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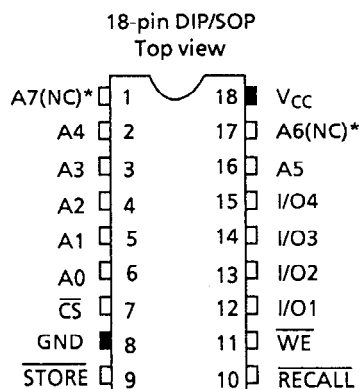
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The S-22 Series is a non-volatile CMOS RAM, composed of a CMOS static RAM and a non-volatile electrically erasable and programmable memory (E²PROM) to backup the SRAM. The organization is 256-word × 4-bit (total 1K bits) for the S-22H12 and the S-22S12, and 64-word × 4-bit (total 256 bits) for the S-22H10 and the S-22S10.

■ Features

- 1K bits
 - S-22H12: TTL input, compatible with the X2212 of Xicor
 - S-22S12: Schmitt input for $\overline{\text{STORE}}$ and $\overline{\text{RECALL}}$ pins
- 256 bits
 - S-22H10: TTL input, compatible with the X2210 of Xicor
 - S-22S10: Schmitt input for $\overline{\text{STORE}}$ and $\overline{\text{RECALL}}$ pins
- Erroneous store protection : $\approx 3.5 \text{ V}$
- +5-V single power supply ($+5 \text{ V} \pm 10\%$)
- Low current consumption
 - Operating: 10 mA typ.
 - Standby : 1 μA max.
- Access time: 200 ns max.
- E²PROM store cycles : 10^5 times
- E²PROM data retention: 10 years
- 18-pin DIP/SOP package

■ Pin Assignment



A0 to A7(A5)*	Address input
I/O1 to I/O4	Data input/output
$\overline{\text{WE}}$	Write enable
$\overline{\text{CS}}$	Chip select
$\overline{\text{RECALL}}$	Recall
$\overline{\text{STORE}}$	Store
GND	Ground
V _{CC}	Power supply voltage (+ 5 V)

*() is for the S-22H10 and S-22S10.

Figure 1

■ Block Diagram

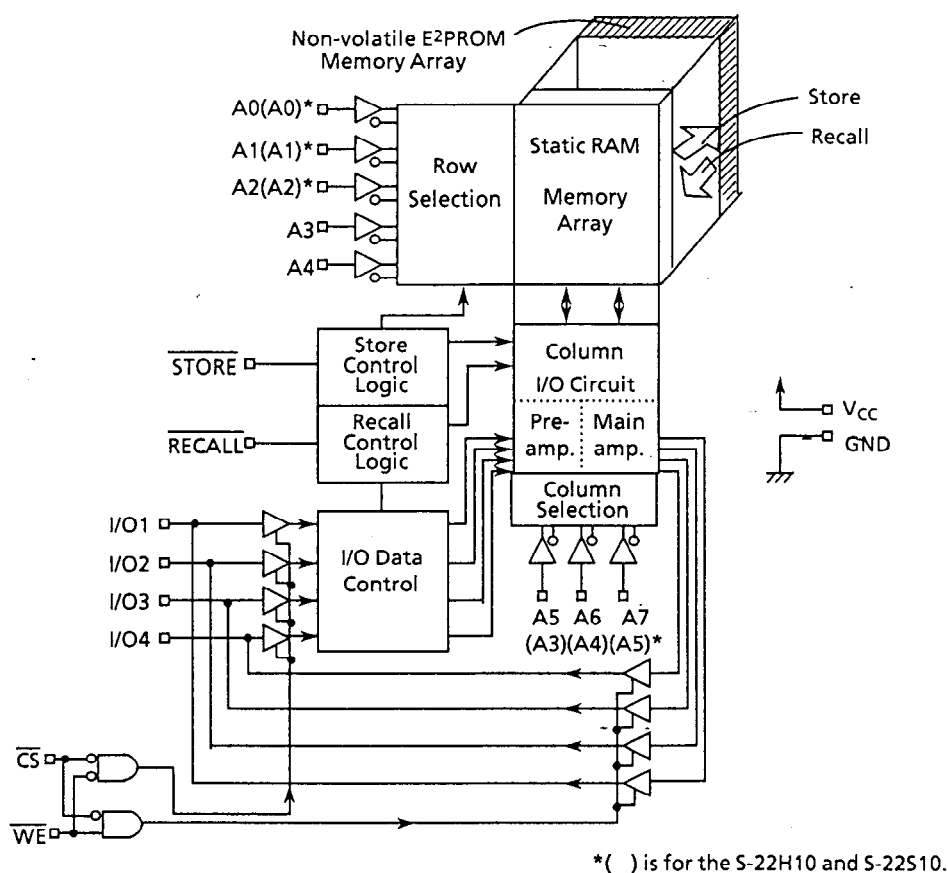


Figure 2

■ Absolute Maximum Ratings

Table 1

Parameter	Symbol	Ratings	Unit
Power supply voltage	V_{CC}	-0.3 to +6.0	V
Input voltage	V_{IN}	-0.3 to $V_{CC} + 0.3$	V
Output voltage	V_{OUT}	0.0 to V_{CC}	V
Storage temperature under bias	T_{bias}	-50 to +95	°C
Storage temperature	T_{stg}	-65 to +150	°C

■ Recommended Operating Conditions

Table 2

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power supply voltage	V_{CC}		4.5	5.0	5.5	V
High level input voltage 1	V_{IH}	S-22H Series : All inputs S-22S Series : $\overline{CS}$, $\overline{WE}$, I/O and address	2.0	—	V_{CC}	V
High level input voltage 2	V_{IHS}	S-22S Series : STORE and RECALL	3.4	—	V_{CC}	V
Low level input voltage 1	V_{IL}	S-22H Series : All inputs S-22S Series : $\overline{CS}$, $\overline{WE}$, I/O and address	0.0	—	0.8	V
Low level input voltage 2	V_{ILS}	S-22S Series : STORE and RECALL	0.0	—	0.8	V
Operating temperature	T_{opr}		-40	—	+85	°C

Pin Capacitance

Table 3

(Ta = 25°C, f = 1.0 MHz, V_{CC} = 5 V)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input capacitance	C _{IN}	V _{IN} = 0 V	—	—	6	pF
Output capacitance (I/O pins)	C _{I/O}	V _{I/O} = 0 V	—	—	10	pF

DC Electrical Characteristics

Table 4

(Ta = -40°C to 85°C, V_{CC} = +5 V ± 10%)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Operating current consumption	I _{CC}		—	10	30	mA
Standby current	I _{SB}	All inputs are V _{CC}	—	—	1	μA
Input leakage current	I _{LI}	V _{IN} = GND to V _{CC}	—	0.1	1	μA
Output leakage current	I _{LO}	V _{OUT} = GND to V _{CC}	—	0.1	1	μA
Low level output voltage	V _{OL}	CMOS : I _{OL} = 100 μA	—	—	0.1	V
		TTL : I _{OL} = 4.2 mA	—	—	0.4	V
High level output voltage	V _{OH}	CMOS : I _{OH} = -100 μA	V _{CC} -0.7	—	—	V
		TTL : I _{OH} = -2 mA	2.4	—	—	V
Store inhibition voltage	V _{WI}		—	3.5	4.1	V
Schmitt width	V _{WD}	S-22S Series : <u>STORE</u> and <u>RECALL</u>	0.4	—	—	V

Data Hold Characteristics

Table 5

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Data hold voltage	V _{DH}	$\overline{CS} \geq V_{CC}-0.2V$, <u>RECALL</u> $\geq V_{CC}-0.2V$	1.5	—	5.5	V
Data hold setup time	t _{CDH}		50	—	—	ns
Recovery time	t _R		300	—	—	ns

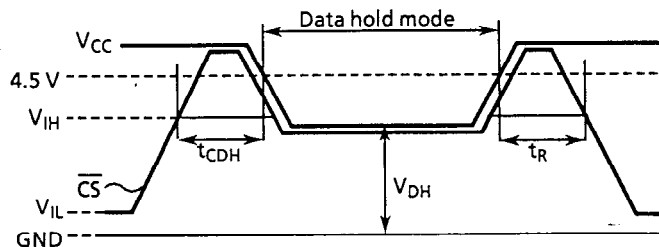


Figure 3 Data hold timing chart

■ AC Electrical Characteristics

Table 6 Measuring conditions

Parameter	Conditions	
Input pulse voltage	S-22H Series : All inputs	0.0 to 3.0 V
	S-22S Series : $\overline{CS}$, $\overline{WE}$, I/O and address	0.0 to 4.0 V
Input pulse rise/fall time	S-22S Series : $\overline{STORE}$ and $\overline{RECALL}$	10 ns
I/O reference voltage		1.5 V
Output load		1TTL + 100pF

1. Read cycle

Table 7

Parameter	Symbol	Min.	Typ.	Max	Unit
Read cycle time	t_{RC}	200	—	—	ns
Address access time	t_{AA}	—	—	200	ns
$\overline{CS}$ access time	t_{CS}	—	—	200	ns
Output data hold time	t_{OH}	20	—	—	ns
Output enable time ($\overline{CS}$)	t_{CLZ}	10	—	—	ns
Output disable time ($\overline{CS}$)	t_{CHZ}	10	—	70	ns

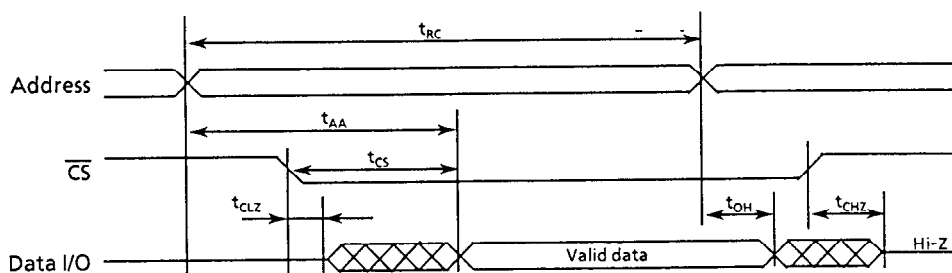


Figure 4

2. Write Cycle

Table 8

Parameter	Symbol	Min.	Typ.	Max	Unit
Write cycle time	t_{WC}	200	—	—	ns
$\overline{CS}$ pulse width	t_{CW}	120	—	—	ns
Address setup time	t_{AS}	20	—	—	ns
$\overline{WE}$ pulse width	t_{WP}	120	—	—	ns
Write reset time	t_{WR}	25	—	—	ns
Input data setup time	t_{DW}	50	—	—	ns
Input data hold time	t_{DH}	20	—	—	ns
Output disable time ($\overline{WE}$)	t_{WHZ}	10	—	70	ns
Output enable time ($\overline{WE}$)	t_{WLZ}	10	—	—	ns

· Write cycle 1 : $\overline{WE}$ control

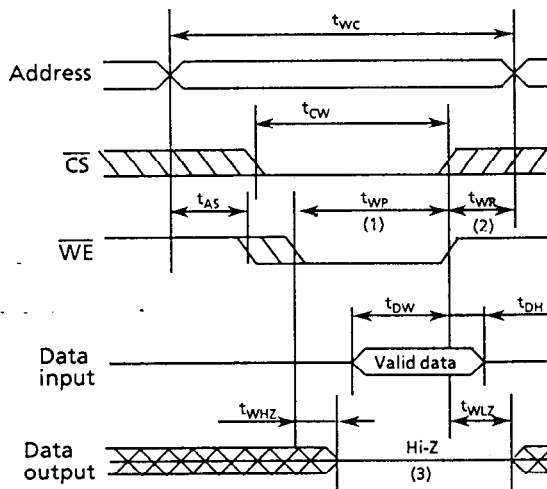


Figure 5

· Write cycle 2 : $\overline{CS}$ control

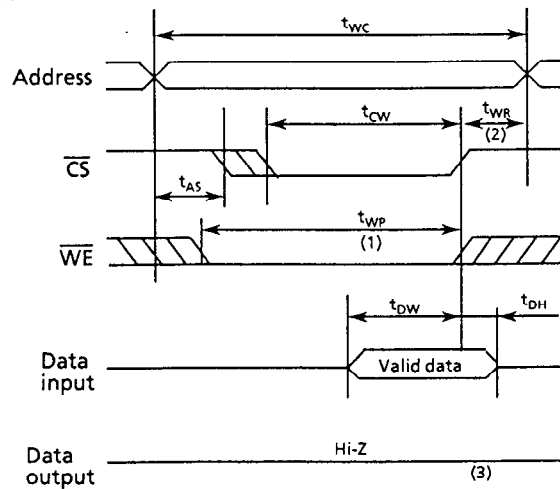


Figure 6

- (1) The write cycle starts when both $\overline{CS}$ and $\overline{WE}$ are low.
- (2) t_{WR} is the period of time from the rise of $\overline{CS}$ or $\overline{WE}$ whichever is the first to the end of write cycle.
- (3) Output remains in high-impedance state when $\overline{CS}$ falls simultaneously with or after the fall of $\overline{WE}$.

3. Store Cycle

Table 9

Parameter	Symbol	Min.	Typ.	Max	Unit
Store time	t_{ST}	—	—	10	ms
Store pulse width	t_{STP}	200	—	—	ns
Store disable time	t_{STZ}	—	—	100	ns
Store enable time	t_{OST}	10	—	—	ns

Store operation starts at the falling of $\overline{STORE}$.

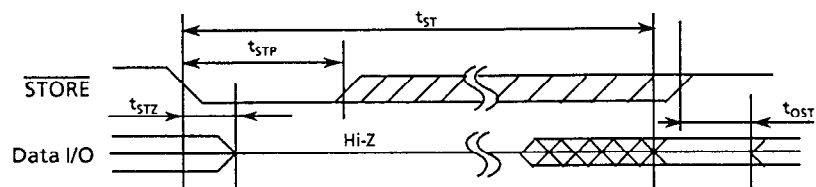


Figure 7

4. Recall cycle

Table 10

Parameter	Symbol	Min.	Typ.	Max	Unit
Recall cycle time	t_{RCC}	1300	—	—	ns
Recall pulse width	t_{RCP}	200	—	—	ns
Recall disable time	t_{RCZ}	—	—	100	ns
Recall enable time	t_{ORC}	10	—	—	ns
Recall data access time	t_{ARC}	—	—	1100	ns

Recall operation starts at the rise of $\overline{RECALL}$. It can be repeated without limitation.

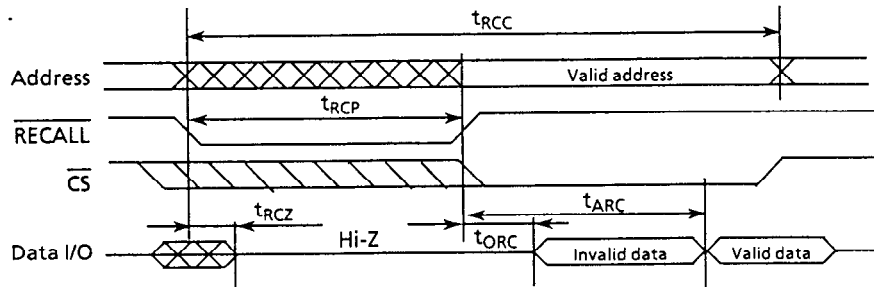


Figure 8

■ Operation Mode

Table 11

Mode	Input				Input/output
	$\overline{CS}$	$\overline{WE}$	$\overline{RECALL}$	$\overline{STORE}$	
Standby mode	H	X	H	H	Output is high impedance
Read mode	L	H	H	H	Output data
Write mode	L	L	H	H	Input data
Recall mode	X	H	L	H	Output is high impedance
Store mode	X	H	H	L	Output is high impedance
	H	X	H	L	

X: Don't care

Notes: When $\overline{RECALL}$ and $\overline{STORE}$ are simultaneously input, $\overline{RECALL}$ is valid.

· When $\overline{RECALL}$ is low, $\overline{STORE}$ cannot be received.

· When power supply voltage (V_{CC}) is below store inhibition voltage V_{WI} , the store operation is inhibited.

■ Operation

1. Standby mode

When $\overline{CS}$ goes high, the S-22 Series enters into the standby mode: power consumption becomes lowest, and I/O1 to I/O4 are high impedance.

2. SRAM modes

2.1 Read mode

When $\overline{CS}$ is low and $\overline{WE}$ is high, the S-22 Series enters into the read mode: the SRAM data is output to I/O1 to I/O4.

2.2 Write mode

When $\overline{CS}$ and $\overline{WE}$ are low, the S-22 Series enters into the write mode: the data input in I/O1 to I/O4 is written to the SRAM.

3. SRAM $\leftrightarrow$ E²PROM mode

3.1 Store mode

When $\overline{\text{STORE}}$ goes $V_{IL}(V_{ILS})$, the S-22 Series enters into the store mode: the SRAM data is copied to the E²PROM. The original data in the SRAM is effective. Since the copied data in the E²PROM is non-volatile, they are retained even if power turns off. When $\overline{\text{STORE}}$ falls, the store operation starts and finishes automatically. When store operation starts, I/O1 to I/O4 go to high impedance and other operations are inhibited until store operation is finished and $\overline{\text{STORE}}$ goes to high. During store operation, the CPU can access other instructions.

The store operation is inhibited if power supply voltage (V_{CC}) is under V_{WI} (≈ 3.5 V).

The following two methods prevent erroneous store, caused by noise when power turns on or off:

- $\overline{\text{RECALL}}$ goes $V_{IL}(V_{ILS})$ when power turns on or off (see Figure 9).
- $\overline{\text{STORE}}$ connects to V_{CC} with pull-up resistor.

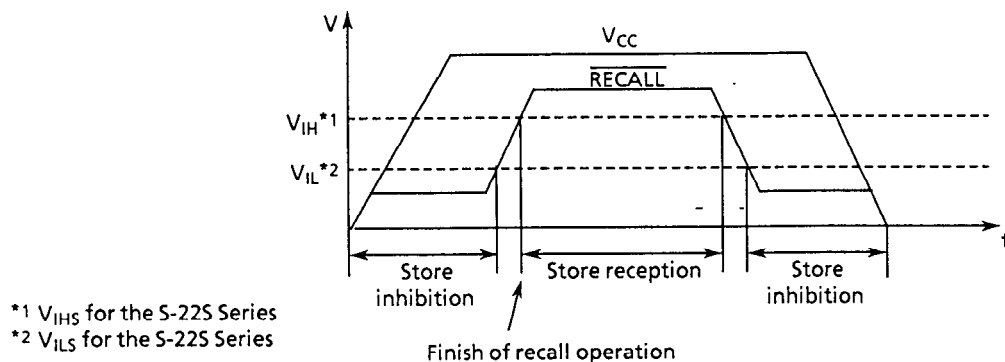


Figure 9 STORE inhibition period and reception period at power ON and OFF

3.2 Recall mode

When $\overline{\text{RECALL}}$ goes $V_{IL}(V_{ILS})$, the S-22 Series enters into the recall mode: the data copied into the E²PROM is recopied to the SRAM. The recopied data can be read or written as SRAM data. Even if the data is copied repeatedly, the data in the E²PROM does not change. Other operations are inhibited during its operation.

PARALLEL NON-VOLATILE RAM
S-22 Series

■ Dimensions (Unit:mm)

1. 18-pin DIP

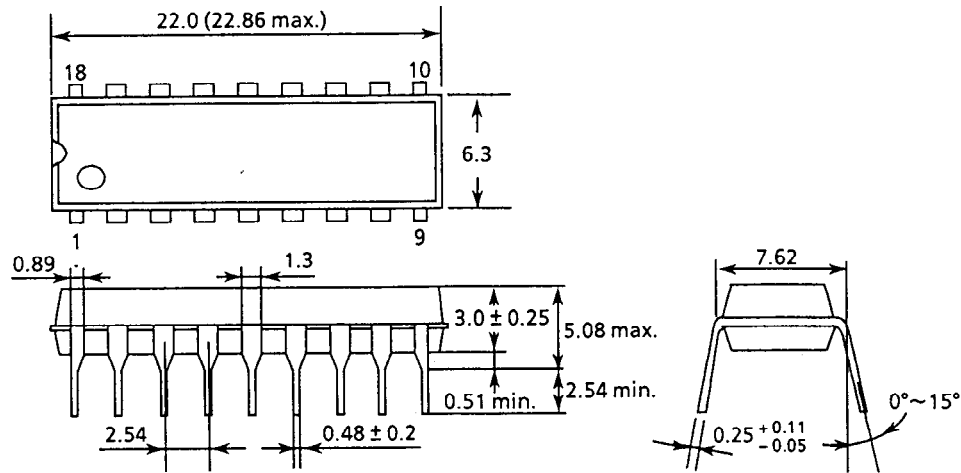


Figure 10

2. 18-pin SOP

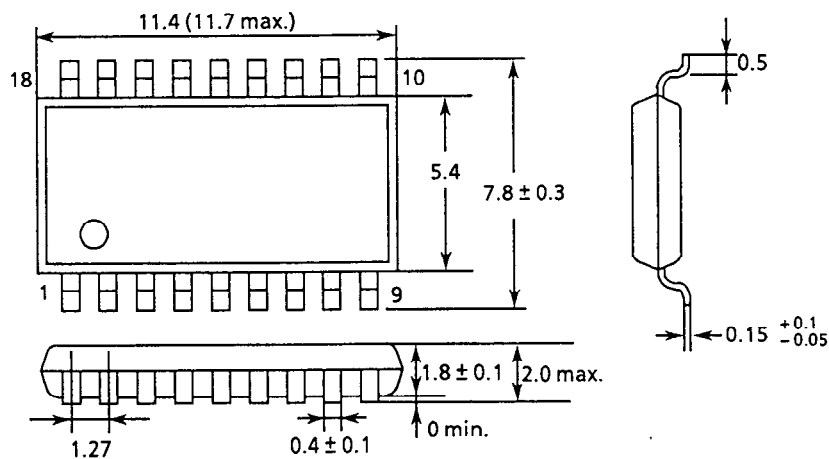


Figure 11

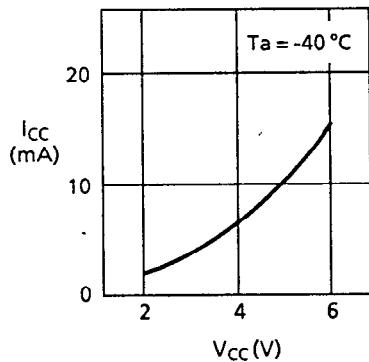
■ Ordering Information

S-22	X	X	X	X	XX	
						Rewriting times
						10 : 10 ⁵ times
						Package
						Blank: DIP
						F : SOP
						Temperature
						I : -40°C to 85°C
						Memory size
						10 : 256-bit
						12 : 1K-bit
						Input level
						H : All pins TTL compatible
						S : Schmitt input for <u>STORE</u> and <u>RECALL</u>

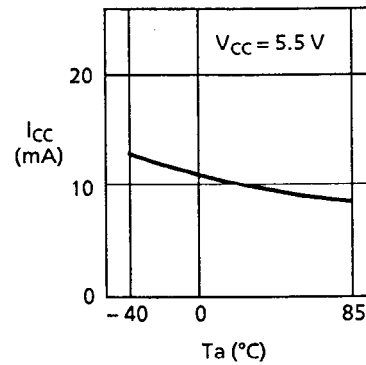
■ Characteristics

1. DC Characteristics

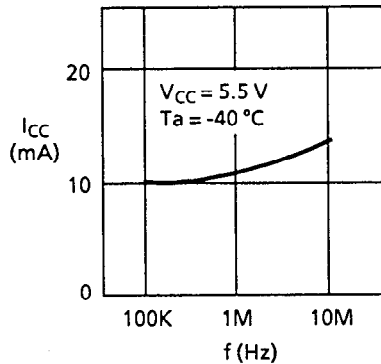
1.1 Operating current consumption I_{CC} — Power supply voltage V_{CC}



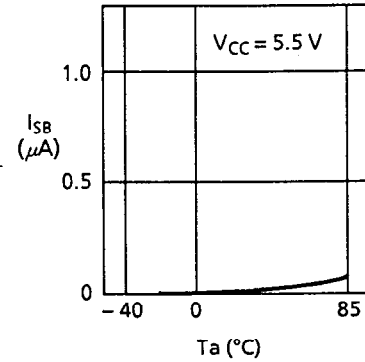
1.2 Operating current consumption I_{CC} — Ambient temperature T_a



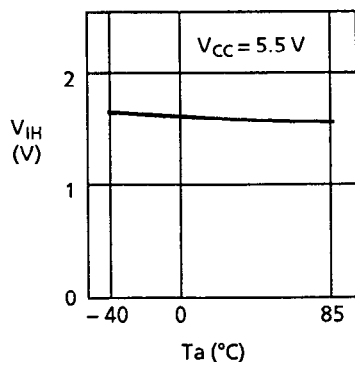
1.3 Operating current consumption I_{CC} — Reading frequency



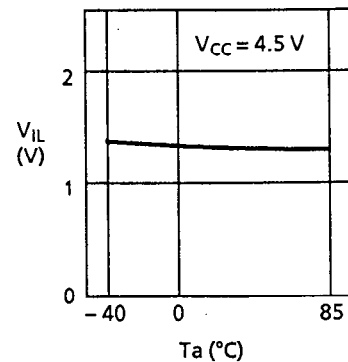
1.4 Standby current consumption I_{SB} — Ambient temperature T_a



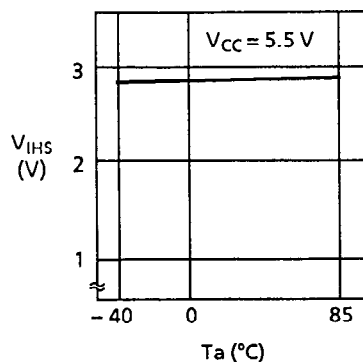
1.5 High level input voltage V_{IH} — Ambient temperature T_a S-22H Series : All inputs S-22S Series : $\overline{\text{CS}}$, $\overline{\text{WE}}$, I/O and address



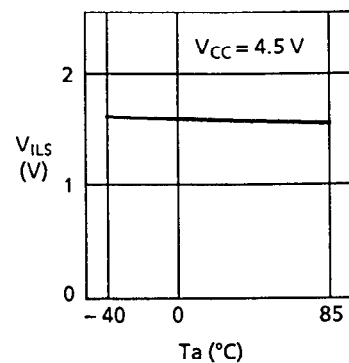
1.6 Low level input voltage V_{IL} — Ambient temperature T_a S-22H Series : All inputs S-22S Series : $\overline{\text{CS}}$, $\overline{\text{WE}}$, I/O and address



1.7 High level input voltage V_{IHS} — Ambient temperature T_a S-22S Series : $\overline{\text{STORE}}$ and $\overline{\text{RECALL}}$

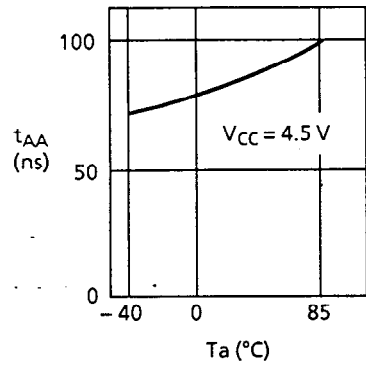


1.8 Low level input voltage V_{ILS} — Ambient temperature T_a S-22S Series : $\overline{\text{STORE}}$ and $\overline{\text{RECALL}}$

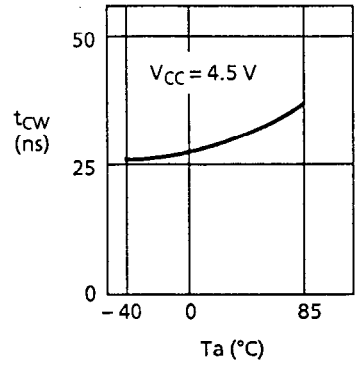


2. AC Characteristics

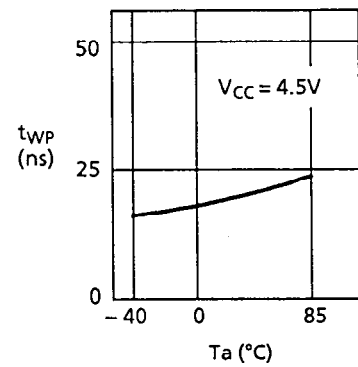
2.1 Address access time t_{AA}
 — Ambient temperature T_a



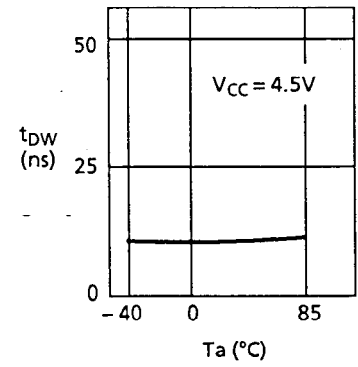
2.2 $\overline{CS}$ pulse width t_{CW}
 — Ambient temperature T_a



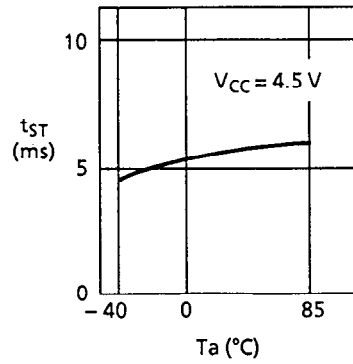
2.3 $\overline{WE}$ pulse width t_{WP}
 — Ambient temperature T_a



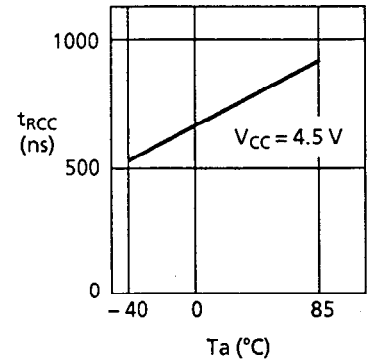
2.4 Input data setup time t_{DW}
 — Ambient temperature T_a



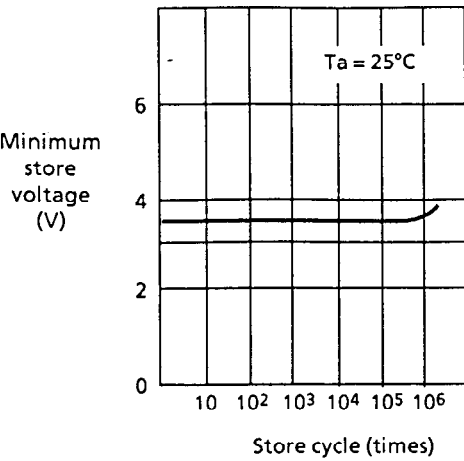
2.5 Store time t_{ST}
 — Ambient temperature T_a



2.6 Recall cycle time t_{RCC}
 — Ambient temperature T_a



3. Rewriting Characteristics



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