

# TOSHIBA MOS MEMORY PRODUCTS

2,048 WORD × 8 BIT CMOS STATIC RAM

TC5517CP-15/CPL-15/CP-20/CPL-20  
TC5517CF-15/CFL-15/CF-20/CFL-20

## DESCRIPTION

The TC5517CP/CF is a 16384-bit high speed and low power fully static random access memory organized as 2048 words by 8 bits using CMOS technology, and operates from a single 5V supply. The TC5517CP/CF has a output enable input (OE) for fast memory access and output control and chip enable input ( $\overline{CE}$ ), which is used for device selection and can be used in order to achieve the minimum standby current mode easily for battery back up. Also the high speed and low power characteristics which maximum access time is 150ns, 200ns and maximum operating current is 5mA/MHz are

achieved. Thus the TC5517CP/CF is most suitable for use in low power applications where battery operation or battery back up for nonvolatility are required. Furthermore the TC5517CPL/CFL guaranteed a standby current equal to or less than  $1\mu A$  at 60°C ambient temperature available. And the TC5517CP/CPL is pin compatible with 2716 type EPROM. This means that the TC5517CP/CPL and EPROM can be interchanged in the same socket, and the flexibility in the definition of the quantity of RAM versus EPROM allows the wide application in microcomputer system.

## FEATURES

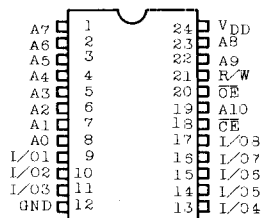
- Low Power Dissipation  
5mA/MHz (Max.)
  - 0.2 $\mu A$ (MAX.) at Ta=25°C
  - 1.0 $\mu A$ (MAX.) at Ta=60°C
  - 5V Single Power Supply
  - Low Voltage Operation : V<sub>DD</sub>=3V  
t<sub>CO</sub>=1 $\mu s$ (MAX.) Ta=60°C
  - Wide Temperature Operation  
Ta=-40~85°C
  - Fully Static Operation
  - Data Retention Voltage : 2.0V~5.5V
  - Output Buffer Control :  $\overline{OE}$
- Operating  
Standby  
Standby

## ● Access Time

	TC5517CP-15/CPL-15	TC5517CP-20/CPL-20
	TC5517CF-15/CFL-15	TC5517CF-20/CFL-20
Address Access Time (MAX.)	150ns	200ns
$\overline{CE}$ Access Time (MAX.)	150ns	200ns
$\overline{OE}$ Access Time (MAX.)	70ns	100ns

- Directly TTL Compatible : All Inputs and Outputs
- 24 Pin Standard Plastic Package : TC5517CP
- 24 Pin Flat Package : TC5517CF

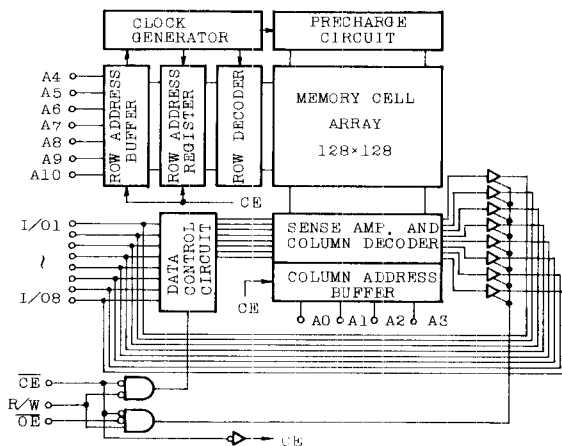
## PIN CONNECTION (TOP VIEW)



## PIN NAMES

A <sub>0</sub> ~A <sub>10</sub>	Address Inputs
R/W	Read/Write Control Input
$\overline{OE}$	Output Enable Input
$\overline{CE}$	Chip Enable Input
I/O <sub>1</sub> ~I/O <sub>8</sub>	Data Input/Output
V <sub>DD</sub>	Power (+5V)
GND	Ground

## BLOCK DIAGRAM



# TC5517CP-15/CPL-15/CP-20/CPL-20 TC5517CF-15/CFL-15/CF-20/CFL-20

## OPERATION MODE

MODE	$\overline{CE}$	$\overline{OE}$	R/W	$A_0 \sim A_{10}$	$I/O_1 \sim I/O_8$	POWER
Read	L	L	H	Stable	Data Out	$I_{DD0}$
Write	L	*	L	Stable	Data In	$I_{DD0}$
Output Deselect	L	H	H	*	High Impedance	$I_{DD0}$
** Standby	H	*	*	*	High Impedance	$I_{DD5}$

Note : \* : H or L    \*\* : Data Retention Mode

## ABSOLUTE MAXIMUM RATINGS

SYMBOL	ITEM	RATING
$V_{DD}$	Power Supply Voltage	-0.3~7.0V
$V_{IN}$	Input Voltage	-0.3V~ $V_{DD}+0.3V$
$V_{I/O}$	Input/Output Voltage	-0.3V~ $V_{DD}+0.3V$
$P_D$	Power Dissipation( $T_a=85^\circ C$ )	0.8W(0.45W)*
$T_{STG}$	Storage Temperature	-55°C~150°C
$T_{OPR}$	Operating Temperature	-40°C~85°C
$T_{SOLDER}$	Soldering Temperature·Time	260°C·10sec.

\*Plastic FP=0.45W

## RECOMMENDED D. C. OPERATING CONDITIONS ( $T_a=-40\sim 85^\circ C$ )

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
$V_{DD}$	Power Supply Voltage	4.5	5.0	5.5	V
$V_{IH}$	Input High Voltage	2.2	—	$V_{DD}+0.3$	V
$V_{IL}$	Input Low Voltage	-0.3	—	0.8	V
$V_{DH}$	Data Retention Voltage	2.0	—	5.5	V

## D. C. CHARACTERISTICS ( $T_a=-40\sim 85^\circ C$ , $V_{DD}=5V\pm 10\%$ )

SYMBOL	PARAMETER	CONDITIONS	TC5517CP-15 CF-15		TC5517CP-20 CF-20		UNIT	
			MIN.	MAX.	MIN.	MAX.		
$I_{IL}$	Input Leakage Current	$0 \leq V_{IN} \leq V_{DD}$	—	$\pm 1.0$	—	$\pm 1.0$	$\mu A$	
$I_{LO}$	I/O Leakage Current	$\overline{CE} = V_{IH}$ , $0V \leq V_{I/O} \leq V_{DD}$	—	$\pm 5.0$	—	$\pm 5.0$	$\mu A$	
$I_{OH}$	Output High Current	$V_{OH} = 2.4V$	-1.0	—	-1.0	—	mA	
$I_{OL}$	Output Low Current	$V_{OL} = 0.4V$	2.0	—	2.0	—	mA	
$I_{DD51}$	Standby Current	$\overline{CE} = 2.2V$	—	3.0	—	3.0	mA	
$I_{DD52}$		$\overline{CE} \leq V_{DD} - 0.5V$	TC5517CPL/ CFL	$T_a = 25^\circ C$	—	0.2	—	0.2
				$T_a = 60^\circ C$	—	1.0	—	1.0
		$V_{DD} = 2 \sim 5.5V$	TC5517CP/ CF	$T_a = 25^\circ C$	—	1.0	—	1.0
				$T_a = 60^\circ C$	—	5.0	—	5.0
$T_a = 85^\circ C$	—	30	—	30	$\mu A$			
$I_{DD01}$	Operating Current	$t_{cycle} = \text{Min. cycle}$ , $\overline{CE} = 0V$ , $I_{OUT} = 0mA$	$V_{IN} = V_{IH}/V_{IL}$	—	45	—	30	
$V_{IN} = V_{DD}/GND$			—	40	—	25		
$I_{DD03}$		$t_{cycle} = 1\mu s$ , $\overline{CE} = 0V$ , $I_{OUT} = 0mA$	$V_{IN} = V_{IH}/V_{IL}$	—	10	—	10	
$I_{DD04}$			$V_{IN} = V_{DD}/GND$	—	5	—	5	

Note : Typical values are at  $T_a=25^\circ C$ ,  $V_{DD}=5V$ .

# TC5517CP-15/CPL-15/CP-20/CPL-20 TC5517CF-15/CFL-15/CF-20/CFL-20

## CAPACITANCE

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
C <sub>IN</sub>	Input Capacitance	—	5	10	pF
C <sub>I/O</sub>	Input/Output Capacitance	—	5	10	pF

Note : This parameter is periodically sampled and is not 100% tested.

## A. C. CHARACTERISTICS (T<sub>a</sub> = -40~85°C, V<sub>DD</sub> = 5V ± 10%)

### Read Cycle

SYMBOL	PARAMETER	TC5517CP-15/CPL-15 TC5517CF-15/CFL-15		TC5517CP-20/CPL-20 TC5517CF-20/CFL-20		UNIT
		MIN.	MAX.	MIN.	MAX.	
t <sub>RC</sub>	Read Cycle Time	150	—	200	—	ns
t <sub>ACC</sub>	Access Time	—	150	—	200	
t <sub>OE</sub>	$\overline{OE}$ to Output Valid	—	70	—	100	
t <sub>CO</sub>	$\overline{CE}$ to Output Valid	—	150	—	200	
t <sub>COF</sub>	$\overline{CE}$ or $\overline{OE}$ to Output Active	10	—	10	—	
t <sub>OD</sub>	Output High-Z from Deselection	—	50	—	60	
t <sub>OH</sub>	Output Hold from Address Change	15	—	20	—	

### Write Cycle

SYMBOL	PARAMETER	TC5517CP-15/CPL-15 TC5517CF-15/CFL-15		TC5517CP-20/CPL-20 TC5517CF-20/CFL-20		UNIT
		MIN.	MAX.	MIN.	MAX.	
t <sub>WC</sub>	Write Cycle Time	100	—	200	—	ns
t <sub>WP</sub>	Write Pulse Width	120	—	150	—	
t <sub>AW</sub>	Address Set up Time	0	—	0	—	
t <sub>WR</sub>	Write Recovery Time	0	—	0	—	
t <sub>ODW</sub>	Output High-Z from R/W	—	50	—	60	
t <sub>OEW</sub>	Output Active from R/W	10	—	10	—	
t <sub>DS</sub>	Data Set up Time	60	—	80	—	
t <sub>DH</sub>	Data Hold Time	0	—	0	—	

## A. C. TEST CONDITIONS

Output Load : 100pF + 1TTL Gate      Timing Measurement Reference Levels

Input Pulse Levels : 0.6V, 2.4V

Input : 0.8V and 2.2V

Output : 0.8V and 2.2V

Input Pulse Rise and Fall Times : 10ns

## 3V OPERATE SPECIFICATION

### D. C. RECOMMENDED OPERATING CONDITIONS (T<sub>a</sub> = -10~60°C)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V <sub>DD</sub>	Power Supply Voltage	2.7	3.0	3.3	V
V <sub>IH</sub>	Input High Voltage	V <sub>DD</sub> - 0.2	—	V <sub>DD</sub>	V
V <sub>IL</sub>	Input Low Voltage	0	—	0.2	V

# TC5517CP-15/CPL-15/CP-20/CPL-20 TC5517CF-15/CFL-15/CF-20/CFL-20

## D. C. CHARACTERISTICS

(Ta = -10~60°C)

SYMBOL	PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNIT	
I <sub>IL</sub>	Input Leakage Current	0 ≤ V <sub>IH</sub> ≤ V <sub>DD</sub>		—	—	±1.0	μA	
I <sub>LO</sub>	Output Leakage Current	CE = V <sub>IH</sub> , 0V ≤ V <sub>I/O</sub> ≤ V <sub>DD</sub>		—	—	±5.0	μA	
I <sub>OH</sub>	Output High Current	V <sub>OH</sub> = V <sub>DD</sub> - 0.2V		-100	—	—	μA	
I <sub>OL</sub>	Output Low Current	V <sub>OL</sub> = 0.2V		100	—	—	μA	
I <sub>DDs</sub>	Standby Current	CE = V <sub>IH</sub>	TC5517CPL/ CFL	Ta = 25°C	—	—	0.2	μA
				Ta = 60°C	—	—	1.0	
			TC5517CP/ CF	Ta = 25°C	—	—	1.0	
				Ta = 60°C	—	—	5.0	
I <sub>DDO</sub>	Operating Current	CE = 0V, I <sub>OL,T</sub> = 0mA t <sub>r</sub> , t <sub>f</sub> ≤ 20 μsec	t <sub>cycle</sub> = 1 μsec	—	2.0	3.0	mA	
			t <sub>cycle</sub> = 10 μsec	—	0.3	0.5		

- All voltage is measured from GND.

## A. C. CHARACTERISTICS

(Ta = -10~60°C, V<sub>DD</sub> = 3V ± 10%)

### Read Cycle

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
t <sub>RC</sub>	Read Cycle Time	1000	—	—	ns
t <sub>ACC</sub>	Address Access Time	—	250	1000	ns
t <sub>OE</sub>	OE to Output Valid	—	80	200	ns
t <sub>CO</sub>	CE to Output Valid	—	250	1000	ns
t <sub>COE</sub>	CE or OE Output Active	10	—	—	ns
t <sub>OD</sub>	Output High-Z Deselection	—	—	200	ns
t <sub>OH</sub>	Output Hold from Address Change	20	—	—	ns

### Write Cycle

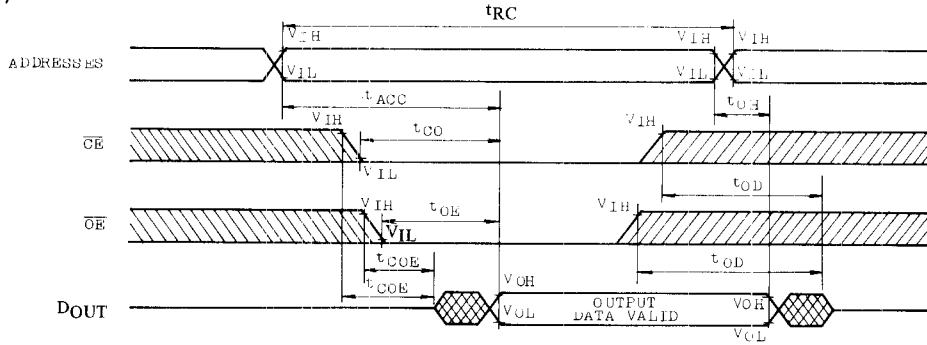
SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
t <sub>WC</sub>	Write Cycle Time	1000	—	—	ns
t <sub>WP</sub>	Write Pulse Width	500	—	—	ns
t <sub>AW</sub>	Address Set up Time	100	—	—	ns
t <sub>WR</sub>	Write Recovery Time	100	—	—	ns
t <sub>ODW</sub>	Output High-Z from R/W	—	—	200	ns
t <sub>OEW</sub>	Output Active from R/W	10	—	—	ns
t <sub>DS</sub>	Data Set up Time	400	—	—	ns
t <sub>DH</sub>	Data Hold Time	50	—	—	ns

## A. C. TEST CONDITIONS

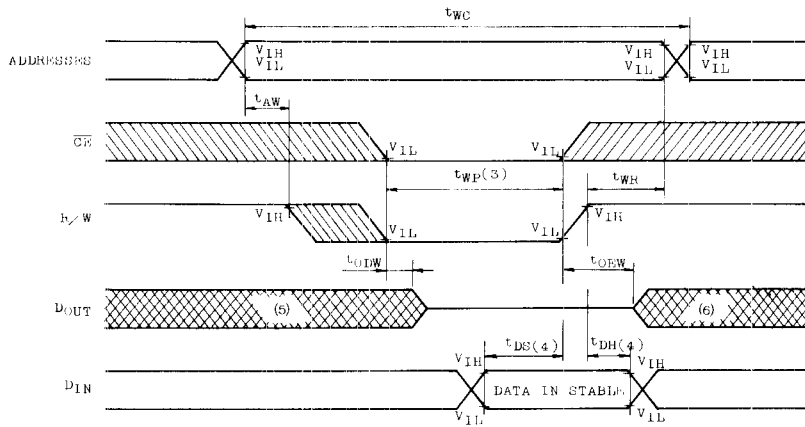
- Output Load : 100pF (Include Jig)
- Input Pulse Levels : 0.2V, V<sub>DD</sub> - 0.2V
- Timing Measurement Level : Input : 1.5V, 1.5V  
Output : 1.5V, 1.5V
- Input Pulse Rise and Fall Times : ≤ 20ns

**TIMING WAVEFORMS**

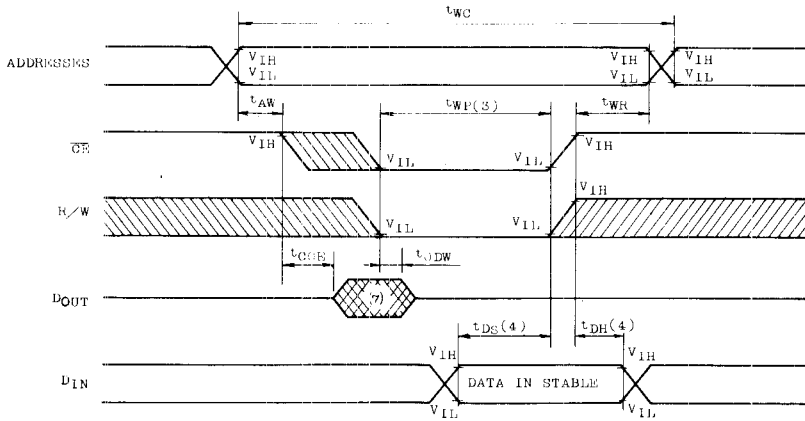
● Read Cycle




● Write Cycle 1 (2)



● Write Cycle 2 (2)



 : UNKNOWN

# TC5517CP-15/CPL-15/CP-20/CPL-20 TC5517CF-15/CFL-15/CF-20/CFL-20

Note:

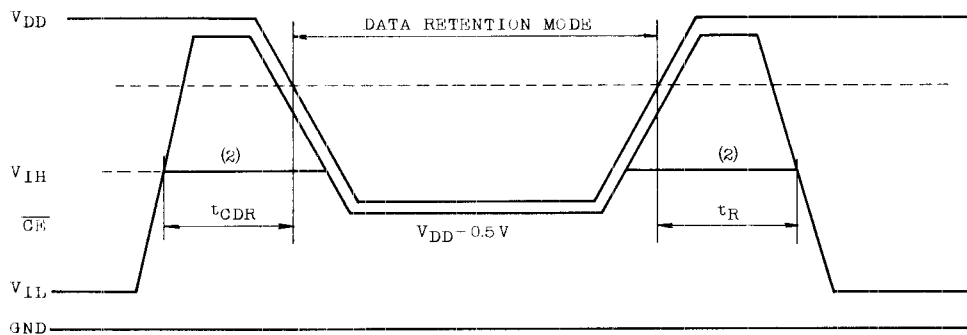
1. R/W is high for a Read Cycle.
2.  $\overline{OE}=V_{IH}$  or  $V_{IL}$ . If,  $\overline{OE}=V_{IH}$  during write cycle, the output buffers remain in a high impedance state.
3.  $t_{WP}$  is specified as the logical "AND" of  $\overline{CE}$  and R/W.  
 $t_{WP}$  is measured from the latter of  $\overline{CE}$  or R/W going low to the earlier of  $\overline{CE}$  or R/W going high.
4.  $t_{DH}$ ,  $t_{DS}$  are measured from the earlier of  $\overline{CE}$  or R/W going high.
5. If the  $\overline{CE}$  low transition occurs simultaneously with or latter from the R/W low transition in a Write Cycle 1, the output buffers remain in a high impedance state in this period.
6. If the  $\overline{CE}$  high transition occurs prior to or simultaneously with the R/W high transition in a Write Cycle 1, the output buffers remain in a high impedance state in this period.
7. If the R/W is low or the R/W low transition occurs prior to or simultaneously with the  $\overline{CE}$  low transition, the output buffers remain in high impedance state in this period.

## DATA RETENTION CHARACTERISTICS (Ta = -40 ~ 85°C)

SYMBOL	PARAMETER		MIN.	TYP.	MAX.	UNIT	
$V_{DH}$	Data Retention Power Supply Voltage		2.0	—	5.5	V	
$I_{DDS2}$	Standby Current	TC5517CPL/CFL	Ta = 25°C	—	0.005	0.2	$\mu A$
			Ta = 60°C	—	—	1.0	
		TC5517CP/CF	Ta = 25°C	—	0.05	1.0	
			Ta = 60°C	—	—	5.0	
			Ta = 85°C	—	—	30	
$t_{CDR}$	From Chip Deselection to Data Retention Mode		0	—	—	$\mu S$	
$t_R$	Recovery Time		$t_{RC}(1)$	—	—		

Note :

1.  $t_{RC}$  : Read Cycle Time

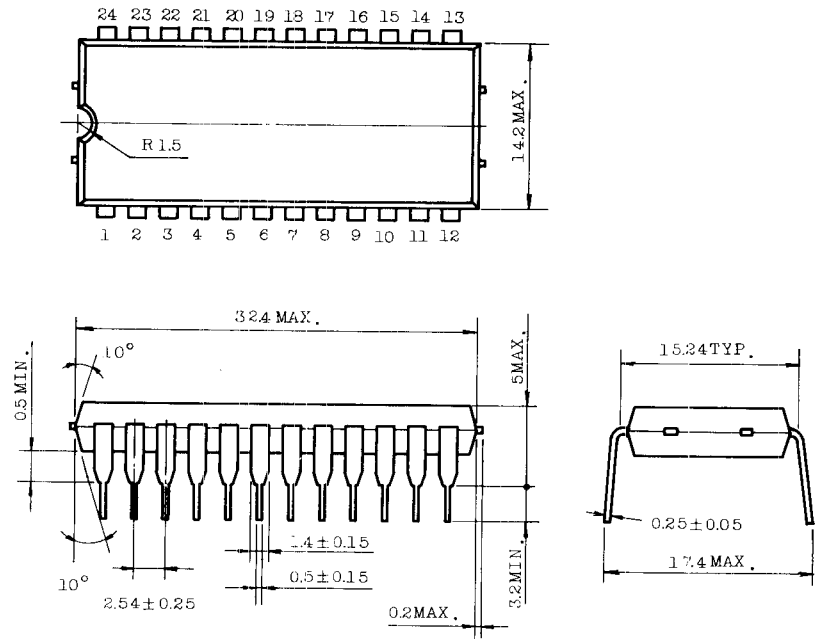


Note :

2. If the  $V_{IH}$  level of  $\overline{CE}$  is 2.2V, during the period that the  $V_{DD}$  voltage is going down from 4.5V to 2.7V  $I_{DDS1}$  current flows.

**OUTLINE DRAWINGS**

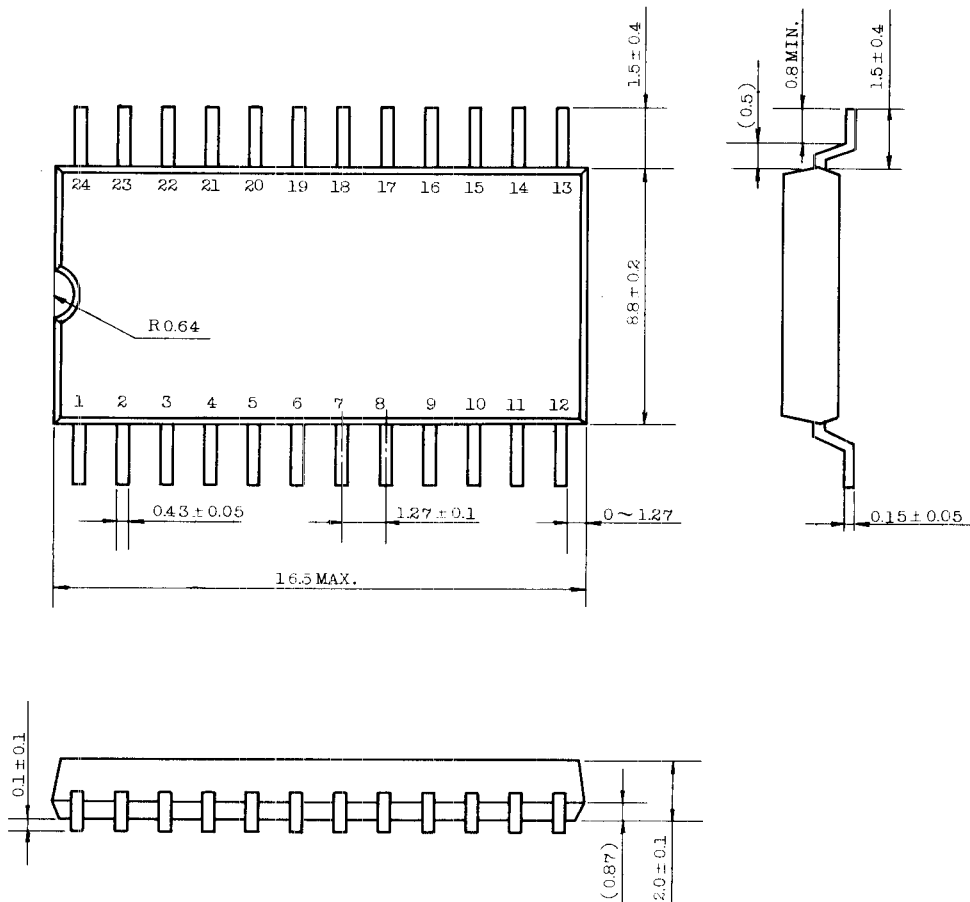
- Plastic DIP



Note : Each lead pitch is 2.54mm. All leads are located within 0.25mm of their true longitudinal position with respect to No.1 and No.24 leads.  
 All dimensions are in millimeters.

TC5517CP-15/CPL-15/CP-20/CPL-20  
 TC5517CF-15/CFL-15/CF-20/CFL-20

- Plastic FP



Note : Each lead pitch is 1.27mm.  
 All leads are located within 0.1mm of their true longitudinal position with respect to No.1 and No.24 leads.



**PACKAGE INFORMATION FOR FLAT PACKAGE**

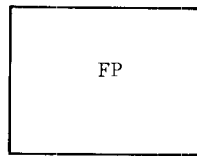
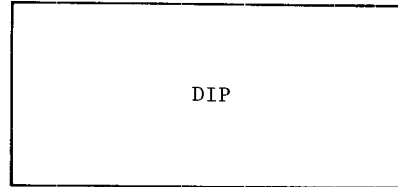
This new flat package is a very small and thin compared with conventional standard dual-in-line package. Differences are as follows.

1. Difference in dimension between flat and standard package.

Unit : mm

	Flat package	Standard package
Length	16.5	32.4
Width	9.0	14.2
Lead Pitch	1.27	2.54
Thickness	2.1	5

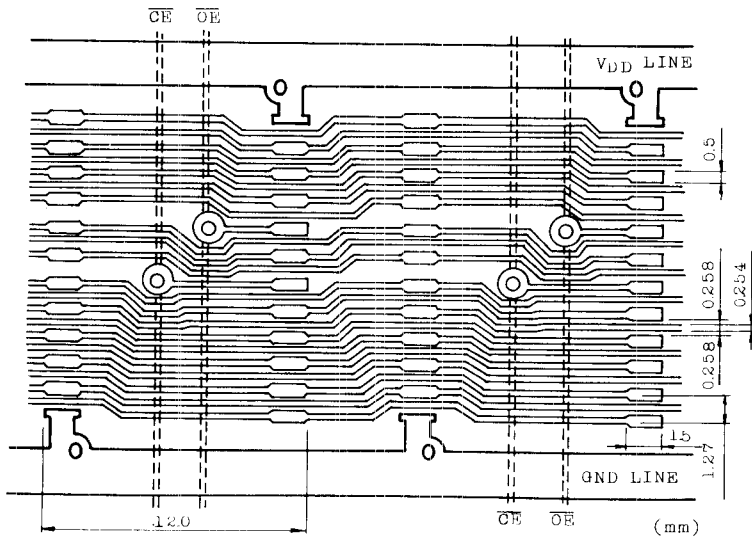
2. Comparison in occupied space.



3. Advantage of this package

- Small dimensions
- Capability of High Density Assembly
- Capability of thin Assembly—Capability of Assembly on both side of PC board.

4. PC pattern layout example.



**TC5517CP-15/CPL-15/CP-20/CPL-20**  
**TC5517CF-15/CFL-15/CF-20/CFL-20**

Note : Toshiba does not assume any responsibility for use of any circuitry described ; no circuit patent licenses are implied, and Toshiba reserves the right, at any time without notice, to change said circuitry.  
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