big trade bloc has indeed brought

SWISS ELECTRONICS MARKETS FORECASTS
(IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	432.2	471.8
Consumer products	133.3	144.4
Computers	155.1	175.7
Communications	66.6	68.8
Industrial electronics	42.9	46.2
Test and measuring equipment	21.0	22.6
Medical electronics	13.3	14.1
Components	123.0	139.0

Exchange rate: \$1 = 3.05 francs

EUROPE'S MARKETS

some of the promised benefits. The high food prices inside the bloc have sent incomes of Danish farmers soaring. Industrial exports have gone up nicely, too. But trade goes both ways, and imports have raced ahead of exports. At year-end, the deficit in the payments balance seemed headed for the record \$500 million level that was reached two years ago.

That means Denmark's new government will have to take steps to curb both inflation and imports, all the while trying to boost exports. Look for a slowdown in the expansion of Denmark's GNP from 6% to about 4% in real terms.

Against this background, it's not hard to understand why the country's export-oriented electronics producers don't expect the kind of growth they've become used to. From 1967 to 1972, output of electronics hardware expanded an average of 16% annually, points out Erik Petersen, managing director of Storno A/S and head of the electronic hardware producers' trade association. "We expect our annual growth from 1972 through 1977 to drop to 13.2%," he adds, speaking as head of the associ-

DANISH ELECTRONICS MARKETS FORECASTS
(IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	326.4	358.2
Consumer products	129.8	139.3
Computers	78.8	92.4
Communications	63.5	67.3
Industrial electronics	33.0	35.7
Test and measuring equipment	13.5	14.7
Medical electronics	7.8	8.8
Components	105.8	116.6

Exchange rate: S1 = 5.7 kroner

ation and not for Storno, a fast-growing producer of radio-communications systems.

There's no doubt in Petersen's mind about the main cause for the slowdown in production growth. Factory hands are very hard to come by. Some electronics companies offer half-day jobs to lure housewives onto their staffs. Another tactic is "cottage work," having housewives do assembly jobs at home. Storno, for example, uses about 100 household workers, trucking parts to

At home. To offset a severe labor shortage, Danish equipment producers, like Storno A/S, farm out pc-board assembly to housewives.



them in the morning and picking up assembled printed-circuit cards in the evening.

The association's forecast, it must be pointed out, covers professional electronics, consumer electronics, and components. But it's only the latter two sectors that are seen slowing down. Output of professional equipment is tagged to rise to some \$370 million by 1977 from the 1972 figure of roughly \$185 million. That averages out to 14.6% a year, a wee bit better than the average for the past five years.

The Danish home market won't keep pace with the export records of the country's electronics producers. *Electronics'* survey puts next year's market for assembled equipment just under \$360 million. That's just 10% above the estimated 1973 figure of \$325 million plus.

In the kingpin consumer electronics sector, color-TV sales surged 30% this year, as expected, to reach an estimated \$61 million. That makes 1973 the second year in a row to show fantastic growth and points to only a moderate rise next year to some \$69 million. For hi-fi and for tape recorders, there's about a 10% rise in the offing. Radio sales look flat and black-and-white TV, of course, will decline.

Turning to other sectors, computers should turn in a good rise of 16% and communications an uninspiring 8%. As for components makers, they can look for a market of something like \$117 million next year, according to *Electronics'* survey. (All dollar figures in this section were calculated at the rate of 5.7 kroner to the dollar.)

Norway

Norway—whose people keep closer to nature, perhaps, than any other people in Western Europe—has trailed most of its neighbors in economic expansion. But just as those who contravene nature often pay a penalty, those who remain in harmony with it often reap a reward.

Norway, it now turns out, has immense reserves of oil off its rugged coast. "I once thought the only chance to get the economy really growing would be through painfully acquired advanced technology," says Gustav Ring, whose intercom company, named after him, sells its systems worldwide. "Now," he goes on, "it looks as if the oil will do it for us."

He's right. The economy started perking up this year, and next year, it should move out some 5.4% in real terms, say the government's economists. The boom, of course, has touched off inflationary price rises, and, in an attempt to curb them, the government revalued the kroner by some 5% last month. But it's difficult to visualize how the boom can slow much. There's so much business in building North Sea platforms that practically every metalworking outfit in the country is delivering something for them. That degree of activity penetrates a long way through the economy.

Electronics markets, then, can't fare too badly. *Electronics'* survey suggests sales of \$240 million next year, up from this year's figures of \$218 million. Computers and color TV will outperform the other major sectors. For computers, the market is poised for a climb of about 15% to \$62 million. (All figures were calculated at the rate of 5.4 kroner to the dollar.)

Colorcasts are officially still test transmissions in Nor-

NORWEGIAN ELECTRONICS MARKETS FORECASTS

(IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	218.4	239.8
Consumer products	55.7	64.4
Computers	54.3	62.0
Communications	63.5	62.8
Industrial electronics	28.0	31.5
Test and measuring equipment	11.0	12.3
Medical electronics	5.9	6.8
Components	58.5	66.2

Exchange rate: \$1 = 5.4 kroner

way, but there are enough of them to keep the market growing fast from a low base. Sales this year should hit some 50,000 sets and perhaps bounce up 30% next year. Oil-well instrumentation will bring a lift for industrial electronics—how much, no one is sure.

Norway's electronics products are expected to do all right abroad, too. Manufacturers set up a trade association a year ago and named Olaf Stavig of Akers Electronics A/S as president. The association's 26 member companies account for about 97% of the country's output. Last year, their business totalled some \$220 million. This year, Stavig predicts a climb of 15% to 20%.

In Norwegian electronics, the two major sectors of domestic production are telephone equipment and entertainment electronics; together they accounted for \$130 million of last year's sales. An expected specialty, maritime electronics—marine radios, echo sounders, ship-automation hardware, and the like—accounted for \$24 million. Radio links, surprisingly, are next at \$11 million, just ahead of computers at \$9 million.

Although the industry is small, it comes up with interesting hardware and far-flung orders. Ring, for example, delivered this year an automatic call distributor for the classified-ad order takers at Norway's largest newspaper, *Aftenposten*. The \$100,000 system distributes incoming calls from 50 lines among 40 operators.

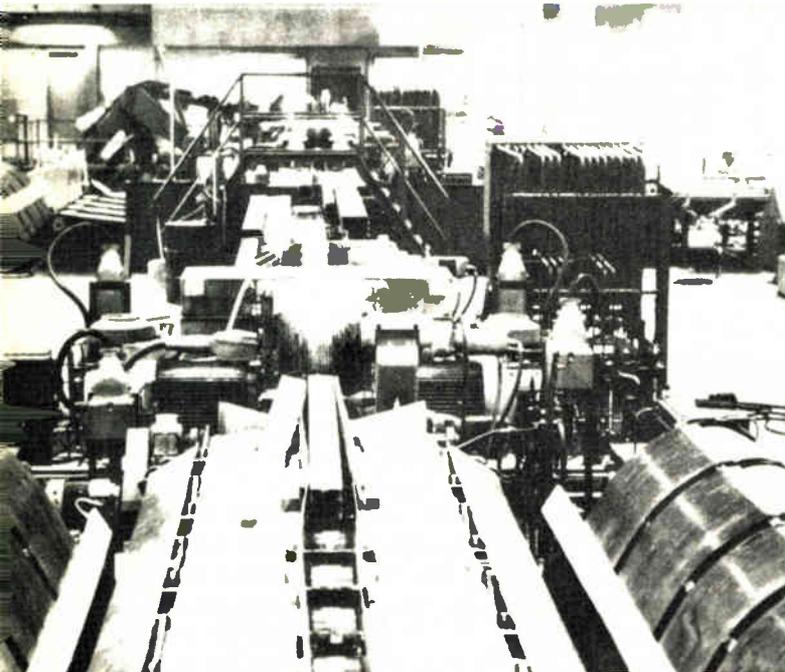
Nera A/S, a Bergen-based company in which the government has a minority holding, straddles the globe. The company has microwave-link projects going in Bulgaria and Turkey, plus contracts for a TV transmitter in Rumania and a marine-mobile setup in Poland. Bernt Krabberød, vice president of Nera's Oslo division, explains that his company has a slight edge over competitors for East European business because Norway is not a member of the European Economic Community, a trading bloc that the East Bloc doesn't particularly favor. "Our prices are slightly lower, too," he adds.

Finland

Finland is experiencing a rapid metamorphosis from its role mainly as a supplier of pulp and paper into a producer of advanced industrial hardware. The changes, in fact, have been so fast and so profound that the business cycle is difficult to discern.

For the Finns, this year has marked solid economic growth, especially welcome after two years of sluggish performance. Yet finance ministry people say the coun-

EUROPE'S MARKETS



Cut out. Strömberg Oy expects to deliver 10 of its sawmill control systems, which are built around Data General's Nova 1200 mini-computers, during the course of 1974.

try's real-term growth rate will fall from this year's 6% to 5% at most, and maybe even as low as 4% next year, despite the new free-trade arrangement with the nine-nation Common Market and a reasonable—but not abundant—supply of oil from the Soviet Union. The ministry men are particularly worried by the 1974 balance of trade. They say that the deficit may go as high as \$800 million, half again as high as this year's figure. Inflation this year reached dangerous levels, and at year-end, the government was working on policies to brake rises in wages and prices.

All the more surprising, prospects for 1974 electronics markets in Finland are nothing short of sensational. *Electronics* forecasts an upward bound for sales of equipment to \$214 million next year from this year's \$168 million. With that 27% rise, Finland for the second year in a row checks in as by far Western Europe's fastest-growing market. Consumer electronics, computers, and industrial electronics are set for rises of better than 25%. Communications-equipment markets turn up at the bottom of the list, but even those will

grow a respectable 11.5%. (All dollar figures were calculated at the exchange rate of 3.70 marks to \$1.)

Entertainment electronics is forecast to spurt 36% to \$65 million next year. A look at the expected sales for color-TV—\$35 million—shows why. The home market, although sprouting fast, is several classes too small to satisfy Finland's leading set maker, Salora Oy. Salora has scheduled the opening of a new plant in December with a goal of 200,000 sets a year for export. Salora has had strong sales in Britain and other Scandinavian countries, but the new capacity and the new free-trade pact with the EEC will give Salora a go at markets like West Germany and the Netherlands.

Right behind the consumer-electronics market comes a computer bonanza. The *Electronics* survey suggests 1974 computer sales (with rentals counted as if sold) of \$61 million—30% above the 1973 figure of \$47 million. During the year, Oy Nokia AB will be working on perhaps the biggest order yet for electronics in Finland, a nationwide 1,600-terminal on-line system for the Kansallis-Osake-Pankki (KOP) bank.

The big order for terminals, plus sales of telecommunications equipment and industrial electronics, will keep Nokia growing fantastically. This year, the company's sales ran \$32.5 million and now seem set to shoot up to \$47 million next year. Such other Finnish professional electronics producers as Oy Stromberg AB, Outokumpu Oy, and Ollituote Oy are stepping out nicely, too. As a result, total turnover next year for the country's electronics producers should bounce upward again. The industries' forecast is something between \$215 million and \$230 million, which will mean an impressive gain of 37% over 1973 results if they make the \$230 million mark. □

FINNISH ELECTRONICS MARKETS FORECASTS (IN MILLIONS OF DOLLARS)

	1973	1974
Assembled equipment, total	167.9	214.0
Consumer products	48.2	65.4
Computers	46.9	61.1
Communications	28.9	32.4
Industrial electronics	24.9	31.5
Test and measuring equipment	6.0	7.4
Medical electronics	13.0	16.2
Components	53.3	69.3

Exchange rate: \$1 = 3.7 marks

Reprints are available at \$2 each. Write Electronics Reprint Dept., P.O. Box 669, Hightstown, N.J. Copyright 1973 Electronics, a McGraw-Hill Publication