

DS8921/DS8921A/DS8921AT Differential Line Driver and Receiver Pair

Check for Samples: [DS8921](#), [DS8921A](#), [DS8921AT](#)

FEATURES

- 12 ns Typical Propagation Delay
- Output Skew - 0.5 ns Typical
- Meet the Requirements of EIA Standard RS-422
- Complementary Driver Outputs
- High Differential or Common-Mode Input Voltage Ranges of $\pm 7V$
- $\pm 0.2V$ Receiver Sensitivity over the Input Voltage Range
- Receiver Input Hysteresis-70 mV Typical
- DS8921AT Industrial Temperature Operation: ($-40^{\circ}C$ to $+85^{\circ}C$)

DESCRIPTION

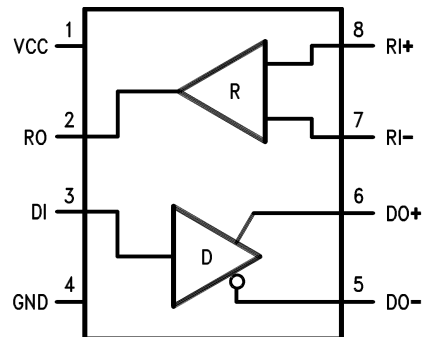
The DS8921, DS8921A are Differential Line Driver and Receiver pairs designed specifically for applications meeting the ST506, ST412 and ESDI Disk Drive Standards. In addition, these devices meet the requirements of the EIA Standard RS-422.

The DS8921, DS8921A receivers offer an input sensitivity of 200 mV over a $\pm 7V$ common mode operating range. Hysteresis is incorporated (typically 70 mV) to improve noise margin for slowly changing input waveforms.

The DS8921, DS8921A drivers are designed to provide unipolar differential drive to twisted pair or parallel wire transmission lines. Complementary outputs are logically ANDed and provide an output skew of 0.5 ns (typ.) with propagation delays of 12 ns.

The DS8921, DS8921A are designed to be compatible with TTL and CMOS.

Connection Diagram



DS8921/DS8921A/DS8921AT
See Package Number D (R-PDSO-G8) or P (R-PDIP-T8)

Truth Table

Receiver		Driver		
Input	V_{OUT}	Input	V_{OUT}	$\overline{V_{OUT}}$
$V_{ID} \geq V_{TH} (MAX)$	1	1	1	0
$V_{ID} \leq V_{TH} (MIN)$	0	0	0	1
Open	1			



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

All trademarks are the property of their respective owners.



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⁾

Supply Voltage	7V
Driver Input Voltage	–0.5V to +7V
Output Voltage	5.5V
Receiver Output Sink Current	50 mA
Receiver Input Voltage	±10V
Differential Input Voltage	±12V
Maximum Package Power Dissipation @ +25°C	
D Package	730 mW
P Package	1160 mW
Derate D Package	9.3 mW/°C above +25°C
Derate P Package	5.8 mW/°C above +25°C
Storage Temperature Range	–65°C to +165°C
Lead Temperature	+260°C
(Soldering, 4 sec.)	+260°C
Maximum Junction Temperature	+150°C

- (1) “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be ensured. They are not meant to imply that the device should be operated at these limits. The Table of [Electrical Characteristics](#) provides conditions for actual device operation.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instrument Sales Office/ Distributors for availability and specifications.

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage	4.5	5.5	V
Temperature (T _A)			
DS8921/DS8921A	0	70	°C
DS8921AT	–40	+85	°C

DS8921/DS8921A Electrical Characteristics ⁽¹⁾⁽²⁾⁽³⁾

Symbol	Conditions	Min	Typ	Max	Units
RECEIVER					
V_{TH}	$-7V \leq V_{CM} \leq +7V$	-200	± 35	+200	mV
V_{HYST}	$-7V \leq V_{CM} \leq +7V$	15	70		mV
R_{IN}	$V_{IN} = -7V, +7V$ (Other Input = GND)	4.0	6.0		k Ω
I_{IN}	$V_{IN} = 10V$			3.25	mA
	$V_{IN} = -10V$			-3.25	mA
V_{OH}	$I_{OH} = -400 \mu A$	2.5			V
V_{OL}	$I_{OL} = 8 \text{ mA}$			0.5	V
I_{SC}	$V_{CC} = \text{MAX}, V_{OUT} = 0V$	-15		-100	mA
DRIVER					
V_{IH}		2.0			V
V_{IL}				0.8	V
I_{IL}	$V_{CC} = \text{MAX}, V_{IN} = 0.4V$		-40	-200	μA
I_{IH}	$V_{CC} = \text{MAX}, V_{IN} = 2.7V$			20	μA
I_I	$V_{CC} = \text{MAX}, V_{IN} = 7.0V$			100	μA
V_{CL}	$V_{CC} = \text{MIN}, I_{IN} = -18 \text{ mA}$			-1.5	V
V_{OH}	$V_{CC} = \text{MIN}, I_{OH} = -20 \text{ mA}$	2.5			V
V_{OL}	$V_{CC} = \text{MIN}, I_{OL} = +20 \text{ mA}$			0.5	V
I_{OFF}	$V_{CC} = 0V, V_{OUT} = 5.5V$			100	μA
$ V_T - \overline{V_T} $				0.4	V
V_T		2.0			V
$ V_{OS} - \overline{V_{OS}} $				0.4	V
I_{SC}	$V_{CC} = \text{MAX}, V_{OUT} = 0V$	-30		-150	mA
DRIVER and RECEIVER					
I_{CC}	$V_{CC} = \text{MAX}, V_{OUT} = \text{Logic } 0$			35	mA

- (1) All currents into device pins are shown as positive values; all currents out of the device are shown as negative; all voltages are referenced to ground unless otherwise specified. All values shown as max or min are classified on absolute value basis.
- (2) All typical values are $V_{CC} = 5V$, $T_A = 25^\circ C$.
- (3) Only one output at a time should be shorted.

Receiver Switching Characteristics

Symbol	Conditions	Min	Typ	Max			Units
				8921	8921A	8921AT	
T_{pLH}	$C_L = 30 \text{ pF}$ (Figure 1 and Figure 2)		14	22.5	20	20	ns
T_{pHL}	$C_L = 30 \text{ pF}$ (Figure 1 and Figure 2)		14	22.5	20	20	ns
$ T_{pLH} - T_{pHL} $	$C_L = 30 \text{ pF}$ (Figure 1 and Figure 2)		0.5	5	3.5	5	ns

Driver Switching Characteristics
SINGLE ENDED CHARACTERISTICS

Symbol	Conditions	Min	Typ	Max			Units
				8921	8921A	8921AT	
T_{pLH}	$C_L = 30 \text{ pF}$ (Figure 3 and Figure 4)		10	15	15	15	ns
T_{pHL}	$C_L = 30 \text{ pF}$		10	15	15	15	ns

Driver Switching Characteristics (continued)

SINGLE ENDED CHARACTERISTICS

Symbol	Conditions	Min	Typ	Max			Units
				8921	8921A	8921AT	
	(Figure 3 and Figure 4)						
T_{TLH}	$C_L = 30 \text{ pF}$ (Figure 7 and Figure 8)		5	8	8	9.5	ns
T_{THL}	$C_L = 30 \text{ pF}$ (Figure 7 and Figure 8)		5	8	8	9.5	ns
Skew	$C_L = 30 \text{ pF}^{(1)}$ (Figure 3 and Figure 4)		1	5	3.5	3.5	ns

(1) Difference between complementary outputs at the 50% point.

Driver Switching Characteristics⁽¹⁾

DIFFERENTIAL CHARACTERISTICS

Symbol	Conditions	Min	Typ	Max			Units
				8921	8921A	8921AT	
T_{pLH}	$C_L = 30 \text{ pF}$		10	15	15	15	ns
	(Figure 3, Figure 5, and Figure 6)						
T_{pHL}	$C_L = 30 \text{ pF}$		10	15	15	15	ns
	(Figure 3, Figure 5, and Figure 6)						
$ T_{pLH} - T_{pHL} $	$C_L = 30 \text{ pF}$		0.5	6	2.75	2.75	ns
	(Figure 3, Figure 5, and Figure 6)						

(1) Differential Delays are defined as calculated results from single ended rise and fall time measurements. This approach in establishing AC performance specifications has been taken due to limitations of available Automatic Test Equipment (ATE). The calculated ATE results assume a linear transition between measurement points and are a result of the following equations: $T_{cr} = \frac{(T_{fb} \times T_{rb}) - (T_{ra} \times T_{fa})}{T_{rb} - T_{ra} - T_{fa} + T_{fb}}$ Where: T_{cr} = Crossing Point T_{ra} , T_{rb} , T_{fa} and T_{fb} are time measurements with respect to the input. See Figure 6.

AC Test Circuits and Switching Diagrams

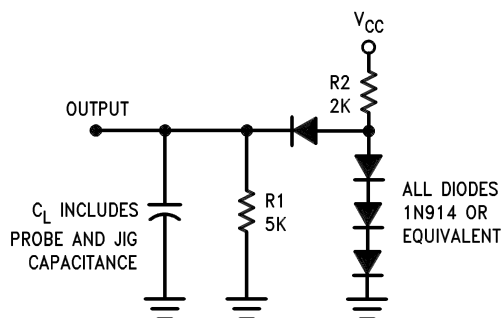


Figure 1.

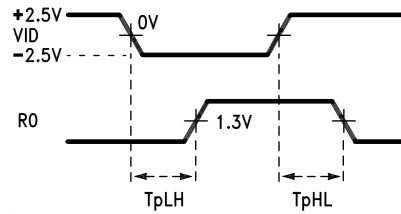


Figure 2.

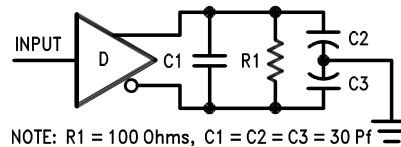


Figure 3.

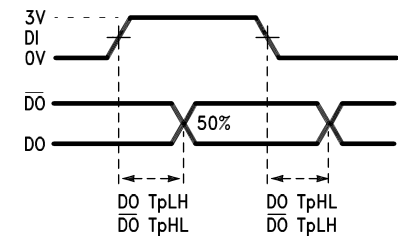


Figure 4.

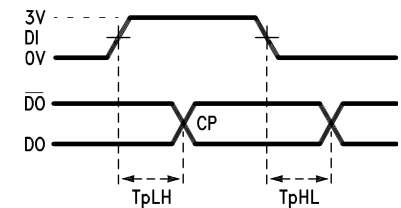


Figure 5.

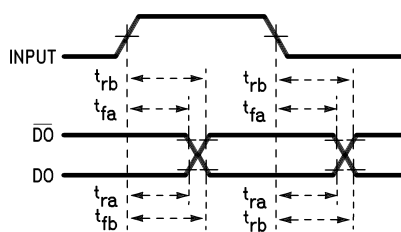


Figure 6.

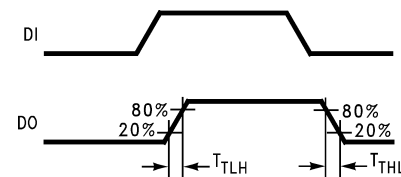


Figure 7.

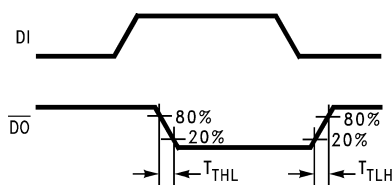


Figure 8.

TYPICAL APPLICATIONS

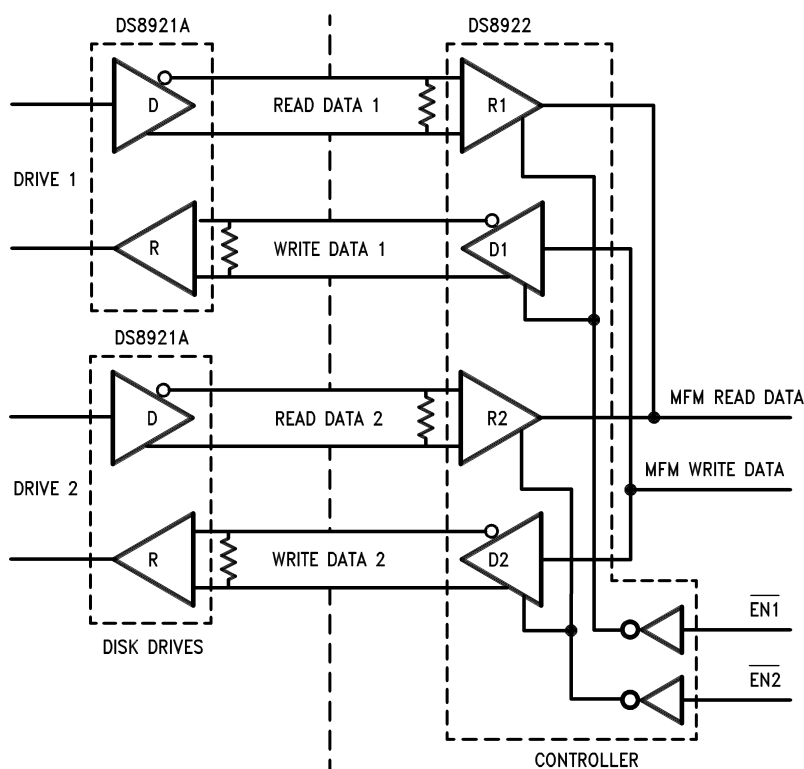


Figure 9. ST506 and ST412 Application

Figure 10.

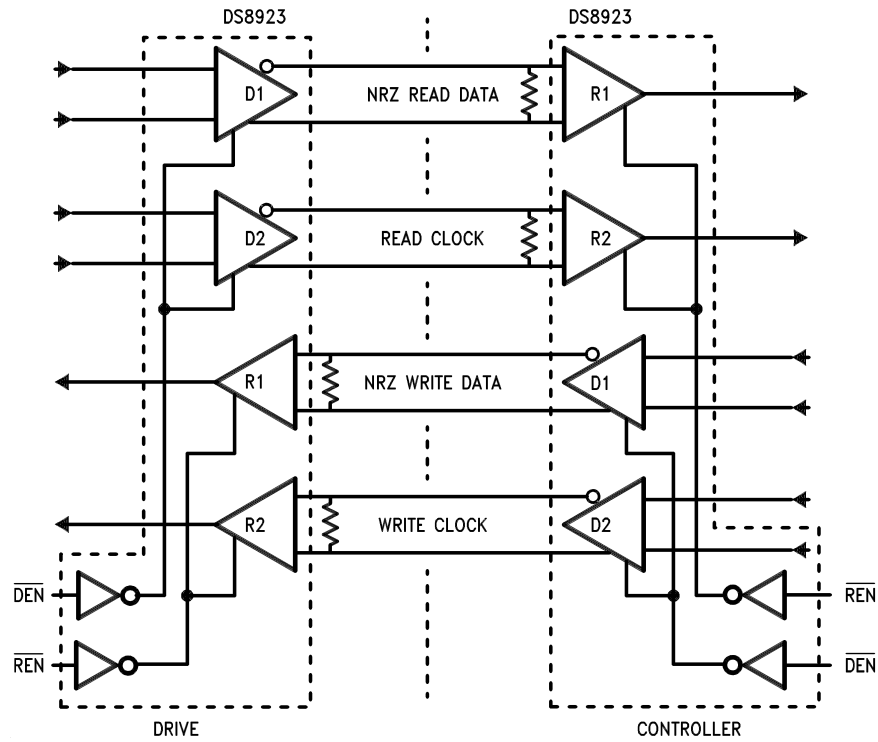


Figure 11. ESDI Application

REVISION HISTORY

Changes from Revision B (April 2013) to Revision C	Page
• Changed layout of National Data Sheet to TI format	7

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DS8921AM	ACTIVE	SOIC	D	8	95	TBD	Call TI	Call TI	0 to 70	DS89 21AM	Samples
DS8921AM/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	DS89 21AM	Samples
DS8921AMX	ACTIVE	SOIC	D	8	2500	TBD	Call TI	Call TI	0 to 70	DS89 21AM	Samples
DS8921AMX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	DS89 21AM	Samples
DS8921ATM	ACTIVE	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 85	DS892 1ATM	Samples
DS8921ATM/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	DS892 1ATM	Samples
DS8921M	ACTIVE	SOIC	D	8	95	TBD	Call TI	Call TI	0 to 70	DS892 1M	Samples
DS8921M/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	DS892 1M	Samples
DS8921MX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	0 to 70	DS892 1M	Samples
DS8921N	ACTIVE	PDIP	P	8	40	TBD	Call TI	Call TI	0 to 70	DS8921N	Samples
DS8921N/NOPB	ACTIVE	PDIP	P	8	40	Green (RoHS & no Sb/Br)	CU SN Call TI	Level-1-NA-UNLIM	0 to 70	DS8921N	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.

⁽⁶⁾ Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION


*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
DS8921AMX	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
DS8921AMX/NOPB	SOIC	D	8	2500	330.0	12.4	6.5	5.4	2.0	8.0	12.0	Q1
DS8921MX/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)
DS8921AMX	SOIC	D	8	2500	367.0	367.0	35.0
DS8921AMX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0
DS8921MX/NOPB	SOIC	D	8	2500	367.0	367.0	35.0

P (R-PDIP-T8)

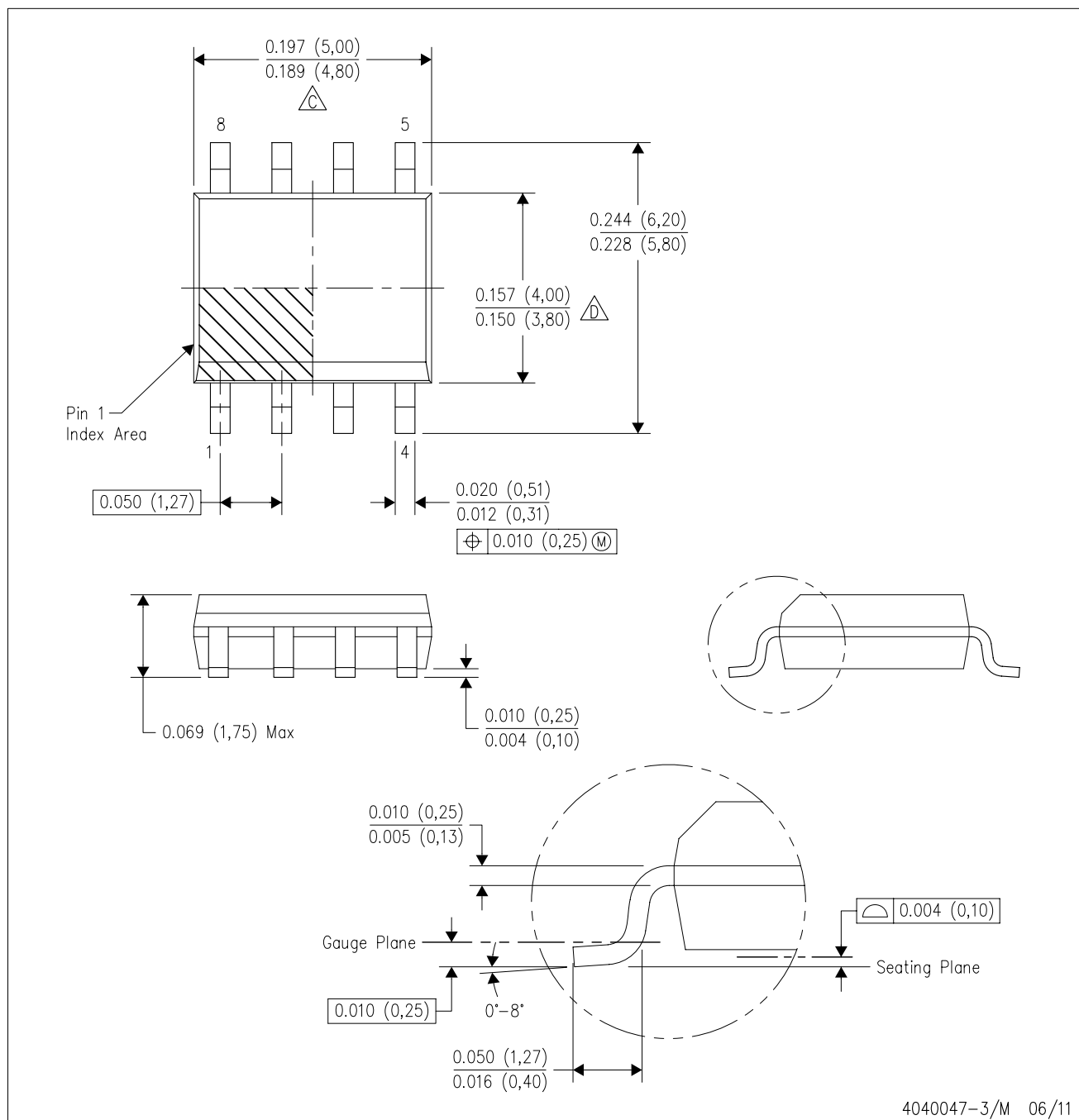
PLASTIC DUAL-IN-LINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Falls within JEDEC MS-001 variation BA.

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.
 - $\triangle C$ 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.
 - $\triangle D$ 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.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com