



National Semiconductor

May 1998

DS96F173C/DS96F173M/DS96F175C/DS96F175M EIA-485/EIA-422 Quad Differential Receivers

General Description

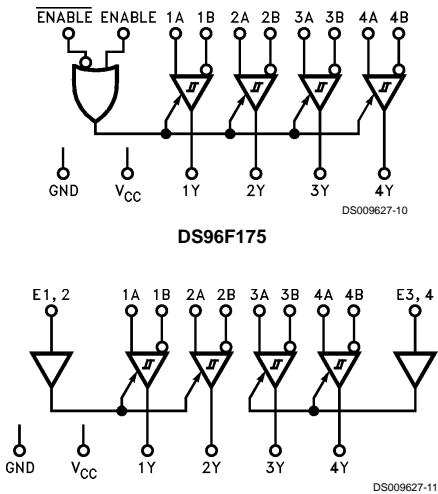
The DS96F173 and the DS96F175 are high speed quad differential line receivers designed to meet the EIA-485 standard. The DS96F173 and the DS96F175 offer improved performance due to the use of L-FAST bipolar technology. The use of LFAST technology allows the DS96F173 and DS96F175 to operate at higher speeds while minimizing power consumption.

The DS96F173 and the DS96F175 have TRI-STATE® outputs and are optimized for balanced multipoint data bus transmission at rates up to 15 Mbps. The receivers feature high input impedance, input hysteresis for increased noise immunity, and input sensitivity of 200 mV over a common mode input voltage range of -7V to +12V. The receivers are therefore suitable for multipoint applications in noisy environments. The DS96F173 features an active high and active low Enable, common to all four receivers. The DS96F175 features separate active high Enables for each receiver pair.

Features

- Meets EIA-485, EIA-422A, EIA-423A standards
- Designed for multipoint bus applications
- TRI-STATE outputs
- Common mode input voltage range: -7V to +12V
- Operates from single +5.0V supply
- Reduced power consumption ($I_{CC} = 50$ mA max)
- Input sensitivity of ± 200 mV over common mode range
- Input hysteresis of 50 mV typical
- High input impedance
- Military temperature range available
- Qualified for MIL STD 883C
- Available to standard military drawings (SMD)
- Available in DIP(J), LCC(E), and FlatPak (W) packages
- DS96F173 and DS96F175 are lead and function compatible with SN75173/175 or the AM26LS32/MC3486

Logic Diagrams



Function Tables

(Each Receiver) DS96F173

Differential Inputs A-B	Enable E	Enable \bar{E}	Output Y
$V_{ID} \geq 0.2V$	H	X	H
	X	L	H
$V_{ID} \leq -0.2V$	H	X	L
	X	L	L
X	L	X	Z
X	X	H	Z

H = High Level

L = Low Level

Z = High Impedance (off)

X = Don't Care

(Each Receiver) DS96F175

Differential Inputs A-B	Enable E	Output Y
$V_{ID} \geq 0.2V$	H	H
$V_{ID} \leq -0.2V$	H	L
X	L	Z

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

COMMERCIAL

Absolute Maximum Ratings (Note 2)

Specifications for the 883 version of this product are listed separately.

Storage Temperature Range (T_{STG})	-65°C to +175°C
Lead Temperature (Soldering, 60 sec.)	300°C
Max. Package Power Dissipation (Note 1) at 25°C	
Ceramic DIP (J)	1500 mW
Supply Voltage	7.0V
Input Voltage, A or B Inputs	$\pm 25V$
Differential Input Voltage	$\pm 25V$
Enable Input Voltage	7.0V
Low Level Output Current	50 mA

Recommended Operating Conditions

	Min	Typ	Max	Units
Supply Voltage (V_{CC})	DS96F173C/DS96F175C	4.75	5.0	5.25
Common Mode Input Voltage (V_{CM})	-7	+12		V
Differential Input Voltage (V_{ID})		12		V
Output Current HIGH (I_{OH})		-400		μA
Output Current LOW (I_{OL})		11		mA
Operating Temperature (T_A)	DS96F173C/DS96F175C	0	25	70
				°C
Note 1: Derate package 10 mW/°C above 25°C.				

Electrical Characteristics (Notes 3, 4)

Over recommended supply voltage and operating temperature ranges, unless otherwise specified

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{TH}	Differential-Input High Threshold Voltage	$V_O = V_{OH}$				0.2	V
V_{TL}	Differential-Input (Note 5)	$V_O = V_{OL}$		-0.2			V
$V_{TH} - V_{TL}$	Hysteresis (Note 6)	$V_{CM} = 0V$			50		mV
V_{IH}	Enable Input Voltage HIGH			2.0			V
V_{IL}	Enable Input Voltage LOW					0.8	V
V_{IC}	Enable Input Clamp Voltage	$I_I = -18 mA$				-1.5	V
V_{OH}	Output Voltage HIGH	$V_{ID} = 200 mV$	0°C to +70°C	2.8			V
		$I_{OH} = -400 \mu A$	-55°C to +125°C	2.5			
V_{OL}	Output Voltage LOW	$V_{ID} = -200 mV$	$I_{OL} = 8.0 mA$		0.45		V
			$I_{OL} = 11 mA$			0.50	
I_{OZ}	High-Impedance State Output	$V_O = 0.4V$ to $2.4V$				± 20	μA
I_I	Line Input Current (Note 7)	Other Input = 0V	$V_I = 12V$			1.0	mA
			$V_I = -7.0V$			-0.8	
I_{IH}	Enable Input Current HIGH	$V_{IH} = 2.7V$				20	μA
I_{IL}	Enable Input Current LOW	$V_{IL} = 0.4V$				-100	μA
R_I	Input Resistance			14	18	22	k Ω
I_{OS}	Short Circuit Output Current	(Note 8)		-15		-85	mA
I_{CC}	Supply Current	No Load	Outputs Enabled			50	mA
I_{CCX}			Outputs Disabled				

COMMERCIAL

Switching Characteristics

$V_{CC} = 5.0V$, $T_A = 25^\circ C$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PLH}	Propagation Delay Time, Low to High Level Output	$V_{ID} = -2.5V$ to $+2.5V$, $C_L = 15 pF$, Figure 1	5.0	15	22	ns
t_{PHL}	Propagation Delay Time, High to Low Level Output		5.0	15	22	ns
t_{ZH}	Output Enable Time to High Level	$C_L = 15 pF$, Figure 2		12	16	ns
t_{ZL}	Output Enable Time to Low Level	$C_L = 15 pF$, Figure 3		13	18	ns
t_{HZ}	Output Disable Time from High Level	$C_L = 5.0 pF$, Figure 2		14	20	ns

Switching Characteristics (Continued)

$V_{CC} = 5.0V$, $T_A = 25^\circ C$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{LZ}	Output Disable Time from Low Level	$C_L = 5.0 \text{ pF}$, <i>Figure 3</i>		14	18	ns
$ t_{PLH} - t_{PHL} $	Pulse Width Distortion (SKEW)	<i>Figure 1</i>		1.0	3.0	ns

Note 2: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Electrical Characteristics" provide conditions for actual device operation.

Note 3: Unless otherwise specified min/max limits apply across the $0^\circ C$ to $+70^\circ C$ range for the DS96F173C/DS96F175C. All typicals are given for $V_{CC} = 5V$ and $T_A = 25^\circ C$.

Note 4: All currents into the device pins are positive; all currents out of the device pins are negative. All voltages are reference to ground unless otherwise specified.

Note 5: The algebraic convention, when the less positive (more negative) limit is designated minimum, is used in this data sheet for common mode input voltage and threshold voltage levels only.

Note 6: Hysteresis is the difference between the positive-going input threshold voltage, V_{TH} , and the negative going input threshold voltage, V_{TL} .

Note 7: Refer to EIA-485 Standard for exact conditions.

Note 8: Only one output at a time should be shorted.

Order Number: DS96F173CJ

DS96F175CJ

See NS Package Number J16A

MIL-STD-883C

Absolute Maximum Ratings (Note 2)

For complete Military Specifications, refer to the appropriate SMD or MDS.

Storage Temperature Range (T_{STG})	-65°C to +175°C
Lead Temperature (Soldering, 60 sec.)	300°C
Max. Package Power Dissipation (Note 9) at 25°C	
Ceramic DIP (J)	1500 mW
Ceramic Flatpak (W)	1034 mW
Ceramic LCC (E)	1500 mW
Supply Voltage	7.0V
Input Voltage, A or B Inputs	±25V
Differential Input Voltage	±25V
Enable Input Voltage	7.0V
Low Level Output Current	50 mA

Recommended Operating Conditions

	Min	Typ	Max	Units
Supply Voltage (V_{CC})	DS96F173M/DS96F175M	4.50	5.0	5.50
Common Mode Input Voltage (V_{CM})		-7	+12	V
Differential Input Voltage (V_{ID})		12		V
Output Current HIGH (I_{OH})		-400		µA
Output Current LOW (I_{OL})		11		mA
Operating Temperature (T_A)	DS96F173M/DS96F175M	-55	25	125
Note 9: Above $T_A = 25^\circ\text{C}$ derate J package 10 mW/C, W package 6.90 mW/C, E package 11.11 mW/C.				°C

Electrical Characteristics (Notes 3, 4)

Over recommended supply voltage and operating temperature ranges, unless otherwise specified

Symbol	Parameter	Conditions		Min	Max	Units
V_{TH}	Differential-Input High Threshold Voltage	$V_{CC} = 4.5\text{V}, 5.5\text{V}$ $V_{CM} = 0\text{V}, 12\text{V}, -12\text{V}$			0.2	V
V_{TL}	Differential-Input (Note 5) Low Threshold Voltage	$V_{CC} = 4.5\text{V}, 5.5\text{V}$ $V_{CM} = 0\text{V}, 12\text{V}, -12\text{V}$		-0.2		V
V_{IH}	Enable Input Voltage HIGH			2.0		V
V_{IL}	Enable Input Voltage LOW				0.8	V
V_{IC}	Enable Input Clamp Voltage	$I_I = -18\text{ mA}$, $V_{CC} = 4.5\text{V}$			-1.5	V
V_{OH}	Output Voltage HIGH	$V_{ID} = 200\text{ mV}$	-55°C to $+125^\circ\text{C}$	2.5		V
V_{OL}	Output Voltage LOW	$V_{ID} = -200\text{ mV}$	$I_{OL} = 8.0\text{ mA}$		0.45	V
I_{OZ}	High-Impedance State Output	$V_O = 0.4\text{V}, 2.4\text{V}$, $V_{CC} = 5.5\text{V}$			±20	µA
I_I	Line Input Current (Note 7)	Other Input = 0V	$V_I = 12\text{V}$	1.0	mA	
			$V_I = -7.0\text{V}$	-0.8		
I_{IH}	Enable Input Current HIGH	$V_{IH} = 2.7\text{V}$, $V_{CC} = 5.5\text{V}$		20		µA
I_{IL}	Enable Input Current LOW	$V_{IL} = 0.4\text{V}$, $V_{CC} = 5.5\text{V}$		-100		µA
R_I	Input Resistance			10		kΩ
I_{OS}	Short Circuit Output Current	(Note 8)		-15	-85	mA
I_{CC}	Supply Current	No Load	Outputs Enabled or Disabled		50	mA
I_{CCX}						

MIL-STD-883C

Switching Characteristics

$V_{CC} = 5.0\text{V}$

Symbol	Parameter	Conditions	$T_A = 25^\circ\text{C}$		$T_A = -55^\circ\text{C}$	$T_A = 125^\circ\text{C}$	Units
			Typ	Max	Max	Max	
t_{PLH}	Propagation Delay Time, Low to High Level Output	$V_{ID} = -2.5\text{V}$ to $+2.5\text{V}$, $C_L = 15\text{ pF}$, Figure 1 $V_{CM} = 0\text{V}$	15	22	30	30	ns
t_{PHL}	Propagation Delay Time, High to Low Level Output		15	22	30	30	ns
t_{ZH}	Output Enable Time to High Level	$C_L = 15\text{ pF}$, Figure 2	12	16	27	27	ns

Switching Characteristics (Continued)

$V_{CC} = 5.0V$

Symbol	Parameter	Conditions	$T_A = 25^\circ C$		$T_A = -55^\circ C$	$T_A = 125^\circ C$	Units
			Typ	Max	Max	Max	
t_{ZL}	Output Enable Time to Low Level	$C_L = 15 \text{ pF}$, Figure 3	13	18	27	27	ns
t_{HZ}	Output Disable Time from High Level	$C_L = 5.0 \text{ pF}$, Figure 2(Note 15)	14	20	27	27	ns
		$C_L = 20 \text{ pF}$, Figure 2(Note 15)	14	30	37	37	ns
t_{LZ}	Output Disable Time from Low Level	$C_L = 5.0 \text{ pF}$, Figure 3	14	18	30	30	ns
$ t_{PLH} - t_{PHL} $	Pulse Width Distortion (SKEW)	Figure 1	1	3	5.0	5.0	ns

SMD Number:	DS96F173MJ	5962-9076602 MEA
	DS96F173MW	5962-9076602 MFA
	DS96F173ME	5962-9076602 M2A
	DS96F175MJ	5962-9076601 MEA
	DS96F175MW	5962-9076601 MFA
	DS96F175ME	5962-9076601 M2A

Order Number:	883 Marking	SMD Marking
	DS96F173MJ/883	DS96F173MJ-SMD
	DS96F175MJ/883	DS96F175MJ-SMD
See NS Package Number		

J16A

DS96F173ME/883	DS96F173ME-SMD
DS96F175ME/883	DS96F175ME-SMD
See NS Package Number	
E20A	

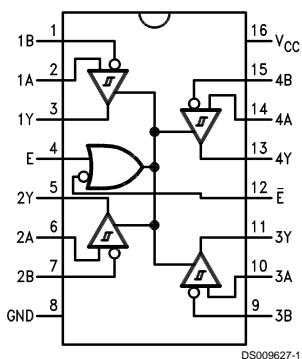
DS96F173MW/883	DS96F173MW-SMD
DS96F175MW/883	DS96F175MW-SMD
See NS Package Number	
W16A	

For complete Military Product Specifications, refer to the appropriate SMD or MDS.

Connection Diagrams

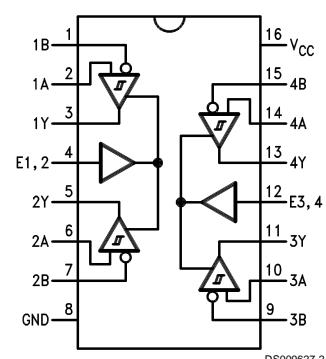
16-Lead Ceramic Dual-In-Line Package
NS Package Number J16A

DS96F173



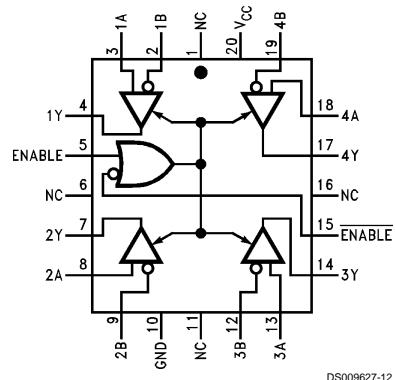
Top View

DS96F175



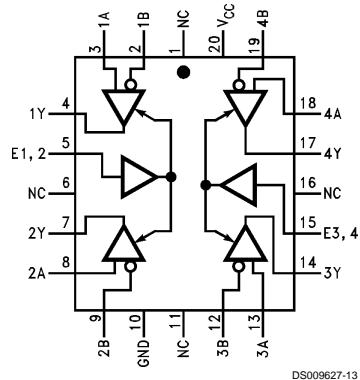
Top View

20-Lead Ceramic Leadless Chip Carrier
NS Package Number E20A



DS009627-12

Top View



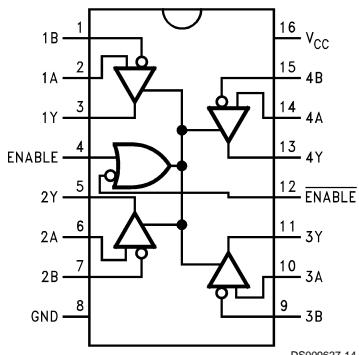
DS009627-13

Top View

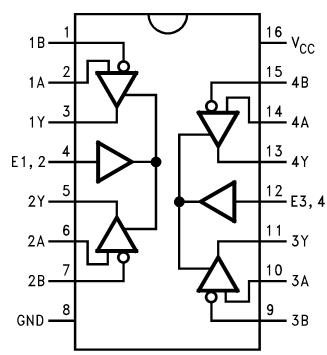
*NC — No Connection

Connection Diagrams (Continued)

16-Lead Ceramic Flatpak
NS Package Number W16A



Top View



Top View

Order Numbers are located at the end of the respective Electrical Tables.

Parameter Measurement Information

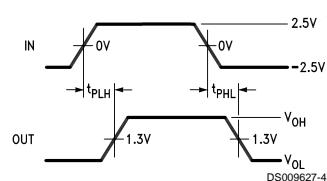
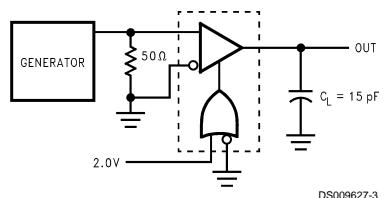


FIGURE 1. t_{PLH} , t_{PHL} (Notes 10, 11)

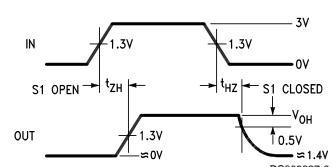
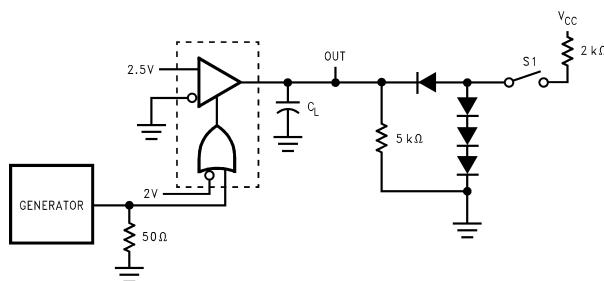


FIGURE 2. t_{HZ} , t_{ZH} (Notes 10, 11, 13, 14)

Parameter Measurement Information (Continued)

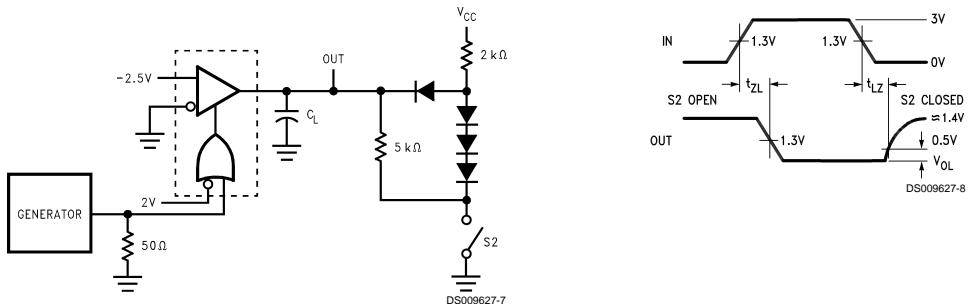


FIGURE 3. t_{ZL} , t_{LZ} (Notes 10, 11, 13, 14)

Note 10: The input pulse is supplied by a generator having the following characteristics: $f = 1.0$ MHz, 50% duty cycle, $t_r \leq 6.0$ ns, $t_f \leq 6.0$ ns, $Z_0 = 50\Omega$.

Note 11: C_L includes probe and stray capacitance.

Note 12: DS96F173 with active high and active low Enables are shown. DS96F175 has active high Enable only.

Note 13: All diodes are 1N916 or equivalent.

Note 14: To test the active low Enable \bar{E} of DS96F173, ground E and apply an inverted input waveform to \bar{E} . DS96F175 has active high enable only.

Note 15: Testing at 20 pF assures conformance to 5 pF specification.

Typical Application

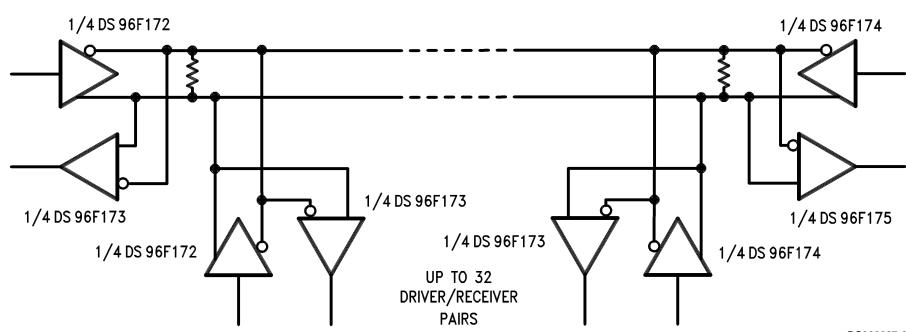
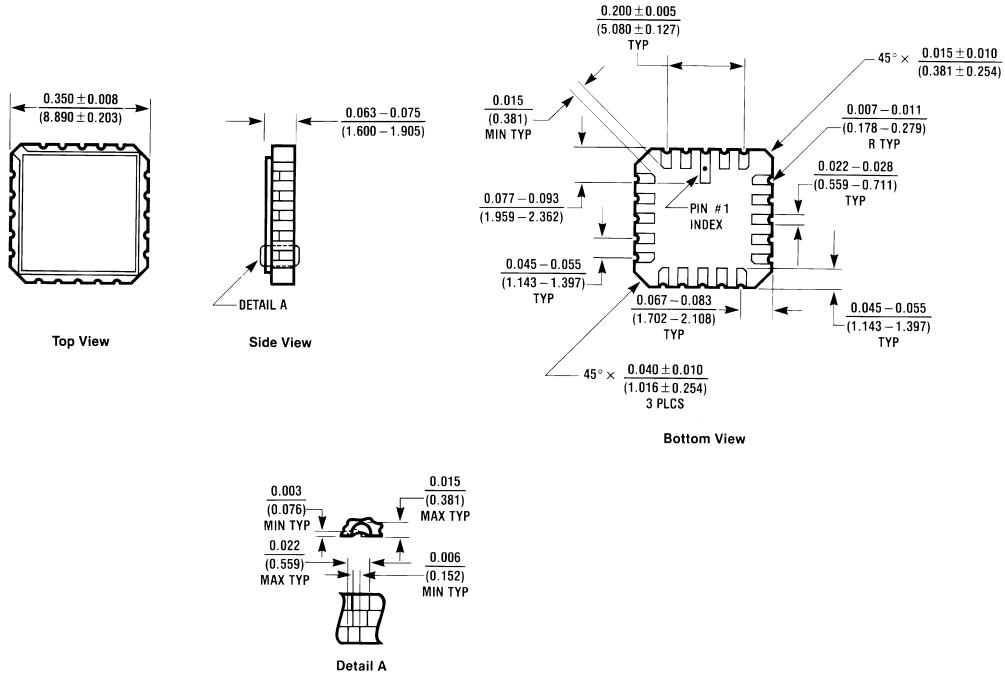


FIGURE 4.

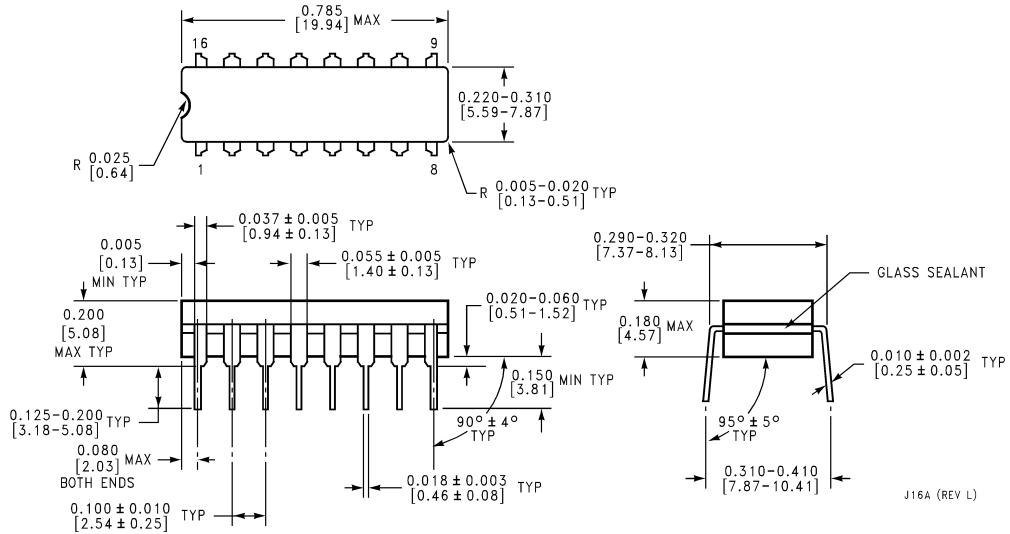
Note: The line length should be terminated at both ends in its characteristic impedance. Stub lengths off the main line should be kept as short as possible.

Physical Dimensions inches (millimeters) unless otherwise noted



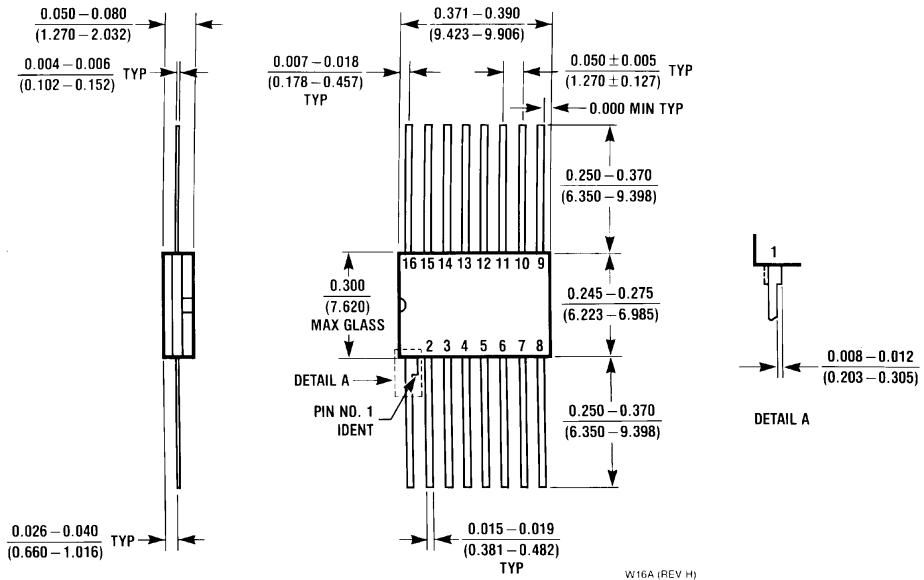
**20-Lead Ceramic Leadless Chip Carrier (E)
Order Number DS96F173ME/883 or DS96F175ME/883
NS Package Number E20A**

E20A (REV D)



16-Lead Ceramic Dual-In-Line Package (J)
Order Number DS96F173CJ, DS96F175CJ, DS96F173MJ/883 or DS96F175MJ/883
NS Package Number J16A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



16-Lead Ceramic FlatPak (W)
Order Number DS96F173MW/883 or DS96F175MW/883
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 in 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**
Americas
Tel: 1-800-272-9959
Fax: 1-800-737-7018
Email: support@nsc.com

www.national.com

National Semiconductor
Europe Fax: +49 (0) 1 80-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 1 80-530 85 85
English Tel: +49 (0) 1 80-532 78 32
Français Tel: +49 (0) 1 80-532 93 58
Italiano Tel: +49 (0) 1 80-534 16 80

**National Semiconductor
Asia Pacific Customer
Response Group**
Tel: 65-2544466
Fax: 65-2504466
Email: sea.support@nsc.com

**National Semiconductor
Japan Ltd.**
Tel: 81-3-5620-6175
Fax: 81-3-5620-6179