

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

### General Description

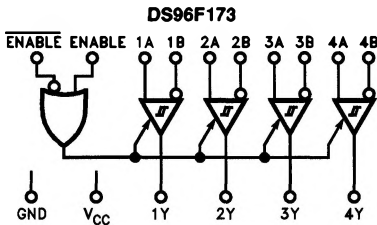
The DS96F173 and the DS96F175 are high speed quad differential line receivers designed to meet the EIA-485 standard. The DS96F173 and the DS96F175 offer improved performance due to the use of L-FAST bipolar technology. The use of LFAST technology allows the DS96F173 and DS96F175 to operate at higher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

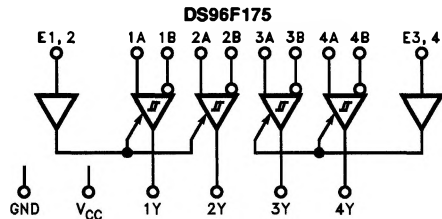
### Features

- 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  $\pm 200$  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



TL/F/9627-10



TL/F/9627-11

### Function Tables

(Each Receiver) DS96F173

Differential Inputs A-B	Enable E	Enable 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

## COMMERCIAL

### Absolute Maximum Ratings (Note 1)

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

Storage Temperature Range (T <sub>STG</sub> )	-65°C to +175°C
Lead Temperature (Soldering, 60 sec.)	300°C
Max. Package Power Dissipation* at 25°C Ceramic DIP (J)	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

\*Derate package 10 mW/°C above 25°C.

### Recommended Operating Conditions

	Min	Typ	Max	Units
Supply Voltage (V <sub>CC</sub> )				
DS96F173C/DS96F175C	4.75	5.0	5.25	V
DS96F173M/DS96F175M	4.50	5.0	5.50	V
Common Mode Input Voltage (V <sub>CM</sub> )	-7		+12	V
Differential Input Voltage (V <sub>ID</sub> )			12	V
Output Current HIGH (I <sub>OH</sub> )			-400	μA
Output Current LOW (I <sub>OL</sub> )			11	mA
Operating Temperature (T <sub>A</sub> )				
DS96F173C/DS96F175C	0	25	70	°C
DS96F173M/DS96F175M	-55	25	125	°C

### Electrical Characteristics

Over recommended supply voltage and operating temperature ranges, unless otherwise specified (Notes 2, 3)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V <sub>TH</sub>	Differential-Input High Threshold Voltage	V <sub>O</sub> = V <sub>OH</sub>			0.2	V
V <sub>TL</sub>	Differential-Input (Note 4) Low Threshold Voltage	V <sub>O</sub> = V <sub>OL</sub>	-0.2			V
V <sub>TH</sub> - V <sub>TL</sub>	Hysteresis (Note 5)	V <sub>CM</sub> = 0V		50		mV
V <sub>IH</sub>	Enable Input Voltage HIGH		2.0			V
V <sub>IL</sub>	Enable Input Voltage LOW				0.8	V
V <sub>IC</sub>	Enable Input Clamp Voltage	I <sub>I</sub> = -18 mA			-1.5	V
V <sub>OH</sub>	Output Voltage HIGH	V <sub>ID</sub> = 200 mV I <sub>OH</sub> = -400 μA	0°C to +70°C 2.8 -55°C to +125°C 2.5			V
V <sub>OL</sub>	Output Voltage LOW	V <sub>ID</sub> = -200 mV	I <sub>OL</sub> = 8.0 mA I <sub>OL</sub> = 11 mA		0.45 0.50	V
I <sub>OZ</sub>	High-Impedance State Output	V <sub>O</sub> = 0.4V to 2.4V			±20	μA
I <sub>I</sub>	Line Input Current (Note 6)	Other Input = 0V	V <sub>I</sub> = 12V V <sub>I</sub> = -7.0V		1.0 -0.8	mA
I <sub>IH</sub>	Enable Input Current HIGH	V <sub>IH</sub> = 2.7V			20	μA
I <sub>IL</sub>	Enable Input Current LOW	V <sub>IL</sub> = 0.4V			-100	μA
R <sub>I</sub>	Input Resistance		14	18	22	kΩ
I <sub>OS</sub>	Short Circuit Output Current	(Note 7)	-15		-85	mA
I <sub>CC</sub>	Supply Current	No Load	Outputs Enabled		50	mA
I <sub>CCX</sub>			Outputs Disabled		50	

## 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, <i>Figure 1</i> $V_{CM} = 0V$	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, <i>Figure 2</i>		12	16	ns
$t_{ZL}$	Output Enable Time to Low Level	$C_L = 15$ pF, <i>Figure 3</i>		13	18	ns
$t_{HZ}$	Output Disable Time from High Level	$C_L = 5.0$ pF, <i>Figure 2</i>		14	20	ns
$t_{LZ}$	Output Disable Time from Low Level	$C_L = 5.0$ 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 1:** "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 2:** Unless otherwise specified min/max limits apply across the  $-55^\circ C$  to  $+125^\circ C$  temperature range for the DS96F173M/DS96F175M and 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 3:** 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 4:** 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 5:** Hysteresis is the difference between the positive-going input threshold voltage,  $V_{TH}$ , and the negative going input threshold voltage,  $V_{TL}$ .

**Note 6:** Refer to EIA-485 Standard for exact conditions.

**Note 7:** Only one output at a time should be shorted.

**Order Number:** DS96F173CJ  
 DS96F173MJ  
 DS96F175CJ  
 DS96F175MJ  
 See NS Package Number J16A

## MIL-STD-883C

### Absolute Maximum Ratings (Note 1)

The 883 specifications are written to reflect the current Reliability Electrical Test Specifications (RETS) established by National Semiconductor for this product. For a copy of the latest version of the RETS please contact your local National Semiconductor sales office or distributor.

Storage Temperature Range (T <sub>STG</sub> )	-65°C to +175°C
Lead Temperature (Soldering, 60 sec.)	300°C
Max. Package Power Dissipation* 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

\*Above T<sub>A</sub> = 25°C derate J package 10 mW/°C, W package 6.90 mW/°C, E package 11.11 mW/°C.

### Recommended Operating Conditions

	Min	Typ	Max	Units
Supply Voltage (V <sub>CC</sub> )				
DS96F173M/DS96F175M	4.50	5.0	5.50	V
Common Mode Input Voltage (V <sub>CM</sub> )	-7		+12	V
Differential Input Voltage (V <sub>ID</sub> )			12	V
Output Current HIGH (I <sub>OH</sub> )			-400	μA
Output Current LOW (I <sub>OL</sub> )			11	mA
Operating Temperature (T <sub>A</sub> )				
DS96F173M/DS96F175M	-55	25	125	°C

### Electrical Characteristics

Over recommended supply voltage and operating temperature ranges, unless otherwise specified (Notes 2, 3)

Symbol	Parameter	Conditions	Min	Max	Units
V <sub>TH</sub>	Differential-Input High Threshold Voltage	V <sub>CC</sub> = 4.5V, 5.5V V <sub>CM</sub> = 0V, 12V, -12V		0.2	V
V <sub>TL</sub>	Differential-Input (Note 4) Low Threshold Voltage	V <sub>CC</sub> = 4.5V, 5.5V V <sub>CM</sub> = 0V, 12V, -12V	-0.2		V
V <sub>IH</sub>	Enable Input Voltage HIGH		2.0		V
V <sub>IL</sub>	Enable Input Voltage LOW			0.8	V
V <sub>IC</sub>	Enable Input Clamp Voltage	I <sub>I</sub> = -18 mA, V <sub>CC</sub> = 4.5V		-1.5	V
V <sub>OH</sub>	Output Voltage HIGH	V <sub>ID</sub> = 200 mV I <sub>OH</sub> = -400 μA -55°C to +125°C	2.5		V
V <sub>OL</sub>	Output Voltage LOW	V <sub>ID</sub> = -200 mV I <sub>OL</sub> = 8.0 mA		0.45	V
I <sub>OZ</sub>	High-Impedance State Output	V <sub>O</sub> = 0.4V, 2.4V, V <sub>CC</sub> = 5.5V		±20	μA
I <sub>I</sub>	Line Input Current (Note 6)	Other Input = 0V V <sub>I</sub> = 12V V <sub>I</sub> = -7.0V		1.0 -0.8	mA
I <sub>IH</sub>	Enable Input Current HIGH	V <sub>IH</sub> = 2.7V, V <sub>CC</sub> = 5.5V		20	μA
I <sub>IL</sub>	Enable Input Current LOW	V <sub>IL</sub> = 0.4V, V <sub>CC</sub> = 5.5V		-100	μA
R <sub>I</sub>	Input Resistance		10		kΩ
I <sub>OS</sub>	Short Circuit Output Current	(Note 7)	-15	-85	mA
I <sub>CC</sub>	Supply Current	No Load		50	mA
I <sub>CCX</sub>					

# MIL-STD-883C

DS96F173C/DS96F173M/DS96F175C/DS96F175M

## Switching Characteristics $V_{CC} = 5.0V$

Symbol	Parameter	Conditions	$T_A = 25^\circ C$		$T_A = -55^\circ C$	$T_A = 125^\circ C$	Units
			Typ	Max	Max	Max	
$t_{PLH}$	Propagation Delay Time, Low to High Level Output	$V_{ID} = -2.5V$ to $+2.5V$ , $C_L = 15$ pF, <i>Figure 1</i>	15	22	30	30	ns
$t_{PHL}$	Propagation Delay Time, High to Low Level Output	$V_{CM} = 0V$	15	22	30	30	ns
$t_{ZH}$	Output Enable Time to High Level	$C_L = 15$ pF, <i>Figure 2</i>	12	16	27	27	ns
$t_{ZL}$	Output Enable Time to Low Level	$C_L = 15$ pF, <i>Figure 3</i>	13	18	27	27	ns
$t_{HZ}$	Output Disable Time from High Level	$C_L = 5.0$ pF, <i>Figure 2</i> (Note 13)	14	20	27	27	ns
		$C_L = 20$ pF, <i>Figure 2</i> (Note 13)	14	30	37	37	ns
$t_{LZ}$	Output Disable Time from Low Level	$C_L = 5.0$ pF, <i>Figure 3</i>	14	18	30	30	ns
$ t_{PLH} - t_{PHL} $	Pulse Width Distortion (SKEW)	<i>Figure 1</i>	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

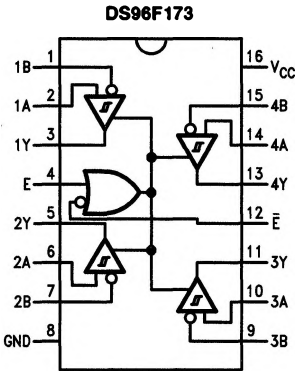
### Order Number:

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 883 Specifications, see RETS Data Sheet.

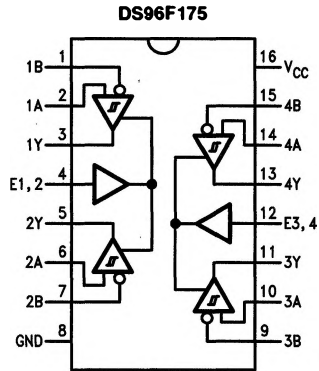
## Connection Diagrams

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



Top View

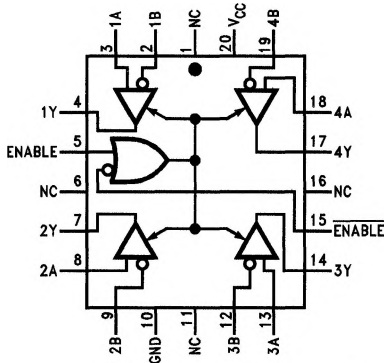
TL/F/9627-1



Top View

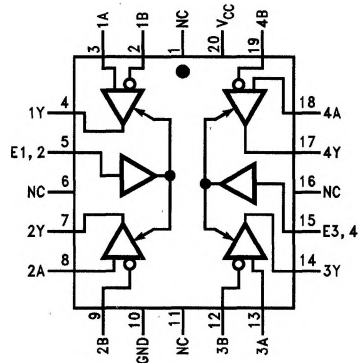
TL/F/9627-2

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



Top View

TL/F/9627-12

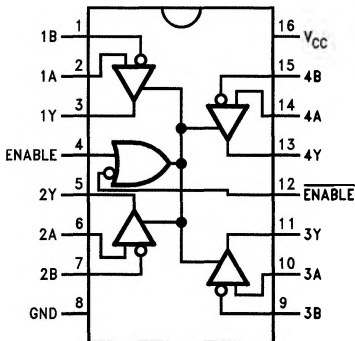


Top View

TL/F/9627-13

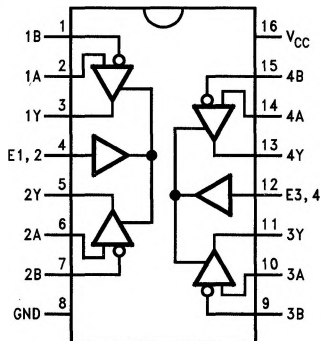
\*NC—No Connection

### 16-Lead Ceramic FlatPak NS Package Number W16A



Top View

TL/F/9627-14

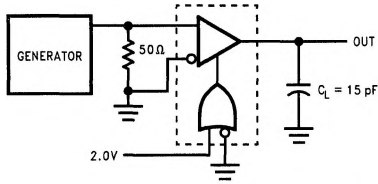


Top View

TL/F/9627-15

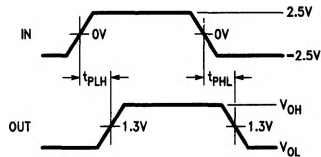
Order Numbers are located at the end of the respective Electrical Tables.

# Parameter Measurement Information

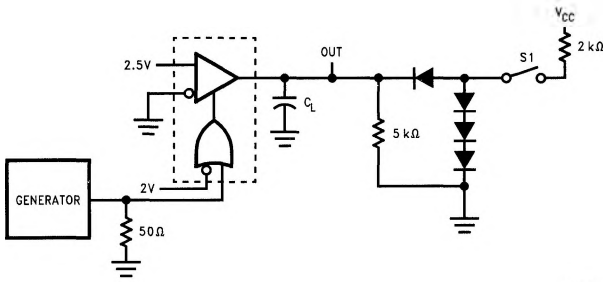


TL/F/9627-3

FIGURE 1.  $t_{PLH}$ ,  $t_{PHL}$  (Notes 8, 9)

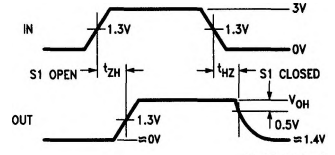


TL/F/9627-4

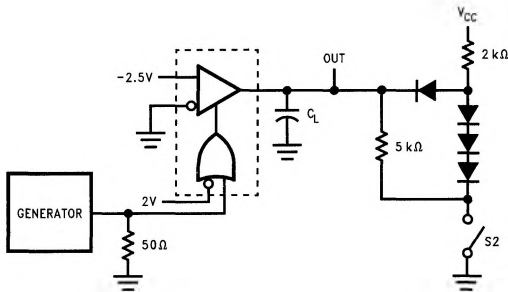


TL/F/9627-5

FIGURE 2.  $t_{HZ}$ ,  $t_{ZH}$  (Notes 8, 9, 11 and 12)

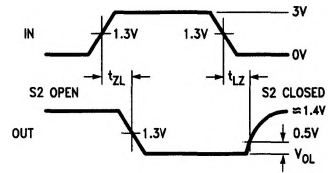


TL/F/9627-6



TL/F/9627-7

FIGURE 3.  $t_{ZL}$ ,  $t_{LZ}$  (Notes 8, 9, 11 and 12)



TL/F/9627-8

**Note 8:** 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,  $Z_O = 50 \Omega$ .

**Note 9:**  $C_L$  includes probe and stray capacitance.

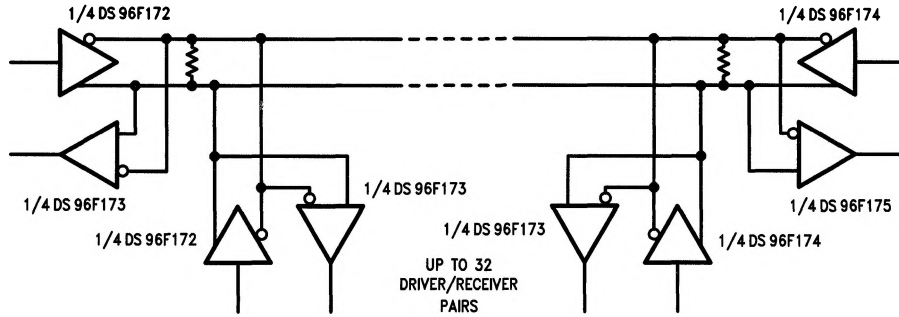
**Note 10:** DS96F173 with active high and active low Enables are shown. DS96F175 has active high Enable only.

**Note 11:** All diodes are 1N916 or equivalent.

**Note 12:** 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 13:** Testing at 20 pF assures conformance to 5 pF specification.

**Typical Application**



**FIGURE 4**

TL/F/9627-9

**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.