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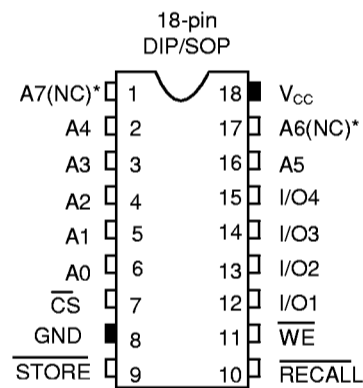
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The S-22 Series is a non-volatile CMOS RAM, composed of a CMOS static RAM and a non-volatile electrically erasable and programmable memory (E²PROM) to backup the SRAM. The organization is 256-word×4-bit (total 1K bits) for the S-22H12 and the S-22S12, 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 $\cong 3.5$ V
- +5-V single power supply (+5 V \pm 10%)
- Low current consumption
 - Operating : 10 mA typ.
 - Standby : 1 μ A max.
- Access time: 200 ns max.
- E²PROM store cycles : 10⁵ 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

PARALLEL NON-VOLATILE RAM
S-22 Series

■ **Block Diagram**

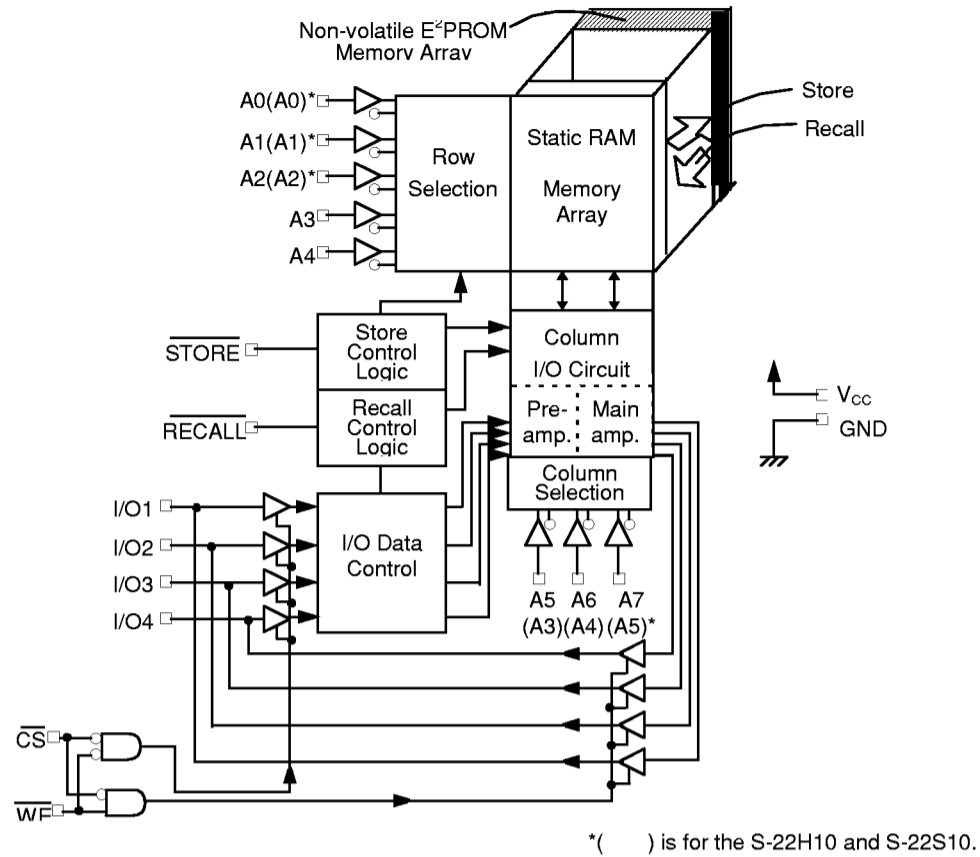


Figure 2

■ **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 : CS, WE, I/O and address	2.0	—	V_{CC}	V
High level input voltage 2	V_{IHS}	S-22S Series : \overline{STORE} and \overline{RECALL}	3.4	—	V_{CC}	V
Low level input voltage 1	V_{IL}	S-22H Series : All inputs S-22S Series : CS, WE, I/O and address	0.0	—	0.8	V
Low level input voltage 2	V_{ILS}	S-22S Series : \overline{STORE} and \overline{RECALL}	0.0	—	0.8	V
Operating temperature	T_{opr}		-40	—	+85	°C

■ Pin Capacitance

Table 3

($T_a=25^\circ\text{C}$, $f=1.0\text{ MHz}$, $V_{CC}=5\text{ V}$)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input capacitance	C_{IN}	$V_{IN}=0\text{ V}$	—	—	6	pF
Output capacitance (I/O pins)	$C_{I/O}$	$V_{I/O}=0\text{ V}$	—	—	10	pF

■ DC Electrical Characteristics

Table 4

($T_a=-40^\circ\text{C}$ to 85°C , $V_{CC}=+5\text{ V}\pm 10\%$)

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}	$V_{IN} = \text{GND to } V_{CC}$	—	0.1	1	μA
Output leakage current	I_{LO}	$V_{OUT} = \text{GND to } V_{CC}$	—	0.1	1	μA
Low level output voltage	V_{OL}	CMOS : $I_{OL}=100\ \mu\text{A}$	—	—	0.1	V
		TTL : $I_{OL}=4.2\ \text{mA}$	—	—	0.4	V
High level output voltage	V_{OH}	CMOS : $I_{OH}=-100\ \mu\text{A}$	$V_{CC}-0.7$	—	—	V
		TTL : $I_{OH}=-2\ \text{mA}$	2.4	—	—	V
Store inhibition voltage	V_{WI}		—	3.5	4.1	V
Schmitt width	V_{WD}	S-22S Series : STORE and RECALL	0.4	—	—	V

■ Data Hold Characteristics

Table 5

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Data hold voltage	V_{DH}	$\overline{CS} \geq V_{CC}-0.2\text{V}$, $\overline{RECALL} \geq V_{CC}-0.2\text{V}$	1.5	—	5.5	V
Data hold setup time	t_{CDH}		50	—	—	ns
Recovery time	t_R		300	—	—	ns

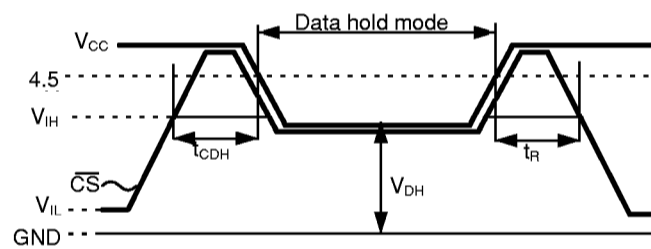


Figure 3 Data hold timing chart

PARALLEL NON-VOLATILE RAM
S-22 Series

■ AC Electrical Characteristics

Table 6 Measuring conditions

Parameter	Conditions	
Input pulse voltage	S-22H Series : All inputs S-22S Series : CS, WE, I/O and address	0.0 to 3.0 V
	S-22S Series : $\overline{\text{STORE}}$ and $\overline{\text{RECALL}}$	0.0 to 4.0 V
Input pulse rise/fall time		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
CS access time	t_{CS}	—	—	200	ns
Output data hold time	t_{OH}	20	—	—	ns
Output enable time (CS)	t_{CLZ}	10	—	—	ns
Output disable time (CS)	t_{CHZ}	10	—	70	ns

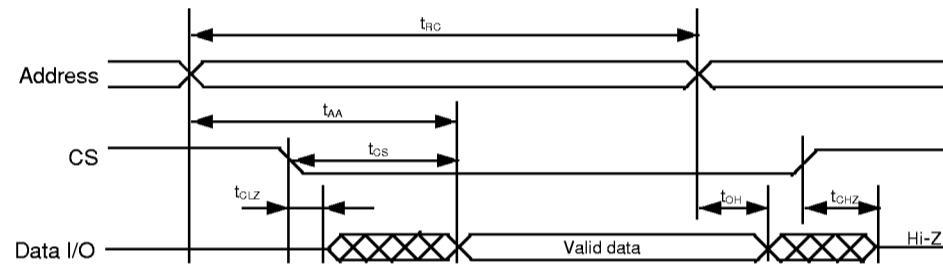


Figure 4

2. Write Cycle

Table 8

Parameter	Symbol	Min.	Typ.	Max.	Unit
Write cycle time	t_{WC}	200	—	—	ns
CS pulse width	t_{CW}	120	—	—	ns
Address setup time	t_{AS}	20	—	—	ns
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 ($\overline{\text{WE}}$)	t_{WHZ}	10	—	70	ns
Output enable time ($\overline{\text{WE}}$)	t_{WLZ}	10	—	—	ns

• Write cycle 1 : \overline{WE} control

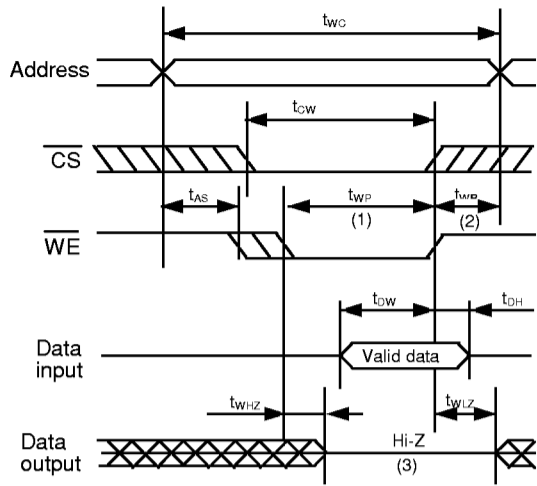


Figure 5

• Write cycle 2 : \overline{CS} control

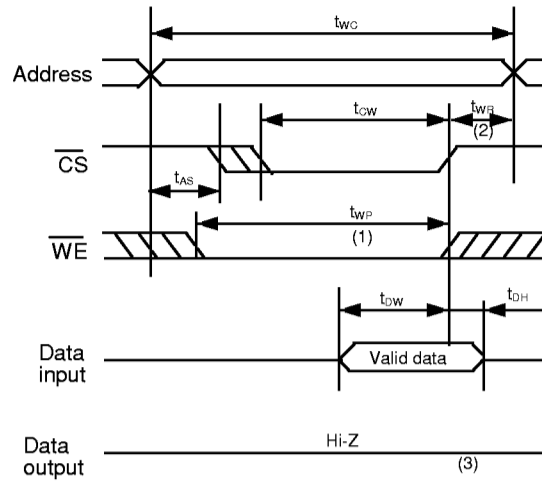


Figure 6

- (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} .

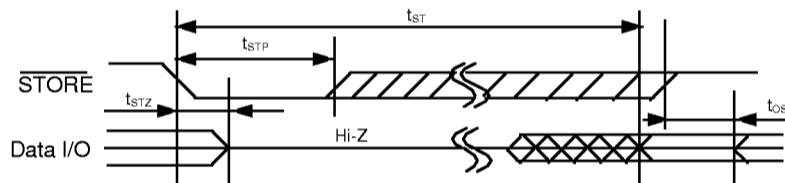


Figure 7

PARALLEL NON-VOLATILE RAM
S-22 Series

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.

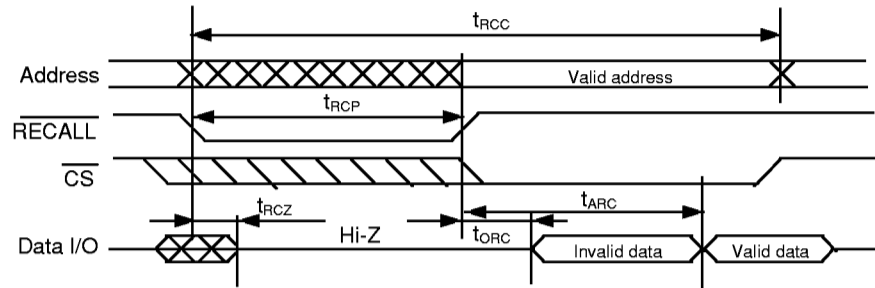


Figure 8

■ **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
	H	X	L	H	
Store mode	X	H	H	L	Output is high impedance
	H	X	H	L	

- 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↔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 $V_{WI} (\cong 3.5 \text{ V})$.

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.

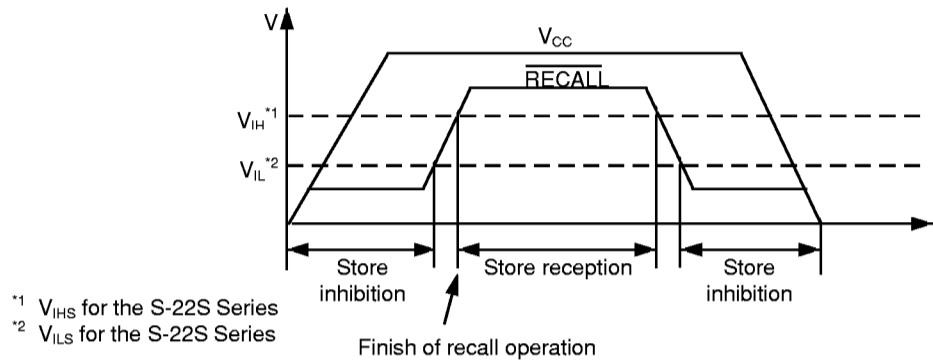


Figure 9 STORE inhibition period and reception period at power ON and OFF

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 copied 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
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■ **Dimensions (Unit:mm)**

1. 18-pin DIP

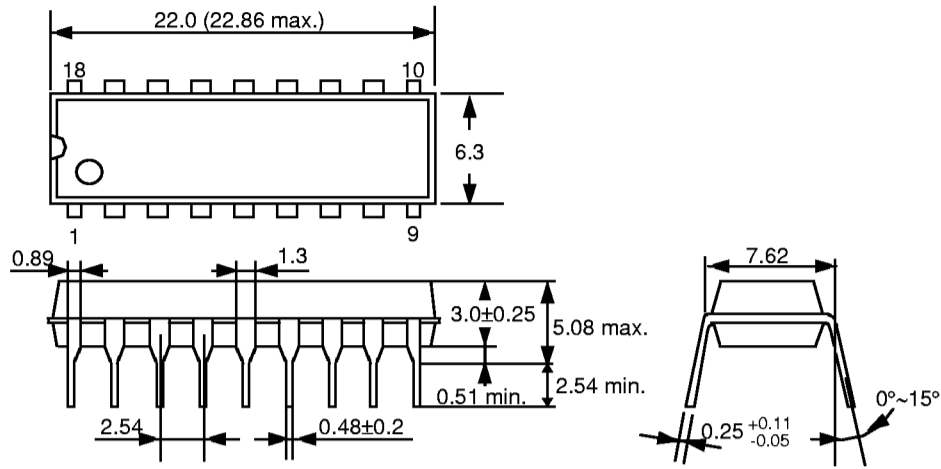


Figure 10

2. 18-pin SOP

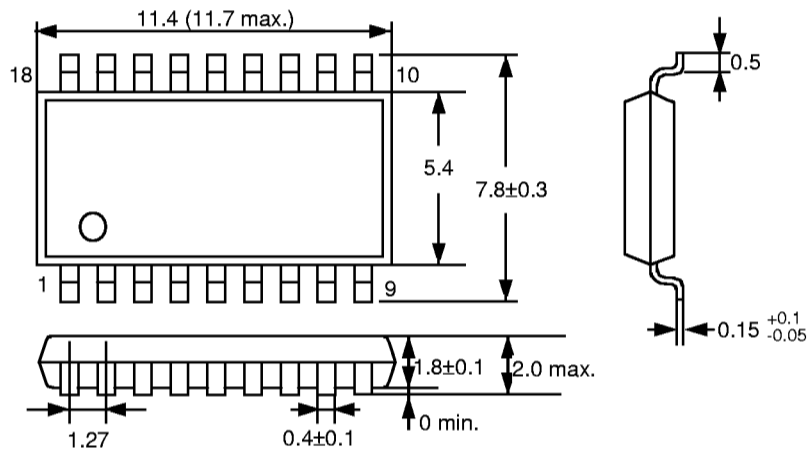


Figure 11

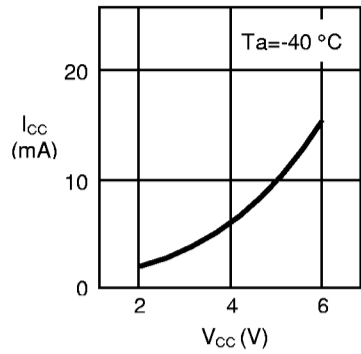
■ **Ordering Information**

S-22X	XX	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 STORE and RECALL pins

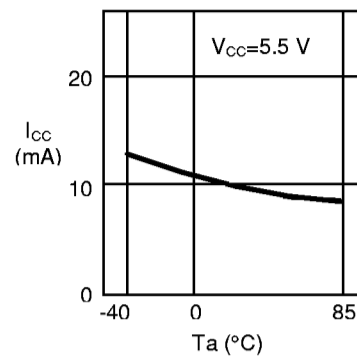
■ Characteristics

1. DC Characteristics

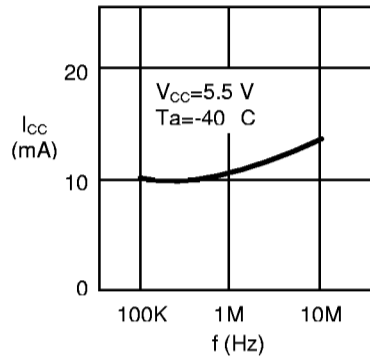
1.1 Operating current consumption I_{CC} – Power supply voltage V_{CC}



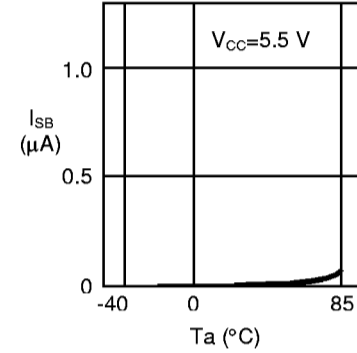
1.2 Operating current consumption I_{CC} – Ambient temperature T_a



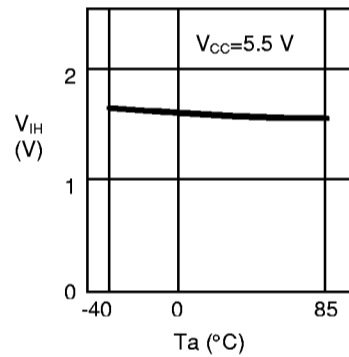
1.3 Operating current consumption I_{CC} – Reading frequency



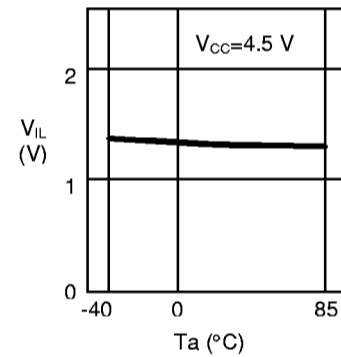
1.4 Standby current consumption I_{SB} – Ambient temperature T_a



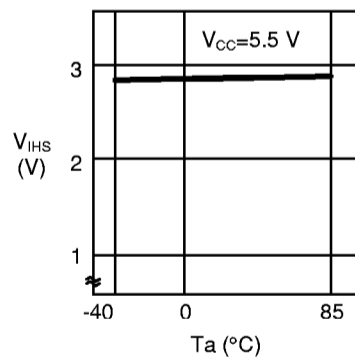
1.5 High level input voltage V_{IH} – Ambient temperature T_a
S-22H Series : All inputs
S-22S Series : CS, WE, I/O and address



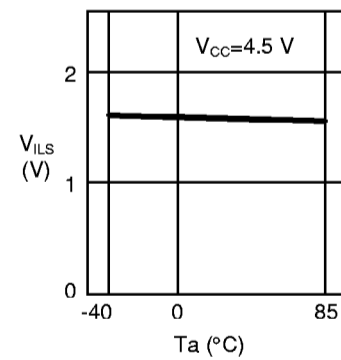
1.6 Low level input voltage V_{IL} – Ambient temperature T_a
S-22H Series : All inputs
S-22S Series : CS, WE, I/O and address



1.7 High level input voltage V_{IHS} – Ambient temperature T_a
S-22S Series : STORE and RECALL



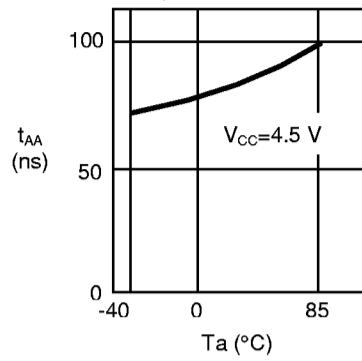
1.8 Low level input voltage V_{ILS} – Ambient temperature T_a
S-22S Series : STORE and RECALL



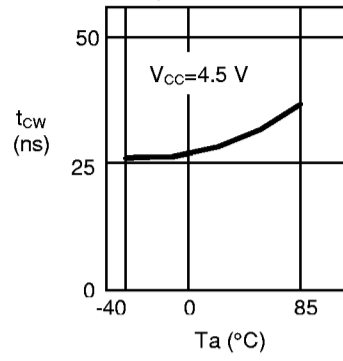
PARALLEL NON-VOLATILE RAM
S-22 Series

2. AC Characteristics

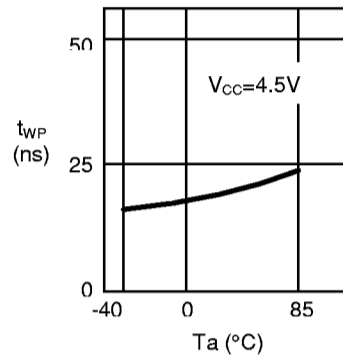
2.1 Address access time t_{AA}
 – Ambient temperature T_a



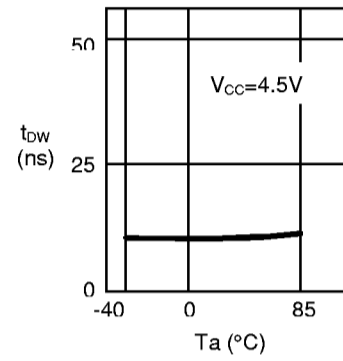
2.2 CS pulse width t_{CW}
 Ambient temperature T_a



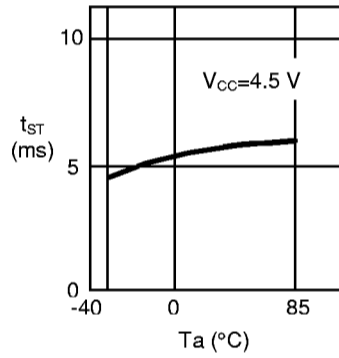
2.3 WE pulse width t_{WP}
 – Ambient temperature T_a



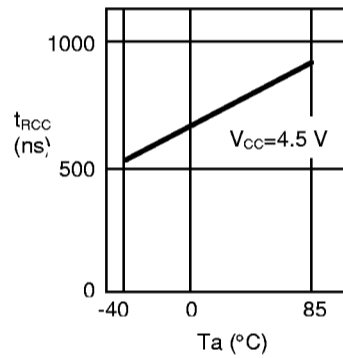
2.4 Input data setup time t_{DW}
 – Ambient temperature T_a



2.5 Store time t_{ST}
 – Ambient temperature T_a



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



3. Rewriting Characteristics

