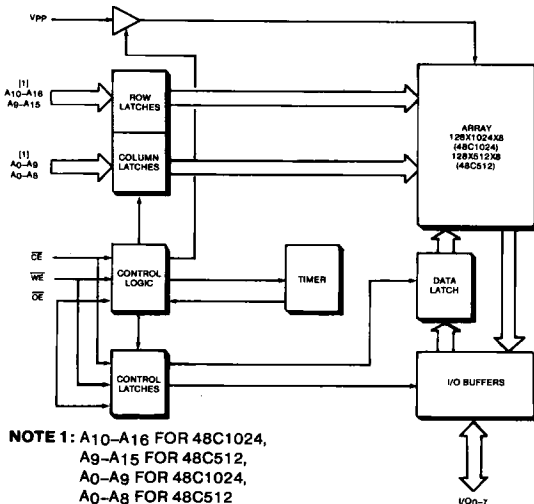


Features

- 64K/128K Byte Writable Non-Volatile Memory
- Low Power CMOS Process
- Electrical Chip and Block Erase
 - 7.5 Second Maximum Erase Time
- Electrical Byte Write
 - 1 ms. Maximum, 500 μ s typical
- Input Latches for Writing and Erasing
- Fast Read Access Time
- Single High Voltage for Writing and Erasing
- Flash™ EEPROM Cell Technology
- Ideal for Low-Cost Program and Data Storage
 - Minimum 100 Cycle Endurance
 - Optional 1000 Cycle Endurance Screening
 - Minimum 10 Year Data Retention
- 5V \pm 10% V_{CC},
0°C to +70°C Temperature Range
- Silicon Signature™ and DiTrace™
- Jedec Standard Byte Wide Pinout
 - 32 Pin D.I.P.
 - 32 Pin J-Bend Plastic Leaded Chip Carrier

Block Diagram



NOTE 1: A10-A16 FOR 48C1024,
A9-A15 FOR 48C512,
A0-A9 FOR 48C1024,
A0-A8 FOR 48C512

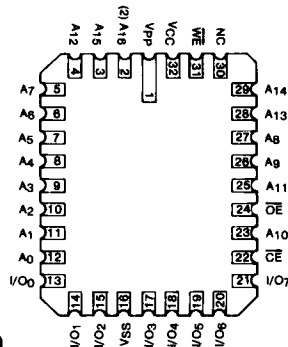
NOTE 2: PIN 2 IS N.C. ON THE 48C512

SILICON SIGNATURE™, FLASH™ and DITRACE™ are registered trademarks of SEEQ Technology.

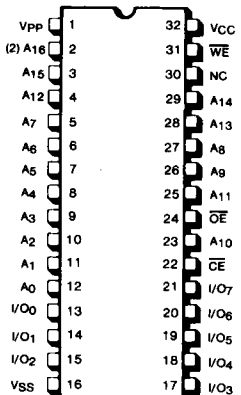


Pin Configuration

TOP VIEW
PLASTIC LEADED CHIP CARRIER



DUAL-IN-LINE
TOP VIEW



Pin Names

A ₀ -A ₈	COLUMN ADDRESS INPUT (48C512)
A ₀ -A ₉	COLUMN ADDRESS INPUT (48C1024)
A ₈ -A ₁₅	ROW ADDRESS INPUT (48C512)
A ₁₀ -A ₁₆	ROW ADDRESS INPUT (48C1024)
\overline{CE}	CHIP ENABLE
\overline{OE}	OUTPUT ENABLE
\overline{WE}	WRITE ENABLE
I/O ₀ -7	DATA INPUT (WRITE)/OUTPUT (READ)
N.C.	NO INTERNAL CONNECTION
V _{pp}	WRITE/ERASE INPUT VOLTAGE

48C512/48C1024

ADVANCE DATA SHEET

Description

The 48C512 and 48C1024 are 512 Kbit and 1024 Kbit CMOS Flash EEPROMS organized as 64K x 8 and 128K x 8 bits. Built using Seeq's proprietary Flash EEPROM single transistor memory cell, they feature input latches on address and data inputs for both erasing and writing, chip erase and block erase capability and a fast byte write. Endurance, the number of times a byte can be written, is specified as 100 with an optional screen to 1000 cycles.

Read

Reading is accomplished by presenting a valid address with chip enable and output enable at V_{IL} , write enable at V_{IH} , and V_{PP} at any level. See timing waveforms for A.C. parameters.

Erase and Write

Latches on address, data and control inputs permit erasing and writing using normal microprocessor bus timing. Address inputs are latched on the falling edge of write enable or chip enable, whichever is later, while data inputs are latched on the rising edge of write enable or chip enable, whichever is earlier. The write enable input is noise protected; a pulse of less than 20 ns. will not initiate a write or erase. In addition, chip enable, output enable and write enable must be in the proper state to initiate a write or erase. Timing diagrams depict write enable controlled writes; the timing also applies to chip enable controlled writes.

Block Erase

Block erase erases all bits in a block of the array to a logical one. It requires that the V_{PP} pin be brought to a high voltage and a write cycle performed. The block to be erased is defined by address inputs A_9 through A_{15} for the 48C512 and A_{10} through A_{16} for the 48C1024. The data inputs must be all ones to begin the erase. Following a write of 'FF', the part will wait for time T_{abort} to allow aborting the erase by writing again. This permits recovering from an unintentional block erase if, for example, in loading a block of data a byte of 'FF' was written. After the T_{abort} delay the block erase will begin. The erase is accomplished by following the erase algorithm in figure 2. V_{PP} can

be brought to any TTL level or left at high voltage after the erase.

Chip Erase

Chip erase changes all bits in the memory to a logical one. Refer to figure 3 for the chip erase algorithm. V_{PP} can be brought to any TTL level or left at high voltage after the erase.

Block and Chip Erase Algorithm

To reduce the block and chip erase times, a software erase algorithm is used. Refer to figures 2 and 3 for the block erase and chip erase flow charts.

Byte Write

A byte write is used to change any 1 in a byte to a 0. To change a bit in a byte from a 0 to a 1, the byte must be erased first via either block erase or chip erase.

Data are organized in these Flash EEPROMs in a group of bytes called a block. There are 128 blocks in both the 48C512 and the 48C1024. A block, which is 512 bytes in the 48C512 and 1024 bytes in the 48C1024, is conceptually like a sector on a disk drive. Individual bytes must be written as part of a block write algorithm which is detailed in figure 1. This algorithm is designed to minimize the total time to write a block of data.

Blocks are written by applying a high voltage to the V_{PP} pin and writing individual non-FF bytes in sequential order. Each byte write is automatically latched on-chip, so that the user can do a normal microprocessor write cycle and then wait a minimum of t_{WC} ns. for the self-timed write to complete. Each byte write incrementally programs bits that are to become a zero. A write loop has been completed when all non-FF data for all desired blocks have been written. Following each loop, a read-verification is done. If any bytes do not verify, another write loop is performed. When all bytes read correctly, additional loops are performed to insure adequate bit cell margin. The total number of loops will vary by device and depends on temperature; low temperature reduces

the number of loops required. For example, a typical (room temperature) loop count is 4. Blocks need not be written separately; the entire device or any combination of blocks can be written using the write algorithm.

Because bytes can only be written as part of a block write, if data is to be added to a partially written block or one or more bytes in a block must be changed, the contents of the block must first be read into system RAM; the bytes can then be added to the block of data in RAM and the block written using the block write algorithm.

Power Up/Down Protection

These two devices contain a V_{CC} sense circuit which disables internal erase and write operations when V_{CC} is below 3.5 volts. In addition, erases and writes are prevented when any control input (CE, OE, WE) is in the wrong state for writing or erasing (see mode table).

High Voltage Input Protection

The V_{PP} pin is at a high voltage for writing and erasing. There is an absolute maximum specifica-

tion which must not be exceeded, even briefly, or permanent device damage may result. To minimize switching transients on this pin we recommend using a minimum 0.1 μ f decoupling capacitor with good high frequency response connected from V_{PP} to ground at each device. In addition, sufficient bulk capacitance should be provided to minimize V_{PP} voltage sag when a device goes from standby to a write or erase cycle.

Silicon Signature™

A row of fixed ROM is present in the 48C512 and 48C1024 which contains the device's Silicon Signature™. Silicon Signature™ contains data which identifies Seeq as the manufacturer and gives the product code. This allows device programmers to match the programming specification against the product which is to be programmed.

Silicon Signature™ is read by raising address A_9 to 12 ± 0.5 V. and bringing all other address inputs plus chip enable and output enable to V_{IL} with V_{CC} at 5 V. The two Silicon Signature™ bytes are selected by address input A_0 . Silicon Signature™ is functional at room temperature only (25 C).

Silicon Signature™ Bytes

	A_0	Data (Hex)
Seeq Code	V_{IL}	94
Product code (48C512)	V_{IH}	1A
Product code (48C1024)	V_{IH}	1C

Mode Selection Table

MODE	\overline{CE}	\overline{OE}	\overline{WE}	V_{PP}	A_9-15 A_{10-16}	A_0-8 A_0-9	D_0-7
Read	V_{IL}	V_{IL}	V_{IH}	X	Address	Address	D_{OUT}
Standby	V_{IH}	X	X	X	X	X	HI-Z
Byte write	V_{IL}	V_{IH}	V_{IL}	V_P	Address	Address	D_{IN}
Chip erase select	V_{IL}	V_{IH}	V_{IL}	TTL	X	X	X
Chip erase	V_{IL}	V_{IH}	V_{IL}	V_P	X	X	'FF'
Block erase	V_{IL}	V_{IH}	V_{IL}	V_P	Address	X	'FF'

DC Operating Characteristics

Over the V_{CC} and temperature range

Symbol	Parameter	Limits			Test Condition
		Min.	Max.	Unit	
I_{IH}	Input leakage high		1	μA	$V_{IN} = V_{CC}$
I_{IL}	Input leakage low		-1	μA	$V_{IN} = 0.1V$
I_{OL}	Output leakage		10	μA	$V_{IN} = V_{CC}$
V_P	Program/erase voltage	11.5	12.5	V	
V_{PR}	V_{PP} voltage during read	0	V_P	V	
I_{PP}	V_P current				
	Standby mode		200	μA	$\overline{CE} = V_{IH}, V_{PP} = V_P$
	Read mode		200	μA	$\overline{CE} = V_{IL}, V_{PP} = V_P$
	Byte write		40	mA	$V_{PP} = V_P$
	Erase		60	mA	$V_{PP} = V_P$
I_{CC1}	Standby V_{CC} current		100	μA	$\overline{CE} = V_{CC} - .3$
I_{CC2}	Standby V_{CC} current		5	mA	$\overline{CE} = V_{IH} \text{ min.}$
I_{CC3}	Active V_{CC} current		60	mA	$\overline{CE} = V_{IL}$
V_{IL}	Input low voltage	-0.3	0.8	V	
V_{IH}	Input high voltage	2.0	$V_{CC} + .3$	V	
V_{OL}	Output low voltage		0.45	V	$I_{OL} = 2.1 \text{ mA}$
V_{OH1}	Output level (TTL)	2.4		V	$I_{OH} = -400 \mu A$
V_{OH2}	Output level (CMOS)	$V_{CC} - .4$		V	$I_{OH} = -100 \mu A$

AC Test Conditions

Output load: 1 TTL gate and $C(\text{load}) = 100 \text{ pf}$.

Input rise and fall times: $< 20 \text{ ns}$.

Input pulse levels: 0.45 V to 2.4 V

Timing measurement reference level:

Inputs 1 V and 2 V

Outputs 0.8 V and 2 V

NOTE:

In A.C. characteristics, all inputs to the device, e.g., setup time, hold time and cycle time, are tabulated as a **minimum** time; the user must provide a valid state on that input or wait for the stated minimum time to assure proper operation. All outputs from the device, e.g., access time, erase time, recovery time, are tabulated as a **maximum** time, the device will perform the operation within the stated time.

Advance Data Sheets contain target product specifications which are subject to change upon device characterization over the full specified temperature range. These specifications may be changed at any time, without notice.

48C512/48C1024

ADVANCE DATA SHEET

Absolute Maximum Stress Ratings

Temperature:

Storage..... -65°C to +150°C

Under bias..... -10°C to +85°C

All Inputs except V_{PP} and outputs with Respect to V_{SS} ... +6 V to -0.3 V

V_{PP} pin with respect to V_{SS} ... 14 V

Recommended Operating Conditions

	48C512/ 48C1024
V_{CC} supply voltage	5V \pm 10%
Temperature range	0°C to 70°C (ambient temp.)

E.S.D. Characteristics

Symbol	Parameter	Value	Test Conditions
V_{ZAP}	E.S.D. Tolerance	>2000 V	MIL-STD 883 Method 3015

Note: Characterization data — not tested.

Capacitance^[1] $T_A=25^\circ\text{C}$, $f=1\text{ MHz}$

Symbol	Parameter	Value	Test Conditions
C_{IN}	Input capacitance	6 pf.	$V_{IN} = 0\text{ V}$
C_{OUT}	Output capacitance	12 pf.	$V_{I/O} = 0\text{ V}$

Note 1: This parameter is only sampled and not 100% tested.

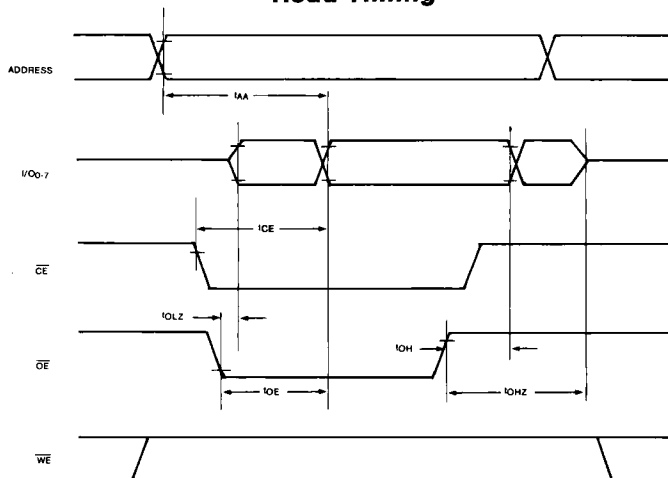
AC Characteristics

(over the V_{CC} and temperature range)

READ

Symbol	Parameter	48CXXX -200		48CXXX -250		48CXXX -300		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{RC}	Read cycle time	200		250		300		ns
t_{AA}	Address to data		200		250		300	ns
t_{CE}	\overline{CE} to data		200		250		300	ns
t_{OE}	\overline{OE} to data		75		100		150	ns
t_{DF}	$\overline{OE}/\overline{CE}$ to data float		50		60		100	ns
t_{OH}	Output hold time	0		0		0		ns

Read Timing



48C512/48C1024

ADVANCE DATA SHEET

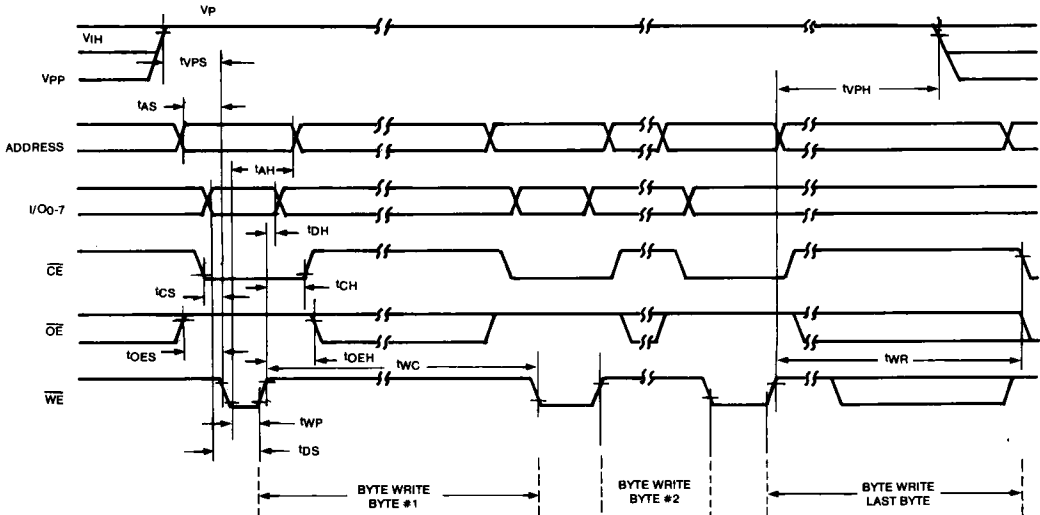
AC Characteristics

(Over the V_{CC} and temperature range)

BYTE WRITE

Symbol	Parameter	48CXXX -200		48CXXX -250		48CXXX -300		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{VPS}	V_{PP} setup time	2		2		2		μ s
t_{VPH}	V_{PP} hold time	250		250		250		μ s
t_{CS}	\overline{CE} setup time	0		0		0		ns
t_{CH}	\overline{CE} hold time	0		0		0		ns
t_{OES}	\overline{OE} setup time	10		10		10		ns
t_{OEH}	\overline{OE} hold time	10		10		10		ns
t_{AS}	Address setup time	20		20		20		ns
t_{AH}	Address hold time	100		100		100		ns
t_{DS}	Data setup time	50		50		50		ns
t_{DH}	Data hold time	0		0		0		ns
t_{WP}	\overline{WE} pulse width	100		100		100		ns
t_{WC}	Write cycle time	100	150	100	150	100	150	μ s
t_{WR}	Write recovery time		1.5		1.5		1.5	ms

Byte Write Timing



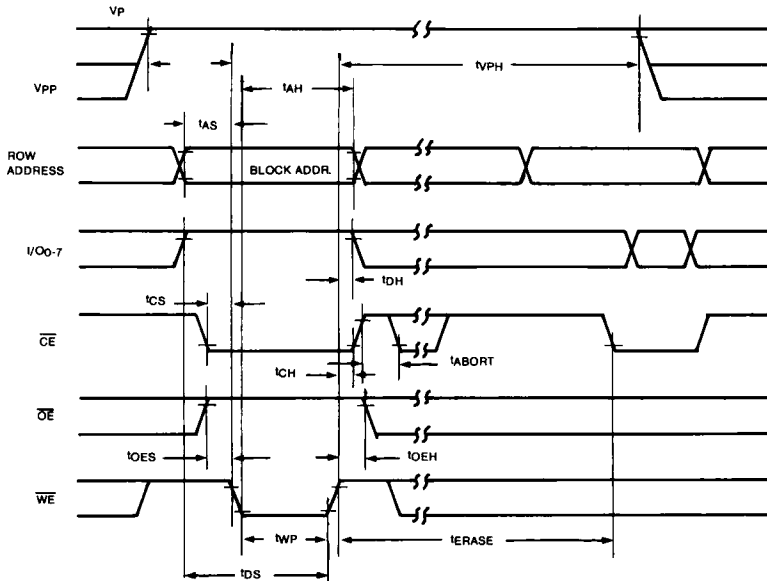
AC Characteristics

(Over the V_{CC} and temperature range)

BLOCK ERASE

Symbol	Parameter	48CXXXX -250		48CXXXX -300		48XXXX -350		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{VPS}	V_{PP} setup time	2		2		2		μs
t_{VPH}	V_{PP} hold time	500		500		500		ms
t_{CS}	\overline{CE} setup time	0		0		0		ns
t_{OES}	\overline{OE} setup time	0		0		0		ns
t_{AS}	Address setup time	20		20		20		ns
t_{AH}	Address hold time	100		100		100		ns
t_{DS}	Data setup time	50		50		50		ns
t_{DH}	Data hold time	0		0		0		ns
t_{WP}	\overline{WE} pulse width	100		100		100		ns
t_{CH}	\overline{CE} hold time	0		0		0		ns
t_{OEH}	\overline{OE} hold time	0		0		0		ns
t_{ERASE}	Block erase time		500		500		500	ms
t_{ABORT}	Block erase delay		250		250		250	μs

Block Erase Timing



48C512/48C1024

ADVANCE DATA SHEET

AC Characteristics

(Over the V_{CC} and temperature range)

CHIP ERASE

Symbol	Parameter	48CXXX -200		48CXXX -250		48CXXX -300		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{VPS}	V_{PP} setup time	2		2		2		μ s
t_{VPH}	V_{PP} hold time	500		500		500		ms
t_{CS}	\overline{CE} setup time	0		0		0		ns
t_{OES}	\overline{OE} setup time	0		0		0		ns
t_{DS}	Data setup time	50		50		50		ns
t_{DH}	Data hold time	0		0		0		ns
t_{WP}	\overline{WE} pulse width	100		100		100		ns
t_{CH}	\overline{CE} hold time	0		0		0		ns
t_{OEH}	\overline{OE} hold time	0		0		0		ns
t_{ERASE}	Chip erase time		500		500		500	ms

Chip Erase Timing

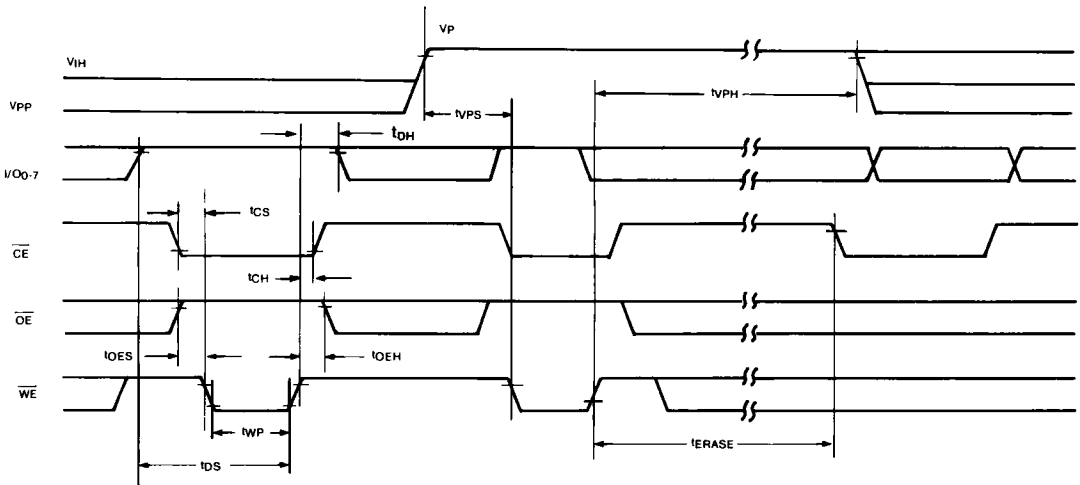


FIGURE 1
48C512/1024 WRITE ALGORITHM

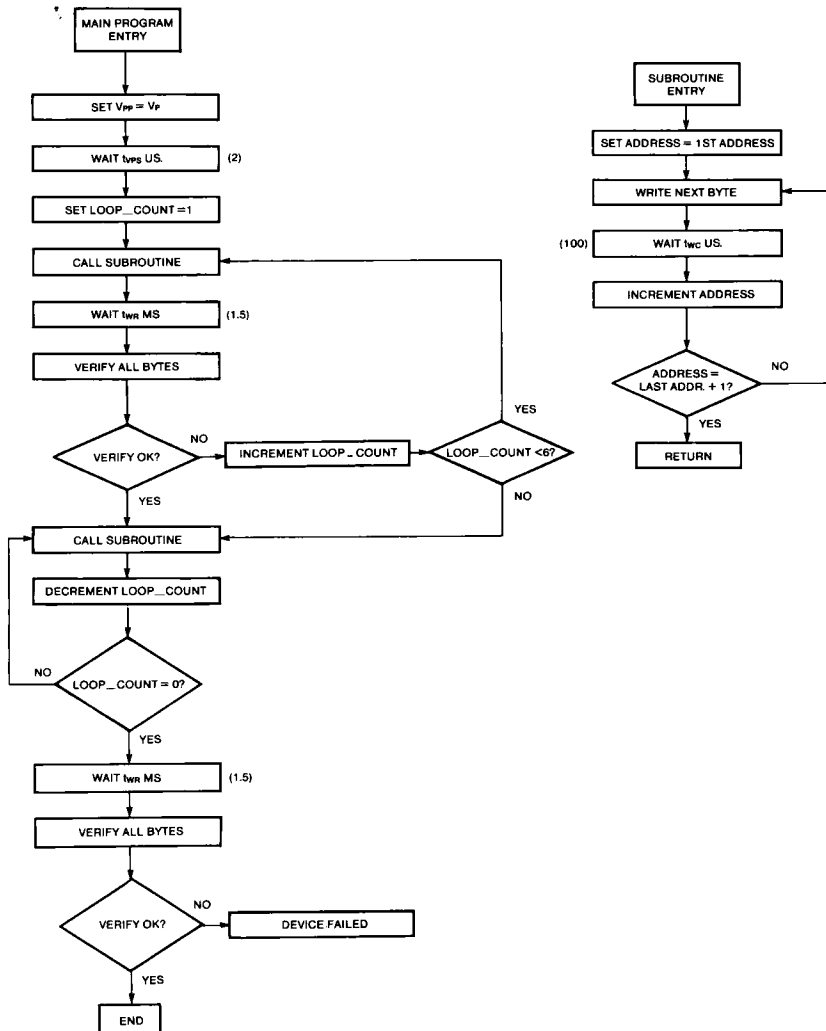


FIGURE 2
48C512/1024
BLOCK ERASE ALGORITHM

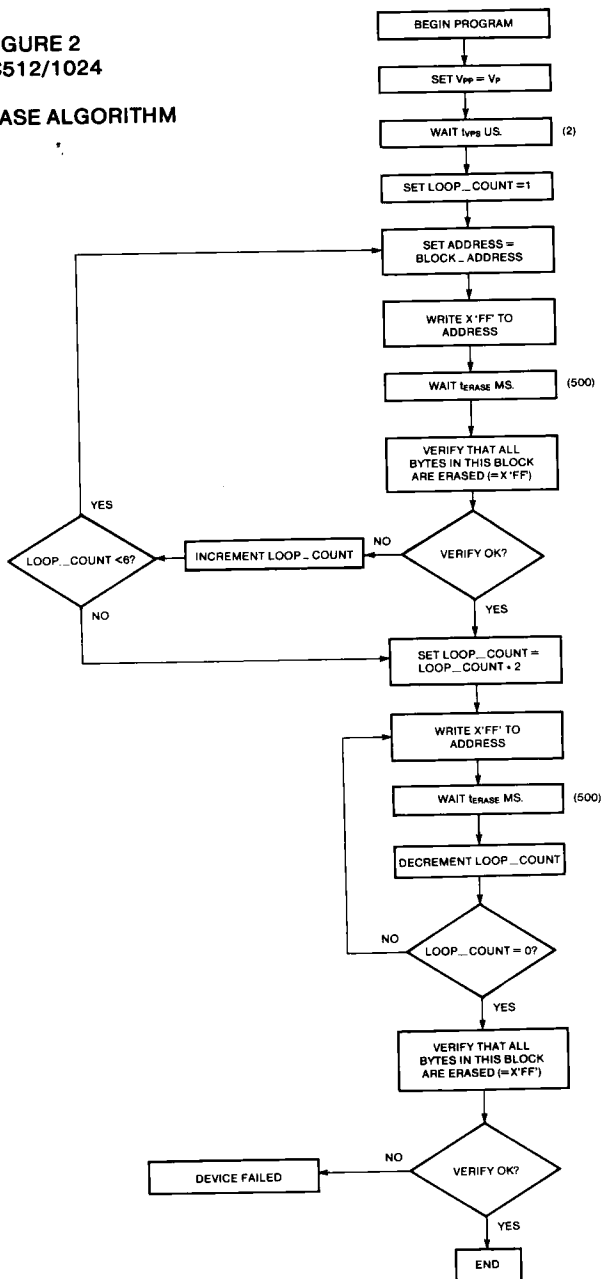
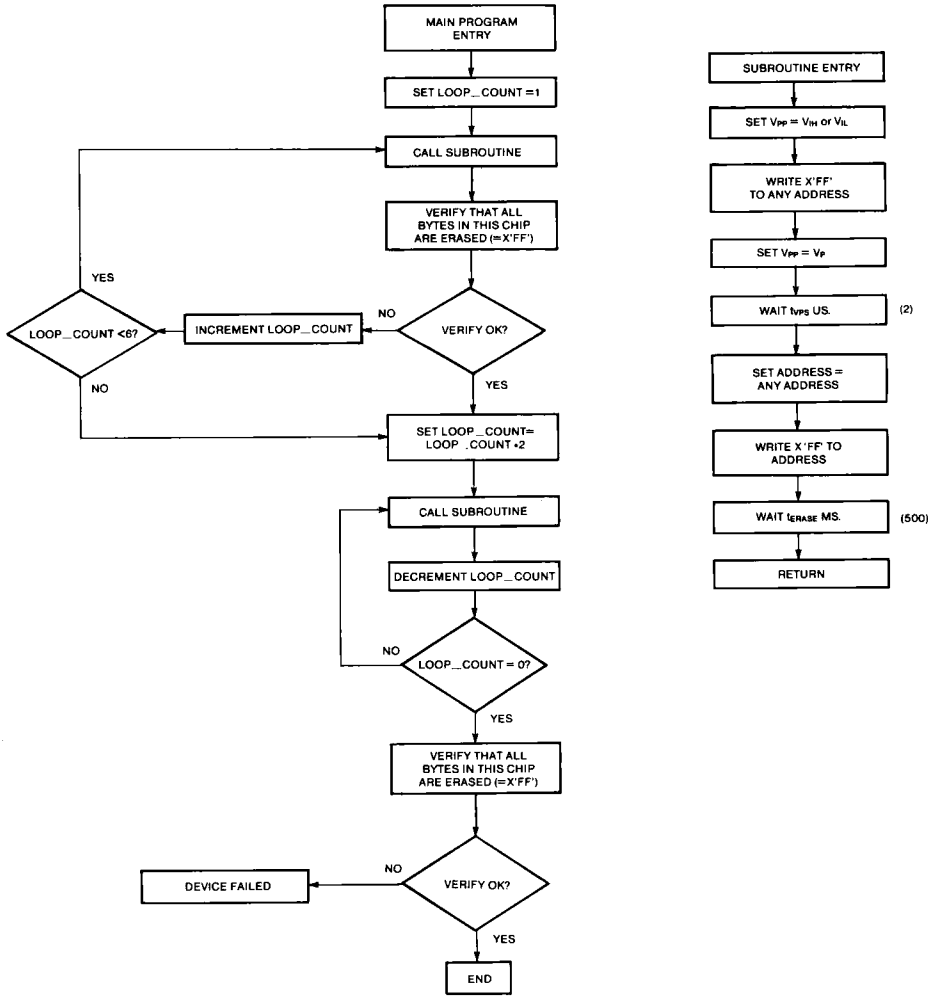


FIGURE 3
48C512/1024
CHIP ERASE ALGORITHM



SALES OFFICES

Corporate Sales and Marketing Headquarters SEEO Technology, Inc. 1849 Fortune Drive San Jose CA 95131 (408) 432-9550 Telex: 295609 FAX: (408) 432-9549	Southern California Sales Office SEEO Technology, Inc. 23101 Lake Center Drive Suite 120 El Toro CA 92630 (714) 472-2313 TWX: 910-595-1548 FAX: (714) 472-2307	Central Area Sales Office SEEO Technology, Inc. 300 Marlingdale, Inc. Suite 650 Schaumburg IL 60173 (312) 882-6460 TWX: 910-651-3057 FAX: (312) 882-6521	Eastern Area Sales Office SEEO Technology, Inc. 15 New England Executive Park, Suite 160 Burlington MA 01783 (617) 229-6350 TWX: 710-332-8926 FAX: (617) 273-0322
---	--	--	---

Authorized North American Manufacturer's Representatives

Alabama Electronic Sales, Inc. Huntsville AL (205) 533-1735	Colorado Component Sales Englewood CO (303) 779-9060	Illinois KMA Sales Rolling Meadows IL (312) 398-5300	Maryland New Era Sales Lakeside Park MD (301) 544-4100	Missouri Advanced Tech Sales St. Louis MO (314) 878-2921	New York (cont.) GenTech Pleasant Valley NY (914) 635-3233 J-Square Marketing, Inc. Jericho NY (516) 935-3200	Pennsylvania Delta Technical Sales Willow Grove PA (215) 657-7250	Washington Electronic Component Sales Mercer Island WA (206) 232-9301
Arizona Western High Tech Scottsdale, AZ 85258 (602) 860-2702	Florida Dyne-A-Mark Corp. Clearwater FL (813) 441-4702 Fort Lauderdale FL (305) 771-6501 Mayland FL (305) 629-5557 Dyne-A-Mark Corp. Casselberry FL (305) 831-2822	Indiana Greenline & Assoc. Westfield IN (317) 888-2260 South Bend IN (219) 288-7070	Massachusetts New England Tech Sales Burlington MA (617) 272-0434	New Mexico Neko Electronics Albuquerque, NM 87111 (505) 293-1399	North Carolina Prime Components Charlotte NC (704) 522-1150	Texas Southern States Marketing Richardson TX (214) 238-7500 Austin, TX (512) 835-5822	Wisconsin KMA Sales Milwaukee WI (414) 259-1771
California Hadden Assoc. San Diego CA (619) 581-9444 Taarcom, Inc. Mountain View CA (415) 960-1550	Georgia Electronic Sales, Inc. Norcross GA (404) 448-6554	Iowa Advanced Technical Sales Cedar Rapids IA (319) 365-3150	Michigan Rathburg Assoc., Inc. Southfield MI (313) 559-9700,	New Jersey GenTech Binghamton NY (607) 648-8633 Liverpool NY (315) 451-3480	Ohio Harris/CSI, Inc. Salt Lake City UT (801) 467-2299	Utah Rexdale, Ontario (416) 675-4980 Nepean, Ontario (613) 726-1452 Pointe Claire, Quebec (514) 694-0404	Canada Electro Source, Inc. Rexdale, Ontario (416) 675-4980 Nepean, Ontario (613) 726-1452 Pointe Claire, Quebec (514) 694-0404
Connecticut New England Tech Sales Wallingford CT (203) 284-6300	Minnesota Cahill, Schmitz, & Cahill St. Paul, MN (612) 646-7217	Kansas Advanced Technical Sales Olathe KS (913) 782-8702	Minnesota Cahill, Schmitz, & Cahill St. Paul, MN (612) 646-7217	New York GenTech Binghamton NY (607) 648-8633 Liverpool NY (315) 451-3480	Oregon Electronic Component Sales Tigard OR (503) 245-2342	Virginia Harris/CSI, Inc. Salt Lake City UT (801) 467-2299	Washington Electronic Component Sales Mercer Island WA (206) 232-9301

Authorized North American Distributors

Alabama O.C. Southeast, Inc. Huntsville AL (205) 830-1881 Schwaber Elect. Inc. Huntsville AL (205) 895-0480	California (cont.) Time Electronics Agoura Hills, CA (818) 707-2890 Time Electronics Anaheim CA (714) 937-0911 Chatsworth CA (818) 998-7200 San Diego CA (619) 586-3311 Sunnyvale CA (408) 734-9888 Torrance CA (213) 320-9880 Zeus Components San Jose CA (408) 998-5121 Yuba Linda CA (714) 921-9000	Florida Schwaber Elect. Inc. Altamonte Springs FL (305) 331-7555 Pompano Beach (305) 977-7511 Time Electronics Ft. Lauderdale FL (305) 974-4800 Orlando FL (305) 841-6565 Zeus Components Oviedo FL (305) 365-3000	Maryland Lionex Columbia MD (301) 964-0400 Schwaber Elect. Inc. Calhousburg MD (301) 840-5900 Time Electronics Columbia MD (301) 964-3090 Zeus Components Columbia MD (301) 997-1118	Missouri Schwaber Elect. Inc. Earth City MO (314) 739-0526 Time Electronics St. Louis MO (314) 391-6444	North Carolina Quality Components Raleigh NC (919) 876-7767 Schwaber Elect. Inc. Raleigh NC (919) 867-0000	Pennsylvania (cont.) Schwaber Elect. Inc. Horsham PA (215) 441-0600 Pittsburgh PA (412) 982-1600 Time Electronics King of Prussia PA (215) 337-0900	Washington Anthem Elect. Inc. Redmond WA (206) 881-0850 Bellevue WA (206) 747-1515 Time Electronics Redmond WA (206) 882-1600	
Arizona Anthem Elect. Inc. Tempe AZ (602) 966-6600 Schwaber Elect. Inc. Phoenix AZ (602) 997-4874 Time Electronics Tempe AZ (602) 967-2000	Colorado Anthem Elect. Inc. Chatsworth CA (818) 700-1000 E. Irvine CA (714) 768-4444 Sacramento CA (916) 922-6800 San Diego CA (619) 453-9005 San Jose CA (408) 295-4200 Schwaber Elect. Inc. Canoga CA (818) 999-4702 Irvine CA (714) 863-0200 Sacramento CA (916) 928-9732 San Diego CA (619) 450-0454 San Jose CA (408) 432-7171 Gardena CA (213) 327-8409	Georgia G.C. Southeast, Inc. Norcross GA (404) 449-9508 Schwaber Elect. Inc. Norcross GA (404) 449-9170 Time Electronics Norcross GA (404) 448-4448	Michigan Lionex Wilmington MA (617) 657-5170 Schwaber Elect. Inc. Bedford MA (617) 275-5100 Time Electronics Peabody MA (617) 532-6200 Zeus Components Lexington MA (617) 863-8900	New Jersey Lionex Fairfield NJ (201) 227-7960 Schwaber Elect. Inc. Fairfield NJ (201) 227-7800 Time Electronics Pinbrook NJ (201) 882-4611	Ohio Schwaber Elect. Inc. Beachwood OH (216) 464-2970 Dayton OH (513) 439-1800 Time Electronics Dublin OH (614) 761-1100 Zeus Components Dayton OH (513) 454-1225	Texas Quality Components Addison TX (214) 733-4300 Austin TX (512) 833-0200 Sugarland TX (713) 240-2255 Schwaber Elect. Inc. Dallas TX (512) 458-8253 Dallas TX (214) 661-5010 Houston TX (713) 784-3600 Time Electronics Austin TX (512) 339-3051 Carrollton TX (214) 241-7441 Houston TX (713) 530-0800 Zeus Components Richardson TX (214) 783-7010	Washington Anthem Elect. Inc. Redmond WA (206) 881-0850 Bellevue WA (206) 747-1515 Time Electronics Redmond WA (206) 882-1600	
California Anthem Elect. Inc. Chatsworth CA (818) 700-1000 E. Irvine CA (714) 768-4444 Sacramento CA (916) 922-6800 San Diego CA (619) 453-9005 San Jose CA (408) 295-4200 Schwaber Elect. Inc. Canoga CA (818) 999-4702 Irvine CA (714) 863-0200 Sacramento CA (916) 928-9732 San Diego CA (619) 450-0454 San Jose CA (408) 432-7171 Gardena CA (213) 327-8409	Connecticut Lionex Meriden CT (203) 265-1244 Schwaber Elect. Inc. Danbury CT (203) 748-7080 Time Electronics Cheshire CT (203) 271-3200	Florida Schwaber Elect. Inc. Elk Grove IL (312) 364-3750 Time Electronics Wood Dale IL (312) 350-0610	Minnesota Schwaber Elect. Inc. Edina MN (612) 941-5280 Time Electronics Bloomington MN (612) 944-9192	New York Lionex Huppauge NY (516) 273-1660 Schwaber Elect. Inc. Rochester NY (716) 424-2222 Westbury NY (516) 334-7474 Time Electronics Huppauge NY (516) 273-0100 E. Syracuse NY (315) 432-0355 Zeus Components Port Chester NY (914) 937-7400	North Carolina Quality Components Raleigh NC (919) 876-7767 Schwaber Elect. Inc. Raleigh NC (919) 867-0000	Oklahoma Quality Components Tulsa OK (918) 664-8812 Schwaber Elect. Inc. Tulsa OK (918) 622-8000	Oregon Anthem Electronics Beaverton OR (503) 643-1114 Time Electronics Portland OR (503) 684-3780	Pennsylvania Lionex Horsham PA (215) 443-5150
Canada Future Electronics Calgary, Alberta (403) 259-6408 Future Electronics Edmonton, Alberta (403) 486-0974 Vancouver, British Columbia (604) 438-5545 Downsview, Ontario (416) 538-4771 Ottawa, Ontario (613) 829-8313 Pointe Claire, Quebec (514) 694-7710	Wisconsin Schwaber Elect. Inc. New Berlin WI (414) 784-9020	Wisconsin Schwaber Elect. Inc. New Berlin WI (414) 784-9020	Wisconsin Schwaber Elect. Inc. New Berlin WI (414) 784-9020	Wisconsin Schwaber Elect. Inc. New Berlin WI (414) 784-9020	Wisconsin Schwaber Elect. Inc. New Berlin WI (414) 784-9020	Wisconsin Schwaber Elect. Inc. New Berlin WI (414) 784-9020	Wisconsin Schwaber Elect. Inc. New Berlin WI (414) 784-9020	

INTERNATIONAL SALES OFFICES

Corporate International Sales Office SEEO Technology, Inc. 1849 Fortune Drive San Jose CA 95131 (408) 432-9550 TWX 910-338-2313 Telex: 295609 FAX: 432-9549	Northern European Sales Office SEEO International Ltd. Dammas House Dammas Lane Old Town Swindon SN1 3EF U.K. Tel: 0793-694999 Telex: 444588 FAX: 447-93616201	Southern European Sales Office SEEO International Sarl 4 Allée de Pomone, RW13 78100 Saint-Germain-en-Laye France Tel: 33 (1) 30 61 21 23 Telex: 699912 FAX: 331-30612192	Eastern Area Sales Office SEEO Technology, Inc. 15 New England Executive Park, Suite 160 Burlington MA 01783 (617) 229-6350 TWX: 710-332-8926 FAX: (617) 273-0322
---	---	---	---

Authorized International Manufacturer's Representatives/Distributors

Australia JRL Perth Tel: 09 272 7511 R&I Industrial Electronics Pty, Ltd Victoria Tel: (03) 277 4033 Sydney Tel: (02) 232 6933 St. Leonards Tel: (02) 439 7599 Austimtex Tel: (02) 232 6933	Brazil Hitech Sao Paulo Tel: 55-11 (531-9355) Denmark Ekatec A/S Copenhagen Tel: 45-1-19 1022 Finland ITT Distl. Helsinki Tel: 358-90739100 Federal Republic of Germany Astek Elektronik Kallmünchen Tel: 49 (4191) 8711	Federal Republic of Germany (cont.) Dacom Elektronik Vertriebs GmbH Stuttgart Tel: 49 (711) 74 10 21 München Tel: 49 (89) 60 98 03 Düsseldorf Tel: 49 (212) 59 30 11 Metronik GmbH München Tel: 49 (89) 611 080 Stuttgart Tel: 49 (711) 76 40 33 Hamburg Tel: 49 (40) 830 40 61 France Radio Television Francaise (RTF) Gentilly Tel: 33 (1) 46 64 11 01 RepTronic Paris Tel: 33 (1) 69 28 87 00	Hong Kong Electrocon Products Ltd. Kowloon Tel: 3-887214-6 India SRI RAM Assoc. Bangalore Tel: 802 140 Israel Vectronics Ltd Herzlia Tel: (052) 556070 / 71 Italy Cefra Spa Milano Tel: 39 (2) 23 52 64 Rome Tel: (06) 8456253 Japan Japan Macnics Corporation (JMC) Paris Tel: (044) 21 0022	Japan (cont.) Japan Macnics Corporation (JMC) Osaka City Tel: (06) 325-0880 Korea Hanaro Seoul Tel: (02) 783 7141 The Netherlands Technation Technation Haarlem Tel: 31 (4189) 2222 New Zealand VSI Electronics (N.Z.) Ltd. Epsom, Auckland Tel: 600 760 Norway Heko-Tech Fjellmarer Tel: (47) 270 5244	People's Republic of China AET (Asia) LTD. Beijing Tel: 507766 Hong Kong Tel: 0 461 384 South Africa Advanced Semiconductor Devices (PTY) Ltd Sandton Tel: (011) 802-5820 Singapore/Malaysia Desner Electronics (Far East) PTE Ltd Singapore Tel: 3373188	Spain Semiconductores Barcelona Tel: 34 (3) 217 23 40 Sweden Svensk Teleindustri AB Vallingby Tel: (46) 8 761 700 ITT Multicomponent, AB Söna Tel: (46) 08-83 00 20 Switzerland Anatec AG Electronics Bauleite Zug Tel: (41) 421 31 54 77	Taiwan Bright Up Industries Co., Ltd. Taipei Tel: (02) 773 2194 United Kingdom Kudos Electronics Reading Tel: 0734-668282 Prolec Electronics Systems Ltd Gants Hills/Essex Tel: (01) 554 6222 ITT Multicomponents Slough, Berkshire Tel: (0753) 824 212
---	---	---	--	---	---	---	--