Dominant Mode Multipoint Transceiver

Check for Samples: DS36277

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 PDIP and SOIC Packages**

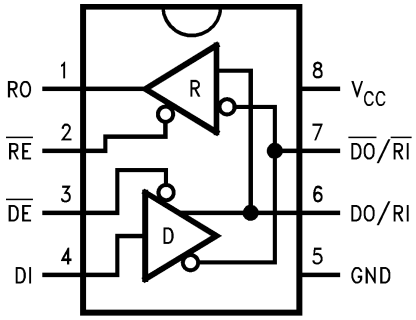
DESCRIPTION

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 ensures 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.

Connection and Logic Diagram



See Package Number D (R-PDSO-G8)
or
P (R-PDIP-T8)

Truth Table

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

Receiver		
Inputs		**Output**
$\overline{RE}$	**DO/RI–$\overline{DO}$ /$\overline{RI}$**	**RO**
L	≥ 0 mV	H
L	≤ −500 mV	L
L	SHORTED	H
L	OPEN	H
H	X	Z

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings(1)(2)

		Value	Unit
Supply Voltage (V_{CC})		7	V
Input Voltage ($\overline{DE}$, $\overline{RE}$, and DI)		5.5	V
Driver Output Voltage/Receiver Input Voltage		−10V to +15	V
Receiver Output Voltage (RO)		5.5	V
Maximum Package Power Dissipation @ +25°C	P Package (derate 9.3 mW/°C above +25°C)	1168	mW
	D 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 kΩ, 100 pF)		7.0	kV

(1) “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be specified. 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.
(2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.

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[1][2]

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

Symbol	Parameter	Conditions			Min	Typ	Max	Units
DRIVER CHARACTERISTICS								
V_{OD}	Differential Output Voltage	I_O = 0 mA (No Load)			1.5	3.6	6	V
V_{oDO}	Output Voltage	I_O = 0 mA (Output to GND)			0		6	V
$V_{o\overline{DO}}$	Output Voltage				0		6	V
V_{T1}	Differential Output Voltage (Termination Load)	R_L = 54Ω (485)	(Figure 1)		1.3	2.2	5.0	V
		R_L = 100Ω (422)			1.7	2.6	5.0	V
ΔV_{T1}	Balance of V_{T1} $\lvert V_{T1} - \overline{V_{T1}} \rvert$	R_L = 54Ω	See[3]		−0.2		0.2	V
		R_L = 100Ω			−0.2		0.2	V
V_{OS}	Driver Common Mode Output Voltage	R_L = 54Ω	(Figure 1)		0	2.5	3.0	V
		R_L = 100Ω			0	2.5	3.0	V
ΔV_{OS}	Balance of V_{OS} $\lvert V_{OS} - \overline{V_{OS}} \rvert$	R_L = 54Ω	See[3]		−0.2		0.2	V
		R_L = 100Ω			−0.2		0.2	V
V_{OH}	Output Voltage High	I_{OH} = −22 mA	(Figure 2)		2.7	3.7		V
V_{OL}	Output Voltage Low	I_{OL} = +22 mA				1.3	2	V
I_{OSD}	Driver Short-Circuit Output Current	V_O = +12V	(Figure 3)			92	290	mA
		V_O = −7V				−187	−290	mA
RECEIVER CHARACTERISTICS								
V_{TH}	Differential Input High Threshold Voltage[4]	$V_O = V_{OH}$, I_O = −0.4 mA				−0.150	0	V
		−7V ≤ V_{CM} ≤ +12V						
V_{TL}	Differential Input Low Threshold Voltage[4]	$V_O = V_{OL}$, I_O = 8.0 mA			−0.5	−0.230		V
		−7V ≤ V_{CM} ≤ +12V						
V_{HST}	Hysteresis[5]	V_{CM} = 0V				80		mV
I_{IN}	Line Input Current (V_{CC} = 4.75V, 5.25V, 0V)	Other Input = 0V, $\overline{DE}$ = V_{IH}[6]	V_I = +12V			0.5	1.5	mA
			V_I = −7V			−0.5	−1.5	mA
I_{OSR}	Short Circuit Current	V_O = 0V		RO	−15	−32	−85	mA
I_{OZ}	TRI-STATE Leakage Current	V_O = 0.4 to 2.4V			−20	1.4	+20	µA
V_{OH}	Output High Voltage (Figure 12)	V_{ID} = 0V, I_{OH} = −0.4 mA			2.3	3.7		V
		V_{ID} = OPEN, I_{OH} = −0.4 mA			2.3	3.7		V
V_{OL}	Output Low Voltage (Figure 12)	V_{ID} = −0.5V, I_{OL} = +8 mA				0.3	0.7	V
		V_{ID} = −0.5V, I_{OL} = +16 mA				0.3	0.8	V
R_{IN}	Input Resistance				10	20		kΩ
DEVICE CHARACTERISTICS								
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	V_{IH} = 2.4V					20	µA
I_{IL}	Low Level Input Current	V_{IL} = 0.4V					−100	µA
V_{CL}	Input Clamp Voltage	I_{CL} = −18 mA				−0.7	−1.5	V
I_{CC}	Output Low Voltage Supply Current (No Load)	$\overline{DE}$ = 0V, $\overline{RE}$ = 0V, DI = 0V				39	60	mA
I_{CCR}		$\overline{DE}$ = 3V, $\overline{RE}$ = 0V, DI = 0V				24	50	mA
I_{CCD}		$\overline{DE}$ = 0V, $\overline{RE}$ = 3V, DI = 0V				40	75	mA
I_{CCX}		$\overline{DE}$ = 3V, $\overline{RE}$ = 3V, DI = 0V				27	45	mA

(1) 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.
(2) All typicals are given for V_{CC} = 5.0V and T_A = +25°C.
(3) Δ $|V_{T1}|$ and Δ $|V_{OS}|$ are changes in magnitude of V_{T1} and V_{OS}, respectively, that occur when the input changes state.
(4) Threshold parameter limits specified as an algebraic value rather than by magnitude.
(5) Hysteresis defined as $V_{HST} = V_{TH} - V_{TL}$.
(6) I_{IN} includes the receiver input current and driver TRI-STATE leakage current.

Switching Characteristics[1]

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRIVER CHARACTERISTICS						
t_{PLHD}	Diff. Prop. Delay Low to High	R_L = 54Ω	8	17	60	ns
t_{PHLD}	Diff. Prop. Delay High to Low	C_L = 50 pF	8	19	60	ns
t_{SKD}	Diff. Skew ($\|t_{PLHD}–t_{PHLD}\|$)	C_D = 50 pF		2	10	ns
t_r	Diff. Rise Time	(Figure 4 and Figure 5)		11	60	ns
t_f	Diff. Fall Time			11	60	ns
t_{PLH}	Prop. Delay Low to High	R_L = 27Ω, C_L = 15 pF (Figure 6 and Figure 7)		22	85	ns
t_{PHL}	Prop. Delay High to Low			25	85	ns
t_{PZH}	Enable Time Z to High	R_L = 110Ω C_L = 50 pF (Figure 8 – Figure 11)		25	60	ns
t_{PZL}	Enable Time Z to Low			30	60	ns
t_{PHZ}	Disable Time High to Z			16	60	ns
t_{PLZ}	Disable Time Low to Z			11	60	ns
RECEIVER CHARACTERISTICS						
t_{PLH}	Prop. Delay Low to High	V_{ID} = −1.5V to +1.5V C_L = 15 pF (Figure 13 and Figure 14)	15	37	90	ns
t_{PHL}	Prop. Delay High to Low		15	43	90	ns
t_{SK}	Skew ($\|t_{PLH}–t_{PHL}\|$)			6	15	ns
t_{PZH}	Enable Time Z to High	C_L = 15 pF (Figure 15 and Figure 16)		12	60	ns
t_{PZL}	Enable Time Z to Low			28	60	ns
t_{PHZ}	Disable Time High to Z			20	60	ns
t_{PLZ}	Disable Time Low to Z			10	60	ns

(1) All typicals are given for V_{CC} = 5.0V and T_A = +25°C.

PARAMETER MEASUREMENT INFORMATION

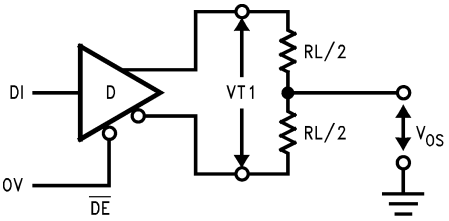


Figure 1. Driver V_{T1} and V_{OS} Test Circuit

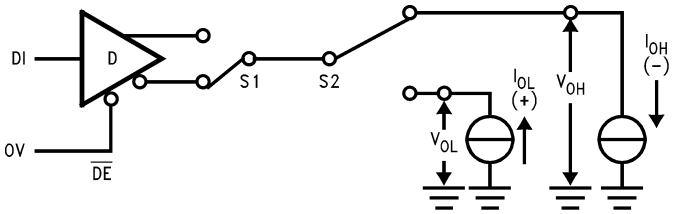


Figure 2. Driver V_{OH} and V_{OL} Test Circuit

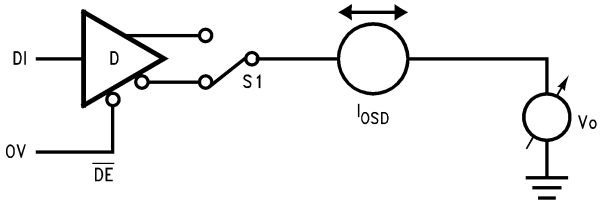
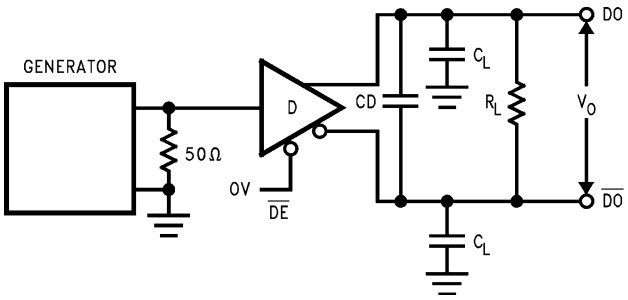


Figure 3. Driver Short Circuit Test Circuit



C_L includes probe and stray capacitance
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=50Ω

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

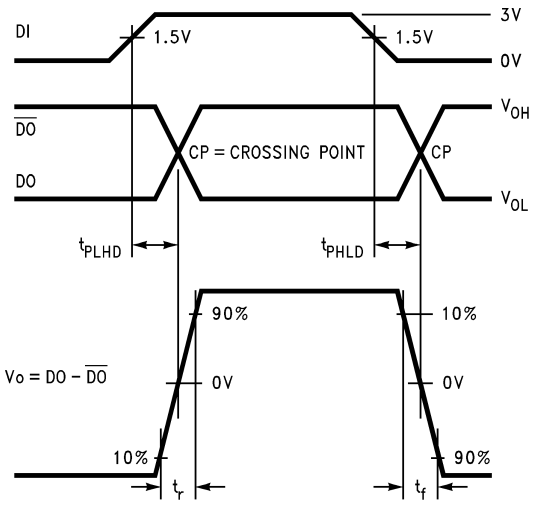
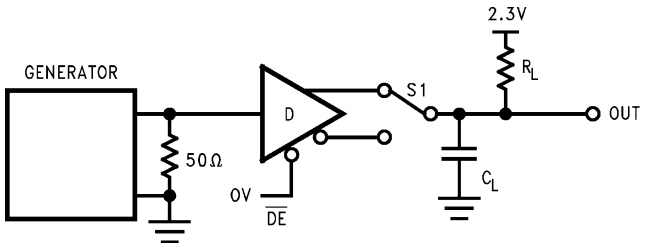


Figure 5. Driver Differential Propagation Delays and Transition Times



C_L includes probe and stray capacitance
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=50Ω

Figure 6. Driver Propagation Delay Test Circuit

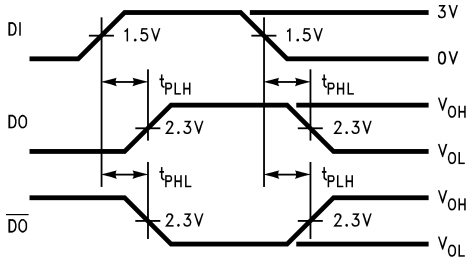
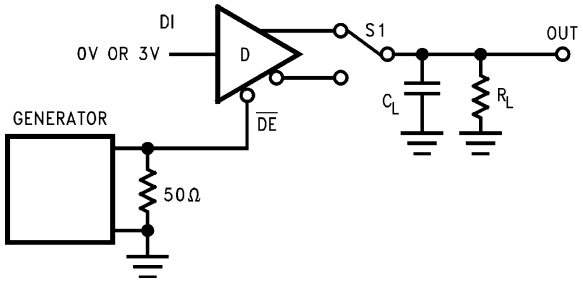


Figure 7. Driver Propagation Delays



S1 to DO for DI = 3V
S1 to $\overline{DO}$ for DI = 0V
C_L includes probe and stray capacitance
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=50Ω

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

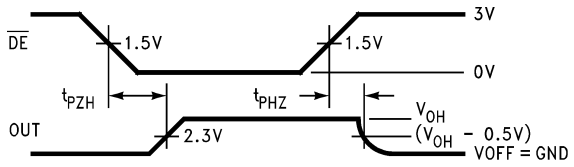
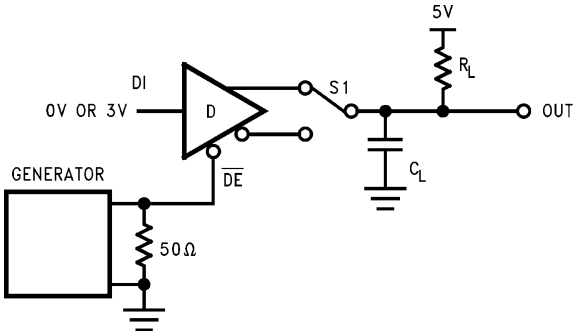


Figure 9. Driver TRI-STATE Delays (t_{PZH}, t_{PHZ})



S1 to DO for DI = 0V
S1 to $\overline{DO}$ for DI = 3V
C_L includes probe and stray capacitance
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=50Ω

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

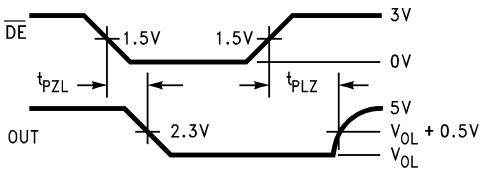


Figure 11. Driver TRI-STATE Delays (t_{PZL}, t_{PLZ})

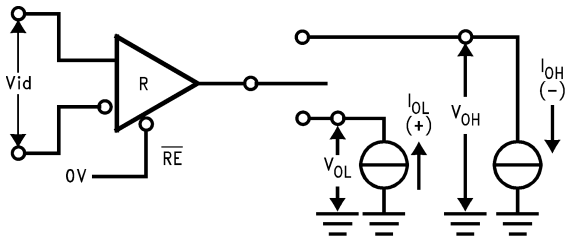
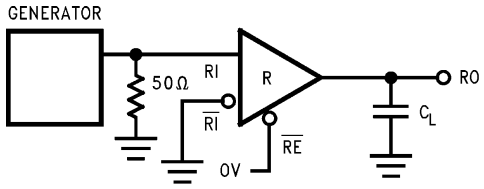


Figure 12. Receiver V_{OH} and V_{OL}



CL includes probe and stray capacitance
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_0=50Ω

Figure 13. Receiver Propagation Delay Test Circuit

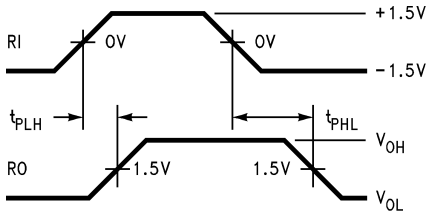
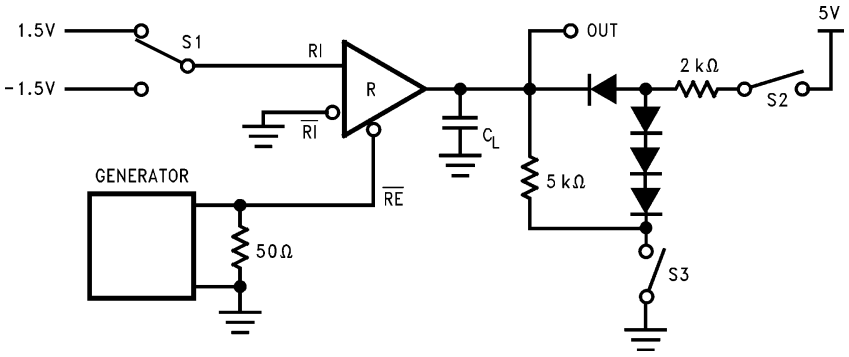
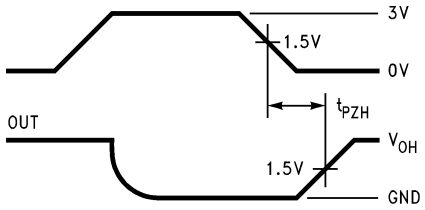


Figure 14. Receiver Propagation Delays

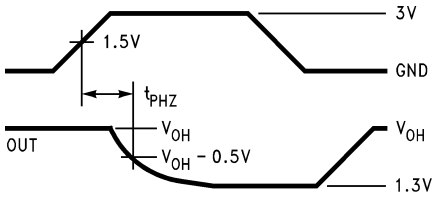


C_L includes probe and stray capacitance
The input pulse is supplied by a generator having the following characteristics: f=1.0 MHz, 50% duty cycle, T_r and t_f<6.0 ns, Z_0=50Ω
Diodes are 1N916 or equivalent.

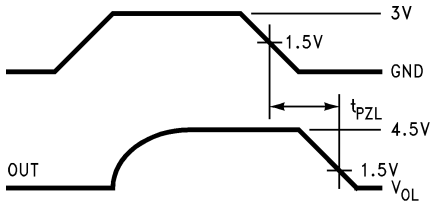
Figure 15. Receiver TRI-STATE Delay Test Circuit



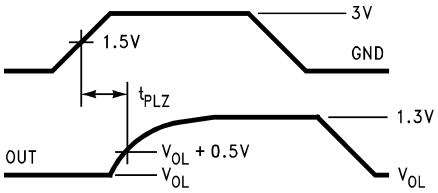
S1 1.5V
S2 OPEN
S3 CLOSED



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

Typical Performance Characteristics

Differential Output Voltage vs Output Current

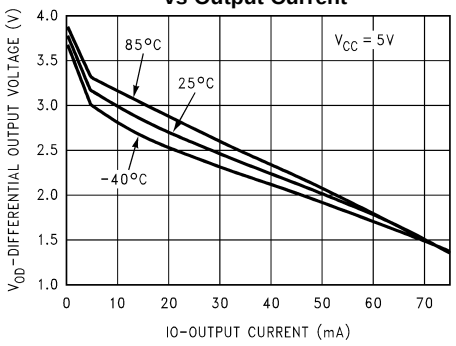


Figure 17.

Differential Output Voltage vs Output Current

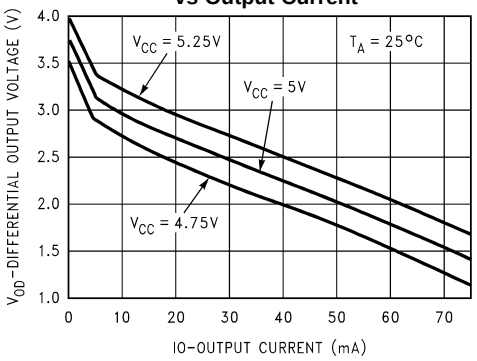


Figure 18.

Driver V_{OH} vs I_{OH} vs V_{CC}

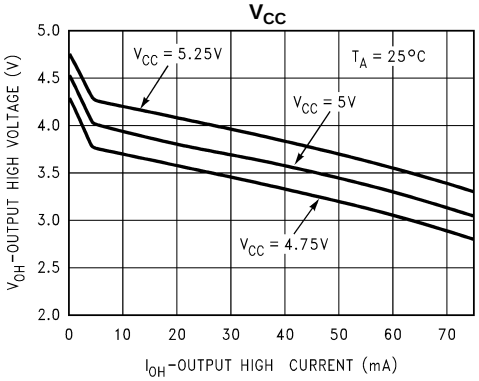


Figure 19.

Driver V_{OH} vs I_{OH} vs Temperature

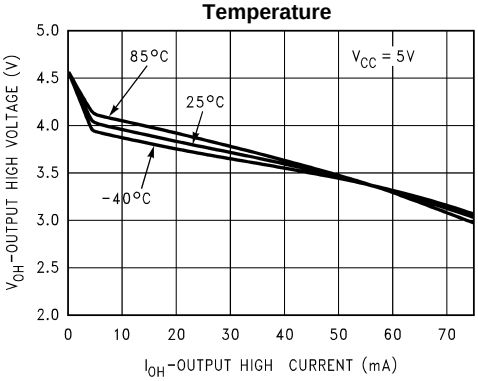


Figure 20.

Driver V_{OL} vs I_{OL} vs V_{CC}

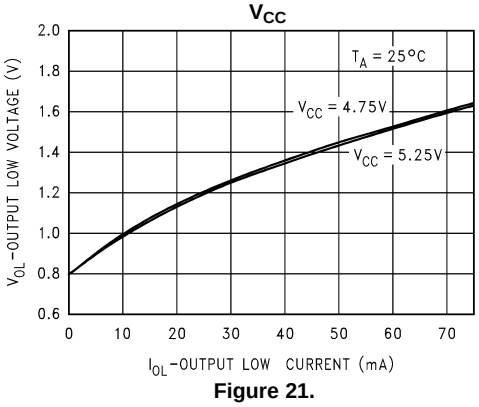


Figure 21.

Driver V_{OL} vs I_{OL} vs Temperature

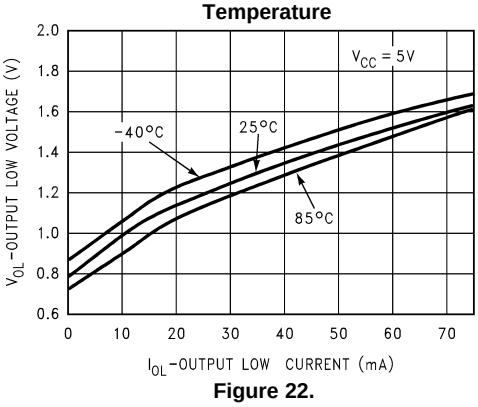


Figure 22.

Typical Performance Characteristics (continued)

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

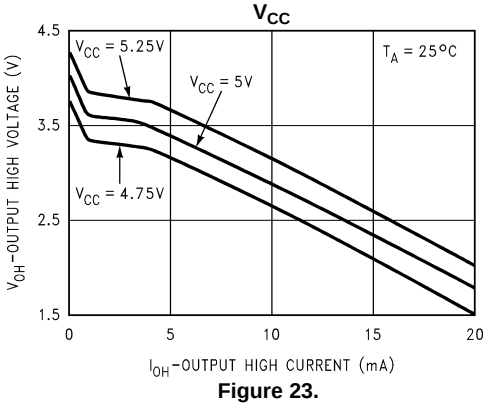


Figure 23.

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

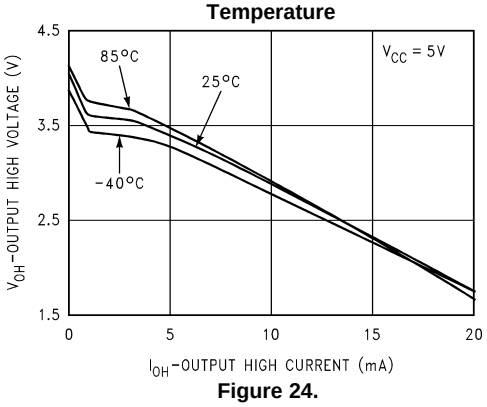


Figure 24.

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

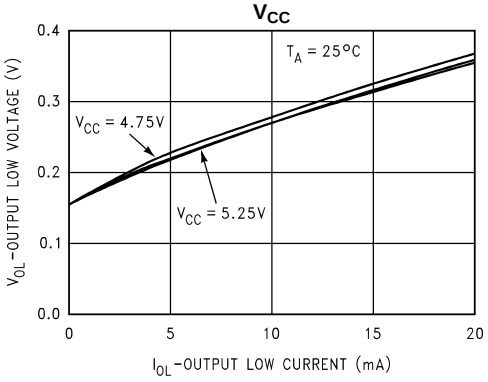


Figure 25.

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

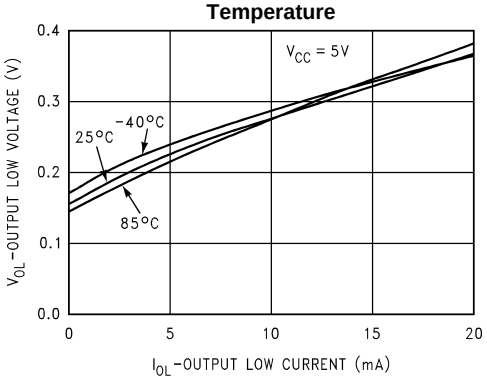


Figure 26.

Supply Current vs Supply Voltage

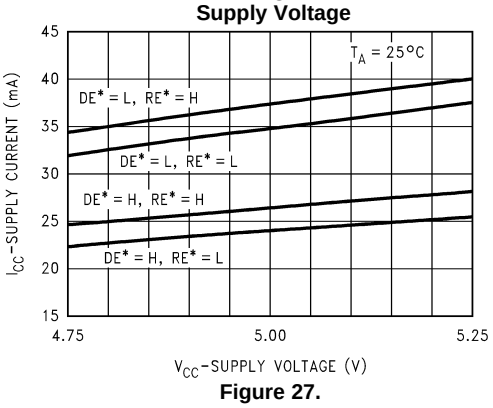


Figure 27.

Supply Current vs Temperature

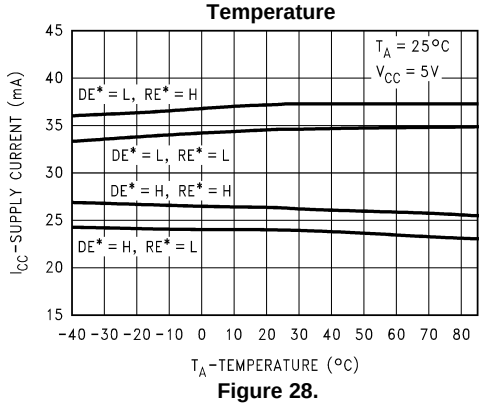


Figure 28.

Typical Performance Characteristics (continued)

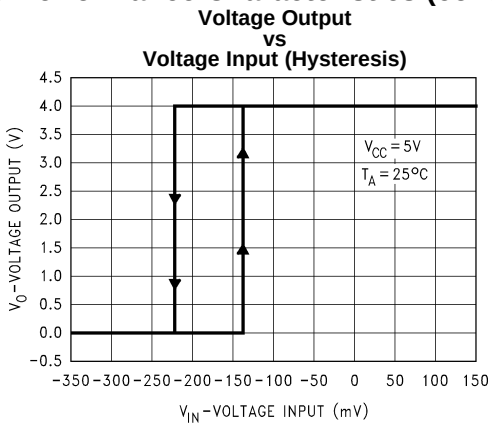


Figure 29.

TYPICAL APPLICATIONS INFORMATION

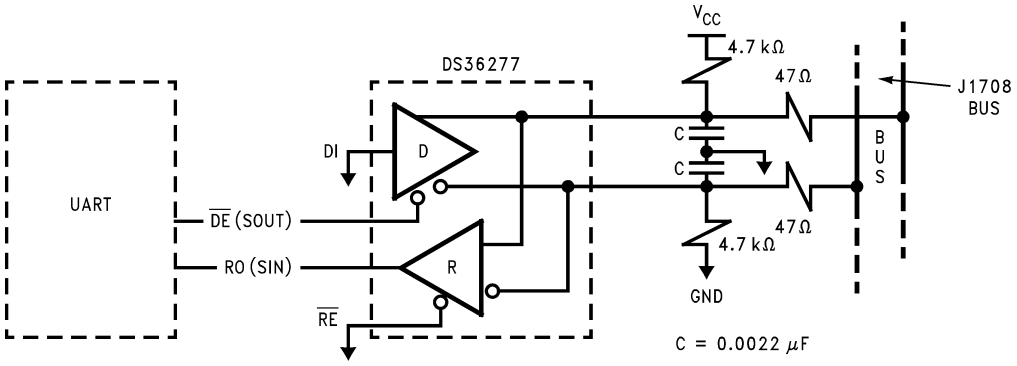


Figure 30. SAE J1708 Node with External Bias Resistors and Filters

REVISION HISTORY

Changes from Revision D (April 2013) to Revision E	Page
• Changed layout of National Data Sheet to TI format	12

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DS36277TMX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	DS362 77TM	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

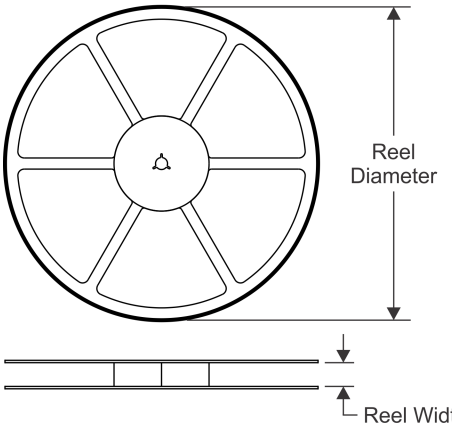
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

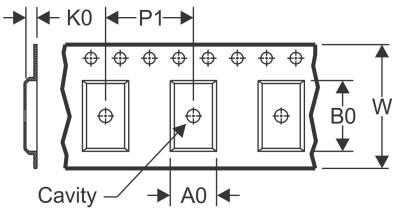
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

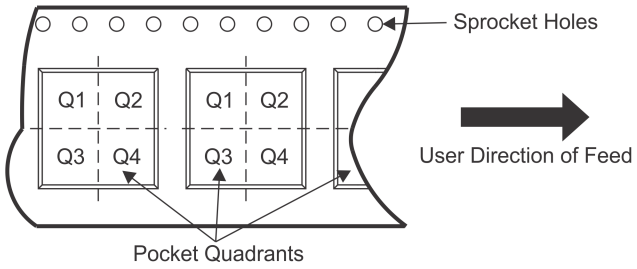


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

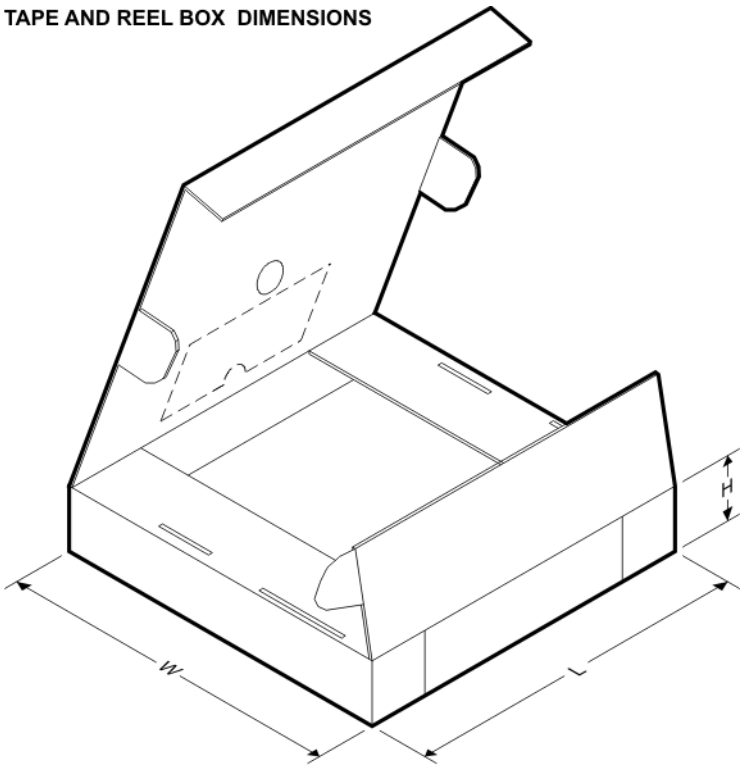
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

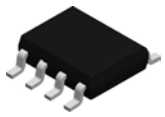
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DS36277TMX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS36277TMX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0

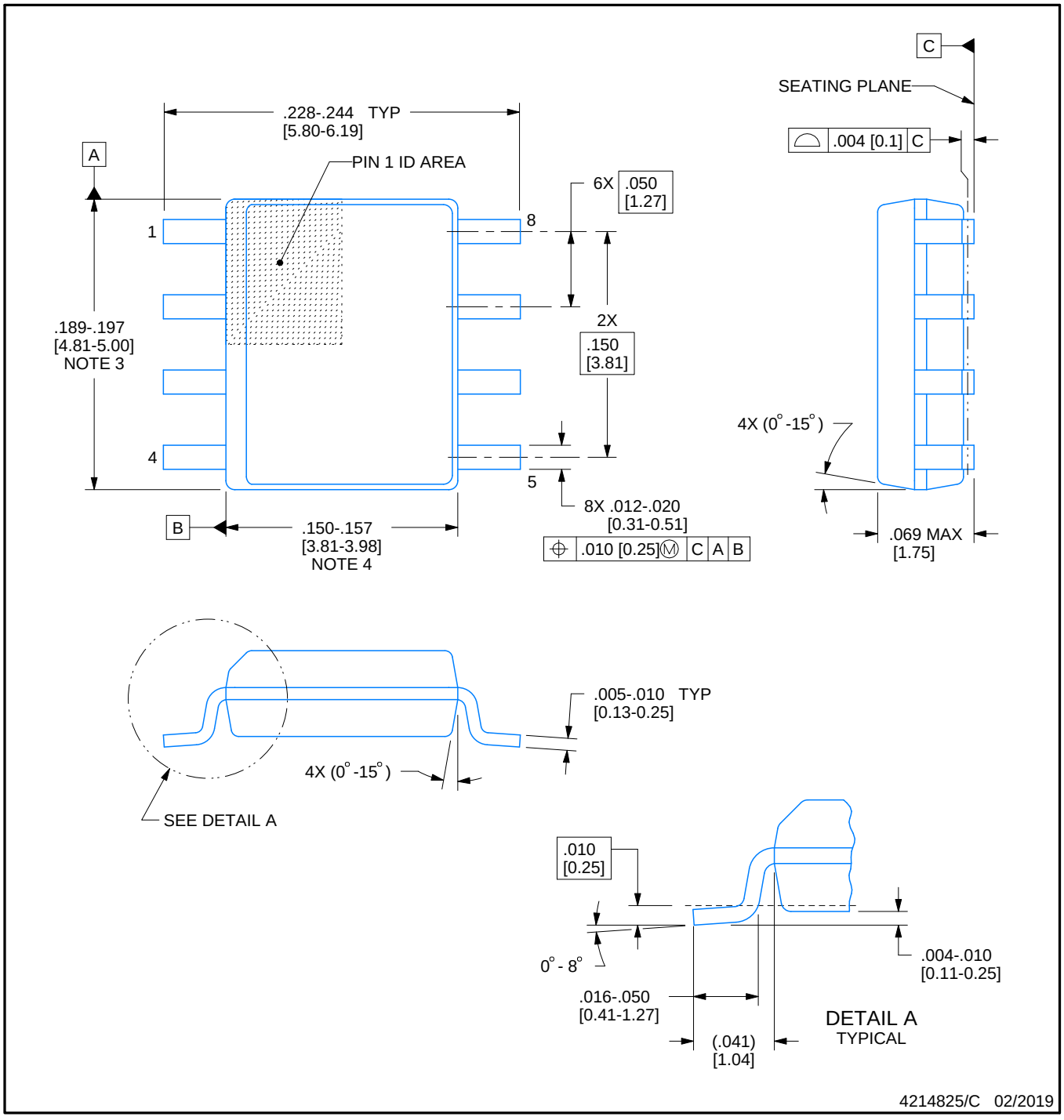


PACKAGE OUTLINE

D0008A

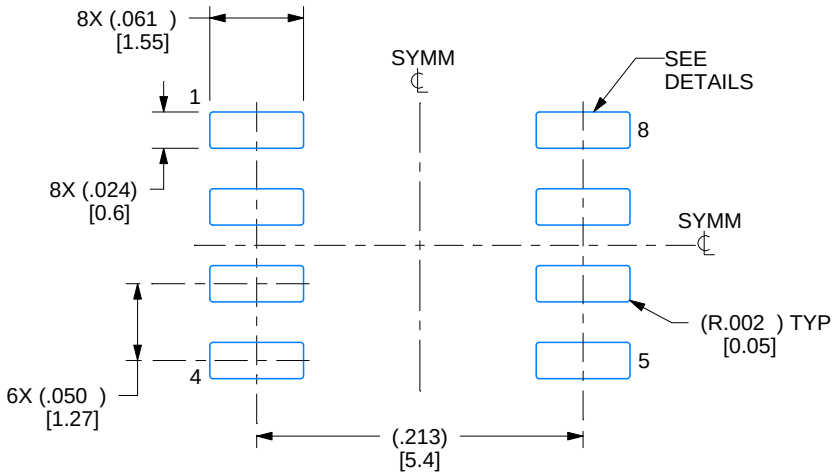
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

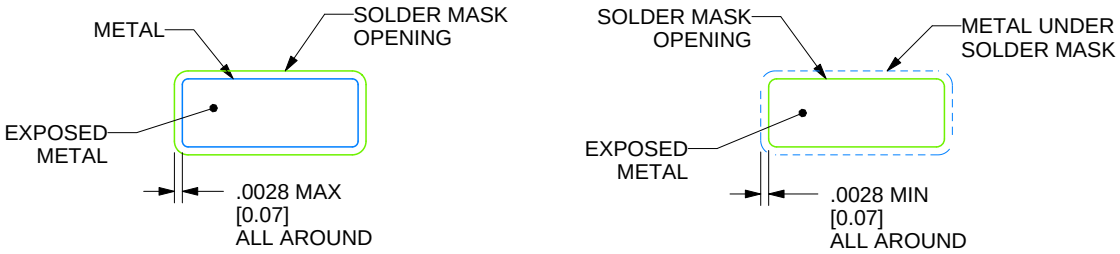


NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

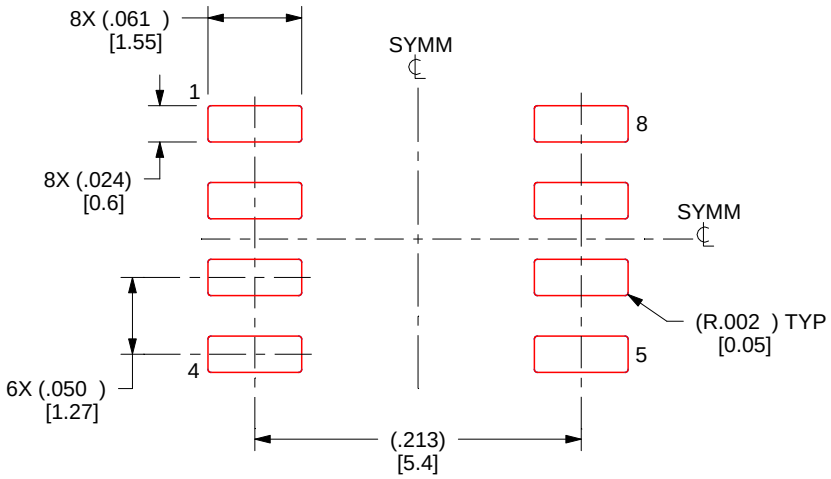
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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