SN74AHC74Q-Q1 DUAL POSITIVE-EDGE-TRIGGERED D-TYPE FLIP-FLOP WITH CLEAR AND PRES

SGDS020A - FEBRUARY 2002 - REVISED APRIL 2008

- **Qualified for Automotive Applications**
- **EPIC™** (Enhanced-Performance Implanted **CMOS) Process**
- Operating Range 2-V to 5.5-V V_{CC}
- Latch-Up Performance Exceeds 250 mA Per **JESD 17**
- **ESD Protection Exceeds 2000 V Per** MIL-STD-883. Method 3015: Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)

D OR PW PACKAGE (TOP VIEW)



description

The SN74AHC74Q dual positive-edge-triggered device is a D-type flip-flop.

A low level at the preset (PRE) or clear (CLR) inputs sets or resets the outputs, regardless of the levels of the other inputs. When PRE and CLR are inactive (high), data at the data (D) input meeting the setup time requirements is transferred to the outputs on the positive-going edge of the clock pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of the clock pulse. Following the hold-time interval, data at the D input can be changed without affecting the levels at the outputs.

ORDERING INFORMATION[†]

TA	PACK	\GE‡	ORDERABLE PART NUMBER	TOP-SIDE MARKING
400C to 40E0C	SOIC - D	Tape and reel	SN74AHC74QDRQ1	AHC74Q
-40°C to 125°C	TSSOP - PW	Tape and reel	SN74AHC74QPWRQ1	HA74Q

[†] For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at http://www.ti.com.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

EPIC is a trademark of Texas Instruments.



[‡] Package drawings, thermal data, and symbolization are available at http://www.ti.com/packaging.

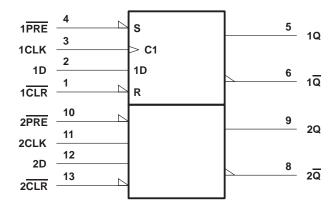
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FUNCTION TABLE (each flip-flop)

	INP		OUTPUTS			
PRE	CLR	CLK	D	Q	Q	
L	Н	Х	Χ	Н	L	
Н	L	X	Χ	L	Н	
L	L	X	Χ	н†	H [†]	
Н	Н	\uparrow	Н	Н	L	
Н	Н	\uparrow	L	L	Н	
Н	Н	L	Χ	Q_0	\overline{Q}_0	

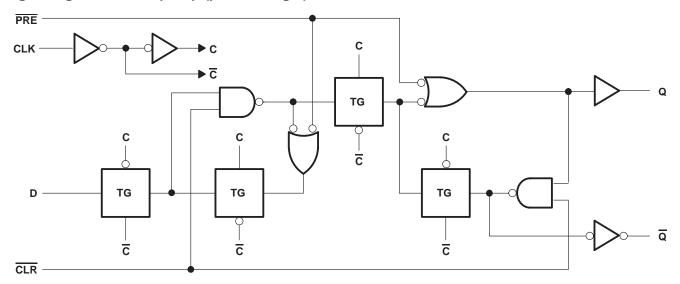
[†] This configuration is nonstable; that is, it does not persist when $\overline{\mathsf{PRE}}$ or $\overline{\mathsf{CLR}}$ returns to its inactive (high) level.

logic symbol‡



 $[\]ddagger$ This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram, each flip-flop (positive logic)





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

Supply voltage range, V _{CC}	–0.5 V to 7 V
Input voltage range, V _I (see Note 1)	–0.5 V to 7 V
Output voltage range, VO (see Note 1)	\dots -0.5 V to V _{CC} + 0.5 V
Input clamp current, $I_{ K }(V_{ C } < 0)$	–20 mA
Output clamp current, I _{OK} (V _O < 0 or V _O > V _{CC})	±20 mA
Continuous output current, $I_O(V_O = 0 \text{ to } V_{CC})$	±25 mA
Continuous current through V _{CC} or GND	±50 mA
Package thermal impedance, θ_{JA} (see Note 2): D package	86°C/W
PW package	113°C/W
Storage temperature range, T _{sto}	–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.

recommended operating conditions (see Note 3)

			MIN	MAX	UNIT
Vcc	Supply voltage		2	5.5	V
		V _{CC} = 2 V	1.5		
V_{IH}	High-level input voltage	V _{CC} = 3 V	2.1		V
		V _{CC} = 5.5 V	3.85		
		V _{CC} = 2 V		0.5	
V_{IL}	Low-level input voltage	V _{CC} = 3 V		0.9	V
		V _{CC} = 5.5 V		1.65	
VI	Input voltage		0	5.5	V
VO	Output voltage		0	VCC	V
		V _{CC} = 2 V		-50	μΑ
loh	High-level output current	$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		-4	A
		$V_{CC} = 5 V \pm 0.5 V$		-8	mA
		V _{CC} = 2 V		50	μΑ
loL	Low-level output current	$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		4	A
		$V_{CC} = 5 V \pm 0.5 V$		8	mA
A 4 / A	$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$			100	0/
Δt/Δv	Input transition rise or fall rate	$V_{CC} = 5 V \pm 0.5 V$		20	ns/V
TA	Operating free-air temperature		-40	125	°C

NOTE 3: 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.

NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

^{2.} The package thermal impedance is calculated in accordance with JESD 51-7.

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

24244555	TEST SOURITIONS	.,	T,	չ = 25°C	;			
PARAMETER	TEST CONDITIONS	VCC	MIN	TYP	MAX	MIN	MAX	UNIT
		2 V	1.9	2		1.9		
	I _{OH} = -50 μA	3 V	2.9	3		2.9		
Voн		4.5 V	4.4	4.5		4.4		V
	$I_{OH} = -4 \text{ mA}$	3 V	2.58			2.48		
	$I_{OH} = -8 \text{ mA}$	4.5 V	3.94			3.8		
		2 V			0.1		0.1	
	I _{OL} = 50 μA	3 V			0.1		0.1	
VOL		4.5 V			0.1		0.1	V
	I _{OL} = 4 mA	3 V			0.36		0.5	
	I _{OL} = 8 mA	4.5 V			0.36		0.5	
lį	V _I = 5.5 V or GND	0 V to 5.5 V	·		±0.1	·	±1	μΑ
Icc	$V_I = V_{CC}$ or GND, $I_O = 0$	5.5 V			2		20	μΑ
Ci	V _I = V _{CC} or GND	5 V		2	10		·	pF

timing requirements over recommended operating free-air temperature range, V_{CC} = 3.3 V \pm 0.3 V (unless otherwise noted) (see Figure 1)

						MAX	UNIT		
	Polar donothy	PRE or CLR low	6		7				
t _W	Pulse duration	CLK	6		7		ns		
	Catura time a historia CLIVA	Data	6		7				
t _{su}	Setup time before CLK↑	PRE or CLR inactive	5		5		ns		
t _h	Hold time, data after CLK↑		0.5		0.5		ns		

timing requirements over recommended operating free-air temperature range, V_{CC} = 5 V \pm 0.5 V (unless otherwise noted) (see Figure 1)

			$T_A = 2$	25°C	MIN	BEAV		
		MIN	MAX	IVIIN	MAX	UNIT		
	Dulas direction	PRE or CLR low	5		5			
t _W	Pulse duration	CLK	5		5		ns	
	Satura tima hafara CLIVA	Data	5		5			
t _{su}	Setup time before CLK↑	PRE or CLR inactive	3		3		ns	
th	Hold time, data after CLK↑	0.5		0.5		ns		

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switching characteristics over recommended operating free-air temperature range, V_{CC} = 3.3 V \pm 0.3 V (unless otherwise noted) (see Figure 1)

DADAMETED	FROM	то	LOAD	T	λ = 25°C	;	BAINI	MAY	LINUT
PARAMETER	(INPUT)	(OUTPUT)	CAPACITANCE	MIN	TYP	MAX	MIN	MAX	UNIT
			C _L = 15 pF	80	125		70		N41.1-
fmax			C _L = 50 pF	50	75		45		MHz
t _{PLH}	PRE or CLR	0 5	0. 455		7.6	12.3	1	14.5	
t _{PHL}	PRE OF CLR	Q or Q	C _L = 15 pF		7.6	12.3	1	14.5	ns
t _{PLH}	0114	Q or Q	0 45 5		6.7	11.9	1	14	
^t PHL	CLK	Q or Q	C _L = 15 pF		6.7	11.9	1	14	ns
^t PLH	DDE OLD	0 5	0 50 5		10.1	15.8	1	18	
t _{PHL}	PRE or CLR	Q or Q	$C_L = 50 pF$		10.1	15.8	1	18	ns
^t PLH	CLK	Q or $\overline{\mathbb{Q}}$	C: - 50 pF		9.2	15.4	1	17.5	20
t _{PHL}	CLK	QUIQ	C _L = 50 pF		9.2	15.4	1	17.5	ns

switching characteristics over recommended operating free-air temperature range, V_{CC} = 5 V \pm 0.5 V (unless otherwise noted) (see Figure 1)

DADAMETED	FROM	то	LOAD	T,	<u> </u> = 25°C	;	84181	MAY	
PARAMETER	(INPUT)	(OUTPUT)	CAPACITANCE	MIN	TYP	MAX	MIN	MAX	UNIT
,			C _L = 15 pF	130	170		110		
f _{max}			C _L = 50 pF	90	115		75		MHz
^t PLH	PRE or CLR	0 5	0 45 = 5		4.8	7.7	1	9	
^t PHL	PRE OF CLR	Q or Q	C _L = 15 pF		4.8	7.7	1	9	ns
^t PLH	CLIK	0 5	0. 455		4.6	7.3	1	8.5	
^t PHL	CLK	Q or Q	C _L = 15 pF		4.6	7.3	1	8.5	ns
^t PLH	PRE or CLR	Q or $\overline{\mathbb{Q}}$	0. 50.5		6.3	9.7	1	11	
^t PHL	PRE OF CLR	Q or Q	C _L = 50 pF		6.3	9.7	1	11	ns
^t PLH	CLK	Q or $\overline{\mathbb{Q}}$	C _L = 50 pF		6.1	9.3	1	10.5	ns
^t PHL	OLK	QUIQ	CL = 30 pr		6.1	9.3	1	10.5	110

noise characteristics, $V_{CC} = 5 \text{ V}$, $C_L = 50 \text{ pF}$, $T_A = 25^{\circ}\text{C}$ (see Note 4)

	PARAMETER	MIN	MAX	UNIT
V _{OL(P)}	Quiet output, maximum dynamic V _{OL}		8.0	V
V _{OL(V)}	Quiet output, minimum dynamic V _{OL}		-0.8	V
VOH(V)	Quiet output, minimum dynamic VOH	4.7		V
VIH(D)	High-level dynamic input voltage	3.5		V
V _{IL(D)}	Low-level dynamic input voltage		1.5	V

NOTE 4: Characteristics are for surface-mount packages only.

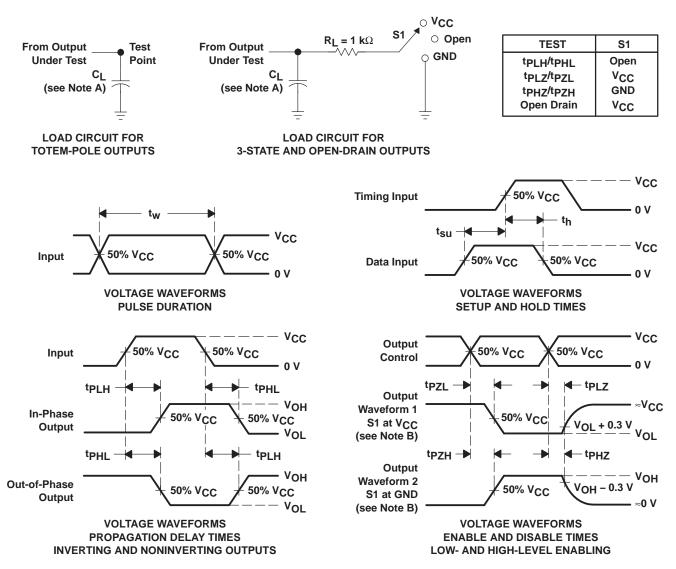
operating characteristics, V_{CC} = 5 V, T_A = 25°C

	PARAMETER	TEST C	ONDITIONS	TYP	UNIT
C _{pd}	Power dissipation capacitance	No load,	f = 1 MHz	32	pF



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PARAMETER MEASUREMENT INFORMATION



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 MHz, $Z_O = 50 \Omega$, $t_f \leq 3$ ns. $t_f \leq 3$ ns.
- D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms





PACKAGE OPTION ADDENDUM



10-Dec-2020

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead finish/ Ball material	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
							(6)				
SN74AHC74QDRG4Q1	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	AHC74Q	Samples
SN74AHC74QDRQ1	ACTIVE	SOIC	D	14	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	AHC74Q	Samples
SN74AHC74QPWRG4Q1	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	HA74Q	Samples
SN74AHC74QPWRQ1	ACTIVE	TSSOP	PW	14	2000	RoHS & Green	NIPDAU	Level-3-260C-168 HR	-40 to 125	HA74Q	Samples

(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 (CI) 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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10-Dec-2020

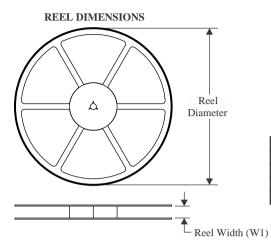
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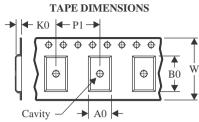
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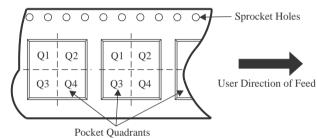
TAPE AND REEL INFORMATION





A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

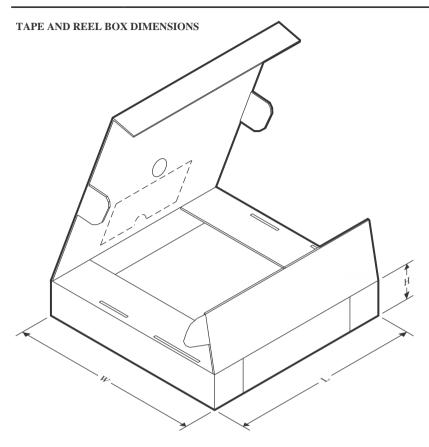


*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74AHC74QPWRG4Q1	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74AHC74QPWRQ1	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

PACKAGE MATERIALS INFORMATION

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*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74AHC74QPWRG4Q1	TSSOP	PW	14	2000	367.0	367.0	35.0
SN74AHC74QPWRQ1	TSSOP	PW	14	2000	356.0	356.0	35.0

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



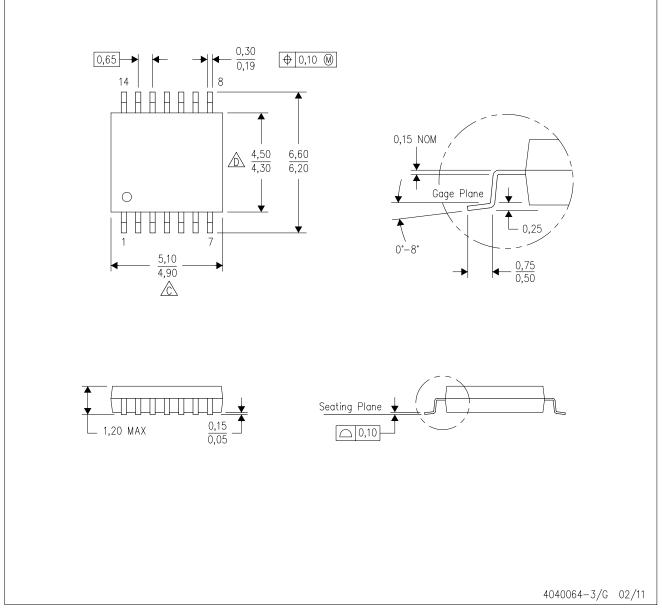
NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AB.



PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



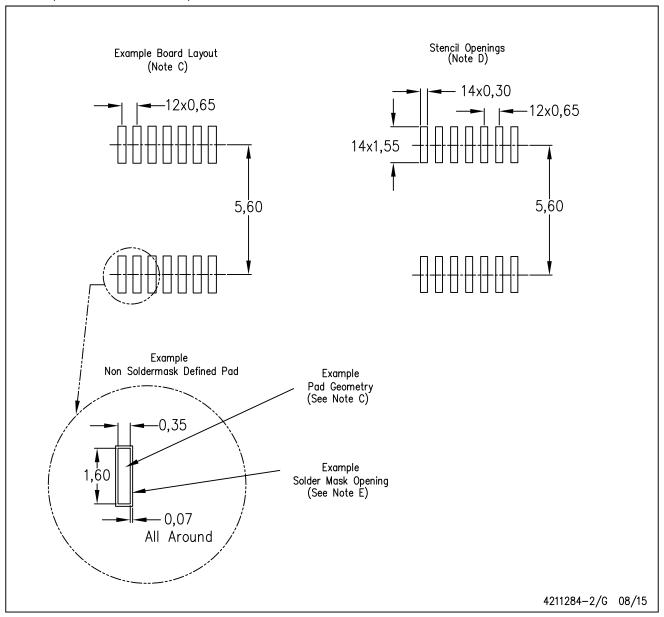
NOTES:

- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
 - Sody length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
- E. Falls within JEDEC MO-153



PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



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