

54F/74F251A

8-Input Multiplexer with TRI-STATE® Outputs

General Description

The 'F251A is a high-speed 8-input digital multiplexer. It provides, in one package, the ability to select one bit of data from up to eight sources. It can be used as a universal function generator to generate any logic function of four variables. Both assertion and negation outputs are provided.

Features

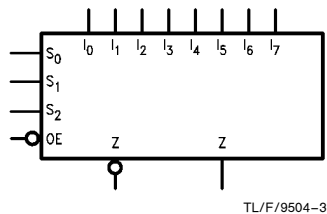
- Multifunctional capability
- On-chip select logic decoding
- Inverting and non-inverting TRI-STATE outputs

Commercial	Military	Package Number	Package Description
74F251APC		N16E	16-Lead (0.300" Wide) Molded Dual-In-Line
	54F251ADM (Note 2)	J16A	16-Lead Ceramic Dual-In-Line
74F251ASC (Note 1)		M16A	16-Lead (0.150" Wide) Molded Small Outline, JEDEC
74F251ASJ (Note 1)		M16D	16-Lead (0.300" Wide) Molded Small Outline, EIAJ
	54F251AFM (Note 2)	W16A	16-Lead Cerpack
	54F251ALL (Note 2)	E20A	20-Lead Ceramic Leadless Chip Carrier, Type C

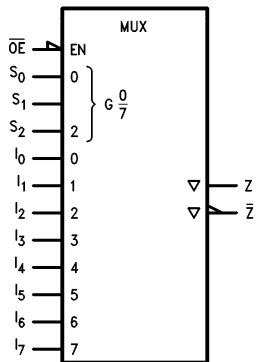
Note 1: Devices also available in 13" reel. Use suffix = SCX and SJX.

Note 2: Military grade device with environmental and burn-in processing. Use suffix = DMQB, FMQB and LMQB.

Logic Symbols

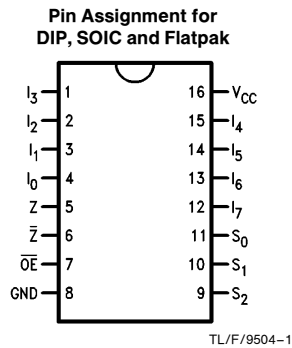


IEEE/IEC

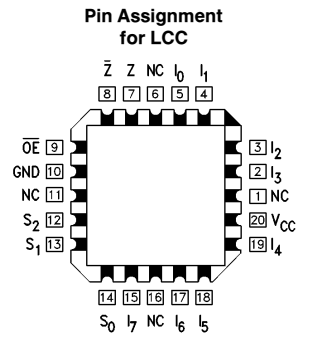


TL/F/9504-5

Connection Diagrams



TL/F/9504-1



TL/F/9504-2

TRI-STATE® is a registered trademark of National Semiconductor Corporation.

Unit Loading/Fan Out

Pin Names	Description	54F/74F	
		U.L. HIGH/LOW	Input I_{IH}/I_{IL} Output I_{OH}/I_{OL}
S_0-S_2	Select Inputs	1.0/1.0	20 μ A/ -0.6 mA
$\overline{OE}$	TRI-STATE Output Enable Input (Active LOW)	1.0/1.0	20 μ A/ -0.6 mA
I_0-I_7	Multiplexer Inputs	1.0/1.0	20 μ A/ -0.6 mA
Z	TRI-STATE Multiplexer Output	150/40 (33.3)	-3 mA/24 mA (20 mA)
$\overline{Z}$	Complementary TRI-STATE Multiplexer Output	150/40 (33.3)	-3 mA/24 mA (20 mA)

Functional Description

This device is a logical implementation of a single-pole, 8-position switch with the switch position controlled by the state of three Select inputs, S_0 , S_1 , S_2 . Both assertion and negation outputs are provided. The Output Enable input ($\overline{OE}$) is active LOW. When it is activated, the logic function provided at the output is:

$$Z = \overline{OE} \cdot (I_0 \cdot \overline{S_0} \cdot \overline{S_1} \cdot \overline{S_2} + I_1 \cdot \overline{S_0} \cdot \overline{S_1} \cdot S_2 + I_2 \cdot \overline{S_0} \cdot S_1 \cdot \overline{S_2} + I_3 \cdot \overline{S_0} \cdot S_1 \cdot S_2 + I_4 \cdot S_0 \cdot \overline{S_1} \cdot \overline{S_2} + I_5 \cdot S_0 \cdot \overline{S_1} \cdot S_2 + I_6 \cdot S_0 \cdot S_1 \cdot \overline{S_2} + I_7 \cdot S_0 \cdot S_1 \cdot S_2)$$

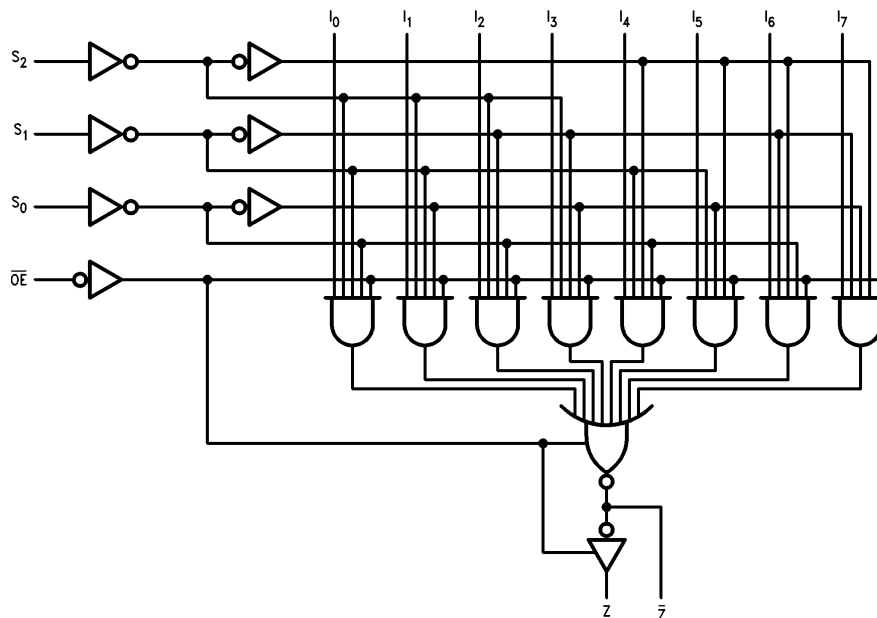
When the Output Enable is HIGH, both outputs are in the high impedance (High Z) state. This feature allows multiplexer expansion by tying the outputs of up to 128 devices together. When the outputs of the TRI-STATE devices are tied together, all but one device must be in the high impedance state to avoid high currents that would exceed the maximum ratings. The Output Enable signals should be designed to ensure there is no overlap in the active LOW portion of the enable voltages.

Truth Table

$\overline{OE}$	Inputs			Outputs	
	S_2	S_1	S_0	$\overline{Z}$	Z
H	X	X	X	Z	Z
L	L	L	L	$\overline{I_0}$	I_0
L	L	L	H	$\overline{I_1}$	I_1
L	L	H	L	$\overline{I_2}$	I_2
L	L	H	H	$\overline{I_3}$	I_3
L	H	L	L	$\overline{I_4}$	I_4
L	H	L	H	$\overline{I_5}$	I_5
L	H	H	L	$\overline{I_6}$	I_6
L	H	H	H	$\overline{I_7}$	I_7

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = High Impedance

Logic Diagram



TL/F/9504-4

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Storage Temperature	−65°C to +150°C
Ambient Temperature under Bias	−55°C to +125°C
Junction Temperature under Bias	−55°C to +175°C
Plastic	−55°C to +150°C
V _{CC} Pin Potential to Ground Pin	−0.5V to +7.0V
Input Voltage (Note 2)	−0.5V to +7.0V
Input Current (Note 2)	−30 mA to +5.0 mA
Voltage Applied to Output in HIGH State (with V _{CC} = 0V)	
Standard Output	−0.5V to V _{CC}
TRI-STATE Output	−0.5V to +5.5V

Current Applied to Output in LOW State (Max)

twice the rated I_{OL} (mA)

Note 1: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 2: Either voltage limit or current limit is sufficient to protect inputs.

Recommended Operating Conditions

Free Air Ambient Temperature

Military	−55°C to +125°C
Commercial	0°C to +70°C

Supply Voltage

Military	+4.5V to +5.5V
Commercial	+4.5V to +5.5V

DC Electrical Characteristics

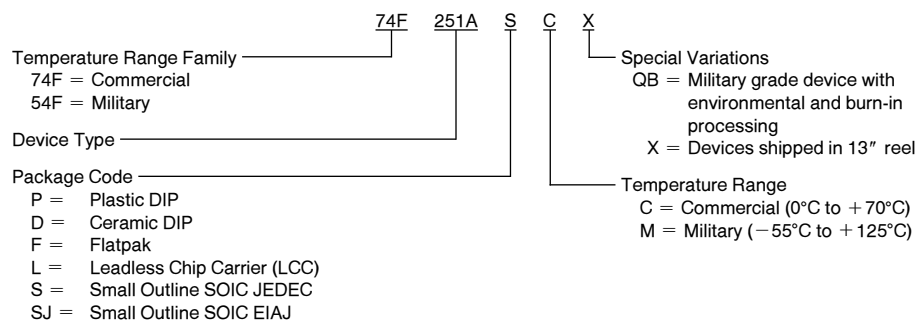
Symbol	Parameter		54F/74F			Units	V _{CC}	Conditions
			Min	Typ	Max			
V _{IH}	Input HIGH Voltage		2.0			V		Recognized as a HIGH Signal
V _{IL}	Input LOW Voltage				0.8	V		Recognized as a LOW Signal
V _{CD}	Input Clamp Diode Voltage				−1.2	V	Min	I _{IN} = −18 mA
V _{OH}	Output HIGH Voltage	54F 10% V _{CC} 54F 10% V _{CC} 74F 10% V _{CC} 74F 10% V _{CC} 74F 5% V _{CC} 74F 5% V _{CC}	2.5 2.4 2.5 2.4 2.7 2.7			V	Min	I _{OH} = −1 mA I _{OH} = −3 mA I _{OH} = −1 mA I _{OH} = −3 mA I _{OH} = −1 mA I _{OH} = −3 mA
V _{OL}	Output LOW Voltage	54F 10% V _{CC} 74F 10% V _{CC}			0.5 0.5	V	Min	I _{OL} = 20 mA I _{OL} = 24 mA
I _{IH}	Input HIGH Current	54F 74F			20.0 5.0	μA	Max	V _{IN} = 2.7V
I _{BI}	Input HIGH Current Breakdown Test	54F 74F			100 7.0	μA	Max	V _{IN} = 7.0V
I _{CEX}	Output HIGH Leakage Current	54F 74F			250 50	μA	Max	V _{OUT} = V _{CC}
V _{ID}	Input Leakage Test	74F	4.75			V	0.0	I _{ID} = 1.9 μA All Other Pins Grounded
I _{OD}	Output Leakage Circuit Current	74F			3.75	μA	0.0	V _{ID} = 150 mV All Other Pins Grounded
I _{IL}	Input LOW Current				−0.6	mA	Max	V _{IN} = 0.5V
I _{OZH}	Output Leakage Current				50	μA	Max	V _{OUT} = 2.7V
I _{OZL}	Output Leakage Current				−50	μA	Max	V _{OUT} = 0.5V
I _{OS}	Output Short-Circuit Current		−60		−150	mA	Max	V _{OUT} = 0V
I _{ZZ}	Bus Drainage Test				500	μA	0.0V	V _{OUT} = 5.25V
I _{CCL}	Power Supply Current			15	22	mA	Max	V _O = LOW
I _{CCZ}	Power Supply Current			16	24	mA	Max	V _O = HIGH Z

AC Electrical Characteristics

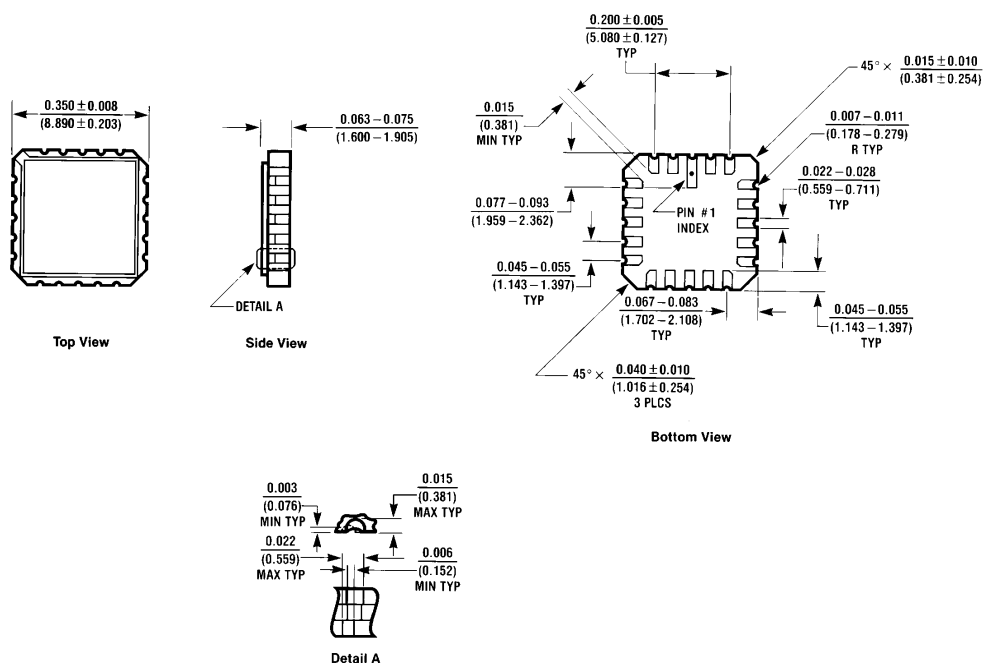
Symbol	Parameter	74F			54F		74F		Units
		T _A = +25°C V _{CC} = +5.0V C _L = 50 pF			T _A , V _{CC} = Mil C _L = 50 pF		T _A , V _{CC} = Com C _L = 50 pF		
		Min	Typ	Max	Min	Max	Min	Max	
t _{PLH} t _{PHL}	Propagation Delay S _n to $\bar{Z}$	3.5 3.2	6.0 5.0	9.0 7.5	3.5 3.2	11.5 8.0	3.5 3.2	9.5 7.5	ns
t _{PLH} t _{PHL}	Propagation Delay S _n to Z	4.5 4.0	7.5 6.0	10.5 8.5	3.5 3.0	14.0 10.5	4.5 4.0	12.5 9.0	ns
t _{PLH} t _{PHL}	Propagation Delay I _n to Z	3.0 1.5	5.0 2.5	6.5 4.0	2.5 1.5	8.0 6.0	3.0 1.5	7.0 5.0	ns
t _{PLH} t _{PHL}	Propagation Delay I _n to Z	3.5 3.5	5.0 5.5	7.0 7.0	2.5 3.5	9.0 9.0	2.5 3.5	8.0 7.5	ns
t _{PZH} t _{PZL}	Output Enable Time $\overline{OE}$ to $\bar{Z}$	2.5 2.5	4.3 4.3	6.0 6.0	2.0 2.5	7.0 7.5	2.5 2.5	7.0 6.5	ns
t _{PHZ} t _{PLZ}	Output Disable Time $\overline{OE}$ to $\bar{Z}$	2.5 1.5	4.0 3.0	5.5 4.5	2.5 1.5	6.0 5.0	2.5 1.5	6.0 4.5	
t _{PZH} t _{PZL}	Output Enable Time $\overline{OE}$ to Z	3.5 3.5	5.0 5.5	7.0 7.5	3.0 3.5	8.5 9.0	3.0 3.5	7.5 8.0	ns
t _{PHZ} t _{PLZ}	Output Disable Time $\overline{OE}$ to Z	2.0 1.5	3.8 3.0	5.5 4.5	2.0 1.5	5.5 5.5	2.0 1.5	5.5 4.5	

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:



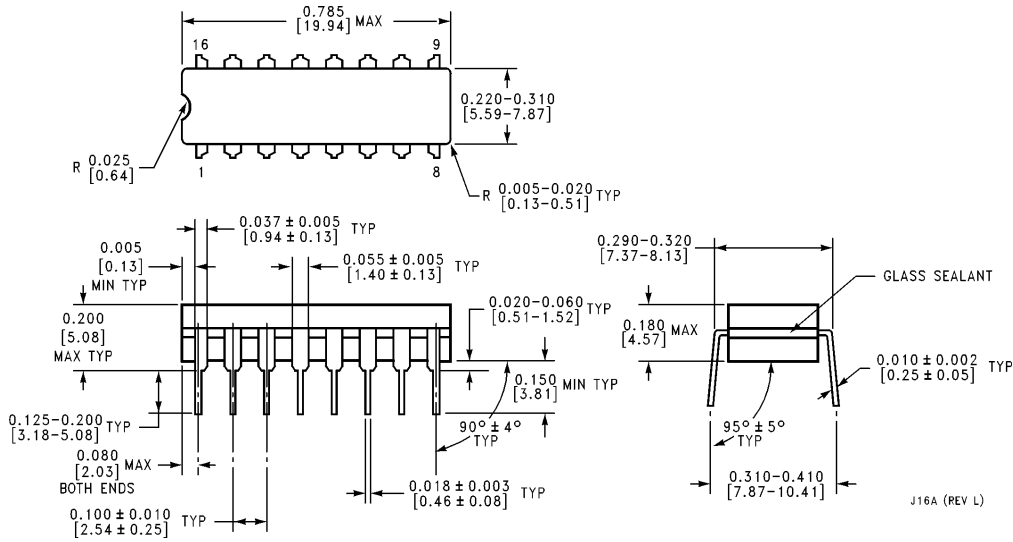
Physical Dimensions inches (millimeters)



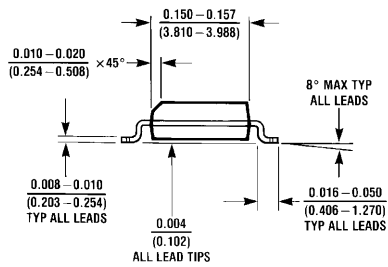
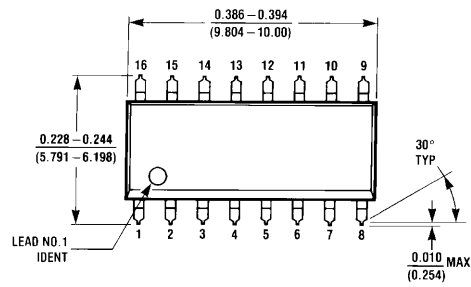
**20-Lead Ceramic Leadless Chip Carrier (L)
NS Package Number E20A**

E20A (REV D)

Physical Dimensions inches (millimeters) (Continued)

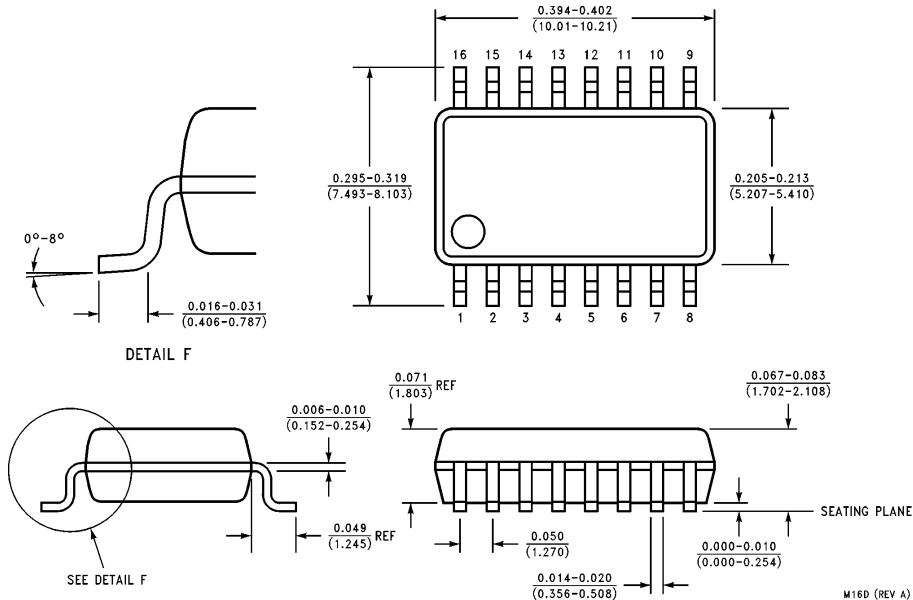


16-Lead Ceramic Dual-In-Line Package (D)
NS Package Number J16A

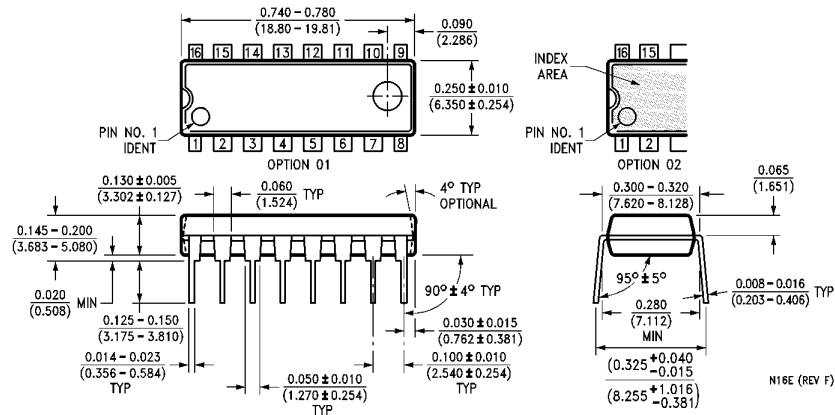


16-Lead (0.150" Wide) Molded Small Outline Package, JEDEC (S)
NS Package Number M16A

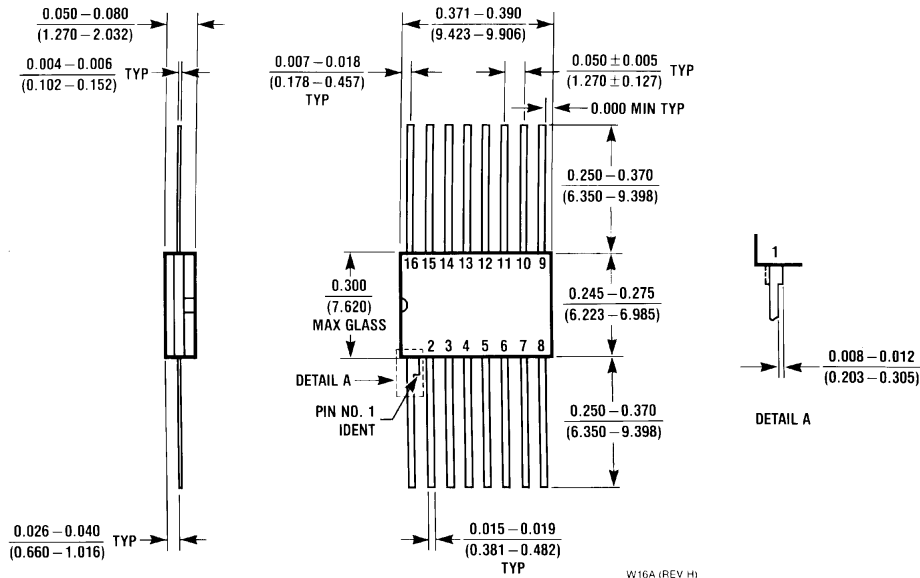
Physical Dimensions inches (millimeters) (Continued)



16-Lead (0.300" Wide) Molded Small Outline Package, EIAJ (SJ)
NS Package Number M16D



16-Lead (0.300" Wide) Molded Dual-In-Line Package (P)
NS Package Number N16E

Physical Dimensions inches (millimeters) (Continued)

16-Lead Ceramic Flatpak (F)
NS Package Number W16A

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
2900 Semiconductor Drive
P.O. Box 58090
Santa Clara, CA 95052-8090
Tel: (408) 272-9959
TWX: (910) 339-9240

National Semiconductor GmbH
Livy-Gargan-Str. 10
D-82256 Fürstentfeldbruck
Germany
Tel: (81-41) 35-0
Telex: 527849
Fax: (81-41) 35-1

National Semiconductor Japan Ltd.
Sumitomo Chemical
Engineering Center
Bldg. 7F
1-7-1, Nakase, Mihama-Ku
Chiba-City,
Chiba Prefecture 261
Tel: (043) 299-2300
Fax: (043) 299-2500

National Semiconductor Hong Kong Ltd.
13th Floor, Straight Block,
Ocean Centre, 5 Canton Rd.
Tsimshatsui, Kowloon
Hong Kong
Tel: (852) 2737-1600
Fax: (852) 2736-9960

National Semicondutores Do Brasil Ltda.
Rue Deputado Lacorda Franco
120-3A
Sao Paulo-SP
Brazil 05418-000
Tel: (55-11) 212-5066
Telex: 391-1131931 NSBR BR
Fax: (55-11) 212-1181

National Semiconductor (Australia) Pty. Ltd.
Building 16
Business Park Drive
Monash Business Park
Nottingham, Melbourne
Victoria 3168 Australia
Tel: (3) 558-9999
Fax: (3) 558-9998

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.