

SERIES 24 AND 28 STANDARD AND LOW POWER PROGRAMMABLE READ-ONLY MEMORIES

SEPTEMBER 1979—REVISED AUGUST 1984

- Expanded Family of Standard and Low Power PROMs
- Titanium-Tungsten (Ti-W) Fuse Links for Reliable Low-Voltage Full-Family-Compatible Programming
- Full Decoding and Fast Chip Select Simplify System Design
- P-N-P Inputs for Reduced Loading On System Buffers/Drivers
- Each PROM Supplied With a High Logic Level Stored at Each Bit Location
- Applications Include:
 - Microprogramming/Firmware Loaders
 - Code Converters/Character Generators
 - Translators/Emulators
 - Address Mapping/Look-Up Tables

description

The 24 and 28 Series of monolithic TTL programmable read-only memories (PROMs) feature an expanded selection of standard and low-power PROMs. This expanded PROM family provides the system designer with considerable flexibility in upgrading existing designs or optimizing new designs. Featuring proven titanium-tungsten (Ti-W) fuse links with low-current MOS-compatible p-n-p inputs, all family members utilize a common programming technique designed to program each link with a 20-microsecond pulse.

The 4096-bit and 8192-bit PROMs are offered in a wide variety of packages ranging from 18-pin 300 mil-wide thru 24 pin 600 mil-wide. The 16,384-bit PROMs provide twice the bit density of the 8192-bit PROMs and are provided in a 24 pin 600 mil-wide package.

All PROMs are supplied with a logic-high output level stored at each bit location. The programming procedure will produce open-circuits in the Ti-W metal links, which reverses the stored logic level at the selected location. The procedure is irreversible; once altered, the output for that bit location is permanently programmed. Outputs that have never been altered may later be programmed to supply the opposite output level. Operation of the unit within the recommended operating conditions will not alter the memory content.

Active level(s) at the chip-select input(s) (S or \bar{S}) enables all of the outputs. An inactive level at any chip-select input causes all outputs to be in the three-state, or off condition.

standard PROMs

The standard PROM members of Series 24 and 28 offer high performance for applications which require the uncompromised speed of Schottky technology. The fast chip-select access times allow additional decoding delays to occur without degrading speed performance.

| TYPE NUMBER | PACKAGE [†] AND TEMPERATURE RANGE DESIGNATORS | OUTPUT CONFIGURATION [‡] | BIT SIZE (ORGANIZATION) | TYPICAL PERFORMANCE | | |
|-------------|--|-----------------------------------|-----------------------------|---------------------|--------|-------------------|
| | | | | ACCESS TIMES | | POWER DISSIPATION |
| | | | | ADDRESS | SELECT | |
| TBP24S10 | MJ, J, N | ▽ | 1024 Bits (256W × 4B) | 35 ns | 20 ns | 375 mW |
| TBP24SA10 | MJ, J, N | ◊ | | | | |
| TBP28S42 | MJ, J, N | ▽ | 4096 Bits (512W × 8B) | 35 ns | 20 ns | 500 mW |
| TBP28SA42 | MJ, J, N | ◊ | | | | |
| TBP28S46 | MJW, JW, NW | ▽ | | | | |
| TBP28SA46 | MJW, JW, NW | ◊ | | | | |
| TBP24S41 | MJ, J, N | ▽ | 4096 Bits (1024 × 4B) | 40 ns | 20 ns | 475 mW |
| TBP24SA41 | MJ, J, N | ◊ | 8192 Bits (2048 × 4B) | 45 ns | 20 ns | 625 mW |
| TBP24S81 | MJ, J, N | ▽ | | | | |
| TBP24SA81 | MJ, J, N | ◊ | 8192 Bits (1024 × 8B) | 45 ns | 20 ns | 625 mW |
| TBP28S86A | MJW, JW, NW | ▽ | | | | |
| TBP28SA86A | MJW, JW, NW | ◊ | | | | |
| TBP28S2708A | NW | ▽ | | | | |
| TBP28S166 | NW | ▽ | 16,384 Bits (2048W × 8B) | 35 ns | 15 ns | 650 mW |

[†]MJ and MJW designates full-temperature-range circuits (formerly 54 Family), J, JW, N, and NW designates commercial-temperature-range circuits (formerly 74 Family).

[‡]▽ = three state, ◊ = open collector.

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PROMS

SERIES 24 AND 28 STANDARD AND LOW-POWER PROGRAMMABLE READ-ONLY MEMORIES

low power PROMs

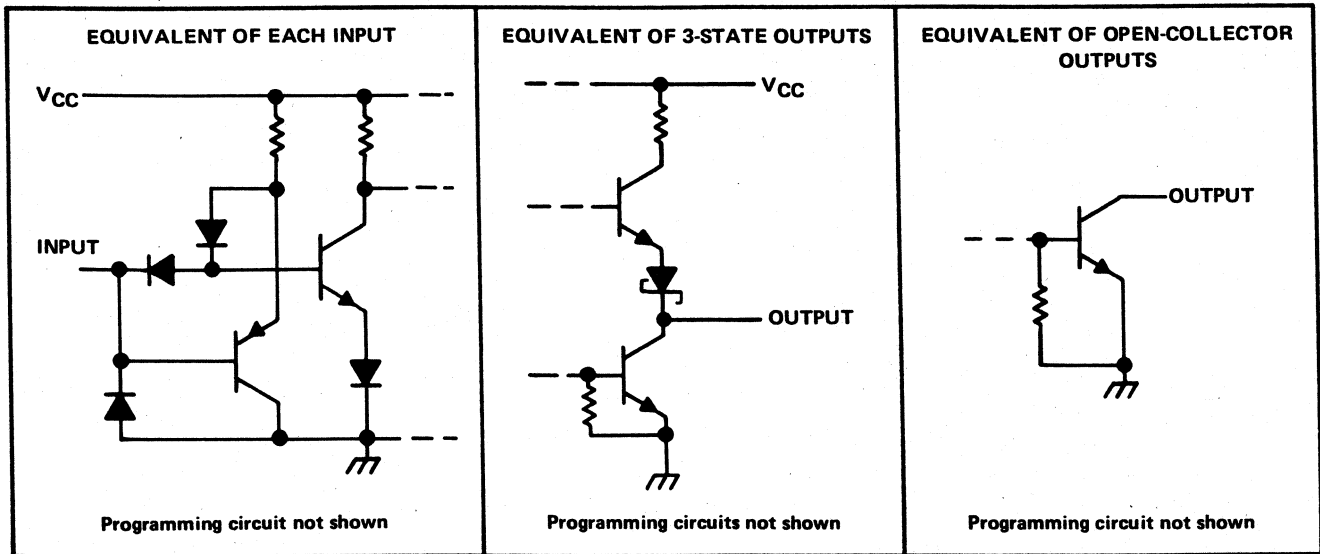
To upgrade systems utilizing MOS EPROMs or MOS PROMs, or when designing new systems which do not require maximum speed, the low-power PROM family offers the output drive and speed performance of bipolar technology, plus reduced power dissipation.

| TYPE NUMBER | PACKAGE [†] AND TEMPERATURE RANGE DESIGNATORS | OUTPUT CONFIGURATION [‡] | BIT SIZE (ORGANIZATION) | TYPICAL PERFORMANCE | | |
|-------------|--|-----------------------------------|-----------------------------|---------------------|--------|-------------------|
| | | | | ACCESS TIMES | | POWER DISSIPATION |
| | | | | ADDRESS | SELECT | |
| TBP28L22 | MJ, J, N | ▽ | 2048 Bits (256W × 8B) | 45 ns | 20 ns | 375 mW |
| TBP28LA22 | MJ, J, N | ◊ | | | | |
| TBP28L42 | MJ, J, N | ▽ | 4096 Bits (512W × 8B) | 60 ns | 30 ns | 250 mW |
| TBP28L46 | MJW, JW, NW | ▽ | | | | |
| TBP28L86A | MJW, JW, NW | ▽ | 8192 Bits (1024W × 8B) | 80 ns | 35 ns | 350 mW |
| TBP28L166 | NW | ▽ | 16,384 Bits (2084W × 8B) | 65 ns | 30 ns | 350 mW |

[†] MJ and MJW designates full-temperature-range circuits (formerly 54 Family), J, JW, N, and NW designates commercial-temperature-range circuits (formerly 74 Family).

[‡] ▽ = three state, ◊ = open collector.

schematics of inputs and outputs



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

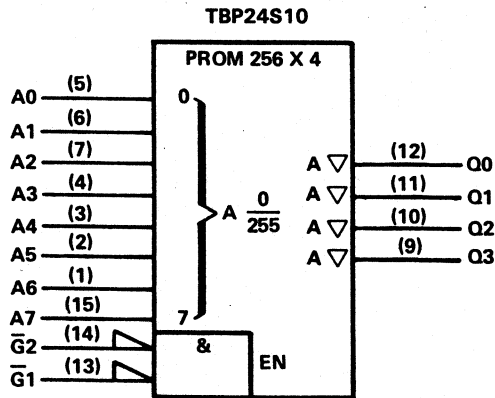
| | |
|--|----------------|
| Supply voltage (see Note 1) | 7 V |
| Input voltage | 5.5 V |
| Chip-select peak input voltage (S, S1, S2) (see Note 2) | 11 V |
| Off-state output voltage | 5.5 V |
| Off-state peak output voltage (see Note 2) | 16.25 V |
| Operating free-air temperature range: Full-temperature-range circuits (M suffix) | -55°C to 125°C |
| Commercial-temperature-range circuits | 0°C to 70°C |
| Storage temperature range | -65°C to 150°C |

NOTES: 1. Voltage values are with respect to network ground terminal.

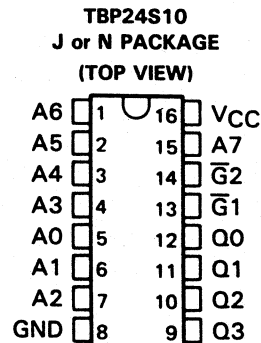
2. These ratings apply only under the conditions described in the programming procedure.

TBP24S10
1024 BIT (256 WORDS BY 4 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | MJ | | | J OR N | | | UNIT |
|---|-----|-----|-----|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| I _{OH} High-level output current | | | -2 | | | -6.5 | mA |
| I _{OL} Low-level output current | | | 16 | | | 16 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS † | MJ | | | J OR N | | | UNIT |
|-------------------|--|-----|------|-------|--------|------|-------|------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| V _{OH} | V _{CC} = MIN, I _{OH} = MAX | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V |
| I _{OZH} | V _{CC} = MAX, V _O = 2.4 V | | | 50 | | | 50 | μA |
| I _{OZL} | V _{CC} = MAX, V _O = 0.5 V | | | -50 | | | -50 | μA |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{OS} § | V _{CC} = MAX | -30 | | -100 | -30 | | -100 | mA |
| I _{CC} | V _{CC} = MAX | | 75 | 100 | | 75 | 100 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | | J OR N | | | UNIT |
|--|-------------------------------------|-----|------|-----|--------|------|-----|------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 35 | 75 | | 35 | 55 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 20 | 40 | | 20 | 35 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 15 | 40 | | 15 | 35 | ns |

†For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

‡All typical values are at V_{CC} = 5 V, T_A = 25 °C.

§Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

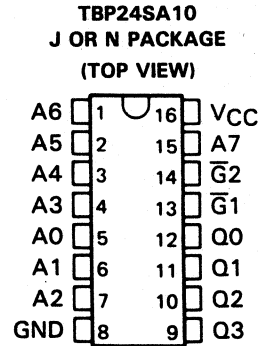
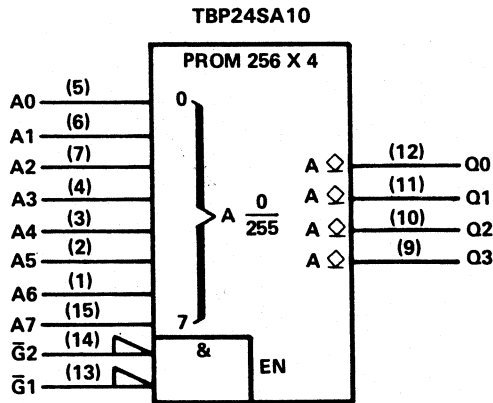
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PROMS

TBP24SA10
1024 BITS (256 WORDS BY 4 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS

logic symbol

pin assignment



recommended operating conditions

| PARAMETER | | MJ | | | J OR N | | | UNIT |
|-----------------|--------------------------------------|-----|-----|-----|--------|-----|------|------|
| | | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} | Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} | High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} | Low-level input voltage | | | 0.8 | | | 0.8 | V |
| V _{OH} | High-level output voltage | | | 5.5 | | | 5.5 | V |
| I _{OL} | Low-level output current | | | 16 | | | 16 | mA |
| T _A | Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

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PROMS

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | MJ | | | J OR N | | | UNIT |
|-----------------|--|-----|------|-------|--------|------|-------|------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| I _{OH} | V _{CC} = MIN, V _{OH} = 2.4 V | | | 0.05 | | | 0.05 | mA |
| | | | | 0.1 | | | 0.1 | |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.45 | V |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | µA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{CC} | V _{CC} = MAX | 75 | 100 | | 75 | 100 | | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | | J OR N | | | UNIT | |
|-------------------|--|-----|------|-----|--------|------|-----|------|----|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | | |
| t _{a(A)} | Access time from address | | | 35 | 75 | | 35 | 65 | ns |
| t _{a(S)} | Access time from chip select (enable time) | | | 20 | 40 | | 20 | 35 | ns |
| t _{PLH} | Propagation delay time low-to-high-level output from chip select | | | 15 | 40 | | 20 | 35 | ns |

†For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

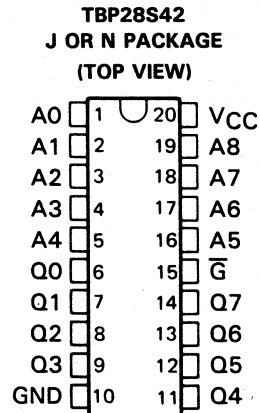
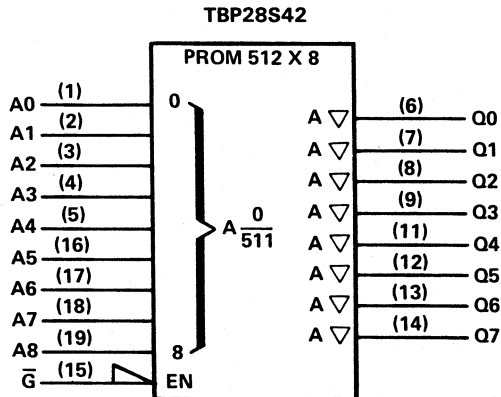
‡All typical values are at V_{CC} = 5 V, T_A = 25°C.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

TBP28S42
4096 BITS (512 WORDS BY 8 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol

pin assignment



recommended operating conditions

| PARAMETER | MJ | | | J OR N | | | UNIT |
|---|-----|-----|-----|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| I _{OH} High-level output current | | | -2 | | | -6.5 | mA |
| I _{OL} Low-level output current | | | 16 | | | 16 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS [†] | MJ | | | J OR N | | | UNIT |
|------------------------------|--|-----|------------------|-------|--------|------------------|-------|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| V _{OH} | V _{CC} = MIN, I _{OH} = MAX | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V |
| I _{OZH} | V _{CC} = MAX, V _O = 2.4 V | | | 50 | | | 50 | μA |
| I _{OZL} | V _{CC} = MAX, V _O = 0.5 V | | | -50 | | | -50 | μA |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{OS} [§] | V _{CC} = MAX | -30 | | -100 | -30 | | -100 | mA |
| I _{CC} | V _{CC} = MAX | | 100 | 135 | | 100 | 135 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | | J OR N | | | UNIT |
|--|-------------------------------------|-----|------------------|-----|--------|------------------|-----|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 35 | 70 | | 35 | 60 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 20 | 45 | | 20 | 45 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 15 | 45 | | 15 | 40 | ns |

[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

[‡]All typical values are at V_{CC} = 5 V, T_A = 25 °C.

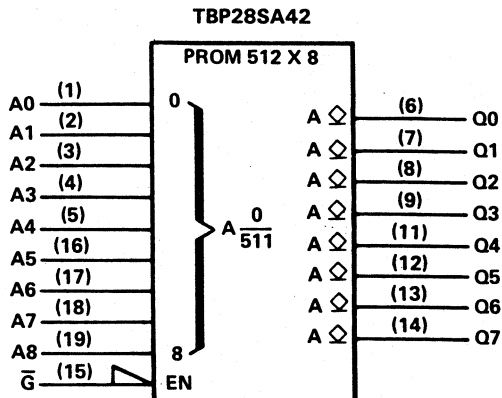
[§]Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

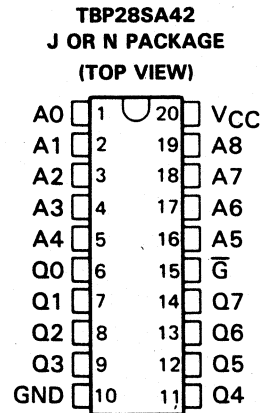
4 PROMS

TBP28SA42
4096 BITS (512 WORDS BY 8 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | MJ | | | J OR N | | | UNIT |
|---|-----|-----|-----|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| V _{OH} High-level output voltage | | | 5.5 | | | 5.5 | V |
| I _{OL} Low-level output current | | | 16 | | | 16 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

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PROMS

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | MJ | | | J OR N | | | UNIT |
|-----------------|--|-----|------|-------|--------|------|-------|------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| I _{OH} | V _{CC} = MIN, V _{OH} = 2.4 V | | | 0.05 | | | 0.05 | mA |
| | | | | 0.1 | | | 0.1 | |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | µA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{CC} | V _{CC} = MAX | 105 | | 135 | 105 | | 135 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | | J OR N | | | UNIT |
|---|---------------------------------------|-----|------|-----|--------|------|-----|------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 35 | 75 | | 35 | 65 | ns |
| t _{a(S)} Access time from chip select (enable time) | R _{L1} = 300 Ω | | 20 | 45 | | 20 | 35 | ns |
| t _{PLH} Propagation delay time low-to-high-level output from chip select | R _{L2} = 600 Ω See Note 3 | | 15 | 45 | | 15 | 35 | ns |

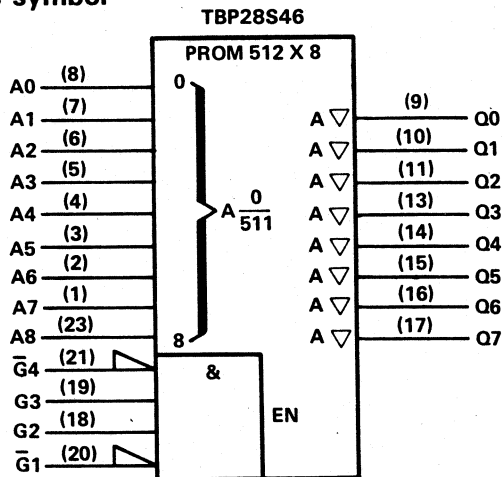
†For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

‡All typical values are at V_{CC} = 5 V, T_A = 25 °C.

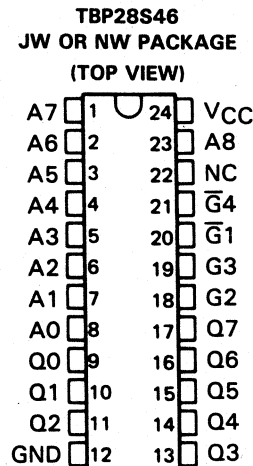
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

TBP28S46
4096 BITS (512 WORDS BY 8 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | MJW | | | JW OR NW | | | UNIT |
|---|-----|-----|-----|----------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| I _{OH} High-level output current | | | -2 | | | -6.5 | mA |
| I _{OL} Low-level output current | | | 16 | | | 16 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS [†] | MJW | | | JW OR NW | | | UNIT |
|------------------------------|--|-----|------------------|-------|----------|------------------|-------|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| V _{OH} | V _{CC} = MIN, I _{OH} = MAX | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V |
| I _{OZH} | V _{CC} = MAX, V _O = 2.4 V | | | 50 | | | 50 | μA |
| I _{OZL} | V _{CC} = MAX, V _O = 0.5 V | | | -50 | | | -50 | μA |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{OS} [§] | V _{CC} = MAX | -15 | | -100 | -20 | | -100 | mA |
| I _{CC} | V _{CC} = MAX | | 100 | 135 | | 100 | 135 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJW | | | JW OR NW | | | UNIT |
|--|-------------------------------------|-----|------------------|-----|----------|------------------|-----|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 35 | 70 | | 35 | 60 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 20 | 45 | | 20 | 35 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 15 | 40 | | 15 | 35 | ns |

[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.
[‡]All typical values are at V_{CC} = 5 V, T_A = 25°C.
[§]Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.
 NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

4 PROMS



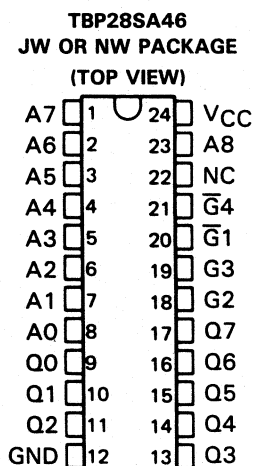
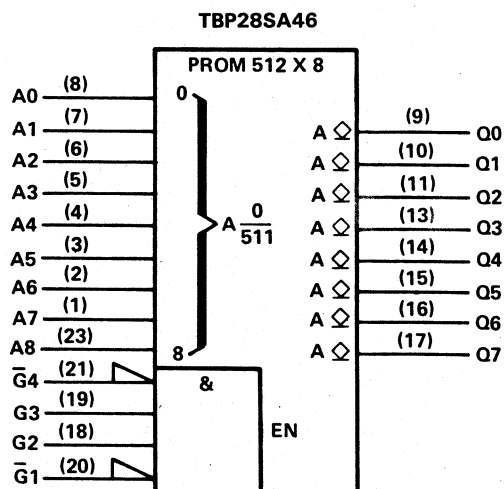
TBP28SA46

4096 BITS (512 WORDS BY 8 BITS)

STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS

logic symbol

pin assignment



recommended operating conditions

| PARAMETER | MJW | | | JW OR NW | | | UNIT |
|---|-----|-----|-----|----------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| V _{OH} High-level output voltage | | | 5.5 | | | 5.5 | V |
| I _{OL} Low-level output current | | | 16 | | | 16 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

4

PROMS

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS [†] | MJW | | | JW OR NW | | | UNIT |
|-----------------|--|-----|------------------|-------|----------|------------------|-------|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| I _{OH} | V _{CC} = MIN, V _{OH} = 2.4 V | | | 0.05 | | | 0.05 | mA |
| | | | | 0.1 | | | 0.1 | |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{CC} | V _{CC} = MAX | 100 | 135 | | 100 | 135 | | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJW | | | JW OR NW | | | UNIT | |
|---|--|-----|------------------|-----|----------|------------------|-----|------|----|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | | |
| t _{a(A)} Access time from address | C _L = 30 pF R _{L1} = 300 Ω R _{L2} = 600 Ω See Note 3 | | | 35 | 75 | | 35 | 65 | ns |
| t _{a(S)} Access time from chip select (enable time) | | | | 20 | 45 | | 20 | 35 | ns |
| t _{PLH} Propagation delay time low-to-high-level output from chip select | | | | | 15 | 40 | | 15 | 35 |

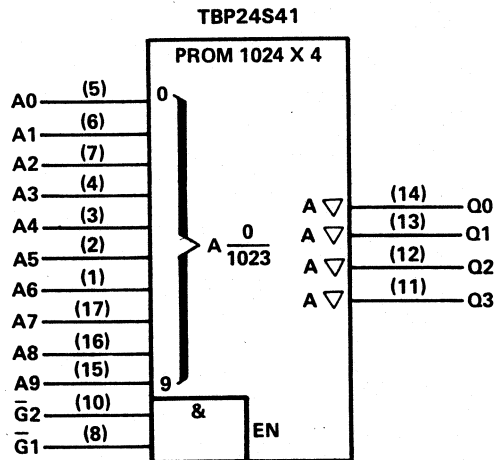
[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

[‡]All typical values are at V_{CC} = 5 V, T_A = 25°C.

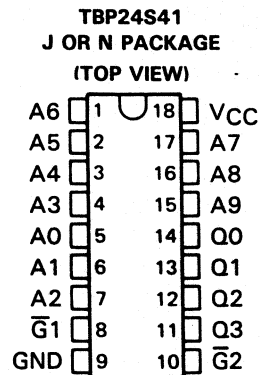
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

TBP24S41
4096 BITS (1024 WORDS BY 4 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | MJ | | | J OR N | | | UNIT |
|---|-----|-----|-----|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| I _{OH} High-level output current | | | -2 | | | -3.2 | mA |
| I _{OL} Low-level output current | | | 16 | | | 16 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS [†] | MJ | | | J OR N | | | UNIT |
|------------------------------|--|-----|------------------|-------|--------|------------------|-------|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| V _{OH} | V _{CC} = MIN, I _{OH} = MAX | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V |
| I _{OZH} | V _{CC} = MAX, V _O = 2.4 V | | | 50 | | | 50 | μA |
| I _{OZL} | V _{CC} = MAX, V _O = 0.5 V | | | -50 | | | -50 | μA |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{OS} [§] | V _{CC} = MAX | -15 | | -100 | -20 | | -100 | mA |
| I _{CC} | V _{CC} = MAX | | 95 | 140 | | 95 | 140 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | | J OR N | | | UNIT |
|--|-------------------------------------|-----|------------------|-----|--------|------------------|-----|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 40 | 75 | | 40 | 60 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 20 | 40 | | 20 | 30 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 20 | 40 | | 20 | 30 | ns |

[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

[‡]All typical values are at V_{CC} = 5 V, T_A = 25°C.

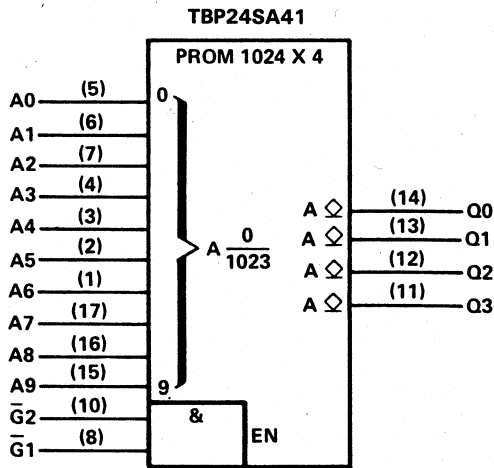
[§]Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

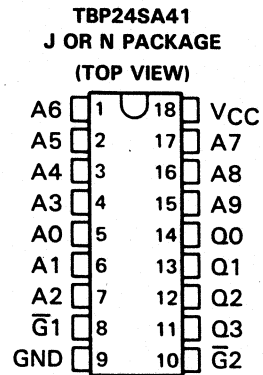
4 PROMS

TBP24SA41
4096 BITS (1024 WORDS BY 4 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | | MJ | | | J OR N | | | UNIT |
|-----------------|--------------------------------------|-----|-----|-----|--------|-----|------|------|
| | | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} | Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} | High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} | Low-level input voltage | | | 0.8 | | | 0.8 | V |
| V _{OH} | High-level output voltage | | | 5.5 | | | 5.5 | V |
| I _{OL} | Low-level output current | | | 16 | | | 16 | mA |
| T _A | Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | MJ | | | J OR N | | | UNIT | |
|-----------------|--|-----|------|-------|--------|------|-------|------|----|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V | |
| I _{OH} | V _{CC} = MIN, V _{OH} = 2.4 V | | | 0.05 | | | 0.05 | mA | |
| | | | | 0.1 | | | 0.1 | | |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V | |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA | |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | µA | |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA | |
| I _{CC} | V _{CC} = MAX | | | 95 | 140 | | 95 | 140 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | J OR N | | UNIT | |
|-------------------|--|-----|------|--------|-----|------|------|
| | | MIN | TYP‡ | MAX | MIN | | TYP‡ |
| t _{a(A)} | Access time from address | | 40 | 75 | 40 | 60 | ns |
| t _{a(S)} | Access time from chip select (enable time) | | 20 | 40 | 20 | 30 | ns |
| t _{PLH} | Propagation delay time low-to-high-level output from chip select | | 20 | 40 | 20 | 30 | ns |

†For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

‡All typical values are at V_{CC} = 5 V, T_A = 25 °C.

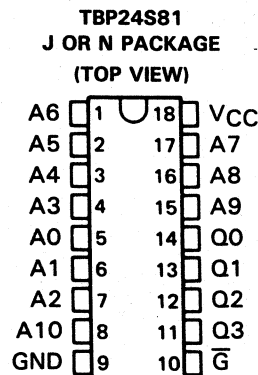
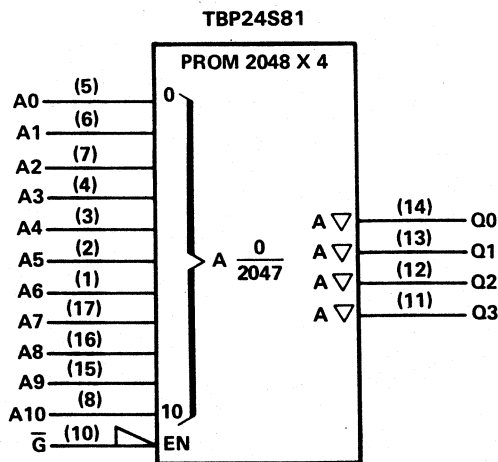
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

4 PROMS

TBP24S81
8192 BITS (2048 WORDS BY 4 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol

pin assignment



recommended operating conditions

| PARAMETER | MJ | | | J OR N | | | UNIT |
|---|-----|-----|-----|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| I _{OH} High-level output current | | | -2 | | | -3.2 | mA |
| I _{OL} Low-level output current | | | 16 | | | 16 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS [†] | MJ | | | J OR N | | | UNIT |
|------------------------------|--|-----|------------------|-------|--------|------------------|-------|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| V _{OH} | V _{CC} = MIN, I _{OH} = MAX | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V |
| I _{OZH} | V _{CC} = MAX, V _O = 2.4 V | | | 50 | | | 50 | μA |
| I _{OZL} | V _{CC} = MAX, V _O = 0.5 V | | | -50 | | | -50 | μA |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{OS} [§] | V _{CC} = MAX | -15 | | -100 | -20 | | -100 | mA |
| I _{CC} | V _{CC} = MAX | | 125 | 175 | | 125 | 175 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | | J OR N | | | UNIT |
|--|-------------------------------------|-----|------------------|-----|--------|------------------|-----|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 45 | 85 | | 45 | 70 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 20 | 50 | | 20 | 40 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 20 | 50 | | 20 | 40 | ns |

[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

[‡]All typical values are at V_{CC} = 5 V, T_A = 25°C.

[§]Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

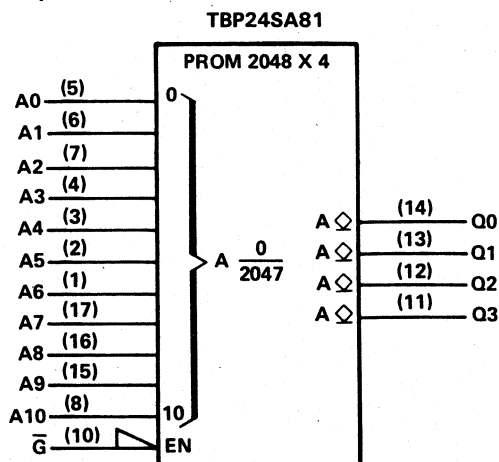
4 PROMS

TBP24SA81

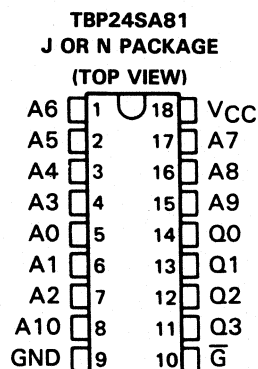
8192 BITS (2048 WORDS BY 4 BITS)

STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | MJ | | | J OR N | | | UNIT |
|---|-----|-----|-----|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| V _{OH} High-level output voltage | | | 5.5 | | | 5.5 | V |
| I _{OL} Low-level output current | | | 16 | | | 16 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | MJ | | | J OR N | | | UNIT | |
|-----------------|--|-----|------|-------|--------|------|-------|------|----|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V | |
| I _{OH} | V _{CC} = MIN, V _{OH} = 2.4 V | | | 0.05 | | | 0.05 | VmA | |
| | | | | 0.1 | | | 0.1 | | |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V | |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA | |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA | |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA | |
| I _{CC} | V _{CC} = MAX | | | 125 | 175 | | 125 | 175 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | | J OR N | | | UNIT |
|---|---------------------------------------|-----|------|-----|--------|------|-----|------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 45 | 95 | | 45 | 70 | ns |
| t _{a(S)} Access time from chip select (enable time) | R _{L1} = 300 Ω | | 20 | 50 | | 20 | 40 | ns |
| t _{PLH} Propagation delay time low-to-high-level output from chip select | R _{L2} = 600 Ω See Note 3 | | 20 | 50 | | 20 | 40 | ns |

†For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

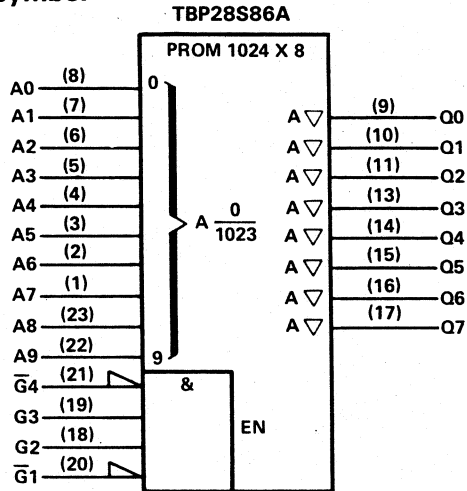
‡All typical values are at V_{CC} = 5 V, T_A = 25°C.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

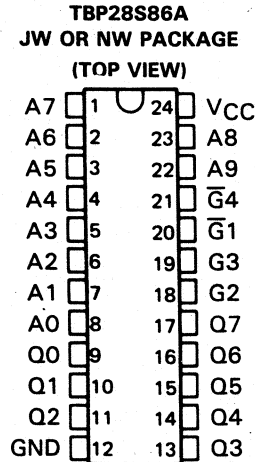
4 PROMS

TBP28S86A
8192 BITS (1024 WORDS BY 8 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | MJW | | | JW OR NW | | | UNIT |
|---|-----|-----|-----|----------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| I _{OH} High-level output current | | | -2 | | | -3.2 | mA |
| I _{OL} Low-level output current | | | 12 | | | 12 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS [†] | MJW | | | JW OR NW | | | UNIT |
|------------------------------|--|-----|------------------|-------|----------|------------------|-------|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| V _{OH} | V _{CC} = MIN, I _{OH} = MAX | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = MIN, I _{OL} = 12 mA | | | 0.5 | | | 0.5 | V |
| I _{OZH} | V _{CC} = MAX, V _O = 2.4 V | | | 50 | | | 50 | μA |
| I _{OZL} | V _{CC} = MAX, V _O = 0.5 V | | | -50 | | | -50 | μA |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{OS} [§] | V _{CC} = MAX | -15 | | -100 | -20 | | -100 | mA |
| I _{CC} | V _{CC} = MAX | | 110 | 170 | | 110 | 165 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJW | | | JW OR NW | | | UNIT |
|--|-------------------------------------|-----|------------------|-----|----------|------------------|-----|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| t _{aA}) Access time from address | C _L = 30 pF | | 35 | 80 | | 35 | 65 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 20 | 50 | | 20 | 40 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 15 | 40 | | 15 | 35 | ns |

[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

[‡]All typical values are at V_{CC} = 5 V, T_A = 25°C.

[§]Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

4

PROMS

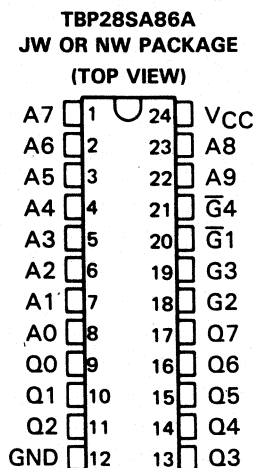
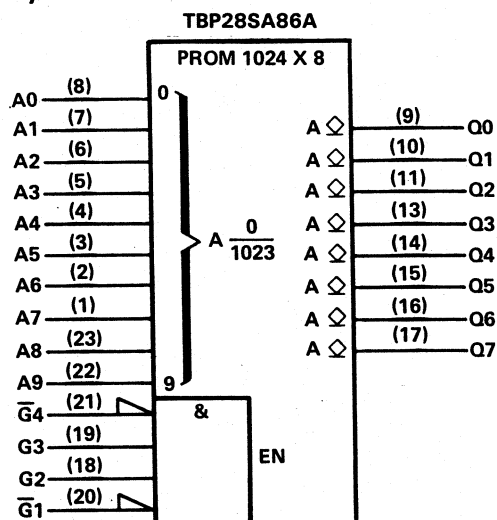
TBP28SA86A

8192 BITS (1024 WORDS BY 8 BITS)

STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS

logic symbol

pin assignment



recommended operating conditions

| PARAMETER | MJW | | | JW OR NW | | | UNIT |
|---|-----|-----|-----|----------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| V _{OH} High-level output voltage | | | 5.5 | | | 5.5 | V |
| I _{OL} Low-level output current | | | 12 | | | 12 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS [†] | MJW | | | JW OR NW | | | UNIT |
|-----------------|--|-----|------------------|-------|----------|------------------|-------|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| I _{OH} | V _{CC} = MIN, V _{OH} = 2.4 V | | | 0.05 | | | 0.05 | mA |
| | | | | 0.1 | | | 0.1 | |
| V _{OL} | V _{CC} = MIN, I _{OL} = 12 mA | | | 0.5 | | | 0.5 | V |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{CC} | V _{CC} = MAX | 125 | 175 | | 125 | 175 | | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJW | | | JW OR NW | | | UNIT |
|---|---------------------------------------|-----|------------------|-----|----------|------------------|-----|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | 35 | | 80 | 35 | | 70 | ns |
| t _{a(S)} Access time from chip select (enable time) | R _{L1} = 300 Ω | 20 | | 50 | 20 | | 40 | ns |
| t _{PLH} Propagation delay time low-to-high-level output from chip select | R _{L2} = 600 Ω See Note 3 | 15 | | 40 | 15 | | 35 | ns |

[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

[‡]All typical values are at V_{CC} = 5 V, T_A = 25°C.

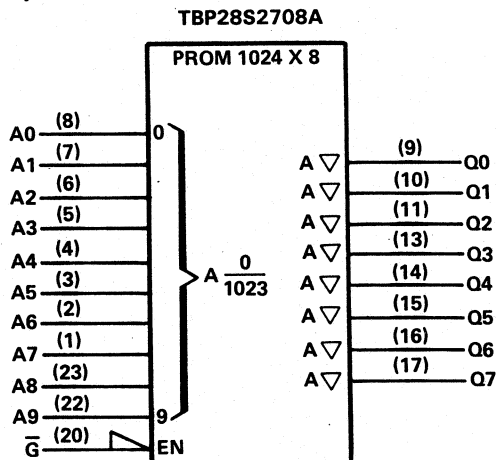
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

4

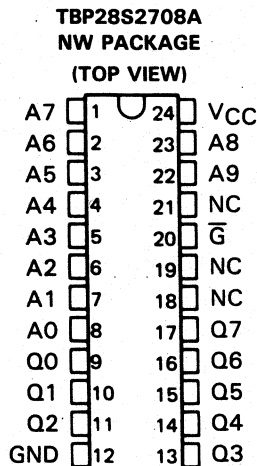
PROMS

TBP28S2708A
8192 BITS (1024 WORDS BY 8 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | NW | | | UNIT |
|---|------|-----|------|------------|
| | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | V |
| V _{IL} Low-level input voltage | | | | 0.8 V |
| I _{OH} High-level output current | | | | -3.2 mA |
| I _{OL} Low-level output current | | | | 12 mA |
| T _A Operating free-air temperature range | 0 | | | 70 °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | NW | | | UNIT |
|-------------------|---|-------|------|-----|------|
| | | MIN | TYP† | MAX | |
| V _{IK} | V _{CC} = 4.75, I _I = -18 mA | -1.2 | | | V |
| V _{OH} | V _{CC} = 4.75, I _{OH} = -3.2 mA | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = 4.75, I _{OL} = 12 mA | 0.5 | | | V |
| I _{OZH} | V _{CC} = 5.25, V _O = 2.4 V | 50 | | | μA |
| I _{OZL} | V _{CC} = 5.25, V _O = 0.5 V | -50 | | | μA |
| I _I | V _{CC} = 5.25, V _I = 5.5 V | 1 | | | mA |
| I _{IH} | V _{CC} = 5.25, V _I = 2.7 V | 25 | | | μA |
| I _{IL} | V _{CC} = 5.25, V _I = 0.5 V | -0.25 | | | mA |
| I _{OS} ‡ | V _{CC} = 5.25 | -20 | -100 | | mA |
| I _{CC} | V _{CC} = 5.25 | 110 | | 165 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

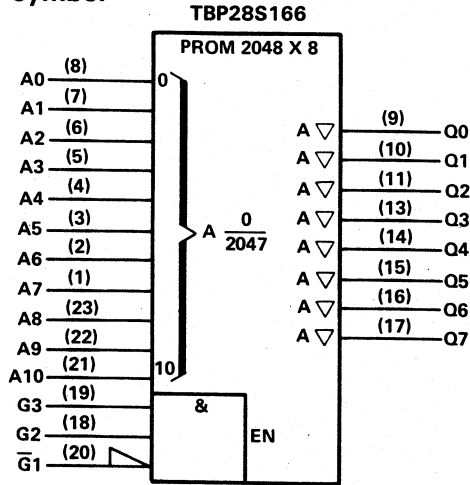
| PARAMETER | TEST CONDITIONS | NW | | | UNIT |
|--|-------------------------------------|-----|------|-----|------|
| | | MIN | TYP† | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | 45 | | 70 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | 20 | | 40 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | 20 | | 40 | ns |

†All typical values are at V_{CC} = 5 V, T_A = 25°C.
 ‡Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.
 NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

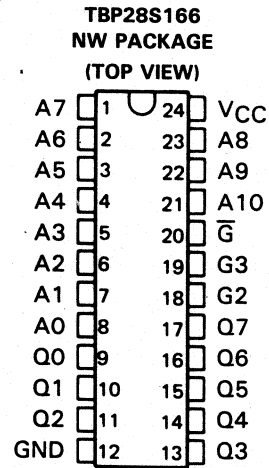
4 PROMS

TBP28S166
16,384 BITS (2084 WORDS BY 8 BITS)
STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | NW | | | UNIT |
|---|------|-----|------|------|
| | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | V |
| I _{OH} High-level output current | | | -3.2 | mA |
| I _{OL} Low-level output current | | | 16 | mA |
| T _A Operating free-air temperature range | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | NW | | | UNIT |
|------------------------------|---|-----|------------------|-------|------|
| | | MIN | TYP [†] | MAX | |
| V _{IK} | V _{CC} = 4.75, I _I = -18 mA | | | -1.2 | V |
| V _{OH} | V _{CC} = 4.75, I _{OH} = -3.2 mA | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = 4.75, I _{OL} = 16 mA | | | 0.5 | V |
| I _{OZH} | V _{CC} = 5.25, V _O = 2.4 V | | | 50 | μA |
| I _{OZL} | V _{CC} = 5.25, V _O = 0.5 V | | | -50 | μA |
| I _I | V _{CC} = 5.25, V _I = 5.5 V | | | 1 | mA |
| I _{IH} | V _{CC} = 5.25, V _I = 2.7 V | | | 25 | μA |
| I _{IL} | V _{CC} = 5.25, V _I = 0.5 V | | | -0.25 | mA |
| I _{OS} [‡] | V _{CC} = 5.25 | -20 | | -100 | mA |
| I _{CC} | V _{CC} = 5.25 | | 130 | 175 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | NW | | | UNIT |
|--|-------------------------------------|-----|------------------|-----|------|
| | | MIN | TYP [†] | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 35 | 75 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 15 | 40 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 15 | 40 | ns |

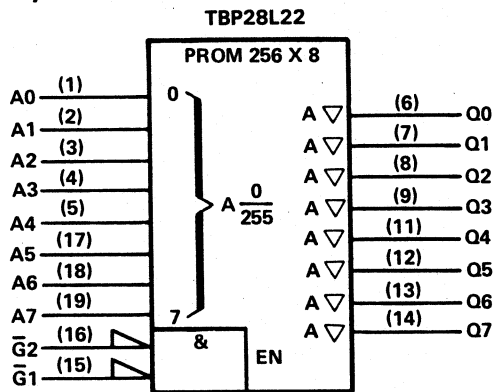
[†]All typical values are at V_{CC} = 5 V, T_A = 25°C.

[‡]Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

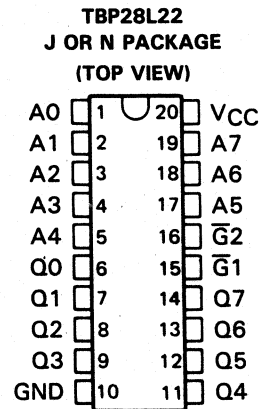
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

TBP28L22
2048 BITS (256 WORDS BY 8 BITS)
LOW-POWER PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | MJ | | | J OR N | | | UNIT |
|---|-----|-----|-----|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| I _{OH} High-level output current | | | -2 | | | -6.5 | mA |
| I _{OL} Low-level output current | | | 16 | | | 16 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS [†] | MJ | | | J OR N | | | UNIT |
|------------------------------|--|-----|------------------|-------|--------|------------------|-------|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| V _{OH} | V _{CC} = MIN, I _{OH} = MAX | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V |
| I _{OZH} | V _{CC} = MAX, V _O = 2.4 V | | | 50 | | | 50 | μA |
| I _{OZL} | V _{CC} = MAX, V _O = 0.5 V | | | -50 | | | -50 | μA |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{OS} [§] | V _{CC} = MAX | -25 | | -100 | -30 | | -100 | mA |
| I _{CC} | V _{CC} = MAX | | 75 | 100 | | 75 | 100 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | | J OR N | | | UNIT |
|--|-------------------------------------|-----|------------------|-----|--------|------------------|-----|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 45 | 75 | | 45 | 70 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 20 | 40 | | 20 | 35 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 15 | 35 | | 15 | 30 | ns |

[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

[‡]All typical values are at V_{CC} = 5 V, T_A = 25°C.

[§]Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

4

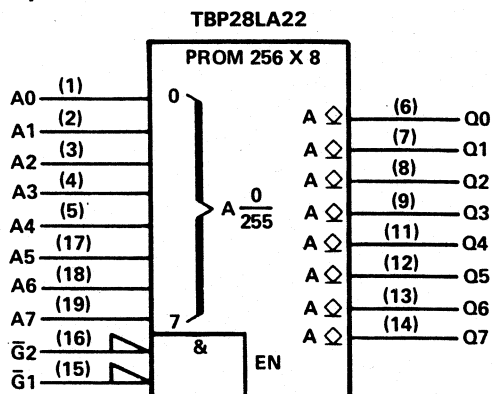
PROMS

TBP28LA22

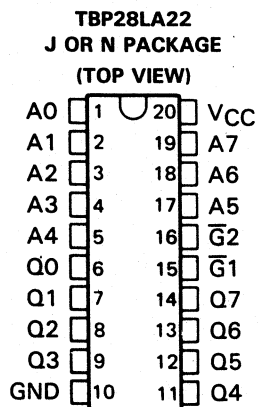
2048 BITS (256 WORDS BY 8 BITS)

LOW-POWER PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | MJ | | | J OR N | | | UNIT |
|---|-----|-----|-----|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| V _{OH} High-level output voltage | | | 5.5 | | | 5.5 | V |
| I _{OL} Low-level output current | | | 16 | | | 16 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

4

PROMS

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | MJ | | | J OR N | | | UNIT |
|-----------------|--|-----|------|-------|--------|------|-------|------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| I _{OH} | V _{CC} = MIN, V _{OH} = 2.4 V | | | 0.05 | | | 0.05 | mA |
| | | | | 0.1 | | | 0.1 | |
| V _{OL} | V _{CC} = MIN, I _{OL} = 16 mA | | | 0.5 | | | 0.5 | V |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{CC} | V _{CC} = MAX | | | 75 | | | 100 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | | J OR N | | | UNIT | |
|---|--|-----|------|-----|--------|------|-----|------|----|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | | |
| t _{aA}) Access time from address | C _L = 30 pF R _{L1} = 300 Ω R _{L2} = 600 Ω See Note 3 | | | 40 | 80 | | 45 | 75 | ns |
| t _{a(S)}) Access time from chip select (enable time) | | | | 20 | 40 | | 20 | 35 | ns |
| t _{PLH}) Propagation delay time low-to-high-level output from chip select | | | | | 15 | 35 | | 15 | 30 |

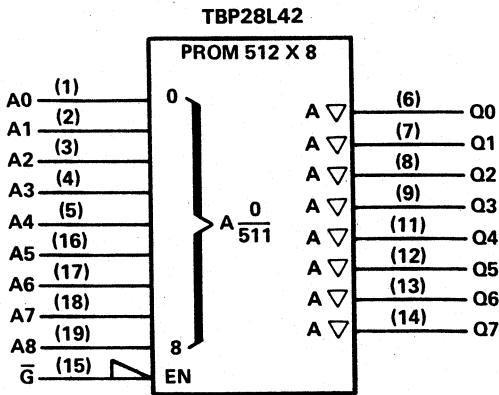
†For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

‡All typical values are at V_{CC} = 5 V, T_A = 25°C.

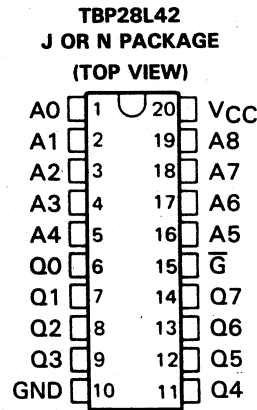
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

TBP28L42
4096 BITS (512 WORDS BY 8 BITS)
LOW-POWER PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | MJ | | | J OR N | | | UNIT |
|---|-----|-----|-----|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | | | 0.8 | V |
| I _{OH} High-level output current | | | -1 | | | -1.6 | mA |
| I _{OL} Low-level output current | | | 8 | | | 8 | mA |
| T _A Operating free-air temperature range | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS [†] | MJ | | | J OR N | | | UNIT |
|------------------------------|--|-----|------------------|-------|--------|------------------|-------|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| V _{OH} | V _{CC} = MIN, I _{OH} = MAX | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = MIN, I _{OL} = 8 mA | | | 0.5 | | | 0.5 | V |
| I _{OZH} | V _{CC} = MAX, V _O = 2.4 V | | | 50 | | | 50 | μA |
| I _{OZL} | V _{CC} = MAX, V _O = 0.5 V | | | -50 | | | -50 | μA |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{OS} [§] | V _{CC} = MAX | -10 | | -100 | -10 | | -100 | mA |
| I _{CC} | V _{CC} = MAX | | 50 | 85 | | 50 | 85 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJ | | | J OR N | | | UNIT |
|--|-------------------------------------|-----|------------------|-----|--------|------------------|-----|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 55 | 110 | | 55 | 95 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 25 | 60 | | 25 | 60 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 25 | 50 | | 25 | 40 | ns |

[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

[‡]All typical values are at V_{CC} = 5 V, T_A = 25°C.

[§]Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

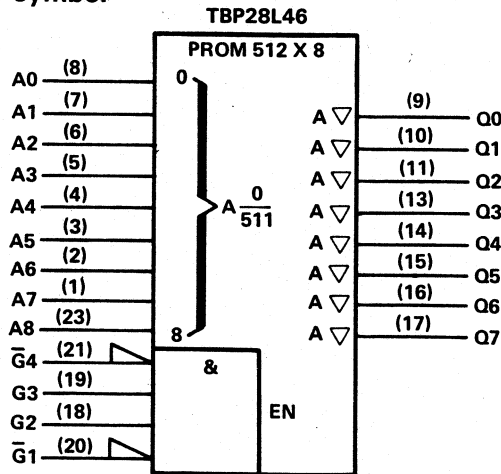
4
PROMS

TBP28L46

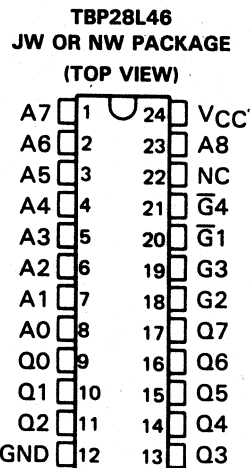
4096 BITS (512 WORDS BY 8 BITS)

LOW-POWER PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol:



pin assignment



recommended operating conditions

| PARAMETER | MJW | | | JW OR NW | | | UNIT |
|---|-----|-----|-----|----------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | | | | | V |
| I _{OH} High-level output current | | | 0.8 | | | 0.8 | V |
| I _{OL} Low-level output current | | | -1 | | | -1.6 | mA |
| T _A Operating free-air temperature range | | | 8 | | | 8 | mA |
| | -55 | | 125 | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS† | MJW | | | JW OR NW | | | UNIT |
|-------------------|--|-----|------|-------|----------|------|-------|------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.2 | | | -1.2 | V |
| V _{OH} | V _{CC} = MIN, I _{OH} = MAX | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = MIN, I _{OL} = 8 mA | | | 0.5 | | | 0.5 | V |
| I _{OZH} | V _{CC} = MAX, V _O = 2.4 V | | | 50 | | | 50 | μA |
| I _{OZL} | V _{CC} = MAX, V _O = 0.5 V | | | -50 | | | -50 | μA |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 25 | | | 25 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | | | -0.25 | | | -0.25 | mA |
| I _{OS} § | V _{CC} = MAX | -10 | | -100 | -10 | | -100 | mA |
| I _{CC} | V _{CC} = MAX | | 50 | 85 | | 50 | 85 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJW | | | JW OR NW | | | UNIT |
|--|-------------------------------------|-----|------|-----|----------|------|-----|------|
| | | MIN | TYP‡ | MAX | MIN | TYP‡ | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 55 | 110 | | 55 | 95 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 25 | 60 | | 25 | 60 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 25 | 50 | | 25 | 40 | ns |

†For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

‡All typical values are at V_{CC} = 5 V, T_A = 25°C.

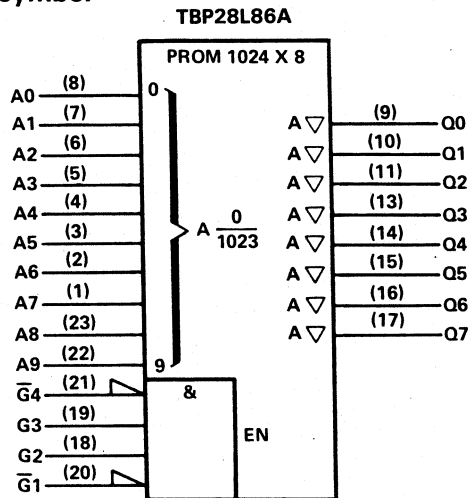
§Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

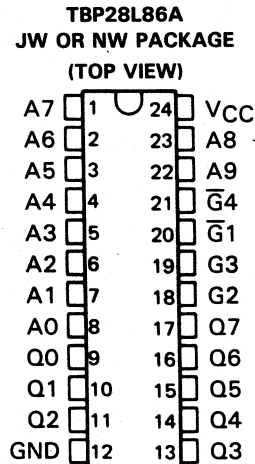
4 PROMS

TBP28L86A
8192 BITS (1024 WORDS BY 8 BITS)
LOW-POWER PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | | MJW | | | JW OR NW | | | UNIT | | |
|-----------------|--------------------------------------|-----|-----|-----|----------|-----|------|------|----|----|
| | | MIN | NOM | MAX | MIN | NOM | MAX | | | |
| V _{CC} | Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V | | |
| V _{IH} | High-level input voltage | 2 | | | 2 | | | V | | |
| V _{IL} | Low-level input voltage | 0.8 | | | 0.8 | | | V | | |
| I _{OH} | High-level output current | -1 | | | -1.6 | | | mA | | |
| I _{OL} | Low-level output current | 8 | | | 8 | | | mA | | |
| T _A | Operating free-air temperature range | -55 | | | 125 | | | 0 | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS [†] | MJW | | | JW OR NW | | | UNIT |
|------------------------------|--|-------|------------------|------|----------|------------------|------|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | -1.2 | | | -1.2 | | | V |
| V _{OH} | V _{CC} = MIN, I _{OH} = MAX | 2.4 | 3.1 | | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = MIN, I _{OL} = 8 mA | 0.5 | | | 0.5 | | | V |
| I _{OZH} | V _{CC} = MAX, V _O = 2.4 V | 50 | | | 50 | | | μA |
| I _{OZL} | V _{CC} = MAX, V _O = 0.5 V | -50 | | | -50 | | | μA |
| I _I | V _{CC} = MAX, V _I = 5.5 V | 1 | | | 1 | | | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | 25 | | | 25 | | | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | -0.25 | | | -0.25 | | | mA |
| I _{OS} [§] | V _{CC} = MAX | -10 | | -100 | -10 | | -100 | mA |
| I _{CC} | V _{CC} = MAX | 55 | | 95 | 55 | | 80 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | MJW | | | JW OR NW | | | UNIT |
|-------------------|--|-----|------------------|-----|----------|------------------|-----|------|
| | | MIN | TYP [‡] | MAX | MIN | TYP [‡] | MAX | |
| t _{a(A)} | Access time from address | 65 | | 200 | 65 | | 110 | ns |
| t _{a(S)} | Access time from chip select (enable time) | 40 | | 125 | 40 | | 80 | ns |
| t _{dis} | Disable time | 25 | | 100 | 25 | | 60 | ns |

[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

[‡]All typical values are at V_{CC} = 5 V, T_A = 25 °C.

[§]Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

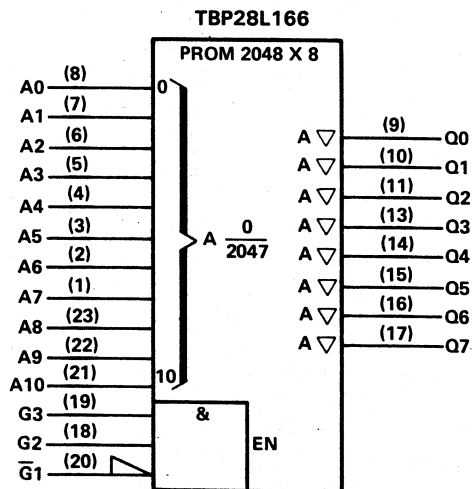
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

4

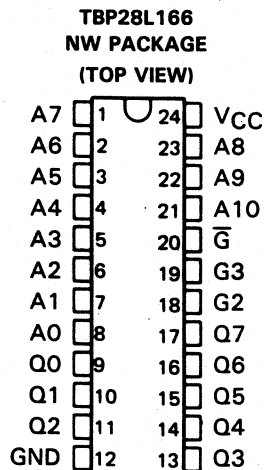
PROMS

TBP28L166
16,384 BITS (2084 WORDS BY 8 BITS)
LOW-POWER PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS

logic symbol



pin assignment



recommended operating conditions

| PARAMETER | NW | | | UNIT |
|---|------|-----|------|------|
| | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.8 | V |
| I _{OH} High-level output current | | | -1.6 | mA |
| I _{OL} Low-level output current | | | 8 | mA |
| T _A Operating free-air temperature range | 0 | | 70 | °C |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | NW | | | UNIT |
|-------------------|---|-----|------|-------|------|
| | | MIN | TYP† | MAX | |
| V _{IK} | V _{CC} = 4.75, I _I = -18 mA | | | -1.2 | V |
| V _{OH} | V _{CC} = 4.75, I _{OH} = -1.6 mA | 2.4 | 3.1 | | V |
| V _{OL} | V _{CC} = 4.75, I _{OL} = 8 mA | | | 0.5 | V |
| I _{OZH} | V _{CC} = 5.25, V _O = 2.4 V | | | 50 | μA |
| I _{OZL} | V _{CC} = 5.25, V _O = 0.5 V | | | -50 | μA |
| I _I | V _{CC} = 5.25, V _I = 5.5 V | | | 1 | mA |
| I _{IH} | V _{CC} = 5.25, V _I = 2.7 V | | | 25 | μA |
| I _{IL} | V _{CC} = 5.25, V _I = 0.5 V | | | -0.25 | mA |
| I _{OS} ‡ | V _{CC} = 5.25 | -10 | | -100 | mA |
| I _{CC} | V _{CC} = 5.25 | | 75 | 110 | mA |

switching characteristics over recommended ranges of T_A and V_{CC} (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | NW | | | UNIT |
|--|-------------------------------------|-----|------|-----|------|
| | | MIN | TYP† | MAX | |
| t _{a(A)} Access time from address | C _L = 30 pF | | 80 | 125 | ns |
| t _{a(S)} Access time from chip select (enable time) | See Note 3 | | 40 | 65 | ns |
| t _{dis} Disable time | C _L = 5 pF See Note 3 | | 30 | 65 | ns |

† All typical values are at V_{CC} = 5 V, T_A = 25°C.

‡ Not more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

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PROMS

SERIES 24 AND 28 PROGRAMMABLE READ-ONLY MEMORIES

recommended operating conditions for programming (see Figure 1)

| | | MIN | NOM | MAX | UNIT |
|---|--------------|-------|-----|-------|-------------|
| Steady-state supply voltage | V_{CC} | 4.75 | 5 | 5.25 | V |
| Input voltage | V_{IH} | 3 | 4 | 5 | V |
| | V_{IL} | 0 | 0 | 0.5 | |
| Voltage at all outputs except the one to be programmed | | 0 | 0 | 0.5 | V |
| Supply voltage level to program a bit | $V_{CC(pr)}$ | 5.75 | 6 | 6.25 | V |
| Select or enable level to program a bit | $V_{S(pr)}$ | 9.75 | 10 | 11 | V |
| Output level during interval t_5 | $V_{O(pr)}$ | 15.75 | 16 | 16.25 | V |
| Supply voltage during verification (see step 14) | Low | 4.4 | 4.5 | 4.6 | V |
| | High | 5.4 | 5.5 | 5.6 | |
| Time from V_{CC} to settle and to verify need to program | t_1 | 0 | 5 | 10 | μs |
| Time from $V_{CC} = 6 V$ until chip select (enable) is at 10 V- | t_2 | 5 | 5 | 10 | μs |
| Time from chip select (enable) high to start of program ramp | t_3 | 0.1 | 5 | 10 | μs |
| Ramp time, output program pulse | t_4 | 10 | 15 | 20 | μs |
| Duration of output program pulse | t_5 | 15 | 20 | 20 | μs |
| Time from end of program pulse to chip select (enable) low | t_6 | 5 | 5 | 10 | μs |
| Time from chip select (enable) $V_{CC} = 0 V$ | t_7 | 0.1 | 5 | 5 | μs |
| Time for cooling between bits | t_8 | 30 | 50 | 100 | μs |
| Time for cooling between words | t_9 | 30 | 50 | | μs |
| Free-air temperature | T_A | 20 | 25 | 30 | $^{\circ}C$ |

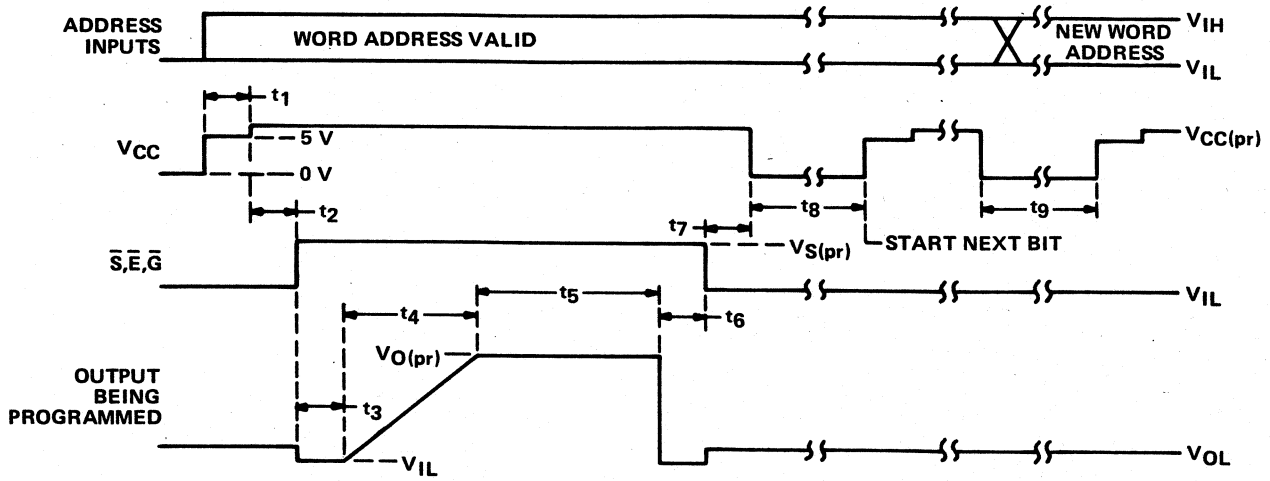
step-by-step programming instruction (see Figure 1)

1. Address the word to be programmed, apply 5 volts to V_{CC} and active levels to all chip select (S and \bar{S}) or chip enable (E and \bar{E}) inputs.
2. Verify the status of a bit location by checking the output level.
3. Decrease V_{CC} to 0 volts.
4. For bit locations that do not require programming, skip steps 5 through 11.
5. Increase V_{CC} to $V_{CC(pr)}$ with a minimum current capability of 250 milliamperes.
6. Apply $V_{S(pr)}$ to all the \bar{S} , \bar{E} or \bar{G} inputs. $I_I \leq 25$ milliamperes. Active-high enables may be left high.
7. Connect all outputs, except the one to be programmed, to V_{IL} . Only one bit is to be programmed at a time.
8. Apply the output programming pulse for 20 microseconds. Minimum current capability of the programming supply should be 250 milliamperes.
9. After terminating the output pulse, disconnect all outputs from V_{IL} conditions.
10. Reduce the voltage at \bar{S} , \bar{E} , or \bar{G} inputs to V_{IL} .
11. Decrease V_{CC} to 0 volts.
12. Return to step 4 until all outputs in the word have been programmed.
13. Repeat steps 2 through 11 for each word in memory.
14. Verify programming of every word after all words have been programmed using V_{CC} values of 4.5 and 5.5 volts.

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**SERIES 24 AND 28
PROGRAMMABLE READ-ONLY MEMORIES**



NOTE 4: Rise and fall times should be $\leq 1 \mu s$.

FIGURE 1. TIMING DIAGRAM AND VOLTAGE WAVEFORMS FOR PROGRAMMING SEQUENCE

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| JBP28L22MJ | ACTIVE | CDIP | J | 20 | 1 | None | Call TI | Level-NC-NC-NC |
| JBP28L42MJ | ACTIVE | CDIP | J | 20 | 1 | None | Call TI | Level-NC-NC-NC |
| JBP28S42MJ | ACTIVE | CDIP | J | 20 | 1 | None | Call TI | Level-NC-NC-NC |

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265