TIBPAL16L8-25C, TIBPAL16R4-25C, TIBPAL16R6-25C, TIBPAL16R8-25C
TIBPAL16L8-30M, TIBPAL16R4-30M, TIBPAL16R6-30M, TIBPAL16R8-30M
LOW-POWER HIGH-PERFORMANCE *IMPACT*™ *PAL*® CIRCUITS

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- **High-Performance Operation: Propagation Delay**
  C Suffix . . . 25 ns Max
  M Suffix . . . 30 ns Max

- **Functionally Equivalent, but Faster Than PAL16L8A, PAL16R4A, PAL16R6A, and PAL16R8A**

- **Power-Up Clear on Registered Devices (All Register Outputs Are Set High, but Voltage Levels at the Output Pins Go Low)**

- **Package Options Include Both Plastic and Ceramic Chip Carriers in Addition to Plastic and Ceramic DIPs**
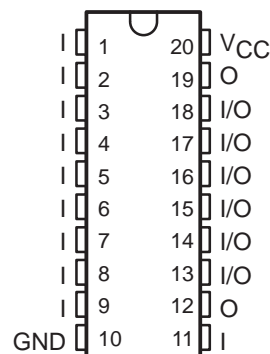
- **Dependable Texas Instruments Quality and Reliability**

TIBPAL16L8'
C SUFFIX . . . J OR N PACKAGE
M SUFFIX . . . J OR W PACKAGE
(TOP VIEW)

```
        ____
  I  [ 1    20 ] V_CC
  I  [ 2    19 ] O
  I  [ 3    18 ] I/O
  I  [ 4    17 ] I/O
  I  [ 5    16 ] I/O
  I  [ 6    15 ] I/O
  I  [ 7    14 ] I/O
  I  [ 8    13 ] I/O
  I  [ 9    12 ] O
GND  [ 10   11 ] I
```

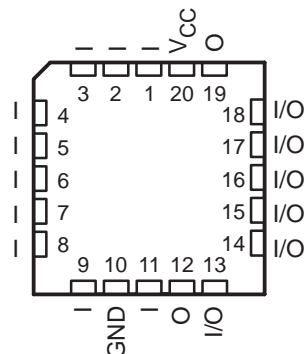| DEVICE	I INPUTS	3-STATE O OUTPUTS	REGISTERED Q OUTPUTS	I/O PORTS
PAL16L8	10	2	0	6
PAL16R4	8	0	4 (3-state buffers)	4
PAL16R6	8	0	6 (3-state buffers)	2
PAL16R8	8	0	8 (3-state buffers)	0

description

These programmable array logic devices feature high speed and functional equivalency when compared with currently available devices. These IMPACT™ 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.

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.

TIBPAL16L8'
C SUFFIX . . . FN PACKAGE
M SUFFIX . . . FK PACKAGE
(TOP VIEW)

```
          V_CC O
      3  2  1  20 19
  I [ 4          18 ] I/O
  I [ 5          17 ] I/O
  I [ 6          16 ] I/O
  I [ 7          15 ] I/O
  I [ 8          14 ] I/O
      9 10 11 12 13
       GND    O  I/O
```

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

These devices are covered by U.S. Patent 4,410,987.
IMPACT is a trademark of Texas Instruments.
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.
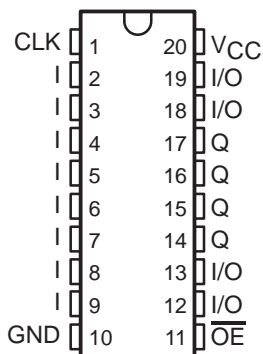
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TEXAS INSTRUMENTS

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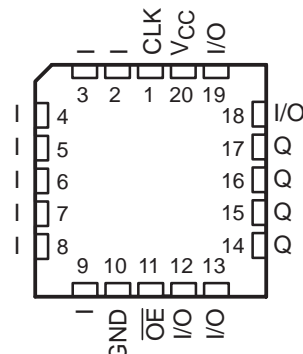This datasheet has been downloaded from http://www.digchip.com at this page

TIBPAL16R4-25C, TIBPAL16R6-25C, TIBPAL16R8-25C
TIBPAL16R4-30M, TIBPAL16R6-30M, TIBPAL16R8-30M
LOW-POWER HIGH-PERFORMANCE *IMPACT*™ *PAL*® CIRCUITS
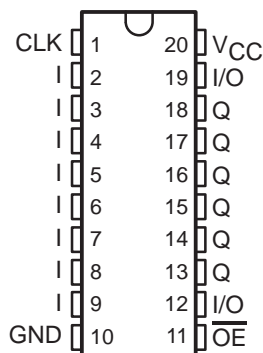
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TIBPAL16R4'
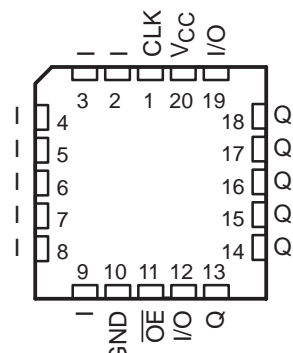**C SUFFIX . . . J OR N PACKAGE**
M SUFFIX . . . J OR W PACKAGE
(TOP VIEW)

Pin		
CLK	1	20 V_{CC}
I	2	19 I/O
I	3	18 I/O
I	4	17 Q
I	5	16 Q
I	6	15 Q
I	7	14 Q
I	8	13 I/O
I	9	12 I/O
GND	10	11 $\overline{OE}$

TIBPAL16R4'
C SUFFIX . . . FN PACKAGE
M SUFFIX . . . FK PACKAGE
(TOP VIEW)

Top: – – CLK V_{CC} I/O (pins 3 2 1 20 19)
Left: I 4, I 5, I 6, I 7, I 8
Right: 18 I/O, 17 Q, 16 Q, 15 Q, 14 Q
Bottom: 9 10 11 12 13 — – GND $\overline{OE}$ I/O I/O

TIBPAL16R6'
C SUFFIX . . . J OR N PACKAGE
M SUFFIX . . . J OR W PACKAGE
(TOP VIEW)

Pin		
CLK	1	20 V_{CC}
I	2	19 I/O
I	3	18 Q
I	4	17 Q
I	5	16 Q
I	6	15 Q
I	7	14 Q
I	8	13 Q
I	9	12 I/O
GND	10	11 $\overline{OE}$

TIBPAL16R6'
C SUFFIX . . . FN PACKAGE
M SUFFIX . . . FK PACKAGE
(TOP VIEW)

Top: – – CLK V_{CC} I/O (pins 3 2 1 20 19)
Left: I 4, I 5, I 6, I 7, I 8
Right: 18 Q, 17 Q, 16 Q, 15 Q, 14 Q
Bottom: 9 10 11 12 13 — – GND $\overline{OE}$ I/O Q

TIBPAL16R8'
C SUFFIX . . . J OR N PACKAGE
M SUFFIX . . . J OR W PACKAGE
(TOP VIEW)

Pin		
CLK	1	20 V_{CC}
I	2	19 Q
I	3	18 Q
I	4	17 Q
I	5	16 Q
I	6	15 Q
I	7	14 Q
I	8	13 Q
I	9	12 Q
GND	10	11 $\overline{OE}$
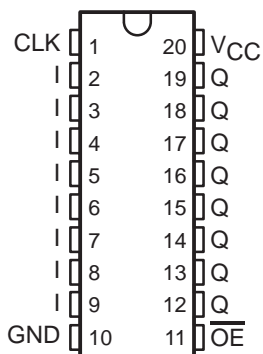
TIBPAL16R8'
C SUFFIX . . . FN PACKAGE
M SUFFIX . . . FK PACKAGE
(TOP VIEW)
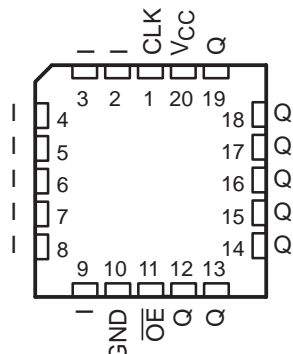
Top: – – CLK V_{CC} Q (pins 3 2 1 20 19)
Left: I 4, I 5, I 6, I 7, I 8
Right: 18 Q, 17 Q, 16 Q, 15 Q, 14 Q
Bottom: 9 10 11 12 13 — – GND $\overline{OE}$ Q Q

TEXAS INSTRUMENTS

functional block diagrams (positive logic)

TIBPAL16L8'

TIBPAL16R4'

∿ denotes fused inputs

functional block diagrams (positive logic)

TIBPAL16R6'

TIBPAL16R8'

$\sim$ denotes fused inputs

TEXAS INSTRUMENTS

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logic diagram (positive logic)

Fuse number = First fuse number + Increment

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TIBPAL16R4-30M
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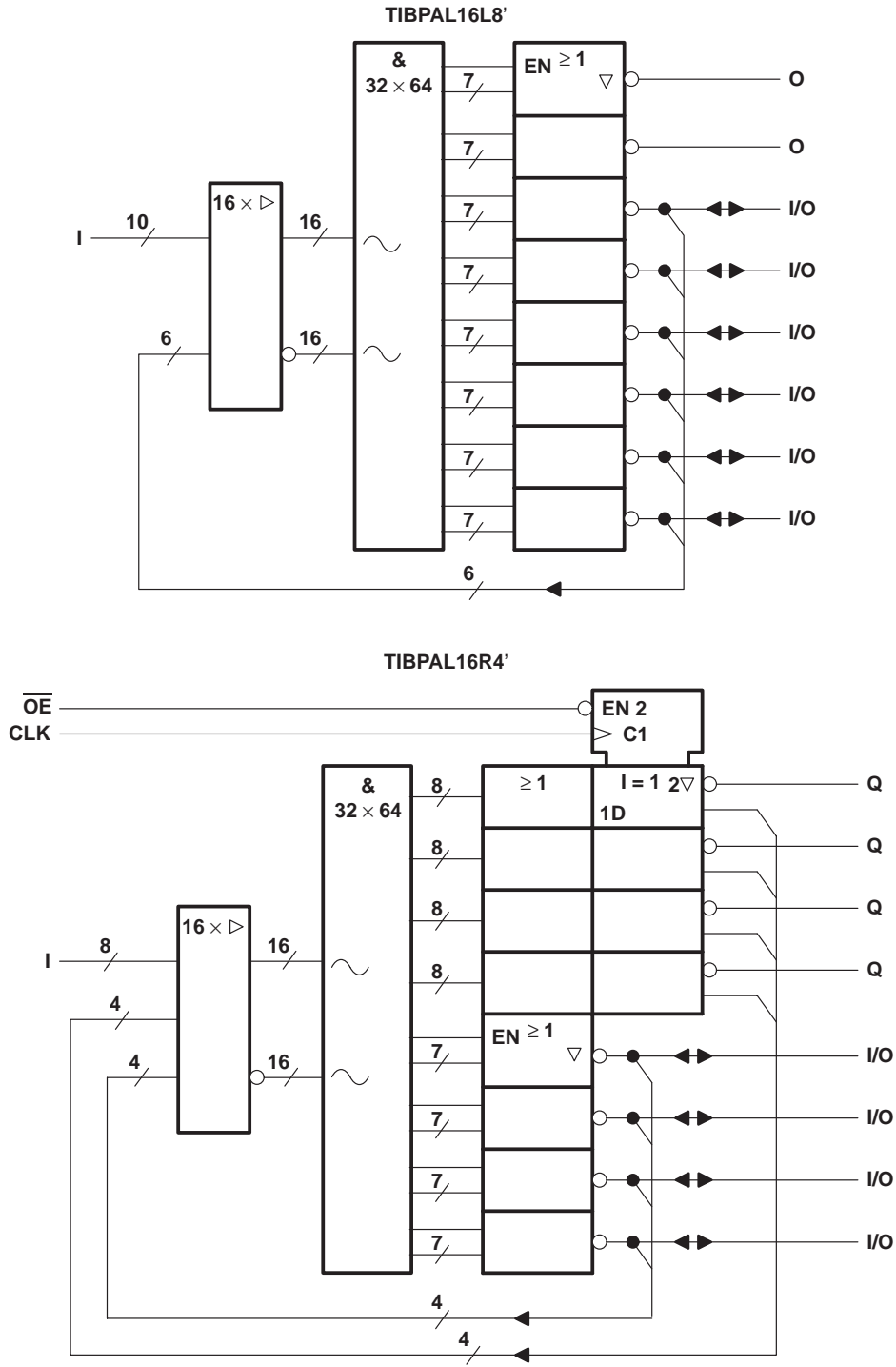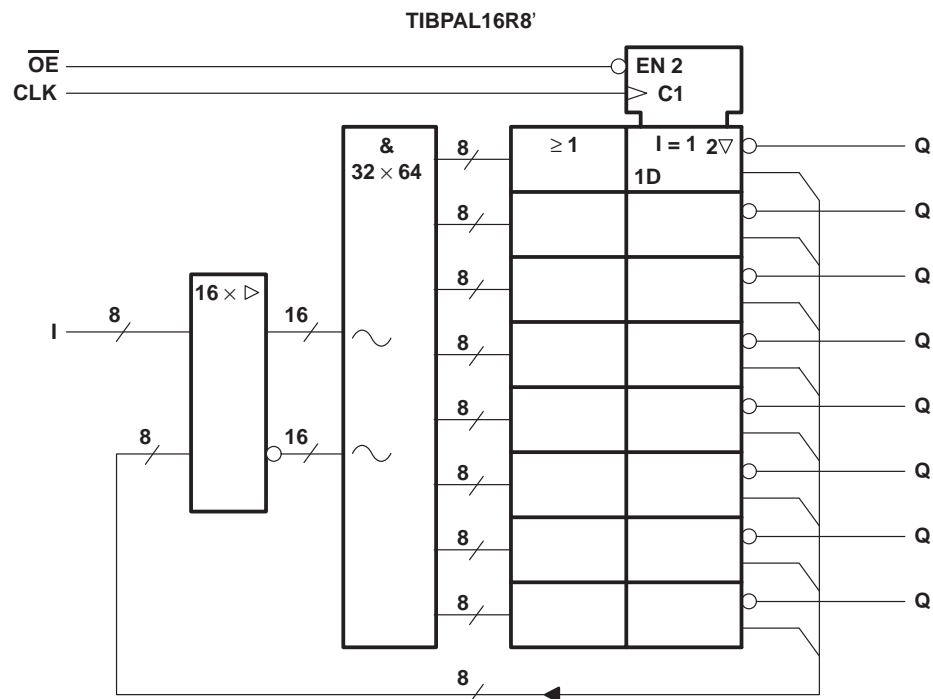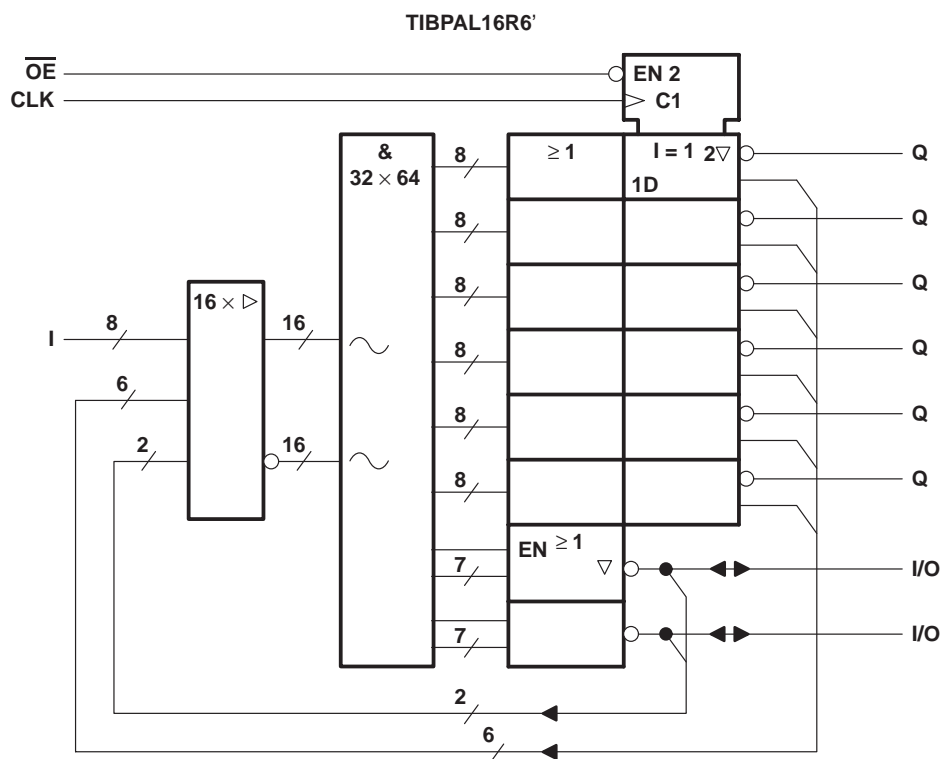
logic diagram (positive logic)
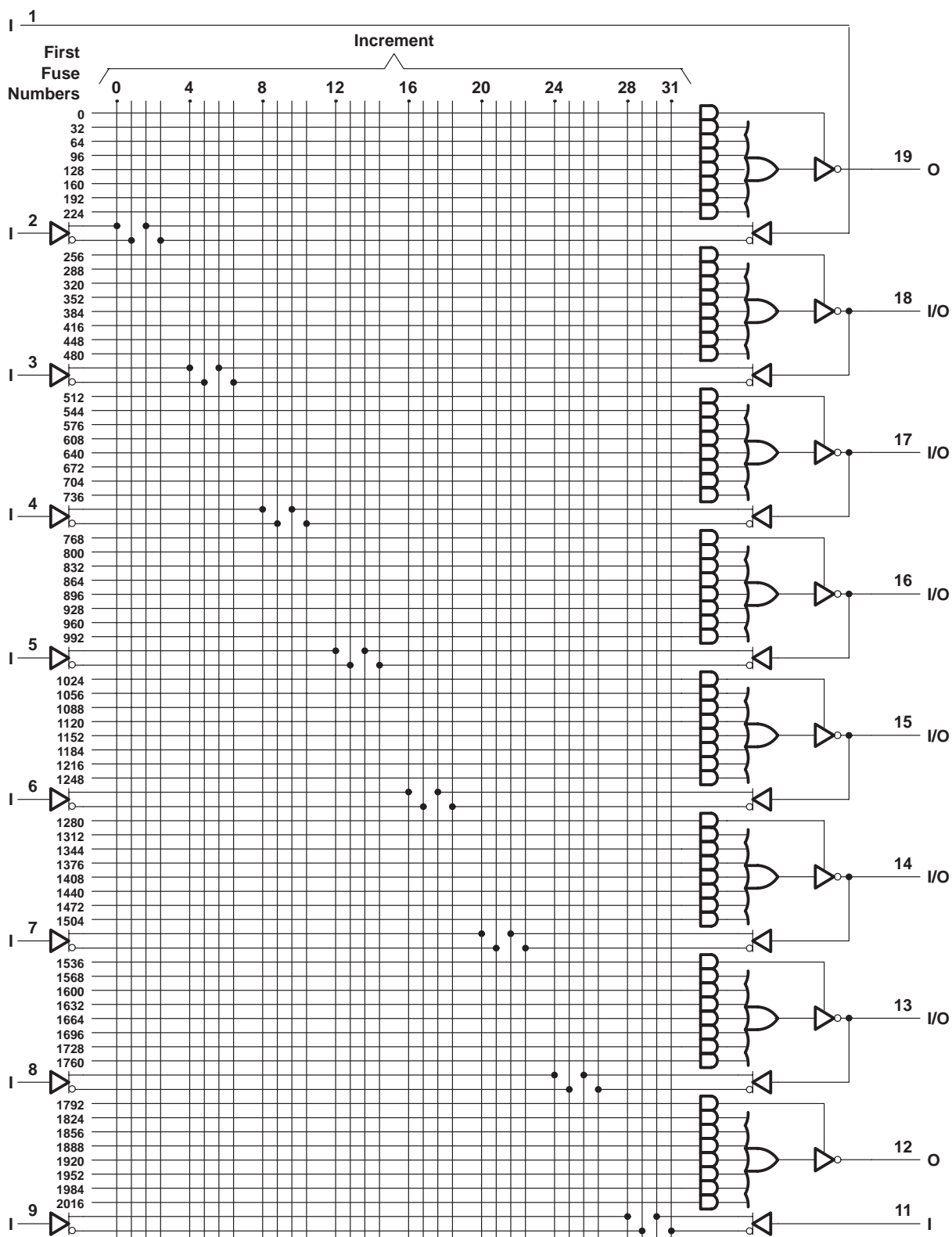
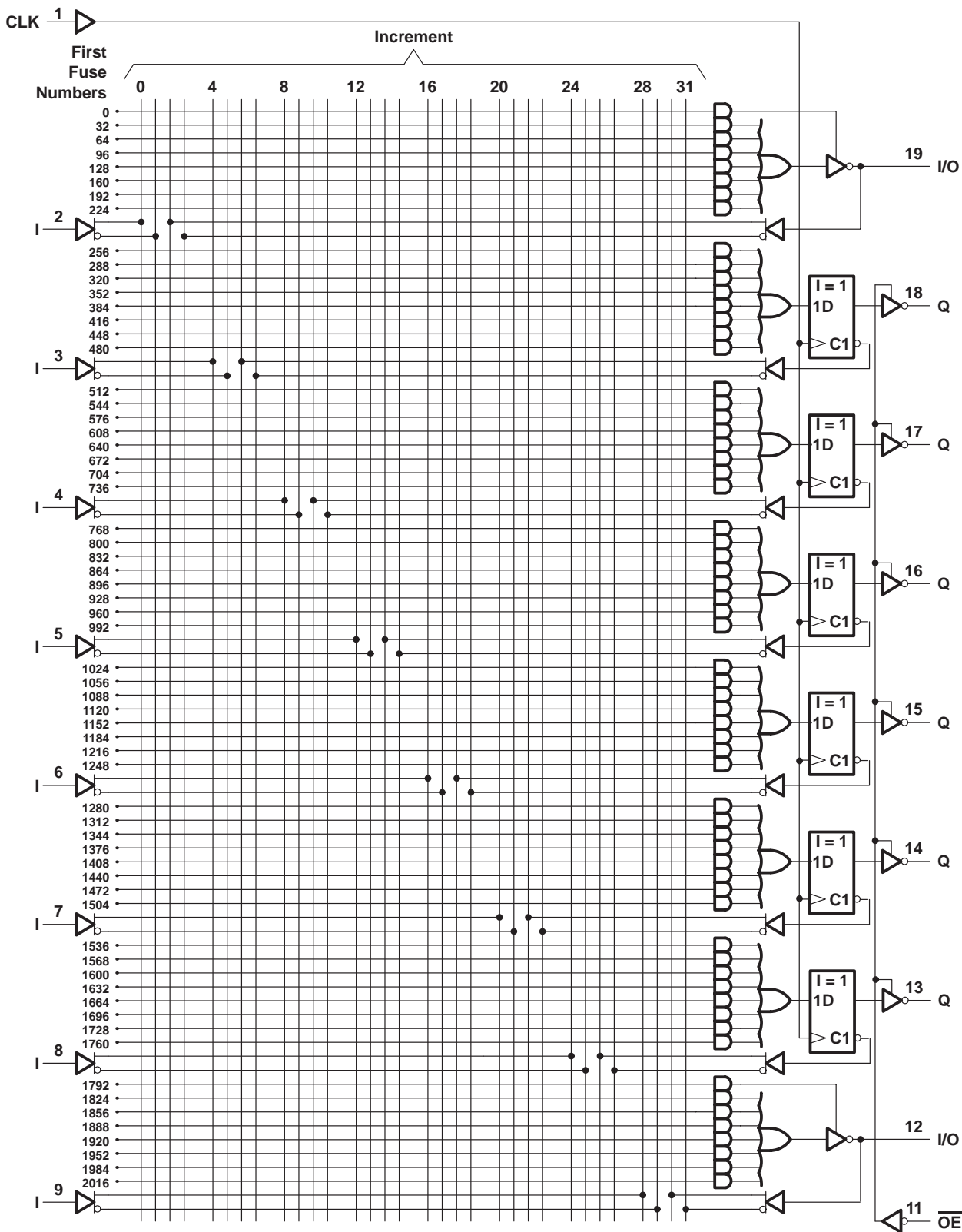

Fuse number = First fuse number + Increment

logic diagram (positive logic)

Fuse number = First fuse number + Increment

TIBPAL16R8-25C
TIBPAL16R8-30M
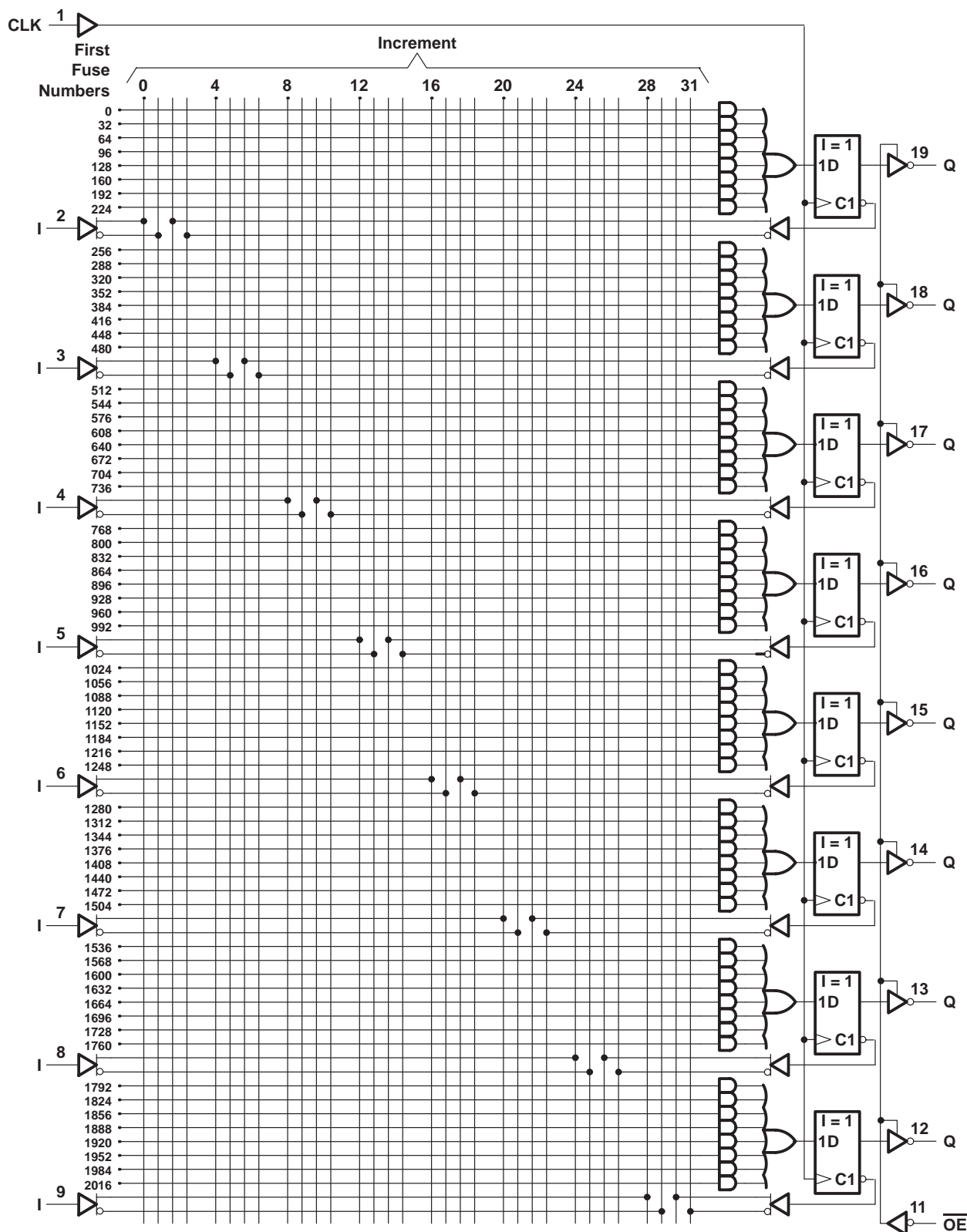## LOW-POWER HIGH-PERFORMANCE *IMPACT*™ *PAL*® CIRCUITS

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logic diagram (positive logic)

Fuse number = First fuse number + Increment

TIBPAL16L8-25C, TIBPAL16R4-25C, TIBPAL16R6-25C, TIBPAL16R8-25C
LOW-POWER HIGH-PERFORMANCE *IMPACT*™ *PAL*® CIRCUITS

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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, T_{stg} . . . . –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		30	MHz
t_w	Pulse duration, clock (see Note 2)	High	10			ns
		Low	15			
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		0	25	75	°C

NOTE 2: The total clock period of clock high and clock low must not exceed clock frequency, f_{clock}. The minimum pulse durations specified are for clock high or low only, but not for both simultaneously.

TIBPAL16L8-25C, TIBPAL16R4-25C, TIBPAL16R6-25C, TIBPAL16R8-25C
LOW-POWER HIGH-PERFORMANCE *IMPACT*™ *PAL*® CIRCUITS

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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				−1.5	V
V_{OH}		V_{CC} = 4.75 V,	I_{OH} = −3.2 mA		2.4	3.3		V
V_{OL}		V_{CC} = 4.75 V,	I_{OL} = 24 mA			0.35	0.5	V
I_{OZH}	Outputs	V_{CC} = 5.25 V,	V_O = 2.7 V				20	μA
	I/O ports						100	
I_{OZL}	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				20	μA
I_{IL}		V_{CC} = 5.25 V,	V_I = 0.4 V				−0.25	mA
I_O‡		V_{CC} = 5.25 V,	V_O = 2.25 V		−30		−125	mA
I_{CC}		V_{CC} = 5.25 V,	V_I = 0,	Outputs open		75	100	mA

† All typical values are at V_{CC} = 5 V, T_A = 25°C.
‡ The output conditions have been chosen to produce a current that closely approximates one-half of the short-circuit output current, I_{OS}.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
f_{max}				30			MHz
t_{pd}	I, I/O	O, I/O			15	25	ns
t_{pd}	CLK↑	Q	R1 = 500 Ω,		10	15	ns
t_{en}	OE↓	Q	R2 = 500 Ω,		15	20	ns
t_{dis}	OE↑	Q	See Figure 3		10	20	ns
t_{en}	I, I/O	O, I/O			14	25	ns
t_{dis}	I, I/O	O, I/O			13	25	ns

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

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TIBPAL16L8-30M, TIBPAL16R4-30M, TIBPAL16R6-30M, TIBPAL16R8-30M
LOW-POWER HIGH-PERFORMANCE *IMPACT*™ *PAL*® CIRCUITS

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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, T_{stg} . . . . −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		25	MHz
t_w	Pulse duration, clock (see Note 2)	High	15			ns
		Low	20			
t_{su}	Setup time, input or feedback before clock↑		25			ns
t_h	Hold time, input or feedback after clock↑		0			ns
T_A	Operating free-air temperature		−55	25	125	°C

NOTE 2: The total clock period of clock high and clock low must not exceed clock frequency, f_{clock}. The minimum pulse durations specified are for clock high or low only, but not for both simultaneously.

TIBPAL16L8-30M, TIBPAL16R4-30M, TIBPAL16R6-30M, TIBPAL16R8-30M
LOW-POWER HIGH-PERFORMANCE *IMPACT*™ *PAL*® CIRCUITS

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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				−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			0.25	0.4	V
I_{OZH}	Outputs	$V_{CC} = 5.5$ V,	$V_O = 2.7$ V				20	μA
	I/O ports						100	
I_{OZL}	Outputs	$V_{CC} = 5.5$ V,	$V_O = 0.4$ V				−20	μA
	I/O ports						−250	
I_I	Pin 1, 11	$V_{CC} = 5.5$ V,	$V_I = 5.5$ V				0.2	mA
	All others						0.1	
I_{IH}	Pin 1, 11	$V_{CC} = 5.5$ V,	$V_I = 2.7$ V				50	μA
	I/O ports						100	
	All others						20	
I_{IL}	I/O ports	$V_{CC} = 5.5$ V,	$V_I = 0.4$ V				−0.25	mA
	All others						−0.2	
I_{OS}‡		$V_{CC} = 5.5$ V,	$V_O = 0.5$ V		−30		−250	mA
I_{CC}		$V_{CC} = 5.5$ V,	$V_I = 0$,	Outputs open		75	105	mA

† All typical values are at $V_{CC} = 5$ V, $T_A = 25°C$.
‡ Not more than one output should be shorted at a time, and the duration of the short circuit should not exceed one second. Set V_O at 0.5 V to avoid test-equipment degradation.

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

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
f_{max}				25			MHz
t_{pd}	I, I/O	O, I/O			15	30	ns
t_{pd}	CLK↑	Q			10	20	ns
t_{en}	OE↓	Q	R1 = 390 Ω, R2 = 750 Ω, See Figure 4		15	25	ns
t_{dis}	OE↑	Q			10	25	ns
t_{en}	I, I/O	O, I/O			14	30	ns
t_{dis}	I, I/O	O, I/O			13	30	ns

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

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 also is available, upon request, from the nearest TI field sales office or local authorized TI distributor, by calling Texas Instruments at +1 (972) 644–5580, or by visiting the TI Semiconductor Home Page at www.ti.com/sc.

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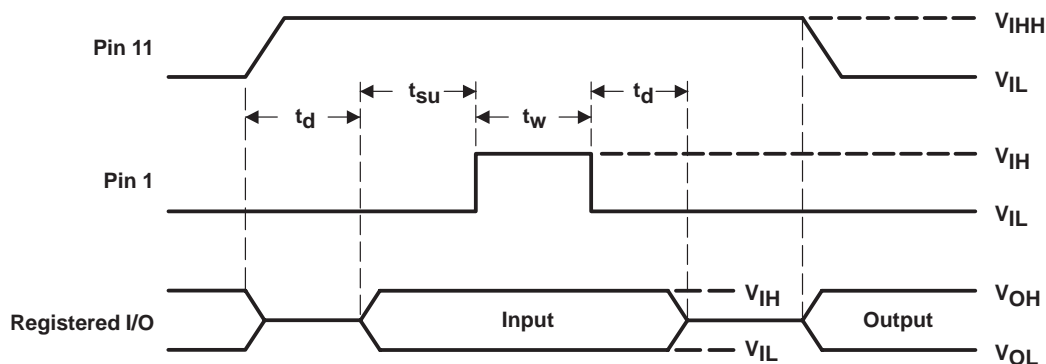
NOTE 3: $t_d = t_{su} = t_h = 100$ ns to 1000 ns $V_{IHH} = 10.25$ V to 10.75 V

Figure 1. Preload Waveforms

power-up reset (see Figure 2)

Following power up, all registers are set high. 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.
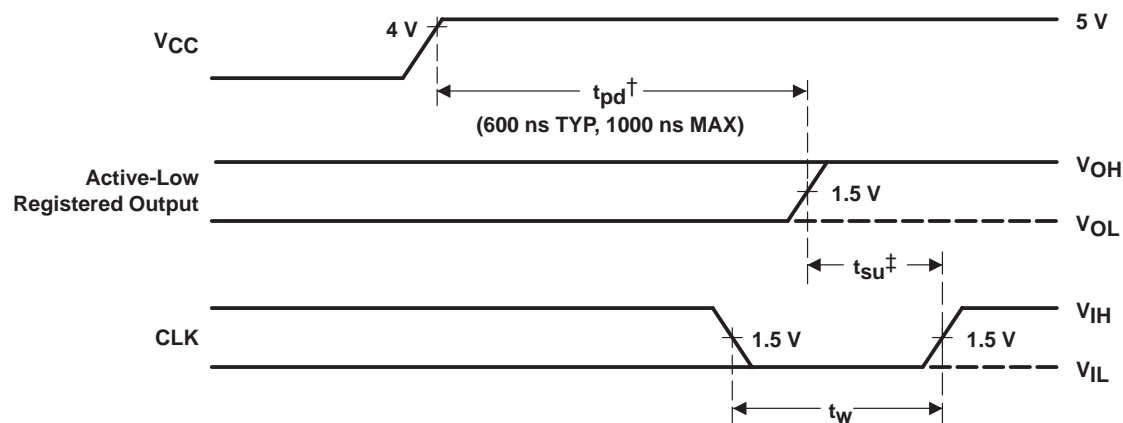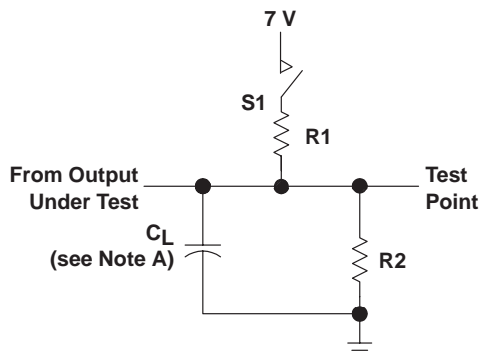

† This is the power-up reset time and applies to registered outputs only. The values shown are from characterization data.
‡ This is the setup time for input or feedback.

Figure 2. Power-Up Reset Waveforms
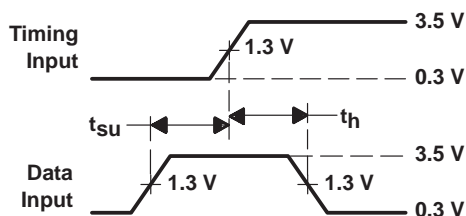
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TIBPAL16L8-25C, TIBPAL16R4-25C, TIBPAL16R6-25C, TIBPAL16R8-25C
LOW-POWER HIGH-PERFORMANCE *IMPACT*™ *PAL*® CIRCUITS

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PARAMETER MEASUREMENT INFORMATION

LOAD CIRCUIT FOR 3-STATE OUTPUTS

VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES

VOLTAGE WAVEFORMS
PULSE DURATIONS

VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES

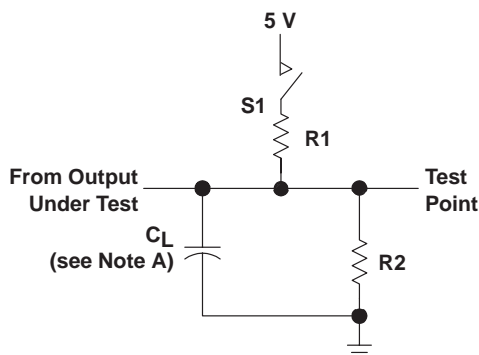**VOLTAGE WAVEFORMS**
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS

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: PRR ≤ 1 MHz, $t_r = t_f ≤ 2$ ns, duty cycle = 50%
   D. When measuring propagation delay times of 3-state outputs from low to high, switch S1 is closed.
      When measuring propagation delay times of 3-state outputs from high to low, switch S1 is open.
   E. Equivalent loads may be used for testing.
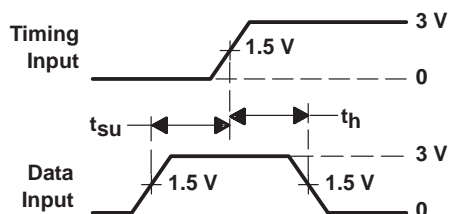
Figure 3. Load Circuit and Voltage Waveforms

TIBPAL16L8-25C, TIBPAL16R4-25C, TIBPAL16R6-25C, TIBPAL16R8-25C
LOW-POWER HIGH-PERFORMANCE *IMPACT*™ *PAL*® CIRCUITS
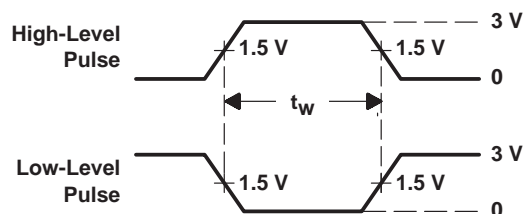
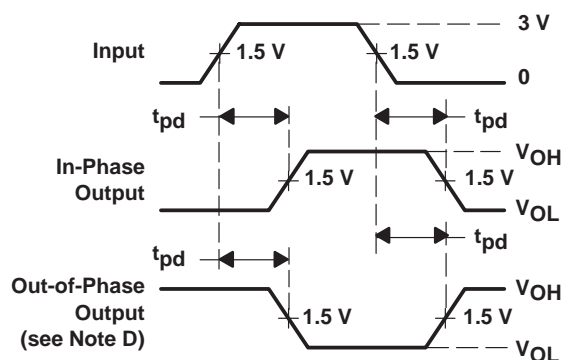SRPS059 – FEBRUARY 1984 – REVISED APRIL 2000

PARAMETER MEASUREMENT INFORMATION
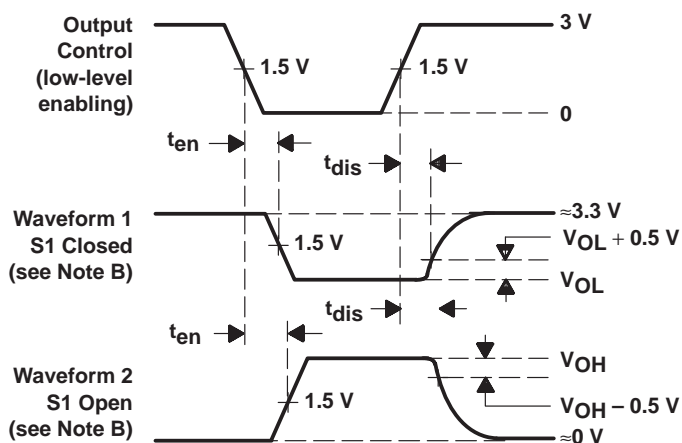
LOAD CIRCUIT FOR 3-STATE OUTPUTS

**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: PRR ≤ 10 MHz, $t_r = t_f ≤ 2$ 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 4. Load Circuit and Voltage Waveforms

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