

# TOSHIBA MOS MEMORY PRODUCTS

2,048 WORD × 8 BIT CMOS STATIC RAM

TC5518CP-15/CPL-15/CP-20/CPL-20  
TC5518CF-15/CFL-15/CF-20/CFL-20

## DESCRIPTION

The TC5518CP/CF is a 16384-bit high speed and low power static random access memory organized as 2048 words by a 8 bits using CMOS technology, and operates from a single 5V supply. The TC5518CP/CF has two chip enable inputs, CE1 and CE2, which are used for device selection and can be used in order to achieve 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.

## FEATURES

- Low Power Dissipation  
5mA/MHz (MAX.)  
0.2μA(MAX.) at Ta=25°C  
1.0μA(MAX.) at Ta=60°C
- 5V Single Power Supply
- Low Voltage Operation : VDD=3V  
tco1, 2=1μs(MAX.) Ta=60°C
- Wide Temperature Operation  
Ta=-40~85°C
- Fully Static Operation
- Data Retention Voltage : 2.0V~5.5V
- Two Chip Enables (CE1, CE2)  
Simple Memory Expansion and Battery Back Up

Operating  
Standby  
Standby

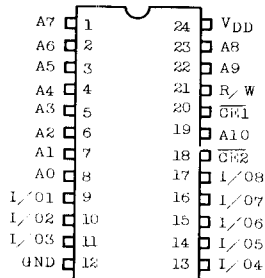
Thus the TC5518CP/CF is most suitable for use in low power applications where battery operation or battery back up for nonvolatility are required. Furthermore the TC5518CPL/CFL guaranteed a standby current equal to or less than 1μA at 60°C ambient temperature available. And the TC5518CP/CPL is pin compatible with 2716 type EPROM. This means that the TC5518CP/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.

## Access Time

	TC5518CP-15/CPL-15	TC5518CP-20/CPL-20
	TC5518CF-15/CFL-15	TC5518CF-20/CFL-20
Address Access Time (MAX.)	150ns	200ns
CE1 Access Time (MAX.)	150ns	200ns
CE2 Access Time (MAX.)	150ns	200ns

- Directly TTL Compatible: All Inputs and Outputs
- 24 Pin Standard Plastic Package : TC5518CP
- 24 Pin Flat Package : TC5518CF

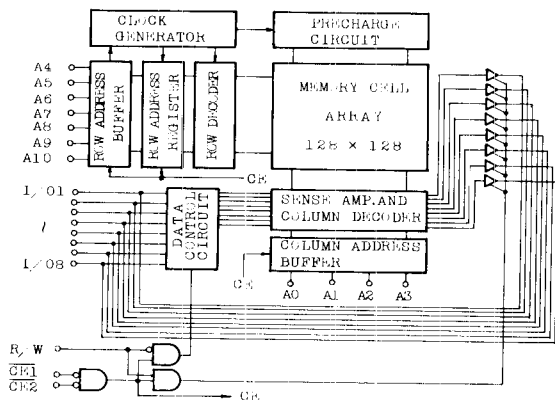
## PIN CONNECTION (TOP VIEW)



## PIN NAMES

A0~A10	Address Inputs
R/W	Read/Write Control Input
CE1, CE2	Chip Enable Inputs
I/O1~I/O8	Data Input/Output
VDD	Power (+5V)
GND	Ground

## BLOCK DIAGRAM



# TC5518CP-15/CPL-15/CP-20/CPL-20 TC5518CF-15/CFL-15/CF-20/CFL-20

## OPERATION MODE

MODE	$\overline{CE}_2$	$\overline{CE}_1$	R/W	A <sub>0</sub> ~A <sub>10</sub>	I/O <sub>1</sub> ~I/O <sub>8</sub>	POWER
Read	L	L	H	Stable	Data Out	I <sub>DD0</sub>
Write	L	L	L	Stable	Data In	I <sub>DD0</sub>
** Standby 1	*	H	*	*	High Impedance	I <sub>DD5</sub>
** Standby 2	H	*	*	*	High Impedance	I <sub>DD5</sub>

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

## ABSOLUTE MAXIMUM RATINGS

SYMBOL	ITEM	RATING
V <sub>DD</sub>	Power Supply Voltage	-0.3~7.0V
V <sub>IN</sub>	Input Voltage	-0.3V~V <sub>DD</sub> +0.3V
V <sub>I/O</sub>	Input/Output Voltage	-0.3V~V <sub>DD</sub> +0.3V
P <sub>D</sub>	Power Dissipation(T <sub>a</sub> =85°C)	0.8W(0.45W)*
T <sub>STG</sub>	Storage Temperature	-55°C~150°C
T <sub>OPR</sub>	Operating Temperature	-40°C~85°C
T <sub>SOLDER</sub>	Soldering Temperature·Time	260°C·10sec.

\*Plastic FP=0.45W

## RECOMMENDED D. C. OPERATING CONDITIONS (T<sub>a</sub>=-40~85°C)

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V <sub>DD</sub>	Power Supply Voltage	4.5	5.0	5.5	V
V <sub>IH</sub>	Input High Voltage	2.2	--	V <sub>DD</sub> +0.3	V
V <sub>IL</sub>	Input Low Voltage	-0.3	--	0.8	V
V <sub>DH</sub>	Data Retention Voltage	2.0	--	5.5	V

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

SYMBOL	PARAMETER	CONDITIONS	TC5518CP-15 CF-15		TC5518CP-20 CF-20		UNIT		
			MIN.	MAX.	MIN.	MAX.			
I <sub>IL</sub>	Input Leakage Current	0 ≤ V <sub>IN</sub> ≤ V <sub>DD</sub>	--	±1.0	--	±1.0	μA		
I <sub>LO</sub>	I/O Leakage Current	$\overline{CE}_2 = V_{IH}, 0V \leq V_{I/O} \leq V_{DD}$	--	±5.0	--	±5.0	μA		
I <sub>OH</sub>	Output High Current	V <sub>OH</sub> =2.4V	-1.0	--	-1.0	--	mA		
I <sub>OL</sub>	Output Low Current	V <sub>OL</sub> =0.4V	2.0	--	2.0	--	mA		
I <sub>DD51</sub>	Standby Current	$\overline{CE}_2 = 2.2V$ or $\overline{CE}_1 = 2.2V$	--	3.0	--	3.0	mA		
I <sub>DD52</sub>		V <sub>DD</sub> =2~5.5V	TC5518CPL/ CFL	T <sub>a</sub> =25°C	--	0.2	--	0.2	μA
				T <sub>a</sub> =60°C	--	1.0	--	1.0	
			TC5518CP/ CF	T <sub>a</sub> =25°C	--	1.0	--	1.0	
				T <sub>a</sub> =60°C	--	5.0	--	5.0	
I <sub>DD01</sub>	Operating Current	t <sub>cycle</sub> = Vin . cycle, $\overline{CE}_1 = \overline{CE}_2 = 0V, I_{OUT} = 0mA$	V <sub>IN</sub> =V <sub>IH</sub> /V <sub>IL</sub>	--	45	--	30	mA	
			V <sub>IN</sub> =V <sub>DD</sub> /GND	--	40	--	25		
		t <sub>cycle</sub> = 1μs, $\overline{CE}_1 =$ $\overline{CE}_2 = 0V, I_{OUT} = 0mA$	V <sub>IN</sub> =V <sub>IH</sub> /V <sub>IL</sub>	--	10	--	10		
			V <sub>IN</sub> =V <sub>DD</sub> /GND	--	5	--	5		

Note : Typical values are at T<sub>a</sub>=25°C, V<sub>DD</sub>=5V.

**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	TC5518CP-15/CPL-15 TC5518CF-15/CFL-15		TC5518CP-20/CPL-20 TC5518CF-20/CFL-20		UNIT
		MIN.	MAX.	MIN.	MAX.	
t <sub>RC</sub>	Read Cycle Time	150	—	200	—	ns
t <sub>ACC</sub>	Address Access Time	—	150	—	200	
t <sub>CO1</sub>	CE <sub>1</sub> to Output Valid	—	150	—	200	
t <sub>CO2</sub>	CE <sub>2</sub> to Output Valid	—	150	—	200	
t <sub>COE</sub>	CE <sub>1</sub> or CE <sub>2</sub> to Output Active	10	—	10	—	
t <sub>OD</sub>	Output High-Z Deselection	—	50	—	60	
t <sub>OH</sub>	Output Hold from Address Change	15	—	20	—	

**Write Cycle**

SYMBOL	PARAMETER	TC5518CP-15/CPL-15 TC5518CF-15/CFL-15		TC5518CP-20/CPL-20 TC5518CF-20/CFL-20		UNIT
		MIN.	MAX.	MIN.	MAX.	
t <sub>WC</sub>	Write Cycle Time	150	—	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

Input Pulse Levels : 0.6V, 2.4V

Timing Measurement Reference Levels

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

# TC5518CP-15/CPL-15/CP-20/CPL-20 TC5518CF-15/CFL-15/CF-20/CFL-20

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

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT		
I <sub>IL</sub>	Input Leakage Current	0V ≤ V <sub>IH</sub> ≤ V <sub>DD</sub>	—	—	±1.0	μA		
I <sub>LO</sub>	Output Leakage Current	$\overline{CE}1, 2 = V_{IH}, 0V \leq V_{IO} \leq V_{DD}$	—	—	±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>DD5</sub>	Standby Current	$\overline{CE}1 = \overline{CE}2 = V_{IH}$	TC5518CPL/ CFL	T <sub>a</sub> = 25°C	—	—	0.2	μA
				T <sub>a</sub> = 60°C	—	—	1.0	
			TC5518CP/ CF	T <sub>a</sub> = 25°C	—	—	1.0	
				T <sub>a</sub> = 60°C	—	—	5.0	
I <sub>DD0</sub>	Operating Current	$\overline{CE}1, 2 = 0V,$ I <sub>OUT</sub> = 0mA t <sub>r</sub> , t <sub>f</sub> ≤ 20μsec	t <sub>cycle</sub> = 1μsec	—	2.0	3.0	mA	
			t <sub>cycle</sub> = 10μsec	—	0.3	0.5		

• All voltage is measured from GND.

## A. C. CHARACTERISTICS (T<sub>a</sub> = -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>CO1</sub>	$\overline{CE}1$ to Output Valid	—	250	1000	ns
t <sub>CO2</sub>	$\overline{CE}2$ to Output Valid	—	250	1000	ns
t <sub>COE</sub>	$\overline{CE}1$ or $\overline{CE}2$ 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

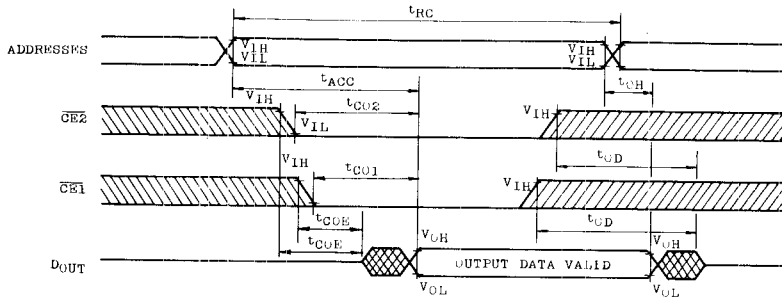
SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
t <sub>WC</sub>	Write Cycle Time	1000	—	—	ns
t <sub>WP</sub>	Write Pulse Width	500	—	—	ns
t <sub>AW</sub>	Address Set up Time	100	—	—	ns
t <sub>WR</sub>	Write Recovery Time	100	—	—	ns
t <sub>ODW</sub>	Output High-Z from R/W	—	—	200	ns
t <sub>OEW</sub>	Output Active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

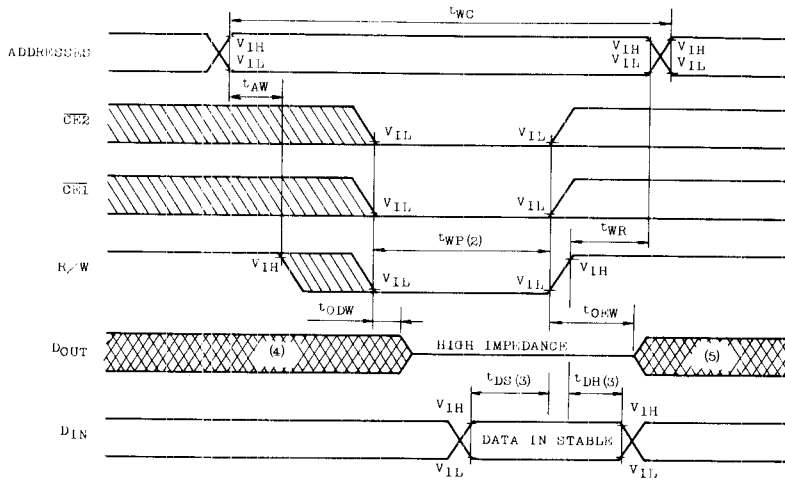
Output Load	: 100pF (Include Jig)
Input Pulse Levels	: 0.2V, V <sub>DD</sub> - 0.2V
Timing Measurement Level	Input: 1.5V, 1.5V
	Output: 1.5V, 1.5V
Input Pulse Rise and Fall Times	: ≤ 20ns

**TIMING WAVEFORMS**

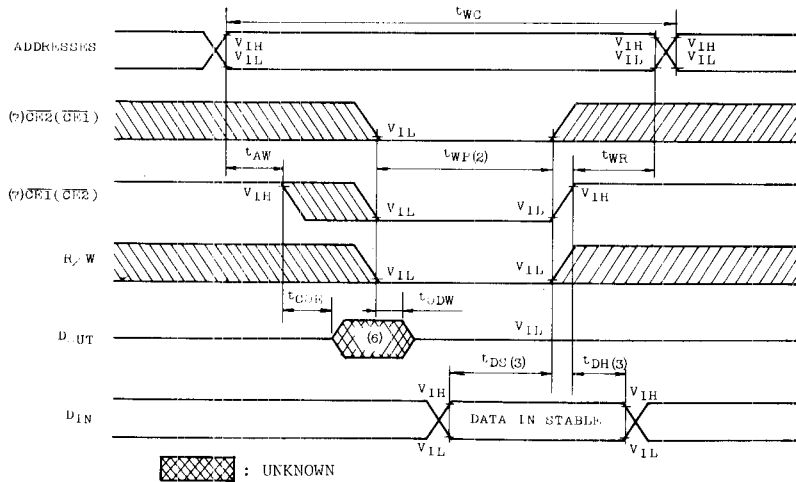
● Read Cycle



● Write Cycle 1



● Write Cycle 2



# TC5518CP-15/CPL-15/CP-20/CPL-20 TC5518CF-15/CFL-15/CF-20/CFL-20

Note :

1. R/W is high for a read Cycle.
2.  $t_{wp}$  is specified as logical "AND" of  $\overline{CE1}$ ,  $\overline{CE2}$  and R/W.  
 $t_{wp}$  is measured from the latter of  $\overline{CE1}$ ,  $\overline{CE2}$  or R/W going low to the earlier of  $\overline{CE1}$ ,  $\overline{CE2}$  or R/W going high.
3.  $t_{DH}$ ,  $t_{DS}$  are measured from the earlier of  $\overline{CE1}$ ,  $\overline{CE2}$  or R/W going high.
4. If the  $\overline{CE1}$  or  $\overline{CE2}$  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.
5. If the  $\overline{CE1}$  or  $\overline{CE2}$  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.
6. If the R/W is low or the R/W low transition occurs prior to or simultaneously with the  $\overline{CE1}$  or  $\overline{CE2}$  low transition, the output buffers remain in a high impedance state in this period.
7. A write occurs during the overlap of a low  $\overline{CE1}$ , low  $\overline{CE2}$  and low R/W.  
In write cycle 2, write is controlled by either  $\overline{CE1}$  or  $\overline{CE2}$ .

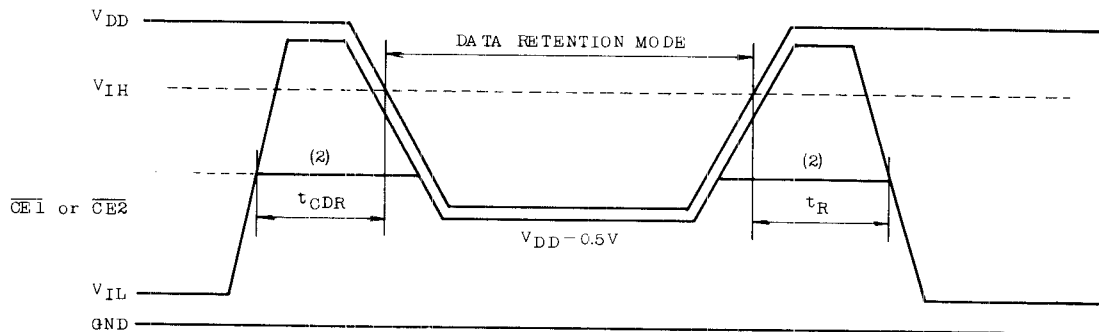
## DATA RETENTION CHARACTERISTICS

( $T_a = -40 \sim 85^\circ\text{C}$ )

SYMBOL	PARAMETER		MIN.	TYP.	MAX.	UNIT	
$V_{DH}$	Data Retention Power Supply Voltage		2.0	—	5.5	V	
$I_{DDS2}$	Standby Current	TC5518CPL/CFL	$T_a = 25^\circ\text{C}$	—	0.005	0.2	$\mu\text{A}$
			$T_a = 60^\circ\text{C}$	—	—	1.0	
		TC5518CP/CF	$T_a = 25^\circ\text{C}$	—	0.05	1.0	
			$T_a = 60^\circ\text{C}$	—	—	5.0	
			$T_a = 85^\circ\text{C}$	—	—	30	
$t_{CDR}$	From Chip Deselection to Data Retention Mode		0	—	—	$\mu\text{s}$	
$t_R$	Recovery Time		$t_{RC}(1)$	—	—	$\mu\text{s}$	

Note :

(1)  $t_{RC}$  : Read Cycle Time

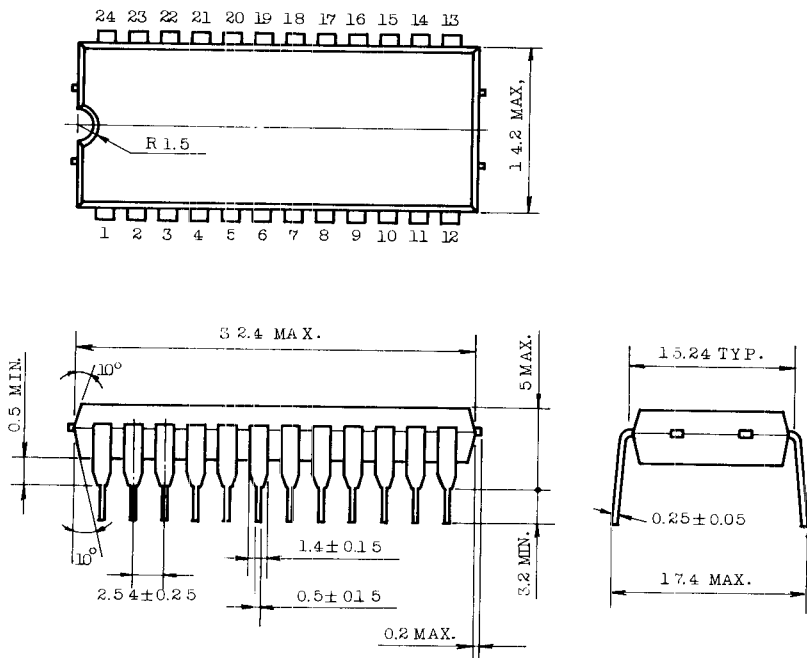


(2) If the  $V_{IH}$  level of  $\overline{CE2}$  ( $\overline{CE1}$ ) is 2.2V, during the period that the  $V_{DD}$  voltage is going down from 4.5V to 2.7V,  $I_{DDS1}$  current flows.

TC5518CP-15/CPL-15/CP-20/CPL-20  
 TC5518CF-15/CFL-15/CF-20/CFL-20

OUTLINE DRAWINGS

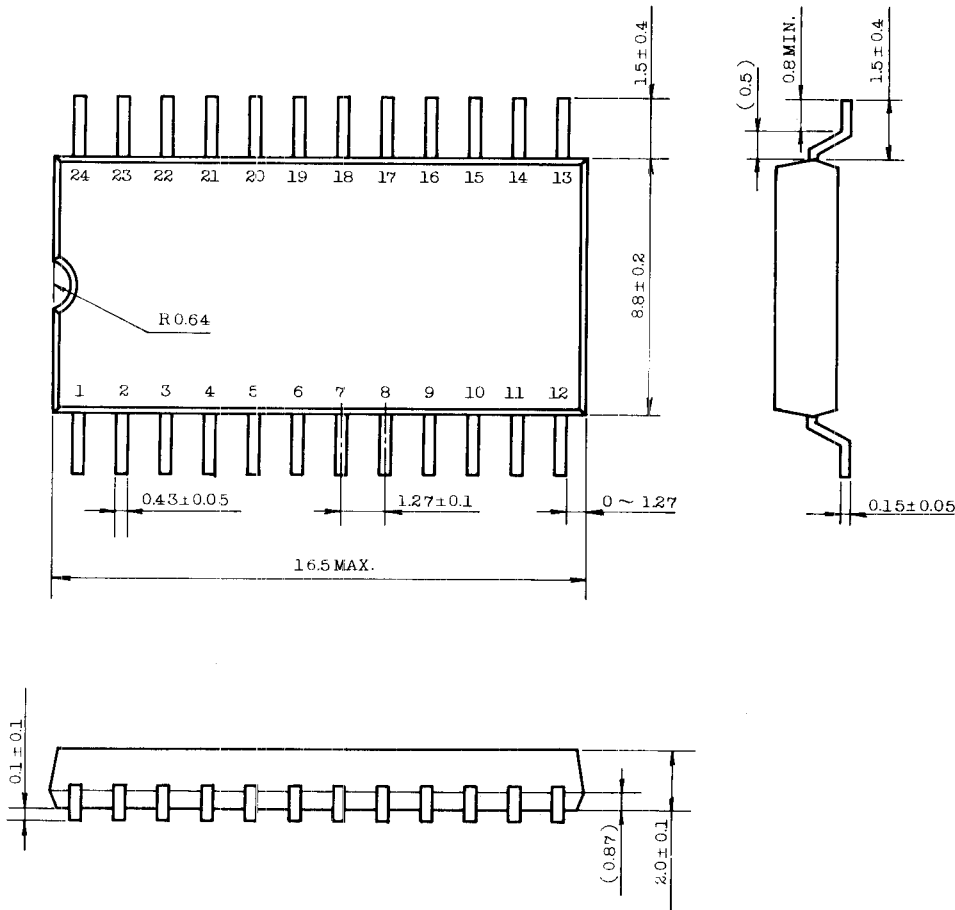
- Plastic DIP



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.

**TC5518CP-15/CPL-15/CP-20/CPL-20**  
**TC5518CF-15/CFL-15/CF-20/CFL-20**

- Plastic FP





**PACKAGE INFORMATION FOR FLAT PACKAGE**

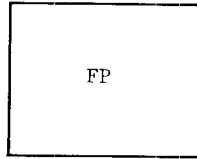
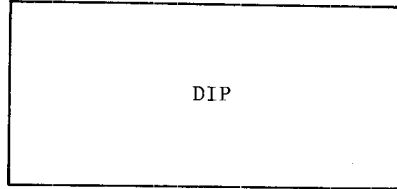
This new flat package is a very small and this compared with conventional standard dual-in-line package. Differences as follows.

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

