Rochester Electronics

Datasheet

Rochester Electronics Manufactured Components

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All recreations are done with the approval of the OCM.

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceed the OCM data sheet.

Quality Overview

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-35835
    - Class Q Military
    - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)

    - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

The original manufacturer's datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OEM specifications. 'Typical' values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.

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.

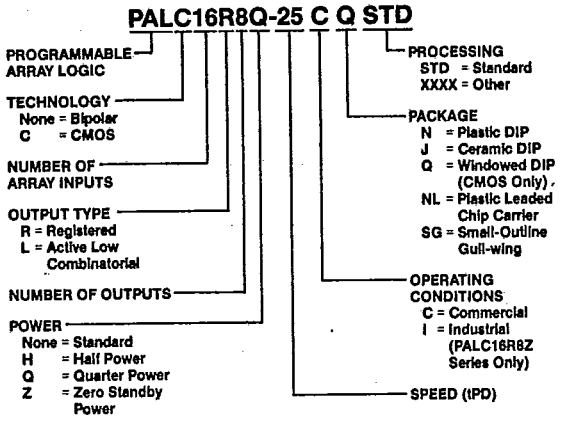
Programmable Three-State Outputs

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.

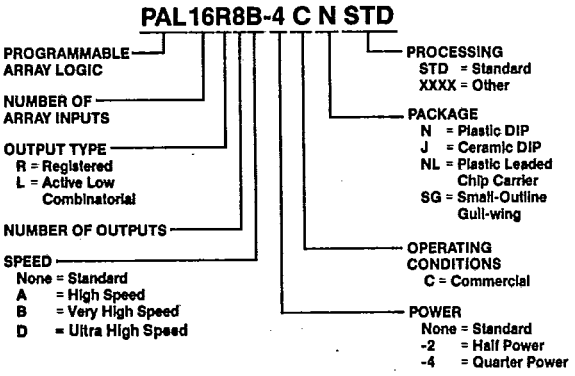
Registers with Feedback

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.

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.

	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

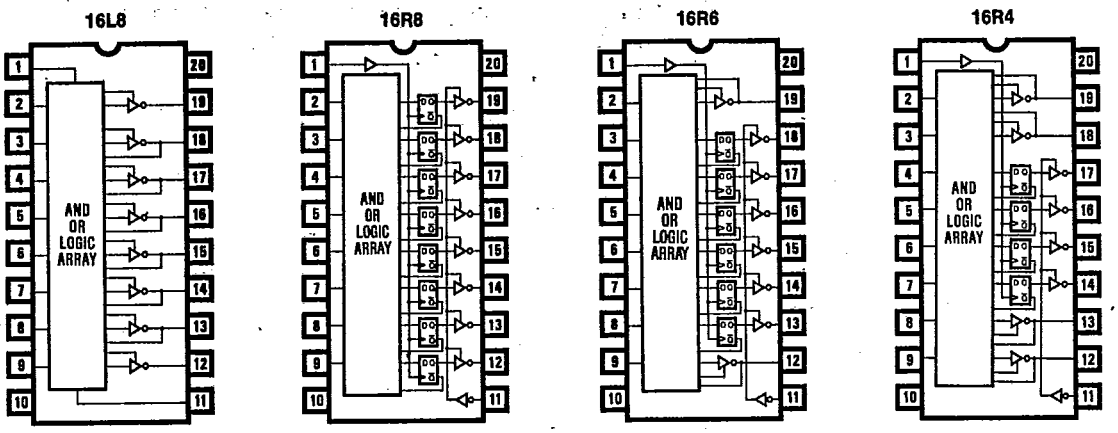
Preload

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.

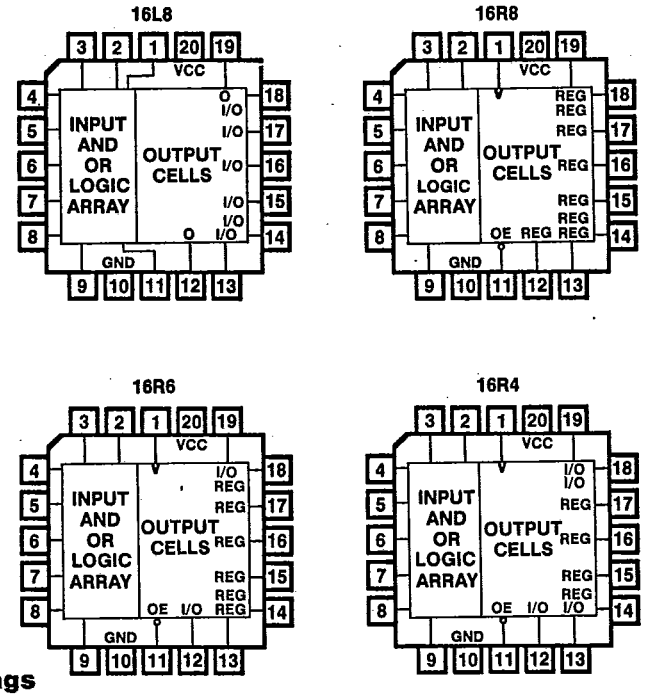
SUFFIX	t_{PD} (ns)	I_{CC} (mA)
A	25	180
A-2	35	90
A-4	55	50
B	15	180
B-2	25	90
B-4	35	55
(C)Q-25	25	45
D	10	180

5

DIP/SO Pinouts



PLCC Pinouts



Package Drawings

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

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] MIN	TYP	MAX	UNIT
V_{CC}	Supply voltage			4.75	5	5.25	V
t_w	Width of clock	Low	16R8, 16R6, 16R4	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} = MIN	I_I = −18 mA		−0.8	−1.5	V
I_{IL}[3]	Low-level input current	V_{CC} = MAX	V_I = 0.4 V		−0.02	−0.25	mA
I_{IH}[3]	High-level input current	V_{CC} = MAX	V_I = 2.4 V			25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5 V			100	μA
V_{OL}	Low-level output voltage	V_{CC} = MIN	I_{OL} = 24 mA		0.3	0.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN	I_{OH} = −3.2 mA	2.4	3.4		V
I_{OZL}[3]	Off-state output current	V_{CC} = MAX	V_O = 0.4 V			−100	μA
I_{OZH}[3]			V_O = 2.4 V			100	μA
I_{OS}[4]	Output short-circuit current	V_{CC} = 5 V	V_O = 0 V	−30	−70	−130	mA
I_{CC}	Supply current	V_{CC} = MAX			120	180	mA
C_{IN}	Input capacitance	V_{IN} = 2.0 V at f = 1 MHz			2		pF
C_{OUT}	Output capacitance	V_{OUT} = 2.0 V at f = 1 MHz			4		pF
$C_{CLK,EN}$	Clock/enable capacitance	$V_{CLK,EN}$ = 2.0 V at f = 1 MHz			9		pF

1. The PAL16R8D 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.

5

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	16R8, 16R6, 16R4		58.8	71		MHz
		Internal			60	76		
		No feedback			62.5	90		

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	10	6		ns
		High	10	5		
t_{su}	Set up time from input or feedback to clock	16R8B, 16R6B, 16R4B	15	10		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} = MIN	I_I = -18 mA		-0.8	-1.5	V
I_{IL}[3]	Low-level input current	V_{CC} = MAX	V_I = 0.4 V		-0.02	-0.25	mA
I_{IH}[3]	High-level input current	V_{CC} = MAX	V_I = 2.4 V			100	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5 V			1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	I_{OL} = 24 mA		0.3	0.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN	I_{OH} = -3.2 mA	2.4	2.8		V
I_{OZL}[3]	Off-state output current	V_{CC} = MAX	V_O = 0.4 V			-100	μA
I_{OZH}[3]			V_O = 2.4 V			100	μA
I_{OS}[4]	Output short-circuit current	V_{CC} = 5 V	V_O = 0 V	-30	-70	-130	mA
I_{CC}	Supply current	V_{CC} = MAX			120	180	mA

1. The PAL16R8B 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.

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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	16R8B, 16R6B, 16R4B		37	45		MHz
		No feedback			50	55		

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°C to 75°C)		>100 mA

Operating Conditions

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

1. The PALC16R8Q-25 Series is designed to operate over the full military operating conditions. For availability and specifications, contact Monolithic Memories.
2. 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.
3. 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 μA max, I_I = 1 mA max.
4. No more than one output should be shorted at a time, and duration of the short-circuit should not exceed one second.
5. Sampled but not 100% tested.

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Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER			TEST CONDITIONS	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
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
f_{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 ± 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/cm^2 (UV intensity x exposure time). For an ultraviolet lamp with a 12 mW/cm^2 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/cm^2.

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.

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] MIN	TYP	MAX	UNIT
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	25	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 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} = MIN	I_I = −18 mA		−0.8	−1.5	V
I_{IL}[3]	Low-level input current	V_{CC} = MAX	V_I = 0.4 V		−0.02	−0.25	mA
I_{IH}[3]	High-level input current	V_{CC} = MAX	V_I = 2.4 V			25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5 V			100	μA
V_{OL}	Low-level output voltage	V_{CC} = MIN	I_{OL} = 24 mA		0.3	0.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN	I_{OH} = −3.2 mA	2.4	2.8		V
I_{OZL}[3]	Off-state output current	V_{CC} = MAX	V_O = 0.4 V			−100	μA
I_{OZH}[3]			V_O = 2.4 V			100	μA
I_{OS}[4]	Output short-circuit current	V_{CC} = 5 V	V_O = 0 V	−30	−100	−250	mA
I_{CC}	Supply current	V_{CC} = 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.

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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 Ω R_2 = 390 Ω		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	16R8B-2, 16R6B-2, 16R4B-2		25	40		MHz
		Internal			28.5	43		
		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 MIN	TYP	MAX	UNIT
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	16R8, 16R6, 16R4	25	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 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} = MIN	I_I = -18 mA		-0.8	-1.5	V
I_{IL}[2]	Low-level input current	V_{CC} = MAX	V_I = 0.4 V		-0.02	-0.25	mA
I_{IH}[2]	High-level input current	V_{CC} = MAX	V_I = 2.4 V			25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5 V			100	μA
V_{OL}	Low-level output voltage	V_{CC} = MIN	I_{OL} = 24 mA		0.3	0.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN	I_{OH} = -3.2 mA	2.4	2.8		V
I_{OZL}[2]	Off-state output current	V_{CC} = MAX	V_O = 0.4 V			-100	μA
I_{OZH}[2]			V_O = 2.4 V			100	μA
I_{OS}[3]	Output short-circuit current	V_{CC} = 5 V	V_O = 0 V	-30	-70	-130	mA
I_{CC}	Supply current	V_{CC} = MAX			120	180	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 curcuit 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		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	16R8A, 16R6A, 16R4A		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 MIN	TYP	MAX	UNIT
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} = MIN	I_I = -18 mA		-0.8	-1.5	V
I_{IL}[2]	Low-level input current	V_{CC} = MAX	V_I = 0.4 V		-0.02	-0.25	mA
I_{IH}[2]	High-level input current	V_{CC} = MAX	V_I = 2.4 V			25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5 V			100	μA
V_{OL}	Low-level output voltage	V_{CC} = MIN	I_{OL} = 8 mA		0.3	0.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN	I_{OH} = -1 mA	2.4	2.8		V
I_{OZL}[2]	Off-state output current	V_{CC} = MAX	V_O = 0.4 V			-100	μA
I_{OZH}[2]			V_O = 2.4 V			100	μA
I_{OS}[3]	Output short-circuit current	V_{CC} = 5 V	V_O = 0 V	-30	-100	-250	mA
I_{CC}	Supply current	V_{CC} = MAX			30	55	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.

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 Ω R_2 = 1.56 KΩ		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	16R8B-4, 16R6B-4, 16R4B-4		16	25		MHz
		No feedback			25	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 MIN	TYP	MAX	UNIT
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} = MIN	I_I = -18 mA		-0.8	-1.5	V
I_{IL}[2]	Low-level input current	V_{CC} = MAX	V_I = 0.4 V		-0.02	-0.25	mA
I_{IH}[2]	High-level input current	V_{CC} = MAX	V_I = 2.4 V			25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5 V			100	μA
V_{OL}	Low-level output voltage	V_{CC} = MIN	I_{OL} = 24 mA		0.3	0.5	V
V_{OH}	High-level output voltage	V_{CC} = MIN	I_{OH} = -1 mA	2.4	2.8		V
I_{OZL}[2]	Off-state output current	V_{CC} = MAX	V_O = 0.4 V			-100	μA
I_{OZH}[2]			V_O = 2.4 V			100	μA
I_{OS}[3]	Output short-circuit current	V_{CC} = 5 V	V_O = 0 V	-30	-100	-250	mA
I_{CC}	Supply current	V_{CC} = 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.

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	16R8A-2, 16R6A-2, 16R4A-2		16	25		MHz
		No feedback			20	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 MIN	TYP	MAX	UNIT
V_{CC}	Supply voltage		4.75	5	5.25	V
t_w	Width of clock	Low	30	20		ns
		High	30	20		
t_{su}	Set up time from input or feedback to clock	16R8A-4, 16R6A-4, 16R4A-4	60	45		ns
t_h	Hold time		0	−15		ns
T_A	Operating free-air temperature		0	25	75	°C

Electrical Characteristics Over Operating Conditions

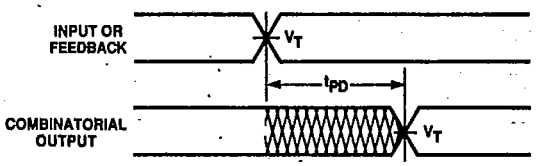
SYMBOL	PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{IL}[1]	Low-level input voltage					0.8	V
V_{IH}[1]	High-level input voltage			2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN	I_I = −18 mA		−0.8	−1.5	V
I_{IL}[2]	Low-level input current	V_{CC} = MAX	V_I = 0.4 V		−0.02	−0.25	mA
I_{IH}[2]	High-level input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

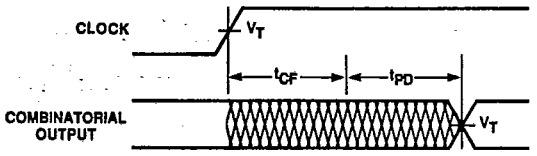
Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{PD}	Input or feedback to output		16L8A-4, 16R6A-4, 16R4A-4	R_1 = 800 Ω R_2 = 1.56 KΩ		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	16R8A-4, 16R6A-4, 16R4A-4		11	18		MHz
		No feedback			16	25		

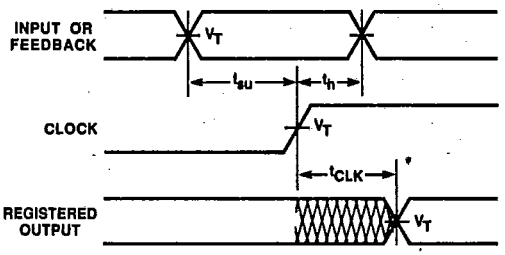
Switching Waveforms



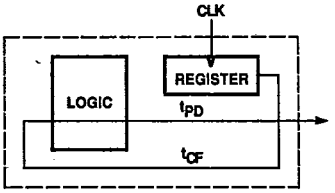
Combinatorial Output



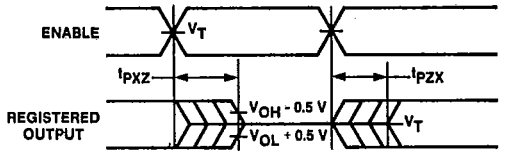
Clock to Feedback to Combinatorial Output (See Path Below)



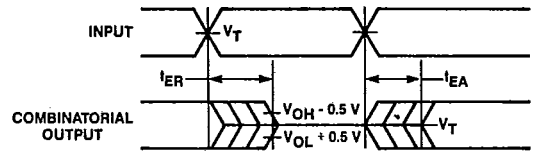
Registered Output



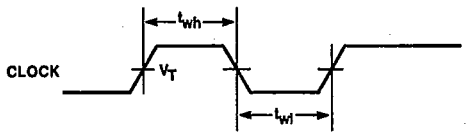
Notes:
1. VT = 1.5 V
2. Input pulse amplitude 0 V to 3.0 V
3. Input rise and fall times 2-5 ns typical



Pin 11 to Output Disable/Enable



Input to Output Disable/Enable



Clock Width

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)

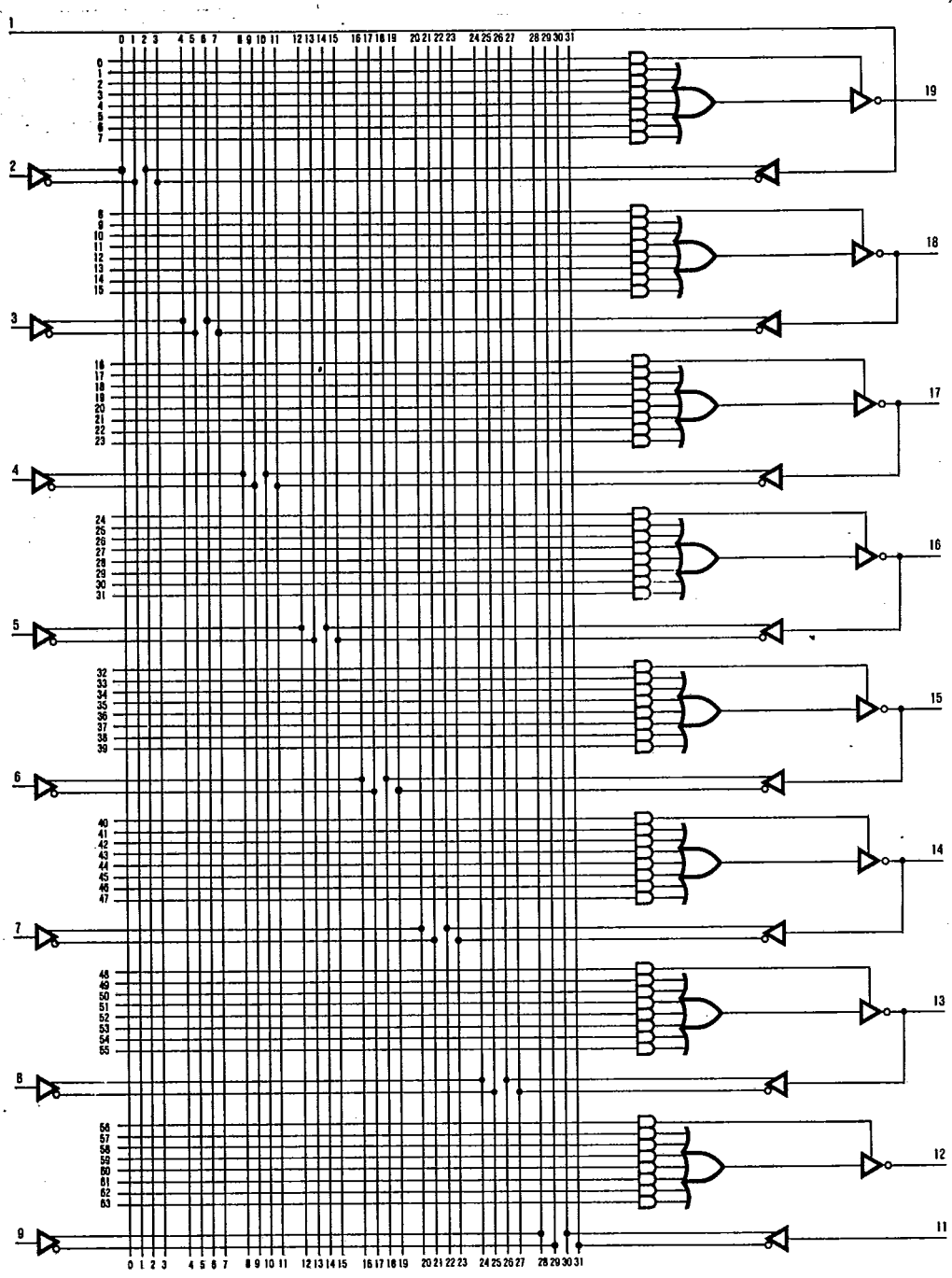
Schematic of Inputs and Outputs
(refer to page 5-164)

5

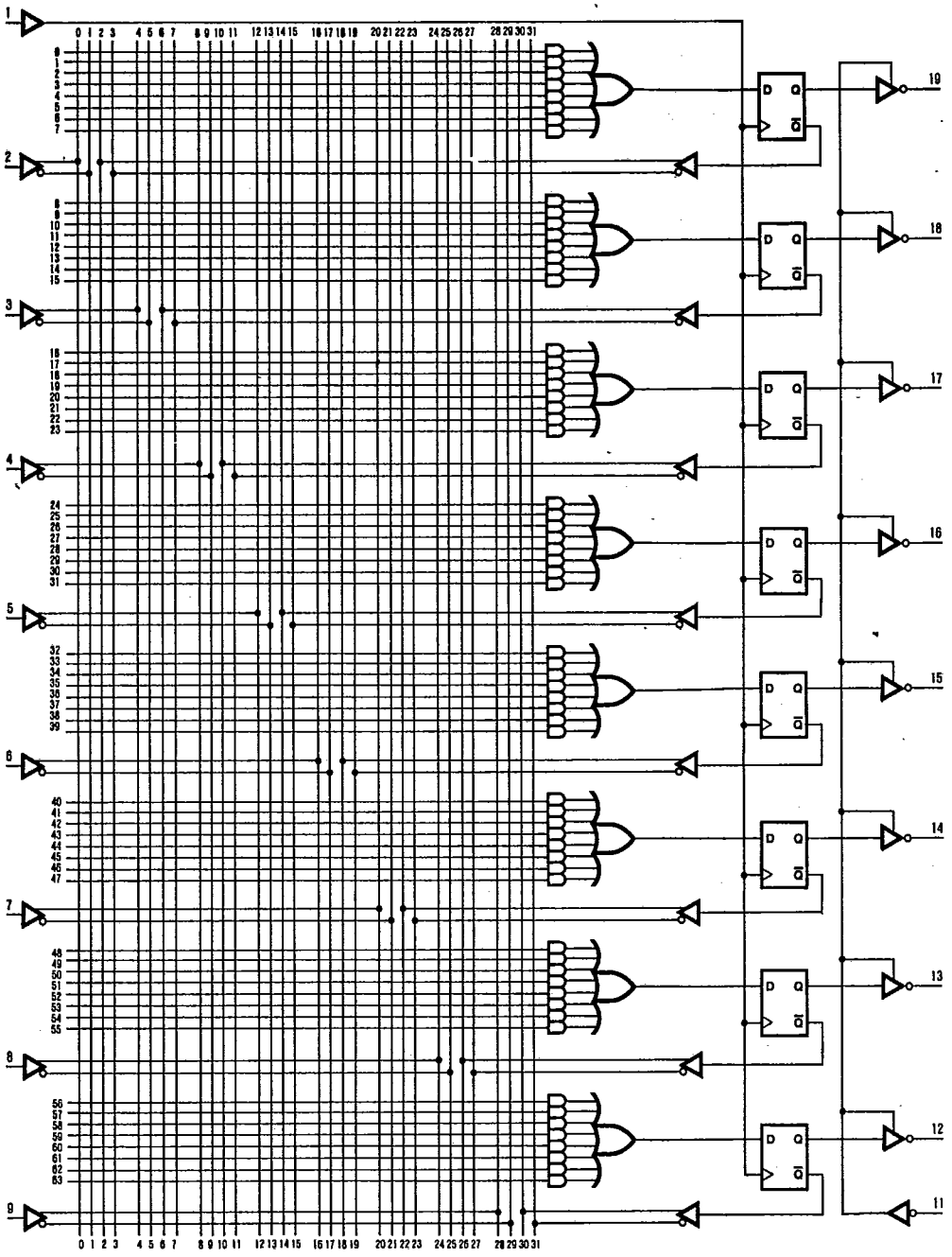
0257526 ADV MICRO PLA/PLE/ARRAYS 96D 27104 D

Logic Diagram

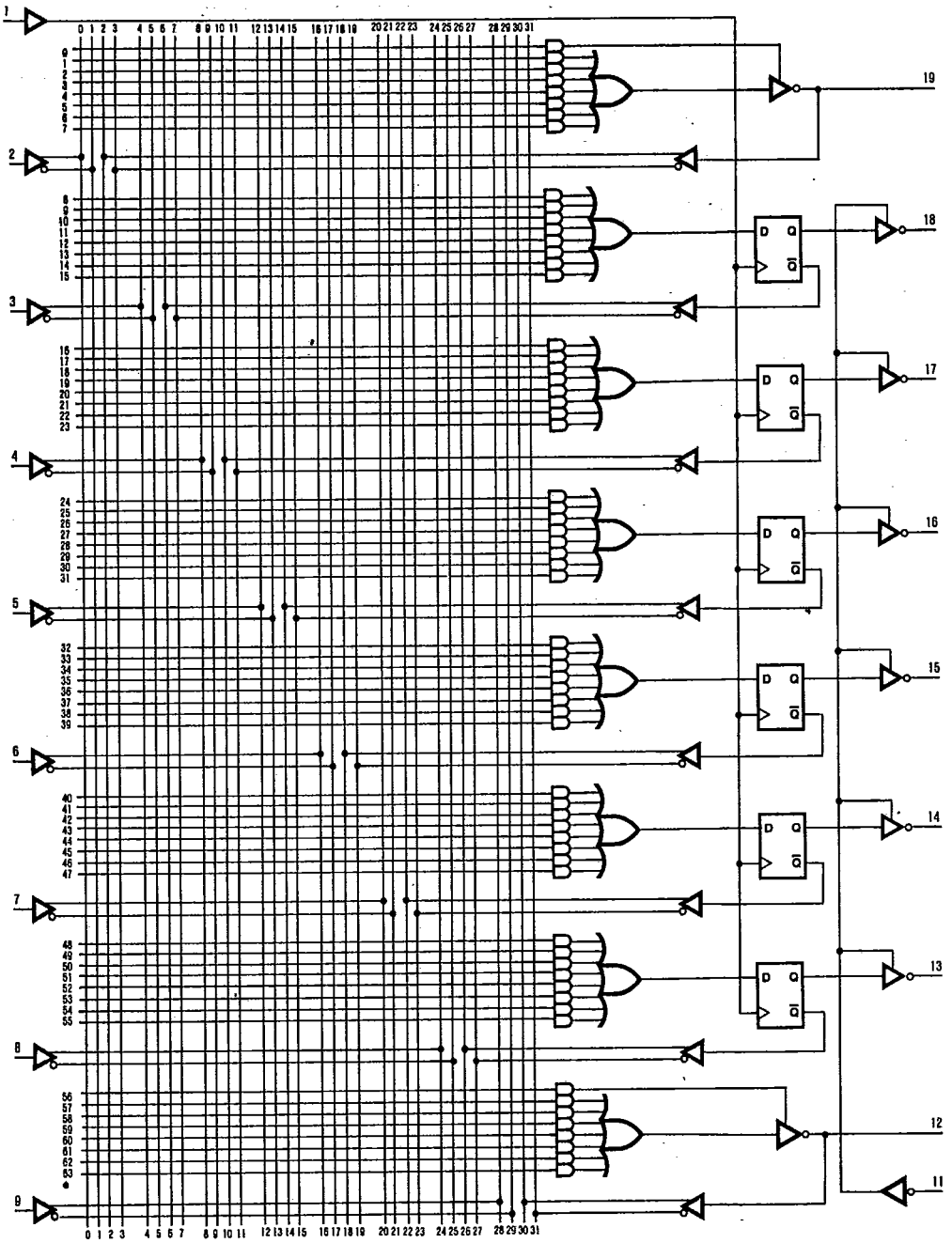
16L8



Logic Diagram **16R8**



Logic Diagram **16R6**



Logic Diagram 16R4