

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

SRPS021 – D2920, JUNE 1986 – REVISED AUGUST 1989

- 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 PORT S
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

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 further reduction in board space.

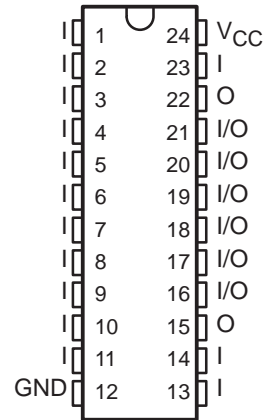
Extra circuitry has been provided to allow loading of each register asynchronously to either a high or low state. This feature simplifies testing because the registers can be set to an initial state prior to executing the test sequence.

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.

These devices are covered by U.S. Patent 4,410,987.
 IMPACT is a trademark of Texas Instruments Incorporated.
 PAL is a registered trademark of Advanced Micro Devices Inc.

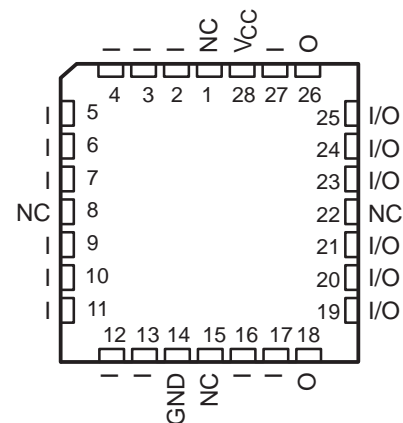
TIBPAL20L8'
 C SUFFIX . . . JT OR NT PACKAGE
 M SUFFIX . . . JT OR W PACKAGE

(TOP VIEW)



TIBPAL20L8'
 C SUFFIX . . . FN PACKAGE
 M SUFFIX . . . FK PACKAGE

(TOP VIEW)



NC – No internal connection
 Pin assignments in operating mode

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.

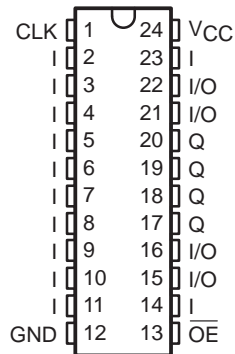


TIBPAL20R4-15C, TIBPAL20R6-15C, TIBPAL20R8-15C
TIBPAL20R4-20M, TIBPAL20R6-20M, TIBPAL20R8-20M
HIGH-PERFORMANCE *IMPACT*™ *PAL*® CIRCUITS

SRPS021 – D2920, JUNE 1986 – REVISED AUGUST 1989

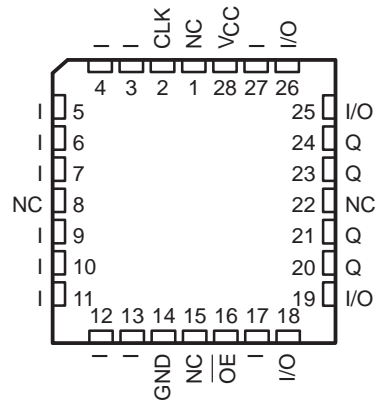
TIBPAL20R4'
C SUFFIX ... JT OR NT PACKAGE
M SUFFIX ... JT OR W PACKAGE

(TOP VIEW)



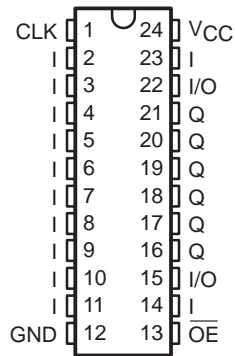
TIBPAL20R4'
C SUFFIX ... FN PACKAGE
M SUFFIX ... FK PACKAGE

(TOP VIEW)



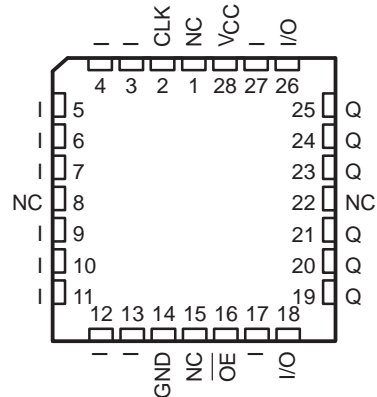
TIBPAL20R6'
C SUFFIX ... JT OR NT PACKAGE
M SUFFIX ... JT OR W PACKAGE

(TOP VIEW)



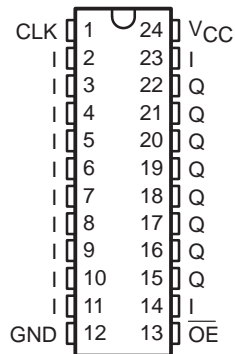
TIBPAL20R6'
C SUFFIX ... FN PACKAGE
M SUFFIX ... FK PACKAGE

(TOP VIEW)



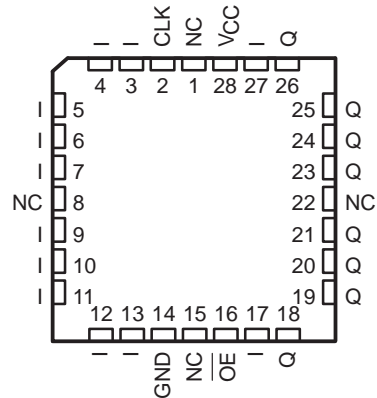
TIBPAL20R8'
C SUFFIX ... JT OR NT PACKAGE
M SUFFIX ... JT OR W PACKAGE

(TOP VIEW)



TIBPAL20R8'
C SUFFIX ... FN PACKAGE
M SUFFIX ... FK PACKAGE

(TOP VIEW)



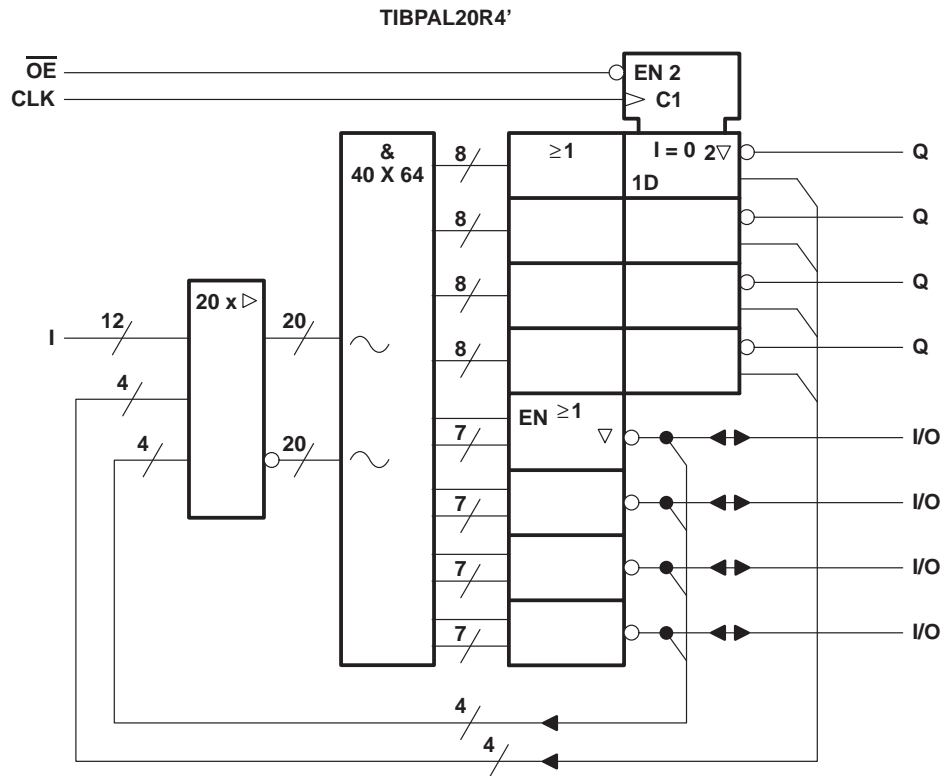
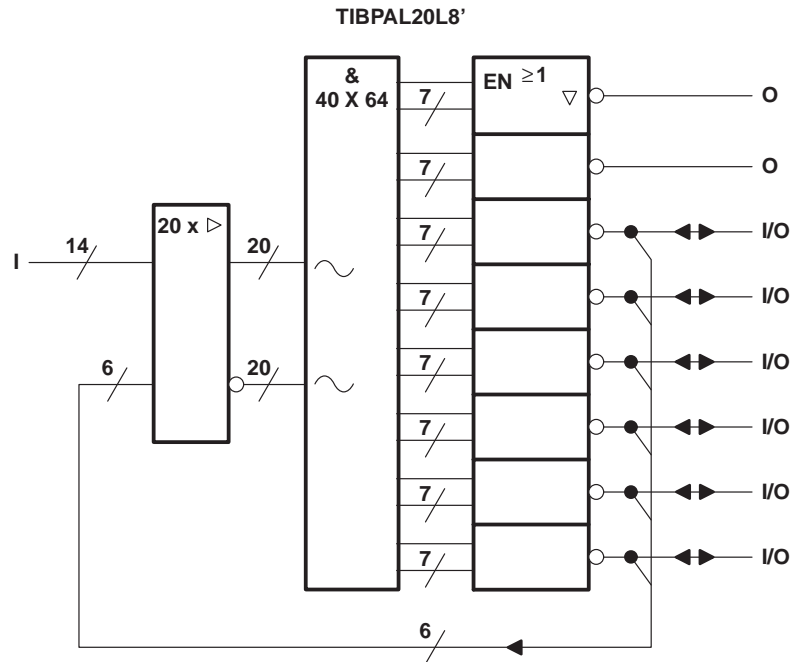
Pin assignments in operating mode

NC – No internal connection



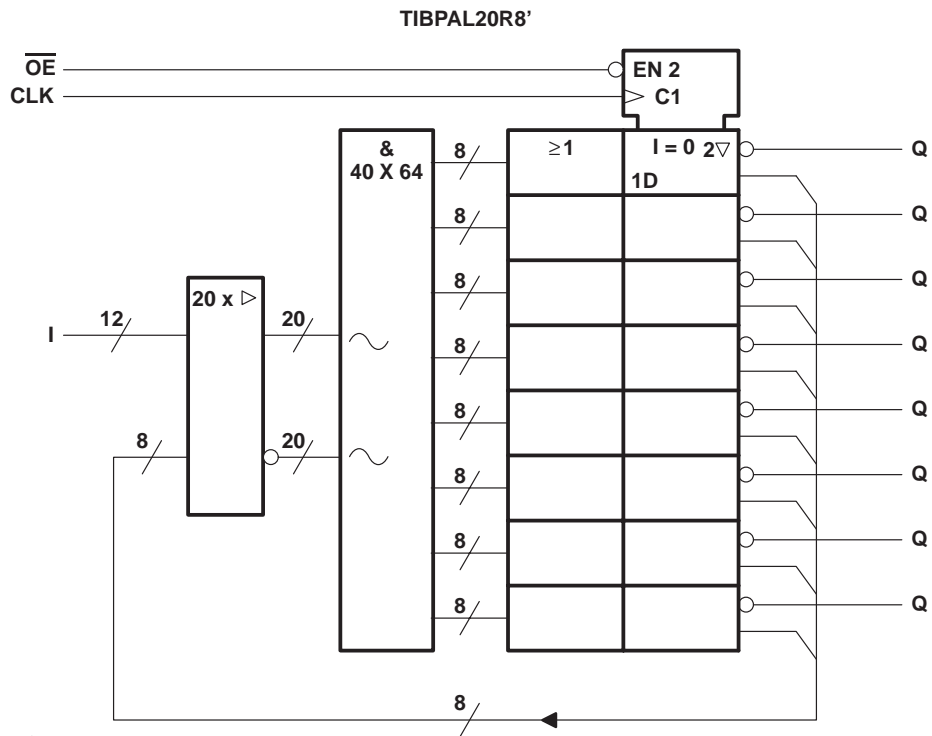
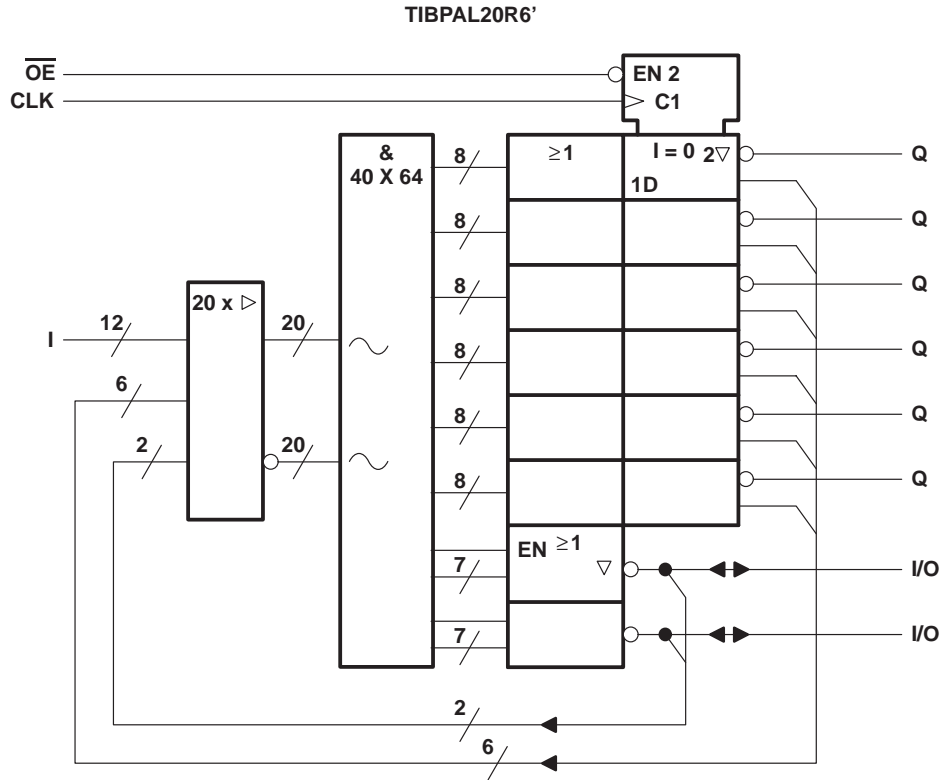
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

functional block diagrams (positive logic)



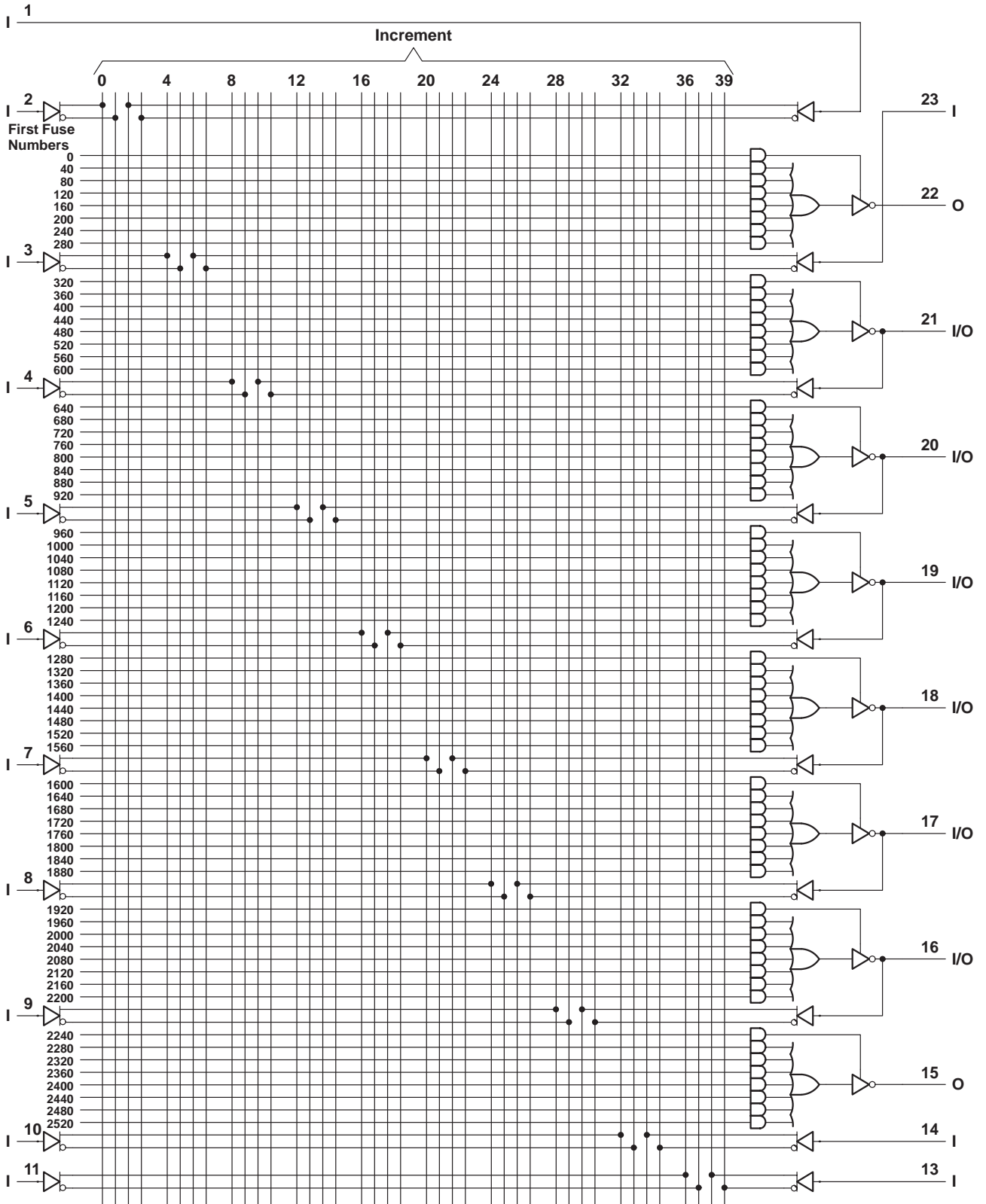
~ denotes fused inputs

functional block diagrams (positive logic)



~ denotes fused inputs

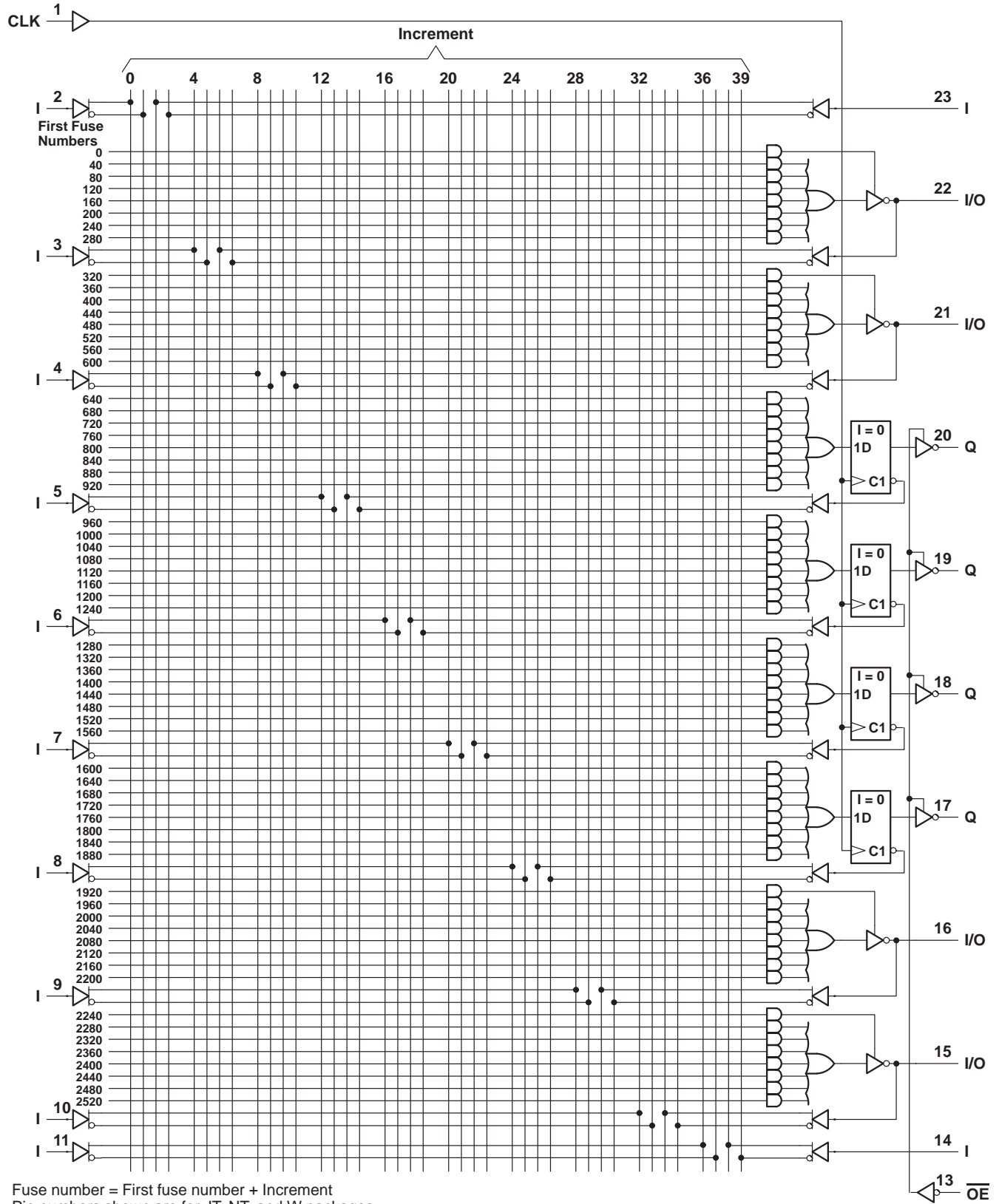
logic diagram (positive logic)



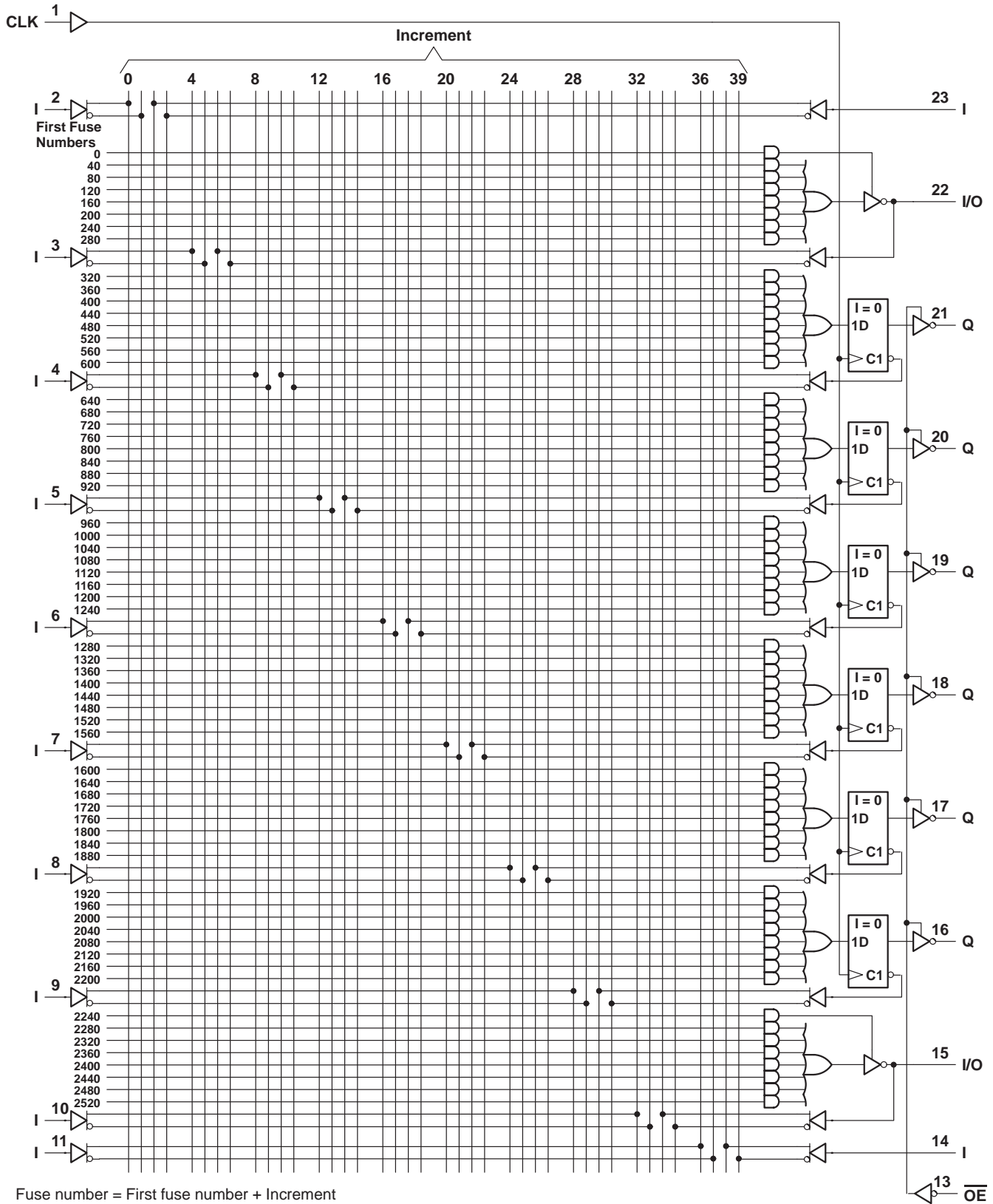
Fuse number = First fuse number + Increment
 Pin numbers shown are for JT, NT, and W packages.

TIBPAL20R4-15C
TIBPAL20R4-20M
HIGH-PERFORMANCE *IMPACT*™ PAL® CIRCUITS
SRPS021 – D2920, JUNE 1986 – REVISED AUGUST 1989

logic diagram (positive logic)



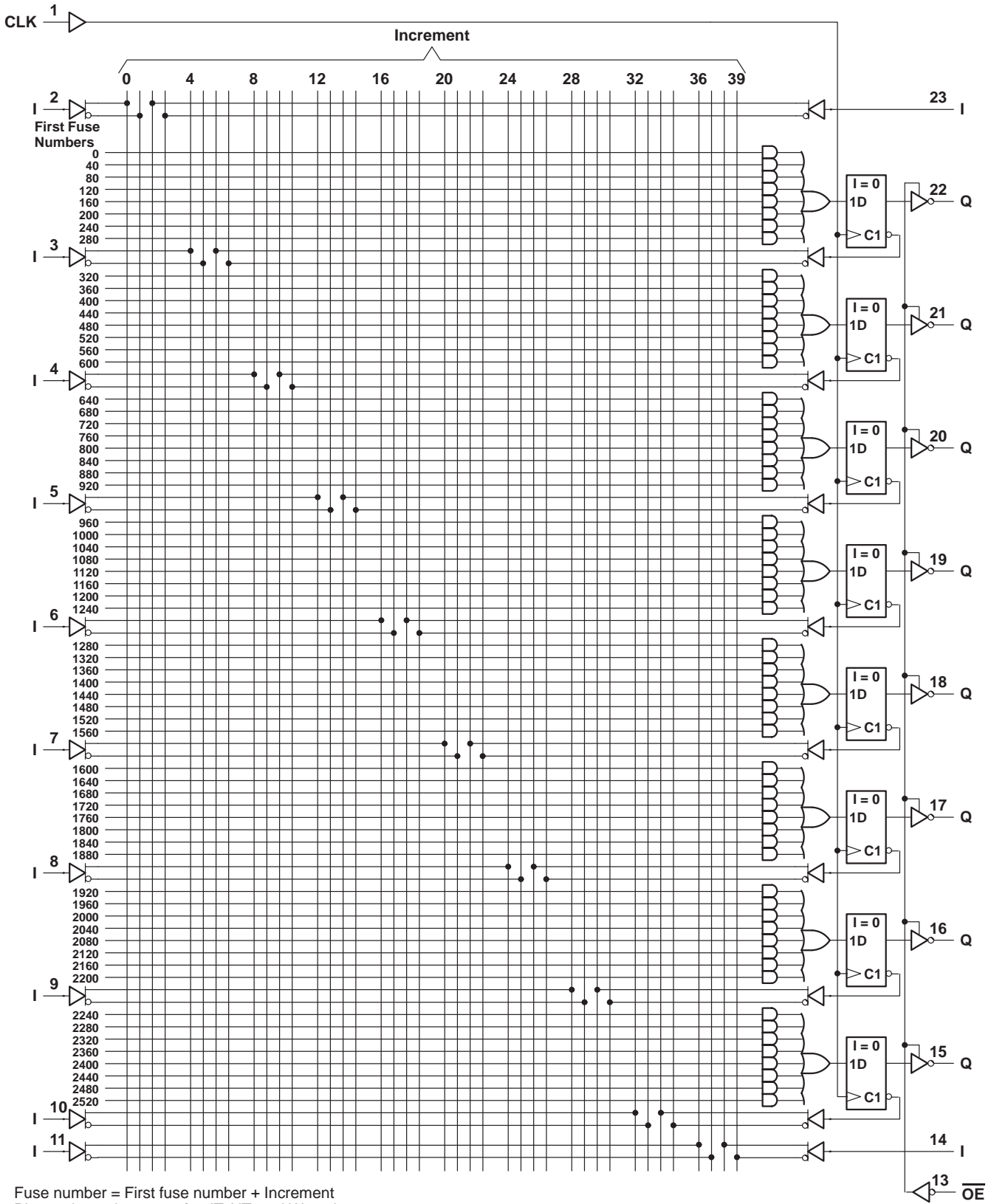
logic diagram (positive logic)



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.



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

SRPS021 – D2920, JUNE 1986 – REVISED AUGUST 1989

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}^\dagger	Clock frequency	0		45	MHz
t_w^\dagger	Pulse duration, clock	High	10		ns
		Low	12		
t_{su}^\dagger	Setup time, input or feedback before clock \uparrow	15			ns
t_h^\dagger	Hold time, input or feedback after clock \uparrow	0			ns
T_A	Operating free-air temperature	0	25	75	°C

$^\dagger f_{clock}$, t_w , t_{su} , and t_h do not apply for TIBPAL20L8'.



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

SRPS021 – D2920, JUNE 1986 – REVISED AUGUST 1989

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,	$\frac{V_I}{OE} = 0,$ 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}	OE	Q			10	15	ns
t _{dis}	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.

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

f_{max} does not apply for TIBPAL20L8.



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

SRPS021 – D2920, JUNE 1986 – REVISED AUGUST 1989

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}^\dagger	Clock frequency	0		41.6	MHz
t_w^\dagger	Pulse duration, clock	High		12	ns
		Low		12	
t_{su}^\dagger	Setup time, input or feedback before clock \uparrow	20			ns
t_h^\dagger	Hold time, input or feedback after clock \uparrow	0			ns
T_A	Operating free-air temperature	–55	25	125	°C

$^\dagger f_{clock}$, t_w , t_{su} , and t_h do not apply for TIBPAL20L8'.



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

SRPS021 – D2920, JUNE 1986 – REVISED AUGUST 1989

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}	OE	Q			10	20	ns
t _{dis}	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.

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

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.

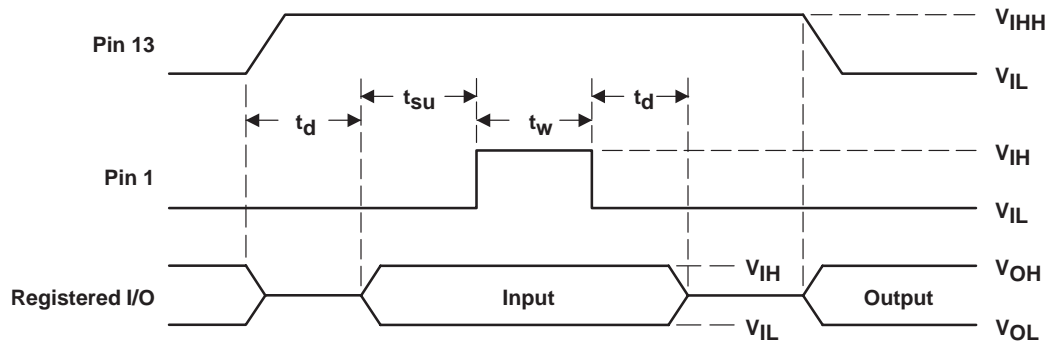


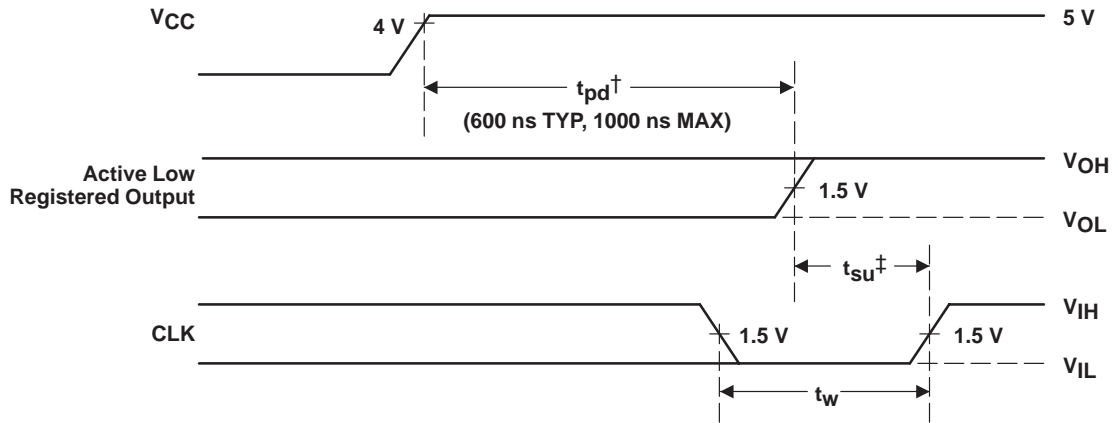
Figure 1. Preload Waveforms

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. $t_d = t_{su} = t_h = 100 \text{ ns to } 1000 \text{ ns}$ $V_{IHH} = 10.25 \text{ V to } 10.75 \text{ v}$

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.

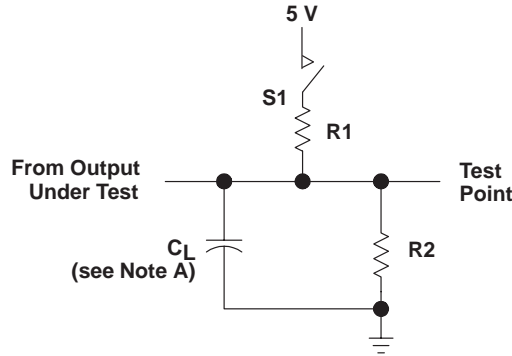


† This is the power-up reset time and applies to registered outputs only. The values shown are from characterization data.

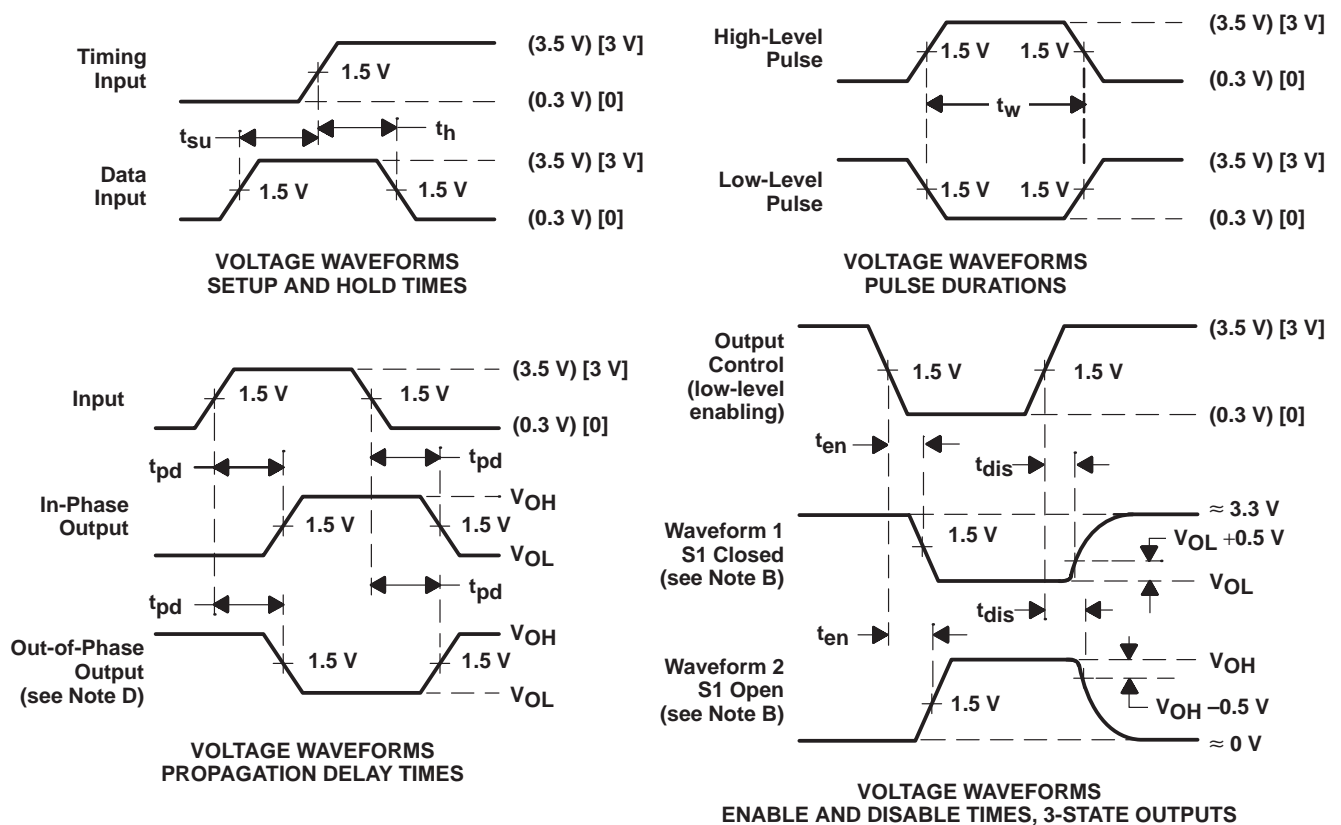
‡ This is the setup time for input or feedback.

Figure 2. Power-Up Reset Waveforms

PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT FOR 3-STATE OUTPUTS



- 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 high except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is low 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 (). $PRR \leq 1$ MHz, $t_r = t_f \leq 2$ ns, duty cycle = 50%. For M suffix, use the voltage levels indicated in brackets []. $PRR \leq 10$ 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; Hall-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



D0892

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.