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 milwide 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	OUTPUT	BIT OUT	TYP	ICAL PERF	ORMANCE
TYPE NUMBER	TEMPERATURE RANGE	CONFIGURATION [‡]	BIT SIZE	ACCESS	S TIMES	POWER
	DESIGNATORS	Contraction	(UNGANIZATION)	ADDRESS	SELECT	DISSIPATION
TBP24S10	MJ, J, N		1024 Bits			
TBP24SA10	MJ, J, N	Q	$(256W \times 4B)$	35 ns	20 ns	375 mW
TBP28S42	MJ, J, N	∇				
TBP28SA42	MJ, J, N	Ŷ	4096 Bits			
TBP28S46	MJW, JW, NW	$\overline{\nabla}$	(512W × 8B)	35 ns	20 ns	500 mW
TBP28SA46	MJW, JW, NW	Ŷ				
TBP24S41	MJ, J, N	∇	4096 Bits			
TBP24SA41	MJ, J, N	\Diamond	$(1024 \times 4B)$	40 ns	20 ns	475 mW
TBP24S81	MJ, J, N	∇	8192 Bits	····		
TBP24SA81	MJ, J, N	\mathbf{Q}	$(2048 \times 4B)$	45 ns	20 ns	625 mW
TBP28S86A	MJW, JW, NW	$\overline{\nabla}$				
TBP28SA86A	MJW, JW, NW	Q	8192 Bits	45 ns	20 ns	605
TBP28S2708A	NW		(1024 × 8B)		20 115	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-temperaturerange circuits (formerly 74 Family).

[‡] ∇ = three state, Δ = open collector.



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	0.170117		TYPICAL PERFORMANCE				
TYPE NUMBER	TEMPERATURE RANGE	OUTPUT	BIT SIZE	ACCESS	POWER			
	DESIGNATORS	CONFIGURATION [‡]	(ORGANIZATION)	ADDRESS	SELECT	DISSIPATION		
TBP28L22	MJ, J,N		2048 Bits	45 ns	20 ns	375 mW		
TBP28LA22	MJ, J, N	Q	(256W × 8B)	45 115	20 115	373 111		
TBP28L42	MJ, J, N		4096 Bits	60 ns	30 ns	250 mW		
TBP28L46	MJW, JW, NW		$(512W \times 8B)$	00 115	30 113	200 11100		
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-temperaturerange circuits (formerly 74 Family).

[‡] ∇ = three state, Δ = open collector.

schematics of inputs and outputs



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

Supply voltage (see Note 1)	
	5.5 V
Chip-select peak input voltage (S, S1,	S2) (see Note 2) 11 V
• • • • •	5.5 V
Off-state peak output voltage (see No	nte 2)
	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.



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



recommended operating conditions

	PARAMETER		MJ			UNIT		
		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			N.
VIL	Low-level input voltage			0.8			0.8	V
юн	High-level output current			-2			-6.5	mA
IOL	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			MJ			J OR N		1 10.117
FANAIMETEN	TEST CO	NDITIONS .	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	$V_{CC} = MIN,$	$i_{\rm I} = -18 \rm mA$			-1.2			-1.2	V
VOH	$V_{CC} = MIN,$	IOH = MAX	2.4	3.1		2.4	3.1		V
VOL	$V_{CC} = MIN,$	I _{OL} = 16 mA			0.5			0.5	V
lozh	$V_{CC} = MAX,$	$V_0 = 2.4 V$			50			50	μA
IOZL	$V_{CC} = MAX,$	$V_0 = 0.5 V$			- 50			- 50	μA
li i	$V_{CC} = MAX,$	V _I = 5.5 V			1			1	mA
ЧН	$V_{CC} = MAX,$	$V_{1} = 2.7 V$			25			25	μA
կլ .	$V_{CC} = MAX,$	$V_{ } = 0.5 V$			-0.25			-0.25	mA
los [§]	$V_{CC} = MAX$		- 30		-100	- 30		- 100	mA
lcc	$V_{CC} = MAX$			75	100		75	100	mA

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

	PARAMETER	TEST	MJ			J OR N		
	FANAMETEN	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	CL = 5 pF	15	. 40		15		
tdis		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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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	V	
VIH	High-level input voltage	2			2			V	
VIL	Low-level input voltage			0.8			0.8	V	
∨он	High-level output voltage		•	5.5			5.5	V	
IOL	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)

	TEAT AA	IDITIONS [†]	MJ	J OR N	UNIT
PARAMETER	TEST COM		MIN TYP [‡] MAX	MIN TYP [‡] MAX	UNIT
VIK	$V_{CC} = MIN,$	lį = −18 mA	-1.2	- 1.2	V
le	$V_{CC} = MIN,$	V _{OH} = 2.4 V	0.05	0.05	mA
юн	$v_{CC} = winv,$	V _{OH} = 5.5 V		0.1	
VOL	$V_{CC} = MIN,$	I _{OL} = 16 mA	0.5	0.45	V
lj	$V_{CC} = MAX,$	VI = 5.5 V	1	1	mA
ЧН	$V_{CC} = MAX,$	$V_{1} = 2.7 V$	25	25	μA
μL	$V_{CC} = MAX,$	VI = 0.5 V	-0.25	-0.25	mA
ICC	$V_{CC} = MAX$		75 100	75 100	mA

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

	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
t _{a(S)}	Access time from chip select (enable time)	$R_{L1} = 300 \Omega$		20	40		20	35	ns
tPLH	Propagation delay time low-to-high-level output from chip select	R _{L2} = 600 Ω See Note 3		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



recommended operating conditions

	PARAMETER		MJ			UNIT		
	FANAIVIETEN	MIN	NOM	MAX	MIN	NOM	MAX	
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
юн	High-level output current			-2			-6.5	mA
ΙΟL	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			MJ			J OR N	l	UNIT
FANAMEICN	TEST COL			TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	$V_{CC} = MIN,$	lı = −18 mA			- 1.2			- 1.2	V
V _{OH}	$V_{CC} = MIN,$	I _{OH} = MAX	2.4	3.1		2.4	3.1		V
VOL	$V_{CC} = MIN,$	$I_{OL} = 16 \text{ mA}$			0.5			0.5	V
^I OZH	$V_{CC} = MAX,$	$V_0 = 2.4 V$			50			50	μA
lozl	$V_{CC} = MAX,$	$V_0 = 0.5 V$			- 50	· ·	· .	- 50	μA
lj	$V_{CC} = MAX,$	$V_{I} = 5.5 V$			1		. •	1	mA
Чн	$V_{CC} = MAX,$	V _I = 2.7 V			25			25	μA
۱ _{IL}	$V_{CC} = MAX,$	$V_{I} = 0.5 V$			-0.25			-0.25	mA
los	$V_{CC} = MAX$		- 30		- 100	- 30		- 100	mA
lcc	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			
		CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT	
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	CL = 5 pF		15	45		15	40		
dis		See Note 3		15	40		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.



PROMs

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



recommended operating conditions

	PARAMETER		MJ					
		MIN		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
VOH	High-level output voltage			5.5			5.5	V
IOL	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	TERT CO	NDITIONS	MJ	J OR N	
	TEST CO		MIN TYP [‡] MAX	MIN TYP [‡] MAX	UNIT
VIK	$V_{CC} = MIN,$	$I_{\rm I} = -18 {\rm mA}$	-1.2	-1.2	V
юн	$V_{CC} = MIN,$	V _{OH} = 2.4 V	0.05	0.05	
'UH		V _{OH} = 5.5 V	0.1	0.1	mA
V _{OL}	$V_{CC} = MIN,$	I _{OL} = 16 mA	0.5	0.5	V
1	$V_{CC} = MAX,$	V _I = 5.5 V	1	1	mA
ін	$V_{CC} = MAX,$	V _I = 2.7 V	25	25	μA
ΪL	$V_{CC} = MAX,$	$V_{I} = 0.5 V$	-0.25	-0.25	mA
lcc	$V_{CC} = MAX$		105 135	105 135	mA

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

	PARAMETER	TEST		MJ		J OR N		
	FANAMETEN	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
^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 $V_{CC} = 5 \text{ V}$, $T_A = 25 \text{ °C}$.

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



recommended operating conditions

-	DADAMETED		MJW		J	W OR N	W	UNIT
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	
Vcc	Supply voltage	4.5	5	5.5	4.75	5	5.25	· v
VIH	High-level input voltage	2			2		la de la composición de la com	V
VIL	Low-level input voltage			0.8			0.8	
юн	High-level output current			-2		1	-6.5	mA
IOL	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)

	7507.00			MJW		J	W OR N	IW .	UNIT
PARAMETER	IEST CO	NDITIONS [†]	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	$V_{CC} = MIN,$	lj = −18 mA		· .	-1.2			- 1.2	V
VOH	$V_{CC} = MIN,$	IOH = MAX	2.4	3.1		2.4	3.1		٠V
VOL	$V_{CC} = MIN,$	$I_{OL} = 16 \text{ mA}$			0.5		*	0.5	V
ЮΖН	$V_{CC} = MAX,$	$V_0 = 2.4 V$			50			50	μA
^I OZL	$V_{CC} = MAX,$	$V_0 = 0.5 V$		÷	- 50			- 50	μA
1	$V_{CC} = MAX,$	$V_{ } = 5.5 V$			1			1	mA
Чн	$V_{CC} = MAX,$	V _I = 2.7 V			25			25	μA
ΙL	$V_{CC} = MAX,$	$V_{ } = 0.5 V$			-0.25			-0.25	mA
IOS	V _{CC} = MAX		- 15		- 100	- 20		- 100	mA
ICC	V _{CC} = MAX			100	135		100	135	mA

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

		TEST	TEST M			JW OR NW			UNIT
	PARAMETER	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	35	ns
	Disable time	C _L = 5 pF	1	15	40		15	35	ns
^t dis		See Note 3		15	40		15		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.

[§]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

logic symbol			pin assignment		
	TBP28SA46			TBP28SA46	
	PROM 512 X 8			JW OR NW PACKA	GE
A0	0			(TOP VIEW)	
A1 <u>(7)</u>	AΩ	(9) Q0			/cc
A2(6)		(10)		A6 🖸 2 23 🗋 A	48
A3 (5)	A Q -	(11) 01		A5 3 22 N	1C
(4)		(13) 02		A4 4 21 0	54
A4 (3)	A 511 A 2	(14) 03			51
A5 (2)	AQ-	(14) (15) Q4			33
A6	A 🗘 –	(16) 05			32
A/ (22)	A Q -	Q6			27
A8	8 AQ-	(17) 07		3 2	
<u>G4 (21)</u>	&		•	Q0 []9 16 [] C	26
G3 (19)	α			Q1 0 15 0	25
G2 (18)	EN				24
$\overline{G2}$					23

recommended operating conditions

	PARAMETER		MJW		J	W	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	÷ 1,		V
VIL	Low-level input voltage		-	0.8			0.8	V
Vон	High-level output voltage			5.5			5.5	V
IOL	Low-level output current	-	1.5	16	1		16	mA
Т _А	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		MJW	JW OR NW	UNIT
FANAMETEN			MIN TYP [‡] MAX	MIN TYP [‡] MAX	UNIT
VIK	$V_{CC} = MIN,$	l₁ = −18 mA	-1.2	-1.2	V
юн	$V_{CC} = MIN,$	V _{OH} = 2.4 V	0.05	0.05	mA
ЧUН	ACC - MINA	V _{OH} = 5.5 V	0.1	0.1	mA
V _{OL}	$V_{CC} = MIN,$	l _{OL} = 16 mA	0.5	0.5	V
I I	$V_{CC} = MAX,$	$V_{1} = 5.5 V$	1	1	mA
ΙΗ	$V_{CC} = MAX,$	$V_{I} = 2.7 V$	25	25	μA
IIL CONTRACT	$V_{CC} = MAX,$	$V_{ } = 0.5 V$	-0.25	-0.25	mA
lcc	$V_{CC} = MAX$		100 135	100 135	mA

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

	PARAMETER	TEST	~	MJW		J	JW OR NW		
	FARAIVIETER	CONDITIONS	MIN	MIN TYP [‡]		MIN TYP [‡]		MAX	UNIT
t _{a(A)}	Access time from address	C _L = 30 pF		35	75	and the substance	35	65	ns
t _a (S)	Access time from chip select (enable time)	$R_{L1} = 300 \Omega$		20	45		20	35	ns
^t PLH	Propagation delay time low-to-high-level output from chip select	$R_{L2} = 600 \Omega$ 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.



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 MA	MAX	
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
юн	High-level output current			-2			- 3.2	mA
IOL	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)

		upiziono t		MJ			J OR N		UNIT
PARAMETER	IEST CO	NDITIONS [†]	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	
VIK	$V_{CC} = MIN,$	lj = -18 mA			-1.2			- 1.2	V
VOH	$V_{CC} = MIN,$	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
IOZH	$V_{CC} = MAX,$	V ₀ = 2.4 V			50			50	. μΑ
IOZL	$V_{CC} = MAX,$	$V_0 = 0.5 V$			- 50			- 50	μA
. II	$V_{CC} = MAX,$	$V_{1} = 5.5 V$			1		1.1	1	mA
Чн	$V_{CC} = MAX,$	$V_{1} = 2.7 V$			25			25	μA
IIL III	$V_{CC} = MAX,$	VI = 0.5 V			-0.25			-0.25	mA
los§	$V_{CC} = MAX$		- 15		- 100	- 20	1997 - 1	- 100	mA
lcc	$V_{CC} = MAX$			95	140		95	140	mA

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

		TEST	MJ MJ			J OR N			UNIT
PARAMETER		CONDITIONS	MIN TYP [‡]		MAX	MIN	TYP [‡]	MAX	
t _a (A)	Access time from address	$C_L = 30 pF$	1	40	75		40	60	ns
ta(S)	Access time from chip select (enable time)	See Note 3		20	40		20	30	ns
	Disable time	$C_L = 5 pF$		20	40		20	30	ns
tdis	Disable time	See Note 3		20			20	00	

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



recommended operating conditions

	PARAMETER	MJ						
	FARAINE I ER	MIN		MAX	MIN	NOM	MAX	
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
VOH	High-level output voltage			5.5			5.5	V
IOL	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	TEST CONDITIONS [†]			J OI		
TANAMETEN	TEST CO		MIN TYP [‡]	MAX	MIN TY	P [‡] MAX	UNIT
VIK	$V_{CC} = MIN,$	lj = −18 mA		-1.2		- 1.2	V
lou	$V_{CC} = MIN,$	V _{OH} = 2.4 V		0.05		0.05	
ЮН		V _{OH} = 5.5 V		0.1		0.1	mA
V _{OL}	$V_{CC} = MIN,$	l _{OL} = 16 mA		0.5		0.5	V
4	$V_{CC} = MAX,$	$V_{ } = 5.5 V_{ }$		1		1	mA
Чн	$V_{CC} = MAX,$	V _I = 2.7 V		25		25	μA
μ	$V_{CC} = MAX,$	$V_{ } = 0.5 V$		-0.25		-0.25	mA
lcc	$V_{CC} = MAX$	· · ·	95	140		95 140	mA

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

	PARAMETER	TEST		MJ			J OR N		UNIT
	FANAMEIEN	CONDITIONS	MIN TYP [‡]		MAX	MIN TYP [‡]		MAX	UNIT
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)	$R_{L1} = 300 \Omega$		20	40		20	30	ns
tPLH	Propagation delay time low-to-high-level	$R_{L2} = 600 \Omega$		20	40		20	30	ns
	output from chip select	See Note 3							

[†]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.



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



recommended operating conditions

	DADAMETER		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			V
VIL	Low-level input voltage			0.8			0.8	V
юн	High-level output current			-2			-3.2	mA
IOL	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 COL			MJ			J OR N		UNIT
PARAMETER	IEST COI		MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	$V_{CC} = MIN,$	lj = −18 mA			-1.2			-1.2	V
VOH	$V_{CC} = MIN,$	I _{OH} = MAX	2.4	3.1		2.4	3.1	a de la composition de	V
VOL	$V_{CC} = MIN,$	I _{OL} = 16 mA			0.5			0.5	V
IOZH	$V_{CC} = MAX,$	$V_0 = 2.4 V$			50	•		50	μA
IOZL	$V_{CC} = MAX,$	$V_0 = 0.5 V$			- 50			- 50	μA
lj .	$V_{CC} = MAX,$	$V_{I} = 5.5 V$			1			1	mA
IIH	$V_{CC} = MAX,$	VI = 2.7 V	and a second		25			25	μA
Ι	$V_{CC} = MAX,$	$V_{I} = 0.5 V$			-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)

		TEST MJ			J OR N	l	UNIT
PARAMETER		CONDITIONS	MIN TYP	* MAX	MIN TYP [‡]	MAX	UNIT
t _a (A)	Access time from address	$C_L = 30 \text{ pF}$	4	5 85	45	70	ns
ta(S)	Access time from chip select (enable time)	See Note 3	2	0 50	20	40	ns
		CL = 5 pF	2	0 50	20	40	ns
tdis	Disable time	See Note 3	Z	0 50	20	40	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.

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.



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



recommended operating conditions

	PARAMETER		MJ			· · · · ·		
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	
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
∨он	High-level output voltage			5.5			5.5	V
IOL	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	IEST CO	MIN TYP [‡]	MAX	MIN	гүр‡	MAX	UNIT	
VIK	$V_{CC} = MIN,$	lj = −18 mA	-	-1.2			-1.2	V
	Vee - MIN	V _{OH} = 2.4 V		0.05			0.05	VmA
ЮН	$V_{CC} = MIN,$	V _{OH} = 5.5 V		0.1			0.1	VIIA
VOL	$V_{CC} = MIN,$	$I_{OL} = 16 \text{ mA}$		0.5			0.5	V
1	$V_{CC} = MAX,$	VI = 5.5 V		1			1	mA
Чн	$V_{CC} = MAX,$	$V_{ } = 2.7 V$		25			25	μA
ΙL	$V_{CC} = MAX,$	$V_{ } = 0.5 V$	-	0.25			-0.25	mA
ICC I	V _{CC} = MAX		125	175		125	175	mA

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

		TEST	MJ			J OR N			
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
t _{a(A)}	Access time from address	$C_L = 30 pF$	- 2 · .	45	95		45	70	ns
t _a (S)	Access time from chip select (enable time)	$R_{L1} = 300 \Omega$		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.



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



recommended operating conditions

	PARAMETER		MJW		J	W OR N	W	
	FARAIVIETER	MIN	NOM	MAX	MIN	NOM	MAX	
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
юн	High-level output current		-	-2	1		- 3.2	mA
OL	Low-level output current	an 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)

PARAMETER	TEST CO			MJW		J	W OR N	W	UNIT
PARAIVIETER	IESI CU		MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	
VIK	$V_{CC} = MIN,$	$I_{\rm I} = -18 {\rm mA}$			-1.2			-1.2	V
VOH	$V_{CC} = MIN,$	I _{OH} = MAX	2.4	3.1		2.4	3.1	-	V
VOL	$V_{CC} = MIN,$	$I_{OL} = 12 \text{ mA}$			0.5			0.5	V
IOZH	$V_{CC} = MAX,$	$V_0 = 2.4 V$			50		19 A.	50	μA
IOZL	$V_{CC} = MAX,$	$V_0 = 0.5 V$			- 50			- 50	μA
4	V _{CC} = MAX,	$V_{I} = 5.5 V$			1			1	mA
Чн	$V_{CC} = MAX,$	V _I = 2.7 V			25			25	μA
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

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

ſ		TEST	MJW			J	UNIT		
	PARAMETER	CONDITIONS	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
	Rischle sime	$C_L = 5 pF$		15	40		15	35	ns
^t dis	Disable time	See Note 3		15	40		15	35	115

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

[‡]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.



TBP28SA86A 8192 BITS (1024 WORDS BY 8 BITS) Standard Programmable Read-Only Memories with Open-Collector Outputs



recommended operating conditions

na da no con u n	PARAMETER	MJW			J.	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			
VIL	Low-level input voltage	$1 \leq 1 \leq 2^{n}$	1997 - S. 1 1997 - S. 1997 - S. 19 1997 - S. 1997 - S. 19	0.8			0.8	V
VOH	High-level output voltage			5.5			5.5	V
IOL	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)

		upuruono t		MJW		J	W OR N	W	UNIT
PARAMETER	TEST CO		MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	$V_{CC} = MIN,$	lj = −18 mA			-1.2			-1.2	V
	Mara Maini	V _{OH} = 2.4 V			0.05	е. 19		0.05	mA
ЮН	$V_{CC} = MIN,$	V _{OH} = 5.5 V			0.1			0.1	
VOL	$V_{CC} = MIN,$	$I_{OL} = 12 \text{ mA}$			0.5			0.5	V
1	$V_{CC} = MAX,$	$V_{ } = 5.5 V$			1			1	mA
lіН	$V_{CC} = MAX,$	$V_{ } = 2.7 V_{ }$			25			25	μA
١ _{IL}	$V_{CC} = MAX,$	$V_{I} = 0.5 V$			-,0.25			-0.25	mA
ICC	$V_{CC} = MAX$			125	175		125	175	mA

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

		TEST	2 · · · ·	MJW		J	W OR N	w	LINUT
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
t _{a(A)}	Access time from address	C _L = 30 pF		35	80	No. A. Ali	35	70	ns
ta(S)	Access time from chip select (enable time)	$R_{L1} = 300 \Omega$	1.14	20	50		20	40	ns
	Propagation delay time low-to-high-level	$R_{L2} = 600 \ \Omega$		15	40		15	35	ns
^t PLH	output from chip select	See Note 3	1	10	40		10	00	115

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

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

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



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



recommended operating conditions

and the second second	DADAMETED		NW		UNIT
	PARAMETER	MIN	NOM	MAX	UNIT
Vcc	Supply voltage	4.75	5	5.25	V
VIH	High-level input voltage	2			V
VIL	Low-level input voltage			0.8	V
юн	High-level output current			-3.2	mA
IOL	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)

			NW		UNIT
PARAMETER	TEST CONDITIONS	MIN	TYP [†]	MAX	
VIK	$V_{CC} = 4.75, \qquad I_{I} = -18 \text{ mA}$			- 1.2	V
VOH	$V_{CC} = 4.75$, $I_{OH} = -3.2 \text{ mA}$	2.4	3.1		V
VOL	$V_{CC} = 4.75,$ $I_{OL} = 12 \text{ mA}$			0.5	V
IOZH	$V_{CC} = 5.25, \qquad V_{O} = 2.4 V$		1940 - 1940 - 1940 - 1940 - 1940 - 1940 - 1940 - 1940 - 1940 - 1940 - 1940 - 1940 - 1940 - 1940 - 1940 - 1940 -	50	μA
^I OZL	$V_{CC} = 5.25, \qquad V_{O} = 0.5 V$			- 50	μA
1	$V_{CC} = 5.25, V_{I} = 5.5 V$			1	mA
ін	$V_{CC} = 5.25, \qquad V_{I} = 2.7 V$			25	μA
ΙL	$V_{CC} = 5.25, V_{I} = 0.5 V$			-0.25	mA
los‡	$V_{CC} = 5.25$	- 20		- 100	mA
ICC	$V_{CC} = 5.25$		110	165	mA

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

		TEST		NW		UNIT
	PARAMETER	CONDITIONS	MIN	TYP [†]	MAX	UNIT
t _{a(A)}	Access time from address	$C_L = 30 \text{ pF}$		45	70	ns
ta(S)	Access time from chip select (enable time)	See Note 3		20	40	ns
tdis	Disable time	$C_L = 5 pF$	1.1	20	40	ns
SID		See Note 3				

[†]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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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
VIH	High-level input voltage	2			v
VIL	Low-level input voltage			0.8	l v
юн	High-level output current			-3.2	mA
IOL ·	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	1. A. A.	
			• • • • • • • • • • • •	MIN	TYP [†]	MAX	UNIT
VIK	. V _{CC} = 4.75,	l₁ = −18 mA				-1.2	V
VOH	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	
lozh	V _{CC} = 5.25,	V ₀ = 2.4 V				50	μA
IOZL	V _{CC} = 5.25,	$V_0 = 0.5 V$				- 50	μΑ
4	V _{CC} = 5.25,	$V_{1} = 5.5 V$				1	mA
Чн	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	$V_{CC} = 5.25$				130	175	mA

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

	PARAMETER	TEST		NW		·
		CONDITIONS	MIN	TYP [†]	MAX	UNIT
^t a(A)	Access time from address	$C_L = 30 \text{ pF}$		35	75	ns
ta(S)	Access time from chip select (enable time)	See Note 3		15	40	ns
^t dis	Disable time	$C_L = 5 pF$		15	40	ns
		See Note 3	1. A. A.			

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



recommended operating conditions

		1	MJ			J OR N		UNIT
	PARAMETER	MIN	NOM	MAX	MIN	NOM	MAX	
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
юн	High-level output current			- 2			-6.5	mA
IOL	Low-level output current			16	1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -		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)

	ſ	•		MJ		· · · ·	J OR N	l	UNIT
PARAMETER	TEST CO	NDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	$V_{CC} = MIN,$	lj = -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	1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -		0.5			0.5	V
IOZH	$V_{CC} = MAX,$	$V_0 = 2.4 V$	1		50			50	μA
IOZL	$V_{CC} = MAX,$	$V_0 = 0.5 V$			- 50			- 50	μA
<u> </u>	V _{CC} = MAX,	$V_{ } = 5.5 V$			1			1	mA
Чн	V _{CC} = MAX,	V _I = 2.7 V	-		25			25	μA
	V _{CC} = MAX,	$V_{1} = 0.5 V$			-0.25			-0.25	mA
los [§]	V _{CC} = MAX		- 25		- 100	- 30		- 100	mA
	 V_{CC} = MAX 			75	100		75	100	mA

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

		TEST	F .	MJ			J OR N	• •	
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
t _{aA)}	Access time from address	$C_L = 30 pF$	<u>ال</u>	45	75		45	70	ns
t _{a(S)}	Access time from chip select (enable time)	See Note 3	1.	20	40		20	35	ns
		CL = 5 pF		15	35		15	30	ns
tdis	Disable time	See Note 3		15	35		15		113

[†]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

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



recommended operating conditions

	PARAMETER		MJ			UNIT		
1		MIN	NOM	MAX	MIN	NOM	MAX	
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
IOL	Low-level output current			16		n de grant de grant de la composition d la composition de la co	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		JC	DR N	
FANAMETEN	TEST CO		MIN TYP [‡]	MAX	MIN TY	P [‡] MAX	UNIT
VIK	$V_{CC} = MIN,$	lj = −18 mA		-1.2		-1.2	V
юн	$V_{CC} = MIN_{c}$	V _{OH} = 2.4 V		0.05		0.05	
ЮН		V _{OH} = 5.5 V	0.1			0.1	mA
VOL	$V_{CC} = MIN,$	I _{OL} = 16 mA		0.5		0.5	V
- I	$V_{CC} = MAX,$	$V_{I} = 5.5 V$		1		1	mA
Iн	$V_{CC} = MAX,$	$V_{I} = 2.7 V$		25		25	μA
١	$V_{CC} = MAX,$	$V_{ } = 0.5 V$		-0.25		-0.25	mA
lcc	$V_{CC} = MAX$		75	100		75 100	mA

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

	PARAMETER	PARAMETER TEST		MJ			J OR N			
	FANAMETEN	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	$R_{L2} = 600 \Omega$		45	0.5					
^t PLH	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. [‡]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.



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



recommended operating conditions

	DADAMETED		MJ				J OR N		
	PARAMETER		MIN	NOM	MAX	MIN	NOM	MAX	
Vcc	Supply voltage		4.5	5	5.5	4.75	5	5.25	· V
VIH	High-level input voltage		2			2	н С		V
VIL	Low-level input voltage	· · · · · · · · · · · · · · · · · · ·			0.8			0.8	V
юн	High-level output current				- 1			- 1.6	mA
IOL	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)

545445755	TEAT OO			MJ			J OR N		
PARAMETER	IEST CO	NDITIONS '	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT
VIK	$V_{CC} = MIN,$	$I_{I} = -18 \text{ mA}$			-1.2			- 1.2	V
VOH	$V_{CC} = MIN,$	IOH = MAX	2.4	3.1		2.4	3.1		V
VOL	$V_{CC} = MIN,$	IOL = 8 mA		1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -	0.5			0.5	V
^I OZH	$V_{CC} = MAX,$	$V_0 = 2.4 V$:	50			50	μA
^I OZL	$V_{CC} = MAX,$	$V_0 = 0.5 V$		-	- 50			- 50	μA
lj	V _{CC} = MAX,	$V_{ } = 5.5 V$			1			1	mA
ΪΗ	$V_{CC} = MAX,$	$V_{ } = 2.7 V$		1. J.	25			25	μA
ΙĮL	$V_{CC} = MAX,$	$V_{ } = 0.5 V$			-0.25			-0.25	mA
los	$V_{CC} = MAX$		- 10		- 100	-10		- 100	mA
ICC	$V_{CC} = MAX$			50	85		50	85	mA

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

· · ·		TEST	MJ			J OR N			CINUT	
	PARAMETER	CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT	
t _{a(A)}	Access time from address	$C_L = 30 \text{ pF}$		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	$C_L = 5 pF$		- 25	50		25	40	ns	
Cais		See Note 3		20		1.1.1.1.1.1	20		115	

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

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

[§]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.





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			2			v		
VIL	Low-level input voltage			0.8			0.8	v		
юн	High-level output current		· · · · · · · · · · · · · · · · · · ·	-1			- 1.6	mA		
IOL	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	JW OR NW	
		MIN TYP [‡] MAX	MIN TYP [‡] MAX	UNIT
VIK	$V_{CC} = MIN, \qquad I_I = -18 \text{ mA}$	-1.2	-1.2	v
VOH	$V_{CC} = MIN, I_{OH} = MAX$	2.4 3.1	2.4 3.1	V
VOL	$V_{CC} = MIN, \qquad I_{OL} = 8 \text{ mA}$	0.5	0.5	V
lozh	$V_{CC} = MAX, \qquad V_{O} = 2.4 V$	50	50	μA
IOZL	$V_{CC} = MAX, \qquad V_O = 0.5 V$	- 50	- 50	μΑ
li li	$V_{CC} = MAX, \qquad V_I = 5.5 V$	1	1	mA
Чн	$V_{CC} = MAX, \qquad V_I = 2.7 V$	25	25	μΑ
ΙL	$V_{CC} = MAX, \qquad V_I = 0.5 V$	-0.25	-0.25	mA
los	$V_{CC} = MAX$	-10 -100	-10 -100	mA
ICC	$V_{CC} = MAX$	50 85	50 85	mA

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

1. A.	PARAMETER	TEST		MJW			JW OR NW			
		CONDITIONS	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNIT	
t _{a(A)}	Access time from address	$C_L = 30 pF$		55	110	<u> 1</u>	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	$C_L = 5 pF$								
Suis		See Note 3	1	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.



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



recommended operating conditions

	PARAMETER		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	V	
⊻н	High-level input voltage	2			2			V	
VIL	Low-level input voltage			0.8			0.8	V	
юн	High-level output current			-1			- 1.6	mA	
IOL	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)

	TEST CONDITIONS [†]			MJW		J	W OR N	W	UNIT
PARAMETER			MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	
VIK	$V_{CC} = MIN,$	lj = −18 mA			- 1.2			- 1.2	V
VOH	$V_{CC} = MIN,$	IOH = MAX	2.4	3.1		2.4	3.1	-	V
VOL	$V_{CC} = MIN,$	IOL = 8 mA			0.5			0.5	V
Іодн	$V_{CC} = MAX,$	$V_0 = 2.4 V$			50		1	50	μA
IOZL	$V_{CC} = MAX,$	V ₀ = 0.5 V			- 50		-	- 50	μA
4	$V_{CC} = MAX,$	$V_{ } = 5.5 V$			1			1	mA
Чн	$V_{CC} = MAX,$	$V_{ } = 2.7 V_{ }$	1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 - 1997 -		25			25	μA
IIL	$V_{CC} = MAX,$	$V_{1} = 0.5 V$		·	-0.25			-0.25	mA
IOS §	V _{CC} = MAX		- 10		- 100	- 10		- 100	mA
lcc	V _{CC} = MAX	<i>i</i> .		55	95		55	80	mA

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

		TEST		MJW		JW OR NW			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
ta(S)	Access time from chip select (enable time)	See Note 3		40	125		40	80	ns
	Disable time	C _L = 5 pF		25	100		25	60	ns
tdis		See Note 3	25	100		25	00		

[†]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.





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



recommended operating conditions

	PARAMETER				T	
		<u>and an </u>	MIN	NOM	MAX	UNIT
Vcc	Supply voltage		4.75	5	5.25	v
VIH	High-level input voltage		2			. V
VIL	Low-level input voltage				0.8	v
юн	High-level output current		N. M. S.	· · · · ·	- 1.6	mA
IOL	Low-level output current		+		8	mA
TA	Operating free-air temperature range		0		70	°C

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

PARAMETER	TEST CONDITIONS				NW		
		MIN	TYPT	MAX	UNIT		
VIK	$V_{CC} = 4.75,$	$I_{I} = -18 \text{ mA}$				-1.2	V
VOH	$V_{\rm CC} = 4.75,$	$I_{OH} = -1.6 \text{ mA}$		2.4	3.1		V
VOL	$V_{CC} = 4.75,$	I _{OL} = 8 mA			ini	0.5	V
IOZH	$V_{\rm CC} = 5.25,$	$V_0 = 2.4 V$				50	μA
IOZL	$V_{CC} = 5.25,$	$V_0 = 0.5 V$				- 50	μA
lj	$V_{\rm CC} = 5.25,$	$V_{ } = 5.5 V$				1	mA
ЧН	$V_{CC} = 5.25,$	V _I = 2.7 V				25	μA
μL	V _{CC} = 5.25,	$V_{1} = 0.5 V$				-0.25	mA
los‡	$V_{CC} = 5.25$			- 10		- 100	mA
ICC	V _{CC} = 5.25		1		75	110	mA

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

PARAMETER		TEST CONDITIONS		NW		
				TYPT	MAX	
t _{a(A)}	Access time from address	$C_L = 30 pF$	1	80	125	ns
t _a (S)	Access time from chip select (enable time)	See Note 3	-	40	65	ns
^t dis	Disable time	CL = 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.



recommended operating condition's for programming (see Figure 1)

		MIN	NOM	MAX	UNI
Steady-state supply voltage	V _{CC}	4.75	5	5.25	V
	VIH	3	4	5	v
Input voltage	VIL	0	0	0.5	l 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
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	t1	0	5	10	μs
Time from V_{CC} = 6 V until chip select (enable) is at 10 V-	t2	5	5	10	μs
Time from chip select (enable) high to start of program ramp	t <u>3</u>	0.1	5	10	μs
Ramp time, output program pulse	t4	10	15	20	μ
Duration of output program pulse	t5	15	20	20	μs
Time from end of program pulse to chip select (enable) low	t6	5	5	10	μ
Time from chip select (enable) V _{CC} = 0 V	t7	0.1	5	5	με
Time for cooling between bits	t8	30	50	100	μ
Time for cooling between words	t9	30	50		μ
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 V_{CC} 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 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 \overline{S} , \overline{E} or \overline{G} inputs. If ≤ 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 \overline{S} , \overline{E} , or \overline{G} inputs to VII.
- 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 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 $\leq 1 \ \mu s$.





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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