

FEATURES

- Controlled Baseline
 - One Assembly/Test Site, One Fabrication Site
- Extended Temperature Performance of -55°C to 125°C
- Enhanced Diminishing Manufacturing Sources (DMS) Support
- Enhanced Product-Change Notification
- Qualification Pedigree ⁽¹⁾
- 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 . . . $1\ \mu\text{A}$ Typical
- External Capacitors . . . $4 \times 0.1\ \mu\text{F}$
- Accepts 5-V Logic Input With 3.3-V Supply
- Alternative High-Speed Pin-Compatible Device (1 Mbit/s)
 - SNx5C3221

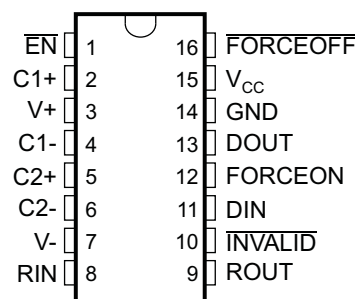
(1) Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

- Auto-Powerdown Feature Automatically Disables Drivers for Power Savings

APPLICATIONS

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

DB PACKAGE
(TOP VIEW)



DESCRIPTION/ORDERING INFORMATION

The MAX3221 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⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-55°C to 125°C	SSOP – DB	Reel of 2000	MAX3221MDBREP	MB3221M

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package



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.

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 **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 **FORCEOFF** is set low and enable (**EN**) is high, both the driver and receiver are shut off, and the supply current is reduced to 1 μ A. 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 **FORCEOFF** are high. With auto-powerdown enabled, the device is activated automatically when a valid signal is applied to the receiver input. The **INVALID** output notifies the user if an RS-232 signal is present at the receiver input. **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 μ s. **INVALID** is low (invalid data) if the receiver input voltage is between -0.3 V and 0.3 V for more than 30 μ s. See Figure 5 for receiver input levels.

FUNCTION TABLES

EACH DRIVER⁽¹⁾

INPUTS				OUTPUT DOUT	DRIVER STATUS
DIN	FORCEON	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	

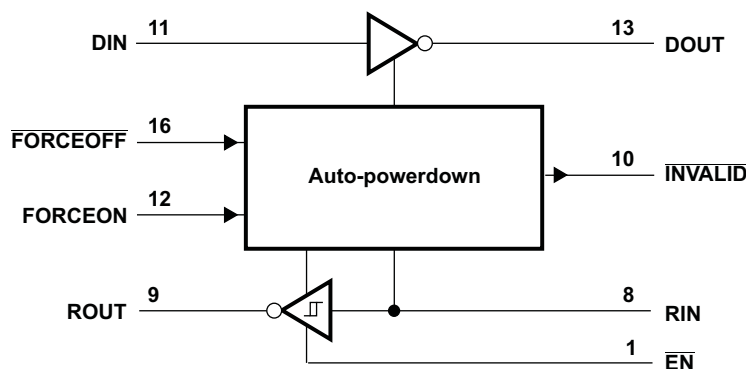
(1) H = high level, L = low level, X = irrelevant, Z = high impedance

EACH RECEIVER⁽¹⁾

INPUTS			OUTPUT ROUT
RIN	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)}			82	°C/W
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⁾

See [Figure 6](#)

			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 and control high-level input voltage	DIN, $\overline{\text{FORCEOFF}}$, FORCEON, $\overline{\text{EN}}$	$V_{CC} = 3.3 \text{ V}$	2		V
			$V_{CC} = 5 \text{ V}$	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		–55		125 ⁽²⁾	°C

- (1) Test conditions are C1–C4 = 0.1 μF at $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$; C1 = 0.047 μF , C2–C4 = 0.33 μF at $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$.
- (2) Long-term high-temperature storage and/or extended use at maximum recommended operating conditions may result in a reduction of overall device life. See http://www.ti.com/ep_quality for additional information on enhanced plastic packaging.

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	$V_{CC} = 3.3 \text{ V}$ or 5 V , $T_A = 25^\circ\text{C}$	No load, $\overline{\text{FORCEOFF}}$ and FORCEON at V_{CC}	0.3	2	mA
		Powered off		No load, $\overline{\text{FORCEOFF}}$ at GND	1	20	μA
		Auto-powerdown enabled		No load, $\overline{\text{FORCEOFF}}$ at V_{CC} , FORCEON at GND, All RIN are open or grounded	1	20	

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

MAX3221-EP
3-V TO 5.5-V SINGLE-CHANNEL RS-232 LINE DRIVER/RECEIVER
WITH ± 15 -kV ESD PROTECTION

SLLS751 – OCTOBER 2006

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 DOUT at R _L = 3 k Ω to GND, DIN = GND	5	5.4		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 = GND		± 0.01	± 1	μ A
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 FORCEOFF = GND	V _O = ± 12 V, V _{CC} = 3 V to 3.6 V		± 25	μ A
		V _O = ± 10 V, V _{CC} = 4.5 V to 5.5 V		± 25	

(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.

(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 k Ω , See Figure 1	150	250		kbit/s
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		100		ns
SR(tr)	Slew rate, transition region (see Figure 1) V _{CC} = 3.3 V, R _L = 3 k Ω to 7 k Ω C _L = 150 pF to 1000 pF	6		30	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.

(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	Human-Body Model (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	FORCEOFF = 0 V		±0.05	±10	μA
r _I	Input resistance	V _I = ±3 V to ±16 V	3	5	11	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	Human-Body Model (HBM)	±15	kV

MAX3221-EP

3-V TO 5.5-V SINGLE-CHANNEL RS-232 LINE DRIVER/RECEIVER

WITH ± 15 -kV ESD PROTECTION

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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
$V_{T+}(\text{valid})$	Receiver input threshold for $\overline{\text{INVALID}}$ high-level output voltage	FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$		2.7	V
$V_{T-}(\text{valid})$	Receiver input threshold for $\overline{\text{INVALID}}$ high-level output voltage	FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$	-2.7		V
$V_{T}(\text{invalid})$	Receiver input threshold for $\overline{\text{INVALID}}$ low-level output voltage	FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$	-0.2	0.3	V
V_{OH}	$\overline{\text{INVALID}}$ high-level output voltage	$I_{OH} = -1 \text{ mA}$, FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$	$V_{CC} - 0.6$		V
V_{OL}	$\overline{\text{INVALID}}$ low-level output voltage	$I_{OL} = 1.6 \text{ mA}$, FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$		0.4	V

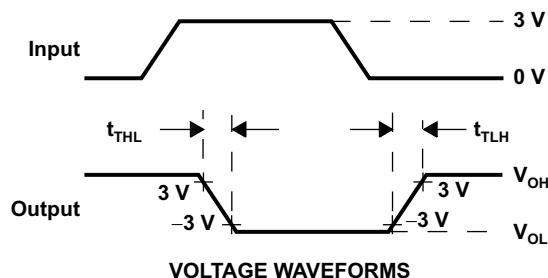
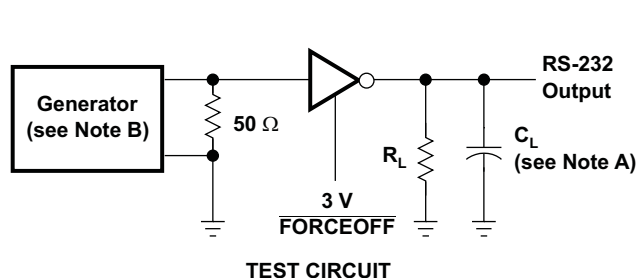
Switching Characteristics

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 $V_{CC} = 3.3 \text{ V}$ or $V_{CC} = 5 \text{ V}$, and $T_A = 25^\circ\text{C}$.

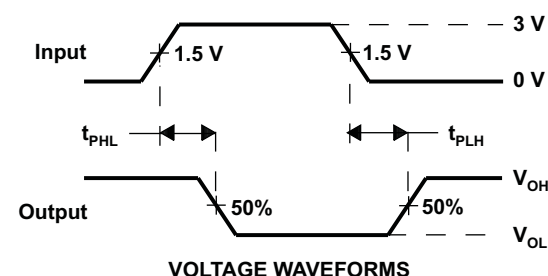
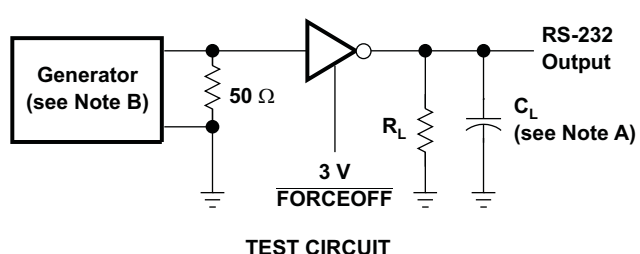
PARAMETER MEASUREMENT INFORMATION



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, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

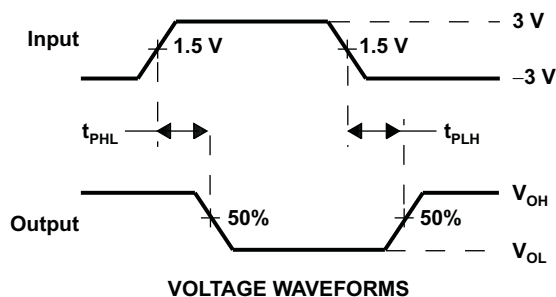
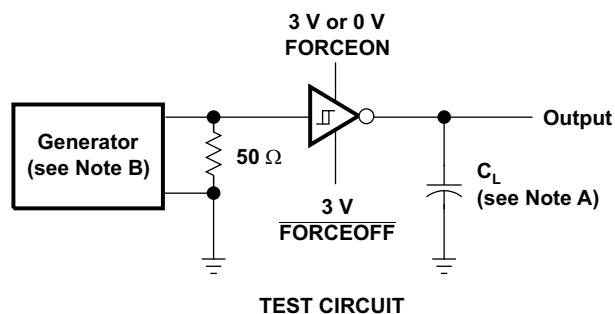
Figure 1. Driver Slew Rate



NOTES: A. C_L includes probe and jig capacitance.

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

Figure 2. Driver Pulse Skew

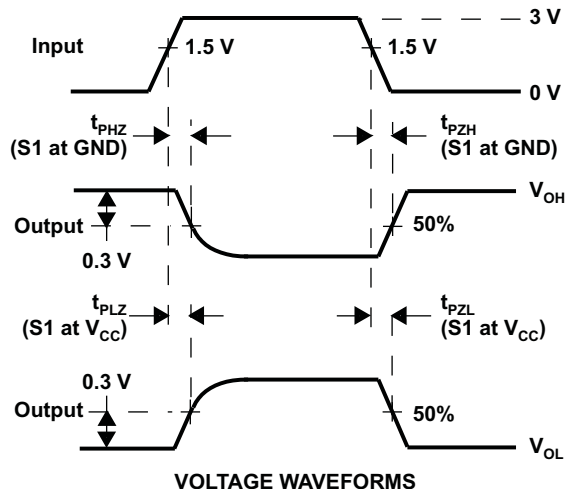
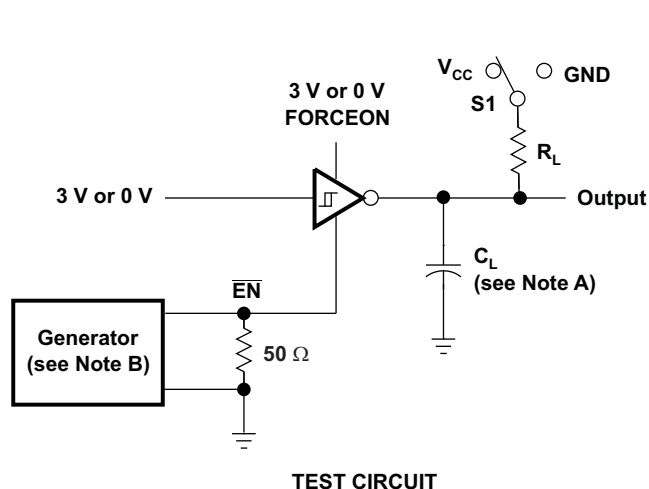


NOTES: A. C_L includes probe and jig capacitance.

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

Figure 3. Receiver Propagation Delay Times

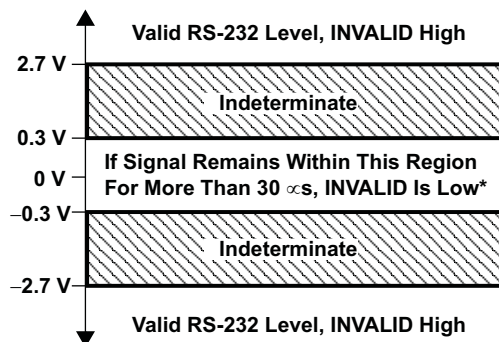
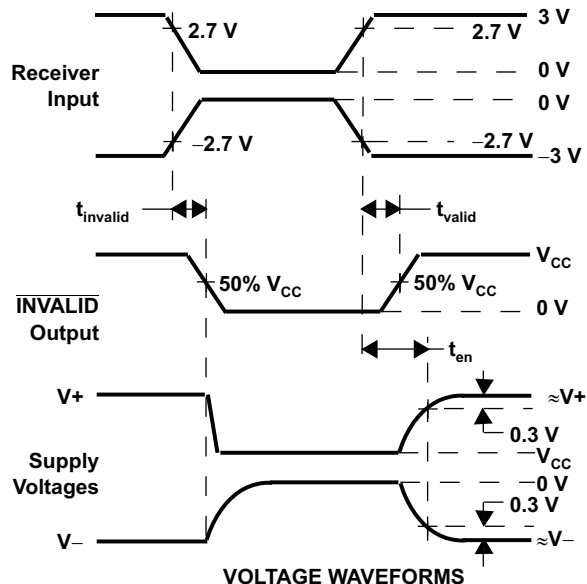
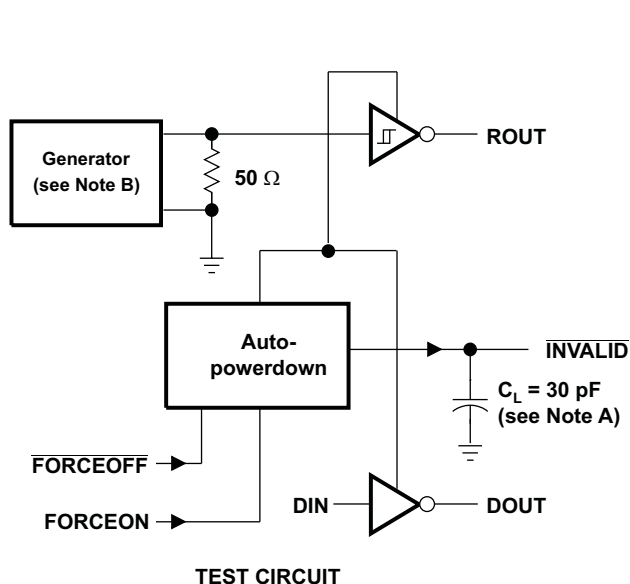
PARAMETER MEASUREMENT INFORMATION (continued)



- 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.
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)



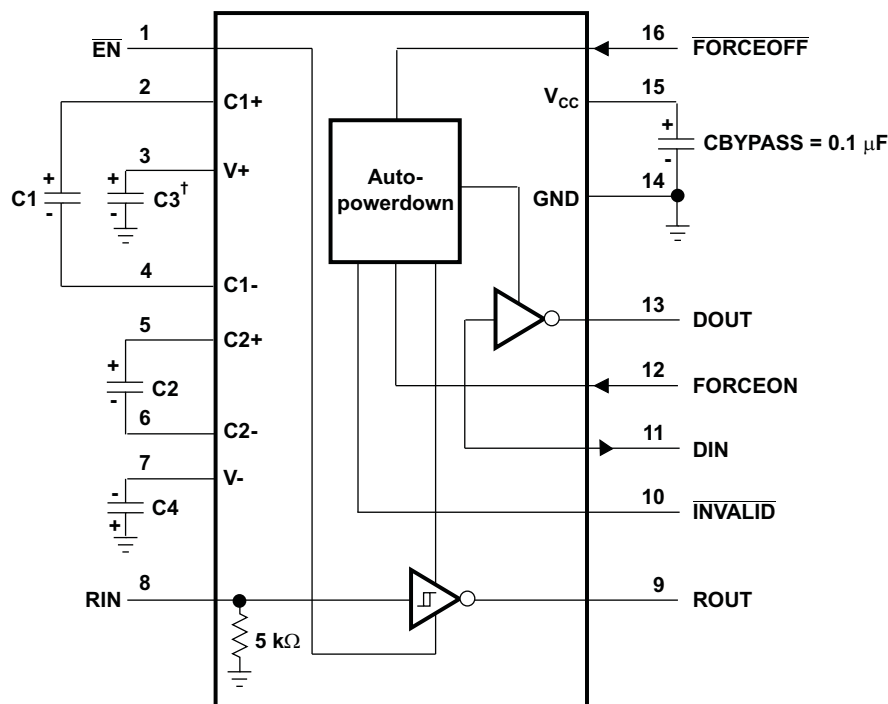
* Auto-powerdown disables drivers and reduces supply current to 1 μ A.

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, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

Figure 5. $\overline{\text{INVALID}}$ 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 $\pm$ 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

Figure 6. Typical Operating Circuit and Capacitor Values

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)
MAX3221MDBREP	Active	Production	SSOP (DB) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	MB3221M
MAX3221MDBREP.A	Active	Production	SSOP (DB) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	MB3221M
V62/06642-01XE	Active	Production	SSOP (DB) 16	2000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-55 to 125	MB3221M

⁽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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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.

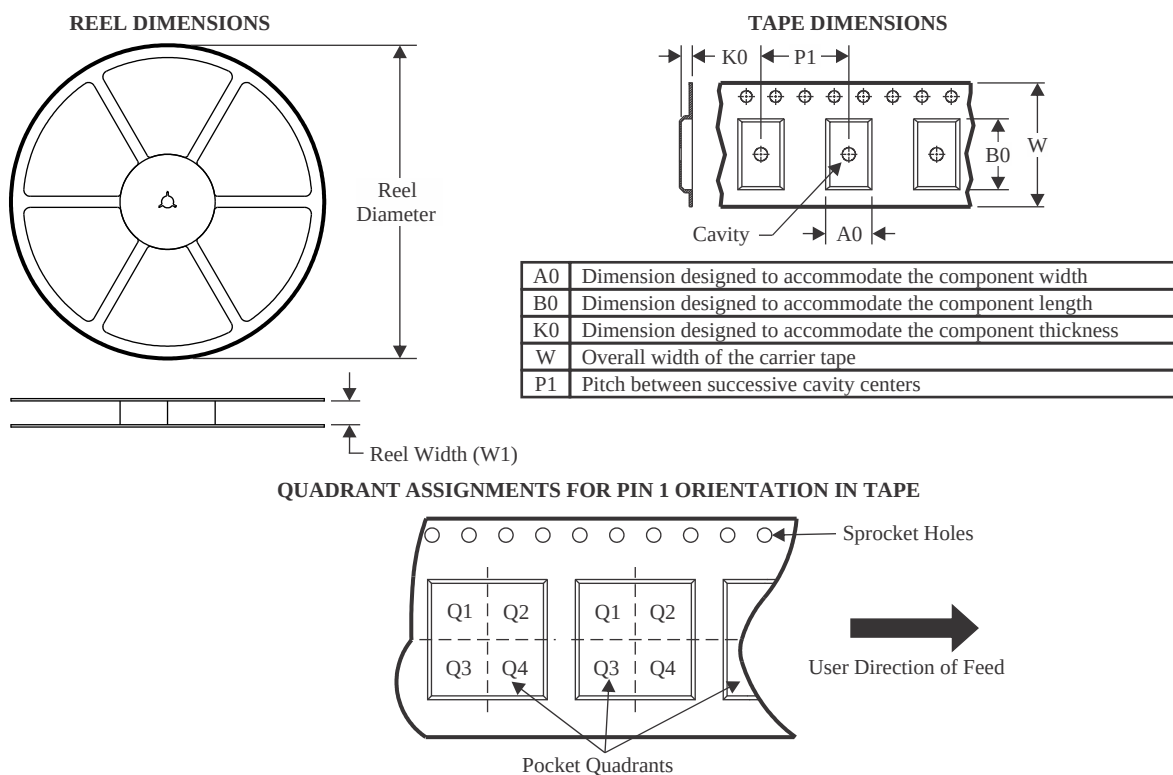
OTHER QUALIFIED VERSIONS OF MAX3221-EP :

- Catalog : [MAX3221](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

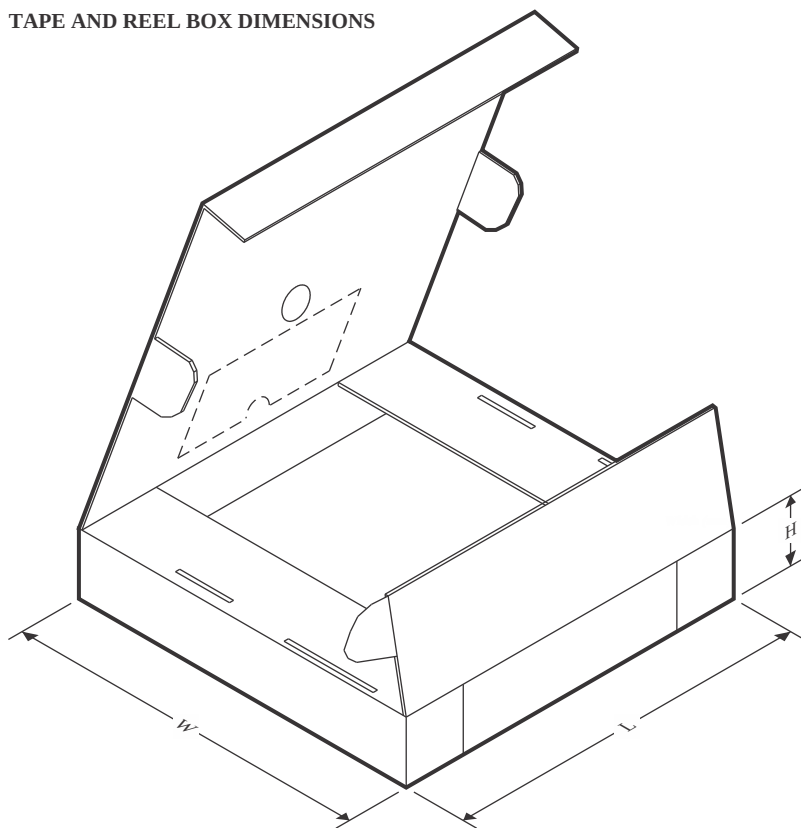
TAPE AND REEL INFORMATION



*All dimensions are nominal

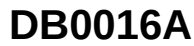
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
MAX3221MDBREP	SSOP	DB	16	2000	330.0	16.4	8.35	6.6	2.4	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
MAX3221MDBREP	SSOP	DB	16	2000	356.0	356.0	35.0



SSOP - 2 mm max height

Technical drawing of a 16-pin connector, showing top, side, and detail views.

Top View:

- Overall width: 8.2 TYP, 7.4
- Pin 1 Index Area: Indicated by a circle and dashed lines.
- Pin 1: Located at the top left.
- Pin 16: Located at the top right.
- Pin 8: Located at the bottom left.
- Pin 9: Located at the bottom right.
- Dimensions: 6.5, 5.9, 5.6, 5.0, 14X 0.65, 2X 4.55, 16X 0.38, 0.22.
- Feature Callouts: A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z.
- Feature Tolerances: 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, 0.001, 0.0005, 0.0002, 0.0001, 0.00005, 0.00002, 0.00001, 0.000005, 0.000002, 0.000001, 0.0000005, 0.0000002, 0.0000001, 0.00000005, 0.00000002, 0.00000001, 0.000000005, 0.000000002, 0.000000001, 0.0000000005, 0.0000000002, 0.0000000001, 0.00000000005, 0.00000000002, 0.00000000001, 0.000000000005, 0.000000000002, 0.000000000001, 0.0000000000005, 0.0000000000002, 0.0000000000001, 0.00000000000005, 0.00000000000002, 0.00000000000001, 0.000000000000005, 0.000000000000002, 0.000000000000001, 0.0000000000000005, 0.0000000000000002, 0.0000000000000001, 0.00000000000000005, 0.00000000000000002, 0.00000000000000001, 0.000000000000000005, 0.000000000000000002, 0.000000000000000001, 0.0000000000000000005, 0.0000000000000000002, 0.0000000000000000001, 0.00000000000000000005, 0.00000000000000000002, 0.00000000000000000001, 0.000000000000000000005, 0.000000000000000000002, 0.000000000000000000001, 0.0000000000000000000005, 0.0000000000000000000002, 0.0000000000000000000001, 0.00000000000000000000005, 0.00000000000000000000002, 0.00000000000000000000001, 0.000000000000000000000005, 0.000000000000000000000002, 0.000000000000000000000001, 0.0000000000000000000000005, 0.0000000000000000000000002, 0.0000000000000000000000001, 0.00000000000000000000000005, 0.00000000000000000000000002, 0.00000000000000000000000001, 0.000000000000000000000000005, 0.000000000000000000000000002, 0.000000000000000000000000001, 0.0000000000000000000000000005, 0.0000000000000000000000000002, 0.0000000000000000000000000001, 0.00000000000000000000000000005, 0.00000000000000000000000000002, 0.00000000000000000000000000001, 0.000000000000000000000000000005, 0.000000000000000000000000000002, 0.000000000000000000000000000001, 0.0000000000000000000000000000005, 0.0000000000000000000000000000002, 0.0000000000000000000000000000001, 0.00000000000000000000000000000005, 0.00000000000000000000000000000002, 0.00000000000000000000000000000001, 0.000000000000000000000000000000005, 0.000000000000000000000000000000002, 0.000000000000000000000000000000001, 0.0000000000000000000000000000000005, 0.0000000000000000000000000000000002, 0.0000000000000000000000000000000001, 0.00000000000000000000000000000000005, 0.00000000000000000000000000000000002, 0.00000000000000000000000000000000001, 0.000000000000000000000000000000000005, 0.000000000000000000000000000000000002, 0.000000000000000000000000000000000001, 0.0000000000000000000000000000000000005, 0.0000000000000000000000000000000000002, 0.0000000000000000000000000000000000001, 0.00000000000000000000000000000000000005, 0.00000000000000000000000000000000000002, 0.00000000000000000000000000000000000001, 0.000000000000000000000000000000000000005, 0.000000000000000000000000000000000000002, 0.000000000000000000000000000000000000001, 0.0000000000000000000000000000000000000005, 0.0000000000000000000000000000000000000002, 0.0000000000000000000000000000000000000001, 0.005, 0.002, 0.001, 0.0005, 0.0002, 0.0001, 0.005, 0.002, 0.001, 0.0005, 0.0002, 0.0001, 0.005, 0.002, 0.001, 0.0005, 0.0002, 0.0001, 0.000000000000000

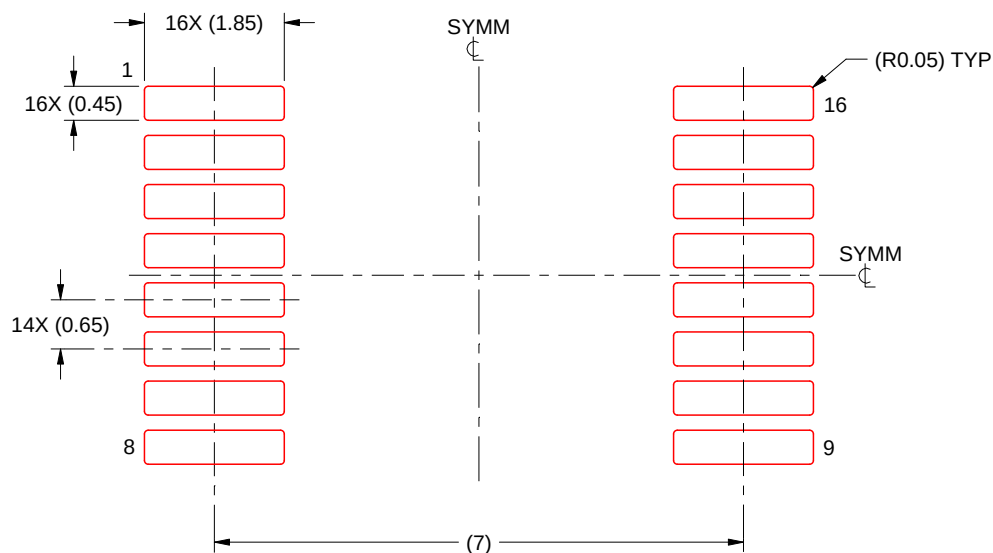
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-150.

EXAMPLE STENCIL DESIGN

DB0016A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 10X

4220763/A 05/2022

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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