

TOSHIBA (LOGIC/MEMORY)

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9097248 0022011 0 TOS2

32,768 WORD x 8 BIT CMOS PSEUDO STATIC RAM

T-46-23-14

**DESCRIPTION**

The TC51832 Family is a 256K bit high-speed CMOS Pseudo-Static RAM organized as 32,768 words by 8 bits. The TC51832 Family utilizes one transistor dynamic memory cell array with CMOS peripheral circuitry to achieve large capacity, high speed accesses, and low power requirements, using a single 5V power supply. The  $\overline{OE}/RFSH$  input allows two types of refresh operations: Auto Refresh and Self Refresh. The TC51832 Family has a static RAM-like read/write functionality, which allows easy interfacing to a microprocessor. The TC51832 Family is pin-compatible with the 256K bit static RAM. The TC51832P is offered in a standard 28 pin 0.6 inch and 0.3 inch width plastic DIP. The TC51832F is offered in a standard 28 pin 0.450 inch width small out-line plastic flat package.

**FEATURES**

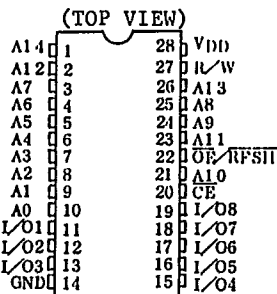
- Organization: 256K bit(32,768 word x 8 bit)
- Fast Access Time and Low Power Dissipation

	TC51832P Family		
	-85	-10	-12
$t_{CEA}$ $\overline{CE}$ Access Time	85ns	100ns	120ns
$t_{OEA}$ $\overline{OE}$ Access Time	35ns	40ns	50ns
$t_{RC}$ Cycle Time	135ns	160ns	190ns
$P_D$ -Operating- Max.	303mW	248mW	220mW
Self Refresh Current	1mA/100 $\mu$ A (-L)		

- Self refresh uses an internal timer.
  - All inputs and outputs: TTL compatible
  - 256 refresh cycle/4ms
  - Pin Compatible: 256K SRAM TC55257
  - Logic Compatible: SRAM R/W Pin
  - 28 pin Standard Plastic PKG
- P/PL : 600 mil DIP  
 SP/SPL: 300 mil DIP  
 F/FL : 450 mil SOP

- Single Power Supply: 5V $\pm$ 10%
- Auto refresh uses an internal counter.

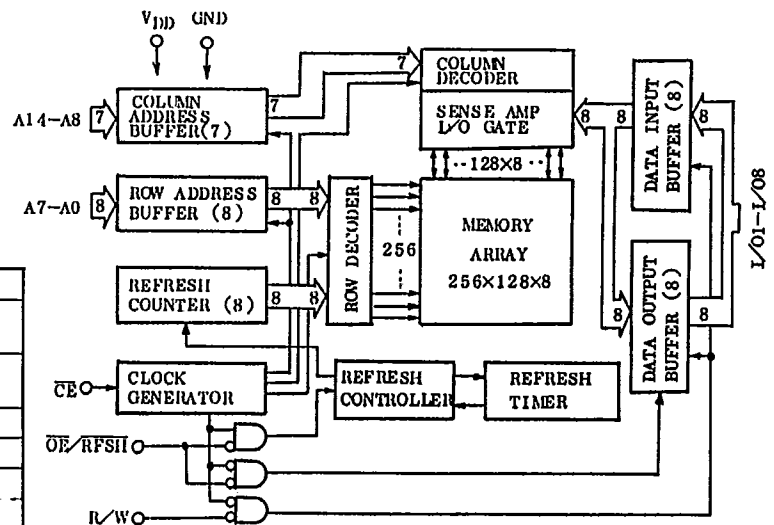
**PIN CONNECTION**



**PIN NAMES**

A0 ~ A14	Address Inputs
R/W	Read/Write Control Input
$\overline{OE}/RFSH$	Output Enable/Refresh Input
$\overline{CE}$	Chip Enable Input
I/O1 ~ I/O8	Data Inputs/Outputs
VDD	Power (+5V)
GND	Ground

**BLOCK DIAGRAM**



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ABSOLUTE MAXIMUM RATINGS

SYMBOL	ITEM	RATING	UNITS	NOTE
V <sub>IN</sub>	Input Voltage	-1.0~7.0	V	1
V <sub>OUT</sub>	Output Voltage	-1.0~7.0	V	1
V <sub>DD</sub>	Power Supply Voltage	-1.0~7.0	V	1
T <sub>OPR</sub>	Operating Temperature	0~70	°C	1
T <sub>STG</sub>	Storage Temperature	-55~150	°C	1
T <sub>SOLDER</sub>	Soldering Temperature·Time	260·10	°C·sec	1
P <sub>D</sub>	Power Dissipation	600	mW	1
I <sub>OUT</sub>	Short Circuit Output Current	50	mA	1

DC RECOMMENDED OPERATING CONDITIONS (T<sub>a</sub>=0~70°C)

SYMBOL	ITEM	MIN.	TYP.	MAX.	UNIT	NOTE
V <sub>DD</sub>	Power Supply Voltage	4.5	5.0	5.5	V	2
V <sub>IH</sub>	Input High Voltage	2.4	-	6.5	V	2
V <sub>L</sub>	Input Low Voltage	-1.0	-	0.8	V	2

DC ELECTRICAL CHARACTERISTICS (V<sub>DD</sub>=5V±10%, T<sub>a</sub>=0~70°C)

SYMBOL	PARAMETER	PERIOD	MIN.	MAX.	UNITS	NOTES
I <sub>DDO</sub>	Operating Current (Average Power Supply Operating Current) CE, Address Cycling: t <sub>RC</sub> =t <sub>RC</sub> MIN.	135ns	-	55	mA	3,4
		160ns	-	45		
		190ns	-	40		
I <sub>DD1</sub>	Standby Current 1 CE=OE/RFSH=V <sub>IH</sub>	TC51832P/SP/F	-	2	mA	
		TC51832PL/SPL/FL	-	1		
I <sub>DD2</sub>	Standby Current 2 CE=OE/RFSH=V <sub>DD</sub> -0.2V	TC51832P/SP/F	-	1	mA	
		TC51832PL/SPL/FL	-	100		
I <sub>DDF</sub>	Self Refresh Current CE=V <sub>DD</sub> -0.2V, OE/RFSH=0.2V	TC51832P/SP/F	-	1	mA	
		TC51832PL/SPL/FL	-	100		
I <sub>I(L)</sub>	Input Leakage Current 0V ≤ V <sub>IN</sub> ≤ V <sub>DD</sub> , All other inputs not under test=0V		-10	10	μA	
I <sub>O(L)</sub>	Output Leakage Current Output Disable, 0V ≤ V <sub>OUT</sub> ≤ V <sub>DD</sub>		-10	10	μA	
V <sub>OH</sub>	Output High Level I <sub>OUT</sub> =-5mA		2.4	-	V	
V <sub>OL</sub>	Output Low Level I <sub>OUT</sub> =4.2mA		-	0.4	V	

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## ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

(V<sub>DD</sub>=5V±10%, T<sub>a</sub>=0~70°C) (NOTES:5,6,7,8,9)

SYMBOL	PARAMETER	-85		-10		-12		UNITS	NOTES
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
t <sub>RC</sub>	Random Read or Write Cycle Time	135	-	160	-	190	-	ns	
t <sub>RMW</sub>	Read Modify Write Cycle Time	200	-	240	-	280	-	ns	
t <sub>CE</sub>	$\overline{\text{CE}}$ Pulse Width	85	10,000	100	10,000	120	10,000	ns	
t <sub>p</sub>	$\overline{\text{CE}}$ Precharge Time	40	-	50	-	60	-	ns	
t <sub>CEA</sub>	$\overline{\text{CE}}$ Access Time	-	85	-	100	-	120	ns	
t <sub>OEA</sub>	$\overline{\text{OE}}$ Access Time	-	35	-	40	-	50	ns	
t <sub>CLZ</sub>	$\overline{\text{CE}}$ to Output in Low-Z	10	-	10	-	10	-	ns	
t <sub>OLZ</sub>	$\overline{\text{OE}}$ to Output in Low-Z	0	-	0	-	0	-	ns	
t <sub>WLZ</sub>	Output Active from End of Write Enable	0	-	0	-	0	-	ns	
t <sub>CHZ</sub>	Chip Disable to Output in High-Z	0	25	0	30	0	35	ns	10
t <sub>OHZ</sub>	$\overline{\text{OE}}$ Disable to Output in High-Z	0	25	0	30	0	35	ns	10
t <sub>WHZ</sub>	Write Enable to Output in High-Z	0	25	0	30	0	35	ns	10
t <sub>OHC</sub>	$\overline{\text{OE}}$ Hold Time Referenced to $\overline{\text{CE}}$	0	-	0	-	0	-	ns	
t <sub>OSC</sub>	$\overline{\text{OE}}$ Set-Up Time Referenced to $\overline{\text{CE}}$	10	-	10	-	10	-	ns	
t <sub>RCS</sub>	Read Command Set-Up Time	0	-	0	-	0	-	ns	
t <sub>RCH</sub>	Read Command Hold Time	0	-	0	-	0	-	ns	
t <sub>WP</sub>	Write Pulse Width	60	-	70	-	85	-	ns	
t <sub>WCH</sub>	Write Command Hold Time	60	-	70	-	85	-	ns	
t <sub>CWL</sub>	Write Command to $\overline{\text{CE}}$ Lead Time	60	-	70	-	85	-	ns	
t <sub>DSW</sub>	Data Set-Up Time Referenced to R/W	35	-	40	-	50	-	ns	11
t <sub>DSC</sub>	Data Set-Up Time Referenced to $\overline{\text{CE}}$	35	-	40	-	50	-	ns	11
t <sub>DHW</sub>	Data Hold Time Referenced to R/W	0	-	0	-	0	-	ns	11
t <sub>DHC</sub>	Data Hold Time Referenced to $\overline{\text{CE}}$	0	-	0	-	0	-	ns	11
t <sub>ASC</sub>	Address Set-Up Time	0	-	0	-	0	-	ns	12
t <sub>AHC</sub>	Address Hold Time	20	-	25	-	30	-	ns	12
t <sub>FC</sub>	Auto Refresh Cycle Time	135	-	160	-	190	-	ns	
t <sub>RFD</sub>	$\overline{\text{CE}}$ to $\overline{\text{RFSH}}$ Delay Time	40	-	50	-	60	-	ns	
t <sub>FAP</sub>	$\overline{\text{RFSH}}$ Pulse Width (Auto Refresh)	80	8,000	80	8,000	80	8,000	ns	13
t <sub>FP</sub>	$\overline{\text{RFSH}}$ Precharge Time	30	-	30	-	30	-	ns	13
t <sub>FCE</sub>	$\overline{\text{RFSH}}$ to $\overline{\text{CE}}$ Active Delay Time	160	-	190	-	225	-	ns	13
t <sub>FAS</sub>	$\overline{\text{RFSH}}$ Pulse Width (Self Refresh)	8000	-	8,000	-	8,000	-	ns	13
t <sub>FRS</sub>	$\overline{\text{CE}}$ Delay Time from $\overline{\text{RFSH}}$ (Self Refresh)	160	-	190	-	225	-	ns	13

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(Continued)

SYMBOL	PARAMETER	-85		-10		-12		UNITS	NOTES
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.		
t <sub>FST</sub>	RFSH Set-Up Time (Refresh Counter Test)	10	30	10	30	10	30	ns	
t <sub>FHT</sub>	RFSH Hold Time (Refresh Counter Test)	65	8,000	65	8,000	65	8,000	ns	
t <sub>REF</sub>	Refresh Period	-	4	-	4	-	4	ms	
t <sub>T</sub>	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	

**CAPACITANCE** (V<sub>DD</sub>=5V, f=1MHz, Ta=25°C)

SYMBOL	PARAMETER	MIN.	MAX.	UNITS
C <sub>I1</sub>	Input Capacitance (A0 ~ A14)	-	5	pF
C <sub>I2</sub>	Input Capacitance ( $\overline{CE}$ , $\overline{OE}/\overline{RFSH}$ , R/W)	-	7	pF
C <sub>IO</sub>	Input/Output Capacitance (I/O1 ~ I/O8)	-	7	pF

NOTE) This parameter is periodically sampled and is not 100% tested.

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## NOTES:

- 1) Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.
- 2) All voltages are referenced to GND.
- 3) IDDO depends on cycle rate.
- 4) IDDO depends on output loading. Specified values are obtained with the output open.
- 5) An initial pause of lms with high  $\overline{CE}$  and high  $\overline{OE}/\overline{RFSH}$  are required after power-up, before proper device operation is achieved.
- 6) AC measurements assume  $t_T=5ns$ .
- 7)  $V_{IH}(min.)$  and  $V_{IL}(max.)$  are reference levels for measuring timing of input signals. Also, transition times are measured between  $V_{IH}$  and  $V_{IL}$ .
- 8) Measured with a load equivalent to 2 TTL loads and 100pF.
- 9) The  $\overline{OE}/\overline{RFSH}$  input operates as the output enable input ( $\overline{OE}$ ) and refresh control input ( $\overline{RFSH}$ ) under the condition of that  $\overline{CE}=V_{IL}$  and  $\overline{CE}=V_{IH}$ , respectively.
- 10)  $t_{CHZ}$ ,  $t_{OHZ}$ ,  $t_{WHZ}$  define the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
- 11) In write cycles, the input data is latched at the earlier of R/W or  $\overline{CE}$  rising edge. Therefore the input data must be valid during set-up time ( $t_{DSW}$ ,  $t_{DSC}$ ) and hold time ( $t_{DIW}$ ,  $t_{DHC}$ ).
- 12) All address inputs are latched at the falling edge of  $\overline{CE}$ . Therefore all the address inputs must be valid during  $t_{ASC}$  and  $t_{AHC}$ .
- 13) Two refresh operation - auto refresh and self refresh are defined by the  $\overline{OE}/\overline{RFSH}$  pulse width under the condition of  $\overline{CE}=V_{IH}$ .

Auto refresh:  $\overline{OE}/\overline{RFSH}$  pulse width  $\leq t_{FAP}$  (max.)

Self refresh:  $\overline{OE}/\overline{RFSH}$  pulse width  $\geq t_{FAS}$  (min.)

The following timing parameter must be kept for proper device operation after refresh

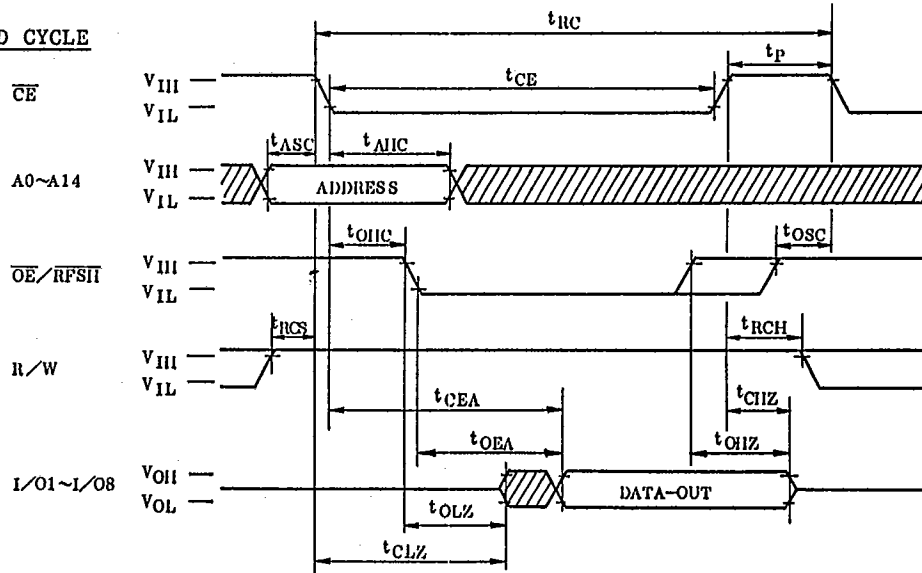
Auto refresh:  $t_{FCE}$

Self refresh:  $t_{FRS}$

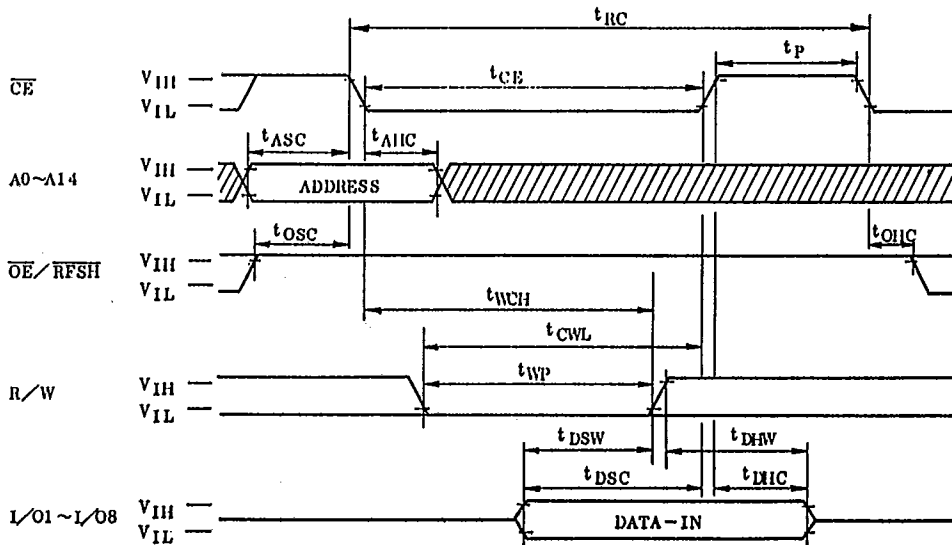
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TIMING CHART

READ CYCLE

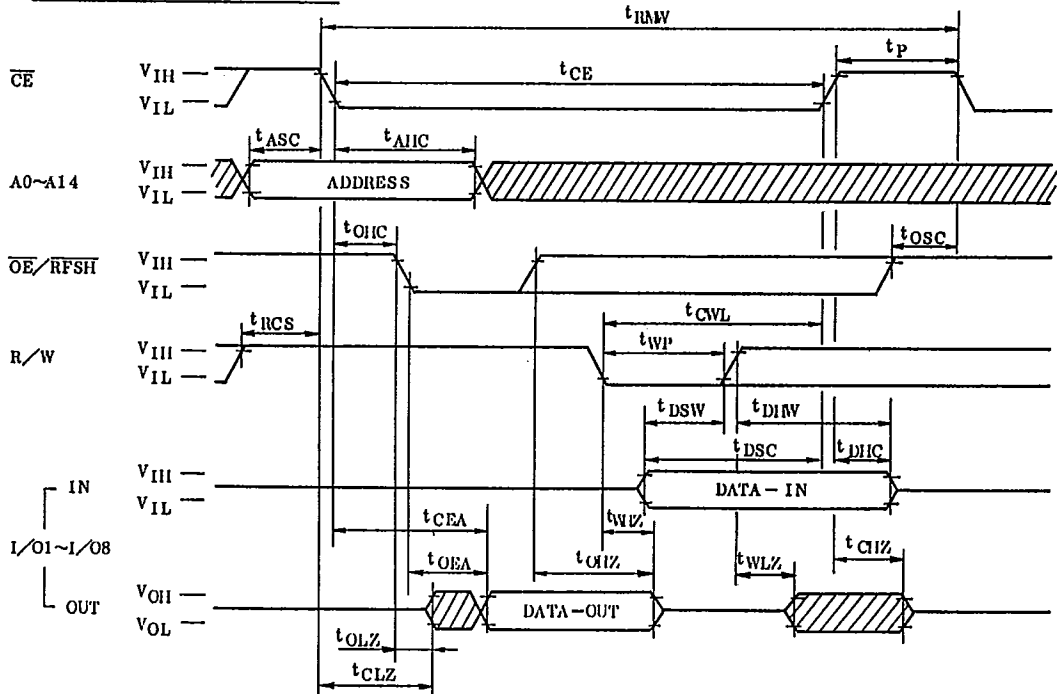


WRITE CYCLE

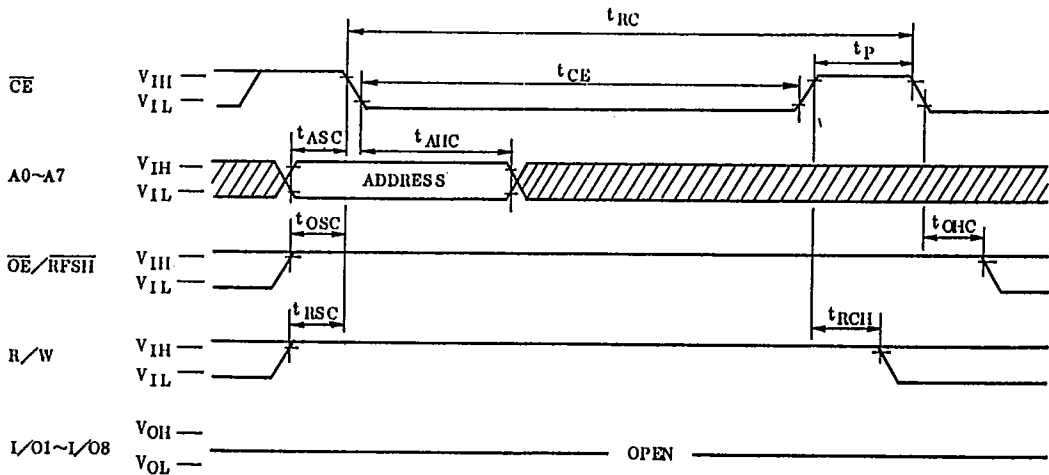


▨ : Don't care

READ MODIFY WRITE CYCLE



$\overline{CE}$  ONLY REFRESH CYCLE



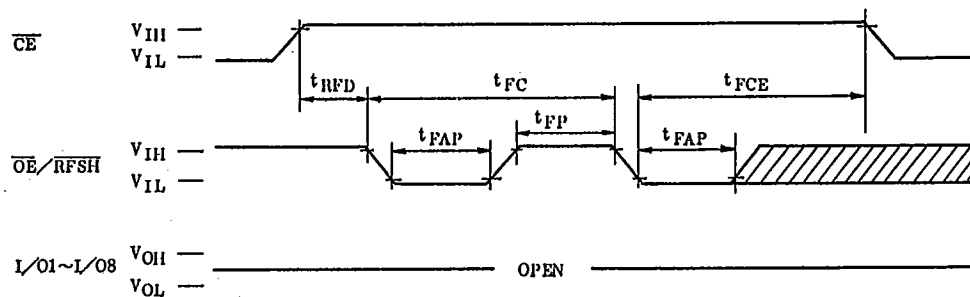
▨ : Don't care

TC51832P/SP/F/PL/SPL/FL-85

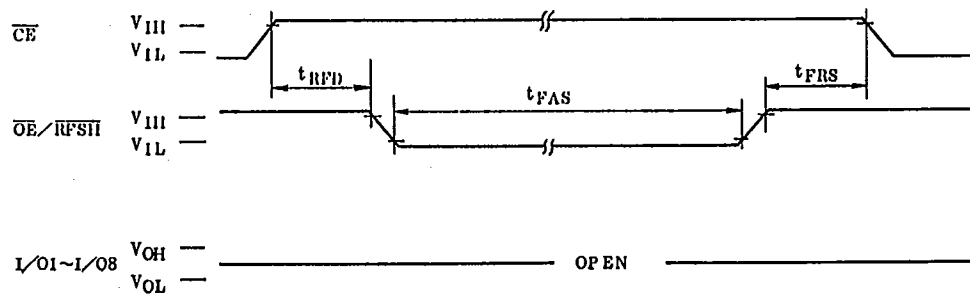
TC51832P/SP/F/PL/SPL/FL-10

TC51832P/SP/F/PL/SPL/FL-12

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AUTO REFRESH CYCLE

Note) A0 ~ A14, R/W=Don't care      : Don't care

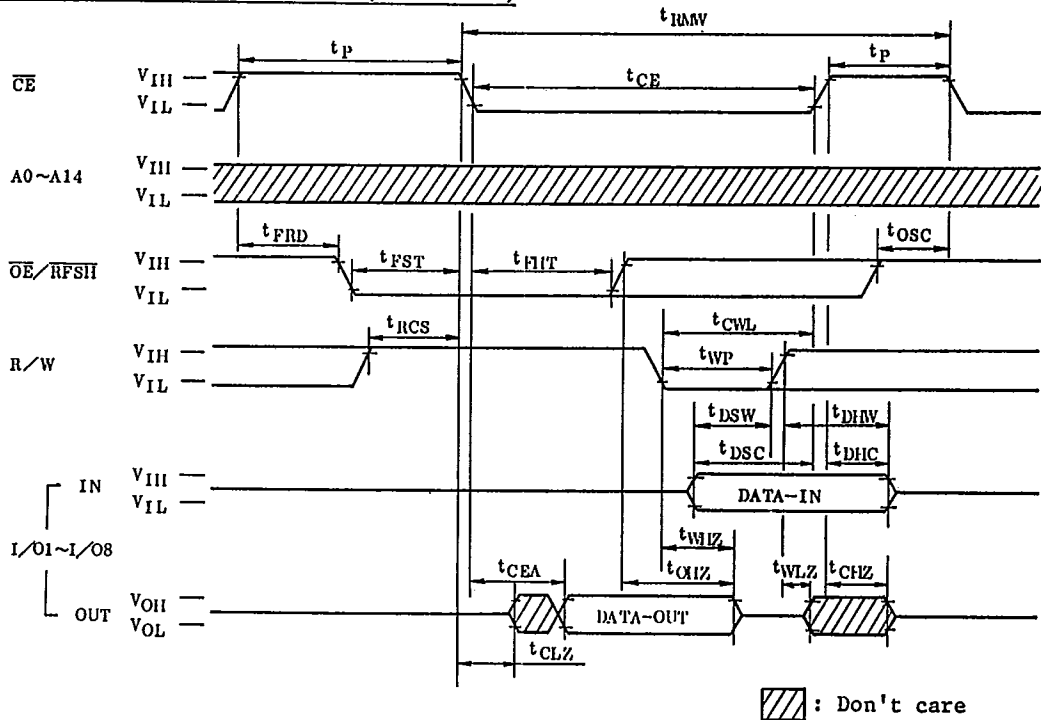
SELF REFRESH CYCLE

Note) A0 ~ A14, R/W=Don't care



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## REFRESH COUNTER TEST CYCLE (READ WRITE)



## REFRESH COUNTER TEST

The internal refresh operation of TC51832P family can be tested by REFRESH COUNTER TEST. This cycle performs READ/WRITE operation taking the internal counter address as row address and fixed zero as column address.

The test procedure is as follows.

- ① Write "0" into all the memory cells at normal write mode.
- ② Read "0" out and write "1" in each cell by performing REFRESH COUNTER TEST.  
Repeat this operation 256 times.
- ③ Check "1" out of 256 bits at normal read mode, which was written at ②.
- ④ Read "1" out and write "0" in each cell by performing REFRESH COUNTER TEST.  
Repeat this operation 256 times.
- ⑤ Check "0" out of 256 bits at normal read mode, which was written at ④.
- ⑥ Perform the above ① to ⑤ the complement data.

TC51832P/SP/F/PL/SPL/FL-85

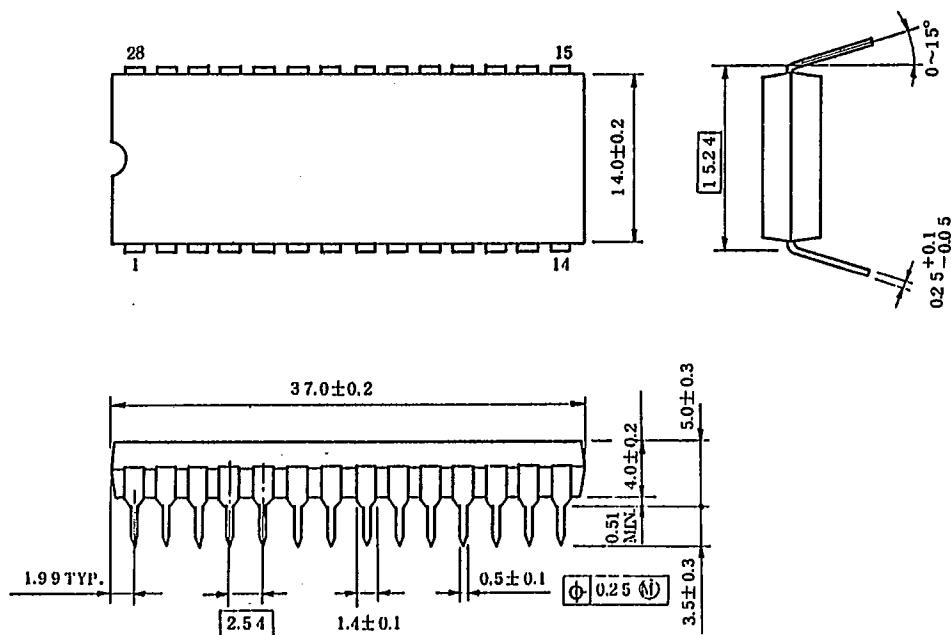
TC51832P/SP/F/PL/SPL/FL-10

TC51832P/SP/F/PL/SPL/FL-12

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## OUTLINE DRAWINGS (DIP28-P-600)

Unit in mm



NOTES: Package width and length do not include mold protrusion, allowable mold protrusion is 0.15mm.

These outline drawings apply to:

TC51832P-85, TC51832PL-85  
 TC51832P-10, TC51832PL-10  
 TC51832P-12, TC51832PL-12

TC51832P/SP/F/PL/SPL/FL-85

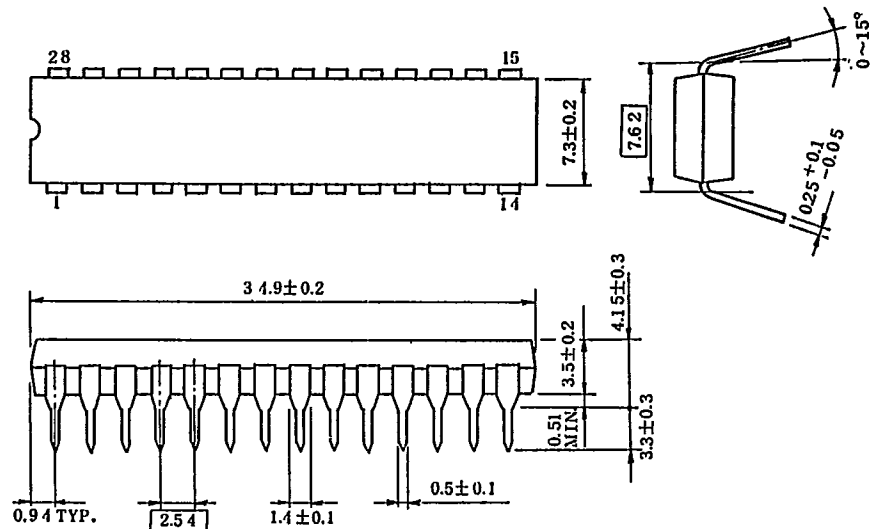
TC51832P/SP/F/PL/SPL/FL-10

TC51832P/SP/F/PL/SPL/FL-12

## OUTLINE DRAWINGS (DIP28-P-300)

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Unit in mm



Note: Package width and length do not include mold protrusion, allowable mold protrusion is 0.15mm.

These outline drawings apply to:

TC51832SP-85, TC51832SPL-85

TC51832SP-10, TC51832SPL-10

TC51832SP-12, TC51832SPL-12

TC51832P/SP/F/PL/SPL/FL-85

TC51832P/SP/F/PL/SPL/FL-10

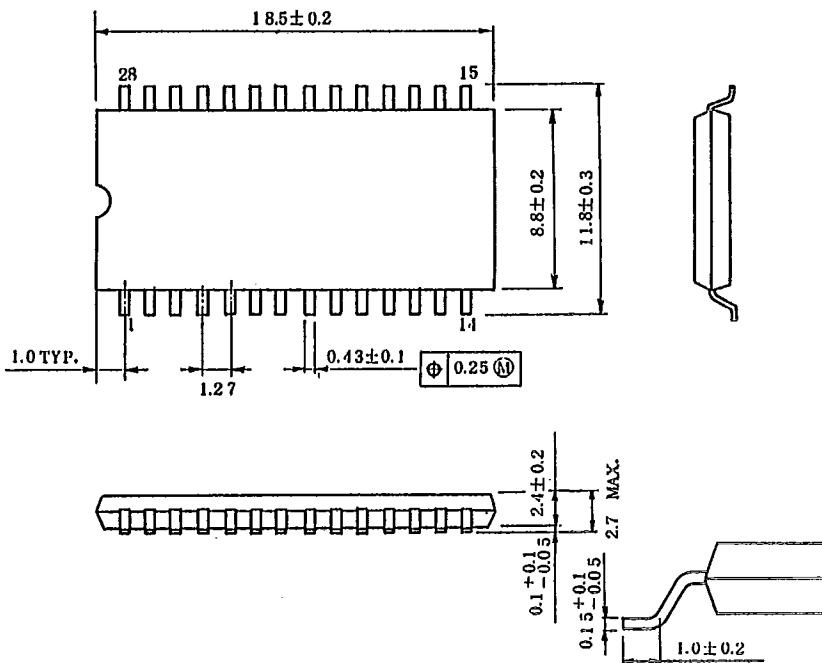
TC51832P/SP/F/PL/SPL/FL-12

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## OUTLINE DRAWINGS

(SOP28-P-450)

Unit in mm



Note: Package width and length do not include mold protrusion,  
allowable mold protrusion is 0.15mm.

These outline drawings apply to:

TC51832F-85, TC51832FL-85

TC51832F-10, TC51832FL-10

TC51832F-12, TC51832FL-12