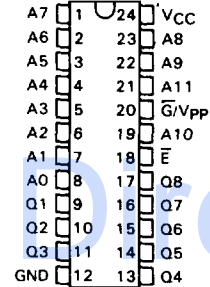


TMS2732A 32,768-BIT ERASABLE PROGRAMMABLE READ-ONLY MEMORY

AUGUST 1983 — REVISED NOVEMBER 1985

- Organization . . . 4096 X 8
- Single 5-V Power Supply
- All Inputs and Outputs Are TTL Compatible
- Max Access/Min Cycle Time
 - TMS2732A-17 170 ns
 - TMS2732A-20 200 ns
 - TMS2732A-25 250 ns
 - TMS2732A-45 450 ns
- Low Standby Power Dissipation . . . 158 mW (Maximum)
- JEDEC Approved Pinout . . . Industry Standard
- 21-V Power Supply Required for Programming
- N-Channel Silicon-Gate Technology
- PEP4 Version Available with 168 Hour Burn-in and Guaranteed Operating Temperature Range from -10°C to 85°C (TMS2732A--JP4)

J PACKAGE
(TOP VIEW)



PIN NOMENCLATURE	
A0-A11	Address Inputs
\bar{E}	Chip Enable
\bar{G}/V_{pp}	Output Enable/21 V
GND	Ground
Q1-Q8	Outputs
VCC	5-V Power Supply

description

The TMS2732A is an ultraviolet light-erasable, electrically programmable read-only memory. It has 32,768 bits organized as 4,096 words of 8-bit length. The TMS2732A only requires a single 5-volt power supply with a tolerance of $\pm 5\%$.

The TMS2732A provides two output control lines: Output Enable (\bar{G}) and Chip Enable (\bar{E}). This feature allows the \bar{G} control line to eliminate bus contention in multibus microprocessor systems. The TMS2732A has a power-down mode that reduces maximum power dissipation from 657 mW to 158 mW when the device is placed on standby.

This EPROM is supplied in a 24-pin dual-in-line ceramic package and is designed for operation from 0°C to 70°C.

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PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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INSTRUMENTS

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operation

The six modes of operation for the TMS2732A are listed in the following table.

FUNCTION (PINS)	MODE					
	Read	Deselect	Power Down (Standby)	Program	Program Verification	Inhibit Programming
\bar{E} (18)	V_{IL}	X	V_{IH}	V_{IL}	V_{IL}	V_{IH}
\bar{G}/V_{pp} (20)	V_{IL}	V_{IH}	X	21 V	V_{IL}	21 V
V_{CC} (24)	5 V	5 V	5 V	5 V	5 V	5 V
Q1-Q8 (9 to 11, 13 to 17)	Q	HI-Z	HI-Z	D	Q	HI-Z

X = V_{IH} or V_{IL}

read

The two control pins (\bar{E} and \bar{G}/V_{pp}) must have low-level TTL signals in order to provide data at the outputs. Chip enable (\bar{E}) should be used for device selection. Output enable (\bar{G}/V_{pp}) should be used to gate data to the output pins.

power down

The power-down mode reduces the maximum power dissipation from 657 mW to 158 mW. A TTL high-level signal applied to \bar{E} selects the power-down mode. In this mode, the outputs assume a high-impedance state, independent of \bar{G}/V_{pp} .

program

The programming procedure for the TMS2732A is the same as that for the TMS2532, except that in the program mode, \bar{G}/V_{pp} is taken from a TTL low level to 21 V.

The program mode consists of the following sequence of events. With the level on \bar{G}/V_{pp} equal to 21 V, data to be programmed is applied in parallel to output pins Q8-Q1. The location to be programmed is addressed. Once data and addresses are stable, a 10-millisecond TTL low-level pulse is applied to \bar{E} . The maximum width of this pulse is 11 milliseconds. The programming pulse must be applied at each location that is to be programmed. Locations may be programmed in any order.

Several TMS2732As can be programmed simultaneously by connecting them in parallel and following the programming sequence previously described.

program verify

After the EPROM has been programmed, the programmed bits should be verified. To verify bit states, \bar{G}/V_{pp} and \bar{E} are set to V_{IL} .

program inhibit

The program inhibit is useful when programming multiple TMS2732As connected in parallel with different data. Program inhibit can be implemented by applying a high-level signal to \bar{E} of the device that is not to be programmed.

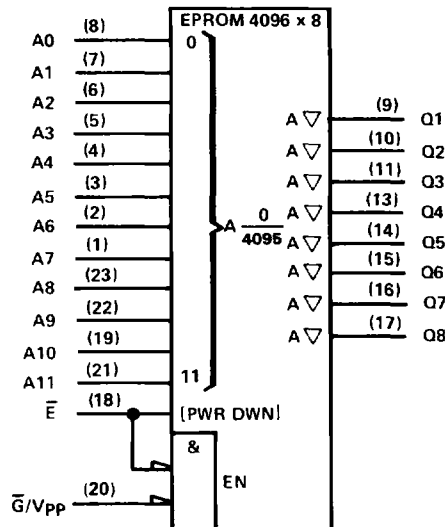
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erasure

The TMS2732A is erased by exposing the chip to shortwave ultraviolet light that has a wavelength of 253.7 nanometers (2537 angstroms). The recommended minimum exposure dose (UV intensity × exposure time) is fifteen watt-seconds per square centimeter. The lamp should be located about 2.5 centimeters (1 inch) above the chip during erasure. After erasure, all bits are at a high level. It should be noted that normal ambient light contains the correct wavelength for erasure. Therefore, when using the TMS2732A, the window should be covered with an opaque label.

logic symbol†



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† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC}	−0.3 V to 7 V
Supply voltage range, V_{PP}	−0.3 V to 22 V
Input voltage range (except program)	−0.3 V to 7 V
Output voltage range	−0.3 V to 7 V
Operating free-air temperature	0°C to 70°C
Storage temperature range	−65°C to 150°C

† Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the "Recommended Operating Conditions" section of this specification is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

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recommended operating conditions

		MIN	NOM	MAX	UNIT
V _{CC}	Supply voltage (see Note 1)	4.75	5	5.25	V
V _{pp}	Supply voltage (see Note 2)	V _{CC}			V
V _{IH}	High-level input voltage	2	V _{CC} +1		V
V _{IL}	Low-level input voltage	-0.1	0.8		V
T _A	Operating free-air temperature	0	70		°C

- NOTES: 1. V_{CC} must be applied before or at the same time as V_{pp} and removed after or at the same time as V_{pp}. The device must not be inserted into or removed from the board when V_{pp} or V_{CC} is applied.
2. V_{pp} can be connected to V_{CC} directly (except in the program mode). V_{CC} supply current in this case would be I_{CC} + I_{pp}. During programming, V_{pp} must be maintained at 21 V (±0.5 V).

electrical characteristics over full ranges of recommended operating conditions

PARAMETER		TEST CONDITIONS	MIN	MAX	UNIT
VOH	High-level output voltage	IOH = −400 μA	2.4		V
VOL	Low-level output voltage	IOL = 2.1 mA		0.45	V
II	Input current (leakage)	VI = 0 V to 5.25 V		± 10	μA
IO	Output current (leakage)	VO = 0.4 V to 5.25 V		± 10	μA
ICC1	VCC supply current (standby)	\bar{E} at VIH, \bar{G} at VIL		30	mA
ICC2	VCC supply current (active)	\bar{E} and \bar{G} at VIL		125	mA

capacitance over recommended supply voltage range and operating free-air temperature range, f = 1 MHz[†]

PARAMETER	TEST CONDITIONS	TYP [‡]	MAX	UNIT
C _i	All except \bar{G} /V _{pp}	4	6	pF
	\bar{G} /V _{pp}		20	
C _o	Output capacitance	8	12	pF

[†]These parameters are tested on sample basis only.

[‡]Typical values are at T_A = 25°C and nominal voltages.

switching characteristics over recommended supply voltage range and operating free-air temperature range

PARAMETER	TEST CONDITIONS	TMS2732A-17		TMS2732A-20		TMS2732A-25		TMS2732A-45		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
t _a (A)	Access time from address	170		200		250		450		ns
t _a (E)	Access time from \bar{E}	170		200		250		450		ns
t _{en} (G)	Output enable time from \bar{G}	65		70		100		150		ns
t _{dis} [†]	Output disable time from \bar{E} or \bar{G} , whichever occurs first	0		0		0		0		ns
t _v (A)	Output data valid time after change of address, \bar{E} , or \bar{G} , whichever occurs first	0		0		0		0		ns

NOTE 3: The timing reference levels for inputs and outputs are 0.8 V and 2 V. Input pulse levels are 0.40 V and 2.4 V.

[†]Value calculated from 0.5 V delta to measured output level. This parameter is only sampled and not 100% tested.

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recommended conditions for programming, $T_A = 25^\circ\text{C}$ (see Note 4)

		MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage	4.75	5	5.25	V
V_{PP}	Supply voltage	20.5	21	21.5	V
V_{IH}	High-level input voltage			$V_{CC} + 1$	V
V_{IL}	Low-level input voltage	-0.1		0.8	V
$t_w(\bar{E})$	\bar{E} pulse duration	9	10	11	ms
$t_{su}(A)$	Address setup time	2			μs
$t_{su}(D)$	Data setup time	2			μs
$t_{su}(V_{PP})$	V_{PP} setup time	2			μs
$t_h(A)$	Address hold time	0			μs
$t_h(D)$	Data hold time	2			μs
$t_h(V_{PP})$	V_{PP} hold time	2			μs
$t_{rec}(PG)$	V_{PP} recovery time	2			μs
$t_r(PG)G$	\bar{G} rise time during programming	50			ns
t_{EHD}	Delay time, data valid after \bar{E} low			1	μs

NOTE 4: When programming the TMS2732A, connect a 0.1 μF capacitor between V_{PP} and GND to suppress spurious voltage transients which may damage the device.

programming characteristics, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IH}	High-level input voltage	2		$V_{CC} + 1$	V
V_{IL}	Low-level input voltage	-0.1		0.8	V
V_{OH}	High-level output voltage (verify)	$I_{OH} = -400 \mu\text{A}$	2.4		V
V_{OL}	Low-level output voltage (verify)	$I_{OL} = 2.1 \text{ mA}$		0.45	V
I_I	Input current (all inputs)	$V_I = V_{IL} \text{ or } V_{IH}$		10	μA
I_{PP}	Supply current	$\bar{E} = V_{IL}, \bar{G} = V_{PP}$		50	mA
I_{CC}	Supply current			125	mA
$t_{dis}(PR)$	Output disable time	0		130	ns

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PARAMETER MEASUREMENT INFORMATION

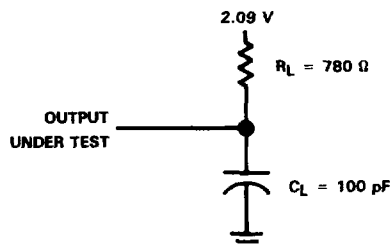
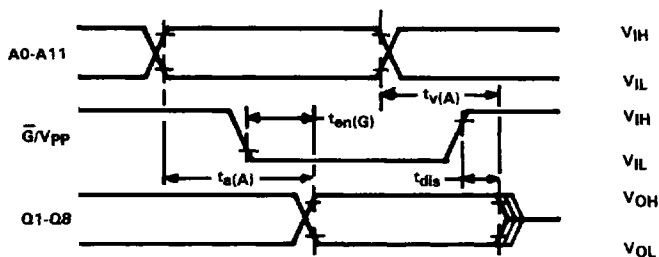
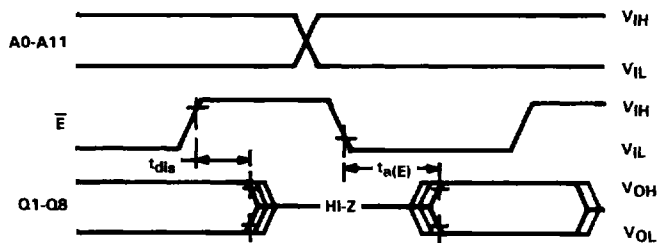


FIGURE 1. TYPICAL OUTPUT LOAD CIRCUIT

read cycle timing



standby mode



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program cycle timing

