TC518128BPL/BFL/BFWL/BFTL-70V/80V/10V

SILICON GATE CMOS

131,072 WORD x 8 BIT CMOS PSEUDO STATIC RAM

Description

The TC518128B-V is a 1M bit high speed CMOS pseudo static RAM organized as 131,072 words by 8 bits. The TC518128B-V utilizes a one transistor dynamic memory cell with CMOS peripheral circuitry to provide high capacity, high speed and low power storage. The TC518128B-V operates from a single power supply of 2.7 ~ 5.5V. Refreshing is supported by a refresh ($\overline{RFSH}$) input which enables two types of refreshing - auto refresh and self refresh. The TC518128B-V features a static RAM-like interface with a write cycle in which the input data is written into the memory cell at the rising edge of R/W thus simplifying the microprocessor interface.

The TC518128B-V is pin-compatible with the 1M bit CMOS static RAM JEDEC standard and is available in a 32-pin, 0.6 inch width plastic DIP, a small outline plastic flat package, and a 32-pin thin small outline plastic package (forward type).

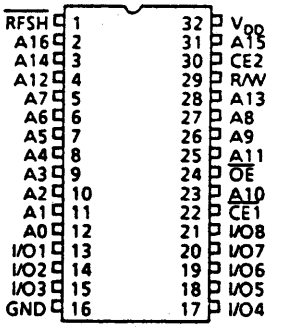
Features

- Organization: 131,072 words x 8 bits
- Low voltage operation 2.7V ~ 5.5V
- Data retention supply voltage: 2.7V ~ 5.5V
- Fast access time

		TC518128B-V Family		
		-70	-80	-10
t_{CEA} $\overline{CE}$ Access Time		70ns	80ns	100ns
t_{OEA} $\overline{OE}$ Access Time		25ns	30ns	40ns
t_{RC} Cycle Time		115ns	130ns	160ns
Power Dissipation		385mW	330mW	275mW
Self Refresh Current	5.5V	50μA		
	3.0V	25μA		

- Auto refresh is supported by an internal refresh address counter
- Self refresh is supported by an internal timer
- Inputs and outputs TTL compatible
- Refresh: 512 refresh cycles/8ms
- Auto refresh power down feature
- Pin compatible: 1M SRAM (JEDEC)
- Package
  - TC518128BPL: DIP32-P-600
  - TC518128BFL: SOP32-P-450
  - TC518128BFWL: SOP32-P-525
  - TC518128BFTL: TSOP32-P-0820

Pin Connection (Top View)



TC518128BPL / BFL / BFWL

TC518128BFTL (Forward)

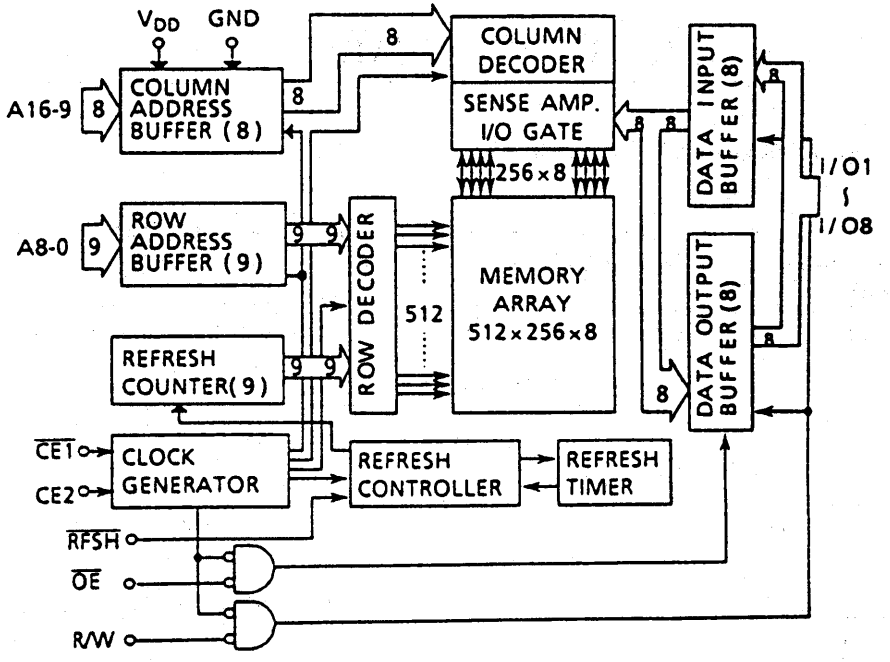
Pin Names

A0 ~ A16	Address Inputs
R/W	Read/Write Control Input
$\overline{OE}$	Output Enable Input
$\overline{RFSH}$	Refresh Input
$\overline{CE1}$, CE2	Chip Enable Inputs
I/O1 ~ I/O8	Data Inputs/Outputs
V_{DD}	Power
GND	Ground

(TSOP)

PIN NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PIN NAME	A_{11}	A_9	A_8	A_{13}	R/W	CE2	A_{15}	V_{DD}	$\overline{RFSH}$	A_{16}	A_{14}	A_{12}	A_7	A_6	A_5	A_4
PIN NO.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
PIN NAME	A_3	A_2	A_1	A_0	I/O1	I/O2	I/O3	GND	I/O4	I/O5	I/O6	I/O7	I/O8	$\overline{CE1}$	A_{10}	$\overline{OE}$

Block Diagram



Operating Mode

MODE \ PIN	$\overline{CE1}$	CE2	$\overline{OE}$	R/W	$\overline{RFSH}$	A0 ~ A16	I/O1 ~ 8
Read	L	H	L	H	*	V*	OUT
Write	L	H	*	L	*	V*	IN
CE only Refresh	L	H	H	H	*	V*	HZ
Auto/Self Refresh	H	*	*	*	L	*	HZ
Auto/Self Refresh	*	L	*	*	L	*	HZ
Standby	H	*	*	*	H	*	HZ
Standby	*	L	*	*	H	*	HZ

H = High level input (V_{IH})
L = Low level input (V_{IL})
* = V_{IH} or V_{IL}
V* = At the falling edge of $\overline{CE1}$ (CE2 = H) or the rising edge of CE2 ($\overline{CE1}$ = L), all address inputs are latched. At all other times, the address inputs are "*".
HZ = High impedance

Maximum Ratings

SYMBOL	ITEM	RATING	UNIT	NOTES
V_{IN}	Input Voltage	-1.0 ~ 7.0	V	1
V_{OUT}	Output Voltage	-1.0 ~ 7.0	V	
V_{DD}	Power Supply Voltage	-1.0 ~ 7.0	V	
T_{OPR}	Operating Temperature	0 ~ 70	°C	
T_{STRG}	Storage Temperature	-55 ~ 150	°C	
T_{SOLDER}	Soldering Temperature • Time	260 • 10	°C • sec	
P_D	Power Dissipation	600	mW	
I_{OUT}	Short Circuit Output Current	50	mA	

DC Recommended Operating Conditions

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT	NOTES
V_{DD}	Power Supply Voltage	4.5	5.0	5.5	V	2
V_{IH}	Input High Voltage	2.4	–	V_{DD} + 1.0	V	
V_{IL}	Input Low Voltage	-1.0	–	0.8	V	

DC Characteristics (Ta = 0 ~ 70°C, V_{DD} = 5V±10%)

SYMBOL	PARAMETER		MIN.	TYP.	MAX.	UNIT	NOTES
I_{DDO}	Operating Current (Average) $\overline{CE1}$, CE2, Address cycling: t_{RC} = t_{RC} min.	70ns version	–	50	70	mA	3,4
		80ns version	–	40	60		
		100ns version	–	35	50		
I_{DDS1}	Standby Current $\overline{CE1}$ = V_{IH} or CE2 = V_{IL}, $\overline{RFSH}$ = V_{IH}		–	–	1	mA	
I_{DDS2}	Standby Current $\overline{CE1}$ = V_{DD} - 0.2V or CE2 = 0.2V, $\overline{RFSH}$ = V_{DD} - 0.2V		–	35	50	µA	
I_{DDF1}	Self Refresh Current (Average) $\overline{CE1}$ = V_{IH} or CE2 = V_{IL}, $\overline{RFSH}$ = V_{IL}		–	–	1	mA	
I_{DDF2}	Self Refresh Current (Average) $\overline{CE1}$ = V_{DD} - 0.2V or CE2 = 0.2V, $\overline{RFSH}$ = 0.2V		–	35	50	µA	
I_{DDF3}	Auto Refresh Current (Average) $\overline{RFSH}$ cycling: t_{FC} = t_{FC} min		–	–	2	mA	
I_{DDF4}	CE only Refresh Current (Average) $\overline{CE1}$, CE2, Address cycling: t_{RC} = t_{RC} min.	70ns version	–	50	70	mA	3
		80ns version	–	40	60		
		100ns version	–	35	50		
$I_{I(L)}$	Input Leakage Current 0V ≤ V_{IN} ≤ V_{DD}, All other Inputs not under test = 0V		–	–	±10	µA	
$I_{O(L)}$	Output Leakage Current Output Disabled ($\overline{CE1}$ = V_{IH} or CE2 = V_{IL} or $\overline{OE}$ = V_{IH} or R/W = V_{IL}), 0V ≤ V_{OUT} ≤ V_{DD}		–	–	±10	µA	
V_{OH}	Output High Level I_{OH} = -1.0 mA		2.4	–	–	V	
V_{OL}	Output Low Level I_{OL} = 2.1mA		–	–	0.4	V	

Note: For I_{DDS1} and I_{DDF1} with $\overline{CE1}$ = V_{IH} (CE2 = V_{IL}), the specified limits are guaranteed under the condition CE2 = V_{IH} or CE2 = V_{IL} ($\overline{CE1}$ =V_{IH} or $\overline{CE1}$ = V_{IL}).
For I_{DDS2} and I_{DDF2} with $\overline{CE1}$ ≥ V_{DD} - 0.2V (CE2 ≤ 0.2V), the specified limits are guaranteed under the condition CE2 ≥ V_{DD} - 0.2V or CE2 ≤ 0.2V ($\overline{CE1}$ ≥ V_{DD} - 0.2V or $\overline{CE1}$ ≤ 0.2V).

Capacitance* (V_{DD} = 5V, Ta = 25°C, f = 1MHz)

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
C_{I1}	Input Capacitance (A0 ~ A16)	–	5	pF
C_{I2}	Input Capacitance ($\overline{CE1}$, CE2, $\overline{OE}$, R/W, $\overline{RFSH}$)	–	7	
C_{IO}	Input/Output Capacitance	–	7	

*This parameter is periodically sampled and is not 100% tested.

AC Characteristics (Ta = 0 ~ 70°C, V_{DD} = 5V±10%) (Notes: 5, 6, 7, 8)

SYMBOL	PARAMETER	-70		-80		-10		UNIT	NOTES
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
t_{RC}	Random Read, Write Cycle Time	115	–	130	–	160	–	ns	
t_{RMW}	Read Modify Write Cycle Time	160	–	180	–	220	–		
t_{CE}	CE Pulse Width	70	10,000	80	10,000	100	10,000		13
t_P	CE Precharge Time	35	–	40	–	50	–		
t_{CEA}	CE Access Time	–	70	–	80	–	100		
t_{OEA}	$\overline{OE}$ Access Time	–	25	–	30	–	40		
t_{CLZ}	CE to Output in Low -Z	20	–	20	–	20	–		
t_{OLZ}	$\overline{OE}$ to Output in Low -Z	0	–	0	–	0	–		
t_{WLZ}	Output Active from End of Write	0	–	0	–	0	–		
t_{CHZ}	Chip Disable to Output in High-Z	0	20	0	20	0	25		9
t_{OHZ}	$\overline{OE}$ Disable to Output in High-Z	0	20	0	20	0	25		9
t_{WHZ}	Write Enable to Output in High-Z	0	25	0	25	0	30		9
t_{ODS}	$\overline{OE}$ Output Disable Setup Time	0	–	0	–	0	–		
t_{ODH}	$\overline{OE}$ Output Disable Hold Time	10	–	10	–	10	–		
t_{RCS}	Read Command Setup Time	0	–	0	–	0	–		
t_{RCH}	Read Command Hold Time	0	–	0	–	0	–		
t_{WP}	Write Pulse Width	20	–	25	–	30	–		
t_{WCH}	Write Command Hold Time	35	10,000	40	10,000	50	10,000		
t_{CWL}	Write Command to CE Lead Time	20	10,000	25	10,000	30	10,000		
t_{DSW}	Data Setup Time from R/W	15	–	20	–	25	–		10
t_{DSC}	Data Setup Time from CE	15	–	20	–	25	–		10
t_{DHW}	Data Hold Time from R/W	0	–	0	–	0	–		10
t_{DHC}	Data Hold Time from CE	0	–	0	–	0	–		10
t_{ASC}	Address Setup Time	0	–	0	–	0	–		11
t_{AHC}	Address Hold Time	20	–	25	–	30	–		11
t_{RHC}	$\overline{RFSH}$ Command Hold Time	15	–	15	–	15	–		
t_{FC}	Auto Refresh Cycle Time	115	–	130	–	160	–		
t_{RFD}	$\overline{RFSH}$ Delay Time from CE	35	–	40	–	50	–		
t_{FAP}	$\overline{RFSH}$ Pulse Width (Auto Refresh)	30	8,000	30	8,000	30	8,000		12
t_{FP}	$\overline{RFSH}$ Precharge Time	30	–	30	–	30	–		12
t_{FAS}	$\overline{RFSH}$ Pulse Width (Self Refresh)	8,000	–	8,000	–	8,000	–		12
t_{FRS}	CE Delay Time from $\overline{RFSH}$ (Self Refresh)	160	–	160	–	190	–		12
t_{REF}	Refresh Period (512 cycles, A0 ~ A8)	–	8	–	8	–	8	ms	
t_T	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	
t_{CES}	CE2 Low Setup Time	5	–	5	–	5	–		14
t_{CEH}	CE2 Low Hold Time	5	–	5	–	5	–		14

3.0V Operation

DC Recommended Operating Conditions

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT	NOTES
V_{DD}	Power Supply Voltage	2.7	3.0	3.3	V	2
V_{IH}	Input High Voltage	V_{DD} - 0.2V	–	V_{DD} + 1.0V	V	
V_{IL}	Input Low Voltage	-0.5	–	0.2	V	

DC Characteristics (Ta = 0 ~ 70°C, V_{DD} = 3.0V±0.3V)

SYMBOL	PARAMETER		MIN.	TYP.	MAX.	UNIT	NOTES
I_{DDO}	Operating Current (Average) $\overline{CE1}$, CE2, Address cycling: t_{RC} = t_{RC} min.		–	15	20	mA	3,4
I_{DDS2}	Standby Current		–	15	25	µA	
I_{DDF2}	Self Refresh Current (Average)		–	15	25	µA	
I_{DDF3}	Auto Refresh Current (Average) $\overline{RFSH}$ cycling: t_{FC} = t_{FC} min		–	–	2	mA	
I_{DDF4}	CE only Refresh Current (Average) $\overline{CE1}$, CE2, Address cycling: t_{RC} = t_{RC} min.		–	15	20	mA	3
$I_{I(L)}$	Input Leakage Current 0V ≤ V_{IN} ≤ V_{DD}, All other Inputs not under test = 0V		–	–	±10	µA	
$I_{O(L)}$	Output Leakage Current Output Disable, 0V ≤ V_{OUT} ≤ V_{DD}		–	–	±10	µA	
V_{OH}	Output High Level	I_{OH} = -1mA	2.4	–	–	V	
		I_{OH} = -100µA	V_{DD} - 0.2V	–	–		
V_{OL}	Output Low Level	I_{OL} = 2.1mA	–	–	0.4	V	
		I_{OL} = 100µA	–	–	0.2		

AC Characteristics (Ta = 0 ~ 70°C, V_{DD} = 3.0V±0.3V) (Notes: 5, 6, 8)

SYMBOL	PARAMETER	MIN.	MAX.	UNIT	NOTES
t_{RC}	Random Read, Write Cycle Time	240	–	ns	
t_{RMW}	Read Modify Write Cycle Time	320	–		
t_{CE}	CE Pulse Width	150	10,000		13
t_{P}	CE Precharge Time	80	–		
t_{CEA}	CE Access Time	–	150		
t_{OEA}	$\overline{OE}$ Access Time	–	80		
t_{CLZ}	CE to Output in Low -Z	20	–		
t_{OLZ}	$\overline{OE}$ to Output in Low -Z	5	–		
t_{WLZ}	Output Active from End of Write	5	–		
t_{CHZ}	Chip Disable to Output in High-Z	0	30		9
t_{OHZ}	$\overline{OE}$ Disable to Output in High-Z	0	30		9
t_{WHZ}	Write Enable to Output in High-Z	0	40		9
t_{ODS}	$\overline{OE}$ Output Disable Setup Time	0	–		
t_{ODH}	$\overline{OE}$ Output Disable Hold Time	10	–		
t_{RCS}	Read Command Setup Time	0	–		
t_{RCH}	Read Command Hold Time	0	–		
t_{WP}	Write Pulse Width	35	–		
t_{WCH}	Write Command Hold Time	70	10,000		
t_{CWL}	Write Command to CE Lead Time	35	10,000		
t_{DSW}	Data Setup Time from R/W	30	–		10
t_{DSC}	Data Setup Time from CE	30	–		10
t_{DHW}	Data Hold Time from R/W	0	–		10
t_{DHC}	Data Hold Time from CE	0	–		10
t_{ASC}	Address Setup Time	0	–		11
t_{AHC}	Address Hold Time	35	–		11
t_{RHC}	$\overline{RFSH}$ Command Hold Time	15	–		
t_{FC}	Auto Refresh Cycle Time	240	–		
t_{RFD}	$\overline{RFSH}$ Delay Time from CE	80	–		
t_{FAP}	$\overline{RFSH}$ Pulse Width (Auto Refresh)	50	8,000		12
t_{FP}	$\overline{RFSH}$ Precharge Time	50	–		12
t_{FAS}	$\overline{RFSH}$ Pulse Width (Self Refresh)	8,000	–		12
t_{FRS}	CE Delay Time from $\overline{RFSH}$ (Self Refresh)	300	–		12
t_{REF}	Refresh Period (512 cycles, A0 ~ A8)	–	8	ms	
t_{T}	Transition Time (Rise and Fall)	3	50	ns	
t_{CES}	CE2 Low Setup Time	10	–		14
t_{CEH}	CE2 Low Hold Time	10	–		14

Timing Reference Levels:
Input Reference Levels: 1.5V/1.5V
Output Reference Levels: 1.5V/1.5V

Notes:

1) Stress greater than those listed under "Maximum Ratings" may cause permanent damage to the device.

2) All voltages are referenced to GND.

3) I_{DDO} and I_{DDF4} depend on the cycle time.

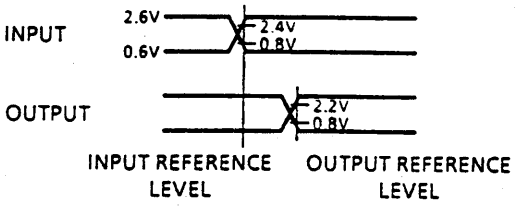
4) I_{DDO} depends on the output loading. Specified values are obtained with the outputs open.

5) An initial pause of 100μs with high $\overline{CE1}$ or low CE2 is required after power-up before proper device operation is achieved.

6) AC measurements assume t_T = 5ns.

7) Timing reference levels

Input Levels	:	V_{IH} = 2.6V V_{IL} = 0.6V
Input Reference Levels	:	V_{IH} = 2.4V V_{IL} = 0.8V
Output Reference Levels	:	V_{OH} = 2.2V V_{OL} = 0.8V



8) Measured with a load equivalent to 1 TTL load and 100pF.

9) t_{CHZ}, t_{OHZ}, t_{WHZ} define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.

10) For write cycles, the input data is latched at the earlier of R/W or $\overline{CE1}$ rising edge (CE2 falling edge). Therefore, the input data must be valid during the setup time (t_{DSW} or t_{DSC}) and hold time (t_{DHW} or t_{DHC}).

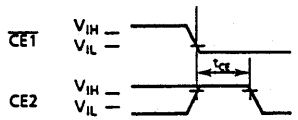
11) All address inputs are latched at the falling edge of $\overline{CE1}$ (rising edge of CE2). Therefore, all the address inputs must be valid during t_{ASC} and t_{AHC}.

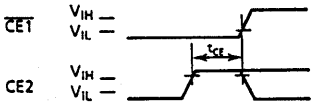
12) The two refresh operations, auto refresh and self refresh, are defined by the $\overline{RFSH}$ pulse width under the condition $\overline{CE1}$ = V_{IH} or CE2 = V_{IL}.

Auto refresh : $\overline{RFSH}$ pulse width ≤ t_{FAP} (max.)
Self refresh : $\overline{RFSH}$ pulse width ≥ t_{FAS} (min.)

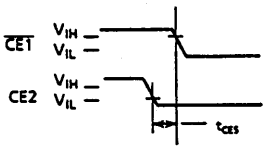
The timing parameter t_{FRS} must be met for proper device operation under the following conditions:
- after self refresh
- if $\overline{RFSH}$ = "L" after power-up

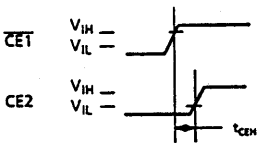
13) The timings, t_{CE} (min.) and t_{CE} (max.) must be met for proper device operation.





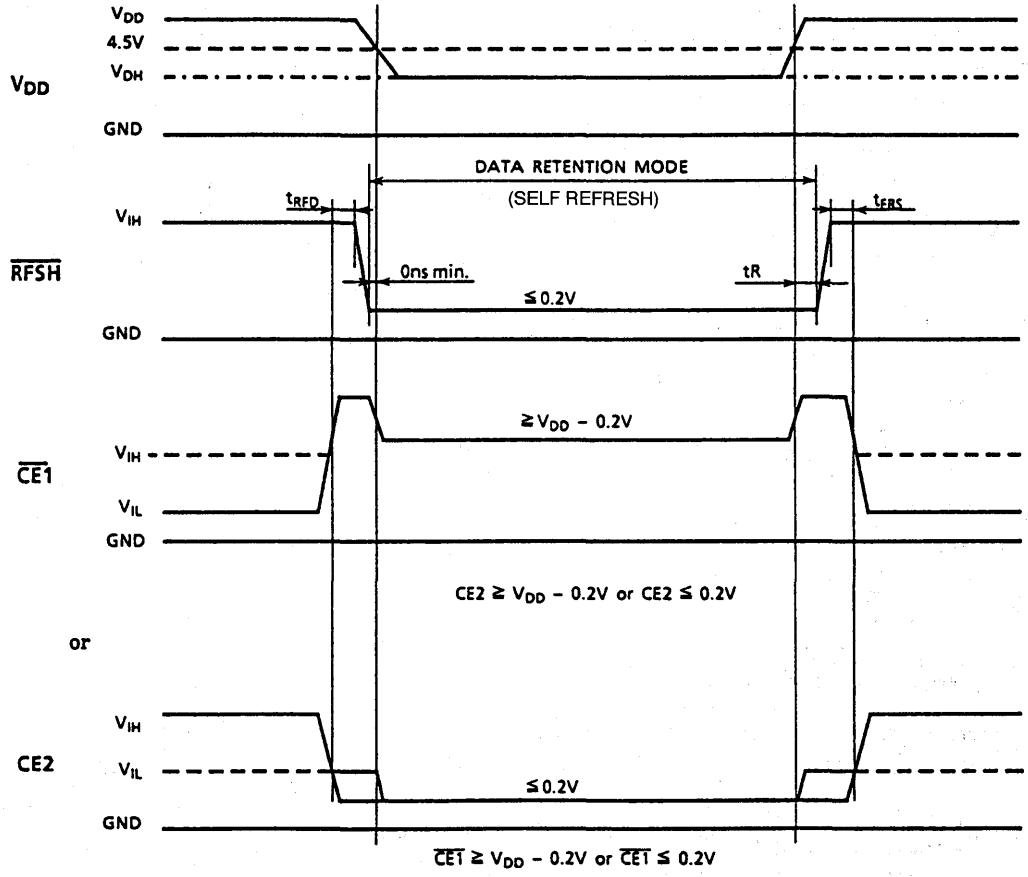
14) The timings, t_{CES} (min.) and t_{CEH} (min.) must be met when using $\overline{CE1}$ and CE2 as shown below.





Data Retention Characteristics (Ta = 0 ~ 70°C)

SYMBOL	PARAMETER		MIN.	TYP.	MAX.	UNIT
V_{DH}	Data Retention Supply Voltage		2.7	–	5.5	V
I_{DDF2}	Self Refresh Current	V_{DH} = 3.0V	–	15	25	μA
		V_{DH} = 5.5V	–	35	50	
t_R	Recovery Time		5	–	–	ms

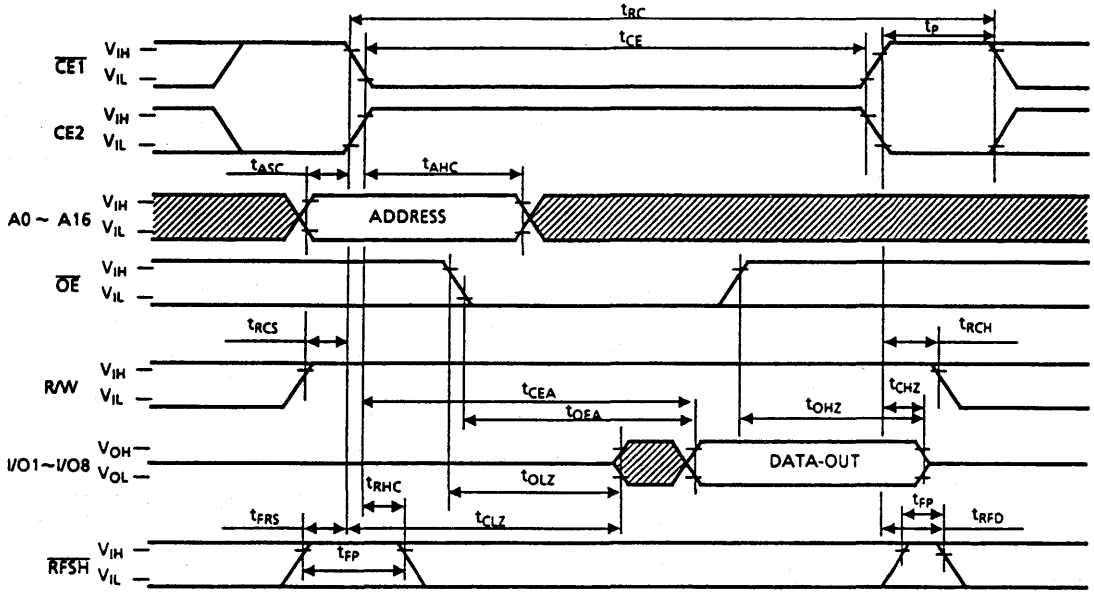


Notes: $\overline{OE}$, R/W, A0 ~ A16 = V_{IH} or V_{IL}

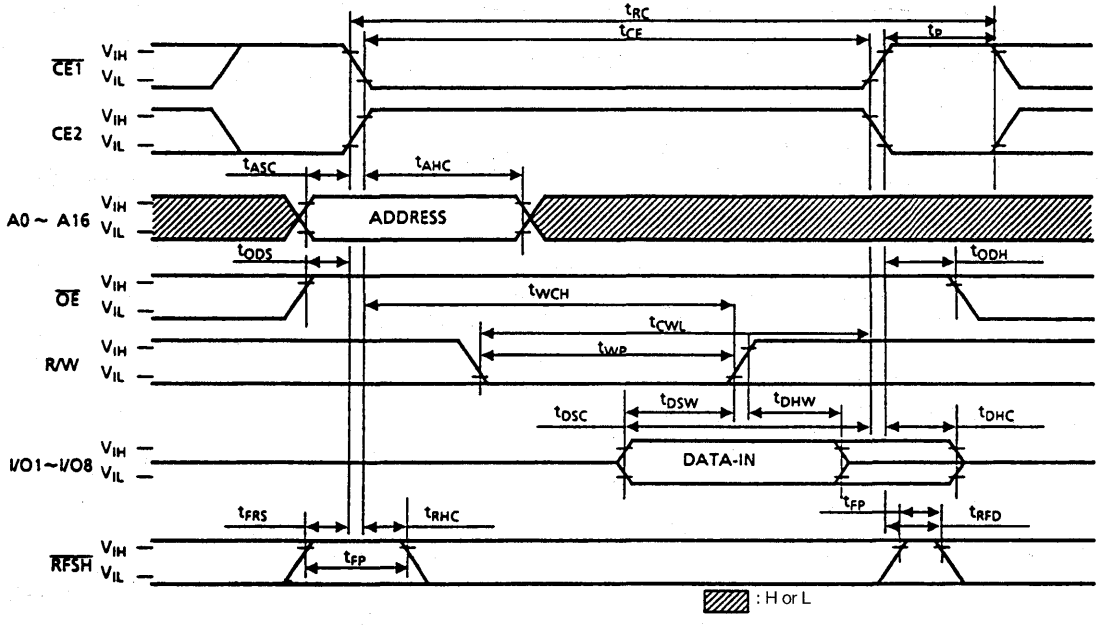
I_{DDF1} is applicable when $\overline{RFSH}$ = V_{IL} (max.), $\overline{CE1}$ = V_{IH} (min.), CE2 = V_{IL} (max.).

Timing Waveforms

Read Cycle

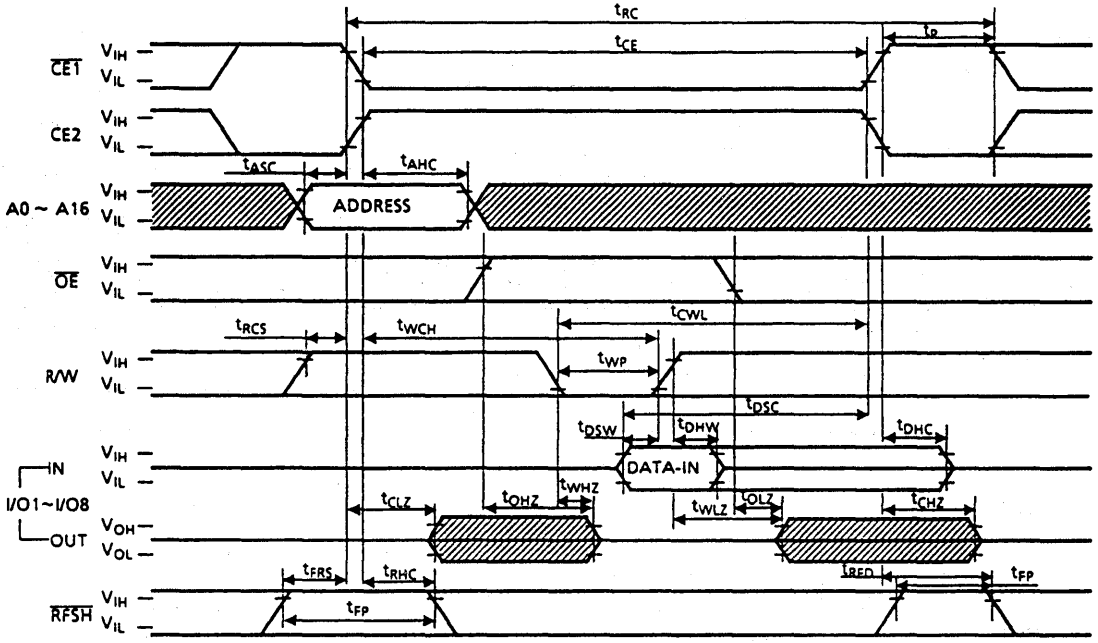


Write Cycle 1 ($\overline{OE}$ Fixed High)

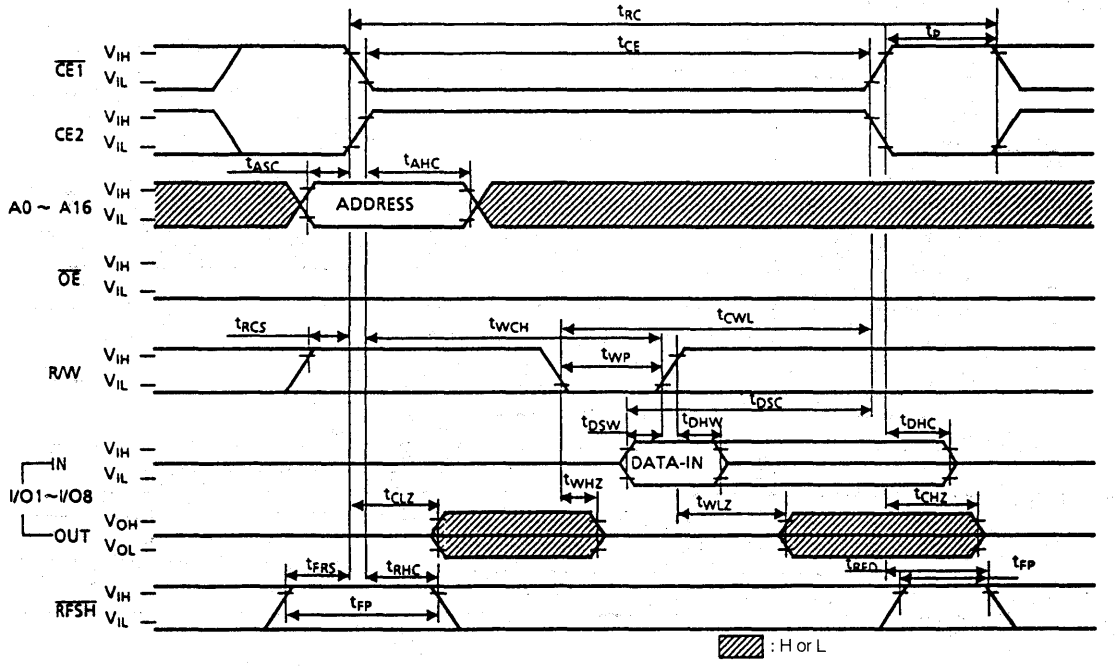


Note: The device can be operated by cycling $\overline{CE1}$ (or CE2) only provided that CE2 (or $\overline{CE1}$) is connected to V_{IH} (or V_{IL}).

Write Cycle 2 ($\overline{OE}$ Clocked)

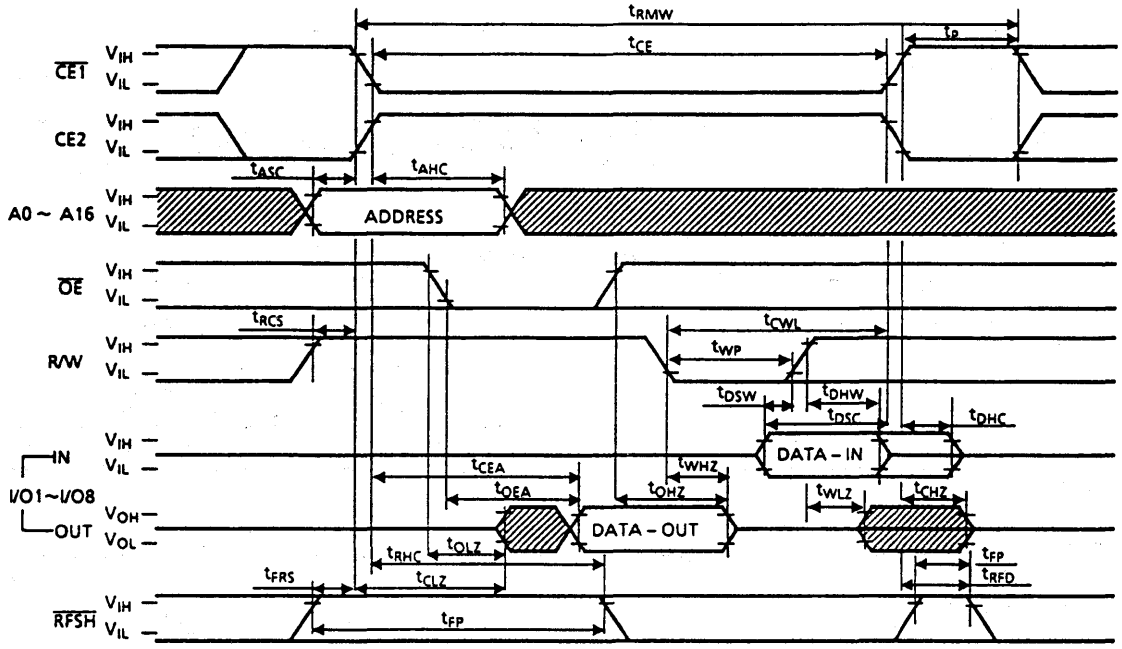


Write Cycle 3 ($\overline{OE}$ Fixed Low)

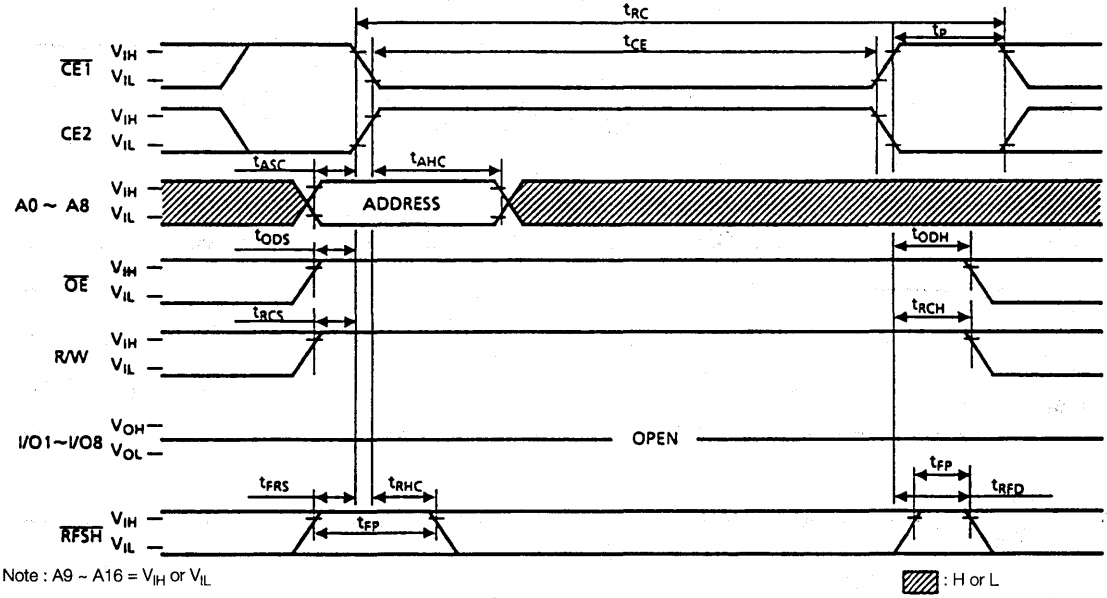


Note: The device can be operated by cycling $\overline{CE1}$ (or CE2) only provided that CE2 (or $\overline{CE1}$) is connected to V_{IH} (or V_{IL}).

Read Modify Write Cycle



CE Only Refresh

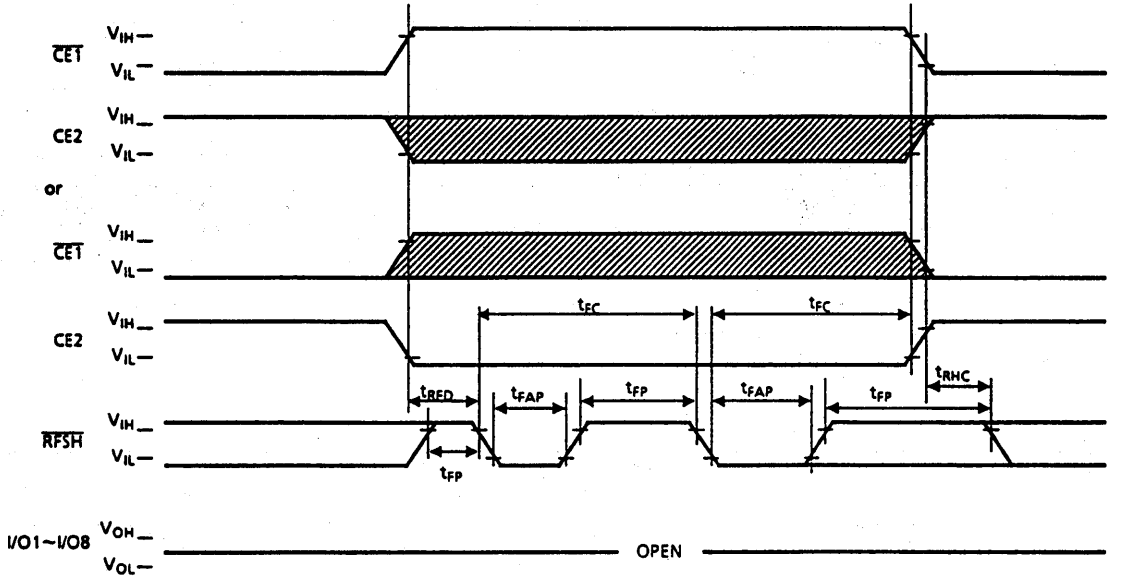


Note : A9 ~ A16 = V_{IH} or V_{IL}

▨ : H or L

Note: The device can be operated by cycling $\overline{CE1}$ (or CE2) only provided that CE2 (or $\overline{CE1}$) is connected to V_{IH} (or V_{IL}).

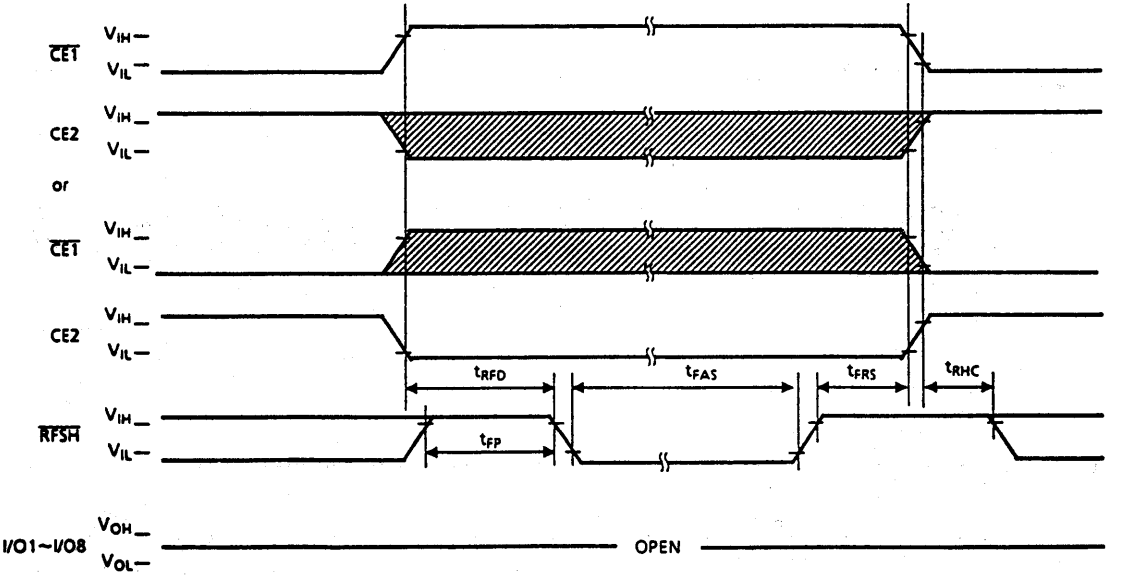
Auto Refresh



Note : $\overline{OE}$, R/W, A0 ~ A16 = V_{IH} or V_{IL}

▨ : H or L

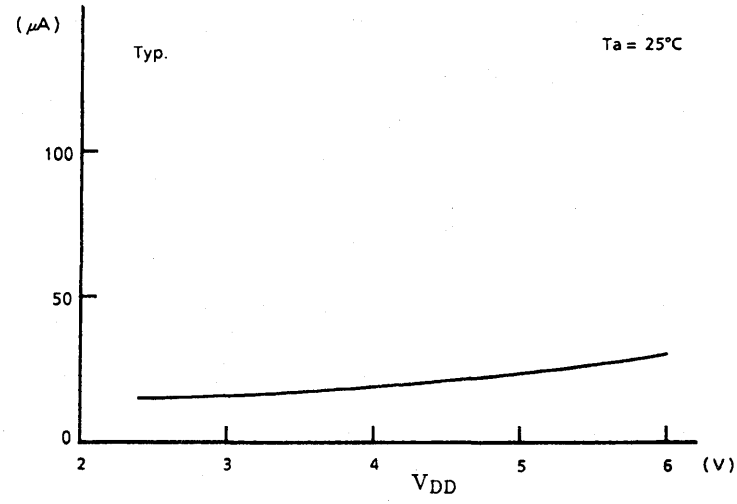
Self Refresh



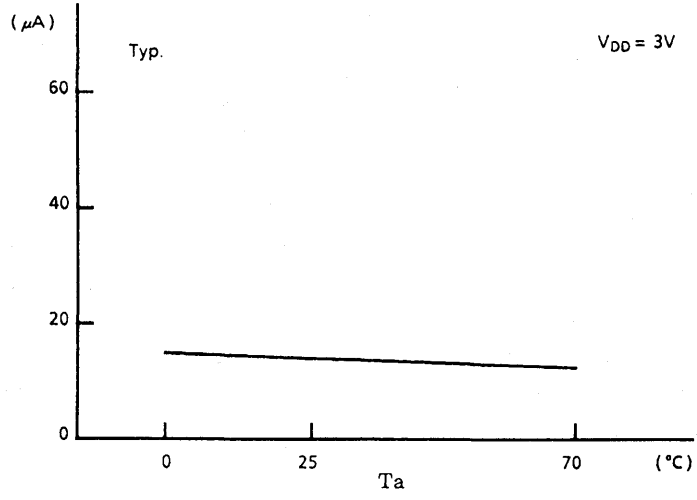
Note : $\overline{OE}$, R/W, A0 ~ A16 = V_{IH} or V_{IL}

▨ : H or L

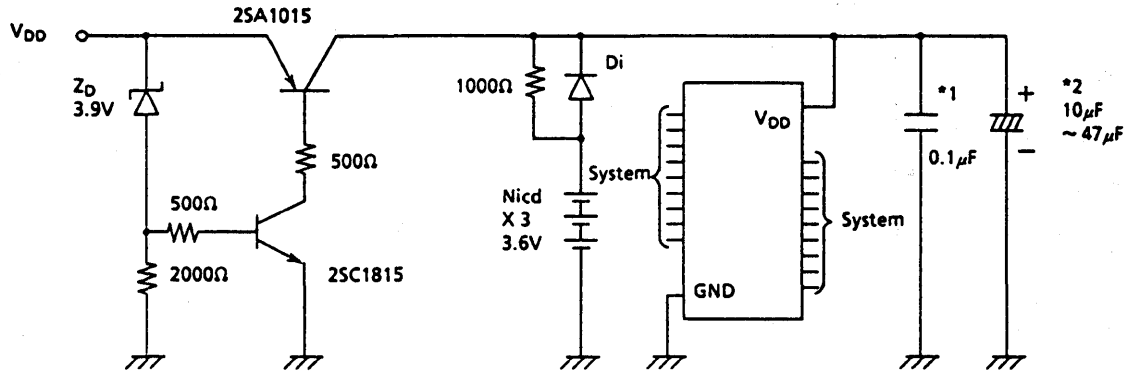
I_{DDF2} V_{DD} Characteristics



I_{DDF2} Temp. Characteristics



Battery Backup Application Example



*1: Ceramic condenser
*2: Tantalum condenser
(A large bypass condenser is preferable to absorb noise when the power supply is switched.)

This circuit does not have memory protection. Therefore, rapid turnoff of the power supply must be avoided. Enter the Self Refresh mode before changing to the battery backup power supply.