

# MM4204/MM5204 4096-Bit (512 × 8) UV Erasable PROM

## General Description

The MM4204/MM5204 is a 4096-bit static read only memory which is electrically programmable and uses silicon gate technology to achieve bipolar compatibility. The device is a non-volatile memory organized as 512 words by 8 bits per word. Programming of the memory is accomplished by storing a charge in a cell location by applying a -50V pulse. A logic input, Power Saver, is provided which gives a 5:1 decrease in power when the memory is not being accessed.

- Static operation—no clock required
- Easy memory expansion—TRI-STATE® output Chip Select input (CS)
- "Q" quartz lid version erasable with short wave ultra-violet light (i.e., 253.7 nm)
- Low power dissipation
- "Power Saver" control for low power applications
- Compatible with SC/MP II N-channel microprocessor

## Features

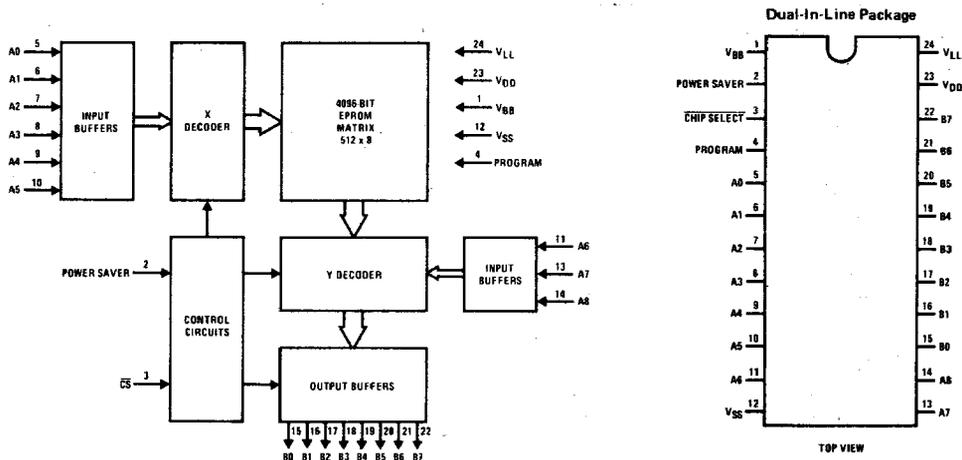
- Field programmable
- Fast program time: ten seconds typical for 4096 bits
- Fast access time
  - MM4204 1.25  $\mu$ s
  - MM5204 1  $\mu$ s
- DTL/TTL compatibility
- Standard power supplies

5V, -12V

## Applications

- Code conversion
- Random logic synthesis
- Table look-up
- Character generator
- Microprogramming
- Electronic keyboards

## Block and Connection Diagrams



Order Number MM4204D  
or MM5204D  
See NS Package D24C

Order Number MM4204Q  
or MM5204Q  
See NS Package J24CQ

## Absolute Maximum Ratings (Note 1)

All Input or Output Voltages with Respect to $V_{BB}$ Except During Programming	+0.3V to -20V
Power Dissipation	750 mW
Storage Temperature Range	-65°C to +125°C
Lead Temperature (Soldering, 10 seconds)	300°C

## Operating Conditions

Operating Temperature Range	MM5204	0°C to +70°C
	MM4204	-55°C to +85°C

**DC Electrical Characteristics**  $T_A$  within operating temperature range,  $V_{LL} = 0V$ ,  $V_{BB} = \text{PROGRAM} = V_{SS}$ .  
MM4204:  $V_{SS} = 5V \pm 10\%$ ,  $V_{DD} = -12V \pm 10\%$ , MM5204:  $V_{SS} = 5V \pm 5\%$ ,  $V_{DD} = -12V \pm 5\%$ , unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP (Note 7)	MAX	UNITS
$V_{IL}$	Input Low Voltage		$V_{SS}-14$		$V_{SS}-4.2$	V
$V_{IH}$	Input High Voltage		$V_{SS}-1.5$		$V_{SS}+0.3$	V
$I_{EI}$	Input Current	$V_{IN} = 0V$			1.0	$\mu A$
$V_{OL}$	Output Low Voltage	$I_{OL} = 1.6 \text{ mA}$	$V_{LL}$		0.4	V
$V_{OH}$	Output High Voltage	$I_{OH} = -0.8 \text{ mA}$	2.4		$V_{SS}$	V
$I_{LO}$	Output Leakage Current	$V_{OUT} = 0V$ , $\overline{CS} = V_{IH}$			1.0	$\mu A$
$I_{DD}$	Power Supply Current	MM5204 $T_A = 0^\circ C$ , $\overline{CS} = V_{IH}$ , Power Saver = $V_{IL}$		28	40.0	mA
		MM4204 $T_A = 0^\circ C$ , $\overline{CS} = V_{IH}$ , Power Saver = $V_{IL}$			50.0	mA
		MM5204 $T_A = 0^\circ C$ , $\overline{CS} = V_{IH}$ , Power Saver = $V_{IH}$		6.0	8.0	mA
		MM4204 $T_A = 0^\circ C$ , $\overline{CS} = V_{IH}$ , Power Saver = $V_{IH}$			10.0	mA
		MM5204 $T_A = 0^\circ C$ , $\overline{CS} = V_{IH}$ , Power Saver = $V_{IL}$			42	mA
		MM4204 $T_A = 0^\circ C$ , $\overline{CS} = V_{IH}$ , Power Saver = $V_{IL}$			52	mA
		MM5204 $T_A = 0^\circ C$ , $\overline{CS} = V_{IH}$ , Power Saver = $V_{IH}$			10	mA
		MM4204 $T_A = 0^\circ C$ , $\overline{CS} = V_{IH}$ , Power Saver = $V_{IH}$			12	mA
$I_{SS}$						

**AC Electrical Characteristics**  $T_A$  within operating temperature range,  $V_{LL} = 0V$ ,  $V_{BB} = \text{PROGRAM} = V_{SS}$ .  
MM4204:  $V_{SS} = 5V \pm 10\%$ ,  $V_{DD} = -12V \pm 10\%$ , MM5204:  $V_{SS} = 5V \pm 5\%$ ,  $V_{DD} = -12V \pm 5\%$ , unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP (Note 7)	MAX	UNITS
$t_{ACC}$	Access Time					
	MM5204	$T_A = 70^\circ C$ , (Figure 1), (Note 4)		0.75	1.0	$\mu s$
	MM4204	$T_A = 85^\circ C$ , (Figure 1), (Note 4)			1.25	$\mu s$
$t_{PO}$	Power Saver Set-Up Time					
	MM5204	(Figure 1)			1.8	$\mu s$
	MM4204	(Figure 1)			2.0	$\mu s$
$t_{CO}$	Chip Select Delay					
	MM5204	(Figure 1)			500	ns
	MM4204	(Figure 1)			600	ns
$t_{OH}$	Data Hold Time	(Figure 1)	30	50		ns
$t_{ODC}$	Chip Select Deselect Time					
	MM5204	(Figure 1)	30	300	500	ns
	MM4204	(Figure 1)	30	300	600	ns
$t_{ODP}$	Power Saver Deselect Time					
	MM5204	(Figure 1)	30	300	500	ns
	MM4204	(Figure 1)	30	300	600	ns
$C_{IN}$	Input Capacitance (All Inputs)	$V_{IN} = V_{SS}$ , $f = 1.0 \text{ MHz}$ , (Note 2)		5.0	8.0	pF
$C_{OUT}$	Output Capacitance (All Outputs)	$V_{OUT} = V_{SS}$ , $\overline{CS} = V_{IH}$ , $f = 1.0 \text{ MHz}$ , (Note 2)		8.0	15	pF

## Programmer Electrical Characteristics

$T_A = 25^\circ\text{C}$ ,  $V_{SS} = \overline{CS} = \text{Power Saver} = 0\text{V}$ ,  $V_{LL} = 0\text{V to } -14\text{V}$ , unless otherwise specified, (Figure 2), (Note 5).

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP (Note 7)	MAX	UNITS
$I_{LD}$	Data Input Load Current	$V_{IN} = -18\text{V}$			-10	mA
$I_{ALD}$	Address Input Load Current	$V_{IN} = -50\text{V}$			-10	mA
$I_{LP}$	Program Load Current	$V_{IN} = -50\text{V}$			-10	mA
$I_{LBB}$	$V_{BB}$ Load Current				50	mA
$I_{LDD}$	$V_{DD}$ Load Current	$V_{DD} = \text{PROGRAM} = -50\text{V}$			-200	mA
$V_{IHP}$	Address Data and Power Saver Input High Voltage		-2.0		0.3	V
$V_{ILP}$	Address Input Low Voltage		-50		-11	V
	Data Input Low Voltage		-18		-11	V
$V_{DHP}$	$V_{DD}$ and Program High Voltage		-2.0		0.5	V
$V_{DLP}$	$V_{DD}$ and Program Low Voltage		-50		-48	V
$V_{BLP}$	$V_{BB}$ Low Voltage		0		0.4	V
$V_{BHP}$	$V_{BB}$ High Voltage		11.4		12.6	V
$V_{OD}$	Pulse Duty Cycle				25	%
$t_{PW}$	Program Pulse Width		0.5		5.0	ms
$t_{DS}$	Data and Address Set-Up Time		40			$\mu\text{s}$
$t_{DH}$	Data and Address Hold Time		0			$\mu\text{s}$
$t_{SS}$	Pulsed $V_{DD}$ Set-Up Time		40		100	$\mu\text{s}$
$t_{SH}$	Pulsed $V_{DD}$ Hold Time		1.0			$\mu\text{s}$
$t_{BS}$	Pulsed $V_{BB}$ Set-Up Time		1.0			$\mu\text{s}$
$t_{BH}$	Pulsed $V_{BB}$ Hold Time		1.0			$\mu\text{s}$
$t_{PSS}$	Power Saver Set-Up Time		1.0			$\mu\text{s}$
$t_{PSH}$	Power Saver Hold Time		1.0			$\mu\text{s}$
$t_{R, tF}$	$V_{DD}$ , Program, Address and Data Rise and Fall Time				1.0	$\mu\text{s}$

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:** Capacitance is guaranteed by periodic testing.

**Note 3:** Positive true logic notation is used except on data inputs during programming  
Logic "1" = most positive voltage level  
Logic "0" = most negative voltage level

**Note 4:**  $t_{ACC} = 700 \text{ ns} + 25 (N-1)$  where N is the number of devices wire-OR'd together.

**Note 5:** The program cycle should be repeated until the data reads true, then over-programmed 5 times that number of cycles. (Symbolized as X + 5X programming).

**Note 6:** The EPROM is initially programmed with all "0's." A  $V_{IHP}$  on any data input B0-B7 will leave the stored "0's" undisturbed, and a  $V_{ILP}$  on any data input B0-B7 will write a logic "1" into that location.

**Note 7:** Typical values are for nominal voltages and  $T_A = 25^\circ\text{C}$ , unless otherwise specified.

## Erase Specification

The recommended dosage of ultraviolet light exposure is 6W sec/cm<sup>2</sup>.

## Programming

The MM4204/MM5204 is normally shipped in the un-programmed state. All 4096-bits are at logic "0" state. The table of electrical programming characteristics and Figure 2 give the conditions for programming of the device. In the program mode the device effectively becomes a RAM with the 512 word locations selected by

address inputs A0-A8. Data inputs are B0-B7 and write operation is controlled by pulsing the Program input. Since the EROM is initially shipped with all "0's," a  $V_{IHP}$  on any data input B0-B7 will leave the stored "0's" undisturbed and a  $V_{ILP}$  on any data input B0-B7 will write a logic "1" into that location.

## Programming (Continued)

National offers programmer options with both the IMP16-P and the PACE IPC-16P Microprocessor Development Systems.

Microprocessor System	Programmer Part Number
IMP16-P	IMP16-P/805
IPC-16P	IPC-16P/805

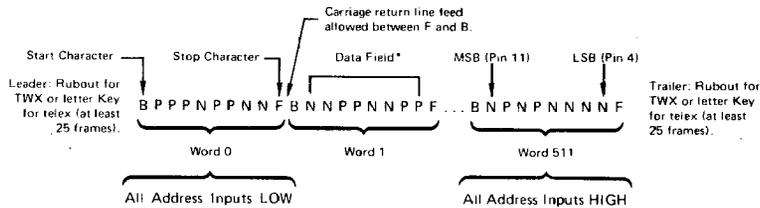
Contact the local sales office for further information. There are also several commercial programmers available such as the Data I/O Model V.

Most National distributors have programming capabilities available. Those distributors should be contacted directly to determine which data entry formats are available.

In addition, data may be submitted to National Semiconductor for factory programming. One of the following formats should be observed:

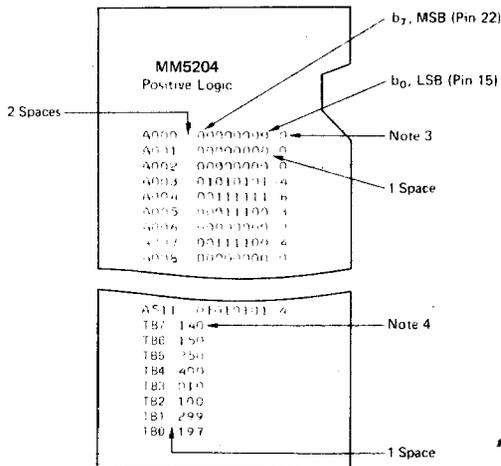
### Preferred Format

The custom patterns may be sent in on a Telex or submitted as a paper tape in a 7-bit ASCII code from model 33 teletype or TWX. The paper tape should be as the following example:



\*Data Field: Must have only P's or N's typed between B and F. No nulls or rubouts. Must have exactly eight P and N characters between B and F. Any characters except B and F may be typed between the F stop character and the B start character. If an error is made in preparing a tape the entire word including the B and F start and stop characters must be rubbed out. Data for exactly 512 words must be entered beginning with word 0.

### Alternate Format [Punched Tape (Note 1) or Cards]



**Note 1:** The code is a 7-bit ASCII code on 8 punch tape. The tape should begin and end with 25 or more "RUBOUT" punches.

**Note 2:** The ROM input address is expressed in decimal form and is preceded by the letter A.

**Note 3:** The total number of "1" bits in the output word.

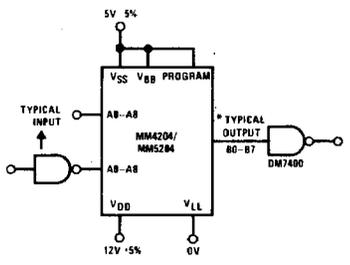
**Note 4:** The total number of "1" bits in each output column or bit position.

### Erasing Procedure

The MM4204Q/MM5204Q may be erased by exposure to short-wave ultraviolet light—253.7 nm. There exists no absolute rule for erasing time or distance from source. The erasing equipment output capability should be calibrated. Establish a worst case time required with the equipment. Then over-erase by a factor of 2, i.e., if the device appears erased after 8 minutes, continue exposure for an additional 16 minutes for a total of 24

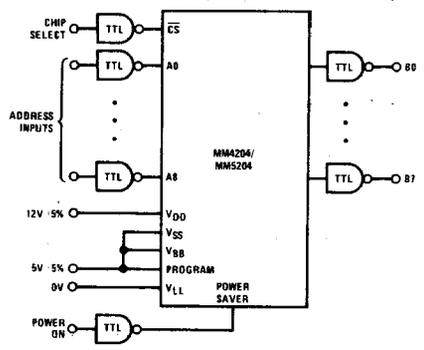
minutes. Examples of UV sources include the Model UVS-54 and Model S-52 manufactured by Ultra-Violet Products, Inc. (5114 Walnut Grove Avenue, San Gabriel, California). The lamps should be used without short-wave filters. The MM4204/MM5204 should be placed about one inch away from the lamp for about 20–30 minutes.

### AC Test Circuit

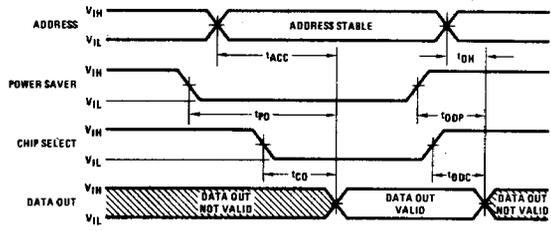


\*  $t_{ACC}$ ,  $t_{OH}$ ,  $t_{CD}$ , and  $t_{OD}$  measured at output of MM4204/MM5204.

### Typical Application



### Switching Time Waveforms



Note. All times measured with respect to 1.5V level with  $t_r$  and  $t_f \leq 20$  ns

FIGURE 1. Read Operation

### Programming Waveforms

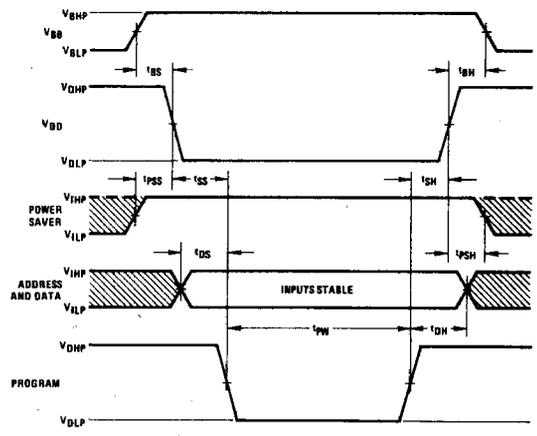


FIGURE 2. Programming Waveforms