LH521002C
CMOS 256K × 4 Static RAM

FEATURES

- Fast Access Times: 17/20/25/35 ns
- JEDEC Standard Pinouts
- Low Power Standby when Deselected
- TTL Compatible I/O
- 5 V ± 10% Supply
- Fully Static Operation
- Packages:
  28-pin, 300-mil SOJ (Preliminary)
  28-pin, 400-mil SOJ

FUNCTIONAL DESCRIPTION

The LH521002C is a high-speed 1M-bit static RAM organized as 256K × 4. A fast, efficient design is obtained with a CMOS periphery and a matrix constructed with polysilicon load memory cells.

This RAM is fully static in operation. The Chip Enable ($\overline{E}$) reduces power to the chip when $\overline{E}$ is HIGH. Standby power drops to its lowest level when $\overline{E}$ is raised to within 0.2 V of V_{CC}.

Write cycles occur when both ($\overline{E}$) and Write Enable ($\overline{W}$) are LOW. Data is transferred from the DQ pins to the memory location specified by the 18 address lines.

Read cycles occur when $\overline{E}$ is LOW and $\overline{W}$ is HIGH. A Read cycle will begin upon an address transition, on a falling edge of $\overline{E}$, or on a rising edge of $\overline{W}$.

The 'L' version will retain data down to a supply voltage of 2 V. A significantly lower current can be obtained (I_{DR}) under this Data Retention condition. CMOS Standby Current (I_{SB2}) is reduced on the 'L' version with respect to the standard version for those applications needing reduced power consumption.

High frequency design techniques should be employed to obtain the best performance from this device. Solid, low-impedance power and ground planes, with high frequency decoupling capacitors, are desirable. Series termination of the inputs should be considered when transmission line effects occur.

PIN CONNECTIONS

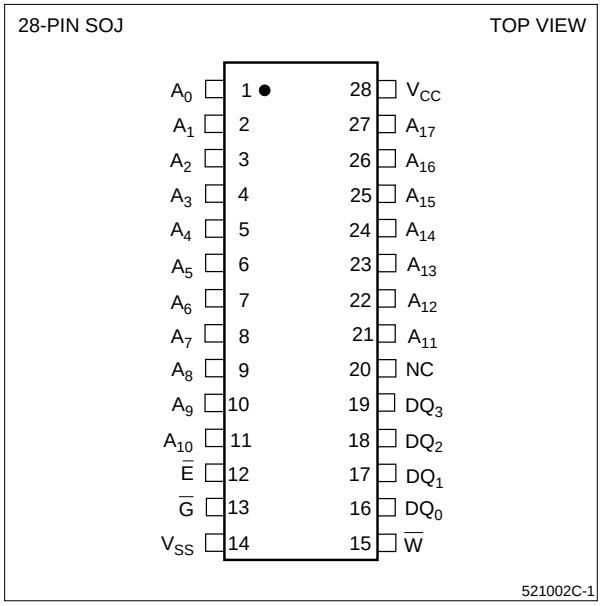


Figure 1. Pin Connections for SOJ Package

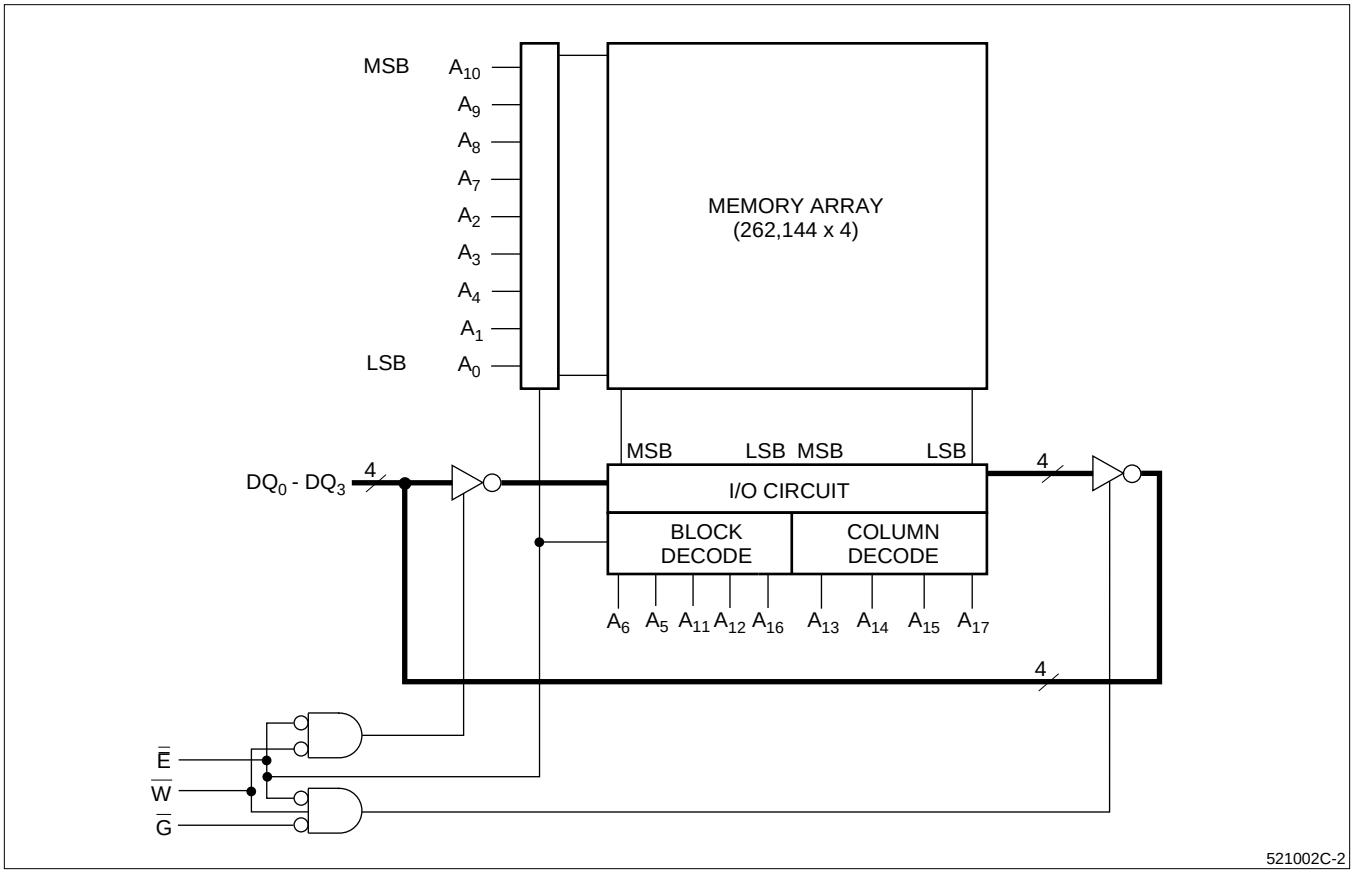


Figure 2. LH521002C Block Diagram

TRUTH TABLE

$\overline{E}$	$\overline{G}$	$\overline{W}$	MODE	DQ	I_{CC}
H	X	X	Standby	High-Z	Standby
L	H	H	Selected	High-Z	Active
L	L	H	Read	Data Out	Active
L	X	L	Write	Data In	Active

NOTE:

X = Don't Care, L = LOW, H = HIGH

PIN DESCRIPTIONS

PIN	DESCRIPTION
$A_0 – A_{17}$	Address Inputs
$DQ_0 – DQ_3$	Data Inputs/Outputs
$\overline{E}$	Chip Enable
$\overline{W}$	Write Enable
$\overline{G}$	Output Enable
V_{CC}	Positive Power Supply
V_{SS}	Ground

ABSOLUTE MAXIMUM RATINGS [1]

PARAMETER	RATING
V_{CC} to V_{SS} Potential	–0.5 V to 7 V
Input Voltage Range	–0.5 V to V_{CC} + 0.5 V
DC Output Current [2]	± 40 mA
Storage Temperature Range	–65°C to 150°C
Power Dissipation (Package Limit)	1.0 W

NOTES:

1.Stresses greater than those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. This is a stress rating for transient conditions only. Functional operation of the device at these or any other conditions above those indicated in the 'Operating Range' of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

2.Outputs should not be shorted for more than 30 seconds. No more than one output should be shorted at any time.

OPERATING RANGES

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
T_A	Temperature, Ambient	0		70	°C
V_{CC}	Supply Voltage	4.5	5.0	5.5	V
V_{SS}	Supply Voltage	0	0	0	V
V_{IL}	Logic '0' Input Voltage [1]	–0.5		0.8	V
V_{IH}	Logic '1' Input Voltage	2.2		V_{CC} + 0.5	V

NOTE:

1.Negative undershoot of up to 3.0 V is permitted once per cycle.

DC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{CC1}	Operating Current [1]	t_{CYCLE} = 17 ns		105	155	mA
I_{CC1}	Operating Current [1]	t_{CYCLE} = 20 ns		95	140	mA
I_{CC1}	Operating Current [1]	t_{CYCLE} = 25 ns		85	125	mA
I_{CC1}	Operating Current [1]	t_{CYCLE} = 35 ns		85	125	mA
I_{SB1}	TTL Standby Current	$\overline{E} \geq V_{IH}$, t_{CYC} = 17 ns, I_{OUT} = 0			50	mA
I_{SB1}	TTL Standby Current	$\overline{E} \geq V_{IH}$, t_{CYC} = 20 ns, I_{OUT} = 0			45	mA
I_{SB1}	TTL Standby Current	$\overline{E} \geq V_{IH}$, t_{CYC} = 25 ns, I_{OUT} = 0			40	mA
I_{SB1}	TTL Standby Current	$\overline{E} \geq V_{IH}$, t_{CYC} = 35 ns, I_{OUT} = 0			35	mA
I_{SB2}	Standby Current	$\overline{E} \geq V_{CC}$ – 0.2 V, t_{CYC} = 0, I_{OUT} = 0			10	mA
I_{LI}	Input Leakage Current	V_{IN} = 0 V to V_{CC}	–2		2	µA
I_{LO}	I/O Leakage Current	V_{IN} = 0 V to V_{CC}	–2		2	µA
V_{OH}	Output High Voltage	I_{OH} = –4.0 mA	2.4			V
V_{OL}	Output Low Voltage	I_{OL} = 8.0 mA			0.4	V

NOTE:

1.I_{CC} is dependent upon output loading and cycle rates. Specified values are with outputs open.

AC TEST CONDITIONS

PARAMETER	RATING
Input Pulse Levels	V_{SS} to 3 V
Input Rise and Fall Times	5 ns
Input and Output Timing Ref. Levels	1.5 V
Output Load, Timing Tests	Figure 3

CAPACITANCE [1,2]

PARAMETER	RATING
C_{IN} (Input Capacitance)	7 pF
C_{DQ} (I/O Capacitance)	8 pF

NOTES:

1.Capacitances are maximum values at 25°C measured at 1 MHz with V_{Bias} = 0 V and V_{CC} = 5.0 V.

2.Guaranteed but not tested.

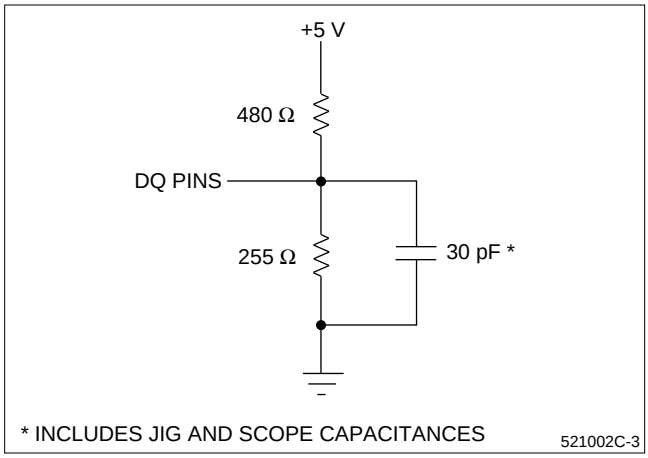


Figure 3. Output Load Circuit

AC ELECTRICAL CHARACTERISTICS [1] (Over Operating Range)

SYMBOL	DESCRIPTION	–17		–20		–25		–35		UNITS
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
READ CYCLE										
t_{RC}	Read Cycle Timing	17		20		25		35		ns
t_{AA}	Address Access Time		17		20		25		35	ns
t_{OH}	Output Hold from Address Change	3		3		3		3		ns
t_{EA}	$\overline{E}$ Low to Valid Data		17		20		25		35	ns
t_{ELZ}	$\overline{E}$ Low to Output Active [2,3]	5		5		5		5		ns
t_{EHZ}	$\overline{E}$ High to Output High-Z [2,3]		8		8		10		15	ns
t_{GA}	$\overline{G}$ Low to Valid Data		7		7		8		12	ns
t_{GLZ}	$\overline{G}$ Low to Output Active [2,3]	0		0		0		0		ns
t_{GHZ}	$\overline{G}$ High to Output High-Z [2,3]		6		6		10		20	ns
t_{PU}	$\overline{E}$ Low to Power Up Time [3]	0		0		0		0		ns
t_{PD}	$\overline{E}$ High to Power Down Time [3]		17		20		25		35	ns
WRITE CYCLE										
t_{WC}	Write Cycle Time	17		20		25		35		ns
t_{EW}	$\overline{E}$ Low to End of Write	12		12		15		20		ns
t_{AW}	Address Valid to End of Write	12		12		15		20		ns
t_{AS}	Address Setup	0		0		0		0		ns
t_{AH}	Address Hold From End of Write	0		0		0		0		ns
t_{WP}	$\overline{W}$ Pulse Width	12		12		15		20		ns
t_{DW}	Input Data Setup Time	9		9		10		12		ns
t_{DH}	Input Data Hold Time	0		0		0		0		ns
t_{WHZ}	$\overline{W}$ Low to Output High-Z [2,3]	0	7	0	8	0	10	0	15	ns
t_{WLZ}	$\overline{W}$ High to Output Active [2,3]	3		3		3		3		ns

NOTES:

1.AC Electrical Characteristics specified at 'AC Test Conditions' levels.

2.Active output to High-Z and High-Z to output active tests specified for a ±200 mV transition from steady state levels into the test load. C_{Load} = 5 pF.

3.Guaranteed but not tested.

TIMING DIAGRAMS – READ CYCLE

Read Cycle No. 1

Chip is in Read Mode: $\overline{W}$ is HIGH, $\overline{E}$ and $\overline{G}$ are LOW. Read cycle timing is referenced from when all addresses are stable until the first address transition. Crosshatched portion of DQ implies that data lines are in the Low-Z state and the data may not be valid.

Read Cycle No. 2

Chip is in Read Mode: $\overline{W}$ is HIGH. Timing illustrated for the case when addresses are valid while $\overline{E}$ goes LOW. Data Out is not specified to be valid until t_{EA}, but may become valid as soon as t_{ELZ}. Outputs will transition from High-Z to Valid Data Out. Data Out is valid after both t_{EA} and t_{GA} are met.

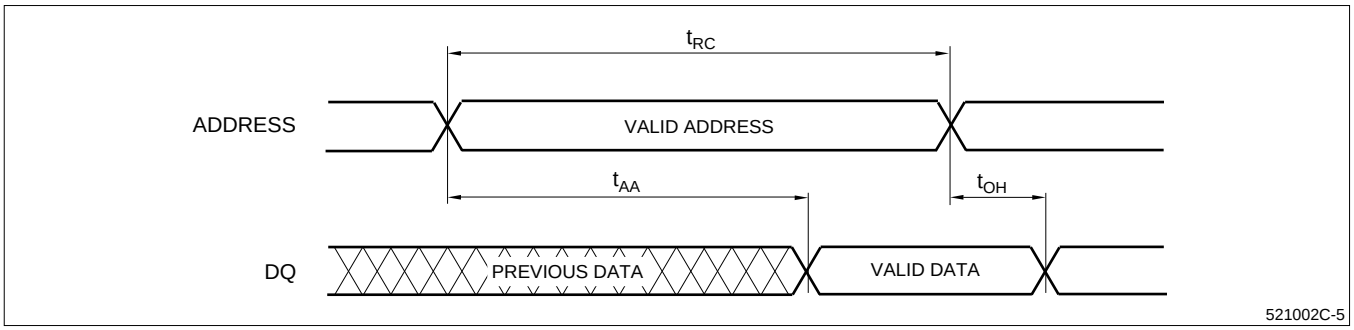


Figure 4. Read Cycle No. 1

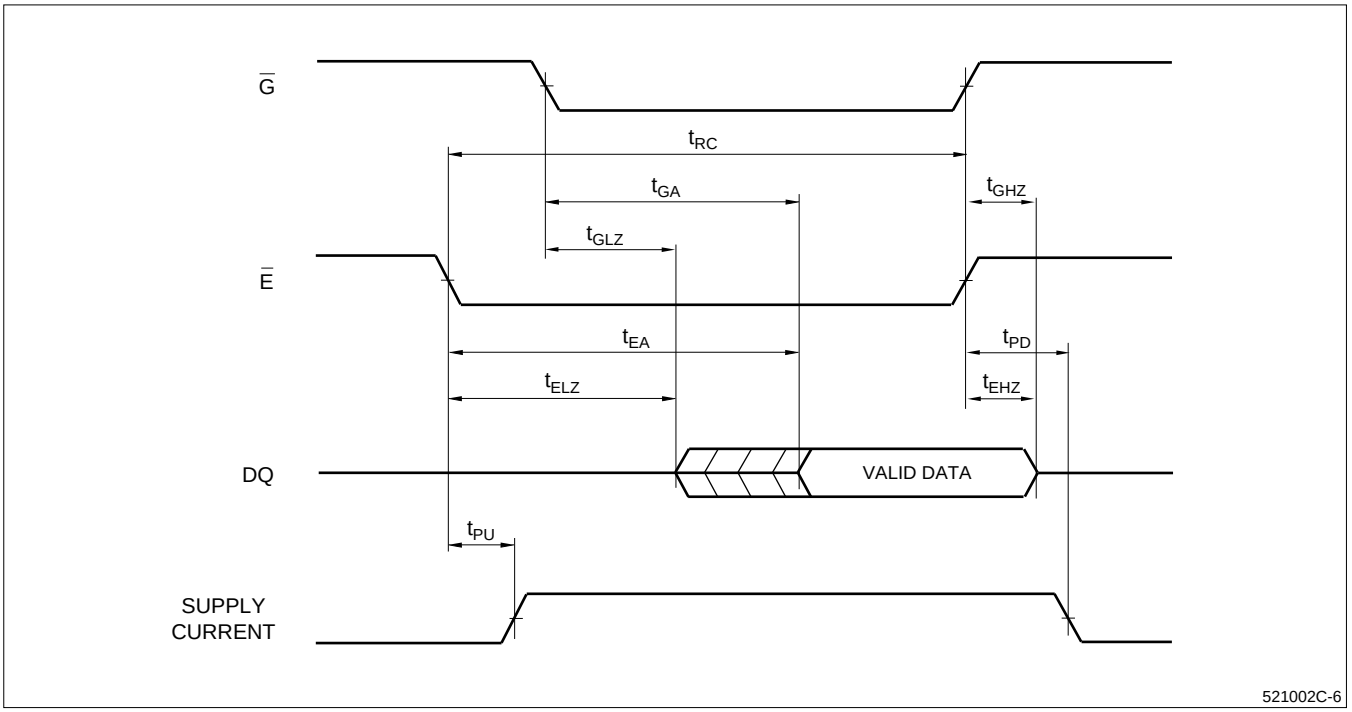


Figure 5. Read Cycle No. 2

TIMING DIAGRAMS – WRITE CYCLE

Addresses must be stable during Write cycles. $\overline{E}$ or $\overline{W}$ must be HIGH during address transitions. The outputs will remain in the High-Z state if $\overline{W}$ is LOW when $\overline{E}$ goes LOW. Care should be taken so that the output drivers are disabled prior to placing the Input Data on the DQ lines. This will prevent bus contention, reducing system noise.

Write Cycle No. 1 ($\overline{W}$ Controlled)

Chip is selected: $\overline{E}$ and $\overline{G}$ are LOW. Using only $\overline{W}$ to control Write cycles may not offer the best device performance, since both t_{WHZ} and t_{DW} timing specifications must be met.

Write Cycle No. 2 ($\overline{E}$ Controlled)

$\overline{G}$ is LOW. DQ lines may transition to Low-Z if the falling edge of $\overline{W}$ occurs after the falling edge of $\overline{E}$.

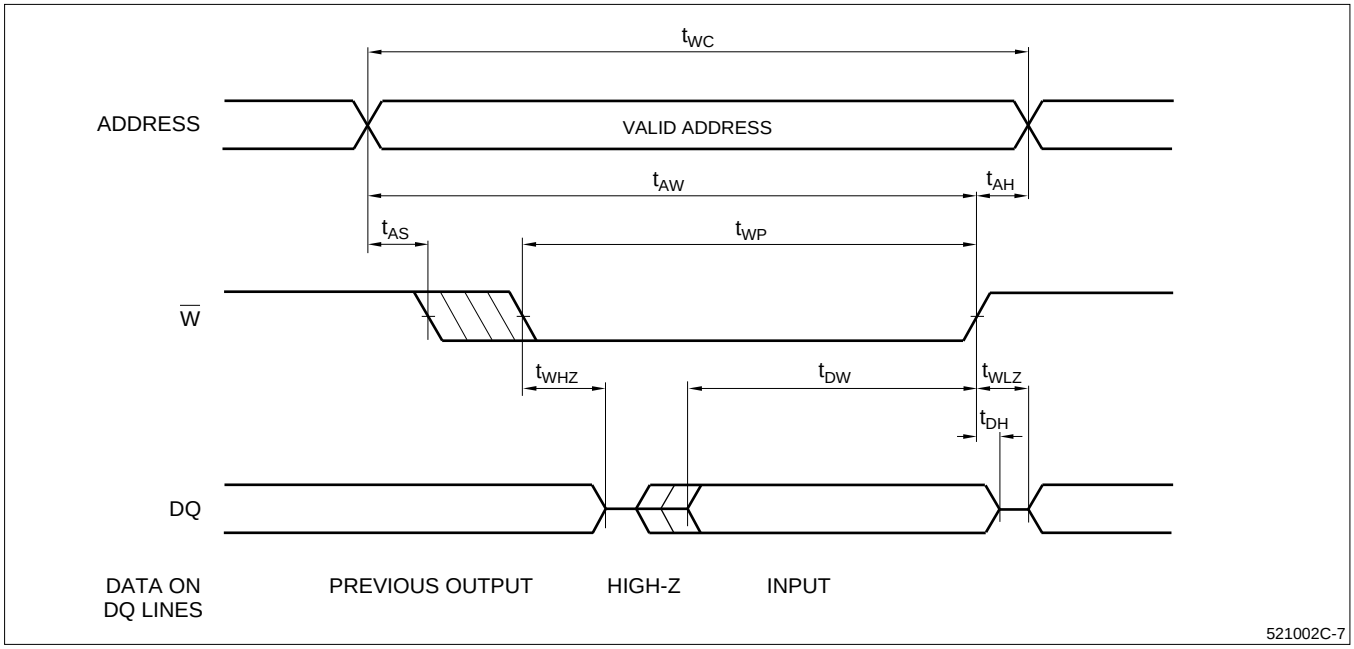


Figure 6. Write Cycle No. 1

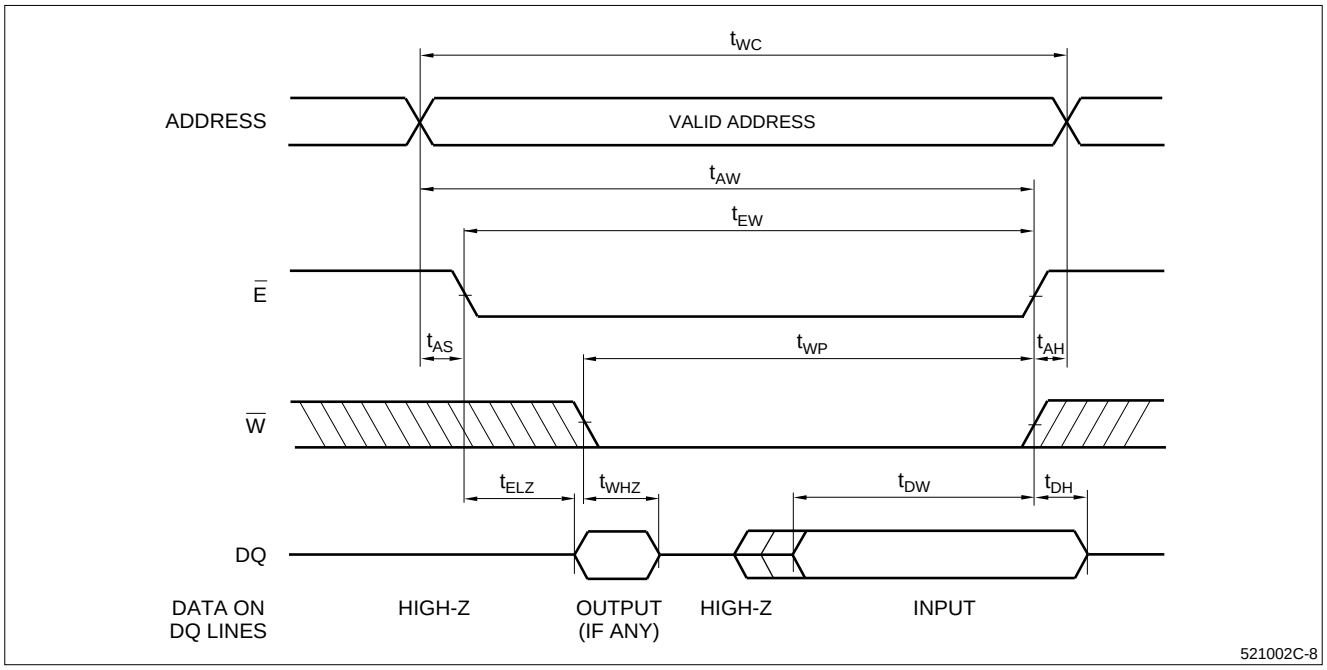
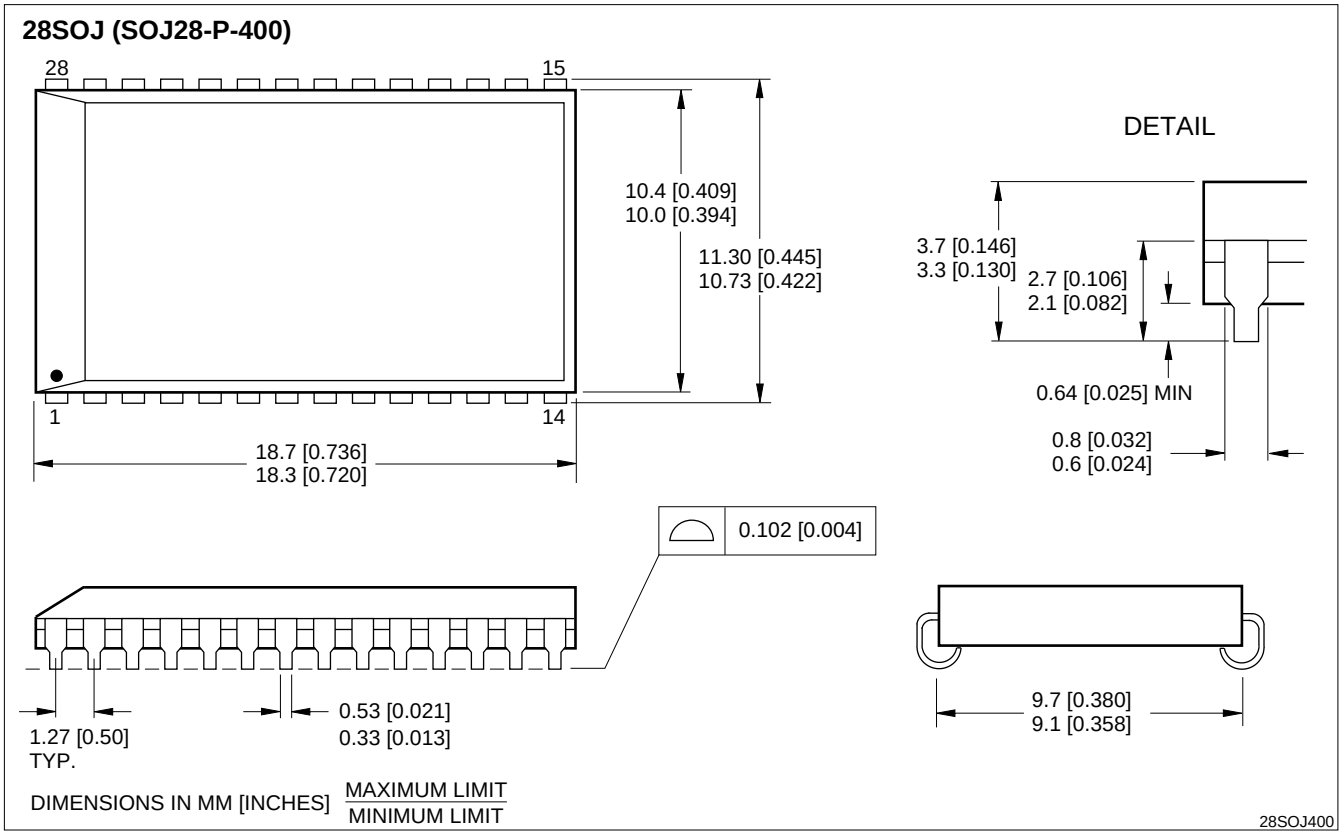


Figure 7. Write Cycle No. 2

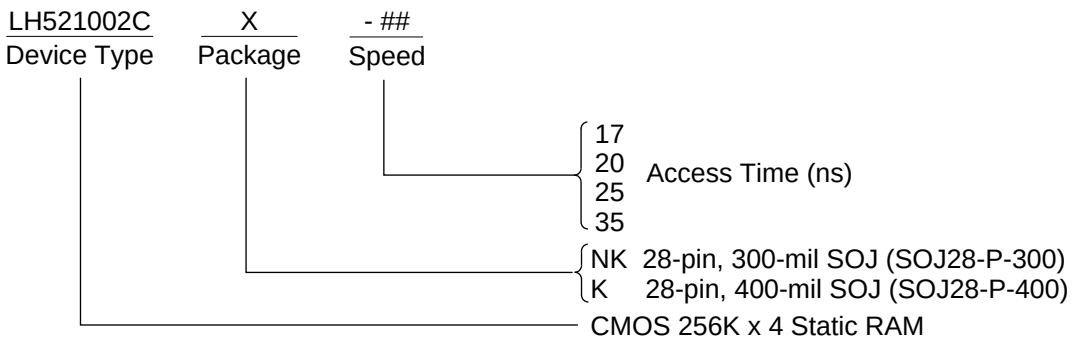
PACKAGE DIAGRAM: 28-PIN, 300-MIL SOJ PACKAGE

TO BE DETERMINED

PACKAGE DIAGRAM: 28-PIN, 400-MIL SOJ PACKAGE



ORDERING INFORMATION



Example: LH521002CK-25 (CMOS 256K x 4 Static RAM, 25 ns, 28-pin, 400-mil SOJ)

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NOTES

NOTES

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