CONGRATULATIONS ON YOUR PURCHASE OF A SEAWELL SEA-16 MEMORY EXPANSION BOARD. IT HAS BEEN CAREFULLY ENGINEERED TO PROVIDE MAXIMUM RELIABILITY AND A LONG SERVICE LIFE.

PLEASE MAKE SURE TO TAKE A FEW MINUTES TO READ THIS USER'S MANUAL COMPLETELY. YOU WILL THEN BE FAMILIAR WITH ALL THE FEATURES OF YOUR SEA-16 AND WILL FIND IT EASY TO ADD MORE MEMORY TO YOUR COMPUTER.

UNPACKAGING

THE MEMORY MODULES USED ON THE SEA-16 ARE MOS DEVICES AND THEY ARE SUSCEPTIBLE TO DAMAGE BY STATIC DISCHARGE. YOUR SEA-16 IS SHIPPED IN AN ANTI-STATIC BAG TO PROTECT AGAINST DAMAGE DUE TO STATIC DISCHARGE DURING SHIPMENT.

RETAIN THE SHIPPING CARTON AND THE ANTI-STATIC BAG FOR POSSIBLE FUTURE USE.

ENCLOSED WITH YOUR SEA-16 IS:

1. USER'S MANUAL
2. WARRANTY AND USER REGISTRATION CARD.

PLEASE FILL OUT AND RETURN THE ENCLOSED WARRANTY REGISTRATION CARD TO VALIDATE YOUR WARRANTY. IF YOU WISH TO RECEIVE FUTURE PRODUCT RELEASES PLEASE FILL OUT THE "USER REGISTRATION" SECTION OF THE ENCLOSED CARD.

SEA-16 IS A GENERAL PURPOSE 16K BY 8 STATIC N-MOS MEMORY BOARD. IT IS COMPATIBLE WITH SEAWELL'S SEA-1 CPU BOARD, SEAWELL'S "LITTLE BUFFERED MOTHER" TM. (THE COMBO MOTHERBOARD FOR THE KIM/SYM/AIM) AS WELL AS THE KIM-4 BY COMMODORE BUSINESS MACHINES, INC.

REFER TO THE USERS MANUAL FOR YOUR MOTHERBOARD FOR INSTALLATION INSTRUCTIONS. WHEN NOT USING A MOTHERBOARD, USE AS SHORT INTERCONNECTION CABLES AS POSSIBLE. THE SEA-16/16 FULLY POPULATED USES APPROXIMATELY 1.3 TO 1.5 AMP FROM 7.5 TO 9 VOLT UNREGULATED DC. DO NOT INSERT YOUR MEMORY BOARD (OR ANY OTHER BOARD) INTO THE MOTHERBOARD WHILE POWER IS CONNECTED TO YOUR SYSTEM.

SEA-16 IS MADE UP OF TWO IDENTICAL 8K BY 8 SECTIONS OF MEMORY. EACH SECTION IS ADDRESSABLE SEPARATELY AND HAS A CORRESPONDING 6 POLE DIP SWITCH. THEY ARE NUMBERED 1 THROUGH 6, RIGHT TO LEFT AS INDICATED ON THE BOARD.

THEY ARE MARKED AS FOLLOWS:

1. A 13, ADDRESS LINE #13
2. A 14
3. A 15
4. WRITE ENABLE
5. BANK 0
6. BANK 1

THE FIRST THREE POSITIONS OF THE SWITCH ARE USED TO SELECT MEMORY IN THE CORRESPONDING 8K SECTION AS NOTED BELOW:

SWITCH # 3 2 1	MEMORY STARTS @	MEMORY ENDS @
0 0 0	0000	1FFF
0 0 1	2000	3FFF
0 1 0	4000	5FFF
0 1 1	6000	7FFF
1 0 0	8000	9FFF
1 0 1	A000	BFFF
1 1 0	C000	DFFF
1 1 1	E000	FFFF

NOTE: 1 = SWITCH TOWARD THE BOARD
0 = SWITCH AWAY FROM THE BOARD

WRITE ENABLE

THE WRITE ENABLE SWITCH IS USED TO WRITE PROTECT THE RESPECTIVE 8K SECTION OF MEMORY. IT CAN BE MOST USEFUL DURING SOFTWARE DEBUGGING. IN NORMAL APPLICATIONS THIS SWITCH IS SET TOWARD THE BOARD, TO ENABLE WRITING INTO MEMORY.

BANK SWITCHING.

THE SEAWELL IMPLEMENTATION OF THE ORIGINAL KIM-4 BUSS REASSIGNS TWO REGULATED POWER SUPPLY CONNECTIONS INTO ONE ADDITIONAL UNREGULATED SUPPLY CONNECTION AND THE BANK SELECT SIGNAL. THE USE OF THE BANK SELECT FEATURE IS OPTIONAL.

THIS TABLE EXPLAINS THE 4 POSSIBLE COMBINATIONS OF THE TWO BANK SWITCHES.

BANK 0	BANK 1	COMMENTS
0	0	MEMORY CAN NOT BE ACCESSED, DISABLED
1	0	SECTION ENABLED IN BANK 0
0	1	SECTION ENABLED IN BANK 1
1	1	SECTION ENABLED IN BOTH BANKS

NOTE: 1 = SWITCH TOWARD THE BOARD
0 = SWITCH AWAY FROM THE BOARD

BY SETTING SWITCH #5 AND #6 TO THE SAME POSITION THEY CAN BE USED AS AN ENABLE/DISABLE SWITCH FOR THE CORRESPONDING SECTION.

THE SEA-1 CPU BOARD HAS ONBOARD HARDWARE TO SUPPORT BANK SWITCHING DIRECTLY. THE "LITTLE BUFFERED MOTHER" TM. HAS ONBOARD HARDWARE TO PROVIDE BANK SWITCHING FOR EITHER THE KIM, SYM OR THE AIM, HOWEVER, THE USE OF THE BANK SWITCHING FEATURE IS OPTIONAL. THE KIM-4 MOTHERBOARD LEAVES THE PIN ASSIGNED FOR BANK SWITCHING FREE. FOR NORMAL OPERATION IN A KIM-4 MOTHERBOARD SET BOTH SWITCH #5 AND #6 TOWARD THE BOARD.

KIM-1 SYSTEMS

THE USE OF A "LITTLE BUFFERED MOTHER" TM. MOTHERBOARD OR A KIM-4 IS REQUIRED DUE TO THE SPECIAL DECODING REQUIRED BY THE KIM-1. IF ANY MEMORY IS SELECTED AT 0000-1FFF IT WILL NOT BE FULLY ACCESSIBLE AND IT IS NOT RECOMMENDED.

SYM-1 SYSTEMS

SEA-16 CAN BE CONNECTED DIRECTLY TO THE "E" (EXPANSION) CONNECTOR USING TWO PROPERLY CONNECTED 22/22 PIN CONNECTORS. DUE TO THE UN-BUFFERED DESIGNED ON BOTH THE SYM AND THE AIM ANY WIRING CONNECTING THE CPU WITH SEA-16 MUST BE KEPT AS SHORT AS POSSIBLE TO AVOID COMPOUNDING LOADING PROBLEMS FOR THE CPU ITSELF. WE STRONGLY RECOMMEND THE USE OF A BUFFERED MOTHERBOARD.

AIM-65 SYSTEMS

SAME AS FOR SYM SYSTEMS ABOVE.

SEA-1 SYSTEMS (ANY SEABUSS COMPATIBLE BUSS)

THE SEA-16 INTERFACES DIRECTLY WITH SEA-1 THROUGH ANY OF THE NORMALLY AVAILABLE MOTHERBOARDS LIKE THE "MICRO-MOTHER" TM. OR THE "MAXI-MOTHER" TM. IT CAN ALSO BE USED WITH THE "LITTLE BUFFERED MOTHER" TM. WHEN PROPERLY CONFIGURED.

OTHER 6500 SYSTEMS.

INFORMATION IS AVAILABLE FOR INTERFACING WITH THE PET COMPUTER UPON REQUEST.

YOU NOW SHOULD HAVE YOUR SEA-16 PROPERLY INSTALLED IN YOUR COMPUTER. ASSUMING YOUR POWER SUPPLY IS CAPABLE OF SUPPLYING AN ADDITIONAL 1.4 AMP. YOU ARE NOW READY TO START USING YOUR NEW MEMORY BOARD.

YOU MAY WISH TO LOAD A MEMORY TEST TO VERIFY PROPER INSTALLATION. INITIALLY YOU CAN WRITE AND READ A FEW MEMORY LOCATIONS USING YOUR SYSTEM MONITOR. SEA-16 IS FULLY TESTED AND DOES NOT REQUIRE A MEMORY TEST PRIOR TO SYSTEMS USE. ALL POPULATED MEMORY BOARDS HAVE A MINIMUM OF 200 HOURS OF ACTIVE BURN-IN AND A FULL HOT-TEST AT RATED SPEED +10%.

IF YOU ENCOUNTER ANY PROBLEMS WHEN INSTALLING OR USING YOUR SEA-16 THEN REFER TO THE SECTION ON THEORY OF OPERATION FOR DETAILED OPERATING INFORMATION.

THE MPS 2114 SERIES OF STATIC RAM'S ARE FULLY STATIC 1K BY 4 BIT DEVICES. THEY HAVE EXTENSIONS TO THEIR PART NUMBER WHICH DESCRIBE NORMAL/LOW POWER AND "-45" OR "-30" WHICH REFERS TO CYCLE/ACCESS TIME SPECIFICATIONS. FOR EXAMPLE:

MPS 2114L-45 LOW POWER (350MW) AND 450NS CYCLE/ACCESS TIME
MPS 2114-30 NORMAL POWER (500MW), 300NS CYCLE/ACCESS TIME

MOST SEA-16 BOARDS ARE POPULATED WITH THE MPS 2114L-45 BUT THEY ARE AVAILABLE WITH FASTER MEMORY DEVICES (SEA-16/16-30).

IN ORDER TO CALCULATE HOW FAST MEMORY DEVICES MUST BE TO PERFORM WITHIN SPECIFICATIONS, A NUMBER OF PARAMETERS MUST BE CONSIDERED. THE FOLLOWING TABLE ONLY TAKES VERY BASIC TIMING REQUIREMENTS INTO CONSIDERATION, CHIP SELECT TIMES, CAPACITIVE LOADING DELAYS ETC. ARE NOT INCLUDED IN THIS SUMMARY.

SYSTEM CLOCK SPEED	1 MHZ	1MHZ	1.5MHZ	2MHZ
SYSTEM CPU 1 OR 2 MHZ	1MHZ	2MHZ	2MHZ	2MHZ
TIME TO ADDRESS VALID	300NS	150NS	150NS	150NS
BUFFER DELAYS (ADDRESS)	25NS	25NS	25NS	25NS
BUFFER DELAYS (DATA)	25NS	25NS	25NS	25NS
DATA STABILITY TIME	100NS	50NS	50NS	50NS
TIME "SPENT"	450NS	250NS	250NS	250NS
SYSTEM CYCLE TIME	1000NS	1000NS	750NS	500NS
TIME "LEFT" FOR 2114 ACCESS/CYCLE	550NS	750NS	500NS	250NS

SEA-16 POPULATED WITH -45 (450NS) DEVICES IS WELL WITHIN WORST CASE SPECIFICATIONS FOR ANY 1 MHZ SYSTEM AND ALSO FOR ANY 1.5 MHZ SYSTEM WITH A 2 MHZ CPU (MPS 6502A).

MANY ENGINEERS CONSIDER 300NS DEVICES TO BE ADEQUATE FOR A 2 MHZ SYSTEM FOR SEVERAL REASONS.

1. TIME TO ADDRESS VALID TIME IS TYPICALLY ONLY 100NS
2. DATA STABILITY TIME REQUIRED IS NORMALLY AROUND 25NS
3. RAM DEVICES NORMALLY HAVE CONSIDERABLE MARGIN BUILT INTO THE CYCLE/ACCESS TIME SPECIFICATION.
4. ALL SPECIFICATIONS ARE OVER A 0 TO 70 DEGREE C TEMPERATURE RANGE, ADDITIONAL MARGIN IS THEREFORE AVAILBLE IF THE UPPER OPERATIONAL TEMPERATURE LIMIT IS 50 DEGREE C.

FOR MORE DETAILED INFORMATION PLEASE REFER TO THE ENCLOSED SPECIFICATIONS FOR THE MPS 2114 SERIES AS MANUFACTURED BY MOS-TECHNOLOGY, INC.

THE SEA-16 BUFFERS ADDRESS LINE 0-9 AND THE READ/WRITE LINE OF THE BUSS ONTO THE 2114 DIRECTLY. ADDRESS LINES A 10 THROUGH A 15 ARE BUFFERED INTO TWO IDENTICAL DECODERS (ONE FOR EACH 8K SECTION).

THE DECODER IS MADE UP OF ONE 74LS85 AND ONE 74LS138. TO ENABLE THE DECODER THE BANK SWITCHING MUST BE CORRECTLY SELECTED AND THE ADDRESS SELECTION SWITCHES PROPERLY SET. THE SYSTEM CLOCK THEN ENABLES ACCESS TO MEMORY DURING PHASE 2. THE DECODER FURTHERMORE ENABLES THE USER TO SELECT A READ ONLY MODE OF OPERATION (WRITE ENABLE SWITCH).

IN CASE OF A MEMORY FAILURE IT IS EASY TO LOCATE THE DEFECTIVE DEVICE AS THE LAYOUT OF THE BOARD IS STRAIGHT FORWARD. THE 2 ROWS OF 2114'S ALONG THE TOP EDGE OF THE BOARD ARE NAMED SECTION "A", U1 THROUGH U16. THE TWO ROWS BELOW MAKE UP SECTION "B", THE CHIP LAYOUT IS IDENTICAL FOR BOTH SECTIONS.

ROW NUMBER ONE AND THREE IS MARKED "MSB" MOST SIGNIFICANT BITS, ROW TWO AND FOUR "LSB" LEAST SIGNIFICANT BITS. THE LOWEST ADDRESS RAM IS LOCATED IN THE TWO DEVICES TO THE LEFT, NEXT 400 (HEX) IN THE NEXT TWO, ETC.

PART #	DESCRIPTION	QTY.	DESIGNATION
SEA16 PCB R.C	PRINTED CIRCUIT BOARD	1	
DYS-6	DIP SWITCH	2	
2.2UF 35V	SOLID TAN. CAPACITOR	3	
1615-202	RESISTOR NETWORK	1	RN1
LM 309K	1AMP +5 VOLT REGULATOR	2	VR1,VR2
5051 AAVID	HEATZINK	2	
SN74LS245	IC	2	U33,U34
SN74LS138	IC	2	U35,U40
SN74LS367	IC	3	U41,U42,U43
SN74LS85	IC	2	U36,U37
SN74LS05	IC	1	U39
SN7407	IC	1	U38
MPS 2114L-45	MEMORY IC	32	U1 - U32
640359-3 (AMP)	18 PIN IC SOCKET	32	
	SCREWS	4	
	LOCKWASHERS	8	
	NUTS	4	
1674 CHOMERICS	HEAT CONDUCTIVE PAD	2	
CP.6	CARD PULLS	2	
RP-250	CARD PULLS MTG.HARDW	2	

MISCELLANEOUS

SER.2100 8X12"	ANTI-STATIC BAG	1	
	SHIPPING CARTON	1	
	CARTON LABEL	1	
	FOAM INSERTS (SET)	1	
SEA-16 MANUAL	USERS MANUAL	1	
	WARRANTY REG. CARD	1	

YOUR SEA-16 IS WARRANTED FOR 3 MONTHS, 100% PARTS, LABOR AND FREIGHT.

IF YOU ENCOUNTER ANY PROBLEMS WHEN INITIALLY INSTALLING OR USING YOUR SEA-16 DON'T HESITATE TO CONTACT US FOR TECHNICAL ADVICE. WE ARE NORMALLY OPEN FROM 9-5 PACIFIC TIME, MONDAY THROUGH FRIDAY.

IF YOU ARE CONVINCED YOU HAVE A HARDWARE PROBLEM AND YOU WISH TO RETURN THE UNIT FOR SERVICE, PACK THE UNIT PROPERLY AND SEND IT DIRECTLY TO US WITH AS ACCURATE PROBLEM DECRIPTION AS POSSIBLE. PLEASE SHIP THE UNIT PRE-PAID AS WE DO NOT ACCEPT FREIGHT COLLECT SHIPMENTS. IF THE UNIT IS STILL UNDER WARRANTY IT WILL BE RETURNED WITH YOUR FREIGHT COST ENCLOSED, NORMALLY UPS GROUND.

IF YOU DON'T WISH TO SEND THE ENTIRE BOARD IN FOR REPAIR AND YOU HAVE TRACED THE FAILURE TO A SINGLE RAM DEVICE, WE WILL REPLACE THE DEFECTIVE DEVICE AT NO CHARGE WITH A FULLY BURNED IN AND TESTED PART. IF YOU SELECT TO DO SO YOU MUST ENCLOSE THE SERIAL NUMBER OF YOUR SEA-16.

OUR SHIPPING ADDRESS IS:

SEAWELL INC.
315 N.W 85 TH
SEATTLE, WA, 98117

OUR TELEPHONE NUMBER IS:

(206) 782-9480

OUTSIDE U.S.A REFER SERVICE QUESTIONS TO OUR LOCAL AUTHORIZED AGENT.