MOS 16K RAM FOR THE APPLE II

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MOS 16K dynamic RAM is getting cheaper. At the time of this writing, one mail-order house is offering 16K bytes of RAM (eight devices) for $120. Apple II owners can now enhance their systems for less than the Apple dealers' price. However, there is a potential drawback to the purchase of your own 16K RAM chips: speed. You may wonder why, since the Apple's 6502 CPU is running at only about 1 MHz, but things aren't quite that simple.

To begin with, the Apple II continually refreshes its video display and dynamic RAM. It does this by sharing every cycle between the CPU and the refresh circuitry, a half-cycle for each. This means that the RAM is being accessed at a 2 MHz rate.

That doesn't sound too fast, until the slowest 16K parts rated at 300ns access time; but you have to remember that the RAM chips are in 16-pin parts by virtue of a multiplexed address bus. There are two address-strobe signals during each memory access cycle, and the access-time specification will be met only if the delay between these strobe signals is within specified limits. In the Apple II this delay is 140ns, which is too long. Furthermore, the Apple II timing doesn't allow long enough RAS precharge or row-address hold time for the slow parts. Judging by the spec sheets, 200ns parts are preferable to 250ns parts, and 300ns parts shouldn't be used at all. In my Apple, 300ns parts caused a zero to turn into a one once in a while.

Many mail-order houses do not mention device speeds in their ads. The best thing to do is to deal only with those suppliers who specify speeds, but for those who didn't, the table below shows the codes used by some 16K dynamic RAM manufacturers to indicate the speeds of their devices. Good luck, and caveat emptor!

SPEED CODES USED BY 16K DYNAMIC RAM MANUFACTURERS

Manufacturer	Part No.	Access Time (ns)			
		150	200	250	300
A M D	9016	-F	-E	-D	-C
Fairchild	F16K	-2	-3	-4	-5
Intel	2117	-2	-3	-4	
MOSTEK	4116	-2	-3	-4	
Motorola	MCM4116C	-15	-20	-25	-30
National	MM5290	-2	-3	-4	
N E C	μD416	-3	-2	-1	
T I	4116	-15	-20	-25	
Zilog	Z6166	-2	-3	-4	