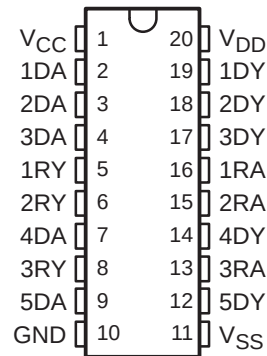


# SN75196 MULTIPLE RS-232 DRIVERS AND RECEIVERS

SLLS188B – MAY 1995 – REVISED APRIL 1998

- Single Chip With Easy Interface Between UART and Serial-Port Connector of an External Modem or Other Computer Peripheral
- Five Drivers and Three Receivers Meet or Exceed the Requirements of TIA/EIA-232-F and ITU Recommendation V.28
- Designed to Support Data Rates up to 120 kbit/s
- ESD Protection Meets Or Exceeds 10 kV on RS-232 Pins and 5 kV on All Other Pins (Human-Body Model)
- Complement to the SN75185
- Pin-to-Pin Replacement for the Goldstar GD75323
- Functional Replacement for the MC145405

DW OR N PACKAGE  
(TOP VIEW)



## description

The SN75196 combines five drivers and three receivers from the trade-standard SN75188 and SN75189 bipolar quadruple drivers and receivers, respectively. The flow-through design of the SN75196 decreases the part count, reduces the board space required, and allows easy interconnection of the UART and serial-port connector. The all-bipolar circuits and processing of the SN75196 provide a rugged, low-cost solution for this function.

The SN75196 complies with the requirements of TIA/EIA-232-F and ITU (formerly CCITT) V.28 standards. These standards are for data interchange between a host computer and peripheral at signal rates of up to 20 kbit/s. The switching speeds of the SN75196 are fast enough to support rates of up to 120 kbit/s with lower capacitive loads (shorter cables). Interoperability at the higher signaling rates cannot be assured unless the designer has design control of the cable and the interface circuits at both ends. For interoperability at signaling rates of up to 120 kbit/s, use of TIA/EIA-423-B (ITU V.10) and TIA/EIA-422-B (ITU V.11) standards are recommended.

The SN75196 is characterized for operation over a temperature range of 0°C to 70°C.



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

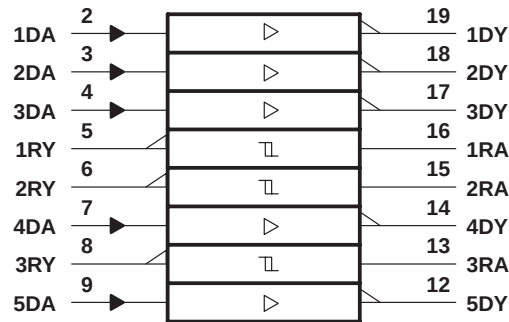
Copyright © 1998, Texas Instruments Incorporated

# SN75196

## MULTIPLE RS-232 DRIVERS AND RECEIVERS

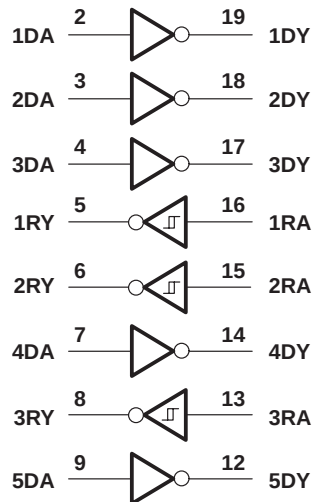
SLLS188B – MAY 1995 – REVISED APRIL 1998

### logic symbol†

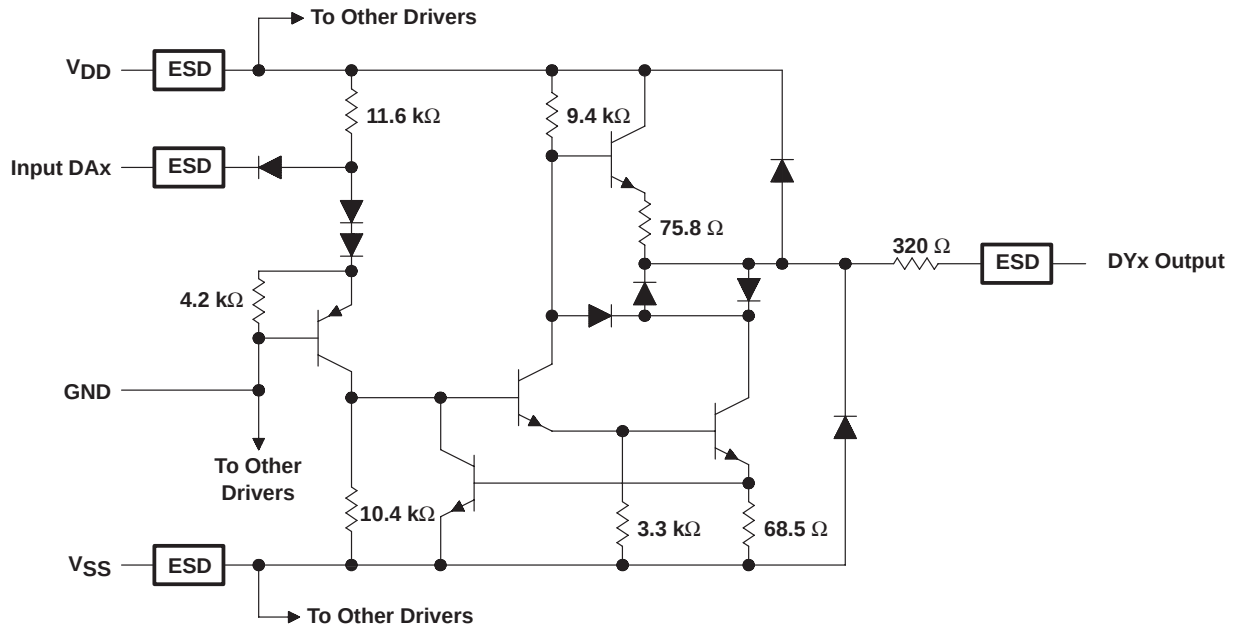


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

### logic diagram (positive logic)

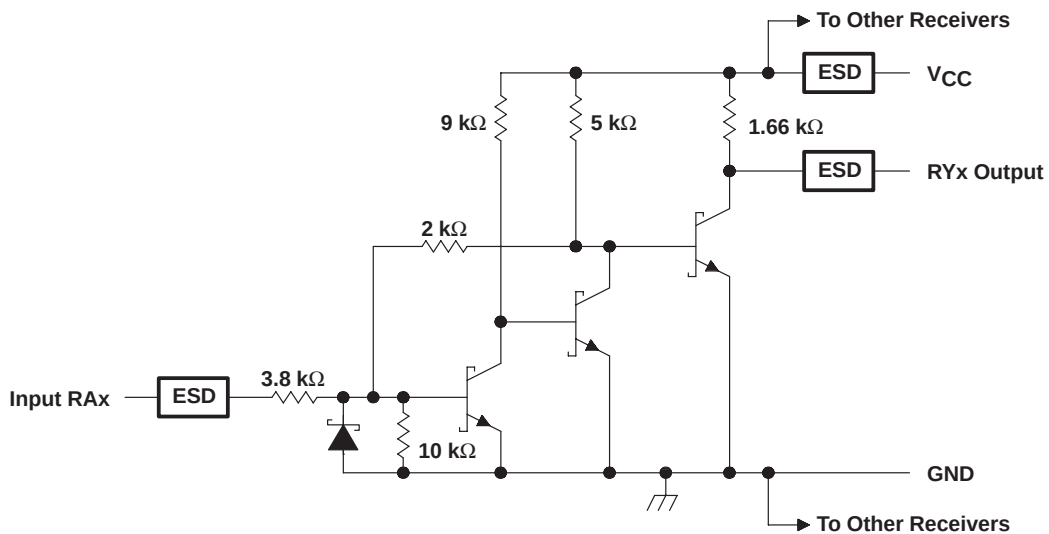


### schematic of each driver



Resistor values shown are nominal.

### schematic of each receiver



Resistor values shown are nominal.

# SN75196

## MULTIPLE RS-232 DRIVERS AND RECEIVERS

SLLS188B – MAY 1995 – REVISED APRIL 1998

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

|                                                              |                              |
|--------------------------------------------------------------|------------------------------|
| Supply voltage, $V_{CC}$ (see Note 1)                        | 10 V                         |
| Supply voltage, $V_{DD}$ (see Note 1)                        | 15 V                         |
| Supply voltage, $V_{SS}$ (see Note 1)                        | –15 V                        |
| Input voltage range, $V_I$ : Driver                          | –15 V to 7 V                 |
| Receiver                                                     | –30 V to 30 V                |
| Output voltage range, $V_O$ (Driver)                         | –15 V to 15 V                |
| Low-level output current, $I_{OL}$ (Receiver)                | 20 mA                        |
| Continuous total power dissipation                           | See Dissipation Rating Table |
| Electrostatic discharge: DY and RA to GND (see Note 2)       | Class 3, A: 10 kV, B: 500 V  |
| All pins (see Note 2)                                        | Class 3, A: 5 kV, B: 300 V   |
| 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 voltages are with respect to the network ground terminal.  
2. Per MIL-PRF-38535, Method 3015.7

DISSIPATION RATING TABLE

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING FACTOR <sup>‡</sup><br>ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$<br>POWER RATING |
|---------|---------------------------------------------|----------------------------------------------------------------|------------------------------------------|
| DW      | 1125 mW                                     | 9.0 mW/°C                                                      | 720 mW                                   |
| N       | 1150 mW                                     | 9.2 mW/°C                                                      | 736 mW                                   |

<sup>‡</sup> This is the inverse of the traditional junction-to-case thermal resistance ( $R_{\theta JA}$ ).

### recommended operating conditions

|                                       |          | MIN  | NOM | MAX   | UNIT |
|---------------------------------------|----------|------|-----|-------|------|
| Supply voltage, $V_{DD}$              |          | 7.5  | 9   | 13.5  | V    |
| Supply voltage, $V_{SS}$              |          | –7.5 | –9  | –13.5 | V    |
| Supply voltage, $V_{CC}$              |          | 4.5  | 5   | 5.5   | V    |
| High-level input voltage, $V_{IH}$    | Driver   | 1.9  |     |       | V    |
| Low-level input voltage, $V_{IL}$     | Driver   |      |     | 0.8   | V    |
| High-level output current, $I_{OH}$   | Driver   |      |     | –6    | mA   |
|                                       | Receiver |      |     | –0.5  |      |
| High-level output current, $I_{OL}$   | Driver   |      |     | 6     | mA   |
|                                       | Receiver |      |     | 16    |      |
| Operating free-air temperature, $T_A$ |          | 0    |     | 70    | °C   |



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

**supply currents over operating free-air temperature range**

| PARAMETER       |                                     | TEST CONDITIONS        |                    | MIN                                                | MAX  | UNIT |
|-----------------|-------------------------------------|------------------------|--------------------|----------------------------------------------------|------|------|
| I <sub>DD</sub> | Supply current from V <sub>DD</sub> | All inputs at 1.9 V,   | No load            | V <sub>DD</sub> = 9 V,    V <sub>SS</sub> = −9 V   | 25   | mA   |
|                 |                                     |                        |                    | V <sub>DD</sub> = 12 V,    V <sub>SS</sub> = −12 V | 32   |      |
|                 |                                     | All inputs at 0.8 V,   | No load            | V <sub>DD</sub> = 9 V,    V <sub>SS</sub> = −9 V   | 7.5  |      |
|                 |                                     |                        |                    | V <sub>DD</sub> = 12 V,    V <sub>SS</sub> = −12 V | 9.5  |      |
| I <sub>SS</sub> | Supply current from V <sub>SS</sub> | All inputs at 1.9 V,   | No load            | V <sub>DD</sub> = 9 V,    V <sub>SS</sub> = −9 V   | −25  | mA   |
|                 |                                     |                        |                    | V <sub>DD</sub> = 12 V,    V <sub>SS</sub> = −12 V | −32  |      |
|                 |                                     | All inputs at 0.8 V,   | No load            | V <sub>DD</sub> = 9 V,    V <sub>SS</sub> = −9 V   | −5.3 |      |
|                 |                                     |                        |                    | V <sub>DD</sub> = 12 V,    V <sub>SS</sub> = −12 V | −5.3 |      |
| I <sub>CC</sub> | Supply current from V <sub>CC</sub> | V <sub>CC</sub> = 5 V, | All inputs at 5 V, | No load                                            | 20   | mA   |

**DRIVER SECTION**

**electrical characteristics over operating free-air temperature range,  $V_{DD} = 9\text{ V}, V_{SS} = -9\text{ V}, V_{CC} = 5\text{ V},$  (unless otherwise noted)**

| PARAMETER                                                        | TEST CONDITIONS                 |                                    |              | MIN  | TYP | MAX   | UNIT          |
|------------------------------------------------------------------|---------------------------------|------------------------------------|--------------|------|-----|-------|---------------|
| $V_{OH}$ High-level output voltage                               | $V_{IL} = 0.8\text{ V},$        | $R_L = 3\text{ k}\Omega,$          | See Figure 1 | 6    | 7.5 |       | V             |
| $V_{OL}$ Low-level output voltage (see Note 3)                   | $V_{IH} = 1.9\text{ V},$        | $R_L = 3\text{ k}\Omega,$          | See Figure 1 | -7.5 | -6  |       | V             |
| $I_{IH}$ High-level input current                                | $V_I = 5\text{ V},$             | See Figure 2                       |              |      |     | 10    | $\mu\text{A}$ |
| $I_{IL}$ Low-level input current                                 | $V_I = 0,$                      | See Figure 2                       |              |      |     | -1.6  | mA            |
| $I_{OS(H)}$ High-level short-circuit output current (see Note 4) | $V_{IL} = 0.8\text{ V},$        | $V_O = 0,$                         | See Figure 1 | -4.5 | -9  | -19.5 | mA            |
| $I_{OS(L)}$ Low-level short-circuit output current (see Note 4)  | $V_{IH} = 2\text{ V},$          | $V_O = 0,$                         | See Figure 1 | 4.5  | 9   | 19.5  | mA            |
| $r_o$ Output resistance (see Note 5)                             | $V_{CC} = V_{DD} = V_{SS} = 0,$ | $V_O = -2\text{ V to } 2\text{ V}$ |              | 300  |     |       | $\Omega$      |

NOTES: 3. The algebraic convention, where the more positive (less negative) limit is designated as maximum, is used in this data sheet for logic levels only, e.g., if -10 V is a maximum, the typical value is a more negative voltage.  
4. Output short-circuit conditions must maintain the total power dissipation below absolute maximum ratings.  
5. Test conditions are those specified by TIA/EIA-232-F and as listed above.

**switching characteristics,  $V_{DD} = 12\text{ V}, V_{SS} = -12\text{ V}, V_{CC} = 5\text{ V} \pm 10\%, T_A = 25^\circ\text{C}$**

| PARAMETER                                                         | TEST CONDITIONS                                 |                         |                         | MIN | TYP | MAX | UNIT          |
|-------------------------------------------------------------------|-------------------------------------------------|-------------------------|-------------------------|-----|-----|-----|---------------|
| $t_{PLH}$ Propagation delay time, low- to high-level output       | $R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega,$ | $C_L = 15\text{ pF},$   | See Figure 3            |     | 315 | 500 | ns            |
| $t_{PHL}$ Propagation delay time, high- to low-level output       | $R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega,$ | $C_L = 15\text{ pF},$   | See Figure 3            |     | 75  | 175 | ns            |
| $t_{TLH}$ Transition time, low- to high-level output (see Note 6) | $R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$  | $C_L = 15\text{ pF},$   | See Figure 3            |     | 60  | 100 | ns            |
|                                                                   |                                                 | $C_L = 2500\text{ pF},$ | See Figure 3 and Note 6 |     | 1.7 | 2.5 | $\mu\text{s}$ |
| $t_{THL}$ Transition time, high- to low-level output (see Note 7) | $R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$  | $C_L = 15\text{ pF},$   | See Figure 3            |     | 40  | 75  | ns            |
|                                                                   |                                                 | $C_L = 2500\text{ pF},$ | See Figure 3 and Note 7 |     | 1.5 | 2.5 | $\mu\text{s}$ |

NOTES: 6. Measured between -3-V and 3-V points of the output waveform (TIA/EIA-232-F conditions), all unused inputs are tied either high or low.  
7. Measured between 3-V and -3-V points of the output waveform (TIA/EIA-232-F conditions), all unused inputs are tied either high or low.

# SN75196

## MULTIPLE RS-232 DRIVERS AND RECEIVERS

SLLS188B – MAY 1995 – REVISED APRIL 1998

### RECEIVER SECTION

electrical characteristics over recommended operating conditions (unless otherwise noted)

| PARAMETER        |                                                         | TEST CONDITIONS                                             |                               | MIN   | TYP† | MAX  | UNIT |
|------------------|---------------------------------------------------------|-------------------------------------------------------------|-------------------------------|-------|------|------|------|
| V <sub>IT+</sub> | Positive-going input threshold voltage                  | See Figure 5                                                | T <sub>A</sub> = 25°C         | 1.75  | 1.9  | 2.3  | V    |
|                  |                                                         |                                                             | T <sub>A</sub> = 0°C to 70 °C | 1.55  |      | 2.3  |      |
| V <sub>IT–</sub> | Negative-going input threshold voltage                  | See Figure 5                                                |                               | 0.75  | 0.97 | 1.25 | V    |
| V <sub>hys</sub> | Input hysteresis (V <sub>IT+</sub> – V <sub>IT–</sub> ) | See Figure 5                                                |                               | 0.5   |      |      | V    |
| V <sub>OH</sub>  | High-level output voltage                               | I <sub>OH</sub> = –0.5 mA, See Figure 5                     | V <sub>IH</sub> = 0.75 V      | 2.6   | 4    | 5    | V    |
|                  |                                                         |                                                             | Inputs open                   | 2.6   |      |      |      |
| V <sub>OL</sub>  | Low-level input voltage                                 | I <sub>OL</sub> = 10 mA, V <sub>I</sub> = 3 V, See Figure 5 |                               |       | 0.2  | 0.45 | V    |
| I <sub>IH</sub>  | High-level input current                                | V <sub>I</sub> = 25 V                                       |                               | 3.6   |      | 8.3  | mA   |
|                  |                                                         | V <sub>I</sub> = 3 V                                        |                               | 0.43  |      |      |      |
| I <sub>IL</sub>  | Low-level input current                                 | V <sub>I</sub> = –25 V                                      |                               | –3.6  |      | –8.3 | mA   |
|                  |                                                         | V <sub>I</sub> = –3 V                                       |                               | –0.43 |      |      |      |
| I <sub>OS</sub>  | Short-circuit output current                            | See Figure 4                                                |                               |       | –3.4 | –12  | mA   |

<sup>†</sup> All typical values are at  $T_A = 25^{\circ}\text{C}$ ,  $V_{CC} = 5\text{ V}$ ,  $V_{DD} = 9\text{ V}$ , and  $V_{SS} = -9\text{ V}$ .

switching characteristics,  $V_{CC} = 5\text{ V}$ ,  $V_{DD} = 12\text{ V}$ ,  $V_{SS} = -12\text{ V}$ ,  $T_A = 25^{\circ}\text{C}$

| PARAMETER                                                   | TEST CONDITIONS                                                | MIN | TYP | MAX | UNIT |
|-------------------------------------------------------------|----------------------------------------------------------------|-----|-----|-----|------|
| $t_{PLH}$ Propagation delay time, low- to high-level output | $C_L = 50\text{ pF}$ , $R_L = 5\text{ k}\Omega$ , See Figure 6 |     | 107 | 500 | ns   |
| $t_{PHL}$ Propagation delay time, high- to low-level output | $C_L = 50\text{ pF}$ , $R_L = 5\text{ k}\Omega$ , See Figure 6 |     | 42  | 150 | ns   |
| $t_{TLH}$ Transition time, low- to high-level output        | $C_L = 50\text{ pF}$ , $R_L = 5\text{ k}\Omega$ , See Figure 6 |     | 175 | 525 | ns   |
| $t_{THL}$ Transition time, high- to low-level output        | $C_L = 50\text{ pF}$ , $R_L = 5\text{ k}\Omega$ , See Figure 6 |     | 16  | 60  | ns   |



## PARAMETER MEASUREMENT INFORMATION

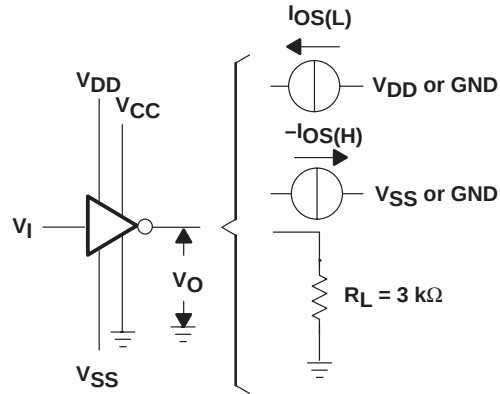


Figure 1. Driver Test Circuit for  $V_{OH}$ ,  $V_{OL}$ ,  $I_{OS(H)}$ , and  $I_{OS(L)}$

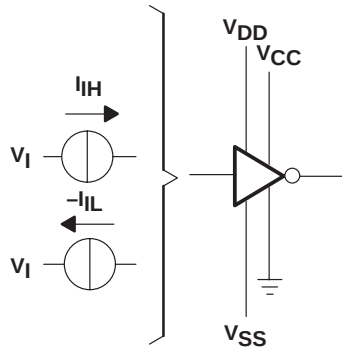
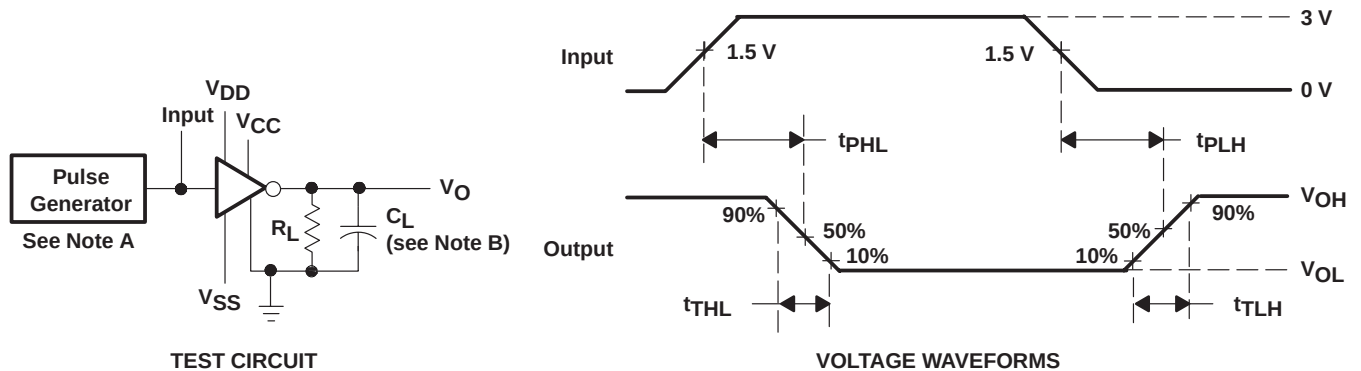


Figure 2. Driver Test Circuit for  $I_{IH}$  and  $I_{IL}$



- NOTES: A. The pulse generator has the following characteristics:  $t_W = 25\text{ }\mu\text{s}$ ,  $\text{PRR} = 20\text{ kHz}$ ,  $Z_O = 50\text{ }\Omega$ ,  $t_r = t_f < 50\text{ ns}$ .  
B.  $C_L$  includes probe and jig capacitance.

Figure 3. Driver Test Circuit and Voltage Waveforms

# SN75196

## MULTIPLE RS-232 DRIVERS AND RECEIVERS

SLLS188B – MAY 1995 – REVISED APRIL 1998

### PARAMETER MEASUREMENT INFORMATION

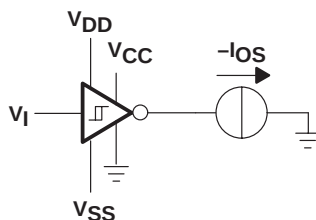


Figure 4. Receiver Test Circuit for  $I_{OS}$

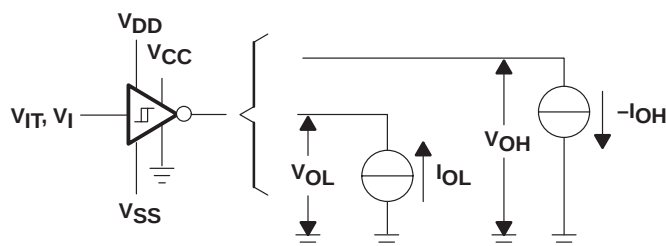
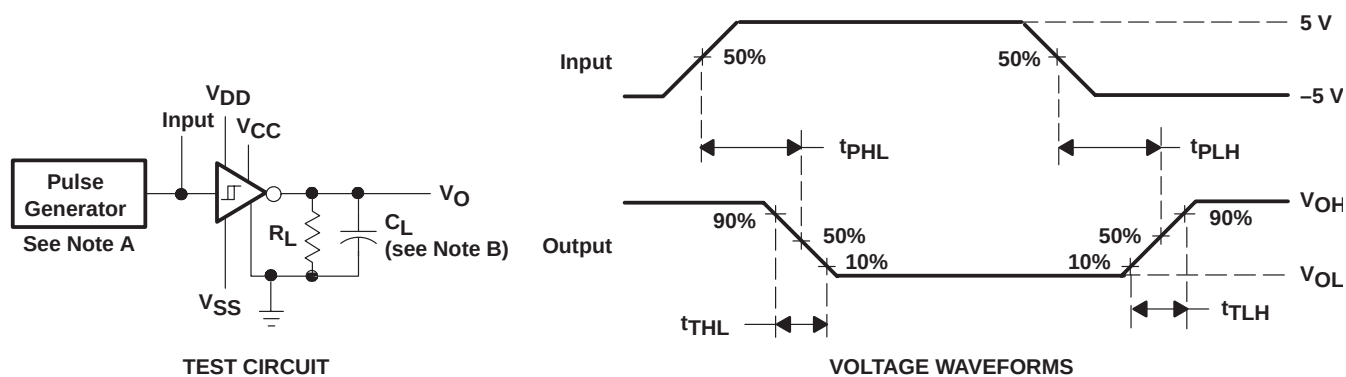


Figure 5. Receiver Test Circuit for  $V_{IT}$ ,  $V_{OH}$ , and  $V_{OL}$



NOTES: A. The pulse generator has the following characteristics:  $t_W = 25 \mu s$ ,  $PRR = 20 \text{ kHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r = t_f < 50 \text{ ns}$ .  
B.  $C_L$  includes probe and jig capacitance.

Figure 6. Receiver Propagation and Transition Times



TYPICAL CHARACTERISTICS

DRIVER SECTION

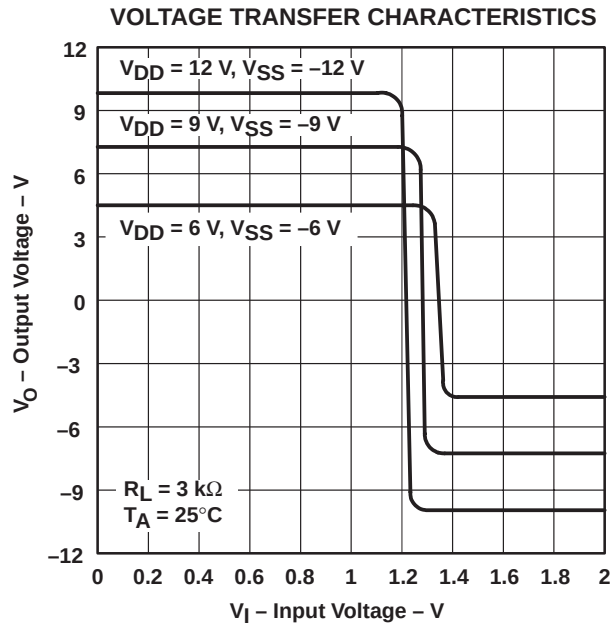


Figure 7

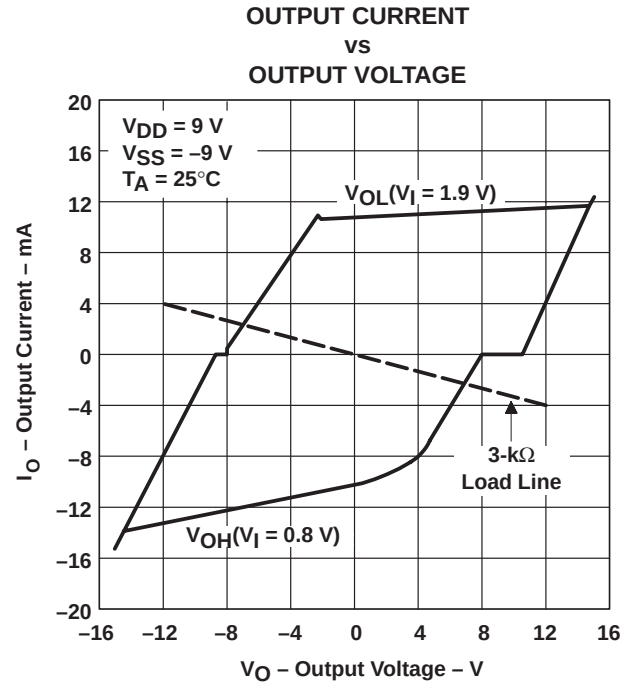


Figure 8

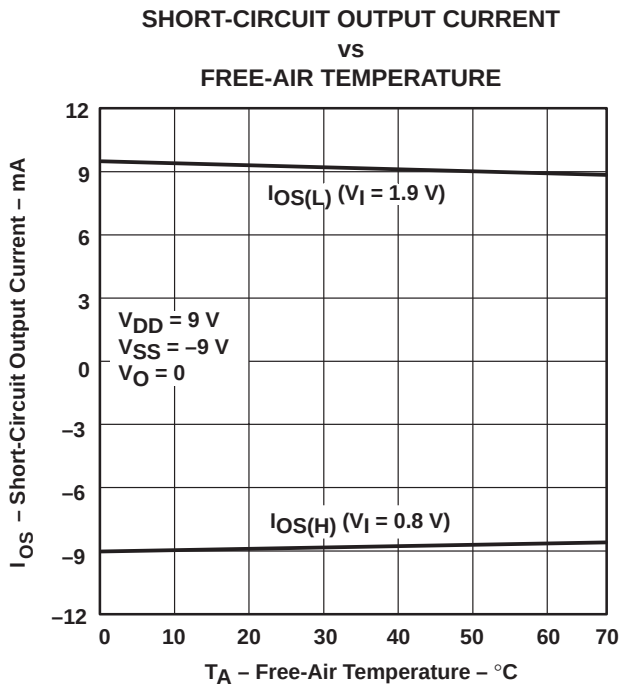


Figure 9

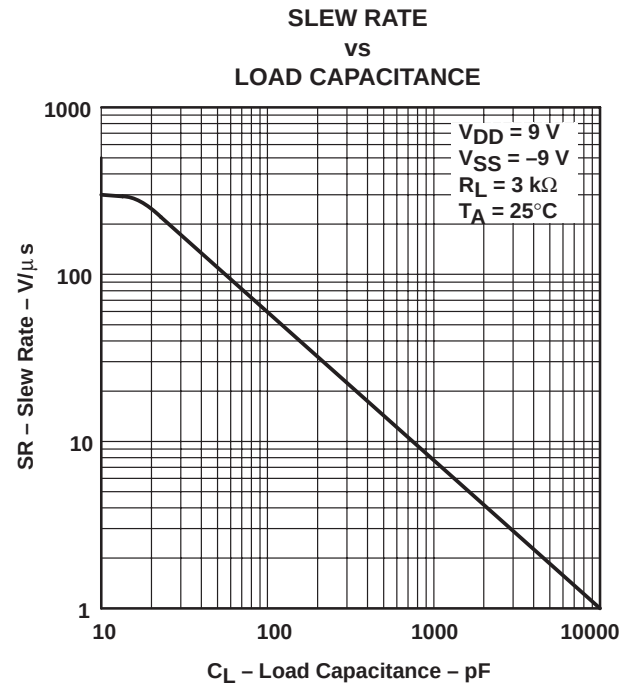


Figure 10

TYPICAL CHARACTERISTICS  
RECEIVER SECTION

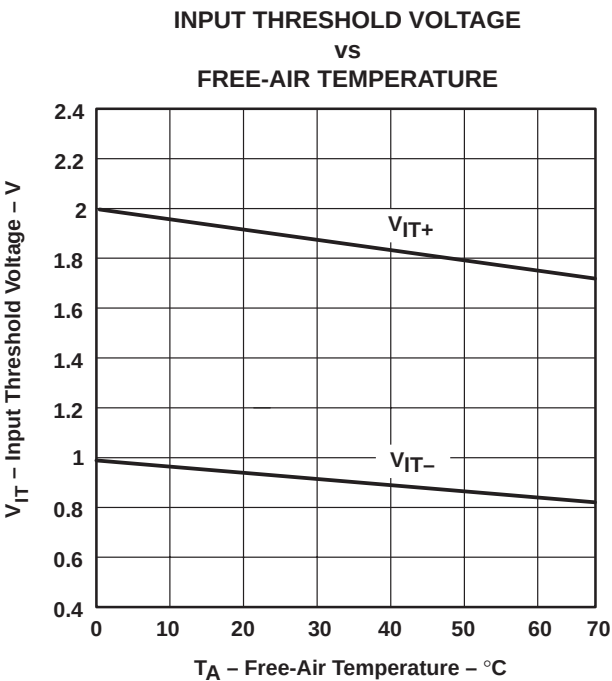


Figure 11

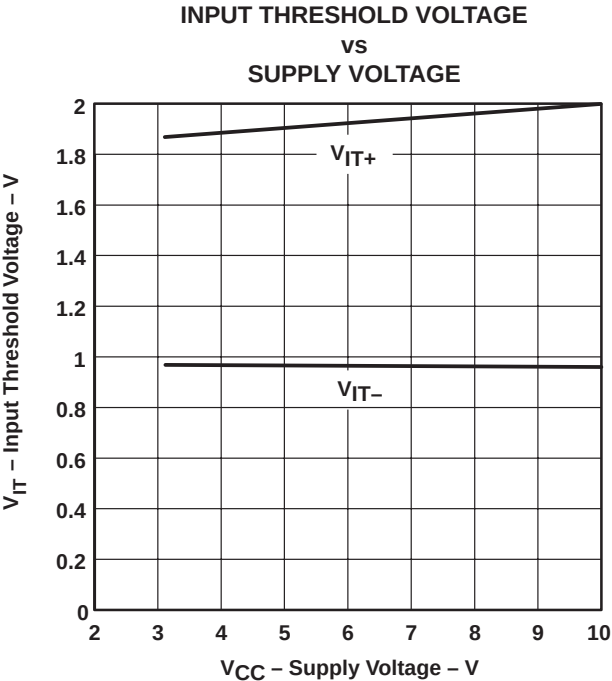
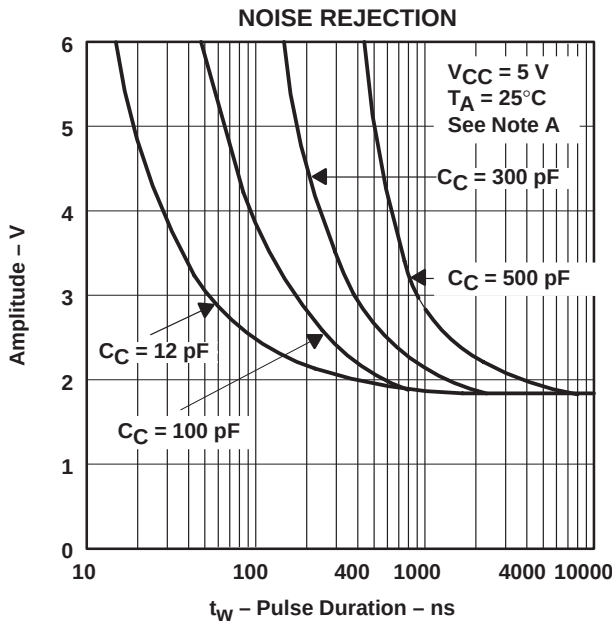


Figure 12



NOTE A: This figure shows the maximum amplitude of a positive-going pulse that, starting from 0 V, does not cause a change of the output level.

Figure 13

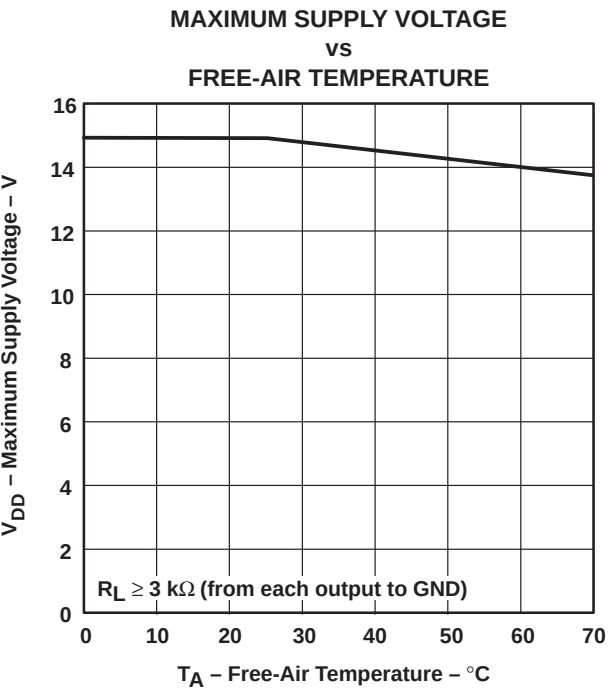
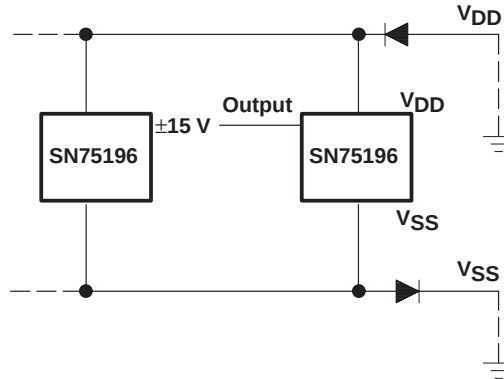


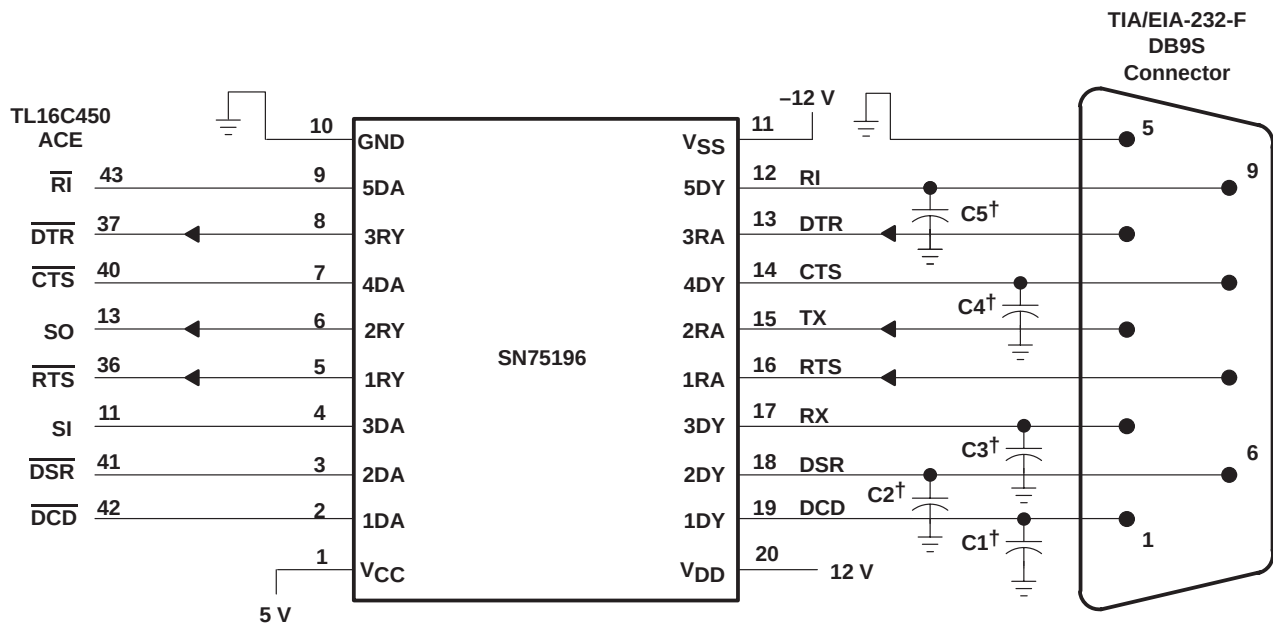
Figure 14

## APPLICATION INFORMATION

Diodes placed in series with the  $V_{DD}$  and  $V_{SS}$  terminals protect the SN75196 in the fault condition when the device outputs are shorted to  $V_{DD}$  or  $V_{SS}$  and the power supplies are at low and provide low-impedance paths to ground (see Figure 15).



**Figure 15. Power-Supply Protection to Meet Power-Off Fault Conditions of TIA/EIA-232-F**



† See Figure 10 to select the correct values for the loading capacitors (C1, C2, C3, C4, and C5), which may be required to meet the RS-232 maximum slew-rate requirement of 30 V/μs. The value of the loading capacitors required depends upon the line length and desired slew rate, but is typically 330 pF.

NOTE A: To use the receivers only,  $V_{DD}$  and  $V_{SS}$  must both be powered or tied to ground.

**Figure 16. Typical TIA/EIA-232-F Connection**

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN75196DW        | ACTIVE        | SOIC         | DW                 | 20   | 25             | Green (RoHS<br>& no Sb/Br) | NIPDAU                  | Level-1-260C-UNLIM   | 0 to 70      | SN75196                 | <a href="#">Samples</a> |
| SN75196DWR       | ACTIVE        | SOIC         | DW                 | 20   | 2000           | Green (RoHS<br>& no Sb/Br) | NIPDAU                  | Level-1-260C-UNLIM   | 0 to 70      | SN75196                 | <a href="#">Samples</a> |

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

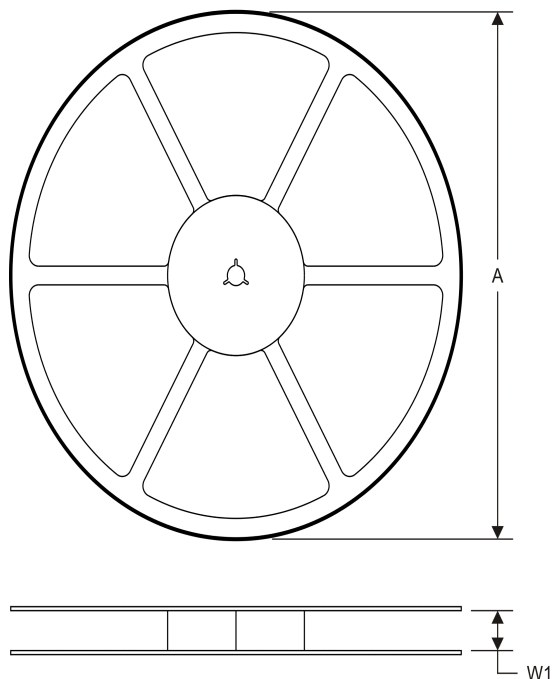
**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. 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.

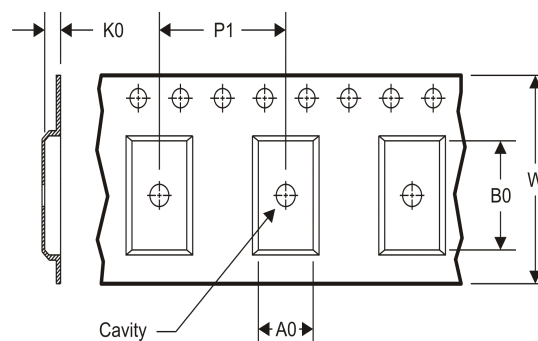


## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



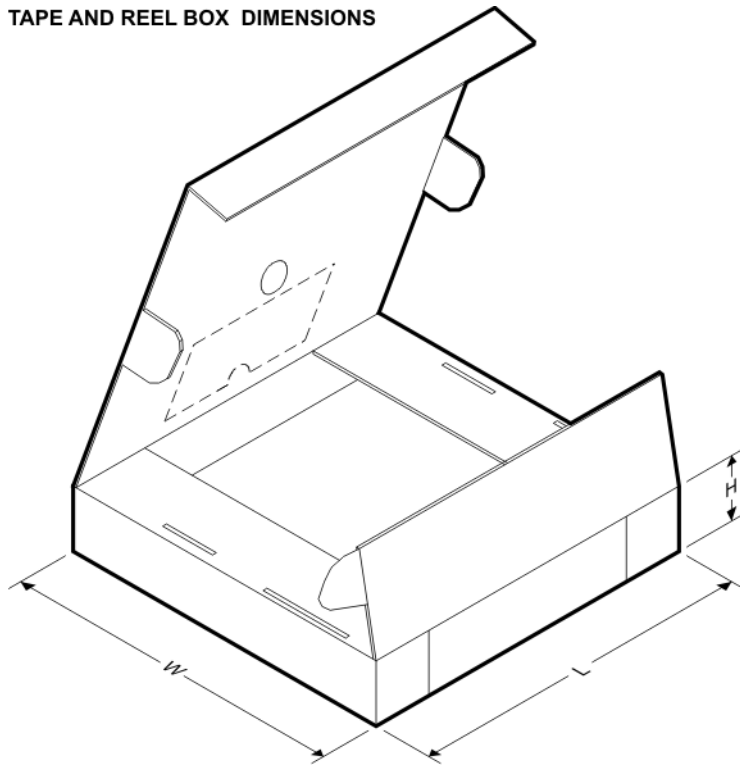
|    |                                                           |
|----|-----------------------------------------------------------|
| A0 | Dimension designed to accommodate the component width     |
| B0 | Dimension designed to accommodate the component length    |
| K0 | Dimension designed to accommodate the component thickness |
| W  | Overall width of the carrier tape                         |
| P1 | Pitch between successive cavity centers                   |

### TAPE AND REEL INFORMATION

\*All dimensions are nominal

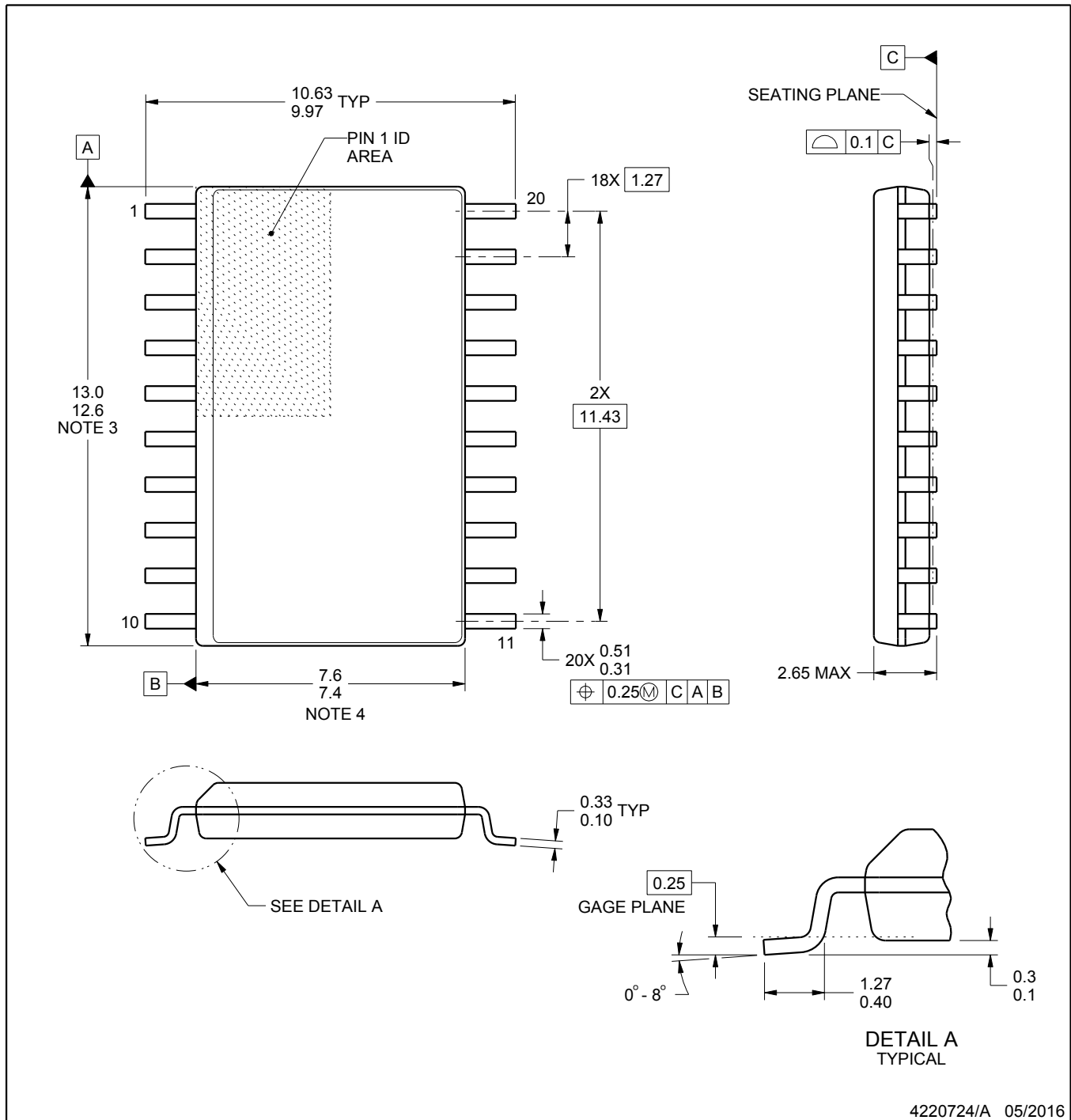
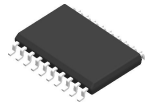
| Device     | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN75196DWR | SOIC         | DW              | 20   | 2000 | 330.0              | 24.4               | 10.8    | 13.0    | 2.7     | 12.0    | 24.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN75196DWR | SOIC         | DW              | 20   | 2000 | 367.0       | 367.0      | 45.0        |



4220724/A 05/2016

## NOTES:

1. All linear dimensions are in millimeters. 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 0.43 mm per side.
5. Reference JEDEC registration MS-013.

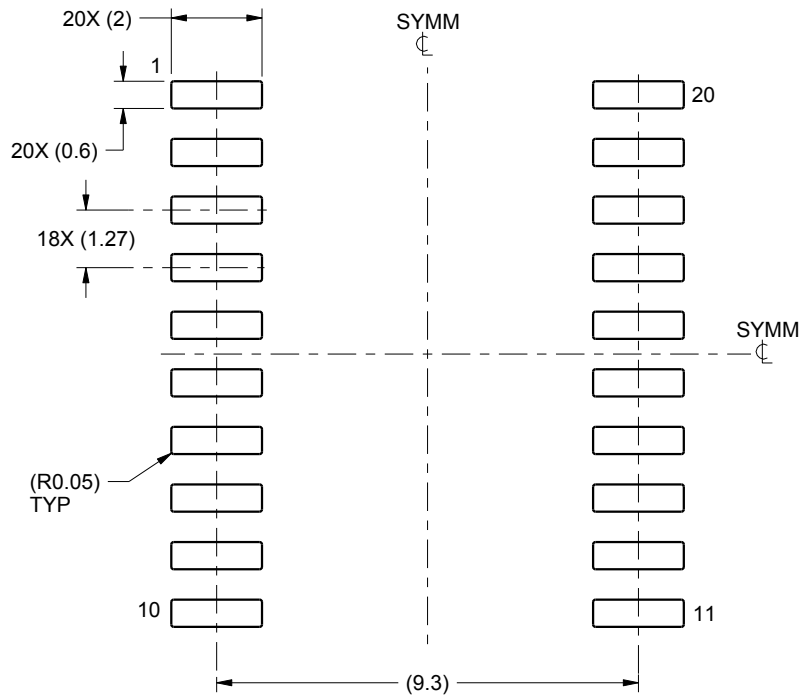


# EXAMPLE BOARD LAYOUT

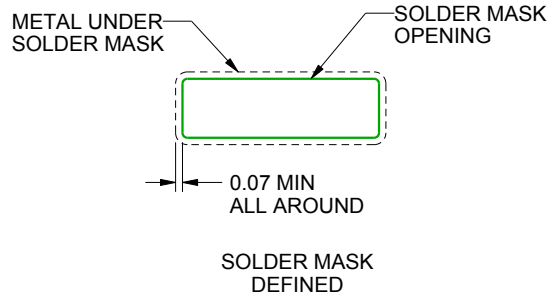
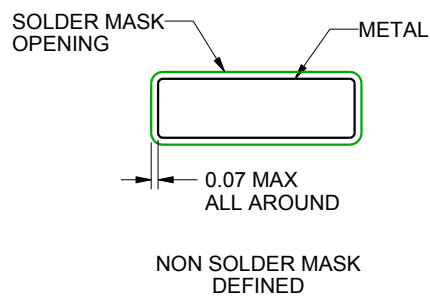
DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

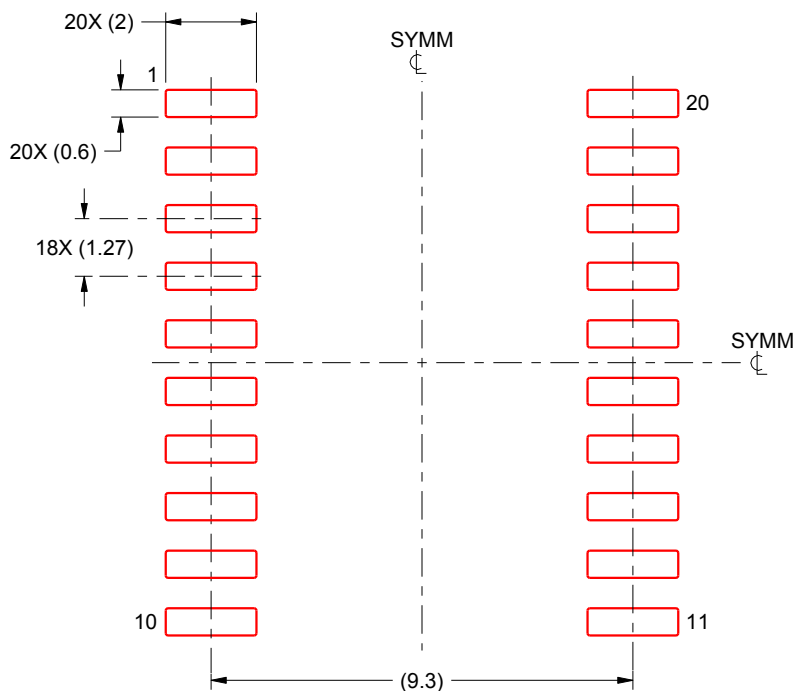
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:6X

4220724/A 05/2016

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.

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale ([www.ti.com/legal/termsofsale.html](http://www.ti.com/legal/termsofsale.html)) or other applicable terms available either on [ti.com](http://ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2020, Texas Instruments Incorporated