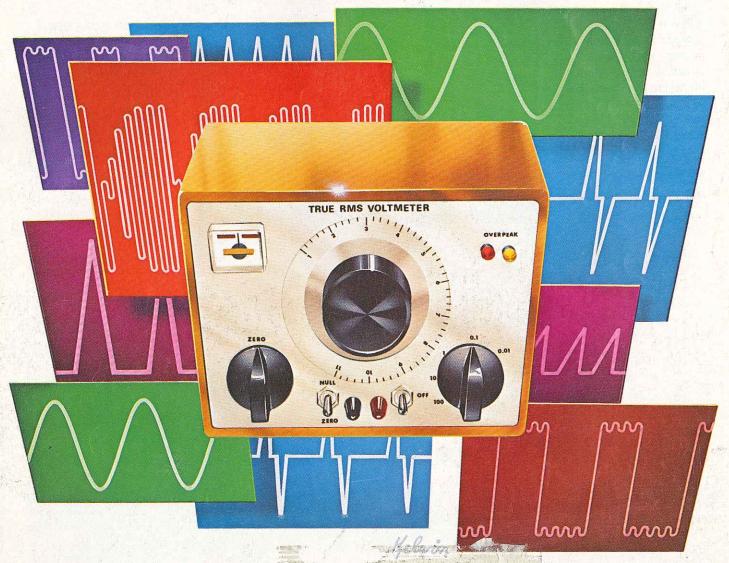
# Popular Electronics MAGAZINE APRIL 1979/\$1.25

Dynamic Audio Filter Removes Hiss & Noise "Morse-A-Word" Alphanumeric Converter, Pt. II Buying Guide to Computer Input/Output Boards

Build a "True RMS" Voltmeter





Tested In This Issue Denon DP-2500 Manual Turntable Kenwood KT-917 FM Tuner Realistic SCT-30 Cassette Deck

## Microcomputer I / O Roard Ruving Directory

Make & Model	Price <sup>1</sup> (\$)	Po +8V	wer requirement (mA) <sup>2</sup> +16V	red -16V	RAM min.	capacity max.	Expansion kit size and price	Speed (ns)	Туре	Min. addr. block size	BS	Fea BB	tures <sup>2</sup> WS W	Remarks
S-100						-	6,880,00				7/11/2			
Advanced Compute Prods. LOGOS 1 LOGOS 1Z	126 (k) 150 (w) 150 (k) 200 (w)				8K 8K	8K 8K	none none	450 250				X X	<b>&gt;</b>	256-byte to 8K incre-
8KS-B 8KS-Z 16S-B 16KS-Z	125 (k) 150 (w) 145 (k) 170 (k) 285 (k) 310 (w) 325 (k) 350 (w)	X X X			8K 8K 16K 16K	8K 8K 16K 16K	none none none none	500 250 500 250	stat. stat. stat.	4K 4K 4K 4K	X X X	x - x - x - x	X X X	250-ns version.
Central Data 16K RAM 32K RAM	289 (w) 475 (w)	300 00	150 150	20 20	16K 32K	32K 32K	16K/\$200 none	450 450	dyn. dyn.	16K 16K				
CGRS Microtech 16K RAM	450 (k) 490 (w)				16K	16K	none		stat.					
Chrislin C1-S100	390 650 825 995				16K 32K 48K 64K	64K 64K	none none	300 300 300 300	dyn, dyn, dyn, dyn,					
Computerware, Inc. 8K Static	146 (w) 186 (w) 350 (w)				8K 8K	8K 8K	none none	450 250	stat, stat,				X	Phantom disable. Phantom disable.
Cromemco 4KZ 16KZ	195 (k) 295 (w) 495 (k) 795 (w)	800 800	599	19	4K 16K	4K 16K	none none	450 200	stat.		X			Wait states only @ 4 MHz on non-se- quential address.
Digital Micro Systems DM16K (w.8K) DM16K	35 (b) 275 (k) 35 (B) 465 (k) 495 (w)	2A 2A			8K 16K	16K 16K	8K none	350 350	stat.	4K 4K	X X		X	Alph-Micro DMA compatible; also available as kit less RAM, \$95.
MS1645 MS1625 MS3245 MS3225	399 (w) 525 (w) 555 (w) 925 (w) 995 (w)	8A 1.6A 1.8A 3.1A 3.8A		.5A	16K 16K 16K 32K 32K	16K 16K 16K 32K 32K	none none none none	459 300 250 300 250	dyn, stat, stat, stat, stat,	8K 4K 4K 4K 4K	X X X	E.		Transparent refresh DMA compatible,
lectricom 4020	287 (w)				2K	2Kx9	\$10	250			X			On-board battery, char er and power-state monitor; wire-wrap

cam you be

### bribed?

You get a \$35.21 bribe when you try only 10 DAK ML90 high energy cassettes for only \$2.19 each!

Hats off to Maxell, Their UDXL cassette established a new standard of quality for all cassettes.

The new DAK ML90 starts another new technology. A technology of extreme reliability and protection from Hi frequency losses.

Later we are going to offer you a valuable bribe, if you will test these cassettes, risk free; so read on!

### YOUR TIME IS PRECIOUS

Imagine yourself just finishing recording the second side of a 90 minute cassette and horrors, the cassette jams. Tape is wound around the capstan, your recorder may be damaged and you've just wasted 90 minutes of your time and perhaps lost a great recording off FM.

I'm sure this is one experience we all dread, and is one of the main reasons to buy name branded guaranteed tape you

Enter DAK. We manufacture over one million units of cassette tape each month, and many of our cassettes are used for high speed duplication, which causes more cassettes to fail than any other use.

When we first started, DAK's cassettes failed, just like many others. So we installed over \$20,000 worth of high speed duplication equipment at our factory and set out to design the perfect cassette.

#### FAILURE

Failure after failure. We substituted, remade, tested and retested the over 20 parts of our cassette, and checked everyone elses cassettes. Finally after over 6 years we positively linked cassette failure or the prevention of failure to the slip sheets, or liners in the cassette.

We were not alone. Scotch, TDK, and several others must have been doing the same research because they have also been coming out with special improved slip sheets.

### MOLYSULFIDE

A new chemical named molysulfide, that reduces friction within the cassette several times better than graphite gave us success.

We developed polyester slip sheets with raised spring loaded ridges coated with a unique formulation of molysulfide and graphite.

The tape ran more smoothly than ever before within the cassette. The new formulation is also much tougher than the graphite formulation, so it is extremely resistant to wear

Static electricity within the cassette was drastically reduced by the low friction, and easily bled off, so its tendency to erase very high frequencies was drastically reduced. A very important consideration for often played tapes.

The molysulfide formulation gives both superior electrical and mechanical performance, thus it has formed the basis for the birth of the new DAK ML cassette.

### MAXELL IS BETTER

Yes honestly, if you own a \$1000 cas-sette deck like a Nakamici, the frequency response of Maxell UDXL is superior to DAK and you just might be able to hear the difference.

DAK ML has a frequency response that is flat from 40cps to 14,500cps ±3db. Virtually all cassette recorders priced under \$600 are flat from 40cps to about 12.000cps, so we have over 2000cps to spare, and you'll probably never know the difference.

No apology We feel that we have equalled or exceeded the mechanical reliability of virtually all cassettes and offer one of the best frequency responses in the industry. Maxell UDXL is truly the Rolls Royce of the industry, and DAK is the 100% US made Cadillac or Corvette!

Price DAK manufactures the tape we sell, you avoid paying distributor and retailer mark ups. While Maxell UDXL 90s may sell for \$3.50 to \$4.50 each, DAK ML90s sell factory direct to you for only \$2.19 each.

#### YOU WIN

You are paying less for the 10 90 minute cassettes than you would pay for the bribes we are offering if you went to a Radio Shack Store.



#### CHECK THE VALUE OF THE BRIBES AT RADIO SHACK

Think of it, 10 six foot hook up cords with RCA plugs at each end. Whether you use the cords now, or when you buy new equipment, those of us who are tape recorder nuts, never seem to have enough. Radio Shack sells six foot cords for \$1.89 each.

You will find dozens of uses for this deluxe battery eliminator AC adaptor around your home or office, 4 voltages, 3, 4.5, 6 and 9 volts. 4 plugs will fit virtually any calculator, radio, or battery operated recorder we have seen. You'll save a lot of money on batteries. Radio

CIRCLE NO. 60 ON FREE INFORMATION CARD

Shack sells a similar 4 voltage adaptor for \$9.95.

10 free 6 ft. RCA to RCA hook up cords

The deluxe 12oz can of spray head cleaner will clean your tape heads for years to come. The handy snorkel included, can reach just about any tape head, even 8trk heads. Radio Shack does not sell a large 12oz can, but 12oz from them costs \$6.36.

The Radio Shack prices are not list prices, but the actual prices you would pay when you walk in the door.



### WE WIN TOO

Customers like you are very valuable in the form of future business. We anticipate receiving over 6000 orders and 4500 repeat customers from this advertisement. We are betting you will buy our cassettes again, and we are putting our money where our mouth is!

#### TRY DAK ML90 FREE

We want you to try these high energy cassettes on your own recorder without obligation for 30 days. If you aren't 100% satisfied for any reason, simply return the tapes and bribes to DAK for a full refund.

To order your 10 DAK ML90 minute high energy cassettes and receive your \$35.21 bribe with your credit card, simply call toll free 800, 423-2636, (in Calif. call 213-984-1559) or send your check for \$21.90 plus \$3 for postage and handling for each group of 10 cassettes and bribes to DAK. (Calif. residents add 6% sales tax)

DAK unconditionally guarantees all DAK cassettes for one year against any defects in material or workmanship.

Why not order an extra group of 10 DAK ML90 cassettes for yourself or a friend? We will add one free ML90 cassette fo reach additional 10 you buy and of course you get all 3 bribes with each group of 10 tapes.



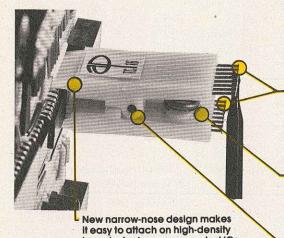
Call TOLL-FREE .....(800) 423-2636 

POPULAR ELECTRONICS

Make & Model	Price <sup>1</sup> (\$)	Power required (mA) <sup>2</sup>	RAM capacity	kit size		Type	Min, addr.	Features <sup>2</sup>	Remarks
		+8,V +1,6V -16V	min. max.	and price	(ns)		block size	BS BB WS WP	
Electronic Control Technology 16K RAM 16K RAM 4MHz	350 (k) 399 (w) 415 (k) 475 (w)	1.5A	16K 16K	none none	450 250	stat.	16K 16K	X	Spare IC spaces for user circuit, Spare IC spaces for user circuits,
Electronic Systems 300	23 (b) 160 (k) 200 (w)		-1 K		250	stat.		X	Bare-board version includes regulator.
Fire Bird Sales	323 (w)	o a effect desired of the	16K 16K	none	260	dyn.	16K	X TOTAL CHICK	
Franklin Electric 8KSr 8KSh	249 (k) 295 (W) 289 (k) 330 (w)	1.2A	8K 8K 8K 8K	none none	400 250	stat.	2K 2K	x x x x x	LED indicators for power O.K., board select, write-protect; DIP addr., SW.
Godbout Econoram II Econoram IV Econoram V Econoram VII	135 (k) 155 (W) 279 (k) 314 (w) 279 (k) 314 (w) 445 (k) 485 (w)	1.5A 2A 2A 2A	8K 8K 16K 16K 16K 16K 24K 24K	none none none		stat. stat. stat. stat.	4K 16K 16K 2, 4K, 2, 8K	X X X X X X X X X X X X X X X X X X X	Software write protect w. vector, Write protect for 4K blocks, Manual high-8K/low- 8K deselect. Can deselect either 4K/8K pair,
GRE Data Products 232-8 232-16	179 (W) .	1.2	8K 16K	12 (20) 201 (20) 201 (20)	400 400	stat	8K 16K	The and the X	Provisions for MWRT and Phantom disable,
IMSAI RAM 4A-4 RAM 16 RAM III-32 RAM III-64	139 (k) 189 (w) 449 (k) 499 (w) 895 (w) 1695 (w)	800	4K 4K 16K 16K 32K 32K 64K 64K	none none none none	500 500 500 500	stat. dyn, dyn, dyn,	4K* 4K* 4K*	X as a state of X	*4K block missing with memory-map option. As above. As above.
Industrial Micro systs. C00282 C00282-HS C00282 C00282-HS C00360 C00360-HS	135 150 304 343 625 689	ab end in verient  an vict  And Habit eld  car for destaction  car for destaction  cardinal work  cardinal work	8K 8K 8K 8K 16K 16K 16K 16K 32K 32K 32K 32K		low hi low hi low	stat. stat. stat. stat. stat. stat.		the first of the test of the t	
Ithaca Audio 8KSR 16KDR	25 (b) 160 (w) 199 (w) 35 (b)	1.4A	1K 8K 8K 8K 8K 8K 16K 64K		450 250	stat. stat. stat. dyn.	4K 4K 4K	X X X X X X X X X X X X X X X X X X X	Software protect/unprotec
700 mm	25 (b) 126 (k) 150 (w) 140 (k) 160 (w) 170 (k) 190 (w)	2.5A 2.5A	8K 8K		450 350 250	stat.	8K 8K 8K	X	Adapter (\$13) available for use with Motorola D-2 6800 Eval, Kit,
Micro Data Systems MD-697 (8K) MD-697 (16K) MD-697 (24K)	179 (k) 199 (w) 308 (k) 348 (w) 437 (k) 497 (w)	1.5A 1.5A 1.5A	8K 32K 16K 32K 24K 32K	8K/\$129 8K/\$129 8K/\$129	450 450 450	stat, stat, stat.	16K 16K 16K	X X X X X X X X X X X X X X X X X X X	250-ns option avail; 250-ns optional, 250-ns optional,



### Meet Super Grip II, the great new test clip from A P Products.



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New button-head pins keep probes from sliding off. (Straight pin models for logical connections.)

The new A P Super Grip II is, without question, the best way there is to trouble-shoot DIP ICs.

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You get positive contacts. No intermittents. No shorts. Ever.
So it's endlessly useful to you—and it's

built to stay useful indefinitely. Try one. You'll find 8, 14, 16, 16 LSI, 18, 20,

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Faster and Easier is what we're all about.

### I/O BOARD BUYING DIRECTORY continued

Make & Model	Price <sup>1</sup> (\$)	Power required (mA) <sup>2</sup> +8V +16V -16V	RAM capacity	Expansion kit size and	Speed (ns)	Туре	Min. addr. block	Features <sup>3</sup>	Remarks
MD-697 (32K)	E20 (W	The Market Street Bearing	min, max.	price		Planto:	size	BS BB WS WP	
WID-097 (32K)	539 (k) 599 (w)	1.5A	32K 32K	none	450	stat.	16K	X	250-ns optional.
National Multiplex 8K	190 (w)		8K 8K	1		stat.			
North Star RAM-16	399 (k) 459 (w)	600 400 100	16K 16K	none	250	dyn,	8K		Parity option, \$39 (k), \$59 (w).
Noval 32K RAM	650		32K 32K		2MHz	dyn.	8K		Hardware disable for any 8K block.
Pacific Digital 8KRS (450) 8KRS (250)	150 (w) 190 (w)	2A 2A	8K 8K 8K 8K	none none	450 250	stat. stat.	4K 4K	X X	
Parasitic Econoram III	188 (w)	350 155	8K 8K	none	250	dyn.	4K		"Invisible refresh".
Piiceon SupeRam 2	1150 (w)	x x x	48K 64K	16K/\$220	2-MHz	dyn,	16K	X	DMA-compatible; uses digital delay lines; software or hardware bank select.
Polymorphic 8K RAM	300 (k)	2.6*			500ns	i de la composition della comp		of Charles	*Standby power, 1,5A @ 2 phantom disable.
Processor Tech, 4KRA 8KRA 16KRA 32KRA	125 (k) 150 (w) 225 (k) 250 (w) 429 (w) 750 (w)	1A 1.9A 800 150 20 800 150 20	4K 4K 8K 8K 16K 32K 32K 32K	none , none none none	460 400 400	stat. stat. dyn, dyn,	4K		
Quay Q80 SMB	235 (w)		8K 8K	none	450	stat.		X X	Memory protect in 4K blocks.
Seattle Computer 24-101 SCP-16K	375 (w) 425 (w) 425 (w) 475 (w)	1.8A 1.8A 1.9A 1.9A	16K 16K 16K 16K 16K 16K 16K 16K	none none none	494 294 471 271	stat, stat, stat, stat,	4K 4K 4K 4K	X X	Parallel addressing capability.
Solid State Music MB4	91 (k)	1.1A	4K 4K	none	2 MHz	stat.	4K	X X	Memory protect in 4K
MB-6A	165 (k) 175 (k)	2.0A 2.0A	8K 8K 8K 8K	none none	2 MHz 4 MHz	stat,	8K	X X X X X X X X X X X X X X X X X X X	blocks. Memory protect to 256- byte blocks; phantom
MB-7	449 (k)	550 80 25	16K 16K	none	2-3 MHz	stat.	16K	x	provisions, 4K memory protect;
MR-9 PROM/RAM		X of 786, 851,651 car San verificación (f) A sancre oto entri bisanti	0 4K		57	stat.		TIZOU XVII. UT BITEVISTI (CATESTICAL)	phantom provision. Can intermix RAM and PROM in 256-byte increments; jump on reset or on power-up,
pace Byte 16K	599 (w)	1.6A	16K 16K		450/ 250	stat.	4K		Phantom disable and write protect for each 4K; DMA-compatible.
SuperRam	149 (w)	240 80 20 2A	8K 8K 16K 16K		47.1 450		4K	leo3	With Synchrofresh.

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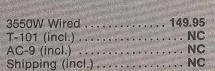
Time Base TCXO 1PPM 65° to 85° F
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Resolution 1HZ to 55MHZ, 10HZ to 550MHZ
Gate Time 1 sec & 1/10 sec with Auto Decimal Point

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Power Batt., 12VDC @ 300Ma, 110VAC (with AC-9)

3550K Kit		\$	99.95
T-101 An			3.95
	Adp		10.00
omphing,	Handling,	1115	10.00







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Make & Model	Price <sup>1</sup> (\$)		ower requi	red	RAM	capacity	Expansion kit size	Speed (ns)	Туре	Min. addr. block		Fea	tures	3	Remarks
		+8∨	+16V	-16V	min.	max.	price	(10)		size	BS	ВВ	WS	WP	
Trace Electronics 1600	499 (w) 599 (w)	1.7A 1.7A			4K 4K	32K 32K	16K/\$256 16K/\$356	450 250	stat,		X				DMA-compatible;
3200	749 (w) 849 (w)	3.3A 3.3A			32K 32K	32K 32K	none none	450 250	stat, stat,		X X				"Megex tend" can address to 1M bytese with 4-bit output port.
Vector Graphic 8KF 16K	245 (w) 485 (w)	1,8A 1.8A			8K 16K	8K 16K	none none	250 300	stat, stat,	8K X		Х		x	Phantom disable, Phantom disable,
Wameco MEM-1	30 (b) 250 (k)				1K	8K		450	stat.	8K			Х		
MEM-2	295 (w) 30 (b) 665 (k) 695 (w)				4K	16K		450	stat.	8K '	X		X		
<b>Kitan</b> Z-16 D-16 D-32	489 (w) 489 (w) 869 (w)	205	105		16K				stat.	4K 4K	X X			Х	Write protects each 4K,
K-32	799 (w)	190	250	*	32K 32K	32K	none	4MHz	dyn. dyn.*	4K 32K	X				*-5V @ 15 mA; transparen refresh; 4K block de-
K-48 K-64 K-128	1099 (w) 1299 (w) 2599	190 • 190 190	250 250 250	* X X	48K 64K	48K 64K 128K	none	4MHz 4MHz 4MHz	dyn.* dyn* dyn.*	48K 64K 128K	X X X				selection (switched).  *As above, but 8K deselect,  *As above,  *As above, 16K deselect,

1(b)=bare board; (k)=kit; (w)=wired.

<sup>2</sup>In amperes where indicated by "A."

<sup>3</sup>BS=bank-select or memory-mapping option; BB=battery

backup; WS=wait-states; WP=write-protect.

\*See "Remarks" column,

Make & Model	Price <sup>1</sup> (\$)	Power required (mA) <sup>2</sup> +8V +12V -12V	RAM capacity	Expansion kit size, and price	Speed (ns)	Туре	Min, addr, block size	Features <sup>2</sup> BS BB WS W	Remarks
SS-50			14821						
Digital Service & Design DSD 2114-16K	27 (ь)	9.5A	1K 16K		450	stat.	8K	X	
Gimix 16KWR	495 (w)	1.6A	16K 16K	none	450	stat,	4K	X	Software-controllable addressing, disable/en- able, write-protect, register-select,
Midwest Scientific RAM-68	225 (k)* 335 (w)*	X	8K				8K	X	*Sockets, \$35.
Smoke Signal M-16A	379 (w)	1.6A	16K 16K	none	250	stat.	16K		DMA-compatible.
Southwest Tech Products MP-M MP-8M MP-16	65 (k) 250 (k) 400 (w)	750 1A X X	2K 4K 8K 8K 16K 32K	2K/\$35 none 16K/\$250	500 500 500	stat. stat. dyn.		·	

Make & Model	Price <sup>1</sup> (\$)	Power required (mA) <sup>2</sup>	RAM capacity	Expansion kit size, and price	Speed (ns)	Туре	Min. addr. block size	Features <sup>2</sup> BS BB WS WP	Remarks
SBC MULTIBUS	Herelisio	reulpe ibdaois - E							
Chrislin C1-8080	390 650 825 995	E CHASTAGE STATE  SE CHASTA ONE CAL  SE CHASTA ONE CAL  SE CHASTA ONE CAL  SE CHASTA ONE CAL  SE CHASTAGE STATE  SE CHASTAGE ST	16K 32K 48K 64K		300 300 300 300	dyn.* dyn.* dyn.* dyn.*			*On-board refresh.
Datacube RM-117	1200 (w) 1250 (w)	X  Characteristics  X  Cha	16K 1M	use CM118	350 350	stat.	8K 32K	x x	Dual-port memory sys- tem allows 2 SBC buses to share common memory w. Intel 8086. Usable as stand-alone 32K RAM w. 8K PROM, or as slave memory.
Electronic Solutions RAM-4 RAM-4L RAM-8 RAM-8L	295 (w) 312 (w) 395 (w) 428 (w)	1.2A 1.2A 2A 2A	4K 4K 4K 4K 8K 8K 8K 8K	none none none	400 400 400 400 400	stat. stat. stat. stat.	4K 4K 8K 8K	X X	With battery back-up. With battery back-up.
National Semiconductor BLC-016 BLC-032 BLC-048 BLC-064	784 (w) 1292 (w) 1767 (w) 2090 (w)	1.5A 10 700 3.0A 47 11 3.0A 47 11 3.0A 47 11	16K 16K 32K 32K 48K 48K 64K 64K	none none none	435 430 430 430	dyn. dyn. dyn. dyn.	16K 16K 16K 16K	X X X X X X X X X X X X X X X X X X X	No wait states with BLC 80/204 CPU,
Xycon Xycon 16 Xycon 32	684 (w) 1024 (w)	PRIM ANGROUND	16K 32K 32K 32K		250 250	stat.	8K 8K	X X X X	

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Built-in deluxe 2K Monitor/Operating ROM!
Cassette/RS 232 or 20 ma./4-1/2 8-bit parallel I/O and timer all on beginner's Level "A" system!

EPIORER/85 gives you "big computer" leatures immediately, without turning you into an appliance operator, doomed to run pre-developed software for Ile. Simply connect EXPLORER is a terminal, video monitor or type and make up games. You can load and play back these programs on an ordinary tape cassette—and display your efforts on any ty screen, video monitor or or printer. (\$8.95 RF modulator required for ty use). The simplified architecture of the intelled by makes EXPLORER is a less than computer with the power of any 8-bit computer on earth. Or you can share and part and educated task, thanks to onboard prototyping, R&M and ROM expansion as a litch field Road. New Millard Road. New Millar

CIBCLE NO. 4 RAM and ROM expansion capabilities.

LEVEL "A" SPECIFICATIONS
EXPLORER'S Level "A" system features an advanced Intel 8085 cpu, which is 50% laster than its 8080A predecessor, yet 100% compatible with 8080A software.

which, you'll discover, exists by the ton. "Big computer features include an 8355 ROM with 2X deluxe monitor/ operating system which has two programmable 8-bit bi-directional parallel I/O ports, bullt-in cassette filles, and commands which include: "display contents of memory," "run at user location (go to)," "insert data," "move contents of memory," "examine registers individually or all," fill command (to fill the contents of memory with any variable), automatic baud rate selection, programmable characters per line display output format, and moret An 8155 RAM—I/O chip, contains 255 bytes of RAM, two programmable 8-bit bi-directional 1/O ports plus programmable 18-bit bi-directional 1/O ports plus programm



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CHOICE OF HEX KEYPAD OR TERMINAL INPUT

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to 64K of memory, Hoppy disks, telephone interface, printers, and all sorts of S-100
lugi-ins—you'll be better off with the Keyboard/Video Terminal input. The \$149.95
EXPLORER Keyboard/Video Terminal includes full ASCII decoding with 128 ASCII
upper/lower case sat, 95 orintable characters, onboard regulators and selectable
display formats—32x16 for tv set or 64x16 for video monitor (not included).

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so pen.

Power Supply kit, 5 amp, ±8 volt, \$34.95 plus \$2 p&h.
Intel 8085 User's Manual, \$7.50 ppd.

ASCII (Reyboard/Video Terminal kit, \$149.95 plus \$3 p&h.

ASCII (Reyboard/Video Terminal kit, \$149.95 plus \$3 p&h.

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