

TIBPAL16L8-7C, TIBPAL16R4-7C, TIBPAL16R6-7C, TIBPAL16R8-7C TIBPAL16L8-10M, TIBPAL16R4-10M, TIBPAL16R6-10M, TIBPAL16R8-10M HIGH-PERFORMANCE *IMPACT-X*™ *PAL*® CIRCUITS

SRPS006E - D3115, MAY 1988 - REVISED DECEMBER 2010

- **High-Performance Operation:**
 - $f_{\max}$ (no feedback)
 - TIBPAL16R'-7C Series . . . 100 MHz Min
 - TIBPAL16R'-10M Series . . . 62.5 MHz Min
 - $f_{\max}$ (internal feedback)
 - TIBPAL16R'-7C Series . . . 100 MHz Min
 - TIBPAL16R'-10M Series . . . 62.5 MHz Min
 - $f_{\max}$ (external feedback)
 - TIBPAL16R'-7C Series . . . 74 MHz Min
 - TIBPAL16R'-10M Series . . . 52.5 MHz Min
 - Propagation Delay
 - TIBPAL16L'-7C Series . . . 7 ns Max
 - TIBPAL16L'-10M Series . . . 10 ns Max
- Functionally Equivalent, but Faster than, Existing 20-Pin PLDs
- Preload Capability on Output Registers Simplifies Testing
- Power-Up Clear on Registered Devices (All Register Outputs are Set Low, but Voltage Levels at the Output Pins Go High)
- Package Options Include Both Plastic and Ceramic Chip Carriers in Addition to Plastic and Ceramic DIPs
- Security Fuse Prevents Duplication
- Dependable Texas Instruments Quality and Reliability

DEVICE	I INPUTS	3-STATE O OUTPUTS	REGISTERED Q OUTPUTS	I/O PORT S
PAL16L8	10	2	0	6
PAL16R4	8	0	4 (3-state buffers)	4
PAL16R6	8	0	6 (3-state buffers)	2
PAL16R8	8	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-X*™ 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.

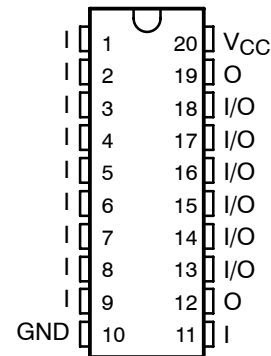
All of the register outputs are set to a low level during power-up. Extra circuitry has been provided to allow loading of each register asynchronously to either a high or low state. This feature simplifies testing because the registers can be set to an initial state prior to executing the test sequence.

The TIBPAL16' C series is characterized from 0°C to 75°C. The TIBPAL16' M series is characterized for operation over the full military temperature range of -55°C to 125°C.

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

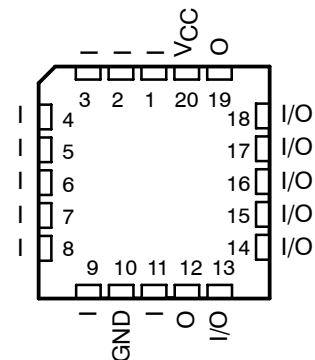
TIBPAL16L8'
C SUFFIX . . . J OR N PACKAGE
M SUFFIX . . . J PACKAGE

(TOP VIEW)

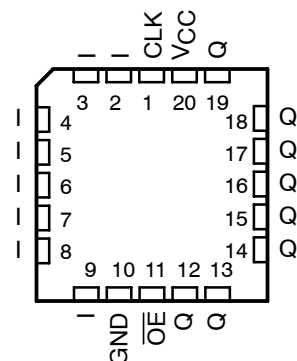
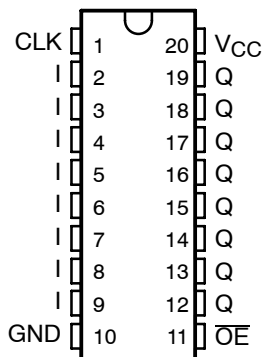
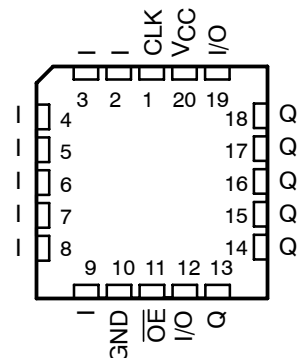
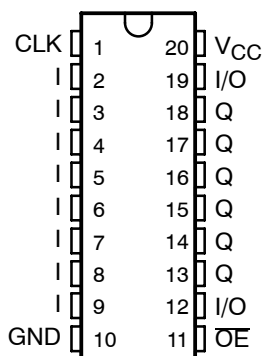
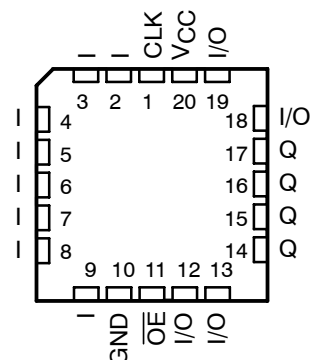
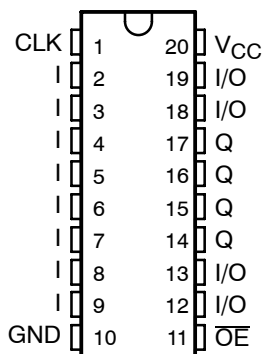


TIBPAL16L8'
C SUFFIX . . . FN PACKAGE
M SUFFIX . . . FK PACKAGE

(TOP VIEW)

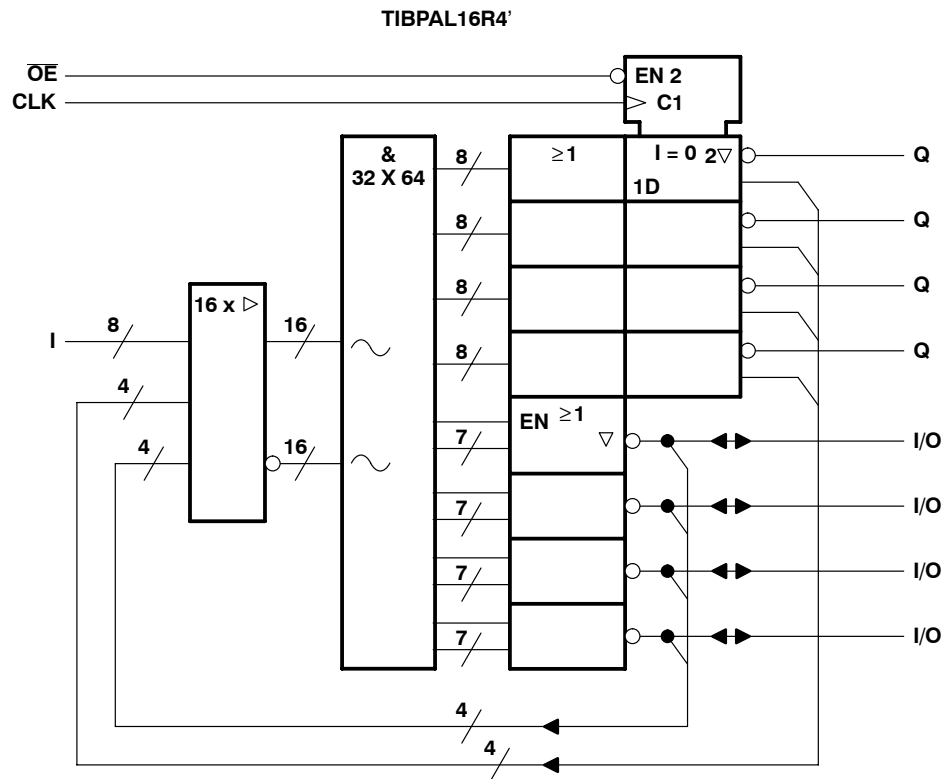
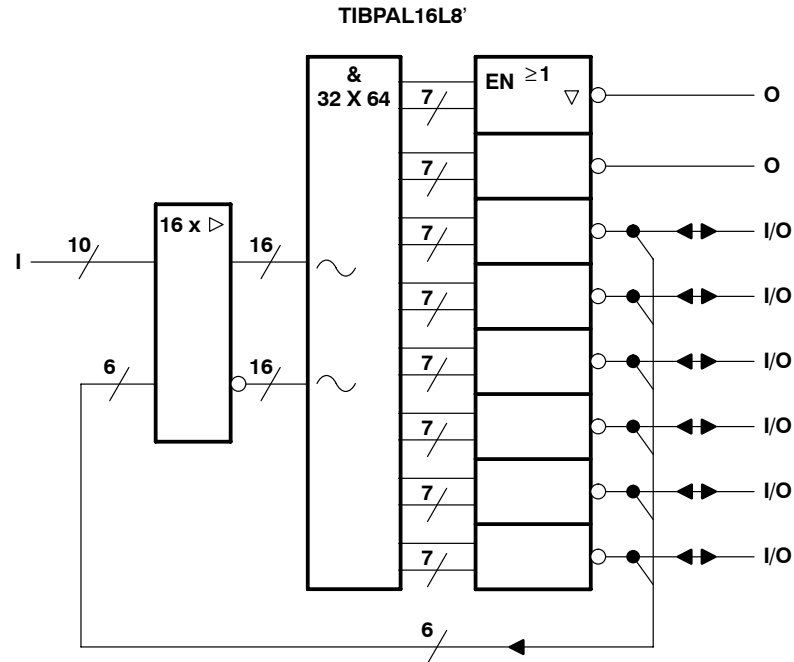


Pin assignments in operating mode



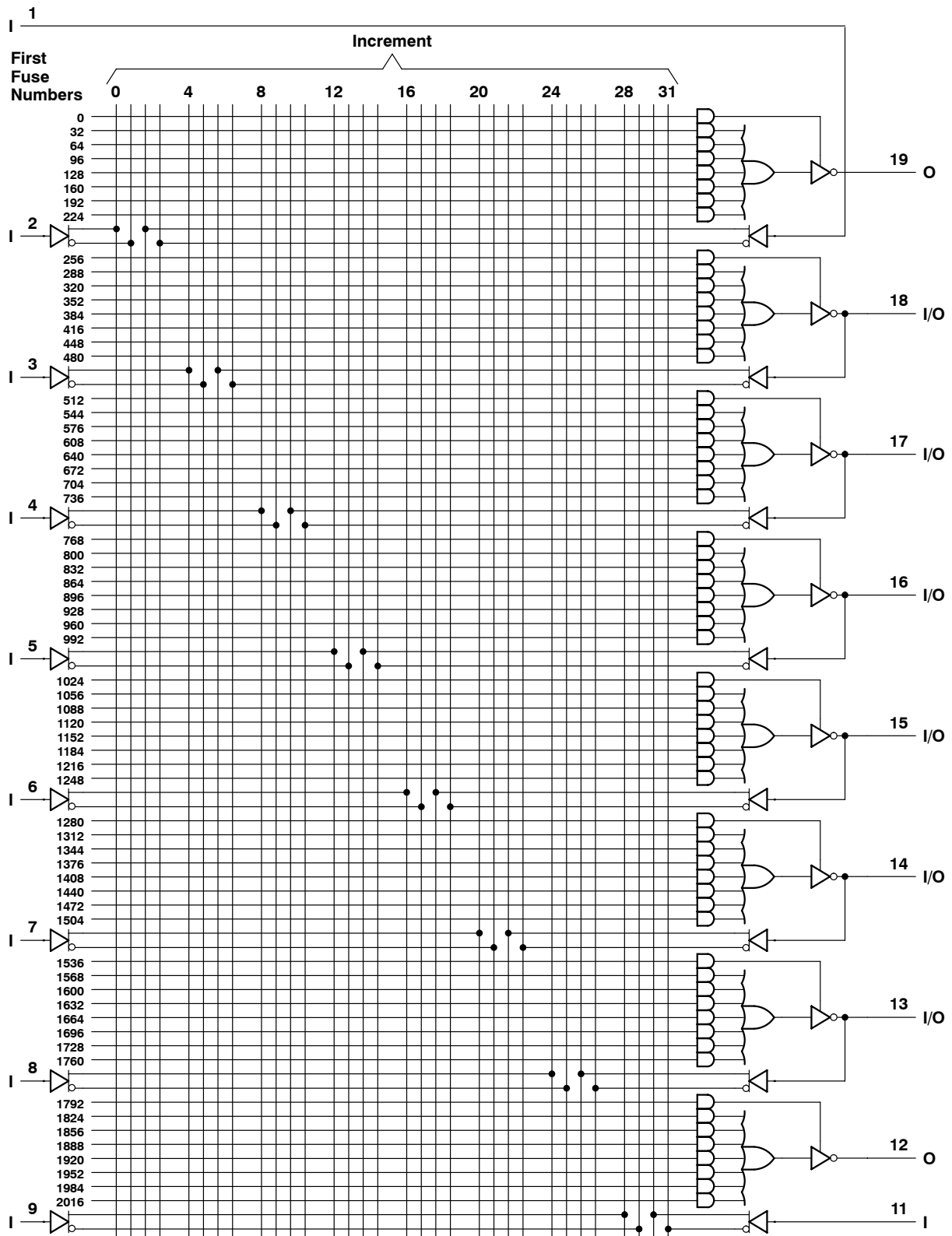
Pin assignments in operating mode

functional block diagrams (positive logic)



$\sim$ denotes fused inputs

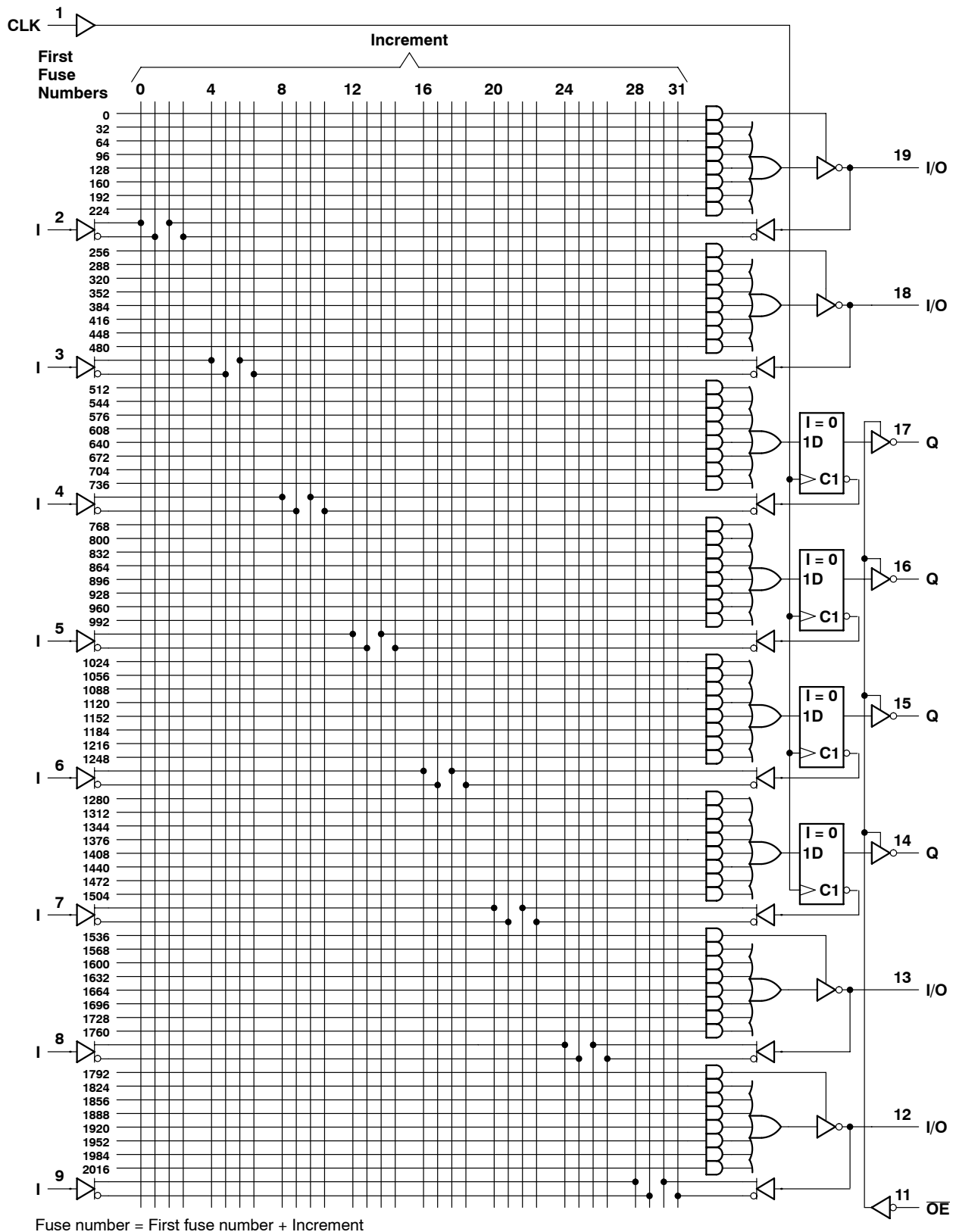
logic diagram (positive logic)



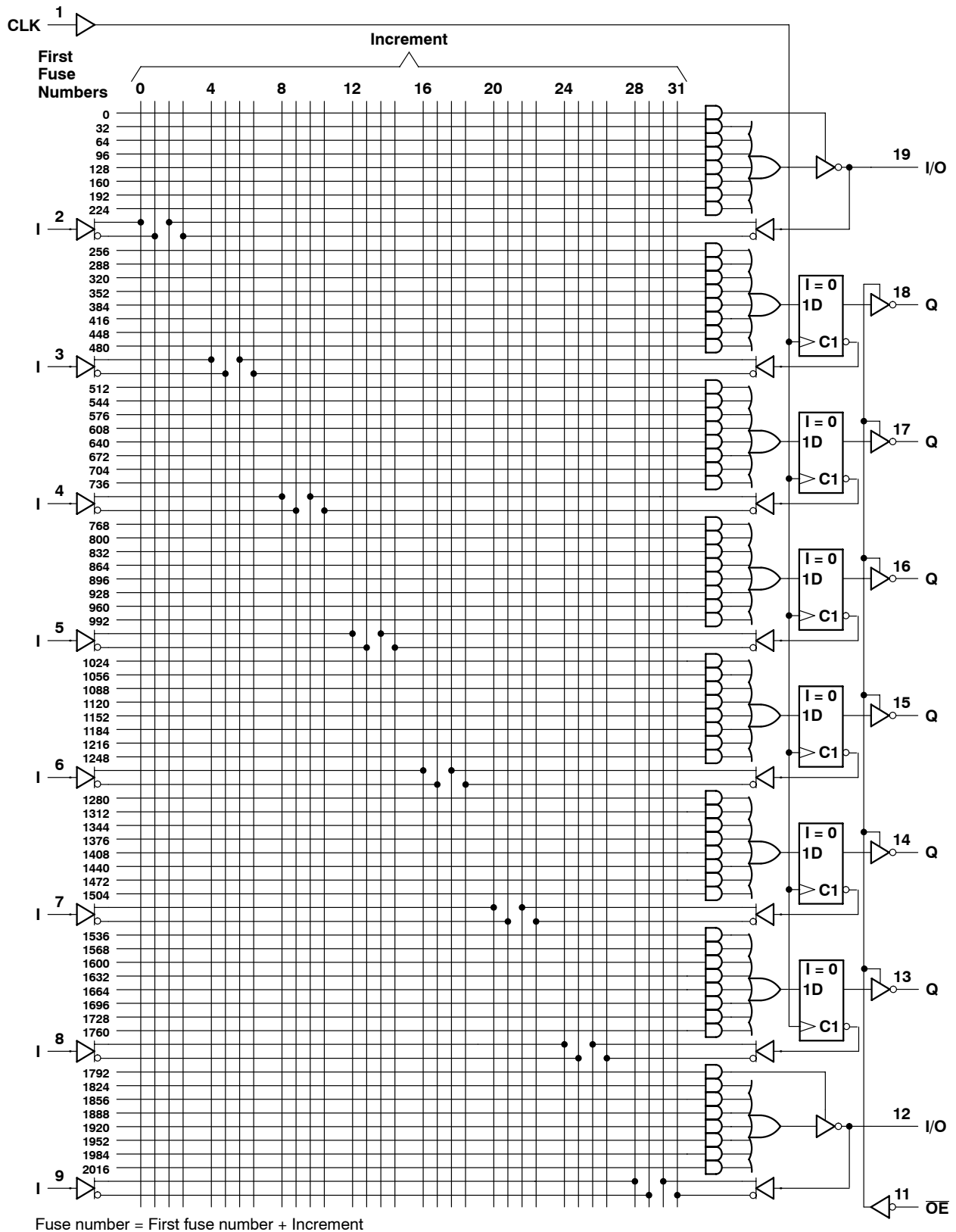
Fuse number = First fuse number + Increment

TIBPAL16R4-7C**TIBPAL16R4-10M****HIGH-PERFORMANCE *IMPACT-X*™ PAL® CIRCUITS**

SRPS006E - D3115, MAY 1988 - REVISED DECEMBER 2010

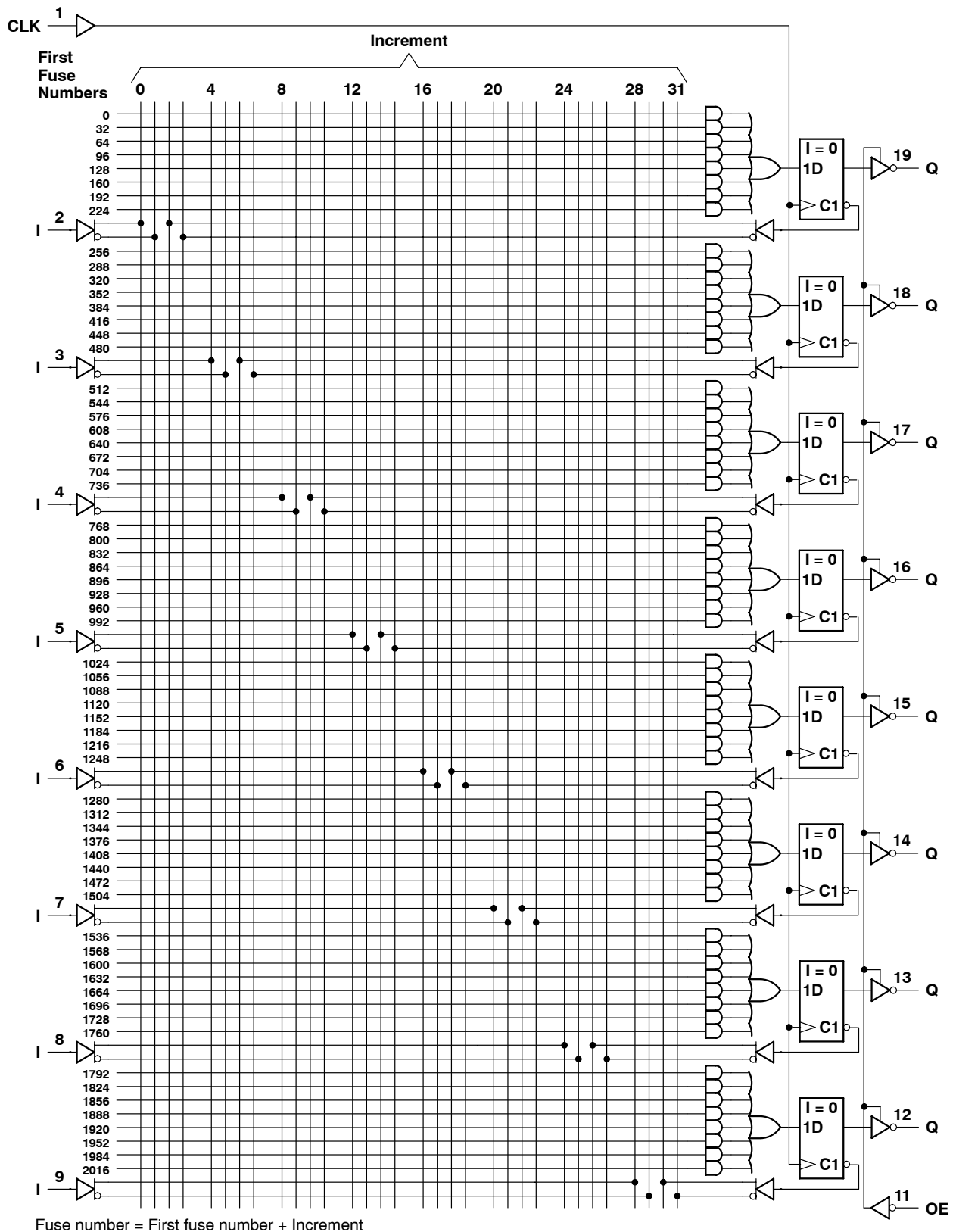
logic diagram (positive logic)

logic diagram (positive logic)



TIBPAL16R8-7C**TIBPAL16R8-10M****HIGH-PERFORMANCE *IMPACT-X*™ PAL® CIRCUITS**

SRPS006E - D3115, MAY 1988 - REVISED DECEMBER 2010

logic diagram (positive logic)

TIBPAL16L8-7C, TIBPAL16R4-7C, TIBPAL16R6-7C, TIBPAL16R8-7C

HIGH-PERFORMANCE *IMPACT-X*™ PAL® CIRCUITS

SRPS006E – D3115, MAY 1988 – REVISED DECEMBER 2010

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 (see Note 2)	2		5.5	V
V_{IL} Low-level input voltage (see Note 2)			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		100	MHz
t_w Pulse duration, clock (see Note 2)	High		5	ns
	Low		5	
t_{su} Setup time, input or feedback before clock↑	7			ns
t_h Hold time, input or feedback after clock↑	0			ns
T_A Operating free-air temperature	0	25	75	°C

NOTE 2: These are absolute voltage levels with respect to the ground pin of the device and include all overshoots due to system and/or tester noise. Testing these parameters should not be attempted without suitable equipment.

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	3.2		V
V_{OL}	$V_{CC} = 4.75$ V,	$I_{OL} = 24$ mA		0.3	0.5	V
$I_{OZH}^{\ddagger}$	$V_{CC} = 5.25$ V,	$V_O = 2.7$ V			100	μA
$I_{OZL}^{\ddagger}$	$V_{CC} = 5.25$ V,	$V_O = 0.4$ V			–100	μA
I_I	$V_{CC} = 5.25$ V,	$V_I = 5.5$ V			100	μA
$I_{IH}^{\ddagger}$	$V_{CC} = 5.25$ V,	$V_I = 2.7$ V			25	μA
$I_{IL}^{\ddagger}$	$V_{CC} = 5.25$ V,	$V_I = 0.4$ V		–80	–250	μA
$I_{OS}^{\S}$	$V_{CC} = 5.25$ V,	$V_O = 0.5$ V	–30	–70	–130	mA
I_{CC}	$V_{CC} = 5.25$ V,	$V_I = 0$, Outputs open		160	180	mA
C_i	$f = 1$ MHz,	$V_I = 2$ V		5		pF
C_o	$f = 1$ MHz,	$V_O = 2$ V		6		pF
C_{clk}	$f = 1$ MHz,	$V_{CLK} = 2$ V		6		pF

† All typical values are at $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$.‡ I/O leakage is the worst case of I_{OZL} and I_{IL} or I_{OZH} and I_{IH} respectively.§ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second. V_O is set at 0.5 V to avoid test problems caused by test equipment ground degradation.

TIBPAL16L8-7C, TIBPAL16R4-7C, TIBPAL16R6-7C, TIBPAL16R8-7C
HIGH-PERFORMANCE *IMPACT-X*™ *PAL*® CIRCUITS

SRPS006E – D3115, MAY 1988 – REVISED DECEMBER 2010

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} [‡]	without feedback			R1 = 200 Ω, R2 = 390 Ω, See Figure 6	100			MHz	
	with internal feedback (counter configuration)				100				
	with external feedback				74				
t _{pd}	I, I/O	O, I/O	1 or 2 outputs switching		3	5.5	7	ns	
			8 outputs switching		3	6	7.5		
t _{pd}	CLK↑	Q				2	4	6.5	ns
t _{pd} [§]	CLK↑	Feedback input				3			ns
t _{en}	OE↓	Q					4	7.5	ns
t _{dis}	OE↑	Q					4	7.5	ns
t _{en}	I, I/O	O, I/O					6	9	ns
t _{dis}	I, I/O	O, I/O					6	9	ns
t _{sk(o)} [¶]	Skew between registered outputs					0.5			ns

† All typical values are at $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$.‡ See section for $f_{\max}$ specifications.§ This parameter applies to TIBPAL16R4' and TIBPAL16R6' only (see Figure 4 for illustration) and is calculated from the measured $f_{\max}$ with internal feedback in the counter configuration.¶ This parameter is the measurement of the difference between the fastest and slowest t_{pd} (CLK-to-Q) observed when multiple registered outputs are switching in the same direction.

TIBPAL16L8-10M, TIBPAL16R4-10M, TIBPAL16R6-10M, TIBPAL16R8-10M HIGH-PERFORMANCE *IMPACT-X*™ *PAL*® CIRCUITS

SRPS006E – D3115, MAY 1988 – REVISED DECEMBER 2010

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		62.5	MHz
t_w Pulse duration, clock (see Note 2)	High	8		ns
	Low	8		
$t_{su}^{\dagger}$ Setup time, input or feedback before clock $\uparrow$	10			ns
$t_h^{\dagger}$ Hold time, input or feedback after clock $\uparrow$	0			ns
T_A Operating free-air temperature	–55	25	125	°C

NOTE 2: These are absolute voltage levels with respect to the ground pin of the device and include all overshoots due to system and/or tester noise. Testing these parameters should not be attempted without suitable equipment.

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
$I_{OZH}^{\ddagger}$	$V_{CC} = 5.5$ V, $V_O = 2.7$ V			100	μA
$I_{OZL}^{\ddagger}$	0, Q outputs I/O ports	$V_{CC} = 5.5$ V, $V_O = 0.4$ V		–0.1	mA
				–0.25	
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	
$I_{IL}^{\ddagger}$	$V_{CC} = 5.5$ V, $V_I = 0.4$ V		–0.08	–0.25	mA
$I_{OS}^{\S}$	$V_{CC} = 5.5$ V, $V_O = 0.5$ V	–30	–70	–130	mA
I_{CC}	$V_{CC} = 5.5$ V, $V_I = GND$, Outputs open		140	200	mA
C_i	$f = 1$ MHz, $V_I = 2$ V		5		pF
C_o	$f = 1$ MHz, $V_O = 2$ V		6		pF
$C_{clk/oe}$	$f = 1$ MHz, $V_{CLK/OE} = 2$ V		6		pF

 † All typical values are at $V_{CC} = 5$ V, $T_A = 25^{\circ}\text{C}$. ‡ I/O leakage is the worst case of I_{OZL} and I_{IL} or I_{OZH} and I_{IH} respectively. § Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second. V_O is set at 0.5 V to avoid test problems caused by test equipment ground degradation.

TIBPAL16L8-10M, TIBPAL16R4-10M, TIBPAL16R6-10M, TIBPAL16R8-10M

HIGH-PERFORMANCE *IMPACT-X*™ *PAL*® CIRCUITS

SRPS006E – D3115, MAY 1988 – REVISED DECEMBER 2010

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} [‡]	without feedback		R1 = 390 Ω, R2 = 750 Ω, See Figure 6	62.5			MHz
	with internal feedback (counter configuration)			62.5			
	with external feedback			52.5			
t _{pd}	I, I/O	O, I/O		2	6	10	ns
t _{pd}	CLK↑	Q		1	4	9	ns
t _{pd} [§]	CLK↑	Feedback input		5			ns
t _{en}	OE↓	Q		1	4	10	ns
t _{dis}	OE↑	Q		1	4	10	ns
t _{en}	I, I/O	O, I/O		2	6	12	ns
t _{dis}	I, I/O	O, I/O		1	6	10	ns

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

‡ See section for $f_{\max}$ specifications. $f_{\max}$ with external feedback is not production tested but is calculated from the equation found in the $f_{\max}$ section.

§ This parameter applies to TIBPAL16R4' and TIBPAL16R6' only (see Figure 4 for illustration) and is calculated from the measured $f_{\max}$ with internal feedback in the counter configuration.

TIBPAL16L8-7C, TIBPAL16R4-7C, TIBPAL16R6-7C, TIBPAL16R8-7C
TIBPAL16L8-10M, TIBPAL16R4-10M, TIBPAL16R6-10M, TIBPAL16R8-10M
HIGH-PERFORMANCE *IMPACT-X*™ PAL® CIRCUITS

SRPS006E – D3115, MAY 1988 – REVISED DECEMBER 2010

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 Note 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 11 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 11 to V_{IL} . Preload can be verified by observing the voltage level at the output pin.

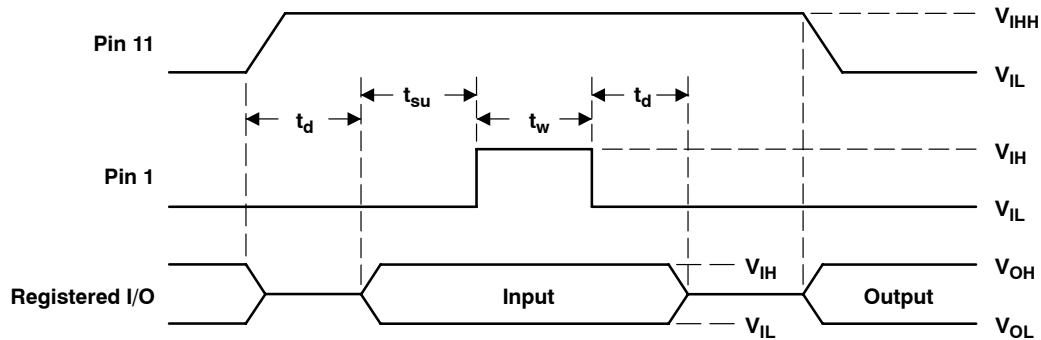


Figure 1. Preload Waveforms

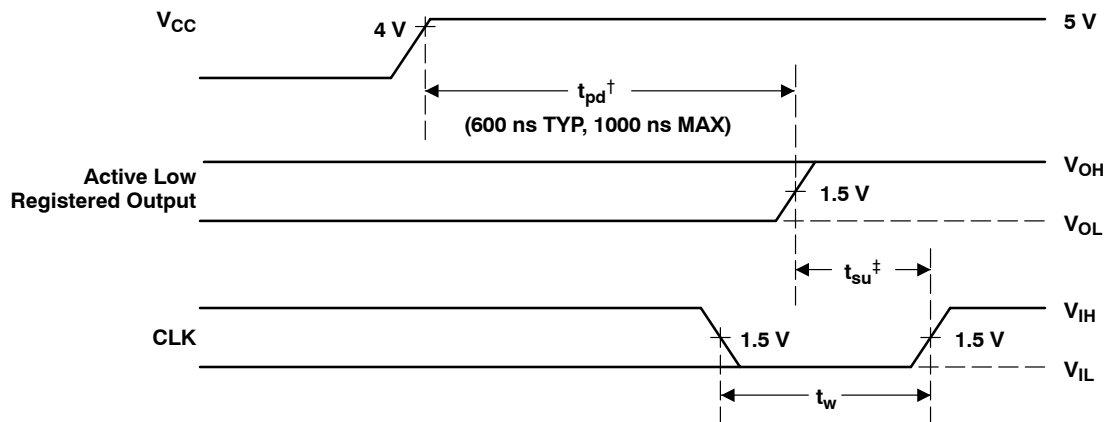
NOTE 3: $t_d = t_{su} = t_h = 100 \text{ ns to } 1000 \text{ ns}$ $V_{IHH} = 10.25 \text{ V to } 10.75 \text{ v}$

TIBPAL16L8-7C, TIBPAL16R4-7C, TIBPAL16R6-7C, TIBPAL16R8-7C
TIBPAL16L8-10M, TIBPAL16R4-10M, TIBPAL16R6-10M, TIBPAL16R8-10M
HIGH-PERFORMANCE *IMPACT-X*™ PAL® CIRCUITS

SRPS006E – D3115, MAY 1988 – REVISED DECEMBER 2010

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

$f_{\max}$ SPECIFICATIONS

$f_{\max}$ without feedback, see Figure 3

In this mode, data is presented at the input to the flip-flop and clocked through to the Q output with no feedback. Under this condition, the clock period is limited by the sum of the data setup time and the data hold time ($t_{su} + t_h$). However, the minimum $f_{\max}$ is determined by the minimum clock period ($t_{w\text{ high}} + t_{w\text{ low}}$).

Thus, $f_{\max}$ without feedback = $\frac{1}{(t_{w\text{ high}} + t_{w\text{ low}})}$ or $\frac{1}{(t_{su} + t_h)}$.

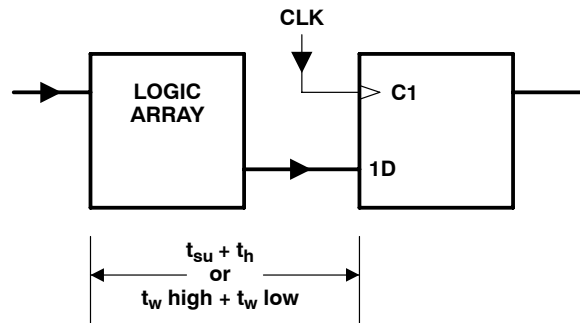


Figure 3. $f_{\max}$ Without Feedback

$f_{\max}$ with internal feedback, see Figure 4

This configuration is most popular in counters and on-chip state-machine designs. The flip-flop inputs are defined by the device inputs and flip-flop outputs. Under this condition, the period is limited by the internal delay from the flip-flop outputs through the internal feedback and logic array to the inputs of the next flip-flop.

Thus, $f_{\max}$ with internal feedback = $\frac{1}{(t_{su} + t_{pd\text{ CLK-to-FB}})}$.

Where $t_{pd\text{ CLK-to-FB}}$ is the deduced value of the delay from CLK to the input of the logic array.

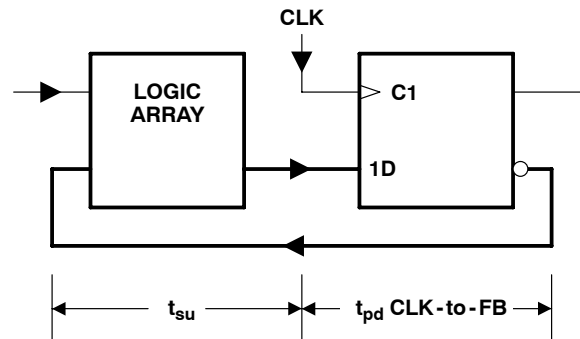


Figure 4. $f_{\max}$ With Internal Feedback

TIBPAL16L8-7C, TIBPAL16R4-7C, TIBPAL16R6-7C, TIBPAL16R8-7C
TIBPAL16L8-10M, TIBPAL16R4-10M, TIBPAL16R6-10M, TIBPAL16R8-10M
HIGH-PERFORMANCE *IMPACT-X*™ *PAL*® CIRCUITS

SRPS006E – D3115, MAY 1988 – REVISED DECEMBER 2010

f_{max} SPECIFICATIONS

f_{max} with external feedback, see Figure 5

This configuration is a typical state-machine design with feedback signals sent off-chip. This external feedback could go back to the device inputs or to a second device in a multi-chip state machine. The slowest path defining the period is the sum of the clock-to-output time and the input setup time for the external signals ($t_{su} + t_{pd} \text{ CLK-to-Q}$).

$$\text{Thus, } f_{\max} \text{ with external feedback} = \frac{1}{(t_{su} + t_{pd} \text{ CLK-to-Q})}.$$

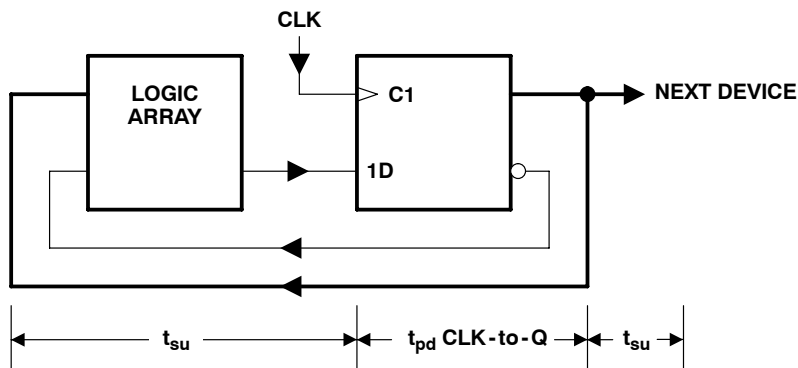
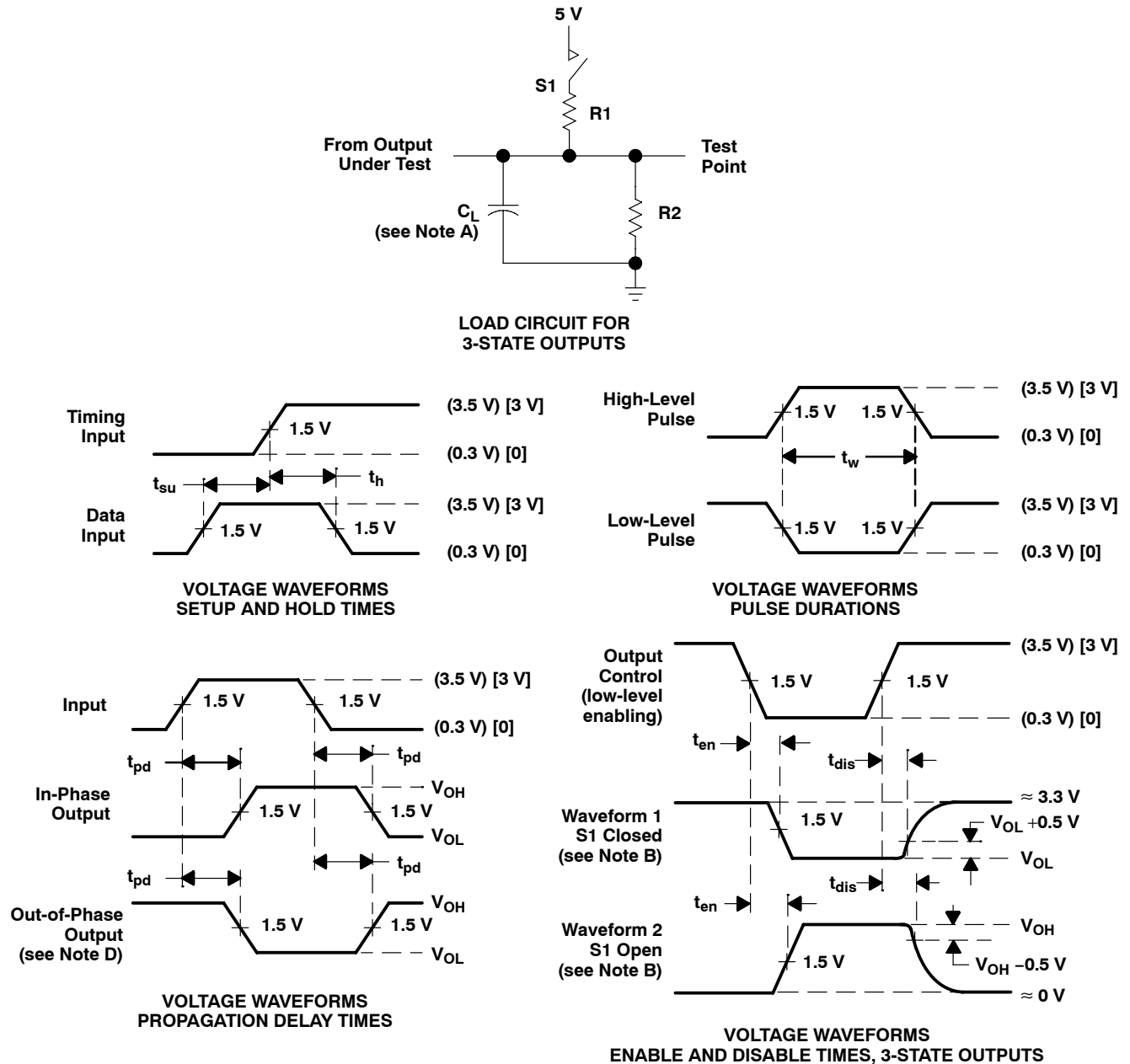


Figure 5. f_{max} With External Feedback

TIBPAL16L8-7C, TIBPAL16R4-7C, TIBPAL16R6-7C, TIBPAL16R8-7C
TIBPAL16L8-10M, TIBPAL16R4-10M, TIBPAL16R6-10M, TIBPAL16R8-10M
HIGH-PERFORMANCE *IMPACT-X*™ *PAL*® CIRCUITS

SRPS006E – D3115, MAY 1988 – REVISED DECEMBER 2010

PARAMETER MEASUREMENT INFORMATION



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 (), $PRR \leq 1$ MHz, $t_r = t_f = 2$ 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 6. Load Circuit and Voltage Waveforms

TIBPAL16L8-7C, TIBPAL16R4-7C, TIBPAL16R6-7C, TIBPAL16R8-7C
TIBPAL16L8-10M, TIBPAL16R4-10M, TIBPAL16R6-10M, TIBPAL16R8-10M
HIGH-PERFORMANCE *IMPACT-X*™ *PAL*® CIRCUITS

SRPS006E – D3115, MAY 1988 – REVISED DECEMBER 2010

TYPICAL CHARACTERISTICS

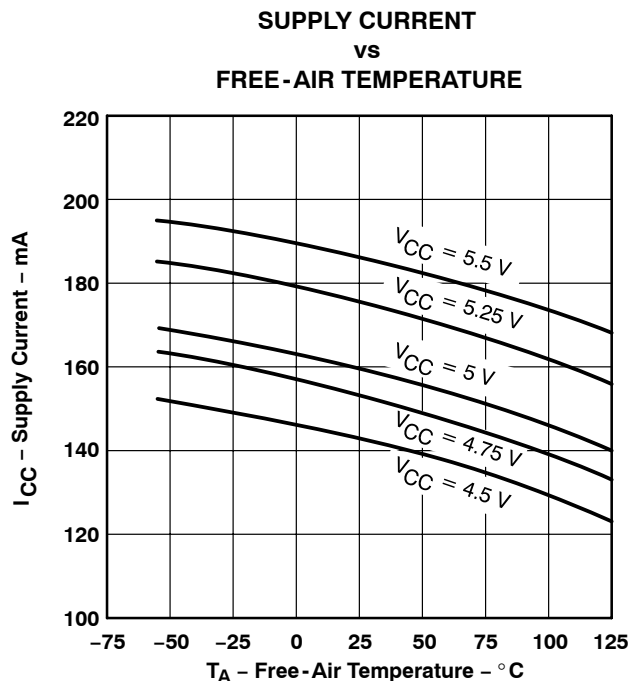


Figure 7

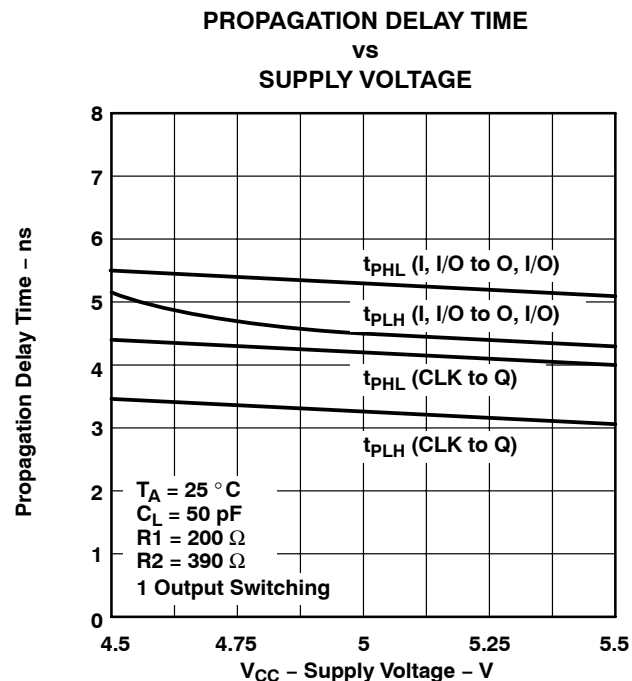


Figure 8

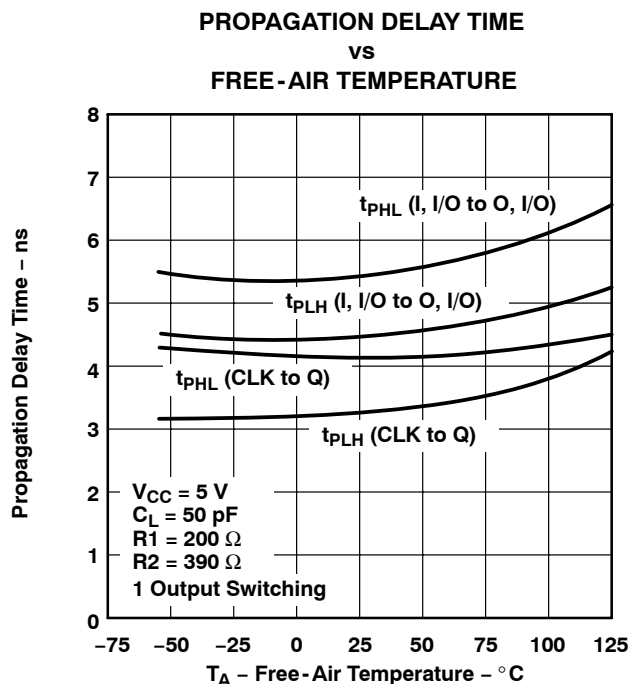


Figure 9

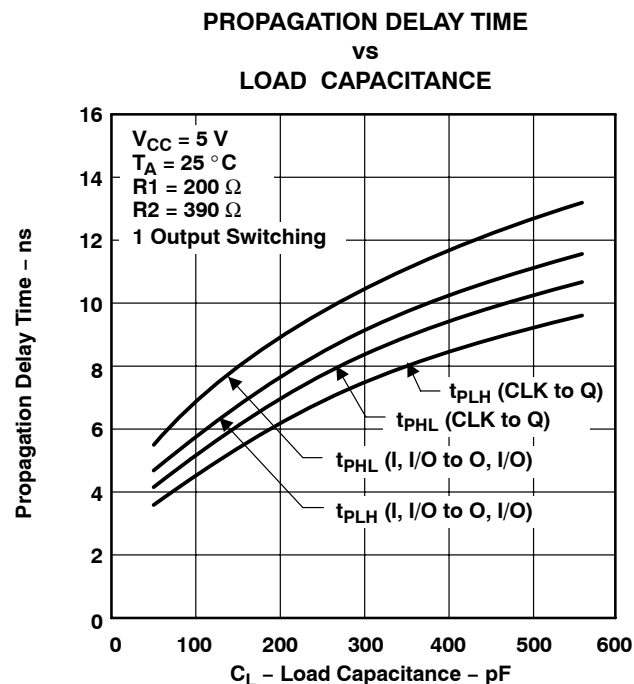


Figure 10

TIBPAL16L8-7C, TIBPAL16R4-7C, TIBPAL16R6-7C, TIBPAL16R8-7C
TIBPAL16L8-10M, TIBPAL16R4-10M, TIBPAL16R6-10M, TIBPAL16R8-10M
HIGH-PERFORMANCE *IMPACT-X*™ *PAL*® CIRCUITS

SRPS006E - D3115, MAY 1988 - REVISED DECEMBER 2010

TYPICAL CHARACTERISTICS

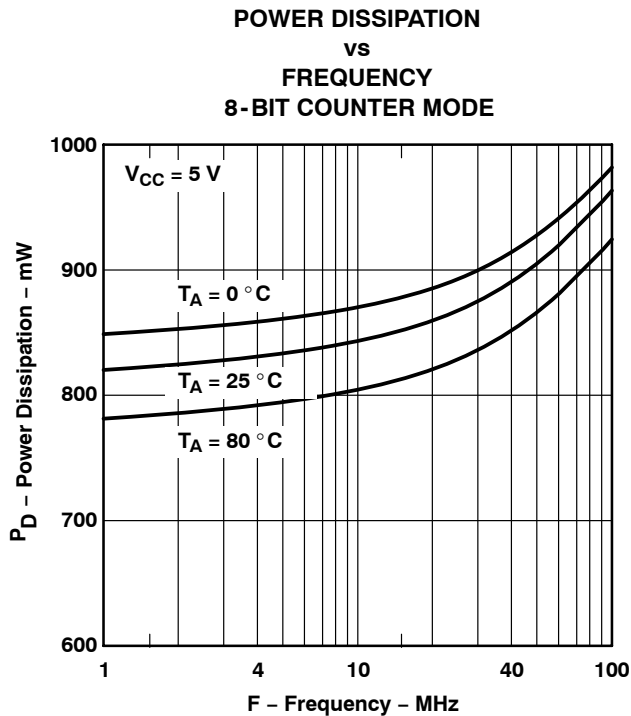


Figure 11

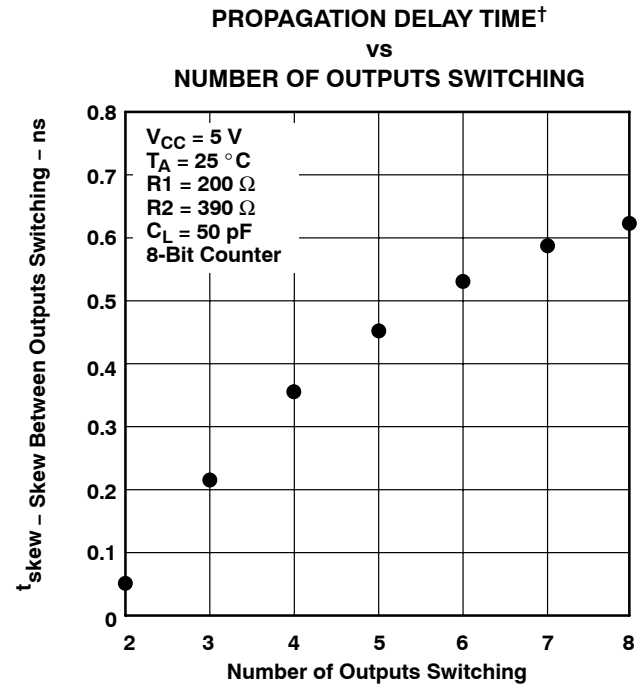


Figure 12

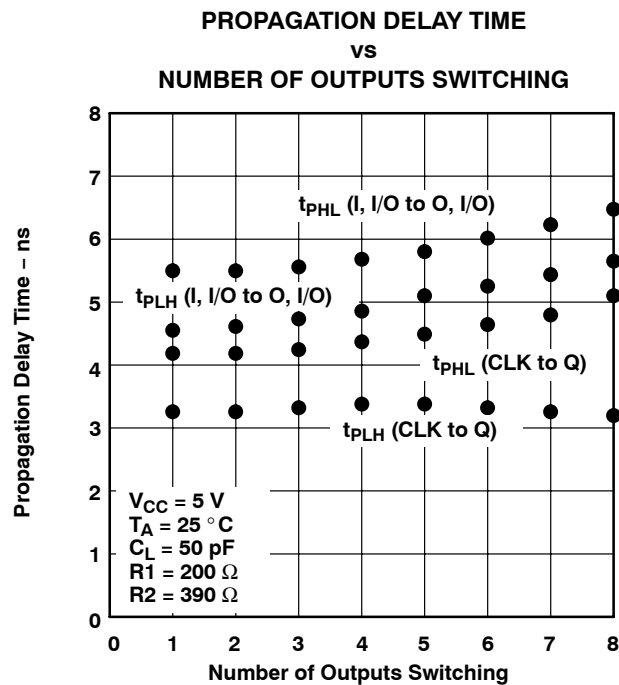


Figure 13

†Outputs switching in the same direction (t_{PLH} compared to t_{PLH}/t_{PHL} to t_{PHL})

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) 778-6502
 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) 430-9477; 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

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-85155172A	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI	-55 to 125		
5962-8515517RA	OBSOLETE	CDIP	J	20		TBD	Call TI	Call TI	-55 to 125		
5962-8515517SA	OBSOLETE	CFP	W	20		TBD	Call TI	Call TI	-55 to 125		
5962-85155182A	NRND	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 85155182A TIBPAL16 R8-10MFKB	
5962-8515518RA	NRND	CDIP	J	20	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8515518RA TIBPAL16R8-10M JB	
5962-8515518SA	NRND	CFP	W	20	1	TBD	Call TI	N / A for Pkg Type	-55 to 125	5962-8515518SA TIBPAL16R8-10M WB	
5962-85155192A	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI	-55 to 125		
5962-8515519RA	OBSOLETE	CDIP	J	20		TBD	Call TI	Call TI	-55 to 125		
5962-8515519SA	OBSOLETE	CFP	W	20		TBD	Call TI	Call TI	-55 to 125		
5962-85155202A	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI	-55 to 125		
5962-8515520RA	OBSOLETE	CDIP	J	20		TBD	Call TI	Call TI	-55 to 125		
5962-8515520SA	OBSOLETE	CFP	W	20		TBD	Call TI	Call TI	-55 to 125		
TIBPAL16L8-10MFKB	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI	-55 to 125	5962- 85155172A TIBPAL16 L8-10MFKB	
TIBPAL16L8-10MJB	OBSOLETE	CDIP	J	20		TBD	A42	N / A for Pkg Type	-55 to 125	5962-8515517RA TIBPAL16L8-10M JB	
TIBPAL16L8-10MWB	OBSOLETE	CFP	W	20		TBD	Call TI	Call TI	-55 to 125	5962-8515517SA TIBPAL16L8-10M WB	
TIBPAL16L8-7CFN	ACTIVE	PLCC	FN	20	46	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-245C-168 HR	0 to 75	16L8-7	Samples
TIBPAL16L8-7CN	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	0 to 75	TIBPAL16L8-7CN	Samples
TIBPAL16R4-10MFKB	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI	-55 to 125		

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TIBPAL16R4-10MJB	OBSOLETE	CDIP	J	20		TBD	Call TI	Call TI	-55 to 125		
TIBPAL16R4-10MWB	OBSOLETE	CFP	W	20		TBD	Call TI	Call TI	-55 to 125		
TIBPAL16R4-7CFN	OBSOLETE	PLCC	FN	20		TBD	Call TI	Call TI	0 to 75		
TIBPAL16R4-7CN	OBSOLETE	PDIP	N	20		TBD	Call TI	Call TI	0 to 75		
TIBPAL16R6-10MFKB	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI	-55 to 125	5962- 85155192A TIBPAL16 R6-10MFKB	
TIBPAL16R6-10MJB	OBSOLETE	CDIP	J	20		TBD	Call TI	Call TI	-55 to 125	5962-8515519RA TIBPAL16R6-10M JB	
TIBPAL16R6-10MWB	OBSOLETE	CFP	W	20		TBD	Call TI	Call TI	-55 to 125	5962-8515519SA TIBPAL16R6-10M WB	
TIBPAL16R6-7CFN	OBSOLETE	PLCC	FN	20		TBD	Call TI	Call TI	0 to 75	16R6-7	
TIBPAL16R6-7CN	OBSOLETE	PDIP	N	20		TBD	Call TI	Call TI	0 to 75	TIBPAL16R6-7CN	
TIBPAL16R8-10MFKB	NRND	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type	-55 to 125	5962- 85155182A TIBPAL16 R8-10MFKB	
TIBPAL16R8-10MJB	NRND	CDIP	J	20	1	TBD	A42	N / A for Pkg Type	-55 to 125	5962-8515518RA TIBPAL16R8-10M JB	
TIBPAL16R8-10MWB	NRND	CFP	W	20	1	TBD	Call TI	N / A for Pkg Type	-55 to 125	5962-8515518SA TIBPAL16R8-10M WB	
TIBPAL16R8-7CFN	OBSOLETE	PLCC	FN	20		TBD	Call TI	Call TI	0 to 75		
TIBPAL16R8-7CN	OBSOLETE	PDIP	N	20		TBD	Call TI	Call TI	0 to 75		

⁽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 - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

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.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

⁽⁴⁾ There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

⁽⁵⁾ Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device 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.

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



PINS ** DIM	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)

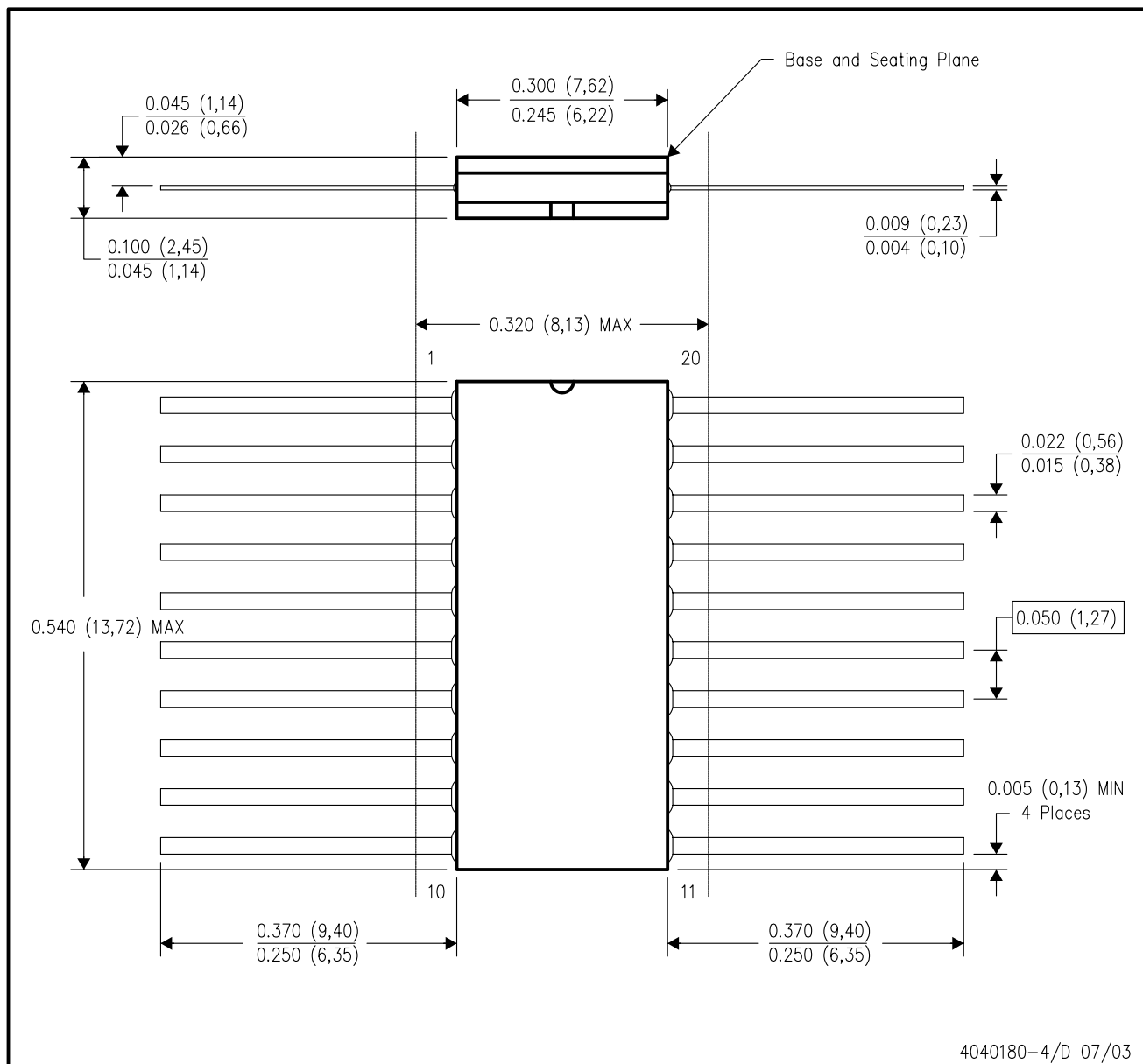


4040083/F 03/03

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package is hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
 - E. Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F20)

CERAMIC DUAL FLATPACK

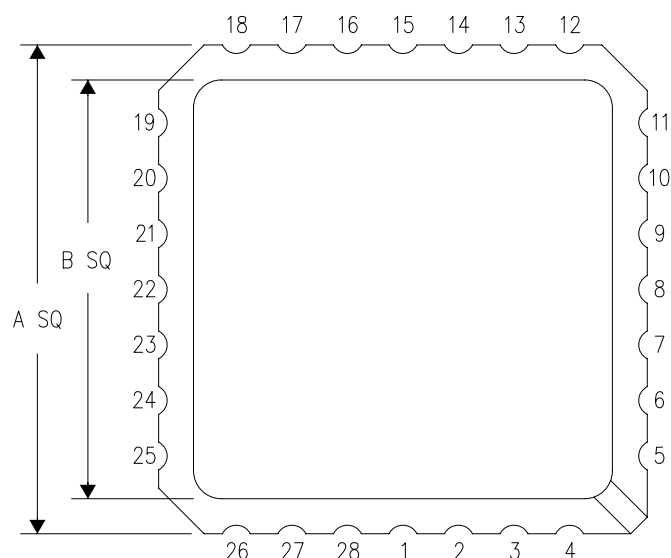


- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package can be hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification only.
 - Falls within Mil-Std 1835 GDFP2-F20

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

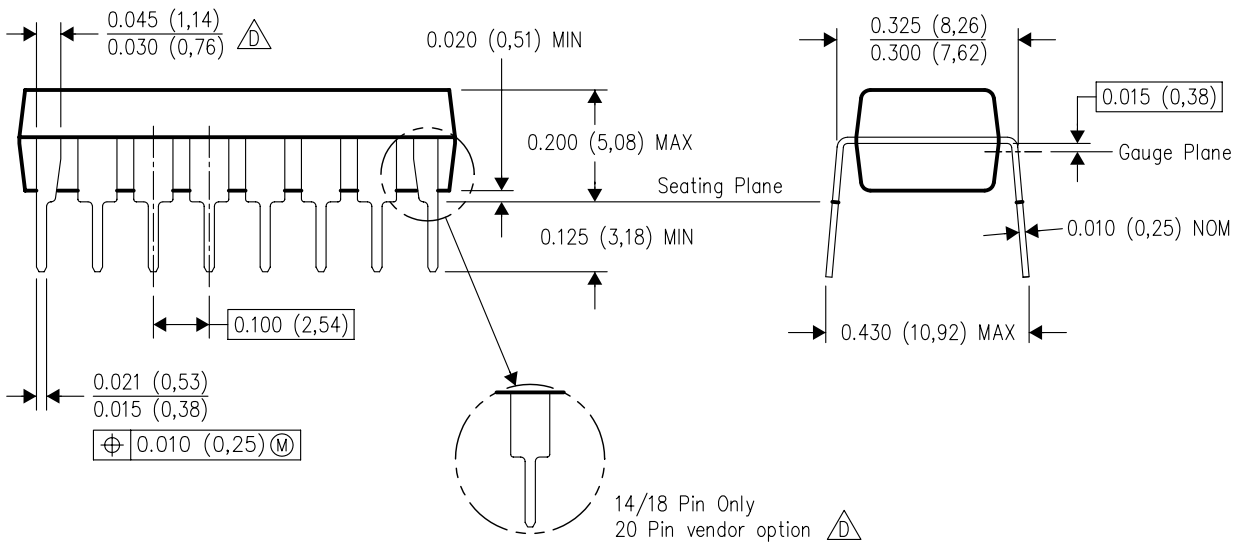
N (R-PDIP-T**)

16 PINS SHOWN

PLASTIC DUAL-IN-LINE PACKAGE



PINS **	14	16	18	20
DIM				
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS-001 VARIATION	AA	BB	AC	AD



14/18 Pin Only
20 Pin vendor option

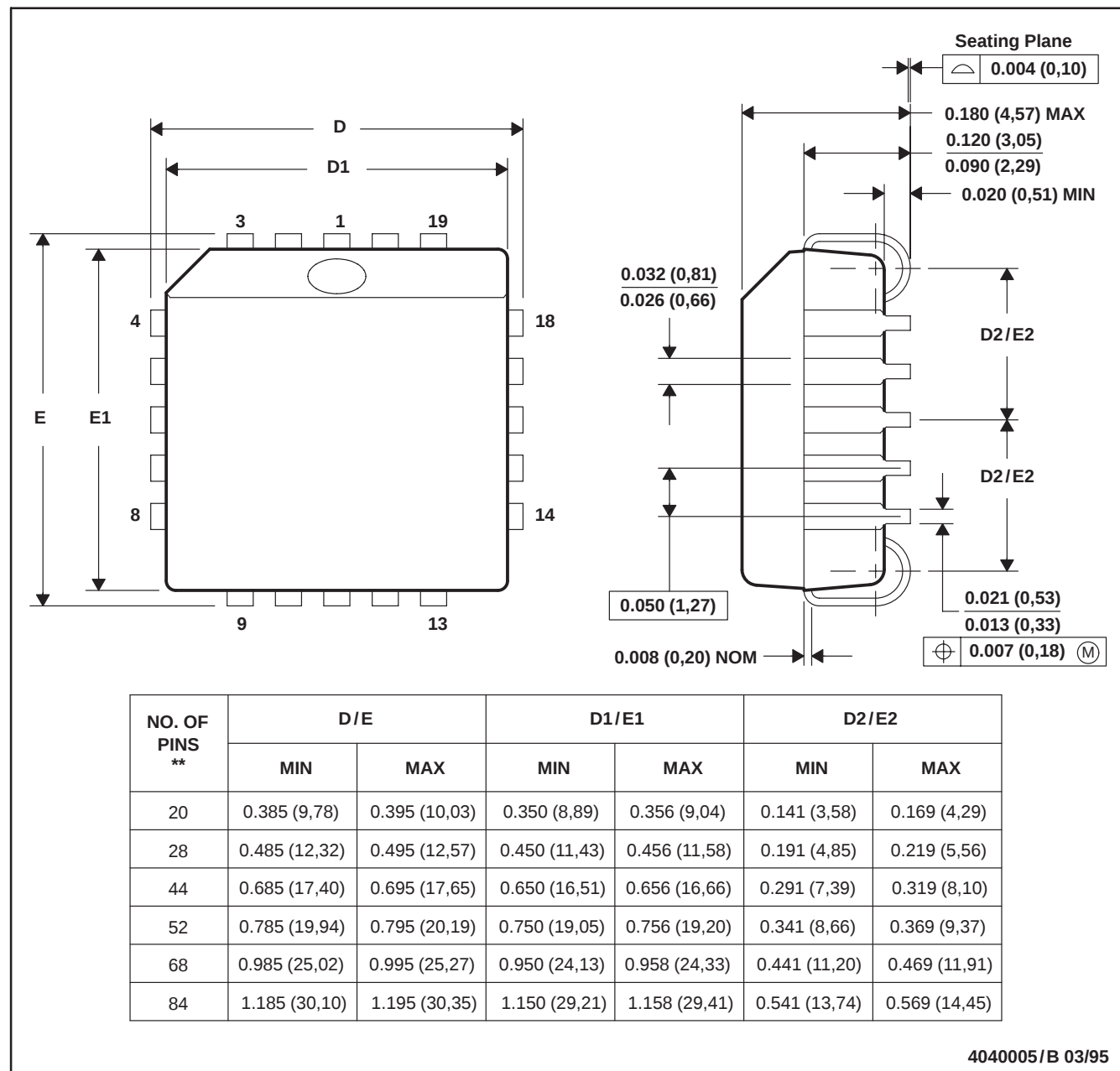
4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

FN (S-PQCC-J**)

PLASTIC J-LEADED CHIP CARRIER

20 PIN SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-018

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

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 relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com