

16k EPROM/RAM MEMORY FOR LSI-11

FEATURES

- Sockets provided for installation of up to 16k words of EPROM or static RAM in any mix of 4k partitions.
- Address space can be customer configured via DIP-switches in the address range from 0 to 128k words.
- Provisions for fast access of RAM segments.
- Operation requires +5V only. Selective battery backup of RAM segments.
- Simple configuration selection requiring few jumper changes.
- Completely compatible with LSI-11 Bus protocol.
- Can be installed in any option location in LSI-11, LSI-11/2, LSI-11/23 and PDP-11/03 systems.
- Built in provisions for "in machine programming" with the VMP11-A programming option.

DESCRIPTION

The VMC11-A module is a LSI-11 memory option that contains 16 sockets for the installation of either UV erasable, field programmable read-only memory (EPROM) or static random access memory (RAM) of the 2716-type and related devices.

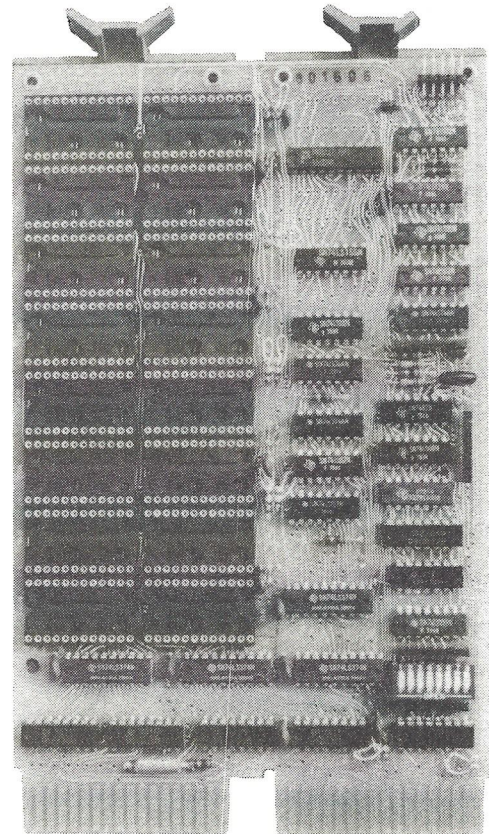
The VMC11-A consists of a single "double height" (two sets of backplane pins) module that plugs into any standard LSI-11 backplane. The fully populated module contains 16'384 by 16-bit of memory. Partially or fully populated configurations of either EPROM, RAM or combinations of both in 4k word partitions are possible.

Convenient address selection is implemented using DIP-switches; the address range is from 0 to 128k words. Additional switches allow the individual selection of any 4k partition within a 16k address space, including the frequently required extra 2k memory segment from 28k to 30k.

A jumper selectable option provides "Fast RAM Access" utilizing the speed benefit of the generally faster RAM circuits.

The RAM partitions may selectively get connected to an external battery backup. Reliable power up/down sequencing maintains data integrity of the nonvolatile RAM partitions.

Built in provisions allow for "in machine programming" using the VMP11-A programming option. Programming is straightforward and can be done using console ODT commands or applying program control.



2716-TYPE 2KX8 MEMORY INTEGRATED CIRCUITS

The organization of the VMC11-A module conforms to the requirements of the 2716-type 2kx8 memory integrated circuits regarding their read, write and "programming" operations. 2716-type 2kx8 memories are commercially available as:

ROM	Read Only Memory (mask programmed)
PROM	Programmable Read Only Memory (fusible link)
EPROM	Erasable Programmable Read Only Memory (erasable)
EAROM	Electrically Alterable Read Only Memory (electrically erasable)
RAM	Random Access Memory

The VMC11-A memory module may be operated using any of these 2716-type memories or certain combinations of them. However the VMC11-A module is most adequately designed for the use of EPROM and RAM circuits or combinations of them.

Static RAM circuits of the 1kx8 organization may also be used. They require the module and addressing space of 2kx8 circuits with the lower 1kx8 addressing space being inoperable.



VMC11-A

16K EPROM/RAM

USER'S MANUAL

P R E L I M I N A R Y

The material in this manual is for informational purposes and is subject to change without notice.

No responsibility is assumed for any errors which may appear in this manual.

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1. INTRODUCTION

1.1 INTRODUCTION

The VMC11-A (Figure 1-1) is a LSI-11 memory option that contains 16 sockets for the installation of either UV erasable, field programmable read-only memory (EPROM) or static random access memory (RAM) of the 2716-type industry devices.

1.2 GENERAL DESCRIPTION

The VMC11-A consists of a single "double height" (two sets of backplane pins) module that plugs into any standard LSI-11 backplane. The fully populated module contains 16'384 by 16-bit of memory. Partially or fully populated configurations of either EPROM, RAM or combinations of both in 4k word partitions are possible.

Convenient address selection is implemented using DIP-switches; the address range is from 0 to 128k words. Additional switches allow the individual selection of any 4k partition within a 16k address space, including the frequently required extra 2k memory segment from 28k to 30k.

A jumper selectable option provides "Fast RAM Access" utilizing the speed benefit of the generally faster RAM circuits.

The RAM partitions may selectively get connected to an external battery backup. Reliable power up/down sequencing maintains data integrity of the nonvolatile RAM partitions.

Built in provisions allow for "in machine programming" using the VMP11-A programming option. Programming is straightforward and can be done using console ODT commands or applying program control.

Features:

- Sockets provided for installation of up to 16k words of EPROM or static RAM in any mix of 4k partitions.
- Address space can be customer configured via DIP-switches in the address range from 0 to 128k words.
- Provisions for fast access of RAM-segments.
- Operation requires +5V only. Selective battery backup of RAM segments.
- Simple configuration selection requiring few jumper changes.
- Completely compatible with LSI-11 Bus protocol.
- Can be installed in any option location in LSI-11, LSI-11/2, LSI-11/23 and PDP-11/03 systems.
- Built in provisions for "in machine programming" with the VMP11-A programming option.

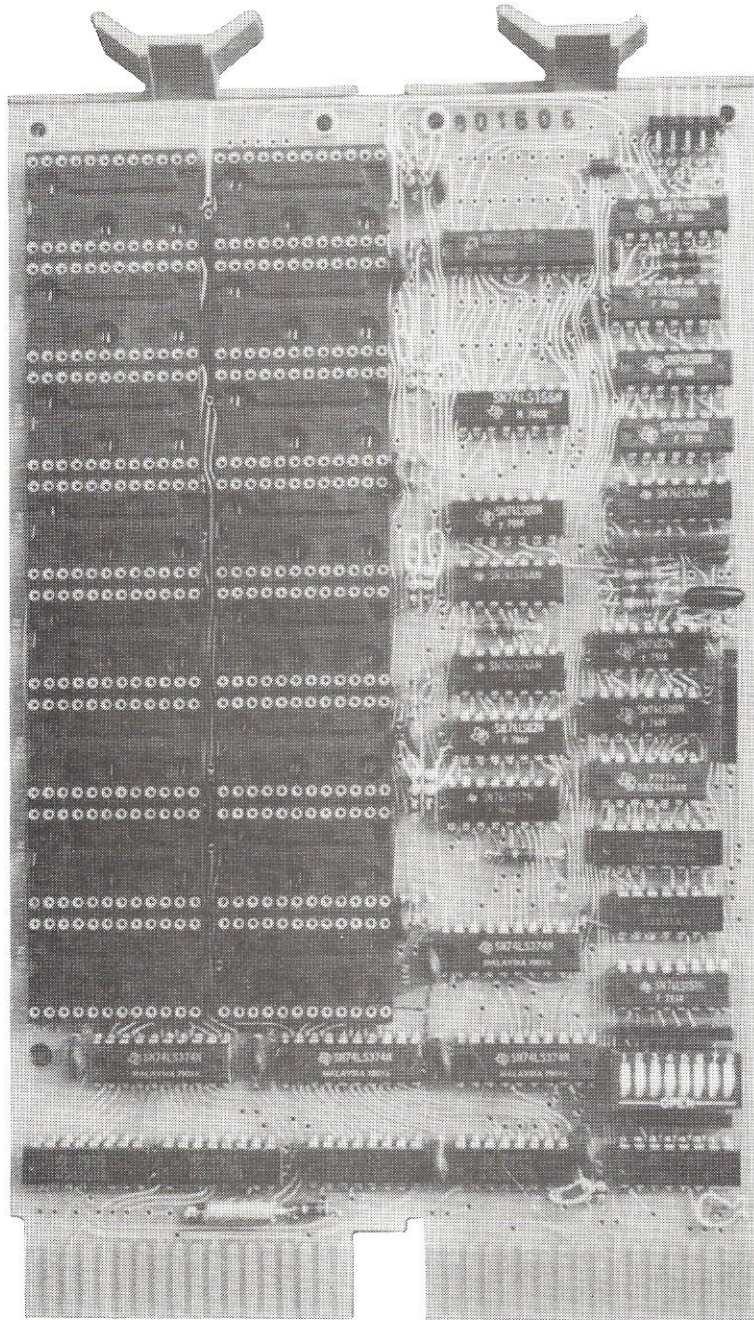


Figure 1-1 VMc11 32k EPROM/RAM

1.3 SPECIFICATIONS

1.3.1 Electrical

System Power

unpopulated module

+5V \pm 5% 0,4 A typ. (0,6 A max.)

with EPROMs/RAMs installed (16k capacity)

+5V \pm 5% 0,75 A typ. (1,3 A max.) active

0,65 A typ. (1,1 A max.) standby

+5V \pm 5% 0,65 A typ. (1,2 A max.) programming

Battery Backup

unpopulated module

operating mode +5V \pm 5% 22 mA typ. (37 mA max.)

retention mode +2,8...3,8V 15 mA typ. (25 mA max.)

with 16k word RAMs installed (CMOS)

operating mode +5V \pm 5% 160 mA typ. (400 mA max.)

retention mode +2,8...3,8V 18 mA typ. (60 mA max.)

Timing

Chip Access Time: EPROM 450 ns max.

RAM 200 ns max.

Chip Write Time: RAM 200 ns max.

Memory Read Time: EPROM (SYNCH to REPLY) 550 ns typ.

*) RAM (DIN to REPLY) 200 ns typ.

Memory Write Time: *) RAM (DOUT to REPLY) 50 ns typ.

*) With "Fast RAM Access" enabled

1.3.2 Environmental

Operating Temperature

0°C to 55°C with a relative humidity of 10% to 95% (no condensation), with an adequate airflow across the module. When operating at the maximum temperature (55°C), air flow must maintain the inlet to outlet air temperature rise across the module to 7°C maximum.

Storage Temperature Range

-40°C to 66°C.

1.3.3 Mechanical

Size

Height 13,2 cm (5,2 in)

Length 22,8 cm (8,9 in)

Width 1,27 cm (0,5 in)

1.3.4 Backplane Pin Utilization

VMC11-A backplane pin utilization is shown in Table 1-1.

1.3.5 Ordering Information

Part No.	Description
VMC11-A	16k EPROM/RAM memory module (unpopulated)

Table 1-1 VMC11-A Backplane Pin Utilization

Module Side 1 (Component Side)		Module Side 2 (Solder Side)	
LSI-11 Bus Pin	Signal Mnemonic	LSI-11 Bus Pin	Signal Mnemonic
AA1		AA2	+5V
AB1		AB2	
AC1	BAD 16	AC2	GND
AD1	BAD 17	AD2	
AE1		AE2	BDOUT L
AF1		AF2	BRPLY L
AH1		AH2	BDIN L
AJ1	GND	AJ2	BSYNC L
AK1		AK2	BWTBT L
AL1		AL2	
AM1	GND	AM2	BIAKI L
AN1		AN2	BIAKO L
AP1		AP2	BBS7 L
AR1	BREF L	AR2	BDMGI L
AS1		AS2	BDMGO L
AT1	GND	AT2	BINIT L
AU1		AU2	BDAL0 L
AV1	+5B	AV2	BDAL1 L
BA1	BDCOK H	BA2	+5V
BB1		BB2	
BC1		BC2	GND
BD1		BD2	
BE1		BE2	BDAL2 L
BF1		BF2	BDAL3 L
BH1		BH2	BDAL4 L
BJ1	GND	BJ2	BDAL5 L
BK1		BK2	BDAL6 L
BL1		BL2	BDAL7 L
BM1	GND	BM2	BDAL8 L
BN1		BN2	BDAL9 L
BP1		BP2	BDAL10 L
BR1		BR2	BDAL11 L
BS1		BS2	BDAL12 L
BT1	GND	BT2	BDAL13 L
BU1		BU2	BDAL14 L
BV1		BV2	BDAL15 L

2. INSTALLATION

2.1 GENERAL

This chapter contains the information required for configuring and installing the VMC11-A module in a LSI-11 system backplane. Configuring the module involves proper setting of switches and changing of jumpers to select addresses and options. Detailed information is included in the following paragraphs.

2.2 CONFIGURING THE VMC11-A MODULE

Sockets, switches and jumpers are located on the VMC11-A module as shown in Figure 2-1. Switches and jumpers allow selection of memory starting address, memory size, memory type battery backup and fast RAM access.

2.2.1 Jumper Functions

Table 2-1 lists the functions of the various jumpers.

Factory jumper configuration is:

DB7	Installed	no effect of I/O Bank Select
DRA	Removed	} "Fast RAM Access" enabled *)
ESS	Removed	
P(0...3)	Installed	} wired for operation of EPROM (0...8k)
W(0...3)	Removed	
P(4...7)	Removed	} wired for operation of RAM (8...16k)
W(4...7)	Installed	
+(0...3)	Installed	} no battery backup on any partition
B(0...3)	Removed	
B(3)to+(3)	Installed	+5VB connected to normal +5V

NOTE *)

In effect only those RAM partitions selected by the setting of switches S1...S5 (see Figure 2-2a) are operated with the fast access time. Avoid selecting fast access time for EPROM partitions.

Table 2-1 Jumper Functions

Jumper	Installed	Removed
DB7	The state of the BBS7 Bus Line (I/O Bank Select) has no effect on the address selection.	With the BBS7 Bus Line (I/O Bank Select) active the memory is disabled.
DRA	The "Fast RAM Access" option is disabled.	The "Fast RAM Access" option is enabled.
ESS	The memory size is determined by the settings of the switches S1...S5.	The full memory size of 16k words (12k with DB7 removed) is enabled regardless of the settings of switches S1...S5.
P(0...7)	Condition: W must be removed. The particular memory partition is wired for operation of EPROMs.	Condition: W must be installed. The particular memory partition is wired for operation of RAMs.
W(0...7)	Condition: P must be removed. The particular memory partition is wired for operation of RAMs.	Condition: P must be installed. The particular memory partition is wired for operation of EPROMs.
+(0...3)	Power from normal +5V.	Power from normal +5V disconnected.
B(0...3)	Power from +5VB (battery backup).	Power from +5VB (battery backup) disconnected.
B(3)to+(3)	Power for normal +5V and +5VB (battery backup) are connected together.	Power for normal +5V and +5VB (battery backup) are separated. Note: Assure that +5B (pin AV1) is externally powered either by +5V or the battery back up.

2.2.2 Address Selection

Address selection switches allow memory addressing through a 128k word address range.

NOTE

System memory must include memory location 000004. This location may be either read-only or read-write memory. The LSI-11 processor executes a dummy read bus cycle during the power up sequence using this address and requires a reply to complete the bus cycle. The actual memory contents read from the location are not used and can be of any value.

VMC11-B memory addresses can be located in any 16k bank of system memory. The relationship between bus address bits VMC11-B memory size and switch settings, is shown in Figure 2-2. Set switches S6 through S8 for a particular 16k bank as directed in Figure 2-2. Also set memory size switches S1 through S5 as shown in Figure 2-3; switches must be set to conform to memory size and access time selection (refer to paragraph 2.2.5)

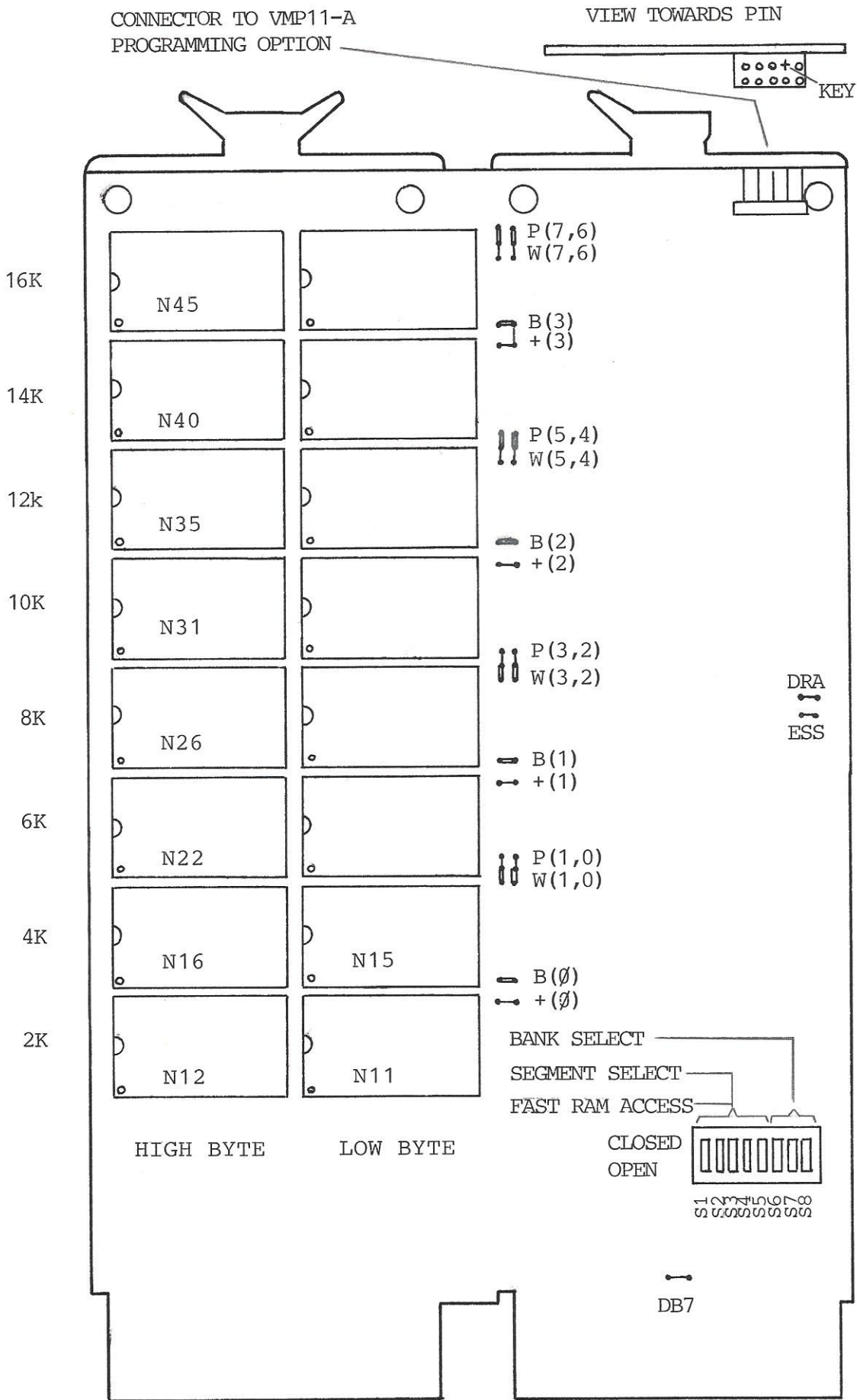
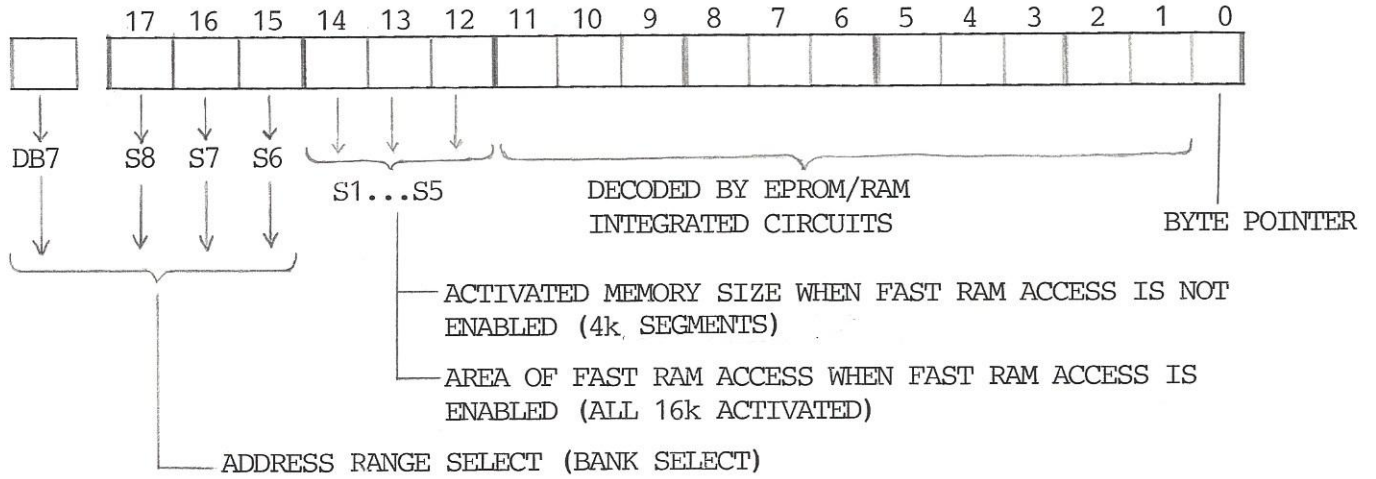


Figure 2-1 Socket, Switch and Jumper Locations

BANK 7 SELECT



ADDRESS RANGE SELECTION

ADDRESS RANGE OCTAL	DECIMAL	JUMPER DB7	SWITCH SETTING		
			S8	S7	S6
000000 - 077776	0 - 16k	x	O	O	O
100000 - 177776	16 - 32k	IN	O	O	C
200000 - 277776	32 - 48k	x	O	C	O
300000 - 377776	48 - 64k	x	O	C	C
400000 - 477776	64 - 80k	x	C	O	O
500000 - 577776	80 - 96k	x	C	O	C
600000 - 677776	96 - 112k	x	C	C	O
700000 - 777776	112 - 128k	IN	C	C	C
100000 - 157776	16 - 28k	OUT	O	O	C
700000 - 757776	112 - 124k	OUT	C	C	C

O = OPEN
 C = CLOSED
 x = DON'T CARE

CPU: 32k ADDRESS SPACE
 CPU: 128k ADDRESS SPACE

Figure 2-2 VMC11-A Addressing

Size Selection (S1...S5 active when open)

Switch Setting	Bank Segment	0	1	2	3	4	5	6	7
S1									
	X17776	4k	20k	36k	52k	68k	84k	100k	116k
S2									
	X37776	8k	24k	40k	56k	72k	88k	104k	120k
S3									
	X57776	12k	28k	44k	60k	76k	92k	108k	124k
S4	X67776	14k							126k
S5	X77776	16k	32k	48k	64k	80k	96k	112k	128k

The combination with S4 enabled and S5 disabled is useful to extend the usable memory area beyond the regular 28k size to 30k (124k to 126k).

The size selection shown above has various meanings depending on the jumper selection for "fast access time" (jumpers ESS and DRA), refer to paragraph 2.2.5 for further details.

Figure 2-3 VMC11-A addressing

2.2.3 EPROM/RAM Configuration

Jumper combinations allow for partially or fully populated configurations of either EPROM, RAM or combinations of both in 4k word partitions.

Jumpers are arranged as follows (refer to Figure 2-1):

```

0... 4k partition:  P(1,0)   W(1,0)
4... 8k partition:  P(3,2)   W(3,2)
8...12k partition: P(5,4)   W(5,4)
12...16k partition: P(7,6)   W(7,6)

```

The jumpers appear in pairs for P and W. No mixed pairs are allowed.

Jumper functions:

```

P installed/ W removed:  EPROM mode
P removed / W installed: RAM mode

```

Combinations with both pairs of P and W either installed or removed are not allowed.

2.2.4 Battery Backup Option

The RAM partitions may selectively get connected to an external battery backup via the +5B (pin AV1) Bus line. Provisions are made for proper power up/down sequencing, monitored by the DCOK Bus line.

Jumpers are arranged as follows (refer to Figure 2-1)

```

0... 4k partition:  B(0)      +(0)
4... 8k      "    :  B(1)      +(1)
8...12k      "    :  B(2)      +(2)
12...16k     "    :  B(3)      +(3)

```

Jumper functions:

```

B installed connects memory partition to +5B (battery backup)
+ installed connects memory partition to +5V (normal)

```

2.2.5 Memory Size and Access Time Selection

The switches S1...S5 and the jumpers ESS and DRA (refer to Figure 2-3) allow for the selection of memory size and access time according to the following table:

jumpers		switches	access time
ESS	DRA	S1...S5	
IN	IN	select active memory size	slow
IN	OUT	select active memory size	fast
OUT	IN	switches neutralized, all segments active	slow
OUT	OUT	select segments for fast access	selectively fast

Only selected memory segments respond with a REPLY signal to an appropriate address.

2.3 2716-type EPROM/RAM HANDLING PRECAUTIONS

2716-type integrated circuit EPROMs/RAMs are Complementary or Metal Oxide Semiconductor (MOS or CMOS) devices that can be damaged through improper handling, particularly by static discharges. Safe installation requires that the conductive foam in which such devices are shipped be brought into physical and electrical contact with the VMC11-A module or EPROM programming equipment prior to removing the devices from the foam. Unnecessary handling of devices should be avoided once removed from the foam. When installed in VMC11-A sockets, there is no more danger of static discharge damaging the devices.

The "in machine programming capability" of the module drastically reduces the hazards of component failure due to improper handling.

Each 2716-type EPROM/RAM is implemented in a 24-pin integrated circuit package. Mechanical damage to the circuits can occur if they are carelessly handled. When installing the circuits, make sure that all pins are properly guided into the socket before pressing the circuit pins all the way into the socket.

2.4 INSTALLING THE VMC11-A MODULE

The VMC11-A module can be installed in any LSI-11 bus structured backplane. It only requires one option location and is not dependent on position (device priority) along the bus. The module requires no special power; all operating power is supplied by the normal power present on the backplane.

The special programming voltage for "in machine programming" (25V) is supplied by the VMP11-A programming option which derives its power requirements from the standard bus supplies (+5V, +12V).

3. USER NOTES

3.1 GENERAL

This chapter contains specific instructions for programming, loading, and erasing 2716-type EPROMs. An overview for using the VMP11-A programmer is included. The VMP11-A programmer allows "in machine loading" of the VMC11-A memory option by using ODT commands or under program control.

3.2 PROGRAMMING NOTES

Generally, programs or data that can be read from read/write memory can also be read from PROMs. However, special care is required when using the MTPS-instruction and KEV11-option EIS instructions. These instructions are listed below:

MNEMONIC	OCTAL CODE	
MTPS	1064SS	Move byte to PS
MUL	070RSS	Multiply
DIV	071RSS	Divide
ASH	072RSS	Shift arithmetically
ASHC	073RSS	Arithmetic shift combined

These instructions, when executed on an LSI-11 processor, fetch source operands via the DATIO bus cycle, rather than the DATI bus cycle. Hence on certain PROM memory systems, fetching a source operand from a PROM location would result in a bus error (time-out) because the processor would attempt to write into the addressed location after fetching the operand.

This potential problem is avoided on the VMC11-A module. A Bus Reply is given regardless whether the LSI-11 processor is attempting to read from or write into a VMC11-A memory location.

3.3. LOADING EPROMs

3.3.1 General

Loading PROMs is the process where the binary information is stored in the PROM locations. This is a process that must be carefully executed as directed by the appropriate EPROM manufacturer's instructions.

3.3.2 Data Word Format

Each EPROM word, when read by the LSI-11 processor, is stored in two bytes in two separate EPROMs. Each word is simultaneously addressed and produces its respective 8-bit portion of the 16-bit word that is read. Since the word format is contained in two 8-bit bytes (one byte in each EPROM), the user must load each EPROM with successive memory locations, but dedicated to one 8-bit byte. This information can be generated manually - an error-prone, time-consuming process - or it can be generated automatically using appropriate ROM program software.

The unprogrammed (or erased) EPROM contents are all "1's" (high state). Loading data into the EPROM introduces logic "0's" (low state). The VMC11-A memory is transparent to this characteristics (note that the logic "1" state on the LSI-11 Bus is low).

3.3.3 Addressing

EPROM integrated circuits, when installed in the VMC11-A module are addressed by high-active address bits. When loading EPROMs, the user must be careful that the correct addressing technique is used. A schematic of this addressing technique, relative to EPROM pins, is provided in Fig. 3-1. Note that LSI-11 bus address bit operations are 16-bit word bus transfers.

3.4 PROM FORMATTING USING FORMATTER PROGRAMS

A PROM formatter program (commercially available) reduces the work required for coding binary patterns for individual PROM chips. Input to such a program is preferably in object tapes punched in absolute loader format. Such a program will produce and verify PROM tapes and listings for PROMs for use in the VMC11-A.

3.5 EPROM LOADING USING THE VMP11-A PROGRAMMER

3.5.1 General

The VMP11-A EPROM programmer is a hardware option that greatly simplifies loading of EPROM chips. It allows the user to perform "in machine loading (or programming)" of any portion of the EPROM either under program control or by using simple console ODT commands. This programmer contains its own ROM and RAM memory (2k words address space). Therefore it is not dependent of or interfering with system memory even though it operates using the systems CPU. The only prerequisite of this option is the VMC11-A or VME11-A memory module.

In addition to the actual programming functions, the VMP11-A EPROM programmer contains a number of useful and convenient commands to facilitate programming sessions.

The VMP11-A EPROM programmer consists of a single "double height" module that plugs into any standard LSI-11 backplane.

For detailed information refer to the VMP11-A UV EPROM-PROGRAMMER's user manual.

3.5.2 Operation

Operation is possible under program control or by using simple console ODT commands. Data of any system memory area can be directly written (loaded) into a specified EPROM area. A scratch pad RAM area on the VMP11-A is useful when manually loading EPROMs using console ODT commands.

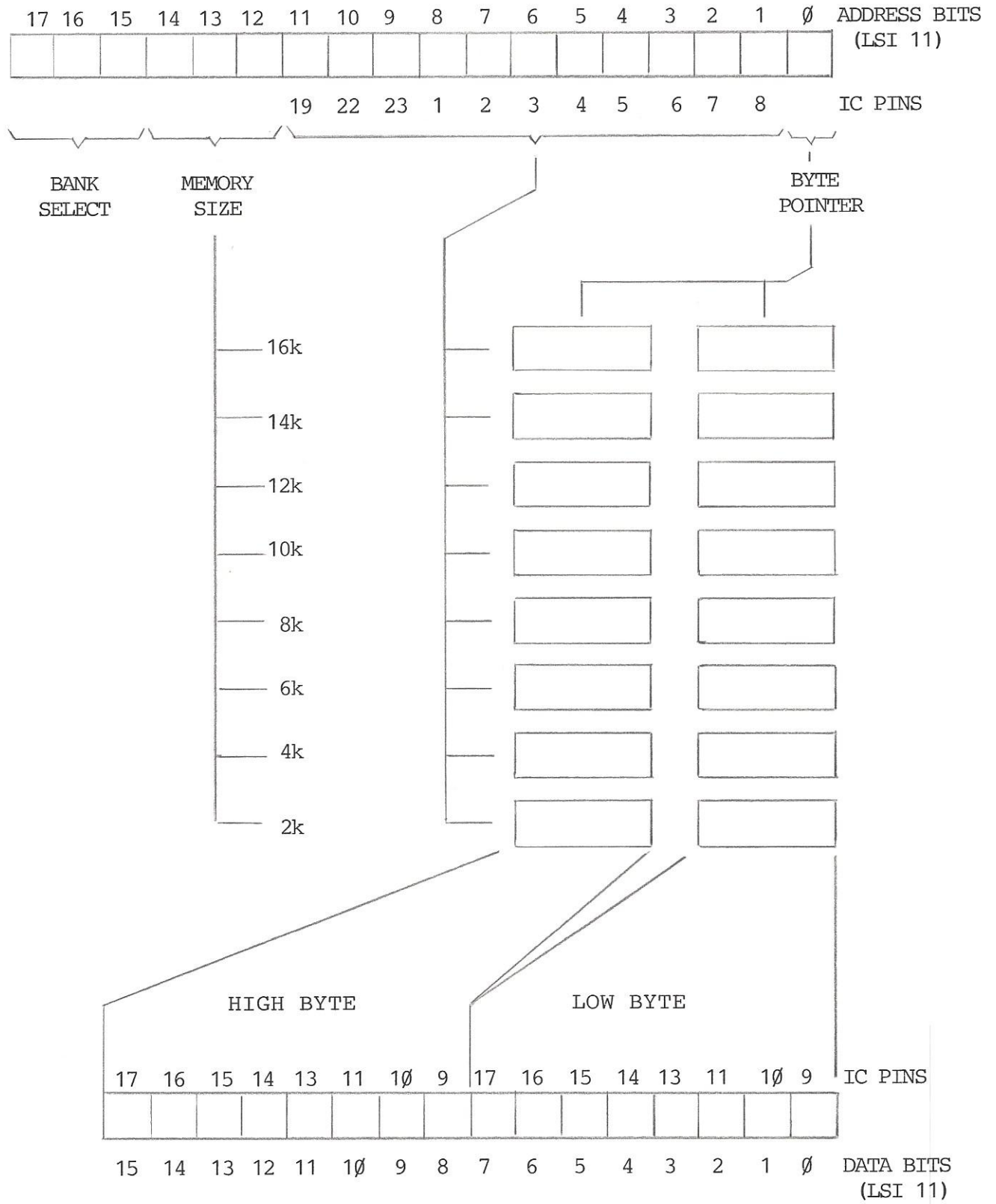


Figure 3-1 EPROM/RAM Addressing

3.5.3 List of commands

Following is a brief description of the VMP11-A programmer commands:

SA = Start Address
EA = End Address

- WRITE The contents of the source data block specified by SA and EA is written (loaded or programmed) into the EPROM portion specified by its SA. The WRITE-command is automatically followed by a COMPARE-command.
- COMPARE The contents of the source data block specified by SA and EA is compared against the contents of the EPROM portion specified by its SA. The contents of any location which do not match are listed on the console terminal with their appropriate addresses.
- LIST The contents of the data block specified by SA and EA are listed on the console terminal.
- ERASED The contents of the data block specified by SA and EA are compared against "1". Any locations which are not properly erased are listed on the console terminal.
- MOVE The contents of the source data block specified by SA and EA are written into RAM portion specified by its SA.
- LOAD Data available in Absolute Loader Format from specified input device is loaded into RAM memory.
- DUMP The contents of the source data block specified by SA and EA is dumped in Absolute Loader Format to the specified output device.
- TEST All data bits of all locations of the EPROM data block specified by SA and EA are loaded and checked thereafter. The test pattern is run twice, first as true data, secondly as inverted data, therefore loading all bits.
- FILL The contents of the RAM block specified by SA and EA are set to a preselected pattern.

3.5.4 Command Modifiers

INVERSION Any command except LIST, DUMP or TEST may be operated with inversed data bits, if so specified in the command word.

DISPLACEMENT By appropriately setting these two bits, an EPROM module with an address space beyond 0...32k (feasible with VMC11-A module) may for instance get loaded from a RAM area residing within the boundaries of the first 32k.

Affected by DISPLACEMENT are the commands WRITE, COMPARE, LIST, ERASED, MOVED, TEST.

MODE The variations are

- ODT-Mode
- SUBROUTINE-Mode
- Printout to Console
- Printout Inhibit
- Printout to Specified Device

Note that the VMP11-A programmer automatically saves all General Register contents. The Stack Pointer (R6) is also preserved. Furthermore it does not access any memory locations except its own and the locations specified by the user in a command.

3.6. INSTALLING EPROMs

EPROMs should be installed in the VMC11-B sockets shown in Figure 2-1. EPROMs are normally installed starting with the first 2k locations (N11 and N12). Check EPROM size switch setting to insure that they agree with the number of EPROMs installed as shown in Figure 2-2. Also be sure to install the low byte and high byte EPROMs in appropriate sockets.

When using the VMP11-A programming option, the EPROMs are installed before the programming takes place. Therefore errors in installing EPROMs are virtually eliminated.

3.7. ERASING EPROMs

EPROMs can be erased by exposure to ultra-violet light at a wavelength of 2537\AA . The recommended integrated light (light intensity x exposure time) is a minimum of 15 W-sec/cm^2 . The lamp is normally placed approximately 1 inch away from the EPROM to be erased and turned on for a period of time. The time required can be determined empirically or by referring to typical times recommended by EPROM integrated circuit manufacturers. Typical times may vary from 10 to 30 minutes (approximately).

Suitable lamps allow for erasing of installed EPROMs.

1k x 8 Static-RAM-Chip Application

Memory Map: 8k EPROM / 4k RAM

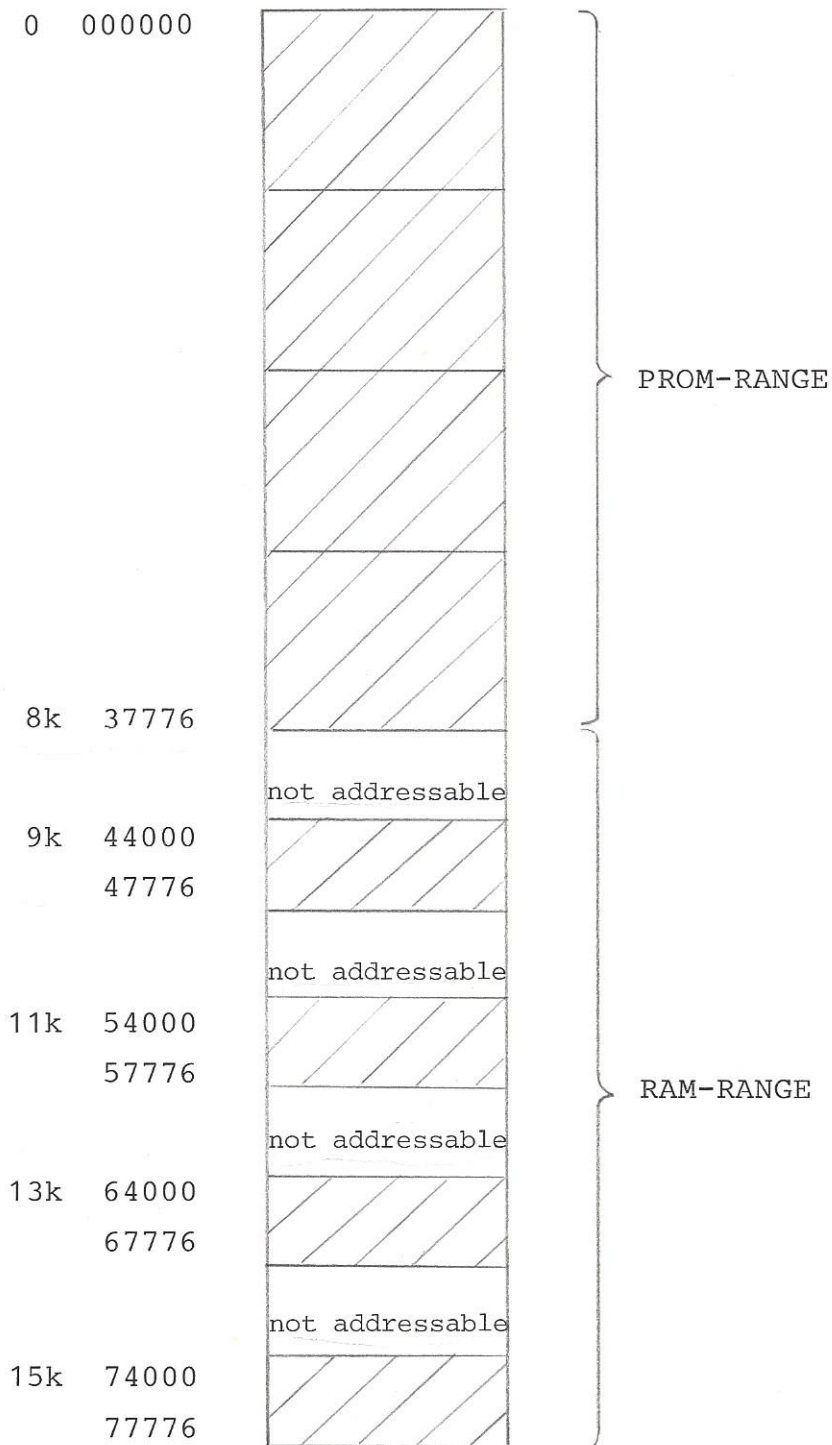


Figure C-1 1kx8 Static-RAM-Chip Application

PROGRAMMING

Programming or loading of the EPROMs may be done the conventional way using commercially available programmers and PROM formatters.

More efficient and virtually error free programming is possible using the VMP11-A EPROM programmer which is an LSI-11 hardware option that greatly simplifies loading of EPROM chips. It allows the user to perform "in machine programming" of any portion of the EPROM either under program control or by using simple console ODT commands. This programmer contains its own ROM and RAM memory. Therefore it is not dependent of, or interfering with system memory even though it operates using the systems CPU.

In addition to the actual programming functions WRITE, COMPARE, LIST, ERASED the VMP11-A EPROM programmer contains a number of useful and convenient commands like MOVE, LOAD, DUMP, TEST, FILL to facilitate programming sessions.

The VMP11-A EPROM programmer consists of a single "double height" module that plugs into any standard LSI-11 backplane and that connects through a cable to the VMC11-A memory module.

INSTALLATION

The VMC11-A module can be installed in any LSI-11 bus structured backplane. It only requires one option location and is not dependent on position (device priority) along the bus. The module requires no special power; all operating power is supplied by the normal power present on the backplane.

The special programming voltage for "in machine programming" (25V) is supplied by the VMP11-A programming option which derives its power requirements from the standard bus supplies (+5V, +12V).

SPECIFICATIONS

Electrical

System Power

unpopulated module

+5V $\pm 5\%$ 0,4 A typ. (0,6 A max.)

with EPROMs/RAMs installed (16k capacity)

+5V $\pm 5\%$ 0,75 A typ. (1,3 A max.) active

0,65 A typ. (1,1 A max.) standby

+5V $\pm 5\%$ 0,65 A typ. (1,2 A max.) programming

Battery Backup

unpopulated module

operating mode +5V $\pm 5\%$ 22 mA typ. (37 mA max.)

retention mode +2,8...3,8V 15 mA typ. (25 mA max.)

with 16k word RAMs installed (CMOS)

operating mode +5V $\pm 5\%$ 160 mA typ. (400 mA max.)

retention mode +2,8...3,8V 18 mA typ. (60 mA max.)

Timing

Chip Access Time: EPROM 450 ns max.

RAM 200 ns max.

Chip Write Time: RAM 200 ns max.

Memory Read Time:*) EPROM (SYNCH to REPLY) 550 ns typ.

RAM (DIN to REPLY) 200 ns typ.

Memory Write Time:*) RAM (DOUT to REPLY) 50 ns typ.

*) With "Fast RAM Access" enabled

Environmental

Operating Temperature

0°C to 55°C with a relative humidity of 10% to 95% (no condensation), with an adequate airflow across the module. When operating at the maximum temperature (55°C), air flow must maintain the inlet to outlet air temperature rise across the module to 7°C maximum.

Storage Temperature Range

-40°C to 85°C.

Mechanical

Size

Height 13,2 cm (5,2 in)

Length 22,8 cm (8,9 in)

Width 1,27 cm (0,5 in)

Ordering Information

Part No.	Description
VMC11-AA	16k EPROM/RAM memory module (unpopulated)