

PAL16R8 Family

**16L8, 16R8
16R6, 16R4**

Features/Benefits

- Standard 20-pin architectures
- TTL and CMOS versions
- High speed, as fast as 10 ns tPD for PAL16R8D Series
- Low power, as low as zero standby for PALC16R8Z Series
- Security fuse/cell on all devices

Description

The PAL16R8 Series offers the four most popular PAL device architectures. It also provides the fastest PAL devices in the industry.

The PAL16R8 Series consists of four devices, each with sixteen array inputs and eight outputs. The devices have either 0, 4, 6, or 8 registered outputs, with the remaining being combinatorial.

The PAL device transfer function is the familiar Boolean sum of products. The PAL device consists of a programmable AND array driving a fixed OR array. Product terms with all bits programmed (disconnected) assume the logical high state, and product terms with both true and complement of any signal connected assume the logical low state.

Variable Input/Output Pin Ratio

The registered devices in the series have eight dedicated input lines, and each combinatorial output is an I/O pin. The combinatorial device has ten dedicated input lines, and only six of the eight combinatorial outputs are I/O pins. Buffers for device inputs have complementary outputs to provide user-programmable input signal polarity. Unused input pins should be tied directly to VCC or GND.

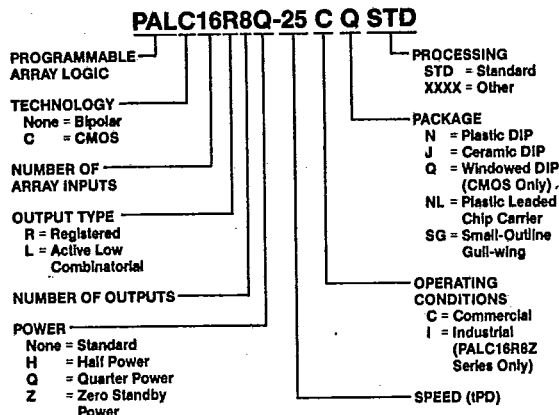
Programmable Three-State Outputs

Each output has a three-state output buffer with programmable three-state control. On combinatorial outputs, a product term controls the buffer, allowing enable and disable to be a function of any combination of device inputs or output feedback. The output provides a bidirectional I/O pin in the combinatorial configuration, and may be configured as a dedicated input if the buffer is always disabled.

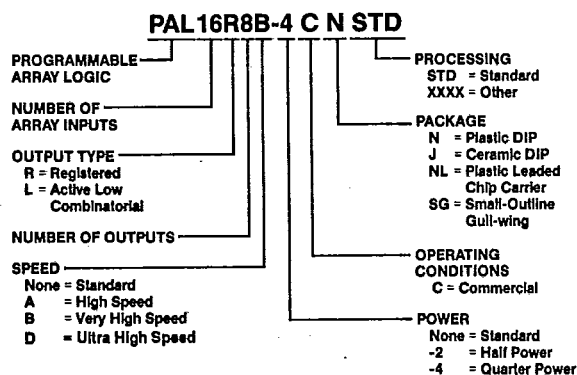
Registers with Feedback

Registered outputs are provided for data storage and synchronization. Registers are composed of D-type flip-flops which are loaded on the low-to-high transition of the clock input.

Ordering Information — Newer Products



Ordering Information — Older Products



Packages

The commercial PAL16R8 Series is available in the plastic DIP (N), ceramic DIP (J), plastic leaded chip carrier (NL), and small outline (SG) packages. The CMOS versions are also available in windowed (Q) packages.

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JANUARY 1988

PAL16R8 Series
16L8, 16R8, 16R6, 16R4

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Polarity

All outputs are active low.

Performance

Several speed/power versions are available (see table). The D Series offers the fastest TTL programmable logic devices in the industry at 10 ns tPD.

Preload

The CMOS Series offers register preload for device testability. The register can be preloaded from outputs by using super-voltages in order to simplify functional testing.

	DEDICATED INPUTS	OUTPUTS	
		COMBINATORIAL	REGISTERED
PAL16L8	10	8 (6 I/O)	0
PAL16R8	8	0	8
PAL16R6	8	2 I/O	6
PAL16R4	8	4 I/O	4

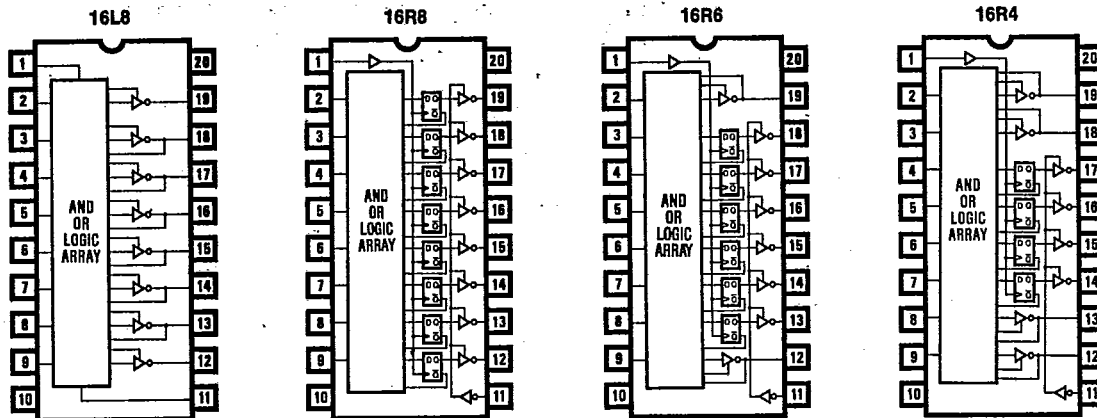
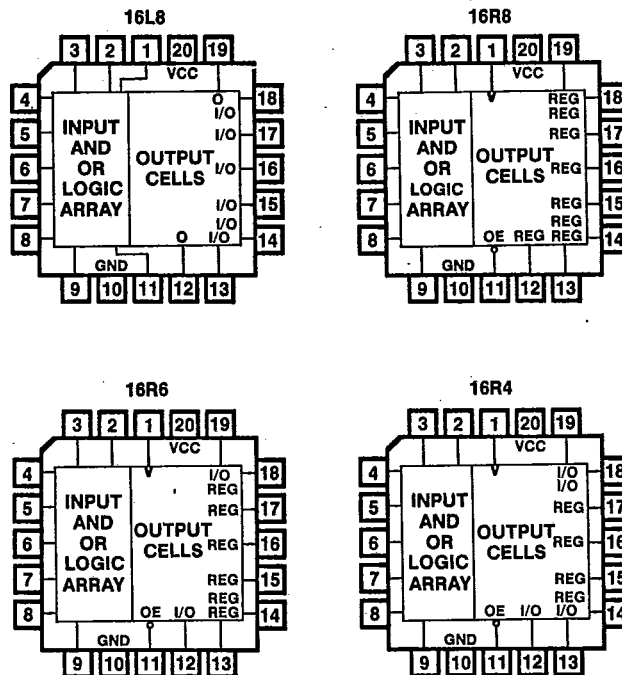
SUFFIX	t _{PD} (ns)	I _{CC} (mA)
A	25	180
A-2	35	90
A-4	55	50
B	15	180
B-2	25	90
B-4	35	55
(C)Q-25	25	45
D	10	180

PAL16R8 Series
16L8, 16R8, 16R6, 16R4

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DIP/SO Pinouts**PLCC Pinouts****Package Drawings**

(refer to PAL Device Package Outlines, page 3-179)

PAL16R8D Series**16L8D, 16R8D, 16R6D, 16R4D**

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Absolute Maximum Ratings

	Operating	Programming
Supply voltage V_{CC}	-0.5 V to 7.0 V	-0.5 V to 12.0 V
Input voltage	-1.5 V to 5.5 V	-1.0 V to 22.0 V
Off-state output voltage	5.5 V	12.0 V
Storage temperature		-65°C to +150°C

Operating Conditions

SYMBOL	PARAMETER		COMMERCIAL ¹			UNIT
			MIN	TYP	MAX	
V_{CC}	Supply voltage		4.75	5	5.25	V
t_w	Width of clock	Low	8	6		ns
		High	8	5		
t_{su}	Set up time from input or feedback to clock		10	8		ns
t_h	Hold time		0	-6		ns
T_A	Operating free-air temperature		0	25	75	°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{IL}^2	Low-level input voltage					0.8	V
V_{IH}^2	High-level input voltage			2			V
V_{IC}	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$	-0.8	-1.5		V
I_{IL}^3	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$	-0.02	-0.25		mA
I_{IH}^3	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$		25		μA
I_I	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$		100		μA
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 24 \text{ mA}$	0.3	0.5		V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}$	$I_{OH} = -3.2 \text{ mA}$	2.4	3.4		V
I_{OZL}^3	Off-state output current	$V_{CC} = \text{MAX}$	$V_O = 0.4 \text{ V}$		-100		μA
I_{OZH}^3			$V_O = 2.4 \text{ V}$		100		μA
I_{OS}^4	Output short-circuit current	$V_{CC} = 5 \text{ V}$	$V_O = 0 \text{ V}$	-30	-70	-130	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$			120	180	mA
C_{IN}	Input capacitance	$V_{IN} = 2.0 \text{ V}$ at $f = 1 \text{ MHz}$			2		pF
C_{OUT}	Output capacitance	$V_{OUT} = 2.0 \text{ V}$ at $f = 1 \text{ MHz}$			4		pF
$C_{CLK,EN}$	Clock/enable capacitance	$V_{CLK,EN} = 2.0 \text{ V}$ at $f = 1 \text{ MHz}$			9		pF

- The PAL16R8D Series is designed to operate over the full military operating conditions. For availability and specifications, contact Monolithic Memories.
- These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- I/O pin leakage is the worst case of I_{IL} and I_{OZL} (or I_{IH} and I_{OZH}).
- No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

16L8D, 16R8D, 16R6D, 16R4D

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Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PD}	Input or feedback to output	16L8, 16R6, 16R4	$R_1 = 200 \Omega$ $R_2 = 390 \Omega$	3	8	10	ns
t_{CLK}	Clock to output or feedback except 16L8			2	6	7	ns
t_{CF}	Clock to feedback			2	5	6.5	ns
t_{PZX}	Pin 11 to output enable except 16L8			3	8	10	ns
t_{PXZ}	Pin 11 to output disable except 16L8			3	8	10	ns
t_{EA}	Input to output enable	16L8, 16R6, 16R4		1	8	10	ns
t_{ER}	Input to output disable	16L8, 16R6, 16R4		1	8	10	ns
f_{MAX}	Maximum frequency	External		58.8	71		MHz
		Internal		60	76		
		No feedback		62.5	90		

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Absolute Maximum Ratings

	Operating	Programming
Supply voltage V_{CC}	-0.5 V to 7.0 V	-0.5 V to 12.0 V
Input voltage	-1.5 V to 5.5 V	-1.0 V to 22.0 V
Off-state output voltage	5.5 V	12.0 V
Storage temperature		-85°C to +150°C

Operating Conditions

SYMBOL	PARAMETER	COMMERCIAL			UNIT
		MIN	TYP	MAX	
V_{CC}	Supply voltage	4.75	5	5.25	V
t_w	Width of clock	10	6		ns
t_{su}	Set up time from input or feedback to clock	10	5		ns
t_h	Hold time	15	10		ns
T_A	Operating free-air temperature	0	-10		ns
		0	25	75	°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IL}^2	Low-level input voltage			0.8		V
V_{IH}^2	High-level input voltage		2			V
V_{IC}	Input clamp voltage	$V_{CC} = \text{MIN}$ $I_I = -18 \text{ mA}$	-0.8	-1.5		V
I_{IL}^3	Low-level input current	$V_{CC} = \text{MAX}$ $V_I = 0.4 \text{ V}$	-0.02	-0.25		mA
I_{IH}^3	High-level input current	$V_{CC} = \text{MAX}$ $V_I = 2.4 \text{ V}$		100		μA
I_I	Maximum input current	$V_{CC} = \text{MAX}$ $V_I = 5.5 \text{ V}$		1		mA
V_{OL}	Low-level output voltage	$V_{CC} = \text{MAX}$ $I_{OL} = 24 \text{ mA}$	0.3	0.5		V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}$ $I_{OH} = -3.2 \text{ mA}$	2.4	2.8		V
I_{OZL}^3	Off-state output current	$V_{CC} = \text{MAX}$ $V_O = 0.4 \text{ V}$		-100		μA
I_{OZH}^3	Off-state output current	$V_{CC} = \text{MAX}$ $V_O = 2.4 \text{ V}$		100		μA
I_{OS}^4	Output short-circuit current	$V_{CC} = 5 \text{ V}$ $V_O = 0 \text{ V}$	-30	-70	-130	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$	120	180		mA

- The PAL16R8B Series is designed to operate over the full military operating conditions. For availability and specifications, contact Monolithic Memories.
- These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- I/O pin leakage is the worst case of I_{IL} and I_{OZL} (or I_{IH} and I_{OZH}).
- No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

PAL16R8B Series
16L8B, 16R8B, 16R6B, 16R4B

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Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PD}	Input or feedback to output	16L8B, 16R6B, 16R4B	Commercial $R_1 = 200 \Omega$ $R_2 = 390 \Omega$	12	15		ns
t_{CLK}	Clock to output or feedback except 16L8B			8	12		ns
t_{PZX}	Pin 11 to output enable except 16L8B			10	15		ns
t_{PXZ}	Pin 11 to output disable except 16L8B			10	15		ns
t_{EA}	Input to output enable	16L8B, 16R6B, 16R4B		12	22		ns
t_{ER}	Input to output disable	16L8B, 16R6B, 16R4B		12	15		ns
f_{MAX}	Maximum frequency	External		37	45		MHz
		No feedback		50	55		

CMOS PALC16R8Q-25 Series

T-46-13-47

Absolute Maximum Ratings

	Operating	Programming
Supply voltage V_{CC}	-0.5 V to 7.0 V	-0.5 V to 5.25 V
Input voltage	-3.0 V to 7.0 V	-1.0 V to 14.0 V
Off-state output voltage	-0.5 V to 7.0 V	-0.5 V to 7.0 V
Output current into outputs		8 mA
Storage temperature		-65°C to +150°C
Ambient temperature with power applied		-55°C to +125°C
UV light exposure		7258 W-sec/cm ²
Static discharge voltage		>2001 V
Latchup current ($T_A = 0^\circ\text{C}$ to 75°C)		>100 mA

Operating Conditions

SYMBOL	PARAMETER			COMMERCIAL ¹			UNIT	
				MIN	TYP	MAX		
V _{CC}	Supply voltage			4.5	5	5.5	V	
t _{wl}	Width of clock	Low	16R8, 16R6, 16R4	15	10		ns	
t _{wh}		High		15	10		ns	
t _{su}	Setup time from input or feedback to clock			20	15		ns	
t _h	Hold time			0	-10		ns	
T _A	Operating free-air temperature			0	25	75	°C	

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
V_{IL}^2	Low-level input voltage				0.8	V
V_{IH}^2	High-level input voltage		2.0			V
I_{IL}^3	Low-level input current	$V_{CC} = \text{MAX}$ $V_I = 0.4 \text{ V}$			-10	μA
I_{IH}^3	High-level input current	$V_{CC} = \text{MAX}$ $V_I = 2.4 \text{ V}$			10	μA
I_I^3	Maximum input current	$V_{CC} = \text{MAX}$ $V_I = 5.5 \text{ V}$			10	μA
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$ $I_{OL} = 8 \text{ mA}$		0.35	0.4	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}$ $I_{OH} = -3.2 \text{ mA}$	2.4	3.4		V
I_{OZL}^3	Off-state output current	$V_{CC} = \text{MAX}$ $V_O = 0.4 \text{ V}$			-100	μA
I_{OZH}^3		$V_{CC} = \text{MAX}$ $V_O = 2.4 \text{ V}$			100	μA
I_{OS}^4	Output short-circuit current	$V_{CC} = \text{MAX}$ $V_O = 0 \text{ V}$			-300	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$, $V_I = \text{GND}$, Outputs open		30	45	mA
C_{IN}	Input capacitance ⁵	$V_{IN} = 0 \text{ V}$ at $f = 1 \text{ MHz}$		5	7	pF
C_{OUT}	Output capacitance ⁵	$V_{OUT} = 0 \text{ V}$ at $f = 1 \text{ MHz}$		5	7	pF

- The PALC16R8Q-25 Series is designed to operate over the full military operating conditions. For availability and specifications, contact Monolithic Memories.
- These are absolute values with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- I/O pin leakage is the worst case of I_{IL} and I_{OZL} (or I_{IH} and I_{OZH}). For pin 1 $I_{IH} = 25 \mu\text{A}$ max, $I_I = 1 \text{ mA}$ max.
- No more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.
- Sampled but not 100% tested.

CMOS PALC16R8Q-25 Series**Switching Characteristics Over Operating Conditions**

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SYMBOL	PARAMETER			TEST CONDITIONS	COMMERCIAL			UNIT
					MIN	TYP	MAX	
t _{PD}	Input or feedback to output 16L8, 16R6, 16R4			R ₁ = 560 Ω R ₂ = 1.1K Ω		20	25	ns
t _{CLK}	CLK to output		16R8, 16R6, 16R4			10	15	ns
t _{CF}	CLK to feedback					9	13	ns
t _{PZX}	Pin 11 to output enable					15	20	ns
t _{PXZ}	Pin 11 to output disable					15	20	ns
t _{EA}	Input to output enable	16L8, 16R6, 16R4				20	25	ns
t _{ER}	Input to output disable					20	25	ns
t _{MAX}	Maximum frequency	External feedback (1/t _{su} + t _{CLK})	16R8, 16R6, 16R4			28.5	40	MHz
		Internal feedback (1/t _{su} + t _{CF})				30	40	
		No feedback (1/t _{wh} + t _{wl})				33.3	50	

Output Register Preload

The preload function allows the register to be loaded from the output pins. This feature aids functional testing of sequential designs by allowing direct loading of output states. The procedure is:

1. Raise VCC to 5.0 V $\pm$ 0.5 V.
2. Disable output registers by setting pin 11 to VIH.
3. Apply VIL/VIH as desired to all registered output pins. Leave combinatorial outputs floating.
4. Pulse pin 5 from VIL to 13.5 V to VIL.
5. Remove VIL/VIH from all registered output pins.
6. Enable output registers.
7. Verify for VOL/VOH at all registered output pins.

Programming and Erasing

The PALC16R8Q-25 Series can be programmed on standard logic programmers. The PALC16R8Q-25 Series may be erased by ultraviolet light when contained in the windowed package.

For erasure, the recommended ultraviolet light wavelength is 2537 Angstroms. The minimum dose required is 25,000 mW-sec/cm² (UV intensity x exposure time). For an ultraviolet lamp with a 12 mW/cm² power rating, the minimum exposure time would be 25,000/12 seconds = 35 minutes. The device needs to be within one inch of the lamp during erasure.

Permanent damage may result if the device is exposed to high-intensity UV light for an extended period of time. The recommended maximum dosage is 7258 W-sec/cm².

Wavelengths of light less than 4000 Angstroms can partially erase the device in the windowed package. For this reason, an opaque label should be placed over the window, especially if the device will be exposed to sunlight or fluorescent lighting for extended periods of time.

PAL16R8B-2 Series
16L8B-2, 16R8B-2, 16R6B-2, 16R4B-2

T-46-13-47

Absolute Maximum Ratings

	Operating	Programming
Supply voltage V_{CC}	-0.5 V to 7.0 V	-0.5 V to 12.0 V
Input voltage	-1.5 V to 5.5 V	-1.0 V to 22.0 V
Off-state output voltage	5.5 V	12.0 V
Storage temperature		-65°C to +150°C

Operating Conditions

SYMBOL	PARAMETER	COMMERCIAL ¹			UNIT
		MIN	TYP	MAX	
V_{CC}	Supply voltage	4.75	5	5.25	V
t_w	Width of clock	Low	15	10	ns
		High	15	10	
t_{su}	Set up time from input or feedback to clock	16R8B-2, 16R6B-2, 16R4B-2			ns
t_h	Hold time	0	-10		ns
T_A	Operating free-air temperature	0	25	75	°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{IL}^2	Low-level input voltage					0.8	V
V_{IH}^2	High-level input voltage			2			V
V_{IC}	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$	-0.8	-1.5		V
I_{IL}^3	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$	-0.02	-0.25		mA
I_{IH}^3	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$		25		μA
I_I	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$		100		μA
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 24 \text{ mA}$	0.3	0.5		V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}$	$I_{OH} = -3.2 \text{ mA}$	2.4	2.8		V
I_{OZL}^3	Off-state output current	$V_{CC} = \text{MAX}$	$V_O = 0.4 \text{ V}$		-100		μA
I_{OZH}^3			$V_O = 2.4 \text{ V}$		100		μA
I_{OS}^4	Output short-circuit current	$V_{CC} = 5 \text{ V}$	$V_O = 0 \text{ V}$	-30	-100	-250	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$		60	90		mA

1. The PAL16R8B-2 Series is designed to operate over the full military operating conditions. For availability and specifications, contact Monolithic Memories.
2. These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
3. I/O pin leakage is the worst case of I_{IL} and I_{OZL} (or I_{IH} and I_{OZH}).
4. No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

PAL16R8B-2 Series
16L8B-2, 16R8B-2, 16R6B-2, 16R4B-2

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Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PD}	Input or feedback to output	16L8B-2, 16R6B-2, 16R4B-2	Commercial $R_1 = 200 \Omega$ $R_2 = 390 \Omega$	17	25	ns	
t_{CLK}	Clock to output or feedback except 16L8B-2			10	15	ns	
t_{CF}	Clock to feedback except 16L8B-2			8	10	ns	
t_{PZX}	Pin 11 to output enable except 16L8B-2			10	20	ns	
t_{PXZ}	Pin 11 to output disable except 16L8B-2			11	20	ns	
t_{EA}	Input to output enable	16L8B-2, 16R6B-2, 16R4B-2		10	25	ns	
t_{ER}	Input to output disable	16L8B-2, 16R6B-2, 16R4B-2		13	25	ns	
f_{MAX}	Maximum frequency	External		25	40		MHz
		Internal		28.5	43		
		No feedback		33	50		
		16R8B-2, 16R6B-2, 16R4B-2					

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Absolute Maximum Ratings

Supply voltage V_{CC}	Operating	Programming
Input voltage	-0.5 V to 7.0 V	-0.5 V to 12.0 V
Off-state output voltage	-1.5 V to 5.5 V	-1.0 V to 22.0 V
Storage temperature	5.5 V	12.0 V
		-65°C to +150°C

Operating Conditions

SYMBOL	PARAMETER	COMMERCIAL			UNIT
		MIN	TYP	MAX	
V_{CC}	Supply voltage	4.75	5	5.25	V
t_w	Width of clock	Low		15	ns
		High		10	
t_{su}	Set up time from input or feedback to clock	16R8, 16R6, 16R4			ns
t_h	Hold time	0			ns
T_A	Operating free-air temperature	0	25	75	°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{IL}^1	Low-level input voltage					0.8	V
V_{IH}^1	High-level input voltage			2			V
V_{IC}	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$	-0.8	-1.5		V
I_{IL}^2	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$	-0.02	-0.25		mA
I_{IH}^2	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$		25		μA
I_I	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$		100		μA
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 24 \text{ mA}$	0.3	0.5		V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}$	$I_{OH} = -3.2 \text{ mA}$	2.4	2.8		V
I_{OZL}^2	Off-state output current	$V_{CC} = \text{MAX}$	$V_O = 0.4 \text{ V}$		-100		μA
I_{OZH}^2			$V_O = 2.4 \text{ V}$		100		μA
I_{OS}^3	Output short-circuit current	$V_{CC} = 5 \text{ V}$	$V_O = 0 \text{ V}$	-30	-70	-130	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$		120	180		mA

- These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- I/O pin leakage is the worst case of I_{IL} and I_{OZL} (or I_{IH} and I_{OZH}).
- No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

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Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PD}	Input or feedback to output	16R6A, 16R4A, 16L8A	$R_1 = 200 \Omega$ $R_2 = 390 \Omega$	15	25		ns
t_{CLK}	Clock to output or feedback			10	15		ns
t_{CF}	Clock to feedback			8	10		ns
t_{PZX}	Pin 11 to output enable except 16L8A			10	20		ns
t_{PXZ}	Pin 11 to output disable except 16L8A			11	20		ns
t_{EA}	Input to output enable	16R6A, 16R4A, 16L8A		10	25		ns
t_{ER}	Input to output disable	16R6A, 16R4A, 16L8A		13	25		ns
f_{MAX}	Maximum frequency	External		25	40		MHz
		Internal		28.5	40		
		No feedback		33	50		

Absolute Maximum Ratings

	Operating	Programming
Supply voltage V_{CC}	-0.5 V to 7.0 V	-0.5 V to 12.0 V
Input voltage	-1.5 V to 5.5 V	-1.0 V to 22.0 V
Off-state output voltage	5.5 V	12.0 V
Storage temperature	-65°C to +150°C	

Operating Conditions

SYMBOL	PARAMETER		COMMERCIAL			UNIT
			MIN	TYP	MAX	
V _{CC}	Supply voltage		4.75	5	5.25	V
t _w	Width of clock	Low	25	10		ns
		High	25	10		
t _{su}	Set up time from input or feedback to clock	16R8B-4, 16R6B-4, 16R4B-4	35	25		ns
t _h	Hold time		0	-10		ns
T _A	Operating free-air temperature		0	25	75	°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{IL}^1	Low-level input voltage					0.8	V
V_{IH}^1	High-level input voltage			2			V
V_{IC}	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$	-0.8	-1.5		V
I_{IL}^2	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$	-0.02	-0.25		mA
I_{IH}^2	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$		25		μA
I_I	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$		100		μA
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 8 \text{ mA}$	0.3	0.5		V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}$	$I_{OH} = -1 \text{ mA}$	2.4	2.8		V
I_{OZL}^2	Off-state output current	$V_{CC} = \text{MAX}$	$V_O = 0.4 \text{ V}$		-100		μA
I_{OZH}^2			$V_O = 2.4 \text{ V}$		100		μA
I_{OS}^3	Output short-circuit current	$V_{CC} = 5 \text{ V}$	$V_O = 0 \text{ V}$	-30	-100	-250	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$		30	55		mA

- These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- I/O pin leakage is the worst case of I_{IL} and I_{OZL} (or I_{IH} and I_{OZH}).
- No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PD}	Input or feedback to output	16L8B-4, 16R6B-4, 16R4B-4	$R_1 = 800 \Omega$ $R_2 = 1.56 K\Omega$	25	35		ns
t_{CLK}	Clock to output or feedback			15	25		ns
t_{PZX}	Pin 11 to output enable except 16L8B-4			15	25		ns
t_{PXZ}	Pin 11 to output disable except 16L8B-4			15	25		ns
t_{EA}	Input to output enable	16L8B-4, 16R6B-4, 16R4B-4		25	35		ns
t_{ER}	Input to output disable	16L8B-4, 16R6B-4, 16R4B-4		25	35		ns
f_{MAX}	Maximum frequency	External		16	25		MHz
		No feedback		25	50		

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Absolute Maximum Ratings

	Operating	Programming
Supply voltage V_{CC}	-0.5 V to 7.0 V	-0.5 V to 12.0 V
Input voltage	-1.5 V to 5.5 V	-1.0 V to 22.0 V
Off-state output voltage	5.5 V	12.0 V
Storage temperature	-65°C to +150°C	

Operating Conditions

SYMBOL	PARAMETER		COMMERCIAL			UNIT
			MIN	TYP	MAX	
V _{CC}	Supply voltage		4.75	5	5.25	V
t _w	Width of clock	Low	25	10		ns
		High	25	10		
t _{su}	Set up time from input or feedback to clock	16R8A-2, 16R6A-2, 16R4A-2	35	25		ns
t _h	Hold time		0	-10		ns
T _A	Operating free-air temperature		0	25	75	°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{IL}^1	Low-level input voltage					0.8	V
V_{IH}^1	High-level input voltage			2			V
V_{IC}	Input clamp voltage	$V_{CC} = \text{MIN}$	$I_I = -18 \text{ mA}$		-0.8	-1.5	V
I_{IL}^2	Low-level input current	$V_{CC} = \text{MAX}$	$V_I = 0.4 \text{ V}$		-0.02	-0.25	mA
I_{IH}^2	High-level input current	$V_{CC} = \text{MAX}$	$V_I = 2.4 \text{ V}$			25	μA
I_I	Maximum input current	$V_{CC} = \text{MAX}$	$V_I = 5.5 \text{ V}$			100	μA
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$	$I_{OL} = 24 \text{ mA}$		0.3	0.5	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}$	$I_{OH} = -1 \text{ mA}$	2.4	2.8		V
I_{OZL}^2	Off-state output current	$V_{CC} = \text{MAX}$	$V_O = 0.4 \text{ V}$			-100	μA
I_{OZH}^2			$V_O = 2.4 \text{ V}$			100	μA
I_{OS}^3	Output short-circuit current	$V_{CC} = 5 \text{ V}$	$V_O = 0 \text{ V}$	-30	-100	-250	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$			60	90	mA

1. These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
2. I/O pin leakage is the worst case of I_{IL} and I_{OZL} (or I_{IH} and I_{OZH}).
3. No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

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Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PD}	Input or feedback to output	16L8A-2, 16R6A-2, 16R4A-2	$R_1 = 200\ \Omega$ $R_2 = 390\ \Omega$	25	35		ns
t_{CLK}	Clock to output or feedback			15	25		ns
t_{PZX}	Pin 11 to output enable except 16L8A-2			15	25		ns
t_{PXZ}	Pin 11 to output disable except 16L8A-2			15	25		ns
t_{EA}	Input to output enable	16L8A-2, 16R6A-2, 16R4A-2		25	35		ns
t_{ER}	Input to output disable	16L8A-2, 16R6A-2, 16R4A-2		25	35		ns
f_{MAX}	Maximum frequency	External		16	25		MHz
		No feedback		20	50		

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Absolute Maximum Ratings

	Operating	Programming
Supply voltage V_{CC}	-0.5 V to 7.0 V	-0.5 V to 12.0 V
Input voltage	-1.5 V to 5.5 V	-1.0 V to 22.0 V
Off-state output voltage	5.5 V	12.0 V
Storage temperature	-65°C to +150°C	

Operating Conditions

SYMBOL	PARAMETER	COMMERCIAL MIN TYP MAX	UNIT
V_{CC}	Supply voltage	4.75 5 5.25	V
t_w	Width of clock	Low	30 20
		High	30 20
t_{su}	Set up time from input or feedback to clock	16R8A-4, 16R6A-4, 16R4A-4	60 45
t_h	Hold time	0 -15	ns
T_A	Operating free-air temperature	0 25 75	°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS	MIN TYP MAX	UNIT
V_{IL}^1	Low-level input voltage		0.8	V
V_{IH}^1	High-level input voltage		2	V
V_{IC}	Input clamp voltage	$V_{CC} = \text{MIN}$ $I_I = -18 \text{ mA}$	-0.8 -1.5	V
I_{IL}^2	Low-level input current	$V_{CC} = \text{MAX}$ $V_I = 0.4 \text{ V}$	-0.02 -0.25	mA
I_{IH}^2	High-level input current	$V_{CC} = \text{MAX}$ $V_I = 2.4 \text{ V}$	25	μA
I_I	Maximum input current	$V_{CC} = \text{MAX}$ $V_I = 5.5 \text{ V}$	100	μA
V_{OL}	Low-level output voltage	$V_{CC} = \text{MIN}$ $I_{OL} = 8 \text{ mA}$	0.3 0.5	V
V_{OH}	High-level output voltage	$V_{CC} = \text{MIN}$ $I_{OH} = -1 \text{ mA}$	2.4 2.8	V
I_{OZL}^2	Off-state output current	$V_{CC} = \text{MAX}$ $V_O = 0.4 \text{ V}$	-100	μA
I_{OZH}^2			100	μA
I_{OS}^3	Output short-circuit current	$V_{CC} = 5 \text{ V}$ $V_O = 0 \text{ V}$	-30 -70 -130	mA
I_{CC}	Supply current	$V_{CC} = \text{MAX}$	30 50	mA

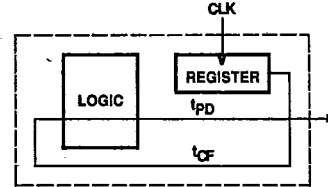
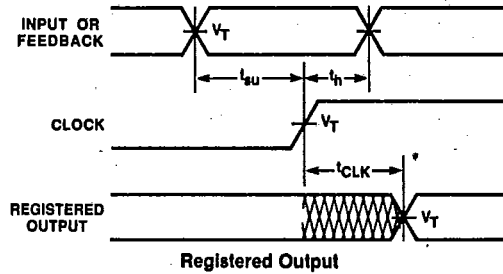
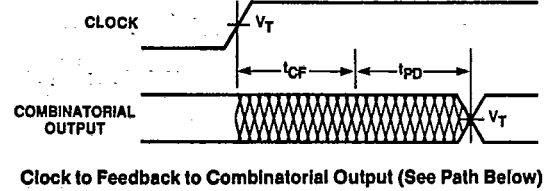
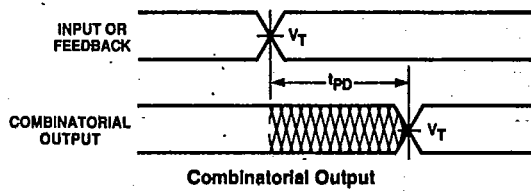
- These are absolute voltages with respect to the ground pin on the device and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- I/O pin leakage is the worst case of I_{IL} and I_{OZL} (or I_{IH} and I_{OZH}).
- No more than one output should be shorted at a time, and duration of the short circuit should not exceed one second.

Switching Characteristics Over Operating Conditions

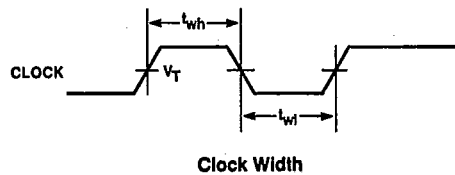
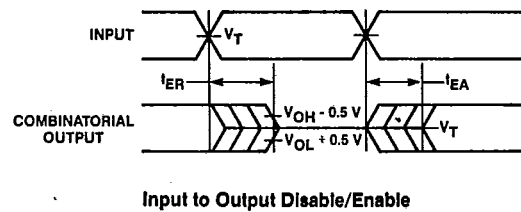
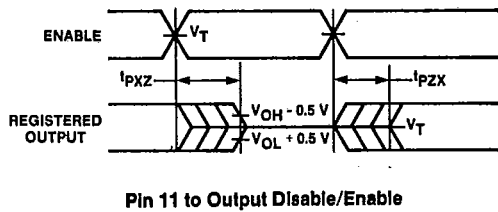
SYMBOL	PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PD}	Input or feedback to output	16L8A-4, 16R6A-4, 16R4A-4	$R_1 = 800 \Omega$ $R_2 = 1.56 K\Omega$	35	55		ns
t_{CLK}	Clock to output or feedback			20	35		ns
t_{PZX}	Pin 11 to output enable except 16L8A-4			15	30		ns
t_{PXZ}	Pin 11 to output disable except 16L8A-4			15	30		ns
t_{EA}	Input to output enable	16L8A-4, 16R6A-4, 16R4A-4		30	50		ns
t_{ER}	Input to output disable	16L8A-4, 16R6A-4, 16R4A-4		30	50		ns
f_{MAX}	Maximum frequency	External		11	18		MHz
		No feedback		16	25		

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Switching Waveforms



- Notes:
1. $V_T = 1.5\text{ V}$
 2. Input pulse amplitude 0 V to 3.0 V
 3. Input rise and fall times 2-5 ns typical



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Key to Timing Diagrams

WAVEFORM	INPUTS	OUTPUTS
	DON'T CARE; CHANGE PERMITTED	CHANGING; STATE UNKNOWN
	NOT APPLICABLE	CENTER LINE IS HIGH IMPEDANCE STATE
	MUST BE STEADY	WILL BE STEADY

Switching Test Load

(refer to page 5-164)

Programmers/Development Systems

(refer to Programmer Reference Guide, page 3-81)

Schematic of Inputs and Outputs

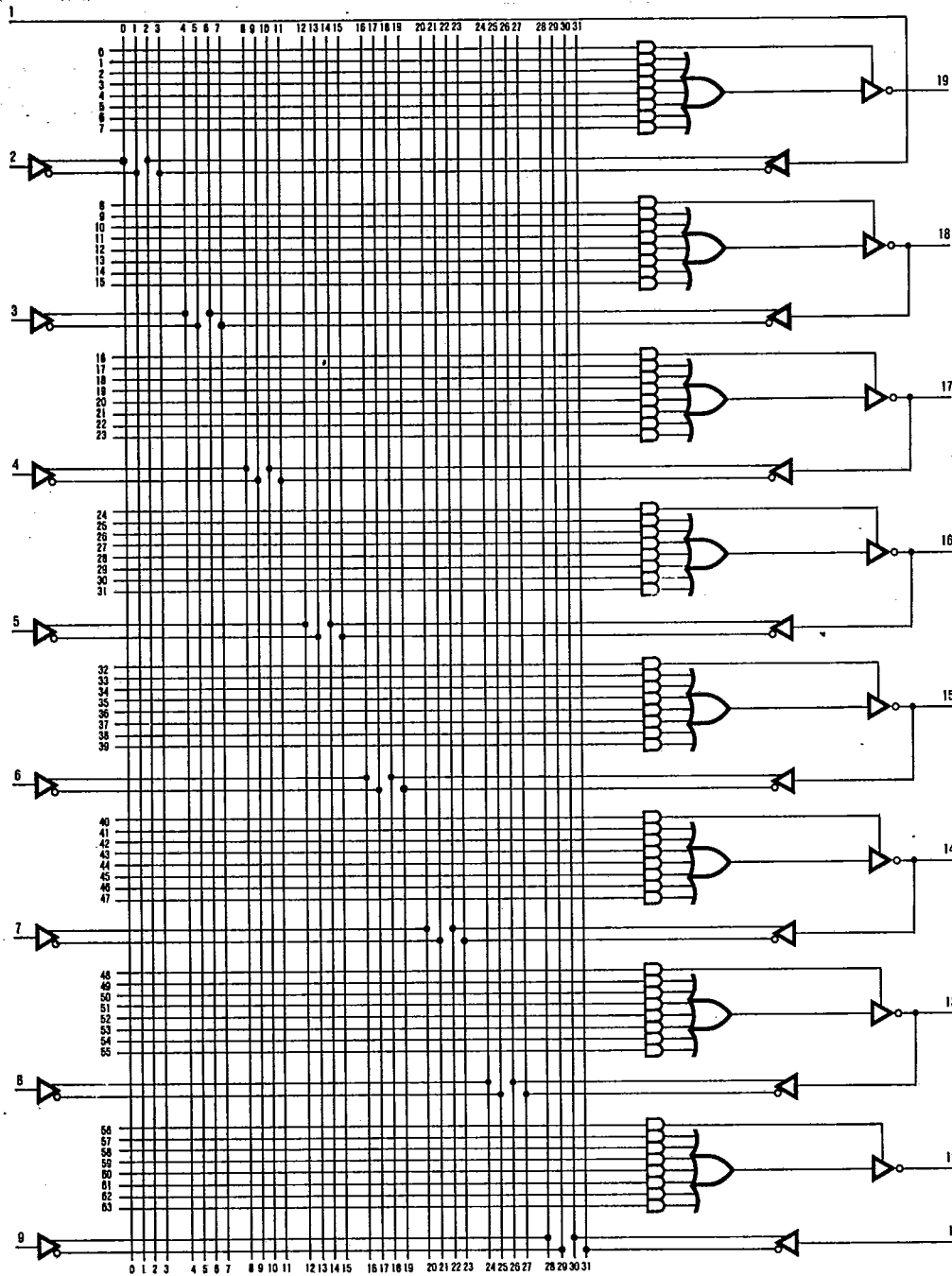
(refer to page 5-164)

PAL16R8 Series
16L8 Logic Diagram

T-46-13-47

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96D 27104 D

Logic Diagram**16L8**

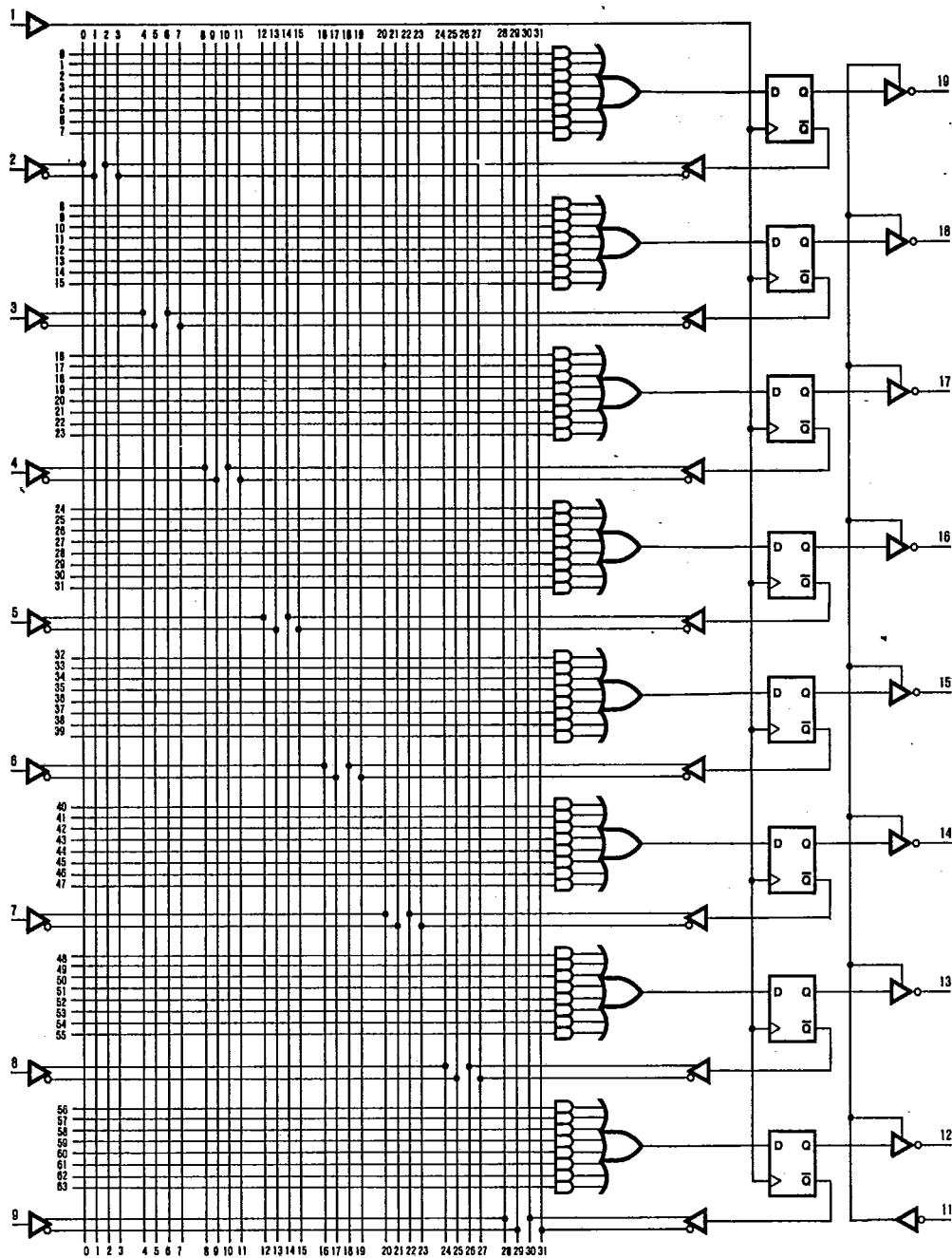
PAL16R8 Series
16R8 Logic Diagram

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Logic Diagram

16R8

96D 27105 D

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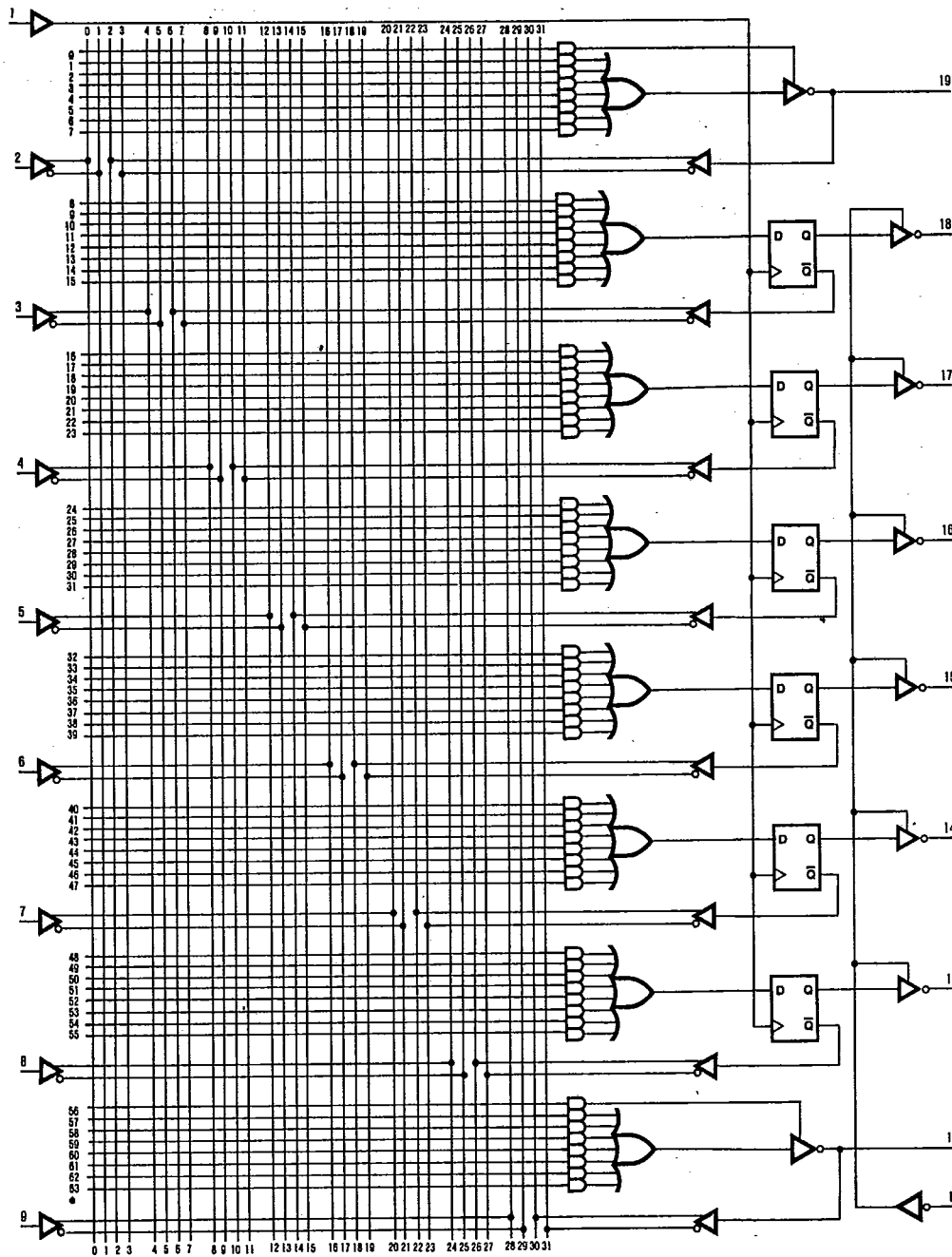
PAL16R8 Series
16R6 Logic Diagram

T-46-13-47

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96D 27106

D

Logic Diagram**16R6**

PAL16R8 Series
16R4 Logic Diagram

T-46-13-47

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96D 27107 D

Logic Diagram**16R4**