VOL. 25 NO.

Electronic Design 25

FOR ENGINEERS AND ENGINEERING MANAGERS — WORLDWIDE

DEC. 6, 1977

Numeric readouts predominate in terms of variety and colors. But alphanumerics are catching up — and with intelligence, too. Display design is simplified by integrating peripheral circuits on array substrates. But technology improvements have bypassed the specs and display selection is tougher than ever. See page 56.

Another Colorful Innovation...

Conductive Plastic Trimmers at Carbon Prices.

Just when you thought "low cost" also meant "low performance", along comes the dazzling new Bourns® Model 3355. Compare it to the CTS 201, Mepco 46X or Piher PT15. Our revolutionary conductive plastic element vs. their carbon . . . fact is we outperform them all. To prove it, we spec important characteristics such as CRV at 1% and a TC of 500 PPM/°C . . . the others don't. And only the 3355 has board-wash capability, a UL-94V-1 flammability rating and an optional choice of nine rotor colors. The standard blue is priced at just 11¢ each (100,000 pieces). . . about what you'd expect to pay for the lower performance carbon types.

Send today for complete details on a colorful new way to design in superior performance for your cost effective needs — the Model 3355 Trimmer. Direct or through your local distributor.

TRIMPOT PRODUCTS DIVISION, BOURNS, INC., 1200 Columbia Ave., Riverside, CA 92507. Phone: 714 781-5050 — TWX: 910 332-1252.

CATALOG SHEET SPECIFICATION COMPARISONS

CHARACTERISTIC	BOURNS 3355	CTS 201*	MEPCO 46X*	PIHER PT15*
Element	Conductive Plastic	Carbon	Carbon	Carbon
Temperature Coefficient	500 PPM/°C	No Spec	No Spec	1000 PPM/°C
Contact Resistance Variation	1.0% max.	No Spec	No Spec	No Spec
Power Rating	.25 W at 70°C	.25 W at 55°C	.25 W at 55°C	.25 W at 40°C
Flammability	UL-94V-1	No Spec	No Spec	UL-94
Board Wash Capability	Yes	No Spec	No Spec	No Spec

*Source: CTS Series 201 Data Sheet, Mepco Data Sheet ME1004, Piher Data Sheet F-2002 Rev 7/73

BOURNS®

International Marketing Affiliates: European Headquarters — Switzerland 042/23 22 42 • Belgium 02/218 2005 • France 01/2039633 • Germany 0711/24 29 36 • Italy 02/32 56 88 • Netherlands 70/87 44 00 • United Kingdom 01/572 6531 • Norway 2/71 18 72 • Sweden 764/20 110 • Japan 075/921 9111 • Australia 02/55-0411 03/95-9566 • Israel 77 71 15/6/7

For Immediate Application — Circle 130
For Future Application — Circle 230

SURPRISE!

Introducing HP's New Optically Coupled Line Receiver

Eliminate troublesome system ground loops and increase long distance communication noise immunity with HP's new easy-to-use optically coupled line receiver. An internal IC regulator serves as a line termination and allows direct connection to transmission lines without any additional components.

Use of a high-speed, high-gain output photo IC permits data rates in excess of 10 Mbits/second. An internal shield provides excellent common mode rejection even at these high data rates.

The HCPL-2602 is designed for high-speed data transmission applications such as computer-peripheral interface, instrumentation, and simplex/multiplex data transmission.

Priced at $6.65* in quantities of 1000, the HCPL-2602 is in stock at any franchised distributor. In the U.S., contact Hall-Mark, Hamilton/Avnet, Pioneer Standard, Schweber, Wilshire or the Wyle Distribution Group (Liberty-Elmar) for immediate delivery.

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01703 A

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CIRCLE NUMBER 2

Did you get the message about our solid state SerenDIP relays?

International telex communication switching systems often are expected to run on a 24-hour, seven-day shift. Continuous duty like that calls for dependable, long-life component reliability — the kind RCA requires from Teledyne SerenDIP® relays used in their trunk terminator modules. These all-solid-state DIP relays provide wear-free and bounce-free switching — features you don't get with electro-mechanical or reed relays. What's more, our SerenDIP's offer high input/output isolation, low level logic input compatibility, and fast response time. And you get all of this in a low cost, low-profile TO-116 DIP package ready-made to replace any standard DIP reed relay. You also get your choice of output: bi-polar, AC (triac), or DC. There's lots more to a SerenDIP relay that you ought to know about. For detailed specs or applications assistance, contact your nearest Teledyne Relays sales office listed in EEM, Gold Book, or Electronic Buyers' Guide. You'll find we have the experience, products and technical support to meet all of your SSR needs.

RCA Trunk Terminator Module

RCA CCT-3 Series
Telex Switching System
(Courtesy of RCA/Camden, N.J.)

TELEDYNE RELAYS

3155 West El Segundo Boulevard, Hawthorne, California 90250
Telephone (213) 973-4545

CIRCLE NUMBER 3

VOL. 25 NO.
Electronic Design 25
FOR ENGINEERS AND ENGINEERING MANAGERS — WORLDWIDE
DEC. 6, 1977

NEWS

TECHNOLOGY

PRODUCTS

DEPARTMENTS

Cover: Photos from top to bottom courtesy of Burroughs, Hewlett-Packard, Litronix, Monsanto and Beckman.

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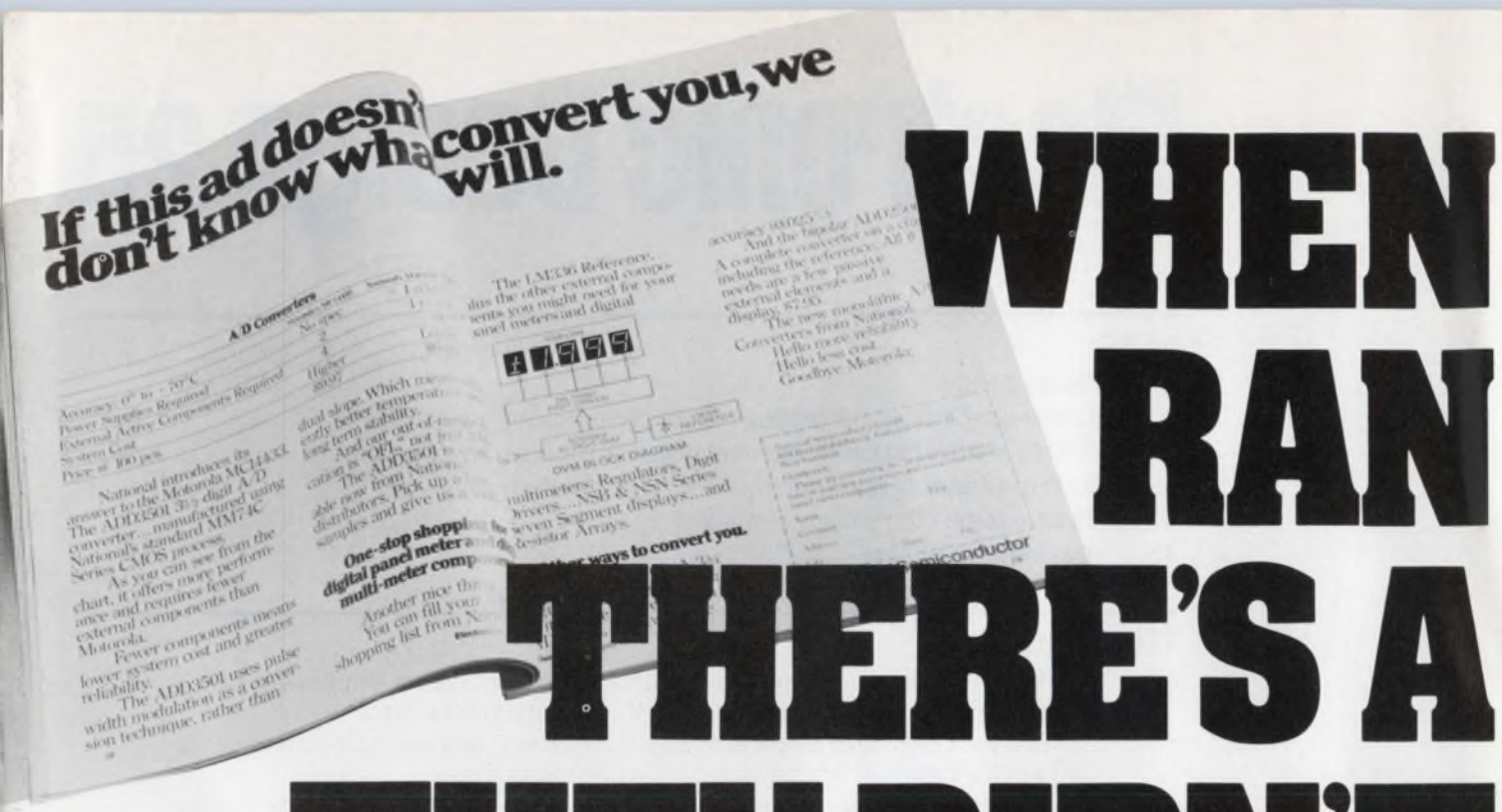


WHEN RAN THERE'S A THEY DIDN'T

In fact, there are several.

A/D CONVERTERS

	Motorola MC14433	National ADD3501	Intersil 7106/7
Accuracy: 0° to + 70°C	No Spec	± 1 count max	± 1 count max
Power Supplies Required:	2	1 (+ 5V)	1 (+5V to +9V)
Additional IC's required:	4	2	0
LCD Compatible	No	No	Yes
System Cost:	Higher	Lower	Lowest
Price @ 100 pcs:	$9.97	$9.95	$9.25
All Display drives on chip:	No	No	Yes
Floating Differential Input:	No	No	Yes
Floating Reference:	No	No	Yes

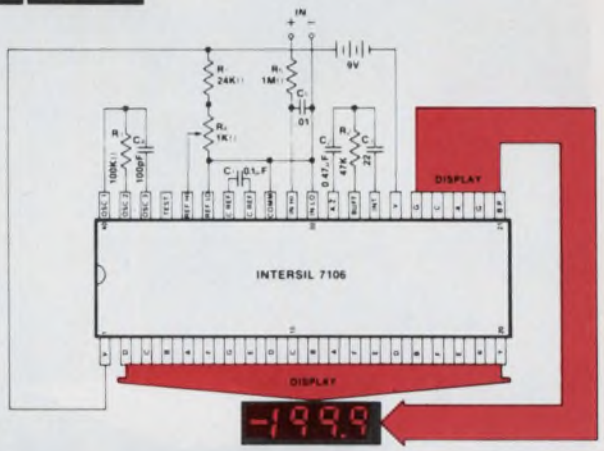
DELIVERY. If price and performance aren't your only criteria, think about this: Intersil is shipping the ICL 7106 and 7107. Now.

ONE CHIP. LED or LCD. Intersil offers you one chip simplicity. Now. And a whole family of A/D, D/A converters that mean you can stop beating the bushes for your converter needs.

DRIVES LCD DISPLAYS. Requires no active external components. Includes back plane drive circuitry.

ARIZONA – Liberty Electronics, Kierulff Electronics. CALIFORNIA – Elmar Electronics, Intermark Electronics Inc., Kierulff Electronics, Liberty Electronics, Schweber Electronics. COLORADO – Century Electronics, Elmar Electronics, Kierulff Electronics. CONNECTICUT – Arrow Electronics, Schweber Electronics. FLORIDA – Arrow Electronics, Diplomat/Southland, Inc., Schweber Electronics. GEORGIA – Arrow Electronics, Schweber Electronics. ILLINOIS – Schweber Electronics, Kierulff Electronics. INDIANA – Advent Electronics, Inc., Sheridan Associates. MARYLAND – Arrow Electronics, Schweber Electronics. MASSACHUSETTS – Arrow Electronics, Kierulff Electronics, Schweber Electronics. MICHIGAN – Schweber Electronics, Sheridan Sales. MINNESOTA – Arrow Electronics, Schweber Electronics. MISSOURI – LCOMP. NEW JERSEY – Arrow Electronics, Diplomat IPC, Corp., Schweber Electronics. NEW HAMPSHIRE – Arrow Electronics. NEW MEXICO – Century Electronics. NEW YORK – Arrow Electronics, Components Plus, Harvey Federal Electronics, Schweber Electronics. NORTH CAROLINA – RESCO. OHIO – Arrow Electronics, Schweber

NATIONAL THIS AD, REASON MENTION US.



TRUE DUAL SLOPE. The ICL 7106 and 7107 are true dual slope... rather than pulse width modulation or digital auto-zero. Then, consider Intersil's better noise rejection and true integration of input signal. And they can handle differential inputs from 200mV to 2.000V full scale.

4-1/2 DIGIT ACCURACY. Other Intersil IC, 8052A/7103A, offer 20,000 count accuracy with immediate availability.

THEIR AD SAID: "The new monolithic A/D from National. Hello reliability. Hello less cost. Goodbye Motorola."

OUR AD SAYS: Goodbye National.

HERE'S HOW WE MAKE IT STICK: Prototype a working DPM for either $24.95 (LED), or, $29.95 (LCD). With our prototyping kits. Just send your check or P.O. to your local Intersil Distributor with the coupon below.

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10710 North Tantau Avenue
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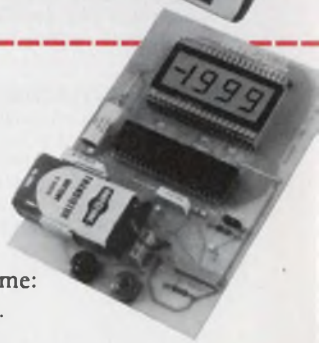

You're talking tough. Here's your chance to prove it. Send me:

☐ Prototyping Kit #ICL 7106EV (LCD) $29.95 complete.
☐ Prototyping Kit #ICL 7107EV (LED) $24.95 complete.
☐ I believe you, send your App. Note: #A016, A017, A018, A023 and 7106/7107 D.S.

I've enclosed a ☐ check, ☐ Purchase Order.

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Company _____
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Across the desk

A misplaced teleprinter

We would like to add some information that somehow was overlooked in your article on 1200-bps data communications (ED No. 20, Sept. 27, 1977, p. 28). General Electric introduced a 1200-bps teleprinter in 1972. The General Electric TermiNet 1200 printer has enjoyed success since that time and thousands of the units are now installed around the world.

Incidentally, General Electric's Information Systems Business Division in Rockville, Maryland, introduced a 1200-bps time-sharing service to its customers in 1973 and was among the first time-sharing companies to make the service available.

Clifford F. Rockwell
Manager Advertising & Sales Promotion
General Electric Co.
Data Communication Products Div.
Waynesboro, VA 22980

The price was wrong

We accidentally tacked an extra $10 onto the price of Data Display Products' nifty little Ledy Bug indicators. Our New Product story (ED No. 20, Sept. 27, 1977, p. 130) quoted a 1000-quantity price of $10.56 instead of $.56. The tiny LED indicator lights have a flat-topped Fresnel lens that gives a viewing angle of over 180 °. Interested now?

Circle No. 530

A needle about a noodle

Thoroughly enjoyed your article on "The Telephone" (ED No. 18, Sept. 1, 1977, p. 42). It was quite informative and I particularly enjoyed the personal anecdotes and historical oddities.

But I have one question. Talking of Harold S. Block's invention, his assistant said, "The invention of negative feedback had all the initial impact of a blow with a wet needle." Oh yeah? Didn't you mean wet noodle?

Tracy L. Johnson
Thiokol/Wasatch
Box 524, MS 541A
Brigham City, UT 84302

Oops—too high a bottom

Contrary to your statment that TTL RAMs bottom out at about 50 ns (Focus on semiconductor memories, ED No. 17, Aug. 16, 1977, p. 56), there are TTL devices that have access times as low as 25 ns for a 64-bit RAM (AMD's 27S02A/03A) and 30 ns for a 1024-bit device (Fairchild's 93415A/25A).

Eugene R. Hnatek
Manager, Product Marketing
Monolithic Memories, Inc.
1165 E. Arques Ave.
Sunnyvale, CA 94086

About that name

It happens often that companies we know well get merged into companies we know less well. So a reader of our Focus report on Power Supplies (ED No. 20, Sept. 27, 1977, p. 58) might have missed leading manufacturers like ACDC or Lambda because these appear as Emerson Electric, ACDC Electronics Co., Inc.; and Veeco Instruments Inc., Lambda Electronics. So if you miss your favorite supplier, look again, or check the Manufacturers' Directory in ELECTRONIC DESIGN's GOLD BOOK for a cross-reference.

Interested now in Emerson Electric —that is, ACDC?

Circle No. 531

Interested now in Veeco—that is, Lambda?

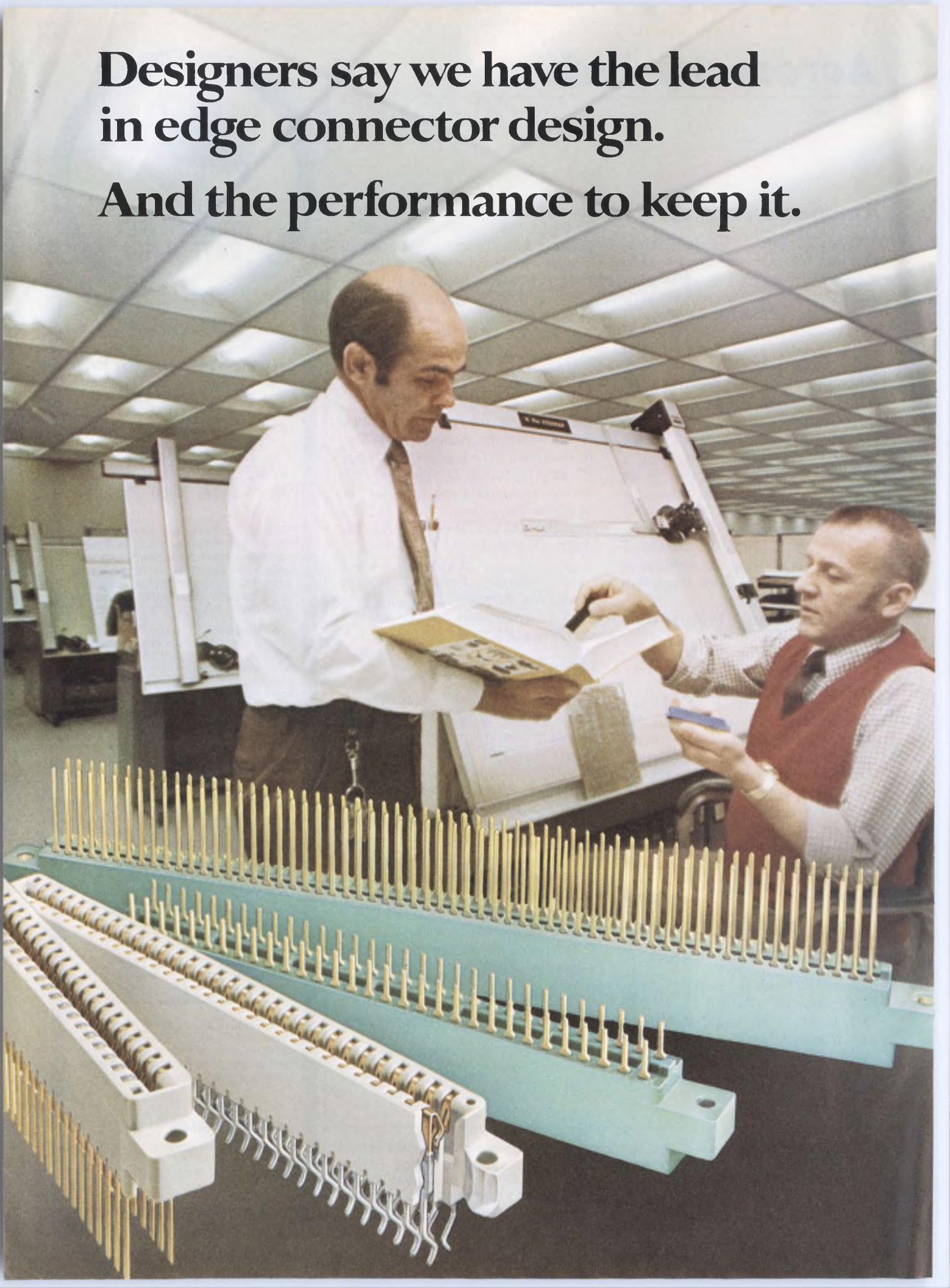
Circle No. 532

(continued on page 14)

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, NJ 07662. Try to keep letters under 200 words. Letters must be signed. Names will be withheld upon request.

Designers say we have the lead in edge connector design.

And the performance to keep it.



The reason why is clear. The contacts for AMP wrap-type edge connectors have unique strength and stress relaxation characteristics that assure long-term top performance. And they come in either leaf spring or cantilever types. Each incorporates full bifurcated design to achieve effective contact redundancy. A choice of contact alloys and selective gold platings is available too. The result is premium reliability and performance at a cost as low as 2 cents a line in quantity.

There's another reason you're ahead with AMP edge connectors, or any other AMP product for that matter. It's called technical support. It means you can call on us for assistance in research, product design, and production. We feel the professional engineer is entitled to it. After all, when he puts his confidence in us, we can do no less than back him fully.

There are other advantages, too, with these AMP edge connectors. You can select from types for either rack or solder-to-board mounting. And if you're a panel maker, we've got ECONOMATE I connectors with outstanding insertion speeds and space savings.

For more information on these wrap-type printed circuit edge connectors, just call AMP Customer Service at (717) 564-0100. Or write AMP Incorporated, Harrisburg, PA 17105.

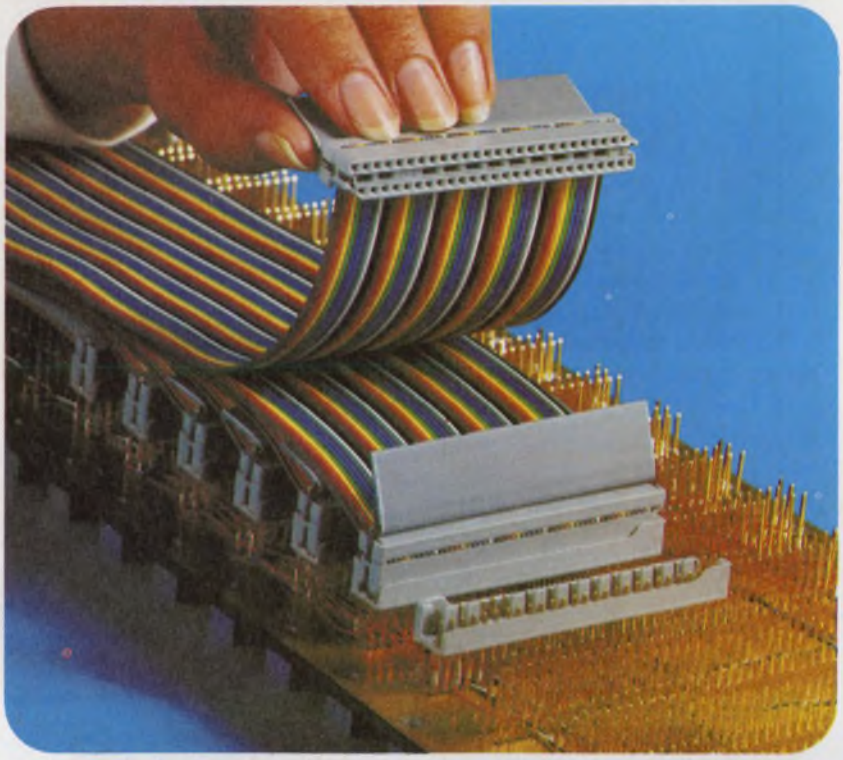
AMP has a better way.

CIRCLE NUMBER 7

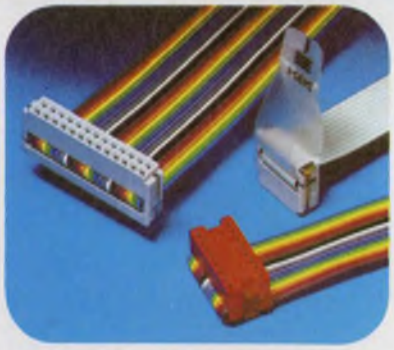
AMP
INCORPORATED

AMP ECONOMATE I contacts and housings allow fast assembly for panel makers and maximum utilization of board space.

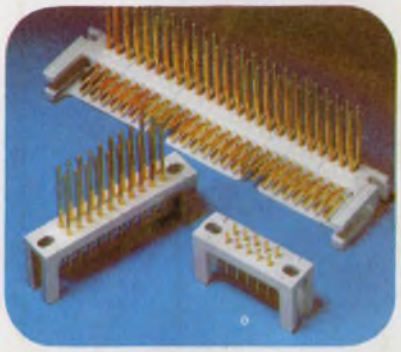
Want simpler backplane connections? Come to the source.



Now, a unique Scotchflex brand Socket Connector and Keying Header system lets you interface directly with backplane wire wrap pins and provides for easy, positive polarization and keying. The header design allows for thousands of unduplicated polarizing combinations without loss of backplane pins. The 50-position connector mates with .025" square pins on .100" x .200" grid spacing. Header allows space for and protects two layers of wrap below it. System also provides polarizing keys and strain relief handles.



Need some other ways to simplify wiring and increase circuit density? 3M's Scotchflex line offers you a broad choice of mass terminating socket connectors, plus wire wrap or solder tail headers to suit your specific design problem. Keying capability is also provided.



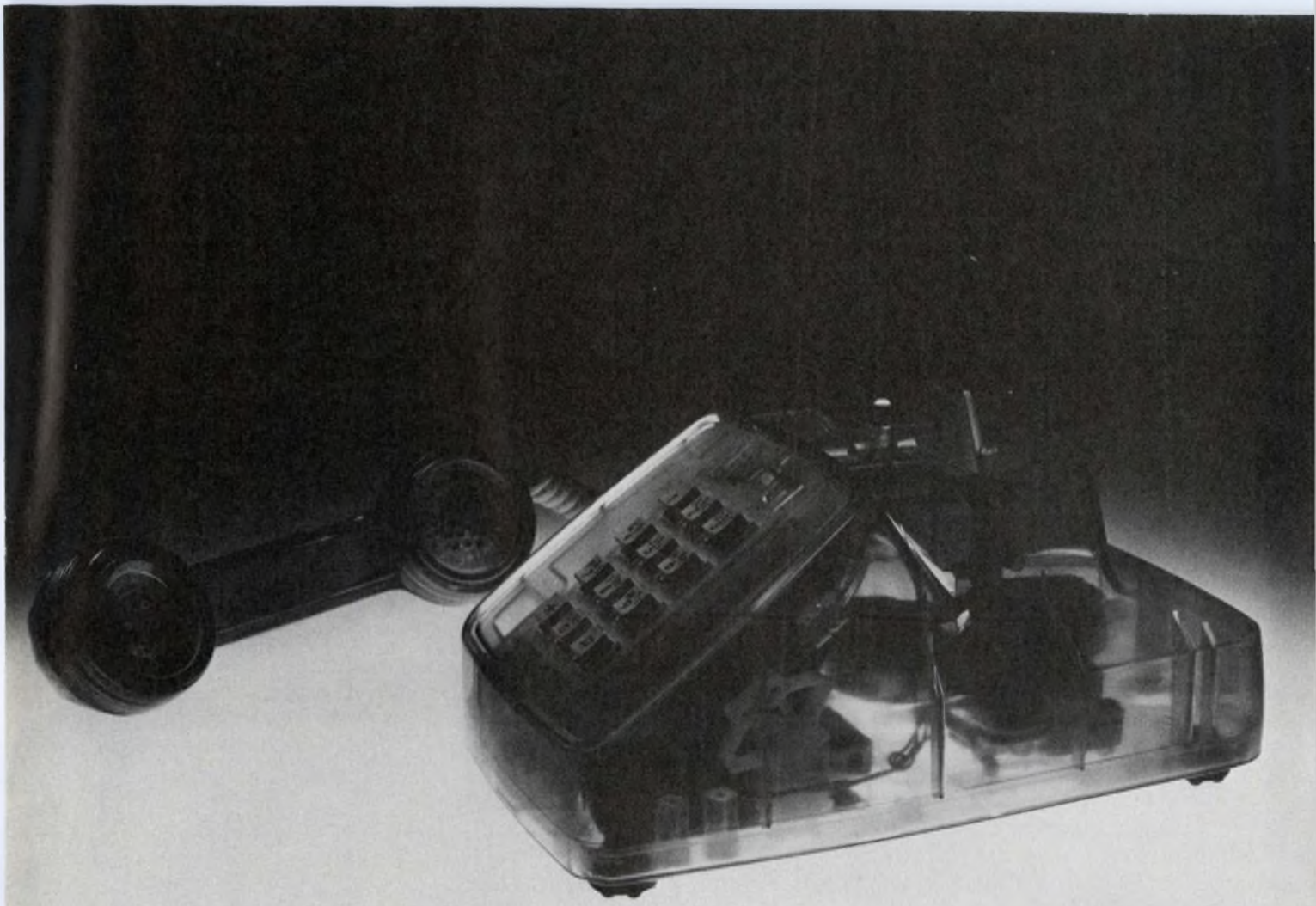
There are several more things you can get only from 3M. The broadest range of flat cables and complete system components. Best off-the-shelf availability. Proven performance. And the unmatched experience of the people who pioneered this reliable mass termination system.

"Scotchflex" is a registered trademark of 3M Co.

Scotchflex® systems from 3M. The source.

3M COMPANY

See our catalog in EEM, page 2256



See, we sell all the parts together. Or all the parts apart.

If you are looking for complete telephones to use as part of a system, or if you need telephone parts to build into your product, GTE Automatic Electric is the logical source.

Why? Because we are the largest U.S. manufacturer of telephones and telephone subassemblies outside the Bell System.

So, if you are an OEM and you have quantity requirements for telephones or telephone components, we'll usually have what you are looking for. Telephones in a large variety of styles and colors. And components ranging from handsets and hookswitches to housings and hardware. If it goes into a telephone system, we probably make it.

Use the coupon for a complete catalog. Or, if you are in a real hurry, call John Ashby at (312) 681-7632.

When it comes to quality components, call THE SOURCE: GTE AUTOMATIC ELECTRIC.

☐ Please send your catalog of communications components.

☐ Please send more information and prices on _____ (Quantity) of _____ (Product).

Name _____

Title _____ Phone _____

Company _____

Address _____

City _____ State _____ Zip _____

Mail to: Mr. J. D. Ashby, B-4,
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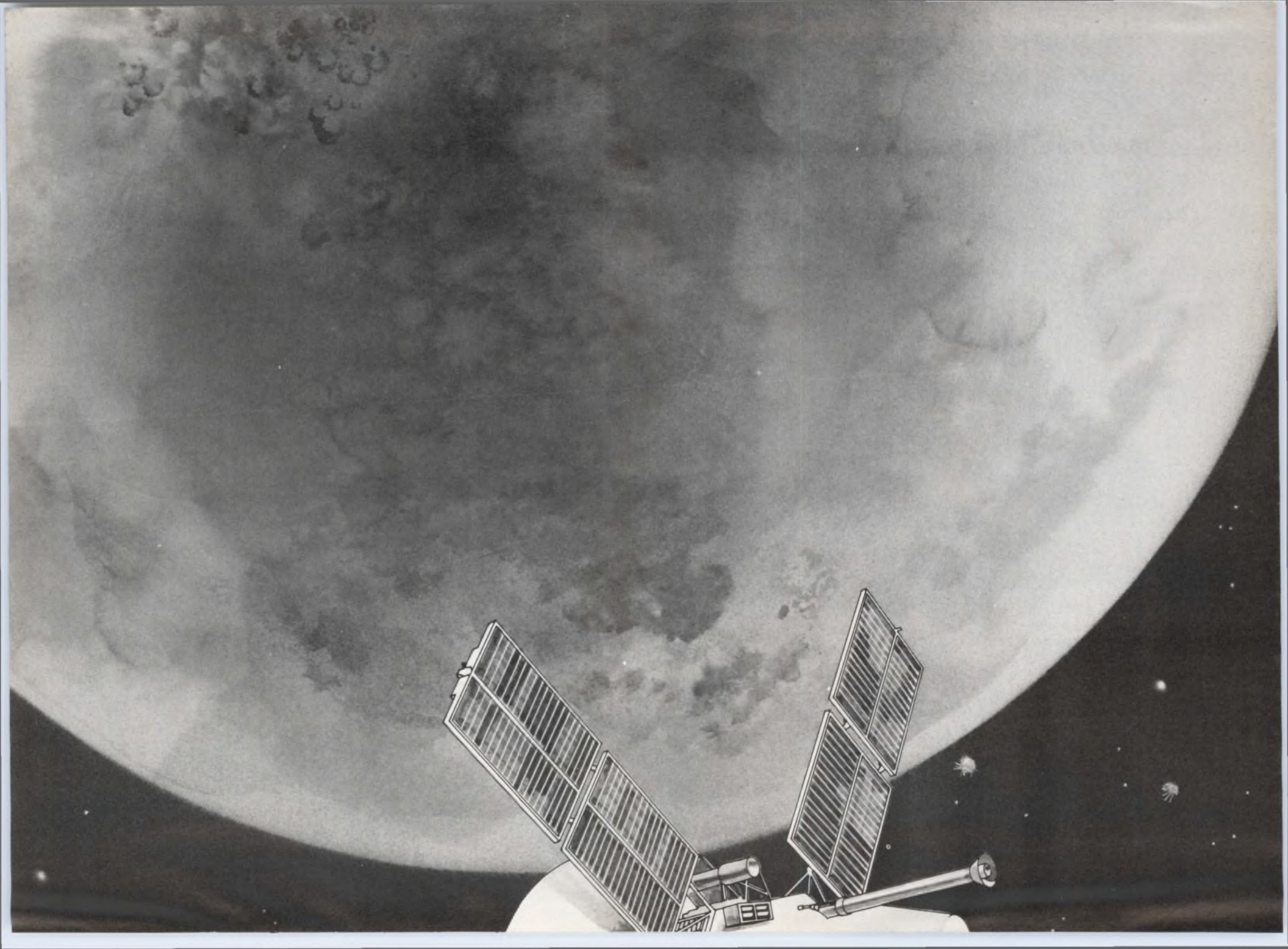
GTE AUTOMATIC ELECTRIC

CIRCLE NUMBER 9



Why PMI's 6-bit DAC-01 wound up orbiting Mars.

When we first laid plans to make the world's first complete 6-bit monolithic DAC, they told us we were wasting our time. "Who needs it?" they said.

Well, the DAC-01 has been around since 1970—in modems, circling Mars (in the Mars Viking spacecraft), in advanced avionics, and in all sorts of applications. People just keep on buying it. Here's why.

There are at least five good reasons why designers prefer to specify the DAC-01 rather than build their own 6-bit digital-to-analog converter. First, its **reliability** is out of this world, as space contractors can tell you. Second, it's **complete**—it contains its own precision internal reference and output op amp. You get an output that's ready to use.

Third, it's **fast**: 1.5 μsec settling time (typ.). Fourth, it uses only **250 mW of power.** And fifth, it has a track record few parts can equal.

That's why PMI fully specifies and guarantees it. Linearity, for example, is guaranteed over the full temperature range, military or commercial.

Electrical Characteristics

Parameter	DAC-01	DAC-01B	DAC-01F	DAC-01C	DAC-01H	DAC-01D	Units
Output Options	Unipolar Bipolar	Unipolar Bipolar	Unipolar	Unipolar Bipolar	Unipolar	Unipolar Bipolar	
Temperature Range	−55/+125	−55/+125	−55/+125	0/+70	0/+70	0/+70	°C
Nonlinearity 25°C – Max.	±0.40	±0.40	±0.40	±0.40	±0.40	±0.78	½FS
Nonlinearity Over Temperature – Max.	±0.45	±0.45	±0.45	±0.45	±0.45	±0.78	½FS

So who needs six bits? Turns out lots of people do. And they'd rather buy than make—especially when they've got the tried and true DAC-01. And that's why it's up there going around and around.

Drop us a line on your company letterhead. We'll see that you get a sample and all the specs.

PMI

Precision Monolithics Incorporated
1500 Space Park Drive
Santa Clara, CA 95050
(408) 246-9222 TWX: 910-338-0528
Cable MONO.

CIRCLE NUMBER 10

Across the desk

(continued from page 7)

Misplaced Caption Dept.

Sophisticated software helps us speed completion of our key programs.

Sorry. That's "Saint Matthew," from the Lindisfarne Gospels in the London British Museum.

Me an editor?

If you'd like to be among the first to know (and write about) what's going on in the electronics industry, you might enjoy being an editor.

We have openings at our home office in Rochelle Park, NJ. Call Ralph Dobriner at (201) 843-0550.

An unreliable system?

When we edited the article "Predict System Dependability..." (ED No. 19, Sept. 13, 1977, p. 100), we found that our own quality control system wasn't completely dependable. The equation for the probability of n failures in a time period, t, should have appeared as follows:

$$P(n) = \frac{e^{-\overline{N}}\overline{N}^n}{n!}$$

where,

$$\overline{N} = \frac{t}{MTBF_t}$$

In the published version, we lost the bar over N.

Also, several readers had difficulty following the program steps in Table 2. Though the table was accurate as published, some of the program steps appeared to be out of sequence. For example, it appeared that location 075 followed location 024 instead of location 074. The table is repeated here with heavy lines added to clarify the program sequence. Three columns of program steps are shown side by side. The sequence of steps follows the number sequence of the locations. Note that numbers are shown only at every fifth location.

Table 2. SR52 coding form

LOC	CODE	KEY	LOC	CODE	KEY	LOC	CODE	KEY
000	46	LBL	025	44	SUM	050	75	−
	18	C'		00	0		04	4
	22	INV		02	2		17	B'
	57	fix		02	2		95	=
	04	4		17	B'		55	÷
005	46	LBL	030	20	1/x	055	04	4
	17	B'		42	STO		17	B'
	42	STO		00	0		65	x
	01	1		03	3		03	3
	09	9		81	HLT		17	B'
010	36	IND	035	46	LBL	060	95	=
	43	RCL		12	B		81	HLT
	01	1		85	+		46	LBL
	09	9		01	1		14	D
	56	rtn		17	B'		55	÷
015	46	LBL	040	95	=	065	53	(
	11	A		55	÷		43	RCL
	46	LBL		01	1		85	+
	13	C		17	B'		01	1
	57	fix		95	=		17	B'
020	02	2	045	20	1/x	070	54	)
	42	STO		49	PROD		94	+/−
	00	0		00	0		85	+
	01	1		04	4		01	1
	20	1/x		01	1		95	=
075	49	PROD	100	47	CMs	125	02	2
	00	0		01	1		55	÷
	05	5		42	STO		53	(
	05	5		00	0		07	7
	17	B'		04	4		17	B'
080	75	−	105	42	STO	130	75	−
	01	1		00	0		06	6
	95	=		05	5		17	B'
	94	+/−		86	rset		85	+
	92	STO		46	LBL		42	STO
085	00	0	110	15	E	135	00	0
	04	4		57	fix		08	8
	55	÷		00	0		01	1
	05	5		42	STO		95	=
	17	B'		00	0		42	STO
090	65	x	115	06	6	140	00	0
	03	3		81	HLT		01	1
	17	B'		42	STO		81	HLT
	95	=		00	0		65	x
	42	STO		07	7		53	(
095	00	0	120	81	HLT	145	43	RCL
	03	3		57	fix		55	÷
	81	HLT		02	2		02	2
	46	LBL		42	STO		17	B'
	16	A'		00	0		54	)
150	45	y^x		85	+		95	=
	08	8		01	1		42	STO
	17	B'		17	B'		01	1
	65	x		95	=	205	00	0
	08	8	180	42	STO		94	+/−
155	17	B'		00	0		22	INV
	29	x!		04	4		23	ln x
	65	x		03	3		65	x
	53	(		17	B'	210	43	RCL
	06	6	185	81	HLT		01	1
160	17	B'		46	LBL		00	0
	75	−		19	D'		45	y^x
	01	1		42	STO		00	0
	54	)		00	0	215	17	B'
	29	x!	190	09	9		55	÷
165	55	÷		00	0		00	0
	07	7		46	LBL		17	B'
	17	B'		10	E'		29	x!
	29	x!		42	STO	220	95	=
	95	=	195	00	0		22	INV
170	42	STO		00	0		57	fix
	00	0		09	9		81	HLT
	03	3		17	B'			
	55	÷		55	÷			
	53	(	200	03	3			
175	43	RCL		17	B'			

Intecolor 8031
Unretouched photo of screen.

Two very sophisticated desk top computers with two very unsophisticated price tags.

We're Intelligent Systems Corporation and we've developed two brand-new stand-alone desk top systems. Both are capable of handling an incredibly diverse range of business, control, research and financial applications—in color. Both have a better price/performance ratio than any other compact computer system on the market.

Take a look at the Intecolor 8031. A compact 13-inch 8-color CRT, it comes complete with graphics hardware and software, a built-in mini disk drive for extra storage, plus "File Handling BASIC" which lets you create, delete, and retrieve program segments from storage, by name.

Now take a look at the Intecolor 8051. Perfect if your needs call for a large-screen format. It comes with the same standard features as the 8031, but it has a big 19-inch diagonal screen and external mini disk drive.

We also have a variety of options available for both units, including a convenient bi-directional desk top printer and a new 2708/2716 PROM programmer.

Contact the ISC representative nearest you for a working demonstration of these two highly sophisticated, versatile and dependable desk top systems. Prices are based on a one unit, cash-with-order basis. Guaranteed 30-day delivery or your money back.

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Norcross, Georgia 30071
Telephone 404-449-5961 TWX: 810-766-1581

Intecolor 8051
Unretouched photo of screen.

CIRCLE NUMBER 11

Made like a fine watch

Inspired design... meticulous craftsmanship in a very low cost, very low profile relay

The Guardian 1475 relay: Engineered to work like clockwork in your most demanding single pole or double pole high density packaging applications. It switches currents from dry circuit right on up to 5 amps that could weld contacts on other small relays and reeds. All because of design features like these (indicated on the above illustration):

(A) Convoluted stationary contacts with built-in wipe because of **(B)** armature with off-center fulcrum. **(C)** .031" diameter terminal pins on .1" grid spacing for PC boards are molded into base with reinforced bosses around thick center section of pins. May be deformed without affecting adjustment. **(D)** Sealed thermoset glass-filled polyester housing and cover. **(E)** Built-in bosses provide air space between board and base for better heat dissipation. Plus U/L recognition... and more:

Sealed to shrug off 650°F wave soldering or immersion in cleaning solvents. Sealed to keep contamination outside—where it can't foul contacts. Fast acting, with typical attract time of 3.5 ms; release time, 2.2 ms at up to 50 operations per second. With contact bounce of less than 1 ms on N.O. contact. Shock and vibration resistant. Typical mechanical life of 100 million operations.

Each relay's performance and reliability are proven by nine—yes, nine!—individual tests. *(Operation at normal, specified pick up and release voltages; time delay limits on attract and release; contact resistance limits; contact gap and pressure; and ground test.)* The nine testing sequences are automatic on *every* relay. A single failure? Automatic rejection. To the scrap pile.

Ask your Guardian Angel for this free 48-page handbook and catalog.

This mark indicates recognition under the component program of Underwriters Laboratories, Inc.

GUARDIAN®

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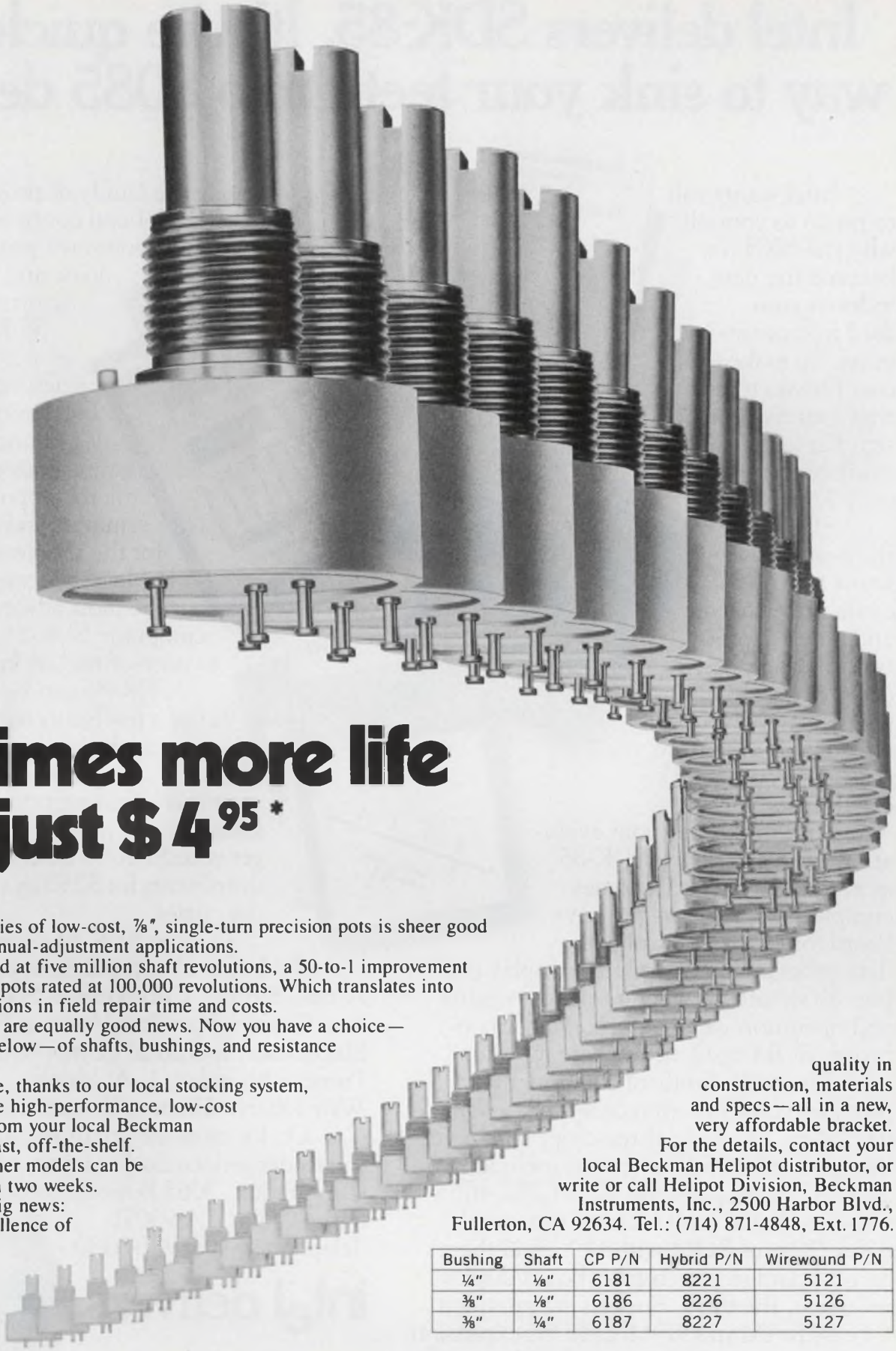
CIRCLE NUMBER 12



50 times more life for just $4.95*

Our new series of low-cost, ⅞", single-turn precision pots is sheer good news for continual-adjustment applications.

They're rated at five million shaft revolutions, a 50-to-1 improvement over short-life pots rated at 100,000 revolutions. Which translates into notable reductions in field repair time and costs.

The options are equally good news. Now you have a choice—see the table below—of shafts, bushings, and resistance elements.

What's more, thanks to our local stocking system, you can get the high-performance, low-cost Model 6187 from your local Beckman distributor—fast, off-the-shelf. Samples of other models can be shipped within two weeks.

That's the big news: Beckman excellence of quality in construction, materials and specs—all in a new, very affordable bracket. For the details, contact your local Beckman Helipot distributor, or write or call Helipot Division, Beckman Instruments, Inc., 2500 Harbor Blvd., Fullerton, CA 92634. Tel.: (714) 871-4848, Ext. 1776.

*100-piece quantity
CP Versions

Bushing	Shaft	CP P/N	Hybrid P/N	Wirewound P/N
¼"	⅛"	6181	8221	5121
⅜"	⅛"	6186	8226	5126
⅜"	¼"	6187	8227	5127

BECKMAN®

CIRCLE NUMBER 13

Intel delivers SDK-85. It's the quickest way to sink your teeth into 8085 design.

Intel wants you to prove to yourself why the 8085 has become the new industry standard microcomputer. To make it easy for you to do that, our System Design Kit for the 8085 is available now for only $250.

SDK-85 is the best way we know for you to evaluate MCS-85™ and develop prototypes of 8085-based designs, because it gives you a hands-on look at this important new microcomputer's capabilities.

And to simplify your evaluation, we've designed SDK-85 as a stand-alone kit. It comes complete with an integral keyboard for system control and data/program entry, and LED display output. To simplify programming, debugging and operation we've incorporated an on-board, ROM-resident software monitor.

The 8085 family of components provides you with unprecedented design flexibility. The basic three-chip, high level integration MCS-85 system is included in SDK-85. It includes the 8085 CPU, 8155 256-byte RAM with I/O and timer and 8355 2K-byte ROM with I/O. And there's an on-board single-chip keyboard/display interface, the 8279. Sockets are provided for easy RAM and ROM/EPROM expansion. And there's ample free space layed out for easy wire wrap expansion using Intel's complete family of programmable peripheral controllers and your own prototype logic and special circuitry.

SDK-85 makes an excellent teaching aid for both microprocessor design and programming courses, for microcomputer design seminars and as a project for the progressive hobbyist. Because the 8085 is the most advanced microcomputer, SDK-85 is the key to state-of-the-art knowledge.

SDK-85 can be assembled in just a few hours with a soldering iron and a few basic tools. Hook it up to your 5V power supply and it's operational the same day you receive it. You can get your SDK-85 from any of Intel's distributors for $250 in single unit quantities.

To order SDK-85 or any of the MCS-85 components, contact: Almac/Stroum, Components Specialties, Cramer, Hamilton/Avenet, Harvey Electronics, Industrial Components, Pioneer, Sheridan, L.A. Varah, Wyle Liberty/Elmar or Zentronics.

Or, for more information, use the reader service card or write: Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051. Telephone: (408) 987-8080.

intel delivers.

CIRCLE NUMBER 14

The IC Tester that's in a class by itself has graduated to MPU.

It's the 48-pin IT-200 bench-top tester. The most flexible integrated circuit tester around. Handles virtually all digital devices.

Now its flexibility stretches to MPU's.

All it takes is our new special test head, which is compatible with all existing IT-200's.

IT-200 will perform DC parametric as well as functional testing via standard factory programs. It can also use an associated MPU instruction set to perform customer specified test routines.

Test the 6800 or the 8080, just to name two of the MPU's which the IT-200 can now handle.

All this plus its original IC test versatility. The 100 kHz functional capability, coupled with a powerful DC parametric capability, allows testing of CMOS, NMOS, PMOS, ECL, and TTL devices of any complexity. The particularly powerful DC parametric test capacity provides current ranges from ±200 na to ±200 ma, and voltage ranges up to ±20V.

Check out the IT-200. You'll find the specs are truly in a class by themselves and the price is surprisingly low.

For more information on what IT-200 can do for you, write or call Cliff Small, Siemens Corporation, Measurement Systems Division, 3 Computer Drive, Cherry Hill, New Jersey 08034. (609) 424-2400.

SIEMENS

IT-200 is manufactured by Imperial Technology and marketed by Siemens.

CIRCLE NUMBER 15

OUR NEGATIVE 5-AMP ADJUSTABLE REGULATOR IS PUTTING A LOT OF 1-AMPS OUT OF WORK.

HYBRID

Throw away the shoehorn! It no longer takes five 1-amp voltage regulators and a handful of components to get to 5 amps. Which means you can get better specs. In less time. Using less room. At less cost.

And get this: The part that makes it all possible, a negative 5-amp adjustable voltage regulator, is available from Fairchild. A major hybrid supplier capable of high volume production.

NOT JUST YOUR REGULAR REGULATOR.

Our μA79HG is a general purpose regulator capable of supplying in excess of 5 amps over a -24 V to -2.2 V output range. It has full thermal overload and short-circuit protection. It's packaged in a hermetically sealed 4-pin TO-3 package that provides 50 W power dissipation.

The regulator consists of a monolithic chip driving a discrete series pass element and short-circuit detection transistors. And that's not all. Our μA79HG needs no electrical insulator because its case is isolated.

ELECTRICAL CHARACTERISTICS: T_J=25°C, I_{OUT} = −2.0 A unless otherwise specified

CHARACTERISTIC	CONDITION	MIN	TYP	MAX	UNITS
Input Voltage Range		−40		−7.0	V
Nominal Output Voltage Range	$V_{IN} = V_{OUT} - 5V$	−24		−2.23	V
Line Regulation	V_{IN} = −7 V to −40 V		0.4	1.0	% (V_{OUT})
Load Regulation	$V_{IN} = V_{OUT} - 10$ V, I_{OUT} = −10 mA to −5 A		0.7	1.0	% (V_{OUT})
Control Pin Current				3.0	μA
Quiescent Current	V_{IN} = −10 V			5.0	mA
Ripple Rejection	V_{IN} = −8.5 V to −18 V, V_{OUT} = −5 V, f = 120 Hz	50			dB
Output Noise Voltage	10 Hz ≤ f ≤ 100 kHz, V_{OUT} = −5V		200		μV
Dropout Voltage	I_{OUT} = −5 A		2.0		V
Peak Output Current	V_{IN} = −10 V		8		A
Control Pin Voltage (Reference)	V_{IN} = −10 V	−2.35		−2.11	V

SO MUCH FOR SO LITTLE.

With all this performance, you'd expect a large price tag. But our μA79HGKC costs only $7.15 in quantities of 100. That's about 30% less than equivalent hermetic 1-amp regulators.

To find out more about our negative 5-amp adjustable voltage regulators (or any of our other hybrids), write or call your Fairchild sales office, distributor or representative today. Or, use the number at the bottom of this ad to call our Hybrid Products people direct. Fairchild Camera & Instrument Corp., 464 Ellis St., Mountain View, CA 94042. Tel:(415)962-3771. TWX:910-379-6435.

FAIRCHILD

CALL US ON IT. (415) 962-3771

CIRCLE NUMBER 16

News scope

DECEMBER 6, 1977

I^2L performance will be improved several ways

Faster speeds, higher power outputs, greater circuit densities, and more compatibility with analog devices on the same chip can all be achieved for integrated injection logic. These findings will be presented this week at the International Electron Devices Meeting in Washington, DC.

One way to improve I^2L performance will be described by John M. Herman, III, member of Texas Instruments' technical staff in Dallas. A buried-collector implant can be used to fabricate Schottky devices on collectors decoupled from the other devices by a p+ implant. With the Schottky devices, gate speeds were improved 40 to 70% over that of second-generation I^2L devices, Herman reports.

The Schottky devices function over the full military temperature range, −55 to 125 C. For a chip with five decoupled gate collectors, a constant speed-power product of 0.16 pJ was achieved at injector currents of 10 μA/gate, and 0.7 pJ at 100 μA.

High current levels of milliamperes instead of the microamperes of typical I^2L circuits would help increase the speed and provide greater immunity to radiation. But a standard I^2L layout—rows of structures—is burdened by uneven collector-current characteristics, which lead to losses that won't permit these high currents.

So L.J. Rangone and N.T. Yang, staff engineers at General Electric, have fabricated a 2 × 2 array of collectors in a square structure with a base contact in the middle. This, they will report, reduces collector losses to about one-quarter that of a worst-case conventional four-collector arrangement. And more than 4 mA of current have been obtained.

What's more, the square structure, which incorporates symmetrical injectors, produces collector currents that enable this configuration to be used in d/a conversion systems that are off-limits to standard I^2L.

Speed and current for I^2L aren't the only things going up. With electron-beam lithography instead of conventional photolithography, the speed-power product has been upgraded five times over that of conventional five-collector, "stick" geometry, n+ guard-ring devices, according to S.A. Evans of Texas Instruments. In addition, the potential number of gates per unit area increases from 400/mm² to 2000/mm².

"We achieved 0.13 pJ at 5 μA," Evans reveals. "And this can be reduced below 0.1 pJ."

Another advantage in using E-beam technology is that *simple* I^2L structures with greatly improved performance can be obtained—in contrast to the increasingly complex devices that have been developed over the past couple of years to get the performance needed by I^2L to compete with TTL and ECL logic. These complex devices use input and output Schottky devices, clamps and double epitaxial layers.

Efforts are under way to combine analog devices and I^2L digital devices on the same chip. But up to now, the thin, highly doped, epitaxial layers needed to produce good I^2L have limited the voltage-breakdown characteristics of the analog circuitry. But with a new process, researchers at the University of California at Berkeley have raised I^2L breakdown voltages from 15 or 20 to 40 or 50 V.

"We start with epitaxial material that is good for analog devices," notes Professor R.G. Meyer. The material is 12 to 14 μm thick and 5Ω-cm resistivity, which gives good breakdown characteristics. Next, the section of the wafer that will contain the I^2L circuitry is ion-implanted with phosphorus. After subsequent high-temperature processing, the implant rediffuses to a concentration of about 0.2 Ω-cm, which gives excellent I^2L characteristics. The I^2L portion has a breakdown of about 3 V.

"The key to this process," Meyer points out, "is to choose the proper level of the initial ion implant."

Businesses to test satellite communications

Rockwell International Corp., Texaco Inc., and Montgomery Ward and Co. Inc. have signed on for a three-month experiment at transmitting business communications via satellite. Data will be gathered on user requirements, equipment performance, and applications and opportunities for satellite communications. An evaluation will be published in a report to NASA and the Federal Communications Commission.

Project Prelude, to be coordinated by Satellite Business Systems, McLean, VA, will use the Communications Technology Satellite maintained by NASA and the Canadian Department of Communications. The satellite system will transmit voice and high-speed digitized data, facsimile, and teleconferencing directly between businesses' premises. Rockwell began experiments in November with transmissions between Pittsburgh and Seal Beach, CA. In December, Texaco will transmit between Harrison, NY, and Bellaire, TX. And in January, Montgomery Ward will transmit between Chicago and Catonsville, MD.

At each pair of sites, SBS and Comsat Laboratories (Clarksburg, MD) will install a small earth station consisting of a trailer with an 8-ft dish antenna and a control center. Transmissions will take place at 12 and 14 GHz, with bandwidths of 85 MHz and data rates to 1.544 Mbps.

Transmission experiments will be conducted several days a week, at prearranged times. Tests will be made of full-motion color television as well as of digital applications of the system, such as data communications, freeze-frame video, and facsimile. Color freeze-frame pictures are transmitted via satellite in half a second, compared with 2½ minutes via telephone lines, according to SBS, and can convey photographs of conference participants, charts and other visuals typical of business conferences.

Equipment to be used in Project Prelude includes Advent large-screen projection television systems, Arvin/Echo freeze-frame storage systems, Dacom/Rapifax facsimile systems, Harris modems, Hewlett-Packard data-processing networks, Ikegami Electronics (USA) color-television cameras, NEC America freeze-frame transmission systems, and Comsat Labs rf terminals.

SBS, a partnership formed by IBM, Comsat General, and Aetna Life & Casualty, expects to have an all-digital satellite system for business communications in operation by 1981.

Logic monitors add data-stream comparison

Two CRT display units that store digital data in two sets of memories enable any logic analyzer to compare the output of a unit under test with that of a known-good system. The LM 208 and LM 216 logic monitors can display up to eight and 16 channels, respectively, of digital data from a logic analyzer in timing-diagram, binary, octal, or hexadecimal format. Each channel is 256 bits deep.

Data can be fed into the monitor's A memory, then transferred into B memory to serve as a reference, or fed directly into the B memory via an RS-232 port. A second set of data can be fed into an A memory, and any differences between the A and B memories can be seen in reverse video on the CRT screen.

The LM 208 and LM 216 also allow mixed-expansion displays in which the data beyond an adjustable cursor is displayed in a × 10 mode. This feature, like the comparison mode, has been available on other logic analyzers, but not in a separate display unit that can hook up with analyzers lacking such capabilities.

The units, designed by Dolch Logic Instruments in West Germany, are built and marketed in the United States by E-H Research Laboratories Inc., Oakland, CA. Controlled by F8-type microprocessors, the LM 208 is priced at $2200 and the LM 216 at $2600.

CIRCLE NO. 319

Electronics in cars must be as reliable as in space

Contrary to popular opinion, electronic devices on drawing boards or under development for cars of the 1980s must be as dependable as devices used in space.

There is a general belief that if electronics can operate reliably in the harsh environment of space, it can perform much more easily in a car. Therefore, less reliability is required.

"No way," says Eugene Karrer, vice president and general manager of Ford Motor Co.'s Electrical and Electronics Div. "The automobile is one of the most difficult design environments, with extremes of heat and cold, high humidity, variations in power, vibrations and severe road jolts."

Addressing a seminar at the American Society for Quality Control in Southfield, MI, Karrer noted that the aerospace designer can spend huge amounts of money to build a protective environment for his electronics, as well as a fully redundant backup system. This luxury is denied to the automotive systems designer.

Still, Ford is speeding up the application of electronics to engine controls, because "this is the only way we can see to meet the Federal requirements for emission control and fuel economy," Karrer explains.

"Not only do we have the problems of meeting emission and fuel economy standards, which are severe enough," Karrer continues. "But we also must consider safety and consumer protection regulations, which require very accurate power-train control and inherently high reliability."

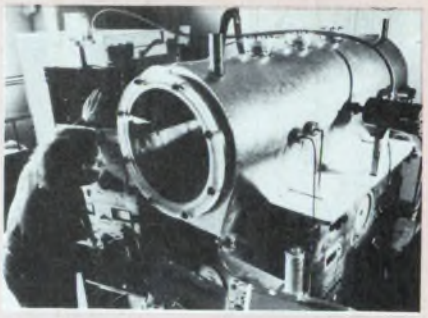
The solution to the problem of reliability is not repairability, concludes the Ford executive, but a return to the fundamentals of design and production.

UV excitation doubles efficiency of CO laser

High-power lasers with efficiencies greater than 50%—twice that of other high-power lasers—are being studied at the Westinghouse Research and Development Center in Pittsburgh under Air Force contract.

Instead of using electron beams to sustain the laser, the Westinghouse design uses an ultraviolet-initiated electrical discharge. The method consists of radiating a low-ionization-potential "seedant" in the laser gas with ultraviolet light, which photoionizes the seedant molecule. The photoelectrons initiate and stabilize the glow discharge at high power levels.

Ultraviolet radiation is generated with a multiple-arc-gap structure. "Since the UV-producing arcs can be generated with simple gap structures, this technique should produce an extremely rugged and maintenance-free design compared to the fragile foil 'windows' on electron guns," says Dr. S.A. Wutzke of the Westinghouse research center. In addition, he says, "the theoretical conversion efficiency of electric-discharge carbon monoxide lasers is at least twice as good as any other high-power laser concept envisioned today.



Doubling the efficiency of high-power CO lasers is the goal of an Air Force project.

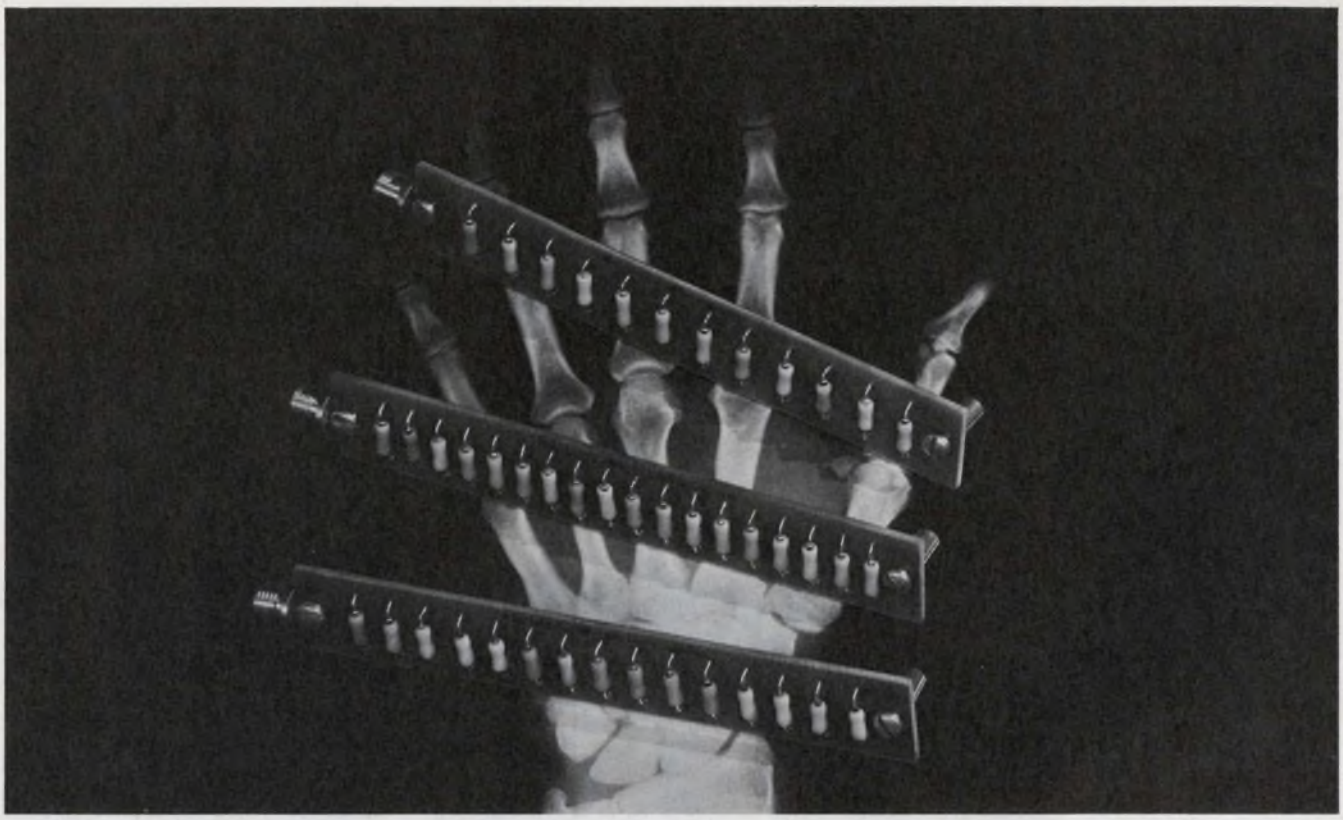
"If the physics of the UV-initiated CO laser now being investigated prove promising, we must next demonstrate its scaling possibilities to the power levels required for industrial and military applications," says Wutzke. The research contract is funded by the Defense Advanced Research Projects Agency and is monitored by the Air Force Weapons Laboratory at Kirtland Air Force Base, NM.

Driving shocks electronically softened

An electronic shock-absorbing system is designed to provide a smoother-than-ever ride for the nation's motorists and truck drivers.

Developed by Monroe Auto Equipment Co., Troy, MI, the electronic ride-control system is designed around a pair of Monroe air-adjustable shock absorbers, one of which contains a photocell unit that constantly senses vehicle height.

As the vehicle is loaded and the shock absorbers compress, the photocell senses that this body position is below normal. The computer, monitoring this change, activates an electric air compressor that adds air to the rear air shocks, and levels the vehicle automatically. When the vehicle is unloaded, the computer automatically returns the body to its proper height by bleeding air from the system.



"X-WAY STIC"

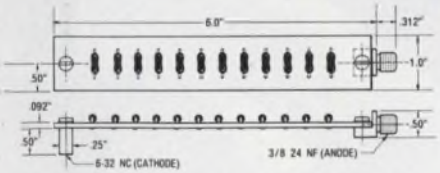
High Quality - Low Cost Rectifiers for X-ray Power Supplies.

Semtech Corporation introduces "X-WAY STIC" a new series of open rectifier sticks specifically designed for X-ray power supplies.

Each X-WAY STIC utilizes hermetically sealed Metoxilite multi-chip "avalanche" rectifiers mounted on a PCB. These Metoxilite multi-chip rectifiers (technology initially developed for high reliability aerospace programs), are now available *at reduced prices.*

In addition to X-ray power supplies, these rectifiers can be effectively used in most standard, single and polyphase circuits.

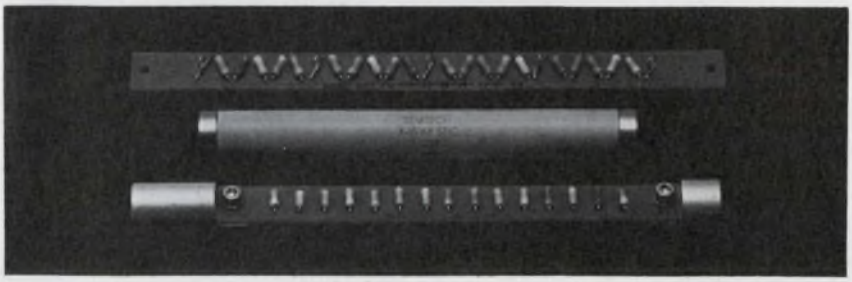
Designed for use in oil environment.



Types: X100KS, X125KS & X150KS
PIV (operating): 100, 125 & 150kV
PRV (test): 125, 150 & 175kV
Average Rectified Current @ 55°C Oil: 150mA
Reverse Current @ PRV: 1.0 μA
Recurrent Surge (10 cycles @ 60 Hz rate): 7.5A
Single Cycle Surge @ 8.3ms: 25A
Forward Voltage @ 50mA: 160, 190 & 220V

RELIABILITY COSTS LESS!

OTHER X-WAY STIC TYPES AVAILABLE:



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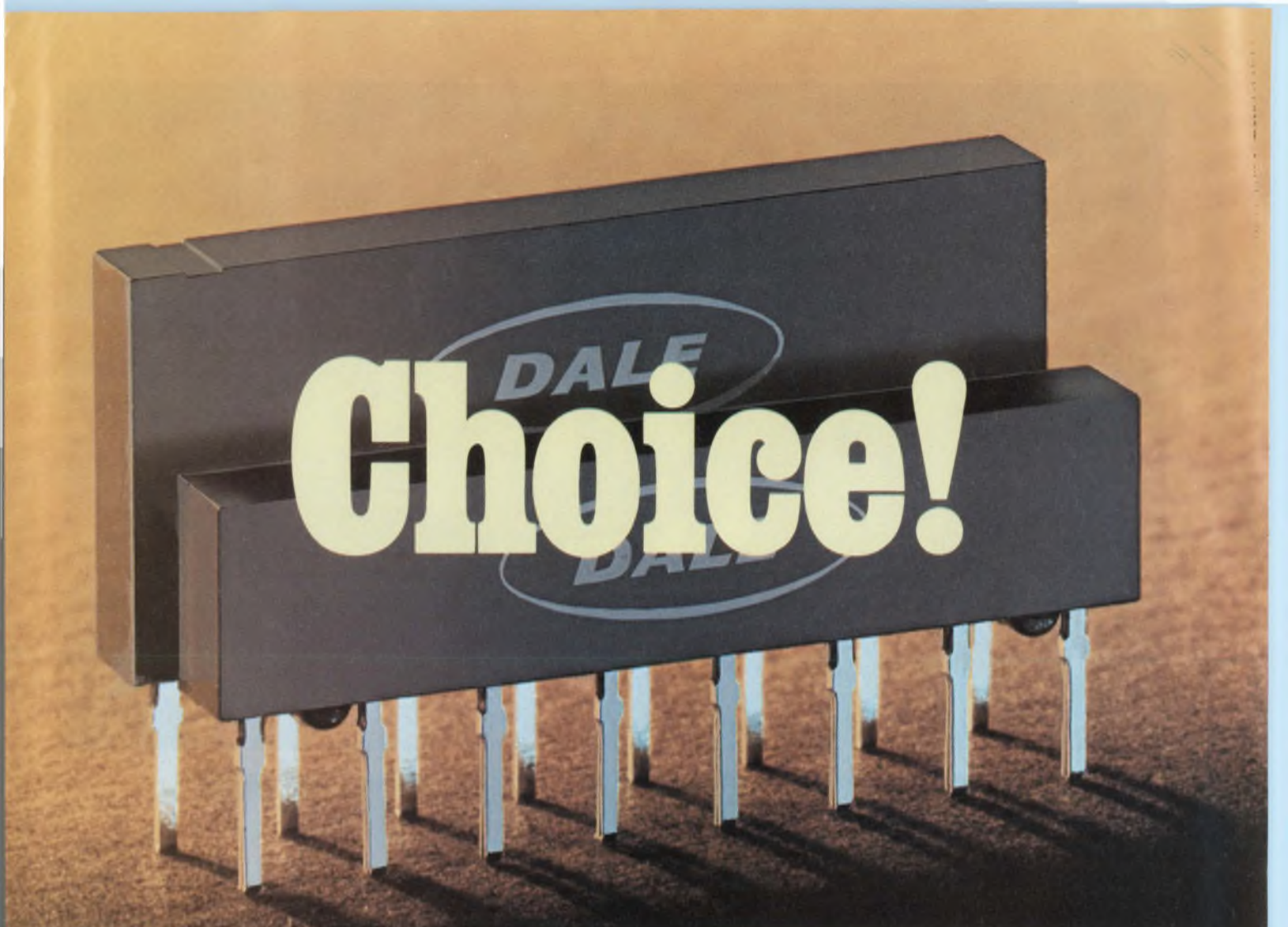
CIRCLE NUMBER 17



New Dale MSP Networks let you match profile, power and package to meet your resistance needs.

Dale's new MSP single-in-line networks are the shape of things to come in resistance. Rugged. Machine insertable. And available in your choice of profiles: .350" with up to .3 watts per resistor or .195" (.19 watts) to meet critical board spacing requirements. Both are molded for extra protection. Both give you the kind of quality assurance we developed for Dale's SDM—the first network to meet MIL-R-83401. Sample the MSP now. It's available fast in quantity from stock... and it's only part of Dale's complete line of SIP and DIP networks.

Contact your Dale Representative or phone 402-371-0080

DALE ELECTRONICS, INC.
Box 74, Norfolk, Nebraska 68701
In Canada: Dale Electronics Canada Ltd.
In Europe: Dale Electronics GmbH,
8 Munchen 60, Falkweg 51, West Germany
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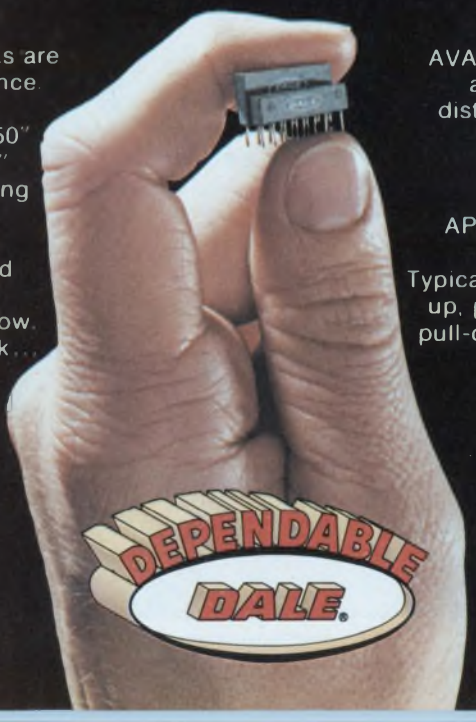

AVAILABLE FAST: .350" model (MSPXXXC) available in 1 week from factory or from distributor stock. 6, 8 or 10 pin models(-01 circuit) in 49 standard values. Consult factory for fast delivery times on other configurations and schematics.

APPLICATIONS: Standard circuit (-01) has 5, 7 or 9 resistors with 1 pin common. Typical applications include "wired OR" pull-up, power gate pull-up, MOS/ROM pull-up/pull-down, open collector pull-up, TTL input pull-down, TTL unused gate pull-up.

SPECIFICATIONS: *Power*: .350" model=.3 watts max. per resistor; .195" model=.19 watts max. per resistor. *Resistance*: 33Ω to 1 Meg. standard. *Tolerance*: ±2% standard. T.C. ±100 PPM/°C. *T.C. Tracking*: 50 PPM/°C. *Operating Temperature*: −55°C to +125°C.

CIRCLE NUMBER 351

Choice!

Dale DIP Resistor Networks meet your industrial and military requirements—from stock!

If you're using, or designing-in, thick film resistor networks—talk to Dale. Our DIP team features the MDP, a rugged new molded package ideal for low-cost industrial applications plus our SDM, the first dual-in-line network to be qualified for MIL-R-83401. Both give you time-saving availability from distributor or factory stock in 14 and 16 pin packages with a choice of two popular schematics. Write for sample of the MDP. It's machine insertable...interchangeable...and very competitively priced.

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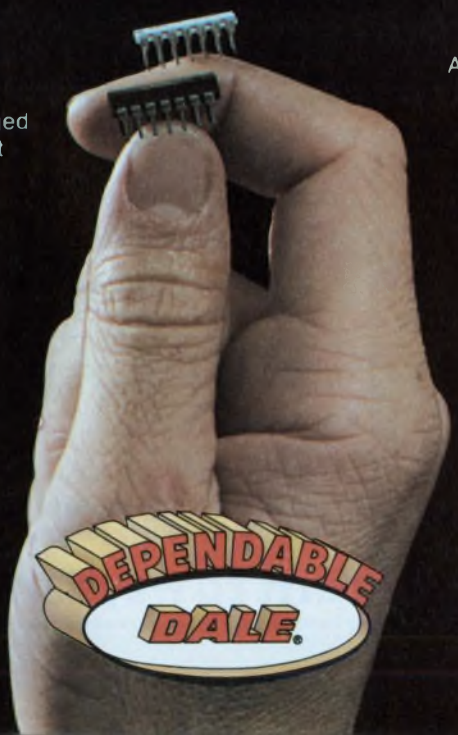
CIRCLE NUMBER 352



AVAILABLE FAST: Both MDP (molded) and SDM (MIL-R-83401) immediately available from factory or distributor stock in 14 and 16 pin models. MDP available in 49 stock values from 33Ω to 1 Megohm, 2% tolerance, 100 PPM/°C. SDM available in 18 stock values from 100Ω to 100KΩ (2% tolerance, "M" or "K" levels).

STANDARD SCHEMATICS: 01 = 7 or 8 isolated resistors. 02 = 13 or 15 resistors with one pin common. Applications include: pull-up, pull-down, impedance balancing and current limiting. Other schematics also available. *For SIP resistor networks*, ask about Dale's MSP. Available from stock in 6, 8, 10 pin models.

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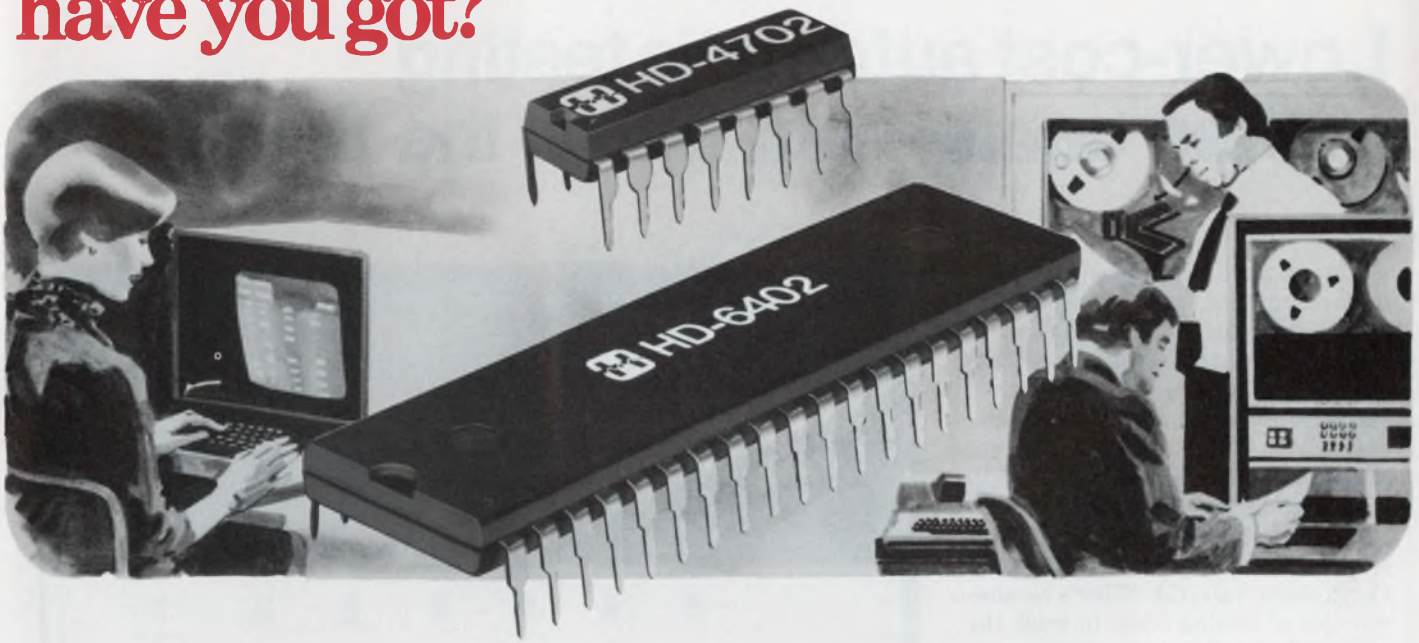

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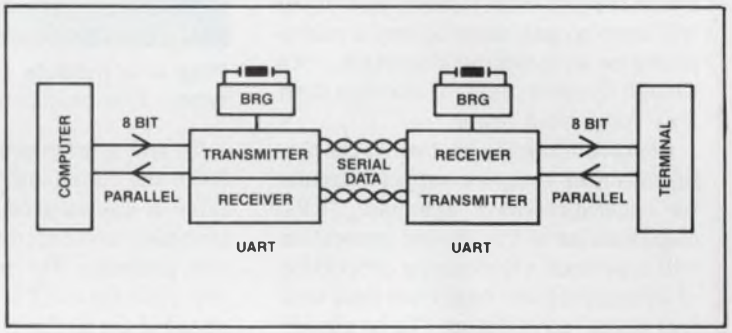

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CIRCLE NUMBER 22

Lower-cost automatic testing makes cents—but not all the time

Automatic-test-equipment users are demanding less expensive ways to check integrated circuits and printed-circuit boards, and equipment vendors are responding with products that are less expensive to buy, maintain, and operate.

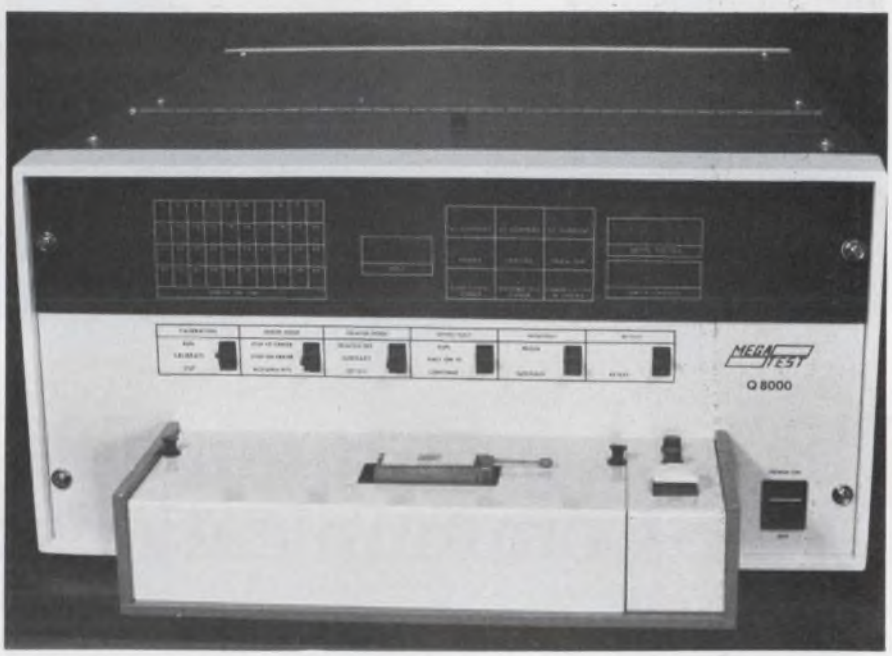
"The cost of testing is already or will soon become the single largest contributor to the cost of a device," says Stephen Bisset, president of Megatest Corp., Sunnyvale, CA. "That's because the cost of testing tends to track the complexity of the device you're testing," he explains, "but the price of the device itself keeps dropping."

Writing a program to test a microprocessor takes longer than writing a program to test a less complex IC, such as a memory, and the microprocessor sits in the test socket longer. So a buyer will have to pay more to test a microprocessor at incoming inspection, even though the price paid for the chip itself may have been lower.

Compounding the problem is the proliferation of complex support circuits for microprocessor systems. "CPU chips similar to the present generation will represent a decreasing proportion of microprocessor hardware (and testing) costs," says Bisset. "To be significant, a testing approach must cover such devices as CPUs, I/O controllers, floppy-disc controllers, CRT controllers, serial communications chips and, last but not least, single-chip microcomputers with RAM, ROM (or EPROM) and I/O on the chip."

In its Model Q8000 tester, Megatest joins a mainframe controller to plug-in "functional data modules," which tailor the tester to specific device types and generate the patterns needed to exercise the device under test. The mainframe goes for $26,000 and plug-ins average $3500.

Andy Santoni
Associate Editor



Plug in a module and configure the Megatest Q8000 to test different device types. The unit can handle microprocessors, memories, and random logic.

To test a microprocessor such as an 8080, the functional-data module contains a known-good reference microprocessor and a memory that stores the test program. The program is run on the reference CPU one clock cycle ahead of the device being tested, so that timing measurements are independent of the characteristics of the known-good device. The outputs of the two ICs are compared to determine if the device under test is good.

The reference device operates in a benign environment in which timing relationships, drive and sense levels, and power supplies are at the most favorable values. Otherwise, a faulty device might pass a test because the reference as well as the device itself cannot meet the test conditions.

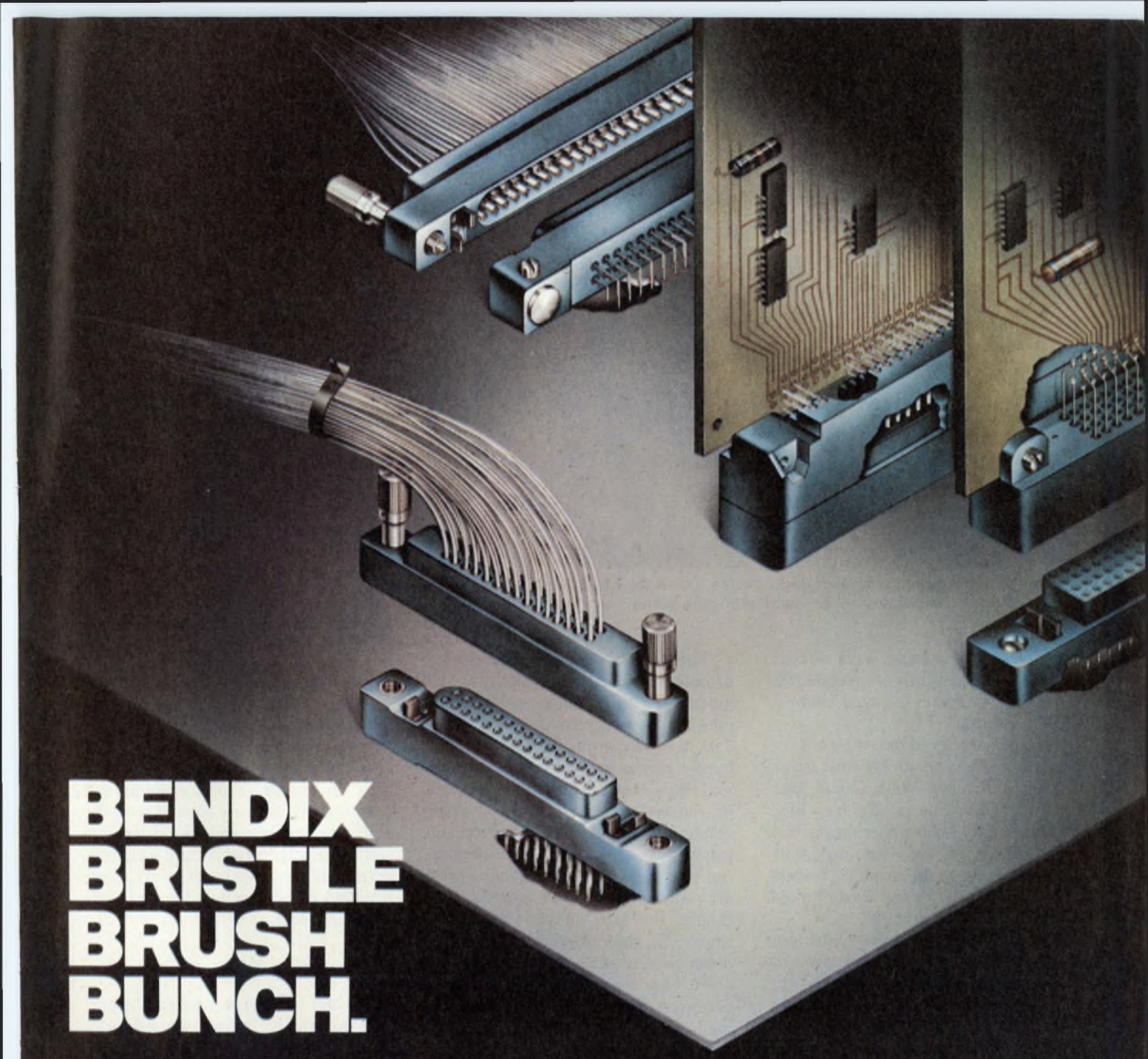
Similar comparison testing is used in Adar Associates' Model MX-17 device test system. With what Adar calls "conditioned natural environment" testing, "worst-case or stress conditions are seen only by the device under test," explains Herb Thaler, senior systems analyst at Adar in Burlington, MA. Thaler described the technique at the Semiconductor Test Symposium in Cherry Hill, NJ.

Lower system cost demanded

"In order to be available to the user market, a system must be low in price," says Thaler. "Programming costs and efforts must be reasonable. In particular, the software must permit easy access and total utilization of the system by design engineers familiar with the microprocessor language."

Programming the Adar system is simplified by separating test-sequence generation from system-controller programming. Bit patterns used in testing are generated by instructions that are written in the language of the microprocessor to be tested, and can be modified to reflect different operating requirements.

The Adar technique meets the defini-



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By comparing against a known-good device, the Adar MX-17 can tell whether a test device's responses to a set of stimulus signals are right or wrong.

tion of low-cost testing, says Thaler, because "as currently implemented, the CNE test system is well below a $50,000 ceiling."

For the majority of incoming inspection test needs, a small, low-cost tester fits the bill, says Walt Luciw, test engineer with Sperry Univac, Blue Bell, PA. But before choosing a test system, he adds, "you have to decide if you're going to do incoming inspection only, or if you're going to do characterization, or both."

Device characterization includes measurements of a device's voltage and timing capabilities, as opposed to simpler go/no-go testing, which only determines whether a device is good or bad by some set of standards. Complete characterization tests require a high-speed—and expensive—tester such as the Fairchild Sentry VIII (see "News Scope," ED 24, Nov. 22, 1977, p. 21).

Expensive systems have a place

Standing up for more sophisticated, more expensive, test systems, James Healy of Fairchild Instrumentation and Systems Group, Wiesbaden, West Germany, believes that programming and analyzing test data rather than test hardware constitutes the major portion of the cost involved in testing microprocessors. A tester must be able to characterize so that either faults can be corrected in the manufacturing process or simple tests for such faults can be developed.

"The $350,000 general-purpose tester usually provides test capability for all kinds of logic, mass-storage peripherals for programs and test result data, and numerous 'nice-to-have' but hardly necessary features like graphics," says Healy. Hardware costs can be reduced substantially by limiting voltage swings and dedicating certain tester pins to specific functions, replacing disc memory with magnetic tape, or simplifying pattern generators—though the last would increase test time. Still, price would then be jacked down to about $200,000, Healy says—about the same as for multiple dedicated test systems for microprocessors, memories, and peripheral chips.

"The general-purpose tester in a low-cost configuration to test microprocessors and related peripheral devices is probably the most cost-effective microprocessor-testing solution today," Healy maintains, adding that the gap in hardware cost between a general-purpose type and a dedicated stand-alone microprocessor tester is justified.

Who needs it?

An IC user can take advantage of the general-purpose tester's capabilities to examine a prospective vendor's parts thoroughly before the vendor is added to the user's qualified-source list. The user can also monitor the quality of the parts received from different vendors to see if any should be dropped from the list. The detailed test data available from a general-purpose tester can also be valuable to design engineers, who can use data on the traits of particular microprocessors.

A general-purpose system can perform characterization tests important to device manufacturers, users of high volumes of different types of devices, and manufacturers of equipment that must be highly reliable, says Doug Smith of Tektronix Measurement Systems Division, Beaverton, OR. And such a system can even save money. The device manufacturer pays for the system by using its results to improve processes and increase yields. High-volume users of mixed device types save by standardizing on a single system type instead of programming and maintaining different special-purpose testers, and by increasing the throughput of devices being tested. High-reliability manufacturers, of course, cannot afford failures, so they need the exhaustive tests a general-purpose system performs so effectively.

When shopping for an automatic test system, a prospective buyer should be looking for four things, says Smith: the highest performance possible at whatever the price; reliability, since down time on expensive test systems can dramatically increase testing cost; the ability to generate enough patterns to test devices thoroughly; and easy programmability, since programming cost is a high percentage of a test system's operating cost.

Generating patterns faster

The last point makes automatic pattern generation a necessity in automatic test systems, Smith goes on. Hand-coding test sequences takes so long that it can eat away at whatever saving is achieved at purchasing time, and might even take long enough for the manufacturing of the final product to be held up. Moreover, human error in a lengthy test sequence is unavoidable, and documentation can be confusing and useless. Automatic pattern generation, on the other hand, provides simpler documentation and more flexibility, since a simple change in the generation program changes the entire test sequence.

But for simpler test programs, less expensive pattern-generating techniques can suffice, since, after all, "the tester really doesn't care where the pattern comes from," says Megatest's Bisset.■■

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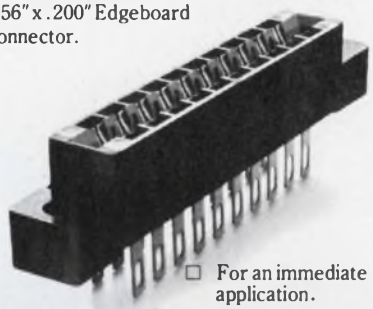

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Sturdy electromagnetic element displays in color, saves power

A rugged visual display element may have considerable impact on the design of large-character displays, annunciators and status indicators. A display array using this element consumes about 97% less power than an array of incandescent lamps. Moreover, the new element lends itself to mixing character displays with graphics—both discrete charts and continuous-tone pictorials.

Developed by Heath and Co. in Los Angeles, the TeleMatrix is a three-position rotary device with only one moving part. Built around a cylindrical permanent magnet, the element floats on a stationary armature.

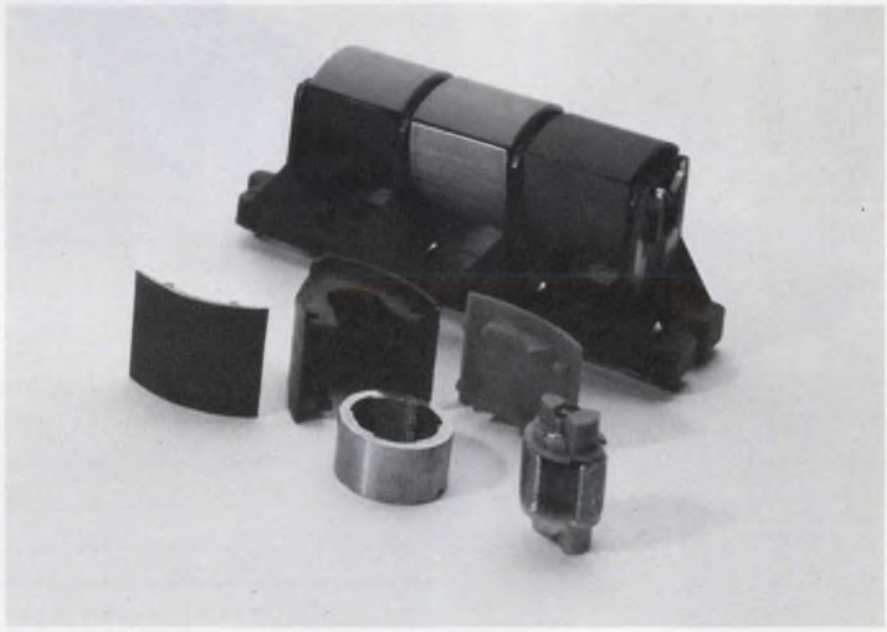
A nonvolatile memory

Pulse one of the three coils in the armature, and the element rotates to show the face desired. The magnet locks the element in place, even after power is removed, in addition to providing the torquing and damping effects that control the motion. The element takes about 50 ms to move, and goes "the short way"—that is, the element turns 120° either way in response to a pulse, never 240°.

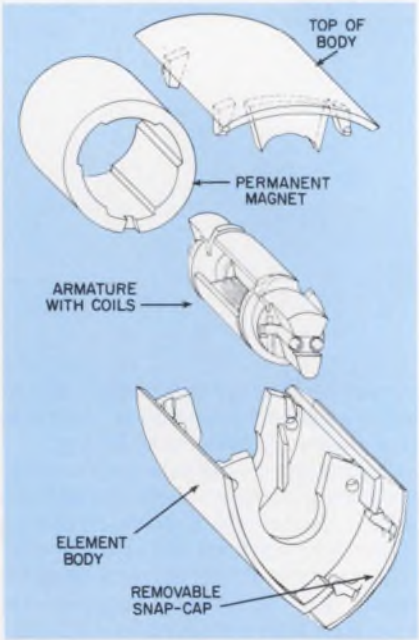
Heath has used arrays of TeleMatrix elements to build full-color message boards with a microprocessor controlling the displayed message. The TeleMatrix elements are also finding their way into outdoor advertising signs, scoreboards, bus-destination signs, and highway signs. The elements are also suitable for smaller displays and for indoor uses, like silent paging, airport-information systems, and brokerage boards. This fall, Heath, a division of Fischbach and Moore, began offering the display elements for OEM use.

Available as unmounted components or in arrays assembled on Standard PC boards, the new element is made 1/2 in., 2 in., or 3 in. high. The body is made of injection-molded plastic for the 1/2-in. unit, and of plastic foam for the larger sizes. So rugged is the element and its holder that one can walk across the face of an assembled array without doing damage.

Dave Barnes
Western Editor



This color display element with one moving part features interchangeable snap-on faces. It comes in arrays or as an unwanted component.



A permanent magnet "floats" a three-faced display element on a stationary armature. Current pulses turn the element so that different sides are visible to the viewer.

Mix and match

Face colors may be specified differently, but current production provides black and yellow faces that are permanent parts of the body, and a third face fitted with an easily removed "snap-cap." The cap can carry a third color, a graphic element, or a pictorial segment made by dicing a picture or poster. Programming selects black characters on a yellow background, or yellow on black, or either on a pictorial background, and so on.

Defective elements can be popped out of the plastic holders, and replacements snapped in. Since the rotor

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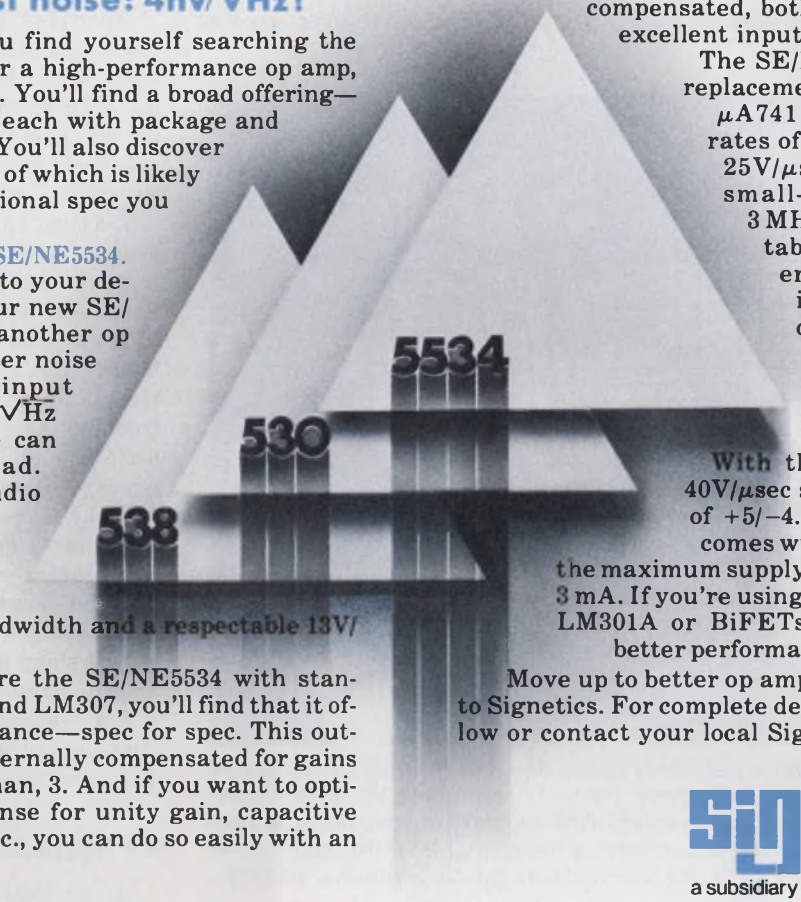

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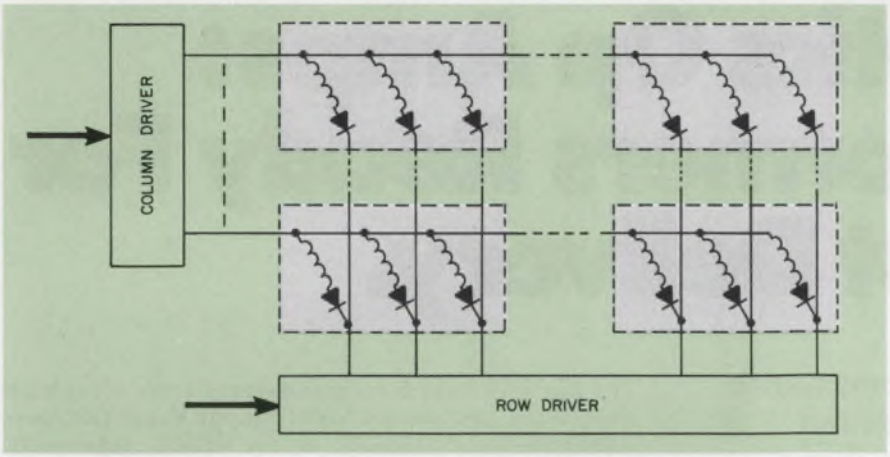
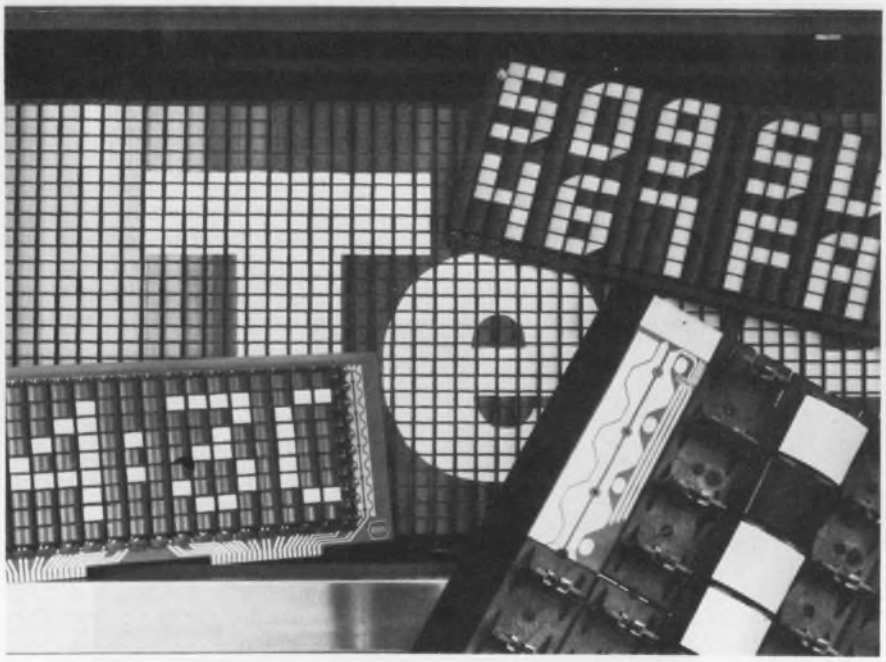


Series diodes built into the element steer 250-mA, 24-V pulses to selected coils in a matrix circuit.



Assembly of 2-in. elements (lower right) shows detail of PC board and die-cast plastic holders with snap-in connectors. Partially assembled PC board (lower left) holds 9 × 22 array of 1/2-in. elements. The legibility of special font (upper right) is obtained from the diagonal pattern of the elements' third side. Painted pictorial (background unit) uses the elements as quasicontinuous surface.

containing the coils is stationary, there are no sliding or wearing contacts.

"The plastic body centers the magnet on the armature so that side forces cancel out," says Greg De Smet, Heath's director of electronic development and inventor of the innovative display. "Since the plastic is just a guide, not a bearing, wear is slight, and the elements have a very long life."

For size, the TeleMatrix character displays begin where most LEDs and LCDs leave off. For letters 2 1/2 in. high up to billboard size, the elements can form character fonts in many ways.

A full ASCII alphanumeric font using only a 4 × 5-element pattern is legible (see photo) because of diagonal patterns on the third face. With only 20 elements to drive, as opposed to 35 for a conventional 5 × 7 matrix, this font can save money. In addition, a numeric font has been developed with only five elements that are horizontal and triple the normal width. "We keep on finding new fonts," De Smet grins.

Won't wash out

By working *with* the available ambient light, the TeleMatrix approach gets away from the tendency of incandescent bulbs to wash out to low contrast in sunlight, yet produce troublesome glare at night.

"Sunlight tries to wash out any self-illuminated display, and you use power to combat it. But ambient light works with our reflective elements, not against them, explains Tim Brosnahan, national manager of electronic systems at Heath. "So visibility and contrast are free in the daytime. At night you use a few inexpensive fluorescent lamps to light up the whole sign.

Blackouts of 1975

When the energy crunch hit two years ago, Brosnahan goes on, outdoor signs across the country were turned off. "We couldn't even give away the conventional incandescent signs, so we searched for something new that would cut power usage dramatically."

The older Heath designs already had been modernized with SCRs and triacs to dim and switch the tungsten bulbs. Then many techniques were evaluated to see if they would do the message-board job and save power. Electroluminescent, electrochromic, electrophoretic, electrostatic-vane, magnetic-disc and magnetic-particle approaches were all weighed.

"None of these technologies was really ready to go, what with the wide temperature range and intense ultraviolet bombardment that outdoor signs have to withstand, so I went back to basics and invented an answer," De Smet explains.

The TeleMatrix element has advantages over all other available elements and saves kilowatts of power.

It's bright to cut power

In one Heath comparison test that is typical for large signs scaled for 1000-ft visibility, 2160 TeleMatrix 3-in. elements were pitted against 2160 33-W incandescent lamps; updating of all elements every five seconds was assumed. Both approaches provided two lines of 24 programmable 5 × 7 characters 21 in. high. Each sign was double-sided, about 2 1/2 ft high and 30 ft long.

Twelve hours of day operation and six hours of night operation were assumed. The lamp system was cut back from full power to half power at night, when less brilliance was needed.

At three cents per kilowatt-hour, electric power costs $481 a month for the incandescent-lamp sign—and $16 per month for the TeleMatrix sign. ■■

"Light-up" your customers

...with Burroughs new microprocessor-controlled thin display systems!

Burroughs announces a major advance in its popular line of SELF-SCAN® gas plasma displays: *microprocessor-control and memory!* This means big savings plus the greatest operating and packaging flexibility *ever* in the flat panel display of alphanumeric information.

Your engineers will "light-up", too, as they discover operating advantages unmatched by any display. The new SELF-SCAN II displays are bright, crisp, easy-to-read. And, with Burroughs' unique new simplified control circuitry, the display panel — complete with electronics — is less than 2" thin for easy installation in compact designs.

The display's built-in microprocessor memory and control eliminate the need for you to design, develop and build circuitry to effect display operation. Just feed in appropriate 8-bit signals for the characters and control commands and you're in operation. Large system manufacturers save 95% of the engineering and development time formerly required and small system producers can now use displays since "design-in" cost is no longer a significant factor.

Adapting the Burroughs displays to your needs is as easy as a change in software. Their operation can be tailored for any product and changed for others with different display requirements.

The display subsystem operates off an 8-bit bi-directional buss or a TTL buss. Data can be entered at rates up to 1 MHz. and, with the addition of a keyboard and communication interface, it becomes a low-cost, compact data terminal!

The system's edit and control routine allows insertion, deletion and blinking of letters or lines, increasing or decreasing brightness, right-to-left data entry, etc.

Light up your customers and your engineers. And lighten your costs with Burroughs SELF-SCAN II microprocessor-controlled displays. For a copy of our SELF-SCAN Subsystems Brochure, write Burroughs Corporation, Electronic Components Division, P.O. Box 1226, Plainfield, New Jersey 07061 or call (201) 757-5000. Overseas, contact Burroughs ECD International, Buckingham House, The Broadway, Stanmore, Middlesex, England.

You can see the difference

Burroughs

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CIRCLE NUMBER 28

SAW oscillator takes strain by working as a pressure sensor

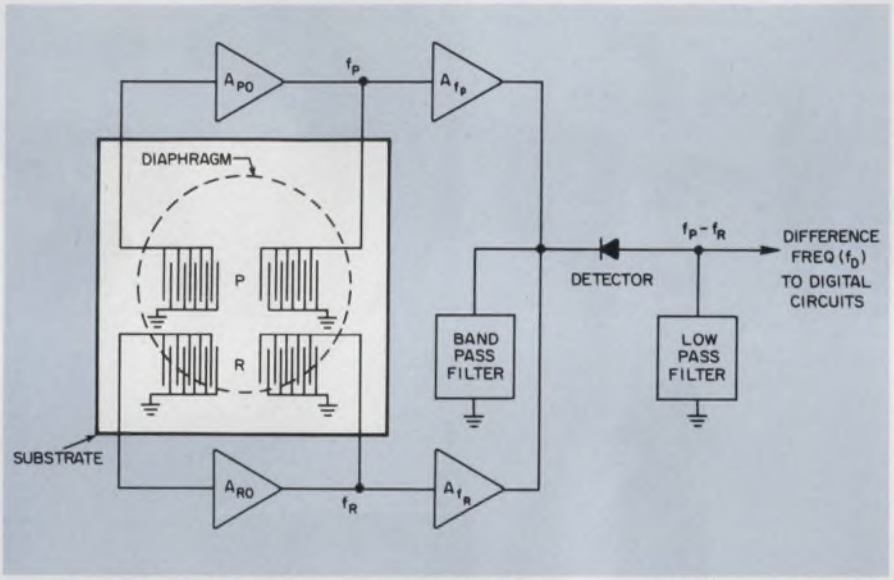
Surface-acoustic-wave filters and oscillators designed for signal processing in communications and radar usually suffer from strains imposed by their mounting and packaging and by temperature variations that alter their operating parameters. But these strains have been put to good use in a SAW oscillator that functions as a pressure sensor and also has several advantages over current sensors.

For one thing, the temperature stability of the SAW pressure sensor, developed at the United Technologies Research Center in East Hartford, CT, is exceptionally high—two parts per billion per °C, or 1000 times better than that of the quartz substrate on which it is formed. Moreover, the sensor can be fabricated for a broad range of pressures, and units monitoring 0 to 15 psi and 0 to 600 psi have been demonstrated.

Linearity is better than 0.1%. The sensor output is a frequency that varies approximately 50 kHz over the full-scale range, so resolution is high. For a 1-psi shift in pressure in a 15-psi unit, the frequency change is over 3 kHz. For a 600-psi device, the output is 83 Hz per unit-pressure variation.

Because its output is a frequency rather than a voltage level, the United Technologies device is compatible with digital circuitry.

Originally developed as a digital airborne sensor for the Naval Air Systems command, the sensor may prove useful for pressure monitoring in jet engines, in large-building climate-control systems and in remote weather-monitoring stations, Donald Cullen, United Technologies research scientist, believes.



This SAW pressure sensor converts strain on its quartz diaphragm into variations of two SAW-oscillator frequencies. The difference in frequencies in this United Technologies device provides pressure measurement.

Sensor has quartz substrate

The pressure sensor is formed of two saw delay lines on a stable YX quartz substrate. The quartz is ultrasonically milled to produce a circular diaphragm a few mils thick. Actual thickness depends on the maximum pressure to be measured. The SAW delay lines are formed on the substrate surface by depositing 0.15-μm thin-film, interdigitated patterns via standard photolithographic techniques.

One delay line, P, is aligned with the diaphragm's center line. The second (R) is offset to one side (see figure). The close proximity of the delay lines not only provides temperature compensation but also increases the pressure sensitivity over that of a single delay line. The delay-lines' outputs are fed to amplifiers that drive the delay-lines' inputs and consequently form two SAW oscillators.

Normally, the oscillators operate at 78 MHz. But under pressure, the mechanical strain in the diaphragm changes the velocity of the acoustic waves and consequently the oscillator's frequencies. For a full-scale strain, the difference between the two oscillator frequencies increases to about 50 kHz.

The dual acoustic channel was originally conceived for temprature compensation, with the reference delay line placed off the diaphragm so that pressure changes wouldn't affect it. Compensation was obtained by subtracting the reference frequency from the pressure signal.

But sensitivity was found unexpectedly to increase—and substantially—by moving the reference transducer partially over the diaphragm, Cullen recalls. With the present arrangement, temperature compensation has been improved from the 22 ppm/°C of the basic quartz substrate to better than 2 ppb/°C.

The outputs of both pressure and reference oscillators are fed to buffer amplifiers, which drive a single mixer diode that selects the sum and difference frequencies. The sum frequency is rejected by the low-pass filter and the difference frequency is fed to a following amplifier.

Accuracy of the present SAW sensors is better than 0.5%, with further refinement expected to increase it to 0.1%.■■

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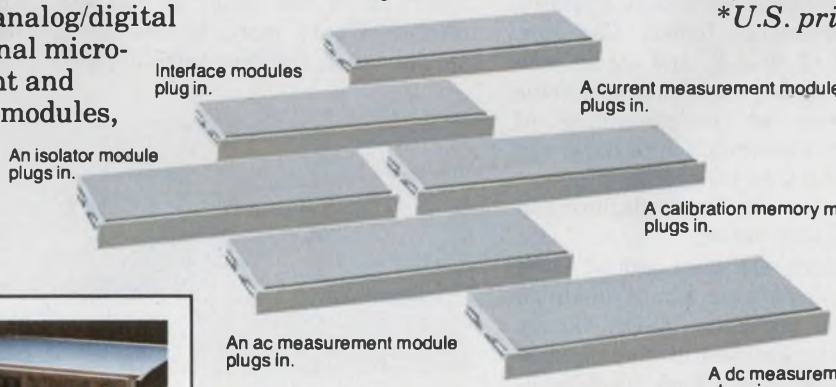
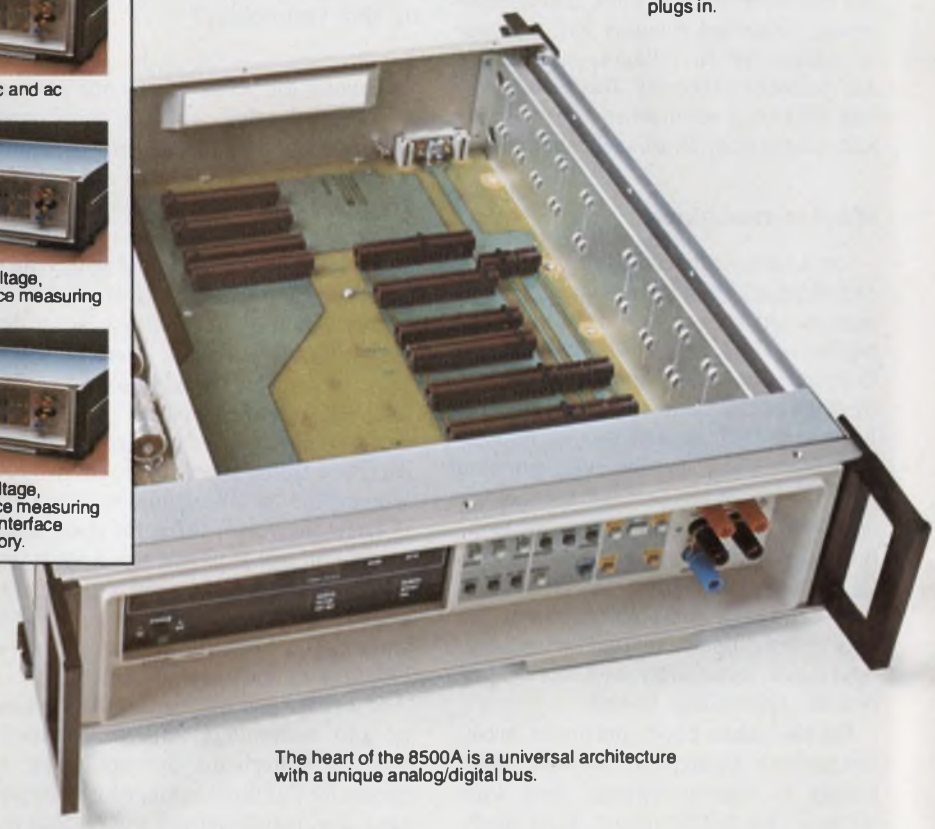


The 8500A can be whatever you want it to be, so it's never obsolete.



The heart of the 8500A is a universal architecture with a unique analog/digital bus.

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CIRCLE 141 FOR LITERATURE CIRCLE 142 FOR DEMONSTRATION

Technology: With society or against it?

"Is technology a friend or foe of people—and the free-enterprise system?" Leaders of industry and education offered answers at the recent National Symposium on Technology and Society. The symposium, sponsored by Lord Corp. of Erie, PA, and WQLN, Public Broadcasting of Northwest Pa., featured luminaries like Donald Alstadt, Lord's president; Dr. Edward David, president of Exxon Research and Engineering; Robert Chitester, president of WQLN; and others who helped organize a national task force to promote an understanding of technology's contribution to American society and free enterprise.

But what is this thing called technology? Opinions varied.

Technology has been around since the beginning of man, some two-billion years ago, according to Dr. George Bugliarello, president of the Polytechnic Institute of New York. Early technology, starting perhaps with the use of sticks, led to villages, agriculture and collective security. But technology has also been an instrument of terror and alienation, Bugliarello added.

It's not machines

Dr. Lewis Branscomb, vice president and chief scientist of IBM, saw technology as an extension of human experience—in other words, much more than machines. Dr. Herbert Hollomon, director of the Center for Policy Alternatives at MIT, agreed. An automobile isn't technology, he observed, nor is a pump or computer. Instead, technology is a body of art, knowledge and technique. When people complain about technology, according to Hollomon, they are really complaining about the way institutions have used technology. And since technology was used, they reason, technology is bad.

On the other hand, problems arise, Branscomb suggested, because technology is what everybody does with what a few people know. Everybody drives a car, but only a few people know how to design and manufacture one. Another problem, Branscomb observed, is that people now have choices they didn't have before—and they may not know how to deal with them.

It's like a spouse

For that matter, western society may be providing disincentives to innovation because its system is based on obsolete knowledge, Fletcher Byrom, chairman of the board at Koppers, offered. What's more, in this age of specialization, the knowledge available is beyond the scope of any one person.

Is this technology?

Yet technology offers tools and capabilities to address an enormous range of problems. In one sense, though, Byrom quipped, technology is like a spouse who helps you with problems you wouldn't have if you hadn't gotten married in the first place.

Nevertheless, technology is an irresistible, irreversible force. Society may be dragged, kicking and screaming, 25 years behind it, noted Branscomb, but technology never becomes a thing apart from the people who exploit it. "We should no more ask if technology is a force for good than we should ask if people are a force for good," Branscomb stated. In fact, he added, from the viewpoint of some endangered animals on this planet—like whales and seals—they're not.

But there is a conflict between society and technology, Byrom rejoined, because Americans operate under a decidedly Calvinist ethic, which simply says that people should work—that is, participate in an activity that produces material goods. A lot of effort is devoted to making work for people when, perhaps, they should be doing something else. "We may be suffering from a fundamental failure in the education process," Byrom observed. "We must educate people to be amenable to change, instead of being desperately afraid of it."

A more optimistic note was sounded by Dr. Allen Wallis, chancellor of the University of Rochester, who argued that material technological developments have brought to hundreds of millions of people a quality of life never dreamed of before—and they will continue to do so.

It makes natural resources

First, he pointed out, the prevalent notion that the world is running out of natural resources is absurd—natural resources are natural resources only by virtue of human technology. Farmland in the central valley of California, for example, is a useful resource only because of irrigation, fertilizers, insecticides, farm machinery, railroads, highways, refrigeration, etc. Uranium wasn't a resource 40 years ago and petroleum wasn't a resource 125 years ago. They became resources thanks to human technology.

Wallis didn't agree with the popular conception of automation, either. Automation doesn't simply eliminate employment, he said. It redistributes employment in time. For example, a pin-setting machine for bowling eventually eliminates man-hours of pin-setting labor, but it also increases employment while it is being manufactured. So automation replaces a long trickle of

future employment with an initial splash. But this splash doesn't lead to a subsequent drought because the total amount of work that is to be done in the future is infinite.

Looking from a different angle, J.M. Leathers, vice president of manufacturing and engineering technology at Dow Chemical, hailed technology for increasing leisure time and for liberating wives from the drudgery of the kitchen and washboard. And thanks to technology, he said, there is less disease and pestilence, essentially no famine, and more of many amenities that are taken for granted.

But the people who reached maturity in the 1960s can see only the unsolved problems, Leathers went on. Reared by television, that instant problem solver, they disapprove of the fact that all problems haven't been solved. So they have become anti-institution, anti-business, anti-everything—education, law, government.

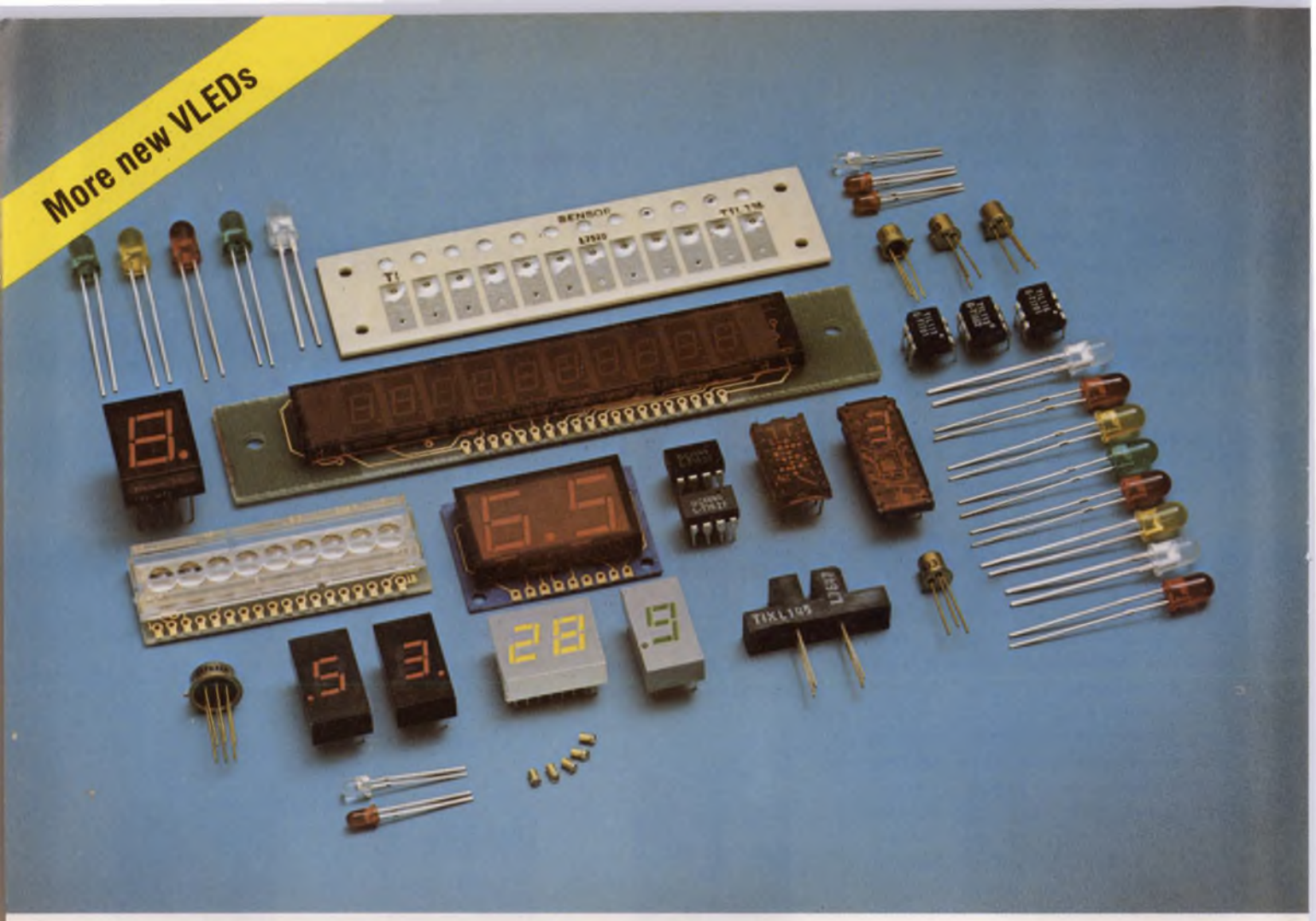
Now they have worked their way into legislature and other organs of power, Leathers continued, where they devote themselves to regulatory strangulation of technology and bureaucratic destruction of the free-enterprise system. Yet only technology can provide the necessary tools for making man's labor more productive, Leathers insisted.

A false plateau

Examining technology from an historical perspective, Dr. C. Lester Hogan, vice chairman of the board of Fairchild Camera and Instrument, recalled that the prevalent view of economists in the 1930s was that the United States had reached a plateau in its growth. Since it had conquered the new frontiers of land and natural resources, it would never again see such a fantastic growth rate.

But those economists failed to realize that there was a never-ending new frontier—technology itself. Their predictions came during the depths of the Depression, Hogan noted, when it was very difficult to be optimistic. That was long before the unparalleled growth of the 1950s and 1960s, when economists put on the other shoe and explained why such rapid growth was now the norm and would continue forever.

"In industry, too, we predict a marvelous year when we're in the middle of one," said Hogan. "And in bad years we become prophets of gloom. In the same way, our view of technology can change." ■■



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Device	Source Color	Lens Color	Package Outline	Typical Brightness @ 20 mA	100-Piece Price
TIL216-1	Red	Red	T-1	1.0 mcd	.28
TIL216-2	Red	Red	T-1	4.0 mcd	.37
TIL228-1	Red	Red	T-1¾	3.0 mcd	.32
TIL228-2	Red	Red	T-1¾	7.5 mcd	.41
TIL228-3	Red	Red	T-1¾	18.0 mcd	.74
TIL212-1	Yellow	Yellow	T-1	1.0 mcd	.28
TIL212-2	Yellow	Yellow	T-1	4.0 mcd	.37
TIL224-1	Yellow	Yellow	T-1¾	3.0 mcd	.32
TIL224-2	Yellow	Yellow	T-1¾	7.5 mcd	.41
TIL224-3	Yellow	Yellow	T-1¾	18.0 mcd	.74
TIL232-1	Green	Green	T-1	0.8 mcd	.28
TIL232-2	Green	Green	T-1	1.5 mcd	.37
TIL234-1	Green	Green	T-1¾	1.0 mcd	.32
TIL234-2	Green	Green	T-1¾	2.5 mcd	.41
TIL234-3	Green	Green	T-1¾	6.5 mcd	.74

Low-Cost Displays

Device	Character Height & Color	Type Characters	Connection	100-Piece Price
TIL312	.3"—Red	7 Segment—r&lhd	Common Anode	1.36
TIL313	.3"—Red	7 Segment—rhd	Common Cathode	1.36
TIL327	.3"—Red	±1—lhd	Common Anode	1.36
TIL314	.3"—Green	7 Segment—r&lhd	Common Anode	2.85
TIL315	.3"—Green	7 Segment—rhd	Common Cathode	2.85
TIL328	.3"—Green	±1—lhd	Common Anode	2.85
TIL316	.3"—Amber	7 Segment—r&lhd	Common Anode	2.85
TIL317	.3"—Amber	7 Segment—rhd	Common Cathode	2.85
TIL329	.3"—Amber	±1—lhd	Common Anode	2.85
TIL321	.5"—Red	7Segment—r&lhd	Common Anode	1.47
TIL322	.5"—Red	7 Segment—rhd	Common Cathode	1.47
TIL330	.5"—Red	±1—lhd	Common Anode	1.47

High-Performance Displays

Device	Type Characters	Character Height	Package	100-Piece Price
TIL302-304	7 Segment	.27"	Standard	4.85
TIL305	5x7 Dot Matrix Alphanumeric	.30"	Standard	4.58
TIL306-309	7 Segment with Logic	.27"	Standard	9.15
TIL311	4x7 Hexadecimal with Logic	.27"	Standard	9.40
4N41 (TIL501)	7 Segment	.27"	Hermetic	47.37
TIL505	5x7 Hexadecimal with Logic	.27"	Hermetic	66.03
TIL506	7 Segment with Logic	.30"	Hermetic	57.41
TIL507	5x7 Alphanumeric with Logic	.30"	Hermetic	69.72
TIL560	3-Character 5x7 Alphanumeric with Logic	.50"	Hermetic	254.26

Seven-Segment Display Sticks

Device	No. of Digits	Character Height & Color	Feature	100-Piece Price
TIL361	2	.50"—Red	PCB—Edge Conn.	4.05
TIL364	4	.50"—Red	12-hr Clock	5.92
TIL370	4	.50"—Red	24-hr Clock	6.15
TIL804	12	.27"—Red	PCB—Edge Conn.	11.65
TIL807	2	.30"—Red	CA—Plug-in Pkg	2.88
TIL808	2	.30"—Red	CC—Plug-in Pkg	2.88
TIL809	2	.30"—Amber	CA—Plug-in Pkg	4.35
TIL810	2	.30"—Amber	CC—Plug-in Pkg	4.35

Opto-Coupled Isolators

Isolator Family	Part Numbers	Isolation Voltage	Package	100-Piece Price
P-DIP	TIL111—TIL119	Up to 2.5 KV	6-Pin DIP	from $0.74
Dual	MCT6 & MCT66	Up to 1.5 KV	8-Pin DIP	from 1.69
JAN, TX, TXV	4N22—4N24	1.0 KV	TO-5 MC	from 5.19
Hi-Rel	TIL120, TIL121	1.0 KV	TO-72 MC	from 3.75
UL Listed	TIL153—TIL157	3.5 KV	6-Pin DIP	from 0.93
Hi-Voltage	TIL124—TIL128	5.0 KV	6-Pin DIP	from 0.99

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CIRCLE NUMBER 31

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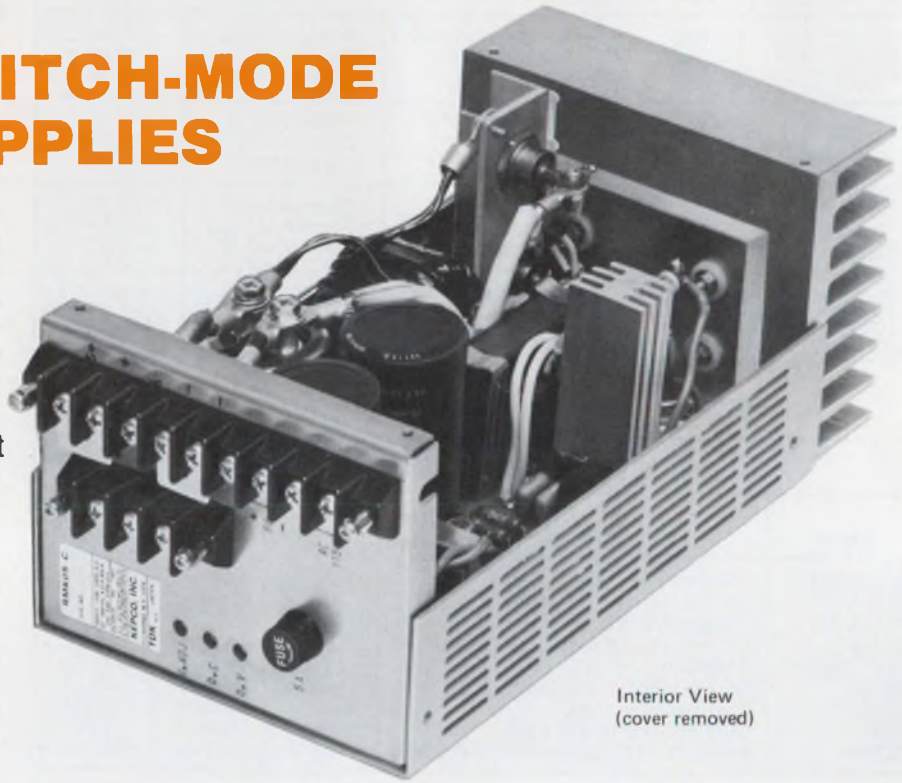
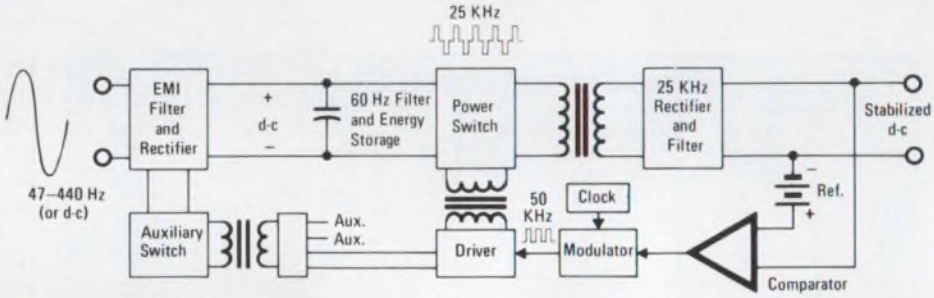


Interior View (cover removed)



BLOCK DIAGRAM OF THE RMK SWITCH-MODE POWER SUPPLY

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CIRCLE NUMBER 32

Washington report

Sinai cease-fire monitoring system upgraded

The State Department is adding a new jam-resistant data link and a day-and-night television monitor powered by a solar-cell array to its monitoring system in the Sinai Desert. The system has been used since Feb. 22, 1976, to police the cease-fire line established after the 1973 war between Israel and Egypt.

The additions are aimed at reducing manpower and improving detection accuracy. The present monitoring system, operated under contract by E-Systems of Dallas, is a network of acoustic sensors and watchtowers. All the sensors will be tied by the data link into a central monitoring station so that observers can view all intrusions simultaneously and get a better idea of how serious they are.

To implement this plan, five Army relay units will be installed. Known as the "Exray" system, they will be modified by the Combat Surveillance and Target Acquisition Laboratory of the Army Electronics Command to be less vulnerable to intentional or unintentional radio interference.

The complete centralized sensor-readout system is scheduled to be installed by mid-February, with six months of evaluations to follow before it is declared operational. The system should cost $75,000, the State Department estimates (not including surplus Army relay units).

Meanwhile, the State Department's Sinai Support Mission, which is responsible for the monitoring system, also plans to install a remotely controlled TV camera overlooking that part of the Giddi Pass that has no watch station. The Army's Night Vision Laboratory is developing this equipment, which the State Department estimates will cost $250,000 and will be operating by next May. These TV images will be relayed to a central monitoring station as well.

In both cases, solar arrays will be used rather than diesel-powered electrical generators because they will require less maintenance in the rugged desert.

Cruise missiles won't have ECM, Pentagon says

For now, electronic countermeasures will not be used on Defense Dept. cruise missiles, but a proposed second-generation cruise missile is still being studied.

ECM is not needed on current cruise missiles, according to top defense officials, because the missiles have a tiny radar signature. They look up to 4000 times smaller than a B-52 bomber to an enemy radar and would have looked 500 times smaller than the canceled B-1 bomber.

One problem with ECM is that its jamming signals would attract attention to the missiles, according to the officials. An enemy could build a passive receiving "home-on jam" system to track the jamming signal and direct antimissile missiles against the incoming cruise missiles.

Currently, only one Soviet radar is believed capable of detecting cruise missiles: a large high-frequency, over-the-horizon radar known by the NATO code name "Buzz Saw." This radar could be jammed by penetrating bombers or knocked out by the bombers' own short-range attack missiles, defense officials say. The

Russians also have about 10,000 air-defense radars, but their range is limited to line of sight, and the officials doubted that they could cope with a saturation attack by the nearly 3000 cruise missiles that would be employed in a U.S. strategic deterrent.

If the Soviets were to upgrade their radars—which the defense officials doubt could be done before 1985—the U.S. could then deploy a second-generation cruise missile with sophisticated ECM, supersonic speeds and an even smaller radar cross-section. Exploratory research is under way on all three improvements.

Navstar accuracy surpasses Air Force requirements

The Air Force claims its Navstar navigation satellite being developed for use in the next decade has already surpassed its required accuracy of 33 feet (10 meters) during tests at the Army's Yuma, AZ, test range.

In the tests, an instrumented C-141 aircraft first locked onto signals from an orbiting Navy Navigation Technology Satellite (NTS-2) incorporating Navstar components, then onto signals from three simulated Navstar satellites placed on the ground at the Yuma range. After the results were checked with a laser-tracking system, the position of the aircraft was computed within 11 ft (3.36 m) in the east-west axis, within 13.5 ft (4.18 m) in the north-south axis and within 12 ft (3.6 m) in the vertical axis. The final results may have been even better, say Air Force officials, who think some of the vertical error may have come from the laser tracking system.

ILLIAC IV computer will analyze Landsat resource data

The ILLIAC IV supercomputer will be used to analyze earth-resources data from the multispectral scanner in the National Aeronautics and Space Administration's Landsat satellite. The required program is being written by the University of Illinois' Center for Advanced Computation, which developed the computer.

Landsat will survey crop conditions, locate mineral deposits and find water sources by scanning four spectral bands: green (5000 to 6000 Å), red (6000 to 7000 Å), far-red (7000 to 8000 Å) and near-IR (8000 to 11,000 Å). Each frame from the camera will contain 7.5-million picture elements called "pixels." Each pixel will correspond to 1.14 acres, each frame to 8.5-million. The frames will be preprocessed by NASA's Goddard Space Flight Center, Greenbelt, MD, and sent to the ILLIAC at Mountain View, CA, for image processing.

Capital Capsules: The two Tiros-N weather satellites to be launched by NASA next year for the National Oceanic and Atmospheric Administration will contain **a new sensor to monitor charged particles that are emitted by the sun** and stream in the vicinity of the satellite's orbit 250 miles above the earth. The 28-lb monitor is being developed by the Western Development Laboratories of Ford Aerospace & Communications Corp. at Palo Alto, CA. . . .The Federal Aviation Administration reports that **all 63 major U.S. airports now have the Minimum Safe Altitude Warning (MSAW) system,** which automatically flashes a warning on a flight controller's display screen when an aircraft is closer to the ground than it should be. Successfully field-tested at Denver's Stapleton Airport, it has been added to FAA's automated radar-terminal (ARTS III) installations. . . . **The Department of Energy has launched a research effort to develop better materials and fluids for solar-energy collectors.** These materials will include new surface coatings and glazings and better insulating and sealing methods.

Mini-misers.

Amphenol Micro-Miniature Connector Series. Minimum size at a miserly price.

Reduced size. *And* reduced weight. Those are just two good reasons for choosing your connectors from this economical trio:

Amphenol 220 Series connectors. For high-contact density rack-and-panel applications. Sturdy monoblock body, injection-molded polycarbonate, 52 or 104 contacts.

Amphenol 221 Series multi-purpose strip connectors. Polycarbonate or nylon, 4" and 6" strip lengths, on .100", .075" and .050" contact centers, in contact arrangements of 60, 53 and 80. Use as is, or cut the strips to lengths (or stack) as desired.

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More savings: new Econo-Tac™ contacts. Gold-over-nickel plating. Stamped, crimp-removable contacts, supplied on 20,000-contact reels or loose. Ideal for high-volume production with the Amphenol semi-automatic termination equipment.

Get most popular sizes immediately from your Amphenol Industrial Distributor. Or for more information, call Harry Jaeger, (312) 986-3770. Or write Amphenol North America Division, Bunker Ramo Corporation, Dept. C27A 900 Commerce Drive, Oak Brook, Illinois 60521.

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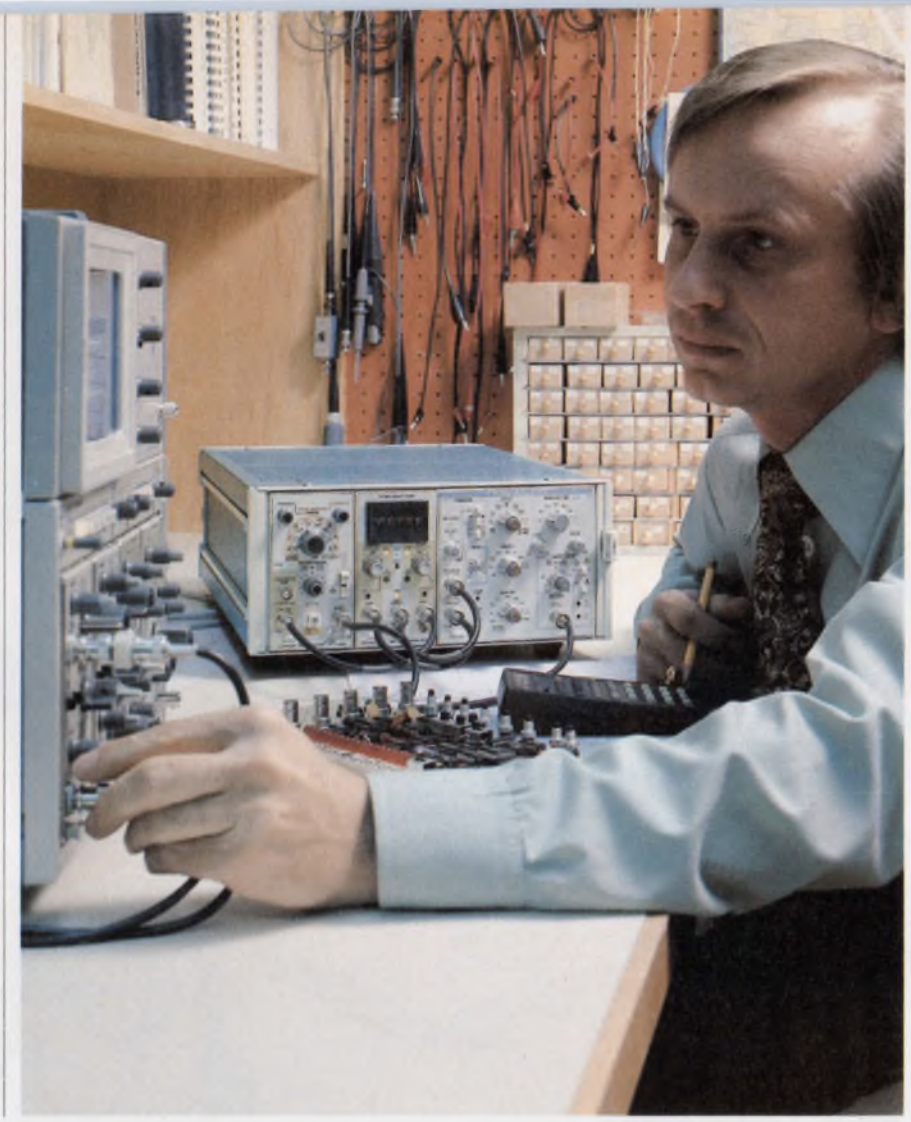
CIRCLE NUMBER 33

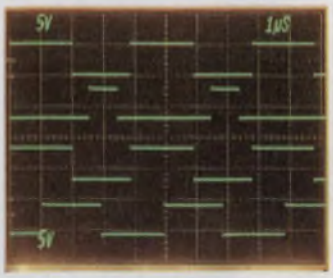


Think about expanding your pulse generation capabilities... think about TM 500.

More waveforms for more applications.

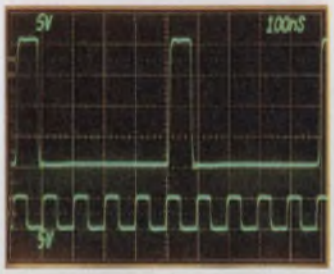
When you're working with today's logic systems, involving a variety of implementations, you need instrumentation built to perform complex functions. This TM 500 pulse generator is such an instrument.

Advanced stimulus functions such as overlapping and non-overlapping biphase clocks help solve race problems and determine critical timing.



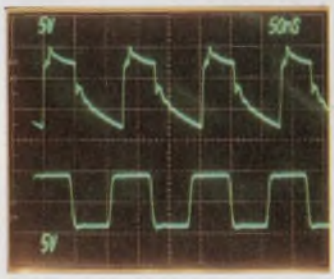
Biphase Clocks

When working with mixed logic systems, two-frequency synchronous clocks operating at different frequencies and different logic levels can be configured.



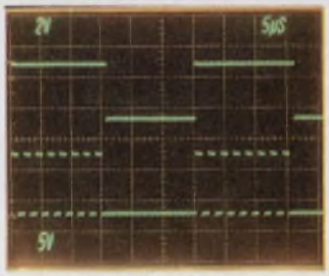
Two Frequency Synchronous Clocks

Also, this instrumentation provides translation capability between common logic families; CMOS to ECL or TTL to CMOS, for example. A unique pulse restoration or superbuffer capability, with high or low input impedance and 50Ω output impedance, helps you produce low aberration signals in unterminated lines.



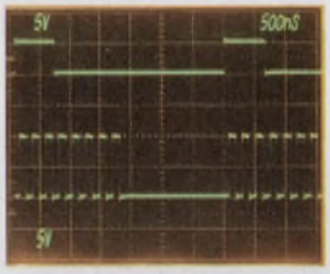
Pulse Restoration

Dual pulse generation within one unit provides self contained burst generation. In this mode, burst rate and width, and pulse rate and width within each burst can be individually controlled.



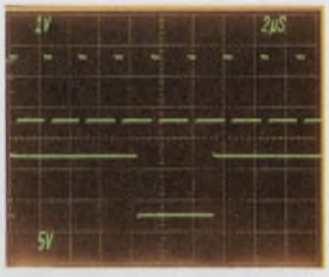
Self Contained Burst

A counted burst feature, with thumbwheel switches, gives exact control when selecting pulses for use with shift registers, CCD delay lines and data transmission. With this instrumentation it is not necessary to reset burst control if width and duration is changed within the burst. When working with a large number of pulses, more stability and ease of resolution is assured.



Counted Burst

When desired, two pulse generators are operable as independent instruments. Both outputs provide true and complement pulses, and other types of mixed pulses. Both outputs are controlled by independent high and low dials.



Independent Pulse Generation

Frequency capabilities are 50 MHz at 20V for MOS and CMOS logic and 250 MHz at 5V for ECL and Schottky TTL. Square wave trigger outputs can be viewed when narrow pulses decrease scope visibility, and simplify counter triggering.

Tektronix has designed a TM 500 pulse generator system capable of these functions and more. Two pulse generators (PG 508 and PG 502) and an independent digital delay (DD 501), packaged together in a versatile mainframe, meet a wider range of applications.

As a single package it's compact, portable and easily adapted to the lab or field. As part of the highly configurable TM 500 line its mechanical and electronic performance can be adapted to suit your specific needs.

If you prefer a bench set-up the three plug-ins (PG 502-PG 508-DD 501) can be installed in a TM 500 mainframe to sit conveniently and neatly on a bench top. When your needs demand a portable test unit, the three plug-in modules can be packed in the small-as-a-suitcase TM 515 Traveler Mainframe.

In addition to this mechanical configurability, your pulse generator unit can be combined with other TM 500 modules to expand your present test and measurement library.

A powerful combination of TM 500 modules—PG 502, PG 508, DD 501 and a mainframe—work for you in two ways: together to surpass their own individual limits, independently to continue meeting your instrumentation needs.

For further information or a demonstration of the TM 500 family of instruments, write or phone: Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97077, (503) 644-0161 Ext. 5283. In Europe: Tektronix Limited, P.O. Box 36, St. Peter Port, Guernsey, Channel Islands.

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TM 500...designed for configurability.

Sooner or later it was bound to get out.

Yes, the Dumb Terminal™ really does have two smarter brothers.

At first, they weren't quite as well known, because their Dumb Brother's smashing success was stealing the show. Although they had been selling quite well all along, even without getting constant headlines, like their Brother.

Now, however, Dumb Brother has pulled them into the limelight. And ADM-1 and -2 have decided, after all, that perhaps it's time you knew a little more about how smart they really are.

ADM-2 is the more intelligent of the two, providing you with flexibility of format, security, editing, interface, and transmission. You'll find, among a variety of other outstanding features, up to 8 screen status indicators and a numeric key pad. And a detachable keyboard with 16 function keys. Which give you the ability to access your special program, or form, or instruction.

The ADM-2 is also available in a model compatible with your Burroughs TD-800 Series. The ADM-2B. The ADM-2B adheres to the standard Burroughs poll and address line discipline.

On top of all that, we've made the ADM-2 micro-programmable. And taken all the mystery out of the procedure. Which makes user-micro-programmable simple, quick, and cost-effective. The ADM-2's versatility is limited only by your imagination.

You could call the other Smarter Brother, ADM-1, the "with-or-without" terminal. Starting with some pretty smart standard features, like a standard 24-line display, a field protection feature with dual-intensity and switch-selectable operating modes – block mode and conversation mode – you build up from there. With options like a hardcopy printer interface, and display editing capabilities (line insert, line delete, line erase, character insert, and character delete). Just add the options you need, and leave the rest of the "bells and whistles" for someone else. That way, it's more systems adaptable. And it's up to you just how smart you want it to be.

The Smarter Brothers have it all. Intelligence, appropriate functions, and sensible cost-per-performance.

So, you might as well get used to seeing more of the ADM-1 and -2 in the future. Because we suspect they're going to be in the spotlight from now on.

After all, there's really nothing wrong with exposing your Smarts.

LSi®

The dumb terminal's smarter brothers.

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CIRCLE NUMBER 36

WE HAVE THE FITS

You'll find a fit for every PC board contact when you browse SAE's inventory. Study this list and imagine the combinations, permutations and amalgamations that make up the broadest line of edge connectors in the industry.

An abundance of contact spacings
Contact to contact, row to row, we've got a lot of numbers: .100/.125, .100/.150, .125/.250, .156/.140, .156/.188, .156/.200, .125/.145. There's more, but we don't have room in this ad.

A bunch of contact designs
Our most common is the bifurcated bellows, but we also offer modified bellows (leaf spring) and cantilever types.

A multitude of terminal configurations
Single row and dual row, wire wrap, dip solder, solder eyelet, insulation displacement (mass termination), right angle and clip wiring (.031/.062). Enough said.

A passel of plating options
Selective gold, gold inlay, gold over nickel, tin. Want more? Just ask.

A batch of housing materials
Thermoplastic polyester, glass filled nylon, phenolic and diallyl-phthalate.

And finally, a legion of options
Shorting contacts (make-before-break/break-before-make), polarizing keys, custom wire wrap tail lengths, hood assemblies, special markings. And you can have any connector with or without mounting ears.

All this and quality too
SAE does everything in house. From contact stamping and plating to injection molding and automated assembly. That's how we maintain the strictest quality control.

For a good fit in edge connectors, specify SAE. You can enjoy any combination of our unique design features and still have complete interchangeability with other brands.

SAE edge connectors are available through a nationwide network of representatives and distributors. See our product data in EEM, page 2213, and call in your order.

We're Stanford Applied Engineering, 340 Martin Avenue, Santa Clara, California 95050. 408/243-9200.

SAE

The OEM Connection

CIRCLE NUMBER 37

THIS WILL SOLVE SOME 555 TIMER PROBLEMS

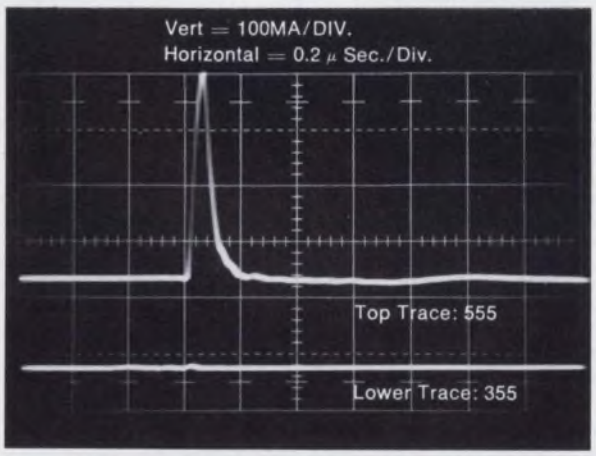
THIS WILL SOLVE THEM ALL

When the output of a 555 timer switches high, a large current spike is generated which can drag down your power supply and upset your flip-flops. One way to cure it is with several hundred μF of capacitance. But that's awkward and space-consuming. Teledyne's new 355 timer is a better way.

The 355 Timer is a pin-for-pin substitute for the 555. It is part of Teledyne's High Noise Immunity Logic (HiNIL) family. It, too, generates a current spike — but only on the order of 1 mA, as compared to 300 mA for the 555.

Two other problems encountered with the 555 are a potential failure to reset on command, and a tendency to exceed the power dissipation ratings when running at 15V. The Teledyne 355 is designed specifically to answer these two potential problems as well.

If you'd like full technical information on our new 355 Timer — or any other members of the Teledyne HiNIL family of logic — call us at (415) 968-9241, or contact your local Teledyne Semiconductor distributor.



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CIRCLE NUMBER 38

Editorial

The shell race

Charlie knew his company had severe morale problems. They affected everything. The reject rate on the factory floor seemed to get worse every week. His people in the field couldn't sell. And his engineers had lost their flair. Even the newer engineers had lost the spark and enthusiasm they had brought with them when they joined the company.

Everybody wants to work for a winning company but, it seems, everybody felt that Charlie's company was a loser. So there was general malaise.

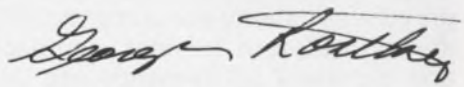
Charlie recognized the importance of morale, so he worried about it a lot. What to do? Finally, he got the brainstorm—competitive sports. He would organize some sports competition against representatives of all the other companies in the area.

Everybody loved the idea. The sport they chose, since they lived in a riverside community, was shell racing—a fine competitive sport requiring skill and teamwork. Teamwork! That's what builds morale.

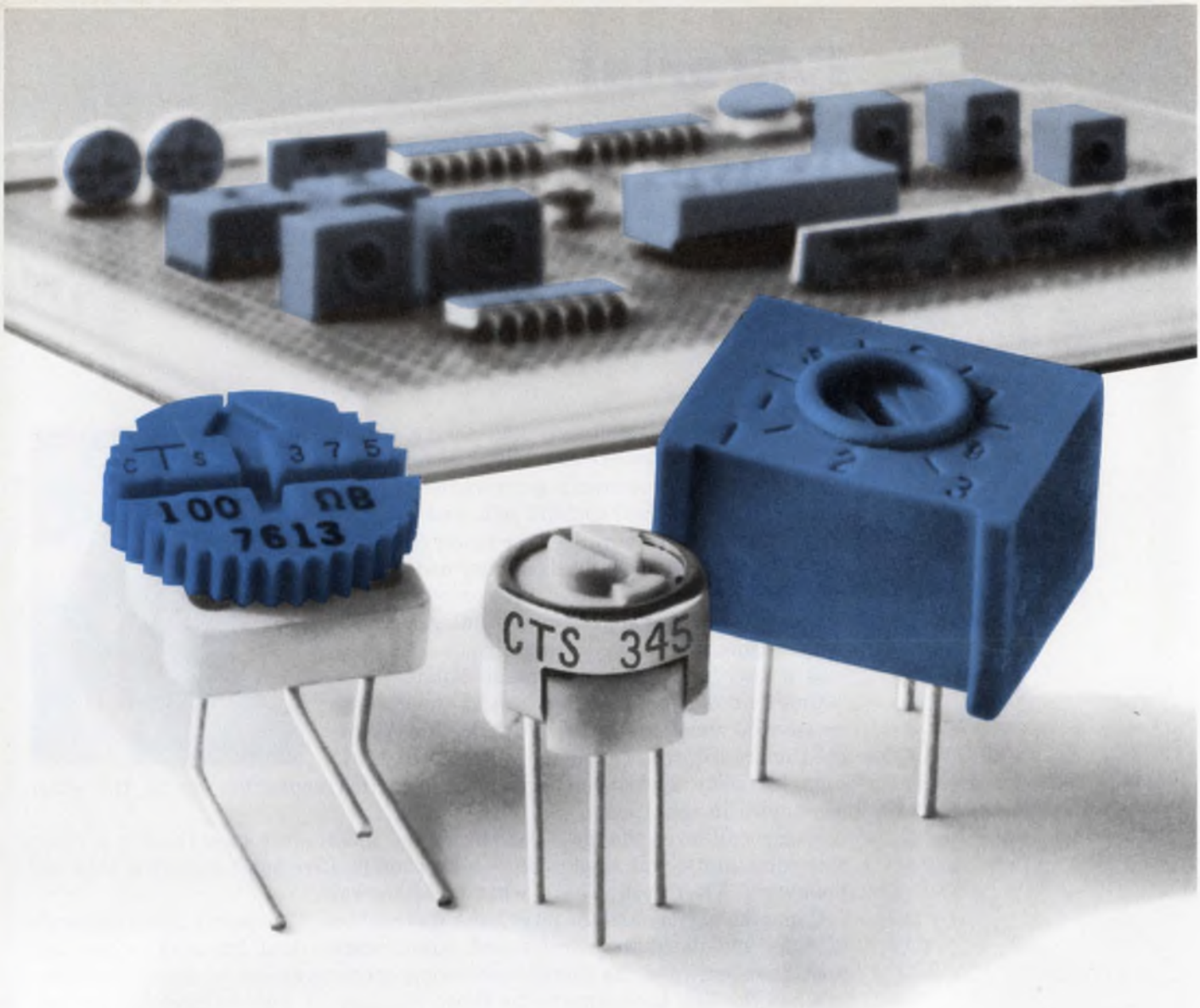
Came the big day and the river bank was mobbed. Thousands upon thousands of sons and daughters, uncles and aunts, sisters and brothers, wives and mistresses crowded the shores, screaming encouragement to their favorites.

When the first boat came to the finish line, alas, it wasn't Charlie's. Nor was the second or third boat, which came close behind. In fact, long after all the other boats had crossed the finish line, Charlie's still was not to be seen. When it finally appeared it was zigging and zagging toward the finish line. As the shell came closer, Charlie could see activity on the shell more clearly. Eight executives were shouting orders to one man with an oar.

Charlie fired the oarsman.



GEORGE ROSTKY
Editor-in-Chief



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Why use multiturn trimmers when CTS single turns provide settability accuracy of .03%... approaching that of a 20-turn trimmer. Compactness, economy and excellent performance add up to a lot of efficiency in product design. You get all these benefits when you rely on CTS *single turn* cermet trimmers.

For example, the ⅜" diameter Series 375 is available in six popular terminal styles. And they're priced as low as 25¢ each in production quantities.

The CTS Series 345 is a "mini" ¼" round design featuring low .180" profile, sealed construction and production priced at just 70¢ each.

The 7/16" square Series 360 satisfies a wide range of critical OEM applications. Eleven popular grid spacings include both top and side adjust .100", .125", .150" and TO-5 centers. Low priced, too. Under 40¢ each in production quantities.

All available off the shelf from CTS Industrial Distributors. CTS single turns handle nearly every trimmer application...economically! You be the judge. Call for your *Free Sample*. **CTS of West Liberty, Inc., 6800 County Road, West Liberty, Ohio 43357. Phone (513) 465-3030.**

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IF THE TELETYPE MODEL 40 SYSTEM EVER MALFUNCTIONS, IT'S DESIGNED TO TELL YOU WHAT'S WRONG.

Even though we probably go to more trouble to insure uninterrupted reliability than anyone else, we're still realistic enough to admit that sometime something's going to go wrong.

So instead of burying our heads in the sand and pretending it won't, we've concentrated our efforts on what can be done to make downtime as short and painless as possible.

For starters, we gave the model 40 product line its own diagnostic capability. To tell you quickly what's wrong. Then, to make it easy to fix, we used a modular design concept. The result is an average mean-time-to-repair of only 3/4 hour.

We also made sure that when something does go wrong, you'll never be alone. We've got a nationwide service network standing behind every product with the Teletype name on it. We offer on-call repair service, maintenance contracts, and even an exchange repair service on components and parts.

The way we look at it, building something the best way humanly possible is only half our job. The other half is being ready for the unexpected.

For more information about the Teletype model 40 product line, write: Teletype, 5555 Touhy Ave., Skokie, IL 60076. Or call: 312/982-2000.

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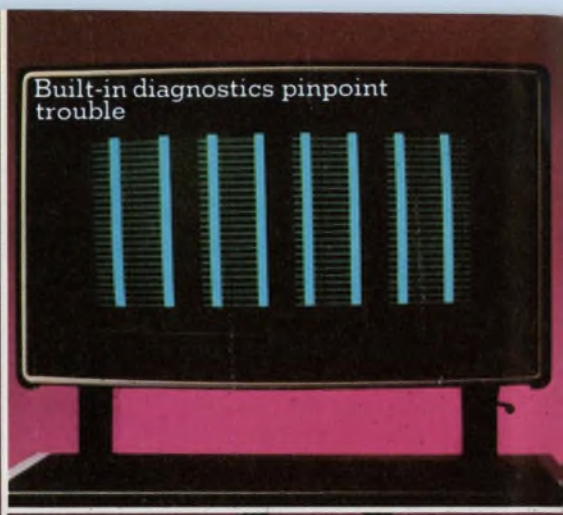


FOCUS on Readouts

Digital and alphanumeric readouts and displays are getting bigger, brighter, better—and more of a problem to select—as they find their way into an expanding variety of new industrial and consumer products. Parodoxically, displays are also getting easier than ever to incorporate into a design.

Whereas a few years ago you had to piece together single-digit LEDs or single fluorescent-tube readouts —hoping all the while for uniform brightness and performance—now you can buy prefabricated displays with uniform visual elements. And circuitry formerly spread around in IC chips is being integrated into newer displays.

But with all these improvements, choosing the right display is harder than ever—display specs haven't been comparably improved. Rather, the opposite is true. You will probably encounter specs that in many cases are confusing, misleading, or downright useless. And specs that should define key elements are sometimes missing altogether.

Your task is further complicated by both physiological and psychological factors that affect visual perception: What looks pleasing to one user may not to another; what one can see well, someone else cannot. For example, some individuals, particularly those with astigmatism have difficulty in focusing on, or looking at, red LEDs for any extended period.

How bright is bright?

The readability of a display is determined by its brightness (except for LCDs) and color, the angle from which it is viewed, and the presence (or absence) of ambient reflected light, or glare. But as important as

Jim McDermott
Eastern Editor

Liquid-crystals use the lowest power of all displays. This clock display by Hamlin draws only a few microwatts with all digits energized.

Four colors of seven-segment LED readouts—red, orange, yellow and green—are now available. The 0.3-in. multicolor devices by Monsanto are mounted in arrays with 0.4-in., center-to-center spacing.

Incandescent displays are the brightest and with the proper filters can give any desired color. Pinlites by Refac can be dimmed easily for night operation.

brightness is, the way it's specified on data sheets makes it virtually useless to you.

First of all, brightness is spec'd in quantities that don't tell the whole story. On most LED sheets it's given in terms of luminous intensity in milli or microcandelas, derived from the foot candle. Brightness data for fluorescent, incandescent or gas-discharge displays are usually given in terms of luminance in foot-lamberts. And in one manufacturer's literature, it's expressed merely as the maximum distance that the display supposedly can be read. But just how readable the display is at that distance, or whether being in a dark room or using binoculars would improve readability, isn't included.

The problem is that brightness is a relative quantity that can't be measured simply in numbers. The light coming from an illuminated digit segment, for example, is automatically compared in the eye to the brightness of adjacent areas of ambient reflected light.

What may seem low brightness, then, can under some conditions have a visual intensity way out of proportion to what the spec indicates. For example, a LED watch display that is almost invisible in sunlight can be brilliant in darkness.

Good readability in a display usually requires a brightness ratio, or contrast, of no less than 5:1 between the light source and surrounding unlit areas. Higher contrasts are preferred. The light output from an "off" display element is reflected ambient light, while that of an "on" element is the sum of the ambient plus that of the illuminated portion. So an effective ratio accounts for the intensity of ambient light, the reflectivity of the display's front surfaces, and the intensity of the light emitted by the display.

But don't forget the Polaroid or bandpass optical filters you'll probably use to increase the ratio. These filters do improve readability, but they also attenuate the display's brightness.

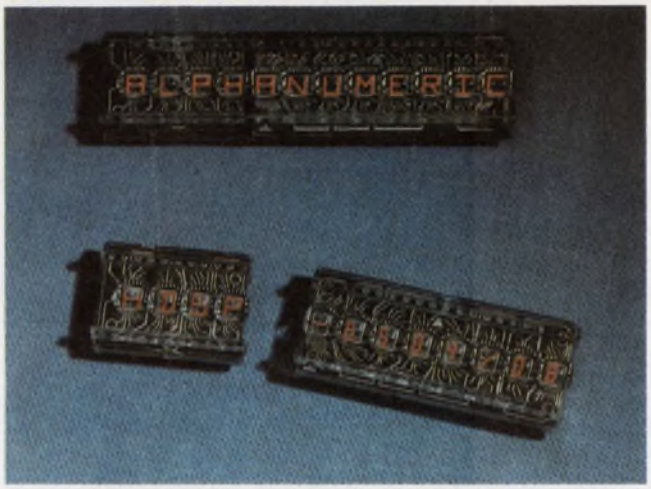
Filters are mandatory

Just how much filters attenuate the optical output is difficult to evaluate with current brightness specs. Invariably, you are given the most favorable value for brightness—in other words, without filters. But filters are required for just about every display. (One reason —not obvious—is that they mask out distracting details of the unlit element structures.)

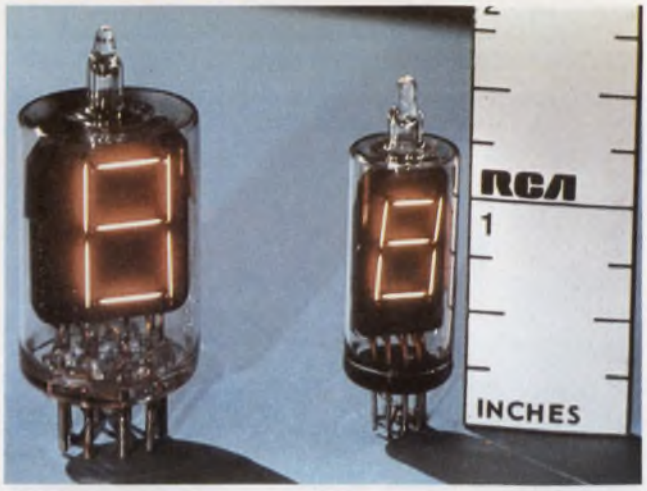
The display vendors' hearts are at least in the right place. Filter numbers and filter manufacturers are referenced copiously in the display literature. But from that point on, with rare exceptions, you are on your own—a tacit admission by vendors that you really should buy a selection of filters and try them out.

Another problem in specifying brightness—and a number of other display specs—is that it is generally specified in terms of "average" or "typical" values, with maximums and minimums frequently missing. But no manufacturer guarantees these typical values, so make sure you get guaranteed *minimum* figures. You don't have to worry about maximum brightness —except possibly for one manufacturer who pointedly specs "no upper maximum limits" for one of his LED displays. Don't look at that one without dark glasses.

Watch out for buzz words like "high brightness" and "high intensity" and "viewable in sunlight." Take these claims with a grain of caution. Even comparing displays by their rated luminous output can be deceiv-



Sixteen-segment alphanumeric displays are mounted in four and eight-character dual-in-line packages. The HP devices can display a 64-character ASCII set as well as a number of other special characters.



The rugged construction of these Numitron incandescent-filament digital readouts by RCA gives them high reliability and a life expectancy of 100,000 hours. The readouts are compatible with 5-V IC decoder-drivers.

ing. For example, because of integration of light, a luminous area of low intensity can appear just as bright to the eye as a much brighter point source.

The best way to compare displays is to get hold of several samples, hook them up, and look at them under the ambient light in which you expect them to operate. P.S. Don't forget the filters.

Contrast equals brightness for LCDs

For liquid-crystal displays—which don't emit light—brightness is never used as a spec. The reason? The LCD readouts depend upon either reflected or refracted ambient (or other) light for their operation. So to tell how bright the figures or letters are against the display's background, LCDs employing reflected light use the term "contrast," while those using refracted light are described by the spec, "transmission ratio." Either contrast or transmission ratio should be specified in the order of 15 or 20:1 or higher.

But the contrast or transmission ratio of LCD devices is usually specified looking directly at the display, whereas these factors decrease as the observer moves to one side or the other. For this reason, the only meaningful way to determine an LCD's effectiveness is to look at it under the expected ambient lighting of the application.

Another factor affecting display readability is the human eye's varied sensitivity to different colors. Eyes are least sensitive to the narrow-bandwidth radiation of red LEDs (see figure). From the standpoints of aesthetics and eye-fatigue, reds are lowest on the display-desirability totem pole.

The oranges, yellows and greens, in that order, have been proven in countless tests to be progressively more attractive. And a user's eyes are progressively more sensitive to these colors, so that, for example, less optical energy is needed for green to have the same effective brightness as orange.

Because of the narrowband radiation produced by displays like LEDs and vacuum-fluorescent panels, and to a lesser extent gas-discharge displays, you are pretty much limited to the color of the device you select. But the broadband output of incandescent displays permits them to be used with a wide variety of color filters. Consequently, your display can have any color you want—simply select the proper filter.

Readability isn't the only big problem in choosing a display. Try finding documented lifetime figures these days. A few years ago, when many of the now-mature displays were in the first few thousand hours of their lifetimes, the vendor's specs were loaded with detailed (although not necessarily credible) extrapolations—based on, say, 5000 hours of accelerated tests. The claims were that devices would last 50 or 100-thousand, or even a million hours till half-brightness. And the good or bad effects of operating conditions on device life were described in detail. But not in today's specs.

A review of up-to-date specs from about 60 vendors reveals that when it comes to specifying device life-

Gas-discharge display modules are supplied with the indicators and decoder-drivers in this CE-3000 series by Canyon. The display is designed with an integral bezel fitted with an antireflective filter.

time there are apparently two philosophies: "Follow the leader" and "Don't worry about it." Thumb through the literature from half a dozen liquid-crystal suppliers and you'll see the same quote: "Expected lifetime 50,000 hours." Look at the specs of incandescent-filament display vendors and the lifetime appears to be universal: 100,000 hours. But don't expect to find evidence.

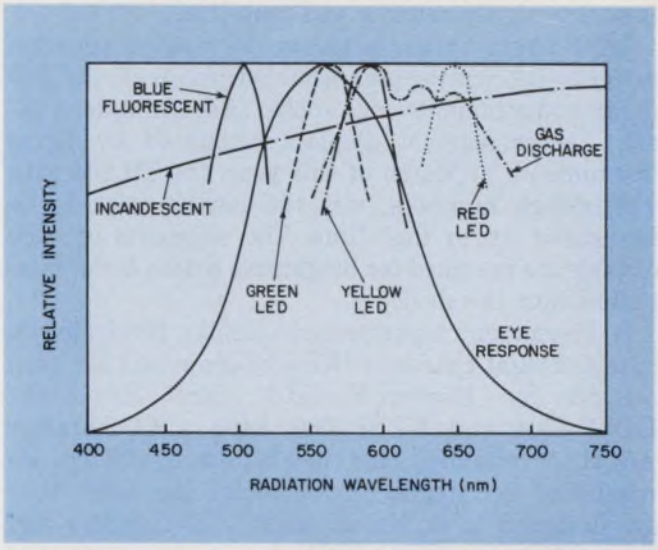
Surprisingly, the spec sheets of several major semiconductor-LED-readout manufacturers have dropped lifetime altogether. One vendor does condescend to claim "rugged, long operating life" for his LEDs.

One gas-discharge-display manufacturer lists a figure of "30,000 hours at rated operating conditions." But "catch 22" operates here—nowhere in an otherwise comprehensive sheet will you find data entitled "Rated operating conditions." In another gas-discharge-display producer's data, the only reference to lifetime can be found in one note in a list of 20 fine-print spec qualifications; the note says, "Values beyond which the life of the device may be reduced." But this note goes on to send you to a "Table of Absolute Maximum Ratings," which leaves you as much in the dark about how long the displays will last as when you started looking for lifetime numbers.

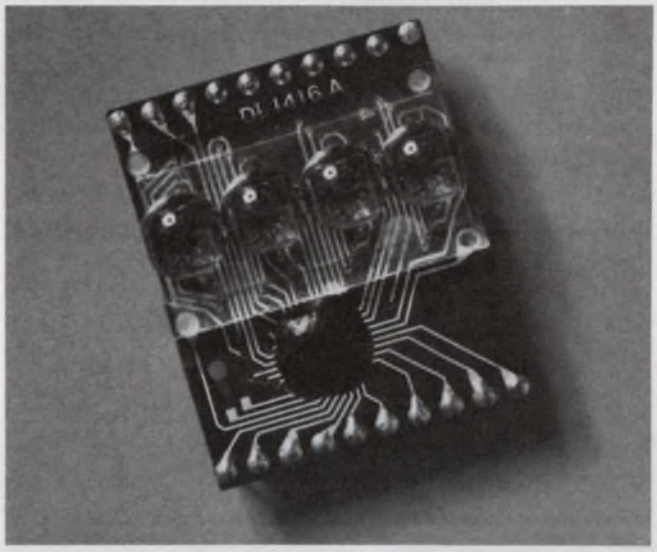
Ironically—and fortunately—the manufacturers do have comprehensive data on device lifetime and factors affecting it—most of which is stored away in special application bulletins and in the files of the vendors' engineering staff. To get this information, you'll have to contact application engineers personally.

Even when a display appears to meet your design requirements, the cost remains an important, overriding factor. The price sheets may give you a cost-per-device that appears low, particularly for the bare-bones single or multiple-element displays. But these prices can be deceptive.

Displays also need mounting and packaging hardware, filters, decoding and driving electronics and power supplies. When the extras are added up, the cost can skyrocket. In some cases it may be better to buy than build. Displays or display subsystems may actually be more economical when purchased from one of the many manufacturers who put a large part or the entire package together for you.



Optical radiation bands of LED, vacuum-fluorescent, gas-discharge and incandescent displays are compared with the bandwidth sensitivity of the human eye.



The four-character, end-stackable, 16-segment alphanumeric DL1416 by Litronix eliminates discrete interface components when used with microprocessors. The interface circuitry—a CMOS IC that includes memory, an ASCII ROM and multiplexing features—is incorporated on the display substrate.

A matter of style

Meanwhile readouts and displays have evolved into three general styles. The most popular presents a single line of numeric data ranging from three or four digits up to 17 or 18. A second and rapidly growing style displays a single line of alphanumeric data, while a third presents a number of lines of alphanumeric data.

To choose one display from the popular types available today—LEDs, liquid crystal, vacuum-fluorescent devices, incandescent displays, gas-discharge displays and plasma panels—be ready for tradeoffs among a number of display requirements. These include display cost, brightness, operating speed, power consumption, reliability and environmental stability.

LED readouts top the list

LEDs remain most popular in the USA, although renewed interest in liquid-crystals promises to increase their share of the market. Besides low cost, LEDs have a number of desirable features for display design. Their low operating voltage makes them TTL-compatible, and they can be readily multiplexed. Also,

they are highly reliable and long-lived.

LED display manufacturers are making your job easier by fabricating preassembled groups of red-LED digits and alphanumeric "sticks." For example, a 12-digit, seven-segment display announced by Texas Instruments in March of this year, the TIL804 with 0.27-in-high numbers, was the largest stick to be fabricated up to that time. The segments of each display are matched for brightness before being integrated into the device.

A 16-segment alphanumeric display fabricated in four and eight-character DIP configurations has been offered by Hewlett-Packard since July. The HDSP-6504 and HDSP-6508 have a 64-character ASCII set capability, and their 0.15-in. characters are magnified by integral plastic lenses. Moreover, they are designed to be driven with ROM decoders and drivers for easy interfacing with microprocessors and LSI circuitry.

Red numeric arrays with magnified digits are available from National Semiconductor in sticks of 6, 7, 8, 9, 10, and 12 digits. Designed to be used in calculators and instrumentation, they are TTL, DTL or CMOS-compatible.

An eight-character, 14-segment alphanumeric display recently announced by Monsanto—the MAN2815—reduces system cost to about half that of 5 × 7 dot-matrix systems. This display can be stacked to give multiples of eight characters. With built-in plastic magnifiers, characters are 0.135-in. high.

For more comfortable viewing, lines of single-device, seven-segment digits in orange, green and yellow are now available. Alphanumeric displays are still, however, restricted to red.

Monsanto's MAN50A, 3600A and 80A series are being produced with 0.3-in. digits in orange, yellow and green, while its MAN6600 series boasts a 0.56-in. digit. Xciton is offering green and yellow in its 3050 and 3080 0.3-in. series, and in its 6500 series a green display that is 0.6-in. high.

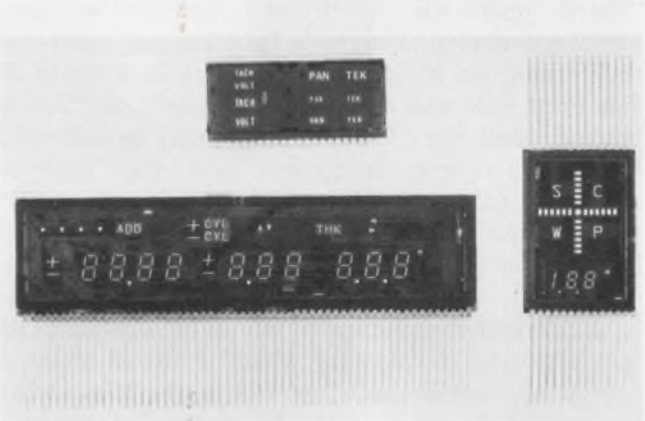
HP's entries are 0.3-in. and 0.43-in. digits in its high-efficiency yellow, green and red, seven-segment 5082 series. The 0.3-in. units operate with as little as 3 mA per segment.

Meanwhile, brightness of segmented LED displays has been upped industrywide with improved LED materials and packaging. The light from radiating elements is carried by plastic light pipes or reflector configurations that concentrate the light from the LED chip more efficiently at the surface of the digit. Litronix even uses computer-generated reflector designs to optimize optical efficiency.

The latest of seven-segment entries in the brightness race are HP's "sunlight-viewable" red and yellow digits for DIP-solderable PC-board mounting. The red HDSP 3530/3750 series and yellow HDSP 4030/4130 series of devices are produced in 0.3 and 0.43-in. digits. The red units are rated at a typical brightness of 2300 μcd/segment at 100 mA peak and 20 mA average, while the yellow units have an output of 2700 μcd/segment for the same current ratings.

One limitation of LEDs is that, being fundamentally semiconductor diodes, they are temperature-sensitive. Operating much above 85 C degrades life and decreases output. But some spec sheets aren't too clear on exactly where a safe upper temperature boundary is, particularly for units with thermoplastic optical elements that soften at fairly low temperatures. One supplier gives operation and storage as between −20 and 70 C, but he also cautions not to operate above 70 C, or the plastic lens will be damaged.

One key development in LED display technology can be related to the growing demand for alphanumeric readouts in microprocessor products—the integration of more "smarts" on the display itself, to reduce or eliminate the need for discrete interface components when it is being used with a microprocessor.



Dc gas-discharge displays can be made in a variety of configurations like these by Pantek. All cathode segments are internally bused and a separate anode connection is provided for each digit position.

Litronix is out in front here with its "intelligent" DL1416 four-character, end-stackable alphanumeric 16-segment display. CMOS circuitry on the substrate includes memory, an ASCII ROM (64 characters) and multiplexing functions. Inputs are TTL and CMOS-compatible as is the power-supply requirement.

Data entry in the Litronix display is asynchronous and random-access. Each 0.160-mil character can be addressed independently and continues to display the last character written until replaced by another. The four-character DL1416 is priced at $22.50 in 1000 quantities.

A four-character, 5 × 7 dot-matrix alphanumeric package from HP is tailored for use with microprocessor-based instruments and systems. To minimize external hardware costs, the package contains shift registers and externally programmable constant-current generators.

Liquid crystals—power misers

When the relatively large amount of power that LED display elements consume becomes objectionable—it can run to 0.5 W or more with all segments lit

—you can turn to other devices like liquid-crystal displays (LCDs) or vacuum-fluorescent readouts. For the lowest power consumption by far, check out LCDs. Standard-size, dynamic-scattering displays, such as clocks, draw on the order of microwatts, whereas field-effect watch displays operate on nanowatts. A major point in the LCDs' favor is that they are compatible with MOS and CMOS driving circuitry.

In the early 1970s, LCDs had their problems. But persistent development efforts have substantially improved fabricating and sealing techniques, and reliability. Lifetimes of 50,000 hours are now commonly quoted. Also, each LCD producer has developed a witch's brew of his own LCD materials that gives features like improved contrast and faster response times than before.

Liquid-crystal displays ranging from watch-sized elements to large-area systems with digits or characters inches high, are being produced by such manufacturers as Ashley-Butler, Beckman, Hamlin, Liquid Crystal Displays, Motorola, Optel, Shelly Associates, Transparent Semiconductors and UCE, Inc.

Costs are now competitive with LEDs. A 3-1/2-digit clock display with 0.5-in. digits goes for $7.35 per 1000 from UCE, Inc., while a 16-segment, four-digit alphanumeric display with 1-in. characters sells for $21.42 per 1000 units from the same supplier.

One disadvantage of LCDs is that they require an ac voltage of 3 to 15 V. Applying dc causes an electrolytic action that plates the cell. Typical frequencies for dc/dc converters range from 25 Hz to 1 kHz.

Response time of an LCD cell is temperature-sensitive, and increases as the cell gets colder. Typical turn-on times range from 75 ms at 25 C to double that at 0 C.

Turn-off times spread from 150 ms at 25 C to four times that at 0 C. But this is a dramatic improvement over the early cells that took as long as 3 seconds to turn off. Still, for low-temperature operation, you'll need a heater.

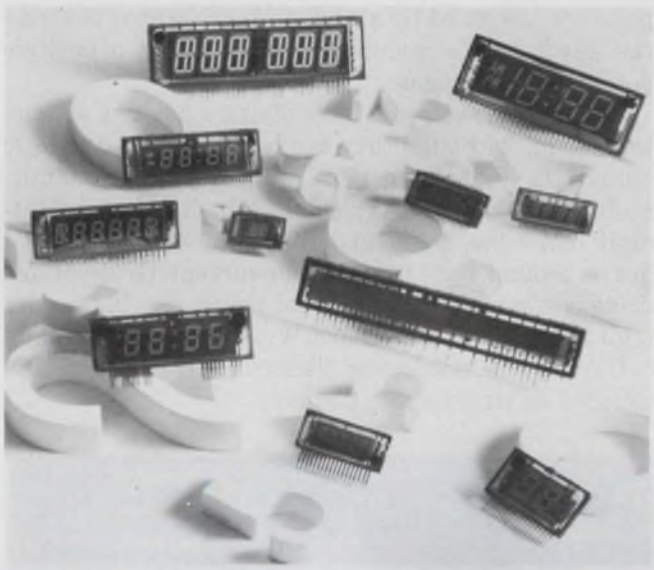
Operating temperature depends upon the type of nematic (liquid crystal) material used, but is generally on the order of −5 to 75 or 80 C.

LCDs are low-cost because they're simple. They consist essentially of two glass plates with 0.5 mil of liquid-crystal material sandwiched between. On the inner surface of the rear glass, a continuous electrode is plated. On the inner surface of the front face, a transparent pattern of the display segments is formed, with connections to the outside world.

Depending upon the type of LCD material, either a dynamic scattering or a field-effect display is produced. When a voltage is applied between the front and rear faces, the digits or other desired patterns appear. The cells are either reflective or transmissive. Reflective cells use ambient light from in front of the display, while transmissive cells either use ambient light that passes through the rear or they incorporate some sort of backlighting.

In dynamic-scattering LCDs—the first to be developed—voltage applied to the cells gives a frosty image. Field-effect devices, developed more recently, operate by rotating the plane of polarization of light that is either reflected from the rear of the cell or transmitted through it. As a result, they require polarizers—a source of trouble. Moisture absorption in highly humid environments rapidly destroys the effectiveness of the polarizing material (usually iodine suspended in a thin, plastic sheet).

To protect against humidity, in some cases, plastic overlays are laminated on top of the polarizer material. But Polaroid has begun pilot production of a new material called the K polarizer, which resists moisture much better. However, it costs more than standard polarizing material.



Flat-pack, multidigit fluorescent displays feature a blue-green color and high brightness. The devices by Futaba can be driven from 12 to 24-V sources.

Polarizers are not needed in the latest type of LCD cell, one that uses what is termed a pleochroic dye. The colored dye is mixed with field-effect liquid-crystal material to give a blank field of the dye's color. Applying a voltage causes the digits to lose all color, so that a colorless number appears against the colored background. These devices are potentially less expensive than available LCDs. Operating characteristics are close to that of field-effect devices. The only supplier of these displays right now is Integrated Display Systems, which offers them in red, blue, purple and brown.

Other advanced LCD devices are being developed. Hamlin is offering multiplexed LCDs on a custom basis, and UCE, Inc., has experimental graphic displays of 64 × 64 X-Y lines, forming 4096 dots. Price is $250 per panel.

Vacuum-fluorescents use less power

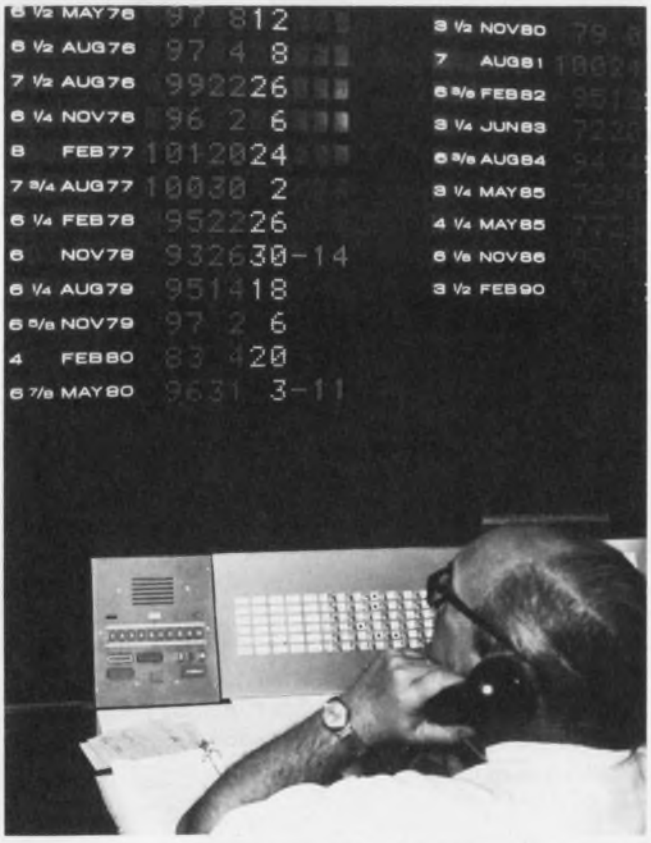
For a display with a power drain of about one-half to two-thirds of a LED, look at the vacuum-fluorescent

device. Originally developed by Ise Electric of Japan, and first used in desktop calculators in 1969, vacuum-fluorescents have seen considerable activity since then.

Vacuum-fluorescent units are produced in four to 13-digit, seven-segment arrays by Ise, Futaba and NEC, and in 9, 10, 16, 20 and 40-character dot-matrix alphanumeric devices by Ise.

The basic fluorescent device is a modified form of a triode vacuum tube. The digit segments are deposited on a flat substrate and coated with material that fluoresces under electron bombardment. Electrons from a cathode heated to subluminous temperature are gated by a grid, and accelerated to strike the anode (plate) segments, which are at a positive potential. The segment glows.

Each digit is selected by applying a positive voltage to its grid. Although they can be operated with static potentials, digits are generally operated in a dynamic, multiplexed mode. A typical 0.43-in. digit in an eight-digit panel has segment voltages of 30 to 40 V and draws around 4 or 5 mA of anode current. Grid-voltage drive is somewhat lower. Total power dissipation per digit ranges from 10 to 100 mW. At least one company —Dionics—is producing dielectrically isolated ICs tailored to drive these displays.



Electromagnetic displays that use light-reflecting, rotating discs to form characters require no power to maintain a display pattern. Ambient light provides good contrast in this display by Ferranti-Packard.

In 1973, a flat multisegment fluorescent display was produced on a monolithic glass substrate. Further improvements have been made, not only by Ise but also by Futaba Industries and NEC, among others. Present designs are superior in performance, appearance and reliability. And they cost less. Today's eight-digit units sell for about $3.75 per 1000, while a 13-digit display goes for $11.20 in 1000s.

Incandescents are the brightest

The most power per digit of any type of display is drawn by incandescents. But they are also the brightest. These displays are rated as high as 12,000 or 13,000 ft-L. Light output levels can be easily varied to maintain a strong contrast from very low to high levels of ambient light. And just about any color can be produced by slipping the proper filter over the front of the display.

Incandescent displays are available in several forms. One is a seven-segment readout, like those from Dialight, IEE and Discon Industries, that uses individual 5-V, 20 or 30-mA lamps to illuminate the transparent segments of a digit mask. A variation of this design is produced by Master Specialties in a series of fiber-optic readouts that are rated at 1000 ft-L. Light is transmitted from 5-V, 10,000-h lamps to the face of the display area where it illuminates seven segments for numerics and 16 for alphanumeric devices.

Matrix displays formed of individual incandescent bulbs are available from Chicago Miniature, Info-Lite, IEE, Electrodata Concepts and Inter-Market, Inc. (Intec).

Rear-projection incandescent readouts that use 10 or 12 single bulbs and lens systems send the light from each of the lamps through 10 or 12 different messages on a film to a frosted-front screen. Each of the lamps is usually energized separately but any combination of characters or words can be projected from these photographic film reticles.

To create compound messages, up to six lamps can be energized simultaneously in projection readouts by Shelly. They can be stacked up to eight units wide. Image heights are 0.437, 0.62 and 0.70 in. IEE has 14 different models of similar capability with message areas from 0.34 to 3.375-in. high.

Meanwhile, segmented-filament incandescent devices are growing in use, such as the Numitrons from RCA, the Petites from Readouts, Inc., Pinlites from Refac, the Day series from Day-Light Corp., the KW series from Wamco Technical and the DPD series from Durgin and Browne.

These devices are all TTL-compatible, work on 5 V, and consume 15 or 20 mA per filament segment. Their outputs are rated up to 10,000 ft-L. The filaments are designed for derated operation, and lifetimes of

thousands of hours are possible. They are fabricated as planar filament structures in evacuated glass envelopes of different designs. For example, Numitrons enclose the filaments in a vacuum tube. Pinlites have a flat package with metal back and a glass front. Normally, these designs are susceptible to damage from shock and vibration. But some have been ruggedized, and they can pass vibration tests in accordance with MIL-STD-202.

Filament readouts can be multiplexed, but to avoid flicker you must use a multiplexing rate greater than 50 Hz.

Gas-discharge displays glow

A version of the granddaddy of the gas-discharge tubes, the Burroughs' Nixie, is available in a line of miniature, standard, super and jumbo readouts designed and sold by National Electronics. But inflation has taken its toll. Just six years ago, prices ranged from $2 to $30 apiece in 1000 lots. Now the costs range from $5.25 to $50.

The Nixie's sophisticated offspring, multidigit gas-discharge displays, are appearing in a host of new products, including desktop calculators, instruments, point-of-sale terminals and even in automobile dashboard displays.

Gas-discharge readouts are bright and can be read in substantially higher ambient light than LED displays. But a drawback is the relatively high operating voltage, 180 to 240 V, that is required for their operation.

Planar gas-discharge devices are being produced in several formats. Burroughs is still manufacturing its Panaplex series with character heights of 0.25, 0.4 and 0.5 in. and four to 16 numeric-digit readouts. To supply the growing alphanumeric market, Burroughs' Model BA16701 with a 0.7-in-character panel boasts a lineup of sixteen 14-segment characters along with decimal points and commas.

Cherry Electrical Products offers its Plasma-Lux displays with four character heights (0.25 in. to 1 in.) and 4 to 16 digits.

Two types of gas-discharge displays are being produced by Beckman's Information Displays Operation at Scottsdale, AZ. One uses a raised, rather than flat, cathode for seven-segment planar segments in one to four digits per unit. Leads are provided for directly soldering it into a PC board. Prices range from $1.50 to $2.00 per digit in 1000 quantities.

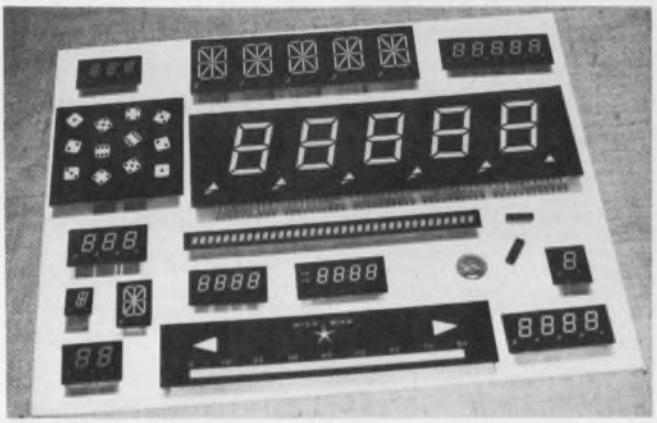
The other type is a 35 to 50-character alphanumeric display that is fabricated by means of a thick-film process. The image displays are screened onto a substrate and alternate layers of conductors and dielectric are superimposed. At present, only custom panels are being turned out with this process. But because it is simple, prices as low as $12 for a 16-character panel with 14-segment, 0.5-in. readouts are envisioned in the near future.

Canyon Electronics is packaging Beckman's gas-discharge elements into panel-mounted hexadecimal modules having from two to eight seven-segment digits. To display numerals 0 to 9 and letters A to F, decoders and drivers included in the modules operate from TTL/DTL four-line binary-coded data.

Where multiple lines of alphanumeric data must be presented, dot-matrix systems like Burroughs' well-known Self-Scan I and II panels or IEE's Argus plasma-display subsystem are available. Both Burroughs' and IEE's panels are bright orange-red neon. But IEE has also introduced a green as an option, using Xenon gas.

The Self-Scan II panels, second-generation versions, compete with CRT computer terminals. Because of the relatively thin profile of the Self-Scan II panels, which come in 40, 240 and 480-character versions, over 50% savings in terminal depth can be achieved. Because of the basic dot-matrix presentation, a variety of characters and different fonts can be programmed easily into the displays.

IEE's Argus systems come in seven basic types that differ in both screen-character capacities and character sizes. These systems are also distinguished by four formats: two lines of 16 characters; four lines of 16 characters; four lines of 32 characters, and eight lines of 32 characters.



Electroluminescent displays emit a pleasant green light. Such displays by T.L. Robinson Co. are packaged in an unbreakable plastic dielectric material. Standard digit sizes are 0.25, 0.375, 0.50, 0.60 and 1.00 in.

A third source for plasma dot-matrix panels, Owens-Illinois, has suspended production of its Digivue system and is phasing itself out of this field. But National Cash Register and Modern Control in this country, and Fujitsu in Japan, are supplying equivalent devices.

There are other displays that aren't widely used. One is a new, $1-per-digit electroluminescent (EL) display by T.L. Robinson Co. Made on PC-board

substrates, it offers either seven-segment, 0.6-in. digits or nine-segment, 0.5-in. digits. Half-inch, 16-segment alphanumeric readouts are also available. These displays require 120 to 275 V, 60 Hz to 20 kHz ac to drive them. Their light is soft green.

Driving the Robinson displays requires extensive discrete circuitry, but two high-voltage IC drivers, the DI-220 and the DI-802P from Dionics of Westbury, NY, can do the job.

Another display, electromagnetically operated, requires power only when data are being entered or removed. In some cases, such as with Montevideo Technology's alphanumeric system, a wheel carrying digits or letters is rotated by magnetic pulses.

In other cases, such as Ferranti-Packard's, the displays are made up of rotatable segments or circular magnetic elements that are black on one side and white or colored on the other. Applying current to these elements rotates them 180°. With the black side out, no data are visible. With the white or colored side out, alphanumeric characters are formed. Although Ferranti's display requires ambient light, it is surprisingly effective in applications ranging from gas pumps to stock-exchange boards.■■

Need more information?

The products cited in this report have been selected for their illustrative qualities. However, other manufacturers not mentioned in the report may offer similar products. Readers may consult manufacturers listed here and in ELECTRONIC DESIGN's GOLD BOOK for further details. The type of display produced is indicated by a code after each listing: EL for electroluminescent; EM for electromagnetic; GD for gas-discharge; IN for incandescent; LC for liquid-crystal; LD for LED; NE for neon; PP for plasma-panel; and VF for vacuum fluorescent.

Ackerman Bodnar Corp., 30 Grove Ave., New Rochelle, NY 10801. (914) 636-4664. (A. Franzone) **Circle No. 501**

Aircraft Instruments Co., Commerce Dr., Montgomeryville, PA 18936. (215) 368-0175. (J.C. Rychlak) (EM) **Circle No. 451**

Alco Electronic Prods. Inc., 1551 Osgood St., North Andover, MA 10845. (617) 685-4371. (C. Czapinski) (IN) **Circle No. 452**

Ashley-Butler Inc., 208 Rte. 206 S, Somerville, NJ 08876. (201) 359-5911. (R. Klein) (LC) **Circle No. 453**

Beckman Instruments Inc., 2500 Harbor Blvd., Fullerton, CA 92634. (714) 871-4848. (C.H. Vessey) (LC) **Circle No. 454**

Beckman Instruments Inc., Info Displays Op, 350 N. Hayden Rd., Scottsdale, AZ 85257. (602) 947-8371. (R.A. Kuntz) (GD) **Circle No. 455**

Burroughs Corp., Electronic Components Div., P.O. Box 1226, Plainfield, NJ 07061. (201) 757-5000. (Robert Gotsch) (GD, PP) **Circle No. 456**

Canyon Electronics, 2001 W. North Lane, Phoenix, AZ 85021 (602) 944-4421. (G.J. Mitlak) (GD, LD) **Circle No. 457**

Cherry Electrical Products Corp., 3600 Sunset, Waukegan, IL 60085. (312) 689-7700. (F.A. Amendola) (PP) **Circle No. 458**

Chicago Miniature/Drake Mfg. Co., 4433 N. Ravenswood Ave., Chicago, IL 60640. (312) 784-1020. (R. Galarneau) (IN, LD, NE) **Circle No. 459**

Dale Electronics, 1376 28 Ave., Columbus, NE 68601. (402) 564-3131 (Herman Person) (GD) **Circle No. 460**

Day-Light Display Corp., 11 Fairfield Pl., West Caldwell, NJ 07006. (201) 575-1045. (Phil Schneider) (IN) **Circle No. 461**

Dialight, 203 Harrison Pl., Brooklyn, NY 11237. (212) 497-7600. (Chet Dambroski) (IN, LD, NE) **Circle No. 462**

Discon Inds. Inc., 1322 NW 14 Ave., Pompano Beach, FL 33060. (305) 782-7424. (M.C. Crockett) (IN) **Circle No. 463**

Durgin & Browne Inc., 82 Allen Rd., South Burlington, VT 05401. (802) 863-6873. (R. Martineau) (IN) **Circle No. 464**

Electrodata Concepts Inc., 21-16 44 Rd., Long Island City, NY 11101. (212) 392-8800. (John Rattinger) (IN) **Circle No. 465**

Electro Mech Components, 1826 N. Floradale, South El Monte, CA 91733. (W.H. Trumbull, Jr.) (EM) **Circle No. 466**

Fairchild Semiconductor OED, 4001 Miranda Ave., Palo Alto, CA 94303. (415) 493-3100. (LD, LC) **Circle No. 467**

Ferranti-Packard Ltd., Electronics Div., 121 Industry St., Toronto Canada (416) 762-3661. (G.L. Jones) (EM) **Circle No. 468**

Fujitsu Ltd., 680 Fifth Ave., New York, NY 10019. (212) 265-5360. (K. Kurahashi) (PP) **Circle No. 502**

Futaba Industries U.S.A., 630 Carob St., Compton, CA 90220. (213) 537-9610. (Ray West) (VF) **Circle No. 469**

Hamlin Inc., Lake & Grove Sts., Lake Mills, WI 53551. (414) 648-2361. (Gerald Gross) (LC) **Circle No. 470**

Hewlett-Packard, 640 Page Mill Rd., Palo Alto, CA 94304. (415) 493-1212. (Rick Kniss) (LD) **Circle No. 471**

Industrial Electronic Engineers Inc., 7740 Lemona Ave., Van Nuys, CA 91405. (213) 787-0311. (K.J. Luskin) (GD, IN, LC, LD, NE, PP) **Circle No. 472**

Info-Lite Corp., 46-10 104 St., Corona, NY 11368. (212) 476-1287. (J.M. Cartelli) (IN) **Circle No. 473**

Integrated Display Systems, Montgomeryville, PA 18936. (215) 368-8050. (Tom Gates) (LC) **Circle No. 474**

Ise Electronics Corp., Noritake Co., Inc., 22410 Hawthorne Blvd., Suite 6, Torrance, CA 90505. (213) 373-6704. (David Shimizu) (VF) **Circle No. 475**

Litronix Inc., 19000 Homestead Rd., Cupertino, CA 95014. (408) 257-7910. (Jim Futer) (LD) **Circle No. 476**

Master Specialites Co., 1640 Monrovia Ave., Costa Mesa, CA 92627. (714) 642-2427. (J. Carpenter) (IN) **Circle No. 477**

Modern Controls Inc., 19228 Industrial Blvd., Elk River, MN 55330. (612) 441-5610. (Bert Johnson) (PP) **Circle No. 503**

Monsanto Electronics Div., 3400 Hillview Ave., Palo Alto, CA 94304. (415) 493-3300. (G. Breeding) (LD) **Circle No. 478**

Montevideo Technology Inc., 204 N. 4th St., Montevideo, MN 55435. (612) 269-6562. (W.L. Nees) (EM) **Circle No. 479**

Motorola Inc., Semiconductor Group, LIX Displays, 3102 N. 56th St., Phoenix, AZ 85018. (602) 244-3046. (John Von Dohlen) (LC) **Circle No. 480**

National Electronics, P.O. Box 269, Geneva, IL 60134. (312) 232-4300. (R.D. Mackowak) (GD) **Circle No. 481**

National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, CA 95051. (408) 732-5000. (Bob Santos) (LD) **Circle No. 482**

NCR Electronic Display Systems Div., 4750 Editon Ave., Colorado Springs, CO 80915. (303) 597-4613. (W.E. Coleman) (PP) **Circle No. 504**

NEC America Inc., 3070 Lawrence Expressway, Santa Clara, CA 95051. (408) 738-2180. (Jason Stewart) (VF) **Circle No. 483**

Nippon Electric Co., World Products Inc., 7625 Bush Lake Rd., Minneapolis, MN 55435. (612) 835-2117. (O. Woller) (PP) **Circle No. 505**

Opcoa Div. of IDS, Inc., 330 Talmadge Rd., Edison, NJ 08817. (201) 287-0355. (Robert C. Kolts) (LD) **Circle No. 484**

Pantek International Corp., P.O. Box 587, Lewistown, PA 17044. (717) 242-1411. (Stewart Harris) (GD) **Circle No. 485**

RCA Distributor & Special Products Div., 2000 Clements Bridge Rd., Deptford, NJ 08096. (609) 963-8000. (E.F. McCaffrey) (IN) **Circle No. 486**

Readouts Inc., P.O. Box 149, Del Mar, CA 92014. (714) 755-2641. (J.D. McKim) (IN) **Circle No. 487**

Refac Electronics Corp., Pinlites Div., P.O. Box 809, W. Hill Rd., Winsted, CT 06098. (W. Gillis) (IN) **Circle No. 488**

TL Robinson Co., Inc., Electronic Div., P.O. Box D, East Aurora, NY 14052. (716) 652-2111. (T.L. Robinson) (EL) **Circle No. 489**

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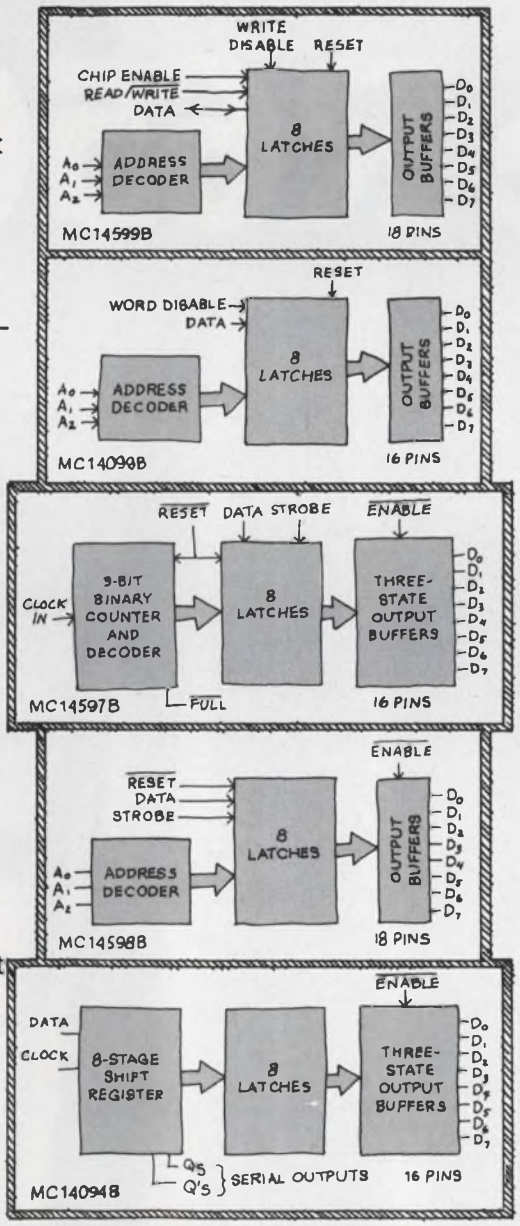

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MC14099B, second sourcing the CD4099B, is an 8-bit addressable latch with an input of a single-direction write only port.

MC14599B, similar in many respects to the MC14099B, has significant difference in the input, a three-state *bidirectional* input which provides communication optimized for bus expansion and readily allows information retrieval. The MC14099B and MC14599B are available now.

MC14598B, a bus-oriented addressable latch, also is similar to the MC14099B, but it has three-state outputs capable of driving bus lines. The output buffers drive either one TTL load or four LSTTL loads. The MC14598B is scheduled for introduction this month.

MC14597B is a bus-oriented 8-bit latch and features an on-board counter at the input for stepping data into the latches. Outputs are the same as those of the MC14598B. The MC14597B also is due out this month.

Last to be introduced (December), but by no means least, is the **MC14094B**, second sourcing the CD4094B. This device actually amounts to an eight-stage serial shift register, with a storage latch for each stage which strobes data to parallel B Series three-state outputs.

There it is. Just what you should expect from the CMOS leader. For information on Motorola's CMOS 8-bit latches, write to Motorola Semiconductor Products Inc., P.O. 20912, Phoenix, Arizona 85036, or circle the reader service number.

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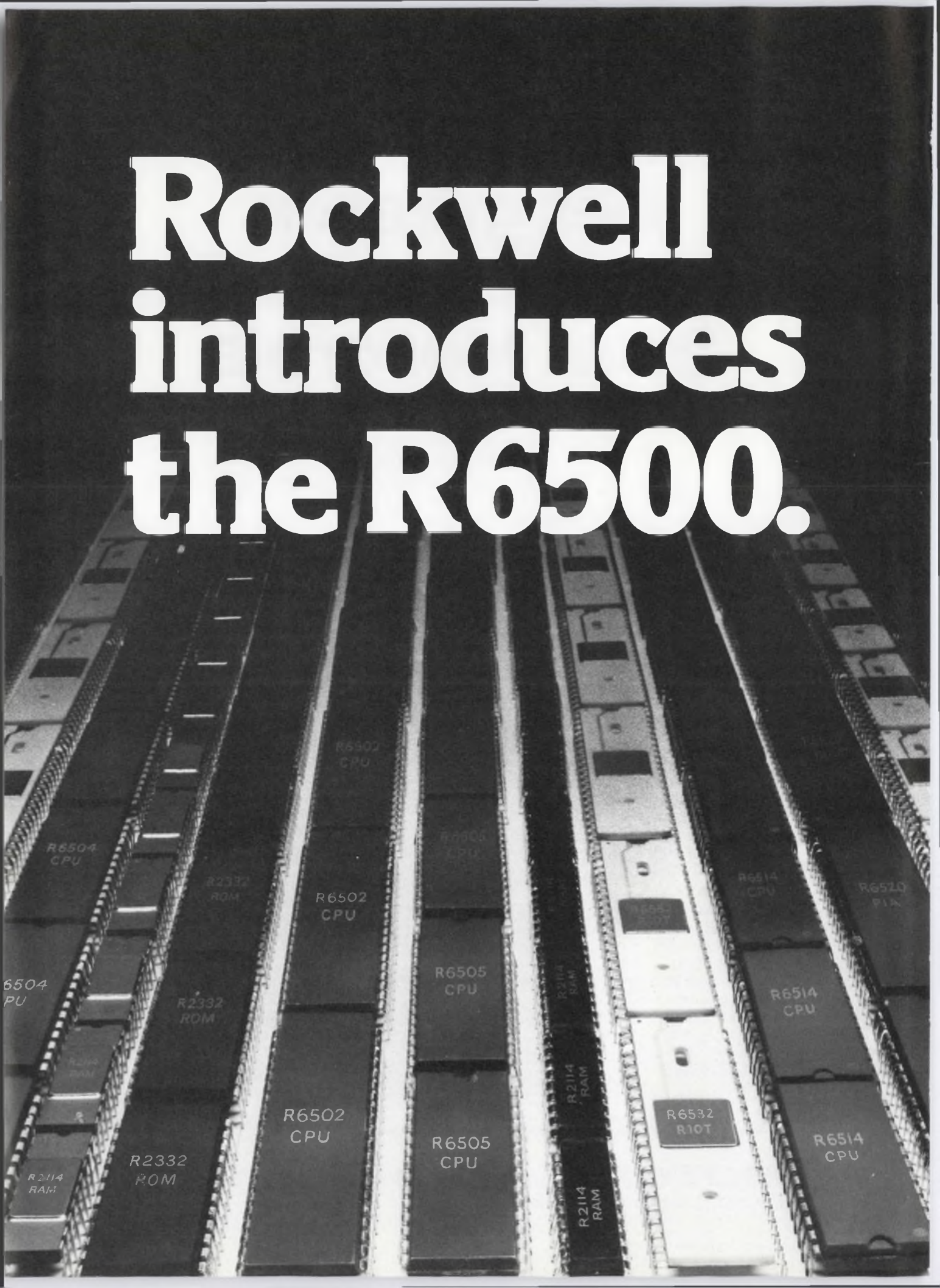
CIRCLE NUMBER 41

Rockwell introduces the R6500.



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R6500 CPU Options

	40-Pin DIP		28-Pin DIP				
	R6502	R6512	R6503 R6513	R6504 R6514	R6505 R6515	R6506	R6507
Memory Address Space	65K	65K	4K	8K	4K	4K	8K
Interrupts – Maskable – Non-Maskable	Yes Yes	Yes Yes	Yes Yes	Yes No	Yes No	Yes No	No No
SYNC – Output indicates op code fetch cycle	Yes	Yes	No	No	No	No	No
RDY – Single step and slow memory synchronization	Yes	Yes	No	No	Yes	No	Yes
$\emptyset_1$ Clock Output	Yes	Yes	No	No	No	Yes	No
DBE – Extended Data Bus Hold Time	No	Yes	No	No	No	No	No

I/O Devices

PART #	NOMENCLATURE	DESCRIPTION
R6520	Peripheral Interface Adapter	2, 8-bit bidirectional I/O ports; 4 peripheral control/interrupt lines.
R6522	Versatile Interface Adapter	PIA functions plus 2, 16-bit programmable interval timers/counters.
R6530	ROM-RAM-I/O-Timer	1024 x 8 ROM, 64 x 8 static RAM; 2, 8-bit bidirectional data I/O ports; 2 programmable data direction registers; 8-bit interval timer.
R6532	RAM-I/O-Timer	128 x 8 RAM; 2, 8-bit bidirectional data ports; 2 programmable data direction registers; 8-bit interval timer.

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...where science gets down to business

Narrow your choice of displays by counting characters and computing costs. CRTs offer the most flexibility but LEDs can cut small-system costs.

Since CRTs, LEDs and plasma panels all compete for many of the same applications, you may have to make several performance tradeoffs before you can choose which type is best for you (Fig. 1). Factors that must be considered include the type of characters or data you want displayed, size of characters, and the number of characters, among other qualities.

For the most flexible display operation, a CRT-based device would seem a natural choice since the drive electronics determines all the characteristics of the display. LED and plasma panels are not as flexible, especially when they use segments instead of a dot matrix to form the characters. With segmented arrays, only the most basic characters can be formed with the nine to 16 segments commonly used in the arrays.

However, if you're going to use the standard ASCII character set, the three display approaches are competitive at the outset. Character size, the number of characters, appearance and cost become the deciding factors.

Display appearance, of course, depends on external factors such as ambient light, aesthetics and required viewing distance. Similarly, character size depends on viewing distance and aesthetics. Character size, though, does limit your choice of display technology. For characters 0.5 in. high and more, you most probably would choose a CRT-based display, since you can adjust character height to any size you want simply by restructuring the control electronics.

However, when displayed characters are less than 0.5 in. high, the choice of display technology again widens to include CRTs, LEDs or plasma panels.

Choose according to quantity

Because all three technologies fit the bill with ASCII characters, the next tradeoff that can be used as a deciding factor is cost, which can be determined by first examining the display characteristics you want —how many characters on a line, how many lines of displayed data, etc?

A CRT terminal system that accepts ASCII-character inputs and provides at least a 32 × 16 character display would typically cost about $500 (about $1/character). And, the cost penalty for adding more characters, say up to 2000, would only be a few hundred dollars. But for less than 100 characters, a CRT-based system is not very economical since a large part of the system cost consists of the monitor and basic control circuits needed regardless of the size of the display.

Although not requiring as large an initial investment for small quantity displays, the LED and plasma technologies cost more per character than a CRT system. However for a display system requiring less than 100 characters they offer economically attractive alternatives (about $5/character). But, displays by themselves do not make a system.

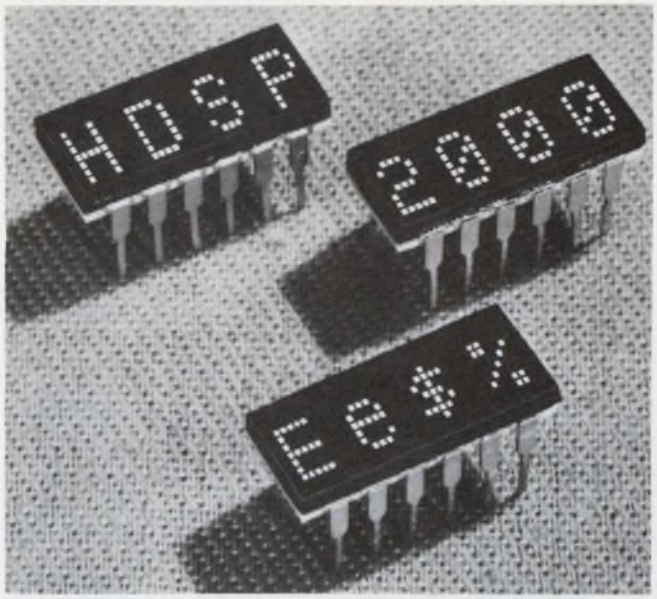
Many small-scale display systems are used in conjunction with microprocessor-based equipment and are often multiplexed to keep circuitry to a minimum. When microprocessor controlled, the display can present some difficult programming problems for the designer.

If the display has no memory, all displayed data must be refreshed quickly enough to prevent any display flicker. So a frame rate of at least 50 Hz is required—but 100 Hz is preferred. If the display is set to handle, say, 32 characters, at least 3200 data words must be loaded from the memory every second. And, the frame rate must be held fairly constant since any large time gaps caused by system interrupts will show as flicker even if the over-all frame rate is high enough. And later on, maintenance, training and checkout will cost more, since the programs held in the processor's main memory must be modified to alter the display.

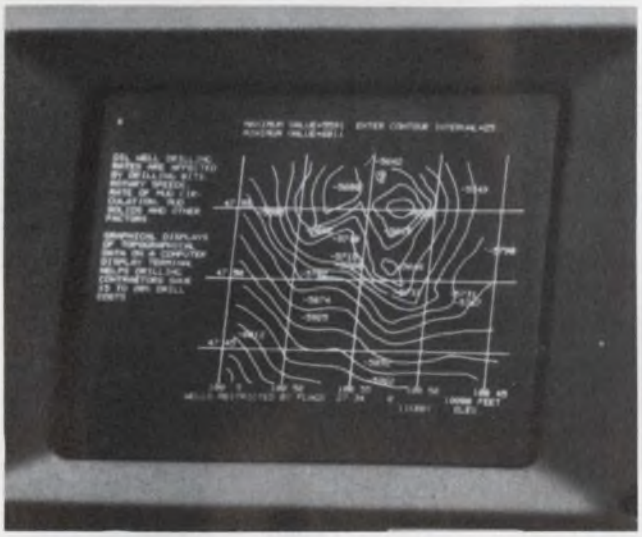
By supplying a separate memory for the display and its operating system, you can circumvent all the programming problems: The display can be treated almost like a memory location or output device. No system interrupts or timing loops are required, and when new data are to be displayed, they are simply written over the old data.

Non-CRT display systems such as the Burroughs SII-0132-0030 Self-Scan array, the Hewlett-Packard HSDP-2000 LED dot-matrix display and the Litronix DL-1416 16-segment array (Figs. 2a, b and c, respectively) can all be used to form low-cost display systems when less than 100 characters are needed. All three

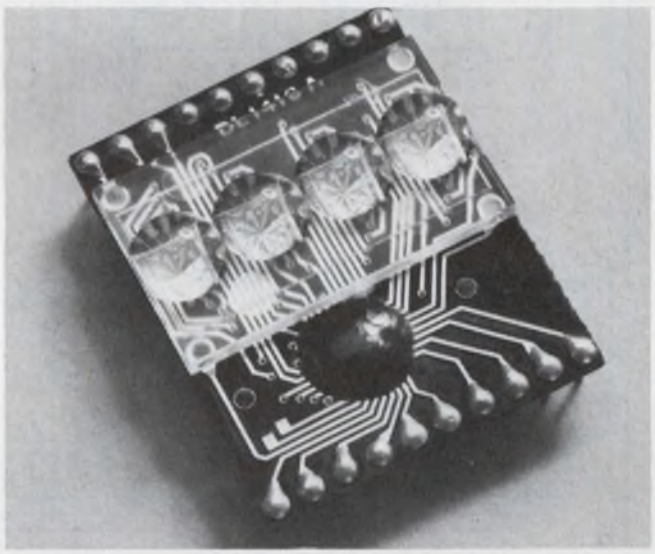
David M. Barton, Marketing Manager, Intelligent Displays, and **David Takagishi,** Applications Engineering Manager, Litronix, 19000 Homestead Road, Cupertino, CA 95014.



Hewlett-Packard dot matrix LED



Tektronix CRT



Litronix 16-segment LED

Burroughs Self-Scan

1. **Competing for many of the same applications,** CRT, LED and plasma-panel displays can be compared by how much money each type will—or will not—save you in a given application.

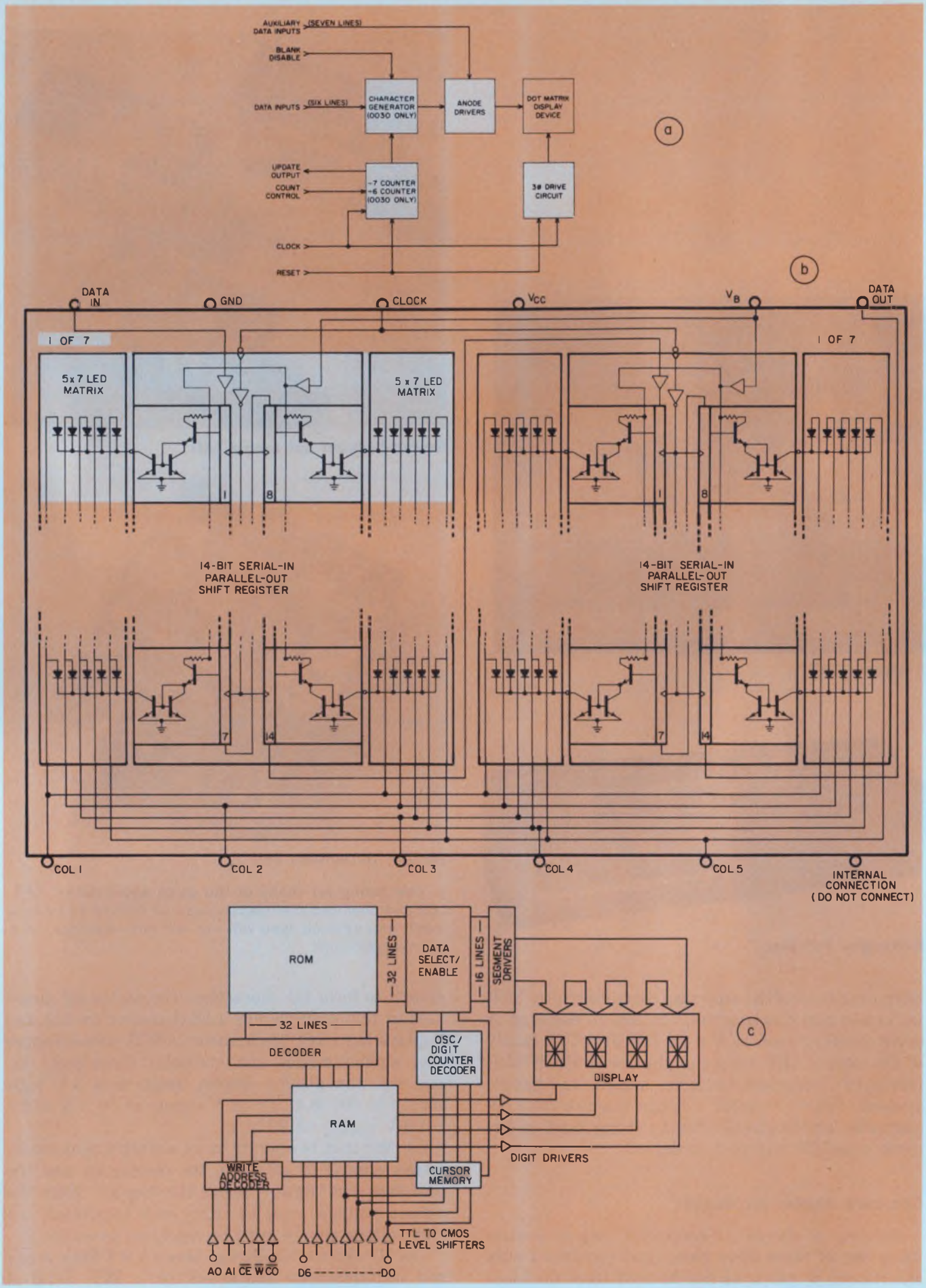
have some or all of the necessary control circuitry built in. Lower cost displays that contain no decoding or drive circuitry such as the old HP 5082-7100 family of dot matrix LED arrays or the newer HSDP-6504 family of 16-segment character arrays. To compare systems, simply examine a design example for a 32-character alphanumeric display using each of the three non-CRT display techniques.

Compare display techniques

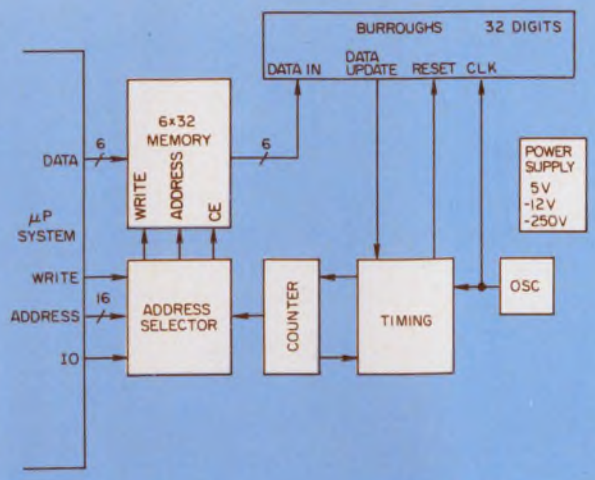
Building a simple μP-controlled display system using one of these three techniques requires a wide assortment of parts, as can be seen from the block diagrams and their accompanying parts lists in Fig. 3. The Burroughs display uses a dot-matrix plasma system to form the characters. The particular model used in this example has a 32-character format and displays the basic 64-character ASCII subset (upper case alphanumerics and symbols). Completely assembled, the plasma display requires a 5-V logic supply at 600 mA, a -12 V supply at 50 mA and a -250-V supply at 20 mA.

For the unit to operate in an asynchronous mode, memory must be added to the display so that the processor can "forget" about the display. Since the plasma voltage must be fairly well controlled, the high-voltage supply must be regulated to within 5%.

The HP dot-matrix display uses a 5×7 diode array and contains four characters to a DIP. Built-in circuitry includes the drivers for the LEDs and a shift register so that data can be entered serially, which



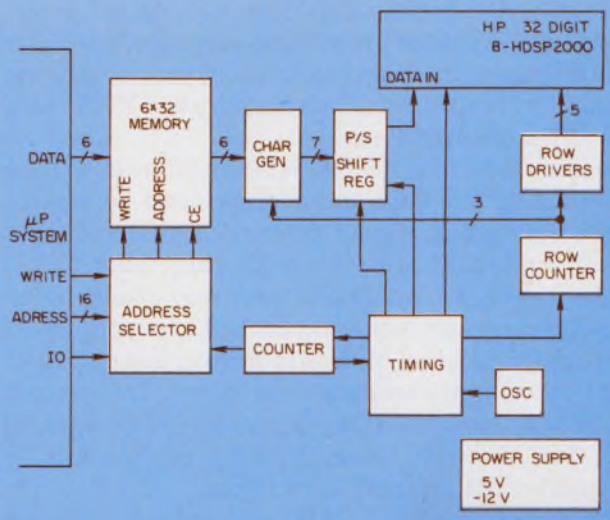
2. **Filling various small-display applications,** the Burroughs Self-Scan array (a), the Hewlett-Packard LED dot-matrix array (b) and the Litronix 16-segment array (c) must be closely compared to determine which one to use.



Qty.	Type	Description
1	Burroughs	S11-0132-0030
8	4036	RAM
3	8212	8-latch buffer, three-state
2	4520	Counter
1	4012	4-input NAND
1	4049	Hex inverter
1	4011	2-input NAND
1	4047	Multivibrator
1		Power supply, −12 V @ 50 mA
1		Power supply, −250 V @ 20 mA

Approximate cost $190

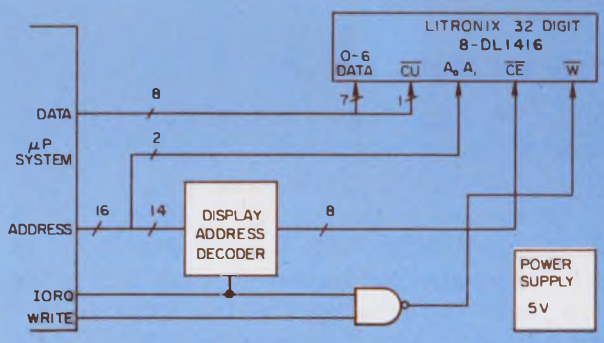
(a)



Qty.	Type	Description
8	HDSP-2000	
1	2516	Character generator
1	4014	P/S Shift Reg, −5 V @ 21 mA
1	4520	Counter, −12 V @ 12 mA
3	4022	÷ 8 counter
1	4029	Settable counter
2	4011	2-input NAND
2	4023	3-input NAND
1	4050	Hex buffer
1	4049	Hex inverter
1	4047	Multivibrator
5	MPSU95	Transistors
8	4036	RAM
2	8212	8-latch buffer, three state
1	7430	8-input NAND
1		Power supply, −5 V @ 25 mA
1		Power supply, −12 V @ 25 mA

Approximate cost $340

(b)



Qty.	Type	Description
8	DL-1416	LED alphanumeric displays @ 100 mA
3	74LS138	Decoder @ 10 mA
1	4011	

Approximate cost $200

(c)

reduces the number of interface pins. No character generator or addressable memory is included on the display. To use external RAM and ROM calls for external row drivers and a counter, as well as timing circuitry for generating memory addresses.

For a 32-character assembly, the HP display typically requires 5 V at 4 A, −5 V at 25 mA, and −12 V at 25 mA. However, most of these supplies are typically included in many large systems and may not have to be specially designed—unlike the Burroughs 250-V supply.

The 16-segment LED display used in the Litronix DL-1416 forms the basic 64-character ASCII subset. Each DL-1416 contains four characters, a character-generator ROM, a RAM, a multiplex oscillator, display drivers and a cursor function. Just 5 V is needed by the display circuit.

Small displays using the DL-1416 require no additional circuitry, since each package has a chip-enable line that can be controlled by the processor. However, to map display locations sequentially, a one-of-N decoder is used to decode all data bits of order two and greater. Address lines A_0 and A_1 drive all the DL-1416s directly. Since only one gate must be added to finish the interface, a special write pulse for "display write" control isn't needed. For 32 characters, the display requires less than an amp.

The small display system shown in Fig. 3c can be treated like a printer port by the programmer. Other

3. **By evaluating the displays in equivalent systems,** you can get a good picture of the required components and the approximate cost for similar systems. Shown here are three 32-character display circuits using the Burroughs Self-Scan (a), the Hewlett-Packard dot matrix (b) and the Litronix 16-segment (c) displays.

routines needn't be interrupted to access the display. And, since the display-data locations can all be accessed asynchronously and randomly, special effects such as paging and moving lines are easy to provide —and they require much less memory and ROM space than other display types.

Loading data into the DL-1416 is similar to writing into a RAM: The data and address must be present before the leading edge of the write signal and must remain stable until after the trailing edge. Multiplexed display systems sequentially read and display data.

In synchronous systems, control circuitry must compare the location of data to be read and displayed to the location of new data to be stored. This process can be very slow when the memory is very large. In a DL-1416, however, each character continues to be displayed until replaced by another.

When enabled, the DL-1416's cursor function causes all 16 of the previously entered character segments to light, which obliterates that character and indicates the position of the next character to be entered. The cursor itself is not a character, and the previously written character reappears after the next character is entered.

The cursor can be written into any position first by enabling the chip enable, the cursor and the positional data, then by supplying a write signal. Cursor position is determined by which of the first four control lines are held high. A HIGH on the $D_Ø$ line places the cursor on the rightmost digit, and a HIGH on D_3 puts the cursor on the leftmost digit of the four-digit group. The cursor can be simultaneously loaded into and erased from more than one position simply by holding more than one data line HIGH during the write signal.

Interface the display to a μP

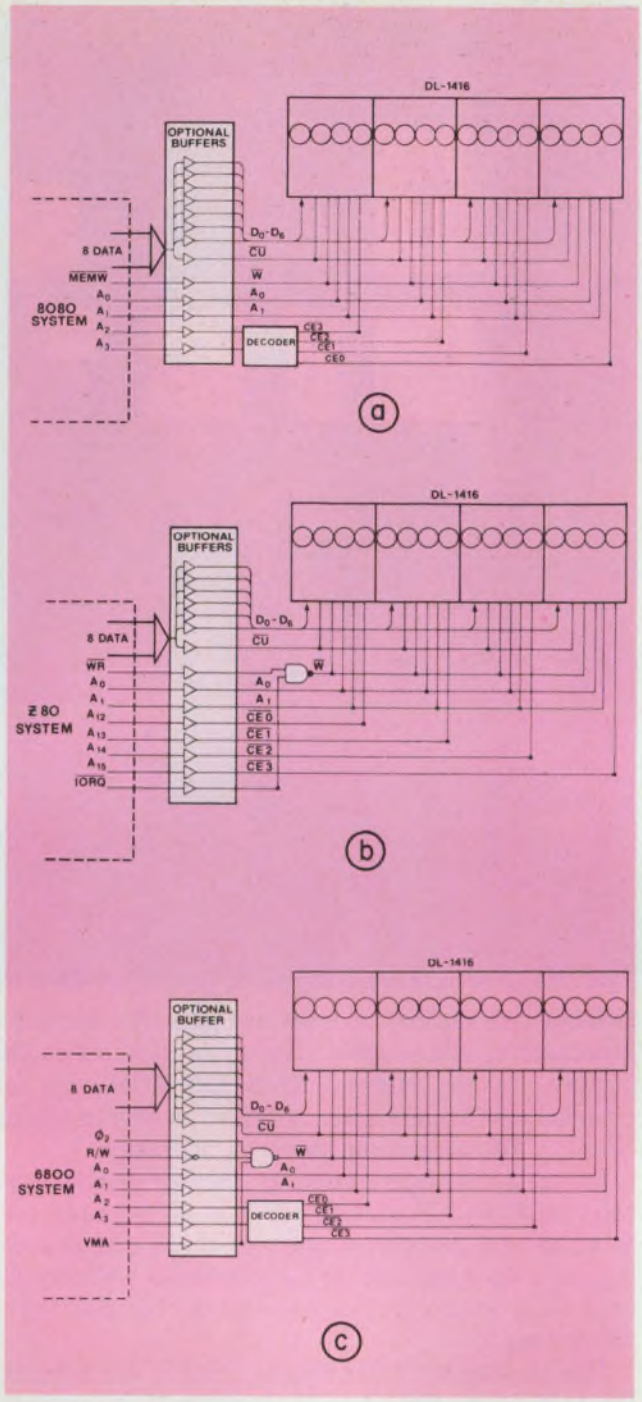
Interconnecting a DL-1416 small-display system to a microprocessor is very straightforward. For a 16-character display, the two least-significant address bits are connected by the $A_Ø$ and A_1 address inputs for all DL-1416s being used. The chip-enable inputs of the four packages can be used to select each of the four packages by decoding the two highest-order address bits. Data lines are connected to all DL-1416 data inputs; so are the write and cursor lines.

Interfacing the display array to an 8080, Z80 or 6800 requires some buffers and a decoder (Fig. 4a). Depending on the size of the system, the bus drivers may be required. All eight μP data lines connect directly to the inputs (seven inputs and the cursor control).

Either isolated or memory-mapped I/O can be used with an 8080.

The interface for a Z80 μP is very similar to that of the 8080, except that the write pulse is generated differently (Fig. 4b). And the interface for a 6800-based system requires very few modifications (Fig. 4c). However, the 6800 uses memory-mapped I/O techniques only, so take care to select the display RAM addresses that don't limit processor RAM expansion.

But you don't have to use any RAM locations to access the display. ROM addresses can be used instead since the processor's read/write line will determine whether the ROM is being read or the display is being written to.■■



4. **Interfacing the Litronix display** to a microprocessor requires nothing more than some buffers and gates. Typical interconnects are shown for an 8080 (a), a Z80 (b), and a 6800 (c).

Need more information?

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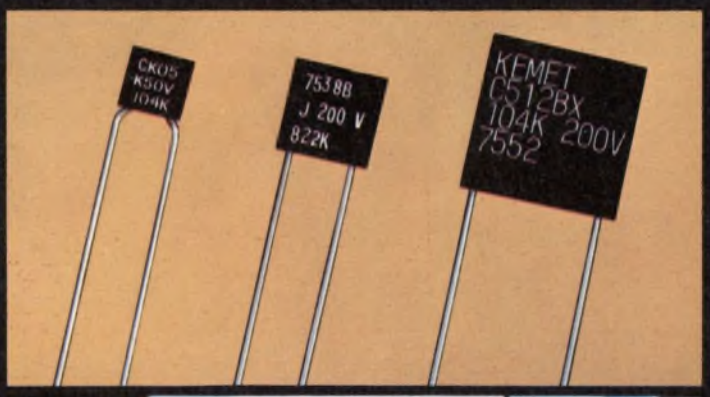

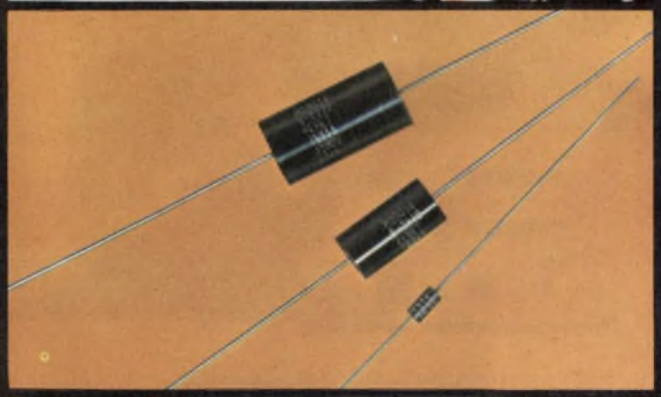

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Electromagnetic-interference specs

may affect your whole design. Minimize their impact by making components serve double-duty for EMI control.

Controlling electromagnetic interference can often be an elusive goal that at first seems incompatible with other specifications, or with your cost objective. But you may be able to sidestep the cost/performance confrontation by making system components do double-duty—e.g. a mounting bracket that also serves as a shield.

Frequently, however, tradeoffs between EMI and other requirements are not at all straightforward. Take, for example, the requirements of a Doppler radar navigation system for a small helicopter. The system consisted of a radar, and a control/display unit. Besides conforming to MIL-STD-461A for EMI (Fig. 1), the system had other requirements to meet:

- Low cost.
- Operation at 71 C.
- Rigid size and shape limits for one to four "boxes."
- Global navigation capability—both latitude/longitude and Universal Transverse Mercator (UTM).
- Compensation for magnetic variation, compass deviation, and antenna signature, including temperature effects.
- Ability to process angular attitude data, convert velocity coordinates, remember way points and targets, and monitor itself.
- Ability to vary the display brightness, to cover a 3:1 contrast ratio.
- Hf, vhf, and umf receivers on board.
- Hf antenna in plastic bubble, only inches from the display.

Because all the other specs were quite rigid, the only "tradeable" requirements were cost and EMI performance. But the final choice in a tradeoff does not always follow the most direct pattern—many factors directly or indirectly affected the trades, as illustrated by Table 1.

The dimmer connection

If EMI had been the only concern, either a liquid-crystal display or an incandescent display with a resistive dimmer would have been best. But other considerations were more important.

Louis A. Messer and **Neville J. Sawyer,** Group Engineers, Teledyne Ryan Aeronautical, 2701 Harbor Drive, San Diego, CA 92112.

For instance, committing the system to masked-ROM storage was considered too restrictive in the development phase. The use of PROMs, however, added to the heat load, even with a memory utilization of 99%.

Choosing between a single and separate power supplies was also difficult. Similar but separate power supplies for the radar and display boxes added heat and cost to the system, but reduced the aircraft wiring and EMI control costs—which were considered more important.

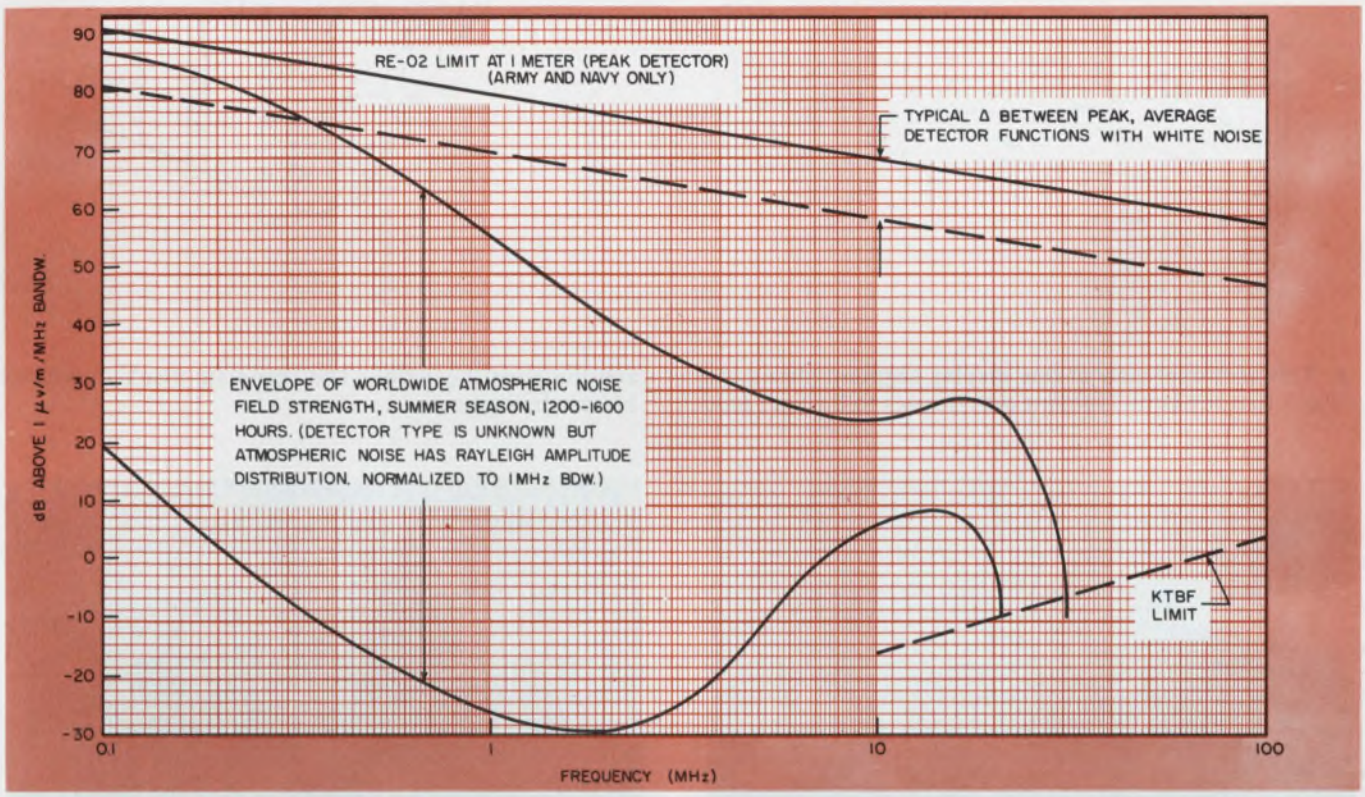
Having made these choices for program storage and power supplies, only the more efficient, switching-type dimmer (Table 1) could be used. But the high electromagnetic noise of this dimmer had to be contained somehow. Could it be done without the added cost and the light absorption of metal screens or conductive films? Could another equipment component that was needed anyway, also control dimmer EMI—such as the front panel?

A panel has more than one face

The primary function of an instrument panel is to support instruments. It must provide this support under shock and vibration, so that the individual components will not be excited beyond their design limits—and with as little weight as possible. Sheet metal is usually out of the question for a front panel in a military vibration environment, but a die-cast structure fulfills the required function economically in volume production.

An instrument panel can also dissipate heat. In the case of an incandescent display, full brilliance typically coincides with maximum ambient temperature. When any helicopter is parked in the desert sun with the doors closed, sunlight hits the panel directly, and the plastic bubble creates a greenhouse. That's why a 71-C operational ambient is required for four successive 1/2-hour periods (MIL-STD-5400).

Only an incandescent display was found to be bright enough in full sunlight (Fig. 2). But it also generated additional heat. In the worst case, the display's seven 0.1-W bulbs for each of 11 numeric characters and 16 bulbs for each of 4 alphanumeric characters dissipated 14.1 W, for a statistical average load of 5.6 W. By embedding the bulbs in an aluminum "swiss cheese"



1. **MIL-STD-461A defines allowable broad and narrow-band emissions,** 1 m from the test sample. Superimposed is the atmospheric noise range, which varies widely with time and season, and can exceed the EMI limits. (The chart is based on CCIR report 322, Geneva, 1963, and ITT's Reference Data for Radio Engineers, p. 27-2, 5th edition.)

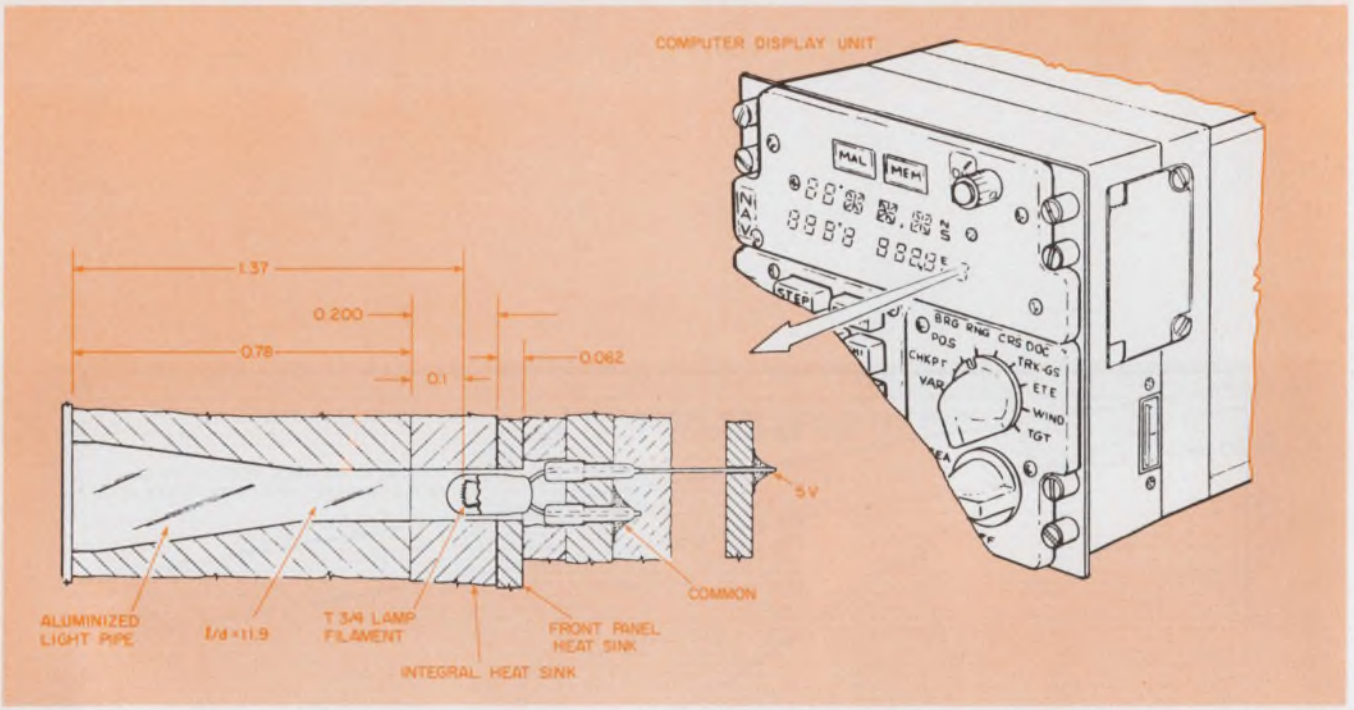
2. **Here, the navigational computer's control display unit** is placed in its natural habitat. Despite the bright sunlight, the display clearly shows the grid coordinates where the picture was taken, 14.5 km southeast of Oceanside, CA. Light-absorbing filters to protect the windshield-mounted receiving antennas were not needed.

matrix of adequate thickness, a path of low thermal resistance was created (Fig. 3).

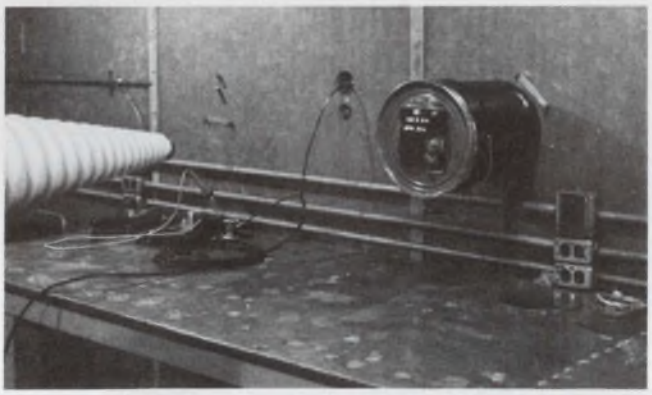
Through a removable display insert, the thermal path was continued into the panel. By choosing comparable dimensions for the thickness of both parts and the overlap, adequate structural rigidity was ensured.

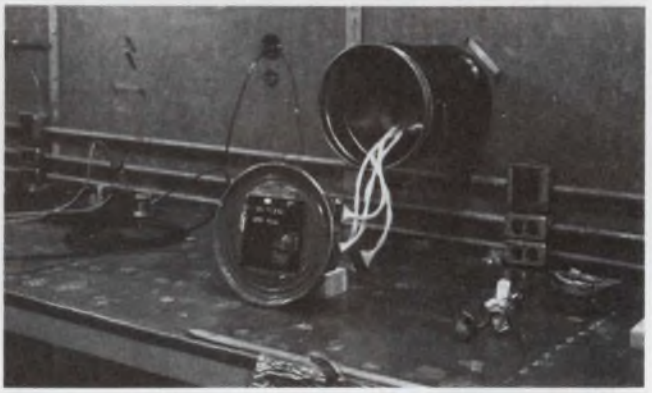
But for EMI control, the ability of a panel to create a barrier for electromagnetic energy proved the most crucial feature. So, the frequency range over which the shield had to be effective had a big impact on the panel design. While the visible radiation of the light bulb filaments had to come through unattenuated, the dimmer-pulse frequencies radiated by these filaments had to be kept from the antenna, only a few inches away.

Here, the ratio between the "signal" wavelength (light) and the shortest "noise" wavelength was so large that a cylindrical waveguide below cut-off could serve as a filter. The required panel thickness (for heat

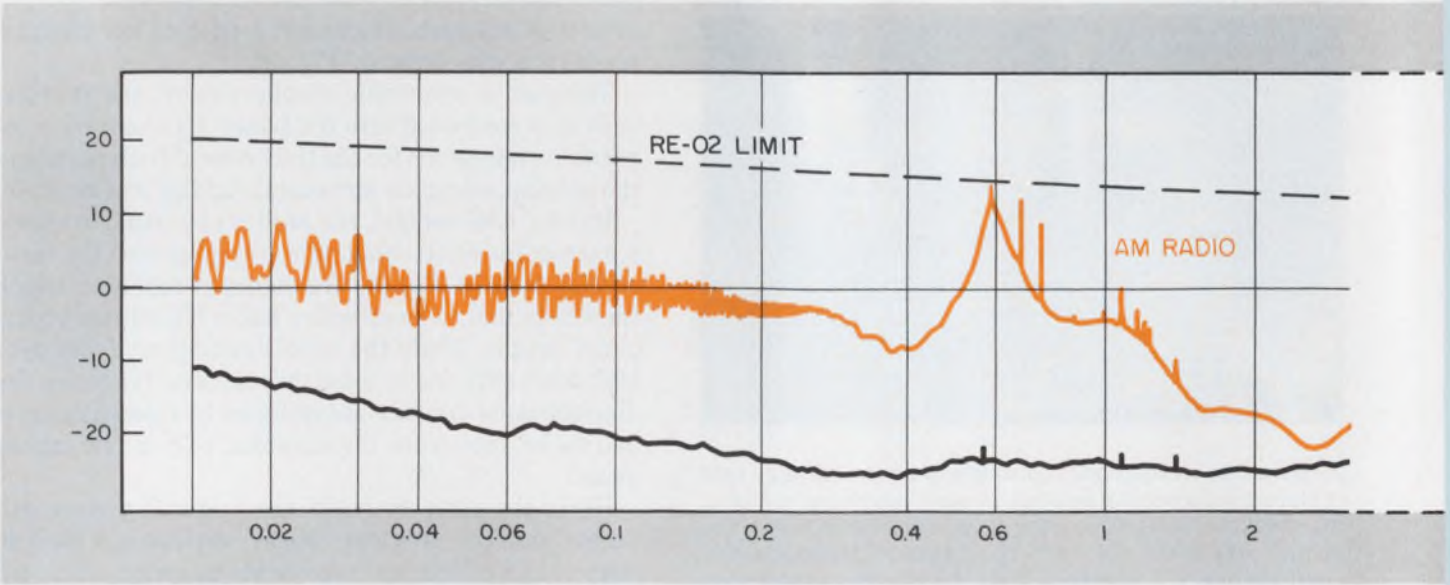


3. **This sectional view of one display segment** shows the location of the lamp filament with respect to the light pipe and the panel heat sink. The complete display contains 141 such segments.





4. **A 5-gallon paint can makes a good temporary enclosure** for evaluating the design's EMI effectiveness. Tests were run with the display unit mounted in the can (left), and lying on the bench (right).



removal) and the small bulb diameters (Fig. 3) made such a filter practical.

Waveguide cut-off occurs where the major dimension of an aperture of finite depth is smaller than half a wavelength.[1] Attenuation (in dB) rises very steeply and follows the expression

$$A = 0.0046\,\ell f\,[(f_c/f)^2 - 1]^{1/2} \qquad (1)$$

where ℓ is the aperture depth in inches (to the filament)

f = the operating frequency in MHz

f_c = 6920/d is the cut-off frequency for a circular aperture, and

d = the aperture diameter in inches.

If $f_c \gg f$, Eq. 1 can be simplified for a circular aperture as follows:

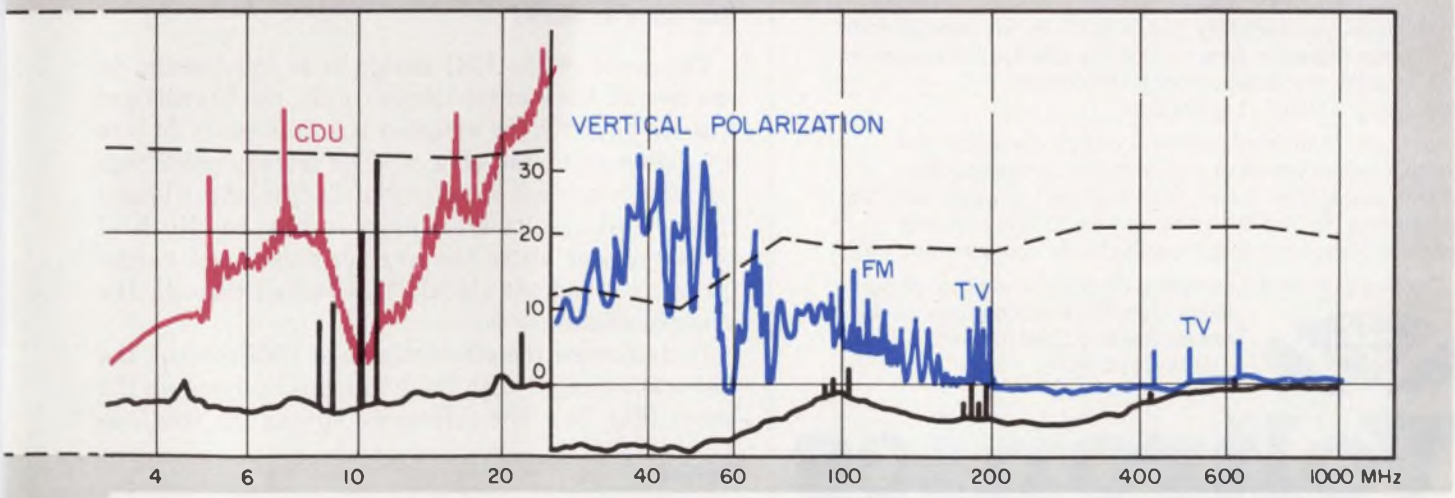
$$A \simeq 0.0046\,\ell\,f_c \simeq 32\,\ell/d$$

Thus, the attenuation is independent of frequency, and with the dimensions from Fig. 3, would be 32 dB. But, the helicopter display itself further enhanced this attenuation. In order to prevent optical cross talk, the fiber-optic segment formers were plated with a metal sheath. This increased the ℓ/d ratio to 12, so that leakage was actually determined by the small cracks between the panel and the display. EMI was undetectable with the lamp dimmer set at 50% duty cycle (maximum ac power).

Such a panel can be die-cast in one piece, which is both economical and desirable. Point contacts in

Table 1. Design tradeoffs

Function	Alternative 1	Alternative 2
Display	Incandescent: Bright enough to read in sunlight; reliable; very high heat dissipation; inexpensive.	Liquid crystal: Insufficient track record; limited visibility; very low power consumption, temperature sensitive.
Display location	Directly viewed: Best visibility in full sunlight; low initial cost; segment gaps appear when dimmed; **high EMI.**	Indirectly viewed: Inexpensive replacement bulbs; wider viewing angle; special characters easily available; **less EMI** and heat radiation.
Display dimmer	Resistive: **Little EMI,** simple and inexpensive; inefficient.	Variable duty cycle: less heat dissipated; **high EMI.**
Display driver	CMOS: Compatible with other digital components; **moderate EMI.**	TTL: For incandescents the only low-cost driver; **EMI radiation extends to 0.4 GHz.**
Program storage	Masked ROMs: Need less space and power; revisions costly.	PROMs: Flexibility during design stage; high power consumption.
CDU and radar power supplies	Common supply: Burdensome interconnections; lower cost (not a decisive factor if supply architecture is simple).	Separate supplies: More flexibility, **better EMI separation;** more heat dissipation.



5. **Radiated emissions measured** with the shielding can closed (black), and open (color). The RE-02 limit from the EMI spec MIL-STD-461A, modified to include equipment calibration, is shown as a broken line.

Help for the needy

Because EMI-control is so tightly interwoven with all electrical and mechanical aspects of the whole equipment, only the system designer himself, and not a consulting specialist, can incorporate EMI-control successfully. But equipment designers often regard EMI-control as a form of black magic because familiar design procedures don't seem to work. The problem is that some circuit elements—often called parasitics—rarely appear on the data sheet.

Unfortunately, many publications are better at explaining theoretical behavior than solving real-world problems. One useful aid, however, is Donald R. White's *EMI Control Methods and Techniques* (Volume 3, EMC Handbook series, Don White Consultants, 14800 Springfield Road, Germantown, MD 20767). The author derives the principal equations, converts them into practical graphs, explains their pitfalls and limitations, and gives numerous quantitative examples. Studying the relevant ones is more effective, and a lot cheaper than attending an intensive crash course.

metallic joints develop discontinuities in the rf surface currents, which act as slot antennas, so a monolithic structure is always preferable. But if any contact points in an EMI shield are anodized, they will again create discontinuities.

This cutoff-attenuator principle was also used in the keyboard. In the helicopter's control/display unit, each key contains a lamp, either for illumination or as an indicator. A small tubing holds the lamp and serves as a guide for the plastic actuator. The metal key separator (escutcheon) increases the ℓ/d ratio, as do the sleeve bushings.

But does it work?

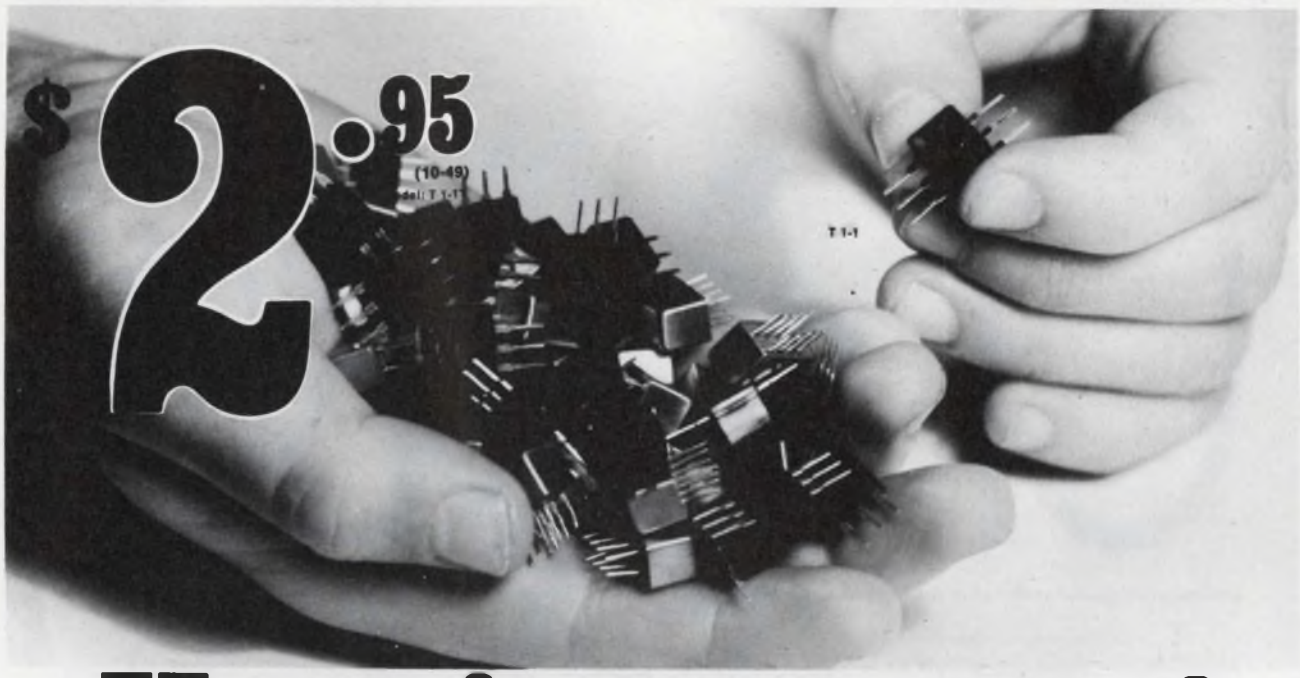
The proof of the EMI design is in the testing. In the case of the control/display unit, the breadboard was too large for the assigned box, but easily fit into a 5-gallon paint can (Fig. 4). The display panel was mounted in a lid cut-out after buffing the lid to a bright finish. Test results are shown in Fig. 5a. No EMI signals appear above the receiver noise level, except for some broadcast signals that leaked through the shielded enclosure ports.

To determine the effectiveness of EMI-control, the test was repeated with the paint can lid lying on the bench (Fig. 5b). The difference speaks for itself. ■■

Reference

1. White, Donald R. J., "EMI Control Methods and Techniques," Vol. 3, EMC Handbook series, Don White Consultants, Inc., Germantown, MD, p. 11.2.

RF TRANSFORMERS



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Plastic Case	T 1-1	T 1.5-1	T 2.5-6	T 4-6	T 9-1	T 16-1
Freq. Range, MHz	.15-400	.1-300	.01-100	.02-200	.15-200	.3-120
Impedance Ratio	1	1.5	2.5	4	9	16
Max. Insertion Loss	MHz	MHz	MHz	MHz	MHz	MHz
3 dB	.15-400	.1-300	.01-100	.02-200	.15-200	.3-120
2 dB	.35-200	.2-150	.02-50	.05-150	.3-150	.7-80
1 dB	2-50	.5-80	.05-20	1-100	2-40	5-20
Price, Model TMO	$4.95	$6.25	$5.95	$5.95	$5.45	$5.95
(10-49) Model T	$2.95	$3.95	$3.95	$3.95	$3.45	$3.95

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Metal Case	TMO 2-1	TMO 3-1	TMO 4-2	TMO 8-1	TMO 14-1
Plastic Case	T 2-1	T 3-1	T 4-2	T 8-1	T 14-1
Freq. Range, MHz	.015-800	5-800	5-600	.15-250	.2-150
Impedance Ratio	2	3	4	8	14
Max. Insertion Loss	MHz	MHz	MHz	MHz	MHz
3 dB	.015-800	5-800	.2-600	.15-250	2-150
2 dB	.02-400	2-400	5-500	25-200	5-100
1 dB	.05-200		2-250	2-100	2-50
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Plastic Case	T 1-1T	T 2-1T	T 2.5-6T	T 3-1T	T 4-1	T 8-1T	T 13-1T
Freq. Range, MHz	.05-200	.07-200	.01-100	.05-250	2-350	.3-300	.3-120
Impedance Ratio	1	2	2.5	3	4	5	13
Max. Insertion Loss	MHz	MHz	MHz	MHz	MHz	MHz	MHz
3 dB	.05-200	.07-200	.01-100	.05-250	2-350	.3-300	.3-120
2 dB	.08-150	.1-100	.02-50	1-200	.35-300	.6-200	.7-80
1 dB	2-80	.5-50	.05-20	.5-70	2-100	5-100	5-20
		Maximum Amplitude Unbalance MHz					
.1 dB	.5-80	1-50	1-20	1-70	5-100	10-100	5-20
.5 dB	.05-200	.07-200	.01-100	.05-250	2-350	.3-300	.3-120
		Maximum Phase Unbalance Degrees MHz					
1°	.5-80	1-50	1-20	1-70	5-100	10-100	5-20
5°	.05-200	.07-200	.01-100	.05-250	.2-350	.3-300	.3-120
Price (10-49)							
Model TMO	$5.95	$6.25	$6.25	$5.95	$4.95	$6.25	$6.25
Model T	$3.95	$4.25	$4.25	$3.95	$2.95	$4.25	$4.25

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CIRCLE NUMBER 49

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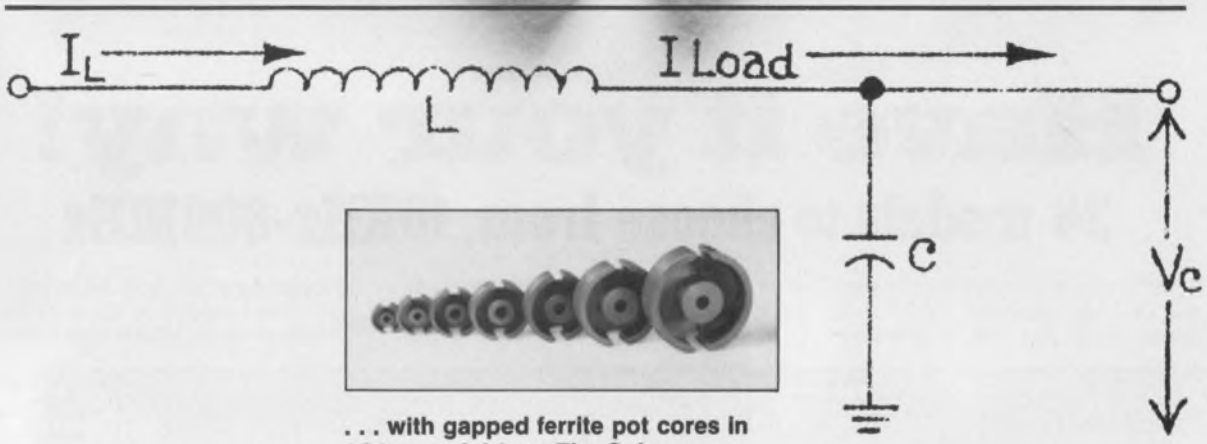

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CIRCLE NUMBER 50

Microprocessor-based video games have it all over fixed-logic. Two approaches—RAM intensive and object-oriented—demonstrate the versatility of 'smart' games.

Perhaps no other application of microprocessors fires the imagination more or better demonstrates μP flexibility than electronic video games. Games that contain microprocessors are easier to modify than games controlled by standard logic. They also have a shorter development cycle—it consists mainly of programming. They are more reliable—fewer parts mean fewer repairs. And they are easier to maintain —problems can be fixed simply by changing ROMs or PROMs.

Video games with microprocessors can be RAM-based, display object-oriented or alphanumeric. Whatever the approach, there are five basic components: a processor, a program-memory, a timing generator, input/output accessories and special games-interface logic.

Choosing a processor depends, among other things, on cost. Normally, ultra-high speed isn't required in consumer-oriented games. Suitable processors include the Signetics 2650, Fairchild F-8, Intel 8080 and 8048, and the Zilog Z-80.

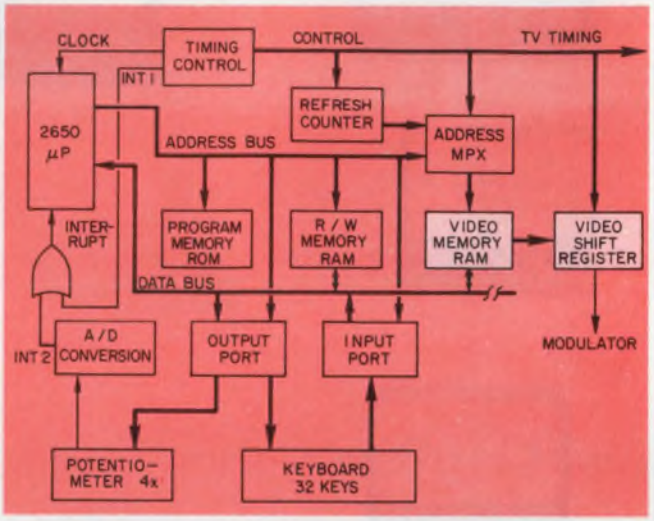
Custom processors are also available. But while their reduced logic tends to keep their cost down, they lack support, can be hard to use, and can be difficult to expand, which is especially important for systems with plug-in cartridges. And custom structures may lock out industry-standard peripherals.

The ROM cartridge holds game programs and can be changed from game to game. Access time need only be as fast as required by the processor. But the ROM has to be large enough to carry the intelligence needed for more complex games.

The μP system is "run" by a timing generator, which also synchronizes it with a TV.

The memory-mapping method

In a typical RAM-intensive approach, the TV screen is divided into 128 dots horizontally and 96 dots vertically, to give a total field of 12,288 dots (Fig. 1). The hardware for the example of Fig. 1 is built around the 2650 microprocessor and 16 k bits of refresh memory, with a full picture of 128 columns and 96 rows.



1. **Keeping picture information in RAM** is one way to design μP-based TV games. Here, a 16-k refresh memory loads a video register every 1.6 μs with data representing X and Y screen coordinates.

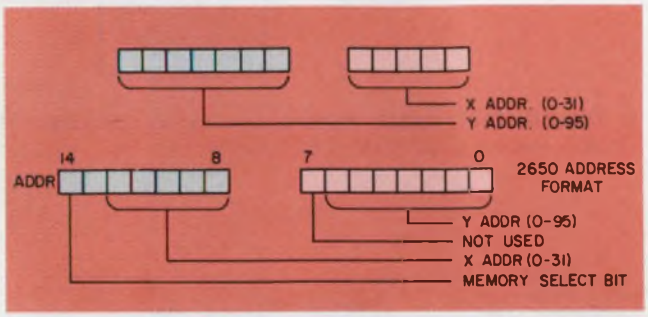
The refresh memory serves as a memory map for the television picture. Sitting, in effect, between the TV set and the microprocessor system, it can be accessed by both. The refresh memory is organized as 4 k × 4 for quick access. The dot position is represented horizontally by an X coordinate and vertically by a Y coordinate.

Each horizontal scan line takes 64 μs, with a dot width of approximately 400 ns. Vertically, there are 96 dots, with three picture lines per dot. A 4-bit video shift register is loaded with data from the refresh memory every 1.6 μs during the active picture period. These data are shifted into the TV with a 2.5-MHz clock. To change the stored picture, the μP can access the refresh memory in between the access required by the shift register.

All the signals necessary to access the refresh memory and form the picture on the TV screen are derived from the timing and control circuit, which also generates the 2650's clock and a program-interrupt signal that synchronizes the game every 16.67 ms.

Input/output accessories consist of a keyboard of 32 keys and four potentiometers, all read by the 2650.

Kam Li, Project Manager, μP TV Games, and **Alex Goldberger,** MOS μP Application Manager, Signetics Corp., 811 E. Arques Ave., Sunnyvale, CA 94086.



2. **The 12 bits needed to address** the refresh memory are divided into two ports: one for horizontal and the other for vertical information.

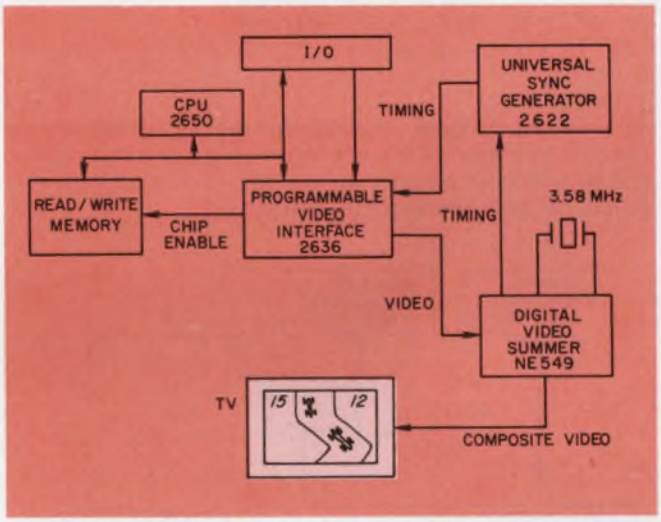
For that purpose, the keyboard is divided into four rows so that eight keys can be read at one time. The read signal also initiates an a/d conversion cycle for one of the four potentiometers. A 4-bit output port selects the potentiometer and keyboard row.

The address format

To address 4 k of memory calls for 12 address bits, which are generated by the refresh counter (C_0 to C_{11}) and the 2650 ($ADDR_\emptyset$ to $ADDR_6$ and $ADDR_8$ to $ADDR_{12}$). The refresh counter and the 2650 address the refresh memory alternately through an address multiplexer. The address of the refresh counter is divided into horizontal and vertical (X,Y) addresses, to give the following address format (Fig. 2):

C_{11}	=	$ADDR_6$	Y coordinate
C_{10}	=	$ADDR_5$	
C_9	=	$ADDR_4$	
C_8	=	$ADDR_3$	
C_7	=	$ADDR_2$	
C_6	=	$ADDR_1$	
C_5	=	$ADDR_\emptyset$	
C_4	=	$ADDR_{12}$	X coordinate
C_3	=	$ADDR_{11}$	
C_2	=	$ADDR_{10}$	
C_1	=	$ADDR_9$	
C_0	=	$ADDR_8$	

The 2650 uses one address bit, $ADDR_{14}$, to distinguish between accesses to the video refresh RAM and those for the scratchpad RAM used for normal program execution.



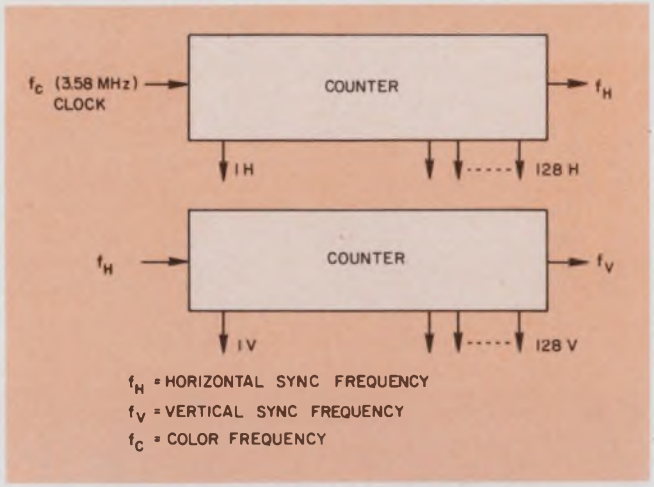
3. **Another approach to video games can be termed "object-oriented,"** rather than "dot" oriented. In the former method, the object-shape information is stored in a RAM, rather than the entire screen image, which saves on over-all cost.

Timing and control

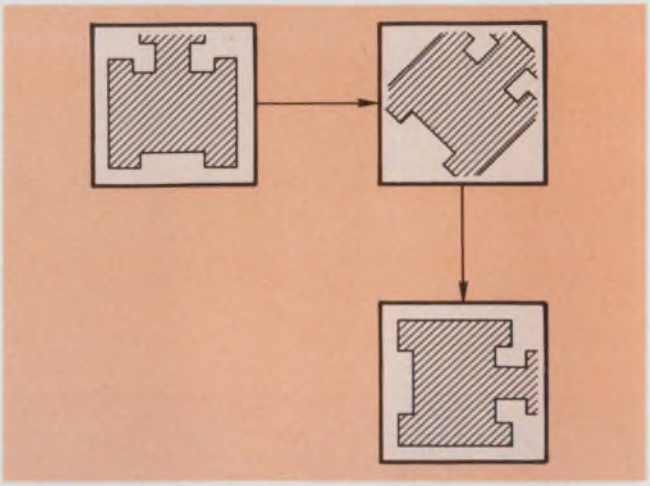
The most important game-control signal, the game-synchronization pulse, functions as an interrupt, INT_1, for the 2650 μP. Motion can be generated by the software, with this interrupt serving as a time reference. A program sequence starts when an INT_1 is received. All program functions are then carried out.

Programming is simplified if all the program functions can be executed between two program-synchronization interrupts, or within 16.67 ms. If exceeded, position changes of moving objects must occur in every other field, and motion can become jerky.

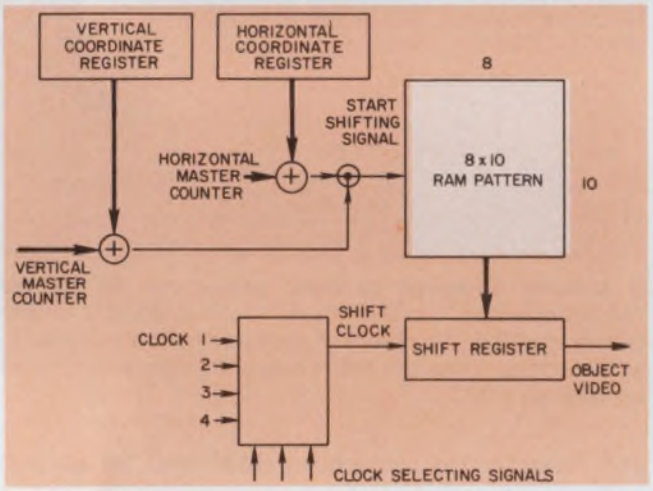
Other program-control signals include those for the 32 keys and four potentiometers. To select one keyboard row and one potentiometer, a 4-bit latch simultaneously enables the keys selected and one of the potentiometers. Port C of the 2650 (WRTC command) latches the vector (four bits of data). At the same time, a one-shot is triggered. The resulting pulse width depends on the value of the potentiometer selected.



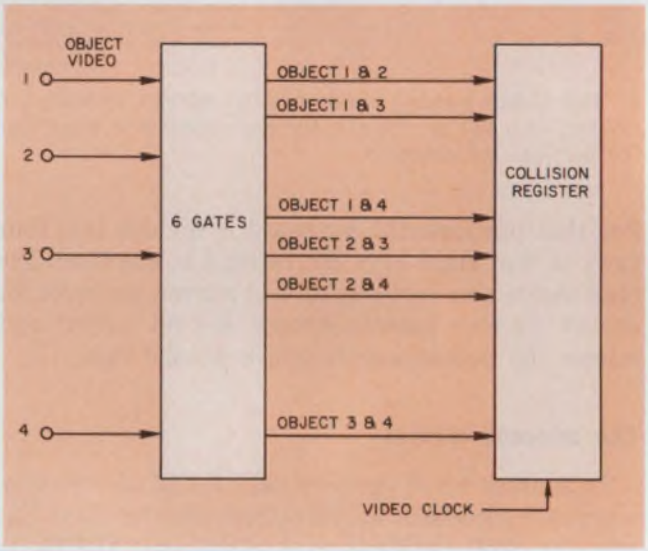
4. **Horizontal object positions on the TV screen** are derived from a 3.58-MHz clock by dividing down in a counter chain. A similar counter divides the TV's horizontal sync pulses to give the vertical positions.



6. **Objects that rotate** require successive displays of several patterns, as in this 90° swing.



5. **Size and location of the picture objects** are determined in an object module, four of which make up a programmable video interface. Object descriptions are held in 8 × 10-bit RAM patterns.



7. **Objects that collide** are detected with logic gates. To "combine" any two objects out of four requires six gates. Collision data are stored in a register read by the μP.

The falling edge of the one-shot pulse generates a second interrupt, INT_2.

The time between selecting the potentiometer and the falling edge of the one-shot (INT_2) is a measure of the potentiometer position, and can be determined under software control, thus performing an a/d conversion. Meanwhile, keyboard rows can be read. To perform various programming sequences or game events, the potentiometer can program analog variations in the game, while the keyboard provides game commands.

The potentiometers and keys are ready every 16.67 ms and take about 3.6 ms max to read and perform a/d conversion. The remaining 13 ms are used for interpreting the keyboard and potentiometer, calculating actions and—as a result—modifying the refresh memory. Only during the 1.6-ms frame-blank period is the mapped memory changed. During this interval, about 70 load, store or compare instructions, and their processing, can be executed.

Still, an object-oriented approach offers several advantages over a RAM-based approach. For one thing, more objects may be used, with their motions easier to control. For another, RAM requirements are minimal, so system cost is reduced.

In one object-oriented approach, a microprocessor reads the game stored in ROM and controls the video presented to the TV (Fig. 3). A programmable video interface (PVI) serves as a video generator, interpreting microprocessor commands and presenting video to the Video Summer Block. The VSB accepts digital video signals from the object block and generates either rf for a standard TV receiver or color-composite video for a TV monitor. A master timing generator

controls all four blocks.

The microprocessor communicates with the PVI over address and data buses. Basically, the PVI looks like part of the memory field to the 2650, which writes data into the PVI RAM field. The RAM stores object shapes, screen coordinates, colors and control information.

In turn, the PVI generates video signals that reflect the information stored in its control field. It also presents the 2650 with I/O and status information (e.g., object collisions) by writing the data into internal registers. The μP can then read the I/O and status information data from the registers and make decisions about game actions.

Setting up the timing

All timing circuits are generated from a 3.58-MHz clock by a Universal Sync Chip, which provides the various timings for the TV's vertical and horizontal oscillators. It also provides sub-multiples of the clock for more complex signals—those bearing a synchronous relationship to the movements of the electron beam.

A horizontal counter chain divides the frequency of the clock into positions 1H, 2H, 4H. . .128H (Fig. 4). A vertical counter chain is identical except that it counts horizontal sync pulses rather than 3.58-MHz clock pulses. A divider chain gives sub-multiples of vertical positions—1V, 2V, 4V. . .128V.

Four object modules comprise the PVI (Fig. 5), with each object module consisting of a pair of coordinate registers that specify where a particular object is to be shifted out. In addition, each object is described by a RAM pattern of 8 × 10 bits. A set of master counters and vertical and horizontal counters is available from the sync block to locate the electron beam at a given instant. When the coordinate registers match the master counters, the object pattern is shifted out.

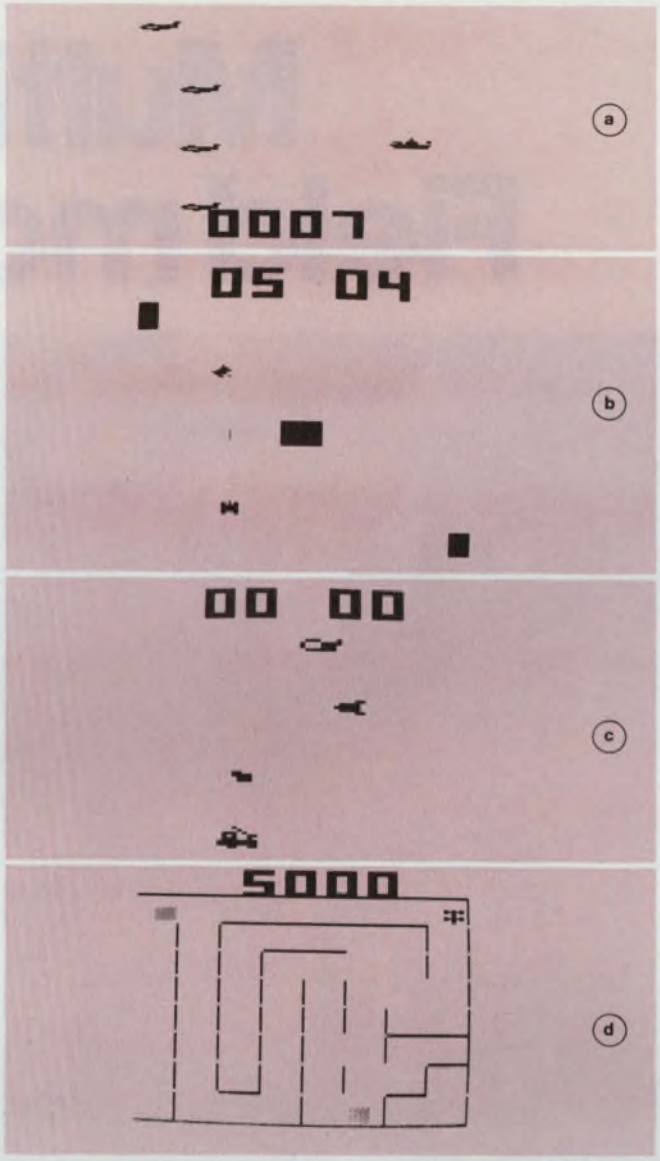
Object size depends on the program-controlled shift rate. Resolution depends on pattern size. Better resolution can be "painted" by a smaller pattern.

Objects are made to move by programming the microprocessor to change the object coordinate-register pair. Vertical motion occurs by incrementing or decrementing the vertical-coordinate register, and horizontal motion by incrementing or decrementing the horizontal-coordinate. In this way, two degrees of freedom are available for each object.

More complex games

Other motions, such as rotation, require more complex programming. For example, a rotating automobile will require several object patterns at different angles. A 90° rotation will need successive displays of several patterns (Fig. 6).

Colliding objects can be detected by hardware (Fig. 7). Four object video signals indicate the presence of each object. To detect all collisions takes 6 gates.



8. **The versatility of object-oriented games** is demonstrated by the variety at the designer's disposal—from jet planes strafing warships (a) to tank battles (b), bombing games (c), and road races (d).

The PVI's digital output is interfaced with a TV receiver by the Video Summer, a single chip. The 16-pin device accepts a binary code (color), along with sync, blanking, and burst information from the PVI and universal synchronizing chip. The IC then provides a 16-color composite video signal (including black and white) that interfaces directly with the rf modulator and is connected into the terminals of a standard TV receiver. (Sound is external to the TV.) Examples of video pictures of games using the object-oriented approach are shown in Fig. 8.

PVIs can also be concatenated in parallel to show more objects. This approach is particularly useful in coin-operated games, where turnaround time must be faster than for home games.■■

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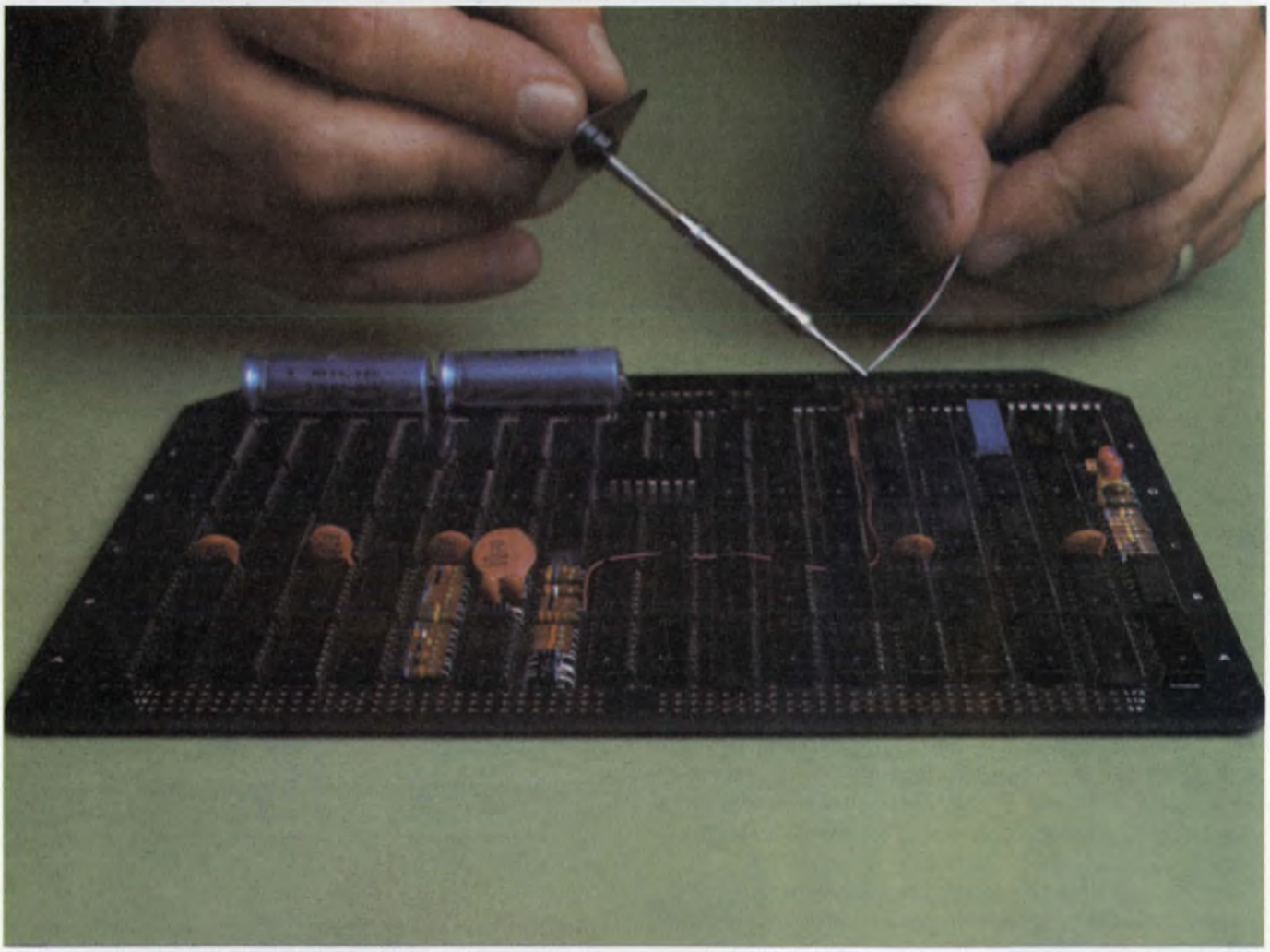

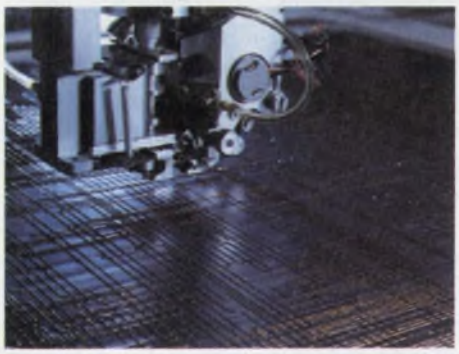

Of the many benefits offered by Multiwire, one of the most important is its simplicity of change and repair. Multiwire boards are normally easier to change after assembly or in the field than multilayer.

All wires are exposed in the typical Multiwire board. To make a change, use a blade to cut the conductor that you want to correct, and remove a portion of the wire to avoid bridging. Then, just solder in a jumper wire and fasten down with epoxy or urethane.

Changes in Multiwire boards can easily be accomplished in minutes by field service technicians.

Multilayer changes, of course, are an entirely different story. Corrections are difficult at best and frequently impossible. As one engineer familiar with multilayer puts it: "Corrections . . . are something of a disaster."

With Multiwire, to replace a discrete or DIP that has failed, the component

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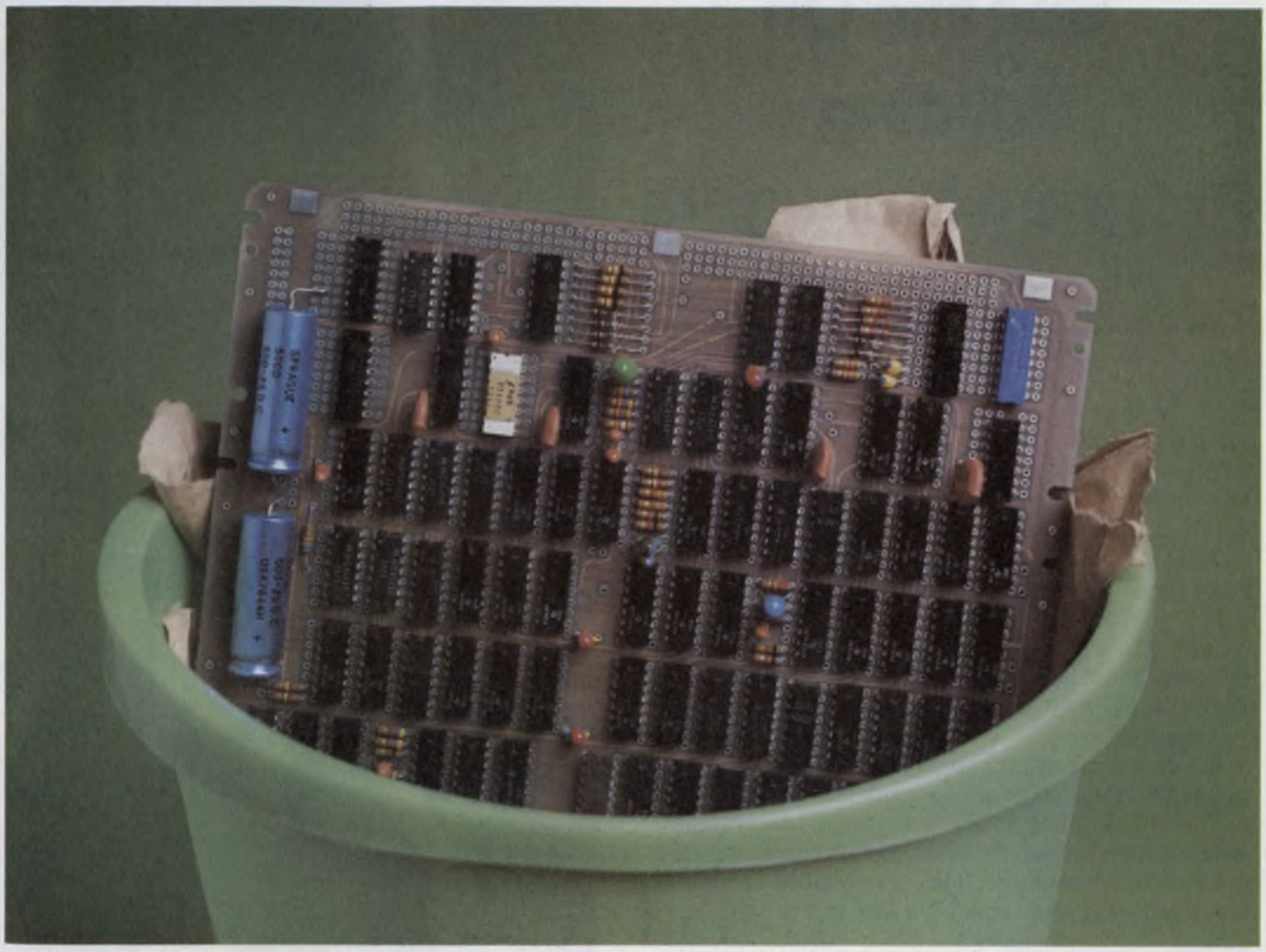

is simply unsoldered; the plated-through holes stand up just as well if not better than regular PC board holes. With multilayer, however, a soldering iron often lifts the land off the board, with many ensuing problems.

Of course, Multiwire will need fewer repairs to begin with. The Multiwire manufacturing method has far greater yield, usually better than 99% reliability at incoming inspection.

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CIRCLE NUMBER 52

Mal Northrup of Rockwell Speaks On Building Program Managers

Good program managers aren't born, they're trained. And one of the best sources of these managers are your own engineers. Their background and experience enables them to segment problems into manageable tasks. So they can put together individual solutions that represent the larger solution. And in any program you have to solve a series of problems before a program can be successfully concluded.

What are the main differences between a project engineer and a program manager?

For one thing, the project engineer is more concerned with a specific element of a system, while the program manager is more involved with the total business as well as technical portions of a large program.

In preparing your engineer for the program manager's slot you've got to teach him to see the big picture. He's going to have a vastly different perspective than he had when he was a line engineer. He's got to know about the total cost requirements and manufacturing limitations he has to live with.

He's got to be taught to take an active interest in all phases of design, not just that little subsystem he's been working on for a year and a half.

You've got to get him to understand the cost restraints on his design. He should know that there's no sense in designing a box too big for the market requirements or, as in our case, a chip that is larger than our competitors offer. That's certainly another key responsibility of your future program manager —to understand what the competition is doing.

Your future program manager should know that a unique product with some technical leverage and a 10 to 20% cost advantage might have a market life of three years. However, two months later a competitor may be on-line with a product that is 25% under your cost. It doesn't matter whether it's a component or a large system, whether it's a capacitor or telephone switching computer. The same competitive pressures are there.

Cost estimating a project is one of the key responsibilities of your program manager. He must see that his projects don't overrun. This is one area for which he is best qualified, since he has had to be cost-conscious since he started working in industry. As an

engineer he had to determine how much time and expense it was going to involve doing the whole job or just a portion. As program manager, he no longer will have hands-on relationship to the project; he's not going to select the individual components that make up the product. Instead, he's going to have to rely on the estimates of others for the total project cost.

Your engineer needs to know that as program manager he's going to have to interface with a variety of customers who in many cases may be technically naive. A customer may be a neophyte in a particular area of electronics. His engineering requirements may be conveyed on the back of an envelope. He may draw a picture and scribble a few words of what it is he'd like done. In fact, you might remind your budding program manager that that's just the way the early calculators were designed: "I want a 4-function machine that adds, subtracts, multiplies and divides, and I'd like it to have batteries that last a certain amount of time. And it should look nice." Bidding on a project like that is far different from receiving a finished specification from a customer.

Your program manager has to be able to recognize what he needs to do the job. He has to be able to say to the customer: "I don't have enough information. Tell me what you need."

As a program manager, your engineer has got to remain objectively analytical in looking at the customer's needs. That doesn't mean that he cannot stand up and say, "Wait! I must have a better definition of what you want, what your environmental specs are, what your output requirements are." But he has to do this in an objective way. Not as an adversary.

Finally, he must make his customer aware of any problems that might delay his project or might affect the final design. His customer must be made aware of progress and delays. It's not always going to make him happy, but it's better than a surprise.

In preparing your engineer for a program management slot, teach him to avoid confrontation techniques. In getting his message across, he must have a story, a plan, facts and figures. If he recommends a product change, he has got to have backup data available. What will the impact be on scheduling? Frequently he'll be frustrated because the program will not change direction.

In all my years as an engineer manager, I found that one of the best tools I had was the ability to present complex data in graphical or pictorial form.

Your program manager can't waste time trying to explain or manipulate data. Teach him to find a way to graphically plot the data so that it's visible and readily understandable to everyone, whether it's to the customer, head of engineering operations or vice president of sales. An exploded pictorial drawing, for example, may show labor times and dollars associated with each of the various product elements—assemblies, subassemblies, packaging, wirebonding, and so on. Because of his training and analytical approach, your engineer has a natural ability to break down these program factors into meaningful chunks that people can understand. By teaching your engineer properly to employ the graphical-presentation method, when he gets to be a program manager he can use it to recognize trend data immediately. It's going to be the key to his success.

A key point to impress upon your engineer is that while he may have been completely at home in the development phase of a project —as program manager he just won't have direct technical and management control.

Frequently, nobody is going to report to him directly, yet he will have ultimate responsibility for the outcome of the program. He may have to figure out how to redirect a program that isn't meeting requirements.

Your program manager will often have full accountability for the profit-and-loss performance of the program. To achieve this he will interface with different departments within the company.

He's got responsibility, but only indirect authority. What this means is that your program manager must be able to achieve results through others—the real key to professional management.

The quickest way to assure a product failure is to stick your engineer into a cubby hole where he simply passes his work across the transom to someone in manufacturing. Get your prospective program manager involved in the total manufacturing process.

It's okay to design a component or system, say, in the privacy of an office, but it's another thing to get it on the production line and get working products of hundreds and thousands or more. It may be simple to build one prototype but it's far different building even ten by people who don't have the gut-care level that your engineers have in that design.

Get him to spend some time in production control and industrial engineering. You can be sure they will explain to him that his "perfect" design is not necessarily built in the way he intended. Make him aware of what the limitations of the factory are.

If your manager is lucky enough to have a high dollar impact on shipments, he may get favored treatment. If not, he has to be aware of this and be able to tell what the scheduling requirements are in the factory. He has to be able to know quickly when he needs additional support from engineering to solve problems in the factory.

As program manager he cannot simply pass off a project to production but must insure that what he gives production is fully characterized and will meet all the test requirements with margin to spare. He

Who is Mal Northrup?

When discussing his education, Malcolm Northrup points out that he was something of a prodigy. "It took me nine years to get a four-year physics degree."

Northrup's educational time-machine started in 1958 when he quit school during his first year at California's San Jose State and joined Ampex in Redwood City as a draftsman. "Working looked like more fun than college at the time," he reminisces. He quickly found out that he had made his first career mistake and began taking night classes at Santa Monica City College. Meanwhile, he moved ahead at Ampex as designer of magnetic tape peripherals and in 1962 was recruited by Collins Radio in Cedar Rapids, IA to design magnetic-tape equipment. During the next four years, he attended Coe College in Cedar Rapids, concentrating on physics while working full time for Collins. He had completed all the technical requirements for his degree when he was transferred to Collins' Computer Systems Division in Dallas in 1966. Working full-time as a mechanical engineer on the company's disc-file project and on the DC-10 flight-data storage project, Northrup also took on a full load at Southern Methodist University in Dallas. He finally won his B.S. in Physics with honors the following year, when he was 31.

"It's a tough way to get your degree," Northrup says, "but it did have the advantage of keeping me current in technology, something that is often difficult for a working engineer to achieve."

In 1970, Northrup became mechanical engineering group manager—Disc and Tape. In 1971, two years before Collins became part of Rockwell International —a company that grossed about $5 billion in 1976— Northrup moved to the Microwave Division in Dallas, serving first as mechanical group manager and later as department manager, Mechanical Design and Product Documentation. In February of this year, Northrup was appointed vice president, Micro-electronic Devices in Rockwell's newly formed Electronic Devices Division.

Northrup lives in Mission Viejo, CA with his wife, Jan, and two of his five children; Amy, 6, and Christian, 8. He enjoys building his own furniture. "It's so malleable, not like metal. And it's a tremendous frustration release." He's currently refinishing an old wooden icebox which he bought in Dallas for about $100. "It would cost about $800 unrestored around here," he says.

For Northrup, on-going education is still a preoccupation. His own interests are now in advanced-management courses and seminars. He also works to encourage his people constantly to update their education through night or company courses. "Three days after joining Ampex, I knew a lot about the importance of education and during the years I worked on my degree, I learned that new ideas and thinking —as well as knowledge—were what make work fun," he says.

must be trusted in the factory. If a problem comes up they know they can go back to him and work on the problem until it's solved.

Your engineer as a program manager must demand more in the area of product testing.

Looking back to when I was a design-engineer, I remember the most satisfying part of my work was to create the raw design. This said I've got a way to solve a particular problem. And probably one of the least palatable parts of the job was to sit down and wring out the design model and figure out whether it had margin in all the areas in which it's supposed to have margin—a tough job. In-depth product testing is a prime responsibility of the program manager, as well as the engineer.

A man who had a great deal to do with influencing my thoughts on engineering once told me that you have two responsibilities as an engineer. One is that you must first prove that your product or idea can work. Then you have to prove that it can't fail.

In today's world of product liability this philosophy becomes a burning issue in every business. Teach your program manager to make darn sure that what comes out of the factory isn't going to be sent back by the customer. Or worse, that it will need to be serviced on the customer's facility or in his system.

The engineer who understands the total perspective of what his job is—which is to bring a product out of the factory and have it delivered to his customers with a minimum number of problems and maximum reliability—is the guy who, when he's program manager, is going to be able to deal with those problems very quickly. He's going to understand where the holdups are; he'll be able to read the signs very early.

Finally, get your engineer more involved in the marketing aspects of your company's business. Engineering says what can be made and is concerned about the product performance. Marketing on the other hand, is concerned as to whether or not the product can be sold. These views aren't necessarily compatible.

The isolation between marketing and engineering these days is far less than what it was 10 years ago. Today, marketing people don't feel any compulsion to stay away from engineering when they feel they have a customer input relating to an aspect of product design. The program manager avoids these inputs only at his own peril.■■

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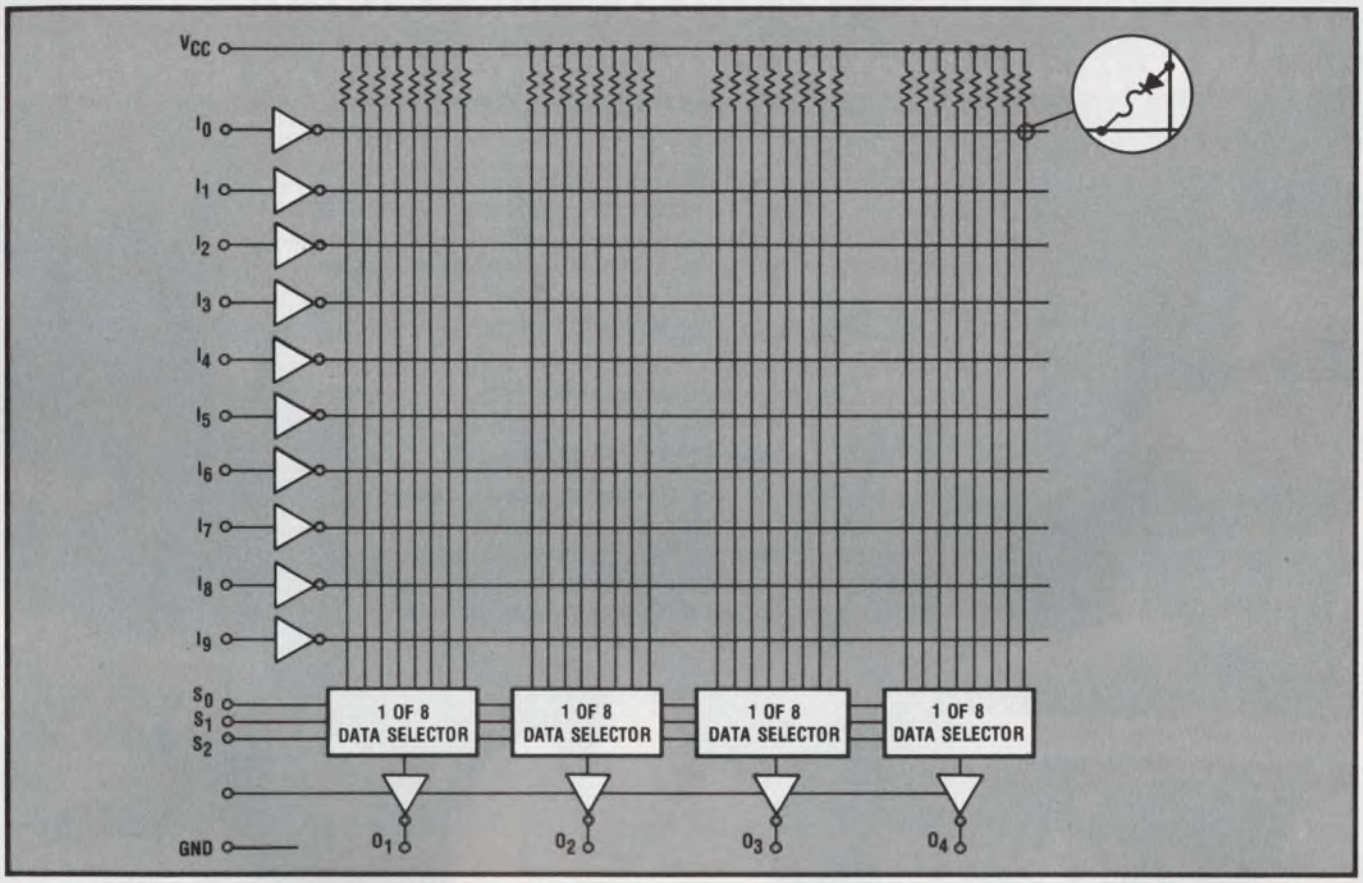

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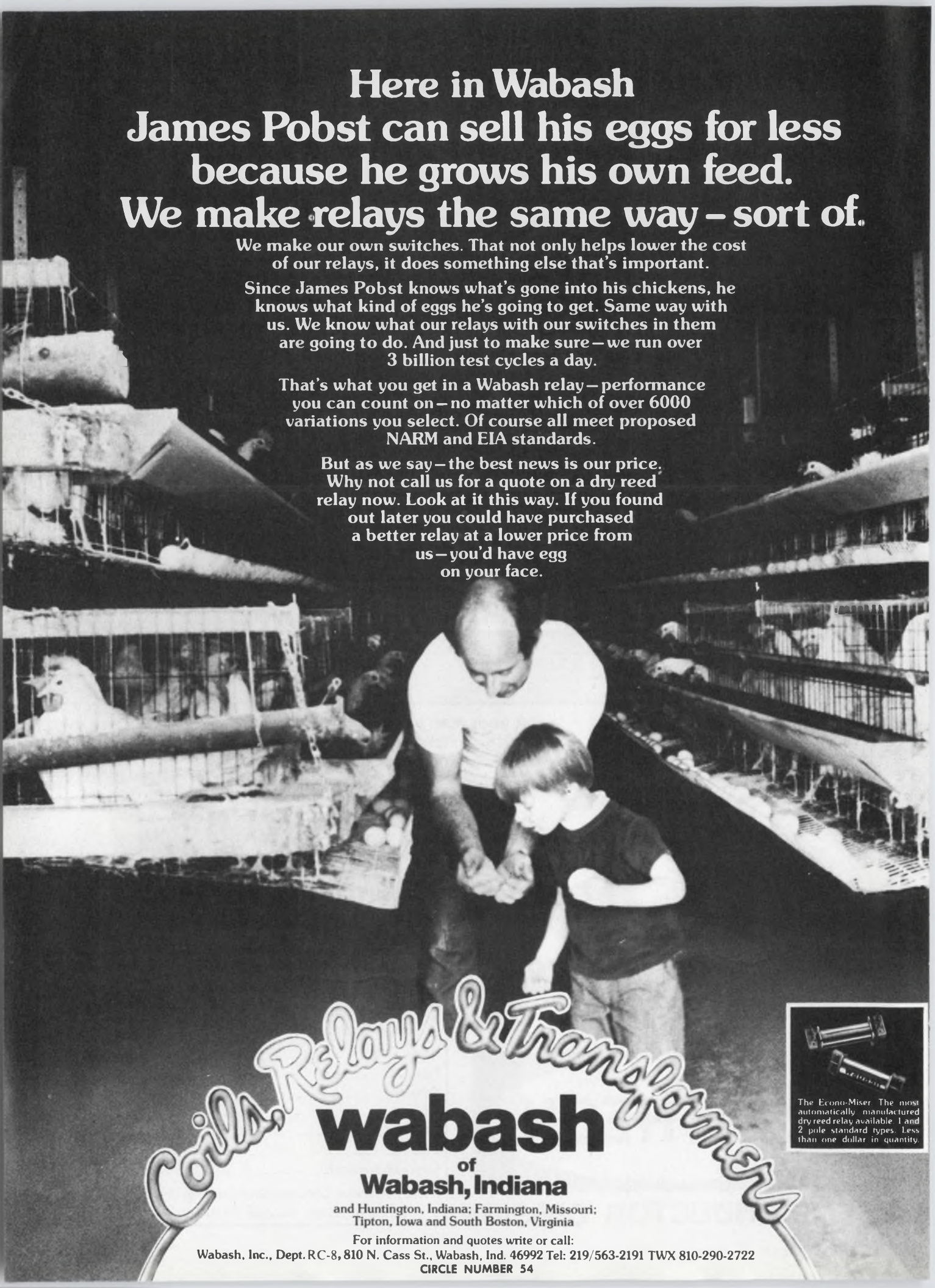

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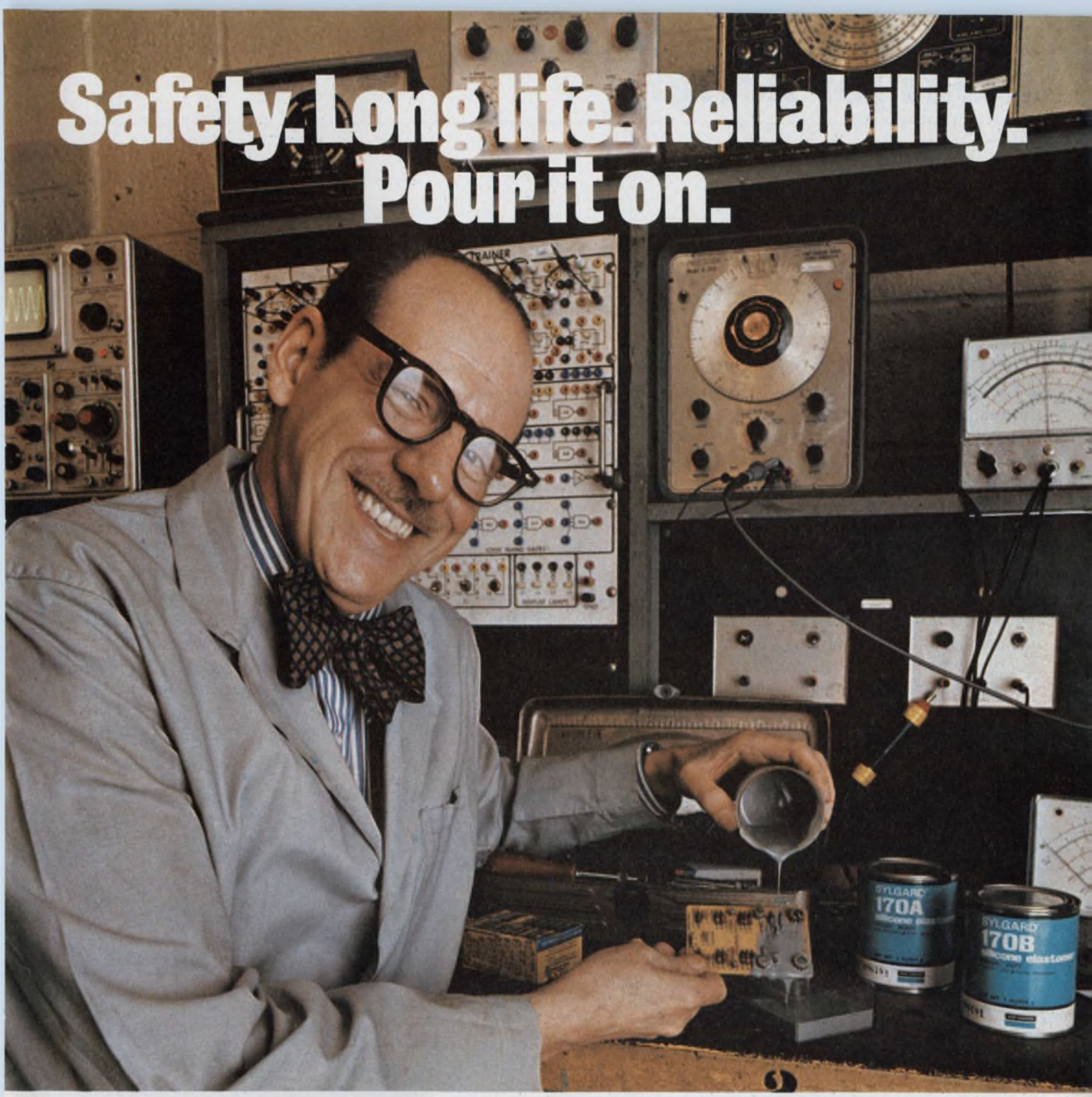

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CIRCLE NUMBER 55

Game timer generates coasting pulses positively clamped to prevent a glitch

The Idea for Design, "Timer Pulses Coasting to a Stop Heighten Electronic Game Realism" (ED No. 5, March 1, 1977, p. 78), has proved useful to many readers. But the circuit has one operational handicap that may prove annoying—and costly. Just when you think the oscillator has finally stopped, the timer pulses once more. However, a second 555 (or the second half of a 556) can provide a positive fix (see figure).

Pressing and releasing switch S_1 charges a low-leakage capacitor, C, which in turn supplies charge to another smaller low-leakage capacitor, C_1, at an ever-decreasing rate. Thus, the frequency of IC_1's output diminishes gradually. When C can no longer supply enough charge to recharge C_1 to $\frac{2}{3}$ V_{CC}, the trip level of the 555's internal comparator, oscillations cease with the output of IC_1 remaining HIGH.

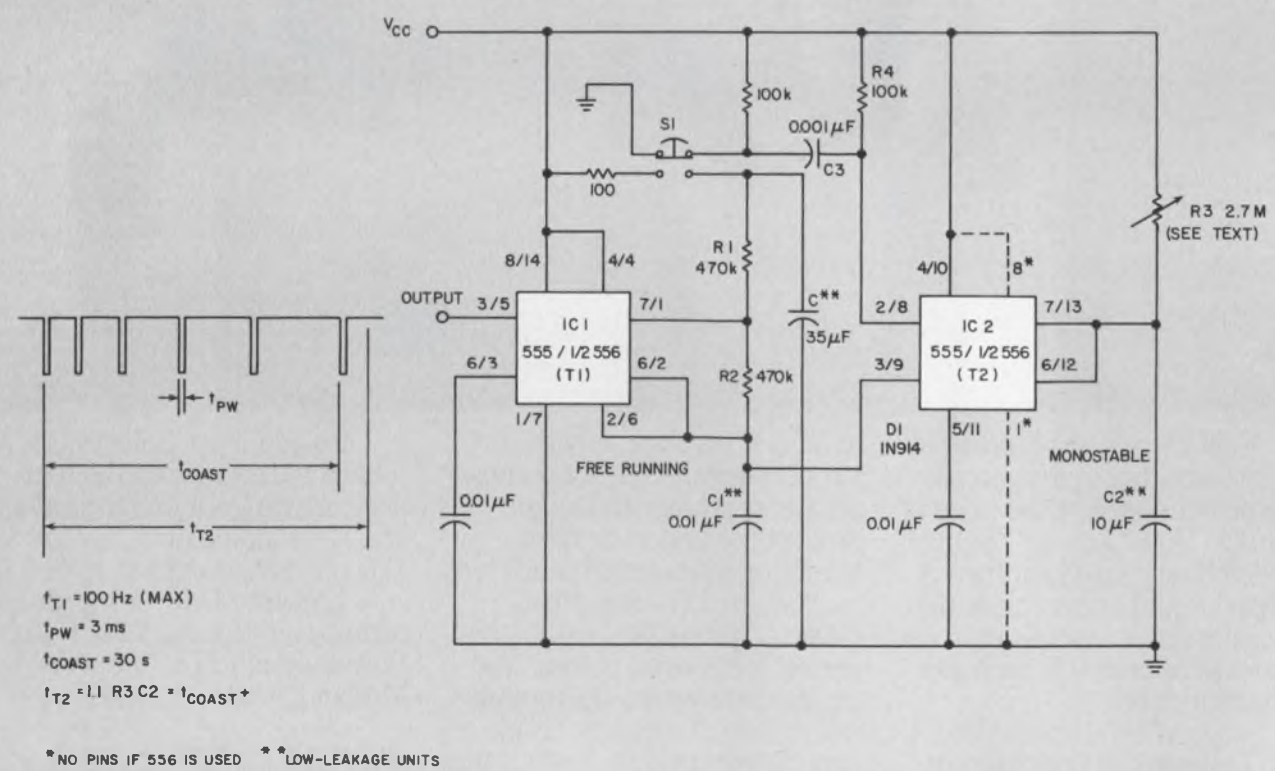
When S_1 is released, timer IC_2, which is configured as a monostable, is triggered through differentiator R_4C_3. Its output remains HIGH for time t_{T2}, which is slightly greater than the desired coast time, t_{coast}, of IC_1. The output of IC_2 (pin 3/9) couples via D_1 to timing capacitor C_1.

When IC_2 times out, its output goes LOW and clamps C_1 to a value less than $\frac{2}{3}$ V_{CC}. This clamping action positively inhibits timer IC_1, whose output remains HIGH until it is again triggered by S_1.

With capacitor C_2 equal to 10 μF, R_3 should be set to about 2.7 MΩ for t_{T2} to slightly exceed a t_{coast} of 30 s. Timer IC_1 supplies 3-ms pulses over the entire 30-s coast period with the values shown in the figure.

William D. Kraengel, Jr., Electrical Engineer, Ground Systems Equipment Corp., 65 Sunset Rd., Valley Stream, NY 11580.

CIRCLE NO. 311



A train of constant-width pulses at a gradually diminishing rate is produced by timer IC_1. When IC_1 finally coasts to a stop, it is clamped by IC_2, which operates in a monostable mode. The clamping action ensures that the pulses from IC_1 will be positively stopped.

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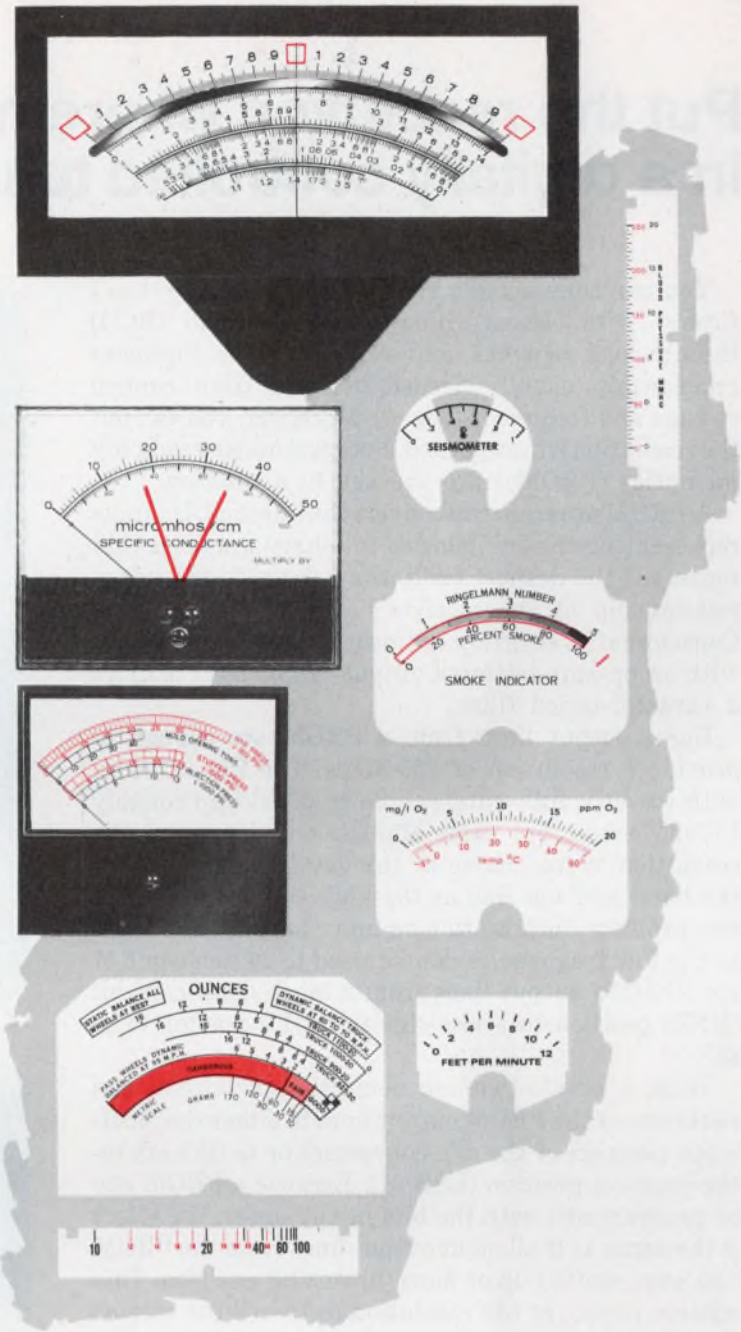

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Put the resolution where needed in a digitally controlled tuning system

You can tune a radio receiver using voltage-tuned filters with linear binary-coded-decimal (BCD) thumbwheel switches, and still obtain the nonlinear relationship usually needed between filter control voltage and frequency (Fig. 1). Moreover, you can put the resolution where needed. Programmable read-only memories (PROMs) are the key to a solution.

A PROM program can convert the linear BCD inputs representing the frequencies to binary numbers that represent the desired nonlinear voltage-to-frequency relationship of the receiver's voltage-tuned filters. Consequently, an ordinary linear binary d/a converter with an op-amp-buffered output can be used to drive a varactor-tuned filter.

Eight output lines from a PROM are enough to provide a resolution of 256 steps. The Fig. 1 curve, with its 40-V full scale, can be resolved into roughly 150-mV steps. For some applications, however, this resolution is too coarse at the low-frequency end of the band and too fine at the high end. To overcome this problem, information on input lines to the PROM at the low frequencies can be used to switch some of the PROM's output lines from a most-significant-bit (MSB) position to a less-significant-bit positon (Fig. 2a).

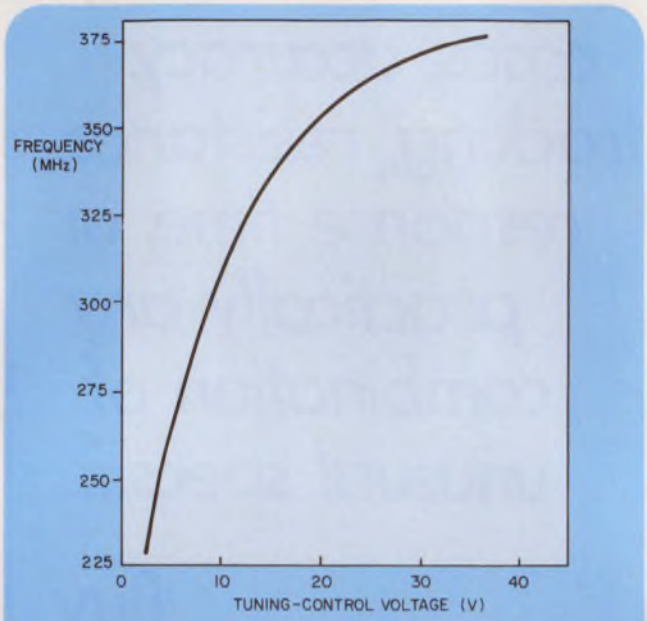
Thus, a one-to-two-line demultiplexer circuit can route one of the PROM output lines to either the MSB-input position of the d/a converters or to its next-to-the-least-bit position (LSB+1). Because a PROM can be programmed with the bits in any order, the effect is the same as if all eight output lines from the PROM line were shifted up or down by one bit position. This scheme improves the resolution to 75 mV per step at the low-frequency end (from 225 to 299 MHz in Fig. 1), but leaves the resolution unaffected at the high-frequency end (above 300 MHz).

Fig. 2b extends the technique by rerouting two PROM output lines, A and B. Since neither the MSB nor the MSB−1 bits in the example of Fig. 1 are used from 225 to 299 MHz, both PROM lines are switched to the LSB+1 and LSB positions, respectively, of the d/a converter in this frequency range. In addition, since the MSB is not used between 300 and 339 MHz, only the MSB−1 is switched to the LSB position.

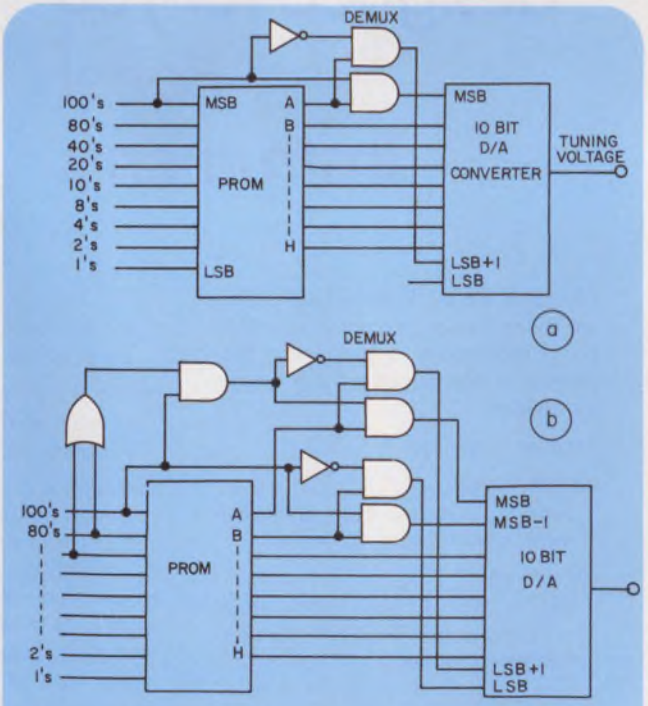
Thus this two-bit demultiplexing scheme provides a resolution of 37 mV from 225 to 299 MHz, 75 mV from 300 to 339 MHz and 150 mV from 340 to 399 MHz.

Carl Andren, Senior Principal Engineer, E-Systems, Inc., 1501 72 St. N., P.O. Box 12248, St. Petersburg, FL 33733.

CIRCLE NO. 312



1. **Most voltage-tuned receivers have a nonlinear relationship** between the control voltage and tuning filter's frequency.



2. **Unused low-order (LSB) input bits** to the d/a converter are used at the low frequency end of the range, where they are needed to improve the resolution. Either one bit (a) or two bits (b) can be multiplexed in this way to enhance resolution.

The Complete Solution to your F3870 and F8 Design-In Problems

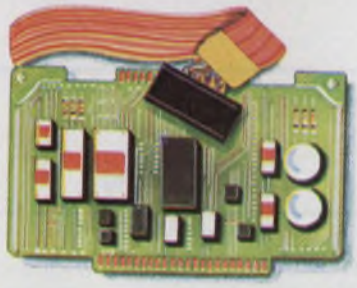
The Formulator Development System

The Formulator family is designed to allow easy, efficient software development and real time hardware simulation of F8 or F3870 based systems. It is supported by a complete line of functional modules including memory, I/O and simulation cards that plug directly into the Formulator cardframe.

The Formulator can, itself, be used as the system breadboard. It provides microprocessor hardware, plus card slots for breadboarding your system. Thus the entire system may reside within the Formulator or in a combination of external and internal configurations.

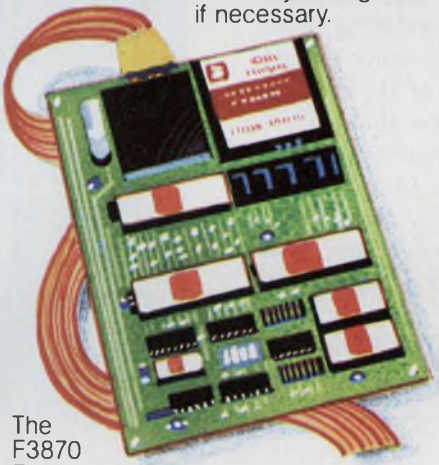
In-Circuit Emulation

To develop, test and debug F8 and F3870 based products, Fairchild offers simulation options that extend the functional features of the microprocessor from the Formulator to the 40-pin socket on your breadboard. This allows complete ROM firmware development, real-time symbolic debugging of your breadboard and freezing of ROM codes during the breadboard stage.



PROM Prototypes

The 3870 Emulator is a PROM-based substitute for the F3870 microprocessor. The Emulator measures 5" x 7" and contains two 2708 or 2716 EROMs in place of the F3870 so ROM codes can be verified and easily changed if necessary.



The F3870 Emulator plugs directly into the F3870 40-pin socket in the production prototype via a short cable.

Powerful and Complete Software

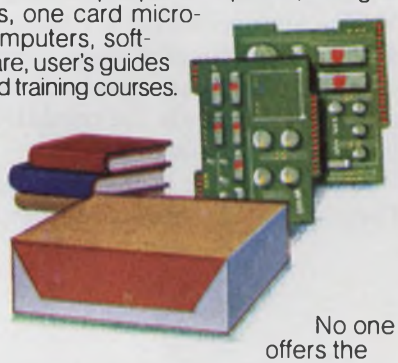
The software consists of an operating system, utility programs and diagnostic routines; a monitor, text editor, assembler and debug package. It includes linking loader and relocating assembler and will operate in interactive or batch mode. The result is an easy to use, reliable, fast and extremely efficient capability for microprocessor based system development.

The Formulator-Floppy Disk Marriage

An inexpensive plug-in module interfaces the Formulator with up to four plug-compatible ICOM Floppy Disc Drives, providing over one megabyte of storage. If you prefer other Floppies an application note provides the information necessary to modify Drivers for your system.

And That Isn't All

There is a lot more to Fairchild's line of design aids: PCB modules, memory options, PROM programmer, application and peripheral options, design kits, one card microcomputers, software, user's guides and training courses.



No one offers the extensive F8 and F3870 support that you can get from Fairchild. Just ask us about it.

Fairchild Instrumentation and Controls, a division of Fairchild Camera and Instrument Corp., 1725 Technology Drive, San Jose, California 95110 (408) 998-0123, Ext. 220.

FAIRCHILD

CIRCLE NUMBER 58

Electronic car-alternator regulator built with low-cost discrete components

Unlike the car-alternator regulator described in the Idea for Design, ED No. 15, July 19, 1977, p. 100, here's one that uses just three discrete transistors and a few other low-cost parts—much less than the $30 you'd have to shell out for a commercial unit. The circuit may be assembled on a small bracket with the power transistor's case directly grounded (see figure).

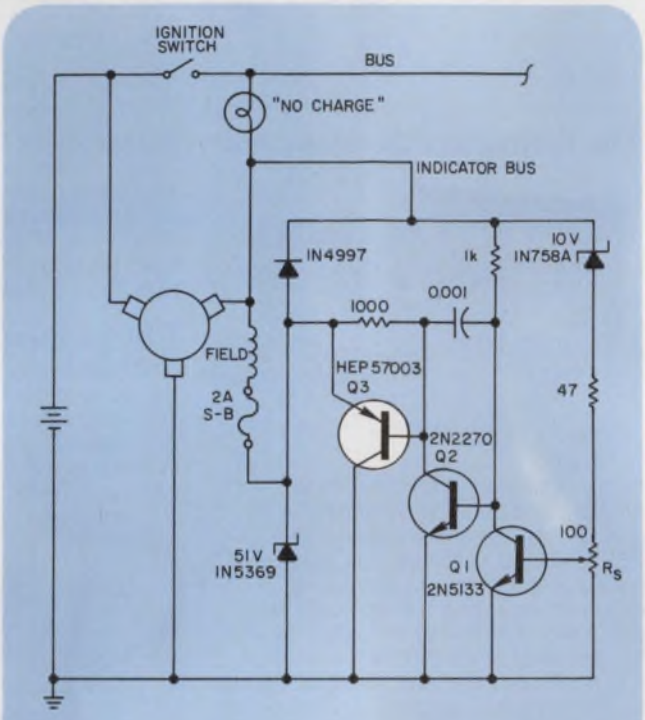
Power transistor Q_3 is in an emitter-follower configuration that drives the alternator's field. Both Q_3 and Q_2 are initially on when the key is on and the engine isn't running. Field current at this time flows via the "idiot" light from the battery.

When the engine is running and the indicator-bus voltage rises sufficiently to cause the 10-V zener diode to conduct, Q_1 turns on, which turns Q_2 and Q_3 off. Transistor Q_1's on threshold is set by potentiometer R_S, which determines the circuit's regulating level.

Temperature sensitivity of the 10-V zener is compensated by the base-to-emitter drop of Q_1. From 23 to −40 C, the zener's voltage decreases about 0.5 V, while Q_1's base-to-emitter voltage increases about 0.1 V. The approximately 4-V potential at the top of the 47-Ω resistor must thereby increase by about 0.6 V —which more than cancels the zener's decrease. Usually, the 0.1-V rise in the regulated voltage that results is entirely satisfactory.

K. C. Herrick, Chief Engineer, ESI Electronics Corp., 1258 Fitzgerald Ave., San Francisco, CA 94124.

CIRCLE NO. 313



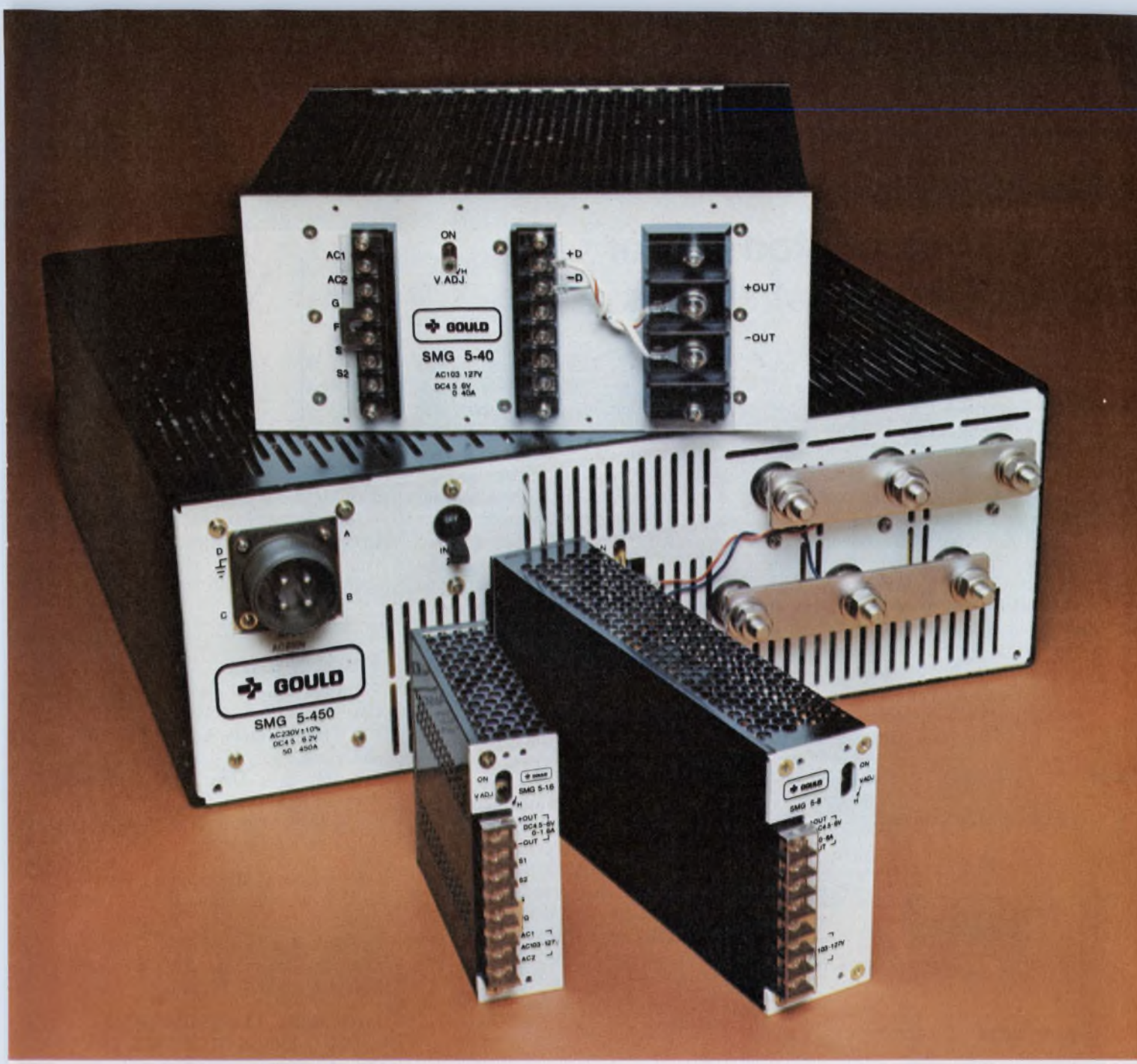
The power-transistor case can be directly grounded in this simple car-alternator regulator circuit.

IFD Winner of August 2, 1977

Durward Priebe, Principal Engineer, R&D Laboratory, Hewlett-Packard, 5301 Stevens Creek Blvd., Santa Clara, CA 95050. His idea "Reduce Ground-Loop Problems in Safety-grounded Instruments" has been voted the Most Valuable of Issue Award.

Vote for the Best Idea in this issue by circling the number for your selection on the Reader Service Card at the back of this issue.

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



Gould introduces a new range of switching power

Gould's new SMG series lets designers switch to smaller, lighter, more efficient switching power supplies without buying more specs than are needed.

Eighteen new SMG models give the Gould line both wider wattage and a lower price range while maintaining the reliability demonstrated by more than 40,000 Gould units now in use.

The SMG series offers outputs from 8 to 2,250 watts in a wide selection of voltage/current combinations. Units rated above 500 watts are fan cooled and are front panel selectable for 110 or 220 VAC.

All SMG units have short circuit and over-voltage protection. Temperature stability and voltage regulation are outstanding. Holdup protection is as high as 63 milliseconds. There's even an LED "on" indicator on the front panel of every unit.

For complete information contact Gould Inc., Electronic Components Division, 4601 N. Arden Drive, El Monte, CA 91731 or phone (213) 442-7755. TWX 910 587 4934.

Gould.
The power in switching power supplies.

GOULD

CIRCLE NUMBER 59

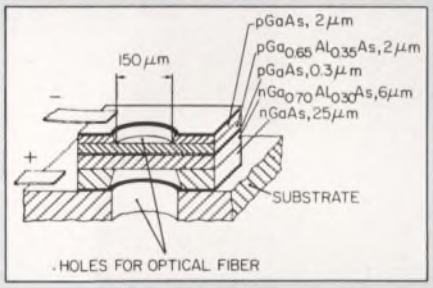
Epitaxial photodetector catches optical signals

A transparent photodetector provides a simple means of picking off optical signals in the middle of a fiber-optic data link. In fact, signals can be picked off more easily than by using an optical branching unit or by breaking a fiber and inserting a detector along with an amplifier for driving a second light source to relaunch the signals. The transparent photodetector, developed by AEG-Telefunken, West Germany, is a diode with an epitaxial structure similar to that of the double-heterostructure configuration used for gallium-arsenide lasers.

The GaAs absorption layer is only 0.3 μm thick to keep attenuation below 1.5 dB. This layer (third from the bottom in the figure) is sandwiched between layers of gallium-alluminum-arsenide that are transparent for wavelengths down to about 650 nm. The over-all diode thickness is kept below 10 μm to minimize fiber-to-diode-to-fiber coupling losses that increase as the ends of the two fibers are separated.

The diode's layers are grown on a (100) gallium-arsenide substrate, and gold-germanium-nickel and gold-zinc contacts are added to the n and p sides, respectively, of the wafer. Chemical etching produces 150 μm diameter holes that are transparent. To minimize reflection losses, one-quarter-wave layers of silicon dioxide are evaporated on both sides of the detector.

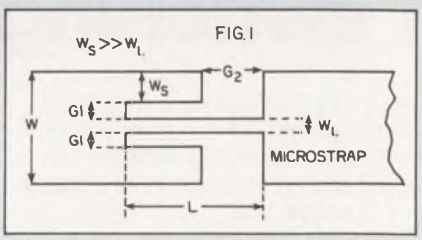
So sharp is the absorption edge of the diode at 860 nm that the diode works well with gallium-arsenide lasers, which limit from 820 to 840 nm. In this range, transmission reaches 70%. Prototype devices have a 2-ns pulse rise time at 9-V reverse bias, but this rise time is expected to be made less than 1 ns by reducing the contact area on the p side, thus reducing junction capacitance.



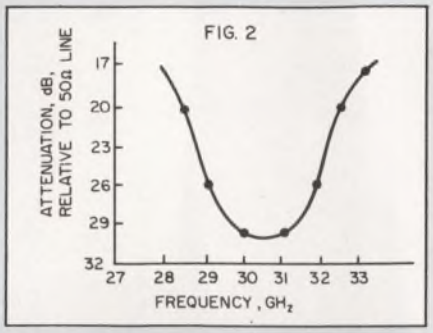
Radiation and losses cut with bandstop filter

A novel bandstop microwave filter overcomes the undesired radiation and losses produced by conventional microstrip filters formed from open-circuit stubs. These losses can be severe above X-band—the new filter can be used up to 40 GHz.

Developed at the Philips Research Laboratories in Surrey, England, the filter is constructed by forming the pattern shown on the microstrip in Fig. 1. The bandstop filter is one-quarter wavelength long, and has an optimum bandwidth for W_L = 40 μm and G_1 = 60 μm—parameters important for obtaining tight coupling and high isolation. For a 30-GHz center frequency, L is 800 μm and G_2 is 100 μm. The width of W_s is not critical, but should be much greater than W_L.



Peak attenuation can be made to exceed 30 dB (Fig. 2) with a greater than 17-dB loss over a 10% bandwidth. What's more, bandstop filters constructed for the 26 to 40-GHz range all exhibit much less radiation than equivalent open-stub filters.



Trade Shows

Pollution Control and Instrumentation Exhibition (Envirotrol '78)—U.S. Trade Centers, London, Apr. 3-6, and Paris, Apr. 11-14.
Sponsor: U.S. Dept. of Commerce. Contact: R. Connan, Office of International Marketing, U.S. Dept of Commerce, Washington DC 20230.

International Electronics Show—Grosvenor House, London, Feb. 14-16, 1978.
Contact: M. Seligman or H. Buchholz, Creative Resources, 2000 S. Dixie Highway, Miami, FL 33133.

Instruments, Electronics and Automation Exhibition (IEA-ELECTREX '78)—National Exhibition Center, Birmingham, England, Mar. 13-17, 1978.
Sponsor: Industrial and Trade Fairs Ltd. Contact: P. Lowndes, publicity manager, IEA-Electrex '78, The International Electrical, Electronic & Instrument Exhibition, National Exhibition Center, Birmingham, England.

Energy sources sought

The Swedish Energy and Research Development Commission has proposed a three-year program of research and development on new energy sources, including the sun, wind and biomass (conversion of waste materials).

The program, if adopted, will cost the equivalent of $200-million.

DDC has developed the world's fastest hybrid 12 bit and 8 bit data acquisition components. The 12 bit has a throughput rate of 450 kHz and the 8 bit has a throughput of 900 kHz. Each consists of two compatible stand-alone 24 pin DDIP modules: an A/D converter and a track/hold or sample/hold amplifier.

The 12 bit ADH-8516 Analog-To-Digital Converter has a conversion time of 1.8μs and 0.012% linearity. It is the smallest Hi-Rel A/D available that also includes 3-State outputs for microcomputer interfacing. With the matching ADH-050 Video Track and Hold Amplifier a super-fast acquisition time of 120ns is achieved. Aperture time uncertainty is a low 500ps. Buffering and pin programming allow many differential and single-ended input options.

The 8 bit data acquisition components include the ADH-8512 A/D Converter which features a 950ns conversion time. The matching SH-8518 Sample and Hold Amplifier has a 25ns acquisition time and a 60ps aperture uncertainty.

Both data acquisition component sets are well suited for military, aerospace and telecommunication applications. All DDC hybrids are processed to MIL-STD-883 requirements to perform under the most extreme environments. DDC also designs custom card mounted multiplexed data acquisition systems. Call your nearest DDC representative listed in EEM, or call Mike Andrews at (516) 567-5600.

DDC

ILC DATA DEVICE CORPORATION

A Wholly Owned Subsidiary of ILC Industries, Inc.

ILC DOVER is the sole designer and manufacturer of the Apollo Skylab and Shuttle space suits

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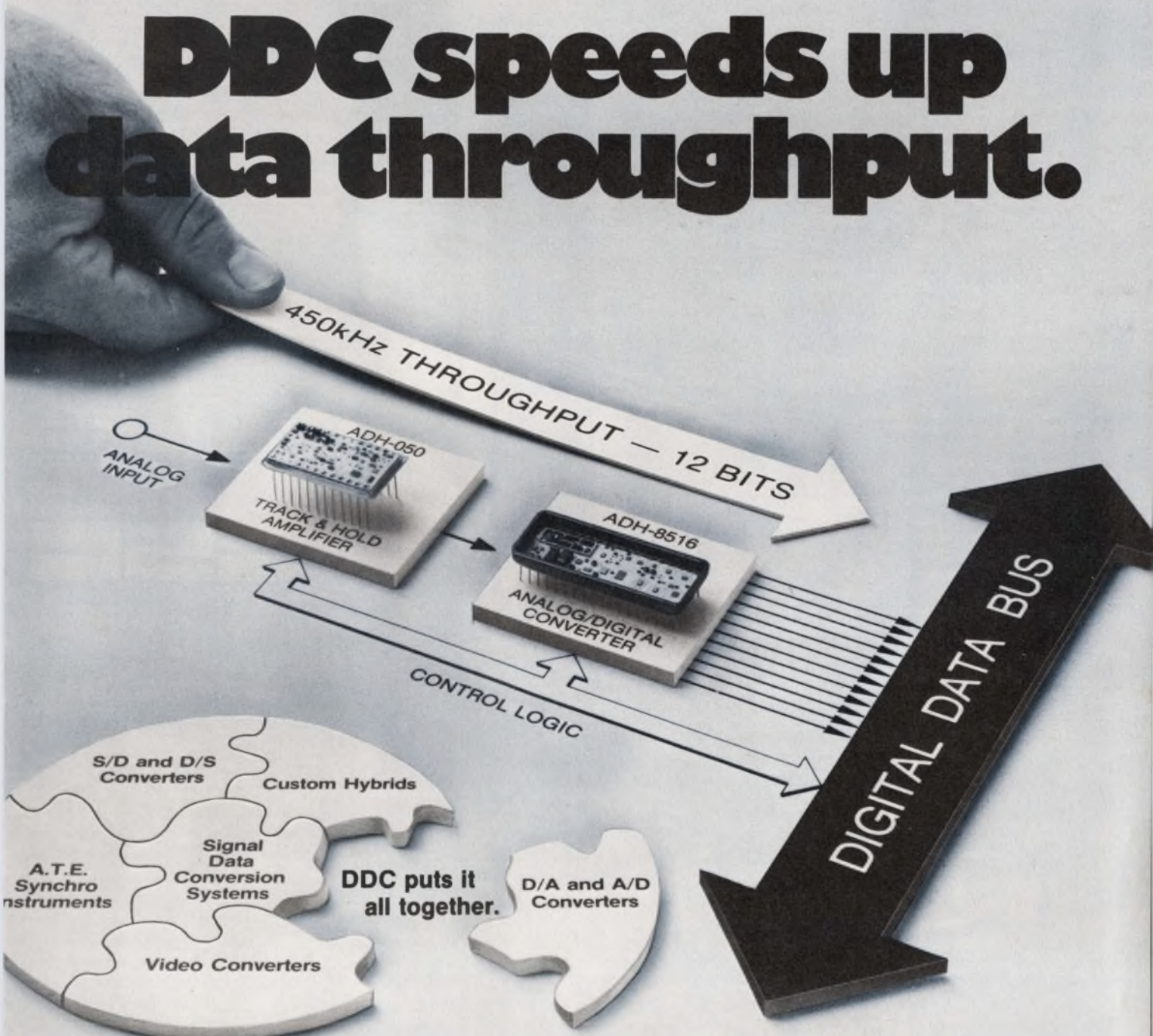
West Coast: 7337 Greenbush Ave., North Hollywood, CA 91605 • 213-982-6454
Southwest: 5050 North 19th Ave., Suite 420, Phoenix, AZ 85015 • 602-249-0703

DDC speeds up data throughput.



CIRCLE NUMBER 60

$74.95 TL SOURCE.

It's CSC's DP-1: the automatic signal source that cuts hours from trouble-shooting TTL/DTL, CMOS and other popular logic circuits.

This compact, circuit-powered unit lets you inject signals at key points to test digital circuits with fast stimulus-response troubleshooting techniques. Just set a switch to the proper logic family; connect two clip-leads to the circuit's supply, and touch the DP-1 probe to a node. It automatically senses the circuit's condition (high or low state) and produces an opposite-polarity pulse of the proper level. That's all there is to it!

Versatility-flexibility. Select single-pulse or 100 pulse-per-second operation with the handy pushbutton control. A LED indicator signals single-shot or continuous mode. DP-1 can also be connected indefinitely, presenting a 300K impedance to the circuit under test. Short circuits can't harm it, even over prolonged periods. It's also protected against overvoltage up to 25V and reverse-polarity up to 50V.

For all its versatility, portability, operating ease and compact size, DP-1 is priced at only $74.95—a fraction of what you'd expect to pay for a precision digital pulse source. See your CSC dealer today. Or call 203-624-3103 (East Coast) or 415-421-8872 (West Coast) for the name of your local stocking distributor and a full-line catalog.

Logic family switch—Sets proper pulse level for TTL/DTL or CMOS families.

Rugged, high-impact plastic case—Built to take it . . . in the lab or in the field.

Protected—Features built-in short-circuit, overvoltage and reverse-polarity protection.

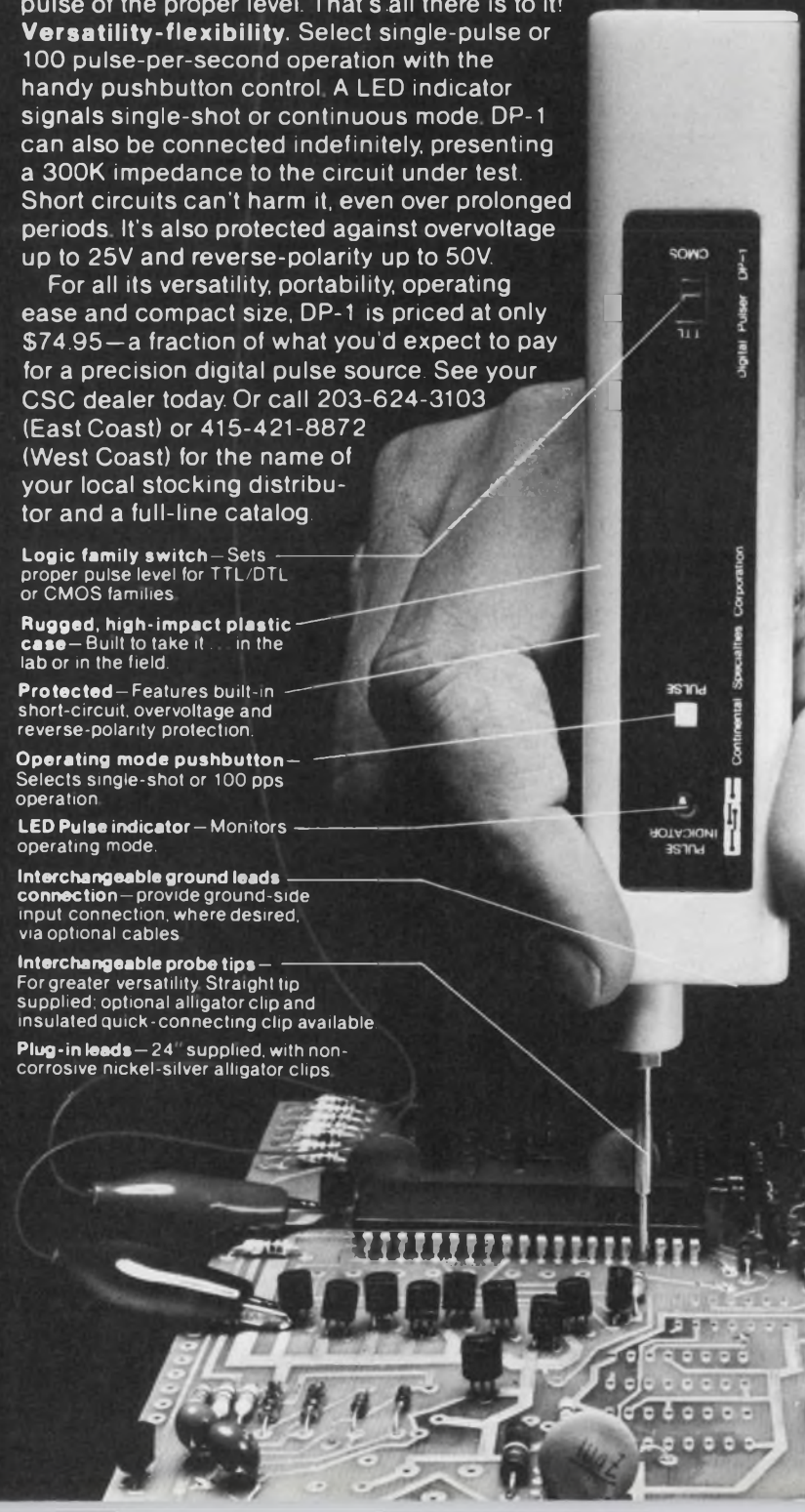
Operating mode pushbutton—Selects single-shot or 100 pps operation.

LED Pulse indicator—Monitors operating mode.

Interchangeable ground leads connection—provide ground-side input connection, where desired, via optional cables.

Interchangeable probe tips—For greater versatility. Straight tip supplied; optional alligator clip and insulated quick-connecting clip available.

Plug-in leads—24" supplied, with non-corrosive nickel-silver alligator clips.



SPECIFICATIONS

Tri-state-output—DP-1 is isolated from circuit under test: Z ≥ 300K

Auto-polarity pulse sensing—DP-1 automatically produces proper polarity pulse for circuit under test: logic "0" level produces a "1" pulse; logic "1" level produces a "0" pulse

LED indicator—flashes once for single pulse; stays lit to indicate pulse train

Short-circuit protection—can pulse into short circuit continuously

Power—overvoltage protected to 25V; reverse-voltage protected to 50V; voltage range 4-18V, 30mA max.

Pulse modes—Single pulse; press pushbutton for one sec. or less. Pulse train (100pps); hold pushbutton down

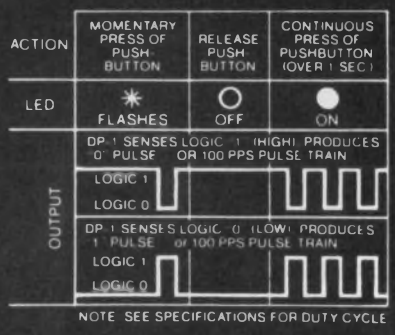
Pulse specs	**TTL**	**CMOS**
Pulse width	1.5usec ± 30%	10usec ± 30%
Fan out	60 loads	
Sink and Source	100mA source to 3.5V; sink to.6V	50mA source to logic 1; sink to logic 0
T_r	100nsec	100nsec
T_f*	one TTL load, 500nsec	100K load, 8nsec

*T_f is directly proportional to load resistance

Dimensions (l x w x d) 5.8 x 1.0 x 0.7" (147 x 25.4 x 17.8mm)

Weight 3 oz. (.085kg)

Power Leads plug-in 24" (610mm); color coded insulated clips; others available



NOTE: SEE SPECIFICATIONS FOR DUTY CYCLE

CONTINENTAL SPECIALTIES CORPORATION

CSC

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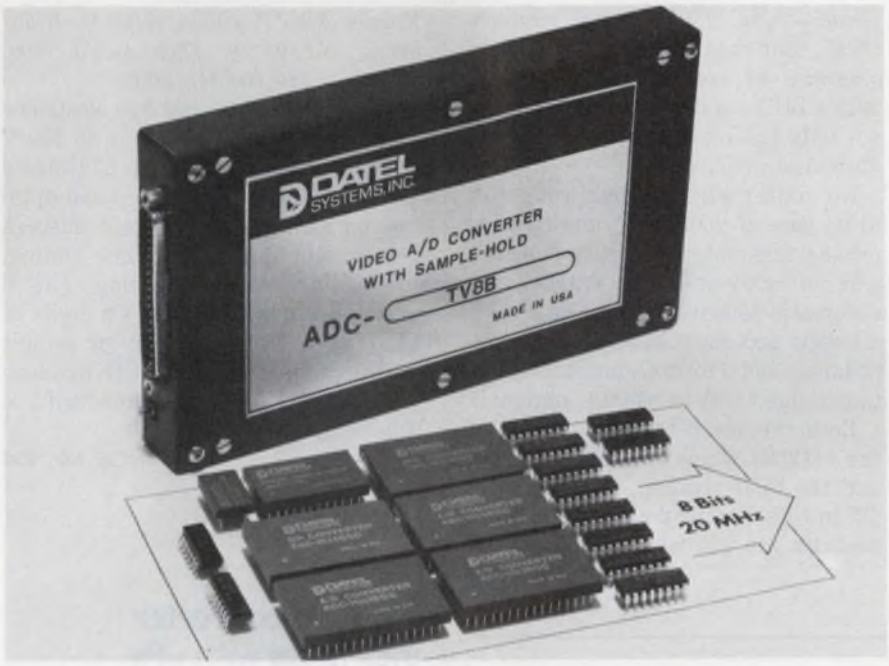
NEW DP-1!

*Manufacturer's Recommended Resale

CIRCLE NUMBER 61

A/d converter delivers 8-bit words at 20-MHz data rates



Datel, 1020 Turnpike St., Canton, MA 02021. Gene Zuch (617) 828-8000. P&A: See text.

A built-in track-and-hold circuit enables the ADC-TV8B a/d converter to supply 8-bit data words at 20 MHz. Intended for video applications, the converter is built on a single card and housed in a 7.5 × 4.25 × 0.875-in. (191 × 108 × 22 mm) aluminum case. Its conversion technique is based on four basic hybrid building blocks—a 3-bit parallel decoded a/d converter, a 15-line (4-bit) d/a converter, a fast sample/hold amplifier and an inverting op amp.

Two 3-bit a/d converters combine to make a 4-bit a/d converter that provides the four MSBs. The 4-bit output is fed into the 4-bit d/a converter, whose output is then subtracted from the input. The remainder is converted by a second 4-bit a/d converter.

User-supplied start-convert pulses permit the throughput to be adjusted for any conversion rate up to 20 MHz. Thus, the rate can easily be set to 14.3 MHz or 17.72 MHz for the U.S. or PAL video requirements, respectively, to obtain four times the TV-color subcarrier frequency. The full-power signal bandwidth reaches 10 MHz and rolls off at 6 dB per octave past that point. Analog-input ranges of 0 to 1 (composite video standard), 0 to 2, 0 to 5, ±1, ±2 or ±5 V are available along with input impedances of 50, 75 or 93 Ω.

The converter is accurate to within 0.4%, and its linearity error is less than ±0.5 LSB, maximum. Acquisition for the track/hold amplifier takes 25 ns with the aperture uncertainty held to less than 30 ps. The operating temperature coefficient is ±60 ppm/°C over the full-scale range. ECL outputs can handle up to 20 ECL loads and the data skew is less than 2 ns between output bits.

Output coding is either straight binary for unipolar operation or offset binary for bipolar operation. Analog inputs come via a 3-mm rf connector, and digital outputs and power connections pass through a subminiature "D" connector.

The Datel converter comes in two basic models—the ADC-TV8B1 for ECL interfaces and the ADC-TV8B2 for TTL interfacing. The ECL version interfaces with the Motorola 10,000 family of circuits.

Basic power requirements for the converters are ±15 V at 200 mA, +5 V at 0.5 A (200 mA more for the TTL version) and −5 V at 1.5 A. Operation is guaranteed over 0 to 70 C, although extended range versions with −25 to +85 C or −55 to +85 C are also available.

The high-speed converter doesn't have many competitors. Several modular converters in the MATV Series from Computer Labs (Greensboro, NC) deliver 8-bit outputs at 8, 11 or 16 MHz and cost $995, $1150 and $1300, respectively. The modules measure just 5.5 × 4.38 × 0.85 in. Also available from Computer Labs is a two-card 8-bit a/d system with an 18-MHz data rate and a cost of $1895.

A multicard converter from ILC Data Device Corp. (Bohemia, NY) provides eight bits at up to 17 MHz, and costs over $3000. Another ILC converter is expected to be available in early 1978—it will come in a 4 × 6 × 1 in. package, cost less than $1500, and convert at 20 MHz.

The Datel ADC-TV8B converters cost $1995 and $2095, for the ECL and TTL versions, respectively, in quantities of 1 to 9. Delivery takes six to eight weeks.

Datel	CIRCLE NO. 302
Computer Labs	CIRCLE NO. 303
ILC Data Devices	CIRCLE NO. 304

Mini printer head has 100-megacharacter life

C. Itoh Electronics, 280 Park Ave., New York, NY 10017. Floyd Makstein (212) 682-0420. $210.

Series 500, 40-column dot-matrix impact printers, features reliability, small size, high speed and low cost. Guaranteed are: continuous-duty head life of 100-million characters and MCBF of 5-million lines per mechanism. Printing speed is 2.5 lines/s. Drive is by dc motor. Size is 175 × 146.5 × 112.5 mm.

CIRCLE NO. 308

Module simplifies DPM recipe —you can choose the display

Analog Devices, Route 1 Industrial Park, Box 280, Norwood, MA 02062. Steve Castilli (617) 329-4700.

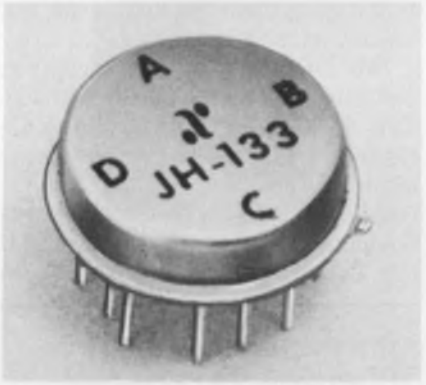
Should you want to drive a three-digit LED display, just add a gain pot and the seven-segment version of Analog Devices' AD 2023 Displayless DPM module, plus 0.1 W of 5-V input power—voila, you've got a complete DPM. But add decoder and driver circuitry as required, and the AD 2023's BCD version can accommodate not only LED but also LCD and gas-discharge displays.

No matter which module you select to be part of your DPM, the finished product has many appetizing features: −99 to +999-mV input range with automatic-polarity indication, 0.1% ±1-digit accuracy, 100-MΩ input impedance, and 0 to 70 C standard operation range (−40 to +100 C optional).

Both the seven-segment version of the AD 2023, which sells for $28 in 100s, and the BCD version, which sells for $27 in 100s, occupy 2 × 2 × 0.4 in. Both modules are available from stock.

CIRCLE NO. 301

Quad coupler gives 30-dB port isolation

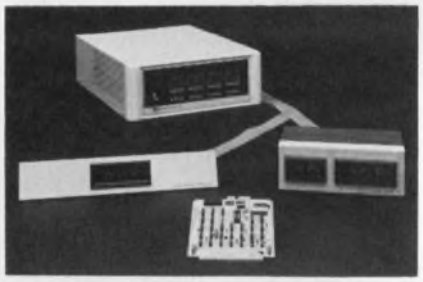


Anzac Electronics, 39 Green St., Waltham, MA 02154. Jim Leonard (617) 899-1900. $45; stock.

A four-port hybrid coupler, Model JH-133, operates from 20 to 40 MHz and provides isolated quadrature outputs of an input signal with isolation between ports of 30 dB at midband. Phase deviation from 90° is typically 1° with a guaranteed maximum deviation of 3°. Amplitude balance is 0.75 dB max and VSWR is 1.2:1. Insertion loss of the TO-8 unit is 0.5-dB max.

CIRCLE NO. 309

Real-time clocks provide μC time and date support

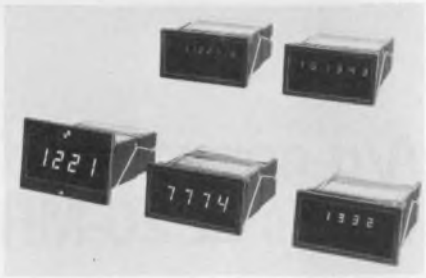


Digital Interface Systems, P.O. Box 1446, Benton Harbor, MI 49022. (616) 926-2148. $375 to $750; 8 to 12 wks.

Models 960-030 and 990-030 real-time clocks are compatible with TI 960 and 990 lines of mini/microcomputers and provide hardware time and date support. Battery backup maintains time and date information during power loss. A 10-digit version displays the date and time. A six-digit version alternates between date and time or displays only time. The 960-030 is compatible with the TI 960 A/B CRU bus. The 990-030 is a half-slot board compatible with the TI 990 CRU bus.

CIRCLE NO. 310

Line-operated counter replaces mechanicals

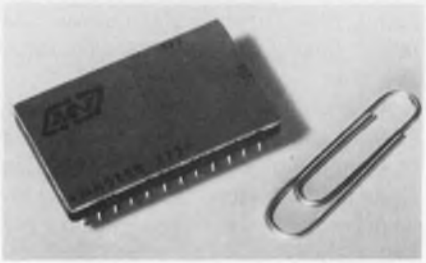


Kessler-Ellis Products, Atlantic Highlands, NJ 07716. Dick Laird (800) 631-2165. $50 (OEM); stock.

The V Model L06 and L16 electronic counters accept pulses of up to 230 V ac directly and count up to 80 times/s with no moving parts. A quad-opto-isolator demodulator circuit ensures long reliable operation while adding, subtracting and or resetting. The V models are available with six digits of LED display 0.2-in. high or 4-digit orange high-efficiency LED displays 0.4-in. high. Units are in standard 1 × 2 in. size.

CIRCLE NO. 320

8-bit a/d converter interfaces with μPs



Micro Networks, 324 Clark St., Worcester, MA 01606. John Munn (617) 852-5400. $75 (0 to 70 C), $149 (−55 to +125 C); stock to 4 wks.

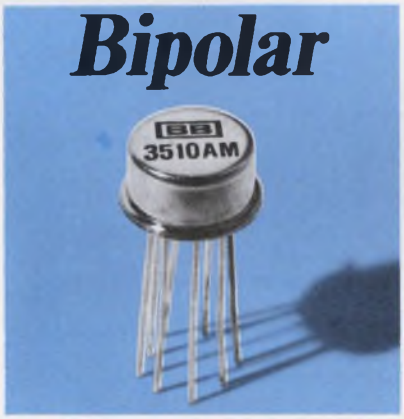
Designed to interface with popular 8-bit μPs, the MN5150 is complete with internal reference and three-state outputs. It has a 2.5-μs conversion time, 7 user-selectable input ranges including unipolar and bipolar configurations, and hermetic DIP packaging. The converter is monotonic, operates from 0 to 70 C (−55 to +125 C for MN5150H), requires 680 mW and has TTL-compatible control inputs and digital outputs. Both serial and parallel data outputs are available and it can be short cycled for uses needing faster conversion times with lower resolutions.

CIRCLE NO. 321

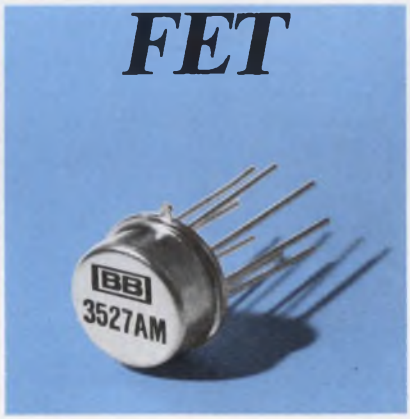
Choice Op Amps from Burr-Brown...

Low Cost
Low Drift
Low Bias Current
Low Offset Voltage

Bipolar



FET



The choice bipolar op amp is Burr-Brown's new 3510. The 3510's low 0.5 μV/°C voltage drift and less than ±15 nA bias current provides the performance you need for high-accuracy systems at low cost.

The 3510's total performance over the −25°C to +85°C temperature range surpasses many competitive units rated for only 0°C to +70°C. It's ideal for high-accuracy analog circuits and instrumentation designs. Three grades give you voltage offset from 60 to 150 μV and voltage drift from 0.5 to 2 μV/°C. Maximum open-loop gain and CMR specs are 120 dB and 110 dB respectively. Prices (in 100's) are only $4.95 (3510AM), $5.95 (3510BM) and $10.00 (3510CM).

The choice FET-input op amp is Burr-Brown's 3527. With bias current of less than 5 pA and low voltage drift of 2 μV/°C, the 3527 is your best buy.

Burr-Brown's 3527 comes out a winner when you compare the three most important FET op amp features—input bias current, offset voltage drift and price. And low laser-trimmed offset voltage means no further adjustment in most applications. Here's a cost-effective answer for current-to-voltage converters and general analog computation circuits. Available in three grades with offset voltage ranging from 250 to 500 μV and voltage drift from 2 to 10 μV/°C, the prices (in 100's) are $7.95 (3527AM), $10.35 (3527BM) and $19.40 (3527CM).

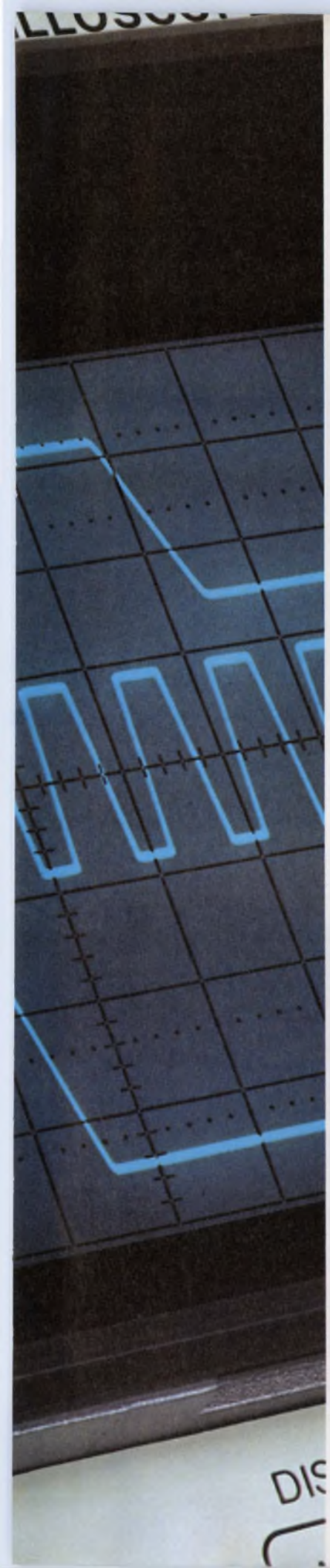
To get details on these price/performance leaders, contact
Burr-Brown, International Airport Industrial Park,
Tucson, Arizona 85734. Phone (602) 294-1431.

BURR-BROWN
BB

Performance,
Reliability, Economy

CIRCLE NUMBER 62


STORE
O ERASE
ICE
OR
VIEW
TIME
ERASE
(PUSH)
MAX
BRIG SS
MAX
WRITE
STORE
DISPLAY
1741A STORAGE OS



For one easy-to-use scope that: Captures single-shot events... Displays low-duty-cycle signals clearly... Provides three channels for the price of two...

HP's the Answer.

And the new 1741A is your scope. It gives you a unique combination of features for a moderately priced 100 MHz storage scope: Variable persistence for clear viewing of glitches and low-duty-cycle traces; storage for studying single-shot events; and third-channel trigger view for convenience in making simultaneous three-channel timing measurements.

Excellent variable persistence means a bright, sharp trace you'd expect only on a nonstorage scope. The result is an easy-to-read display of fast, low-duty-cycle repetitive signals. And the ability to see leading edges and glitches you'd otherwise miss.

Auto erase/Auto store. In Auto erase you adjust the display rate up to 2.5 per second. After that, it's all automatic, which means you simplify set-ups and eliminate smeared displays of digital data. It's a powerful tool for capturing those elusive glitches in data streams. In Auto store, your 1741A is armed, and as long as the instrument is fully operational and powered, will wait indefinitely, ready to store a random, single-shot event when it occurs.

Third-channel trigger view, selected at the push-of-a-button, lets you observe an external trigger signal along with channel A and B—three traces in all—so you can easily make timing measurements between all three channels. In most applications, that means three-channel capability for the cost of a two-channel variable persistence/storage scope.

For measurement convenience, the 1741A has a selectable 50 ohm input in addition to the standard 1 megohm input. A 5X magnifier permits two-channel measurements as low as 1 mV/div to 30 MHz, without cascading. You can even select a special modification (TV Sync) to tailor this scope for TV broadcast and R&D applications. Priced at $3950*, the 1741A is an exceptional storage scope value.

Call your local HP field engineer today for all details. And for low-cost variable persistence/storage in a 15 MHz scope, ask him about HP's new 1223A.

And here's something NEW for scopes. HP's EASY-IC PROBES. A new idea for probing high-density IC circuits that eliminates shorting hazards, simplifies probe connection to DIP's and generally speeds IC troubleshooting. Ask your HP field engineer about them.

*Domestic U.S.A. price only

HEWLETT hp PACKARD

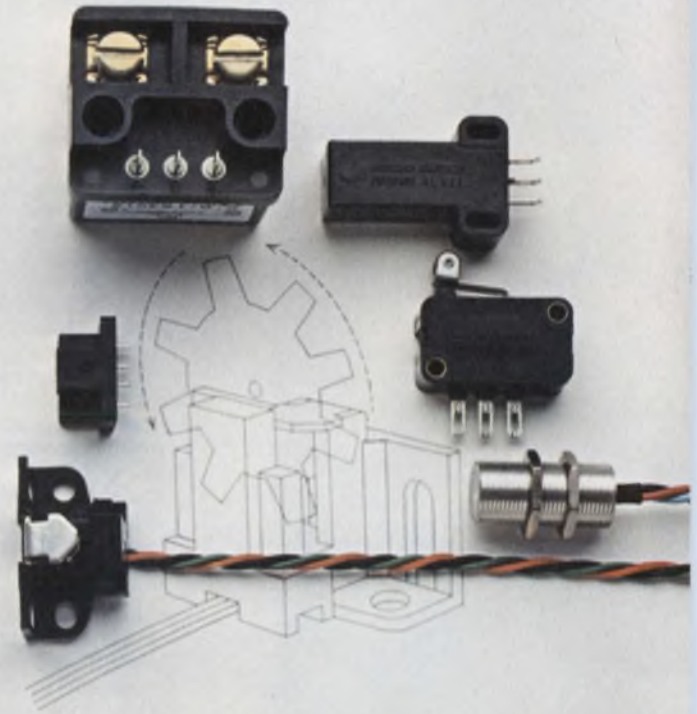
1507 Page Mill Road, Palo Alto, California 94304

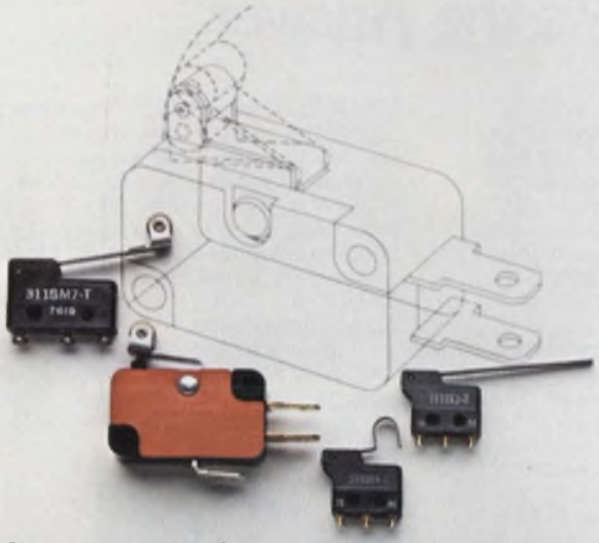
For assistance call: Washington (301) 948-6370, Chicago (312) 255-9800, Atlanta (404) 955-1500, Los Angeles (213) 877-1282

CIRCLE NUMBER 63

Some of these components will probably never The others will just come close.

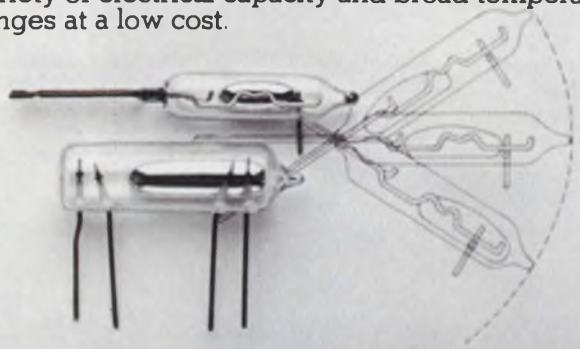
The SR, XL, XK and AV are solid state position sensors featuring almost infinite life. All offer zero speed operation with some up to 100 Khz. ES current sensor utilizes Hall-effect IC and protects against damage from short circuits or overcurrent conditions.





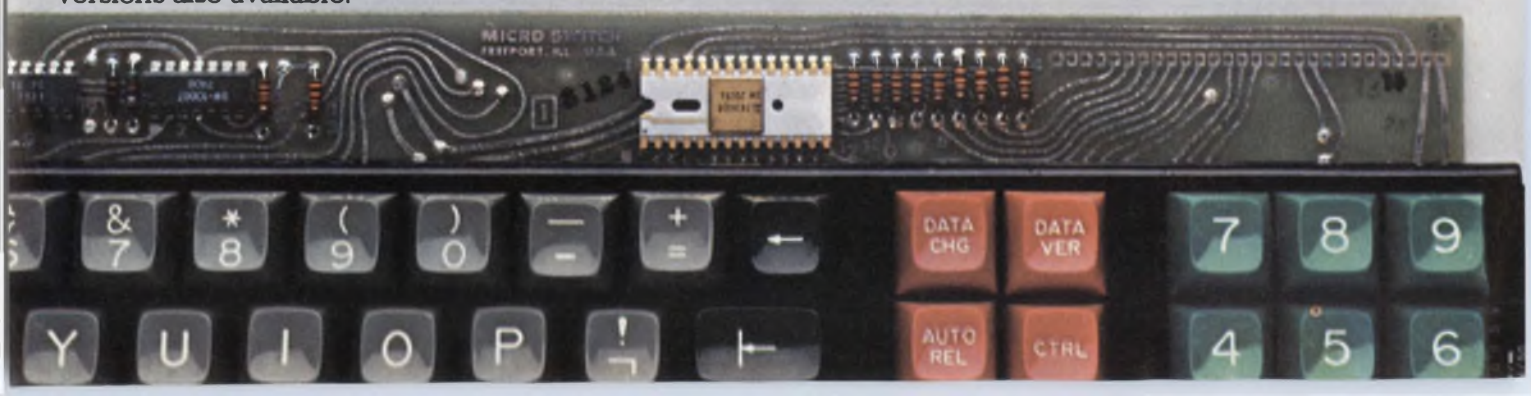
Snap-action V3, SM and SX switches offer wide variety of actuators, electrical capacity and termination.

Mercury switches offer hermetic sealing, a variety of electrical capacity and broad temperature ranges at a low cost.

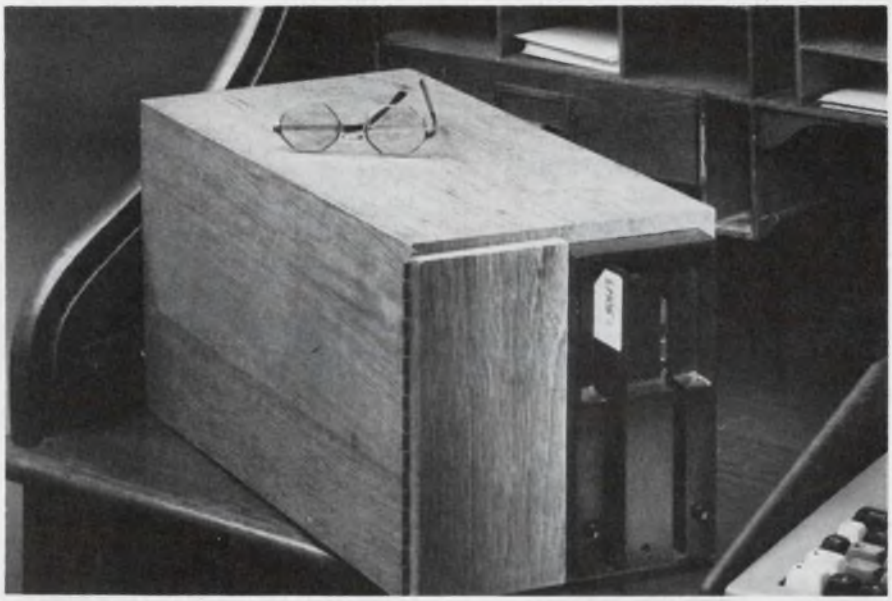


AML manual devices for low installed cost, electrical flexibility and attractive panel appearance. Series 8 miniature manual switches provide small size and wide variety of operators. DM offers inexpensive snap-in panel mount design.

Solid state keyboards provide high reliability no mechanical keyboard can offer. Panel sealed versions also available.



Control up to four drives with processor-based system



Extensys, 592 Weddell Dr., Sunnyvale, CA 94086. Ed Hartnett (408) 734-1525. P & A: See text.

The FOS100 disc system from Extensys can handle up to four floppy-disc drives and comes in either a dual drive or quad drive version. Furthermore, by using an optional memory controller board, multiple 64-kbyte banks of semiconductor memory can be connected to an 8080A-based host system. Because the FOS100 has its own control processor and buffer memory, it minimizes the loading of the host system.

Boards in the disc system permit the host computer to control up to four PerSci 277 drives via a "personality" module (a dedicated controller board). The system can interface to the S-100 microcomputer bus. The memory management controller board permits up to 16 disc drive systems to operate on the host computer, thus allowing access to up to 64 drives. Or, multiple 64-kbyte RAM banks can be accessed via a bank-switching scheme controlled by software.

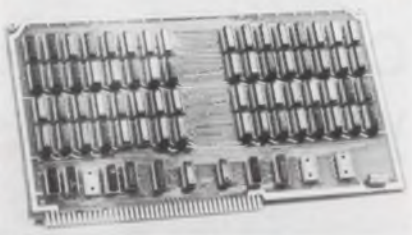
Software for the FOS100, a diskette-based program called EMOS, contains an assembler, editor, disc copy, file copy, basic bank-switching routines and an extended Basic high-level language developed by Microsoft. The operating system contains software executed by both the host and I/O processors as well as a file privacy feature to protect data held on disc.

The essence of the FOS100 system is the File I/O board, which contains its own 8080A processor, a bootstrap PROM, 8192 bytes of RAM and all interface logic necessary for the personality module and S-100 bus. The board can act as a buffer between the disc and the host processor and eliminate the need for the host unit to stop operation to handle an I/O routine.

Two versions of the FOS100 are available, the FOS100-2 with one dual drive ($2880), and the FOS100-4, with two dual drives ($4680). Both versions are housed in 9.5 × 9.5 × 19-in. woodgrain cabinets, suitable for desktop use. The memory-management feature that permits multiple 64-kbyte banks to be used costs an additional $295. Delivery is 30 days.

CIRCLE NO. 307

Static RAM boards are SBC 80/10 compatible



Electronic Solutions, 8070 Engineer Rd., San Diego, CA 92111. Richard Van Antwerp (714) 292-0242. $295 (4 k), $395 (8 k).

RAM-4 and RAM-8 are 4-k and 8-k RAM boards using low-power static RAMs. The boards are compatible with Intel's SBC 80/10 and National's BLC 80/10 μCs. Memory cycle time is 630 ns and power consumption on an 8-k board is 9.5 W. Address selection is done via jumpers. All ICs on the board are socketed.

CIRCLE NO. 322

ROM tester permits manual or auto stepping

Tetrahedron Associates, 7605 Convoy Ct., San Diego, CA 92111. (714) 277-2820. $495; 2 wks.

The RC-102 ROM, PROM and EPROM checker compares the code in a programmed ROM with a known good listing. Accepting ROMs with capacities of up to 4096 × 8 bits, the tester displays both the data and the address of the accessed location. Operation is possible in either octal or hex modes, via switch selection, and there are two basic test modes. The RC-102 can perform a compare test against a reference and automatically cycle through all address locations or it can perform a step-by-step output to the display under manual control or automatically step through the addresses at an adjustable rate. Address stepping can be done either forward or reverse. Error indicators in the compare mode include a Hold light that remains on if an error has been detected and a Flash light that goes on momentarily when passing through an error. The memory tester is housed in a 10 × 12 × 2.5 in. cabinet and requires 115 V ac.

CIRCLE NO. 323

CPU board mates with general-purpose modules

Control Logic, 9 Tech Circle, Natick, MA 01760. Hiram French (617) 655-1170. $350; 4 wks.

A Z-80 based applications system, the MM1-ZCPU, is compatible with the MM1 modular support boards developed for the Intel 8080A. Using a bus-structured system, either a Z-80 or 8080A CPU board can be used with the same memory and I/O support boards. The device has a capacity for 4 k of EPROM plus 1 k of RAM and operates at a clock rate of 2 MHz.

CIRCLE NO. 324

Desktop μC is turnkey system

Mohr Labs, Route 4 Fish Hatchery Rd., Madison, WI 53711. Bob Herbst (608) 271-5380. $3449.

A desktop microcomputer turnkey system, based on the MOS Technology 6502 processor incorporates a 20 × 64 character CRT and an ANSII keyboard with a numeric keypad. It also includes a 4-k RAM (expandable to 16 k), a 3-k system monitor EROM, a 16-level priority interrupt system, a modem and a TTY interface.

CIRCLE NO. 325

Transmit/receive module mates μP to phone line

Wintek, 902 N. 9th St., Lafayette, IN 47904. (317) 742-6802. $1499.

Bidirectional communications between a μP and the telephone system are possible with the telephone-tone transmit/receive module. It contains a central office quality tone transmitter and receiver based on the 6800 μP modules. It is available on industry standard 4.5 × 6.5 in. PC boards with dual 22-pin edge contacts.

CIRCLE NO. 326

Relax

It's amazing how an easy mind cements relationships.

We're the easy mind people. TRW Capacitors.

We can solve your problems connected with reliability in ultra-miniature capacitors. Our X463UW metallized polycarbonates are designed to do just that.

The X463UW gives you "Space Age" performance in circuits demanding the smallest possible size. Capacitances range from .001 to 10 mfd, at 50, 100, 200 and 400 vdc—with less than 1.5% capacitance change from —55°C through 125°C. IR is 60,000 megohm x mfd minimum at 25°C. DF is less than 0.3% at 25°C and 1 KHz. And stability? In humidity and shelf life tests the stability of the X463UW is actually two to three times better than polysulfone.

You get all that because we've applied the latest in component technology to combine the improved electrical performance of polycarbonate with dramatic size and weight reductions made possible by the use of our exceptionally reliable metallized dielectric.

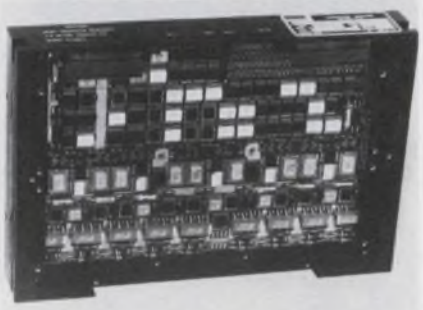
We also put the same kind of effort into our engineering services and our field support. Try us. We can help reduce the tension. Give us a call, or write: TRW capacitors, An Electronic Components Division of TRW, Inc., 301 West "O" St., Ogallala, Nebraska 69153. Tel: (308) 284-3611.

TRW CAPACITORS

ANOTHER PRODUCT OF A COMPANY CALLED TRW

CIRCLE NUMBER 66

Core memory permits use in severe environments

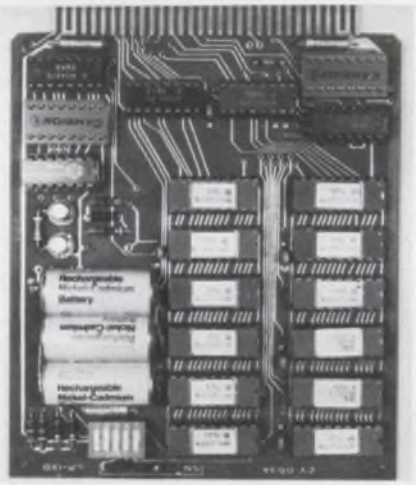


Electronic Memories & Magnetics, 20630 Plummer St., Chatsworth, CA 91311. Ted Lutz (213) 998-9090.

SEMS-16 core memory system meets the environmental requirements of aerospace, shipboard and severe industrial use. The memory has a 32 k × 18 capacity with an access time of 350 ns and cycle time of 900 ns. Size is 6 × 9 × 1.4 in.

CIRCLE NO. 327

CMOS RAM simulates 6312 ROM for protos



Cybertek, 222 150th Ave., Madeira Beach, FL 33708. (813) 392-3467. $280; 4 wks.

A 1 k × 12 CMOS RAM module has been added to the LP-12 family of low-power OEM μC boards. In addition to being a general-purpose RAM board in the LP-12 family, the LP-12D RAM module can be strapped for address block recognition and RSEL signal generation. This enables it to simulate the 6312 ROM for prototyping purposes. It includes write-protect capability and optional on-board batteries for nonvolatility.

CIRCLE NO. 328

Cartridge drive handles data at 9.6 Mbits/s

Control Data, Box O, Minneapolis, MN 55440. Kent Nichols (612) 853-4656. $3900 to $6000.

Model 9448 cartridge-module disc drive (CMD) transfers data at 9.6 Mbits/s. The module is interface-compatible with the company's storage-module drive (SMD) and mini-module drive (MMD) families of OEM disc products. The drive is available in three basic models, with storage capacities of 32, 64 or 96 Mbytes. Storage is divided between a 16-Mbyte front-loading cartridge and up to 80 Mbytes of fixed-disc capacity. Specs include an average random-data access time of 30 ms at a rotational speed of 3600 rpm, and average latency time of 8.33 ms. Each data recording surface has a track density of 384 tracks/in., and data are recorded at densities of 6038 bits/in. The drive includes μP-based control logic, and comes in a pedestal cabinet or 19-in. rack-mount case.

CIRCLE NO. 329

Add-in memory improves operating margins

Ampex, 200 N. Nash St., El Segundo, CA 90245. Clyde Cornwell (213) 640-0150. $1725; stock.

An add-in memory, ARM-1280, reduces memory costs while improving operating margins for a broad range of computers. The device provides 16 kwords of add-in memory that is pin-compatible and totally transparent to all models of Nova 800, Nova 1200, D116H and D116S computers. Memory cycle speed is switch-selectable to match the requirements for each model. For the Nova 800, cycle time is 800 ns; Nova 1200, 1200 ns; D116H, 960 ns; and for the D116S, 1200 ns. The 16 kwords are available on a single board and can be plugged into any memory slot. The unit operates in any address field up to the maximum addressable in any of the computer models.

CIRCLE NO. 330

Bin allows fast diskette storage and retrieval

Printcraft Systems, 11-17 Beach St., New York, NY 10013. Don Hubbinett (212) 966-0001. $22.50 to $25.50; stock.

Bins for the fast retrieval and storage of the new mini diskette are available in 50-diskette capacity units. Each has five support plates and five titled dividers. A 100 diskette capacity unit with 10 plates and dividers is also available. Color is tan with padded base for desktop protection. Highly portable, the unit can easily be stored on a cabinet shelf, or any standard file drawer.

CIRCLE NO. 331

Small data terminal doesn't cost a bundle

Micon Industries, 252 Oak St., Oakland, CA 94607. Bill Northfield (415) 763-6033. $400.

The Miget, a data-communications terminal, provides keyboard entry and display output for all μC and μPs using RS-232C interface and ASCII code. It is light weight (4 lb), small (8 × 10 × 3 in.), and has a built-in power supply. Basic operation of the unit is via a simplified typewriter keyboard that provides a simultaneous 32-character display. Features include eight selectable baud rates from 110 to 9600, TTY compatibility, an optional memory system and acoustical coupler, and a choice of eight colors.

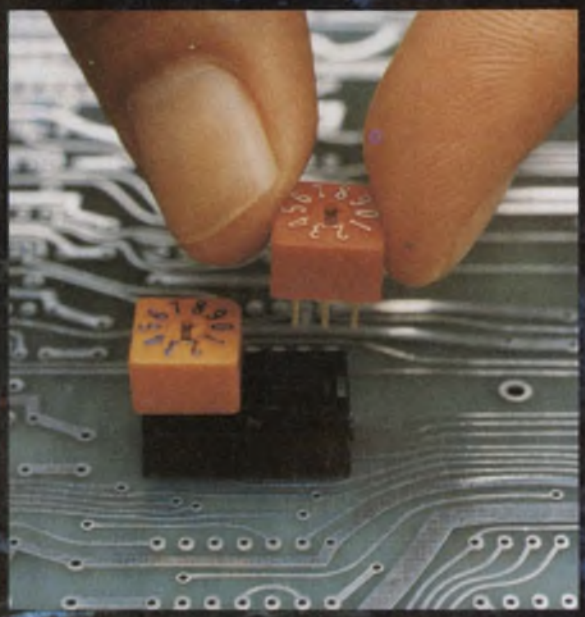
CIRCLE NO. 332

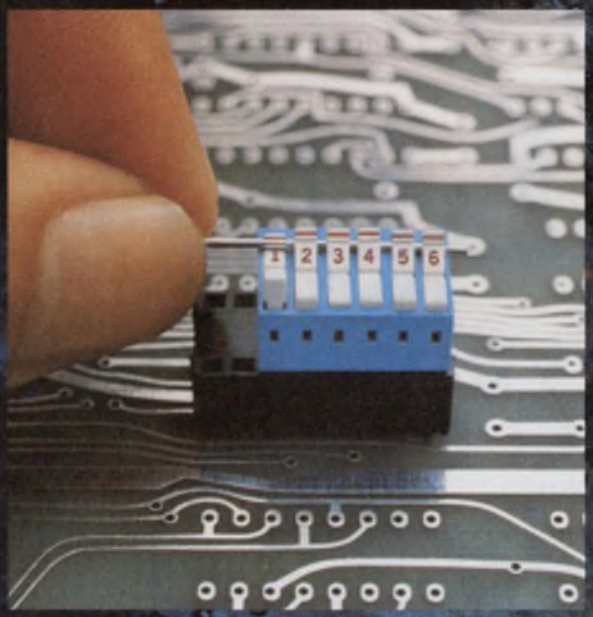
CIRCLE NUMBER 67 ▶

MICRO / MINI

DIP SWITCH

DIP SWITCH





MICRO-DIP...10 and 16 position miniature binary coded DIP switch designed to be mounted directly to PC Boards. Ideal for address encoding, presetting, PCB programming...every area of digital electronics.

Packaged in a color coded, glass-filled nylon housing with terminals on .100 x .300 centers. It occupies only one half of a standard 14-pin DIP socket.

Screwdriver slot is rotated in either direction to desired setting. Gold contacts protected by dust-seal design.

Positive detenting 10 position BCD, 16 position binary with separate common to not true bits, repeating 1 and 2 pole codes. Guaranteed life of 10,000 detent operations. Operating temperature range of −10°C to +85°C, contact resistance of 25 milliohms max. initial.

One year warranty.

MINI-DIP...new from EECO. Form A and C contact arrangements ideal for positive on/off switching and programming.

Easily actuated, positive wiping, gold contacts are packaged in a dust free glass-filled nylon housing.

Interference-fit of terminal pins and one piece housing prevent contamination. Larger cross section pins allow positive insertion into sockets and P.C. Boards.

New locking design in which .035 diameter locking rod is inserted through rockers, insures against accidental actuations.

Guaranteed life of 50,000 cycles. Operating temperature range −10°C to +85°C, contact resistance 25 milliohms max. initial.

Standard .100 x .300 centers allows retrofitting of other major brands of DIP switches. Available in 2-10 station Form A, 1-5 station Form C contacts.

One year warranty.

EECO

1441 East Chestnut Avenue, Santa Ana, California 92701 · Phone 714-835-6000. Distributed in U.S. by Marshall Industries, Hall-Mark, and Schweber. In Canada by R.A.E. and Penryn. Agents throughout the world.

Graphic display system delivers 262,144 points

Matrox Electronic Systems, P.O. Box 56, Ahuntsic Stn., Montreal, Quebec H3L 3N5. Lorne Trottier (514) 481-6838. From $895 (unit qty); 4 to 6 wks.

Capable of providing a variable resolution graphics display, the MTX-512 can be user programmed to produce 256 × 256 × 512, 512 × 512 or 256 × 1024 point displays. American or European TV compatibility is also field programmable. Changing the resolution is as simple as changing the size of the RAM used to hold data, starting with 4-k dynamics for the 256 × 256 display, increasing to 8-k dynamics and then to 16-k dynamics. The display system comes on a 7.75 × 10.5-in. circuit card and requires 5 V at 800 mA and 15/12 V at 200 mA. Boards are available that mate with the PDP-11 and LSI-11 buses. Write time for the display is 1.4 μs/dot and the full screen erase time is 48 ms.

CIRCLE NO. 431

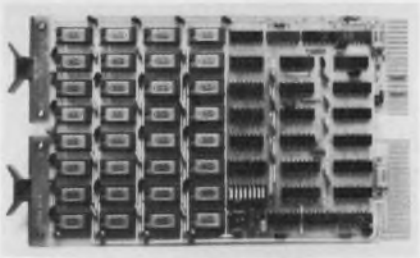
Single-line displays have 10 to 32 characters

Digital Electronics, 415 Peterson St., Oakland, CA 94601. (415) 532-2920. $99 to $199 (100 qty).

Alphanumeric, single-line display modules using vacuum fluorescent technology and 14-segment character design are available. The models are DE/210 (10-character positions), DE/220 (20 characters), and DE/232 (32 characters). They feature an on-board μP that has a character generator, display buffer and refresh logic. The displays have both parallel and serial interfaces and they represent as few as one output address to the host system.

CIRCLE NO. 432

DEC-compatible RAM has 32 k on single board



Cyberchron, 5768 Mosholu Ave., Riverdale, NY 10471. Chris Fadden (212) 548-0503. $1995 (user), $1795 (OEM); stock.

A 32-kword single width memory board for the DEC LSI-11 and PDP-11/03 computers, CDM-77/03, uses 16 k dynamic RAMs to achieve maximum memory density. The memory is addressable as a contiguous block from 0 through 30 k with the address selection accomplished via an on-board DIP switch. It is completely LSI-11 hardware and software compatible and will function with either burst (CPU) and refresh or distributed (DMA) refresh.

CIRCLE NO. 433

Dialight is your second source to C&K for miniature rockers and toggles...

Come to the people who've always been specialists in having more good ways to solve problems: Dialight. What we've done in indicator lights, illuminated switches, readouts and LEDs, we're doing now in miniature rockers and toggles.

This new Dialight family of switches, which comes in a full range of sizes is, we're proud to point out, all-American made.

When you consider all the configurations of styles, sizes, life and safety ratings, colors and mountings, you'll find there are literally hundreds of thousands of design combinations. Such a number of possibilities can in itself be a problem, except that the new Dialight catalog is specifically designed to prevent confusion and help you quickly and easily find the most advantageous combination of features for your applications.

If you'd like to see what Dialight quality rockers and toggles can do for the looks, durability and economics of your products, contact us today for the Dialight "Meets Your Need" Book. Your free copy will include a list of stocking distributors in the U.S. and Canada.

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A North American Philips Company

American made by DIALIGHT in Brooklyn, N.Y.

Dialight meets your needs.

Dialight, 203 Harrison Place, Brooklyn, N.Y. 11237 (212) 497-7600

CIRCLE NUMBER 150

Low-loss broadband mixer has high isolation

Hewlett-Packard, 1501 Page Mill Rd., Palo Alto, CA 94304. John Kane (415) 493-1501. $325; stock.

A double-balanced mixer for broadband-microwave use, the HMXR-5001, has low conversion loss and high isolation across the 2 to 12.4-GHz band, while retaining a wideband i-f of 0.01 to 1 GHz. Conversion loss is typically 7.5 dB from 2 to 8 GHz and 8.5 dB from 8 to 12.4 GHz. LO-to-rf isolation is typically 30 dB. With a slight sacrifice in performance, the device can be used up to 18 GHz.

CIRCLE NO. 333

Image rejection mixer covers 2 to 12.4 GHz

Varian, Salem Rd., Beverly, MA 01915. (617) 922-6000. 4-8 wk.

Compact packaging is featured in the 9753 series of low-noise image-rejection mixers covering the 2.0 to 12.4-GHz range in bands up to an octave wide. Each model consists of two mixers, a 90° hybrid, and a power divider combined in a single microwave IC. Minimum image rejection is 18 dB and i-f is dc to 300 MHz with any 20% bandwidth. 4.4 oz and 1 × 2.5 × 1.5 in.

CIRCLE NO. 334

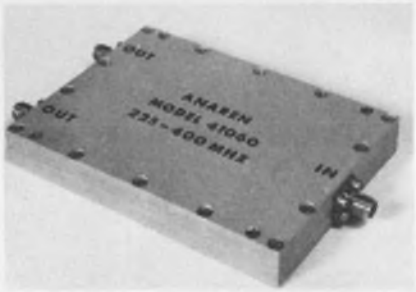
Mini step attenuator meets MIL specs

Micronetics, 36 Oak St., Norwood, NJ 07648. A. Steinhauer (201) 767-1320. $375; 6 to 8 wks.

Model 8986 broadband step attenuator meets all applicable military specifications and covers the range of dc to 12.4 GHz. Attenuation is 0 to 90 dB with 50-Ω impedance. Power rating is 0.5 W to 2 kW over the temperature range of −25 to +125 C. Connector types are SMA, BNC or TNC.

CIRCLE NO. 335

Power dividers offer 100-W cw dissipation



Anaren Microwave, 185 Ainsley Dr., Syracuse, NY 13205. J.R. McVicker (315) 476-7901. $150 to $390.

Two in-phase, high-power dividers with stripline construction dissipate 100-W cw with an 85-C heat sink. Model 41060 is 2-way; Model 41070, 4-way. Typical VSWRs are 1.15 and 1.20 and max amplitude balance is ±0.2 dB and ±0.3 dB. Min isolation is 20 dB. Case sizes are 0.5 × 0.75 × 3.75 and 5.0 × 6.0 in.

CIRCLE NO. 336

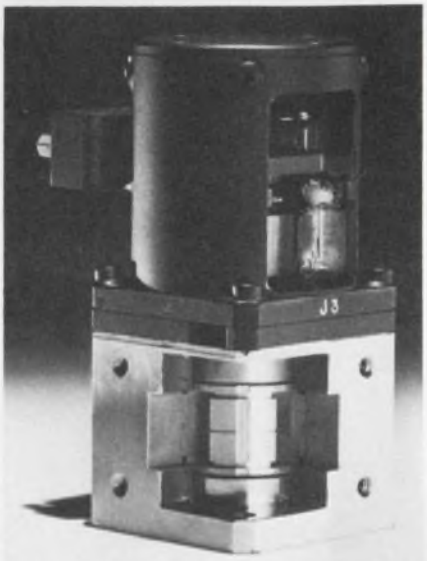
Cover 1.7 to 40 GHz with motorized latch-switch

Waveline, P.O. Box 718, West Caldwell, NJ 07006. (201) 226-9100.

The 79 series of motorized, latching-type waveguide switches feature a removable drive head with rotor-locking capability. The switches cover the range from 1.7 to 40 GHz. The standard rf section is available as a dpdt (transfer) type with paths of the continuous-arc design. No lossy material is used in the rf section. The rotor is supported on low-friction ball bearings. Rotor clearance in the housing is such that a temperature rise due to high-power loading will not cause binding.

CIRCLE NO. 337

Waveguide switch covers 10 to 15 GHz



Transco Products, 4241 Glencoe Ave., Venice, CA 90291. Evert Kjellberg (213) 822-0800.

WR-75 is a waveguide switch for the 10 to 15-GHz range and is qualified for space or commercial use. It uses a "transactor" actuator that combines the actuator rotor and switch rf rotor in a single assembly. Typical performance within specified bands is 1.06 VSWR, 0.05-dB insertion loss and 70-dB isolation.

CIRCLE NO. 338

Small-diameter laser offered for OEM use

Hughes Laser Products, 6155 El Camino Real, Carlsbad, CA 92008. (714) 438-9191. $115 to $245; 4 wks.

Helium-neon lasers, using a 1.375-in. diameter unit (LC series), offer high efficiency with low operating-current demand and are aimed at the high-volume OEMs. The lasers are available in three basic formats: plasma tube alone, mounted in a cylindrical aluminum housing, or in a cylindrical aluminum housing with precision mounting grooves. Power output is 1 or 2 mW min. Beam diameter is 0.49 mm and beam divergence is 1.7 mrad. Random (better than 500:1) polarization is offered and the lasers can be provided with alternative beam divergence, noise and other characteristics to meet specific OEM requirements. The housed laser is 1.375 diameter and 11 in. long.

CIRCLE NO. 339

now there is one... in signal processing

IF and Microwave Components From One Source.

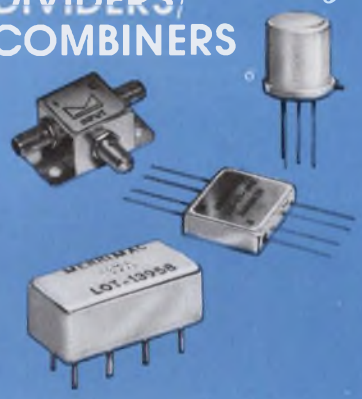
At Merrimac we have over 750 standard catalog items from DC to 18GHz with lumped elements, stripline or ferrites. If these standard units don't meet your requirements we pride ourselves in designing and producing custom or special components. . . in fact specials are over 50% of our business. Additionally, we can design and manufacture Sub-Systems and Integrated Packages of active and passive IF, RF and Microwave components within an IF Processing Chain, Microwave sub-system or the combination of both. NOW THERE IS ONE IN SIGNAL PROCESSING. . . MERRIMAC with over 750 standard units, Custom components and Sub-system capability.

SPORTS ILLUSTRATIONS SUITABLE FOR FRAMING.

Football, Basketball, Soccer and Hockey. Two Color reproductions FREE on request.

CIRCLE NUMBER 68

AUDIO, VHF AND UHF IN-PHASE, REACTIVE LUMPED ELEMENT POWER DIVIDERS/ COMBINERS



50 kHz to 2 GHz

The winning combination is 83 different standard catalog 2, 3, 4, 6, 8, 12 and 16 way Power Dividers in TO-5, FLAT PACK, RELAY HEADER, LOW PROFILE PC PLUG-IN, SMA, BNC, TNC AND "N" CONNECTOR PACKAGES. Newest models feature ultra-broadband, multi-decade frequency ranges within the range of 50 kHz to over 1 GHz, at low costs.

Following are 4 standard low cost, ultra broadband, 2-way Dividers which demonstrate Merrimac's variety of different packages available off the shelf.
Frequency range (all models) 5 (or 10) to 500 MHz

PACKAGE	MODEL NO	PRICE	ISOLATION dB	PHASE BALANCE
TO-5 (0.3" high)	P-110	$12.00	25 TYP. 20 MIN.	2°
RELAY HEADER	113-C	$ 9.00	30TYP. 25 MIN.	1° TYP. 2° MAX.
FLAT PACK	PDF-2A-250	$17.00	30TYP. 25 MIN.	1°
WITH SMA CONNECTORS	PDM-20-250	$35.00	30 MIN.	1°

For complete detailed specifications on the above 4 models as well as our other 79 standard IF power dividers:

Send for our NEW '77 CATALOG OF IF SIGNAL PROCESSING COMPONENTS.

CIRCLE NUMBER 69

MICROWAVE IN-PHASE, STRIPLINE BINARY POWER DIVIDERS/ COMBINERS

.5 to 18.0 GHz

The winning combination is 58 different standard catalog 2, 4, and 8 way Power Dividers with SMA and TYPE N, in octave, multi-octave and straddle bands from 500 MHz to 18 GHz with in-line and angled output configurations.

Following are 4 standard models which are typical of the other 54 standard items: prices from $85.00 for 2-ways to $265.00 for 8-ways.

MODEL No.	POWER DIVISION	FREQUENCY RANGE (GHz)	ISOLATION dB(MIN)	INSERTION LOSS dB(MAX)
PDM-22-.75G	2:1	.50-1.0	20	.30
PDM-42-3.95GA	4:1	3.7-4.2	18	.50
PDM-82-6GA	8:1	4.0-8.0	17	1.0
PDM-22-15G	2:1	12.4-18	14	1.0

For complete detailed specifications on the above 4 models as well as our other 54 Standard Microwave Power Dividers:

Send for our NEW '77 MICROWAVE CATALOG

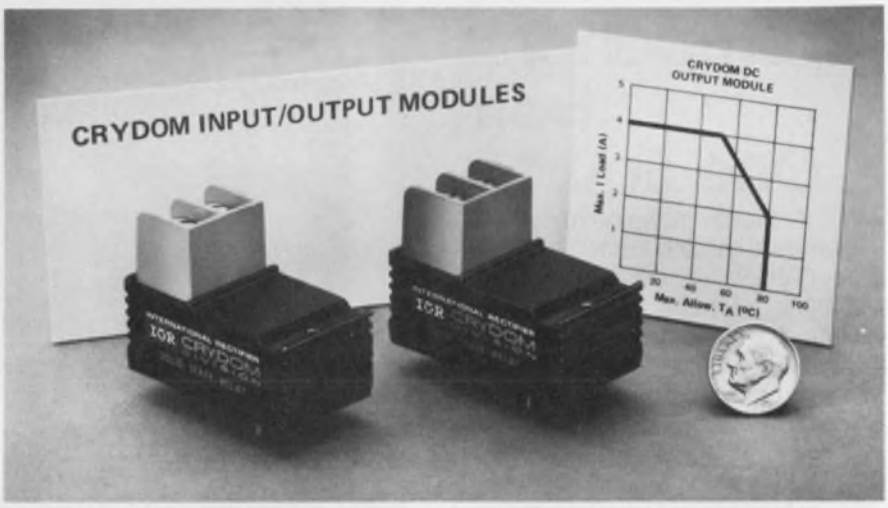
CIRCLE NUMBER 70

now there is one...in signal processing

EXPORT REPRESENTATIVES DAGE CORP.
STAMFORD, CONNECTICUT 06902
(203) 324-3123 TWX 710-474-2490 Telex: 96-5928

Merrimac
INDUSTRIES, INCORPORATED
POST OFFICE BOX 986, 41 FAIRFIELD PL., W. CALDWELL, N.J. 07006
• 201 575-1300 • TWX 710-734-4314

Solid-state I/O relays control loads of up to 4 A



International Rectifier, Crydom Div., 233 Kansas St., El Segundo, CA 90245. (213) 322-3331. P&A: See text.

Packing more punch to the cubic inch, the Series-4 solid-state input/output switches can handle 4 A at up to 40 C—about 25% more than the closest competing units. These I/O circuits from the Crydom Div. of International Rectifier come in 1.75 × 1.3 × 0.96-in. panel-mount packages, compatible with the Teledyne Relays (Hawthorne, CA) 671 Series of I/O modules.

There are five input models and three output models in the series. Each module contains a LED status indicator and color-coded barrier-type power terminals. Output models can deliver 4 A at up to 40 C and are derated to 2.75 A at up to 70 C. All the units are essentially four-terminal solid-state relays that accept logic-level signals and switch a dc or ac power output. And all of them are available in two pinout versions, are optically isolated and have internal transient protection.

The S410, S411 and S412 (and the S450, S451 and S452 alternate pinouts) handle dc inputs of 10 to 32 V, 10 to 55 V and 40 to 120 V, respectively. Their maximum output voltage capability is 30 V dc from open-collector transistors. Two ac-input models, the S420 and S421 (and the S460 and S461) can handle inputs of 90 to 135 V and 180 to 270 V rms, respectively, and can also control output voltages of up to 30 V dc via an open-collector output transistor.

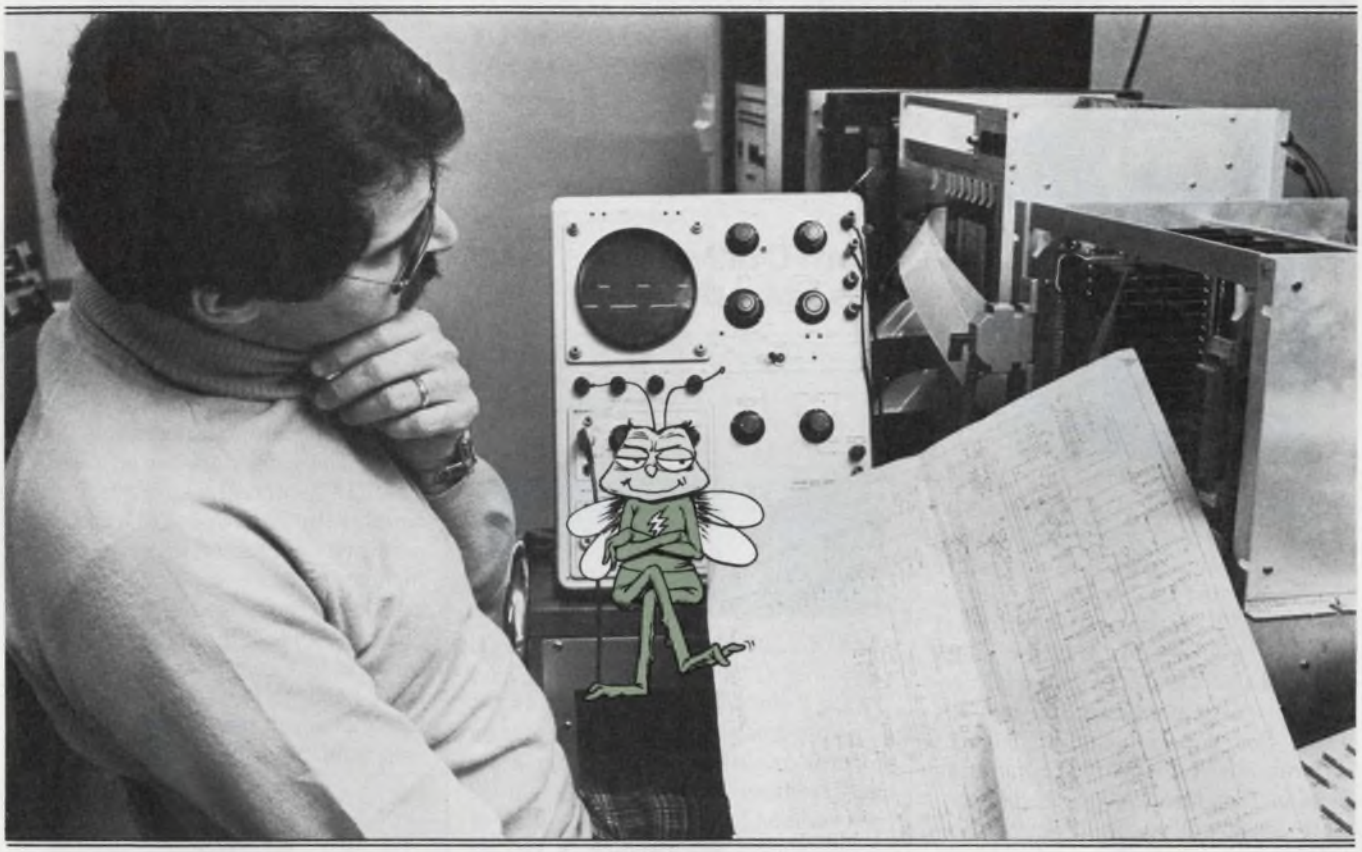
One dc output model, the S430 (and the S470) accepts inputs of 4 to 8 V dc and handles output voltages of up to 55 V dc at currents to 4 A. Two ac output models, the S440 and S441 (and the S480 and S481) accept 3.5 to 8-V-dc control inputs and can handle 140 V ac and 280 V ac, respectively, at 4 A. The ac output models also have a maximum surge current of 80 A for 10^2 surges with a pulse duration of about 18 ms. Lower surges can be handled with higher repetition numbers. For instance, 30-A surges can occur 10^{10} times, and last 18 ms.

Competing units in the Teledyne 671 series are available with current-output ratings of up to 3 A at 25 C and derate down to 0.75 A at 70 C. They measure 3.1 × 2.06 × 0.99 in. Another Teledyne series, the 673 family, comes in 1.93 × 1.5 × 0.96-in. cases; dc models can handle 3-A loads up to 40 C and ac models up to 55 C. The units derate to 1.5 and 2 A, respectively, at 70 C. Typical price for a dc output model is $12.75 in 100-unit quantities.

Prices for the Crydom Series 4 family, in 50 to 99 quantities, are as follows: $10.65 for the S410, $11.40 for the S420, $18.15 for the S430, and $15.15 for the S440. Delivery is from stock.

Crydom Div. of IR — **CIRCLE NO. 305**
Teledyne Relays — **CIRCLE NO. 306**

SOME STABILITY PROBLEMS ARE EASIER TO CURE THAN YOU MIGHT THINK.



Possibly you have become so accustomed (and inured) to a slight instability or drift in your equipment that you no longer regard the problem as soluble. You've learned to live with it.

But have your customers? They're still waiting for a solution. And if you can't provide one, someone else may.

There are so many stability problems directly traceable to resistive devices that skimping on the quality of a few critical resistors, resistive networks, or trimming potentiometers is simply bad design—and poor business.

Of course not every resistance application calls for the ultra precision and stability of a Vishay Bulk Metal* component. But in those circuits that are causing you trouble, you just may cure your customers' field-adjustment and MTBF problems with a few well-placed Vishay resistors or trimmers.

Sure, they cost more. But the extra initial cost for Vishay precision often pays for itself in reduced compensating circuitry or temperature-controlling systems. And, too, the resulting higher reliability and better overall system performance prove you've got a good design—and that's good business.

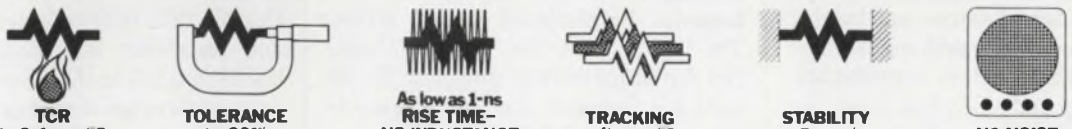
Now a word, please, about the real meaning of precision in resistors. If you're paying for a tolerance of, say, ±0.05% and after a few hundred hours it's loosened to ±1%, you haven't gotten what you paid for. Vishay treats you much better than that. One of our unique contributions to your peace of mind is long-term load-life stability (within 0.05% for 2,000 hours under full rated power at 125°C as *standard*).

In fact, only from Vishay can you get the complete set of top performance characteristics (see below), a combination which will most often free your equipment from that tormenting bug.

Would you like to learn—in a half-day seminar in or near your plant—how to *make your own* custom bulk-metal resistors from Vishay chips, for breadboarding, prototype, or even production use in your products? Call us or write for information. Vishay Resistive Systems Group, 63 Lincoln Highway, Malvern, PA 19355; phone (215) 644-1300; TWX 510-688-8944.

VISHAY RESISTIVE SYSTEMS GROUP

Only Vishay resistors give you all six top performance specs.

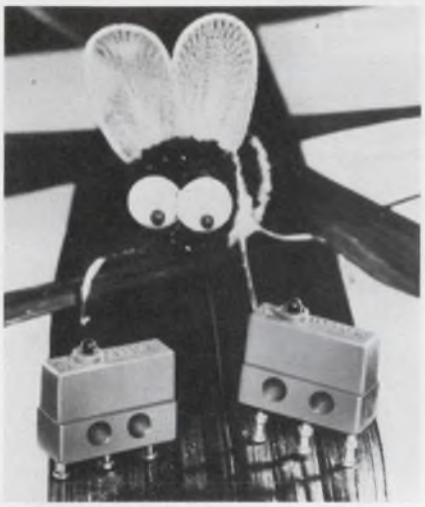


*Vishay

#6843

CIRCLE NUMBER 72

Snap action provided by submini switch



Otto Controls, 36 Main St., Carpentersville, IL 60110. Ron Sparks (312) 428-7171. $1.93 (100 qty); stock to 6 wks.

The B2 snap-action subminiature switch is rated at 7 A for 28 V dc or 115 V ac. It features five different terminal styles and qualifies under M8805/4 (MS24547). Commercial versions are also available. Size is 0.5 × 0.2 in. Some specs include movement differentials to 0.005 in., operating force of 5 oz max., silver or gold contacts for low-level or dry-circuit requirements.

CIRCLE NO. 340

Knobs ease control with tactile shapes

Aerospace Knob, 9835 Dupree St., South El Monte, CA 91733. (213) 442-4700.

Eight different tactile-knob shapes allow the user to differentiate among several controls located in the same area. An operator can easily distinguish between controls both visually and by tactile feel. Each knob shape has the same base diameter and height, thereby allowing interchangeability. Available options include assorted colors, markings and shaft-hole sizes, for a total of 192 part numbers.

CIRCLE NO. 341

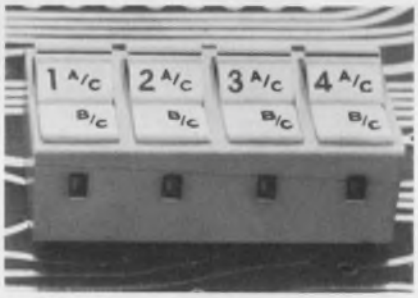
Phone-hybrid Xformers carry up to 120 mA dc

Pulse Engineering, P.O. Box 12235, San Diego, CA 92112. (910) 335-1527. See text.

Three types of hybrid transformers, PE61555/6/7, include units capable of carrying up to 120 mA dc. All units provide a 2-wire return loss of 26 dB minimum and trans-hybrid balance of 45 dB minimum. Insertion loss is 5 dB max. They are priced at $11.00 for a zero dc current model and $26.85 for 900:900-Ω impedance at 120 mA dc.

CIRCLE NO. 342

Form-C DIP switch has heavy-duty pins



EECO, 1441 E. Chestnut Ave., Santa Ana, CA 92701. (714) 835-6000. Under $1.90: 2-station (1000 qty); 6 wks.

Large cross-section terminal pins on form-C mini-DIP switches facilitate positive insertion into sockets and PC boards and reduce the potential of misalignment and bending. A locking design ensures against accidental actuation and gold contacts feature positive wiping. Switches are available in 1-to-5 station models with green body, white rocker and red marking.

CIRCLE NO. 343

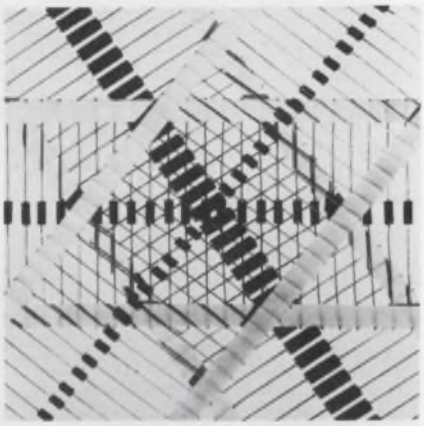
Metalized capacitors are flame retardant

W-K Industries, 1960 Walker Ave., Monrovia, CA 91016. (213) 358-4914.

Flame-retardant film capacitors in several case styles have been added to the H-Series of metalized-polycarbonate types. They feature the same sizes and electrical characteristics as non-flame-retardant styles. And they are available in wrap-and-fill and epoxy packages, also in round and rectangular hermetically sealed styles. The units meet the highest classification standards of proposed UL 94 tests for flammability and oxygen-index test of ASTM D-2863-74.

CIRCLE NO. 344

Capacitors packaged for high-speed insertion



Sprague Electric, 347 Marshall St., North Adams, MA 01247. (413) 664-4411.

Type 292C capacitors, intended for volume production, are furnished mounted on lead tapes for use with high-speed automatic-insertion equipment. The capacitors are available in five EIA temperature characteristics. Units with Z5U and Y5U EIA temperature characteristics have the highest possible capacitance in the smallest case size, according to Sprague, and X5R and X7R types are semistable. Temperature characteristic COG (NPO)—neg-pos-zero—exhibits a capacitance change of less than ±30 ppm/°C from −55 to 125 C.

CIRCLE NO. 345

Alphanumeric keyboard features 60 keys

Chomerics, 77 Dragon Ct., Woburn, MA 01801. Dick Seeger (617) 935-4850.

Alphanumeric keyboard, Model EA, provides 60 keys and a space bar coded into as few as 24 output lines on a flexible tail. Bounce is less than 3 ms and resistance less than 50 Ω. Key travel is 0.125 in. Custom key legends and a wide range of coding matrices are available.

CIRCLE NO. 346

What is a BREECH-LOK™?

If you can imagine what the first transistor meant to the electronic industry, you have some idea what the Breech-Lok means to a connector user. It is truly unique in that the Breech-Lok provides a rugged, fool-proof mating system in a miniature electrical connector and meets all MIL-C-38999 specifications.

The Breech-Lok mechanism distributes the coupler load over solid metal locking lands, while internal drive threads provide the mechanical advantage required to engage contacts and interfacial seals.

Features:

The interlocking metal lands replace bayonet pins and provide:

- Superior EMI/EMP shielding (90 dB at 100 MHz —70 dB at 10 GHz).
- Withstands greater shock (MIL-S-901C high intensity) with backshells.
- Higher vibration (to $3G^2/Hz$) with backshells.
- Backshell threads suitable for MIL-C-915 cable.
- Scoop proof-all configurations.
- Quick coupling (90° to lock or unlock)
- 3 full mate indicators (audible, tactile, visual)
- Standard shell types, sizes, contact-inserts & tools.

Applications:

Breech-Lok is a general purpose connector rugged enough for cabling, high shock or sustained vibration and is optimized for Electromagnetic Compatability (EMC).

Please ask for our new 16 page Breech-Lok catalog. For price and delivery quotes, call or write our home office or your area field representative.

G&H Technology, Inc.

1649 17TH STREET, SANTA MONICA, CA 90404
TELEPHONE: (213) 450-0561

CIRCLE NUMBER 73

MIL-C-38999G
SERIES IV

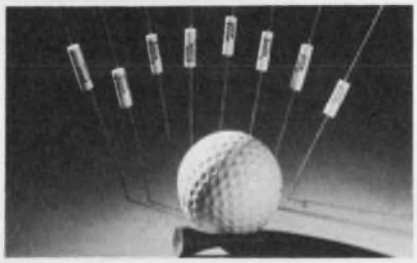
Low-profile Xformers mount on PC boards

Abbott Transistor, 639 S. Glenwood Pl., Burbank, CA 91506. (213) 841-3630. $5.75; stock.

Packaged for PC mounting with a height of only 1.03 in., the Model 6LP12-1 power transformer supplies 12 V ac at 0.1 A or 24 V ac center-tapped at 0.05 A at 1.2 W. Output-voltage tolerance is within 5% at full load with 115-V-ac input. Voltage regulation is better than 20%.

CIRCLE NO. 347

Capacitors with high WV reduced in size



TRW Capacitors, 301 West "O" St., Ogallala, NE 69153. (308) 284-3611. $0.40 up; stock.

Subminiature polystyrene dielectric capacitors with metallized carrier feature high-voltage breakdown capability and reduced size. The X1263UW has a 100-V-dc rating and is available in sizes from 0.001 to 1.0 μF. A low controlled negative TC (50 ± 50 ppm/°C) permits easy compensation in RC circuits. Dissipation factor is less than 0.1% at 1 kHz. Operating temperature is 0 to 70 C.

CIRCLE NO. 348

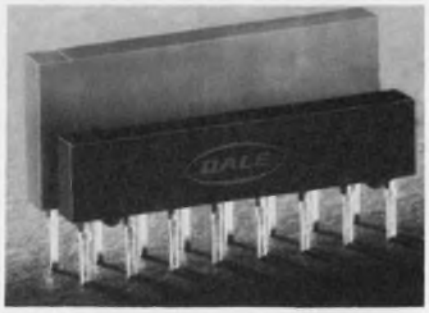
Mercury thermostat senses within 0.03 C

Mack Electric Devices, 211 Glenside Ave., Wyncote, PA 19095. Ken McKinney (215) 884-8123. $10 (25 qty); 4 wks.

Hermetically sealed mercury-in-glass thermostats accurately sense high or low temperatures within 0.03 C of set points. Factory calibrated, the drift-free precision units require no adjustment after installation. Temperatures are set from −57 to +300 C. Straight or angle-shaped, the units are 0.125-to-0.25-in. OD by 1.5, 3 or 7-in. long. Contact load is rated 110/220 V ac or dc, 10-mA noninductive.

CIRCLE NO. 349

Thick-film network packs in 9 resistors



Dale Electronics, Box 74, Norfolk, NE 68701. Dave Dossett (402) 371-0080. See text.

A low-profile thick-film resistor network, MSP Series, accommodates up to nine resistors in a high-density package. The network with a 0.195-in. height and tough, molded coating is available in 6, 8 and 10-pin models. Individual resistors have a max rating of 0.18 W with a total max rating of 1.7 W per 10-pin package. Standard resistance range is 10 Ω to 1 MΩ with ±2% tolerance. TC is ±100 ppm/°C from −55 to 150 C. A five-resistor model with a resistance of 1 kΩ is priced at $0.31 in 1000 quantity.

CIRCLE NO. 350

Variable Xformer saves back-of-panel space

Superior Electric, 383 Middle St., Bristol, CT 06010. Ivan Bourgoin (203) 582-9561. $16; stock.

Handling up to 1.5-A constant-current or up to 2-A constant-impedance loads, the Type 9 Powerstat variable transformer occupies a depth of 1.72 in. in back of a panel. The unit is offered only as a 120-V, single-phase, manually operated assembly. Taps permit an output voltage of 0 to 132 V. Any frequency between 50 and 2000 Hz can be used with no reduction in allowable output current.

CIRCLE NO. 356

Quad package combines op-amp and comparator

Motorola, P.O. Box 20912, Phoenix, AZ 85036. Bob Benzer (602) 962-3151. $1.15 to $7.50 (100 qty); stock.

A versatile IC, MC3405/3505, combines a pair of op-amps and a pair of dc comparators. The comparators and op amps are capable of common-mode inputs down to the negative supply, and operate from a single supply of 3 to 36 V, or dual supplies from ±1.5 to ±18 V. The devices are available in two temperature ranges in plastic and ceramic 14-pin DIPs. The MC3405 operates from 0 to +70 C and the MC3505 is specified from −55 to +125 C.

CIRCLE NO. 357

Precision reference lets you adjust TC

National Semiconductor, 2900 Semiconductor Dr., Santa Clara, CA 95051. Dave Whetstone (408) 737-5856. See text; stock.

Using a differential input circuit, a 2.5-V band-gap reference IC (LM136/236/336) has adjustable TC and performs as if it were a zener shunt regulator. The device is usable as either a positive or negative reference with adjustable breakdown voltage. Regulation is over a range of 300 μA to 10 mA. Dynamic impedance is 0.6 Ω max. The LM136 operates from −55 to +125 C and the LM236 range is −25 to +85 C. Both come in TO-46 metal packages. The LM336 operates from 0 to +70 C and is available in a three-lead TO-46 metal or a TO-92 plastic package. Unit prices for 100-up quantities are: $6.00, $4.20, $2.20 and $1.20 for the LM 136, 236, 336 (TO-46), and 336 (TO-92), respectively.

CIRCLE NO. 358

Quad devices serve as plasma-display drivers

Texas Instruments, P.O. Box 5012, M/S 308 (Attn: Plasma Display Drivers), Dallas, TX 75222. Dale Pippenger (214) 238-2165. 100-qty. prices: $1.41 (75426), $1.76 (75427); stock.

Two IC plasma-display drivers, the SN75426 and SN75427, are quad devices capable of 90-V output swings. The devices have CMOS-compatible inputs, 1-MΩ input impedance and 30-mA clamp diodes on the output. Independent addressing of each gate permits serial or parallel use. Logic of the two drivers is complementary to permit controlled writing or erasing at a specified point on the display. The devices require two power supplies, one for the logic section and one for the high-voltage outputs. Both drivers operate from 0 to 70 C.

CIRCLE NO. 359

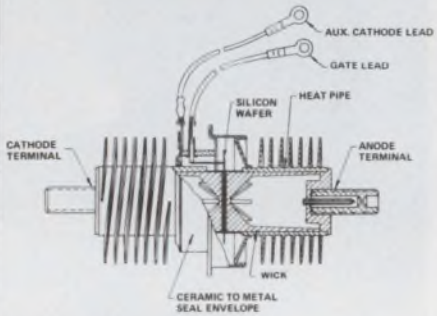
Static RAM keeps power drain low

Mitel Semiconductor, 18 Airport Blvd., Bromont, Quebec, Canada JOE 1LO. (514) 534-2321. $12.30 to $22.40; stock.

A 1024-bit static RAM, the SIL 1902A, keeps the power drain low, even at high temperatures. At 125 C, the worst-case standby current is only 190 nA/bit with a V_{cc} of 5 V, less than 1 mW total. The device has a maximum access time of 800 ns. It is TTL compatible, including its three-state output, and features a low supply-voltage memory-retention capability. Prices vary with package type and operating temperature range.

CIRCLE NO. 360

Power devices have heat pipes bonded to wafer



RCA, New Holland Ave., Lancaster, PA 19604. (717) 297-7661. See text.

Silicon power devices that have heat pipes bonded directly to the device wafers feature high current, high blocking voltages, light weight and small size. They are called "Transcalent" devices. Types are the P95000EB 250-A rectifiers with blocking voltages to 1200 V, the P95200EE4 100-A npn transistors, and the P95400EB 400-A thyristors (SCRs) with blocking voltages to 1200 V. The rectifier and thyristor series weigh 12 oz and have volumes of less than 14 in^3. The transistor has a dissipation of 500 W, yet weighs less than 2 lb and requires less than 70 in^3. The devices can be supplied with radiator structures for either air or liquid cooling. Prices in sample quantities are: $1125 for the rectifier, $1375 for the thyristor, and $1825 for the transistor.

CIRCLE NO. 361

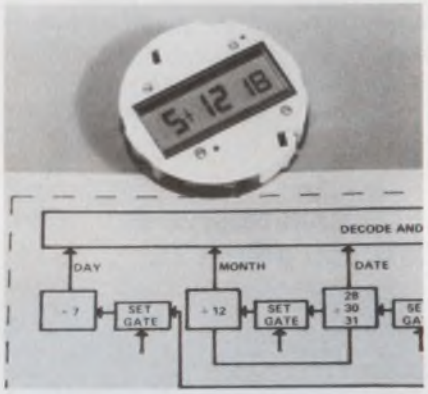
Bridge rectifier handles 10 A

Solitron Devices, 8808 Balboa Ave., San Diego, CA 92123. Larry Simmons (714) 278-8780.

Using a process that maximizes thermal transfer, the TJ118 bridge rectifier operates at high current levels. The units handle up to 10 A and 600 PRV. Fast-recovery versions with t_{rr}'s of 250 ns are available.

CIRCLE NO. 362

Six-function watch chip drives 5½-digit LCD



Solid State Scientific, Montgomeryville, PA 18936. A. Genchi (215) 855-8400. $2.95 (100 qty).

The SCL 5450 chip provides all six timekeeping functions and directly drives a 5½-digit alphanumeric LCD. Time, including seconds, is displayed continuously. Month, date and day of week are displayed upon interrogation. The chip features a high-density CMOS process and measures only 142 mils per side. Operating from a 1.5-V battery, the chip includes a high-efficiency voltage doubler/tripler to provide the LCD drive voltage.

CIRCLE NO. 363

4-k static RAM accesses as fast as 100 ns

Zilog, 10460 Bubb Rd., Cupertino, CA 95014. Jim Gibbons (408) 446-4666. See text; stock.

The Z-6104 is a 4096 × 1-bit static RAM with an access time as fast as 100 ns and low standby current. The memory is available in five speeds from 100 to 300-ns access time. Pricing for 100 to 999 quantity in ceramic package is $20 for a 250-ns circuit and $22 for a 200-ns version.

CIRCLE NO. 364

If you're this kind of systems OEM,

You're building complex turnkey projects.

You need more than "iron".

You know that your best buy is not a mixed bag of bottom-priced components, but a proved system, with all essential support, from a supplier who becomes your working partner.

we're your kind of computer systems source.

We're different. Instead of selling you black boxes, we supply complete computer systems. We've been doing this for seven years.

We have a state-of-the-art line of standard processors, memories, I/O devices, terminals and other peripherals. Plus proved system operating software that speeds your application programming. Advanced network and transaction software. And we'll quote special hardware and software where needed.

You'll like our systems engineering help, because we understand system problems. And we don't love you and leave you, but supply full support — field service, documentation, personnel training, even sales support.

What you get from MODCOMP is a fully checked-out system, factory burned-in, ready to bring on-line quickly and efficiently.

Get the full MODCOMP OEM story, by asking for the brochure, "Power Tools For Building OEM Systems". Modular Computer Systems Inc., 1650 W. McNab Road, Fort Lauderdale, Fla. 33309. (305) 974-1380.

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The systems store.

European Headquarters:

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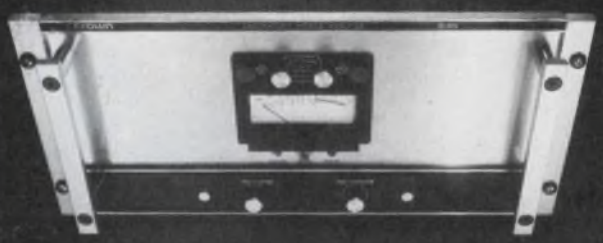
Surrey, England
Phone: (04862) 71471

CIRCLE NUMBER 79

Two Modcomp IV and four Modcomp II processors are the center of a new digital traffic control system for the city of Baltimore, engineered by TRW Inc. The TRW system has the capacity to control signals at 1200 key intersections in the city, and also provide surveillance of a five-mile section of the Jones Falls Expressway.

The crown M-600 will drive shake tables, speaker coils, sonar transducers or servo motors.



The Crown M-600 Amplifier is good at driving transducers, no matter what they're used for.

It's immune to damage from shorted, open or mismatched loads.

It operates continuously at full rated power.

It will give you up to 78 volts RMS. It will give you up to 1000 watts into 4 ohms, DC to 15 KHz. It works into any impedance. Compare the M-600 to any other amp in its frequency range, no matter what it's used for.

We're especially interested in helping you answer any application questions you might foresee for the M-600. Tell us your problem. We may already know a solution.

crown INDUSTRIAL

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CIRCLE NUMBER 80

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Model D-72C Two Element X-Y-T Recorder

Features

1. Two element time axis
Model D-72C permits time recording by two systems; mechanical recording chart feed and time axis sweep by time.

2. High performance chart attraction
Troubles due to faulty attraction of the chart due to friction during chart feed has been completely eliminated regardless of the temperature or feed rate.

3. Automatic chart replacement in XY recording
The chart can be automatically fed and stopped at the end of chart replacement with one touch by loading roll chart.

4. Remote control terminals
● Pen up-down ● X-axis electronic time sweep trigger ● Mechanical time feed recording chart start/stop ● XY chart automatic replacement feed trigger

5. Easy-to-install optional chart take-up device (Optional)

6. Felt tip pen (Optional)

7. High input impedance 10MΩ fixed

● *For further information, please contact:*

Riken Denshi Co., Ltd.

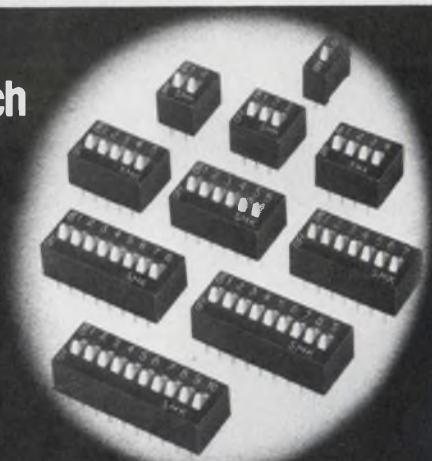
5-5-2, Yutenji, Meguro-ku, Tokyo, Japan. TELEX: 0246-8107

PAYTON ASSOCIATES INC.

244 Delaware Avenue, Buffalo, New York 14202 Phone: (716) 852-6213, 855-1314

CIRCLE NUMBER 81

DIP Switch Line from SMK



The JS-8722 Series is a complete line of DIP Switches, from 1 to 10 positions, featuring sealed construction to prevent flux contamination during wave soldering. A clip-type wiper design assures positive 2-sided contact to provide excellent shock and vibration characteristics.

Available in SPST configuration, the switches are rated at 24V DC at 300mA switching, resistive load, and will operate from −20°C to +60°C.

Typical price for a 4 position DIP Switch in 100 piece quantity would be $1.16 each.

SMK Electronics Corporation of America

118 East Savarona Way Carson, California 90746

Tel: (213) 770-8915

CIRCLE NUMBER 82

Great Timing Products...

One generation

after another

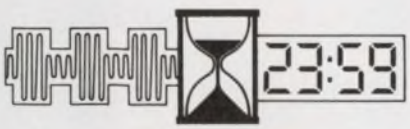
after...

Introducing Moxon's new Model 175 system that performs in more timing applications...

Since time measurement began there have been constant improvements in techniques and accuracy. So too, since the aerospace days of Astrodata timing equipment leadership . . . a tradition of leadership that Moxon continues today.

Moxon's newest state-of-the-art Model 175 timing systems have the same precision, quality, and *reliability* . . . not only for military and aerospace applications, but also for numerous medical, scientific, industrial and related applications, as well.

To meet these requirements, Moxon designed the Model 175 . . . modular timing systems which let the user select what's needed now, and expands it as needed in the future. Complete timing systems start at $800.



Moxon's current timing products include a full spectrum of sophisticated generators, translators, translator/generators, time code tape search and control units, etc. . . . whatever you require. They handle all modulated time codes, interface with computers, provide display and output of milliseconds thru years . . . and just about any other function you'll need.

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moxon inc.

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CIRCLE NUMBER 281

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LEADERSHIP IN MASS TERMINATION CONTACT RELIABILITY starts with our exclusive patented TULIP™ contact that provides 4 points of electrical contact per conductor for gas-tight, corrosion-free terminations. Comprehensive test information is available upon request.

LEADERSHIP IN LOWER INSTALLED COSTS begins with a one piece connector design that eliminates unnecessary handling to reduce installation time by as much as 65%. This one piece design incorporates mating grooves which assures positive cable to connector alignment, and it eliminates the operator variable when assembling the cable to the connector. Insulation displacing TULIP contacts let you simultaneously mass terminate up to 60 conductors in seconds —without wire stripping or soldering.

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The mass termination company.

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Subsidiary of Thomas & Betts Corporation
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CIRCLE NUMBER 282

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CIRCLE NUMBER 283

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How do you squeeze 7000 feet of reliability into a fighting package?

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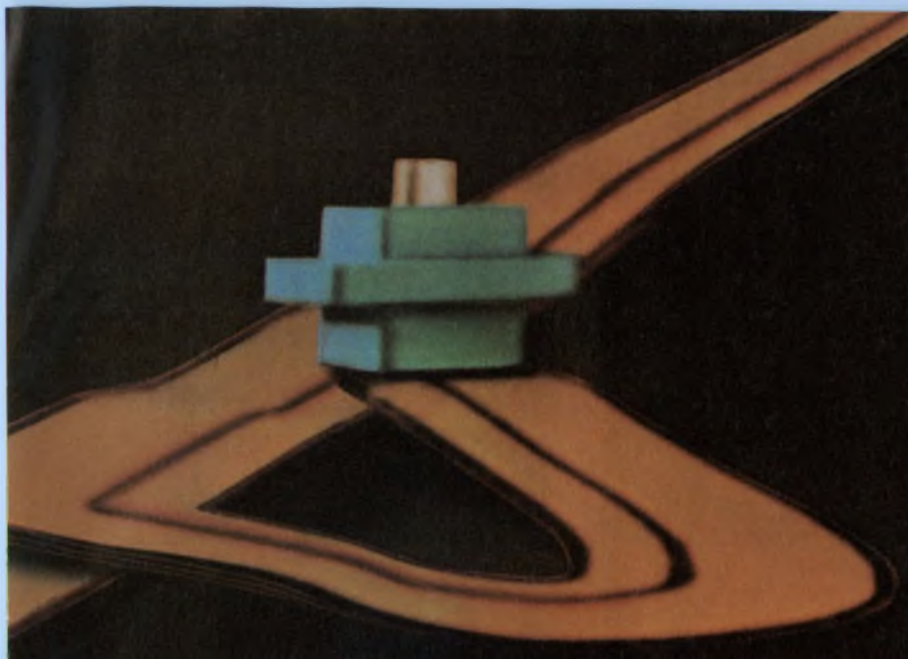

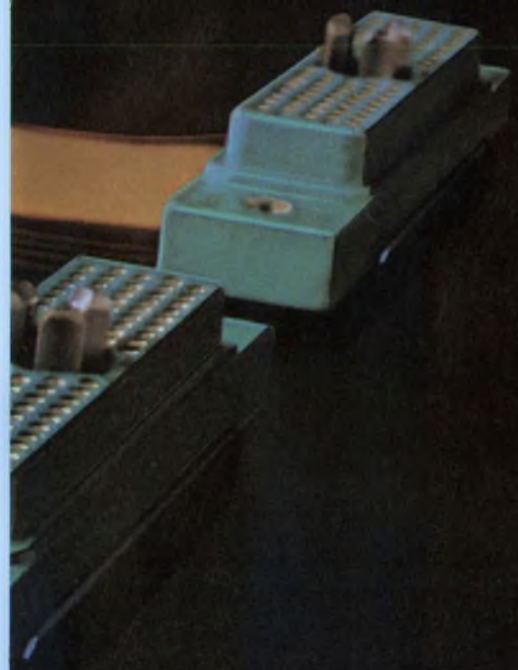

Total interconnection technology.

When it's a complex fighting machine like the Navy's A-6E and its TRAM target-sensing system's highly sophisticated avionics, you connect with Hughes capability. Hughes, because of our deep involvement in high-technology military and aerospace programs: Phoenix, Maverick, Lance, Minuteman, AWACS, F-14, F-15, Space Shuttle, Viking, Sonobuoy, F-4, A-7, Condor, Standard Missile, F-8, Trident, Hobo, Sprint, and many more.

With all that experience, we've developed not only the hardware and the circuitry, but also the concepts and design capability to solve the toughest interconnection problem. And the techniques to make it work. Aside from our design-to-system advanced packaging, we also offer umbilical and special connectors and off-the-shelf connectors.

Umbilical and other special connectors. Our umbilical on the new laser-guided Maverick is typical of our specials; we also have connectors on many of the country's airborne missiles where sure-fire operation is critical to national defense. Meeting your requirements is the challenge to us. We give priority to your special-connector problems. Solutions are just part of what we offer.

Off-the-shelf connectors. The new C-21 (MIL-C-85028) is another typical example of Hughes hi-rel technology. For high-altitude applications the C-21 has individual seals for up to 250 psi on the contacts, preventing altitude breathing and consequent contamination. It's a Hughes exclusive.

Our standard line also features subminiature rectangulars, standard size, subminiature circulars, and miniature rectangulars—better because they're super hi-density connectors. Our exclusive PolarHex™ Center Jackscrew coupling device makes it all possible. Another Hughes first is our HAC PAK™ connector (MIL-C-28804), the simplest way to connect round to flat cables.

Ask Hughes. Squeezing reliability into any sophisticated machine is no problem for you. Just ask Hughes Connecting Devices, 17150 Von Karman Avenue, Irvine, CA 92714, or call (714) 549-5701.

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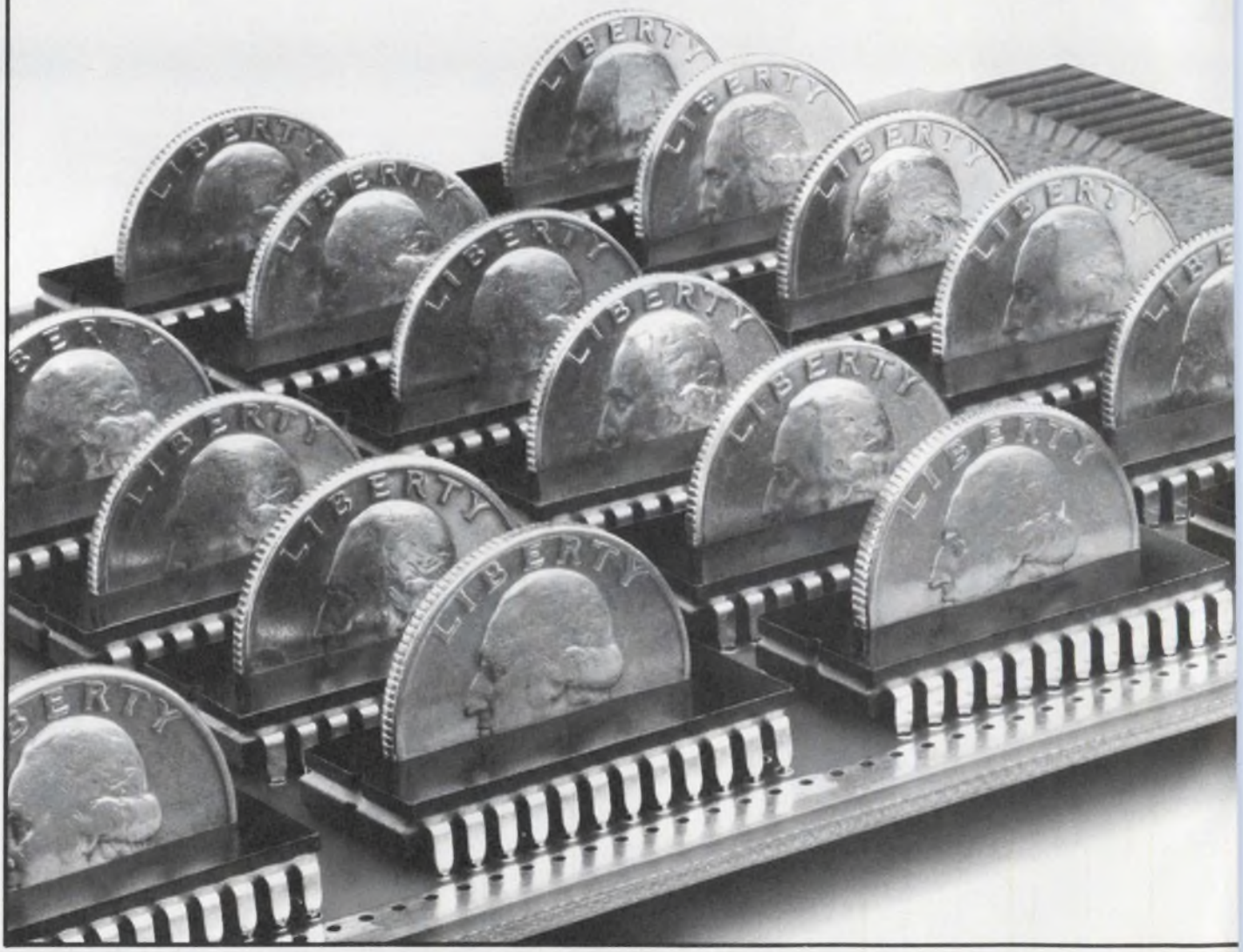
Total interconnection technology: the hardware, the circuitry, and the concepts.

CIRCLE NUMBER 296

Stop wasting space and dollars.



Use our faster 8K ROM.

Monolithic Memories' new 6280-2 bipolar 8K ROM costs $10 in volume and guarantees 55nS T_{AA}.

The 6275-1 bipolar 16K ROM, with 110nS access time, gives you the best speed/density product going.

You're no longer forced to specify a 4K ROM to get access speeds below 70nS. Our new 6280-2 1024x8 bit ROM ends that with 55nS maximum access time in commercial grade models, or 70nS access in MIL-temp models. Slower versions (6280-1 at 100nS max. T_{AA}) are available in volume at prices down to $8.50.

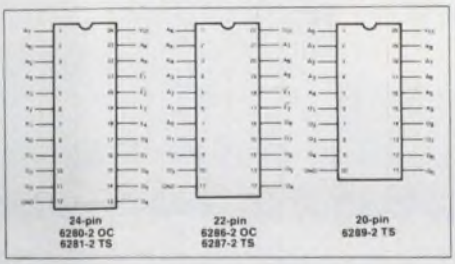
For higher density applications we've got 9K (6260-1) and 10K (6255-1) ROMs, both with 100nS access.

Or for the ultimate in bipolar ROM density, look into our 6275-1 bipolar 16K ROM, the world's fastest at 110nS access. All are available in open collector or tri-state outputs and in commercial or MIL-temp ranges.

Flexible design with bipolar speed.

Already working with a 20-pin 4K ROM? That's okay.

Our 6280-2 is available in 20-pin, 22 or 24-pin packages, with pinouts designed as drop-in replacement for whatever you're using. And the 22 and 24-pin versions have compatible PROMs available off the shelf. Add to this the inherent speed and simplicity of Monolithic Memories' bipolar technology for a total design package you can't beat.



Design in now, plug in 5 weeks.

Delivery on most orders is five weeks from receipt of your bit pattern. Masking charge is only $750 per pattern in minimum quantities of 100 pieces.

From the undisputed world leader in bipolar memories.

Every year since its incorporation in 1970, Monolithic Memories has delivered more bipolar read only memory than any other company in the world. We introduced the first 1K PROM, the first 2K PROM, the first 4K PROM and the first 8K PROM. Look for much more from Monolithic Memories. Call (408) 739-3535 TWX 910-339-9229 or write 1165 East Arques Avenue, Sunnyvale, CA 94086.

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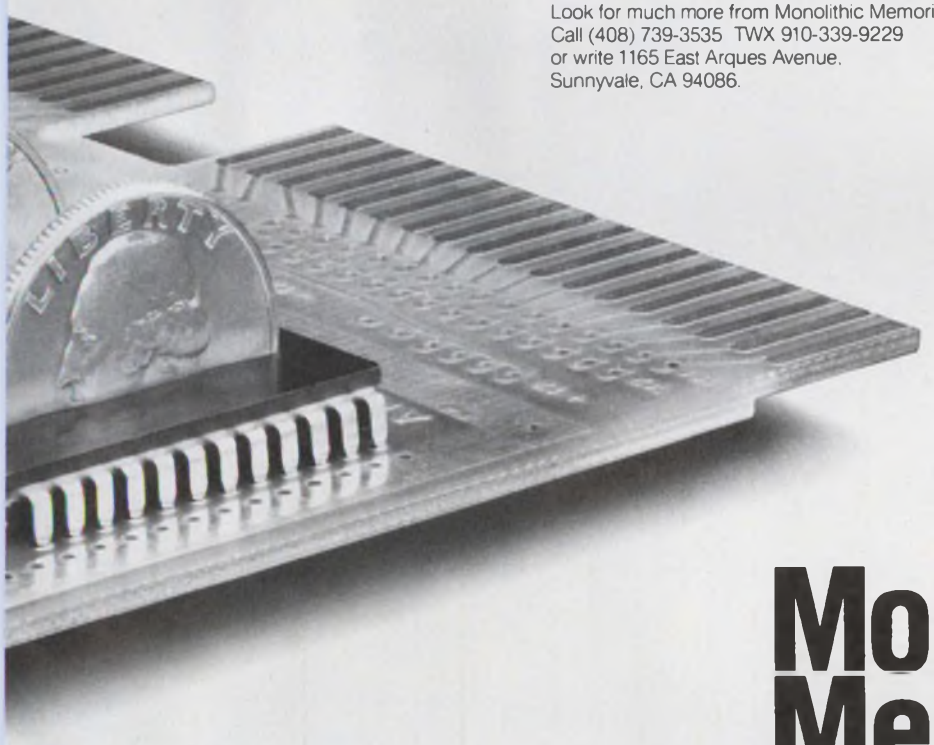

Monolithic Memories

Bipolar is our business.

CIRCLE NUMBER 284

Series 10, Circle No. 131
Series 90, Circle No. 132
Series 440, Circle No. 133
Series 481, Circle No. 134
Series 600, Circle No. 135
Series 800, Circle No. 136
Series 925, Circle No. 137

Modern electronics demands switches of all types. Switches capable of withstanding the most rugged working conditions. And giving reliable service that continues throughout the life of the systems they serve.

The same electronic technology demands displays that speak to you clearly. Conveying vital information without confusing the issue.

MSC manufactures a wide range of switches and displays that meet the many applications of today's technology. All have unique characteristics which help to make your system just that little bit more easy to operate and comprehend.

Small wonder that MSC switches and displays are an everyday word in avionics, military and shipboard applications. And in computers, telephone panels and hundreds of other uses which have a daily influence on your life.

Take a look at the variety:

Series 10 — This rugged, versatile four lamp pushbutton switch has become the standard of the industry with many diverse applications in control panels for ships, oil fields and power generating plants, just to name a few. This switch has UL approval, is QPL (MIL-S-22885/9/10) listed and features positive indexing and front panel re-lamping without tools. RFI protection, solid state switching, and "high shock" modifications are available as options.

Series 90 — This two lamp pushbutton switch is cased in stainless steel and is resistant to most environmental extremes. A favorite of designers everywhere because of its overall versatility and the wide variety of terminations available for low cost assembly. Standard features include: UL approval, QPL (MIL-S-22885/58), relamping and legend change from front panel without tools, and a wide choice of switch actions.

Series 440 — This switch series provides the electronic designer with a microprocessor compatible, touch activated solid state switch. The 440 switch becomes part of the electronic circuitry without the need for interface. Because it is a capacity transducer, the reliability of the switch equals that of any transistor. The compact design eliminates the need for deep panel clearance. The touch face incorporates an optional LED as a visual activation indicator.

Series 481 — A true solid state electronic "thumbwheel" switch with the same design advantages as the Series 440. Incorporating two series 440 switching functions with an encoder/decoder/driver IC which makes an all solid state lighted thumbwheel switch with true BCD output. The seven segment LED display occupies the center section of the switch plate. The bottom plate advances the count and the top plate resets the switch to zero.

Series 600 — The Series 600 computer-grade switch is the most versatile switch in its class; unmatched performance is provided by the wiping action contact design unavailable in any other line of low-cost, computer-grade lighted pushbutton switches. Available in many different mounting configurations, sizes, styles and colors, the 600 also offers a wide choice of switch actions.

Series 800 — Ideal for matrix mount applications, this four lamp pushbutton switch is available in two display face sizes. A standard 3/4" square and a 3/4" by 1" provide the flexibility needed in panel design. Standard features include positive indexing and front panel relamping without tools. Optional solid state models and electrical interlock holding coils are available. The 800-H has received MIL-S-22885/74/80 approval.

Series 925 — Designed to meet MIL-R-28803, the 925 offers sunlight readability, required for avionic displays and other control panels used in high ambient light conditions. Utilizing fiber optics, this compact unit can be ordered with 7 or 16-segment displays. Other sizes and character configurations are also available. All MSC fiber optic displays are re-lampable and replaceable from the panel front.

Switch on to MSC today by circling the numbers of the products in which you're interested on the enclosed reader card.

MSC

Worth Switching To

Master Specialties Company, 1640 Monrovia, Costa Mesa, CA 92627, Telephone 714/642-2427

Digital announces a PDP-8 with an enormous memory.

Something big has just happened to the world's most famous small computer. In fact, something enormous.

Digital has just put 128K of memory into the PDP-8.

This act is brought to you by a powerful new memory management option called KT8-A. And by two new MOS memory modules that fit large amounts of memory into small amounts of space. Simply by adding these 16K or 32K modules in whatever combination you choose, you now expand your PDP-8/A into something bigger. What's even better, you can mix MOS and core. And that means you can protect your program in non-volatile core while you expand your data base in MOS.

And thanks to the KT8-A all this memory is under new management. Not only does the KT8-A let you address up to 128K words of memory, but it also offers you memory relocation and memory protection, while asking little in operating system overhead so you get faster system performance.

What's the cost of these enormous advancements? That's the next attraction.

The new PDP-8A MOS memory models are available at prices that are as crowd-pleasing as their performance. For a 16K 8A205 you'll pay as little as $3900 (quan. 1). 8A425 with 64K is as low as $11,000. And the top of the line 8A625 with 128K is yours for as little as $18,050.

They're the new big-memory Eights from Digital. Step right up.

Large memories aren't our only new trick.

New hardware and software improvements are also in the PDP-8 spotlight.

The VK8-A is a new low cost PDP-8A option that provides high quality video output plus keyboard and printer interfaces. Video character generation uses a super-sharp 9x9 dot matrix for high resolution on single or multiple CRT monitors up to one thousand feet away.

Also new for PDP-8 users is MACREL/LINKER—a sophisticated assembler with MACRO facilities that lets you implement, expand and update your system faster while reducing software development time.

And last but not least there's DECNET 8—a series of software protocols that let you form your own PDP-8 network.

The PDP-8. Bigger. Smaller. And better than ever.

A short while ago, we made big news with DECstation 78. A low-end system that set new highs for ease of use and simplicity.

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CIRCLE NUMBER 287

The New Giant in optoelectronics

Affiliation with Siemens gives Litronix all you could want from an optoelectronics source.

On OCTOBER 18, 1977, Siemens A.G., an $8 billion per year firm, acquired an 80% interest in Litronix through a wholly-owned subsidiary — bringing financial stability, new technologies and dozens of new products to the American firm.

Foremost among the new technologies and products are LCD displays, high-power infra-red emitters, green, yellow and red GaP LEDs, and a full line of photo detectors. Nearly all types of optoelectronic products will now be available from Litronix.

Litronix will operate under its own name and market all products in the U.S. and abroad through the same distributors and sales representatives as before.

All resources devoted to components

Litronix ceased manufacture of calculators and digital watches in January 1977. All the design and production capability once devoted to these products is now directed entirely to components. The component portion of the company's business has always been highly successful. Now, operating from a strong financial position, Litronix will resume its place as the leading source of advanced, cost-effective optoelectronic components.

New, advanced products coming fast

Already in 1977 Litronix has developed 21 new products. With the recent affiliation, new product development is being further accelerated. The company's line of displays, lamps and other opto devices is being broadened and upgraded. Special emphasis is being placed on "intelligent" displays and indicators — devices which incorporate a display and integrated logic in the same package.

The recently introduced DL-1416 alphanumeric display, which interfaces exactly like a RAM, is an apt example. Such devices eliminate need for much associated interface and logic circuitry — simplifying design and producing a sizable net saving in the production cost of customers' products. Litronix is the uncontestable leader in this promising extension of optoelectronic integration.

When you have need for virtually anything in optoelectronics, contact Litronix at 19000 Homestead Road, Cupertino, California 95014. Phone (408) 257-7910.

litronix

An affiliate of Siemens.

CIRCLE NUMBER 288

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4900 Old Ironsides Drive, Santa Clara, CA 95050. (408) 988-2900. TWX 910-338-7350.

In Europe: 645 Hanau, Muehlstrasse 19, Germany, 06181 15011, TWX 418-4170.

CIRCLE NUMBER 289

Intel delivers PDP-11 memory for people who can't afford to wait.

When you're in a hurry for more semiconductor memory for your PDP-11, call Intel. We deliver memory for the full PDP-11 line. And because we're the largest manufacturer of semiconductor memory in the world, delivery is when you want it.

Why wait? Since you've chosen the leader to supply your minicomputer, it makes sense to go to the leader for memory, too. That's us.

Intel memory systems save you more than time. Our in-1670 add-on memory for the PDP-11/70 is one example. It gives you four times the capacity in the same frame compared to the DEC MJ11-A core memory. And built in Error Correction Code (ECC) and Error Logging improve up-time and reduce maintenance time by automatically correcting and recording single-bit failures and detecting and recording double-bit errors.

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Get more memory for your LSI-11 and PDP-11/03 in less space with our in-1611 add-in memory. You get up to 32K words, in 8K increments, on a single, two-wide, board. That's up to eight times the memory you get with a DEC board.

When you can't afford to wait call us at 800-538-8476. In California and Canada, call 408-734-8102, x575. We'll save you time, and much more.

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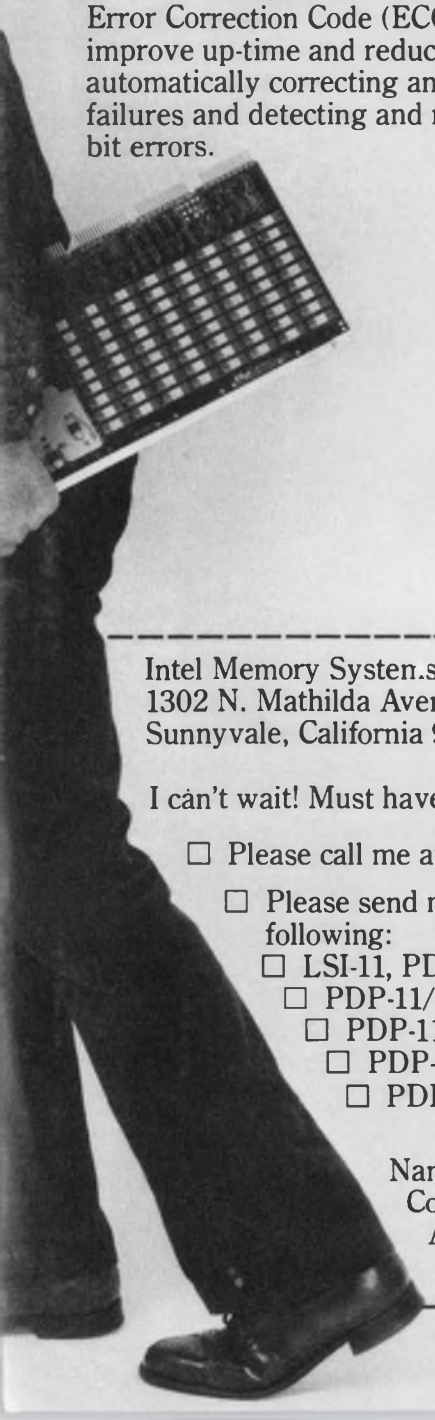

Intel Memory Systems
1302 N. Mathilda Avenue
Sunnyvale, California 94086

I can't wait! Must have delivery in ☐ 5 Days ☐ 30 Days ☐ _____ Days

☐ Please call me at _____/_____ Ext. _____

☐ Please send me information on semiconductor memory for the following:

☐ LSI-11, PDP-11/03
☐ PDP-11/04
☐ PDP-11/05
☐ PDP-11/34
☐ PDP-11/35
☐ PDP-11/40
☐ PDP-11/45
☐ PDP-11/55
☐ PDP-11/70

Name/Title _____
Company _____ Mail Station _____
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City/State/Zip _____

UNIBUS is a trademark of Digital Equipment Corp. Maynard, Mass.

CIRCLE NUMBER 290

Broadband sweep osc boasts lower price tag

Wavetek Indiana, 66 N. First Ave., Beech Grove, IN 46107. Mari Vian (317) 783-3211. $625; 4 wks.

Model 1061 sweep generator is said to be one-half the cost of comparable units on the market. The instrument has a frequency range of 1 to 400 MHz and features p-i-n diode leveling to provide an output flatness of ±0.25 dB. Both harmonic and nonharmonic spurious signals are 30-dB below the output. The unit has provision for up to six crystal-controlled, birdy bypass markers with amplitude adjustment of 2 mV to 2 V pk-pk and width adjustment of about 100 to 400 kHz. The markers are accurate to 0.005%. The sweeper is available with 50 or 75-Ω outputs. Also included are programmable center frequency, sweep width and amplitude over the 20-dB vernier range.

CIRCLE NO. 365

Data gen has keyboard entry and CRT display

Moxon, 2222 Michelson Dr., Irvine, CA 92715. Tom Clark (714) 833-2000. $3950; stock to 4 wk.

Data generator, Model 720, features a hex keypad and scratchpad memory that directs the integral CRT display to show programming of 1024 serial bits or 64-word, 16-bit parallel channels as they are being formulated for loading into a transmit memory. In operation, the 720 can generate an algorithmic pattern that will pin-point faults, thus simplifying testing. Output data rates to 20 MHz can be generated internally or fed in from an external source. Operators are offered a choice of 1 bit, 1 word, start-stop bits or continuous run at true positive and negative TTL levels.

CIRCLE NO. 366

16-channel digital latch added to logic analyzer

Tektronix, P.O. Box 500, Beaverton, OR 97077. Wyn Giluck (503) 644-0161. $1350; 4 wk.

An extension of the Tektronix logic-analyzer line, the 16-channel DL 502 digital latch makes asynchronous measurements by latching pulses as narrow as 5 ns and amplitudes as small as 500 mV—centered on a threshold set by the user. It plugs into any TM 500 mainframe/power module. The digital latch is interfaced to the LA 501W logic analyzer with both housed in a TM 500 mainframe. It can also be used for convenient connection to the 7D01 analyzer in a configuration such as the 7603 scope/7D01F logic-analyzer/display-formatter combination. The P6451 low-capacitance data-acquisition probes connect to the DL 502 which then interfaces to either the 7D01 or LA 501W logic analyzers.

CIRCLE NO. 367

Auto multicounter spans 5 Hz to 520 MHz

John Fluke Mfg., P.O. Box 43210, Mountlake Terrace, WA 98043. (800) 426-0361. $620; 6 wks.

The 1912A automatic multicounter provides a frequency range of 5 Hz to 520 MHz and has period, period average and totalize capability. Up to 10^4 periods can be averaged in the period-average mode giving a resolution range of 100 ns to 10 ps. Up to 9,999,999 events can be counted in totalized mode at a rate of up to 125 MHz. Input impedance is 1 MΩ from 5 Hz to 125 MHz and 50 Ω from 50 to 520 MHz. Sensitivity is 15 mV. The display is a 7-digit LED. The counter may be ordered with a 2 ppm or 0.5 ppm TXCO.

CIRCLE NO. 368

Direct-dial data station offers fast operation

International Communications, 8600 NW 41st St., Miami, FL 33166. (305) 592-7654. 6 to 8 wks.

A high-speed direct-dial data station, the 40+TK1, cuts costs and improves operator efficiency in communication systems. It stores messages in a MOS solid-state buffer rather than on paper tape or magnetic tapes and can replace low-speed, leased-line and tape-operated terminals. Speed ranges from 1200 to 2400 bit/s. Operation is over dial-up lines. The data station includes an ICC 40+ display, keyboard, control modules, buffer, and a 110-char/s printer and desk.

CIRCLE NO. 369

6-bit computer has enhanced software

Interdata, 2 Crescent Pl., Oceanport, NJ 07757. (201) 229-4040. $27,645 (typ); 6 wks.

The Model 8/16E processor, Interdata's first 16-bit computer system, is capable of addressing 256 kbytes of mainframe memory. The system includes the 8/16E computer as well as two enhanced software packages, the OS/16 MT2 operating system and Extended Fortran IV. The 8/16E processor includes such big-machine features as 16 general purpose registers, an IBM-like instruction set, list-processing instructions, dual input/output bus architecture and 255 automatic input/output channels. Its integral memory-management hardware permits addressing up to 256 kbytes. Memory is available in 32 kbyte increments with an access time of 275 ns and a cycle time of 750 ns.

CIRCLE NO. 370

Limited-distance modem handles 8 data rates

General DataComm Industries, 131 Danbury Rd., Wilton, CT 06897. (203) 762-0711.

The LDM-1 limited-distance modem transmits and receives synchronous or asynchronous binary serial data over nonloaded cable systems at eight distinct data rates from 1800 to 19,200 bits/s. The device contains a continuous or controlled carrier feature, operates half or full duplex over 4-wire systems and can be used in point-to-point and multipoint networks. A phase-delay method of data encoding permits the sending of a narrower spectrum. The modem has diagnostic functions, with LED indicators, that permit local and remote verification of operation.

CIRCLE NO. 371

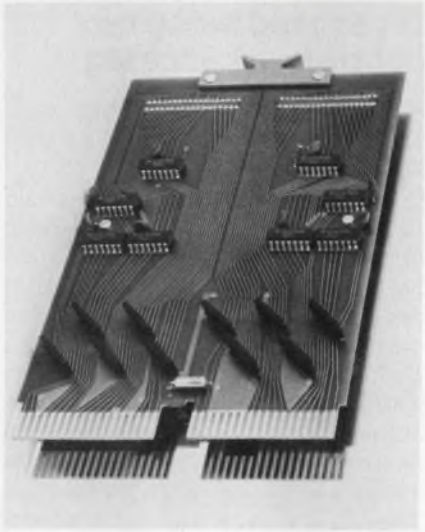
Remote terminals mate with any popular μC

LFE Control System Ind., 2920 San Ysidro Way, Santa Clara, CA 95051. (408) 732-9400.

Model 5000/6000 remote terminal units (RTU) can be linked to central computers via in-plant wiring, phone circuits, microwave or uhf/vhf radio. U/ART-compatible word formats and an RS232-C serial interface permit RTU-CPU communications via any computer's standard serial asynchronous interface port at bit rates to 1200 baud. Geometric coding assures virtual elimination of undetected command and data errors. The units can have up to 16 kbytes of PROM or RAM memory.

CIRCLE NO. 372

Fast bus-repeater is for PDP-11 systems



Datafusion, 21031 Ventura Blvd., Woodland Hills, CA 91364. Dick Erickson (213) 887-9523. $995.

The OSB11-A bus-repeater allows for the physical and electrical extension of the Unibus for the DEC PDP-11 series computer. Each repeater will drive up to 19 extra bus loads or up to a 50-ft extension of the bus cable length. It is compatible with the DEC DB11-A repeater and has the following features: approximately four times faster in MSYNC to return SSYNC response through the repeater; 34 operational circuit components; installed by replacing an M920 jumper module; does not require an extra system unit. Master and slave sync response time is 80 ns max. Signal delay through the repeater is 40 ns max.

CIRCLE NO. 373

Optical mark reader eliminates keypunching

NCS/Equipment Div., 4401 W. 75 St., Minneapolis, MN 55435. Tom Probst (612) 830-7600. $1050/mo. lease.

Sentry 7005 is a high-speed unit that can read and record nearly 7×10^6 items of information from 2400 response sheets every hour, eliminating keypunch operation. The device is available in both stand-alone and on-line models. The on-line feeds information to a computer mainframe; the stand-alone puts the information onto a reel-to-reel tape for processing. Options include a sorter that automatically selects out mismarked response sheets, and a transport printer to encode or abstract key information and print it on each sheet.

CIRCLE NO. 374

Datel's Microelectronic Data Acquisition System

HDAS-16/HDAS-8

- **16 Single-ended Channels or 8 Differential Channels**
- **12 bits Resolution**
- **50 KHz Throughput Rate**
- **Internal Instrumentation Amplifier**
- **Three-State Data Outputs**
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- **Priced at $295.00* (1-9)**

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CIRCLE NUMBER 83

DATA PROCESSING

CRT terminal handles bilingual characters

Hewlett-Packard, 1501 Page Mill Rd., Palo Alto, CA 94304. Mike Fournell (415) 493-1501. $4000; 12 wks.

Offering 64 Japanese characters (Katakana) and a 128-character Roman set, the HP 2645K is easily switched from one character set to another. It can even mix the characters within the same display. The terminal uses a Japanese keyboard layout as well as the standard Roman layout, having both legends on the keycaps. The unit can transmit or receive bilingual information using either shift-in or shift-out control characters or an 8-bit code-extension protocol. Operation is up to 4800 baud and asynchronous point-to-point data communication uses an RS232C interface.

CIRCLE NO. 375

Display formatter gives 3 formats on scope

B P Instruments, 10601 S. De Anza Blvd., Cupertino, CA 95014. (408) 446-4322. $1128; 6 wks.

The 50D011 formatter expands the capabilities of Models 50D and 50D16 logic analyzers. The unit permits displaying digital data on any X-Y display or oscilloscope in any of three formats: timing domain, data domain, and map mode.

CIRCLE NO. 376

Fixed-head disc system features high speed

Data General, Route 9, Westboro, MA 01581. Bob Palmer (617) 366-8911. $9900/$13,900; 12 wks.

High speed, extended-controller features and configuration flexibility make the fixed-head DG/disc subsystems useful where high-speed data access or acquisition rates are required. The subsystems transfer data at the rate of 910 kbytes/s; average access time is 10.12 ms. Drives are available in 2-Mbyte (Model 6064) and 1-Mbyte (Model 6063) capacities. Maximum subsystem capacity is four drives per subsystem in any combination of the two sizes. The devices can be used with NOVA or ECLIPSE computers.

CIRCLE NO. 377

Datel's 16 Bit, Microelectronic D/A Converters

DAC-HP16BMC & DAC-HP16DMC

- 16 Bit Binary or 4 Digit BCD Coding
- 15ppm/°C Tempco, max.
- Linearity to 0.003%
- 0 to +10V or ±5V Output
- 35μsec.Settling Time (Binary Version)
- Priced from $119.00* (1-24)

$77.50* (100's)

*U.S.A. domestic prices only

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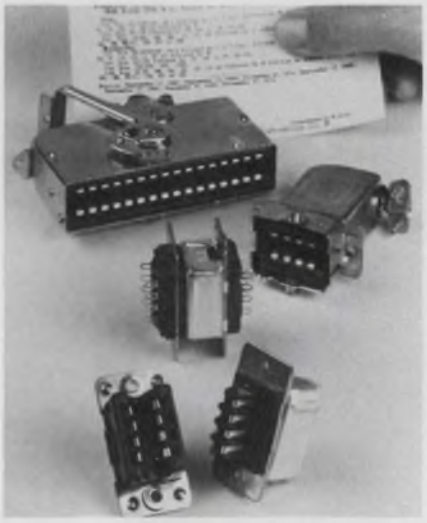
CIRCLE NUMBER 85

Line of connectors get blanket UL listing



Amphenol, 900 Commerce Dr., Oak Brook, IL 60521. Harry Jaeger (312) 986-3770. See text; stock.

A line of rack-and-panel connectors, the Blue Ribbon 26 Series, recently obtained UL's "yellow-card" recognition. The connectors are offered in choice of 8, 16, 24 and 32 contacts with three shell-polarization styles—barrier, pin and barrier with keyed shells. Cable-to-panel and cable-to-cable shells that can accommodate both top and side cable entry are available. Current-carrying capacity is 5 A per contact and voltage rating is 750 V dc at sea level. Connectors are priced from $1.69 a mated pair in 1000 quantity.

CIRCLE NO. 378

IC socket inserts with low force

AMP, 449 Eisenhower Blvd., Harrisburg, PA 17105. Jim Pletcher (717) 564-0100.

Intended for high-pin-count μP packages, the LIF-Lock connector socket is a low-insertion-force socket. Its contacts don't transmit force to the leads during insertion or extraction, thus minimizing package and lead damage. After insertion, a screwdriver-operated, cam-actuated mechanism releases the contacts with a force of about 200-gm each. Available in 24, 28 and 40-position sizes, these sockets fit 0.1 × 0.6 PC-board hole patterns. Contacts are rated at 3 A and have less than 25-mΩ of contact resistance.

CIRCLE NO. 379

Modular terminal blocks reduce assembly time

Electrovert, 86 Hartford Ave., Mount Vernon, NY 10553. (914) 664-6090.

The Wiba line of modular terminal blocks reduces assembly time by as much as 90%, according to its maker. Using a rapid-mounting system, the terminals are packed and shipped in specially designed cardboard boxes with 10 terminal blocks per row and 10 rows per box. A special insertion tool is used to pick up an entire row of 10 terminals at one time. Then, an easy manual action mounts them on the assembly rail with the same effort and time it would take to mount a single block. The rapid-insertion tools are supplied at no charge.

CIRCLE NO. 380

Epoxy adhesive holds up at 190 C

Tra Con, 55 North St., Medford, MA 02155. Jim Hart (617) 391-5550.

Tra-Bond 2248, a high-temperature epoxy adhesive for bonding and staking to 190 C, has good high and low-temperature mechanical and electrical properties. This thixotropic, two-component, 100%-solids adhesive bonds to metal, glass, ceramics and plastics. The adhesive is mixed, handled and applied at room temperature, but needs a final high-temperature cure for satisfactory bonding. It resists water, weather, oxygen and ozone, most petroleum solvents and fuels, mild acids and alkalis and many organic and inorganic compounds.

CIRCLE NO. 381

Slide-on connectors are MIL-spec interfaces

Sealectro, 225 Hoyt St., Mamaroneck, NY 10543. (914) 698-5600.

Conhex rf connectors mate modules to modules, or panels to panels. Interface is to MIL-C-39012, except engagement is not detented, thus reducing the engagement and disengagement forces. Engagement is about 6 lb max, while disengagement is 0.5 lb min. For use up to 12.4 GHz, the connectors are suited where several rf connections must be made between components simultaneously, and where other mechanical fastening devices are employed.

CIRCLE NO. 382

Hold wire bundles with bundle retainer

Panduit, 17301 Ridgeland Ave., Tinley Park, IL 60477. (312) 532-1800.

The BR75-E6-C wire-bundle retainer supports ¾-in. diameter wire bundles at a uniform height off a harness board. The overlapping mounting feet allow two or more bundle retainers to be mounted close together for wire breakouts. The retainer is installed with No. 6 screws, and wires are snapped in or out of the top of the device. Material is black acetal.

CIRCLE NO. 383

High-temp coatings do and don't conduct

Delta Electro-Chemical Products, 49 Brunswick Rd., Montclair, NJ 07042. J.J. Cole (201) 744-8117.

Two coating compounds withstand continuous service to 800 F. Electro-Chem 100 is a conductive coating of carbon in a solution of silicone resin. The surface resistance is 100 Ω/cm. Electro-Chem Mica 10 contains mica suspended in a silicone resin, which after curing has a surface resistivity of 10^{15} Ω/cm. Both compounds conform to MIL-P-20087A.

CIRCLE NO. 384

Datel's New Low Priced Digital Panel Meter

MODEL DM-3100

FEATURES

- ▶ Miniature case with 0.5" LED display
- ▶ Bipolar, differential ±2VFS input
- ▶ 3½ Digit resolution with Autozeroing
- ▶ LCD display available at additional cost
- ▶ Additional ranges — customer programmable
- ▶ 4½ digit resolution also available— $59 (100's)
- ▶ Additional current and ohmmeter capability — customer programmable

$29*

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CIRCLE NUMBER 86

PACKAGING & MATERIALS

Crimping tool installs insulated terminals

Panduit, 17301 Ridgeland Ave., Tinley Park, IL 60477. (312) 532-1800.

A heavy-duty crimping tool, CT250, installs insulated terminals, splices, disconnects and wire joints. The tool cuts wire and crimps terminal products on wire ranging in size from #10 to #22. Its extra-length handle reduces hand fatigue.

CIRCLE NO. 385

Applicator deposits fluid at exact point required

Electro Fusion Devices, 977 Waterman Ave., East Providence, RI 02914. Jim McGovern (800) 556-3484. $340; stock.

The 1000D lubricant applicator provides highly accurate deposits of lubricants or almost any other fluid at the exact point required, even in difficult access spots in completed assemblies. For set-up, the fluid is loaded into a disposable polypropylene reservoir with a preselected dispensing tip. The air pressure is regulated to suit the material's viscosity and a solid-state timer is set between 50 ms and 1 s. In operation, the tip is placed at the application spot and a foot pedal pressed.

CIRCLE NO. 386

Nomex spiral wrap has high-temp stability

Icore International, 180 N. Wolfe Rd., Sunnyvale, CA 94086. (408) 732-5400.

DuPont Nomex, an aramid paper that is extremely light and absorbs very little moisture, is now available for cable spiral wrapping. UL tests show that the material retains about 2/3 of its room-temperature dielectric strength at 225 C. Ultimate elongation is essentially constant up to 200 C, and shrinkage is less than 2% at 300 C. An advantage of this spiral-wrap material is its ability to be entered or broken out of the cable bundle at any point.

CIRCLE NO. 387

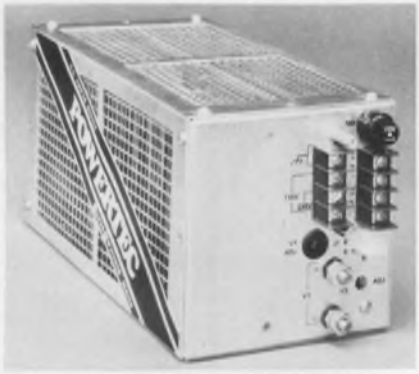
Thrifty switcher supply is in open frame

California DC, 2348 Towngate Rd., Westlake Village, CA 91361. Jim Burens (213) 991-1168. $99 up; stock to 4 wks.

Open-frame switching supply models (LR7500, 7700, 7800) include 75-W single, triple and quad-output units offering weight, volume and cost savings. The units protect against transient loss of input voltage and brownout conditions down to 92 V ac. Efficiencies are greater than 70% on multi-output models and 80% on single-output units. Regulation is 0.2% and foldback current limiting is provided. LR7500 models offer outputs of 5 V at 15 A, 12 V at 6.5 A and 15 V at 5 A in a 4.9 × 2.1 × 7 in. package. LR7700 models contain a 7500 supply and two 5, 12 or 15-V units at up to 15 W each in a 4.87 × 2.1 × 9 in. size. LR7800 adds a fourth unit in a 4.87 × 2.1 × 10 in. size.

CIRCLE NO. 388

80% efficiency delivered by 40-kHz switcher



Powertec, 9168 De Soto Ave., Chatsworth, CA 91311. Larry Keenen (213) 882-0004. $550 up.

Operating at 40 kHz, the Model 9F switching-regulated power supply is a natural-convection-cooled unit boasting approximately 80% efficiency. Up to three independent dc outputs from 2 to 28 V can be provided. Input voltage is 115 or 230 V ac with a tolerance of −20% to +10% and storage time is 30 ms. Size: 5 × 5 × 10.8 in. Weight: 8.5 lb.

CIRCLE NO. 389

Dual outputter needs no external heat sink

Valor Instruments, 1122 Llewellyn, Torrance, CA 90501. (213) 320-5471. $65 (100 qty); stock to 2 wks.

The Model 7600 power supplies feature die-cast housings with built-in heat sinking and card-rack mounting. External heat sinking is not required. The units are available in eight standard dual or ± tracking models from ±5 V at 1 A to ±28 V at 0.15 A. Specs include: 105 to 125-V-ac input at 50 to 400 Hz, ±0.1% regulation, ±0.01%/°C tempco and −20 to +60 C. Size is 6.5 × 4.75 × 1.6 in.

CIRCLE NO. 390

TRW High-Frequency Darlington Reliability

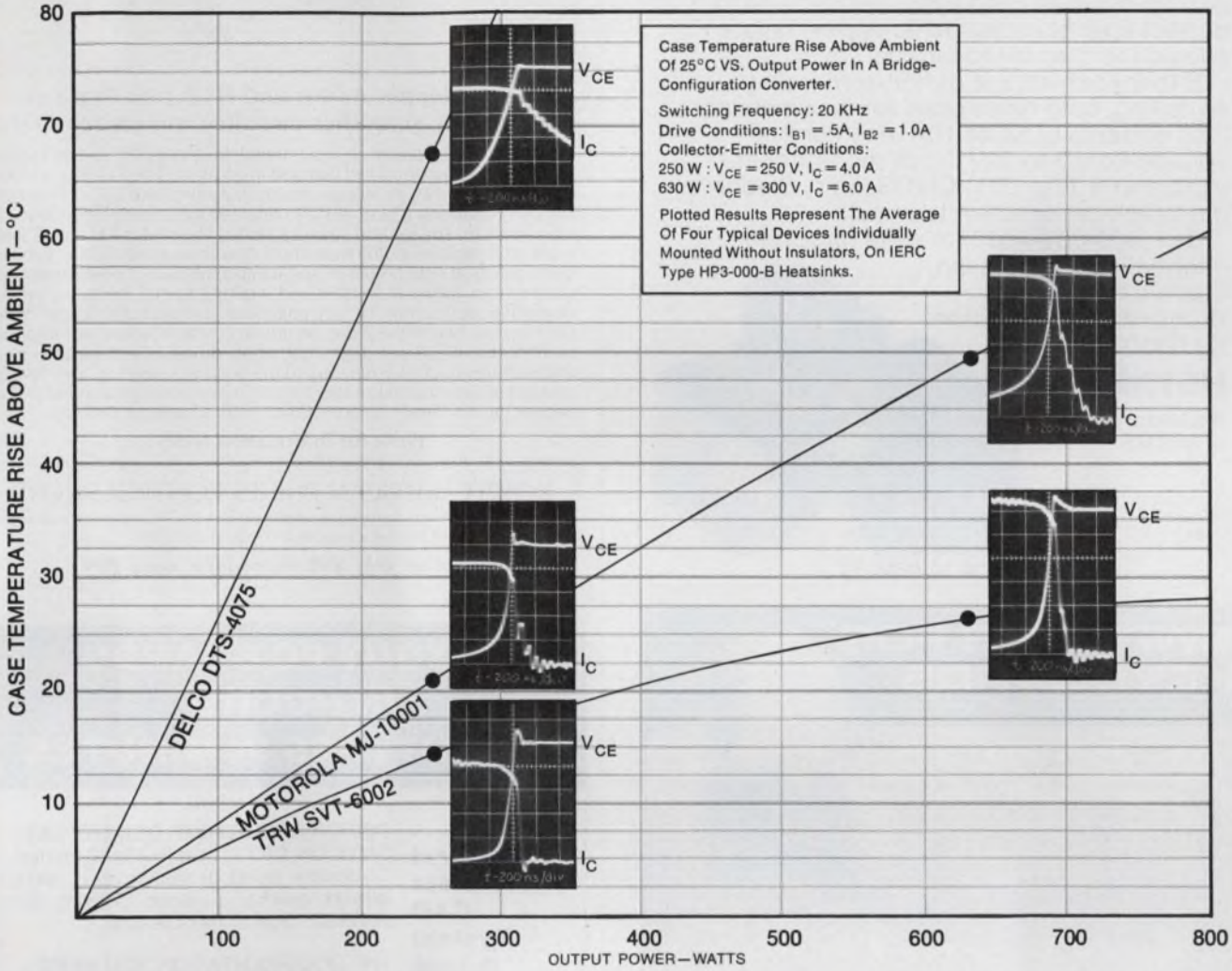
Pure logic and hard facts

1. In high-frequency power switching, heat is a prime factor in Darlington failure.

2. Turn-off time is the dominant cause of destructive temperature rise.

3. The faster the turn-off, the cooler the Darlington, the greater the reliability.

Take a look at competitive Darlingtons in an actual 20 KHz bridge converter circuit:



TRW operates at the lowest temperatures for the greatest reliability in high-frequency Darlington off-line switching regulators

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To get all the facts on TRW's high-frequency Darlington, use coupon or phone John Power at (213)679-4561.

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☐ **Please send me samples for_____voltage and _____current.**

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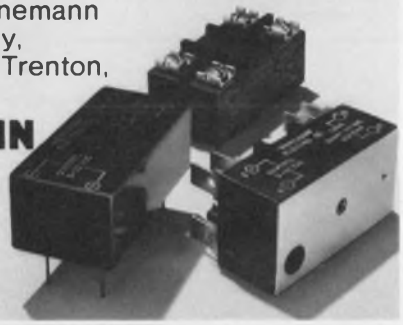

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Information only #98 Immediate need #99

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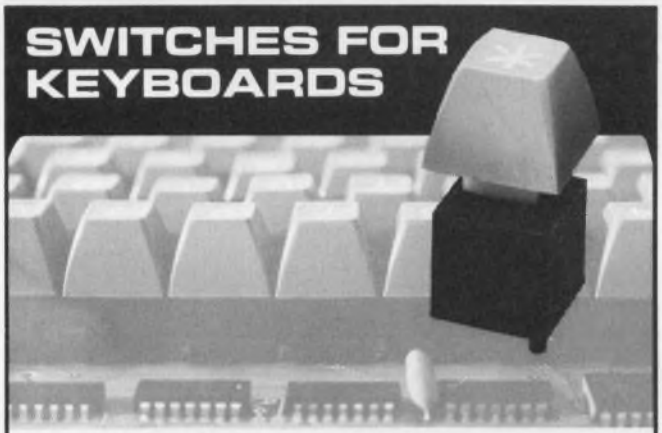

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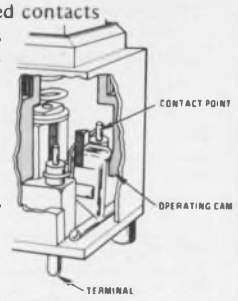

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CIRCLE NUMBER 100

Application notes

Isolation v/f converters

Isolation techniques for industrial systems are covered in an eight-page brochure. Objectives and approaches are discussed and specific application techniques using the isolation v/f converter are presented. Dynamic Measurements, Winchester, MA

CIRCLE NO. 391

Real-time analyzer

How successful in-field trim balancing of rotating machines is accomplished using a real-time analyzer is shown in a 12-page note. The application note includes a pocket-calculator program to simplify implementation. Nicolet Scientific, Northvale, NJ

CIRCLE NO. 392

Alarm and security cable

A 16-page guide for selecting and installing alarm and security cable provides information for use on the job and during initial evaluation and specification of alarm/security cable interconnection requirements. Belden, Geneva, IL

CIRCLE NO. 393

Opto-isolators

A well-illustrated 22-page handbook describes how to use opto-isolators effectively. The handbook defines terminology and specifications, shows connecting circuits for use with TTL devices, describes techniques for increasing speed, and contains several circuit diagrams of popular applications. Litronix, Cupertino, CA

CIRCLE NO. 394

Programmable ACE

Ac and dc electrical characteristics, timing waveforms and block diagrams are included in an app. note describing the INS8250 asynchronous communications element. National Semiconductor, Santa Clara, CA

CIRCLE NO. 395

Minicomputers

An unbiased, "no-nonsense" guide for the prospective minicomputer user deals with all of the requirements for a successful minicomputer installation. Turnkey Sales & Leasing, New York, NY

CIRCLE NO. 396

Spectrum analyzer

How a calibrated spectrum analyzer can be used for making accurate measurements on either AM or FM signals is explained in an application note. Marconi Instruments, Northvale, NJ

CIRCLE NO. 397

Data communications

Some of the technical aspects and applications of modems, automatic dialers and associated equipment is covered in a 16-page handbook. Vadic, Mountain View, CA

CIRCLE NO. 398

New literature

Variable resistors

Dimensional drawings, key electrical and mechanical characteristics of ¾-in. dia series 550 cermet variable resistors are given in a six-page catalog. CTS of West Liberty, West Liberty, OH

CIRCLE NO. 403

Security systems

A 72-page catalog describes over 900 burglar and fire-alarm products. Mountain West Alarm Supply, Phoenix, AZ

CIRCLE NO. 404

Connectors

Connecting systems and related products are described in an 8-page catalog. Viking Industries, Chatsworth, CA

CIRCLE NO. 405

Temperature measurement

The 1977 Temperature Measurement Handbook, second edition, contains over 200 pages of temperature-measurement products. The introductory 38-page data section contains complete current/temperature/millivolt tables for all practical thermocouple calibrations prepared by the National Bureau of Standards in both degrees Celsius and Fahrenheit. Omega Engineering, Stamford, CT

CIRCLE NO. 406

Oscillators

In addition to specifications, outline drawings and performance data on voltage-controlled oscillators, a 16-page catalog includes a selection guide, VCO capabilities and a list of pertinent definitions. Watkins-Johnson, Scotts Valley, CA

CIRCLE NO. 407

Electronic hardware

A 110-page catalog covers collars, couplings, fasteners, ferrules, hand screws and nuts, spacers, standoffs, universal joints and washers. Accurate Screw, Nutley, NJ

CIRCLE NO. 408

Air conditioners

Industrial air conditioners for computer-controlled machine-tool systems, and/or other electronic or computerized applications are described in a four-page brochure. McLean Engineering Laboratories, Maple Grove, MN

CIRCLE NO. 409

Instrument applications

Featured in a 60-page instrument catalog are technical articles, which provide detailed information on methods to improve accuracies of transmissions, reflection and phase measurements. Wiltron, Mountain View, CA

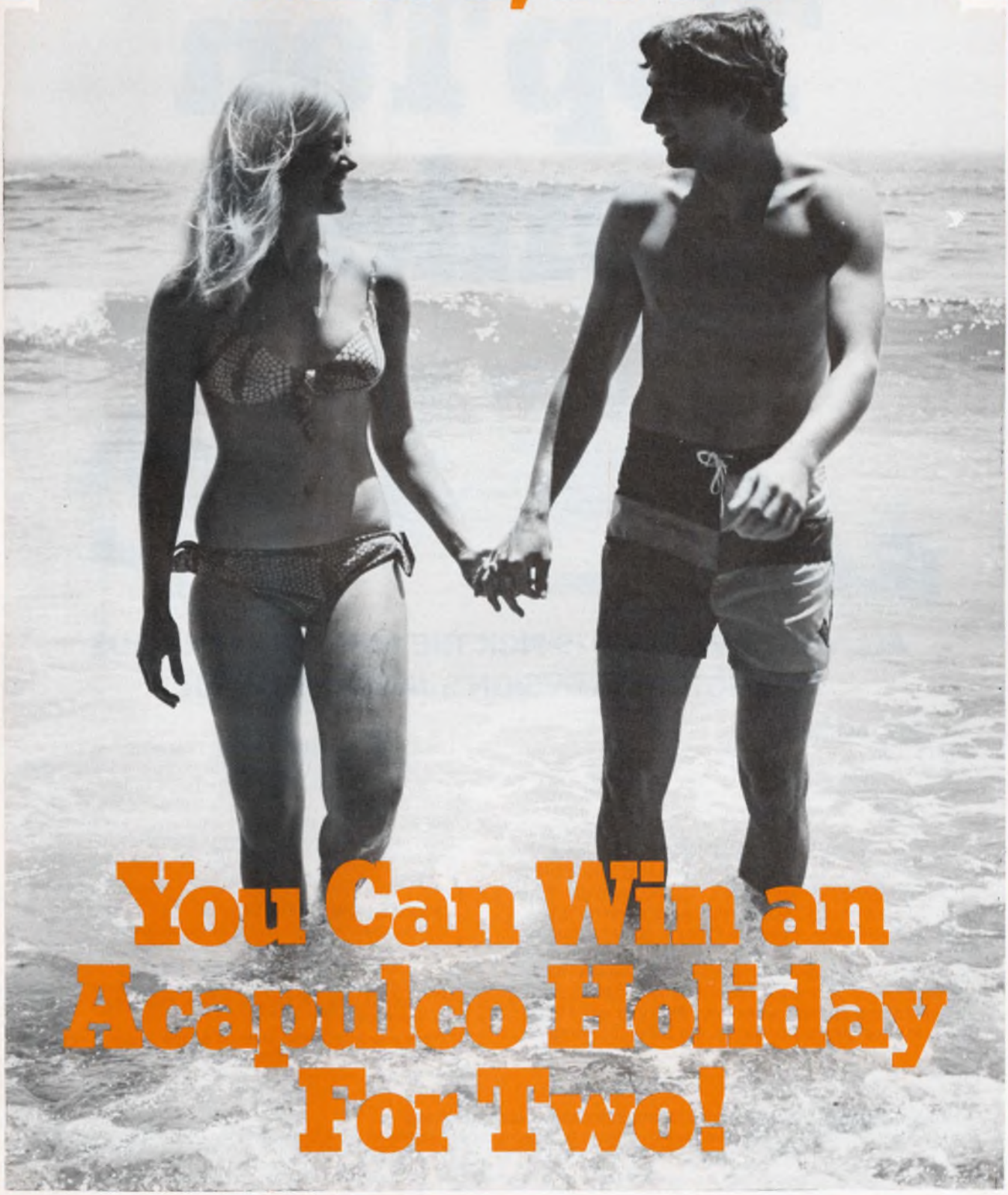
CIRCLE NO. 410

Data-conversion products

A 288-page handbook features monolithic and hybrid data-conversion components and computer-interface systems. Datel Systems, Canton, MA

CIRCLE NO. 411

On Jan. 4, 1978



You Can Win an Acapulco Holiday For Two!

Electronic Design's Famous Top Ten Contest

ALL YOU HAVE TO DO IS PICK THE 10 TOP SCORING ADS IN ELECTRONIC DESIGN'S JANUARY 4 ISSUE

WIN FOR YOURSELF

That's right ... you can win a 10-day prepaid vacation for two in fabulous Acapulco *plus* $1,000 cash or one of 99 other valuable prizes. There's nothing to write; no slogans; no drawings or gimmicks. All you have to do is pick the 10 advertisements that our readers will best remember having seen in the January 4 issue.

Acapulco is paradise. You'll stay at the exotic Paraiso Marriott — an "island" 22 stories high. You can sun, swim, sail, skin dive, take a parachute ride over Acapulco bay or browse through quaint shops. In the evening you can choose from sizzling night life or take a relaxed moonlight stroll on the beach. It's a perfect blend of casual sophistication, carefree excitement and spirited adventure. *And* you get $1,000 cash to cover air transportation, bar bill or incidentals!

FREE RERUNS FOR THE TOP TEN ADS

One of the biggest bonuses for companies who have an advertisement in the Top Ten Contest issue is often overlooked. It's the chance to get a free rerun of that ad with the extra impact, extra inquiries and sales that can result. (For a two-page spread in full color it can be worth more than $5,000 for your company.)

HERE'S HOW TO ENTER:

(1) Read the rules contained in the January 4 issue.

(2) Pick the 10 ads that you think *Electronic Design's* readers will best remember having seen.

(3) List these ads by company name and Reader Service Number on the entry card. Mail before February 28, 1978.

Your selections will be checked against Reader Recall, *Electronic Design's* method of measuring readership.

NOTE: SEPARATE CONTEST FOR ADVERTISERS AND THEIR AGENCIES

If you are an advertiser or an advertising agency, there's a separate "advertiser" contest for you with separate prizes for the top three winners. First and second prizes are the same in both the advertiser and reader contests. That means you can win an Acapulco holiday for two plus $1,000 cash or a $600 personal computer. Third prize is a digital wristwatch, $100 value. The free reruns for the winning ads and extra readership for *all* advertisements in the issue make the Top Ten Contest issue one of the year's outstanding advertising opportunities.

First Prize!
10-Day Vacation for Two at the Exotic
Paraíso/Marriott
in Acapulco
Plus $1,000 Cash!

Includes first class air conditioned accommodations for two, plus modified American plan meals (breakfast and dinner) for 10 days, 9 nights. Subject to space availability May through Dec. 1978. The $1,000 cash award may be used for incidental expenses, luncheons, local transportation, air transportation etc.

2nd PRIZE

PET PERSONAL COMPUTER

The Personal Electronic Transactor computer by Commodore Business Machines is a complete home data processing system that features BASIC language, a CRT display and cassette-tape mass storage. You can do your taxes, balance your checkbook, plus much, much more.

$600 VALUE

3rd PRIZE

WIDE FIELD TELESCOPE

There's no other telescope like it! Edmund's Astroscan® 2001 4¼" F/4.4 Newtonian wide field reflector gives clear, bright, spectacular wide-angle views of stars, moon, comets. It's portable, easy to use. No complicated set up. Just insert the eye piece and focus. Top quality optical system.

$150 VALUE.

4th & 5th PRIZES

DIGITAL WRISTWATCH

$100 VALUE

6th through 100th PRIZES

Hayden Technical Books

NOTE: COMPLETE ENTRY BLANKS AND RULES WILL APPEAR IN JANUARY 4, 1978 ISSUE

NEW LITERATURE

Optical encoders

High-resolution absolute and incremental optical shaft-angle encoders are featured in a six-page catalog. Itek, Newton, MA

CIRCLE NO. 412

Radio test equipment

The "Two-way Radio Test Equipment Catalog" describes 31 of the newest and most advanced additions to the line. Motorola, Communications Div., Schaumburg, IL

CIRCLE NO. 413

Resistors, capacitors

A 12-page, information-packed catalog lists resistors and capacitors. Panasonic, Secaucus, NJ

CIRCLE NO. 414

Microprocessors

PROM programmers, μP systems and support hardware and μP test instruments are covered in a 52-page catalog. Pro-Log, Monterey, CA

CIRCLE NO. 415

Timekeeping circuits

Block diagrams and background information on low-voltage aluminum-gate circuits used for LED and LCD watches, high-voltage B-series CMOS circuits for automobile clocks, high-frequency low-power silicon-on-sapphire circuits for battery-operated wall clocks, and industrial timers are covered in a 12-page brochure. RCA Solid State Div., Somerville, NJ

CIRCLE NO. 416

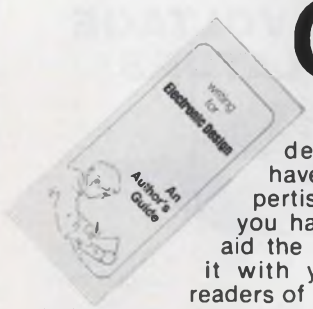
3M Brand Light Control Film Improves Readout Readability.

Microlouvers within the film enhance contrast, screen out ambient light. Works equally well on LED and CRT displays. For information on how you can use 3M Light Control Film in your product write: Visual Products Division, Industrial Optics, 3M Center, St. Paul, MN 55101.

3M COMPANY

CIRCLE NUMBER 108

AUTHOR'S GUIDE



If you've solved a tricky design problem, if you have developed special expertise in a specific area, if you have information that will aid the design process... share it with your fellow engineer-readers of *Electronic Design*.

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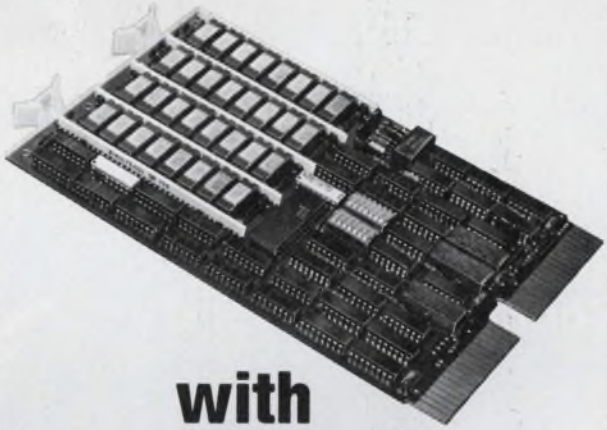
It's easy to write for *Electronic Design*, but it's often hard to get started. Send for your copy of our Author's Guide today.

Circle No. 250

MAKING MEMORIES



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Monolithic Systems Corporation engineers used Mini/Bus to solve size constraint problems, shorten assembly time, simplify testing, eliminate numerous filter capacitors, and increase reliability.

For more details on how Mini/Bus can handle your design problem, contact the Mini/Bus product specialist at

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CIRCLE NUMBER 109

Vendors report

Annual and interim reports can provide much more than financial position information. They often include the first public disclosure of new products, new techniques and new directions of our vendors and customers. Further, they often contain superb analyses of segments of industry that a company serves.

Selected companies with recent reports are listed here with their main electronic products or services. For a copy, circle the indicated number.

Keene. Industrial products and pollution-control/fluid-handling products.
CIRCLE NO. 417

Basic Inc. Steel-making refractories; specialized chemicals, and electronic products.
CIRCLE NO. 418

INCO (formerly The International Nickel Co. of Canada). Metals.
CIRCLE NO. 419

Four-Phase Systems. Computers.
CIRCLE NO. 420

Warner Electric. Motion-control devices.
CIRCLE NO. 421

Honeywell. Information systems and industrial control systems.
CIRCLE NO. 422

RCA. Commercial and consumer electronics products; broadcasting; communications; government systems; and vehicle renting and related services.
CIRCLE NO. 423

Applied Materials. Chemical vapor deposition reactors.
CIRCLE NO. 424

Intel. Integrated electronic devices, microcomputers and electronic circuits.
CIRCLE NO. 425

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- To promote communication among members of the electronics engineering community.

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quick ads

New and current products for the electronic designer presented by their manufacturers.

MINIATURE CERAMIC TRIMMER CAPACITORS 9371 series of ceramic trimmer capacitors are compact, economical and rugged. They are 50% smaller than other trimmers of this type yet provide high capacitance values. Available in 4 capacitance ranges, 1.5 to 4, 3.0 to 10, 3.5 to 18 and 5.0 to 25 pf with Q's $>$ 300 at 10 MHz. They have an overall diameter of .225" with .215" above board height. JOHANSON MANUFACTURING CORPORATION, Rockaway Valley Road, Boonton, N.J. 07005 201-334-2676

TRIMMER CAPACITORS **181**

STOCK CASES AND ENCLOSURES, OVER 600 SIZES, ranging from 4" x 4" to 13" x 13". Depth variations to 12" in increments of 1/8". Laminated Formica®-mahogany-Formica® construction for utmost strength and attractiveness. Prices from $35. to $85., less quantity discounts. Choices of hardware. Modifications if required. Prompt off-the-shelf shipments. W. A. Miller Co., Inc., 36 Mingo Loop, Oquossoc, Maine 04964. (207) 864-3344

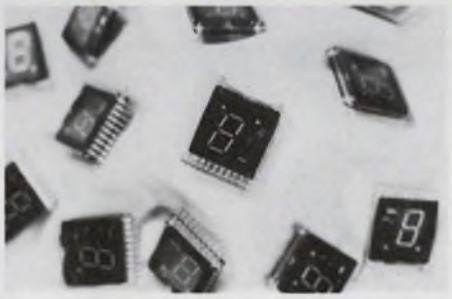
STOCK CASES/ENCLOSURES **184**

CMOS Crystal Oscillators in Low profile TO-5. Frequency range is 10 kHz to 300 kHz (divided outputs to 1 kHz, low as one cycle per month available). Low milliamp current consumption. Accuracy ±0.01%. Shock 1000 g. Hybrid thick and thin film chip and wire design is rugged and ideally suited for portable equipment. Details in Gold Book & EEM * STATEK CORP * 512 N. Main, Orange, Ca. 92668 * (714) 639-7810 * Telex 67-8394.

CRYSTAL OSCILLATOR **187**

FREE 16-PAGE BROCHURE ON CONVERTER/CHARGERS from Dormeyer's Coach. Describes plug-in power converter/chargers (filtered & unfiltered DC output), NI-CAD battery chargers and AC low voltage step-down transformers. Catalog CC-75A has complete data on electrical output, duty cycle, input watts and plug-in case size for each application. Load curves also included. All units described are U/L listed or recognized. DORMEYER INDUSTRIES, 3418 N. Milwaukee Ave., Chicago, IL 60641 (312) 283-4000.

CONVERTER/CHARGERS CATALOG **182**



A bright new line of standard gas discharge displays from Pantek. Digits are 0.55" high and are available as 1, 2, 3, 4 and 5 digit sticks. Display thickness is only 0.15" and feature DIP leads for automatic insertion and soldering. Pantek International, P. O. Box 587, Lewistown, Pa. 17044 (717) 242-1411

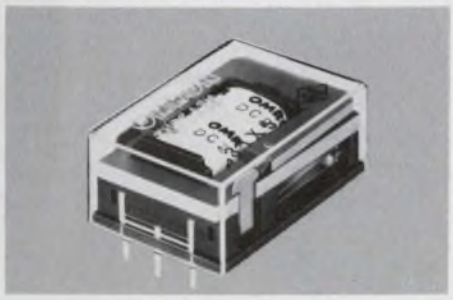
GAS DISCHARGE DISPLAYS **185**

FORM YOUR OWN MAGNETIC SHIELDS When you need only one or two magnetic shields, save time and money by shaping your own. All it takes is a scissors and our improved Eagle alloys for magnetic shielding. We'll gladly help. Check the card in this publication and we'll send full details on Eagle foil and sheet stock. Eagle Magnetic Co., Inc., Box 24283, Indianapolis, IN 46224 317/243-1030.

MAGNETIC SHIELDING **188**

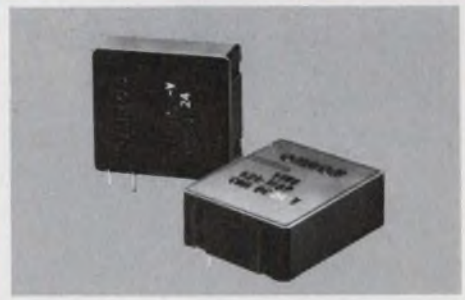
OMRON HIGH-POWER SUGAR CUBE RELAY Highest power for its size. Built to resist flux wicking. Switches up to 3A at 24 VDC, occupies less than 0.3 cubic inch. Reliable silver-palladium cross bar contacts. Saves space in portable battery instruments, radio gear, security devices, phone networks, etc. Long life of 5 million mechanical operations. Available in DC6-DC24 coil voltages. PCB pins match 0.100" grid. OMRON ELECTRONICS INC., 233 South Wacker Drive, Chicago, Ill. 60606. Phone (312) 876-0800.

G2K SUGAR CUBE RELAY **183**



OMRON LOW PROFILE DRY CIRCUIT RELAY Reduces contact resistance for stringent low-voltage/low-current circuits, switches up to 3A at 24 VDC. Offers DPDT or 4PDT format, packaged to fit PCBs on 1/2" centers. High reliability, with 100 million mechanical operations (min.) with bifurcated cross bar contacts. Plastic covers can be sealed for wave soldering, with air or nitrogen filling. OMRON ELECTRONICS, INC., 233 South Wacker Drive, Chicago, Ill. 60606 Phone (312) 876-0800.

LZN LOW PROFILE RELAY **186**

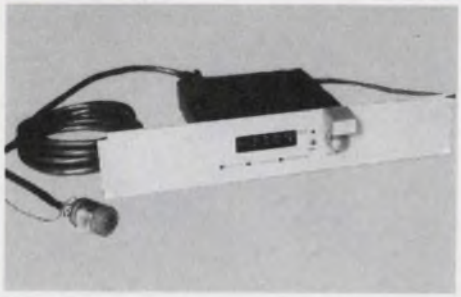


OMRON LOW-PROFILE POWER RELAY Takes the bulk out of power switching up to 8A at 24 VDC. Mounts flat for PCBs on 1/2" centers, or upright to save board area (1.22" x 0.413"). Extra long life of 200 million mechanical operations (min.). Available in DC3 to DC48 coil voltages. Dielectric strength exceeds 2500 VAC. Meets UL, CSA and VDE requirements. OMRON ELECTRONICS, INC. 233 South Wacker Drive, Chicago, Ill. 60606. Phone (312) 876-0800

G2L LOW PROFILE POWER RELAY **189**

quick ads

New and current products for the electronic designer presented by their manufacturers.



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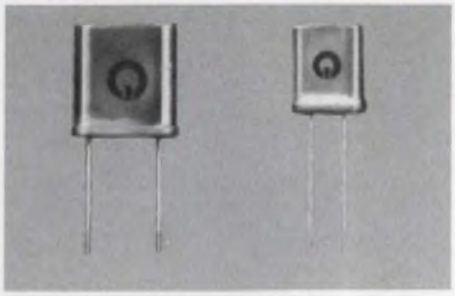
ENCODER 190



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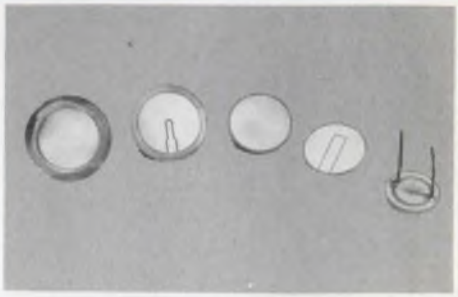
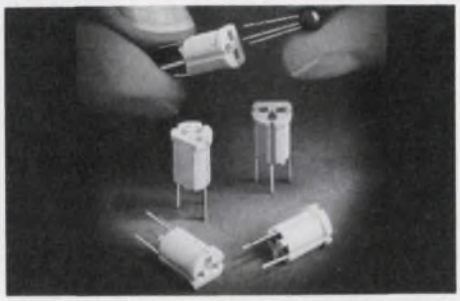
CRYSTAL 193



BENDERS FOR AUDIO ALARMS Ideal for low voltage or battery operated applications. Linden's low frequency, highly sensitive benders are available in standard (off-the-shelf) or custom designs to meet your specifications. Write for free catalog. LINDEN LABORATORIES, INC., Box 920, State College, PA 16801, 814-355-5491. A RESOURCE MANAGEMENT CORPORATION SUBSIDIARY.

BENDERS 196



NEW 3-LEAD TRANSISTOR SOCKETS from Methode have an extended funnel-shaped lead-in which eliminates the need for transistor lead preforming or trimming. Also, ideally suited for automatic insertion of transistors into the socket. Contacts are reliable dual leaf cantilever type of phosphor bronze with tin plating. Insulation is flame retardant polyester rated 94VO. Methode Electronics, Inc., 1700 Hicks Rd., Rolling Meadows, IL 60008. (312) 392-3500.

3-LEAD TRANSISTOR SOCKETS 191

CGH Metal Glaze Resistors from TRW operate in high ambient temperatures with excellent high voltage load stability. These thick film resistors are particularly suited for precision high voltage and high impedance applications such as voltage multipliers, X-ray equipment, and high voltage power supplies where precision tolerances and TCs are required. TRW/IRC Resistors, an operation of TRW Electronic Components, 401 N. Broad St., Phila., Pa. 19108. (215) 922-8900.

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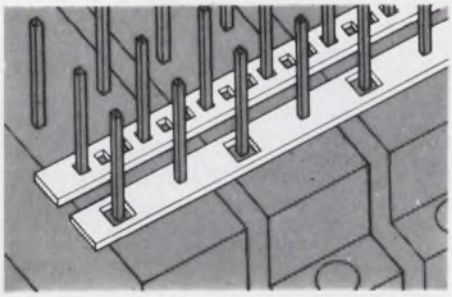
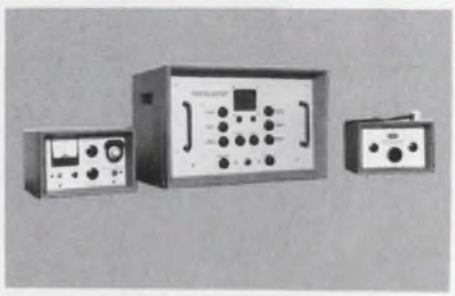
SHOCK-ABSORBENT CASES 197



STRIP/BUS BY ROGERS. Low Cost Bussing Systems; easy installation, reliable solder joints; greater pin exposure. Write or call for details. Rogers Corporation, Chandler, AZ 85224. Phone (602) 963-4584. (EUROPE: Mektron NV, Ghent, Belgium; JAPAN: Nippon Mektron, Tokyo)

STRIP/BUS 192



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NMR GAUSSMETER 195

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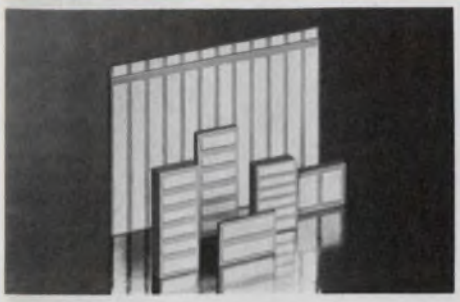
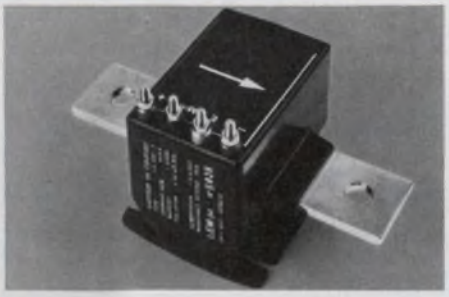
POWER SUPPLIES 198



MULTIPLE CAPACITOR ARRAYS are single-plate multiple capacitance elements and serve as replacements of individually bonded chips in hybrid circuits. They are perfect for multiple circuit coupling, filtering, by-pass and high voltage meter multiplier circuits. They are easy to install and provide savings over the assembly of individual capacitors. Multiple capacitor arrays available in a variety of dielectric characteristics to meet specific requirements. JOHANSON DIELECTRICS, INC., Bx 6456, Burbank, Ca. 91510 213-848-4465.

CAPACITOR ARRAYS 199



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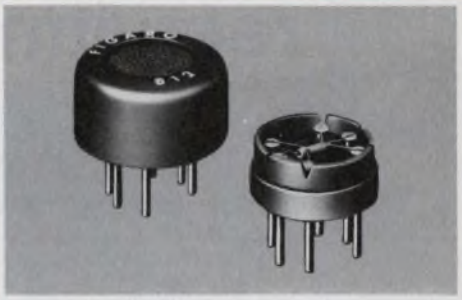
L E M ELECTRONIC CURRENT MEASUREMENT 202



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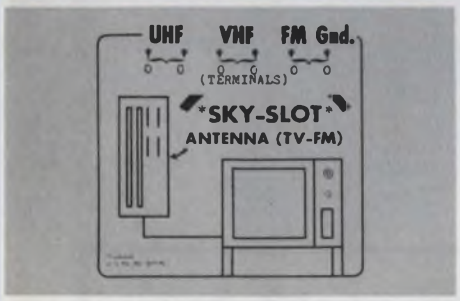
GAS SENSOR 205



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SLOTTED ARRAY ANTENNA 200

THE '77-'78 GOLD BOOK IS NOW OFF THE PRESS. Contains 2,496 pages of up-to-the-minute information about the entire electronics industry. Complete with Product, Trade Name, Manufacturers, Distributors Directories and Catalogue Compendium. Price: $30–U.S., Canada and Mexico. Other countries $40–Overseas postage included. To order, send check or company purchase order to GOLD BOOK, Dept. #437-R, Hayden Publishing, 50 Essex St., Rochelle Park, NJ, 07662.

'77-'78 GOLD BOOK 203

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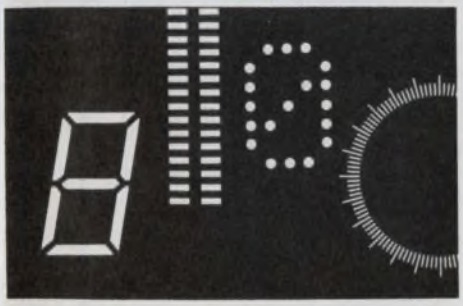
QUIK/STRIP 206



Power converters for gas discharge displays DC-to-DC power supplies convert low DC line voltages of 5, 9, 12 or 15 volts to nominal 200 or 250 volt DC levels required to activate gas discharge displays (multi-segment, matrix or bar graph). Ideal for battery powered applications. Ask about custom designs and cost-efficient models for high-volume users. For PC board mounting. ENDICOTT COIL CO., INC., 31 Charlotte Street, Binghamton, N. Y. 13905 (607) 797-1263.

DC-to-DC CONVERTER 201

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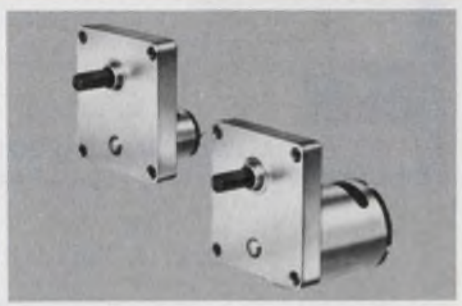
MECHANICAL FILTERS 204



DC GEARMOTORS ECM's permanent magnet gearmotors provide running torque up to 20 lb-in, output speeds from 3 to 700 RPM. With 12 or 24 VDC ratings, these motors feature variable speed, reversibility, and compact size. Heavy duty versions are available for torque up to 50 lb-in as well as other models rated to 200 lb-in. Send for information now! ECM MOTOR COMPANY, 1301 E. Tower Rd., Schaumburg, IL 60196 312/885-4000

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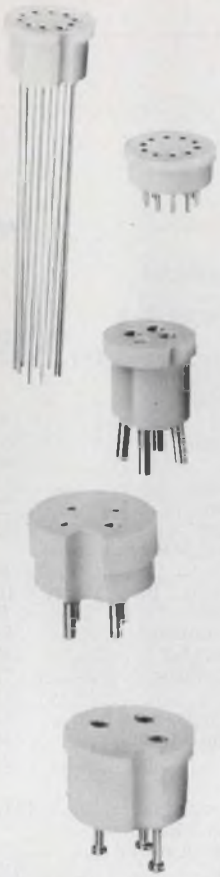

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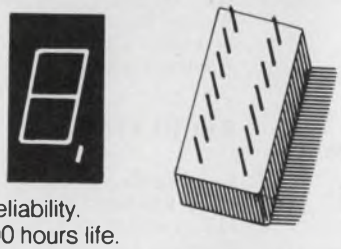

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Advertiser's index

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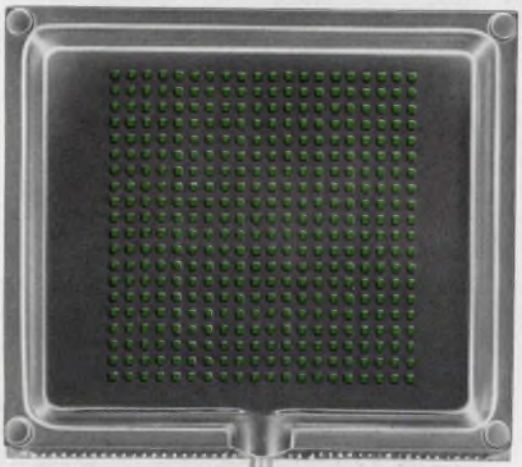

DM400A1
Dimension: 114(H)×130(W)× 17(D)mm

DC95A2
Dimension:
24(H)×75(W)×7.2(D)mm
Character Size:
5.05(H)×3.55(W)mm

FG48D6
Dimension:
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Character Size:
8.0(H)×4.2(W)mm

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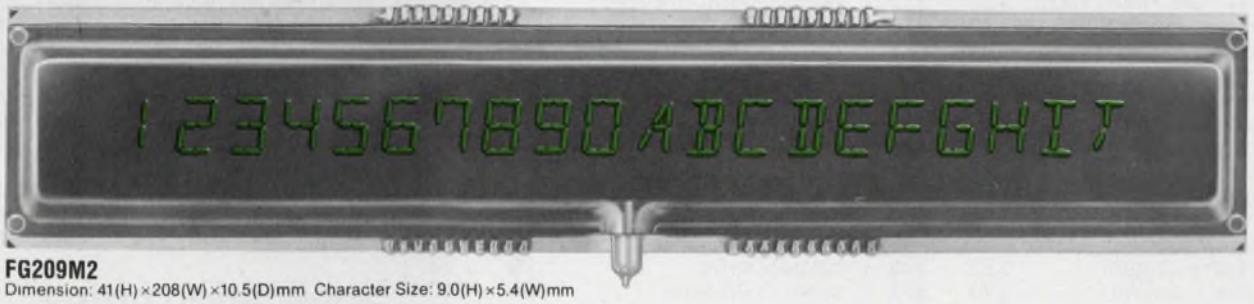

FG209M2
Dimension: 41(H)×208(W)×10.5(D)mm Character Size: 9.0(H)×5.4(W)mm

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Phone: 351-0293 Telex: 11176

Manufacturer:
ISE ELECTRONICS CORP.
P.O. Box 46, Ise-shi,
Mie-Pref., Japan
Phone: (0596) 39-1111
Telex: 4969523

CIRCLE NUMBER 120

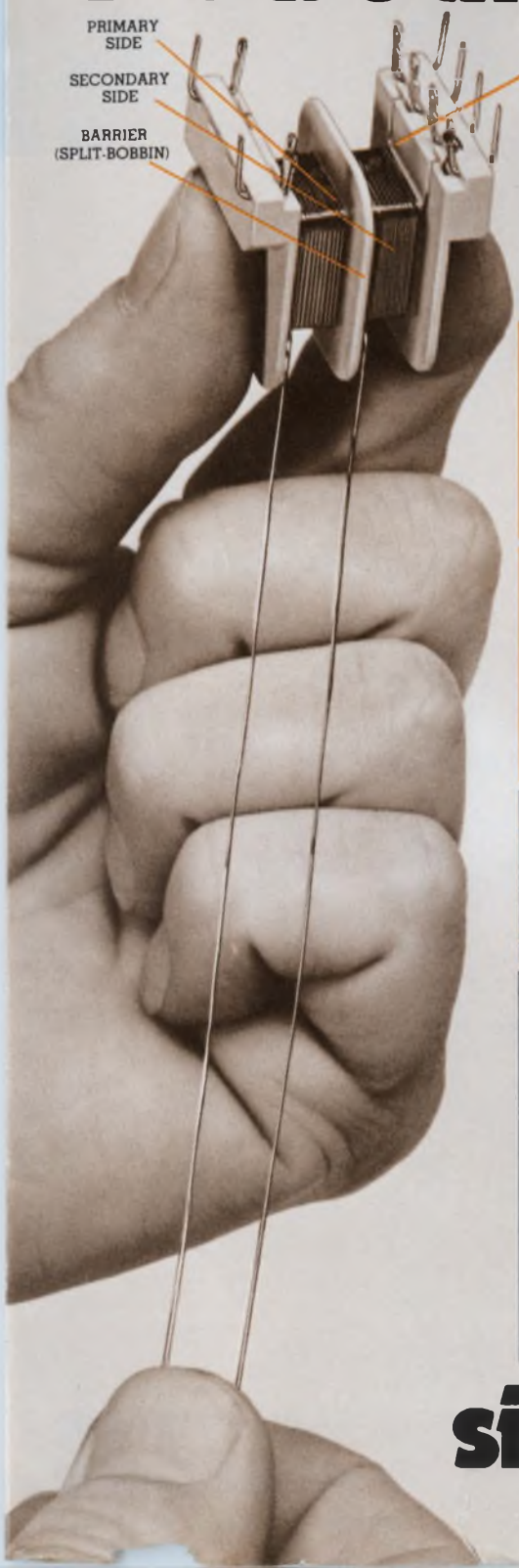
Product index

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 Reader Service numbers. Reader requests will be promptly processed by computer and mailed to the manufacturer within three days.

new literature

application notes

Announcing Split/Tran®— high isolation at prices lower than standard PC board transformers.



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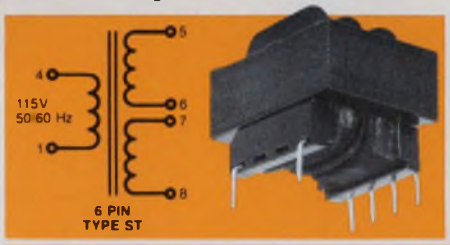

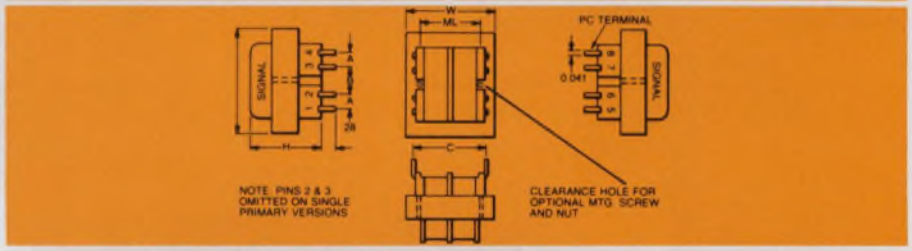

Size	VA	L	W	H	ML	A	B	C	Optional Mtg. Screw & Nut*	Lbs.
3	2.4	1 3/8	1 1/8	1 3/16	1 15/16	.250	.250	1.200	None	0.25
4	6	1 5/8	1 5/16	1 5/16	1 1/16	.250	.350	1.280	4-40 x 1 3/8 Nylon	0.44
5	12	1 7/8	1 9/16	1 7/16	1 1/4	.300	.400	1.410	4-40 x 1 3/8 Nylon	0.70
6	20	2 1/4	1 7/8	1 7/16	1 1/2	.300	.400	1.600	4-40 x 1 3/8 Nylon	0.80

*Available from Signal: Part No. ST-MS (Screw) & Part No. ST-MN (Nut)

PART NUMBER*		SECONDARY RMS RATING		PART NUMBER*		SECONDARY RMS RATING	
Single 115V 6 Pin	Dual 115/230V 8 Pin	Series	Parallel	Single 115V 6 Pin	Dual 115/230V 8 Pin	Series	Parallel
ST 3-10	DST 3-10	10V C.T. @ 0.25A	5V @ 0.5A	ST 3-28	DST 3-28	28V C.T. @ 0.085A	14V @ 0.17A
ST 4-10	DST 4-10	10V C.T. @ 0.6A	5V @ 1.2A	ST 4-28	DST 4-28	28V C.T. @ 0.2A	14V @ 0.4A
ST 5-10	DST 5-10	10V C.T. @ 1.2A	5V @ 2.4A	ST 5-28	DST 5-28	28V C.T. @ 0.42A	14V @ 0.84A
ST 6-10	DST 6-10	10V C.T. @ 2A	5V @ 4A	ST 6-28	DST 6-28	28V C.T. @ 0.7A	14V @ 1.4A
ST 3-12	DST 3-12	12.6V C.T. @ 0.2A	6.3V @ 0.4A	ST 3-36	DST 3-36	36V C.T. @ 0.065A	18V @ 0.13A
ST 4-12	DST 4-12	12.6V C.T. @ 0.5A	6.3V @ 1.0A	ST 4-36	DST 4-36	36V C.T. @ 0.17A	18V @ 0.34A
ST 5-12	DST 5-12	12.6V C.T. @ 1.0A	6.3V @ 2.0A	ST 5-36	DST 5-36	36V C.T. @ 0.35A	18V @ 0.7A
ST 6-12	DST 6-12	12.6V C.T. @ 1.6A	6.3V @ 3.2A	ST 6-36	DST 6-36	36V C.T. @ 0.55A	18V @ 1.1A
ST 3-16	DST 3-16	16V C.T. @ 0.15A	8V @ 0.3A	ST 3-48	DST 3-48	48V C.T. @ 0.05A	24V @ 0.1A
ST 4-16	DST 4-16	16V C.T. @ 0.4A	8V @ 0.8A	ST 4-48	DST 4-48	48V C.T. @ 0.125A	24V @ 0.25A
ST 5-16	DST 5-16	16V C.T. @ 0.8A	8V @ 1.6A	ST 5-48	DST 5-48	48V C.T. @ 0.25A	24V @ 0.5A
ST 6-16	DST 6-16	16V C.T. @ 1.25A	8V @ 2.5A	ST 6-48	DST 6-48	48V C.T. @ 0.4A	24V @ 0.8A
ST 3-20	DST 3-20	20V C.T. @ 0.12A	10V @ 0.24A	ST 3-56	DST 3-56	56V C.T. @ 0.045A	28V @ 0.09A
ST 4-20	DST 4-20	20V C.T. @ 0.3A	10V @ 0.6A	ST 4-56	DST 4-56	56V C.T. @ 0.11A	28V @ 0.22A
ST 5-20	DST 5-20	20V C.T. @ 0.6A	10V @ 1.2A	ST 5-56	DST 5-56	56V C.T. @ 0.22A	28V @ 0.44A
ST 6-20	DST 6-20	20V C.T. @ 1A	10V @ 2A	ST 6-56	DST 6-56	56V C.T. @ 0.35A	28V @ 0.7A
ST 3-24	DST 3-24	24V C.T. @ 0.1A	12V @ 0.2A	ST 3-120	DST 3-120	120V C.T. @ 0.02A	60V @ 0.04A
ST 4-24	DST 4-24	24V C.T. @ 0.25A	12V @ 0.5A	ST 4-120	DST 4-120	120V C.T. @ 0.05A	60V @ 0.1A
ST 5-24	DST 5-24	24V C.T. @ 0.5A	12V @ 1.0A	ST 5-120	DST 5-120	120V C.T. @ 0.1A	60V @ 0.2A
ST 6-24	DST 6-24	24V C.T. @ 0.8A	12V @ 1.6A	ST 6-120	DST 6-120	120V C.T. @ 0.16A	60V @ 0.32A

*Explanation of Part Number: Series—ST; Size 4; Series Secondary Volts—36

Special variations will be quoted and shipped promptly. NET PRICES (1-4 pcs.)

ALL		ALL	
ST-3	$4.90	DST-3	$5.80
ST-4	5.00	DST-4	5.90
ST-5	5.50	DST-5	6.50
ST-6	6.90	DST-6	7.90

signal TRANSFORMER

CIRCLE NUMBER 231

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ANNOUNCING THE RCA BiMOS BONANZA.

BiMOS is the RCA Linear IC technology that is not only being made by the millions, but used by the millions.

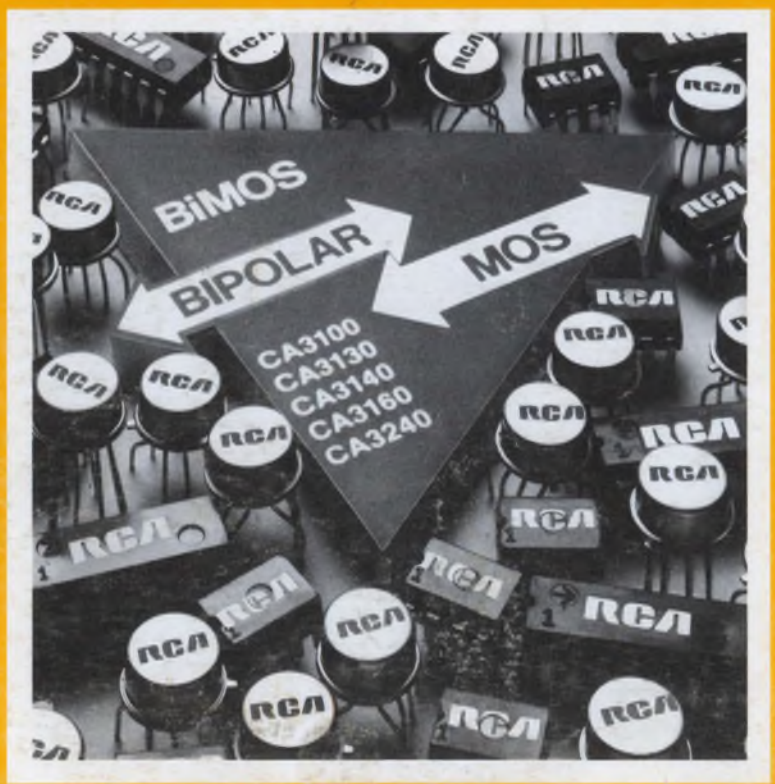
Now we're adding new BiMOS products and new BiMOS prices so you can make even wider use of the highly cost-effective performance of BiMOS op amps.

CA3140 2-for-1 Bonanza

At our new price for the mini-dip 3140, you can buy twice as many as you could at the old. So now, for the same dollar, you can double your use of the most useful op amp since the 741.

CA3240 2-in-1 Bonanza

Our new CA3240E gives you two 3140's in one mini-dip package. At less than twice our new low 3140 price. Your new designs can be achieved with half as many packages.



And the 3240 is available now in prototype quantities. In both mini-dip and 14-lead DIP.

CA3140 CA307G Gold CHIP Bonanza

It's your choice. Two CA3140E's or one 3140 and one CA307G. They both have the same new low price. This BiMOS/Gold CHIP team-up gives you a variety of ways to beat the 741 where you want more performance. Or beat many premium Bifet types where you want lower price or greater availability.

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Note: All price references are based on the unit prices in effect November 1, 1977. Prices optional with distributors.

RCA Linear IC experience is working for you.

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