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 \overline{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.

	PACKAGE† AND	ОИТРИТ	BIT SIZE	TYPICAL PERFORMANCE					
TYPE NUMBER	TEMPERATURE RANGE	CONFIGURATION#	(ORGANIZATION)	ACCESS TIMES		POWER			
	DESIGNATORS		(3113/112/11014)	ADDRESS	SELECT	DISSIPATION			
TBP24S10	MJ, J, N	∇	1024 Bits	440	-7 7				
TBP24SA10	MJ, J, N	\Diamond	$(256W \times 4B)$	35 ns	20 ns	375 mW			
TBP28S42	МЈ, Ј, И	∇				77.0			
TBP28SA42	MJ, J, N	Φ	4096 Bits	1	A 48				
TBP28S46	MJW, JW, NW	∇	(512W × 8B)	35 ns	20 ns	500 mW			
TBP28SA46	MJW, JW, NW	Ω	(31244 × 66)						
TBP24S41	MJ, J, N	∇	4096 Bits						
TBP24SA41	MJ, J, N	Ω	(1024 × 4B)	40 ns	20 ns	475 mW			
TBP24S81	MJ, J, N	∇	8192 Bits						
TBP24SA81	MJ, J, N	Ω	(2048 × 4B)	45 ns	20 ns	625 mW			
TBP28S86A	MJW, JW, NW	∇	(1010 X 4B)						
TBP28SA86A	MJW, JW, NW	Ω	8192 Bits	45 ns	20	005 144			
TBP28S2708A	NW	$\overline{\nabla}$	(1024 × 8B)	70118	20 ns	625 mW			
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, Δ = open collector.

TROM

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

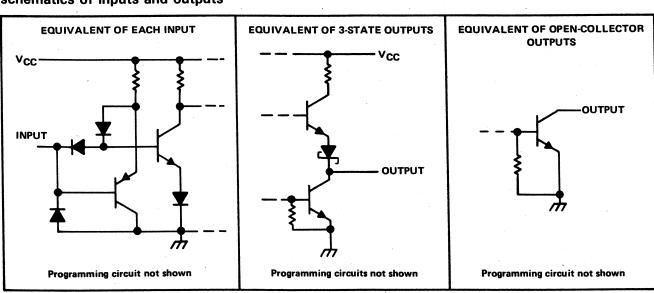
low power PROMs

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.

	PACKAGE [†] AND	ОИТРИТ	BIT SIZE	ТҮРІ	CAL PERFO	ORMANCE
TYPE NUMBER	TEMPERATURE RANGE	CONFIGURATION [‡]	(ORGANIZATION)	ACCESS	TIMES	POWER
	DESIGNATORS	CONFIGURATION	(URGANIZATION)	ADDRESS	SELECT	DISSIPATION
TBP28L22	MJ, J,N	∇	2048 Bits	45 ns	20 ns	375 mW
TBP28LA22	MJ, J, N	\Diamond	(256W × 8B)	45 118	20 115	3/5 11100
TBP28L42	MJ, J, N	∇	4096 Bits	60 ns	30 ns	250 mW
TBP28L46	WIW, JW, NW	∇	(512W × 8B)	OU IIS	30 115	250 11100
TBP28L86A	WJW, 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).

schematics of inputs and outputs



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

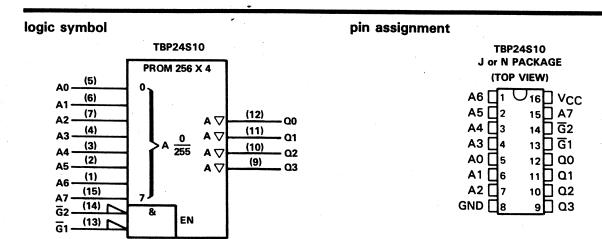
Supply voltage (see Note 1) 7 V
Input voltage
Chip-select peak input voltage (S, S1, S2) (see Note 2)
Off-state output voltage
Off-state peak output voltage (see Note 2)
Operating free-air temperature range: Full-temperature-range circuits (M suffix)55°C to 125°C
Commercial-temperature-range circuits 0 °C to 70 °C
Storage temperature range65°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.

 $^{^{\}ddagger} \nabla =$ three state, $\Delta =$ open collector.

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



recommended operating conditions

	PARAMETER		MJ			J OR N			
	FARAIVETER	MIN	NOM	MAX	MIN	NOM	MAX	UNIT	
VCC	Supply voltage	4.5	5	5.5	4.75	5	5.25	V	
VIH	High-level input voltage	2			2			Ņ	
٧ _{IL}	Low-level input voltage			0.8			0.8	V	
ЮН	High-level output current			-2			-6.5	mA	
loL	Low-level output current			16			16	mA	
TA	Operating free-air temperature range	- 55		125	0		70	°C	

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

PARAMETER	TEST CO	NDITIONS†		MJ			J OR N		1 10/17
PANAMETER .	1231 00	NDITIONS .	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
V _{IK}	$V_{CC} = MIN,$	I _I = -18 mA		7	-1.2			-1.2	V
Voн	$V_{CC} = MIN,$	I _{OH} = MAX	2.4	3.1		2.4	3.1		٧
VOL	V _{CC} = MIN,	I _{OL} = 16 mA			0.5			0.5	٧
^I OZH	$V_{CC} = MAX$,	$V_0 = 2.4 \text{ V}$			50			50	μΑ
^I OZL	V _{CC} = MAX,	V _O = 0.5 V			- 50			- 50	μА
lj .	V _{CC} = MAX,	V _I = 5.5 V			1			1	mA
IIH —	$V_{CC} = MAX$,	$V_1 = 2.7 V$			25			25	μА
IIL .	V _{CC} = MAX,	V _I = 0.5 V			-0.25			-0.25	mA
los§	V _{CC} = MAX		-30		-100	-30		-100	mA
Icc	V _{CC} = MAX			75	100		75	100	mA

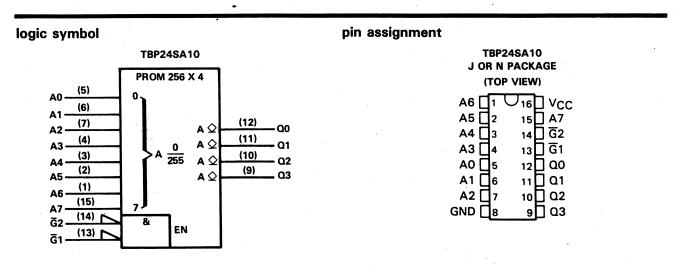
	PARAMETER	TEST		MJ			J OR N		
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
ta(A)	Access time from address	C _L = 30 pF		35	75		35	55	ns
ta(S)	Access time from chip select (enable time)	See Note 3		20	40		20	35	ns
•	Disable time	C _L = 5 pF		15	40		4.5	٥٢	
^t dis	Disable time	See Note 3		15	. 40		15	35	ns

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

 $^{^{\}ddagger}$ 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.

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



recommended operating conditions

	PARAMETER	MJ				J OR N			
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	UNIT	
Vcc	Supply voltage	4.5	5	5.5	4.75	. 5	5.25	٧	
VIH	High-level input voltage	2			2			٧	
VIL	Low-level input voltage			0.8			0.8	V	
Voн	High-level output voltage		*.	5.5		-	5.5	٧	
lOL	Low-level output current		-	16			16	mA	
TA	Operating free-air temperature range	- 55		125	0		70	°C	

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

242445752	TEOT 00	NDITIONS [†]	MJ		J OF	R N	
PARAMETER	IEST CO	י פאטוווטאס	MIN TYP‡	MAX	MIN TYP	* MAX	UNIT
VIK	V _{CC} = MIN,	l₁ = −18 mA	•	-1.2	•	-1.2	٧
	V MIN	V _{OH} = 2.4 V		0.05		0.05	
ЮН	$V_{CC} = MIN,$	V _{OH} = 5.5 V		0.1		0.1	mA
V _{OL}	V _{CC} = MIN,	I _{OL} = 16 mA		0.5		0.45	٧
l _l	V _{CC} = MAX,	V _I = 5.5 V		1		1	mA
ΉΗ	V _{CC} = MAX,	$V_1 = 2.7 V$		25		25	μΑ
liL li	V _{CC} = MAX,	V _I = 0.5 V	-	0.25		-0.25	mA
lcc	V _{CC} = MAX		75	100		75 100	mA

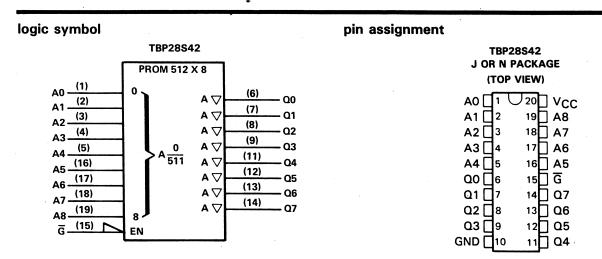
	PARAMETER	TEST	-	MJ			J OR N		UNIT
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
t _{a(A)}	Access time from address	C _L = 30 pF		35	75		35	65	ns
ta(S)	Access time from chip select (enable time)	$R_{L1} = 300 \Omega$		20	40		20	35	ns
*	Propagation delay time low-to-high-level	$R_{L2} = 600 \Omega$		15	40		20	35	ns
^t PLH	output from chip select	See Note 3	1	15	40		20	33	115

[†]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



recommended operating conditions

	PARAMETER		MJ			J OR N			
	PANAIVIETEN	MIN	NOM	MAX	MIN	NOM	MAX	UNIT	
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	V	
VIH	High-level input voltage	2			2			V	
VIL	Low-level input voltage			0.8		:	0.8	V	
Іон	High-level output current			-2			-6.5	mA	
loL	Low-level output current			16			16	mÁ	
TA	Operating free-air temperature range	- 55		125	0		70	°C	

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

PARAMETER	TEST COL	NDITIONS [†]		MJ			J OR N	1	LIAUT
PANAIVIETEN	IESI COI	NDITIONS .	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
V _{IK}	$V_{CC} = MIN,$	l _l = -18 mA			-1.2			-1.2	V
Voн	V _{CC} = MIN,	I _{OH} = MAX	2.4	3.1		2.4	3.1		V
VOL	V _{CC} = MIN,	I _{OL} = 16 mA		-	0.5			0.5	V
^I OZH	V _{CC} = MAX,	$V_0 = 2.4 V$			50			50	μΑ
^I OZL	V _{CC} = MAX,	$V_0 = 0.5 V$			- 50	1	1.4	- 50	μА
l ₁	V _{CC} = MAX,	V _I = 5.5 V			1			1	mA
lін	V _{CC} = MAX,	V _I = 2.7 V			25			25	μΑ
IIL .	V _{CC} = MAX,	V _I = 0.5 V			-0.25			-0.25	mA
los§	V _{CC} = MAX		-30		-100	-30		-100	mA
Icc	V _{CC} = MAX	·		100	135		100	135	mA

switching characteristics over recommended ranges of TA and VCC (unless otherwise noted)

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

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

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

 $^{^{\}ddagger}$ 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.

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

ogic symbol			pin assignment	
	TBP28SA42			TBP28SA42
ag (1)	PROM 512 X 8			J OR N PACKAGE (TOP VIEW)
A1 (2)	^ A \(\hat{\phi} \)	(6) (7) Q0		AO T VCC
A2 (3) A3 (4)	A	(8) 02		A1
A4 (5)	$\begin{array}{cccc} & & & & & & & & & & \\ & & & & & & & & $	(9) (11) Q4		A3
A5 (17)	A♀	(12) Q5		Ω 0
A7 (18)	A	(6.4)		Q1 []7
$\overline{G} = \frac{(15)}{G}$	8 EN			Q3 9 12 Q5 GND 10 11 Q4

recommended operating conditions

	PARAMETER	MJ						
	FARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	UNIT
VCC	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
VIH	High-level input voltage	2			2			V
VIL	Low-level input voltage			0.8			0.8	V
Vон	High-level output voltage			5.5			5.5	V
lOL	Low-level output current			16			16	mA
TA	Operating free-air temperature range	- 55		125	0		70	°C

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

PARAMETER	TEST COL	NDITIONS†		MJ			J OR N	1	
PARAMETER	TEST COI	4D110143	MIN	TYP [‡]	,MAX	MIN	TYP [‡]	MAX	UNIT
VIK	$V_{CC} = MIN,$	I _I = -18 mA			-1.2			-1.2	٧
ЮН	V _{CC} = MIN,	$V_{OH} = 2.4 V$		•	0.05			0.05	
'OH	VCC - 141114,	$V_{OH} = 5.5 V$			0.1			0.1	mA
V _{OL}	$V_{CC} = MIN,$	I _{OL} = 16 mA			0.5			0.5	V
l _l	$V_{CC} = MAX$,	$V_{I} = 5.5 V$			1			1	mA
IIH	$V_{CC} = MAX$,	V _I = 2.7 V			25			25	μΑ
IJĽ	$V_{CC} = MAX$,	V _I = 0.5 V			-0.25			-0.25	mA
¹ CC	V _{CC} = MAX			105	135		105	135	mA

	PARAMETER	TEST		MJ	-	J OR N		
	FANAMICIEN	CONDITIONS	MIN	TYP [‡]	MAX	MIN TYP‡	MAX	UNIT
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)	$R_{L1} = 300 \Omega$		20	45	20	35	ns
*====	Propagation delay time low-to-high-level	$R_{L2} = 600 \Omega$		4.5	4.5	4.5	0.5	
^t PLH	output from chip select	See Note 3	1	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	TBP28S46		pin assignment	TBP28S46
A0 (8) A1 (7) A2 (6) A3 (5) A4 (3) A5 (2) A6 (1) A7 (23) G4 (21) G3 (19) G2 (18) G1 (20)	PROM 512 X 8 A A A A A A A A A A A A A	(9) Q0 Q1 (11) Q2 (13) Q3 (14) Q4 (15) Q5 (16) Q6 (17) Q7		JW OR NW PACKAGE (TOP VIEW) A7

recommended operating conditions

	DADAMETED		MJW		J	W OR N	W	UNIT
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	UNIT
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
VIH	High-level input voltage	2			2			٧
VIL	Low-level input voltage			0.8			0.8	V
ЮН	High-level output current			-2			-6.5	mA
lOL	Low-level output current		-	16			16	mA
TA	Operating free-air temperature range	-55		125	0		70	°C

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

	TEOT 00	NOITIONOT		MJW		J	W OR N	W	UNIT
PARAMETER	IEST CO	NDITIONS [†]	MIN	TYP‡	MAX	MIN	TYP [‡]	MAX	ONL
VIK	V _{CC} = MIN,	I _I = -18 mA			-1.2			-1.2	V
Voн	V _{CC} = MIN,	I _{OH} = MAX	2.4	3.1		2.4	3.1		·V
VOL	V _{CC} = MIN,	I _{OL} = 16 mA			0.5			0.5	٧
lozн	V _{CC} = MAX,	V _O = 2.4 V			50			50	μΑ
lozL	V _{CC} = MAX,	$V_0 = 0.5 V$			- 50			- 50	μΑ
l _l	V _{CC} = MAX,	V _I = 5.5 V			1			1	mΑ
¹ ІН	V _{CC} = MAX,	V _I = 2.7 V			25			25	μΑ
Iμ	V _{CC} = MAX,	V _I = 0.5 V			-0.25			-0.25	mA
los§	V _{CC} = MAX		-15		- 100	-20		- 100	mA
¹cc .	V _{CC} = MAX			100	135		100	135	mA

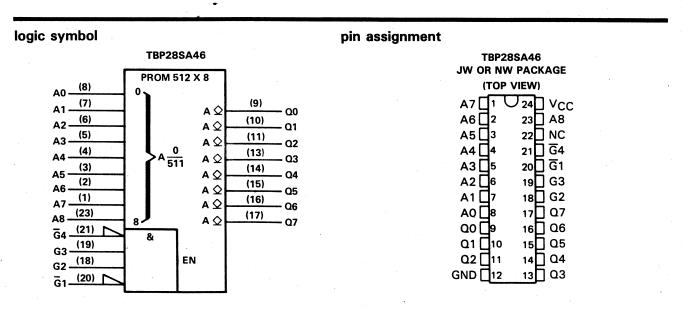
	DADAMETED	TEST		MJW		J	W OR N	W	UNIT
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	ONII
t _{a(A)}	Access time from address	C _L = 30 pF		35	70		35	60	ns
ta(S)	Access time from chip select (enable time)	See Note 3		20	45		20	35	ns
^t dis	Disable time	C _L = 5 pF See Note 3		15	40		15	35	ns

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

 $^{^{\}ddagger}$ 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.

TBP28SA46 4096 BITS (512 WORDS BY 8 BITS) STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS



recommended operating conditions

	PARAMETER		MJW		J	W OR N	W	UNIT
	FARMIETER	MIN	NOM	MAX	MIN	NOM	MAX	UNIT
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	٧
VIH	High-level input voltage	2			2			V
VIL	Low-level input voltage			0.8			0.8	V
Vон	High-level output voltage			5.5			5.5	V
lOL	Low-level output current	-	- 4.	16	·		16	mA
TA	Operating free-air temperature range	-55		125	0		70	°C

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

PARAMETER	TEST CO	NDITIONS†	MJW	JW OR NW	
PANAIVIETEN	TEST CO	NUTTONS	MIN TYP [‡] MAX	MIN TYP# MAX	UNIT
V _{IK}	V _{CC} = MIN,	I _I = -18 mA	-1.2	-1.2	V
lou	V _{CC} = MIN,	V _{OH} = 2.4 V	0.05	0.05	
ЮН	ACC - MILLY	$V_{OH} = 5.5 V$	0.1	0.1	mA.
V _{OL}	V _{CC} = MIN,	I _{OL} = 16 mA	0.5	0.5	V
l _l	$V_{CC} = MAX,$	V _I = 5.5 V	1	1	mA
Iн	V _{CC} = MAX,	$V_{ } = 2.7 V$	25	25	μΑ
IIL	V _{CC} = MAX,	$V_{ } = 0.5 V$	-0.25	-0.25	mA
ICC	V _{CC} = MAX		100 135	100 135	mA

	PARAMETER	TEST	_ MJW	J				
	PANAIVIETEN	CONDITIONS	MIN TYP‡	MAX	MIN	TYP [‡]	MAX	UNIT
ta(A)	Access time from address	C _L = 30 pF	35	75		35	65	ns
ta(S)	Access time from chip select (enable time)	$R_{L1} = 300 \Omega$	20	45		20	35	ns
•	Propagation delay time low-to-high-level	$R_{L2} = 600 \Omega$	4.5	40				
^t PLH	output from chip select	See Note 3	15	40	-	15	35	ns

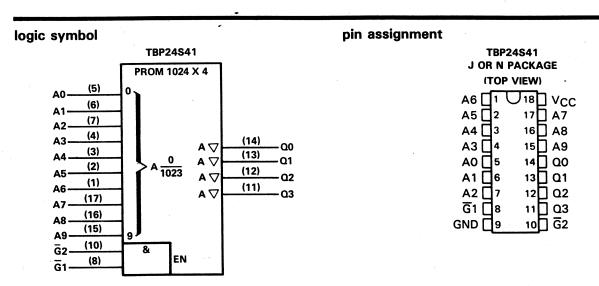
[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

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



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

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



recommended operating conditions

	DADAMETED		MJ			J OR N		
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	UNIT
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	٧
VIH	High-level input voltage	2	-		2			٧
VIL	Low-level input voltage			0.8			0.8	٧
ЮН	High-level output current			-2			-3.2	mA
lOL	Low-level output current			16			16	mA
TA	Operating free-air temperature range	- 55		125	0		70	°C

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

24244	TEOT 001	NDITIONS†		MJ			J OR N		UNIT
PARAMETER	IEST CO	NDITIONS'	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	V _{CC} = MIN,	l ₁ = -18 mA			-1.2			-1.2	٧
Voн	V _{CC} = MIN,	I _{OH} = MAX	2.4	3.1		2.4	3.1		٧
V _{OL}	V _{CC} = MIN,	I _{OL} = 16 mA			0.5			0.5	V
lozh	V _{CC} = MAX,	$V_0 = 2.4 V$			50			50	. μΑ
^I OZL	V _{CC} = MAX,	$V_0 = 0.5 V$			- 50			- 50	μΑ
l _l	$V_{CC} = MAX$,	V _I = 5.5 V			1			1	mA
liн	V _{CC} = MAX,	$V_1 = 2.7 V$			25			25	μΑ
IIL	$V_{CC} = MAX,$	V _I = 0.5 V			-0.25			-0.25	mA
los§	V _{CC} = MAX		-15		-100	-20		- 100	mA
Icc	V _{CC} = MAX			95	140		95	140	mA

	0.00.45750	TEST	TEST			J OR N			UNIT
PARAMETER		CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
t _{a(A)}	Access time from address	C _L = 30 pF		40	75		40	60	ns
ta(S)	Access time from chip select (enable time)	See Note 3	10	20	40		20	30	ns
tdis	Disable time	C _L = 5 pF See Note 3		20	40		20	30	ns

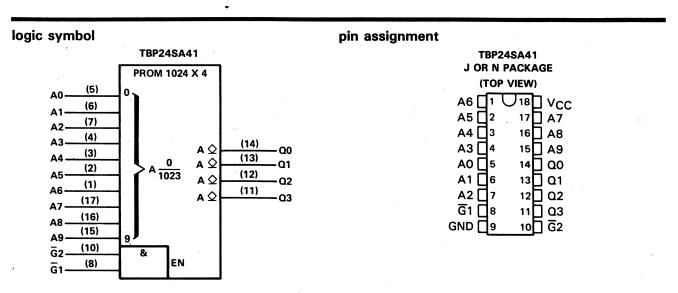
[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

[‡]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.

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



recommended operating conditions

	PARAMETER		MJ				J OR N			
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	UNIT		
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	V		
VIH	High-level input voltage	2			2			V		
VIL	Low-level input voltage			0.8		· · · · · · · · · · · · · · · · · · ·	0.8	V		
Voн	High-level output voltage			5.5			5.5	V		
lOL	Low-level output current			16			16	mA		
TA	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		
PANAMETEN				TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	$V_{CC} = MIN,$	I _I = -18 mA			-1.2			-1.2	V
ЮН	V _{CC} = MIN,	$V_{OH} = 2.4 V$			0.05			0.05	
юн	VCC - WIIIV,	V _{OH} = 5.5 V	0.1					0.1	mA
V _{OL}	$V_{CC} = MIN,$	I _{OL} = 16 mA			0.5			0.5	V
l _I	$V_{CC} = MAX$,	V _I = 5.5 V			1			1	mA
ИН	$V_{CC} = MAX$,	V _I = 2.7 V			25			25	μΑ
IJĹ	$V_{CC} = MAX$,	$V_{ } = 0.5 V$			-0.25	1 .		-0.25	mA
Icc	V _{CC} = MAX			95	140		95	140	mA

	PARAMETER TEST			MJ			J OR N		UNIT
	PANAMETEN	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNII
ta(A)	Access time from address	$C_L = 30 pF$		40	75		40	60	ns
ta(S)	Access time from chip select (enable time)	$R_{L1} = 300 \Omega$		20	40		20	30	ns
† D	Propagation delay time low-to-high-level	$R_{L2} = 600 \Omega$		20	40				
^t PLH	output from chip select	See Note 3		20	40	100	20	30	ns

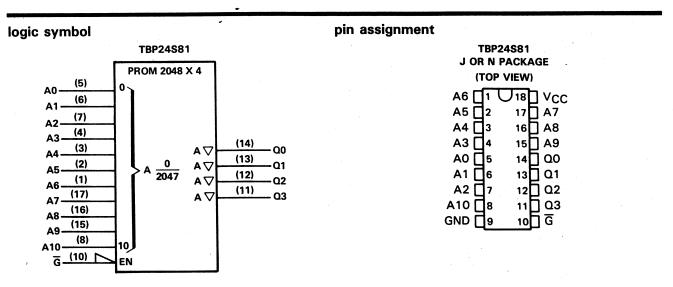
For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

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



 $^{^{\}ddagger}$ All typical values are at $V_{CC} = 5 \text{ V}$, $T_{A} = 25 ^{\circ}\text{C}$.

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



recommended operating conditions

	DADAMETED	MJ				J OR N		UNIT
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	UNIT
Vċc	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
VIH	High-level input voltage	2			2			٧
VIL	Low-level input voltage			0.8			0.8	V
IOH	High-level output current			-2			-3.2	mA
lOL	Low-level output current			16			16	mA
TA	Operating free-air temperature range	- 55		125	. 0		70	°C

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

	TEST CONDITIONS†			MJ			J OR N		UNIT
PARAMETER	IESI CO	י פאטוווטא	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	V _{CC} = MIN,	I _I = -18 mA			-1.2			-1.2	٧
V _{OH}	V _{CC} = MIN,	IOH = MAX	2.4	3.1		2.4	3.1		٧
VOL	V _{CC} = MIN,	I _{OL} = 16 mA			0.5			0.5	٧
lozh	V _{CC} = MAX,	$V_0 = 2.4 \text{ V}$			50			50	μА
lozL	V _{CC} = MAX,	$V_0 = 0.5 V$			- 50			- 50	μА
l ₁	V _{CC} = MAX,	V _I = 5.5 V			1			1	mA
11Н	V _{CC} = MAX,	V _I = 2.7 V			25			25	μΑ
I IIL	V _{CC} = MAX,	V _I = 0.5 V			-0.25			-0.25	mA
los§	V _{CC} = MAX		-15	-	- 100	-20		- 100	mA
Icc	V _{CC} = MAX			125	175		125	175	mA

switching characteristics over recommended ranges of TA and VCC (unless otherwise noted)

	DADAMETED	TEST	1 1 2	MJ			J OR N		UNIT
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
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
	Disable sime	C _L = 5 pF		20	50		20	40	ns
^t dis	Disable time	See Note 3		20	30		20	40	113

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

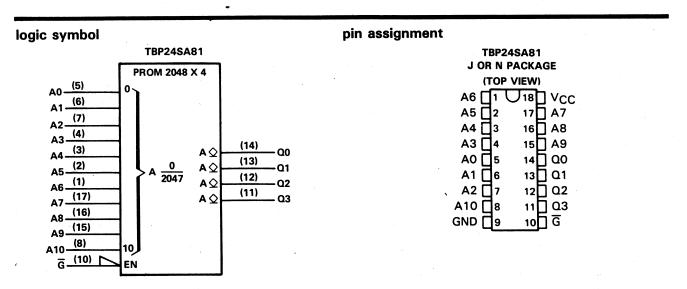
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



 $^{^{\}ddagger}$ All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25 ^{\circ}\text{C}$.

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

TBP24SA81 8192 BITS (2048 WORDS BY 4 BITS) STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS



recommended operating conditions

	DADAMETED	MJ				UNIT		
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	ONT
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	٧
VIH	High-level input voltage	2			2			V
VIL	Low-level input voltage			0.8			0.8	٧
Voн	High-level output voltage			5.5			5.5	٧
lOL	Low-level output current			16			16	mA
TA	Operating free-air temperature range	- 55		125	0		70	°C

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

242445752	TEST CONDITIONS†		MJ	MJ			UNIT
PARAMETER	IEST CON	MIN TYP‡	MAX	MIN T	/P [‡] MA	X	
VIK	V _{CC} = MIN,	I _I = -18 mA		-1.2		-1.	2 V
1	Voc - MIN	V _{OH} = 2.4 V		0.05		0.0	5 VmA
ЮН		V _{OH} = 5.5 V		0.1		0.	1 1
VoL	V _{CC} = MIN,	I _{OL} = 16 mA		0.5	100	0.	5 V
lı .	$V_{CC} = MAX$,	V _I = 5.5 V		1			1 mA
lін	V _{CC} = MAX,	V _I = 2.7 V		25		2	5 μΑ
Iμ	$V_{CC} = MAX$,	V _I = 0.5 V		-0.25		-0.2	5 mA
^I CC	V _{CC} = MAX		125	175		125 17	5 mA

	DADAMETED	TEST		MJ			J OR N		UNIT
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNII
ta(A)	Access time from address	C _L = 30 pF	2.	45	95		45	70	ns
ta(S)	Access time from chip select (enable time)	$R_{L1} = 300 \Omega$		20	50		20	40	ns
•	Propagation delay time low-to-high-level	$R_{L2} = 600 \Omega$		20	50		20	40	ns
tPLH	output from chip select	See Note 3		, 20	50		20	+0	115

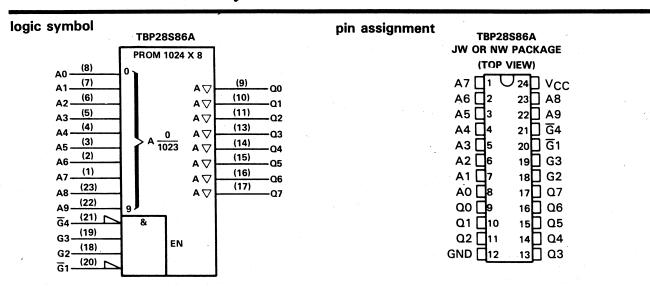
[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.

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



 $^{^{\}ddagger}$ All typical values are at V_{CC} = 5 V, T_A = 25 °C.

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



recommended operating conditions

-	PARAMETER		MJW			JW OR NW			
	PANAIVIETEN	MIN	NOM	MAX	MIN	NOM	MAX	UNIT	
V _{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	٧	
V _{IH}	High-level input voltage	2		10 to 10	2			V	
VIL	Low-level input voltage			0.8			0.8	V	
ЮН	High-level output current		-	-2			-3.2	mA	
lOL	Low-level output current	A		12			12	mA	
TA	Operating free-air temperature range	- 55		125	0		70	°C	

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

	TEOT 00	uniziono t		MJW		J	W OR N	W	Γ
PARAMETER	IEST CO	NDITIONS [†]	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	V _{CC} = MIN,	I _I = -18 mA			-1.2			-1.2	V
Voн	V _{CC} = MIN,	I _{OH} = MAX	2.4	3.1		2.4	3.1	-	V
VOL	V _{CC} = MIN,	I _{OL} = 12 mA			0.5			0.5	V
lozh	V _{CC} = MAX,	$V_0 = 2.4 \text{ V}$			50			50	μΑ
^I OZL	V _{CC} = MAX,	$V_0 = 0.5 V$			- 50			- 50	μΑ
lj .	$V_{CC} = MAX$,	V _I = 5.5 V			1			1	mA
liH -	$V_{CC} = MAX,$	$V_1 = 2.7 V$			25			25	μΑ
l _{IL}	$V_{CC} = MAX$,	V _I = 0.5 V			-0.25			-0.25	mA
los§	V _{CC} = MAX		- 15		- 100	-20		- 100	mA
^I CC	V _{CC} = MAX			110	170		110	165	mA

	TEST		MJW			J	W		
	PARAMETER	CONDITIONS	MIN	TYP‡	MAX	MIN	TYP [‡]	MAX	UNIT
taA)	Access time from address	C _L = 30 pF		35	80	100	35	65	ns
ta(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

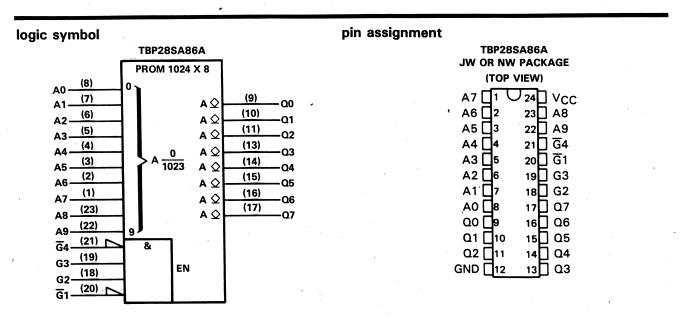
[†]For conditions shown as MIN or MAX, use appropriate value specified under recommended operating conditions.



 $^{^{\}ddagger}$ 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.

TBP28SA86A 8192 BITS (1024 WORDS BY 8 BITS) STANDARD PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS



recommended operating conditions

			MJW		J'	W OR N	W -	UNIT
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	ONT
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	٧
VIH	High-level input voltage	2			2			· V
VIL	Low-level input voltage			0.8			8.0	٧
Voн	High-level output voltage			5.5			5.5	V
lOL	Low-level output current			12			12	mA
TA	Operating free-air temperature range	-55		125	0		70	°C

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

		t		MJW		J	W OR N	IW	118117
PARAMETER	TEST CO	NDITIONS†	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	V _{CC} = MIN,	I _I = -18 mA			-1.2			-1.2	٧
	A AMA	V _{OH} = 2.4 V			0.05			0.05	mA
loн	$V_{CC} = MIN,$	V _{OH} = 5.5 V			0.1			0.1	111/
VOL	V _{CC} = MIN,	I _{OL} = 12 mA			0.5			0.5	٧
11	V _{CC} = MAX,	V _I = 5.5 V			1			1	mA
1 _{IH}	V _{CC} = MAX,	V _I = 2.7 V			25			25	μΑ
l _{IL}	V _{CC} = MAX,	V _I = 0.5 V			-0.25			-0.25	mA
Icc	V _{CC} = MAX			125	175		125	175	mA

		TEST	MJW			J	W	UNIT	
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
ta(A)	Access time from address	C _L = 30 pF		35	80	7	35	70	ns
ta(S)	Access time from chip select (enable time)	$R_{L1} = 300 \Omega$	1/2	20	50		20	40	ns
	Propagation delay time low-to-high-level	$R_{L2} = 600 \Omega$		15	40		15	35	ns
tPLH .	output from chip select	See Note 3		13	40				

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

 $^{^{\}ddagger}$ 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.

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

logic symbol			pin assignment		
	TBP28S2708A			TBP28S2708A	
	PROM 1024 X 8			NW PACKAGE (TOP VIEW)	
A0 (8) A1 (7) A2 (6) A3 (5)	A ▽ - A ▽ - A ▽ - A ▽ - A ▽ - A ▽ - A ▽ - A ▽ - A ▽ - A ▽ - A ▽ - A ▽ - A ▽ - A ▽ - A □ -	(9) — Q0 — (10) — Q1 — (11) — Q2 — (13) — —		A7 1 24 V _{CC} A6 2 23 A8 A5 3 22 A9 A4 4 21 NC A3 5 20 G	
A4 (4) A5 (2) A6 (1)	$ \begin{array}{c cccc} & A & & A & \\ \hline & 1023 & A & \\ \hline & A & \\ \hline & A & \\ \end{array} $	(15) Q3 (14) Q4 (15) Q5 (16) Q6 (17) Q6		A2 6 19 NC A1 7 18 NC A0 8 17 Q7 Q0 9 16 Q6	
A8 (23) A9 (22) G (20)	A▽ EN	Q7		Q1 10 15 Q5 Q2 11 14 Q4 GND 12 13 Q3	

recommended operating conditions

	annut to the second sec		NW		UNIT
	PARAMETER	MIN	NOM	MAX	UNIT
Vcc	Supply voltage	4.75	5	5.25	٧
VIH	High-level input voltage	2			٧
VIL	Low-level input voltage			0.8	V
ЮН	High-level output current			-3.2	mA
lOL	Low-level output current			12	mA
TA	Operating free-air temperature range	0		70	°C

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

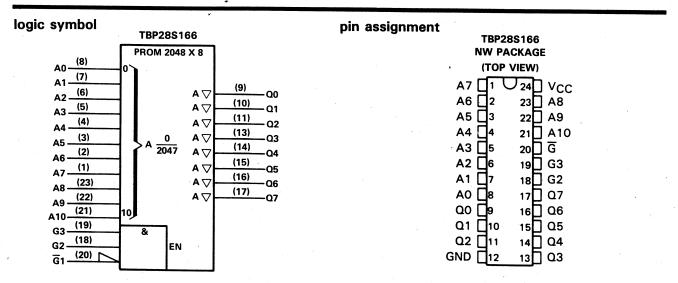
		ALDITIONA		NW		UNIT
PARAMETER	IESI CO	NDITIONS	MIN	TYP [†]	MAX	UNIT
VIK	$V_{CC} = 4.75,$	I _I = -18 mA			-1.2	V
Voн	$V_{CC} = 4.75,$	I _{OH} = -3.2 mA	2.4	3.1		V
VOL	$V_{CC} = 4.75,$	I _{OL} = 12 mA			0.5	V
lоzн	$V_{CC} = 5.25,$	V _O = 2.4 V		14. 4.	50	μΑ
lozL	$V_{CC} = 5.25,$	$V_0 = 0.5 V$			- 50	μΑ
1	$V_{CC} = 5.25,$	V _I = 5.5 V			1	mA
ΊΗ	$V_{CC} = 5.25,$	V _I = 2.7 V			25	μΑ
IIL	$V_{CC} = 5.25,$	V _I = 0.5 V			-0.25	mA
los [‡]	V _{CC} = 5.25		- 20		- 100	mA
lcc	$V_{CC} = 5.25$			110	165	mA

	DADAMETED	TEST		NW		1 18117
	PARAMETER	CONDITIONS	MIN	TYP [†]	MAX	UNIT
ta(A)	Access time from address	C _L = 30 pF		45	70	ns
ta(S)	Access time from chip select (enable time)	See Note 3		20	40	ns
	District Aires	C _L = 5 pF	1	20	40	ns
^t dis	Disable time	See Note 3		20	40	l lis

 $^{^{\}dagger}$ 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.

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



recommended operating conditions

	PARAMETER		NW		
		MIN	NOM	MAX	UNIT
VCC	Supply voltage	4.75	5	5.25	V
V_{IH}	High-level input voltage	2			V
VIL	Low-level input voltage			0.8	V
Іон	High-level output current			-3.2	mA
lOL	Low-level output current			16	mA
TA	Operating free-air temperature range	 0		70	°C

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

PARAMETER	TEST CO	NDITIONS			NW		l
1 To				MIN	TYP [†]	MAX	UNIT
VIK	$V_{CC} = 4.75,$	l _l = -18 mA				-1.2	V
Voн	$V_{CC} = 4.75,$	$I_{OH} = -3.2 \text{ mA}$		2.4	3.1		V
VOL	$V_{CC} = 4.75,$	I _{OL} = 16 mA			****	0.5	V
^I OZH	$V_{CC} = 5.25,$	$V_0 = 2.4 \text{ V}$				50	μΑ
^l OZL	$V_{CC} = 5.25,$	V _O = 0.5 V				- 50	μΑ
l _l	$V_{CC} = 5.25,$	V _I = 5.5 V				1	mA
lн	$V_{CC} = 5.25,$	V _I = 2.7 V				25	μΑ
կլ	$V_{CC} = 5.25,$	$V_1 = 0.5 V$	•			-0.25	mA
los [‡]	$V_{CC} = 5.25$			-20		- 100	mA
ICC	$V_{CC} = 5.25$				130	175	mA

	PARAMETER	TEST		NW		T
	T AND THE SECOND	CONDITIONS	MIN	TYP [†]	MAX	UNIT
ta(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

 $^{^{\}dagger}$ All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25 ^{\circ}\text{C}$.

^{*}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	
	TBP28L22		TBP28L22 J OR N PACKAGE
(4)	PROM 256 X 8		(TOP VIEW)
A0 (1) A1 (2) A2 (3) A3 (4) A4 (5) A5 (18) A6 (19) G2 (16) G1 (15)	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		A0

recommended operating conditions

			MJ			J OR N		UNIT
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	ONT
VCC	Supply voltage	4.5	5	5.5	4.75	5	5.25	٧
VIH	High-level input voltage	2			2			V
VIL	Low-level input voltage			0.8			0.8	V
ЮН	High-level output current			-2			-6.5	mA
lOL	Low-level output current		-	16			16	mA
TA	Operating free-air temperature range	-55		125	0		70	°C

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

				MJ		-	J OR N		UNIT
PARAMETER	TEST COI	NDITIONS [†]	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	ONIT
VIK	V _{CC} = MIN,	I _I = -18 mA			-1.2			-1.2	٧
VOH	V _{CC} = MIN,	. I _{OH} = MAX	2.4	3.1		2.4	3.1		٧
VOL	V _{CC} = MIN,	I _{OL} = 16 mA			0.5			0.5	٧
lozh	V _{CC} = MAX,	$V_0 = 2.4 \text{ V}$			50			50	μΑ
IOZL	V _{CC} = MAX,	$V_0 = 0.5 V$. – 50			- 50	μΑ
11	V _{CC} = MAX,	$V_1 = 5.5 \text{ V}$			1	1.5		1	mA
IIH	V _{CC} = MAX,	V ₁ = 2.7 V	-		25			25	μΑ
lil .	V _{CC} = MAX,	V ₁ = 0.5 V			-0.25			-0.25	mA
los§	V _{CC} = MAX		- 25		- 100	-30		- 100	mA
¹cc	• V _{CC} = MAX			75	100		75	100	mA

		TEST		MJ			J OR N		UNIT
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	ONII
taA)	Access time from address	C _L = 30 pF	٠.	45	75		45	70	ns
t _{a(S)}	Access time from chip select (enable time)	See Note 3	1	20	40		20	35	ns
	8: 11 4:	C _L = 5 pF		15	35		15	30	ns
^t dis	Disable time	See Note 3			33				

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

 $^{^{\}ddagger}$ 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.

TBP28LA22 2048 BITS (256 WORDS BY 8 BITS) LOW-POWER PROGRAMMABLE READ-ONLY MEMORIES WITH OPEN-COLLECTOR OUTPUTS

logic symbol		pin assignment	
	TBP28LA22	TBP28LA22	
	PROM 256 X 8	J OR N PACKAGE	
A0 (1)		(TOP VIEW)	
	A \(\(\begin{picture}(6) \\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	A0 [1 U20] V _{CC}	
A1 (3) A2 (4)	A △ (7) Q1	A1 ☐2 19 A7	
A3 (4)	A \Diamond (8) 02	A2 □3 18 A6	
(5)	$A = \begin{bmatrix} 0 & A & Q & (9) \\ \hline 255 & A & Q & (11) \end{bmatrix} \qquad Q3$	A3 ☐4 17☐ A5	
A4 (17)	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	A4 ☐5 16 ☐ <u>G</u> 2	
A5 (18)	A Q (12) Q5	QO ☐6 15∏ <u>G</u> 1	
(19)	A 🗘 (13) 06	Ω1 ☐7 14 ☐ Ω7	
A7 (16)	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Q2	
G2 (15)	α EN	Q3	
Ğ1 (15)		GND ☐10 11 ☐ Q4	

recommended operating conditions

	PARAMETER		MJ			J OR N		UNIT
	FANAMETEN	MIN	NOM	MAX	MIN	NOM	MAX	UNIT
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
VIH	High-level input voltage	2			2			V
VIL	Low-level input voltage			0.8			0.8	V
Voн	High-level output voltage			5.5			5.5	V
lOL	Low-level output current			16			16	mA
TA	Operating free-air temperature range	-55		125	0		70	°C

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

PARAMETER	TEST COL	NDITIONS†		MJ '		J	OR N		
PANAIVIE I EN	TEST COI	ADITIONS.	MIN	TYP [‡]	MAX	MIN 7	ГҮР‡	MAX	UNIT
VIK	V _{CC} = MIN,	l _l = -18 mA		100	-1.2			-1.2	V
Iон	V _{CC} = MIN,	V _{OH} = 2.4 V			0.05			0.05	
ЮН	VCC - MINA,	V _{OH} = 5.5 V			0.1			0.1	mA
V _{OL}	$V_{CC} = MIN,$	I _{OL} = 16 mA			0.5			0.5	V
l _l	$V_{CC} = MAX,$	V _I = 5.5 V			1			1	mA
ΊΗ	$V_{CC} = MAX,$	$V_{\parallel} = 2.7 \text{ V}$			25	· · · · · · ·		25	μΑ
l _{IL}	$V_{CC} = MAX,$	$V_{ } = 0.5 V$			-0.25			-0.25	mA
Icc	V _{CC} = MAX			75	100		75	100	mA

	PARAMETER	TEST	MJ			J OR N		
	/ AIAMETEN	CONDITIONS	MIN TYP‡	MAX	MIN	TYP [‡]	MAX	UNIT
t _{aA)}	Access time from address	C _L = 30 pF	40	80		45	75	ns
t _a (S)	Access time from chip select (enable time)	$R_{L1} = 300 \Omega$	20	40		20	35	ns
*====	Propagation delay time low-to-high-level	$R_{L2} = 600 \Omega$	15	05		4.5		
tPLH	output from chip select	See Note 3	15	35		15	30	ns

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

 $^{^{\}ddagger}$ 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		
	TBP28L42			TBP2	
(1)	PROM 512 X 8			J OR N P (TOP)	
A0 (1) A1 (2) A2 (3) A3 (4) A4 (5) (16) (17) A6 (17) (18)	$ \begin{vmatrix} 0 & & & & & & \\ A & & & & & \\ A & & & & & \\ A & & & & & \\ \hline A & & \\ \hline A$	(6) Q0 (7) Q1 (8) Q2 (9) Q3 (11) Q4 (12) Q5 (13) Q6 (14) Q7		A0 1 2 A1 2 A2 3 A3 4 A4 5 Q0 6 Q1 7	720 VCC 19 A8 18 A7 17 A6 16 A5 15 G
$\frac{A8}{G} \frac{(19)}{(15)}$	8 A ▽	Q7		Q2 8 Q3 9 GND 10	13 Q6 12 Q5 11 Q4

recommended operating conditions

	DADAMETED		MJ			J OR N		UNIT
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	UNIT
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	٧
VIH	High-level input voltage	2			2	T.		٧
٧ıL	Low-level input voltage			0.8			0.8	V
ЮН	High-level output current			-1			-1.6	mA
lOL	Low-level output current			8			8	mA
TA	Operating free-air temperature range	- 55		125.	0		70	°C

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

242445752	TF0T 00	NDITIONS†		MJ			J OR N		UNIT
PARAMETER	IEST CO	NDITIONS '	MIN	TYP [‡]	MAX	MIN	TYP‡	MAX	ONLI
VIK	V _{CC} = MIN,	I _I = -18 mA			-1.2			-1.2	٧
Voн	V _{CC} = MIN,	IOH = MAX	2.4	3.1		2.4	3.1		٧
V _{OL}	V _{CC} = MIN,	IOL = 8 mA			0.5			0.5	٧
^I OZH	V _{CC} = MAX,	V _O = 2.4 V			50			50	μΑ
^I OZL	$V_{CC} = MAX$	V _O = 0.5 V			- 50			- 50	μА
l _l	V _{CC} = MAX,	V _I = 5.5 V			1			1	mA
ΊΗ	V _{CC} = MAX,	$V_1 = 2.7 V$	Į		25			25	μΑ
l _{IL}	V _{CC} = MAX,	$V_1 = 0.5 V$			-0.25			-0.25	mA
los§	V _{CC} = MAX		-10		- 100	-10		- 100	mA
^I CC	V _{CC} = MAX			50	85		50	85	mA

	DADAMETED	TEST		MJ			J OR N		FINIT
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP‡	MAX	UNIT
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
	Disable sime	C _L = 5 pF		25	50		25	40	
^t dis	Disable time	See Note 3		25	50		25	40	ns

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

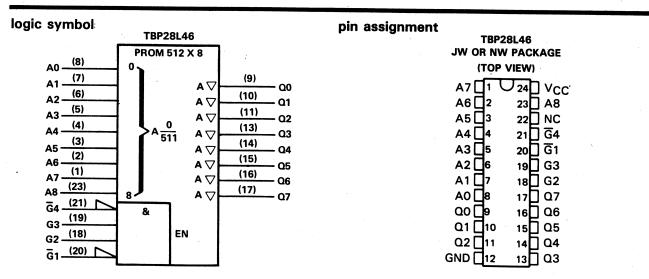
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



 $^{^{\}ddagger}$ All typical values are at $V_{CC} = 5 \text{ V}$, $T_{A} = 25 ^{\circ}\text{C}$.

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

TBP28L46 4096 BITS (512 WORDS BY 8 BITS) LOW-POWER PROGRAMMABLE READ-ONLY MEMORIES WITH 3-STATE OUTPUTS



recommended operating conditions

	PARAMETER			MJW			JW OR NW		
		MIN	NOM	MAX	MIN	NOM	MAX	UNIT	
VCC	Supply voltage	4.5	5	5.5	4.75	5	5.25	V	
VIH	High-level input voltage	2		100	2			V	
VIL	Low-level input voltage	1		0.8			0.8	V	
ŌH	High-level output current	1		-1			-1.6	mA	
ŌL	Low-level output current			8			8	mA	
TA	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		J	W	LINIT	
		1451110110	MIN	TYP‡	MAX	MIN	TYP [‡]	MAX	UNIT
V _{IK}	$V_{CC} = MIN,$	lj = -18 mA			-1.2			-1.2	V
Voн	V _{CC} = MIN,	IOH = MAX	2.4	3.1		2.4	3.1	•	V
V _{OL}	V _{CC} = MIN,	IOL = 8 mA			0.5			0.5	V
^I OZH	$V_{CC} = MAX$	V _O = 2.4 V			50			50	μА
lozL	V _{CC} = MAX,	V _O = 0.5 V			- 50			- 50	μΑ
lj .	$V_{CC} = MAX,$	V _I = 5.5 V			1			1	mA
liH	V _{CC} = MAX,	V _I = 2.7 V			25			25	μΑ
IIL	V _{CC} = MAX,	V _I = 0.5 V			-0.25			-0.25	mA
los [§]	V _{CC} = MAX		-10		-100	-10		- 100	mA
ICC	V _{CC} = MAX			50	85		50	85	mA

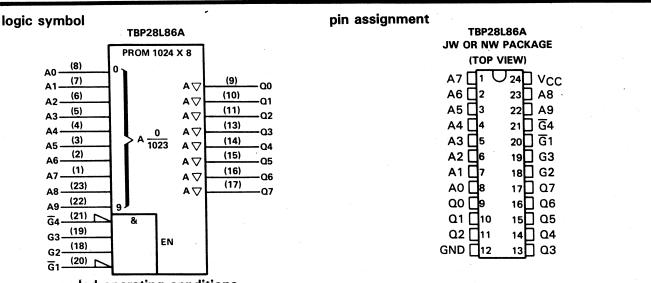
PARAMETER		TEST		MJW			JW OR NW		
		CONDITIONS	MIN	TYP‡	MAX	MIN	TYP [‡]	MAX	UNIT
ta(A)	Access time from address	C _L = 30 pF		55	110	(55	95	ns
ta(S)	Access time from chip select (enable time)	See Note 3		25	60	<u> </u>	25	60	ns
t _{dis}	Disable time	C _L = 5 pF							1.0
_ uis		See Note 3	i	25	50	14 - A	25	40	ns

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

 $^{^{\}ddagger}$ All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25 ^{\circ}\text{C}$.

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.

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



recommended operating conditions

	242445		MJW			JW OR NW			
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	UNIT	
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	٧	
VIH	High-level input voltage	2			2			٧	
VIL	Low-level input voltage			0.8			0.8	٧	
IOH	High-level output current			- 1			- 1.6	mA	
lOL	Low-level output current			8			8	mA	
TA	Operating free-air temperature range	- 55		125	0		70	°C	

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

	TTOT COMPLETIONS T			MJW		J	W OR N	W	UNIT
PARAMETER	TEST CONDITIONS†			TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	V _{CC} = MIN,	I _I = -18 mA			-1.2			- 1.2	٧
Voн	V _{CC} = MIN,	I _{OH} = MAX	2.4	3.1		2.4	3.1		V
VOL	V _{CC} = MIN,	I _{OL} = 8 mA			0.5			0.5	٧
lozh	V _{CC} = MAX,	V _O = 2.4 V			50			50	μΑ
lozL	V _{CC} = MAX,	V _O = 0.5 V			- 50			- 50	μΑ
l _l	V _{CC} = MAX,	V _I = 5.5 V			1			1	mA
ЧН	V _{CC} = MAX,	V _I = 2.7 V	./ " "s		25			25	μΑ
IIL	$V_{CC} = MAX$,	V _I = 0.5 V			-0.25			-0.25	mA
los§	V _{CC} = MAX		-10		-100	-10		- 100	mA
lcc	V _{CC} = MAX			55	95		55	80	mA

24244577		TEST	MJW			J	W	UNIT	
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
t _{a(A)}	Access time from address	C _L = 30 pF		65	200		65	110	ns
t _a (S)	Access time from chip select (enable time)	See Note 3		40	125		40	80	ns
tdis	Disable time	C _L = 5 pF		25	100		25	60	ns
ais	Disable time	See Note 3	1			1			

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

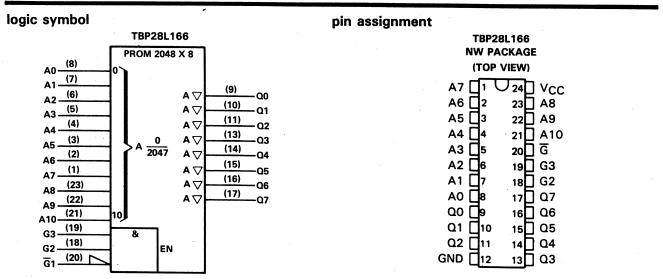
NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



[‡]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.

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



recommended operating conditions

	PARAMETER		NW		
	Principle 1611	MIN	NOM	MAX	UNIT
Vcc	Supply voltage	4.75	5	5.25	V
V_{IH}	High-level input voltage	2			. v
٧ _{IL}	Low-level input voltage			0.8	V
ЮН	High-level output current			-1.6	mA
lOL	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 CO	TEST CONDITIONS				UNIT
						UNII
VIK	$V_{CC} = 4.75,$	I _I = -18 mA			-1.2	V
Voн	$V_{CC} = 4.75,$	$I_{OH} = -1.6 \text{ mA}$	2.4	3.1		V
VOL	$V_{CC} = 4.75,$	I _{OL} = 8 mA			0.5	V
lozh	$V_{CC} = 5.25,$	$V_0 = 2.4 \text{ V}$			50	μΑ
lozL	$V_{CC} = 5.25,$	$V_0 = 0.5 V$			- 50	μΑ
11	$V_{CC} = 5.25,$	V _I = 5.5 V			1	mA
IH	$V_{CC} = 5.25,$	V _I = 2.7 V			25	μА
l _I L	$V_{CC} = 5.25,$	V _I = 0.5 V			-0.25	mA
los [‡]	$V_{CC} = 5.25$		- 10		-100	mA
^I CC	V _{CC} = 5.25			75	110	mA

	PARAMETER	TEST		ŇW		
		CONDITIONS	MIN	TYP	MAX	UNIT
ta(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				
-uis	Diodolo timo	See Note 3	1	30	65	ns

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

[‡]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.

SERIES 24 AND 28 PROGRAMMABLE READ-ONLY MEMORIES

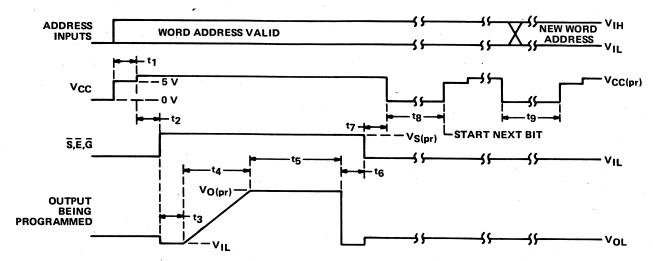
recommended operating conditions for programming (see Figure 1)

		MIN	NOM	MAX	UNIT
Steady-state supply voltage	Vcc	4.75	5	5.25	٧
	ViH	3	4	5	V
Input voltage	VIL	0	0	0.5	V
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 t5	VO(pr)	15.75	16	16.25	V
	Low	4.4	4.5	4.6	v
Supply voltage during verification (see step 14)	High	5.4	5.5	5.6	7 "
Time from VCC 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	t3	0.1	5	10	μs
Ramp time, output program pulse	t4	10	15	20	μs
Duration of output program pulse	t5	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	t7	0.1	5	5	μs
Time for cooling between bits	t ₈	30	50	100	μs
Time for cooling between words	tg	30	50		μs
Free-air temperature	TA	20	25	30	°C

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

- 1. Address the word to be programmed, apply 5 volts to VCC and active levels to all chip select (S and S) or chip enable (E and E) inputs.
- 2. Verify the status of a bit location by checking the output level.
- 3. Decreass VCC to 0 volts.
- 4. For bit locations that do not require programming, skip steps 5 through 11.
- 5. Increase VCC to VCC(pr) with a minimum current capability of 250 milliamperes.
- 6. Apply $V_{S(pr)}$ to all the \overline{S} , \overline{E} or \overline{G} inputs. $I_l \leq 25$ milliamperes. Active-high enables may be left high.
- 7. Connect all outputs, except the one to be programmed, to VIL. 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 VIL conditions.
- 10. Reduce the voltage at S, E, or G inputs to VII.
- 11. Decrease VCC 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 VCC values of 4.5 and 5.5 volts.

SERIES 24 AND 28 PROGRAMMABLE READ-ONLY MEMORIES



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

FIGURE 1. TIMING DIAGRAM AND VOLTAGE WAVEFORMS FOR PROGRAMMING SEQUENCE



PACKAGE OPTION ADDENDUM

28-Feb-2005

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins I	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 JEDECindustry standard classifications, and peak solder temperature.

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