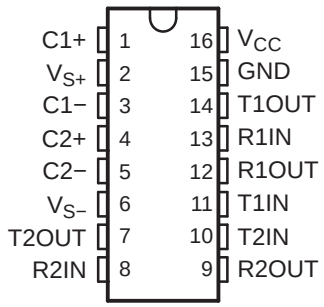
DUAL RS-232 DRIVER/RECEIVER WITH IEC61000-4-2 PROTECTION

FEATURES

- **Meets or Exceeds TIA/RS-232-F and ITU Recommendation V.28**
- **Operates From a Single 5-V Power Supply With 1.0-μF Charge-Pump Capacitors**
- **Operates up to 120 kbit/s**
- **Two Drivers and Two Receivers**
- **±30-V Input Levels**
- **Low Supply Current . . . 8 mA Typical**
- **ESD Protection Exceeds JESD22**
  - **2000-V Human-Body Model (HBM) (A114-A)**
- **Upgrade With Improved ESD (15-kV HBM) and 0.1-μF Charge-Pump Capacitors Is Available With the TRS202**

D, DW, N, NS, OR PW PACKAGE
(TOP VIEW)



APPLICATIONS

- **TIA/RS-232-F**
- **Battery-Powered Systems**
- **Terminals**
- **Modems**
- **Computers**

DESCRIPTION/ORDERING INFORMATION

The TRS232 is a dual driver/receiver that includes a capacitive voltage generator to supply TIA/RS-232-F voltage levels from a single 5-V supply. Each receiver converts TIA/RS-232-F inputs to 5-V TTL/CMOS levels. This receiver has a typical threshold of 1.3 V, a typical hysteresis of 0.5 V, and can accept ±30-V inputs. Each driver converts TTL/CMOS input levels into TIA/RS-232-F levels. The driver, receiver, and voltage-generator functions are available as cells in the Texas Instruments LinASIC™ library.

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.

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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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ORDERING INFORMATION

T_A	PACKAGE(1)(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	PDIP – N	Tube of 25	TRS232CN	TRS232CN
	SOIC – D	Tube of 40	TRS232CD	TRS232C
		Reel of 2500	TRS232CDR	
	SOIC – DW	Tube of 40	TRS232CDW	TRS232C
		Reel of 2000	TRS232CDWR	
	SOP – NS	Reel of 2000	TRS232CNSR	TRS232C
	TSSOP – PW	Tube of 25	TRS232CPW	TRS232C
		Reel of 2000	TRS232CPWR	
–40°C to 85°C	PDIP – N	Tube of 25	TRS232IN	TRS232IN
	SOIC – D	Tube of 40	TRS232ID	TRS232I
		Reel of 2500	TRS232IDR	
	SOIC – DW	Tube of 40	TRS232IDW	TRS232I
		Reel of 2000	TRS232IDWR	
	SOP – NS	Reel of 2000	TRS232INSR	TRS232I
	TSSOP – PW	Tube of 25	TRS232IPW	TRS232I
		Reel of 2000	TRS232IPWR	

(1) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.
(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

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FUNCTION TABLES

Each Driver(1)

INPUT TnIN	OUTPUT TnOUT
L	H
H	L

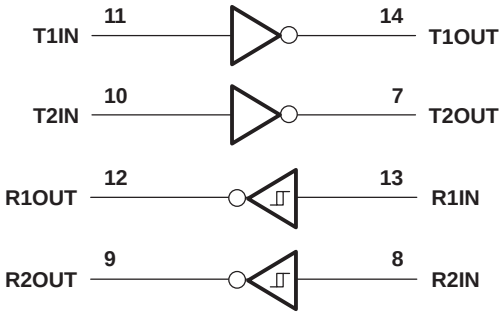
(1) H = high level, L = low level

Each Receiver(1)

INPUT RnIN	OUTPUT RnOUT
L	H
H	L

(1) H = high level, L = low level

LOGIC DIAGRAM (POSITIVE LOGIC)



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Absolute Maximum Ratings(1)

over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
V_{CC}	Input supply voltage range(2)		–0.3	6	V
V_{S+}	Positive-output supply voltage range		V_{CC} – 0.3	15	V
$V_{S–}$	Negative-output supply voltage range		–0.3	–15	V
V_I	Input voltage range	Driver	–0.3	V_{CC} + 0.3	V
		Receiver		±30	
V_O	Output voltage range	T1OUT, T2OUT	$V_{S–}$ – 0.3	V_{S+} + 0.3	V
		R1OUT, R2OUT	–0.3	V_{CC} + 0.3	
	Short-circuit duration	T1OUT, T2OUT		Unlimited	
θ_{JA}	Package thermal impedance(3)(4)	D package		73	°C/W
		DW package		57	
		N package		67	
		NS package		64	
		PW package		108	
T_J	Operating virtual junction temperature			150	°C
T_{stg}	Storage temperature range		–65	150	°C

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltages are with respect to network GND.
(3) Maximum power dissipation is a function of $T_J(max)$, θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
(4) The package thermal impedance is calculated in accordance with JESD 51-7.

Recommended Operating Conditions

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	V
V_{IH}	High-level input voltage	T1IN, T2IN	2			V
V_{IL}	Low-level input voltage	T1IN, T2IN			0.8	V
	Receiver input voltage	R1IN, R2IN			±30	V
T_A	Operating free-air temperature	TRS232C	0		70	°C
		TRS232I	–40		85	

Electrical Characteristics(1)

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 4)

PARAMETER		TEST CONDITIONS	MIN	TYP(2)	MAX	UNIT
I_{CC}	Supply current	V_{CC} = 5.5 V, All outputs open, T_A = 25°C		8	10	mA

(1) Test conditions are C1–C4 = 1 µF at V_{CC} = 5 V ± 0.5 V.
(2) All typical values are at V_{CC} = 5 V and T_A = 25°C.

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DRIVER SECTION

Electrical Characteristics(1)

over recommended ranges of supply voltage and operating free-air temperature range

PARAMETER			TEST CONDITIONS		MIN	TYP(2)	MAX	UNIT
V_{OH}	High-level output voltage	T1OUT, T2OUT	R_L = 3 kΩ to GND		5	7		V
V_{OL}	Low-level output voltage(3)	T1OUT, T2OUT	R_L = 3 kΩ to GND			–7	–5	V
r_o	Output resistance	T1OUT, T2OUT	V_{S+} = V_{S-} = 0,	V_O = ±2 V	300			Ω
I_{OS}(4)	Short-circuit output current	T1OUT, T2OUT	V_{CC} = 5.5 V,	V_O = 0		±10		mA
I_{IS}	Short-circuit input current	T1IN, T2IN	V_I = 0				200	µA

(1) Test conditions are C1–C4 = 1 µF at V_{CC} = 5 V ± 0.5 V.
(2) All typical values are at V_{CC} = 5 V and T_A = 25°C.
(3) The algebraic convention, in which the least-positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.
(4) Not more than one output should be shorted at a time.

Switching Characteristics(1)

V_{CC} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
SR	Driver slew rate	R_L = 3 kΩ to 7 kΩ, See Figure 2			30	V/µs
SR(t)	Driver transition region slew rate	See Figure 3		3		V/µs
	Data rate	One TnOUT switching		120		kbit/s

(1) Test conditions are C1–C4 = 1 µF at V_{CC} = 5 V ± 0.5 V.

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RECEIVER SECTION

Electrical Characteristics(1)

over recommended ranges of supply voltage and operating free-air temperature range

PARAMETER			TEST CONDITIONS		MIN	TYP(2)	MAX	UNIT
V_{OH}	High-level output voltage	R1OUT, R2OUT	I_{OH} = –1 mA		3.5			V
V_{OL}	Low-level output voltage(3)	R1OUT, R2OUT	I_{OL} = 3.2 mA				0.4	V
V_{IT+}	Receiver positive-going input threshold voltage	R1IN, R2IN	V_{CC} = 5 V,	T_A = 25°C		1.7	2.4	V
$V_{IT–}$	Receiver negative-going input threshold voltage	R1IN, R2IN	V_{CC} = 5 V,	T_A = 25°C	0.8	1.2		V
V_{hys}	Input hysteresis voltage	R1IN, R2IN	V_{CC} = 5 V		0.2	0.5	1	V
r_i	Receiver input resistance	R1IN, R2IN	V_{CC} = 5 V,	T_A = 25°C	3	5	7	kΩ

(1) Test conditions are C1–C4 = 1 μF at V_{CC} = 5 V ± 0.5 V.
(2) All typical values are at V_{CC} = 5 V and T_A = 25°C.
(3) The algebraic convention, in which the least-positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.

Switching Characteristics(1)

V_{CC} = 5 V, T_A = 25°C (see Figure 1)

PARAMETER		TYP	UNIT
$t_{PLH(R)}$	Receiver propagation delay time, low- to high-level output	500	ns
$t_{PHL(R)}$	Receiver propagation delay time, high- to low-level output	500	ns

(1) Test conditions are C1–C4 = 1 μF at V_{CC} = 5 V ± 0.5 V.

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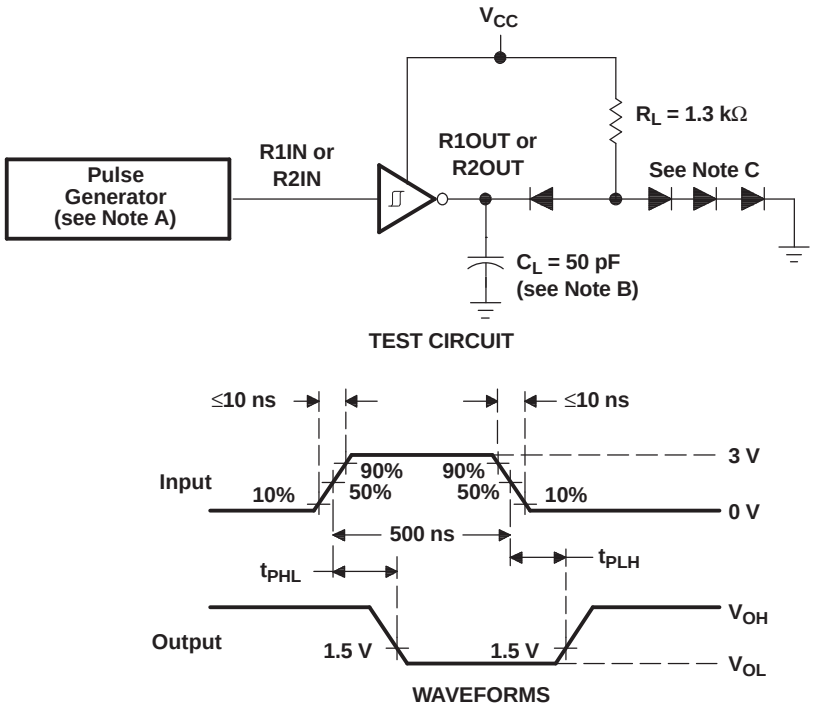
PARAMETER MEASUREMENT INFORMATION



A. The pulse generator has the following characteristics: Z_O = 50 Ω, duty cycle ≤ 50%.

B. C_L includes probe and jig capacitance.

C. All diodes are 1N3064 or equivalent.

Figure 1. Receiver Test Circuit and Waveforms for t_{PHL} and t_{PLH} Measurements

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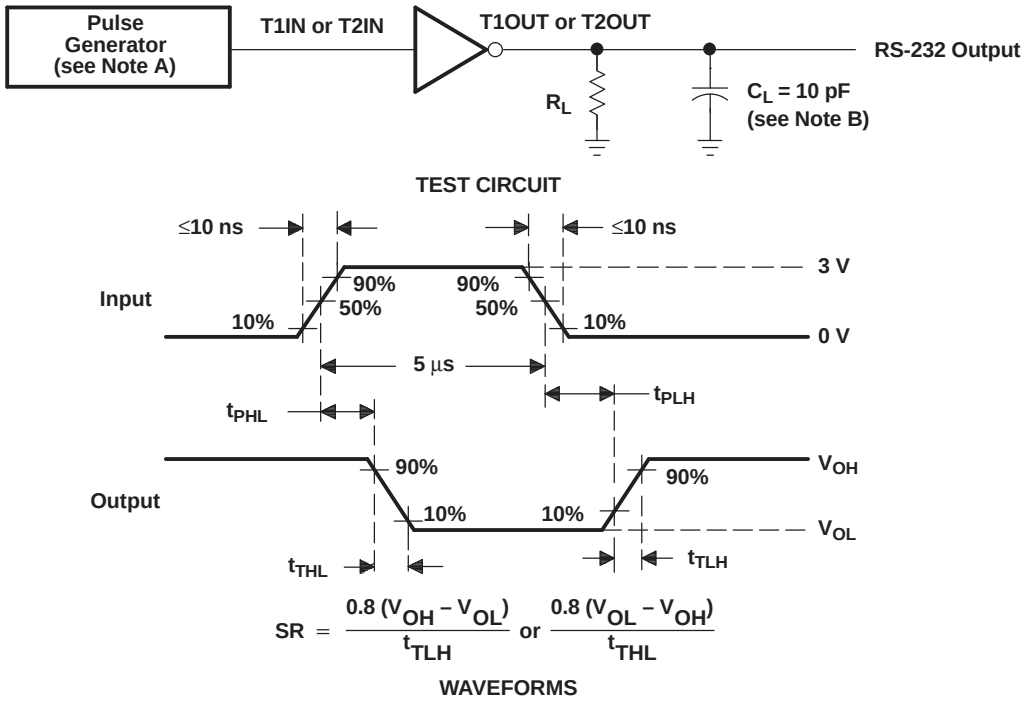
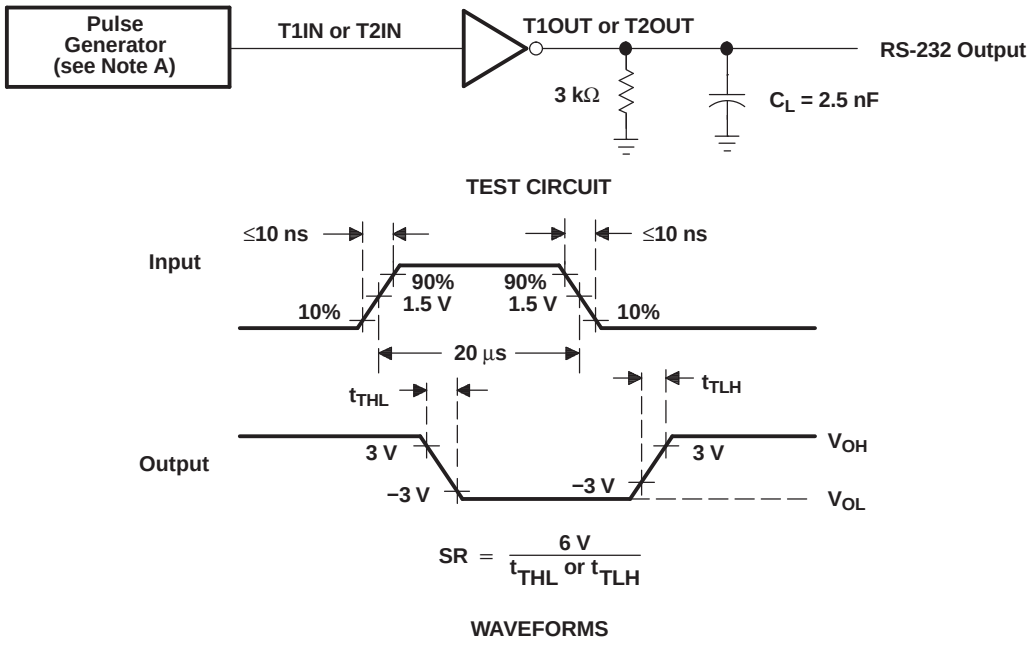
PARAMETER MEASUREMENT INFORMATION (continued)



A. The pulse generator has the following characteristics: Z_O = 50 Ω, duty cycle ≤ 50%.

B. C_L includes probe and jig capacitance.

Figure 2. Driver Test Circuit and Waveforms for t_{PHL} and t_{PLH} Measurements (5-μs Input)



A. The pulse generator has the following characteristics: Z_O = 50 Ω, duty cycle ≤ 50%.

Figure 3. Test Circuit and Waveforms for t_{THL} and t_{TLH} Measurements (20-μs Input)

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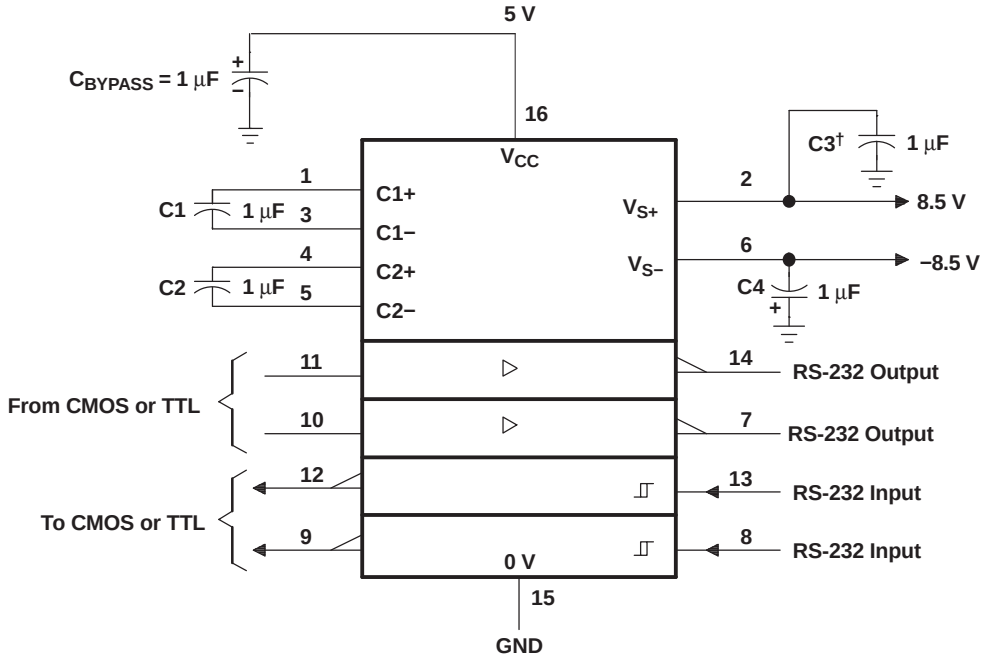
APPLICATION INFORMATION



† C3 can be connected to V_{CC} or GND.

A. Resistor values shown are nominal.

B. Nonpolarized ceramic capacitors are acceptable. If polarized tantalum or electrolytic capacitors are used, they should be connected as shown. In addition to the 1-µF capacitors shown, the TRS202 can operate with 0.1-µF capacitors.

Figure 4. Typical Operating Circuit

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TRS232D	Obsolete	Production	SOIC (D) | 16	-	-	Call TI	Call TI	0 to 70	TRS232
TRS232DR	Obsolete	Production	SOIC (D) | 16	-	-	Call TI	Call TI	0 to 70	TRS232
TRS232DWR	Obsolete	Production	SOIC (DW) | 16	-	-	Call TI	Call TI	0 to 70	TRS232
TRS232ID	Obsolete	Production	SOIC (D) | 16	-	-	Call TI	Call TI	-40 to 85	TRS232I
TRS232IN	Obsolete	Production	PDIP (N) | 16	-	-	Call TI	Call TI	-40 to 85	TRS232IN
TRS232NSR	Obsolete	Production	SOP (NS) | 16	-	-	Call TI	Call TI	0 to 70	TRS232

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

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

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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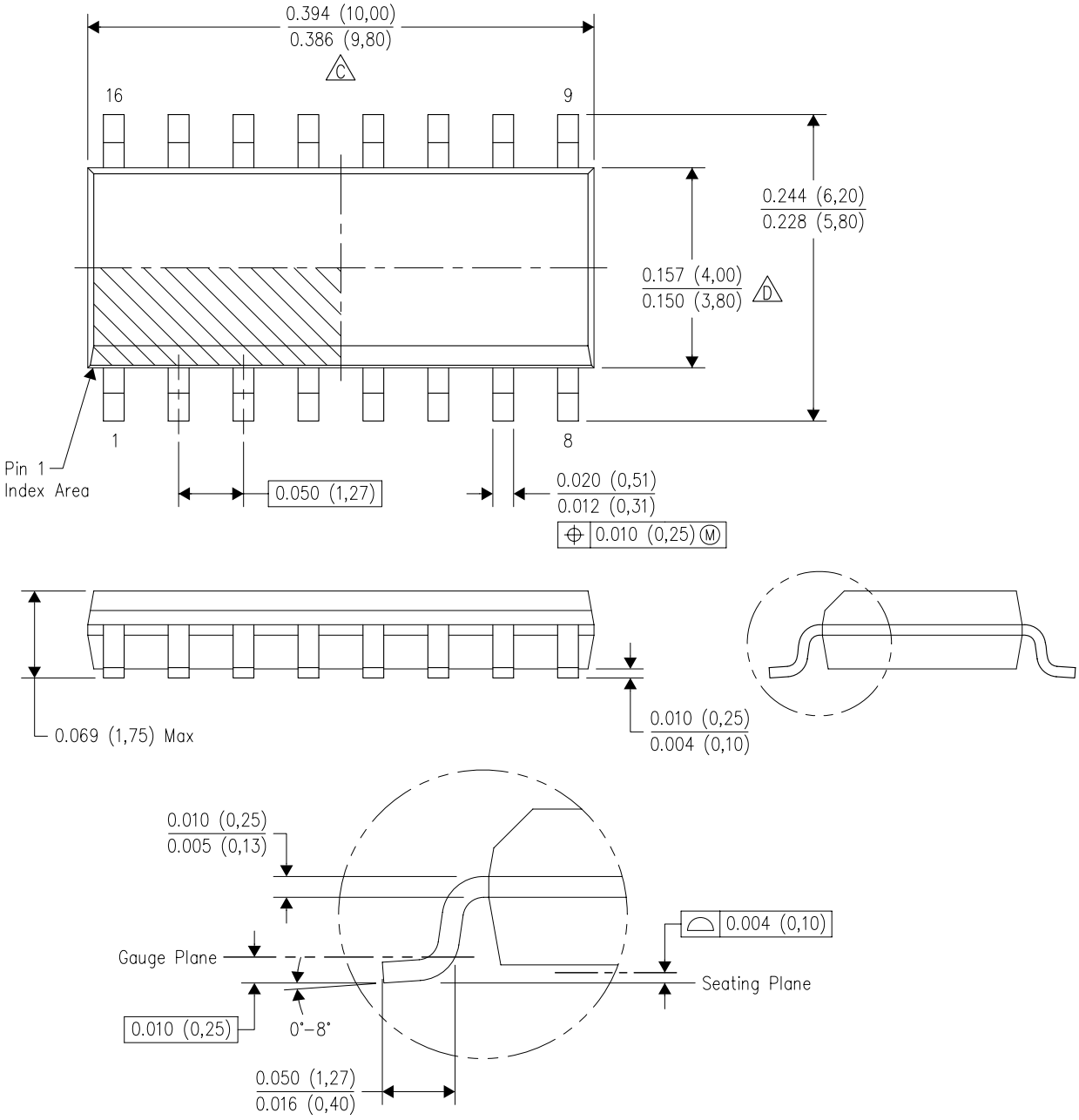
D (R–PDSO–G16) PLASTIC SMALL OUTLINE



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 AC.

GENERIC PACKAGE VIEW

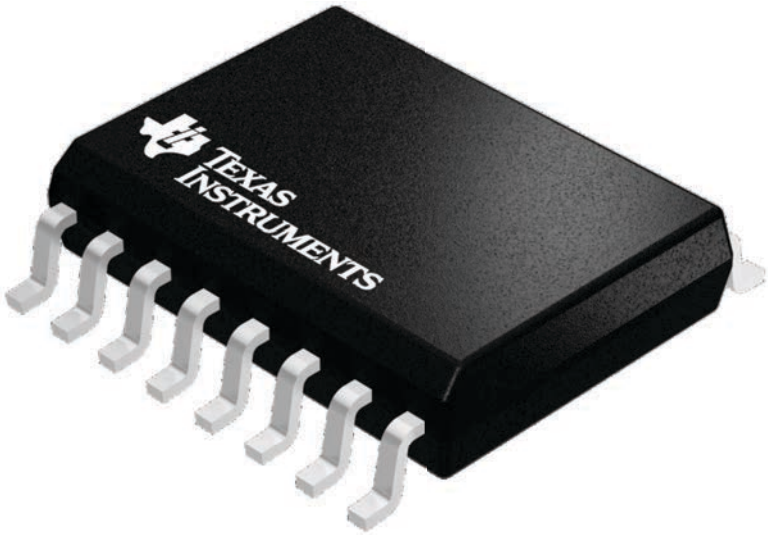
DW 16

SOIC - 2.65 mm max height

7.5 x 10.3, 1.27 mm pitch

SMALL OUTLINE INTEGRATED CIRCUIT

This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



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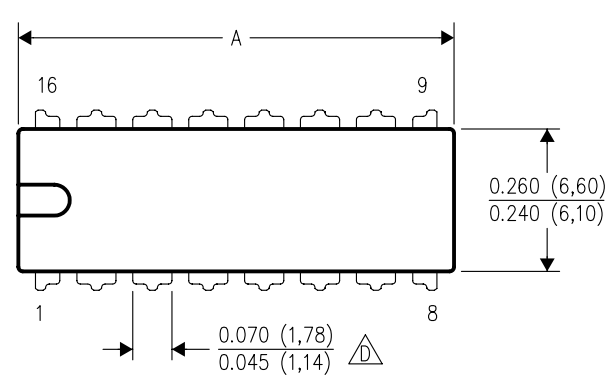
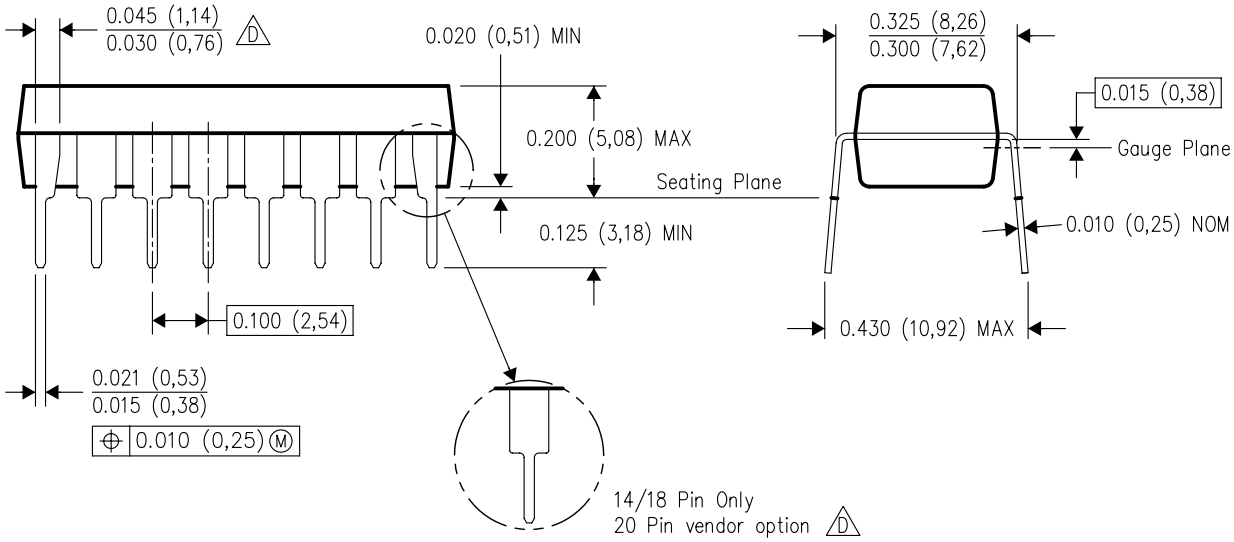
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN

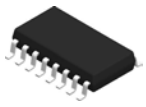


DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION (C)	AA	BB	AC	AD



4040049/E 12/2002

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

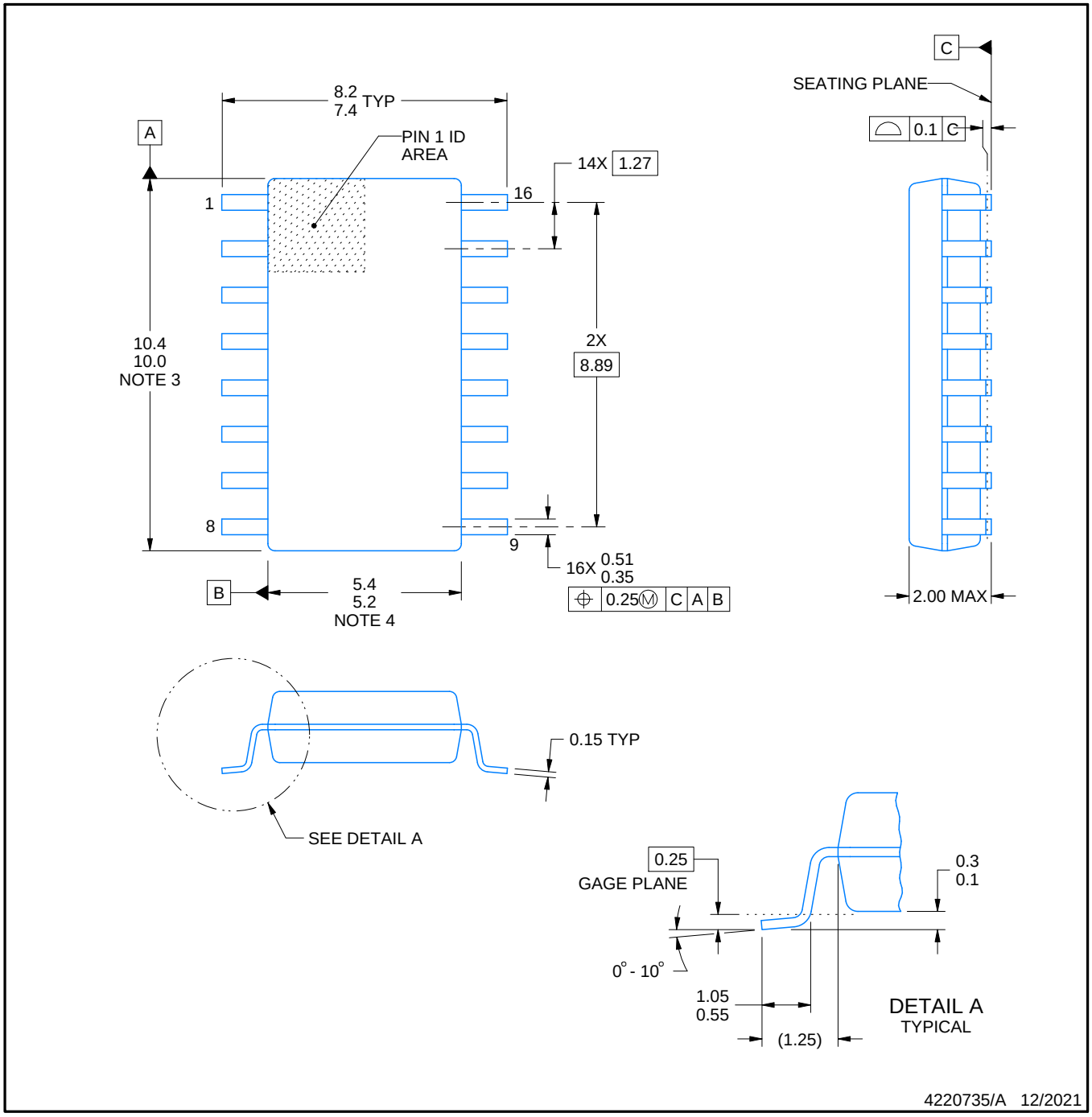


PACKAGE OUTLINE

NS0016A

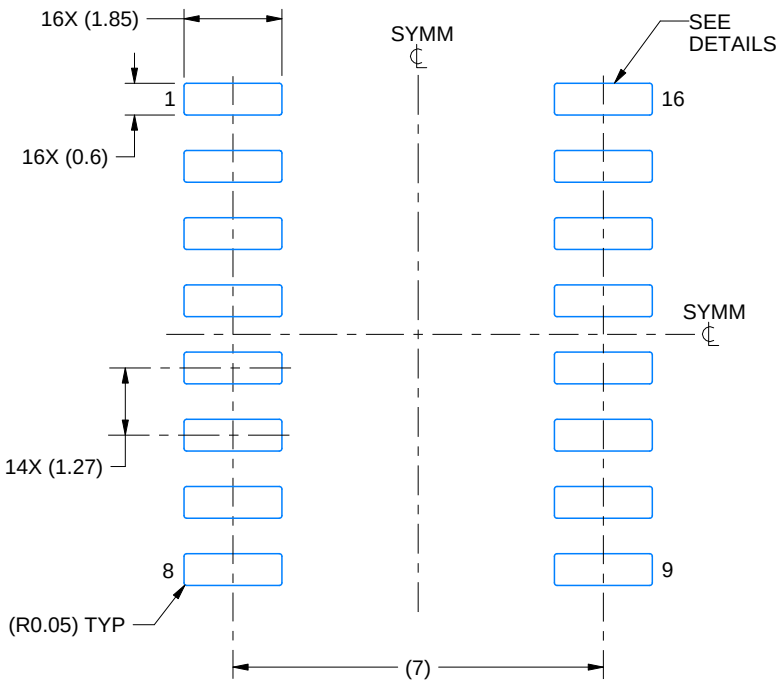
SOP - 2.00 mm max height

SOP

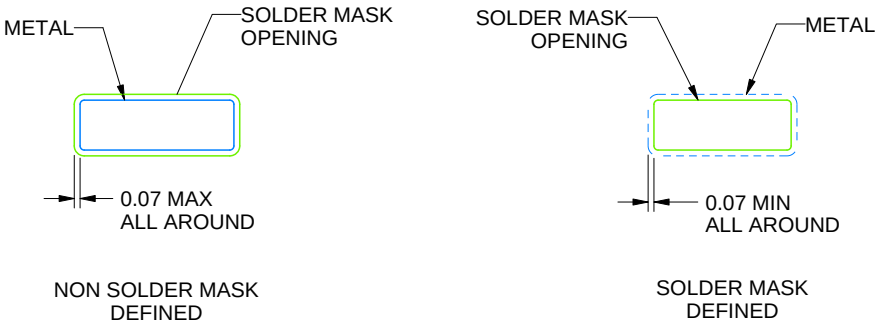


NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. 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 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.



LAND PATTERN EXAMPLE
SCALE:7X



NON SOLDER MASK
DEFINED

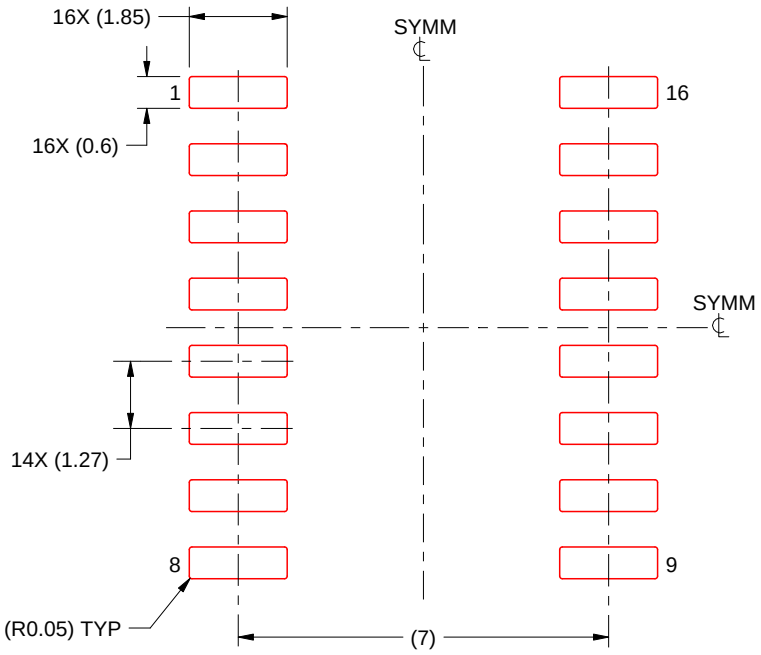
SOLDER MASK
DEFINED

SOLDER MASK DETAILS

4220735/A 12/2021

NOTES: (continued)

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



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:7X

4220735/A 12/2021

NOTES: (continued)

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

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