

DS89C21 Differential CMOS Line Driver and Receiver Pair

General Description

The DS89C21 is a differential CMOS line driver and receiver pair, designed to meet the requirements of TIA/EIA-422-A (RS-422) electrical characteristics interface standard. The DS89C21 provides one driver and one receiver in a minimum footprint. The device is offered in an 8-pin SOIC package.

The CMOS design minimizes the supply current to 6 mA, making the device ideal for use in battery powered or power conscious applications.

The driver features a fast transition time specified at 2.2 ns, and a maximum differential skew of 2 ns making the driver ideal for use in high speed applications operating above 10 MHz.

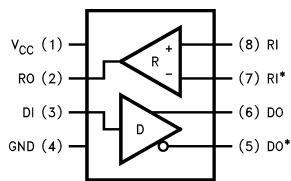
The receiver can detect signals as low as 200 mV, and also incorporates hysteresis for noise rejection. Skew is specified at 4 ns maximum.

The DS89C21 is compatible with TTL and CMOS levels (DI and RO).

Features

- Meets TIA/EIA-422-A (RS-422) and CCITT V.11 recommendation
- LOW POWER design — 15 mW typical
- Guaranteed AC parameters:
 - Maximum driver skew 2.0 ns
 - Maximum receiver skew 4.0 ns
- Extended temperature range: -40°C to $+85^{\circ}\text{C}$
- Available in SOIC packaging
- Operates over 20 Mbps
- Receiver OPEN input failsafe feature

Connection Diagram



DS011753-1

Order Number **DS89C21TM**
See NS Package Number **M08A**

Truth Tables

Driver

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

Receiver

Inputs	Output
RI-RI*	RO
$V_{\text{DIFF}} \geq +200 \text{ mV}$	H
$V_{\text{DIFF}} \leq -200 \text{ mV}$	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 [*])	±14V
Differential Receiver Input Voltage — V_{DIFF} (RI, RI [*])	±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
Derate M Package	5.7 mW/°C above +25°C

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})	4.50	5.50	V
Operating Temperature (T_A)	-40	+85	°C
Input Rise or Fall Time (DI)		500	ns

Electrical Characteristics (Notes 2, 3)

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

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,		4.2	6.0	V
V_{OD2}	Differential Output Voltage	$R_L = 100\Omega$	DO*	2.0	3.0		V
ΔV_{OD2}	Change in Magnitude of V_{OD2} for Complementary Output States				5.0	400	mV
V_{OD3}	Differential Output Voltage	$R_L = 150\Omega$		2.1	3.1		V
V_{OD4}	Differential Output Voltage	$R_L = 3.9 k\Omega$			4.0	6.0	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	-115	-150	mA
I_{OFF}	Output Leakage Current	$V_{CC} = 0V$			0.03	+100	µA
		$V_{OUT} = +6V$ $V_{OUT} = -0.25V$			-0.08	-100	µA
RECEIVER CHARACTERISTICS							
V_{TL}, V_{TH}	Differential Thresholds	$V_{IN} = +7V, 0V, -7V$	RI, RI*	-200	±25	+200	mV
V_{HYS}	Hysteresis	$V_{CM} = 0V$		20	50		mV
R_{IN}	Input Impedance	$V_{IN} = -7V, +7V, Other = 0V$		5.0	9.5		kΩ
I_{IN}	Input Current	Other Input = 0V, $V_{CC} = 5.5V$ and $V_{CC} = 0V$	$V_{IN} = +10V$		+1.0	+1.5	mA
			$V_{IN} = +3.0V$		0	+0.22	mA
			$V_{IN} = +0.5V$			-0.04	mA
			$V_{IN} = -3V$		0	-0.41	mA
			$V_{IN} = -10V$			-1.25	-2.5
V_{OH}	Output HIGH Voltage	$I_{OH} = -6 mA$	$V_{DIFF} = +1V$	RO	3.8	4.9	V
			$V_{DIFF} = OPEN$		3.8	4.9	V
V_{OL}	Output LOW Voltage	$I_{OL} = +6 mA, V_{DIFF} = -1V$			0.08	0.3	V
I_{OSR}	Output Short Circuit Current	$V_{OUT} = 0V$		-25	-85	-150	mA

Electrical Characteristics (Notes 2, 3) (Continued)

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

Symbol	Parameter	Conditions	Pin	Min	Typ	Max	Units
DRIVER AND RECEIVER CHARACTERISTICS							
I_{CC}	Supply Current	No Load	V_{CC}		3.0	6	mA
					3.8	12	

Switching Characteristics (Note 3)

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
DIFFERENTIAL DRIVER CHARACTERISTICS							
t_{PLHD}	Propagation Delay LOW to HIGH	$R_L = 100\Omega$ $C_L = 50\text{ pF}$	2	4.9	10	ns	
t_{PHLD}	Propagation Delay HIGH to LOW						
t_{SKD}	Skew, $ t_{PLHD} - t_{PHLD} $	(Figures 2, 3)		0.4	2.0	ns	
t_{TLH}	Transition Time LOW to HIGH		(Figures 2, 4)		2.2	9	ns
t_{THL}	Transition Time HIGH to LOW				2.1	9	ns
RECEIVER CHARACTERISTICS							
t_{PLH}	Propagation Delay LOW to HIGH	$C_L = 50\text{ pF}$ $V_{DIFF} = 2.5\text{V}$ $V_{CM} = 0\text{V}$	6	18	30	ns	
t_{PHL}	Propagation Delay HIGH to LOW						
t_{SK}	Skew, $ t_{PLH} - t_{PHL} $	(Figure 7)		0.5	4.0	ns	
t_r	Rise Time			2.5	9	ns	
t_f	Fall Time			2.1	9	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 $V_{CC} = 5.0\text{V}$ 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 $\geq 2000\text{V}$.

EIAJ (0 Ω , 200 pF) $\geq 250\text{V}$

Parameter Measurement Information

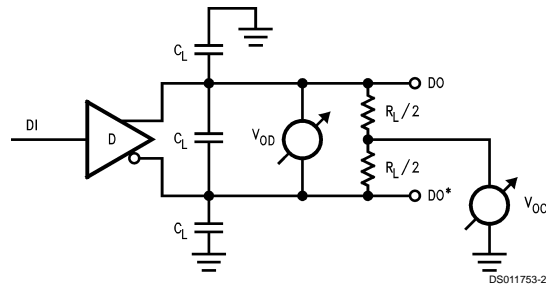
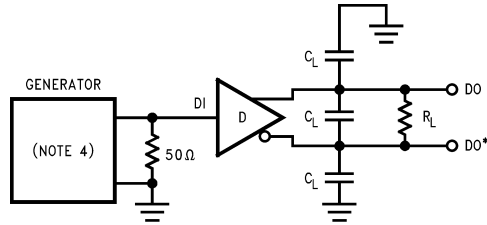


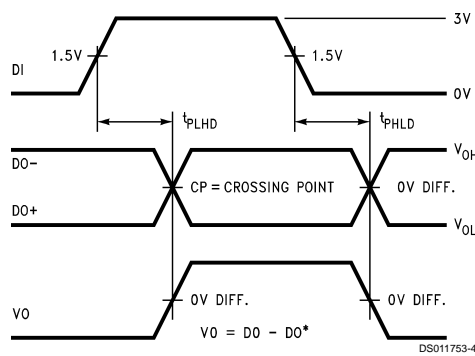
FIGURE 1. V_{OD} and V_{OC} Test Circuit

Parameter Measurement Information (Continued)



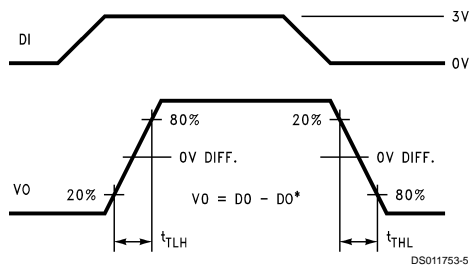
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FIGURE 2. Driver Propagation Delay Test Circuit



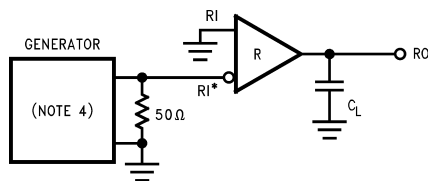
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FIGURE 3. Driver Differential Propagation Delay Timing



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FIGURE 4. Driver Differential Transition Timing



DS011753-6

FIGURE 5. Receiver Propagation Delay Test Circuit

Parameter Measurement Information (Continued)

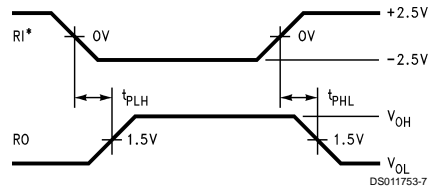


FIGURE 6. Receiver Propagation Delay Timing

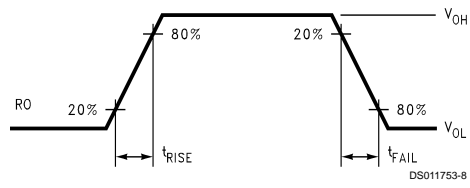
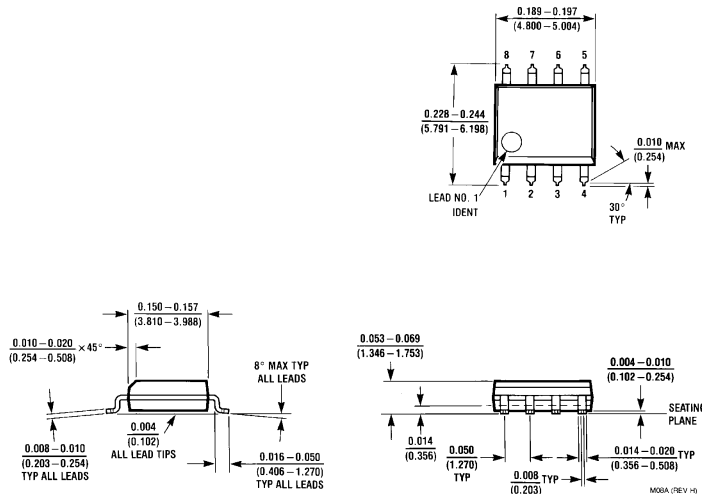


FIGURE 7. Receiver Rise and Fall Times

Physical Dimensions inches (millimeters) unless otherwise noted



Order Number DS89C21TM
NS Package Number M08A

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