TOSHIBA MOS MEMORY PRODUCTS

TC541000P/F-20, -25
TC541001P/F-20, -25

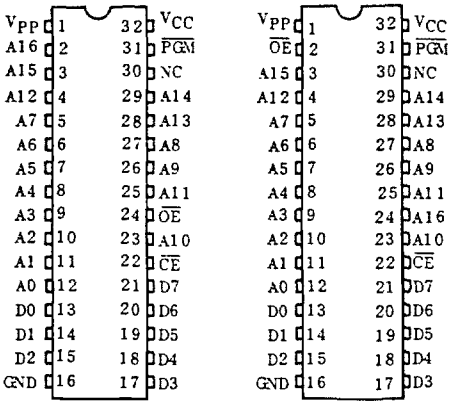
DESCRIPTION

The TC541000P/F and TC541001P/F are 131,072 word × 8 bit one time programmable read only memory, and molded in a 32 pin plastic package.
The access time of TC541000P/F and TC541001P/F are 200ns/250ns and has low power stand-by mode which reduces the power dissipation without increasing access time. The electrical characteristics and programming method are the same as U.V. EPROM TC571000D/TC571001D's. Once programed, the TC541000P/F and TC541001P/F can not be erased because of using plastic DIP without transparent window.

FEATURES

- Peripheral circuit: CMOS
  Memory cell : N-MOS
- Fast access time
  TC541000P/F-20/TC541001P/F-20: 200ns
  TC541000P/F-25/TC541001P/F-25: 250ns
- Low power dissipation
  Active : 30mA/5.0MHz
  Standby: 100μA (Ta=85°C)
- Single 5V power supply
- Wide operating temperature range: -40~85°C
- Full static operation
- High speed programming operation: t_{PW} 0.1ms
- Input and output TTL compatible
- JEDEC standard 32 pin: TC541000P
- 1M MROM compatible : TC541001P
- TC541000P/TC541001P:
  Standard 32 pin DIP plastic package
- TC541000F/TC541001F: Plastic flat package

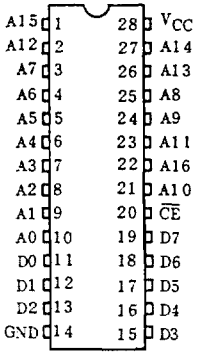
PIN CONNECTION (TOP VIEW)



TC541000P/F

TC541001P/F

(Reference)

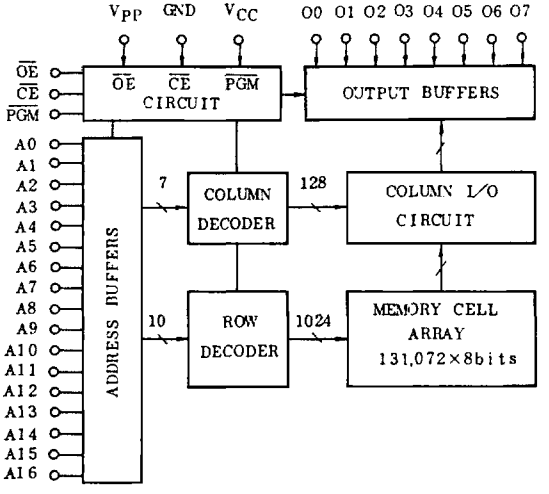


(1M Mask ROM TC531000P)

PIN NAMES

A0 ~ A16	Address Inputs
D0 ~ D7	Outputs (Inputs)
$\overline{CE}$	Chip Enable Inputs
$\overline{OE}$	Output Enable Input
$\overline{PGM}$	Program Control Input
V_{CC}	V_{CC} Supply Voltage
V_{PP}	Program Supply Voltage
GND	Ground
NC	No Connection

BLOCK DIAGRAM



MODE SELECTION

MODE \ PIN	PGM	CE	OE	VPP	VCC	O0 ∿ O7	POWER
Read	H	L	L	5V	5V	Data Out	Active
Output Deselect	*	*	H			High Impedance	
Standby	*	H	*			High Impedance	Standby
Program	L	L	H	12.75V	6.25V	Data In	Active
Program Inhibit	*	H	*			High Impedance	
	H	L	H			High Impedance	
Program Verify	H	L	L			Data Out	

*: H or L

MAXIMUM RATINGS

SYMBOL	ITEM	RATING	UNIT
V_{CC}	V_{CC} Power Supply Voltage	-0.6 ∿ 7.0	V
V_{PP}	Program Supply Voltage	-0.6 ∿ 14.0	V
V_{IN}	Input Voltage	-0.6 ∿ 7.0	V
$V_{I/O}$	Input/Output Voltage	-0.6 ∿ V_{CC}+0.5	V
P_D	Power Dissipation	1.5	W
T_{SOLDER}	Soldering Temperature · Time	260 · 10	°C·sec
T_{STRG}	Storage Temperature	-65 ∿ 125	°C
T_{OPR}	Operating Temperature	-40 ∿ 85	°C

READ OPERATION

D.C. RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{IH}	Input High Voltage	2.2	-	V_{CC}+0.3	V
V_{IL}	Input Low Voltage	-0.3	-	0.8	
V_{CC}	V_{CC} Power Supply Voltage	4.75	5.00	5.25	
V_{PP}	V_{PP} Power Supply Voltage	V_{CC}-0.6	V_{CC}	V_{CC}+0.6	

D.C. and OPERATING CHARACTERISTICS (Ta=-40 ~ 85°C, V_{CC}=5V±5%)

SYMBOL	PARAMETER	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
I_{LI}	Input Current	V_{IN}=0 ~ V_{CC}		-	-	±10	μA
I_{CC01}	Operating Current	$\overline{CE}$=0V	f=5.0MHz	-	-	30	mA
I_{CC02}		I_{OUT}=0mA	f=1MHz	-	-	10	
I_{CCS1}	Standby Current	$\overline{CE}$=V_{IH}		-	-	1	mA
I_{CCS2}		$\overline{CE}$=V_{CC}-0.2V		-	-	100	μA
V_{OH}	Output High Voltage	I_{OH}=-400μA		2.4	-	-	V
V_{OL}	Output Low Voltage	I_{OL}=2.1mA		-	-	0.4	V
I_{PP1}	Vpp Current	Vpp=V_{CC}±0.6V		-	-	±10	μA
I_{LO}	Output Leakage Current	V_{OUT}=0.4V ~ V_{CC}		-	-	±10	μA

A.C. CHARACTERISTICS (Ta=-40 ~ 85°C, V_{CC}=5V±5%, V_{PP}=V_{CC}±0.6V)

SYMBOL	PARAMETER	TC541000P-20/TC541001P-20 TC541000F-20/TC541001F-20		TC541000P-25/TC541001P-25 TC541000F-25/TC541001F-25		UNIT
		MIN.	MAX.	MIN.	MAX.	
t_{ACC}	Address Access Time	-	200	-	250	ns
t_{CE}	$\overline{CE}$ to Output Valid	-	200	-	250	
t_{OE}	$\overline{OE}$ to Output Valid	-	70	-	100	
t_{PGM}	$\overline{PGM}$ to Output Valid	-	70	-	100	
t_{DF1}	$\overline{CE}$ to Output in High-Z	0	60	0	90	
t_{DF2}	$\overline{OE}$ to Output in High-Z	0	60	0	90	
t_{DF3}	$\overline{PGM}$ to Output in High-Z	0	60	0	90	
t_{OH}	Output Data Hold Time	0	-	0	-	

A.C. TEST CONDITIONS

Output Load : 1 TTL Gate and C_L=100pF

Input Pulse Rise and Fall Times : 10ns Max.

Input Pulse Levels : 0.45V to 2.4V

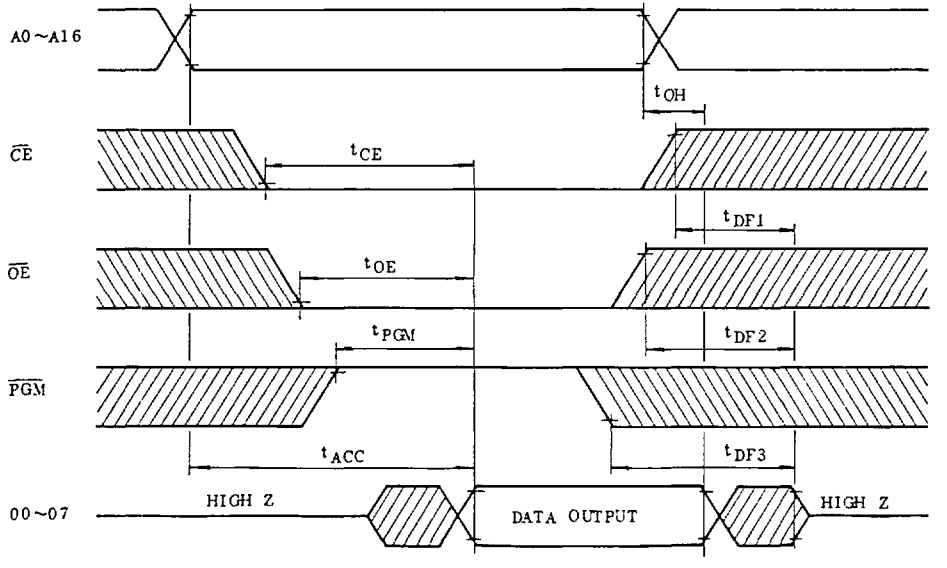
Timing Measurement Reference Level: Inputs 0.8V and 2.2V Outputs 0.8V and 2.0V

CAPACITANCE* (Ta=25°C, f=1MHz)

SYMBOL	PARAMETER	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
C_{IN}	Input Capacitance	V_{IN}=0V	-	4	8	pF
C_{OUT}	Output Capacitance	V_{OUT}=0V	-	10	12	

* This parameter is periodically sampled and is not 100% tested.

TIMING WAVEFORMS (READ)



HIGH SPEED PROGRAM OPERATION

D.C. RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{IH}	Input High Voltage	2.2	-	V_{CC}+1.0	V
V_{IL}	Input Low Voltage	-0.3	-	0.8	
V_{CC}	V_{CC} Power Supply Voltage	6.00	6.25	6.50	
V_{PP}	V_{PP} Power Supply Voltage	12.50	12.75	13.00	

D.C. AND OPERATING CHARACTERISTICS (Ta=25±5°C, V_{CC}=6.25±0.25V, Vpp=12.75±0.25V)

SYMBOL	PARAMETER	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
I_{LI}	Input Current	V_{IN}=0 ∿ V_{CC}	-	-	±10	μA
V_{OH}	Output High Voltage	I_{OH}=-400μA	2.4	-	-	V
V_{OL}	Output Low Voltage	I_{OL}=2.1mA	-	-	0.4	V
I_{CC}	V_{CC} Supply Current	-	-	-	30	mA
I_{PP2}	V_{PP} Supply Current	V_{PP}=13.0V	-	-	50	mA

A.C. PROGRAMMING CHARACTERISTICS (Ta=25±5°C, V_{CC}=6.25±0.25V, V_{PP}=12.75±0.25V)

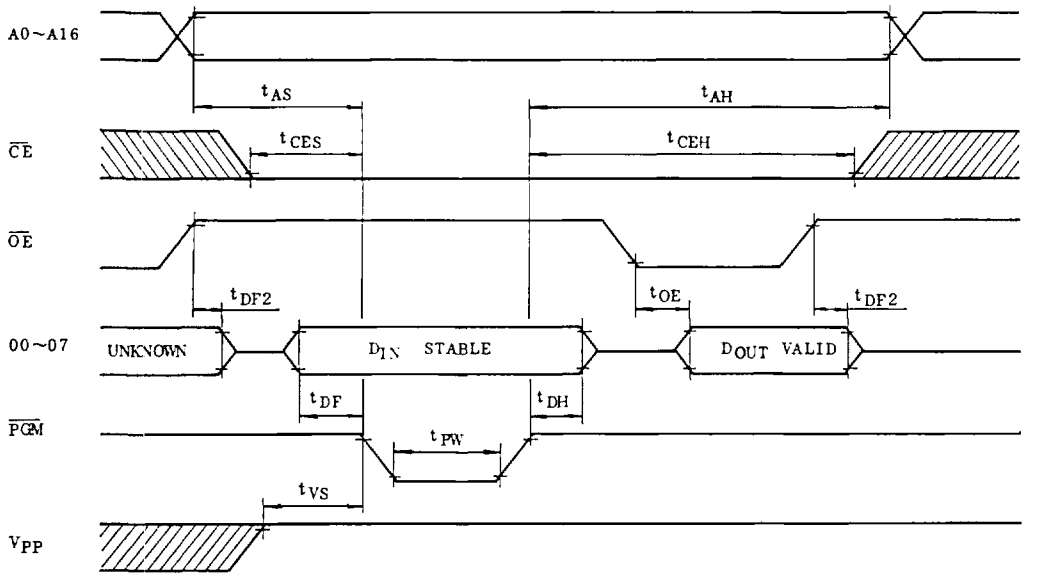
SYMBOL	PARAMETER	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
t_{AS}	Address Setup Time	-	2	-	-	μs
t_{AH}	Address Hold Time	-	2	-	-	μs
t_{CES}	$\overline{CE}$ Setup Time	-	2	-	-	μs
t_{CEH}	$\overline{CE}$ Hold Time	-	2	-	-	μs
t_{DS}	Data Setup Time	-	2	-	-	μs
t_{DH}	Data Hold Time	-	2	-	-	μs
t_{VS}	V_{PP} Setup Time	-	2	-	-	μs
t_{PW}	Program Pulse Width	-	0.095	0.1	0.105	ms
t_{OE}	$\overline{OE}$ to Output Valid	-	-	-	100	ns
t_{DF2}	$\overline{OE}$ to Output in High-Z	$\overline{CE}$=V_{IL}	-	-	90	ns

A.C. TEST CONDITIONS

- Output Load : 1 TTL Gate and C_L (100pF)
- Input Pulse Rise and Fall Time : 10ns Max.
- Input Pulse Levels : 0.45V and 2.4V
- Timing Measurement Reference Level: Input 0.8V and 2.2V, Output 0.8V and 2.0V

HIGH SPEED PROGRAM OPERATION

TIMING CHART



Note: 1. V_{CC} must be applied simultaneously or before Vpp and cut off simultaneously or after Vpp.

2. Removing the device from socket and setting the device in socket with V_{PP}=12.75V may cause permanent damage to the device.

3. The V_{PP} supply voltage is permitted up to 14V for program operation, so the voltage over 14V should not be applied to the Vpp terminal. When the switching pulse voltage is applied to the Vpp terminal, the overshoot voltage of its pulse should not be exceeded 14V.

OPERATION INFORMATION

The TC541000P/F/TC541001P/F's six operation modes are listed in the following table. Mode selection can be achieved by applying TTL level signal to all inputs.

		$\overline{PGM}$	$\overline{CE}$	$\overline{OE}$	V_{PP}	V_{CC}	O0 ~ O7	POWER
READ OPERATION (Ta=-40~85°C)	Read	H	L	L	5V	5V	Data Out	Active
	Output Deselct	*	*	H			High Impedance	
	Standby	*	H	*			High Impedance	Standby
PROGRAM OPERATION (Ta=25±5°C)	Program	L	L	H	12.75V	6.25V	Data In	Active
	Program Inhibit	*	H	*			High Impedance	
		H	L	H			High Impedance	
	Program Verify	H	L	L			Data Out	

Note: H; V_{IH}, L; V_{IL}, *; V_{IH} or V_{IL}

READ MODE

The TC541000P/F/TC541001P/F has three control functions. The chip enable ($\overline{CE}$) controls the operation power and should be used for device selection.
The output enable ($\overline{OE}$) and the program control ($\overline{PGM}$) control the output buffers, independent of device selection.
Assuming in that $\overline{CE}$=$\overline{OE}$=V_{IL} and $\overline{PGM}$=V_{IH}, the output data is valid at the output after address access time from stabilizing of all addresses.
The $\overline{CE}$ to output valid (t_{CE}) is equal to the address access time (t_{ACC}).
Assuming that $\overline{CE}$=V_{IL}, $\overline{PGM}$=V_{IH} and all addresses are valid, the output data is valid at the outputs after t_{OE} from the falling edge of $\overline{OE}$.
And assuming that $\overline{CE}$=$\overline{OE}$=V_{IL} and all addresses are valid, the output data is valid at the outputs after t_{PGM} from the rising edge of $\overline{PGM}$.

OUTPUT DESELECT MODE

Assuming that $\overline{CE}$=V_{IH} or $\overline{OE}$=V_{IH}, the outputs will be in a high impedance state.
So two or more ROMs can be connected together on a common bus line.
When $\overline{CE}$ is decoded for device selection, all deselected devices are in low power standby mode.

STANDBY MODE

The TC541000P/F/TC541001P/F has a low power standby mode controlled by the $\overline{CE}$ signal. By applying a high level to the $\overline{CE}$ input, the TC541000P/F/TC541001P/F is placed in the standby mode which reduce the operating current to 100μA by applying MOS-high level (V_{CC}) and then the outputs are in a high impedance state, independent of the $\overline{OE}$ inputs.

PROGRAM MODE

Initially, when received by customers, all bits of the TC541000P/F/TC541001P/F are in the "1" state which is erased state.
Therefore the program operation is to introduce "0's" data into the desired bit locations by electrically programming.
The levels required for all inputs are TTL. The TC541000P/F/TC541001PF can be programmed any location at anytime —— either irdividually, sequentially, or at random.

PROGRAM VERIFY MODE

The verify mode is to check that the desired data is correctly programmed on the programmed bits.
The verify is accomplished with $\overline{OE}$ and $\overline{CE}$ at V_{IL} and $\overline{PGM}$ at V_{IH}.

PROGRAM INHIBIT MODE

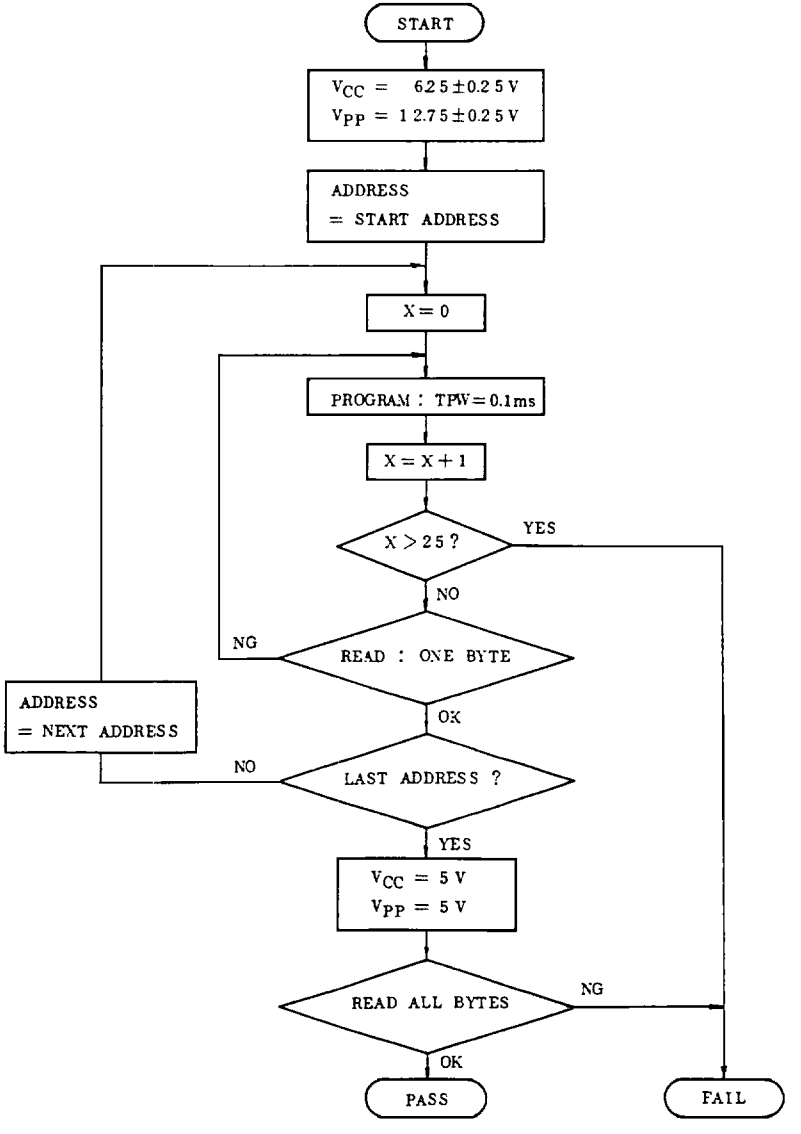
Under the condition that the program voltage (+12.75V) is applied to V_{PP} terminal, a high level $\overline{CE}$ or $\overline{PGM}$ input inhibits the TC541000P/F/TC541001P/F from being programmed. Programming of two or more EPROMs in parallel with different data is easily accomplished. That is, all inputs except for $\overline{CE}$ or $\overline{PGM}$ may be commonly connected, and a TTL low level program pulse is applied to the $\overline{CE}$ and $\overline{PGM}$ of the desired device only and TTL high level signal is applied to the other devices.

HIGH SPEED PROGRAM OPERATION

The device is set up in the high speed programming mode when the programming voltage (+12.75V) is applied to the V_{PP} terminal with V_{CC}=6.25V and $\overline{PGM}$=V_{IH}.
The programming is achieved by applying a single TTL low level 0.1ms pulse the $\overline{PGM}$ input after addresses and data are stable. Then the programmed data is verified by using Program Verify Mode.
If the programmed data is not correct, another program pulse of 0.1ms is applied and then programmed data is verified. This should be repeated until the program operates correctly (max. 25 times).
When programming has been completed, the data in all addresses should be verified with V_{CC}=V_{PP}=5V.

HIGH SPEED PROGRAM OPERATION

FLOW CHART



ELECTRIC SIGNATURE MODE

Electric signature mode allows to read out a code from TC541000P/F/TC541001P/F which identifies it's manufacturer and device type.

The programming equipment may read out manufacturer code and device code from TC541000P/F/TC541001P/F by using this mode before program operation and automatically set program voltage (V_{PP}) and algorithm.

Electric Signature mode is set up when 12V is applied to address line A9 and the rest of address lines is set to V_{IL} in read operation. Data output in this conditions is manufacturer code. Device code is identified when address A0 is set to V_{IH}. These two codes possess an odd parity with the parity bit of MSB (07).

The following table shows electric signature of TC541000P/F/TC541001P/F.

SIGNATURE \ PINS		A0	07	06	05	04	03	02	01	00	HEX. DATA
Manufacture Code		V_{IL}	1	0	0	1	1	0	0	0	98
Device Code	TC541000P/F	V_{IH}	1	0	0	0	0	1	1	0	86
	TC541001P/F		0	0	0	0	0	1	1	1	07

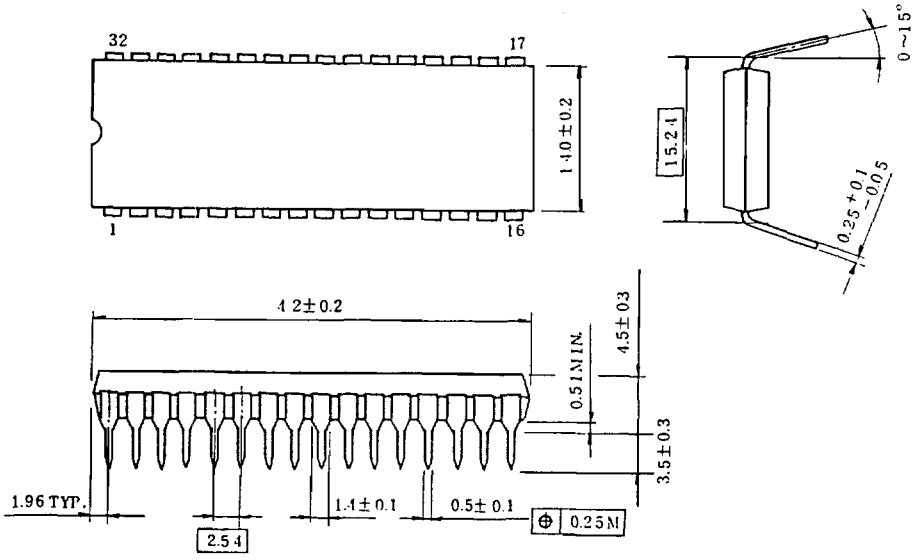
Notes: A9=12V±0.5V

A1 ∿ A8, A10 ∿ A16, $\overline{CE}$, $\overline{OE}=V_{IL}$

$\overline{PGM}=V_{IH}$

OUTLINE DRAWINGS

Unit in mm

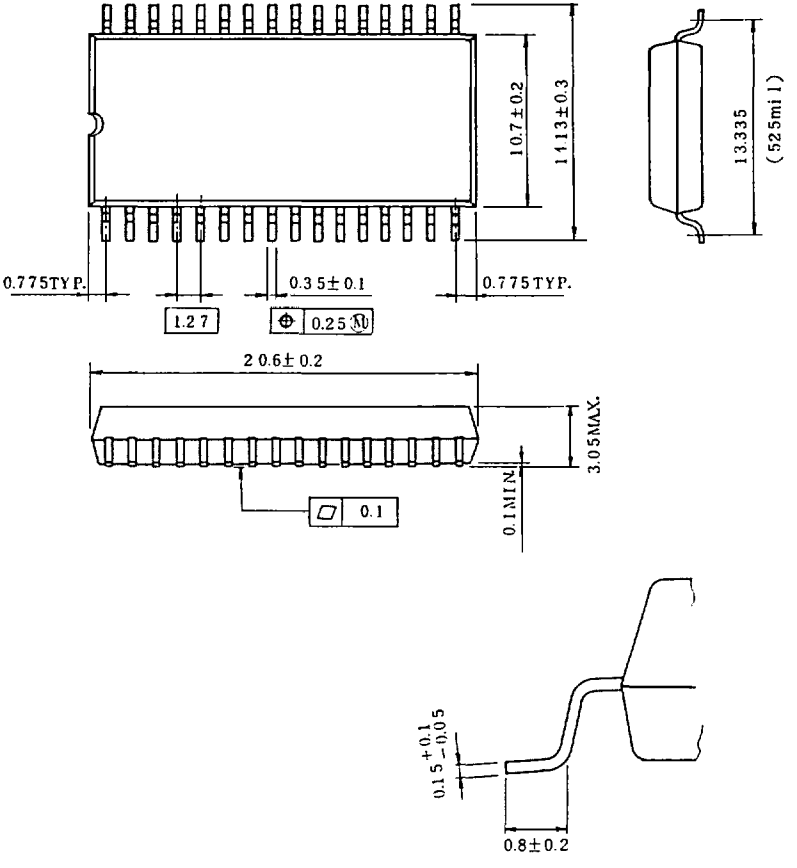


Note: Package width and length do not include mold protrusion, allowable mold protrusion is 0.15mm.

OUTLINE DRAWINGS

Plastic FP

Unit: mm



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