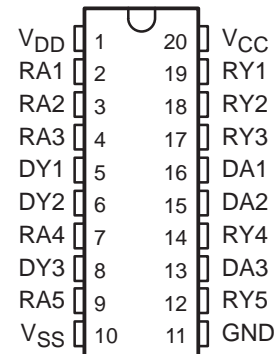


# SN75LP185A LOW-POWER MULTIPLE RS-232 DRIVERS AND RECEIVERS

SLLS257G – AUGUST 1996 – REVISED SEPTEMBER 1998

- **Single-Chip TIA/EIA-232-F Interface for IBM™ PC/AT™ Serial Port**
- **Designed to Transmit and Receive 4-μs Pulses (Equivalent to 256 kbit/s)**
- **Less Than 21-mW Power Consumption**
- **Wide Supply-Voltage Range, 4.75 V to 15 V**
- **Driver Output Slew Rates Are Internally Controlled to 30 V/μs Max**
- **Receiver Input Hysteresis, 1000 mV Typ**
- **TIA/EIA-232-F Bus-Pin ESD Protection Exceeds:**
  - 15-kV, Human-Body Model
  - 15-kV IEC1000-4-2, Air Gap
  - 8-kV IEC1000-4-2, Contact
- **Three Drivers and Five Receivers Meet or Exceed the Requirements of TIA/EIA-232-F and ITU V.28**
- **Complements the SN75LP196**
- **Designed to Replace the Industry-Standard SN75185 and SN75C185 With the Same Flow-Through Pinout**
- **Packaged in Plastic Small-Outline Package**

**DW PACKAGE  
(TOP VIEW)**



## description

The SN75LP185A is a low-power bipolar device containing three drivers and five receivers with 15 kV of ESD protection on the bus pins with respect to each other. Bus pins are defined as those pins that tie directly to the serial-port connector, including GND. The pinout matches the flow-through design of the industry-standard SN75185 and SN75C185. The flow-through pinout of the SN75LP185A allows easy interconnection of the UART and serial-port connector of the IBM PC/AT and compatibles. The SN75LP185A provides a rugged, low-cost solution for this function with the combination of the bipolar processing and 15 kV of ESD protection.

The SN75LP185A has internal slew-rate control to provide a maximum rate of change in the output signal of 30 V/μs. The driver output swing is nominally clamped at ±6 V to enable the higher data rates associated with this device and to reduce EMI emissions. Even though the driver outputs are clamped, they can handle voltages up to ±15 V without damage. All the logic inputs can accept 3.3-V or 5-V input signals.

The SN75LP185A complies with the requirements of TIA/EIA-232-F and ITU V.28. These standards are for data interchange between a host computer and peripheral at signaling rates up to 20 kbit/s. The switching speeds of the SN75LP185A support rates up to 256 kbit/s.

The SN75LP185A is characterized for operation from 0°C to 70°C.



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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**

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SN75LP185A  
LOW-POWER MULTIPLE RS-232 DRIVERS AND RECEIVERS

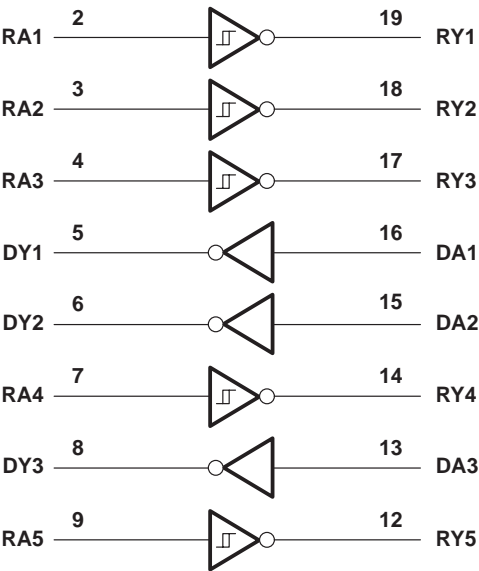
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Function Tables

| DRIVER      |              |
|-------------|--------------|
| INPUT<br>DA | OUTPUT<br>DY |
| H           | L            |
| L           | H            |
| Open        | L            |

| RECEIVER    |              |
|-------------|--------------|
| INPUT<br>RA | OUTPUT<br>RY |
| H           | L            |
| L           | H            |
| Open        | H            |

logic diagram (positive logic)



# SN75LP185A

## LOW-POWER MULTIPLE RS-232 DRIVERS AND RECEIVERS

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### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

|   |                          |
|---|--------------------------|
| Positive supply-voltage range (see Note 1): $V_{CC}$ .....              | –0.5 V to 7 V            |
| $V_{DD}$ (see Note 1) .....   | –0.5 V to 15 V           |
| Negative supply-voltage range, $V_{SS}$ (see Note 1) .....              | 0.5 V to –15 V           |
| Input-voltage range, $V_I$ : Receiver (RA) .....                        | –30 V to 30 V            |
| Driver (DA) .....   | –0.5 V to $V_{CC}+0.4$ V |
| Output-voltage range, $V_O$ : Receiver (RY) .....                       | –0.5 V to 6 V            |
| Driver (DY) .....   | –15 V to 15 V            |
| Electrostatic discharge (see Note 2): Bus pins (human-body model) ..... | Class 3, A: 15 kV        |
| Bus pins (machine model) .....  | Class 3, B: 500 V        |
| Bus pins (IEC1000-4-2, contact) .....                                   | Class 3, C: 8 kV         |
| Bus pins (IEC1000-4-2, air gap) .....                                   | Class 3, D: 15 kV        |
| All pins (human-body model) .....                                       | Class 3, A: 5 kV         |
| All pins (machine model) .....  | Class 3, B: 400 V        |
| Package thermal impedance, $\theta_{JA}$ (see Note 3) .....             | 97°C/W                   |
| Storage temperature range, $T_{stg}$ .....                              | 65°C to 150°C            |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .....      | 260°C                    |

<sup>†</sup> 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 voltage values are with respect to network ground terminal, unless otherwise noted.  
 2. Per MIL-STD-883 Method 3015.7  
 3. The package thermal impedance is calculated in accordance with JESD 51.

### recommended operating conditions

|          |                                | MIN  | NOM | MAX  | UNIT |
|----------|--------------------------------|------|-----|------|------|
| $V_{CC}$ | Supply voltage (see Note 4)    | 4.75 | 5   | 5.25 | V    |
| $V_{DD}$ | Supply voltage (see Note 5)    | 9    | 12  | 15   | V    |
| $V_{SS}$ | Supply voltage (see Note 5)    | –9   | –12 | –15  | V    |
| $V_{IH}$ | High-level input voltage       | DA   | 2   |      | V    |
| $V_{IL}$ | Low-level input voltage        | DA   |     | 0.8  | V    |
| $V_I$    | Receiver input voltage         | RA   | –25 | 25   | V    |
| $I_{OH}$ | High-level output current      | RY   |     | –1   | mA   |
| $I_{OL}$ | Low-level output current       | RY   |     | 2    | mA   |
| $T_A$    | Operating free-air temperature | 0    |     | 70   | °C   |

- NOTES: 4.  $V_{CC}$  cannot be greater than  $V_{DD}$ .  
 5. The device operates down to  $V_{DD} = V_{CC}$  and  $|V_{SS}| = V_{CC}$ , but supply currents increase and other parameters may vary slightly from the data-sheet limits.



# SN75LP185A

## LOW-POWER MULTIPLE RS-232 DRIVERS AND RECEIVERS

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### supply currents over the recommended operating conditions (unless otherwise noted)

| PARAMETER                              | TEST CONDITIONS   | MIN | TYP | MAX  | UNIT          |
|--|---|-----|-----|------|---------------|
| Supply current for $V_{CC}$ , $I_{CC}$ | $V_{DD} = 9\text{ V}$ , $V_{SS} = -9\text{ V}$  |     |     | 1000 | $\mu\text{A}$ |
|  | $V_{DD} = 12\text{ V}$ , $V_{SS} = -12\text{ V}$  |     |     | 1000 |               |
| Supply current for $V_{DD}$ , $I_{DD}$ | No load,<br>All inputs at minimum $V_{OH}$ or<br>maximum $V_{OL}$<br>$V_{DD} = 9\text{ V}$ , $V_{SS} = -9\text{ V}$ |     |     | 450  |               |
|  | $V_{DD} = 12\text{ V}$ , $V_{SS} = -12\text{ V}$  |     |     | 450  |               |
| Supply current for $V_{SS}$ , $I_{SS}$ | $V_{DD} = 9\text{ V}$ , $V_{SS} = -9\text{ V}$  |     |     | -625 |               |
|  | $V_{DD} = 12\text{ V}$ , $V_{SS} = -12\text{ V}$  |     |     | -625 |               |

### driver electrical characteristics over the recommended operating conditions (unless otherwise noted)

| PARAMETER   | TEST CONDITIONS   | MIN | TYP† | MAX  | UNIT          |
|---|---|-----|------|------|---------------|
| $V_{OH}$ High-level output voltage                  | $V_{IL} = 0.8\text{ V}$ ,<br>$R_L = 3\text{ k}\Omega$ ,<br>See Figure 1<br>$V_{DD} = 9\text{ V}$ , $V_{SS} = -9\text{ V}$ | 5   | 5.8  | 6.6  | V             |
|   | $V_{DD} = 12\text{ V}$ , $V_{SS} = -12\text{ V}$ , See Note 6   | 5   | 5.8  | 6.6  |               |
| $V_{OL}$ Low-level output voltage                   | $V_{IH} = 2\text{ V}$ ,<br>$R_L = 3\text{ k}\Omega$ ,<br>See Figure 1<br>$V_{DD} = 9\text{ V}$ , $V_{SS} = -9\text{ V}$   | -5  | -5.8 | -6.9 | V             |
|   | $V_{DD} = 12\text{ V}$ , $V_{SS} = -12\text{ V}$ , See Note 6   | -5  | -5.9 | -6.9 |               |
| $I_{IH}$ High-level input current                   | $V_I$ at $V_{CC}$   |     |      | 1    | $\mu\text{A}$ |
| $I_{IL}$ Low-level input current                    | $V_I$ at GND  |     |      | -1   | $\mu\text{A}$ |
| $I_{OS(H)}$ Short-circuit high-level output current | $V_O = \text{GND or } V_{SS}$ , See Figure 2 and Note 7   |     | -30  | -55  | mA            |
| $I_{OS(L)}$ Short-circuit low-level output current  | $V_O = \text{GND or } V_{DD}$ , See Figure 2 and Note 7   |     | 30   | 55   | mA            |
| $r_o$ Output resistance                             | $V_{DD} = V_{SS} = V_{CC} = 0$ , $V_O = 2\text{ V}$   | 300 |      |      | $\Omega$      |

NOTES: 6. Maximum output swing is nominally clamped at  $\pm 6\text{ V}$  to enable the higher data rates associated with this device and to reduce EMI emissions. The driver outputs may slightly exceed the maximum output voltage over the full  $V_{CC}$  and temperature ranges.  
7. Not more than one output should be shorted at one time.

# SN75LP185A

## LOW-POWER MULTIPLE RS-232 DRIVERS AND RECEIVERS

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### driver switching characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER        |   | TEST CONDITIONS  |   | MIN | TYP | MAX  | UNIT |
|------------------|---|--|---|-----|-----|------|------|
| t <sub>PHL</sub> | Propagation delay time, high- to low-level output | R <sub>L</sub> = 3 kΩ to 7 kΩ, C <sub>L</sub> = 15 pF, See Figure 1  |   | 300 | 800 | 1600 | ns   |
| t <sub>PLH</sub> | Propagation delay time, low- to high-level output | R <sub>L</sub> = 3 kΩ to 7 kΩ, C <sub>L</sub> = 15 pF, See Figure 1  |   | 300 | 800 | 1600 | ns   |
| t <sub>TLH</sub> | Transition time, low- to high-level output        | V <sub>CC</sub> = 5 V,<br>V <sub>DD</sub> = 12 V,<br>V <sub>SS</sub> = −12 V,<br>R <sub>L</sub> = 3 kΩ to 7 kΩ,<br>See Figure 1 and Note 9 | Using V <sub>TR</sub> = 10%-to-90% transition region,<br>Driver speed = 250 kbit/s, C <sub>L</sub> = 15 pF,<br>See Note 8 | 375 |     | 2240 | ns   |
|                  |   |  | Using V <sub>TR</sub> = ±3 V transition region,<br>Driver speed = 250 kbit/s, C <sub>L</sub> = 15 pF                      | 200 |     | 1500 |      |
|                  |   |  | Using V <sub>TR</sub> = ±2 V transition region,<br>Driver speed = 250 kbit/s, C <sub>L</sub> = 15 pF                      | 133 |     | 1000 |      |
|                  |   |  | Using V <sub>TR</sub> = ±3 V transition region,<br>Driver speed = 125 kbit/s, C <sub>L</sub> = 2500 pF                    |     |     | 2750 |      |
| t <sub>THL</sub> | Transition time, high- to low-level output        | V <sub>CC</sub> = 5 V,<br>V <sub>DD</sub> = 12 V,<br>V <sub>SS</sub> = −12 V,<br>R <sub>L</sub> = 3 kΩ to 7 kΩ,<br>See Figure 1 and Note 9 | Using V <sub>TR</sub> = 10%-to-90% transition region,<br>Driver speed = 250 kbit/s, C <sub>L</sub> = 15 pF,<br>See Note 8 | 375 |     | 2240 | ns   |
|                  |   |  | Using V <sub>TR</sub> = ±3 V transition region,<br>Driver speed = 250 kbit/s, C <sub>L</sub> = 15 pF                      | 200 |     | 1500 |      |
|                  |   |  | Using V <sub>TR</sub> = ±2 V transition region,<br>Driver speed = 250 kbit/s, C <sub>L</sub> = 15 pF                      | 133 |     | 1000 |      |
|                  |   |  | Using V <sub>TR</sub> = ±3 V transition region,<br>Driver speed = 125 kbit/s, C <sub>L</sub> = 2500 pF                    |     |     | 2750 |      |
| SR               | Output slew rate                                  | V <sub>CC</sub> = 5 V,<br>V <sub>DD</sub> = 12 V,<br>V <sub>SS</sub> = −12 V   | Using V <sub>TR</sub> = ±3 V transition region,<br>Driver speed = 0 to 250 kbit/s, C <sub>L</sub> = 15 pF                 | 4   | 20  | 30   | V/us |

NOTES: 8. Equivalent to the SN75C185. The SN75LP185A output-voltage swing is clamped to about 70% of the typical SN75C185 output-voltage swing, and the specified limits reflect the reduced output swing.  
9. Maximum output swing is limited to ±6 V to enable the higher data rates associated with this device and to reduce EMI emissions.

### receiver electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER  | TEST CONDITIONS  | MIN   | TYP  | MAX  | UNIT |
|--|--|-------|------|------|------|
| V <sub>IT+</sub> Positive-going input threshold voltage              | See Figure 3   | 1.6   | 2    | 2.55 | V    |
| V <sub>IT-</sub> Negative-going input threshold voltage              | See Figure 3   | 0.6   | 1    | 1.45 | V    |
| V <sub>HYS</sub> Input hysteresis, V <sub>IT+</sub> V <sub>IT-</sub> | See Figure 3   | 600   | 1000 |      | mV   |
| V <sub>OH</sub> High-level output voltage                            | I <sub>OH</sub> = -1 mA                                    | 2.5   | 3.9  |      | V    |
| V <sub>OL</sub> Low-level output voltage                             | I <sub>OL</sub> = 2 mA                                     |       | 0.33 | 0.5  | V    |
| I <sub>IH</sub> High-level input current                             | V <sub>I</sub> = 3 V                                       | 0.43  | 0.6  | 1    | mA   |
|  | V <sub>I</sub> = 25 V                                      | 3.6   | 5.1  | 8.3  |      |
| I <sub>IL</sub> Low-level input current                              | V <sub>I</sub> = -3 V                                      | -0.43 | -0.6 | -1   | mA   |
|  | V <sub>I</sub> = -25 V                                     | -3.6  | -5.1 | -8.3 |      |
| I <sub>OS(H)</sub> Short-circuit high-level output current           | V <sub>O</sub> = 0, See Figure 5 and Note 7                |       |      | -20  | mA   |
| I <sub>OS(L)</sub> Short-circuit low-level output current            | V <sub>O</sub> = V <sub>CC</sub> , See Figure 5 and Note 7 |       |      | 20   | mA   |
| R <sub>IN</sub> Input resistance                                     | V <sub>I</sub> = ±3 V to ±25 V                             | 3     | 5    | 7    | kΩ   |

NOTE 7: Not more than one output should be shorted at one time.



# SN75LP185A

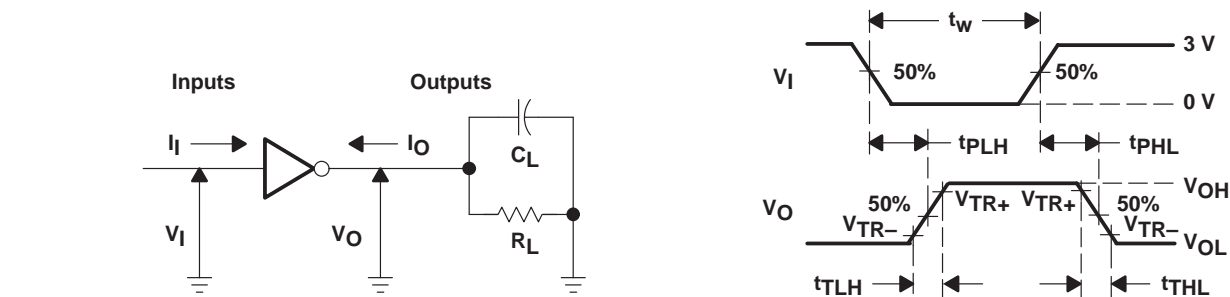
## LOW-POWER MULTIPLE RS-232 DRIVERS AND RECEIVERS

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receiver switching characteristics over recommended operating free-air temperature range,  $C_L = 50\text{ pF}$  (unless otherwise noted) (see Figure 4)

| PARAMETER   | MIN | TYP | MAX | UNIT |
|---|-----|-----|-----|------|
| $t_{PHL}$ Propagation delay time, high- to low-level output |     | 400 | 900 | ns   |
| $t_{PLH}$ Propagation delay time, low- to high-level output |     | 400 | 900 | ns   |
| $t_{TLH}$ Transition time, low- to high-level output        |     | 200 | 500 | ns   |
| $t_{THL}$ Transition time, high- to low-level output        |     | 200 | 400 | ns   |
| $t_{SK(p)}$ Pulse skew $ t_{PLH} - t_{PHL} $                |     | 200 | 425 | ns   |

### PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The pulse generator has the following characteristics:  
 For  $C_L < 1000\text{ pF}$ :  $t_w = 4\text{ }\mu\text{s}$ ,  $\text{PRR} = 250\text{ kbit/s}$ ,  $Z_O = 50\text{ }\Omega$ ,  $t_r = t_f < 50\text{ ns}$ .  
 For  $C_L = 2500\text{ pF}$ :  $t_w = 8\text{ }\mu\text{s}$ ,  $\text{PRR} = 125\text{ kbit/s}$ ,  $Z_O = 50\text{ }\Omega$ ,  $t_r = t_f < 50\text{ ns}$ .  
 B.  $C_L$  includes probe and jig capacitance.

Figure 1. Driver Parameter Test Circuit and Waveform

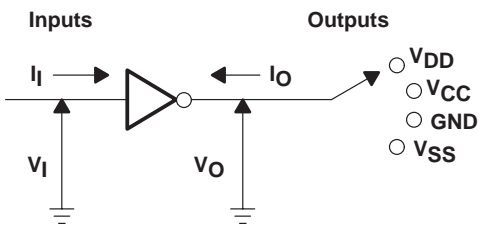


Figure 2. Driver  $I_{OS}$  Test

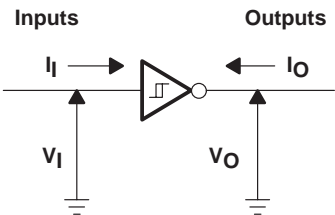
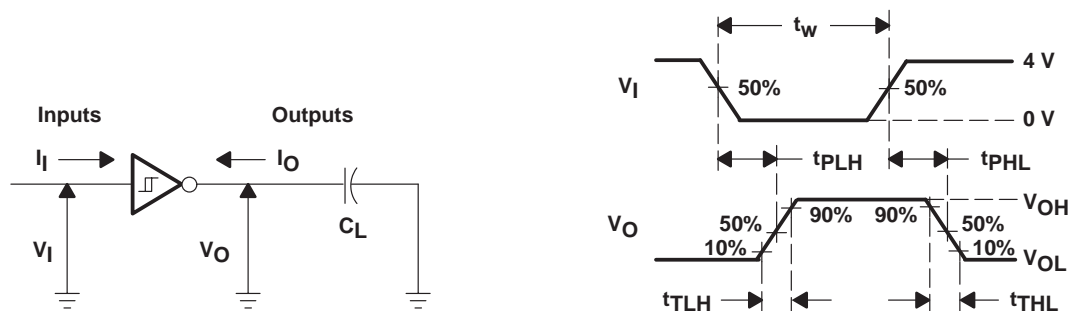


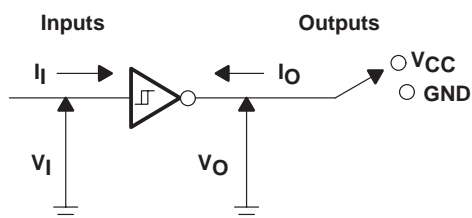
Figure 3. Receiver  $V_{IT}$  Test

## PARAMETER MEASUREMENT INFORMATION



NOTES: A. The pulse generator has the following characteristics:  $t_W = 4 \mu\text{s}$ ,  $\text{PRR} = 250 \text{ kbit/s}$ ,  $Z_O = 50 \Omega$ ,  $t_r = t_f < 50 \text{ ns}$ .  
 B.  $C_L$  includes probe and jig capacitance.

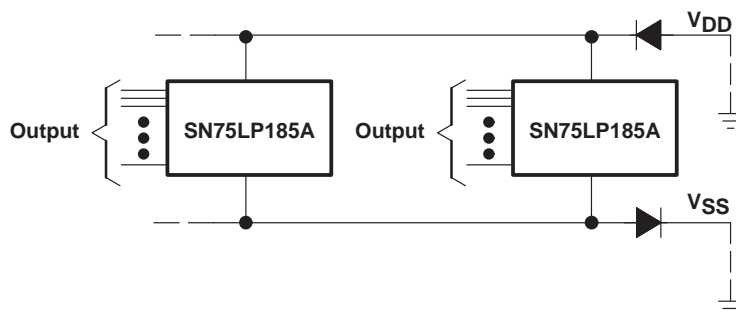
**Figure 4. Receiver Parameter Test Circuit and Waveform**



**Figure 5. Receiver  $I_{OS}$  Test**

## APPLICATION INFORMATION

Diodes placed in series with the  $V_{DD}$  and  $V_{SS}$  leads protect the SN75LP185A in the fault condition when the device outputs are shorted to  $\pm 15 \text{ V}$  and the power supplies are at low voltage and provide low-impedance paths to ground (see Figure 6).



**Figure 6. Power-Supply Protection to Meet Power-Off Fault Conditions of TIA/EIA-232-F**

## PACKAGING INFORMATION

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN75LP185ADW     | OBSOLETE              | SOIC         | DW              | 20   |             | TBD                     | Call TI          | Call TI                      |
| SN75LP185ADWR    | OBSOLETE              | SOIC         | DW              | 20   |             | TBD                     | Call TI          | Call TI                      |

<sup>(1)</sup> 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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) 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.

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**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)

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

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DW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
  - 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 AC.

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