

DS89LV21

3V Differential CMOS Line Driver and Receiver Pair

General Description

The DS89LV21 is a differential CMOS line driver and receiver pair, designed to operate with TIA/EIA-422-B (RS-422) and V.11 electrical characteristics interface standards. The DS89LV21 provides one driver and one receiver in a minimum footprint. The device is featured in 8-pin SOIC and DIP packages.

The 3V CMOS design minimizes the supply current to 1.8 mA, making the device ideal for use in battery powered or power conscious applications.

The driver features a fast transition time specified at 3 ns, and a maximum differential skew of 2 ns making the driver ideal for use in high speed applications operating above 5 MHz.

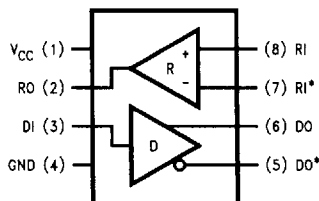
The receiver can detect signals as low as 200 mV, and also incorporates hysteresis for noise rejection. Skew is specified at 4 ns maximum.

The DS89LV21 is compatible with TTL and CMOS levels (DI and RO).

Features

- Single 3.3V power supply operation
- Operates with TIA/EIA-422-B (RS-422) and ITU V.11
- LOW POWER design—6 mW typical
- Guaranteed AC parameters:
 - Maximum driver skew 2.0 ns
 - Maximum receiver skew 4.0 ns
- Extended temperature range
—40°C to +85°C
- Available in SOIC packaging
- Operates over 10 Mbps
- Receiver OPEN† input failsafe feature

Connection Diagram



TL/F/12620-1

Order Number DS89LV21TM or DS89LV21TN
See NS Package Number M08A or N08E

Truth Tables

Driver

Input	Outputs	
DI	DO	DO*
H	H	L
L	L	H

Receiver

Inputs	Output
RI-RI*	RO
$V_{DIFF} \geq +200 \text{ mV}$	H
$V_{DIFF} \leq -200 \text{ mV}$	L
OPEN†	H

†Non-terminated

Absolute Maximum Ratings (Note 1)

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

Supply Voltage (V_{CC})	7V
Driver Input Voltage (DI)	-1.5V to V_{CC} + 1.5V
Driver Output Voltage (DO, DO*)	-0.5V to +7V
Receiver Input Voltage— V_{CM} (RI, RI*)	$\pm 14V$
Differential Receiver Input Voltage— V_{DIF} (RI, RI*)	$\pm 14V$
Receiver Output Voltage (RO)	-0.5V to V_{CC} + 0.5V
Receiver Output Current (RO)	± 25 mA
Storage Temperature Range (T_{STG})	-65°C to +150°C
Lead Temperature (T_L) (Soldering 4 sec.)	+260°C

Maximum Junction Temperature	150°C
Maximum Package Power Dissipation @ +25°C	
M Package	714 mW
N Package	1275 mW
Derate M Package	5.7 mW/°C above +25°C
Derate N Package	10.2 mW/°C above +25°C

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})	3.0	3.6	V
Operating Temperature (T_A)	-40	+85	°C
Input Rise or Fall Time (DI)		500	ns

Electrical Characteristics

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

Symbol	Parameter	Conditions	Pin	Min	Typ	Max	Units
DRIVER CHARACTERISTICS							
V_{IH}	Input Voltage HIGH		DI	2.0		V_{CC}	V
V_{IL}	Input Voltage LOW			GND		0.8	V
I_{IH}, I_{IL}	Input Current	$V_{IN} = V_{CC}, GND, 2.0V, 0.8V$			0.05	± 10	μA
V_{CL}	Input Clamp Voltage	$I_{IN} = -18$ mA				-1.5	V
V_{OD1}	Unloaded Output Voltage	No Load	DO, DO*		2.6	4.0	V
V_{OD2}	Differential Output Voltage	$R_L = 100\Omega$		1.2	1.6		V
ΔV_{OD2}	Change in Magnitude of V_{OD2} for Complementary Output States				5.0	400	mV
V_{OD3}	Differential Output Voltage	$R_L = 150\Omega$		1.3	1.8		V
V_{OD4}	Differential Output Voltage	$R_L = 3.9$ k Ω			2.3	4.0	V
V_{OC}	Common Mode Voltage	$R_L = 100\Omega$			2.0	3.0	V
ΔV_{OC}	Change in Magnitude of V_{OC} for Complementary Output States				2.0	400	mV
I_{OSD}	Output Short Circuit Current	$V_{OUT} = 0V$		-30	-65	-100	mA
I_{OFF}	Output Leakage Current	$V_{CC} = 0V$			0.03	+100	μA
		$V_{OUT} = +4V$ $V_{OUT} = -0.25V$			-0.08	-100	μA

Electrical Characteristics

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

Symbol	Parameter	Conditions		Pin	Min	Typ	Max	Units
RECEIVER CHARACTERISTICS								
V_{TL}, V_{TH}	Differential Thresholds	$V_{IN} = +7V, 0V, -7V$		RI, RI*	-200	± 35	+200	mV
V_{HYS}	Hysteresis	$V_{CM} = 0V$				70		mV
R_{IN}	Input Impedance	$V_{IN} = -7V, +7V, \text{Other} = 0V$			6.5	8.5		k Ω
I_{IN}	Input Current	Other Input = 0V, $V_{CC} = 3.6V$ and $V_{CC} = 0V$	$V_{IN} = +10V$			+1.1	+1.5	mA
			$V_{IN} = +3.0V$		0	+0.27		mA
			$V_{IN} = +0.5V$			-0.02		mA
			$V_{IN} = -3V$		0	-0.43		mA
			$V_{IN} = -10V$			-1.25	-2.0	mA
V_{OH}	Output HIGH Voltage	$I_{OH} = -6\text{ mA}$	$V_{DIFF} = +1V$	RO	2.4	3.0		V
			$V_{DIFF} = \text{OPEN}$		2.4	3.0		V
V_{OL}	Output LOW Voltage	$I_{OL} = +6\text{ mA}, V_{DIFF} = -1V$				0.08	0.3	V
I_{OSR}	Output Short Circuit Current	$V_{OUT} = 0V$			-15	-40	-100	mA
DRIVER AND RECEIVER CHARACTERISTICS								
I_{CC}	Supply Current	No Load	$DI = V_{CC}$ or GND	V_{CC}		1.8	3	mA
			$DI = 2.4V$ or 0.5V			2.0	6	mA

Switching Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
DIFFERENTIAL DRIVER CHARACTERISTICS							
t _{PLHD}	Propagation Delay LOW to HIGH	R _L = 100Ω C _L = 50 pF	(Figures 2, 3)	2	5.5	11	ns
t _{PHLD}	Propagation Delay HIGH to LOW			2	6.5	11	ns
t _{SKD}	Skew, t _{PLHD} - t _{PHLD}				1	2.0	ns
t _{TLH}	Transition Time LOW to HIGH	(Figures 2, 4)		3	6	ns	
t _{THL}	Transition Time HIGH to LOW			3	6	ns	
RECEIVER CHARACTERISTICS							
t _{PLH}	Propagation Delay LOW to HIGH	C _L = 50 pF V _{DIFF} = 2.5V V _{CM} = 0V	(Figures 5, 6)	10	27	45	ns
t _{PHL}	Propagation Delay HIGH to LOW			10	26	45	ns
t _{SK}	Skew, t _{PLH} - t _{PHL}				1	4.0	ns
t _r	Rise Time	(Figure 7)		3	6	ns	
t _f	Fall Time			3	6	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" specify conditions for device operation.

Note 2: Current into device pins is defined as positive. Current out of device pins is defined as negative. All voltages are referenced to ground unless otherwise specified.

Note 3: All typicals are given for $V_{CC} = 3.3V$ and $T_A = 25^\circ\text{C}$.

Note 4: $f = 1\text{ MHz}$, t_r and $t_f \leq 6\text{ ns}$.

Note 5: ESD Rating: HBM (1.5 k Ω , 100 pF) all pins $\geq 2000V$.
EIAJ (0 Ω , 200 pF) $\geq 250V$

Parameter Measurement Information

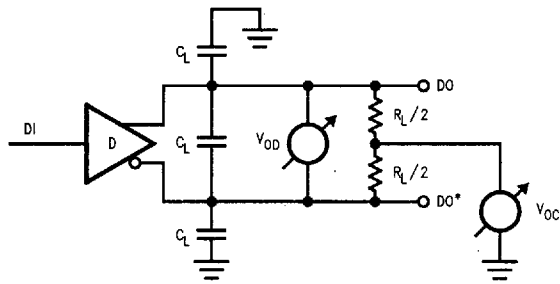


FIGURE 1. V_{OD} and V_{OC} Test Circuit

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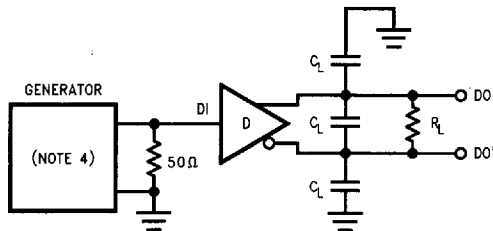


FIGURE 2. Driver Propagation Delay Test Circuit

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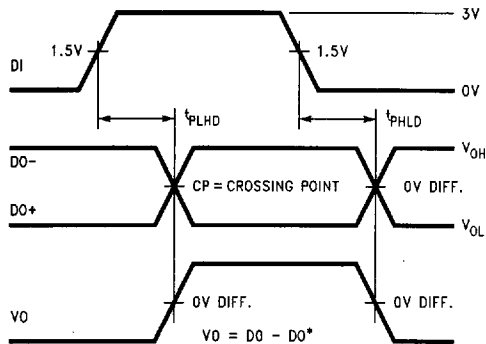


FIGURE 3. Driver Differential Propagation Delay Timing

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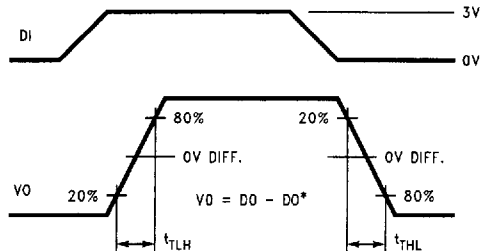
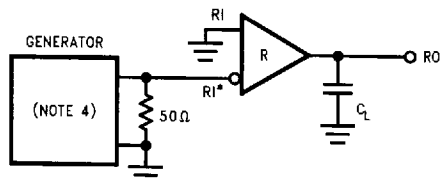


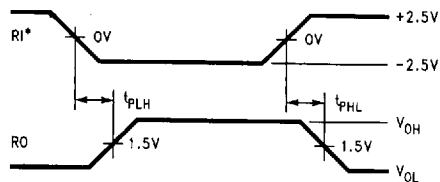
FIGURE 4. Driver Differential Transition Timing

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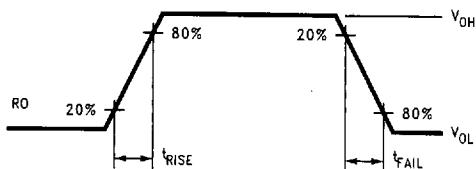
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FIGURE 5. Receiver Propagation Delay Test Circuit



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FIGURE 6. Receiver Propagation Delay Timing



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FIGURE 7. Receiver Rise and Fall Times