

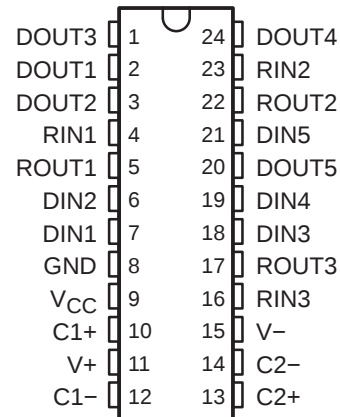
MAX207

5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER WITH ± 15 -kV ESD PROTECTION

SLLS592B – OCTOBER 2003 – REVISED JANUARY 2004

- ESD Protection for RS-232 I/O Pins
 - ± 15 kV – Human-Body Model
- Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU v.28 Standards
- Operates at 5-V V_{CC} Supply
- Operates Up To 120 kbit/s
- External Capacitors . . . $4 \times 0.1 \mu\text{F}$
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- Applications
 - Battery-Powered Systems, PDAs, Notebooks, Laptops, Palmtop PCs, and Hand-Held Equipment

DB OR DW PACKAGE
(TOP VIEW)



description/ordering information

The MAX207 consists of five line drivers, three line receivers, 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 5-V supply. The devices operate at data signaling rates up to 120 kbit/s and a maximum of 30-V/ μs driver output slew rate.

ORDERING INFORMATION

T_A	PACKAGE [†]		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	SOIC (DW)	Tube of 25	MAX207CDW	MAX207C
		Reel of 2000	MAX207CDWR	
	SSOP (DB)	Reel of 2000	MAX207CDBR	MA207C
-40°C to 85°C	SOIC (DW)	Tube of 25	MAX207IDW	MAX207I
		Reel of 2000	MAX207IDWR	
	SSOP (DB)	Reel of 2000	MAX207IDBR	MB207I

[†] 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.

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

 **TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2004, Texas Instruments Incorporated

MAX207
5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER
WITH ± 15 -kV ESD PROTECTION

SLLS592B – OCTOBER 2003 – REVISED JANUARY 2004

Function Tables

EACH DRIVER

INPUT D _{IN}	OUTPUT D _{OUT}
L	H
H	L

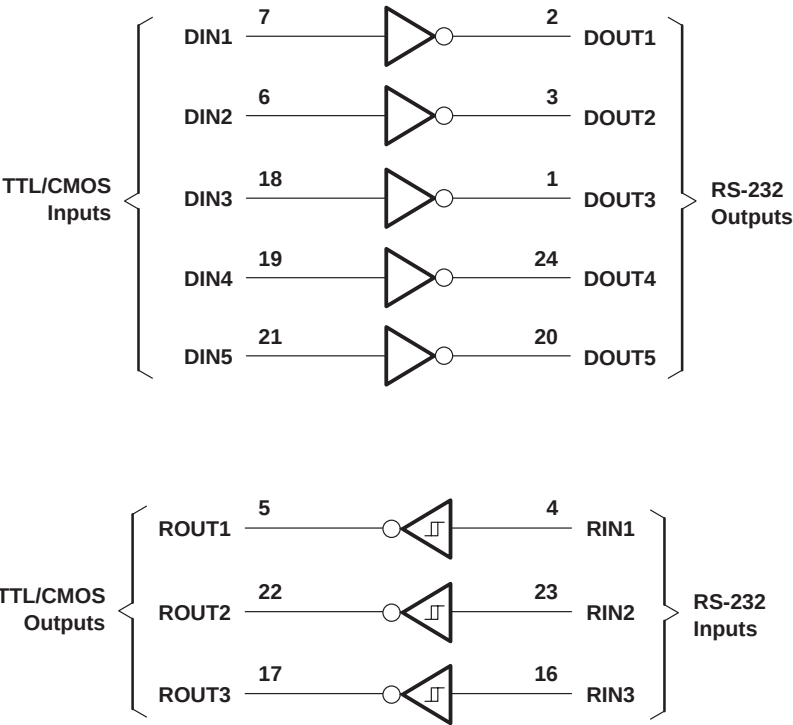
H = high level, L = low level

EACH RECEIVER

INPUT R _{IN}	OUTPUT R _{OUT}
L	H
H	L
Open	H

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

logic diagram (positive logic)



MAX207

5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

WITH ± 15 -kV ESD PROTECTION

SLLS592B – OCTOBER 2003 – REVISED JANUARY 2004

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{CC} (see Note 1)	–0.3 V to 6 V
Positive charge pump voltage range, $V+$ (see Note 1)	$V_{CC} - 0.3$ V to 14 V
Negative charge pump voltage range, $V-$ (see Note 1)	–14 V to 0.3 V
Input voltage range, V_I : Drivers	–0.3 V to $V+ + 0.3$ V
Receivers	± 30 V
Output voltage range, V_O : Drivers	$V- - 0.3$ V to $V+ + 0.3$ V
Receivers	–0.3 V to $V_{CC} + 0.3$ V
Short-circuit duration: D_{OUT}	Continuous
Package thermal impedance, θ_{JA} (see Notes 2 and 3): DB package	63°C/W
DW package	46°C/W
Operating virtual junction temperature, T_J	150°C
Storage temperature range, T_{stg}	–65°C to 150°C

[†] 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.

NOTES: 1. All voltages are with respect to network GND.

2. 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.

3. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions (see Note 4 and Figure 4)

			MIN	NOM	MAX	UNIT
	Supply voltage		4.5	5	5.5	V
V_{IH}	Driver high-level input voltage	D_{IN}	2			V
V_{IL}	Driver low-level input voltage	D_{IN}			0.8	V
V_I	Driver input voltage	D_{IN}	0		5.5	V
	Receiver input voltage		–30		30	
T_A	Operating free-air temperature	MAX207C	0		70	°C
		MAX207I	–40		85	

NOTE 4: Test conditions are C1–C4 = 0.1 μ F at $V_{CC} = 5$ V $\pm$ 0.5 V.

electrical characteristics over recommended ranges of supply voltage (unless otherwise noted) (see Note 4 and Figure 4)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{CC} Supply current	No load, $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$		11	20	mA

NOTE 4: Test conditions are C1–C4 = 0.1 μ F at $V_{CC} = 5$ V $\pm$ 0.5 V.



DRIVER SECTION

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

PARAMETER	TEST CONDITIONS	MIN	TYP [†]	MAX	UNIT
V _{OH} High-level output voltage	D _{OUT} at R _L = 3 k Ω to GND, D _{IN} = GND	5	9		V
V _{OL} Low-level output voltage	D _{OUT} at R _L = 3 k Ω to GND, D _{IN} = V _{CC}	-5	-9		V
I _{IH} High-level input current	V _I = V _{CC}		15	200	μ A
I _{IL} Low-level input current	V _I at 0 V		-15	-200	μ A
I _{OS} [‡] Short-circuit output current	V _{CC} = 5.5 V, V _O = 0 V		± 10	± 60	mA
r _O Output resistance	V _{CC} , V ₊ , and V ₋ = 0 V, V _O = ± 2 V	300			Ω

[†] All typical values are at V_{CC} = 5 V, and T_A = 25°C.

[‡] 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.

NOTE 4: Test conditions are C1–C4 = 0.1 μ F at V_{CC} = 5 V $\pm$ 0.5 V.

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

PARAMETER	TEST CONDITIONS	MIN	TYP [†]	MAX	UNIT
Maximum data rate	C _L = 50 to 1000 pF, R _L = 3 k Ω to 7 k Ω , One D _{OUT} switching, See Figure 1	120			kbit/s
t _{PLH} (D) Propagation delay time, low- to high-level output	C _L = 2500 pF, R _L = 3 k Ω , all drivers loaded, See Figure 1		2		μ s
t _{PHL} (D) Propagation delay time, high- to low-level output	C _L = 2500 pF, R _L = 3 k Ω , all drivers loaded, See Figure 1		2		μ s
t _{sk} (p) Pulse skew [§]	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)	C _L = 50 pF to 1000 pF, R _L = 3 k Ω to 7 k Ω , V _{CC} = 5 V	3	6	30	V/ μ s

[†] All typical values are at V_{CC} = 5 V, and T_A = 25°C.

[§] Pulse skew is defined as |t_{PLH} – t_{PHL}| of each channel of the same device.

NOTE 4: Test conditions are C1–C4 = 0.1 μ F at V_{CC} = 5 V $\pm$ 0.5 V.

ESD protection

PIN	TEST CONDITIONS	TYP	UNIT
D _{OUT} , R _{IN}	Human-Body Model	± 15	kV

MAX207

5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

WITH ± 15 -kV ESD PROTECTION

SLLS592B – OCTOBER 2003 – REVISED JANUARY 2004

RECEIVER SECTION

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

PARAMETER	TEST CONDITIONS	MIN	TYP [†]	MAX	UNIT
V _{OH} High-level output voltage	I _{OH} = -1 mA	3.5	V _{CC} - 0.4 V		V
V _{OL} Low-level output voltage	I _{OL} = 1.6 mA			0.4	V
V _{IT+} Positive-going input threshold voltage	V _{CC} = 5 V, T _A = 25°C		1.7	2.4	V
V _{IT-} Negative-going input threshold voltage	V _{CC} = 5 V, T _A = 25°C	0.8	1.2		V
V _{hys} Input hysteresis (V _{IT+} - V _{IT-})		0.2	0.5	1	V
r _i Input resistance	V _I = ± 3 V to ± 25 V	3	5	7	k Ω

[†] All typical values are at V_{CC} = 5 V, and T_A = 25°C.

NOTE 4: Test conditions are C1–C4 = 0.1 μ F at V_{CC} = 5 V $\pm$ 0.5 V.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 3)

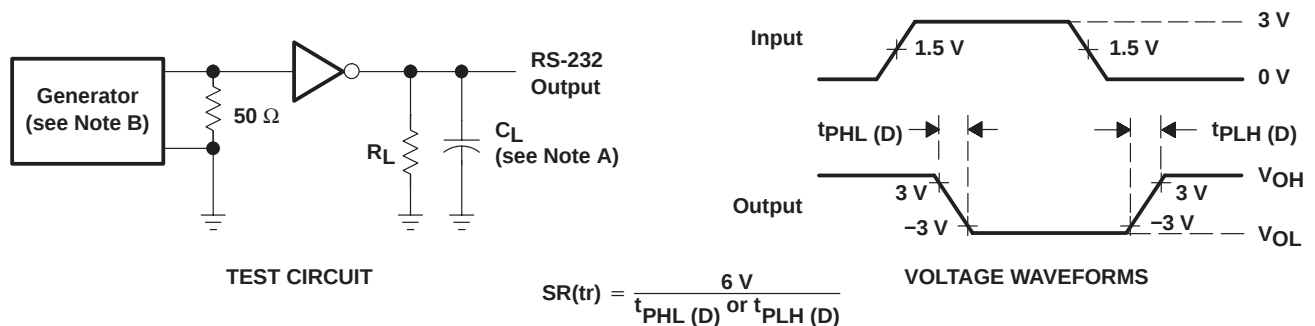
PARAMETER	TEST CONDITIONS	MIN	TYP [†]	MAX	UNIT
t _{PLH} Propagation delay time, low- to high-level output	C _L = 150 pF		0.5	10	μ s
t _{PHL} Propagation delay time, high- to low-level output			0.5	10	μ s
t _{sk(p)} Pulse skew [‡]			300		ns

[†] All typical values are at V_{CC} = 5 V, and T_A = 25°C.

[‡] Pulse skew is defined as |t_{PLH} - t_{PHL}| of each channel of the same device.

NOTE 4: Test conditions are C1–C4 = 0.1 μ F, at V_{CC} = 5 V $\pm$ 0.5 V.

PARAMETER MEASUREMENT INFORMATION



NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 120 kbit/s, Z_O = 50 Ω , 50% duty cycle, t_r $\leq$ 10 ns, t_f $\leq$ 10 ns.

Figure 1. Driver Slew Rate

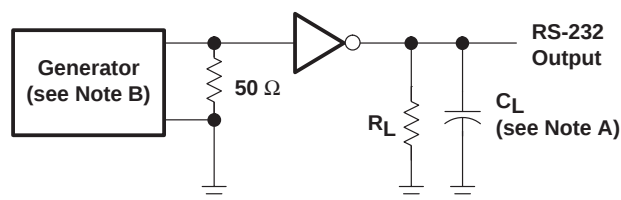
MAX207

5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

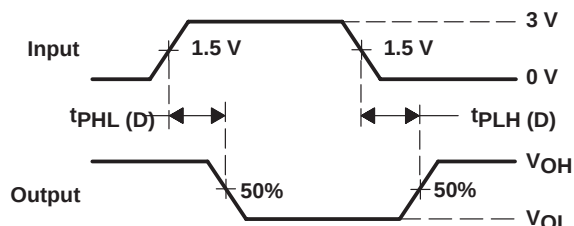
WITH ± 15 -kV ESD PROTECTION

SLLS592B – OCTOBER 2003 – REVISED JANUARY 2004

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT

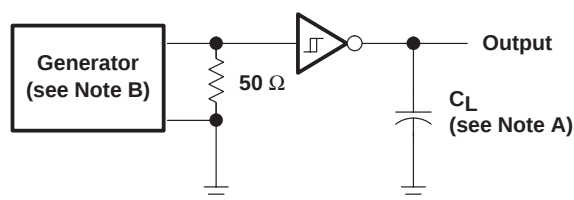


VOLTAGE WAVEFORMS

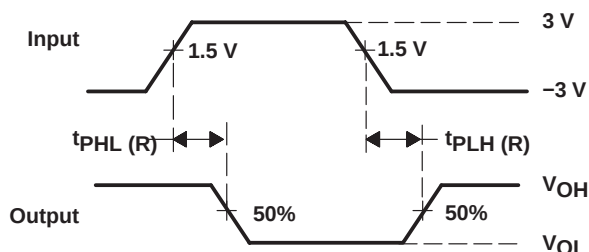
NOTES: A. C_L includes probe and jig capacitance.

B. The pulse generator has the following characteristics: PRR = 120 kbit/s, $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

Figure 2. Driver Pulse Skew



TEST CIRCUIT



VOLTAGE WAVEFORMS

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

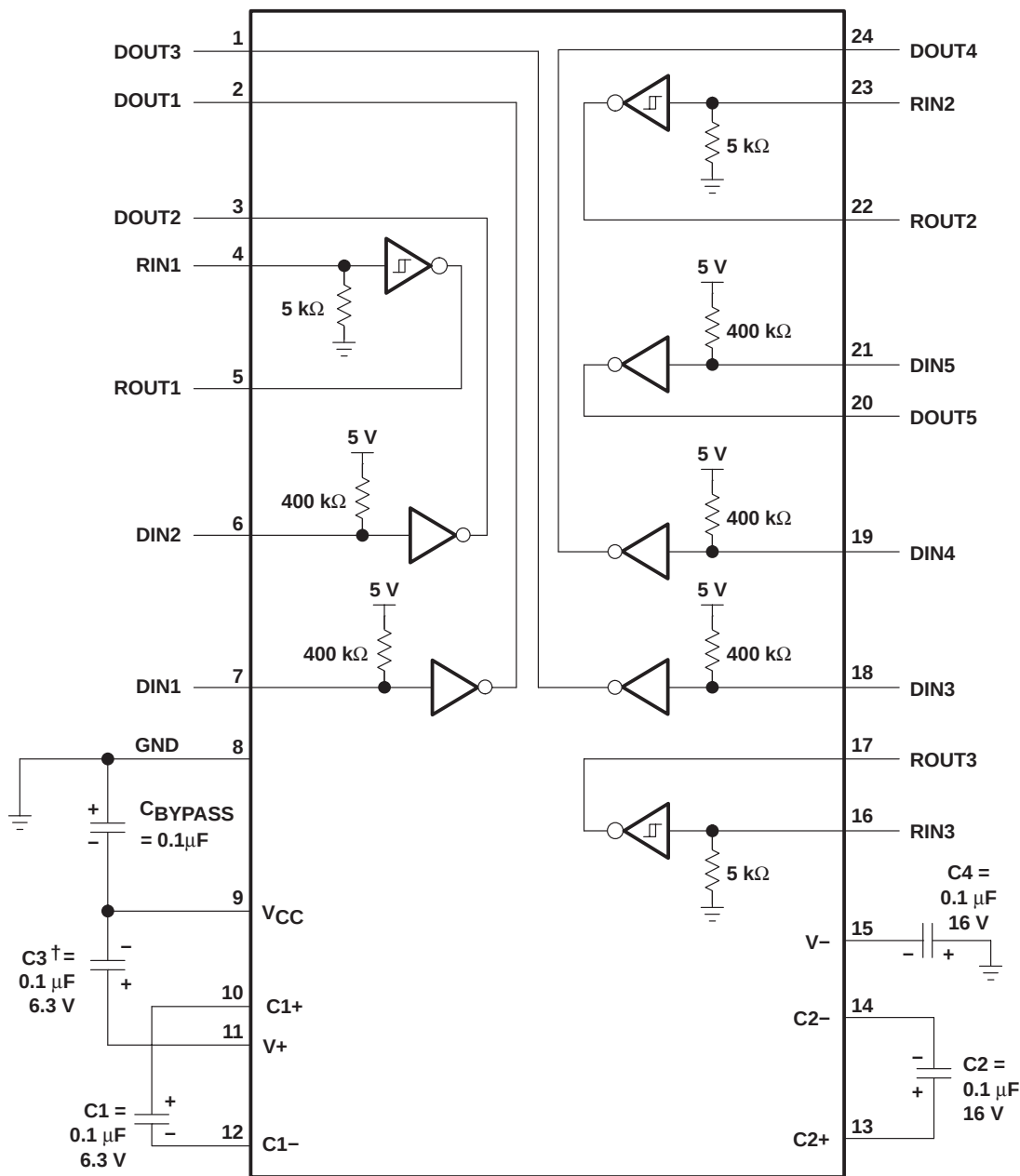
MAX207

5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

WITH ± 15 -kV ESD PROTECTION

SLLS592B – OCTOBER 2003 – REVISED JANUARY 2004

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.

Figure 4. Typical Operating Circuit and Capacitor Values

MAX207

5-V MULTICHANNEL RS-232 LINE DRIVER/RECEIVER

WITH ± 15 -kV ESD PROTECTION

SLLS592B – OCTOBER 2003 – REVISED JANUARY 2004

APPLICATION INFORMATION

capacitor selection

The capacitor type used for C1–C4 is not critical for proper operation. The MAX207 requires 0.1- μ F capacitors, although capacitors up to 10 μ F can be used without harm. Ceramic dielectrics are suggested for the 0.1- μ F capacitors. When using the minimum recommended capacitor values, make sure the capacitance value does not degrade excessively as the operating temperature varies. If in doubt, use capacitors with a larger (e.g., 2 $\times$) nominal value. The capacitors' effective series resistance (ESR), which usually rises at low temperatures, influences the amount of ripple on V+ and V–.

Use larger capacitors (up to 10 μ F) to reduce the output impedance at V+ and V–.

Bypass V_{CC} to ground with at least 0.1 μ F. In applications sensitive to power-supply noise generated by the charge pumps, decouple V_{CC} to ground with a capacitor the same size as (or larger than) the charge-pump capacitors (C1–C4).

ESD protection

TI MAX207 devices have standard ESD protection structures incorporated on the pins to protect against electrostatic discharges encountered during assembly and handling. In addition, the RS232 bus pins (driver outputs and receiver inputs) of these devices have an extra level of ESD protection. Advanced ESD structures were designed to successfully protect these bus pins against ESD discharge of ± 15 -kV when powered down.

ESD test conditions

ESD testing is stringently performed by TI, based on various conditions and procedures. Please contact TI for a reliability report that documents test setup, methodology, and results.

Human-Body Model

The Human-Body Model (HBM) of ESD testing is shown in Figure 5, while Figure 6 shows the current waveform that is generated during a discharge into a low impedance. The model consists of a 100-pF capacitor, charged to the ESD voltage of concern, and subsequently discharged into the device under test (DUT) through a 1.5-k Ω resistor.

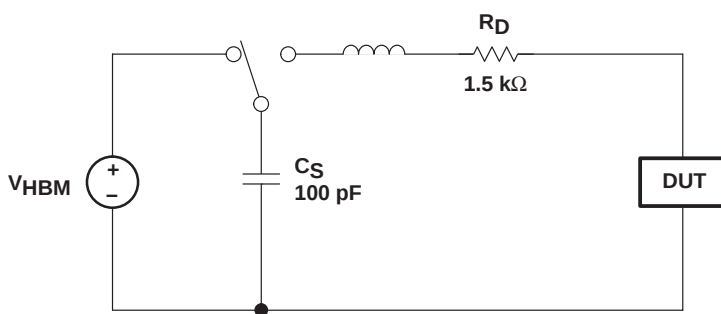


Figure 5. HBM ESD Test Circuit

APPLICATION INFORMATION

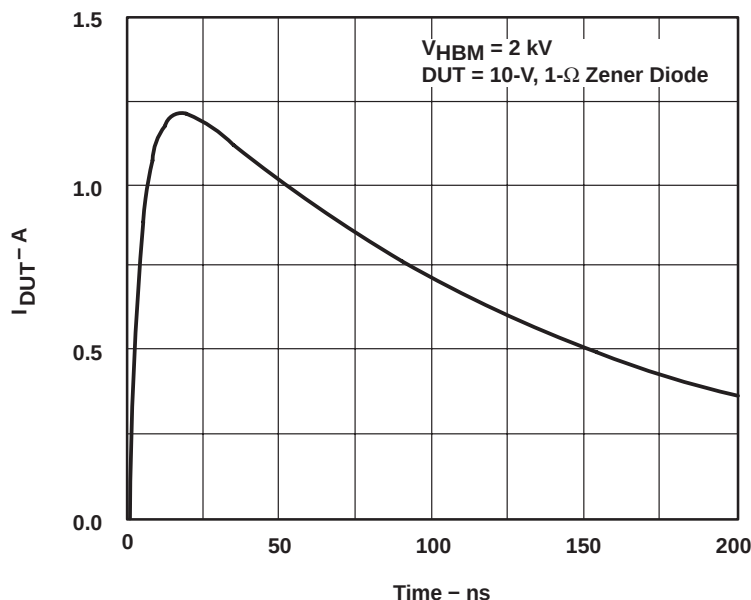


Figure 6. Typical HBM Current Waveform

Machine Model

The Machine Model (MM) ESD test applies to all pins using a 200-pF capacitor with no discharge resistance. The purpose of the MM test is to simulate possible ESD conditions that can occur during the handling and assembly processes of manufacturing. In this case, ESD protection is required for all pins, not just RS-232 pins. However, after PC board assembly, the MM test no longer is as pertinent to the RS-232 pins.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
MAX207CDB	ACTIVE	SSOP	DB	24	60	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
MAX207CDBR	ACTIVE	SSOP	DB	24	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
MAX207CDW	ACTIVE	SOIC	DW	24	25	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
MAX207CDWR	ACTIVE	SOIC	DW	24	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
MAX207IDB	ACTIVE	SSOP	DB	24	60	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
MAX207IDBR	ACTIVE	SSOP	DB	24	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
MAX207IDW	ACTIVE	SOIC	DW	24	25	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
MAX207IDWR	ACTIVE	SOIC	DW	24	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM

⁽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 - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

None: Not yet available Lead (Pb-Free).

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.

Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

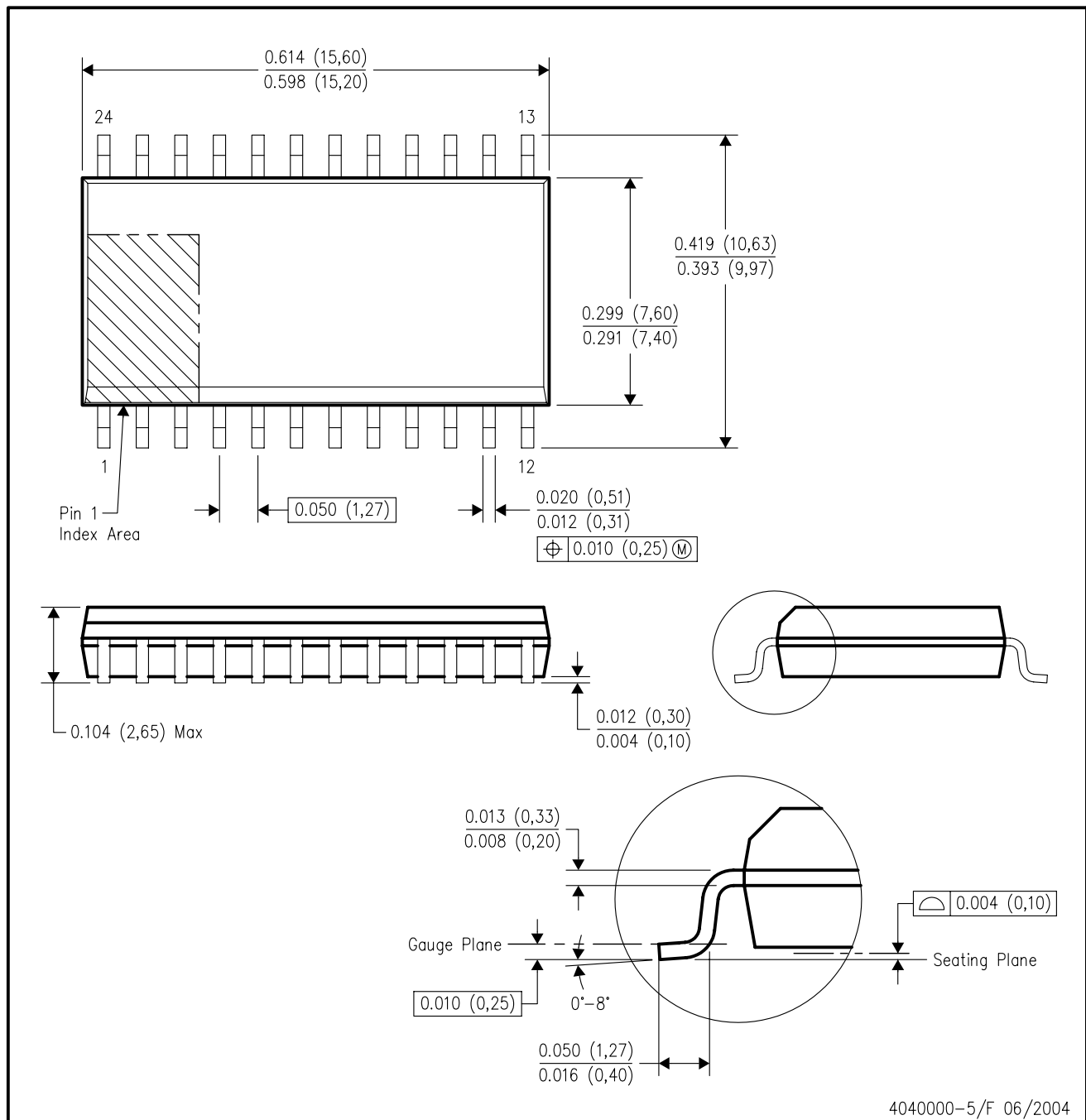
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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.

DW (R-PDSO-G24)

PLASTIC SMALL-OUTLINE PACKAGE

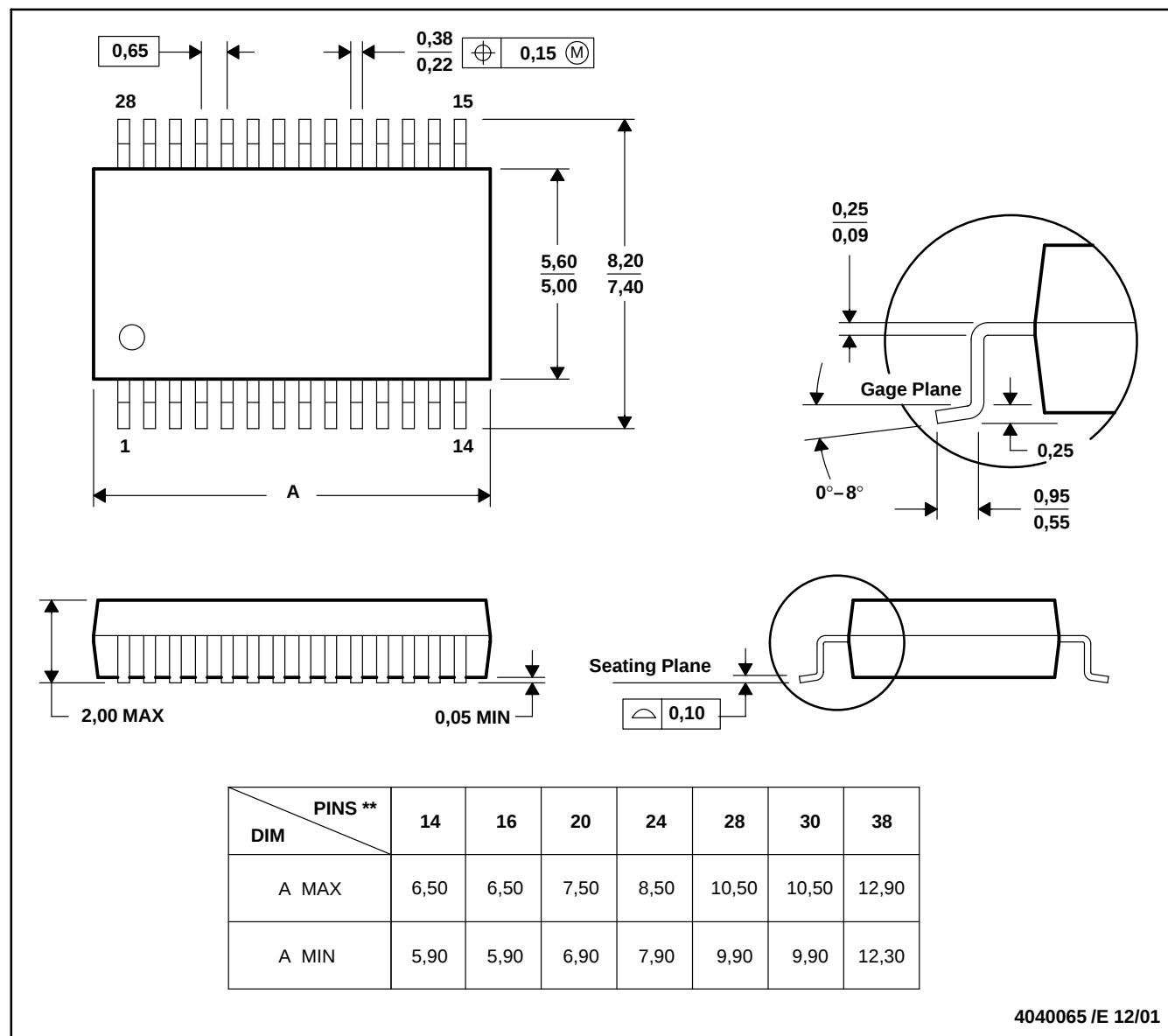


- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - Falls within JEDEC MS-013 variation AD.

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

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265

Copyright © 2005, Texas Instruments Incorporated