

# Popular Electronics®

WORLD'S LARGEST-SELLING 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 Board Buying Directory

Make & Model	Price <sup>1</sup> (\$)	Power required (mA) <sup>2</sup>			RAM capacity		Expansion kit size and price	Speed (ns)	Type	Min. addr. block size	Features <sup>2</sup>				Remarks
		+8V	+16V	-16V	min.	max.					BS	BB	WS	WP	
<b>S-100</b>															
<b>Advanced Computer Prods.</b>															
LOGOS 1	126 (k) 150 (w)				8K	8K	none	450				X	X	Hardware protect in 256-byte to 8K increments, switchable from top of board.	
LOGOS 1Z	150 (k) 200 (w)				8K	8K	none	250				X	X		
<b>Base 2</b>															
8KS-B	125 (k) 150 (w)	X			8K	8K	none	500	stat.	4K	X	X	X		
8KS-Z	145 (k) 170 (k)	X			8K	8K	none	250	stat.	4K	X	X	X	250-ns version.	
16S-B	285 (k) 310 (w)	X			16K	16K	none	500	stat.	4K	X	X	X		
16KS-Z	325 (k) 350 (w)	X			16K	16K	none	250	stat.	4K	X	X	X	250-ns version.	
<b>Central Data</b>															
16K RAM	289 (w)	300	150	20	16K	32K	16K/\$200	450	dyn.	16K					
32K RAM	475 (w)	00	150	20	32K	32K	none	450	dyn.	16K					
<b>CGRS Microtech</b>															
16K RAM	450 (k) 490 (w)				16K	16K	none		stat.						
<b>Chrislin</b>															
CI-S100	390 650 825 995				16K	64K	none	300	dyn.						
					32K			300	dyn.						
					48K			300	dyn.						
					64K	64K	none	300	dyn.						
<b>Computerware, Inc.</b>															
8K Static	146 (w) 186 (w) 350 (w)				8K	8K	none	450	stat.				X	Phantom disable. Phantom disable.	
					8K	8K	none	250	stat.						
<b>Cromemco</b>															
4KZ	195 (k) 295 (w)	800			4K	4K	none	450	stat.		X	X		Wait states only @ 4 MHz on non-sequential address.	
16KZ	495 (k) 795 (w)	800	599	19	16K	16K	none	200	stat.		X				
<b>Digital Micro Systems</b>															
DM16K (w.8K)	35 (b) 275 (k)	2A			8K	16K	8K	350	stat.	4K	X		X	Alpha-Micro DMA compatible; also available as kit less RAM, \$95.	
DM16K	35 (b) 465 (k) 495 (w)	2A			16K	16K	none	350	stat.	4K	X		X		
<b>Dynabyte</b>															
MD161	399 (w)	8A	.5A		16K	16K	none	459	dyn.	8K				Transparent refresh DMA compatible.	
MS1645	525 (w)	1.6A			16K	16K	none	300	stat.	4K	X				
MS1625	555 (w)	1.8A			16K	16K	none	250	stat.	4K	X				
MS3245	925 (w)	3.1A			32K	32K	none	300	stat.	4K	X				
MS3225	995 (w)	3.8A			32K	32K	none	250	stat.	4K	X				
<b>Electricom</b>															
4020	287 (w)				2K	2Kx9	\$10	250					X	On-board battery, charger and power-state monitor; wire-wrap ribbon-cable or S-100 connection.	

# Can 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 can trust.

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 cassette deck like a Nakamichi, 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  $\pm 3$ db. 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.



Yours Free

### 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

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

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.



Yours Free

### 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).

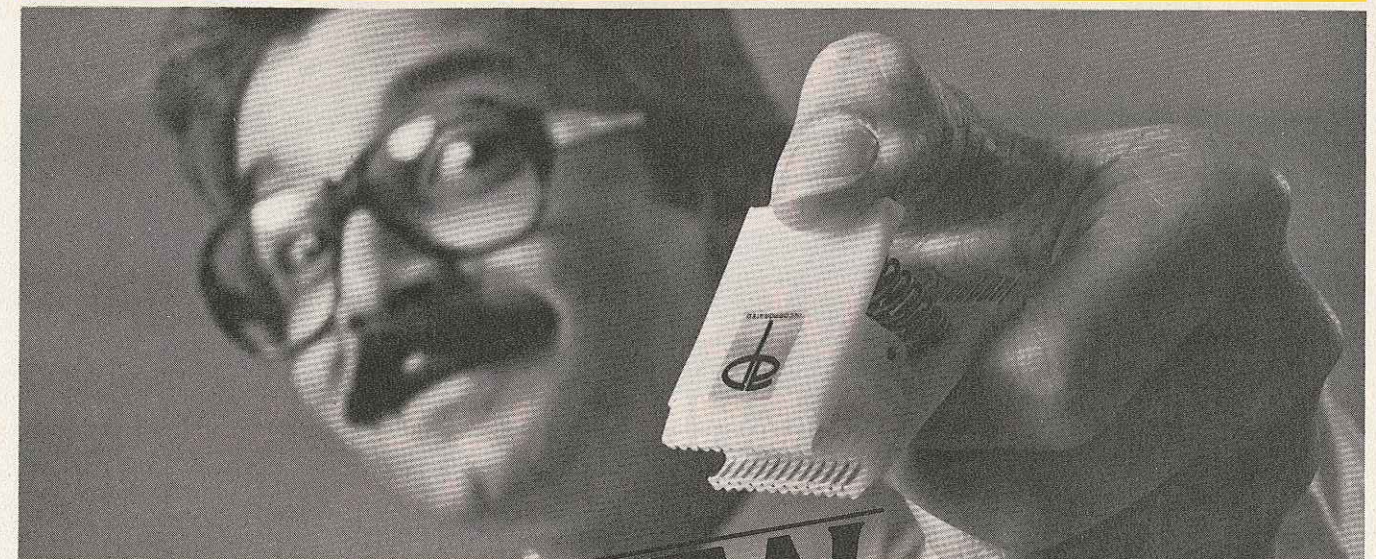
DAK unconditionally guarantees all DAK cassettes for one year against any defects in material or workmanship.

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



Call TOLL-FREE .....(800) 423-2636  
In California Call .....(213) 984-1559  
10845 Vanowen St., North Hollywood, CA 91605

Make & Model	Price <sup>1</sup> (\$)	Power required (mA) <sup>2</sup>			RAM capacity		Expansion kit size and price	Speed (ns)	Type	Min. addr. block size	Features <sup>2</sup>				Remarks	
		+8V	+16V	-16V	min.	max.					BS	BB	WS	WP		
<b>Electronic Control Technology</b> 16K RAM	350 (k) 399 (w)	1.5A			16K	16K	none	450	stat.	16K		X				Spare IC spaces for user circuit. Spare IC spaces for user circuits.
16K RAM 4MHz	415 (k) 475 (w)				16K	16K	none	250	stat.	16K		X				
<b>Electronic Systems</b> 300	23 (b) 160 (k) 200 (w)				1K			250	stat.				X			Bare-board version includes regulator.
<b>Fire Bird Sales</b> 16KRB	323 (w)				16K	16K	none	260	dyn.	16K	X					
<b>Franklin Electric</b> 8KSr	249 (k) 295 (w)	1.2A			8K	8K	none	400	stat.	2K	X	X		X	LED indicators for power OK, board select, write protect; DIP addr. SW.	
8KSh	289 (k) 330 (w)	1.7A			8K	8K	none	250	stat.	2K	X	X		X		
<b>Godbout</b> Econoram II	135 (k) 155 (w)	1.5A			8K	8K	none		stat.	4K			X	X	Software write protect w. vector. Write-protect for 4K blocks. Manual high-8K/low-8K deselect. Can deselect either 4K/8K pair.	
Econoram IV	279 (k) 314 (w)	2A			16K	16K	none		stat.	16K				X		
Econoram V	279 (k) 314 (w)	2A			16K	16K	none		stat.	16K				X		
Econoram VII	445 (k) 485 (w)	2A			24K	24K	none		stat.	2, 4K 2, 8K	X			X		
<b>GRE Data Products</b> 232-B	179 (w)	1.2			8K			400	stat.	8K					Provisions for MWRT and Phantom disable.	
232-16	319 (w)				16K			400	stat.	16K	X					
<b>IMSAI</b> RAM 4A-4	139 (k) 189 (w)	800			4K	4K	none	500	stat.	4K		X			*4K block missing with memory-map option. As above. As above.	
RAM 16	449 (k) 499 (w)	500 150 10			16K	16K	none	500	dyn.	4K*	X					
RAM III-32	895 (w)	360 250 10			32K	32K	none	500	dyn.	4K*	X					
RAM III-64	1695 (w)	360 250 10			64K	64K	none	500	dyn.	4K*	X					
<b>Industrial</b> Micro systs. C00282	135				8K	8K		low	stat.							
C00282-HS	150				8K	8K		hi	stat.							
C00282	304				16K	16K		low	stat.							
C00282-HS	343				16K	16K		hi	stat.							
C00360	625				32K	32K		low	stat.							
C00360-HS	689				32K	32K		hi	stat.							
<b>Ithaca Audio</b> 8KSR	25 (b) 160 (w)	1.4A			1K	8K			stat.	4K	X	X	X	X	Software protect/unprotect.	
	199 (w)	1.4A			8K	8K		450	stat.	4K	X	X	X	X		
16KDR	35 (b)	1.4A			16K	64K		250	stat.	4K	X	X	X	X		
<b>Jade Computer</b> JG8K	25 (b) 126 (k) 150 (w) 140 (k) 160 (w) 170 (k) 190 (w)	2.5A			8K			450	stat.	8K	X		X		Adapter (\$13) available for use with Motorola D-2 6800 Eval. Kit.	
		2.5A			8K			350	stat.	8K	X		X			
		2.5A			8K			250	stat.	8K	X		X			
		2.5A			8K											
<b>Micro Data Systems</b> MD-697 (8K)	179 (k) 199 (w)	1.5A			8K	32K	8K/\$129	450	stat.	16K	X				250-ns option avail.	
MD-697 (16K)	308 (k) 348 (w)	1.5A			16K	32K	8K/\$129	450	stat.	16K	X				250-ns optional.	
MD-697 (24K)	437 (k) 497 (w)	1.5A			24K	32K	8K/\$129	450	stat.	16K	X				250-ns optional.	



# NEW.

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

- New "duck bill" contacts are flat, won't roll off IC leads.
- Open-nose construction enables probe at IC leg.
- Pin rows are offset for easy attachment of probes.
- Contacts are gold-plated phosphor bronze. "Contact comb" construction separates contacts with precision. No shorts.
- Heavy-duty, industrial-grade springs for firm contact pressure—and a good grip when pulling ICs. They'll keep their spring indefinitely. No intermittents.
- Steel pivot pin. Engineering-grade thermoplastic body molded around contact pins. Made to last!
- New narrow-nose design makes it easy to attach on high-density boards. And now you can test ICs with only .040" between opposing legs.
- 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.  
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,

22, 24, 28, 36 and 40-pin models at your nearby A P store. (Make sure it's your A P store.)  
Need the address? Call (toll-free) 800-321-9668. And ask for our complete A P catalog, The Faster and Easier Book.

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Tel. 216/354-2101  
TWX: 810-425-2250

**Faster and Easier is what we're all about.**

Make & Model	Price <sup>1</sup> (\$)	Power required (mA) <sup>2</sup>			RAM capacity		Expansion kit size and price	Speed (ns)	Type	Min. addr. block size	Features <sup>3</sup>				Remarks
		+8V	+16V	-16V	min.	max.					BS	BB	WS	WP	
MD-697 (32K)	539 (k) 599 (w)	1.5A			32K	32K	none	450	stat.	16K	X				250-ns optional.
National Multiplex 8K	190 (w)				8K	8K			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				X			*Standby power, 1.5A @ 2.2V; phantom disable.
Processor Tech. 4KRA 8KRA 16KRA 32KRA	125 (k) 150 (w) 225 (k) 250 (w) 429 (w) 750 (w)	1A 1.9A 800 800			4K 8K 16K 32K	4K 8K 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 none	494 294 471 271	stat. stat. stat. stat.	4K 4K 4K 4K		X X			Parallel addressing capability.
Solid State Music MB4 MB-6A MB-7 MR-9 PROM/RAM 80 (k)	91 (k) 165 (k) 175 (k) 449 (k) X	1.1A 2.0A 2.0A 550 X	80 25		4K 8K 8K 16K 0	4K 8K 8K 16K 4K	none none none	2 MHz 2 MHz 4 MHz 2.3 MHz	stat. stat. stat. stat.	4K 8K 8K 16K		X X X X			Memory protect in 4K blocks. Memory protect to 256- byte blocks; phantom provisions. 4K memory protect; phantom provision. Can intermix RAM and PROM in 256-byte increments; jump on reset or on power-up.
Space Byte 16K	599 (w)	1.6A			16K	16K	--	450/ 250	stat.	4K	X	X			Phantom disable and write protect for each 4K; DMA-compatible.
Thinker Toys EconoRam III SuperRam	159 (k) 149 (w) 299 (k) 334 (w)	240 2A	80 20		8K 16K	8K 16K	none none	471 450	dyn. stat.	4K 4K			X		With Synchrofresh.

**YOU ASKED FOR IT**

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**50 HZ TO 550 MHZ COUNTER KIT**

**95% ASSEMBLED 100% TESTED**

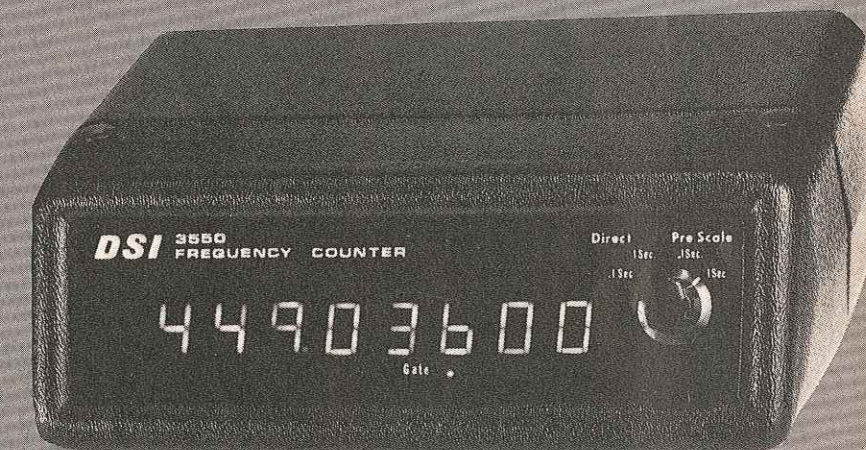
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includes built-in  
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**DSI OFFERS THE BEST OF TWO WORLDS...**

An unprecedented DSI VALUE... in a high quality, LSI Design, 50 HZ to 550 MHZ frequency counter kit. And, because it's a DSI innovation, you know it obsoletes all competitive makes, both in price & performance.

With 95% of the assembly completed by DSI, you are only one hour away from solving all of those difficult bench problems, from adjusting 60 HZ clock-time bases to setting the frequency of a 468 MHZ Mobile Radio.

**FACT:** Every 3550 QUIK-KIT® PC board is factory assembled and tested before shipment. **FACT:** The problems of bad LED's, IC's, and Capacitors are a thing of the past. **FACT:** No manufacturer except DSI offers a 550MHZ frequency counter with... 8 digits, .5 in. LED's, TCXO, 1HZ resolution and a one year warranty on parts for under \$100.00. **FACT:** We do not know how long we can hold this low, low price. **GO WITH THE LEADER... BUY A DSI FREQUENCY COUNTER KIT TODAY. SAVE TIME & MONEY AND BE ASSURED IT WILL WORK THE FIRST TIME.**

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**Time Base** TCXO 1PPM 65° to 85° F  
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**Display** 8 digits, 1/2 inch LED with Leading Zero Blanking  
**Sensitivity** 25MV @ 25MHZ, 150MHZ, 250MHZ;  
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