

# DS36276

*DS36276 FAILSAFE Multipoint Transceiver*



Literature Number: SNLS085A

# DS36276 FAILSAFE Multipoint Transceiver

## General Description

The DS36276 FAILSAFE Multipoint Transceiver is designed for use on bi-directional differential busses. It is compatible with existing TIA/EIA-485 transceivers, however, it offers an additional feature not supported by standard transceivers.

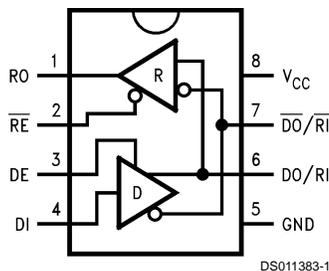
The FAILSAFE feature guarantees the receiver output to a known state when the Interface is in the following conditions: Floating Line, Idle Line (no active drivers), and Line Fault conditions (open or short). The receiver output is in a HIGH state for the following conditions: OPEN Inputs, Terminated Inputs ( $50\Omega$ ), and SHORTED Inputs.

FAILSAFE is a highly desirable feature when the transceivers are used with Asynchronous Controllers such as UARTs.

## Features

- FAILSAFE receiver, RO = HIGH for:
  - OPEN inputs
  - Terminated inputs
  - SHORTED inputs
- Compatible with popular interface standards:
  - TIA/EIA-485 (RS-485)
  - TIA/EIA-422-A (RS-422-A)
  - CCITT Recommendation V.11
- Bi-Directional Transceiver
  - Designed for multipoint transmission
- Separate driver input, driver enable, receiver enable, and receiver output for maximum flexibility
- Wide bus common mode range
  - (-7V to +12V)
- Pin compatible with: DS75176B, DS96176, DS3695 and SN75176A and B
- Available in SOIC package

## Connection and Logic Diagram



**Order Number DS36276M**  
See NS Package Number M08A

## Driver

Inputs			Outputs	
$\overline{RE}$	DE	DI	DO/RI	$\overline{DO/RI}$
X	H	H	H	L
X	H	L	L	H
X	L	X	Z	Z

## Receiver

Inputs			Output
$\overline{RE}$	DE	RI- $\overline{RI}$	RO
L	L	$\geq 0V$	H
L	L	$\leq -500\text{ mV}$	L
H	X	X	Z

## Receiver FAILSAFE

Inputs			Output
$\overline{RE}$	DE	RI- $\overline{RI}$	RO
L	L	SHORTED	H
L	L	OPEN	H
H	X	X	Z

**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
Input Voltage (DE, $\overline{RE}$ , and DI)	5.5V
Driver Output Voltage/ Receiver Input Voltage	-10V to +15V
Receiver Output Voltage (RO)	5.5V
Maximum Package Power Dissipation @ +25°C M Package (derate 5.8 mW/°C above +25°C)	726 mW
Storage Temperature Range	-65°C to +150°C

Lead Temperature (Soldering 4 sec.)	260°C
Max Junction Temperature	150°C
ESD Rating (HBM, 1.5 k $\Omega$ , 100 pF)	$\geq 6.0$ kV

**Recommended Operating Conditions**

	Min	Max	Units
Supply Voltage, $V_{CC}$	4.75	5.25	V
Bus Voltage	-7	+12	V
Operating Temperature ( $T_A$ ) DS36276	0	+70	°C

**Electrical Characteristics** (Notes 2, 4)

Over recommended Supply Voltage and Operating Temperature ranges, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units		
<b>DRIVER CHARACTERISTICS</b>								
$V_{OD}$	Differential Output Voltage	$I_O = 0$ mA (No Load)	1.5	4.8	6.0	V		
$V_{oDO}$	Output Voltage	$I_O = 0$ mA (Output to GND)	0		6.0	V		
$\overline{V_{oDO}}$	Output Voltage		0		6.0	V		
$V_{T1}$	Differential Output Voltage (Termination Load)	$R_L = 54\Omega$ (485)	(Figure 1)		1.5	2.0	5.0	V
		$R_L = 100\Omega$ (422)			2.0	2.3	5.0	V
$\Delta V_{T1}$	Balance of $V_{T1}$ $ V_{T1}  -  \overline{V_{T1}} $	$R_L = 54\Omega$	(Note 3)		-0.2	0.07	+0.2	V
		$R_L = 100\Omega$			-0.2	0.07	+0.2	V
$V_{OS}$	Driver Common Mode Output Voltage	$R_L = 54\Omega$	(Figure 1)		0	2.5	3.0	V
		$R_L = 100\Omega$			0	2.3	3.0	V
$\Delta V_{OS}$	Balance of $V_{OS}$ $ V_{OS}  -  \overline{V_{OS}} $	$R_L = 54\Omega$	(Note 3)		-0.2	0.08	+0.2	V
		$R_L = 100\Omega$			-0.2	0.08	+0.2	V
$I_{OSD}$	Driver Short-Circuit Output Current	$V_O = +12V$	(Figure 3)			134	290	mA
		$V_O = V_{CC}$				140		mA
		$V_O = 0V$				-140		mA
		$V_O = -7V$				-180	-290	mA
<b>RECEIVER CHARACTERISTICS</b>								
$V_{TH}$	Differential Input High Threshold Voltage (Note 5)	$V_O = V_{OH}$ , $I_O = -0.4$ mA $-7V \leq V_{CM} \leq +12V$		-0.18	0	V		
$V_{TL}$	Differential Input Low Threshold Voltage (Note 5)	$V_O = V_{OL}$ , $I_O = 8.0$ mA $-7V \leq V_{CM} \leq +12V$	-0.5	-0.23		V		
$V_{HST}$	Hysteresis (Note 6)	$V_{CM} = 0V$		50		mV		
$I_{IN}$	Line Input Current ( $V_{CC} = 4.75V, 5.25V, 0V$ )	Other Input = 0V DE = $V_{IH}$ (Note 7)	$V_I = +12V$		0.7	1.0	mA	
			$V_I = -7V$		-0.5	-0.8	mA	
$I_{OSR}$	Short Circuit Current	$V_O = 0V$	RO	-5.0	-30	-85	mA	
$I_{OZ}$	TRI-STATE® Leakage Current	$V_O = 0.4$ to 2.4V		-20		+20	$\mu A$	
$V_{OH}$	Output High Voltage (Figure 12)	$V_{ID} = 0V$ , $I_{OH} = -0.4$ mA		2.5	3.5		V	
		$V_{ID} = OPEN$ , $I_{OH} = -0.4$ mA		2.5	3.5		V	
$V_{OL}$	Output Low Voltage (Figure 12)	$V_{ID} = -0.5V$ , $I_{OL} = +8$ mA		0.25	0.6	V		
		$V_{ID} = -0.5V$ , $I_{OL} = +16$ mA		0.35	0.7	V		
$R_{IN}$	Input Resistance		12	19		k $\Omega$		

## Electrical Characteristics (Notes 2, 4) (Continued)

Over recommended Supply Voltage and Operating Temperature ranges, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>DEVICE CHARACTERISTICS</b>						
$V_{IH}$	High Level Input Voltage		2.0		$V_{CC}$	V
$V_{IL}$	Low Level Input Voltage		GND		0.8	V
$I_{IH}$	High Level Input Current	$V_{IH} = 2.4V$			20	$\mu A$
$I_{IL}$	Low Level Input Current	$V_{IL} = 0.4V$			-100	$\mu A$
$V_{CL}$	Input Clamp Voltage	$I_{CL} = -18\text{ mA}$		-0.75	-1.5	V
$I_{CC}$	Output Low Voltage	$DE = 3V, \overline{RE} = 0V, DI = 0V$		42	60	mA
$I_{CCR}$	Supply Current	$DE = 0V, \overline{RE} = 0V, DI = 0V$		28	45	mA
$I_{CCD}$	(No Load)	$DE = 3V, \overline{RE} = 3V, DI = 0V$		43	60	mA
$I_{CCX}$		$DE = 0V, \overline{RE} = 3V, DI = 0V$		31	50	mA

## Switching Characteristics (Note 4)

Over recommended Supply Voltage and Operating Temperature ranges, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>DRIVER CHARACTERISTICS</b>						
$t_{PLHD}$	Diff. Prop. Delay Low to High	$R_L = 54\Omega$ $C_L = 50\text{ pF}$ $C_D = 50\text{ pF}$ (Figures 4, 5)	7	21	60	ns
$t_{PHLD}$	Diff. Prop. Delay High to Low		7	19	60	ns
$t_{SKD}$	Diff. Skew ( $ t_{PLHD} - t_{PHLD} $ )		2	10		ns
$t_r$	Diff. Rise Time		12	50		ns
$t_f$	Diff. Fall Time		12	50		ns
$t_{PLH}$	Prop. Delay Low to High	$R_L = 27\Omega, C_L = 15\text{ pF}$ (Figures 6, 7)		22	45	ns
$t_{PHL}$	Prop. Delay High to Low			22	45	ns
$t_{PZH}$	Enable Time Z to High	$R_L = 110\Omega$ $C_L = 50\text{ pF}$ (Figure 8 – Figure 11)		32	55	ns
$t_{PZL}$	Enable Time Z to Low			32	65	ns
$t_{PHZ}$	Disable Time High to Z			22	55	ns
$t_{PLZ}$	Disable Time Low to Z			16	55	ns
<b>RECEIVER CHARACTERISTICS</b>						
$t_{PLH}$	Prop. Delay Low to High	$V_{ID} = -1.5V\text{ to }+1.5V$ $C_L = 15\text{ pF}$ (Figures 13, 14)	15	40	70	ns
$t_{PHL}$	Prop. Delay High to Low		15	42	70	ns
$t_{SK}$	Skew ( $ t_{PLH} - t_{PHL} $ )		2	15		ns
$t_{PZH}$	Enable Time Z to High	$C_L = 15\text{ pF}$ (Figures 15, 16)		15	50	ns
$t_{PZL}$	Enable Time Z to Low			17	50	ns
$t_{PHZ}$	Disable Time High to Z			24	50	ns
$t_{PLZ}$	Disable Time Low to Z			19	50	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:**  $\Delta |V_{T1}|$  and  $\Delta |V_{OS}|$  are changes in magnitude of  $V_{T1}$  and  $V_{OS}$ , respectively, that occur when the input changes state.

**Note 4:** All typicals are given for  $V_{CC} = 5.0V$  and  $T_A = +25^\circ C$ .

**Note 5:** Threshold parameter limits specified as an algebraic value rather than by magnitude.

**Note 6:** Hysteresis defined as  $V_{HST} = V_{TH} - V_{TL}$ .

**Note 7:**  $I_{IN}$  includes the receiver input current and driver TRI-STATE leakage current.

# Parameter Measurement Information

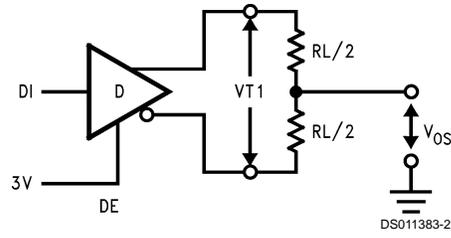


FIGURE 1. Driver  $V_{T1}$  and  $V_{OS}$  Test Circuit

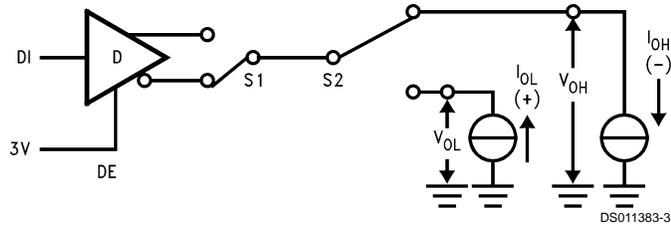


FIGURE 2. Driver  $V_{OH}$  and  $V_{OL}$  Test Circuit

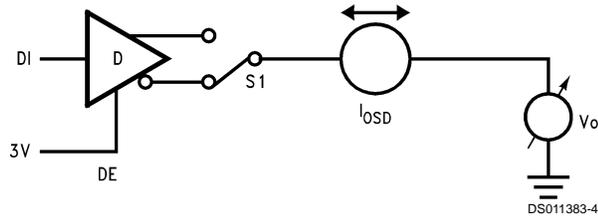


FIGURE 3. Driver Short Circuit Test Circuit

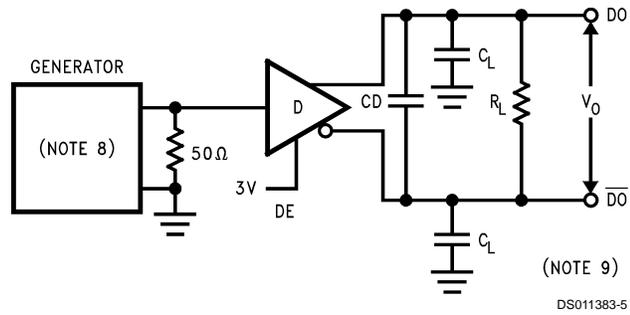


FIGURE 4. Driver Differential Propagation Delay and Transition Time Test Circuit

Parameter Measurement Information (Continued)

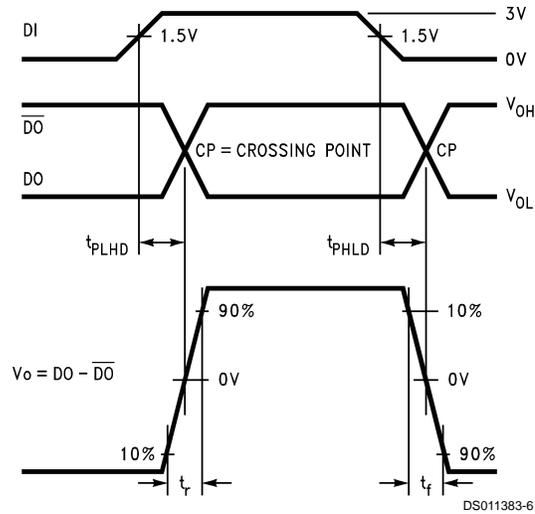


FIGURE 5. Driver Differential Propagation Delays and Transition Times

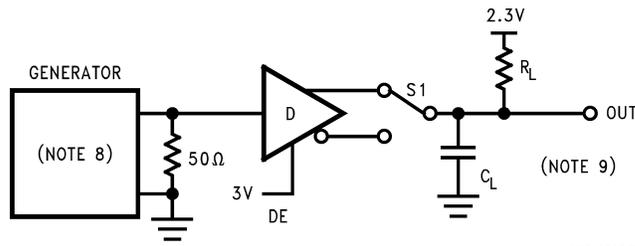


FIGURE 6. Driver Propagation Delay Test Circuit

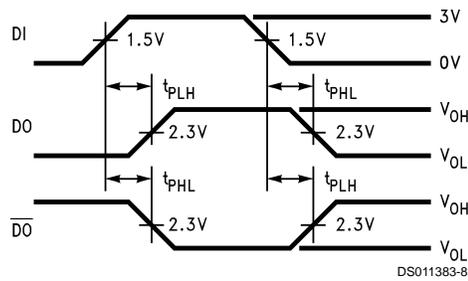
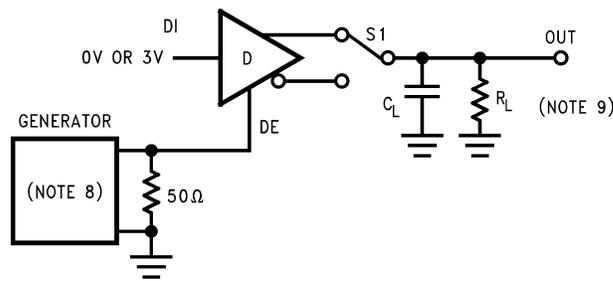


FIGURE 7. Driver Propagation Delays



S1 to DO for DI = 3V  
S1 to DO-bar for DI = 0V

FIGURE 8. Driver TRI-STATE Test Circuit ( $t_{PZH}$ ,  $t_{PHZ}$ )

Parameter Measurement Information (Continued)

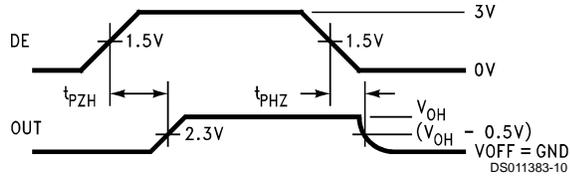
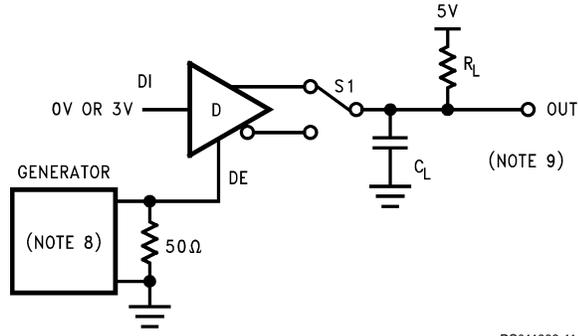


FIGURE 9. Driver TRI-STATE Delays ( $t_{PZH}$ ,  $t_{PHZ}$ )



S1 to DO for DI = 0V  
S1 to  $\overline{DO}$  for DI = 3V

FIGURE 10. Driver TRI-STATE Test Circuit ( $t_{PZL}$ ,  $t_{PLZ}$ )

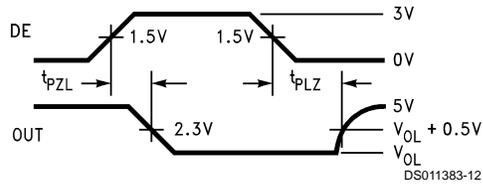


FIGURE 11. Driver TRI-STATE Delays ( $t_{PZL}$ ,  $t_{PLZ}$ )

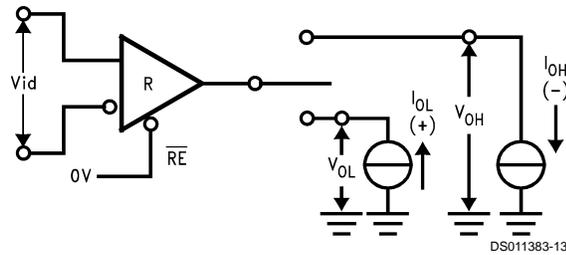


FIGURE 12. Receiver  $V_{OH}$  and  $V_{OL}$

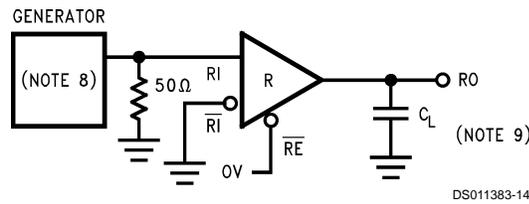


FIGURE 13. Receiver Propagation Delay Test Circuit

Parameter Measurement Information (Continued)

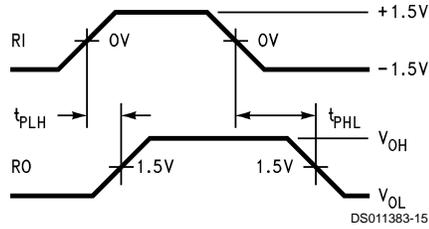


FIGURE 14. Receiver Propagation Delays

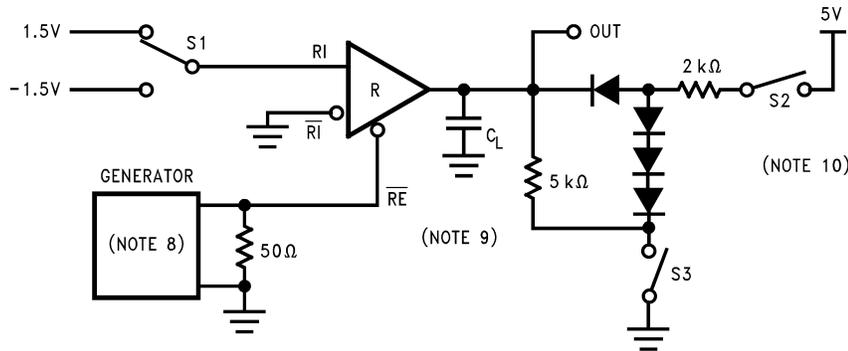
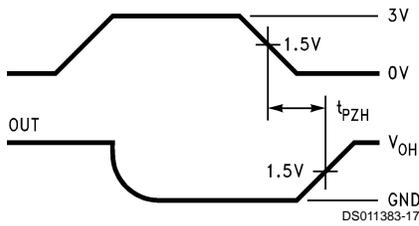
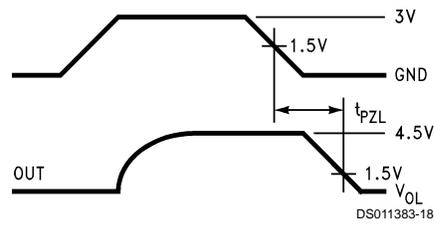


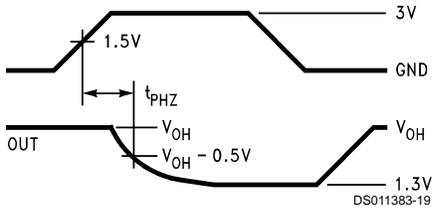
FIGURE 15. Receiver TRI-STATE Delay Test Circuit



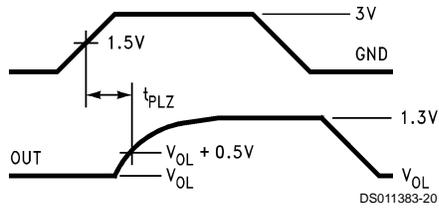
S1 1.5V  
S2 OPEN  
S3 CLOSED



S1 -1.5V  
S2 CLOSED  
S3 OPEN



S1 1.5V  
S2 CLOSED  
S3 CLOSED



S1 -1.5V  
S2 CLOSED  
S3 CLOSED

**Note 8:** The input pulse is supplied by a generator having the following characteristics:  $f = 1.0 \text{ MHz}$ , 50% duty cycle,  $t_r$  and  $t_f < 6.0 \text{ ns}$ ,  $Z_O = 50\Omega$ .

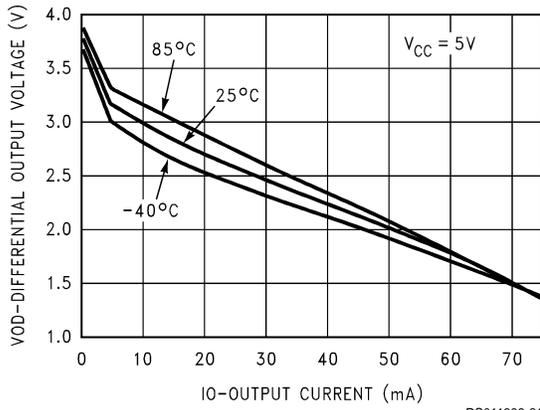
**Note 9:**  $C_L$  includes probe and stray capacitance.

**Note 10:** Diodes are 1N916 or equivalent.

FIGURE 16. Receiver Enable and Disable Timing

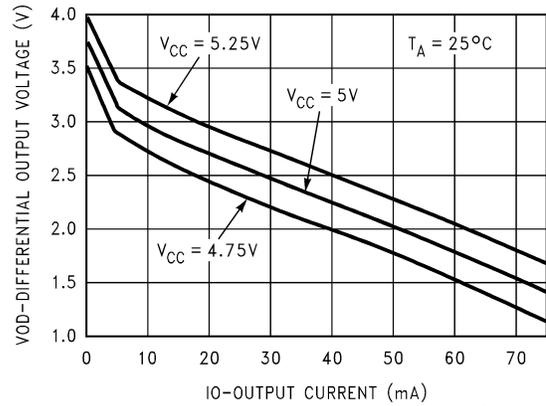
# Typical Performance Characteristics

Differential Output Voltage vs Output Current



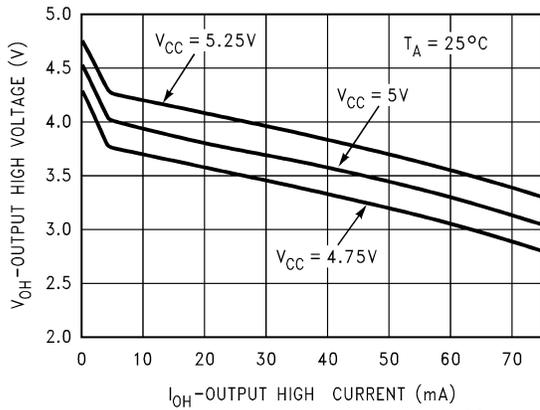
DS011383-21

Differential Output Voltage vs Output Current



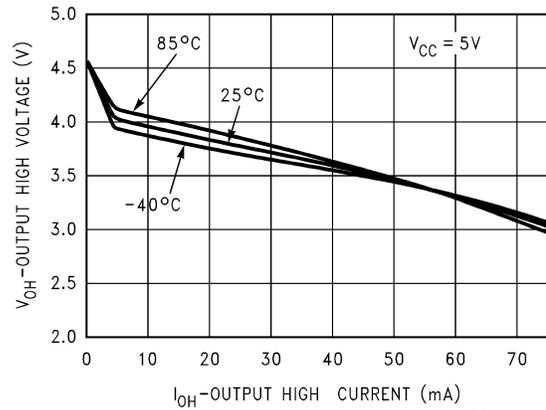
DS011383-22

Driver V<sub>OH</sub> vs I<sub>OH</sub> vs V<sub>CC</sub>



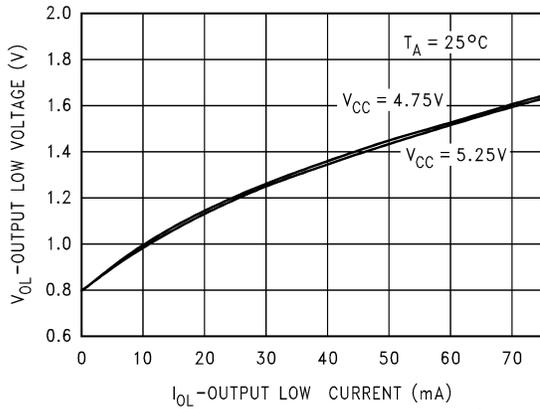
DS011383-23

Driver V<sub>OH</sub> vs I<sub>OH</sub> vs Temperature



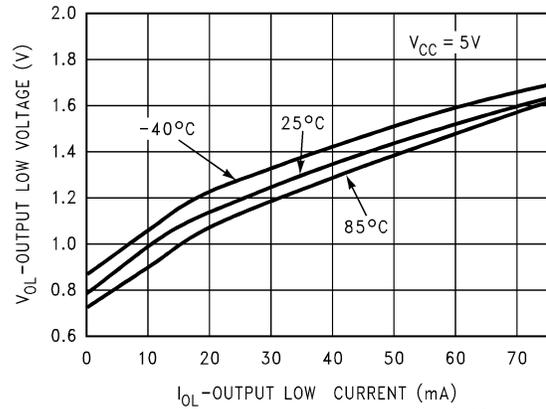
DS011383-24

Driver V<sub>OL</sub> vs I<sub>OL</sub> vs V<sub>CC</sub>



DS011383-25

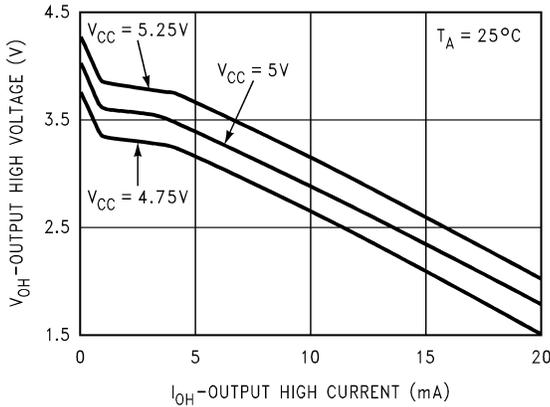
Driver V<sub>OL</sub> vs I<sub>OL</sub> vs Temperature



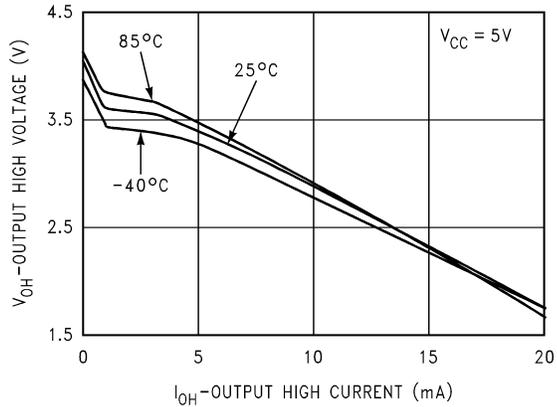
DS011383-26

Typical Performance Characteristics (Continued)

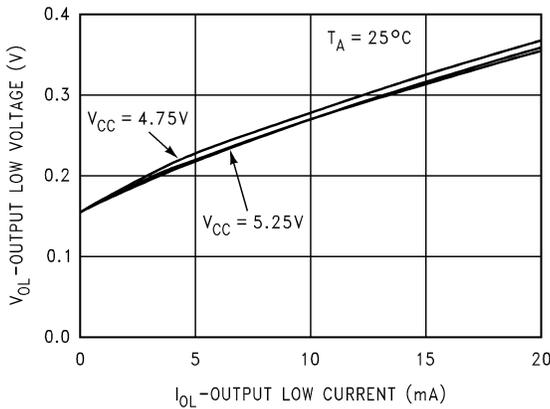
Receiver  $V_{OH}$  vs  $I_{OH}$  vs  $V_{CC}$



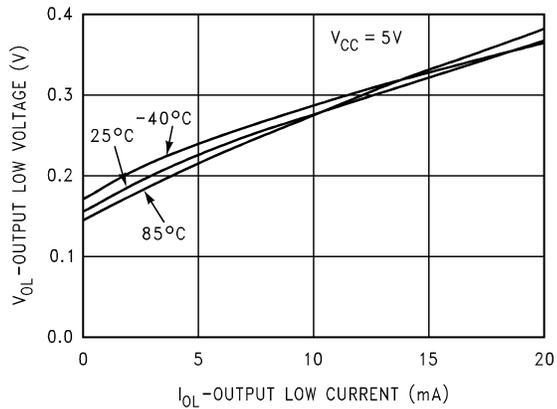
Receiver  $V_{OH}$  vs  $I_{OH}$  vs Temperature



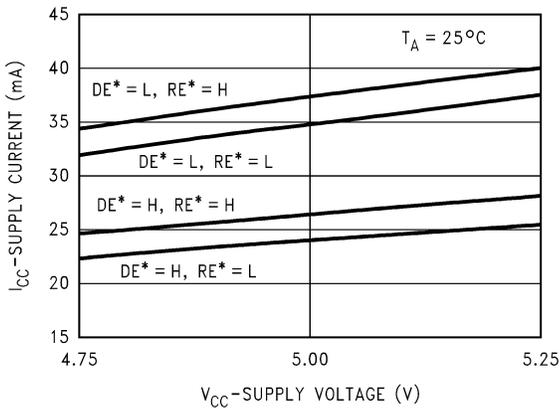
Receiver  $V_{OL}$  vs  $I_{OL}$  vs  $V_{CC}$



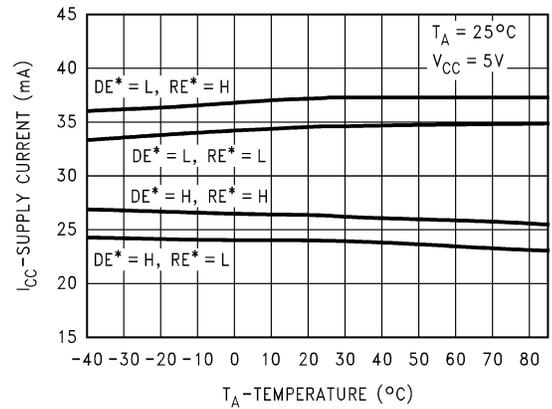
Receiver  $V_{OL}$  vs  $I_{OL}$  vs Temperature



Supply Current vs Supply Voltage

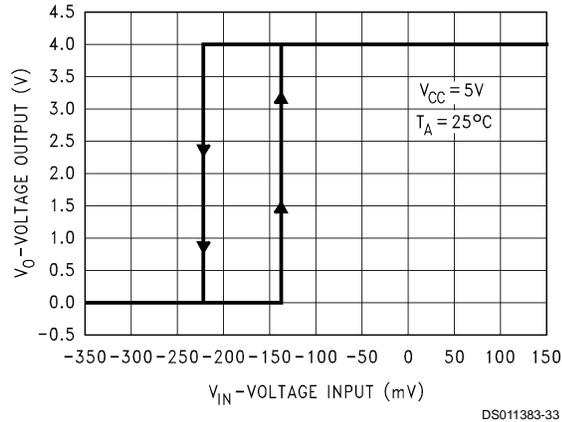


Supply Current vs Temperature

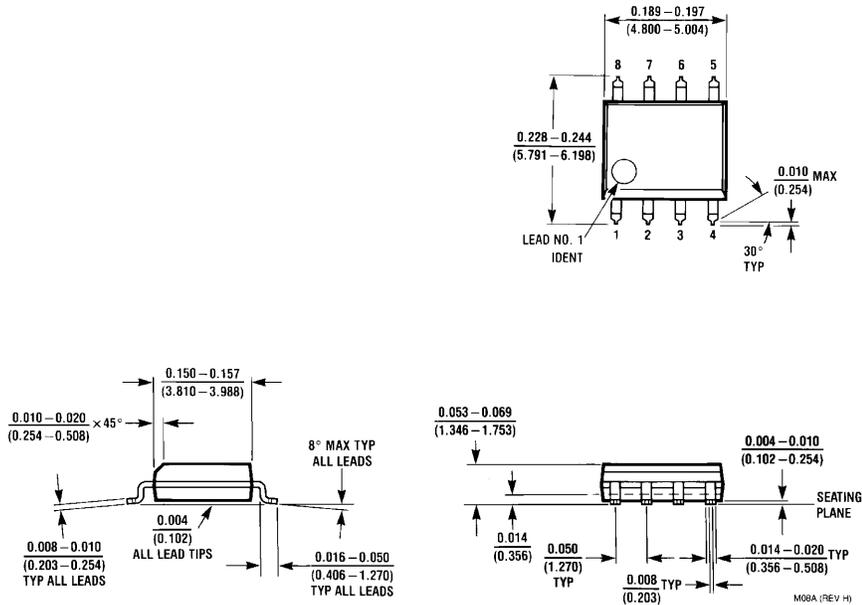


# Typical Performance Characteristics (Continued)

## Voltage Output vs Voltage Input (Hysteresis)



**Physical Dimensions** inches (millimeters) unless otherwise noted



**Order Number DS36276M  
NS Package Number M08A**

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