



February 2002

## DS36277

### Dominant Mode Multipoint Transceiver

#### General Description

The DS36277 Dominant Mode Multipoint Transceiver is designed for use on bi-directional differential busses. It is optimal for use on Interfaces that utilize Society of Automotive Engineers (SAE) J1708 Electrical Standard.

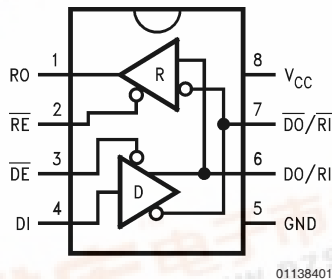
The device is similar to standard TIA/EIA-485 transceivers, but differs in enabling scheme. The Driver's Input is normally externally tied LOW, thus providing only two states: Active (LOW), or Disabled (OFF). When the driver is active, the dominant mode is LOW, conversely, when the driver is disabled, the bus is pulled HIGH by external bias resistors.

The receiver provides a FAILSAFE feature that guarantees a known output 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 HIGH for the following conditions: Open Inputs, Terminated Inputs (50Ω), or 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
- Optimal for use in SAE J1708 Interfaces
- Compatible with popular interface standards:
  - TIA/EIA-485 and TIA/EIA-422-A
  - CCITT recommendation V.11
- Bi-directional transceiver
  - Designed for multipoint transmission
- Wide bus common mode range
  - (−7V to +12V)
- Available in plastic DIP and SOIC packages

#### Connection and Logic Diagram



Order Number DS36277TM or DS36277TN  
See NS Package Number M08A or N08E

#### Truth Tables

Driver			
Inputs		Outputs	
DE	DI	DO/RI	DO /Ri
L	L	L	H
L	H	H	L
H	X	Z	Z

Receiver		
Inputs		Output
RE	DO/RI-DO /Ri	RO
L	$\geq 0$ mV	H
L	$\leq -500$ mV	L
L	SHORTED	H
L	OPEN	H
H	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 ( $\overline{DE}$ , $\overline{RE}$ , 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	
N Package	
(derate 9.3 mW/°C above +25°C)	1168 mW
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
ESD Rating (HBM, 1.5 k $\Omega$ , 100 pF)	5.0 kV

**Recommended Operating Conditions**

	Min	Max	Units
Supply Voltage, $V_{CC}$	4.75	5.25	V
Bus Voltage	-7	+12	V
Operating Temperature ( $T_A$ )			
DS36277T	-40	+85	°C

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

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

Symbol	Parameter	Conditions		Min	Typ	Max	Units	
DRIVER CHARACTERISTICS								
V <sub>OD</sub>	Differential Output Voltage	I <sub>O</sub> = 0 mA (No Load)		1.5	3.6	6	V	
V <sub>oDO</sub>	Output Voltage	I <sub>O</sub> = 0 mA (Output to GND)		0		6	V	
V <sub>oDO</sub>	Output Voltage			0		6	V	
V <sub>T1</sub>	Differential Output Voltage (Termination Load)	R <sub>L</sub> = 54Ω (485)	(Figure 1 )	1.3	2.2	5.0	V	
		R <sub>L</sub> = 100Ω (422)		1.7	2.6	5.0	V	
ΔV <sub>T1</sub>	Balance of V <sub>T1</sub>  V <sub>T1</sub> – V <sub>T1</sub>	R <sub>L</sub> = 54Ω	(Note 3)	–0.2		0.2	V	
		R <sub>L</sub> = 100Ω		–0.2		0.2	V	
V <sub>OS</sub>	Driver Common Mode Output Voltage	R <sub>L</sub> = 54Ω	(Figure 1 )	0	2.5	3.0	V	
		R <sub>L</sub> = 100Ω		0	2.5	3.0	V	
ΔV <sub>OS</sub>	Balance of V <sub>OS</sub>  V <sub>OS</sub> – V <sub>OS</sub>	R <sub>L</sub> = 54Ω	(Note 3)	–0.2		0.2	V	
		R <sub>L</sub> = 100Ω		–0.2		0.2	V	
V <sub>OH</sub>	Output Voltage High	I <sub>OH</sub> = –22 mA	(Figure 2 )	2.7	3.7		V	
V <sub>OL</sub>	Output Voltage Low	I <sub>OL</sub> = +22 mA			1.3	2	V	
I <sub>OSD</sub>	Driver Short-Circuit Output Current	V <sub>O</sub> = +12V	(Figure 3 )		92	290	mA	
		V <sub>O</sub> = –7V			–187	–290	mA	
RECEIVER CHARACTERISTICS								
V <sub>TH</sub>	Differential Input High Threshold Voltage (Note 5)	V <sub>O</sub> = V <sub>OH</sub> , I <sub>O</sub> = –0.4 mA –7V ≤ V <sub>CM</sub> ≤ +12V			–0.150	0	V	
V <sub>TL</sub>	Differential Input Low Threshold Voltage (Note 5)	V <sub>O</sub> = V <sub>OL</sub> , I <sub>O</sub> = 8.0 mA –7V ≤ V <sub>CM</sub> ≤ +12V		–0.5	–0.230		V	
V <sub>HST</sub>	Hysteresis (Note 6)	V <sub>CM</sub> = 0V			80		mV	
I <sub>IN</sub>	Line Input Current (V <sub>CC</sub> = 4.75V, 5.25V, 0V)	Other Input = 0V	V <sub>I</sub> = +12V		0.5	1.5	mA	
		DE = V <sub>IH</sub> (Note 7)	V <sub>I</sub> = –7V		–0.5	–1.5	mA	
I <sub>OSR</sub>	Short Circuit Current	V <sub>O</sub> = 0V		RO	–15	–32	–85	mA
I <sub>OZ</sub>	TRI-STATE® Leakage Current	V <sub>O</sub> = 0.4 to 2.4V			–20	1.4	+20	μA
V <sub>OH</sub>	Output High Voltage (Figure 12 )	V <sub>ID</sub> = 0V, I <sub>OH</sub> = –0.4 mA			2.3	3.7		V
		V <sub>ID</sub> = OPEN, I <sub>OH</sub> = –0.4 mA			2.3	3.7		V
V <sub>OL</sub>	Output Low Voltage (Figure 12 )	V <sub>ID</sub> = –0.5V, I <sub>OL</sub> = +8 mA				0.3	0.7	V
		V <sub>ID</sub> = –0.5V, I <sub>OL</sub> = +16 mA				0.3	0.8	V
R <sub>IN</sub>	Input Resistance			10	20		kΩ	

## 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	$\overline{DE}$ , $\overline{RE}$ , or $DI$	2.0		$V_{CC}$	V
$V_{IL}$	Low Level Input Voltage		GND		0.8	V
$I_{IH}$	High Level Input Current				20	$\mu A$
$I_{IL}$	Low Level Input Current				-100	$\mu A$
$V_{CL}$	Input Clamp Voltage			-0.7	-1.5	V
$I_{CC}$	Output Low Voltage	$\overline{DE} = 0V, \overline{RE} = 0V, DI = 0V$		39	60	mA
$I_{CCR}$	Supply Current	$\overline{DE} = 3V, \overline{RE} = 0V, DI = 0V$		24	50	mA
$I_{CCD}$	(No Load)	$\overline{DE} = 0V, \overline{RE} = 3V, DI = 0V$		40	75	mA
$I_{CCX}$		$\overline{DE} = 3V, \overline{RE} = 3V, DI = 0V$		27	45	mA

## Switching Characteristics (Note 4)

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRIVER CHARACTERISTICS						
t <sub>PLHD</sub>	Diff. Prop. Delay Low to High	R <sub>L</sub> = 54Ω C <sub>L</sub> = 50 pF C <sub>D</sub> = 50 pF (Figures 4, 5 )	8	17	60	ns
t <sub>PHLD</sub>	Diff. Prop. Delay High to Low		8	19	60	ns
t <sub>SKD</sub>	Diff. Skew (t <sub>PLHD</sub> –t <sub>PHLD</sub> )			2	10	ns
t <sub>r</sub>	Diff. Rise Time			11	60	ns
t <sub>f</sub>	Diff. Fall Time			11	60	ns
t <sub>PLH</sub>	Prop. Delay Low to High	R <sub>L</sub> = 27Ω, C <sub>L</sub> = 15 pF (Figures 6, 7 )		22	85	ns
t <sub>PHL</sub>	Prop. Delay High to Low			25	85	ns
t <sub>PZH</sub>	Enable Time Z to High	R <sub>L</sub> = 110Ω C <sub>L</sub> = 50 pF (Figure 8 – Figure 11 )		25	60	ns
t <sub>PZL</sub>	Enable Time Z to Low			30	60	ns
t <sub>PHZ</sub>	Disable Time High to Z			16	60	ns
t <sub>PLZ</sub>	Disable Time Low to Z			11	60	ns
RECEIVER CHARACTERISTICS						
t <sub>PLH</sub>	Prop. Delay Low to High	V <sub>ID</sub> = –1.5V to +1.5V C <sub>L</sub> = 15 pF (Figures 13, 14 )	15	37	90	ns
t <sub>PHL</sub>	Prop. Delay High to Low		15	43	90	ns
t <sub>SK</sub>	Skew (t <sub>PLH</sub> –t <sub>PHL</sub> )			6	15	ns
t <sub>PZH</sub>	Enable Time Z to High	C <sub>L</sub> = 15 pF (Figures 15, 16 )		12	60	ns
t <sub>PZL</sub>	Enable Time Z to Low			28	60	ns
t <sub>PHZ</sub>	Disable Time High to Z			20	60	ns
t <sub>PLZ</sub>	Disable Time Low to Z			10	60	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:**  $\Delta I_{VT1}$  and  $\Delta I_{VOS}$  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

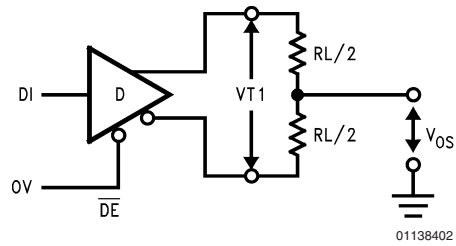


FIGURE 1. Driver  $V_{T1}$  and  $V_{OS}$  Test Circuit

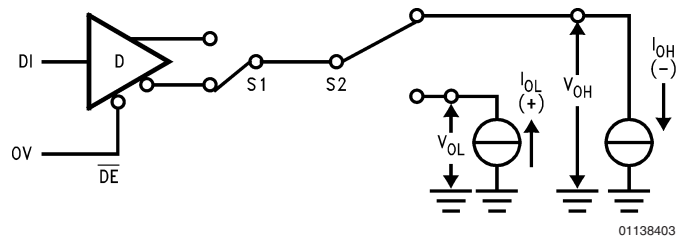


FIGURE 2. Driver  $V_{OH}$  and  $V_{OL}$  Test Circuit

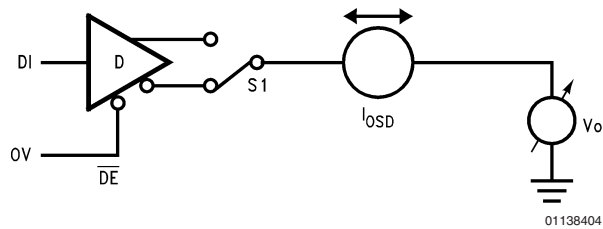


FIGURE 3. Driver Short Circuit Test Circuit

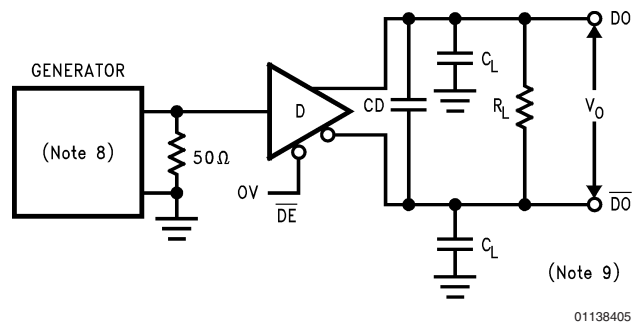


FIGURE 4. Driver Differential Propagation Delay and Transition Time Test Circuit

## Parameter Measurement Information (Continued)

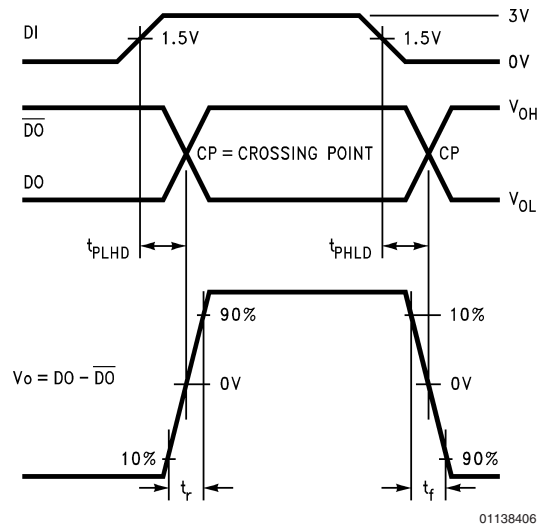


FIGURE 5. Driver Differential Propagation Delays and Transition Times

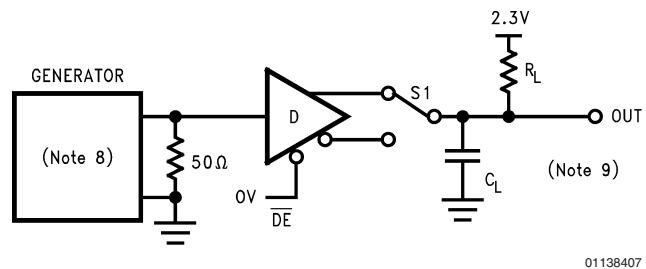


FIGURE 6. Driver Propagation Delay Test Circuit

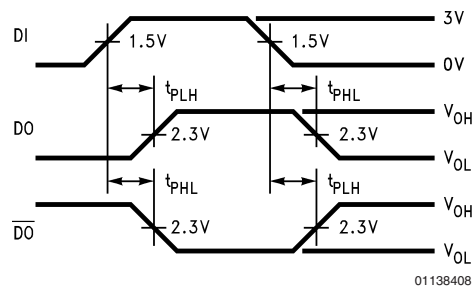
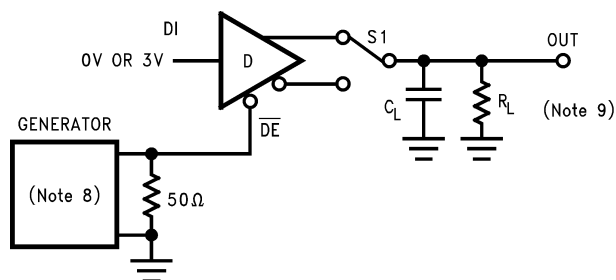


FIGURE 7. Driver Propagation Delays

## Parameter Measurement Information (Continued)

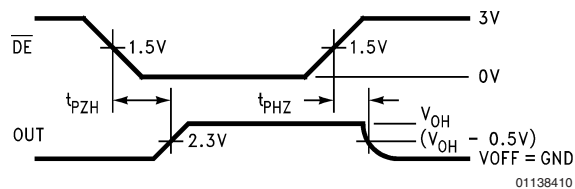


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S1 to DO for DI = 3V

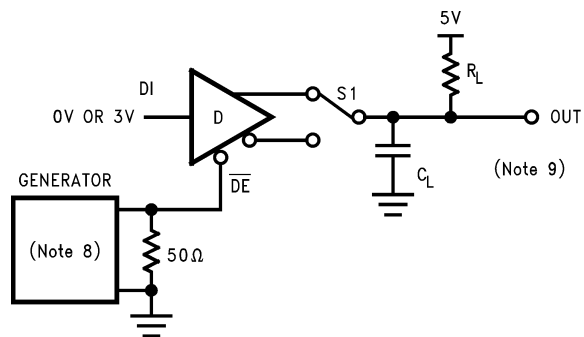
S1 to  $\overline{DO}$  for DI = 0V

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



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

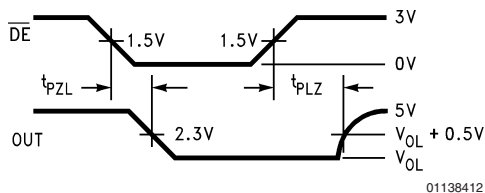


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S1 to DO for DI = 0V

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

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



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

## Parameter Measurement Information (Continued)

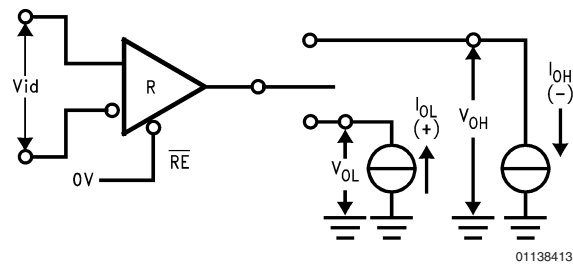


FIGURE 12. Receiver  $V_{OH}$  and  $V_{OL}$

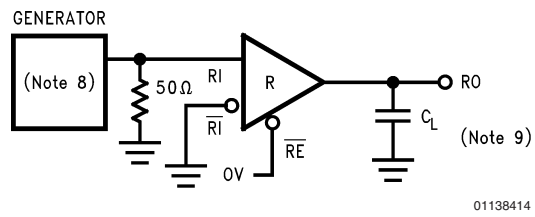


FIGURE 13. Receiver Propagation Delay Test Circuit

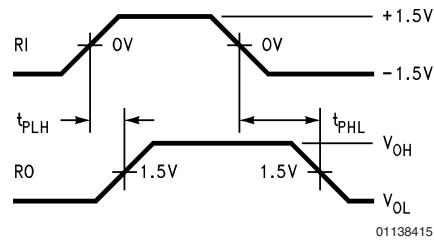


FIGURE 14. Receiver Propagation Delays

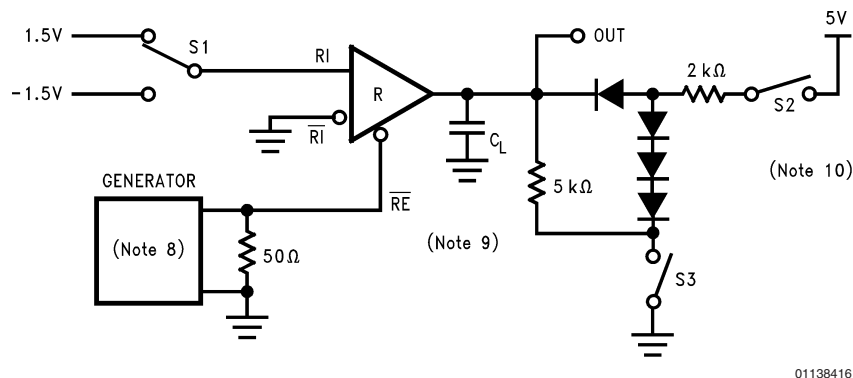
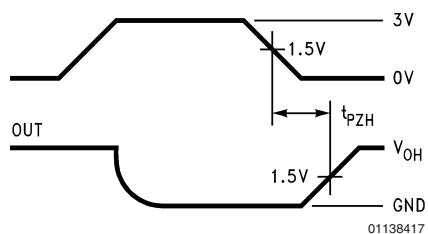


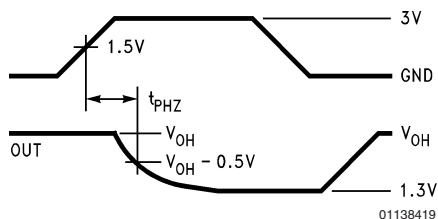
FIGURE 15. Receiver TRI-STATE Delay Test Circuit

## Parameter Measurement Information (Continued)

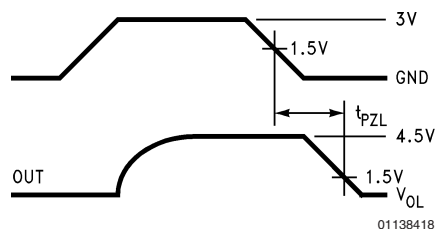
S1 1.5V  
S2 OPEN  
S3 CLOSED



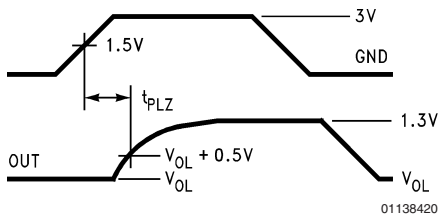
S1 1.5V  
S2 CLOSED  
S3 CLOSED



S1 -1.5V  
S2 CLOSED  
S3 OPEN



S1 -1.5V  
S2 CLOSED  
S3 CLOSED



**FIGURE 16. Receiver Enable and Disable Timing**

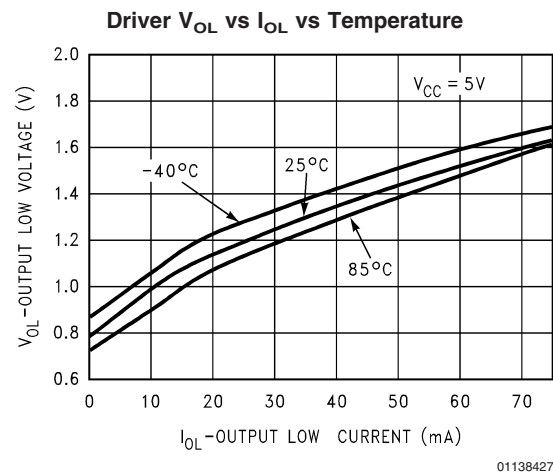
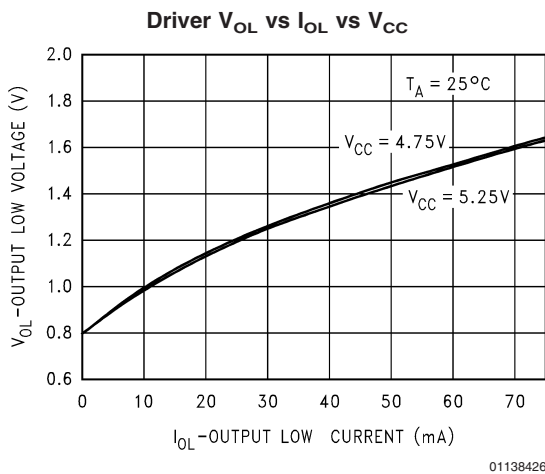
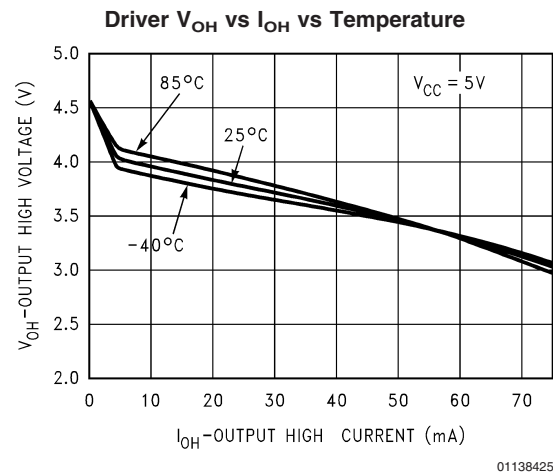
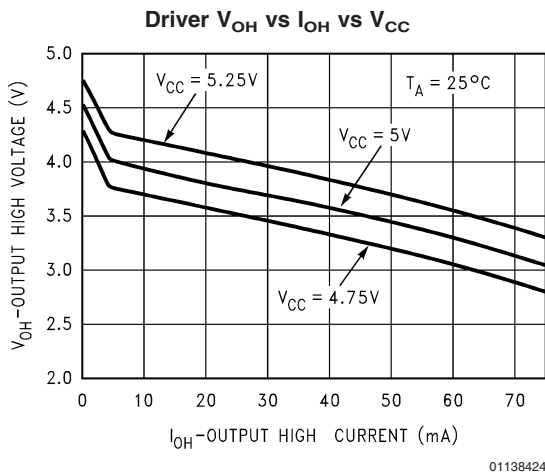
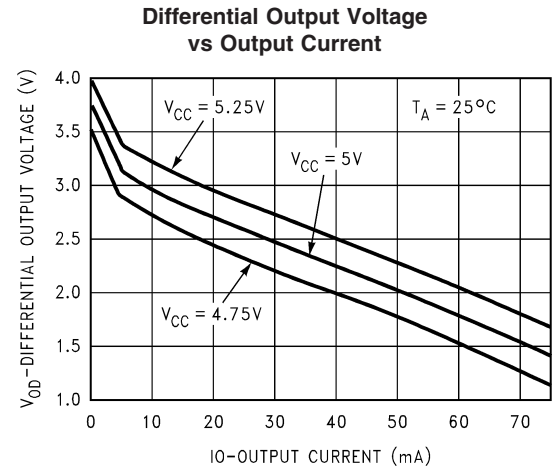
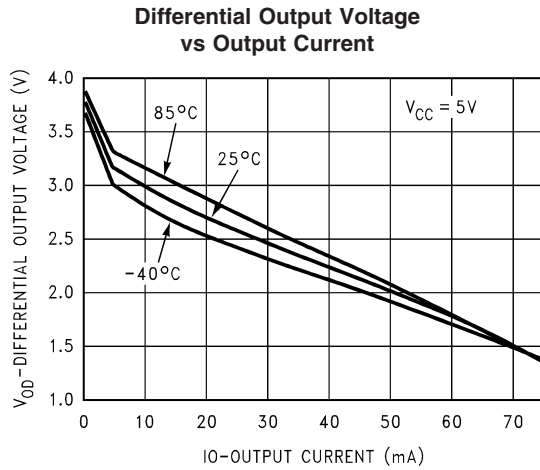
**Note 8:** The input pulse is supplied by a generator having the following characteristics:  $f = 1.0$  MHz, 50% duty cycle,  $t_r$  and  $t_f < 6.0$  ns,  $Z_O = 50\Omega$ .

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

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

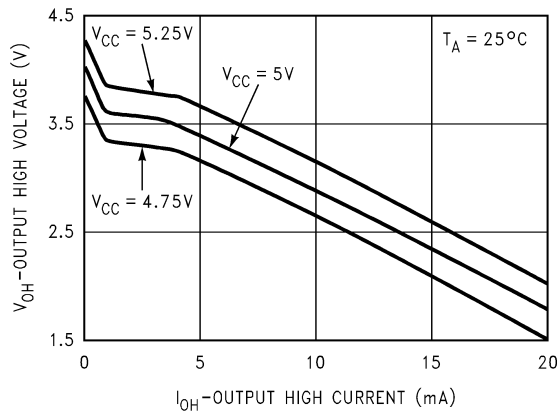


## Typical Performance Characteristics



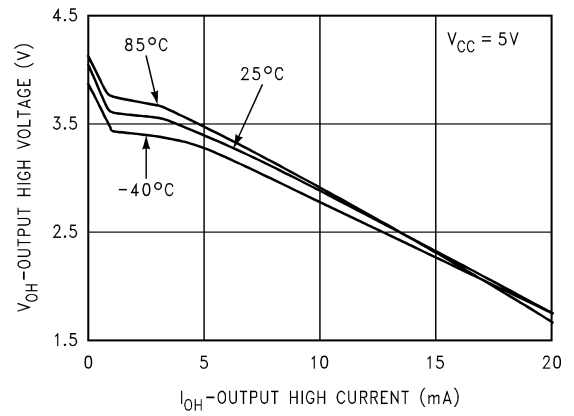
# Typical Performance Characteristics (Continued)

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



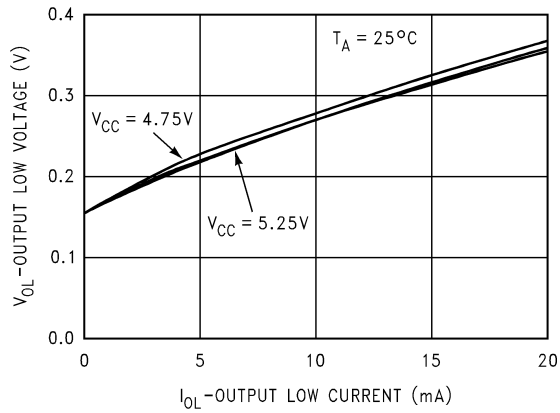
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## Receiver $V_{OH}$ vs $I_{OH}$ vs Temperature



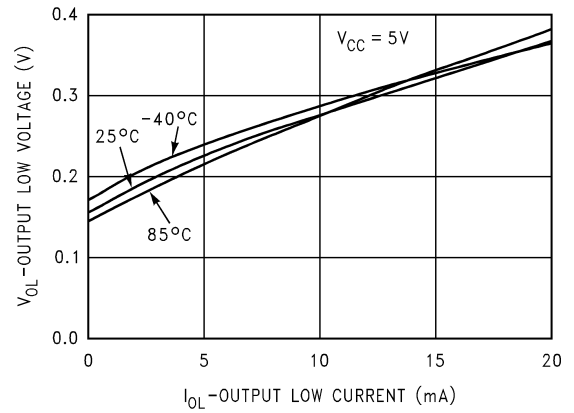
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## Receiver $V_{OL}$ vs $I_{OL}$ vs $V_{CC}$



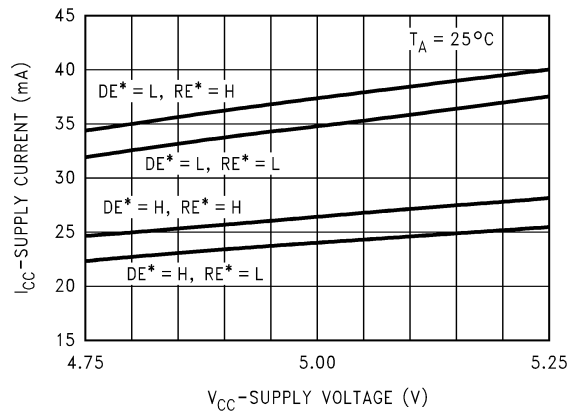
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## Receiver $V_{OL}$ vs $I_{OL}$ vs Temperature



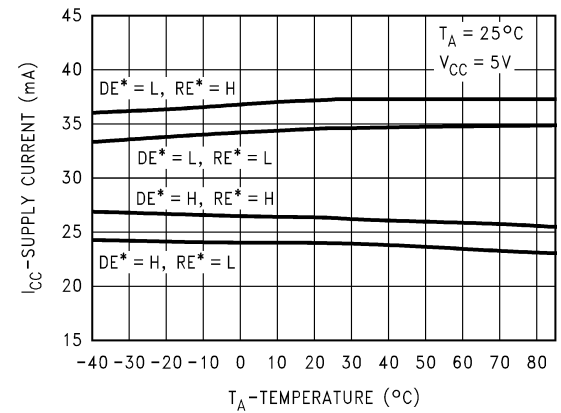
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## Supply Current vs Supply Voltage



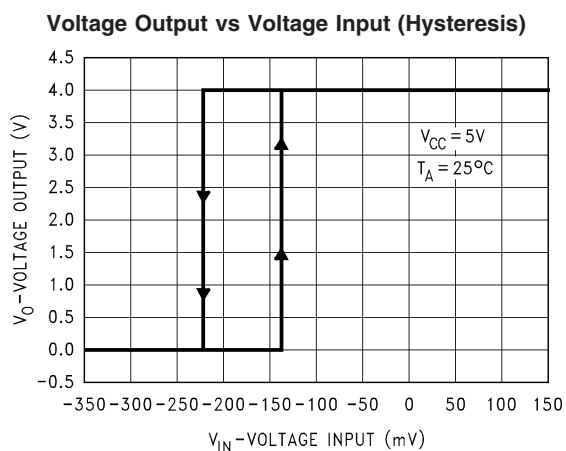
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## Supply Current vs Temperature



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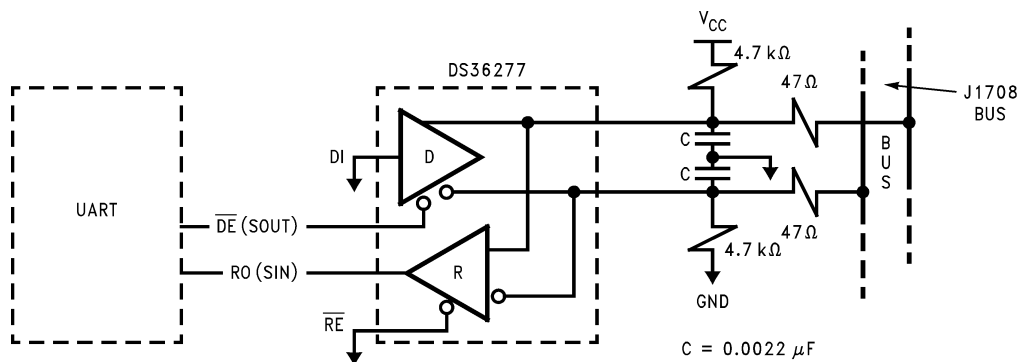
### Typical Performance Characteristics (Continued)



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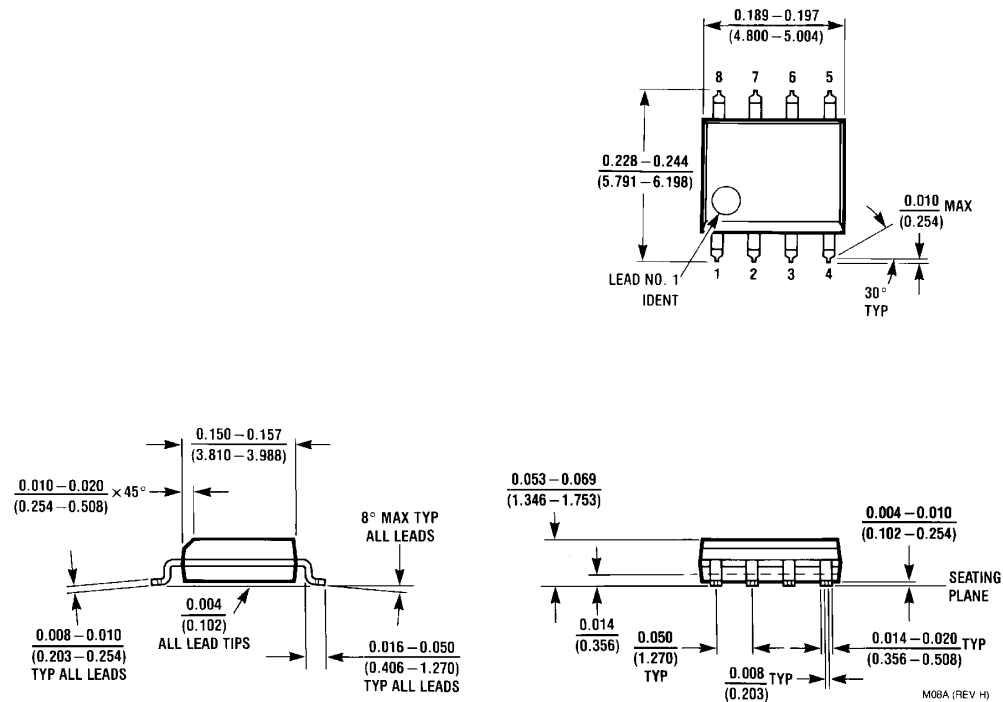
## Typical Applications Information

## SAE J1708 Node with External Bias Resistors and Filters

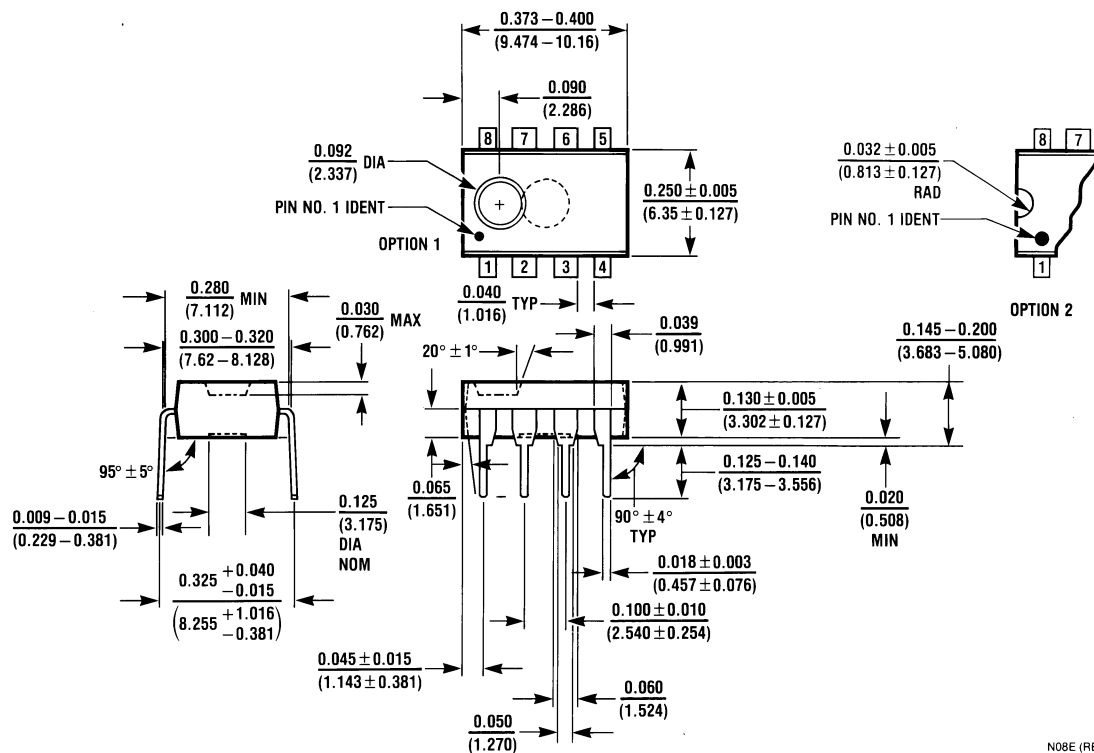


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# Physical Dimensions inches (millimeters) unless otherwise noted



**8-Lead Molded Package (SO)**  
**Order Number DS36277TM**  
**NS Package Number M08A**



**8-Lead Molded Dual-In-Line Package (N)**  
**Order Number DS36277TN**  
**NS Package Number N08E**

## Notes

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