TEXAS INSTRUMENTS
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TRS3221
3-V TO 5.5-V SINGLE-CHANNEL RS-232 LINE DRIVER/RECEIVER WITH ±15-kV ESD PROTECTION

SLLS814–JULY 2007

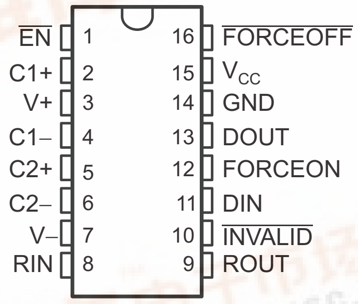
FEATURES

- **RS-232 Bus-Pin ESD Protection Exceeds ±15 kV Using Human-Body Model (HBM)**
- **Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU v.28 Standards**
- **Operates With 3-V to 5.5-V V_{CC} Supply**
- **Operates Up To 250 kbit/s**
- **One Driver and One Receiver**
- **Low Standby Current . . . 1 μA Typical**
- **External Capacitors . . . 4 × 0.1 μF**
- **Accepts 5-V Logic Input With 3.3-V Supply**
- **Alternative High-Speed Pin-Compatible Device (1 Mbit/s)**
  - **TRSF3221**
- **Auto-Powerdown Feature Automatically Disables Drivers for Power Savings**

APPLICATIONS

- **Battery-Powered, Hand-Held, and Portable Equipment**
- **PDAs and Palmtop PCs**
- **Notebooks, Subnotebooks, and Laptops**
- **Digital Cameras**
- **Mobile Phones and Wireless Devices**

DB OR PW PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The TRS3221 consists of one line driver, one line receiver, and a dual charge-pump circuit with ±15-kV ESD protection pin to pin (serial-port connection pins, including GND). The device meets the requirements of TIA/EIA-232-F and 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. These devices operate at data signaling rates up to 250 kbit/s and a maximum of 30-V/μs driver output slew rate.

ORDERING INFORMATION

T_A	PACKAGE[1][2]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	SSOP – DB	Tube of 50	TRS3221CDB	RS21C
		Reel of 2000	TRS3221CDBR	
	TSSOP – PW	Tube of 50	TRS3221CPW	RS21C
		Reel of 2000	TRS3221CPWR	
–40°C to 85°C	SSOP – DB	Tube of 50	TRS3221IDB	RS21I
		Reel of 2000	TRS3221IDBR	
	TSSOP – PW	Tube of 50	TRS3221IPW	RS21I
		Reel of 2000	TRS3221IPWR	

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
(2) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI Web site at www.ti.com.

DESCRIPTION/ORDERING INFORMATION (CONTINUED)

Flexible control options for power management are available when the serial port is inactive. The auto-powerdown feature functions when FORCEON is low and $\overline{\text{FORCEOFF}}$ is high. During this mode of operation, if the device does not sense a valid RS-232 signal on the receiver input, the driver output is disabled. If $\overline{\text{FORCEOFF}}$ is set low and $\overline{\text{EN}}$ is high, both the driver and receiver are shut off, and the supply current is reduced to 1 µA. Disconnecting the serial port or turning off the peripheral drivers causes the auto-powerdown condition to occur. Auto-powerdown can be disabled when FORCEON and $\overline{\text{FORCEOFF}}$ are high. With auto-powerdown enabled, the device is activated automatically when a valid signal is applied to the receiver input. The $\overline{\text{INVALID}}$ output notifies the user if an RS-232 signal is present at the receiver input. $\overline{\text{INVALID}}$ is high (valid data) if the receiver input voltage is greater than 2.7 V or less than –2.7 V, or has been between –0.3 V and 0.3 V for less than 30 µs. $\overline{\text{INVALID}}$ is low (invalid data) if the receiver input voltage is between –0.3 V and 0.3 V for more than 30 µs. Refer to Figure 5 for receiver input levels.

FUNCTION TABLES

Each Driver[1]

INPUTS				OUTPUT DOUT	DRIVER STATUS
DIN	FORCEON	$\overline{\text{FORCEOFF}}$	VALID RIN RS-232 LEVEL		
X	X	L	X	Z	Powered off
L	H	H	X	H	Normal operation with auto-powerdown disabled
H	H	H	X	L	
L	L	H	Yes	H	Normal operation with auto-powerdown enabled
H	L	H	Yes	L	
L	L	H	No	Z	Powered off by auto-powerdown feature
H	L	H	No	Z	

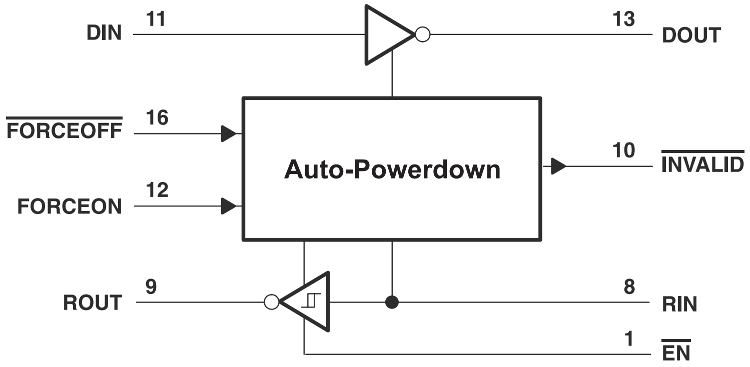
(1) H = high level, L = low level, X = irrelevant, Z = high impedance

Each Receiver[1]

INPUTS			OUTPUT ROUT
RIN	$\overline{\text{EN}}$	VALID RIN RS-232 LEVEL	
L	L	X	H
H	L	X	L
X	H	X	Z
Open	L	No	H

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

LOGIC DIAGRAM (POSITIVE LOGIC)



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	Driver ($\overline{\text{FORCEOFF}}$, FORCEON, $\overline{\text{EN}}$)	–0.3	6	V
		Receiver	–25	25	
V_O	Output voltage range	Driver	–13.2	13.2	V
		Receiver ($\overline{\text{INVALID}}$)	–0.3	V_{CC} + 0.3	
θ_{JA}	Package thermal impedance[3][4]	DB package		82	°C/W
		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[1]

See Figure 6

				MIN	NOM	MAX	UNIT
	Supply voltage		V_{CC} = 3.3 V	3	3.3	3.6	V
			V_{CC} = 5 V	4.5	5	5.5	
V_{IH}	Driver and control high-level input voltage	DIN, $\overline{\text{FORCEOFF}}$, FORCEON, $\overline{\text{EN}}$	V_{CC} = 3.3 V	2			V
			V_{CC} = 5 V	2.4			
V_{IL}	Driver and control low-level input voltage	DIN, $\overline{\text{FORCEOFF}}$, FORCEON, $\overline{\text{EN}}$				0.8	V
V_I	Driver and control input voltage	DIN, $\overline{\text{FORCEOFF}}$, FORCEON		0		5.5	V
V_I	Receiver input voltage			–25		25	V
T_A	Operating free-air temperature		TRS3221C	0		70	°C
			TRS3221I	–40		85	

[1] Test conditions are C1–C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2–C4 = 0.33 µF at V_{CC} = 5 V ± 0.5 V.

Electrical Characteristics[1]

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 6)

PARAMETER			TEST CONDITIONS		MIN	TYP[2]	MAX	UNIT
I_I	Input leakage current	$\overline{\text{FORCEOFF}}$, FORCEON, $\overline{\text{EN}}$				±0.01	±1	µA
I_{CC}	Supply current	Auto-powerdown disabled	V_{CC} = 3.3 V or 5 V, T_A = 25°C	No load, $\overline{\text{FORCEOFF}}$ and FORCEON at V_{CC}		0.3	1	mA
		Powered off		No load, $\overline{\text{FORCEOFF}}$ at GND		1	10	µA
		Auto-powerdown enabled		No load, $\overline{\text{FORCEOFF}}$ at V_{CC}, FORCEON at GND, All RIN are open or grounded		1	10	

[1] Test conditions are C1–C4 = 0.1 µF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 µF, C2–C4 = 0.33 µF at V_{CC} = 5 V ± 0.5 V.
[2] All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

DRIVER SECTION

Electrical Characteristics[1]

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 6)

PARAMETER		TEST CONDITIONS		MIN	TYP[2]	MAX	UNIT
V_{OH}	High-level output voltage	All DOUT at R_L = 3 kΩ to GND,	DIN = GND	5	5.4		V
V_{OL}	Low-level output voltage	All DOUT at R_L = 3 kΩ to GND,	DIN = V_{CC}	–5	–5.4		V
I_{IH}	High-level input current	V_I = V_{CC}			±0.01	±1	μA
I_{IL}	Low-level input current	V_I at GND			±0.01	±1	μA
I_{OS}	Short-circuit output current[3]	V_{CC} = 3.6 V,	V_O = 0 V		±35	±60	mA
		V_{CC} = 5.5 V,	V_O = 0 V		±35	±60	
r_o	Output resistance	V_{CC}, V+, and V– = 0 V,	V_O = ±2 V	300	10M		Ω
I_{off}	Output leakage current	$\overline{\text{FORCEOFF}}$ = GND	V_O = ±12 V, V_{CC} = 3 V to 3.6 V			±25	μA
			V_O = ±10 V, V_{CC} = 4.5 V to 5.5 V			±25	

(1) Test conditions are C1–C4 = 0.1 μF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V_{CC} = 5 V ± 0.5 V.
(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) (see Figure 6)

PARAMETER		TEST CONDITIONS			MIN	TYP[2]	MAX	UNIT
	Maximum data rate	C_L = 1000 pF,	R_L = 3 kΩ,	See Figure 1	150	250		kbit/s
$t_{sk(p)}$	Pulse skew[3]	C_L = 150 pF to 2500 pF,	R_L = 3 kΩ to 7 kΩ,	See Figure 2		100		ns
SR(tr)	Slew rate, transition region (see Figure 1)	V_{CC} = 3.3 V, R_L = 3 kΩ to 7 kΩ	C_L = 150 pF to 1000 pF		6		30	V/μs
			C_L = 150 pF to 2500 pF		4		30	

(1) Test conditions are C1–C4 = 0.1 μF at V_{CC} = 3.3 V + 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V_{CC} = 5 V ± 0.5 V.
(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	13	HBM	±15	kV

RECEIVER SECTION

Electrical Characteristics[1]

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 6)

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		1.6	2.4	V
		V_{CC} = 5 V		1.9	2.4	
$V_{IT–}$	Negative-going input threshold voltage	V_{CC} = 3.3 V	0.6	1.1		V
		V_{CC} = 5 V	0.8	1.4		
V_{hys}	Input hysteresis (V_{IT+} – $V_{IT–}$)			0.5		V
I_{off}	Output leakage current	$\overline{\text{FORCEOFF}}$ = 0 V		±0.05	±10	μA
r_I	Input resistance	V_I = ±3 V to ±25 V	3	5	7	kΩ

(1) Test conditions are C1–C4 = 0.1 μF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V_{CC} = 5 V ± 0.5 V.
(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,	See Figure 3	150	ns
t_{PHL}	Propagation delay time, high- to low-level output	C_L = 150 pF,	See Figure 3	150	ns
t_{en}	Output enable time	C_L = 150 pF, R_L = 3 kΩ,	See Figure 4	200	ns
t_{dis}	Output disable time	C_L = 150 pF, R_L = 3 kΩ,	See Figure 4	200	ns
$t_{sk(p)}$	Pulse skew[3]	See Figure 3		50	ns

(1) Test conditions are C1–C4 = 0.1 μF at V_{CC} = 3.3 V + 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V_{CC} = 5 V ± 0.5 V.
(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	HBM	±15	kV

AUTO-POWERDOWN SECTION

Electrical Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 5)

PARAMETER		TEST CONDITIONS		MIN	MAX	UNIT
$V_{T+(valid)}$	Receiver input threshold for $\overline{\text{INVALID}}$ high-level output voltage	FORCEON = GND,	$\overline{\text{FORCEOFF}}$ = V_{CC}		2.7	V
$V_{T-(valid)}$	Receiver input threshold for $\overline{\text{INVALID}}$ high-level output voltage	FORCEON = GND,	$\overline{\text{FORCEOFF}}$ = V_{CC}	–2.7		V
$V_{T(invalid)}$	Receiver input threshold for $\overline{\text{INVALID}}$ low-level output voltage	FORCEON = GND,	$\overline{\text{FORCEOFF}}$ = V_{CC}	–0.3	0.3	V
V_{OH}	$\overline{\text{INVALID}}$ high-level output voltage	I_{OH} = –1 mA, FORCEON = GND, $\overline{\text{FORCEOFF}}$ = V_{CC}		V_{CC} – 0.6		V
V_{OL}	$\overline{\text{INVALID}}$ low-level output voltage	I_{OL} = 1.6 mA, FORCEON = GND, $\overline{\text{FORCEOFF}}$ = V_{CC}			0.4	V

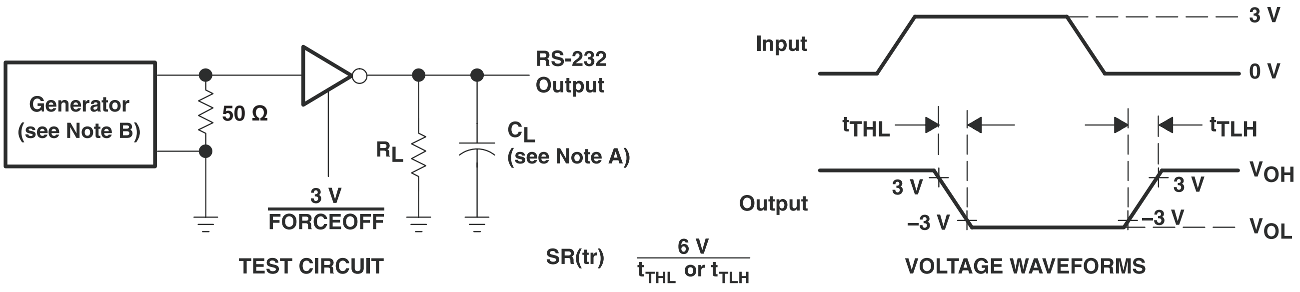
Switching Characteristics

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 5)

PARAMETER		TYP (1)	UNIT
t_{valid}	Propagation delay time, low- to high-level output	1	μs
$t_{invalid}$	Propagation delay time, high- to low-level output	30	μs
t_{en}	Supply enable time	100	μs

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

PARAMETER MEASUREMENT INFORMATION

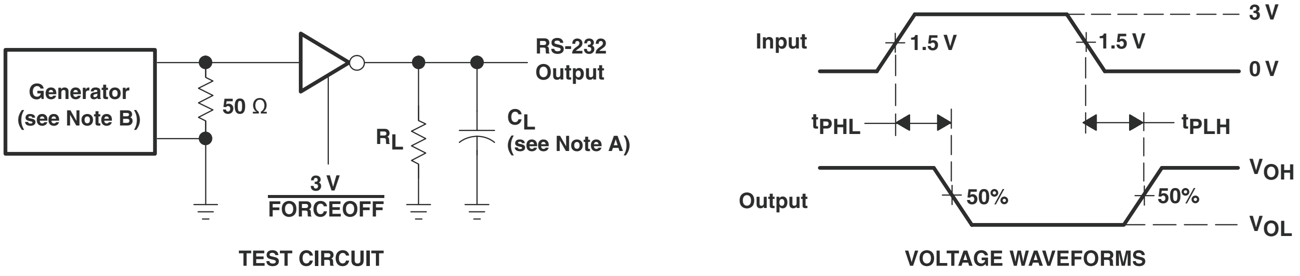


$$SR(tr) = \frac{6\ V}{t_{THL}\ or\ t_{TLH}}$$

NOTES: A. C_L includes probe and jig capacitance.

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

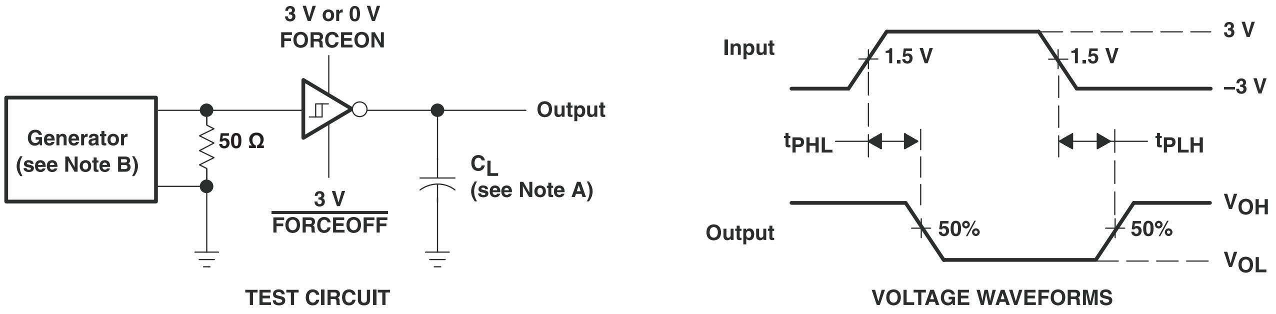
Figure 1. Driver Slew Rate



NOTES: A. C_L includes probe and jig capacitance.

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

Figure 2. Driver Pulse Skew

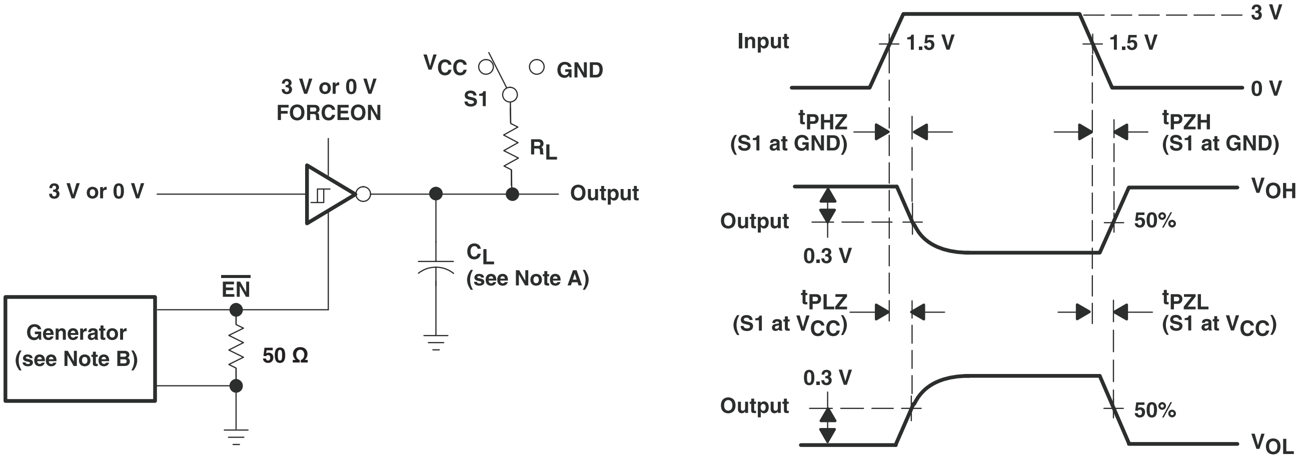


NOTES: A. C_L includes probe and jig capacitance.

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

Figure 3. Receiver Propagation Delay Times

PARAMETER MEASUREMENT INFORMATION (continued)



TEST CIRCUIT

VOLTAGE WAVEFORMS

NOTES: A. C_L includes probe and jig capacitance.

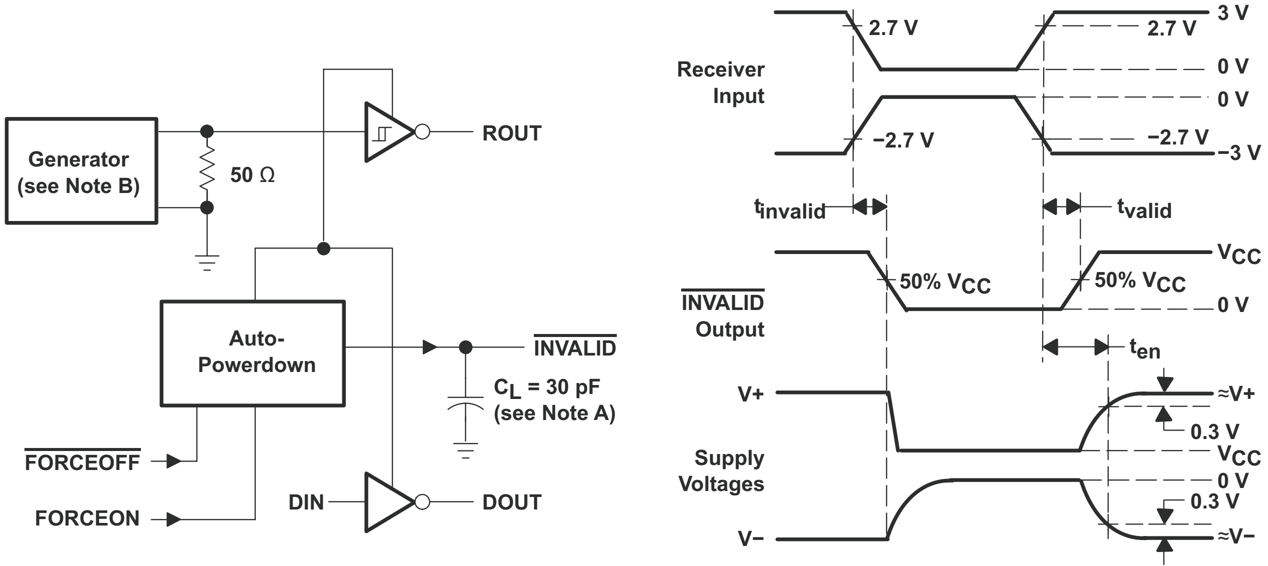
B. The pulse generator has the following characteristics: Z_O = 50 Ω, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

C. t_{PLZ} and t_{PHZ} are the same as t_{dis}.

D. t_{PZL} and t_{PZH} are the same as t_{en}.

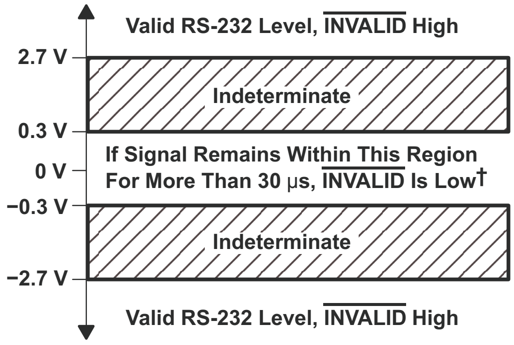
Figure 4. Receiver Enable and Disable Times

PARAMETER MEASUREMENT INFORMATION (continued)



TEST CIRCUIT

VOLTAGE WAVEFORMS

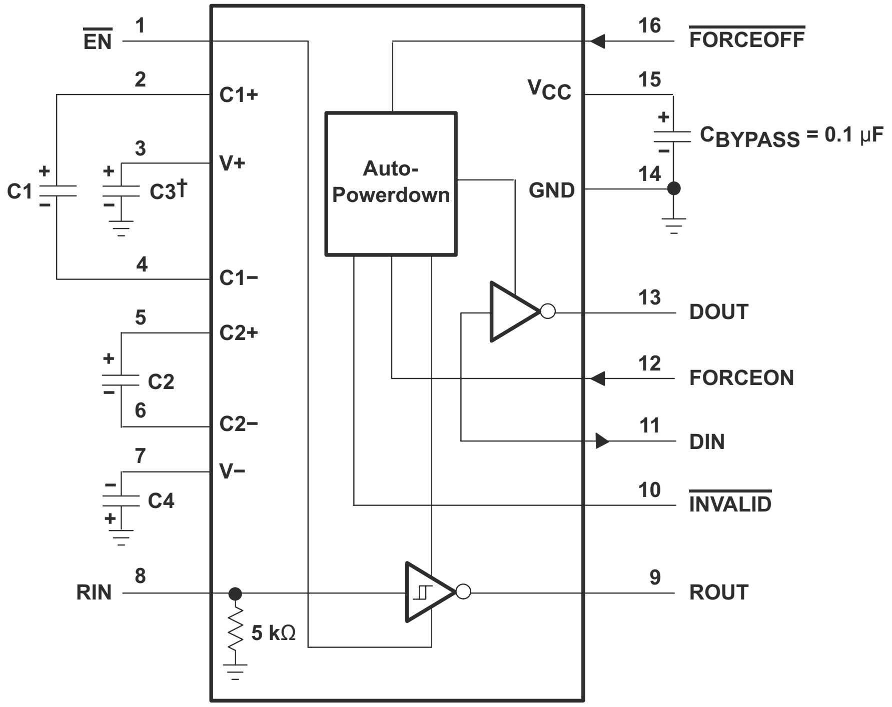


† Auto-powerdown disables drivers and reduces supply current to 1 µA.

NOTES:
- A. C_L includes probe and jig capacitance.
- B. The pulse generator has the following characteristics: PRR = 5 kbits/s, Z_O = 50 Ω, 50% duty cycle, $t_r \leq$ 10 ns, $t_f \leq$ 10 ns.

Figure 5. INVALID Propagation Delay Times and Driver Enabling Time

APPLICATION INFORMATION



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

NOTES: 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.

V_{CC} vs CAPACITOR VALUES

V_{CC}	C1	C2, C3, and C4
3.3 V ± 0.3 V	0.1 μF	0.1 μF
5 V ± 0.5 V	0.047 μF	0.33 μF
3 V to 5.5 V	0.1 μF	0.47 μF

Figure 6. 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	MSL Pea
TRS3221CDB	ACTIVE	SSOP	DB	16	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221CDBG4	ACTIVE	SSOP	DB	16	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221CDBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221CDBRG4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221CPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221CPWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221IDBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221IDBRG4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221IPW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221IPWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221IPWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260
TRS3221IPWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260

[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
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.
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
lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable fo
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,
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 retard
in homogeneous material)

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

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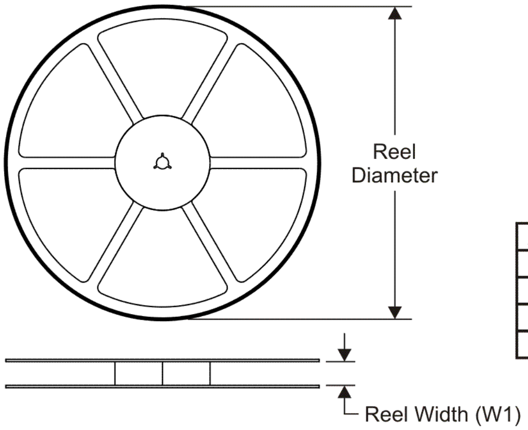
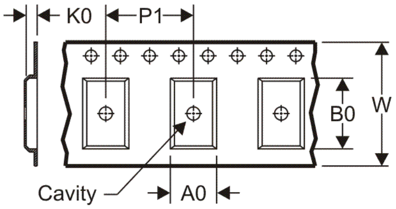
TAPE AND REEL INFORMATION

REEL DIMENSIONS

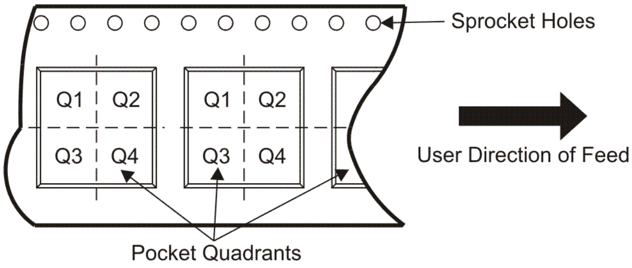


TAPE DIMENSIONS



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

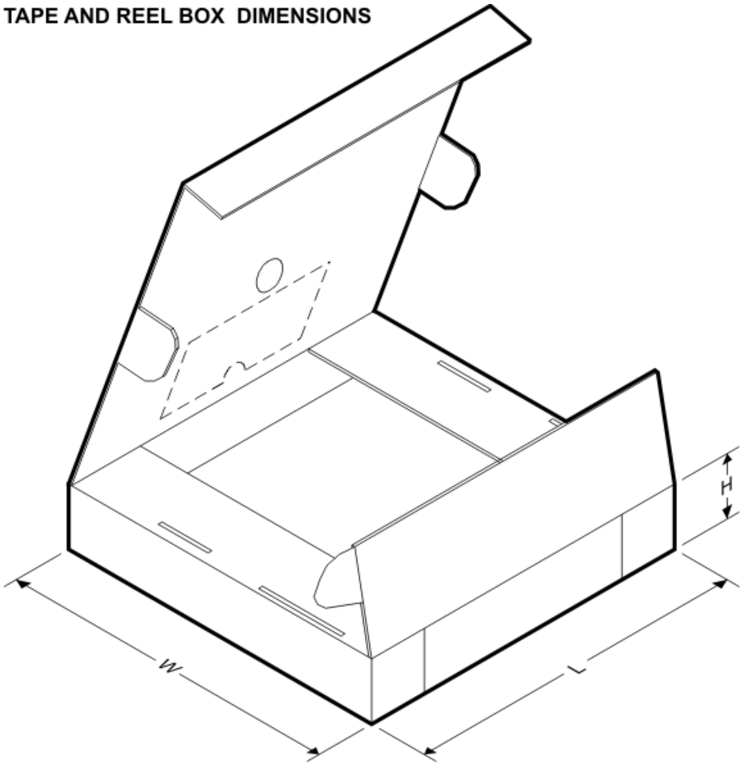
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TRS3221CDBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
TRS3221CPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
TRS3221IDBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
TRS3221IPWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

TAPE AND REEL BOX DIMENSIONS

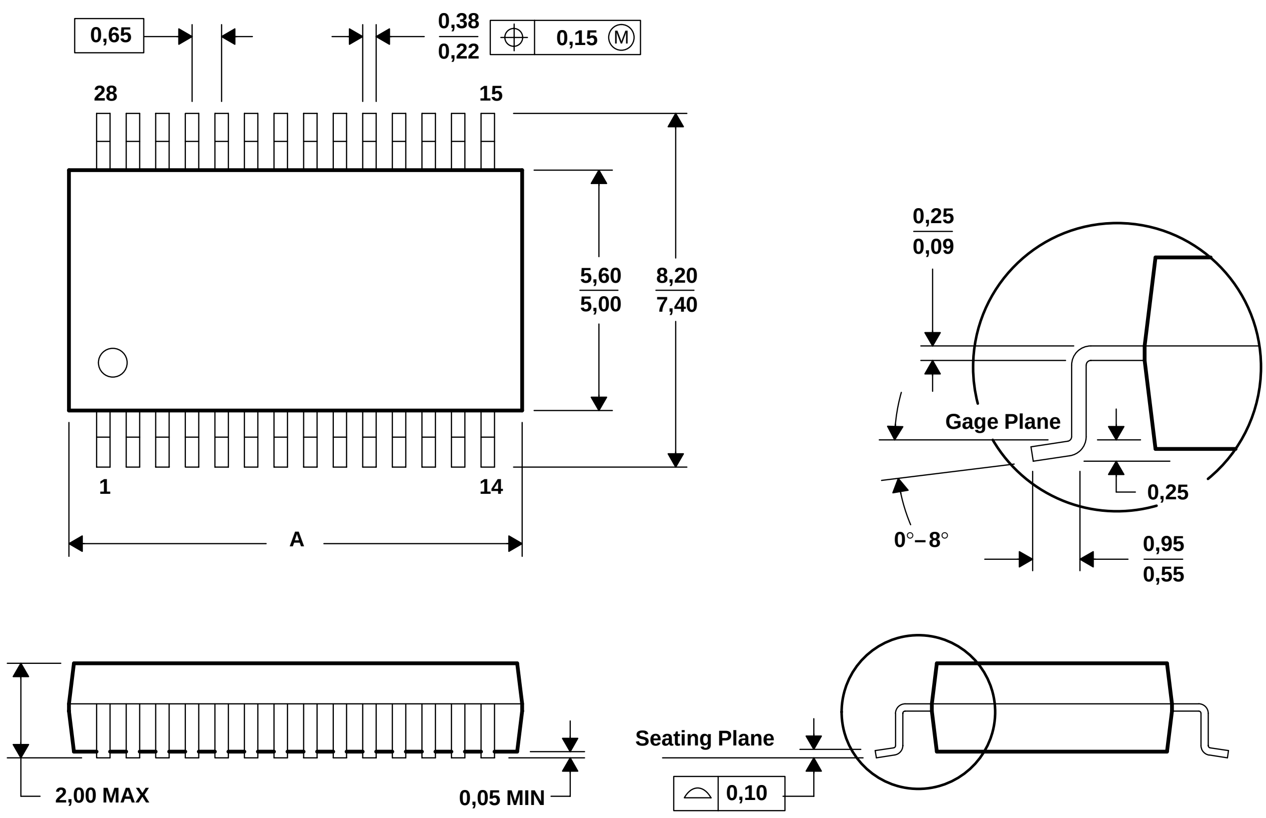


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TRS3221CDBR	SSOP	DB	16	2000	346.0	346.0	33.0
TRS3221CPWR	TSSOP	PW	16	2000	346.0	346.0	29.0
TRS3221IDBR	SSOP	DB	16	2000	346.0	346.0	33.0
TRS3221IPWR	TSSOP	PW	16	2000	346.0	346.0	29.0

DB (R-PDSO-G**) PLASTIC SMALL-OUTLINE

28 PINS SHOWN



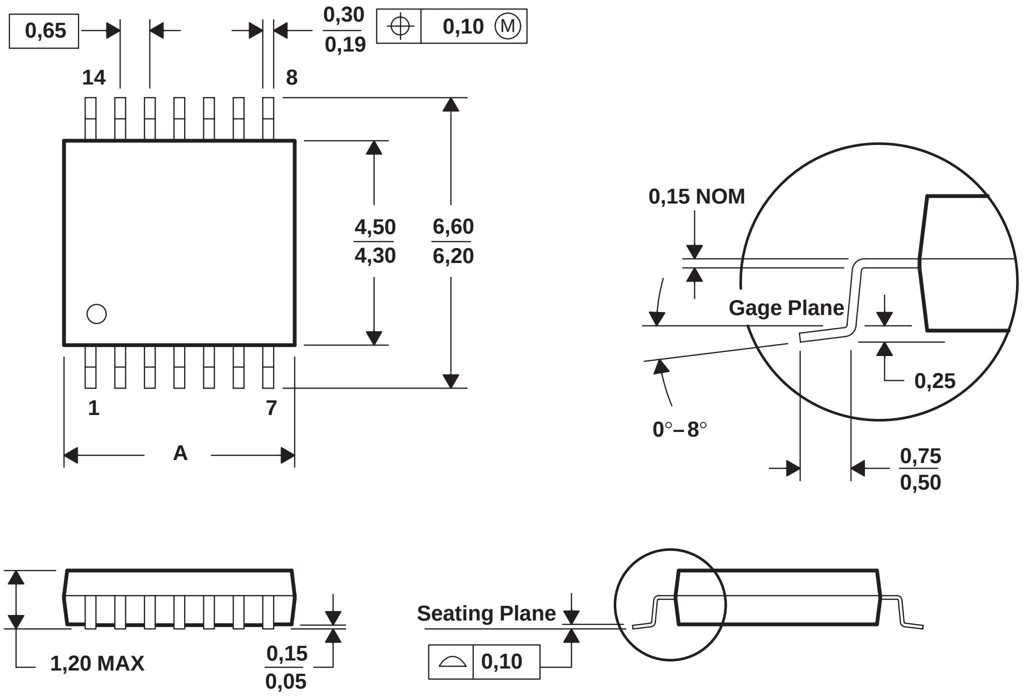
DIM \ PINS **	14	16	20	24	28	30	38
A MAX	6,50	6,50	7,50	8,50	10,50	10,50	12,90
A MIN	5,90	5,90	6,90	7,90	9,90	9,90	12,30

4040065 /E 12/01

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

PW (R-PDSO-G**) PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN

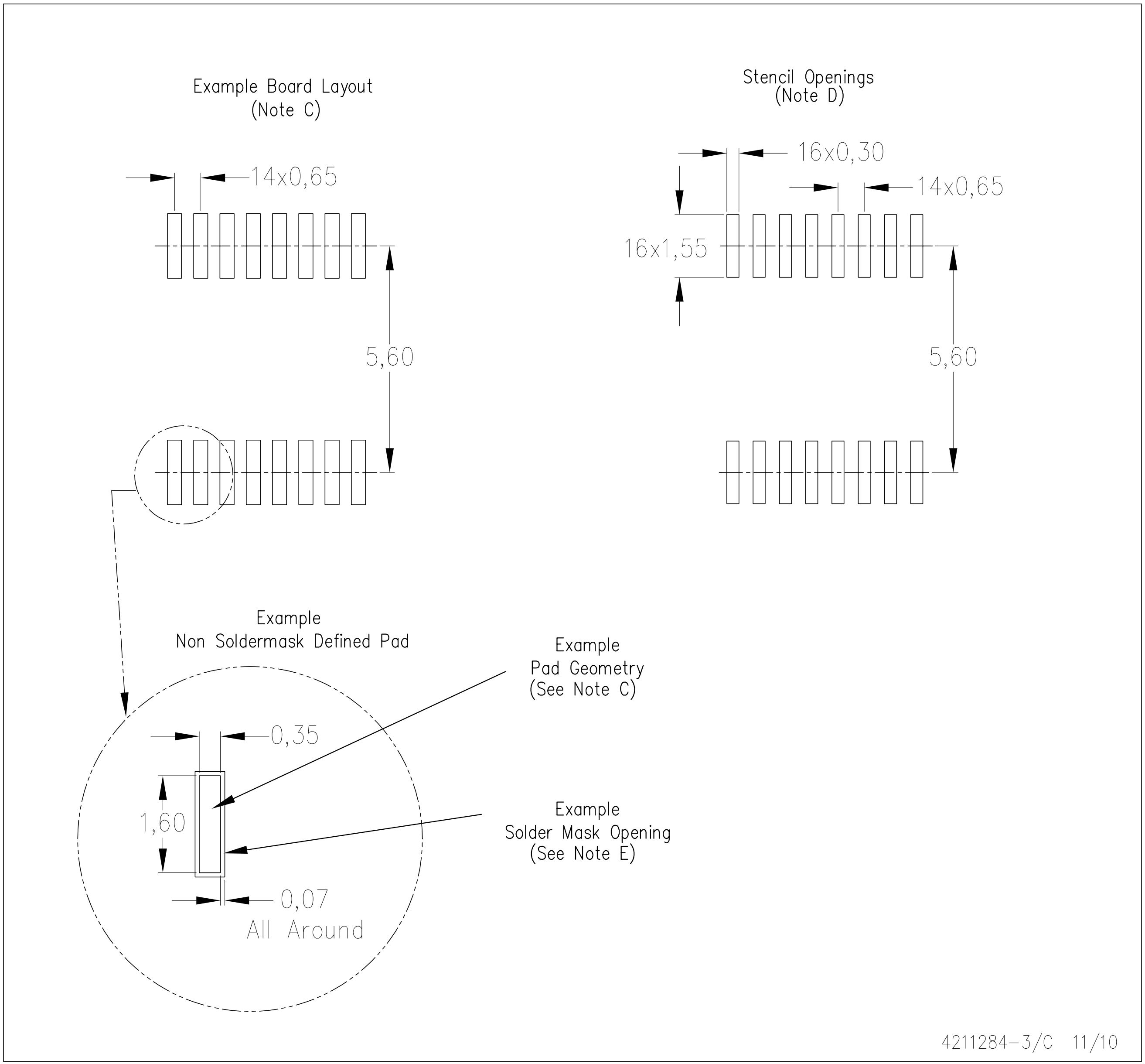


PINS ** DIM	8	14	16	20	24	28
A MAX	3,10	5,10	5,10	6,60	7,90	9,80
A MIN	2,90	4,90	4,90	6,40	7,70	9,60

4040064/F 01/97

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-153

PW (R–PDSO–G16) PLASTIC SMALL OUTLINE



NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC–7351 is recommended for alternate designs.
- D. 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.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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