

## 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
- Lower power version
- Input sensitivity of ±200 mV over common mode range
- Input hysteresis of 50 mV typical
- High input impedance
- DS96F173 and DS96F175 are lead and function compatible with SN75173/175 or the AM26LS32/MC3486

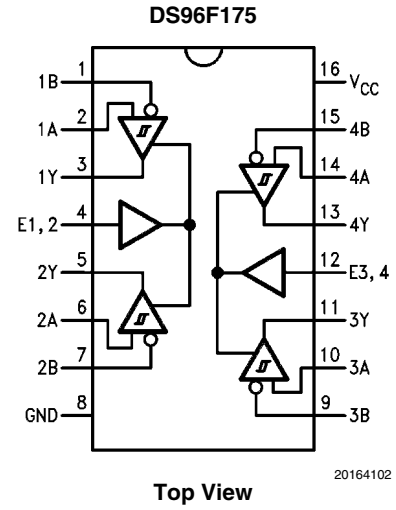
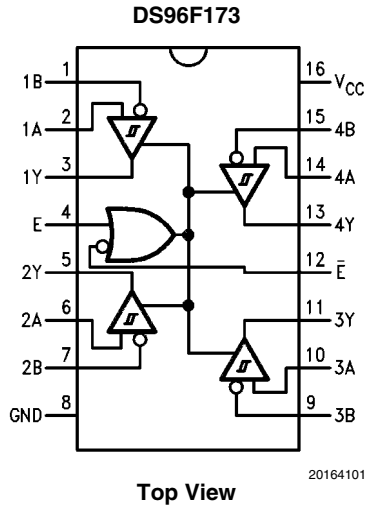
### Ordering Information

NS Part Number	SMD Part Number	NS Package Number	Package Description
DS96F173ME/883	5962-9076602M2A	E20A	20LD Leadless Chip Carrier
DS96F173MJ/883	5962-9076602MEA	J16A	16LD Ceramic Dip
DS96F175ME/883	5962-9076601M2A	E20A	20LD Leadless Chip Carrier
DS96F175MJ-QMLV	5962-9076601VEA	J16A	16LD Ceramic Dip

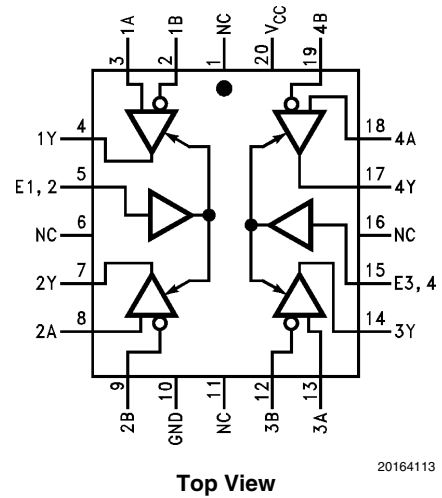
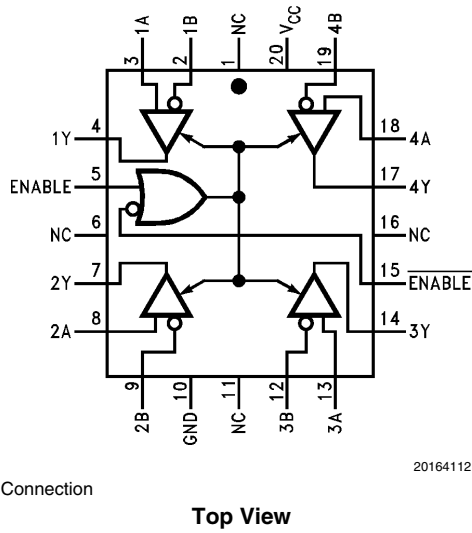
TRI-STATE® is a registered trademark of National Semiconductor Corporation.

## Connection Diagrams

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

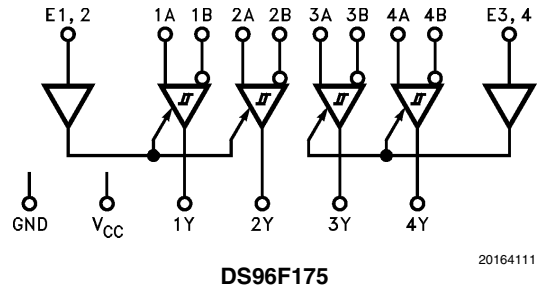
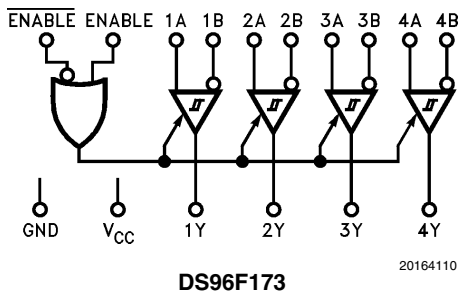


### 20-Lead Ceramic Leadless Chip Carrier (NS Package Number E20A)



\*NC—No Connection

## Logic Diagrams



## Function Tables

(Each Receiver) DS96F173

Differential Inputs A-B	Enable		Output Y
	E	$\bar{E}$	
$V_{ID} \geq 0.2V$	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

## Absolute Maximum Ratings *(Note 1)*

Storage Temperature Range ( $T_{Sig}$ )	$-65^{\circ}\text{C} \leq T_A \leq +175^{\circ}\text{C}$
Lead Temperature (Soldering, 60 sec.)	300°C
Max. Package Power Dissipation at 25°C <i>(Note 2)</i>	
Ceramic DIP (J)	1,500 mW
Ceramic Flatpak (W)	1,034 mW
Ceramic LCC (E)	1,500 mW
Supply Voltage	7.0V
Input Voltage, A or B Inputs	$\pm 25\text{V}$
Differential Input Voltage	$\pm 25\text{V}$
Enable Input Voltage	7.0V
Low Level Output Current	50 mA

## Recommended Operating Conditions

	Min	Max	Units
Supply Voltage ( $V_{CC}$ )	4.50	5.50	V
Common Mode Input Voltage ( $V_{CM}$ )	-7	+12	V
Differential Input Voltage ( $V_{ID}$ )	-7	+12	V
Output Current HIGH ( $I_{OH}$ )		-400	$\mu\text{A}$
Output Current LOW ( $I_{OL}$ )		16	mA
Operating Temperature ( $T_A$ )	-55	125	°C

## Quality Conformance Inspection

Mil-Std-883, Method 5005 - Group A

Subgroup	Description	Temp (°C)
1	Static tests at	+25
2	Static tests at	+125
3	Static tests at	-55
4	Dynamic tests at	+25
5	Dynamic tests at	+125
6	Dynamic tests at	-55
7	Functional tests at	+25
8A	Functional tests at	+125
8B	Functional tests at	-55
9	Switching tests at	+25
10	Switching tests at	+125
11	Switching tests at	-55
12	Settling time at	+25
13	Settling time at	+125
14	Settling time at	-55

## DC Parameters

The following conditions apply, unless otherwise specified.  $V_{CC} = 5.0V$ , Outputs Enabled

Symbol	Parameter	Conditions	Notes	Min	Max	Units	Sub-groups
$I_{CC}$	Supply Current	$V_{CC} = 5.5V, V_{ID} = 2V$	(Note 3)		50	mA	1, 2, 3
$V_{OH}$	Logical "1" Output Voltage	$V_{CC} = 4.5V, I_{OH} = -400\mu A,$ $V_{ID} = 0.2V$	(Note 4)	2.5		V	1, 2, 3
$V_{OL}$	Logical "0" Output Voltage	$V_{CC} = 4.5V, I_{OL} = 8mA,$ $V_{ID} = -0.2V$	(Note 4)		0.45	V	1, 2, 3
$V_{TH}$	Differential-Input High Threshold Voltage	$V_{CC} = 4.5V \text{ \& } 5.5V, V_{CM} = 0V, V_O = 2.5V, I_O = -400\mu A$			0.20	V	1, 2, 3
		$V_{CC} = 4.5V \text{ \& } 5.5V,$ $V_{CM} = -12V, V_O = 2.5V,$ $I_O = -400\mu A$			0.20	V	1, 2, 3
		$V_{CC} = 4.5V \text{ \& } 5.5V, V_{CM} = 12V,$ $V_O = 2.5V, I_O = -400\mu A$			0.20	V	1, 2, 3
$V_{TL}$	Differential-Input Low Threshold Voltage	$V_{CC} = 4.5V \text{ \& } 5.5V, V_{CM} = 0V, V_O = 0.5V, I_O = 16mA$		-0.20		V	1, 2, 3
		$V_{CC} = 4.5V \text{ \& } 5.5V,$ $V_{CM} = -12V, V_O = 0.5V,$ $I_O = 16mA$		-0.20		V	1, 2, 3
		$V_{CC} = 4.5V \text{ \& } 5.5V, V_{CM} = 12V,$ $V_O = 0.5V, I_O = 16mA$		-0.20		V	1, 2, 3
$I_I$	Input Line Current	$V_{CC} = 4.5V, V_I = 12V,$ Untested Inputs are 0V			1.0	mA	1, 2, 3
		$V_{CC} = 5.5V, V_I = -7V,$ Untested Inputs are 0V		-0.8		mA	1, 2, 3
$I_{IH}$	Logical "1" Enable Input Current	$V_{CC} = 5.5V, V_{IH} = 2.7V$			10	$\mu A$	1, 2, 3
$I_{IL}$	Logical "0" Enable Input Current	$V_{CC} = 5.5V, V_{IL} = 0.4V$		-100		$\mu A$	1, 2, 3
$I_{OS}$	Output Short Circuit Current	$V_{CC} = 4.5V, V_O = 0V$	(Note 8)	-85	-15	mA	1, 2, 3
		$V_{CC} = 5.5V, V_O = 0V$		-85	-15	mA	1, 2, 3
$V_{IK}$	Enable Input Clamp Voltage	$V_{CC} = 4.5V, I_I = -18mA$		-1.5		V	1, 2, 3
$I_{OZ}$	High Impedance Output Current	$V_{CC} = 5.5V, V_{En} = 0.8V,$ $V_O = 0.4V,$ Outputs disabled		-20	20	$\mu A$	1, 2, 3
		$V_{CC} = 5.5V, V_{En} = 0.8V,$ $V_O = 2.4V,$ Outputs disabled		-20	20	$\mu A$	1, 2, 3
$V_{IH}$	Logical "1" Enable Input Voltage		(Note 5)	2.0		V	1, 2, 3
$V_{IL}$	Logical "0" Enable Input Voltage		(Note 6)		0.8	V	1, 2, 3
$R_I$	Input Resistance			10		k $\Omega$	1, 2, 3

## AC Parameters

The following conditions apply, unless otherwise specified.  $V_{CC} = 5.0V$

Symbol	Parameter	Conditions	Notes	Min	Max	Units	Sub-groups
$t_{PHL}$	Propagation Delay	$C_L = 15pF$			22	ns	1
					30	ns	2, 3
$t_{PLH}$	Propagation Delay	$C_L = 15pF$			22	ns	1
					30	ns	2, 3
$t_{PZH}$	Propagation Delay	$C_L = 15pF$			16	ns	1
					27	ns	2, 3
$t_{PZL}$	Propagation Delay	$C_L = 15pF$			18	ns	1
					27	ns	2, 3
$t_{PHZ}$	Propagation Delay	$C_L = 5pF$	(Note 7)		20	ns	1
					27	ns	2, 3
		$C_L = 20pF$		30	ns	1	
				37	ns	2, 3	
$t_{PLZ}$	Propagation Delay	$C_L = 5pF$			18	ns	1
					30	ns	2, 3
$t_{PW}$	Propagation Delay				3.0	ns	1
					8.0	ns	2
					5.0	ns	3

**Note 1:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

**Note 2:** Above  $T_A = 25^\circ C$  derate J package 10 mW/ $^\circ C$ , W package 6.90 mW/ $^\circ C$ , E package 11.11 mW/ $^\circ C$ .

**Note 3:**  $I_{CC}$  is tested with outputs disabled (worst case),  $I_{CC}$  enabled is guaranteed by this test.

**Note 4:**  $V_{OH}$  &  $V_{OL}$  are tested over common mode voltage range of +/-12V via the  $V_{TH} / V_{TL}$  tests.

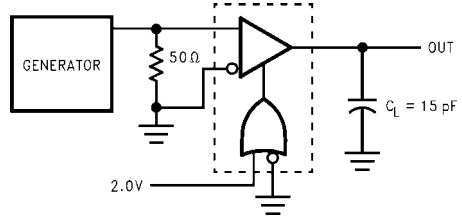
**Note 5:** Guaranteed by  $V_{OL}$  &  $V_{OH}$  tests.

**Note 6:** Guaranteed by  $I_{OZ}$  test.

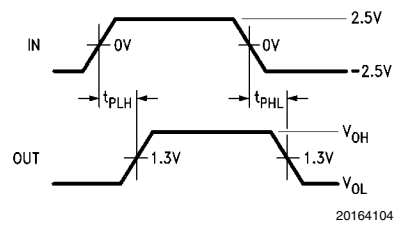
**Note 7:** Testing at 20pF assures conformance to spec at 5pF.

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

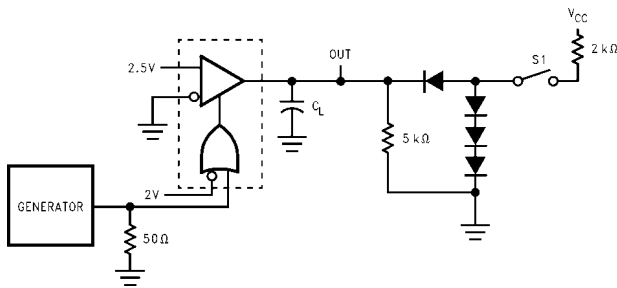
## Parameter Measurement Information



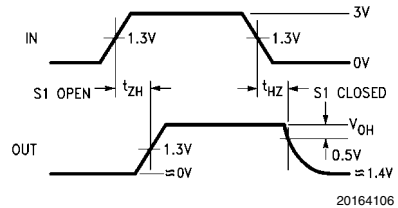
20164103  
**FIGURE 1.  $t_{PLH}$ ,  $t_{PHL}$**  (Note 9, Note 10)



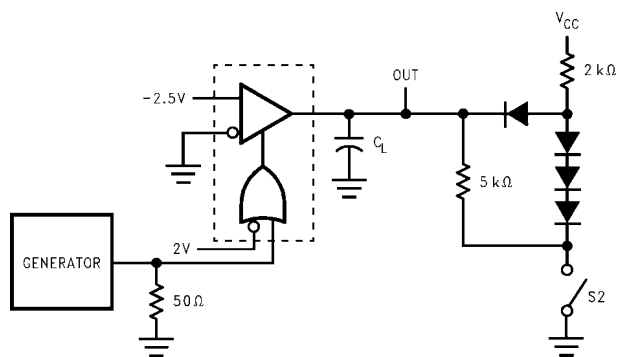
20164104



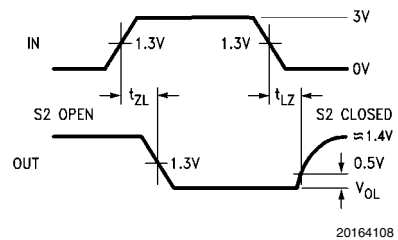
20164105  
**FIGURE 2.  $t_{HZ}$ ,  $t_{ZH}$**  (Note 9, Note 10, Note 12, Note 13)



20164106



20164107  
**FIGURE 3.  $t_{ZL}$ ,  $t_{LZ}$**  (Note 9, Note 10, Note 12, Note 13)



20164108

**Note 9:** The input pulse is supplied by a generator having the following characteristics:  $f = 1.0 \text{ MHz}$ , 50% duty cycle,  $t_r \leq 6.0 \text{ ns}$ ,  $t_f \leq 6.0 \text{ ns}$ ,  $Z_o = 50\Omega$ .

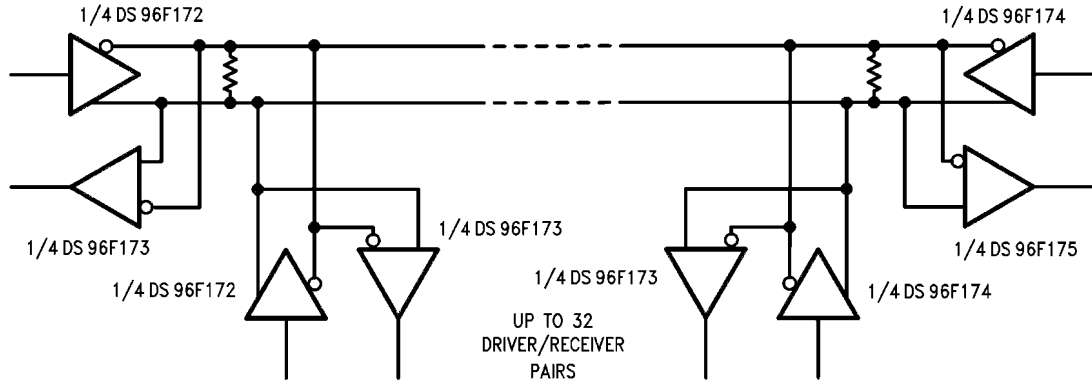
**Note 10:**  $C_L$  includes probe and stray capacitance.

**Note 11:** DS96F173 with active high and active low Enables are shown. DS96F175 has active high Enable only.

**Note 12:** All diodes are 1N916 or equivalent.

**Note 13:** 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.

## Typical Application



20164109

**FIGURE 4.**

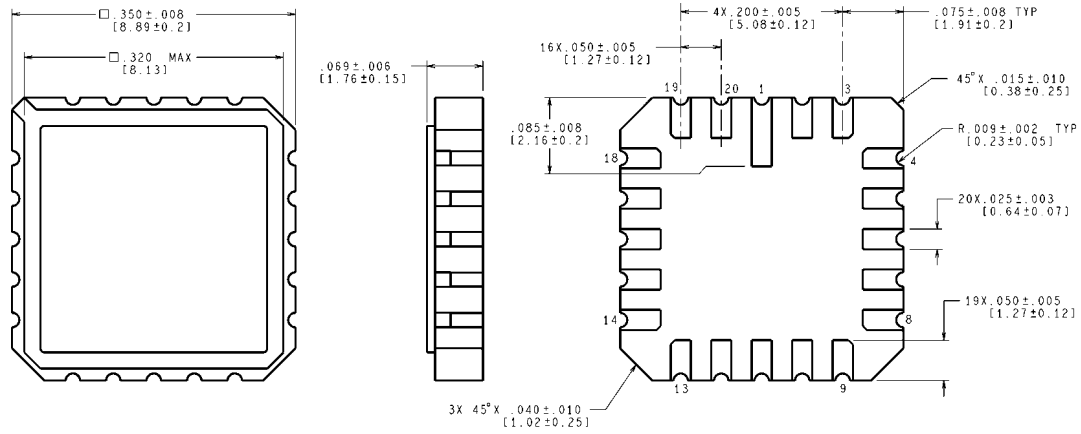
Note: The line length should be terminated at both ends in its characteristic impedance. Stub lengths off the main line should be kept as short as possible.



## Revision History

Released	Revision	Section	Changes
28-Apr-11	A	New Release, Corporate format	2 MDS data sheets converted into one Corp. data sheet format. MNDS96F173M-X Rev 0A0 & MNDS96F175M-X Rev 0B0 will be archived.

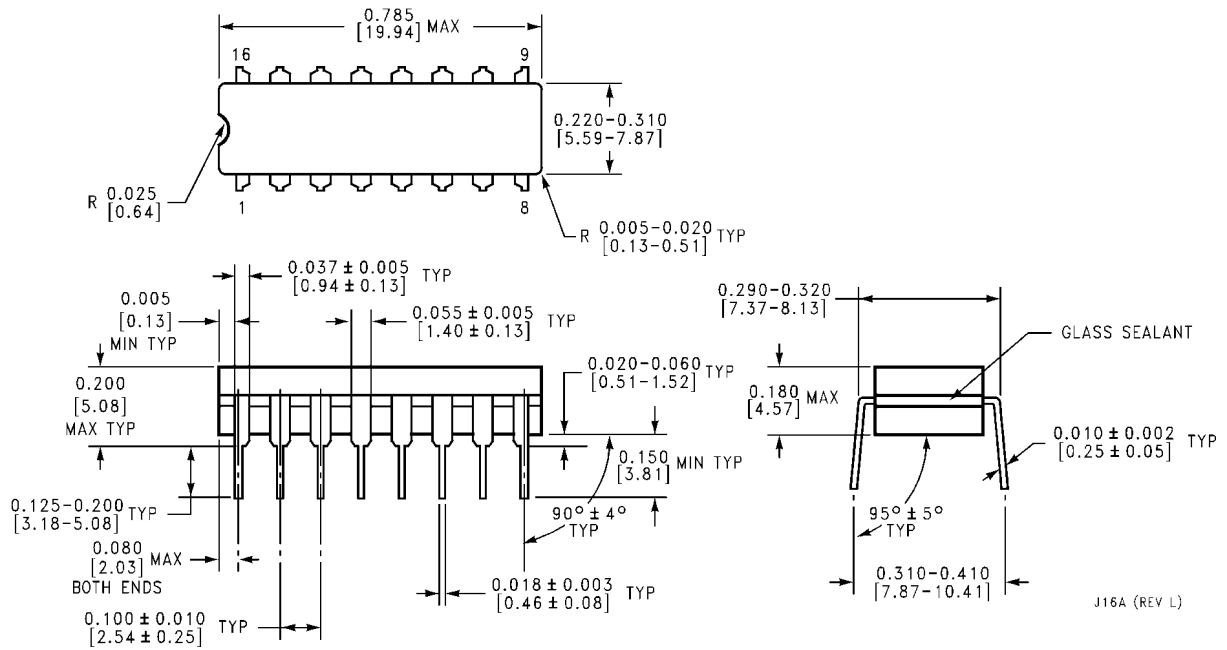
**Physical Dimensions** inches (millimeters) unless otherwise noted



CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

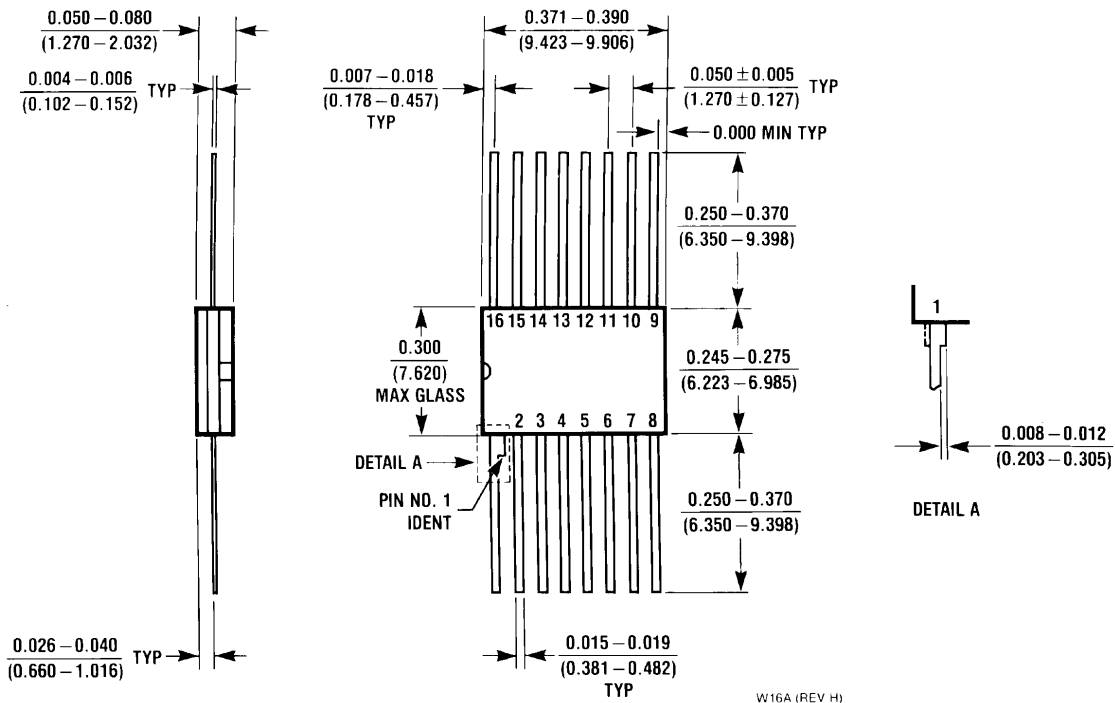
E20A (Rev F)

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



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

J16A (REV L)



**16-Lead Ceramic FlatPak (W)  
NS Package Number W16A**

W16A (REV H)

## Notes

For more National Semiconductor product information and proven design tools, visit the following Web sites at:  
[www.national.com](http://www.national.com)

Products		Design Support	
Amplifiers	<a href="http://www.national.com/amplifiers">www.national.com/amplifiers</a>	WEBENCH® Tools	<a href="http://www.national.com/webench">www.national.com/webench</a>
Audio	<a href="http://www.national.com/audio">www.national.com/audio</a>	App Notes	<a href="http://www.national.com/appnotes">www.national.com/appnotes</a>
Clock and Timing	<a href="http://www.national.com/timing">www.national.com/timing</a>	Reference Designs	<a href="http://www.national.com/refdesigns">www.national.com/refdesigns</a>
Data Converters	<a href="http://www.national.com/adc">www.national.com/adc</a>	Samples	<a href="http://www.national.com/samples">www.national.com/samples</a>
Interface	<a href="http://www.national.com/interface">www.national.com/interface</a>	Eval Boards	<a href="http://www.national.com/evalboards">www.national.com/evalboards</a>
LVDS	<a href="http://www.national.com/lvds">www.national.com/lvds</a>	Packaging	<a href="http://www.national.com/packaging">www.national.com/packaging</a>
Power Management	<a href="http://www.national.com/power">www.national.com/power</a>	Green Compliance	<a href="http://www.national.com/quality/green">www.national.com/quality/green</a>
Switching Regulators	<a href="http://www.national.com/switchers">www.national.com/switchers</a>	Distributors	<a href="http://www.national.com/contacts">www.national.com/contacts</a>
LDOs	<a href="http://www.national.com/ldo">www.national.com/ldo</a>	Quality and Reliability	<a href="http://www.national.com/quality">www.national.com/quality</a>
LED Lighting	<a href="http://www.national.com/led">www.national.com/led</a>	Feedback/Support	<a href="http://www.national.com/feedback">www.national.com/feedback</a>
Voltage References	<a href="http://www.national.com/vref">www.national.com/vref</a>	Design Made Easy	<a href="http://www.national.com/easy">www.national.com/easy</a>
PowerWise® Solutions	<a href="http://www.national.com/powerwise">www.national.com/powerwise</a>	Applications & Markets	<a href="http://www.national.com/solutions">www.national.com/solutions</a>
Serial Digital Interface (SDI)	<a href="http://www.national.com/sdi">www.national.com/sdi</a>	Mil/Aero	<a href="http://www.national.com/milaero">www.national.com/milaero</a>
Temperature Sensors	<a href="http://www.national.com/tempensors">www.national.com/tempensors</a>	SolarMagic™	<a href="http://www.national.com/solarmagic">www.national.com/solarmagic</a>
PLL/VCO	<a href="http://www.national.com/wireless">www.national.com/wireless</a>	PowerWise® Design University	<a href="http://www.national.com/training">www.national.com/training</a>

THE CONTENTS OF THIS DOCUMENT ARE PROVIDED IN CONNECTION WITH NATIONAL SEMICONDUCTOR CORPORATION ("NATIONAL") PRODUCTS. NATIONAL MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS PUBLICATION AND RESERVES THE RIGHT TO MAKE CHANGES TO SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. NO LICENSE, WHETHER EXPRESS, IMPLIED, ARISING BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT.

TESTING AND OTHER QUALITY CONTROLS ARE USED TO THE EXTENT NATIONAL DEEMS NECESSARY TO SUPPORT NATIONAL'S PRODUCT WARRANTY. EXCEPT WHERE MANDATED BY GOVERNMENT REQUIREMENTS, TESTING OF ALL PARAMETERS OF EACH PRODUCT IS NOT NECESSARILY PERFORMED. NATIONAL ASSUMES NO LIABILITY FOR APPLICATIONS ASSISTANCE OR BUYER PRODUCT DESIGN. BUYERS ARE RESPONSIBLE FOR THEIR PRODUCTS AND APPLICATIONS USING NATIONAL COMPONENTS. PRIOR TO USING OR DISTRIBUTING ANY PRODUCTS THAT INCLUDE NATIONAL COMPONENTS, BUYERS SHOULD PROVIDE ADEQUATE DESIGN, TESTING AND OPERATING SAFEGUARDS.

EXCEPT AS PROVIDED IN NATIONAL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, NATIONAL ASSUMES NO LIABILITY WHATSOEVER, AND NATIONAL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE SALE AND/OR USE OF NATIONAL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

### LIFE SUPPORT POLICY

**NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE CHIEF EXECUTIVE OFFICER AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION.** As used herein:

Life support devices or systems are devices 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. A critical component is any component in 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 and the National Semiconductor logo are registered trademarks of National Semiconductor Corporation. All other brand or product names may be trademarks or registered trademarks of their respective holders.

Copyright© 2011 National Semiconductor Corporation

For the most current product information visit us at [www.national.com](http://www.national.com)



**National Semiconductor Americas Technical Support Center**  
 Email: [support@nsc.com](mailto:support@nsc.com)  
 Tel: 1-800-272-9959

**National Semiconductor Europe Technical Support Center**  
 Email: [europe.support@nsc.com](mailto:europe.support@nsc.com)

**National Semiconductor Asia Pacific Technical Support Center**  
 Email: [ap.support@nsc.com](mailto:ap.support@nsc.com)

**National Semiconductor Japan Technical Support Center**  
 Email: [jpn.feedback@nsc.com](mailto:jpn.feedback@nsc.com)