

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

 Check for Samples: [DS96F173M/DS96F175C/DS96F175M](#)

### 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

### 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.

### Logic Diagram

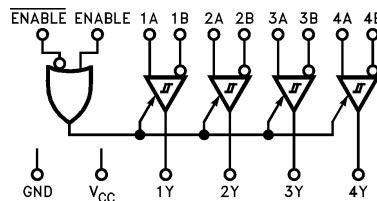


Figure 1. DS96F173

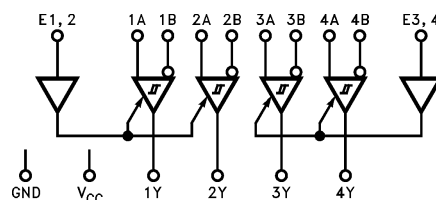


Figure 2. DS96F175



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## Function Tables

**Table 1. (Each Receiver) DS96F173<sup>(1)</sup>**

Differential Inputs	Enable		Output
	E	$\bar{E}$	
A–B			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

**Table 2. (Each Receiver) DS96F175<sup>(1)</sup>**

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

- (1) H = High Level  
 L = Low Level  
 Z = High Impedance (off)  
 X = Don't Care



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## Absolute Maximum Ratings **COMMERCIAL** <sup>(1)</sup>

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 <sup>(2)</sup> 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

- (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.  
 (2) Derate package 10 mW/°C above 25°C.

## Recommended Operating Conditions

	Min	Typ	Max	Units
Supply Voltage ( $V_{CC}$ )				
DS96F175C	4.75	5.0	5.25	V
Common Mode Input Voltage ( $V_{CM}$ )	-7		+12	V
Differential Input Voltage ( $V_{ID}$ )			12	V
Output Current HIGH ( $I_{OH}$ )			-400	$\mu$ A
Output Current LOW ( $I_{OL}$ )			11	mA
Operating Temperature ( $T_A$ )				
DS96F175C	0	25	70	$^{\circ}$ C

## Electrical Characteristics <sup>(1)</sup> <sup>(2)</sup>

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 <sup>(3)</sup> Low Threshold Voltage	$V_O = V_{OL}$		-0.2			V
$V_{TH} - V_{TL}$	Hysteresis <sup>(4)</sup>	$V_{CM} = 0V$			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	$0^{\circ}$ C to $+70^{\circ}$ C	2.8			V
		$I_{OH} = -400$ $\mu$ A	$-55^{\circ}$ C to $+125^{\circ}$ C	2.5			V
$V_{OL}$	Output Voltage LOW	$V_{ID} = -200$ mV	$I_{OL} = 8.0$ mA			0.45	V
			$I_{OL} = 11$ mA			0.50	V
$I_{OZ}$	High-Impedance State Output	$V_O = 0.4V$ to $2.4V$				$\pm 20$	$\mu$ A
$I_I$	Line Input Current <sup>(5)</sup>	Other Input = $0V$	$V_I = 12V$			1.0	mA
			$V_I = -7.0V$			-0.8	mA
$I_{IH}$	Enable Input Current HIGH	$V_{IH} = 2.7V$				20	$\mu$ A
$I_{IL}$	Enable Input Current LOW	$V_{IL} = 0.4V$				-100	$\mu$ A
$R_I$	Input Resistance			14	18	22	k $\Omega$
$I_{OS}$	Short Circuit Output Current	<sup>(6)</sup>		-15		-85	mA
$I_{CC}$	Supply Current	No Load	Outputs Enabled			50	mA
$I_{CCX}$			Outputs Disabled			50	mA

- (1) Unless otherwise specified min/max limits apply across the  $0^{\circ}$ C to  $+70^{\circ}$ C range for the DS96F175C. All typicals are given for  $V_{CC} = 5V$  and  $T_A = 25^{\circ}$ C.
- (2) 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.
- (3) 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.
- (4) Hysteresis is the difference between the positive-going input threshold voltage,  $V_{TH}$ , and the negative going input threshold voltage,  $V_{TL}$ .
- (5) Refer to EIA-485 Standard for exact conditions.
- (6) Only one output at a time should be shorted.

## 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, <a href="#">Figure 9</a>	5.0	15	22	ns
$t_{PHL}$	Propagation Delay Time, High to Low Level Output	$V_{CM} = 0V$	5.0	15	22	ns
$t_{ZH}$	Output Enable Time to High Level	$C_L = 15$ pF, <a href="#">Figure 10</a>		12	16	ns
$t_{ZL}$	Output Enable Time to Low Level	$C_L = 15$ pF, <a href="#">Figure 11</a>		13	18	ns
$t_{HZ}$	Output Disable Time from High Level	$C_L = 5.0$ pF, <a href="#">Figure 10</a>		14	20	ns
$t_{LZ}$	Output Disable Time from Low Level	$C_L = 5.0$ pF, <a href="#">Figure 11</a>		14	18	ns
$ t_{PLH} - t_{PHL} $	Pulse Width Distortion (SKEW)	<a href="#">Figure 9</a>		1.0	3.0	ns

## Absolute Maximum Ratings MIL-STD-883C <sup>(1)</sup>

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 <sup>(2)</sup> 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

- (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.
- (2) Above  $T_A = 25^\circ C$  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 ( $V_{CC}$ )				
DS96F173M/DS96F175M	4.50	5.0	5.50	V
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	°C

**Electrical Characteristics** <sup>(1)</sup> <sup>(2)</sup>

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

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 Low Threshold Voltage <sup>(3)</sup>	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 <sup>(4)</sup>	Other Input = 0V	V <sub>I</sub> = 12V		1.0	mA
			V <sub>I</sub> = -7.0V		-0.8	
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	<sup>(5)</sup>		-15	-85	mA
I <sub>CC</sub>	Supply Current	No Load	Outputs Enabled or Disabled		50	mA
I <sub>CCX</sub>						

- (1) Unless otherwise specified min/max limits apply across the 0°C to +70°C range for the DS96F175C. All typicals are given for V<sub>CC</sub> = 5V and T<sub>A</sub> = 25°C.
- (2) 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.
- (3) 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.
- (4) Refer to EIA-485 Standard for exact conditions.
- (5) Only one output at a time should be shorted.

### MIL-STD-883C Switching Characteristics

V<sub>CC</sub> = 5.0V

Symbol	Parameter	Conditions	T <sub>A</sub> = 25°C		T <sub>A</sub> = -55°C	T <sub>A</sub> = 125°C	Units
			Typ	Max	Max	Max	
t <sub>PLH</sub>	Propagation Delay Time, Low to High Level Output	V <sub>ID</sub> = -2.5V to +2.5V, C <sub>L</sub> = 15 pF, <a href="#">Figure 9</a>	15	22	30	30	ns
t <sub>PHL</sub>	Propagation Delay Time, High to Low Level Output	V <sub>CM</sub> = 0V	15	22	30	30	ns
t <sub>ZH</sub>	Output Enable Time to High Level	C <sub>L</sub> = 15 pF, <a href="#">Figure 10</a>	12	16	27	27	ns
t <sub>ZL</sub>	Output Enable Time to Low Level	C <sub>L</sub> = 15 pF, <a href="#">Figure 11</a>	13	18	27	27	ns
t <sub>HZ</sub>	Output Disable Time from High Level	C <sub>L</sub> = 5.0 pF, <a href="#">Figure 10</a> <sup>(1)</sup>	14	20	27	27	ns
		C <sub>L</sub> = 20 pF, <a href="#">Figure 10</a> <sup>(1)</sup>	14	30	37	37	ns
t <sub>LZ</sub>	Output Disable Time from Low Level	C <sub>L</sub> = 5.0 pF, <a href="#">Figure 11</a>	14	18	30	30	ns
t <sub>PLH</sub> -t <sub>PHL</sub>	Pulse Width Distortion (SKEW)	<a href="#">Figure 9</a>	1	3	5.0	5.0	ns

(1) Testing at 20 pF assures conformance to 5 pF specification.

### Connection Diagrams

#### 16-Lead Ceramic Dual-In-Line Package

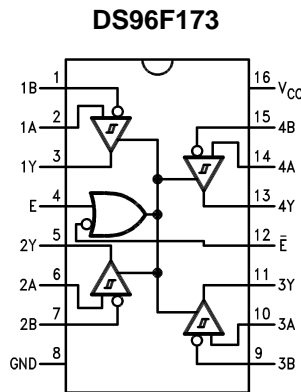


Figure 3. Top View

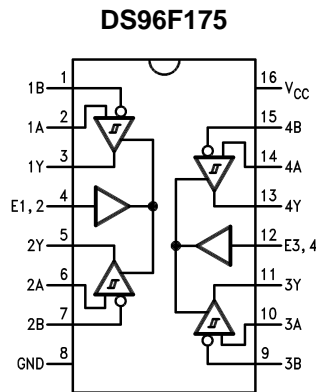
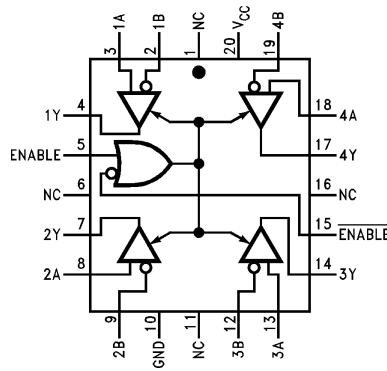


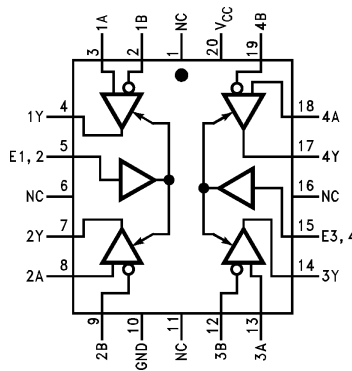
Figure 4. Top View

**20-Lead Ceramic Leadless Chip Carrier**



\*NC—No Connection

**Figure 5. Top View**



**Figure 6. Top View**

16-Lead Ceramic Flatpack

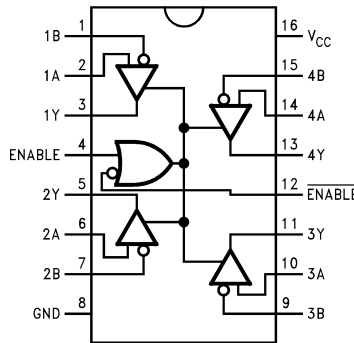


Figure 7. Top View

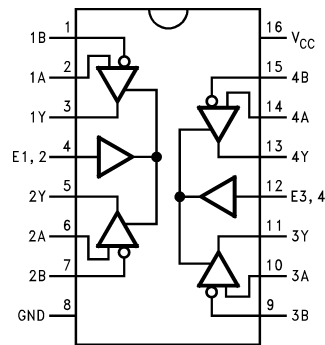
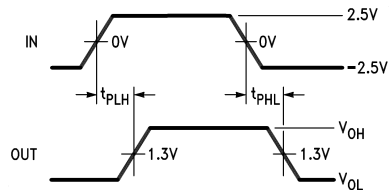
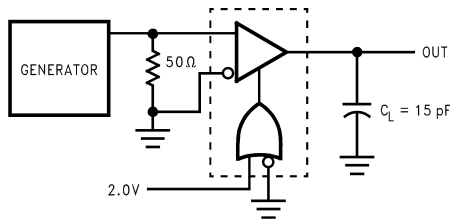


Figure 8. Top View



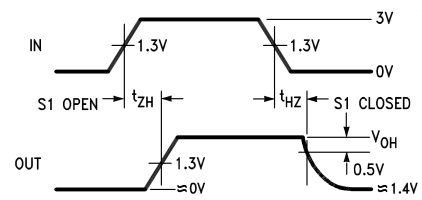
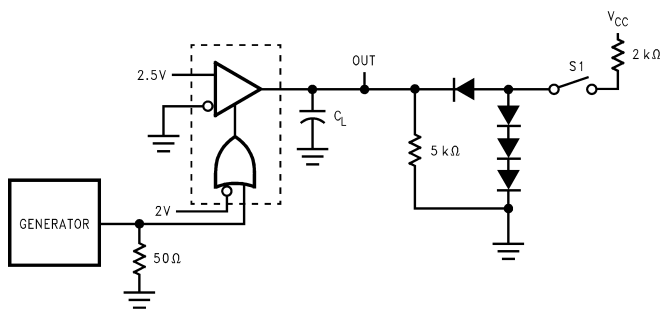
Parameter Measurement Information



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

(11)  $C_L$  includes probe and stray capacitance.

Figure 9.  $t_{PLH}$ ,  $t_{PHL}$  (see Notes)



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

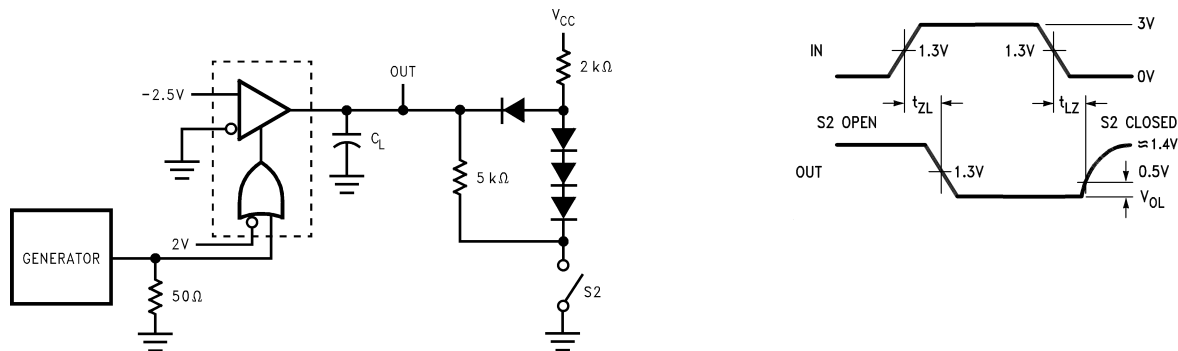
(11)  $C_L$  includes probe and stray capacitance.

(12) DS96F173 with active high and active low Enables are shown. DS96F175 has active high Enable only.

(13) All diodes are 1N916 or equivalent.

(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.

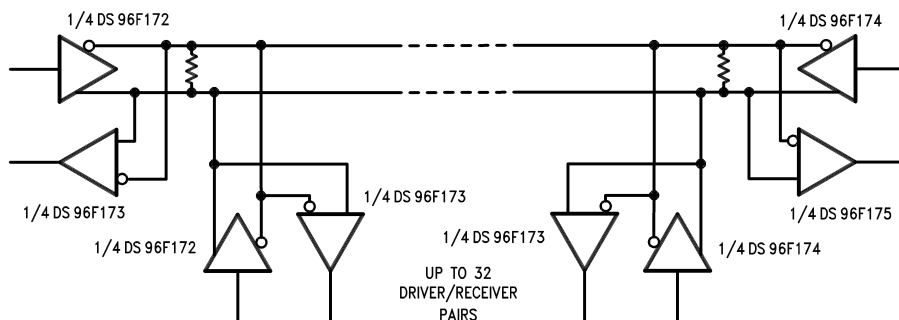
Figure 10.  $t_{HZ}$ ,  $t_{ZH}$  (see Notes)



- (10) The input pulse is supplied by a generator having the following characteristics:  $f = 1.0 \text{ MHz}$ , 50% duty cycle,  $t_r \leq 6.0 \text{ ns}$ ,  $t_f \leq 6.0 \text{ ns}$ ,  $Z_0 = 50\Omega$ .
- (11)  $C_L$  includes probe and stray capacitance.
- (12) DS96F173 with active high and active low Enables are shown. DS96F175 has active high Enable only.
- (13) All diodes are 1N916 or equivalent.
- (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.

Figure 11.  $t_{ZL}$ ,  $t_{LZ}$  (see Notes)

Typical Application



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.

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Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
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