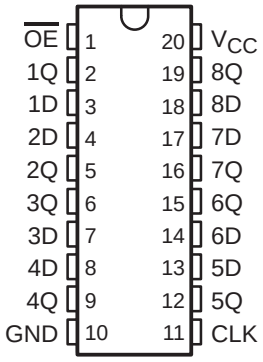
- **BiCMOS Technology With Low Quiescent Power**
- **3-State Outputs Drive Bus Lines Directly**
- **Buffered Inputs**
- **Noninverted Outputs**
- **Input/Output Isolation From V_{CC}**
- **Controlled Output Edge Rates**
- **48-mA Output Sink Current**
- **Output Voltage Swing Limited to 3.7 V**
- **SCR Latch-Up-Resistant BiCMOS Process and Circuit Design**
- **Package Options Include Plastic Small-Outline (M) and Shrink Small-Outline (SM) Packages and Standard Plastic (E) DIP**

E, M, OR SM PACKAGE
(TOP VIEW)



description

The CD74FCT374 is an octal, edge-triggered, D-type flip-flop that uses a small-geometry BiCMOS technology and features 3-state outputs designed specifically for driving highly capacitive or relatively low-impedance loads. This device is particularly suitable for implementing buffer registers, I/O ports, bidirectional bus drivers, and working registers.

The output stage is a combination of bipolar and CMOS transistors that limits the output high level to two diode drops below V_{CC}. This resultant lowering of output swing (0 V to 3.7 V) reduces power-bus ringing [a source of electromagnetic interference (EMI)] and minimizes V_{CC} bounce and ground bounce and their effects during simultaneous output switching. The output configuration also enhances switching speed and is capable of sinking 48 mA.

The eight flip-flops enter data into their registers on the low-to-high transition of the clock (CLK). The output-enable ($\overline{OE}$) input controls the 3-state outputs and is independent of the register operation. When $\overline{OE}$ is high, the outputs are in the high-impedance state.

A buffered $\overline{OE}$ input can be used to place the eight outputs in either a normal logic state (high or low) or the high-impedance state. In the high-impedance state, the outputs neither load nor drive the bus lines significantly. The high-impedance state and the increased drive provide the capability to drive bus lines without interface or pullup components.

$\overline{OE}$ does not affect internal operations of the flip-flop. Old data can be retained or new data can be entered while the outputs are in the high-impedance state.

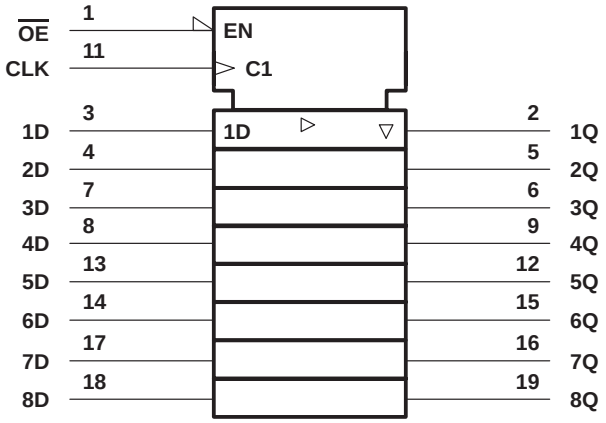
To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The CD74FCT374 is characterized for operation from 0°C to 70°C.

FUNCTION TABLE
(each flip-flop)

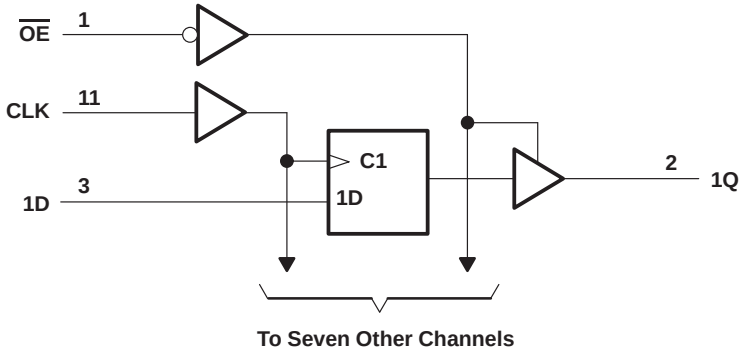
INPUTS			OUTPUT
$\overline{OE}$	CLK	D	Q
L	↑	H	H
L	↑	L	L
L	H or L	X	Q_0
H	X	X	Z

logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

DC supply voltage range, V_{CC} . . . . . –0.5 V to 6 V
DC input clamp current, I_{IK} (V_I < –0.5 V) . . . . . –20 mA
DC output clamp current, I_{OK} (V_O < –0.5 V) . . . . . –50 mA
DC output sink current per output pin, I_{OL} . . . . . 70 mA
DC output source current per output pin, I_{OH} . . . . . –30 mA
Continuous current through V_{CC}, I_{CC} . . . . . 140 mA
Continuous current through GND . . . . . 400 mA
Package thermal impedance, θ_{JA} (see Note 1): E package . . . . . 69°C/W
M package . . . . . 58°C/W
SM package . . . . . 70°C/W
Storage temperature range, T_{stg} . . . . . –65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: The package thermal impedance is calculated in accordance with JESD 51.

recommended operating conditions (see Note 2)

		MIN	MAX	UNIT
V_{CC}	Supply voltage	4.75	5.25	V
V_{IH}	High-level input voltage	2		V
V_{IL}	Low-level input voltage		0.8	V
V_I	Input voltage	0	V_{CC}	V
V_O	Output voltage	0	V_{CC}	V
I_{OH}	High-level output current		–15	mA
I_{OL}	Low-level output current		48	mA
$\Delta t/\Delta v$	Input transition rise or fall rate	0	10	ns/V
T_A	Operating free-air temperature	0	70	°C

NOTE 2: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

electrical characteristics over recommended operating temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS		V_{CC}	T_A = 25°C		MIN	MAX	UNIT
				MIN	MAX			
V_{IK}	I_I = –18 mA		4.75 V		–1.2		–1.2	V
V_{OH}	I_{OH} = –15 mA		4.75 V	2.4		2.4		V
V_{OL}	I_{OL} = 48 mA		4.75 V		0.55		0.55	V
I_I	$V_I = V_{CC}$ or GND		5.25 V		±0.1		±1	µA
I_{OZ}	$V_O = V_{CC}$ or GND		5.25 V		±0.5		±10	µA
I_{OS}‡	$V_I = V_{CC}$ or GND,	V_O = 0	5.25 V	–60		–60		mA
I_{CC}	$V_I = V_{CC}$ or GND,	I_O = 0	5.25 V		8		80	µA
ΔI_{CC}§	One input at 3.4 V, Other inputs at V_{CC} or GND		5.25 V		1.6		1.6	mA
C_i	$V_I = V_{CC}$ or GND				10		10	pF
C_o	$V_O = V_{CC}$ or GND				15		15	pF

‡ Not more than one output should be tested at a time, and the duration of the test should not exceed 100 ms.
§ This is the increase in supply current for each input at one of the specified TTL voltage levels rather than 0 V or V_{CC}.

timing requirements over recommended operating conditions, (unless otherwise noted) (see Figure 1)

			MIN	MAX	UNIT
f_{clock}	Clock frequency			70	MHz
t_w	Pulse duration	CLK high or low	7		ns
t_{su}	Setup time	Data before CLK↑	2		ns
t_h	Hold time	Data after CLK↑	2		ns

switching characteristics over recommended operating conditions, V_{CC} = 5 V ± 0.25 V (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	T_A = 25°C	MIN	MAX	UNIT
			TYP			
f_{max}				70		MHz
t_{pd}	CLK	Q	6.6	2	10	ns
t_{en}	$\overline{OE}$	Q	9	1.5	12.5	ns
t_{dis}	$\overline{OE}$	Q	6	1.5	8	ns

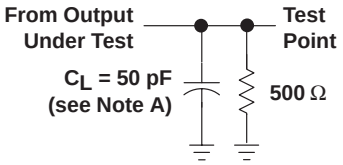
noise characteristics, V_{CC} = 5 V, C_L = 50 pF, T_A = 25°C

PARAMETER		MIN	TYP	MAX	UNIT
$V_{OL(P)}$	Quiet output, maximum dynamic V_{OL}		1		V
$V_{OH(V)}$	Quiet output, minimum dynamic V_{OH}		0.5		V
$V_{IH(D)}$	High-level dynamic input voltage	2			V
$V_{IL(D)}$	Low-level dynamic input voltage			0.8	V

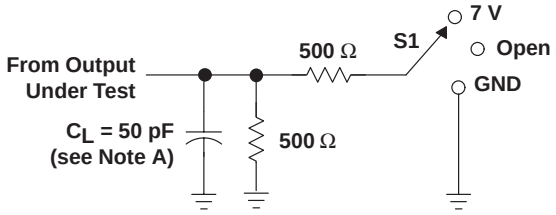
operating characteristics, V_{CC} = 5 V, T_A = 25°

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance	No load, f = 1 MHz	33	pF

PARAMETER MEASUREMENT INFORMATION

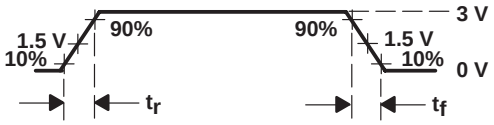


LOAD CIRCUIT FOR
TOTEM-POLE OUTPUTS

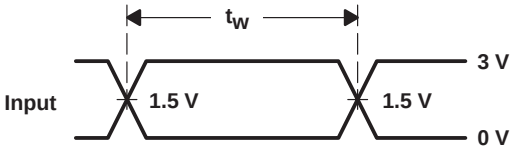


LOAD CIRCUIT FOR
3-STATE AND OPEN-DRAIN OUTPUTS

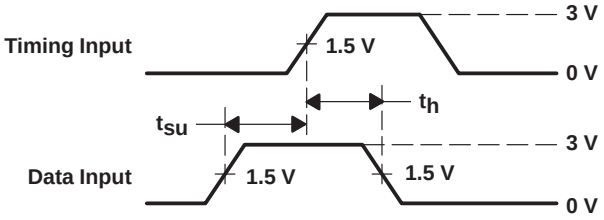
TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	7 V
t_{PHZ}/t_{PZH}	Open
Open Drain	7 V



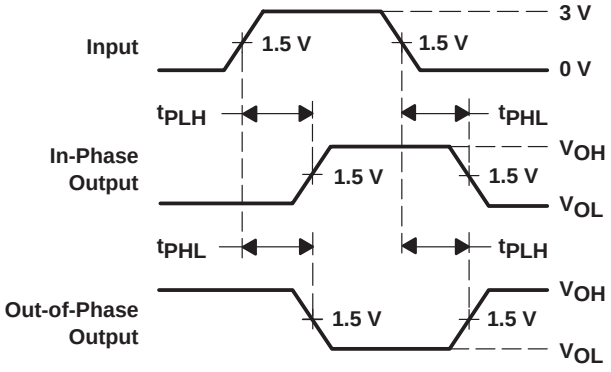
VOLTAGE WAVEFORM
INPUT RISE AND FALL TIMES



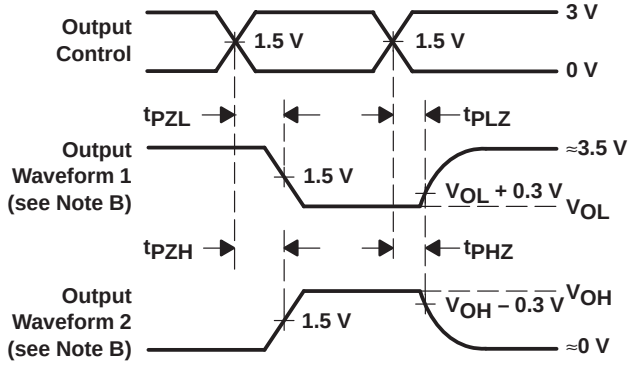
VOLTAGE WAVEFORMS
PULSE DURATION



VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
LOW- AND HIGH-LEVEL ENABLING

NOTES: A. C_L includes probe and jig capacitance.
B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r and t_f = 2.5 ns.
D. The outputs are measured one at a time with one input transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis}.
F. t_{PZL} and t_{PZH} are the same as t_{en}.
G. t_{PHL} and t_{PLH} are the same as t_{pd}.

Figure 1. Load Circuit and Voltage Waveforms

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Customers are responsible for their applications using TI components.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.