

# Octal 3-State Non-Inverting D Flip-Flop

## High-Performance Silicon-Gate CMOS

# **MC74HC374A, MC74HCT374A**

The MC74HC374A/MC74HCT374A is identical in pinout to the LS374. The MC74HC374A inputs are compatible with standard CMOS outputs; with pull-up resistors, they are compatible with LSTTL outputs. The MC74HCT374A may be used as a level converter for interfacing TTL or NMOS outputs to High Speed CMOS inputs.

Data meeting the set-up time is clocked to the outputs with the rising edge of the Clock. The Output Enable input does not affect the states of the flip-flops but when Output Enable is high, all device outputs are forced to the high-impedance state. Thus, data may be stored even when the outputs are not enabled.

The HC374A/HCT374A is identical in function to the HC574A/HCT574A which has the input pins on the opposite side of the package from the output. This device is similar in function to the HC534A/HCT534A which has inverting outputs.

## Features

- Output Drive Capability: 15 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2.0 to 6.0 V (HC), 4.5 to 5.5 V (HCT)
- Low Input Current: 1.0  $\mu$ A
- High Noise Immunity Characteristic of CMOS Devices
- In Compliance with the Requirements Defined by JEDEC Standard No. 7 A
- Chip Complexity: 276 FETs or 69 Equivalent Gates
- -Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant



**SOIC-20  
DW SUFFIX  
CASE 751D**

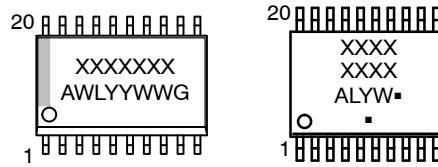


**TSSOP-20  
DT SUFFIX  
CASE 948E**

## PIN ASSIGNMENT

OUTPUT			
ENABLE	1•	20	V <sub>CC</sub>
Q0	2	19	Q7
D0	3	18	D7
D1	4	17	D6
Q1	5	16	Q6
Q2	6	15	Q5
D2	7	14	D5
D3	8	13	D4
Q3	9	12	Q4
GND	10	11	CLOCK

## MARKING DIAGRAMS



(Note: Microdot may be in either location)

## FUNCTION TABLE

Inputs		Output	
Output Enable	Clock	D	Q
L	/	H	H
L	/	L	L
L	L,H,\	X	No Change
H	X	X	Z

X = don't care

Z = high impedance

## ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

## MC74HC374A, MC74HCT374A

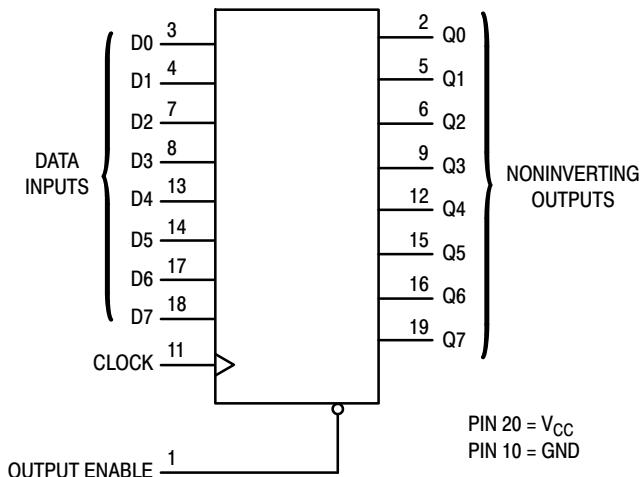


Figure 1. Logic Diagram

### MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	DC Supply Voltage	-0.5 to +6.5	V
V <sub>IN</sub>	DC Input Voltage	-0.5 to V <sub>CC</sub> +0.5	V
V <sub>OUT</sub>	DC Output Voltage	-0.5 to V <sub>CC</sub> +0.5	V
I <sub>IN</sub>	DC Input Diode Current, per Pin	±20	mA
I <sub>OUT</sub>	DC Input Diode Current, Per Pin	±35	mA
I <sub>CC</sub>	DC Supply Current, V <sub>CC</sub> and GND Pins	±75	mA
I <sub>IK</sub>	Input Clamp Current (V <sub>IN</sub> < 0 or V <sub>IN</sub> > V <sub>CC</sub> )	±20	mA
I <sub>OK</sub>	Output Clamp Current (V <sub>OUT</sub> < 0 or V <sub>OUT</sub> > V <sub>CC</sub> )	±20	mA
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 secs	260	°C
T <sub>J</sub>	Junction Temperature Under Bias	+150	°C
θ <sub>JA</sub>	Thermal Resistance (Note 1)	96 99 111 150	°C/W
P <sub>D</sub>	Power Dissipation in Still Air at 25°C	1302 1256 1127 833	mW
MSL	Moisture Sensitivity	SOIC-20W All Other Packages	Level 3 Level 1
F <sub>R</sub>	Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in
V <sub>ESD</sub>	ESD Withstand Voltage (Note 2)	Human Body Model Charged Device Model	> 2000 > 1000

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.

1. Measured with minimum pad spacing on an FR4 board, using 76 mm-by-114 mm, 2-ounce copper trace no air flow per JESD51-7.
2. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.

# MC74HC374A, MC74HCT374A

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit	
<b>MC74HC</b>					
$V_{CC}$	DC Supply Voltage	2.0	6.0	V	
$V_{IN}, V_{OUT}$	DC Input Voltage, Output Voltage (Note 3)	0	$V_{CC}$	V	
$T_A$	Operating Free-Air Temperature	-55	+125	°C	
$t_r, t_f$	Input Rise or Fall Time	$V_{CC} = 2.0\text{ V}$ $V_{CC} = 4.5\text{ V}$ $V_{CC} = 6.0\text{ V}$	0 0 0	1000 500 400	ns
<b>MC74HCT</b>					
$V_{CC}$	DC Supply Voltage	4.5	5.5	V	
$V_{IN}, V_{OUT}$	DC Input Voltage, Output Voltage (Note 3)	0	$V_{CC}$	V	
$T_A$	Operating Free-Air Temperature	-55	+125	°C	
$t_r, t_f$	Input Rise or Fall Time	0	500	ns	

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

3. 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.

## DC ELECTRICAL CHARACTERISTICS (MC74HC374A)

Symbol	Parameter	Test Conditions	$V_{CC}$ V	Guaranteed Limit			Unit
				-55 to 25°C	≤ 85°C	≤ 125°C	
$V_{IH}$	Minimum High-Level Input Voltage	$V_{out} = 0.1\text{ V}$ or $V_{CC} - 0.1\text{ V}$ $ I_{out}  \leq 20\text{ }\mu\text{A}$	2.0 3.0 4.5 6.0	1.50 2.10 3.15 4.20	1.50 2.10 3.15 4.20	1.50 2.10 3.15 4.20	V
$V_{IL}$	Maximum Low-Level Input Voltage	$V_{out} = 0.1\text{ V}$ or $V_{CC} - 0.1\text{ V}$ $ I_{out}  \leq 20\text{ }\mu\text{A}$	2.0 3.0 4.5 6.0	0.50 0.90 1.35 1.80	0.50 0.90 1.35 1.80	0.50 0.90 1.35 1.80	V
$V_{OH}$	Minimum High-Level Output Voltage	$V_{in} = V_{IH}$ or $V_{IL}$ $ I_{out}  \leq 20\text{ }\mu\text{A}$	2.0 4.5 6.0	1.90 4.40 5.90	1.90 4.40 5.90	1.90 4.40 5.90	V
		$V_{in} = V_{IH}$ or $V_{IL}$ $ I_{out}  \leq 2.4\text{ mA}$ $ I_{out}  \leq 6.0\text{ mA}$ $ I_{out}  \leq 7.8\text{ mA}$	3.0 4.5 6.0	2.48 2.98 5.48	2.34 3.84 5.34	2.20 3.70 5.20	V
$V_{OL}$	Maximum Low-Level Output Voltage	$V_{in} = V_{IH}$ or $V_{IL}$ $ I_{out}  \leq 20\text{ }\mu\text{A}$	2.0 4.5 6.0	0.10 0.10 0.10	0.10 0.10 0.10	0.10 0.10 0.10	V
		$V_{in} = V_{IH}$ or $V_{IL}$ $ I_{out}  \leq 2.4\text{ mA}$ $ I_{out}  \leq 6.0\text{ mA}$ $ I_{out}  \leq 7.8\text{ mA}$	3.0 4.5 6.0	0.26 0.26 0.26	0.33 0.33 0.33	0.40 0.40 0.40	V
$I_{in}$	Maximum Input Leakage Current	$V_{in} = V_{CC}$ or GND	6.0	$\pm 0.1$	$\pm 1.0$	$\pm 1.0$	$\mu\text{A}$
$I_{OZ}$	Maximum Three-State Leakage Current	Output in High-Impedance State $V_{in} = V_{IL}$ or $V_{IH}$ $V_{out} = V_{CC}$ or GND	6.0	$\pm 0.5$	$\pm 5.0$	$\pm 10$	$\mu\text{A}$
$I_{CC}$	Maximum Quiescent Supply Current (per Package)	$V_{in} = V_{CC}$ or GND $I_{out} = 0\text{ }\mu\text{A}$	6.0	4	40	160	$\mu\text{A}$

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

# MC74HC374A, MC74HCT374A

## AC ELECTRICAL CHARACTERISTICS (MC74HC374A)

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit	
			-55 to 25°C	≤ 85°C	≤ 125°C		
f <sub>max</sub>	Maximum Clock Frequency (50% Duty Cycle)	2.0 3.0 4.5 6.0	6 15 30 35	5 10 24 28	4 8 20 24	MHz	
t <sub>PLH</sub> t <sub>PHL</sub>	Maximum Propagation Delay, Input Clock to Q (Figures 2 and 3)	2.0 3.0 4.5 6.0	125 80 25 21	155 110 31 26	190 130 38 32	ns	
t <sub>PLZ</sub> t <sub>PHZ</sub>	Maximum Propagation Delay, Output Enable to Q (Figures 2 and 4)	2.0 3.0 4.5 6.0	150 100 30 26	190 125 38 33	225 150 45 38	ns	
t <sub>PZL</sub> t <sub>PZH</sub>	Maximum Propagation Delay, Output Enable to Q (Figures 2 and 4)	2.0 3.0 4.5 6.0	150 100 30 26	190 125 38 33	225 150 45 38	ns	
t <sub>TLH</sub> t <sub>THL</sub>	Maximum Output Transition Time, Any Output (Figures 2 and 3)	2.0 3.0 4.5 6.0	75 27 15 13	95 32 19 16	110 36 22 19	ns	
C <sub>in</sub>	Maximum Input Capacitance			10	10	10	pF
C <sub>out</sub>	Maximum Three-State Output Capacitance (Output in High-Impedance State)			15	15	15	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Per Enabled Output)*	Typical @ 25°C, V <sub>CC</sub> = 5.0 V				pF	
		34					

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

\*Used to determine the no-load dynamic power consumption: P<sub>D</sub> = C<sub>PD</sub> V<sub>CC</sub><sup>2</sup>f + I<sub>CC</sub> V<sub>CC</sub>.

## TIMING REQUIREMENTS (MC74HC374A)

Symbol	Parameter	Figure	V <sub>CC</sub> V	Guaranteed Limit						Unit	
				-55 to 25°C		≤ 85°C		≤ 125°C			
				Min	Max	Min	Max	Min	Max		
t <sub>su</sub>	Minimum Setup Time, Data to Clock	5	2.0 3.0 4.5 6.0	50 40 10 9		65 50 13 11		75 60 15 13		ns	
t <sub>h</sub>	Minimum Hold Time, Clock to Data	5	2.0 3.0 4.5 6.0	5.0 5.0 5.0 5.0		5.0 5.0 5.0 5.0		5.0 5.0 5.0 5.0		ns	
t <sub>w</sub>	Minimum Pulse Width, Clock	2	2.0 3.0 4.5 6.0	60 23 12 10		75 27 15 13		90 32 18 15		ns	
t <sub>r</sub> , t <sub>f</sub>	Maximum Input Rise and Fall Times	2	2.0 3.0 4.5 6.0		1000 800 500 400			1000 800 500 400		ns	

# MC74HC374A, MC74HCT374A

## DC ELECTRICAL CHARACTERISTICS (MC74HCT374A)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	Guaranteed Limit			Unit
				−55 to 25°C	≤ 85°C	≤ 125°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage	V <sub>out</sub> = 0.1 V or V <sub>CC</sub> − 0.1 V  I <sub>out</sub>   ≤ 20 μA	4.5 5.5	2.0 2.0	2.0 2.0	2.0 2.0	V
V <sub>IL</sub>	Maximum Low-Level Input Voltage	V <sub>out</sub> = 0.1 V or V <sub>CC</sub> − 0.1 V  I <sub>out</sub>   ≤ 20 μA	4.5 5.5	0.8 0.8	0.8 0.8	0.8 0.8	V
V <sub>OH</sub>	Minimum High-Level Output Voltage	V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 20 μA	4.5 5.5	4.4 5.4	4.4 5.4	4.4 5.4	V
		V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 6.0 mA	4.5	3.98	3.84	3.7	
V <sub>OL</sub>	Maximum Low-Level Output Voltage	V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 20 μA	4.5 5.5	0.1 0.1	0.1 0.1	0.1 0.1	μA
		V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub>  I <sub>out</sub>   ≤ 6.0 mA	4.5	0.26	0.33	0.4	
I <sub>in</sub>	Maximum Input Leakage Current	V <sub>in</sub> = V <sub>CC</sub> or GND	5.5	±0.1	±1.0	±1.0	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current (per Package)	V <sub>in</sub> = V <sub>CC</sub> or GND I <sub>out</sub> = 0 μA	5.5	4.0	40	160	μA
I <sub>OZ</sub>	Maximum Three-State Leakage Current	V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> (Note 4) V <sub>out</sub> = V <sub>CC</sub> or GND	5.5	−0.5	−5.0	−10	μA

ΔI <sub>CC</sub>	Additional Quiescent Supply Current	V <sub>in</sub> = 2.4 V, Any One Input V <sub>in</sub> = V <sub>CC</sub> or GND, Other Inputs I <sub>out</sub> = 0 μA	5.5	≥ −55°C	25°C to 125°C	mA
				2.9	2.4	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Output in high-impedance state.

# MC74HC374A, MC74HCT374A

## AC ELECTRICAL CHARACTERISTICS (MC74HCT374A)

Symbol	Parameter	Guaranteed Limit			Unit
		–55 to 25°C	≤ 85°C	≤ 125°C	
f <sub>MAX</sub>	Maximum Clock Frequency (50% Duty Cycle)	30	24	20	MHz
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Clock to Q	30	38	45	ns
t <sub>PLZ</sub> , t <sub>PHZ</sub>	Maximum Propagation Delay, Output Enable to Q	28	35	42	ns
t <sub>PZH</sub> , t <sub>PZL</sub>	Maximum Propagation Delay Time, Output Enable to Q	28	35	42	ns
t <sub>TLH</sub> , t <sub>THL</sub>	Maximum Output Transition Time, Any Output	12	15	18	ns
C <sub>in</sub>	Maximum Input Capacitance	10	10	10	pF

C <sub>PD</sub>	Power Dissipation Capacitance (Per Flip-Flop)*	Typical @ 25°C, V <sub>CC</sub> = 5.0 V		pF
		58	58	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

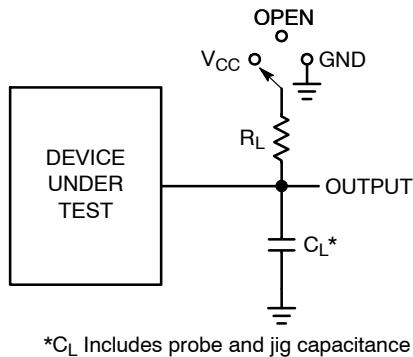
\*Used to determine the no-load dynamic power consumption: P<sub>D</sub> = C<sub>PD</sub> V<sub>CC</sub><sup>2</sup>f + I<sub>CC</sub> V<sub>CC</sub>.

## TIMING REQUIREMENTS (MC74HCT374A)

Symbol	Parameter	Guaranteed Limit						Unit	
		– 55 to 25°C		≤ 85°C		≤ 125°C			
		Min	Max	Min	Max	Min	Max		
t <sub>su</sub>	Minimum Setup Time, Data to Clock	10		13		15		ns	
t <sub>h</sub>	Minimum Hold Time, Clock to Data	5.0		5.0		5.0		ns	
t <sub>w</sub>	Minimum Pulse Width, Clock	15		19		22		ns	
t <sub>r</sub> , t <sub>f</sub>	Maximum Input Rise and Fall Times		500		500		500	ns	

# MC74HC374A, MC74HCT374A

## SWITCHING WAVEFORMS



\* $C_L$  Includes probe and jig capacitance

Test	Switch Position	$C_L$	$R_L$
$t_{PLH} / t_{PHL}$	Open	50 pF	1 k $\Omega$
$t_{PLZ} / t_{PZL}$	$V_{CC}$		
$t_{PHZ} / t_{PZH}$	GND		

Figure 2. Test Circuit

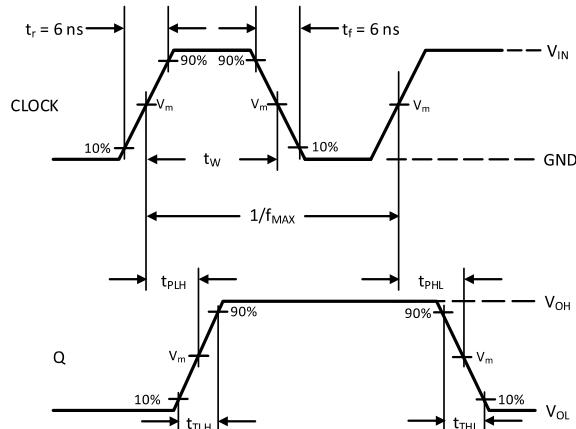


Figure 3.

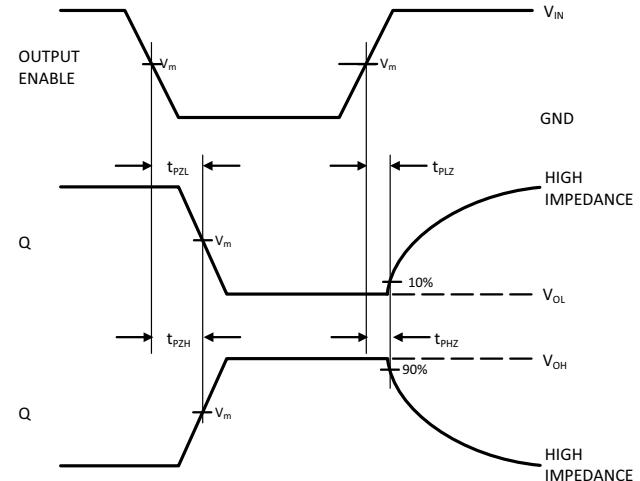


Figure 4.

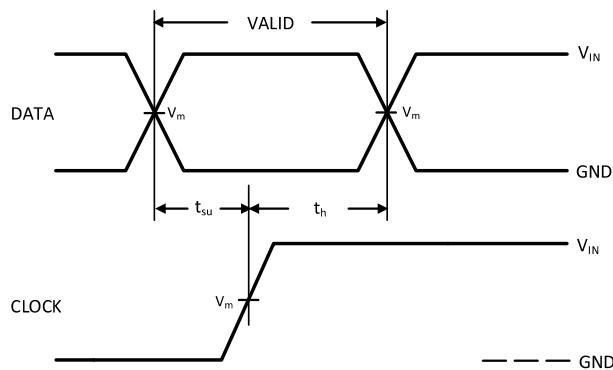


Figure 5.

Device	$V_{IN}, V$	$V_m, V$
MC74HC374A	$V_{CC}$	50% x $V_{CC}$
MC74HCT374A	3 V	1.3 V

## MC74HC374A, MC74HCT374A

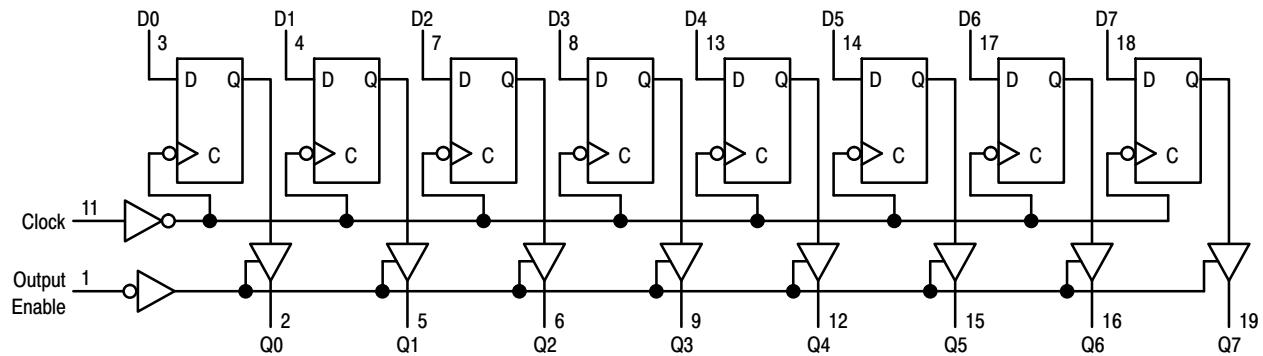


Figure 6. Expanded Logic Diagram

### ORDERING INFORMATION

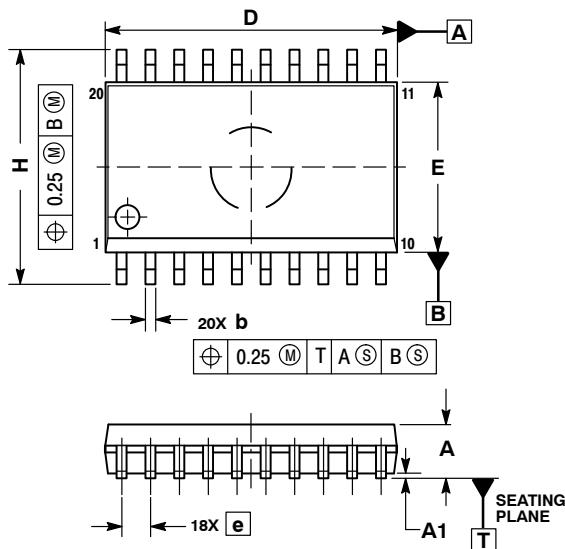
Device	Marking	Package	Shipping <sup>†</sup>
MC74HC374ADWG	HC374A	SOIC-20 Wide	38 Units / Rail
MC74HC374ADWR2G	HC374A	SOIC-20 Wide	1000 / Tape & Reel
MC74HC374ADWR2G-Q*	HC374A	SOIC-20 Wide	1000 / Tape & Reel
MC74HC374ADTR2G	HC 374A	TSSOP-20	2500 / Tape & Reel
MC74HC374ADTR2G-Q*	HC 374A	TSSOP-20	2500 / Tape & Reel
MC74HCT374ADWG	HCT374A	SOIC-20 Wide	38 Units / Rail
MC74HCT374ADWR2G	HCT374A	SOIC-20 Wide	1000 / Tape & Reel
MC74HCT374ADWR2G-Q*	HCT374A	SOIC-20 Wide	1000 / Tape & Reel
MC74HCT374ADTR2G	HCT 374A	TSSOP-20	2500 / Tape & Reel
MC74HCT374ADTR2G-Q*	HCT 374A	TSSOP-20	2500 / Tape & Reel

<sup>†</sup>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.

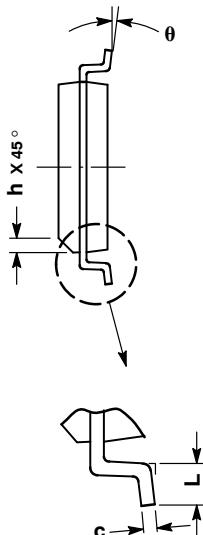
\*-Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.



SCALE 1:1

SOIC-20 WB  
CASE 751D-05  
ISSUE H

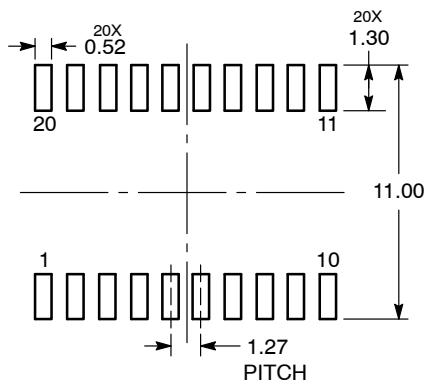
DATE 22 APR 2015



NOTES:

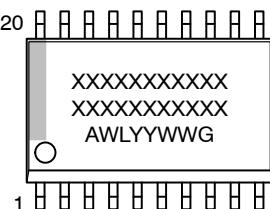
1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

MILLIMETERS		
DIM	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
b	0.35	0.49
c	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
θ	0 °	7 °

RECOMMENDED  
SOLDERING FOOTPRINT\*

DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the [onsemi](#) Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC  
MARKING DIAGRAM\*

XXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
YY = 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. Some products may not follow the Generic Marking.

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