

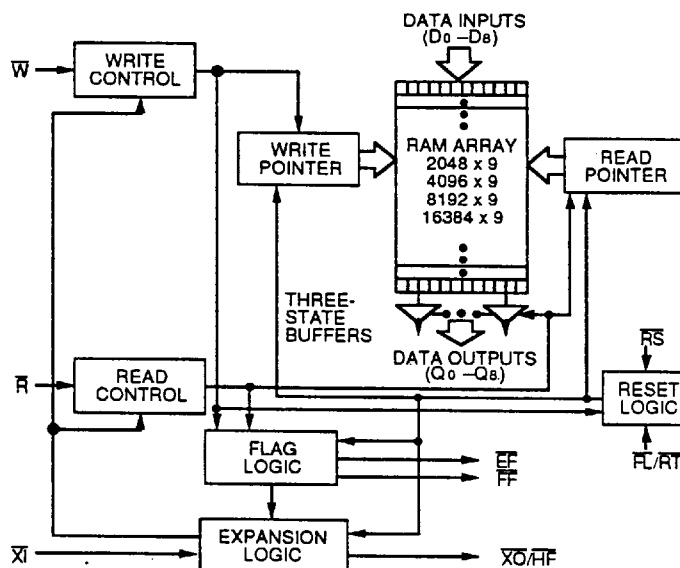
4096 x 9-Bit FIFO - Radiation Hardened 7204ERP

Epi - CMOS Parallel
Cascadeable FIFO

For Space Applications

SEI's 7204ERP (RP for RAD-PAK®) high speed FIFO microcircuit features a minimum 100 kilorad (Si) total dose tolerance. Using SEI's radiation hardened RAD-PAK® packaging technology, the 7204ERP

is fully equivalent to the commercial 7204 (IDT) and the CY7C433 (Cypress Semiconductor). It is a dual-port memory buffers with internal pointers that load and empty data on a first in/first out basis. The device uses Full and Empty flags to prevent data overflow and underflow and expansion logic to allow for unlimited expansion capability in both word size and depth. The 7203ERP uses a high speed CMOS technology. It is designed for applications requiring asynchronous and simultaneous read/writes in multiprocessing, rate buffering, and other applications. The RAD-PAK® technology incorporates radiation shielding in the microcircuit package. It eliminates box shielding while providing lifetime in orbit. The 7204ERP features the same system performance and architecture as the commercial counterparts and is manufactured on an epitaxial substrate to enhance single event latchup performance. Capable of surviving space environments, the 7204ERP is ideal for satellite, spacecraft, and space probe missions. It is available in Class S packaging and screening.

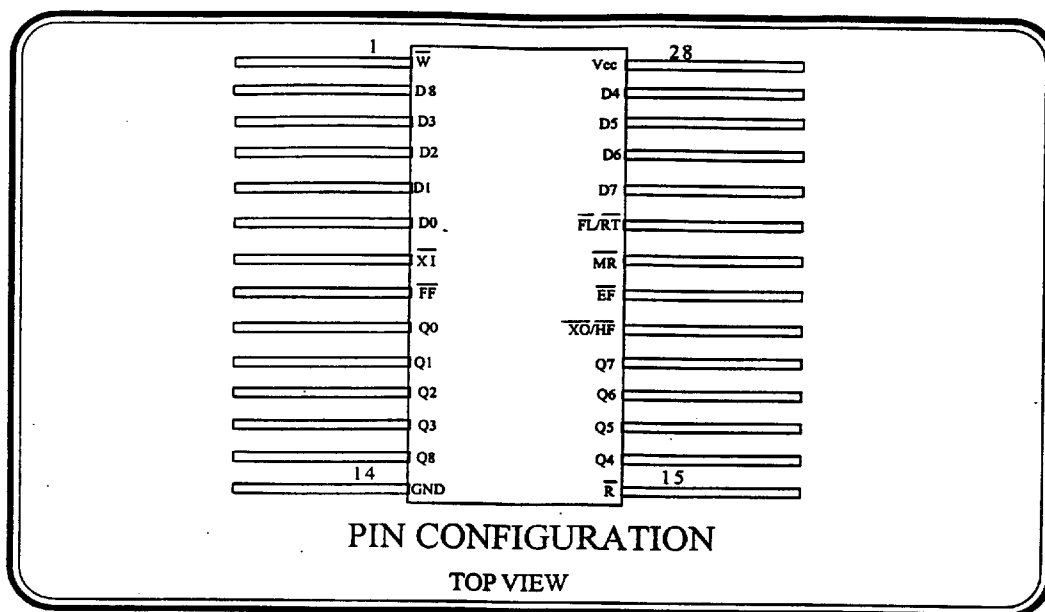


**SPACE
ELECTRONICS
INCORPORATED**

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Radiation Hardened 7204ERP

Epi-CMOS 28 Pin
Cascadeable 4k x 9 FIFO



Features

- 4096k x 9-bit Organization
- Pin Compatible with IDT7204/CY7C433
- RAD-PAK[®] Radiation Hardened
Against Natural Space Radiation
- Manufactured on epitaxial substrate for improved SEL performance.
- Total Dose Hardness >100 krad (Si)
- Package:
 - 28 Pin RAD-PAK[®] flat pack (410 mils x 720 mils)
 - Weight - 5.2 grams
 - 28 Pin RAD-PAK[®] DIP (410 mils x 720 mils)
 - Weight - 5.2 grams
- Fast Propagation Time (Max access time):
 - 30 ns: 7204ERP_x-30
 - 25 ns: 7204ERP_x-25
 - 20 ns: 7204ERP_x-20
- Asynchronous read/ write
- High Speed CMOS Technology
 - Half full flag in standalone
 - Empty and full flags
 - Three state outputs, TTL compatible
 - High speed 33.3 MHz read/write independent of depth/width
 - Retransmit in standalone
 - Low operating power, I_{cc} (max) = 147 mA
- Screening per TM 5004
- QCI per TM5005

Specifications and designs are subject to change without notice.



Aug 1994

For Further Information Contact:

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7204ERP ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNITS
Positive Supply Voltage	V_{CC}	-0.5	7.0	V
DC Voltage to Outputs (During High-Z State)		-0.5	7.0	V
Output Current into Outputs (Low)			20	mA
DC Input Voltage	V_{IN}	-0.5	7.0	V
Power Dissipation	P_d		1000	mW
Storage Temperature Range	T_s	-65	+150	°C
Operating Temperature Range	T_A	-55	+125	°C

7204ERP RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	MAX	UNITS
Positive Supply Voltage	V_{dd}	4.5	5.5	V
High Level Input Voltage	V_{IH}	2.2		V
Low Level Input Voltage	V_{IL}		0.8	V
Case Operating Temperature Range	T_C	-55	+125	°C



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7204ERP DC ELECTRICAL CHARACTERISTICS¹

PARAMETER	SYMBOL	MIN	MAX	UNITS
Input Low Voltage	V_{IL}		0.8	V
Input High Voltage	V_{IH}	2.2		V
Output Low Voltage $V_{CC} = 4.5 \text{ V}$, $V_{IN} = V_{IL}/V_{IH}$, $I_{OL} = 8 \text{ mA}$	V_{OL}		0.4	V
Output High Voltage $V_{CC} = 4.5 \text{ V}$, $V_{IN} = V_{IL}/V_{IH}$, $I_{OH} = -2 \text{ mA}$	V_{OH}	2.4		V
Input Low Current, $V_{IN} = 0 \text{ V}$, $V_{CC} = \text{Max}$	I_{IL}	-10	10	μA
Input High Current, $V_{IN} = 5.5 \text{ V}$, $V_{CC} = \text{Max}$	I_{IH}	-10	10	μA
Output Leakage Current, $V_{IN} = 5.5 \text{ V}/0 \text{ V}$, $V_{CC} = \text{Max}$	I_{OZ}	-10	10	μA
Active Power Supply Current ²	I_{CC1}		147	mA
Standby Supply Current ² ($R_{L1} = W_{L1} = R_{L2} = FLV_{RT} = V_{IH}$)	I_{CC2}		12	mA
Power Down Current ² , All Input = $V_{CC} - 0.2 \text{ V}$	I_{CC3}		2	mA
Input Capacitance ³	C_{IN}		11	pF
Output Capacitance ³	C_{OUT}		15	pF

Notes:

1. $V_{CC} = 5 \pm 5\%$ volts; $T_A = -55$ to $+125^\circ\text{C}$.
2. All measurements are made with outputs open (only capacitive loading).
3. Guaranteed by design, $f = 1 \text{ MHz}$.



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7204ERP TIMING CHARACTERISTICS¹

PARAMETER	SYMBOL	MIN	MAX	UNIT
Shift Frequency 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	f_s		25 28.5 33.3	ns
Read Cycle Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RC}	40 35 30		ns
Data Access Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_A		30 25 20	ns
Read Recovery Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RR}	10 10 10		ns
Read Pulse Width ² 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RPW}	30 25 20		ns
Read LOW to Data Bus LOW ³ 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RLZ}	5 5 5		ns
Write HIGH to Data Bus Low-Z ^{3,4} 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{WLZ}	5 5 5		ns
Data Valid from Read HIGH 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{DV}	5 5 5		ns
Read HIGH to Data Bus High-Z ³ 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RHZ}		20 18 15	ns



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7204ERP TIMING CHARACTERISTICS¹ - (Continued)

PARAMETER	SYMBOL	MIN	MAX	UNIT
Write Cycle Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{wc}	40 35 30		ns
Write Pulse Width ² 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{wpw}	30 25 20		ns
Write Recovery Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{wr}	10 10 10		ns
Data Set-up Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{ds}	18 15 12		ns
Data Hold Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{dh}	0 0 0		ns
Reset Cycle Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{rsc}	40 35 30		ns
Reset Pulse Width ² 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{rs}	30 25 20		ns
Reset Set-up Time ³ 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{rss}	30 25 20		ns
Reset Recovery Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{rsr}	10 10 10		ns



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7204ERP TIMING CHARACTERISTICS¹ - (Continued)

PARAMETER	SYMBOL	MIN	MAX	UNIT
Retransmit Cycle Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RTC}	40 35 30		ns
Retransmit Pulse Width ² 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RT}	30 25 20		ns
Retransmit Set-up Time ³ 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RTS}	30 25 20		ns
Retransmit Recovery Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RSR}	10 10 10		ns
Reset to EF\ LOW 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{EFL}		40 35 30	ns
Reset to HF\ and FF\ HIGH 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{HFH}, t_{FFH}		40 35 20	ns
Retransmit LOW to Flags Valid 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RTF}		40 35 20	ns
Read LOW to EF\ LOW 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{REF}		30 25 20	ns
Read HIGH to FF\ HIGH 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t_{RFF}		30 25 20	ns



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7204ERP TIMING CHARACTERISTICS¹ - (Continued)

PARAMETER	SYMBOL	MIN	MAX	UNIT
Read Pulse Width after EF\ HIGH 7204ERPx-30 7204ERPx-25 7204ERPx-20	t_{RPE}	30 25 20		ns
Write HIGH to EF\ HIGH 7204ERPx-30 7204ERPx-25 7204ERPx-20	t_{WEF}		30 25 20	ns
Write LOW to FF\ LOW 7204ERPx-30 7204ERPx-25 7204ERPx-20	t_{WFF}		30 25 20	ns
Write LOW to HF\ Flag LOW 7204ERPx-30 7204ERPx-25 7204ERPx-20	t_{WHF}		40 35 30	ns
Read HIGH to HF\ Flag HIGH 7204ERPx-30 7204ERPx-25 7204ERPx-20	t_{RHF}		40 35 30	ns
Write Pulse Width after FF\ HIGH 7204ERPx-30 7204ERPx-25 7204ERPx-20	t_{WPF}	30 25 20		ns
Read/Write LOW to XO\ LOW 7204ERPx-30 7204ERPx-25 7204ERPx-20	t_{XOL}		30 25 20	ns
Read/Write HIGH to XO\ HIGH 7204ERPx-30 7204ERPx-25 7204ERPx-20	t_{XOH}		30 25 20	ns
XI\ Pulse Width ² 7204ERPx-30 7204ERPx-25 7204ERPx-20	t_{XI}	30 25 20		ns



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7204ERP TIMING CHARACTERISTICS¹ - (Continued)

PARAMETER	SYMBOL	MIN	MAX	UNIT
XI\ Recovery Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t _{XIR}	 10 10 10		ns
XI\ Set-up Time 7204ERP _x -30 7204ERP _x -25 7204ERP _x -20	t _{XIS}	 10 10 10		ns

Notes:

1. V_{CC} = +5 volts; T_A = +25 °C; use switching test circuit. AC tests are performed with input rise and fall times of 5 ns or less, timing reference levels of 1.5 V, input pulse levels of 0 to 3.0 V and the output load circuit, unless otherwise specified.
2. Pulse widths less than minimum are not allowed.
3. Guaranteed by design, not tested.
4. Only applies to read data flow-through mode.

7204ERP Package Ordering Guide

Package Style	Case Outline	1/	Description
D	D-28		28 Pin Dual In Line Package
F	F-28		28 Pin Flat Package

Note:

- 1/ For outline information, see Appendix A (Package Information - Outline Dimension)

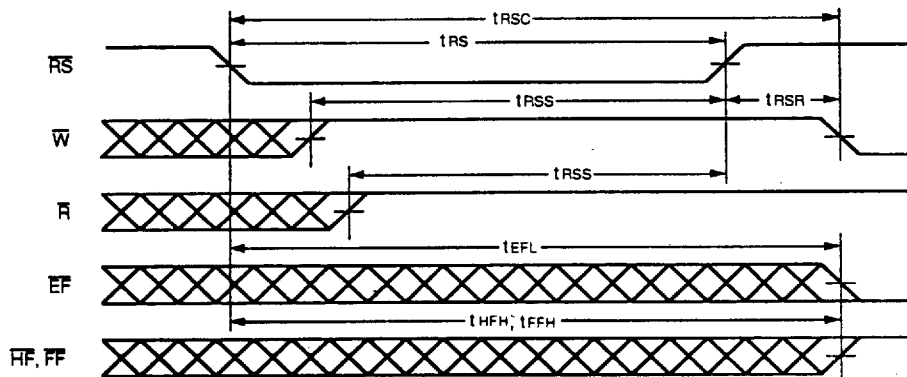


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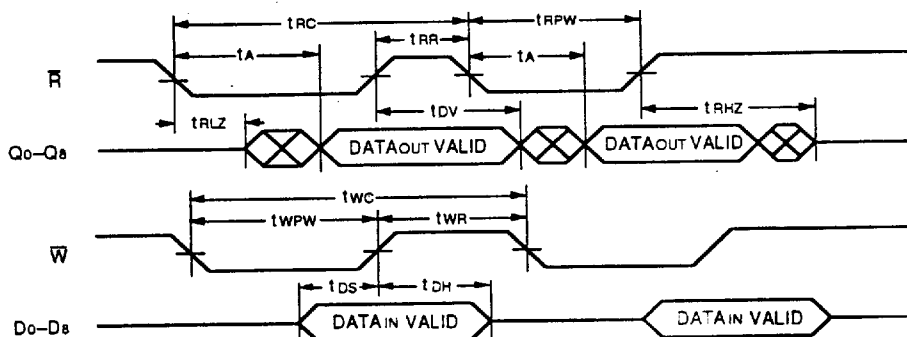
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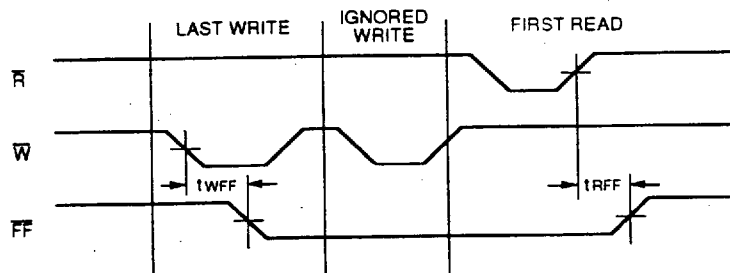
Reset



Asynchronous Write and Read Operation



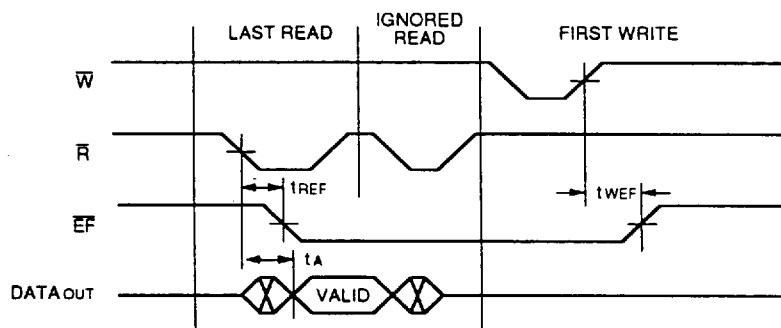
Full Flag Timing From Last Write to First Read



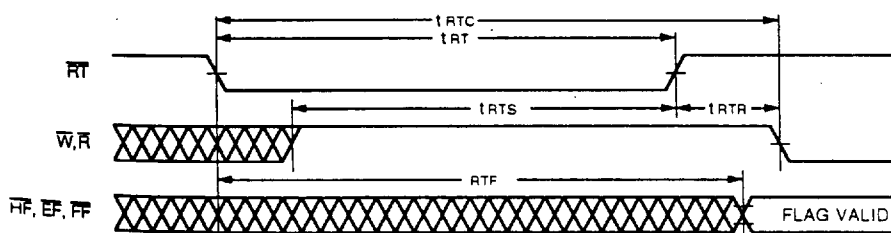
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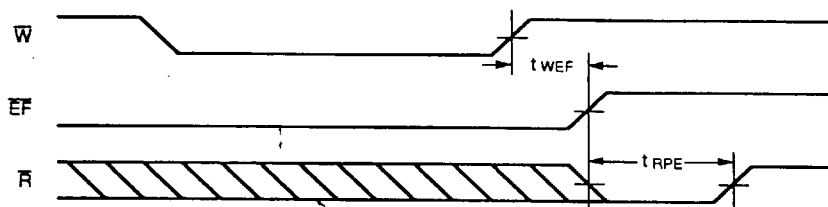
Empty Flag Timing From Last Read to First Write



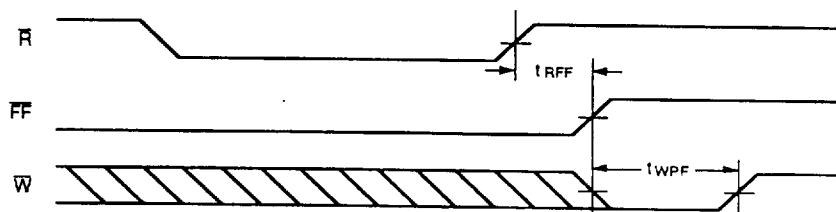
Retransmit



Minimum Timing for an Empty Flag Coincident Read Pulse



Minimum Timing for a Full Flag Coincident Write Pulse

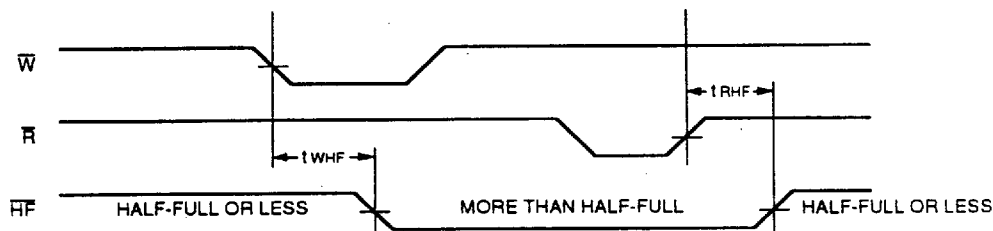


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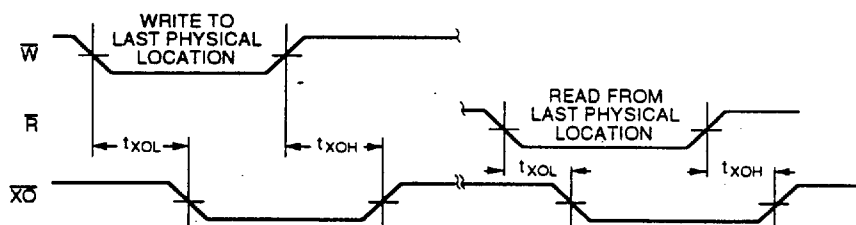
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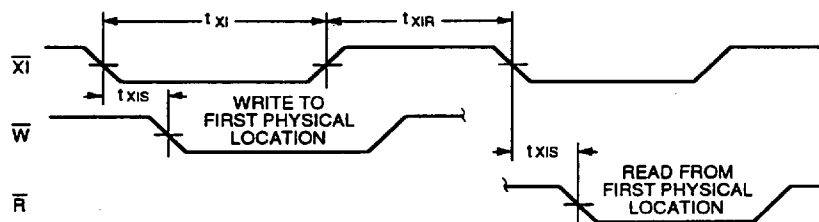
Half-Full Flag Timing



Expansion Out



Expansion In



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7204ERP PINOUT

PIN	SIGNAL	PIN	SIGNAL
1	W\	15	R\
2	D8	16	Q4
3	D3	17	Q5
4	D2	18	Q6
5	D1	19	Q7
6	D0	20	XO\HG\
7	XI\	21	EF\
8	FF\	22	RS\
9	Q0	23	FL\RT\
10	Q1	24	D7
11	Q2	25	D6
12	Q3	26	D5
13	Q8	27	D4
14	GND	28	Vcc



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