VOL. 23 NO.

Electronic Design® 17

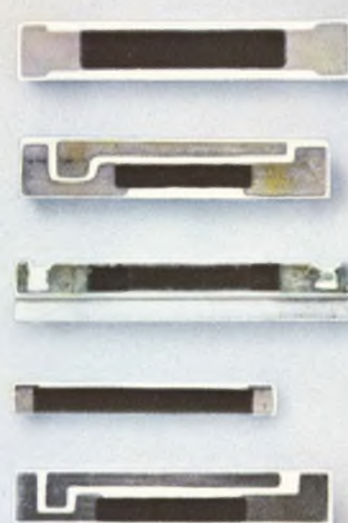
FOR ENGINEERS AND ENGINEERING MANAGERS

AUG. 16, 1975

Pot and trimmer specs: Don't let them point you the wrong way. The wide variety of potentiometer and trimmer types can make you go in circles. Are you sure you know what vendors mean when they specify tempco, linearity or noise? And don't forget specs like rotational life and backlash. For some bearings, see p. 52.

Don't cheat yourself on trimmer performance.

Compare element size and see why Dale gives you better value!



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INFORMATION RETRIEVAL NUMBER 252

Our complete product line can be found in Electronic Design's GOLD BOOK.

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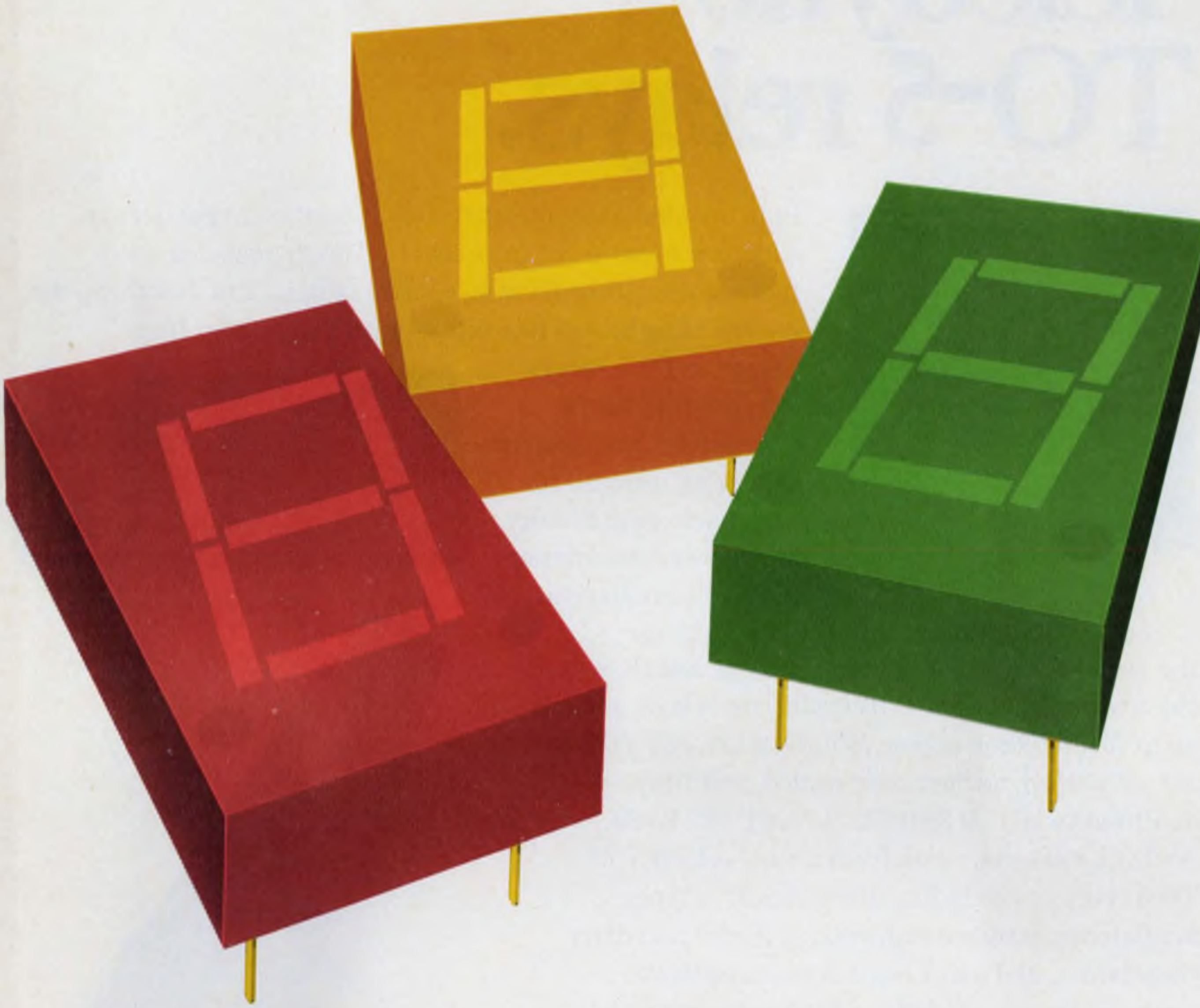

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VOL. 23 NO.

Electronic Design 17

FOR ENGINEERS AND ENGINEERING MANAGERS

AUG. 16, 1975

NEWS

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Across the Desk

User offers tips on scope cameras

"Focus on Scopes and Scope Cameras" (ED 8, April 12, 1975, p. 48) was well done. Your readers should be made aware of three additional facts about scope cameras that use Polaroid film:

1. The hand-held scope camera —for example. Polaroid CR-9—is usually a very satisfactory low-cost camera, but it has a major shortcoming that does not become apparent until after the purchase: It isn't easy to use for multiple-exposure photographs. Such photographs superimpose waveforms from two or more different test conditions on the same photograph for easy comparison of results—such as with and without some circuit feature, or with setting A and setting B of some system variable. When the hand-held camera is held against the scope face for the second exposure, it can't be positioned exactly as it was the first time. Result: two sets of graticule lines that are not quite superimposed. If the graticule is exposed only on the last photo, there may be only one graticule, but the multiple traces aren't all aligned the same with respect to the graticule. The more expensive bolt-on cameras don't have that problem.

2. The article stated that a disadvantage of Polaroid film is that it is difficult to write on the prints. It's very easy to write on the black background with the heated fine tip of a small soldering iron, either before the liquid coating material has been applied or after it has been applied and has hardened. The result is legible, white writing on the black background. Alternatively, a sharp-pointed tool, such as a metal scribe, can easily scratch white writing on the black background before the print is coated. Or thirdly, a ballpoint pen can be used to write in the white border before or after the print is coated or on the back, but the coating liquid shouldn't be applied on top of the writing because it smears the ballpoint ink.

3. The article said that Polaroid prints don't reproduce well on office copiers. Polaroid film type 55PN (ASA 50) and type 105PN (ASA 75) yield transparent negatives that reproduce well on office copiers. The penalty paid for the reproducibility of these films is their low film speeds relative to the 3000 speed of type 107, but that's quite acceptable for most scope photography work. Polaroid's print copy service (coupon packed with film) has always given me excellent copies within one day of the expected two-way mail delivery time. The cost is 15 cents each for 2-1/2 × 3-1/4 copies and 20 cents for 3-1/4 × 4-1/4 copies, plus a 75-cent handling charge.

Nathan O. Sokal
President

Design Automation, Inc.
809 Massachusetts Ave.
Lexington, MA 02173.

A simpler way noted to tape-record EEGs

The EEG (electroencephalograph) unit described in the June 7 issue represents a significant advance in low-power, high-density digital storage of analog data ("EEG Unit Worn by Patient Records Data for 12 Hours at 7000 BPI," ED No. 12, p. 30). As point-

(continued on pg. 10)

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.

INFORMATION RETRIEVAL NUMBER 6

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more effective in today's difficult market
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circuit designs.

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other good things like clean neat units . . .
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increase in cost.
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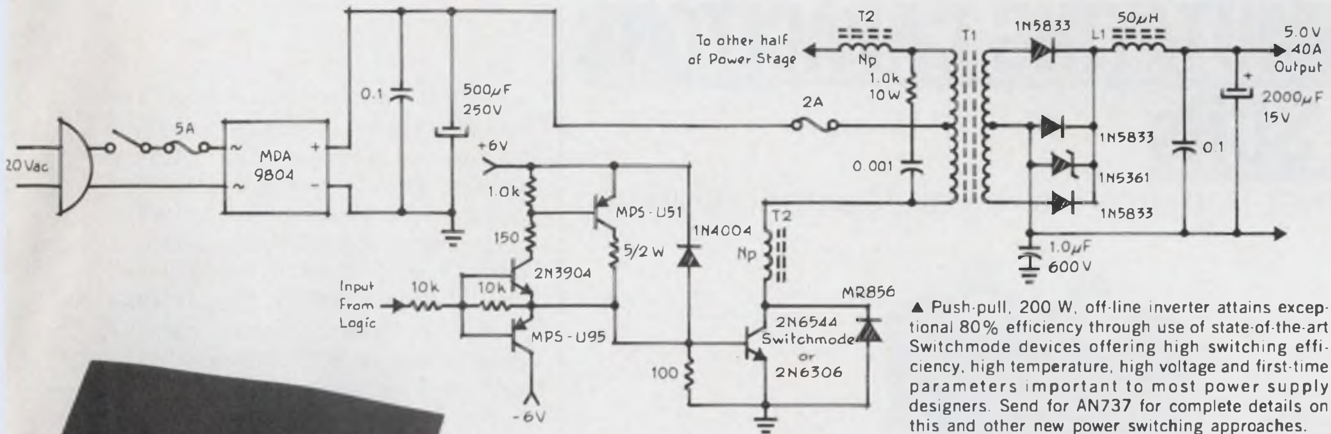
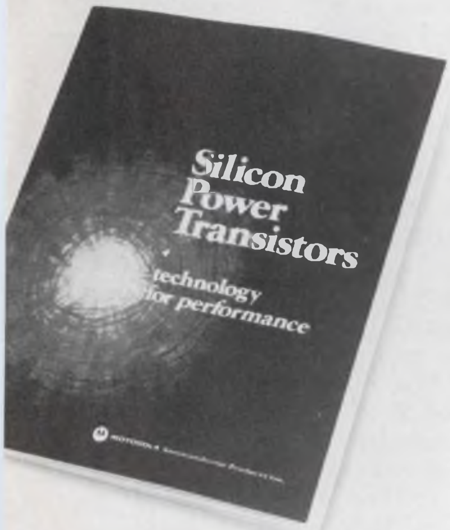
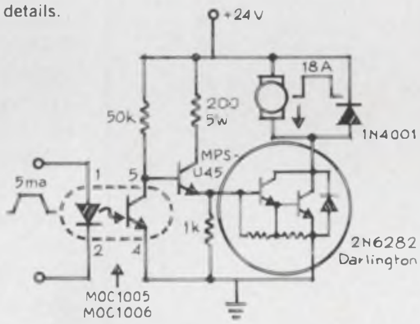


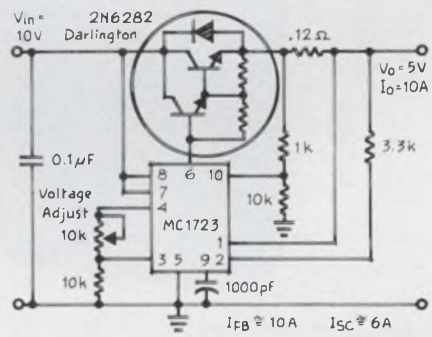
▲ Push-pull, 200 W, off-line inverter attains exceptional 80% efficiency through use of state-of-the-art Switchmode devices offering high switching efficiency, high temperature, high voltage and first-time parameters important to most power supply designers. Send for AN737 for complete details on this and other new power switching approaches.



▼ Only one additional transistor is needed to drive an 18 A load from the opto coupler in this 24 V isolated dc motor controller using a 2N6282 power Darlington for high gain, high current, low sat performance. With modification, the circuit can be easily adapted for hammer driver use. Send for AN712A for more details.



▼ Use of one high gain power Darlington permits just one single external pass element, lowers output impedance and cuts space in the 5 V, 10 A regulator. The Darlington's low sat voltage allows lower input-output voltage differential and less power dissipation.



The device	The price: Ours 250-Up	The price: Others† lowest published price
2N3055	1.00	1.05
2N3439S	95	1.10
2N3440S	.79	.79
2N3442	2.00	2.65
2N3740	1.05	1.20
2N3741	1.20	1.40
2N3773	3.05	3.60
2N4913	1.15	1.20
2N4914	1.25	1.30
2N4915	1.35	1.40
2N5301	3.00	3.20
2N5302	3.50	3.50
2N5303	4.25	4.50
2N5683	13.00	14.00
2N5684	15.00	17.00
2N5685	9.40	11.00
2N5686	11.65	14.00
2N5838	1.70	1.98
2N5839	1.85	2.10
2N5840	2.00	2.34
2N5875	1.21	1.75
2N5876	1.57	2.07
2N5877	95	1.25

The device	The price: Ours 250-Up	The price: Others† lowest published price
2N5878	1.29	1.55
2N5879	2.01	2.60
2N5880	2.54	3.00
2N5881	1.90	2.15
2N5882	2.15	2.40
2N5883	2.95	3.05
2N5884	3.25	3.45
2N5885	2.80	2.90
2N5886	3.25	3.30
2N6055	1.40	1.60
2N6056	1.55	1.81
2N6306	3.12	3.25
2N6307	3.52	3.67
2N6308	4.56	4.70
MJE29	41	.45
MJE29A	.45	48
MJE29B	.52	.53
MJE29C	.60	.60
MJE30	.46	.50
MJE30A	.49	.53
MJE30B	54	.58
MJE30C	64	.65
MJE31	.47	.52

The device	The price: Ours 250-Up	The price: Others† lowest published price
MJE31A	.51	.55
MJE31B	59	.60
MJE31C	.72	.67
MJE32	.52	.57
MJE32A	.55	.60
MJE32B	.61	.65
MJE32C	.71	.72
MJE33	.70	.71
MJE33A	.75	.77
MJE33B	.81	.83
MJE33C	.93	.94
MJE34	.80	.80
MJE34A	.84	.86
MJE34B	.90	.92
MJE34C	1.02	1.03
MJE41	.64	.65
MJE41A	.69	.71
MJE41B	.75	.77
MJE41C	.86	.88
MJE42	.73	.74
MJE42A	.78	.80
MJE42B	.84	.86
MJE42C	.96	.97

†Based on lowest known competitive price shown in published price list at date of publication.

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INFORMATION RETRIEVAL NUMBER 7

ACROSS THE DESK

(continued from pg. 7)

ed out in the article, however, the use of a digital recording technique to achieve such a high packing density greatly increases the cost and manufacturing difficulty of the recording system. Because absolute amplitude accuracy is not required for diagnostic EEGs (better than ±10% suffices), greater packing density can be achieved with ordinary ac bias recording.

We have developed a 24-hour, four-channel EEG cassette recording system that consists of "active electrodes" affixed to the scalp and a miniature tape recorder worn on the belt. The active electrode housings (0.68 in. diam and 0.25 in. thick) contain integrated-circuit differential preamplifiers, and they are so small that they are attached to the scalp like ordinary electrodes. The miniature tape recorder is 4-1/2 × 3-3/8 × 1-1/2 in. and weighs less than a pound with batteries included inside.

This EEG recording system, produced by Research Instrumentation Associates Inc. of Cleveland, has been commercially available for 1-1/2 years.

Richard C. Burgess
Howard P. Apple, Ph.D.
Patient Monitoring Laboratory
Case Western Reserve University
School of Medicine
2065 Adelbert Rd.
Cleveland, OH 44106

Wrong picture, right facts

In the New Product item "Voltage Sensing LED has 2.5 V Threshold," (ED No. 13, June 21, 1975 on p. 116), a Data Display photo inadvertently accompanied the Hewlett-Packard product announcement. For those readers desiring more information from HP,

CIRCLE NO. 319

Who? Me an editor?

Who knows? You could be our next star on the West Coast. We're looking for an engineer in the San Francisco Bay Area who has

(continued on pg. 14)

International Rectifier.

New 10 Amp device makes one-stop shopping easy for fast-switching power transistors.

Now, IR is your source for a wide variety of 3, 5 and 10 Amp JEDEC fast-switching power transistors, to simplify your buying. These hard-glass passivated devices are the ones to use for better reliability and lower costs in line operated power supplies, whether you're chopping line voltages at 20 KHz or inverting and stepping down at high frequency.

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New International Rectifier Fast Switching Power Transistors

IR Part No	$V_{CEO(sus)}$ (Max V)	I_C Peak (A)	h_{FE} (min/max)	@ I_C(A)	V_{CE} (sat) (Max V)	@ I_C(A)	P_d (W)	t_r/t_f (µs)
2N6306	250	16	15/75	3.0	0.8	3.0	125	.6/.4
2N6307	300	16	15/75	3.0	1.0	3.0	125	.6/.4
2N6308	350	16	12/60	3.0	1.5	3.0	125	.6/.4
2N6542	300	10	7/35	3.0	1.0	3.0	100	.7/.8
2N6543	400	10	7/35	3.0	1.0	3.0	100	.7/.8
2N6544	300	16	7/35	5.0	1.5	5.0	125	1/1
2N6545	400	16	7/35	5.0	1.5	5.0	125	1/1
2N6249	200	30	10/50	10.0	1.5	10.0	175	2/1
2N6250	275	30	8/50	10.0	1.5	10.0	175	2/1
2N6251	350	30	6/50	10.0	1.5	10.0	175	2/1

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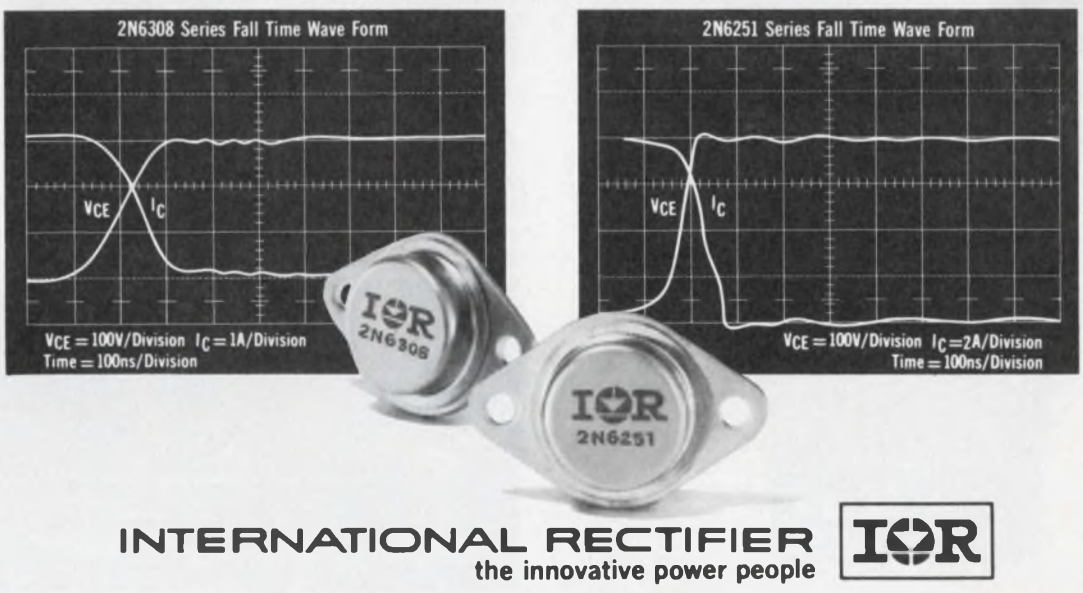

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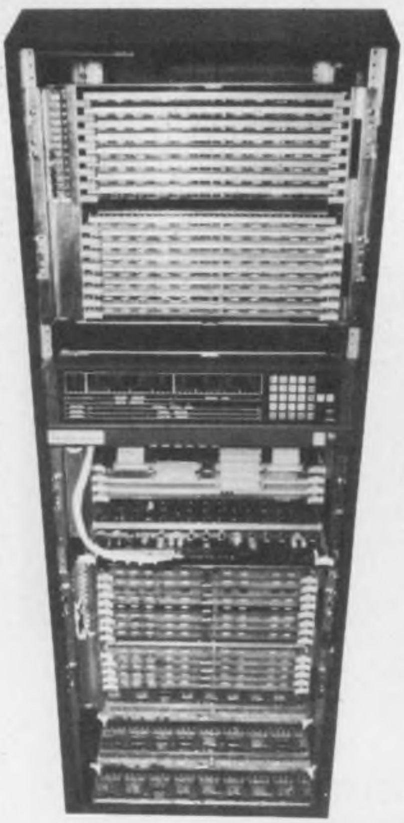

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MEGAMINI SOFTWARE: POWERFUL, FLEXIBLE, EASY-TO-USE.

Today's hardware must be designed to ease your software effort. You shouldn't have to spend a lot of expensive programming time trying to figure out how to get around minicomputer hardware limitations. With the 8/32 Megamini you don't – because there are none.

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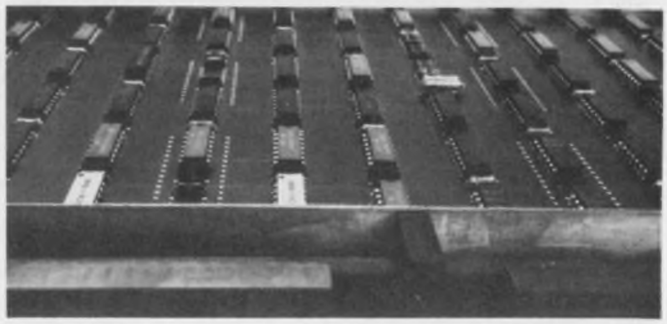

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INSTRUCTION TIMES (Register to Memory)					
Integer Add	1.25	1.8	.9	1.8	2.5
Multiply	3.54	6.2	2.0	3.9	8.8
Divide	5.8	14.4	9.9	8.3	11.2
Floating Point Add	2.3	6.1	2.4	8.25	5.5
Multiply	3.0	9.1	2.3	11.25	7.2
Divide	5.35	23.3	8.9	12.25	7.9
HARDWARE I/O	Yes	Yes	Yes	No	No
MAX. DMA RATE/SECOND	6MB	4MB	6.7MB	4MB	2MB
DIRECT ADDRESSING RANGE	1MB	1MB	16MB	64KB	64KB
GENERAL PURPOSE REGISTERS	2 stacks 16 each*	4 stacks 16 each	1 stack 16 each	2 stacks 8 each	1 stack 4 each
PRICING (Basic Configuration)					
CPU + 128KB Memory	$51,900	$128,700	N/A	$54,600	$32,500
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☐ You may have hit on the solution to my megaproblem. Have a representative call me.

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INFORMATION RETRIEVAL NUMBER 10

ACROSS THE DESK
(continued from pg. 10)

a good knowledge of semiconductors and test equipment from the user's point of view. This person should enjoy interviewing industry authorities, asking sharp questions, and writing clear and simple English prose.

If you think that's you, call or write David Kaye, who is listed next to where you might appear on page 6.

Coil inductance—it's a running argument

It was interesting to read the comments that came Across the Desk on coil inductance. We have been winding coils since radio became commercial in the 20's and, it seems, have solved the same problem every year. What is a tightly wound coil to one person is not necessarily tightly wound to another, and though wire standards are precise and exact, they are not without tolerance.

Therefore, unless the coil is wound at specific turns per inch—which allows room for a maximum sized wire and a maximum serving of insulation—the argument is going to continue. Even with these precautions, you will continually have the change in nominal diameter, which can be changed, of course, for every batch of wire. wire.

Alfred Sfreddo

General Instrument Corp.
F. W. Sickles Div.
165 Front St.
Chicopee, MA 01014

Yes. It happened.

We ran an incorrect caption in our Misplaced Caption Dept. (ED No. 15, July 19, 1975, p. 10). Those lovely ladies in the painting were not having lunch on the grass and the artist was not Edouard Manet. That picture appeared in ED No. 11, May 24, 1975, p. 16. The painting that appeared in ED No. 15 is Jean Francois Millet's "The Gleaners," which hangs at the Louvre in Paris.

Misplaced Caption Dept.

"And for designing the first . . ."

Sorry. That's Sandro Botticelli's "Portrait of a Man with a Medal," which hangs in the Uffizi Gallery in Florence.

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Bourns has the broadest line of trimming potentiometers in the industry. We produce just about any type, shape, size, style you're likely to need. We make them more readily available via a large factory inventory . . . and 92 stocking distributors.

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Trimming potentiometers are the *most* cost-effective method of adjusting, regulating and controlling circuits . . . and they will remain so for the foreseeable future. Bourns is the *most* capable, straightforward and reliable supplier of trimming potentiometers. Depend on Bourns.

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INFORMATION RETRIEVAL NUMBER 13

It's a systems workhorse

The Fluke 5½ digit 8400A systems DVM

Perhaps you've only known the 8400A as the ultimate bench DVM. It has a basic accuracy of 0.002% over five ranges of DC from 1 μV to 1100 V.

But did you know that it's also the ultimate systems DVM as well?

The 8400A has field installable data output and remote control systems interface options. The 34 bit, buffered, isolated data output option can be easily configured for 4, 8, 12 or 16 bit character serial operation, and is separately addressable in multi-voltmeter installations.

Inverted logic levels or codes other than 8-4-2-1 can be user configured.

Systems settling timeouts are also provided in the data output option. The isolated remote control option features stored and continuous modes with appropriate inhibit functions.*

Other options (all field installable) include: ■ 4 ranges of AC volts. ■ True RMS AC from 10 μV to 1100 V. ■ 7 ranges of resistance with 4 terminal capability. ■ DC ratio. ■ AC ratio.

Here's what you get for $1895 (US price only). Patented Recirculating Remainder A/D conversion system, five ranges DC volts, 1500 V peak overload protection, 0.001% resolution, switched filter for AC and DC measurements with better than 65 dB noise rejection at 60 Hz.

Finally, there are the toughest published DVM specs around, including 10,000 hour MTBF. And the Fluke name is second to none.

**For more system interface information, dial our toll-free hotline and ask for applications bulletin #11.*

For data out today, dial our toll-free hotline: 800-426-0361

FLUKE®

John Fluke Mfg. Co., Inc., P. O. Box 43210, Mountlake Terrace, WA 98043
For a demo circle #281 . For literature only circle #282
For information on the rest of the Fluke line, see EEM or the Gold Book.

COOL POWER FROM SEMTECH

SEMTECH NEWS

SILICON RECTIFIERS & ASSEMBLIES

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

More Super-Fast Silicon Rectifiers

Featuring 30 nanoseconds Reverse Recovery Time

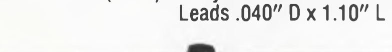
A breakthrough in junction technology makes Super-Fast silicon rectifiers possible. These new high speed silicon rectifiers feature low forward voltage drop at higher operating currents and reverse recovery time better than 30 nanoseconds. In addition, these devices have extremely low reverse leakage and high surge ratings. Super-Fast rectifiers use Semtech's proven Metoxilite non-cavity monolithic high temperature construction. Designed for high frequency applications, such as high speed switching regulators and converter circuits. Semtech's Super-Fast silicon rectifiers are stocked for immediate delivery.

LO-V_F Metoxilite

Available as JAN, JAN TX & JAN TXV to MIL-S-19500/503 (EL)

Types: 1N6073, 74 & 75 *(Trr 30ns)*
PIV: 50, 100 &150V
Reverse Current (Max.): 1μA DC @ 25°C
Instantaneous Forward Voltage @ 1.5A:
1.0V @ 100°C
Capacitance @ 12V DC (Max.): 24 pF
Single Cycle Surge Current: 35A
Dimensions (Max.): Body .070" D x .165" L
Leads .031" D x 1.25" L

Types: 1N6076, 77 & 78 *(Trr 30ns)*
PIV: 50, 100 & 150V
Reverse Current (Max.): 5μA DC @ 25°C
Instantaneous Forward Voltage @ 3.0A:
1.0V @ 100°C
Capacitance @ 12V DC (Max.): 58 pF
Single Cycle Surge Current: 75A
Dimensions (Max.): Body .110" D x .165" L
Leads .040" D x 1.10" L



Types: 1N6079, 80 & 81 *(Trr 30ns)*
PIV: 50, 100 & 150V
Reverse Current (Max.): @ 25°C 10μA DC
Instantaneous Forward Voltage @ 5.0A:
.8V @ 100°C
Capacitance @ 12V DC (Max.): 230 pF
Single Cycle Surge Current: 175A
Dimensions (Max.): Body .165" D x .165" L
Leads .040" D x 1.10" L

"State-of-the-art"

Types: FF30, FF40 & FF50 *(Trr 30ns)*
PIV: 300, 400 & 500V
Reverse Current (Max.): 1μA @ 25°C
Instantaneous Forward Voltage @ .5A:
1.5V @ 25°C
Capacitance @ 12V DC (Max.): 15 pfd
Single Cycle Surge Current: 10A
Dimensions (Max.): Body .070" D x .165" L
Leads .031" D x 1.25" L

Types: 3FF30, 3FF40 & 3FF50 *(Trr 30ns)*
PIV: 300, 400 & 500V
Reverse Current (Max.): 5μA @ 25°C
Instantaneous Forward Voltage @ 1A:
1.5V @ 25°C
Capacitance @ 12V DC: 20 pF
Single Cycle Surge Current: 25A
Dimensions (Max.): Body .154" D x .165" L
Leads .040" D x 1.10" L

LO-V_F DO-4 Stud

Types: SFF05, 10 & 15 and *2SFF05, 10 & 15 *(Trr 30ns)*

PIV: 50, 100 & 150V
Reverse Current (Max.) IR:
10 & *20μA DC @ 25°C
Instantaneous Forward Voltage:
VF @ 10A DC: 1.1V @ 25°C
*VF @ 20A DC: 1.2V @ 25°C
Single Cycle Surge Current: 125 & *250A
Dimensions (Max.): Body .424" D x .405" H

DO-4 Doublers & Center Taps

Types: SDFF05, 10 & 15; SNFF05, 10 & 15, & SPFF05, 10 & 15
(Trr 30ns)

PIV: 50, 100 & 150V
Reverse Current (Max.): IR @ PIV:
10μA DC @ 25°C
Instantaneous Forward Voltage VF @ 10A:
1.1V @ 25°C
Single Cycle Surge Current: 125A
Dimensions (Max.): Body .424" D x .405" H

LOV$_F$ DO-5L Stud

Types: STFF05, 10 & 15 *(Trr 40ns)*
Add "R" to type number for reverse polarity

PIV: 50, 100 & 150V
IR (Max.) @ PIV:
@ 25°C 0.1mA &
@ 100°C 3mA
VF (Max.) 10A:
@ 25°C .84V; @ 100°C .70V; @ 150°C .63V
VF (Max.) 30A:
@ 25°C .96V; @ 100°C .85V; @ 150°C .78V
VF (Max.) 50A:
@ 25°C 1.05V; @100°C .93V; @ 150°C .90V
Dimensions (Max.): Body .64" D x .50" H
Stud ¼ 28 UNF x .43" L

NEW

LO-VF DO-5DL Isolated Stud

Types: STFF05DL, 10DL & 15 DL
(Trr 30ns)
PIV: 50, 100 & 150V
Reverse Current (Max.): IR 20μA @ 25°C
Instantaneous Forward Voltage @ 10A:
1.2V @ 25°C
Single Cycle Surge Current: 250A
Dimensions (Max.): Body .64" D x .50" H
Stud ¼ 28 UNF x .43" L

★★★★

1975 NATIONAL SBA SUBCONTRACTOR OF THE YEAR

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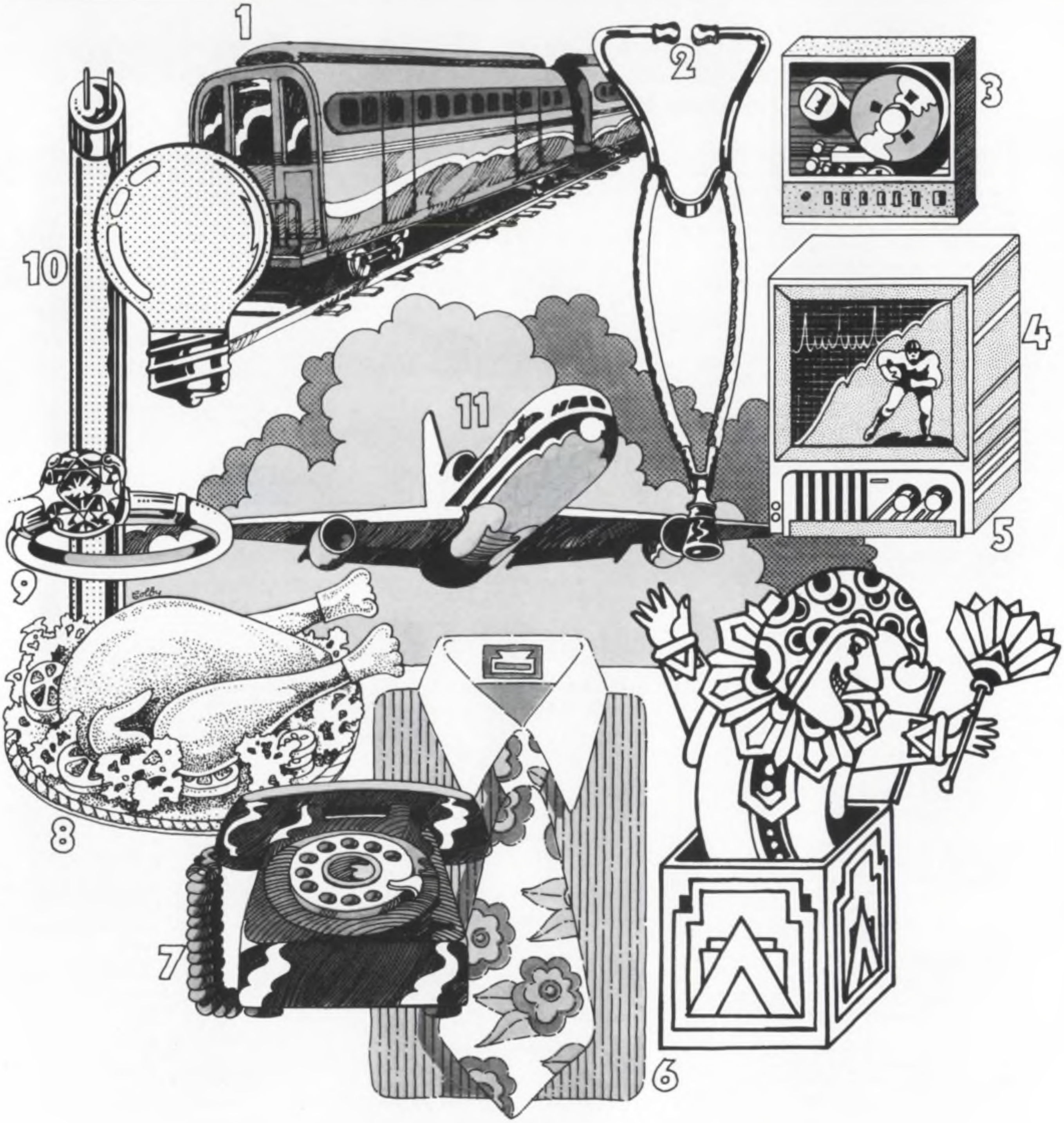
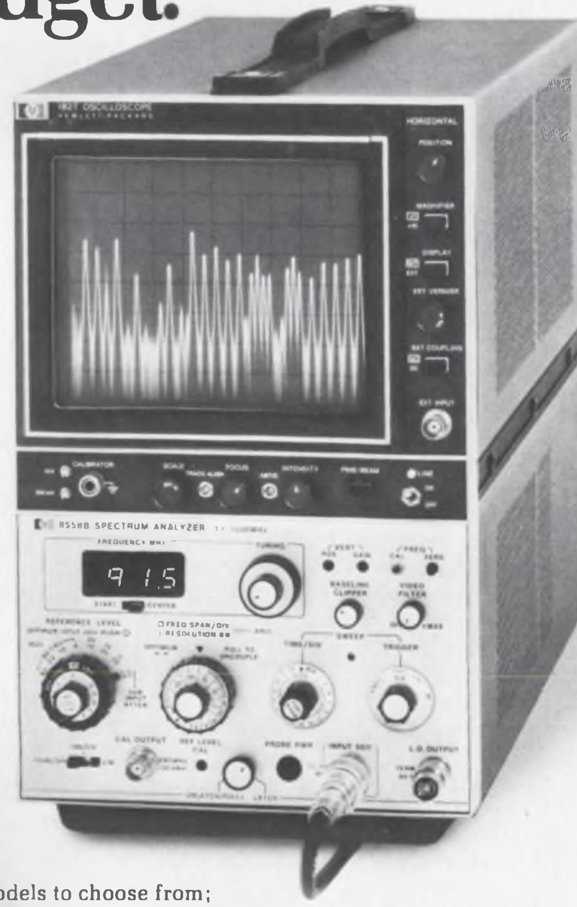
INFORMATION RETRIEVAL NUMBER 131

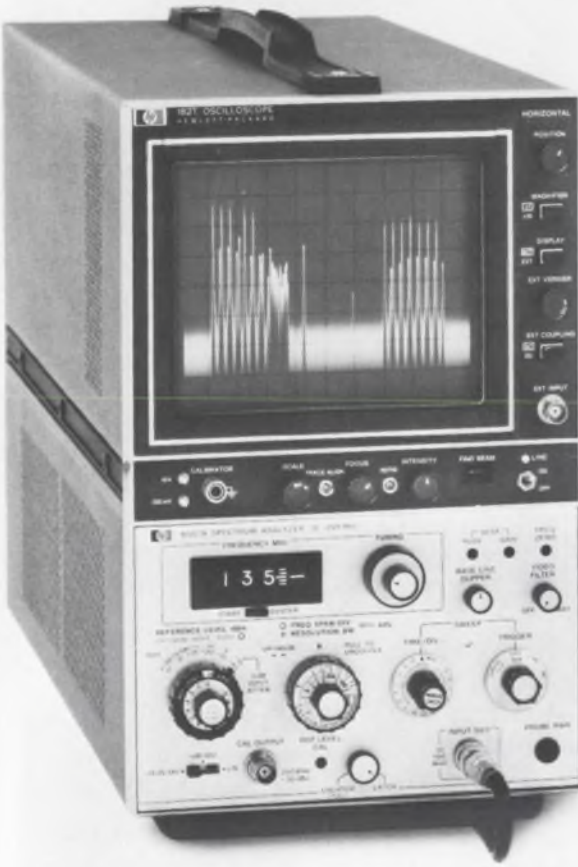
There's nothing
semiconductor ex



Two for your budget.

Affordable spectrum analyzers that typically will make over 90% of your everyday frequency domain measurements. Easily. Accurately.





Two models to choose from;
they're plug-ins for HP's versatile 180 Series Scopes.

Performance:	HP 8557A	HP 8558B
Frequency Range	10 kHz — 350 MHz	100 kHz — 1500 MHz
Amplitude Range	−117 dBm — +20 dBm	−115 dBm — +30 dBm
Frequency Response	±0.75 dB	±1.0 dB
Distortion-free Dynamic Range	>70 dB	>70 dB
Frequency Span Range	50 kHz — 350 MHz	50 kHz — 1000 MHz
Resolution Bandwidths	1 kHz — 3 MHz	1 kHz — 3 MHz
Price (Plug-in)	$3450	$4300

(HP 182T Large Screen Display Unit, $ 1400.) Domestic USA prices.

Ease of use is another important feature of these HP Spectrum Analyzers. For most measurements you use just three controls:

1. Tune to the signal. Frequency is displayed on a digital readout.
2. Set the Frequency Span. View a wide spectrum then zoom in on your signal — *resolution, sweep time, video filtering are all set automatically* for optimum signal presentation.
3. Measure Amplitude Level. Read it directly from Reference Level control and CRT.

To help minimize chances for erroneous measurements, panel markings show optimum signal levels, and there's out-of-range blanking or limiting.

Economical for use on every bench, these analyzers provide the performance for over 90% of your everyday applications. This means they can relieve the need to use the more expensive high-resolution analyzer for routine measurement, with equivalent amplitude and frequency accuracy.

Want more information? Just call your nearest HP field office, or write.

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INFORMATION RETRIEVAL NUMBER 133

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Rack and Panel by Elco

Featuring the NEW LOW INSERTION FORCE VARICON* contact.

We've got three facts to tell you and 20 seconds of your time to tell it. We'll make it short and sweet.

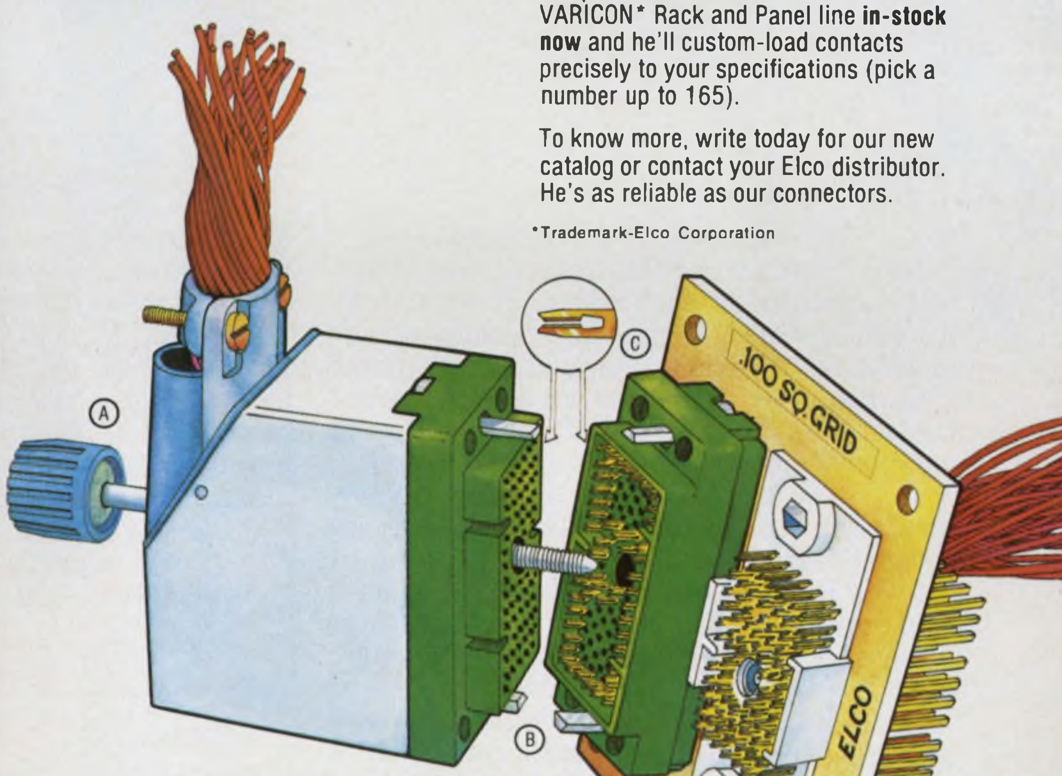
FACT #1. To meet market needs, Elco Corporation announces the in-stock availability of the new LOW INSERTION FORCE VARICON* contact in a complete line of Rack and Panel Connectors.

FACT #2. This new generation represents an improvement; accomplished with no degradation to the unique hermaphroditic VARICON design.

FACT #3. Your Elco distributor has the complete LOW INSERTION FORCE VARICON* Rack and Panel line **in-stock now** and he'll custom-load contacts precisely to your specifications (pick a number up to 165).

To know more, write today for our new catalog or contact your Elco distributor. He's as reliable as our connectors.

*Trademark-Elco Corporation



A) Single Actuating Jackscrew
B) 36 Plus Polarizing Variations
C) New Low Insertion Force Varicon* Contacts

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INFORMATION RETRIEVAL NUMBER 15

News Scope

AUGUST 16, 1975

$15 microprocessor coming for simpler applications

For the designer who doesn't really need the performance of a general-purpose microprocessor, a specialized unit will be announced next month for $15 in quantity lots.

Built by National Semiconductor, the unit, called Scamp (simple cost-effective applications microprocessor), will be good for simple control and timing functions usually taken care of by random logic, says Philip Roybal, the company's marketing manager for microprocessors.

Scamp is expected to find application in appliance controls, small building security monitors, fuel-injection units for cars as well as traffic-signal control, word-processing terminals and scales and electronic toys—"anything that doesn't require speed or too much computation," Roybal says.

The 8-bit PMOS microprocessor operates at 2-μs cycle time. It requires a single 12-V supply, with a comfortable margin of ±2 V. And it generates its own timing right on the chip, as opposed to a need for other chips to handle this function.

Multiple Scamps can communicate with one another when they all share a common bus. Logic built on the chip allows each Scamp to sense when the bus is in use. Only one Scamp can use the bus at a time, but a daisy-chain arrangement notifies each Scamp when its turn comes. When one of the Scamps stops transmitting or receiving, the one next to it can take over. If it declines, the one adjacent to it is given a chance.

Meanwhile, for more demanding applications, RCA plans to introduce an advanced high-speed version of its Cosmac microprocessor early next year. It will be a CMOS-on-sapphire unit with a cycle time of less than 1 μs. Cosmac's cycle time is 6 μs.

CIRCLE NO. 316

Improvements claimed with GaAs diode LED

A new GaAs diode LED is said to have better heat-flow characteristics and a lower threshold than other LEDs on the market.

Developed by Xerox Research Laboratories, Palo Alto, CA, the LED, which is also said to be cheaper to manufacture than competing LEDs, will be used as part of a fiber-optic data link.

The GaAs diode can be operated in either a lasing or nonlasing mode. The threshold current for lasing is about 140 mA.

The device differs from other striped-geometry LEDs in that the n-type stripe of GaAs surrounded by p-type GaAs is diffused below the epitaxial layer rather than above it. The diode has been developed by Dr. Robert Burnham and Donald Scifres, both members of the research staff.

With an output wavelength of 8600 Å and output power of about 7 mW, the diode has been used as the source for a 150 Mb/s fiber-optic data link by Dr. Eric G. Rawson and Robert E. Norton, members of the Xerox Laboratories research staff.

"We used a single 1/2 km graded index fiber from Corning with a loss of about 10 dB/km," Rawson reports. "The diode was mounted directly to the end of the fiber and was operated in a nonlasing mode. Coupling loss into the fiber was 15.9 dB. We found no errors in 10^{11} bits at a 150 Mb/s data rate. An avalanche photodetector was used on the receiving end of the link."

Rawson found the pulse dispersion of the graded index fiber to be less than 1/2 ns/km. This indicates that Gb/s data rates might be possible on the fiber.

Because of the small output cross-section of the diode, Rawson says, it can be used with a single fiber in the LED mode. Other LEDs, he says, require a bundle of many fibers to get reasonable coupling efficiency.

An advance reported in optical modulators

A new gallium-arsenide waveguide structure—the result of a breakthrough in fabrication technology—is described as the first practical ultra-wideband optical modulator that can be interfaced directly with microwave stripline traveling-wave devices.

The claim is made by Dr. P.K.E. Cheo, senior research scientist at United Technologies Center, East Hartford, CT, who says that in contrast, optical waveguides made by diffusion or thin-film techniques are too fragile or not physically suited for integration into a practical microwave device. And their power-handling capability is low, he adds.

The new waveguide device, which is being developed by United Technologies to modulate CO_2 lasers in optical radars and high-data optical communications, has exceptionally high optical transmission efficiency, Cheo says. The structure has passed tests using 100 W of microwave power, he points out.

In a recent experiment, using germanium prism couplers to feed optical energy into and to take it out of the waveguide, more than 3-W output was obtained from a CO_2 Gaussian beam input of 6 W—a power previously unattained with this type device.

The efficiency in this case was 52%, but Cheo says this figure can be raised substantially closer to the theoretical maximum level of 81%.

The new waveguides have been subjected to optical power densities of greater than 7 kW/cm² without damage, according to Cheo. And he sees the power-handling capability raised to as high as 20 W without heating problems.

The three major advances of the new design—compatibility with microstrip circuitry, high efficiency and high power-handling capabilities—are due to the method of fabricating the structures, Cheo points out.

The waveguide structure itself is a slab of gallium arsenide that is typically 1 cm wide, 4.5 to 5 cm long, and 20 to 30 μm thick. The thickness, Cheo says, is governed by the 10-μm wavelength of the CO_2 laser. Ion-beam milling is used to thin the GaAs to 20 to 30 μm from 0.015 in. thick bulk material.

The waveguide strip is optically polished and bonded to an optically polished copper block. This forms a stiff, rugged device that permits the use of prism couplers—the most efficient—because they require pressure against the waveguide.

The copper block forms the ground plane of the microwave modulator, which is designed to operate in the 10-to-15-GHz region. The copper also serves as a good heat sink for optical microwave power.

When used as a modulator, the waveguide is interfaced with the microwave system, and variations in the microwave field phase-modulate the optical energy.

The United Technologies development program is funded by the Advanced Research Projects Agency.

Independent entered in IEEE election

To some, Irwin Feerst is a Don Quixote jousting at imaginary IEEE enemies. To others, he is a Martin Luther crusading for total IEEE reform.

Whatever he is, Feerst has accomplished a goal after two previous failures. His name will appear on this year's presidential ballot for the Institute of Electrical and Electronics Engineers. This makes it the first time a nominee for the IEEE presidency has been challenged.

Feerst is an independent engineering consultant with a masters degree in electrical engineering from New York University. He will oppose Joseph K. Dillard, manager of advanced-systems technology for Westinghouse Electric Corp., Pittsburgh.

Flick of wrist gives time in new Pulsar

A flick of the wrist is all that's needed to command the latest Pulsar solid-state watch to display time.

Available from Time Computer, Inc., a division of HMW Industries, Lancaster, PA, the new Pulsar Auto/Command digital watch contains an inertial switch built around a minute ball of mercury trapped in a hermetically sealed glass tube. The mercury ball rolls with the movement of the wrist to first activate then deactivate circuits that turn on the LED display.

To prevent the Pulsar time display from lighting at unwanted moments, the watch is designed to work only with a specific wrist motion and within a specific time sequence. Too fast or too slow a movement will not light the display.

Gun fells intruders with electrical current

There is an alternative to shooting an intruder with a gun. You simply pull out a Taser TF-1, squeeze a trigger and two barbed contacts connected to fine electrical wires strike the intruder. A pulsating electrical current charges through his body, knocking him to the floor, helpless. The current continues as long as the electric release button on the Taser is held down. When it's held down as long as 2.7 seconds, an intruder may lose consciousness—a volunteer "intruder" did.

Developed and built by Taser System, Inc., City of Industry, CA, the TF-1 looks like a flashlight, is smaller than a pack of cigarettes and operates on 3 W. Voltage is high—50 kV and up.

The Taser develops short, microseconds-long pulses of electrical energy, delivered at about 10 pps and peaking at 50 to 60 kV, according to its inventor, John Cover.

The peak power per pulse delivered into the human body is greater than 10 kW. To prevent heart fibrillation—the predominant factor causing death from electric shock—the Taser operates in a region some 100 times below the maximum safe level for the heart.

Power is provided by rechargeable nickel cadmium batteries. Circuitry for the inverter was specially developed to minimize the number of components and size, with over-all efficiency at about 40%.

High-voltage insulation, a key requirement, was accomplished through a combination of encapsulation, spatial-geometric placement of parts, the use of plastic materials throughout the case and a unique method of switching the high voltage for the two-shot capability, Cover says.

Gas-pressure sensor offers ultra precision

A unique quartz diaphragm is the sensitive but stable pressure sensor that allows a new portable field instrument to measure or control barometric or gas pressure. Laboratory-standard accuracy is claimed.

The instrument, developed by the Bendix Test Systems Div., Teterboro, NJ, uses the proprietary rugged quartz element as one arm of a solid-state, temperature-compensated capacitance bridge. Pressure measurements are accurate to better than ±0.002-in. of mercury over the range of 0.6 to 40 in. of mercury, according to Bernard Gollomp, Bendix senior engineer.

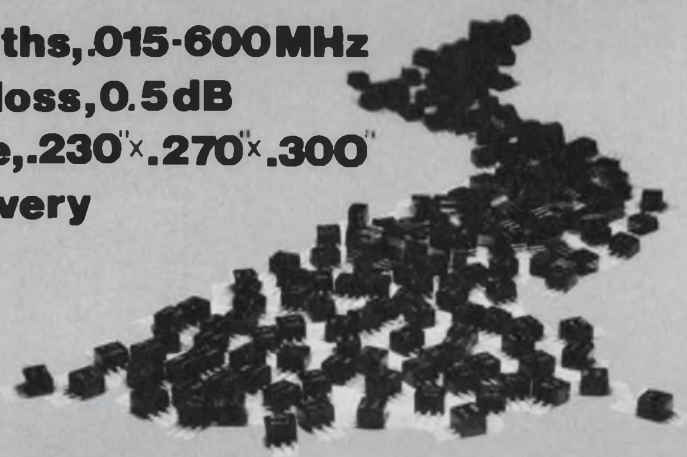
Competing systems with comparable accuracies use laboratory-tube mercury barometers with tempcos of typically 0.008-in. per °C for a 30-in. column, Gollomp says. In addition these setups are highly sensitive to vibration and must be used in a stable environment.

The Bendix instrument has an unusually high frequency response on the order of 150 to 200 cycles, Gollomp notes, and the sensor is being used to test elements like air-data computers and dynamic pressure sensors on the F-15 aircraft program.

Surprise! $2.95 (10-49)

Wideband Transformers

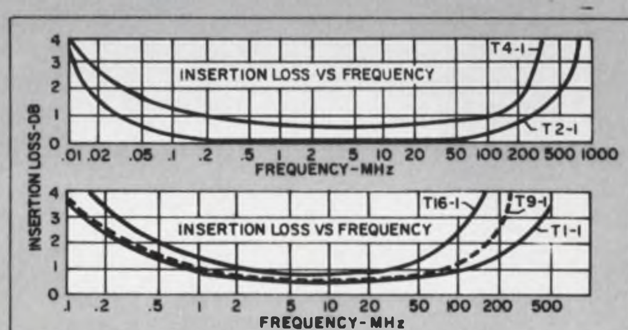
SURPRISE! Wide bandwidths, .015-600 MHz
SURPRISE! Low insertion loss, 0.5 dB
SURPRISE! Microminiature, .230" x .270" x .300"
SURPRISE! One week delivery



DESIGNERS KIT AVAILABLE:
2 TRANSFORMERS OF EACH TYPE
T1-1, T2-1, T4-1, T9-1, T16-1
KIT # TK-1 ... **$32.00**

NO "~~MAKE~~ OR BUY" DECISION HERE ... it costs less to buy Mini-Circuits wideband transformers and there's no delivery delay. Impedance levels from 12.5 to 800 ohms with insertion loss typically less than 0.5 dB

MODEL		T1-1	T2-1	T4-1	T9-1	T16-1
Impedance Ratio (50 Ω pri. imp.)		1	2	4	9	16
Band-width (MHz)	1db loss	2-50	.05-200	2-100	2-40	5 20
	3db loss	.15-400	.015-600	.2-350	15-200	.3-120
Price	(10-49)	$2.95	$3.45	$2.95	$3.45	$3.95



For complete product specifications and U.S. Rep. listing see MicroWaves' "Product Data Directory," Electronic Designs' "Gold Book" or Electronic Engineers Master "EEM"

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INFORMATION RETRIEVAL NUMBER 17

The SR-50A. The SR-51A.

Texas Instruments is steeped in calculator technology from start to finish. We make all critical parts, and control quality every step of the way. This is the key to the exceptional quality and value of TI's professional calculators.

Capability. Quality. Value.

The technological achievement under the keyboard is still the reason TI's professional calculators offer so much quality and math power for the money.

Engineer ... Scientist ... Businessman ... Geologist ... Chemist ... Statistician ... Student ... whatever your field, if you're doing more than basic mathematics, consider an SR-50A or SR-51A from Texas Instruments.*

SR-51A: simple arithmetic to complex statistics.
Sheer math power. Log and trig and hyperbolics and functions of x. The SR-51A has these and also statistical functions. Like mean, variance and standard deviation. Factorials, permutations, slope and intercept. Trend line analysis. And there's a random number generator. Plus 20 preprogrammed conversions and inverses. Check this list for a closer look at the real math power you can get in both the SR-51A and the SR-50A:

FUNCTION	SR-51A	SR-50A
Log. lnx	yes	yes
Trig (sin, cos, tan INV)	yes	yes
Hyperbolic (sinh, cosh, tanh, INV)	yes	yes
Degree-radian conversion	yes	yes
Deg/rad mode selection switch	yes	yes
Decimal degrees to deg.min.sec.	yes	no
Polar-rectangular conversion	yes	no
y^x	yes	yes
e^x	yes	yes
10^x	yes	no
x^2	yes	yes
$\sqrt{x}$	yes	yes
$\sqrt[x]{y}$	yes	yes
1/x	yes	yes
x!	yes	yes
Exchange x with y	yes	yes
Exchange x with memory	yes	no
% and Δ%	yes	no
Mean, variance and standard deviation	yes	no
Linear regression	yes	no
Trend line analysis	yes	no
Slope and intercept	yes	no
Store and sum to memory	yes	yes
Recall from memory	yes	yes
Product to memory	yes	no
Random number generator	yes	no
Automatic permutation	yes	no
Preprogrammed conversions	20	1
Digits accuracy	13	13
Algebraic notation (sum of products)	yes	yes
Memories	3	1
Fixed decimal option	yes	no
Keys	40	40
Second function key	yes	no
Constant mode operation	yes	no

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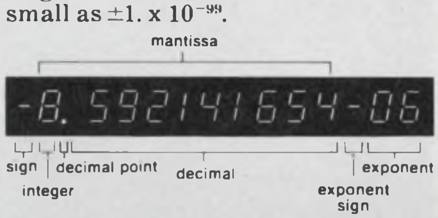

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inches	centimeters
feet	meters
yards	meters
miles	kilometers
miles	nautical miles
acres	square feet
fluid ounces	cubic centimeters
fluid ounces	liters
gallons	liters
ounces	grams
pounds	kilograms
short ton	metric ton
BTU	calories, gram
degrees	gradients
degrees	radians
°Fahrenheit	°Celsius
deg.min.sec.	decimal degrees
polar	rectangular
voltage ratio	decibels

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News

A special report on ICs

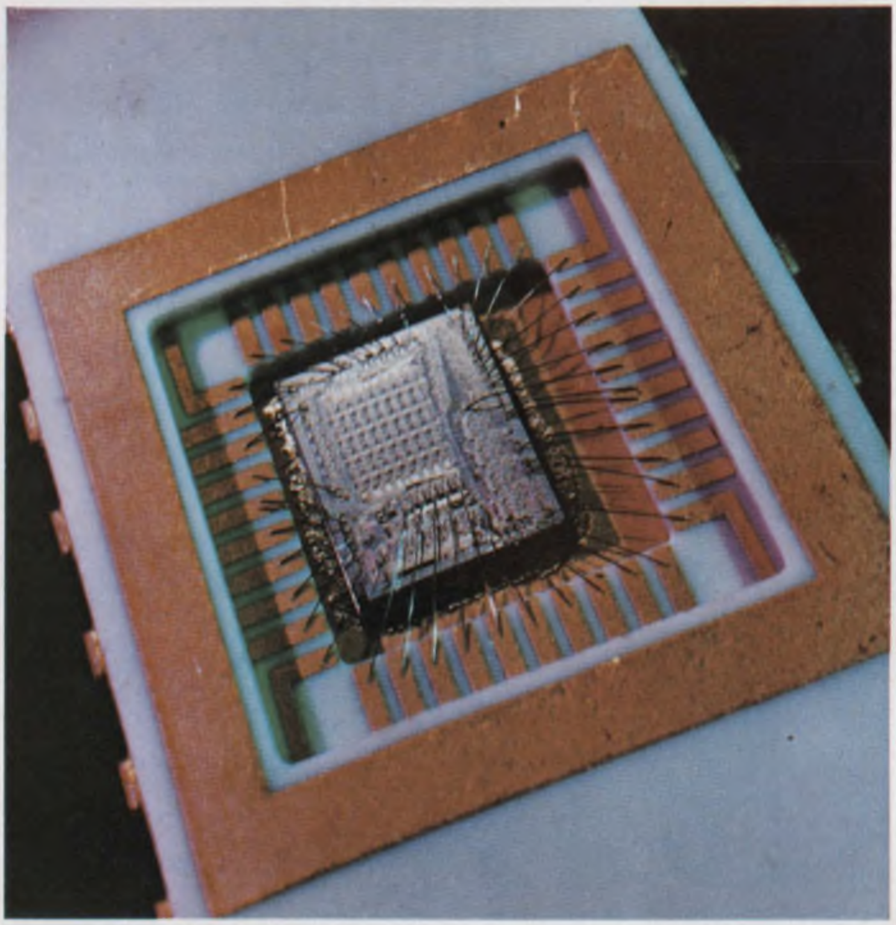
Semi firms speed up drive to develop new logic circuits

Semiconductor manufacturers have accelerated a three-way drive to develop new circuits for future logic designs.

One approach involves MOS and bipolar microprocessors and their peripheral support circuitry. Another encompasses special-purpose LSI circuits that run the gamut from completely dedicated ICs (like calculator chips) to high-speed families. The third approach consists of user-programmable logic arrays and read-only memories.

Intense competition in each of these areas has produced the following major developments:

- Following a pattern set by MOS predecessors, newer bipolar "bit-slice" microprocessors have increased speeds, and they are moving to longer word-length slices.
- Emerging bipolar/LSI families are providing fast, flexible and complex components for applications ranging from microcomputers to mainframes.
- With the arrival of field-programmable logic arrays, digital designers now have a vastly more efficient alternative to PROMs to replace hardwired logic.



A 4-bit microprocessor slice, or microcontroller, has a cycle time of about 100 ns. The low-power Schottky-TTL circuit from Advanced Micro Devices can be used for minicomputer emulation.

Bipolar/LSI microprocessors

Just two years ago, only Monolithic Memories offered a bipolar microprocessor slice. Now five other manufacturers have entered the field, and more are expected. The current list includes Advanced Micro Devices, Intel, Motorola Semiconductor, Signetics and Texas Instruments.

The bipolar speeds of these microprocessor slices, or microcontrollers, assure a precise emulation of conventional systems which employ standard bipolar circuits. By using microprogramming techniques, designers can replace scores of SSI and MSI packages at reduced power. The leading applications are currently in minicomputers.

"In a 16-bit mini that has been built and delivered," says Monolithic Memories' systems and applications manager Joseph McDowell, "the TTL-package count was reduced from 157 to 70." As a result, an original PC-board size of 15 × 15 in. became 6 × 9 in. Power dissipation dropped by 50% to 14 W, and system speed increased by 20% to a 1.2-μs instruction execution time.

"And this compact system is a

Edward A. Torrero
Associate Editor

complete mini consisting of central processing unit, interrupt and direct-memory-access structures and input/output buffers," McDowell observes.

Like Monolithic Memories, Advanced Micro Devices and Intel employ Schottky-TTL. Cycle times range from about 100 ns for the AMD microcontroller to about 200 ns for the other two. A slower speed is offered in the TI version, which uses integrated injection logic (I^2L) to decrease power dissipation.

In forthcoming product introductions, Motorola's entry will be an emitter-coupled-logic circuit having a cycle time of about 55 ns. Signetics will alternate source Intel's model.

The next announcement might well be from Monolithic Memories. The manufacturer plans a higher-speed version that will decrease cycle time to 150 ns, thereby closing the speed gap between its product and AMD's. Both have similar internal architectures.

A growing application area for bit-slice processors—high-speed, stand-alone controllers—makes use of special support circuits. These peripheral ICs are intended to enhance and match the microprocessor slices they support. One key circuit is a control unit that contains the necessary sequencing capability for a complete subsystem.

With the chip set, manufacturers envision as few as eight IC packages forming, say, a 10-megabyte disc controller. The eight ICs consist of four 4-bit processor slices, one control unit and three PROMs.

Even more dramatic benefits are in the wings when the industry advances from the present 4-bit slice up to 8 bits. "I would expect to see an 8-bit slice, but not from us," says McDowell, who believes yield problems would be a formidable barrier. First, chip size would probably increase from a current low of about 20,000 sq. mils to over 30,000. And the chip's internal RAM would grow to 128 bits. "Trying to combine this RAM with other functions on a bipolar chip is no trivial task," McDowell observes.

Meanwhile on the MOS front, manufacturers have overcome early sole-source limitations. In less than a year, three 8-bit n-channel processors have found alternate sources. American Microsystems now offers Motorola's 6800 microprocessor family, while Mostek has agreed to produce Fairchild's F8 series. Intel's 8080 has two new homes: Advanced Micro Devices and Texas Instruments.

Next in line might well be National Semiconductor's microprocessors. The company is reportedly on the verge of announcing an alternate-source agreement with a major U.S.-based semiconductor house. Also, the company plans to expand its line with low-cost and bipolar versions.

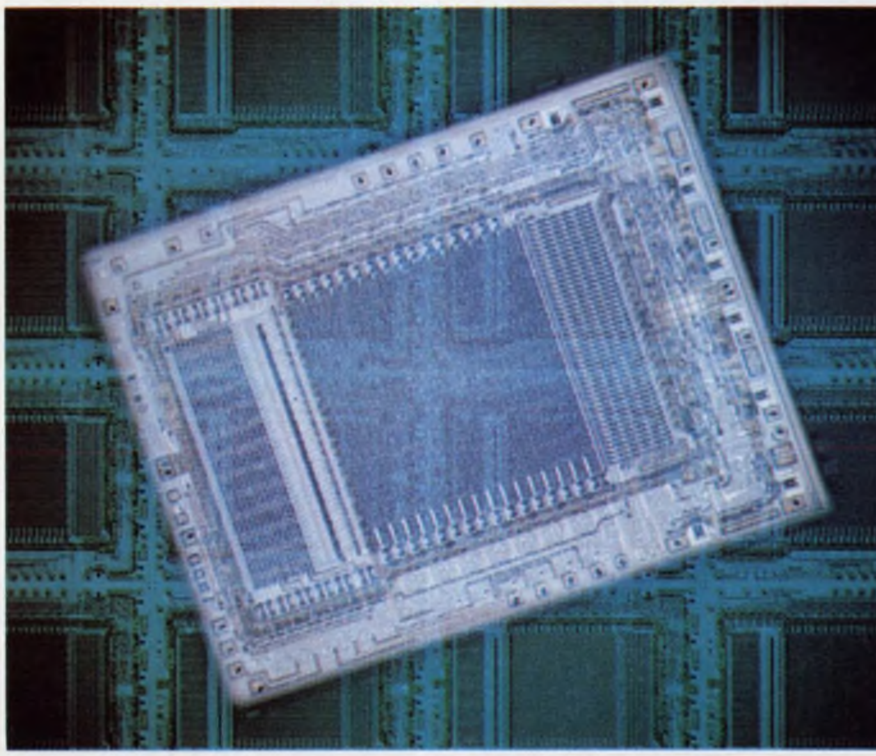
Due for announcement next month, National's SCAMP (short for simple, cost-effective applications microprocessor) aims for general-purpose uses that don't require high speed. It will sell for $15 in volume quantities. Also coming are bipolar versions of National's IMP-16 microprocessor. An MSI model is expected in November, and an LSI version is planned after that.

Future designs involving MOS microprocessors will be able to benefit from bipolar/LSI peripheral circuits. Motorola's Megalogic family, for example, contains a programmable delay module, 8 × 8-bit multiplier and a DMA controller.

"The delay module and multiplier can support any bus-oriented microprocessor, bipolar or MOS. The DMA controller is being designed specifically for our 6800," says Jim Loro, Motorola's bipolar/LSI product planner. Expected early next year, all three monolithic circuits employ I^2L techniques.

The delay module allows timing intervals ranging from less than a microprocessor cycle, or microcycle, up to 1 hour. The multiplier processes two 8-bit words and outputs a 16-bit result in only four microcycles. When software routines are employed, multiplication takes 200 to 300 microcycles.

The Megalogic family encompasses several technologies. However the major ones are I^2L and TRL (a simplified form of old RTL). Motorola employs I^2L to achieve chip complexities of 1000 to 2000 equivalent gates, and TRL to obtain 140-to-160 gates.



A field-programmable logic array has 16 inputs, allows 48 product terms and generates eight output functions. From Signetics, the FPLA employs fusible nichrome links as the programming elements.

Like other manufacturers investigating I^2L potentials, Motorola's effort is a two-way thrust. One approach seeks to develop low-cost LSI circuits having speeds in the 50-to-100-ns range of current NMOS ICs and power dissipation heretofore associated with CMOS circuits. The other approach aims for the 5-to-15-ns speed range of current TTL parts. Which approach will lead to a Motorola I^2L microprocessor has yet to be decided.

Meanwhile the company that introduced I^2L processors—Texas Instruments—has upgraded its original fabrication methods. Recently developed I^2L techniques make feasible 4-bit slices with 100-ns cycle time at less than 1 W dissipation per chip. The same techniques could also be used to build a complete 16-bit microcomputer on a single chip.

Further, TI's Schottky capability now extends to the nanosecond range. And several members of a family of 1-ns parts have been sampled. By year's end, the high-speed Schottky family will include a 4-bit microprocessor slice with expected cycle times of about 50 ns. This is about the speed range of Motorola's forthcoming ECL processor slice, so a new battle between ECL and Schottky may be in the offing.

For subnanosecond speeds, Fairchild employs ECL in its version of the MECL 20-k family, a low-profile segment of Motorola's ECL arsenal. Fairchild's version, ECL 100-k, features propagation delays of only 700 ps from an actual gate driving a 50-Ω load. Circuit complexity doesn't yet exceed MSI.

"It's probably the last conventional logic family," predicts Robert Walker, Fairchild's manager for new product planning. Any faster family would have to be all LSI. Otherwise, delay-increasing interconnections could neutralize the speed enhancements built into the chip.

While ECL 100-k can provide the springboard for future LSI products, current LSI efforts focus on the company's Macrologic circuits. The family has a typical chip complexity of 150 to 250 gates. It consists of one set of TTL circuits and another set of functionally equivalent, pin-compatible Isoplanar-CMOS versions. A CMOS or TTL microcontroller can be built by combining several packages.

Field-PLAs arrive

One of the fastest growing new products is the field-programmable logic array (FPLA). Within the last few months, six manufacturers have either announced products or said they will do so. The list consists of Advanced Micro Devices, Harris Semiconductor, Intersil, Monolithic Memories, National Semiconductor and Signetics.

Why the sudden popularity? Manufacturers say the quick turnaround benefits of FPLAs will assure rapid acceptance by designers.

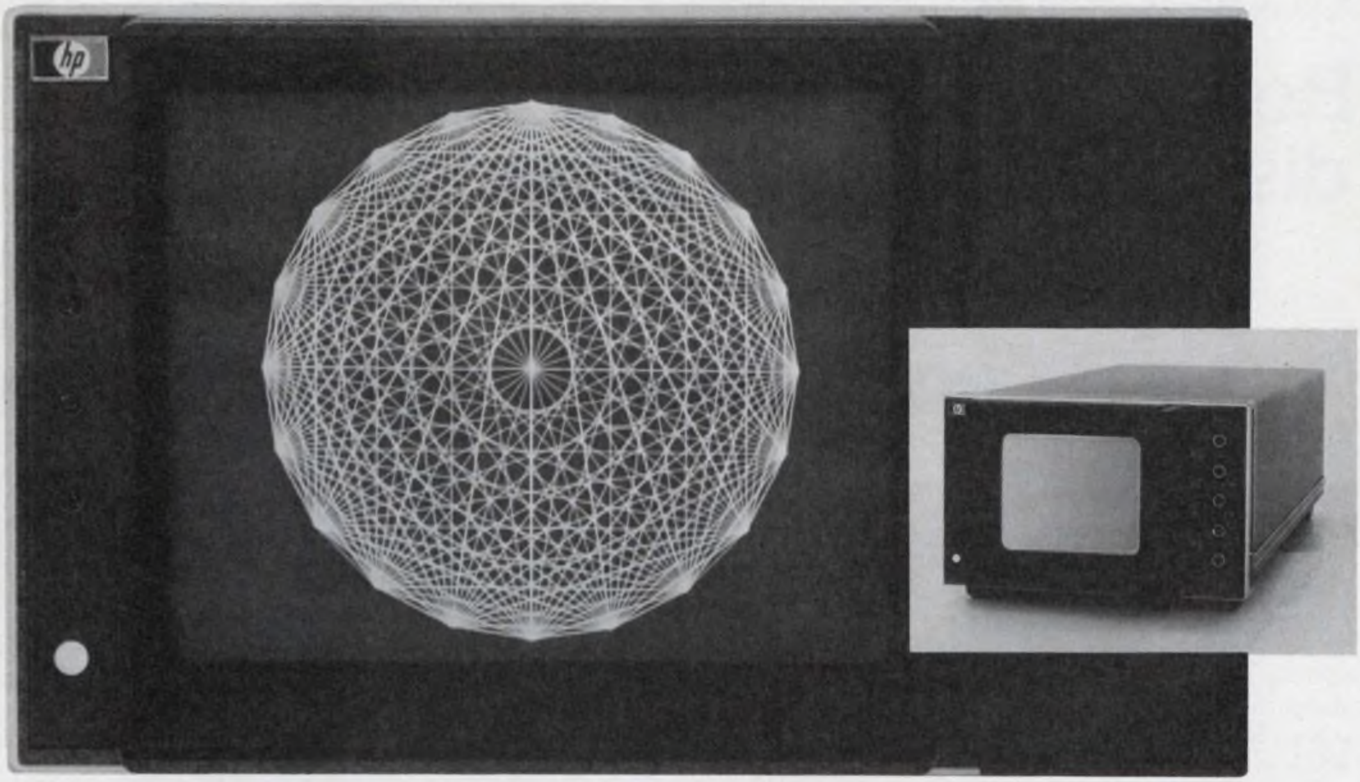
"With earlier mask-programmable logic arrays," says Ralph Kaplan, Signetics' bipolar marketing manager, "designers had to wait 10 to 12 weeks and spend up to $1000 just to get prototype parts." The cost includes tooling charges for the mask and the price for a minimum number of parts. "But with FPLAs," continues Kaplan, "a designer can get a programmed and tested FPLA within a week, spending only a few hundred dollars."

Besides entailing fewer IC packages than PROMs, FPLAs permit substantial compression of truth tables. So a complete set of logic states, generated by control variables, need not be programmed fully. FPLAs even have an editing capability that allows post-programming design changes.

FPLAs are best suited for designs calling for a small subset of the total numbers of logic states possible. Examples include the 12-bit Hollerith code, which contains only 96 graphic characters out of 2^{12} coding states. Similarly, a typical 16-bit microprogrammed machine may really need only 50 or so subroutine-start addresses out of a total of 2^{16}.

But the use of FPLAs does entail some difficulties, too. For example, programming involves three successive and different steps. Further, FPLA testing is no trivial task. Manufacturers are responding to the problem by developing several software and hardware design aids. ■■

HP displays.



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OEMs who need a display with a larger viewing area and a brighter image at faster scan rates have made the **1332A** a popular choice. They appreciate its 9.6 x 11.9 cm viewing area, its superior performance, and the ease with which the 1332A, like the 1335A, integrates into a variety of racks, cabinets, or systems. All frequently used controls on both displays have been placed on the front panel for maximum accessibility.

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A special report on ICs

Better analog ICs are matching discrete modules in performance

"Day by day, in every way, I am getting better and better," said Emil Coúe, French founder of a form of self-suggestion called Coúeism in the early 1900s. Today the analog IC industry has apparently adopted that philosophy, according to a survey of the new analog ICs available and of those to be introduced in the coming months.

Performance once found only in discrete modular components can now be found in small hybrid and monolithic IC versions. And the performance-to-cost ratio is getting better with the newer products.

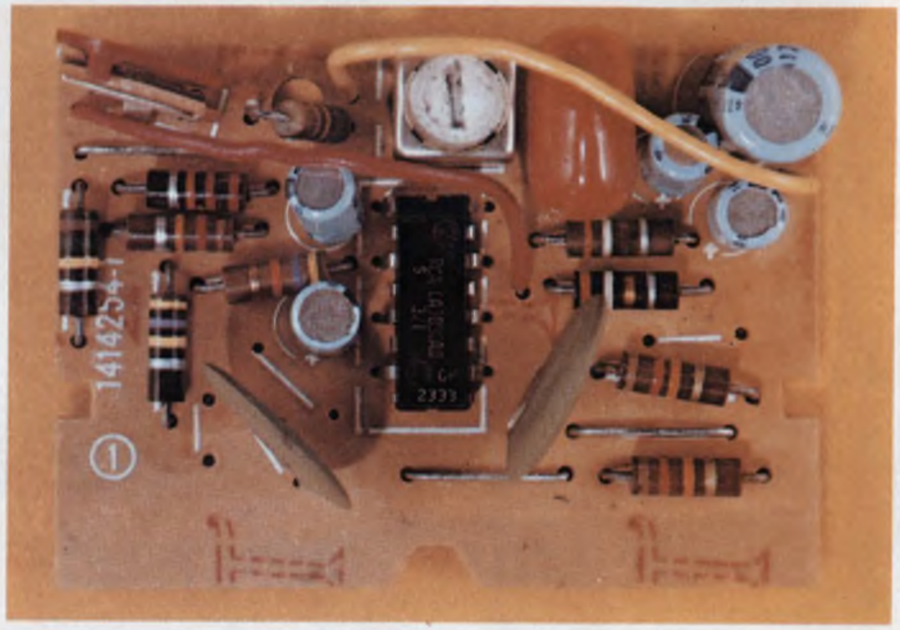
"The modular circuits are being challenged by hybrid versions of the same thing," says Joseph Santen, product manager of analog circuit functions for Burr-Brown Research, Tucson, AZ. "These newer versions are much smaller and give comparable performance for one-half to one-third the price."

And for very high-volume products, the semiconductor companies tend to make the ICs in monolithic form, which is even more cost-effective.

A major influence in producing better analog ICs at lower costs is improved fabrication. Better understanding by manufacturers of the fabrication processes has led to the following:

- Increasing use of multiple IC technologies on the same chip—like combining bipolar and MOS or CMOS.
- Laser trimming on both monolithic chips and hybrid ICs to improve performance.
- Ion-implantation techniques to produce circuits that have less noise.
- I^2L technology to reduce chip size and permit more effective use of a chip.

Jim McDermott
Eastern Editor



Stereo decoder printed circuit board contains an RCA 3090 phase-locked loop IC. These decoders are produced by the millions for use in home, auto and hi-fi FM radios.

More op amps per chip

The use of multiple technologies and improved processing have probably had the greatest impact on monolithic op amps. A major trend is the production of two or four op amps on one chip. One result is an improvement in the tracking of various tolerances, such as the temperature-sensitive factors.

The first—and so far the only—monolithic chopper-stabilized amplifiers to hit the market, the Harris HA-2900 series, resulted from combined bipolar and MOS technology. The series features a low offset drift of 0.2 $\mu V/°C$, bias currents in picoamperes and offset voltage drift of ± 10 μV per year. The price for commercial temperature range is $25 (100 quantities).

The inputs of the 2900 series are symmetrical and differential, notes Frank Abreu, linear product marketing manager for Harris Semiconductor, Melbourne, FL. Which means that the series can be operated in an inverting, non-inverting or balanced configuration.

A combination of MOSFET, bipolar and CMOS in RCA's CA-3130 series provides an input resistance on the order of 1.5×10^{12} Ω, a gain-bandwidth product of 15 MHz at unity-gain crossover, an open-loop gain of 110 dB and a slew rate of 10 $V/\mu s$ typical.

Merle Hoover, manager of bipolar applications engineering in the RCA Solid State Div., Somerville, NJ, points out that the CA-3130 uses a CMOS transistor pair at the output. This pair can swing the output voltage to within millivolts of either supply voltage.

The output current is high, Hoover says—typically 20 mA.

While Harris is still sole supplier of the monolithic chopper-stabilized op amp, National has just introduced a two-chip nonchopper hybrid that is intended to compete with it. Dean Coleman, National's marketing manager for standard analog modules, says that the new precision op amp—the LH0044—has guaranteed offset voltage and drift of 50 μV and 0.5 μV/°C, along with very low 1/f noise. The long-term stability is given as better than 1 μV per month and the noise level as lower than 0.7 μV, pk-pk, from 0.1 to 10 Hz. The open-loop gain is better than 120 dB.

The improved characteristics were achieved by new processing techniques and laser trimming of critical metal-film resistors to minimize offset voltage and drift.

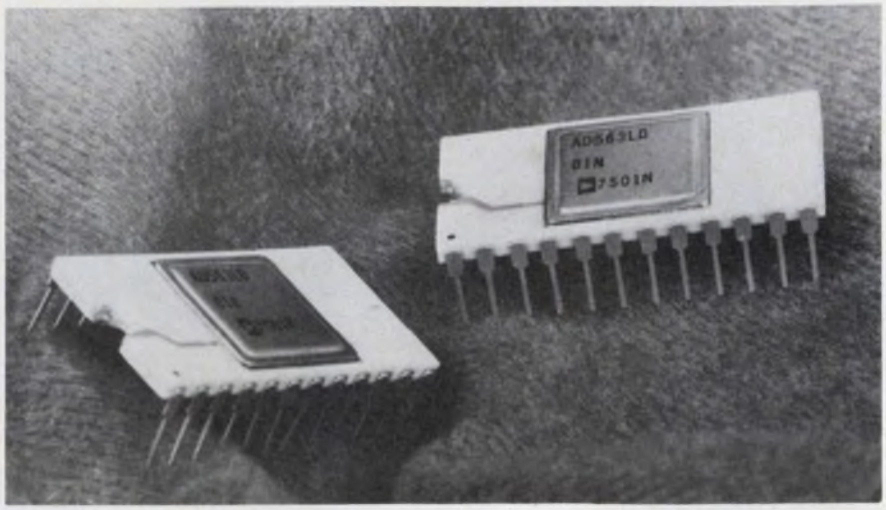
To reduce op-amp noise, National Semiconductor uses ion-implantation techniques that put JFET transistors and bipolar devices on the same monolithic chip. Previously the production of a pair of JFETs matched to a bipolar pair was difficult, because control of the vertical JFET implant dimensions required a tolerance 10 times closer than that for the bipolar devices. Ion implantation solved the problem in National's LF series by producing an ultra-thin, precisely controlled doped layer.

The noise figure of the National LF 156 is typically 15 nV/$\sqrt{\text{Hz}}$ at 100 Hz. Typical input current is 30 pA; the offset, 3 mV, and drift with temperature, 5 μV/°C. The supply current for the device is only 5 mA.

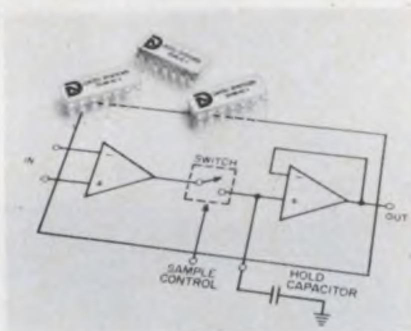
Phase-locked-loop monolithic circuitry currently found in integral packages—the Exar 2211, for example—is designed to perform such functions as tone detection and decoding and FSK data modulation and demodulation.

Advantages of PLLs

The phase-locked-loop circuitry is also incorporated on monolithic chips for consumer ICs, along with additional circuitry on the same chip, to provide such functions as stereo multiplex decoding (where PLLs are used most), TV chroma subcarrier regeneration, TV hori-



Three IC chips are mounted in this hybrid 12-bit current-output DAC by Analog Devices. The hermetically sealed device uses high stability, thin-film SiCr resistors. Laser trimming provides this AD563 with true 12-bit accuracy.



Bipolar and MOS transistors are combined on the chip of this high-performance sample-and-hold unit by Datel Systems. An external holding capacitor is used.

zontal sync and FM i-f demodulation.

The temperature instability of the VCO in integral PLLs—a principal early problem—has been substantially improved, says Alan Grebene, Exar's president and developer of the first monolithic PLL. The temperature stability of the Exar-2211 VCO, one of the latest devices, has been increased to 20 ppm/°C, compared with 600 ppm or more for first-generation devices.

"The stability is now high enough so the devices can be used for narrow-band tone decoding, such as in telegraph FSK channels," Grebene points out. These channels have a bandwidth of ±5 cycles, compared with about ±20 cycles for telephone tone decoding.

A trend in PLLs, notes RCA's Hoover, is toward higher frequencies and lower power for portable applications. As an example, he points to RCA's 4046 micropower CMOS PLL.

Frequency drift is spec'd at 0.06/°C at a V_{DD} of 10 V. The operating frequency range is 1.2 MHz max, and power requirements are typically 70 μW at 10 kHz with a drain voltage of 5 V.

Laser trimming cuts costs

The use of laser trimming is proving widely useful in improving precision and reducing the costs of a/d and d/a converters, multipliers and other functional circuits.

"The ability to laser-trim a monolithic chip is important," notes Burr-Brown's Santen. "On a low-cost, low-accuracy, 2 to 4% multiplier, we can laser-trim the resistors on the chip to give us accuracies down to 1%. For example, our 4205 is a 1% monolithic device that sells for $26 in small quantities."

At Motorola a new 10-bit DAC being readied for the end of this year—the MC 3510—"will be a low-price unit with real performance," says Ronald Campo, marketing manager of linear circuits.

"To achieve this, we've had to go to the laser-trim technique," he reports. "And we can supply 8-bit DACs in the $3 or $4 range because of the inherent low-cost advantage of monolithic design.

Jerry Fishman, marketing manager of Analog Devices' Semiconductor Div. in Wilmington, MA, says:

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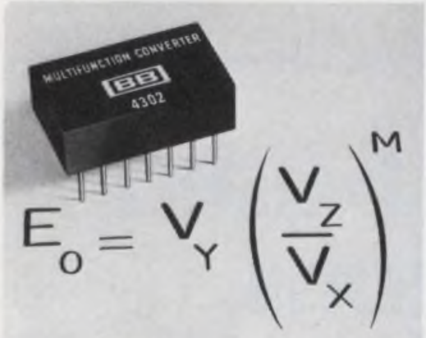


Complex mathematical operations can be performed using this 4204 multifunction converter by Burr-Brown. This $23.50 package uses hybrid design.

"Laser trimming is necessary to achieve the kind of accuracies that designers want in IC converters. We trim at both the wafer level and also do outboard trimming on a separate substrate for these devices.

"In the 12-bit area, we believe that the best technology possible is that of a two-chip hybrid design. But within the 10-bit a/d area we have a new monolithic CMOS device made in our Santa Clara Facility, the AD7250. In the low-accuracy end of the spectrum, we have a monolithic 8-bit d/a converter.

"We've just introduced a very-high-precision op amp, the AD510, a laser-trimmed bipolar amplifier with initial offset voltages as low as 25 μV. Previously the best we could get was about 1 mV."

Low-cost monolithic d/a

An unusual low-cost monolithic d/a converter recently introduced—the MonoDAC-08, by Precision Monolithics, Santa Clara, CA—is an 8-bit multiplying d/a converter—that is, the output current is the product of a digital number and an input reference current of 0 to 4 mA.

Selling for $6.95 each in quantities of 100, the device has 0-to-70-C temperature range, and a settling time of 85 ns, according to Donn Soderquist, the company's applications engineer. Linearity of the unit is 0.40% over the temperature range.

The input supply of the MonoDAC-08 ranges from ±4.5 V to ±18 V. An output compliance from −1 V to 18 V allows current-to-voltage conversion without output op amps. This feature has not been available before, Soderquist points out.

"It's also the first DAC capable of interfacing with all forms of logic, and it's also the first one with complementary output," he adds.

"With no external components or trims, we get 0.25% accuracy," says Burr-Brown's Santen. "Adding external resistors to eliminate some offset will provide 0.1%."

JFETs supersede PMOS

Analog switches and gates for selection and multiplying now are available as monolithic and hybrid IC devices. Some years ago Siliconix introduced PMOS analog switches, which were monolithic having up to eight channels.

"But the PMOS switches required high drive and had a large variation in R_{ON} along with the input signal," says James Spicer, product marketing manager for analog switches at Siliconix.

"Today these devices have been supplanted by JFET analog switches driven by a variety of process-type drivers. The most popular is a combination of bipolar, Schottky and PMOS technology, all integrated on one substrate.

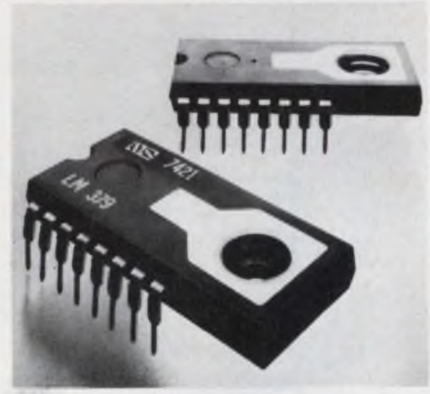
"This gives the advantage of TTL compatibility at the input, very high speed at the drive point—due to the Schottky transistors—and zero variation of JFET channel resistance with the applied signal."

Intersil uses five fabrication techniques in its line of switches and gates, according to George Krautner, product manager of the analog gate line. One hybrid approach uses a bipolar driver with JFET for the switch, and another employs a bipolar driver with a PMOS switch array.

A third approach, Krautner says, is the use of monolithic CMOS switches, such as in the IH5060 16-channel multiplexer and the IH-5070 differential eight-channel IC.

A fourth type uses a CMOS driver with a proprietary Vara-FET switch. Rather than supply gate voltage to turn the device on or off, the VaraFET works on a charge-transfer principle.

The fifth approach is found in Intersil's low-cost analog gate family—hybrids having from one to four gates per package. This family uses a JFET with a p rather than an n channel. It is TTL-compatible, Krautner points out.



This monolithic, dual-channel power amplifier, by National, delivers 7-W per channel to an 8-Ω load. The device has overcurrent and thermal protection.

Consumer ICs improve

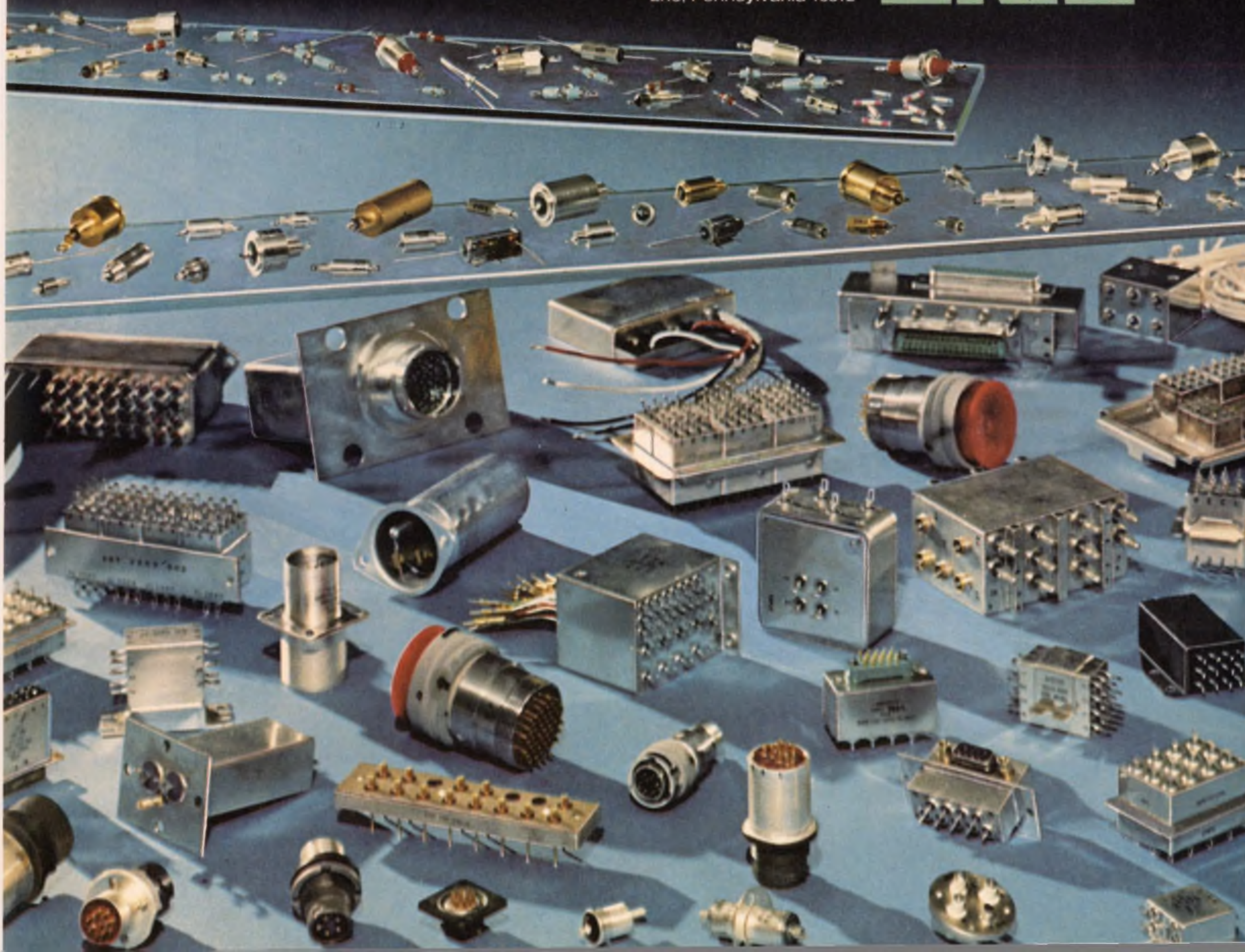
In the consumer field, audio ICs for radios, TV and stereos are improving steadily. John Oliver, radio IC designer at Sprague Electric in Worcester, MA, points out that while 10 years ago the output stages of an audio IC were capable of a few tenths of a watt, today 3, 5 and 10-W power amplifiers are feasible as fully monolithic devices.

For example, Sprague's ULN 2280 is a 3-W power amplifier that is short-circuit protected and also has inherent thermal shutdown.

Motorola has IC projects that use I^2L technology in all consumer areas, according to John Comeau, consumer linear product planner.

"We've taken the I^2L process and made it linear-compatible," Comeau says. "I^2L is most effective when you have a digital function that you can put in one corner of an IC chip, and then put all the linear interfacing, and buffers on that same chip."

Among new parts developed for color TV circuitry, Motorola has two triple chroma demodulators—the 1323 and the 1399. While the MC 1399 is suitable only for TV, Comeau says, the MC 1323 can also be used in applications where a simple modulator-demodulator is needed. ■■



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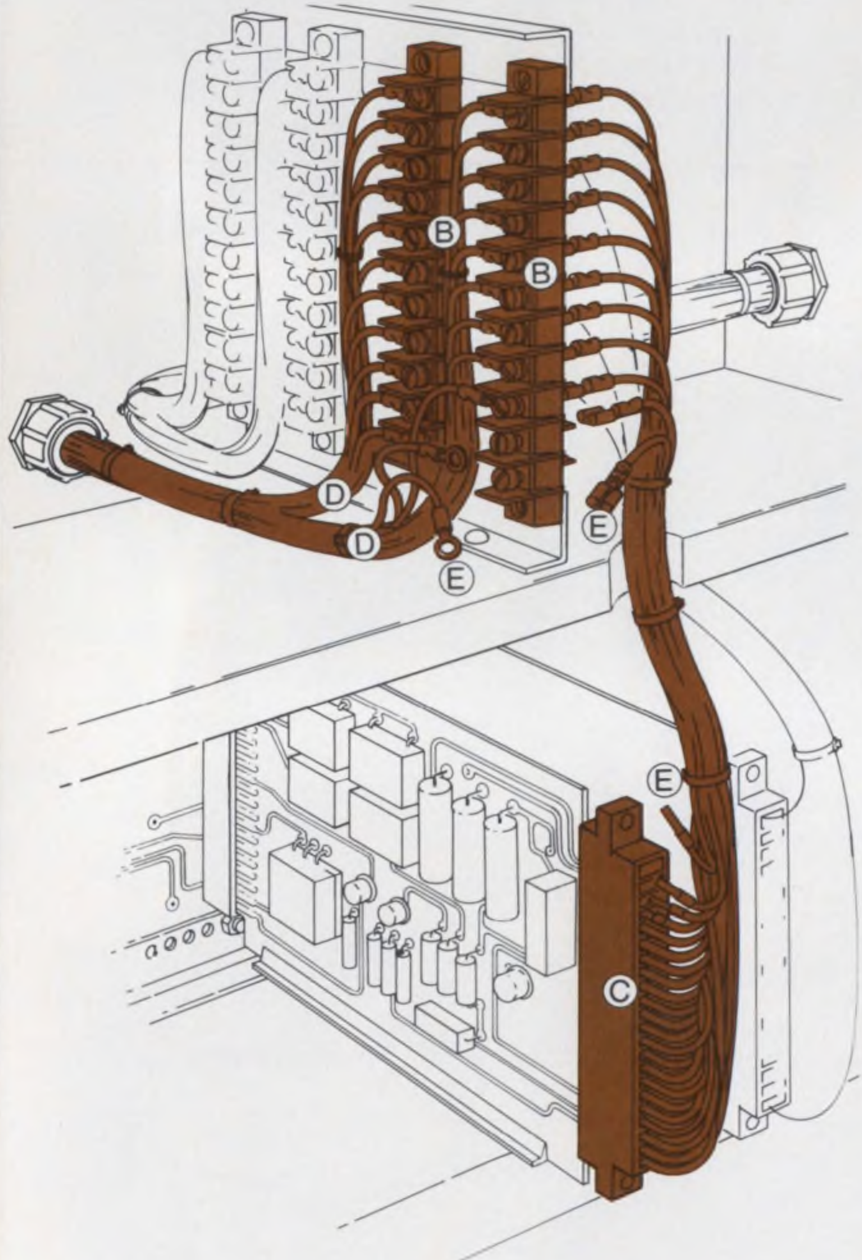
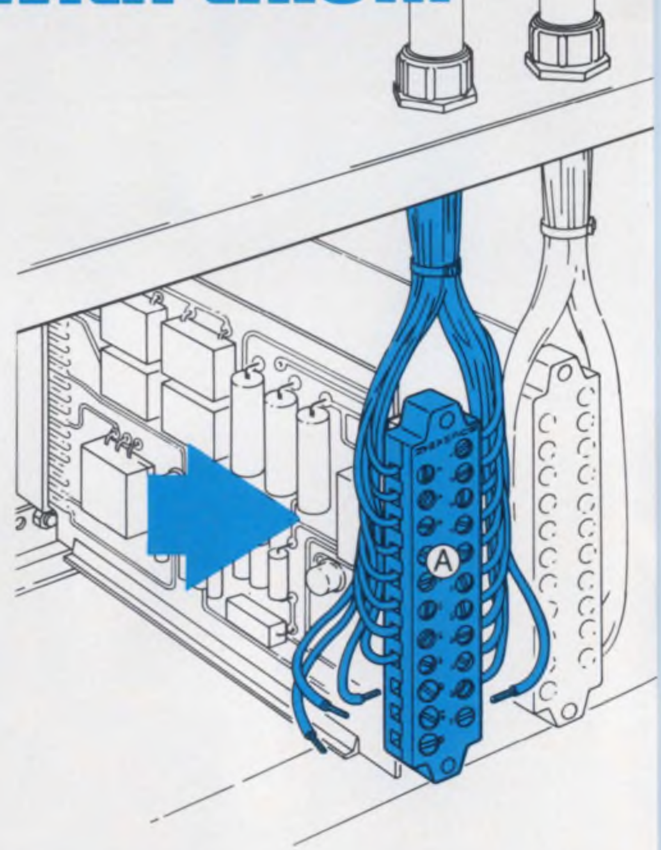


with this...



Just one Buchanan Printed Circuit Board Connector (A) replaces the two barrier strips (B), the edge card connector (C), the double wiring (D), and the 110 costly terminations (E) shown at left. Result: LTIC (Lower Total Installed Cost)!

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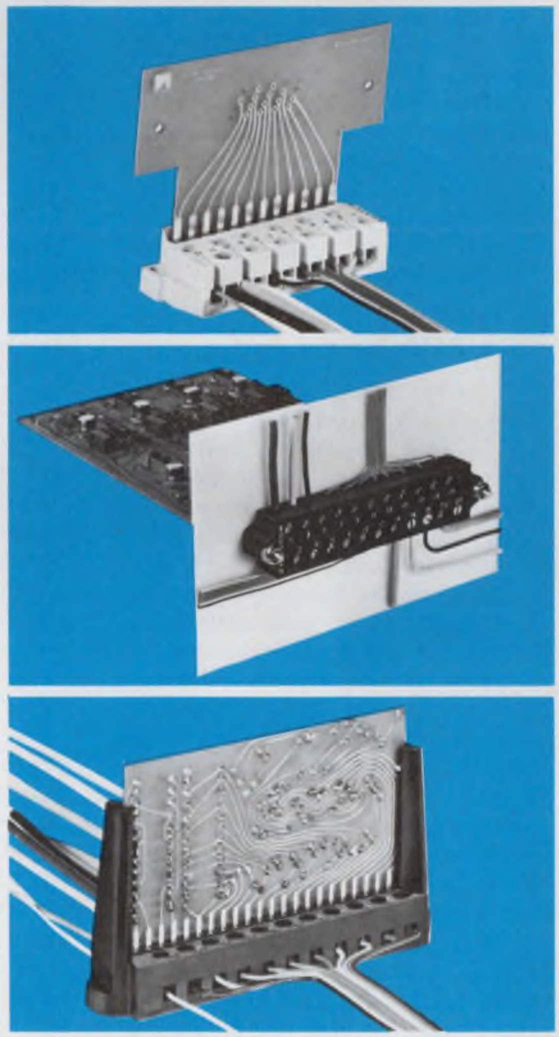

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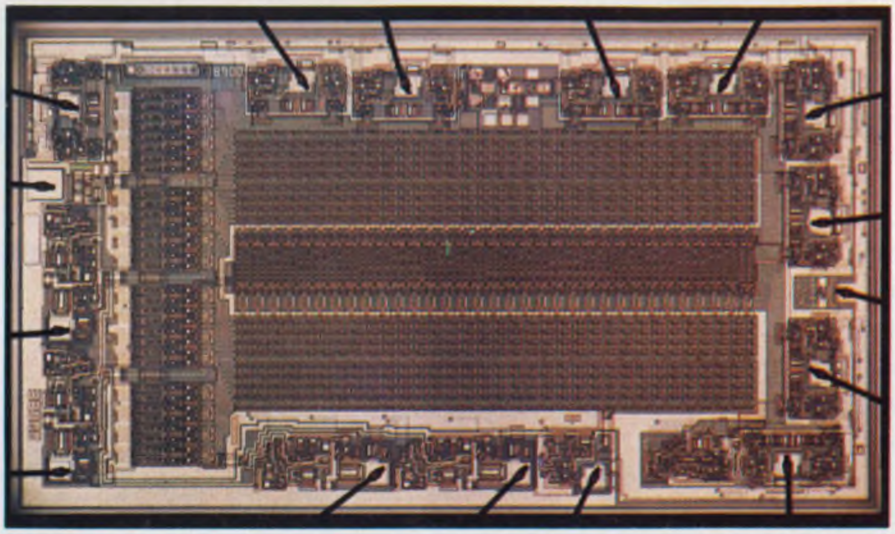
A special report on ICs

16-k RAM and reprogrammable ROM races begin to heat up

Even before the dust has a chance to settle in the hotly contested 4-k RAM sweepstakes, semiconductor manufacturers are straining at the starting gate as the race to capture the 16-k crown is about to begin.

In another contest, the 1-k SOS/CMOS RAM is challenging the well-entrenched 1-k bipolar RAM for applications requiring high speed and low power.

Meanwhile, the enormous demand for reprogrammable ROMs—which has been caused in part by the increased use of microprocessors—has prompted two industry leaders to come out with bigger and better devices.



Standardization of programming requirements is the key feature of a new family of PROMs from Harris Semiconductor. The HM7620 is a 512-by-4 PROM that is part of this family of devices that are called Generic PROMs.

16-k RAMs on the way

True to Gordon Moore's rule of four, which states that the memory density advances will come in multiples of four, the semiconductor industry is on the verge of introducing the 16-k RAM. While commercial parts are not expected to be available for at least a year and maybe more, semi makers are racing the clock to see who will be the first to announce, on the theory that the first one will get the lion's share of the business. Some think Intel will keep up the tradition of being the leader and once again will announce the latest development in semi memories at the International Solid-State Circuits Conference next February.

When the 4-k RAM was introduced, confusion erupted in the marketplace because just about every manufacturer had a different design. The situation will be different for the 16-k devices because most semi makers are expected to come out with pin-compatible memories. At a recent meeting in Colorado, the memory makers got together to discuss the pin assignments for the 16-k device.

While no official standard was adopted, it was generally agreed that most 16-k offerings would be patterned after the Mostek 16-pin 4-k device. All the pinouts would remain the same except for the chip-select bar, which would be eliminated and replaced by another address pin. Since the address lines in this configuration are multiplexed, adding one more address pin effectively gives two additional address lines. This permits the jump from 4-k to 16-k. Also, since the same address pins are used to select both the row and column being addressed in the memory, speculation is that the 16-k RAM will have a 128-by-128 format.

Though most semiconductor manufacturers seem satisfied with the modified Mostek pin arrangement discussed, Texas Instruments indicates that it may try to come out with an initial offering in a 22-pin package.

According to Ed Huber, TI's manager of MOS memory marketing, the 16-pin package has a serious constraint—it is only 300 mils wide. This, says Huber, limits the size of the chip that can be used for the 16-k memory. Estimates are that a chip would be limited to a width of 150 mils and a length of 220 mils. On the other hand, he points out, a 22-pin package is 400 mils wide, making feasible a larger chip and one that is easier to fabricate. The larger 22-pin package has other advantages as well, notes Huber. Its thermal impedance is lower, and consequently its power dissipation is better.

Another thing that makes the 22-pin package more attractive, he remarks, is that the extra pins allow full binary addressing instead of multiplexed. This should result in a higher performance memory.

Jules H. Gilder
Associate Editor

Commenting on the cell size required for the 16-k memory, Huber notes that it should be about half the size of the cell used in the 4-k memory. That would make it anywhere between 0.75 and 1 sq. mil.

Ron Livingston, National Semiconductor's manager of random-access memories, agrees with Huber that the cell size has to come down. He also points out that this could lead to a potential problem. In theory, says Livingston, if the cell size becomes smaller, refresh and data rentention problems are likely to crop up. This is due to the smaller capacitances involved and the high leakage rates. But, he continues, if the process improves—as it does continuously—it will be possible to get better surfaces and thus lower leakages. The net result is a break-even situation, he reports.

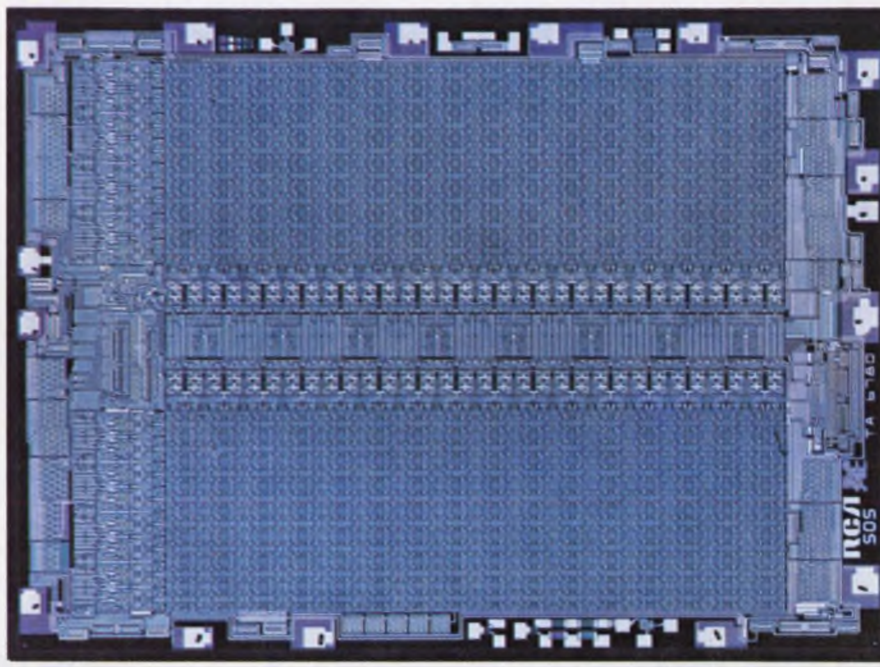
Livingston cautions that it is essential for memory makers to stay with a simple process, like standard silicon-gate technology. Otherwise, he warns, manufacturers are likely to have problems such as Mostek had when it went to the more complex nitride process.

Motorola's Peter Bagnell agrees. He points out that the combination metal-gate, silicon-gate process that Mostek used on the 4-k RAM resulted in reliability problems. These were primarily related to oxide steps and microcracking of the metallization. Industry sources indicate that Mostek is still having problems and that it is redesigning its 4-k 16-pin device so that it will use standard silicon-gate technology.

RCA's memory manager Hank Miiller disagrees with both Bagnell and Livingston. 16-k memories, says Miiller, require the perfection of the nitride process. Both nitride transistors and nitride capacitors are needed for storage. Miiller acknowledges that it's easy to rationalize simplicity such as that attainable with the silicon-gate process. But, he predicts, one guy is going to be a bit more clever and he's going to perfect nitride processing. And when he does, he's going to have an advantage over everyone else. Explaining further, Miiller notes that nitride technology offers a size advantage over the silicon-gate approach. The chip size required for silicon gate is not competitive, he claims.

"You need a chip with a total area of between 28,000 and 29,000 sq. mils," he reports. And it may not be possible with silicon-gate technology.

As to availability, National's Livingston says we'll probably see a few people playing with the 16-k RAM by the end of the year. But, he cautions, don't look for any production quantities before 1977. After all, he continues, we're just now getting the 4-k into production; why screw it up by sending out a 16-k device?



SOS/CMOS memories, such as this 1-k TA6780 from RCA, are challenging bipolar devices for applications where speed and low power operation are important. The device is now available in sample quantities.

4-k RAMs for here and now

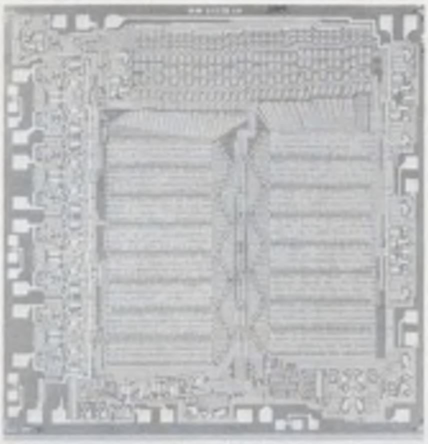
Back on the production front, semiconductor manufacturers are turning out 4-k RAMs by the thousands, but as yet there is no industry standard. There are now five different 4-k RAMs available with five different pin configurations and three different package sizes. But indications are that at least one of them—the Mostek 16-pin device, MK 4096—will become a de facto standard. The reason is that in addition to Mostek, at least six and maybe even seven other semi makers are planning to come out with memories compatible with it. They include Motorola, Intel, Fairchild, AMI, Rockwell, Western Digital and maybe Texas Instruments.

The reason for the keen interest by the semiconductor manufacturers in the 16-pin RAM: major customers for these parts realize that there is a significant savings in PC-board space associated with the device. It is possible to put more than twice as many 16-pin 4-k RAMs on a card as 22-pin RAMs. So most customers have an alternate PC-card design that will accommodate the 16-pin devices.

But the most powerful selling feature of the 16-pin 4-k RAM, claims Motorola's Bagnell, is that it is extremely simple to update any design using it to the 16-k memory chip when it becomes available.

"Since all but one of the pinouts on the 16-k are the same as the pinouts on the 4-k, it is only necessary to change the connection to one pin to update the circuit to the 16-k device," he notes.

Bagnell believes the race for top spot in the production of 4-k devices will be between Motorola and Intel. "Before the end of the year we'll have shipped about a quarter of a million units. Intel should be doing about the same." And Mos-



Static ROMs like this p-channel 4096-bit device from National Semiconductor use a low threshold voltage technology to achieve bipolar compatibility.

tek, which pioneered the design that is expected to make such a big impact on the marketplace, will be in third position, Bagnell contends. Explaining why, he points to the reliability problems they've had and the redesign they are now going through. "They're simply not in a volume mode yet," he says.

Taking a look at the over-all 4-k memory market for next year, Bagnell predicts that 55% to 65% will go to the 16-pin device, 15% to 20% to the 18-pin design and the remaining 20% to 25% to the 22-pin unit.

TI's Huber strongly disagrees with Bagnell. He claims that a large majority of the 4-k devices that will be sold next year will be of the 22-pin variety, because they have been designed in and are being shipped in large quantities. Everyone else, except for Mostek, is just getting started in the 16-pin design, and it will be some time before they can get volume up, Huber points out.

SOS challenges 1-k bipolars

Bipolar RAMs, which are still only at the 1-k density level, are finding wide applications in areas where speed is most important. But parts like the 93415 are in for some stiff competition from 1-k SOS/CMOS RAMs from RCA and Advanced Memory Systems.

According to RCA's Miiller, the SOS memory, called the TA6780, is currently being sampled. It provides speeds comparable to those of the 93415, consumes less power and has the same pinouts. At 10 V, the access time for the TA6780 is about 120 ns. By the end of the year, RCA expects to be able to cut that time in half. In the active mode, the SOS memory consumes 20 mW of power and dissipates only 1 mW in standby. This compares with 0.5 W for the 93415.

Commenting on the viability of SOS as a memory technology, Miiller notes that CMOS on sapphire is now a production technology. RCA has overcome a lot of the problems that have plagued would-be CMOS/SOS manufacturers by combining silicon-gate technology with ion implantation. Ion implantation, reports Miiller, overcomes a lot of control problems. It is no longer necessary to overdesign in order to be sure that you'll get exactly what you want, he claims.

Talking about future plans for SOS technology, Miiller predicts that by next year RCA will have a 4-k SOS/CMOS RAM. That just

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Finally, a second source for ECL III. Plessey's got 'em!

might beat the bipolar memory makers to the punch.

EAROMs getting bigger

Electrically alterable ROMs are quickly becoming the darlings of the PROM market. Yet only a few short years ago, most industry experts were wondering whether the complex nitride processing and extra expense that these devices require, would make them a viable product.

Bruce Moore, National's marketing manager for ROMs and PROMs, notes that the sudden interest in reprogrammable PROMs is due largely to the dramatically increased use of microprocessors. In fact, industry sources estimate that more than half of the EAROMs that will be sold will go into microprocessor systems.

Another reason for the increased use of EAROMs, says Moore, is that they are being accepted more. People are not as nervous about using them and accidentally losing their data as they used to be. Also, he continues, the larger fusible-link PROMs are producing extremely poor yields when they are programmed. The reason for this, he explains, is that there is no way of final-testing them. Once the link is blown, that's it. It can't be restored. No one, says Moore, can supply a 4-k fusible link PROM that will yield in the 90% range.

This is where the EAROM has a fantastic advantage, he declares. Because it is erasable, every single bit can be programmed and tested. If a part isn't up to par, the customer never sees it.

Until this year, any designer who wanted to use an EAROM was limited, with a few exceptions, to the 1702A, a 2-k ultraviolet erasable device. Then, answering the prayers of circuit designers for larger, easier-to-use devices, Intel and National announced larger devices almost simultaneously.

National came out with the MM-5204, a p-channel silicon-gate device that is organized into 512 words of 8 bits each. The device that Intel announced during the second quarter of this year was a 4-k unit similar to National's, and the industry's first 8-k EAROM.

The new reprogrammable devices operate at twice the speed, dissipate only one third as much power per bit and can be programmed five times faster than the 2-k standard.

Even though Intel's 8-k EAROM has only recently been announced, National's Moore thinks they may be having problems with it. Explaining why, he notes that they are already speed-selecting the device for a slower part.

In fusible-link bipolar PROMs, the latest development is Harris Semiconductor's family of Generic PROMs. According to Ed Fernandez, Harris' manager of memory products, the Generic PROMs are aimed at overcoming a major problem that faces users of programmable ROMs—lack of standardization. Unlike other fusible-link PROMs whose programming requirements vary from device to device, all the PROMs in the new Harris family have the same programming requirements and standard dc parameters. ■■

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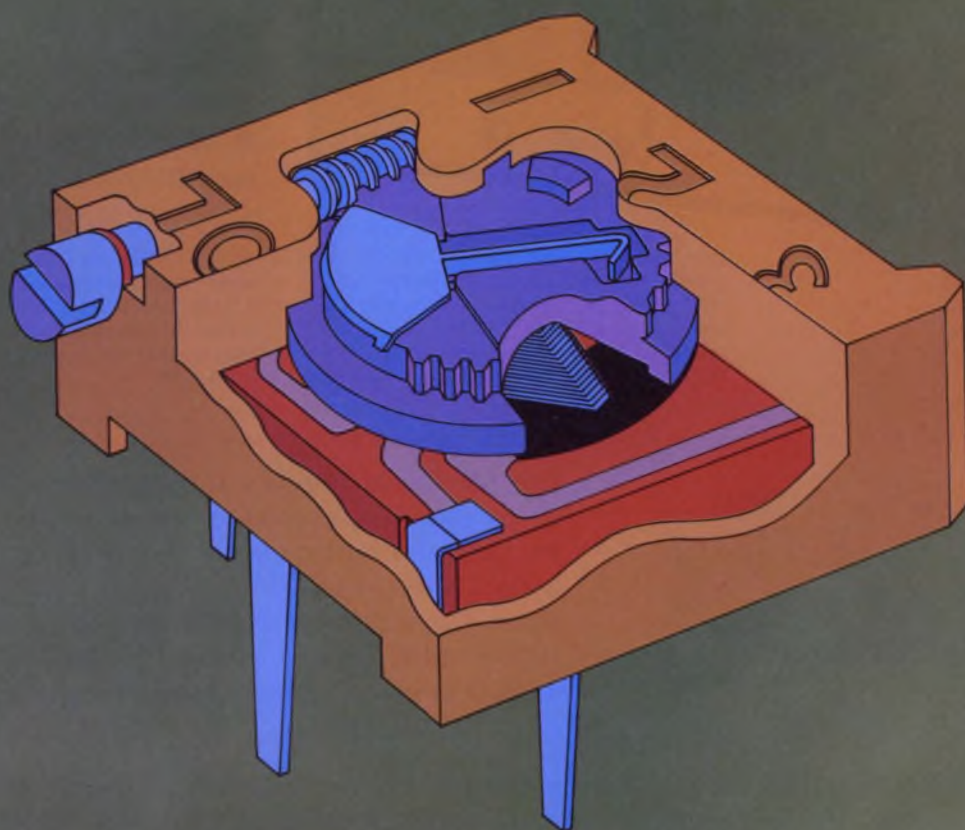

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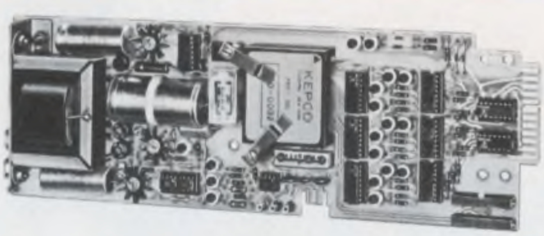

Washington Report

Congress bids to halt long-range spending

A move is under way in Congress to impose time limits on long term spending authorization, not only for major weapon systems but for small projects as well.

Sen. Joseph R. Biden Jr. (D-Del.) would like to limit congressional spending authorization to four years, and has introduced such a bill.

After four years a review would be conducted to examine not only the increased costs, but to evaluate the worthiness of the program itself. "Once a program gets started," he says, "it is very difficult to stop it, or even change its emphasis, regardless of its past performance."

Sen. Biden is also concerned that many small spending programs might otherwise automatically be continued without careful scrutiny. A lot of bad small programs could add up to a lot of wasted money.

Is technical innovativeness on the decline?

There is growing pressure in Congress for a national policy regarding research and development.

Sen. Lloyd Bentsen (D-Tex.), chairman of the Joint Economic Subcommittee on Economic Growth, warns of an increasing tendency in the U.S. to favor the protection of threatened industries over innovative moves into new and risky areas. Over the past 15 years, he says that U.S. companies have found it easier and safer to expand by manufacturing old products than to create new ones.

The Senator, decrying the nation's declining commitment to technological innovation, relates the drop in R&D spending to the decline in export sales. From 1953 to 1964 the annual R&D spending rate increased at a 12% clip and the balance of trade surplus in 1964 was \$6.1-billion. From 1964 to 1971, R&D spending increased at a rate of five per cent and the 1972 surplus became a \$6-billion deficit.

Environmentalists are gunning for PCBs

If the Environmental Protection Agency succeeds in pushing through its proposed effluent-discharge standards for polychlorinated biphenyls (PCBs), it may cost industry, and eventually the consumer, \$500-million a year. The cost will come from less efficient capacitors and transformers, which require more energy to produce. The extra energy would probably eat up 35-million barrels of oil a year, EIA says.

PCBs are compounds produced by replacing hydrogen atoms in biphenyls with chlorine atoms. They are used as fluid electrolytics in capacitors and in large electric utility transformers. Major advantages are their fire retardant qualities and desirable chemical qualities.

The proposed alternative chemical substitutes are not fire retardant and are not as safe and reliable. Also to get equivalent performance, capacitors and transformers made with the substitute materials will be physically larger.

EIA proposes adoption of two standards, one for Monsanto's PCBs, which are sold only to transformer and capacitor manufacturers, and one for imports which are not as biodegradable as American products.

The trade association argues that with over 200 variations of PCBs with differing characteristics they can't justifiably be lumped under one standard. EIA says the proposed standards are "unnecessarily stringent, practically unattainable and legally indefensible."

Avionics contract gets field performance clause

The Air Force has awarded the first large avionics production contract within the Defense Dept. with a Reliability Improvement Warranty—a clause that holds the contractor responsible for the field performance of the equipment for a specified period of time. The $14.6-million contract with Rockwell International's Collins Radio calls for an initial 1000 solid-state AN/ARN-118 (V) tactical air navigation Tacan units with options for 7000 more. The new units have an air-to-ground range of 390 nautical miles and an air-to-air range of 200.

Capital Capsules:

The National Science Foundation has been reorganized. The present Research Directorate now becomes three directorates: Mathematical, Physical and Engineering Sciences; Astronomical, Earth and Ocean Sciences; and Biological and Social Sciences. Functions of the Research Applications Directorate are unchanged, as are existing procedures, such as submitting proposals. . . . The Energy Research and Development Administration has awarded $1.4-million in contracts to General Electric, Westinghouse and Spectrolab **to study designs of terrestial photovoltaic electric power systems.** . . . The Air Force is soliciting manufacturers to to use an Air Force patented process **to produce high reliability nickel-cadmium batteries and nickel hydroxide electrodes for nickel-hydrogen batteries.** Sources are also sought to conduct exploratory development on octave bandwidth YIG-tuned oscillators in the 4-to-10-GHz range. . . . **Companies planning to export technology vital to the national interest no longer have to file a report with the East-West Foreign Trade Board.** Since the same information is included in the application for export licenses the Board has decided that this will be sufficient. . . . **The Navy will hold a briefing on SIRCs—Shipboard Intermediate Range Combat System—on Aug. 19** at the Naval Surface Weapons Center in Silver Spring, MD. SIRCs is an integrated, detection-to-kill, modular combat system for the mid-1980s and beyond for defending surface ships. . . . The Federal Council for Science and Technology has published **a directory on Federal technically oriented programs.** Called the "Directory of Federal Technology Transfer," it describes programs, agency contact points, and technical support resources of 43 agencies of the Federal government. Copies sell for $4.30 through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. . . . A low-cost, advanced flight control system for general aviation aircraft in which about one-third of the control surfaces are controlled by a **new automated avionics system is being tested** by the National Aeronautics and Space Administration in a Beechcraft Model 99 commuter aircraft.

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FOR DEMONSTRATION CIRCLE 289

HiNIL Interface

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CMOS systems are subject to latch-ups and failures in the field because of high voltage transients, static charge and improper field maintenance procedures. Moreover, due to their increased output impedance, CMOS is more susceptible to transient errors than corresponding bipolar logic.

A simple solution to these problems is to use Teledyne's bipolar High Noise Immunity Logic (HiNIL) as the system I/O interface. The I/O design approach shown in Figure 1 has solved these problems in applications such as business equipment, industrial controls and electronic games. The HiNIL interfaces protect the delicate CMOS inputs with a rugged bipolar "front end" not susceptible to CMOS failure modes. Also system noise immunity is maximized, and the HiNIL output devices provide direct, high current logic drive of relays, displays and long lines.

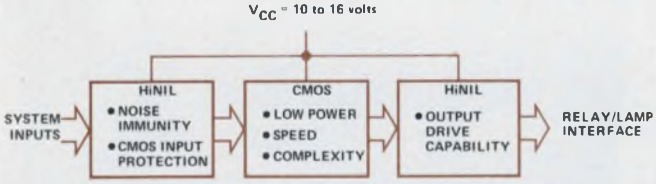

Figure 1. HiNIL input interface protects CMOS inputs while HiNIL outputs directly drive long lines and peripheral devices

The two families are directly compatible at the 10 to 16 volts V_{cc} range. The designer can take full advantage both of HiNIL's capabilities and of CMOS' low power dissipation, supply voltage flexibility and improved noise margin at higher supply voltages.

Parasitic SCR latch-up is an all too common CMOS malfunction. Large noise transients and DC input levels below ground or above V_{cc} could force CMOS input diodes into forward conduction, causing SCR action in the four-layer diodes formed by the diode and parasitic p-n substrate junctions. This condition leads to device latch-up, increased I_{cc} current and, when current is not limited, to gate destruction. Maximum protection can be obtained by using

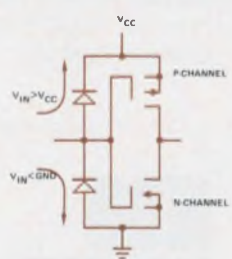

Figure 2A. CMOS latch-up causes

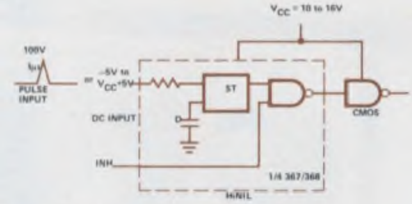

Figure 2B. HiNIL input protection

HiNIL Schmitt triggers. They prevent latch-up at DC input levels from −5 volts to V_{cc} +5 volts and suppress 100 volts transients as wide as 1μsec (Figure 2).

HiNIL inputs on plug-in cards will protect a CMOS system from problems associated with "on power" fault isolation, a widely used TTL system maintenance method. Plugging CMOS into powered connectors has led to latch-up failures because it allows inputs to see logic "1" signals before V_{cc} rises on the card. The failure is frequently catastrophic if input current is not limited.

HiNIL's lower output impedance and DC noise margin of 3.5 volts ignore large voltage noise transients that can cause CMOS logic errors. Also, static charges large enough to rupture CMOS oxide regions are often generated in dry environments by movement of materials and users. A HiNIL input gives more immunity to static and maximizes noise protection.

Examples of HiNIL Interface Devices

301 Dual 5-Input Power Gate 302 Quad Power NAND Gate (OC)	65mA relay or lamp driver
323 Quad NAND Gate (OC) 332 Hex Inverter (OC) 334 Strobed Hex Inverter (OC)	Input noise protection plus open-collector pullup to other logic levels
350 8-Bit Multiplexer 351 Dual 4-Bit Multiplexer	Drive longer lines than TTL with 10X noise immunity (I_{OH} = 12mA)
361 Dual Input Interface 362 Dual Output Interface 363 Quad Output Interface	361 directly connects HiNIL to DTL/RTL/TTL 362 and 363 connect DTL/RTL/TTL to HiNIL
367 Quad Schmitt Trigger 368 Quad Schmitt Trigger (OC)	Suppress 100V/1μs spikes, protect CMOS decode switches, etc.
380 BCD to Decade Decoder 381 BCD to Decade Decoder (OC) 382 BCD to Decade Decoder 383 BCD to 7-Segment Decoder	Provide decode/drive for lamps, LEDs, gas discharge displays, etc.
390 Interface Buffer Series	250mA HiNIL driver series will be available soon.

HiNIL reliability insurance costs little since the I/O circuits—unlike filters and shielding—generally replace other logic and drive circuits. So, don't wait until your new CMOS system runs into costly problems in the field. We'll show you how to build foolproof low-power systems. Call or write today for HiNIL application notes and specifications.

TELEDYNE SEMICONDUCTOR

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INFORMATION RETRIEVAL NUMBER 35

Editorial

The man who was never wrong

I used to think that arrogance was inversely proportional to a man's competence. I was wrong; competent people can be arrogant, too. My view was colored by Harry, an engineer who had more jobs than he could remember. Harry was good and, if you weren't certain, you had merely to ask him. There was nothing that he couldn't justify with the most cogent logic.

Harry was, in fact, one of the brighter engineers. But he was sloppy. He made lots of mistakes that could have been avoided with some care. If you showed him his mistakes, he always came out clean. He changed the subject; he gave a logical justification for the errors; or he blamed someone else, usually his technician.

When Harry lost a job, that was always someone else's fault: he had been knifed by someone playing company politics; the chief engineer was stupid and didn't recognize Harry's genius; people didn't like his showing up the ineptness of others; or somebody was making room for the boss' nephew.

Clarence was different. Clarence never lost a job; he owned the company. Like Harry, he never made mistakes. When he initiated design changes that made equipment blow up, he laced into his engineers for their stupidity. When his salesman made realistic sales forecasts, he boosted their sales quotas because, of course, his salesmen were simply lazy. And he raised hell when they didn't make the new quotas. When Clarence visited customers, he tried to show some humility, but couldn't quite succeed. Not surprisingly, he lost customers. These losses, of course, were always the fault of his inept salesmen or blundering engineers.

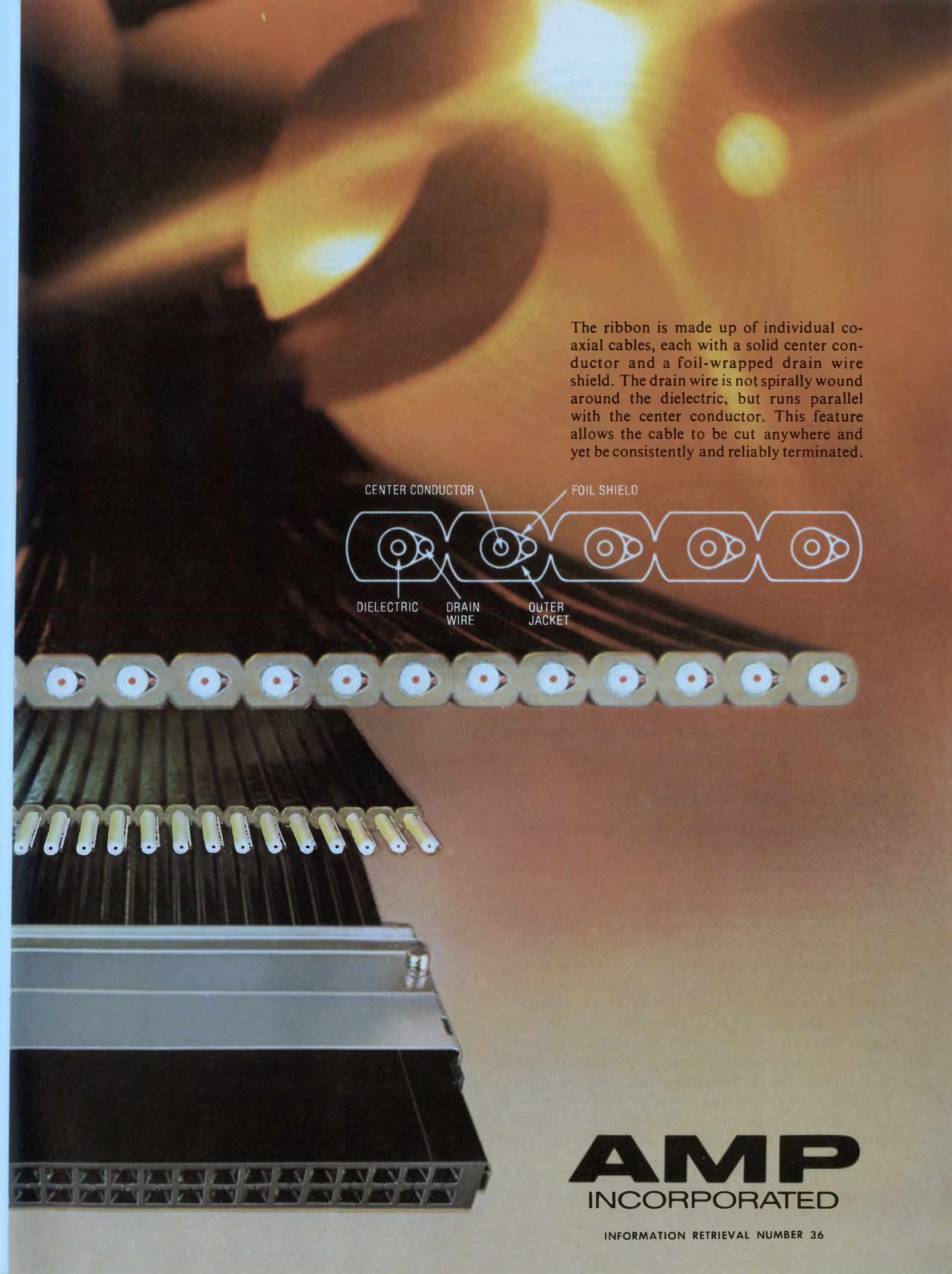
Clarence often harasses his staff and chews everybody out. He treats them like children and teaches them "lessons" about business. It's no surprise that Clarence's company is much smaller than it could have been.

But Clarence, like Harry, is extremely bright. So his company may survive. The unfortunate thing is that Harry and Clarence are completely unaware of the damage caused by their arrogance. Neither knows he's arrogant. Either could instantly justify every move and every decision with inexorable logic. They simply can't see what they're doing.

Can the rest of us?

GEORGE ROSTKY
Editor-in-Chief

We know you have more important things to do with your time than filling out forms. But once a year we're required to re-verify the qualifications of everyone who wants to continue his free subscription. Please take a moment now to fill out the form tucked inside the front cover. We promise we won't bother you again until next year.


The ribbon is made up of individual coaxial cables, each with a solid center conductor and a foil-wrapped drain wire shield. The drain wire is not spirally wound around the dielectric, but runs parallel with the center conductor. This feature allows the cable to be cut anywhere and yet be consistently and reliably terminated.
CENTER CONDUCTOR
FOIL SHIELD
DIELECTRIC
DRAIN WIRE
OUTER JACKET
AMP
INCORPORATED
INFORMATION RETRIEVAL NUMBER 36

FOCUS on Pots and trimmers

Environment, shock, vibration and even testing can shorten the life of a potentiometer or trimmer from millions or hundreds of operations to just one or a few.

The expected life is just one of the many factors that must be considered when you select and use a pot or trimmer. Here are some others: temperature coefficient, conformity, linearity, resolution, contact resistance variation, starting torque, backlash, environmental endurance and power rating.

Studying the pot or trimmer data sheet may not give you the true facts, even if the numbers are guaranteed minimum or maximum specifications. Let's look at some of the different specifications that relate to both pots and trimmers.

Resistances change with temperature

As the external temperatures change, resistance elements will drift off their specified values. Each element type has a temperature coefficient that the manufacturer specifies. Or does he? Some companies define the tempco over the entire range of the device and might give you a number like 100 ppm/°C. But this number could remain constant over the entire range or it could be 200 ppm/°C in the higher temperatures and only 30 ppm/°C at lower temperatures. Most likely the number you get from the data sheet is an average and can't really be trusted over a narrow range. Check out some units yourself to determine their actual drifts.

Also, make sure the amount of temperature drift doesn't take the resistance out of the tolerance band you need. A drift of, say, 200

Dave Bursky
Associate Editor

Precision bulk-metal trimmer potentiometers, made by Vishay, keep any resistance drift in check with their temperature coefficients of only 10 ppm/°C.

Large and small pots and trimmers by Bourns fill almost any application. There are sealed and unsealed versions in either single and multiturn configurations.

ppm/°C over a 50-C temperature change may alter the resistance enough to cause a failure in the external circuit.

How well does the resistance element conform to the specified linear, or other, characteristic. As the wiper travels along the element, you can check conformity by plotting the transfer function of the pot or trimmer as a graph of voltage vs percentage of shaft rotation. And how does temperature affect the conformity? If the element is made of one material, there should be no difference.

But, wirewound pots may have several types of wire, connected together in one element to form the characteristics you need. Each wire can have a different tempco and thus throw the conformity out of whack as temperatures change.

If you've selected a linear resistance device, how does the manufacturer define linearity? Vendors use several definitions. The Variable Resistive Components Institute (VRCI), 1717 Howard St., Evanston, IL 60202, lists most in standards VRCI-p-100A and VRCI-t-110A. And in standards VRCI-p-200A and VRCI-t-215A the institute describes how to inspect and test precision pots and trimmers, respectively.

The military also has specifications that describe several types of pots and trimmers: MIL-R-22097, 27208, 39015 and 39035 are just a few.

Make sure you can set the value

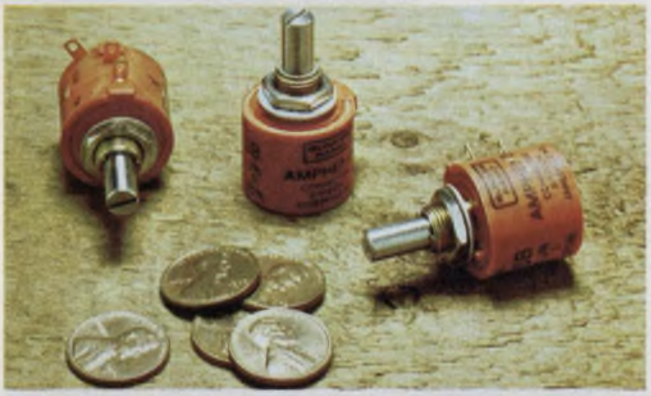
Whether you need a pot or trimmer, you have a choice of single or multiturn shaft capabilities. The multiturn types provide better resolution and settability but, of course, cost more than equivalent single-turn devices.

Multiturn pots and trimmers also have more complex mechanical drive mechanisms. Consider your application carefully, since the cost of a multiturn can range from double to 10 times that of a comparable single-turn unit. And some wiper drive mechanisms are more reliable than others. Ask the manufacturer how many rotations his unit can withstand. Another thing: How many turns do you need? Manufacturers offer a wide variety, from 1 to 40.

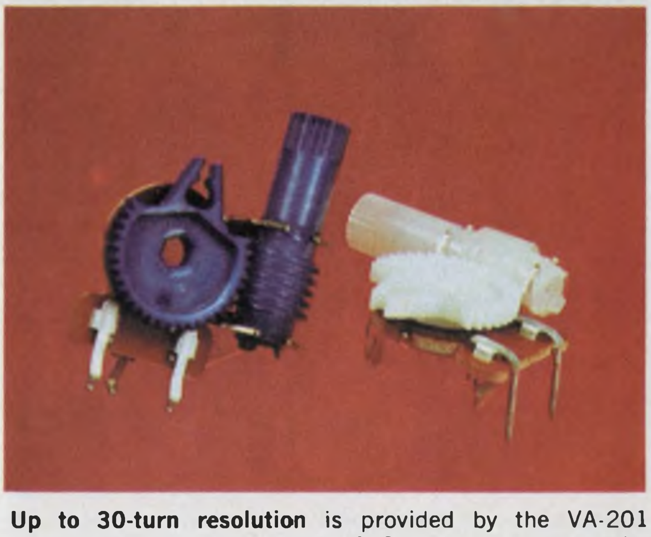
Some manufacturers now offer see-through trimmers that let you see the position of the wiper. This permits you to set the value faster and also gives you an initial "feel" for the setting. And you can get other mechanical aids that can indicate wiper position—turns-counting dials and pointers.

Pot or trimmer resolution depends upon the mechanical drive used, the type of resistance element selected and the shape of the element. For instance, wirewound elements usually produce an output that looks like a staircase—jumping up at discrete values as the wiper arm

These low-cost carbon trimmers from Stackpole are intended for high-volume applications. But they provide almost no environmental protection for the element.

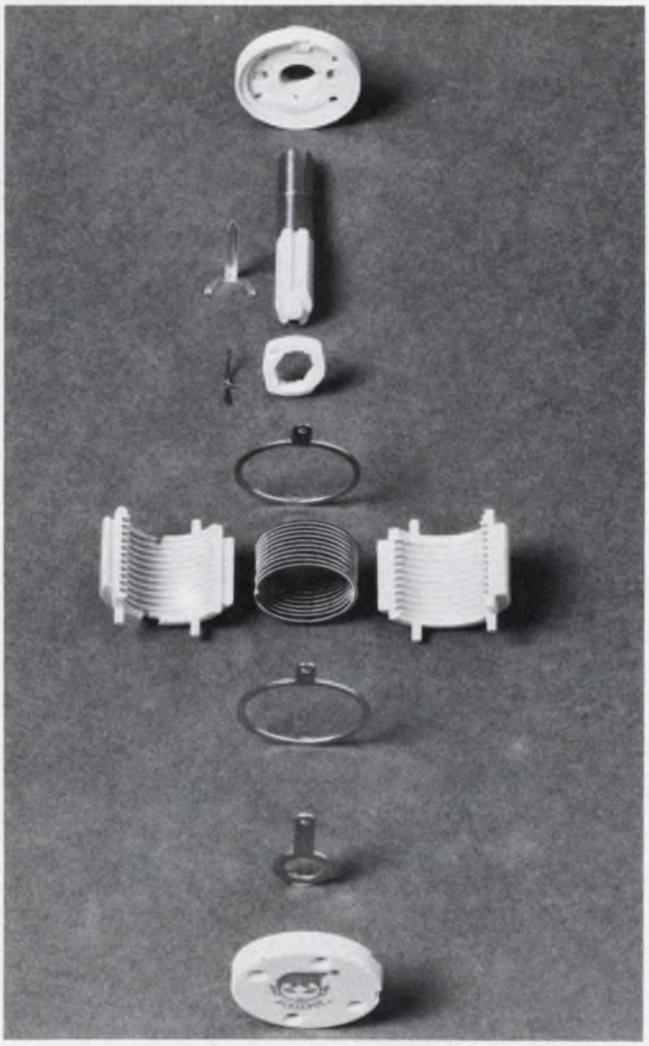


Miniature panel-mounting potentiometers by Amphenol, such as these Model 4201Bs, can handle several watts of power and provide multiturn resolution.



Up to 30-turn resolution is provided by the VA-201 trimmer potentiometers from CTS of Elkhart. The units can be mounted horizontally or vertically.

Ultraminiature panel-mounting potentiometers (Model 9917) from the IRC division of TRW require only 0.33 in. of behind-panel width and handle 0.5 W at 85 C.



A helical resistance element is just one of the parts that makes up a Duncan Pixipot. These units are available with resistances up to 150 kΩ.

moves from turn to turn. Some companies, though, have overcome this step problem by using a wiper that tracks a spirally wound wire; it doesn't miss any of the winding. This type of system is used in precision multiturn pots.

Another alternative to calibrated dials is provided by decade potentiometers that use thumbwheel switches to set values to within the desired accuracy. However, the mechanical life of the thumbwheel switches is usually far less than the usable life of the resistance elements.

Most element types provide so-called "infinite" resolution—as long as you don't need resistances down in the 0-to-50-Ω region. In this low area only wirewound elements reliably provide the low resistances.

As a wiper arm moves over a resistance element, how does the contact resistance vary? This error source, commonly called CRV, depends upon the pressure of the wiper against the element and can change the resistance "seen" by the external circuit. Some of the newer pots and trimmers use multifingered wipers that help eliminate some of this variation. An example of a fairly good CRV spec for a multifingered wiper would be 1% of total resistance or 3 Ω, maximum.

A side benefit of the multifingered wiper is lower noise. As the wiper moves across the element, it generates noise, but by spreading out the wiper contacts, manufacturers have reduced the noise.

Wirewound elements generate the least noise; carbon-composition elements generate the most. The noise is random and stems from several sources: friction and heat generated by the moving wiper, electrical heating due to current flow, and impurities within the element.

The wiper contact wears down the element material as you vary its position. Here's where you can get into trouble. If the pressure is light, you'll have minimal wear, but you'll also have a high value of CRV. Heavier pressure will wear the element faster but will lower the CRV. And the heavier the pressure the more torque needed to turn the adjustment shaft.

Adjust the units with care

How many times can you turn the shaft before the pot or trimmer fails? Most precision potentiometers are rated for over a million cycles, commercial pots in hundreds of thousands of operations and trimmers in hundreds of operations.

Precision units such as servo pots must be durable since they must go through hundreds of operations in just a single use. Low cost pots —like those used in stereos and TV sets—are not usually cycled over their full range but are adjusted over a limited span. They can thus be rated for a lower number of cycles.

Trimmers, on the other hand, are usually set once and then forgotten until it's time to recalibrate the equipment they're used in. They might be adjusted 10 to 20 times over the life of the equipment.

Whether you use a pot or trimmer, you must adjust the resistance with either a rotating knob, screwdriver or sliding knob. If the applied force or torque is too much, it can damage the unit; if too little, it won't move the wiper. Thus you'd like to know what starting torque is needed. If it's not on the data sheet, check with the vendor.

When you set the pot or trimmer, backlash caused by the mechanism changes the pot or trimmer setting by a slight amount. Check the data sheet for the backlash. Small changes in resistance after setting can cause measurement problems or a need for constant readjustment.

Aside from mechanical backlash, there are other problems when you try to return the resistance to a previously set value. Most of the time you'll be able to get within about 0.1% or better without much difficulty on calibrated precision devices and to within 5% on most noncalibrated units. Many companies spec this as settability—and along with a percentage figure they'll tell you how long, at the most, it will take you to set the value. However, every time the wiper moves, the resistance element value changes ever so slightly, as does the surface smoothness of the element and the pressure of the wiper. Thus, returning to a previously set value may not be as easy as you think.

After a pot or trimmer is set, what type of shock and vibration will it encounter? Even the lightest jar can move the wiper slightly. Make sure the shaft or slide doesn't move when the unit bounces. Many painstaking calibration procedures can be wasted if you don't use a locking shaft or some other preventive to keep the shaft from moving.

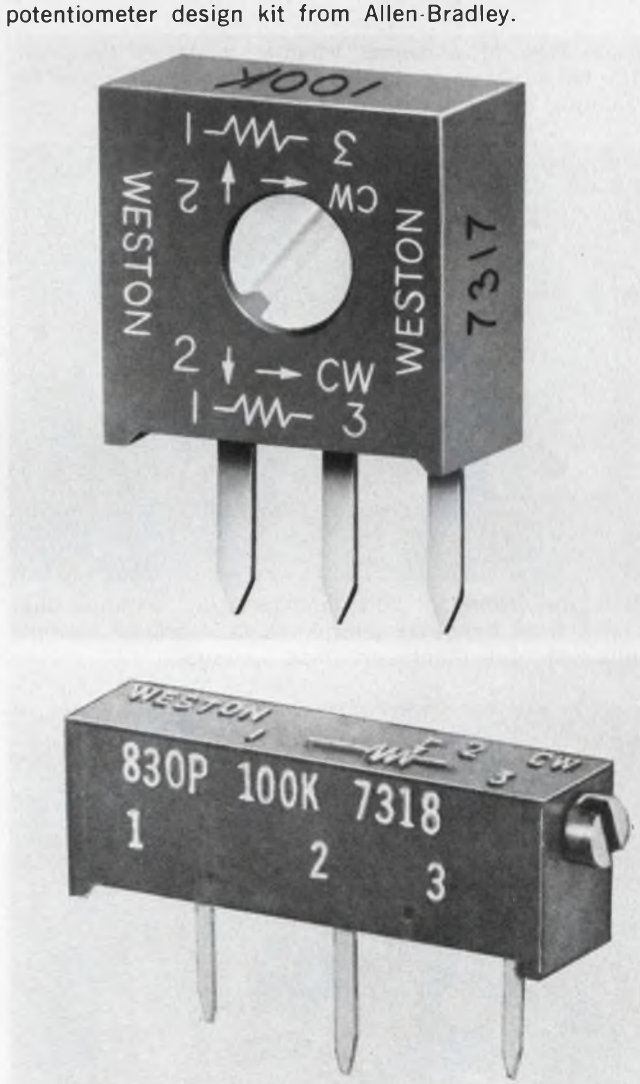
When the pot or trimmer is mounted on a circuit board, heat from the assembly process or fumes from the solder, flux or cleaner can ruin the element.

Be sure the pot or trimmer you've selected can withstand the assembly conditions. Some manufacturers may use a solder with a low melting point for element connections within the pot or trimmer. When you solder the unit into your circuit, you may open the connections to the resistance element or loosen them enough so vibration will cause an intermittent open.

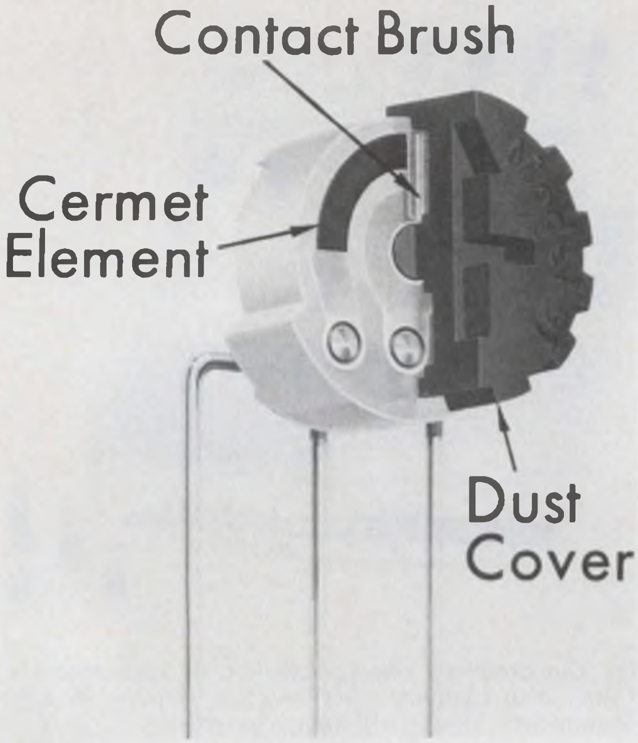
There are some types of connections that are fairly immune to typical solder temperatures. These include swage bonding, welding and clip terminations.

As for the flux or solvent you use, check with

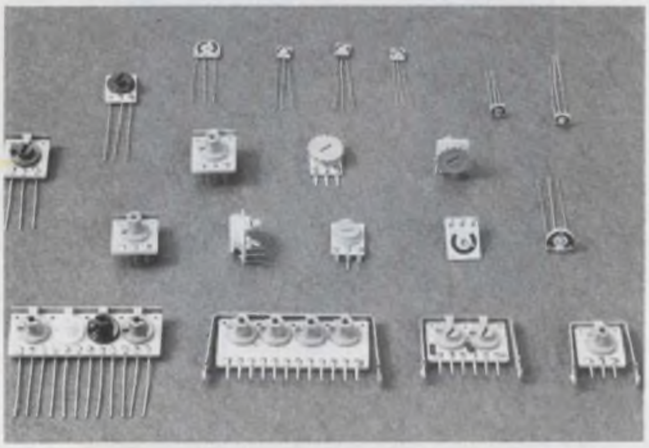
You can prototype any combination of resistance elements, shaft style and on-off switches with the Mod-Pot potentiometer design kit from Allen-Bradley.



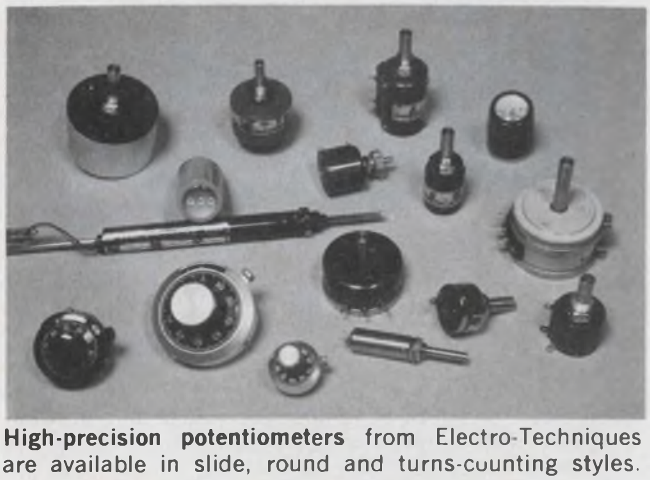
Square and rectangular trimmers are just part of Weston's line. The rectangular Model 830P 0.75-in. cermet unit shown costs less than $1 in 1000 pc lots, and the square unit, Model 840X, less than 60 cents.



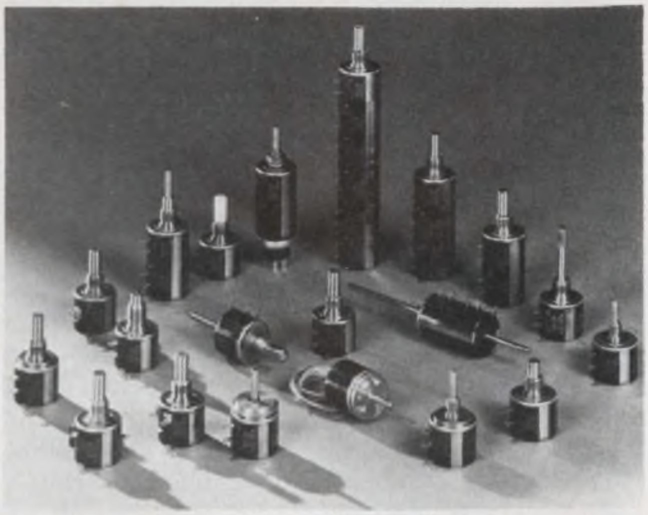
Inside view of a cermet trimmer made by Beckman. This Model 91 is a single-turn cermet device made for mounting onto printed-circuit boards.



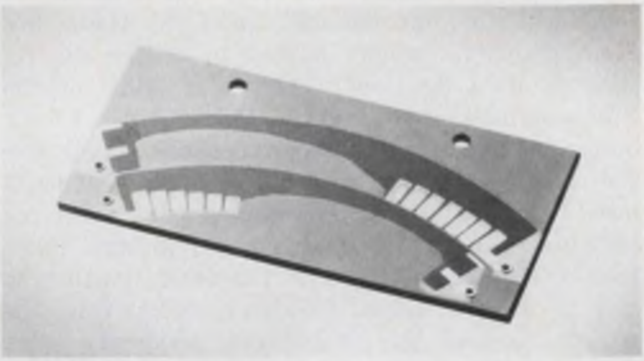
Miniature trimming potentiometers on ceramic substrates from Centralab permit the mounting of multiple units with just a single machine operation.



High-precision potentiometers from Electro-Techniques are available in slide, round and turns-counting styles. You can also get units with locking shafts.



Precision potentiometers from Spectrol are available with many different shaft styles and stacking arrangements. Also, switches can be added to the last element in a stack.



This quadrasonic joystick-panner control element made by Computer Instrument Corp. provides a 90° sine/cosine function and has mechanical travel of 60°.

the manufacturer to find out if it can contaminate the resistance element in unsealed pots or trimmers. The elements are very vulnerable to chemical attack. Even with sealed pots and trimmers, some solvents can get through the air-tight seals or damage the seal material and cause leaks.

Know the size you need

Size can be a determining factor when you select a pot or trimmer. For instance, if you need a unit that can handle 2 W or more don't expect to find it in a 0.25-in. square package or a 1-in. rectangular. You'll probably have to use a panel mounting pot. If you need a device with 5-W capability don't expect to buy a carbon composition pot in a 0.5 in. diam. case; wirewound and cermet units can fill this need.

Whether the pot or trimmer is square, rectangular or round, there are limitations on the power-handling capability. The larger the case, the larger the resistance element and the higher the power dissipation capability.

Element type / Parameter	Typical cost	Resistance range available	Power handling capability	Useful frequency range	Mechanical durability	Stability	Resolution capability	Setting ability
Wirewound	10¢ to \$10 +	1 Ω to 200 kΩ	1	6	3	1	3	6
Metal film	\$1 to \$10 +	10 Ω to 500 kΩ	5	1	5	3	1	3
Carbon composition	6¢ to \$1	50 Ω to 1000 MΩ	3	3	1	4	1	2
Carbon film	10¢ to 25¢	100 Ω to 1 MΩ	6	1	6	6	1	4
Conductive plastic	\$1 to \$10	50 Ω to 5 MΩ	4	1	4	5	1	5
Cermet	35¢ to \$5 +	10 Ω to 5 MΩ	2	2	2	2	2	1

Grading scale: 1 = best, 6 = worst
The table has been compiled from data supplied by Allen-Bradley, Beckman, Centralab, New England Instrument and Spectrol.

Typical sizes of rectangular trimmers, for instance, have decreased from the 1.25 in. long unit of the 1960s to the 0.75 and 0.5 in. models of today. Square and round trimmers are available in diameters or widths as small as 0.1875 in. Power ratings, of course, run from a few milliwatts for the carbon units to about 1.5 W for the cermet and wirewound trimmers.

Potentiometers have also shrunk in size, but not in capability or power-handling capacity. Cermet elements offer improved power ratings over carbon, and in some cases over wirewound elements. Wirewound pots and rheostats usually have the highest power ratings—you can pack 7.5-W capabilities into round cases with diameters of about 0.5 in. Cermet pots are not too far behind and should be in the 4-to-10-W range in the next few years.

Mounting the pot or trimmer is the next problem.

There are many types of mechanical mounting schemes. Custom mounting is usually available from most manufacturers, but you'll pay dearly for it. First, you'll probably have to commit yourself to a large order; many companies won't talk unless you want 100,000 pieces at between 5 and 50 cents each. Then comes a tooling charge for those custom metal or plastic parts needed to mount the device. Unless your requirements are so exotic that they rule out a standard mounting scheme, don't go custom. Many companies offer hundreds of mounting options, including different shaft styles for their own pots and trimmers, but you have to scour the catalogs to find what you need.

Picking the element taper

The resistance taper of potentiometer elements is another area where exotic requirements can prove expensive. Check the standard types available before you order a custom design. For customs, you'll spend from five to 100 times more.

But choose the standard taper carefully. Make sure both you and the manufacturer agree on exactly what's meant by a certain characteristic—for example, the type of logarithmic function, the number of decades and the percent rotation per decade. There are more variations than can be written for resistive elements; you can get types that conform to the sine, cosine, tangent or any other function that you care to create.

It's easy enough to zap the resistance element—just try using a VOM to measure the resistance of a low-power pot or trimmer. If one lead of the VOM is connected to the wiper and the other to one end of the element, the scale set on ohms $\times 1$ and you try to measure the minimum resistance of the unit—you can easily end up with a burned out element.

The VOM has an internal power source that generates a current that can reach several hundred milliamps when using the ×1 setting. This current can generate enough power and heat through the element to open it before the pot or trimmer is ever put in a circuit.

Placing too high a voltage across the element is another fast way to wipe it out. In this case, though, you can cause even more damage. If the voltage is too high it can break down the dielectric material that separates the resistance element from the case or panel in which the unit is mounted. Make sure you don't accidentally set the stage for subsequent shock hazards.

Ground potential differences can also cause unexpected failures. Make sure there are no large differences that can cause dielectric breakdown. If you do have large differences get a unit that is specially designed for high voltages.

When you use a pot or trimmer as a variable voltage divider to supply a large current, the power dissipation along the resistive element may be uneven. The section from the wiper to the end terminal connected to the supply conducts a current that is the sum of the load current and the current through the rest of the element. The power dissipation per unit length of the element is a function of the square of the

Need more information?

We wish to thank the many companies that provided information for this report. Readers may wish to consult the manufacturers listed below and in Electronic Design's GOLD BOOK for further technical details. (Companies that manufacture pots are noted with a P and those that make trimmers with a T.)

Allen-Bradley Co., 1201 S. 2 St., Milwaukee, WI 53204. (414) 671-2000. (C. Ryder) P, T **Circle No. 401**

Amphenol Connector Div., Bunker Ramo Corp., 2801 S. 25 Ave., Broadview, IL 60153. (312) 345-9000. (C. Kucera) P, T **Circle No. 402**

Astrosystems Inc., 6 Nevada Dr., Lake Success, NY 11040. (516) 328-1600. (G. Shinbrot) P **Circle No. 403**

Beckman Instruments, Helipot Div., 2500 Harbor Blvd., Fullerton, CA 92634. (714) 871-4848. (R. Allen) P, T **Circle No. 404**

Bourns Inc., Trimpot Products Div., 1200 Columbia Ave., Riverside, CA 92507. (714) 684-1700. (B. Todd) P, T **Circle No. 405**

Bowmar TIC Inc., 850 Lawrence Dr., Newbury Park, CA 91320. (805) 498-2161. (D. Gustafson) P **Circle No. 406**

British Radio Electronics Ltd., 927 Gist Ave., Silver Spring, MD 20910. (301) 589-6688. (J. Yonker) P, T **Circle No. 407**

Carter Mfg Corp., Sugar Rd., Bolton, MA 01740. (617) 779-5501. (L. Tedstone) P, T **Circle No. 408**

Centralab Elecs Div., Globe-Union Inc., 5757 N. Green Bay Ave., Milwaukee, WI 53201. (414) 228-1200. (D. MacDonald) P, T **Circle No. 409**

Clarostat Manufacturing Co., Inc., Lower Washington St., Dover, NH 03820. (603) 742-1120. (J. McDevitt) P **Circle No. 410**

Computer Instruments, Potentiometer Div., 92 Madison Ave., Hempstead, NY 11550. (516) 483-8200. (S. Granat) P **Circle No. 411**

CTS Corp., 905 N. W. Blvd., Elkhart, IN 46514. (219) 293-7511. (R. Ramsby) P, T **Circle No. 412**

CTS Keene Inc., 3230 Riverside Ave., Paso Robles, CA 93446. (805) 238-0350. (J. Bell) P, T **Circle No. 413**

CTS Microelectronics Inc., Box 1278, Lafayette, IN 47902. (317) 463-2565. (F. A. Leingang) T **Circle No. 414**

CTS of Asheville, Mills Gap Rd., Skyland, NC 28776. (704) 684-6451. (T. Haney). P, T **Circle No. 415**

CTS of Berne Inc., 406 Parr Rd., Berne, IN 47371. (219) 589-3111. (J. Long) T **Circle No. 416**

Dale Electronics, 1376 28 Ave., Columbus, NE 68601. (402) 564-3131. (B. Klug) P, T **Circle No. 417**

Diplohmatic Div., Harry Levinson Co., 1211 E. Denny Way, Seattle, WA 98122. (206) 323-5100. (H. Levinson) T **Circle No. 418**

Duncan Electronics Inc., 2865 Fairview Rd., Costa Mesa, CA 92626. (714) 545-8261. (J. Houdyshell) P **Circle No. 419**

EECO, 1441 E. Chestnut Ave., Santa Ana, CA 92701. (714) 835-6000. (T. Price) P **Circle No. 460**

Electrol Co., Inc., 771 Spring Ln., York, PA 17403. (717) 843-0242. (R. T. Dudley) P, T **Circle No. 420**

Electro-Techniques, 215 Via Del Norte, Oceanside, CA 92054. (714) 757-7770. (W. Galvan) P, T **Circle No. 421**

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Weston Components Div., Archbald, PA 18403. (717) 876-1500. (F. Butteri) T **Circle No. 458**

Wilbrecht Electronics Inc., 240 Plato Blvd., St. Paul, MN 55107. (612) 222-2791. (J. Wilbrecht) P, T **Circle No. 459** current passing through it.

And, when you use the pot or trimmer as a rheostat, don't use the rating given on the data sheet unless it is specifically for that application. Only a fraction of the pot or trimmer power rating can be used in the two-terminal mode.

Fortunately, power handling requirements are now dropping with the increasing use of solid-state circuits. Most of the newer active components need less power to do the job of older circuits, and thus need lower ratings on pots and trimmers within the equipment. But this advantage is offset by the need for miniaturization.

Picking the element material

Pot or trimmer resistance elements can be made from many materials—wire, carbon composition, carbon film, metal film, cermet, conductive plastic and bulk metal are the most common. Each has different electrical and mechanical properties (see table) that best fit widely divergent applications.

Some applications call for extra precautions. Wirewound elements, for instance, have a limited useful frequency range, from dc to about 5 kHz, while cermet and some film elements aren't much use if the required resistance is under 50 Ω.

No matter which element material you select, check the element size. Manufacturers use different chemical compositions for their resistance elements, and elements may thus have different sizes or shapes, even if they are all rated for the same resistance or power dissipation. In general, the larger the resistance element, the better the resolution and the higher the power dissipation.

A mix of capabilities is provided by hybrid potentiometers—in these units the wiper path of a wirewound element is coated with a conductive film, such as plastic or metal.

These units backstop the catastrophic failure problems that plague film elements. And, they blend the stability of wirewounds with the long life and infinite resolution of the metal film elements.

There are even some wiperless potentiometers available. These devices use variable transformers to handle ac voltages, or a mechanical transducer and conditioning circuitry for dc voltages, or Hall-effect transducers that change resistance depending upon the position of a nearby magnet. Some of these units do, however, require an external power supply to bias the sensor or conditioning circuitry.

And, if you need the ultimate in stability, bulk-metal elements produce trimmers that have tempcos down to 10 ppm/°C and settabilities to within 0.05%. ■■

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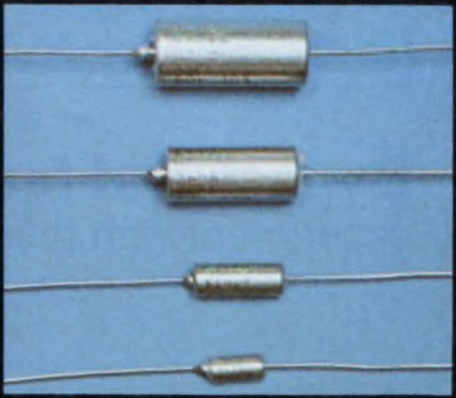

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Technology

Bypass and feedthrough filters: You needn't experiment with their design. A simple graphic technique provides accurately predictable filter performance.

Circuit engineers need no longer resort to trial and error to design single-element bypass and feedthrough interference filters. Their design has been reduced to the use of a few graphs and some simple ratios. With this technique, even the degrading effects of capacitor lead length on bypass-filter insertion loss is easily determined.

Schematics of both idealized and practical low-pass capacitor filters are shown in Fig. 1. The practical version includes a series inductance to account for capacitor lead length. Insertion-loss curves for the ideal capacitor filter are plotted over a range of normalized frequency ratios, F, for several values of mismatch ratio A. And a nomograph solves for cutoff frequencies (Fig. 2).

Robert B. Cowdell, Senior EMI/Tempest Engineer, Collins Radio Group of Rockwell International, Newport Beach, CA 92663.

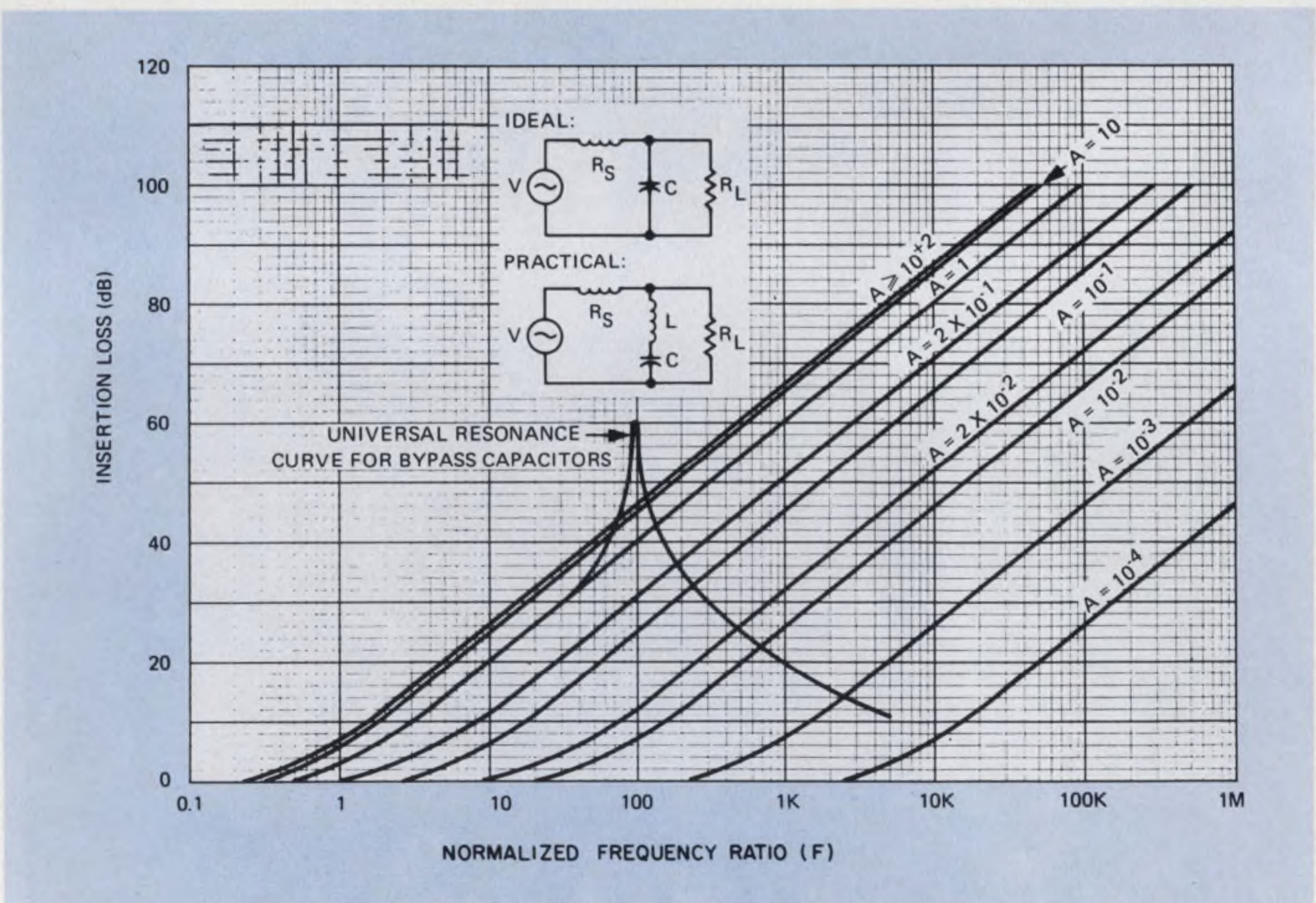
The normalized frequency ratio is

$$F = f/f_o,$$

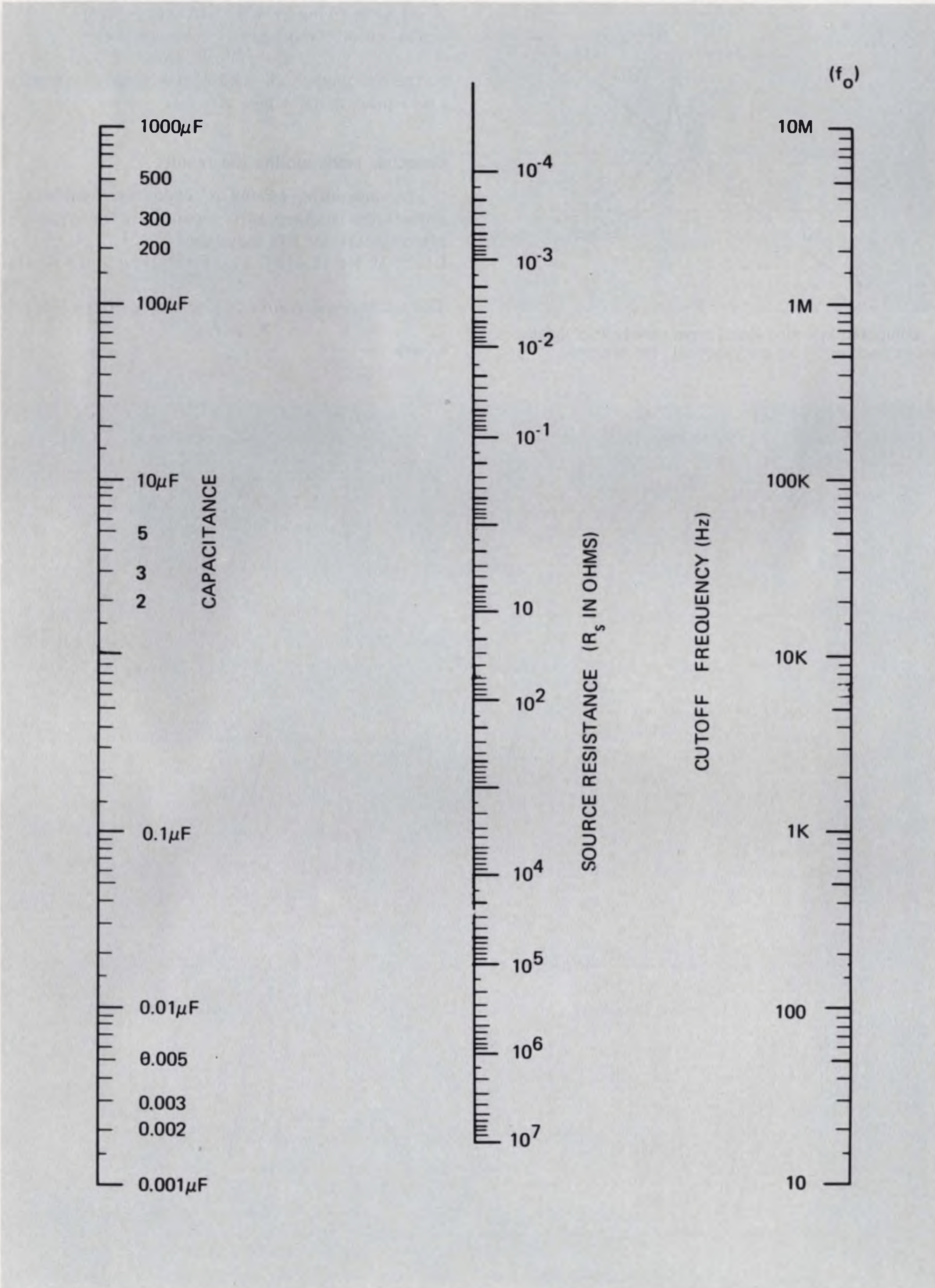
where f is the frequency of interest and f_o is the filter cutoff frequency. The mismatch ratio is

$$A = R_L/R_S,$$

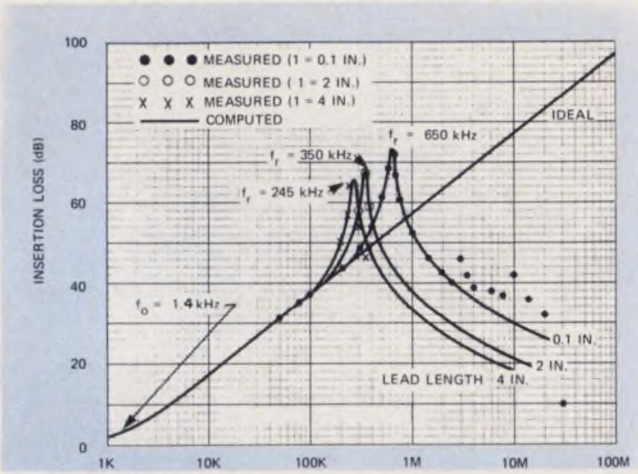
where R_L is the load resistance and R_S is the source resistance. And the normalized insertion



1. **A family of normalized insertion-loss curves** for idealized bypass circuits and a universal curve to correct for capacitor lead length enable accurate prediction of the filter's insertion-loss performance.



2. **A nomograph simplifies the calculation** of a bypass filter's cutoff frequency, f_o.



3. **Computed insertion loss agrees closely** with measured results, especially at the practical lead lengths.

loss equation for an ideal capacitor filter is

$$I.L. = 10 \log \{1 + F^2 [4A^2/(1+A)^2]\}. \quad (1)$$

The cutoff frequency, expressed as

$$f_o = 1/\pi R_S C,$$

is the frequency at which the filter's insertion loss equals 3 dB when $A = 1$.

Capacitor leads modify the results

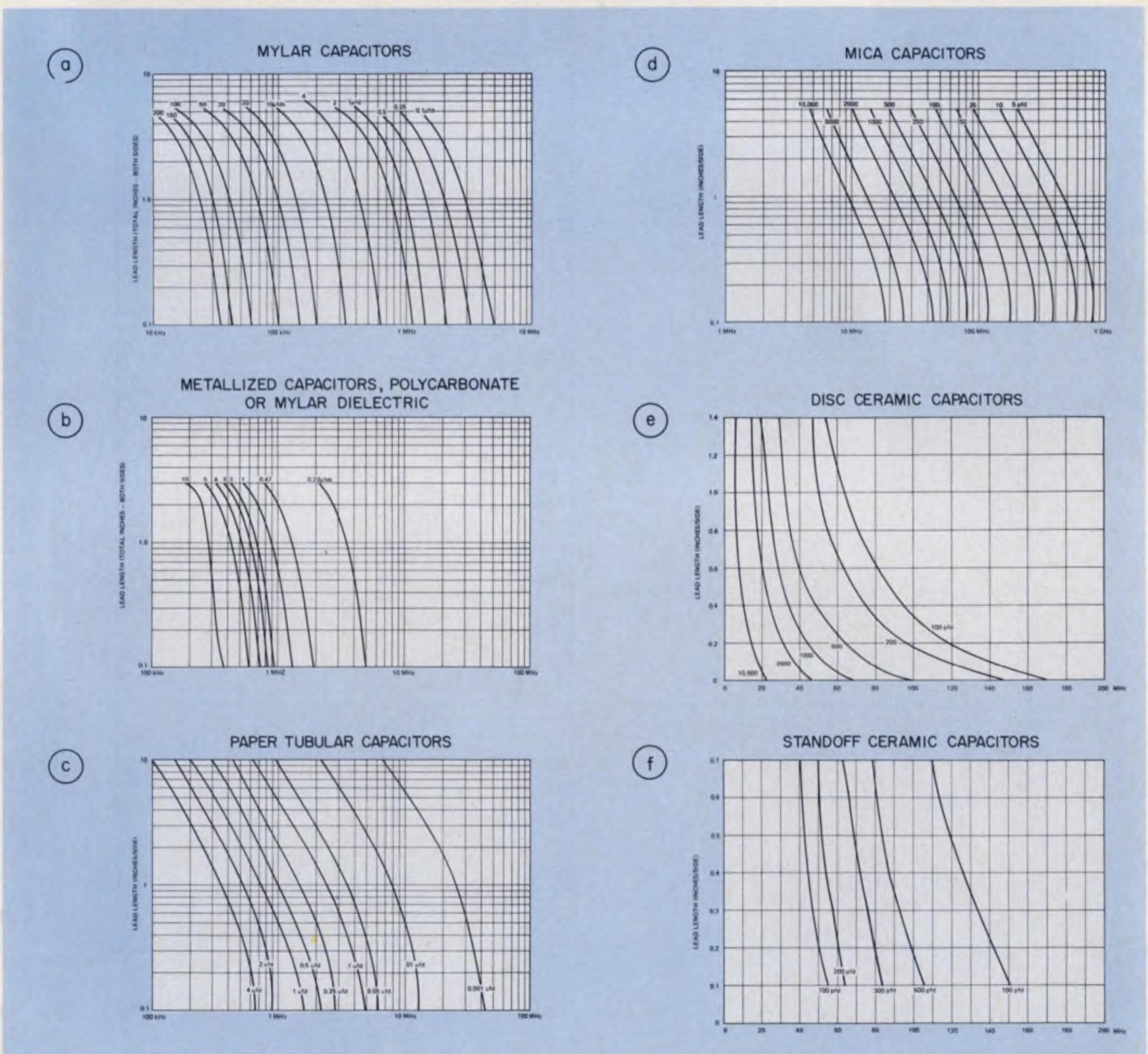
The degrading effects of capacitor lead-length inductance is taken into account in the practical filter circuit by the equation

$$I.L. = 10 \log \{1 + [F^2/(1-F_r^2)^2] \; [4A^2/(1+A)^2]\}. \quad (2)$$

The normalized resonant frequency of the filter is

$$F_r = f/f_r,$$

where



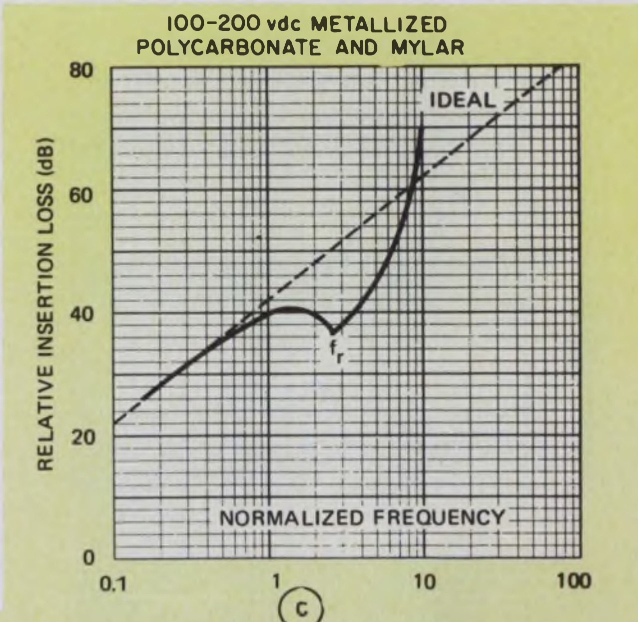
4. **Measured resonant frequency vs lead length** is provided for a variety of capacitor types used in bypass filters. The resonant frequency, f_r, is used to align the universal resonance curve with the idealized curve.

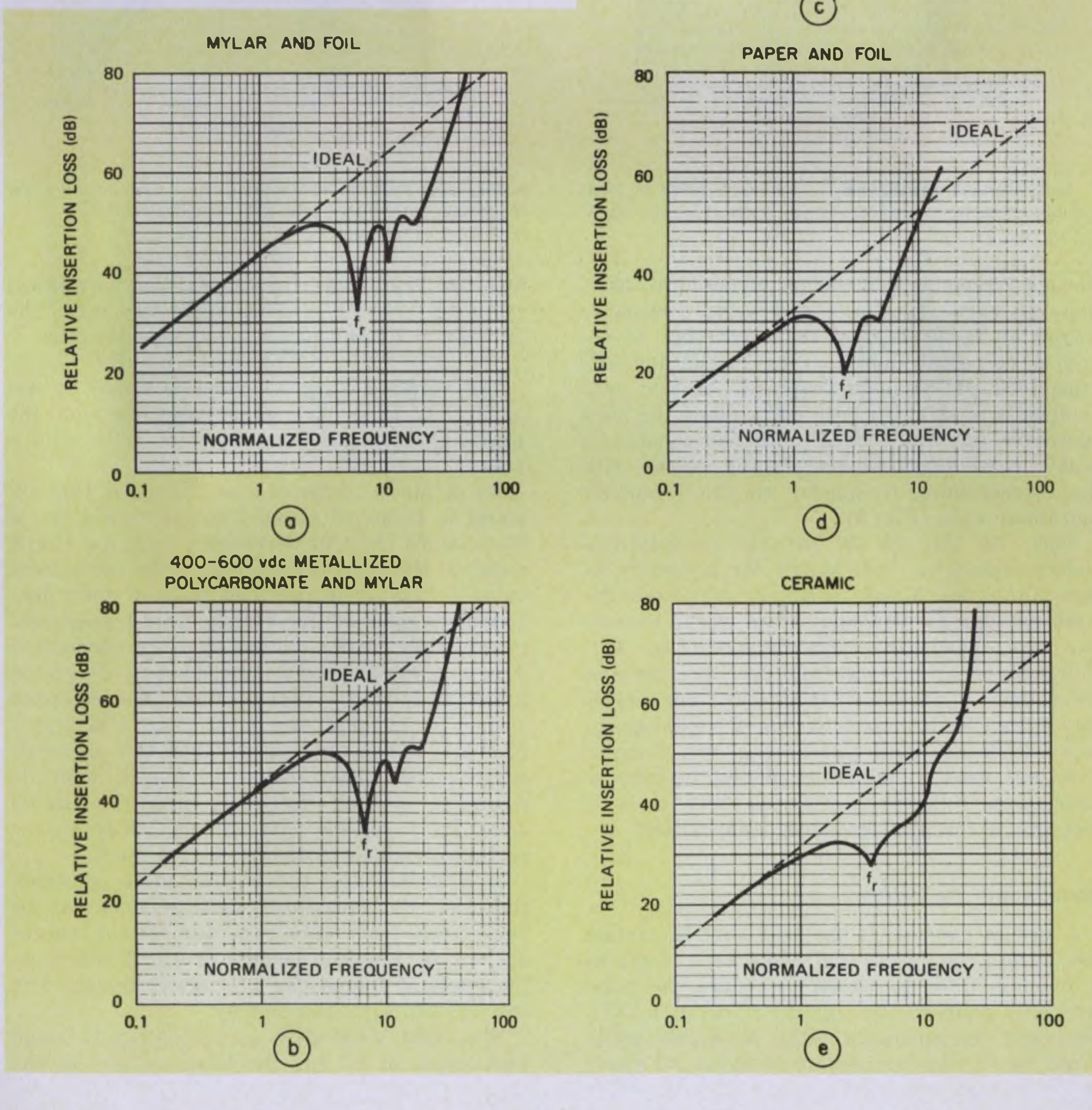
$$f_r = 1/(2\pi\sqrt{LC}).$$

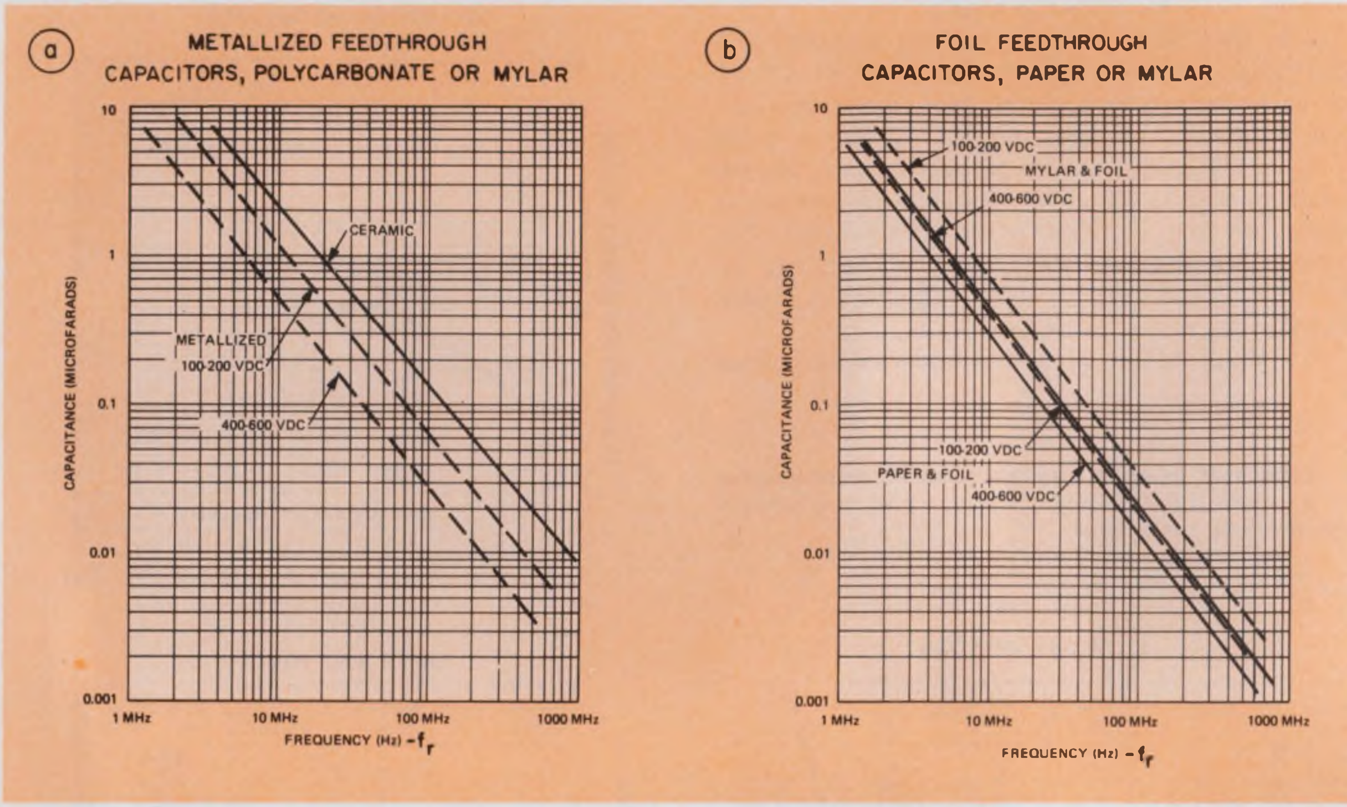
Note that the equations for the practical and ideal cases differ only in the term $(1-F_r^2)^2$, which is defined as the universal resonance correction factor. A plot of Eq. 2 for a ratio $f_r/f_o = 100$ yields the cusp-shaped curve shown superimposed in Fig. 1 on the ideal insertion-loss curve for $A = 1$. This curve is universal. The same curve shape is used to correct for lead inductance of all bypass filter capacitance values and any degree of mismatch.

For small values of f, the universal resonance

5. **Normalized insertion-loss resonance correction curves** for a variety of feedthrough capacitor types help simplify insertion-loss predictions.







6. **Self-resonant frequencies,** f_r, for some types of feedthrough capacitors are dependent upon the capacitors' voltage specification. The value of f_r is used to align the resonance correction curve with the ideal curve.

curve corresponds to the shape of the ideal insertion loss curve, because the universal resonance correction factor is close to unity. Thus to obtain a corrected insertion loss curve for any capacitor's self-resonant frequency, all that need be done is to shift the cusp curve along the ideal curve for any value of A until the capacitor's peak, or resonant-frequency point, aligns with the corresponding frequency on the frequency coordinate axis (Fig. 3).

Figs. 4a through 4f provide resonant-frequency values vs. lead length for a variety of capacitor types. Mylar capacitors have been the most popular for low-pass filter work, because they are inexpensive and rugged (Fig. 4a). However, metalized capacitors can save space in low-voltage applications (Fig. 4b). For values larger than 5 μF in ac filter work, paper capacitors are often a good choice (Fig. 4c). Ceramic units are used in miniature filters, because of their high volumetric efficiency, and mica is best suited for high-frequency applications.

Working with the curves

A design example is the best way to explain how to use the curves and nomograph. Suppose a low-pass filter is needed to reduce the noise level on a matched 50-Ω line by 57 dB at 1 MHz. Obviously the mismatch ratio, A, equals unity. From Fig. 1, the intersection of the A = 1 curve and the 57-dB loss line yields the normalized frequency ratio, F = 700. From this ratio, the filter's cutoff frequency is easily calculated as

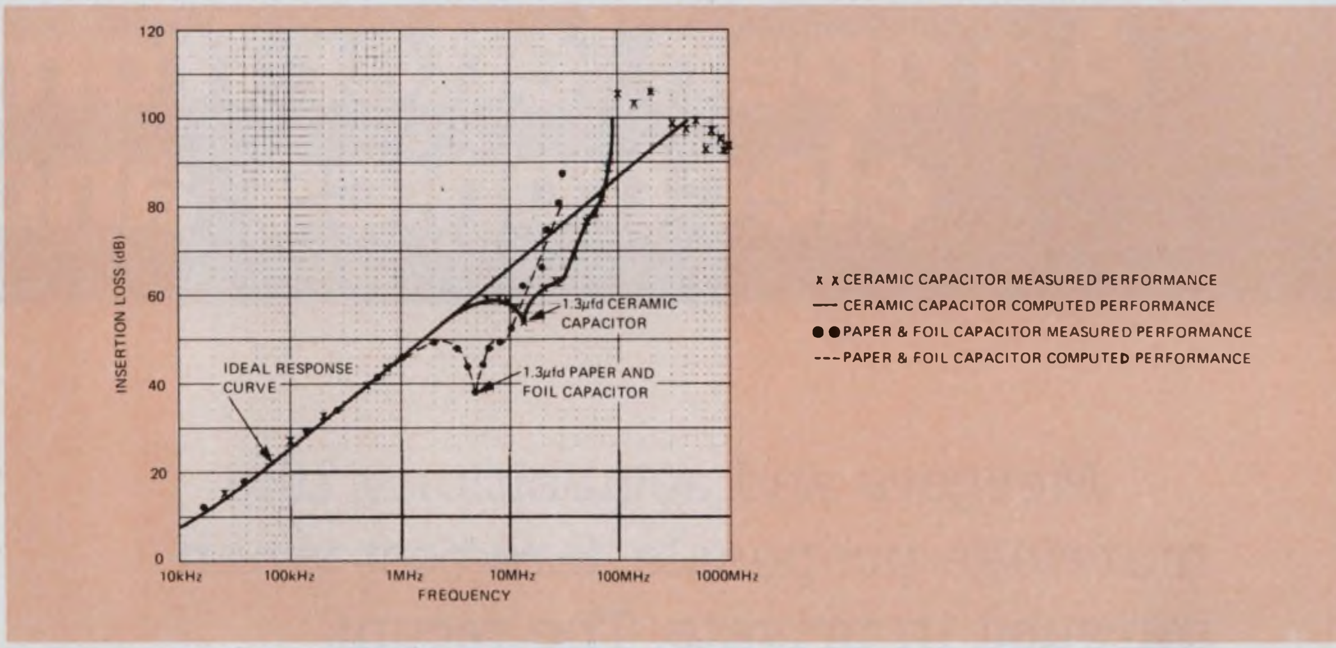
$$f_o = f/F = 1 \text{ MHz}/700 = 1.4 \text{ kHz}.$$

The required capacitor value is found by use of Fig. 2. Place a straight edge through the points f_o = 1.4 kHz and R_S = 50 Ω to yield a value C = 4.5 μF.

To obtain a corrected loss curve for this example in terms of actual frequency (Fig. 3), a transparent sheet of seven-cycle semi-log graph paper of the same dimensions as the normalized curve of Fig. 1 is provided with a convenient frequency scale on its x axis. This transparent graph paper is then aligned over the normalized A = 1 curve. The frequency scale of the overlayed graph at f_o = 1.4 kHz is made to correspond with F = 1. First, the A = 1 curve is traced onto the transparent sheet. Then the universal self-resonant cusped curve is traced, with its resonant, or peak, frequency properly located along the frequency axis and its low-frequency portion coincident with the A = 1 curve.

If a Mylar capacitor is selected to construct the filter, the capacitor's self-resonance can be determined from data provided by the curves on Fig. 4a. For lead lengths of 0.1, 2 and 4 in., the resonant frequencies are approximately 640, 350 and 245 kHz, respectively.

Note that with even an impractically short lead length of 0.1 in., the insertion loss of the



7. **Measured and predicted insertion loss** for feedthrough capacitors agree closely below 100 MHz.

practical circuit at 1 MHz is less than desired—about 53 instead of 57 dB—because of the resonance correction. Either this lower degree of filtering must be accepted or another capacitor type found that can provide a higher resonant frequency and with longer leads. However, a small disc ceramic capacitor in parallel with the 4.5-μF Mylar unit might be an easier solution.

Feedthroughs have complex properties

A practical equivalent circuit for feedthrough capacitors is complex and results in equations that are difficult to use. Instead, measured and normalized universal resonance correction curves are provided for a variety of capacitor types (Figs. 5a through 5e).

All feedthrough capacitors exhibit at least one resonance point and some as many as three. The first, or lowest frequency, is designated f_r.

Measured f_r values for some feedthrough types show a strong relationship between the capacitor's voltage rating and its f_r (Figs. 6a and 6b). The smaller dimensions of low voltage rated Mylar and paper capacitors, of course, result in lower inductances and higher resonant frequencies. In addition the shapes of the normalized correction curves sometimes change with voltage rating (Figs. 5b and 5c).

By contrast, in bypass filtering a capacitor's voltage rating is not an important factor. For example, as the lead length of a metalized 1-μF polycarbonate capacitor is increased from 0.1 to 3 in., the self-resonant frequency of a 50-V unit changes from about 1.3 MHz to 530 kHz, and a 400-V unit covers almost the same range—from 1 MHz to 530 kHz.

As a design example of how to use the feedthrough filter curves, consider a 50-Ω matched line that requires noise suppression of at least 70 dB between 1.5 MHz and 1 GHz. The line voltage level is 24 V dc. To find the size and type of capacitor best suited for this job, proceed as follows:

- In Fig. 1 for A = 1 and I.L. = 50 dB, find F = 300.
- Compute $f_o = f/F = 1.5$ MHz/300 = 5 kHz.
- In Fig. 2 with $R_S = 50\ \Omega$ and $f_o = 5$ kHz, find C = 1.3 μF.
- Trace on a piece of transparent seven-cycle semi-log paper the ideal response, with $f_o = 5$ kHz aligned with F = 1 on Fig. 1 (see Fig. 7).
- Consider a 50-V ceramic feedthrough capacitor. From Fig. 10, find $f_r = 13.5$ MHz for a 1.3-μF ceramic capacitor.

Align the resonant dip, f_r on Fig. 5e to coincide with 13.5 MHz on the ideal response curve for A = 1, as in Fig. 6. Trace the universal resonance correction curve. The resulting response coincides very closely with the measured response.

Now consider solving the same problem with a 100-V-dc, 1.3-μF paper-and-foil feedthrough capacitor. From Fig. 6b, $f_r = 4.8$ MHz. The response is now traced from Fig. 5d. This capacitor does not provide the required 50 dB of insertion loss until 9 MHz.

The paper-and-foil capacitor is inadequate because its lower f_r significantly impairs the insertion loss in the desired frequency range. To achieve 50 dB at 1.5 MHz with a paper capacitor, a very large capacitor value would have to be used to bring its f_r down to about 0.15 MHz, and its size and weight would be excessive. ■■

An open letter from electronics and

Mergers and acquisitions, like marriage proposals, fare best when pursued in private. The recent acquisition of Signetics by U.S. Philips Corporation wasn't talked about until it became a fact. Then the announcement naturally prompted a number of questions. We would like to reply to those which have been asked frequently enough to indicate that the answers are of general interest to our friends, customers and vendors.

Sincerely,

Charles C. Harwood

Charles C. Harwood, President
Signetics Corporation

Consider using resolvers and synchros

when you design mechanical positioning and sensing systems. They offer important advantages, even in digital applications.

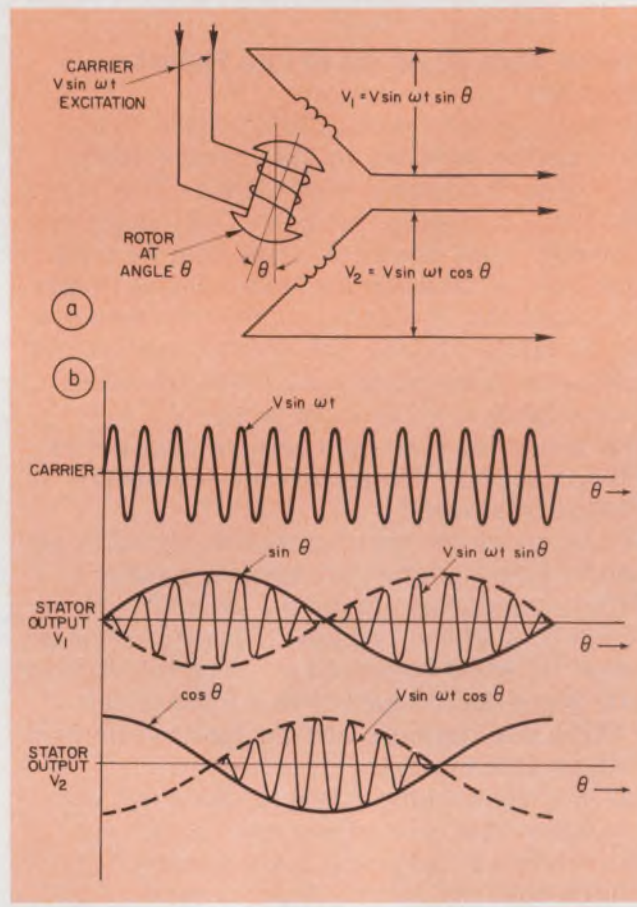
Resolvers and synchros are found in many electromechanical systems that sense position, perform machining operations and do simple calculations. These analog transducers provide infinite-resolution sinusoidal output signals that define the position of a rotating shaft.

There is one essential difference between resolvers and synchros—resolvers provide a two-phase signal while synchros deliver three-phase signals. But you can use either a resolver or synchro, as long as you use a Scott-T network to convert two-phase signals into three-phase or vice-versa. You can also make the sinusoidal outputs of these transducers compatible with digital displays or computers by use of solid-state converter circuits.

Basically, the resolver and synchro are built with one moving winding on the armature and several fixed windings. As the armature shaft turns, the coupling between it and the fixed coils varies with the sine of the angle, and, in turn, modulates a carrier signal that is fed into the armature coil. Thus the output signals in the fixed coils are a modulated form of the carrier, displaced by the angular distance between each coil.

There is very little wear, so life expectancy of these transducers is good. The cost, for moderate precision units (equivalent to about 14-bits), is less than for other types of encoding systems.

Resolvers and synchros are each available in three different versions, defined in terms of function—transmitter, receiver and differential transmitter.



1. **Coupling between the rotor and stator windings** of the resolver transmitter varies with the sine and cosine of the shaft angle (a). The carrier waveform gets modulated by the motion of the rotor and the resulting variation in the coupling between the rotor and the two fixed stator coils of the resolver (b).

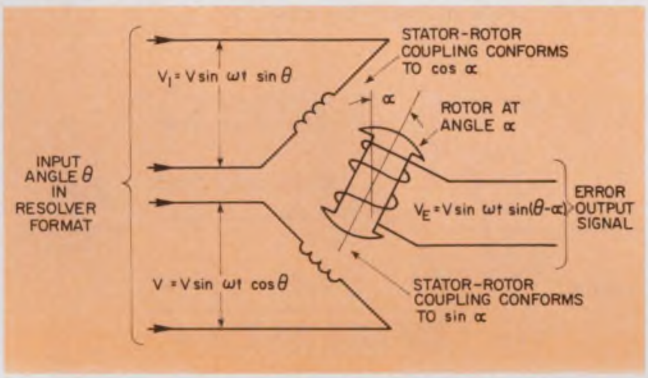
Each type has its own function

The transmitter develops sinusoidal output signals whose amplitude ratios define the angle to which the connected shaft has been positioned. Resolver or synchro transmitters are referred to as control transmitters and designated by the symbol CX in most literature.

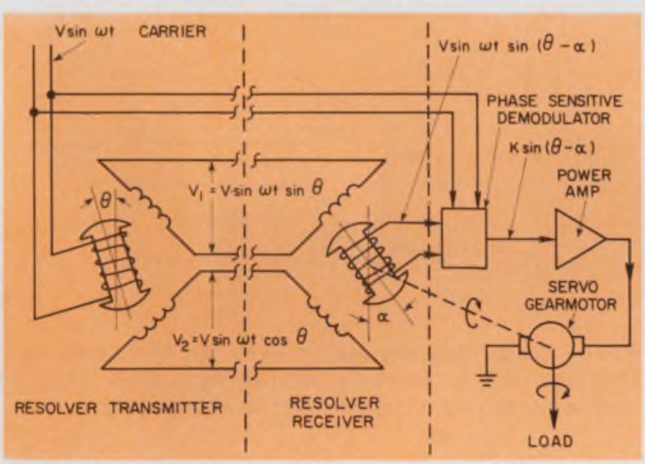
A receiver accepts electrical carrier-borne input data that define the angle to which an associated servo motor will turn the receiver's shaft. The receiver develops an error signal that is proportional to shaft deviation from the incoming electrically specified angle. Synchros and resolvers for this function are usually referred to as control transformers—designated by CT.

The differential develops an electrical output signal that defines the sum (or difference) be-

Richard Ferrero, Product Manager, Synchro Converters, Analog Devices, Route 1 Industrial Park, Norwood, MA 02021.



2. **The electrical circuit of the resolver receiver** looks identical to that of the transmitter, except that the roles of the coil windings are reversed.



3. **A simple resolver control system** consists of a resolver transmitter, receiver, phase-sensitive detector and a power amplifier to boost the output.

tween an electrical input angle in resolver or synchro format and the differential's own shaft angle. The full name for this device is control differential transmitter—designated by CDX.

The basic resolver transmitter has a rotating primary and fixed secondaries (Fig. 1a). The resulting variable-coupling transformer impresses outgoing shaft angle data onto a sinusoidal carrier (usually around 400 Hz, though versions are available for other frequencies). The rotor winding, excited by the carrier voltage Vsin ωt, induces variable fractions of the carrier—depending upon the shaft angle θ—into the two secondaries.

Secondary windings are oriented at right angles to each other, which results in outputs that vary with the sine and cosine of the shaft angle θ. If we assume a 1:1 turns ratio between primary and secondary coils, the two stator output voltages become

$$V_1 = V(\sin \omega t)\sin\theta \text{ and}$$
$$V_2 = V(\sin \omega t)\cos\theta.$$

As the resolver shaft turns, the amplitude envelopes of outputs V_1 and V_2 will rise and fall 90° out of phase with each other (Fig. 1b). However, the carrier components, Vsin ωt, remain in phase. Only V_1 and V_2 amplitude envelopes, sin θ and cos θ, which convey the shaft angle information, are in quadrature.

The instantaneous ratio of the information components, sin θ and cos θ, accurately expresses the resolver's shaft-angle information. By taking the ratio of V_1/V_2, you get tan θ and can, in turn, find θ by taking the arctangent. Phase-sensitive demodulation techniques separate the information components of V_1 and V_2.

Some solid-state circuits can make exact measurements of instantaneous V_1 and V_2, from which angle information can be extracted. Other circuits, using servo-nulling techniques, apply ratiometric methods for angle computations.

Determining receiver-shaft position

The resolver receiver looks electrically identical to the CX, except that the roles of the primary and secondary windings are interchanged (Fig. 2). Usually, though, the CX will have higher VA ratings and lower impedances for its secondary windings, since it may be required to energize several parallel CTs. Otherwise both CX and CT functions are interchangeable.

The CT's two stator windings couple fractions of the incoming angular data, V_1 and V_2, into the common rotor winding. The coupled data develop a rotor output voltage, $V(\sin\omega t)\sin(\theta - \alpha)$, which is a function of the angular difference between the two inputs. The stator-rotor coupling varies with the receiver shaft angle, α, and, as with the CX, conforms to the sine and cosine of the shaft angle.

The resolver receiver's rotor output, $V(\sin \omega t)\sin(\theta - \alpha)$, is used in mechanical positioning systems (Fig. 3). The rotor output, or error voltage, drives a servo through a phase-sensitive detector and servo driver.

The resolver differential, or CDX, develops an electrical output in resolver format (Fig. 4). This unit retransmits the angular signals that come from resolvers. The input signals are redefined as the difference between the electrical input angle, θ, and the differential's own shaft angle, ϕ. The CDX's electrical output defines the difference angle $(\theta - \phi)$ in terms of the carrier borne signals $V_1 = V(\sin \omega t)\sin(\theta - \phi)$ and $V_2 = V(\sin \omega t)\cos(\theta - \phi)$.

The stator of the CDX is electrically similar to the resolver receiver's and handles incoming angular signals, θ, in resolver format. The CDX rotor, however, has two windings at right angles to each other and thus produces two output signals that are related by the sine and cosine functions. If one CDX output is $V_3 = V(\sin \omega t)\sin(\theta - \phi)$, the other differs by 90° and is thus $V_4 = V(\sin \omega t)\cos(\theta - \phi)$. These output voltages, V_3 and V_4, are obtained by connection of the V_1 and V_2 inputs so the rotor-induced signals conform to the basic trigonometric relationship

$$\sin(A - B) = (\sin A)\cos B - (\cos A)\sin B.$$

However, if the incoming signals are connected to the opposite stator coils the voltage components induced into coil A will be $V_1 \sin \phi$ and $V_2 \cos\phi$ instead of $V_1 \cos \phi$ and $V_2 \sin \phi$. Thus the coil A output will be the difference between $V(\sin \omega t)(\sin \theta)(\sin \phi)$ and $V(\sin \omega t)(\cos \theta)(\cos \phi)$.

With the use of another trig identity

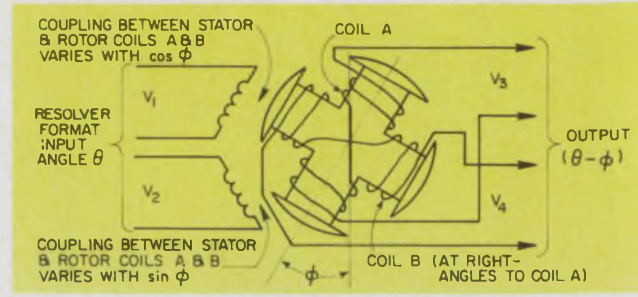
$$\cos(A + B) = (\cos A)\cos B - (\sin A)(\sin B),$$

you can see that the induced voltage in coil A, $V(\sin \omega t)(\sin\theta\sin\phi - \cos\theta\cos\phi)$, can be simplified to $-V(\sin \omega t)\cos(\theta + \phi)$. The 90° mechanical displacement of coil B produces a signal of $V(\sin \omega t)\sin(\theta - \phi)$ as an output. Thus the CDX can be connected to develop an output that represents the sum of two angular inputs as well as their difference.

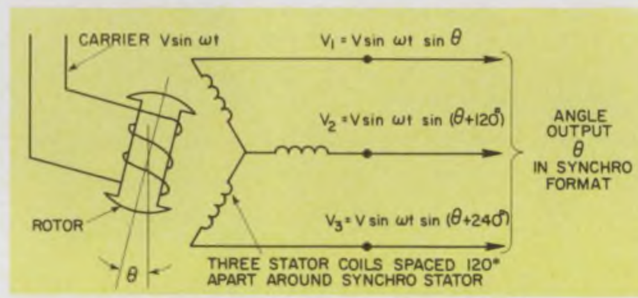
Synchros can also resolve

Synchros differ from resolvers in only one way—they have three, rather than two, stator windings (Fig. 5). Thus instead of having sine and cosine voltage relationships, a synchro transmitter delivers signals related to the rotor shaft angle by

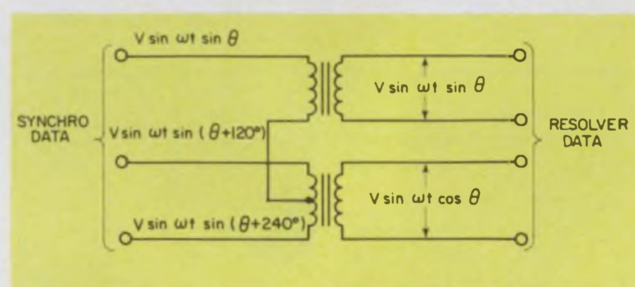
$$V_1 = V(\sin \omega t)\sin \theta,$$
$$V_2 = V(\sin \omega t)\sin(\theta + 120°) \text{ and}$$
$$V_3 = V(\sin \omega t)\sin(\theta + 240°).$$



4. **The resolver differential transmitter** has two fixed coils at 90° to each other and two moving coils, also at 90° to each other. These moving coils determine the output of the unit in terms of the input angle and the shaft angle of the differential.



5. **Synchro transmitters or receivers** have three fixed coils that are spaced at 120° angles around a moving coil. The carrier signal on the moving shaft gets modulated and impresses signals in the three fixed coils that are 120° out of phase with one another.



6. **The Scott-T transformer** changes the three-wire synchro signals into four-wire resolver-compatible data, or vice versa since the transformer is bidirectional.

It is uneconomical to manipulate these three-phase signals with solid-state interface circuits. There is no true solid-state counterpart of the synchro transmitter or receiver; instead, these functions are usually performed by solid-state resolvers that use Scott-T (or equivalent) transformers to convert the synchro signals into resolver format (Fig. 6).

The Scott-T networks, well known in power engineering, provide the link or interface between three-phase and two-phase systems. Scott-T transformers function bidirectionally and provide isolation between input and output circuits. Many newer systems, though, use active networks to perform the signal conversion and thus require less space within the interface module. ■■

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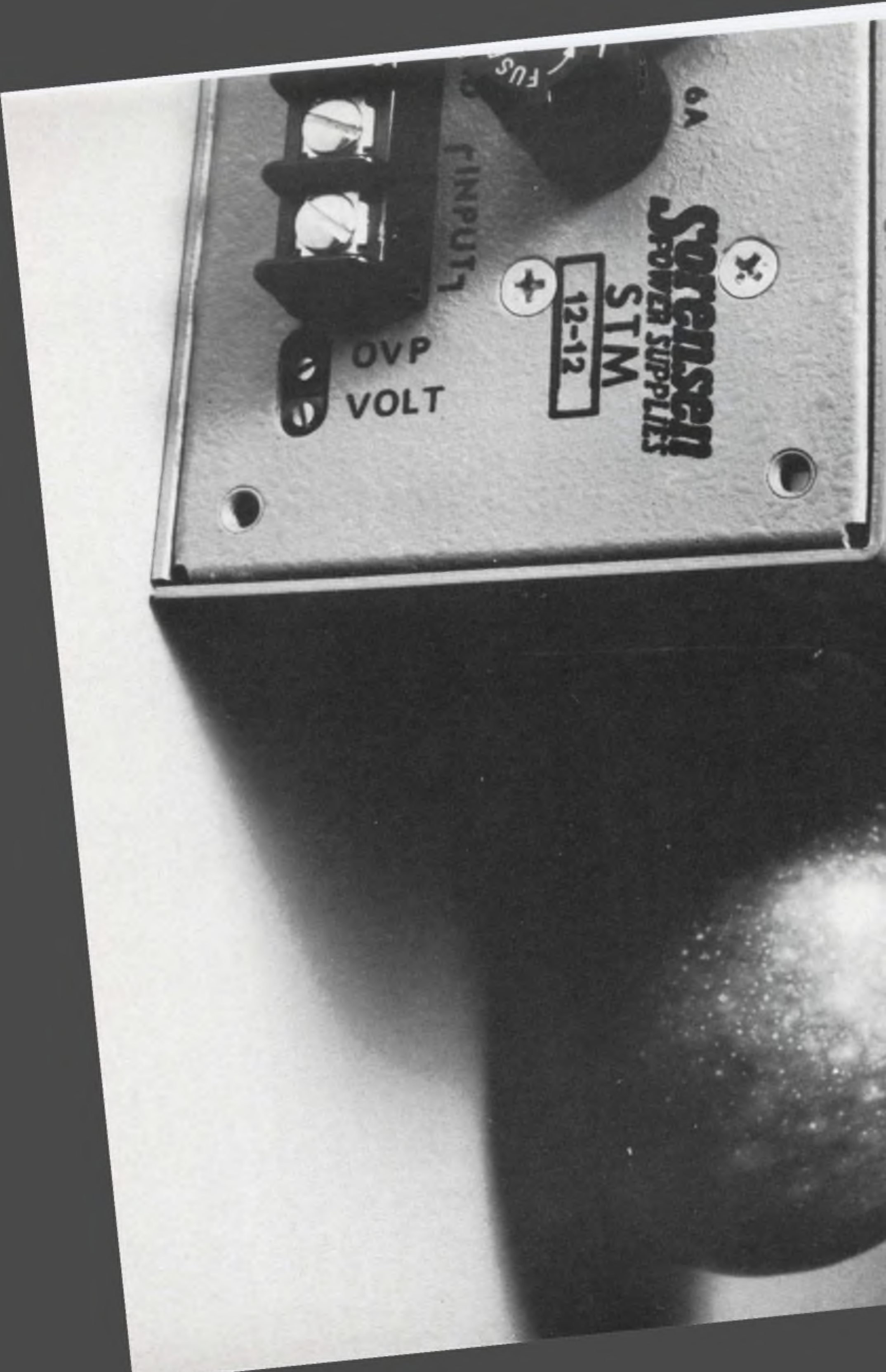
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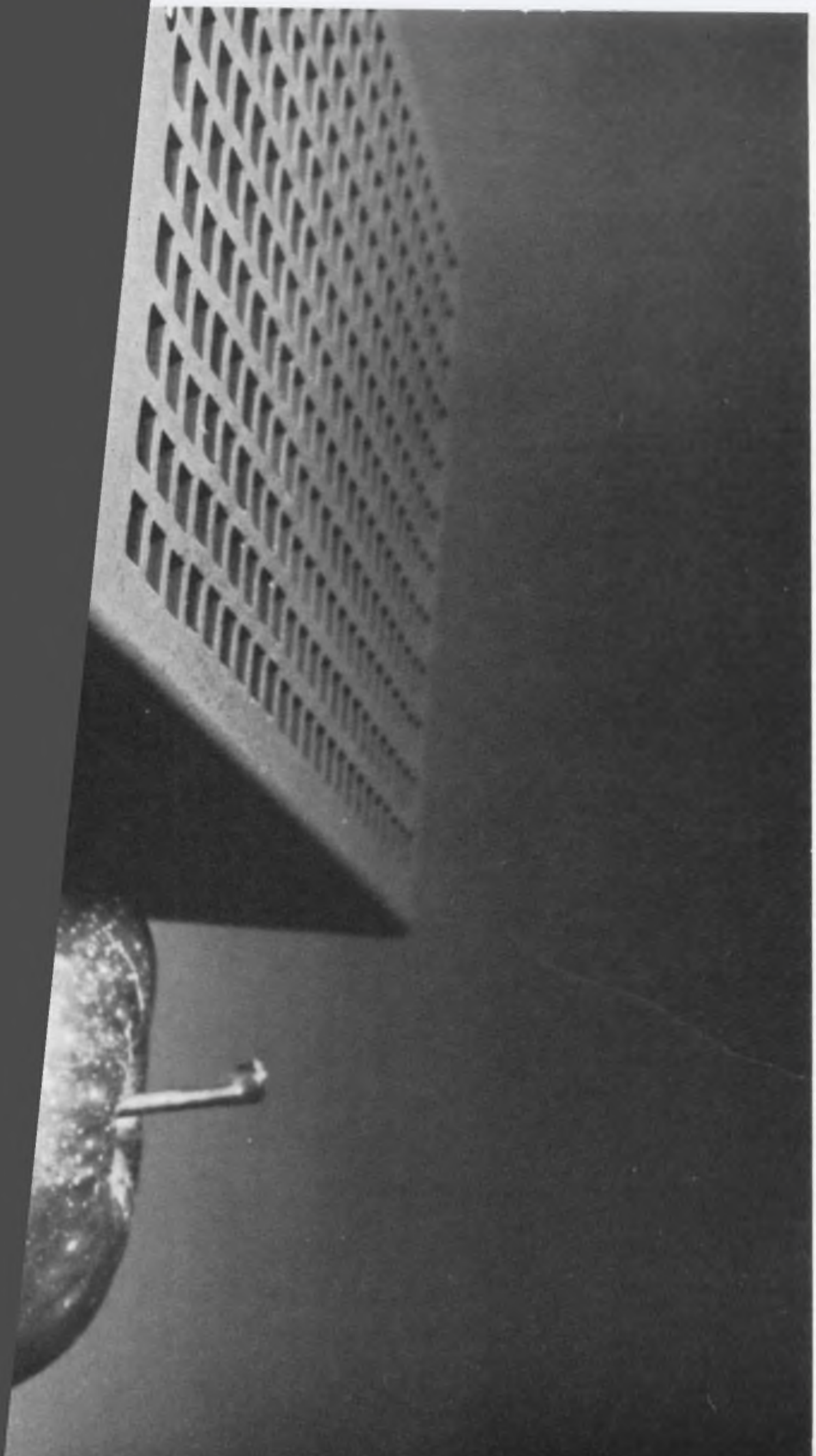


Two components added to CMOS flip-flop convert it to one-shot or level detector

The addition of a resistor and a capacitor to a CMOS edge-triggered D-type flip-flop can convert it into a one-shot or level-detector circuit (Fig. 1).[1] A sharp-edged pulse or step produces a one-shot output (Fig. 2a). For any other arbitrary wave shapes (Figs. 2b and 2c), the circuit triggers when the input signal crosses the circuit's CMOS threshold voltage.

Here's how the circuit works: With the Q output normally low and the D input tied to a logic ONE, a positive-going step applied to the clock input, C, causes the Q output to go to a logic ONE state. After a delay determined by R_1 and C_1, the Q signal fed back to the reset terminal causes the flip-flop to reset, and the output from Q returns to its ZERO state. The circuit thus behaves as a one-shot.

The one-shot delay can be determined from

$$T_D = R_1C_1 \ln\left(\frac{V_{DD}}{V_{DD} - V_{TH}}\right),$$

where

V_{DD} = supply voltage ($V_{SS} = 0$),
V_{TH} = CMOS threshold voltage.

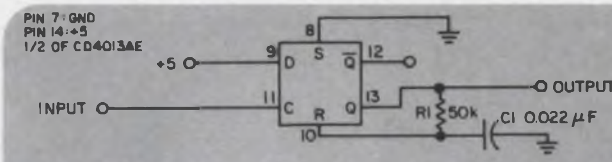
The values in Fig. 1 provide a delay, T_D, of 1.32 ms.

Reference

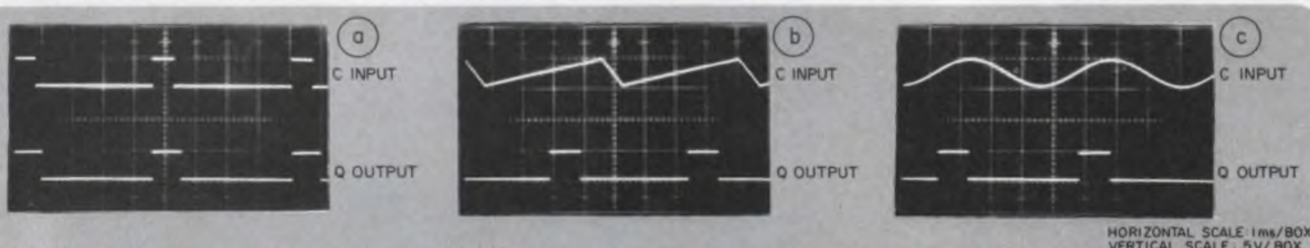
1. Yen, T. T., "Make Simple Voltage-level Detectors with CMOS Inverters." *Electronic Design*, June 21, 1975, p. 102.

Gordon Silverman, Ph.D., and Michelangelo Rossetto, Electronics and Computer Laboratory, Rockefeller University, New York, NY 10021.

CIRCLE NO. 311



1. **An edge-triggered CMOS flip-flop** can be modified to behave as a one-shot or level detector, with the addition of a resistor and capacitor.



2. **Any wave shape can trigger the CMOS filp-flop.** Examples include a step input (a), sawtooth input (b) and sinusoidal input (c). The lowest level of each waveshape is at a zero-volts level.

Impedance matching made easy: a 3-step uncomplicated method

Even a specialist in digital design sometimes has to match two complex impedances. The result often is a frantic search for that misplaced textbook on the subject. Next time try a straightforward approach that requires only three steps to solve either purely resistive or complex impedance-matching problems accurately and without guesswork. Also, the designer has the option of using either a high-pass or low-pass matching section. However, the networks are matched at only one frequency, and the VSWR increases as the frequency moves off the design center.

Fig. 1a shows a typical matching situation. Reactive elements XM_1 and XM_2, which are used

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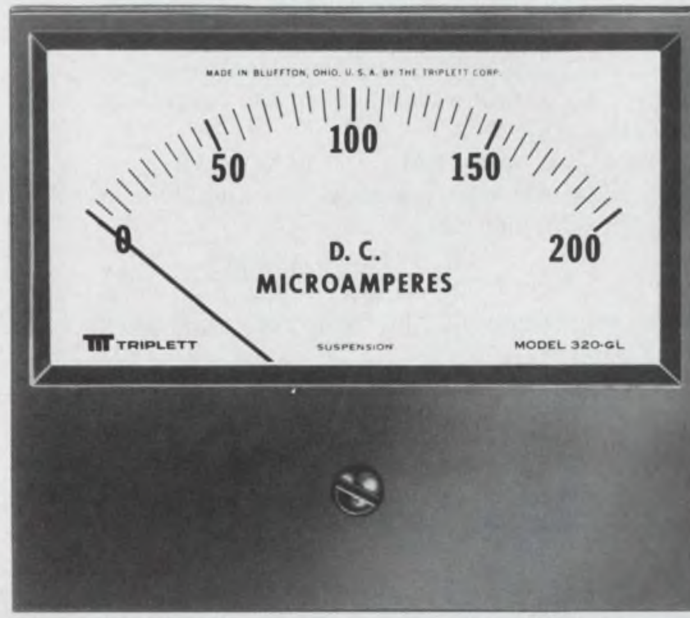

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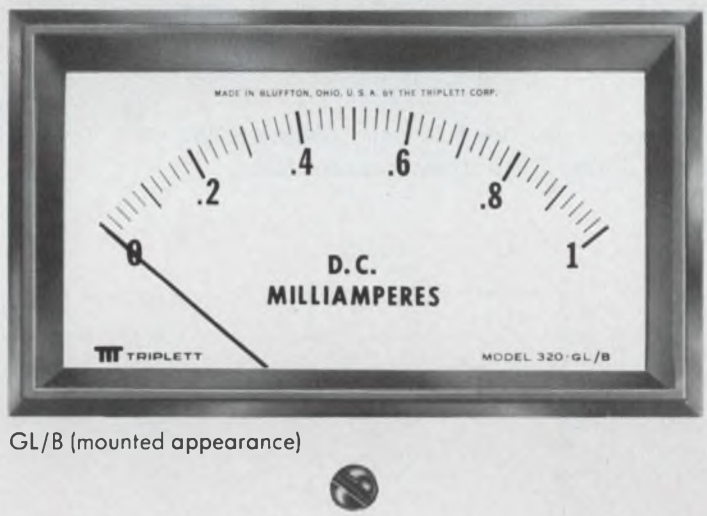

GL/B (mounted appearance)

Triplett's newest panel instruments, the Series GL and GL/B, feature glass windows, matte-finish phenolic cases and a dial design that can readily accommodate multiple scales. They are available in 3½", 4½" and 5½" sizes.

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INFORMATION RETRIEVAL NUMBER 43

to match R_1 and R_2, also tune out the effects of X_1 and X_2. The circuit is considered to be matched when R_1 equals the effective series resistance, R_s, and XM_1 tunes out X_1 and the effective series reactance, X_2, across terminal B in the equivalent circuit (Fig. 1b).

Thus $R_1 = R_s$ and $JXM_1 = -(JX_1 + JX_s)$.

First solve for the quantities R_s and JX_s in terms of R_2, X_2 and XM_2:

$$Z_s = R_s + JX_2 = \frac{(R_2 + JX_2)\cdot(JXM_2)}{R_2 + J(X_2 + XM_2)}. \quad (1)$$

And by separation of the real and imaginary parts, we get:

$$R_s = \frac{R_2(XM_2)\cdot(X_2 + XM_2) - (X_2)(XM_2)(R_2)}{(R_2)^2 + (X_2 + XM_2)^2}, \quad (2)$$

and

$$X_s = \frac{X_2\cdot(XM_2)\cdot(X_2 + XM_2) + (R_2)^2(XM_2)}{(R_2)^2 + (X_2 + XM_2)^2}. \quad (3)$$

For a match, R_s must equal R_1. Thus we set Eq. 2 equal to R_1 and solve for the required value of XM_2:

$$XM_2 = \frac{R_1(X_2) \pm \sqrt{(R_2)^3R_1 + R_1(R_2)(X_2)^2 - (R_1)^2(R_2)^2}}{(R_2 - R_1)}. \quad (4)$$

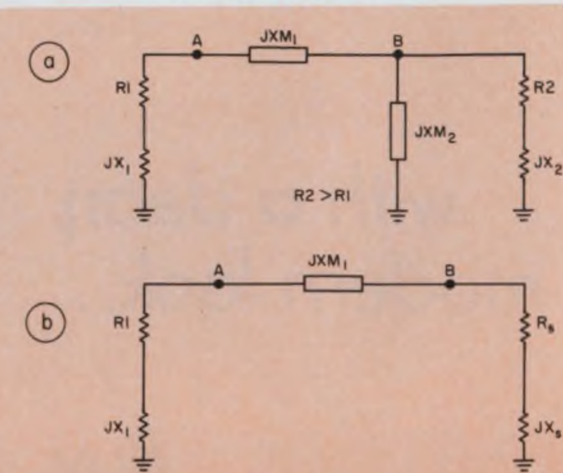
Of course, if the load is only resistive, $X_2 = 0$, and Eq. 3 and 4 are greatly simplified.

To determine XM_1, we substitute the value of XM_2 into Eq. 3. Reactance XM_1 may then be calculated as

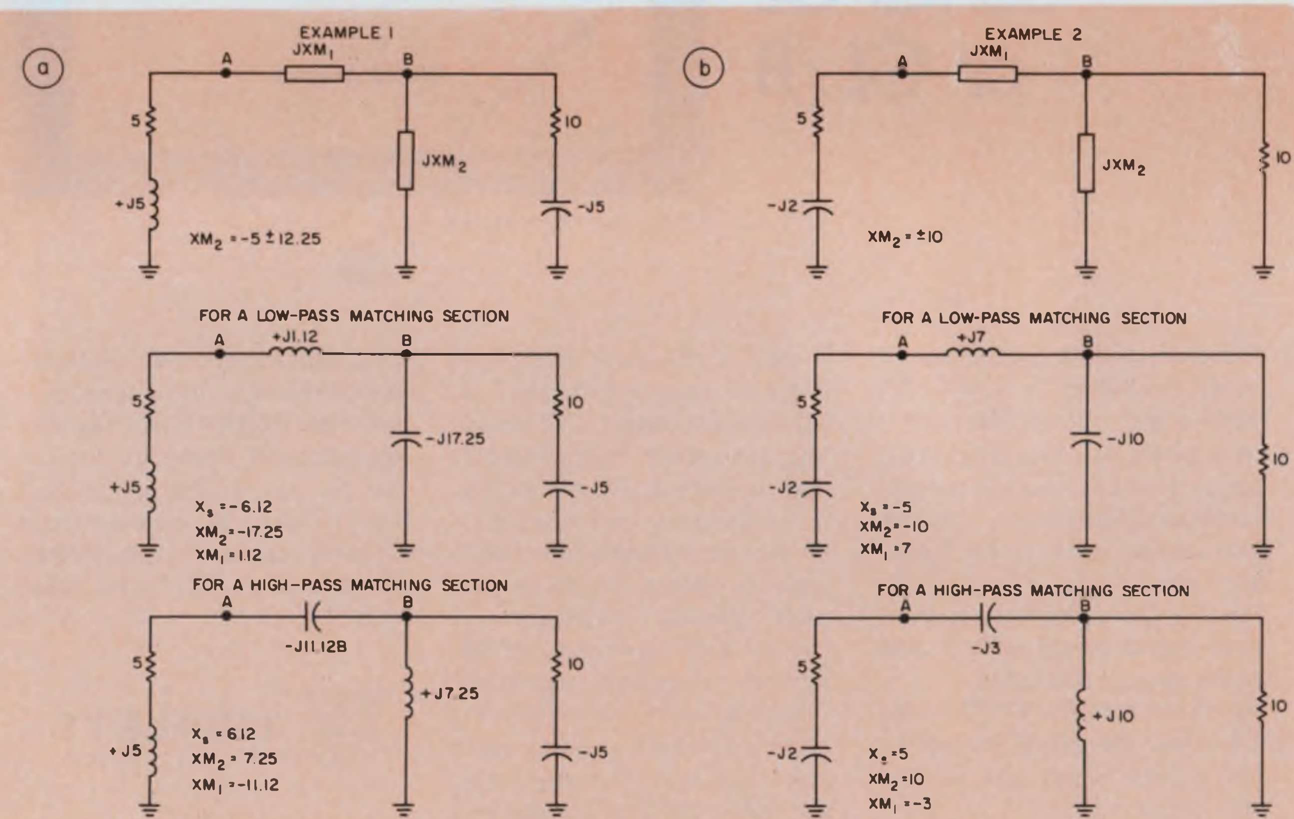
$$JXM_1 = -(JX_1 + JX_s).$$

Two examples of the use of the equations are shown in Figs. 2a and 2b.

Roy Nardin, Staff Engineer, Frequency Electronics Inc., 3 Delaware Dr., New Hyde Park, NY 11040. CIRCLE NO. 312



1. **Reactive elements XM_1 and XM_2 match R_1 to R_2** and tune out X_1 and X_2 (a), and XM_1 tunes out X_1 and X_s in the equivalent series circuit (b).



2. **For a low-pass matching section,** XM_1 is inductive and XM_2 is capacitive. However for high-pass, XM_1 is capacitive and XM_2 inductive, as determined by the two solutions for XM_2.

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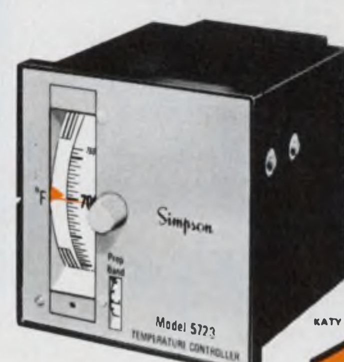

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INFORMATION RETRIEVAL NUMBER 44

Power op amps drive dc motor from single-ended power supply

Direct application of power to aircraft electrical devices from the aircraft's standard 28-V source avoids the inefficiencies and undesirable side effects of power conversion. The circuit in the figure can drive a permanent-magnet dc motor with the power op amps energized solely from the single-ended 28 V.

The motor is differentially driven from two power op amps. The op amps are biased midway between +28 V and ground, and thereby each applies +14 V to each motor terminal under zero-signal conditions. As an amplifier input signal is applied, the voltage on one terminal increases and the other decreases. Obviously motor rotation direction depends on the polarity of the op-amps' input signal.

Op-amp A is connected as an inverting amplifier, and op-amp B is noninverting. Positive input signals cause the output from A to decrease toward ground and that from B to increase toward +28 V. Signal inputs can originate from any low-impedance source that is capable of sinking a low dc milliamp-range current and driving a 1-kΩ load.

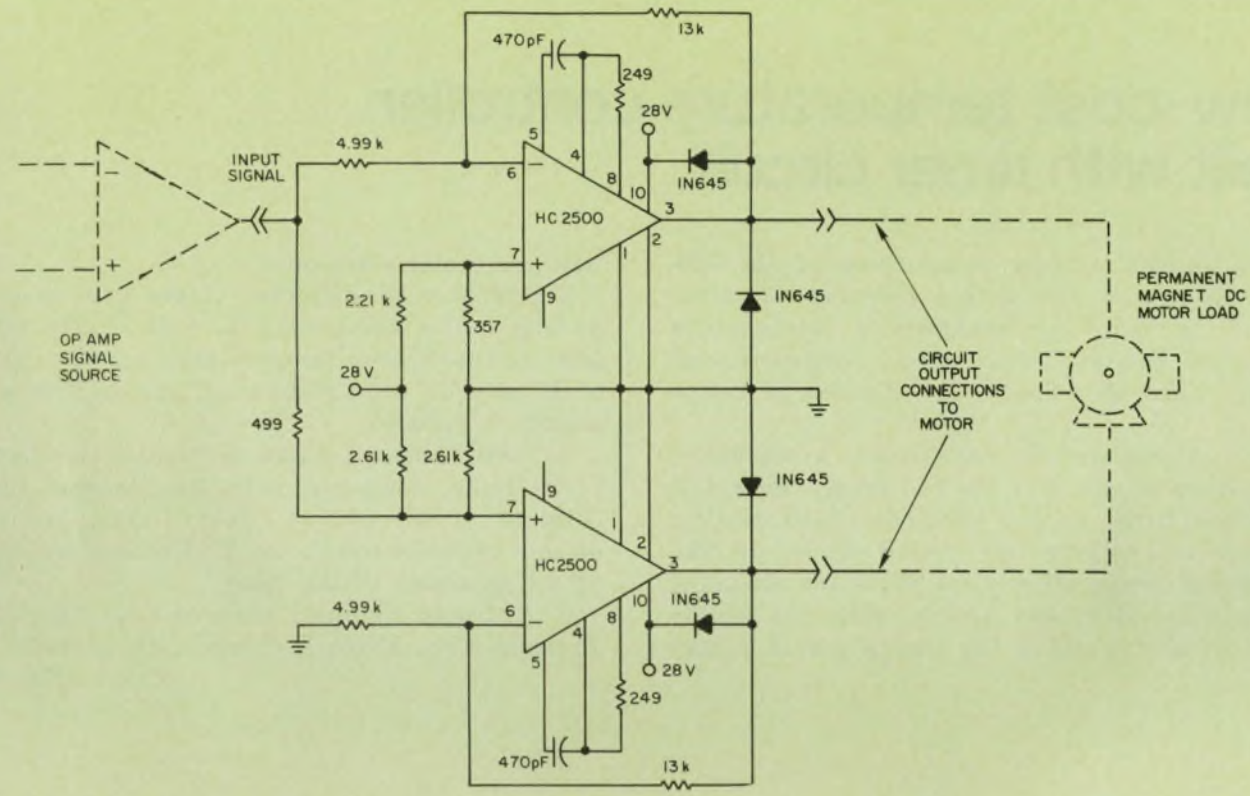
RCA HC2500 power op amps are used. Their slew rate and bandwidth is controlled by external 470-pF capacitors, and their standby current drain is determined by external 249-Ω resistors. The closed-loop gain of each stage is approximately 2.6, and no feedback capacitors are required to stabilize the circuit. Commutation diodes at the output prevent op-amp damage from motor spiking.

Features of this circuit include the following:

- Low standby power—less than 1 W per op amp, including bias network.
- Good gain-bandwidth product, allowing use as a servoamplifier in closed-loop applications.
- Low parts count—11 resistors, two capacitors and four diodes, in addition to the two op amps.
- High power output. In an experimental set up, the circuit was able to drive a 30-W permanent-magnet motor.

C. E. Musser, Project Engineer, General Electric Co., Avionics Controls and Electrical Systems Dept., P.O. Box 5000, Binghamton, NY 13902.

CIRCLE NO. 314



Two power op amps can drive a 30-W PM motor from a single-ended power supply.

Low-cost temperature controller built with timer circuit

The internal trigger comparator of the 555 timer IC can be used with a thermistor-resistor divider to build an inexpensive temperature controller. You don't even need a well-regulated supply, since all voltages are derived as ratios of V_{CC}.

When thermistor R_3 cools below a set value, the voltage at pin 2 of the 555 drops below 1/3 V_{CC}. This turns on the triac-controlled heating element and starts the timing cycle. If the thermistor temperature rises above the set point before the end of the timing cycle, the heater shuts off at the end of the timing period, otherwise the heater stays on.

Thermistors of different values can be used as long as the relationship $R_3 + R_2 = 2R_1$ holds true at the desired temperature. Larger values of R_2 provide wide adjustment ranges, but sensitivity is reduced.

A timing interval equal to $1.1R_4C$ is selected to be small, compared with the thermal time-constant of the system. Yet it must be long enough to prevent excessive RFI caused by rapid on-off switching of the triac.

G. R. Lewis, Engineer, Cerwin-Vega Inc., 6945 Tujunga Ave., North Hollywood, CA 91605.

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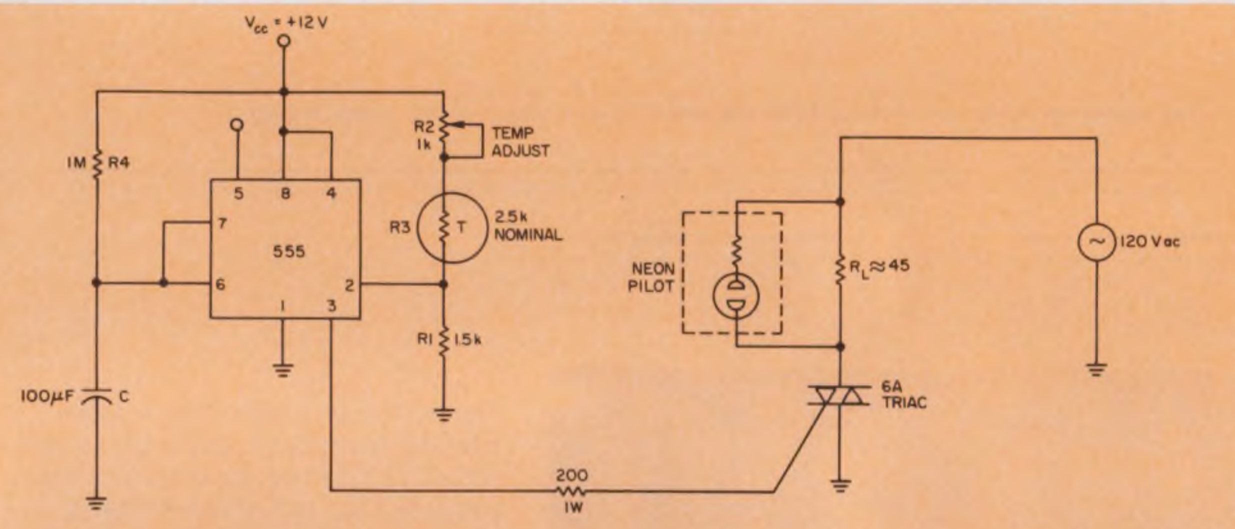

The internal comparator of the 555 timer, combined with a thermistor, makes a low-cost temperature controller. Resistor R_2 sets the temperature trip point.

IFD Winner for April 12, 1975

Vijay B. Tandon, Electro-Mechanical Designer, American Foundation for the Blind, 15 W. 16th St., New York, NY 10011. His idea "Circuit Converts Single-Trace Scope to Dual-Trace Display for Logic Signals" has been voted the most valuable of Issue Award.

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The Harris Report.

New series of generic PROMs–a family affair.

Stand alone PROM designs are now a thing of the past. Now the diverse requirements for density, modularity and performance within a system can be satisfied with Harris' new family of PROMs featuring generic characteristics.

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In addition, these PROMs have fast programming speeds. Equivalent I/O characteristics for easy upgrading. Faster access time, guaranteed over temperature and voltage. Improved testability.

Right now, the first two PROM devices are in volume production. The 256 x 4 organization (1K) and the 512 x 4 (2K). Other PROM devices will be available in the months ahead (see table).

So instead of settling for PROMs with unique performance capability and diverse programming requirements, get the new Harris generic family of PROMs. Lower your system costs and make your life easier.

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- Fast access time—guaranteed over voltage and temperature (see table).
- Expandable—three-state or open collector—"wired-or" outputs with chip select.
- Industry standard pin-out.

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HM-7610 (open coll.) HM-7611 (three-state)	1024	256 x 4	16	60/75ns	in stock
HM-7620 (open coll.) HM-7621 (three-state)	2048	512 x 4	16	70/85ns	in stock
HM-7640 (open coll.) HM-7641 (three-state)	4096	512 x 8	24	70/85ns	August
HM-7642 (open coll.) HM-7643 (three-state)	4096	1024 x 4	18	70/85ns	January '76
HM-7644 (active pullup)	4096	1024 x 4	16	70/85ns	January '76

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INFORMATION RETRIEVAL NUMBER 46

Jimmy R. Young of Motorola Semiconductor wins annual 'Idea for Design' award

"This isn't what I expected," said Jimmy Randy Young.

What the senior design engineer did expect was a company patent award for a CMOS-circuit design. The first step toward a patent had been taken some time ago. And Motorola provides cash awards for these achievements.

And what other reason would there be for him and his boss, Section Manager Jim Remedi, to be in the office of John Welty, Vice President and General Manager of the Semiconductor Products Div.?

Well, the visit had to do with Young's IC all right. But it was his use of the chip in an ELECTRONIC DESIGN Idea for Design that was about to be recognized. Young's idea had been selected as the best in 1974.

Jimmy developed a special RC oscillator that was made part of a three-digit counter, Motorola's MC 14553. The idea—"Low-Power CMOS Digital Voltmeter Built With Only Six Integrated Circuits"—hooked up the counter, five other CMOS chips and LED readouts to form a compact instrument.

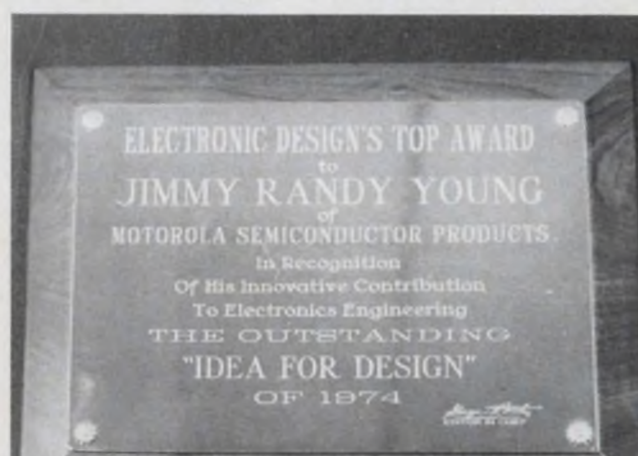
The tall, friendly engineer didn't learn he was the winner until Associate Editor Edward A. Torrero presented him with an engraved plaque. Then Young could only shake his head in disbelief as Torrero handed him a $1000 check.

To Welty's query on what he would do with the prize money, Young replied: "Keep my wife from spending it." In a more serious vein, he said he would use it for their next vacation, one that would serve as a 10th-anniversary honeymoon. "We had one when we married," he said, "but after 10 years, you need a renewal."

Young's winning idea stemmed from years of systems work that led him far from his native Phoenix. He has worked on aerospace equipment in Colorado and in data communications in California. Motorola, the first semiconductor house he has worked for, took him back to Arizona.

Past experience helped to smooth his adjustment to semiconductors. "It's easier to go the route I took than the other way," Young believes. After having designed hybrid and discrete systems, his understanding of interface problems improved, as did his feel for the special problems customers face.

Young and his wife, Kitty, have two girls—Lorie, 7, and Tanya, 5. In his spare time he likes woodworking, hiking or playing tennis. Now, buoyed by his prize, he thinks he would like to write more technical articles for magazines. Furthermore, Young expects more of his coworkers will want to write, too.

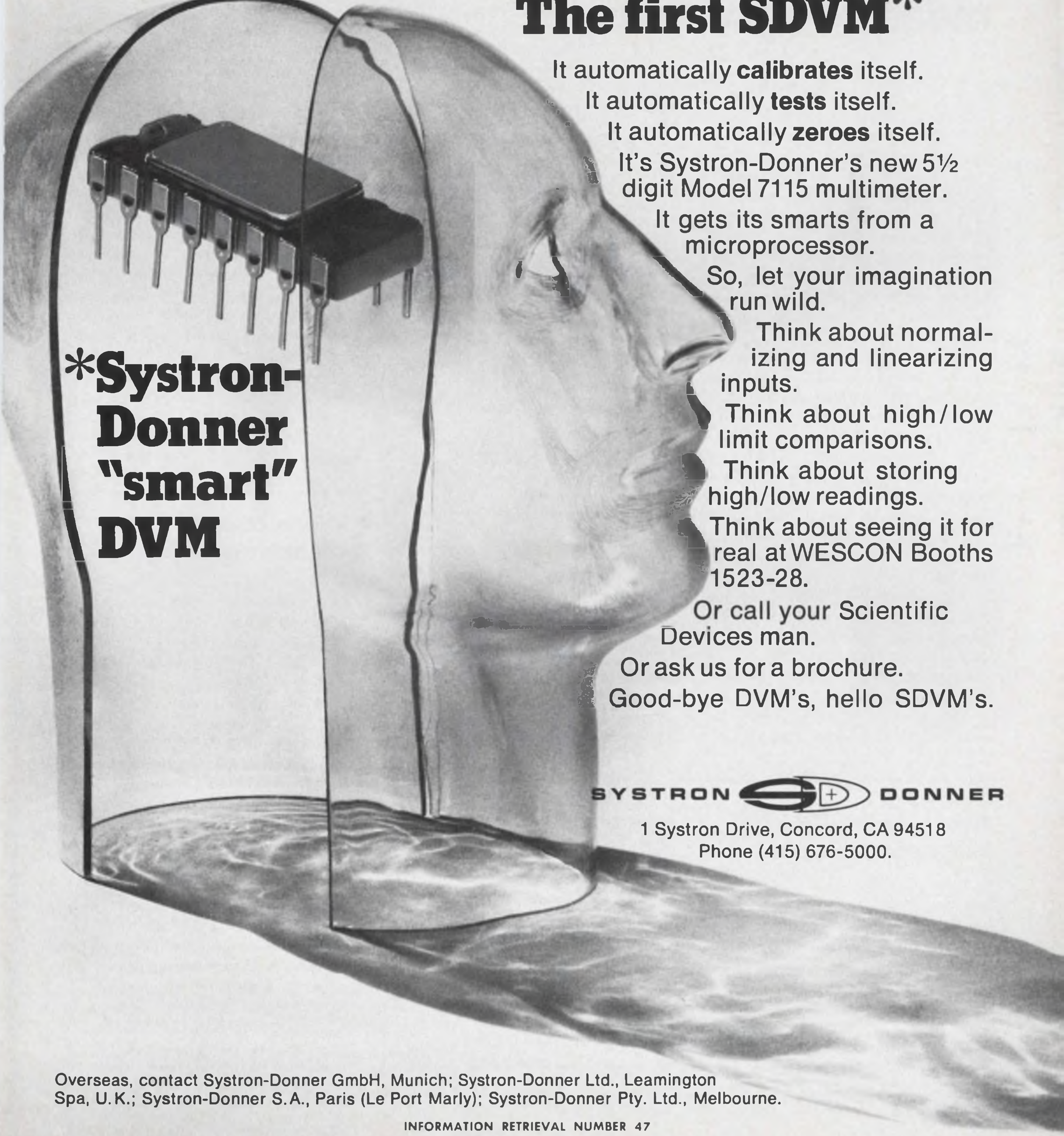


A happy winner, Jimmy Randy Young (left), is congratulated by his boss, Jim Remedi, after receiving Idea for Design plaque and $1000. Motorola Semiconductor's General Manager, John Welty, looks on.

RENEWAL ISSUE

Three minutes is all it takes to keep ELECTRONIC DESIGN coming your way. RENEW TODAY (see inside front cover).

BRAINSTORM



The first SDVM*

It automatically **calibrates** itself.
It automatically **tests** itself.
It automatically **zeroes** itself.
It's Systron-Donner's new 5½ digit Model 7115 multimeter.
It gets its smarts from a microprocessor.
So, let your imagination run wild.
Think about normalizing and linearizing inputs.
Think about high/low limit comparisons.
Think about storing high/low readings.
Think about seeing it for real at WESCON Booths 1523-28.
Or call your Scientific Devices man.
Or ask us for a brochure.
Good-bye DVM's, hello SDVM's.

***Systron-Donner "smart" DVM**

SYSTRON DONNER
1 Systron Drive, Concord, CA 94518
Phone (415) 676-5000.

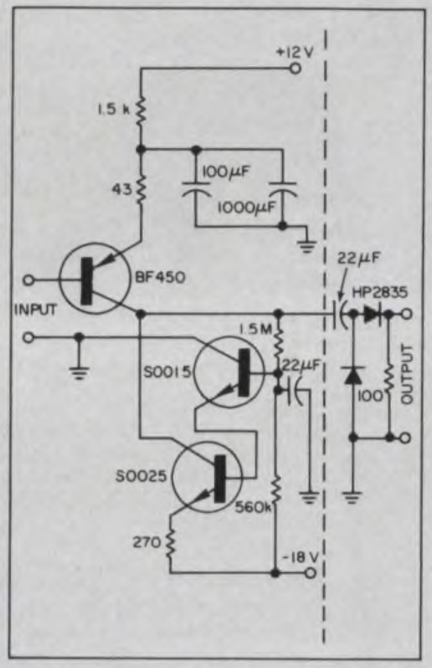
Overseas, contact Systron-Donner GmbH, Munich; Systron-Donner Ltd., Leamington Spa, U.K.; Systron-Donner S.A., Paris (Le Port Marly); Systron-Donner Pty. Ltd., Melbourne.

Noise generator output measured accurately

A special ac-to-dc converter to measure the output level of a wideband noise generator up to 500 MHz has been developed at the University of Salford in England. The circuit, which is reported to have an accuracy of ±2% over the 500-MHz spectrum and substantially better over smaller ranges is stable. In addition the design overcomes the detrimental effects of diode resistance at low frequencies and of load capacitance.

In the schematic of the circuit the section to the left of the broken line is a constant current source. In this, a low-capacitance BF224 (Motorola S0025) and BC-169 (Motorola S0015) form an active load with the 270 Ω, 560 Ω and 1.5 MΩ resistors and the lower 22-μF capacitor. The dc at the BF224 collector is stablized at about −0.5 V by the three resistors.

For linear performance at low frequencies, the current source has a high resistance, which is achieved in this circuit by an increase in the BF450 (Siemens, U.S.A.) collector resistance by feedback. For high-frequency operation the BF450 and BF224 transistors have low shunt capacitances of about 1 pF.



The HP2835 hot-carrier diode has low capacitance, low leakage and low forward voltage. The HP-2835 passes positive half cycles to the load, and the other diode limits the voltage swing at the collector of the BF450.

Iron 'needles' improve magnetic tape s/n

Iron particles formed like minute needles on the surface of magnetic tape respond more effectively than more conventional materials when exposed to tape recording-head signals, according to investigators at Philips Research Laboratories in West Germany. The researchers, led by Dr. K. G. Knauff, determined that iron particles about 0.3 μm long will give tapes a signal to noise ratio as much as four times better than that obtained from most magnetic oxides.

The needles are made in a fluid bed of iron-hydroxide through progressive reduction by hydrogen. Spontaneous ignition of the needles on exposure to air is prevented by forming a passivated layer on the needle surfaces. This is accomplished by passing inert gas over the needles while they are in the fluidized bed and adding small amounts of hydrogen.

Measurements made at 10 to 12 kHz at a tape speed of 4.75 cm/s gave a 12 dB gain in s/n compared with ferrite and 7 dB compared with chrome oxide.

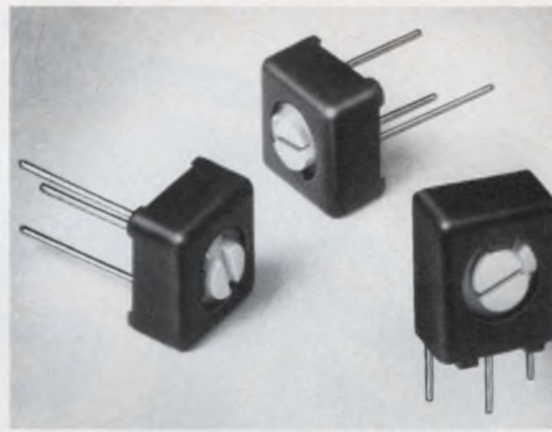
Xenon laser delivers UV pulses at 4 MW

Ultraviolet laser pulses with peak powers of 4 MW at a 3-nsec pulsewidth have been generated in a tunable region between 1690 and 1760 Å by researchers at Imperial College, London. Tuning is accomplished with a prism in the laser cavity. The laser's working medium is xenon gas, compressed and pumped with a relativistic electron beam that delivers orders of magnitude more energy in much shorter pulses than does a flash lamp.

The Imperial researchers have been able to frequency-shift the laser from the visible to the UV in ultrashort, 1 to 10 ps, light pulses. Using this technique, the researchers expect to pump dense plasmas and create population inversions sufficient to lase on X-ray emission lines at wavelengths of less than 100 Å. If this is achieved, it should be possible to create X-ray holograms, they report.

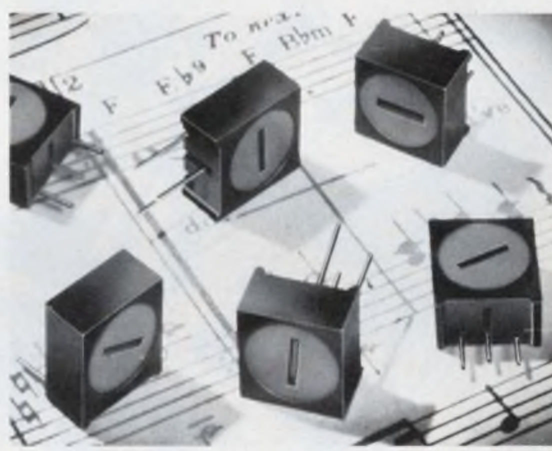
Here's what's new in pots and trimmers from TRW/IRC Potentiometers

Precision Wirewound Potentiometers
CIRCLE NO. 291



1/4" Square Type 180 Cermet Trimmers
CIRCLE NO. 293

.330" Diam. Panel Potentiometer
CIRCLE NO. 292



3/8" Square Type 76 Cermet Trimmers
CIRCLE NO. 294

Precision Potentiometers:
⅞" to 3" diam., 1 to 6 watts, wide range of options, including 0.1% linearity

0.330" Diam. Panel Pot:
Type 9917 rated at 0.5W @ 85° C, 100 ohms to 1 megohm linear, non linear and squelch tapers.

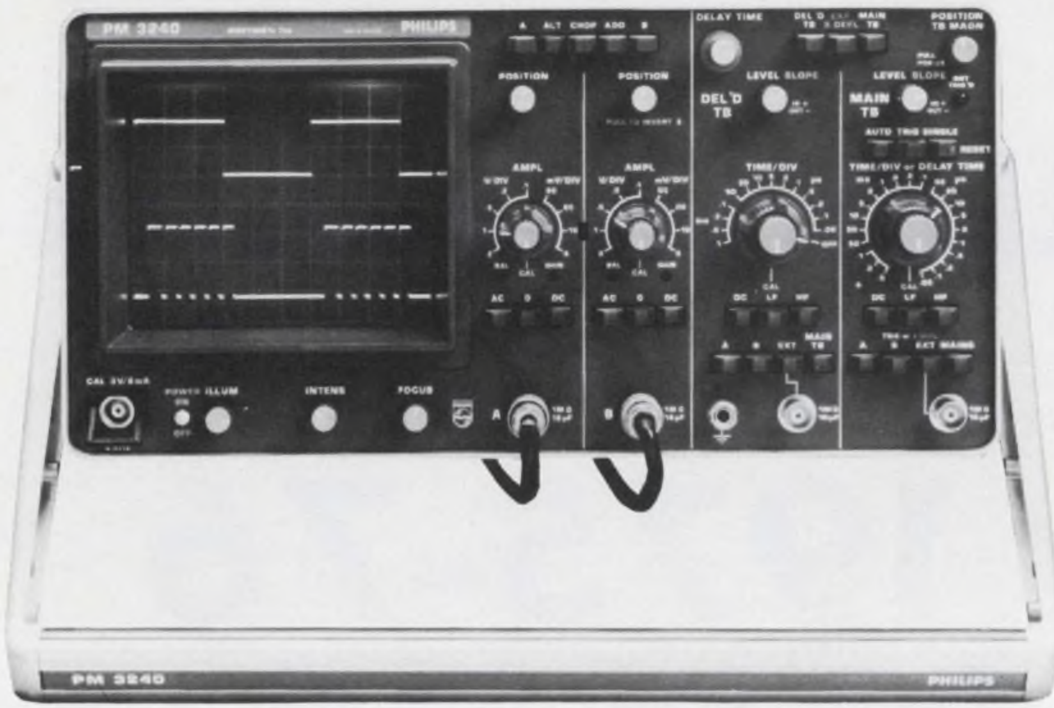
1/4" Square Trimmer:
Rated at 0.5W @ 70° C, three mounting styles, 100 ohm to 1 megohm

3/8" Square Trimmer:
Rated at 0.5W @ 70° C, six basic mounting styles, four with CW and CCW rotation

For additional information, contact your TRW/IRC Potentiometer Distributor or write TRW/IRC Potentiometers, 2801—72nd Street, North, St. Petersburg, Florida 33733 (813) 347-2181

TRW® IRC POTENTIOMETERS

CPI-7504



HEAVYWEIGHT PERFORMANCE FROM A LIGHTWEIGHT

Lugging excess weight around on service calls under all kinds of environmental circumstances doesn't improve the efficiency or enthusiasm of servicemen. That's why more and more of the purchasing decisions are being influenced by weight besides the price and performance of a portable oscilloscope.

The Philips PM3240, a 50 MHz dual trace oscilloscope, has the facilities you need for the majority of your service applications - - - - - generally below 50 MHz. This ultra lightweight (only 18.5 lbs.) dual time base oscilloscope with the bright 8 x 10 cm display has been designed with specific emphasis on ease of use. Every control falls naturally and quickly to hand. The controls are grouped in four vertical sections; Ya, Yb, delayed and main time bases - with all the main controls on exactly the same level. In this way, the desired switch is found without even having to look away from the screen, while the clear separation of the two timebases eliminate confusion and a possible source of error. This low priced PM3240 gives the operator full control of the triggering parameters, but uses LED's which immediately indicate when triggering conditions are not correct.

The chances are that before the Philips PM3240 was available, you were forced to buy an expensive instrument more transportable than truly portable - - - - - with more bandwidth than was necessary - - - for more money than you wanted to pay. Aren't you glad you've got a better choice now? To get further information or have a field engineer contact you for a demonstration of the Philips PM3240, utilize our toll free HOT LINE 800 645-3043.

New York State residents call collect (516) 921-8880

Philips Model PM3240 50 MHz/50mV dual trace oscilloscope priced at $ 1470.00.

Philips Model PM3240X includes TV sync separator, priced at $ 1570.00

Philips Test & Measuring Instruments, Inc.
A NORTH AMERICAN PHILIPS COMPANY
400 Crossways Park Drive
Woodbury, N.Y.11797

PHILIPS

PHILIPS

FOR DEMONSTRATION CIRCLE 297

FOR SALESMAN TO CALL CIRCLE 298

New Products

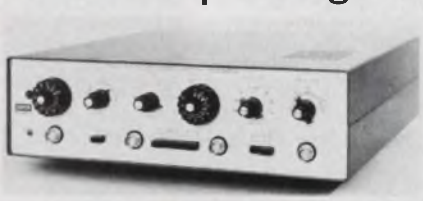
3-1/2-digit DPMs consume just 3/4 W

Meterex Corp., 646 Summer St., Brockton, MA 02402. (617) 588-8826. $69 (100); stock-4 wks.

This new line of logic-powered 3-1/2-digit DPMs are built around a CMOS LSI IC. Designated the MX2500 series, these new meters consume only 750 mW and employ an auto zero technique that zeroes both offset voltage and input current. Input current is typically 10 pA. The meters are housed in a die-cast case that occupies less than 4 cu. in. behind the customer's panel. LED displays are used for the readout.

CIRCLE NO. 308

11-MHz function gen carries low price tag



Dana/Exact, 455 S.E. 2nd Ave., Hillsboro, OR 97123. (503) 648-6661. $695; stock.

First in a series of low-cost 11-MHz function generator, Model 516 is a pulse sweep unit. With a dynamic frequency range of 0.001 Hz to 11 MHz, the Model 516 offers sine, square, triangle, ramp and pulse waveforms at 20 V pk-pk open circuit, 10 V pk-pk into 50 Ω. A 20-Hz to 20-kHz range is provided for audio use and sweeping the entire audio range.

CIRCLE NO. 309

Slightly over 2 lb, just under $200: it's a DVM

Sencore, 3200 Sencore Dr., Sioux Falls, SD 57107. (605) 339-0100. $198.

Three key features describe the DVM32 DMM: 1. Portability with protection; 2. Automatic 3-1/2-digit LED readout; 3. 0.5% dcV accuracy. The unit uses standard "C" cells, rechargeables, or optional 115/230-V line-cord power. An AUTO-OFF circuit turns the LED off between measurements on any range, when in the Auto position. A specially designed high-impact Cycloac case means that the DVM-32 can take a fall from the top of a service bench and go right on working. This physical protection is backed by electrical protection to 2000 V on all dc ranges and 1000 V on all other ranges, with back-up fuse protection.

CIRCLE NO. 310

A/d unit converts in 25 μs, expands easily

Preston Scientific, 805 E. Cerritos Ave., Anaheim, CA 92805. (714) 776-6400. Start at $1539; 8-10 wks.

A new rack-mounted, a/d conversion system that operates at a 25-μs conversion time has now been added to the company's GM Series. Available with either 10, 12 or 15-bit resolution, this new low-profile unit—the GMAD-4—is completely enclosed in a standard rack-mounted enclosure only 5-1/4-in. high, and includes the a/d converter, front-panel controls for selection of operating mode and multiplexer channels, front-panel indication of multiplexer channel and a/d output.

CIRCLE NO. 320

Test set replaces 7 different instruments

3M Co., P.O. Box 33600, St. Paul, MN 55133. (612) 733-2925. Approx. $6000.

Electronic measurements requiring seven different test instruments can be achieved by a single test set said to cost about two-thirds as much. Model 6110 provides precise digital readout for these and other functions: distortion analysis, with automatic frequency tracking (including harmonics) and automatic ranging for percent distortion, fundamentals from 100 Hz to 1 MHz; wideband tunable wave analyzer with push-button selection of measurement bandwidth, 100 Hz to 3 MHz; frequency counting, with automatic ranging, 100 Hz to 3 MHz; voltage measurement, 0.001 to 30 V (rms), with automatic ranging.

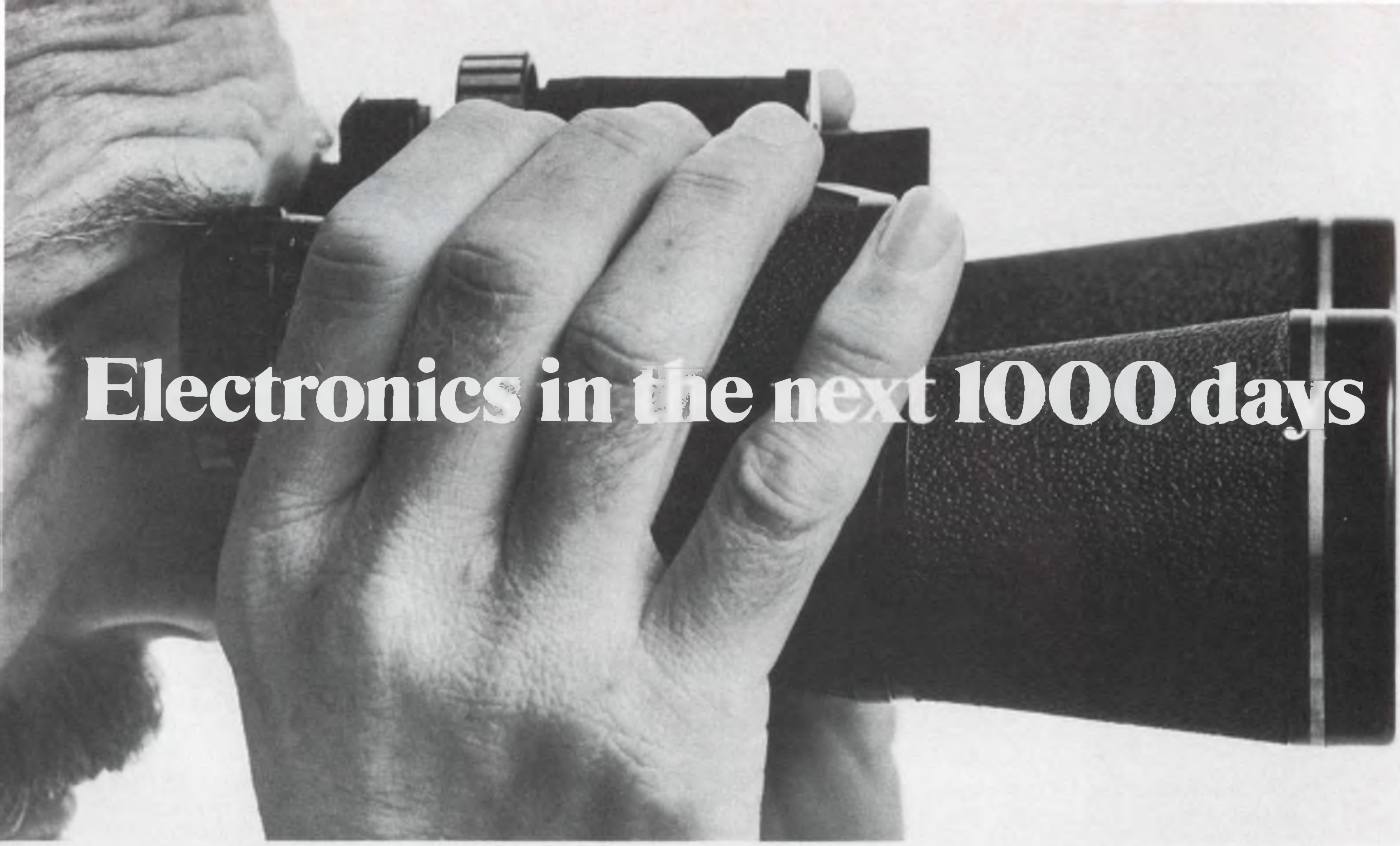
CIRCLE NO. 321

Counter resolves low frequencies fast

Heath/Schlumberger, Benton Harbor, MI 49022. (616) 983-3961. $640.

SM-109A computing frequency counter measures the elapsed time (T) for a number of periods (N) of the input waveform, then computes the frequency for the relationship, F = N/T. And it does this in much less time than would be required with a conventional counter. For example, a resolution of 0.00001 Hz can be obtained for a 1-Hz input frequency with a total measurement time of only 1 s. A standard counter would require 27.28h for the same measurement.

CIRCLE NO. 322



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The very best.

It presents the best and most useful professional program for engineers, all concentrated on need-to-know in the next thousand days.

325 OEM's will introduce the newest generation of leading-edge products and systems in a demo-show that's been *sold out* for three months.

Meaningful seminars and special events all aimed at helping *you* in *your* career now!—not in the far future.

It's a booming Wescon Week in beautiful San Francisco—and it gives you the best possible "short course" in what's coming, and coming fast.

You can have all four busy, profitable days of it for a $5 registration fee, payable at the door.

Don't miss "Electronics in the Next Thousand Days."

It's the very best!

WESCON75

Sept. 16-19, Brooks Hall/Civic Auditorium, San Francisco

Further information: Wescon, 3600 Wilshire Boulevard, Los Angeles, California 90010 (213)381-2871

INFORMATION RETRIEVAL NUMBER 50

Rugged portable scope aims at industrial use

Tektronix, P.O. Box 500, Beaverton, OR 97005. (503) 644-0161. $1650; 8 wks.

The 455 is a rugged, lightweight portable oscilloscope. Featured are dual-channel operation with 50-MHz bw, vertical sensitivity ranging from 5 mV/div to 5 V/div, delayed sweep, and sweep rate to 50 ns/div (extended to 5 ns/div by a 10X magnifier). Other features include trigger view, lighted deflection-factor indicators (1X or 10X probe attenuation automatically accounted for), probe coding and a full 8 × 10-cm display. The case is made of shock-resistant, reinforced plastic.

CIRCLE NO. 323

Signal source sweeps, pulses, delivers sines

Dana Exact Electronics, 455 S. E. 2nd Ave., Hillsboro, OR 97123. (503) 648-6661. $1895; stock.

A combination pulse/sweep/function generator, Model 7059, combines the features of a general-purpose pulse generator and an 11-MHz sweep function generator. The instrument offers sine, square, triangle, ramp and, in addition, positive and negative pulses with precision control of rep rate, pulse width, and duty cycle. As a function generator, the unit has a frequency range of 0.0001 Hz to 11 MHz and can be triggered or gated externally or from an internal trigger source. Frequency sweep width is 0 to 1000:1. Pulse widths range from 1000 s to 100 ns.

CIRCLE NO. 324

INTEGRATED CIRCUITS

Single IC drives large LCDs

LSI Computer Systems Inc., 22 Cain Dr., Plainview, NY 11803. (516) 293-3850. $18.20 (100); stock to 8 wks.

The Model C1200 MOS clock circuit can drive large seven-segment LCDs directly. The new chip outputs 40 V ac—80 V pk-pk—from a single V_{DD} supply of 50 V dc. The circuit presents a 12-hour clock format with leading zero blanking. It can also be used as an elapsed-time indicator, when the clock is reset to zero, by a simultaneous activation of both hour and minute time-set inputs.

CIRCLE NO. 325

CMOS multiplexers avoid 'glitches'

Siltek International Ltd., Aiport Industrial Park, Bromont, Quebec, Canada JOE 1LO. (514) 534-2255. $1.40 to $2.92 (100 up).

Three 4000-series-compatible 3-to-18-V CMOS analog multiplexers/demultiplexers eliminate "glitches" due to differential address delays, and they provide a worst-case ON resistance of 300 Ω at 10 V and 175 Ω at 15 V. The SIL4051B is an 8-to-1 line circuit with three-line binary address; the SIL4052B is a dual 4-to-1 line circuit with common two line address; and the SIL4053B is a triple 2-to-1 line IC with three independent channel-select inputs. Off leakage is only 100 pA. Propagation delay from address and inhibit to output is 90 ns at 10-V.

CIRCLE NO. 326

PLL circuit simplifies uses

Exar Integrated Systems, 750 Palomar Ave., Sunnyvale, CA 94086. (408) 732-7970. $5.16 (100 up); stock.

Improved capabilities in an FSK demodulator/tone decoder permit the circuit's use in narrowband communication equipment. The XR2211 has about 10 times the frequency stability and response speed of previous designs, allowing operation at bandwidths as narrow as ±1%. Also the use of any channel requires the selection of only five or six component values. And the XR-2211 is the first PLL system with simultaneous FSK demodulation and tone or FSK-carrier detection capability. Typical frequency stability is 20 ppm/°C over temperature and 0.05%/V for supply drift. Input dynamic range is 2 mV to 3 V rms, frequency range is 0.01 Hz to 300 kHz, adjustable tracking range is ±1% to ±80%, and power supply range is 4.5 to 20 V.

CIRCLE NO. 327

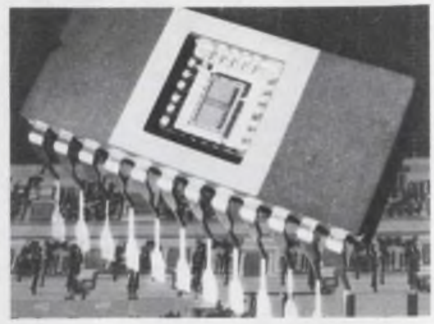
CMOS processor executes PDP-8 set

Intersil Inc., 10900 N. Tantau Ave., Cupertino, CA 95014. (408) 257-5450. $395 (1-24).

The IM6100 CMOS single-chip microprocessor executes the instruction set of the popular PDP-8/E minicomputer. The 12-bit IM6100 consists of six 12-bit registers, a programmed logic array (PLA), an arithmetic and logic unit (ALU) and associated gating and timing circuitry. The IC uses a single 5-V supply, has an on-chip crystal-controlled oscillator and comes in a 40-pin DIP. The device operates with standard MOS RAMs, PROMs and FPLAs, with no more than six standard 54/74-TTL packages for interface. To complement the IM6100, Intersil plans to introduce four additional LSI CMOS devices: a UART, a 1-k × 12-bit ROM, a parallel interface element and a 256 × 4-bit RAM. In addition, the company offers three PC boards: 4-k × 12-bit CMOS RAM, CPU/TTY and control panel.

CIRCLE NO. 328

EPROMs move up to 8-k bits



Intel Corp., 3065 Bowers Ave., Santa Clara, CA 95051. (408) 246-7501. $39.30 to $65.50 (100-999).

An 8192-bit ultraviolet erasable and electrically reprogrammable ROM—the largest yet—increases speed by a factor of two over that of earlier units. Organized 1024 × 8-bits, the new Model 2708 has a guaranteed worst-case access time of only 500 ns over the 0-to-70-C temperature range. By contrast, the popular Model 1702A—a 2-k bit EPROM—has a worst-case access of 1 μs. Also, the 2708 typically dissipates 97 μW/bit compared with 292 μW/bit for the 1702A. The dissipation and speed specs of the 2708 can also be obtained in a 4-k bit version, the Model 2704, which is organized as 512 × 8-bits. A reprogramming of the new EPROMs can be achieved with a single high-voltage pulse per bit while the new memories maintain operation from standard supplies of ±5 and +12 V. Typical programming time is 12 ns per bit, or about 100 seconds for the 8-bit EPROM.

CIRCLE NO. 329

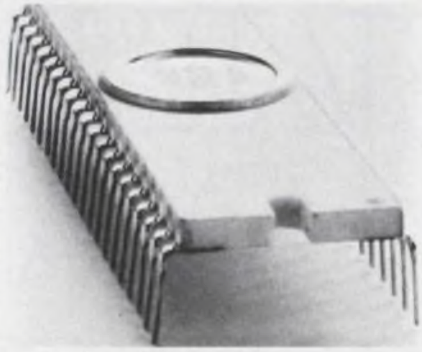
1-k bit CMOS RAM aims for 2102 sockets

Siltek International Ltd., Airport Industrial Park, Bromont, Quebec, Canada JOE 1LO. (514) 534-2255.

The 1902A, a fully static CMOS RAM organized 1024 × 1 bit, features pin compatibility with 2102-type n-channel MOS RAMs. The 1902A has low battery drain even at 125 C, where standby current is only 200 nA per bit with V_{DD} = 5.5 V. The circuit offers a typical access time of 450 ns with V_{DD} = 5.5 V and C_L = 50 pF.

CIRCLE NO. 330

Enhanced 8080-type processor makes debut



NEC Microcomputers, Inc., 5 Militia Dr., Lexington, MA 02173. (617) 862-6410.

The μCOM-8, an n-channel MOS silicon-gate microprocessor, features pin compatibility with Intel's 8080 processor. However, several enhancements have been built into the new version. It has multibyte interrupt instruction capability, and it can do BCD subtraction as well as addition. Moreover it gives 20% faster register-to-register transfers—just 2 μs. The new processor lists 78 instructions. Support circuits include a 4096-bit dynamic NMOS RAM—the UPD-411D-3—with the fastest available access time of 150 ns. The company also offers a range of hardware and software support as well as documentation.

CIRCLE NO. 331

IC holds TV i-f system

Plessey Semiconductors, 1674 McGaw Ave., Santa Ana, CA 92705. (714) 540-9979. $10.56 (100 up); stock.

The SL437, a TV i-f system requiring only external tuning elements, contains a video i-f amplifier with agc, video detector and noise limiter, agc generator with gating input, tuner agc with variable delay limiting sound i-f, quadrature detector and dc-volume control. The video i-f amplifier has an agc range of 65 dB, and conversion gain of 96 dB (15 μV/V). The video output zero-carrier level is typically 7 V, with sync tips at 2.3 V. Video output impedance is 25 Ω. Also the SL437 provides an afc output.

CIRCLE NO. 332

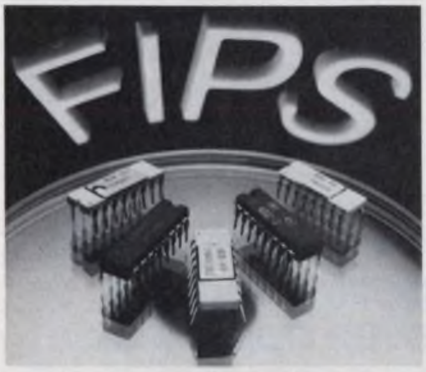
2-k bit TTL PROM reads in 30 ns

Fairchild Integrated Circuit Group, 464 Ellis St., Mountain View, CA 94042. $20.48 to $51.50 (100-999); stock.

A 2048-bit TTL PROM combines Isoplanar and Schottky technology with fuse-link techniques. The PROM has a maximum read cycle time of 50 ns over the 0 to 75 C temperature range and 60 ns over the full military temperature range. Typical read cycle is 30 ns. The PROM is available in two versions: the 93436 open collector and the 93446 three-state output, in a 16-pin ceramic DIP. The new PROM can replace standard 1024-bit PROMs by a change of one pin from chip select to address.

CIRCLE NO. 333

4-bit processor finds alternate source



National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, CA 95051. (408) 732-5000. $7.50 to $9.95 (100).

Intended as a replacement for Intel's MCS-4 microprocessor system, the new FIPS (Four-bit Integrated Processor System) features a CPU chip that sells for less than $10 and reduced chip-set power dissipation. In addition to the INS4004 CPU, the chip set includes a combination 256 × 8-bit ROM and 4-bit I/O port (INS-4001), a 320-bit RAM with a 4-bit output port (INS4002) and a 10-bit serial-in parallel-out shift register (INS4003). Other units are an 8-bit address latch-memory interface (INS4008) and 8-bit instruction and I/O transfer device (INS4009). Together they permit the use of the standard MM1702AQ 2048-bit erasable PROM.

CIRCLE NO. 334

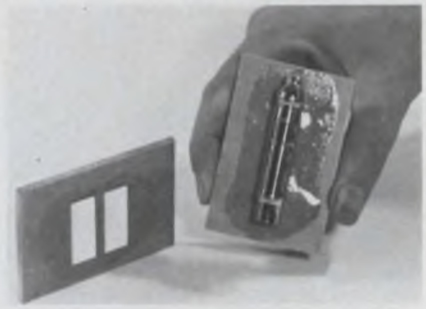
Mag-shielding case protects tape cassette

Ad-Vance Magnetics, Inc., 226 E. Seventh St., Rochester, IN 46975. (219) 223-3158. $15 (unit qty); 2 to 6 wks.

Severe electrical storms, nearby radiating equipment or power-generating equipment may partially erase or degrade vital data on cassette tapes. A new cassette data protector, Model CDTP AD-MU, prevents such possible losses. If dropped, the single cassette tape inside each protector remains undamaged. It is impervious to most postal abuse.

CIRCLE NO. 335

Temporary adhesive speeds production



Aremco Products, P.O. Box 429, Ossining, NY 10562. (914) 762-0685. $27.50/package of five sticks; stock.

Crystalbond 509, an acetone-soluble polymer-based adhesive, can speed production dicing of silicon, glass and alumina substrates. Due to the minimal glue line of 0.001 to 0.002 in. there is excellent adherence and this permits dicing of miniature die with minimal chipping down to 0.005 in. The material can be recycled for further use. Crystalbond 509 does not gum up diamond blades used in dicing.

CIRCLE NO. 336

Ultra-mini connectors have 0.125 in. diameters

Microtech, Inc., Park Square Bldg., 777 Henderson Blvd., Folcroft, PA 19032. (215) 532-3388. From $0.95 (1000-up); stock.

A line of ultra-miniature coaxial connectors and multicontact 4, 7 and 12-pin connectors is designed to meet high density packaging. The co-axial connectors are available in ultra-miniature and miniature sizes with outer diameters of 0.125 and 0.25 in., respectively. Over-all length of the ultra-miniature plugs is less than 0.25 in. and they have outer diameters of 1/4, 5/16 and 7/16 in., respectively. Over-all length of the plugs is less than 0.5 in.

CIRCLE NO. 337

Oven stabilizes crystal temperature

Ovenaire, Div. of Walter Kidde & Co., Inc., 706 Forrest St., Charlottesville, VA 22901. (804) 977-8050. $7 (OEM qty.).

Ovenaire Model PCL1-27, a miniature crystal oven for HC-18/U, HC-25/U, HC-42/U or HC-43/U crystals, improves stability by greater than 30 to 1. Power consumption is less than 0.5 W at 25-C ambient and 50-C operating temperature. Size is 0.750-in. dia × 0.562-in. high. The ovens are available with temperature settings from 35 to 95 C and voltages from 5 to 36 V dc. An adjustment temperature control for crystal-frequency optimizing is also available at no additional cost.

CIRCLE NO. 338

Edge connectors feature gold-over-nickel plate

TRW Inc., 1500 Morse Ave., Elk Grove Village, IL 60007. (312) 439-8800. $1.71: 22 position (100 up).

A new line of seven sizes of low-cost edge connectors with contacts on 0.156-in. centers, the Series 90, is available in 6, 10, 12, 15, 18, 22 and 25 position, single and double readout with either solder-tab or dip-solder PC-board terminals. The bellows type, bifurcated contacts are made of a selectively plated copper alloy with 20 microinches of gold over 30 microinches of nickel at the contact area. Nickel provides a barrier to base-metal migration that is a significant improvement, with no increase in price, over copper-underplating, according to TRW. Insulation is glass-filled polyester.

CIRCLE NO. 339

(Advertisement)

ELECTRONIC PACKAGING

Racks delivered pre-assembled; 27 sizes

Bud Radio, Inc., 4605 E. 355 St., Willoughby, O. 44094, (216) 946-3200. Off-the-shelf delivery.

Series 60 upright and inclined panel racks from Bud. Interiors easily accessible from front and rear. 19" panel space. Upright: 14 sizes; clear inside depths, 20½" and 24". Clear inside depth of seven extra-deep units, 29¼". Inclined: three sizes; clear inside depth, 20½". Clear inside depth of three extra-deep units, 29¼". "U" braces. Adjustable mounting rails. Available at your Bud Distributor. For further information, phone —

1-800-321-1764, TOLL FREE
IN OHIO, 1-800-362-2265, TOLL FREE

Custom-made look, yet standard enclosures.

Bud Radio, Inc., 4605 E. 355 St., Willoughby, O. 44094, (216) 946-3200. The sleek TR Series.

Available at your Bud Distributor. Four sizes, plus accessory chassis. Also accepts P.C. boards. Body, .050 aluminum; front panel, .090 aluminum. Top and bottom removed easily for access to dust-free interior. Carrying handle used as tilting bail. Handle/bail, front panel and self-adhesive rubber feet included. Finished in mar-resistant, durable Nextel. Compare delivery, value, shipping economies. For further information, phone —

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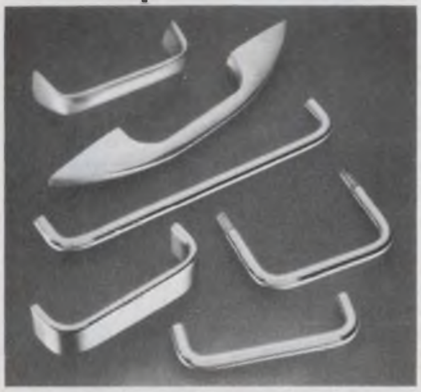
Handles for enclosures – a complete line

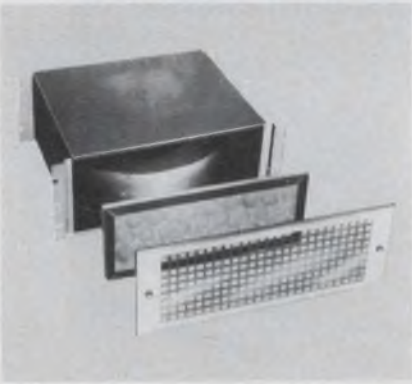


Bud Radio, Inc., 4605 E. 355 St., Willoughby, O. 44094, (216) 946-3200. 33 different types.

Handles plus hardware for electronic enclosures are in stock at your Bud Distributor: chrome plated, silver anodized, brushed chrome recessed and satin chrome lever types, chrome plated catch sets. Fasteners included. Designed for all types of applications. Construction equals that of higher priced counterparts. Range of sizes and configurations. Compare. For further information, phone –

1-800-321-1764, TOLL FREE
IN OHIO, 1-800-362-2265, TOLL FREE

Low silhouette blowers cool electronic equipment

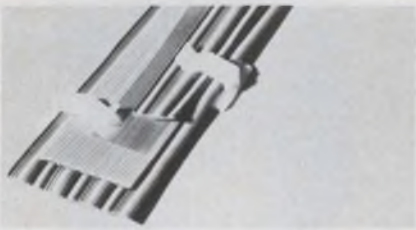


Bud Radio, Inc., 4605 E. 355 St., Willoughby, O. 44094, (216) 946-3200. Now at your Bud Distributor.

Six models. Each cools electronic equipment in racks, cabinets, consoles efficiently, economically. Panel heights: 3½", 5¼" and 7" – lowest heights, highest CFM output in the industry. Each has 19" panel width, standard E.I.A. notching for rack mounting. Filters removed through front panel; no tools required. Guaranteed for 20,000 hours. For further information, phone –

1-800-321-1764, TOLL FREE
IN OHIO, 1-800-362-2265, TOLL FREE

Universal press clip holds flat cable



Weckesser Co., Inc., 4444 W. Irving Park Rd., Chicago, IL 60641. (312) 282-8626.

New Weckesser FCA-15 molded nylon press clips meet the need for a single-sized universal clip to hold any size flexible-flat or ribbon cable. The clips are used along the edges of the cable. They provide flexibility in mounting and allow the stacking of flat cables even if they have varying widths and thicknesses. Adhesive-backing speeds assembly and cuts installation costs. The clips stay permanently once pressed into place, yet cables can be removed and replaced when necessary. Clips should be applied only to clean surfaces that are free from dust and oil.

CIRCLE NO. 340

LEDs and pushbuttons combined on DIP

Illinois Tool Works Inc., 6615 W. Irving Park, Chicago, IL 60634. (312) 282-4040. $4 (OEM qty)

SPST normally-open pushbutton switches are combined with miniature, T-1-sized red LEDs on a standard DIP with 1 × 0.3-in. spacings. Over-all height, from the bottom of the package to the top of the LEDs, is 0.44 in. The pushbutton mechanism has been tested to over 100,000 cycles. Initially, three configurations will be available in the same package size—one switch and four LEDs, five switches and four LEDs and four LEDs only.

CIRCLE NO. 341

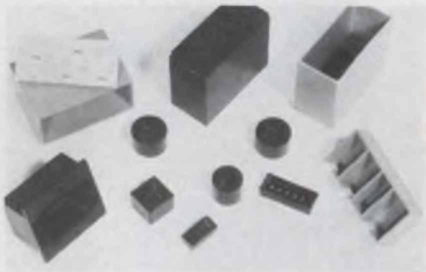
Mini heat sinks keep power semis cool

Aham, 968 W. Foothill Blvd., P.O. Box 909, Azusa, CA 91702. (213) 334-5135. From $0.74 (5000-up).

The Series 400/420 heat sink is a highly efficient combination of two heat sinks. The 400/420 offers the user a greater heat transfer of natural convection without sacrificing additional board and space. For TO-3 packages Models 402/423 and 403/425 provide 1.875 × 1.875 × 0.75 in. and 1.875 × 1.875 × 1 in. areas, respectively. And, for TO-66 packages the 402/428 and 403/429 provide identical amounts of heat sink areas, respectively.

CIRCLE NO. 342

Potting cups molded from 400-V/mil resins



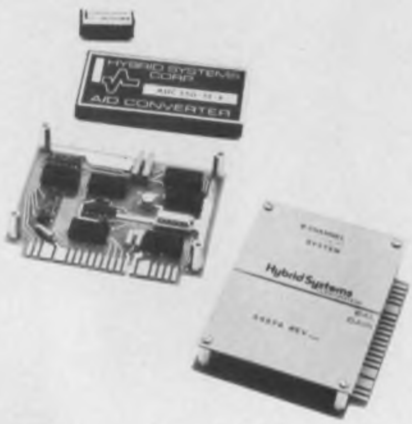
Precision Paper Tube Co., 1033 S. Noel Ave., Wheeling, IL 60090. (312) 537-4250.

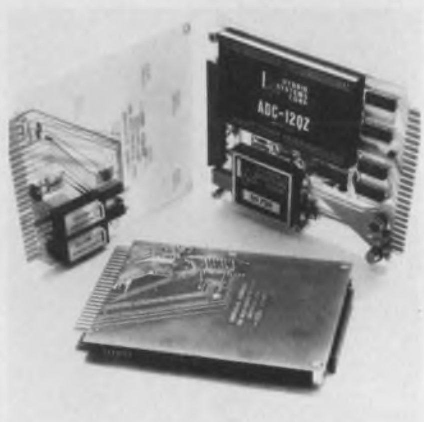
Custom-molded potting cups and lids made of electrical-grade phenolic or alkyd resins can be supplied with holes for lugs or terminals as well as molded-in identifying information. Tooling time is as short as two weeks. Dielectric strength for both resins is 400 V/mil, but the alkyd has a higher tensile strength—9000 compared with 7000 psi for the phenolic. The alkyd also has a heat deflection temperature of 450 F and the phenolic is only 310 F. Sizes and shapes of cups can vary from 1/2-in. diameter up to 5-in. maximum rectangular measurements.

CIRCLE NO. 343

DON'T MISS AN ISSUE. FILL IN AND RETURN YOUR RENEWAL FORM TODAY. (See inside front cover.)

Multichannel data-acquisition systems cut costs but not versatility





Hybrid Systems, 22 Third Ave., Northwest Park, Burlington, MA 01803. (617) 332-7584. P&A: See text.

Multichannel data-acquisition subsystems are available from several manufacturers—but usually at a high price. Hybrid Systems has slashed costs with its introduction of the DAS-400, eight-channel data-acquisition system. The DAS-400 costs only $199 in unit quantities—about half the cost of the closest competing subsystem.

The DAS-400 multichannel a/d converter system has an accuracy of 0.03% and a throughput speed of 30,000 channels/s. To keep costs down, Hybrid Systems has eliminated some of the features, such as expandability and a sequential address counter, that are available in more expensive units like the MP6912 from Analogic (Wakefield, MA), the SDM8501 from Burr-Brown (Tucson, AZ), the DT1600 series from Data Translation (Framingham, MA), the DAS-16-M12 from Datel (Canton, MA), the MN-7000 from Micro Networks (Worcester, MA) and the 7200 from Zeltex (Concord, CA).

The DAS-400 system handles eight single-ended inputs with a 0 to 10 or −5 to +5 V input range. The range can be electronically switched so that unipolar and bipolar signals can be mixed. The a/d converter delivers a 12-bit data word plus the complement of the most significant bit and a status signal that indicates the start and completion of conversion.

The system has an input impedance of 100 MΩ minimum, a gain tempco of 30 ppm/°C and a linearity tempco of only 15 ppm/°C. With a 1-kHz, 10-V pk-pk input signal, crosstalk is less than 0.5 LSB; the maximum error for a full-scale input swing between successively addressed channels is only 1 LSB, max.

Hybrid Systems has also announced a larger system, the DAS-450, a 16-channel module that can be expanded up to 128 single-ended channels. The DAS-450 can also be expanded to handle 64 differential channels.

The output lines of the DAS-450 are three-state, buffered logic to ease connection to computer interface busses. Fixed input ranges of 0 to 10, −5 to +5 and −10 to +10 V are available and can be altered in the field.

Included in the DAS-450 system is the channel-address logic and all necessary timing logic. With all its features, the DAS-450 still has a unit-quantity price of only $399—about $100 less than other units with similar features.

Typical specs for the DAS-450

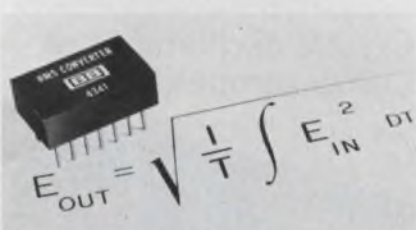
INFORMATION RETRIEVAL NUMBER 63

include an acquisition time of 1 μs for a 10-V step in the sample/hold amplifier, an a/d conversion time of 40 μs and a multiplexer addressing time of 200 ns. Gain and offset are adjustable to zero with built-in trim potentiometers.

The DAS-400 eight-channel system is built on two 4.5 $\times$ 3.5 in. PC cards and requires +15 V at 25 mA, −15 V at 15 mA and +5 V at 200 mA. The DAS-450 consists of two 3.5 $\times$ 6 in. PC cards and requires +15 V at 66 mA, −15 V at 83 mA and +5 V at 723 mA. Both units are available from stock.

For Hybrid Systems	CIRCLE NO. 301
Analogic	CIRCLE NO. 302
Burr-Brown	CIRCLE NO. 303
Data Translation	CIRCLE NO. 304
Datel	CIRCLE NO. 305
Micro Networks	CIRCLE NO. 306
Zeltex	CIRCLE NO. 307

True rms-to-dc converter housed in 14-pin DIP



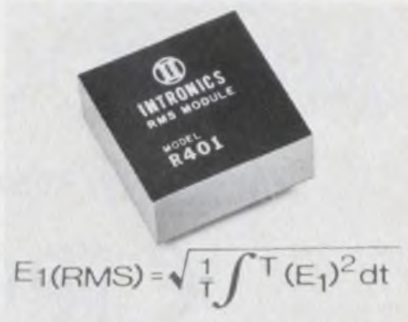
Burr-Brown, International Airport Industrial Park, Tucson, AZ 85734. (602) 294-1431. $19 (100-up); stock.

The Model 4341 rms converter, in a 14-pin DIP, has an accuracy of ±0.2% of reading ±2 mV. The response time and the magnitude of output ripple are adjusted by an external capacitor. The offset and gain errors can be removed by the addition of external resistors. The unit has an input impedance of 5 kΩ and can accept ±10-V input signals. The output delivers 0 to 10 V at +5 mA, and has an impedance of 1 Ω, maximum. Bandwidth is 450 kHz for −3-dB response and stability is ±0.1 mV ±0.01% of reading/°C.

CIRCLE NO. 344

MODULES & SUBASSEMBLIES

Rms-to-dc converter has ±10 V input range



Intronics, 57 Chapel St., Newton, MA 02158. (617) 332-7350. $60 (1 to 9); 2 wk.

The R401 modular rms-to-dc converter produces an output voltage proportional to the root-mean-square value of the input signal. This unit smoothly performs the rms function on many types of input waveforms. For input signals from −10 to +10 V, the total output error is 5 mV +0.1% of reading. The scale factor is set at 1 V dc/V rms so that a 10-V peak sine wave will produce an output voltage of 7.07 V dc. For operation at low frequencies (less than 50 Hz) or for a reduction in output ripple, an external capacitor may be connected between the SP and output terminals. When used with an external filter network, operation down to 0.5 Hz can be achieved.

CIRCLE NO. 345

Standard circuit cards hold control system

JC Systems, Box 23445, San Diego, CA 92123. (714) 277-6585. From $55 (unit qty.); stock.

The 'Mini-mod' system line contains modular electronic control system building blocks. Circuits are assembled on two-sided printed circuit cards. A standard card measures 4.5 × 6 in. The front edge of the card has indicators which can display the operational status of the module when in use; the rear edge of the card has fingers for a dual sided printed circuit connector. Functions available include amplifiers, clamps, isolators, motor drivers, time delays and sequencers.

CIRCLE NO. 346

Instrumentation amp housed in TO-8 package

National Semiconductor, 2900 Semiconductor Dr., Santa Clara, CA 95051. (408) 732-5000. 100-up prices: $23.55 (CG); $43.90 (G); stock.

The LH0036G hybrid instrumentation amplifier is a micropower circuit designed for precision, differential-signal processing. A combination of high input impedance (300 MΩ) and high common-mode rejection ratio (100 dB) provide the accuracy. Gain deviation is only 0.3% typ. The power supply operating range is very wide, from ±1 to ±18 V, and the circuit's power demand is only 90 μW at the low end of the supply voltage range. The gain can be programmed from 1 to 1000 with a single resistor. Output bandwidth is also adjustable—from 350 kHz (small signal) to 5 kHz (full power) at unity gain—as is the input bias current. A guard-drive output pin is also provided. The LH0036G is specified for operation between −55 and +125 C; an industrial version, the LH0036CG, operates from −25 to +85 C. Both parts are housed in hermetic, 12-lead, TO-8 metal cans.

CIRCLE NO. 347

Crystal oscillators are CMOS-compatible

Conner-Winfield, West Chicago, IL 60185. (312) 231-5270. From $20 (10 to 100); 4 wk.

The S14R low-profile CMOS-compatible DIP crystal oscillator is available at any fixed frequency from 4 to 20 MHz. Its frequency tolerance is ±0.01% from −25 to +75 C. The unit is housed in a DIP-like package that measures 0.3 × 0.8 × 0.5 in. The oscillator can operate from any supply voltage between +3 and +15 V dc with ±5% regulation and draws a current of less than 5 mA.

CIRCLE NO. 348

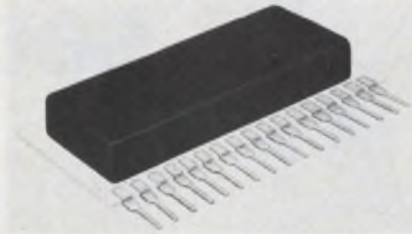
Digital angle converters accept BCD or binary

Computer Central, P.O. Box 804, Gaithersburg, MD 20760. (301) 948-5557. From $525 (unit qty); 6 wk.

The Model 840 rotary digital-difference-to-analog converter (DD/A) is available with BCD or binary input ranges. The inputs cover 359° (to 2^{10}), 359.9° (to 2^{14}), 359.99° (to 2^{18}), and 359.999° (to 2^{21}) for use in digital instrumentation and control systems. The converter subtracts the two parallel TTL input numbers and converts the difference to a proportional bipolar analog (error) voltage that can be power amplified to control analog motors, servovalves, etc. The sign and magnitude of the rotary DD/A output voltage is continuous through the 359° to 0° transition such that feedback systems are driven through the least angular displacement. The converter is accurate to 1/2 LSD over the full temperature range from 0 to 70 C.

CIRCLE NO. 349

Hybrid active filters have 0.15-dB ripple



General Instrument, 600 W. John St., Hicksville, NY 11802. (516) 733-3000. $12.50 (1000-up); stock to 4 wk.

The D-3 low-pass active filter is designed to be used in both the transmit and receive modes. Some of its specs include: a ±0.15-dB passband ripple from 0 to 70 C, better than 40-dB stop-band attenuation at 4600 Hz, a 3.4-kHz cut-off frequency, less than 2.5-mW power dissipation and a size of 1.9 × 0.9 × 0.25 in. The filter is housed in a single in-line package. These hybrid filters are designed with low temperature coefficient thick-film resistors and NPO capacitors on ceramic substrates.

CIRCLE NO. 350

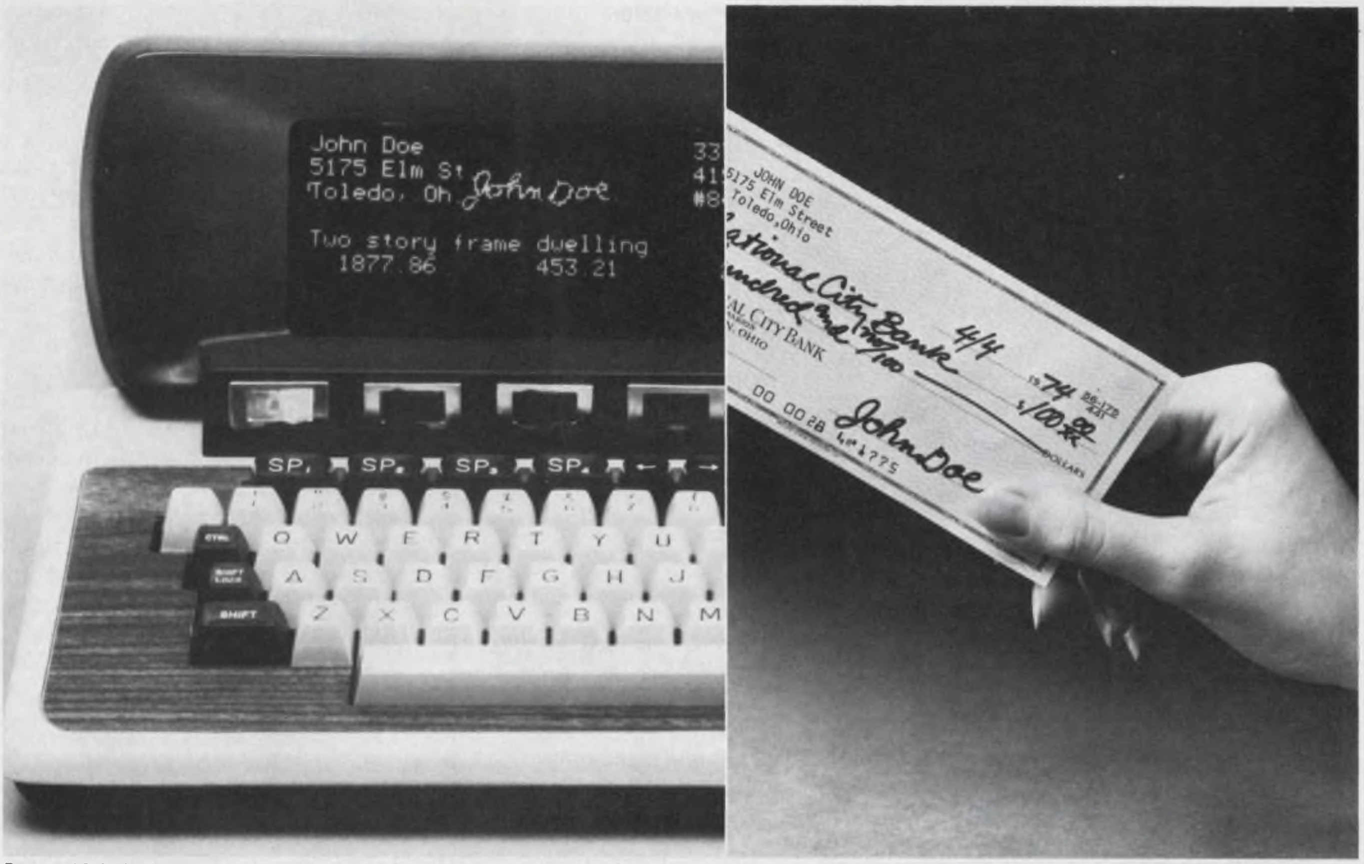
Signal conditioner linearizes temp sensors

Yellow Springs Instrument Co., Box 279, Yellow Springs, OH 45387. (513) 767-7241. From $130; stock.

Thermivolt Systems are precision temperature-to-millivolt signal conditioners. They convert the temperature sensed by resistance elements to a linear, dc analog voltage. This permits direct connection to computers, digital equipment, indicators, alarms, recorders and other process equipment. Thermivolts are available for use with two types of sensors, platinum RTDs and linear thermistor. They can cover temperatures from −40 to +600 C (−40 to +1112 F). Both encased and open models are available.

CIRCLE NO. 351

Digivue® - a better way to look at it.



Digivue 80-33 in demonstration unit, showing high-contrast display for use in signature verification.

Because computer time is valuable to your customers, Digivue display/memory units offer an unforgettable advantage.

The advantage is inherent memory and it's an inherent part of every Digivue unit. This makes Digivue units especially useful for graphic presentations like signature verification since refresh is not required.

And Digivue units offer a high-contrast, flicker free display for precise readings with less chance of eye fatigue for people who spend long periods referring to data displays and computer terminals.

There's a lot more to Digivue, too. Our 512-60 models have hard copy and rear projection capabilities. And Digivue panels are flat and thin, allowing precise display and broad equipment design parameters.

As you may have guessed, Digivue display/memory units currently cost more than CRT's. But then, they offer a lot more. For a booklet that explains Digivue more fully, call (419) 242-6543, Ext. 66-415. Or write Electro/Optical Display Business Operations, Owens-Illinois, Inc., P.O. Box 1035, Toledo, Ohio 43666

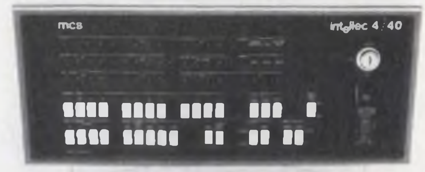
Demonstration model incorporates a Digivue display/memory unit 512 x 512 lines at 60 lines per inch resolution. Display area 8.5 inches square.

Smaller demonstration unit, utilizing a Digivue unit with 80 x 256 lines at 33 lines per inch resolution, has display area of 7.7 x 2.4 inches.

OWENS-ILLINOIS
Toledo, Ohio

INFORMATION RETRIEVAL NUMBER 73

Table-top prototyper speeds μP designs

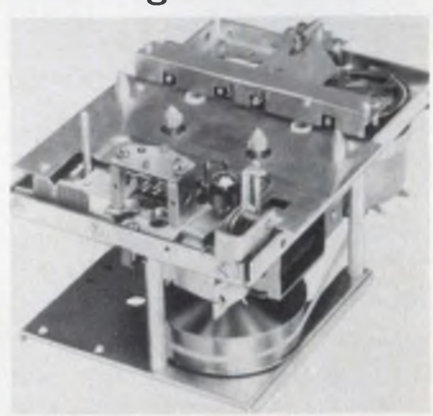


Intel Corp., Microcomputer Div., 3065 Bowers Ave., Santa Clara, CA 95051. (408) 246-7501. $2845; stock.

A table-top microcomputer development system, called Intellec 4/MOD 40, simplifies implementation of 4040 CPU (4-bit) systems. The unit has 5-k bytes of memory, expandable to 12-k bytes. The memory is a combination of PROM, data RAM and program RAM available in 4-k byte segments. The system has 60 instructions including conditionals, logicals, binary and decimal arithmetic and I/O. Cycle time is 10.8 μs. A PROM-resident system monitor and a RAM-resident assembler support software development.

CIRCLE NO. 352

Digital cassette drive uses single reel motor



Amilon Corp., 49-12 30th Ave., Woodside, NY 11377. (212) 274-1794. $100 (1000 qty); see text.

The A-7 Series digital transport drive is based on one reel motor and one capstan motor. Elimination of one reel motor is said to reduce tape tension. Salient features include mechanical and electrical interlocks to assure proper cassette use, fail-safe braking and a self-aligning pinch roller. Samples are available from stock.

CIRCLE NO. 353

Disc storage for PDP-11 offers 640 mbytes

Advanced Electronics Design, 754 N. Pastoria St., Sunnyvale, CA 94086. (408) 733-3555. From $17,-500; 60 days.

A disc storage system with PDP-11 compatibility, the AED 8000, can control as many as eight, 80 mbyte disc packs, and can simultaneously interface with up to four CPUs. A microcontroller replaces the typical hardwired formatter. And the controller can be reprogrammed for a variety of minicomputers. The present unit is plug-compatible with the DEC RP11-C. The drive provides a data transfer rate of 1.2 Mbyte/s with average access of 30 ms.

CIRCLE NO. 354

Photopen device capable of 200-ns response

Sanders Associates, Inc., Computer Graphics Div., Daniel Webster Hwy, S., Nashua, NH 03060. (603) 885-5280. $1200.

A solid-state Photopen Device features a 200 ns response time and is capable of operating with either stroke-written or high resolution TV displays. The unit can detect low light levels from CRT phosphors, without false triggering from high ambient light levels or EMI sources. Two TTL-level outputs are provided: pulse and switch. The pulse signal is generated when the unit detects the CRT beam; the switch signal is generated by lightly depressing the pen tip against the CRT display surface.

CIRCLE NO. 355

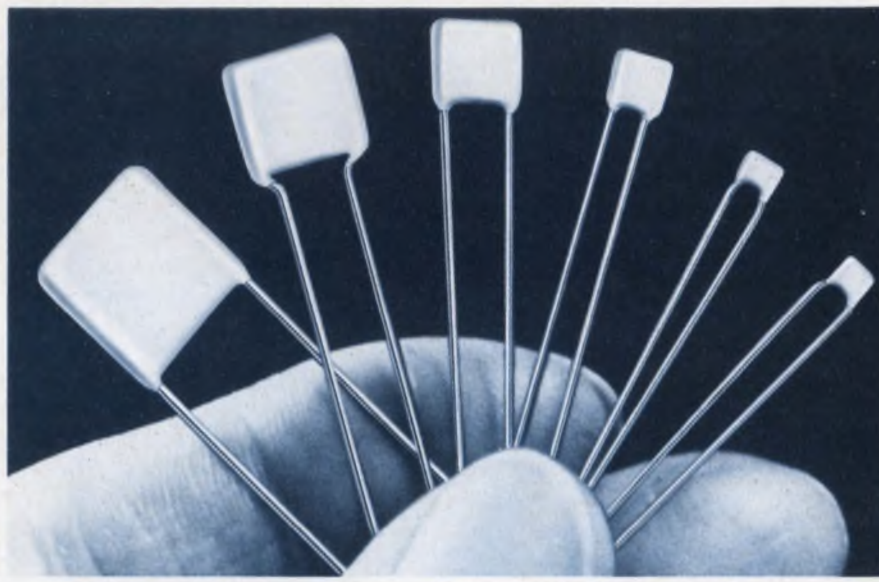
Floppy-disc memory includes section buffers

Sykes Datatronics, 375 Orchard St., Rochester, NY 14606. (716) 458-8000. $2691 (10 qty); Sept.

The Sykesdisk, a floppy disc memory, offers IBM compatibility, dual sector buffers and an intelligent controller. The unit can operate asynchronously and does not require an I/O area in the mini. The memory comes with single or dual drives and includes minicomputer interfaces plus software.

CIRCLE NO. 356

QUALITY IN VOLUME



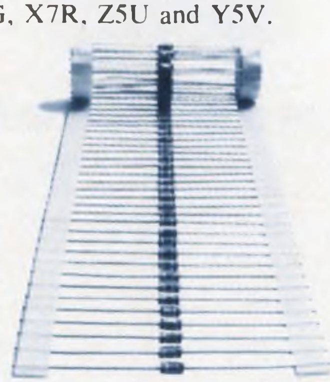
When you achieve it, you can offer true competitive value. That's just what we're doing at USCC/Centralab for 1975. MONO-KAP™ radial, and MONO-GLASS axial monolithic ceramic capacitors are now available to volume users *from stock* to eight weeks. Our investment and "learning curves" last year guarantee competitive responsiveness — USCC will welcome your specials and non-stock orders. Here's an offer you haven't heard lately — your money is going to buy more at USCC. Cash in on the best values in monolithic ceramic capacitors.

DISCRETE ASSEMBLY

MONO-KAP™ radial-leaded epoxy coated capacitors are reliable performers; they're rugged enough to work in MIL environments. 4.7 pF to 10 Mfd., 50 to 200 WVDC in 4 dielectrics, including Z5U, in a variety of case sizes featuring meniscus control to 0.032 inches. Large quantity orders from stock.

AUTOMATIC INSERTION

MONO-GLASS axials are glass encapsulated, designed for automatic PCB insertion; furnished reel-packed for high volume applications. They're available in 50 and 100 WVDC from 1 pF to 1.0 Mfd.; four dielectrics: COG, X7R, Z5U and Y5V.



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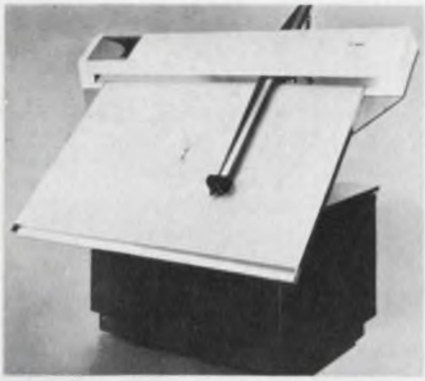
INFORMATION RETRIEVAL NUMBER 76

DATA PROCESSING

Precision digital plotters offered at reduced price



Data Technology, 4 Gill St., Woburn, MA 01801. (617) 935-8820. $13,400 (qty 2); 90 days.

Designed for medium to high volume drafting operations, the 3454 Series plotters provide accuracy of ±0.004-in., resolution of ±0.0025-in. and plotting speeds up to 1320 in/min. The line quality and operating specs are those usually found on plotters costing $30,000 or more. Two high-torque stepping motors and a proprietary electronics package replace the complex mechanical linkages required on other flatbed plotter designs. The 3454 plotters can be interfaced with any digital data source and offer a standard plotting area of 34 in. by 54 in.

CIRCLE NO. 357

Computer and printer joined by µP device

Air Land Systems Co., 2820 Dorr Ave., Fairfax, VA 22030. (703) 573-1100.

Two microprocessor-based controllers mate Centronics and ODEC printers as print-only terminals to host computers. The ALS/MPC-3 operates with IBM Bisync protocol or Burroughs polling environment. The ALS/MPC-5 works in an asynchronous or synchronous mode at rates up to 9600 baud. Software changes for other line disciplines will be quoted on request.

CIRCLE NO. 358

IT TAKES MONTHS to get back on ELECTRONIC DESIGN's qualified subscription list. Keep your copies coming. RENEW NOW (see inside front cover).

DIP package houses 1800-baud modem

Ventel, 1190 Dell Ave., Campbell, CA 95008. (408) 374-1363. $75 to $250 (1-24 qty).

Operating at rates from 0 to 1800 bit/s, these 4-oz devices provide modem functions, supervisory functions and EIA or CCITT interfaces—all with no additional circuits or components. The micro modems are housed in a 36-pin dual in-line package that measures 0.72 square in. A low voltage of ±15 V at 100 mA powers the unit. Modes of operation include originate, originate/answer, auto-answer and originate/auto-answer. Microphone amplifier and speaker circuits are included for acoustic coupling.

CIRCLE NO. 359

Graphics terminal boasts 250-kHz rate

Nuclide Corp., 642 E. College Ave., State College, PA 16801. (814) 238-0541. $6500; 90 days.

The Dynagraph computer-graphics terminal accepts data at rates up to 250 kHz and is compatible with mini or microcomputers. The flicker-free raster display provides multiple display capability. Other features include hardware vector and/or character generation with internal storage for up to 4k vectors and display storage for 64k addressable locations. Single computer instructions can control the construction and translation of multivector and/or character picture sets as well as control multiple pictures. Storage of vector and control information at the terminal reduces computer storage overhead and permits high-speed data presentations even with conversational languages such as Basic or Focal.

CIRCLE NO. 360

Megabyte mini also has intelligent I/O system

Computer Automation, 18651 Von Karman, Irvine, CA 92664. (714) 833-8830. See text.

Called the MegaByter because of its 1 Mbyte capacity, this 16-bit mini is intended to match wits with the likes of DEC's PDP 11/45, Data General's Eclipse and Interdata's 7/32. The unit features 224 microcoded instructions, multiple hardware stacks and decimal string arithmetic. A flexible interface system consisting of a basic I/O board plus cables with built-in intelligent deuces eliminates special-purpose interfaces for each cable has a microprogrammed processor attached to it and the distributor handles eight cables; each cable in turn attaches to a single peripheral. Cost of the MegaByter ranges from $9600 (32 kbytes; 1.2 μs) to $110,000. Comprehensive software is also available.

CIRCLE NO. 361

Software package aids remote data access

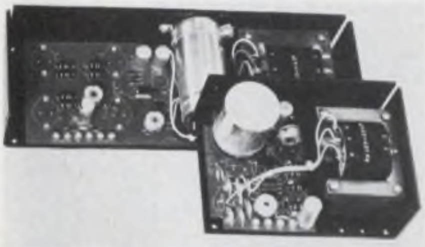
Interdata, 2 Crescent Pl., Oceanport, NJ 07757. (201) 229-4040. $2500.

A software package named ITAM provides access to remote terminals or computers as easily as to a local peripheral. The software package offers two levels of communications: a device-independent level, for easy access and a device-dependent level for sophisticated users who wish to provide their own terminal protocols. The device-independent level supports asynchronous terminals such as TTYs, CRTs and remote entry terminals. This level includes asynchronous and binary synchronous program modules that can be integrated to accommodate a variety of facilities, protocols and networks. A minimum ITAM system includes a Model 7/32 with 65 k bytes of memory, OS/32-MT, memory access controller, a real-time clock, a control console and appropriate data set adaptors.

CIRCLE NO. 362

POWER SOURCES

18 models form dc open-frame series



Powertec, 9168 De Soto Ave., Chatsworth, CA 91311. (213) 882-0004. Begin at $24.95; stock.

OEM II is the company's second generation line of open-frame dc supplies. Eighteen single-output models include three new package sizes. Each model provides an epoxy glass circuit board IC, regulation, output screw terminals, remote sensing and programming, metal film resistors, computer-grade capacitors, reverse polarity protection, adjustable current limiting, vacuum-impregnated transformer, hemetic semiconductors, interchangeability with previous models and ac input options.

CIRCLE NO. 363

Bench supply delivers triple outputs

Acopian, Easton, PA 18042. (215) 258-5441. $235; stock.

Model KT7-20 benchtop power supply provides a 0-to-7-V output for digital logic and balanced plus/minus output voltages for op amps or other analog circuits. The 7-V output is rated at 2 A and has a constant-voltage/constant-current crossover characteristic with continuously adjustable current control. Adjustable overvoltage protection is provided. Line and load regulation are ±0.01% each; ripple is 0.25 mV. The balanced outputs are adjustable from ±10 to ±20 V and are rated at 500 mA/output. Line and load regulation are ±0.05% each; ripple is 1 mV.

CIRCLE NO. 364

Converters give 10 W at 60% efficiency

B. H. Industries, 5784 Venice Blvd., Los Angeles, CA 90019. (213) 937-4763. $91.50; 3 wk.

Dc/dc converters with dual 5-to-15-V tracking outputs achieve 10-W output at 60% efficiency. The 2068 series is provided with a plate for mounting to a heat sink. The 10-W output can be taken from one output or it can be split between both outputs. Voltage accuracy is 100 mV and regulation is 10 mV for load and line changes. Size is 3.75 × 2.0 × 0.82 in.

CIRCLE NO. 365

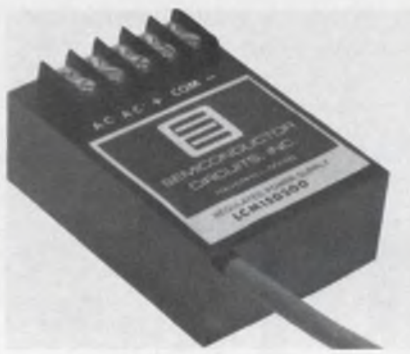
Line regulators aimed at processors & minis

Sola Electric, 1717 Busse Rd., Elk Grove Village, IL 60007. (312) 439-2800. $198.30 to $498.75; stock.

A new minicomputer regulator is designed to prevent malfunction and damage caused by brownouts and other line voltage irregularities. Line voltage can vary from 95 to 130 V and output is stabilized to less than ±3%. Output remains within the standard ±5% even when power line voltages drop to 65% of nominal. Four models offer ratings of 500, 750, 1000 and 2000.

CIRCLE NO. 366

Chassis-mount minis feature terminal strips

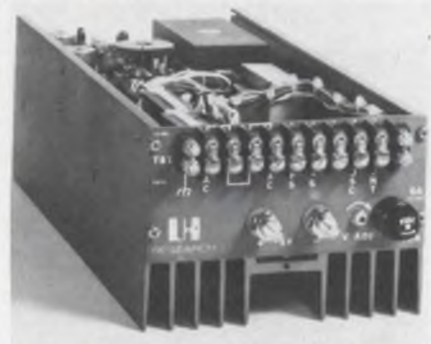


Semiconductor Circuits, 306 River St., Haverhill, MA 01830. (617) 373-9104. $69.95 to $107.95; stock-2 wks.

The new CM and LCM series of chassis-mount, miniature encapsulated power supplies buck the plug-in trend by providing a top-mounted, barrier-type terminal strip for easy power entry and exit: four 4-40 × 0.2-in. deep threaded inserts located in the base of each module ensure easy but secure installation. The CM series is powered by connection to two terminals on the barrier strip, the LCM series includes an internally connected 6-foot line cord. Standard models provide single outputs of 5 V dc at 750, 1000, 1500 or 2000 mA, as well as dual outputs of ±12 V dc or ±15 V dc at 100, 200 or 300 mA.

CIRCLE NO. 367

250-W switcher 'tips' the scale at 7 lb



LH Research Inc., 4444 Riverside Dr., Burbank, CA 91505. (213) 843-8465. $360.

These 250-W switching-regulated power supplies weigh only 7 lb and measure 3.65 × 5.05 × 12.25 in. The 250 series have 80% efficiency with outputs of 5, 12, 15, 18 or 24 V dc. Standard features include fully regulated output, overvoltage protection, and selectable input voltages, 115/230 V ac, 47 to 440 Hz, simply by changing a jumper on the front-terminal strip.

CIRCLE NO. 368

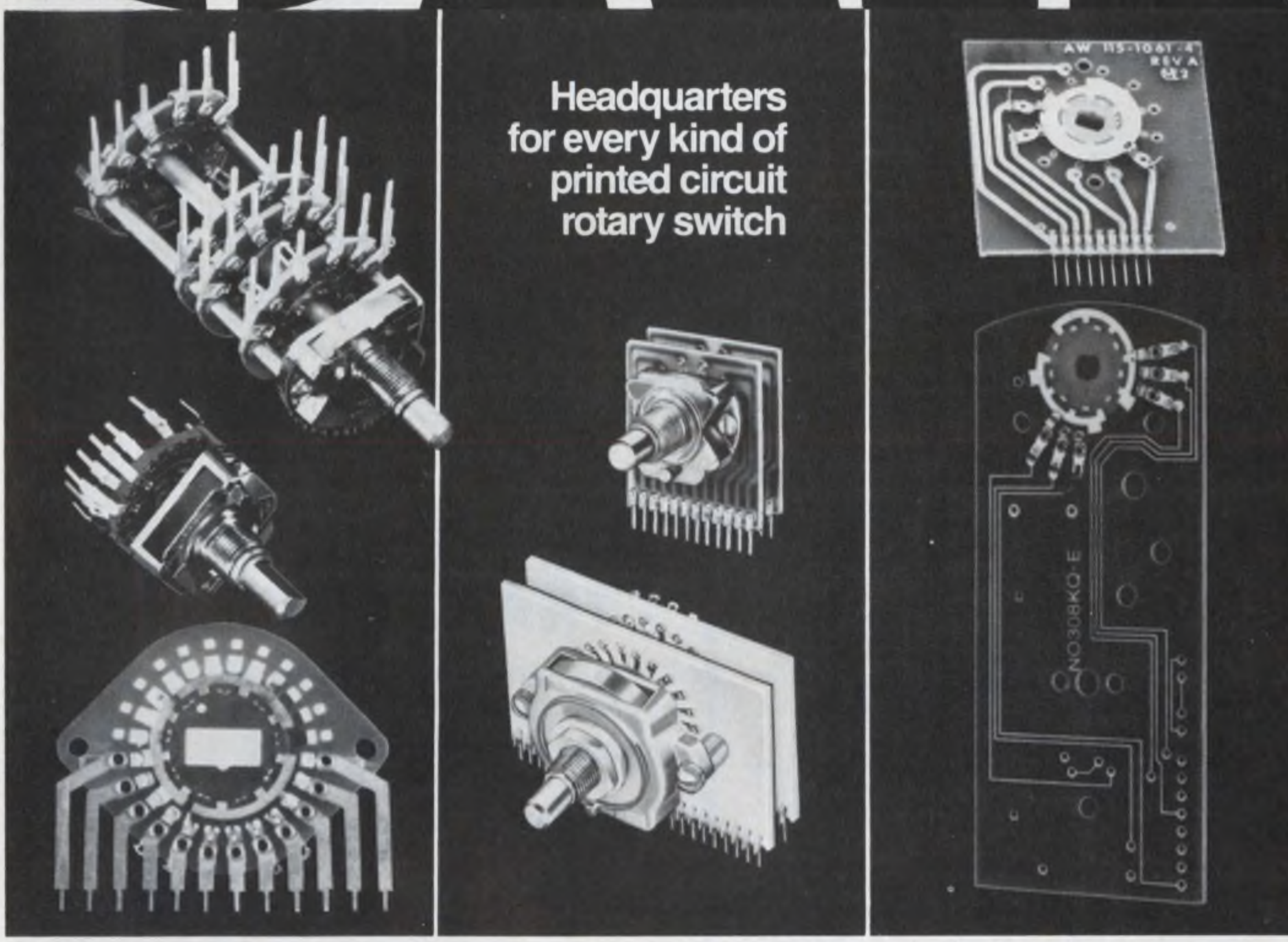
Open-frame units run cool

Faratron, 280 Green St., South Hackensack, NJ 07606. (201) 488-1440. $31 to $145; stock.

Referred to as "the cooler," this 5-V, 25-A open-frame supply has a maximum power-transistor temperature rise of 50 C. All OEM open-frame models come with plug-in/self-locking printed-circuit regulators. All models are adjustable ±5% with cermet potentiometers and are supplied with 115/230 V inputs. Input and output connections are made with barrier-strips. The units cover a range of 5 V through and including 28 V dc, with current ranges from 3 to 30 A.

CIRCLE NO. 369

OAK



Simplify your equipment design and reduce assembly costs with this broad selection.

1. PCB Terminations can be provided on any conventional Oak rotary switch—the most extensive line in the industry—(1/2" to 2 5/16" diameter sections).

2. Standard PC Board section switches, 12 and 24 position, with PCB terminations are tooled for volume production.

A NEW CATALOG
Detailing Oak PCB switch products and capabilities has just been published. Write for your free copy . . . or call our toll free number: 800-435-6106.

3. Custom designs to meet special applications, including switching built directly into the PC board are readily supplied.

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SWITCH DIVISION/CRYSTAL LAKE, ILLINOIS 60014
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INFORMATION RETRIEVAL NUMBER 84

MICROWAVES & LASERS

Radar transponder outputs 5-W pk

Vega Precision Laboratories, 800 Follin Ln., Vienna, VA 22180. (703) 938-6300.

A compact, X-Band solid-state radar transponder, weighing only 10 oz, combines a sensitivity of −40 dBm with a power output of 5-W pk. Called the Model 229X, it operates with an input voltage of from 22 to 32 V dc and draws only 10 mA when quiescent and 80 mA at a prf of 2500 pps.

CIRCLE NO. 370

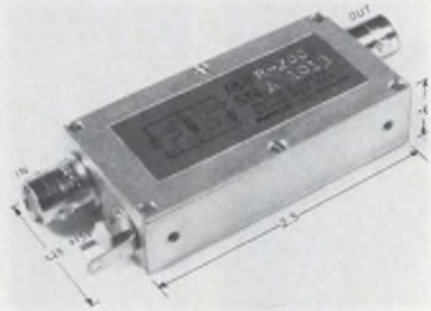
Laser-diode driver provides fast pulses

Power Technology, Inc., P.O. Box 4403, Little Rock, AR 72204. (501) 568-1995.

The ILC series of laser-diode pulsers provides pulse widths of 10 to 200 ns and rise and fall times as low as 2 ns. Any drive current between 1 and 100 A may be specified and pulse repetition rates of over 1-M PPS can be obtained with low-current models. An internal clock is provided for pulse rates to 20-k PPS. Temperature compensation is standard in all models. Operation is from 6 to 28 V dc. Sizes range from 1 to 1-1/2 in. dia. by 2 to 4 in. long.

CIRCLE NO. 371

Linear amp delivers 1 W with 3-dB NF



FG Engineering, Black Canyon Stage, Box 506, Phoenix, AZ 85020. (602) 465-7735. $475; 4 wks.

The Model R-160-40 linear amplifier has 30 ±3-dB gain, with a maximum noise figure of 3 dB. And it delivers a minimum of 1-W output at the 1-dB compression point. Bandwidths from 7 to 70% can be provided anywhere from 10 to 200 MHz with a 20/3-dB shape factor of 6:1. Units can also be supplied with recovery times down to 100 ns. The amplifier can be used in repeater-station front ends to prevent receiver overloading by the transmitter.

CIRCLE NO. 372

Industry standards... Seven cermet trimmers that can

How?
- Through design versatility
- Fast delivery
- Excellent quality

Necessary Decisions:
1. Single vs. multiturn
2. Sealed vs. not sealed
3. Size
4. Resistance
5. Pin spacing
6. All-important, PRICE

Take a close look before you select your next trimmer. Call your local Beckman Helipot distributor for free evaluation samples, or immediate technical literature.

For fast response, call (714) 871-4848, Ext. 1776.

Beckman
HELIPOT DIVISION

Single-turn

Model 91
- High quality – low price
- Unique brush contact
- Excellent setability
- 100% inspected
- Protective dust cover
- Top or side adjust
- Screwdriver or hand adjust
- Standoffs prevent rotor binding and permit board washing
- Small 3/8" dia. size
- 12 pin configurations
- Wide resistance range: 10Ω to 2 megΩ

Price: $0.42*

Model 72
- Sealed for board washing
- Available in VALOX 420-SEO housing
- Top or side adjust
- Brush contact
- Excellent setability
- Only 2 ohms of end resistance
- 3/8" square
- 100% inspected
- 7 pin configurations
- 19 resistance values

Price: $0.54*

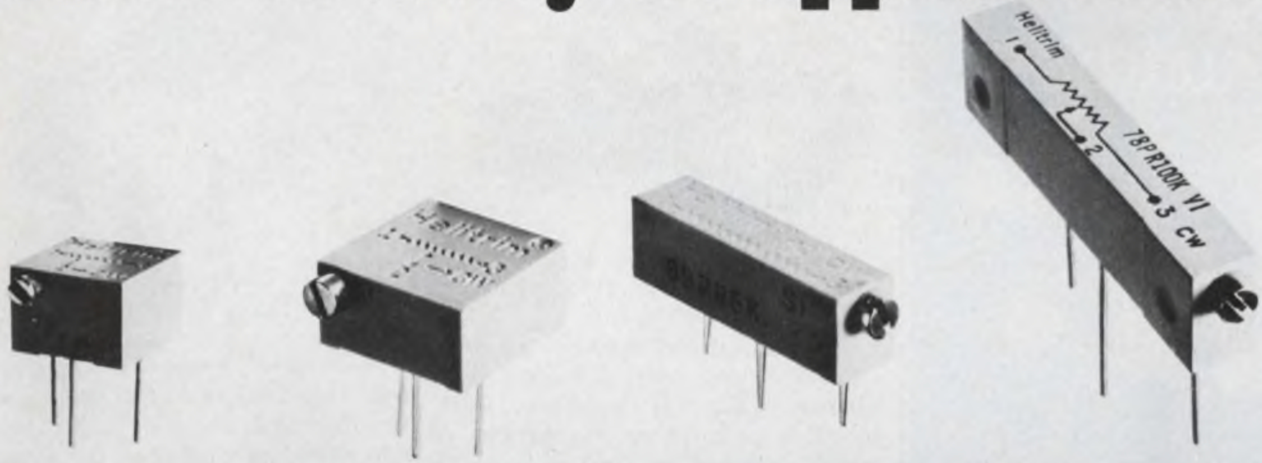
Model 82
- Lowest profile trimmer in industry
- 1/4" dia. by 0.150" max. height
- Sealed for board washing
- Flame-retardant design
- 82P – top adjust
- 82PA – side adjust
- 100% inspected
- Brush contact provides excellent setability
- A cermet benefit that wirewound can't approach: resistance range 10Ω to 1 megΩ

Price: $1.12*

★ Still waiting for delivery on trimmers from another manufacturer?

Call your local Beckman Helipot distributor for a convenient cross reference from stock.

handle 95% of your applications.



Multiturn

Model 64
- Miniature, sealed trimmer
- 22 turns of adjustment
- Operates with 0.25 watt at 85°C derating to zero watts at 150°C
- 100% inspected
- 18 resistance values: 10Ω to 1 megΩ
- ¼″ square size is excellent for P.C. board packaging
- Uses Beckman's unique brush contact design
- Adjustability – voltage ratio within 0.01%

Price: $4.20*

Model 66
- Low-cost, multiturn with benefits of more costly trimmers
- Sealed for board washing
- 20 turns for adjustment accuracy
- Compact ⅜″ square housing
- Brush contact
- 3 pin styles for efficient space utilization
- Broad resistance range: 10Ω to 2 megΩ
- Operates with ½ watt at 25°C
- 100% inspected

Price: $2.70*

Model 89
- Our lowest cost multiturn
- Sealed for board washing
- ¾″ rectangular trimmer just 0.250″ high
- Needs no O-ring because of our unique ultrasonic sealing technique
- Only 2 ohms of end resistance
- 15 turns for accurate and quick adjustment
- 4 pin styles including in-line for mounting versatility.
- Panel mount available
- 100 ppm/°C tempco
- 19 resistance values available
- 100% inspected

Price: $1.05*

Model 78
- Military performance at industrial prices
- 1¼″ rectangular only 0.195″ wide
- Sealed
- 3 terminal styles:
  - Flex leads
  - Printed circuit pins
  - Solder lugs
- Panel mount available
- Power rating 0.75 watt at 70°C
- 100% inspected
- 22 turns of adjustment
- Resistance range: 10Ω to 2 megΩ
- 100 ppm/°C tempco

Price: $2.28*

*1,000-piece price

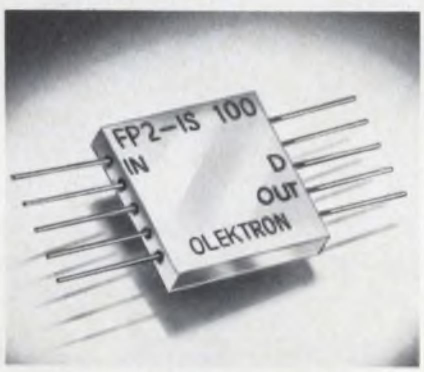
Thin-film amps cover 2 to 5.4 GHz

Varian, 611 Hansen Way, Palo Alto, CA 94303. (415) 493-4000. 60 days.

Covering the frequency range from 2 to 5.4 GHz, a family of compact, thin-film amplifiers is intended for airborne and tactical-system applications. Typical is the VSG-7420G for ECM use. The amplifier has a minimum power output at the 1-dB gain compression point of 5 dBm, and the unit measures 0.44 × 1.0 × 2.77-in. Maximum noise figure is 8.5 dB.

CIRCLE NO. 373

Flatpack holds rf switch

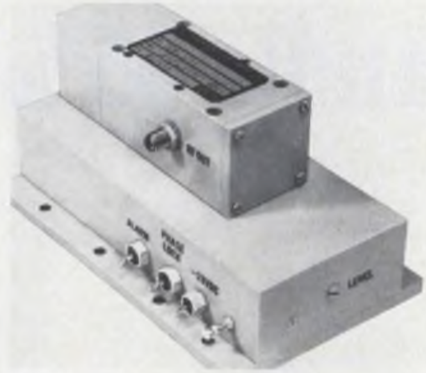


Olektron Corp., 6 Chase Ave., Dudley, MA 01570. (617) 943-7440. $125 (1-9); 4-6 wks.

Model FP2-IS-100 miniature rf switch covers the 2-to-500-MHz range with switching speeds of less than 10 ns. Supplied in a flatpack case, the unit's package measures 5/8 × 5/8 × 0.125-in. exclusive of leads. The switch has an impedance of 50 Ω, a VSWR of 1.5:1 max (ON state), an insertion loss of 2.0 dB max, an isolation of 50 dB min and a suppression control of −30 dB. The drive required for the ON state is 30 mA; for the OFF state, it's 10 V.

CIRCLE NO. 374

Phase-lock osc comes in compact package

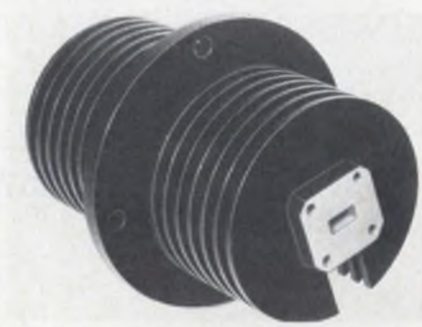


Engelmann Microwave Co., Skyline Dr., Montville, NJ 07045. (201) 334-5700.

Low-profile phase-lock oscillators (the Series LP) come in packages that are less than 2-in. high. And they maintain the same plate dimensions as earlier, 3-1/2-in. high units. The new oscillators incorporate a 0-to-6-dB continuous level set attenuator. Other features include 10% frequency tuning range between 0.6 to 14.0 GHz, maximum power output of 50-to-500-mW full band and 75-to-1000-mW narrowband (depending upon frequency range). Spurious responses are 80 dB below carrier level in the band and 30 dB out of band.

CIRCLE NO. 375

Ka band rotary joint specs 2 kW



Kevlin Manufacturing Co., 26 Conn St., Woburn, MA 01801. (617) 935-4800.

A Ka-band rotary joint can operate at 2-kW cw without auxiliary cooling. VSWR equals 1.5 maximum with insertion loss at 0.35 dB maximum. The unit has an over-all length of 3.5 in. with the outside diameter measuring 2 in. Operating temperature range is −40 to +160 F.

CIRCLE NO. 376

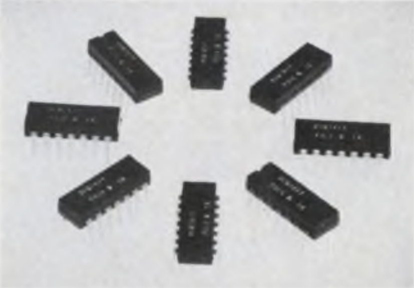
Rotary switches built to metric specs

Grayhill, Inc., 561 Hillgrove Ave., La Grange, IL 60525. (312) 354-1040.

For the international marketplace and to prepare for metrication in the US, miniature enclosed rotary switches in its Series 71 are built to metric specifications. The 17 mm dia, 0.25-A switches, with shaft and bushing dimensions conforming to IEC Document 390 (4-mm dia shaft, M7 × 0.75 bushing), are available in the 10 or 12-position versions with one-to-six-poles per deck—up to 12 decks. A wide range of options include concentric shafts, PC terminals out one side and adjustable stops.

CIRCLE NO. 377

Resistor networks have tolerance of ±2%



KDI Pyrofilm, 60 S. Jefferson Rd., Whippany, NJ 07981. (201) 887-8100. Stock.

Pyrofilm is tooled for 14 and 16-pin resistor-network DIPs with maximum capabilities of 24 and 28 resistors per package. The resistance range covers 10 Ω to 1 MΩ with a standard tolerance of ±2%. Tolerances of 0.5% are available on request. Tolerance-ratio match can be as low as 0.5%. Available temperature coefficients are 100 ppm/°C and 300 ppm/°C. Standard temperature-coefficient tracking is 50 ppm/°C, but 25 ppm/°C is available.

CIRCLE NO. 378

Film resistors handle kVs in kMΩ values

Dale Electronics, Inc., P.O. Box 74, Norwalk, NE 68701. (402) 371-0080. $3.66; EI 1511, 10% tol, 1 kMΩ (1000 up).

Type EI is a new series of film resistors for high voltage and power. They provide a wider resistance range than previously available, according to Dale. Power rating is 5 W and in close tolerance ranges (Type EI 1510) —0.5%, 1% or 2%—they have a working voltage of 14 kV with resistance values to 300 MΩ. Looser tolerance models (Type EI 1511) handle to 20 kV with up to 20 kMΩ resistance. Construction incorporates either metal or metal-oxide film on a ceramic core. Environmental protection and insulation resistance is provided by a double sleeving of flame-retardant irradiated polyolefin.

CIRCLE NO. 379

Flexed-spring operates small, lighted switch

Illuminated Products Inc., 207 S. Helena St., P.O. Box 4011, Anaheim, CA 92803. (714) 535-6037.

Lighted pushbutton switches, the new series 650, feature both double-throw and alternate action. The new switches pack the same functions into units that usually require twice the space, according to the manufacturer. Its Marcoflex, single flexed-spring mechanism uses few parts, but provides the characteristics associated with larger units: wiping action, multiple point contact, snap action, tactile feel and high contact force. The switches mount in a standard 0.625-in. square hole and the contacts are rated at 1 A, 30 V dc and 0.25 A, 115 V ac. A choice of seven pushbutton colors can be custom engraved. Eight lamp styles are available—from 5 to 125 V and unbased T-1-3/4 or AIC neon. Mounting choices include snap mounting clips with solder terminals for 1/16 to 1/8 in. panels and PC terminals.

CIRCLE NO. 380

Bellows pushbutton operates remote switch

Logicomp Electronics Inc., 52 Fayette Rd., Scarsdale, NY 10583. (914) 723-3334.

A small air-bellows pushbutton, connected by flexible tubing to a pressure switch, sends a low-pressure air pulse through the tubing to activate the switch. The switch, in a variety of configurations, can handle to 15 A. Applications include foot controls and switching from areas containing combustibles.

CIRCLE NO. 381

Incremental volt divider has fine-tuning pot

Electronic Engineering Company of California, 1441 E. Chestnut Ave., Santa Ana, CA 92701. (714) 835-6000.

A knurled potentiometer on the least-significant decade of a Thumbpot incremental voltage divider permits ultra-fine adjustments without sacrifice of the fast setting advantages of the divider decades. The dividers are available with incremental steps as small as 1 part in 10,000. These incremental voltage dividers can replace 10-turn pots when front panel in-line readout is desired.

CIRCLE NO. 382

Thermistor flakes claim 'mini' title

Victory Engineering, Victory Rd., Springfield, NJ 07081. (201) 379-5900. Single flake about $6 (quant.).

"Thinistor" flakes are just 1/2 mm × 1/2 mm in size and come in resistances from 25 kΩ through 1 MΩ. They are said to be the smallest available in the industry and, because of their size, thermal and infrared time constants are drastically reduced and infrared sensitivity is improved. Typical thermal time constants now available are 20 ms and typical infrared time constants are 160 ms. A chief advantage of the new flakes is that they can be used at higher chopping frequencies (10 to 20 Hz) because of the smaller time constants.

CIRCLE NO. 383

Solid-state temp probe has two-point limits

Control Products Inc., East Hanover, NJ 07936. (201) 887-9400.

A dual-temperature thermal switch is capable of sensing both upper and lower temperature limits. Designed for operation on 20 to 28 V dc, the switching unit features solid-state circuitry. The unit is available in two configurations: a 2-1/2 × 3-1/2 × 1-1/2-in. package with a single sensing probe connected via a cable, or a version with electronics and probe in one package. The user may specify the temperature points, which are then pre-set by CPI. An output signal compatible with CMOS or TTL logic is provided for each set point.

CIRCLE NO. 384

DISCRETE SEMICONDUCTORS

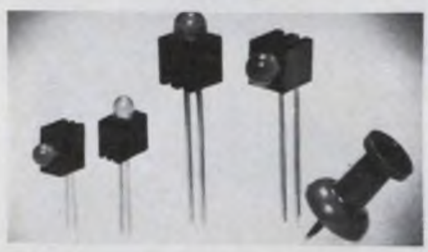
Npn power transistors complement older units

RCA, Route 202, Somerville, NJ 08876. (201) 722-3200. From $1.14 (100-up); stock.

Two npn power transistors, types 2N6465 and 2N6466, are complements of the previously announced pnp types 2N6467 and 2N6468, respectively. Type 2N6465 is a 100-V ($V_{CEO(sus)}$) 40-W device with a dc beta of 15 to 150 measured at a 1.5-A collector current. The 2N-6466 offers the same device-dissipation rating and dc-beta range, but at 120 V $V_{CEO(sus)}$. Both types may be obtained with heat radiators for printed-circuit board applications on special order. They are normally supplied in hermetic TO-66 packages.

CIRCLE NO. 385

PC board mount LEDs made in four styles



Data Display Products, 5428 W. 104 St., Los Angeles, CA 90045. (213) 641-1232. From $0.49 (1000-up); stock to 2 wk.

LEDs for PC board mounting are available in diffused or clear green, yellow, amber and red. These units have good visibility at 5 mA drive and are bright at 40 mA. The typical luminous intensity at 20 mA is better than 5 mcd (in T 1-3/4 units, clear tinted styles). Forward voltage is 2.2 V at 20 mA, typical. Four package styles are available. Model PCH125 is made for horizontal viewing and uses a T-1 LED; the PCV125 for vertical viewing, also uses a T-1 LED; the PCH190 for horizontal viewing uses a T 1-3/4 LED; and the PCV-190 for vertical viewing uses a T 1-3/4 LED. Models PCH125 and PCV125 can be mounted on 0.165 in. centers and Models PCH190 and PCV190 can be mounted on 0.25 in. centers. All housings are black for maximum on/off contrast.

CIRCLE NO. 386

Rf power transistors operate at 2.3 GHz max

Power Hybrids, 1742 Crenshaw Blvd., Torrance, CA 90501. (213) 320-6160. From $100; stock to 2 wk.

A family of four internally matched broadband rf power transistors is characterized at 22 V. The PH2310 driven by the company's PH2304, when operated at 22 V will produce 10 W of broadband power over the 2 to 2.3 GHz band with an input drive level of 500 mW. The PH2012 driven by the PH2304 will produce over 11 W over the 1.7-to-2-GHz band, with an input drive level of 500 mW. The common base transistors have gold metalization and individual emitter finger ballast resistors.

CIRCLE NO. 387

Zener diodes cover 3.3 to 200 V

Siemens Aktiengesellschaft, D-8000 Munchen 1, Postfach 103, West Germany.

A line of zener diodes is designed for entertainment equipment, professional electronics and control engineering applications. The BZY 97 series has a wide variety of versions housed in plastic cases. The diodes have a power dissipation of 1.32 W and the zener voltage range extends from 3.3 V to 200 V, arranged in steps as per the international series E-24. The diodes are housed in DO-41 plastic cases with axial connecting leads. The zener voltages have a tolerance of ±5%, and zener currents are as low as 4.8 mA for the upper voltage value and as high as 276 mA for the lower voltage. These values apply for ambient temperatures up to 45 C.

CIRCLE NO. 388

IT TAKES MONTHS to get back on ELECTRONIC DESIGN's qualified subscription list. Keep your copies coming. RENEW NOW (see inside front cover).

Press-fit & stud-mount triacs handle to 40 A

Thyrotek, P.O. Box 5407, 611 109th St., Arlington, TX 76011. (817) 265-7381. From $2.05 (100-up); stock.

A line of triacs in 0.5 in. press fit and 0.5 in. stud mount packages is designated the TE series, an electrically isolated stud mount; the TD series, a nonisolated press-fit package and the TF series a nonisolated stud mount. All three series are available with V_{DROM} from 50 to 600 V and in 10, 15, 30 and 40 A rms on-state current ratings. The 0.5 in. series chips are center-gated and heavily glass-passivated for improved critical and commutating dv/dt ratings and high in-rush di/dt capability. All terminals have flags for standard Faston 0.11 in. and 0.187 in. fasteners. A third terminal is available as an option on the nonisolated series.

CIRCLE NO. 389

Application Notes

Capacitors

"The Secret Life of Capacitors" covers the imperfections of capacitors and what to do about them. ECD Corp., Cambridge, MA

CIRCLE NO. 390

Heating elements

The many and varied instrumentation applications for flexible silicon rubber heating elements are described in a four-page reprint. Electro-Flex Heat, Bloomfield, CT

CIRCLE NO. 391

VCM removal process

A new method of removing VCM monomer from PVC compounds during the dry blending operation is covered in a four-page brochure. Werner & Pfleiderer, Waldwick, NJ

CIRCLE NO. 392

IC interconnects

Things you've always wanted to know about IC interconnection devices (but had no one to ask) are covered in a guide. Robinson-Nugent, New Albany, IN

CIRCLE NO. 393

Vibration control system

Digital control of random vibration tests in the environmental laboratory is the topic of a brochure. Time/Data, Palo Alto, CA

CIRCLE NO. 394

Cooling equipment

How to select cooling equipment for electronics subject to hostile environments is the topic of a four-page guide. Kooltronic, Princeton, NJ

CIRCLE NO. 395

Video scanners

The selection of video scanners for use with image analyzing computers is discussed in a newsletter. Imanco, Monsey, NY

CIRCLE NO. 396

Evaluation Samples

Circuit board accessories

Three sizes of circuit board standoffs and cable clips are molded in red nylon and are designed to be mounted on panels or chassis ranging from 0.060 to 0.098 in. in thickness. Vero Electronics.

CIRCLE NO. 461

Pushbutton switch

A new pushbutton-switch design allows users to customize from the basic standard product. The switch is designed for positive panel mounting or front removal and is rated at a 25,000-cycle minimum life. Various button colors and hot-stamping legends are available along with different bezel colors. Molex.

CIRCLE NO. 462

Soldering aid

Solderwax 550F is a white wax developed for use in continuous soldering operations. It is supplied in flaked form. Solderwax Chemical.

CIRCLE NO. 463

HV silicon rectifiers

Miniature, fast recovery, high-voltage silicon rectifiers are available in peak reverse voltages from 3000 to 12,000. Current is 25 mA, peak at 150 mA, and 300-ns recovery. The diodes are 0.4-in. long by 0.1-in. sq. with 0.3-in. minimum leads. Electronic Devices.

CIRCLE NO. 464

Epoxy tubing

Centrifugally cast epoxy tubing comes in sizes ranging from 0.137 in. O.D. to 2 in. O.D. and larger, in almost any wall thickness required. The tubing comes in lengths up to 56 in. without I.D. or O.D. taperings. Samples are available in black, clear and colors. A telephone call or request on company letterhead gets you the samples. Resdel Corp., Bldg. No. 22, County Airport, Rio Grande, NJ 08242

INQUIRE DIRECT

New Literature

Transistors

A 40-page condensed transistor catalog includes JFETs, photo sensitive FETs and bipolar transistors. Teledyne Crystalonics, Cambridge, MA

CIRCLE NO. 465

Impedance converters

Specifications and drawings of the series 300 impedance converters are given in a four-page brochure. Eltec Instruments, Daytona Beach, FL

CIRCLE NO. 466

Thermistors

Technical questions relative to thermistors are answered in a 12-page catalog. Resistance deviations beta tolerance tables, tempco tables and resistance temperature conversion tables are included. Fenwal Electronics, Framingham, MA

CIRCLE NO. 467

Data conversion products

Modular data conversion products, systems and accessories; logic and line powered digital panel instruments and accessories; and industrial digitizing systems and instruments are described in a 40-page catalog/handbook. Analogic, Wakefield, MA

CIRCLE NO. 468

Terminal blocks

A 12-page brochure covers 300-V and 600-V terminal blocks. The brochure shows in pictorial form how to assemble and mount both types of blocks. Allen-Bradley, Milwaukee, WI

CIRCLE NO. 469

Integrated circuits

High-reliability integrated circuits intended for military, aerospace and critical industrial applications are illustrated in a 28-page brochure. RCA Solid State Div., Somerville, NJ

CIRCLE NO. 470

Communications equipment

Antennas and ground communications equipment for single channel per carrier, television receive-only, shipboard terminal and tracking, telemetry and command systems are described in a catalog. Scientific-Atlanta, Atlanta, GA

CIRCLE NO. 471

Potentiometers and dials

Sixty pages of photographs, specifications, dimensional drawings and user-oriented applications information are found in "Precision Potentiometers and Dials." Beckman Instruments, Helipot Div., Fullerton, CA

CIRCLE NO. 472

Microcomputer courses

A six-volume, 700-page programmed learning course covers the concepts, uses, design criteria and implementations of microprocessor-based systems. More than 1700 self-tests, hundreds of illustrations and detailed information on four microcomputers—Intel's 4004, 4040, 8008 and 8080—are included. The course costs $124.50 for Volumes I through VI, design aids and the Microcomputer Applications Handbook. Iasis, 770 Welch Rd., Suite 154, Palo Alto, CA 94304

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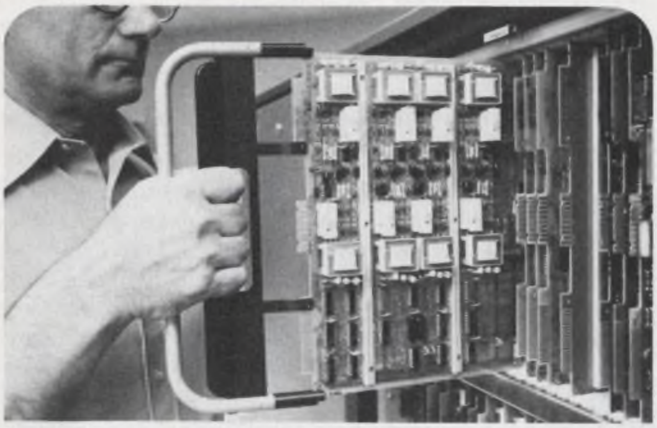

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MA-1202	3-7 VDC	90 - 140 VAC	2.0 A
MA-0602	3-7 VDC	10 - 60 VDC	2.0 A
MB-0602	7-15 VDC	10 - 60 VDC	2.0 A
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* Add "S" suffix to Model Number for 500 microampere Control Sensitivity

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* Patent applied for

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INFORMATION RETRIEVAL NUMBER 114

Microcontroller system

A 59-page application guide opens with a description of the SMS MicroController system and its various elements and presents 14 programming examples and six system applications. Circle the number to receive another descriptive folder with a form letter that offers the application guide if requested on letterhead. Corning, Corning, NY

CIRCLE NO. 473

Electron tubes

The 1975/76 EEV/M-OV electron tube catalog is available in five separate parts or as a single publication. For Part A—Products for Broadcasting and Communications Equipment

CIRCLE NO. 474

For Part B—Products for Radar Equipment

CIRCLE NO. 475

For Part C—Products for Electro-optical/TV Equipment

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For Part D—Products for Industrial and Scientific Equipment

CIRCLE NO. 477

For Part E—Comprehensive Equivalent Index

CIRCLE NO. 478

For entire publication

CIRCLE NO. 479

Microprocessors

The MP12 microprocessor, a digital computer designed for dedicated control applications, is described in a two-page brochure. Fabri-Tek, Minneapolis, MN

CIRCLE NO. 480

Relay proceedings

Proceedings of the 23rd annual National Relay Conferences cover technical information on electromechanical relays, solid-state relays and other related switching devices. The conference was cosponsored by the National Association of Relay Manufacturers. Copies of the proceedings may be purchased at $10 each from NARM, P.O. Box 1649, Scottsdale, AZ 85252

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Bulletin Board

Power Physics Corp.'s npn-pnp epitaxial base power transistors are available in the following JEDEC types: 2N5632 through 2N5634, 2N6229 through 2N6231, 2N5879 through 2N5886 and 2N-6029 through 2N6031. Devices in the families can handle from 5 to 10 A and have V_{CEO}'s from 40 to 140 V. Power dissipation ranges from 117 to 200 W.

CIRCLE NO. 481

A **software package** from **Tektronix**, the Plot-10/Terminal Control System implementation for PDP-11 DOS users with 24 k of core memory, supports all of the company's 4010 family of terminals.

CIRCLE NO. 482

A price increase averages 8% for **Xerox Sigma computers** and their peripheral equipment, whether purchased or leased, and leased 500 **series computers.** All computer maintenance services are increased by 8%.

CIRCLE NO. 483

Fifteen circuits have been added to the standard **CD4000B series of CMOS ICs** by **RCA Solid State Div.**

CIRCLE NO. 484

Houston Instrument has increased the plotting speed of the **Model DP-1 digital plotter** by 50%.

CIRCLE NO. 485

Burr-Brown is providing **alternate source** for Analog Devices' **DAC-12QZ 12-bit modular d/a converter** and is cutting the price to $75 (1-9) and $45 (100 up).

CIRCLE NO. 486

National Semiconductor has added four **JEDEC-registered opto couplers** to its line of optoelectrical products. The 4N25, 4N26, 4N27 and 4N28 consist of a gallium arsenide LED optically coupled to a silicon phototransistor.

CIRCLE NO. 487

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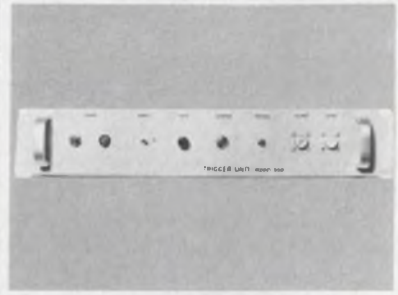

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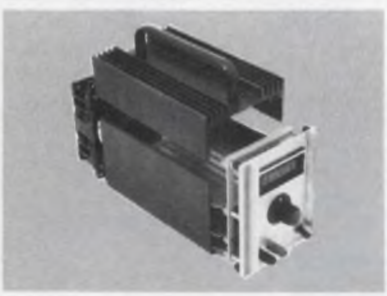

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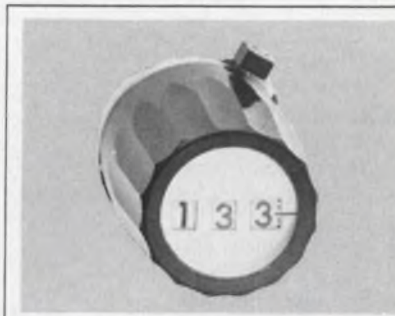

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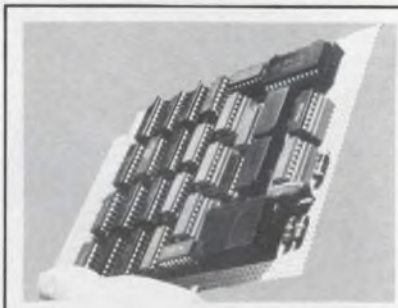

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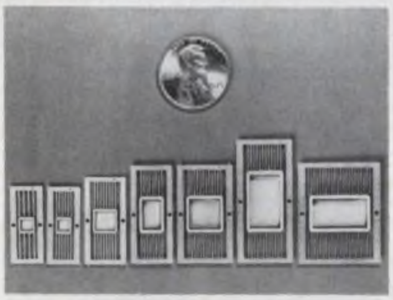

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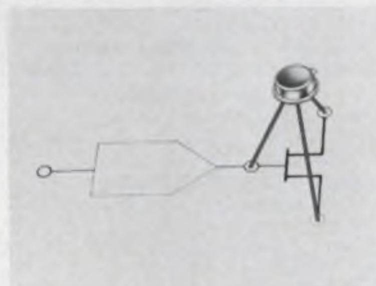

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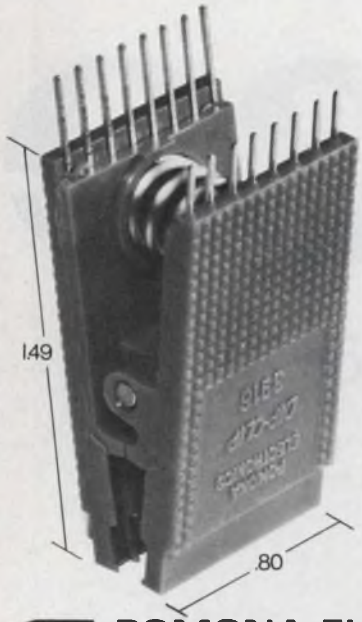
INFORMATION RETRIEVAL NUMBER 126

Product Index

Information Retrieval Service. New Products, Evaluation Samples (ES), Design Aids (DA), Application Notes (AN), and New Literature (NL) in this issue are listed here with page and Information Retrieval numbers. Reader requests will be promptly processed by computer and mailed to the manufacturer within three days.

skinny DIP CLIP

designed to test high density integrated packages



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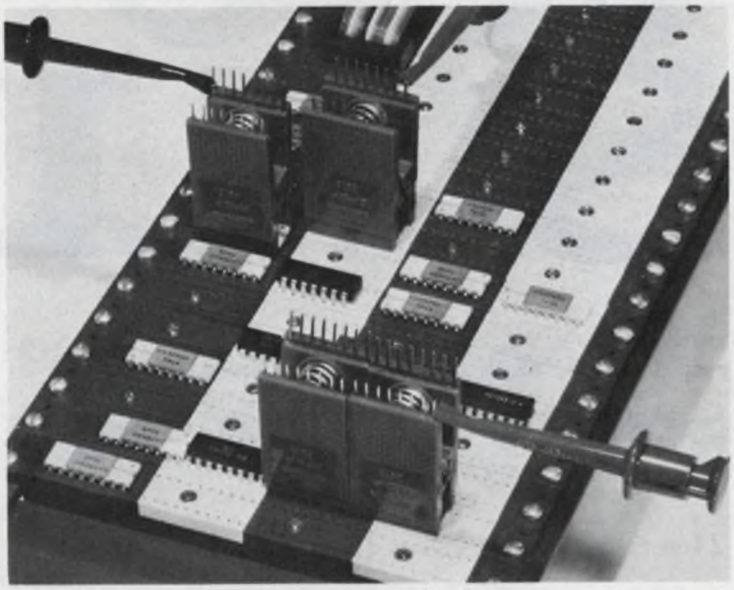

Original wide body DIP CLIP shown at rear for size comparison.

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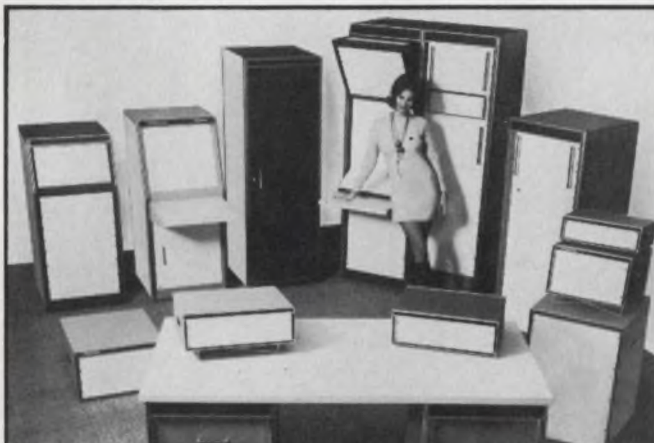

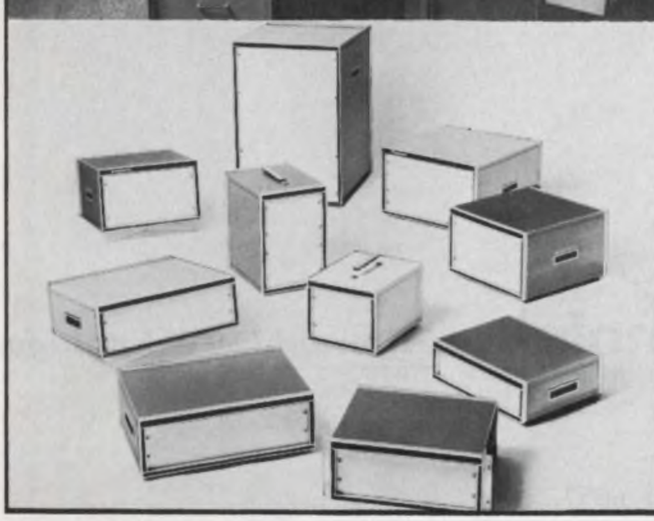

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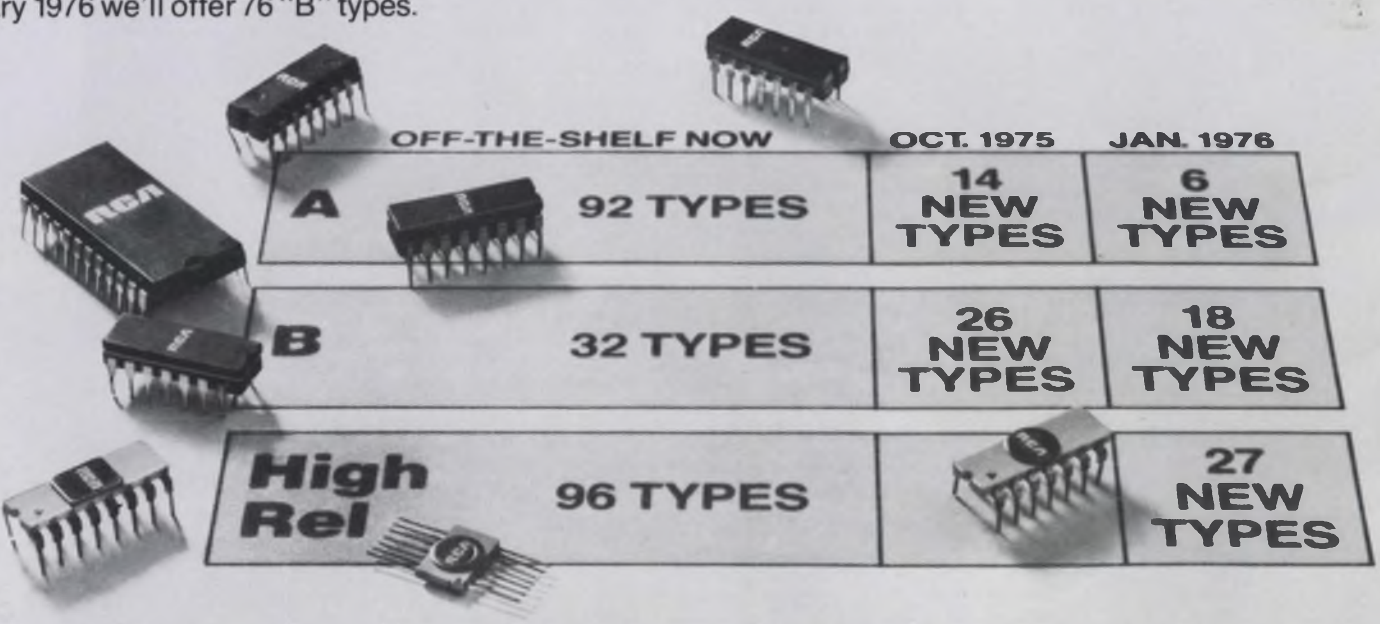

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