

TOSHIBA MOS MEMORY PRODUCTS

32,768 WORD × 8 BIT N-MOS UV ERASABLE AND
ELECTRICALLY PROGRAMMABLE READ ONLY MEMORY
SILICON STACKED GATE MOS

TMM27256ADI-15 TMM27256ADI-20

DESCRIPTION

The TMM27256ADI is a 32,768 word × 8 bit ultraviolet light erasable and electrically programmable read only memory.

For read operation, the TMM27256ADI's access time is 150ns/200ns, and the TMM27256ADI operates from a single 5-volt power supply and has low power standby mode which reduces the power dissipation without increasing access time. The standby

mode is achieved by applying a TTL-high level signal to the \overline{CE} input.

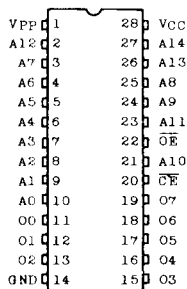
For program operation, the programming is achieved by using the high speed programming mode.

The TMM27256ADI is fabricated with the N-channel silicon double layer gate MOS technology.

FEATURES

	-15	-20
V _{CC}	5V ±5%	
t _{ACC}	150ns	200ns
I _{CC2}	120mA	
I _{CC1}	35mA	

PIN CONNECTION (TOP VIEW)

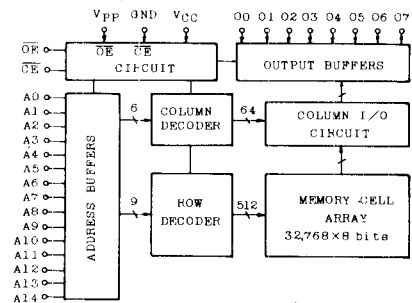


PIN NAMES

A ₀ ~A ₁₄	Address Inputs
O ₀ ~O ₇	Outputs (Inputs)
\overline{CE}	Chip Enable Input
\overline{OE}	Output Enable Input
V _{PP}	Program Supply Voltage
V _{CC}	Power Supply Voltage (+5V)
GND	Ground

- Wide operating temperature range -40~85°C
- Full static operation
- High speed programming mode
- Inputs and outputs TTL compatible
- Pin compatible with i27256
- Standard 28 pin DIP cerdip package

BLOCK DIAGRAM



MODE SELECTION

MODE	PIN	\overline{CE} (20)	\overline{OE} (22)	V _{PP} (1)	V _{CC} (28)	O ₀ ~O ₇ (11~13, 15~19)	POWER
Read		L	L	5V	5V	Data Out	Active
Output Deselect	*	H	High Impedance				
Standby	H	*	High Impedance			Standby	
Program		L	H	12.5V	6V	Data In	Active
Program Inhibit	H	H	High Impedance				
Program Verify	*	L	Data Out				

Note * : H or L

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MAXIMUM RATINGS

SYMBOL	ITEM	RATING	UNIT
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 ~ 7.0	V
P _D	Power Dissipation	1.5	W
T _{SOLDER}	Soldering Temperature · Time	260 · 10	°C·sec
T _{STG}	Storage Temperature	-65 ~ 125	°C
T _{OPR}	Operating Temperature	-40 ~ 85°C	°C

READ OPERATION

D. C. AND A. C. RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	TMM27256ADI-15/20
T _a	Operating Temperature	-40 ~ 85°C
V _{CC}	V _{CC} Power Supply Voltage	5V ± 5%
V _{PP}	V _{PP} Power Supply Voltage	2.2 ~ V _{CC} + 0.6V

D. C. AND OPERATING CHARACTERISTICS

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.	MAX.	UNIT
I _{II}	Input Current	V _{IN} = 0 ~ V _{CC}	—	—	± 10	μA
I _{IO}	Output Leakage Current	V _{OUT} = 0.4 ~ V _{CC}	—	—	+ 10	μA
I _{CC1}	Supply Current (Standby)	CE = V _{IH}	—	—	35	mA
I _{CC2}	Supply Current (Active)	CE = V _{IL}	—	—	120	mA
V _{IH}	Input High Voltage		2.2	—	V _{CC} + 1.0	V
V _{IL}	Input Low Voltage		-0.3	—	0.8	V
V _{OH}	Output High Voltage	I _{OH} = -400μA	2.4	—	—	V
V _{OL}	Output Low Voltage	I _{OL} = 2.1mA	—	—	0.4	V
I _{PP}	V _{PP} Current	V _{PP} = 0 ~ V _{CC} + 0.6	—	—	+ 10	μA

A. C. CHARACTERISTICS

(T_a = -40 ~ 85°C, V_{CC} = 5V ± 5%, V_{PP} = 2.0V ~ V_{CC} + 0.6V)

SYMBOL	PARAMETER	TEST CONDITION	TMM27256AD-15		TMM27256AD-20		UNIT
			MIN.	MAX.	MIN.	MAX.	
t _{ACC}	Address Access Time	CE = OE = V _{IL}	—	150	—	200	ns
t _{CE}	CE to Output Valid	OE = V _{IL}	—	150	—	200	ns
t _{OE}	OE to Output Valid	CE = V _{IL}	—	70	—	70	ns
t _{DF1}	CE to Output in High-Z	OE = V _{IL}	0	60	0	60	ns
t _{DF2}	OE to Output in High-Z	CE = V _{IL}	0	60	0	60	ns
t _{OH}	Output Data Hold Time	CE = OE = V _{IL}	0	—	0	—	ns

A. C. TEST CONDITIONS

- Output Load : 1 TTL Gate and C_i = 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 2.0V, Outputs 0.8V and 2.0V

TMM27256ADI-15

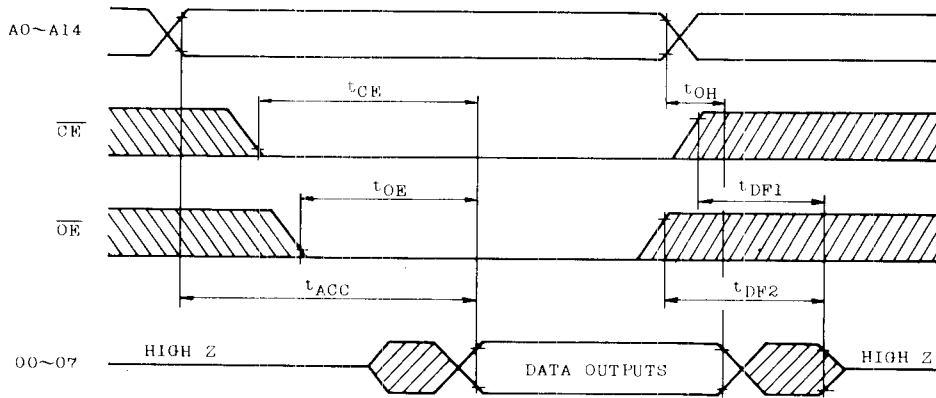
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CAPACITANCE * (Ta=25°C, f=1MHz)

SYMBOL	PARAMETER	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
C _{IN}	Input Capacitance	V _{IN} =0V	—	4	6	pF
C _{OUT}	Output Capacitance	V _{OUT} =0V	—	8	12	pF

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

TIMING WAVEFORMS (READ)



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
V _{CC}	V _{CC} Power Supply Voltage	5.75	6.0	6.25	V
V _{PP}	V _{PP} Power Supply Voltage	12.0	12.5	13.0	V

D.C. and OPERATING CHARACTERISTICS (Ta=25±5°C, V_{CC}=6V±0.25V, V_{PP}=12.5V±0.5V)

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				120	mA
I _{PP2}	V _{PP} Supply Current	V _{PP} = 13.0V			50	mA

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A. C. PROGRAMMING CHARACTERISTICS (Ta = 25 ± 5 C, Vcc = 6V ± 0.25V, Vpp = 12.5V ± 0.5V)

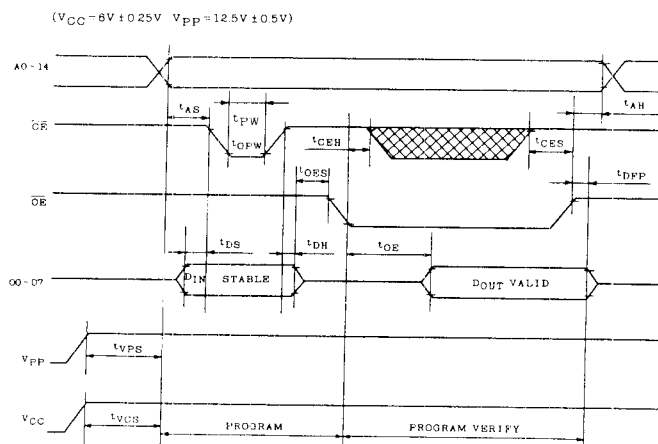
SYMBOL	PARAMETER	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
tAS	Address Setup Time	—	2	—	—	μs
tAH	Address Hold Time	—	2	—	—	μs
tCS	CE Setup Time	—	0	—	—	ns
tCEH	CE Hold Time	—	0	—	—	ns
tOS	OE Setup Time	—	2	—	—	μs
tDS	Data Setup Time	—	2	—	—	μs
tDH	Data Hold Time	—	2	—	—	μs
tVPS	VPP Setup Time	—	2	—	—	μs
tVCS	VCC Setup Time	—	2	—	—	μs
tPW	Initial Program Pulse Width	CE = VIL, OE = VIH	0.95	1	1.05	ms
tOPW	Overprogram Pulse Width	Note 1	2.85	3	78.75	ms
tOF	OE to Output Valid	CE = VIH	—	—	150	ns
tOFP	OE to Output in High-Z	CE = VIH	—	—	130	ns

A. C. TEST CONDITIONS

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

Note : 1. The length of the overprogram pulse may vary as a function of the counter value X.

TIMING WAVEFORMS (PROGRAM)



- Note :
1. VCC 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 VPP = 12.5V may cause permanent damage to the device.
 3. The VPP 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.

ERASURE CHARACTERISTICS

The TMM27256ADI's erasure is achieved by applying shortwave ultraviolet light which has a wavelength of 2537Å (Angstroms) to the chip through the transparent window.

Then integrated dose (ultraviolet light intensity [$\mu\text{w}/\text{cm}^2$] \times exposure time [sec.]) for erasure should be a minimum of 15 [$\text{w}\cdot\text{sec}/\text{cm}^2$].

When the Toshiba sterilizing lamp GL-15 is used and the device is exposed at a distance of 1cm from the lamp surface, the erasure will be achieved within 60 minutes. And using commercial lamps whose

ultraviolet light intensity is a 12000 [$\mu\text{w}/\text{cm}^2$] will reduce the exposure time to about 20 minutes. (In this case, the integrated dose is 12000 [$\mu\text{w}/\text{cm}^2$] \times (20 \times 60) [sec] \cong 15 [$\text{w}\cdot\text{sec}/\text{cm}^2$].)

The TMM27256ADI's erasure begins to occur when exposed to light with wavelength shorter than 4000Å. The sunlight and the fluorescent lamps will include 3000~4000Å wavelength components. Therefore when used under such lighting for extended periods of time, the opaque seals-Toshiba EPROM Protect Seal AC901-are available.

OPERATION INFORMATION

The TMM27256ADI's six operation modes are listed in the following table. Mode selection can be

achieved by applying TTL level signal to all inputs.

MODE	PIN NAMES(NUMBER)		V _{PP} (1)	V _{CC} (28)	O ₀ ~O ₇ (11~13, 15~19)	POWER	
	CE (20)	OE (22)					
Read Operation (T _a = 40~85°C)	Read	L	L	5 V	5V	Data Out	Active
	Output Deselect	*	H			High Impedance	Active
	Standby	H	*			High Impedance	Standby
Program Operation (T _a = 25 ± 5°C)	Program	L	H	12.5V	6V	Data In	Active
	Program Inhibit	H	H			High Impedance	Active
	Program Verify	*	L			Data Out	Active

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

READ MODE

The TMM27256ADI has two control functions. The chip enable (CE) controls the operation power and should be used for device selection.

The output enable (OE) control the output buffers, independent of device selection.

Assuming that $\overline{\text{CE}} = \overline{\text{OE}} = \text{V}_{\text{IL}}$, the output data is valid at the outputs after address access time from

stabilizing of all addresses.

The $\overline{\text{CE}}$ to output valid (t_{CE}) is equal to the address access time (t_{ACC}).

Assuming that $\overline{\text{CE}} = \text{V}_{\text{IL}}$ and all addresses are valid, the output data is valid at the outputs after t_{OE} from the falling edge of OE.

OUTPUT Deselect MODE

Assuming that $\overline{\text{CE}} = \text{V}_{\text{IH}}$ or $\overline{\text{OE}} = \text{V}_{\text{IH}}$, the outputs will be in a high impedance state.

So two or more TMM27256ADI's can be con-

nected together on a common bus line.

When CE is decoded for device selection, all deselected devices are in low power standby mode.

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STANDBY MODE

The TMM27256ADI has a low power standby mode controlled by the CE signal.

By applying a high level to the CE input, the TMM27256ADI is placed in the standby mode which

PROGRAM MODE

Initially, when received by customers, all bits of the TMM27256ADI are in the "1" state which is erased state.

Therefore the program operation is to introduce "0s" data into the desired bit locations by electrically programming.

PROGRAM VERIFY MODE

The verify mode is to check that desired data is correctly programmed on the programmed bits.

PROGRAM INHIBIT MODE

Under the condition that the program voltage (+12.5V) is applied to V_{PP} terminal, a TTL high level CE input inhibits the TMM27256ADI from being programmed.

Programming of two or more TMM27256ADI's in parallel with different data is easily accomplished.

HIGH SPEED PROGRAMMING MODE

The program time can be greatly decreased by using this high speed programming mode. The device is set up in the high speed programming mode when the programming voltage (+12.5V) is applied to the V_{PP} terminal with $V_{CC}=6V$.

The programming is achieved by applying a single TTL low level 1ms pulse to the \overline{CE} 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

reduce 70% of the operating current by applying TTL-high level (V_{CC}) and then the outputs are in a high impedance state, independent of the OE inputs.

The TMM27256ADI is in the programming mode when the V_{PP} input is at 12.5V and CE is at TTL-Low under $OE = V_{IH}$.

The TMM27256ADI can be programmed any location at anytime either individually, sequentially, or at random.

The verify is accomplished with \overline{OE} at V_{IL} and \overline{CE} at V_{IH} or V_{IL} .

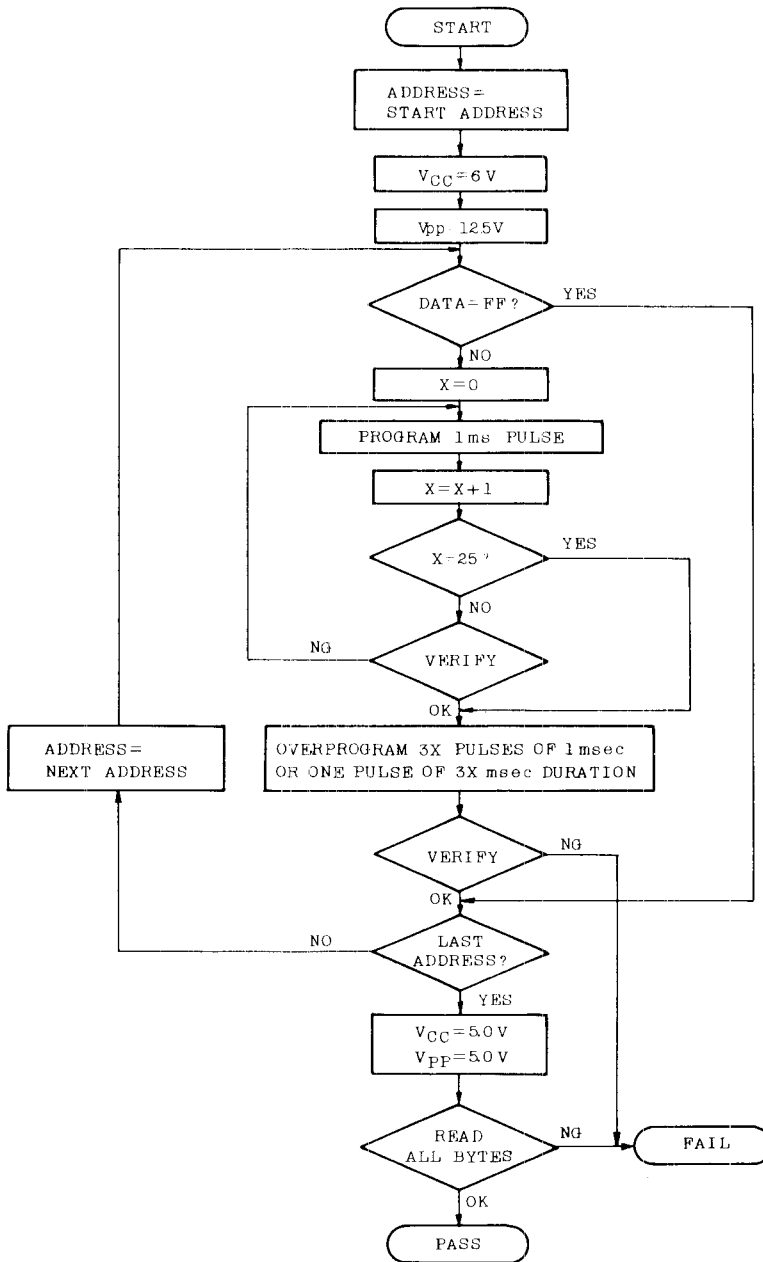
That is, all inputs except for CE and OE may be commonly connected, and a TTL low level program pulse is applied to the CE of the desired device only and TTL high level signal is applied to the other devices.

program pulse of 1ms is applied and then the programmed data is verified. This should be repeated until the program operates correctly (max. 25 times).

After correctly programming the selected address, the additional program pulse with width 3 times that needed for initial programming is applied.

When programming has been completed, the data in all addresses should be verified with $V_{CC}=V_{PP}=5V$.

HIGH SPEED PROGRAM MODE FLOW CHART



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ELECTRIC SIGNATURE MODE

Electric signature mode allows to read out a code from TMM27256ADI which identifies its manufacturer and device type.

The programming equipment may read out manufacturer code and device code from TMM27256ADI 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 A_9 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 A_0 is set to V_{IH} . These two codes possess an odd parity with the parity bit of MSB (O_7).

The following table shows electric signature of TMM27256ADI

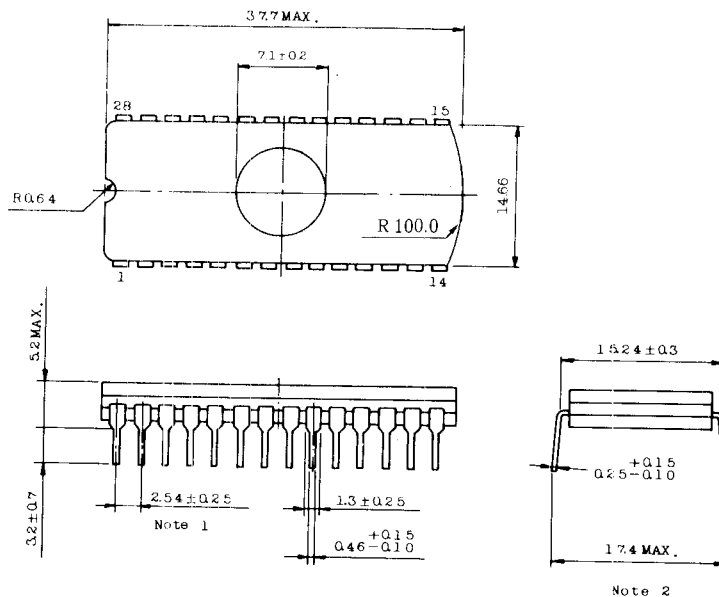
SIGNATURE \ PINS	A_0 (10)	O_7 (15)	O_6 (18)	O_5 (17)	O_4 (16)	O_3 (15)	O_2 (13)	O_1 (12)	O_0 (11)	HEX. DATA
Manufacture Code	V_{IH}	1	0	0	1	1	0	0	0	98
Device Code	V_{IH}	0	1	0	1	0	1	0	0	54

Notes: $A_9 = 12V \pm 0.5V$

$A_1-A_8, A_{10}-A_{14}, \overline{CE}, \overline{OE} = V_{IL}$

OUTLINE DRAWINGS

Unit in mm



- Note: 1. Each lead pitch is 2.54mm. All leads are located within 0.25mm of their true longitudinal position with respect No. 1 and No.28 leads.
 2. This value is measured at the end of leads.
 3. All dimensions are in millimeters.

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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