

National Semiconductor is now part of
Texas Instruments.

Search <http://www.ti.com/> for the latest technical
information and details on our current products and services.

74VHC74 • 74VHCT74

Dual D-Type Flip Flop with Preset and Clear

General Description

The VHC/VHCT74 is an advanced high speed CMOS Dual D-Flip Flop fabricated with silicon gate CMOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The signal level applied to the D INPUT is transferred to the Q OUTPUT during the positive going transition of the CK pulse. CLR and PR are independent of the CK and are accomplished by setting the appropriate input low.

An input protection circuit ensures that 0V to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery backup. This circuit prevents device destruction due to mismatched supply and input voltages.

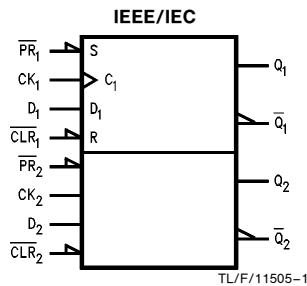
Features

- High noise immunity:
VHC $V_{NIH} = V_{NIL} = 28\% V_{CC} (\text{min})$
VHCT $V_{IH} = 2.0V, V_{IL} = 0.8V$
 - Power down protection:
VHC inputs only
VHCT inputs and outputs
 - Low power dissipation:
 $I_{CC} = 2 \mu A (\text{max})$ at $T_A = 25^\circ C$
 - Balanced propagation delays: $t_{PLH} \cong t_{PHL}$
- NOTE: ADD EXTERNAL PULL UP RESISTOR TO 'VHCT OUTPUTS TO DRIVE CMOS INPUTS**

Commercial	Package Number	Package Description
74VHC74M	M14A	14-Lead Molded JEDEC SOIC
74VHC74SJ	M14D	14-Lead Molded EIAJ SOIC
74VHC74MSC	MSC14	14-Lead Molded EIAJ Type 1 SSOP
74VHC74MTC	MTC14	14-Lead Molded JEDEC Type 1 TSSOP
74VHC74N	N14A	14-Lead Molded DIP
74VHCT74M	M14A	14-Lead Molded JEDEC SOIC
74VHCT74SJ	M14D	14-Lead Molded EIAJ SOIC
74VHCT74MTC	MTC14	14-Lead Molded JEDEC Type 1 TSSOP
74VHCT74N	N14A	14-Lead Molded DIP

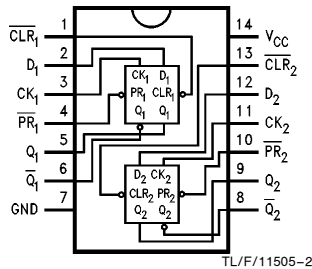
Note: Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.
EIAJ Type 1 SSOP available on Tape and Reel only, Order MSCX.

Logic Symbol



Connection Diagram

Pin Assignment for DIP, SSOP, TSSOP and SOIC



Pin Names	Description
D ₁ , D ₂	Data Inputs
CK ₁ , CK ₂	Clock Pulse Inputs
CLR ₁ , CLR ₂	Direct Clear Inputs
PR ₁ , PR ₂	Direct Preset Inputs
Q ₁ , Q ₁ , Q ₂ , Q ₂	Outputs

Inputs				Outputs		Function
CLR	PR	D	CK	Q	Q	
L	H	X	X	L	H	Clear Preset
H	L	X	X	H	L	
L	L	X	X	H	H	
H	H	L	1	L	H	
H	H	H	1	H	L	No Change
H	H	X	1	Q _n	Q _n	

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Voltage (V_{IN})	−0.5V to +7.0V
DC Output Voltage (V_{OUT})	
VHC	−0.5V to V_{CC} + 0.5V
VHCT*	−0.5V to 7.0V
Input Diode Current (I_{IK})	−20 mA
Output Diode Current (I_{OK})	
VHC	±20 mA
VHCT	−20 mA
DC Output Current (I_{OUT})	±25 mA
DC V_{CC} /GND Current (I_{CC})	±50 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Lead Temperature (T_L)	
Soldering (10 seconds)	260°C

* $V_{OUT} > V_{CC}$ only if output is in H state.

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation outside databook specifications.

Recommended Operating Conditions

Supply Voltage (V_{CC})	
VHC	2.0V to 5.5V
VHCT	4.5V to 5.5V
Input Voltage (V_{IN})	0V to +5.5V
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_{OPR})	
74VHC/VHCT	−40°C to +85°C
Input Rise and Fall Time (t_r, t_f)	
$V_{CC} = 3.3V \pm 0.3V$ (VHC only)	0 ~ 100 ns/V
$V_{CC} = 5.0V \pm 0.5V$	0 ~ 20 ns/V

DC Characteristics for 'VHC Family Devices

Symbol	Parameter	V _{CC} (V)	74VHC			74VHC		Units	Conditions	
			T _A = 25°C			T _A = −40°C to +85°C				
			Min	Typ	Max	Min	Max			
V _{IH}	High Level Input Voltage	2.0 3.0–5.5	1.50 0.7 V _{CC}			1.50 0.7 V _{CC}		V		
V _{IL}	Low Level Input Voltage	2.0 3.0–5.5	0.50 0.3 V _{CC}			0.50 0.3 V _{CC}		V		
V _{OH}	High Level Output Voltage	2.0	1.9	2.0		1.9		V	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −50 μA
		3.0	2.9	3.0		2.9				
		4.5	4.4	4.5		4.4		V		I _{OH} = −4 mA I _{OH} = −8 mA
		3.0 4.5	2.58 3.94			2.48 3.80				
V _{OL}	Low Level Output Voltage	2.0		0.0	0.1		0.1	V	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50 μA
		3.0		0.0	0.1		0.1			
		4.5		0.0	0.1		0.1	V		I _{OL} = 4 mA I _{OL} = 8 mA
		3.0 4.5			0.36 0.36		0.44 0.44			
I _{IN}	Input Leakage Current	0–5.5	±0.1			±1.0		μA	V _{IN} = 5.5V or GND	
I _{CC}	Quiescent Supply Current	5.5	2.0			20.0		μA	V _{IN} = V _{CC} or GND	

DC Characteristics for 'VHCT Family Devices

Symbol	Parameter	V _{CC} (V)	74VHCT			74VHCT		Units	Conditions	
			T _A = 25°C			T _A = −40°C to +85°C				
			Min	Typ	Max	Min	Max			
V _{IH}	High Level Input Voltage	4.5	2.0		2.0		V			
		5.5	2.0		2.0					
V _{IL}	Low Level Input Voltage	4.5	0.8		0.8		V			
		5.5	0.8		0.8					
V _{OH}	High Level Output Voltage	4.5	3.15	3.65	3.15		V	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −50 μA	
		4.5	2.5		2.4				I _{OH} = −8 mA	
V _{OL}	Low Level Output Voltage	4.5	0.0		0.1		V	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50 μA	
		4.5			0.36				0.44	
I _{IN}	Input Leakage Current	0–5.5			±0.1		μA	V _{IN} = 5.5V or GND		
I _{CC}	Quiescent Supply Current	5.5			2.0		μA	V _{IN} = V _{CC} or GND		
I _{CCT}	Maximum I _{CC} /Input	5.5			1.35		mA	V _{IN} = 3.4V Other Inputs = V _{CC} or GND		
I _{OPD}	Output Leakage Current (Power Down State)	0.0			+0.5		μA	V _{OUT} = 5.5V		

AC Electrical Characteristics for 'VHC

Symbol	Parameter	V _{CC} (V)	74VHC			74VHC		Units	Conditions
			T _A = 25°C			T _A = −40°C to +85°C			
			Min	Typ	Max	Min	Max		
f _{MAX}	Maximum Clock Frequency	3.3 ± 0.3	80	125		70		MHz	C _L = 15 pF
			50	75		45			C _L = 50 pF
		5.0 ± 0.5	130	170		110		MHz	C _L = 15 pF
			90	115		75			C _L = 50 pF
t _{PLH} , t _{PHL}	Propagation Delay Time (CK-Q, $\overline{Q}$)	3.3 ± 0.3	6.7	11.9		1.0	14.0	ns	C _L = 15 pF
			9.2	15.4		1.0	17.5		C _L = 50 pF
		5.0 ± 0.5	4.6	7.3		1.0	8.5	ns	C _L = 15 pF
			6.1	9.3		1.0	10.5		C _L = 50 pF
t _{PLH} , t _{PHL}	Propagation Delay Time ($\overline{CLR}$, $\overline{PR}$ -Q, $\overline{Q}$)	3.3 ± 0.3	7.6	12.3		1.0	14.5	ns	C _L = 15 pF
			10.1	15.8		1.0	18.0		C _L = 50 pF
		5.0 ± 0.5	4.8	7.7		1.0	9.0	ns	C _L = 15 pF
			6.3	9.7		1.0	11.0		C _L = 50 pF
C _{IN}	Input Capacitance		4	10		10		pF	V _{CC} = Open
C _{PD}	Power Dissipation Capacitance		25					pF	(Note 1)

Note 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 from the equation: I_{CC} (opr.) = C_{PD} * V_{CC} * f_{IN} + I_{CC}/2 (per F/F).

AC Operating Requirements for 'VHC

Symbol	Parameter	*V _{CC} (V)	74VHC		74VHC	Units	Conditions
			T _A = 25°C		T _A = −40°C to +85°C		
			Typ	Guaranteed Minimum			
t _{W(L)} t _{W(H)}	Minimum Pulse Width (CK)	3.3 5.0		6.0 5.0	7.0 5.0	ns	
t _{W(L)}	Minimum Pulse Width (CLR, PR)	3.3 5.0		6.0 5.0	7.0 5.0	ns	
t _S	Minimum Setup Time	3.3 5.0		6.0 5.0	7.0 5.0	ns	
t _H	Minimum Hold Time	3.3 5.0		0.5 0.5	0.5 0.5	ns	
t _{rem}	Minimum Removal Time (CLR, PR)	3.3 5.0		5.0 3.0	5.0 3.0	ns	

*V_{CC} is 3.3 ± 0.3V or 5.0 ± 0.5V

AC Electrical Characteristics for 'VHCT

Symbol	Parameter	*V _{CC} (V)	74VHCT			74VHCT		Units	Conditions
			T _A = 25°C			T _A = −40°C to +85°C			
			Min	Typ	Max	Min	Max		
f _{MAX}	Maximum Clock Frequency	5.0	100	160	80		MHz	C _L = 15 pF	
		5.0	80	140	65			C _L = 50 pF	
t _{PLH} , t _{PHL}	Propagation Delay Time (CK-Q, $\overline{Q}$)	5.0	5.8 7.8		1.0 9.0		ns	C _L = 15 pF	
		5.0	6.3 8.8		1.0 10.0			C _L = 50 pF	
t _{PLH} , t _{PHL}	Propagation Delay Time ($\overline{CLR}$, $\overline{PR}$ -Q, $\overline{Q}$)	5.0	7.6 10.4		1.0 12.0		ns	C _L = 15 pF	
		5.0	8.1 11.4		1.0 13.0			C _L = 50 pF	
C _{IN}	Input Capacitance		4 10		10		pF	V _{CC} = Open	
C _{PD}	Power Dissipation Capacitance		24				pF	(Note 1)	

*V_{CC} is 5.0 ± 0.5V

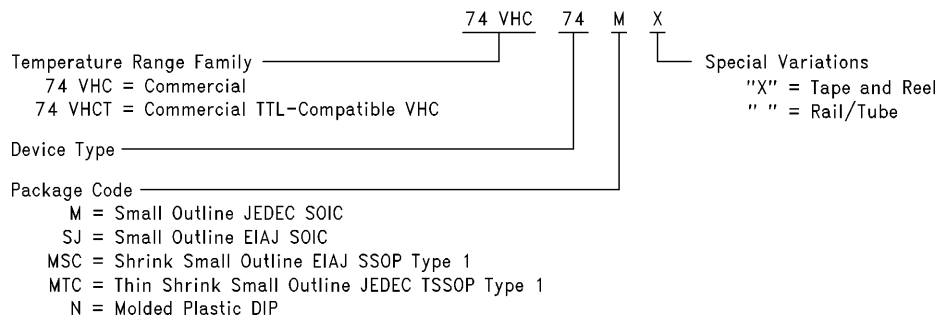
Note 1: C_{PD} is defined as the value of internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I_{CC} (opr) = C_{PD} × V_{CC} × f_{IN} + I_{CC}/2 (per flip-flop).

AC Operating Requirements for 'VHCT

Symbol	Parameter	V _{CC} (V)	74VHCT		74VHCT		Units	Conditions
			T _A = 25°C		T _A = −40°C to +85°C			
			Typ	Guaranteed Minimum				
t _{W(L)} t _{W(H)}	Minimum Pulse Width (CK)	5.0 ± 0.5			5.0	ns		
t _{W(L)}	Minimum Pulse Width ($\overline{\text{CLR}}$, $\overline{\text{PR}}$)	5.0 ± 0.5		5.0	5.0	ns		
t _S	Minimum Setup Time	5.0 ± 0.5		5.0	5.0	ns		
t _H	Minimum Hold Time	5.0 ± 0.5		0	0	ns		
t _{rem}	Minimum Removal Time ($\overline{\text{CLR}}$, $\overline{\text{PR}}$)	5.0 ± 0.5		3.5	3.5	ns		

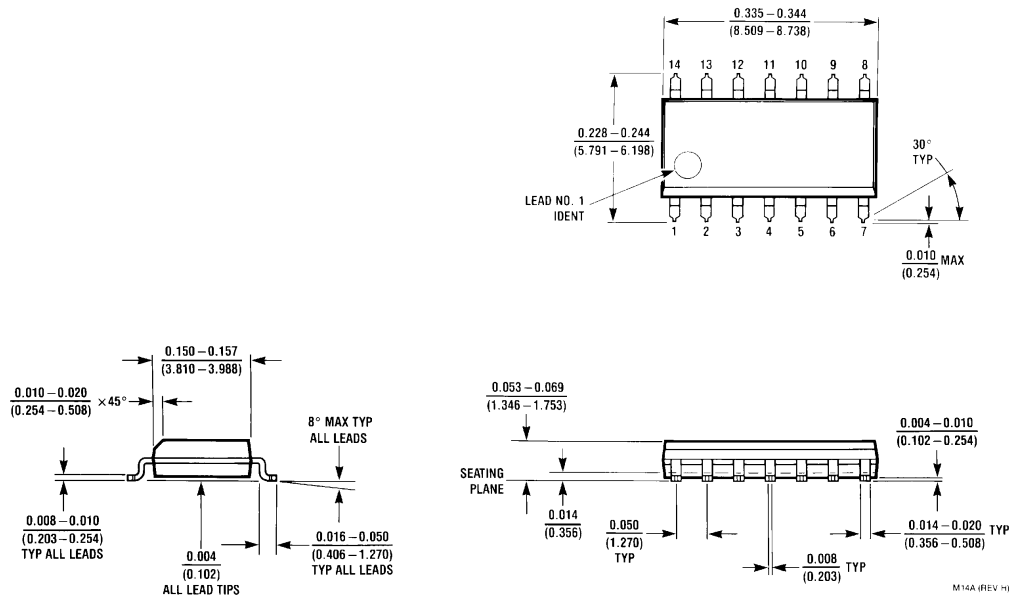
Ordering Information

The device number is used to form part of a simplified purchasing code, where the package type and temperature range are defined as follows:

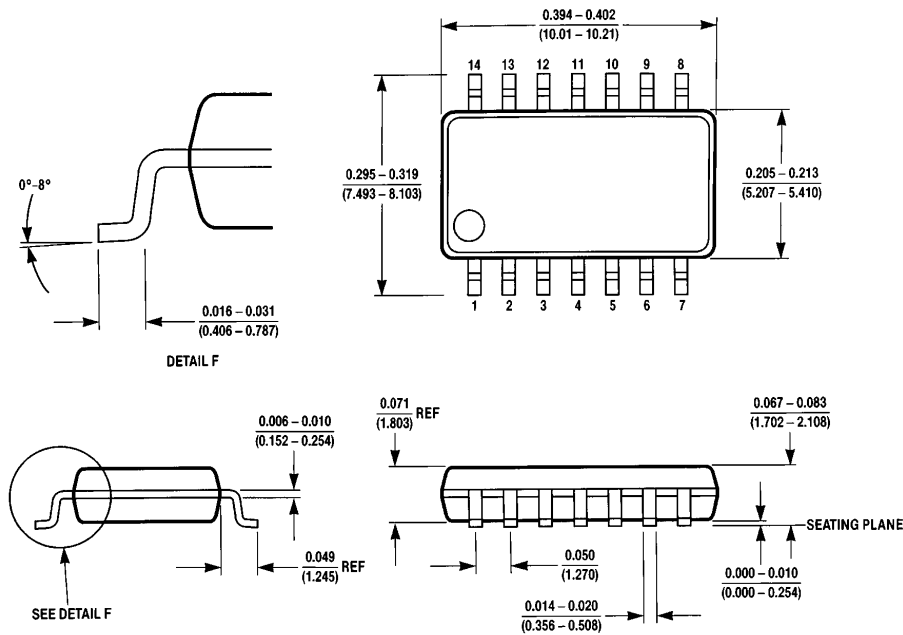


TL/F/11505-5

Physical Dimensions inches (millimeters)

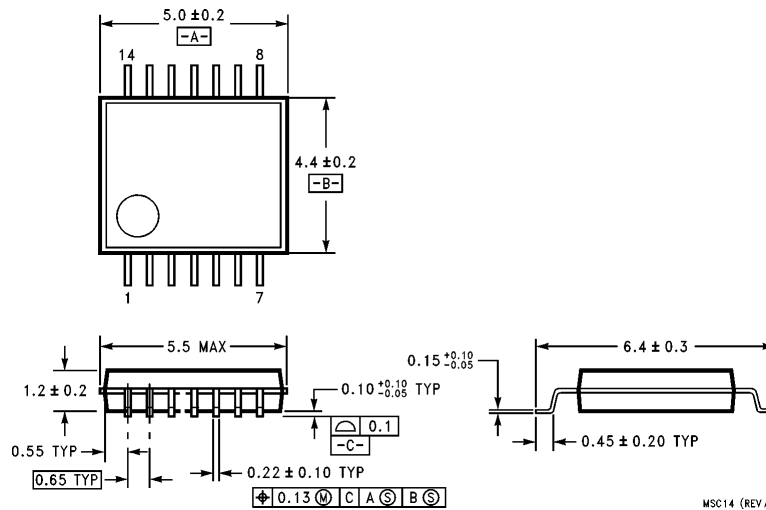


14-Lead Small Outline Integrated Circuit—JEDEC (M)
Order Number 74VHC74M, 74VHC74MX, 74VHCT74M or 74VHCT74MX
NS Package Number M14A



14-Lead Small Outline Package - EIAJ (SJ)
Order Number 74VHC74SJ, 74VHC74SJX, 74VHCT74SJ or 74VHCT74SJX
NS Package Number M14D

Physical Dimensions millimeters (Continued)

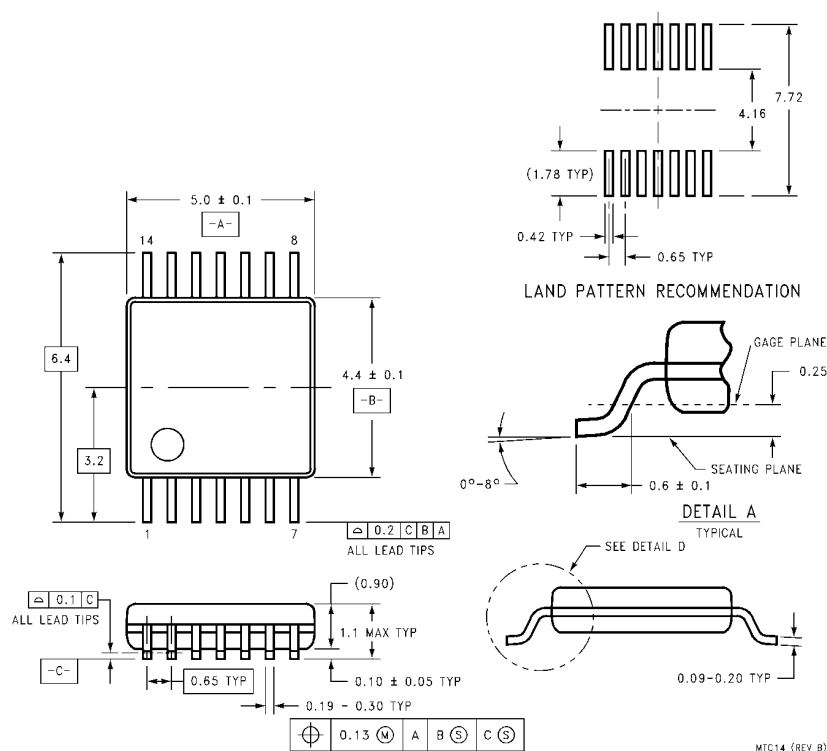


MSC14 (REV A)

14-Lead Plastic EIAJ SSOP Type 1 (MSC)

Order Number 74VHC74MSCX

NS Package Number MSC14



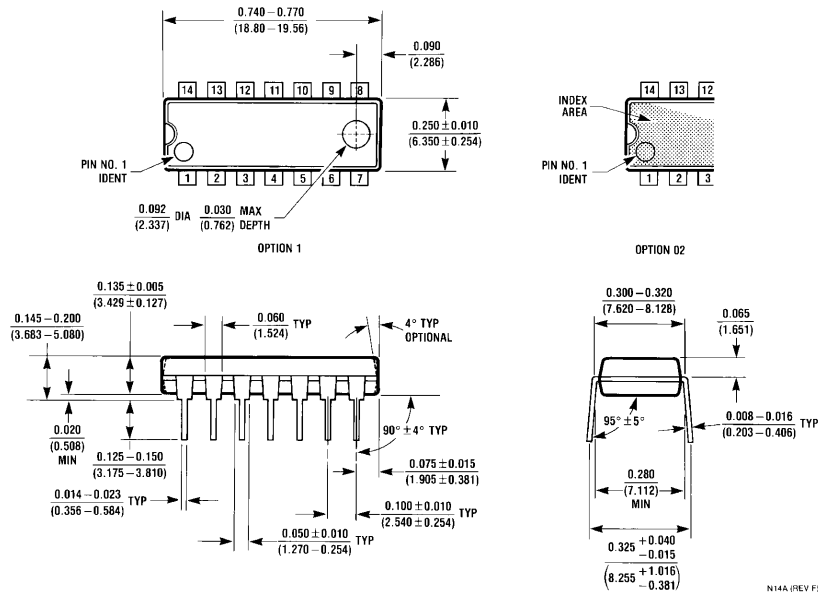
MTC14 (REV B)

14-Lead Plastic JEDEC TSSOP Type 1 (MTC)

Order Number 74VHC74MTC, 74VHC74MTCX, 74VHCT74MTC or 74VHCT74MTCX

NS Package Number MTC14

Physical Dimensions inches (millimeters) (Continued)



14-Lead Molded Dual In-Line Package
Order Number 74VHC74N or 74VHCT74N
NS Package Number N14A

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



National Semiconductor Corporation
 1111 West Bardin Road
 Arlington, TX 76017
 Tel: (800) 272-9959
 Fax: (800) 737-7018

National Semiconductor Europe
 Fax: (+49) 0-180-530 85 86
 Email: cnjwge@tevm2.nsc.com
 Deutsch Tel: (+49) 0-180-530 85 85
 English Tel: (+49) 0-180-532 78 32
 Français Tel: (+49) 0-180-532 93 58
 Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
 19th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: (852) 2737-1600
 Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
 Tel: 81-043-299-2309
 Fax: 81-043-299-2408

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.