DS3695A/DS3695AT/DS3696A Multipoint RS485/RS422 Transceivers

Check for Samples: DS3695A, DS3695AT, DS3696A

FEATURES

- **Meets EIA standard RS485 for multipoint bus transmission and is compatible with RS-422**
- **10 ns driver propagation delays (typical)**
- **Single +5V supply**
- **−7V to +12V bus common mode range permits ±7V ground difference between devices on the bus**
- **Thermal shutdown protection**
- **High impedance to bus with driver in TRI-STATE or with power off, over the entire common mode range allows the unused devices on the bus to be powered down**
- **Combined impedance of a driver output and receiver input is less than one RS485 unit load, allowing up to 32 transceivers on the bus**
- **70 mV typical receiver hysteresis**
- **Available in SOIC packaging**

DESCRIPTION

The DS3695A and DS3696A are high speed differential TRI-STATE® bus/line transceivers designed to meet the requirements of EIA standard RS485 with extended common mode range (+12V to −7V), for multipoint data transmission. In addition they are compatible with requirements of RS-422.

The driver and receiver outputs feature TRI-STATE capability. The driver outputs remain in TRI-STATE® over the entire common mode range of +12V to −7V. Bus faults that cause excessive power dissipation within the device trigger a thermal shutdown circuit, which forces the driver outputs into the high impedance state. The DS3696A provides an output pin (TS) which reports the thermal shutdown of the device. TS is an "open collector" pin with an internal 10 kΩ pull-up resistor. This allows the TS outputs of several devices to be wire OR-ed.

Datasheet-Directory

Both AC and DC specifications are guaranteed over the 0°C to 70°C temperature and 4.75V to 5.25V supply voltage range.

Connection and Logic Diagram

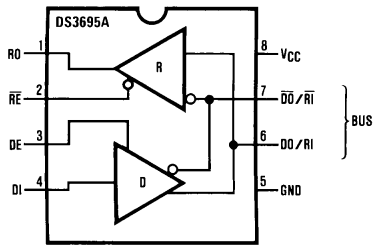
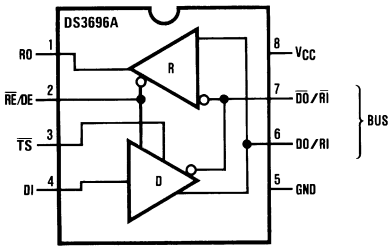


Figure 1. Molded Package, Small Outline (M)



TS was LF (Line Fault) on previous datasheets, TS goes low upon thermal shutdown.

Figure 2. Top View

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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)

Supply Voltage, V_{CC}	7V
Control Input Voltages	7V
Driver Input Voltage	7V
Driver Output Voltages	+15V/−10V
Receiver Input Voltages	+15V/−10V
Receiver Output Voltage	5.5V
Continuous Power Dissipation @ 25°C	
M Package	630 mW (2)
Storage Temp. Range	−65°C to +150°C
Lead Temp. (Soldering 4 seconds)	260°C

(1) "Absolute maximum ratings" are those beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the device should be operated at these limits. The tables of "Electrical Characteristics" provide conditions for actual device operation.
(2) Derate linearly at 6.5 mW/°C to 337 mW at 70°C.

Recommended OperatingConditions

	Min	Max	Units
Supply Voltage, V_{CC}	4.75	5.25	V
Bus Voltage	−7	+12	V
Operating Free Air Temp. (T_A)			
Commercial (DS3695AM)	0	+70	°C
Industrial (DS3695ATM)	−40	+85	°C
Commercial (DS3696AM)	0	+70	°C

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Electrical Characteristics (1) (2)

0°C ≤ T_A ≤ 70°C, 4.75V < V_{CC} < 5.25V unless otherwise specified

Symbol	Parameter		Conditions		Min	Typ	Max	Units
V_{OD1}	Differential Driver Output		I_O = 0				5	V
	Voltage (Unloaded)							
V_{OD2}	Differential Driver Output			R = 50Ω; (RS-422) (3)	2			V
	Voltage (with Load)			R = 27Ω; (RS-485)	1.5			V
ΔV_{OD}	Change in Magnitude of Driver							
	Differential Output Voltage For						0.2	V
	Complementary Output States							
V_{OC}	Driver Common Mode Output Voltage			R = 27Ω			3.0	V
$\Delta\|V_{OC}\|$	Change in Magnitude of Driver							
	Common Mode Output Voltage						0.2	V
	For Complementary Output States							
V_{IH}	Input High Voltage				2			V
V_{IL}	Input Low Voltage	DI, DE,					0.8	V
V_{CL}	Input Clamp Voltage	$\overline{RE}$, R$\overline{E}$ /DE		I_{IN} = −18 mA			−1.5	V
I_{IL}	Input Low Current			V_{IL} = 0.4V			−200	µA
I_{IH}	Input High Current			V_{IH} = 2.4V			20	µA
I_{IN}	Input Current	DO/RI, $\overline{DO}$ /$\overline{RI}$	V_{CC} = 0V or 5.25V	V_{IN} = 12V			+1.0	mA
		RI, $\overline{RI}$	DE or R$\overline{E}$ /DE = 0V	V_{IN} = −7V			−0.8	mA
V_{TH}	Differential Input Threshold		−7V ≤ V_{CM} ≤ +12V		−0.2		+0.2	V
	Voltage for Receiver							
ΔV_{TH}	Receiver Input Hysteresis		V_{CM} = 0V			70		mV
V_{OH}	Receiver Output High Voltage		I_{OH} = −400 µA		2.4			V
V_{OL}	Output Low Voltage	RO	I_{OL} = 16 mA (3)				0.5	V
		$\overline{TS}$	I_{OL} = 8 mA				0.45	V
I_{OZR}	OFF-State (High Impedance)		V_{CC} = Max				±20	µA
	Output Current at Receiver		0.4V ≤ V_O ≤ 2.4V					
R_{IN}	Receiver Input Resistance		−7V ≤ V_{CM} ≤ +12V		12			kΩ
I_{CC}	Supply Current		No Load	Driver Outputs Enabled		42	60	mA
			(3)	Driver Outputs Disabled		27	40	mA
I_{OSD}	Driver Short-Circuit		V_O = −7V (3)				−250	mA
	Output Current		V_O = +12V (3)				+250	mA
I_{OSR}	Receiver Short-Circuit		V_O = 0V		−15		−85	mA
	Output Current							

(1) All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to device ground unless otherwise specified.
(2) All typicals are given for V_{CC} = 5V and T_A = 25°C.
(3) All limits for which Note 5 is applied must be derated by 10% for DS3695AT. Other parameters remain the same for this extended temperature range device (−40°C ≤ T_A ≤ +85°C).

Switching Characteristics

0°C ≤ T_A ≤ 70°C, 4.75V < V_{CC} < 5.25V unless otherwise specified (4)

(4) All typicals are given for V_{CC} = 5V and T_A = 25°C.

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Receiver Switching Characteristics

(Figure 3 Figure 4 and Figure 5)

Symbol	Conditions	Min	Typ	Max	Units
t_{PLH}	C_L = 15 pF	15	28	42	ns
t_{PHL}	S1 and S2	15	28	42	ns
$\lvert t_{PLH} - t_{PHL} \rvert$	Closed	0	3		ns
t_{PLZ}	C_L = 15 pF, S2 Open	5	29	35	ns
t_{PHZ}	C_L = 15 pF, S1 Open	5	12	16	ns
t_{PZL}	C_L = 15 pF, S2 Open	7	15	28	ns
t_{PZH}	C_L = 15 pF, S1 Open	7	15	20	ns

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Driver Switching Characteristics

Symbol	Conditions	Min	Typ	Max	Units
SINGLE ENDED CHARACTERISTICS (Figure 7 Figure 8 and Figure 10)					
t_{PLH}	R_{LDIFF} = 60Ω	9	15	22	ns
t_{PHL}	$C_{L1} = C_{L2}$ = 100 pF	9	15	22	ns
$t_{SKEW}\lvert t_{PLH} - t_{PHL}\rvert$		0	2	8	ns
t_{PLZ}	C_L = 15 pF, S2 Open	7	15	30	ns
t_{PHZ}	C_L = 15 pF, S1 Open	7	15	30	ns
t_{PZL}	C_L = 100 pF, S2 Open	30	35	50	ns
t_{PZH}	C_L = 100 pF, S1 Open	30	35	50	ns
DIFFERENTIAL SWITCHING CHARACTERISTICS (Figure 10)					
t_r, t_f	R_{LDIFF} = 60Ω $C_{L1} = C_{L2}$ = 100 pF	6	10	18	ns

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AC Test Circuits and Switching Waveforms

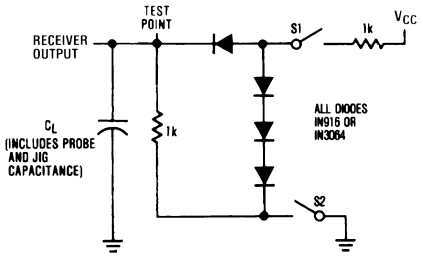

Figure 3. Receiver Propagation Delay Test Circuit

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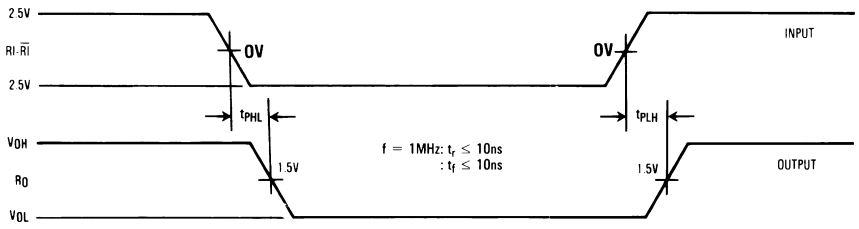

Differential input voltage may be realized by grounding $\overline{RI}$ and pulsing RI between +2.5V and −2.5V

Figure 4. Receiver Input-to-Output Propagation Delay Timing

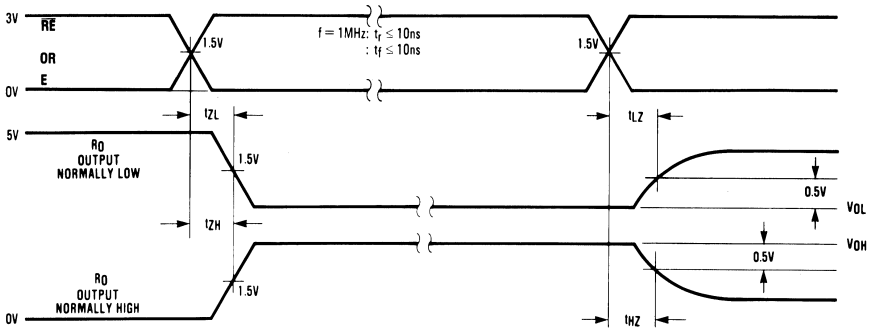

Figure 5. Receiver Enable/Disable Propagation Delay Timing

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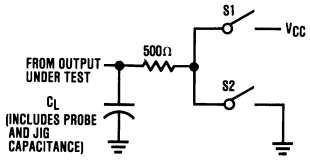

Figure 6. Unless otherwise specified the switches are closed.

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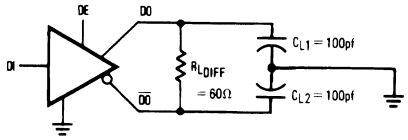

Figure 7. Driver Propagation Delay Test Circuits

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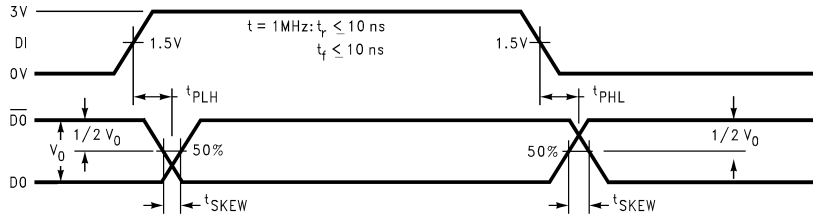

t_{PLH} and t_{PHL} are measured to the respective 50% points. t_{SKEW} is the difference between propagation delays of the complementary outputs.

Figure 8. Driver Input-to-Output Propagation Delay Timing (Single-Ended)

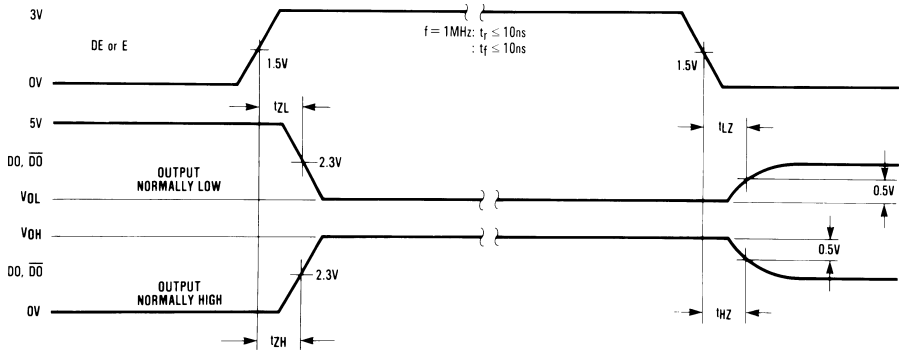

Figure 9. Driver Enable/Disable Propagation Delay Timing

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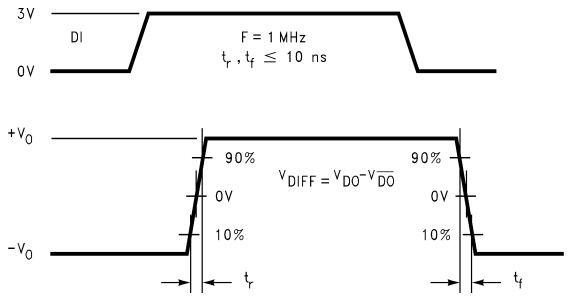

Figure 10. Driver Differential Transition Timing

Function Tables DS3695A/DS3696A Transmitting

Inputs			Line	Outputs		
$\overline{RE}$	DE	DI	Condition	$\overline{DO}$	DO	$\overline{TS}$ * (DS3696A Only)
X	1	1	No Fault	0	1	H
X	1	0	No Fault	1	0	H
X	0	X	X	Z	Z	H
X	1	X	Fault	Z	Z	L

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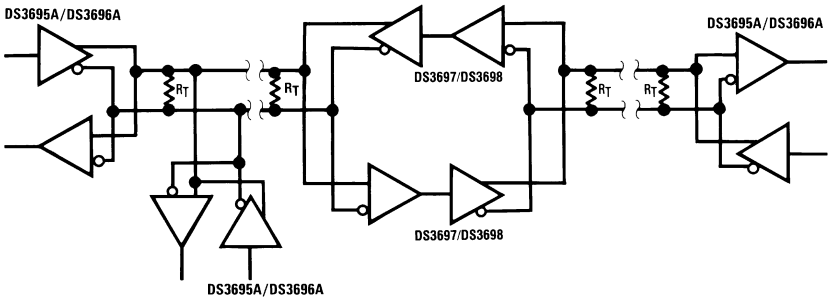
Function Tables DS3695A/DS3696A Receiving

Inputs			Output	
$\overline{RE}$	DE	RI–$\overline{RI}$	RO	$\overline{TS}$ * (DS3696A Only)
0	0	≥+0.2V	1	H
0	0	≤−0.2V	0	H
0	0	Inputs Open**	1	H
1	0	X	Z	H

Typical Application



Repeater control logic not shown. See AN-702.

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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)	Top-Side Markings (4)	Samples
DS3695AM	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	0 to 70	DS36 95AM	Samples
DS3695AM/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	DS36 95AM	Samples
DS3695AMX	ACTIVE	SOIC	D	8	2500	TBD	CU SNPB	Level-1-235C-UNLIM	0 to 70	DS36 95AM	Samples
DS3695AMX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	DS36 95AM	Samples
DS3695ATM	ACTIVE	SOIC	D	8	95	TBD	CU SNPB	Level-1-235C-UNLIM	-40 to 85	DS369 5ATM	Samples
DS3695ATM/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	DS369 5ATM	Samples
DS3695ATMX	ACTIVE	SOIC	D	8	2500	TBD	CU SNPB	Level-1-235C-UNLIM	-40 to 85	DS369 5ATM	Samples
DS3695ATMX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	DS369 5ATM	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.
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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) Only one of markings shown within the brackets will appear on the physical device.

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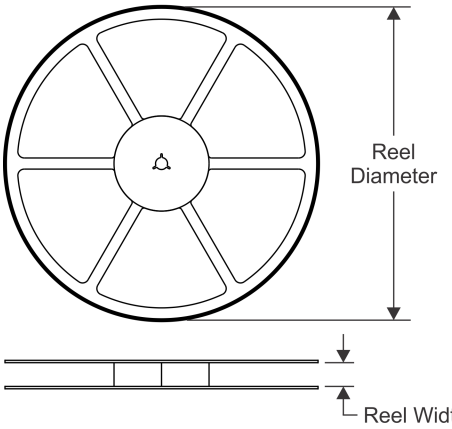
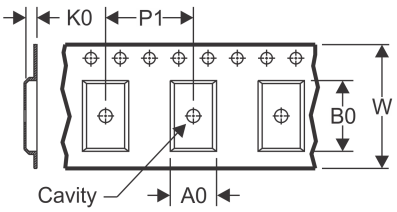
TAPE AND REEL INFORMATION

REEL DIMENSIONS

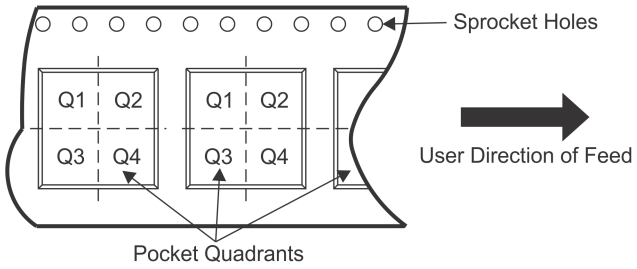


TAPE DIMENSIONS



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

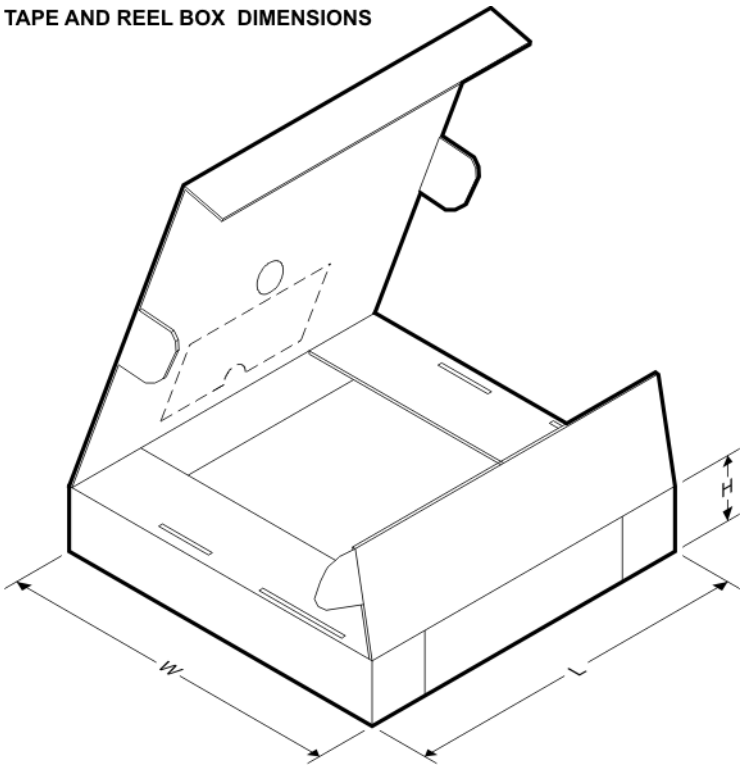
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
DS3695AMX	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
DS3695AMX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
DS3695ATMX	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
DS3695ATMX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1

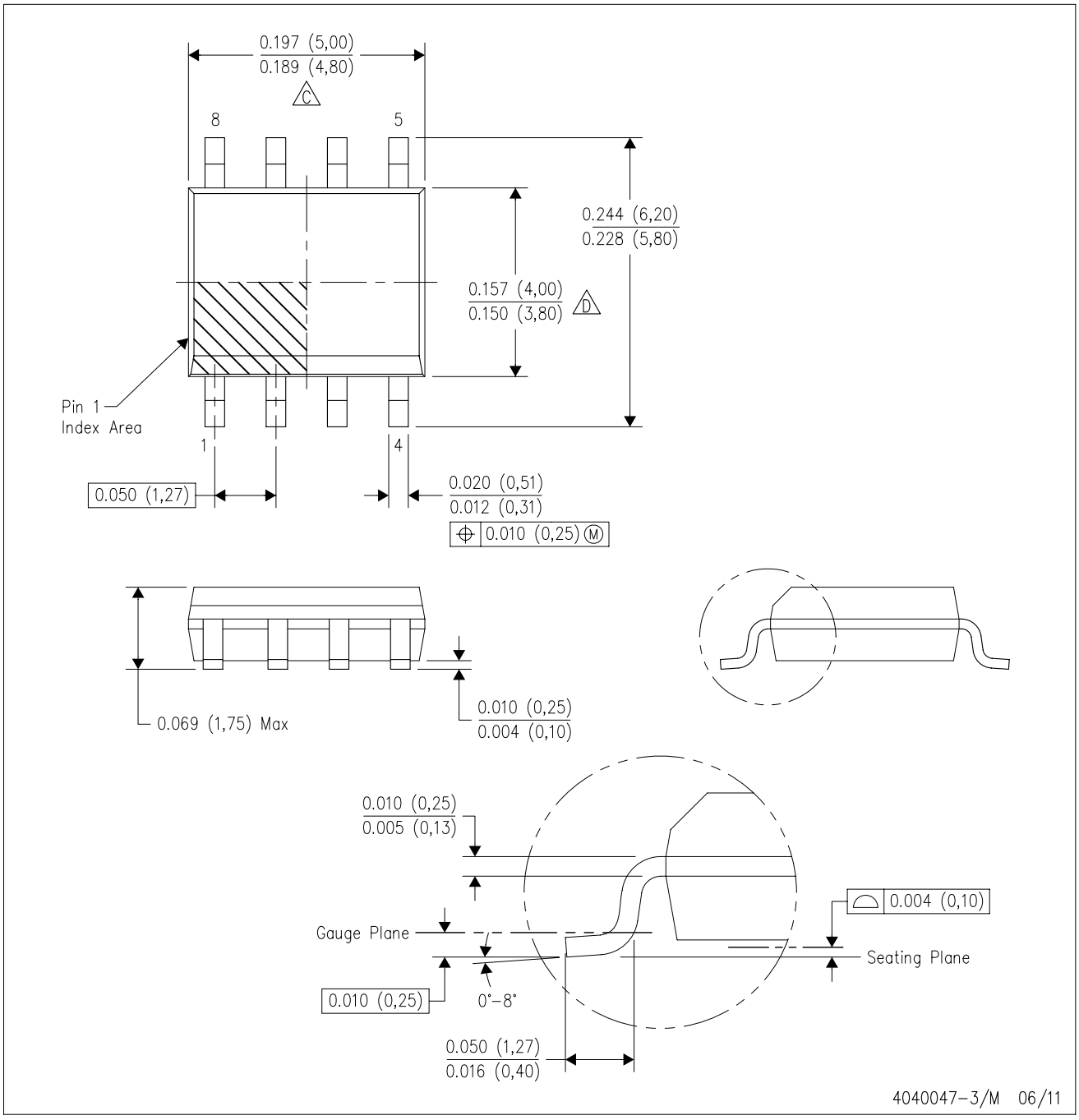
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS3695AMX	SOIC	D	8	2500	349.0	337.0	45.0
DS3695AMX/NOPB	SOIC	D	8	2500	349.0	337.0	45.0
DS3695ATMX	SOIC	D	8	2500	349.0	337.0	45.0
DS3695ATMX/NOPB	SOIC	D	8	2500	349.0	337.0	45.0

D (R–PDSO–G8) PLASTIC SMALL OUTLINE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
E. Reference JEDEC MS–012 variation AA.

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