

DIGITAL RESEARCH CORP.

INTRODUCTION

The 16K Static RAM you have just purchased is one of the best RAM bargains on the market today. We have gone to great lengths to combine the right mix of features that are most often required on High Density RAM boards for S-100 systems.

FEATURES:

Fully S-100 Compatible !

Uses the very popular 2114 4K Static RAM

Addressable as four separate 4K blocks.

On board bank select (Cromemco standard) is provided!

On board selectable wait states !

Board Access time under 500 NS.

PC Board is solder masked and silk screened.

Gold plated contact fingers for long life.

All address and data lines fully buffered.

Phantom is Jumperable to buss pin #67.

LOW POWER dissipation (<2 amps typical).

Kit includes ALL parts and sockets.

PDBIN strobe is used for reliable operation.

Blank PC board may be populated as any multiple of 4K

PARTS LIST

1	4 Pin Low Profile Socket
13	14 Pin Low Profile Sockets
9	16 Pin Low Profile Sockets
32	18 Pin Low Profile Sockets
1	24 Pin Low Profile Sockets
4	Heatsinks (with hardware) for regulators.
53	Disc Bypass Capacitors
8	Tantalum Capacitors for regulators
1	1K ohm Resistor
5	2.2K ohm Resistors
4	7805 5VDC Regulators
32	2114 1K X 4 Static RAM's
5	74LS367 Buffers (8T97 or 74367)
1	74LS138 3 to 8 Decoder
1	74LS154 4 to 16 Decoder
3	74LS04 Hex Inverters
4	74LS32 Quad 2 Input OR
2	74LS05 Hex Inverter (O.C)
1	74LS10 Triple 3 Input Nand
1	74LS20 Dual 4 Input Nand
1	74LS30 8 Input Nand
1	74LS74 Dual D FF
1	74LS175 Quad D FF
1	Red LED

GENERAL CONSTRUCTION HINTS

For soldering we recommend a 32 Watt soldering pencil . DO NOT use a soldering gun !!! Use small diameter (such as 22 ga.) rosin core 60/40 alloy solder.

Keep the soldering pencil CLEAN with a wet sponge or cloth.

After such components as resistors or capacitors have been soldered, use a small pair of diagonal cutters to remove the excess lead length.

Observe polarities of all tantalum caps and the LED.

If you notice any discrepancies between the parts received and those listed please notify us immediately.

LIMITED WARRANTY

Digital Research Corp. of Texas warrants all components in this kit to be free from defects in material and workmanship for a period of 90 days. Any defective parts must be returned to us and will be replaced at no charge. Any board purchased as a kit which malfunctions during the warranty period which has not been subjected to abuse and that has been assembled with reasonable care will be repaired or replaced at no charge.

Any unassembled kit purchased from us may be returned within 14 days of receipt for a FULL "no questions asked" refund. No reason is necessary. The above warranties also apply to kits assembled by Digital Research Corp.

Any board which is not covered by the above warranty will be repaired at a cost commensurate with the work required. This charge will not exceed \$20 without prior approval.

This warranty is made in lieu of any other warranty expressed or implied and is limited in all cases to the repair or replacement of the kit involved.

() Insert 74LS367's in the following locations: 39, 40, 49, 50, and 51. Be extremely careful to match the dot on each socket with pin 1 of each IC denoted by a small notch or indentation.

() Insert 74LS32 in locations 34, 35, 36, 37.

() Insert 74LS04 in locations 42, 47, and 48.

() Insert 7405's in locations 52 and 53.

() Insert a 74LS10 in location 41.

() Insert a 74LS20 in location 38.

() Insert a 74LS30 in location 46.

() Insert a 74LS74 in location 43.

() Insert a 74LS138 in location 33.

() Insert a 74LS154 in location 44.

() Insert a 74LS175 in location 45.

() Insert 2114's in locations 1 through 32. WARNING: All pin #1's are UP !!!

() Now that all IC's have been installed in sockets you should again check the regulators for proper operation.

16K SET UP AND USE

There are several options available to the user. These include "ADDRESS SELECTION", "WAIT STATES", "PHANTOM", and "BANK SELECT".

ADDRESS SELECTION

The DIGITAL RESEARCH CORP. 16K Static RAM is configured as four independent 4K blocks. Each 4K block can be addressed on any of the sixteen available 4K areas of the S-100 buss. The four 4K blocks on the board are designated by the letters A,B,C,D. The sixteen system 4K areas are designated by 0 through 15. It is necessary to place Jumpers between each 4K block (A,B,C,D) and the desired 4K area (0 through 15). The address select area is located at the lower left-hand side of the board.

If your board is not fully populated then the pins corresponding to the unused 4K blocks should be pulled up to +5 VDC. This is accomplished as shown

4K Block not used	2.2K on back of PC (pin 1 to pin 14)
A	IC 34
B	IC 35
C	IC 36
D	IC 37

WAIT STATES

Wait states are normally not required however they can be Jumpered if your system needs them. To select wait states place a Jumper between "W" and the number desired (1 through 4). With no Jumper, no wait states are inserted.

PHANTOM

If your computer requires PHANTOM it is easily Jumperable to buss pin 67 by placing a Jumper at the location marked PHANTOM.

BANK SELECT

This board supports CROMEMCO standard bank select which is a feature of some of their software. Bank select is a method of interchanging up to eight 64K blocks of RAM under software control. This is accomplished by outputting a byte of data to Port 40H. Each bit (when high) determines which bank is enabled. Bit 0 is Bank 1 and Bit 7 is Bank 8.

To select which bank this board is part of, place a Jumper from the left side to the right side at the point designated by the BANK # stenciled on the PC board. This socket for Jumpering is at the lower right side of the board.

Also in the lower right of the board is an area labeled RESET. A Jumper must be installed in this location such that a system reset will either enable or disable the board. Normally a Jumper is placed from the ENABLE to the RESET pads. This will enable the board after a system reset. If, for example, the board is jumpered to be Bank 5 and it is not desired that BANK 5 be enabled after a system reset then the a Jumper would be placed between DISABLE and RESET. Now the only way the board could be enabled would be via software. Only one bank of upto 64K is enabled at one time.

THEORY OF OPERATION

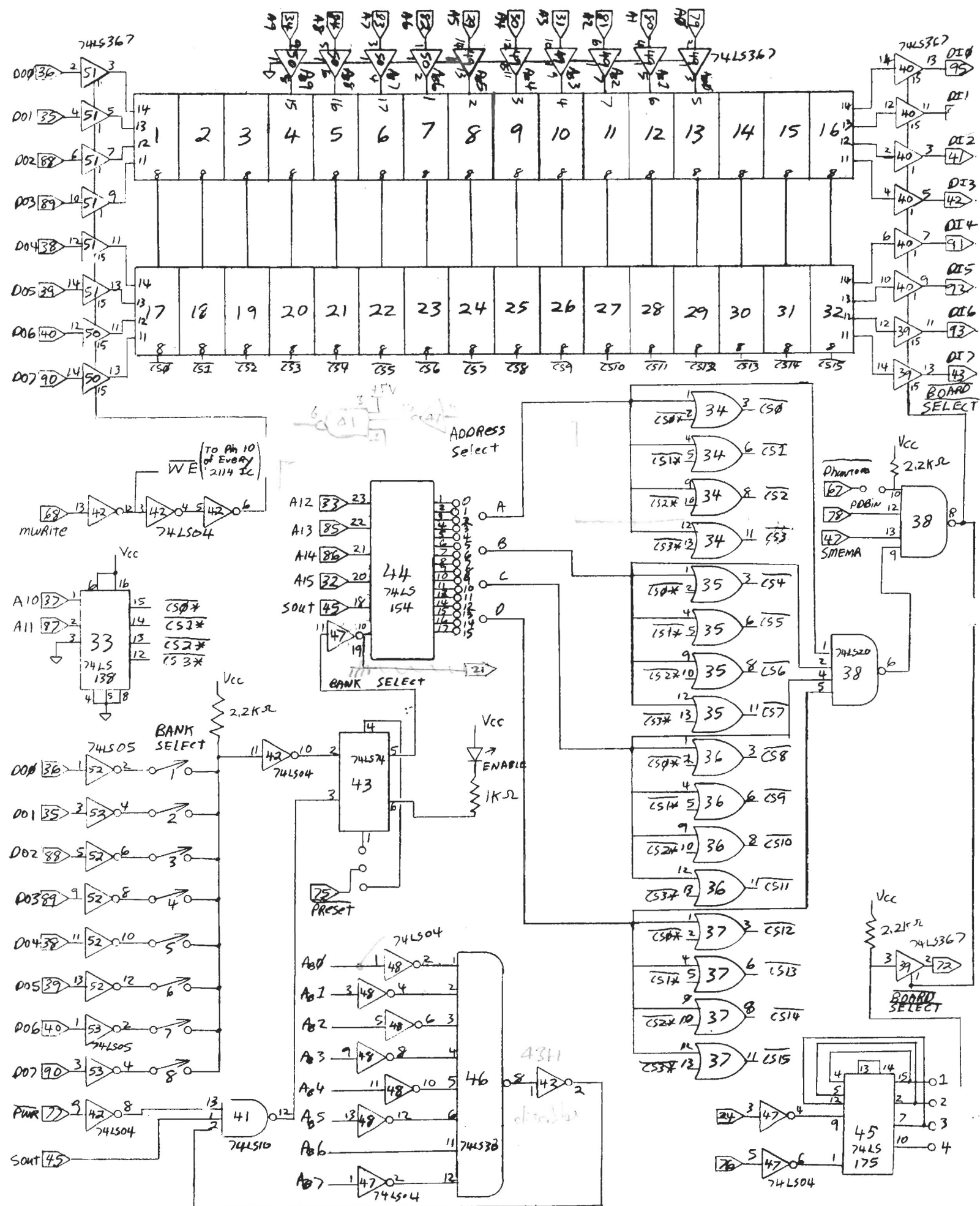
This 16K board can reside in any of four 16K Ram areas available on the S-100 buss. IC 44 (74LS154) is used to decode the four high order address (A12-A15) and generates the outputs (0-15) brought out to the address Jumper area. IC 33 (74LS138) is used to decode addresses A10 and A11. The outputs of IC33 and IC44 are ORed (negative logic AND) together to form the 16 Ram Chip Select signals. Addresses A0-A9 are buffered by IC's 49 and 50. The Write Enable signal required by the 2114 is generated by inverting MWRITE from the buss (pin 68).

D00-D07 are buffered by IC's 50,51 which are enabled by the inverted MWRITE signal. This is data out of the CPU and in to the Ram board. D00-D07 are also inverted by IC52 and 53 the outputs of which are selected by the Bank Select Jumper area (Wired ORed) then inverted (by IC42) and fed into the Data input of FF IC43. IC's 46,47, 48, 42 and 41 decode output port 40 as the clock input of ic 43. The active high output of IC43 is the Bank Select signal and is used to enable IC 44. The active low output is used to drive the Board Enable LED. The preset and clear inputs of IC 43 are jumperable to buss pin 75 (PRESET).

IC45 is configured as a ripple counter which counts 02 and is cleared by PSYNC. IC45'S outputs are brought out to Jumpers. This allows you to select how many 02's are counted before PSYNC clears the counter.

D10-D17 (data in to the CPU) are buffer by IC39 and 40. These are enabled by the output of IC38. The inputs of IC38 are comprised SMEMR,PDBIN, PHANTOM, and Board Select. Board Select is derived from the jumpered outputs of IC 44.

Modified so that w: + 45 di



APPLICATIONS EXCHANGE

ALTAIR 8800 MEMORY CHECK PROGRAM

It seems that many of the members of S.C.C.S. are owners or soon to be owners of ALTAIR'S (myself included) and are in the first stages of going through the learning curve(s) of this "new" microcomputer technology. Building the hardware is only a small part of this hobby, because once everything is soldered together you're done. Software is where the real challenge and excitement come in. There is no "done" in software where you may sit back and say "I've done all the programs". There is no such point, as software can keep you occupied for years (I hope not on the same program). So to those members still in their learning curve I offer two basic programs for ALTAIR owners.

The first is a memory check program, of which there are several running around. This one is useful when you've just finished that new 4k board you bought from so-n-so and you're wondering if it's OK (memory chips do have a small failure rate).

The second is a cassette tape read and write program so you can dump all those programs you were playing with before you put your 8800 to bed and it forgets all it learned. This program was written to operate through the MITS Inc. Audio Cassette Interface, although any I/O parallel to serial modem operating around 2kHz should work. Any medium quality recorder can be used.

The tape I/O port is addressed for control channel - 6 and data channel - 7. Put the bootstrap in manually, it will load the tape input program, which must be the first program recorded. Make sure that the starting address of where the bootstrap is to start loading into memory is four addresses lower than where the body of the program being loaded is to start. This is because the boot is a dump type program and will load into memory the 4 preamble words that the output program places before each program it writes. After the programs are initially entered the output program can be used to write itself onto tape.

SCOTT WILCOX
405-B No. Monterey
Alhambra, CA 91801

DESCRIPTION: This program checks any block of directly addressable memory for read/write data errors. All possible bit patterns are read in and out of each memory location. The program stops (enters a futile loop) and stores the address of the "bad" memory location and the data byte that execution failed on for three situations:

1. a faulty memory location was encountered (data read did not equal data written)
2. a protected block of memory was encountered.
3. the program "stop memory check" address was set higher than the amount of memory actually in the machine

ADDRESS	MNEMONIC		COMMENT
000	LXI H,L	041	Load stop address of memory check
001		XXX	377 Example: Shows stopping at
002		XXX	037 end of 1st 8K block.
003	LXI D,E	021	Load start address of memory check
004		XXX	060 Start test just above
005		XXX	000 this program.
006	MVI A	076	
007		377	Initial check data
010	MOV A,B	107	Save data for comparison to memory read data
011	STAX D,E	022	
012	STA	062	Store data in case memory fails
013		056	
014		000	
015	LDAX D,E	032	Read data for comparison
016	CMP B	270	compare read/write data
017	JZ	312	Loop if no memory error
020		031	
021		000	

APPLICATIONS EXCHANGE

022	XCHG	353	
023	SHLD	042	Store address of bad memory
024		054	
025		000	
026	JMP	303	end of program futile loop
027		023	
030		000	
031	SUI	326	decrement check data
032		001	
033	JNC	322	loop if not final data case (000)
034		010	
035		000	
036	INX D,E	023	increment to next memory address
037	MOV D,A	172	
040	CMP H	274	
041	JNZ	302	loop if not last memory check address
042		006	
043		000	
044	MOV E,A	173	
045	CMP L	275	
046	JNZ	302	loop if not last memory check address
047		006	
050		000	
051	JMP	303	loop to store stop address
052		023	
053		000	
054		XXX	lo address of bad memory
055		XXX	hi address of bad memory
056		XXX	data case that memory failed on

LIMITATIONS: The program requires 46 bytes of known good memory and must not be located in a protected block of memory. Running time is approximately 30 sec. for each 4k of memory being checked

RUNNING THE MEMORY TEST

When the test is running properly most of the address lights on the front of the computer will be lit. You will be able to observe that several of the lights will be brighter than the others and will be working their way across from right to left as the program proceeds through the memory. If you are testing, for example, one 4K board in your system then you would use the start and stop addresses shown in the example. When the program is finished most of the address lights will go out and locations 54 and 55 will hold the address of the bad byte of memory or the address of the next byte above the stopping address. (i.e., the stopping address that you specified in the program)

APPLICATIONS EXCHANGE

64K MEMORY CHART

The chart below identifies (in hex and octal) the high order portion of the address for any given 1/4K of memory. Each 1/4K begins with low order address 00₁₆ (000₈) and ends with FF₁₆ (377₈). Each K is sectioned off for easy identification. Examples:

Section:

Begins with

Ends with

HX OCT
1C00 034 000
8000 200 000
0600 006 000
9400 224 000

HX OCT
1FFF 037 377
BFFF 277 377
06FF 006 377
9BFF 233 377

The 8th K

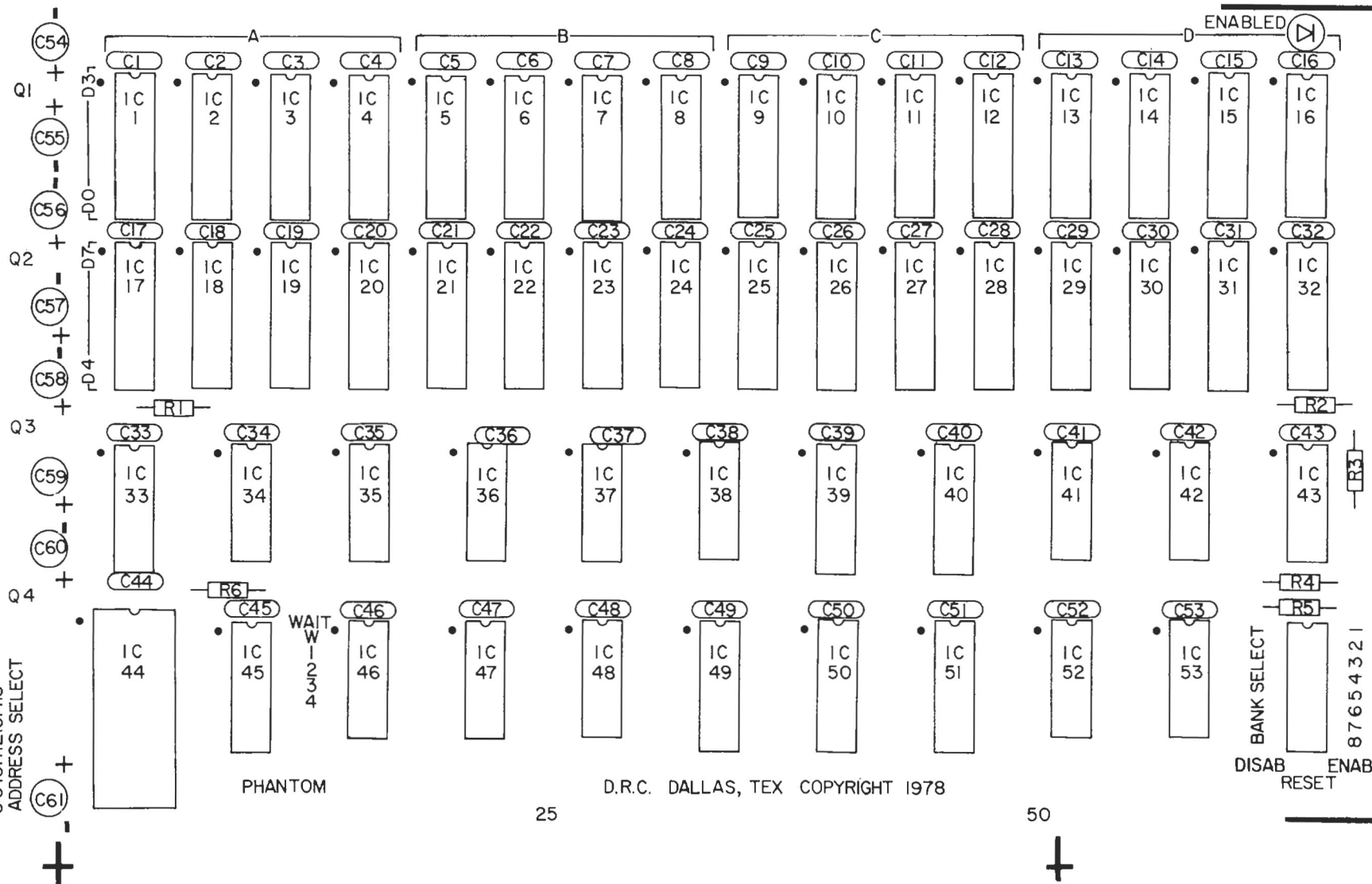
The 3rd quarter of all 64K

The 2nd quarter of the 2nd K

The 38th & 39th K

HX OCT K	HX OCT K	HX OCT K	HX OCT K	HX OCT K	HX OCT K	HX OCT K	HX OCT K
00 000 1	20 040 1	40 100 1	60 140 1	80 200 1	A0 240 1	C0 300 1	E0 340 1
01 001 2	21 041 2	41 101 2	61 141 2	81 201 2	A1 241 2	C1 301 2	E1 341 2
02 002 3	22 042 3	42 102 3	62 142 3	82 202 3	A2 242 3	C2 302 3	E2 342 3
03 003 1	23 043 9	43 103 17	63 143 25	83 203 33	A3 243 41	C3 303 49	E3 343 57
04 004 1	24 044 1	44 104 1	64 144 1	84 204 1	A4 244 1	C4 304 1	E4 344 1
05 005 2	25 045 2	45 105 2	65 145 2	85 205 2	A5 245 2	C5 305 2	E5 345 2
06 006 3	26 046 3	46 106 3	66 146 3	86 206 3	A6 246 3	C6 306 3	E6 346 3
07 007 2	27 047 10	47 107 18	67 147 26	87 207 34	A7 247 42	C7 307 50	E7 347 58
08 010 1	28 050 1	48 110 1	68 150 1	88 210 1	A8 250 1	C8 310 1	E8 350 1
09 011 2	29 051 2	49 111 2	69 151 2	89 211 2	A9 251 2	C9 311 2	E9 351 2
0A 012 3	2A 052 3	4A 112 3	6A 152 3	8A 212 3	AA 252 3	CA 312 3	EA 352 3
0B 013 3	2B 053 11	4B 113 19	6B 153 27	8B 213 35	AB 253 43	CB 313 51	EB 353 59
0C 014 1	2C 054 1	4C 114 1	6C 154 1	8C 214 1	AC 254 1	CC 314 1	EC 354 1
0D 015 2	2D 055 2	4D 115 2	6D 155 2	8D 215 2	AD 255 2	CD 315 2	ED 355 2
0E 016 3	2E 056 3	4E 116 3	6E 156 3	8E 216 3	AE 256 3	CE 316 3	EE 356 3
0F 017 4	2F 057 12	4F 117 20	6F 157 28	8F 217 36	AF 257 44	CF 317 52	EF 357 60
10 020 1	30 060 1	50 120 1	70 160 1	90 220 1	B0 260 1	D0 320 1	F0 360 1
11 021 2	31 061 2	51 121 2	71 161 2	91 221 2	B1 261 2	D1 321 2	F1 361 2
12 022 3	32 062 3	52 122 3	72 162 3	92 222 3	B2 262 3	D2 322 3	F2 362 3
13 023 5	33 063 13	53 123 21	73 163 29	93 223 37	B3 263 45	D3 323 53	F3 363 61
14 024 1	34 064 1	54 124 1	74 164 1	94 224 1	B4 264 1	D4 324 1	F4 364 1
15 025 2	35 065 2	55 125 2	75 165 2	95 225 2	B5 265 2	D5 325 2	F5 365 2
16 026 3	36 066 3	56 126 3	76 166 3	96 226 3	B6 266 3	D6 326 3	F6 366 3
17 027 6	37 067 14	57 127 22	77 167 30	97 227 38	B7 267 46	D7 327 54	F7 367 62
18 030 1	38 070 1	58 130 1	78 170 1	98 230 1	B8 270 1	D8 330 1	F8 370 1
19 031 2	39 071 2	59 131 2	79 171 2	99 231 2	B9 271 2	D9 331 2	F9 371 2
1A 032 3	3A 072 3	5A 132 3	7A 172 3	9A 232 3	BA 272 3	DA 332 3	FA 372 3
1B 033 7	3B 073 15	5B 133 23	7B 173 31	9B 233 39	BB 273 47	DB 333 55	FB 373 63
1C 034 1	3C 074 1	5C 134 1	7C 174 1	9C 234 1	BC 274 1	DC 334 1	FC 374 1
1D 035 2	3D 075 2	5D 135 2	7D 175 2	9D 235 2	BD 275 2	DD 335 2	FD 375 2
1E 036 3	3E 076 3	5E 136 3	7E 176 3	9E 236 3	BE 276 3	DE 336 3	FE 376 3
1F 037 8	3F 077 16	5F 137 24	7F 177 32	9F 237 40	BF 277 48	DF 337 56	FF 377 64

REDUCE TO 10000:005



D.R.C. DALLAS, TEX COPYRIGHT 1978