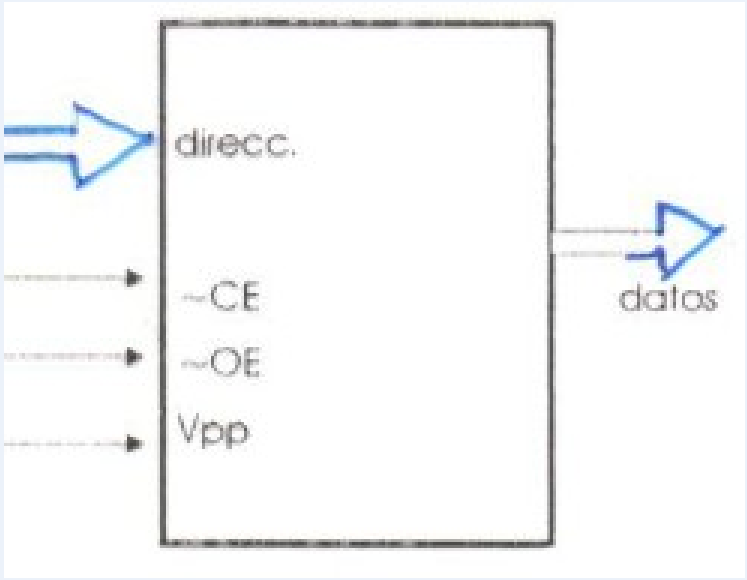
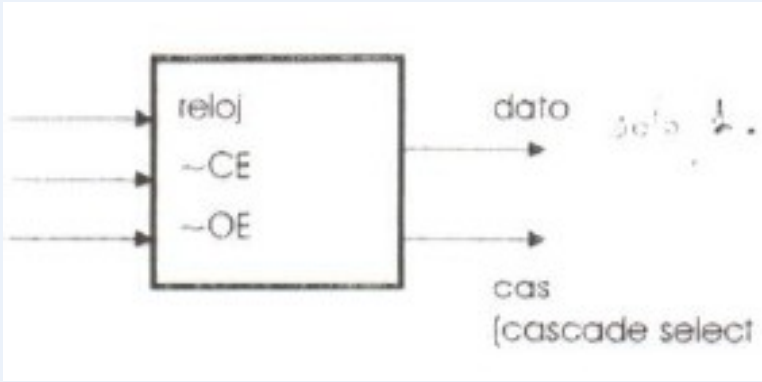
EQUIPOS MICROPROGRAMABLES

20. DISPOSITIVOS PROGRAMABLES

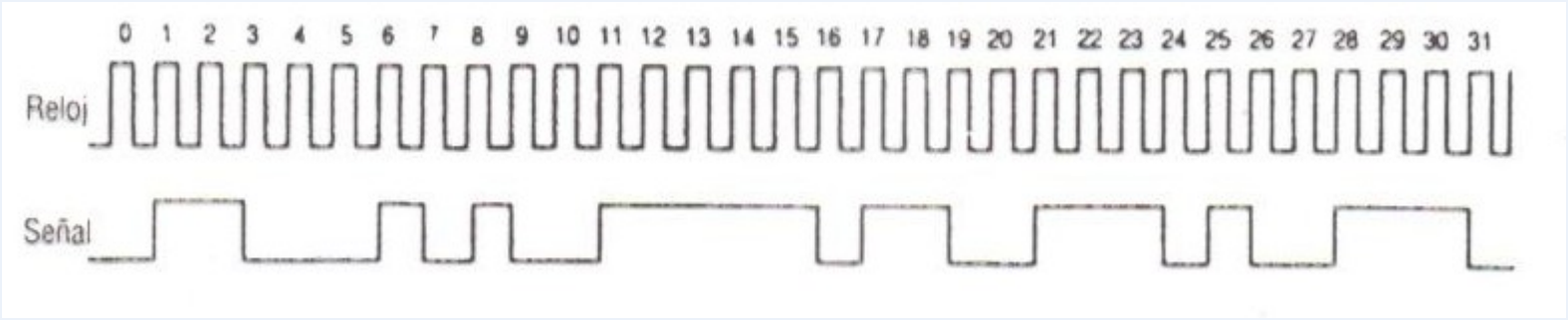
EPROM, E2PROM, UVPROM

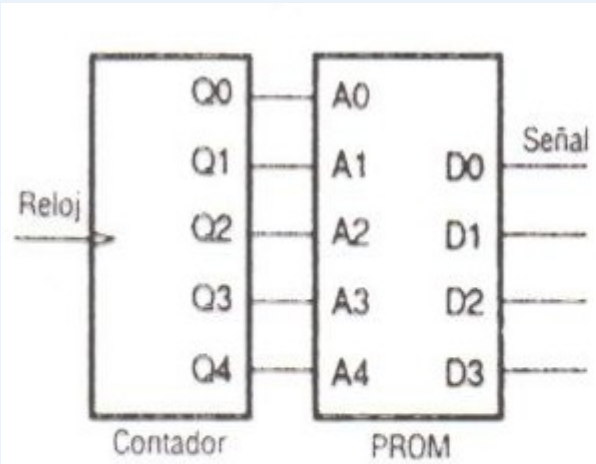
- Primer dispositivo programable.
- Se utilizan como tablas de valores preasignados (LUT= look-up tables) para implementar funciones lógicas, tablas de conversión, operaciones aritméticas, generación de señales, etc. Ej: un circuito que genere $4*\log_7 n$





EJEMPLOS DE USO DE EPROM



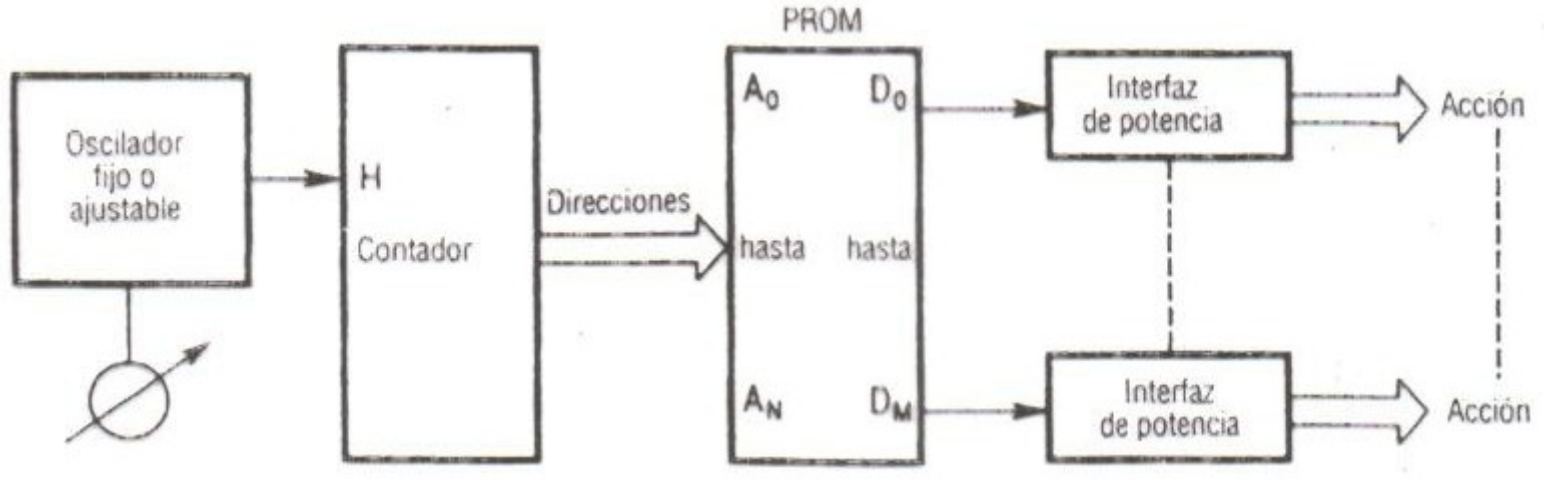


Dirección	A_4	A_3	A_1	A_2	A_0	D_0
0	0	0	0	0	0	0
1	0	0	0	0	1	1
2	0	0	1	0	0	1
3	0	0	1	0	1	0
4	0	0	0	1	0	0
5	0	0	0	1	1	0
6	0	0	1	1	0	1
7	0	0	1	1	1	0
8	0	1	0	0	0	1
9	0	1	0	0	1	0
10	0	1	1	0	0	0
11	0	1	1	0	1	1
12	0	1	0	1	0	1
13	0	1	0	1	1	1
14	0	1	1	1	0	1
15	0	1	1	1	1	1

Dirección	A_4	A_3	A_1	A_2	A_0	D_0
16	1	0	0	0	0	0
17	1	0	0	0	1	1
18	1	0	1	0	0	1
19	1	0	1	0	1	0
20	1	0	0	1	0	0
21	1	0	0	1	1	1
22	1	0	1	1	0	1
23	1	0	1	1	1	1
24	1	1	0	0	0	0
25	1	1	0	0	1	1
26	1	1	1	0	0	0
27	1	1	1	0	1	0
28	1	1	0	1	0	1
29	1	1	0	1	1	1
30	1	1	1	1	0	1
31	1	1	1	1	1	0

EJEMPLOS DE USO DE EPROM

- Autómata programable mediante PROM.



FICHERO DE PROGRAMACIÓN

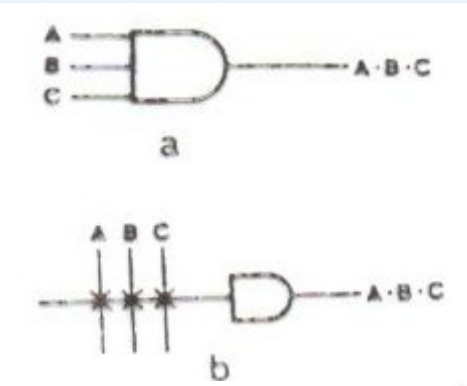
```
:020000020000FC
:1C000000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF00
:1C001C00FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE4
:1C003800FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFC8
:1C005400FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFAC
:1C007000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF90
:1C008C00FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF74
:1C00A800FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF58
:1C00C400FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF3C
:1C00E000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF20
:1C00FC00FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF04
:1C011800FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE7
:1C013400FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFCB
:1C015000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFAF
:1C016C00FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF93
:1C018800FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF77
:1C01A400FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF5B
:1C01C000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF3F
:1C01DC00FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF23
:1C01F800FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF07
:1C021400FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFEA
:1C023000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFCE
:1C024C00FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFB2
```

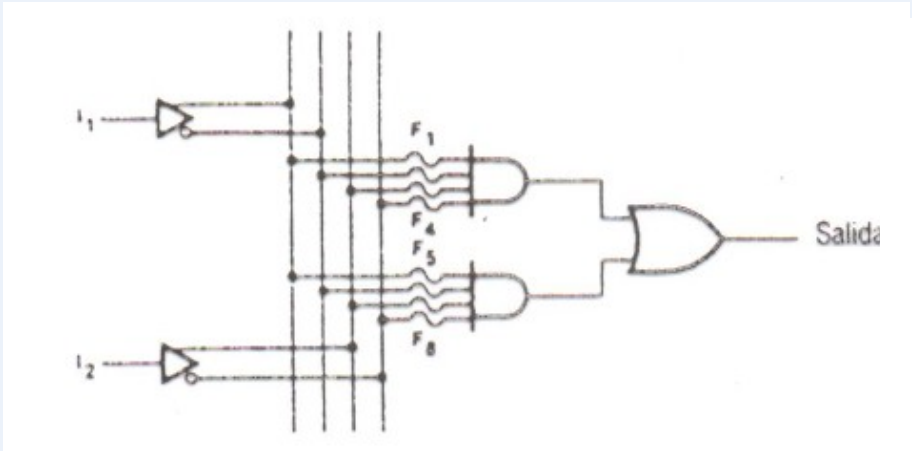
OTROS CIRCUITOS PROGRAMABLES

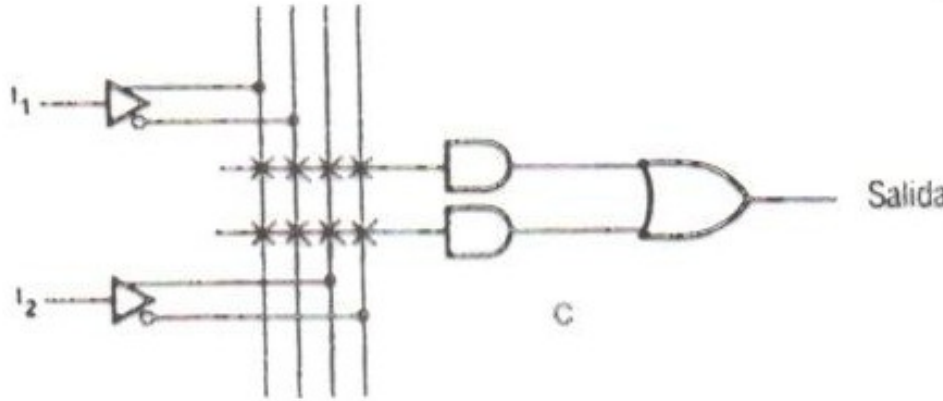
ASIC:	application-specific integrated circuit.
ASPL:	application-specific programmable logic
E2PROM:	sinónimo de EEPROM.
EEPROM:	electrically erasable programmable read-only memory.
EPLD:	electrically programmable logic device.
EPROM:	erasable programmable read-only memory.
FLASH EPROM:	tipo de EEPROM.
FLEX:	flexible logic elemen matrix.
FPGA:	field-programmable gate array.
FPLS:	field-programmable logic sequencer.
GAL:	generic array logic.
LCA:	logic cell array. (xilinx)
MAX:	multiple array matrix.
MPLD:	mask-programmable logic device.
NOVRAM:	non-volatile RAM.
PAL:	programmable array logic.
PIC:	programmable integrated circuit.
PLA:	programmable logic array.
PLD:	programmable logic device.
ROM:	read-only memory.
UVPROM:	Ultra-violet EPROM
PLS:	Programmable logic sequencer

PALs

- Inventada por MMI (actualmente parte de AMD)
- PAL es PAL™
- Las cruces indican fusibles intactos.
- Array de AND (con entradas programables), cuya salida se conectan (programables) a un array OR.

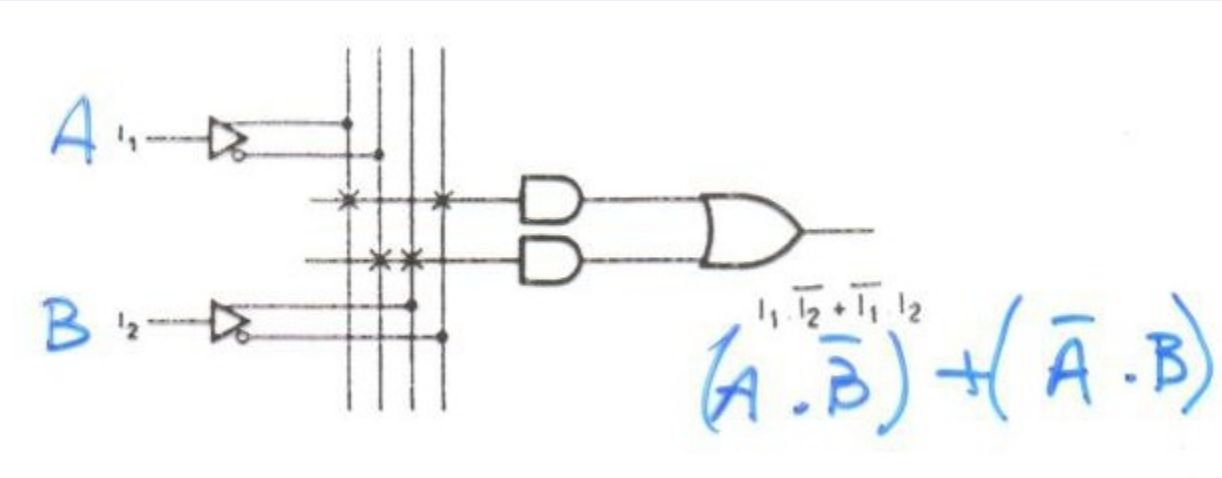




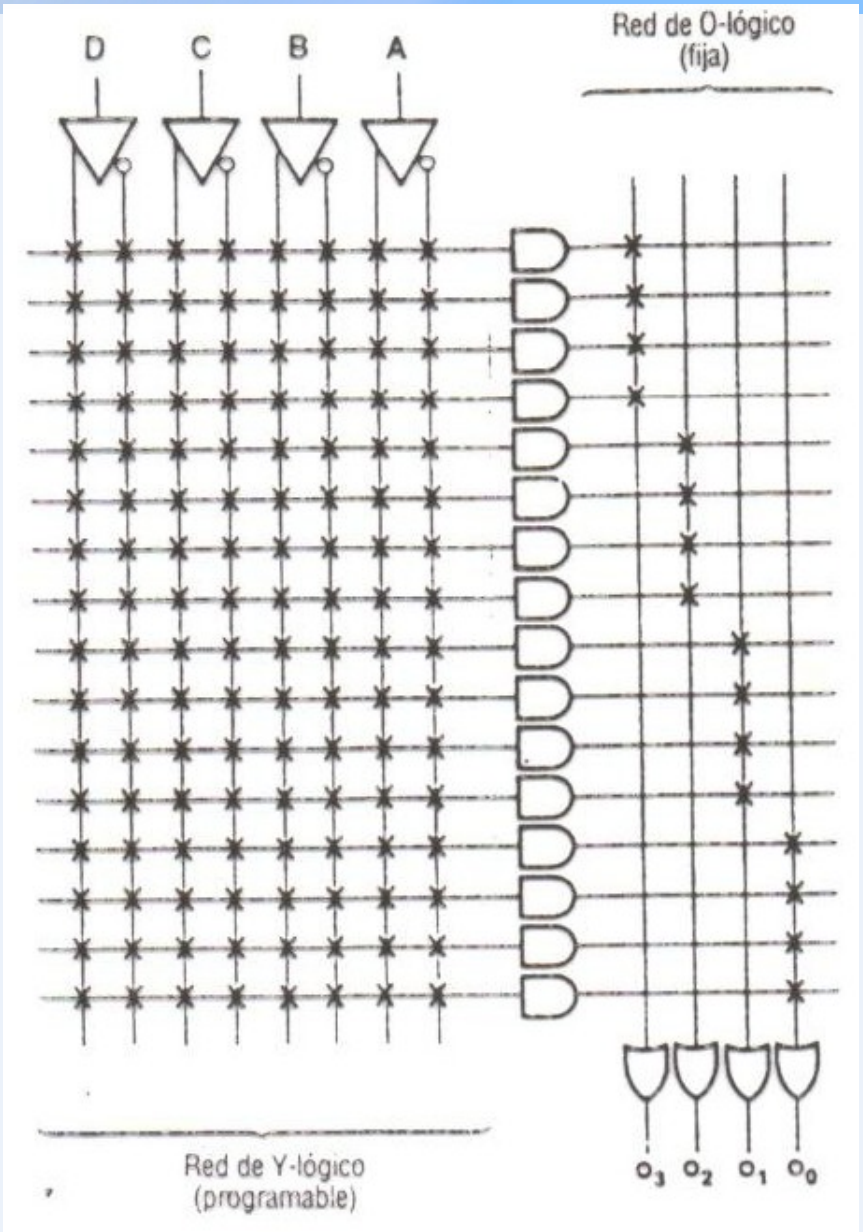


EJEMPLO DE PROGRAMACIÓN

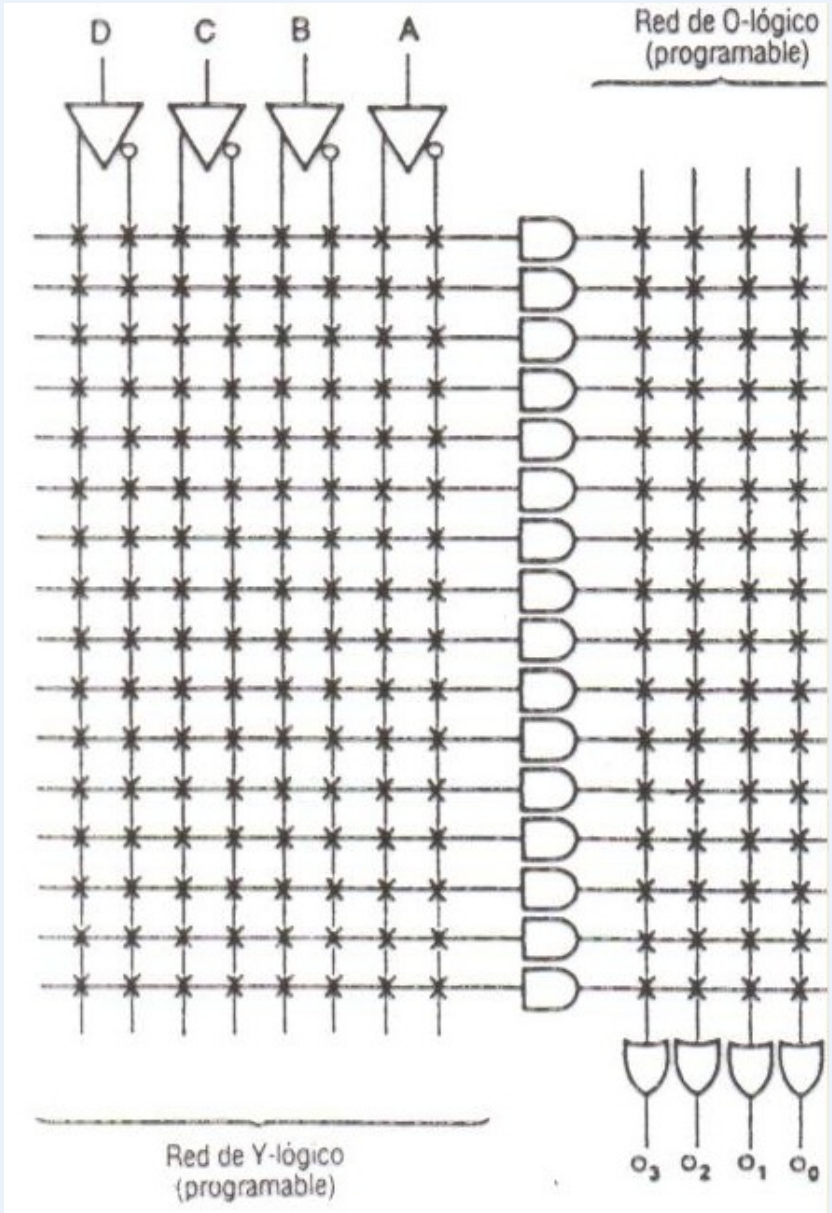
- O-EXCLUSIVA
- La ausencia del símbolo x indica desconexión (sitio donde los fusibles han sido quemados)



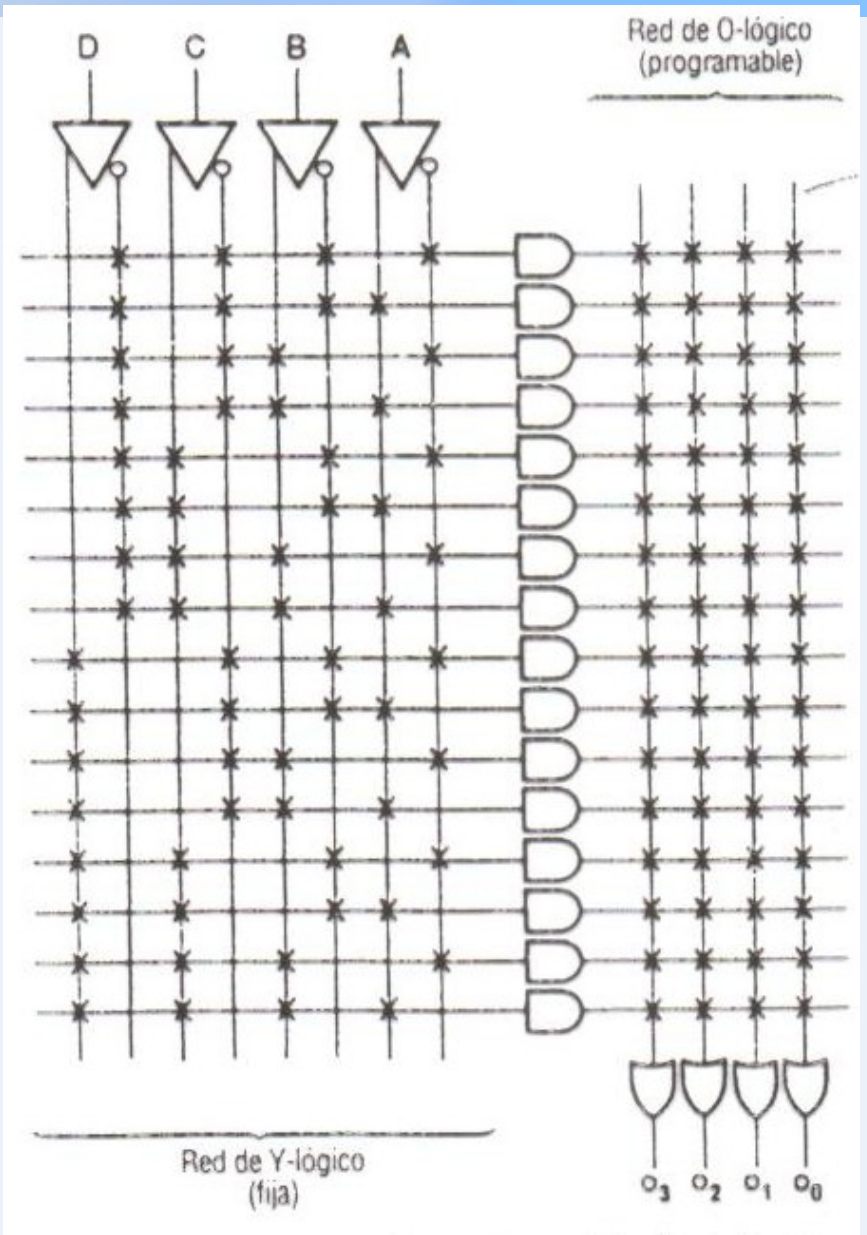
ESTRUCTURA PAL



ESTRUCTURA FPLA



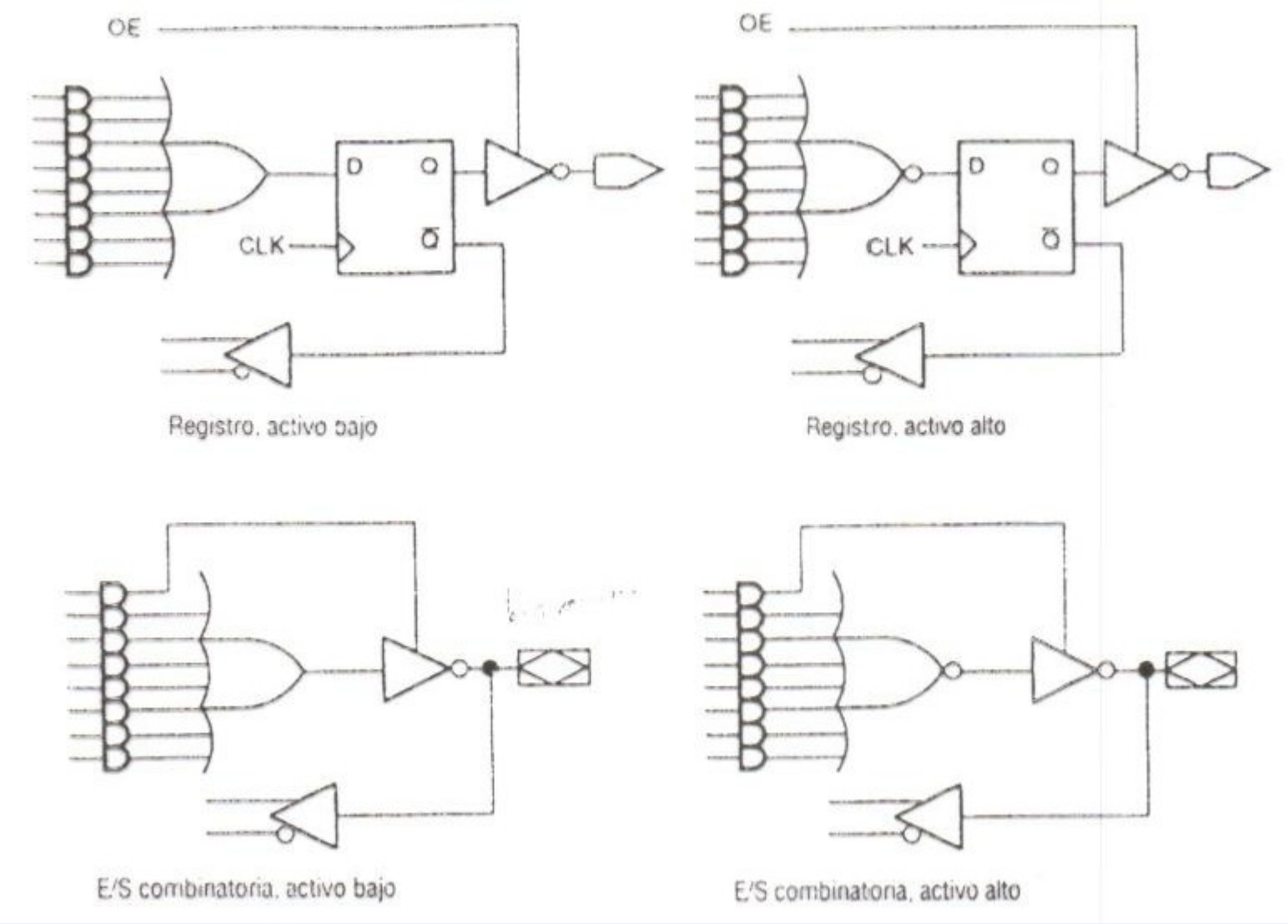
ESTRUCTURA PROM



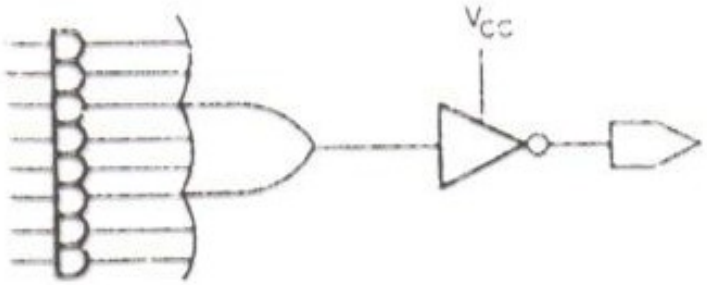
TIPOS DE ENTRADA SALIDA

- Activo alto, activo bajo, realimentadas, registradas, registradas realimentadas, O-exclusiva.
- 16L8: 16 entradas, 8 salidas activo bajo (L).
- 16R8: ídem pero con salida registrada.
- La velocidad se indica con un guion y un número que generalmente indica el retardo entre E/S en nanosegundos. Ej: 20R8-15
- Tecnologías:
  - TTL: veloz y económica
  - ECL: veloz
  - CMOS: pueden ser borradas y reprogramadas (EEPROM o UVPROM)

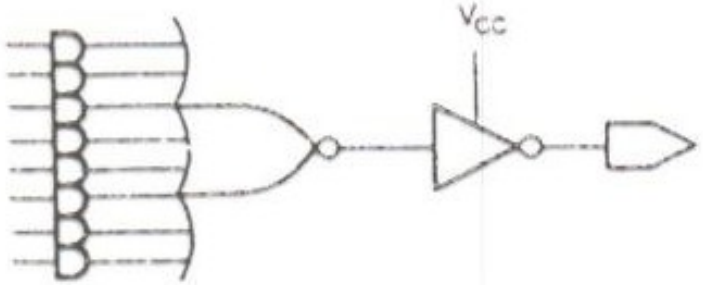
TIPOS DE ENTRADA SALIDA



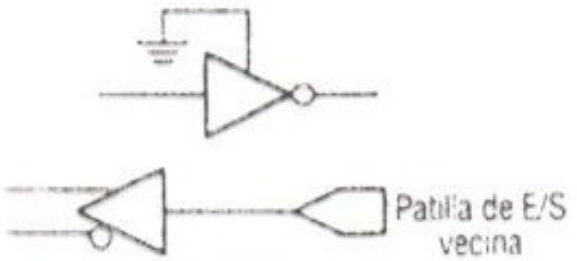
TIPOS DE ENTRADA SALIDA



Salida combinatoria, activo bajo



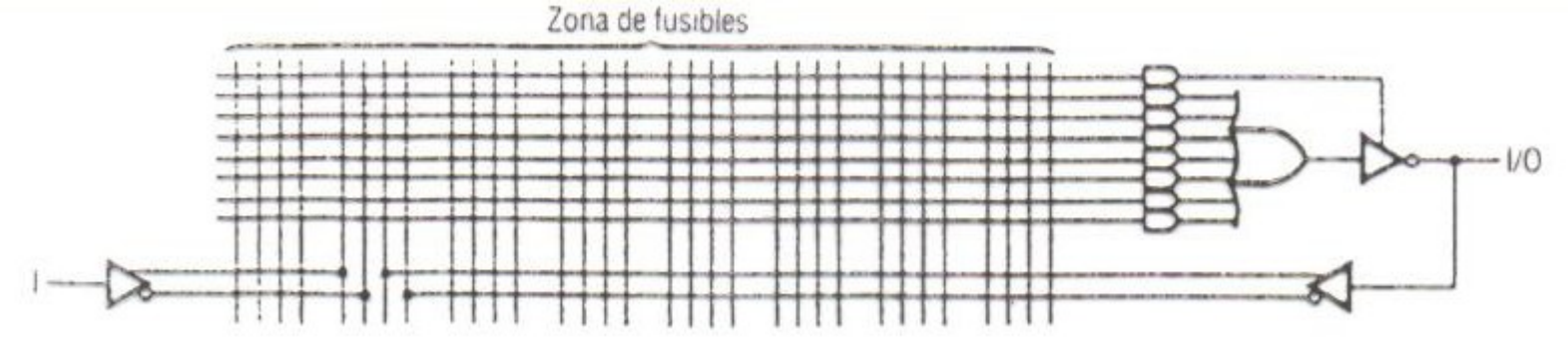
Salida combinatoria, activo alto

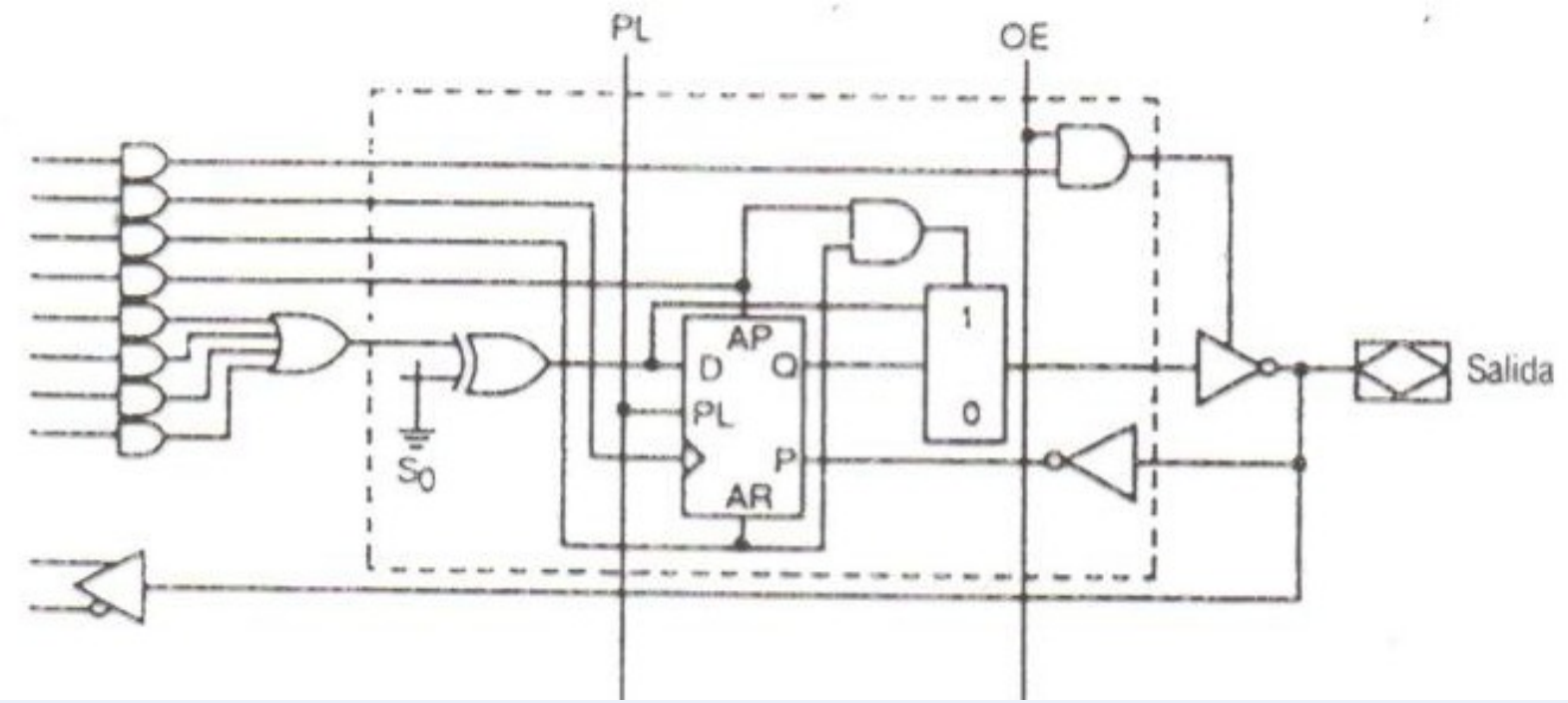


Entrada cedicada

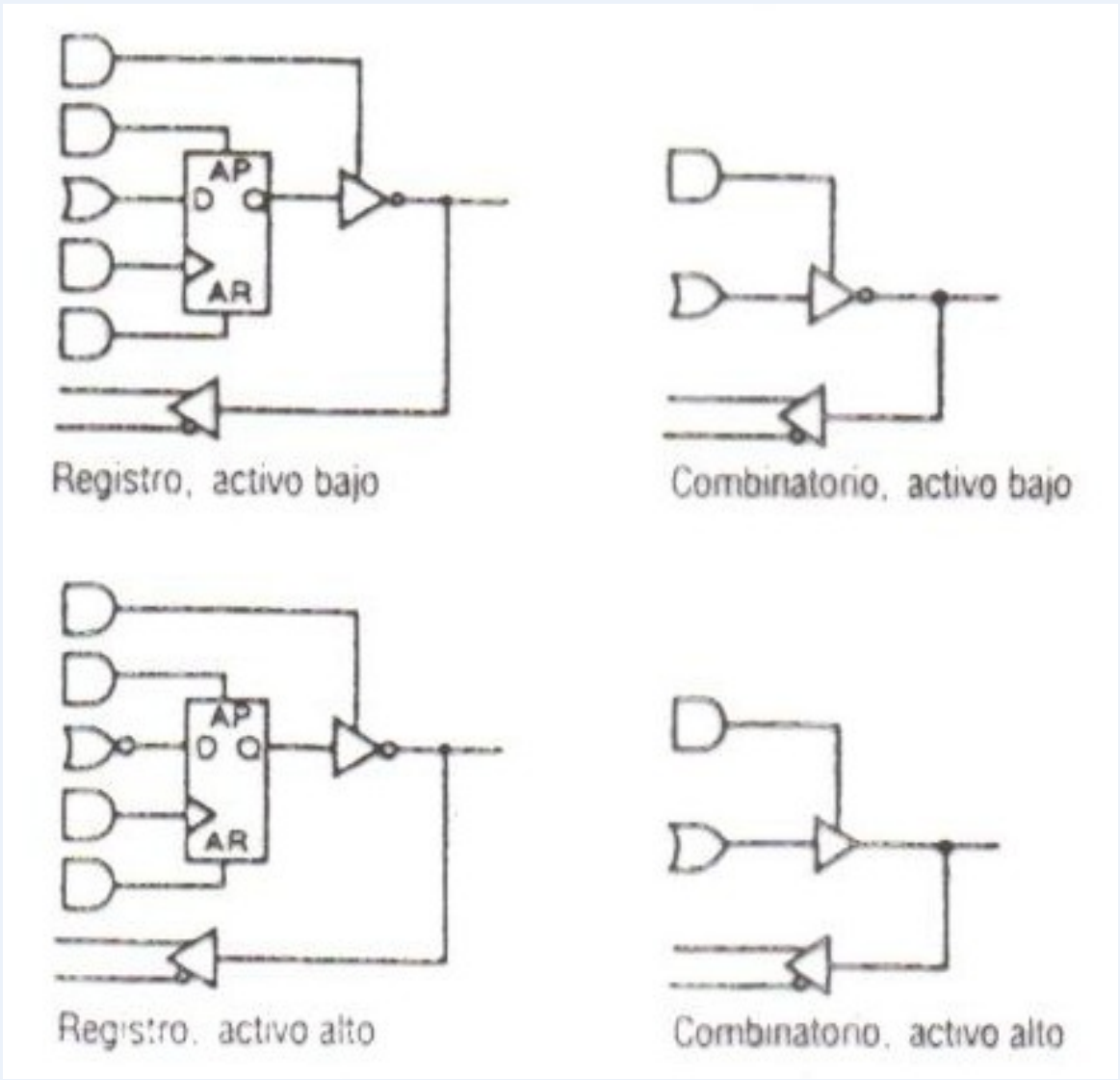
SG0	SG1	SLOx	Tipo de PAL emulada
0	1	0	16R8, 16R6, 16R4
0	1	1	16R6, 16R4
1	0	0	10H8, 12H6, 14H4, 16H2, 10L8, 12L6, 14L4, 16L2
1	0	1	12H6, 14H4, 16H2, 12L6, 14L4, 16L2
1	1	1	16L8

TIPOS DE ENTRADA SALIDA

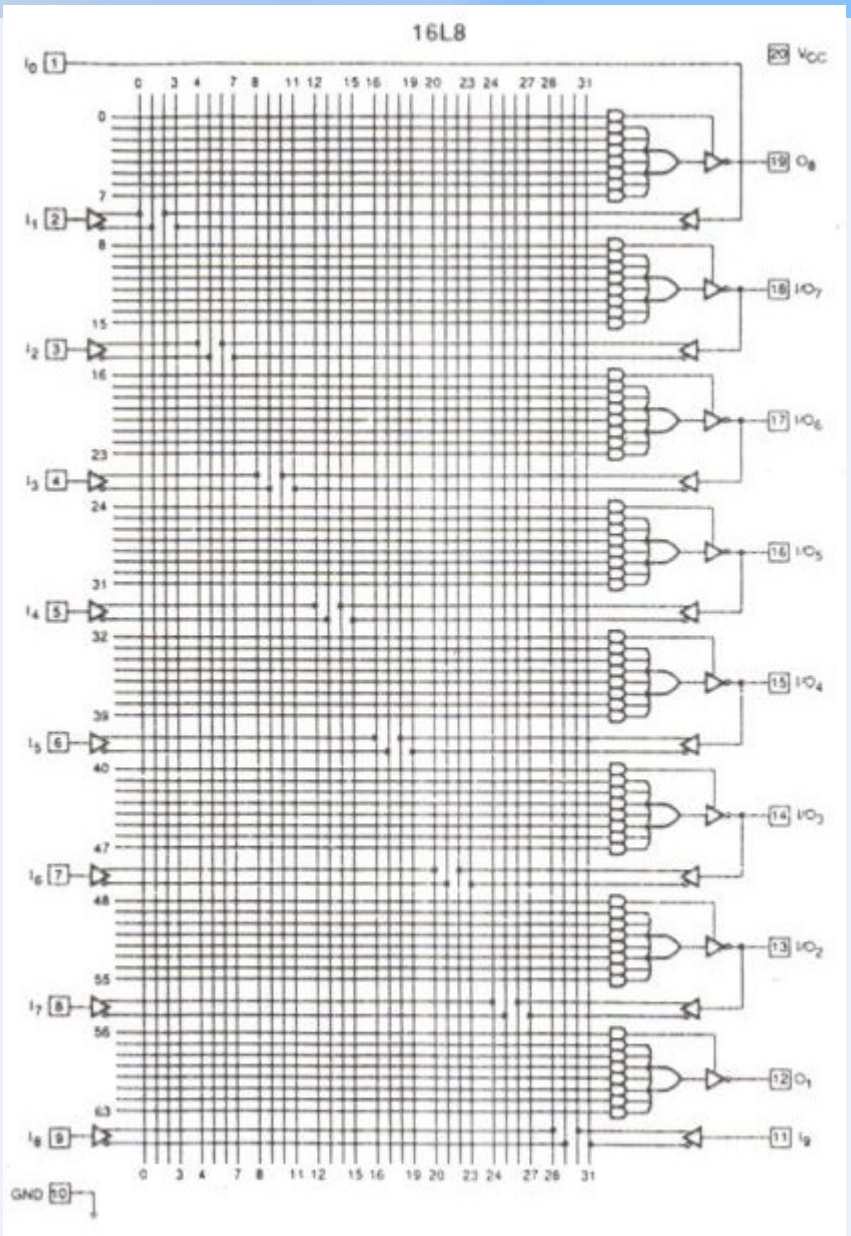


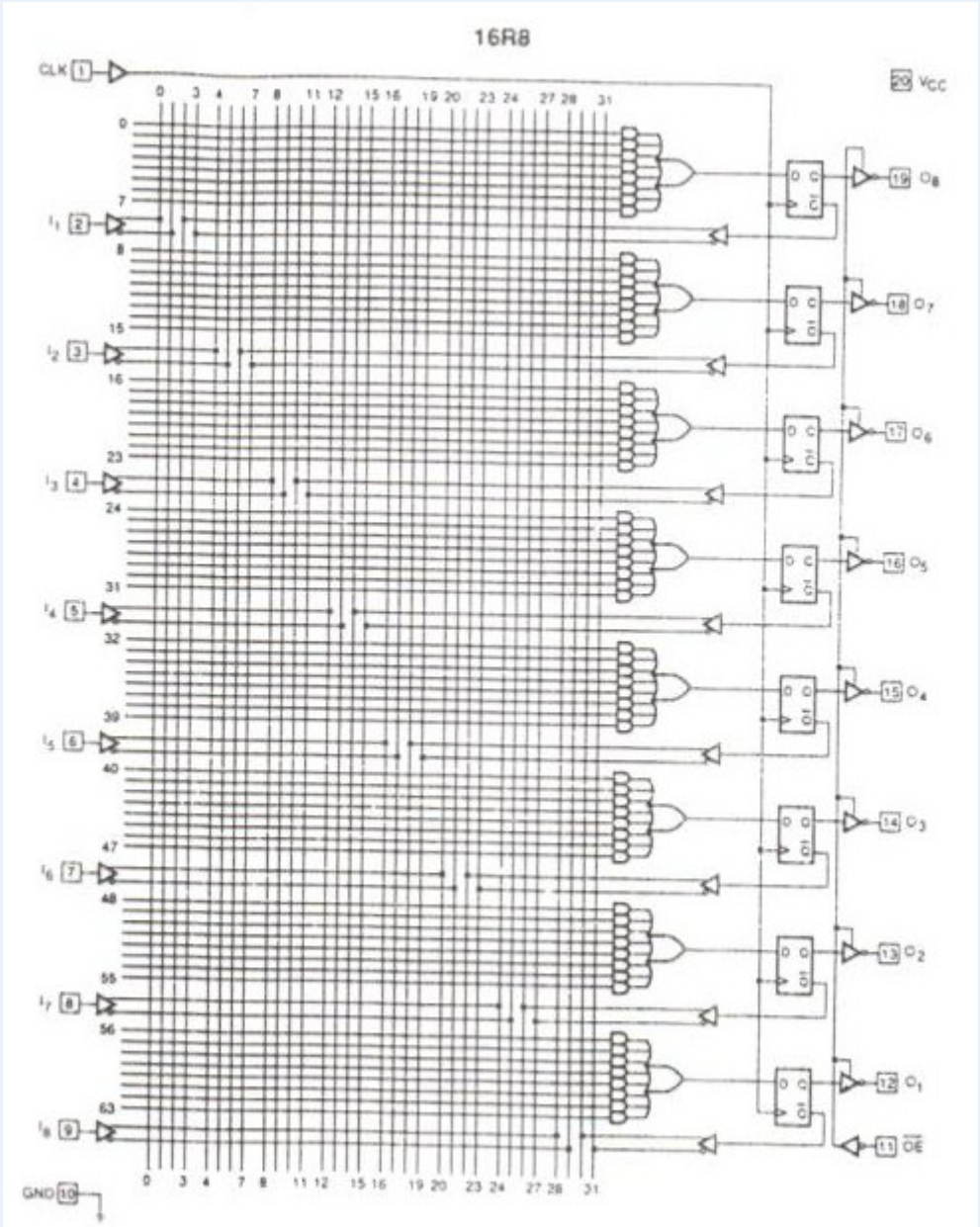


TIPOS DE ENTRADA SALIDA

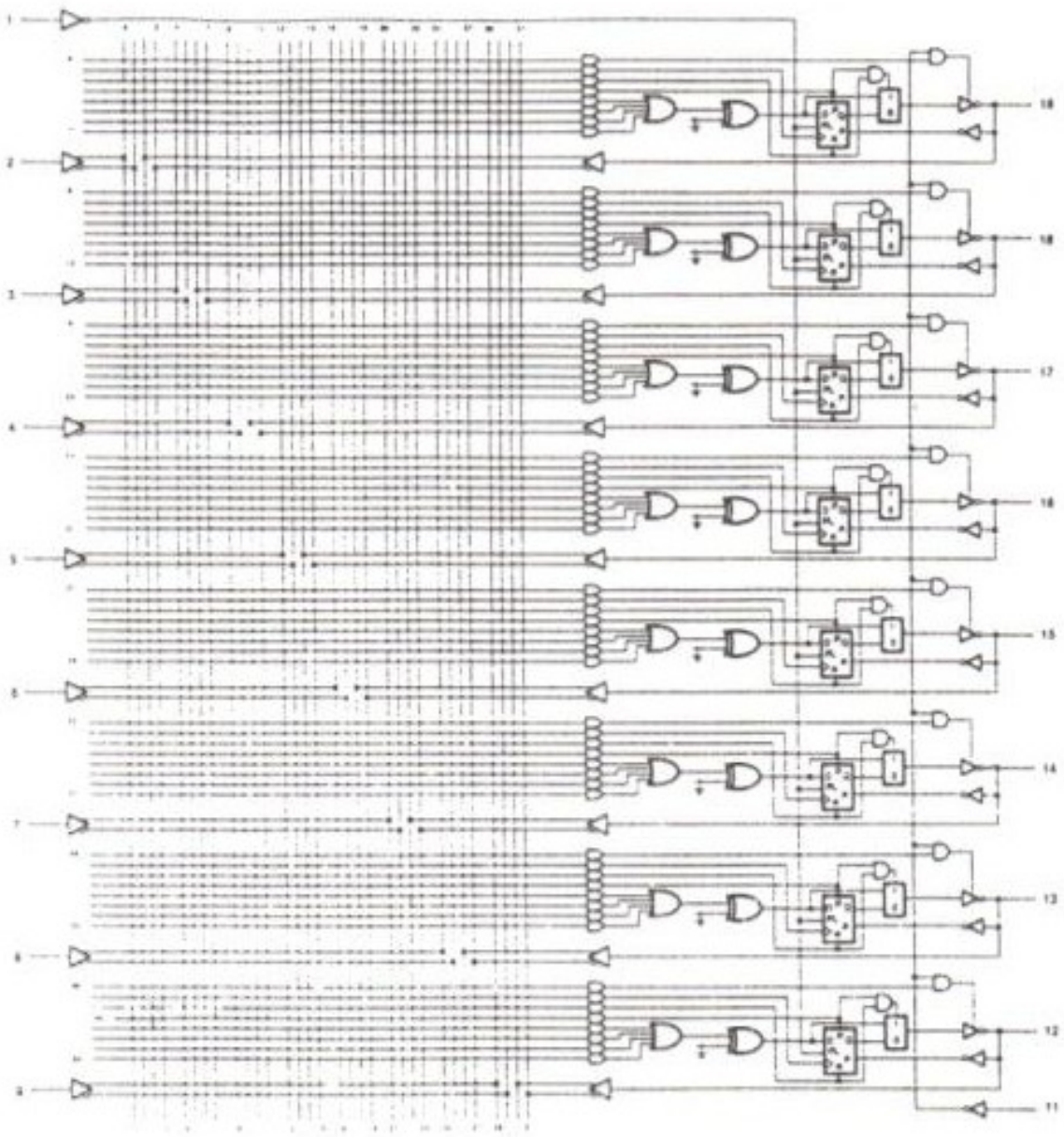


ESTRUCTURA PAL



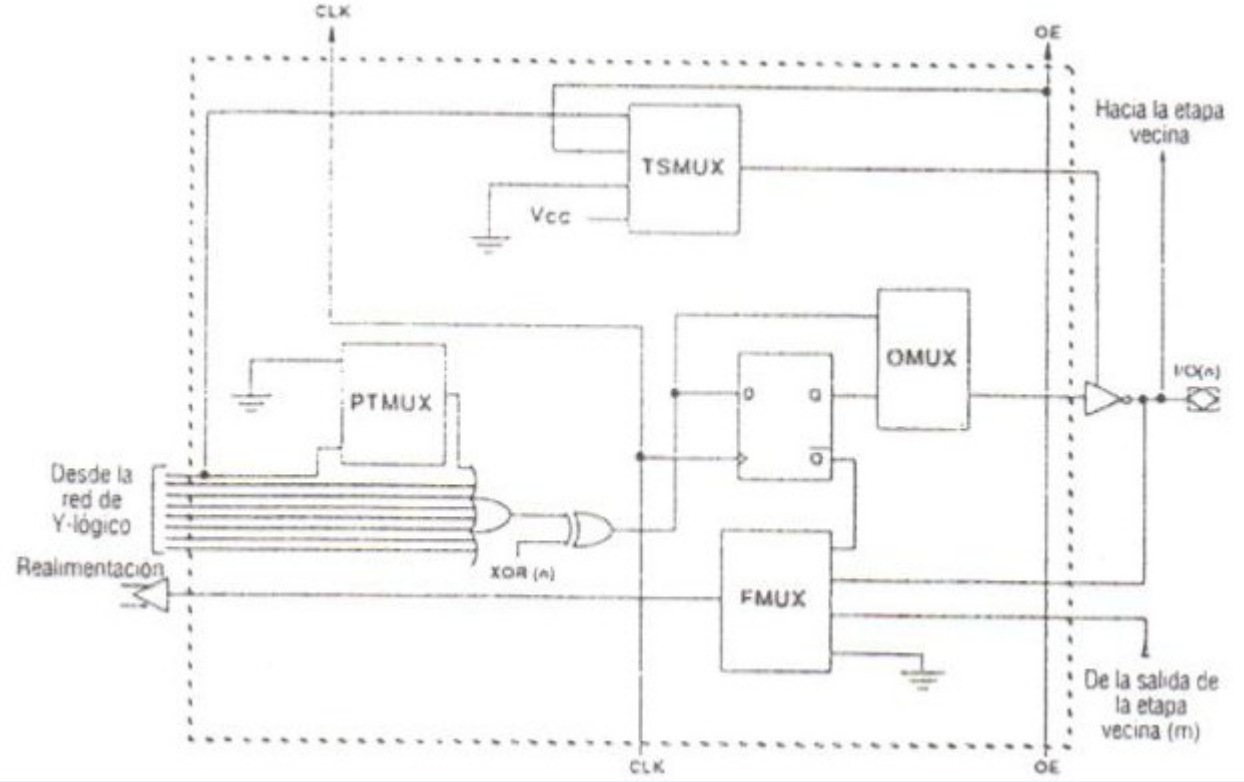

16R8
CLK 1
20 VCC
0 3 4 7 8 11 12 15 16 19 20 23 24 27 28 31
0
7
I1 2
8
15
I2 3
16
23
I3 4
24
31
I4 5
32
39
I5 6
40
47
I6 7
48
55
I7 8
56
63
I9 9
GND 10
19 O8
18 O7
17 O6
16 O5
15 O4
14 O3
13 O2
12 O1
11 OE

PAL16RA8

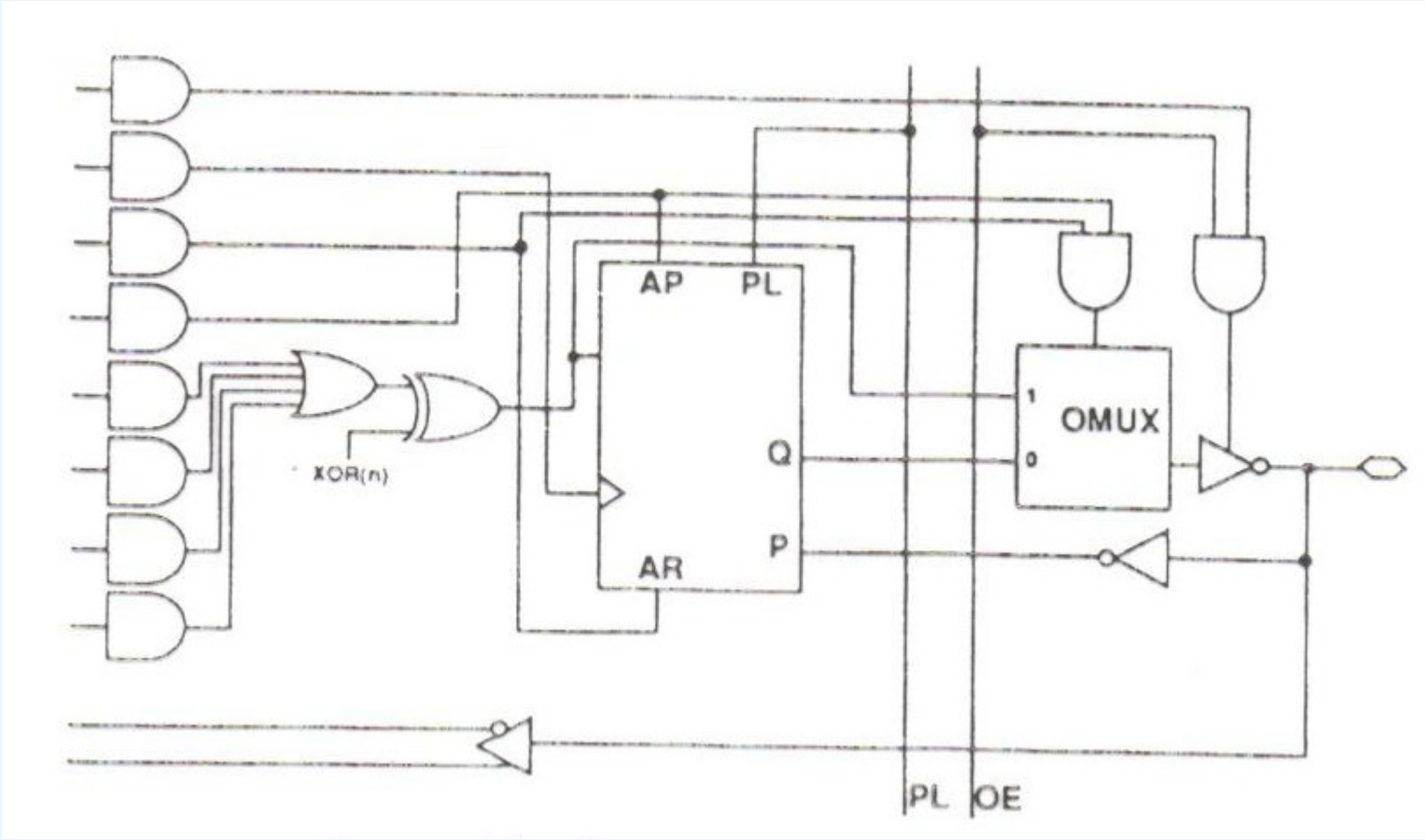


GAL

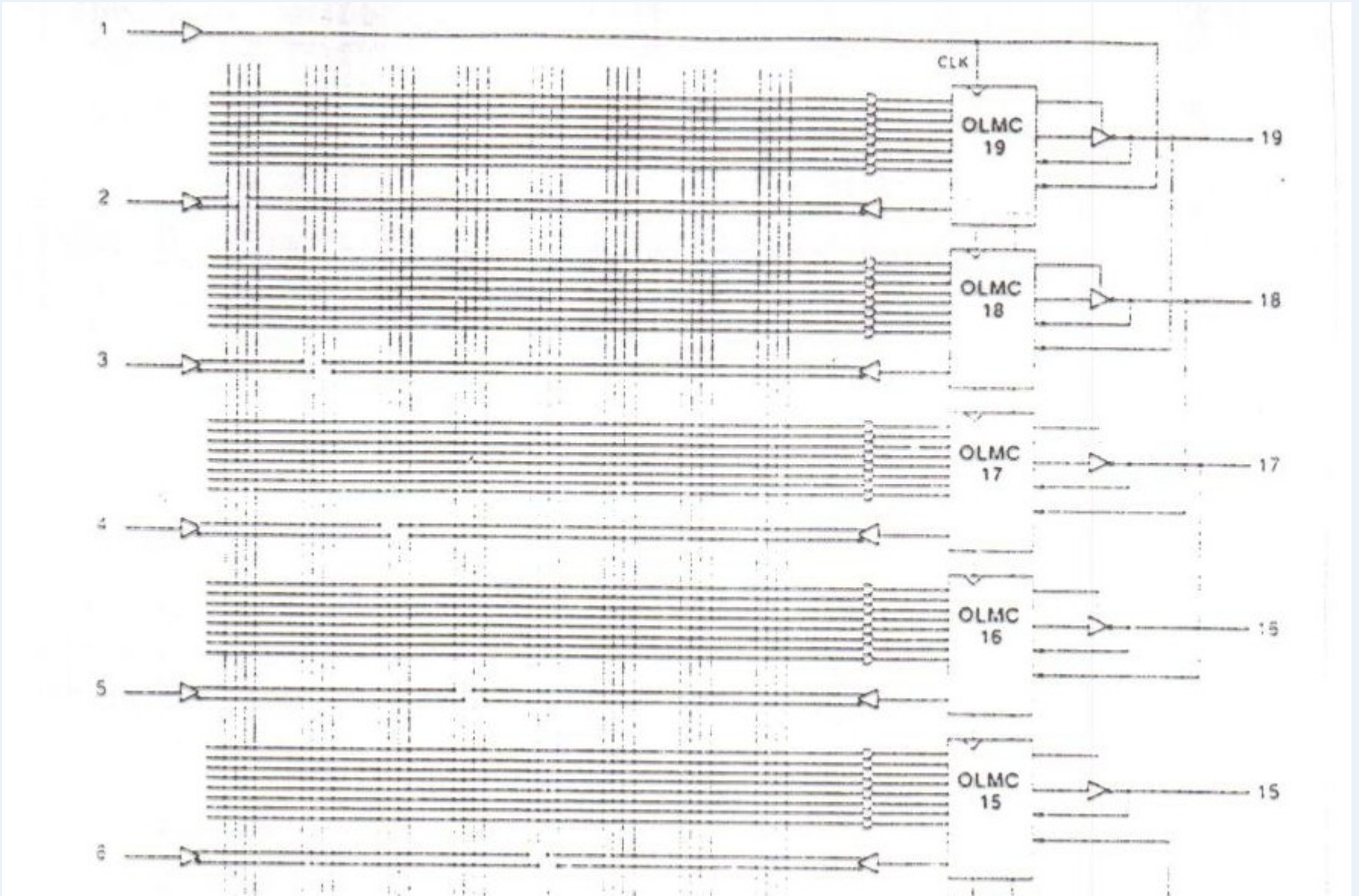
- Generic Array Logic. (Lattice Semiconductor)
- Borrable eléctricamente.
- CMOS, bajo consumo. Alta flexibilidad en la configuración de la E/S. Pines compatibles con PAL.



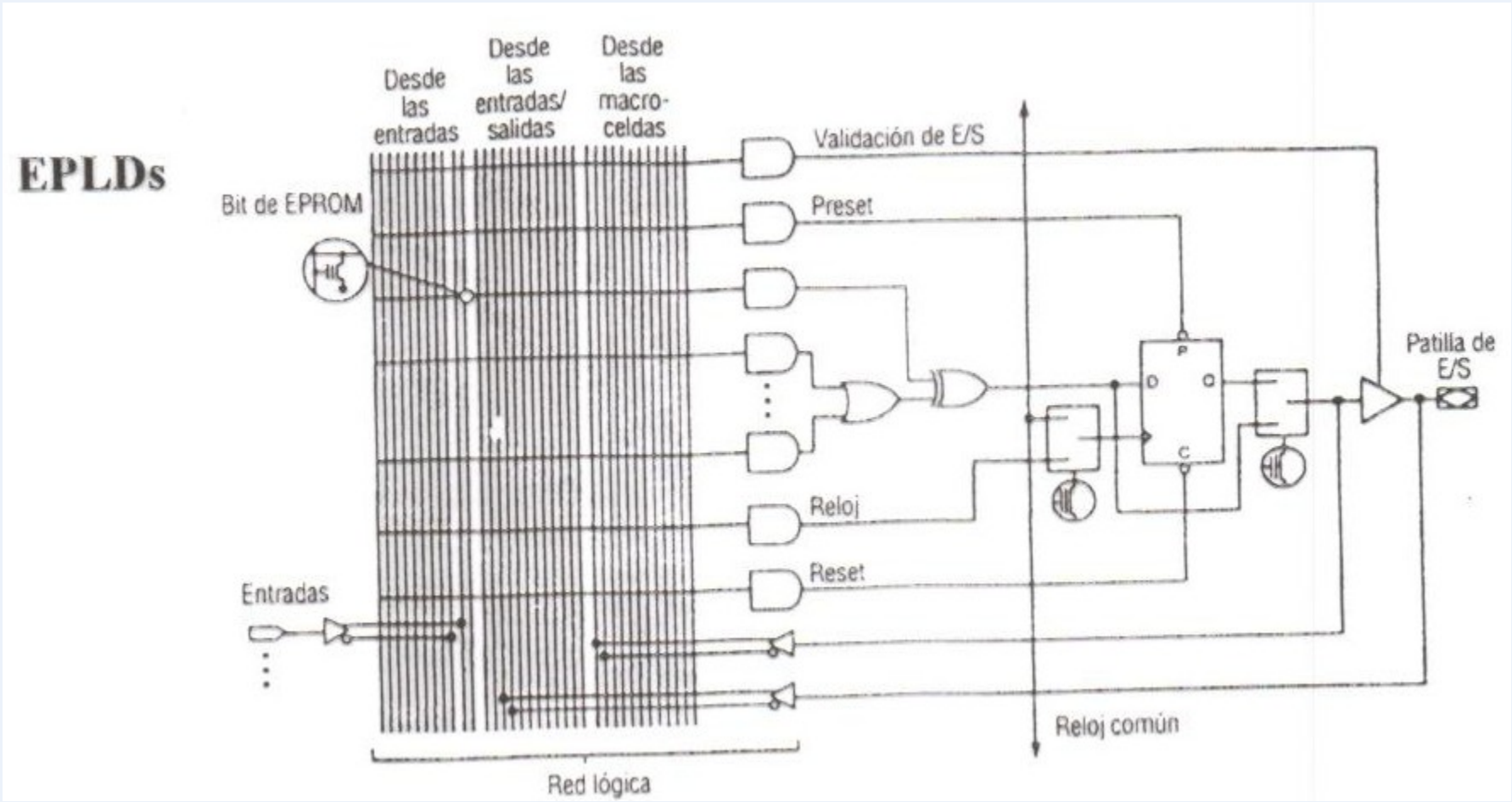
GAL. ESTRUCTURA DE SALIDA



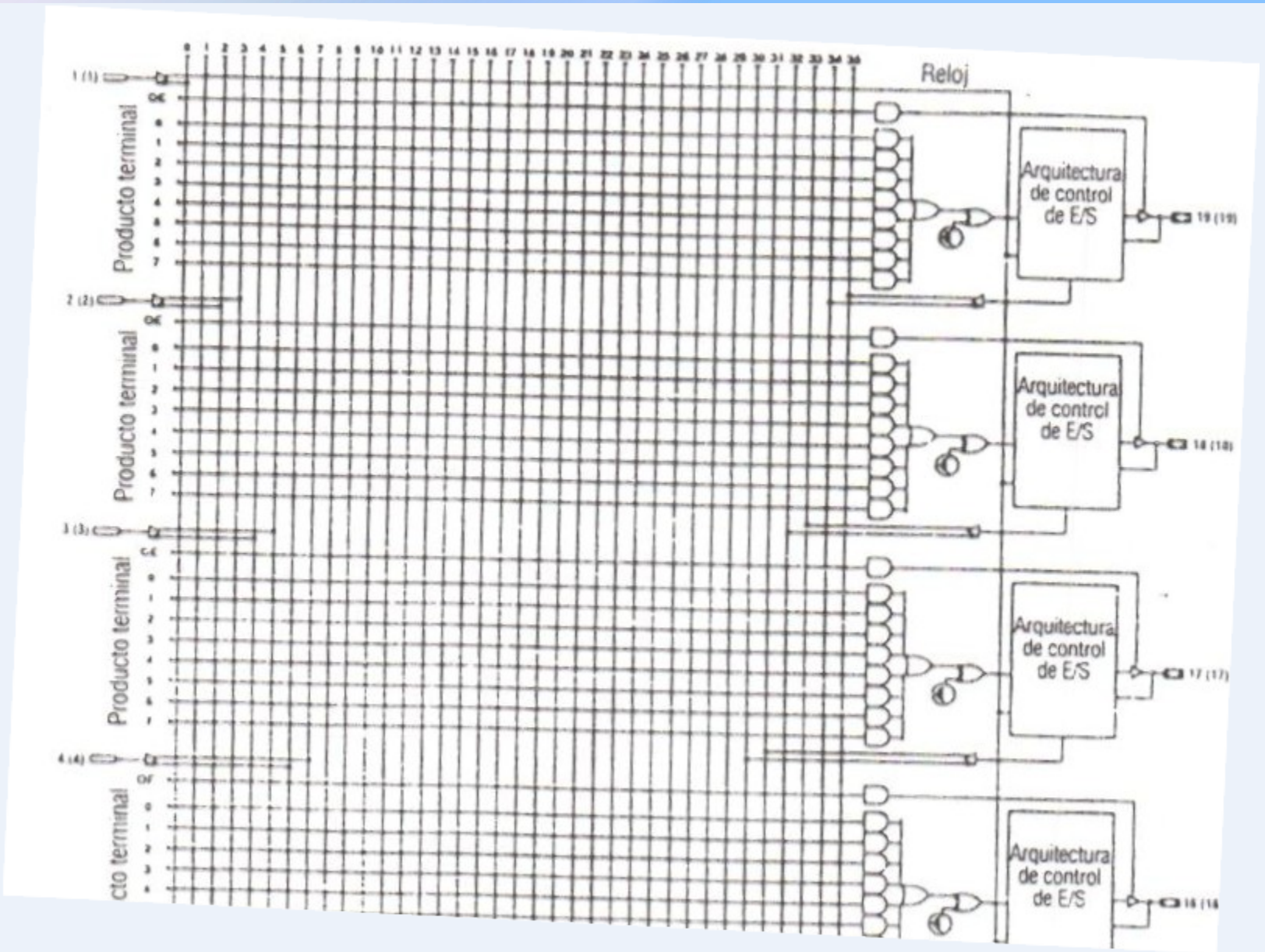
GAL



EPLD


EPLDs
Desde las entradas
Desde las entradas/ salidas
Desde las macro-celdas
Validación de E/S
Bit de EPROM
Preset
Reloj
Reset
Entradas
Patilla de E/S
Reloj común
Red lógica

ESTRUCTURA


Reloj
Producto terminal
Producto terminal
Producto terminal
cto terminal
Arquitectura de control de E/S
Arquitectura de control de E/S
Arquitectura de control de E/S
Arquitectura de control de E/S