

# SN75LBC187 MULTICHANNEL EIA-232 DRIVER/RECEIVER WITH CHARGE PUMP

SLLS130C – SEPTEMBER 1991 – REVISED MAY 1995

- **Single IC and Single 5-V Supply Interface for Serial Communication Ports**
- **Meets or Exceeds the Requirements of ANSI Standards EIA/TIA-232-E-1991, EIA/TIA-562, and ITU Recommendation V.28**
- **Switched-Capacitor Voltage Converter Eliminates Need for  $\pm 12$ -V Supplies**
- **Voltage Converter Operates With Low Capacitance . . . 0.1  $\mu$ F Min**
- **Designed for Data Rates up to 120 kb/s Over 3-m Cable**
- **Available in Shrink Small-Outline 25-mil-Pitch Package**
- **Shutdown Mode to Save Power When Not in Use**
- **$\pm 30$ -V Receiver Input Voltage Range**
- **LinBiCMOS™ Process Technology**
- **Applications**
  - Laptop or Notebook Computers
  - Portable Terminals
  - Single-Board Computers
  - Portable Test Equipment

**DB PACKAGE  
(TOP VIEW)**

DY3	1	28	NC
DY1	2	27	RA3
DY2	3	26	RY3
RA2	4	25	SHUTDOWN
RY2	5	24	NC
DA2	6	23	RA4
DA1	7	22	RY4
RY1	8	21	NC
RA1	9	20	DA3
GND	10	19	RY5
V <sub>CC</sub>	11	18	RA5
C1+	12	17	V <sub>SS</sub>
V <sub>DD</sub>	13	16	C2–
C1–	14	15	C2+

NC – No internal connection

## description

The SN75LBC187 is a low-power LinBiCMOS™ device containing three drivers, five receivers, and a switched-capacitor voltage converter. The SN75LBC187 provides a single chip and single 5-V supply interface between the asynchronous communications element and the serial port connector of the data terminal equipment (DTE). This device has been designed to conform to ANSI Standards EIA/TIA-232-E, EIA/TIA-562, and ITU recommendation V.28.

The switched-capacitor voltage converter of the SN75LBC187 uses four small external capacitors to generate the positive and negative voltages required by EIA/TIA-232-E (and V.28) line drivers from a single 5-V input. The drivers feature output slew-rate limiting to eliminate the need for external filter capacitors. The receivers can accept  $\pm 30$  V without damage. The device also features a reduced power or shutdown mode that cuts the quiescent power to the IC when not transmitting data between the CPU and peripheral.

The SN75LBC187 has been designed using LinBiCMOS™ technology and cells contained in the Texas Instruments LinASIC™ library. The SN75LBC187 is characterized for operation from 0°C to 70°C.

### NOTE:

This device includes circuit designs and process technologies that have patents pending.



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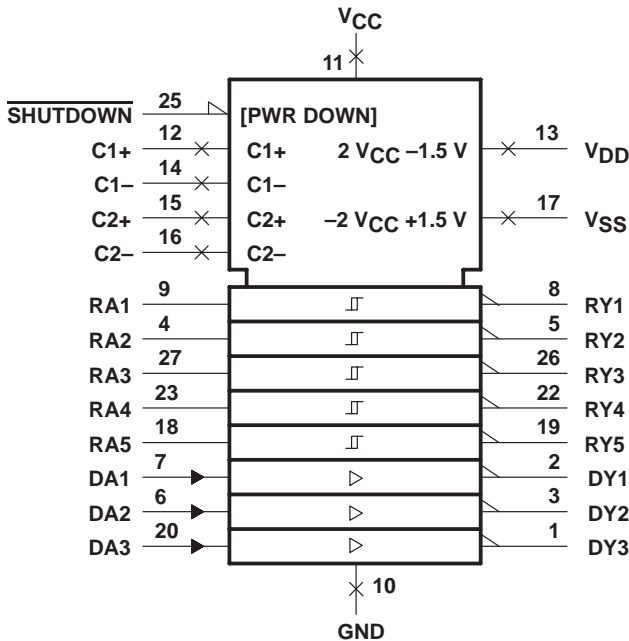
# SN75LBC187

## MULTICHANNEL EIA-232 DRIVER/RECEIVER

### WITH CHARGE PUMP

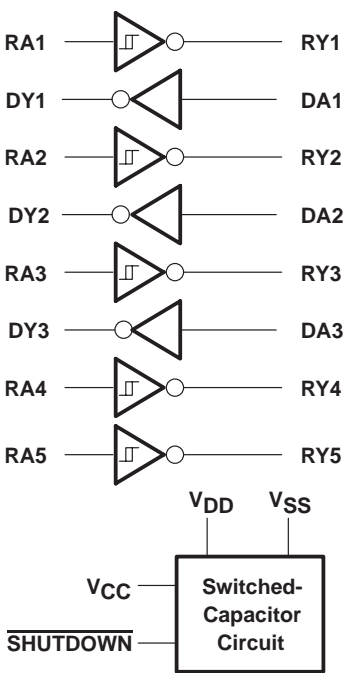
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logic symbol†



† This symbol is in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)‡

Supply voltage range, V <sub>CC</sub> (see Note 1)	0.3 V to 6 V
Positive output supply voltage range, V <sub>DD</sub>	V <sub>CC</sub> - 0.3 V to 15 V
Negative output supply voltage range, V <sub>SS</sub>	0.3 V to -15 V
Input voltage range, V <sub>I</sub> : RA	±30 V
All other inputs	-0.3 V to V <sub>CC</sub> + 3 V
Output voltage range, V <sub>O</sub> : DY	-2 V <sub>CC</sub> + 1.2 V to 2 V <sub>CC</sub> - 1.2 V
All other outputs	-0.3 V to V <sub>CC</sub> + 3 V
Continuous total power dissipation	See Dissipation Rating Table
Operating free-air temperature range, T <sub>A</sub>	0°C to 70°C
Storage temperature range, T <sub>stg</sub>	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°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.

NOTE 1: All voltages are with respect to the network ground terminal.

DISSIPATION RATING TABLE

PACKAGE	T <sub>A</sub> ≤ 25°C POWER RATING	DERATING FACTOR ABOVE T <sub>A</sub> = 25°C	T <sub>A</sub> = 70°C POWER RATING
DB	1025 mW	8.2 mW/°C	656 mW

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**recommended operating conditions**

		MIN	NOM	MAX	UNIT	
Supply voltage, V <sub>CC</sub>		4.5	5	5.5	V	
High-level input voltage, V <sub>IH</sub>	DA	2			V	
	RA, <u>SHUTDOWN</u>	2.4				
Low-level input voltage, V <sub>IL</sub>	RA, DA, <u>SHUTDOWN</u>	0.8			V	
Receiver input voltage, V <sub>I</sub>		−25			25	V
High-level output current, I <sub>OH</sub>	RY				−1	mA
Low-level output current, I <sub>OL</sub>	RY				3.2	mA
Output current, I <sub>O</sub>	V <sub>DD</sub>				±10	μA
	V <sub>SS</sub>				±10	μA
C1, C2, C3, C4 charge pump capacitors		0.1	0.47			μF
Operating free-air temperature, T <sub>A</sub>		0		70		°C

**electrical characteristics over recommended operating conditions (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
$V_{OH}$ High-level output voltage	Receiver	$I_O = -1$ mA	3.5			V
	Driver	$R_L = 3$ k $\Omega$ to GND	5	7		
$V_{OL}$ Low-level output voltage	Receiver	$I_O = 3.2$ mA			0.4	V
	Driver	$R_L = 3$ k $\Omega$ to GND		–7	–5	
$V_{IT+}$ Receiver positive-going input voltage threshold				1.7	2.4	V
$V_{IT-}$ Receiver negative-going input voltage threshold			0.8	1.2		V
$V_{hys}$ Receiver input hysteresis voltage ( $V_{IT+} - V_{IT-}$ )				0.5	1	V
$r_i$ Receiver input resistance		$V_{CC} = 5$ V, $T_A = 25^{\circ}C$	3	5	7	k $\Omega$
$r_o$ Driver output resistance		$V_{CC} = 0$ , $V_O = \pm 2$ V	300			$\Omega$
$I_I$ Input current (DA, <u>SHUTDOWN</u> )		$V_I = 0$ to $V_{CC}$			$\pm 50$	$\mu A$
$I_{OS}$ Driver output short-circuit current		$V_O = 0$	$\pm 10$			mA
$I_{CC}$ Supply current	Normal operation	All outputs open, <u>SHUTDOWN</u> at 2.4 V		15	30	mA
	Shutdown mode	All outputs open, <u>SHUTDOWN</u> at 0.1 V			10	$\mu A$

† All typical values are at  $V_{CC} = 5$  V and  $T_A = 25^{\circ}C$ .

# SN75LBC187

## MULTICHANNEL EIA-232 DRIVER/RECEIVER WITH CHARGE PUMP

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switching characteristics over recommended operating conditions,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	MAX	UNIT
$t_{PLH}$ Propagation delay time, low- to high-level output	Receiver	$R_L = 5\text{ k}\Omega$ , See Figure 1	$C_L = 50\text{ pF}$ ,		1.25	$\mu\text{s}$
	Driver	$R_L = 3\text{ k}\Omega$ , See Figure 2	$C_L = 1200\text{ pF}$ ,		1.25	$\mu\text{s}$
$t_{PHL}$ Propagation delay time, high- to low-level output	Receiver	$R_L = 5\text{ k}\Omega$ , See Figure 1	$C_L = 50\text{ pF}$ ,		1.25	$\mu\text{s}$
	Driver	$R_L = 3\text{ k}\Omega$ , See Figure 2	$C_L = 1200\text{ pF}$ ,		1.25	$\mu\text{s}$
$t_r$ Rise time, driver output		$R_L = 3\text{ k}\Omega$ , $V_O = -3\text{ V to } 3\text{ V}$ ,	$C_L = 50\text{ pF}$ , See Note 2	200		ns
		$R_L = 3\text{ k}\Omega$ , $V_O = -3.3\text{ V to } 3.3\text{ V}$ ,	$C_L = 2500\text{ pF}$ , See Note 3		1.5	$\mu\text{s}$
$t_f$ Fall time, driver output		$R_L = 3\text{ k}\Omega$ , $V_O = 3\text{ V to } -3\text{ V}$	$C_L = 50\text{ pF}$ ,	200		ns
		$R_L = 3\text{ k}\Omega$ , $V_O = 3.3\text{ V to } -3.3\text{ V}$	$C_L = 2500\text{ pF}$ ,		1.5	$\mu\text{s}$

NOTES: 2. The 200 ns for the output to change from  $-3\text{ V}$  to  $3\text{ V}$  (or vice versa) corresponds to the  $30\text{ V}/\mu\text{s}$  maximum slew rate of EIA/TIA-232-E, EIA/TIA-562, and ITU Recommendation V.28.

3. The more stringent requirement for transition times comes from the EIA/TIA-562, which requires the rise and fall times to be measured from  $3.3\text{ V}$ .



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## PARAMETER MEASUREMENT INFORMATION

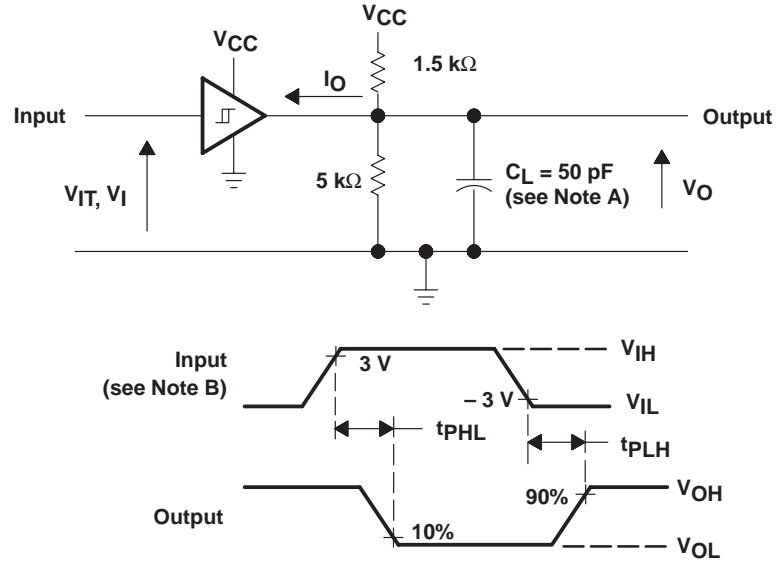
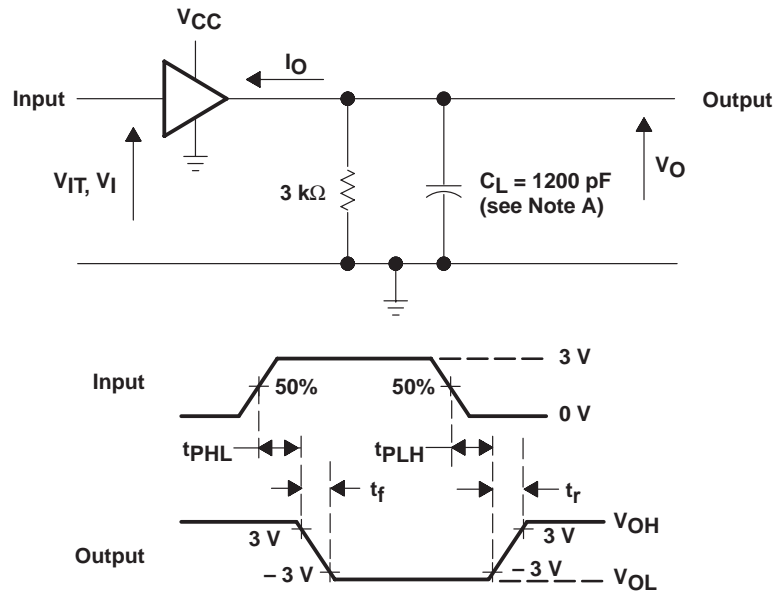


Figure 1. Receiver Test Circuit and Waveforms



NOTES: A.  $C_L$  includes probe and jig capacitance.

B. The pulse generator has the following characteristics:  $t_W = 8.33\text{ }\mu\text{s}$ ,  $\text{PRR} = 60\text{ kHz}$ ,  $t_r = t_f \leq 50\text{ ns}$ .

Figure 2. Driver Test Circuit and Waveforms

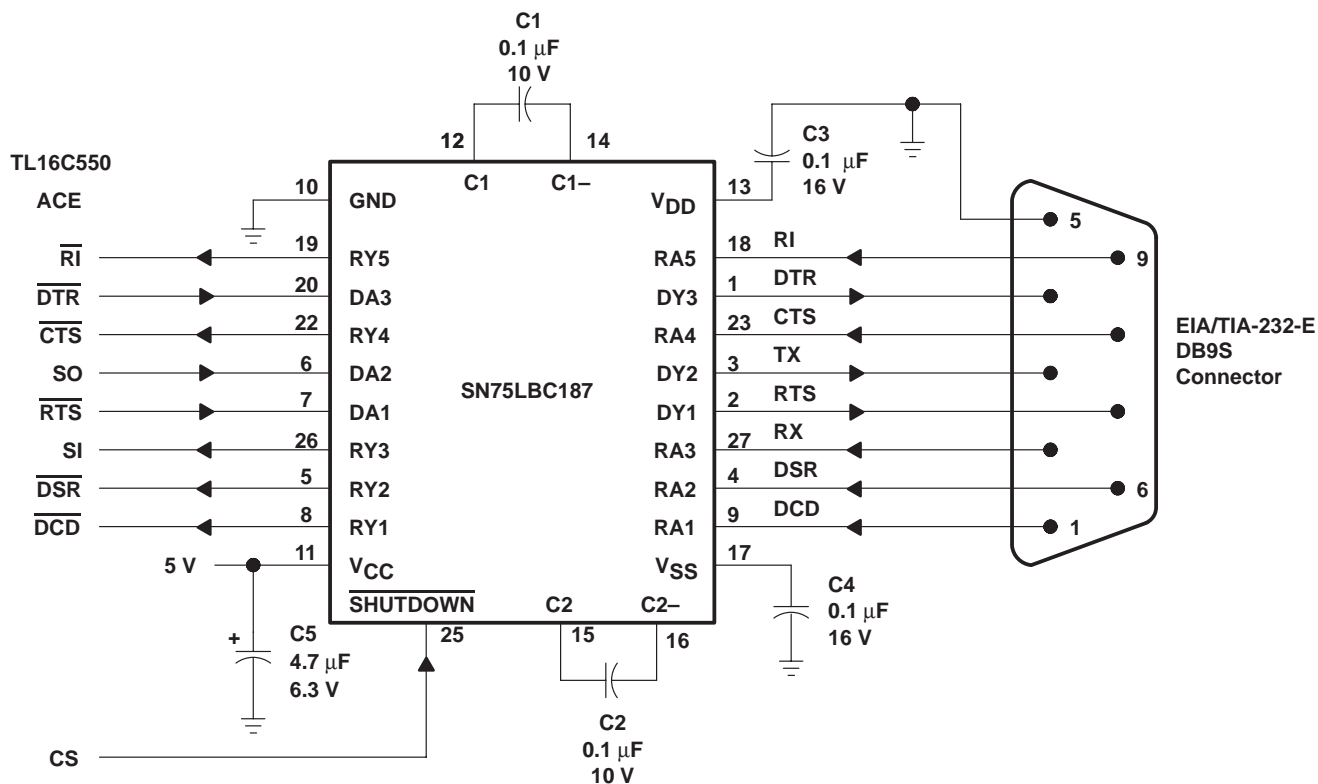
# SN75LBC187

## MULTICHANNEL EIA-232 DRIVER/RECEIVER

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#### APPLICATION INFORMATION



NOTE: C1, C2, C3, and C4 are Z5U-type ceramic-chip capacitors.

Figure 3. Typical SN75LBC187 Connection

**SN75LBC187**  
**MULTICHANNEL EIA-232 DRIVER/RECEIVER**  
**WITH CHARGE PUMP**

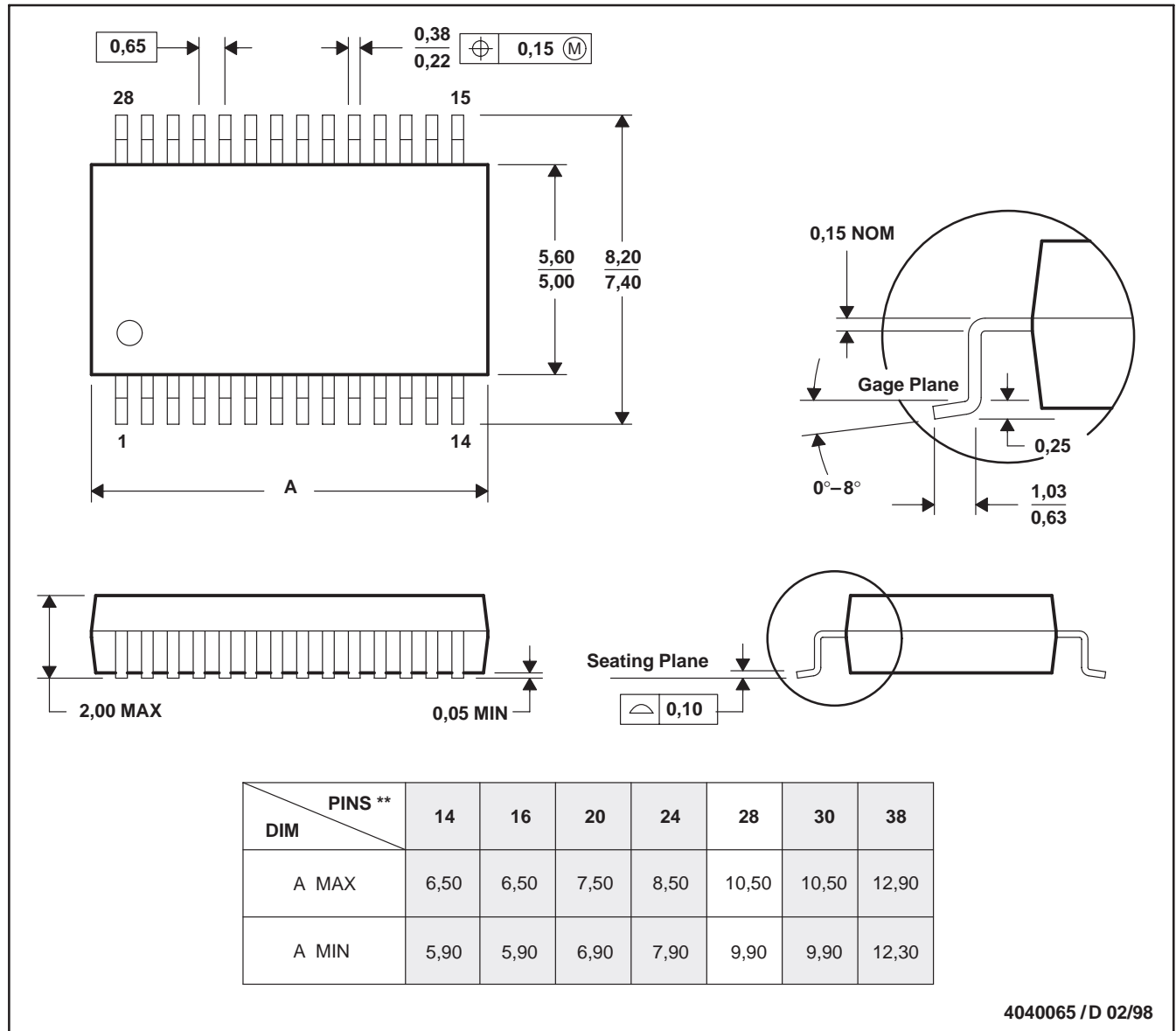
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**MECHANICAL DATA**

**DB (R-PDSO-G\*\*)**

**PLASTIC SMALL-OUTLINE PACKAGE**

**28 PIN 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

## 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)
<a href="#">SN75LBC187DBR</a>	Active	Production	SSOP (DB)   28	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	75LBC187
SN75LBC187DBR.A	Active	Production	SSOP (DB)   28	2000   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	0 to 70	75LBC187

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **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.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **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.

<sup>(5)</sup> **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.

<sup>(6)</sup> **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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## TAPE AND REEL INFORMATION



\*All dimensions are nominal

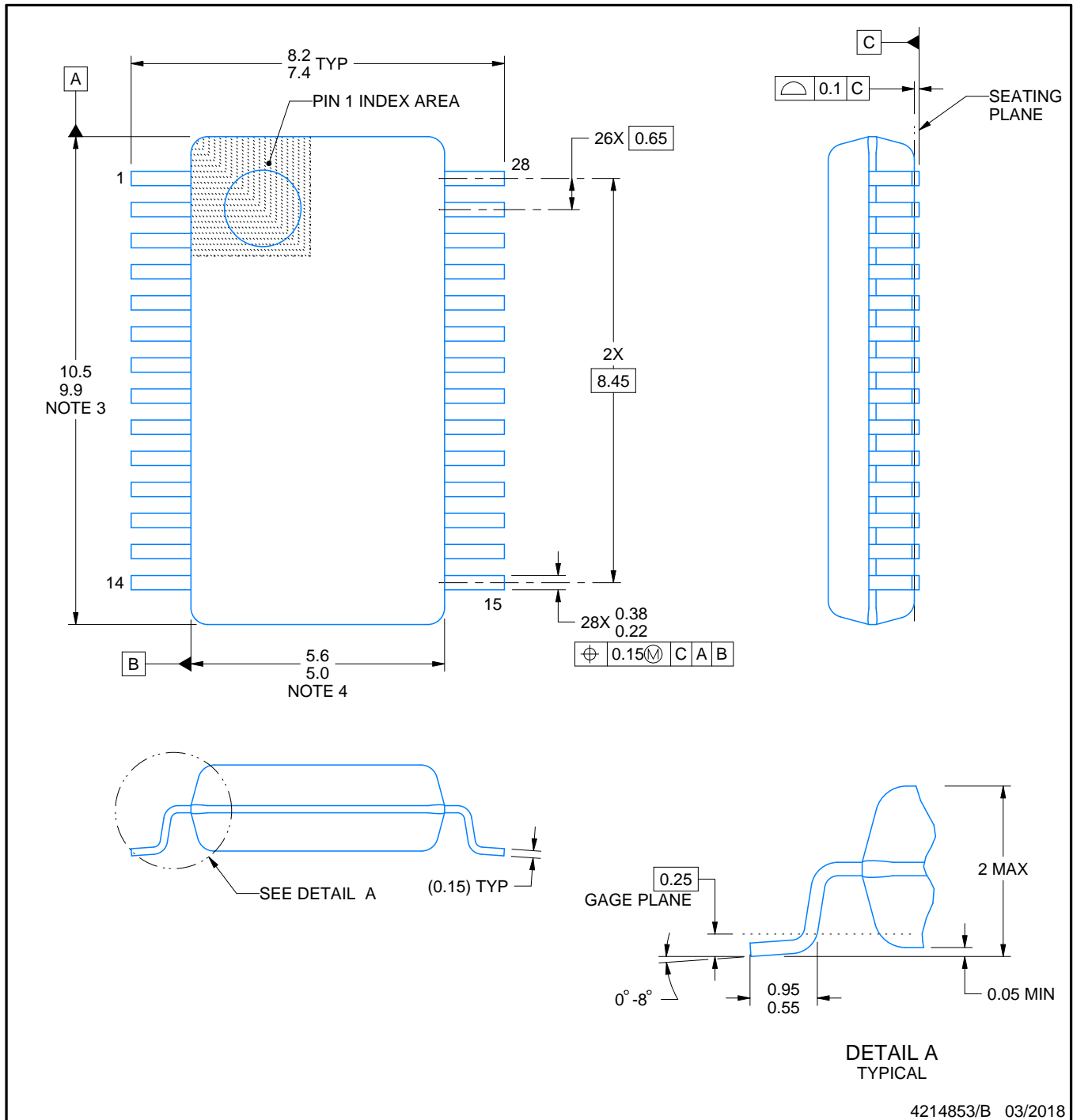
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN75LBC187DBR	SSOP	DB	28	2000	330.0	16.4	8.45	10.55	2.5	12.0	16.2	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN75LBC187DBR	SSOP	DB	28	2000	353.0	353.0	32.0



## NOTES:

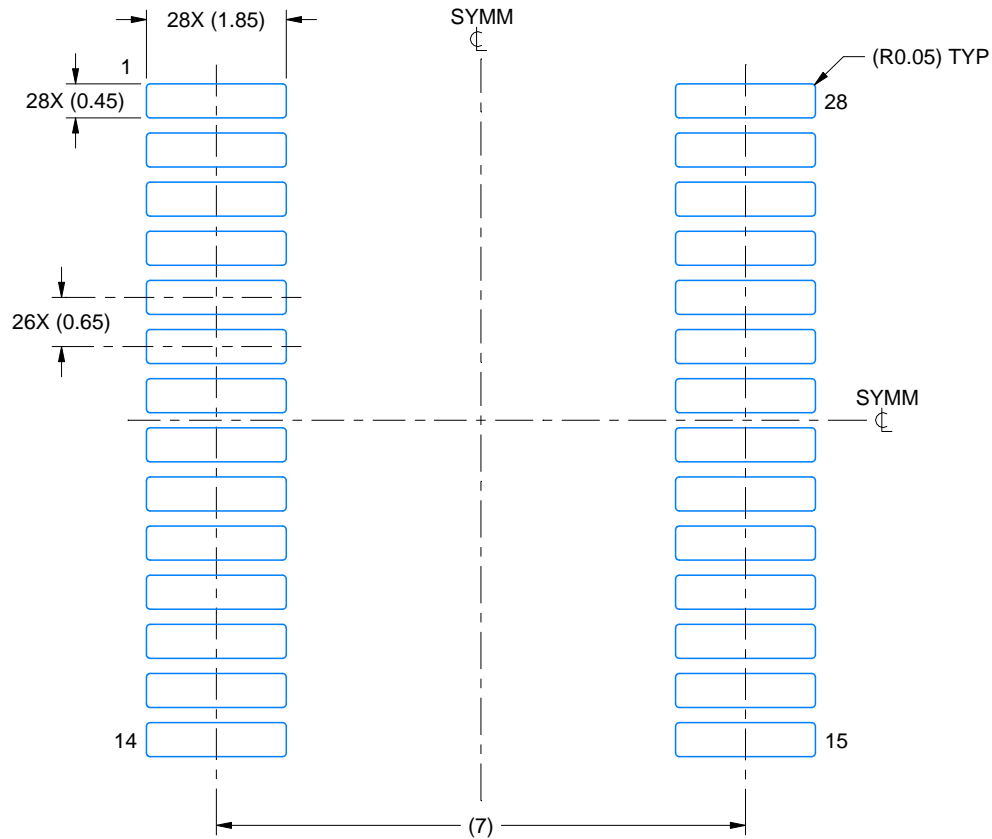
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-150.

# EXAMPLE BOARD LAYOUT

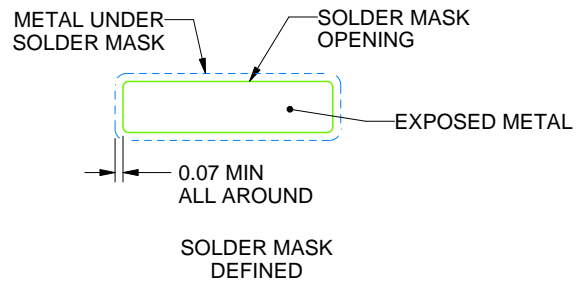
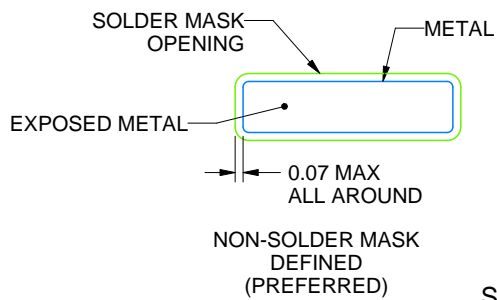
DB0028A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



SOLDER MASK DETAILS

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NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

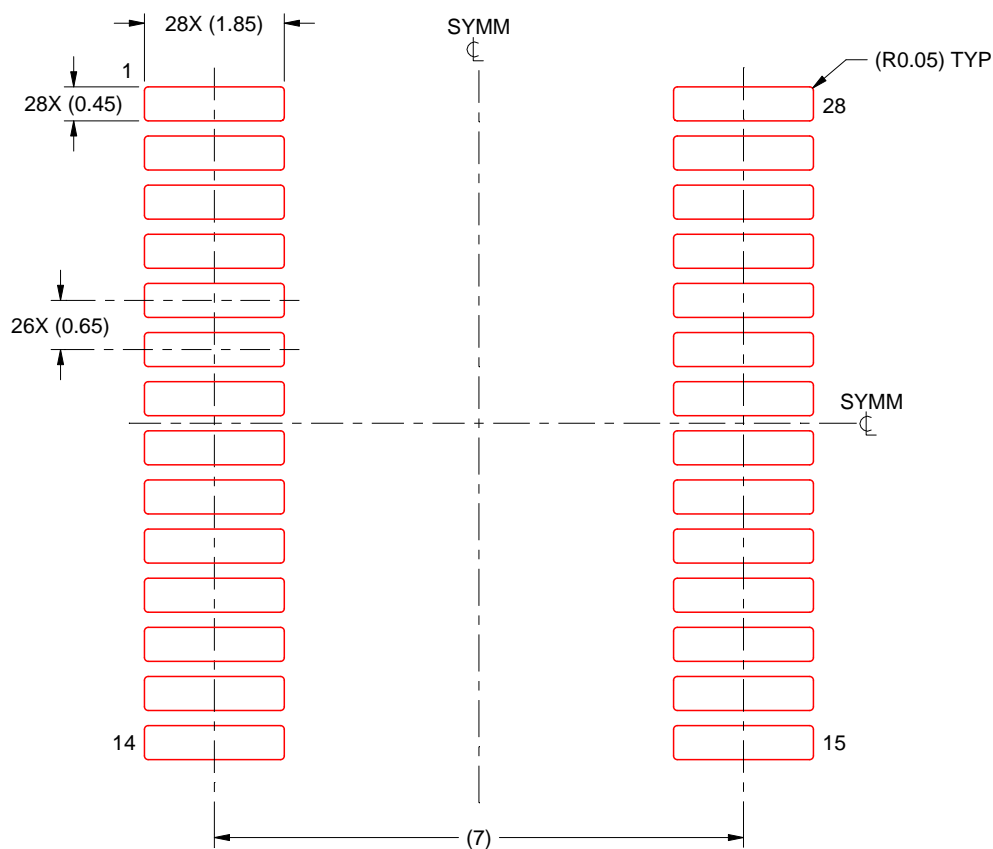
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

DB0028A

SSOP - 2 mm max height

SMALL OUTLINE PACKAGE



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

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NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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