

# MM54C89/MM74C89 64-Bit TRI-STATE® Random Access Read/Write Memory

## General Description

The MM54C89/MM74C89 is a 16-word by 4-bit random access read/write memory. Inputs to the memory consist of four address lines, four data input lines, a write enable line and a memory enable line. The four binary address inputs are decoded internally to select each of the 16 possible word locations. An internal address register latches the address information on the positive to negative transition of the memory enable input. The four TRI-STATE data output lines working in conjunction with the memory enable input provide for easy memory expansion.

**Address Operation:** Address inputs must be stable  $t_{SA}$  prior to the positive to negative transition of memory enable. It is thus not necessary to hold address information stable for more than  $t_{HA}$  after the memory is enabled (positive to negative transition of memory enable).

**Note:** The timing is different than the DM7489 in that a positive to negative transition of the memory enable must occur for the memory to be selected.

**Write Operation:** Information present at the data inputs is written into the memory at the selected address by bringing write enable and memory enable low.

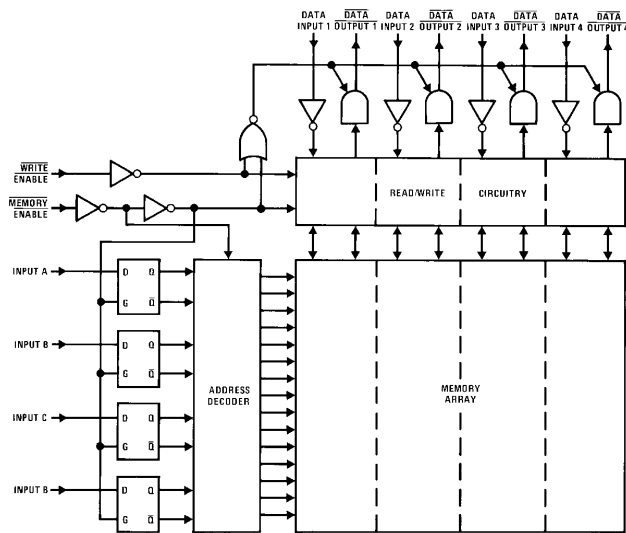
**Read Operation:** The complement of the information which was written into the memory is non-destructively read out at the four outputs. This is accomplished by selecting the desired address and bringing memory enable low and write enable high.

When the device is writing or disabled the output assumes a TRI-STATE (Hi-z) condition.

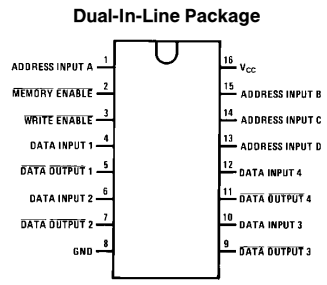
## Features

- Wide supply voltage range 3.0V to 15V
- Guaranteed noise margin 1.0V
- High noise immunity 0.45  $V_{CC}$  (typ.)
- Low power fan out of 2
- TTL compatibility driving 74L
- Low power consumption 100 nW/package (typ.)
- Fast access time 130 ns (typ.) at  $V_{CC} = 10V$
- TRI-STATE output

## Logic and Connection Diagrams



TL/F/5888-1



Top View TL/F/5888-2

Order Number MM54C89  
or MM74C89

MM54C89/MM74C89 64-Bit TRI-STATE Random Access Read/Write Memory

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## Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Voltage at any Pin	-0.3V to $V_{CC} + 0.3V$
Operating Temperature Range	
MM54C89	-55°C to +125°C
MM74C89	-40°C to +85°C
Storage Temperature Range ( $T_S$ )	-65°C to +150°C

Power Dissipation ( $P_D$ )	
Dual-In-Line	700 mW
Small Outline	500 mW
Operating $V_{CC}$ Range	3.0V to 15V
Absolute Maximum $V_{CC}$	18V
Lead Temperature ( $T_L$ )	
(Soldering, 10 seconds)	260°C

## DC Electrical Characteristics Min/Max limits apply across temperature range, unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>CMOS TO CMOS</b>						
$V_{IN(1)}$	Logical "1" Input Voltage	$V_{CC} = 5.0V$ $V_{CC} = 10V$	3.5 8.0			V V
$V_{IN(0)}$	Logical "0" Input Voltage	$V_{CC} = 5.0V$ $V_{CC} = 10V$			1.5 2.0	V V
$V_{OUT(1)}$	Logical "1" Output Voltage	$V_{CC} = 5.0V, I_O = -10 \mu A$ $V_{CC} = 10V, I_O = -10 \mu A$	4.5 9.0			V V
$V_{OUT(0)}$	Logical "0" Output Voltage	$V_{CC} = 5.0V, I_O = +10 \mu A$ $V_{CC} = 10V, I_O = +10 \mu A$			0.5 1.0	V V
$I_{IN(1)}$	Logical "1" Input Current	$V_{CC} = 15V, V_{IN} = 15V$		-0.005	1.0	$\mu A$
$I_{IN(0)}$	Logical "0" Input Current	$V_{CC} = 15V, V_{IN} = 0V$	-1.0	-0.005		$\mu A$
$I_{OZ}$	Output Current in High Impedance State	$V_{CC} = 15V, V = 15V$ $V_{CC} = 15V, V_O = 0V$	-1.0	0.005 -0.005	1.0	$\mu A$ $\mu A$
$I_{CC}$	Supply Current	$V_{CC} = 15V$		0.05	300	$\mu A$
<b>CMOS/LPTTL INTERFACE</b>						
$V_{IN(1)}$	Logical "1" Input Voltage	54C, $V_{CC} = 4.5V$ 74C, $V_{CC} = 4.75V$		$V_{CC} - 1.5$ $V_{CC} - 1.5$		V V
$V_{IN(0)}$	Logical "0" Input Voltage	54C, $V_{CC} = 4.5V$ 74C, $V_{CC} = 4.75V$			0.8 0.8	V V
$V_{OUT(1)}$	Logical "1" Output Voltage	54C, $V_{CC} = 4.5V, I_O = -360 \mu A$ 74C, $V_{CC} = 4.75V, I_O = -360 \mu A$	2.4 2.4			V V
$V_{OUT(0)}$	Logical "0" Output Voltage	54C, $V_{CC} = 4.5V, I_O = +360 \mu A$ 74C, $V_{CC} = 4.75V, I_O = +360 \mu A$			0.4 0.4	V V
<b>OUTPUT DRIVE (See 54C/74C Family Characteristics Data Sheet) (Short Circuit Current)</b>						
$I_{SOURCE}$	Output Source Current (P-Channel)	$V_{CC} = 5.0V, V_{OUT} = 0V$ $T_A = 25^\circ C$	-1.75	-3.3		mA
$I_{SOURCE}$	Output Source Current (P-Channel)	$V_{CC} = 10V, V_{OUT} = 0V$ $T_A = 25^\circ C$	-8.0	-15		mA
$I_{SINK}$	Output Sink Current (N-Channel)	$V_{CC} = 5.0V, V_{OUT} = V_{CC}$ $T_A = 25^\circ C$	1.75	3.6		mA
$I_{SINK}$	Output Sink Current (N-Channel)	$V_{CC} = 10V, V_{OUT} = V_{CC}$ $T_A = 25^\circ C$	8.0	16		mA

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating 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.

## AC Electrical Characteristics\* $T_A = 25^\circ C, C_L = 50 pF$ , unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{pd}$	Propagation Delay from Memory Enable	$V_{CC} = 5V$ $V_{CC} = 10V$		270 100	500 220	ns ns
$t_{ACC}$	Access Time from Address Input	$V_{CC} = 5V$ $V_{CC} = 10V$		350 130	650 280	ns ns
$t_{SA}$	Address Setup Time	$V_{CC} = 5V$ $V_{CC} = 10V$	150 60			ns ns
$t_{HA}$	Address Hold Time	$V_{CC} = 5V$ $V_{CC} = 10V$	60 40			ns ns
$t_{ME}$	Memory Enable Pulse Width	$V_{CC} = 5V$ $V_{CC} = 10V$	400 150	250 90		ns ns

### AC Electrical Characteristics\* $T_A = 25^\circ\text{C}$ , $C_L = 50\text{ pF}$ , unless otherwise noted (Continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{SR}$	Write Enable Setup Time for a Read	$V_{CC} = 5\text{V}$	0			ns
		$V_{CC} = 10\text{V}$	0			ns
$t_{WS}$	Write Enable Setup Time for a Write	$V_{CC} = 5\text{V}$			$t_{ME}$	ns
		$V_{CC} = 10\text{V}$			$t_{ME}$	ns
$t_{WE}$	Write Enable Pulse Width	$V_{CC} = 5\text{V}$ , $t_{WS} = 0$ $V_{CC} = 10\text{V}$ , $t_{WS} = 0$	300 100	160 60		ns ns
$t_{HD}$	Data Input Hold Time	$V_{CC} = 5\text{V}$	50			ns
		$V_{CC} = 10\text{V}$	25			ns
$t_{SD}$	Data Input Setup	$V_{CC} = 5\text{V}$	50			ns
		$V_{CC} = 10\text{V}$	25			ns
$t_{1H}$ , $t_{0H}$	Propagation Delay from a Logical "1" or Logical "0" to the High Impedance State from Memory Enable	$V_{CC} = 5\text{V}$ , $C_L = 5\text{ pF}$ , $R_L = 10\text{ k}$		180	300	ns
		$V_{CC} = 10\text{V}$ , $C_L = 5\text{ pF}$ , $R_L = 10\text{ k}$		-85	120	ns
$t_{1H}$ , $t_{0H}$	Propagation Delay from a Logical "1" or Logical "0" to the High Impedance State from Write Enable	$V_{CC} = 5\text{V}$ , $C_L = 5\text{ pF}$ , $R_L = 10\text{ k}$		180	300	ns
		$V_{CC} = 10\text{V}$ , $C_L = 5\text{ pF}$ , $R_L = 10\text{ k}$		85	120	ns
$C_{IN}$	Input Capacity	Any Input (Note 2)		5		pF
$C_{OUT}$	Output Capacity	Any Output (Note 2)		6.5		pF
$C_{PD}$	Power Dissipation Capacity	(Note 3)		230		pF

\*AC Parameters are guaranteed by DC correlated testing.

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

**Note 3:**  $C_{PD}$  determines the no load AC power consumption of any CMOS device. For complete explanation see 54C/74C Family Characteristics application note, AN-90.

### AC Electrical Characteristics\* Guaranteed across the specified temperature range, $C_L = 50\text{ pF}$

Parameter	Conditions	MM54C89		MM74C89		Units
		$T_A = -55^\circ\text{C to } +125^\circ\text{C}$		$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		
		Min	Max	Min	Max	
$t_{PD}$	$V_{CC} = 5\text{V}$		700		600	ns
	$V_{CC} = 10\text{V}$		310		265	ns
	$V_{CC} = 15\text{V}$		250		210	ns
$t_{ACC}$	$V_{CC} = 5\text{V}$		910		780	ns
	$V_{CC} = 10\text{V}$		400		345	ns
	$V_{CC} = 15\text{V}$		320		270	ns
$t_{SA}$	$V_{CC} = 5\text{V}$	210		180		ns
	$V_{CC} = 10\text{V}$	90		80		ns
	$V_{CC} = 15\text{V}$	70		60		ns
$t_{HA}$	$V_{CC} = 5\text{V}$	80		70		ns
	$V_{CC} = 10\text{V}$	55		50		ns
	$V_{CC} = 15\text{V}$	45		40		ns
$t_{ME}$	$V_{CC} = 5\text{V}$	560		480		ns
	$V_{CC} = 10\text{V}$	210		180		ns
	$V_{CC} = 15\text{V}$	170		150		ns
$t_{WE}$	$V_{CC} = 5\text{V}$	420		360		ns
	$V_{CC} = 10\text{V}$	140		120		ns
	$V_{CC} = 15\text{V}$	110		100		ns
$t_{HD}$	$V_{CC} = 5\text{V}$	70		60		ns
	$V_{CC} = 10\text{V}$	35		30		ns
	$V_{CC} = 15\text{V}$	30		25		ns

\*AC Parameters are guaranteed by DC correlated testing.

## AC Electrical Characteristics\*

Guaranteed across the specified temperature range,  $C_L = 50 \text{ pF}$  (Continued)

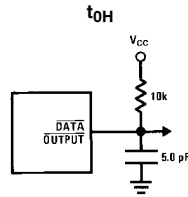
Parameter	Conditions	MM54C89		MM74C89		Units
		$T_A = -55^\circ\text{C to } +125^\circ\text{C}$		$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		
		Min	Max	Min	Max	
$t_{SD}$	$V_{CC} = 5\text{V}$	70		60		ns
	$V_{CC} = 10\text{V}$	35		30		ns
	$V_{CC} = 15\text{V}$	30		25		ns
$t_{1H}, t_{0H}$	$V_{CC} = 5\text{V}$		420		360	ns
	$V_{CC} = 10\text{V}, C_L = 5 \text{ pF}$		170		145	ns
	$V_{CC} = 15\text{V}, R_L = 10 \text{ k}\Omega$		135		115	ns

\*AC Parameters are guaranteed by DC correlated testing.

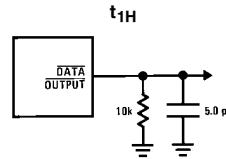
## Truth Table

ME	WE	Operation	Condition of Outputs
L	L	Write	TRI-STATE
L	H	Read	Complement of Selected Word
H	L	Inhibit, Storage	TRI-STATE
H	H	Inhibit, Storage	TRI-STATE

## AC Test Circuits

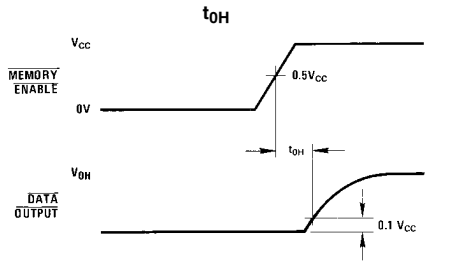


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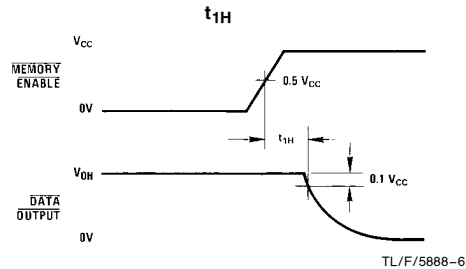


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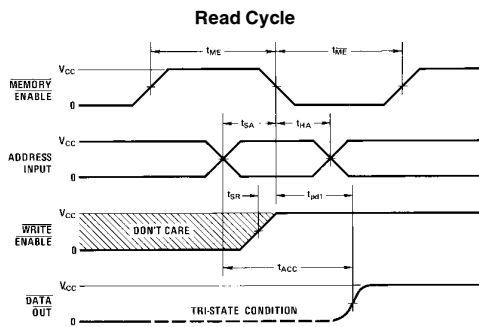
## Switching Time Waveforms



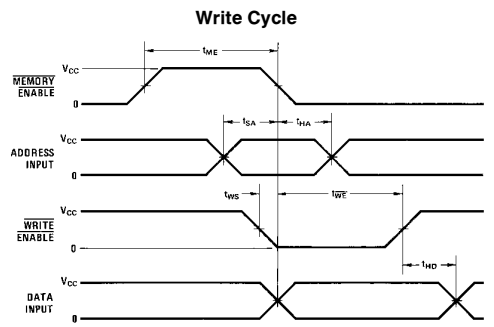
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TL/F/5888-6



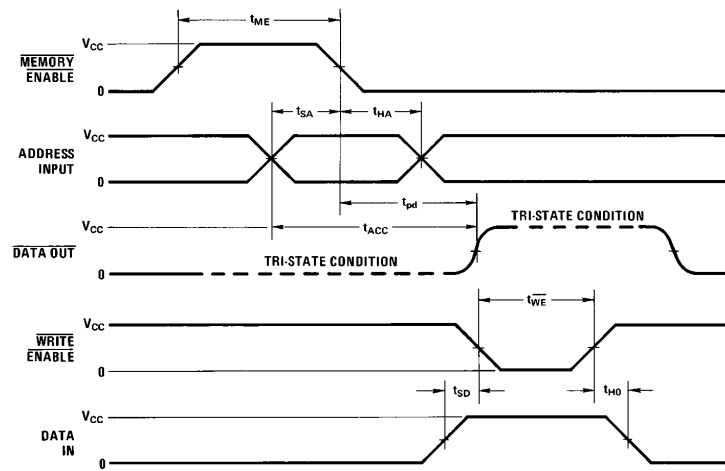
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TL/F/5888-8

## Switching Time Waveforms (Continued)

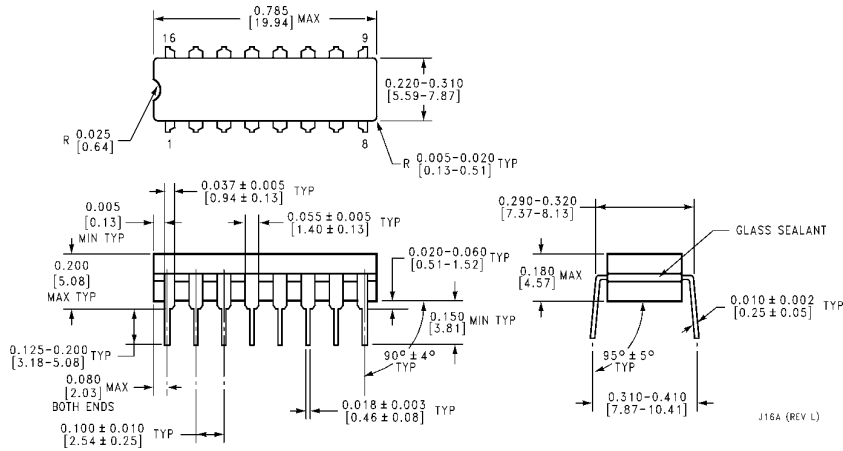
### Read Modify Write Cycle



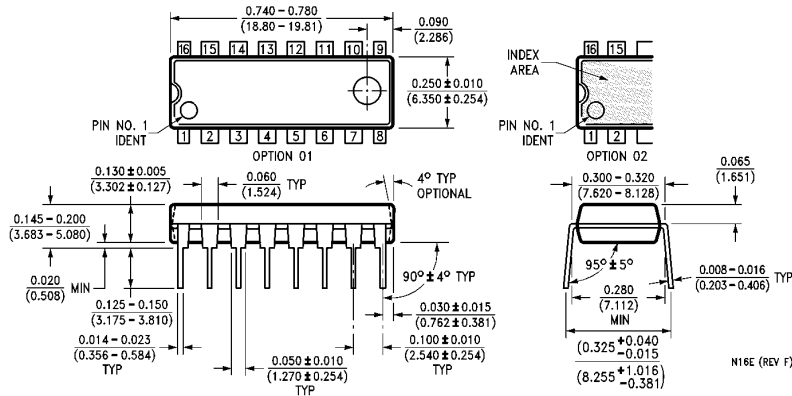
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**Note:**  $t_r = 60$  ns  
 $t_f = 10$  ns

**Physical Dimensions** inches (millimeters)



**Ceramic Dual-In-Line Package (J)**  
**Order Number MM54C89J or MM74C89J**  
**NS Package Number J16A**



**Molded Dual-In-Line Package (N)**  
**Order Number MM54C89N or MM74C89N**  
**NS Package Number N16E**

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