DS96172, µA96172, DS96172, µA96174

RS-485/RS-422 Quad Differential Line Drivers

The DS96172/µA96172 and DS96174/µA96174 are high speed quad differential line drivers designed to meet EIA Standard RS-485. The devices have TRI-STATE outputs and are optimized for balanced multipoint data bus transmission at rates up to 10 Mbps. The drivers have wide positive and negative common mode range for multipoint applications in noisy environments. Positive and negative current-limiting is provided which protects the drivers from line fault conditions over a +12V to -7.0V common mode range. A thermal shutdown feature is also provided and occurs at junction temperature of approximately 160°C. The DS96172/µA96172 features an active high and active low Enable, common to all four drivers. The DS96174/µA96174 features separate active high Enables for each driver pair.

Rochester Electronics Manufactured Components

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All recreations are done with the approval of the OCM.

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceeds the OCM data sheet.

Quality Overview

• ISO-9001
• AS9120 certification
• Qualified Manufacturers List (QML) MIL-PRF-38535
  • Class Q Military
  • Class V Space Level
• Qualified Suppliers List of Distributors (QSLD)
  • Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

The original manufacturer's datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OEM specifications. 'Typical' values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.

National Semiconductor

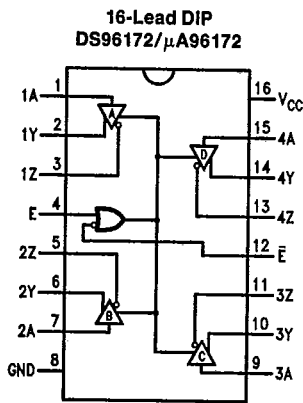# DS96172/µA96172/DS96174/µA96174
RS-485/RS-422 Quad Differential Line Drivers

General Description

The DS96172/µA96172 and DS96174/µA96174 are high speed quad differential line drivers designed to meet EIA Standard RS-485. The devices have TRI-STATE® outputs and are optimized for balanced multipoint data bus transmission at rates up to 10 Mbps. The drivers have wide positive and negative common mode range for multipoint applications in noisy environments. Positive and negative current-limiting is provided which protects the drivers from line fault conditions over a +12V to −7.0V common mode range. A thermal shutdown feature is also provided and occurs at junction temperature of approximately 160°C. The DS96172/µA96172 features an active high and active low Enable, common to all four drivers. The DS96174/µA96174 features separate active high Enables for each driver pair. Compatible RS-485 receivers, transceivers, and repeaters are also offered to provide optimum bus performance. The respective device types are DS96173/µA96173, DS96175/µA96175, DS96176/µA96176, DS96177/µA96177 and DS96178/µA96178.

Features

■ Meets EIA Standard RS-485 and RS-422A
■ Monotonic differential output switching
■ Transmission rate to 10 Mbs
■ TRI-STATE outputs
■ Designed for multipoint bus transmission
■ Common mode output voltage range: −7V to +12V
■ Operates from single +5V supply
■ Thermal shutdown protection
■ DS96172/µA96172/DS96174/µA96174 are lead and function compatible with the SN75172/75174 or the AM26LS31/MC3487 respectively

Connection Diagrams

16-Lead DIP
DS96172/µA96172

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Top View

16-Lead DIP
DS96174/µA96174
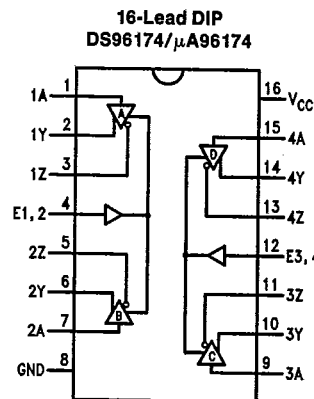
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Top View

Order Number DS96172J, µA96172DC or DS96174J, µA96174DC
See NS Package Number J16A

Order Number DS96172N, µA96172PC or DS96174N, µA96174PC
See NS Package Number N16A

DS96172/µA96172/DS96174/µA96174

Absolute Maximum Ratings (Note 1)

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

Storage Temperature Range	
Ceramic DIP	−65°C to +175°C
Molded DIP	−65°C to +150°C
Operating Temperature Range	0°C to +70°C
Lead Temperature	
Ceramic DIP (soldering, 60 sec.)	300°C
Molded DIP (soldering, 10 sec.)	265°C
Supply Voltage	7V
Enable Input Voltage	5.5V
Maximum Power Dissipation*	25°C
Cavity Package	1500 mW
Molded Package	1040 mW

*Derate cavity package 10 mW/°C above 25°C; derate molded DIP package 8.3 mW/°C above 25°C.

Recommended Operating Conditions

	Min	Typ	Max	Units
Supply Voltage (V_{CC})	4.75	5	5.25	V
Common Mode Output Voltage (V_{OC})	−7		+12	V
Output Current HIGH (I_{OH})			−60	mA
Output Current LOW (I_{OL})			60	mA
Operating Temperature (T_A)	0	25	70	°C

Electrical Characteristics

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

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{IH}	Input Voltage HIGH			2			V
V_{IL}	Input Voltage LOW					0.8	V
V_{OH}	Output Voltage HIGH	$I_{OH} = -20$ mA			3.1		V
V_{OL}	Output Voltage LOW	$I_{OL} = 20$ mA			0.8		V
V_{IC}	Input Clamp Voltage	$I_I = -18$ mA				−1.5	V
$|V_{OD1}|$	Differential Output Voltage	$I_O = 0$ mA				6	V
$|V_{OD2}|$	Differential Output Voltage	$R_L = 54\Omega$, Figure 1a		1.5	2		V
		$R_L = 100\Omega$, Figure 1b		2	2.3		V
$\Delta|V_{OD}|$	Change in Magnitude of Differential Output Voltage (Note 4)	$R_L = 54\Omega$ or 100Ω, Figure 1b				±0.2	V
V_{OC}	Common Mode Output Voltage (Note 5)					3	V
$\Delta|V_{OC}|$	Change in Magnitude of Common Mode Output Voltage (Note 4)					±0.2	V
I_O	Output Current with Power Off	$V_{CC} = 0V$, $V_O = -7.0V$ to 12V				±100	µA
I_{OZ}	High Impedance State Output Current	$V_O = -7.0V$ to 12V			±50	±200	µA
I_{IH}	Input Current HIGH	$V_I = 2.7V$				20	µA
I_{IL}	Input Current LOW	$V_I = 0.5V$				−100	µA
I_{OS}	Short Circuit Output Current (Note 6)	$V_O = -7.0V$				−250	
		$V_O = 0V$				−150	mA
		$V_O = V_{CC}$				150	
		$V_O = 12V$				250	
I_{CC}	Supply Current (All Drivers)	No Load	Outputs Enabled		50	70	mA
			Output Disabled		50	60	

Switching Characteristics $V_{CC} = 5V$, $T_A = 25°C$

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Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{DD}	Differential Output Delay Time	$R_L = 60\Omega$, *Figure 2*		15	25	ns
t_{TD}	Differential Output Transition Time			15	25	ns
t_{PLH}	Propagation Delay Time, Low-to-High Level Output	$R_L = 27\Omega$, *Figure 3*		12	20	ns
t_{PHL}	Propagation Delay Time, High-to-Low Level Output			12	20	ns
t_{PZH}	Output Enable Time to High Level	$R_L = 110\Omega$, *Figure 4*		30	45	ns
t_{PZL}	Output Enable Time to Low Level	$R_L = 110\Omega$, *Figure 5*		30	45	ns
t_{PHZ}	Output Disable Time from High Level	$R_L = 110\Omega$, *Figure 4*		25	35	ns
t_{PLZ}	Output Disable Time from Low Level	$R_L = 110\Omega$, *Figure 5*		30	45	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 0°C to +70°C range for the DS96172/µA96172/DS96174/µA96174. All typicals are given for $V_{CC} = 5V$ and $T_A = 25°C$.

Note 3: All currents into the device pins are positive; all currents out of the device pins are negative. All voltages are referenced to ground unless otherwise specified.

Note 4: $\Delta |V_{OD}|$ and $\Delta |V_{OC}|$ are the changes in magnitude of V_{OD} and V_{OC} respectively, that occur when the input is changed from a high level to a low level.

Note 5: In EIA Standards RS-422A and RS-485, V_{OC}, which is the average of the two output voltages with respect to ground, is called output offset voltage, V_{OS}.

Note 6: Only one output at a time should be shorted.
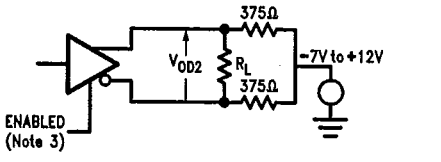
Parameter Measurement Information

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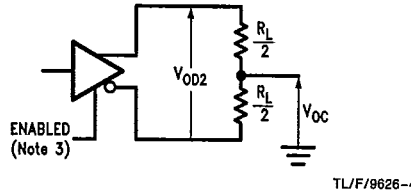**FIGURE 1. Differential Output Voltage with Varying Common Mode Voltage**

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FIGURE 1a. Differential and Common Mode Output Voltage

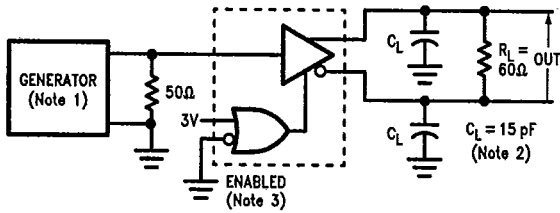TL/F/9626-5

TL/F/9626-6

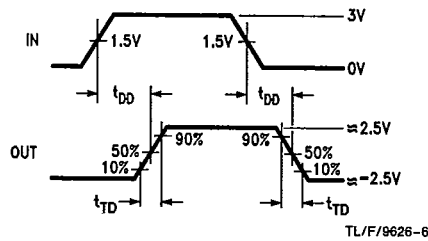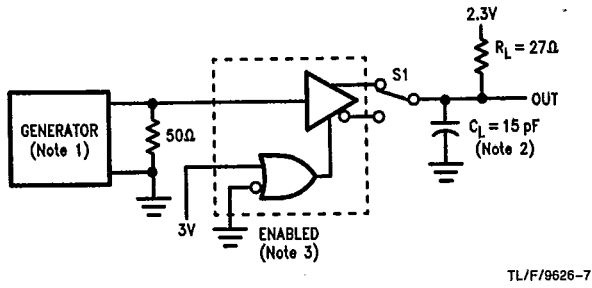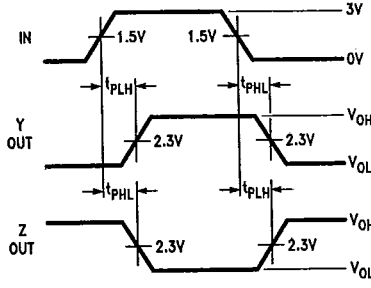**FIGURE 2. Differential Output Delay and Transition Times**

Parameter Measurement Information (Continued)

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FIGURE 3. Propagation Delay Times
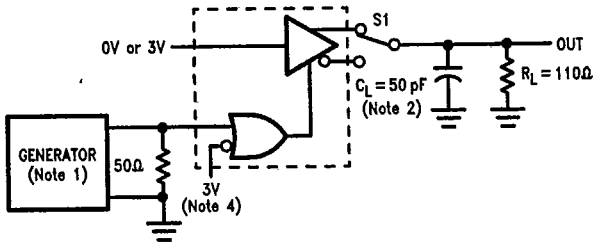
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TL/F/9626–10
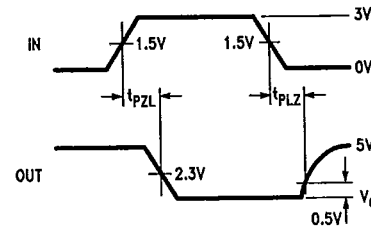
FIGURE 4. t_{PZH} and t_{PHZ}
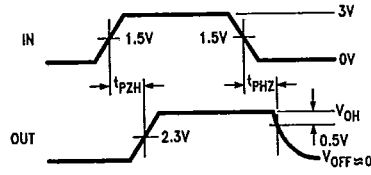
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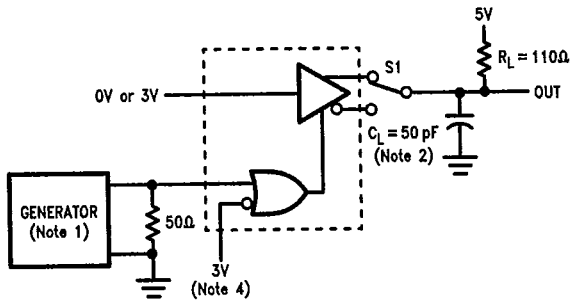
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FIGURE 5. t_{PZL} and t_{PLZ}

Note 1: The input pulse is supplied by a generator having the following characteristics: PRR = 1.0 MHz, duty cycle = 50%, $t_r \leq 5.0$ ns, $t_f \leq 5.0$ ns, $Z_O = 50\Omega$.

Note 2: C_L includes probe and jig capacitance.

Note 3: DS96172/μA96172 with active high and active low Enables is shown here. DS96174/μA96174 has active high Enable only.

Note 4: To test the active low Enable Ē of DS96172/μA96172, ground E and apply an inverted waveform to Ē. DS96174/μA96174 has active high Enable only.

Function Tables

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DS96172/μA96172

Input A	Enables		Outputs	
	E	Ē	Y	Z
H	H	X	H	L
L	H	X	L	H
H	X	L	H	L
L	X	L	L	H
X	L	H	Z	Z

DS96174/μA96174

Input	Enable	Outputs	
		Y	Z
H	H	H	L
L	H	L	H
X	L	Z	Z

H = High Level   X = Immaterial
L = Low Level   Z = High Impedance (off)

Typical Application

1/4 DS96172/μA96172
1/4 DS96174/μA96174
1/4 DS96173/μA96173
1/4 DS96173/μA96173
1/4 DS96173/μA96173
1/4 DS96175/μA96175
1/4 DS96172/μA96172
1/4 DS96174/μA96174
UP TO 32
DRIVER/RECEIVER
PAIRS

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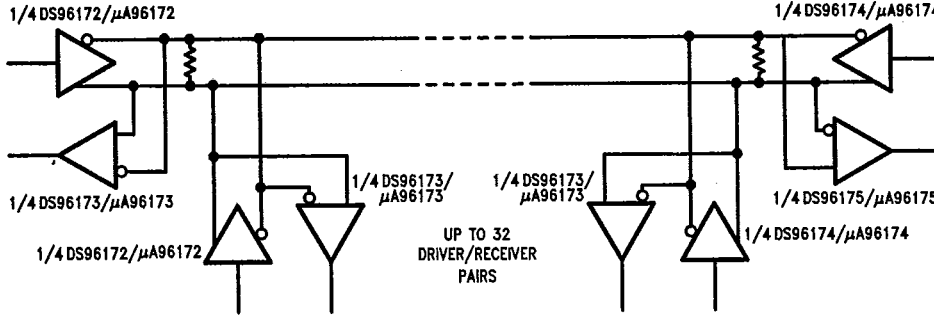
FIGURE 6

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.

DS96172/μA96172/DS96174/μA96174

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