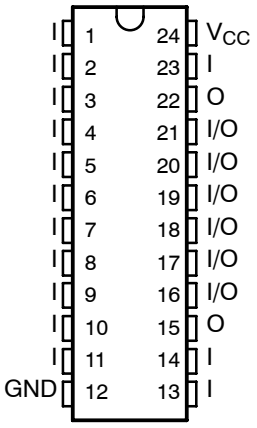
TIBPAL20L8-15C, TIBPAL20R4-15C, TIBPAL20R6-15C, TIBPAL20R8-15C
TIBPAL20L8-20M, TIBPAL20R4-20M, TIBPAL20R6-20M, TIBPAL20R8-20M
HIGH-PERFORMANCE *IMPACT* ™ *PAL*® CIRCUITS

SRPS021A – D2920, JUNE 1986 – REVISED DECEMBER 2010

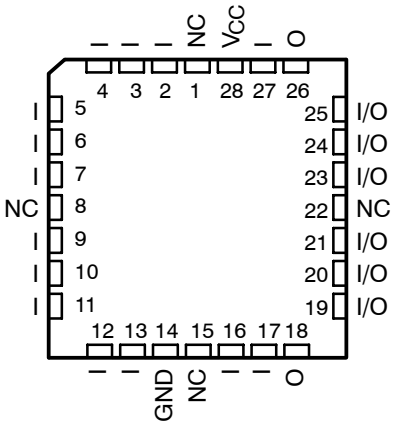
- **High-Performance: f_{max} (w/o feedback)**
  TIBPAL20R' -15C Series . . . 45 MHz
  TIBPAL20R' -20M Series . . . 41.6 MHz
- **High-Performance . . . 45 MHz Min**
- **Reduced I_{CC} of 180 mA Max**
- **Functionally Equivalent, but Faster Than PAL20L8, PAL20R4, PAL20R6, PAL20R8**
- **Power-Up Clear on Registered Devices (All Register Outputs are Set Low, but Voltage Levels at the Output Pins Go High)**
- **Preload Capability on Output Registers Simplifies Testing**
- **Package Options Include Both Plastic and Ceramic Chip Carriers in Addition to Plastic and Ceramic DIPs**

DEVICE	I INPUTS	3-STATE O OUTPUTS	REGISTERED Q OUTPUTS	I/O PORTS
PAL20L8	14	2	0	6
PAL20R4	12	0	4 (3-state buffers)	4
PAL20R6	12	0	6 (3-state buffers)	2
PAL20R8	12	0	8 (3-state buffers)	0

TIBPAL20L8'
C SUFFIX . . . JT OR NT PACKAGE
M SUFFIX . . . JT OR W PACKAGE
(TOP VIEW)



TIBPAL20L8'
C SUFFIX . . . FN PACKAGE
M SUFFIX . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection
Pin assignments in operating mode

description

These programmable array logic devices feature high speed and functional equivalency when compared with currently available devices. These IMPACT™ circuits combine the latest Advanced Low-Power Schottky technology with proven titanium-tungsten fuses to provide reliable, high-performance substitutes for conventional TTL logic. Their easy programmability allows for quick design of custom functions and typically results in a more compact circuit board. In addition, chip carriers are available for futher reduction in board space.

Extra circuitry has been provided to allow loading of each register asynchronously to either a high or low state. This feature simplifies testing because the registers can be set to an initial state prior to executing the test sequence.

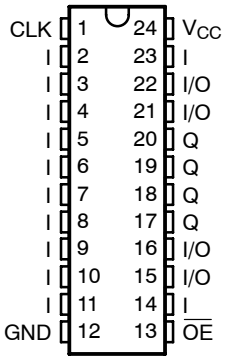
The TIBPAL20' C series is characterized from 0°C to 75°C. The TIBPAL20' M series is characterized for operation over the full military temperature range of −55°C to 125°C.

IMPACT is a trademark of Texas Instruments Incorporated.
PAL is a registered trademark of Advanced Micro Devices Inc.

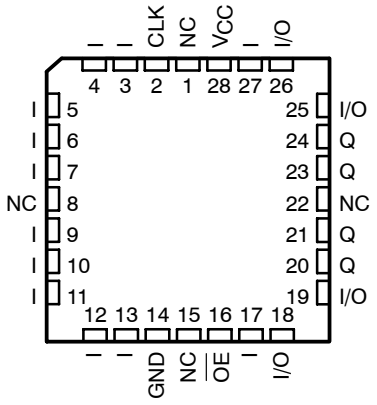
PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

Copyright © 2010, Texas Instruments Incorporated

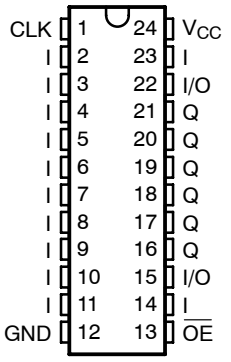
TIBPAL20R4'
C SUFFIX . . . JT OR NT PACKAGE
M SUFFIX . . . JT OR W PACKAGE
(TOP VIEW)



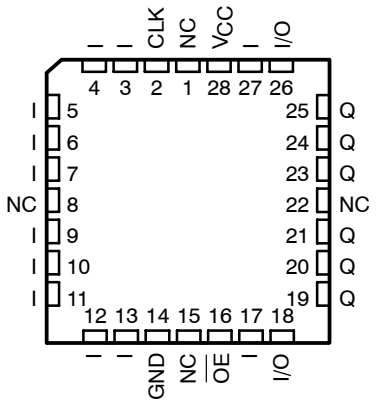
TIBPAL20R4'
C SUFFIX . . . FN PACKAGE
M SUFFIX . . . FK PACKAGE
(TOP VIEW)



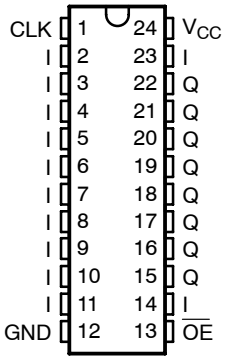
TIBPAL20R6'
C SUFFIX . . . JT OR NT PACKAGE
M SUFFIX . . . JT OR W PACKAGE
(TOP VIEW)



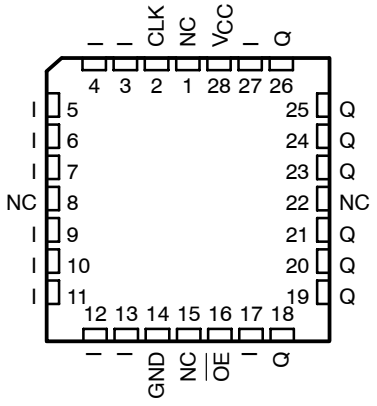
TIBPAL20R6'
C SUFFIX . . . FN PACKAGE
M SUFFIX . . . FK PACKAGE
(TOP VIEW)



TIBPAL20R8'
C SUFFIX . . . JT OR NT PACKAGE
M SUFFIX . . . JT OR W PACKAGE
(TOP VIEW)



TIBPAL20R8'
C SUFFIX . . . FN PACKAGE
M SUFFIX . . . FK PACKAGE
(TOP VIEW)

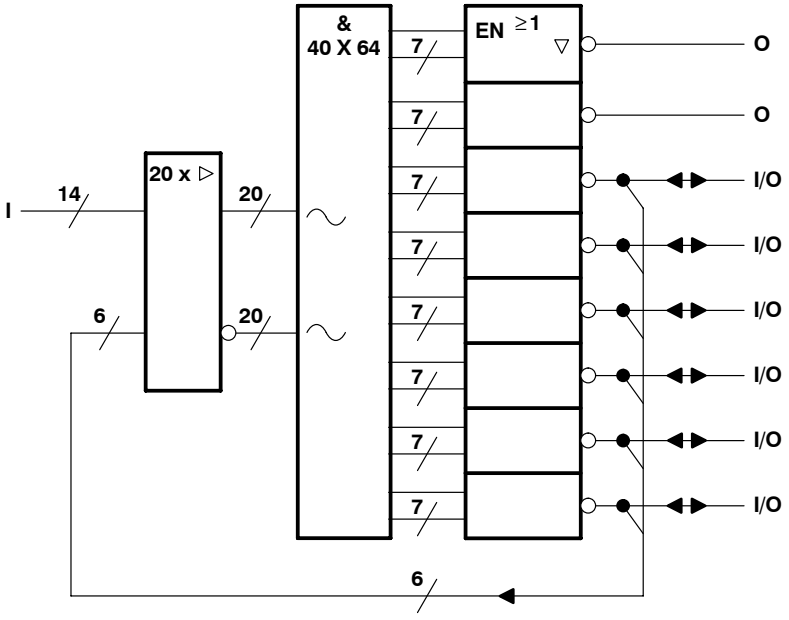


Pin assignments in operating mode

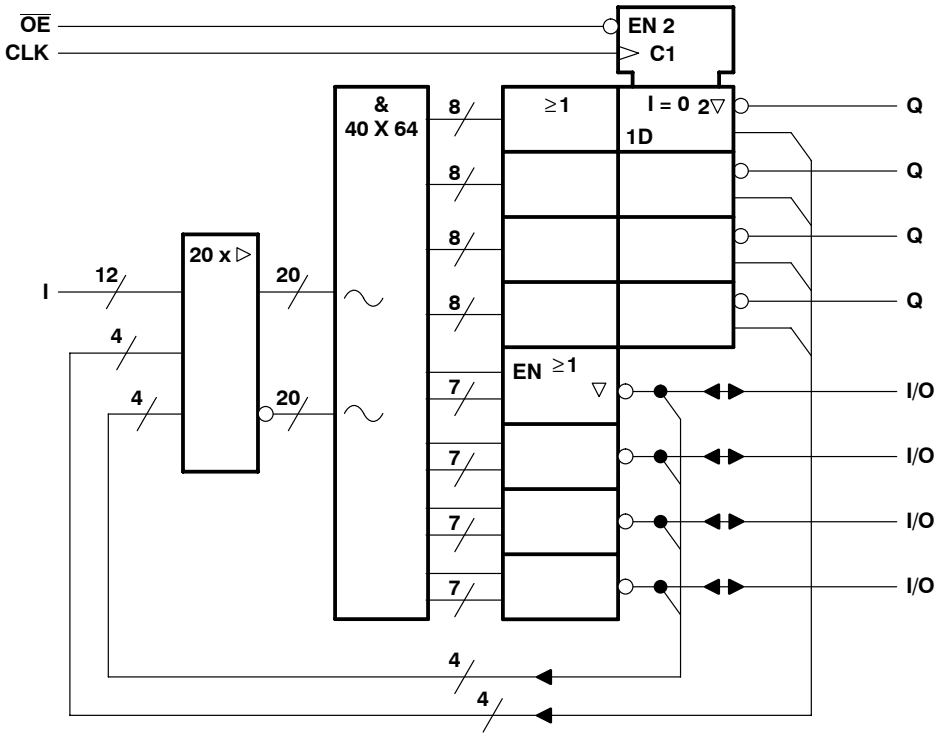
NC – No internal connection

functional block diagrams (positive logic)

TIBPAL20L8'



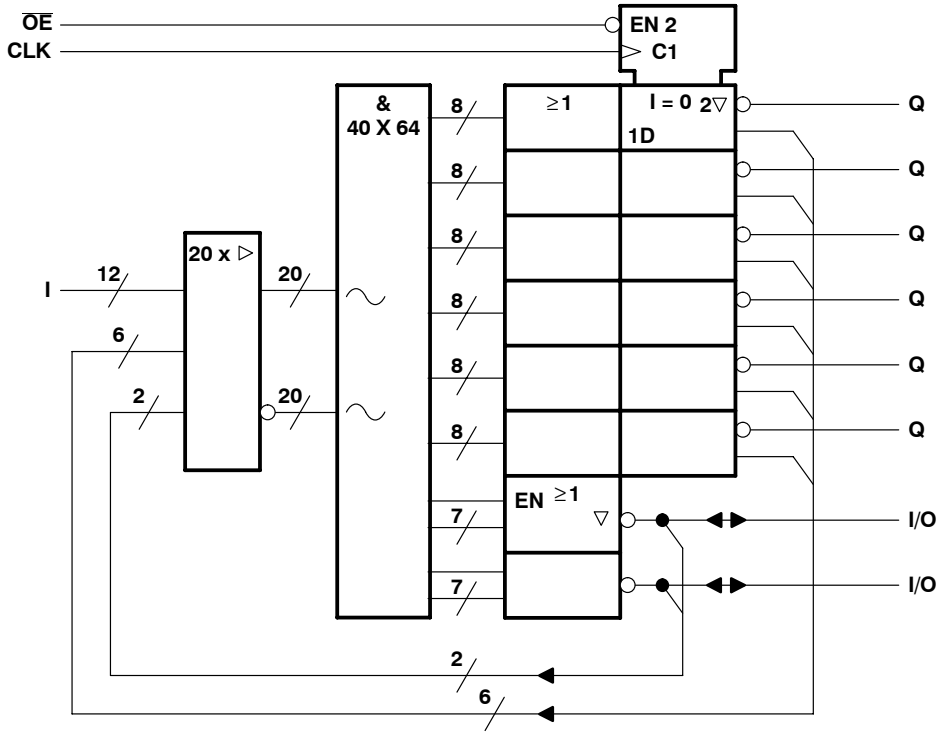
TIBPAL20R4'



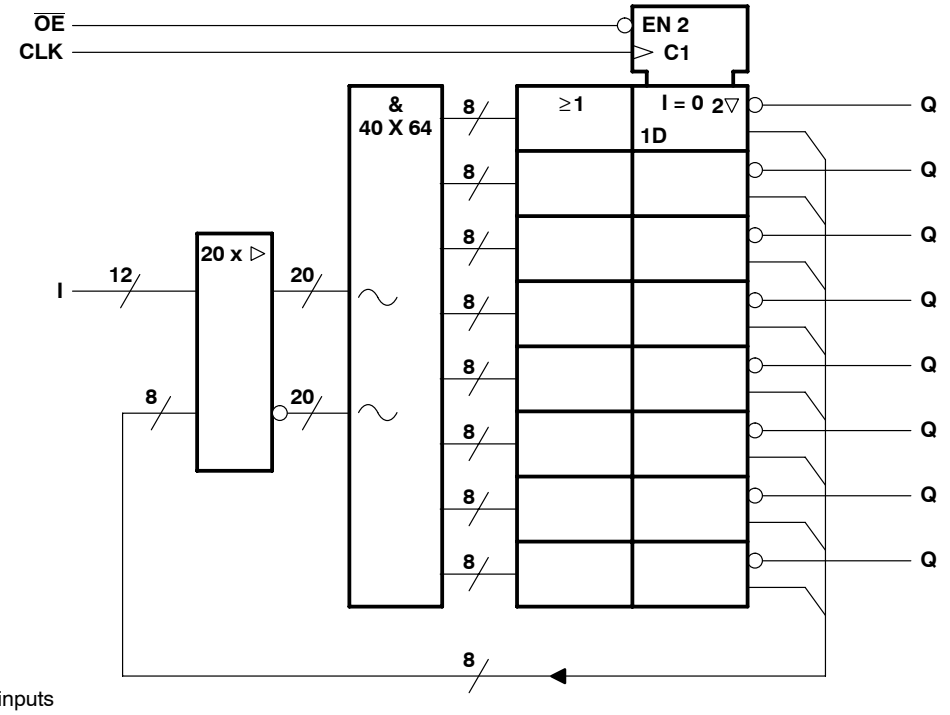
~ denotes fused inputs

functional block diagrams (positive logic)

TIBPAL20R6'

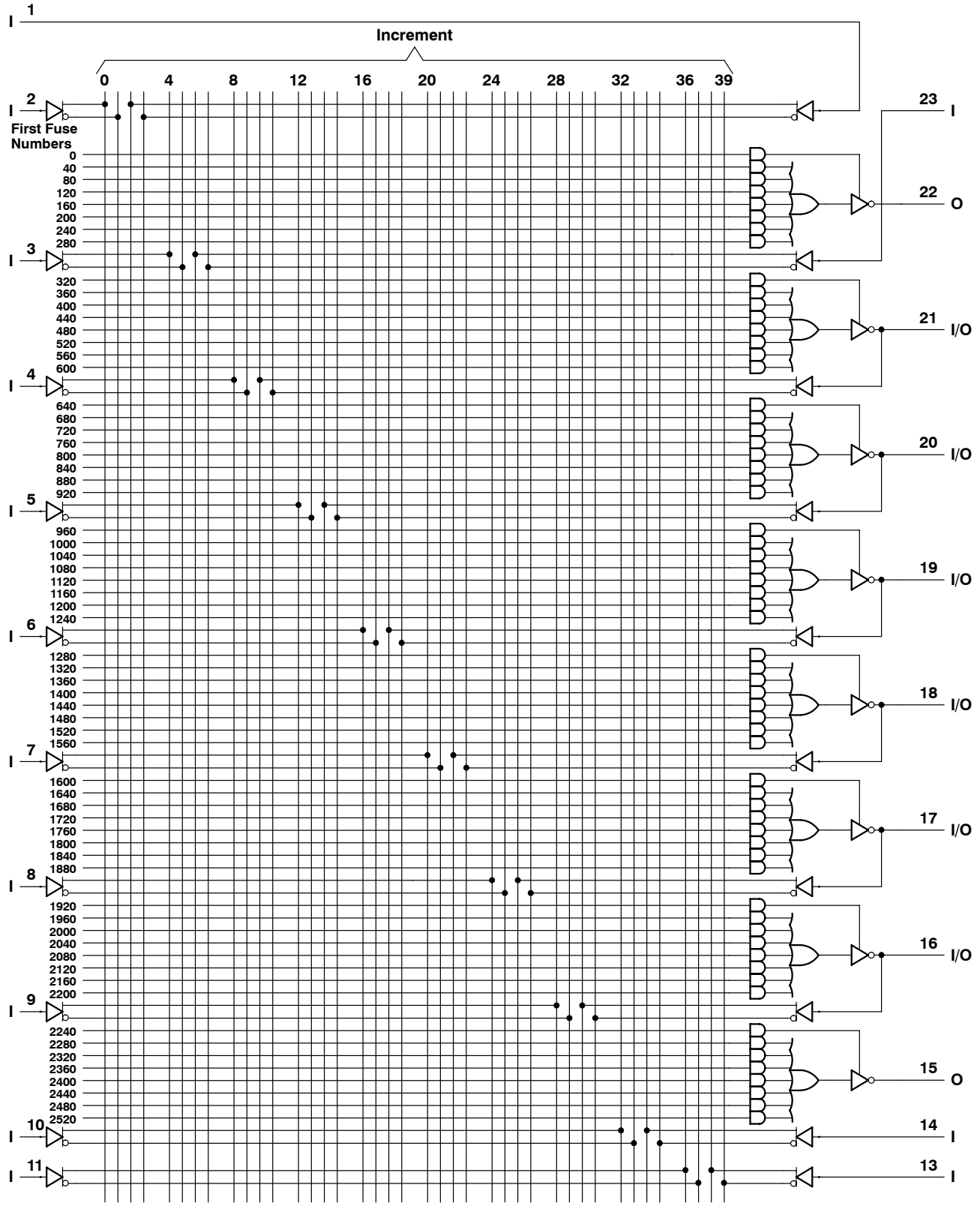


TIBPAL20R8'



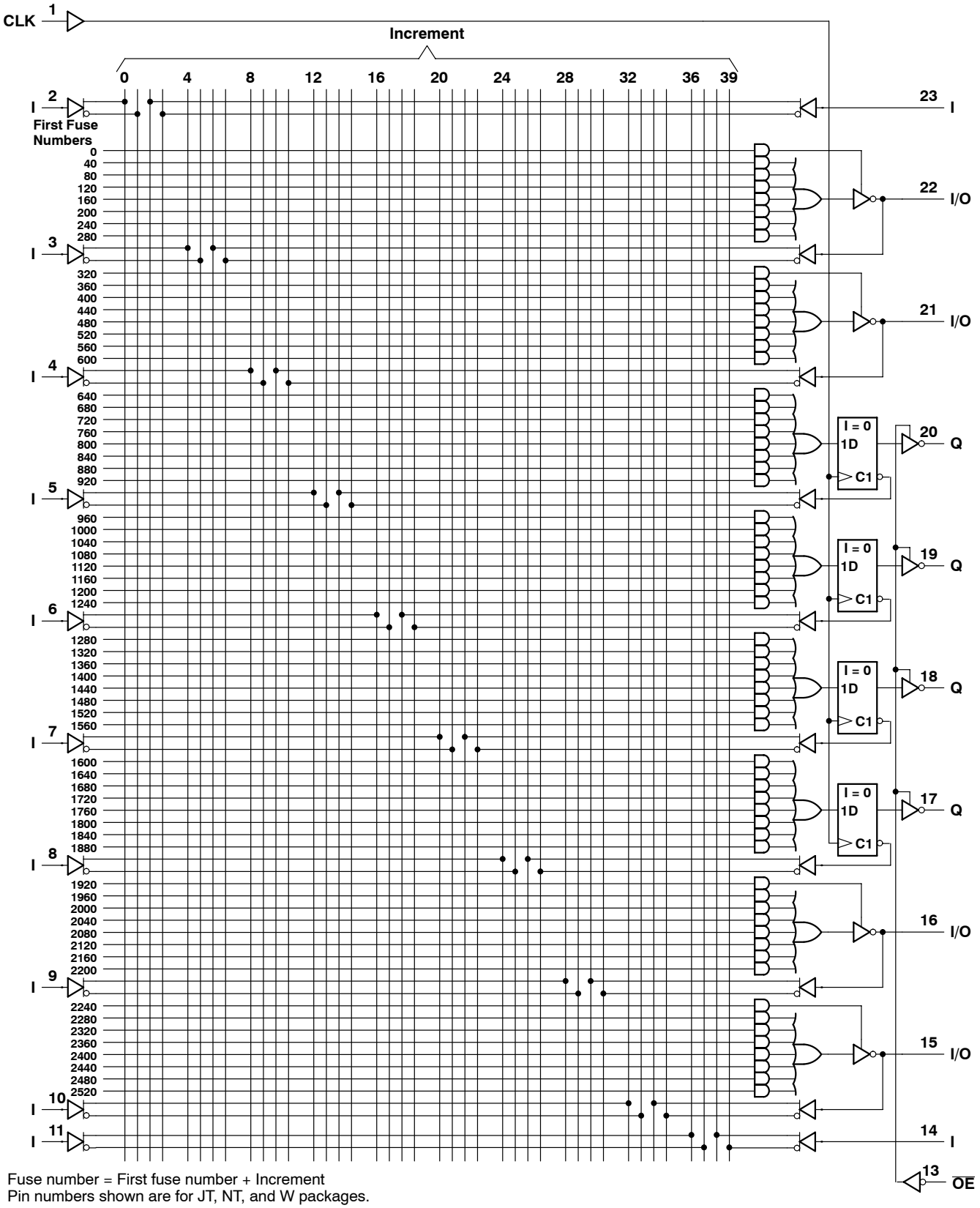
denotes fused inputs

logic diagram (positive logic)



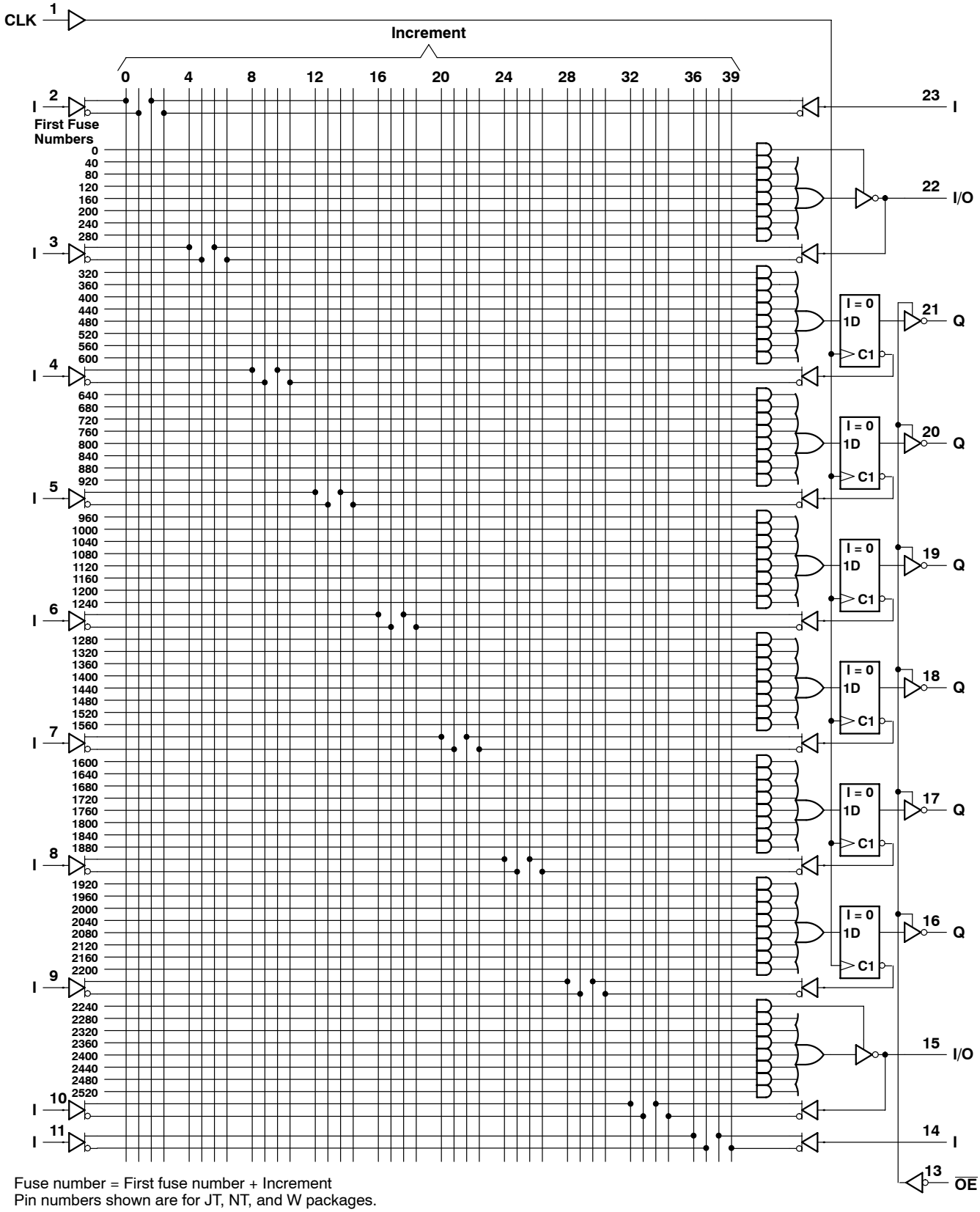
Fuse number = First fuse number + Increment
Pin numbers shown are for JT, NT, and W packages.

logic diagram (positive logic)



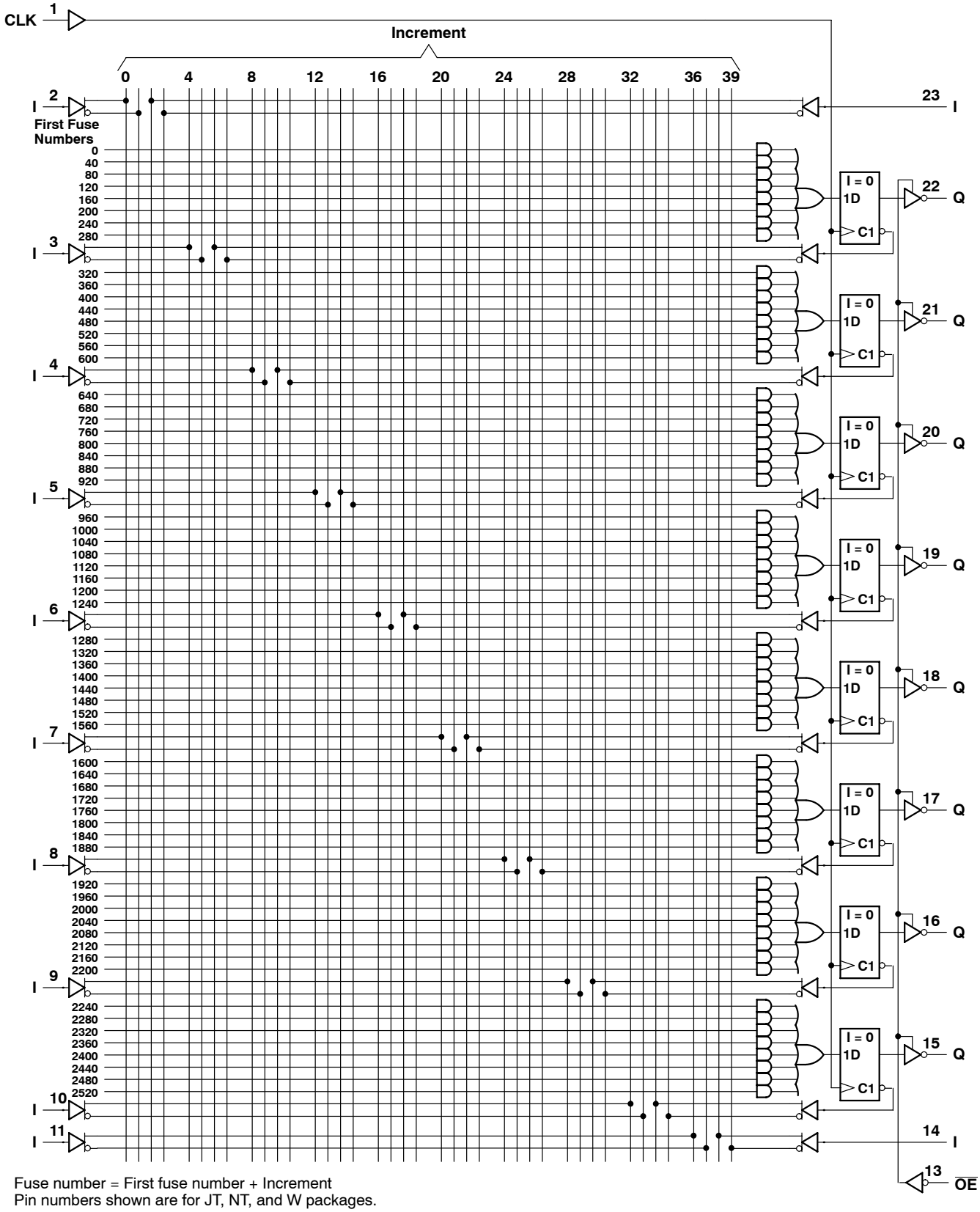
Fuse number = First fuse number + Increment
Pin numbers shown are for JT, NT, and W packages.

logic diagram (positive logic)



Fuse number = First fuse number + Increment
Pin numbers shown are for JT, NT, and W packages.

logic diagram (positive logic)



Fuse number = First fuse number + Increment
Pin numbers shown are for JT, NT, and W packages.

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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage (see Note 1) . . . . . 5.5 V
Voltage applied to disabled output (see Note 1) . . . . . 5.5 V
Operating free-air temperature range . . . . . 0°C to 75°C
Storage temperature range . . . . . –65°C to 150°C

NOTE 1: These ratings apply except for programming pins during a programming cycle.

recommended operating conditions

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		4.75	5	5.25	V
V_{IH}	High-level input voltage		2		5.5	V
V_{IL}	Low-level input voltage				0.8	V
I_{OH}	High-level output current				–3.2	mA
I_{OL}	Low-level output current				24	mA
f_{clock}†	Clock frequency		0		45	MHz
t_w†	Pulse duration, clock	High	10			ns
		Low	12			
t_{su}†	Setup time, input or feedback before clock↑		15			ns
t_h†	Hold time, input or feedback after clock↑		0			ns
T_A	Operating free-air temperature		0	25	75	°C

† f_{clock}, t_w, t_{su}, and t_h do not apply for TIBPAL20L8'.

electrical characteristics over recommended operating free-air temperature range

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{IK}		V_{CC} = 4.75 V,	I_I = –18 mA		–0.8	–1.5	V
V_{OH}		V_{CC} = 4.75 V,	I_{OH} = –3.2 mA	2.4			V
V_{OL}		V_{CC} = 4.75 V,	I_{OL} = 24 mA		0.3	0.5	V
I_{OZH}	O, Q outputs	V_{CC} = 5.25 V,	V_O = 2.7 V			20	μA
	I/O ports					100	
I_{OZL}	O, Q outputs	V_{CC} = 5.25 V,	V_O = 0.4 V			–20	μA
	I/O ports					–250	
I_I		V_{CC} = 5.25 V,	V_I = 5.5 V			0.1	mA
I_{IH}‡		V_{CC} = 5.25 V,	V_I = 2.7 V			25	μA
I_{IL}‡		V_{CC} = 5.25 V,	V_I = 0.4 V			–0.25	mA
I_{OS}§		V_{CC} = 5.25 V,	V_O = 0.5 V	–30	–70	–130	mA
I_{CC}		V_{CC} = 5.25 V, Outputs open,	V_I = 0, $\overline{OE}$ at V_{IH}		120	180	mA

switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITION	MIN	TYP†	MAX	UNIT
f_{max}¶	With feedback		R1 = 200 Ω, R2 = 390 Ω, See Figure 3	37	40		MHz
	Without feedback			45	50		
t_{pd}	I, I/O	O, I/O			12	15	ns
t_{pd}	CLK↑	Q			8	12	ns
t_{en}	$\overline{OE}$	Q			10	15	ns
t_{dis}	$\overline{OE}$↑	Q			8	12	ns
t_{en}	I, I/O	O, I/O			12	18	ns
t_{dis}	I, I/O	O, I/O			12	15	ns

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

‡ For I/O ports, the parameters I_{IH} and I_{IL} include the off-state output current.

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

¶ $f_{max}(\text{with feedback}) = \dfrac{1}{t_{su} + t_{pd}\ (\text{CLK to Q})}$, $f_{max}(\text{without feedback}) = \dfrac{1}{t_w\ \text{high} + t_w\ \text{low}}$,

f_{max} does not apply for TIBPAL20L8,.

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

Supply voltage, V_{CC} (see Note 1) . . . . . 7 V
Input voltage (see Note 1) . . . . . 5.5 V
Voltage applied to disabled output (see Note 1) . . . . . 5.5 V
Operating free-air temperature range . . . . . –55°C to 125°C
Storage temperature range . . . . . –65°C to 150°C

NOTE 1: These ratings apply except for programming pins during a programming cycle.

recommended operating conditions

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	V
V_{IH}	High-level input voltage		2		5.5	V
V_{IL}	Low-level input voltage				0.8	V
I_{OH}	High-level output current				–2	mA
I_{OL}	Low-level output current				12	mA
f_{clock}†	Clock frequency		0		41.6	MHz
t_w†	Pulse duration, clock	High	12			ns
		Low	12			
t_{su}†	Setup time, input or feedback before clock↑		20			ns
t_h†	Hold time, input or feedback after clock↑		0			ns
T_A	Operating free-air temperature		–55	25	125	°C

† f_{clock}, t_w, t_{su}, and t_h do not apply for TIBPAL20L8'.

electrical characteristics over recommended operating free-air temperature range

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V_{IK}		V_{CC} = 4.5 V,	I_I = –18 mA		–0.8	–1.5	V
V_{OH}		V_{CC} = 4.5 V,	I_{OH} = –2 mA	2.4	3.2		V
V_{OL}		V_{CC} = 4.5 V,	I_{OL} = 12 mA		0.3	0.5	V
I_{OZH}		V_{CC} = 5.5 V,	V_O = 2.7 V			100	μA
I_{OZL}‡	O, Q outputs	V_{CC} = 5.5 V,	V_O = 0.4 V			–20	μA
	I/O ports					–250	
I_I		V_{CC} = 5.5 V,	V_I = 5.5 V			1	mA
I_{IH}‡	I/O ports	V_{CC} = 5.5 V,	V_I = 2.7 V			100	μA
	All others					25	
I_{IL}‡		V_{CC} = 5.5 V,	V_I = 0.4 V			–0.25	mA
I_{OS}§		V_{CC} = 5.5 V,	V_O = 0.5 V	–30	–70	–250	mA
I_{CC}		V_{CC} = 5.5 V, Outputs open,	V_I = 0, OE = V_{IH}		120	180	mA

switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITION	MIN	TYP†	MAX	UNIT
f_{max}¶	With feedback		R1 = 390 Ω, R2 = 750 Ω, See Figure 3	28.5	40		MHz
	Without feedback			41.6	50		
t_{pd}	I, I/O	O, I/O			12	20	ns
t_{pd}	CLK↑	Q			8	15	ns
t_{en}	$\overline{OE}$	Q			10	20	ns
t_{dis}	$\overline{OE}$↑	Q			8	20	ns
t_{en}	I, I/O	O, I/O			12	25	ns
t_{dis}	I, I/O	O, I/O			12	20	ns

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

‡ For I/O ports, the parameters I_{IH} and I_{IL} include the off-state output current.

§ Not more than one output should be shorted at a time, and the duration of the short-circuit should not exceed one second. Set V_O at 0.5 V to avoid test equipment ground degradation.

¶ $f_{max}(\text{with feedback}) = \dfrac{1}{t_{su} + t_{pd}\ (\text{CLK to Q})}$, $f_{max}(\text{without feedback}) = \dfrac{1}{t_w\ \text{high} + t_w\ \text{low}}$,

f_{max} does not apply for TIBPAL20L8,.

programming information

Texas Instruments programmable logic devices can be programmed using widely available software and inexpensive device programmers.

Complete programming specifications, algorithms, and the latest information on hardware, software, and firmware are available upon request. Information on programmers capable of programming Texas Instruments programmable logic is also available, upon request, from the nearest TI field sales office, local authorized TI distributor, or by calling Texas Instruments at (214) 997-5666.

preload procedure for registered outputs (see Figure 1 and Notes 2 and 3)

The output registers can be preloaded to any desired state during device testing. This permits any state to be tested without having to step through the entire state-machine sequence. Each register is preloaded individually by following the steps given below.

Step 1. With V_{CC} at 5 volts and Pin 1 at V_{IL}, raise Pin 13 to V_{IHH}.
Step 2. Apply either V_{IL} or V_{IH} to the output corresponding to the register to be preloaded.
Step 3. Pulse Pin 1, clocking in preload data.
Step 4. Remove output voltage, then lower Pin 13 to V_{IL}. Preload can be verified by observing the voltage level at the output pin.

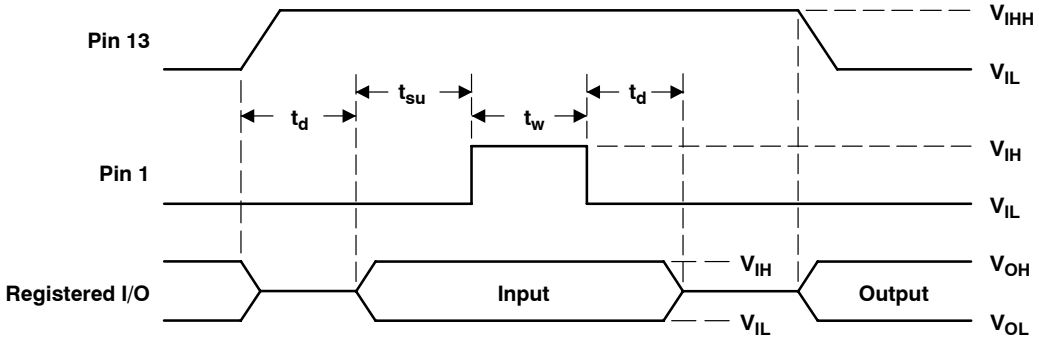
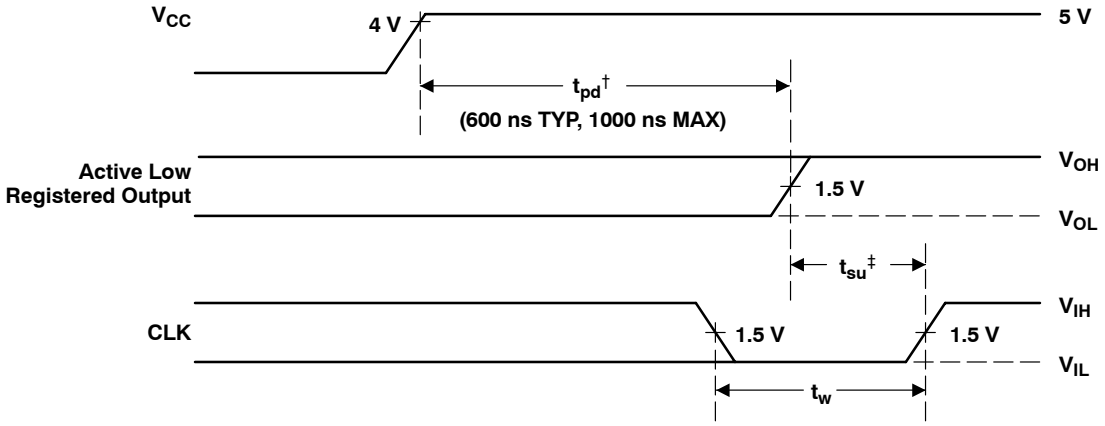


Figure 1. Preload Waveforms

NOTES: 2. Pin numbers shown are for JT, NT, and W packages only. If chip carrier socket adapter is not used, pin numbers must be changed accordingly.
3. $t_d = t_{su} = t_h$ = 100 ns to 1000 ns V_{IHH} = 10.25 V to 10.75 v

power-up reset (see Figure 2)

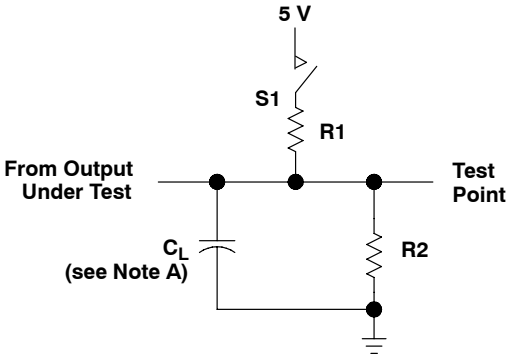
Following power up, all registers are reset to zero. This feature provides extra flexibility to the system designer and is especially valuable in simplifying state-machine initialization. To ensure a valid power-up reset, it is important that the rise of V_{CC} be monotonic. Following power-up reset, a low-to-high clock transition must not occur until all applicable input and feedback setup times are met.



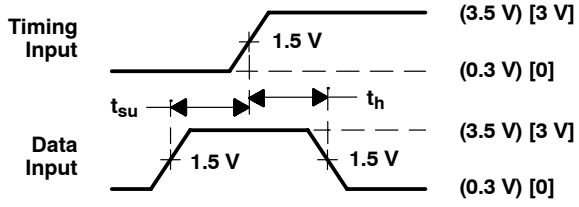
† This is the power-up reset time and applies to registered outputs only. The values shown are from characterization data.
‡ This is the setup time for input or feedback.

Figure 2. Power-Up Reset Waveforms

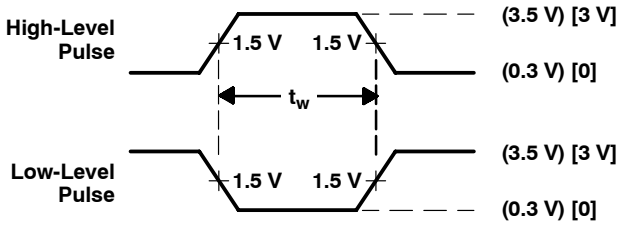
PARAMETER MEASUREMENT INFORMATION



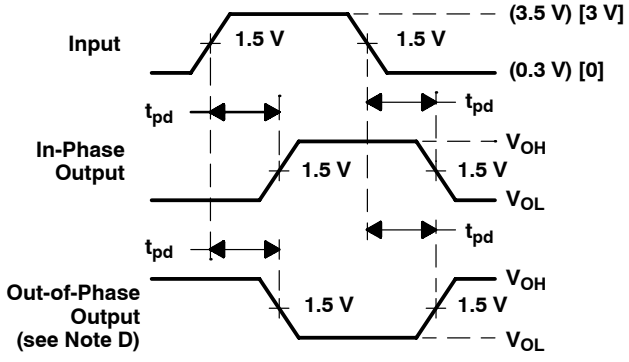
LOAD CIRCUIT FOR 3-STATE OUTPUTS



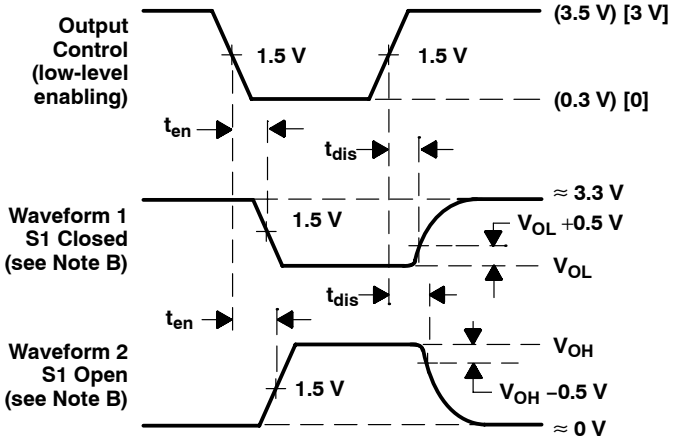
VOLTAGE WAVEFORMS SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS PULSE DURATIONS



VOLTAGE WAVEFORMS PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

NOTES: A. C_L includes probe and jig capacitance and is 50 pF for t_{pd} and t_{en}, 5 pF for t_{dis}.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. All input pulses have the following characteristics: For C suffix, use the voltage levels indicated in parentheses ( ). PRR ≤ 1 MHz, $t_r = t_f \leq 2$ ns, duty cycle = 50%. For M suffix, use the voltage levels indicated in brackets [ ]. PRR ≤ 10 MHz, t_r and $t_f \leq 2$ ns, duty cycle = 50%.
D. When measuring propagation delay times of 3-state outputs, switch S1 is closed.
E. Equivalent loads may be used for testing.

Figure 3. Load Circuit and Voltage Waveforms

TI North American Sales Offices

ALABAMA: Huntsville: (205) 837-7530
ARIZONA: Phoenix: (602) 995-1007
CALIFORNIA: Irvine: (714) 660-1200
San Diego: (619) 278-9600
Santa Clara: (408) 980-9000
Woodland Hills: (818) 704-8100
COLORADO: Aurora: (303) 368-8000
CONNECTICUT: Wallingford: (203) 269-0074
FLORIDA: Altamonte Springs: (407) 260-2116
Fort Lauderdale: (305) 973-8502
Tampa: (813) 885-7588
GEORGIA: Norcross: (404) 662-7967
ILLINOIS: Arlington Heights: (708) 640-3000
INDIANA: Carmel: (317) 573-6400
Fort Wayne: (219) 489-4697
KANSAS: Overland Park: (913) 451-4511
MARYLAND: Columbia: (410) 964-2003
MASSACHUSETTS: Waltham: (617) 895-9100
MICHIGAN: Farmington Hills: (313) 553-1581
MINNESOTA: Eden Prairie: (612) 828-9300
MISSOURI: St. Louis: (314) 821-8400
NEW JERSEY: Iselin: (908) 750-1050
NEW MEXICO: Albuquerque: (505) 345-2555
NEW YORK: East Syracuse: (315) 463-9291
Fishkill: (914) 897-2900
Melville: (516) 454-6600
Pittsford: (716) 385-6770
NORTH CAROLINA: Charlotte: (704) 527-0930
Raleigh: (919) 876-2725
OHIO: Beachwood: (216) 765-7258
Beavercreek: (513) 427-6200
OREGON: Beaverton: (503) 643-6758
PENNSYLVANIA: Blue Bell: (215) 825-9500
PUERTO RICO: Hato Rey: (809) 753-8700
TEXAS: Austin: (512) 250-6769
Dallas: (214) 917-1264
Houston: (713) 778-6592
Midland: (915) 561-7137
UTAH: Salt Lake City: (801) 466-8972
WISCONSIN: Waukesha: (414) 798-1001
CANADA: Nepean: (613) 726-1970
Richmond Hill: (416) 884-9181
St. Laurent: (514) 335-8392

TI Regional Technology Centers

CALIFORNIA: Irvine: (714) 660-8140
Santa Clara: (408) 748-2222
GEORGIA: Norcross: (404) 662-7945
ILLINOIS: Arlington Heights: (708) 640-2909
INDIANA: Indianapolis: (317) 573-6400
MASSACHUSETTS: Waltham: (617) 895-9196
MEXICO: Mexico City: 491-70834
MINNESOTA: Minneapolis: (612) 828-9300
TEXAS: Dallas: (214) 917-3881
CANADA: Nepean: (613) 726-1970

Customer Response Center

TOLL FREE: (800) 336-5236
OUTSIDE USA: (214) 995-6611
(8:00 a.m. – 5:00 p.m. CST)

TI Authorized North American Distributors

Alliance Electronics, Inc. (military product only)
Almac/Arrow
Anthem Electronics
Arrow/Schweber
Future Electronics (Canada)
GRS Electronics Co., Inc.
Hall-Mark Electronics
Marshall Industries
Newark Electronics
Rochester Electronics, Inc.
(obsolete product only (508) 462-9332)
Wyle Laboratories
Zeus Components

TI Distributors

ALABAMA: Arrow/Schweber (205) 837-6955; Hall-Mark (205) 837-8700; Marshall (205) 881-9235.

ARIZONA: Anthem (602) 966-6600; Arrow/Schweber (602) 437-0750; Hall-Mark (602) 431-0030; Marshall (602) 496-0290; Wyle (602) 437-2088.

CALIFORNIA: Los Angeles/Orange County: Anthem (818) 775-1333, (714) 768-4444; Arrow/Schweber (818) 380-9686, (714) 838-5422; Hall-Mark (818) 773-4500, (714) 727-6000; Marshall (818) 878-7000, (714) 458-5301; Wyle (818) 880-9000, (714) 863-9953; Zeus (714) 921-9000, (818) 889-3838;

Sacramento: Anthem (916) 624-9744; Hall-Mark (916) 624-9781; Marshall (916) 635-9700; Wyle (916) 638-5282;

San Diego: Anthem (619) 453-9005; Arrow/Schweber (619) 565-4800; Hall-Mark (619) 268-1201; Marshall (619) 578-9600; Wyle (619) 565-9171; Zeus (619) 277-9681.

San Francisco Bay Area: Anthem (408) 453-1200; Arrow/Schweber (408) 441-9700, (510) 490-9477; Hall-Mark (408) 432-4000; Marshall (408) 942-4600; Wyle (408) 727-2500; Zeus (408) 629-4789.

COLORADO: Anthem (303) 790-4500; Arrow/Schweber (303) 799-0258; Hall-Mark (303) 790-1662; Marshall (303) 451-8383; Wyle (303) 457-9953.

CONNECTICUT: Anthem (203) 575-1575; Arrow/Schweber (203) 265-7741; Hall-Mark (203) 271-2844; Marshall (203) 265-3822.

FLORIDA: Fort Lauderdale: Arrow/Schweber (305) 429-8200; Halll-Mark (305) 971-9280; Marshall (305) 977-4880.

Orlando: Arrow/Schweber (407) 333-9300; Hall-Mark (407) 830-5855; Marshall (407) 767-8585; Zeus (407) 788-9100.

Tampa: Hall-Mark (813) 541-7440; Marshall (813) 573-1399.

GEORGIA: Arrow/Schweber (404) 497-1300; Hall-Mark (404) 623-4400; Marshall (404) 923-5750.

ILLINOIS: Anthem (708) 884-0200; Arrow/Schweber (708) 250-0500; Hall-Mark (312) 860-3800; Marshall (708) 490-0155; Newark (312)784-5100.

INDIANA: Arrow/Schweber (317) 299-2071; Hall-Mark (317) 872-8875; Marshall (317) 297-0483.

IOWA: Arrow/Schweber (319) 395-7230.

KANSAS: Arrow/Schweber (913) 541-9542; Hall-Mark (913) 888-4747; Marshall (913) 492-3121.

MARYLAND: Anthem (301) 995-6640; Arrow/Schweber (301) 596-7800; Hall-Mark (301) 988-9800; Marshall (301) 622-1118; Zeus (301) 997-1118.

MASSACHUSETTS: Anthem (508) 657-5170; Arrow/Schweber (508) 658-0900; Hall-Mark (508) 667-0902; Marshall (508) 658-0810; Wyle (617) 272-7300; Zeus (617) 246-8200.

MICHIGAN: Detroit: Arrow/Schweber (313) 462-2290; Hall-Mark (313) 416-5800; Marshall (313) 525-5850; Newark (313) 967-0600.

MINNESOTA: Anthem (612) 944-5454; Arrow/Schweber (612) 941-5280; Hall-Mark (612) 881-2600; Marshall (612) 559-2211.

MISSOURI: Arrow/Schweber (314) 567-6888; Hall-Mark (314) 291-5350; Marshall (314) 291-4650.

NEW JERSEY: Anthem (201) 227-7960; Arrow/Schweber (201) 227-7880, (609) 596-8000; Hall-Mark (201) 515-3000, (609) 235-1900; Marshall (201) 882-0320, (609) 234-9100.

NEW MEXICO: Alliance (505) 292-3360.

NEW YORK: Long Island: Anthem (516) 864-6600; Arrow/Schweber (516) 231-1000; Hall-Mark (516) 737-0600; Marshall (516) 273-2424; Zeus (914) 937-7400.

Rochester: Arrow/Schweber (716) 427-0300; Hall-Mark (716) 425-3300; Marshall (716) 235-7620.

Syracuse: Marshall (607) 785-2345.

NORTH CAROLINA: Arrow/Schweber (919) 876-3132; Hall-Mark (919) 872-0712; Marshall (919) 878-9882.

OHIO: Cleveland: Arrow/Schweber (216) 248-3990; Hall-Mark (216) 349-4632; Marshall (216) 248-1788.

Columbus: Hall-Mark (614) 888-3313.

Dayton: Arrow/Schweber (513) 435-5563; Marshall (513) 898-4480; Zeus (513) 293-6162.

OKLAHOMA: Arrow/Schweber (918) 252-7537; Hall-Mark (918) 254-6110.

OREGON: Almac/Arrow (503) 629-8090; Anthem (503) 643-1114; Marshall (503) 644-5050; Wyle (503) 643-7900.

PENNSYLVANIA: Anthem (215) 443-5150; Arrow/Schweber (215) 928-1800; GRS (215) 922-7037; (609) 964-8560; Marshall (412) 788-0441.

TEXAS: Austin: Arrow/Schweber (512) 835-4180; Hall-Mark (512) 258-8848; Marshall (512) 837-1991; Wyle (512) 345-8853;

Dallas: Anthem (214) 238-7100; Arrow/Schweber (214) 380-6464; Hall-Mark (214) 553-4300; Marshall (214) 233-5200; Wyle (214) 235-9953; Zeus (214) 783-7010;

Houston: Arrow/Schweber (713) 530-4700; Hall-Mark (713) 781-6100; Marshall (713) 467-1666; Wyle (713) 879-9953.

UTAH: Anthem (801) 973-8555; Arrow/Schweber (801) 973-6913; Marshall (801) 973-2288; Wyle (801) 974-9953.

WASHINGTON: Almac/Arrow (206) 643-9992, Anthem (206) 483-1700; Marshall (206) 486-5747; Wyle (206) 881-1150.

WISCONSIN: Arrow/Schweber (414) 792-0150; Hall-Mark (414) 797-7844; Marshall (414) 797-8400.

CANADA: Calgary: Future (403) 235-5325;

Edmonton: Future (403) 438-2858;

Montreal: Arrow/Schweber (514) 421-7411; Future (514) 694-7710; Marshall (514) 694-8142

Ottawa: Arrow/Schweber (613) 226-6903; Future (613) 820-8313.

Quebec: Future (418) 897-6666.

Toronto: Arrow/Schweber (416) 670-7769; Future (416) 612-9200; Marshall (416) 458-8046.

Vancouver: Arrow/Schweber (604) 421-2333; Future (604) 294-1166.

TI Die Processors

Chip Supply	(407) 298-7100
Elmo Semiconductor	(818) 768-7400
Minco Technology Labs	(512) 834-2022

TEXAS INSTRUMENTS

D0892

©1992 Texas Instruments Incorporated

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
5962-87671013A	Active	Production	LCCC (FD) | 28	42 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-87671013A TIBPAL20 L8-20MFDB
5962-87671013A.A	Active	Production	LCCC (FD) | 28	42 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-87671013A TIBPAL20 L8-20MFDB
5962-87671043A	Active	Production	LCCC (FD) | 28	42 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-87671043A TIBPAL20 R4-20MFDB
5962-87671043A.A	Active	Production	LCCC (FD) | 28	42 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-87671043A TIBPAL20 R4-20MFDB
5962-8767104LA	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8767104LA TIBPAL20R4-20M JTB
5962-8767104LA.A	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8767104LA TIBPAL20R4-20M JTB
8412901XA	Active	Production	LCCC (FK) | 28	42 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8412901XA TIBPAL20 L8-20MFKB
8412901XA.A	Active	Production	LCCC (FK) | 28	42 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8412901XA TIBPAL20 L8-20MFKB
8412902LA	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8412902LA TIBPAL20R8-20M JTB
8412902LA.A	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8412902LA TIBPAL20R8-20M JTB

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
8412904LA	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8412904LA TIBPAL20R4-20M JTB
8412904LA.A	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	8412904LA TIBPAL20R4-20M JTB
JM38510/50501BLA	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 50501BLA
JM38510/50501BLA.A	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 50501BLA
JM38510/50502BLA	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 50502BLA
JM38510/50502BLA.A	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 50502BLA
JM38510/50504BLA	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 50504BLA
JM38510/50504BLA.A	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 50504BLA
M38510/50501BLA	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 50501BLA
M38510/50502BLA	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 50502BLA
M38510/50504BLA	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	JM38510/ 50504BLA
TIBPAL20R4-20MJT	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	TIBPAL20R4-20M JT
TIBPAL20R4-20MJT.A	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	TIBPAL20R4-20M JT
TIBPAL20R4-20MJTB	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8767104LA TIBPAL20R4-20M JTB
TIBPAL20R4-20MJTB.A	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8767104LA TIBPAL20R4-20M JTB

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TIBPAL20R8-20MJTB	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8767102LA TIBPAL20R8-20M JTB
TIBPAL20R8-20MJTB.A	Active	Production	CDIP (JT) | 24	15 | TUBE	No	SNPB	N/A for Pkg Type	-55 to 125	5962-8767102LA TIBPAL20R8-20M JTB

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

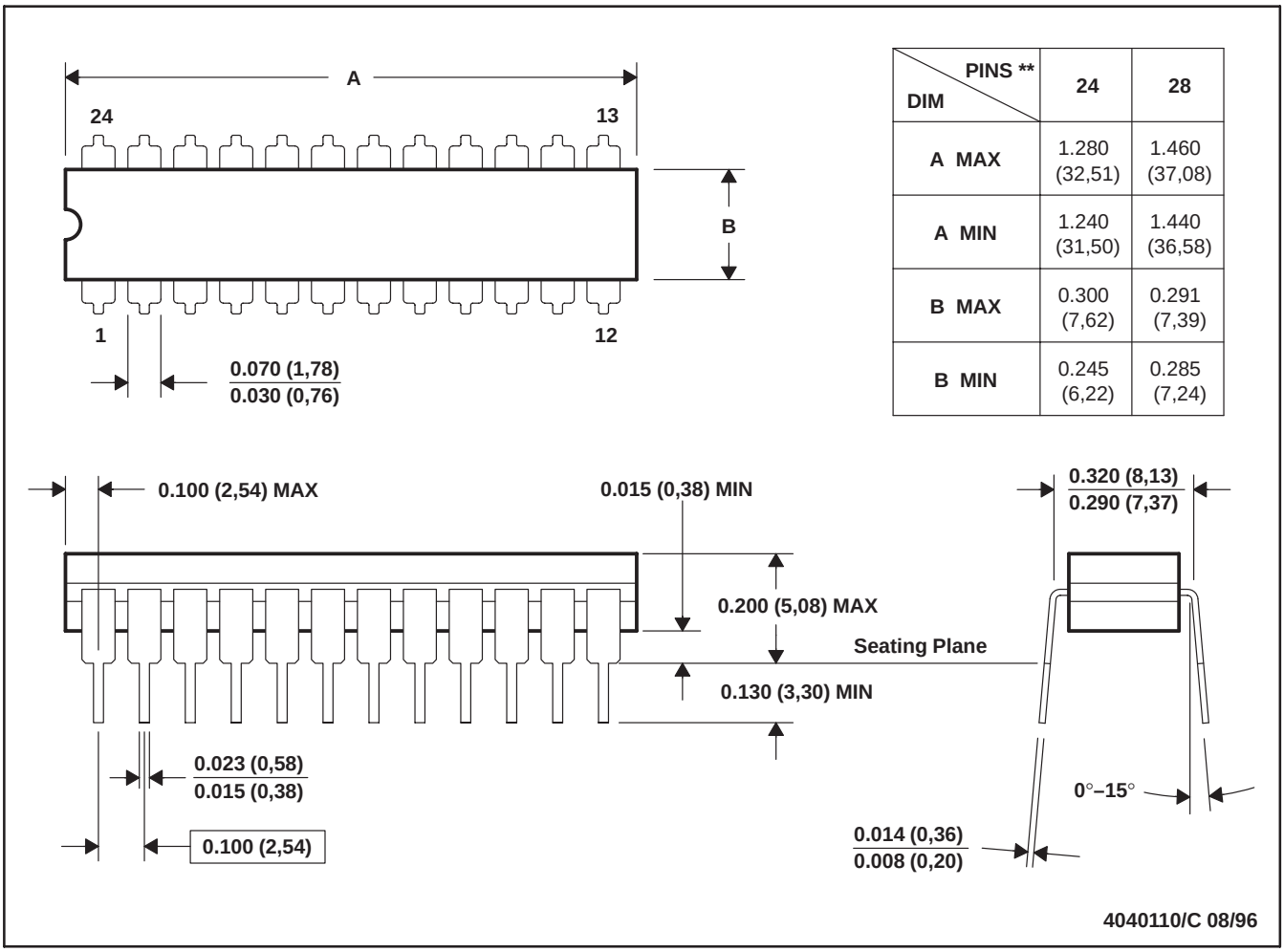
Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

MCER004A – JANUARY 1995 – REVISED JANUARY 1997

JT (R-GDIP-T)** **CERAMIC DUAL-IN-LINE**

24 LEADS SHOWN

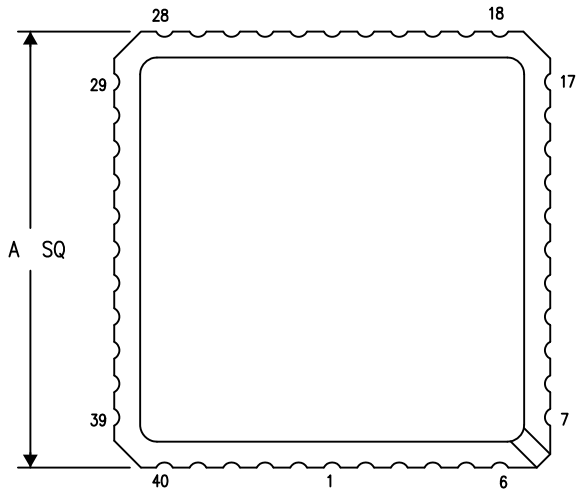


DIM \ PINS **	24	28
A MAX	1.280 (32,51)	1.460 (37,08)
A MIN	1.240 (31,50)	1.440 (36,58)
B MAX	0.300 (7,62)	0.291 (7,39)
B MIN	0.245 (6,22)	0.285 (7,24)

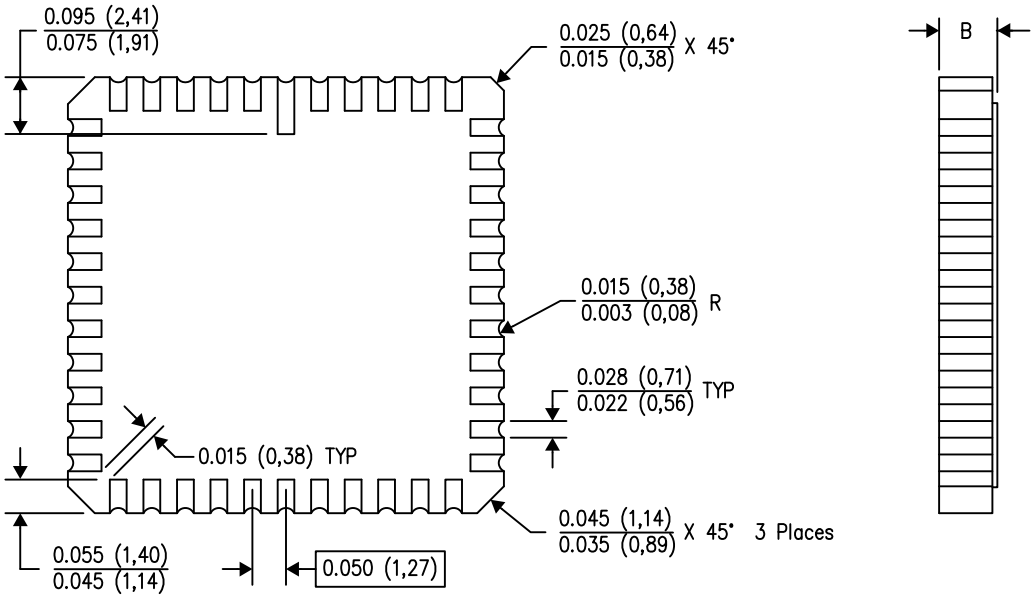
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification.
E. Falls within MIL STD 1835 GDIP3-T24, GDIP4-T28, and JEDEC MO-058 AA, MO-058 AB

FD (S–CQCC–N**) LEADLESS CERAMIC CHIP CARRIER

44 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.064 (1,63)	0.080 (2,03)
28	0.442 (11,23)	0.458 (11,63)	0.064 (1,63)	0.080 (2,03)
44	0.640 (16,26)	0.660 (16,76)	0.069 (1,75)	0.120 (3,05)
52	0.739 (18,78)	0.761 (19,33)	0.082 (2,08)	0.120 (3,05)
68	0.938 (23,83)	0.962 (24,43)	0.082 (2,08)	0.120 (3,05)
84	1.135 (28,83)	1.165 (29,59)	0.082 (2,08)	0.120 (3,05)

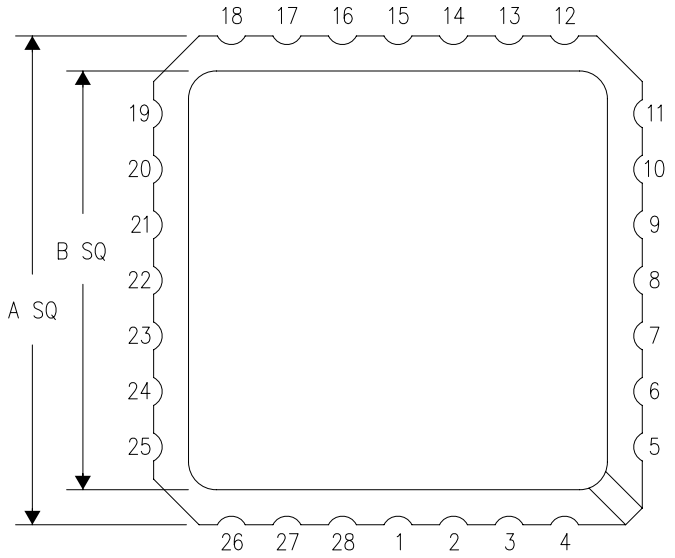


4040136/C 08/12

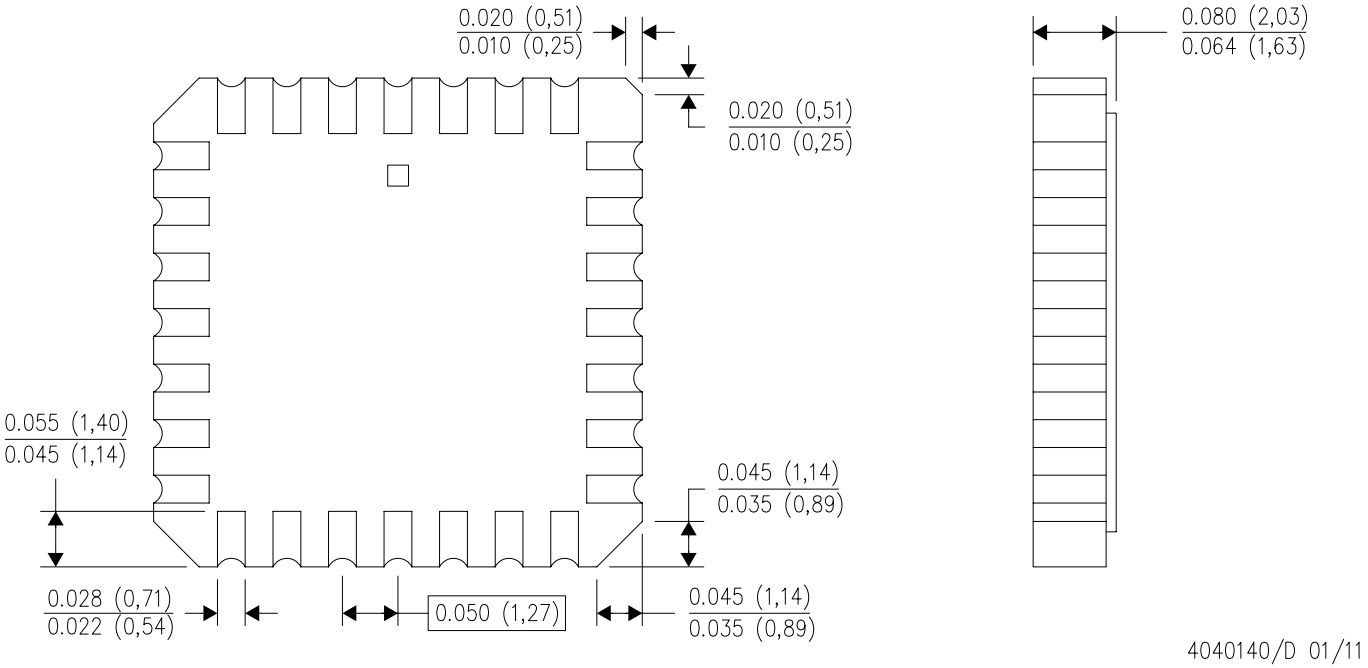
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a metal lid.
D. The terminals will be gold plated.
E. Falls within JEDEC MS–004.

FK (S–CQCC–N**) LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.740 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



4040140/D 01/11

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a metal lid.
D. Falls within JEDEC MS–004

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2025, Texas Instruments Incorporated