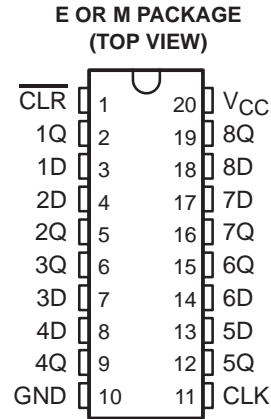


# CD74FCT273 BiCMOS OCTAL D-TYPE FLIP-FLOP WITH RESET

SCBS737A – JULY 2000 – REVISED JULY 2000

- BiCMOS Technology With Low Quiescent Power
- Buffered Inputs
- Direct Clear Input
- 48-mA Output Sink Current
- Output Voltage Swing Limited to 3.7 V
- Controlled Output Edge Rates
- Input/Output Isolation From  $V_{CC}$
- SCR Latch-Up-Resistant BiCMOS Process and Circuit Design
- Applications Include:
  - Buffer/Storage Registers
  - Shift Registers
  - Pattern Generators
- Package Options Include Plastic Small-Outline (M) Package and Standard Plastic (E) DIP



## description

The CD74FCT273 is a positive-edge-triggered, D-type flip-flop with a direct clear ( $\overline{CLR}$ ) input. This device uses a small-geometry BiCMOS technology. 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.

Information at the data (D) inputs meeting the setup time requirements is transferred to the Q outputs on the positive-going edge of the clock (CLK) pulse. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going pulse. When CLK is at either the high or low level, the D input has no effect at the output. All eight flip-flops are controlled by a common clock (CLK) and a common reset ( $\overline{CLR}$ ). The outputs are placed in a low state when  $\overline{CLR}$  is taken low, independent of the CLK.

The CD74FCT273 is characterized for operation from 0°C to 70°C.

**FUNCTION TABLE**  
(each flip-flop)

INPUTS			OUTPUT Q
$\overline{CLR}$	CLK	D	
L	X	X	L
H	↑	H	H
H	↑	L	L
H	L	X	$Q_0$



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

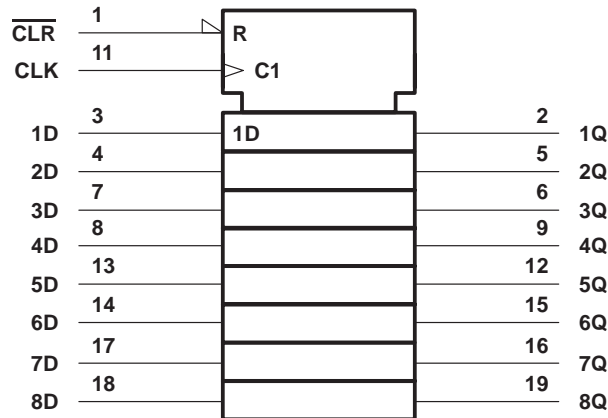
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# CD74FCT273 BiCMOS OCTAL D-TYPE FLIP-FLOP WITH RESET

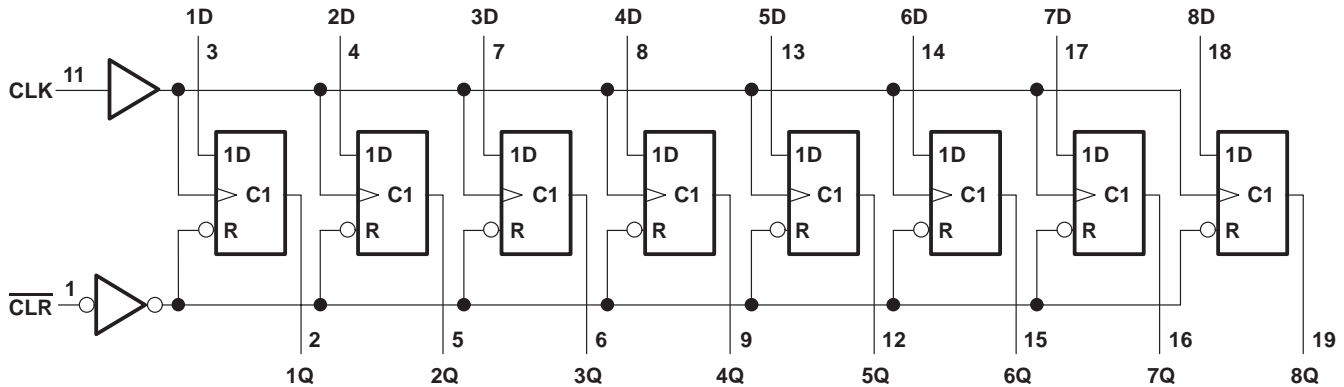
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## logic symbol†

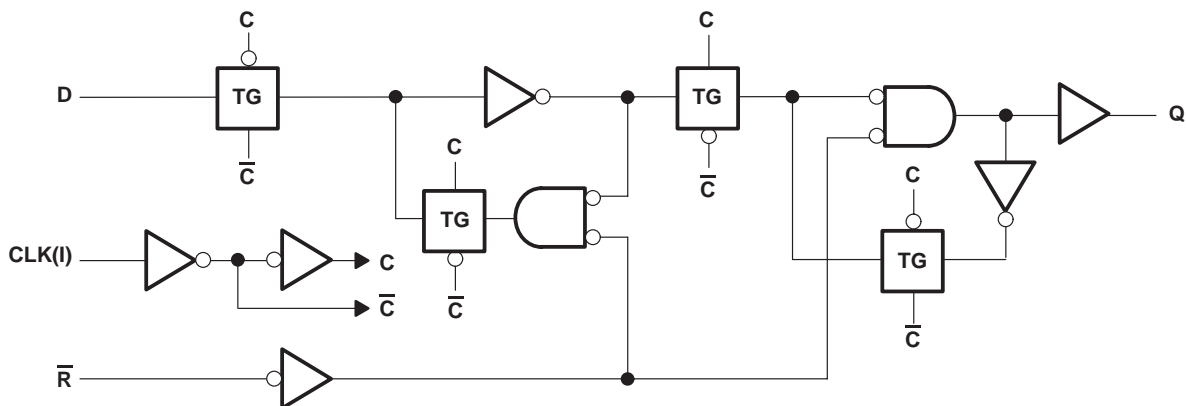


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

## logic diagram (positive logic)



## logic diagram, each flip-flop (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 diode current, $I_{IK}$ ( $V_I < -0.5$ V) .....	-20 mA
DC output diode 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, $\theta_{JA}$ (see Note 1): E package .....	69°C/W
M package .....	58°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	$V_{CC}$	$T_A = 25^\circ\text{C}$		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		$\pm 0.1$	$\pm 1$		$\mu\text{A}$
$I_{OZ}$	$V_O = V_{CC}$ or GND	5.25 V		$\pm 0.5$	$\pm 10$		$\mu\text{A}$
$I_{OS}^\ddagger$	$V_I = V_{CC}$ 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		$\mu\text{A}$
$\Delta I_{CC}^\S$	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		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  $V_{CC}$ .

**CD74FCT273**  
**BiCMOS OCTAL D-TYPE FLIP-FLOP**  
**WITH RESET**

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

		MIN	MAX	UNIT
$f_{\text{clock}}$	Clock frequency		70	MHz
$t_w$	Pulse duration	$\overline{\text{CLR}}$ low	7	ns
		CLK high or low	7	
$t_{\text{su}}$	Setup time	Data before CLK $\uparrow$	3	ns
		$\overline{\text{CLR}}$ before CLK $\uparrow$	4	
$t_h$	Hold time	Data after CLK $\uparrow$	2	ns

**switching characteristics over recommended operating conditions,  $C_L = 50$  pF (unless otherwise noted) (see Figure 1)**

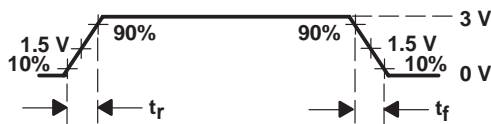
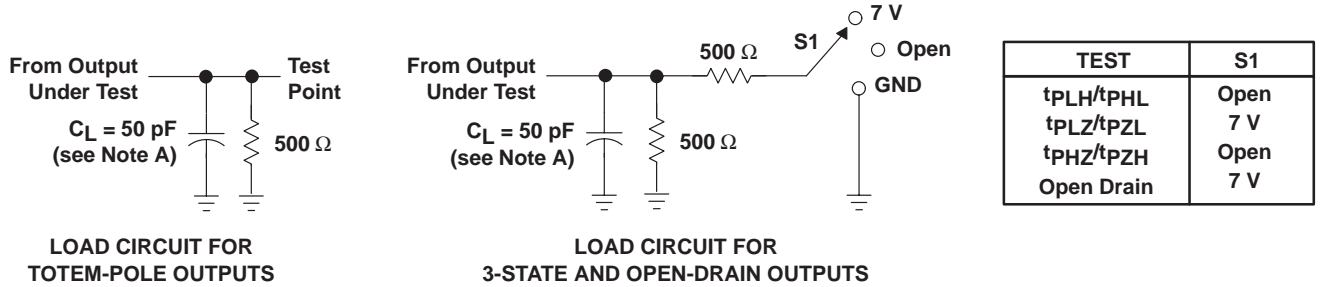
PARAMETER	FROM (INPUT)	TO (OUTPUT)	$T_A = 25^\circ\text{C}$	MIN	MAX	UNIT
			TYP			
$f_{\text{max}}$				70		MHz
$t_{\text{pd}}$	CLK	Any Q	7	2	13	ns
	$\overline{\text{CLR}}$		8	2	13	

**operating characteristics,  $T_A = 25^\circ\text{C}$**

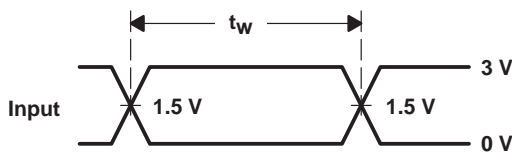
PARAMETER	TEST CONDITIONS	TYP	UNIT
$C_{\text{pd}}$ Power dissipation capacitance	No load, $f = 1$ MHz	36	pF



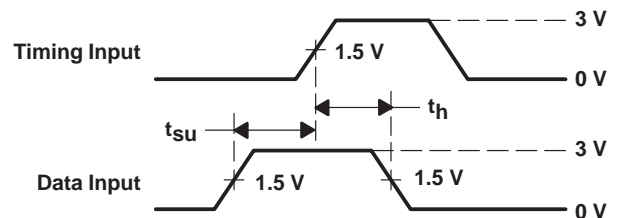
PARAMETER MEASUREMENT INFORMATION



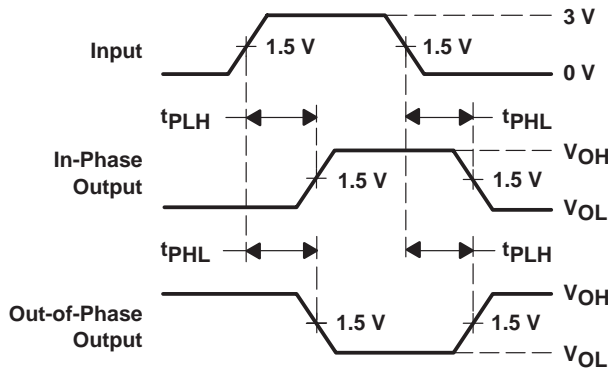
VOLTAGE WAVEFORM  
INPUT RISE AND FALL TIMES



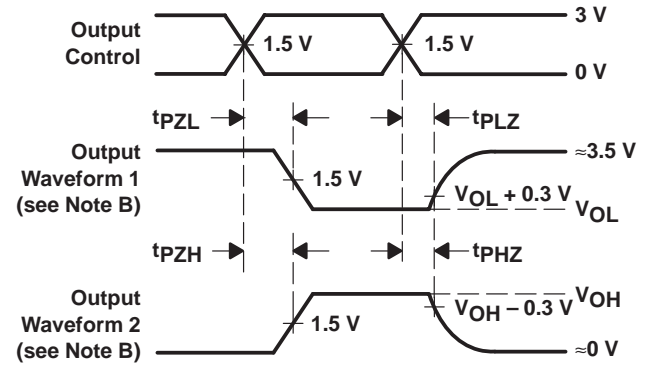
VOLTAGE WAVEFORMS  
PULSE DURATION



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:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r$  and  $t_f = 2.5 \text{ ns}$ .  
 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

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CD74FCT273E	ACTIVE	PDIP	N	20	20	RoHS & Non-Green	NIPDAU	N / A for Pkg Type	0 to 70	CD74FCT273E	Samples
CD74FCT273M	LIFEBUY	SOIC	DW	20	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	74FCT273M	

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
CD74FCT273E	N	PDIP	20	20	506	13.97	11230	4.32
CD74FCT273M	DW	SOIC	20	25	507	12.83	5080	6.6

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - $\triangle D$  The 20 pin end lead shoulder width is a vendor option, either half or full width.



# DW0020A



# PACKAGE OUTLINE

## SOIC - 2.65 mm max height

SOIC



4220724/A 05/2016

### NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm per side.
5. Reference JEDEC registration MS-013.

# EXAMPLE BOARD LAYOUT

DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

- 6. Publication IPC-7351 may have alternate designs.
- 7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:6X

4220724/A 05/2016

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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