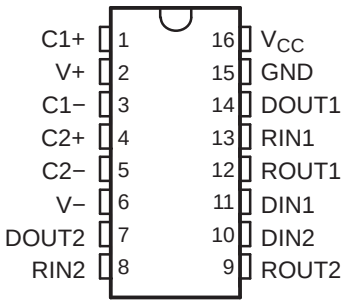
TRSF3232
3-V TO 5.5-V MULTICHANNEL RS-232 COMPATIBLE LINE DRIVER/RECEIVER

SLLS858 – AUGUST 2007

FEATURES

- **Operates With 3-V to 5.5-V V_{CC} Supply**
- **Operates up to 1 Mbit/s**
- **Low Supply Current . . . 300 µA Typ**
- **External Capacitors . . . 4 × 0.1 µF**
- **Accepts 5-V Logic Input With 3.3-V Supply**
- **Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II**
- **RS-232 Bus-Pin ESD Protection Exceeds ±15 kV Using Human-Body Model (HBM)**

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



NC − No internal connection

APPLICATIONS

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

DESCRIPTION/ORDERING INFORMATION

The TRSF3232 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 TRSF3232 operates at typical data signaling rates up to 1 Mbit/s and a driver output slew rate of 24 V/µs to 150 V/µs.

ORDERING INFORMATION

T_A	PACKAGE(1)(2)		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	SOIC – D	Tube of 40	TRSF3232CD	TRSF3232C
		Reel of 2500	TRSF3232CDR	
	SOIC – DW	Tube of 25	TRSF3232CDW	TRSF3232C
		Reel of 2000	TRSF3232CDWR	
	SSOP – DB	Tube of 70	TRSF3232CDB	RT22C
		Reel of 2000	TRSF3232CDBR	
	TSSOP – PW	Tube of 70	TRSF3232CPW	RT22C
		Reel of 2000	TRSF3232CPWR	
–40°C to 85°C	SOIC – D	Tube of 40	TRSF3232ID	TRSF3232I
	SOIC – DW	Reel of 2000	TRSF3232IDR	
	SOIC – DW	Tube of 25	TRSF3232IDW	TRSF3232I
		Reel of 2000	TRSF3232IDWR	
	SSOP – DB	Tube of 70	TRSF3232IDB	RT22I
		Reel of 2000	TRSF3232IDBR	
	TSSOP – PW	Tube of 70	TRSF3232IPW	RT22I
		Reel of 2000	TRSF3232IPWR	

(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.

FUNCTION TABLES

Each Driver(1)

INPUT DIN	OUTPUT DOUT
L	H
H	L

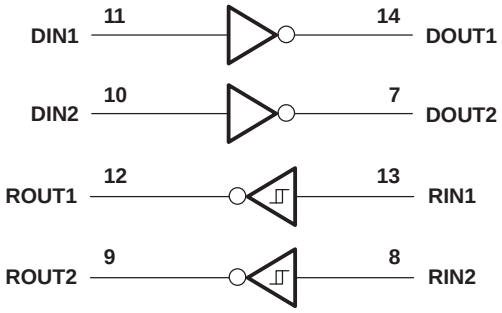
(1) H = high level, L = low level

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)



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 $T_J(max)$, 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 4

				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 high-level input voltage	DIN	V_{CC} = 3.3 V	2			V
			V_{CC} = 5 V	2.4			
V_{IL}	Driver low-level input voltage	DIN				0.8	V
V_I	Driver input voltage	DIN		0		5.5	V
	Receiver input voltage			–25		25	
T_A	Operating free-air temperature		TRSF3232C	0		70	°C
			TRSF3232I	–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 4)

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

(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 4)

PARAMETER		TEST CONDITIONS		MIN	TYP(2)	MAX	UNIT
V_{OH}	High-level output voltage	DOUT at R_L = 3 kΩ to GND,	DIN = GND	5	5.4		V
V_{OL}	Low-level output voltage	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_O = 0 V	V_{CC} = 3.6 V		±35	±60	mA
			V_{CC} = 5.5 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 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 4)

PARAMETER		TEST CONDITIONS			MIN	TYP(2)	MAX	UNIT
	Maximum data rate (see Figure 1)	R_L = 3 kΩ, One DOUT switching	C_L = 1000 pF		250			kbit/s
			C_L = 250 pF,	V_{CC} = 3 V to 4.5 V	1000			
			C_L = 1000 pF,	V_{CC} = 4.5 V to 5.5 V	1000			
$t_{sk(p)}$	Pulse skew(3)	C_L = 150 pF to 2500 pF,	R_L = 3 kΩ to 7 kΩ,	See Figure 2		300		ns
SR(tr)	Slew rate, transition region (see Figure 1)	R_L = 3 kΩ to 7 kΩ,	C_L = 150 pF to 1000 pF,	V_{CC} = 3.3 V	18		150	V/µs

(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.

RECEIVER SECTION

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
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	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.

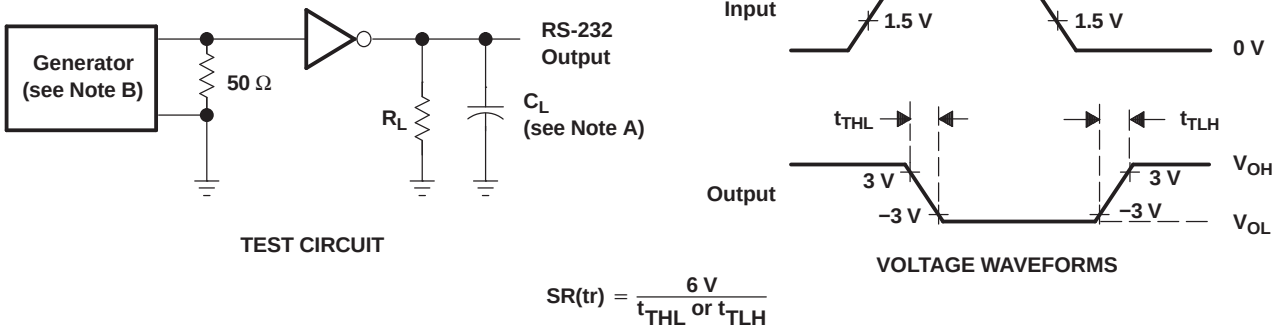
Switching Characteristics(1)

over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 3)

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 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.

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

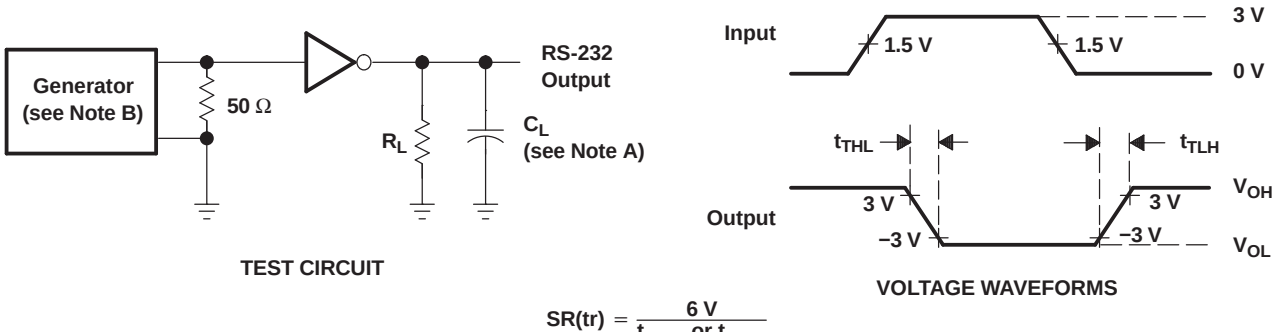
VOLTAGE WAVEFORMS

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

A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 250 kbit/s, Z_O = 50 Ω, 50% duty cycle, t_r ≤ 10 ns, t_f ≤ 10 ns.

Figure 1. Driver Slew Rate



TEST CIRCUIT

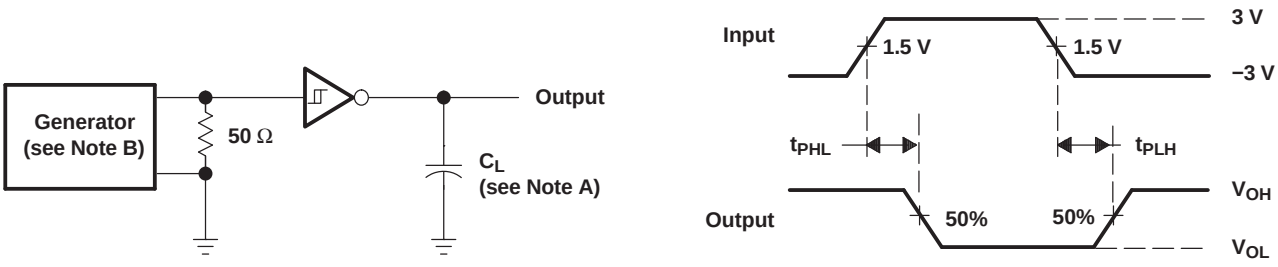
VOLTAGE WAVEFORMS

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

A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 250 kbit/s, Z_O = 50 Ω, 50% duty cycle, t_r ≤ 10 ns, t_f ≤ 10 ns.

Figure 2. Driver Pulse Skew



TEST CIRCUIT

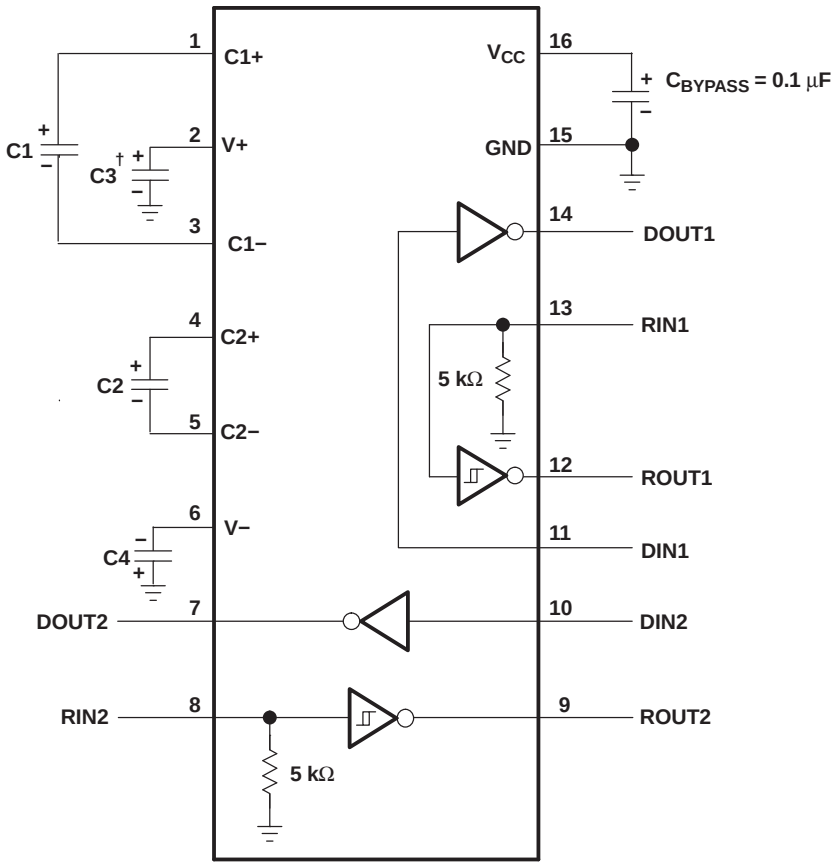
VOLTAGE WAVEFORMS

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 ≤ 10 ns, t_f ≤ 10 ns.

Figure 3. Receiver Propagation Delay Times

APPLICATION INFORMATION



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

V_{CC} vs CAPACITOR VALUES

V_{CC}	C1	C2, C3, 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 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	MSL Peak Temp (3)	Samples (Requires Login)
TRSF3232CD	ACTIVE	SOIC	D	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDB	ACTIVE	SSOP	DB	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDBG4	ACTIVE	SSOP	DB	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDBR	ACTIVE	SSOP	DB	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDBRG4	ACTIVE	SSOP	DB	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDG4	ACTIVE	SOIC	D	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDR	ACTIVE	SOIC	D	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDRG4	ACTIVE	SOIC	D	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDW	ACTIVE	SOIC	DW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDWG4	ACTIVE	SOIC	DW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDWR	ACTIVE	SOIC	DW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CDWRG4	ACTIVE	SOIC	DW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CPW	ACTIVE	TSSOP	PW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CPWG4	ACTIVE	TSSOP	PW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CPWR	ACTIVE	TSSOP	PW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232CPWRG4	ACTIVE	TSSOP	PW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232ID	ACTIVE	SOIC	D	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IDB	ACTIVE	SSOP	DB	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IDBG4	ACTIVE	SSOP	DB	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IDBR	ACTIVE	SSOP	DB	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IDBRG4	ACTIVE	SSOP	DB	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IDG4	ACTIVE	SOIC	D	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IDR	ACTIVE	SOIC	D	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IDRG4	ACTIVE	SOIC	D	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IDW	ACTIVE	SOIC	DW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IDWG4	ACTIVE	SOIC	DW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IDWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Contact TI Distributor or Sales Office
TRSF3232IDWRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	Contact TI Distributor or Sales Office

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
TRSF3232IPW	ACTIVE	TSSOP	PW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IPWG4	ACTIVE	TSSOP	PW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IPWR	ACTIVE	TSSOP	PW	16		TBD	Call TI	Call TI	Purchase Samples
TRSF3232IPWRG4	ACTIVE	TSSOP	PW	16		TBD	Call TI	Call TI	Purchase Samples

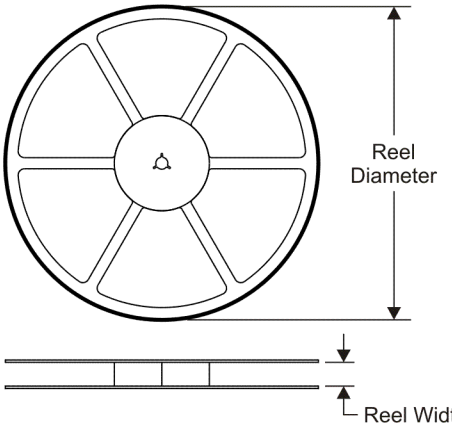
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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)

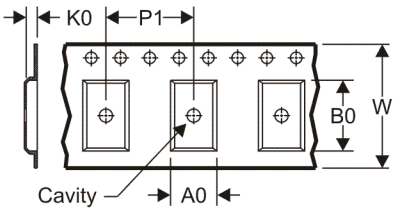
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

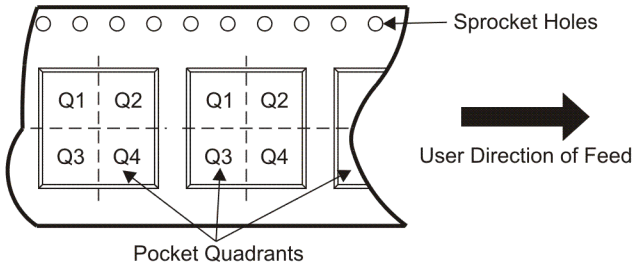


TAPE DIMENSIONS



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

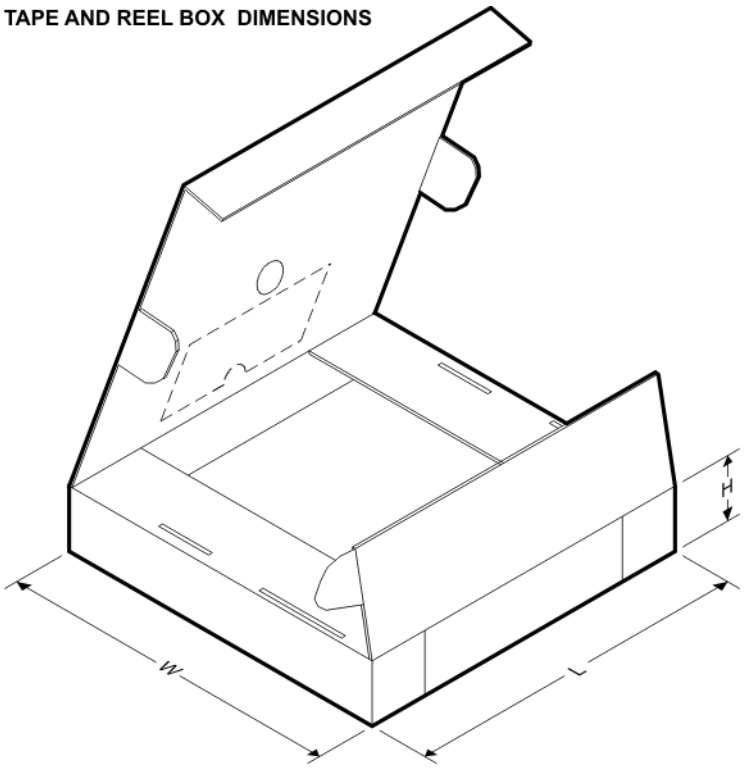
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TRSF3232IDWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1

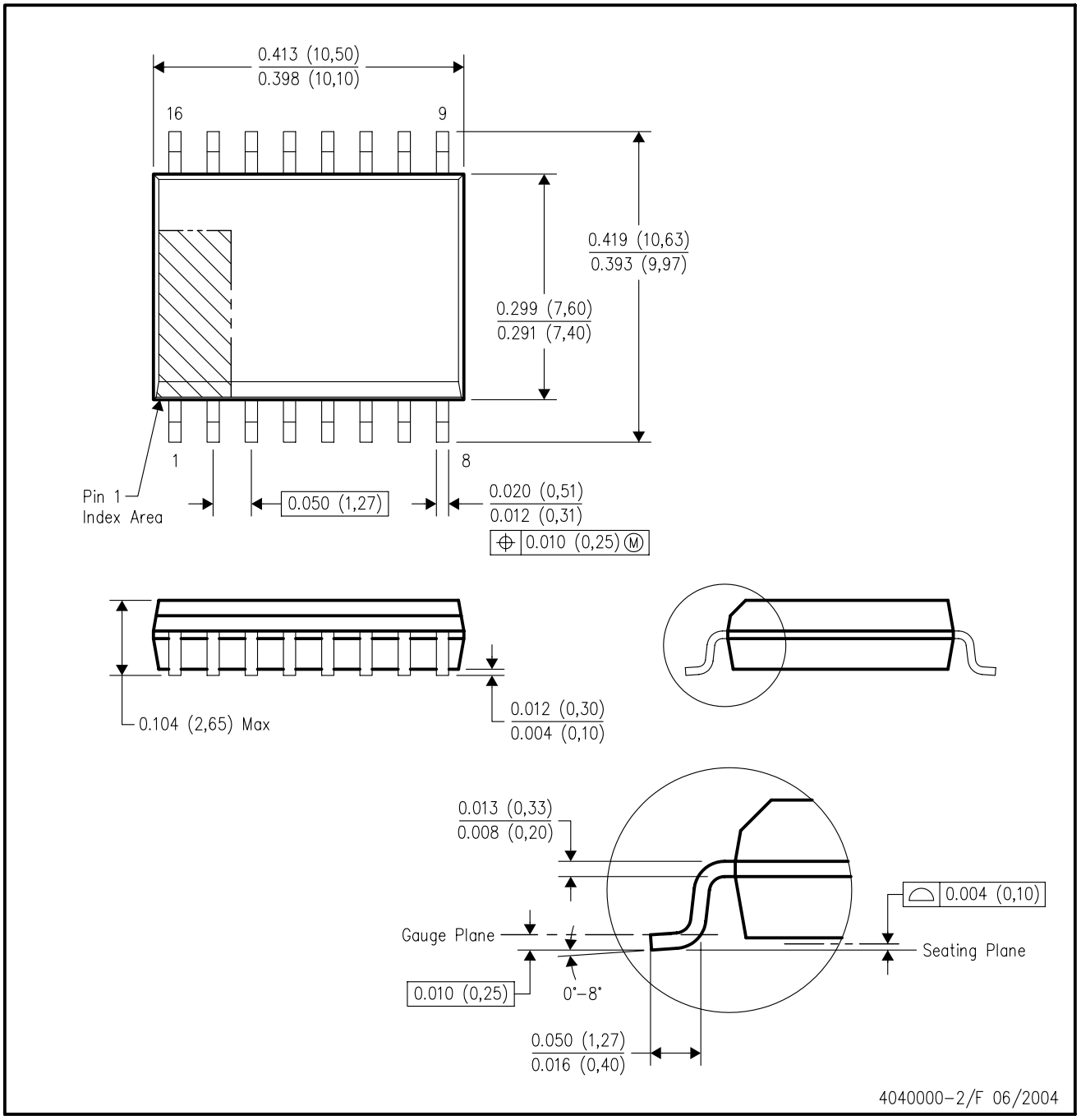
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TRSF3232IDWR	SOIC	DW	16	2000	346.0	346.0	33.0

DW (R–PDSO–G16) PLASTIC SMALL–OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
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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