TOSHIBA MOS MEMORY PRODUCT

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 5 volt supply. The TC5517CP/CF has a output enable inputs, $\overline{OE}$ for fast memory access and output control and chip enable enable input $\overline{CE}$, which is 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. 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 epual to or less than 1μA 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

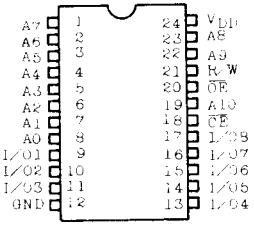
- Low Power Dissipation
  5mA/MHz (Max.) — Operating
  0.2μA(MAX.) at Ta = 25°C — Standby
  1.0μA(MAX.) at Ta = 60°C — Standby
- 5V Single Power Supply
- Low Voltage Operation : V_{DD} = 3V
  t_{CO} = 1μs(MAX.) Ta = 60°C
- Wide Temperature Operation
  Ta = −40 ~ 85°C
- Fully Static Operation
- Data Retention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

- Access Time

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

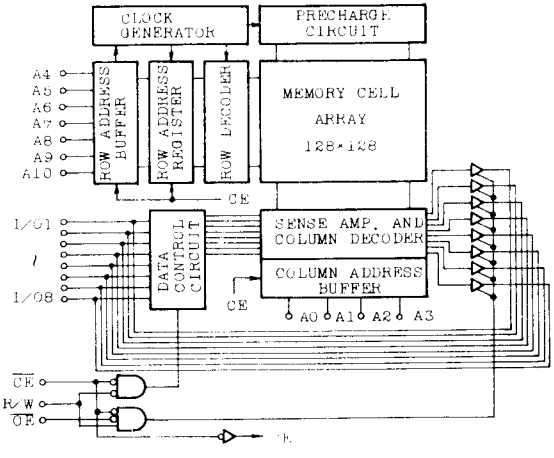
PIN CONNECTION (TOP VIEW)



PIN NAMES

A_0 ~ A_{10}	Address Inputs
R/W	Read/Write Control Input
$\overline{OE}$	Output Enable Input
$\overline{CE}$	Chip Enable Input
I/O_1 ~ I/O_8	Data Input/Output
V_{DD}	Power (+5V)
GND	Ground

BLOCK DIAGRAM



OPERATION MODE

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

Note : * : H or L ** : DataRetention 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(Ta=85°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 (Ta=-40~85°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 (Ta=-40~85°C, V_{DD}=5V±10%)

SYMBOL	PARAMETER	CONDITIONS			TC5517CP-15 CF-15 MIN.	TC5517CP-15 CF-15 MAX.	TC5517CP-20 CF-20 MIN.	TC5517CP-20 CF-20 MAX.	UNIT
I_{IL}	Input Leakage Current	$0 \leqq V_{IN} \leqq V_{DD}$			—	±1.0		±1.0	μA
I_{LO}	I/O Leakage Current	$\overline{CE}=V_{IH}$, $0V \leqq V_{I/O} \leqq V_{DD}$			—	±5.0		±5.0	μA
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_{DDS1}	Standby Current	$\overline{CE2}$=2.2V			-	3.0	—	3.0	mA
I_{DDS2}	Standby Current	$\overline{CE} \geqq V_{DD}-0.5V$	TC5517CPL/CFL	Ta=25°C	—	0.2	—	0.2	μA
				Ta=60°C	—	1.0	—	1.0	
			TC5517CP/CF	Ta=25°C	—	1.0	—	1.0	
				Ta=60°C	—	5.0	—	5.0	
				Ta=85°C	—	30	—	30	
I_{DDO1}	Operating Current	t_{cycle}=Min. cycle, $\overline{CE}$=0V, I_{OUT}=0mA		$V_{IN}=V_{IH}/V_{IL}$	—	45		30	mA
I_{DDO2}				$V_{IN}=V_{DD}/GND$	—	40		25	
I_{DDO3}		t_{cycle}=1μs, $\overline{CE}$=0V, I_{OUT}=0mA		$V_{IN}=V_{IH}/V_{IL}$	—	10	—	10	
I_{DDO4}				$V_{IN}=V_{DD}/GND$	—	5	—	5	

Note : Typical values are at Ta=25°C, V_{DD}=5V.

CAPACITANCE

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
C_{IN}	Input Capacitance	—	5	10	pF
$C_{I/O}$	Input/Output Capacitance	—	5	10	pF

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

A. C. CHARACTERISTICS (Ta = −40~85°C, V_{DD} = 5V ± 10%)

Read Cycle

SYMBOL	PARAMETER	TC5517CP-15/CPL-15 TC5517CF-15/CFL-15		TC5517CP-20/CPL-20 TC5517CF-20/CFL-20		UNITS
		MIN.	MAX.	MIN.	MAX.	
t_{RC}	Read Cycle Time	150	—	200	—	ns
t_{ACC}	Address Time	—	150	—	200	
t_{OE}	$\overline{OE}$ to Output Valid	—	70	—	100	
t_{CO}	$\overline{CE}$ to Output Valid	—	150	—	200	
t_{COE}	$\overline{CE}$ or $\overline{OE}$ to Output Active	10	—	10	—	
t_{OD}	Output High-Z from Deselection	—	50	—	60	
t_{OH}	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		UNITS
		MIN.	MAX.	MIN.	MAX.	
t_{WC}	Write Cycle Time	100	—	200	—	ns
t_{WP}	Write Pulse Width	120	—	150	—	
t_{AW}	Address Set up Time	0	—	0	—	
t_{WR}	Write Recovery Time	0	—	0	—	ns
t_{ODW}	Output High-Z from R/W	—	50	—	60	ns
t_{OEW}	Output Active from R/W	10	—	10	—	
t_{DS}	Data Set up Time	60	—	80	—	
t_{DH}	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 (Ta = −10~60°C)

SYMBOL	PARAMETER	MIN.	TYP	MAX.	UNIT
V_{DD}	Power Supply Voltage	2.7	3.0	3.3	V
V_{IH}	Input High Voltage	V_{DD} − 0.2	—	V_{DD}	V
V_{IL}	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_{LI}	Input Leakage Current	$0V \leqq V_{IN} \leqq V_{DD}$				±1.0	μA
I_{LO}	Output Leakage Current	$\overline{CE}$ = V_{IH}, $0V \leqq V_{OUT} \leqq V_{DD}$				±5.0	μA
I_{OH}	Output High Current	V_{OH} = V_{DD} − 0.2V			100	—	μA
I_{OL}	Output Low Current	V_{OL} = 0.2V			100	—	μA
I_{SB}	Standby Current	$\overline{CE}$ = V_{DD}	TC5517CPL Ta = 25°C	—	—	0.2	μA
			CFL Ta = 60°C	—	—	1.0	
			TC5517CP Ta = 25°C	—	—	1.0	
			CF Ta = 60°C	—	—	5.0	
I_{DDO}	Operating Current	$\overline{CE}$ = 0V, I_{OUT} = 0mA	t_{RC} = 1μsec	—	2.0	3.0	mA
		t_r, $t_f \leqq$ 20nsec	t_{RC} = 10μsec	—	0.3	0.5	

● All voltage is measured from GND.

A. C. CHARACTERISTICS

(Ta = 10 ~ 60°C, V_{DD} = 3V ± 10%)

Read CYCLE

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
t_{RC}	Read Cycle Time	1000	—	—	ns
t_{ACC}	Address Access Time	—	250	1000	ns
t_{OE}	$\overline{OE}$ to Output Valid	—	80	200	ns
t_{CO}	$\overline{CE}$ to Output Valid	—	250	1000	ns
t_{COE}	$\overline{CE}$ or $\overline{OE}$ Output Active	10	—	—	ns
t_{OD}	Output High-Z Deselection	—	—	200	ns
t_{OH}	Output Hold from Address Change	20	—	—	ns

WRITE CYCLE

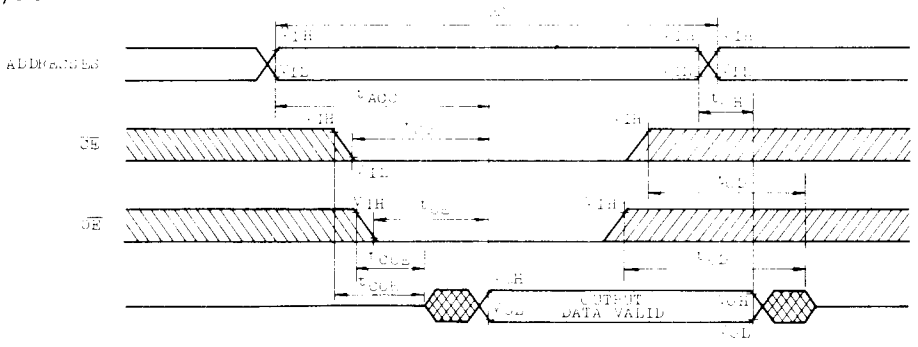
SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
t_{WC}	Write Cycle Time	1000	—	—	ns
t_{WP}	Write Pulse Width	500	—	—	ns
t_{AW}	Address Set up Time	100	—	—	ns
t_{WR}	Write Recovery Time	100	—	—	ns
t_{ODW}	Output High-Z from R/W	—	—	200	ns
t_{OEW}	Output Active from R/W	10	—	—	ns
t_{DS}	Data Set up Time	400	—	—	ns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

A. C. TEST CONDITIONS

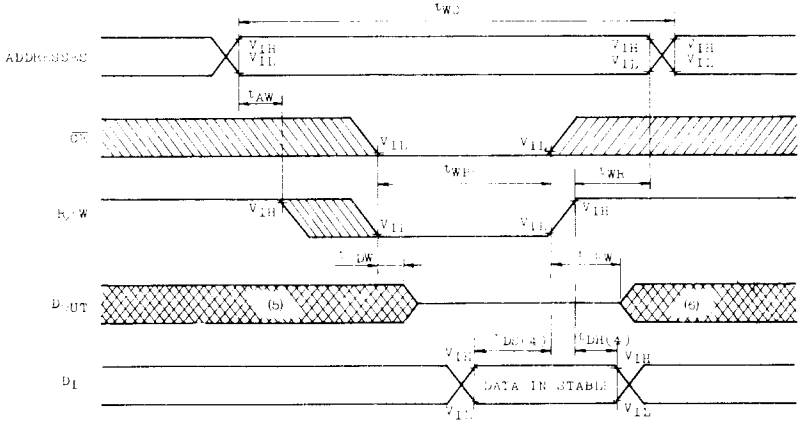
- Output Load : 100pF (Include Jig)
- Input Pulse Levels : 0.2V, V_{DD} − 0.2V
- Timing Measurement Level Input : 1.5V , 1.5V
- Output : 1.5V , 1.5V
- Input Pulse Rise and Fall Times : ≦20ns

TIMING WAVEFORMS

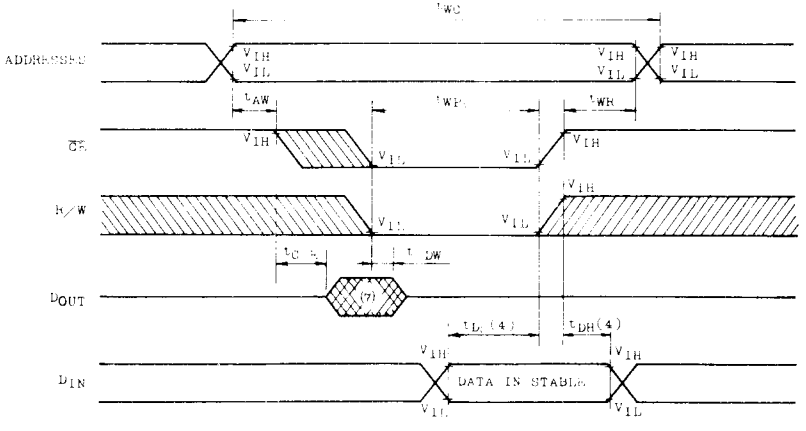
- Read Cycle



- Write Cycle 1 (2)



- Write Cycle 2 (2)



: UNKNOWN

Note:

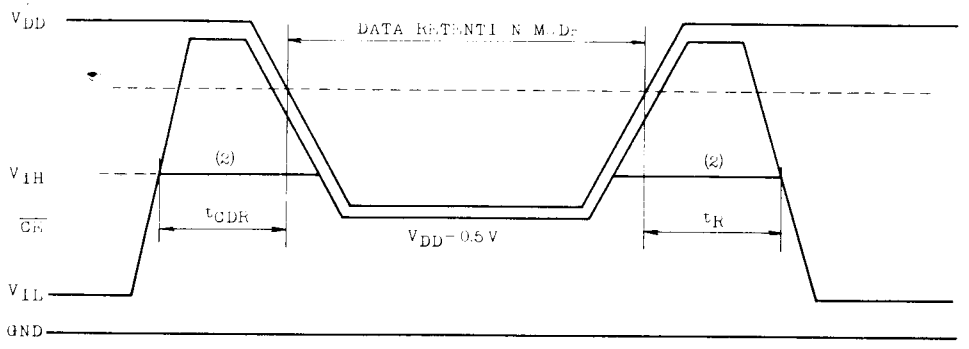
1. R/W is high for a Read Cycle.
2. $\overline{OE}$: V_{IH} or V_{IL}. If, $\overline{OE}$: V_{IH} during write cycle, the output buffers remain in a high impedance state.
3. t_{WP} is specified as the logical "AND" of $\overline{CE}$ and R/W.
   t_{WP} is measured from the latter of $\overline{CE}$ 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_{DDS1}	Standby Current	TC5517CPL/CFL	Ta = 25°C	—	0.005	0.2	μA
			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	—	—	ns
t_R	Recovery Time			t_{RC}(1)	—	—	

Note :

1. t_{RC} : Read Cycle Time

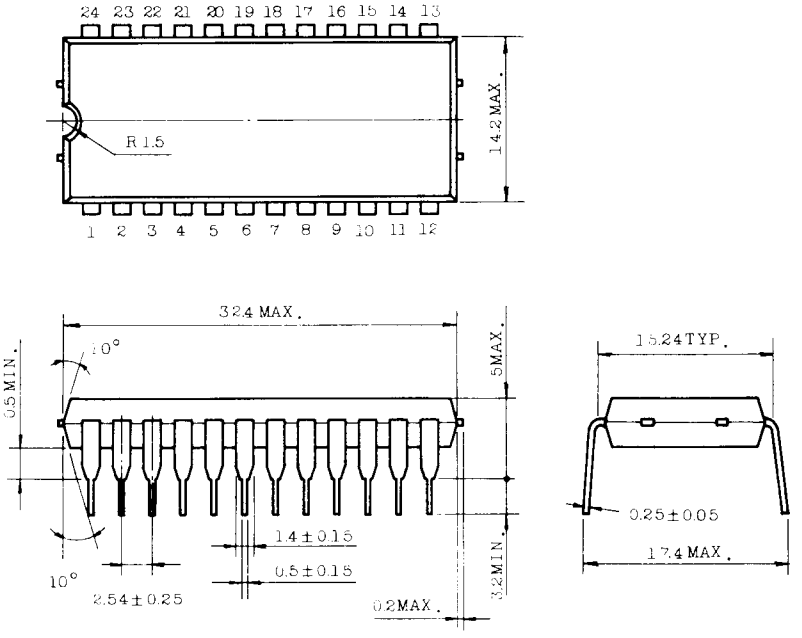


Note :

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.

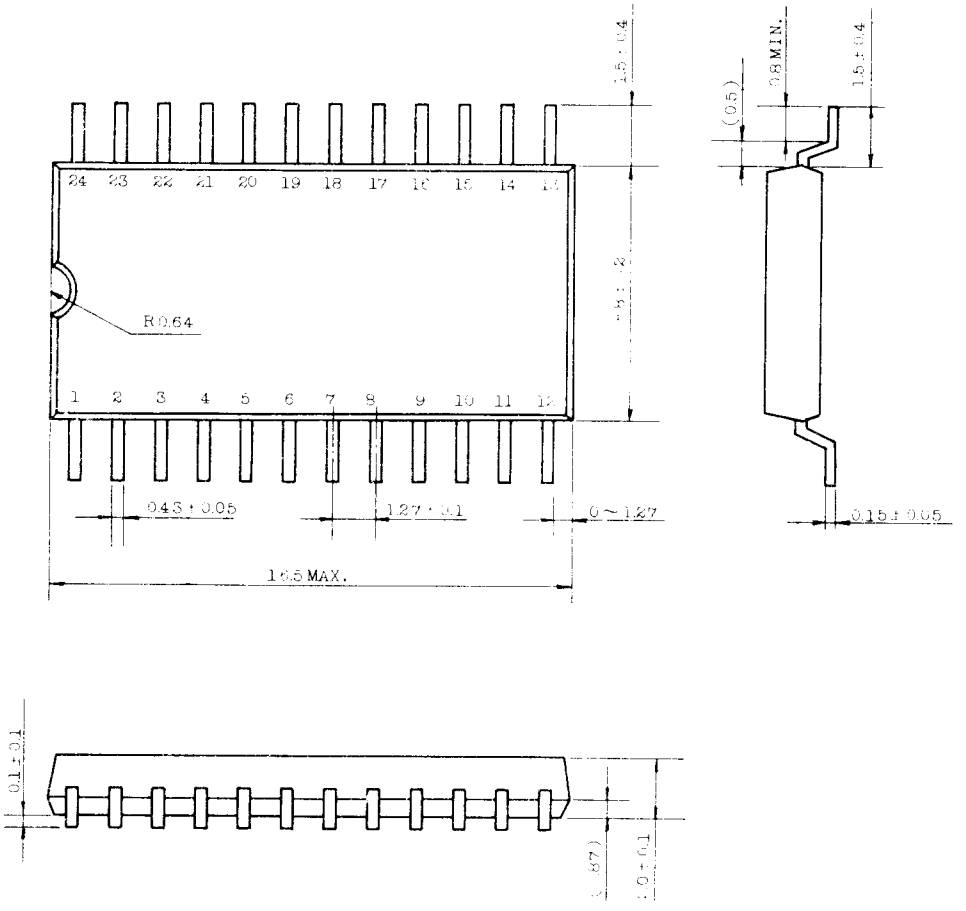
OUTLINE DRAWINGS

- Plastic DIP



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

- 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

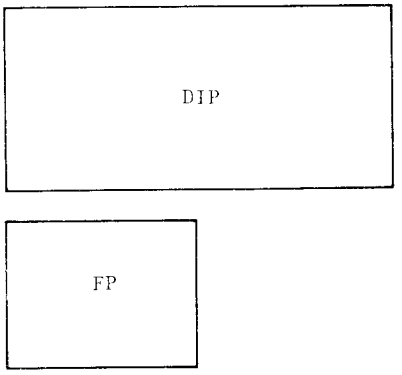
This new flat package is a very small and thin compared with conventional standard dual-in-line package. Differences are as follows.

1. Difference in dimension between flat and standard package.

Unit: mm

	Flat pacpage	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.