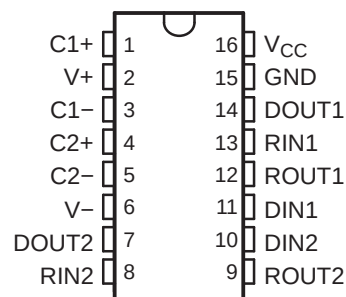


FEATURES

- Operates With 3-V to 5.5-V V_{CC} Supply
- Operates up to 1 Mbit/s
- Low Supply Current . . . 300 μ A Typ
- External Capacitors . . . $4 \times 0.1 \mu$ F
- Accept 5-V Logic Input With 3.3-V Supply
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection for RS-232 Pins
 - ± 15 -kV Human-Body Model (HBM)
 - ± 15 -kV IEC 61000-4-2 Air-Gap Discharge
 - ± 8 -kV IEC 61000-4-2 Contact Discharge

D, DB, DW, OR PW PACKAGE
(TOP VIEW)



APPLICATIONS

- Battery-Powered Systems
- PDAs
- Notebooks
- Laptops
- Palmtop PCs
- Hand-Held Equipment

DESCRIPTION/ORDERING INFORMATION

The TRSF3232E consists of two line drivers, two line receivers, and a dual charge-pump circuit with ± 15 -kV ESD protection pin to pin (serial-port connection pins, including GND). This device provides the electrical interface between an asynchronous communication controller and the serial-port connector. The charge pump and four small external capacitors allow operation from a single 3-V to 5.5-V supply. The TRSF3232E operates at data signaling rates up to 1 Mbit/s and a driver output slew rate of 14 V/ μ s to 150 V/ μ s.

ORDERING INFORMATION

T_A	PACKAGE ⁽¹⁾⁽²⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	SOIC – D	Tube of 40	TRSF3232ECD	TRSF3232EC
		Reel of 2500	TRSF3232ECDR	
	SOIC – DW	Tube of 40	TRSF3232ECDW	TRSF3232EC
		Reel of 2000	TRSF3232ECDWR	
	SSOP – DB	Reel of 2000	TRSF3232ECDBR	RT32EC
	TSSOP – PW	Tube of 90	TRSF3232ECPW	RT32EC
		Reel of 2000	TRSF3232ECPWR	
–40°C to 85°C	SOIC – D	Tube of 40	TRSF3232EID	TRSF3232EI
		SOIC – DW	TRSF3232EIDR	
	SOIC – DW	Tube of 40	TRSF3232EIDW	TRSF3232EI
		TSSOP – PW	TRSF3232EIDWR	
	SSOP – DB	Reel of 2000	TRSF3232EIDBR	RT32EI
	TSSOP – PW	Tube of 90	TRSF3232EIPW	RT32EI
		Reel of 2000	TRSF3232EIPWR	

(1) Package drawings, thermal data, and symbolization are available at www.ti.com/packageing.

(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.



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.

TRSF3232E
3-V TO 5.5-V TWO-CHANNEL RS-232 1-Mbit/s LINE DRIVER/RECEIVER
WITH ± 15 -kV IEC ESD PROTECTION

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Table 1. 1-Mbit/s RS-232 Parts

TEMPERATURE RANGE	PART NO.	NO. OF DRIVERS	NO. OF RECEIVERS	ESD	SUPPLY V_{CC} (V)	FEATURE	PIN/ PACKAGE
0°C to 70°C	TRSF3221E	1	1	± 15 -kV Air-Gap Discharge, ± 8 -kV Contact Discharge, ± 15 -kV HBM	3.3 or 5	Auto-powerdown	16-pin SOIC, SSOP, TSSOP
	TRSF3232E	2	2	± 15 -kV Air-Gap Discharge, ± 8 -kV Contact Discharge, ± 15 -kV HBM	3.3 or 5	Low pin count	16-pin SOIC, SSOP, TSSOP
	TRS3227	1	1	± 8 -kV Air-Gap Discharge, ± 8 -kV Contact Discharge, ± 15 -kV HBM	3.3 or 5	Auto-powerdown plus, ready signal	16-pin SSOP
	TRSF3221	1	1	± 15 -kV HBM	3.3 or 5	Auto-powerdown	16-pin SOIC, SSOP, TSSOP
	TRSF3222	2	2	± 15 -kV HBM	3.3 or 5	Enable, powerdown signal	20-pin SOIC, SSOP, TSSOP
	TRSF3223	2	2	± 15 -kV HBM	3.5 or 5	Auto-powerdown, enable signal	20-pin SOIC, SSOP, TSSOP
	TRSF3232	2	2	± 15 -kV HBM	3.3 or 5	Low pin count	16-pin SOIC, SSOP, TSSOP
	TRSF3238	5	3	± 15 -kV HBM	3.3 or 5	Auto-powerdown plus	28-pin SOIC, SSOP, TSSOP
	TRSF3243	3	5	± 15 -kV HBM	3.3 or 5	Auto-powerdown	28-pin SOIC, SSOP, TSSOP
–40°C to 85°C	TRSF3221E	1	1	± 15 -kV Air-Gap Discharge, ± 8 -kV Contact Discharge, ± 15 -kV HBM	3.3 or 5	Auto-powerdown	16-pin SOIC, SSOP, TSSOP
	TRSF3232E	2	2	± 15 -kV Air-Gap Discharge, ± 8 -kV Contact Discharge, ± 15 -kV HBM	3.3 or 5	Low pin count	16-pin SOIC, SSOP, TSSOP
	TRS3227	1	1	± 8 -kV Air-Gap Discharge, ± 8 -kV Contact Discharge, ± 15 -kV HBM	3.3 or 5	Auto-powerdown plus, ready signal	16-pin SSOP
	TRSF3221	1	1	± 15 -kV HBM	3.3 or 5	Auto-powerdown	16-pin SOIC, SSOP, TSSOP
	TRSF3222	2	2	± 15 -kV HBM	3.3 or 5	Enable, powerdown signal	20-pin SOIC, SSOP, TSSOP
	TRSF3223	2	2	± 15 -kV HBM	3.3 or 5	Auto-powerdown, enable signal	20-pin SOIC, SSOP, TSSOP
	TRSF3232	2	2	± 15 -kV HBM	3.3 or 5	Low pin count	16-pin SOIC, SSOP, TSSOP
	TRSF3238	5	3	± 15 -kV HBM	3.3 or 5	Auto-powerdown plus	28-pin SOIC, SSOP, TSSOP
	TRSF3243	3	5	± 15 -kV HBM	3.3 or 5	Auto-powerdown	28-pin SOIC, SSOP, TSSOP

FUNCTION TABLES

Each Driver⁽¹⁾

INPUT DIN	OUTPUT DOUT
L	H
H	L

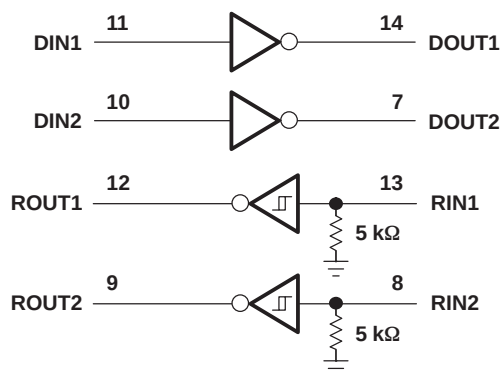
(1) H = high level, L = low level

Each Receiver⁽¹⁾

INPUT RIN	OUTPUT ROUT
L	H
H	L
Open	H

(1) H = high level, L = low level,
Open = input disconnected or
connected driver off

LOGIC DIAGRAM (POSITIVE LOGIC)



TRSF3232E

3-V TO 5.5-V TWO-CHANNEL RS-232 1-Mbit/s LINE DRIVER/RECEIVER

WITH ± 15 -kV IEC ESD PROTECTION

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Absolute Maximum Ratings⁽¹⁾

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage range ⁽²⁾		–0.3	6	V
V_+	Positive-output supply voltage range ⁽²⁾		–0.3	7	V
V_-	Negative-output supply voltage range ⁽²⁾		0.3	–7	V
$V_+ - V_-$	Supply voltage difference ⁽²⁾			13	V
V_I	Input voltage range	Drivers	–0.3	6	V
		Receivers	–25	25	
V_O	Output voltage range	Drivers	–13.2	13.2	V
		Receivers	–0.3	$V_{CC} + 0.3$	
θ_{JA}	Package thermal impedance ⁽³⁾⁽⁴⁾	D package		82	°C/W
		DB package		46	
		DW package		57	
		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 $T_J(\text{max})$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$. 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⁽¹⁾

			MIN	NOM	MAX	UNIT
Supply voltage		$V_{CC} = 3.3 \text{ V}$	3	3.3	3.6	V
		$V_{CC} = 5 \text{ V}$	4.5	5	5.5	
V_{IH}	Driver high-level input voltage	DIN	$V_{CC} = 3.3 \text{ V}$	2		V
V_{IL}	Driver low-level input voltage	DIN	$V_{CC} = 5 \text{ V}$	2.4		V
V_I	Driver input voltage	DIN	0	5.5		V
T_A	Operating free-air temperature	TRSF3232EI	–40		85	°C
		TRSF3232EC	0		70	

- (1) Test conditions are $C1-C4 = 0.1 \mu\text{F}$ at $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$; $C1 = 0.047 \mu\text{F}$, $C2-C4 = 0.33 \mu\text{F}$ at $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$ (see Figure 4).

Electrical Characteristics⁽¹⁾

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

PARAMETER	TEST CONDITIONS	MIN	TYP ⁽²⁾	MAX	UNIT
I_{CC}	Supply current	No load, $V_{CC} = 3.3 \text{ V}$ or 5 V	0.3	1	mA

- (1) Test conditions are $C1-C4 = 0.1 \mu\text{F}$ at $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$; $C1 = 0.047 \mu\text{F}$, $C2-C4 = 0.33 \mu\text{F}$ at $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$ (see Figure 4).
- (2) All typical values are at $V_{CC} = 3.3 \text{ V}$ or $V_{CC} = 5 \text{ V}$, and $T_A = 25^\circ\text{C}$.

DRIVER SECTION

Electrical Characteristics⁽¹⁾

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

PARAMETER	TEST CONDITIONS	MIN	TYP ⁽²⁾	MAX	UNIT
V _{OH} High-level output voltage	DOUT at R _L = 3 k Ω to GND, DIN = GND	5	5.5		V
V _{OL} Low-level output voltage	DOUT at R _L = 3 k Ω to GND, DIN = V _{CC}	–5	–5.4		V
I _{IH} High-level input current	V _I = V _{CC}		± 0.01	± 1	μ A
I _{IL} Low-level input current	V _I at GND		± 0.01	± 1	μ A
I _{OS} ⁽³⁾ Short-circuit output current	V _{CC} = 3.6 V, V _O = 0 V		± 35	± 60	mA
	V _{CC} = 5.5 V, V _O = 0 V		± 35	± 90	
r _o Output resistance	V _{CC} , V ₊ , and V _– = 0 V, V _O = ± 2 V	300	10M		Ω

(1) Test conditions are C1–C4 = 0.1 μ F at V_{CC} = 3.3 V $\pm$ 0.3 V; C1 = 0.047 μ F, C2–C4 = 0.33 μ F at V_{CC} = 5 V $\pm$ 0.5 V (see Figure 4).

(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

(3) Short-circuit durations should be controlled to prevent exceeding the device absolute power dissipation ratings, and not more than one output should be shorted at a time.

Switching Characteristics⁽¹⁾

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

PARAMETER	TEST CONDITIONS	MIN	TYP ⁽²⁾	MAX	UNIT
Maximum data rate (see Figure 1)	R _L = 3 k Ω , One DOUT switching	C _L = 250 pF, V _{CC} = 3 V to 4.5 V	1000		kbit/s
		C _L = 1000 pF, V _{CC} = 3.5 V to 5.5 V	1000		
t _{sk(p)} Pulse skew ⁽³⁾	C _L = 150 pF to 2500 pF, R _L = 3 k Ω to 7 k Ω , See Figure 2		300		ns
SR(tr) Slew rate, transition region (see Figure 1)	R _L = 3 k Ω to 7 k Ω , C _L = 150 pF to 1000 pF, V _{CC} = 3.3 V		14	150	V/ μ s

(1) Test conditions are C1–C4 = 0.1 μ F at V_{CC} = 3.3 V $\pm$ 0.3 V; C1 = 0.047 μ F, C2–C4 = 0.33 μ F at V_{CC} = 5 V $\pm$ 0.5 V (see Figure 4).

(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

(3) Pulse skew is defined as |t_{PLH} – t_{PHL}| of each channel of the same device.

ESD Protection

TERMINAL		TEST CONDITIONS	TYP	UNIT
NAME	NO.			
DOUT	7, 14	HBM	± 15	kV
		IEC 61000-4-2 Air-Gap Discharge	± 15	
		IEC 61000-4-2 Contact Discharge	± 8	

TRSF3232E
3-V TO 5.5-V TWO-CHANNEL RS-232 1-Mbit/s LINE DRIVER/RECEIVER
WITH ± 15 -kV IEC ESD PROTECTION

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RECEIVER SECTION

Electrical Characteristics⁽¹⁾

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

PARAMETER	TEST CONDITIONS	MIN	TYP ⁽²⁾	MAX	UNIT
V _{OH} High-level output voltage	I _{OH} = –1 mA	V _{CC} – 0.6	V _{CC} – 0.1		V
V _{OL} Low-level output voltage	I _{OL} = 1.6 mA			0.4	V
V _{IT+} Positive-going input threshold voltage	V _{CC} = 3.3 V		1.5	2.4	V
	V _{CC} = 5 V		1.8	2.4	
V _{IT–} Negative-going input threshold voltage	V _{CC} = 3.3 V	0.6	1.2		V
	V _{CC} = 5 V	0.8	1.5		
V _{hys} Input hysteresis (V _{IT+} – V _{IT–})			0.3		V
r _i Input resistance	V _I = ± 3 V to ± 25 V	3	5	7	k Ω

(1) Test conditions are C1–C4 = 0.1 μ F at V_{CC} = 3.3 V $\pm$ 0.3 V; C1 = 0.047 μ F, C2–C4 = 0.33 μ F at V_{CC} = 5 V $\pm$ 0.5 V (see Figure 4).

(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

Switching Characteristics⁽¹⁾

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

PARAMETER	TEST CONDITIONS	TYP ⁽²⁾	UNIT
t _{PLH} Propagation delay time, low- to high-level output	C _L = 150 pF	300	ns
t _{PHL} Propagation delay time, high- to low-level output	C _L = 150 pF	300	ns
t _{sk(p)} Pulse skew ⁽³⁾		300	ns

(1) Test conditions are C1–C4 = 0.1 μ F at V_{CC} = 3.3 V $\pm$ 0.3 V; C1 = 0.047 μ F, C2–C4 = 0.33 μ F at V_{CC} = 5 V $\pm$ 0.5 V (see Figure 4).

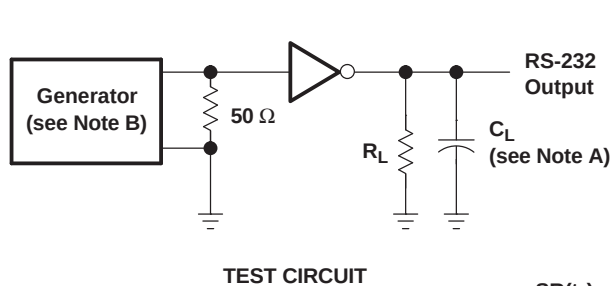
(2) All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

(3) Pulse skew is defined as |t_{PLH} – t_{PHL}| of each channel of the same device.

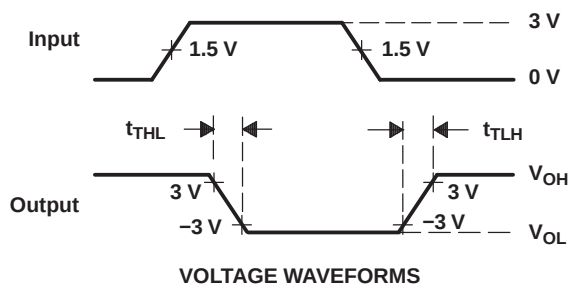
ESD Protection

TERMINAL		TEST CONDITIONS	TYP	UNIT
NAME	NO.			
RIN	8, 13	HBM	± 15	kV
		IEC 61000-4-2 Air-Gap Discharge	± 15	
		IEC 61000-4-2 Contact Discharge	± 8	

PARAMETER MEASUREMENT INFORMATION



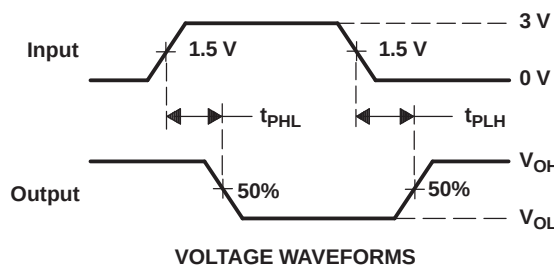
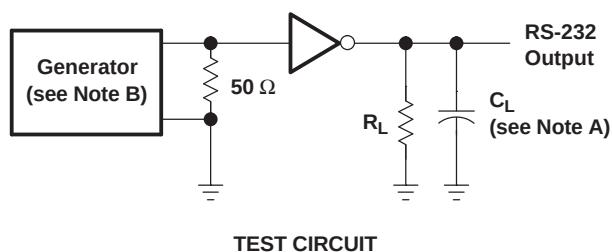
$$SR(tr) = \frac{6\text{ V}}{t_{THL} \text{ or } t_{TLH}}$$



NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 250 kbit/s, $Z_O = 50\ \Omega$, 50% duty cycle, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

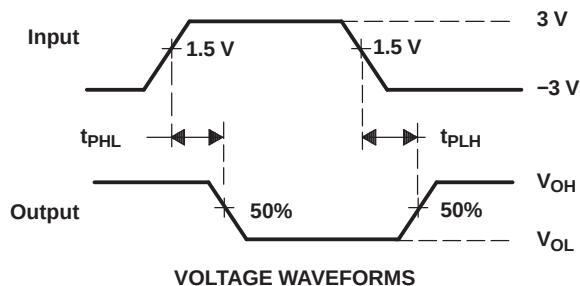
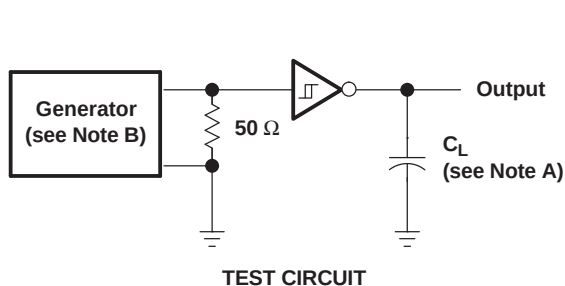
Figure 1. Driver Slew Rate



NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 250 kbit/s, $Z_O = 50\ \Omega$, 50% duty cycle, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

Figure 2. Driver Pulse Skew

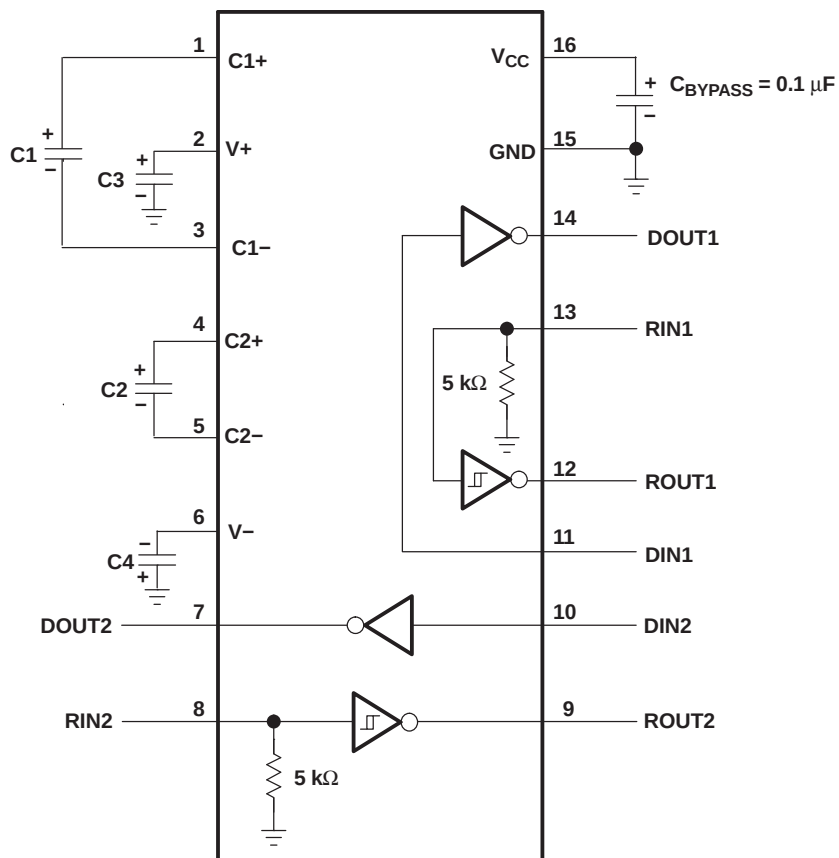


NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: $Z_O = 50\ \Omega$, 50% duty cycle, $t_r \leq 10\text{ ns}$, $t_f \leq 10\text{ ns}$.

Figure 3. Receiver Propagation Delay Times

APPLICATION INFORMATION



V_{CC} vs CAPACITOR VALUES

V _{CC}	C1	C2, C3, C4
3.3 V $\pm$ 0.3 V	0.1 μ F	0.1 μ F
5 V $\pm$ 0.5 V	0.047 μ F	0.33 μ F
3 V to 5.5 V	0.1 μ F	0.47 μ F

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

Figure 4. Typical Operating Circuit and Capacitor Values

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
TRSF3232ECD	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	TRSF3232EC	Samples
TRSF3232ECDB	ACTIVE	SSOP	DB	16	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	RT32EC	Samples
TRSF3232ECDBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	RT32EC	Samples
TRSF3232ECDBRG4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	RT32EC	Samples
TRSF3232ECDR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	TRSF3232EC	Samples
TRSF3232ECDW	OBSOLETE	SOIC	DW	16		TBD	Call TI	Call TI	0 to 70		
TRSF3232ECDWG4	OBSOLETE	SOIC	DW	16		TBD	Call TI	Call TI	0 to 70		
TRSF3232ECDWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	TRSF3232EC	Samples
TRSF3232ECPW	OBSOLETE	TSSOP	PW	16		TBD	Call TI	Call TI	0 to 70		
TRSF3232ECPWG4	OBSOLETE	TSSOP	PW	16		TBD	Call TI	Call TI	0 to 70		
TRSF3232ECPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	0 to 70	RT32EC	Samples
TRSF3232EID	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRSF3232EI	Samples
TRSF3232EIDB	OBSOLETE	SSOP	DB	16		TBD	Call TI	Call TI	-40 to 85		
TRSF3232EIDBG4	OBSOLETE	SSOP	DB	16		TBD	Call TI	Call TI	-40 to 85		
TRSF3232EIDBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	RT32EI	Samples
TRSF3232EIDG4	ACTIVE	SOIC	D	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRSF3232EI	Samples
TRSF3232EIDR	ACTIVE	SOIC	D	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRSF3232EI	Samples
TRSF3232EIDW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRSF3232EI	Samples
TRSF3232EIDWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRSF3232EI	Samples

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
TRSF3232EIDWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	TRSF3232EI	Samples
TRSF3232EIPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	RT32EI	Samples
TRSF3232EIPWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	RT32EI	Samples
TRSF3232EIPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	RT32EI	Samples
TRSF3232EIPWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	RT32EI	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.

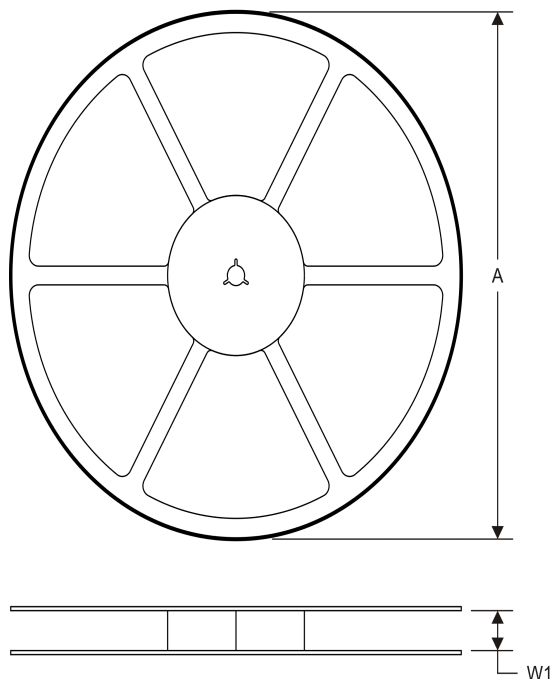
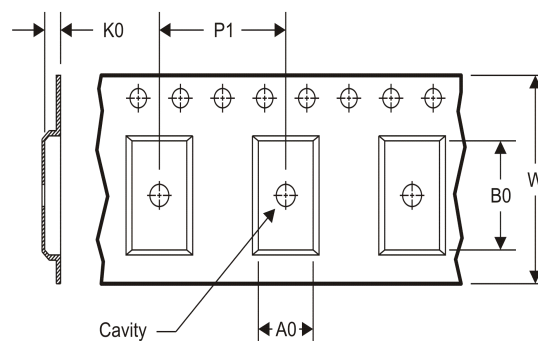
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

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TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


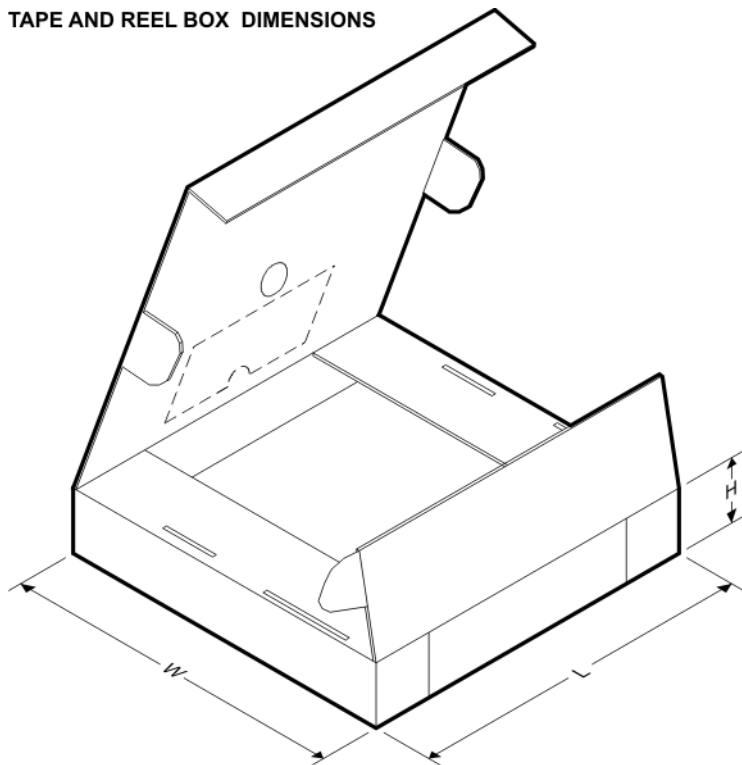
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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
TRSF3232ECDBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
TRSF3232ECDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
TRSF3232ECDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
TRSF3232ECPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TRSF3232EIDBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
TRSF3232EIDR	SOIC	D	16	2500	330.0	16.4	6.5	10.3	2.1	8.0	16.0	Q1
TRSF3232EIDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
TRSF3232EIPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS

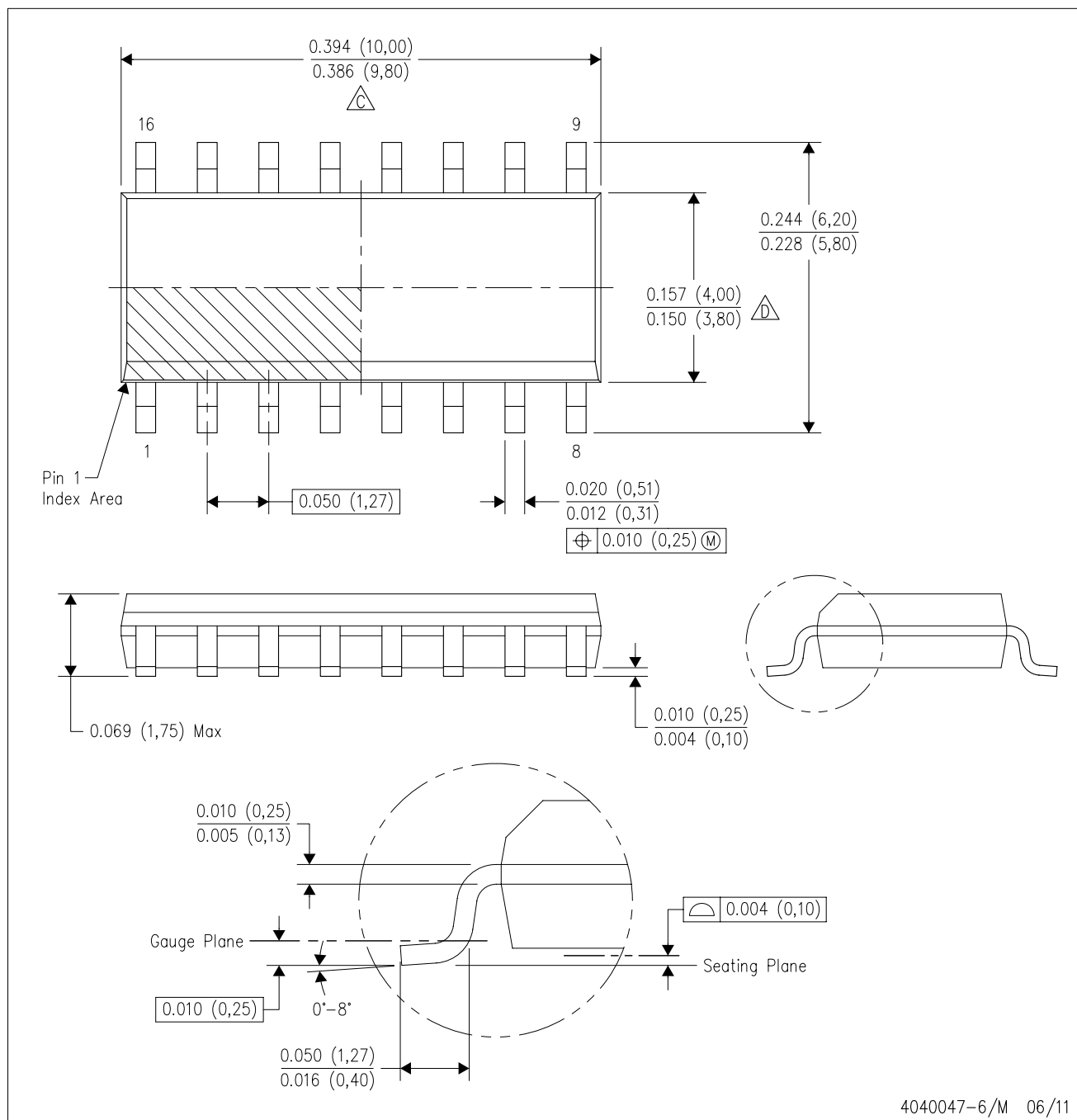


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TRSF3232ECDDBR	SSOP	DB	16	2000	367.0	367.0	38.0
TRSF3232ECDR	SOIC	D	16	2500	367.0	367.0	38.0
TRSF3232ECDWR	SOIC	DW	16	2000	367.0	367.0	38.0
TRSF3232ECPWR	TSSOP	PW	16	2000	367.0	367.0	35.0
TRSF3232EIDBR	SSOP	DB	16	2000	367.0	367.0	38.0
TRSF3232EIDR	SOIC	D	16	2500	367.0	367.0	38.0
TRSF3232EIDWR	SOIC	DW	16	2000	367.0	367.0	38.0
TRSF3232EIPWR	TSSOP	PW	16	2000	367.0	367.0	35.0

D (R-PDSO-G16)

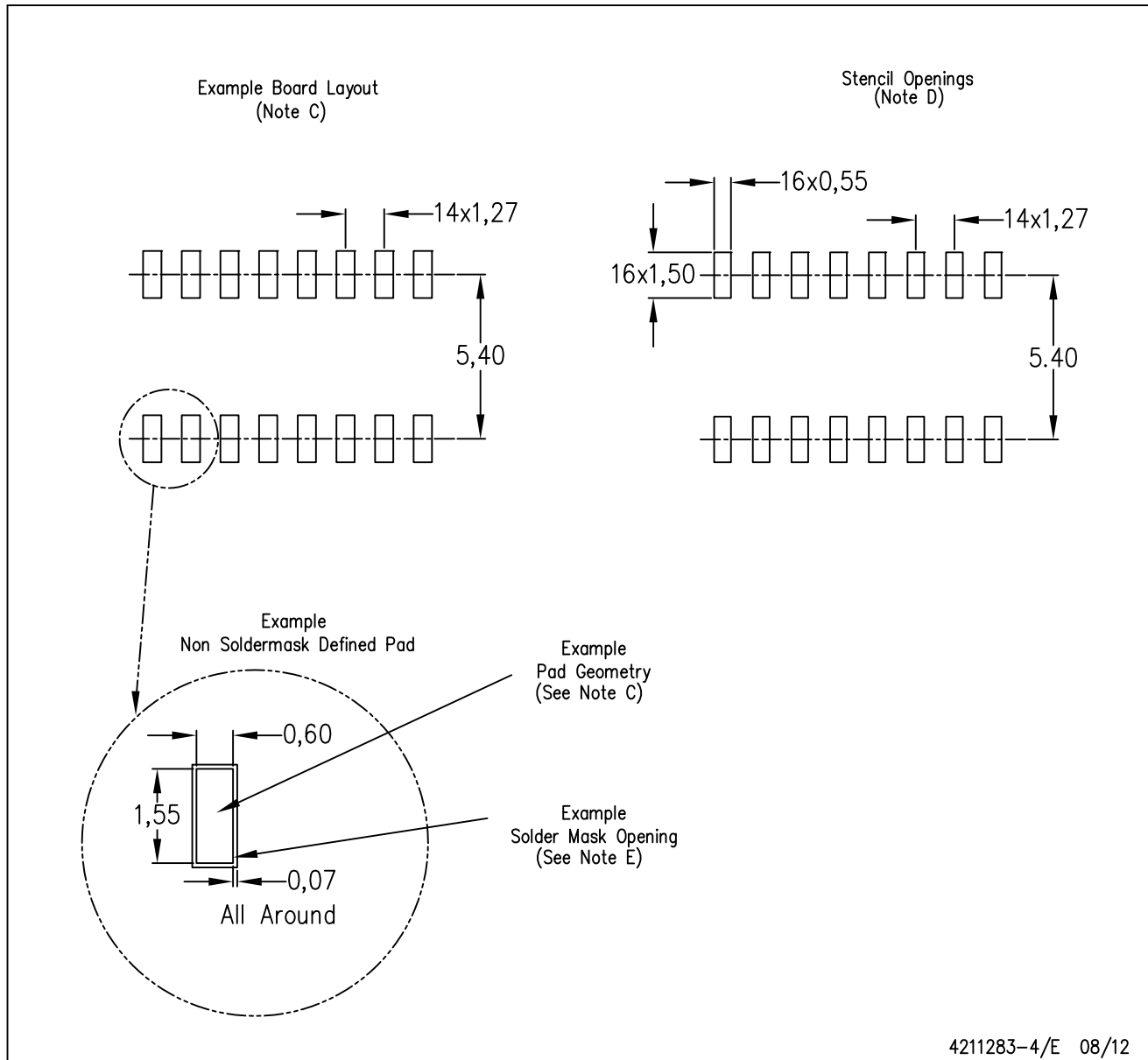
PLASTIC SMALL OUTLINE



- 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.

D (R-PDSO-G16)

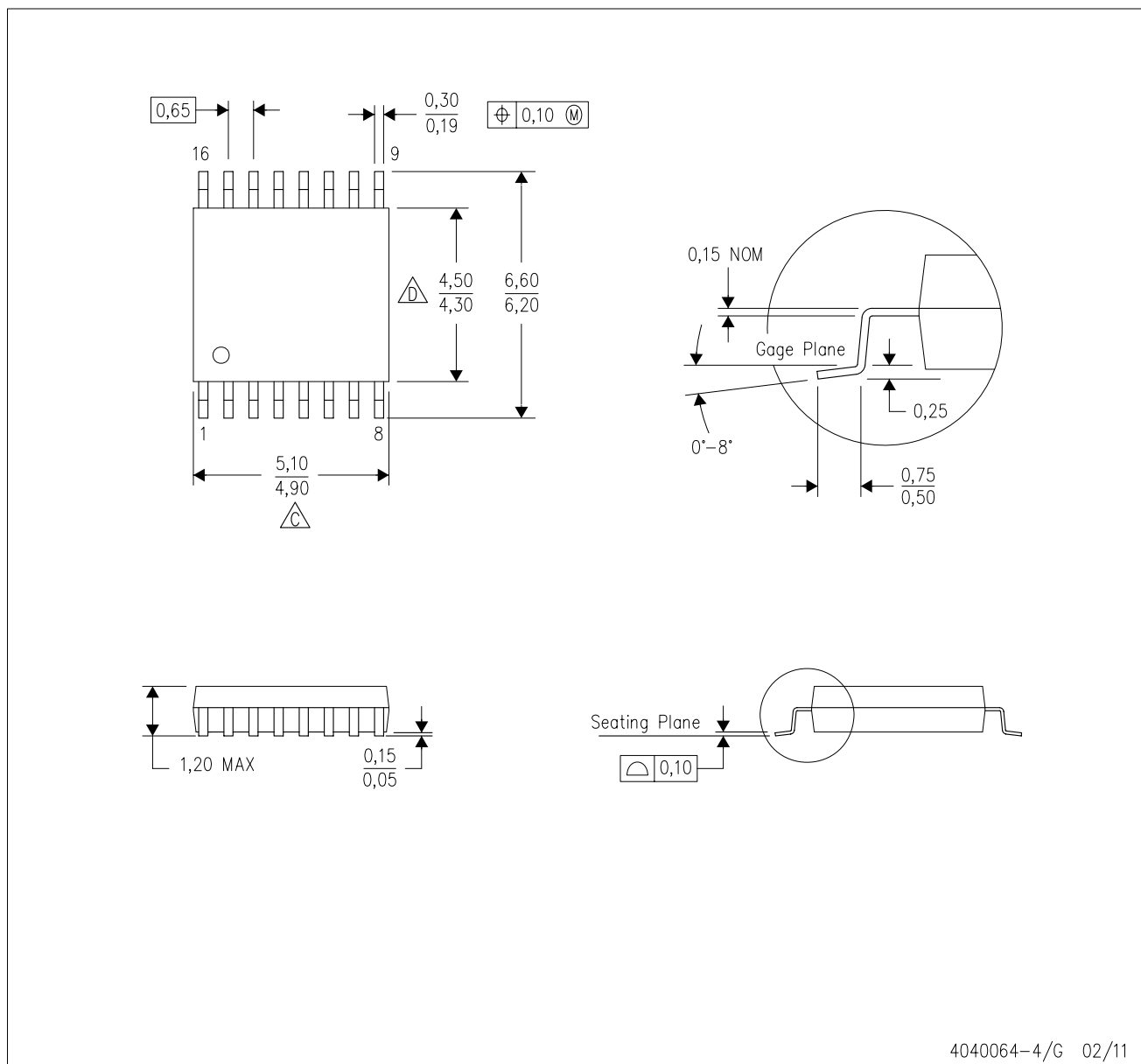
PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

PW (R-PDSO-G16)

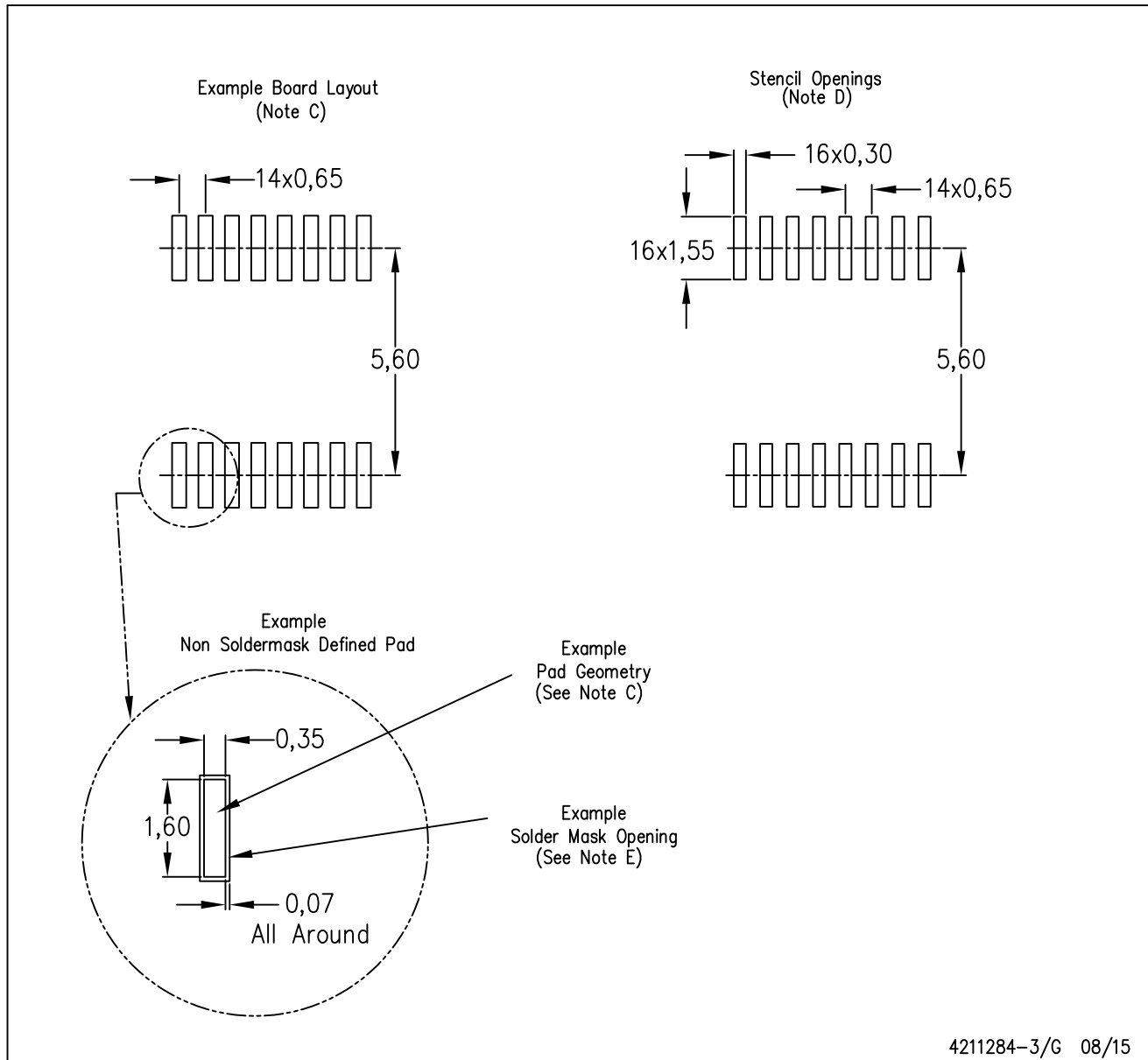
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - 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 0,15 each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
 - E. Falls within JEDEC MO-153

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE

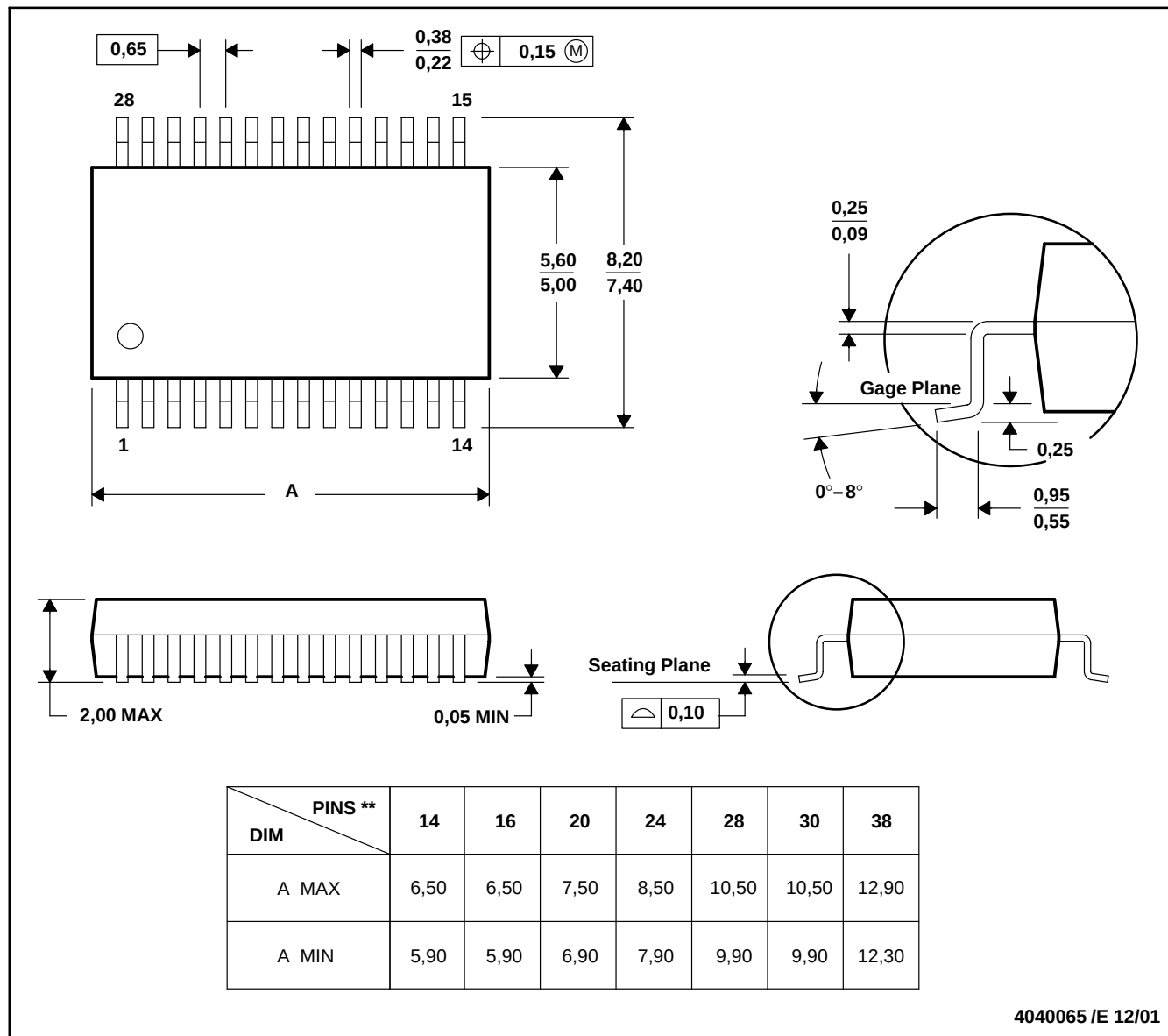


- NOTES:
- All linear dimensions are in millimeters.
 - This drawing is subject to change without notice.
 - Publication IPC-7351 is recommended for alternate designs.
 - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

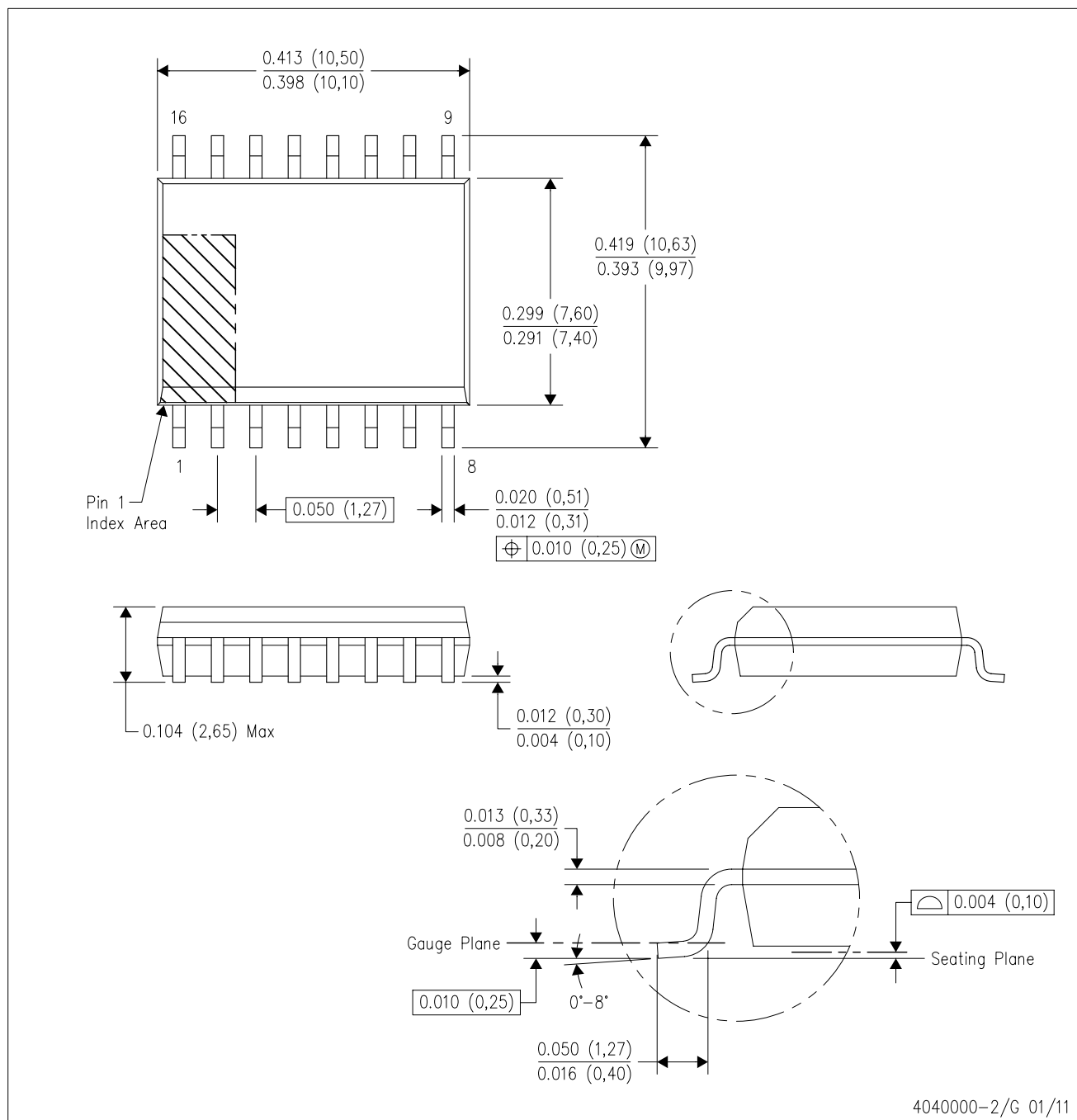
28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

DW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



NOTES: A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 D. Falls within JEDEC MS-013 variation AA.

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