PAL®-Programmable Array Logic
HAL®-Hard Array Logic

Features/Benefits

- **Reduces SSI/MSI chip count greater than 5 to 1**
- **Saves space with SKINNYDIP® packages**
- **Reduces IC inventories substantially**
- **Expedites and simplifies prototyping and board layout**
- **PALASM™ silicon compiler provides auto routing and test vectors**
- **Security fuse reduces possibility of copying by competitors**

Description

The PAL family utilizes an advanced Schottky TTL process and the Bipolar PROM fusible link technology to provide user programmable logic for replacing conventional SSI/MSI gates and flip-flops at reduced chip count.

The HAL family utilizes standard Low-Power Schottky TTL process and automated mask pattern generation directly from logic equations to provide a semi-custom gate array for replacing conventional SSI/MSI gates and flip-flops at reduced chip count.

There are four different speed/power families offered. Choose from either the standard, high speed, half power, or quarter power family to maximize design performance.

The PAL/HAL lets the systems engineer "design his own chip" by blowing fusible links to configure AND and OR gates to perform his desired logic function. Complex interconnections which previously required time-consuming layout are thus "lifted" from PC board etch and placed on silicon where they can be easily modified during prototype check-out or production.

The PAL transfer function is the familiar sum of products. Like the PROM, the PAL has a single array of fusible links. Unlike the PROM, the PAL is a programmable AND array driving a fixed OR array (the PROM is a fixed AND array driving a programmable OR array).

The HAL transfer function is the familiar sum of products. Like the ROM, the HAL has a single array of selectable gates. Unlike the ROM, the HAL is a selectable AND array driving a fixed OR array (the ROM is a fixed AND array driving a selectable OR array).

In addition the PAL/HAL provides these options:

- **Variable input/output pin ratio**
- **Programmable three-state outputs**
- **Registers with feedback**
- **Arithmetic capability**
- **Exclusive-OR gates**
- **Other options identified on page 5-17**

Unused inputs are tied directly to V_{CC} or GND. Product terms with all fuses blown assume the logical high state, and product terms connected to both true and complement of any single input assume the logical low state. Registers consist of D type flip-flops which are loaded on the low-to-high transition of the clock. PAL/HAL Logic Diagrams are shown with all fuses blown, enabling the designer to use the diagrams as coding sheets.

The entire PAL family is programmed using inexpensive conventional PROM programmers with appropriate personality and socket adapter cards. Once the PAL is programmed and verified, two additional fuses may be blown to defeat verification. This feature gives the user a proprietary circuit which is very difficult to copy.

To design a HAL, the user first programs and debugs a PAL using PALASM and the "PAL DESIGN SPECIFICATION" standard format. This specification is submitted to Monolithic Memories where it is computer processed and assigned a bit pattern number, e.g., P01234.

Monolithic Memories will provide a PAL sample for customer qualification. The user then submits a purchase order for a HAL of the specified bit pattern number, e.g., HAL18L4 P01234. See Ordering Information below.

Ordering Information

PAL16L8 -2 M J SHRP P01234

- PAL = Programmable Family; HAL = Hard Array Family
- NUMBER OF ARRAY INPUTS
- OUTPUT TYPE
  - H = Active High
  - L = Active Low
  - C = Complementary
  - P = Programmable
  - R = Registered
  - RA = Registered Asynchronous
  - S = Shared
  - X = Exclusive OR Registered
  - A = Arithmetic Registered
- NUMBER OF OUTPUTS
- SPEED/POWER
  - A = High Speed
  - -2 = 1/2 Power
  - -4 = 1/4 Power
  - A-2 = High Speed and 1/2 Power
  - A-4 = High Speed and 1/4 Power
- TEMPERATURE CODE
  - C = Commercial
  - M = Military
- PACKAGE
  - N = Plastic Dip
  - J = Ceramic Dip
  - F = Flat Pack
  - NL = Plastic Leadless Chip Carrier
  - NS = Plastic SKINNYDIP
  - JS = Ceramic SKINNYDIP
  - L = Leadless Chip Carrier
  - P = Pin Grid Array
- OPTIONAL PROCESSING
  - SHRP = Commercial Reliability Enhanced
  - XXXX = Hi-Rel
- BIT PATTERN NUMBER

TWX: 910-338-2376
2175 Mission College Blvd. Santa Clara, CA 95054-1592 Tel: (408) 970-9700 TWX: 910-338-2374

Register Bypass

Outputs within a bank must either be all registered or all combinatorial. Whether or not a bank of registers is bypassed depends on how the outputs are defined in the equations. A colon followed by an equal sign [:=] specifies a registered output with feedback which is updated after the low-to-high transition of the clock. An equal sign [=] defines a combinatorial output which bypasses the register. Registers are bypassed in banks of eight. Bypassing a bank of registers eliminates the feedback lines for those outputs.

Output Polarity

Output polarity is defined by comparison of the pin list and the equations. If the logic sense of a specific output in the pin list is different from the logic sense of that output as defined by its equation, the output is inverted or active low polarity. If the logic sense of a specific output in the pin list is the same as the logic sense of that output as defined by its equation, the output is active high polarity.

Product Term Sharing

The basic configuration is sixteen product terms shared between two output cells. For a typical output pair, each product term can be used by either output; but, since product term sharing is exclusive, a product term can be used by only one output, not both. If equations call for an output pair to use the same product term, two product terms are generated, one for each output. This should be taken into account when writing equations. PAL assemblers configure product terms automatically.

This example uses the 84-pin package. Four output equations are shown to demonstrate functionality. Pin names are arbitrary.

Product Term Editing

A unique feature of product term sharing is the ability to edit the design after the device has been programmed. Without this feature, a new PAL device had to be programmed if the user needed to change his design. Product term editing allows the user to delete an unwanted product term and reprogram a previously unused product term to the desired fuse pattern. This feature is made possible by the product term sharing architecture. Since each product term can be routed to either output in a given pair by selecting one of two steering fuses, it is possible to blow both of the steering fuses thereby completely disabling that product term. Once disabled, that product term is powered down, saving typically 0.25 mA. The desired change may now be programmed into one of the previously unused product terms corresponding to that output pair. Additional edits can be made as long as there are unused product terms for the output in question.

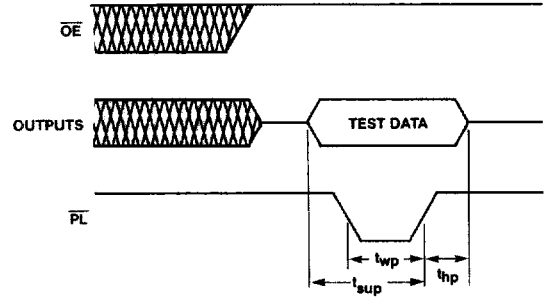
PRESET Feature (PAL64R32 only)

Register banks of eight may be PRESET to all highs on the outputs by setting the PRESET pin (PS) to a Low level. Note from the Logic Diagram that when the state of an output is High, the state of the register is Low due to the inverting tri-state buffer.

PAL Testability Features

Preload pins have been added to enable the testability of each state in state-machine design. Typically, for a modulo-n counter or a state machine there are many unreachable states for the registers. These states, and the logic which controls them are untestable without a way to "set-in" the desired starting state of the registers. In addition, long test sequences are sometimes needed to test a state machine simply to reach those starting states which are legal. Since complete logic verification is needed to ensure the proper exit from "illegal" or unused states, a way to enter these states must be provided. The ability to preload a given bank of registers is provided in this device.

To use the preload feature, several steps must be followed. First, a high level on an assertive-low output enable pin disables the outputs for that bank of registers. Next, the data to be loaded is presented at the output pins. This data is then loaded into the register by placing a low level on the PRELOAD pin. PRELOAD is asynchronous with respect to the clock.



Programmable Set and Reset (PAL20RA10 only)

In each SMAC, two product lines are dedicated to asynchronous set and reset. If the set product line is high, the register output becomes a logic 1. If the reset product line is high, the register output becomes a logic 0. The operation of the programmable set and reset overrides the clock.

Individually Programmable Register Bypass (PAL20RA10 only)

If both the set and reset product lines are high, the sum-of-products bypasses the register and appears immediately at the output, thus making the output combinatorial. This allows each output to be configured in the registered or combinatorial mode.

Programmable Clock (PAL20RA10 only)

One of the product lines in each group is connected to the clock. This provides the user with the additional flexibility of a programmable clock, so each output can be clocked independently of all the others.

PAL Input/Output/Function/Performance Chart

GENERIC LOGIC	PINS	PACKAGE	DESCRIPTION	PART NUMBER			
				STANDARD	HIGH SPEED	1/2 POWER	1/4 POWER
10H8	20	N,J,F,L,NL	Octal 10 Input And-Or Gate Array	PAL10H8 HAL10H8		PAL10H8-2 HAL10H8-2	
12H6	20	N,J,F,L,NL	Hex 12 Input And-Or Gate Array	PAL12H6 HAL12H6		PAL12H6-2 HAL12H6-2	
14H4	20	N,J,F,L,NL	Quad 14 Input And-Or Gate Array	PAL14H4 HAL14H4		PAL14H4-2 HAL14H4-2	
16H2	20	N,J,F,L,NL	Dual 16 Input And-Or Gate Array	PAL16H2 HAL16H2		PAL16H2-2 HAL16H2-2	
16C1	20	N,J,F,L,NL	16 Input And-Or/Nor Gate Array	PAL16C1 HAL16C1		PAL16C1-2 HAL16C1-2	
10L8	20	N,J,F,L,NL	Octal 10 Input And-Or Invert Gate Array	PAL10L8 HAL10L8		PAL10L8-2 HAL10L8-2	
12L6	20	N,J,F,L,NL	Hex 12 Input And-Or-Invert Gate Array	PAL12L6 HAL12L6		PAL12L6-2 HAL12L6-2	
14L4	20	N,J,F,L,NL	Quad 14 Input And-Or-Invert Gate Array	PAL14L4 HAL14L4		PAL14L4-2 HAL14L4-2	
16L2	20	N,J,F,L,NL	Dual 16 Input And-Or-Invert Gate Array	PAL16L2 HAL16L2		PAL16L2-2 HAL16L2-2	
16L8	20	N,J,F,L,NL	Octal 16 Input And-Or-Invert Gate Array	PAL16L8 HAL16L8	PAL16L8A HAL16L8A	PAL16L8A-2 HAL16L8A-2	PAL16L8A-4 HAL16L8A-4
16R8	20	N,J,F,L,NL	Octal 16 Input Registered And-Or Invert Gate Array	PAL16R8 HAL16R8	PAL16R8A HAL16R8A	PAL16R8A-2 HAL16R8A-2	PAL16R8A-4 HAL16R8A-4
16R6	20	N,J,F,L,NL	Hex 16 Input Registered And-Or Invert Gate Array	PAL16R6 HAL16R6	PAL16R6A HAL16R6A	PAL16R6A-2 HAL16R6A-2	PAL16R6A-4 HAL16R6A-4
16R4	20	N,J,F,L,NL	Quad 16 Input Registered And-Or Invert Gate Array	PAL16R4 HAL16R4	PAL16R4A HAL16R4A	PAL16R4A-2 HAL16R4A-2	PAL16R4A-4 HAL16R4A-4
16X4	20	N,J,F,L,NL	Quad 16 Input Registered And-Or-Xor Invert Gate Array	PAL16X4 HAL16X4			
16A4	20	N,J,F,L,NL	Quad 16 Input Registered And-Carry-Or-Xor Invert Gate Array	PAL16A4 HAL16A4			
12L10	24 (28)	NS,JS,F,(L),(NL)	Deca 12 Input And-Or-Invert Gate Array	PAL12L10 HAL12L10			
14L8	24 (28)	NS,JS,F,(L),(NL)	Octal 14 Input And-Or-Invert Gate Array	PAL14L8 HAL14L8			
16L6	24 (28)	NS,JS,F,(L),(NL)	Hex 16 Input And-Or-Invert Gate Array	PAL16L6 HAL16L6			
18L4	24 (28)	NS,JS,F,(L),(NL)	Quad 18 Input And-Or-Invert Gate Array	PAL18L4 HAL18L4			
20L2	24 (28)	NS,JS,F,(L),(NL)	Dual 20 Input And-Or-Invert Gate Array	PAL20L2 HAL20L2			
20C1	24 (28)	NS,JS,F,(L),(NL)	20 Input And-Or/Nor Gate Array	PAL20C1 HAL20C1			
20L10	24 (28)	NS,JS,F,(L),(NL)	Deca 20 Input And-Or-Invert Gate Array	PAL20L10 HAL20L10			
20X10	24 (28)	NS,JS,F,(L),(NL)	Deca 20 Input Registered And-Or-Xor Invert Gate Array	PAL20X10 HAL20X10			
20X8	24 (28)	NS,JS,F,(L),(NL)	Octal 20 Input Registered And-Or-Xor Invert Gate Array	PAL20X8 HAL20X8			
20X4	24 (28)	NS,JS,F,(L),(NL)	Quad 20 Input Registered And-Or-Xor Invert Gate Array	PAL20X4 HAL20X4			
20L8	24 (28)	NS,JS,F,(L),(NL)	Octal 20 Input And-Or-Invert Gate Array		PAL20L8A HAL20L8A		
20R8	24 (28)	NS,JS,F,(L),(NL)	Octal 20 Input Registered And-Or Invert Gate Array		PAL20R8A HAL20R8A		
20R6	24 (28)	NS,JS,F,(L),(NL)	Hex 20 Input Registered And-Or Invert Gate Array		PAL20R6A HAL20R6A		
20R4	24 (28)	NS,JS,F,(L),(NL)	Quad 20 Input Registered And-Or Invert Gate Array		PAL20R4A HAL20R4A		

( ) = Military Product Standard

PAL Input/Output/Function/Performance Chart

GENERIC LOGIC	PINS	PACKAGE	DESCRIPTION	PART NUMBER			
				STANDARD	HIGH SPEED	1/2 POWER	1/4 POWER
*16P8	20	N,J,L,NL	Octal 16 Input And-Or Array w/Programmable Polarity		PAL16P8A HAL16P8A		
*16RP8	20	N,J,L,NL	Octal 16 Input Registered And-Or Array w/Programmable Polarity		PAL16RP8A HAL16RP8A		
*16RP6	20	N,J,L,NL	Hex 16 Input Registered And-Or Array w/Programmable Polarity		PAL16RP6A HAL16RP6A		
*16RP4	20	N,J,L,NL	Quad 16 Input Registered And-Or Array w/Programmable Polarity		PAL16RP4A HAL16RP4A		
20S10	24 (28)	N,J,W,(L),(NL)	Deca 20 Input And-Or Array w/Product Term Sharing		PAL20S10 HAL20S10		
20RS10	24 (28)	N,J,W,(L),(NL)	Deca 20 Input Registered And-Or Array w/Product Term Sharing		PAL20RS10 HAL20RS10		
20RS8	24 (28)	N,J,W,(L),(NL)	Octal 20 Input Registered And-Or Array w/Product Term Sharing		PAL20RS8 HAL20RS8		
20RS4	24 (28)	N,J,W,(L),(NL)	Quad 20 Input Registered And-Or Array w/Product Term Sharing		PAL20RS4 HAL20RS4		
20RA10	24 (28)	N,J,W,(L),(NL)	Deca 20 Input Registered Asynchronous And-Or Array		PAL20RA10 HAL20RA10		
32R16	40 (44)	N,J,(L),(NL)	16 Output, 32 Input Registered And-Or Gate Array		PAL32R16 HAL32R16		
64R32	84 (88)	L,(P)	32 Output, 64 Input Registered And-Or Gate Array		PAL64R32 HAL64R32		

* Contact Factory for Flat Pack

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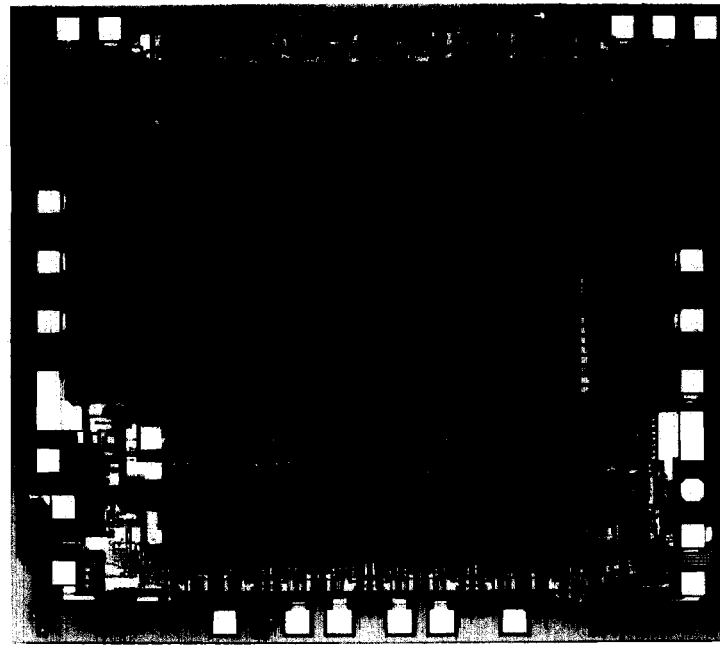
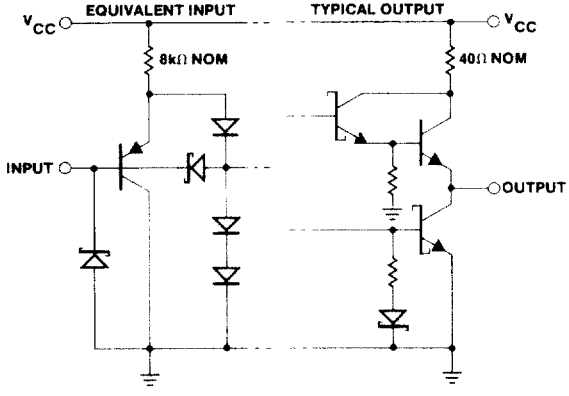
Die Configuration: PAL16L8



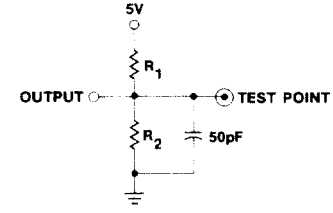
Absolute Maximum Ratings

	Operating	Programming
Supply Voltage, V_{CC}	-0.5V to 7.0V	-0.5V to 12.0V
Input Voltage	-1.5V to 5.5V	-1.0 to 22V
Off-state output Voltage	5.5V	12.0V
Storage temperature		-65° to +150°C

Schematic of Inputs and Outputs



Test Load



Other loads may be used.

Typical notes for all the following specifications (pages 5-21 — 5-39)

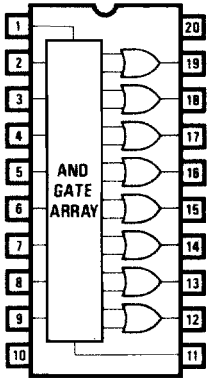
Notes: Apply to electrical and switching characteristics

† I/O pin leakage is the worst case of I_{OZX} or I_{IX} e.g., I_{IL} and I_{OZH}.

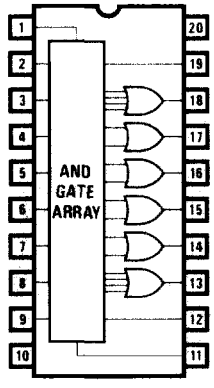
* These are absolute voltages with respect to the ground pin on the device and includes all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.

** Only one output shorted at a time.

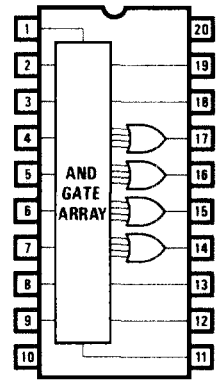
10H8



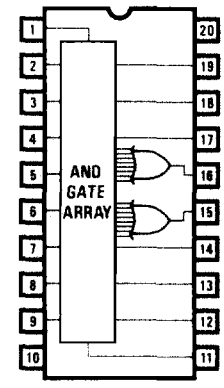
12H6



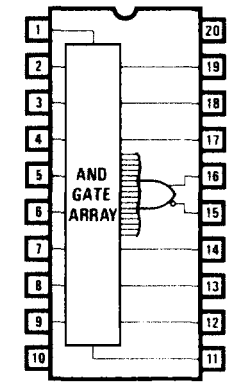
14H4



16H2

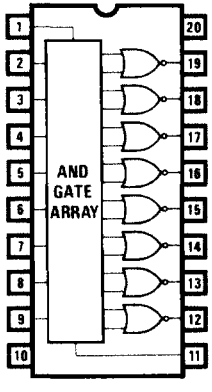


16C1

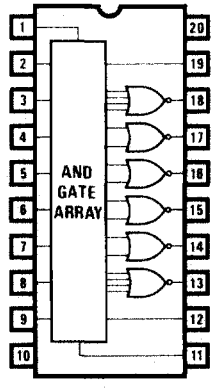


5

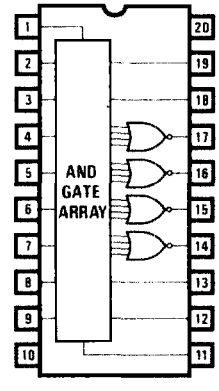
10L8



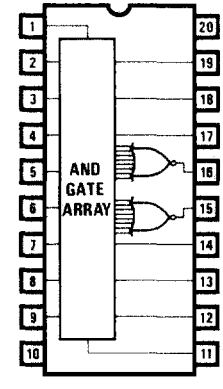
12L6



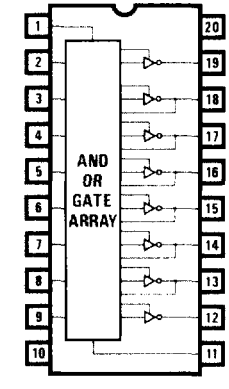
14L4



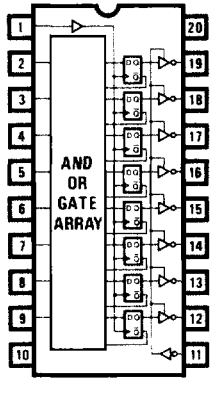
16L2



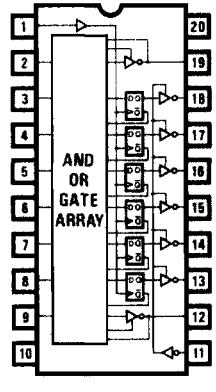
16L8



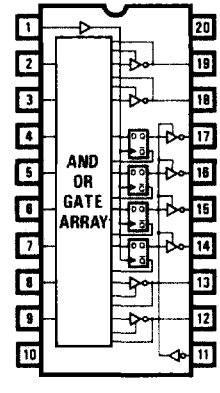
16R8



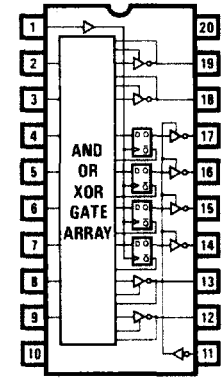
16R6



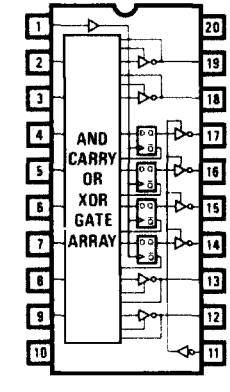
16R4



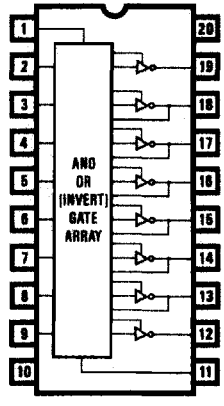
16X4



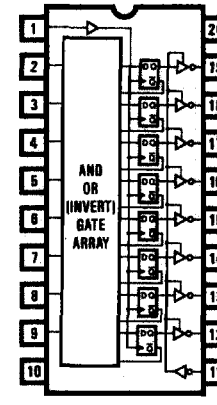
16A4



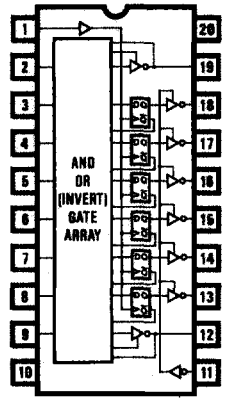
PAL16P8



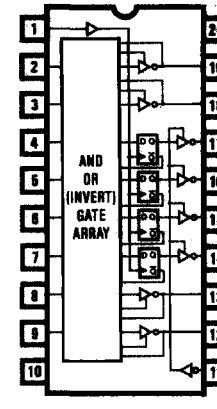
PAL16RP8



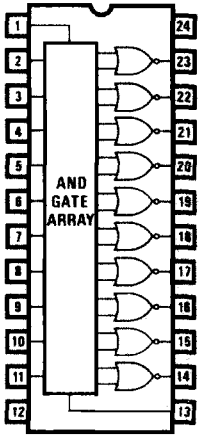
PAL16RP6



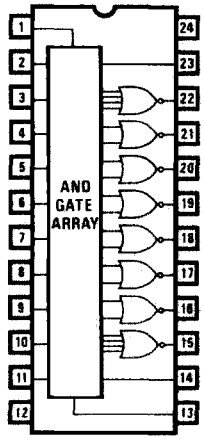
PAL16RP4



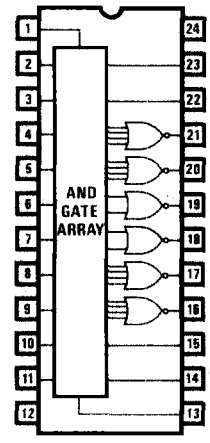
12L10



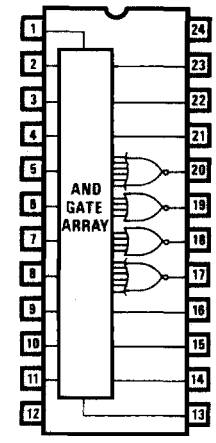
14L8



16L6



18L4



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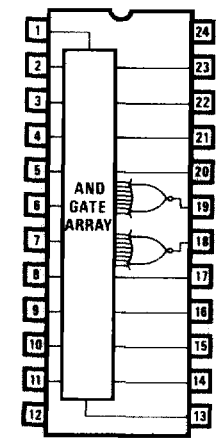

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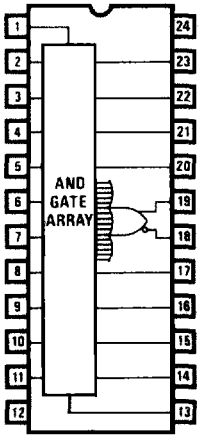

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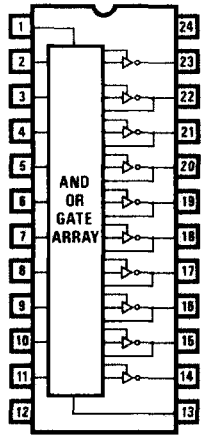

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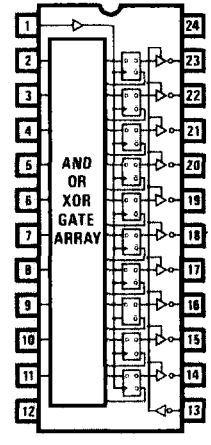

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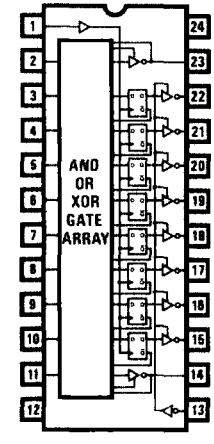

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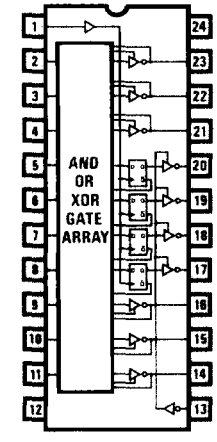

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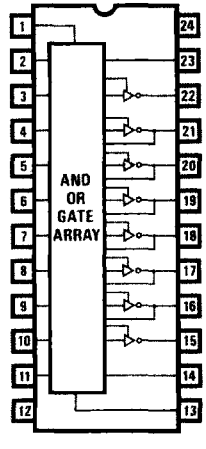

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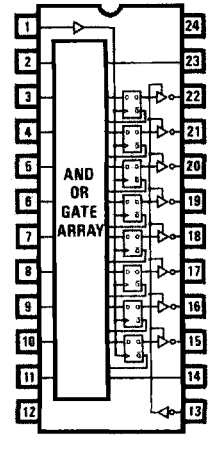

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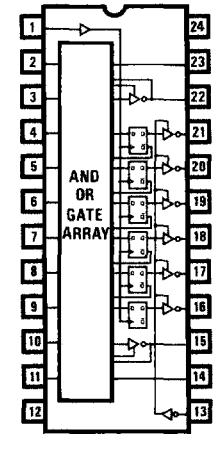

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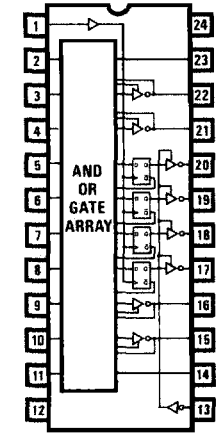

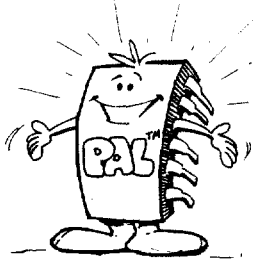

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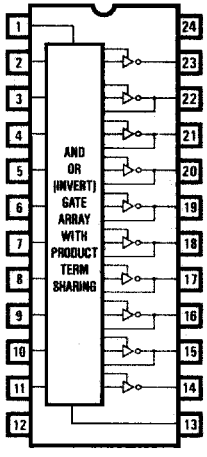

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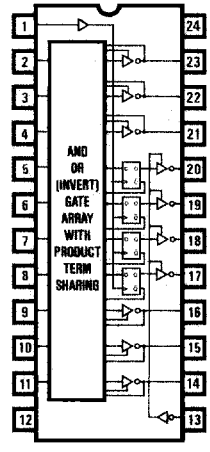

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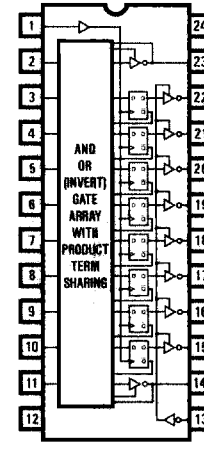

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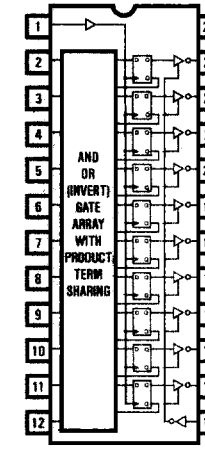
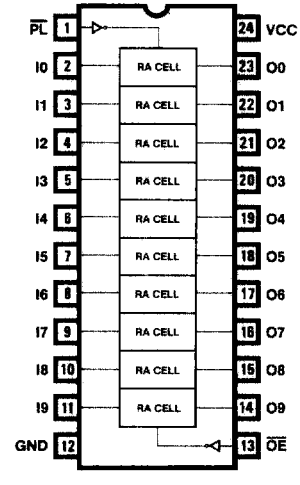
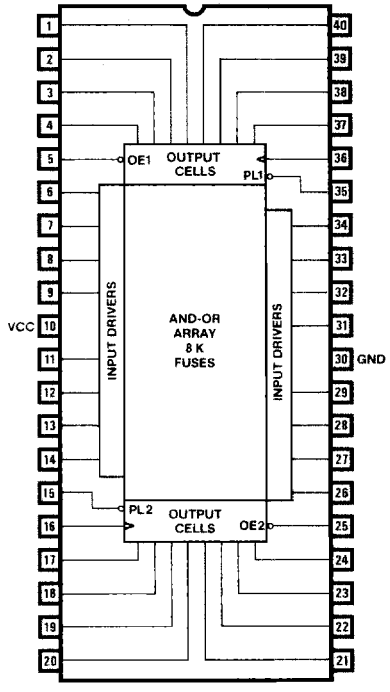


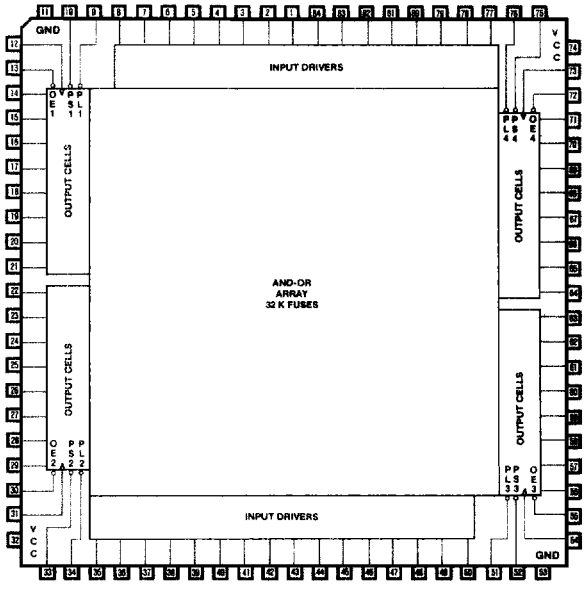
20RA10



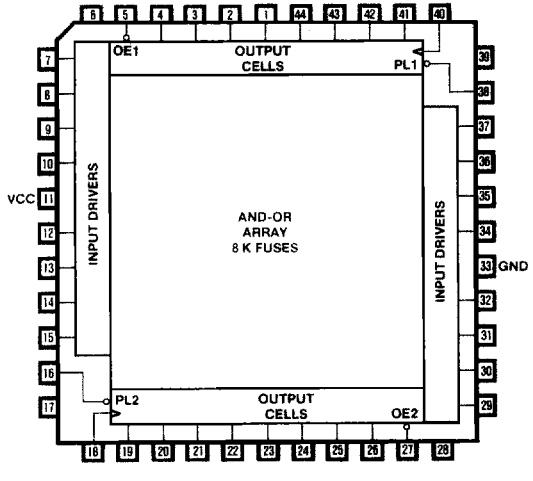
32R16



64R32



32R16



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Operating Conditions

SYMBOL	PARAMETER	MILITARY			COMMERCIAL			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
T_A	Operating free-air temperature	−55			0		75	°C
T_C	Operating case temperature			125				°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	High-level input voltage				2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN	I_I = −18mA			−0.8	−1.5	V
I_{IL}	Low-level input current	V_{CC} = MAX	V_I = 0.4V			−0.02	−0.25	mA
I_{IH}	High-level input current	V_{CC} = MAX	V_I = 2.4V				25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5V				1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 8mA		0.3	0.5	V
			COM	I_{OL} = 8mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = −2mA	2.4	2.8		V
			COM	I_{OH} = −3.2mA				
I_{OS}	Output short-circuit current**	V_{CC} = 5V		V_O = 0V	−30	−70	−130	mA
I_{CC}	Supply current	V_{CC} = MAX				55	90	mA

Switching Characteristics

SYMBOL	PARAMETER		TEST CONDITIONS	MILITARY			COMMERCIAL			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
t_{PD}	Input or feedback to output	Except 16C1	R1 = 560Ω, R2 = 1.1kΩ		25	45		25	35	ns
		16C1			25	45		25	40	

Operating Conditions

SYMBOL	PARAMETER	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
T_A	Operating free-air temperature	-55			0		75	°C
T_C	Operating case temperature			125				°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	High-level input voltage				2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN	I_I = -18mA			-0.8	-1.5	V
I_{IL}	Low-level input current	V_{CC} = MAX	V_I = 0.4V			-0.02	-0.25	mA
I_{IH}	High-level input current	V_{CC} = MAX	V_I = 2.4V				25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5V				1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 8mA		0.3	0.5	V
			COM	I_{OL} = 8mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = -2mA	2.4	2.8		V
			COM	I_{OH} = -3.2mA				
I_{OS}	Output short-circuit current**	V_{CC} = 5V		V_O = 0V	-30	-70	-130	mA
I_{CC}	Supply current	V_{CC} = MAX				60	100	mA

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	Input or feedback to output	R1 = 560Ω R2 = 1.1kΩ		25	45		25	40	ns

Operating Conditions

SYMBOL	PARAMETER		MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
t_w	Width of clock	Low	25	10		25	10		ns
		High	25	10		25	10		
t_{su}	Set up time from input or feedback to clock	16R8 16R6 16R4	45	25		35	25		ns
		16X4 16A4	55	30		45	30		
t_h	Hold time		0	−15		0	−15		ns
T_A	Operating free-air temperature		−55			0		75	°C
T_C	Operating case temperature				125				°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	High-level input voltage				2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN	I_I = −18mA			−0.8	−1.5	V
I_{IL}	Low-level input current †	V_{CC} = MAX	V_I = 0.4V			−0.02	−0.25	mA
I_{IH}	High-level input current †	V_{CC} = MAX	V_I = 2.4V				25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5V				1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 12mA		0.3	0.5	V
			COM	I_{OL} = 24mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = −2mA	2.4	2.8		V
			COM	I_{OH} = −3.2mA				
I_{OZL}	Off-state output current †	V_{CC} = MAX		V_O = 0.4V			−100	μA
I_{OZH}				V_O = 2.4V			100	μA
I_{OS}	Output short-circuit current**	V_{CC} = 5V		V_O = 0V	−30	−70	−130	mA
I_{CC}	Supply current	V_{CC} = MAX	16R4 16R6 16R8 16L8			120	180	mA
			16X4			160	225	
			16A4			170	240	

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	Input or feedback to output	16R6 16R4 16L8	R_1 = 200Ω, R_2 = 390Ω		25	45		25	35	ns
		16X4 16A4			30	45		30	40	ns
t_{CLK}	Clock to output or feedback				15	25		15	25	ns
t_{PZX}	Pin 11 to output enable except 16L8				15	25		15	25	ns
t_{PXZ}	Pin 11 to output disable except 16L8				15	25		15	25	ns
t_{PZX}	Input to output enable	16R6 16R4 16L8			25	45		25	35	ns
		16X4 16A4			30	45		30	40	ns
t_{PXZ}	Input to output disable	16R6 16R4 16L8			25	45		25	35	ns
		16X4 16A4			30	45		30	40	ns
f_{MAX}	Maximum frequency	16R8 16R6 16R4		14	25		16	25		MHz
		16X4 16A4		12	22		14	22		

Operating Conditions

SYMBOL	PARAMETER		MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
t_w	Width of clock	Low	40	20		35	20		ns
		High	30	10		25	10		
t_{su}	Set up time from input or feedback to clock		60	38		50	38		ns
t_h	Hold time		0	−15		0	−15		ns
T_A	Operating free-air temperature		−55			0		75	°C
T_C	Operating case temperature				125				°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	High-level input voltage				2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN	I_I = −18mA			−0.8	−1.5	V
I_{IL}	Low-level input current †	V_{CC} = MAX	V_I = 0.4V			−0.02	−0.25	mA
I_{IH}	High-level input current †	V_{CC} = MAX	V_I = 2.4V				25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5V				1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 12mA		0.3	0.5	V
			COM	I_{OL} = 24mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = −2mA	2.4	2.8		V
			COM	I_{OH} = −3.2mA				
I_{OZL}	Off-state output current †	V_{CC} = MAX		V_O = 0.4V			−100	μA
I_{OZH}				V_O = 2.4V			100	μA
I_{OS}	Output short-circuit current**	V_{CC} = 5V		V_O = 0V	−30	−70	−130	mA
I_{CC}	Supply current	V_{CC} = MAX	20X10 20X8 20X4			120	180	mA
I_{CC}	Supply current	V_{CC} = MAX	20L10			90	165	mA

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	Input or feedback to output	R_1 = 200Ω, R_2 = 390Ω		35	60		35	50	ns
t_{CLK}	Clock to output or feedback			20	35		20	30	ns
$t_{PXZ/ZX}$	Pin 13 to output disable/enable except 20L10			20	45		20	35	ns
t_{PZX}	Input to output enable except 20X10			35	55		35	45	ns
t_{PXZ}	Input to output disable except 20X10			35	55		35	45	ns
f_{MAX}	Maximum frequency		10.5	16		12.5	16		MHz

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Operating Conditions

SYMBOL	PARAMETER		MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
t_w	Width of clock	Low	20	10		15	10		ns
		High	20	10		15	10		
t_{su}	Set up time from input or feedback to clock	16R8A 16R6A 16R4A 16RP8A 16RP6A 16RP4A	30	15		25	15		ns
t_h	Hold time		0	-10		0	-10		ns
T_A	Operating free-air temperature		-55			0		75	°C
T_C	Operating case temperature				125				°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	High-level input voltage				2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN	I_I = -18mA			-0.8	-1.5	V
I_{IL}	Low-level input current †	V_{CC} = MAX	V_I = 0.4V			-0.02	-0.25	mA
I_{IH}	High-level input current †	V_{CC} = MAX	V_I = 2.4V				25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5V				1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 12mA		0.3	0.5	V
			COM	I_{OL} = 24mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = -2mA	2.4	2.8		V
			COM	I_{OH} = -3.2mA				
I_{OZL}	Off-state output current †	V_{CC} = MAX		V_O = 0.4V			-100	μA
I_{OZH}				V_O = 2.4V			100	μA
I_{OS}	Output short-circuit current**	V_{CC} = 5V		V_O = 0V	-30	-70	-130	mA
I_{CC}	Supply current	V_{CC} = MAX				120	180	mA

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	Input or feedback to output	16R6A 16R4A 16L8A 16RP6A 16RP4A 16P8A	R_1 = 200Ω R_2 = 390Ω		15	30		15	25	ns
t_{CLK}	Clock to output or feedback				10	20		10	15	ns
t_{PZX}	Pin 11 to output enable except 16L8A 16P8A				10	25		10	20	ns
t_{PXZ}	Pin 11 to output disable except 16L8A 16P8A				11	25		11	20	ns
t_{PZX}	Input to output enable	16R6A 16R4A 16L8A 16RP6A 16RP4A 16P8A			10	30		10	25	ns
t_{PXZ}	Input to output disable	16R6A 16R4A 16L8A 16RP6A 16RP4A 16P8A			13	30		13	25	ns
f_{MAX}	Maximum frequency	16R8A 16R6A 16R4A 16RP8A 16RP6A 16RP4A		20	40		28.5	40		MHz

Operating Conditions

SYMBOL	PARAMETER		MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
t_w	Width of clock	Low	20	7		15	7		ns
		High	20	7		15	7		
t_{su}	Set up time from input or feedback to clock	20R8A 20R6A 20R4A	30	15		25	15		ns
t_h	Hold time		0	-10		0	-10		ns
T_A	Operating free-air temperature		-55			0		75	°C
T_C	Operating case temperature				125				°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	High-level input voltage				2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN		I_I = -18mA		-0.8	-1.5	V
I_{IL}	Low-level input current †	V_{CC} = MAX		V_I = 0.4V		-0.02	-0.25	mA
I_{IH}	High-level input current †	V_{CC} = MAX		V_I = 2.4V			25	μA
I_I	Maximum input current	V_{CC} = MAX		V_I = 5.5V			1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 12mA		0.3	0.5	V
			COM	I_{OL} = 24mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = -2mA	2.4	2.8		V
			COM	I_{OH} = -3.2mA				
I_{OZL}	Off-state output current †	V_{CC} = MAX		V_O = 0.4V			-100	μA
I_{OZH}				V_O = 2.4V			100	μA
I_{OS}	Output short-circuit current**	V_{CC} = 5V		V_O = 0V	-30	-90	-130	mA
I_{CC}	Supply current	V_{CC} = MAX				160	210	mA

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	Input or feedback to output	20R6A 20R4A 20L8A	R_1 = 200Ω, R_2 = 390Ω		15	30		15	25	ns
t_{CLK}	Clock to output or feedback				10	20		10	15	ns
t_{PZX}	Pin 13 to output enable except 20L8A				10	25		10	20	ns
t_{PXZ}	Pin 13 to output disable except 20L8A				11	25		11	20	ns
t_{PZX}	Input to output enable	20R6A 20R4A 20L8A			10	30		10	25	ns
t_{PXZ}	Input to output disable	20R6A 20R4A 20L8A			13	30		13	25	ns
f_{MAX}	Maximum frequency	20R8A 20R6A 20R4A		20	40		28.5	40		MHz

Operating Conditions

SYMBOL	PARAMETER	MILITARY			COMMERCIAL			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
T_A	Operating free-air temperature	−55		125	0		75	°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	High-level input voltage				2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN		I_I = −18mA		−0.8	−1.5	V
I_{IL}	Low-level input current	V_{CC} = MAX		V_I = 0.4V		−0.02	−0.25	mA
I_{IH}	High-level input current	V_{CC} = MAX		V_I = 2.4V			25	μA
I_I	Maximum input current	V_{CC} = MAX		V_I = 5.5V			1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 4mA		0.3	0.5	V
			COM	I_{OL} = 4mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = −1mA	2.4	2.8		V
			COM	I_{OH} = −1mA				
I_{OS}	Output short-circuit current**	V_{CC} = 5V		V_O = 0V	−30	−70	−130	mA
I_{CC}	Supply current	V_{CC} = MAX				30	45	mA

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST	MILITARY			COMMERCIAL			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{PD}	Input or feedback to output	R1 = 1.12kΩ R2 = 2.2kΩ		45	80		45	60	ns

Operating Conditions

SYMBOL	PARAMETER		MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
t_w	Width of clock	Low	25	10		25	10		ns
		High	25	10		25	10		
t_{su}	Set up time from input or feedback to clock	16R6A-2 16R4A-2 16R8A-2	50	25		35	25		ns
t_h	Hold time		0	-15		0	-15		ns
T_A	Operating free-air temperature		-55		125	0		75	°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	High-level input voltage				2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN		I_I = -18mA		-0.8	-1.5	V
I_{IL}	Low-level input current †	V_{CC} = MAX		V_I = 0.4V		-0.02	-0.25	mA
I_{IH}	High-level input current †	V_{CC} = MAX		V_I = 2.4V			25	μA
I_I	Maximum input current	V_{CC} = MAX		V_I = 5.5V			1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 12mA		0.3	0.5	V
			COM	I_{OL} = 24mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = -2mA	2.4	2.8		V
			COM	I_{OH} = -3.2mA				
I_{OZL}	Off-state output current †	V_{CC} = MAX		V_O = 0.4V			-100	μA
I_{OZH}				V_O = 2.4V			100	μA
I_{OS}	Output short-circuit current**	V_{CC} = 5V		V_O = 0V	-30	-70	-130	mA
I_{CC}	Supply current	V_{CC} = MAX				60	90	mA

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	Input or feedback to output	16L8A-2 16R6A-2 16R4A-2	R_1 = 200Ω, R_2 = 390Ω		25	50		25	35	ns
t_{CLK}	Clock to output or feedback				15	25		15	25	ns
$t_{PXZ/ZX}$	Pin 11 to output disable/enable except 16L8A-2				15	25		15	25	ns
t_{PZX}	Input to output enable	16L8A-2 16R6A-2 16R4A-2			25	45		25	35	ns
t_{PXZ}	Input to output disable	16R8A-2 16R6A-2 16R4A-2			25	45		25	35	ns
f_{MAX}	Maximum frequency	16R8A-2 16R6A-2 16R4A-2		14	25		16	25		MHz

Operating Conditions

SYMBOL	PARAMETER			MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage			4.5	5	5.5	4.75	5	5.25	V
t_w	Width of clock	16R8A-4 16R6A-4 16R4A-4	Low	40	20		30	20		ns
			High	40	20		30	20		
t_{su}	Set up time from input or feedback to clock	16R8A-4 16R6A-4 16R4A-4		90	45		60	45		ns
t_h	Hold time			0	-15		0	-15		ns
T_A	Operating free-air temperature			-55		125	0		75	°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	High-level input voltage				2			V
V_{IC}	Input clamp voltage	V_{CC} = MIN	I_I = -18mA			-0.8	-1.5	V
I_{IL}	Low-level input current †	V_{CC} = MAX	V_I = 0.4V			-0.02	-0.25	mA
I_{IH}	High-level input current †	V_{CC} = MAX	V_I = 2.4V				25	μA
I_I	Maximum input current	V_{CC} = MAX	V_I = 5.5V				1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 4mA		0.3	0.5	V
			COM	I_{OL} = 8mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = -1mA	2.4	2.8		V
			COM	I_{OH} = -1 mA				
I_{OZL}	Off-state output current†	V_{CC} = MAX		V_O = 0.4V			-100	μA
I_{OZH}				V_O = 2.4V			100	μA
I_{OS}	Output short-circuit current**	V_{CC} = 5V		V_O = 0V	-30	-70	-130	mA
I_{CC}	Supply current	V_{CC} = MAX	16R4A-4 16R6A-4 16R8A-4 16L8A-4			30	50	mA

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	Input or feedback to output	16R6A-4 16R4A-4 16L8A-4	R_1 = 800Ω, R_2 = 1.56kΩ		35	75		35	55	ns
t_{CLK}	Clock to output or feedback				20	45		20	35	ns
$t_{PXZ/ZX}$	Pin 11 to output disable/enable — except 16L8A-4				15	40		15	30	ns
t_{PZX}	Input to output enable	16R6A-4 16R4A-4 16L8A-4			30	65		30	50	ns
t_{PXZ}	Input to output disable	16R6A-4 16R4A-4 16L8A-4			30	65		30	50	ns
f_{MAX}	Maximum frequency	16R8A-4 16R6A-4 16R4A-4		8	18		11	18		MHz

Operating Conditions

SYMBOL	PARAMETER		MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
t_w	Width of clock		25	13		20	13		ns
t_{wp}	Preload pulse width		45	15		35	15		ns
t_{su}	Setup time for input or feedback to clock		25	10		20	10		ns
t_{sup}	Preload setup time		30	5		25	5		ns
t_h	Hold time	Polarity fuse intact	10	-2		10	-2		ns
		Polarity fuse blown	0	-6		0	-6		
t_{hp}	Preload hold time		30	5		25	5		ns
T_A	Operating free-air temperature		-55			0		75	°C
T_C	Operating case temperature				125				°C

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Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITION		MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage					0.8	V
V_{IH}*	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}	Low-level input current	V_{CC} = MAX	V_I = 0.4 V		-0.02	-0.25	mA
I_{IH}	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			1	mA
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}: Mil-2 mA Com-3.2 mA	2.4	2.8		V
I_{OZ}	Off-state output current	V_{CC} = MAX	V_O = 2.4 V/V_O = 0.4 V	-100		100	μA
I_{OS}	Output short-circuit current**	V_{CC} = 5 V	V_O = 0 V	-30	-70	-130	mA
I_{CC}	Supply current	V_{CC} = MAX			155	200	mA

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	Input or feedback to output	Polarity fuse intact	R_1 = 560 Ω, R_2 = 1.1 KΩ		20	35		20	30	ns
		Polarity fuse blown			25	40		25	35	
t_{CLK}	Clock to output or feedback			10	17	35	10	17	30	ns
t_S	Input to asynchronous set				22	40		22	35	ns
t_R	Input to asynchronous reset				27	45		27	40	ns
t_{PZX}	Pin 13 to output enable				10	25		10	20	ns
t_{PXZ}	Pin 13 to output disable				10	25		10	20	ns
t_{PZX}	Input to output enable				18	35		18	30	ns
t_{PXZ}	Input to output disable				15	35		15	30	ns
f_{MAX}	Maximum frequency			16	35		20	35		MHz

Operating Conditions

SYMBOL	PARAMETER		MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
t_w	Width of clock	Low	20	10		15	10		ns
		High	20	10		15	10		
t_{su}	Setup time from input or feedback to clock	20RS10, 20RS8, 20RS4	40	25		35	25		ns
t_h	Hold time		0	−10		0	−10		ns
T_A	Operating free-air temperature		−55			0		75	°C
T_C	Operating case temperature				125				°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITION			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	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}	Low-level input current †	V_{CC} = MAX	V_I = 0.4 V			−0.02	−0.25	mA
I_{IH}	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				1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 12 mA		0.3	0.5	V
			COM	I_{OL} = 24 mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = −2 mA	2.4	2.8		V
			COM	I_{OH} = −3.2 mA				
I_{OZL}	Off-state output current†	V_{CC} = MAX		V_O = 0.4 V			−100	μA
I_{OZH}				V_{OL} = 2.4 mA			100	
I_{OS}	Output short-circuit current**	V_{CC} = 5V		V_O = 0 V	−30	−70	−130	mA
I_{CC}	Supply current	V_{CC} = MAX				175	240	mA

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	20S10, 20RS8, 20RS4 Input or feedback to output	Polarity fuse intact	R_1 = 200 Ω, R_2 = 390 KΩ		25	40		25	35	ns
		Polarity fuse blown			30	45		30	40	
t_{CLK}	Clock to output or feedback				12	20		12	17	ns
t_{PZX}	Pin 13 to output enable except 20S10				10	25		10	20	ns
t_{PXZ}	Pin 13 to output disable except 20S10				11	25		11	20	ns
t_{PZX}	Input to output enable	20S10, 20RS8, 20RS4			25	35		25	35	ns
t_{PXZ}	Input to output disable	20S10, 20RS8 20RP4			13	25		13	25	ns
f_{MAX}	20RS10, 20RS8, 20RS4 Maximum frequency			18	28		20	28		MHz

HAL PARAMETERS MAY DIFFER. CONTACT FACTORY FOR DETAILS.

Operating Conditions

SYMBOL	PARAMETER		MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
t_w	Width of clock	Low	25			20			ns
		High	25			20			
t_{wp}	Preload pulse width		45			35			ns
t_{su}	Setup time for input to clock	Polarity fuse intact	50			40			ns
		Polarity fuse blown	50			40			
t_{sup}	Preload setup time		30			25			ns
t_h	Hold time		0		-10	0		-10	ns
t_{hp}	Preload hold time		10			5			ns
T_A	Operating free-air temperature		-55			0		75	°C
T_C	Operating case temperature				125				°C

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Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITION			MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage						0.8	V
V_{IH}*	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}	Low-level input current	V_{CC} = MAX	V_I = 0.4 V			-0.02	-0.25	mA
I_{IH}	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				1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL	I_{OL} = 8 mA		0.3	0.5	V
			COM	I_{OL} = 8 mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL	I_{OH} = -2 mA	2.4	2.8		V
			COM	I_{OH} = -3.2 mA				
I_{OZL}	Off-state output current	V_{CC} = MAX		V_O = 0.4 V			-100	μA
I_{OZH}				V_O = 2.4 V			100	μA
I_{OS}	Output short-circuit current**	V_{CC} = MAX		V_O = 0 V	-30	-70	-130	mA
I_{CC}	Supply current	V_{CC} = MAX				200	280	mA

Switching Characteristics Over Operating Conditions

SYMBOL	PARAMETER		TEST CONDITIONS	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	Input to output	Polarity fuse intact	R_1 = 560 Ω R_2 = 1.1 KΩ			50			40	ns
		Polarity fuse blown				55			45	
t_{CLK}	Clock to output or feedback					30			25	ns
t_{PZX}	Output enable					25			20	ns
t_{PXZ}	Output disable					25			20	ns
f_{MAX}	Maximum frequency			14			16			MHz

HAL PARAMETERS MAY DIFFER. CONTACT FACTORY FOR DETAILS.

Operating Conditions

SYMBOL	PARAMETER		MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	4.75	5	5.25	V
t_w	Width of clock	Low	25			20			ns
		High							
t_{su}	Setup time for input to clock	Polarity fuse intact	50			40			ns
		Polarity fuse blown							
t_h	Hold time		0		−10	0		−10	ns
T_A	Operating free-air temperature		−55			0		75	°C
T_C	Operating case temperature				125				°C

Electrical Characteristics Over Operating Conditions

SYMBOL	PARAMETER	TEST CONDITION		MIN	TYP	MAX	UNIT
V_{IL}*	Low-level input voltage					0.8	V
V_{IH}*	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}	Low-level input current	V_{CC} = MAX	V_I = 0.4 V		−0.02	−0.25	mA
I_{IH}	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			1	mA
V_{OL}	Low-level output voltage	V_{CC} = MIN	MIL I_{OL} = 8 mA		0.3	0.5	V
			COM I_{OL} = 8 mA				
V_{OH}	High-level output voltage	V_{CC} = MIN	MIL I_{OH} = −0.4 mA	2.4	2.8		V
			COM I_{OH} = −0.4 mA				
I_{OZL}	Off-state output current	V_{CC} = MAX	V_O = 0.4 V			−100	μA
I_{OZH}			V_O = 2.4 V			100	μA
I_{OS}	Output short-circuit current**	V_{CC} = MAX	V_O = 0 V	−10	−40	−60	mA
I_{CC}	Supply current	V_{CC} = MAX			400	640	mA

Switching Characteristics Over Operating Conditions

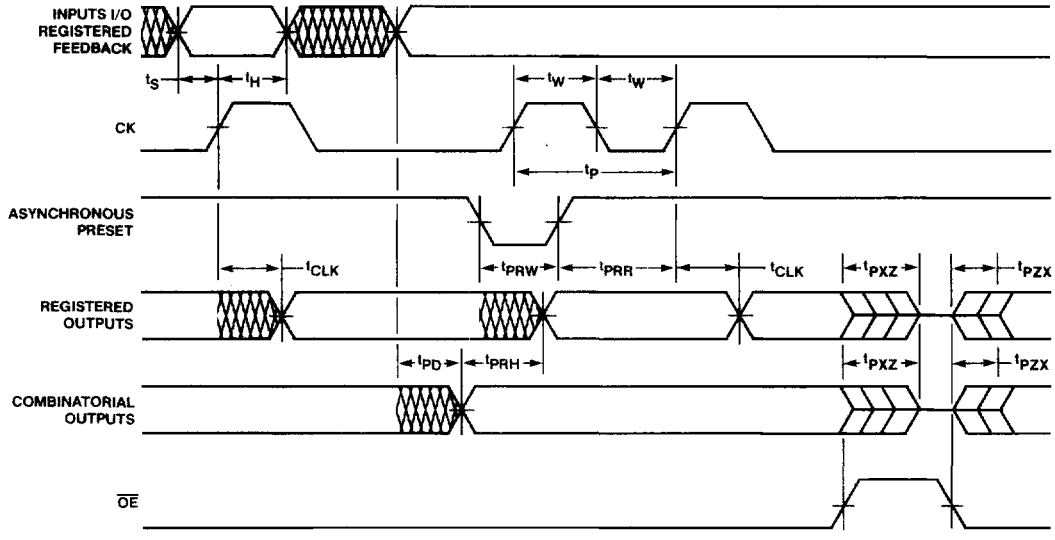
SYMBOL	PARAMETER		TEST CONDITIONS	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{PD}	Input to output	Polarity fuse intact	R_1 = 560Ω, R_2 = 1.1 KΩ			55			50	ns
		Polarity fuse blown				60			55	
t_{CLK}	Clock to output or feedback					30			22	ns
t_{PZX}	Output enable					35			30	ns
t_{PXZ}	Output disable					35			30	ns
t_{PRH}	Preset to output					40			35	ns
f_{MAX}	Maximum frequency			12.5			16	20		MHz

HAL PARAMETERS MAY DIFFER. CONTACT FACTORY FOR DETAILS.

Testing Conditions

SYMBOL	PARAMETER	MILITARY MIN	MILITARY TYP	MILITARY MAX	COMMERCIAL MIN	COMMERCIAL TYP	COMMERCIAL MAX	UNIT
t_{wp}	Preload pulse width	45			35			ns
t_{sup}	Preload setup time	60			50			ns
t_{hp}	Preload hold time	10			5			ns
t_{PRW}	Preset pulse width	30			25			ns
t_{PRR}	Preset recovery time	40			35			ns

Switching Waveforms



Output Register PRELOAD Series 20AP

The PRELOAD function allows the register to be loaded from data placed on the output pins. This feature aids functional testing which would otherwise require a state sequencer for test coverage. The procedure for PRELOAD is as follows:

1 Raise V_{CC} to 4.5 V.

2 Disable output registers by setting pin 11 to V_{IH}.

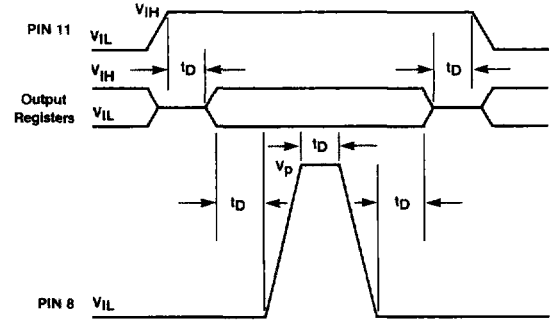
3 Apply V_{IL}/V_{IH} to all output registers.

4 Pulse pin 8 to V_p. Then back to 0 V.

5 Remove V_{IL}/V_{IH} from all output registers.

6 Lower pin 11 to V_{IL} to enable the output registers.

7 Verify for V_{OL}/V_{OH} at all output registers.



Output Register PRELOAD Series 24RS

The PRELOAD function allows the register to be loaded from data placed on the output pins. This feature aids functional testing which would otherwise require a state sequencer for test coverage. The procedure for PRELOAD is as follows:

1 Raise V_{CC} to 4.5 V.

2 Disable output registers by setting pin 13 to V_{IH}.

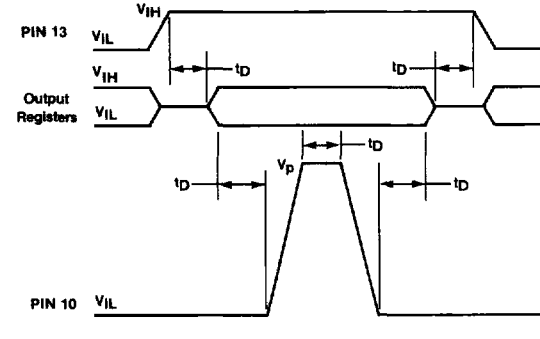
3 Apply V_{IL}/V_{IH} to all output registers.

4 Pulse pin 10 to V_p. Then back to 0 V.

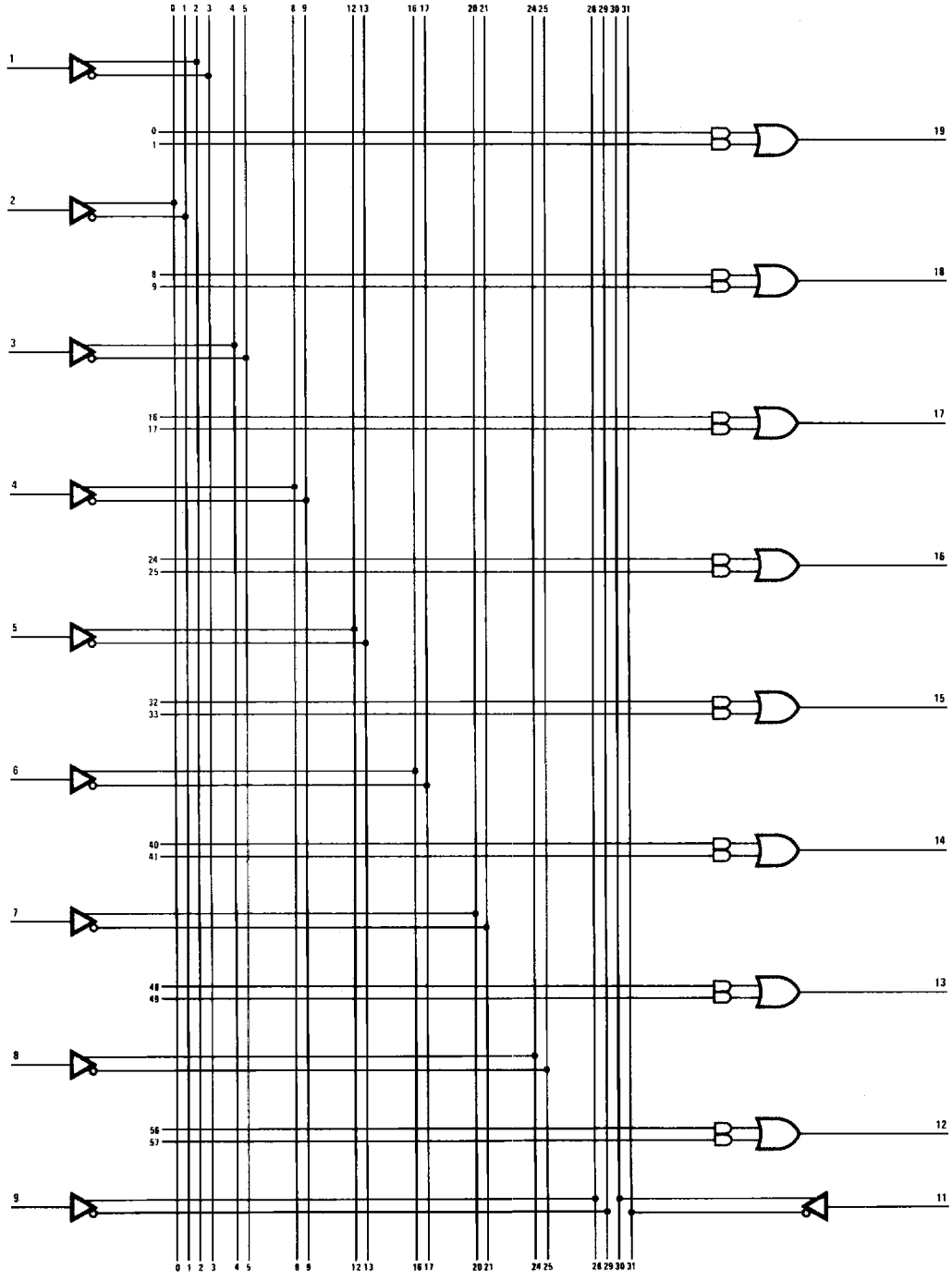
5 Remove V_{IL}/V_{IH} from all output registers.

6 Lower pin 13 to V_{IL} to enable the output registers.

7 Verify for V_{OL}/V_{OH} at all output registers.



10H8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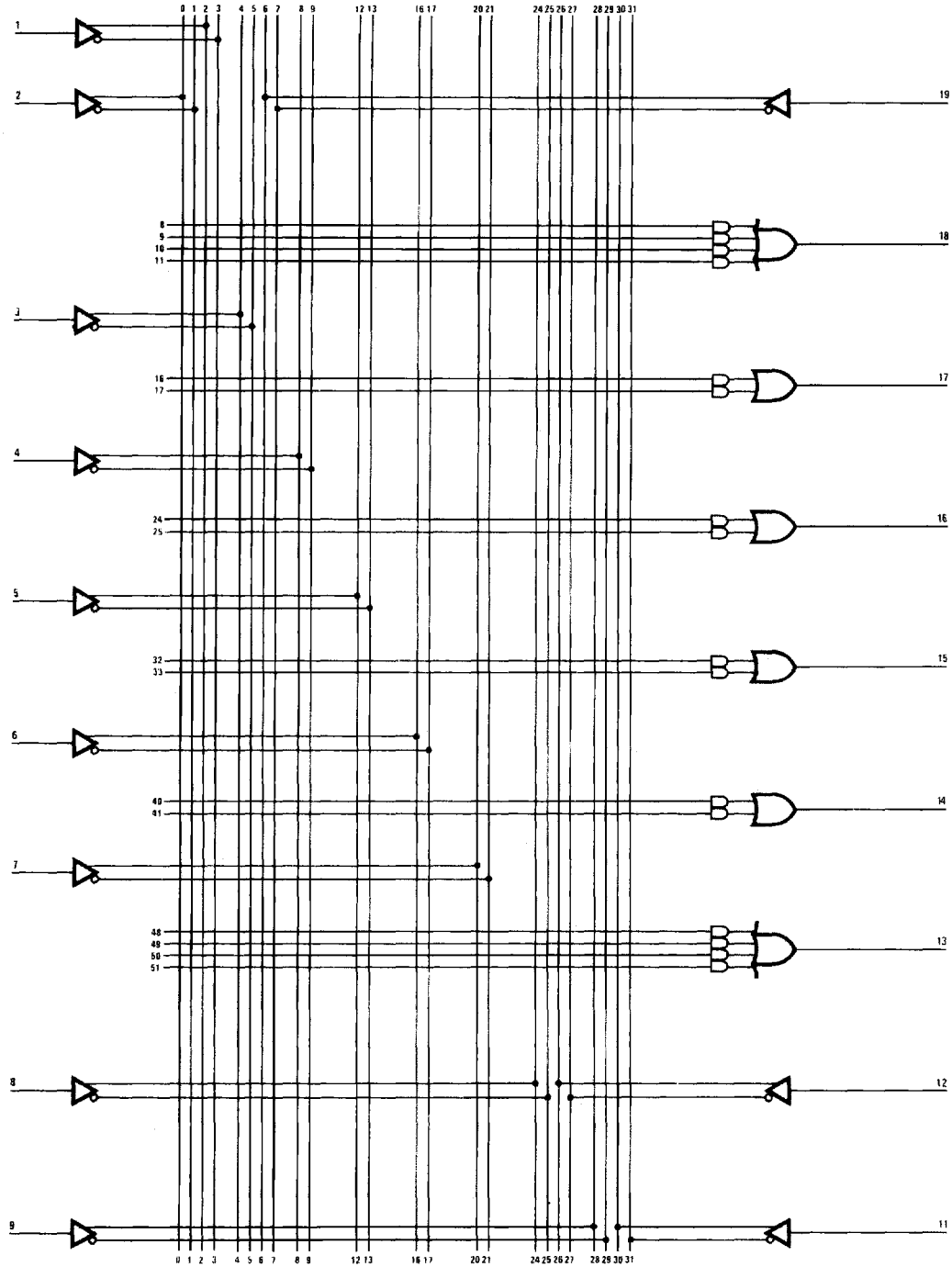
12H6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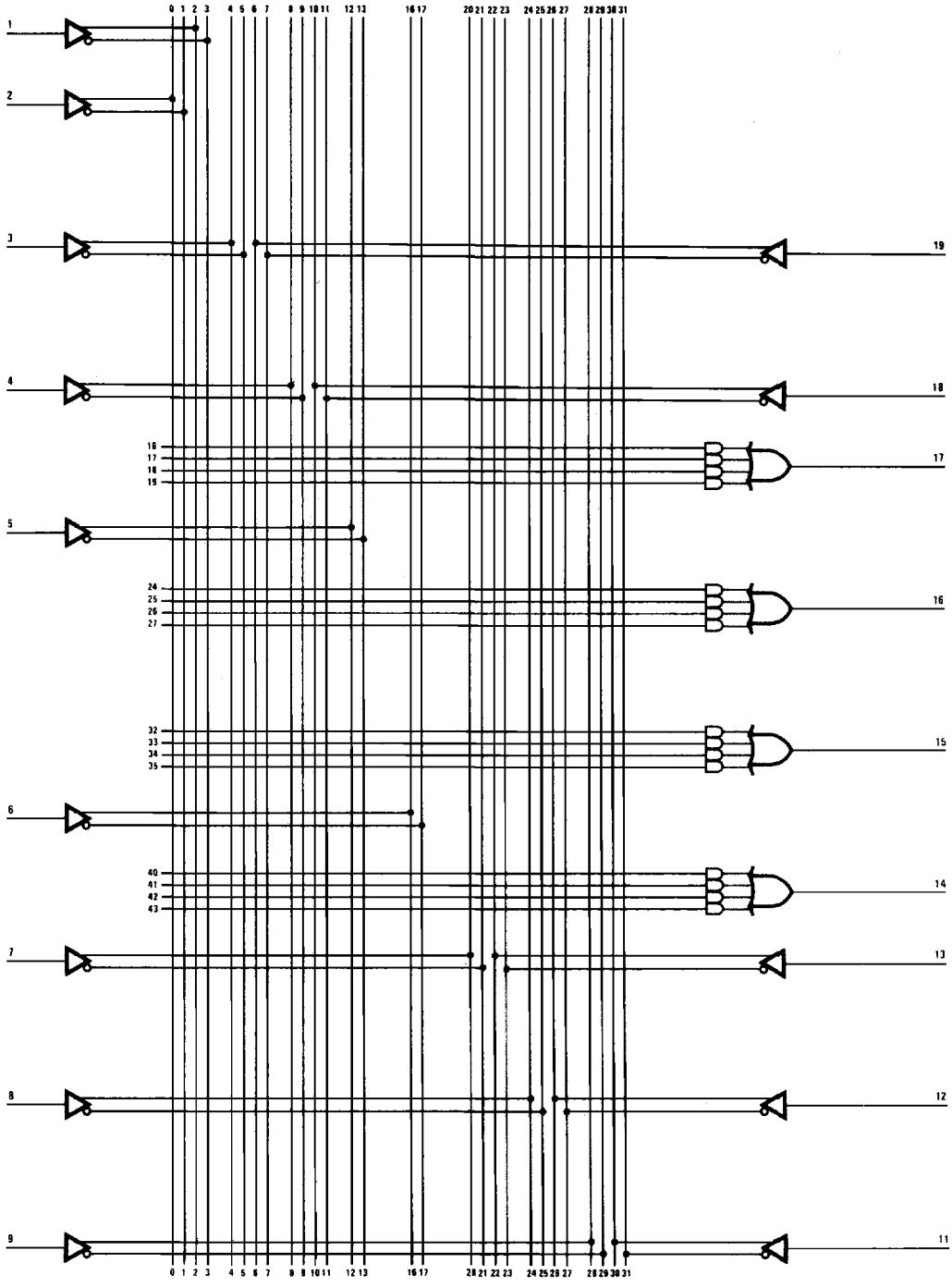
14H4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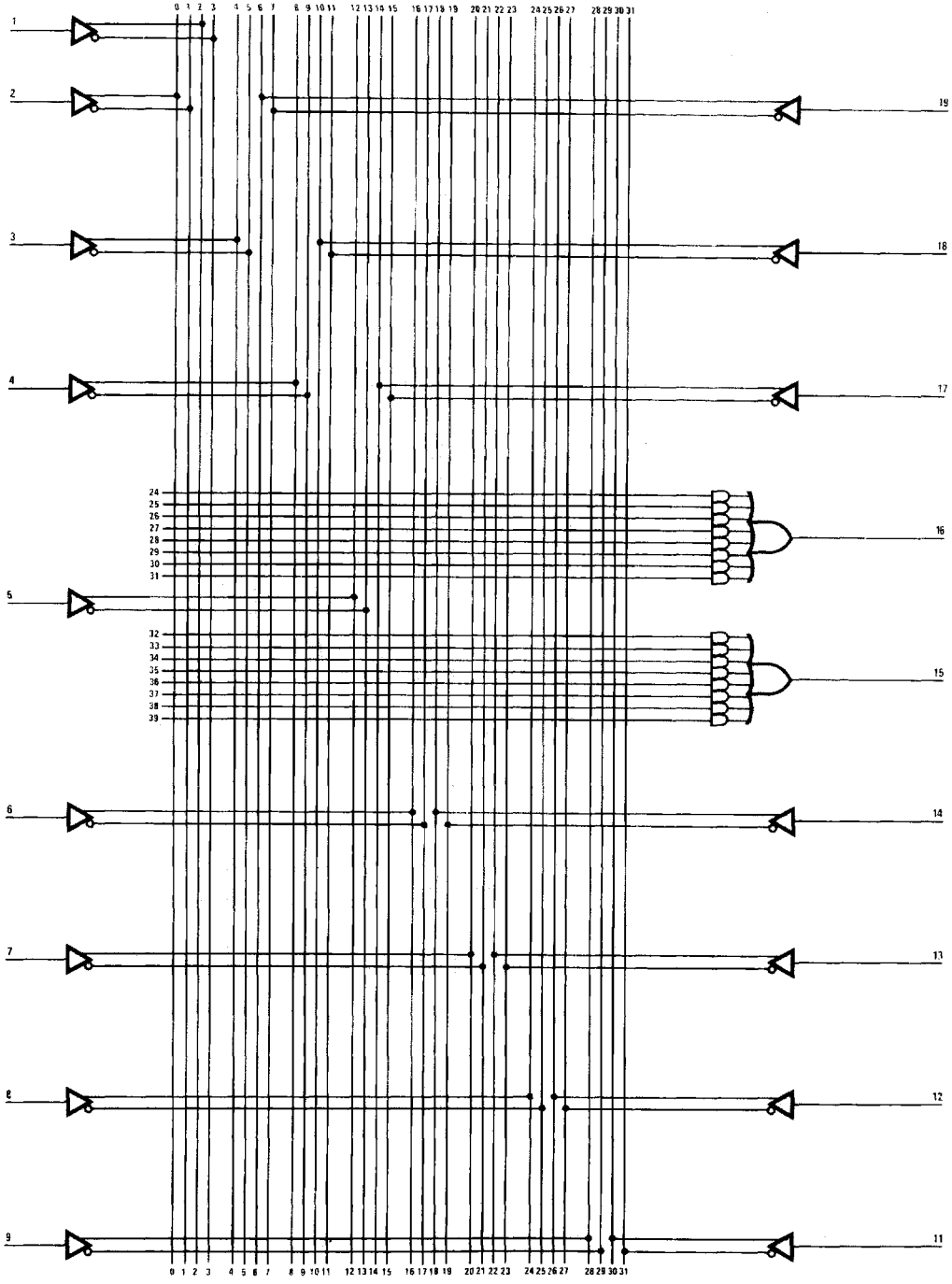
16H2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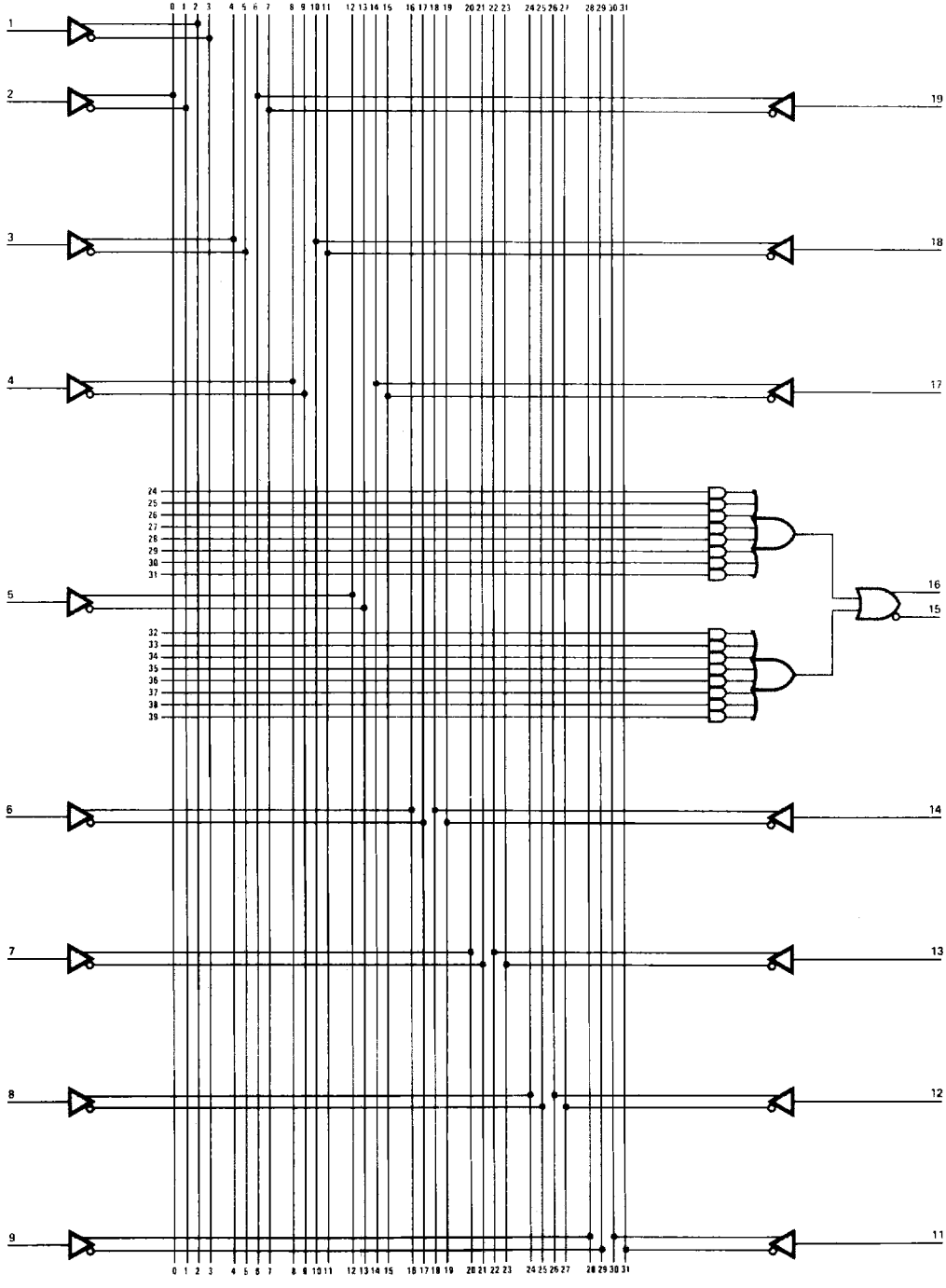
16C1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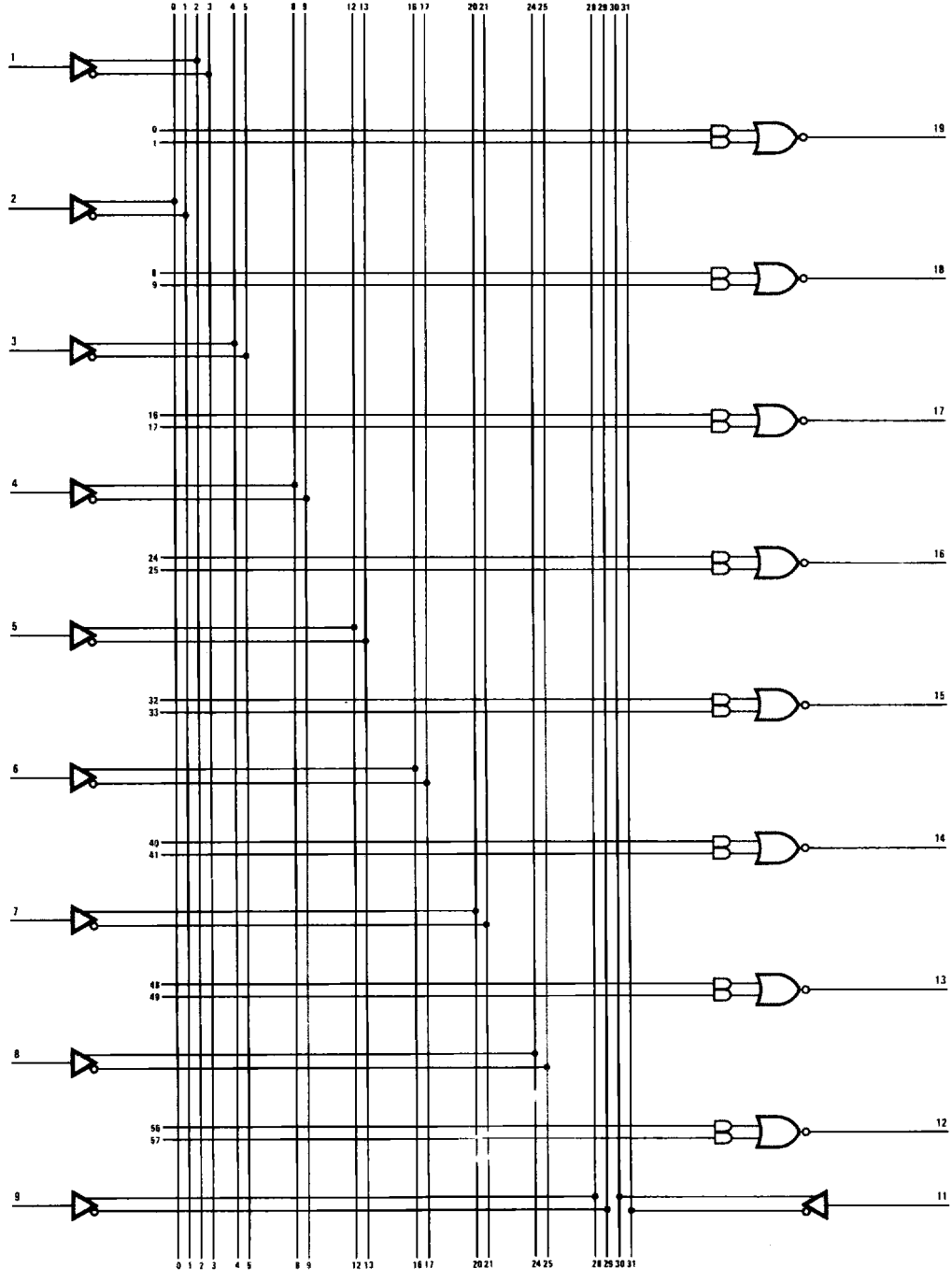
10L8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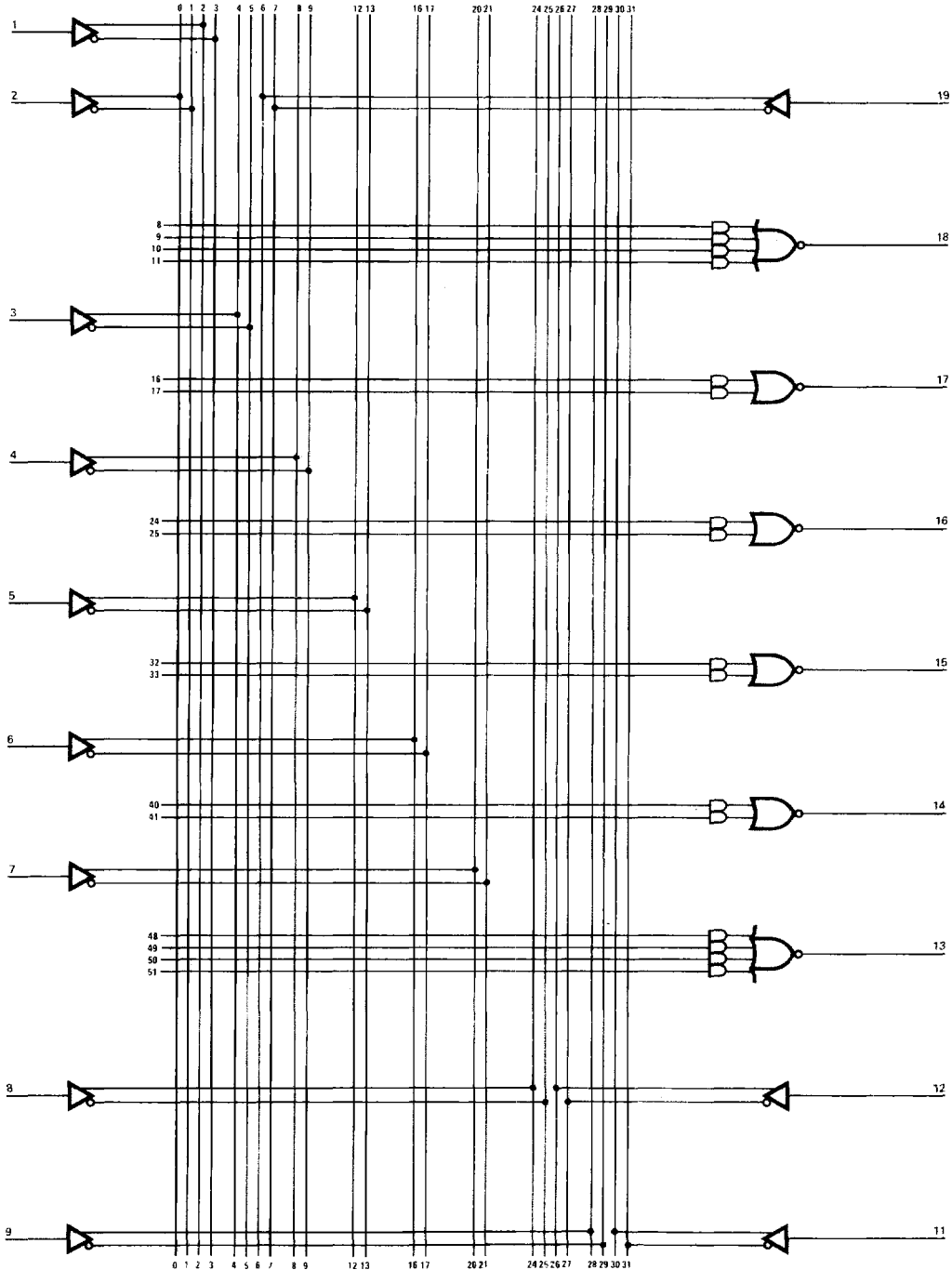
12L6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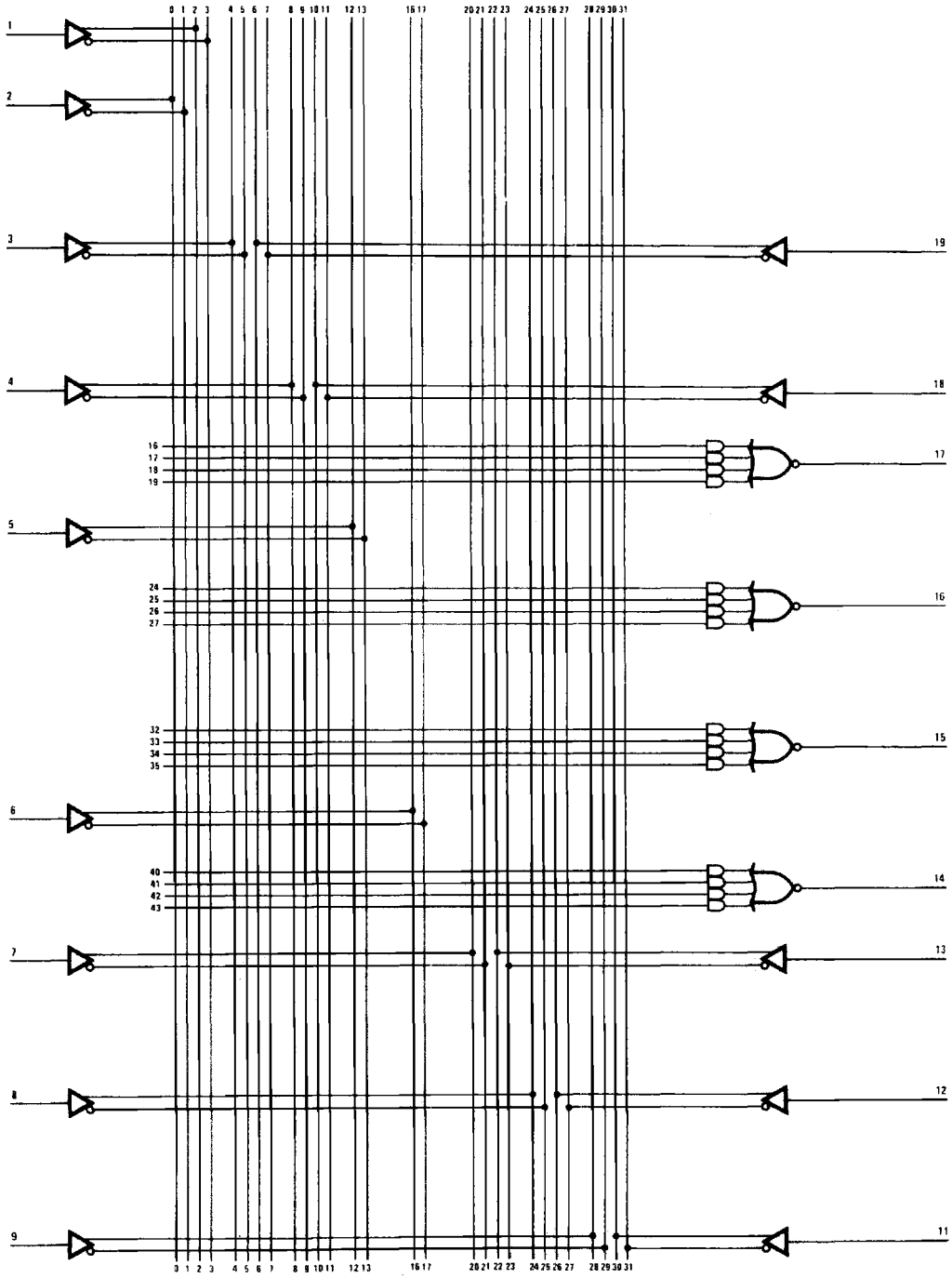
14L4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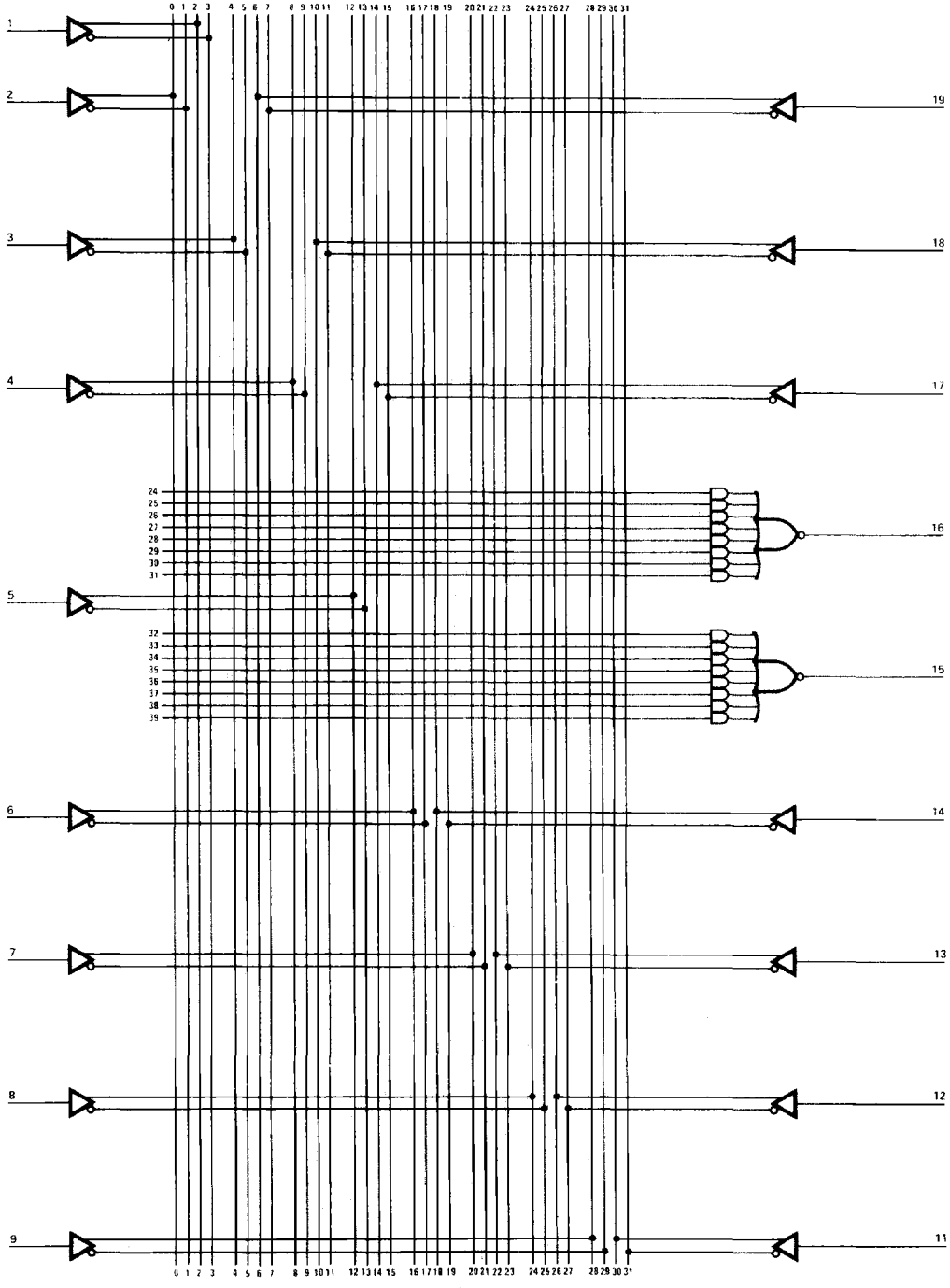
16L2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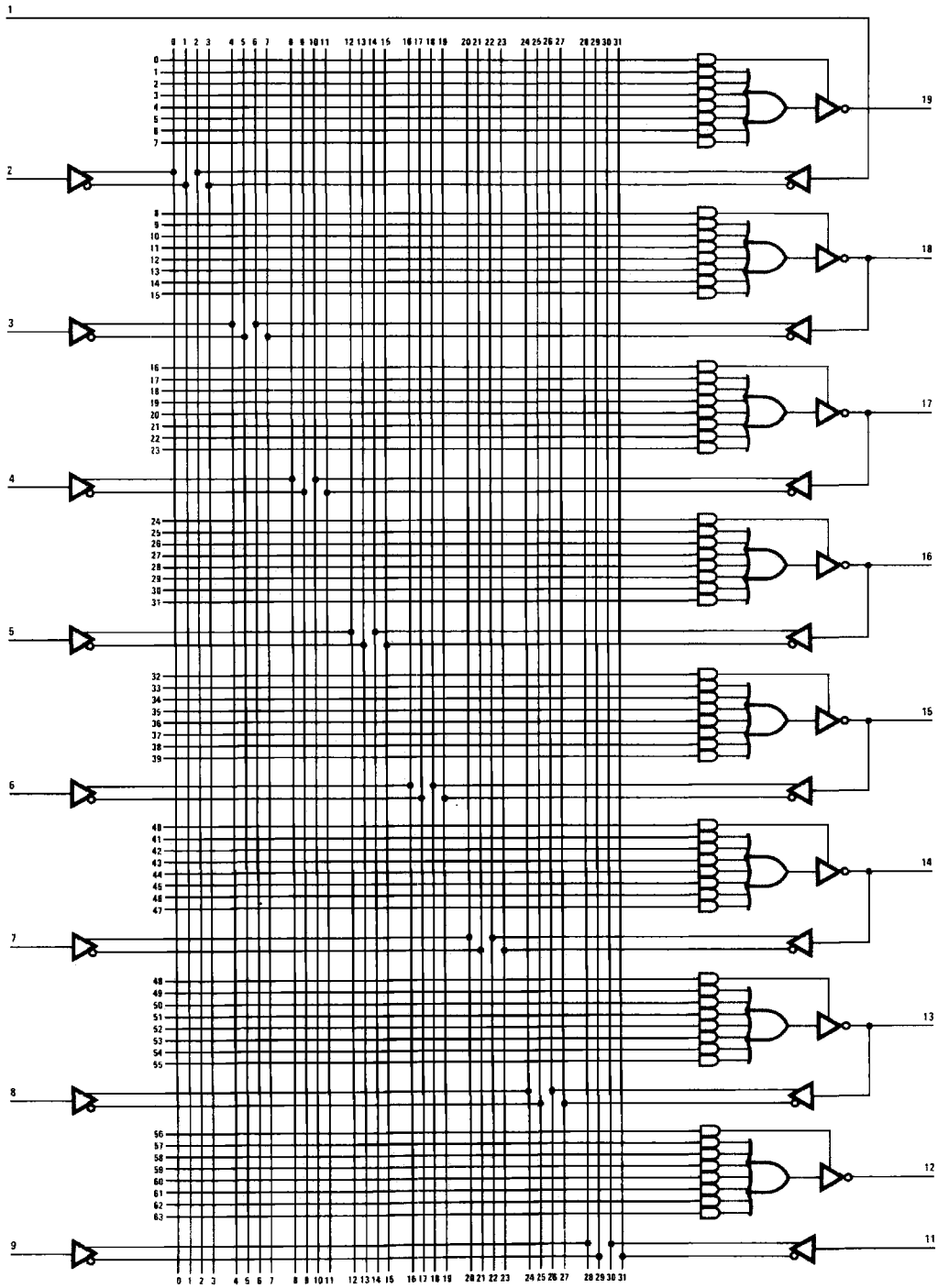
16L8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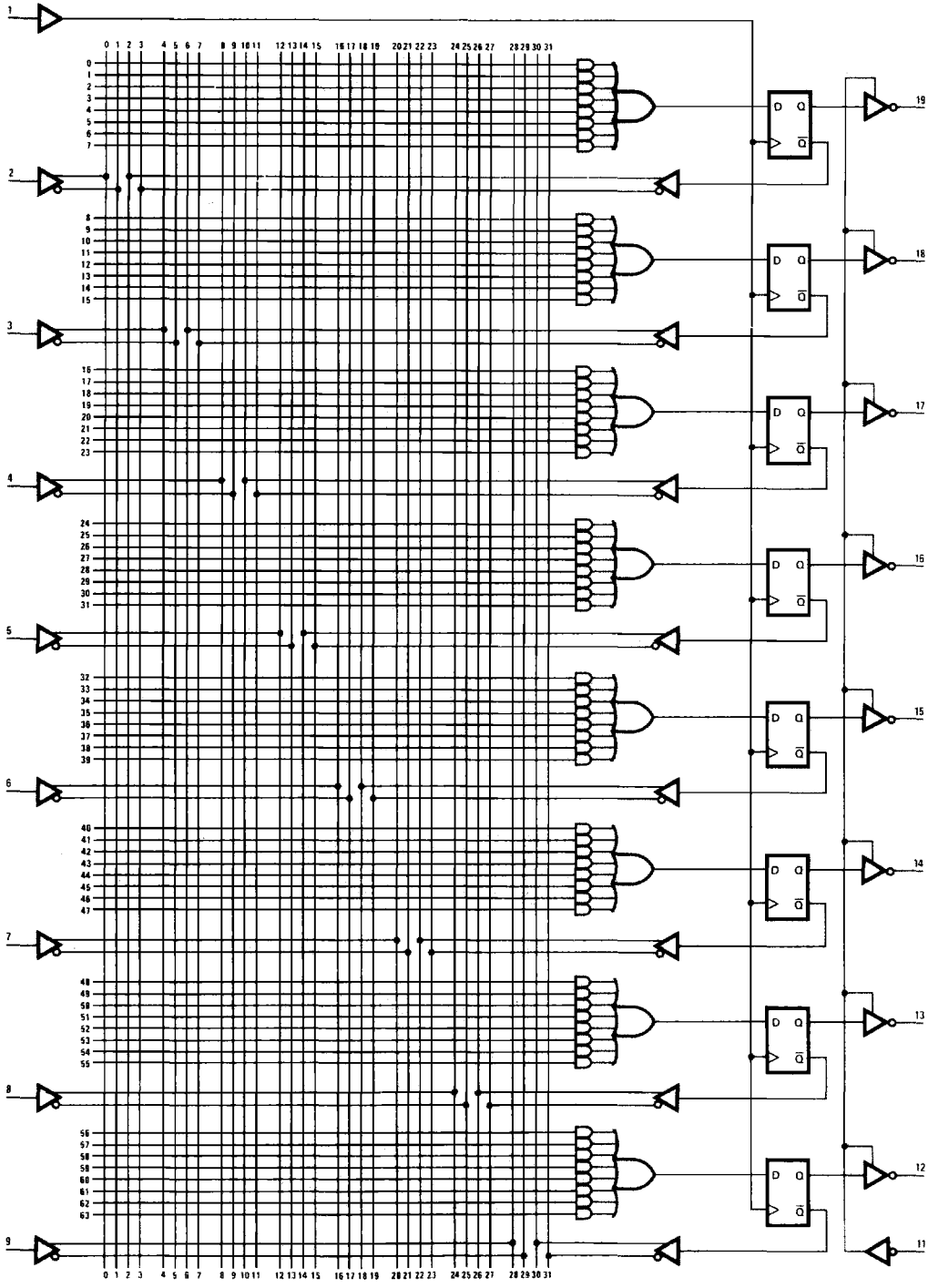
16R8



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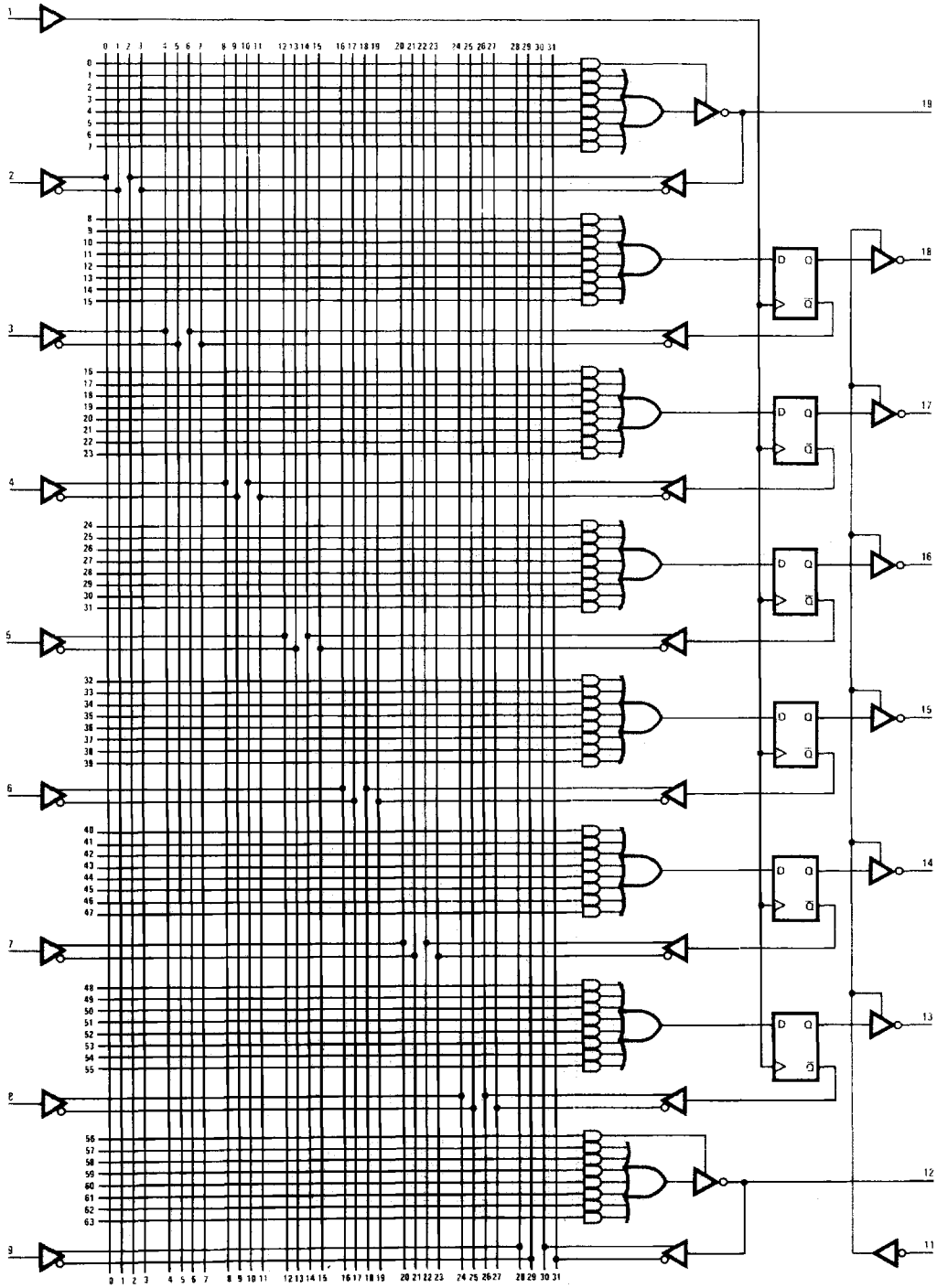

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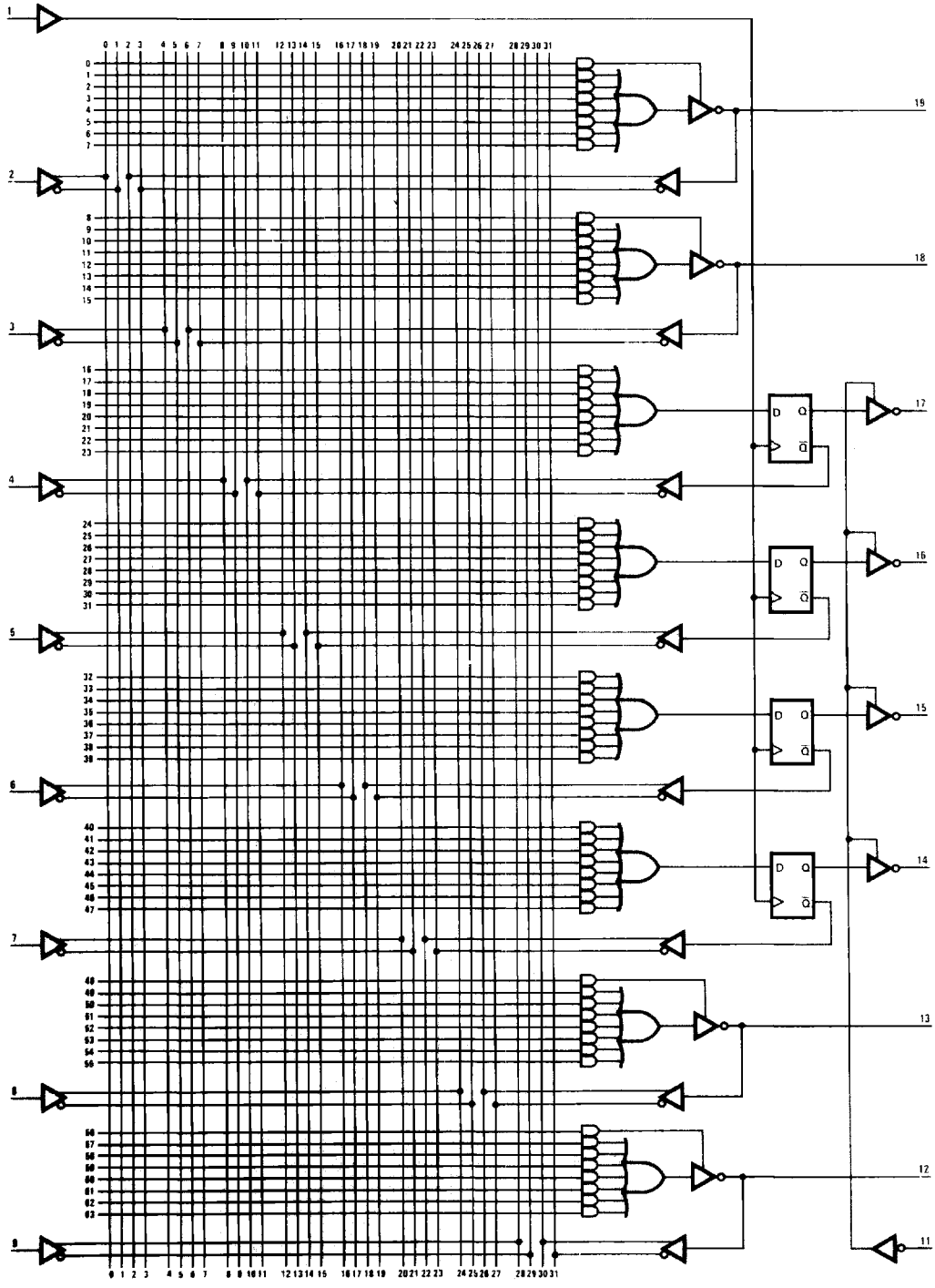

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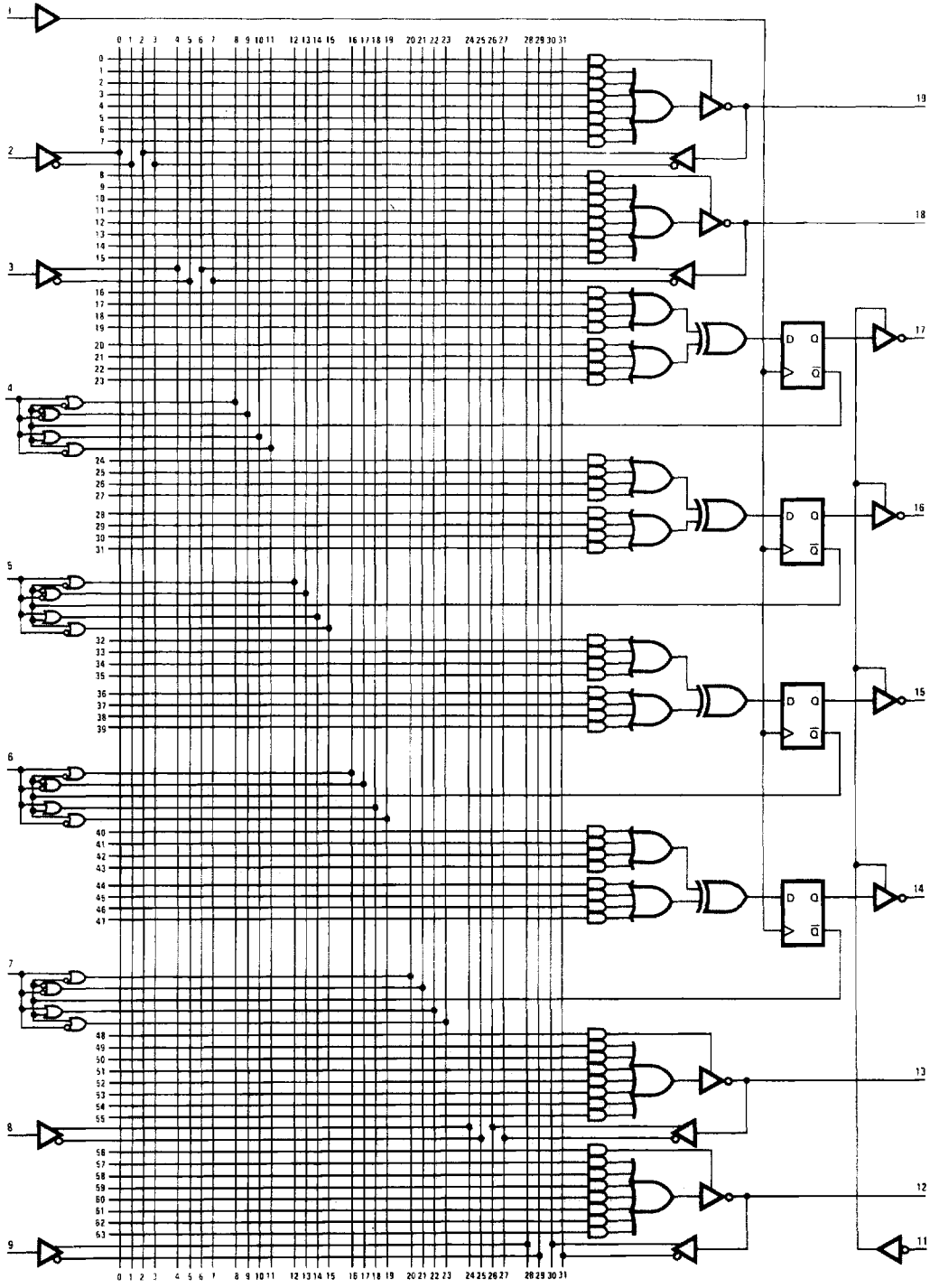

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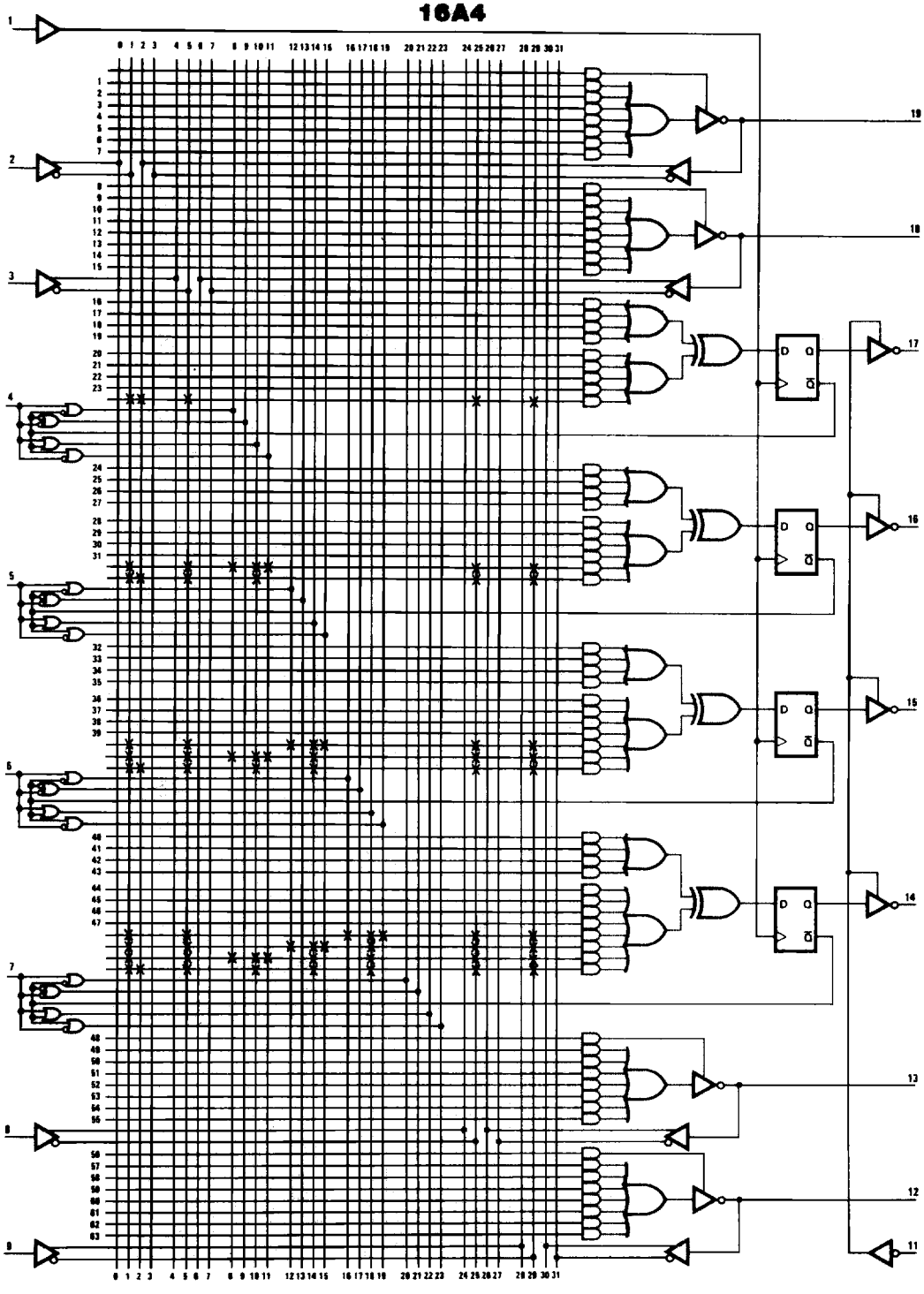

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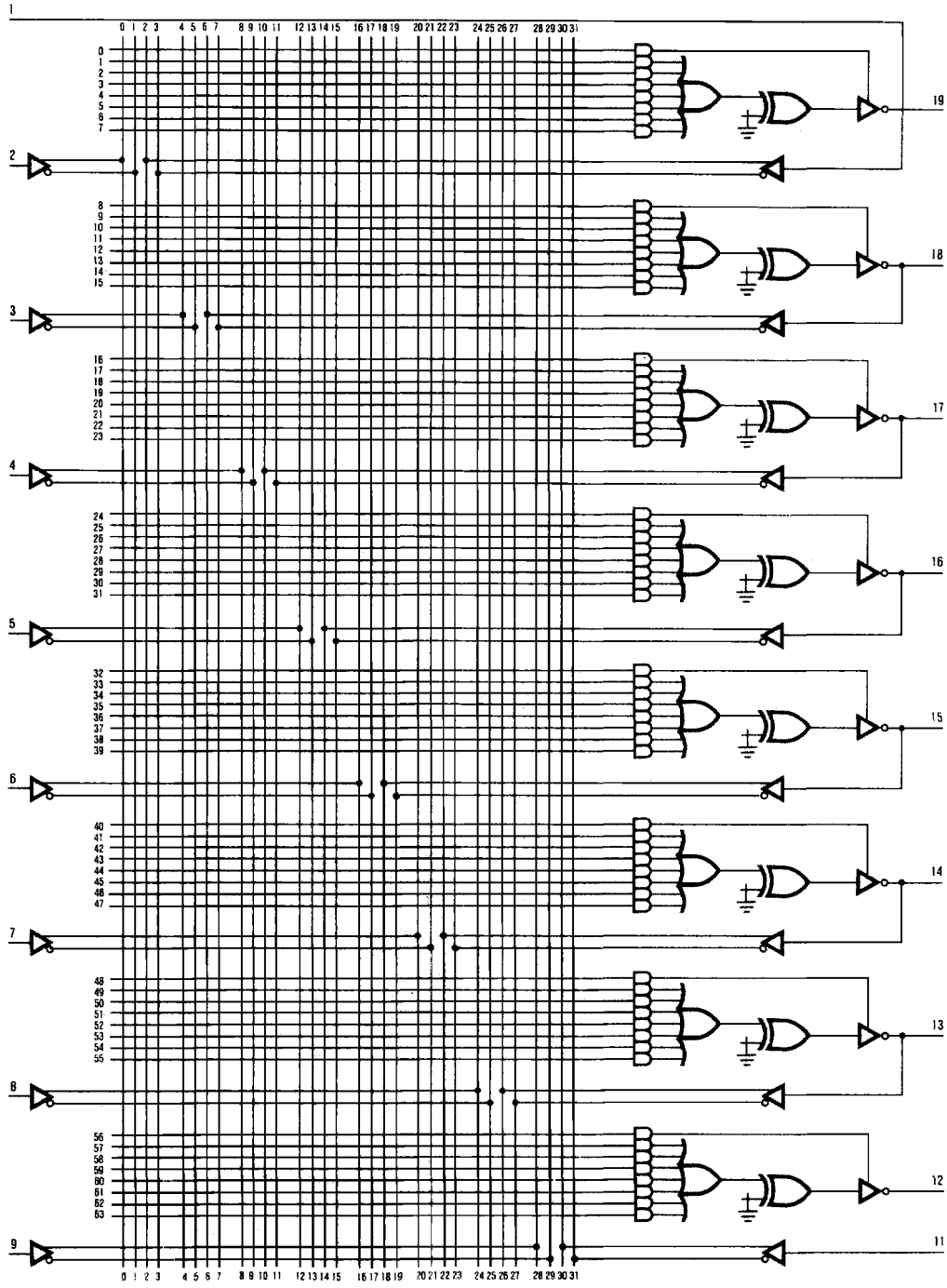

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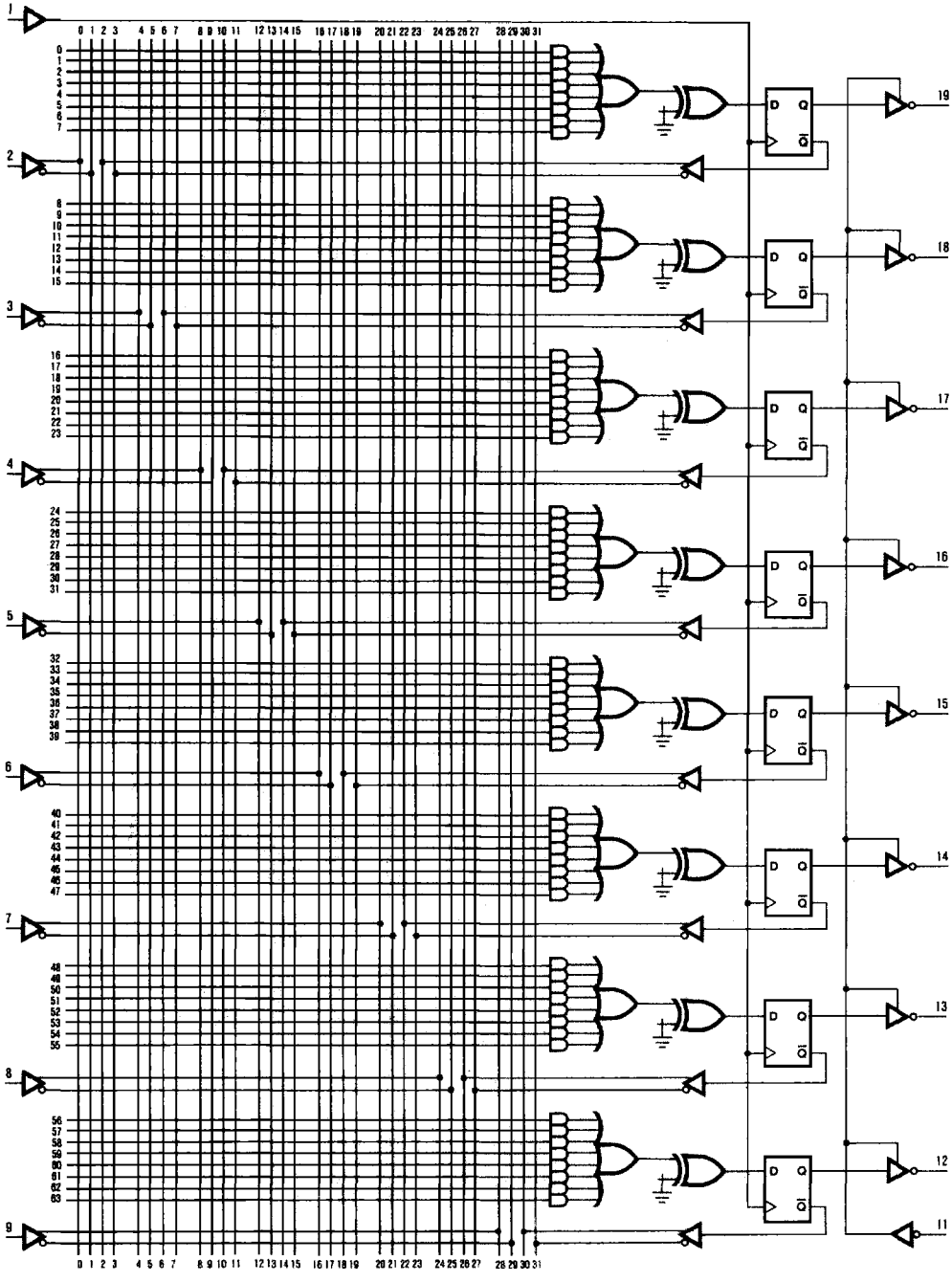

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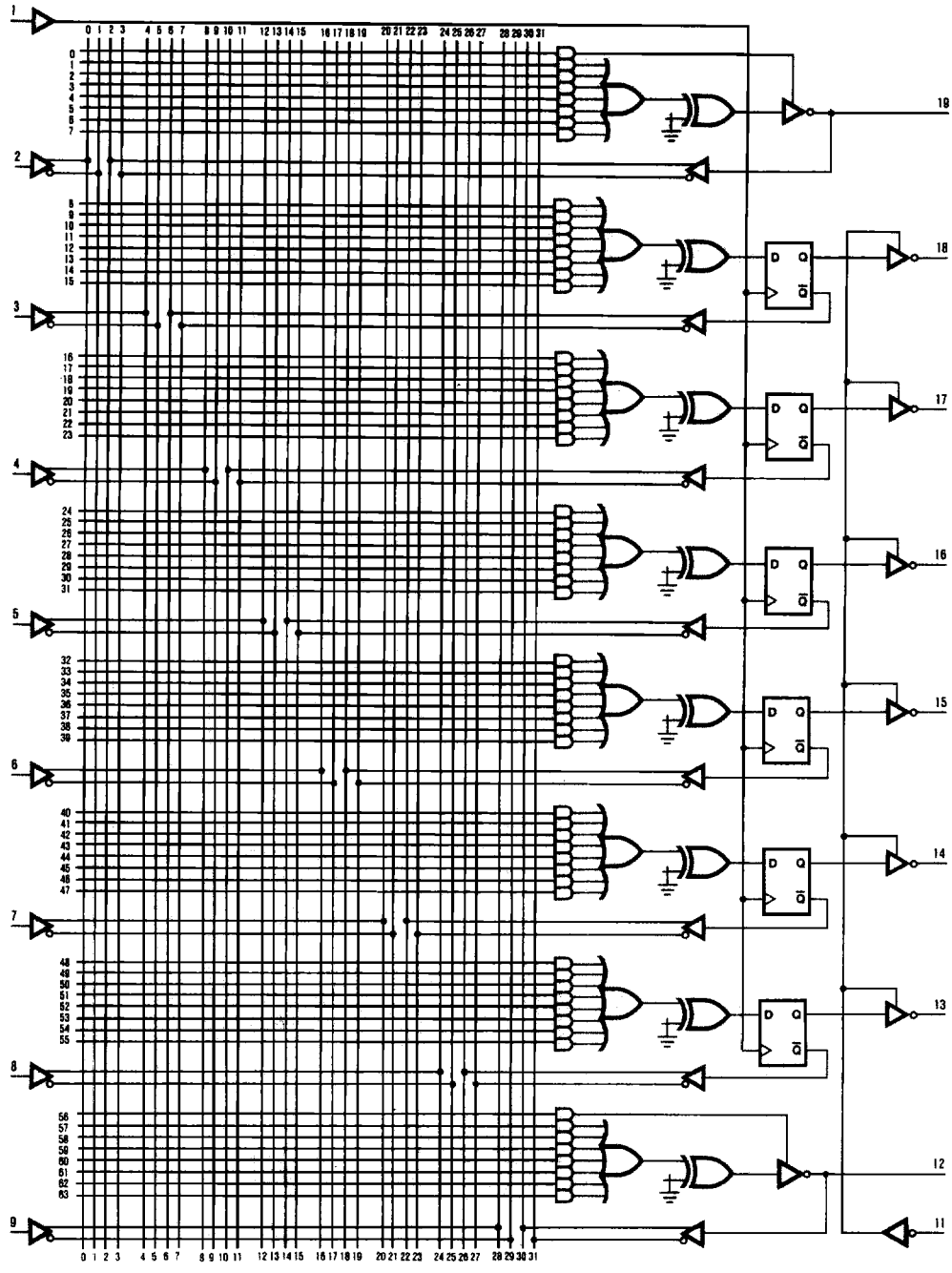

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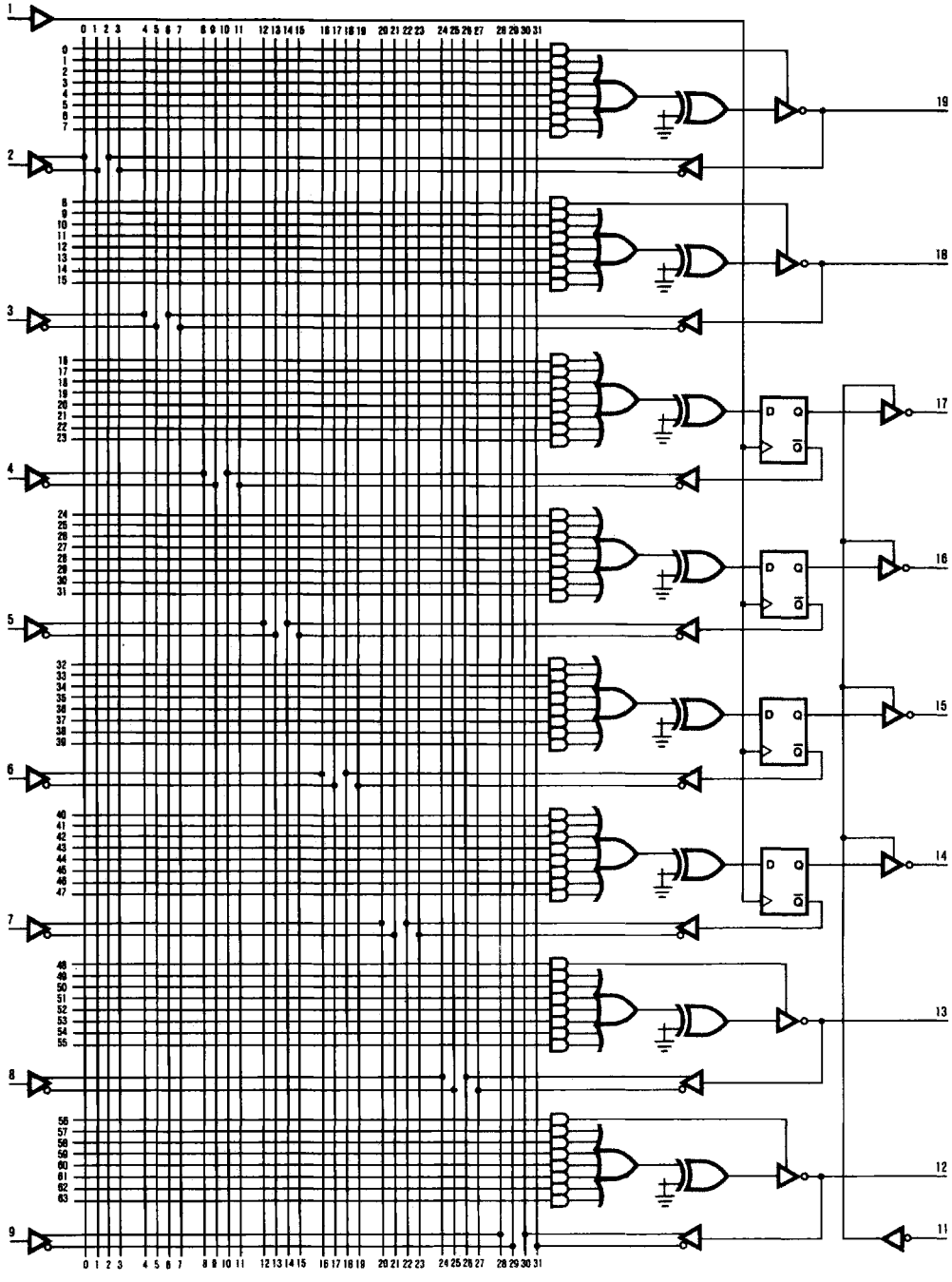

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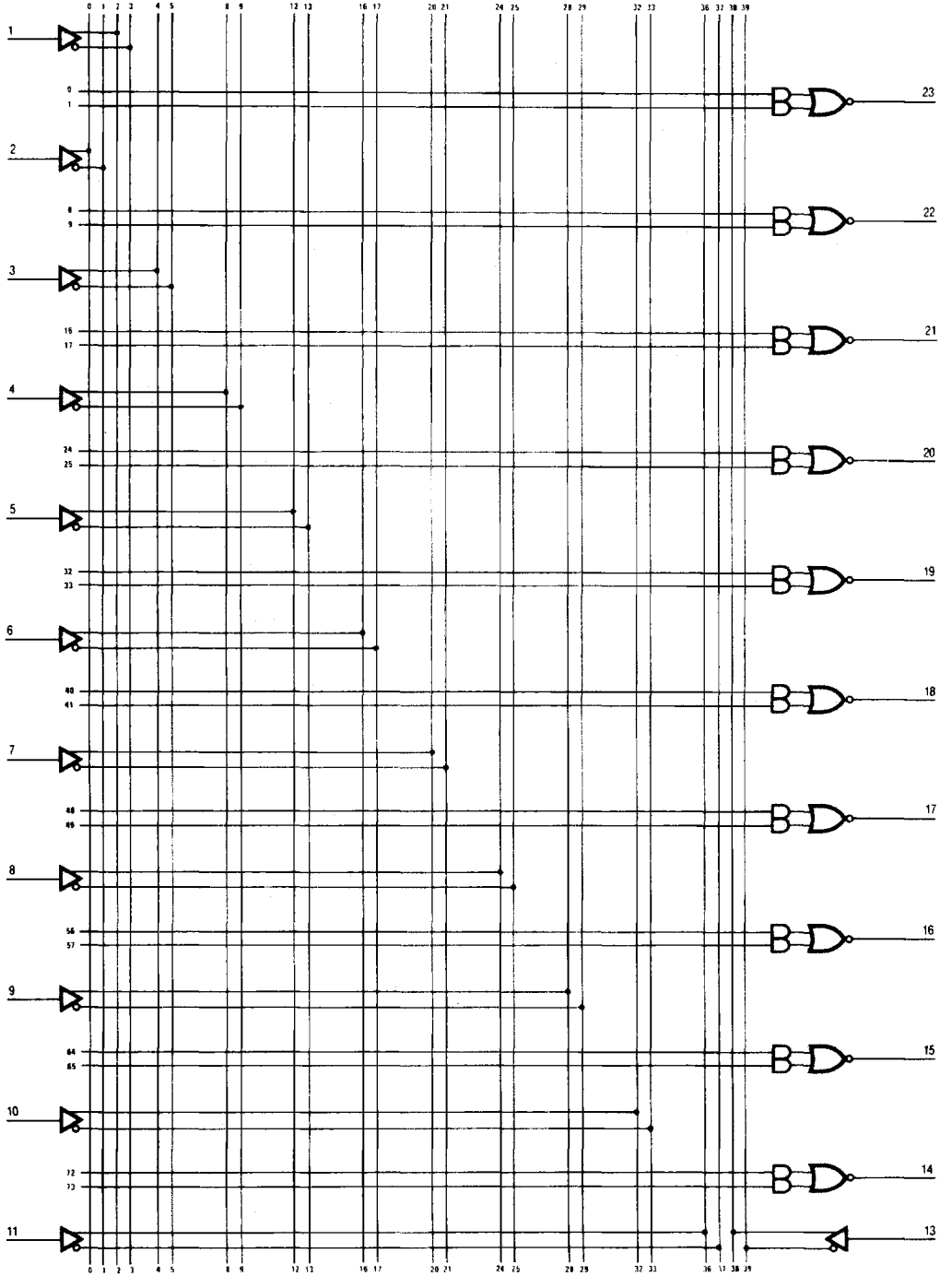
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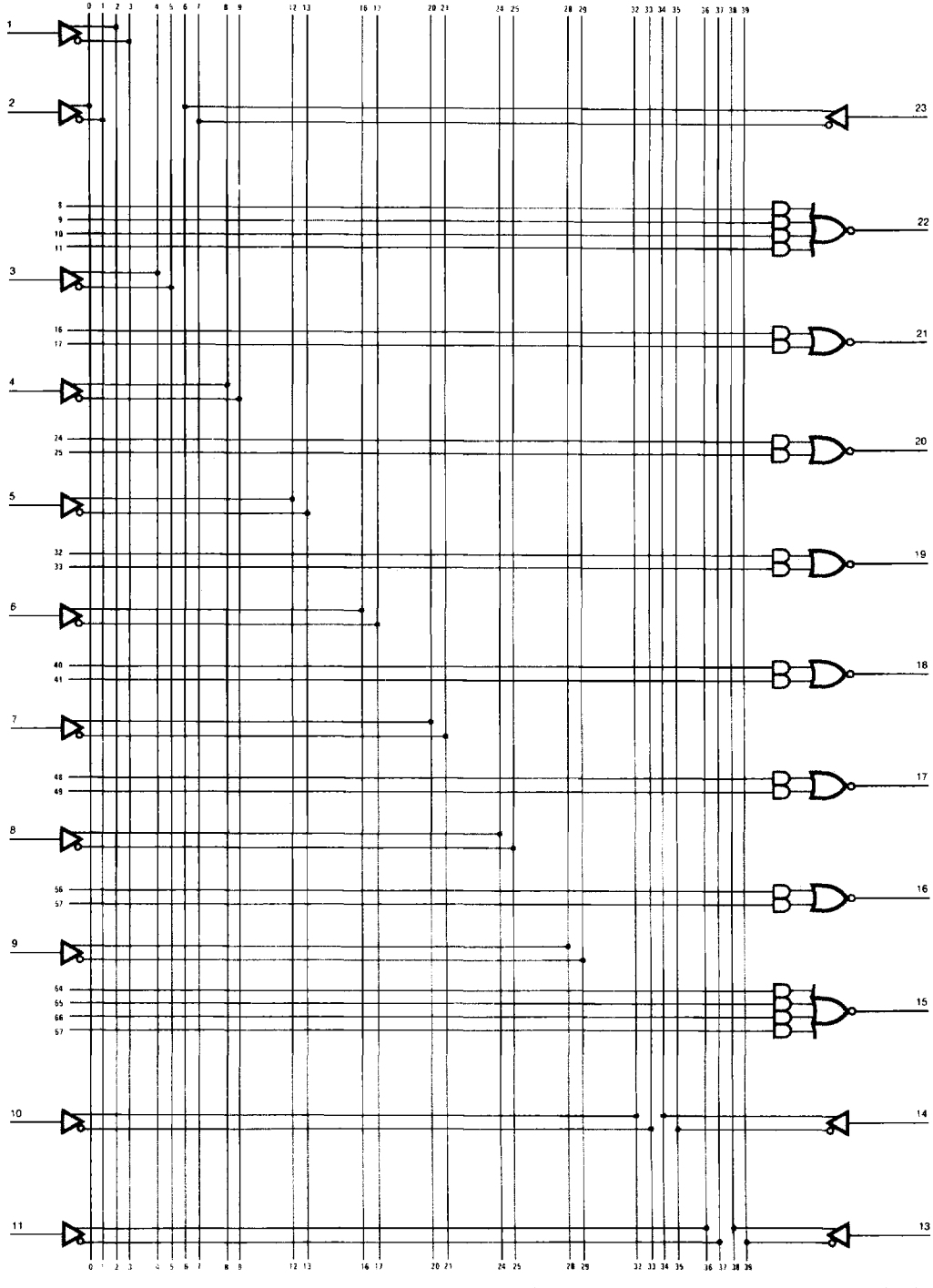
14L8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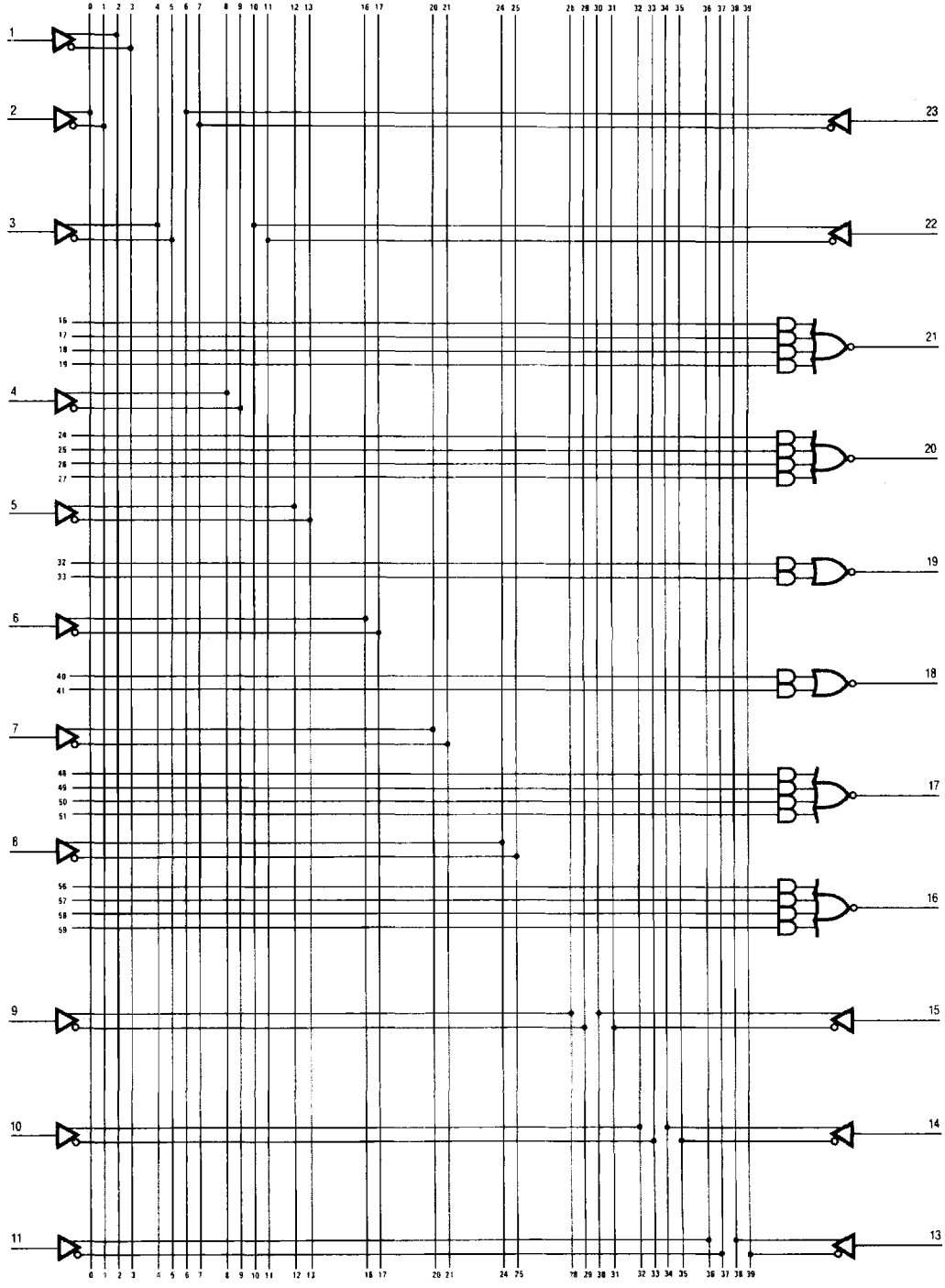
16L6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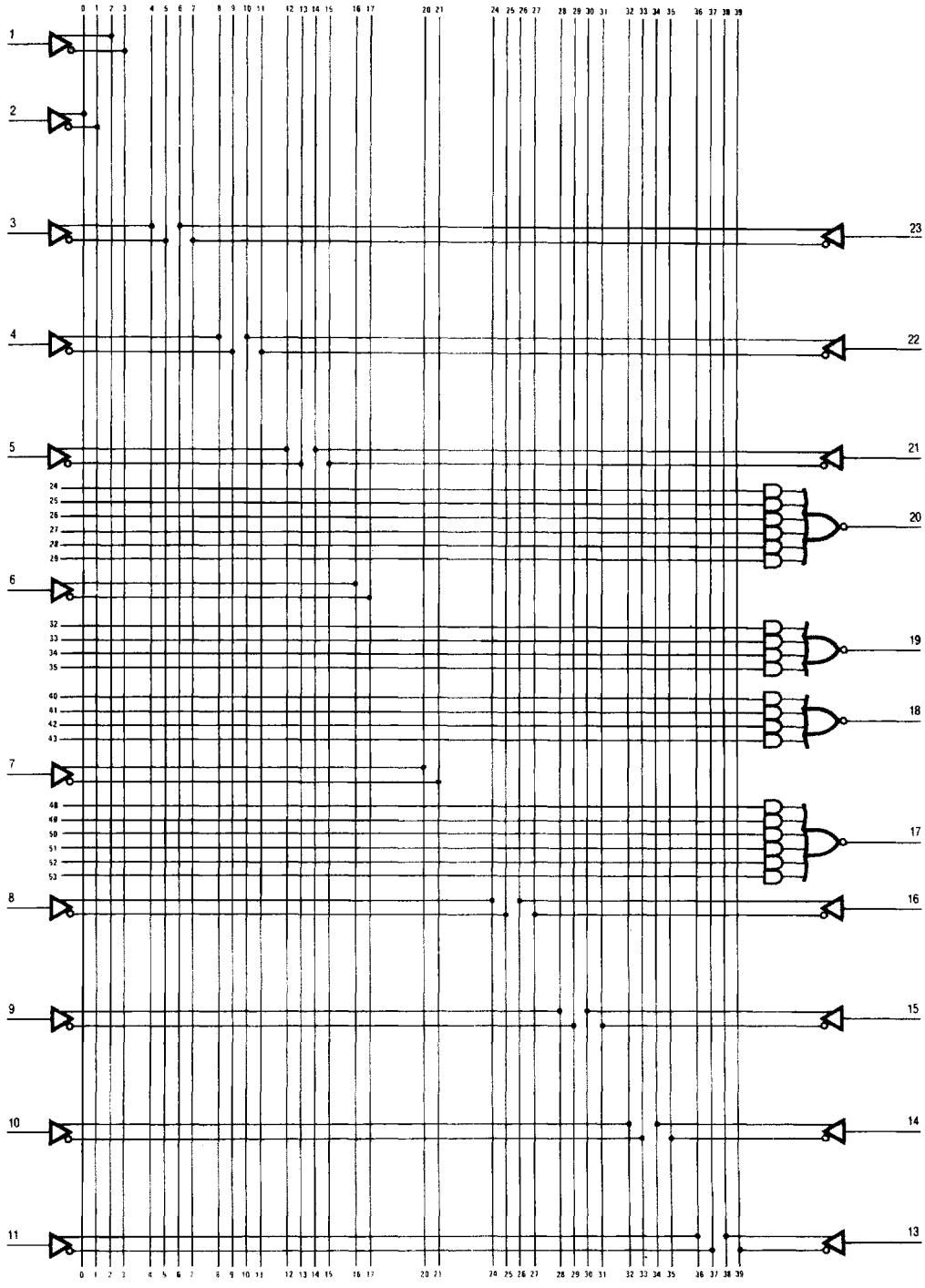
18L4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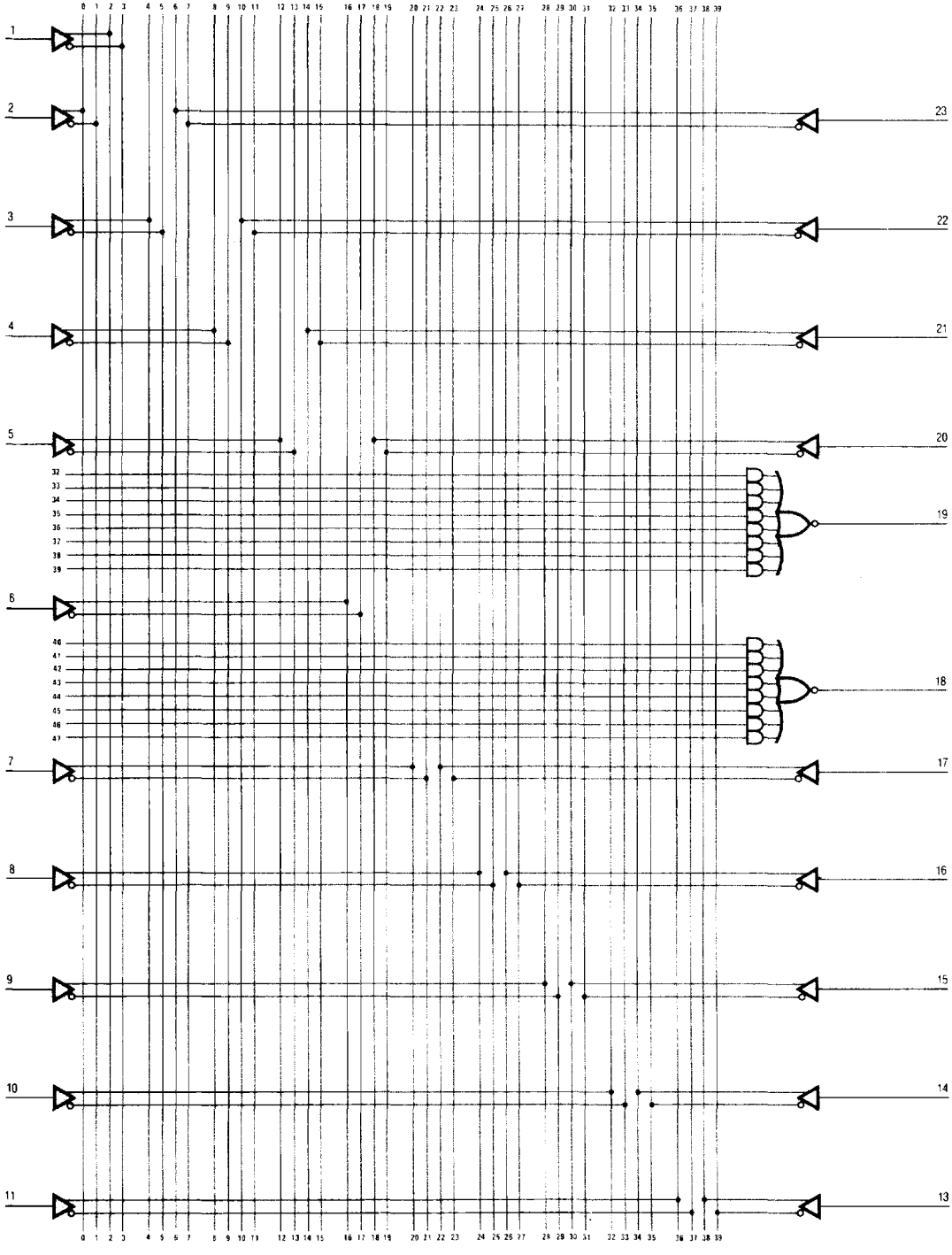
20L2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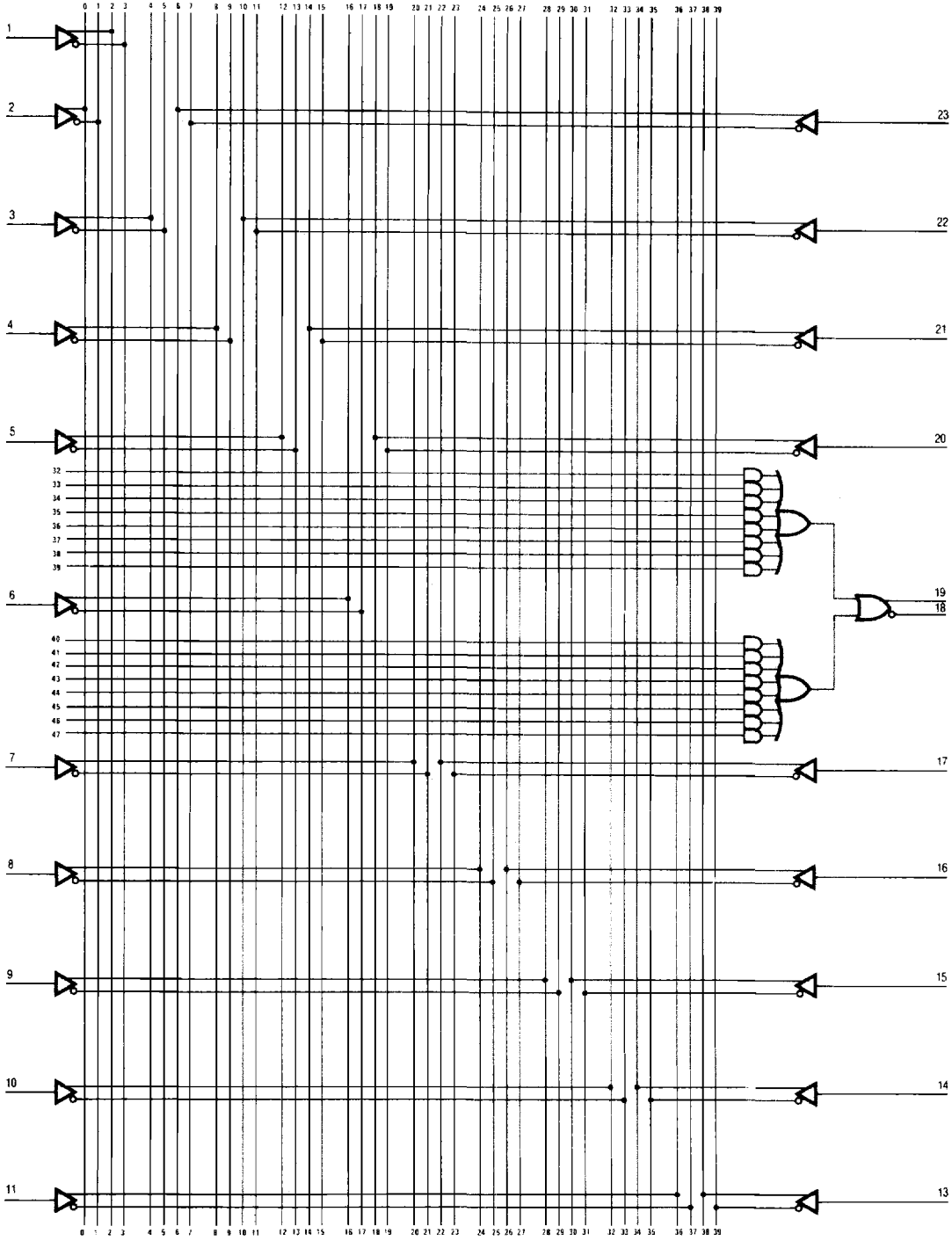
20C1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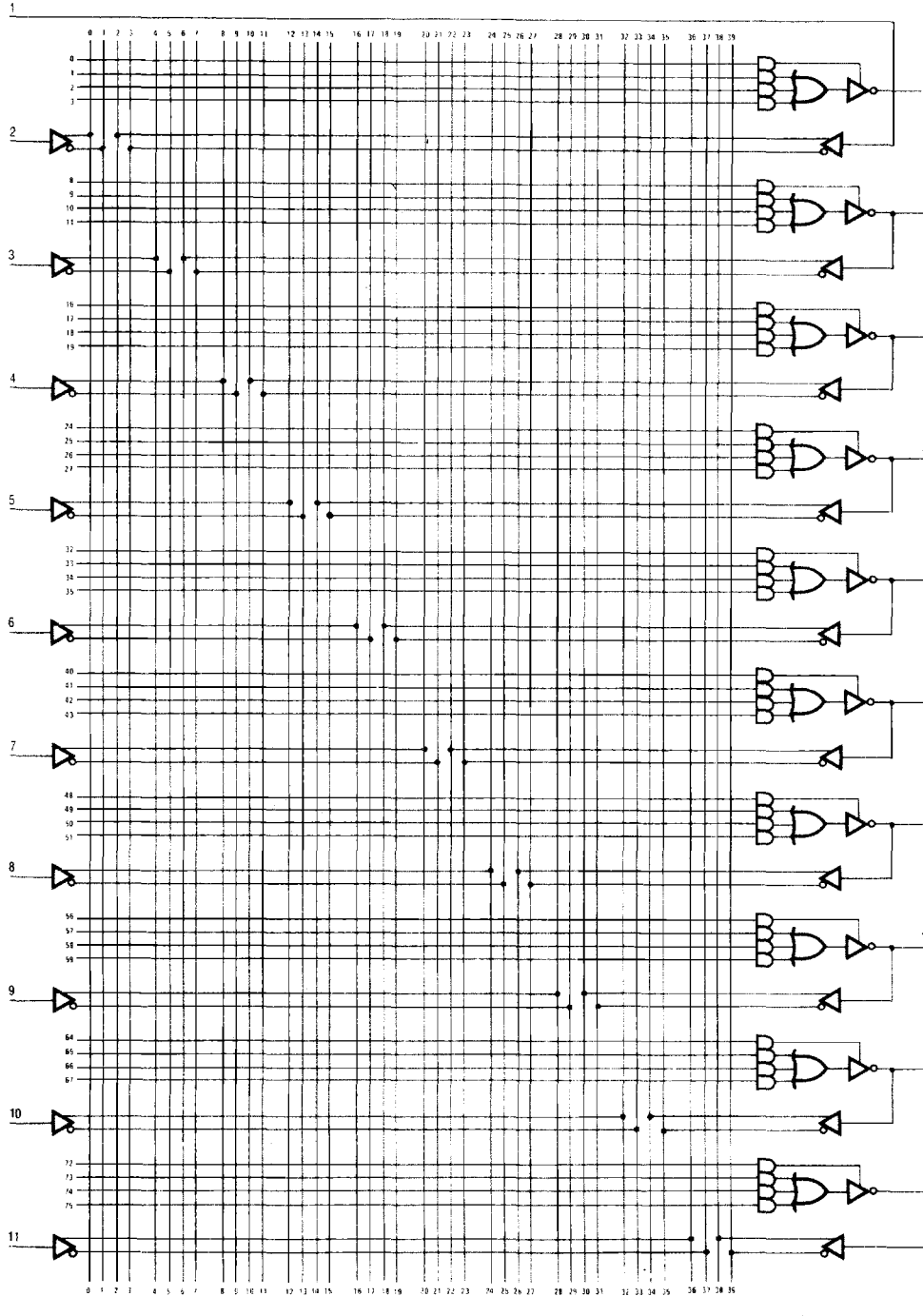
20L10



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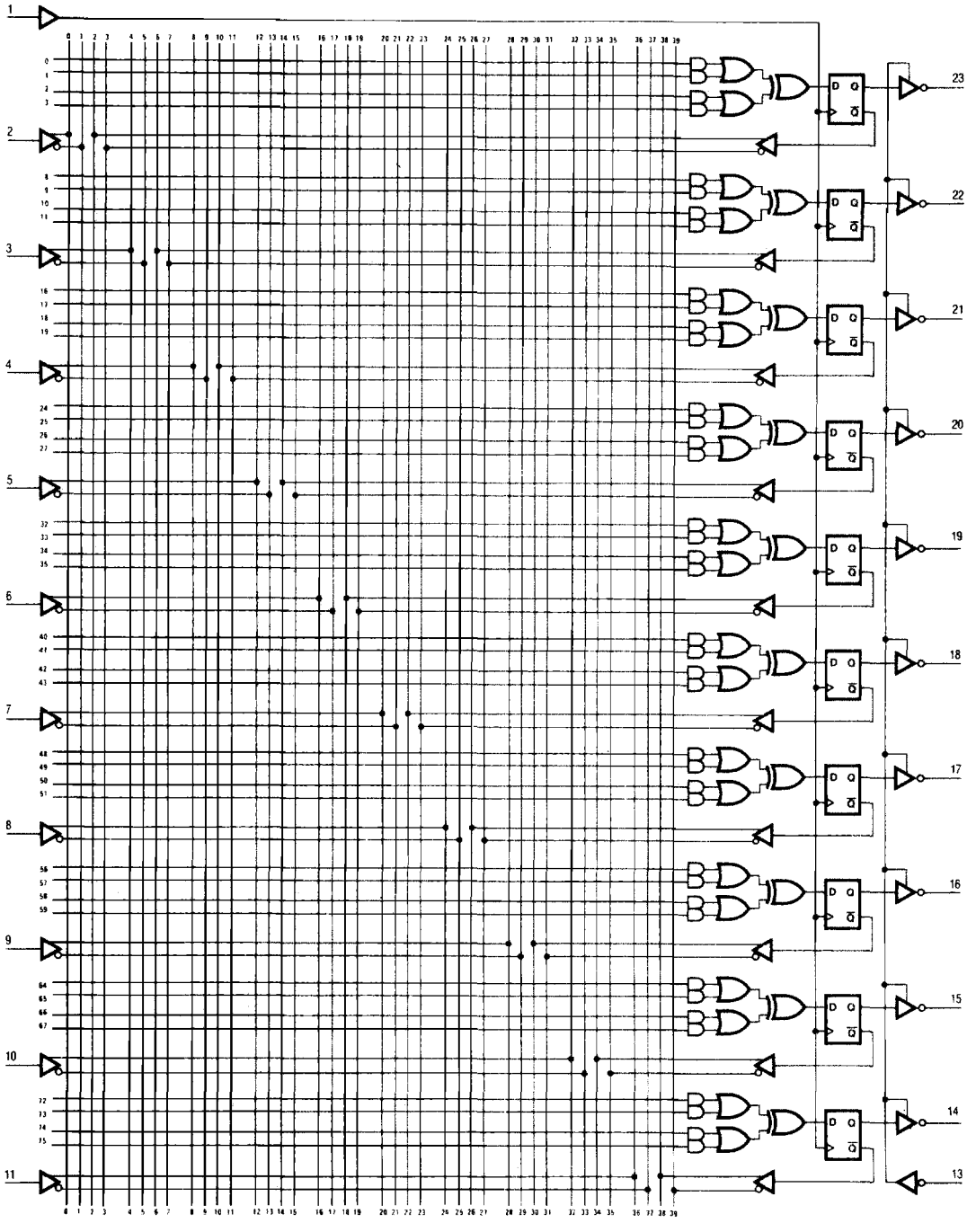

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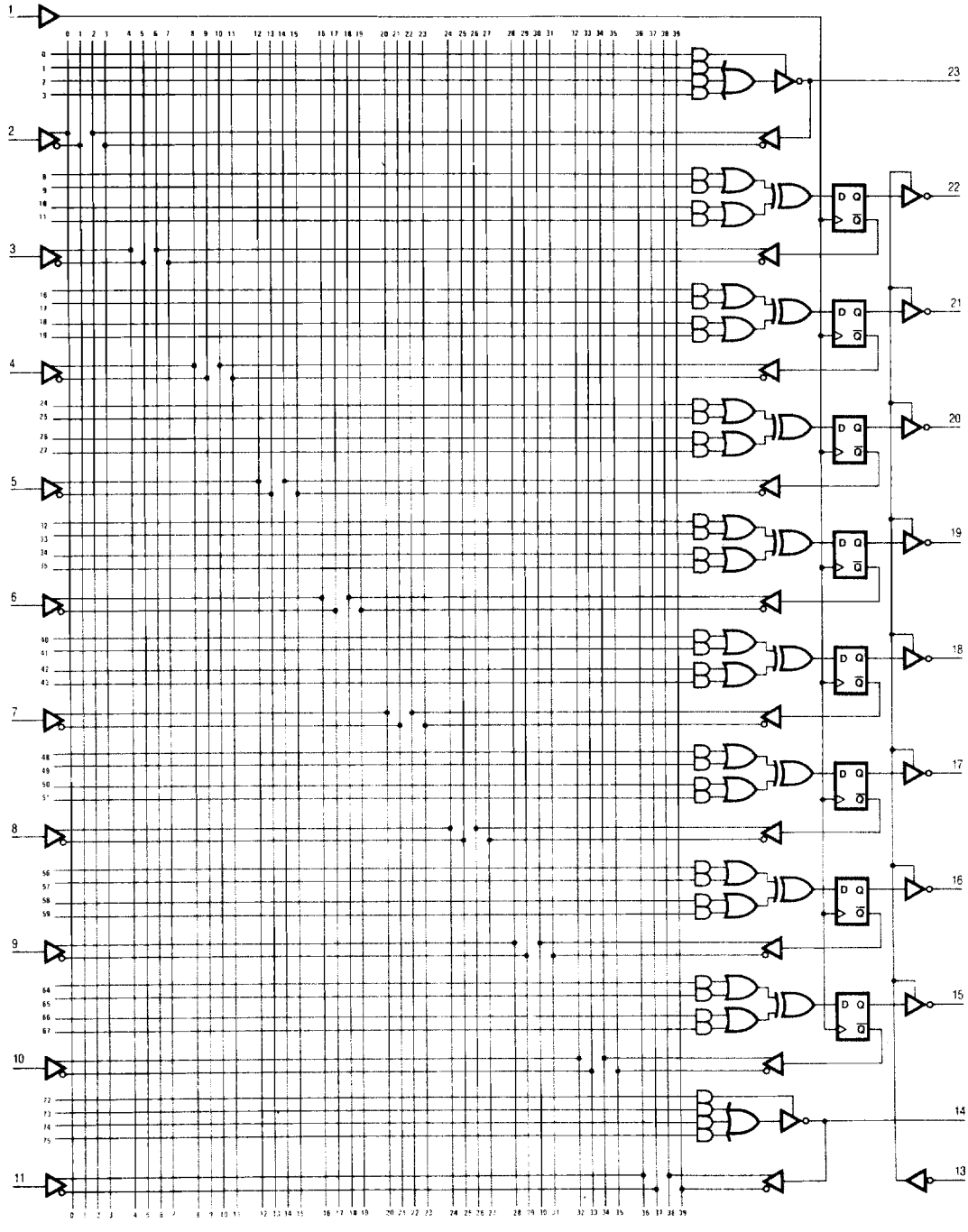

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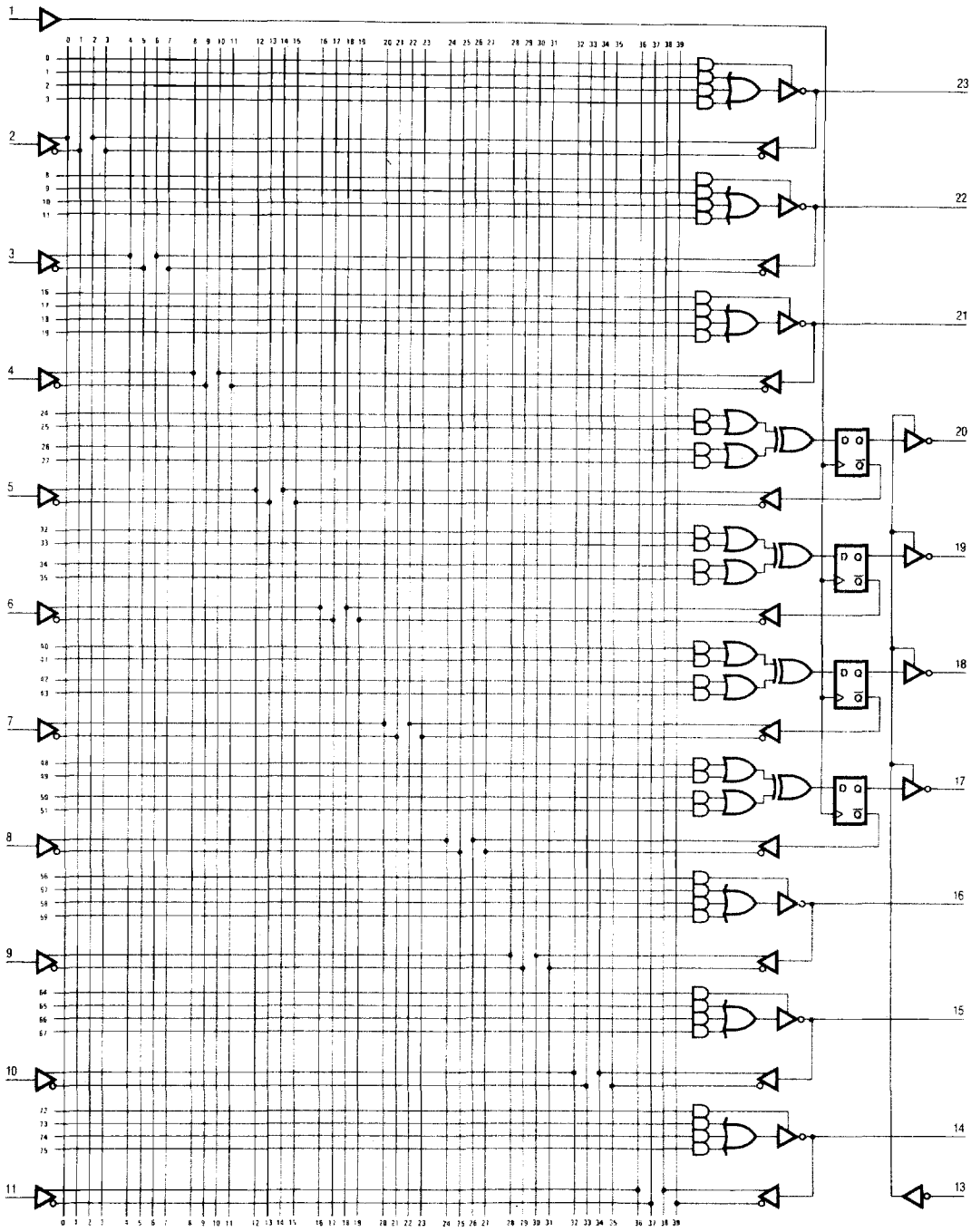

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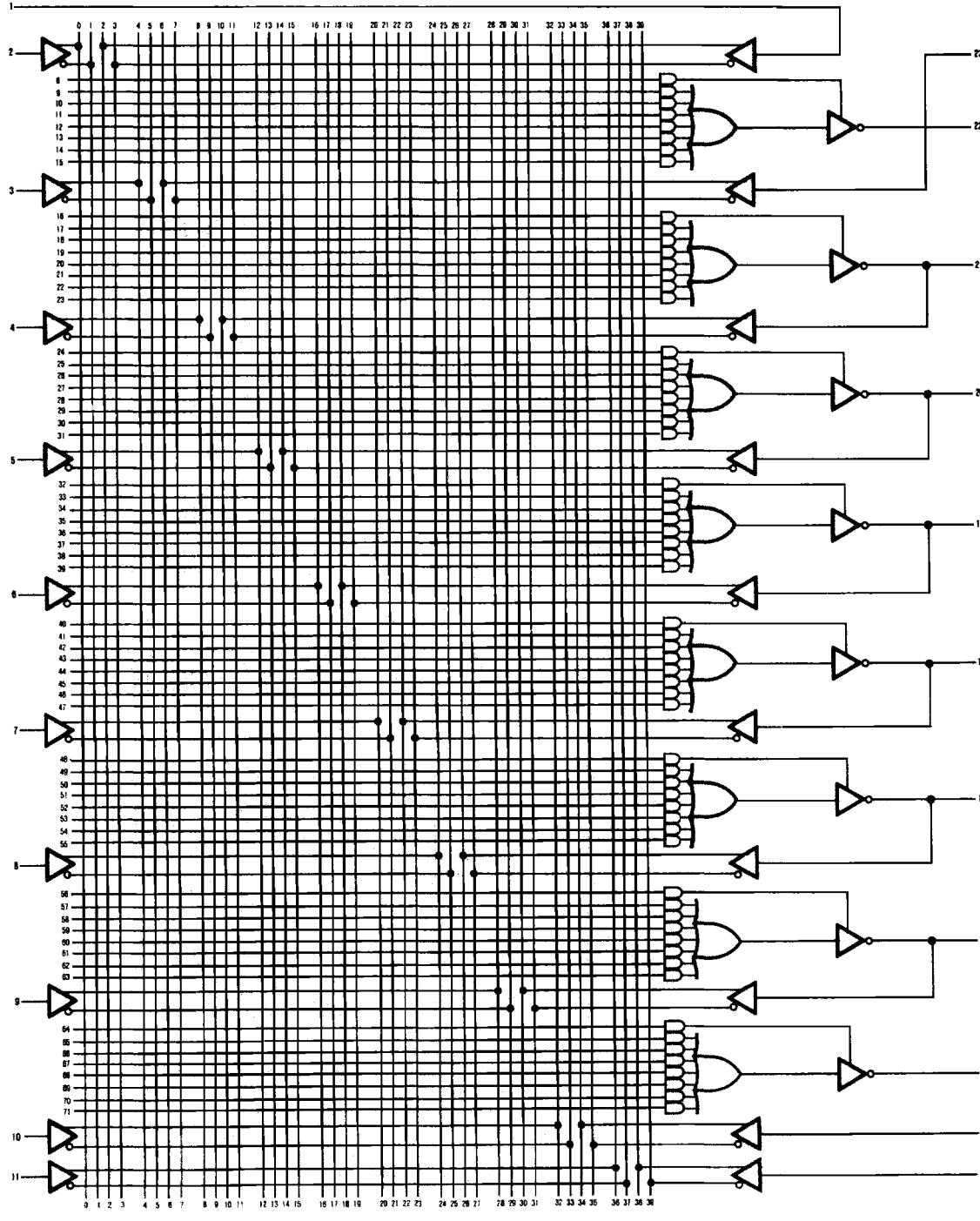

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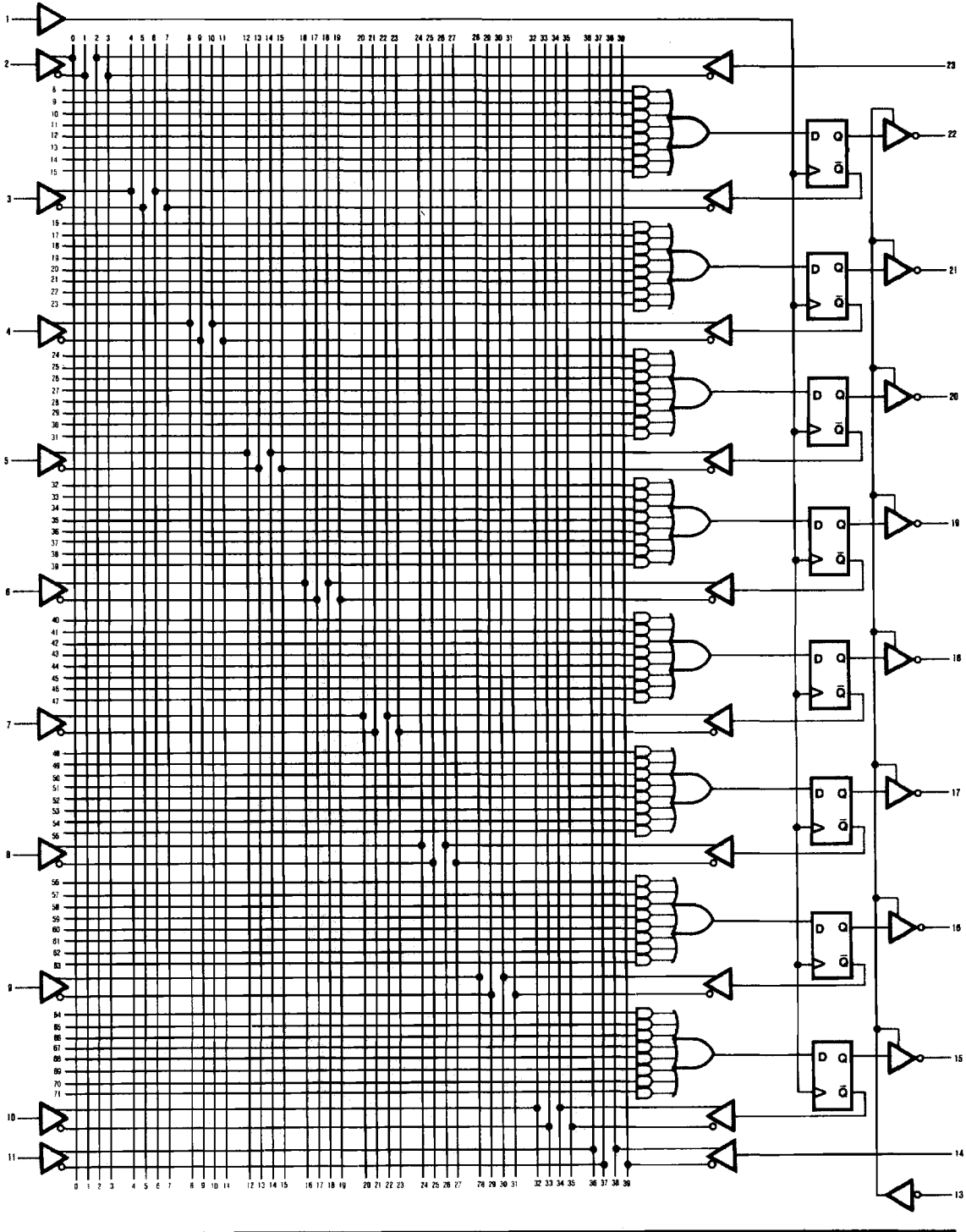

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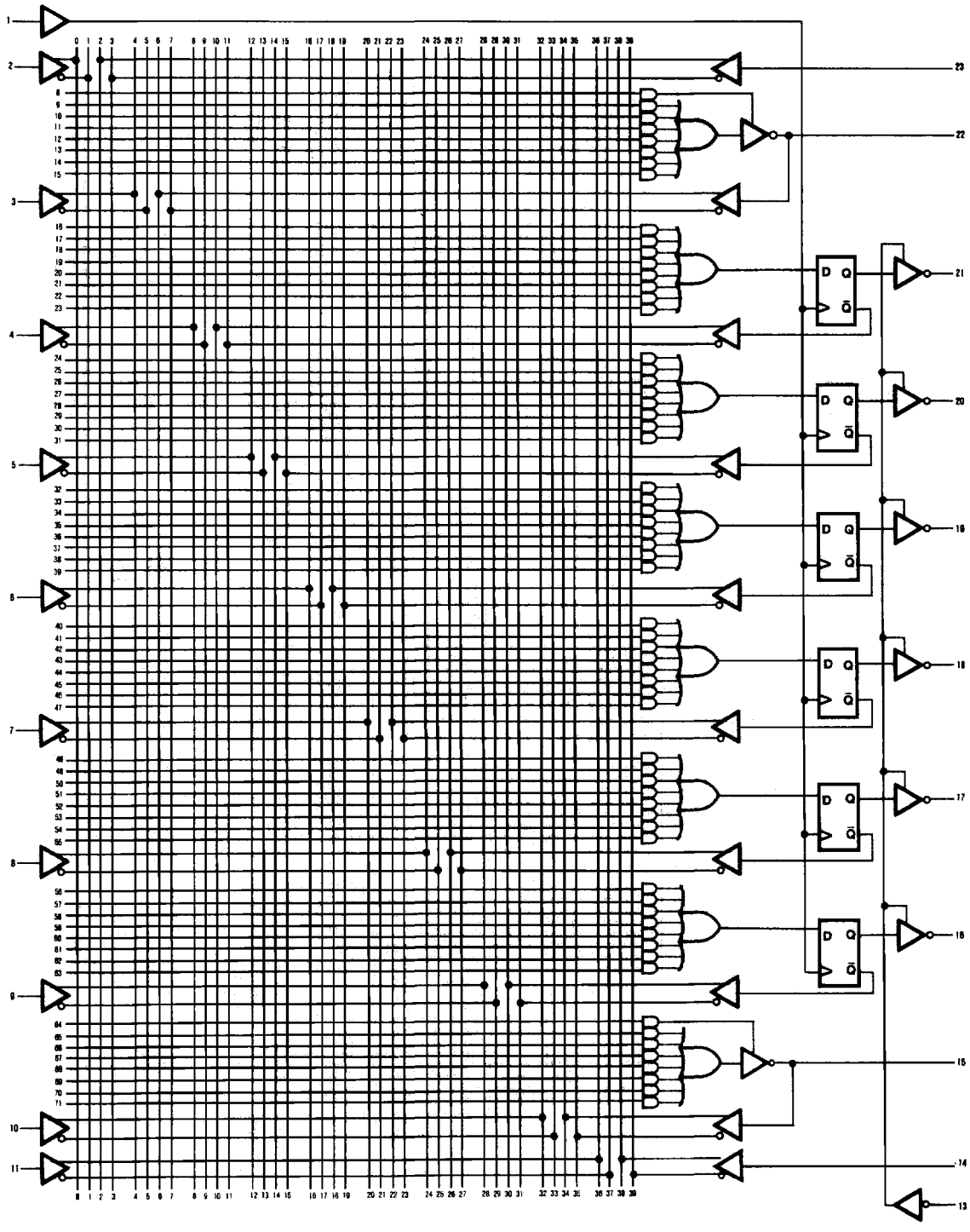

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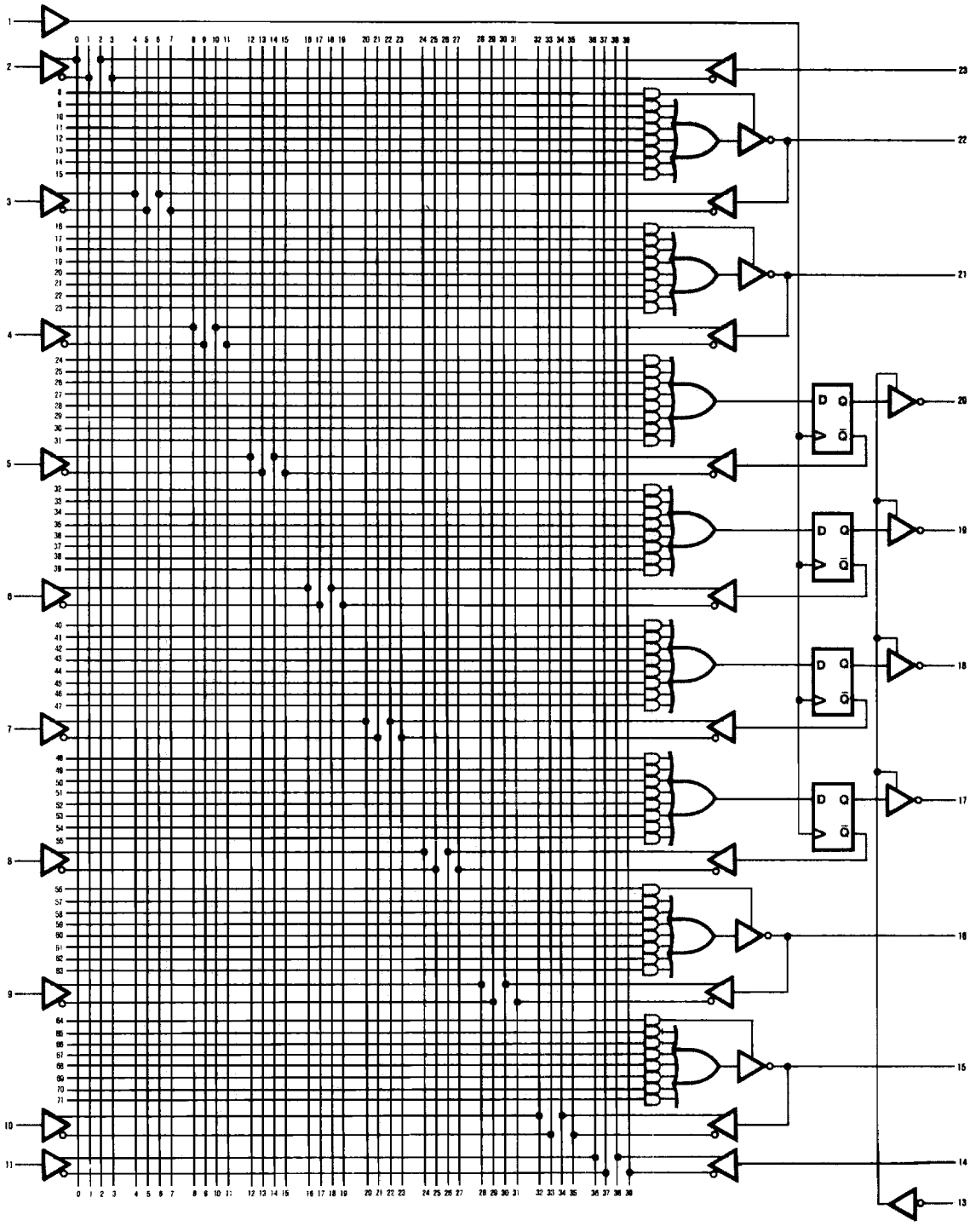

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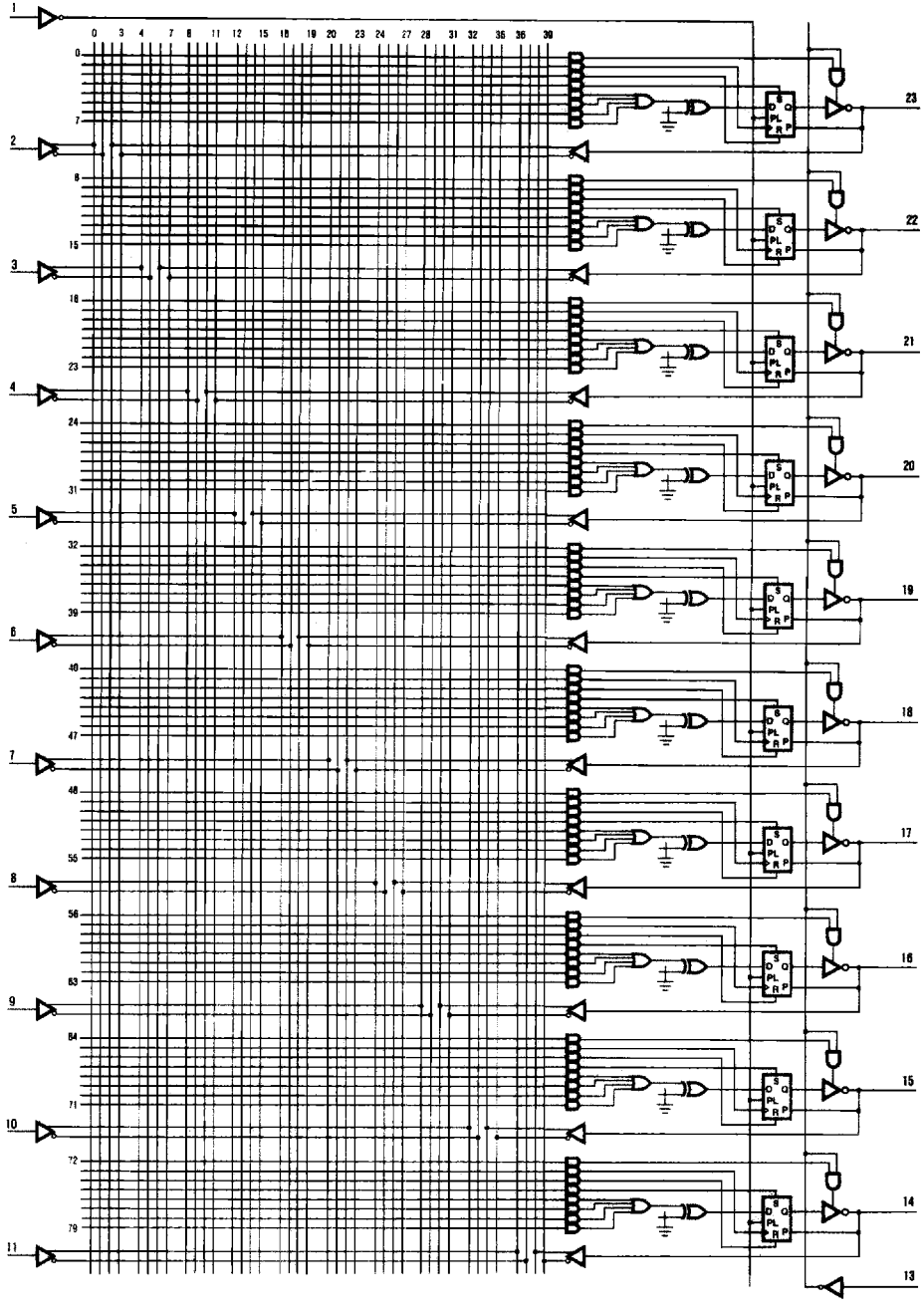

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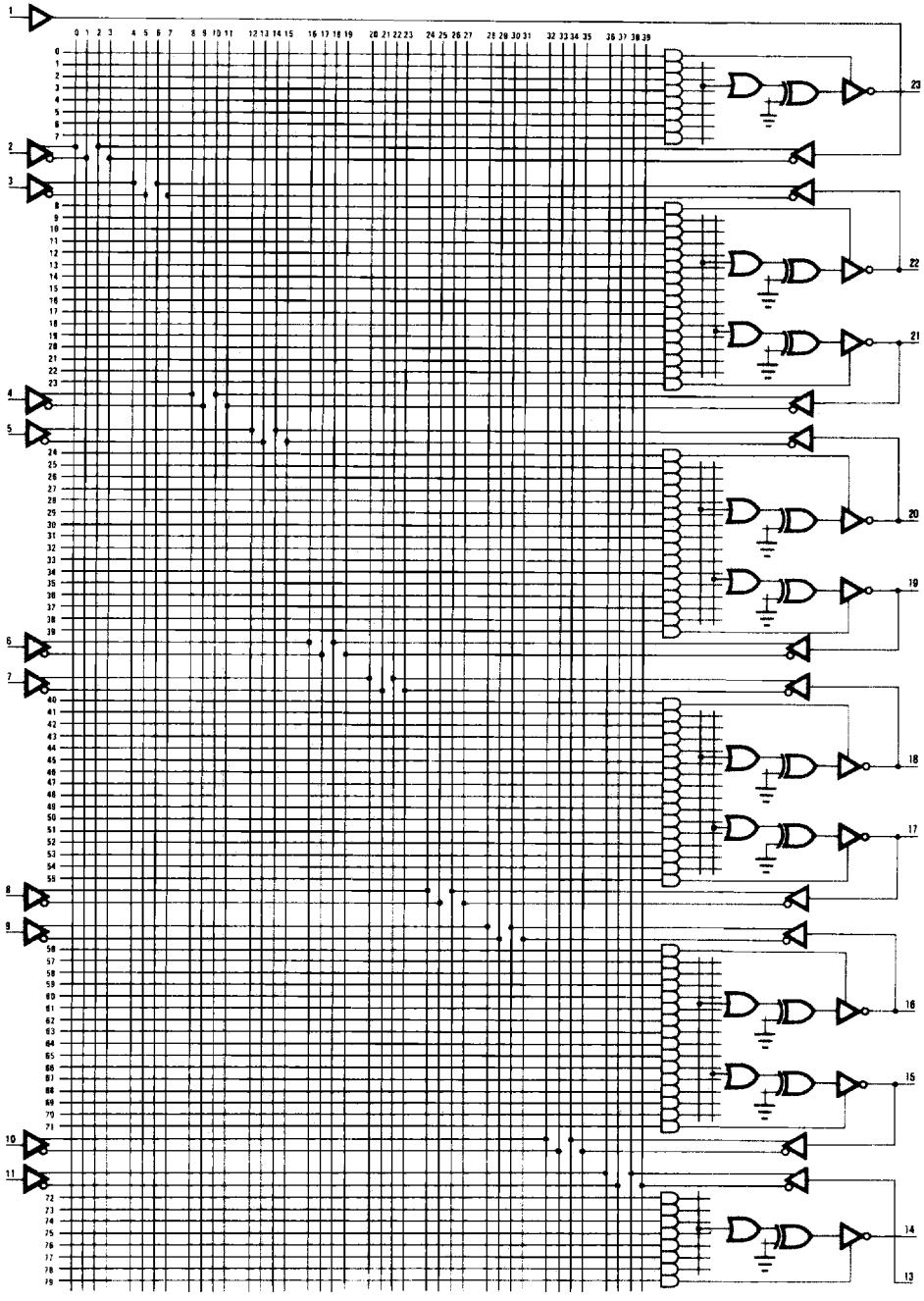

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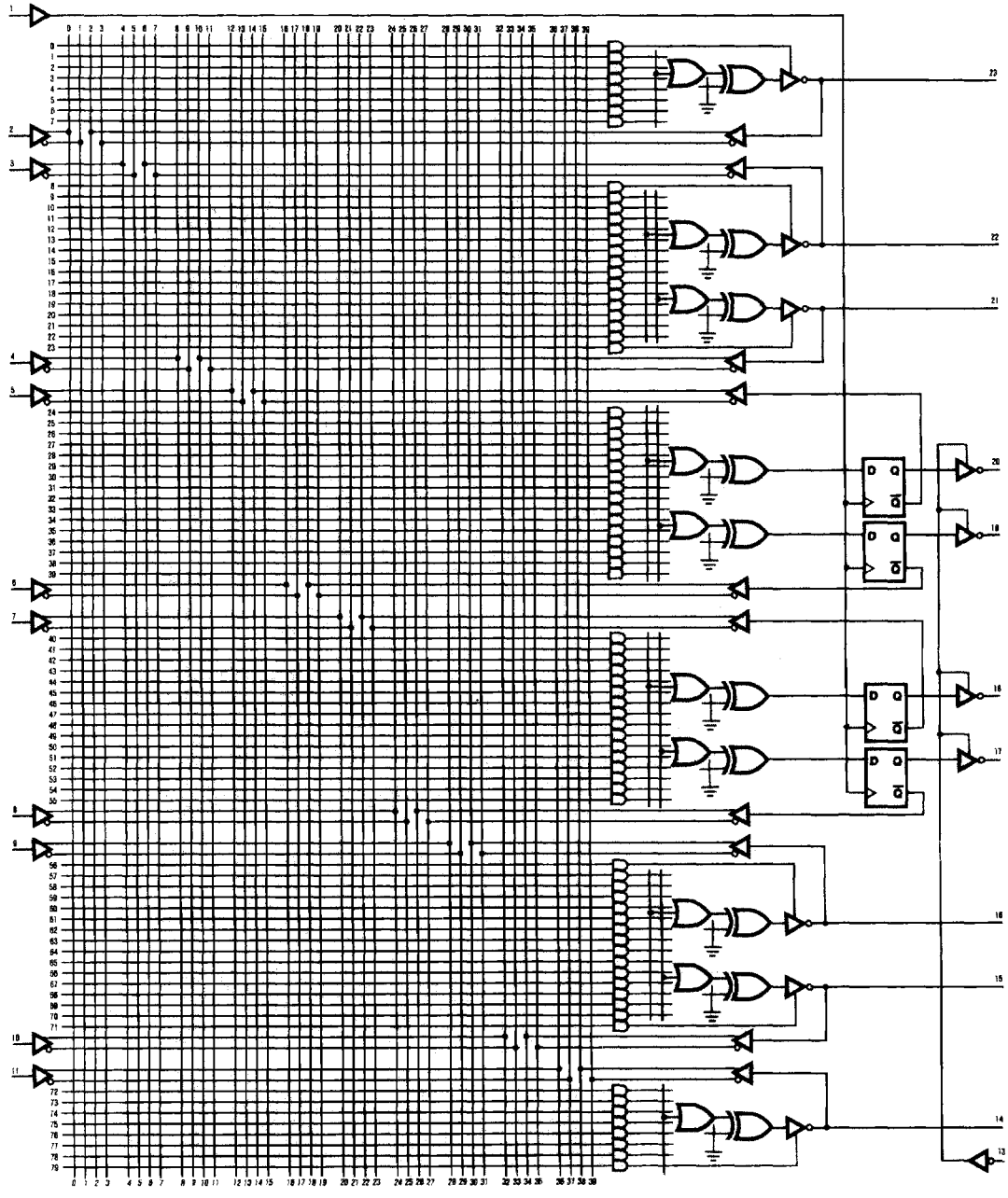

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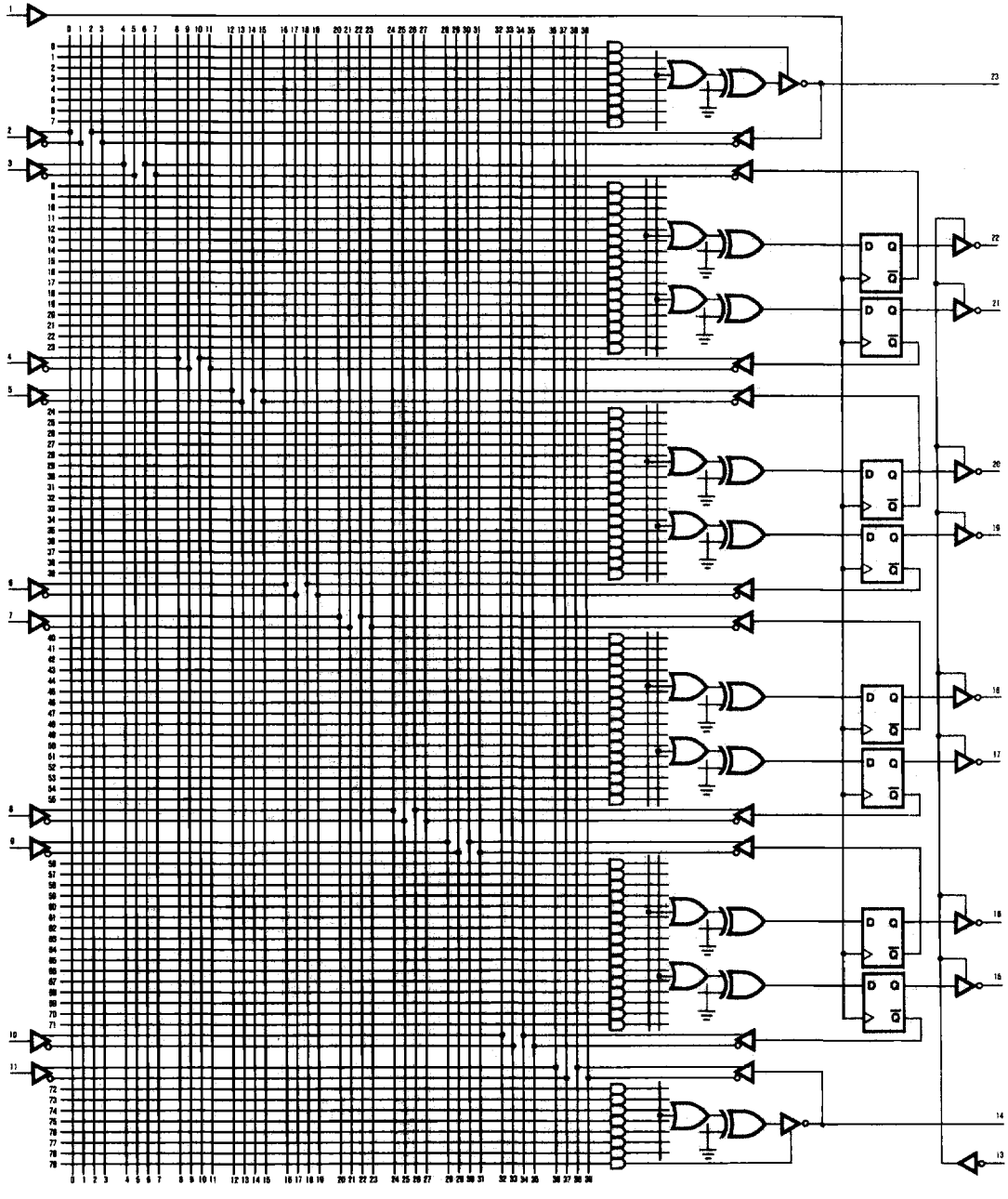

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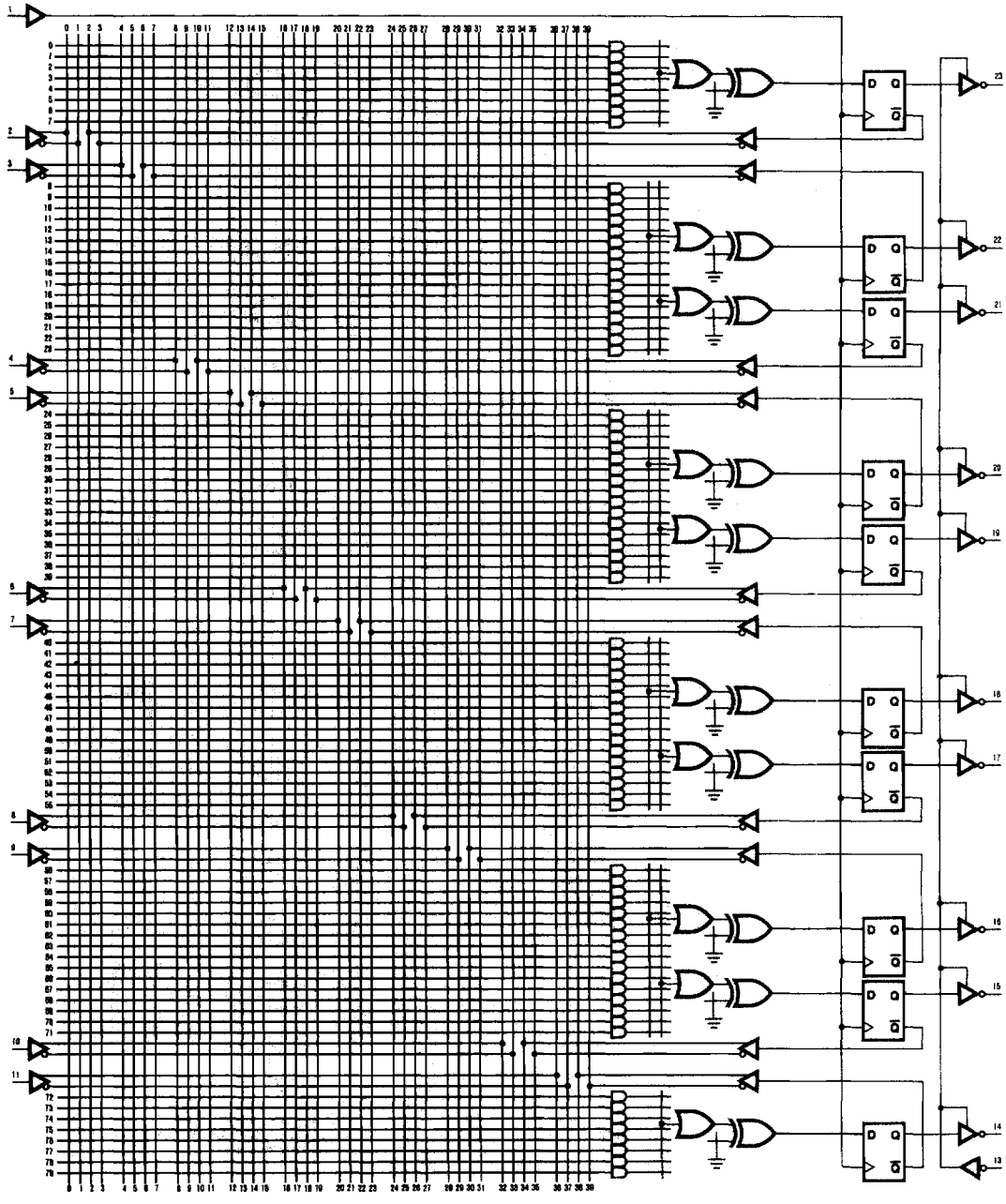
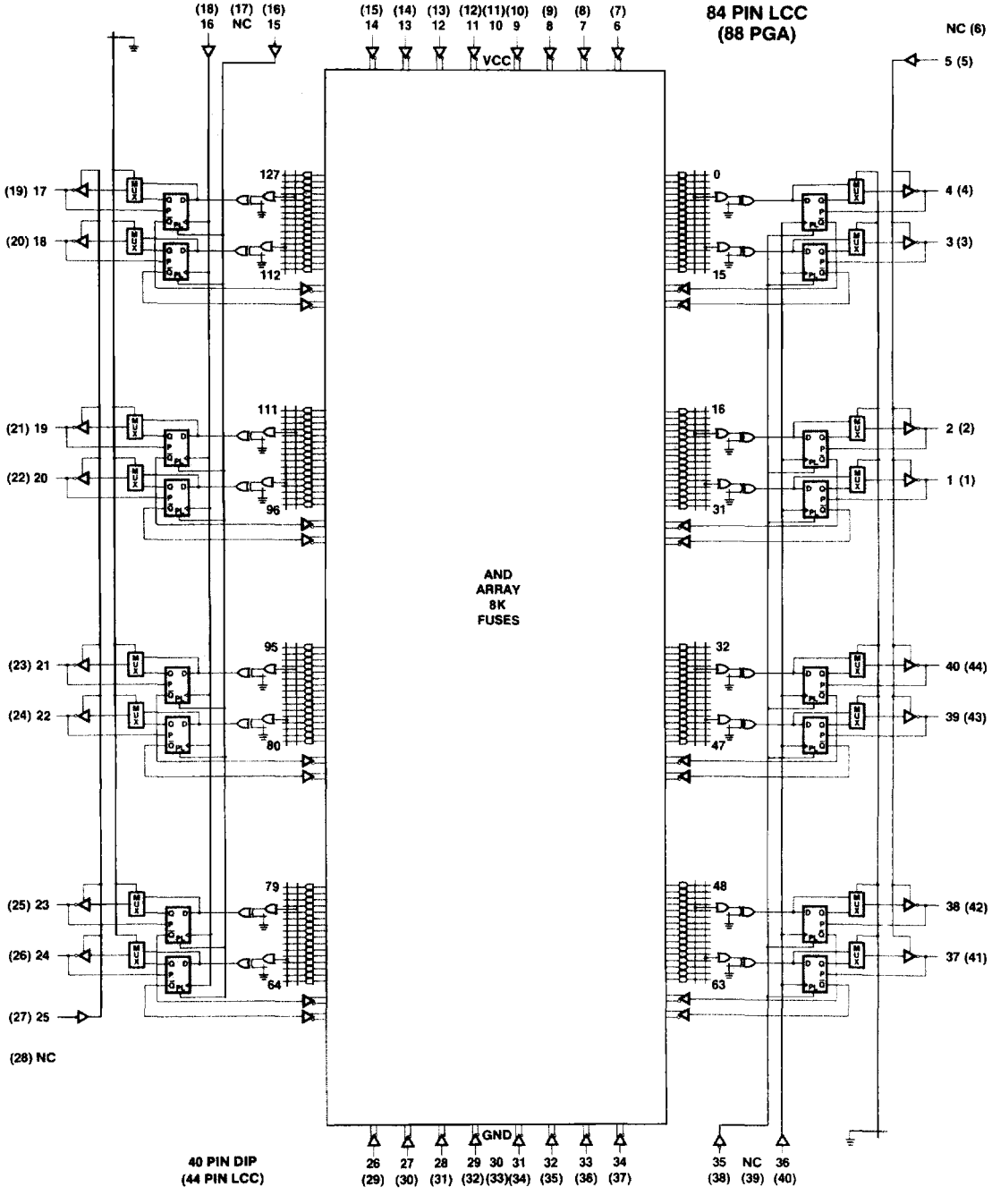


32R16


(18) 16
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(7) 6
VCC
84 PIN LCC
(88 PGA)
NC (6)
5 (5)
(19) 17
(20) 18
(21) 19
(22) 20
(23) 21
(24) 22
(25) 23
(26) 24
(27) 25
(28) NC
127
112
111
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4 (4)
3 (3)
2 (2)
1 (1)
40 (44)
39 (43)
38 (42)
37 (41)
AND
ARRAY
8K
FUSES
GND
40 PIN DIP
(44 PIN LCC)
26 (29)
27 (30)
28 (31)
29 (32)
30 (33)
31 (34)
32 (35)
33 (36)
34 (37)
35 (38)
NC (39)
36 (40)

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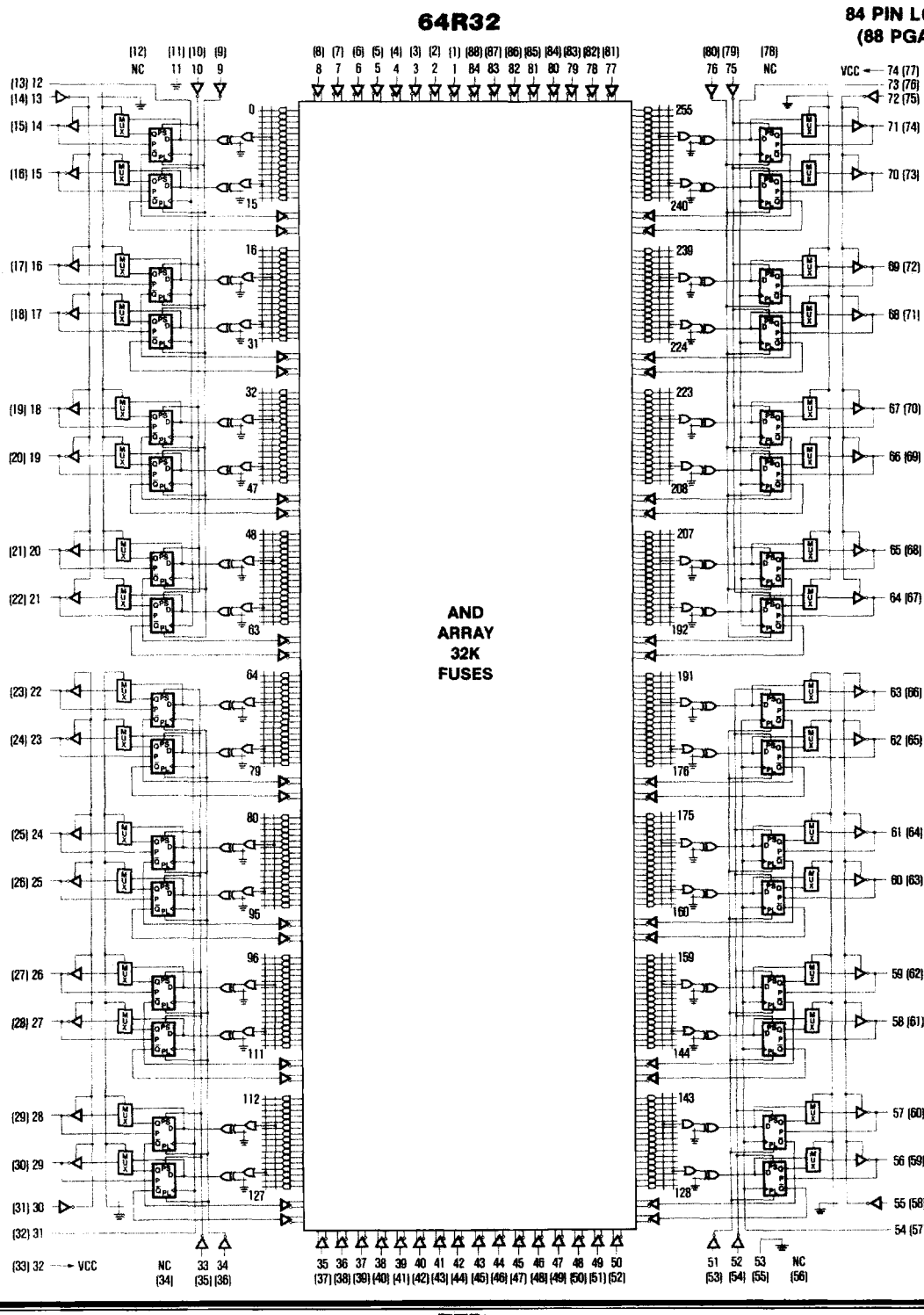
64R32
84 PIN LCC
(88 PGA)
AND
ARRAY
32K
FUSES
VCC
NC

Programmer/Development System

VENDOR	MegaPAL	PAL20RA10	PAL24RS	PAL20	PAL24	PAL24A
Data I/O	-Logic PAK (32R16 only)	-Logic PAK	-Logic PAK	-Logic PAK	-Logic PAK	-Logic PAK
Kontron	—	—	—	-EEP 80* PAL Adapter	-EEP 80 PAL Adapter	-EEP 80 PAL Adapter
Structured Design	—	—	—	-SD 1000	-SD 1000	-SD 1000
Stag	—	—	—	-ZL30	-ZL30	-ZL30
Varix	Omni Programmer	—	—	-Omni* Programmer	-Omni Programmer	-Omni Programmer
Valley Data Sciences	—	—	—	-Model 160	-Model 160	-Model 160
Storey Systems	—	—	—	-P240*	-P240	-P240
Digelec	—	—	—	-UP803*	-UP803	-UP803

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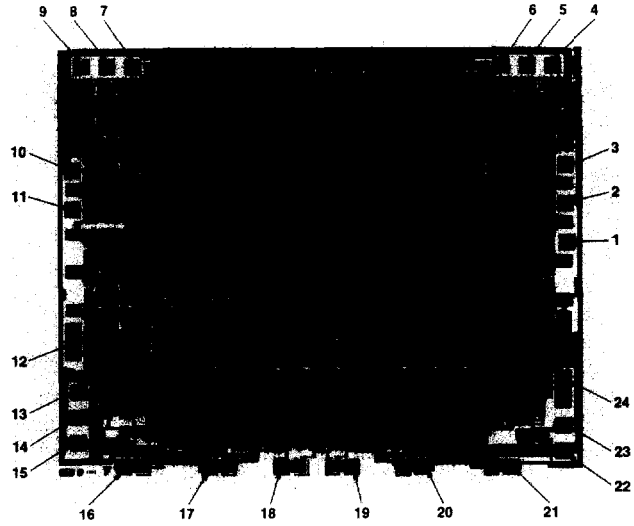
* Except 16P8A, 16RP8A, 16RP6A, 16RP4A

The above chart represents those units which, at the time of printing, have been submitted to Monolithic Memories for evaluation and have demonstrated the capability to satisfactorily program the indicated devices.

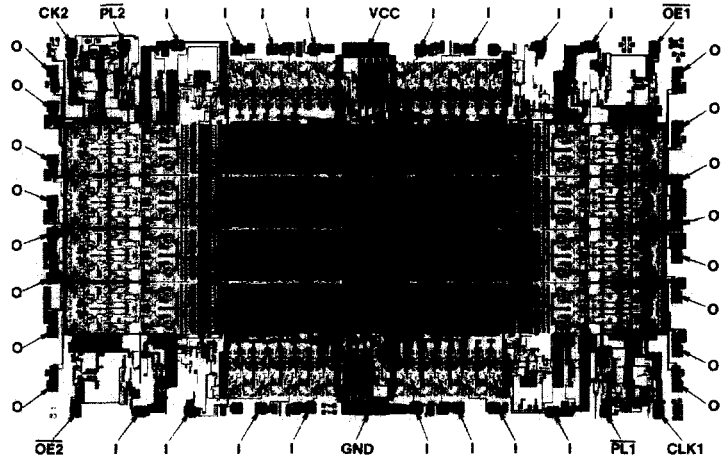
Die Configuration

PAL20RA10



Die Configurations

PAL32R16



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