VOL. 20 NO. 13

Electronic Design

FOR ENGINEERS AND ENGINEERING MANAGERS

JUNE 22, 1972

Get your real-time scope to store. A continuous-loop signal recorder with a storage period of 20 ms does the trick. The instrument makes permanent recordings on standard, 1/4-inch magnetic tape from dc to 100 kHz and plays them back on any scope. To learn more about this unusual new instrument, see page105.

DOWN WITH UNTOLERANCE

UP WITH WIREPOWER

Dale's way with wire matches your need for precision at a price...and meets your special design needs.

Shuntsmanship

Your meter needs Dale's new LVR. Dale has slashed shunt resistor prices as much as 66% and reduced resistance values to as low as .008 ohm. 2, 5, 10 watt styles.
Circle 181

Fuse News

Two Dale styles combine precision resistance with predictable fusing times. Axial lead (CFR) has ¼ to 2½ W power. Special disc type for use in socket applications.
Circle 182

Wirepower in RN50 Size

Dale's tiny new RS-⅛ dissipates up to ¼ watt in .155". Operates to +275°C. Molded body can be automatically inserted. T.C. as low as ±20 PPM.
Circle 183

Networks with Muscle

WDP wirewound network handles up to 3.5 watts in standard 14-pin DIP size. Contains up to seven resistors which can have closely-matched tolerance (.1%) and T.C. (±5 PPM).
Circle 184

It's all in the family. If the resistance function you need isn't in Dale's Catalog A... don't worry, we have it. No one beats our ability to mix and match resistance parameters.

DEPENDABLE DALE...comes to you with the courtesy of the best representatives and distributors in the business. There's a source of information near you...or call 402-564-3131 today.

DALE ELECTRONICS, INC.
1300 28th Ave., Columbus, Nebr. 68601
A subsidiary of The Lionel Corporation
In Canada: Dale Electronics Canada, Ltd

DEPENDABLE DALE®

The PDP-11 family grows on. The rugged one: PDP-11 R20

Some computer problems are plain impossible to bring to the computer. PDP-11R20 goes to them.

Goes where there are bad things like 5G shocks, 500Hz vibration, 55°C temperatures, 95% relative humidity, severe EMI, 30% voltage swings, 10% frequency transients. Even if the power source fails completely, the PDP-11R20 processor will resume when the power does — from just where it left off. You won't lose data.

Then there are convenience features: Peripheral connections are MIL type — quick and reliable. The computer will operate in any attitude — at weird angles, even upside down if it comes to that.

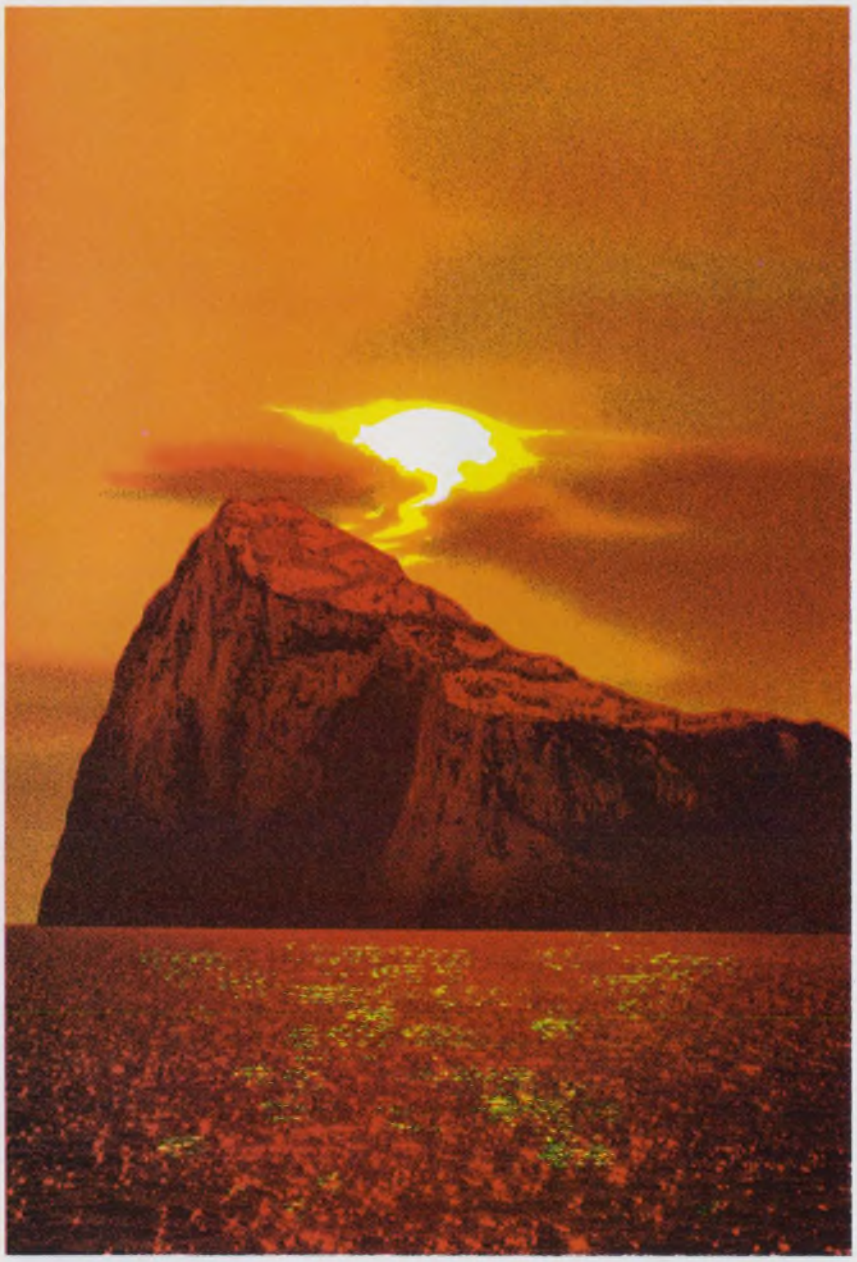
Aside from these and other protective features, the 11R20 is the same high-performance 16-bit computer as the PDP-11/20 and possesses the most powerful mini-computer architecture in the world. Like core memory expandable to 124K words, built-in multi line and level priority interrupt, 8 general purpose registers, over 400 instructions, direct memory access, automatic power fail and restart.

It goes on and on. So if you happen to have an ocean going ship, or a tank, or just an ordinary van, take PDP-11R20 to where the control or processing problems are. It will not only survive the environment, it will keep processing in the environment for a long time.

But first, send for the complete story. Digital Equipment Corporation, Main St., Maynard, Mass. 01754. (617) 897-5111. European Headquarters: 81, route de l'Aire, 1211 Geneva 26 Tel.: 427950

digital

LONGEVITY CANNOT BE MEASURED BY SIZE



TO-5 Relay

The Rock of Gibraltar has stood sentinel to the Mediterranean since time began. So have the small stones at its base. In the electronics world, both long life and stability of components play an important part. The Teledyne TO-5 is ideally suited for this role. Housed in a miniature TO-5 Transistor Case, the tiny Teledyne TO-5 Relay has consistently met the tests of time and continues to be the most advanced and reliable general purpose relay available today for both industrial and aerospace applications.

The same tenacity that made the TO-5 Relay the present day industry standard is also dedicated to the development of Solid State relays. Teledyne provides a broad family of devices to fit most aerospace and industrial applications. Send us your requirements.

3155 West El Segundo Boulevard
Hawthorne, California 90250
Telephone (213) 679-2205

TELEDYNE RELAYS

INFORMATION RETRIEVAL NUMBER 3

VOL. 20 NO.
Electronic Design 13
FOR ENGINEERS AND ENGINEERING MANAGERS
JUNE 22, 1972

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Cover: Photo by Edward Padykula, courtesy of Ballantine Labs Inc., Boonton, N.J.

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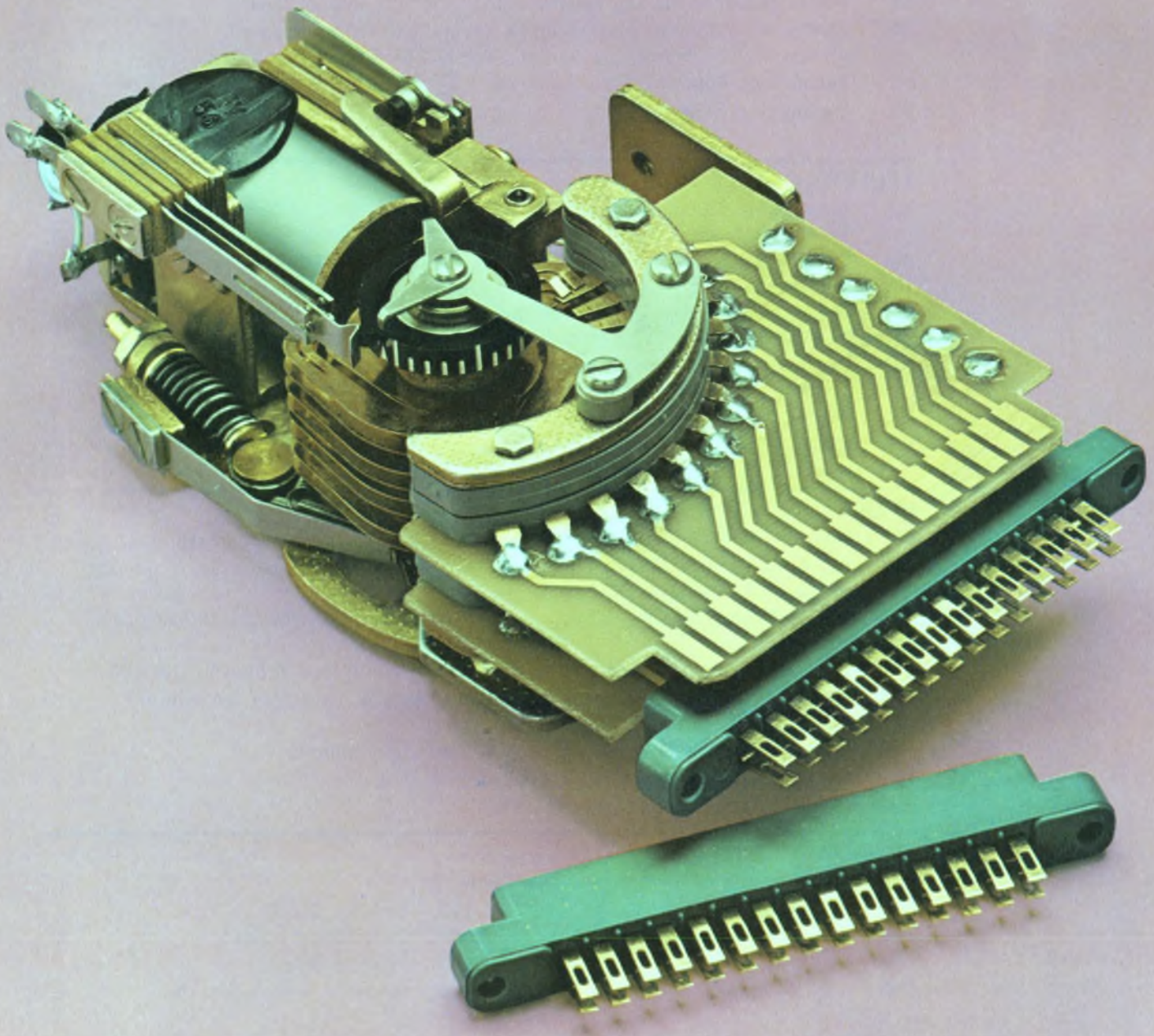
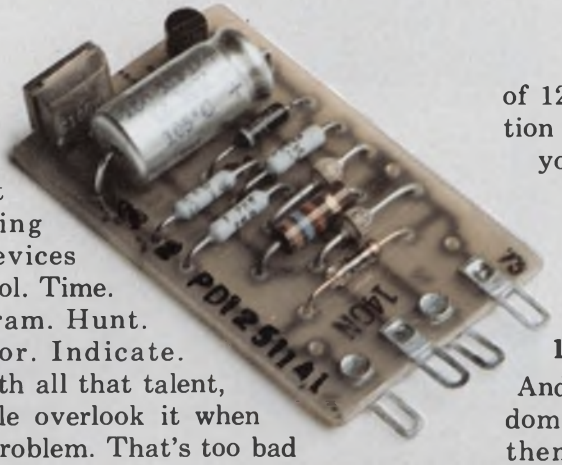
You can teach our stepping switch all the newest tricks.





You can make a rotary stepping switch do just about anything solid state devices can do. Control. Time. Count. Program. Hunt. Test. Monitor. Indicate. Select. Yet with all that talent, a lot of people overlook it when they have a problem. That's too bad because it's often the most practical solution.

Think of the stepping switch as a time machine.

It conserves what you have the least of. Time. That's because most of the logic you need is built right in. It's part of the mechanical construction, not something you have to create. And by adding our Series 300 Time Delay module, you'll practically have a complete control system in the palm of your hand. Lots of people have created exotic solid state circuits only to discover they could have done the same thing faster and easier with a stepping switch.

Ten cents a contact.

That same exotic circuit probably costs three to five times more than a stepping switch, too. For example, a type 45 with 8 levels of 52 contacts will cost you about a dime a contact. We don't know of any switching method that costs so little.

A better memory than an elephant. And just as tough.

A stepping switch never forgets after a power outage. When the juice comes back on, it starts up right where it left off. And it shrugs off doses of 1250 volts because of inherently high insulation resistance and dielectric strength. This gives you a system reliability that can't be matched by solid state. Should the day ever come when maintenance is necessary, a plug-in style, like the type 44 in the picture, can be removed or installed in minutes.

10 million laps around the track.

And maybe 10 million more. We've yanked random units off our production line and worked them to death. Many have lasted twice as long as their rated 10 million wiper sweeps across the bank. One reason is our "free floating" pawl. It can't possibly bind or overthrow because we don't use pawl or armature stops.

Sometimes a stepping switch isn't the answer.

If you need to switch in microseconds, or squeeze your system into a TO-5 can, forget it. But if you're looking for a simple, economical, reliable, easy-to-design solution to a switching problem, consider the stepping switch. We'll be happy to help you do it. If you want a head start, write today for a copy of our 40-page manual. GTE Automatic Electric, Industrial Sales Division, Northlake, Illinois 60164.

GTE AUTOMATIC ELECTRIC

INFORMATION RETRIEVAL NUMBER 4

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Peter Coley

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Information Retrieval

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across the desk

A prodding on probes by a competing vendor

We have read your article "Logic Pulser and Probe Simplify In-Circuit Logic Functional Tests" (ED 9, April 27, 1972, p. 92). We found it very interesting and educational. However, since the article is a survey, and represents a technical evaluation for the benefit of potential users, we found it very disturbing that you did not mention our probe and pulser.

We know that we are a small company, but usually when a survey is made to find the best and most economical product, it includes all of the information that is available, to provide users with the best available tools. Judging from the prices and specifications of the other products, we are confident that our probe and pulser are the best and cheapest.

Our probe uses as indicators long-life light-emitting diodes. In principle our probe can indicate a short or logic ZERO (light 1) and logic ONE or pulses (light 2). The repetition rate of accepted pulses is 10 MHz. A single pulse of less than 40 ns is displayed by light 2. The probe contains a built-in scaler that will divide pulses of any rate down to five pulses per second, permitting visual observation of rates. In addition a built-in power regulator permits operation from power supplies of 4.75 to 15 V and is reverse-polarity protected. A plug-in cable eliminates the disadvantages of a permanently connected cable.

The total price of our probe, operating from 4.75 to 15 V (our number L-2002) is $45, while the same probe for 4.75 to 5.5 V (our number L-2001) is $35. These prices represent only 50% of the price of the two probes described in your article.

The only specification not offered by our probe is 5-ns pulse detection. Judging from reports from distinguished research institutes and corporations, 5-ns detection is too sophisticated a demand —something like manufacturing an automobile capable of going 500 mph. Most circuitry still uses microsecond pulses.

D. Pryse
Sales Manager

Aqua Survey and
Instrument Co., Inc.
7041-43 Vine St.
Cincinnati, Ohio 45216

Plated wire for space? It's not that new

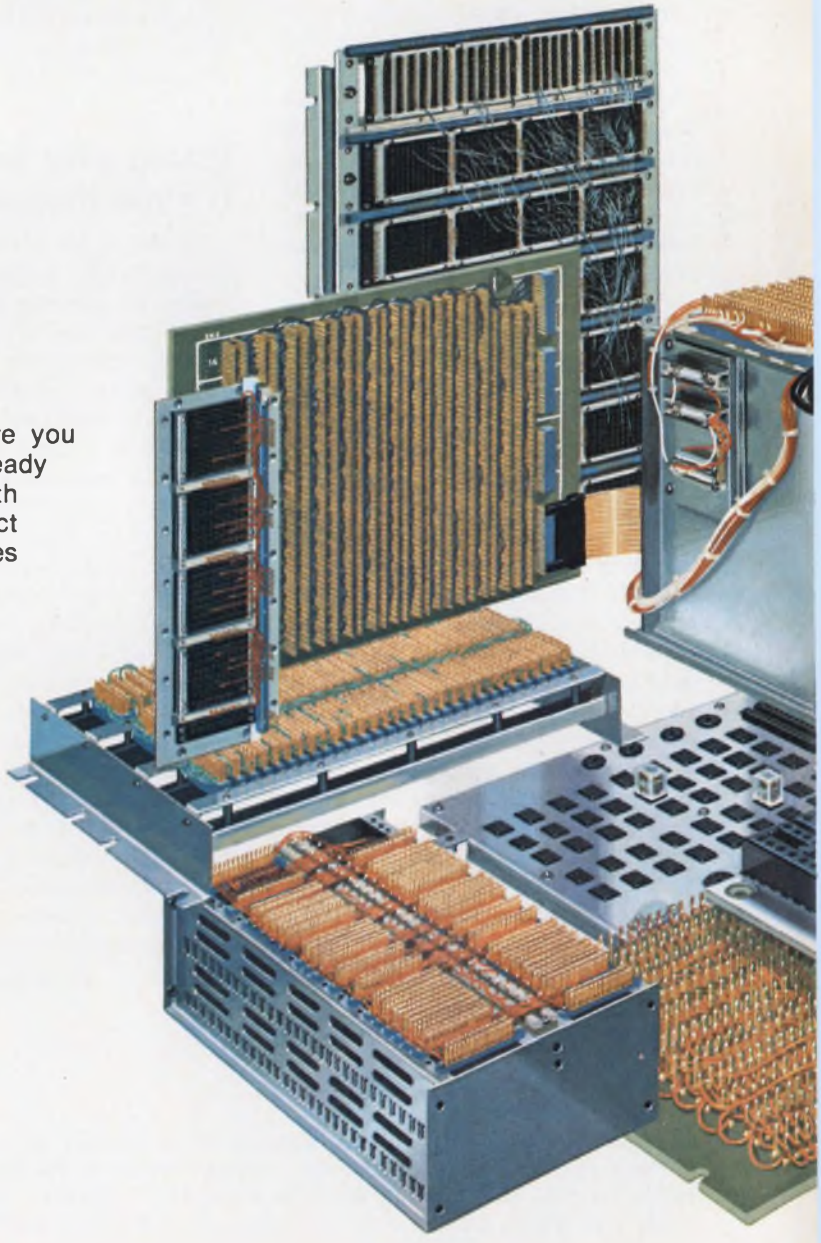
In the April 27 issue under the "News Brief" section on p. 22, you made the statement that the first plated-wire memory to fly in space on a NASA vehicle will be delivered in several months to Jet Propulsion Laboratory for flight on the MM-73 spacecraft. I must differ with that statement.

A 64-k plated wire-memory system flew on Apollo 15 and 16, and will fly again on Apollo 17. This memory system was a critical element of the data processor for the Advanced Lunar Experiment Module. This processor was adapted by NASA from an existing Air Force program that has an extensive orbital operational history. These systems are designed and manufactured by SCI Systems, Inc., of Huntsville, Ala., and have been functional in space for the past several years. However, they are only one of approximately 20 plated-

(continued on page 11)

Electronic Design welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to Managing Editor, Electronic Design, 50 Essex St. Rochelle Park, N. J. 07662. Try to keep letters under 200 words. Letters must be signed. Names will be withheld on request.

We can m any panel



Wired or unwired.

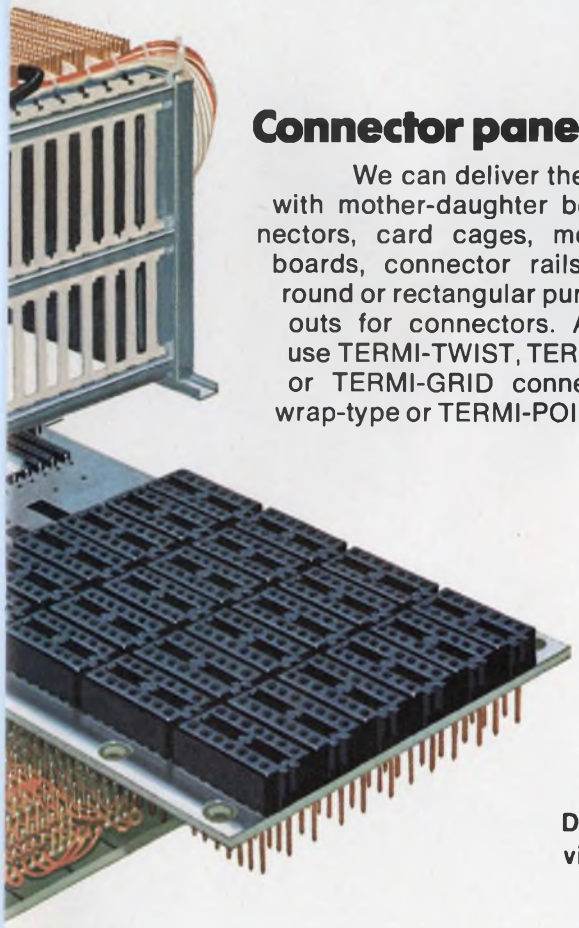
Just give us your parameters. We'll give you *assembled* IC or connector panels, prewired or ready for you to wire—by hand or machine. Panels with the kind of built-in reliability you've come to expect from AMP. With pricetags and turnaround times you absolutely can't afford to pass up.

Here are a few of the things in our bag.

IC panels.

We'll build anything you need in custom panels. Single-, double-, or multilayer. Complete with IC receptacle packaging, feed-through posts, miniature spring sockets, or DIP headers. Or, if it's standard panels you need, we'll supply them, too. With 30, 60, 90, or 120 DIPS per panel. We can prewire both types of panel. Or supply them ready for wrap-type or TERMI-POINT machine wiring.

ake you need.



Connector panels.

We can deliver these panels with mother-daughter board connectors, card cages, metal plugboards, connector rails, or with round or rectangular punched cutouts for connectors. All panels use TERMI-TWIST, TERMI-PLATE or TERMI-GRID connectors for wrap-type or TERMI-POINT wiring.

Full-range capability.

When you buy an assembled panel from AMP, you get more than just another source of supply. You get a quality product. Quality that begins with computer-generated artwork which provides the most efficient utilization of precious panel area. Manufacturing techniques like selective solder predeposition that assures highly reliable board-to-receptacle connections and leaves posts clean and solder-free for wrap-type or TERMI-POINT clip wiring. And a 100% quality check that relieves you of the burden of incoming inspection.

Want to know how we're able to make any panel you need? Write on your company letterhead for our Panel Packaging Kit. It contains full documentation of our various processes, with suggestions of how they can work best for you. **AMP Incorporated, Industrial Division, Harrisburg, Pa. 17105.**

During the NEPCON Show visit the AMP booth #4301

AMP INCORPORATED

Manufacturing and direct sales facilities worldwide: Barcelona, Brussels, Buenos Aires, Frankfurt, London, Mexico City, Paris, Puerto Rico, Sao Paulo, s'Hertogenbosch (Holland), Sydney, Stockholm, Tokyo, Toronto, Turin, Vienna.

Termi-Twist, Termi-Plate, Termi-Grid & Termi-Point are trademarks of AMP Incorporated.

INFORMATION RETRIEVAL NUMBER 7

Relieves design headaches 16 ways.

CONTACT MATERIAL is often the critical difference in relay performance. So Clare gives you 16 choices to relieve headaches caused by trying to fit a compromise relay into an uncompromising application. While Clare GP relays can be tightly "spec'd" to your needs, most are available off-the-shelf from a Clare distributor near you. For complete specifications on Clare UL recognized GP relays, circle the reader service number or write C. P. Clare & Co., 3101 Pratt Blvd., Chicago, Illinois 60645.

CLARE

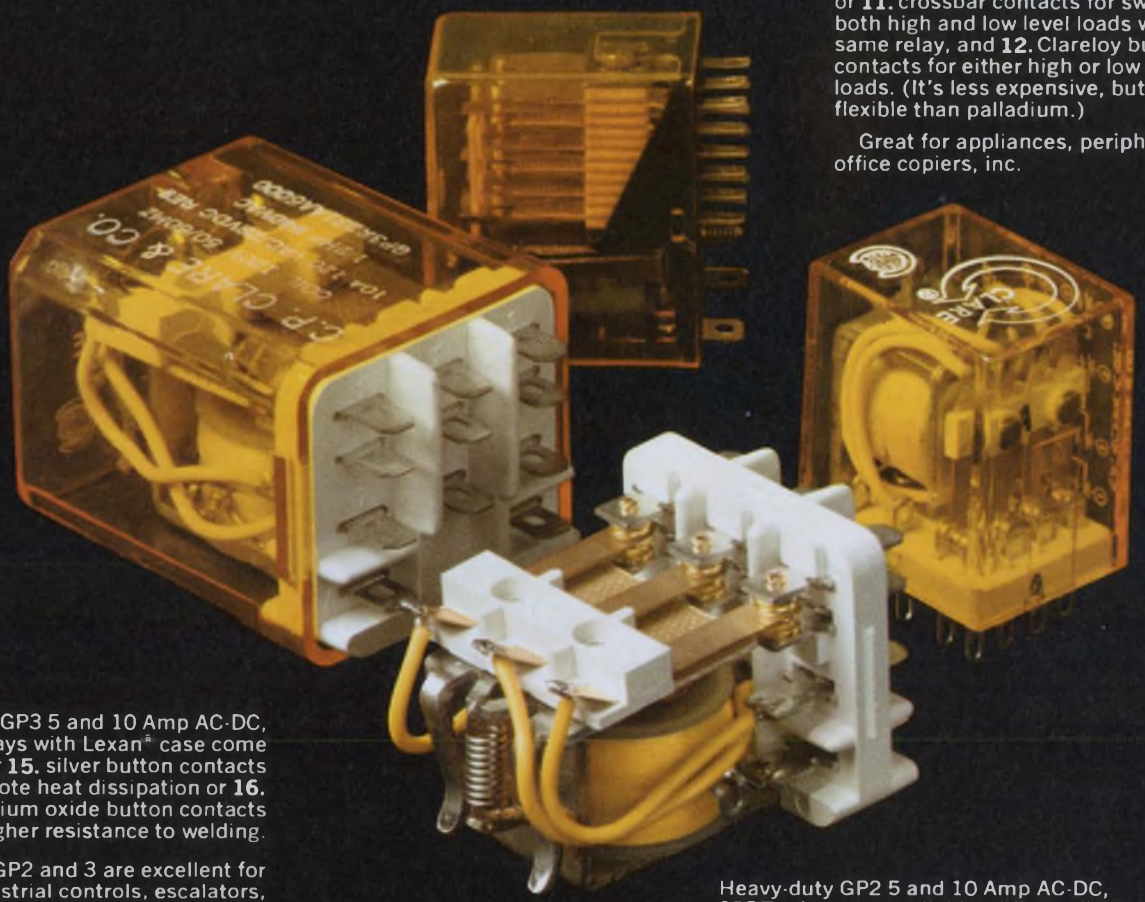
a GENERAL INSTRUMENT company

Space-saving VP relays from 2-5 Amps AC-DC, up to 6PDT and with Lexan® cases are available with **1.** bifurcated silver contacts or **2.** bifurcated gold contacts if redundancy is important, **3.** silver button contacts, **4.** silver cadmium oxide contacts, and **5.** WE #1 gold contacts.

Ideal for telecommunications, vending machines, appliances, etc.

Miniature GP1 4PDT relays up to 5 Amps AC-DC with Lexan® dust covers come with **6.** silver button contacts for intermediate loads, **7.** silver cadmium oxide button contacts for difficult loads, high currents, inductive loads, motor loads, lamp loads, **8.** Western Electric #1 gold button or **9.** crossbar contacts for low level loads, **10.** palladium button or **11.** crossbar contacts for switching both high and low level loads with the same relay, and **12.** Clareloy button contacts for either high or low level loads. (It's less expensive, but less flexible than palladium.)

Great for appliances, peripherals, office copiers, inc.



Rugged GP3 5 and 10 Amp AC-DC, 3PDT relays with Lexan® case come with either **15.** silver button contacts that promote heat dissipation or **16.** silver cadmium oxide button contacts with higher resistance to welding.

Both the GP2 and 3 are excellent for elevators, industrial controls, escalators, business machines, etc.

Heavy-duty GP2 5 and 10 Amp AC-DC, 3PDT relays are available with **13.** silver button contacts that provide low contact resistance and high electrical conductivity and **14.** silver cadmium oxide button contacts offering a low rate of electrical erosion under arcing conditions.

(continued from page 7)

wire memory programs currently in production at SCI for aerospace and other applications.

I am sure your readers will be interested to know that plated wire is currently a well-proven, fully space-qualified technology with extensive operational history.

Olin B. King,
President

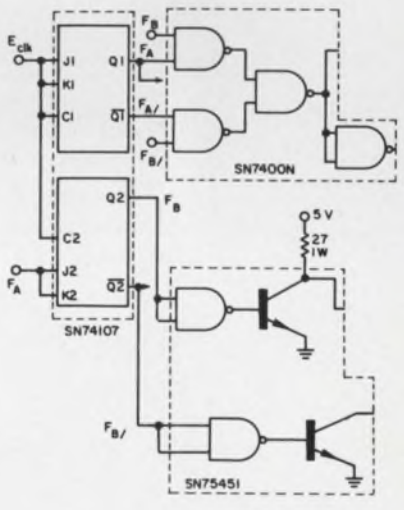
SCI Systems, Inc.
P.O. Box 4208
Huntsville, Ala. 35802

Corrections

In Harold Minuskin's article "Build-it Yourself Stepper Motor Drive" (ED 10, May 11, 1972, p. 52), switches SW1-SW4 appeared as the SN75451 IC switches in Fig. 1. The equation for the coil drive current that appeared on p. 54 did not include the motor coil inductance L. The correct equation is

$$I = K\,[1\text{-}e^{R/L(t)}].$$

Figure 3 did not have the F_{B} and F_{B1} labels at the Q_2 and $\overline{Q}_2$ outputs of the SN74107. A portion of the corrected drawing appears below.

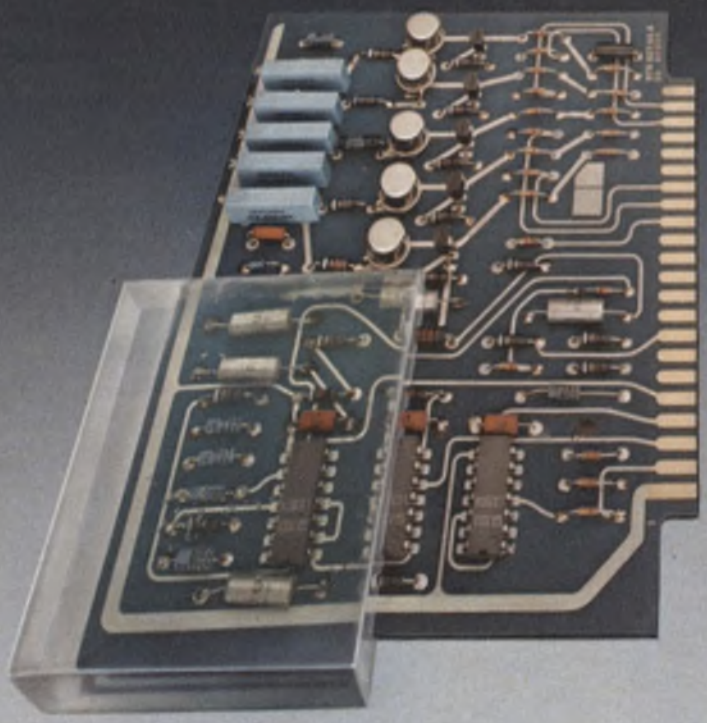


'Don't be an engineer! Be an entrepeneur'

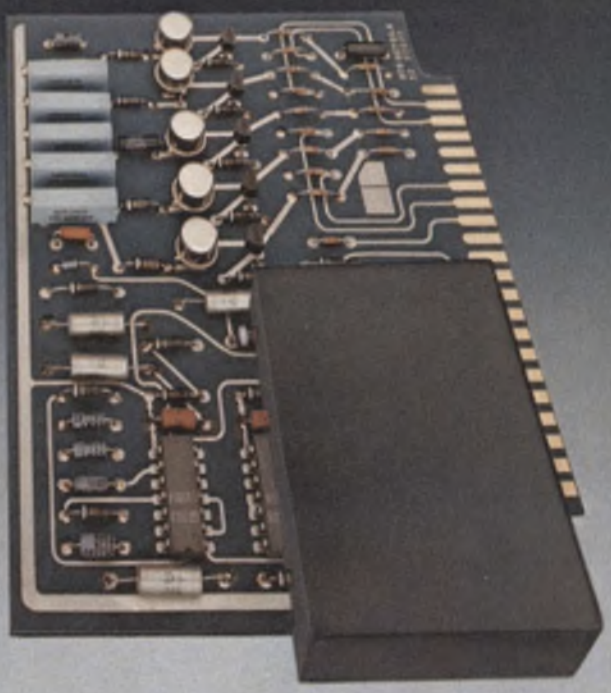
In the March 16 issue, Robert Bruce, MSEE, parrots the oft-repeated cry to "form a strong professional association" (Across the

(continued on page 16)

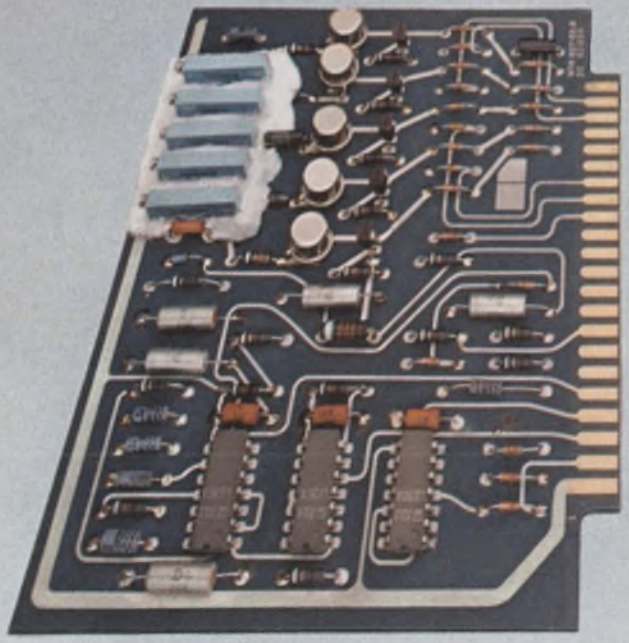
As components become more sophisticated, the versatility of silicones is more evident.



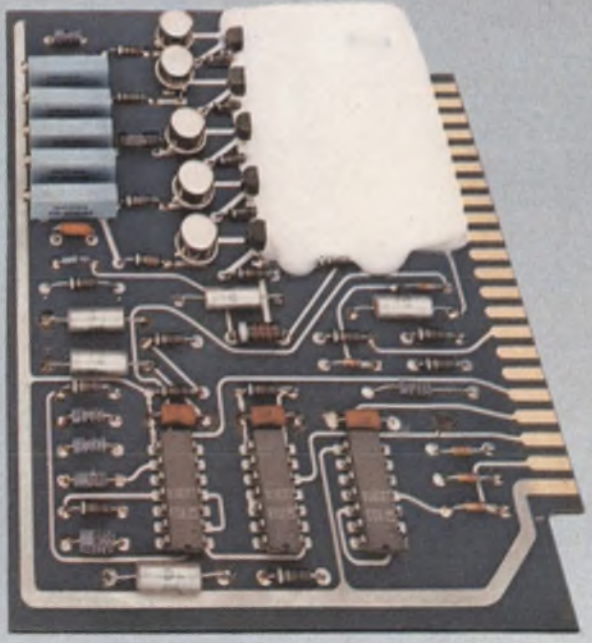
For see-through protection, encapsulate with this clear, resilient silicone resin. Self-extinguishing, it guards against humidity, heat, cold, radiation, thermal shock and vibration. Information retrieval number 221.



For added safety, specify this flame-retardant, pourable silicone elastomer. Uses for this low-cost packaging material include coating, potting and encapsulating. Information retrieval number 222.



For excellent adhesion to corrosion-prone metals such as copper, use this new noncorrosive, one-part Dow Corning sealant. Cure mechanism produces no exothermic heat or acetic acid. Information retrieval number 223.



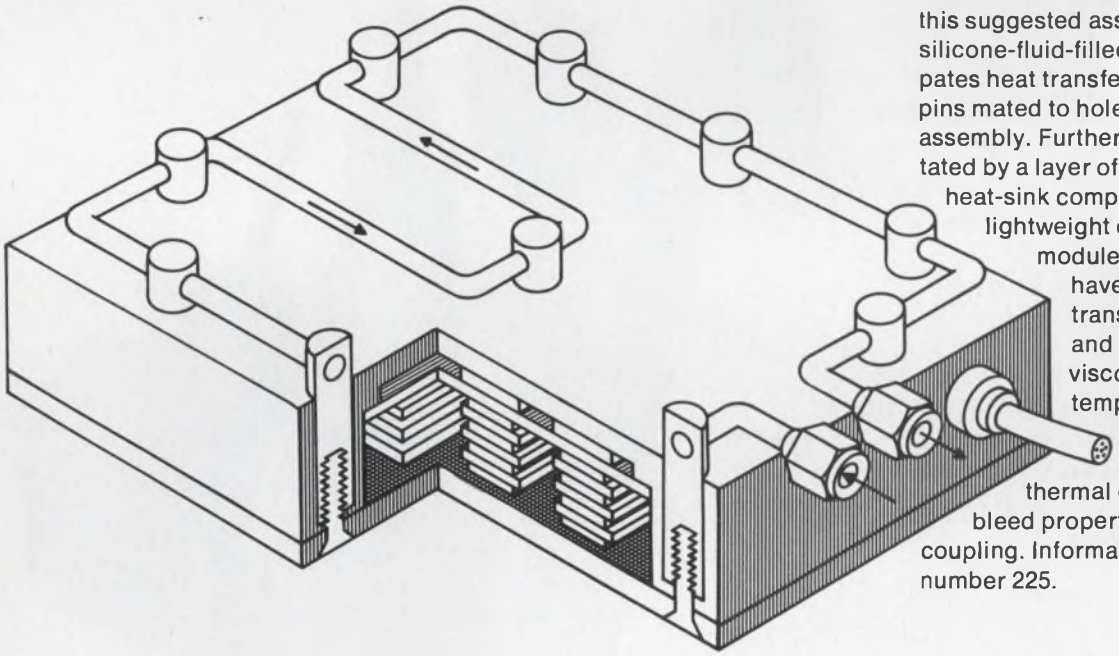
For protection against moisture, dirt, ozone, radiation and many solvents and chemicals, select this conformal coating. It flows on easily and cures at room temperature to a tough silicone rubber with excellent dielectric properties. Information retrieval number 224.

Silicones are unusual in the number of ways they protect. They resist change in hostile environments where other materials are unstable. They have excellent dielectric properties. With the electronic industry's concentration on higher performance and smaller components, the application areas where only silicone materials can ensure design integrity have increased dramatically. Here are some of the newest examples. Many others are described in our Silicone Electronic Materials brochure available from your Dow Corning distributor. His name appears on the following page. Or write Dept. A-2202, Midland, Michigan 48640.

Electrical/electronic materials from

DOW CORNING

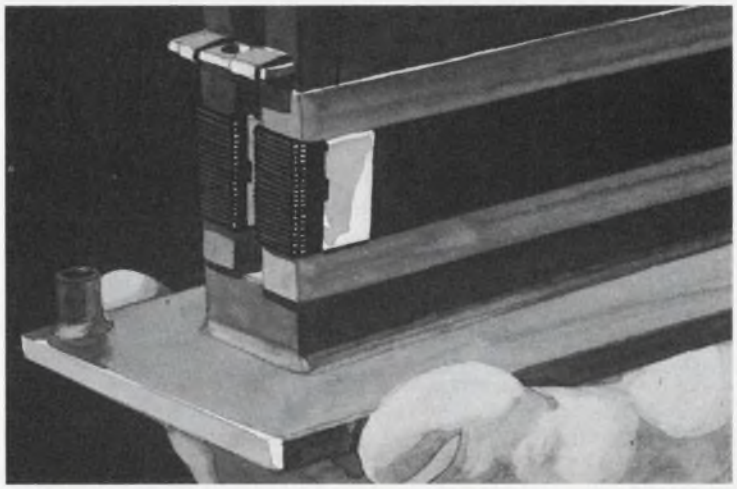
DOW CORNING



Silicones for cooling high-density modules. More efficient cooling of electronic modules is possible with this suggested assembly design. A silicone-fluid-filled coolant tube dissipates heat transferred to it from dowel pins mated to holes in the module assembly. Further conduction is facilitated by a layer of Dow Corning® heat-sink compound between a lightweight cold plate and module base. Silicone fluids have excellent heat-transfer properties and maintain constant viscosity over a wide temperature range. The heat-sink compound has high thermal conductivity and low bleed properties for long-term coupling. Information retrieval number 225.

Silicones add durability to Ominimite* transducer. This magnetostrictive device converts electrical energy into sound for ultrasonic cleaning systems. It is insulated with Dow Corning silicones. Bendix Instruments and Life Support Division uses coil forms fabricated from a Dow Corning silicone resin bonded glass laminate. Finished coils are dipped in Dow Corning® 997 varnish and baked. Silicones help add the physical and electrical stability required for long-term performance. Information retrieval number 226.

*TM, Bendix Corporation



Announcing a reliable way to come in under budget.

Our new commercial Series 8 miniature manual switches provide quality construction and reliable performance at a low cost.

The positive detent action is a good example of our quality construction. It assures you of excellent tactile feedback.

For safer operation, there's maximum separation between the terminals and the metal mounting and operating elements. And our case, using superior arc-resistant materials, has excellent compartmentation to isolate individual internal circuits.

There's a choice of toggles (select from lever styles and colored, slip-on caps), paddles and rockers (snap-in mounting and choice of colored buttons), and lighted rockers. Also select from pushbuttons with colored buttons in two sizes.

All this makes the Series 8 perfect for jobs where money and space are limited, but performance standards aren't. Communications equipment, test and measuring devices, computer peripheral and business equipment are examples. Series 8 switches are rated 6 amps, 125 VAC.

For additional information, see your MICRO SWITCH Branch Office or Authorized Distributor (Yellow Pages, "Switches, Electric"). Or write for our Series 8 Product Brochure.

MICRO SWITCH makes your ideas work.

Shown 20% oversize

MICRO SWITCH
FREEPORT, ILLINOIS 61032
A DIVISION OF HONEYWELL

INFORMATION RETRIEVAL NUMBER 10

(continued from page 11)

Desk, ED 6, p. 7). Cut the semantics and call it a UNION!

The credo of professionalism has been so drummed into us that we tend to overlook hard economic facts: Engineers are merely bodies to be manipulated to suit the needs of business. That string of degrees and titles means nothing to your creditors. Your "challenging" career with the XYZ Co. lasts only as long as the company makes a buck by using you. Your job dies when the work package can be expedited by a cheaper body.

The problem perpetuates itself as long as one persists in remaining a *captive* engineer. The answer: Stop thinking like an engineer and start thinking like a business person! Become an entrepeneur.

To members of the "team," such rabble-rousing talk may elicit feelings of inadequacy. Once you feel inadequate to deal with problems facing you, you have in fact become inadequate.

If you don't dig selling real estate or soap powder, create your own product or service and *go*! I did it and it works—engineering, marketing, manufacturing, my bag runneth over!

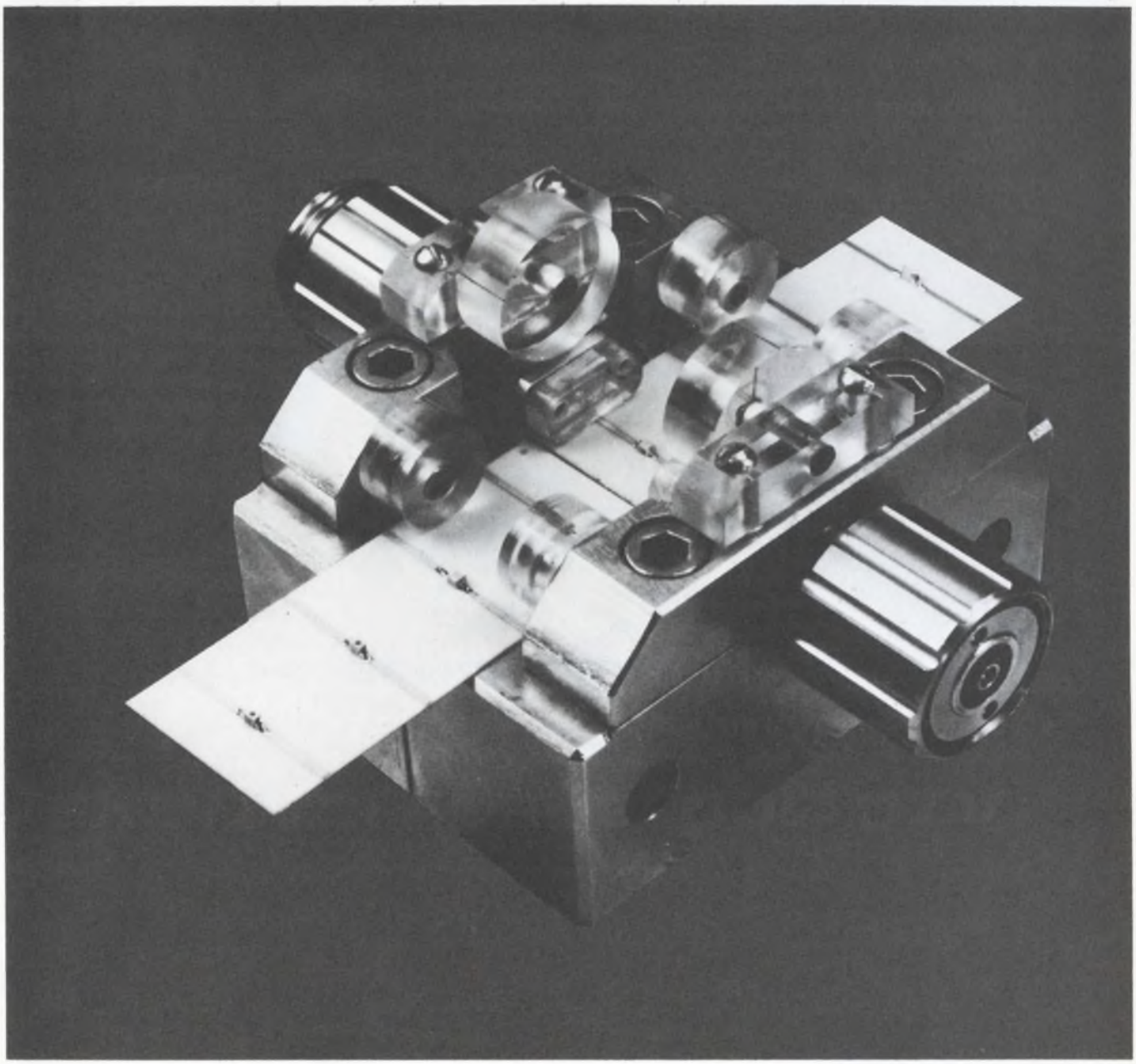
David L. Hirsch
Pres., Chief Engr., Mgr. of Mrktg., Dir. of Mfg., Head Custodian
Seacrafters Ltd.
11815 Indianapolis St.
Mar Vista, Calif. 90066

Acronyms are great—if you know them

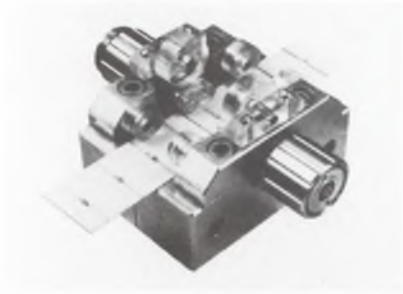
ELECTRONIC DESIGN has been of great help to me, but occasionally a term like "IC" (which, of course, "everyone knows" is an integrated circuit) or "DAC" or "ADC" (which, of course, mean digital-to-analog and analog-to-digital converter) and terms like "MOS" will be used without a definition or at least some details of the transla-

(continued on page 20)

UHF/MICROWAVE CAPACITORS



american technical ceramics



COVER... ATC S PARAMETER TEST FIXTURE

S-Parameter characterization of ATC-100 microwave porcelain capacitors, from 100 MHz to 3 GHz. VSWR, Insertion Loss, S_{11}, S_{21}, X_c and Y_c data (see RF Capacitor Handbook).

COMPANY... AMERICAN TECHNICAL CERAMICS

ATC has been manufacturing fixed, high quality RF capacitors for UHF and microwave equipment for seven years. The Huntington Station plant devotes 7000 square feet of Clean Room area for greenware fabrication, with over 20,000 square feet of modern air conditioned facilities for Q.C., final assembly, and other manufacturing activities. ATC has over 100 employees producing high quality monolithic porcelain and ceramic capacitors.

CIRCUIT DESIGN ENGINEERS

Four experienced RF engineers are available to assist you with your specific application. Dial (516) 271-5112.

CAPACITANCE PER UNIT VOLUME

Case A (actual size) to 100,000 pF
Case B (actual size) to 1,000,000 pF (1 MFD)

Request ultra-high capacitance data sheet.

CAPACITORS, CAPACITORS!

Large inventory for fast delivery of chips and leaded types. Dial (516) 271-9668 for fast, firm delivery dates.

ATC CAPACITORS

ATC 100 LOW-LOSS PORCELAIN

(see pp. A4-A9)

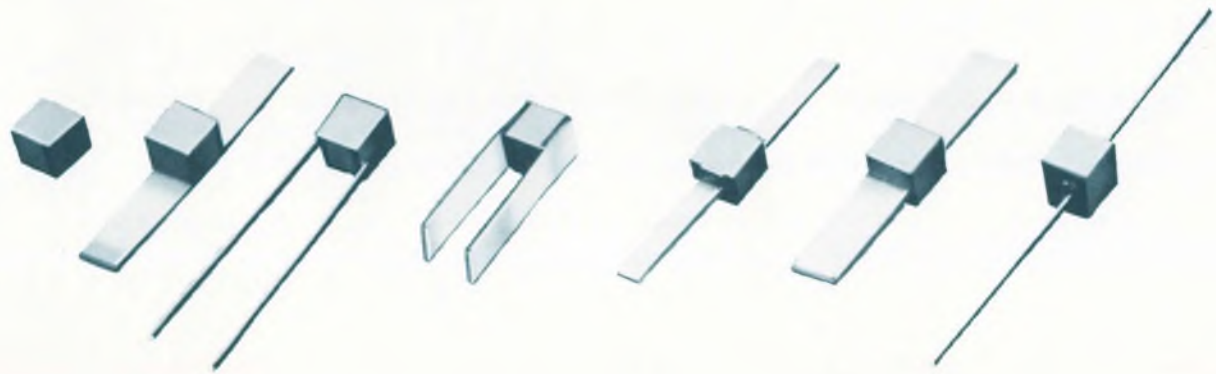
Ultra-High Q	Increases gain and power output Maximizes DC-RF conversion efficiency
High Power	17 Amperes, 3000 Volts, 500 Megahertz
Low Noise	Lowest Equivalent-Noise-Resistance
High Self-Resonance	Allows construction of wideband discrete-component circuits
Ultra-Stable	Minimal deviation with temperature, voltage, frequency, time
Rugged	Withstands severe thermal shock Repeatedly solderable
Hermetic	Impervious even to boiling salt water

ATC 700 ULTRA STABLE CERAMIC

(see pp. A10-A11)

ATC 200 HIGH CAPACITY CERAMIC

(see p. A12)



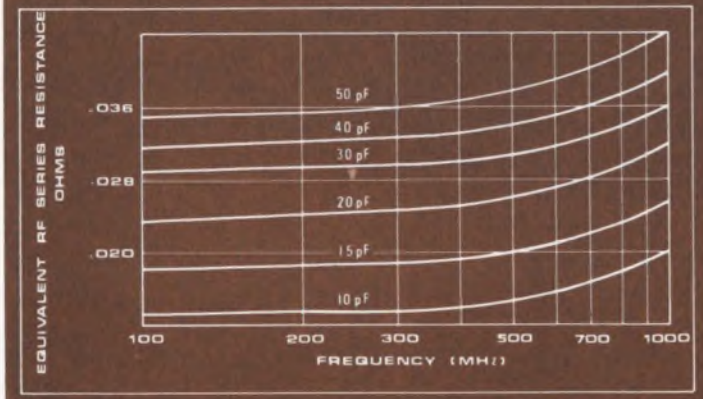
ATC 100

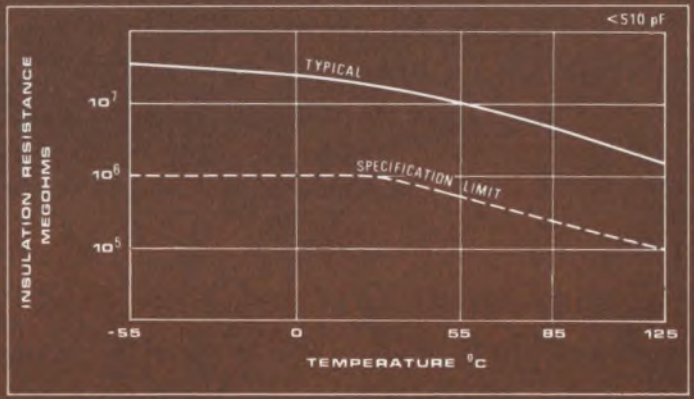
ULTRA HIGH Q is characteristic of the ATC 100 capacitors through microwave frequencies, even at high ambient temperatures, and under extremely high currents, permitting reliable operation at high power levels. Output power increases of greater than 20% per stage are reported when ATC 100's, with their negligible I^2R losses, are substituted for conventional capacitors. The reduction of losses also produces greater DC-to-RF conversion efficiency, improvements of 35% being reported. Improvements in Noise Figure are also attainable in receiver applications.

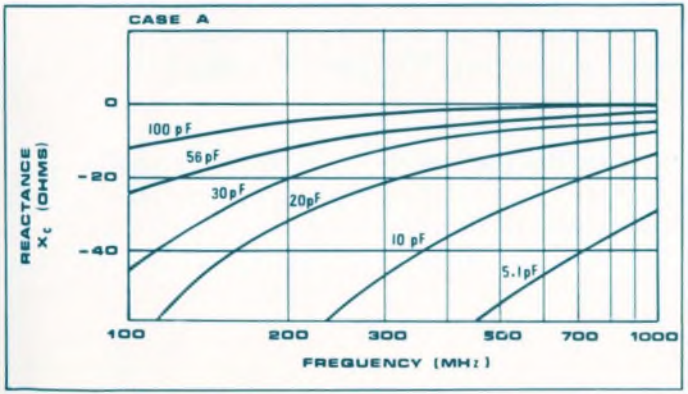
HIGH-POWER operation thru microwave frequencies. Extremely low R_s and high dielectric strength permit 15 KW pulse operation (900 Watts average) at 500 MHz (3000 Volts, 17 Amps RF) in a 50 Ohm system. Other typical applications are 500 Watts (CW) at 1 GHz and 1 KW (Avg.) at 50 Ohms up to 3 GHz.

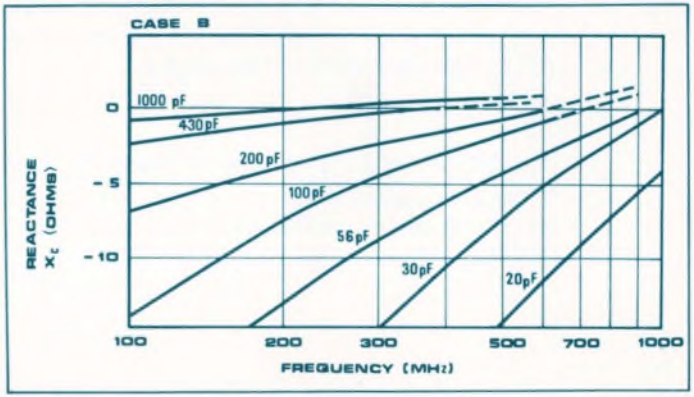
LOW NOISE FIGURE in receiving systems is achieved by the very low equivalent series resistance and extremely high Insulation Resistance of the ATC 100's. In an RF preamplifier, their low R_s helped attain a N.F. of 1.4 dB with a 1.2 dB transistor N.F. at 500 MHz. The high Insulation Resistance (ultra-low leakage) of an ATC 100 used as a calibration capacitor at the input of a charge storage amplifier on an X-Ray Spectrometer made possible a threshold sensitivity of 150 eV.

HIGH SELF-RESONANCE is shown by test data taken on a Hewlett Packard 8542A Network Analyzer covering S-Parameters, VSWR, Reactance, and Insertion Loss over the frequency range of 100 to 3000 MHz.



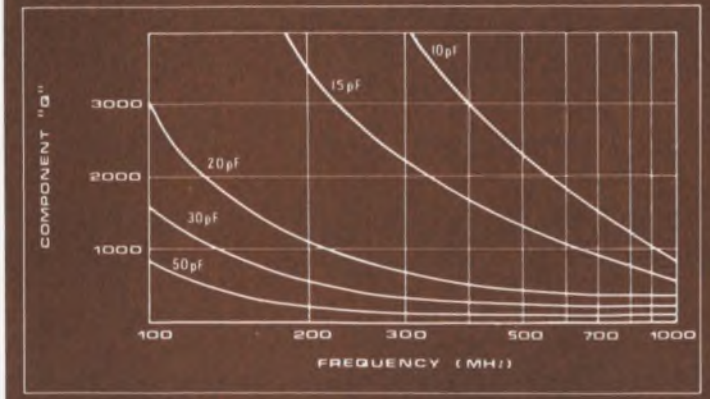


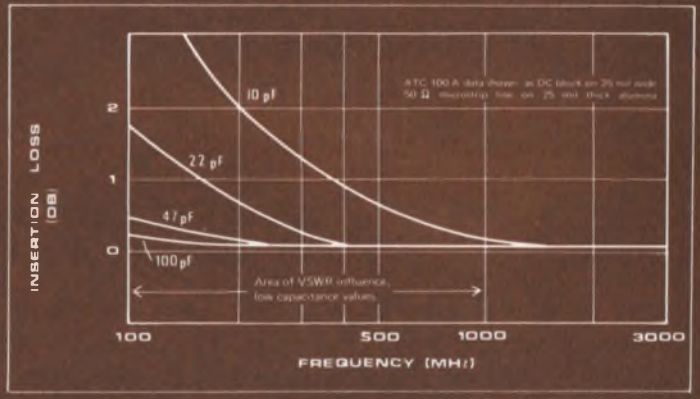


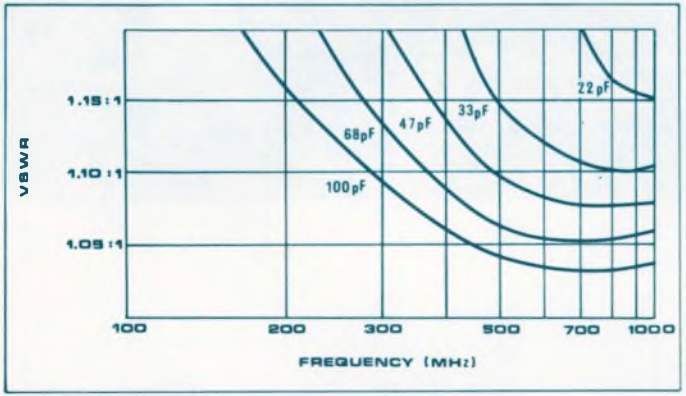


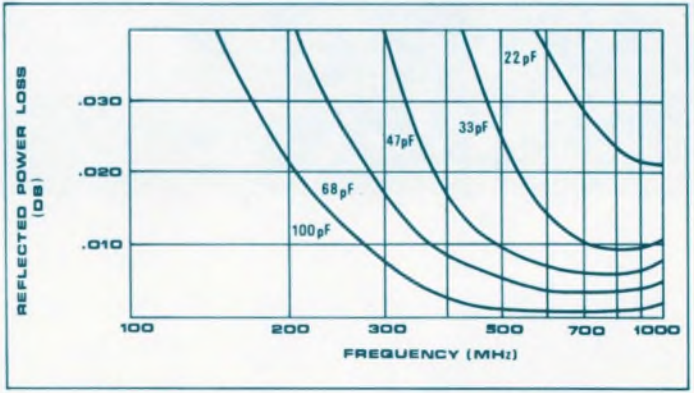
Curves developed in part from data supplied by HP8542A Network Analyzer

ATC 100


COMPONENT "Q"
3000
2000
1000
10pF
15pF
20pF
30pF
50pF
100
200
300
500
700
1000
FREQUENCY (MHz)


INSERTION LOSS (DB)
2
1
0
10 pF
22 pF
47 pF
100pF
Area of VSWR influence, low capacitance values
100
500
1000
3000
FREQUENCY (MHz)


VSWR
1.15:1
1.10:1
1.05:1
68pF
47pF
33pF
22pF
100pF
100
200
300
500
700
1000
FREQUENCY (MHz)


REFLECTED POWER LOSS (DB)
.030
.020
.010
22pF
47pF
33pF
68pF
100pF
100
200
300
500
700
1000
FREQUENCY (MHz)

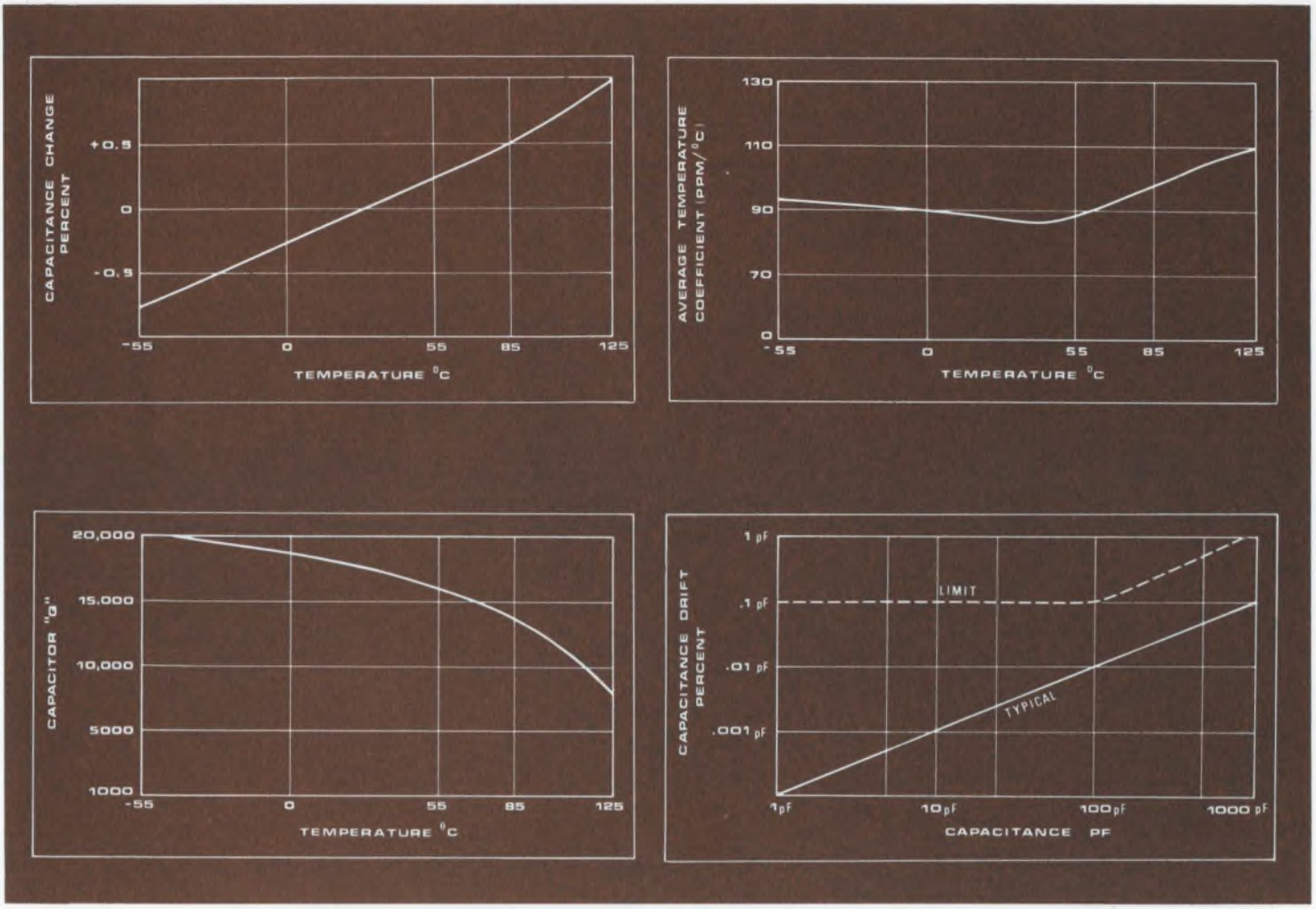
ULTRA-STABLE performance is assured by the self-encapsulating porcelain construction. ATC 100's provide absolute retrace, no measurable drift, and complete stability under extremes of voltage, frequency, time and temperature. They are ideal for high-power, high-current, tuning, or impedance-matching applications.

RUGGED end metallization does not break off under thermal shock; capacitors do not delaminate even if no preheating is used prior to soldering; terminations are not dissolved away by even the most careless soldering.

HERMETIC The severe thermal shock to which capacitors are subjected by direct soldering during circuit assembly can destroy the integrity of conventional capacitors, permitting flux and solvents to penetrate the dielectric. ATC porcelain capacitors are hermetic and are not degraded by the assembly process.

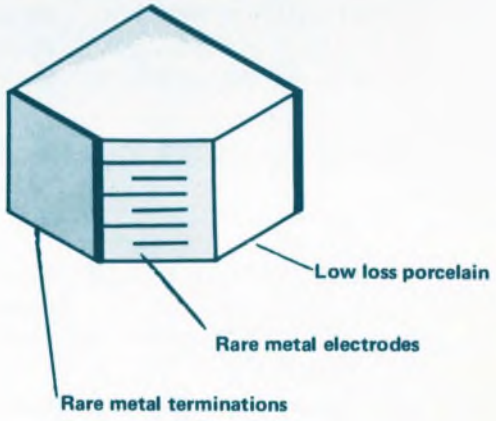
Here is a simple and easy hermeticity test to simulate the thermal shock of soldering and subsequent absorption of contaminants: drop the capacitor into boiling salt water. Remove, wash and verify hermeticity by retesting I.R., capacity, and Q.

CAPACITANCE STABILITY



SELF-ENCAPSULATING PORCELAIN CONSTRUCTION

Rare metal internal electrodes are molecularly bonded and sealed in a monolith of non-porous porcelain. The ATC 100 is a hermetic, microminiature, self-encapsulated, high-voltage, porcelain chip capacitor.



COST ADVANTAGES EXPERIENCED from ATC usage are: increased simplicity of circuit design, shorter equipment development time, and a smooth-flowing production facility. (See RF Capacitor Handbook for specific customer examples.)

ATC 100 SPECIFICATIONS

ELECTRICAL CHARACTERISTICS:

QUALITY FACTOR: (Q_{cap}): greater than 10,000 at 1 MHz.
CAPACITANCE VALUES AND TOLERANCES:
Case A: standard values and tolerances from 0.1 pF to 100 pF (see page A9.)
Case B: standard values and tolerances from 0.1 pF to 1000 pF (see page A9.)
TEMPERATURE COEFFICIENT OF CAPACITANCE: +90 ±20 PPM/°C (–55°C to 125°C)
DIELECTRIC TEST VOLTAGE: 250% of WVDC rating for 5 secs.
RETRACE: Less than ±0.1%.
AGING EFFECTS: None
PIEZOELECTRIC EFFECTS: None (No capacitance variation with voltage or pressure)
CAPACITANCE DRIFT: ±0.1% or 0.1 pF, whichever is greater.
CAPACITANCE RANGE, INSULATION RESISTANCE, AND OPERATING VOLTAGE (WVDC) BY CASE SIZE

CASE A:	.1	pF	to	100	pF	(	50	WVDC);	10^6	Megohms	Min	@	25°C,	10^5	Megohms	Min	@ 125°C
CASE B:	.1	pF	to	100	pF	(	500	WVDC);	10^6	Megohms	Min	@	25°C,	10^5	Megohms	Min	@ 125°C
	110	pF	to	200	pF	(	300	WVDC);	10^6	Megohms	Min	@	25°C,	10^5	Megohms	Min	@ 125°C
	220	pF	to	470	pF	(	200	WVDC);	10^6	Megohms	Min	@	25°C,	10^5	Megohms	Min	@ 125°C
	510	pF	to	620	pF	(	100	WVDC);	10^5	Megohms	Min	@	25°C,	10^4	Megohms	Min	@ 125°C
	680	pF	to	1000	pF	(	50	WVDC);	10^5	Megohms	Min	@	25°C,	10^4	Megohms	Min	@ 125°C

LIFE TEST: 150% rated voltage for 2000 hours at 125°C as per MIL-STD-202C, method 208A (test condition F).
CHANGE IN CAPACITANCE: At 25°C; 0.5% max or 0.5 pF, whichever is greater.
QUALITY FACTOR: greater than 10,000.
INSULATION RESISTANCE: See table above; no degradation.
Standard frequency of measurements, 1 MHz, unless otherwise noted.

MECHANICAL CHARACTERISTICS:

HERMETICITY: The porcelain dielectric is non-porous and impervious to moisture and commonly used cleaning solvents.
TERMINATION STYLES: available in Case A as chips and pellets; Case B units as chips, pellets, and leaded devices. See ATC Capacitor Terminations and Dimensions on page A13.
TERMINAL STRENGTH: All leaded capacitors withstand a lead pull of 5 lbs. for 5 seconds in the axis of the lead per MIL-STD-202 method 211.
OUTLINE DIMENSIONS: See ATC Capacitor Terminations and Dimensions, page A13.

ENVIRONMENTAL CHARACTERISTICS:

MILITARY SPECIFICATIONS: All ATC-100 capacitors meet MIL-C-11272B and MIL-C-23269. (Independent lab test data available.)
TEMPERATURE RANGE: From –55°C to +125°C (no derating of working voltage); above 125°C, derate linearly to 50% DCWV @ 200°C.
ATC 100 porcelain capacitors are designed and manufactured to exceed the following requirements of MIL-STD-202:

Barometric pressure	(method 105, cond. B)	Moisture resistance	(method 106)
Shock	(method 213, cond. J)	Solderability	(method 208)
Vibration	(method 204, cond. B)	Terminal Strength	(method 211)
Temperature Cycling	(method 102, cond. C)	Salt Spray	(method 101, cond. B)
Immersion	(method 104, cond. B)		

ATC SW 100 BOILING SALT WATER TEST: Thermal Shock and Hermeticity Test

PURPOSE: To provide a non-destructive, simulation of the thermal shock and degradation caused by contaminant absorption experienced during normal circuit mounting and "cleaning".
PROCEDURE: With plastic tweezers, drop capacitors into a boiling salt water solution. Remove after two hours, wash thoroughly (distilled water), then dry at 150°C for 10 minutes.
MEASURE: I.R., capacity, and Q (shall be within published specifications).

ATC 100 CAPACITY VALUES

CAP CODE	CAP (pF)	TOL	WVDC 125°C	CAP CODE	CAP (pF)	TOL	WVDC 125°C	CAP CODE	CAP (pF)	TOL	WVDC 125°C
0R1	0.1	B	500	4R3	4.3	BCD	500	680	68	FGJKM	500
0R2	0.2	B	500	4R7	4.7	BCD	500	750	75	FGJKM	500
0R3	0.3	BC	500	5R1	5.1	BCD	500	820	82	FGJKM	500
0R4	0.4	BC	500	5R6	5.6	BCD	500	910	91	FGJKM	500
0R5	0.5	BCD	500	6R2	6.2	BCD	500	101	100	FGJKM	500
0R6	0.6	BCD	500	6R8	6.8	BCJKM	500	111	110	FGJKM	300
0R7	0.7	BCD	500	7R5	7.5	BCJKM	500	121	120	FGJKM	300
0R8	0.8	BCD	500	8R2	8.2	BCJKM	500	131	130	FGJKM	300
0R9	0.9	BCD	500	9R1	9.1	BCJKM	500	151	150	FGJKM	300
1R0	1.0	BCD	500	100	10	FGJKM	500	161	160	FGJKM	300
1R1	1.1	BCD	500	110	11	FGJKM	500	181	180	FGJKM	300
1R2	1.2	BCD	500	120	12	FGJKM	500	201	200	FGJKM	300
1R3	1.3	BCD	500	130	13	FGJKM	500	221	220	FGJKM	200
1R4	1.4	BCD	500	150	15	FGJKM	500	241	240	FGJKM	200
1R5	1.5	BCD	500	160	16	FGJKM	500	271	270	FGJKM	200
1R6	1.6	BCD	500	180	18	FGJKM	500	301	300	FGJKM	200
1R7	1.7	BCD	500	200	20	FGJKM	500	331	330	FGJKM	200
1R8	1.8	BCD	500	220	22	FGJKM	500	361	360	FGJKM	200
1R9	1.9	BCD	500	240	24	FGJKM	500	391	390	FGJKM	200
2R0	2.0	BCD	500	270	27	FGJKM	500	431	430	FGJKM	200
2R1	2.1	BCD	500	300	30	FGJKM	500	471	470	FGJKM	200
2R2	2.2	BCD	500	330	33	FGJKM	500	511	510	FGJKM	100
2R4	2.4	BCD	500	360	36	FGJKM	500	561	560	FGJKM	100
2R7	2.7	BCD	500	390	39	FGJKM	500	621	620	FGJKM	100
3R0	3.0	BCD	500	430	43	FGJKM	500	681	680	FGJKM	50
3R3	3.3	BCD	500	470	47	FGJKM	500	751	750	FGJKM	50
3R6	3.6	BCD	500	510	51	FGJKM	500	821	820	FGJKM	50
3R9	3.9	BCD	500	560	56	FGJKM	500	911	910	FGJKM	50
				620	62	FGJKM	500	102	1000	FGJKM	50

CASE A mini-cubes® * are available from 0.1 pF through 100 pF in the values and tolerances listed above; working voltages 50 VDC, to +125°C. Case A capacitors may also be obtained with a working voltage of 100 VDC on special order.

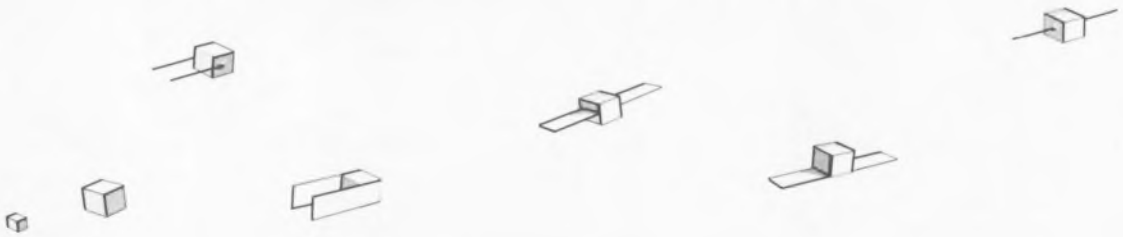
CASE B MAXI-"Q"UBES™ * are available in all values and tolerances at the working voltages shown in the table above. The Case B size may be ordered with a rating of 1000 WVDC, 0.1 pF to 47 pF, or with a rating of 100 WVDC, 680 pF to 1000 pF. To order, specify new WVDC in the ordering code.

TOLERANCE CODE; B = ±0.1 pF; C = ±0.25 pF; D = ±0.5 pF; F = ±1%; G = ±2%; J = ±5%; K = ±10%; M = ±20%

*CASE A mini-cubes® is a registered trademark of ATC. *CASE B MAXI-"Q"UBES™ is a proprietary trademark of ATC.

ATC 700 ULTRA STABLE CERAMIC

- T.C. = 0+30 PPM/°C (–55°C to +125°C)
- To 1000 pF in a 55 mil cube Case A  (actual size)
- Highest packaging density of any NPO capacitor
- To 5100 pF in a 110 mil cube Case B  (actual size)
- No capacitance change with voltage



APPLICATIONS

Excellent for low power levels at UHF frequencies as DC blocks and emitter bypasses . . . . . superior in VHF low power high-stability tank circuits for variable-frequency oscillators, and H.F. discriminators . . . . . reduces variation due to temperature in low frequency filters . . . . . permits predictable RC timing circuits . . . . . replaces mica, polystyrene and teflon dielectric capacitors with much greater capacity values per unit volume and improved environmental characteristics.

CHARACTERISTICS

CAPACITY VALUES: Case A, all standard RETMA values from 47 pF to 1000 pF.
Case B, all standard RETMA values from 200 pF to 5100 pF.
TOLERANCES: F (±1%), G (±2%), J (±5%), K (±10%), and M (±20%).
WORKING VOLTAGE: 50 WVDC
TEMPERATURE COEFFICIENT OF CAPACITANCE: 0±30 PPM/°C (–55°C to +125°C)
DISSIPATION FACTOR: .0005 max @ 1 KHz except .001 for Case A > 470 pF.
INSULATION RESISTANCE: 10^5 megohms minimum @ 25°C; 10^4 megohms minimum @125°C
DIELECTRIC TEST VOLTAGE: 300% rated voltage for 5 seconds.
OPERATING TEMPERATURE RANGE: –55°C to +125°C.
MILITARY SPECIFICATIONS: ATC 700 capacitors meet MIL-C-55681.

Termination Styles: Available in Case A as chips and pellets; Case B units as chips, pellets, and leaded devices. See ATC Capacitor Terminations and Dimensions, page A13.

ATC 700 CAPACITY VALUES

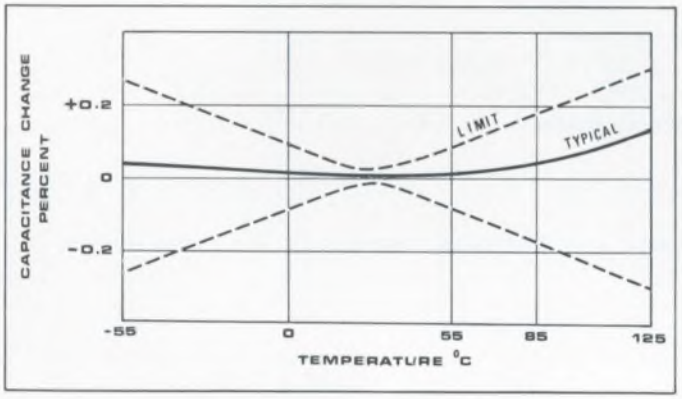
CASE A

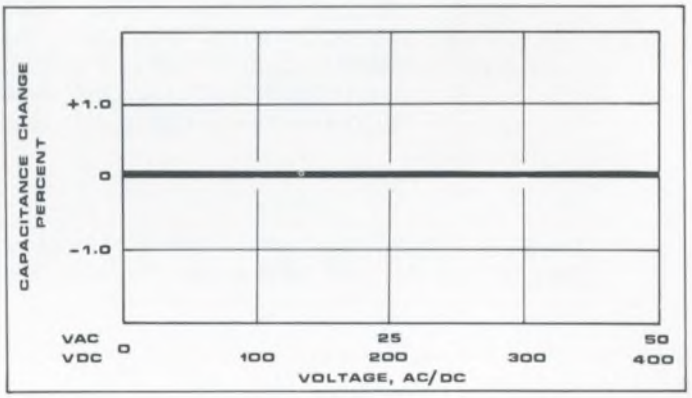
CAP. CODE	CAP. PF	CAP. CODE	CAP. PF
470	47	221	220
510	51	241	240
560	56	271	270
620	62	301	300
680	68	331	330
750	75	361	360
820	82	391	390
910	91	431	430
101	100	471	470
111	110	511	510
121	120	561	560
131	130	621	620
151	150	681	680
161	160	751	750
181	180	821	820
201	200	911	910
		102	1000

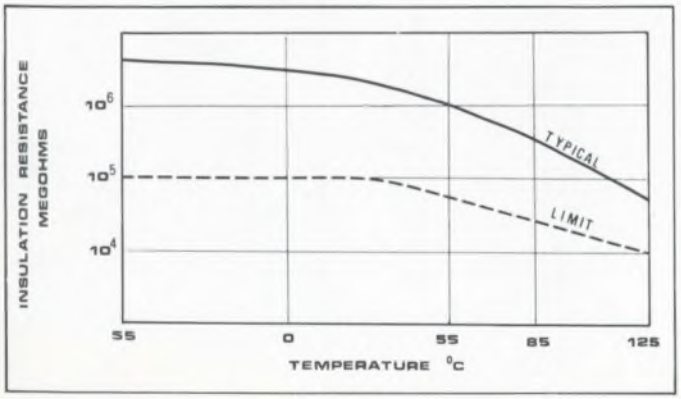
CASE B

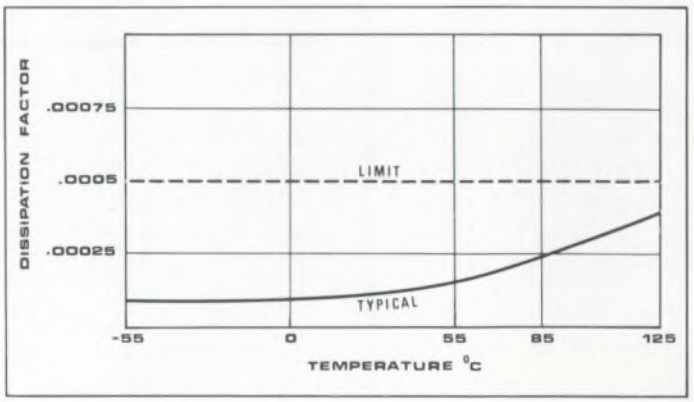
CAP. CODE	CAP. PF	CAP. CODE	CAP. MF
201	200	112	.0011
221	220	122	.0012
241	240	132	.0013
271	270	152	.0015
301	300	162	.0016
331	330	182	.0018
361	360	202	.002
391	390	222	.0022
431	430	242	.0024
471	470	272	.0027
511	510	302	.0030
561	560	332	.0033
621	620	362	.0036
681	680	392	.0039
751	750	432	.0043
821	820	472	.0047
911	910	502	.005
102	1000	512	.0051

CAPACITANCE STABILITY









ATC 200 HIGH CAPACITY CERAMIC

- 10,000 pF in 55 mil case — Case A  (actual size)
- 100,000 pF in 110 mil case — Case B  (actual size)
- Temperature range –55°C to +125°C
- 50 WVDC

CHARACTERISTICS

CAPACITY VALUES: Case A, standard values from 510 pF to .01 MF
Case B, standard values from .005 MF to 0.1 MF
TOLERANCES: K(±10%), M(±20%), and N(±30%)
WORKING VOLTAGE: 50 WVDC (25 WVDC from 85°C to 125°C)
CAPACITANCE CHANGE WITH TEMPERATURE: ±15% maximum (–55°C to +125°C)
DISSIPATION FACTOR: 2.5% maximum @ 1 KHz
INSULATION RESISTANCE: 10,000 megohms minimum
DIELECTRIC TEST VOLTAGE: 150 VDC for 5 secs
RECOMMENDED TESTING SEQUENCE: Cap., DF, IR, Dielectric Test Voltage
OPERATING TEMPERATURE RANGE: –55°C to +125°C
MILITARY SPECIFICATIONS: meet applicable portions of MIL-C-11015D

Termination Styles: Available in Case A as chips and pellets; Case B units as chips, pellets, and leaded devices. See ATC Capacitor Terminations and Dimensions, page A13.

CASE A

CAP. CODE	CAP. PF	CAP. CODE	CAP. MF
511	510	202	.002
561	560	222	.0022
621	620	272	.0027
681	680	332	.0033
751	750	392	.0039
821	820	472	.0047
911	910	502	.005
102	1000	562	.0056
122	1200	682	.0068
152	1500	822	.0082
182	1800	103	.01

CASE B

CAP. CODE	CAP. MF	CAP. CODE	CAP. MF
502	.005	273	.027
562	.0056	333	.033
682	.0068	393	.039
822	.0082	473	.047
103	.01	503	.05
123	.012	563	.056
153	.015	683	.068
183	.018	823	.082
203	.02	104	.1
223	.022		

ATC CAPACITOR TERMINATIONS AND DIMENSIONS

CASE A AND B CHIPS

CODE	CASE SIZE	TYPE	OUTLINE AND TERMINATION MATERIAL * W/T IS A TERMINATION SURFACE	DIMENSIONS		
				LENGTH	WIDTH	THICKNESS
C	A	Chip	Palladium Silver (PdAg)	.055 ±.010 in. 1.4 ±.25 mm.		.055 in. max. 1.4 mm. max.
C	B	Chip	Palladium Silver (PdAg)	.110 ±.015 in. 2.79 ±.38 mm.		.100 in. max. 2.54 mm. max.

CASE A AND B PELLETS (chip terminations solder coated)

CODE	CASE SIZE	TYPE	OUTLINE AND TERMINATION MATERIAL * W/T IS A TERMINATION SURFACE	DIMENSIONS		
				LENGTH	WIDTH	THICKNESS
P	A	Pellet	372°F solder, 62% Sn, 36% Pb, 2% Ag	.070 in. max. 1.78 mm. max.	.055 ±.010 in. 1.4 ±.25 mm.	.055 in. max. 1.4 mm. max.
P	B	Pellet	565°F solder 5% Sn, 93.5% Pb, 1.5% Ag	.130 in. max. 3.30 mm. max.	.110 ±.015 in. 2.79 ±.38 mm.	.100 in. max. 2.54 mm. max.

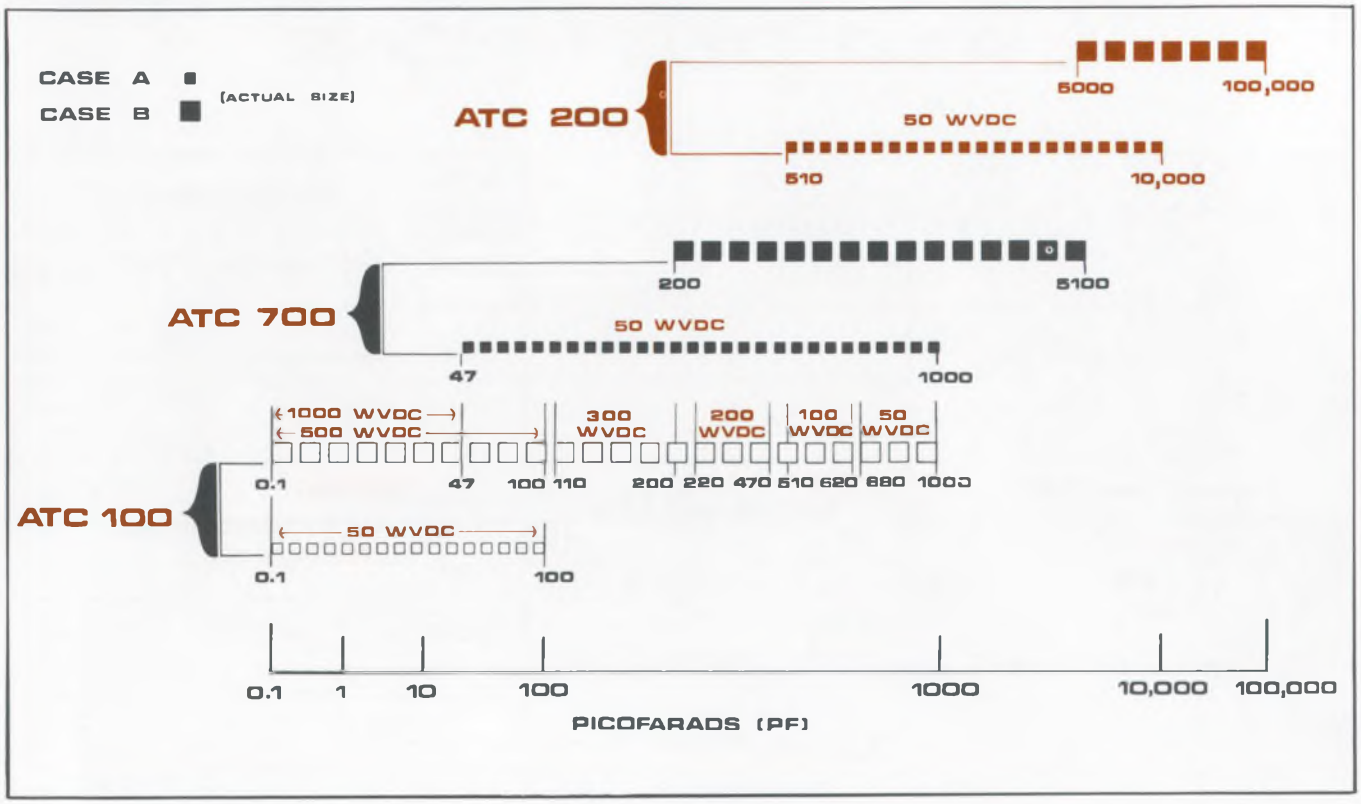
CASE B SILVER RIBBON AND SILVER WIRE LEADS

CODE	LEAD STYLE	DIMENSIONS L = .135 ±.015 in.; 3.43±0.38 mm. W = .110 ±.015 in.; 2.79±0.38 mm. T = .100 in. max.; 2.54 mm. max.	LEAD DIMENSIONS		
			LENGTH	WIDTH	THICKNESS
MS	Micro-strip		.250 in. min. 6.35 mm. min.	0.93 ±.005 in. 2.36 ±.13 mm.	.004 ±.001 in. .102 ±.025 mm.
AR	Axial Ribbon				
RR	Radial Ribbon				
NAR	Narrow Axial Ribbon			.050 ±.005 in. 1.27 ±.13 mm.	.006 ±.003 in. .153 ±.076 mm.
NMS	Narrow Micro-strip				
RW	Radial Wire		.500 in. min. 12.7 mm. min.	#26 AWG, nom. .016 in. dia. nom. .375 mm. dia.	
AW	Axial Wire				

HIGH TEMPERATURE brazed lead withstands 1500°F. These extra-rugged leaded capacitors can be ordered by adding the suffix (HT) to the ATC Termination Code; for example, MS(HT).

CAPACITORS MARKED with ATC logo, capacity, and tolerance code are available for any case B size (including chips and pellets). To order, add suffix (X) to code.

CAPACITOR SELECTOR



ORDERING CODE:

The specimen part number shown below **(ATC 100-B-910-F-AW-500)** designates ATC 100 dielectric, B size case, 91 pF ±1%, with axial wire leads, 500 WVDC.

ATC 100	ATC SERIES (ATC 100, ATC 700, or ATC 200)	
B	CASE SIZE (A or B)	
910	CAPACITANCE (CODE):	ATC 100, page A9; ATC 700, page A11; ATC 200, page A12.
F	TOLERANCE (CODE):	
AW	LEAD STYLE (CODE): page A13.	
500	WORKING VOLTAGE (D.C.)	

Mfg. Ident. #29990

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Jerid Marketing Specialists, Inc.
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Tempe, Arizona 85251
Tel: (602) 967-8861

ARKANSAS

Parvin Sales
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Addison, Texas 75001
Tel: (214) 239-9148

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Mountain View, Calif. 94040
Tel: (415) 961-9686

CALIFORNIA (south)

Wright Engineering Company, Inc.
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Burbank, Calif. 91503
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Wayland Engineering Sales
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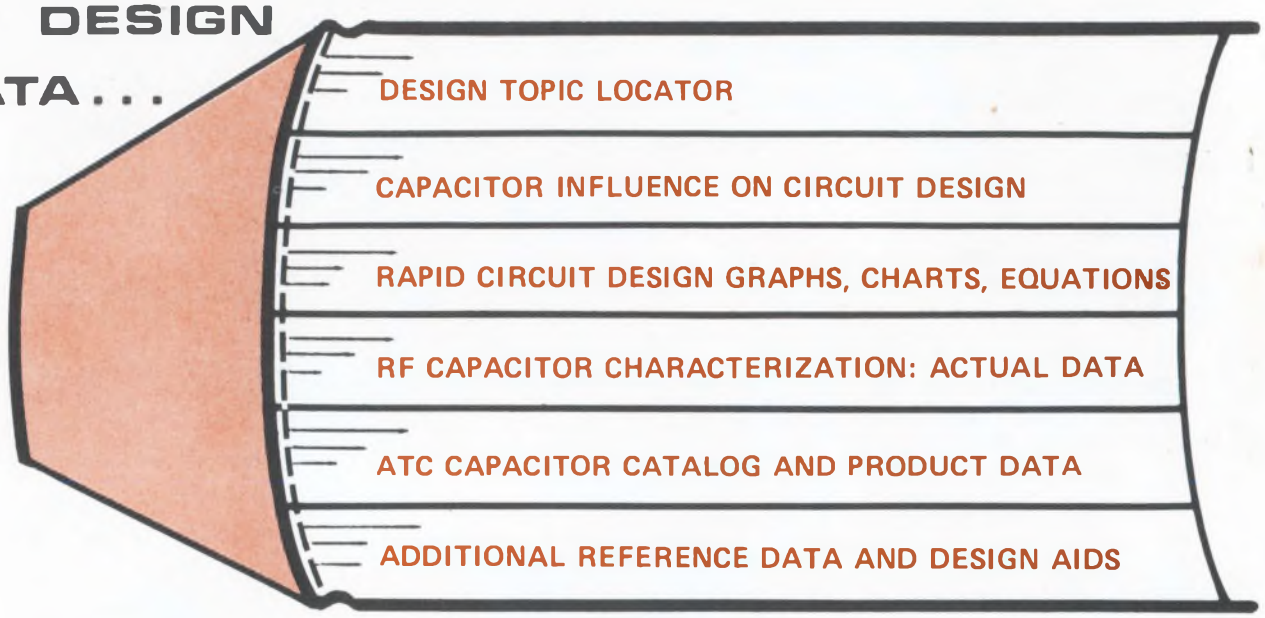

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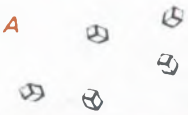
$49.95 KIT 1 — *Microstrip Lead* — *Case B*

60 ATC 100 capacitors, four each of the following values and tolerances:

pF	Tol.	pF	Tol.	pF	Tol.	pF	Tol.	pF	Tol.
1.0	C	5.1	D	16	J	51	J	200	J
2.2	D	7.5	D	24	J	75	J	470	M
3.6	D	11	J	36	J	100	J	820	M

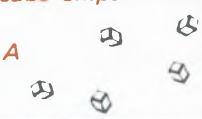
$49.95 KIT 2 — *Minicube® Chips* — *Case A*



125 ATC 100 capacitors, five each of the following values and tolerances:

pF	Tol.	pF	Tol.	pF	Tol.	pF	Tol.	pF	Tol.
1.0	B	2.7	D	6.8	K	18.0	K	47	K
1.3	B	3.3	D	8.2	K	22.0	K	56	K
1.6	C	3.9	D	10.0	K	27	K	68	K
1.9	C	4.7	D	12.0	K	33	K	82	K
2.1	C	5.6	D	15.0	K	39	K	100	K

$19.95 KIT 3 — *Minicube® Chips* — *Case A*



40 ATC 100 capacitors, four each of the following values and tolerances:

pF	Tol.	pF	Tol.	pF	Tol.	pF	Tol.	pF	Tol.
1.0	B	2.7	D	4.7	D	12.0	K	47	K
1.8	C	3.3	D	8.2	K	22.0	K	100	K

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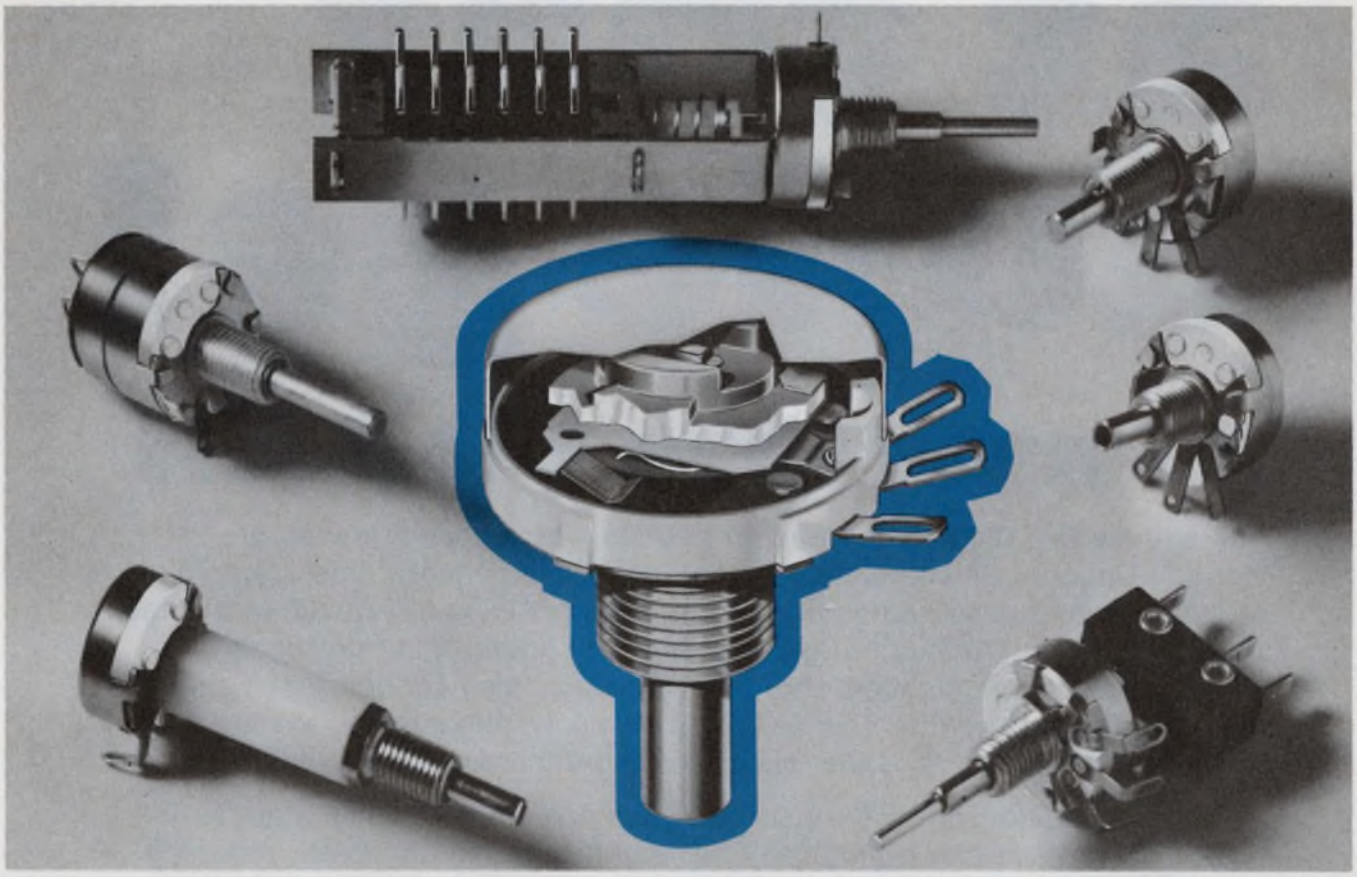
Centralab Potentiometers... in line with your design requirements

Write Centralab for Bulletin No. 1526P3



You can't tell a pot by its cover

You have to look inside to see how a potentiometer is made. Centralab's new ULTRA-ONE™ ⅝-inch potentiometer simply has more quality under its gold finished cover.

The extremely quiet ULTRA-ONE operates within 0.5% maximum CRV (contact resistance variation) for linear tapers—*not just initially—but through 100,000 cycles!*

We did it by an improved resistor system and by using a new contact. This quiet combination is a smooth conductive plastic element and a ten-fingered contact. The result is that CRV is almost unmeasurable throughout the life of the potentiometer.

For versatility, the ULTRA-ONE can be coupled with snap-action, line and push button switches. It's available with a high-voltage bushing and shaft—with hollow shaft—and a high-torque feature.

ULTRA-ONE is the industrial potentiometer line that gives you more design flexibility . . . low noise operation, component add-ons, long life, and high-quality . . . in an extremely attractive package.

For complete specs, write Potentiometer Sales Manager, Centralab.

ULTRA-ONE features

- 0.5% maximum noise through 100,000 ∿
- Multi-fingered contact
- Conductive plastic element
- ± 250 PPM/°C
- ½ watt at 40°C
- 500 volts DC
- Δ R < 10% after load life
- Δ R < 10% after 100,000 ∿

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INFORMATION RETRIEVAL NUMBER 12

Look at that dude go!

85 nsec 1024 Bit RAM

The all new EA1500 sets the pace for RAMs—high speed, low cost—using N-Channel Silicon Gate Technology. 85nsec access time! Yes sir, and that's worst case guaranteed. Price is a low $25 bucks in 100 quantities. And then there's *Automatic Refresh.* Memory timing and control are simplified by the elimination of precharge and refresh addressing. A single write pulse does the job. The EA1500 RAM allows the memory system to be refreshed "invisibly," and that means no more memory busy signals.

In active operation, the EA 1500 dissipates only 160mW while standby is typically 11mW. It can be logically turned off between accesses, reducing standby dissipation to a few milliwatts.

The EA1500 interfaces easily with bipolar logic, operates on +15V and −15V supplies. For other good things about the Dude, write for our data pack and your free Dude pin.

electronic arrays, inc.

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INFORMATION RETRIEVAL NUMBER 13

INFORMATION RETRIEVAL NUMBER 14 ►

More ways to light a one light.

Licon has added LED's to one LPB switch line . . . another line offers neon or incandescent lamps . . . both feature patented Butterfly® switching.

You always get a great choice with Licon® LPB switches. For example, take just two of our many lines – Types 01-700 and 01-600 single light switches. Our 01-700 line is now available with integral Light Emitting Diodes. That means virtually infinite light life and negligible operating current. And the 01-700's low profile design assures maximum light intensity. Or choose neon or incandescent lamps instead. In either line. Mounting styles? Type 01-600 line features bezel or bezel-barrier, in a single switch or multiple in matrix. Time-saving, snap-in mounting. Switching action? Choose from momentary or alternate – plus a selection of non-lighted switches or non-switching indicator lights in matching styles. But whatever you choose, you also get patented double-break Butterfly switching which offers greater reliability and other advantages not possible with single-break switches. Licon LPB's are easily installed and serviced.
Test light them yourself.

Call your local Licon rep or distributor for a lighted demo in your office. Or call or write for a Licon Switch Catalog.
Licon, Division Illinois Tool Works Inc., 6615 W. Irving Park Road, Chicago, Illinois 60634. Phone (312) 282-4040. TWX 910-221-0275.

itw LICON

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(continued from page 16)

tion. It would be helpful if, at the end of these articles, there was a glossary.

Also, I think it might be well to devote some significant amount of space to the question of cost, particularly from the small manufacturer's viewpoint.

L. A. Scholz
Sykesville, Md.

Ed. Note: It's perhaps unfortunate that heavy usage turns common phrases into acronyms whose ancestry, in time, gets lost. The acronyms themselves, when they are well worked into the language, tend to lose their upper-case distinctiveness and become mere lower-case words. Even outside the technical community, for example, most people know what radar and sonar are, but how many of us remember their derivations from RAdio Detection And Ranging and from SOund Navigation And Ranging?

This magazine does try to translate newer acronyms, but we feel our transmission of information would be too much slowed were we repeatedly to translate terms like IC and MOS. We agree, too, that cost is an essential parameter in any design decision, and we include cost information wherever possible.

Reader calls editorial 'insulting' to designers

Your editorial of March 16 ("When Was the Last Time You Created Something?" ED 6, p. 67) shows little knowledge of the American design engineer. American designers are given projects, left alone to solve them and innovate like crazy. The fact that they must specialize does not mean their innovative spirit will be stifled, but rather puts them in a good position to pursue their ideas. This type of editorial is indeed insulting to Amercan designers and reflects a certain prejudice.

Stephen J. Faris, Engineer
Honeywell ISI

10 Brookdale Circle
P.O. Box 52
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INFORMATION RETRIEVAL NUMBER 16 ►

Coil Cords

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Belden has the experience. Hundreds of retractile cord designs that are solving problems in communications, power and control applications. Coil cords in a wide variety of strain and stress relief configurations, special connectors, custom wire assemblies . . .

We've got a new booklet covering coil cord design parameters. It will help you determine important trade-offs between shielding, tensile strength, environmental protection, elasticity, and cost. We'll show you how Beldfoil® can eliminate noise problems that can originate in the shield itself. The advantages of thermoplastic and thermosetting jacket materials. And how to get the right elasticity for your equipment application. Just contact Electronic Sales Service Dept., Belden Corporation, Richmond, Indiana 47374. Phone (317) 966-6681.

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○ I have an immediate coil cord design problem; please contact me.

○ Please send me the new Retractile Cord Design Guide.

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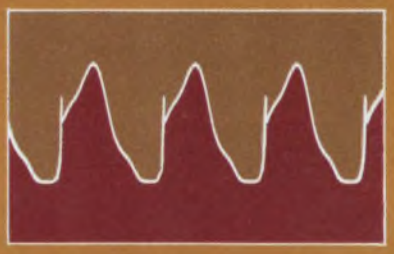
Application_____

8-6-1

Fluke problem solvers

Plug in true rms... at the lowest price available!

These new Fluke plug-in options let you add true rms capability to Fluke 8200A and 8400A DVMs. Take the measure of non-sinusoidal waveforms in 500 ms. Get accurate readings from 1 mv to 1000V rms.



Now you can put true rms to work in your Fluke 8200A for just $595, and for only $750 in the 8400A. These are the lowest prices offered for true rms in 4½ and 5½ digit DVMs.

But price is only part of our story. Even at an unexcelled low price, we offer performance the others don't even begin to match.

For instance, we measure low levels that competitive units can't touch. Why? Because we use an exclusive converter technique which doesn't have square law response limitations of thermal rms converters.

This same technique allows us to measure waveforms that quasi-rms or distortion insensitive converters can't handle. And, we can do it up to five times faster than thermal converters. Mid-band accuracy (50 Hz to 10 kHz) is 0.1%.

A crest factor of seven takes care of waveforms with a duty cycle as low as 2%. Common mode rejection from DC to 60 Hz is greater than 120 dB.

These options are field installable. All other features and specs are those of the respective instrument. The Model 8200A is a high-speed 0.01% 4½ digit voltmeter with 60% overranging, auto polarity, and auto ranging on all functions. It features switched input filter, full 1000 volt guarding. Full multimeter and systems options are available. Base price is $995.

Fluke's Model 8400A is the ultimate bench and systems DVM. It features an accuracy of 0.002%, 1 microvolt resolution, resistance measurements down to 100 micro ohms, auto polarity and auto ranging. For $2450 you get five ranges of DC from 0.1V full scale to 1000 volts with 20% overrange. The switched filter provides better than 65 dB noise rejection for DC, AC, resistance and ratio.

Both DVMs feature 1500V peak overload protection and the ability to meet tough environmental specs.

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FLUKE

INFORMATION RETRIEVAL NUMBER 17

Simplified CAS proposed for all aircraft at low cost

A simplified, low-cost collision-avoidance system (CAS) for all types of aircraft is under development by the Honeywell Government and Aeronautics Products Div., Minneapolis.

Based upon an interrogator-responder (transponder) system that Honeywell has produced for the Army flight training center at Fort Rucker, Ala., the proposed system meets essentially all of the original CAS requirements established for the airlines by the Air Transport Association.

Honeywell system, called Avoid (Avionics Observation of Intruder Danger) has a single frequency. An RCA system, Secant, which is competitive, uses 24 frequencies.

Robert J. Follen, projected engineer at Honeywell, says of Avoid: "The projected costs for an airline system that meets ATA requirements are under $9000."

This is in contrast with some $30,000 for an ATA time-frequency system.

A simpler general-aviation version of Honeywell's Avoid, providing both warning and evasive action indication, could sell for about $1000, Follen says. And a basic version that would give a pilot a warning signal only, could cost about $500, he adds.

The key to the reduced prices lies in the use of several circuits of the basic general-aviation transponder, as well as a simplified solution for a major problem with this type system—the reduction of "fruit," or false returns.

Three techniques are incorporated in the full Avoid system to reduce false signals: altitude encoding, variation of interrogation rate and reduction of this period during which the transponder is sensitive to replies. Computer analysis of the system indicates an average of only 1.3 false pulses per interrogation.

With the proposed system, all aircraft would transmit their altitude along with other signals. Other planes in the same vicinity would reply only if they were at, or near, the same altitude.

The interrogation rate changes automatically with traffic density. For example, Avoid may transmit a set of two interrogations, separated from each other by 3 ms. The first is for aircraft that are 1600 to 3200 feet above the interrogator's own altitude. If no response is received, a second set of interrogations is transmitted one second later. If there is still no reply, the system temporarily stops interrogations in this altitude layer for four seconds.

For altitudes from 0 to 1600 feet about the interrogating aircraft and 0 to 1600 feet below, the interrogations are sent at intervals of 0.5 second. If no aircraft are within the potential threat range at these altitudes, the system temporarily stops interrogations there for 2 seconds.

One other method of reducing fruit is used: A limit is placed on the time during which the CAS receiver is sensitive to replies. If, for example, a maximum range of eight miles is used for slower aircraft, the receiver would be sensitive for only 80 μs after each interrogation.

U.S. urged to foster education electronics

Electronics for education, recognized more for potential than sales at present, has received a strong promotional boost from the Carnegie Commission on Higher Education.

The commission, a private group based in Washington, D.C., recommended that the Federal Government spend from $100-million to $300-million a year over the next seven years to promote instruction based on electronics.

Calling electronics aids "higher education's first great technological revolution in five centuries," the commission foresees videotape cassettes, cable television and computers in general use on campus by the year 2000.

According to the commission chairman, Clark Kerr, electronics can reduce instructional costs, provide more flexibility of approach and a richer variety of content.

Computer voice warns fliers of nearby traffic

The synthetic voice of a computer is warning aircraft within a 50-mile radius of Knoxville, Tenn., of the location of other planes in the vicinity.

The test program is being directed at pilots flying under visual flight rules (VFR). Advisory messages are produced automatically through a system of computer voice synthesis and broadcast over a special 128-MHz frequency.

At present VFR advisories are provided by Federal Aviation Administration controllers who observe the aircraft on their radar displays and warn pilots by radio of other aircraft in the vicinity. However, the warnings are given when the task doesn't interfere with the controller's primary job of controlling aircraft operating under instrument flight rules (IFR).

The Knoxville test, according to FAA Administrator John H. Schaffer, is in line with the development of a system to provide increased service to VFR pilots and also to relieve the workload on controllers.

A pilot within 50 miles of Knoxville can request the automatic voice service from a regular controller. The controller acquires the pilot's plane on radar and then turns it over to computers at Knoxville—a Univac 1230 and a Goodyear Aerospace Associative processor.

The Goodyear computer tracks the plane either by its transponder returns or by direct radar-targets

returns. From the velocities and directions of the various aircraft under control, the Goodyear computer initiates advisory messages whenever planes approach within five miles of each other.

The advisory message algorithms are in the Univac 1230, which also has a priority system for determining the sequence of voice messages to be transmitted.

The 1230 initiates the messages to the pilot over a 2000 bits-per-second data link between Knoxville and Univac's speech laboratory in Egan Township, Minn., where a Univac 1206 computer has the advisory message vocabulary stored in digital form on a magnetic drum. The average word, about 40K-bits long, is read off the drum in half a second. The computer calls the pilot by his aircraft number and informs him of the direction and distance of other aircraft.

The pilot does not answer the broadcast. However, he can always call on 128 MHz a Knoxville controller who continuously monitors the system.

Cryogenic power nets seem feasible in tests

An aluminum power cable—chilled to −320 F—has withstood up to 435,000 V during experiments. This finding has led engineers at the General Electric Research and Development Center in

Cryogenically cooled (−320 F) aluminum power cable withstood 435,000 V at GE's R&D Center.

Schenectady, N. Y. to believe that electric power transmitted by a cryogenic cable system could exceed 3500 MVA—seven times the rating of transmission cables now serving metropolitan areas.

The experiments were carried out by GE over three years at a cost of $1.05-million. The researchers estimated that cryogenic systems 20 to 40 miles long could carry power underground from outer edges of a city into its center.

The first phase of the research project was financed by the Edison Electric Institute, the Tennessee Valley Authority and the American Public Power Association under the operation of the Electric Research Council.

RCA criticizes aluminum TO-3's

Aluminum TO-3 power transistors are being challenged by RCA's Solid State Div., Sommerville, N.J. In a recently completed reliability report, RCA states: "The aluminum package, as it is now manufactured, is unacceptable, and in addition it has some fundamental engineering problems that indicate it may never be a viable hermetic-package system."

All TO-3 packages are supposed to have a reliable hermetic seal. But this is not so, says Eugene VanWagner, RCA's power transistor marketing manager. With aluminum packages, he reports, the solder used to seal the pin leads to the case can develop microcracks during thermal cycling and lead to a loss of hermeticity.

RCA's report is based on tests with type 2N3055 power transistors from three major manufacturers of aluminum devices. RCA uses a steel TO-3 can and is therefore able to use glass, instead of solder, seals.

Leo Lehner, operating manager for power transistors at Motorola Semiconductor in Phoenix, a manufacturer of aluminum devices, dismisses the RCA report, saying that while it is possible for the aluminum cans to develop microcracks, he has no reports of this happening.

VanWagner, on the other hand, says that it is possible for aluminum transistors to have a failure and for users not to know the cause. He is confident that after engineers are made aware of the problem, many unexplained failures will be cleared up.

IEEE acts to upgrade its 1973 exhibition

In an effort to make the 1973 IEEE show more interesting, the organizers are seeking the support of leading trade magazines to help identify "hot" subjects and outstanding speakers.

In the past the trade publications have often criticized the IEEE's technical program. Now they will have a chance to work with the organizing committee to help upgrade the program.

In another development, the IEEE is planning a series of seminars to tour the country. Here again, it is seeking the aid of trade publications to produce these seminars.

News Briefs

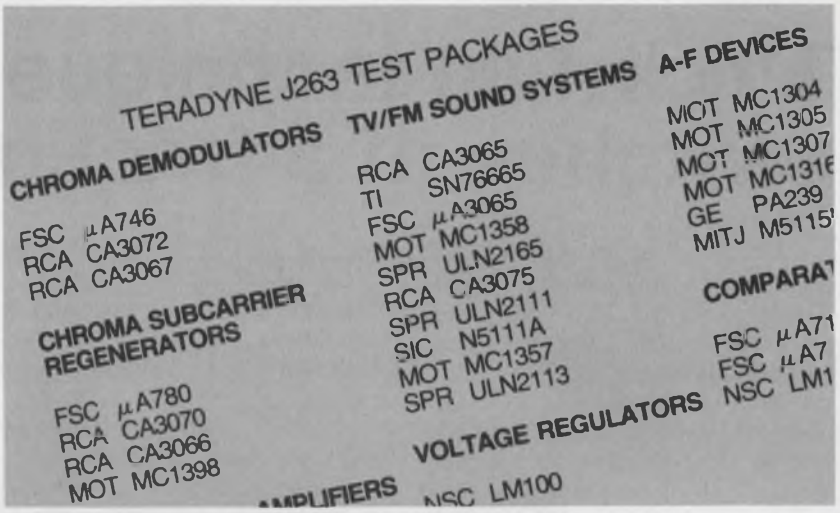
Two photomultipliers built by the Bendix Corp. for the Pioneer 10 spacecraft, now on its way to Jupiter, are **so sensitive that if one were placed in New York and aimed at Los Angeles, the illumination from a 50-W light bulb could be detected.**

Cable-television operators are expected to invest $4.5 billion for equipment and installation services between now and 1980, according to a study by Frost & Sullivan, Inc., a New York market research concern. These investment expenditures, the report says, will be paced by demand for line amplifiers and construction services, each of which will represent annual markets of more than $200-million by the mid-70s.

Motorola and Signetics are working out an agreement to exchange technology and manufacturing know-how. In the soon-to-be announced exchange, Motorola will help Signetics get started in the manufacturing of CMOS integrated circuits in exchange for Signetics' help in PMOS technology.

100% ac testing of consumer ICs

Is it really necessary? Is it practical? Is it available?



Sample testing of TV and radio parts is no way to ensure a good night's sleep. Ideally, both makers and users of consumer ICs should test every device for ac characteristics.

But 100% ac testing sounds expensive, so what do people do? They compromise.

They tighten up on AQL specs.

They make dc correlations instead of true ac tests.

If the return rate climbs, or if bad parts show up in the finished product, they shout a little louder at the vendor or the inspector or the QC manager.

There's a better way.

Our J263 will automatically test for every ac spec from stereo channel separation to chroma demodulation angle to video i-f gain. And it will do it so fast that 100% testing is economically practical.

On an IC production line, the J263 will even wafer probe, and it will multiplex to as many as seven stations.

In incoming inspection, the J263 will datalog chapter and verse on all your suppliers, so you'll know who's shipping you what.

Backing up the J263 is a long list of test packages. They include the applications hardware and software for just about any consumer IC on the market. All the tests have already been worked out with the key producers and users, so you start off with a thoroughly proven, debugged installation.

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TERADYNE

INFORMATION RETRIEVAL NUMBER 18

news

AT THE ELECTRONIC COMPONENTS CONFERENCE

Thick-film technique promises switches at a fraction of a cent

Up till now, thick-film technology has been limited to passive circuit elements. But two papers presented at the Electronic Components Conference disclosed that a quasi-active switching function has been exhibited in a thick-film device. If the technique proves capable of full development, it could lead to the manufacture of switches that cost less than a cent, compared with about 20 cents today.

Thick films are cheaper than the discrete components now used in switches for two reasons: There is a total absence of interconnection steps, and the switches can be simultaneously fired and processed with the other elements on the film. The material costs of such a switch depend on the switch geometry.

The papers were presented in Washington, D.C., last month. One—by Dr. Stephen C. Thayer, Research Physicist of the Photo Products Dept. of E. I. Du Pont de Nemours & Co., Wilmington, Del., and four others—described a new thick-film material that can be screen-printed and air-fired on a ceramic substrate and perform a switching function. The switch also has properties of volatile memory and thermal control.

The other paper—by Richard A. Moser of Owens-Illinois, Perrysburg, Ohio—discussed an amorphous semiconductor switch made with thick-film fabrication techniques. It exhibits a nonvolatile memory effect.

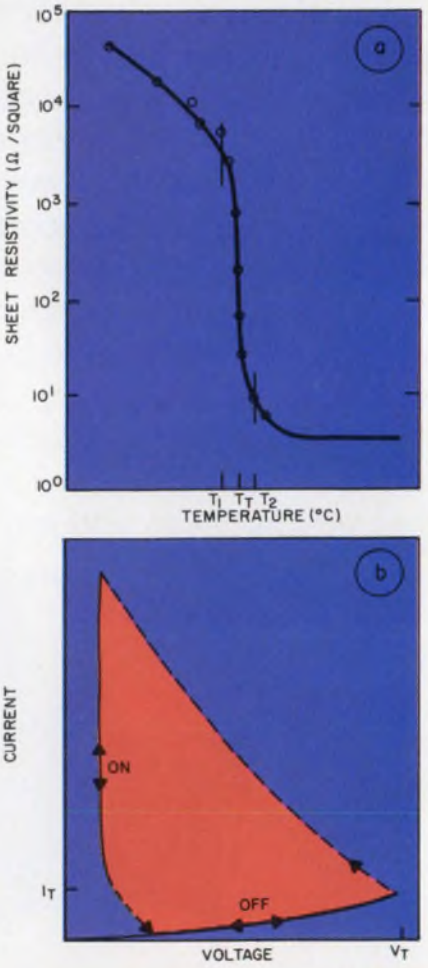
Richard Lee Goldberg
Associate Editor

New material employed

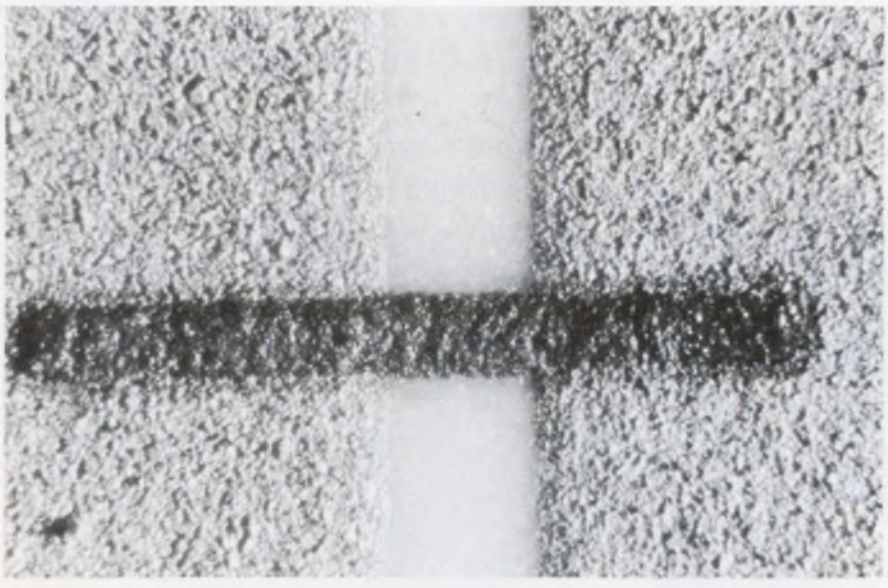
Du Pont's new thick-film material, called Tyox, switches between two states of resistivity that differ by up to three orders of magnitude. The switch may be triggered either electronically or by external heat. Typical rise times during electronic triggering are given as 1 μs.

Tyox is based on four oxides of vanadium. Du Pont would not disclose further details of the material's composition beyond this.

If the switch is triggered thermally, Thayer reported, a transition (Fig. 1a) occurs over an interval $T_2 - T_1$ that is less than 10 C, with a typical hysteresis of less



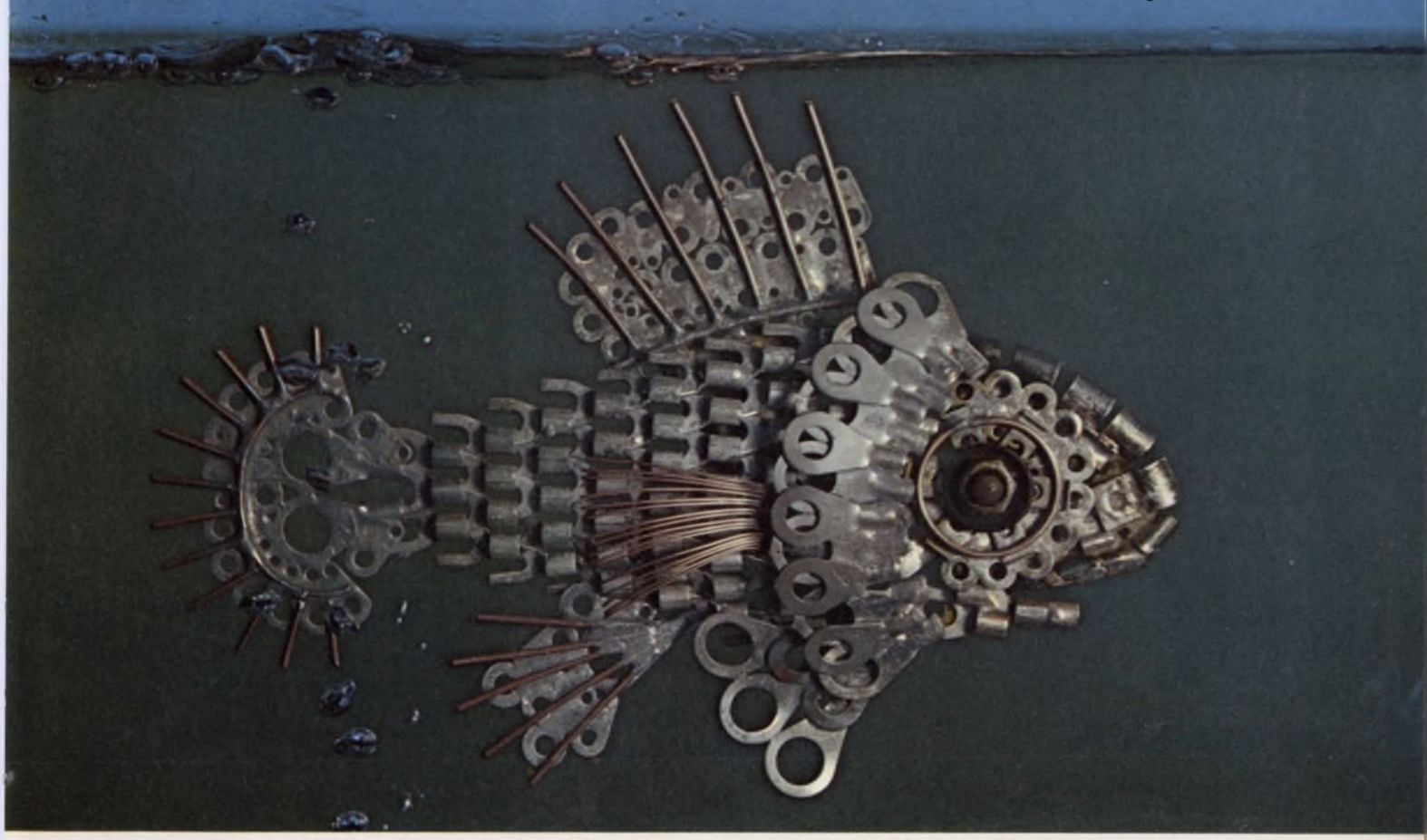
1. **Sheet resistivity** (a) and the current-voltage characteristic (b) illustrate the switching effect.



Photomicrograph shows a two-terminal switch 10-mil wide by 15-mil long (dark line), terminated by Pd/Ag conductors. The light gray alumina substrate, 20 mils thick appears between the conductors.

INFORMATION RETRIEVAL NUMBER 19 ►

Rust. Corrosion. Galvanic coupling. Why tolerate them? Eliminate corrosion indefinitely with Dow Corning silicone dielectrics.



The fish, shown here in a tank of water, has since spent over 312 hours in a salt-fog chamber under accelerated aging test ASTM B117-64. Parts coated with Dow Corning® 6 Compound show no signs of corrosion.

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than 1 C. The transition temperature, T_T, can be adjusted between 40 and 70 C through chemical modification of the composition. If considered as a narrow-range thermistor, the switch exhibits a temperature coefficient of resistance of $10^7 - 10^9$ ppm/°C.

If used as a threshold detector, Thayer said, the switch has a current-voltage characteristic shown in Fig. 1b. As the applied voltage is increased, the element draws a low-level current until it reaches the threshold values of both current I_T and voltage V_T. The switch characteristic then passes through a region of negative resistance on its approach to the low resistance, or ON state. The switch remains on until the applied current is reduced to a value near I_T. Its ability to remain in a conductive state, with passage of a low-level current and an applied potential well below V_T, provides the basis for the memory function.

The threshold current and voltage are independent functions of element width and length, respectively, and are expressed by the following:

$$I_T = K \cdot \frac{\text{width}}{\sqrt{\text{sheet resistance}}}$$

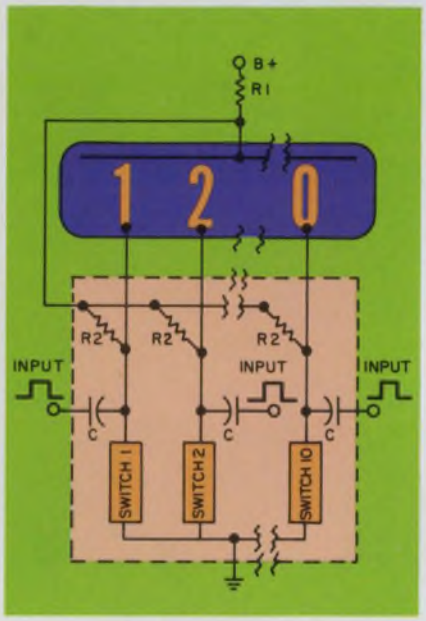
$$V_T = K \cdot \text{Length} \cdot \sqrt{\text{sheet resistance}}$$

The constant K is a function of print thickness and the power density required to switch.

Why switching occurs

Switching, according to Dr. Richard M. Rosenberg, another of the paper's authors, is caused by a change in the crystal symmetry of the material when it is heated. The atom spacing is altered by the thermal activation during self-heating of the material as threshold voltage and current are reached. The change in resistance thus results from a first-order transition between two crystalline states, unlike the behavior of switches based on amorphous semiconductors.

Since the crystallographic change only involves a slight change in lattice constant, the change from the semiconducting to the conducting state is completely reversible.



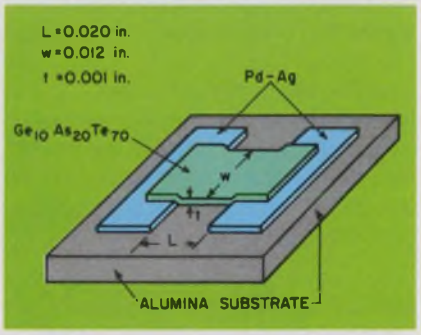
2. **Plasma numeric display circuits** use thick-film switches as memory drivers.

The self-heating mechanism causes the switch to turn off an order of magnitude more slowly than it turns on.

Since switching is thermally initiated, switching time is a function of element cross-section, thermal conductivity of the substrate and ambient temperature.

A switch element (see photo) was used in a plasma numeric display tube-memory/driver circuit. The circuit called for switches having an OFF resistance of 150 kΩ and a 1 mA threshold current.

The switches perform the driving function normally carried out by discrete transistor drivers (Fig. 2). Each switch is biased to a point below its threshold with current from the bypass resistor, R_2. This establishes a voltage drop across the plasma tube elements that is smaller than their ignition voltage, preventing premature lighting of the tube.



3. **Construction of thick-film ovionic memory switch** shows conducting layer between alumina substrate and amorphous semiconductor material.

Nominal threshold parameters for electronic-mode switching are 0.3 to 50 mA and 5 to 20,000 V. Stability has been demonstrated by a series of 3-mil-wide elements that exhibited less than a 5% change in threshold parameters after cycling 10^{11} times with 30 V of sawtooth pulses at the maximum frequency of 100 kHz.

Nonvolatile memory switch

The paper by Moser of Owens-Illinois described the first nonvolatile memory switch made by thick-film processing and composed of an amorphous semiconductor material —a screen-printable technique that has been used with thin films. Thick-film fabrication offers the advantage of higher threshold voltages, ranging from 40 to 250 V.

Substrates are prepared with two Pd-Ag contacts spaces (Fig. 3). The $Ge_{10}As_{20}Te_{70}$ amorphous semiconductor is then screen-printed across the gap between the contacts.

Switching from high to a low resistance state occurs when an applied voltage pulse (exceeding the threshold level) creates a filament-like conducting path within the amorphous material. The nature of the conducting filament is thought to be a local ordering of atoms (crystallization). However, this theory does not explain the ability of the filaments to move laterally within the amorphous semiconductor without further formation energy.

The conducting path maintains the low-resistance state until it is destroyed by a high-current pulse, returning the switch to the high-resistance state. Thus the device exhibits a nonvolatile switching effect. The change in resistance is typically at least three orders of magnitude, with turn-off times in the range of several milliseconds, according to Moser. ■■

(coverage continued on p. 30)

Simplify designs, save space and assembly costs with another new chip on the old block.

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Newest of the displays-with-logic is the TIL311, a hexadecimal LED display with an internal TTL/MSI logic chip providing latch, decoder and driver. It accepts 8-4-2-1 data and displays 0 through 9 and A through F with both right and left decimal points.

Other TI displays-with-logic include a 7-segment with latch, decoder and driver and a 7-segment with decade counter, latch, decoder and driver. Both have left and right decimal point versions.

For data sheets on the entire TI hybrid display line, plus applications information, circle 245 on the Reader Service Card. Or for opto Packet 245 write Texas Instruments Incorporated, M/S 308, P. O. Box 5012, Dallas, Texas 75222.

TI's fast-growing hybrid LED display line.

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TIL304	Plus or minus overflow	7.80
TIL305	5 x 7 alphanumeric	13.00
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TIL307	Same as TIL306 but with decimal on right	15.50
TIL308	7-segment hybrid with latch, decoder, driver	12.50
TIL309	Same as TIL308 but with decimal on right	12.50
TIL311	Hexadecimal with latch, decoder, driver	12.50

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Deposited metal underpasses enhance LSI interconnections

Diffused silicon underpasses have been used in complex LSI structures to provide interconnection paths. But there have been shortcomings with this technique. If deposited metal is substituted for the diffused silicon in the underpasses, many of the undesirable characteristics are reduced sharply.

This was disclosed at the Electronic Components Conference in Washington in a paper presented by H. E. Culver, principal engineer of Raytheon's Missile Systems Div. in Bedford, Mass.

Reductions were reported in the following problem areas:

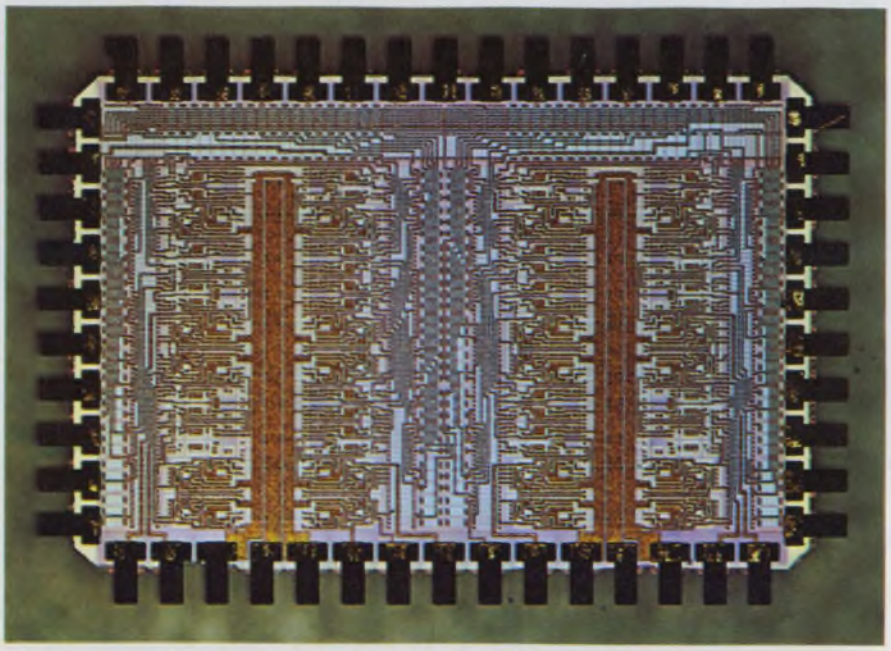
- High parasitic capacitance.
- Resistivity of the underpasses.
- Limitations on yield.

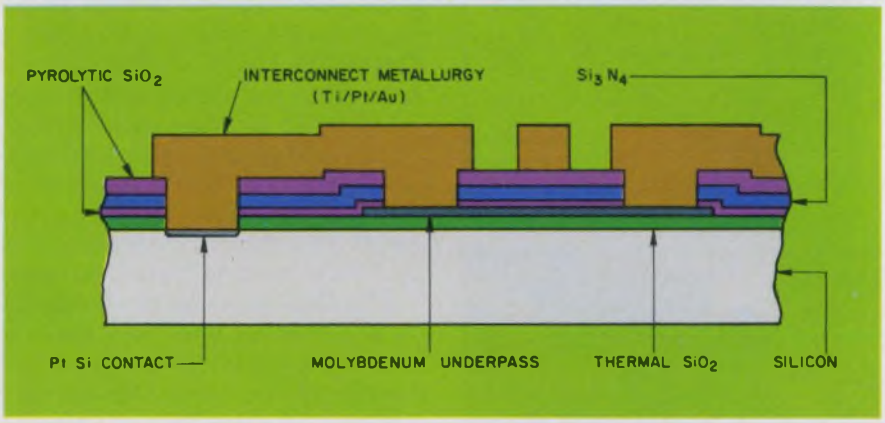
The high parasitic capacitance and resistance inherent to diffused underpasses greatly restrict system speed and fan-out capability. Since deposited metal prevents formation of a pn junction, the sheet resistivity and parasitic capacitance of the underpasses have each been reduced by an order of magnitude.

This decreases signal losses without need to redesign the basic silicon cell or interconnect masks. The metal-deposition process can easily be incorporated in laboratories already fabricating beam-lead, sealed-junction devices.

Molybdenum was chosen because it withstands extended heating to 850 C while remaining stable when the silicon nitride and silicon dioxide depositions are performed over it. Tungsten could be used in a similar manner.

LSI circuits, when fabricated, require either a separate photoresist and diffusion step for the underpasses, or else the underpasses are formed during emitter diffusion. Metalized underpasses eliminate the additional handling required for separately diffused underpasses, Culver reported.





Molybdenum underpasses, which appear as light blue rectangles in the photo above, replace the usual diffused silicon ones to minimize parasitic capacitance, lower underpass resistivity and improve device yield. Active devices surround the gold-colored power and ground bus lines. As can be readily seen, half of the area of the beam-lead LSI chip is taken up by interconnection paths. The cross-sectional view (drawing) shows the underpass structure.

Yield is increased

If the underpasses are formed during emitter diffusion, the requirement that their resistivities be minimized presents a serious constraint on the emitters. The resulting high concentration of phosphorous, necessarily deposited in the emitter areas, is a source of structural defects, such as bulk and edge dislocations and surface damage. This causes enhanced phosphorous diffusion in the regions of greatest damage. Often, the dislocations create emitter-to-collector "pipes," and failure of the entire circuit can result.

Metalized underpasses eliminate the need for extremely high phosphorous concentrations, Culver said. The inherent damage caused by emitter diffusion is thus reduced, and device yield improves.

Besides Culver the paper was authored by R. P. Flynn, P. J. Geiss and H. Schilling. ■■

Sound reading: An aid for blind

Blind people can read printed or typed material at up to 60 words a minute with a new reading aid that identifies letters by producing a different sound for each.

Developed for the Veterans Administration by Mauch Laboratories, Dayton, Ohio, the device uses a 1 × 10 array of photoresistors that control 10 oscillators. The oscillators operate between 440 and 3520 Hz and produce 10 tones, which are combined to form a distinct sound for each letter.

The blind person moves a wand containing the optics and photoarray across the printed material. The image of each letter is projected onto the photoarray, activating individual elements and thus oscillators, depending on the letter being read. The resulting tones are then amplified and fed to two earphones.

The right ear is used to detect letters with upward excursions, such as b, d and l, while the left ear detects letters with downward excursions such as g, j and p. This is done by selectively amplifying the signals controlled by the photoarray. For the left ear, signals produced by the highest elements in the array—those activated by b, d and l—are amplified loudest. Amplification decreases with each element in the array. The reverse is true for the right ear.

New reading aid for blind people.

Power raised in Zig-Zag laser by linking it to 2 smaller lasers

Last year General Electric developed a high-power glass laser called the Zig-Zag Face Pumped Laser (FPL), with an average power output of from several hundred to more than 1000 W. Now, the company has produced two lower-power glass lasers called the Mini FPL and the Big Mini FPL, with average power output of 1 W to a few hundred.

These low and moderate-power lasers will serve as an oscillator and a preamplifier, respectively, for the Zig-Zag FPL, thereby boosting its power higher than it could achieve alone.

The 1000-W is useful for laboratory studies, such as thermonuclear fusion phenomena, as well as for range measurements of satellites and the moon, according to Donald White, manager of the Optical Physics Branch of GE's Corporate Research and Development Center in Schenectady, N.Y., where the lasers were developed. The less-powerful versions, besides boosting the Zig-Zag FPL, can be used alone as range finders in aircraft and tanks and, industrially, for drilling holes.

Glass was used for all three lasers, White says, because it has particularly good properties for giving high output energies in pulses of short duration—from 10 to 100 ps. These features are good for both ranging and drilling holes.

The conventional glass-rod configuration was not used, however. "To increase the power of a glass-rod laser, you have to increase its size—a technique that works only to a certain point," White notes. "A rod more than two to three inches in diameter begins to have thermal problems. It's difficult to get the heat out. Also, energy going into the rod is absorbed."

GE solved this problem by "taking a rod and slicing it up like bologna." The result is a series of elliptical discs, or glass slabs, one-inch thick. They are set at an angle to the beam and surrounded by flash lamps. The slabs are placed in a zigzag line, with the laser beam traveling through them in a straight line. The slabs are face-pumped and face-cooled. Being thin, they cool easily, White says.

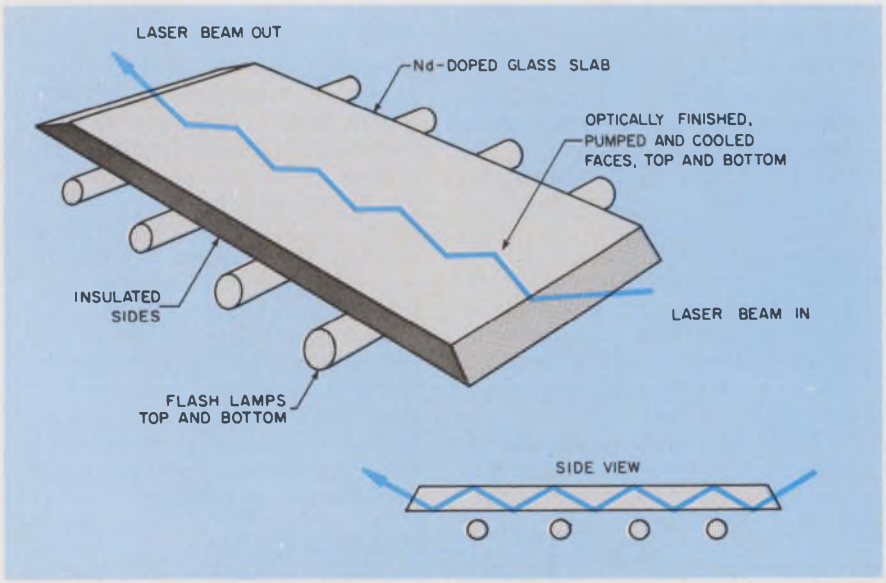
The Mini FPL and the Big Mini FPL, in contrast, use a straight slab of glass and the beam zigzags through it. The glass is neodymium, built with a rectangular cross-section. The laser beam zigzags down its length, being internally reflected off two opposing faces of the slab, which are optically polished. The two faces are also cooled, while the side faces are thermally insulated, causing the center plane of the slab to be warmer than the outer surfaces.

As with the big Zig-Zag laser, flash tubes on both sides of the smaller lasers pump energy into it.

Zigzaging of the laser beam is desirable to eliminate distortion. When the beam passes through all portions of the glass and all its nonuniformities an equal number of times, it averages them out. "Each beam has the same optical history," White explains. ■■

John F. Mason
Associate Editor

GE's new Big Mini glass laser, built for moderate-power operation (up to several hundred watts, average) is the preamp for a bigger laser.



The Mini-Face Pumped Laser uses a straight slab of glass through which the beam zigzags, reflected off both opposing faces of the slab.

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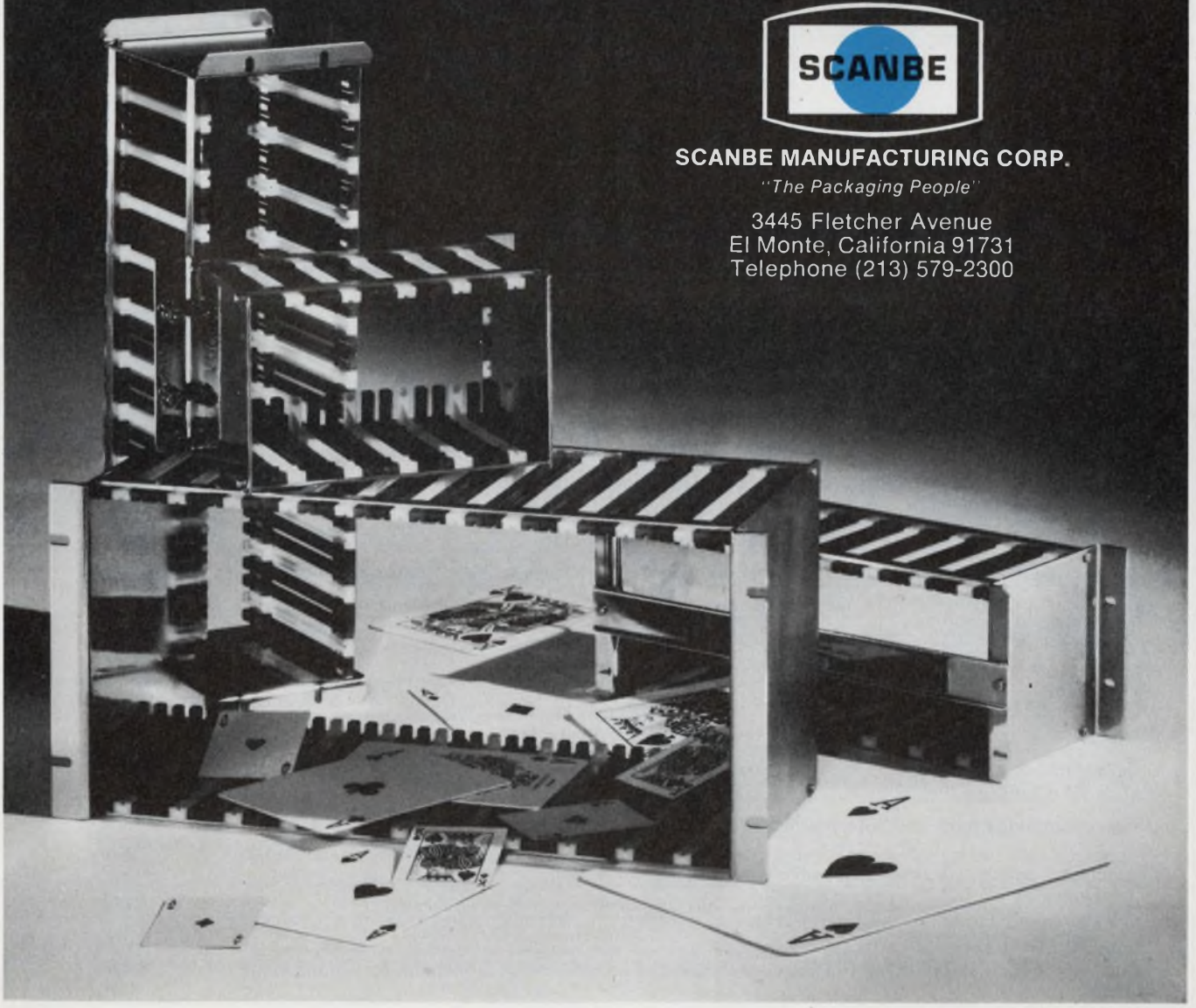

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INFORMATION RETRIEVAL NUMBER 21

EIA crystal ball shows trends in electronics to the year 2012

At a time when the electronics industry is beginning to pull out of a brief but painful slump, the Electronics Industries Association has raised its sights and forecast a range of optimistic electronic events between now and the year 2012.

The predictions were made public last month in Chicago at a long-range planning symposium called "Electronics 1985." Although the conference was mainly marketing-oriented, the EIA gave industry leaders a report on some of the technical developments to look for in the future. The report, "A Backdrop for Planning in the Electronics Industry," was prepared for the association by Theodore J. Gordon, Wayne I. Boucher and Thomas R. Mullaney of The Futures Group, Glastonbury, Conn.

How accurate are the predictions?—They've a 50-50 chance of coming true, according to the EIA.

"The factors delaying the forecasted possibilities are seldom technological," the report notes. "More often they are economic or political."

The report hedges a bit, saying that the predictions are not exhaustive and that the reader may want to add to the list.

The forecast takes on added importance if the statistics presented at an economic session at "Electronics 1985" are taken seriously. That session, led by Bruce R. Carlson, president of the Sprague Electrical Co., North Adams, Mass., indicated that domestic sales and profits would diminish in the U.S. electronics industry if manufacturers failed to expand into international markets and failed to develop new products.

Following are the events forecast in the EIA report:

Richard L. Turmail
Management Editor

Event	Year
Computers and computer technology	
Reduction of the cost of character CRT terminals to that of current teletypewriters.	1972-1975
Availability of computer terminals capable of hard copy at one-tenth of current cost (making computer-aided instruction and hence computer use possible).	1975
Production control minicomputers: 22,000 minicomputers operating various manufacturing processes (against 5,000 in 1971).	1975
Development of devices that can store and retrieve very large amounts of graphical data (100 million to 1 billion entries).	1975-1980
One million data phones in service.	1980
Cost of one bit of IC memory equals cost of current disc storage.	1981
Home terminals available with two-way communications, TV displays with wide range of services.	1981-1985
Wide use of multi-color display devices (liquid crystal, plasma, electroluminescent).	1985
Laser-holography computer memories available.	1984
Magnetic bubble domains used for information storage in computers.	1985
Computers capable of self-repair development.	1989
Computer that comprehends standard IQ tests and scores above 150.	1990
Development of random-access memory capable of storing a collection of documents as large as that in the Library of the National Diet in Japan.	1990
Other communications and information systems	
First large-scale testing of economically productive earth resources reconnaissance (agricultural productivity, pollution sources, mineral deposits, etc.) from orbit.	1973
Operation of communications satellite carrying 200,000 voice channels or equivalent.	1975
Over 100,000 videophones in operation.	1975
Use of fiber optic devices excited by modulated laser to provide cheap broadband communications channels.	1976

Event	Year
Video systems used for instruction in 10% of all schools.	1977
Multiple-user systems: Development of systems capable of simultaneously handling 100,000 data transmissions in peak periods.	1978-1980
Development of sophisticated teaching machines utilizing adapting programs that respond not only to the student's answers but also to certain physiological responses of the student.	1980
Video networks linking campuses, permitting faculty exchange programs.	1980
Operation of helical waveguides carrying 250,000 voice channels or equivalent.	1980
Laboratory demonstration of automated language translators capable of coping with idiomatic syntactical complexities.	1980
Number of educational television stations grows to 380.	1980
High-frequency lasers: Operation of lasers in the X and gamma-ray region of the spectrum.	1985
Commercial use of laser in telecommunication service: first commercial service using lasers for transmitting information; 200,000,000 voice channels or equivalent.	1985
First commercial transmission using lasers.	1985
Voice-to-digital decoder: Development of a voice recognition system capable of producing digital text at low-error rate.	1981-1985
Development of visual output devices that permit three-dimensional viewing.	1986
Wide use of facsimile news services in the home.	1990
Transportation	
Aircraft inflight monitoring and diagnostic telemetry: 20% of commercial aircraft in the U.S. automatically transmitting performance data to ground-based receiver, which compare data to a standard, warn pilots of impending components failures, unsafe conditions and schedule maintenance.	1975-1977
Automated airport and air-traffic control: The replacement of conventional ground-controller operations with automated systems functioning during landings and takeoffs at 10 world airports.	1978-1980
Automated urban traffic control: Installation of systems in at least 20 large American cities, which, through computer control, regulate traffic volumes and speeds, thereby preventing bottlenecks and directing traffic re-routing.	1978-1980
Automobile radar collision-avoidance systems: 20% of all U.S. automobiles equipped with devices that slow then stop automobiles when an impending collision is detected.	Later than 1985
Medicine and health services	
Medical electronics regulations: Establishment of Federal Drug Administration or similar agency of regulations relating to reliability and performance of medical electronics equipment.	1973
Most all hospitals using computers for record storage and data retrieval.	1975
Automated medical check-up booth: A diagnostic series of self-administered physiological tests, monitored and reported automatically.	1975
Demonstration of implantable artificial heart with long-duration radio-isotope batteries.	1980
Clinical decision support systems: Availability in the U.S. of a medical data analysis system in 20% of all hospitals of greater than 500 beds, which, when supplied with physiological data about a patient, performs diagnosis and prognosis and includes medical reasoning.	1978-1980
Common use of electronic anesthesia and pain deadening.	1985
Wide use of electronic prosthetic devices, such as radar for the blind or servomechanical limbs.	1985
Artificial hands with sense of touch and maneuverability close to hands.	1989
Control of human behavior by radio stimulation of the brain.	2000
Remote electrocardiograms: Wide use of instruments that permit electrocardiogram and electroencephlogram reading in the home, transmission via telephone lines, and automated readings in the home, transmission via telephone lines, and automated reading and interpretation.	2000
Manufacturing and production	
Ultrasonic sewing machines: Commercial use of ultrasonic energy to bond fabrics containing more than 35% synthetics.	1972
Most petroleum refineries in the U.S. under automated control.	1975-1980
25% of food companies in the U.S. using automatic control techniques to monitor production, quality and purity for at least half their products.	1980-1985
75% of American-made tires produced in commercially automated plants.	1980-1985
Finance, business and government	
Crime via computer becoming major concern in U.S.; loss of at least $1-billion a year due to computer crime (theft of corporate proprietary information stored in computer files or embezzlement via computer).	1975

(continued on p. 36)

(continued from p. 25)

Nearly 400 EIA representatives gathered in Chicago last month for the opening session of "Electronics 1985."

Event	Year
Data-retrieval system installed for U.S. House of Representatives.	1975
Stock-transfer system: Availability of computer systems to record security sales and transfer ownership and to issue stock automatically on the day of sale.	1978-1980
Financial utility: Establishment of integrated fiscal services, including automated transfer of funds among subscriber accounts, automatic deposit of salaries, centralized credit checks, etc.	1978-1980
Automated supermarket check-out system: Installation in 1% of all supermarkets of computer-controlled inventories and check-out systems linked to pricing and purchasing system.	1978-1980
Checkless society: Point-of transaction debiting in 20% of metropolitan areas (connected to the financial utility).	1981-1985
Personal data bank: Use in the U.S. of a central data bank containing statistics on most all U.S. residents, including data about credit and financial transactions, arrests, etc.—with access rigidly controlled.	Later than 1985
Housing and household appliances	
Wide market for home video recording and playback devices.	1975
Computer-controlled education available in the home; cost on the order of $100.	1980
Economical 3-D color TV set.	1980
Very wide use of microwave ovens in the home.	1980
Practical use of video tape recorders for leisure purposes and for record-keeping.	1981
Computer-aided customized tailoring (computer directs the whole process from fitting to cutting to sewing).	1985
Individual portable two-way communications devices carried by most people in U.S.	1990
Complex robots that are programmable, self-adaptive and capable of performing household chores, such as preparing meals and cleaning or disposing of dishes.	1990
Robots directed by humans for mechanical contact sports.	1991
Preselected food cooked automatically at a preset time.	2000
Other	
Transparent ceramics: Commercial use of ceramics (polycrystalline alumina and yttrium oxide that are transparent to visible and IR energy.	1975
Ferroelectric ceramics: Commercial availability of ferroelectric ceramics wafers for storing video images.	1975
Microelectronics: Component packing density increased by two orders of magnitude at the cost of today's circuitry or less.	1975
Air purifiers: Electrostatic systems that kill bacteria and odors and eliminate pollen and dust.	1980
Directed-energy weapons: Use of electromagnetic radiation from lasers or other sources, particle beams, etc., as weapons.	1980
Development of a semiconductor element with output of more than one kilowatt in the microwave portion of the spectrum.	1985
Electronic slide rules: Essentially all slide-rule functions performed electronically by pocket sized device costing no more than $25.	1985
Developing of a method of predicting earthquakes (one month in advance, greater than 6 on the Richter scale) for areas as small as 1000 square miles.	1994
Automated recognition techniques: Development of techniques to recognize human characteristics, such as faces, fingerprints, etc.	1991
Elevated temperature superconductors: Wide use of superconductors in the 20 to 30 K range.	2012

Scanner flies at 5000 feet

A broadband, multispectral scanner array has been developed for use on small aircraft to analyze earth resources spectrally. It will identify crops and their condition, mineral deposits, algae growing in water and oil film on water. It also will assess damage caused by floods.

Manufactured by United Detector Technology, Inc., of Santa Monica, Calif., for Daedalus Enterprises, Inc., of Ann Arbor, Mich., the array matches the information channels of ground stations for the Earth Resources Technology Satellite to be launched by NASA this summer.

In operation in an aircraft flying at 5000 feet, the array views a strip 78 degrees wide. The image is transmitted through diffraction optics and divided into 10 spectral components from 0.4 to 1.0 μ. The output from each element is recorded on tape in the aircraft or is telemetered to ground stations from a satellite. The 10 planar, diffused elements are constructed on a single chip of silicon, with each element antireflection-coated to maximize response within the wavelength band of each detector.

The area of each element is 0.003 to 0.025 inch squared. The spectral response is from 4000 to 10,000 Å. The noise equivalent power is 10^{-11} W. Crosstalk is 1% between adjacent channels. The dark current is a very low 1 nA. Capacitance is 6 pf. ■■

Ten-element spectral array will analyze earth resources from small aircraft flying at 5000 feet.

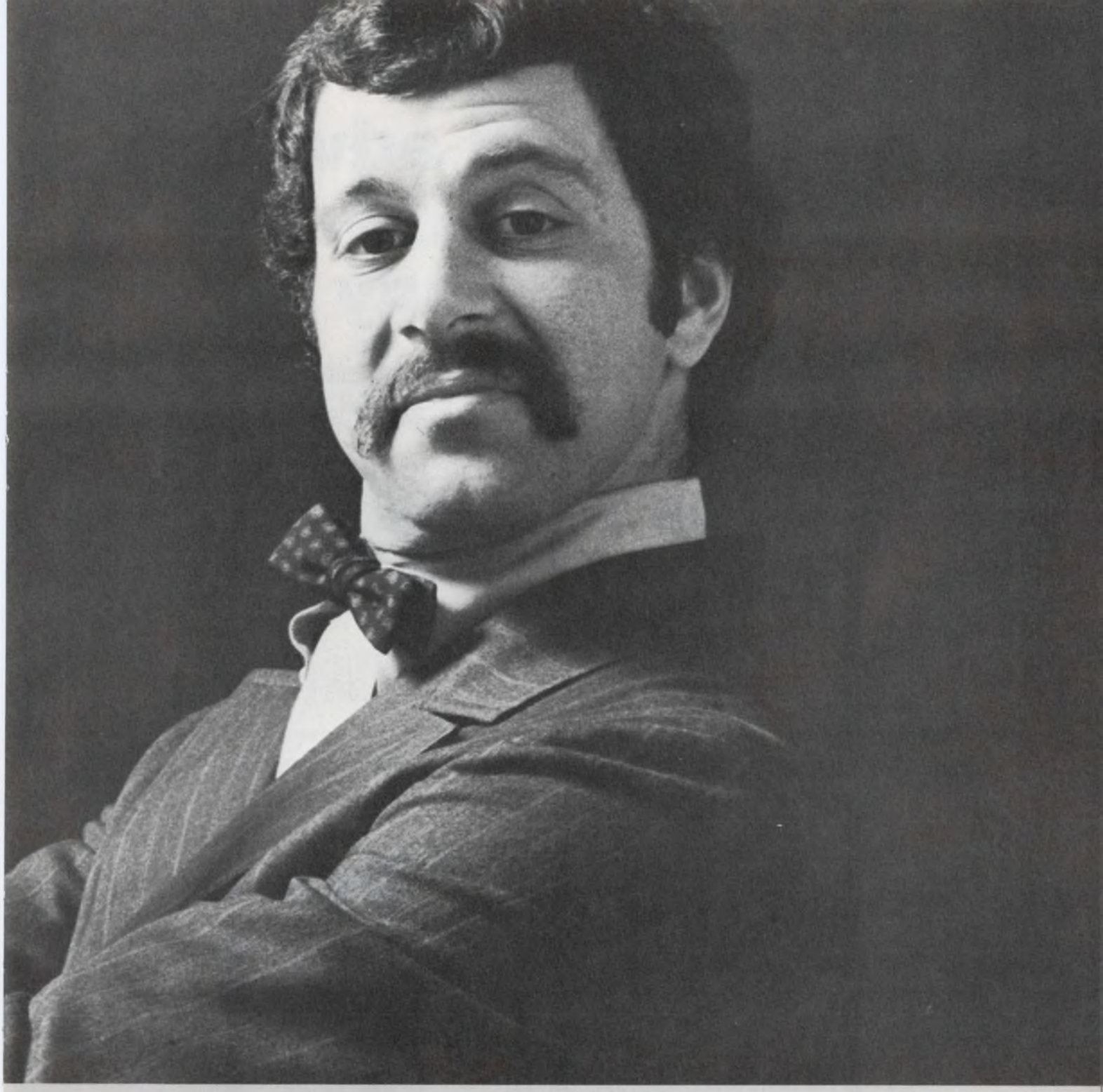
PDP-8. PDP-11. For OEM's

A few months ago, we came out with new low cost versions of our PDP-8 and PDP-11 families for the OEM.

With prices as low as $2436. In quantities of 50.

We made sure they'd have the features, architecture and compatibility that make PDP-11 and PDP-8 the most popular, most imitated minis ever.

We must have hit on the right combination. We've been mixing it up with some of the toughest OEM's around. And coming away with their business.



who hate to spend money.

We're after your business, too. Because now we have the right computers. At the right prices. From the right company.

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Digital Equipment Corporation, 146 Main Street, Maynard, Mass. 01754. (617) 897-5111.

European Headquarters: Geneva.

digital

INFORMATION RETRIEVAL NUMBER 24

MEASUREMENT NEWS
information for better measurement

JUNE edition

in this issue

IC troubleshooting that pays for itself

The plot to simplify computer graphics

Meet our spectrum analyzer family

NOW: an automatic sweeping synthesizer

Combines state-of-the-art frequency synthesis, precision amplitude control, and HP calculator technology.

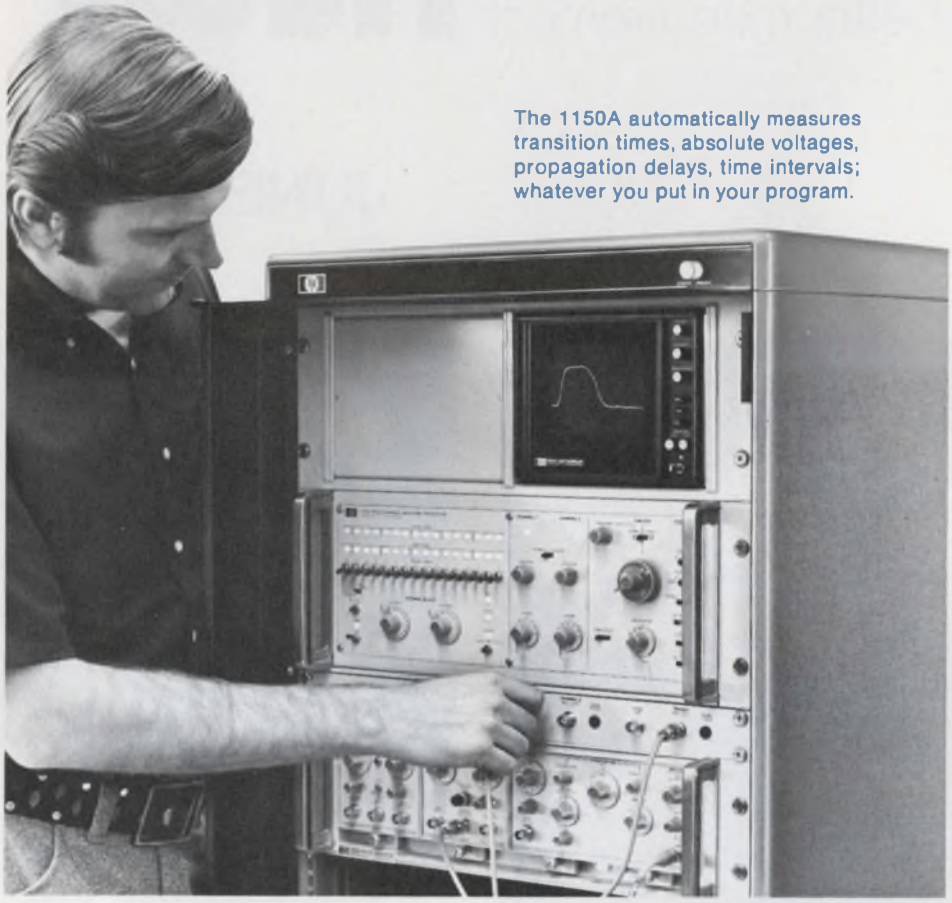
HP's two new frequency synthesizers represent a new generation of signal sources. Besides constant resolution of 0.1 Hz up to 13 MHz, spectral purity and a stability of $\pm 1 \times 10^{-8}$/day, both synthesizers have read-only-memories built in to control all instrument operations. You don't need an external computer for automatic operation; both models are programmable. You merely input parameters directly on the synthesizer's pushbutton keyboard.

Solid-state displays show frequency and amplitude on the 3330B, and frequency only on the 3330A.

The A version has a manual

(continued on page 3)

New waveform analyzer for automated testing



The 1150A automatically measures transition times, absolute voltages, propagation delays, time intervals; whatever you put in your program.

Automatic analysis of complex waveforms is a cinch with the new 1150A programmable waveform processor. Use it in local mode as a stand-alone oscilloscope, or link it to a minicomputer to test electronic circuits on-line.

Basically, this dual-channel, 1 GHz sampling oscilloscope-like processor digitizes incoming analog waveforms after counting the frequency down to 50 kHz or less. For sampling, there are 50-ohm inputs, a 1-2-5 sequence on attenuators and sweep times, internal triggering to 1 GHz, and signal averaging.

Plug the waveform processor into a computer or calculator. The central processor programs the ranges and settings, controls the point along the waveform where samples are taken, calibrates measurement accuracy to 1%, and calculates final results.

To help you write test programs, the 1150A has a unique pushbutton function called LEARN. Simply set up as you would to make a manual measurement from a standard oscilloscope, then press LEARN. All front panel settings are transferred to the CPU, and automatically become parameters in the measurement program.

Price: $12,000.

For more information, check A on the HP Reply Card.

Cable/waveguide tests? Here's a good way

If you are testing transmission lines (coaxial and waveguide), you will want a copy of the new 8325A Microwave Test Set brochure. It describes how, using standard test instruments, you can locate discontinuities, measure insertion and return loss—all on a frequency-selective basis, 10 MHz to 18 GHz.

Check K on the HP Reply Card for your free copy.

One universal counter for all your needs

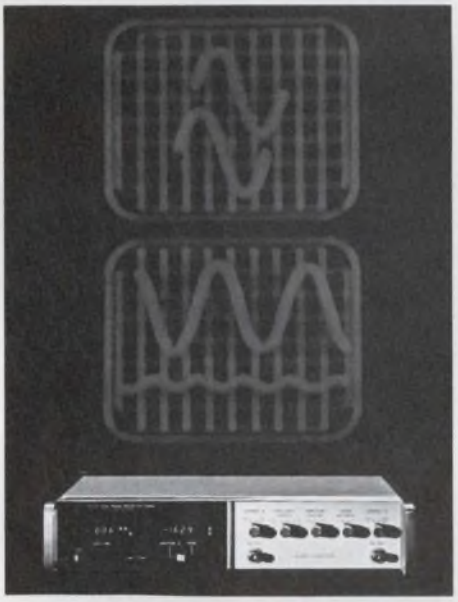
Whether you need a bench instrument or a system peripheral, try the 5326/5327 timer-counters. Moderate prices, extreme versatility, and high precision make these counters truly "universal" problem-solvers. (Just about the only thing they can't do is measure microwave frequencies.)

Your choice is almost universal, too; there are six models and many options from which to select. You buy just what you require, without paying for irrelevant extras and without compromising either your budget or your specification. For example, choose:

- Frequency range from 50 MHz to 550 MHz
- Optional seven or eight-digit display
- The simplest model measures frequency (burst or CW), period average, frequency ratio, multiple ratio, simple time interval, and totalizes.
- Or, the deluxe model that has unique time interval averaging for subnanosecond measurements, plus a built-in three-range integrating DVM for exact definition of time-interval measuring points, as well as external DC measurements.
- High-sensitivity, high-stability time bases and over 12 function-extending options.
- Complete programmability and computer interface.
- Price range from $995 to $2195, plus options.

For all the facts and features, check G on the HP Reply Card.

Delay/loss measurement made easy with new gain phase meter



Measure signals from 0.2 mV to 200V *digitally* with HP's new gain phase meter.

The new 3575A Gain Phase Meter measures both amplitude and phase from 1 Hz to 13 MHz, then displays the answer on a solid-state digital readout. It takes four samples per second with a digital display resolution of 0.1° for phase and 0.1 dB for amplitude. The dynamic range is 80 dB.

Two channels are provided for phase measurements. Shape of the waveform is irrelevant; this meter measures square waves and sine waves with equal ease.

Not only can you measure the amplitude of either channel but, by merely turning a function switch, you measure the ratio of the two channels (in decibels). Ratio simplifies Q measurements and is a handy tool for engineers concerned with separation in stereo systems.

HP's logic circuitry reduces errors caused by noise, a common problem with broadband instruments. The gain phase meter filters and rejects higher frequencies, even harmonics.

This vector voltmeter is a basic instrument applicable to a variety of measurement situations. Instead of using expensive, dedicated instruments for Bode plots, employ the gain phase meter. It measures complex poles and zeros and complex impedance; or use it to test integrators and differentiators over a wide frequency range. An option is available for programming.

Prices range from $2450 to $3150.

For more information, check item E on the HP Reply Card.

continued from page 1

control of its amplitude over a 0 to +13 dB range. The B version, with precision leveled output, has a range of −86.55 dB to +13.44 dB and has amplitude sweeping capability.

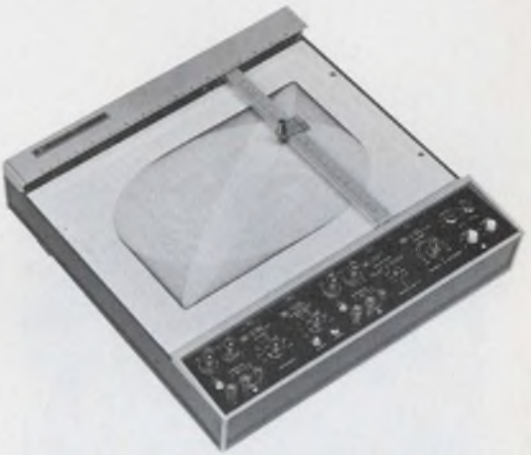
Both units have spectral purity not commonly associated with frequency synthesizers. Spurious signals are greater than 70 dB below the carrier, and harmonics are greater than 60 dB to 40 dB below the carrier (depending on the frequency setting).

The two instruments use precise digital sweeping for linearity—either single or continuous sweeps. Step size can be as small as 0.1 Hz. Parameters are entered from the keyboard; pressing a single button initiates sweep. You can even modify many parameters while the instrument is sweeping.

Whether you need a frequency synthesizer, a precision sweeper, a time-saving bench instrument, or a programmable signal source, consider the 3330 family. The 3330A costs $5100; the 3330B, $6000.

Check item D on the HP Reply Card for all the facts and features.

Nine recorders in one—that's flexibility



The 7004B front panel accommodates up to four option modules at a time—two per axis.

Ever wish your x-y recorder could do more than x and y? The versatile HP 7004B recorder lets you change applications merely by plugging in different function modules. You can record ac from 5 Hz to 100 kHz today, and do some high-speed point plotting tomorrow—all with the same general-purpose recorder.

The 7004B has an 11 in. by 17 in. mainframe. Acceleration is greater than 1500 in/sec^2; slewing speed, greater than 30 in/sec. For high-sensitivity x-y, x-t and y-t plots, insert a module into the front panel. Plot two channels independently and extract signals superimposed on steady state dc.

There are nine modules: a dc coupler, dc pre-amplifier, time base, null detector, dc offset, filter, scanner, ac/dc converter, and dc attenuator. That's equivalent to a roomful of recorders, yet the modules store easily in your desk drawer.

The 7004B costs $1445, and the function modules start at $25.

For detailed information, check item I on the HP Reply Card.

Diversified uses for new HP storage scopes

The 1703A variable persistence scope makes it easy to check slowly moving waveforms, such as in medical equipment.

The 1702/1703 portable variable persistence/storage oscilloscopes provide laboratory quality plus mobility. That's why their applications are so numerous and diversified.

A major use is in servicing digital equipment where low duty cycle pulses are encountered. The integrating feature of the CRT lets you gradually build the intensity of the pulse so that measurements can be made. This is particularly helpful for servicing peripherals and input/output devices.

A second application area is digital numerical control of industrial equipment. Although a computer is controlling the machines, measurements of the control signals often require fairly slow sweep speeds. With variable persistence, you can eliminate annoying flicker to make the trace bright and clear for quantitative measurements.

Battery operation—a first in storage scopes—makes these ideal for outdoor use. The public utilities use them to service remote information and meteorological stations and to monitor signals transmitted from these remote stations to a central receiver. Information on weather, temperature, and humidity may be transmitted infrequently, so storage is needed to capture the information when it happens.

The 1703A (delayed sweep) sells for $2725; and the 1702A (non-delayed), for $2375.

Perhaps you have an application for our new variable persistence scopes. Just check item B on the HP Reply Card.

Inexpensive dc supplies for lab or school

Only 5½ by 3¼ by 8 inches, these nifty little power supplies weigh only 4½ pounds each.

Need a low-cost bench supply? The 6211A (constant voltage/current limited) or the 6212A (constant voltage/constant current) solves your problem. Both power supplies are rated at 0 to 100 V, 0 to 100 mA. Compact size and bargain price make them ideal for circuit design, testing, student experiments, or even your own home laboratory in the basement.

Both models provide a 0.01% load and line regulation, 200 μV rms/1 mV peak-to-peak ripple and noise (dc to 20 MHz), and a switchable front panel meter.

And we do mean low-cost. The 6211A sells for $105; the 6212A, for $130.

To learn more, check H on the HP Reply Card.

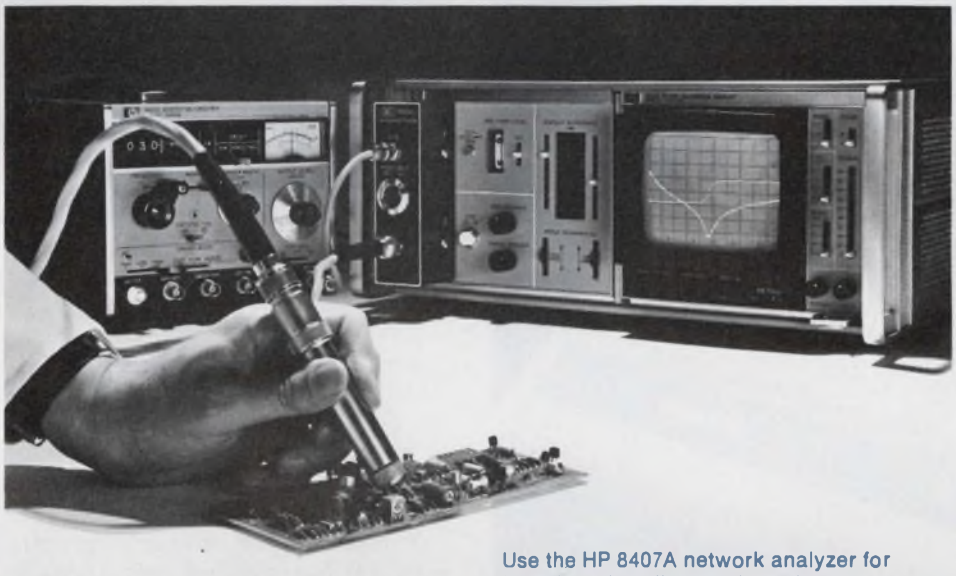
New 'carefree' storage tubes for HP scopes

Tired of giving your storage oscilloscope special care to avoid damaging the CRT? Afraid to use your storage scopes at normal intensities for fear of burning the CRT? HP has solved the problem with a new storage mesh in our variable persistence cathode-ray tubes. New mesh material and processing gives the storage tube ruggedness approaching that of conventional CRTs, making the scopes truly "carefree" in operation.

These 5-inch rectangular CRTs are standard equipment on all new HP storage scopes, and they retrofit earlier models without special adjustments. Don't worry about trade-offs. Writing speed, brightness, storage time and cost are unaffected.

Interested in the new storage oscilloscopes? Just check O on the HP Reply Card.

HP's RF network analyzer: boon for designers



Use the HP 8407A network analyzer for "touch-and-see" swept impedance measuring in circuits.

Designing RF circuits and systems becomes easier and more certain when the elements within are fully characterized. The HP 8407A network analyzer is a "tracking detector" system that interfaces with the HP 8601A sweeper to make accurate swept measurements of network characteristics from 100 kHz to 110 MHz. Magnitude ratios exceeding 100 dB can be measured, and 0.05 dB resolution is attainable. Phase range is 360° with 0.2° phase resolution.

Use the 8407A to measure voltage and current transfer functions, gain/loss and phase shift. There are low-cost accessories for 50Ω and 75Ω coax and probes for circuit measurements. You can also measure impedance, return loss, and reflection coefficient (magnitude and phase). The new impedance probe with 0.1Ω to 10 kΩ range is especially useful for swept impedance measurements of discrete devices or in-circuit elements.

Complete network analyzer systems (sweeper, analyzer with precision display, and full array of measuring devices) are in the $7000 to $8000 price range.

Check L on the HP Reply Card for more information.

Real-time frequency and time analysis

The 3720A Spectrum Display provides a comprehensive and economical frequency and time analysis of complex electrical waveforms, usually those representing physical phenomena.

After receiving the auto-correlation or cross-correlation function from the HP 3721A Correlator, the 3720A Fourier transforms it and displays the resutling power spectrum or cross-power spectrum on a CRT. It also provides ensemble averaging to reduce statistical variance.

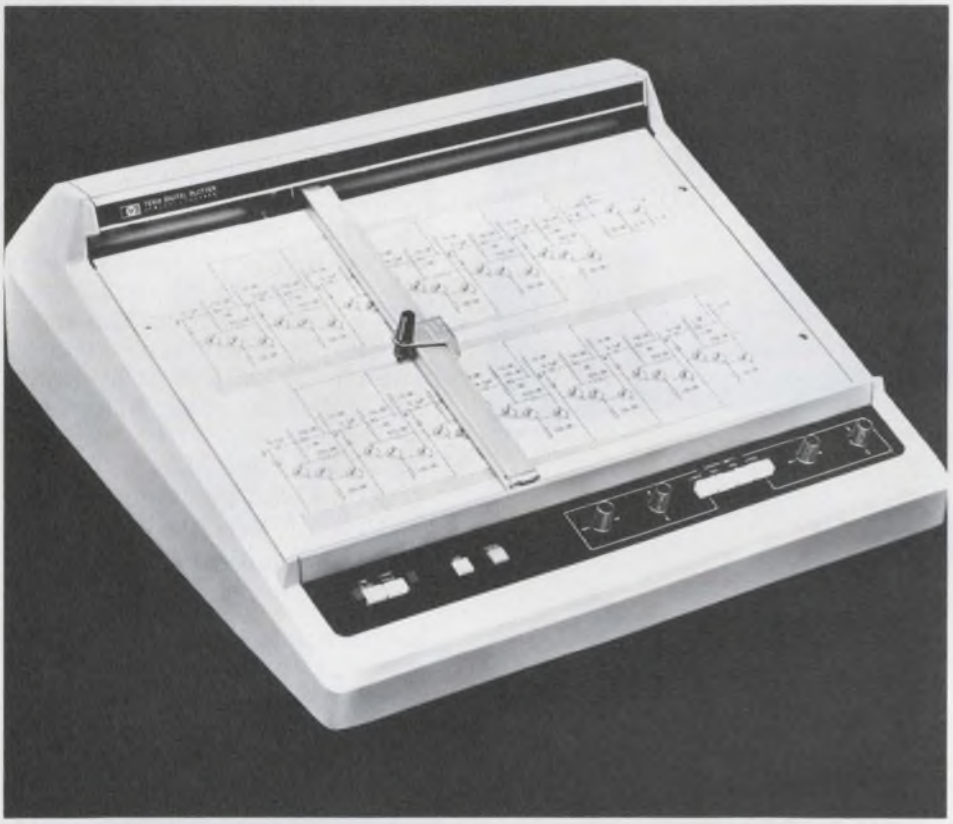
Frequency functions can be displayed in Cartesian or polar coordinates with linear or log scales, as real and imaginary parts, or as Nyquist and Bode plots.

Prices: 3720A spectrum display, $5500; the 3721A correlator, $7600.

For more information, check item F on the HP Reply Card.

The 3720A spectrum display converts 3721A correlator to frequency domain analyzer.

Your computer's running mate: HP's new graphic plotter



The fast, versatile 7210A graphic plotter will even draw your schematics.

Now there is an easy inexpensive way to automatically produce hard-copy graphs. Just connect one of HP's 7200 series graphic plotters to your computer or terminal and get those charts immediately.

There are models that connect to practically any time-sharing or computer terminal operating up to 30 characters/second. A switchable-speed unit permits operation at 10, 15 and 30 characters/second. No special software is required, and the plotters can be driven using any source language such as BASIC or FORTRAN.

If you have a minicomputer, you can couple the new high-speed 7210A directly to the computer and plot up to 20 coordinate pairs per second. It takes only 5 minutes to install a 7210A—complete with interface, I/O card and software—to any HP computer.

The 7200A costs $3300, and the 7210A costs $3400. Rental and lease plans are available.

For "The Full Story of Computer Graphics," check item J on the HP Reply Card.

Reduce time-share costs with two new systems

System backup for 2000E and 2000F is completely disc-based, and magnetic tapes are available for sequential files.

Two new systems, 2000E and 2000F, make low-cost time-sharing a reality. The 2000E supports up to 16 terminals, and is expandable to the 2000F with up to 32 simultaneous terminals and dual processors.

You get proven time-sharing software; HP has installed over 200 such systems. The programming language is HP BASIC, conversational, easy-to-learn, but powerful. Two levels of libraries are maintained in mass storage: "public" programs available to any user, and "private" programs. This way, engineers can solve design problems without accessing the corporate payroll; students can program without contaminating doctoral research. And over 100 applications programs are available from HP, so your programmers don't have to write them.

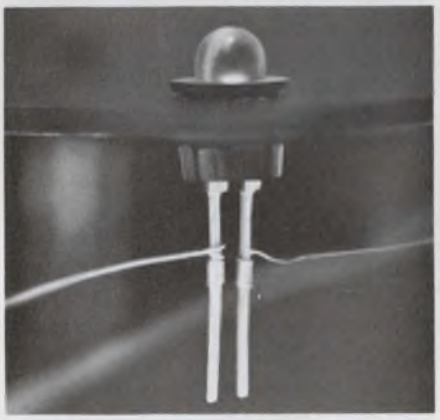
Both systems use the popular 2100 computer with floating point arithmetic as the central processor. A unique HP fast moving-head disc eliminates the need for an expensive swapping disc.

The 2000E costs less than $50K; the 2000F, less than $110K.

For more information, check C on HP Reply Card.

COMPONENT NEWS

The new LED leader – by 0.7 inches



Low cost, high brightness and the convenience of wire-wrap assembly—you get all three with the 5082-4880 LED.

Designed to be wire-wrapped, the new 5082-4880 series LEDs are the first offered for solderless, socketless assembly. Not only are they the brightest for their size in the industry, but these gallium-arsenide-phosphide lamps have a long life for permanent installations.

The long leads (0.7 inch) let you mount the lamp in a panel or printed-circuit board, then wire-wrap directly.

Select one of three light levels (0.5, 1.0 and 1.6 millicandelas), each with three different lenses. You can choose red diffused, clear diffused, or clear.

These LED lamps are available directly from stock. The price depends on quantity and light output.

For more information and prices, check T on the HP Reply Card.

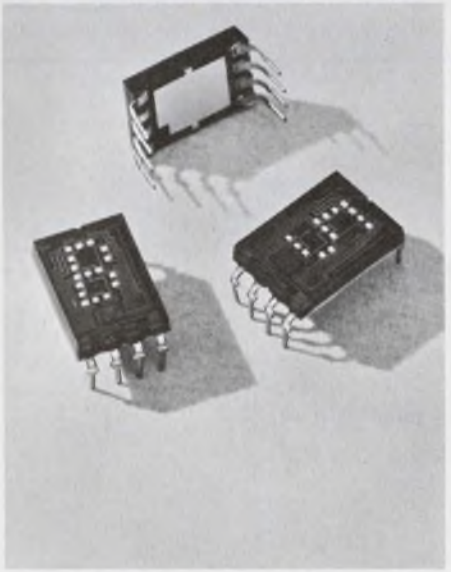
New LED display shows 0-9 and A-F

For the first time, an inexpensive LED display converts binary logic to a base 16 numbering system and displays letters A–F, as well as digits 0–9. Used in computers and test instruments, this solid-state display is suitable wherever you need to show more than 10 states.

The 5082-7340 hexadecimal indicator has built-in decoder/driver and memory. The unique blanking control lets you turn off the display, and retain or change the data stored in the on-board memory. The hexadecimal indicator is also completely DTL and TTL compatible.

Prices: $22 (1–99), $18 (100–499), $15 (500–999), and $12.25 each for 1000 or more.

To learn more, check N on the HP Reply Card.



The new hexadecimal readout shows digits or letters.

Logic comparator saves up to $50 per bad IC

No unsoldering, no adjustments—the 10529A Logic Comparator cuts trouble-shooting time to save you up to $50 in labor cost per bad digital IC located. You merely:

Select the IC to be tested.

Select a reference board with a good IC that has the same type number.

Insert the reference board into the logic comparator.

Attach the clip to the suspect IC and check the comparator display.

The suspect and reference ICs are compared automatically. Indicator lights signal which pins are faulty.

Because it only costs $295, the 10529A Logic Comparator can pay for itself within a few days.

To learn more, check M on the HP Reply Card.

The HP spectrum analyzer family: audio to microwave

A spectrum analyzer visualizes the frequency domain as an oscilloscope displays the time domain. HP's spectrum analyzer family has an extra plus: you can custom-tailor your measurement system from 20 Hz to 40 GHz.

Each spectrum analyzer consists of a tuning section that determines frequency range:

- 8556A—20 Hz to 300 kHz
- 8553B—1 kHz to 110 MHz
- 8554L—550 kHz to 1250 MHz
- 8555A—10 MHz to 40 GHz

and an IF section that determines resolution:

- 8552B—10 Hz bandwidth
- 8552A—50 Hz bandwidth.

Both tuning and IF sections plug into a display—your choice of standard persistence, variable persistence, or large screen CRT. And you can add a tracking generator, preamplifier, or automatic preselector to extend performance range and applications. That's the convenience of our "Family Plan."

All four analyzers offer excellent signal analysis capability through features like absolute amplitude calibration, low noise and distortion, high resolution, plus wide and narrow frequency scans. Display the whole tuning range at once, then zoom down to a very narrow spectrum segment for that rigorous measurement. Measure signal amplitudes (as voltage and power) and frequency, quantity modulation levels and identify distortion products—all with one instrument. Add the tracking generator and you have a precision swept frequency test system with 120 dB range.

Plug-in flexibility plus versatile companion instruments make the HP spectrum analyzer family your best signal analysis value.

With the modular spectrum analyzer family, you pay only for the capability you need. Tuning sections range from $1690 to $6175; the IF sections, $2275 to $2950; and the displays, $950 to $1800.

For full details on precision spectrum analyzers, check P, Q, R or S on the HP Reply Card.

Examine modulated RF by spectrum analysis

The modern spectrum analyzer is a powerful tool for quantitative measurements of modulated RF carriers. Two new application notes cover the topic lucidly. AN150-1 treats Amplitude- and Frequency-Modulation from theory to effective measurement techniques. AN150-2 takes a similar approach with Pulsed RF signals, explaining how measurements are affected by pulse width PRF plus analyzer bandwidth and scan time.

Check U and V on the HP Reply Card for your free copies.

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Europe— Post Office Box 85, CH-1217 Meyrin 2, Geneva, Switzerland, Ph. (022) 41 54 00.
Canada—275 Hymus Boulevard, Pointe Claire, Quebec, Canada, Ph. (518) 561-6520.
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If we didn't build a lot more experience into our capacitors, we couldn't get a little more for them

We know you couldn't care less about TRW's experience in making capacitors. Unless it affects your experience—in using them.

It does. Because we come by it two ways. From innovation, which gives us a lead in technology. And from specialization in wound film and tantalum types, giving us the deepest, broadest experience. The kind that makes our capacitors worth more to you.

To see how, consider the metallized kind.

Anyone can make them small. Or reliable. But it takes real design experience to realize their full potential—making them small as possible, without sacrificing performance or full operational reliability. And, plainly, no one has more experience than a company that specializes in them. Us.

We also have more application experience. We know what metallized capacitors can and can't do. How far they can be pushed. When and how to use them best. We can often solve a customer's size problems by fitting the right design to a specific application where metallized parts hadn't been previously considered.

In manufacturing and handling, our experience means what you see in engineering design is what you get in volume. The same high performance.

Why do so many companies gladly pay the little extra we have to charge for our capacitors? One reason is our experience. Another is theirs.

To share it, write or call TRW Capacitors, an Operation of TRW Electronic Components, Box 1000, Ogallala, Nebraska 69153, (308) 284-3611. TWX 910-620-0321.

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CAPACITORS

INFORMATION RETRIEVAL NUMBER 26

technology abroad

A standard audio cassette tape provides a low-cost analog memory for a new data-acquisition system to be used with large computer networks. Designed by Micro Computer Systems Ltd., England, the cassette-tape storage is intended for use at remote sites that are linked by telephone lines to the central computer. The signals are stored on the tape in analog form. When called for by the computer, the signals are converted to digital form by a standard digital voltmeter. The parallel data-bit output of the voltmeter—in ASCII Code—is converted to serial form by large-scale MOS ICs. The digital data is transmitted at 110 baud. With this tape system, between four and 32 channels of data can be transmitted at scan rates of one to four per second.

CIRCLE NO. 441

An electro-acoustic system for a notepad type of input to a CRT display has been introduced by Siemens, in Munchen, Germany. A thin piezoelectric ceramic sheet is pulsed at a 500-Hz rate, along its X and Y coordinates, with ultrasonic signals. Where the X and Y signals meet on the sheet, a voltage node is created. This voltage is picked off by a pen-like capacitive probe. An electronic analyzer, connected to the ceramic sheet and to the probe, produces a signal from the propagation times of the acoustic pulses from the X and Y edges of the sheet. Resolution is better than 0.2 mm. The output is adaptable to transmission over telephone lines.

CIRCLE NO. 442

A precision dc current transformer for loads from 250 to 20,000 A has been introduced by Brentford Electric Ltd. of England. Typical linearity errors are less than 100 parts per million at 20,000 A. Hysteresis errors are negligible. The current transformer has two high-permeability toroidal magnetic cores linking with the magnetic fields of load busbar. The cores are energized through diodes in alternate half cycles of an ac supply. Secondary-winding currents from the two cores are commutated from one to the other every half-cycle. Each core remains unsaturated for about three-quarters of a cycle of the ac supply voltage. This design eliminates zero-current notches that characteristically occur every half-cycle in conventional series-connected transductor dc current transformers.

CIRCLE NO. 443

A liquid-crystal display in color has been developed at Thompson-CSF's Central Research Laboratories. The display, comprised of a matrix of 1-mm square elements, presents up to six characters. The colors vary with the applied voltage. At 10 V, yellow characters on a black background were obtained. At 15 V, red characters on a green background appear, and at 18 V, green characters on a red background. With optical filters, excellent image contrast is reported obtained.

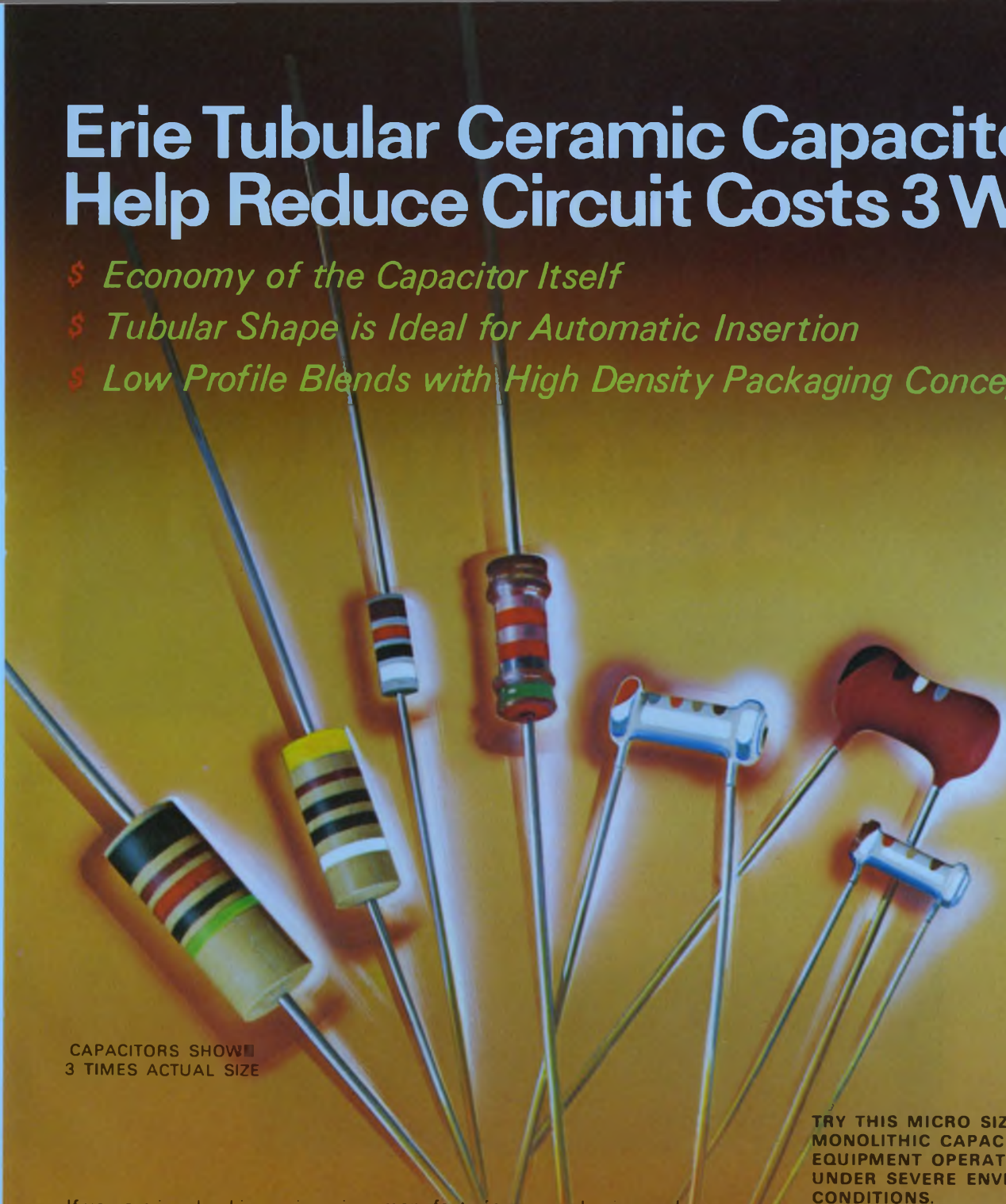
CIRCLE NO. 444

A three-chip calculator and a number of other digital arrays have been produced by Philips of Eindhoven with a high-density bipolar process. The key to the process, which was announced last year as a laboratory development, is the limiting of transistor current by integrating a diode junction into the transistor structure. The diode eliminates a current-stabilizing resistor that normally occupies a large area of silicon. Other benefits include a reduction in power consumption and a very low speed/power factor of 1 picojoule (pJ). By comparison, a 7400 series gate has a factor of 130 pJ, Motorola's 10000 series has a factor of 60 pJ, while a CMOS gate has a factor of 5 pJ. Circuit densities for the Philips array are on the order of 200 gates per square millimeter. Power required by the three calculator chips is only 21 mW.

CIRCLE NO. 445

Erie Tubular Ceramic Capacitors Help Reduce Circuit Costs 3 Ways!

- $ *Economy of the Capacitor Itself*
- $ *Tubular Shape is Ideal for Automatic Insertion*
- $ *Low Profile Blends with High Density Packaging Concepts.*



CAPACITORS SHOWN
3 TIMES ACTUAL SIZE

If you are involved in engineering, manufacturing or purchasing and finding "a better way" is vital, ERIE Tubular Ceramic Capacitors can help you cut operating costs and boost profits in a number of different ways.

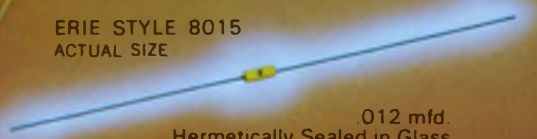
For example, if you have a tuned circuit application needing very precise temperature compensation . . . specify ERIE Tubular Ceramic Capacitors. Or where nominal capacitance control to ±1% is important. Or where rising production costs dictate components be designed for automatic insertion. Or where you want a low profile capacitor that blends with high density circuit packaging schemes. Specify ERIE Tubular Ceramic Capacitors.

These completely versatile, low cost capacitors are perfect for a wide range of applications . . . from the competitive entertainment market to sophisticated military and aerospace programs. Reliable? We've made billions of them . . . for nearly four decades. And they cost only pennies each. Think Tubular . . . Erie Tubulars.

Talk to your Erie representative . . . or write for literature — ERIE TUBULAR CERAMIC CAPACITORS.

TRY THIS MICRO SIZE MONOLITHIC CAPACITOR FOR EQUIPMENT OPERATING UNDER SEVERE ENVIRONMENTAL CONDITIONS.

ERIE STYLE 8015
ACTUAL SIZE



.012 mfd.
Hermetically Sealed in Glass

We also offer you a whole new world of packaging ideas with our state of the art monolithic ceramic capacitors. Select the capacitance values, voltages and characteristics to suit your circuit needs. Ask your nearest Erie representative . . . or write for literature about Erie Monobloc® Ceramic Capacitors.

ERIE TECHNOLOGICAL PRODUCTS, INC.
Erie, Pennsylvania 16512

ERIE

For built-in reliability, design with "Scotchflex" Flat Cable/Connector Systems.

"SCOTCHFLEX" IS A REGISTERED TRADEMARK OF 3M CO.

"Scotchflex" Flat Cable and Connectors can offer you trouble-free packaging for your next generation equipment.

There's built-in reliability for your circuit inter-connects. Our flat, flexible PVC Cable has up to 50 precisely spaced conductors. The gold plated U-contacts are set into a plastic body to provide positive alignment. They strip through the insulation, capture the conductor, and provide a gas-tight pressure connection.

Assembly cost reductions are built-in, too. "Scotchflex" Connectors make up to 50 simultaneous connections without stripping or soldering. No special training or costly assembly equipment is needed.

Off-the-shelf stock offers you flat cable in a choice of lengths and number of conductors from 14 to 50. Connector models interface with standard DIP sockets, wrap posts on .100 x .100 in. grid, or printed circuit boards. Headers are available to provide a de-pluggable inter-connection between cable jumpers and printed circuit boards (as shown). Custom assemblies are also available on request.

For full information on the "Scotchflex" systems approach to circuitry, write to Dept. EAH-1, 3M Center, St. Paul, Minn. 55101.

3M COMPANY

INFORMATION RETRIEVAL NUMBER 29

washington report

Don Byrne
Washington Bureau

House to hold hearing on U.S.-Soviet agreements

If you have something you want to say about the recent space, environment and technology agreements between the Soviet Union and the United States, get in touch with Rep. James W. Symington (D-Mo.), chairman of the House Subcommittee on International Cooperation in Science and Space, a panel of the Committee on Science and Astronautics. He will hold hearings on the agreements during the third week in July. While the Senate usually holds such hearings, there is nothing to stop a House committee from doing so to build a public record, and that, Representative Symington says, is exactly what he wants to do; he is seeking as many viewpoints as possible.

Arms pact not likely to affect defense budget

Capitol Hill sources say the Arms Limitation Agreement with the Soviet Union will have little effect on this year's Defense Dept. budget. "It'll be a little tougher to get passed, and there will be a lot of yak," one source said. Earlier estimates that about $3-billion will be hacked out of the $84-billion budget were still viewed as realistic.

The Navy's Trident submarine development program, formally known as ULMs, is expected to continue, although a cut of about $300-million is anticipated. The Navy has asked for more than $900-million for the sub this year. With the numerical ceiling on missiles and other weapons, the emphasis will now switch to refining military equipment. "If we're limited by number, then we'll have to improve the quality," is the way it's being put.

U.S.-Soviet space pact creates a bit of job fog

In announcing the U.S.-Soviet space-cooperation agreement, NASA and White House spokesmen were quick to point out that the pact would create about 4400 jobs. But when pressed for a breakdown of those jobs, a highly reliable NASA source admitted that the figure probably represented jobs held by people already on the payroll—either NASA's or a contractor's.

Also, there is a little less "cooperation" in the agreement than was originally intended. During the negotiations, which began about 10 months ago, the Russians agreed to provide a space station—Salyut. But at

the last minute this was withdrawn. Now the Russians will merely fly a Soyuz mission, while the U.S. will provide the hardware for docking and crew transfer at a cost of about $250-million.

FCC approves Chicago-New York microwave link

The latest specialized microwave common carrier to get the nod from the Federal Communications Commission is MCI-New York West, an affiliate of Microwave Communications, Inc., which had proposed a 300-voice channel system between New York and Chicago. The approval was the third since the commission issued its rules opening the specialized microwave field to competition about two years ago. The original award went to MCI for a Chicago-St. Louis link. Since then, authorization has been given to Interdata Communications, Inc., for a New York-to-Washington service and to the Data Transmission Co. for Houston to Palo Alto, Calif. Meanwhile the rate fight between the specialized microwave companies and established carriers, such as Western Union and the telephone companies, continues before the FCC, with MCI asking the FCC to reject the Western Union tariff for the Chicago-to-St. Louis route. MCI contends that Western Union never showed any interest in private business for the route until MCI was granted a license.

Import quotas challenged under antitrust laws

While the U.S. Treasury Dept. continues to look for antidumping and government-subsidy violations by Japanese exporters that would warrant additional U.S. tariffs, the Consumer's Union in this country has filed a suit in Federal District Court here to eliminate restrictive import quotas of any kind.

The suit, directed at steel, contends that limiting the amount of steel that can be imported causes artificially high prices and represents a restraint of trade. If the suit is successful, the court's ruling could be applied to any other commodity.

Adding fuel to the import-export fire was the recent Commerce Dept. announcement that the U.S. had nearly a $1-billion trade deficit in electronics with Japan last year.

Capital Capsules:

The Senate has confirmed the appointments of Richard E. Wiley and **Benjamin L. Hooks** to the FCC. **Hooks will be the FCC's first black member.** . . . Down but apparently not dead, **the SST gets $12.1-million in the form of a contract from the Dept. of Transportation** to Boeing to complete advanced technological projects started during the development of the supersonic transport. Included are studies in electronic displays and flight controls. . . . The long awaited **decision by the FCC on who can own and operate domestic communications satellites is expected in a few days.** The reason: The agency's chairman Dean Burch has to leave for reserve military duty and FCC staffers say he wants to make the announcement himself. . . . Composers of **electronic music** should not expect encouragement from composer-conductor Leonard Bernstein. **It's like "glorified wallpaper—excessive Musak,"** he told a National Press Club audience.

SAVE $$$ // GAIN performance

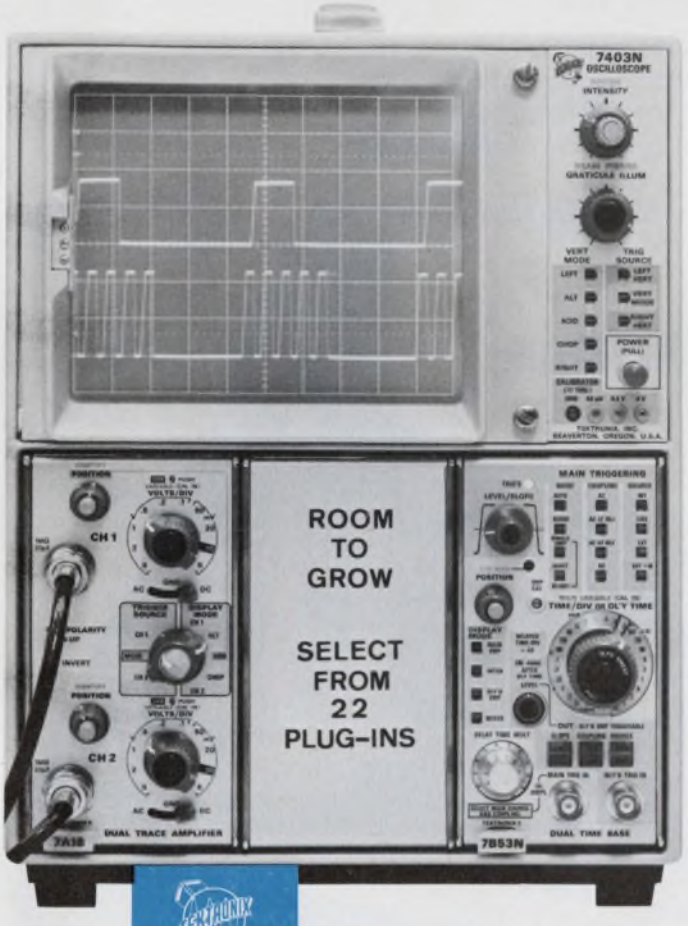
over any other 50-MHz, plug-in oscilloscope.

50-MHz oscilloscope with:

5-mV dual-trace amplifier and delaying sweep	$2200
5-mV dual-trace amplifier and single time base	1900
5-mV single-trace amplifier and single time base	1650

AND LOOK AT THESE BONUSES:

- ☑ 3 plug-in compartments and mainframe mode switching
- ☑ 6½-inch CRT — 50% larger than 8 x 10 cm CRT's
- ☑ time bases have 5 ns/div sweep rate
- ☑ amplifiers and time bases accurate within 2%
- ☑ high writing-speed CRT gives a brighter trace
- ☑ 5¼-inch rackmount version



If you wish, select a plug-in for the second vertical compartment to give you 10 μV/div at 1 MHz *or* 1 mV/div at 55 MHz *or* 1 mA/div at 55 MHz *or* another dual-trace unit for 4-trace capability, etc., etc. Plug-in prices start at a low $95. Call your nearby TEKTRONIX Field Engineer today for a demonstration, or write: Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97005.

7403N Oscilloscope	$950
R7403N Oscilloscope	$1050
7A18N Dual-Trace Amplifier	$500
7A15AN Single-Trace Amplifier	$250
7A17 Single-Trace Amplifier	$95
7B53N Dual Time Base	$750
7B50 Time Base	$450

U.S. Sales Prices FOB Beaverton, Oregon

TEKTRONIX lease and rental programs are available in U.S.

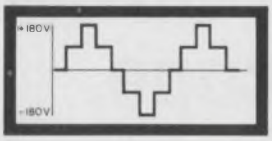
TEKTRONIX®

committed to technical excellence

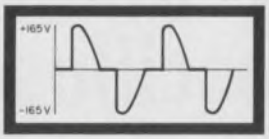
INFORMATION RETRIEVAL NUMBER 30

A digital multimeter that measures true RMS and dBm directly.

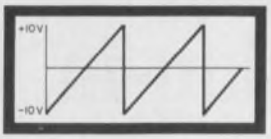
Look what you can measure with the Hickok 3310 Universal Multimeter: true RMS voltage and current like these —



Sine wave synthesis by voltage switching
ERMS = 110.2 Volts; 43.1 dBm



Load voltage using full-wave SCR phase control
ERMS = 98.6 Volts; 42.1 dBm



Sawtooth waveform
ERMS = 5.77 Volts; 17.4 dBm

For just $845.00

You save money and receive performance with the Hickok 3310. Here are some of its RMS specs — 100-μV resolution, 4:1 crest factor, bandwidth from 20 Hz to 50 kHz, RMS current capability from 100 nA to 2 A plus all-solid-state circuits for reliability and ruggedness.

But keep going. The 3310 reads from −40 dB to +60 dB with 0.1-dB resolution directly; no conversion or mental additions are necessary. You can choose between a 600 and 900-ohm internal reference with a front panel switch.

And don't forget the "multi." The 3310 measures DC voltage from 100 μV to 1.5 kV, DC current from 100 nA to 2 A, and resistance from 100 milliohms to 200 megohms.

Then, there are the extras. You can add an internal rechargeable battery option with 20 hours consecutive operation or you can add a BCD-output option. Accessories extend ranges to 30 kV or 100 A, and one converts the 3310 to a 20-MHz counter. All accessories will fit into a convenient carrying case along with the 3310.

Try the 3310 for yourself. Call Hickok or your nearest Hickok field engineer for a demonstration and see RMS for yourself.

HICKOK
the value innovator

Instrumentation & Controls Division
10514 Dupont Ave. Cleveland, OH 44108
(216) 541-8060

shown
⅔ actual size

INFORMATION RETRIEVAL NUMBER 31

power supplies for op-amps...$14

These 2.3 x 1.8 x 1-inch modules have tracking outputs of ±15V with regulation of ±0.1% and ripple of 1 mv. The Model D15-03 (25 ma outputs) costs $14.00 in 1000 lots and only $24.00 for one. The Model D15-05 (50 ma outputs) is $39.00. For ±12V, the model numbers are D12-03 and D12-05. Same prices. Three-day shipment guaranteed.

Acopian

Acopian Corp., Easton, Pa. 18042
Telephone: (215) 258-5441

INFORMATION RETRIEVAL NUMBER 32

TWT amplifier line four models: 10, 20, 100 and 200 watts solid state with protective circuitry beam and helix current metering modular construction

The industry's most advanced TWT amplifier line can now provide the microwave power and stability you need for EMI/susceptibility testing, antenna pattern measurement, RF power instrumentation calibration and component testing.

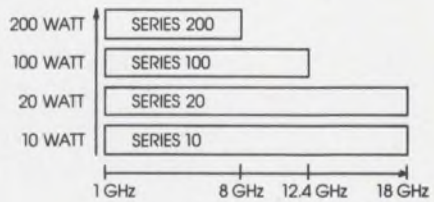
Modular construction and plug-in boards allow the versatility to accommodate a wide variety of TWTs. Options include VSWR protection, harmonic filtering and variable output. Solid state components (except series regulator and TWT) and conservative design provide the reliability and performance necessary in modern electronic instruments.

Beam current and voltage protection are built in along with regulation of all power supplies.

Maximum TWT life is assured through efficient cooling: the 10 and 20 watt systems use conventional air cooling and the 100 and 200 watt are cooled with a liquid to air heat exchanger for quiet, reliable and efficient operation.

One of our twenty-six TWT amplifiers will meet your power, gain, and frequency requirements. And all have a one year warranty. For complete specifications call (312) 354-4350 or write: MCL, Inc., 10 North Beach Avenue, La Grange, Ill. 60525.

10 and 20 watt TWTA



100 and 200 watt TWTA

MCL INC

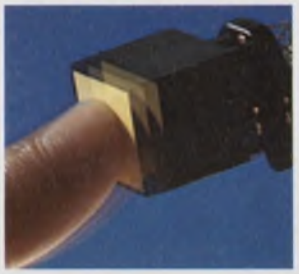
Opportunities developing now for RF engineers at MCL, Inc. — an equal opportunity employer.

INFORMATION RETRIEVAL NUMBER 33

Press here to save on lighted pushbutton switches.

buys all the switch you need.

Oak's Series 300 gives you good looks and a small price-tag in lighted pushbutton switches. Plenty of switching performance for most jobs, without paying a premium. Even the Series 300 Split-Legend/4 Lamp Switch is less than $1.60 (normal latch, 2P2T, glass alkyd insulation, no engraving, less lamps.)

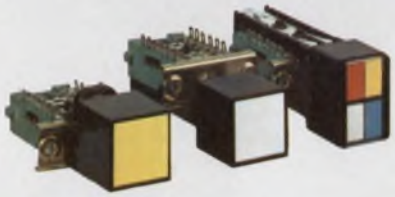


Built to take it.

Series 300 is built for reliable performance and long life. Applications galore—bank terminals, calculators, and copy equipment.

Modular design.

Single-legend/single-lamp, split-legend/4-lamp, and single-legend/redundant lamp switches have snap-on lamp holders. Plus replaceable legend plates, lens caps, and button assemblies. Front-panel relamping, too, without special tools on all types.



Three versions with switching up to 4P2T.

Choose from single, dual, or four lamp display as well as non-lighted type. One to twelve station, momentary, interlock, alternate action, or any combination available on the same switch bank. Lockout feature available for all types. Power Module 3A125VAC. Lighted indicators are identical in size and appearance, but without switching.

Gang them up by the dozen.

Order up to 12 switching stations on a single channel, any switching mix, with convenient panel-mounting studs. Color selection: white, lunar white, yellow, amber, orange, red, green, blue. Choose silk-screened, hot-stamped, or engraved-and-filled legends. Split-legend switches can be specified with any two, three, or four colors on insertable legend plates.

Write for our Series 300 Brochure

OAK Industries Inc.
SWITCH DIVISION / CRYSTAL LAKE, ILLINOIS 60014
TELEPHONE: 815 • 459 • 5000 ■ TWX: 910 • 634•3353 ■ TELEX: 72 • 2447

INFORMATION RETRIEVAL NUMBER 34

COOL POWER FROM SEMTECH

SEMTECH NEWS

SILICON RECTIFIERS & ASSEMBLIES CERAMIC CAPACITORS

Published from time to time by SEMTECH CORPORATION • 652 Mitchell Road, Newbury Park, California 91320 / Phone: (805) 498-2111

METOXILITE RECTIFIERS SET INDUSTRY STANDARDS

Metoxilite, the material that pushed Semtech to the forefront of the industry for sub-miniature medium power silicon rectifiers, now makes its debut in a whole new spectrum of "state-of-the-art" devices. Metoxilite (metal oxides) is fused to the metallurgically bonded junction-tungsten pin assembly forming a "tough" sub-miniature package. Designed to electrically approach the theoretical, the Metoxilite rectifier, introduced in 1969, is the result of years of applied research and extensive testing. You'll see them used in stringent military and space environments as well as industrial and commercial applications. JAN and SIN parts available in most types.

PRESENT STANDARDS

The Metoxilite 3-amp series is the first family introduced by Semtech. Supplied in an axial leaded package, it filled the product gap in the industry between the lower current axial leaded rectifier and the higher current stud packages.

3-AMP METOXILITE RECTIFIERS (6-AMP/MIL-STD-750)

MEDIUM RECOVERY (Trr) 2 μs
Peak Inverse Volt.: 200, 400 600, 800 & 1000V
Reverse Current @ 25°C: 1.0 μA; @ 100°C: 20 μA
Forward Voltage @ 3A, 25°C: 1.0 to 1.1V
Single Cycle Surge: 150A; Recurrent Surge: 25A
Body Dimension: .165" D x .165" L
Types: 1N5550-54

FAST RECOVERY (Trr) 150-250 ns
Peak Inverse Voltage: 50, 100, 200, 400 & 500V
Reverse Current @ 25°C: 1.0 μA; @100°C: 20 μA
Forward Voltage: @ 3A, 25°C: 1.1V
Single Cycle Surge: 150A; Recurrent Surge: 25A
Body Dimension: .165" D x .165" L
Types: 1N5415-19 CIRCLE NO. 191

RECTIFICATION EFFICIENCY IMPROVED

The Metoxilite LO VF rectifiers open the door previously barred to the designer who required high efficiency rectification with ultra fast recovery times. These units are ideally suited to today's power supply design technology.

LO-VF WITH FAST RECOVERY (Trr) 100 ns
Peak Inverse Voltage: 30 and 50V
Reverse Current @ 25°C: 1.0 μA; @100°C: 20 μA
Forward Voltage @ 3A, 25°C: 0.9V
Single Cycle Surge: 150A; Recurrent Surge: 25A
Body Dimension: .165" D x .165" L
Types: 3L03 & 3L05 CIRCLE NO. 192

RADIATION RESISTANT RECTIFIERS

Specifically designed to operate in a radiation environment. Now available in Metoxilite. Extremely rugged part is ideally suited for missile and space applications.

Peak Inverse Voltage: 100, 200, 300 & 400V
Average Rectified Current: 1A
Forward Voltage @ 1A 25°C: 1.2V
Reverse Current @ 25°C: 1 μA; @ 100°C: 25 μA
Single Cycle Surge: 30A; Recurrent Surge: 6A
Reverse Recovery: (Trr) 300—1000 ns
Body Dimension: .070" D x .165" L
Types: R1, R2, R3 & R4 CIRCLE NO. 193

THE WORK HORSE

The Metoxilite 1-amp rectifier family introduced with the 3-amp family has since become the workhorse of the industry. Utilizing the .060" diameter die, it offers more capability than the similar devices now available in the industry.

1-AMP METOXILITE RECTIFIERS (3-AMP/MIL-STD-750)

MEDIUM RECOVERY (Trr) 2 μs
Peak Inverse Volt.: 200, 400 600, 800 & 1000V
Forward Voltage @ 1A. 25°C: 1.2V
Reverse Current @ 25°C: 0.5 μA; @100°C: 25 μA
Single Cycle Surge: 50A; Recurrent Surge: 10A
Body Dimension: .110" D x .165" L
Types: 1N5614-22

FAST RECOVERY (Trr) 150-500 ns
Peak Inverse Volt.: 200, 400, 600, 800 & 1000V
Forward Voltage @ 1A. 25°C: 1.2V
Reverse Current @ 25°C: 0.5 μA; @100°C: 25 μA
Single Cycle Surge: 25A; Recurrent Surge: 6A
Body Dimension: .110" D x .165" L
Types: 1N5615-23 CIRCLE NO. 194

NEW GENERATION 1N645

Our new ½-amp Metoxilite rectifier is small enough to replace the unreliable whisker type devices (1N645-7). This rectifier is now available in the Metoxilite non-cavity case with a high temperature metallurgically bonded internal assembly.

NEW ½-AMP METOXILITE RECTIFIER

MEDIUM RECOVERY (Trr) 2 μs
Peak Inverse Volt.: 200, 400, 600, 800 & 1000V
Average Rectified Current: 0.5A
Reverse Current @ 25°C: 100 nA ; 100°C: 7 μA
Forward Voltage @ 0.5A, 25°C: 1V
Single Cycle Surge: 25A; Recurrent Surge: 5A
Body Dimension: .070" D x .165" L
Types M2, M4, M8 & MO

FAST RECOVERY (Trr) 150 ns
Peak Inverse Voltage: 100, 200, 400 & 500V
Average Rectified Current: 0.5A
Reverse Current @ 25°C: 250 nA; @100°C: 15 μA
Forward Voltage @ 0.5A, 25°C: 1V
Single Cycle Surge: 12.5A; Recurrent Surge: 3A
Capacitance @ 4V: 20 pF
Body Dimension: .070" D x .165" L
Types: F1, F2, F4 & F5 CIRCLE NO. 195

LO-DYNAMIC Z-ZENERS

Semtech's new Metoxilite low dynamic impedance zeners offer voltages of 30 to 120 volts for 1, 3, and 5 watt applications. This new series of devices offers ⅓ lower dynamic impedance when compared at the same operating current to those presently available. As an added plus, the device is radiation resistant. The zener body measures .165" long (max.) and is .110" in diameter (max.). Types SX30-120. CIRCLE NO. 196

FOR VOLTAGE MULTIPLIERS

Introducing the Ministac in Metoxilite, multi-chip high voltage rectifier, particularly adaptable for high frequency applications such as voltage multipliers.

NEW METOXILITE MINISTAC

MEDIUM RECOVERY (Trr) 2 μs
Average Inverse Voltage: 2, 3, 4, & 5 KV
Average Rectified Current: 125 mA
Reverse Current @ 25°C: 100 nA; @100°C: 7.0 μA
Forward Voltage @ 125 mA, 25°C: 5V
Single Cycle Surge: 7A; Recurrent Surge: 1.25A
Body Dimension: .070" D x .215" L
Types: M20, M30, M40 & M50

FAST RECOVERY (Trr) 250 ns
Peak Inverse Voltage: 1.5, 2.0, 2.5 & 3 KV
Average Rectified Current: 100 mA
Reverse Current @ 25°C: 100 nA; @100°C: 7.0 μA
Forward Voltage @ 100 mA, 25°C: 5V
Single Cycle Surge: 5A; Recurrent Surge: 1.25A
Body Dimension: .070" D x .215" L
Types: F15, F20, F25 & F30 CIRCLE NO. 197

SUB-MINIATURE HIGH VOLTAGE METOXILITE RECTIFIERS

A sub-miniature high voltage rectifier obtained by Semtech's unique technology. A multi-junction device high temperature metallurgically bonded and fused in a non-cavity Metoxilite case. This small device is designed to solve packaging problems where size and environmental criteria are critical.

MEDIUM RECOVERY (Trr) 2 μsec
Peak Inverse V: 1000, 1500, 2000, 2500 & 3000V.
Average Rectified Current: 250 mA
Forward Voltage @ 100 mA, 25°C: 3.5V
Reverse Current @ 25°C: 1 μA; @ 100°C: 20 μA
Single Cycle Surge: 14A; Recurrent Surge: 2.5A
Body Dimension: .110" D x .215" L
Types: 1N3643-47 & SM20, SM25 & SM30

FAST RECOVERY (Trr) 300 ns
Peak Inverse Voltage: 1500, 2000 & 2500V
Average Rectified Current: 250 mA
Forward Voltage @ 100 mA, 25°C: 4V
Reverse Current @ 25°C: 1 μA; @ 100°C: 20 μA
Single Cycle Surge: 10A; Recurrent Surge: 2.5A
Body Dimension: .110" D x .215" L
Types: S15F, S20F & S25F CIRCLE NO. 198

SEMTECH CORPORATION

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BOLD NEW LOOK IN ILLUMINATED SWITCHES!

It not only looks good, the Series 67000 illuminated DW "Multi-Switch"® switch is a glamorous bit of switch packaging. It's compact, low-cost and operates beautifully, too!

Large, square pushbuttons (19/32" sq.), in 6 different colors, provide brilliant (or soft), evenly—diffused lighting over the entire face of the pushbutton. Front relamping. Really, this is a honey!

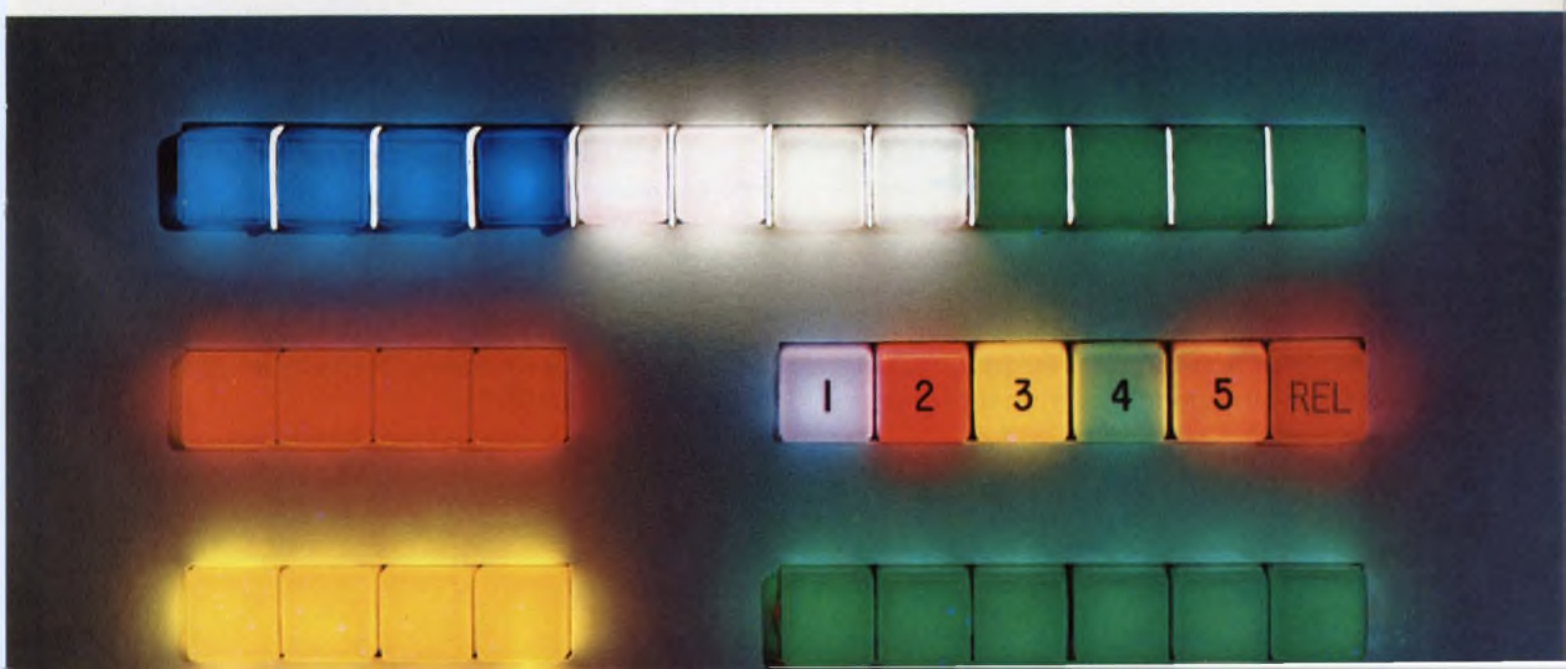
Versatility? It's a low cost multiple station push-button switch available up to 18 stations in a row, in interlock, all-lock, non-lock and push-lock/push-release, with up to 4PDT switching per station.

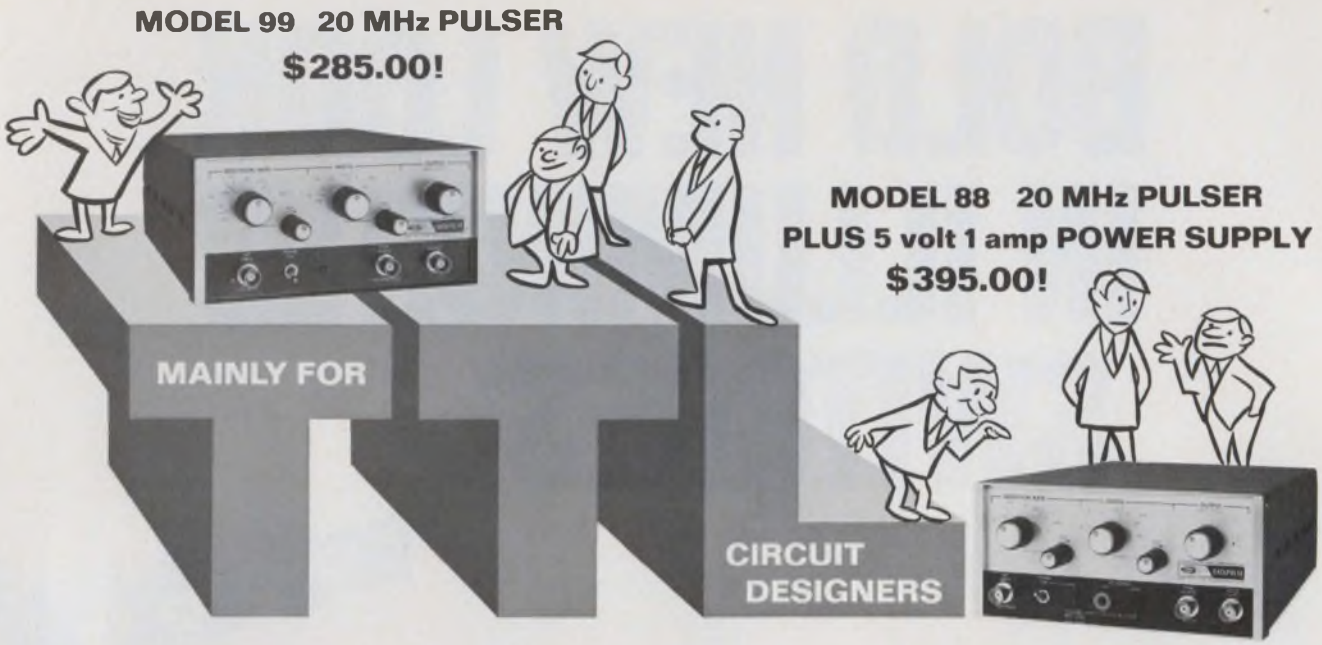
Quality! You're getting the same reliability and performance you're used to in other DW "Multi-Switch"® switches.

You can get optional extras such as barriers, solenoid release, multi-row ganged assemblies, intermixed functions, P.C. terminals. Fact is, there's a Series 67000 DW "Multi-Switch"® switch available for nearly every control panel requirement, from computers to home entertainment systems.

For additional information contact a Switchcraft Representative or write for Bulletin 208. SWITCHCRAFT, INC. 5531 N. Elston Avenue, Chicago, Illinois 60630.

SWITCHCRAFT INC.





■ REPETITION RATES 2 Hz to 20 MHz ■ PULSE WIDTHS 20 nsec to 200 msec ■ RISE AND FALL TIME 5 nsec ■ OUTPUT +1 volt to +5 volts (40 ma sink) ■ POWER SUPPLY (Model 88 Only) 5 volts 1 amp.

2 new bargain boxes from Systron-Donner/Datapulse

The Models 88 and 99 both feature the same excellent pulse generating capabilities and, as an added convenience, the Model 88 provides an independent power supply output. T^2L designers will really appreciate the exceptional versatility of the Model 88 . . . an extremely compact, light and portable source of high quality TTL driving pulses with a useful +5 volts TTL breadboard power supply built right in.

The Model 99 duplicates the 88's pulse generator characteristics precisely, making it an outstanding bench instrument for use in applications where a power supply is separately available or is not required.

Both instruments employ advanced designs and incorporate standard, top quality components, with the emphasis on high grade performance and low end-product prices to meet and beat today's economies and purchase restrictions. Result: Two superbly engineered instruments at prices you can't afford not to afford.

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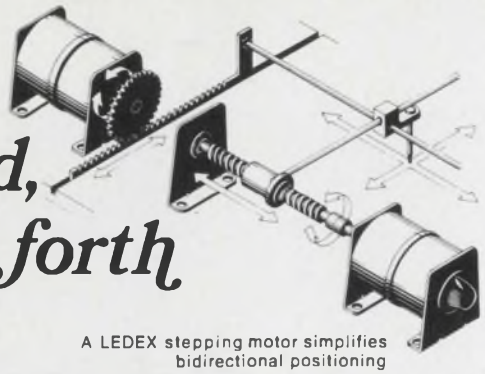

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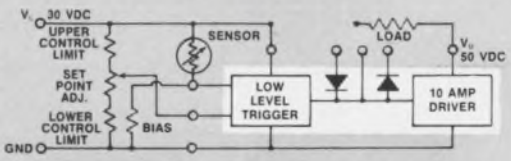

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SRL10-25	0-10	25	22	16.7	350	20	10mA	0.01% or 2mV	0.02% +4mA	150	200	1	40	20	$450
-50	0-10	50	44	33.5	300	10	20mA		0.02% +4mA	150	200	1	20	8	$650
-100	0-10	100	88	67	300	20	30mA		0.02% +6mA	150	200	1	10	2.5	$825
SRL20-12	0-20	12	10.5	8	200	20	3mA		0.02% +4mA	70	200	1	80	80	$435
-25	0-20	25	22	16.7	300	20	10mA		0.02% +4mA	150	200	1	40	20	$525
-50	0-20	50	44	33.5	500	40	10mA		0.02% +4mA	150	200	1	20	8	$775
SRL40-6	0-40	6	5.3	4	200	20	0.5mA		0.02% +1mA	70	200	1	150	150	$435
-12	0-40	12	10.5	8	300	20	1mA		0.02% +4mA	150	200	1	80	80	$525
-25	0-40	25	22	16.7	500	10	10mA		0.02% +4mA	150	200	1	40	20	$630
-50	0-40	50	44	33.5	700	40	10mA		0.02% +4mA	150	200	1	20	8	$850
SRL60-4	0-60	4	3.5	2.68	300	20	0.5mA		0.02% +1mA	70	200	1	250	250	$450
-8	0-60	8	7	5.36	300	20	1mA		0.02% +1mA	70	200	1	125	125	$580
-17	0-60	17	14.9	11.4	500	10	3mA		0.02% +4mA	150	200	1	50	40	$690
-35	0-60	35	31	23.4	700	40	10mA		0.02% +4mA	150	200	1	25	15	$970

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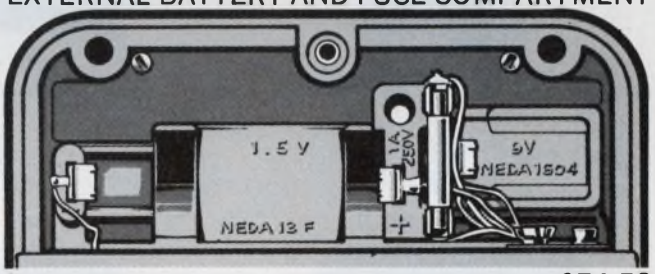

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14.
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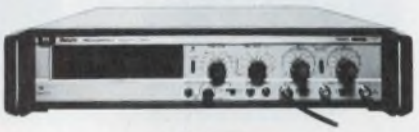

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INFORMATION RETRIEVAL NUMBER 43

editorial

Know how and when to speak up

A prominent space scientist, Dr. Kraft Ehricke, once said that a specialized education makes it possible for an engineer to build the best spacecraft in the world and still be unable to explain the economic implications of his accomplishments.

Are you working in such splendid isolation? Robert C. Wilson, president of the Collins Radio Co., says many of you are. He recently told engineers at the Southeastern IEEE Conference that they must make their voices heard in the struggle for world markets, because U.S. industry is fighting for its life. Of more concern to you personally is the possibility that if you don't offer ideas to help your company make a profit, you could be indirectly helping to dry up the company income upon which your salary depends.

So what can you do? Wilson urges you to develop business-oriented strategies that will help your management identify technologies that are really critical to the success of the business. To help make this identification possible, it's important to learn how and when to speak up.

Engineers who have trouble getting their ideas across often fail to realize that there's no objective, unbiased attitude toward ideas. When people are committed to other ideas, it's difficult to change their minds, even if your idea is better. So, think ahead. Time your presentation to the day when people's minds aren't made up yet—when they're prepared to listen.

Be cognizant of the other guy's pride, too. Creative people and those in high positions don't like to be told that they've made the wrong decision; they also don't like to get all their ideas from others. So, exercise tact and diplomacy. Don't focus on competitiveness or conflict only; try interpretation and synthesis as well.

Now, more than ever, your company needs your help to stay in business. The contract it loses today could be the paychecks you lose tomorrow.

Richard L. Turmail

RICHARD L. TURMAIL
Management Editor

Simplify shift-counter design with this sequence-tree technique. The method provides the minimum feedback logic for a given count cycle.

Though there are many approaches to counter design, two techniques—sequence tree and count multiplication—make it particularly easy to minimize the logic needed for any arbitrary-count shift counter. The sequence tree is handiest for counters with up to four stages, while the count-multiplication technique is more useful for longer counters.

A shift counter is basically a shift register that uses feedback to cycle the register through a prescribed sequence of states. Once a requirement for a particular n-state counter is defined, the problem becomes one of determining the minimum feedback logic.

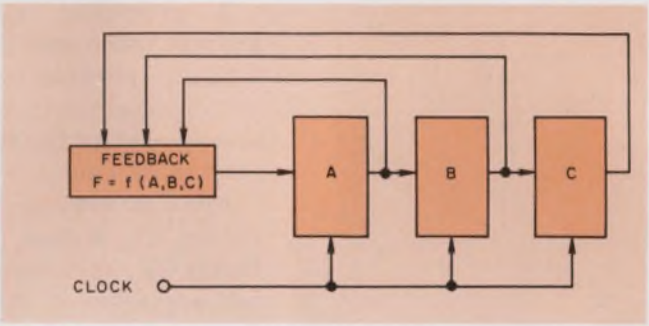
The feedback, a Boolean function of the outputs of the register, is applied to the first stage and determines the sequence and number of states per cycle. A shift counter that uses an n stage register has 2^n possible states. With proper feedback, it is possible to obtain a cycle length, K, where $K \leq 2^n$. If K is less than 2^n, the unnecessary states can be used as redundancies to simplify the feedback equations.

A potential problem, inherent in shift counters, is sensitivity to noise or transients (caused by power turn-on). This can divert the counter into an unwanted state. When this happens, the counter can remain locked up in that state or in a cycle of unwanted states. To insure that lockup does not occur, the designer must modify the feedback so all unused states lead to the desired cycle of states.

In general, for any given cycle length, more than one feedback function is possible. Ideally the designer should determine the feedback function that uses a minimum number of gates. But difficulty usually arises because of the existence of more than one solution.

Use the sequence tree

The simplest feedback function for a desired cycle length can be determined by using the sequence-tree method. The feedback is only to the first stage. This is a practical way of designing shift counters when one considers the shift-register building blocks currently available. The method is simple to use when four stages or fewer are required, and it guarantees a minimum-gate feedback function.



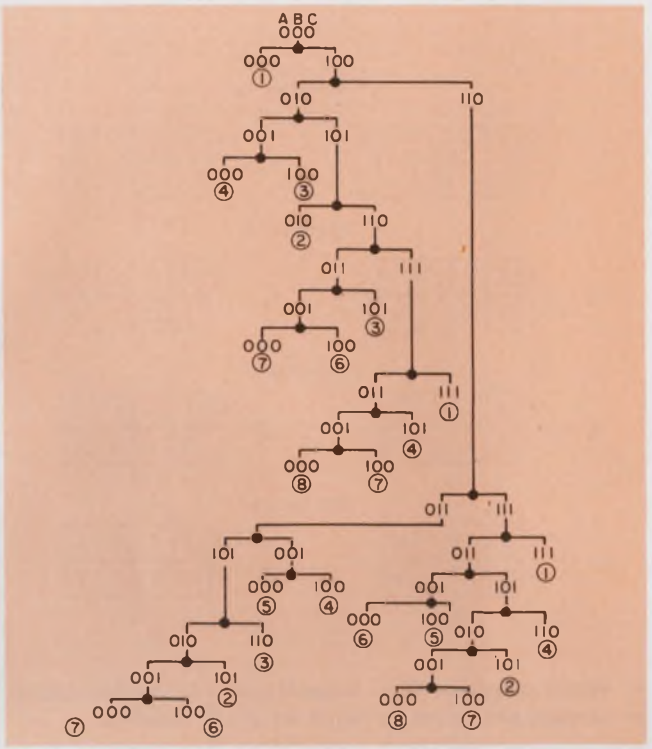
1. **Three-stage shift counter** with feedback to the first stage. The goal is to determine the minimum logic.

Consider the design of the three-stage shift counter in Fig. 1. This shift register is comprised of three stages, A, B and C. The feedback is a function of the outputs of each of the three stages. The clock controls each change of state of the register, and since there are three stages in the register, there are eight possible states. With proper feedback, therefore, it is possible to cycle

Table 1. Next-state table for Fig. 1

PRESENT STATE			NEXT STATE F=0			NEXT STATE F=1		
A	B	C	A	B	C	A	B	C
0	0	0	0	0	0	1	0	0
0	0	1	0	0	0	1	0	0
0	1	0	0	0	1	1	0	1
0	1	1	0	0	1	1	0	1
1	0	0	0	1	0	1	1	0
1	0	1	0	1	0	1	1	0
1	1	0	0	1	1	1	1	1
1	1	1	0	1	1	1	1	1

Earl F. Carlow, Section Manager,
Motorola, Inc., Phoenix, Ariz.



2. **State-sequence tree** for the three-stage counter. All possible state sequences are shown.

the register continuously through a given number of states, equal to eight or fewer.

The first step in determining the feedback function is to generate the "next-state table" for a general three-stage shift counter. The result is shown in Table 1. The table relates all possible present states of the register to the corresponding next states, as a function of the feedback, F. Each next-state entry in the table can be found by shifting the present state one column to the right and then setting the first column, A, equal to ONE (if the feedback is ONE) or to ZERO (if the feedback is ZERO).

Next, we use the information in Table 1 to construct the state-sequence tree shown in Fig. 2. This tree shows all the possible state sequences. To start the construction, the counter is assumed to be in any one of its eight possible states. In this example, we have chosen state 000 and placed it at the top of the tree.

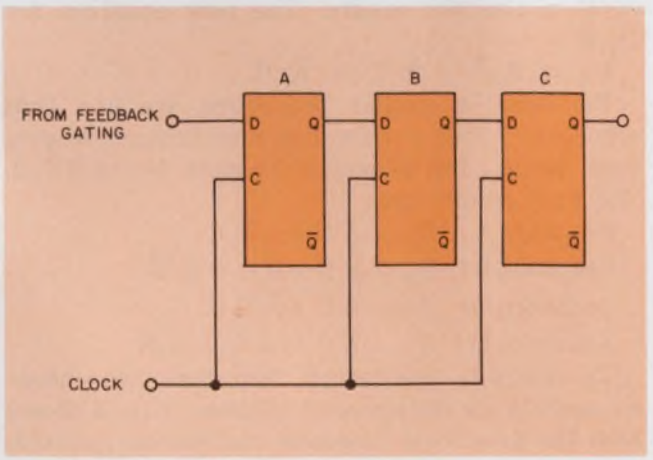
Following this state, the tree shows the sequence of possible states as a function of the feedback. A branch in the tree ends when a state is repeated, since this represents a completed cycle. The circled numbers under each branch indicate the total number of states in that cycle. For example, the tree shows that there are four possible seven-state cycles but only two eight-state cycles.

The third step of the procedure determines the feedback equations that yield the desired cycle length for each sequence. In arriving at these equations, we can use the unused states as redundancies. The equations must then be examined to see if any modifications are required to prevent lockup and to choose the simplest solution. This procedures is illustrated in the design of a divide-by-seven shift counter.

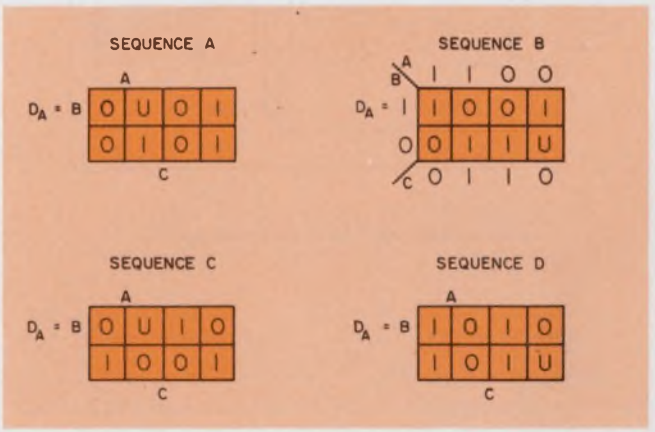
The divide-by-seven counter

In this example, the memory elements for the register are D-type, clocked flip-flops: a ONE at the D input causes the flip-flop to be set to a ONE on the clock transition, and a ZERO at the D input causes the output to be clocked to a ZERO. The basic connections are shown in Fig. 3. The register uses three flip-flops, A, B and C. The problem is to find the simplest equation for D_A that will cycle the register through seven states. The state sequence tree in Fig. 2 shows that there are four such sequences. The next-state tables for these sequences are given in Table 2.

We can now generate a Veitch diagram for the D_A input. This is mapped directly from the state tables and is shown in Fig. 4. The rule here is



3. **Connections for a divide-by-seven shift register.** D-type flip-flops are used for the basic memory element.



4. **Veitch diagrams** for the three-stage counter. The diagrams are obtained from the state tables.

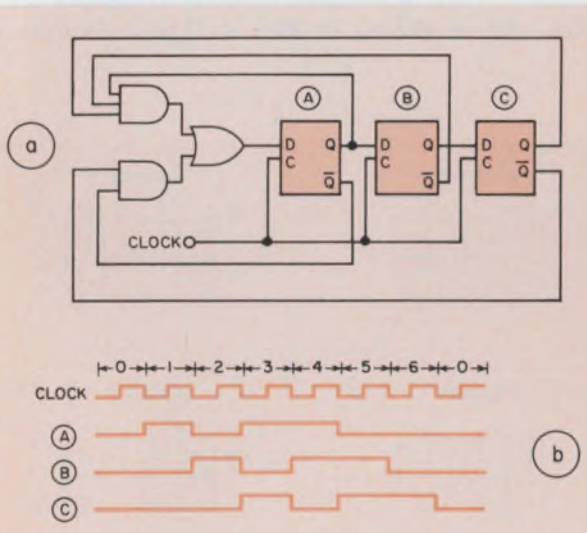
Table 2. Next-state table for Fig. 3

SEQUENCE A					
PRESENT STATE A	B	C	NEXT STATE A	B	C
0	0	0	1	0	0
1	0	0	0	1	0
0	1	0	1	0	1
1	0	1	1	1	0
1	1	0	0	1	1
0	1	1	0	0	1
0	0	1	0	0	0
UNUSED STATE			1	1	1

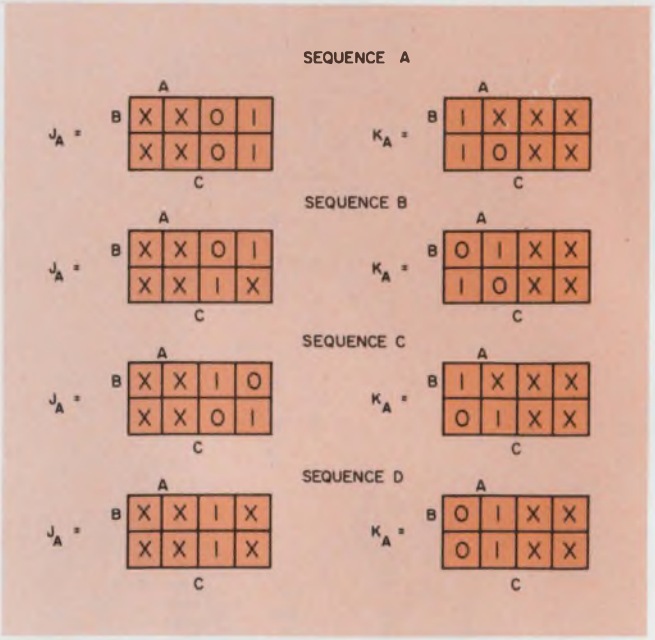
SEQUENCE B					
PRESENT STATE A	B	C	NEXT STATE A	B	C
1	0	0	0	1	0
0	1	0	1	0	1
1	0	1	1	1	0
1	1	0	1	1	1
1	1	1	0	1	1
0	1	1	0	0	1
0	0	1	1	0	0
UNUSED STATE			0	0	0

SEQUENCE C					
PRESENT STATE A	B	C	NEXT STATE A	B	C
0	0	0	1	0	0
1	0	0	1	1	0
1	1	0	0	1	1
0	1	1	1	0	1
1	0	1	0	1	0
0	1	0	0	0	1
0	0	1	0	0	0
UNUSED STATE			1	1	1

SEQUENCE D					
PRESENT STATE A	B	C	NEXT STATE A	B	C
1	0	0	1	1	0
1	1	0	1	1	1
1	1	1	0	1	1
0	1	1	1	0	1
1	0	1	0	1	0
0	1	0	0	0	1
0	0	1	1	0	0
UNUSED STATE			0	0	0



5. **The final divide-by-seven counter,** using two AND gates and one OR gate. The timing waveforms are in b.



6. **Veitch diagrams** for a three-stage, J-K flip-flop counter. Design procedure is same as for D flip-flop.

to plot a ONE in the squares representing the present state when a corresponding ONE exists in the next state. For sequence A, for example, we plot a ONE for the present states 000, 010 and 101. The D_A input equations are then written:

Sequence A: $D_A = \overline{A}\,\overline{C} + A\,\overline{B}\,C$

Sequence B: $D_A = B\overline{C} + \overline{B}C$

Sequence C: $D_A = \overline{B}\,\overline{C} + \overline{A}\,B\,C$

Sequence D: $D_A = A\,\overline{C} + \overline{A}\,C$

The next step is to determine if the equations must be modified to prevent lockup. Examination shows that the unused state, 111, for sequence A will not be a lockup state. However, unused state 000 of sequence B is a lockup state. To prevent lockup, therefore, the A flip-flop must be set whenever the 000 state occurs. This can be done easily on the D_A map by placing a ONE in the 000 square. The new equation for D_A is:

$$D_A = B\,\overline{C} + \overline{B}\,C + \overline{A}\,\overline{B}.$$

Following a similar procedure, we find that sequence C does not require modification to prevent lockup, but sequence D must be modified. The final results are:

Sequence A: $D_A = \overline{A}\,\overline{C} + A\,\overline{B}\,C$

Sequence B: $D_A = B\,\overline{C} + \overline{B}\,C + \overline{A}\,\overline{B}$

Sequence C: $D_A = \overline{B}\,\overline{C} + \overline{A}\,B\,C$

Sequence D: $D_A = \overline{A}\,C + A\,\overline{C} + \overline{A}\,\overline{B}$

To complete the design, therefore, we choose sequence A as the simplest solution. Fig. 5 shows both the final logic diagram and the corresponding timing waveforms.

The same procedure holds for other types of

flip-flops, such as the J-K, except for the construction of the Veitch diagrams. For the J-K flip-flop, the diagrams for the J and K inputs can be mapped directly from the state tables by using the following rules:

- On both the J_A and K_A maps, plot redundancies (X) for each unused state in the sequence.
- On the J_A map, plot redundancies on the entire A side of the map.
- On the K_A map, plot redundancies on the entire $\overline{A}$ side of the map.
- On the K_A map, plot ONEs for each state in the present-state column for which A goes from a ZERO in the present state column to a ONE in the next state column.
- On the K_A map, plot ONEs for each state in the present state column for which A goes from a ZERO in the present state column to a ONE in the next state column.

Use of these rules results in the J_A and K_A maps shown in Fig. 6 for sequences A through D.

From the maps, the equations for J_A and K_A can be written:

Sequence A: $J_A = K_A = \overline{C}$

Sequence B: $J_A = B + C$; $K_A = B\,C + \overline{B}\,\overline{C}$

Sequence C: $J_A = B\,C + \overline{B}\,\overline{C}$; $K_A = B + C$

Sequence D: $J_A = K_A = C$.

An examination for lockup conditions shows that sequences A and D are susceptible. To prevent lockup for sequence A, flip-flop A must be reset whenever the 111 state occurs. This can be done on the K_A map by placing a ONE in the 111 square. The resulting equation becomes:

$$K_A = B + \overline{C}$$

After modification, the final equations are:

Sequence A: $J_A = \overline{C}$; $K_A = B + \overline{C}$

Sequence B: $J_A = \overline{B} + \overline{C}$; $K_A = B\,C + \overline{B}\,\overline{C}$

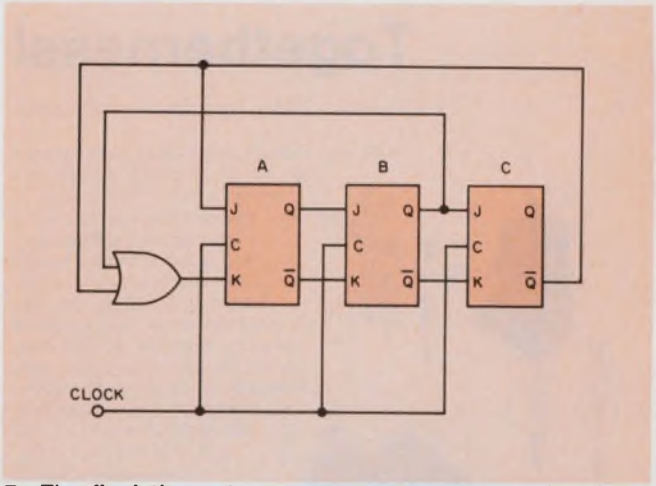
Sequence C: $J_A = B\,C + \overline{B}\,\overline{C}$; $K_A = B + C$

Sequence D: $J_A = \overline{B} + C$; $K_A = C$

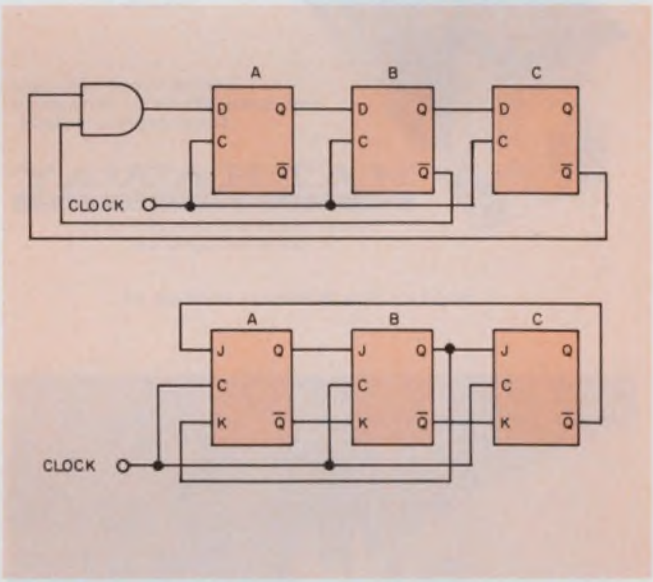
From the equations, we see that sequences A and D are the simplest to implement. Choosing sequence A, we generate the logic diagram of Fig. 7. Note that flip-flops B and C can be either D or J-K types.

Count multiplication may be needed

The vast number of possible sequences makes the sequence-tree method impractical for shift counters of more than four stages. For these cases, we can extend cycle length by using the count-multiplication technique. Count multiplication is achieved by gating together the outputs of two or more subcounters. The cycle length of the resulting composite counter is the lowest number that is evenly divisible by each of the cycle lengths of the individual subcounters. If



7. **The final three-stage, seven-state counter** using J-Ks. Only one OR gate is required.



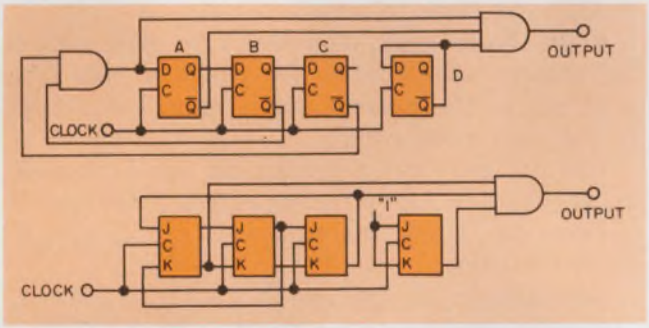
8. **A divide-by-seven shift counter** designed with the sequence-tree method. Both flip-flop types are shown.

Table 3. Next-state table for Fig. 8

PRESENT STATE A	B	C	NEXT STATE A	B	C
0	0	0	1	0	0
1	0	0	1	1	0
1	1	0	0	1	1
0	1	1	0	0	1
0	0	1	0	0	0
UNUSED STATES			0	1	0
			1	0	1
			1	1	1

Table 4. Next-state table for Fig. 9

PRESENT STATE A	B	C	D	NEXT STATE A	B	C	D
0	0	0	0	1	0	0	1
1	0	0	1	1	0	1	0
1	0	1	0	1	0	1	1
1	0	1	1	1	1	0	0
1	1	0	0	1	1	0	1
1	1	0	1	1	1	1	0
1	1	1	0	0	0	0	0
1	1	1	1	0	0	0	1
UNUSED STATES				0	1	0	0
				0	1	0	1
				1	0	1	0
				1	0	1	1
				1	1	0	1
				1	1	1	0



9. **J-K and D-type divide-by-10 counters** are obtained by using divide-by-five and divide-by-two counters.

the cycle lengths have no common factor, this number will then be the product of the cycle lengths of each of the subcounters.

For example, count multiplication can be used to combine a divide-by-three counter with a divide-by-seven counter to obtain a divide-by-21 counter. However, count multiplication cannot be used to combine a divide-by-eight counter with a divide-by-four counter to obtain a divide-by-32 counter. An attempt to do this would result in a counter with an eight-state cycle length—not a 32-state length.

To illustrate the count multiplication technique, consider the design of a simple counter which develops an output pulse for every 10 input clock pulses. This counter can be designed by combining a divide-by-five counter with a divide-by-two counter.

For designing the divide-by-five counter, we can use the sequence tree method. One solution is shown in Fig. 8. This counter has the state sequence shown in Table 3 and has no lockup states. A divide-by-two counter can be obtained simply by toggling a flip-flop with the clock. When these two counters are combined, the state sequence shown in Table 4 results. The output can be obtained by decoding any of the states yielded by the table. Fig. 9 shows two possible designs in which the 0000 state has been chosen for the output. ■■

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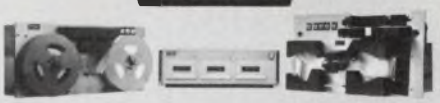

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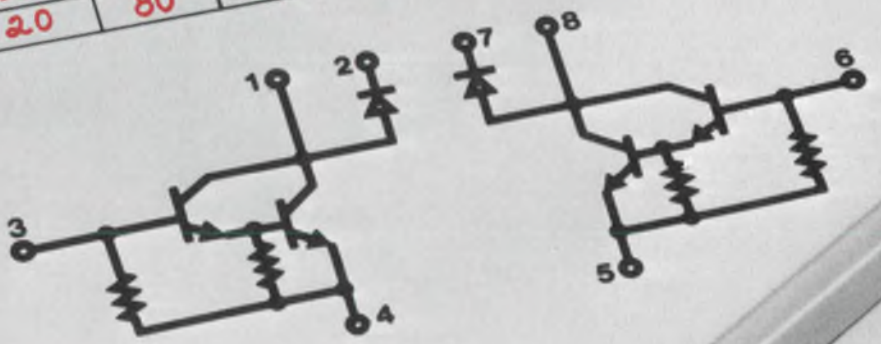
PIC501	20	100	1000	2.0	0.65	3.6		6.50
PIC502	20	80	750	2.0	0.65	3.6		4.90



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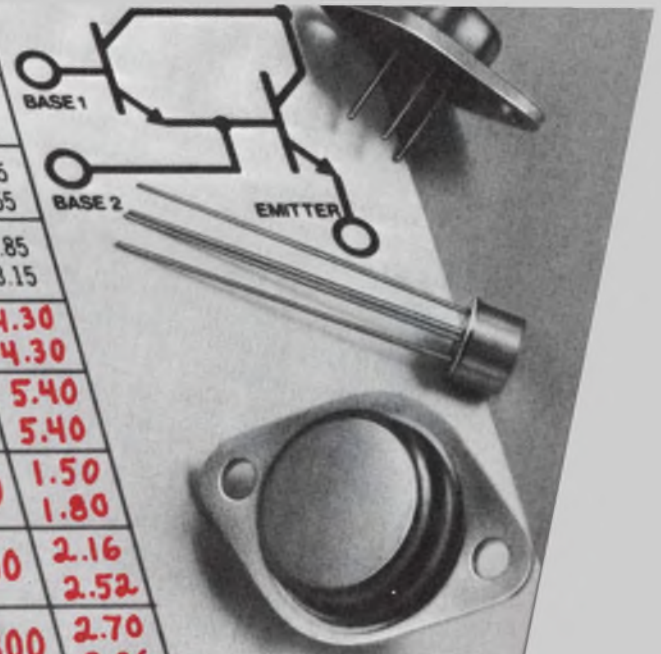
		U2T305 U2T405	TO-33 TO-66	150	1000 @2A	2.5 @2A	400	1.80 2.10
	10	U2T101 U2T201	TO-33 TO-66	80	2000 @5A	1.5 @5A	400	2.25 2.55
		U2T105 U2T205	TO-33 TO-66	150	1000 @5A	2.5 @5A	500	2.85 3.15
	20	U2T501 U2T601	TO-66 TO-3	80	2000 @10A	1.5 @10A	400	4.30 4.30
		U2T505 U2T605	TO-66 TO-3	150	1000 @10A	2.5 @10A	500	5.40 5.40
PNP	5	U2T351 U2T451	TO-33 TO-66	60	1000 @2A	2.0 @2A	250	1.50 1.80
		U2T355 U2T455	TO-33 TO-66	120	1000 @2A	2.5 @2A	300	2.16 2.52
	10	U2T151 U2T251	TO-33 TO-66	80	2000 @5A	2.5 @5A	300	2.70 3.06
		U2T155 U2T255	TO-33 TO-66	120	1000 @5A	3.0 @5A	400	3.44 3.78
	20							



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Cut system testing and troubleshooting

by designing subsystems with the total system in mind, not just 'black boxes' that meet their own individual specs.

Giving a subsystem designer only a few basic specs—such as the electrical input-output requirements—is a sure way to a disaster. His subsystem—which is often a logic card among hundreds of other cards (Fig. 1)—will, after meeting its own specifications, either fail itself or cause failures of adjacent cards during the complete system test. This quickly turns what was supposed to be a short test run into a costly troubleshooting sequence, with flying tempers, overtime charges and missed deliveries.

To insure that a system test is quick confirmation of the ability of all subsystems to function together, subsystem designers should be kept informed of all the requirements—electrical, environmental and mechanical—that their "black boxes" will have to meet *in the system.* Here are some major trouble spots that commonly plague many electronic systems:

- Multiple ac/dc ground points.
- Error detection when using common support logic for monolithic storage.
- Input-signal noise when detecting low-level analog signals from various transducers.
- An underdesigned power-distribution system.
- Pitfalls in designing circuitry around specific vendors' components.
- Unexpected heat generated within a system.
- Maintainability and serviceability of the subsystems.

Let's examine some solutions to these problems.

Anticipating multiple ac/dc ground points

As each engineer designs his subsystem, he uncovers and eliminates various noise problems, often by grounding certain strategic points. But when the design is incorporated into a system, ground loops develop that result in ground shifts or noise. Analog circuits are especially susceptible to this problem. Figure 2a shows a typical case in which many ground loops may develop in a system.

To prevent this, a system ground should be designed (not usually done) to accommodate the independently designed circuits. This "common" ground will help eliminate ground shifts and noise problems (Fig. 2b).

George F. Gibson, Project Engineer, IBM General Systems Div., Boca Raton, Fla. 33432

Detecting errors with common support logic

Monolithic storage is often laid out with two bits per card and common support logic for both bits. In some instances the system data word is made up of 16 bits with odd parity checking per byte (eight bits). The system uses the storage by checking bits in consecutive order on the cards. If the common support logic fails, the system error-checking circuits may not detect the error.

To correct this, it is only necessary to alternate bits on the card between the bytes of the word. Thus a common logic failure would be detected.

Reducing input-signal noise

When amplifiers detect low-level analog signals from various transducers, protection against input-signal noise is often overlooked by the circuit designer. The amplifier circuits are designed and tested independently instead of in the system where they will be used. When placed in the system, the surrounding electrical noise is suddenly too high.

To solve this problem, the input analog signal should be applied to a differential amplifier (a method that might seem superflous while the circuit is being designed and tested as a subsystem). The noise then appears as a common-mode input, and the differential amplifier can reduce significantly the effects of the common-mode input noise (Fig. 3).

Design an adequate power-distribution system

Power-supply requirements are usually based on maximum loads. Cabling (wire size) is often designed for an average of about 75% of load. When a system is fully loaded, the power-distribution subsystem is stressed beyond the designed capability. Therefore it may no longer meet its

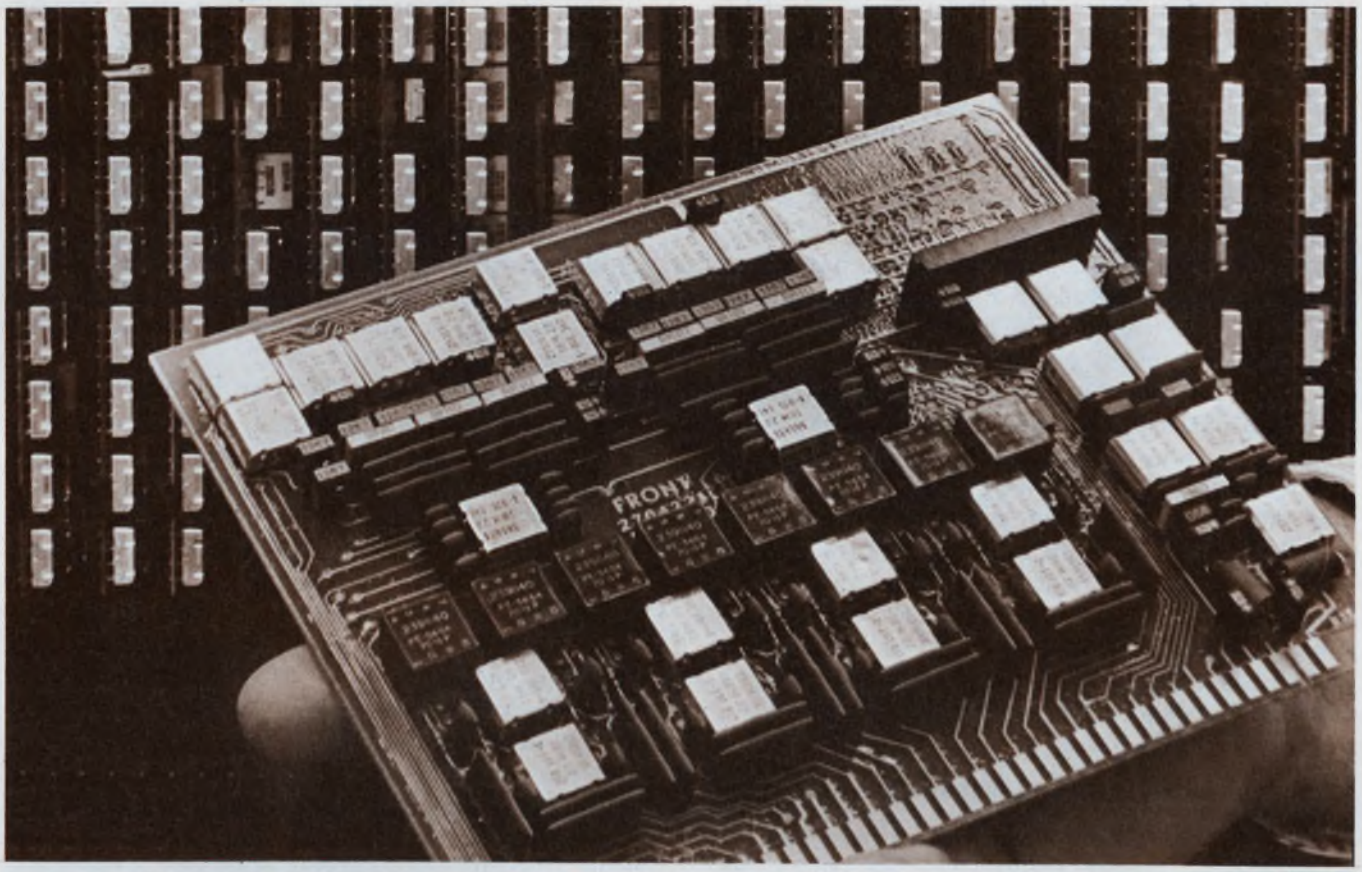
voltage specifications.

On the other hand, minimum loads are not usually specified in the basic design (other than in the power supply itself). Minimum loads, however, should be taken into account in systems with variable features that will affect the power-system loads. Also, if the power supply has too much power, regulation can be lost.

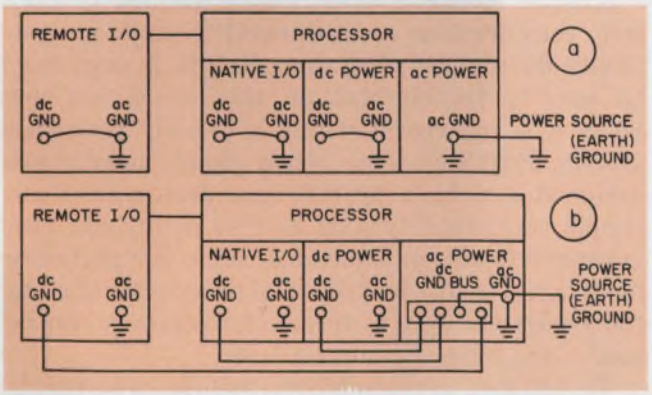
One remedy for these problems is a variable preload, which can be set, depending on the features within each system. With a modular system, rather than design separate power supplies for each module, use one power supply. This will enhance the system by centralizing the power-supply subsystem, and it will also provide the flexibility required for modular systems.

Don't design around specific vendor's parts

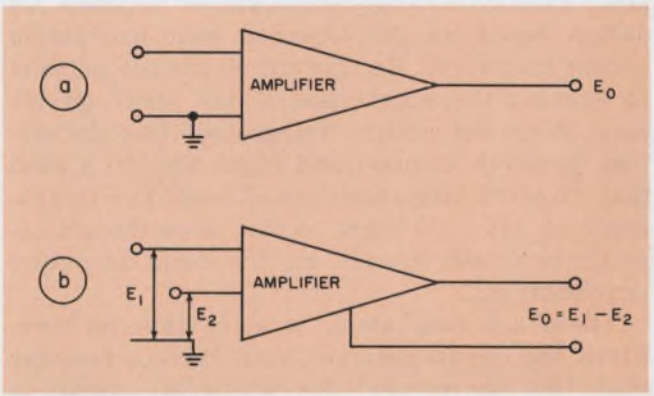
One of the most frequent problems encountered during system testing is caused when engineers design their circuits around a particular vendor's



1. **Do you know where your subsystem will go?** It might be a single logic card, surrounded by hundreds of other cards, some of which will generate heat, others electromagnetic waves, others light. Find out whether or not your card can cope with its neighbors. This should be checked before starting a design.



2. **Ground loops develop** when individual subsystems are integrated into a total system and dc ground points are connected to multiple ac grounds (a). By tying together all dc grounds and then connecting them to a single ac ground, the problem is eliminated (b).



3. **Input-signal noise is often a problem** in a single-ended amplifier (a). Thus, while a subsystem test may show that a single-ended amplifier is adequate, a differential amplifier should be considered in anticipation of possible high-level noise in the system (b).

component specification. A problem occurs when the component is purchased from another source. Even though the parameter specifications of both vendors are identical, it has been found that the secondary-source component may not function properly in the particular design situation. The reason for this is usually that there are differences in the fabrication process of the two vendors, causing subtle performance differences.

Consider a hypothetical case of a particular MOSFET built by two vendors. The FET built by one is used in the original circuit design. It is found to be unnecessary to tie the substrate lead (the fourth lead) to a voltage source; the circuit functions well with the fourth lead floating, thus simplifying the circuit.

At a later time, however, these FETs are bought from several other vendors. Suddenly, during system testing, circuits that have been functioning well begin to fail. Investigation reveals that one vendor's MOSFET is much more sensitive to normal circuit transients than the original FET. Further investigation might reveal that this particular vendor's FET displays higher leakage currents than the other vendor's FET.

One solution is to connect the substrate to a bias voltage. The over-all remedy is for the circuit designer to keep in mind that there may be inherent differences among similar components made by different manufacturers. To avoid problems, no attempt should be made to design close to the component performance limits. Keep a margin of safety in the design.

Is your subsystem next to a 'hot spot'?

"Hot spots" often occur in systems because of packaging design faults. The hot spots can cause component overheating and failure.

This trouble develops when circuit cards that dissipate large amounts of heat are placed in the same module with cards that dissipate very little heat. Usually a subsystem designer develops his design based on the expected heat dissipation *within his circuit*. He lays out all the components to prevent the occurrence of hot spots on his card. When his card is "integrated" into the system, however, it may land right next to a card that gives off large amounts of heat. The components on his card begin to fail, even though his card, by itself, passed all the tests including environmental.

There are four steps to solve this problem. First, the circuit designer must become familiar with the environment for which his circuit is being designed, including the card orientation within the system. Second, the packaging engineer should place cards that are susceptible to hot spots away from heat sources. Third, adequate system cooling should be designed to make sure that no hot spots occur. Fourth, the designer should keep in mind the total system environment, especially the ambient temperature.

Will your card take vibration?

Several packaging aspects tend to be overlooked and lead to problems when the system is subjected to vibration. They include:

Circuit card contact wear. Cards tend to rock back and forth in their mounting slots as a result of vibration. This causes wear of connector pins, which, in turn, causes electrical instability and discontinuities. This problem is particularly troublesome in the case of low-level signals.

Components and subassembly mounting. Components and subsystems are often assembled so as to produce a cantilever effect. Under vibration, this will quickly lead to structural failure, because of metal fatigue, resulting from vibration at resonant points.

Strength calculations. It is an unfortunate fact that, by and large, subsystem designers tend to disregard strength calculations during the design phase. Little or no effort is made to employ dynamic design techniques when the packaging of a subsystem is considered. Usually the problems are resolved during system testing. This leads to greatly increased testing and troubleshooting, as well as added costs in making changes in the fully designed system.

To prevent vibration-induced problems, subsystem designers should understand thoroughly the vibrational requirements that the *system* must meet. The common tendency to stick a component here and a component there, without really choosing the locations carefully, often leads to mechanical failures.

Is your card serviceable and maintainable?

Another common oversight is failure to take into consideration maintainability and serviceability during the subsystem design. A card may be easy to troubleshoot on the bench, but not when it is incorporated into a densely packaged system. Problems occur when circuit boards are designed and built by different designers. Such simple serviceability aids as test points are frequently left out, or additional logic for software diagnostics is overlooked. If not corrected during the subsystem design, these shortcomings can be costly and time consuming later.

To enhance serviceability, include test points and test logic. Package the cards so they are easy to extract and easy to troubleshoot. Simple design should be the goal of each subsystem designer from the outset. ■■

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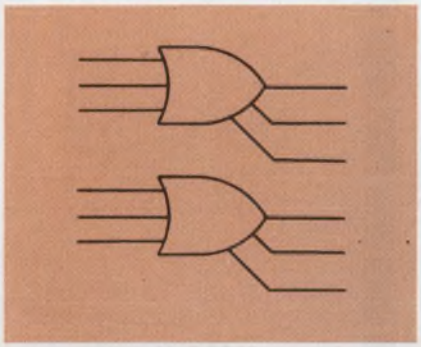
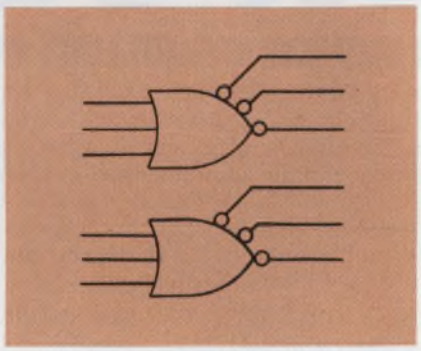
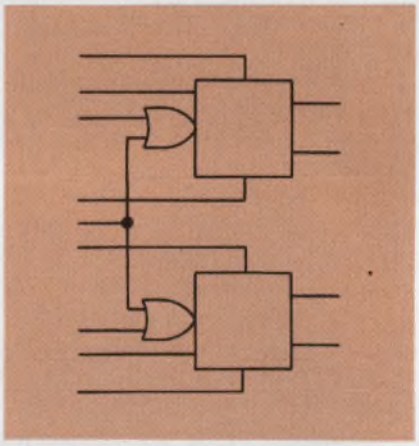


MC10210 Dual 3-Input 3-Output "OR" Gate



MC10211 Dual 3-Input 3-Output "NOR" Gate

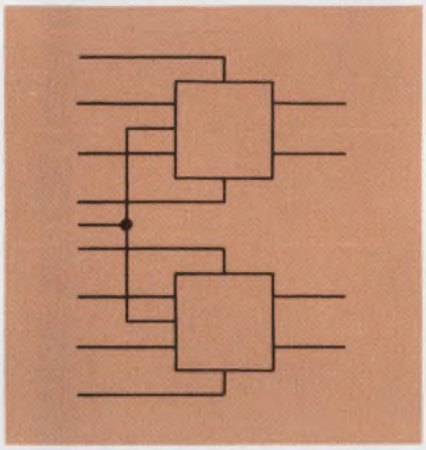
These dual gate packages are designed to drive large fanout/high-speed clock lines in synchronous applications. The multiple outputs along with minimum delay times and fast rise and fall times are useful in clock distribution where minimum clock skew is desired.



MC10231 High-Speed Dual D Flip-Flop

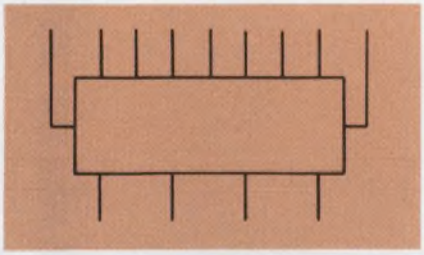
This device has the lowest industry power (225 mW/pkg) for a dual 225 MHz master-slave type D flip-flop and is ideal for applications such as airborne digital equipment.

As part of the planned growth of the 10,100 series here are three new additions.



MC10135 Dual J-K Master-Slave Flip-Flop

Recommended for storage and counting applications. Particularly useful where minimum gating logic is required. Has the ability to inhibit operation and store information independent of the clock. Also can be used to store data by holding both the $\overline{J}$ and $\overline{K}$ inputs high.



MC10141 Four-Bit Universal Shift Register

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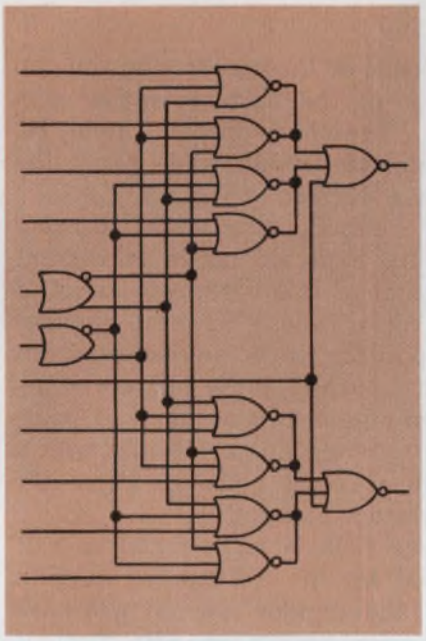
...MECL 10,000 Adds 6 More.



MC10174 Dual 4-To-1 Multiplexer

Useful for communications and computer applications requiring multiplexing of four inputs. Features an Enable input which can place the outputs low to allow data bussing the outputs with other devices.

MECL 10,000 — The Comprehensive Line

Here's a look at functions now available and an indication of future product planning.

GATES
- MC10101 Quad OR/NOR Gate With Strobe
- MC10102 Quad NOR Gate
- °MC10104 Quad AND Gate
- MC10105 Triple 2-3-2 OR/NOR Gate
- MC10106 Triple 4-3-3 NOR Gate
- MC10107 Triple Exclusive OR/NOR Gate
- MC10109 Dual 4-5 OR/NOR Gate
- MC10110 Dual 3-Input/3-Output OR Gate
- MC10111 Dual 3-Input/3-Output NOR Gate
- MC10117 Dual 2-Wide OR-AND/OR-AND-INVERT Gate
- MC10118 Dual 2-Wide OR-AND Gate
- MC10119 4-Wide OR-AND Gate
- MC10121 4-Wide OR-AND/OR-AND-INVERT Gate
- MC10210 High-Speed, 3-Input/3-Output OR Gate
- MC10211 High-Speed, 3-Input/3-Output NOR Gate

COUNTERS
- °MC10136 Universal Up/Down Binary Counter
- °MC10137 Universal Up/Down Decade Counter

MEMORIES
- °MCM10140 64-Bit RAM (64x1)
- °MCM10145 64-Bit RAM (16x4)
- °MCM10146 1024-Bit RAM (1024x1)
- °MCM10149 1024-Bit PROM (256x4)

TRANSLATORS
- "MC10124 Quad TTL-TO-MECL Translator
- "MC10125 Quad MECL-TO-TTL Translator
- °MC10127 Dual MECL-TO-MOS Translator

MULTIPLEXERS
- °MC10132 Dual Multiplexer With Latch (Common Select)
- °MC10134 Dual Multiplexer With Latch (Separate Select)
- MC10164 8 Line Multiplexer
- °MC10173 Quad Multiplexer With Latch
- MC10174 Dual 4-1 Multiplexer

DRIVERS AND RECEIVERS
- MC10115 Quad Line Receiver
- MC10116 Triple Differential Line Receiver
- °MC10216 High-Speed, Triple Diff. Line Receiver
- °MC10128 Bus Driver (Separate Select)
- "MC10129 Bus Receiver

FLIP-FLOPS AND LATCHES
- MC10130 Dual D Latch
- MC10131 Dual D Master-Slave Flip-Flop
- MC10231 High-Speed, Dual D Master-Slave Flip-Flop
- MC10133 Quad Latch with Output Enable
- MC10135 Dual Master-Slave J-K Flip-Flop
- °MC10175 Quint Latch

ARITHMETIC FUNCTIONS
- MC10179 Look Ahead
- "MC10180 Dual 2-Bit Adder/Subtractor
- MC10181 4-Bit Arithmetic Logic Unit

OTHER LOGIC FUNCTIONS
- MC10141 4-Bit Universal Shift Register
- MC10160 12-Bit Parity Generator/Checker
- MC10161 Binary 1 of 8 Low Decoder
- MC10162 Binary 1 of 8 High Decoder
- °MC10165 Priority Encoder

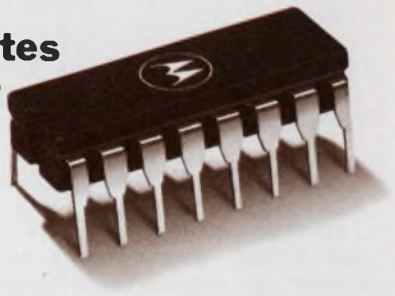
*To be introduced

In addition, MECL 10,000 will shortly be available in the *full military temperature range* of −55°C to +125°C as well as the present commercial temperature range listed above (−30°C to +85°C).

For complete specifications on these new products write to Motorola Semiconductor Products Inc., P.O. Box 20912, Phoenix, AZ 85036. And for immediate evaluation call your local Motorola distributor.

MECL 10,000 technology will meet your present high-speed requirements and is flexible for future evolution. Designers now have available more MSI and SSI functions than any other high-speed digital logic line; truly the industry's #1, fastest growing high-speed logic family.

MECL 10,000 eliminates the alternatives. Evaluate and compare!



MOTOROLA MECL

. . . for faster computers & systems

INFORMATION RETRIEVAL NUMBER 49

Replace your bridge circuit with this

unique meter movement. It offers a novel approach to monitoring small variations around a large current level.

Need a sensitive current meter for an instrument system? A unique rotary device, called a synthetic bridge, detects small current variations around a large nominal level. The device can be easily constructed in the laboratory, since it consists of only three major parts: a laminated stator core, the stator windings and a permanent magnetic rotor.

Rotating field vector is the key

The synthetic bridge develops an electromagnetic-field vector whose direction is a spatial analog of the dc current being monitored. A simple, magnetized rotor aligns itself with this field vector to provide a direct readout of the unknown current.

The spatial variance of the field vector is achieved with a controlled set of biasing fields. The vector diagram of Fig. 1 shows the relationship between these interacting fields. One field, B_p, is in phase opposition to the unknown current, and the other field, B_q, is in space quadrature.

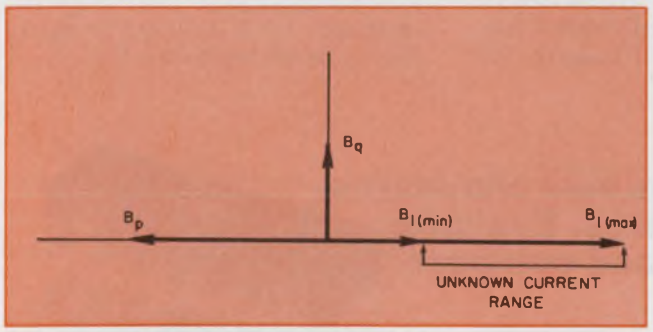
The magnitudes of the biasing fields depend on the anticipated range of the unknown currents. With knowledge of these currents, you can establish the range of the field-generating currents, I_{min} and I_{max}. The phase-opposing field, B_p, is then set to center the input range about the origin of the vector diagram (Fig. 2).

The quadrature field, B_q, is adjusted to equal some fraction of the expected range of current values. The net result of this composite array of field vectors is a vector whose direction changes from an angular position in the second quadrant to one in the first quadrant as the unknown current varies from minimum to maximum. A near-linear 90-degree excursion can be obtained over a range of unknown currents equal to twice the value of the quadrature current.

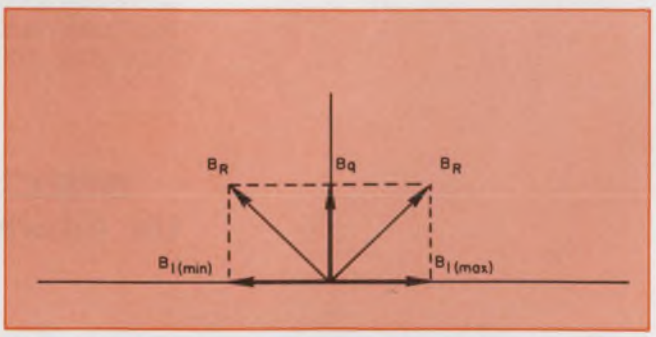
If the quadrature field is made equal to half the field generated by the anticipated current range, I_{min} to I_{max}, the angular readout will have the linearity deviation shown in Fig. 3. This yields a maximum deviation of only 4.1 degrees over the total range.

Values outside this range will cause progressively compressed angular excursions of the resultant field vector. In this way you avoid some of the problems you get with conventional meters. There is virtually no possibility of burning out a sensitive coil movement or precision shunt resistors with overrange currents, or of pegging the meter needle, or of getting unreadable off-scale values.

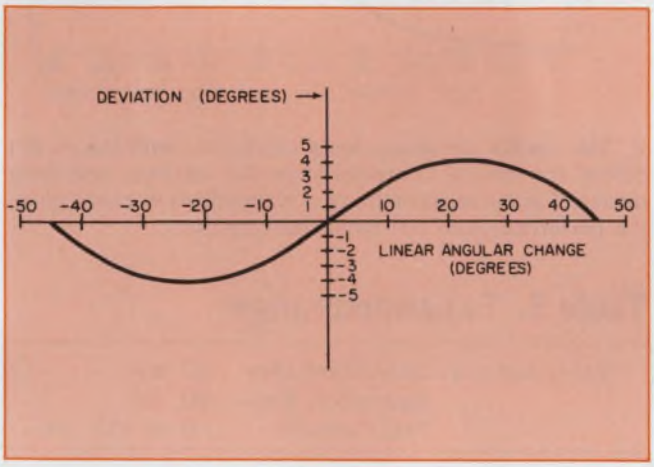
Bernard J. Petrillo, Staff Engineer, Rhodes Instrument Corp., Rye, N.Y. 10580



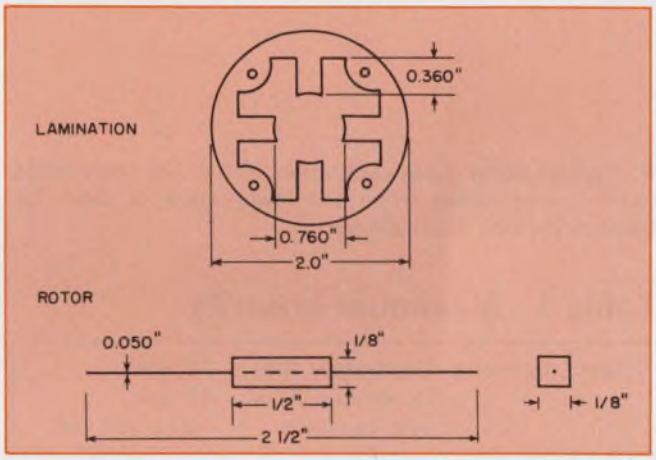
1. **Electromagnetic-field vectors** associated with the synthetic bridge. Bias currents establish two field components, one of which is out-of-phase, and the other in quadrature with the test current.



2. **The phase-opposing field, B_p, centers** the current-produced vectors about the origin. The resulting field, B_r, moves from second quadrant to the first as the current changes from I (min) to I (max).



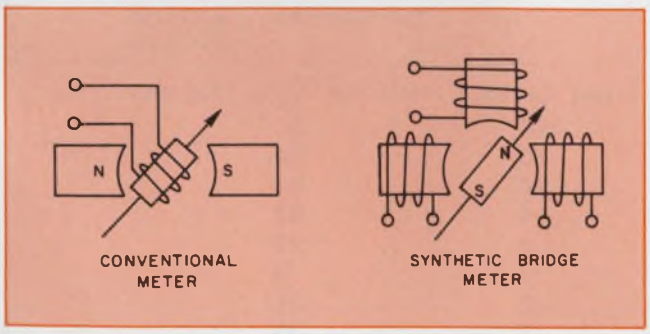
3. **Linearity remains within ±4.1 degrees** over a ±45-degree excursion of the resultant field. The quadrature bias equals one-half of the difference between the maximum and minimum fields.



5. **Lamination and rotor used in the breadboard** model. The magnetic rotor is suspended in a low-friction pivot. Rotational restraints are not needed since there is no moving coil or flexible conductors.

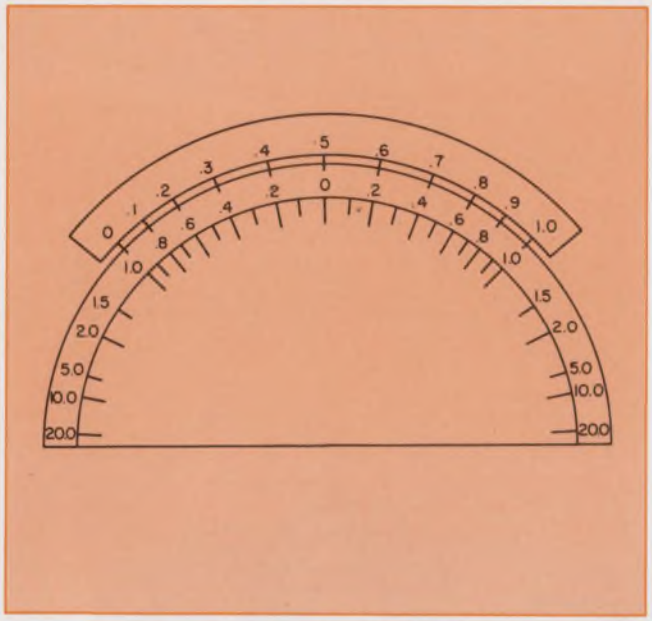
You can expand or contract the scale merely by altering the magnitude of the quadrature biasing field. If a current range with a different center reading is required, the phase-opposing bias field is correspondingly altered. The meter thus provides a flexible readout, with the ability to expand any selected portion of a range of dc currents.

The construction of the readout device is similar to that of a two-pole stepping motor. However, the rotor magnet does not have a pronounced attraction to any of the stator poles until they are excited by their coil currents. Further, since the only work being done is the positioning of the rotor shaft with a balanced needle at low-frequency rotations, the rotor can be small and light. Small-area, low-friction suspension pivots can be used. Fig. 4 schematically compares the synthetic-bridge meter with a conventional D'Arsonval movement. Unlike the D'Arsonval, the synthetic bridge has no electrical conductors in the rotor. This simplifies the device construction since slip rings or flexible conductors are not needed. The stator lamination used for the test model is shown in Fig. 5. Seventy-five laminations (Magnetics, Inc., PN-65205, with a thickness of 0.01 inch) are bolted together to form the basic pole structure. The coils consist of 1000 turns of 34-gauge magnet wire.

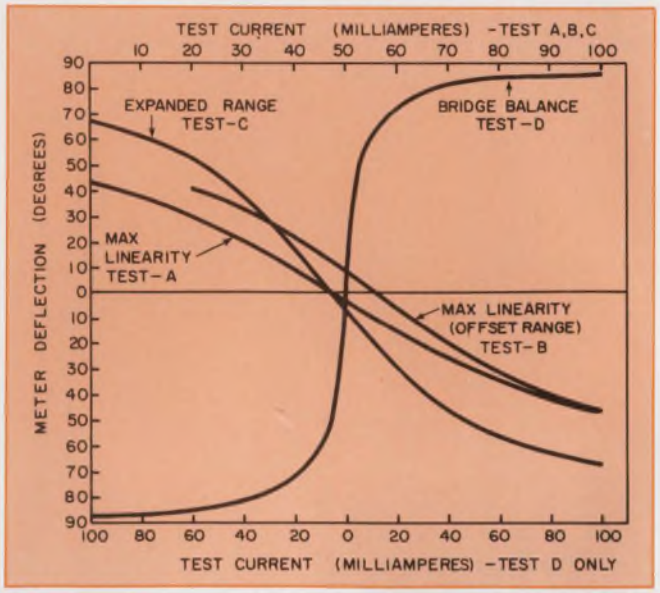


4. **Schematic comparison of the synthetic bridge** with a conventional meter movement. No rotational restraints are encountered with the synthetic bridge since the device has no moving coil or slip rings.

The figure also shows the rotor shaft and magnet assembly. The steel shaft has a diameter of 0.050 inch and a conical taper at each end for pivotal surfaces. Centered on this shaft is a soft bar magnet. A set of conventional meter pivot jewels can be used to support the rotor in the completed assembly.



6. **Typical meter scale calibration.** The upper scale reads current magnitudes while the lower scale is used for balanced-bridge applications.



7. **The results of various tests** conducted with the model define the device characteristics for various operating modes. The curve resembling a magnetization curve gives the performance in the balanced condition.

Table 1. Maximum linearity

Test Conditions:	Quadrature Bias	50 mA.
	Opposition Bias	50 mA.
	Test Currents	0 to 100 mA.

Test Current	Readout Angle (degrees)
0	44
10	38
20	30
30	20
40	9
50	−3
60	−15
70	−26
80	−34
90	−40
100	−46

Table 2. Max. linearity, offset range

Test Conditions:	Quadrature Bias	40 mA.
	Opposition Bias	60 mA.
	Test Currents	20 to 100 mA.

Test Current	Readout Angle (degrees)
20	42
30	33
40	22
50	9
60	−6
70	−20
80	−31
90	−39
100	−46

Table 3. Expanded range

Test Conditions:	Quadrature Bias	25 mA.
	Opposition Bias	50 mA.
	Test Currents	0 to 100 mA.

Test Current	Readout Angle (degrees)
0	68
10	62
20	54
30	39
40	18
50	−7
60	−30
70	−46
80	−55
90	−61
100	−66

Table 4. Balanced bridge

Test Conditions:	Quadrature Bias	5 mA.
	Opposition Bias	0 mA.
	Test Currents	+100 to −100 mA.

Test Current	Readout Angle (degrees)
100	87
50	84
10	63
6	52
2	23
0	0
−2	−26
−6	−50
−10	−62
−50	−84
−100	−87

The synthetic bridge, while completely different in concept and structure from a conventional bridge circuit, accomplishes similar objectives. It measures slight variations from a non-zero quiescent value of current. But since the metered arm of a conventional bridge sees zero (or near zero) current under balanced conditions, it requires a sensitive current meter (usually a microammeter) that can be easily damaged. This does not occur with the more rugged synthetic bridge.

Advantages over a conventional bridge

A number of other advantages make the new rotary device superior to the bridge in many applications. These advantages include:

- There is dc isolation from the circuit being monitored; dc coupling between the legs of the synthetic bridge is avoided. Scale changes can be made without affecting the circuit under test.
- The monitored current drives the readout directly. A conventional bridge measures currents that are an order of magnitude less than the actual current in the legs of the bridge. A sensitive meter movement is needed to detect the small currents.
- No power supply regulation is required. When the windings are excited by a common power supply, the readout becomes ratio-sensitive and is not primarily dependent on the absolute values of the circuit currents.
- Full-range capability is provided. The device gives a near-linear, wide-angle, 90-degree scale (Fig. 6) for a desired range of values, and it displays all values in excess of this range on a progressively compressed scale. The total possible angular deflection is 180 degrees.
- There is no moving coil, because there are no electrical conductors in the rotor. This greatly simplifies the construction of the readout device, by avoiding the need for slip rings or flexible conductors.
- Only two precision resistors are needed. Each scale change requires only one additional resistor. In contrast, the conventional bridge uses a minimum of three precision resistors, with each scale change requiring three additional resistors.

Four general tests were conducted with a breadboard model to determine the device's characteristics, both as a standard current meter and as a bridge. These are: the maximum linearity, response to an offset current range, expanded range operation and, finally, use as a balanced bridge. The results of the tests are plotted in Fig. 7 and listed in Tables 1 to 4.

The tests generally show that the 90-degree scale represents the best compromise between viewing angle and reading linearity, and that optimum readout is obtained by tailoring the bias currents for a particular application. ■■

FIFO: FIRST ASYNCHRONOUS SUBSYSTEM FOR DATA RATE TRANSLATION.

FIFO: Our 3341 OPTIMOS 4x64-Bit Buffer Memory. Most cost effective way to interface two systems with different data rates.

Instead of designing your own special subsystem, use our new FIFO. For example:

1. Irregular data can be collected from a telemetry system and stored in FIFO for use when it's convenient.

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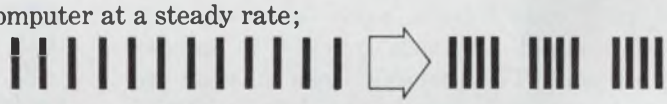
3. Inserted between an A/D and a D/A Converter, FIFO can be used to stretch or contract the time base or change the frequency of acoustic or sensing signals.

4. Information input at keyboard rate can be stored and transferred at high speed on demand from a CPU.

5. From peripheral equipment, you can input to a computer at a steady rate; FIFO stores information and re-formats it in even bursts for efficient off-line use.



FIFO is an asynchronous buffer subsystem designed specifically to solve the kind of handshaking problems that occur between a computer and its peripheral equipment. Input and output operate completely independent of each other – without common clocking – translating two dissimilar data rates simultaneously, and giving the system designer more freedom.

Now the faster part of your system doesn't have to wait for the slower part to catch up. Instead, FIFO translates the data rates, and the CPU can move on to more important things.

FIFO, as its name implies, operates in a first-in first-out mode. Four bits of input data are clocked into the FIFO device and 'bubble' automatically to the last unoccupied location. Special on-chip input pullup circuits and bipolar compatible output buffers provide direct compatibility with TTL and DTL, without any external components. Control signals make vertical and horizontal expansion easy. 1MHz input/output rate guaranteed.

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INFORMATION RETRIEVAL NUMBER 51

Put 'tiger teams' in your managing game.

Used discretely, a few creative, highly motivated people help keep the manager's organization technically strong and cost-effective.

Herb Sobel, Lab Manager, Raytheon, Bedford, Mass. 02173.

How does a manager who's responsible for 250 people and more than two dozen projects a year keep his operation technically strong and cost-effective? If I didn't have some kind of staff group that I could motivate quickly to handle sudden problems, I'd probably lose a year or more in getting some projects started. I call the group that helps me the "tiger team."

Who are these 'cats'?

The tiger team is a staff of about six creative, highly motivated guys who take on new concepts and step in to guide faltering segments of various projects. If I had to come up with the over-all prerequisites for the members of this kind of team, I'd list these qualities: ability to solve engineering problems from a total systems point of view; multiple capabilities—you can't afford to hire specialty services; enough persuasion to defend or challenge specifications; self-motivation—the manager motivates the group, and they'll reciprocate; ability to write a proposal or a report without assistance—you can't afford to hire a ghost writer.

Part of my function as the manager is to define the initial concept. I might even come up with the initial concept myself, and one of the guys might say, "Hey, how about doing it this way, instead?" So I apply the initial thrust and let their ideas take over. I allow them to express their creativity, which gets them personally involved and committed, and then I can back off a bit and let them run with the ball.

Who are these highly motivated people who make good tiger-team material? There are six basic types:

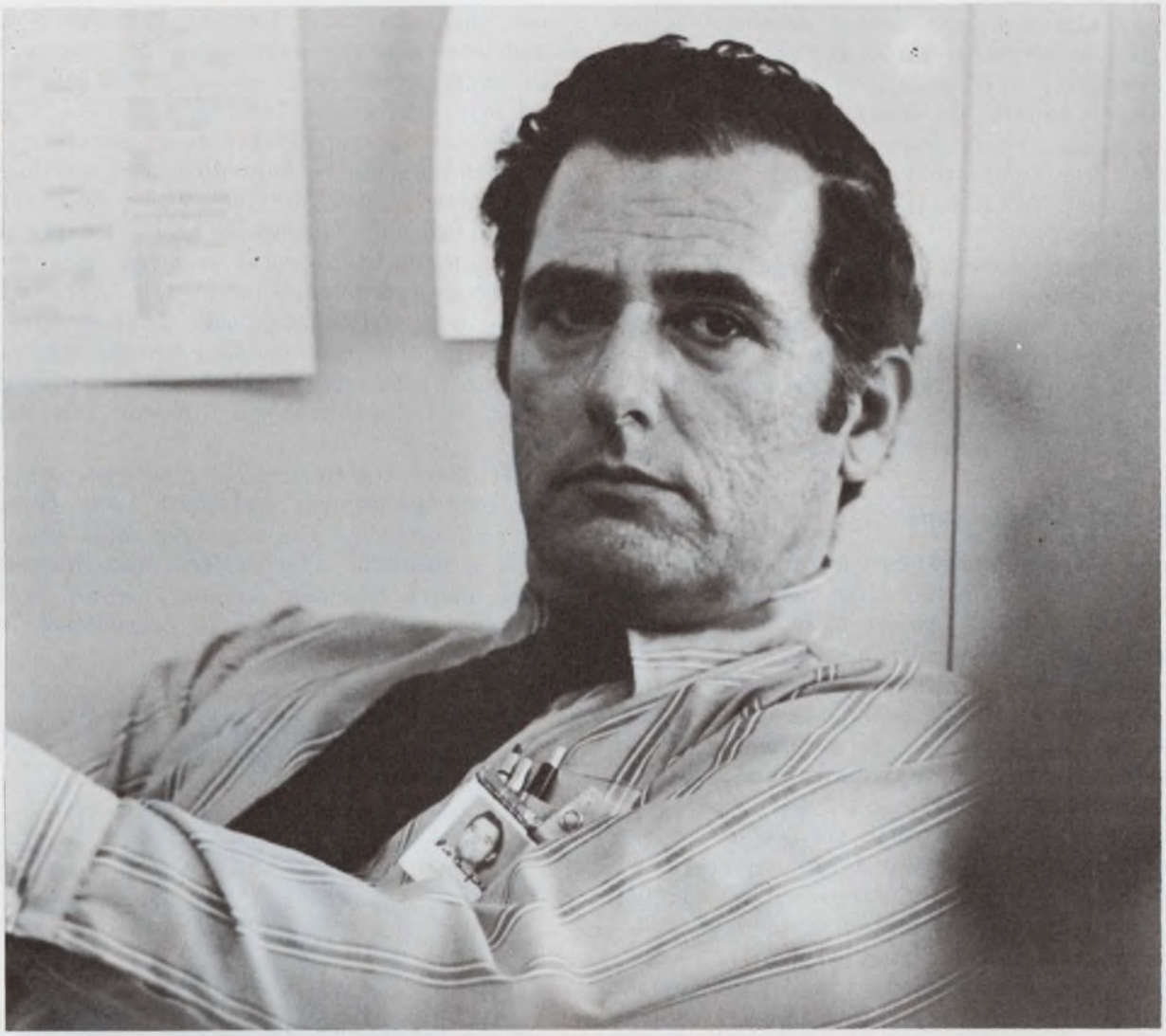
1. *The project engineer type:* He's more of an administrator than some of his teammates. He's innovative in project management, and he may be a good systems engineer. He's not as creative as they are, but he'll pick up the details that some of the other guys might tend to slough off. He's a practical stabilizer, and he coordinates the team into a force. He's a good project engineer, because he knows all the ways of getting something done in an organization. He knows how to feed things into drafting and fabrication, and he knows who's likely to do what to whom, because he's been there before. As a young engineer, he started off curious about everything, and when he started running projects, he did it better than anyone else.

2. *The spectral type:* This guy has a moderate knowledge of machines, but he also knows software and something about military systems. He's spectrally oriented and wants to know systems hardware, software and marketing. He has grown through the ranks, has about four year's experience, is energetic and bright, and was hired from college. He has matured to this capability.

3. *The machine designer type:* He's not just a logic designer; he's not interested in just a piece of logic. He's interested in the total machine design, the total architecture. Usually he has about 10 years' experience, and he comes recommended to you.

4. *The software specialist type:* He can take a problem from the beginning, establish how he's going to solve it, what kind of language he's going to use, and do it. He's usually well-versed in higher order and machine language; he's problem oriented and software systems oriented. He's also a very fast contributor. He's broad enough to do the whole job by himself. He's a senior guy with 15 years' experience in the field and has done everything from managing large groups of programmers to developing new compiler structures. He likes a challenge, wants to be a prime contributor, and can usually be found working on four or five projects at once to keep his mind occupied.

5. *The genius type:* This guy has a genius IQ with a specialty, say, in arithmetic design. If you turn him loose on a computer, he'll come up with the most novel, creative algorithmic ways of dividing and multiplying that you can imagine. He's also the kind of guy that you can put into a new area like signal processing. He'll also show you slick ways of doing arithmetic processing for fast Fourier transforms or other special purpose arithmetic operation. He's in an



Herb Sobel

Education: M.S.E.E., Northeastern University, 1965; B.S.E.E., M.I.T., 1958; B.S.B.A., Boston University, 1953.

Experience: Responsible for the technical and administrative activities of approximately 250 engineers at Raytheon, and for the design and development of the computer-controlled SAM-D advanced multi-mode radar system; machine-aided design for SAM-D; the radar control unit, the radar signal processor, the central test facility of SAM-D, and many other programs.

Professional Affiliations: IEEE—PGEC; Massachusetts Professional Engineer.

Patents: Magnetic control system granted 1964; modular-general purpose signal processor, 1972 pending.

Publications: Text (Addison-Wesley), "Introduction to Computer Design," (1971); Periodical (Electronic Progress), "Multi-Mode Digital Radar Control," (1968); Design Consideration for an Advanced Digital Beam Steering Computer," (1966); "Digital Module Testing Concept," (1964); "Digital Data Processing," (1961).

Employer: Raytheon is an international science-based company with annual sales in excess of $1-billion. It provides electronic products, systems and services to defense and other government markets and is active in commercial and consumer fields. Headquartered in Lexington, Mass., Raytheon has eight divisions, seven major operating subsidiaries, and 50 plants and laboratories in the U.S. Overseas subsidiaries and affiliates are located in eight nations. Over 46,000 people are employed.

ivory tower. Everyone comes to him as an expert and asks him if he can beat a problem; he becomes the super expert. You can put him into a new discipline and within a week or two he becomes an expert; inside of six months no one can touch him. These types are fun to work with because after awhile they sort of leave you in a cloud of dust. You have to take a lot of what they say on faith.

6. *The high capacity, accuracy type:* He takes on a tremendous quantity of design work and executes it to a precision that few people can equal. For example, in the control sections of a computer, people use read-only memories in the current technology. This guy can make 10,000 entries and rarely make a mistake.

Ground rules for the game

Ten years ago I organized my first tiger team here. I decided that rather than change the direction of the existing project team, it was more cost-effective to bring in a new team. It's easier to do it all over again than to make a patch-work quilt. I've stopped ailing projects that were ready to release for fabrication and brought in a tiger team. Within a month or two the team caught up with the original schedule.

I've never used more than six people on these teams to replace as many as 30 engineers. On those rare occasions that represented an 80% reduction in manpower, and an average of a 2-to-1 savings in time and money.

There are some limiting ground rules for the tiger-team game, however. For instance, you can afford to play only in cases where you are in deep trouble in developing the equipment, or with advanced-research, internal-development-funded projects, where there's a limitation on money.

You couldn't possibly run a project with stringent contract requirements with a tiger team or even a group of tiger teams. Why? There's an analogy between the liberal and the conservative here; the liberal has very creative ideas, but have you noticed how difficult it is to organize a group of liberals? Remember that you're usually negotiating with a customer who's on the conservative side, and if you try to deal with him in a laissez-faire manner, ultimately he won't want to do business with you.

Besides, a member of a tiger team isn't happy working on the average project. He's unhappy with red tape. He's a rebel in his own right, but a creative rebel, and you exploit that for what it's worth. During this exploitation, however, remember another ground rule: Rebels are apt to have personality hangups.

The more mature, experienced manager, who has had the benefit of a well-balanced background will usually be sensitive to the types of personalities that can cause trouble. But the younger managers and the engineers who look forward to becoming managers should watch out for the following personality problems:

Stubbornness—unwillingness to negotiate; lack of open-mindedness. How do I cope with a stubborn man? I give him jobs where he can make all the decisions himself. If he can't make sound decisions, his stubborness is a real liability.

Uncooperativeness—inability to work with a team or to organize quickly. I often give him one-man jobs. The manager should cultivate a climate where intellectual stimulation will grow. Also, feed the tigers' ego three or four times a day.

Drifting—the tendency for a tiger to pick up his own assignment and drift away from the over-all problem. The manager must give each man a deadline. The project man must relate each man's specialty to the over-all problem, keeping what he's doing in perspective. There must be a frequent, often daily, update on activities.

Lack of enthusiasm—which can happen if the project continues too long. A manager can sustain interest pretty well up to a year. But if the project lasts longer than a year, tigers start to lose interest.

My involvement with these guys keeps me on my toes in engineering. They allow me, as a manager, to keep the organization strong technically. I know that we can turn out hardware; I know that we can turn out advanced concepts. The main problem is finding these budding-genius types and recognizing them. They're the ones who work faster than anybody else and are always asking for more work. I can't find them by staying in my office; I have to get out and circulate a lot.

There's also a group of people with professional standing in the industry that we constant-

ly track. When an R&D-oriented company fails, many tiger types are available in the job market. We interview them to find out what they've learned—since we knew what they were—and if they have the right combination of capabilities, we pick them up.

Tiger teams are maintained without turnover on an average of one and a half to two years. The secret is to keep them stimulated, keep them busy.

So what does the tiger team do in the off-season when they're not working on a project? They're involved in what I call advanced development and research. You can give them advanced concepts to keep them stimulated—new machine structures, new software techniques or new simulation activities. In our case, it's often advanced signal-processing, or computer techniques.

How the game is played

A typical tiger-team project has been to eliminate three or four subsystems from a major program. If they could be eliminated, hardware and labor could be reduced and the project schedule improved.

The first time I tried to solve this problem, I tried it with one man, a project engineer type. His solution: no reduction. I figured that the job was too big for one man. So I called in a computer-oriented specialist to lead a tiger team consisting of a machine designer, a software specialist, a high-capacity-for-accuracy type and a peripheral-equipment specialist. These guys were dedicated to putting together a concept for this kind of machine in something like eight to 12 weeks. When they finished they put out a report stating the concept they intend to use.

The leader had to have a good solid computer background across the board. Why? Because his concept was supposed to evolve into a computer concept, as opposed to a special-purpose piece of logic. The software guy had to do the analysis of the throughput to find out if what they postulate is really going to work on a capacity basis. The peripheral-equipment specialist had to find out if all the interfaces with which this machine had to communicate would really work. The machine-designer title is self-explanatory, and the accuracy type filled in where he was needed most. The leader used the project type, who was also a detailer, to pump in all the requirements for the whole system, because he had working knowledge of the job.

The most serious problem with a group like this is that the project type may feel that he's being replaced when in fact he's getting additional support.

So I say: "Look, I'll take on some of your administrative responsibilities, or I'll get someone to assist you with them. Finally I convince him that a lot of his administrative tasks are not as important as a sound technical approach.

He then starts to participate in the program after we get locked up in a room and personally gets involved in the project. He feels that if it's important enough for me to spend my time at it, it's important enough for him. The group and I may challenge him with suggestions for simplification. After a while, his intellectual curiosity and personal involvement take over.

Manage but don't control

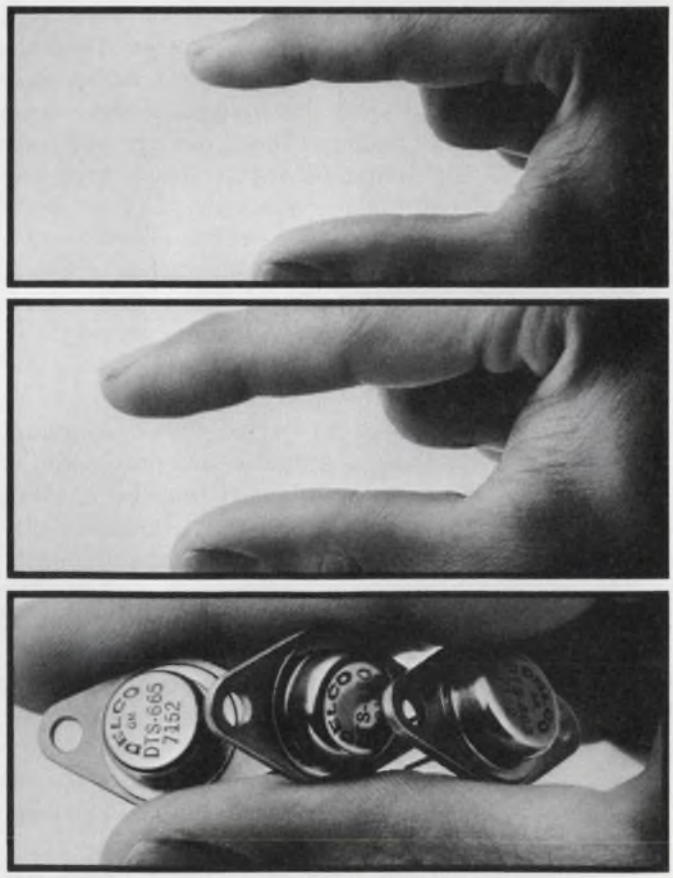
For tiger teams to be successful, they must be managed, not controlled. I think the electronics industry loses tremendous creativity by having too many controls on its people. Many policies and procedures are designed to control people, schedules and dollars. Certainly, controls are necessary for business to function in an orderly fashion. However, management methods should

have enough flexibility to foster creativity. The tiger team can't do its thing under a regimented set of controls and regulations.

The most serious problem our industry faces today is that it doesn't have enough money to expand advanced development. Most of the customers are looking for off-the-shelf systems and/or hardware. This requires an advanced-development activity that places a strong burden on the company. We must develop advanced-technology equipment in a shrinking market area. That's tough. Companies don't have the money to invest in technology, unless there's going to be a market return.

This show-me-before-I-buy attitude makes the manager's job more difficult than ever before. I can't have inefficiency in an R&D program. This is the problem today. Get the thing out with no money. I'd have trouble doing it without tiger teams. ■■

Delco's TO-66 silicon transistors for BIG POWER



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DTS-660	3.5A / 10.0A	200V	30 / 90	200V	60W	$5.93 ea.
DTS-663	3.5A / 10.0A	400V	30 / 90	325V	60W	$9.57 ea.
DTS-665	3.5A / 10.0A	500V	30 / 90	400V	60W	$14.94 ea.

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INFORMATION RETRIEVAL NUMBER 52

Complementary transistor latch is built with two tunnel diodes

A memory or latching function results from a complementary transistor switch when two tunnel diodes are added across the transistor base-emitter junctions (Fig. 1).

When the input e_i is zero, then (assuming a V_{BE} of 0.7 V for each transistor) i_{T1} will be 0.59 mA. The values of the currents i_{D1} and i_{b1} depend on the load on the switch, but D1 is forced into its high-voltage, forward-conductance region.

The latching or memory operation occurs when the input (point A) is open-circuited. The operating point of diode D1 moves down its forward characteristic to a point determined by the new total series resistance, 2·R1, and the loop voltage drops. If diode current, i_{D1}, is above the diode's i_v value, and i_{D2} is below its i_p value, the circuit will remain in the original state.

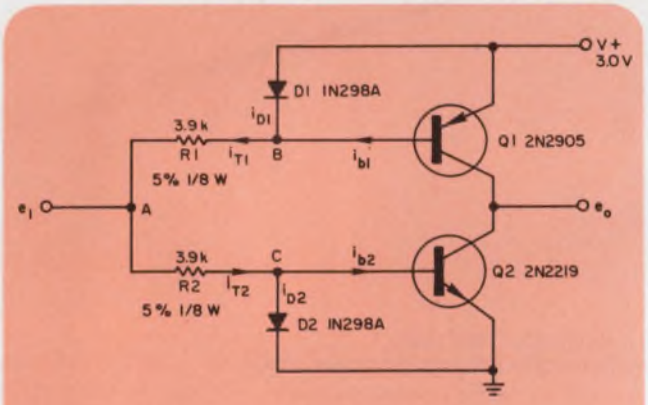
Branch currents i_{T1} and i_{T2} are equal to 0.28 mA under the worst-case assumptions of V_{BE} = 0.7 V and V_{D2} = 0.08 V. These currents flow through diodes D1 and D2, if negligible base currents (i_{b1} and i_{b2}) are assumed. The value of 0.28 mA is above i_v and below i_p, thus satisfying the conditions for latching operation.

The opposite situation occurs when a 3-V level is applied at point A and then removed. Transistor Q2 will then be held ON and Q1 will be OFF.

For the latching operation, the upper and lower trip points (with one of the two diodes in the HIGH state when the input is open-circuited) are 2.2 V and 0.8 V, respectively. Open-circuit control of point A can be obtained by using a series switch or a tristate logic element. Applications for the circuit include memory-reference switches in successive-approximation a/d converters, offboard output latch drivers, low-power memories and single-switch, D-type flip-flops.

C. J. Huber, Westinghouse Electric Corp., Systems Development Div., Baltimore, Md.

CIRCLE NO. 311



Bipolar complementary switch exhibits latching function when tunnel diodes D1 and D2 are added.

Inverted mode switching gives digital control of analog signal

Digital control of an analog signal can be realized with inverted-mode switching, as shown in Fig. 1. Transistor Q1, operated in the inverted mode, is turned on and off directly by the TTL gate, G1. The V_{CE} of Q1, a 2N2432A, is typically 5 mV, and the effective ON resistance is 20 Ω.

When operated in the inverted configuration, as shown, Q1's turn-on conditions depend on the base current. The resistor-diode network R1, D1, D2, D3 determines the base current independently of the high-state voltage of the TTL gate.

In the high state, G1 supplies no current to the base of Q1. The gate only has the potential to back-bias the input diode D1. For the low state, the gate must sink the current through resistor R1. Q1's base is held about 0.7 V below

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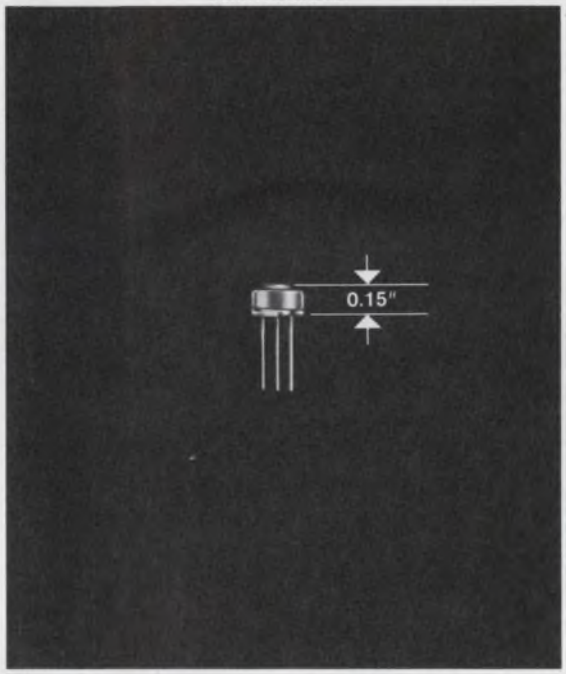

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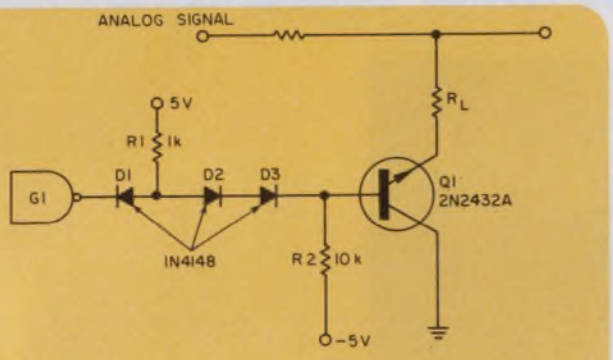
INFORMATION RETRIEVAL NUMBER 53

ground resistor R2.

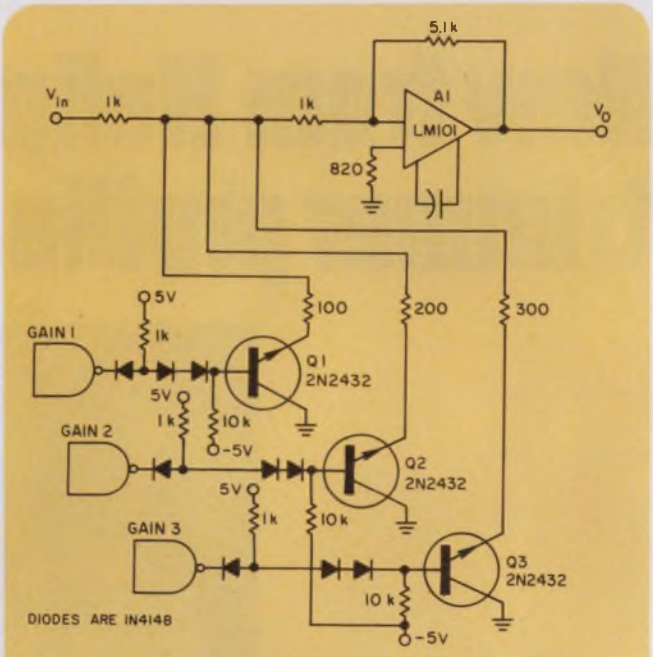
If three such inverted-mode stages are joined at their outputs to an op amp, digital gain control of the analog amplifier results (Fig. 2).

Mike Black, Texas Instruments, P.O. Box 6015, M.S. 257, Dallas, Tex. 75222

CIRCLE No. 312



1. **Inverted mode transistor Q1 is switched** from the TTL output of gate G1.



2. **The gain of analog amplifier A1 is digitally controlled** by the three transistors, Q1, Q2, and Q3.

Counter delay slashed in half with interconnection scheme

An interconnection technique for any ripple counter that uses J-K flip-flops cuts the usual propagation delay in half while retaining the normal binary weighted output. No extra components are required.

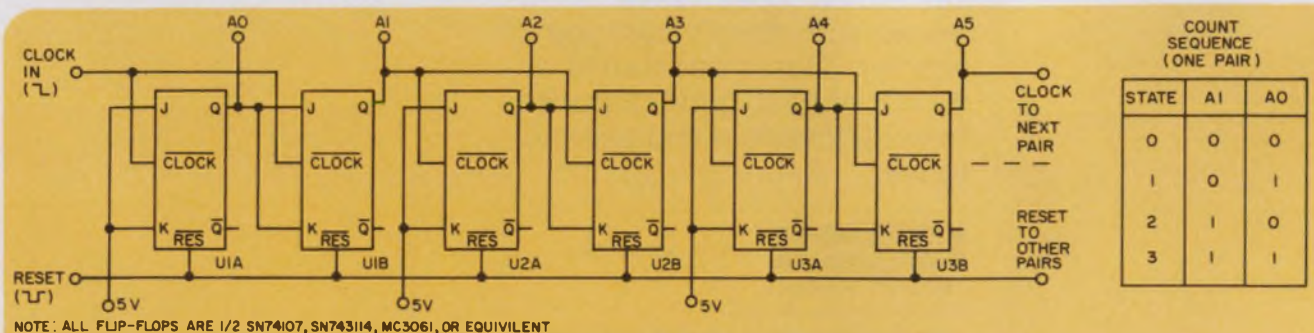
The scheme (see figure) arranges the flip-flops into synchronous pairs. The pairs are then joined, ripple fashion. There are three pairs: U1 (A and B), U2 and U3. Each pair is connected to produce a binary-weighted output, as shown in the count sequence.

Each pair is clocked on the negative transition of the most significant bit of the preceding pair. An over-all binary-weighted output results, just as in a standard ripple counter. The propagation delay is reduced by one-half, however, because there is only one flip-flop propagation delay for each pair of flip-flops. In a conventional ripple counter there is one propagation delay per flip-flop.

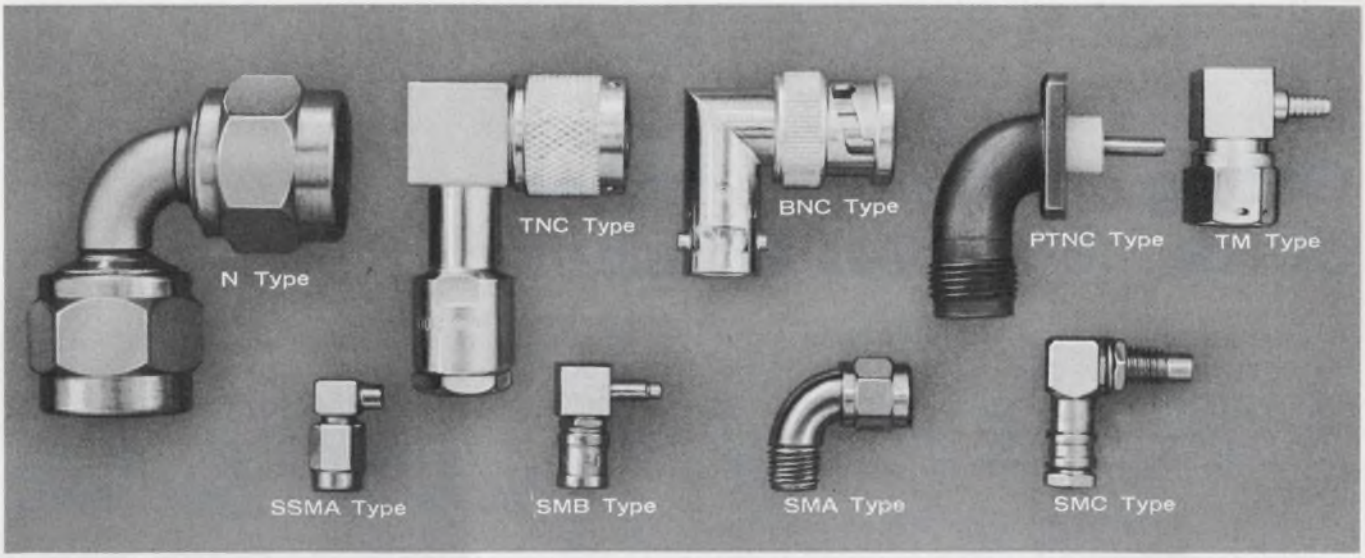
Since all the possible states of two flip-flops are included in the desired counting sequence, there is no danger of the synchronous counters becoming "lost" in branch loops. The same arrangement also works for D flip-flops. The pairs are connected as ring counters. The output of each ring would then be a Gray code.

William Farnbach, Hewlett-Packard, 1900 Garden of the Gods Rd., Colorado Springs, Colo. 80907

CIRCLE No. 313



Modified ripple counter cuts propagation delay in half by pairing flip-flops.



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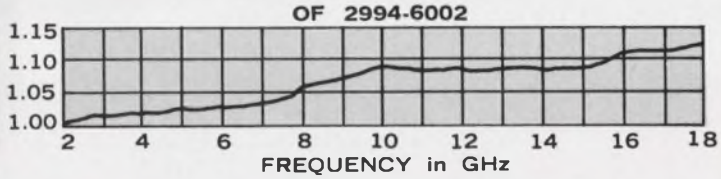

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INFORMATION RETRIEVAL NUMBER 54

Gating scheme maximizes dc-dc converter efficiency

When power-switching transistors in dc-dc converters are on, overlap of the ON states decreases efficiency as the switching frequency increases. But a gating scheme can sense the delays, as the transistors turn off, and minimize overlap.

Overlap results from turn-off delay once the transistor's base drive has been removed. If the delay, which can be on the order of 10 μs, is sensed, overlap can be minimized by preventing one transistor from turning on until the other is off.

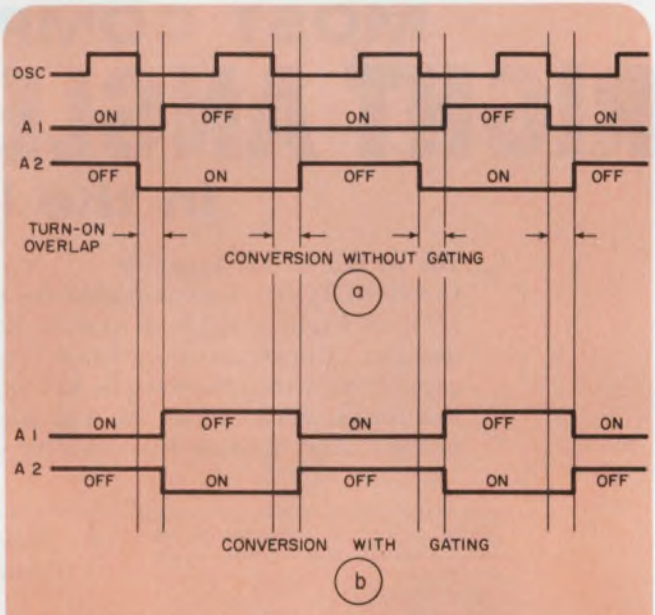
The dc-dc converter in Fig. 1 consists of an oscillator that clocks a toggle flip-flop. The flip-flop in turn switches the primary of transformer T1 about its dc-biased center tap via transistor amps A1 and A2. The winding configuration of T1 and the rectifier network determine the dc voltage output. T1 is a nonsaturating transformer.

When the delay is sensed, transistor A1 is gated with the output of A2, and vice versa. Diodes D1 and D2 prevent the high primary swing voltages from damaging the 5-V powered logic gates. Resistors R1 or R2 bias the inputs of gates G1 or G3 HIGH, while D1 or D2 are back-biased.

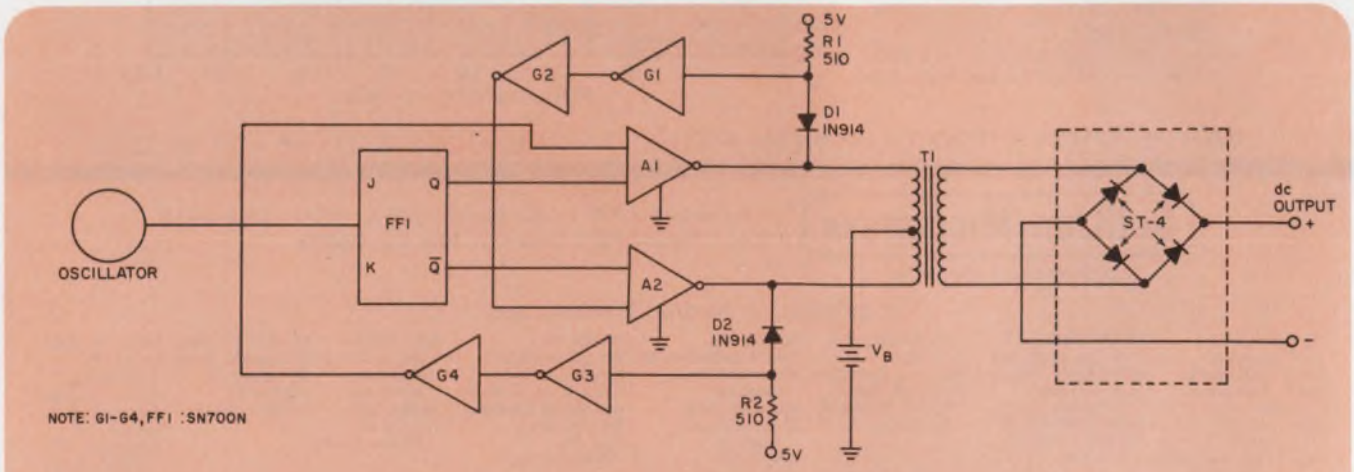
Assume FF1 is reset and all power-transistor delays of A1 and A2 have passed. Since V_B is greater than 5 V and A1 is biased off by FF1, D1 is off and A2 is on. Flip-flop FF1 supplies logic ONE to A1 and logic ZERO to A2. The logic ZERO starts to turn off A2 (turn-off delay), but D2 remains forward-biased and G4 prevents A1 from turning on until A2 actually turns off. After the A2 turn-off delay has passed (logic ZERO output of A2 removed), D2 is back-biased and A1 is turned on via R2, G3, and G4. The sequence simply repeats each time FF1 toggles on each cycle. Fig. 2 shows the effects of gating on overlap and efficiency.

Alphonso H. Marsh, Sr. Engineer, Raytheon Co., Sudbury, Mass. 01766

CIRCLE NO. 314



2. **Conversion efficiency** with and without gating. Gating prevents an increase in overlap from accompanying an increase in switching frequency.



1. **Gates G1 and G4 sense** turn-off delay of transistors A1 and A2 and minimize overlap.

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Clock-select circuit minimizes initial phase uncertainty

When a local clock is synchronized to incoming data or timing signals, the initial phase error is critical. The usual way to minimize this error is to count down a higher frequency signal (CLK_{hf}) to the basic clock rate (CLK_{basic}) of interest. The maximum initial phase uncertainty is thus reduced from the period of the basic clock to the period of CLK_{hf}. The circuit in Fig. 1 further reduces the phase uncertainty to half the period of CLK_{hf}.

Assume the incoming timing signal causes the pull-over (PO) bus to change state from logic ONE to logic ZERO (Fig. 2). This enables gates G3 and G5, whose respective outputs reflect the phase of their associated complementary clock inputs from G1. Either gate G3 or G5 will go to logic state ONE, depending on the phase of the clock input when the PO bus changes states. The other phase of the clock is thus disabled (G2 in Fig. 2), synchronizing the incoming clock to the leading edge of the clock. The same results follow from using a clock of frequency that is twice CLK_{hf} by synchronizing with the usual technique.

The highest frequency of operation is given by the equation:

$$f_{max} = \frac{1}{2t_{pd} + t_{pd1} - t_{pd0}}$$

where $t_{pd} = \frac{t_{pd1} + t_{pd0}}{2}$

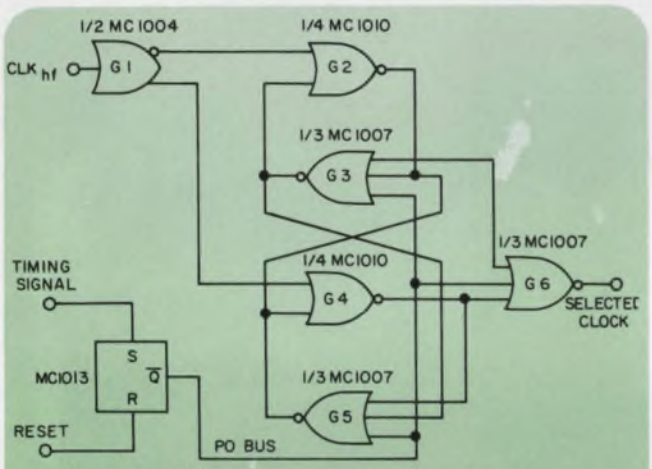
t_{pd1} = propagation delay to logic ONE.

t_{pd0} = propagation delay to logic ZERO.

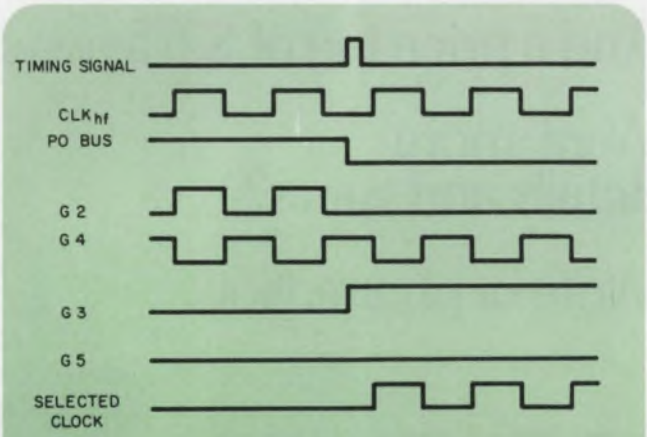
Oscillations occur if operation at frequencies of greater than f_{max} is attempted.

H. Corday and D. Zagardo, Hazeltine Corp., Greenlawn, N.Y. 11740

CIRCLE No. 315



1. **Gates G3 and G5 select a clock** synchronized to the moment when the timing signal changes the state of the PO bus.



2. **Waveforms show the selected clock** in relation to the various gate outputs. Maximum phase uncertainty is equal to the period of CLK_{hf}.

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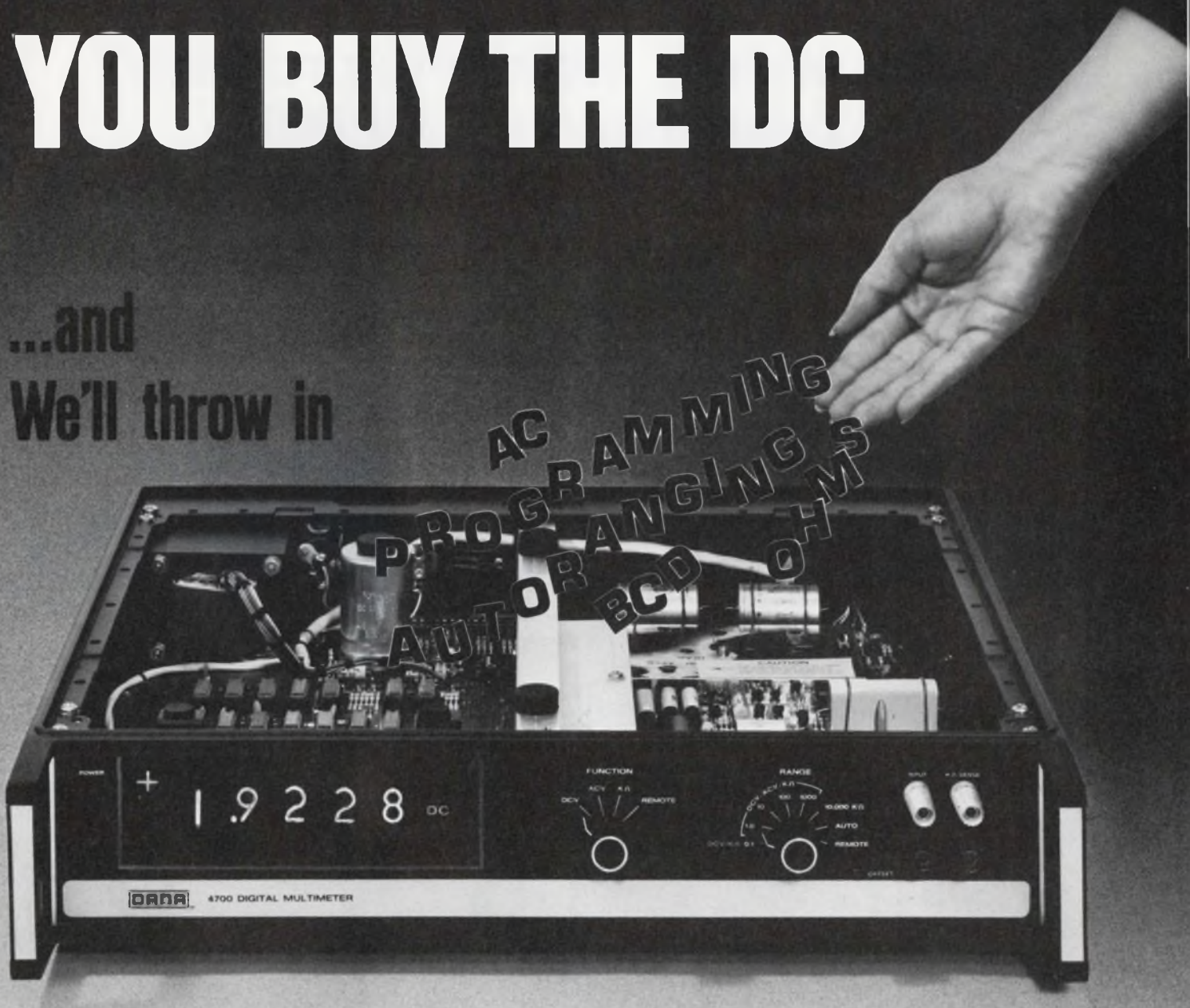

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Nearly every engineering group has access to an oscilloscope. A storage scope—well, that's another story. If the company's equipment is seldom free, this new Ballantine storage instrument may be just what your group should order.

Designated the Model 7050A Electronic Signal Recorder (ESR), the unit records repetitive or transient signals (up to 100 kHz and 3.6-μs rise time) on a small, endless loop of computer-grade magnetic tape. The captured signal can then be played back on any scope at a writing speed of 3000 divisions per millisecond, and it can be minutely examined with any of the scope's display features.

Unlike a storage scope, in which displays can be stored and viewed for limited periods, the recorded signals may be stored indefinitely and viewed at any time. Thus a transient can be stored for later analysis, freeing the ESR and scope for other measurements.

The Model 7050A operates in either of two modes: record or playback. In the record mode the capstan-driven loop makes one revolution every 20 ms, and an erase head erases prior signals before each revolution.

Both recording and erasure stop when a transfer command is received; the previous 20 ms of recorded signals are then read out (playback mode) as a continuously repeated analog voltage. The transfer is done automatically either by a trigger signal derived from the input signal, or by an external signal, or manually by a front-panel pushbutton. Another front-panel control allows the transfer to be variably delayed up to 20 ms after the trigger. This shifts the storage duration so that only those signals that occur after the triggering are displayed.

In playback, a +13-V pulse output—which can be adjustably delayed from 4 to 17 ms (not to be confused with the transfer trigger)—can be used to trigger the scope sweep. By using the recorder's output trigger delay (horizontal-position control) in combination with the scope's sweep-rate control, you can expand and zero in on any part of a waveform. A separate 13-V pulse output can be used for Z-axis brightening or blanking, to identify the start of the recording.

In use, a one-shot or repetitive signal of up to 400 V (dc plus peak ac) is connected to the 1-MΩ, 36-pF input jack. The sensitivity switch is then set to the appropriate level. Nine ranges are provided (for a scope deflection factor set at 100 mV/cm), varying from 4 mV/cm to 2 V/cm. A signal that is 10 times the sensitivity setting will then give the full recording level. If the correct level is not known, the ESR can be switched to a through mode and the signal measured directly on the scope.

A pushbutton is then hit to initiate the record mode, which is so indicated by a panel light. In the internal mode, transfer to playback is automatic and is indicated by another panel light. The captured signal will now be displayed on the scope, provided the scope trigger level is correctly set.

Transfer can also be accomplished by an external signal of at least 50-mV amplitude and 100-ns duration, or by manually pressing a pushbutton. The button overrides the other transfer methods.

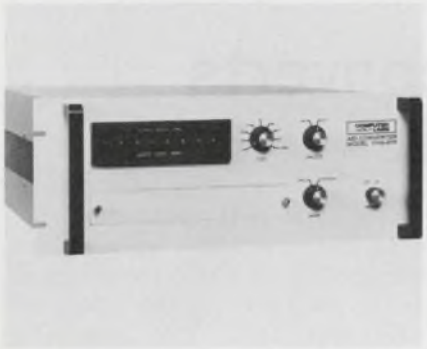
Other specifications and features of the ESR include:

- A maximum distortion of 1.5% at 1 kHz.
- A minimum signal-to-noise ratio of 34 dB, referenced to full scale.
- An output impedance of 50 ohms.
- A short-duration, reference-level pulse recorded on the tape during transfer.
- A ground-reference adjustment that allows the recorded signal to be offset by ± 3 times the input sensitivity setting.

The 7050A weighs 6-1/2 pounds, measures 11-1/4 by 9-1/2 by 4-1/3 inches and consumes 35 W. It can operate over a temperature range of 0 to 40 C and can be stored over a range of −30 to +75 C.

CIRCLE NO. 256

7-bit a/d converter doubles word rate



Computer Labs Inc., 1109 S. Chapman St., Greensboro, N.C. 27403. (919) 292-6427; 4-6 wks.

Computer Labs has announced two new high-speed a/d converters. The VHS-720 is capable of 7 bits at 20-MHz word rates; and the VHS-815 provides 8 bits at 15-MHz rates. The highest speeds previously available were 7 and 8 bits at 10 MHz. Both of the latest units are self-contained and include track-and-hold; power supplies; and built-in test circuits.

CIRCLE NO. 257

Modular test system offers many plug-ins

Tektronix, Inc., P.O. Box 500, Beaverton, Ore. 97005. (503) 644-0161.

The plug-in concept, pioneered by Tektronix for their scope line, is now being offered in a low cost per function measurement system. Designated the TM 500 System, it features a full line of compact, interchangeable plug-ins, comprised of counters, DMMs, function generators, power supplies, oscillators and other instruments. The system is designed for rack, bench, or mobile use and comes in single or triple compartment mainframes with rear-panel access to the intra-compartment, plug-in interface.

CIRCLE NO. 258

Dual-channel scope offers 10 MHz, is 14 lb.

Dumont Oscilloscope Laboratories, Inc., 40 Fairfield Place, W. Caldwell, N.J. 07006 (201) 228-3665. $995; 30 days.

Dumont's new, dual-channel scope, called the 2100, features a dc to 10 MHz BW, sensitivity of 10 mV/div, maximum sweep speed of 50 ns/div, 8 × 10 div display and delayed sweep. Push-button front panel controls and functional color-groupings make the instrument easy to use. Use of ICs eliminates variable components. Full auto triggering is included in the 2100, as well as AND/gate logic for external triggering of as many as four simultaneous inputs.

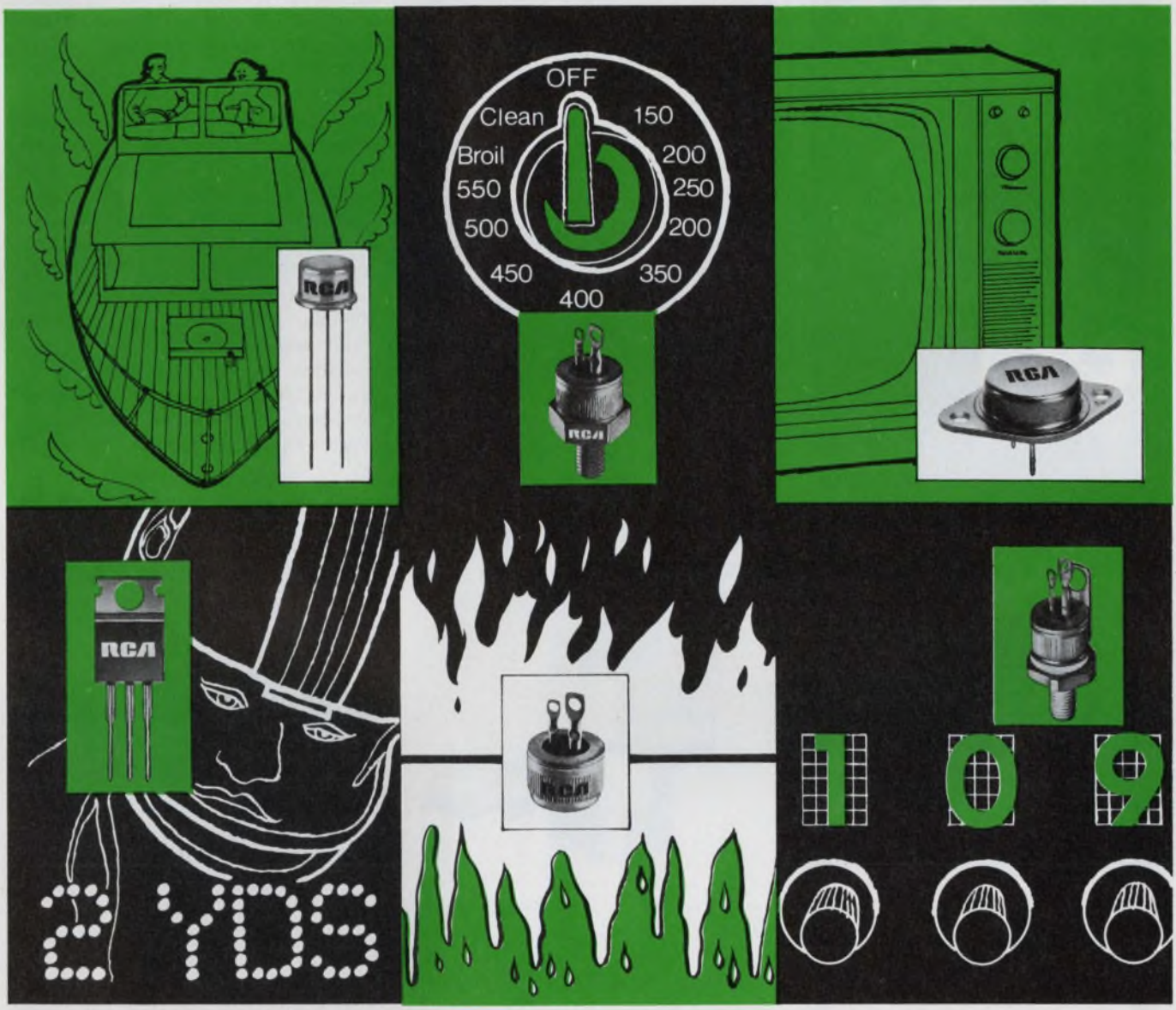
CIRCLE NO. 259

Control what you're doing ...with RCA Thyristors.

Cut tune-up requirements in marine engines with RCA SCR's designed-in as part of capacitive discharge ingnition systems. Use 40655 (illustrated below) for 100 Ampere surge and high di/dt capability. Voltages to 600 V are standard.

Handle oven heater loads reliably with RCA-40661, 30 A triacs. Use RCA-40706, 30 A triac in conjunction with RCA zero voltage switch CA3059 for precise temperature control. Choose RCA-40669 VERSAWATT or 40902 ISOWATT for electric top burner controls.

40640, 40641, and 40888 and 40889, proved in hundreds of thousands of TV sets, take the critical aspects of design out of horizontal deflection circuits. SCR's are the superior approach world-wide. Investigate, too, RCA's full line of diodes: 40642, 40643, 40890, 40891.



From simple time and temperature displays to scoreboards in sports arenas, your indicator board circuits should include RCA. For electronic accuracy and solid-state reliability, pick the 40530 family for low-level logic circuits. For heavier surge capability, select plastic VERSAWATT types such as 40668 and 40669.

In home comfort systems – heating, cooling, humidifying, and pollution control equipment – use the solid-state techniques that offer reliability in interfacing low-level logic with high power motor controls. Choose your devices from RCA: 40530, 2N5445, 40918, 40868 and 40869, all designed for new and improved systems.

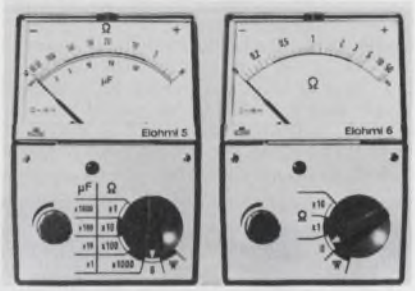
With 30 A and 40 A triacs to choose from, you can select the proper device to control the high intensity lamp in your photocopier. RCA can easily adapt any standard stud or electrically-isolated stud package to a custom package configuration to meet your needs as well as UL requirements.

For more information on these and other RCA thyristors, see your local RCA Representative or your RCA Distributor. For technical data on specific types, write: RCA Solid State Division, Section 57F-22/UR15, Box 3200, Somerville, N.J. 08876. International: RCA, Sunbury-on-Thames, U.K., or Fuji Building, 7-4, Kasumigaseki, 3-chome, Chiyoda-ku, Tokyo, Japan. In Canada: RCA Limited, Ste. Anne de Bellevue 810, Quebec.

RCA Solid State
products that make products pay off

INFORMATION RETRIEVAL NUMBER 61

Pocket-sized ohmmeters have built-in buzzer

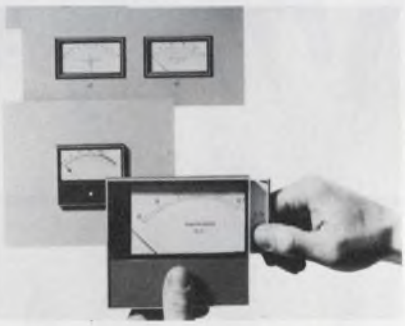


Epic Inc., 150 Nassau St., New York, N.Y. 10038. (212) 349-2470.

Ehlomi 5 and 6 are battery-operated (1.5 V), pocket-sized (4 × 3-1/2 × 1-1/2 in.) ohmmeters. Model 6 is especially suitable for resistance measurements of transformer windings motors, printed circuits and brush contacts. Model 6 has a range of 0.1 to 500 Ω and Model 5, 1 Ω to 1 MΩ. Model 5 has a scale for estimation of capacitances up to 50,000 μF. Both models test continuity with a built-in buzzer. Accuracy is within ±1.5%.

CIRCLE NO. 260

2-1/2-inch panel meter offers slide-in scales



LFE Corp., Process Control Div., 1601 Trapelo Rd., Waltham, Mass. 02154. (617) 890-2000.

The 7025 panel meter, a 2-1/2-inch model in the API 7000 series, features slide-in scales. The meter, especially useful for power supplies and portable instruments, is available as a VU meter for audio equipment and in pyrometers for ovens. Thus, a small, basic stock of meters can be modified with a larger number of slide-in scales. A wide range of standard dials is available. 1% tracking is standard for many popular ranges and available for all; 1/2% tracking is also available.

CIRCLE NO. 261

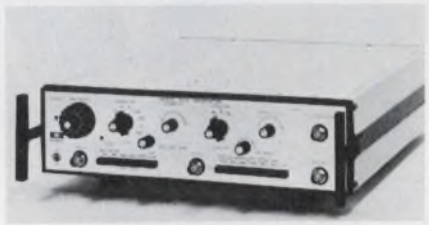
Synchro-digital converter or programmed bridge

The Singer Co., Los Angeles Operation, 3211 S. La Cienega Blvd., Los Angeles, Calif. 90016. (213) 870-2761.

A series of main frames and plug-in modules which can be used either as synchro/resolver-to-digital converters or as programmable bridges are available from Singer. The main frames differ only in accuracy and frequency capability. As a converter, the ADC presents a digital readout of angle within 250 ms. As a bridge, it compares input angle to angle selected and provides an error voltage input. Major features are: 0.001 degree accuracy; 0.0005 degree resolution; input impedance greater than 500 kΩ.

CIRCLE NO. 262

Function generator gives 10^{-4} Hz to 11 MHz



Exact Electronics Inc., 455 S.E. 2nd Ave., Hillsboro, Ore. 97123. (503) 648-6661. $995; 2 wks.

The Model 7056 is an AM/phase lock function generator with a 0.0001 Hz to 11 MHz range and trigger and gate capability for single shot and burst waveforms. AM modulation is variable from zero through 100% to suppressed carrier. The VCA (voltage controlled amplitude) input allows amplitude control from dc to wideband ac. Output amplitude can be varied without changing the percentage of modulation. The unit offers sine, square, triangle, ramp, pulse and sync waveforms. The operator can select variable ±15 V of dc offset to position the waveform above or below ground.

CIRCLE NO. 263

OUR ANGLE: angle position indicators that do more and cost less

SHOULDN'T YOU TAKE A NEW READING ON THIS COST-PERFORMANCE ANGLE?

For better ways to measure synchro and resolver data, North Atlantic offers the best of both worlds: budget prices for the popular API-8025; superior performance and increased capability of the new 8525. • Both are interchangeable without any mechanical or wiring modifications. North Atlantic's solid-state 8525 offers an accuracy of 0.05° (3 minutes). Following a 180° step input, it synchronizes a five-digit NIXIE readout in ½ second flat. And it tracks at up to 1000° per second. Where cost can be traded against performance, the proven electromechanical API-8025 . . . a recognized industry workhorse . . . is available with its 6 minute accuracy, 25°/second slew speed, and many options. • Input of the 8525 is any 60 or 400Hz resolver/synchro data from control instrumentation. The patented servo design eliminates all inertia and improves dynamic performance many times over. Its digital outputs are especially suited to the computer-oriented requirements of today's automatic test systems. The 8525 . . . priced at $1885 . . . and the API-8025 priced at $995 actually cost less because they perform more functions per dollar. And with greater reliability.

MODEL 8525

MODEL 8025

For complete information on the cost-performance angle, please write or phone now.

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200 TERMINAL DRIVE, PLAINVIEW, NEW YORK 11803
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INFORMATION RETRIEVAL NUMBER 63

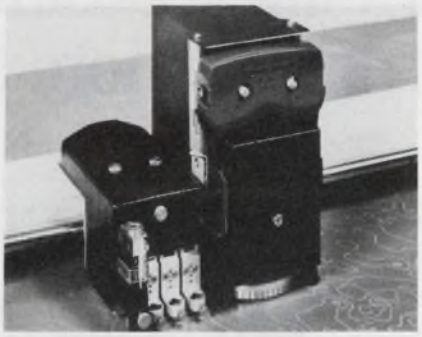
Ultrasonic wirebonder has two channels, ten W

Orthodyne Electronics, 817 W. 17th St., Costa Mesa, Calif. 92627. (714) 646-8349. $675; stock to 2 wks.

The Model 363 ultrasonic generator, designed for production wirebonding, features two channels and power output to 10 W. The time and power controls are ten-turn, high-resolution potentiometers. A test meter and switch allow the user to check wedge tuning, system lock and other characteristics without scopes or other test equipment. A number of factory options are available to adapt the 363 to most wirebonders.

CIRCLE NO. 264

Scribe tool cuts repro masters



Electronic Associates, Inc., W. Long Branch, N.J. 07764. (201) 229-1100.

Electronic Associates, Inc. has announced a new scribe tool accessory for their 430 DATAPLOTTER. The tool mounts in the existing, standard plotter pen assembly. Up to four cutters may be used to produce top-quality, reproduction masters of any preprogrammed drawing. The tool is a motorized, rotating scribe, using a sapphire cutter and is available in cutter widths of 0.009, 0.018 and 0.030 in. The cutting depth is adjustable by setting a ball limit stop.

CIRCLE NO. 265

Multi-band sweeper covers 1 to 18 GHz

Servo Corp. of America, 111 New South Rd., Hicksville, N.Y. 11802. (516) 938-9700.

A new, extended-range, microwave sweeper designated Model 404-A, is completely self-contained. It sequentially sweeps the multiband range of 1 to 18 GHz with 5 mW ±1 dB of internally-leveled rf power. Four discrete oscillators covering 1 to 2 GHz, 2 to 4 GHz, 4 to 8 GHz and 8 to 18 GHz, allow the user to operate the instrument in single-octave, straddle-band, or multi-band configurations in any part or all of the instrument's range. Sweep time, from 1 to 18 GHz, is 50 ms.

CIRCLE NO. 266

FOR SYSTEMS ENGINEERS *only!*

Introducing

MILLIVERTER II

— the flexible ADC

that gives your analog signals the careful conditioning they deserve.

Check the performance features of **MILLIVERTER II** — They're all designed to save you time and trouble — and lots of money, too!

1. Expandable up to 1024 analog inputs — *now or at any time!*
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9. Features amplifiers with high CMR.
10. Accepts both differential and common low analog inputs.
11. Front panel controls for system monitoring and check-out feature long-life LED indicators.

Low Level signals conditioned with amplifier-per-channel

High level signals multiplexed prior to conditioning.

AND HERE'S THE BONUS

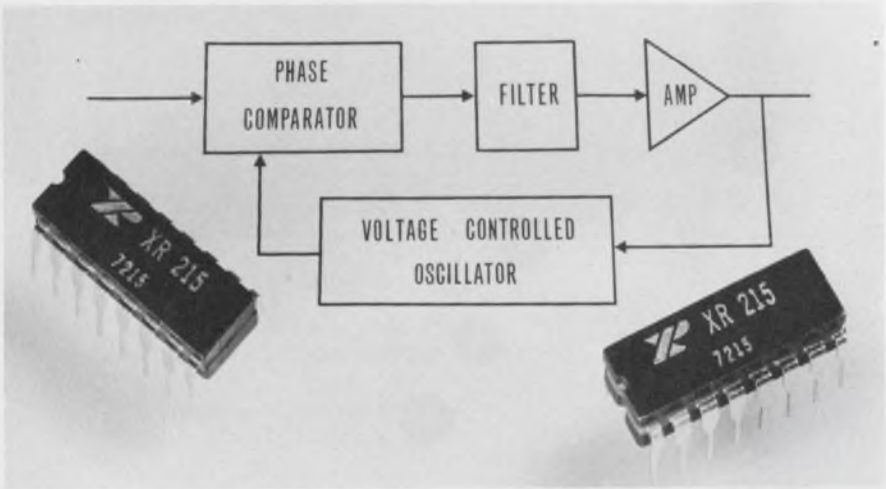
The MILLIVERTER II team —
ready with the know-how, and the circuits, to interface with your minicomputers, controllers and mag-tape units.

Give them a call collect — (714) 546-7160 ext. 567 — and they'll come back to you with the finest, fastest, and most flexible A-to-D conversion system you've ever seen!

Data Technology Corporation
2700 South Fairview Road
Santa Ana, California 92704

INFORMATION RETRIEVAL NUMBER 66

Monolithic phase-locked loops extend the frequency range to 35 MHz



Exar Integrated Systems, Inc., 733 N. Pastoria Ave., Sunnyvale, Calif. 94086. (408) 732-7970. P&A: See text.

A monolithic phase-locked loop (PLL), the XR-215 by Exar Integrated Systems, boosts typical frequency capability to 35 MHz. Compared with Signetics' SE 560, 561 and 562—earlier high-frequency phase loops—that's a gain of 5 MHz.

The XR-215 is comparable to the recently announced high-frequency PLL offered by Harris Semiconductor—the HA-2800. Both list a typical high frequency of 35 MHz and operate over the MIL spec range of −55 to 125 C. But minimum frequencies over this temperature range are given as 20 MHz for the XR-215 and 25 MHz for the HA-2800.

Other differences exist. The XR-215 can operate from a supply ranging from 5 to 26 V. At the low end, total power drain reaches about 50 mW. It's higher for the Harris device, which typically requires ±15 V supplies.

Comparing the XR-215 with Signetics' PLLs, the advantages include improved signal-to-noise ratio—65 dB vs 35 dB, typically. And reduced distortion—0.15% vs 0.3 to 0.5% typically. And power dissipation for the XR-215 can be much less at the low end of its supply-voltage range.

The XR-215 consists of a balanced phase comparator, stable voltage-controlled oscillator (VCO) and high-speed op amp. The phase comparator outputs are internally connected to the VCO inputs and to the noninverting input of the op amp. A self-contained PLL system can be formed by simply ac-coupling the VCO output to any of the phase-comparator inputs and adding a low-pass filter to the phase-comparator output terminals.

The VCO section has frequency sweep, ON-OFF keying, digital programming and sync capabilities. A single capacitor sets the frequency of the VCO, and the sweep range is listed as 8:1. The op amp can be used for audio preamplification in FM detector applications or as a sense amp in FSK demodulation.

In addition the XR-215 has two-channel multiplex capability. The operating frequency can be stepped by a digital control (channel-select pulse), allowing for the time-sharing of a single circuit between two separate data channels

The use of the XR-215 for frequency synthesis requires a digital binary counter in feedback around the circuit.

The XR-215 is available in a 16-pin DIP. Unit costs at $10 (100-999) are essentially the same as for the Harris device—$9.85 (100-999). Delivery for the XR-215 is from stock.

For Harris **CIRCLE NO. 253**

For Signetics **CIRCLE NO. 254**

For Exar **CIRCLE NO. 255**

Low-drift op amps move only 10 μV in 1000 hrs

National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, Calif. 95051. (408) 732-5000. LM725: $15; LM725A: $20; LM725C: $5.95 (100 up).

High gain with low noise and drift are the main features of the company's LM725, LM725A and LM725C op amps. Long-term drift is typically 10 μV per 1000 hours, while the open-loop gain exceeds 3 million. Common-mode rejection reaches 120 dB, and supply rejection is 10 μV/V. Supplies and inputs up to ±22 V can be handled. The LM725 has a maximum initial offset of 1 mV. When nulled, its offset drift is typically 0.6 μV/°C over the MIL temperature range. The LM725A provides higher accuracies, while the LM725C is a low-cost commercial version of the LM725.

CIRCLE NO. 267

Hot off the press.

Teledyne's new FET Fact Finder

From the company with the broadest line of FETs, comes the most comprehensive FET data book ever. Its 164 pages present a big section of applications and complete characteristic curves on every FET we make. It also contains detailed min/max parameters on every device. It's the most complete JFET data manual ever compiled.

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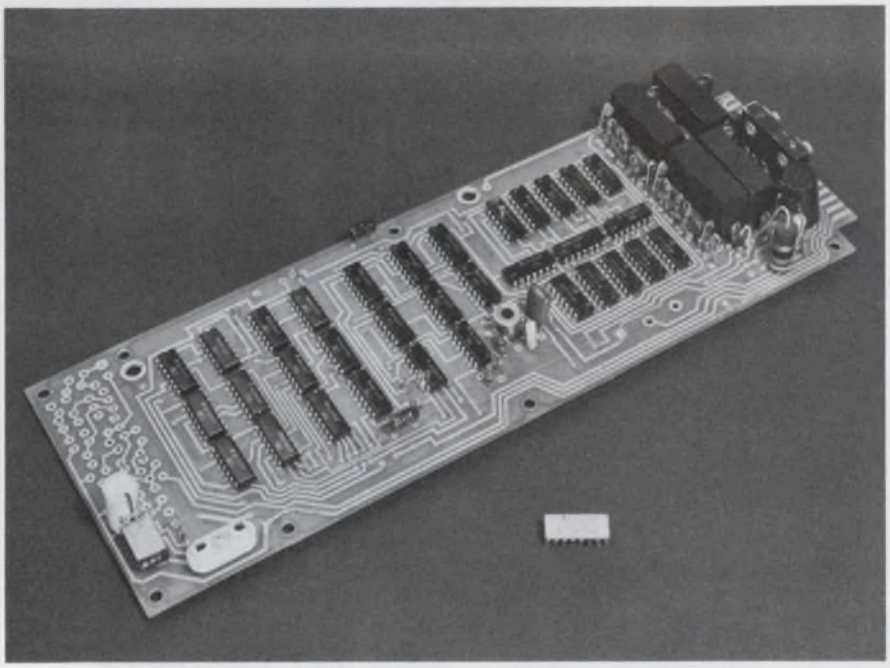
TELEDYNE SEMICONDUCTOR

1300 Terra Bella Avenue Mountain View, California 94040 (415) 968-9241 TWX: 910-379-6494 Telex: 34-8416

INFORMATION RETRIEVAL NUMBER 67

Video sync generator on chip provides all waveforms for TV signal



Fairchild Semiconductor, 313 Fairchild Dr., Mountain View, Calif. 94041. (415) 962-5011. $19.50 (99-999).

A monolithic video sync generator, the FSC 3261, can be used to obtain the six waveforms required by EIA specification for compositing a TV signal. One chip does the job of an array of IC packages—and at a corresponding reduction in cost. Applications include color TV cameras, as well as black and white, video tape recorders and computer terminals.

The 3261—fabricated with p-channel, enhancement-mode, silicon-gate technology—generates these six waveforms for a TV signal: horizontal drive, vertical drive, composite sync, composite blanking, color subcarrier (zero-degree phase) and color burst flag. In addition the IC generates 0 and 180-degree frame waveforms. All waveforms are directly decoded from a low-voltage, two-phase clock.

Each output buffer, except for the color subcarrier, can drive a bipolar load directly without the addition of external components. The color-subcarrier output is designed to drive a capacitive load. Different input frequencies can be used when the standard 59.9-Hz scan rate is not required.

The generator chip uses counters and decoders to obtain the various waveforms. The counters divide down the master-clock frequency at 14 MHz for color signals, or 2 MHz for black-and-white signals. Division occurs in three steps for color ($\div$ 7, $\div$ 65, $\div$ 2) or two steps for black and white ($\div$ 65, $\div$ 2). The horizontal rate is divided down to the vertical rate in one $\div$ 525 step. A separate $\div$ 4 counter furnishes the color subcarrier signal at 4 MHz. All counters are synchronous.

The decoders generate the standard waveforms by decoding from the counter edges. The decoding is done in three sections.

The horizontal drive is obtained from a line decoder. It decodes the edges at a horizontal rate from the $\div$ 65 and $\div$ 2 counters. Similarly a frame decoder generates the vertical drive from the vertical rate and a $\div$ 525 counter. Finally a composite decoder combines the pulses at horizontal and vertical rates to generate the remaining standard waveforms. All pulse widths are fixed.

The 3261, with a maximum power dissipation of 1000 mW, can be operated over a 0-to-70-C temperature range. The dc output current (with the output low) is 10 mA max. The 3261 is available in a 16-lead DIP package. On request, a package with more pins can also make available the 90-degree color subcarrier.

CIRCLE NO. 268

1-k RAM offers high speed with low power

Electronic Arrays, 501 Ellis St., Mountain View, Calif. 94040. (415) 964-4321. $19.50 (100 quantities); stock.

A 1024-bit, n-channel silicon gate RAM with 125 ns typical access time has a typical power dissipation of 60 mW. Termed the EA-1501, it operates off $\pm$12 V supplies and draws only 0.01 mW/bit typically in standby. The memory is organized in a 1024 $\times$ 1 configuration.

CIRCLE NO. 269

Culver Pictures

Support.

Giving assistance. Making difficult problems easy. Making cooperation something more than an offer to talk.

Support is what justifies a company's bigness. It shows that a company wants to further everyone's interests, not just its own. It shows that a company is interested not just in growth, but in improvement as well. Support is an industry's strength.

At Matsushita Electric, support is business as usual. Support is part of our philosophy . . . the improvement of life through the improvement of technology. Trying to make things better for everyone. All of the time.

As the parent of Panasonic, Matsushita Electric makes life easy for consumers. Behind the scenes, we make life easy for the OEM. With a variety of industrial products that staggers the imagination.

Matsushita Electric supplies motors to hundreds of electrical industry manufacturers. All kinds of motors. Electric and electronic. From big to small. From 200 horsepower to 1/200 horsepower. Many of our motors are unique. Like our direct-drive phonomotor for phonographs. A special design that drastically reduces wow, flutter and rumble.

We supply compressors too. For everything from coolers to refrigerators to air conditioners. Matsushita Electric makes more than 1,200,000 compressors a year. Each with the quality you'd expect from one of the world's largest electronics manufacturers.

Motors and compressors are just two of the ways Matsushita Electric supports the OEM. There are many, many more. The next time you're looking for help, look to Matsushita and Panasonic. Help is what we're here for.

Panasonic./Matsushita Electric

Industrial Division, 200 Park Avenue, New York, N. Y. 10017

INFORMATION RETRIEVAL NUMBER 68

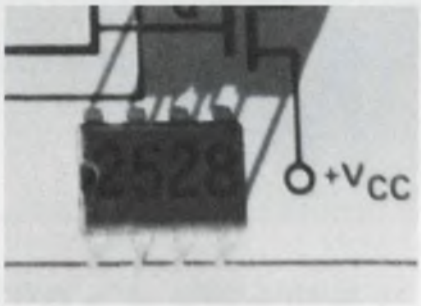
Improved op amps are plug-in replacements

Sprague Electric Co., 347 Marshall St., North Adams, Mass. 01247. (413) 664-4411. ULN-2139: $2.36; ULS-2139: $3.54; 1-24; stock.

The Series 2139 op amps are improved plug-in replacements for the company's MC-1439 and MC-1539 op amps. The 2139 op amps feature 4.2 V/μs slew rate at unity gain, 20-V pk-pk voltage (min) at 20 kHz, 1 mV offset voltage and 20 nA offset current. The ULN-2139 covers the −55 to +100 C range and the ULS-2139, the military temperature range.

CIRCLE NO. 270

Long static SRs draw only 28 mA at 3 MHz

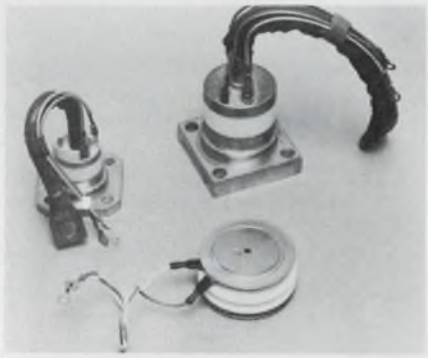


Signetics, 811 E. Arques Ave., Sunnyvale, Calif. 94086. (408) 739-7700. $9.20 (100-999); stock.

A dual 256-bit shift register, the Model 2527; a dual 250-bit register, the Model 2528; and a 240-bit version, the Model 2529 are capable of operating over a wide range of power supply voltages. And with typical supply voltages of +5 V and −12 V, power supply current is 28 mA when the register is in continuous operation at 3 MHz. The three circuits, among the longest static shift registers currently available, can also be operated from a single supply of −17 V. The registers are rated for the temperature range 0 to 70 C.

CIRCLE NO. 271

Power SCRs good to 10 kHz



Westcode Semiconductors, 282 Belfield Rd., Rexdale 605, Ontario, Canada.

Three SCRs combine speed with power. The 444DGT, largest of the three, can handle a sine-wave peak of 1050 A for a pulse base-width of 50 μs at 5 kHz. A 50-μs square wave at 10 kHz can have a repetitive peak of 520-A. The medium-size D1170 has a rating of 125-A (half-wave average) up to 400 Hz. It can handle a 225-A sine wave peak (50% duty cycle) at 10 kHz. And the D1162 offers a half-wave average current of 30 A up to 40 Hz.

CIRCLE NO. 272

ECL/MSI devices include 200-MHz SR

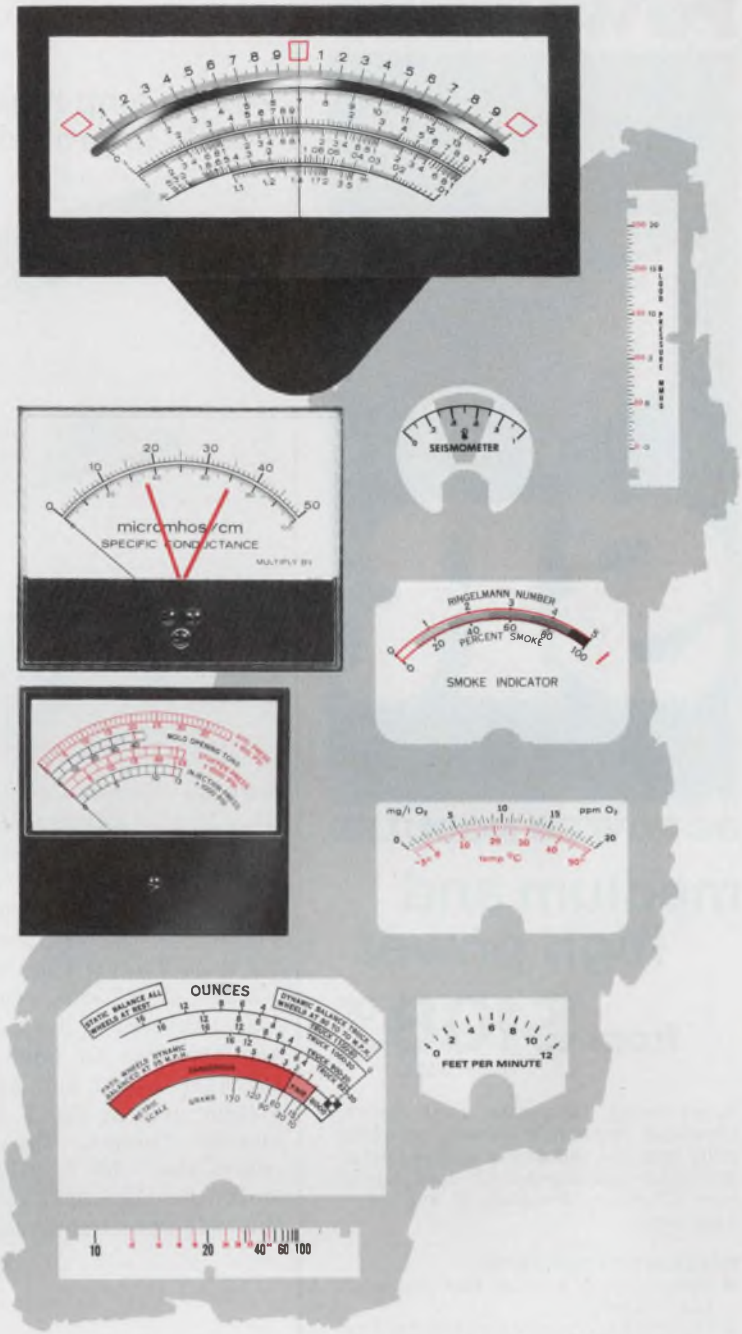
Fairchild, Semiconductor Components Group, 464 Ellis St., Mountain View, Calif. 94040. (415) 962-3816. 95H00: $12.50; 9580: $5.20; 95H55: $5.20; 95H28: $5.55.

Four MSI devices are added to the company's 9500 family of temperature-compensated ECL products. Three devices—the 95H00, 95H55, and the 9580—are the only such devices in ECL logic. The 95H00, a 4-bit universal shift register, has a typical shift frequency of 200 MHz. The 95H55 comparator can compare two 5-bit words in less than 6 ns. And the 9580 triple two-input multiplexer has a data delay of 2.6 ns and select-to-output delay of 3.2 ns. The other new device is the 95H28, a high-speed version of the 9528 dual-D flip-flop; it extends the operating frequency from 150 to 260 MHz.

CIRCLE NO. 273

If you need panel instruments with custom dials, cases, accuracy, tracking, resistance, response time, or practically any combination of unusual specs...

Buy Triplett's designed-for-you Panel Instruments



Although we stock some 1369 different styles, sizes and types of standard panel instruments, a very large proportion of our customers buy custom instruments.

Because they need:

custom dials
: reading in such units as pH, roentgens, mm Hg, rpm, %, inches.

custom cases
: square, round, rectangular, edgewise (horizontal and vertical), wide, narrow, shallow.

custom accuracy
: to within ½% with mirror scales and knife-edge pointers.

custom tracking
: to match the specific needs of existing or new instrument designs.

custom resistance
: for low circuit loading with tolerances as low as ±1%.

custom damping
: to meet stringent electrical and vibration requirements.

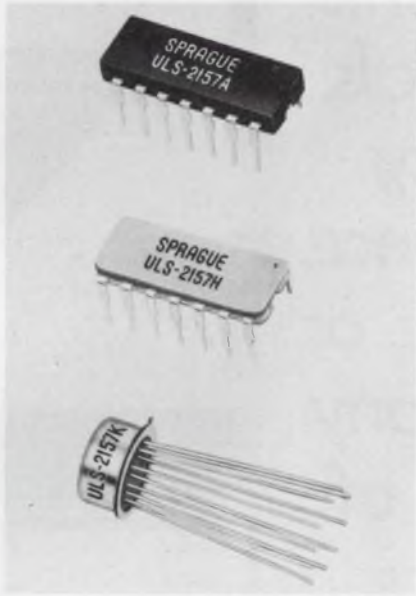
For instance, one of our customers had us design and manufacture a custom instrument to replace — in every detail of physical and electrical specifications — one which he was using on a delicate piece of medical instrumentation. Rejects from his previous source had risen to over 20%. He rejected only 3 of the first hundred we shipped—with almost negligible rejections from the many hundreds we've shipped since.

What custom panel instrument specifications do you need to make your product more reliable, more accurate, more rugged and — in the long run — less expensive? For quick, dependable delivery of small quantities of Triplett's "designed-for-you" panel instruments, contact your Triplett Sales/Service/Modification Center. For prototypes or production quantities, contact your Triplett representative. He'll put you in touch with our Instrument Designers/Engineers who'll help you analyze the problem and suggest the optimum cost/result solution.

TRIPLETT
BLUFFTON, OHIO 45817
Manufacturers of the World's most complete line of V-O-M's

INFORMATION RETRIEVAL NUMBER 70

747 op-amp replacement boasts improved specs



Sprague Electric Co., 347 Marshall St., North Adams, Mass. 01247. (413) 664-4411. ULN-2157; $2.68; ULS-2157: $4.20 (1-24).

The 2157 dual op amp, a direct plug-in replacement for the μA747 op amp, features an input offset voltage of 0.7 mV, with an input offset current of 2 nA. In addition, the 2157 has an input bias resistance of 3 MΩ and an open loop voltage gain of 250 V/mV. A commercial version, the ULN-2157, covers the −55 to +100 C range, while the ULS-2157 operates over the MIL-spec temperature range.

CIRCLE NO. 274

Four functions and memory on a chip

Cal-Tex, 3090 Alfred St., Santa Clara, Calif. 95050. (408) 247-7660.

The CT5005 FlexiChip offers not only the standard four calculator functions (add,subtract, multiply, divide) but a memory register as well. This is believed to be an industry first. The CT5005 contains the equivalent of 3000 transistors and a logic circuit with over 400 gates and 230 shift-register bits. Designed for a 12-digit display calculator, the CT5005 is a p-channel MOS chip. Packaging is a 28-pin DIP.

CIRCLE NO. 275

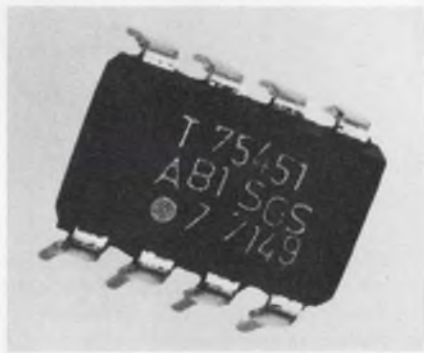
Liquid crystal, COS/MOS display kit offered

Semiconductor Specialists, Inc., P.O. Box 66125, O'Hare International Airport, Chicago, Ill. 60666. (312) 279-1000. $35.

With this liquid crystal, COS/MOS display kit, the user can build a one-digit-up counter for use in a digital display system. The kit comes complete with a single-digit 7-segment numeric liquid-crystal readout, six Augat sockets and several COS/MOS ICs. All the user has to add to complete his digital display system is four fixed resistors, one capacitor and two small 9-V batteries.

CIRCLE NO. 276

Dual peripheral AND driver delivers 300 mA



SGS/ATES, Via C Olivetti 1, 20041 Agrate Brianza, Milan, Italy.

A dual peripheral positive AND driver, the T75451A, has a maximum output sinking current of 300 mA at a guaranteed output low voltage of 0.7 V. And a leakage current of 100 μA is guaranteed at 30 V of output high voltage. The driver can be used in systems that employ TTL and DTL logic, and to meet requirements such as a high speed logic buffer, power driver, relay driver, lamp driver, MOS driver and memory driver.

CIRCLE NO. 277

If you're not an engineer, scientist or technician, don't read this page.

Model 1666. Available everywhere in the USA and Canada. Call (800) 631-1971 free for the Monroe office nearest you. In New Jersey call (800) 962-2804.

Programming: Choose either 128 or 256-step models.

Dynamic range of 10^{+99} to 10^{-98} in either preset or scientific notation.

Accessory card reader available for automatic entry of programs and additional functions not available through keyboard.

10 completely separate storage registers with complete entry, recall, transfer and accumulation flexibility.

Automatic special functions for:

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SIN COS | LOG Ln

Σ^2_n | SIN^{-1} COS^{-1}

$R \rightarrow^{\theta}$ | π e

a^x | $x!$

Complete program library covering every scientific and engineering discipline available to Monroe users.

Litton

Monroe. The Calculator Company.

550 Central Avenue, Orange, New Jersey 07051
81 Advance Road, Toronto 18, Ontario, Canada

INFORMATION RETRIEVAL NUMBER 72

Free samples introduce line of lasers

Hughes Aircraft Co., Electron Dynamics Div., 3100 W. Lomita Blvd., Torrance, Calif. 90509. (213) 534-2121. see text.

A line of He-Ne laser plasma tubes offer the smallest size, lowest price and highest reliability available, according to the company. In addition, free samples are offered to qualified OEMs. Available in 1 and 2-mW versions, with polarization optional, plasma tubes measure 9 inches in length. Thousand-piece price of the tube is $79.95, and an 18-month, no-hour-limit, OEM warranty is offered.

CIRCLE NO. 278

Transistor amp offers 1-W class A output

Avantek, Inc., 2981 Copper Rd., Santa Clara, Calif. 95051. (408) 739-6170.

The AP-2300N transistor amplifier offers 1 W of linear, class A, output power across any 200-MHz portion of the 1.7 to 2.3 GHz frequency range. Other features include a gain of 25 dB (min), gain flatness of ±1.0 dB (max) and noise figure of 10.0 dB (max). The input VSWR is 1.5:1.

CIRCLE NO. 279

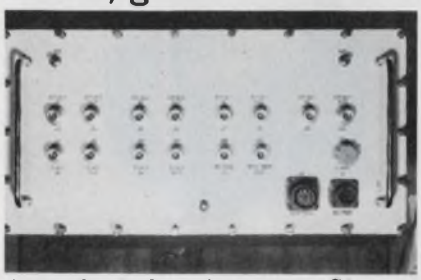
Fixed attenuator line in 50 to 600-Ω offered

Allen Avionics, Inc., 224 E. 2nd St., Mineola, N.Y. 11501. (516) 747-5450. stock.

Fixed attenuators from 0.5 dB to 40 dB attenuation are offered in 50, 75, 100 and 600-Ω characteristic impedances. The units are manufactured with 1% precision film resistors and are designed in π networks. The frequency response is extremely flat from dc to 100 MHz, according to the company. Standard units are produced in 3/4″ diameter brass enclosures with B.N.C. connectors on each end.

CIRCLE NO. 280

Down converter takes 2 GHz, gives 1/2 GHz



Aertech Industries, 825 Stewart Dr., Sunnyvale, Calif. 94086 (408) 732-0880.

A six-channel down converter, the Model C5247, accepts input frequencies from 2.2 to 2.3 GHz and provides output frequencies from 400 to 500 MHz. The remote control panel features selectable LOs (internal standard or external standard). The unit also contains two sum-channels for use in conjunction with low noise paramps and four error-channels that feature built-in transistor preamps.

CIRCLE NO. 281

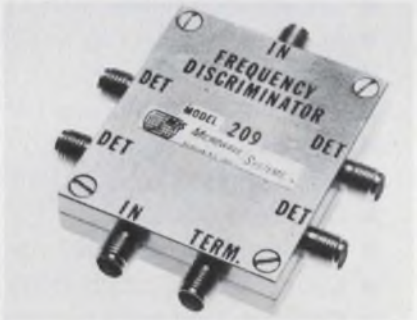
Varactor diodes combine high Qs and low leakage

Varian Associates, Solid State Div., 8 Salem Rd., Beverly, Mass. 01915. (617) 922-6000.

The VAT-200 series of microwave tuning varactors offer Qs up to 4000 with leakage currents as low as 5 nA (at 25 C). Fabricated with the company's Plesa passivation technique, the varactors also feature reverse breakdown voltages of 30, 45 and 60 V; a capacitance/temperature coefficient of 200 ppm/°C (typical) and an ambient operating temperature range of −55 to 175 C.

CIRCLE NO. 300

Frequency discriminator saves user up to $350



Microwave/Systems, Inc., 1 Adler Dr., E. Syracuse, N.Y. 13057. (315) 437-9951. See text.

The Model 209 stripline frequency discriminator, with built-in detectors, is priced at $850. According to the company, this price can save the user $250-$350 over the conventional method of purchasing discriminator and detectors separately. The 209 discriminator has a frequency range of 8-12.4 GHz, detector sensitivity of 250 mV/mW, tangential sensitivity of −34 dBm (with 2-MHz video bandwidth) and frequency sensitivity of 325°/4 GHz.

CIRCLE NO. 301

Rf current probes measure rfi to 1 GHz

Singer Instrumentation, 3211 S. La Cienga Blvd., Los Angeles, Calif. 90016. (213) 870-2761.

A line of rf current probes cover the range 1 kHz to 1 GHz. The probes feature a split, two-piece structure enabling them to be clamped around a conductor, rather than breaking the conductor as with standard probes. Models are available with maximum ratings of 1 A for rf current, 350 A for power current and 500 A for pulse current.

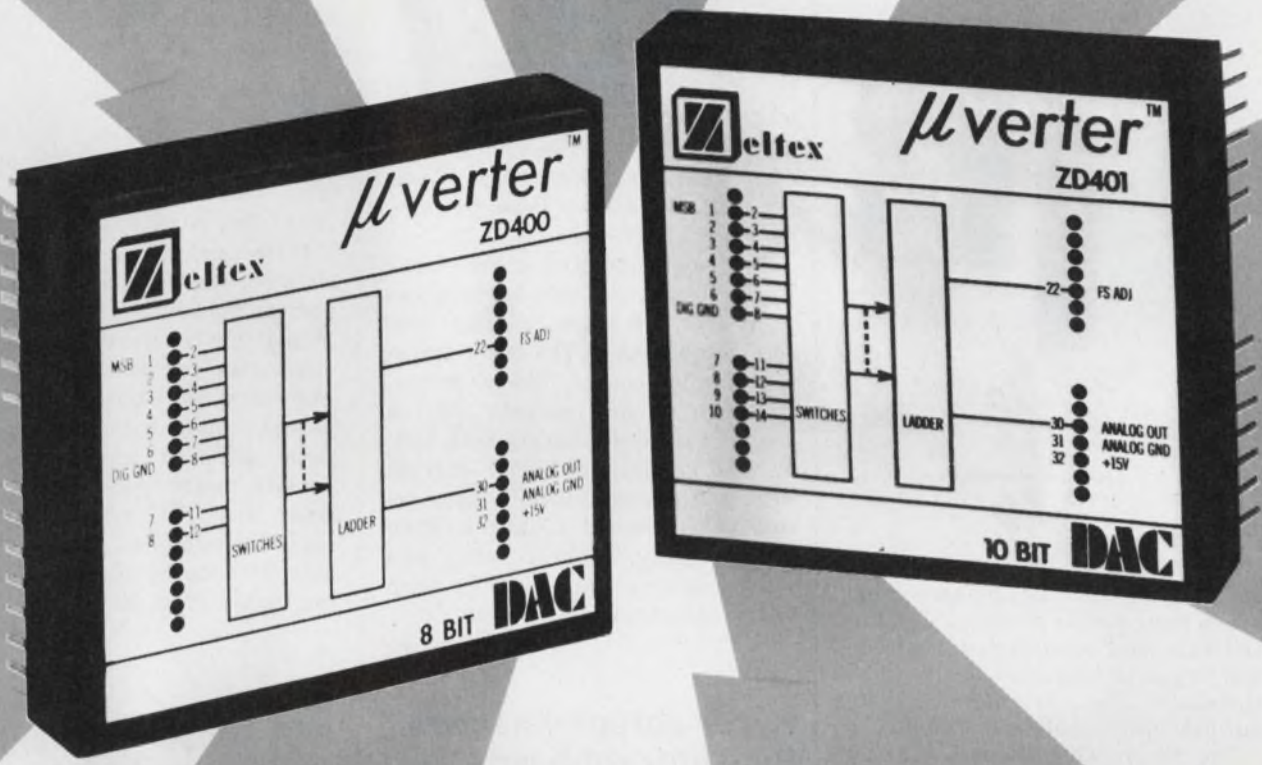
CIRCLE NO. 302

Oscillators offer high power, octave tuning

Texscan Corp., 2446 N. Shadeland Ave., Indianapolis, Ind. 46219. (317) 357-8781. $195; stock to 2 wks.

The VTS series of electronically tuned solid-state oscillators offer as much as 600 mW output power over octave tuning ranges from 10 MHz to 2 GHz. The minimum power output falls below 600 mW in the 500-to-1000 MHz octave range (where it is 400 mW) and in the 1-to-2 GHz range (where it is 200 mW). Power flatness is ±1 dB (max) and spurious outputs are greater than 50-dB down.

CIRCLE NO. 303



ZELTEX DACability!

Meet the two newest current DAC's to join our μverter™ line: The ZD400 and ZD401... 8- and 10-Bit Models that sell for only $8.00 and $12.65 (in OEM quantities).

The ZD400 settles to ½ LSB in less than 1 μsec; the ZD401 is accurate to ±0.05% ±½ LSB. Output current for both converters is rated at 0 to +2.6 mA with a compliance voltage of +1.2V.

Plus higher reliability: Our thick-film DAC's are subject to 16 hours "stabilization bake" at 85°C reducing infant mortality to virtually zero; active resistor trimming guarantees accuracy; DIP leads provide compatibility with most DIP printed circuit boards, and high quality packaging meets most shock, stress, and environmental conditions.

Use them for CRT ramp generators, special function generators, and for building custom ADC's.

Ask about our other 17 versions of DAC's—from 2-Digit BCD to 12-Bit Binary, from modules to systems—μverters™ mean DACability!

Call or write today for a complete Zeltex Data Pak.

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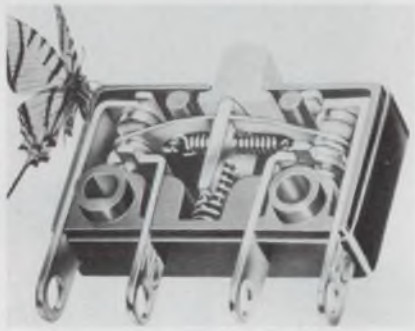
Zeltex INC.

INFORMATION RETRIEVAL NUMBER 77

Double-break provides better switching action



Licon, Div. of Illinois Tool Works Inc., 6615 W. Irving Park, Chicago, Ill. 60634. (312) 282-4040.

In Licon's patented, double-break Butterfly switch there are twice as many contact gaps, contact surfaces, and blades. The latter transfer simultaneously, like a butterfly's wings, and actuate with a snap. This dissipates arc heat faster, and results in higher current interrupting capability. Wiping action helps prevent contact welding by producing a shear force, and also penetrates surface film with every actuation.

CIRCLE NO. 304

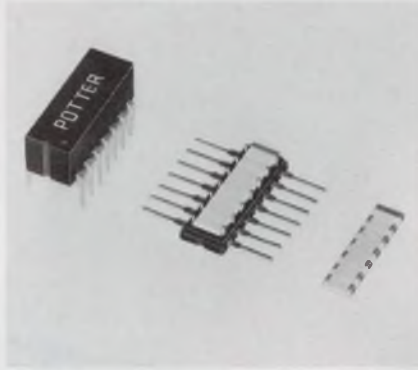
Hyper-abrupt varacters tune uhf/vhf bands

MSI Electronics, Inc., 34-32 57th St., Woodside, N.Y. 11377. (212) 672-6500. $14.00 (100-999); 2 weeks.

The HA1915A Series hyper-abrupt tuning varactor changes its capacitance by 25% more than other abrupt-junction diodes, in going from 2 to 30 V, reverse bias. Available in the DO-7 package, there are 20 different types ranging from 2.7 pF to 100 pF at 4 V. The HA Series can be matched for "ganged" tuning applications.

CIRCLE NO. 305

Multilayer-monolithic capacitors use DIP

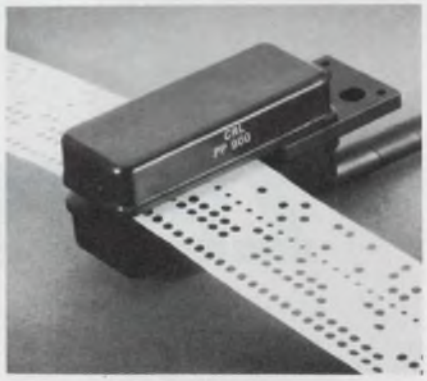


The Potter Co., 500 W. Florence Ave., Ingelwood, Calif. 90301. (213) 781-3034. $1.00; 6-8 weeks.

With improved performance claimed, the multilayer ceramic-capacitor matrix is available in DIP. Monolithic construction of the unit eliminates the need for installing individual multilayer chips. The inherent matching characteristics thus achieved make this high-density matrix suitable for use in delay lines, RC networks, and capacitor assemblies. They are available with up to 16 capacitors having values from 50 pF to 0.1 μF.

CIRCLE NO. 306

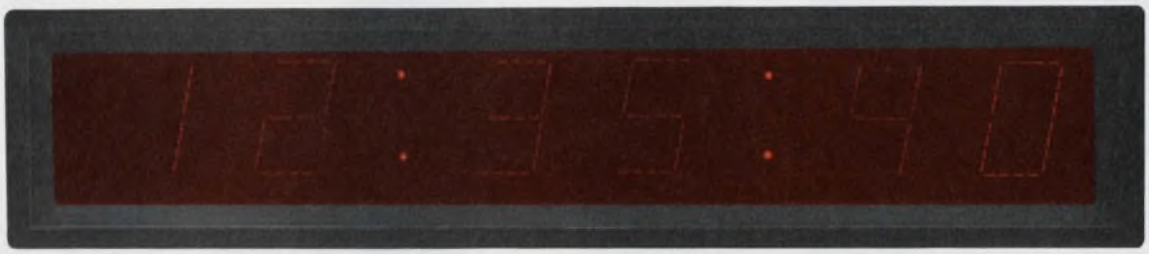
LED-sensor package reads punched tape



Centralab Semiconductor, 4501 N. Arden Dr., El Monte, Calif. 91734. (213) 579-0700. $100 (1-9); stock.

A complete, packaged, solid-state LED/sensor/amplifier subsystem for tape and card reading, combines matched light-emitting diodes and sensors that are ready to install. The standard PP900 has nine channels, is compatible with DTL/TTL logic systems, and is capable of operating at speeds in excess of 1000 char/s. The unit operates at 5 V and 120 mA max.

CIRCLE NO. 307

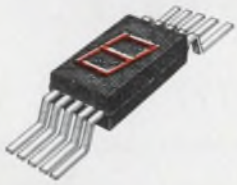


MAN6 — .6" high, the MAN6 looks an inch high from across the room. The complete, gapless font makes all ten digits and nine letters unmistakably clear. It should find application in many instruments, consumer electronics, and cockpit displays.

MAN1 — The standard of the industry, the .27" MAN1 is mounted on a 14-pin DIP and encapsulated in clear epoxy. Directly compatible with IC's, it is being used in a wide variety of alphanumeric display sockets. (Shown in a demonstration clock face.)

The Monsanto GaAsLITE Display display.

MDA6101 — Typical of our modules, the MDA6101 single-digit display module requires minimum space in computer, avionic and military systems. Contains a decoder-driver circuit designed to accept four-input BCD (8, 4, 2, 1) code and to provide .27" visual readout of decimal numbers and nine distinct letters. Provides decimal point input and has ripple-blanking input and blanking input/ripple-blanking output terminals for zero suppression and intensity control.



MAN3A — Encapsulated in transparent red epoxy, this small (.115") readout is very useful in desk calculator displays, portable instruments, and film annotation sockets. Displays ten digits and nine letters.

MAN2 — A 5 x 7 light-emitting-diode matrix, the .35" MAN2 alphanumeric displays the full 64-character ASCII code. Finds application as keyboard verifier, avionics display, in computer peripherals and has 2^{16} bits available for film annotation work.

MAN1002 — A .27" 7-segment hexinumeric display, the MAN1002 provides all numbers and the letters A, B, C, D, E, F, H, I, J, L, O, P, S, and U for digital and cockpit readouts that require this capability. Like all our GaAsLITE displays, it is shock resistant and impervious to vibration.

We're displaying our array of light-emitting diode displays to point out the obvious: We've got them all.

Big GaAsLITEs—the new .6" MAN6.

Low-cost little MAN3's, in single-digit or multi-digit packages.

5 x 7 dot matrix MAN2's.

9-segment hexidecimal MAN1002's.

Red, green, and yellow.

And a line of display modules that will answer the industry's felt need: pre-designed display sub-assemblies for nixie retrofit, edge-card plug-ins, etc.

So what more can you look for in solid-state, TTL-compatible, long-lived light-emitting-diode displays? They're all in stock at our distributors. And the time is right. Get into GaAsLITEs. Display your wisdom.

If you'd like more information on our expanding line of module display products, clip the coupon and shoot it in.

If you need more information on displays, circle the bingo card number below. And if you're smart enough already, just tuck this name into your head when you order displays: **Monsanto Commercial Products Co.,** Electronic Special Products, 10131 Bubb Road, Cupertino, California 95014.

FREE DISPLAY MODULE BROCHURE

Dear Monsanto:

I'm curious about your new line of display modules. Do some contain complete IC driving circuits? Send me the Module Brochure, please.

Name _____

Title _____

Company _____

Address _____

City/State/Zip _____

Monsanto

INFORMATION RETRIEVAL NUMBER 79

Electronic Design Congratulates the
READER-WINNERS
of the 1972 Top Ten Contest

2nd Prize

HEATHKIT 25-INCH SOLID STATE COLOR TV

THE WINNER IS:

William R. Austin
Senior Engineer
Singer, Simulated Products Division
Binghamton, New York

Mr. Austin selected 37 ads which he considered potential winners. Then he made a chart, assigning points to each ad for esthetic appeal, copy approach, usefulness, etc. — six rating categories in all. The final results were then modified using a purely subjective approach. His system must be a good one . . . 2 or 3 hours of work paid off with second prize!

1st Prize

10 DAY WINDJAMMER CRUISE OF THE CARIBBEAN, PLUS FLIGHT FOR 2 VIA AMERICAN AIRLINES 727 ASTROJET

THE WINNER IS:

Ronald S. Newbower
Associate in Anesthesia
Boston, Massachusetts

Dr. Newbower looked through the contest issue with particular attention to general-interest advertisements. He assumed, rightly, that those ads with appeal to a large fraction of readers would place in the "Top Ten." He also tended to choose ads for products that were (a) new, and of general interest, or (b) had their logos emphasized. He writes, "As you can see from the photo–the cruise will be much appreciated."

3rd Prize

BROTHER MINIATURIZED DESK-TOP DIGITAL CALCULATOR

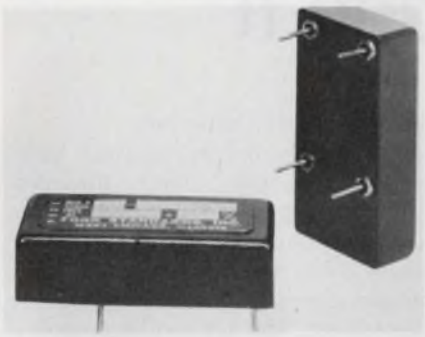
THE WINNER IS:

Arthur L. Moorcroft
E.E.
Naval Underwater Systems Center
New London, Connecticut

Mr. Moorcroft first selected the 15 or 20 ads that he considered exceptional, then culled them to pick the "Top Ten." He leaned heavily toward new advertisements, new products, or new features in making his choices. The system worked well enough to make him one of the 3 big winners in this year's contest.

PLUS 100 OTHER PRIZE WINNERS who will be notified by mail. Readership really pays off in *Electronic Design* — in more ways than one. Next time, *you* can be a winner! Be sure to watch for next year's Top Ten contest announcements.

Crystal oscillator goes down to 1 cycle/minute

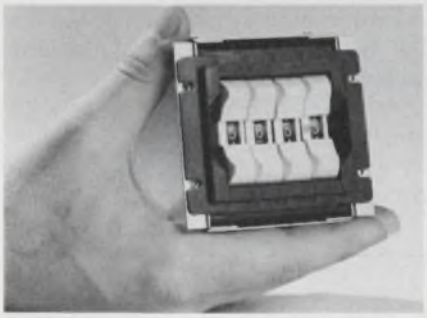


Fork Standards, Inc., 205 Main St., W. Chicago, Ill. 60185. (312) 231-3511. $39.75 (100 and up) 4-6 wks.

A millihertz-to-megahertz frequency range and a case volume of less than half a cubic inch are features of the Model LQ crystal oscillator. Designed for PC board mounting, it will drive commonly used IC logic. Frequency range is 16.67 mHz (one cycle per minute) to 20 MHz; output is a square wave with nanosecond transition times. A 5 V dc ± 10% supply with current drain to 40 mA max., depending on frequency, is required.

CIRCLE NO. 308

Numerical display make resistance setting easy

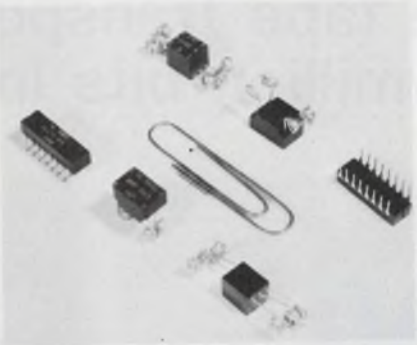


General Resistance, Inc., 500 Nuber Ave., Mount Vernon, N.Y. 10550. (914) 699-8010. Stock to 30 days.

Total resistance values range from 999 Ω to 9.999999 MΩ. The DA-X Series thus provides resistance in decade steps from 0.01 Ω to 10 MΩ with resolution to 0.1 ppm. Precision wirewound resistors are used. Switching circuitry is coded so that a minimum number of resistors per decade is required.

CIRCLE NO. 309

Pulse transformers are available in DIP form

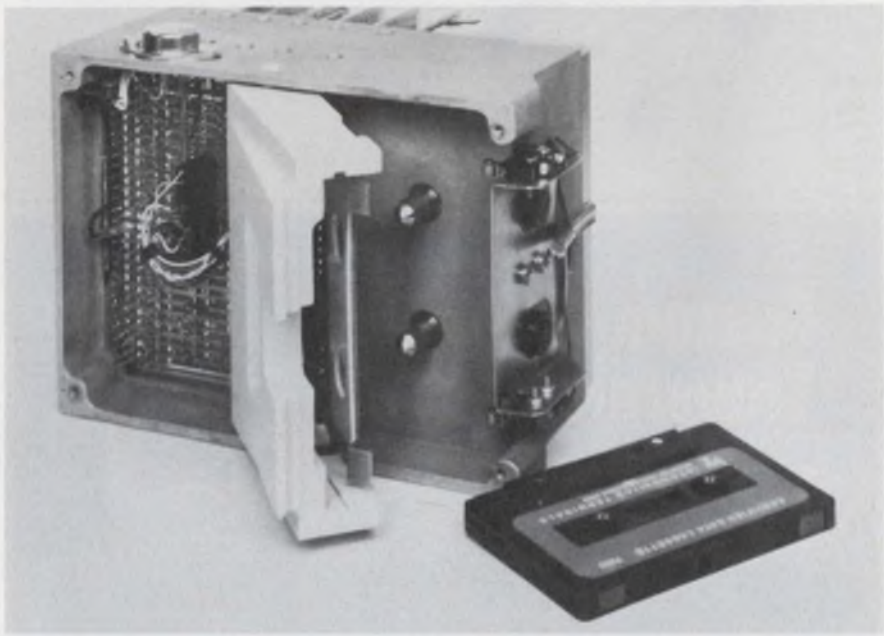


Vanguard Electronics, 930 W. Hyde Park Blvd., Inglewood, Calif. 90302. (213) 678-7161. $2.00 (large quantities); 4-6 weeks.

The new DIP pulse transformers provide high layout density, and are offered in 14 and 16-pin configurations, with up to four transformers per package. Primary inductance ranges from 5 to 2000 μH in a 1:1 turn ratio, and from 5 to 200 μH in a 2:1 turns ratio.

CIRCLE NO. 310

Digital cassette tape transport stores up to 8 million bits in 300 ft



Peripheral Dynamics Corp., a subsidiary of Datum, Inc., 1809 National Ave., Anaheim, Calif. 92801. (714) 871-2200. $1000 (basic drive), to $1600 with options; 60 days.

Up to eight million bits can be stored on a standard Philips type of data cassette loaded with 300 feet of 0.7-mil, 0.15-inch magnetic tape. This is possible with the new Peripheral Dynamics Model 4200 Digital Cassette Tape Transport in its optional 1600 bpi, phase-encoded, four-track recording configuration. No other data recorder using Philips-type cassettes can store this much information in a single cassette.

Standard recording speed on the 4200 is 37.5 ips, but options offer from 10 ips to 75 ips. Start/stop times are 5 ms at 75 ips and 10 ms at 37.5 ips. This gives a total start/stop distance of 0.375 inch.

Either single-gap read/write or dual-gap read-after-write magnetic heads are available in one, two or four-track configurations.

Unlike cassette drives that pull the tape out of the cassette mechanically to guide it more accurately, the 4200 preserves accuracy with a spring-loaded tracking surface. It provides ±0.001-inch tracking with a total skew of less than 2 μs at 37.5 ips, and does it without pulling the tape out.

A reel-driven servo control, with only two moving parts, provides constant tape velocity across the heads without capstan, pinch rollers or solenoids. The two reel-drive motors operate together in a dual-servo loop. The take-up reel motor is in a loop whose feedback signal is tape-velocity information derived from shaft-velocity information. The input signal to this loop is a voltage proportional to the desired tape velocity. The supply reel motor is in a loop whose feedback signal is tape-tension information derived from motor-torque and shaft-velocity information. The input signal to this loop is a voltage proportional to the desired tape tension.

Complete bidirectional operation is offered: high speed or low speed; local or remote control. Operating modes include forward/reverse, normal/high speed, rewind and on-line/off-line.

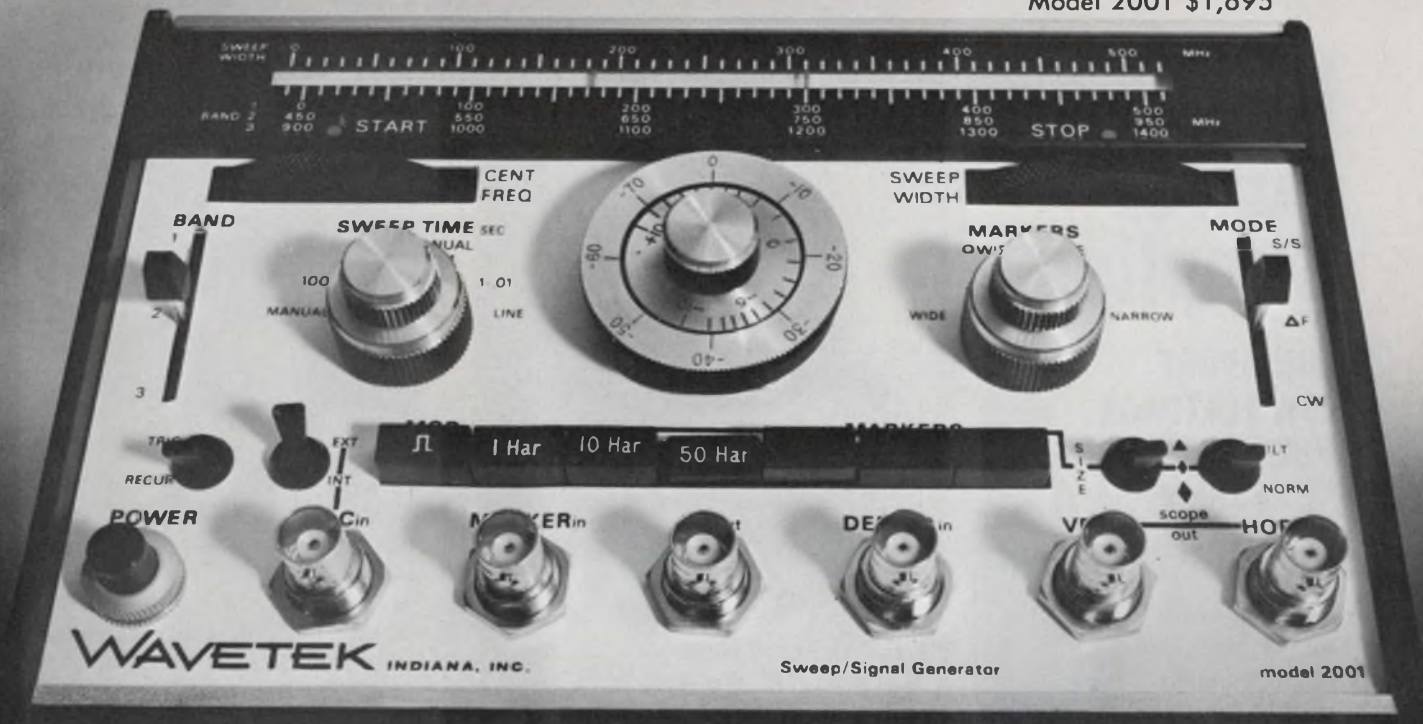
The rewind speed is 120 ips. Beginning-of-tape and end-of-tape limits are sensed optically, and tape motion is inhibited in these areas.

Power supplies are included in the basic transport price. Options include controllers and software.

Although the drive is to be sold unpackaged to OEMs, it will also be available packaged, with up to three drives to a package.

CIRCLE NO. 320

Model 2001 $1,695



The brand new Model 2000 Sweep/Signal Generator costs $320 less than the 2001 (our top-of-the-line sweeper). Yet the two instruments are remarkably alike—especially in the specifications, which are identical. Both have solid-state varactor-tuned and swept oscillators from CW to full-band sweep width. They share a frequency range of 1 MHz to 1.4 GHz with P.I.N. diode attenuation and P.I.N. diode internal or external leveling. Both are programmable with remote control of frequency, bandwidth, output level, and FM, AM or pulse modulation. The only real differences are the ones you can see—the controls on the front panel and the price. So, if you can't tell why the 2001 should cost $320 more, buy the 2000. After all, that's why we built it.

We just came down with a new sweeper.

P.O. Box 190, 66 North First Avenue
Beech Grove, Indiana 46107
Ph. (317) 783-3221 TWX 810-341-3226

Model 2000 $1,375

Flexible disc recorder competes with cassettes

Potter Instrument Co., 532 Broad Hollow Rd., Melville, N.Y. 11746. (516) 649-9000. $500 (large quantities).

Using a single, flexible disc, the DD 480 can be used in applications where cassette units have previously been specified. Advantages of the disc recorder include fast random accessing and ability to check reading within 667 ms (one disc revolution). Packing density averages 1295 b/in. A disc speed of 90 r/m provides a data transfer rate of 33.3 k b/s.

CIRCLE NO. 321

Digital cassette deck uses brushless dc motor

Electronic Associates, W. Long Branch, N.J. 07764. (201) 229-1100. $618.

A minimum of moving parts in the CT100A cassette digital tape transport is claimed as the primary reliability factor—no clutches, springs, pulleys or adjustments. Its brushless, dc-capstan motor provides a non-cogging tape movement without brush noise. Start/stop time is 20 ms, with recording density up to 1600 b/in. at tape speeds from 4 to 12-in./s.

CIRCLE NO. 322

Tape controller couples PDP-11 with four tapes

Information Products, Inc., 4202 Directors Row, Houston, Tex. 77018. (713) 686-1192. $3040; stock.

Series 1 X 15 tape controller is a tape-memory controller interface to the PDP-11 that handles up to four transports (7 or 9-track) with a simple I/O cable interface. Minimal software intervention is required. I/O-driver subroutines and diagnostics are supplied with the controller.

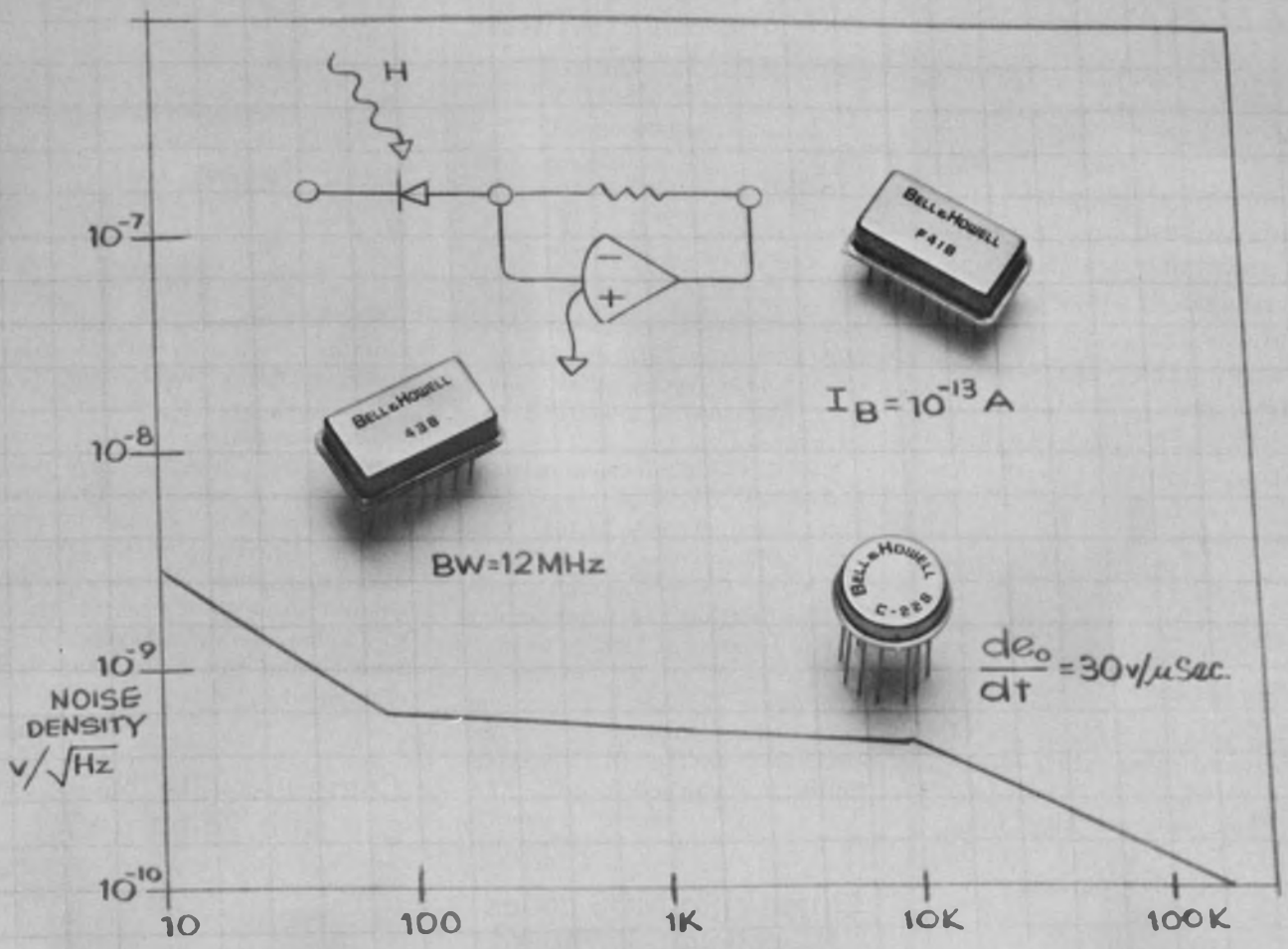
CIRCLE NO. 323

Serial IC memory stores millions of ½¢ bits

Intel Memory Systems Operation, 3065 Bowers Ave., Santa Clara, Calif. 95051. (408) 246-7501.

Intel's new System in-60 serial-IC-memory system stores to 200,000 bits per PC card. A 50-million-bit system, using these 8 × 10-1/2 in. cards is now under construction to sell for less than 1/2¢ per bit. The systems operate at 25-kHz to 1-MHz clock rates, and have a guaranteed access time of 500 ns at the maximum clock rate. They operate on one +5 V, 7 A power supply per card and interface directly with TTL logic.

CIRCLE NO. 324



The perfect pre-amps for your optical detector

If you're looking for amplifiers that are perfectly compatible with your optical detectors, look no further. These Bell & Howell hybrid amplifiers offer all the performance features that make them the perfect preamps for optical detectors.

The F-418 for example is a low noise FET hybrid amplifier with input bias current of 100 femtoamps (10^{-13}A.) in a hermetic DIP package.

The C-438 and C-228 are very low noise, high performance FET input hybrid differential op amps that offer wide bandwidth, fast slew rate and fast settling time.

All units are processed to MIL-STD-883.

Now that you've discovered where they are, write or phone for a fast response on the complete specs.

CONTROL PRODUCTS DIVISION

706 Bostwick Ave. Bridgeport, Conn. 06605 (203) 368-6751

BELL & HOWELL

INFORMATION RETRIEVAL NUMBER 83

Minicomputer furnished with operating software

XLO Computer Products, 850 Ladd Rd., Walled Lake, Mich. 48088. (313) 868-3900. $2500 (and up); 30 days.

The XLO-8 minicomputer is furnished with a core memory of 4096 bytes (expandable to 32,768), a 64-byte ROM (expandable to 32,768) and seven I/O ports, each capable of transmitting and receiving data at burst speeds of 500,000 words/s. Also included are an operator console, power supplies, a general-purpose display-status register, real-time clock and a TTY interface. Software furnished with the XLO-8 is a complete operating package.

CIRCLE NO. 325

Single-chip MOS codes "N"-rollover keyboard

Controls Research Corp., 2100 S. Fairview, Santa Ana, Calif. 92704. (714) 557-7161. $100 (1000 and up).

A new MOS-encoded keyboard features N-key rollover and a single, 40-pin, ceramic-MOS chip for random-pair coding of up to 64 keys. The keyboard is offered in standard reed-switch contacts or the new BI-PAC switches which feature dual cross-wire, gold-plated, spring contacts and wiping action. The N-key rollover feature allows fully-sequential key outputs, even at maximum typing speeds.

CIRCLE NO. 326

Card-to-punched-tape converter is faster

Datatex Corp., 6119 Jessamine, Houston, Texas 77036. (713) 774-9741.

Datatex points out that older card-to-tape converters have reading rates of only 8 to 10 cards/min. making its Model 40 CTP four to five times faster. Plug-in electronics allow changing to any desired tape code. Formats with up to 64 characters are decoded in the reader, and unwanted characters eliminated.

CIRCLE NO. 327

Computer fills 16-32 bit gap with 24-bit design

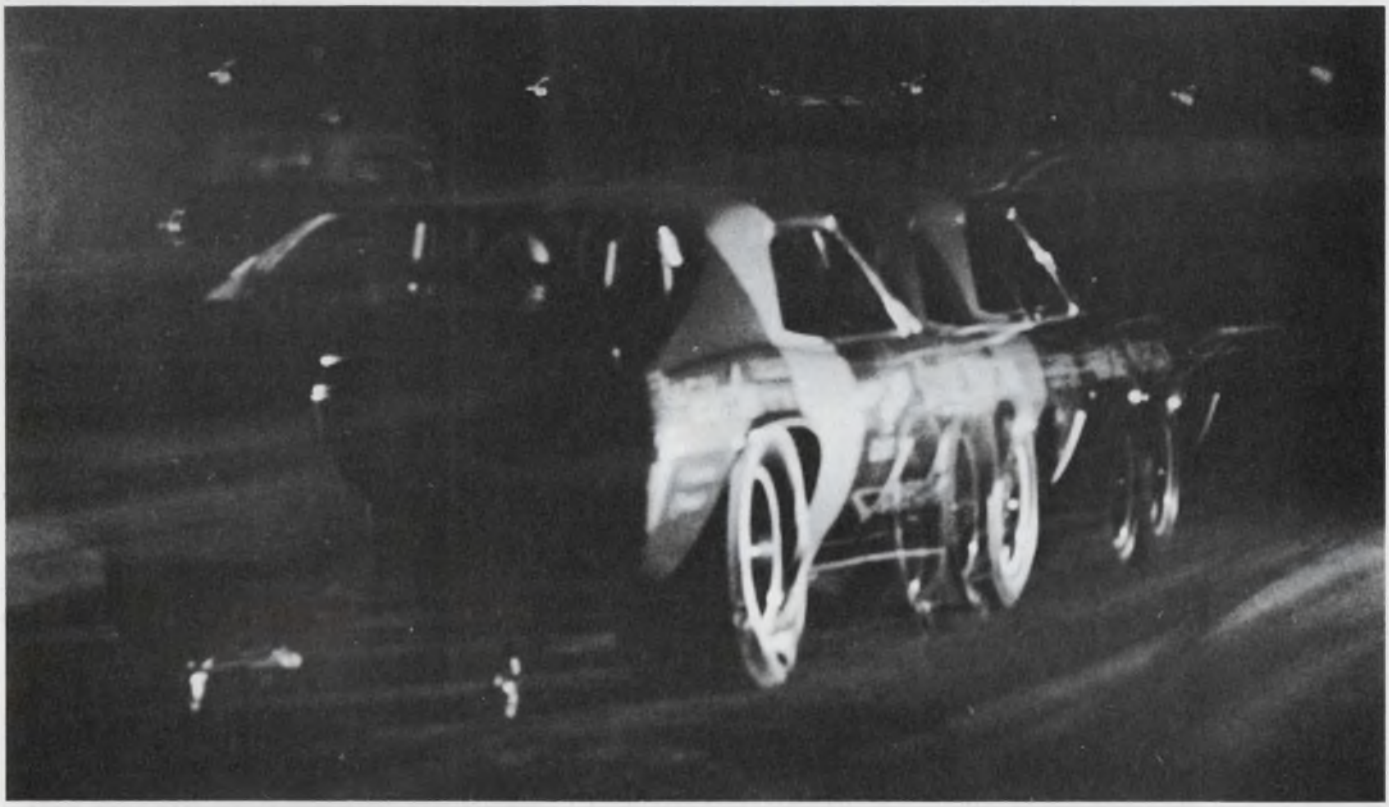
Data Craft Corp., 1200 N.W. 70th St., Fort Lauderdale, Fla. 33307. (305) 974-1700. $10,900.

The DC 6024/5, with its 24-bit word length, can directly address 32-k words or indirectly up to 65-k words. Cycle time is 1.0 μs with a standard repertoire of 592 hard-wired operating codes. Included in the basic price is a CPU with 4-k of memory, five general purpose registers, hardware-multiply/divide/square-root functions, four levels of external-priority interrupt, display panel and power supplies.

CIRCLE NO. 328

If you're looking for power.

Move out fast with TRW.



$I_C$max = 15 amps . . . h_{FE} = 300 . . . BV_{CEO} = 650 volts
Switching Time < 300 nsec

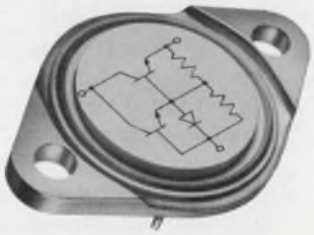
Our SVT 6000 series monolithic Darlington has the specifications you need if you've got power conditioning applications for automotive electronic systems, high gain, high power regulators and converters, or AC motor controllers.

These NPN high voltage, high gain monolithic Darlingtons are ideal for use in all high speed circuits. (Also available is the SVT 6100 series up to 50 amps and 200 volts.)

These SVT series Darlingtons will allow you to make substantial cost saving reductions in your power conditioning designs.

Both are available in quantity right now.

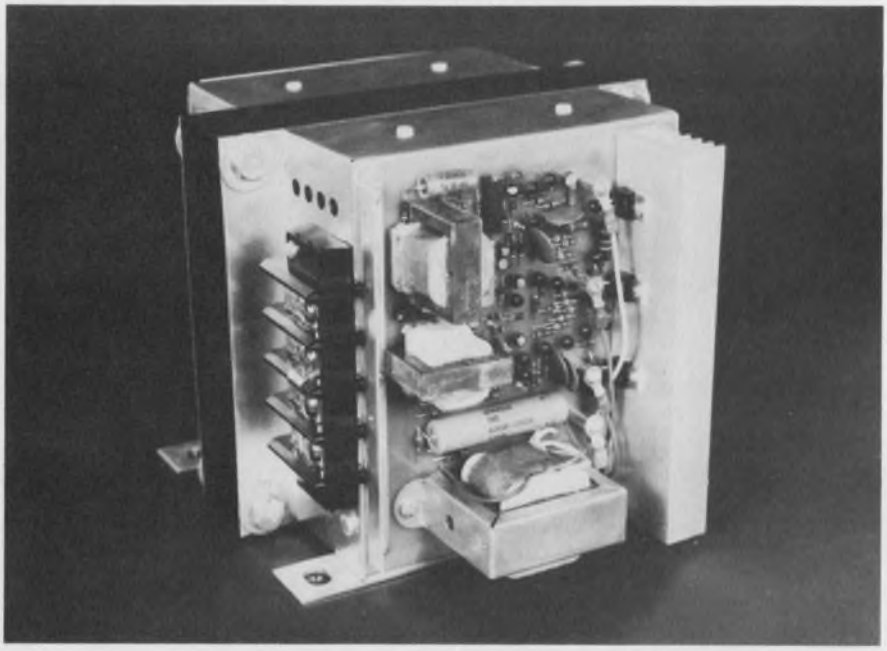
For complete specifications or delivery information on these devices see your authorized TRW distributor or call Dick Seinfeld. In California call (213) 679-4561, collect. Or write TRW Electronics Functions, an Operation of TRW Electronic Components, 14520 Aviation Blvd., Lawndale, California 90260.



TRW®
ELECTRONIC FUNCTIONS

INFORMATION RETRIEVAL NUMBER 85

Latest ac-line voltage regulators are lighter and cheaper than competing units



Power-Matic, Inc., 6621 Convoy Court, San Diego, Calif. 92111. (714) 292-4422. See text; stock to 4 weeks.

Weight and price hit a new low with the introduction of the MPS series of line voltage regulators by Power-Matic. These regulators are of the multi-primary, switching ac type. The only competitor on the market with this type of regulator is Topaz Electronics. However, in each competitive power range, Topaz is heavier and more expensive. The most significant force in the line voltage regulator market is Sola Electric. But Sola's line of variable-conduction-angle Solatron regulators are also heavier and more expensive for comparable power ratings.

Power-Matic's MPS series handles input line variation of +10% to −30%, with outputs adjustable over a 20% range—100 to 120 V and 200 to 240 V. Models are available in the following power ranges: 500 VA, 1 kVA, 2 kVA, 4 kVA and 8 kVA. Topaz does not offer any range below 2 kVA, but it does offer a wider selection of input and output voltages. Sola's line goes up to 25 kVA with an input voltage range of +10% to −20%.

Sola offers line regulation of ±1/2% at unity power factor loading. It does not quote the change in regulation when the loading is not strictly resistive. Both Power-Matic and Topaz offer ±7% regulation independent of power factor. The lack of dependence on power factor is due to a low open-loop output impedance.

Whereas the Sola units work over only a 6-Hz frequency window, the others can tolerate line-frequency variation of from 45 to 70 Hz.

Harmonic distortion of the MPS series is 0.2% max. Efficiency is 98 to 99%. The units operate over a temperature range of 0 to 55 C.

Terminals are provided for remote load sensing.

Regulation is achieved in a multi-primary switching ac regulator by sensing the regulated output voltage in a high-speed sample-and-hold circuit, and terminating the end of a selected primary winding to accomplish step-up, step-down or straight-through switching. The sample-and-hold circuit makes a decision near the end of every half cycle, and the proper primary winding is always selected at a zero voltage crossing. This technique eliminates the several-cycle regulation lag inherent in other types of line voltage regulators.

Power-Matic, Topaz and Sola also offer models designed for ±10% input voltage variation at improved regulation.

For ease of installation, a separate circuit breaker is supplied with each unit in the MPS series. The circuit breakers have optimized delay characteristics to permit heavy inrush currents from motor or lamp loads. Temperature coefficient is given as 0.01%/C (typical). MPS regulators measure 7-1/2 inches wide by 6-3/8-inches high. Length of the units varies from 7-1/2 inches for a 1/2-kVA model to 10-1/2 inches for a model with a maximum load spec of 8 kVA.

Power range, weight and price are compared in the following table for single-phase regulators:

Manuf.	Max. Load (kVA)	Wt. (lbs)	Price ($)
Power-Matic MPS	0.5	25	275
	1.0	30	325
	2.0	35	400
	4.0	50	500
	8.0	65	650
Topaz LR	2.0	40	450
	4.0	50	570
	8.0	75	790
Sola LVR	0.5	40	363
	1.0	58	400
	2.0	81	532
	3.0	95	610
	5.0	127	799
	7.5	168	989

For Power-Matic **CIRCLE NO. 250**

For Topaz **CIRCLE NO. 251**

For Sola **CIRCLE NO. 252**

The IR/Schottky Power Curve. A new twist that cuts power loss 50%.

Schottky had a good idea. His hot-carrier principle brought unique advantages to users of signal level diodes. So we teamed up to bring the same advantages to the high power league: designers of I/C power supplies and switching regulators in the 50 Amp/20 Volt range. Now it's a whole new ball game.

Check our curve. The dotted line shows the voltage-current characteristics of junction rectifiers. The solid line is the basis for our new pitch. There's quite a difference.

Half The Forward Voltage Drop. Note the forward voltage drop of 0.65 Volt vs. 1.25 Volts for typical rectifiers. At low voltage-low frequency, it means 50% less power loss, for a marked increase in efficiency. Like 10% at 5 Volts/100 Amps. Now you can use fewer rectifiers, smaller transformers, and cut heat-sinks in half. If you design high-frequency circuits, you'll do even better.

More Efficient at High Frequencies. The higher the operating frequency, the more efficient the IR/Schottky rectifier becomes. At 20 KHz, system efficiency can increase by an additional 25%. And, it can operate at even higher frequencies.

No Reverse Recovery Losses. Unlike junction rectifiers, the IR/Schottky barrier doesn't store minority carrier charges. There are none to be swept out as it is switched to the reverse mode. So time-lag and electrical loss are virtually zero, which accounts for its increased efficiency in high and ultra-high frequency systems.

Reliability/Stability. You can forget about conservative derating. IR proprietary passivation and metallization technology assure long-term stability, extremely low leakage and low sensitivity to temperature. You can count on reliability and optimum life at full ratings.

Try our new curve. Call your IR sales office or distributor today and ask for details on IR/Schottky Power Rectifiers — in either forward or reverse polarities. You'll get everything you need for a whole new ball game.

New from IR...
the innovative power people

IOR INTERNATIONAL RECTIFIER

SEMICONDUCTOR DIVISION • 233 KANSAS STREET, EL SEGUNDO, CALIFORNIA 90245 • (213) 678-6281

MODULES & SUBASSEMBLIES

Log/antilog amplifier needs only 10 pA bias

Analog Devices, Inc., Route 1 Industrial Park, P.O. Box 280, Norwood, Mass. 02062. (617) 329-4700. $55.

The Model 755 log/antilog amplifier features 10 pA bias, said to be a five-to-ten-time improvement over current models. The device is pin compatible with other units and has an adjustable scale factor. The 755 comes in a 1.5 × 1.5 × 0.4 in. case. In addition to its low bias current the 755 offers 120 dB of current logging (1 nA to 1 mA), 80 dB of voltage logging (1 mV to 10 V) and 15 μV/°C voltage drift. Conformance to ideal log operation is held to ±1% over its total current range and to ±0.5% over the voltage range.

CIRCLE NO. 329

Variable attenuators work to 82 db and to 1%

Hope Electronics, Box 773, Clifton, N.J. 07013. (201) 777-3522. AT-42, $70; AT-82, $85; stock to 2 wks.

These attenuators are spec'd to 300 MHz and are usable to 500 MHz. Models AT-42 and AT-82 provide attenuation ranges from 0 to 42 dB and from 0 to 82 dB, respectively, in 1-dB steps. They may be specified in 50 or 75 ohm impedance. The units provide rated accuracy of ±1% over a frequency range from dc to 150 MHz and ±2% accuracy from 150 MHz to 300 MHz.

CIRCLE NO. 330

FET-input amplifier has 60 V/μs, 18 MHz BW

Datel Systems Inc., 1020 Turnpike St., Canton, Mass. 02021 (617) 828-6395. AM-100A, $40; AM-100B, $45; AM-100C, $52; stock.

Model AM-100 A/B/C is a differential FET amplifier designed for high speed applications. Model AM-100 A/B/C offers 60 V/μsec slew rate, 18-MHz unity-gain BW and 20 mA output for driving up to 500 pF of capacitance. Models AM-100A (50 μV/°C, 100 pA bias), AM-100B (25 μV/°C, 50 pA bias), and AM-100C (10 μV/°C, 20 pA bias) settle to 0.01% in the 150 ns (max) inverting mode. CMR is 60 dB at ±10 V cm voltage.

CIRCLE NO. 331

FET-input op amp gives 20 mA at 1 MHz

Bell & Howell, Control Products Div., 706 Bostwick Ave., Bridgeport, Conn. 06605. (203) 368-6751. $48 (100); stock.

An FET-input, hybrid op amp that delivers 20 mA output current at 1 MHz, describes the Type 438. The unit is supplied in a hermetically-sealed, 14-pin DIP. The most significant features of the 438 are a bias current of 5 pA; a slew rate of 50 V/μs in the inverting, noninverting and differential modes; 1-MHz full frequency output (±10 V at 20 mA); and a settling time to ±0.01% or less than 1 μs. The C-438 is laser trimmed to less than 1 mV offset and requires no external trim pots.

CIRCLE NO. 332

MODULES & SUBASSEMBLIES

Small power supplies give ±12 V for $12

Servotron Corp., P.O. Box 292, Haverhill, Mass. 01830. (617) 374-0777. see text; stock.

Servotron has introduced its economy encapsulated line of power supply modules, which measure just 2 × 2 × 0.875 inches and sell for $12 in single quantity and less than $10 for 1000 quantity. Models EE12D25 and EE15D25 provide ±12 and ±15 V dc, respectively, at 25 mA. Model EE5S200 provides 5 V dc at 200 mA. Regulation is 0.25% line and 0.25% load. Ripple and noise is 2 mV rms and TC is 0.02%/C. Warm up drift is 15 mV. Performance is not derated over any part of the operating temperature range of −25 to +71 C. Input voltage and frequency are 105 to 125 V ac at 50 to 440 Hz.

CIRCLE NO. 333

High-current supplies give 100 A at 5 V

ACDC Electronics, Inc., Oceanside Industrial Center, Oceanside, Calif. 92054 (714) 757-1880. $245 and up; stock.

Ten new, high-current power supplies ranging from 100 A @ 5 V to 16 A @ 28 V are available from ACDC Electronics. Designated the HCM series, they feature 0.1% regulation and inherent protection against overload and short circuit. Provisions are made for over-voltage protection, remote sensing, remote programming and rack mounting. Prices are claimed to be as much as 50% less than previously available high current supplies.

CIRCLE NO. 334

13-bit d/a converter works at −55 to +125 C

Helipot Div., Beckman Instruments, 2500 Harbor Blvd., Fullerton, Calif. 92634. (714) 871-4848. $185; stock.

A four-quadrant, general purpose d/a converter has been introduced by the Helipot Division of Beckman Instruments, Inc. The Model 849 accepts a serial binary code of up to 13 bits and, upon command, converts and holds the number as an output voltage. The unit has a metal, 20-pin package, operates over a temperature range of −55 to +125 C and meets applicable portions of MIL-STD-883. The unit requires external reference voltages, a two-phase clock, command signals and power supplies.

CIRCLE NO. 335

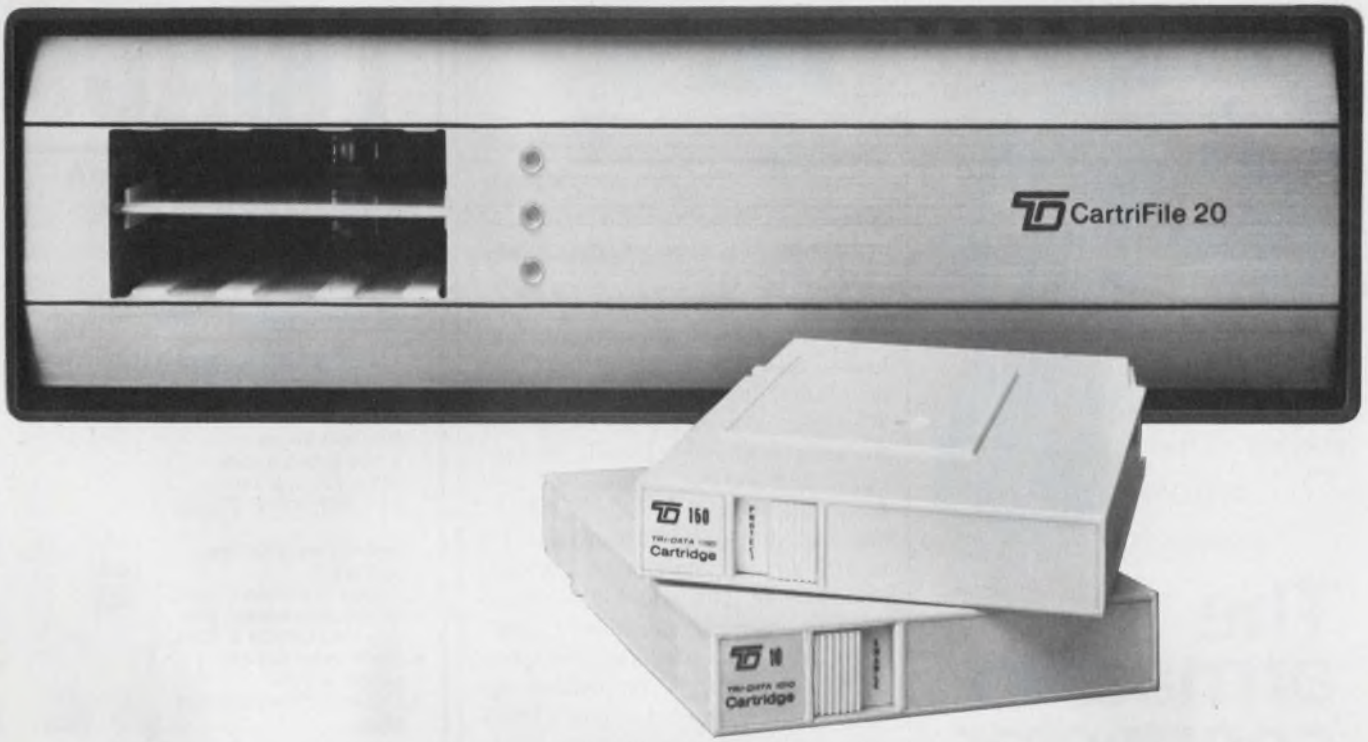
Bi-directional counter takes pos/neg inputs

Hecon Corp., 31 Park Rd., New Shrewsbury, N.J. 07724. (201) 542-9200. 6-digit, dc unit under $40 in quantity.

A new bi-directional counter, the Model GO 431, is designed to accept positive and negative pulses—even simultaneously—without jamming or missing a pulse count. The unit uses two solenoids with a true-differential mechanism to prevent miscounting. It offers a 6-digit display, white on black, 5/32 in. high. It will operate on 6 to 220 V, ac or dc. Power consumption is 3.7 W. Available counter speeds are 10 to 25 counts per second.

CIRCLE NO. 336

OUR NEW BIT PICKER



(With Single-Tape Cartridge to Match)

We call our newest "bit picker" the CartriFile® 20. It gives you two independently controllable tape drives. You can read or write up to 18,000 bits per second with either drive, as you choose.

It operates with convenient, single-tape cartridges: our new 1000 SERIES. These are available in 10, 25, 50, and 150 foot lengths. Each 150 foot cartridge packs over 3 million bits of data.

CartriFile 20 comes complete with read/write and control electronics and integral power supply. Also interfacing, cables, and basic software for all popular minicomputers.

And we've priced it to surprise you: only $3650 (with interface)—$2025 in small OEM quantities (without interface).

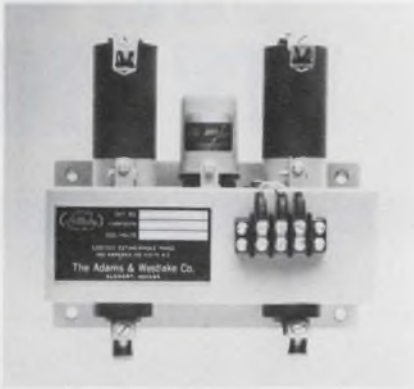
Get all the facts on our newest minitape system—the CartriFile 20.

TRI-DATA

800 Maude Avenue / Mountain View / CA 94040
Phone (415) 969-3700 / TWX 910-379-6978

INFORMATION RETRIEVAL NUMBER 91

DPST pulse latch switches 100 A



Adams & Westlake Co., 1025 N. Michigan St., Elkhart, Ind. 46514. (219) 264-1141.

A new power-pulse latch, Series HR-1000, for primary power and heavy load current switching has been introduced by The Adams & Westlake Company. A completely solid-state control circuit accepts input and gating signals and controls the DPST (N.O. or N.C.) mercury displacement switches. Up to 100 A per pole can be switched at 120 V ac. 230 and 440 V operation is also recommended. Latch operating voltages may be specified as 24 or 48 V dc. Switch operation may be continuous (100% duty cycle) or intermittent, up to 6 operations per minute.

CIRCLE NO. 337

Low-level dc amp permits ±500 V CM use

Bay Laboratories, 20160 Center Ridge Rd., Cleveland, Ohio 44116. (216) 333-3898. $470; 30 days.

A completely direct-coupled design permits ±500 V common mode operation without intermodulation or chopper hash and spikes. The Series 5000 data amplifier is offered in 108 different configurations, from combinations of filter, output, offset and gain options. Other features are: 120 dB CMR (1 k unbalance) 250 MΩ input impedance, linearity ±0.005%, 100 kHz BW, ± 10 V @ 100 mA output, integral power supply, 10 units in 5-1/4 in. rack, ±10 V offset option, 1 μV/°C drift and 1000 MΩ isolation.

CIRCLE NO. 338

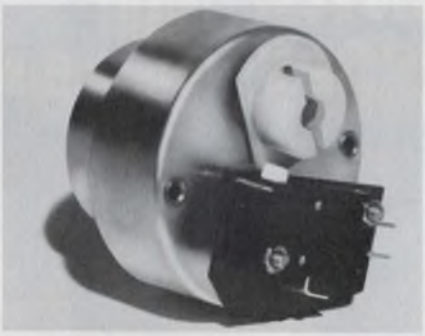
Differential amplifier offers 120-dB CMR

Neff Instrument Corp., 1088 E. Hamilton Rd., Duarte, Calif. 91010. (213) 357-2281. $520; 30-60 days.

The Model 124A differential instrumentation amplifier handles low-level signals in the presence of common-mode voltages of ±300 V. The amplifier output is ±10 V at 100 mA from dc to 100 kHz. Eleven fixed-gain steps, plus a precision 10-turn multiplier provide a continuous gain span of 1 to 2500. The 124A achieves ±0.003% linearity. A guard-to-ground impedance greater than 1000 MΩ insures a CMR of 140 dB at dc and 120 dB from dc to 60 Hz, with up to 1000 ohm unbalance in either input lead.

CIRCLE NO. 339

Push-button timer gives fixed interval

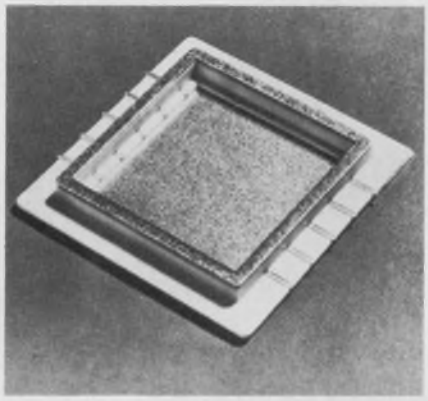


Bristol Saybrook Co., 90 Coulter Ave., Old Saybrook, Conn. 06475 (203) 388-3414.

The Model 1402 provides fixed-time intervals ranging from 1/30 of a second to 1 month. The timer contains a Bristol Sync-Lock synchronous hysteresis timing motor and an enclosed snap-action switch. These components are linked together by a heavy duty plastic cam to create the controller. The 10 A switch operates both motor and load.

CIRCLE NO. 340

Microwave package exhibits 50-Ω impedance

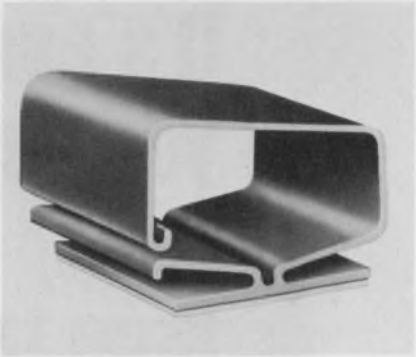


Bendix Corp., Sherman Ave., Sidney, N.Y. 13838. (607) 563-9511.

A controlled impedance package for microelectronic microwave devices exhibits a nominal 50-ohms impedance with a VSWR of 1.15 max. from dc to over 4 GHz. The hermetic enclosure accommodates a microwave circuit on a 1.0 by 1.0-inch substrate and is compatible with microstrip transmission lines and motherboards.

CIRCLE NO. 341

Self-adhesive fastener secures wire bundles

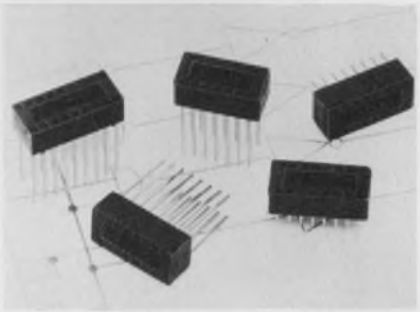


Eaton Corp., Engineered Fasteners Div., 100 Erie View Plaza, Cleveland, Ohio 44101. (216) 523-5000.

Retention of wire bundles up to 0.5 by 1.156-inch no longer requires drilling or punching panel holes for fastening wire harnesses. Tinnerman pressure-sensitive wire harness clamps, backed by a 1/32-inch-thick pressure-sensitive tape, have a tensile holding power of 30 lbs.

CIRCLE NO. 342

DIP sockets boast high density

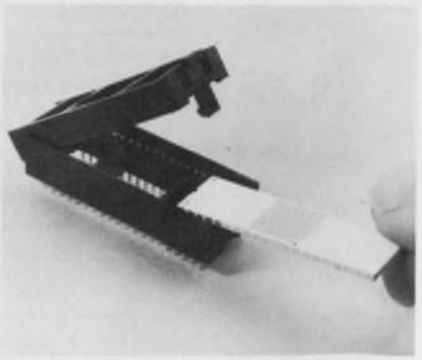


Stanford Applied Engineering Inc., 2165 S. Grand Ave., Santa Ana, Calif. 92705. (714) 540-9256. $0.51 to $0.59/terminal (1000 quantities); stock.

Designed for 18-pin MOS and bipolar memory ICs, the 2200/2900 series of DIP sockets provide circuit designers with side-by-side mounting with 400-mil centers and with 100-mil end-to-end centers. The glass filled nylon sockets are 395 by 898 mils in size, and allow either soldered or solderless-wrap interconnections.

CIRCLE NO. 343

Substrate socket needs no insertion force

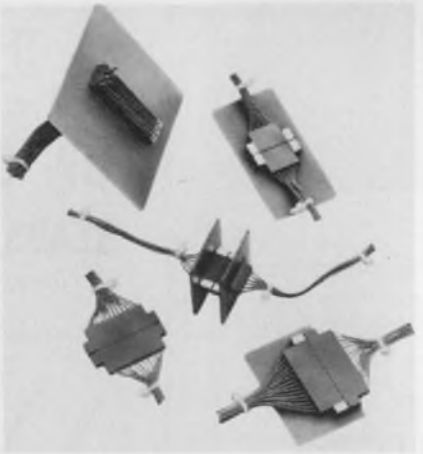


Amp Inc., Eisenhower Blvd., Harrisburg, Pa. 17105. (717) 564-0101.

With the ability to accommodate the new 2.000 × 0.578-inch side-metallized leadless ceramic substrates, this zero-insertion force receptacle is only slightly larger than the substrate itself (2.375 × 0.800 × 0.500 inch). The receptacle requires no tools. A series of guides and bosses molded into the glass-filled plastic receptacle body position the substrate and protect the contacts against snubbing.

CIRCLE NO. 344

Miniature two-piece connectors in five sizes



Elco Corp., Computer Ave., Willow Grove, Pa. 19090. (215) 659-7000.

A line of two-piece, metal-to-metal connectors, called 8229, is available in five discrete sizes: 6, 9, 10, 12 and 15 single row contact positions, all on standard 100 mil centers. The connector features wire-crimp/removable mini-Varilok contacts in a flame resistant, glass filled, diallyl phthalate insulator.

CIRCLE NO. 345

Ceramic materials kit can be used at 3000 F

Aremco Products, Inc., P.O. Box 145, Briarcliff Manor, N.Y. 10510. (914) 762-0685. $99; stock.

A high temperature ceramic materials kit includes both castable ceramics, adhesives and coatings. Kit No. 500 includes five basic ceramic materials and a special thinner for use with these materials. The kit includes Ceramabond 503, an alumina base ceramic adhesive; Ceramacast 505 and 510 castable ceramics; a potting material for high temperature applications called Ceramacast 511; and a high temperature coating product, Ceramacast 512.

CIRCLE NO. 346

14- and 16-pin headers are DIP compatible

Aries Electronics, Inc., P.O. Box 231, Frenchtown, N.J. (201) 996-6200. $0.50 to $1; stock.

A line of 14- and 16-pin headers that are DIP compatible have a contact pin shape that allows components to be laid in and then easily soldered. Contacts are brass, gold or tin plated. Both the header and the caps are glass filled nylon. The headers can be directly soldered to PC boards, or used with DIP panels.

CIRCLE NO. 347

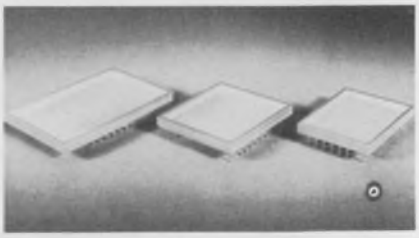
DC cards handle 14 to 40-pin sockets

Cambridge Thermionic Corp., 445 Concord Ave., Cambridge, Mass. 02138. (617) 491-5400.

A line of general purpose PC cards provide a medium of handling 14, 16, 18, 24, 36, or 40-pin IC sockets in any combination. Each board is 4.5 inches square and features a 70-finger edge connector circuit-tied to the 70 input/output double-ended solderless wrap pins. Each card is pre-drilled with a row of mounting holes for sockets with 600 mil centers and two rows of 8 sets each of mounting holes for sockets with 300 mil centers.

CIRCLE NO. 348

Microcircuit packages come in custom sizes

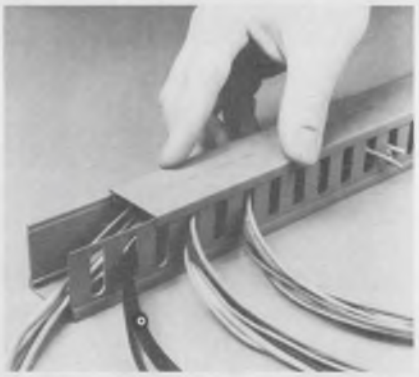


Tekform Products Co., 2780 Coronado St., Anaheim, Calif. 92806. (714) 630-2340.

A rugged, lightweight series of Modular Sidewall enclosures eliminates the need for expensive tooling for special IC package configurations. Intended for monolithic and hybrid microelectronics, these cases are formed of Kovar component pieces precision cut to customer requirements, to permit wide latitude in microcircuit package design. Standard 14 to 40-lead packages are available, with rigid 40-mil bases.

CIRCLE NO. 349

Plastic wiring duct offers modular form



American Pamcor, Inc., Box 1776, Paoli, Pa. 19301. (215) 647-1000.

Customized wiring ducts can be assembled from the removable base, cover and side panels of a modular plastic wiring duct. Available in 1, 1-1/2, and 3-inch height or width, the 6-foot long components can be readily cut with snips and punched or drilled for mounting. The duct locks together securely to withstand shock and vibration—yet the cover can be readily removed if necessary for wire or cable maintenance.

CIRCLE NO. 350

Core material does not depend on temperature

Ampex Corp., 13031 W. Jefferson Blvd., Marina del Rey, Calif. 90291. (213) 821-8933.

A temperature independent ferrite material for computer memory cores operates within a range from —25 C to 100 C without temperature compensation.

CIRCLE NO. 351

Resistive pastes more rugged than PdAg

Electro-Science Laboratories, Inc., 1601 Sherman Ave., Pennsauken, N.J. 08110. (609) 663-7777. $44/oz.

The 2800 series cermet resistive pastes are used in thick film printed resistors, microelectronic hybrid circuits and discrete components, such as cylindrical resistors or trimming potentiometers. These resistor pastes may be used where hostile environments would harm Palladium-silver resistor compositions. The pastes are available from 30 to 1,000,000 ohms/sq. nominal sheet resistivity.

CIRCLE NO. 352

Iron oxide plate coating claims hardness

Towne Laboratories, Inc., One, U.S. Highway 206, Somerville, N.J. 08876 (201) 722-9500.

Ferroxoplate, an iron see-through plate claims to have the hardest coating yet offered to the photomasking industry. The coating has a nonreflective surface which minimizes line spreading from multiple reflections.

CIRCLE NO. 353

Bandoliering tape has rubber-based adhesive

Permacel Div., Johnson & Johnson, Box 671, New Brunswick, N.J. (201) 524-0400.

A flatpack tape is useful for bandoliering and sequencing electronic components. Made of rope-fiber paper, coated with a high-strength, rubber-based adhesive, P-271 offers superior adhesion to leads and mass-to-mass adhesion. It has high backing strength and resists the force of lead insertion between layers. P-271 is 6.5 mils thick and is available in five colors.

CIRCLE NO. 354

evaluation samples

Ceramic capacitors

Mono-Kap, an extended line of miniature ceramic capacitors, comes in 50, 100 and 200 V dc units in six sizes (.100 × .100; .150 × .150; .200 × .200; .300 × .300; .400 × .400 and .500 × .500) and four dielectrics: COG (NPO), W5R, Z5U and General Purpose. With 100% monolithic construction, capacitance values of 4.7 pF to 10 μF are offered in this radial lead, epoxy coated ceramic capacitor. USCC/Centralab.

CIRCLE NO. 355

IC terminal strips

Problems of solder wicking and excess flux in assembly of PC board IC terminals are minimized with Soldercon terminals housed in a nylon "nest." Use of the Model 2460 Series 06-05 nest also protects terminal contact areas from accidental damage after assembly. Soldercon 1938-4 Series 05-30/35 terminals are available in specified pre-cut strips, or chain form, with a carrier strip for PC board assembly on 100-mil center spacing. They provide the advantage of plug-in packages for connecting integrated circuits. Molex Inc.

CIRCLE NO. 356

TO5/TO18 mounting pads

The TO518-007 transistor mounting pads are designed for use with both TO18 and TO5 transistors having 3 or 4 leads. When used with TO18 transistors, the pad spreads the leads to the TO5 configuration, thus simplifying the design of PC boards. Jermyn.

CIRCLE NO. 357

Cable ties

A line of no twist-no turn nylon harness ties has holding capacities up to 50 pounds. The line, named "Dektie," provides positive locking, the result of precision injection molding. Heads are free of burrs and blinds and locking strips have regular, consistent-depth serrations. Installation is said to be easily done by hand, or with tie tools widely used. Made of flexible, translucent nylon, the products conform to military requirements, MIL Spec MS 18034-1, -2 and MS17821-1. They are available in five bundle-size capacities, 3/4, 1-1/4, 1-3/4, 3 and 4 inches. Dek, Inc.

CIRCLE NO. 358

RFI attenuation filters

E Z Kleen Air Filters can be used for EMI/RFI attenuation in electronic equipment requiring ventilation. A recent series of shielding tests per MIL-STD 285, indicate the 1/2-inch E Z Kleen Filter, Type 71, had excellent EMI/RFI characteristics in the magnetic, electric and plane wave fields. The filters are made of slit and expanded aluminum to create a staggered baffle design. This staggered pattern sets up a controlled turbulence in the air passing through the filter. Air is bounced from baffle to baffle to increase the filtering surface area. Research Products Corp.

CIRCLE NO. 359

application notes

Phenolics

A 30-page brochure describes "S" grade phenolic compounds for in-line injection molding. The booklet discusses the properties and processing characteristics of four phenolic compounds specifically designed for injection molding. Two of these phenolics—general purpose EMRS-5440 and heat-resistant BMRS-5303—are two-step molding compounds. The other two materials—general-purpose BMRS-2798 and heat-resistant BMRS-2035 — are one-step molding compounds. Union Carbide Corporation, Long Island City, N.Y.

CIRCLE NO. 360

Hybrid voltage regulators

High-current voltage regulators that supply 5, 12, or 15 volts, with both crowbar-trigger load-protection and foldback self-protection, are described in a 12-page application note. "Application Considerations for Hybrid Series Voltage Regulators," AN-6026, discusses the design, construction, and use of the RCA-HC4000 family of power hybrid circuits. Any of these compact units can deliver a load current of up to 4 A, or can be used in conjunction with external booster transistors to supply as much as 100 A. RCA Solid State Div., Somerville, N.J.

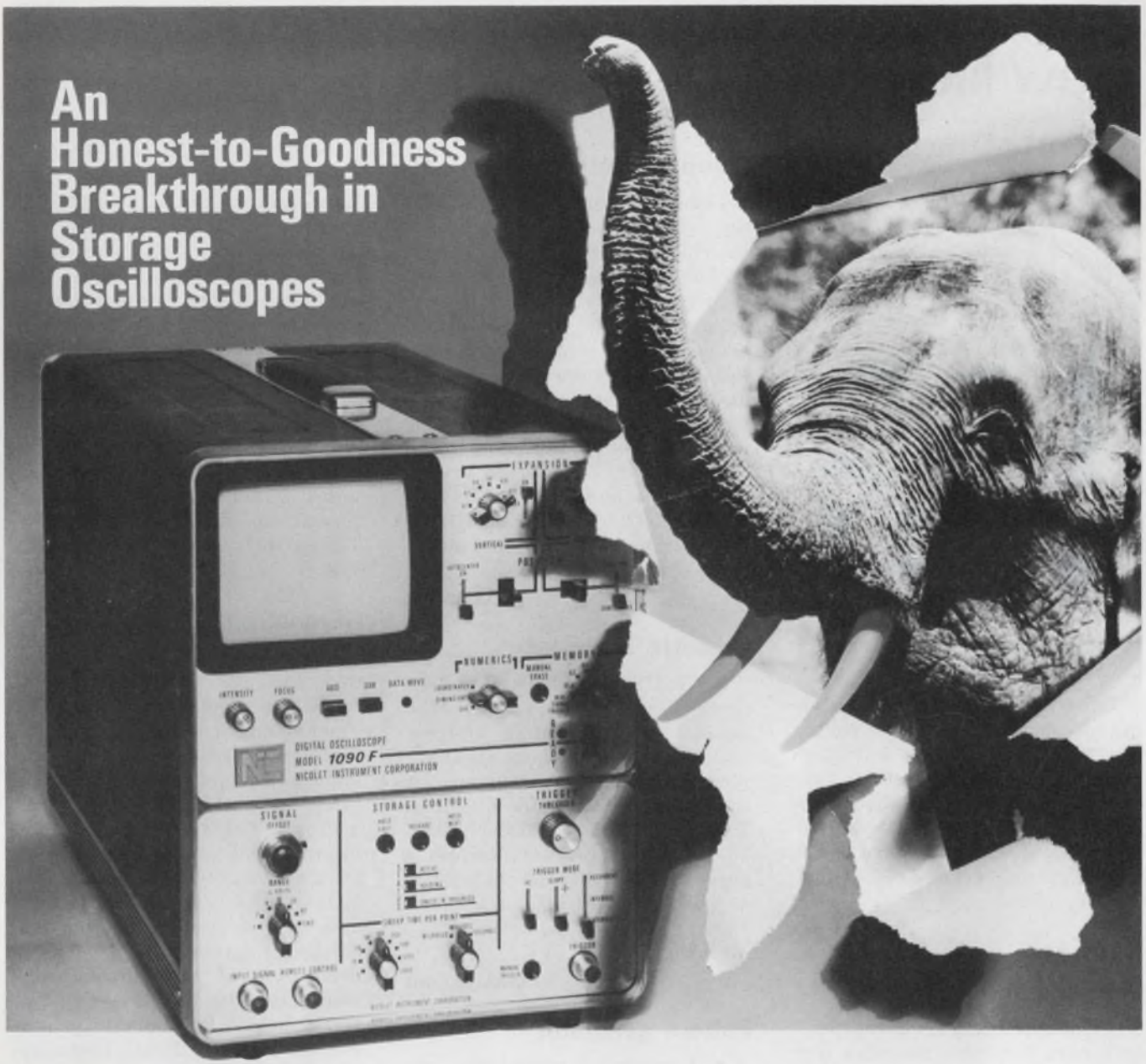
CIRCLE NO. 361

Microprogramming design

A ten-page booklet entitled "Design of Microprogrammable Systems" includes an introduction, a background discussion of the concept of microprogramming, advice on building a simple microprogrammed system, a description of practical microprogrammed implementations, Read-Only Storage addressing techniques, microinstruction word encoding, writeable control storage, and the advantages of microprogramming. Signetics Memory Systems, Sunnyvale, Calif.

CIRCLE NO. 362

An Honest-to-Goodness Breakthrough in Storage Oscilloscopes



The Nicolet 1090 digital storage oscilloscope looks like a storage oscilloscope, acts like a storage oscilloscope, and is operated like a storage oscilloscope — except —

- It has about 20 times the resolution in both time and voltage. It would require hundreds of storage tubes to capture as much information about a single waveform as is recorded in the 1090's memory.
- It is about a hundred times as accurate.
- It has far greater equivalent writing speed than most storage oscilloscopes.
- It is easier, by far, to operate.
- Its stored information doesn't fade away.
- It provides normalized numerical information about any point in the waveform.
- It has sweep speeds as slow as you wish, even days in length.
- It can be told to retain a waveform before, during, or after the signal occurrence, with local or remote control.
- It can provide accurate voltages for operating a pen recorder.

Other than these exceptions, it is like an ordinary storage oscilloscope. If you know how to operate an oscilloscope, you don't even need to look at an operator's manual to make the 1090 serve your needs. Bandwidth 100 KHz ($2x10^5$ samples/second). Resolution 4096x4096. Price, with model 90-1 single channel plug-in unit: $4500. (Pen recorder drive and binary output are extra cost options.)

NICOLET INSTRUMENT CORPORATION

5225 Verona Road, Madison, Wisconsin 53711
Phone 608/271-3333 TWX: 910-286-2713

Write for complete information or to arrange a demonstration.

INFORMATION RETRIEVAL NUMBER 109

new literature

CRT terminals

Ten CRT terminal models offering parallel, serial, serial polling and TTY replacement interfaces are described in an 8-page, full-color Data-Screen terminals brochure. Prices, specifications, options, features and details of modular design are included. TEC, Inc., Tucson, Ariz.

CIRCLE NO. 363

Computers

"Computer Systems Capabilities," an 8-page brochure, describes how the computer systems organization provides completely integrated systems tailored to the unique application problems of its csutomers. It also summarizes typical applications of such systems in the areas of communications, data gathering and processing, flight test and spacecraft telemetry, laboratory operation, industrial monitoring and control, simulation and business data processing. Xerox Corp., El Segundo, Calif.

CIRCLE NO. 364

Transistor amplifiers

Specifications and outline drawings are shown in a 4-page brochure describing transistor amplifiers. Aertech Industries, Sunnyvale, Calif.

CIRCLE NO. 365

Computer interfaces

Complete information on MACS, the universal computer-to-process interface, is described in a 30-page booklet aimed at the scientific and industrial computer user. The booklet describes the universal MACS chassis and its expansion capabilities. A configurator block diagram depicts the array of module combinations available for interfacing with both the on-line process and the computer. Data sheets are included in a pocket at the back of the booklet. Systems Engineering Laboratories, Inc., Fort Lauderdale, Fla.

CIRCLE NO. 366

Cassette systems

An eight-page illustrated brochure describes the Model 2020 cassette tape operating systems. Included in the brochure are interface and software descriptions for the Model 2020/PDP-8, Model 2020/PDP-11 and Model 2020/NOVA. The brochure provides a good over-all view of the system support provided with the Model 2020. Canberra Industries, Inc., Meriden, Conn.

CIRCLE NO. 367

Pattern generator

A brochure describes the test pattern generator (PG-303) and data analyzer (DMS-303). They are available either rack mounted or supplied with a lightweight rugged portable carrying case. Data Products, Woodland Hills, Calif.

CIRCLE NO. 368

Phase meters

A comprehensive catalog describes and illustrates a line of high-speed precision instruments and test systems for measuring impedance, phase angle, voltage and current, transfer function, and real and imaginary power. Complete custom systems incorporating many of the instruments are described in a systems capability section. Dranetz Engineering Laboratories, Inc., S. Plainfield, N.J.

CIRCLE NO. 369

TI semiconductors

A comprehensive 816-page hardback publication, Data Book CC-404, provides complete specifications on a broad line of power transistors, thyristors and power functions, and is priced at $3.95. In addition to product specifications, various sections of the book are devoted to terms and definitions, testing procedures, cross-reference guides, quality and reliability information and applications. Covered in the book is the Technical Response Lab which is a special facility for custom design and assembly of power devices. Power semiconductor technology is detailed including both silicon and germanium materials technology. Texas Instruments Inc., Dallas, Tex.

GE controls

The general purpose control two-color 304-page catalog (GEP-1260) contains a complete listing of over 10,000 control devices, including those that start, switch, sense and indicate. Detailed descriptions, features, applications, pricing information and ordering directions are included. The catalog also provides an easy to use alphabetical index and CR number index. Technical data such as electrical ratings and detailed diagrams give a complete illustration of each product line from miniature reed relays to control panels. GE, General Purpose Control Products Dept., Bloomington, Ill.

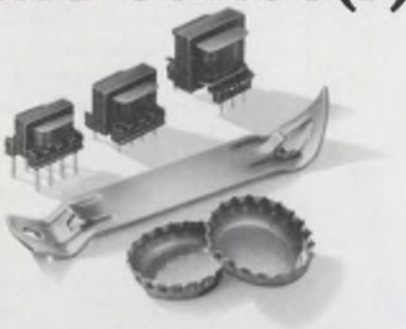
CIRCLE NO. 370

16-bit computer

"Hardware and Software Building Blocks for Real-Time Systems" highlights the many capabilities that make Systems 71 computers ideal for process monitoring, data acquisition, testing and control in real time. Details are provided on the CPU, core memory, input/output facilities, software and the totally modular computer-to-process interface. The family concept behind the 16-bit computer line is also described in terms of hardware and software compatibility between Systems 71 and its virtual-memory counterpart, Systems 72. Engineering Laboratories, Fort Lauderdale, Fla.

CIRCLE NO. 371

bounce to the ounce(r)



TRW/UTC Ouncers, Subouncers and Sub-subouncers can open up some refreshing solutions to PC board audio transformer problems. These units have been the quality standards for years. Now they're the cost-saving standards, too, available in plug-in versions, with leads compatible with wave soldering.

These plug-in units offer all the quality, reliability and utility of the famous UTC Ouncer line with insulated leads. Nothing has been compromised. This line couples highest performance and reliability with plug-in economy and the shortest delivery cycles. Write for catalog data. TRW/UTC Transformers, an Operation of TRW Electronic Components, 150 Varick Street, New York, N. Y. 10013. Tel: (212) 255-3500.

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INFORMATION RETRIEVAL NUMBER 110

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INFORMATION RETRIEVAL NUMBER 111

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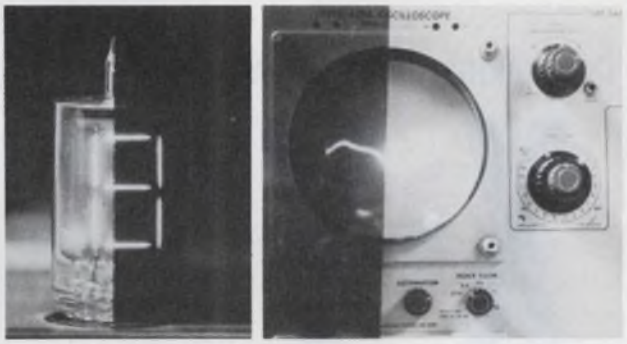

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14

INFORMATION RETRIEVAL NUMBER 112

NEW LITERATURE

X-Y, strip chart recorder

X-Y and one and two-pen strip chart recorders are fully described in a 16-page bulletin. The characteristics of signal handling, time base and point plotting modules are also described. The brochure includes specifications and prices. Bausch & Lamb, Houston Instrument Div., Bellaire, Tex.

CIRCLE NO. 372

Voltage comparators

Specifications for over 70 different models of a meter relay substitute—the Voltsensor, a solid state voltage comparator module—are described in a selection chart. The Voltsensor is available in single set point and dual set point models with options of controller action, time delay, latching, adjustable, hysteresis, reversed polarity, etc. Calex, Alamo, Calif.

CIRCLE NO. 373

Spectrum analyzer

The complete line of Fourier spectrum analyzers featuring a high-speed processing unit is described in a comprehensive data sheet, Elsytec, Inc., Syosset, N.Y.

CIRCLE NO. 374

ITT semiconductors

MOS arrays, ICs, transistors, rectifiers and diodes are detailed in a 24-page catalog. Electrical characteristics, special applications and a buying guide are included. ITT Semiconductors, W. Palm Beach, Fla.

CIRCLE NO. 375

Insulated terminals

Press-Fit teflon terminals and circuit hardware are described in a 48-page catalog. The new catalog provides detailed listings and technical information on the complete line of press-fit feed-thrus, stand-offs, plungers, jacks, probes, lamp holders and cloverleaf teflon terminals in miniature and microminiature sizes. In addition, the catalog provides information on automation and installation procedures, insertion tool information and MIL-T-55555 cross-reference. Sealectro Corp., Mamaroneck, N.Y.

CIRCLE NO. 376

Power cards

A six-page, two-color brochure describes lines of power cards and power supply modules. Features, specifications and prices are given for three series and 44 models of both single output and dual output power cards. Seven series and 120 models of modular power supplies are also discussed. Applications for the line of regulated dc power supplies are detailed. Specifications and prices are also given for a wide variety of accessories and options. Power Pac, Inc., Stamford, Conn.

CIRCLE NO. 377

Relays

A revised edition of the Distributor Stock Relay Catalog 100 has 32 pages filled with pertinent technical data, wiring diagrams and prices for more than 90 standard relays. The variety of contacts, arrangements, and coil voltages available allows the selection of a relay from a thousand choices. Potter & Brumfield, Princeton, Ind.

CIRCLE NO. 378

Hybrid tantalum capacitors

Hybrid tantalum capacitors, which the company says are the first to be offered in standardized ceramic sizes in capacitance values are described in a 4-page brochure. Physical standards, capacitance, ratings, application notes and assembly and mounting procedures are included. National Components Industries, Inc., W. Palm Beach, Fla.

CIRCLE NO. 379

Sockets and contactors

A line of sockets, contactors and carriers for solid state devices is described in a 24-page catalog. Quick selection charts offer visual and preliminary specification by sight, number of pins, method of mounting, material used and part number. Flat pack, DIP and TO type sockets are separated into two categories—test sockets and production sockets. Contactor and carrier charts are aligned to provide instant cross referencing. Amphenol Barnes Div., Lansdowne, Pa.

CIRCLE NO. 380

Avionics connectors

A new series of data sheets describes an expanded line of rack and panel connectors per MIL-C-81659A. Full physical and electrical characteristics are presented for rear-release connectors having 40 to 212 contact positions. Standard MS tooling is described as is a stripper-crimper machine that can produce up to 1200 completed leads per hour crimped per MIL-C-22520. AMP Inc., Harrisburg, Pa.

CIRCLE NO. 381

Voltage sensing relays

Low cost under/over voltage protection for electrical and electronic equipment with voltage sensing thermal relays is described in Product Bulletin PD 15-1. Sola Basic Industries, G-V Controls Div., Livingston, N.J.

CIRCLE NO. 382

Microwave components

An eight-page short form catalog lists a complete line of rf, i-f and microwave components and subsystems. The catalog contains performance specifications, prices and other features for each standard model in the family of quadrature (90°) hybrids (both lumped element and stripline configurations), hybrid junctions, power dividers, directional couplers, attenuators, phase shifters, mixers, phase comparators, terminations, subsystems and other products. Merrimac Research and Development, Inc., W. Caldwell, N.J.

CIRCLE NO. 383

bulletin board

Thirteen new beam-lead low-power **Schottky TTL/MSI** chips have been introduced by **Texas Instruments.** Power dissipation for these TTL/MSI chips is typically 50 mW each, except for the BL54LS-181 which requires 100 mW. Also available is a custom Random Logic Bar. Featuring 60-gate complexity, the Random Logic Bar, designated the RLB-60, can be used to implement low-power Schottky MSI functions or groups of random gates/flip-flops.

CIRCLE NO. 384

Motorola has added four **op amps** and three **voltage regulators** to its broad linear IC line. The seven new parts are pin-for-pin replacements for ICs presently manufactured by National Semiconductor Inc., or Fairchild Semiconductor. Examples are the MLM101AG, an op amp featuring an input bias current of 30 nA and an input offset voltage of 0.7 mV at room temperature. The MLM210G is a unity gain amp featuring a slew rate of 30 V/μs and an input bias current of 10 nA maximum. The MLM105G is an adjustable positive voltage regulator. From 4.5 to 40 V output may be obtained with load regulation of 0.02 mV at room temperature and rated load current. The MLM109K is a fixed 5 V, three-pin regulator which is capable of supplying over 1 A without an external transistor.

CIRCLE NO. 385

Price reductions

Fiberfil Division, Dart Industries Inc. has announced price reductions of 10 cents per pound for four grades of **Nylafil fiberglass reinforced type 612 nylon injection molding compound.** .The grades affected are G-4/35 and G-4/45, both long glass fiber material; J-4/35 and J-4/45, intermediate length fiber reinforced.

CIRCLE NO. 386

Prices on the **Litronix** line of **opto-isolators** have been cut by up to 40%. The IL-1, opto-isolator with a 20% minimum current transfer ratio, now sells for $2.95 vs $3.50 in 1,000 quantities. It is a second source for the MCT-2. The IL-12 has a 2% minimum current transfer ratio and now sells for $1.40. It is a second source for the TIL-112. The IL-16 has a 6% minimum current transfer ratio and was reduced from $2.75 to $1.50 in 1,000 quantities. It is a second source for the MCT-26.

CIRCLE NO. 387

Sixteen **TTL integrated circuits** which feature PNP inputs and outputs clamped by Schottky diodes have been designed by **Signetics Corp.** for use in high-speed, high-performance digital systems. Designated as **the 82S series,** the new TTL, MSI circuits employ full Schottky-barrier-diode clamping to achieve ultra-high speeds previously attainable only with emitter-coupled logic, yet they retain the desirable features of, and are completely compatible with, most of the popular saturated logic circuits. Typical propagation delay of 82S circuits is 3 ns per gate, and power dissipation is 20 mW per gate. Schottky-barrier-diode clamping prevents transistors from achieving classic saturation and thereby effectively eliminates excess charge storage and subsequent recovery times.

CIRCLE NO. 388

A price slash of 37-1/2% on the **Model AH-52 modular rf amplifier** has been announced by **Optimax Inc.** As a result of increased customer demand and improved production methods, the unit price has been cut from $120 to $75 in quantities of one to nine units. Orders in quantities above 250 will average less than $50 per unit.

CIRCLE NO. 389

vendors report

Annual and interim reports can provide much more than financial-position information. They often include the first public disclosure of new products, new techniques and new directions of our vendors and customers. Further, they often contain superb analyses of segments of industry that a company serves.

Selected companies with recent reports are listed here with their main electronic products or services. For a copy, circle the indicated number.

United Utilities, Inc. Electronic switching technologies, time-sharing computer services.

CIRCLE NO. 390

Data Recognition Corp. General-purpose-computer peripherals.

CIRCLE NO. 391

Raytheon. Data processing, data displays, microwave communications, avionics.

CIRCLE NO. 392

Cubic Corp. Avionics, computer-support equipment, data-processing and medical equipment.

CIRCLE NO. 393

Aydin Corp. Aerospace digital-data communications and display, microwave power supplies, transformers and magnetic components, PC boards and molded plastics.

CIRCLE NO. 394

Interdata. Computers, software and hardware.

CIRCLE NO. 395

UCC. Computers and peripherals, digital data transmission equipment.

CIRCLE NO. 396

Tracor, Inc. Components, instruments, sonar, communications, radar and navigation equipment.

CIRCLE NO. 397

P.R. Mallory & Co., Inc. Components, high-energy batteries, timing devices, metals and materials.

CIRCLE NO. 398

Design Data from Manufacturers

Advertisements of booklets, brochures, catalogs and data sheets. To order use Reader-Service Card.
(Advertisement)

Get Frequency Signatures When There's No Reference

To obtain frequency signatures where there's no tachometer output or other sampling reference signal, such as when analyzing aircraft or moving vehicles, new Option 24X normalizes the spectrum produced by a Ubiquitous® Real-Time Spectrum Analyzer. The 24X derives a sampling reference for the analyzer directly **from the signal itself.** The reference may even be corrupted by noise. Once the 24X is tuned to a single prominent frequency component in the signal, it locks onto it and tracks its frequency, producing a clean output signal. (Option 24AX may be added to the 24X to multiply its output to display higher orders of the device being analyzed).

Federal Scientific Corporation CIRCLE NO. 171
subsidiary of Elgin National Industries Inc.
615 West 131st St., New York, N.Y. 10027

1972 Electronic Components Drafting Aids Catalog

Free Catalog! Free Samples! Exciting innovations in pressure-sensitive electronic component drafting aids and methods are detailed in the new 1972 edition of the combined Bishop Technical Manual and Catalog 105.
84 illustrated pages of over 15,000 multi-pad configurations, symbols, tapes, sequential reference designations plus hundreds of time-and-money saving hints in making artwork for PC boards. Includes instructions for using the industry's only red and blue tape system for making two-sided boards in perfect registration.
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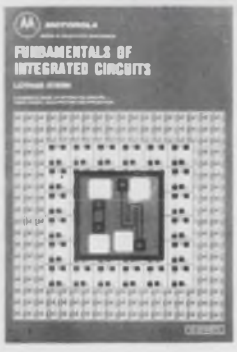

A practical guide to integrated circuits, their theory, manufacture, and applications. This new guide by Lothar Stern offers compete, highly readable coverage of the various techniques of circuit fabrication, and their effect on circuit design and performance. As to marketing considerations, it compares the characteristics of the numerous IC structures devised to date in terms of economics and logistics. A volume in the **Motorola Series in Solid-State Electronics.** 198 pages, 7 x 10, illustrated. $8.95, clothbound. Circle the reader-service number below for 15-day examination copies.

Hayden Book Company, Inc. CIRCLE NO. 173
116 West 14th Street
New York, N.Y. 10011

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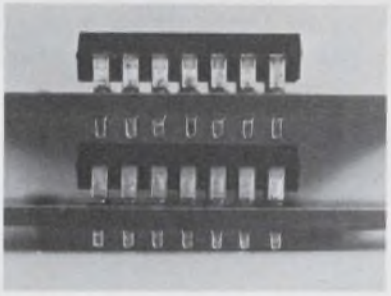

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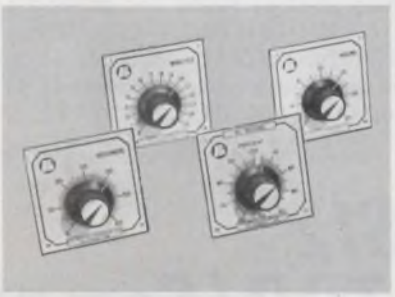

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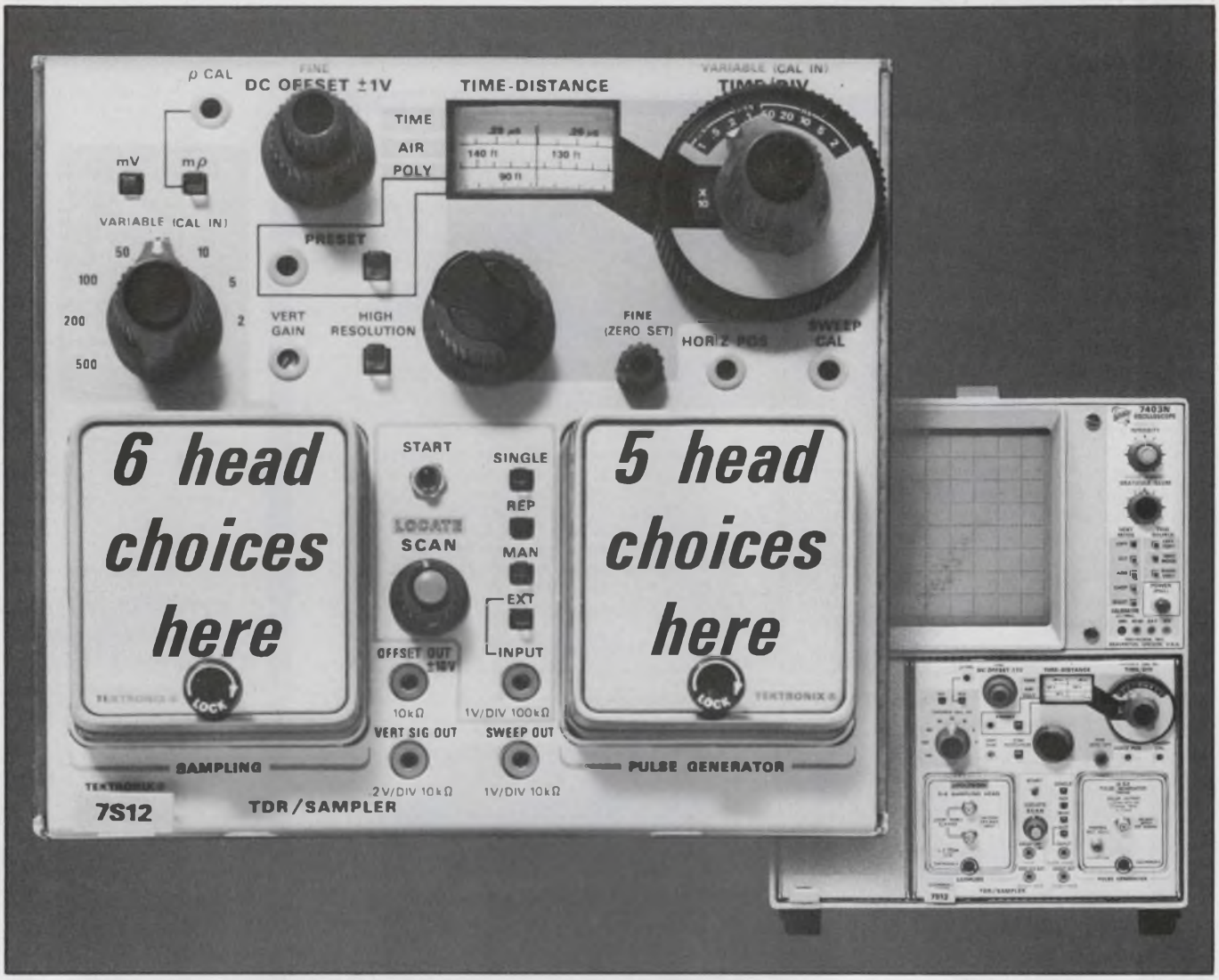

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LVA-EE-12-OV	12± 5%	34	415
LVA-EE-15-OV	15± 5%	28	415
LVA-G-5-OV	5± 5%	130	750
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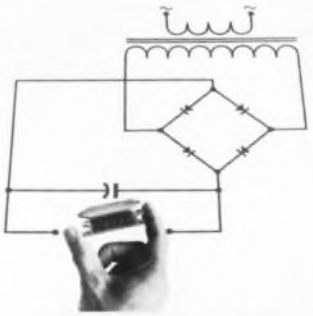

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