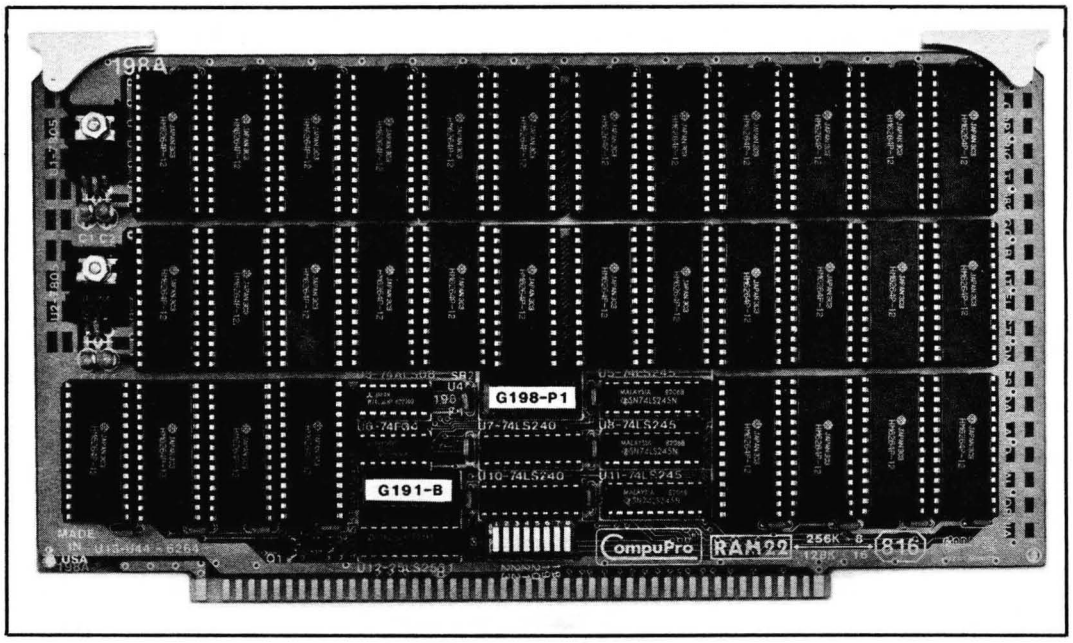
CompuPro®
A *GODBOUT* COMPANY

RAM 22™

Technical Manual

IEEE 696/S-100



STATIC MEMORY

256K x 8 or 128K x 16

$15.00

A242

RAM 22 TECHNICAL MANUAL
Copyright 1983 CompuPro
Hayward, CA 94545

First Edition: August 1983
Second Printing: January 1984
Third Printing: May 1984

Document # 11989
File Name: RAM22.MAN
Board No. 198 Rev.A

RAM 22 is a trademark of CompuPro.

DISCLAIMER - CompuPro makes no representations or warranties with respect to the contents hereof and specifically disclaims any implied warranties of merchantability or fitness for any particular purpose. Further, CompuPro reserves the right to revise this publication and to make any changes from time to time in the content hereof without obligation of CompuPro to notify any person of such revision or changes.

All rights reserved. No part of this publication may be reproduced or transmitted in any form, or by any means, without the written permission of CompuPro. Printed and assembled in the United States of America.

CONTENTS

About RAM 22 1
Technical overview 1
How to configure the RAM 22 for your system 2
Switch settings for S1 - address selection 2
Theory of operation 2
Locating RAM ICs by address and bit 3
Logic diagram 4-7
Parts list 8
Component layout 9
Customer service/limited warranty information . . . backpage

RAM 22 TECHNICAL MANUAL

ABOUT RAM 22

The RAM 22 from CompuPro represents one of the most advanced RAM boards ever produced for the IEEE 696/S-100 Bus. Combining state of the art static CMOS RAM technology with CompuPro's design excellence makes the RAM 22 the most versatile, efficient and reliable RAM available today. The RAM 22 works as a "byte-wide" memory in 8 bit systems and automatically switches to "word-wide" mode for today's newer 16 bit systems. The RAM 22 is the choice of professionals for scientific, industrial and commercial applications where the emphasis is on full speed operation with the advanced CPUs of today and tomorrow while maintaining downward compatibility with 8 bit CPUs.

TECHNICAL OVERVIEW

The RAM 22 uses thirty-two high performance 8K X 8 CMOS RAM chips to provide a total of 256K bytes or 128K words of storage. The RAM 22 is addressable on any 256K byte boundary in the 16 megabyte address space specified by the IEEE 696 standard.

The RAM 22 also dynamically switches between "byte-wide" or "word-wide" modes per the state of the sXTRQ* signal on the S-100 Bus (see the Theory of Operation section for a complete discussion of how this protocol works).

The RAM 22 was designed to work with 8086/88 type processors at speeds exceeding 10 MHz. It also handles DMA flawlessly, a feature few boards can boast.

To reduce the number of support ICs required to pack all this function and capacity onto a standard height S-100 board, two PAL (programmable array logic) elements are used. The PAL selects the proper memory chips and controls the complicated data bus switching scheme required to mix 8 and 16 bit operations.

All of this goes onto a high-quality double-sided circuit board that has a full solder-mask and legend. Sockets are provided for all ICs for ease of maintenance. All edge connector contacts are gold on a nickel substrate to insure long and reliable operation.

NOTE: This board does not allow any of the four 64K blocks on the board to be disabled.

HOW TO CONFIGURE THE RAM 22 FOR YOUR SYSTEM

The RAM 22 requires only that the starting address of the board be set using switch S1. All other features such as PHANTOM and byte (8 bit)/word (16 bit) transfers are handled automatically by onboard logic. This board responds to the upper eight address lines (A16-23) as provided for by the IEEE 696/S-100 standard.

The starting address of the board is selected by setting the middle six paddles of dip-switch S1. S1 is located near the bottom center of the board. The address is set in a binary fashion with each paddle of S1 representing an address bit. An "ON" paddle represents a binary "zero" and an "OFF" paddle represents a binary "one". The paddle to address bit relationship is shown in the following table:

SWITCH SETTINGS FOR S1 - ADDRESS SELECTION

ADDRESS BIT	PADDLE NUMBER	
A23	2	
A22	3	
A23	4	ON = 0
A20	5	OFF = 1
A19	6	1&8 = NC
A18	7	

EXAMPLE: If this is the first RAM board in your system and you want 256K starting at address 000000H, set paddles 2 through 7 of S1 ON.

EXAMPLE: If this is the second 256K board in the above system and you want it addressed at 040000H set paddles 2 through 6 ON and paddle 7 OFF.

EXAMPLE: If you want this board to reside at the top of the first megabyte of address space (i.e., starting address 0C0000H), set paddles 2 through 5 ON and paddles 6 and 7 OFF. Incidentally, this would put the board at the highest 256K address which an 8086 or an 8088 can directly address.

THEORY OF OPERATION

The RAM 22 is designed to work in 8 and 16 bit systems per the protocol established by the IEEE 696/S-100 standard. The DATA IN and DATA OUT buses operate as a bidirectional 16 bit data path when word transfers are performed. The two buses remain uni-directional during byte operations.

Here's how the protocol works: The bus master requests a 16 bit transfer by asserting sXTRQ* (line 58 low). If the slave (in this case the RAM 22) is capable of performing word transfers, it acknowledges this fact to the master by asserting SIXTN* (line 60 low). Sometimes, even a 16 bit master may only want to transfer one byte rather than a whole word. In this case, the master does not assert sXTRQ* but instead uses the data buses as an 8 bit master would, that is: data from the master would be transferred on the DO bus and data to the master would be transferred on the DI bus.

The RAM 22 handles this multiplexing of the data buses with two bidirectional bus buffers (U5 and U11) and one intermediate buffer (U8). Both U5 and U11 are enabled for all word transfers. Both U5 and U11 are enabled for word read operations. When byte writes occur with A0=0, U15 is enabled. When byte writes occur with A0=1, U5 and U8 are enabled. When byte reads occur with A0=0, U8 and U11 are enabled. When byte reads occur with A0=1, U11 is enabled.

This complicated algorithm is executed by PAL (programmable array logic) element G191 (U9). A second PAL (U4) acts as the array decoder along with U3. The RAM is configured as two arrays of 128K by 8 bits, A and B. The bit/address decode scheme is covered in the next section. The decoder PAL only generates select signals, which enable the RAM chips only during memory reference operations. This feature, coupled with the use of RAM chips which power down when not selected makes the RAM 22 consume less power than most dynamic RAM designs while providing the speed of operation and reliability that only static RAM delivers.

The base address of the board is set with dip-switch S1. Octal comparator (U8) generates signal BSEL* when the address present on bus lines A18 through A23 matches that set in S1-2 through S1-7. Positions 1 and 8 of S1 are not used.

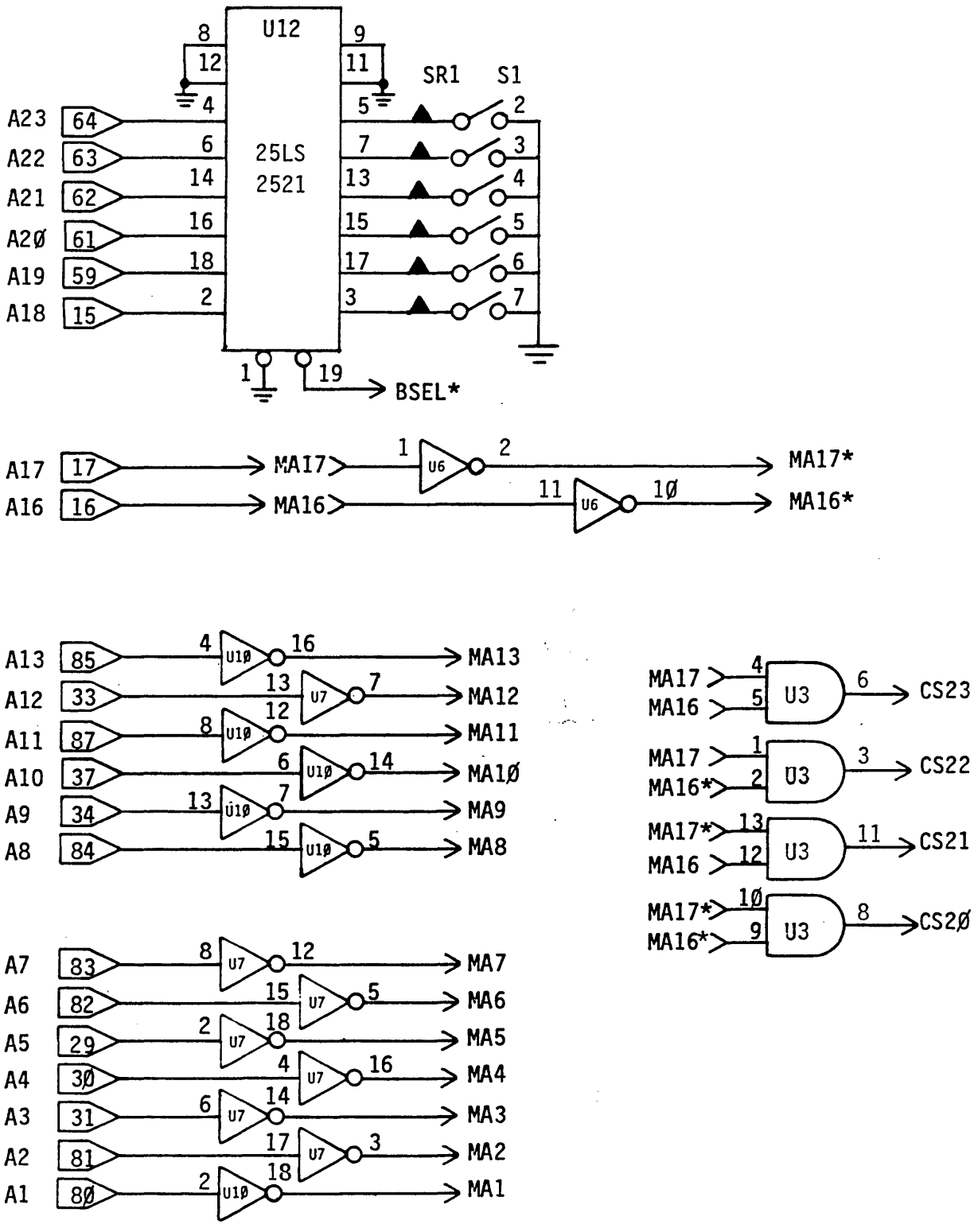
ESXT* is the signal generated in the PAL (U9) which causes the RAM 22 to acknowledge requests for word transfers when the board is selected. Transistor Q1 provides the open collector output required to drive bus signal SXTN* (line 60).

LOCATING RAM ICs BY ADDRESS AND BYTE

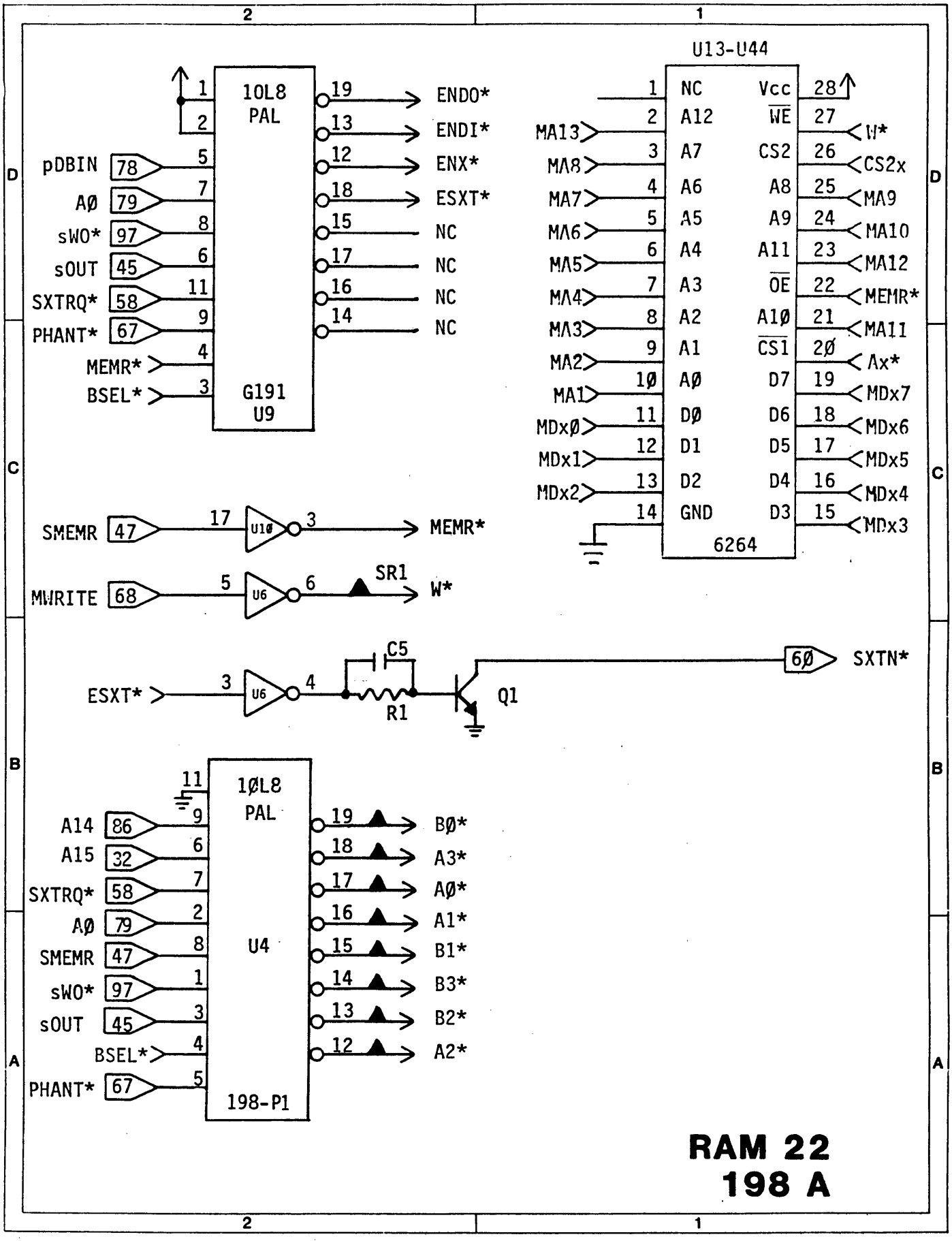
The COMPONENT LAYOUT at the back of this manual may be used as a map to locate RAM ICs by address and byte. Each RAM chip is identified by address and high or low byte position.

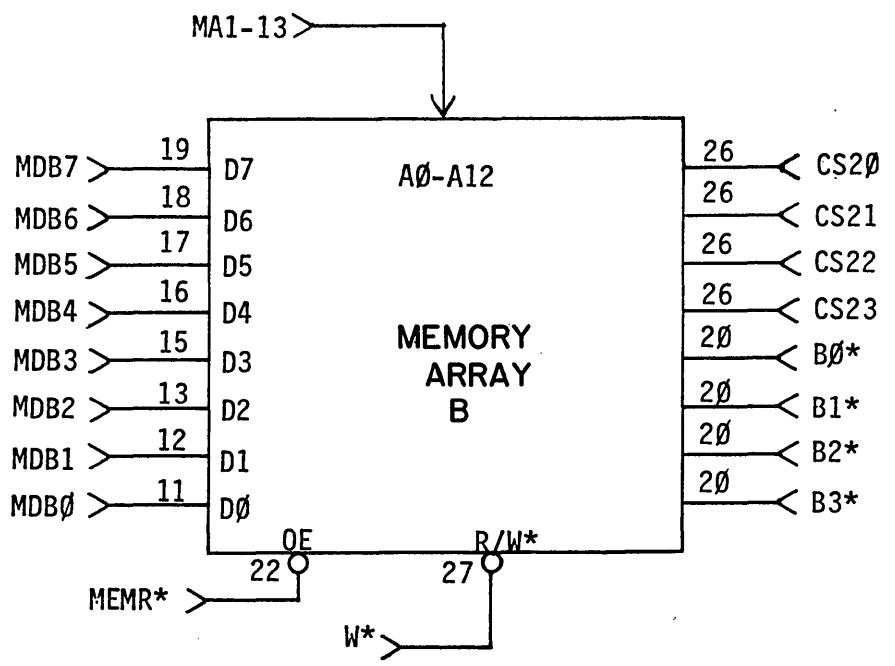
In the byte or 8 bit mode only one RAM is selected. All even bytes, A0 in the zero state, are in array A. All odd bytes, A0 in the one state, are in array B.

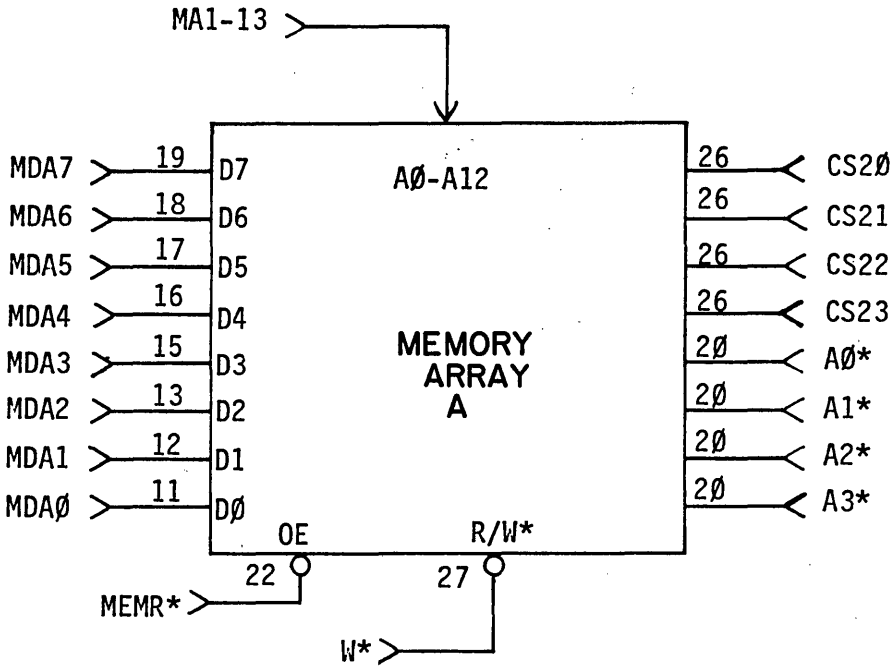
In the word or 16 bit mode, two RAM chips are enabled. One RAM chip in the odd array and one RAM chip in the even array.


U12
25LS
2521
SR1
S1
A23 64
A22 63
A21 62
A2Ø 61
A19 59
A18 15
BSEL*
A17 17
A16 16
MA17
MA16
U6
MA17*
MA16*
A13 85
A12 33
A11 87
A10 37
A9 34
A8 84
U1Ø
U7
MA13
MA12
MA11
MA1Ø
MA9
MA8
A7 83
A6 82
A5 29
A4 3Ø
A3 31
A2 81
A1 8Ø
MA7
MA6
MA5
MA4
MA3
MA2
MA1
MA17
MA16
MA16*
MA17*
MA16
MA17*
MA16*
U3
CS23
CS22
CS21
CS2Ø

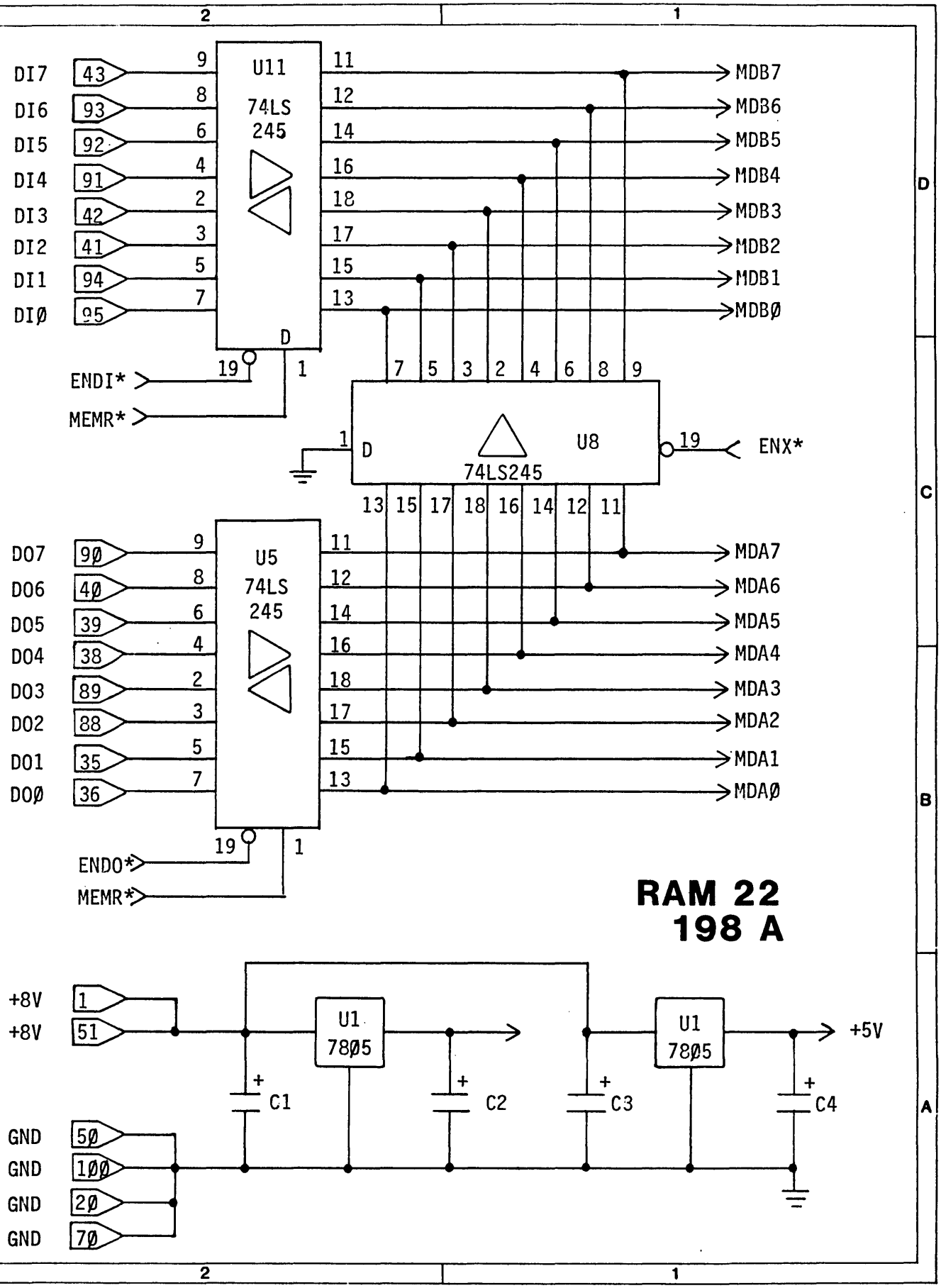
RAM 22
198 A


2
1
D
C
B
A
10L8
PAL
G191
U9
1 2 5 7 8 6 11 9 4 3
19 13 12 18 15 17 16 14
pDBIN 78
AØ 79
sWO* 97
sOUT 45
SXTRQ* 58
PHANT* 67
MEMR*
BSEL*
ENDO*
ENDI*
ENX*
ESXT*
NC
NC
NC
NC
U13-U44
NC Vcc 1 28
A12 WE 2 27
A7 CS2 3 26
A6 A8 4 25
A5 A9 5 24
A4 A11 6 23
A3 OE 7 22
A2 A1Ø 8 21
A1 CS1 9 2Ø
AØ D7 1Ø 19
DØ D6 11 18
D1 D5 12 17
D2 D4 13 16
GND D3 14 15
6264
MA13
MA8
MA7
MA6
MA5
MA4
MA3
MA2
MA1
MDxØ
MDx1
MDx2
W*
CS2x
MA9
MA10
MA12
MEMR*
MA11
Ax*
MDx7
MDx6
MDx5
MDx4
MDx3
SMEMR 47
17 U1Ø 3
MEMR*
MWRITE 68
5 U6 6
SR1
W*
ESXT* 3 U6 4
C5
R1
Q1
6Ø SXTN*
1ØL8
PAL
U4
198-P1
11 9 6 7 2 8 1 3 4 5
19 18 17 16 15 14 13 12
A14 86
A15 32
SXTRQ* 58
AØ 79
SMEMR 47
sWO* 97
sOUT 45
BSEL*
PHANT* 67
BØ*
A3*
AØ*
A1*
B1*
B3*
B2*
A2*
RAM 22
198 A


MA1-13
MDB7
MDB6
MDB5
MDB4
MDB3
MDB2
MDB1
MDBØ
19
18
17
16
15
13
12
11
D7
D6
D5
D4
D3
D2
D1
DØ
AØ-A12
MEMORY
ARRAY
B
OE
R/W*
22
27
MEMR*
W*
26
26
26
26
2Ø
2Ø
2Ø
2Ø
CS2Ø
CS21
CS22
CS23
BØ*
B1*
B2*
B3*


MA1-13
MDA7
MDA6
MDA5
MDA4
MDA3
MDA2
MDA1
MDAØ
19
18
17
16
15
13
12
11
D7
D6
D5
D4
D3
D2
D1
DØ
AØ-A12
MEMORY
ARRAY
A
OE
R/W*
22
27
MEMR*
W*
26
26
26
26
2Ø
2Ø
2Ø
2Ø
CS2Ø
CS21
CS22
CS23
AØ*
A1*
A2*
A3*

RAM 22
198 A


U11
74LS
245
DI7
DI6
DI5
DI4
DI3
DI2
DI1
DIØ
43
93
92
91
42
41
94
95
MDB7
MDB6
MDB5
MDB4
MDB3
MDB2
MDB1
MDBØ
ENDI*
MEMR*
U8
74LS245
ENX*
U5
74LS
245
DO7
DO6
DO5
DO4
DO3
DO2
DO1
DOØ
9Ø
4Ø
39
38
89
88
35
36
MDA7
MDA6
MDA5
MDA4
MDA3
MDA2
MDA1
MDAØ
ENDO*
MEMR*
RAM 22
198 A
+8V
+8V
GND
GND
GND
GND
1
51
5Ø
1ØØ
2Ø
7Ø
U1
78Ø5
U1
78Ø5
+5V
C1
C2
C3
C4

PARTS LIST

SEMICONDUCTORS

Q1	MPS 3646
U1,2	7805
U3	74ALS08
U4	G198-P1
U5,8,11	74LS245
U6	74ALS04
U7,10	74LS240
U9	G191
U12	25LS2521
U13-44	HM6264

CAPACITORS

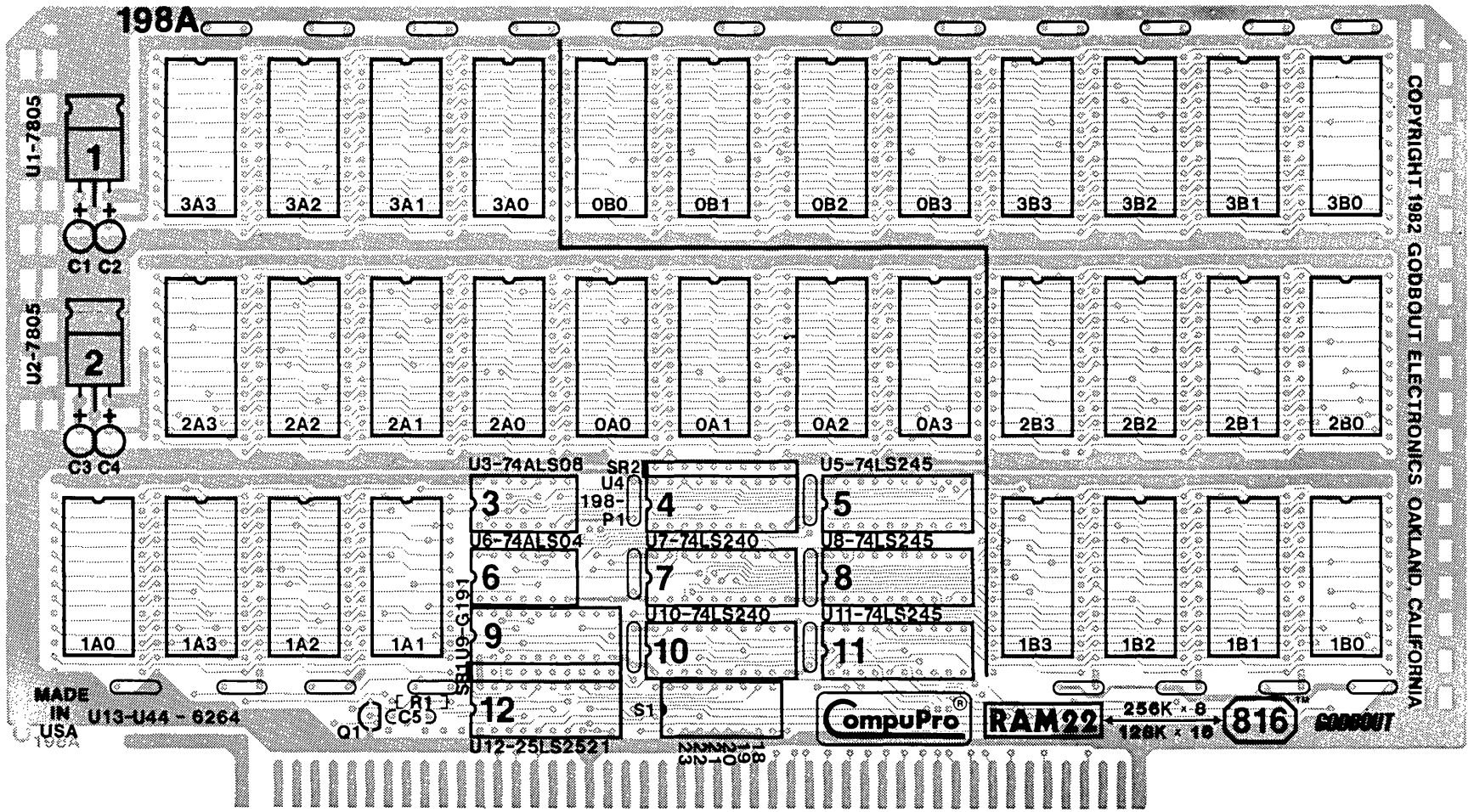
C1-4	10V/higher dipped tant.
C5	68 pF dipped mica
(26)	bypass capacitors

RESISTORS

R1	1.5K Ohm
SR1,2	5.1K Ohm SIP - 10 pin

MISCELLANEOUS

S1	8 position DIP switch



COMPONENT LAYOUT

LIMITED WARRANTY

COMPUPRO warrants this computer product to be in good working order for a period of one (1) year, (two [2] years CSC and six [6] months for disk drives) from the date of purchase by the original end user. Should this product fail to be in good working order at any time during this warranty period, COMPUPRO will, at its option, repair or replace the product at no additional charge except as set forth below. Repair parts and replacement products will be furnished on an exchange basis and will be either reconditioned or new. All replaced parts and products become the property of COMPUPRO. This limited warranty does not include service to repair damage to the product resulting from accident, disaster, misuse, abuse, or unauthorized modification of the product.

If you need assistance, or suspect an equipment failure, always contact your COMPUPRO System Center or dealer first. COMPUPRO System Center technicians are factory trained to provide prompt diagnosis and repair of equipment failures. If you prefer, or if you are not satisfied by the actions taken by your System Center/dealer, you may return the product to COMPUPRO for warranty service. Please call COMPUPRO at (415) 786-0909 to obtain a **R**eturn **M**aterial **A**uthorization (**RMA**) number, or, write to COMPUPRO at 3481 Arden Road, Hayward, California 94545, Attn.: RMA. Be sure to include a copy of the original bill of sale to establish purchase date. If the product is delivered by mail or common carrier, you agree to insure the product or assume the risk of loss or damage in transit, to prepay shipping charges to the warranty service location (System Center or COMPUPRO) and to use the original shipping container or equivalent. Contact your COMPUPRO System Center/dealer or write to COMPUPRO at the above address for further information.

ALL EXPRESS AND IMPLIED WARRANTIES FOR THIS PRODUCT, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO A PERIOD OF ONE (1) YEAR FROM THE DATE OF PURCHASE, AND NO WARRANTIES, WHETHER EXPRESS OR IMPLIED, WILL APPLY AFTER THIS PERIOD. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU.

IF THIS PRODUCT IS NOT IN GOOD WORKING ORDER AS WARRANTED ABOVE, YOUR SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS PROVIDED ABOVE. IN NO EVENT WILL COMPUPRO BE LIABLE TO YOU FOR ANY DAMAGES, INCLUDING ANY LOST PROFITS, LOST SAVINGS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF OR INABILITY TO USE SUCH PRODUCT, EVEN IF COMPUPRO OR A COMPUPRO FULL SERVICE SYSTEM CENTER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, OR FOR ANY CLAIM BY ANY OTHER PARTY.

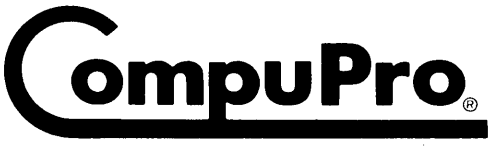
SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH MAY VARY FROM STATE TO STATE.

COMPUPRO
3481 Arden Road
Hayward, CA 94545
(415) 786-0909

Note: This warranty supersedes all previous warranties, and all other warranties are now obsolete.

RAM 22



A *GODBOUT* COMPANY
3506 Breakwater Court, Hayward, CA 94545