Dual D-Type Flip-Flop with Set and Reset

The MC74VHC74 is an advanced high speed CMOS D-type flip-flop fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The signal level applied to the D input is transferred to Q output during the positive going transition of the Clock pulse.

Reset (\overline{RD}) and Set (\overline{SD}) are independent of the Clock (CP) and are accomplished by setting the appropriate input Low.

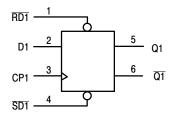
The internal circuit is composed of three stages, including a buffer output which provides high noise immunity and stable output. The inputs tolerate voltages up to 7.0 V, allowing the interface of 5.0 V systems to 3.0 V systems.

Features

- High Speed: $f_{max} = 170MHz$ (Typ) at $V_{CC} = 5V$
- Low Power Dissipation: $I_{CC} = 2\mu A$ (Max) at $T_A = 25^{\circ}C$
- High Noise Immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2.0 V to 5.5 V Operating Range
- Low Noise: $V_{OLP} = 0.8 \text{ V (Max)}$
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance:

Human Body Model > 2000 V; Machine Model > 200 V

- Chip Complexity: 128 FETs or 32 Equivalent Gates
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb–Free, Halogen Free/BFR Free and are RoHS Compliant



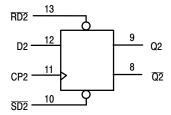


Figure 1. LOGIC DIAGRAM



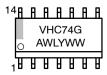
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MARKING DIAGRAMS



SOIC-14 D SUFFIX CASE 751A





TSSOP-14 DT SUFFIX CASE 948G



A = Assembly Location

WL, L = Wafer Lot Y, YY = Year

WW, W = Work Week
G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

FUNCTION TABLE

	Inputs				puts
SD	RD	CP	D	Q	Ø
L	Н	Х	Χ	Н	Г
н	L	Χ	X	L	Н
L	L	Χ	X	H*	H*
H	Н	\mathcal{L}	Н	Н	L
H	Н	\mathcal{L}	L	L	Н
Н	Н	L	Χ	No Cl	nange
H	Н	Н	X	No Cl	nange
Н	Н	~	Χ	No Cl	nange

^{*}Both outputs will remain high as long as Set and Reset are low, but the output states are unpredictable if Set and Reset go high simultaneously.

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

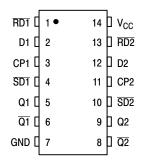


Figure 2. PIN ASSIGNMENT

MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V _{CC}	DC Supply Voltage		- 0.5 to + 7.0	V
V _{in}	DC Input Voltage		- 0.5 to + 7.0	V
V _{out}	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	V	
I _{IK}	Input Diode Current		-20	mA
lok	Output Diode Current		±20	mA
l _{out}	DC Output Current, per Pin		±25	mA
I _{CC}	DC Supply Current, V _{CC} and GND Pins		±50	mA
P _D	Power Dissipation in Still Air, SOIC Pac TSSOP Pa		500 450	mW
T _{stg}	Storage Temperature		-65 to +150	°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high–impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range GND \leq (V_{in} or V_{out}) \leq V_{CC} .

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

†Derating SOIC Packages: – 7 mW/°C from 65° to 125°C

TSSOP Package: - 6.1 mW/°C from 65° to 125°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V _{CC}	DC Supply Voltage	2.0	5.5	V
V _{in}	DC Input Voltage	0	5.5	V
V _{out}	DC Output Voltage	0	V _{CC}	V
T _A	Operating Temperature, All Package Types	-55	+ 125	°C
t _r , t _f	Input Rise and Fall Time $ V_{CC} = 3.3 V \pm 0.3 V \\ V_{CC} = 5.0 V \pm 0.5 V $	0	100 20	ns/V

DC ELECTRICAL CHARACTERISTICS

			V _{CC}		T _A = 25°C	;	T _A = -55°C	to +125°C	
Symbol	Parameter	Test Conditions	v	Min	Тур	Max	Min	Max	Unit
V _{IH}	Minimum High-Level Input Voltage		2.0 3.0 to 5.5	1.50 V _{CC} x 0.7			1.50 V _{CC} x 0.7		V
V _{IL}	Maximum Low-Level Input Voltage		2.0 3.0 to 5.5			0.50 V _{CC} x 0.3		0.50 V _{CC} x 0.3	V
V _{OH}	Minimum High-Level Output Voltage	$V_{in} = V_{IH} \text{ or } V_{IL}$ $I_{OH} = -50 \mu A$	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5		1.9 2.9 4.4		V
		$\begin{aligned} V_{in} &= V_{IH} \text{ or } V_{IL} \\ I_{OH} &= -4\text{mA} \\ I_{OH} &= -8\text{mA} \end{aligned}$	3.0 4.5	2.58 3.94			2.48 3.80		
V _{OL}	Maximum Low-Level Output Voltage	$V_{in} = V_{IH} \text{ or } V_{IL}$ $I_{OL} = 50 \mu A$	2.0 3.0 4.5		0.0 0.0 0.0	0.1 0.1 0.1		0.1 0.1 0.1	V
		$V_{in} = V_{IH}$ or V_{IL} $I_{OL} = 4mA$ $I_{OL} = 8mA$	3.0 4.5			0.36 0.36		0.44 0.44	
I _{in}	Maximum Input Leakage Current	V _{in} = 5.5V or GND	0 to 5.5			± 0.1		± 1.0	μΑ
I _{CC}	Maximum Quiescent Supply Current	V _{in} = V _{CC} or GND	5.5			2.0		20.0	μΑ

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0 \text{ns}$)

					T _A = 25°C		T _A = -55°C to +125°C		
Symbol	Parameter	Test Condi	tions	Min	Тур	Max	Min	Max	Unit
t _{PLH} , t _{PHL}	Maximum Propagation Delay, CP to Q or Q	$V_{CC} = 3.3 \pm 0.3 V$	C _L = 15pF C _L = 50pF		6.7 9.2	11.9 15.4	1.0 1.0	14.0 17.5	ns
		$V_{CC} = 5.0 \pm 0.5 V$	C _L = 15pF C _L = 50pF		4.6 6.1	7.3 9.3	1.0 1.0	8.5 10.5	
t _{PLH} , t _{PHL}	Maximum Propagation Delay, SD or RD to Q or Q	$V_{CC} = 3.3 \pm 0.3 V$	C _L = 15pF C _L = 50pF		7.6 10.1	12.3 15.8	1.0 1.0	14.5 18.0	ns
		$V_{CC} = 5.0 \pm 0.5 V$	C _L = 15pF C _L = 50pF		4.8 6.3	7.7 9.7	1.0 1.0	9.0 11.0	
f _{max}	Maximum Clock Frequency (50% Duty Cycle)	$V_{CC} = 3.3 \pm 0.3 V$	C _L = 15pF C _L = 50pF	80 50	125 75		70 45		MHz
		$V_{CC} = 5.0 \pm 0.5 V$	$C_L = 15pF$ $C_L = 50pF$	130 90	170 115		110 75		
C _{in}	Maximum Input Capacitance				4	10		10	pF

		Typical @ 25°C, V _{CC} = 5.0V	
C _{PD}	Power Dissipation Capacitance (Note 1)	25	pF

^{1.} C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I_{CC(OPR)} = C_{PD} • V_{CC} • f_{in} + I_{CC}/2 (per flip-flop). C_{PD} is used to determine the no–load dynamic power consumption; P_D = C_{PD} • V_{CC}² • f_{in} + I_{CC} • V_{CC}.

TIMING REQUIREMENTS (Input $t_r = t_f = 3.0 \text{ns}$)

			V _{CC} Guaranteed Limit		
Symbol	Parameter	V	T _A = 25°C	T _A = -55°C to +125°C	Unit
t _w	Minimum Pulse Width, CP	$3.3 \pm 0.3 \\ 5.0 \pm 0.5$	6.0 5.0	7.0 5.0	ns
t _w	Minimum Pulse Width, RD or SD	$3.3 \pm 0.3 \\ 5.0 \pm 0.5$	6.0 5.0	7.0 5.0	ns
t _{su}	Minimum Setup Time, D to CP	3.3 ± 0.3 5.0 ± 0.5	6.0 5.0	7.0 5.0	ns
t _h	Minimum Hold Time, D to CP	3.3 ± 0.3 5.0 ± 0.5	0.5 0.5	0.5 0.5	ns
t _{rec}	Minimum Recovery Time, SD or RD to CP	3.3 ± 0.3 5.0 ± 0.5	5.0 3.0	5.0 3.0	ns

ORDERING INFORMATION

Device	Package	Shipping [†]
MC74VHC74DR2G	SOIC-14 (Pb-Free)	2500 / Tape & Reel
MC74VHC74DTG	TSSOP-14 (Pb-Free)	96 Units / Rail
MC74VHC74DTR2G	TSSOP-14 (Pb-Free)	2500 / Tape & Reel
NLV74VHC74DTR2G*	TSSOP-14 (Pb-Free)	2500 / Tape & Reel

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP

Capable.

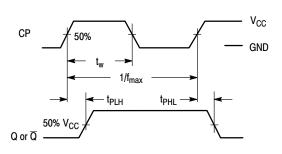


Figure 3.

Figure 4.

Switching Waveforms

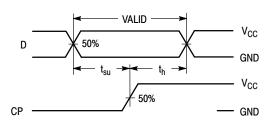
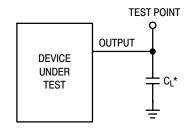


Figure 5.



*Includes all probe and jig capacitance

Figure 6.

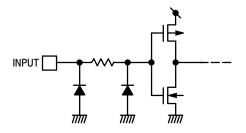


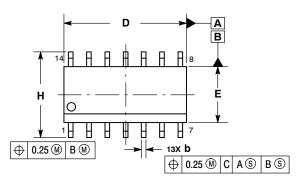
Figure 7. Input Equivalent Circuit



△ 0.10

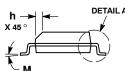
SOIC-14 NB CASE 751A-03 ISSUE L

DATE 03 FEB 2016









- NOTES:
 1. DIMENSIONING AND TOLERANCING PER
 - ASME Y14.5M, 1994.
 CONTROLLING DIMENSION: MILLIMETERS.
 - DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT
- MAXIMUM MATERIAL CONDITION.
 DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
- 5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE

	MILLIN	IETERS	INCHES		
DIM	MIN	MAX	MIN	MAX	
Α	1.35	1.75	0.054	0.068	
A1	0.10	0.25	0.004	0.010	
АЗ	0.19	0.25	0.008	0.010	
b	0.35	0.49	0.014	0.019	
D	8.55	8.75	0.337	0.344	
Е	3.80	4.00	0.150	0.157	
e	1.27	BSC	0.050 BSC		
Н	5.80	6.20	0.228	0.244	
h	0.25	0.50	0.010	0.019	
L	0.40	1.25	0.016	0.049	
М	0 °	7°	0 °	7 °	

GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code Α = Assembly Location

WL = Wafer Lot Υ = Year WW = Work Week G = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator. "G" or microdot " ■". may or may not be present.

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DIMENSIONS: MILLIMETERS

C SEATING PLANE

STYLES ON PAGE 2

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^{*}For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

SOIC-14 CASE 751A-03 ISSUE L

DATE 03 FEB 2016

STYLE 1: PIN 1. COMMON CATHODE 2. ANODE/CATHODE 3. ANODE/CATHODE 4. NO CONNECTION 5. ANODE/CATHODE 6. NO CONNECTION 7. ANODE/CATHODE 8. ANODE/CATHODE 9. ANODE/CATHODE 10. NO CONNECTION 11. ANODE/CATHODE 12. ANODE/CATHODE 13. NO CONNECTION 14. COMMON ANODE	STYLE 2: CANCELLED	STYLE 3: PIN 1. NO CONNECTION 2. ANODE 3. ANODE 4. NO CONNECTION 5. ANODE 6. NO CONNECTION 7. ANODE 8. ANODE 9. ANODE 10. NO CONNECTION 11. ANODE 12. ANODE 13. NO CONNECTION 14. COMMON CATHODE	STYLE 4: PIN 1. NO CONNECTION 2. CATHODE 3. CATHODE 4. NO CONNECTION 5. CATHODE 6. NO CONNECTION 7. CATHODE 8. CATHODE 9. CATHODE 10. NO CONNECTION 11. CATHODE 12. CATHODE 13. NO CONNECTION 14. COMMON ANODE
STYLE 5: PIN 1. COMMON CATHODE 2. ANODE/CATHODE 3. ANODE/CATHODE 4. ANODE/CATHODE 5. ANODE/CATHODE 6. NO CONNECTION 7. COMMON ANODE 8. COMMON CATHODE 9. ANODE/CATHODE 10. ANODE/CATHODE 11. ANODE/CATHODE 12. ANODE/CATHODE 13. NO CONNECTION 14. COMMON ANODE	STYLE 6: PIN 1. CATHODE 2. CATHODE 3. CATHODE 4. CATHODE 5. CATHODE 6. CATHODE 7. CATHODE 8. ANODE 9. ANODE 10. ANODE 11. ANODE 12. ANODE 13. ANODE 14. ANODE	STYLE 7: PIN 1. ANODE/CATHODE 2. COMMON ANODE 3. COMMON CATHODE 4. ANODE/CATHODE 5. ANODE/CATHODE 6. ANODE/CATHODE 7. ANODE/CATHODE 8. ANODE/CATHODE 9. ANODE/CATHODE 10. ANODE/CATHODE 11. COMMON CATHODE 12. COMMON ANODE 13. ANODE/CATHODE 14. ANODE/CATHODE	STYLE 8: PIN 1. COMMON CATHODE 2. ANODE/CATHODE 3. ANODE/CATHODE 4. NO CONNECTION 5. ANODE/CATHODE 6. ANODE/CATHODE 7. COMMON ANODE 8. COMMON ANODE 9. ANODE/CATHODE 10. ANODE/CATHODE 11. NO CONNECTION 12. ANODE/CATHODE 13. ANODE/CATHODE 14. COMMON CATHODE

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DATE 17 FEB 2016

- NOTES.

 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

 2. CONTROLLING DIMENSION: MILLIMETER.

 3. DIMENSION A DOES NOT INCLUDE MOLD
- FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
 DIMENSION B DOES NOT INCLUDE
- INTERLEAD FLASH OR PROTRUSION.
 INTERLEAD FLASH OR PROTRUSION SHALL
- INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.

 5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.

 6. TERMINAL NUMBERS ARE SHOWN FOR DEFERENCE ONLY.
- REFERENCE ONLY.
 DIMENSION A AND B ARE TO BE
- DETERMINED AT DATUM PLANE -W-.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
Α	4.90	5.10	0.193	0.200
В	4.30	4.50	0.169	0.177
С		1.20		0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
Н	0.50	0.60	0.020	0.024
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
М	0°	8 °	0 °	8 °

GENERIC MARKING DIAGRAM*



= Assembly Location

= Wafer Lot ٧ = Year

W = Work Week

= Pb-Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot " ■", may or may not be present.

◀	7.06
1	
	
	0.65
, <u> </u>	— — — • • • • • • • • • • • • • • • • • • •
14X	─
0.36 14X 1.26	DIMENSIONS: MILLIMETERS

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