*October 1990*
*Edition 1.0*

FUJITSU

*DATA SHEET*

# *MBM27C1001P-17/-20/-25*

## *CMOS 1M-BIT OTPROM*

### CMOS 1,048,576-BIT UV ONE TIME ELECTRICALLY PROGRAMMABLE READ ONLY MEMORY

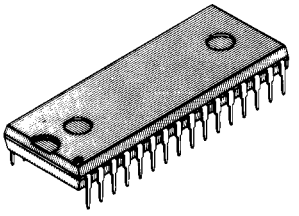
The Fujitsu MBM27C1001P is a high speed 1,048,576 bits CMOS one time electrically programmable read only memory (OTPROM). It is especially well suited for application where rapid turn-around and/or bit pattern experimentation, and low-power consumption are important.

The MBM27C1001P is fabricated using CMOS double polysilicon gate technology with single transistor stacked gate cells and housed in standard 32-pin plastic DIP package and 32-pin plastic SOP package, 32-pin plastic bend-type(Gull-Wing) TSOP package and 32-pin plastic J-Lead LCC package.

It is organized as 131,072 words by 8 bits for use in microprocessor applications. Single +5V operation greatly facilitates its use in systems.

The MBM27C1001P has the same functions including write operations as MBM27C1001(EPROM) except for erase.

- Single5V(±10%) power supply with low current drain:
  Active operation = 30mA(Max.) for 200ns/250ns
  40mA(Max.) for 170ns
  Standby operation= 0.1mA(Max.)
- 131,072 words x 8 bits organization with on-chip decoding
- Single-byte or Four-byte programming capability with Quick Programming Algorithm
- Static operation (no clocks required)
- Fast access time:
  170ns max. (MBM27C1001P-17)
  200ns max. (MBM27C1001P-20)
  250ns max. (MBM27C1001P-25)
- Three-state output for wired-OR capability
- Programming voltage: +12.5V
- Standard 32-pin plastic DIP (Suffix: P)
- Standard 32-pin plastic SOP (Suffix: PF)
- Standard 32-pin plastic bend-type(Gull-Wing) TSOP (Suffix: PFT)
- Standard 32-pin plastic J-Lead LCC (Suffix: PD)

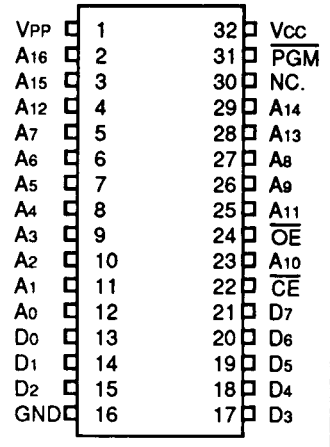


**PLASTIC PACKAGE**
**DIP-32P-M01**

**FPT-32P-M03: See page 1, 14**
**FPT-32P-M04: See page 15**
**FPT-32P-M05: See page 16**
**LCC-32P-M02: See page 17**

**PIN ASSIGNMENT**

( TOP VIEW )




DIP & SOP

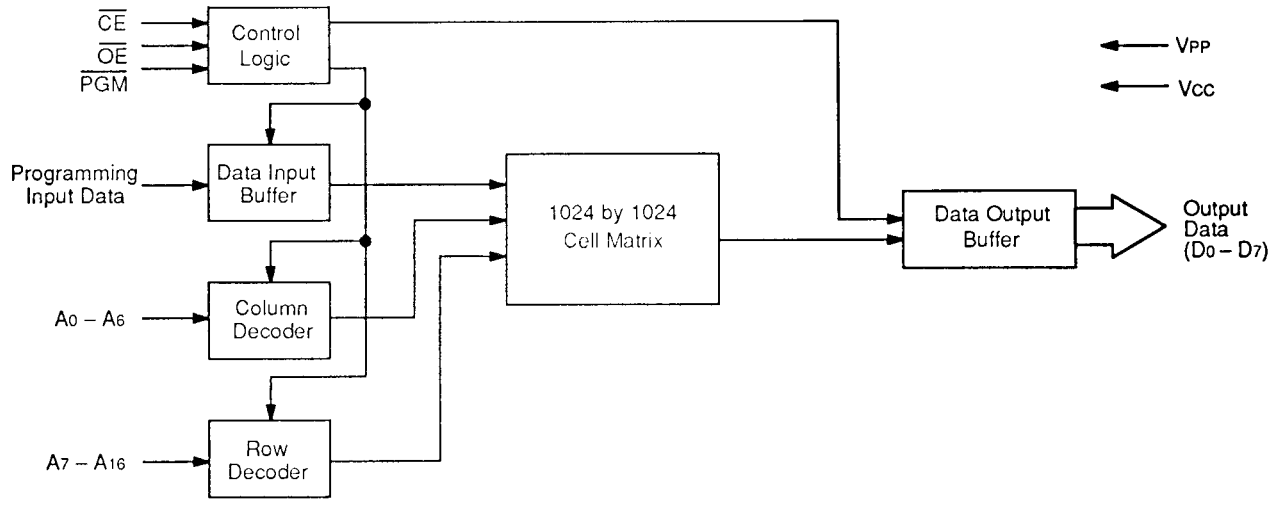
### ABSOLUTE MAXIMUM RATINGS (see NOTE)

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Temperature under Bias | $T_{BIAS}$ | −25 to + 85 | °C |
| Storage Temperature Range | $T_{STG}$ | −45 to +125 | °C |
| All Inputs/Outputs Voltage with respect to GND | $V_{IN}$, $V_{OUT}$ | −0.6 to $V_{CC}$ + 0.3 | V |
| Voltage on A9 with respect to GND | $V_{A9}$ | −0.6 to + 13.5 | V |
| Programming Voltage with respect to GND | $V_{PP}$ | −0.6 to + 14.0 | V |
| Supply Voltage with respect to GND | $V_{CC}$ | −0.6 to + 7.0 | V |

**NOTE:** Permanent device damage may occur if the above **Absolute Maximum Ratings** are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

Fig. 1 — BLOCK DIAGRAM




# CAPACITANCE ($T_A$ = 25° C, f = 1MHz)

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | Min | Typ | Max | |
| Input Capacitance ($V_{IN}$=0V) | $C_{IN}$ | | 8 | 12 | pF |
| Output Capacitance ($V_{OUT}$=0V) | $C_{OUT}$ | | 8 | 12 | pF |

# PIN DESCRIPTION

| Symbol | Pin No. | Function |
|---|---|---|
| $V_{PP}$ | 1 | +12.5V programming voltage |
| $\overline{OE}$ | 24 | Output enable. When $\overline{OE}$ and $\overline{CE}$ are active Low and the $\overline{PGM}$ strobe is active High; all output lines($D_0$–$D_7$) are enabled. |
| $A_0$–$A_{16}$ | 2–12, 23 25–29 | Address lines |
| $D_0$–$D_7$ | 13–15, 17–21 | Three-state output data line |
| GND | 16 | Circuit ground |
| $\overline{CE}$ | 22 | When active Low, the device is enabled for data read. |
| NC. | 30 | No connection |
| $\overline{PGM}$ | 31 | When active Low, programming data from the input buffer is written into a specified address of memory. |
| $V_{CC}$ | 32 | +5V power supply |

# FUNCTIONS AND PIN CONNECTIONS

## 1. Read Mode

| Mode \ Symbol | $A_0$–$A_{16}$ | $D_0$–$D_7$ | $\overline{OE}$ | $\overline{CE}$ | $\overline{PGM}$ | $V_{CC}$ | $V_{PP}$ | GND |
|---|---|---|---|---|---|---|---|---|
| Read | $A_{IN}$ | $D_{OUT}$ | $V_{IL}$ | $V_{IL}$ | $V_{IH}$ | +5V | +5V | GND |
| Standby | X | Hi-Z | X | $V_{IH}$ | X | +5V | +5V | GND |
| Output Disable | $A_{IN}$ | Hi-Z | $V_{IH}$ | $V_{IL}$ | X | +5V | +5V | GND |
| | | | X | $V_{IL}$ | $V_{IL}$ | | | |

Legend: X=Don't care

# FUNCTIONS AND PIN CONNECTIONS(Cont'd)

## 2. Single-Byte Programming Mode

| Mode \ Symbol | $A_0$–$A_{16}$ | $D_0$–$D_7$ | $\overline{OE}$ | $\overline{CE}$ | $\overline{PGM}$ | Vcc | VPP | GND |
|---|---|---|---|---|---|---|---|---|
| Program | AIN | DIN | VIH | VIL | VIL | +6V | +12.5V | GND |
| Verify | AIN | DOUT | VIL | VIL | VIH | +6V | +12.5V | GND |
| Program Inhibit | AIN | Hi-Z | VIH | VIL | VIH | +6V | +12.5V | GND |

## 3. Four-Byte Programming Mode

| Mode \ Symbol | $A_0$, $A_1$ | $A_2$ to $A_{16}$ | $D_0$–$D_7$ | $\overline{OE}$ | $\overline{CE}$ | $\overline{PGM}$ | Vcc | VPP | GND |
|---|---|---|---|---|---|---|---|---|---|
| Program | AIN | AIN | DIN | VIH | VIH | VIH | +6V | +12.5V | GND |
| Program | X | AIN | Hi-Z | VIL | VIH | VIL | +6V | +12.5V | GND |
| Verify | AIN | AIN | DOUT | VIL | VIL | VIH | +6V | +12.5V | GND |
| Program Inhibit | AIN | AIN | Hi-Z | VIL | VIH | VIH | +6V | +12.5V | GND |

Legend: X=Don't care

# RECOMMENDED OPERATING CONDITIONS

(Referenced to GND)

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Supply Voltage | Vcc | 4.5 | 5.0 | 5.5 | V |
| Supply Voltage *1 | VPP | Vcc –0.6 | Vcc | Vcc +0.6 | V |
| Operating Temperature | TA | 0 | | 70 | °C |

*1 : VPP supply voltage is applied posterior to or coincident with Vcc supply voltage and cut off prior to or coincident with Vcc supply voltage.

# DC CHARACTERISTICS

**(Recommended operating conditions unless otherwise noted)**

| Parameter | | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Input Leakage Current | | $\|I_{LI}\|$ | $V_{IN} = V_{CC} = 5.5V$ | | | 10 | μA |
| Output Leakage Current | | $\|I_{LO}\|$ | $V_{OUT} = V_{CC} = 5.5V$ | | | 10 | μA |
| Vcc Standby Current | | $I_{SB1}$ | $\overline{CE} = V_{IH}$ | | | 1.0 | mA |
| Vcc Standby Current | | $I_{SB2}$ | $\overline{CE} = V_{CC} \pm 0.3V$ | | 1.0 | 100 | μA |
| Vcc Active Current | 200ns/250ns | $I_{CC1}$ | $\overline{CE}=V_{IL}$, $I_{OUT} = 0mA$ | | | 30 | mA |
| | 170ns | | | | | 40 | mA |
| Vcc Operation Current | 200ns/250ns | $I_{CC2}$ | Cycle = min., $I_{OUT} = 0mA$ | | | 30 | mA |
| | 170ns | | | | | 40 | mA |
| $V_{PP}$ Supply Current | | $I_{PP}$ | $V_{PP} = V_{CC} \pm 0.6V$ | | 1.0 | 100 | μA |
| Input High Level | | $V_{IH}$ | | 2.0 | | Vcc +0.3 | V |
| Input Low Level | | $V_{IL}$ | | −0.1 | | 0.8 | V |
| Output High Level | | $V_{OH1}$ | $I_{OH} = -400\mu A$ | 2.4 | | | V |
| Output High Level | | $V_{OH2}$ | $I_{OH} = -100\mu A$ | Vcc −0.7 | | | V |
| Output Low Level | | $V_{OL}$ | $I_{OL} = 2.1mA$ | | | 0.45 | V |

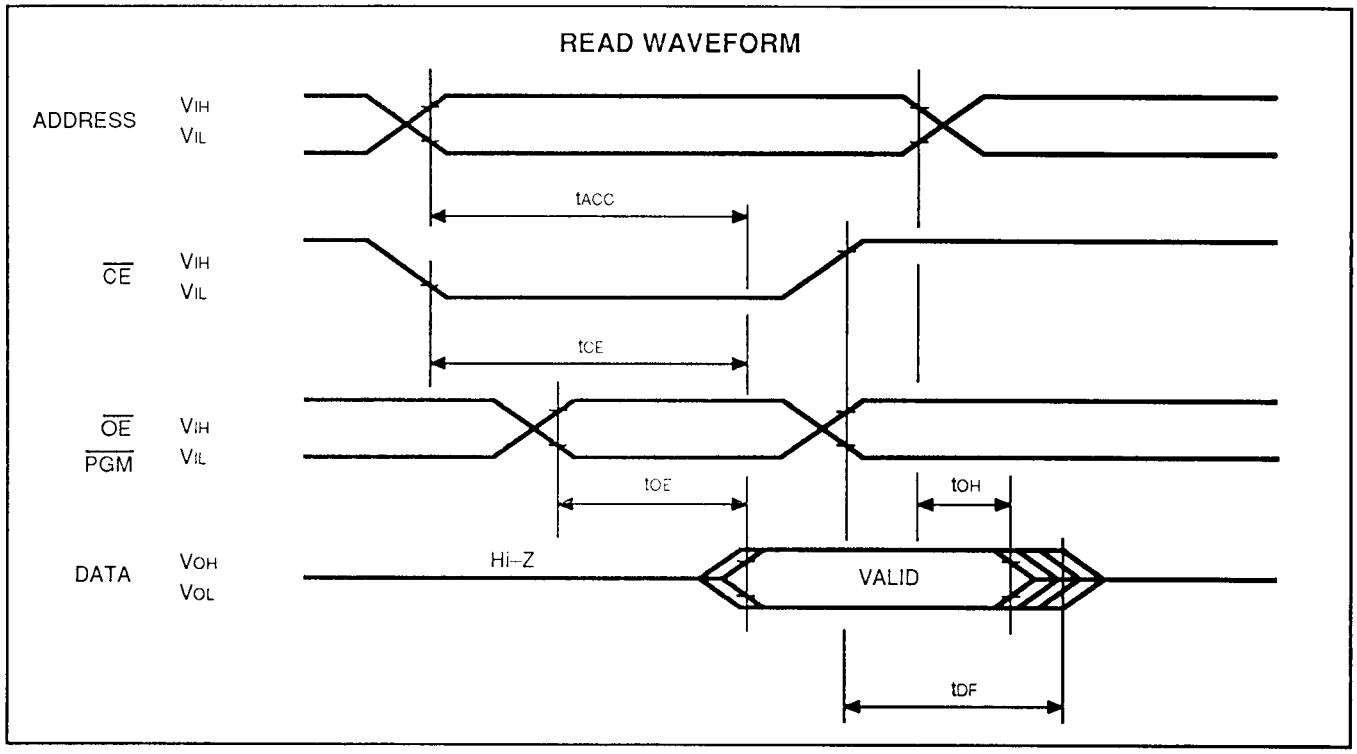
# AC CHARACTERISTICS

**(Recommended operating conditions unless otherwise noted)**

| Parameter | Conditions | Symbol | MBM27C1001P-17 Values | | MBM27C1001P-20 Values | | MBM27C1001P-25 Values | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Max | Min | Max | Min | Max | |
| Address Access Time | $\overline{CE}=\overline{OE}=V_{IL}$, $\overline{PGM}=V_{IH}$ | $t_{ACC}$ | | 170 | | 200 | | 250 | ns |
| $\overline{CE}$ to Output Delay Time | $\overline{OE}=V_{IL}$, $\overline{PGM}=V_{IH}$ | $t_{CE}$ | | 170 | | 200 | | 250 | ns |
| $\overline{PGM}$, $\overline{OE}$ to Output Delay Time | $\overline{CE}=V_{IL}$ | $t_{OE}$ | | 70 | | 70 | | 100 | ns |
| $\overline{PGM}$, $\overline{OE}$ to Output Float Delay | $\overline{OE}=\overline{CE}=V_{IL}$, $\overline{PGM}=V_{IH}$ | $t_{DF}$ | 0 | 60 | 0 | 60 | 0 | 60 | ns |
| Address to Output Hold Time | $\overline{CE}=\overline{OE}=V_{IL}$, $\overline{PGM}=V_{IH}$ | $t_{OH}$ | 0 | | 0 | | 0 | | ns |

# AC CHARACTERISTICS

(Recommended operating conditions unless otherwise noted)



# PROGRAMMING INFORMATION

## PROGRAMMING

**Single-Byte Programming.** When +12.5V(±0.3) volts is applied to Vpp, +6(±0.25) volts is applied to Vcc, $\overline{CE}$ and $\overline{PGM}$=$V_{IH}$ and $\overline{OE}$ =$V_{IH}$, the programming mode is initiated. Next, the proper address is input and the data pattern is applied to the input buffer (Figure 1). When both address and data are stable, a 0.5–millisecond negative pulse is applied to the $\overline{PGM}$ pin. Upon verification of written data an over pulse (three times the initial pulse width times the number of pulses used to accomplish a write) should be applied to complete the programming of one byte. Refer to the PROGRAMMING FLOWCHART that follows for step–by–step programming procedures.

**Four-Byte Programming.** When Compared to the Single-byte programming, the four-byte programming method reduces the programming time by about 75% one quarter. Voltages applied to $V_{PP}$ and Vcc are the same as those for Single-byte programming; however, some logic levels differ (refer to "Four Byte Programming" in the truth table ). In conjunction with $\overline{OE}$ pin, address pins $A_0$ and $A_1$ are used to latch four bytes of data. When both address and data are stable, a 0.5–millisecond negative pulse is applied to the $\overline{PGM}$ pin. Upon verification of written data an over pulse (three times the initial pulse width times the number of pulses used to accomplish a write) should be applied to complete the programming of four bytes. Refer to the PROGRAMMING FLOWCHART for step–by–step programming procedures.

## CAUTION

The width of one programming pulse must not exceed 40–millisecond; thus, a continuous TTL low–level voltage should not be applied to the $\overline{PGM}$ pin. Also, a 0.1–microfarad capacitor must be connected between $V_{PP}$ and ground to prevent excessive voltage transients. Neglecting either of these precautions may cause device failure.

## ELECTRONIC SIGNATURE/PROGRAMMING ALGORITHM

When MBM27C1001P is shipped from the factory, all memory cells (1,048,576 bits) are set to the high state (logic 1). During the programming procedure, affected bit cells are set to the Low(logic 0) state.

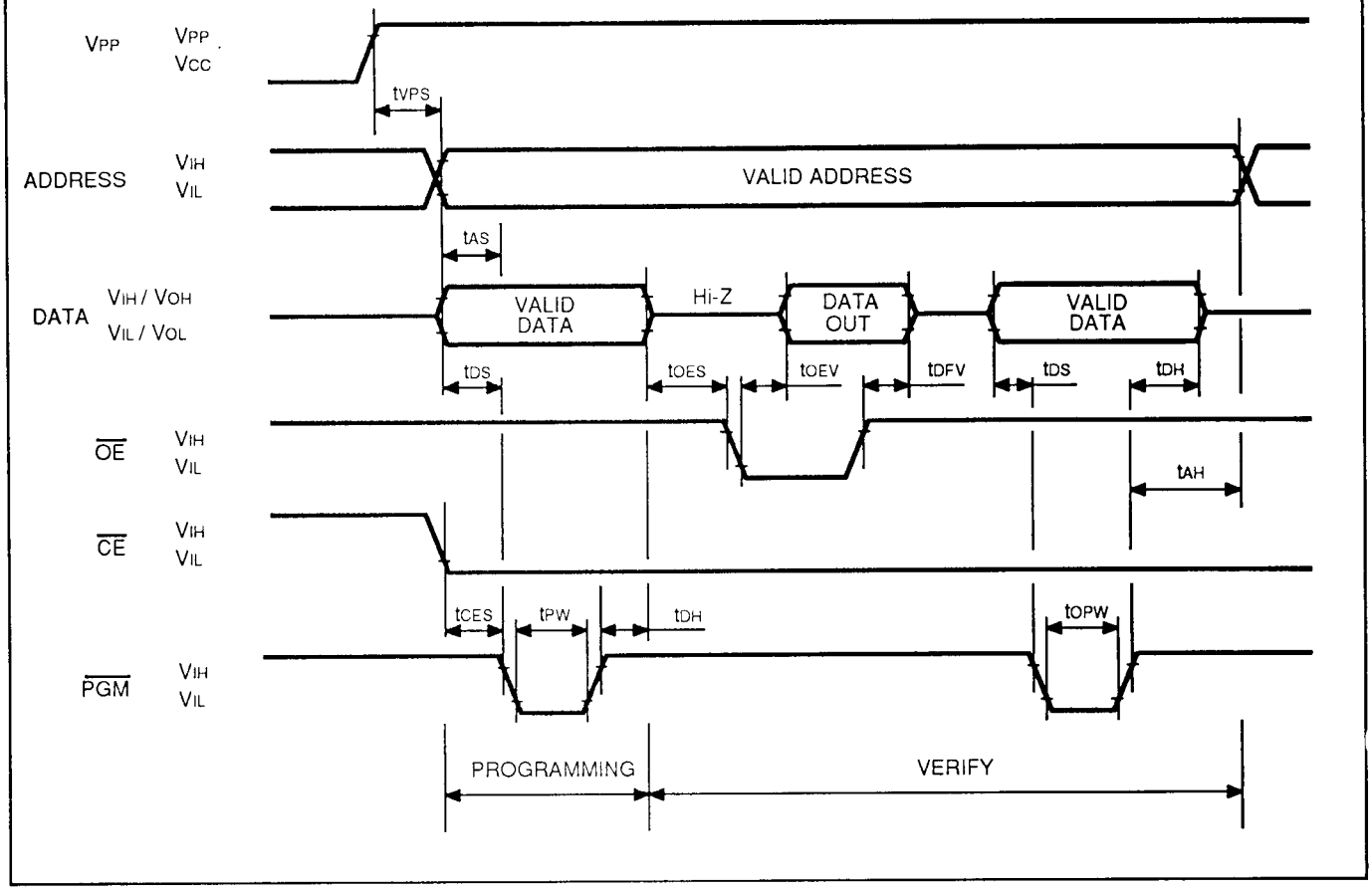
The MBM27C1001P is programmed with a fast programming algorithm designed by Fujitsu Quick programming. Manufacturer and device codes are electronically stored in each device; these codes can be read at the output port ($D_0$ to $D_7$) for the purpose of matching the device with the Quick programming algorithm. The Electronic Signature Code List is shown in the table preceding the ELECTRICAL CHARACTERISTICS.

## ELECTRONIC SIGNATURE CODE LIST

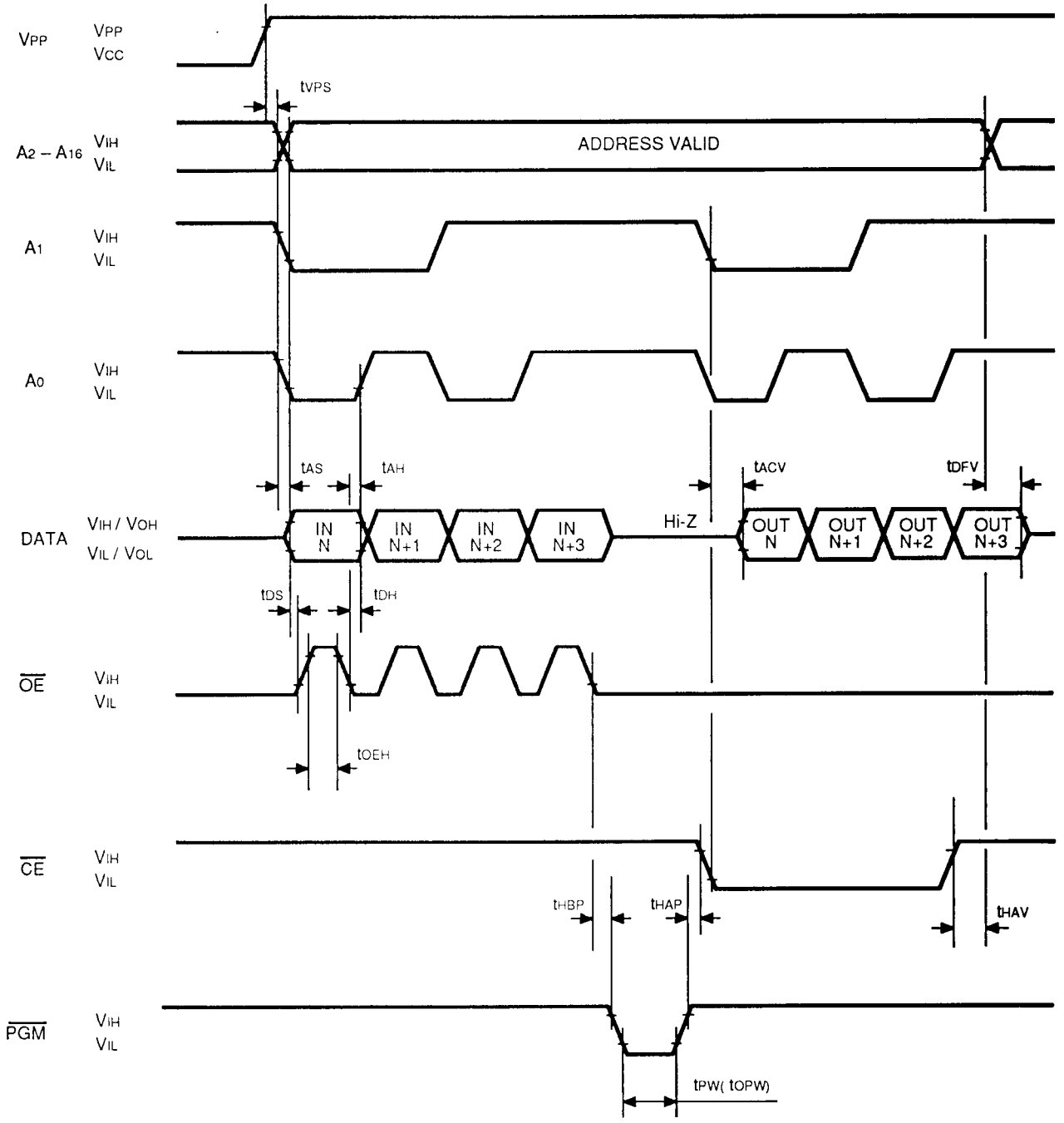
| Definition | Vcc | $V_{PP}$ | $A_0$ to $A_6$ | $A_7$ to $A_{16}$ | $\overline{OE}$ | $\overline{CE}$ | $\overline{PGM}$ | $D_0$ | $D_1$ | $D_2$ | $D_3$ | $D_4$ | $D_5$ | $D_6$ | $D_7$ | HEX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Manufacture | Vcc | Vcc | #0000 | Don't Care | $V_{IL}$ | $V_{IL}$ | $V_{IH}$ | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | #04 |
| Device | Vcc | Vcc | #0001 | Don't Care | $V_{IL}$ | $V_{IL}$ | $V_{IH}$ | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | #E5 |

NOTE: $A_9$=12V±0.5V

## PROGRAMMING WAVEFORM (Single-Byte)



## PROGRAMMING WAVEFORM (Four-Byte)



# PROGRAMMING INFORMATION (Cont'd)

## DC CHARACTERISTICS

($T_A$ = 25 °C± 5°C, $V_{CC}$ *1 = 6V± 0.25V, $V_{PP}$ *2 = 12.5V± 0.3V)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Input Leakage Current | $\|I_{LI}\|$ | $V_{IN}$ = 6.25V/0V | | | 10 | µA |
| $V_{PP}$ Supply Current (Single-Byte) | $I_{PP1}$ | $\overline{CE}$ = $V_{IL}$, $\overline{OE}$ = $V_{IH}$, $\overline{PGM}$=$V_{IL}$ | | | 30 | mA |
| $V_{PP}$ Supply Current (Four-Byte) | $I_{PP2}$ | $\overline{CE}$ = $V_{IH}$, $\overline{OE}$ = $V_{IL}$, $\overline{PGM}$=$V_{IL}$ | | | 100 | mA |
| $V_{PP}$ Supply Current | $I_{PP3}$ | $\overline{PGM}$=$V_{IH}$ | | | 5 | mA |
| $V_{CC}$ Supply Current | $I_{CC}$ | | | | 30 | mA |
| Input Low Level | $V_{IL}$ | | –0.1 | | 0.6 | V |
| Input High Level | $V_{IH}$ | | 2.4 | | $V_{CC}$ +0.3 | V |
| Output Low Level | $V_{OL}$ | $I_{OL}$ = 2.1mA | | | 0.45 | V |
| Output High Level | $V_{OH}$ | $I_{OH}$ = –400µA | 2.4 | | | V |

NOTE : *1 $V_{CC}$ must be applied either coincidentally or before $V_{PP}$ and removed either coincidentally or after $V_{PP}$.

*2 $V_{PP}$ must not be 13.5volts or more including overshoot. Permanent device damage may occuer if the device is taken out or put into socket remaining $V_{PP}$=12.5volts.

## AC CHARACTERISTICS

### 1. Single-Byte Programming Mode

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | Min | Typ | Max | |
| Address Setup Time | $t_{AS}$ | 2 | | | µs |
| Data Setup Time | $t_{DS}$ | 2 | | | µs |
| $\overline{CE}$ Setup Time | $t_{CES}$ | 2 | | | µs |
| Programming Pulse Width | $t_{PW}$ | 0.475 | 0.5 | 0.525 | ms |
| Over Programming Pulse Width (Note) | $t_{OPW}$ | 1.4 | | 39.4 | ms |
| Over Programming Pulse Number | N | 1 | | 25 | times |
| Data Hold Time | $t_{DH}$ | 2 | | | µs |
| $\overline{OE}$ Setup time | $t_{OES}$ | 2 | | | µs |
| $\overline{OE}$ to Output Valid | $t_{OEV}$ | | | 500 | ns |
| $\overline{OE}$ to Output Float | $t_{DFV}$ | | | 150 | ns |
| Address Hold Time | $t_{AH}$ | 0 | | | µs |
| $V_{PP}$ Setup Time | $t_{VPS}$ | 2 | | | µs |

Note: $t_{OPW}$=1.5 x Nms±5%

## AC CHARACTERISTICS(Cont'd)

### 2. Four-Byte Programming Mode

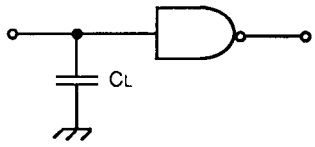
| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | Min | Typ | Max | |
| Address Setup Time | $t_{AS}$ | 2 | | | µs |
| Address Hold Time | $t_{AH}$ | 2 | | | µs |
| Data Setup Time | $t_{DS}$ | 2 | | | µs |
| Data Hold Time | $t_{DH}$ | 2 | | | µs |
| $\overline{OE}$ High Hold Time | $t_{OEH}$ | 2 | | | µs |
| Hold Time Before Programming | $t_{HBP}$ | 2 | | | µs |
| Programming Pulse Width | $t_{PW}$ | 0.475 | 0.5 | 0.525 | ms |
| Over Programming Pulse Width (Note) | $t_{OPW}$ | 1.4 | | 39.4 | ms |
| Over Programming Pulse Number | N | 1 | | 25 | times |
| Hold Time After Program | $t_{HAP}$ | 2 | | | µs |
| Address Access Time at Verify | $t_{ACV}$ | | | 500 | ns |
| $\overline{OE}$ to Output Float | $t_{DFV}$ | | | 150 | ns |
| Hold Time After Verify | $t_{HAV}$ | 0 | | | µs |
| $V_{PP}$ Setup Time | $t_{VPS}$ | 2 | | | µs |

Note: $t_{OPW}$=1.5 x Nms±5%

# AC TEST CONDITIONS

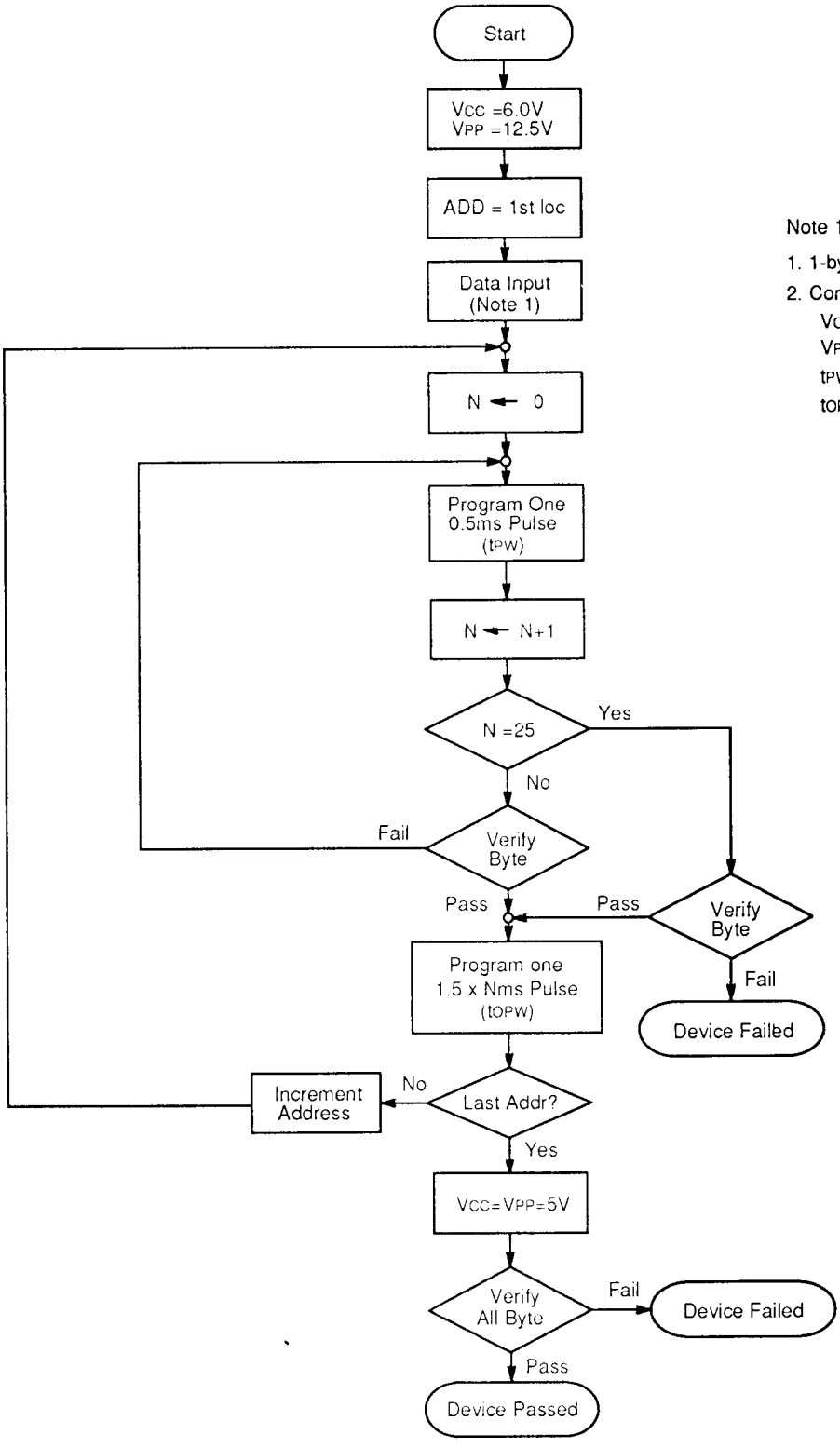
Fig. 2 — AC TEST CONDITIONS

| | |
|---|---|
| Input pulse levels: | 0.45V to 2.4V (Programming: 0.3V to 2.8V) |
| Input Rise/Fall Times: | ≤20ns |
| Input Reference Levels: | 0.8V to 2.0V (Programming: 0.6V to 2.4V) |
| Output Reference Levels: | 0.8V to 2.0V |
| Output Load: | 1 TTL gate and $C_L$ = 100pF |



# PROGRAMMING INFORMATION

## QUICK PROGRAMMING FLOWCHART



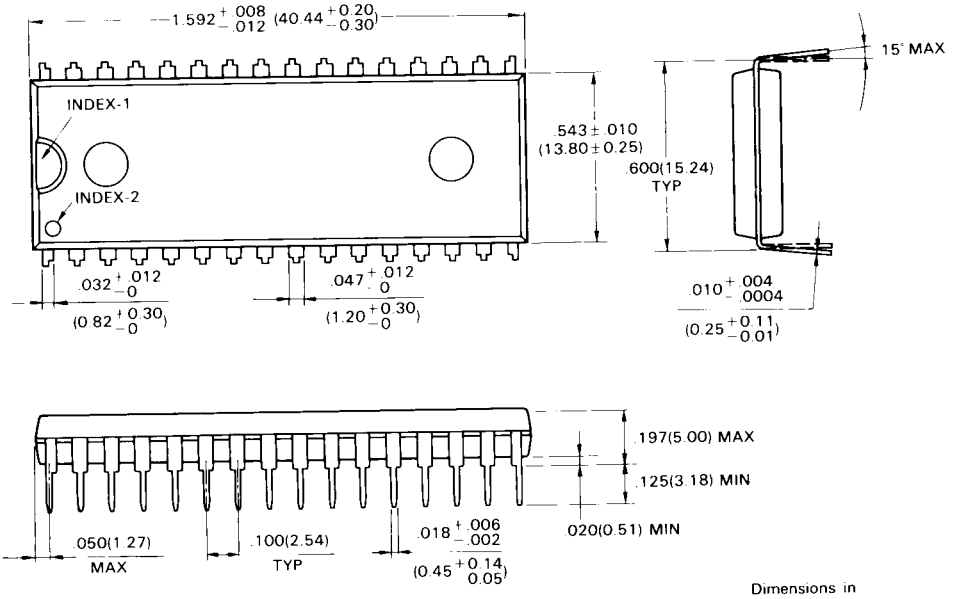

Note 1 :

1. 1-byte or 4-byte:
2. Conditions:
   - $V_{CC}$ = 6V(±0.25)V
   - $V_{PP}$ = 12.5V(±0.3)V
   - $t_{PW}$ = 0.5ms±25μs
   - $t_{OPW}$ = 1.5 x Nms(±5%)

# PACKAGE DIMENSIONS (Cont'd)

(Suffix: P)

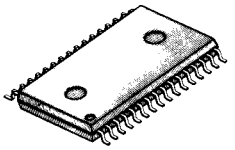
32-LEAD PLASTIC DUAL IN-LINE PACKAGE
(CASE No.: DIP-32P-M01)




Dimensions in inches (millimeters)

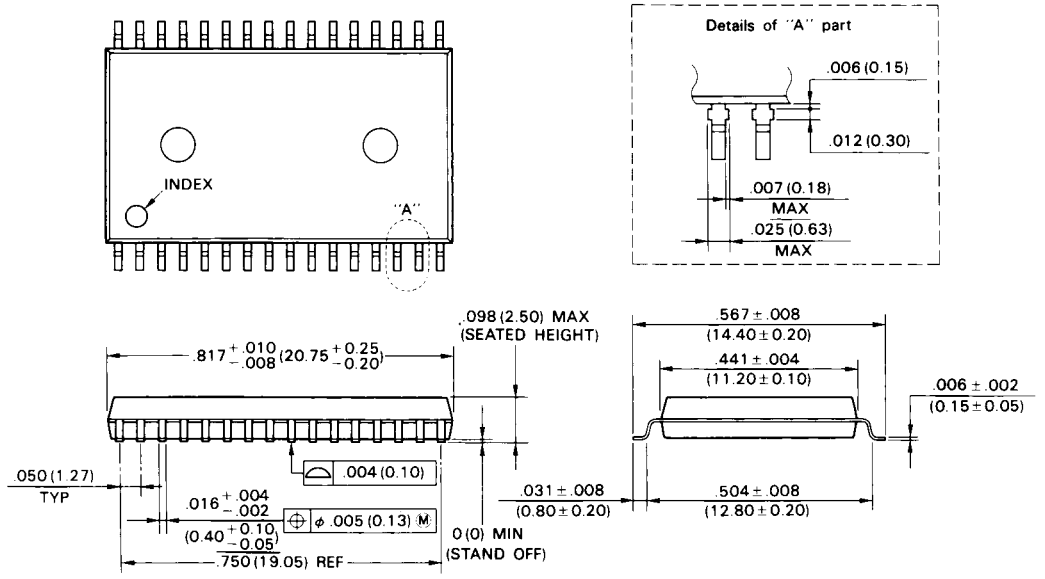
# PACKAGE DIMENSIONS (Cont'd)

(Suffix: PF)



FPT-32P-M03

32-LEAD PLASTIC FLAT PACKAGE
(CASE No.: FPT-32P-M03)

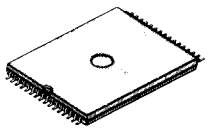





Dimensions in inches (millimeters)

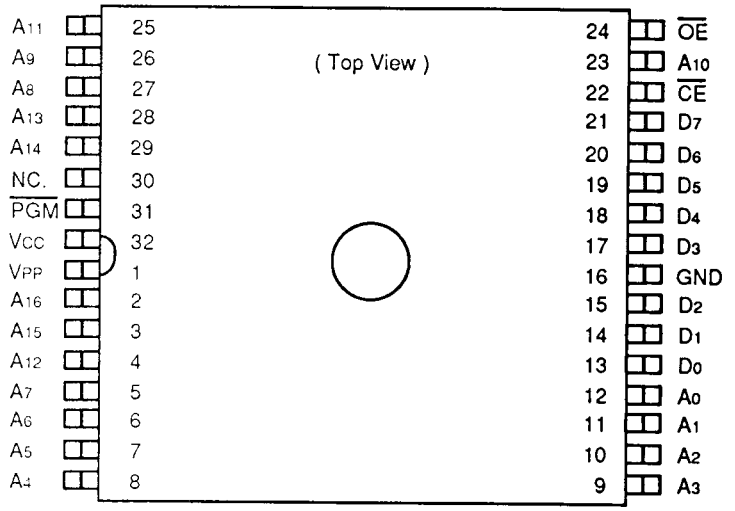
# PACKAGE DIMENSIONS (Cont'd)

(Suffix: PFTN)

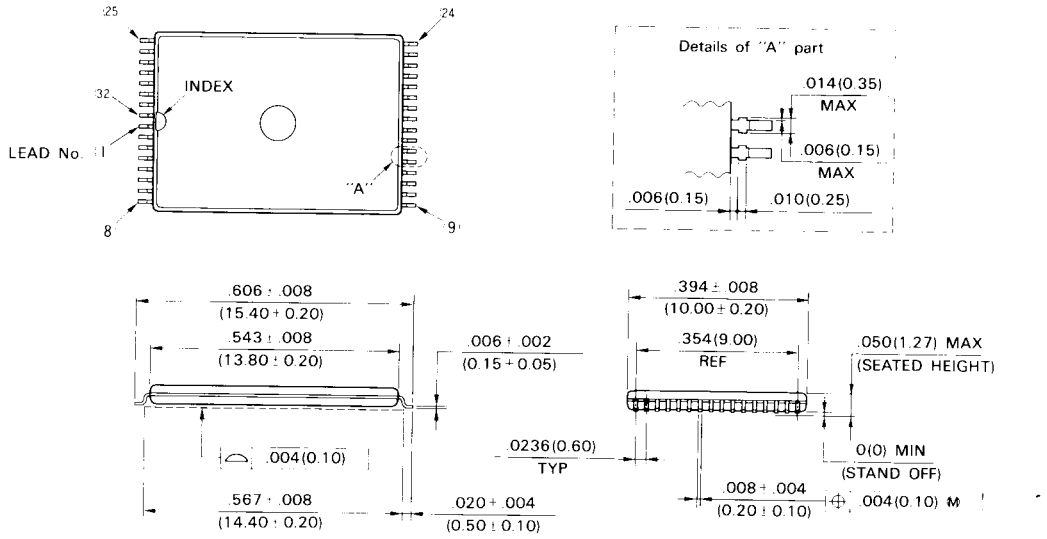


PLASTIC PACKAGE
FPT-32P-M04

**PIN ASSIGNMENT**
(Normal Bend)




**32-LEAD PLASTIC FLAT PACKAGE**
**(CASE No.: FPT-32P-M04)**

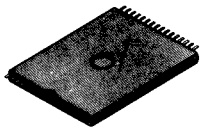





Dimensions in
inches (millimeters)

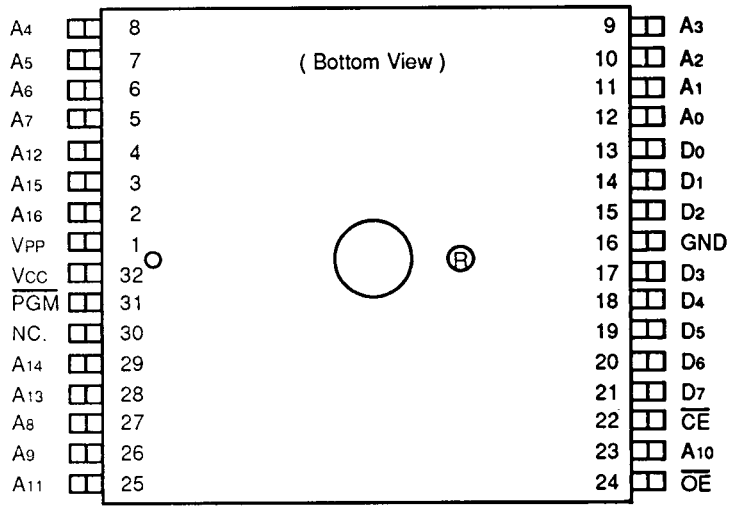
# PACKAGE DIMENSIONS (Cont'd)

(Suffix: PFTR)

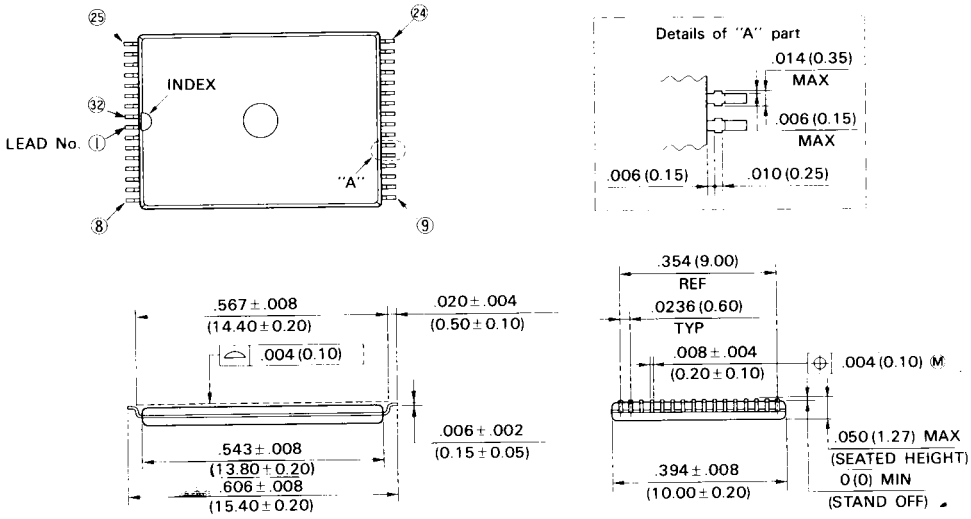


PLASTIC PACKAGE
FPT-32P-M05

**PIN ASSIGNMENT**
(Reversed Bend)




**32-LEAD PLASTIC FLAT PACKAGE**
**(CASE No.: FPT-32P-M05)**

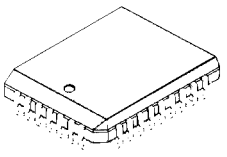





Dimensions in
inches (millimeters)

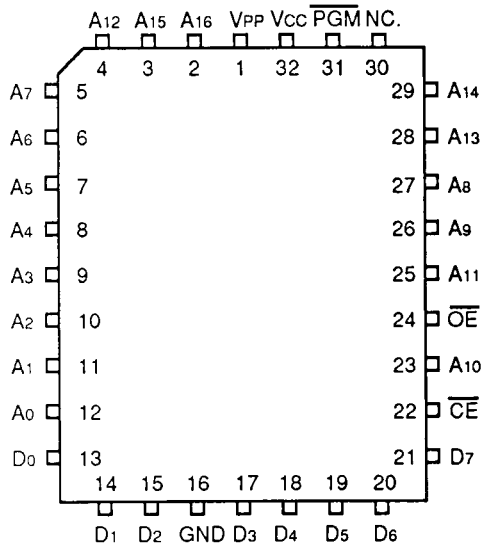
# PACKAGE DIMENSIONS

(Suffix: PD)

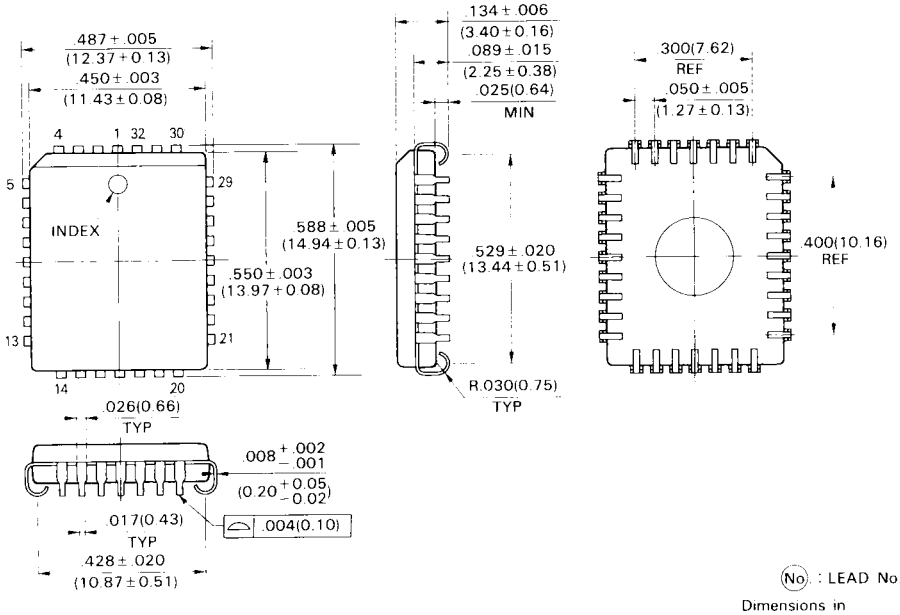


PLASTIC PACKAGE
LCC-32P-M02

PIN ASSIGNMENT




32-LEAD PLASTIC LEADED CHIP CARRIER
(CASE No.: LCC-32P-M02)






(No) : LEAD No.
Dimensions in
inches (millimeters)