TMS2114, TMS2114L
1024-WORD BY 4-BIT STATIC RAMS

DECEMBER 1979 – REVISED AUGUST 1983

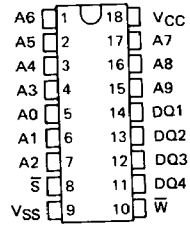
- Previously Called TMS4045/TMS40L45
- 1024 X 4 Organization
- Single +5-V Supply
- High Density 300-mil (7.62 mm) 18-Pin Package
- Fully Static Operation (No Clocks, No Refresh, No Timing Strobe)
- 4 Performance Ranges:

	ACCESS READ OR WRITE TIME (MAX)	CYCLE (MIN)
TMS2114-15, TMS2114L-15	150 ns	150 ns
TMS2114-20, TMS2114L-20	200 ns	200 ns
TMS2114-25, TMS2114L-25	250 ns	250 ns
TMS2114-45, TMS2114L-45	450 ns	450 ns

- 400-mV Guaranteed DC Noise Immunity with Standard TTL Loads – No Pull-Up Resistors Required
- Common I/O Capability
- 3-State Outputs and Chip Select Control for OR-Tie Capability
- Fan-Out to 2 Series 74, 1 Series 74S, or 8 Series 74LS TTL Loads
- Low Power Dissipation

	MAX (OPERATING)
TMS2114	550 mW
TMS2114L	330 mW

TMS2114, TMS2114L . . . NL PACKAGE
(TOP VIEW)



PIN NOMENCLATURE	
A0 – A9	Addresses
DQ1 – DQ4	Data In/Data Out
S̄	Chip Select
VCC	+5-V Supply
VSS	Ground
W̄	Write Enable

description

This series of static random-access memories is organized as 1024 words of 4 bits each. Static design results in reducing overhead costs by elimination of refresh-clocking circuitry and by simplification of timing requirements. Because this series is fully static, chip select may be tied low to further simplify system timing. Output data is always available during a read cycle.

All inputs and outputs are fully compatible with Series 74, 74S or 74LS TTL. No pull-up resistors are required. This 4K Static RAM series is manufactured using TI's reliable N-channel silicon-gate technology to optimize the cost/performance relationship.

The TMS2114/2114L series is offered in the 18-pin dual-in-line plastic (NL suffix) package designed for insertion in mounting-hole rows on 300-mil (7.62 mm) centers. The series is guaranteed for operation from 0°C to 70°C.

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operation

addresses (A0 – A9)

The ten address inputs select one of the 1024 4-bit words in the RAM. The address inputs must be stable for the duration of a write cycle. The address inputs can be driven directly from standard Series 54/74 TTL with no external pull-up resistors.

chip select ($\overline{S}$)

The chip-select terminal, which can be driven directly from standard TTL circuits, affects the data-in and data-out terminals. When chip select is at a logic low level, both terminals are enabled. When chip select is high, data-in is inhibited and data-out is in the floating or high-impedance state.

write enable ($\overline{W}$)

The read or write mode is selected through the write enable terminal. A logic high selects the read mode; a logic low selects the write mode. $\overline{W}$ or $\overline{S}$ must be high when changing addresses to prevent erroneously writing data into a memory location. The $\overline{W}$ input can be driven directly from standard TTL circuits.

data-in/data-out (DQ1 – DQ4)

Data can be written into a selected device when the write enable input is low. The DQ terminal can be driven directly from standard TTL circuits. The three-state output buffer provides direct TTL compatibility with a fan-out of two Series 74 TTL gates, one Series 74S TTL gate, or eight Series 74LS TTL gates. The DQ terminals are in the high-impedance state when chip select ($\overline{S}$) is high or whenever a write operation is being performed. Data-out is the same polarity as data-in.

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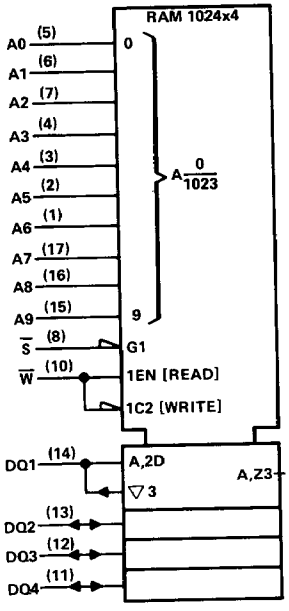
logic symbol†



†This symbol is in accordance with IEEE Std 91/ANSI Y32.14 and recent decisions by IEEE and IEC. See explanation on page 10-1.

FUNCTION TABLE

$\overline{W}$	$\overline{S}$	DQ1 – DQ4	MODE
L	L	VALID DATA	WRITE
H	L	DATA OUTPUT	READ
X	H	HI-Z	DEVICE DISABLED

absolute maximum ratings over operating free-air temperature (unless otherwise noted)†

Supply voltage, V_{CC} (see Note 1) . . . . . −0.5 V to 7 V
Input voltage (any input) (see Note 1) . . . . . −1 V to 7 V
Continuous power dissipation . . . . . 1 W
Operating free-air temperature range . . . . . 0°C to 70°C
Storage temperature range . . . . . −55°C to 150°C

† Stresses beyond those listed under "Absolute Maximum Rating" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the "Recommended Operating Conditions" section of this specification is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: Voltage values are with respect to the ground material.

recommended operating conditions

PARAMETER	TMS2114 TMS2114L			UNIT
	MIN	NOM	MAX	
Supply voltage, V_{CC}	4.5	5	5.5	V
Supply voltage, V_{SS}		0		V
High-level input voltage, V_{IH}	2		5.5	V
Low-level input voltage, V_{IL} (see Note 2)	−1		0.8	V
Operating free-air temperature, T_A	0		70	°C

NOTE 2: The algebraic convention, where the more negative (less positive) limit is designated as minium, is used in this data sheet for logic voltage levels only.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS†			MIN	TYP‡	MAX	UNIT
V_{OH}	High-level voltage	I_{OH} = −1 mA	V_{CC} = MIN (operating)		2.4			V
V_{OL}	Low-level voltage	I_{OL} = 3.2 mA	V_{CC} = MIN (operating)				0.4	V
I_I	Input current	V_I = 0 V to MAX					10	μA
I_{OZ}	Off-state output current	$\overline{S}$ at 2 V or $\overline{W}$ at 0.8 V	V_O = 0 V to MAX				±10	μA
I_{CC}	Supply current from V_{CC}	I_O = 0 mA, T_A = 0°C (worst case)	TMS 2114	V_{CC} = MAX		90	100	mA
			TMS 2114L	V_{CC} = MAX		50	60	
C_i	Input capacitance	V_I = 0 V, f = 1 MHz					8	pF
C_o	Output capacitance	V_O = 0 V, f = 1 MHz					8	pF

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.
‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.

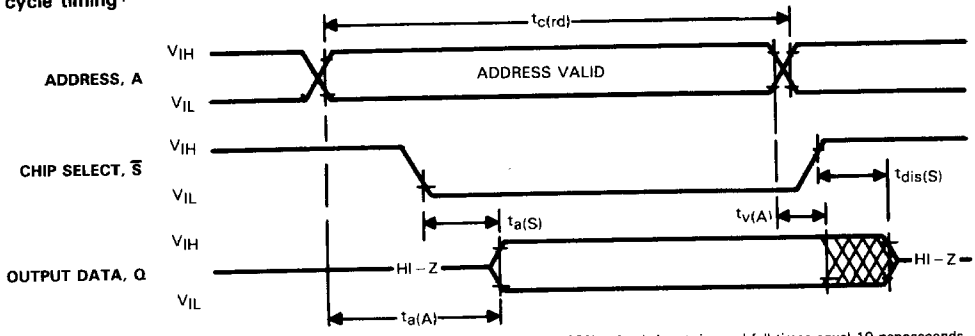
timing requirements over recommended supply voltage range, T_A = 0°C to 70°C, 1 Series 74 TTL load, C_L = 100 pF

PARAMETER		TMS2114-15 TMS2114L-15		TMS2114-20 TMS2114L-20		TMS2114-25 TMS2114L-25		TMS2114-45 TMS2114L-45		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{c(rd)}$	Read cycle time	150		200		250		450		ns
$t_{c(wr)}$	Write cycle time	150		200		250		450		ns
$t_{w(W)}$	Write pulse width	80		100		100		200		ns
$t_{su(A)}$	Address set up time	0		0		0		0		ns
$t_{su(S)}$	Chip select set up time	80		100		100		200		ns
$t_{su(D)}$	Data set up time	80		100		100		200		ns
$t_{h(D)}$	Data hold time	0		0		0		0		ns
$t_{h(A)}$	Address hold time	0		0		0		20		ns

switching characteristics over recommended voltage range, T_A = 0°C to 70°C, 1 Series 74 TTL load, C_L = 100 pF

PARAMETER		TMS2114-15 TMS2114L-15		TMS2114-20 TMS2114L-20		TMS2114-25 TMS2114L-25		TMS2114-45 TMS2114L-45		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
$t_{a(A)}$	Access time from address		150		200		250		450	ns
$t_{a(S)}$	Access time from chip select (or output enable) low		70		85		100		120	ns
$t_{a(W)}$	Access time from write enable high		70		85		100		120	ns
$t_{v(A)}$	Output data valid after address change	20		20		20		20		ns
$t_{dis(S)}$	Output disable time after chip select (or output enable) high		50		60		60		100	ns
$t_{dis(W)}$	Output disable time after write enable low		50		60		60		100	ns

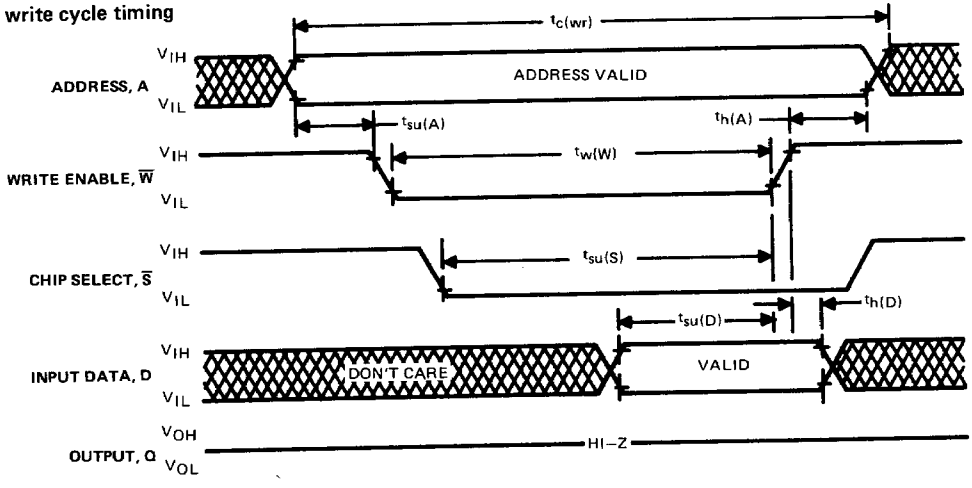
read cycle timing†



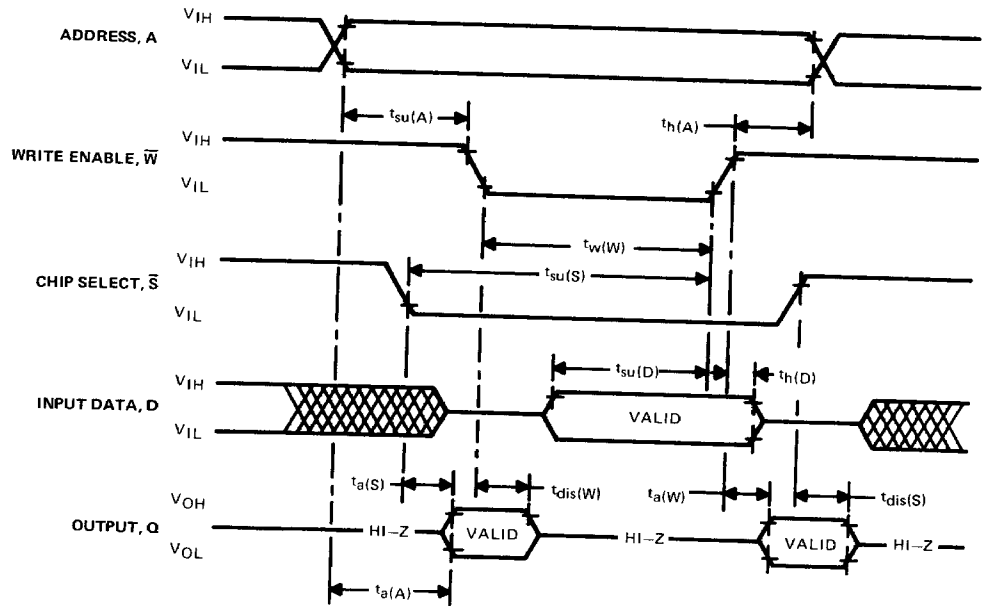
All timing reference points are 0.8 V and 2.0 V on inputs and 0.6 V and 2.2 V on outputs (90% points). Input rise and fall times equal 10 nanoseconds.

†Write enable is high for a read cycle.

early write cycle timing



read-write cycle timing



TYPICAL APPLICATION DATA

Early write cycle avoids DQ conflicts by controlling the write time with $\overline{S}$. On the diagram above, the write operation will be controlled by the leading edge of $\overline{S}$, not $\overline{W}$. Data can only be written when both $\overline{S}$ and $\overline{W}$ are low. Either $\overline{S}$ or $\overline{W}$ being high inhibits the write operation. To prevent erroneous data being written into the array, the addresses must be stable during the write cycle as defined by $t_{su(A)}$, $t_{w(W)}$, and $t_{h(A)}$.