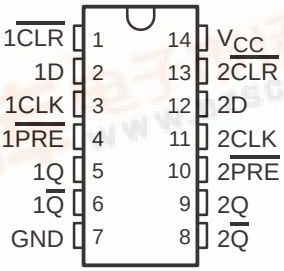
SN74HC74-Q1
DUAL D-TYPE POSITIVE-EDGE-TRIGGERED FLIP-FLOP WITH CLEAR AND PRESET

SCLS577 – MARCH 2004

- **Qualification in Accordance With AEC-Q100†**
- **Qualified for Automotive Applications**
- **Customer-Specific Configuration Control Can Be Supported Along With Major-Change Approval**
- **Wide Operating Voltage Range of 2 V to 6 V**
- **Outputs Can Drive Up To 10 LSTTL Loads**
- **Low Power Consumption, 80-μA Max I_{CC}**
- **Typical t_{pd} = 15 ns**
- **±4-mA Output Drive at 5 V**
- **Low Input Current of 1 μA Max**

† Contact factory for details. Q100 qualification data available on request.

D OR PW PACKAGE
(TOP VIEW)



description/ordering information

The SN74HC74 device contains two independent D-type positive-edge-triggered flip-flops. A low level at the preset ($\overline{PRE}$) or clear ($\overline{CLR}$) inputs sets or resets the outputs, regardless of the levels of the other inputs. When $\overline{PRE}$ and $\overline{CLR}$ are inactive (high), data at the data (D) input meeting the setup time requirements are transferred to the outputs on the positive-going edge of the clock (CLK) pulse. Clock triggering occurs at a voltage level and is not directly related to the rise time of CLK. Following the hold-time interval, data at the D input can be changed without affecting the levels at the outputs.

ORDERING INFORMATION

T_A	PACKAGE‡		ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 125°C	SOIC − D	Reel of 2500	SN74HC74QDRQ1	HC74Q
	TSSOP − PW	Reel of 2000	SN74HC74QPWRQ1	HC74Q

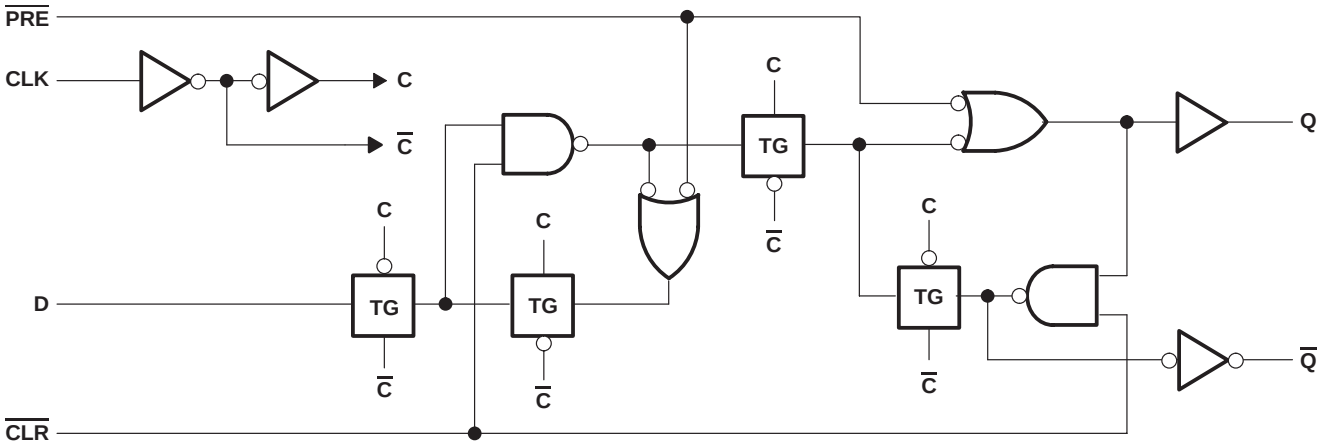
‡ Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

FUNCTION TABLE

INPUTS				OUTPUTS	
$\overline{PRE}$	$\overline{CLR}$	CLK	D	Q	$\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
L	L	X	X	H†	H†
H	H	↑	H	H	L
H	H	↑	L	L	H
H	H	L	X	Q_0	$\overline{Q}_0$

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

logic diagram (positive logic)



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

Supply voltage range, V_{CC} . . . . . −0.5 V to 7 V
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) (see Note 1) . . . . . ±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) (see Note 1) . . . . . ±20 mA
Continuous output current, I_O (V_O = 0 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_{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.

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.

recommended operating conditions (see Note 3)

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		2	5	6	V
V_{IH}	High-level input voltage	V_{CC} = 2 V	1.5			V
		V_{CC} = 4.5 V	3.15			
		V_{CC} = 6 V	4.2			
V_{IL}	Low-level input voltage	V_{CC} = 2 V			0.5	V
		V_{CC} = 4.5 V			1.35	
		V_{CC} = 6 V			1.8	
V_I	Input voltage		0		V_{CC}	V
V_O	Output voltage		0		V_{CC}	V
$\Delta t/\Delta v$	Input transition rise/fall time	V_{CC} = 2 V			1000	ns
		V_{CC} = 4.5 V			500	
		V_{CC} = 6 V			400	
T_A	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.

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

PARAMETER	TEST CONDITIONS		V_{CC}	T_A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
V_{OH}	$V_I = V_{IH}$ or V_{IL}	I_{OH} = −20 μA	2 V	1.9	1.998		1.9		V
			4.5 V	4.4	4.499		4.4		
			6 V	5.9	5.999		5.9		
		I_{OH} = −4 mA	4.5 V	3.98	4.3		3.7		
		I_{OH} = −5.2 mA	6 V	5.48	5.8		5.2		
V_{OL}	$V_I = V_{IH}$ or V_{IL}	I_{OL} = 20 μA	2 V		0.002	0.1		0.1	V
			4.5 V		0.001	0.1		0.1	
			6 V		0.001	0.1		0.1	
		I_{OL} = 4 mA	4.5 V		0.17	0.26		0.4	
		I_{OL} = 5.2 mA	6 V		0.15	0.26		0.4	
I_I	$V_I = V_{CC}$ or 0		6 V		±0.1	±100		±1000	nA
I_{CC}	$V_I = V_{CC}$ or 0,	I_O = 0	6 V			4		80	μA
C_i			2 V to 6 V		3	10		10	pF

timing requirements over recommended operating free-air temperature range (unless otherwise noted)

			V_{CC}	T_A = 25°C		MIN	MAX	UNIT
				MIN	MAX			
f_{clock}	Clock frequency		2 V		6		4.2	MHz
			4.5 V		31		21	
			6 V	0	36	0	25	
t_w	Pulse duration	$\overline{PRE}$ or $\overline{CLR}$ low	2 V	100		150		ns
			4.5 V	20		30		
			6 V	17		25		
		CLK high or low	2 V	80		120		
			4.5 V	16		24		
			6 V	14		20		
t_{su}	Setup time before CLK↑	Data	2 V	100		150		ns
			4.5 V	20		30		
			6 V	17		25		
		$\overline{PRE}$ or $\overline{CLR}$ inactive	2 V	25		40		
			4.5 V	5		8		
			6 V	4		7		
t_h	Hold time, data after CLK↑		2 V	0		0		ns
			4.5 V	0		0		
			6 V	0		0		

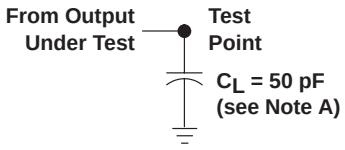
switching characteristics over recommended operating free-air temperature range, C_L = 50 pF (unless otherwise noted) (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			MIN	MAX	UNIT
				MIN	TYP	MAX			
f_{max}			2 V	6	10		4.2		MHz
			4.5 V	31	50		21		
			6 V	36	60		25		
t_{pd}	$\overline{PRE}$ or $\overline{CLR}$	Q or $\overline{Q}$	2 V		70	230		345	ns
			4.5 V		20	46		69	
			6 V		15	39		59	
	CLK	Q or $\overline{Q}$	2 V		70	175		250	
			4.5 V		20	35		50	
			6 V		15	30		42	
t_t		Q or $\overline{Q}$	2 V		28	75		110	ns
			4.5 V		8	15		22	
			6 V		6	13		19	

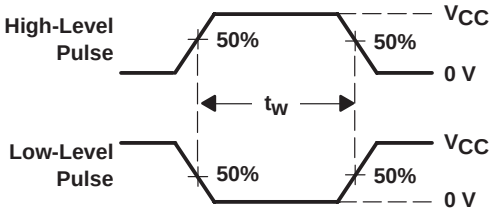
operating characteristics, T_A = 25°C

PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance per flip-flop	No load	35	pF

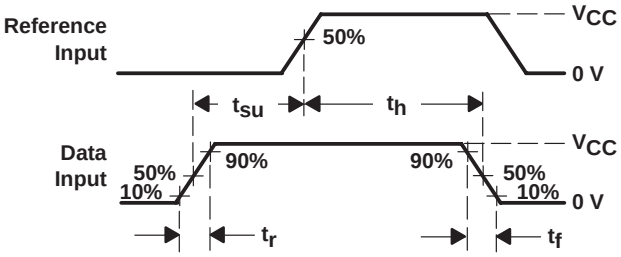
PARAMETER MEASUREMENT INFORMATION



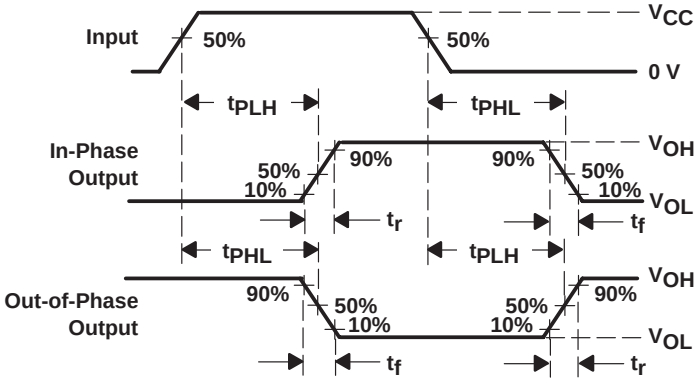
LOAD CIRCUIT



VOLTAGE WAVEFORMS
PULSE DURATIONS



VOLTAGE WAVEFORMS
SETUP AND HOLD AND INPUT RISE AND FALL TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY AND OUTPUT TRANSITION TIMES

NOTES: A. C_L includes probe and test-fixture capacitance.
B. Phase relationships between waveforms were chosen arbitrarily. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r = 6 ns, t_f = 6 ns.
C. For clock inputs, f_{max} is measured when the input duty cycle is 50%.
D. The outputs are measured one at a time, with one input transition per measurement.
E. t_{PLH} and t_{PHL} are the same as t_{pd}.

Figure 1. Load Circuit and Voltage Waveforms

PACKAGE OPTION ADDENDUM

27-Jan-2006

PACKAGING INFORMATION

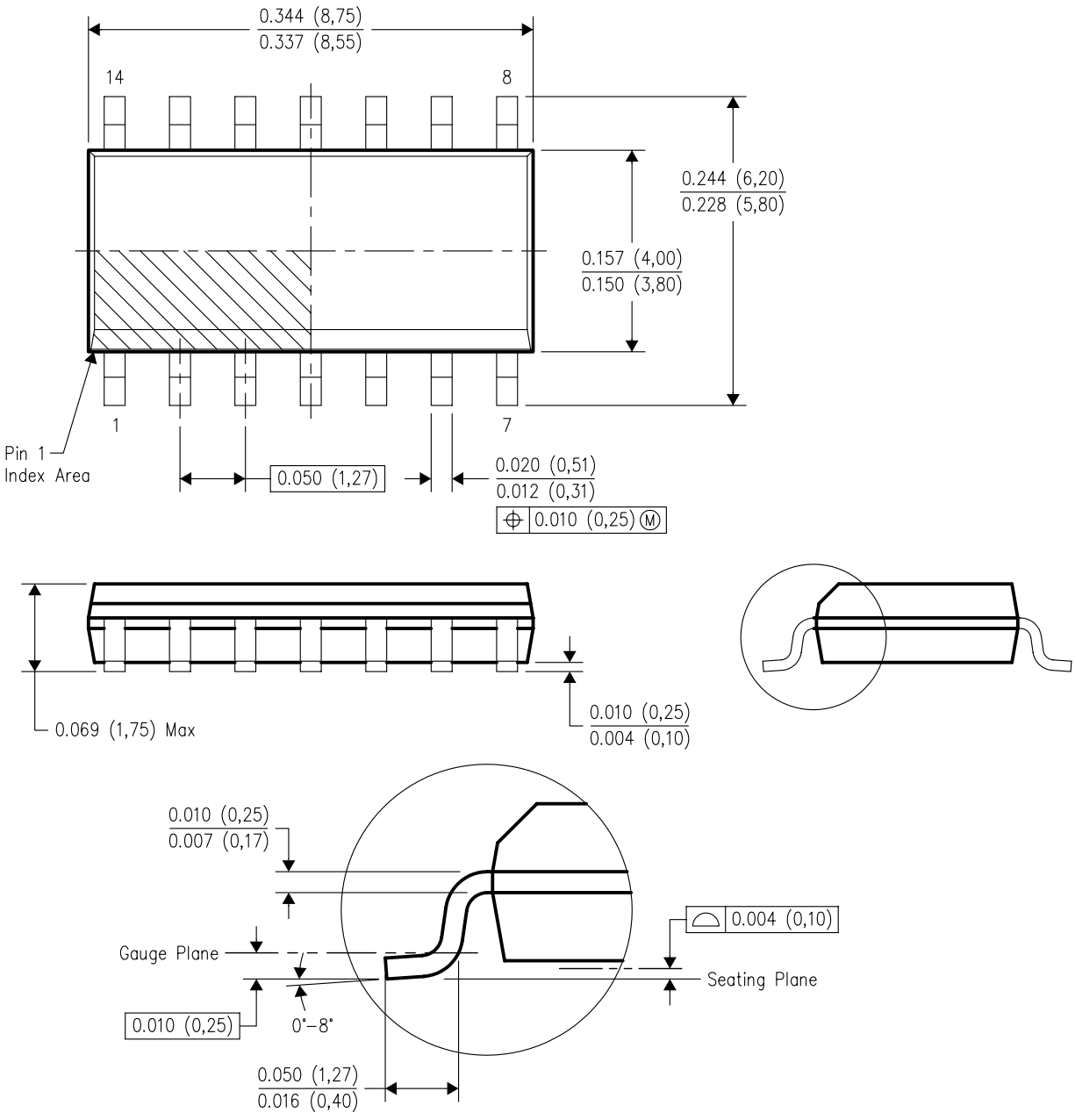
Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
SN74HC74QDRQ1	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
SN74HC74QPWRQ1	ACTIVE	TSSOP	PW	14	2000	Pb-Free (RoHS)	CU NIPDAU	Level-1-250C-UNLIM

(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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

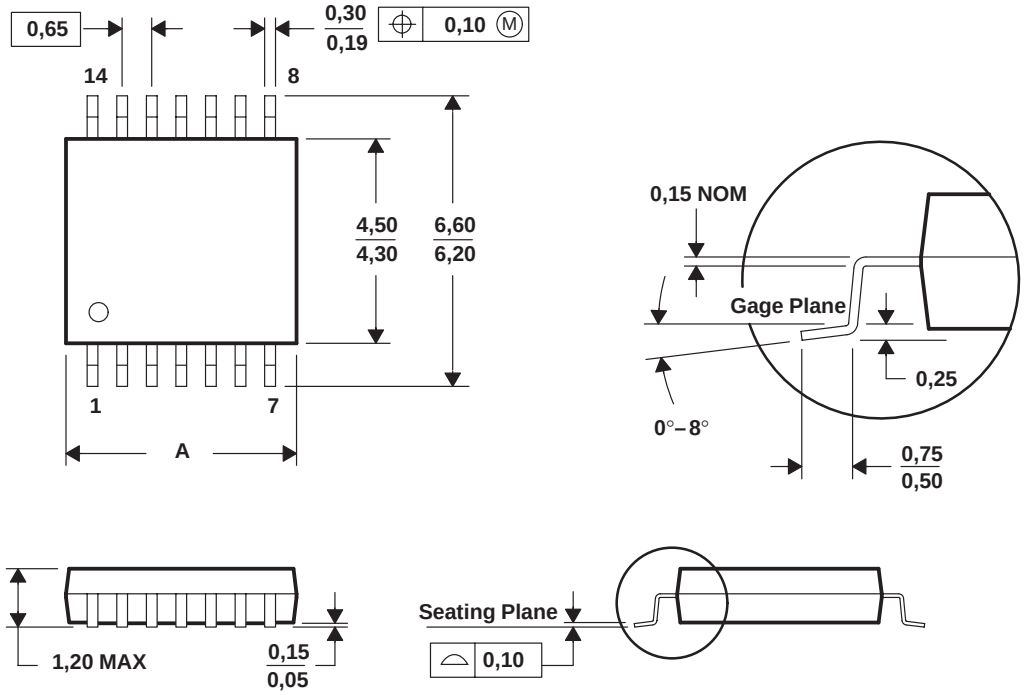
D (R–PDSO–G14) PLASTIC SMALL–OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–012 variation AB.

PW (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14 PINS SHOWN



DIM \ PINS **	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

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NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

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