

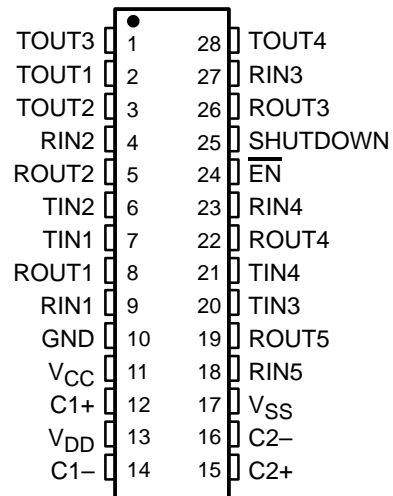
# SN75LBC241

## LOW-POWER LinBiCMOS™ MULTIPLE DRIVERS AND RECEIVERS

SLLS137F – MAY 1992 – REVISED FEBRUARY 2001

- Operates With Single 5-V Power Supply
- Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU Recommendation V.28
- Improved Performance Replacement for MAX241
- Operates at Data Rates up to 100 kbit/s Over a 3-m Cable
- Low-Power Shutdown Mode . . .  $\leq 1 \mu\text{A Typ}$
- LinBiCMOS™ Process Technology
- Four Drivers and Five Receivers
- $\pm 30\text{-V}$  Input Levels
- 3-State TTL/CMOS Receiver Outputs
- $\pm 9\text{-V}$  Output Swing With a 5-V Supply
- Applications
  - TIA/EIA-232-F Interface
  - Battery-Powered Systems
  - Terminals
  - Modems
  - Computers
- Packaged in Plastic Small-Outline Package

**DW PACKAGE  
(TOP VIEW)**



### description

The SN75LBC241 is a low-power LinBiCMOS™ line-interface device containing four independent drivers and five receivers. It is designed as a plug-in replacement for the Maxim MAX241. The SN75LBC241 provides a capacitive-charge-pump voltage generator to produce RS-232 voltage levels from a 5-V supply. The charge-pump oscillator frequency is 20 kHz. Each receiver converts RS-232 inputs to 5-V TTL/CMOS levels. The receivers have a typical threshold of 1.2 V and a typical hysteresis of 0.5 V and can accept  $\pm 30\text{-V}$  inputs. Each driver converts TTL/CMOS input levels into RS-232 levels.

The SN75LBC241 includes a receiver, a 3-state control line, and a low-power shutdown control line. When the  $\overline{\text{EN}}$  line is high, receiver outputs are placed in the high-impedance state. When  $\overline{\text{EN}}$  is low, normal operation is enabled.

The shutdown mode reduces power dissipation to less than  $5 \mu\text{W}$ , typically. In this mode, receiver outputs have high impedance, driver outputs are turned off, and the charge-pump circuit is turned off. When SHUTDOWN is high, the shutdown mode is enabled. When SHUTDOWN is low, normal operation is enabled.

This device has been designed to conform to TIA/EIA-232-F and ITU Recommendation V.28.

The SN75LBC241 has been designed using LinBiCMOS technology and cells contained in the Texas Instruments LinASIC™ library. Use of LinBiCMOS circuitry increases latch-up immunity in this device over an all-CMOS design.

The SN75LBC241 is characterized for operation from  $0^\circ\text{C}$  to  $70^\circ\text{C}$ .



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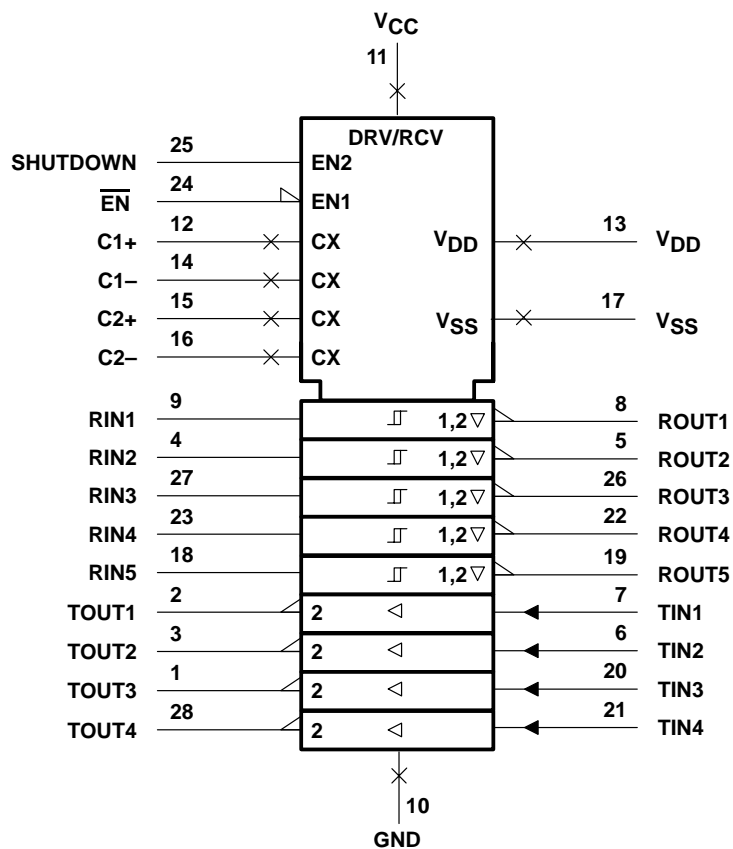
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# SN75LBC241 LOW-POWER LinBiCMOS™ MULTIPLE DRIVERS AND RECEIVERS

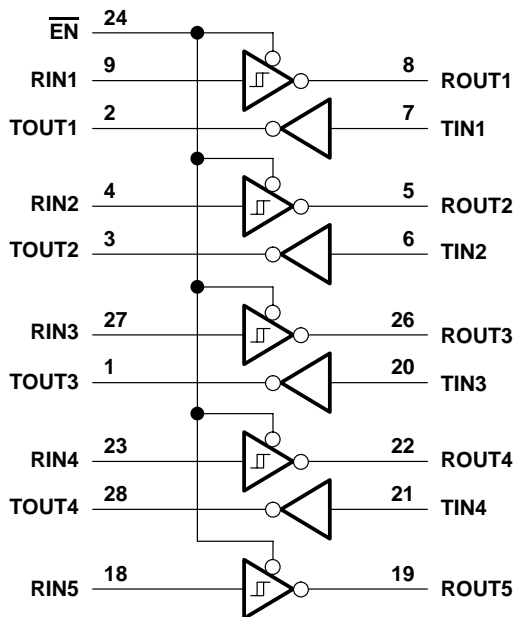
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## logic symbol†



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

## logic diagram (positive logic)



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# SN75LBC241

## LOW-POWER LinBiCMOS™ MULTIPLE DRIVERS AND RECEIVERS

SLLS137F – MAY 1992 – REVISED FEBRUARY 2001

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

|  |                                     |
|--|-------------------------------------|
| Input supply voltage range, $V_{CC}$ (see Note 1)            | –0.3 V to 6 V                       |
| Positive output supply voltage range, $V_{DD}$               | $V_{CC}$ –0.3 V to 15 V             |
| Negative output supply voltage range, $V_{SS}$               | 0.3 V to –15 V                      |
| Input voltage range, $V_I$ : Driver                          | –0.3 V to $V_{CC} + 0.3$ V          |
| Receiver   | ±30 V                               |
| Output voltage range, $V_O$ : TOUT                           | $V_{SS}$ –0.3 V to $V_{DD} + 0.3$ V |
| ROUT   | –0.3 V to $V_{CC} + 0.3$ V          |
| Short-circuit duration: TOUT                                 | Unlimited                           |
| Continuous total dissipation                                 | See Dissipation Rating Table        |
| Package thermal impedance, $\theta_{JA}$ (see Note 2)        | 46°C/W                              |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°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 voltage values are with respect to the network ground terminal.  
 2. The package thermal impedance is calculated in accordance with JESD 51-7.

**DISSIPATION RATING TABLE**

| PACKAGE | T <sub>A</sub> ≤ 25°C<br>POWER RATING | OPERATING FACTOR<br>ABOVE T <sub>A</sub> = 25°C | T <sub>A</sub> = 70°C<br>POWER RATING |
|---------|---------------------------------------|---|---------------------------------------|
| DW      | 1603 mW                               | 12.8 mW/°C                                      | 1026 mW                               |

### recommended operating conditions

|                 |   | MIN  | NOM | MAX | UNIT |     |   |
|-----------------|---|--|-----|-----|------|-----|---|
| V <sub>CC</sub> | Supply voltage                                | Supply voltage, $V_{CC}$                     |     | 4.5 | 5    | 5.5 | V |
| V <sub>IH</sub> | High-level input voltage                      | T <sub>IN</sub>                              |     | 2   |      | V   |   |
|                 |   | $\overline{EN}$ , SHUTDOWN                   |     | 2.4 |      |     |   |
| V <sub>IL</sub> | Low-level input voltage                       | T <sub>IN</sub> , $\overline{EN}$ , SHUTDOWN |     | 0.8 |      | V   |   |
|                 | External charge-pump capacitor                | C1–C4 (see Figure 5)                         |     | 1   |      | μF  |   |
|                 | External charge-pump capacitor voltage rating | C1, C3 (see Figure 5)                        |     | 6.3 |      | V   |   |
|                 |   | C2, C4 (see Figure 5)                        |     | 16  |      |     |   |
| V <sub>I</sub>  | Receiver input voltage                        |  |     | ±30 |      | V   |   |
| T <sub>A</sub>  | Operating free-air temperature                | 0  |     | 70  |      | °C  |   |



# SN75LBC241

## LOW-POWER LinBiCMOS™ MULTIPLE DRIVERS AND RECEIVERS

SLLS137F – MAY 1992 – REVISED FEBRUARY 2001

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature range (unless otherwise noted)

| PARAMETER  |      | TEST CONDITIONS  | MIN | TYP† | MAX | UNIT |
|--|------|--|-----|------|-----|------|
| V <sub>OH</sub> High-level output voltage  | TOUT | R <sub>L</sub> = 3 kΩ to GND, See Note 3                                       | 5   | 9    |     | V    |
|  | ROUT | I <sub>OH</sub> = -1 mA  | 3.5 |      |     |      |
| V <sub>OL</sub> Low-level output voltage   | TOUT | R <sub>L</sub> = 3 kΩ to GND, See Note 4                                       |     | -9‡  | -5  | V    |
|  | ROUT | I <sub>OL</sub> = 3.2 mA   |     |      | 0.4 |      |
| V <sub>IT+</sub> Receiver positive-going input threshold voltage                 | RIN  | V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C                                   |     | 1.7  | 2.4 | V    |
| V <sub>IT-</sub> Receiver negative-going input threshold voltage                 | RIN  | V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C                                   | 0.8 | 1.2  |     | V    |
| V <sub>hys</sub> Input hysteresis voltage (V <sub>IT+</sub> - V <sub>IT-</sub> ) | RIN  | V <sub>CC</sub> = 5 V  |     | 0.5  | 1   | V    |
| r <sub>i</sub> Receiver input resistance   | RIN  | V <sub>CC</sub> = 5 V, T <sub>A</sub> = 25°C                                   | 3   | 5    | 7   | kΩ   |
| r <sub>o</sub> Output resistance   | TOUT | V <sub>DD</sub> = V <sub>SS</sub> = V <sub>CC</sub> = 0, V <sub>O</sub> = ±2 V | 300 |      |     | Ω    |
| I <sub>OS</sub> Short-circuit output current§                                    | TOUT | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 0                                    |     | ±10  |     | mA   |
| I <sub>IS</sub> Short-circuit input current                                      | TIN  | V <sub>I</sub> = 0   |     |      | 200 | μA   |
| I <sub>CC</sub> Supply current   |      | V <sub>CC</sub> = 5.5 V, T <sub>A</sub> = 25°C, All outputs open               |     | 4    | 8   | mA   |
|  |      | All outputs open, T <sub>A</sub> = 25°C, SHUTDOWN high                         |     | 1    | 10  |      |

† All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

‡ The algebraic convention, in which the least positive (most negative) value is designated minimum, is used in this data sheet for logic voltage levels only.

§ Not more than one output should be shorted at one time.

NOTES: 3. Total I<sub>OH</sub> drawn from TOUT1, TOUT2, TOUT3, TOUT4, and V<sub>DD</sub> terminals should not exceed 12 mA.

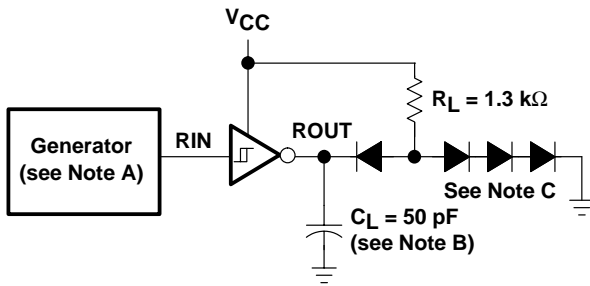
4. Total I<sub>OL</sub> drawn from TOUT1, TOUT2, TOUT3, TOUT4, and V<sub>SS</sub> terminals should not exceed -12 mA.

### switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

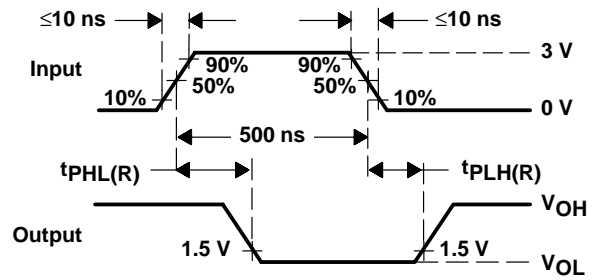
| PARAMETER  |  | TEST CONDITIONS   | MIN | TYP | MAX | UNIT |
|--|--|---|-----|-----|-----|------|
| t <sub>PLH(R)</sub> Receiver propagation-delay time, low- to high-level output |  | See Figure 1  |     | 500 |     | ns   |
| t <sub>PHL(R)</sub> Receiver propagation-delay time, high- to low-level output |  | See Figure 1  |     | 500 |     | ns   |
| t <sub>PZH</sub> Receiver output-enable time to high level                     |  | See Figure 4  |     | 100 |     | ns   |
| t <sub>PZL</sub> Receiver output-enable time to low level                      |  | See Figure 4  |     | 100 |     | ns   |
| t <sub>PHZ</sub> Receiver output-disable time from high level                  |  | See Figure 4  |     | 50  |     | ns   |
| t <sub>PLZ</sub> Receiver output-disable time from low level                   |  | See Figure 4  |     | 50  |     | ns   |
| SR Driver slew rate  |  | R <sub>L</sub> = 3 kΩ to 7 kΩ, C <sub>L</sub> = 2500 pF, See Figure 3 |     |     | 30  | V/μs |
| SR <sub>(tr)</sub> Driver transition-region slew rate                          |  | R <sub>L</sub> = 3 kΩ to 7 kΩ, C <sub>L</sub> = 2500 pF, See Figure 3 | 4   | 6   |     | V/μs |



### PARAMETER MEASUREMENT INFORMATION



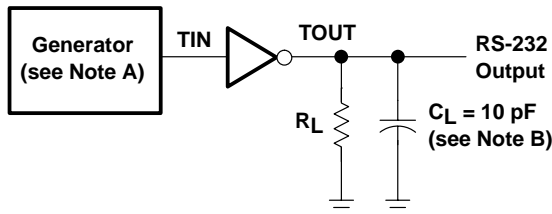
**TEST CIRCUIT**



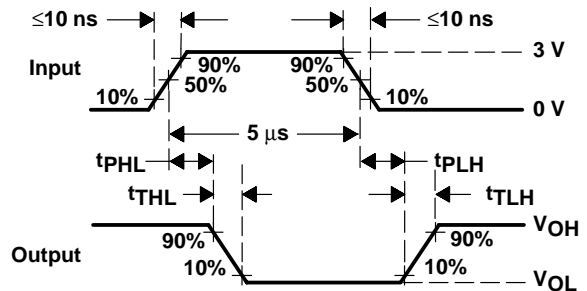
**VOLTAGE WAVEFORMS**

- NOTES: A. The pulse generator has the following characteristics:  $Z_O = 50 \Omega$ , duty cycle  $\leq 50\%$ .  
 B.  $C_L$  includes probe and jig capacitance.  
 C. All diodes are 1N3064 or equivalent.

**Figure 1. Receiver Test Circuit and Waveforms for  $t_{PHL}$  and  $t_{PLH}$  Measurement**



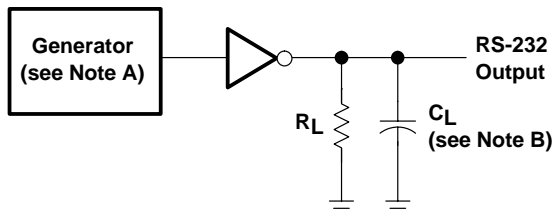
**TEST CIRCUIT**



**VOLTAGE WAVEFORMS**

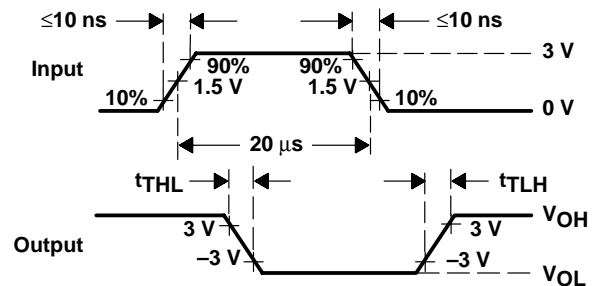
- NOTES: A. The pulse generator has the following characteristics:  $Z_O = 50 \Omega$ , duty cycle  $\leq 50\%$ .  
 B.  $C_L$  includes probe and jig capacitance.

**Figure 2. Driver Test Circuit and Waveforms for  $t_{PHL}$  and  $t_{PLH}$  Measurement (5- $\mu$ s Input)**



**TEST CIRCUIT**

$$SR = \frac{6 \text{ V}}{t_{THL} \text{ or } t_{TLH}}$$



**VOLTAGE WAVEFORMS**

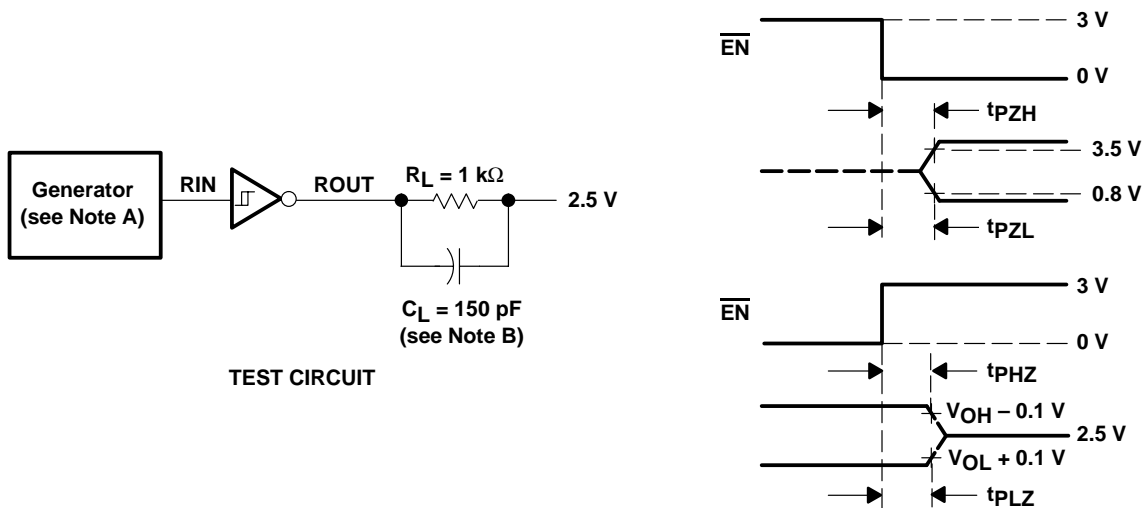
- NOTES: A. The pulse generator has the following characteristics:  $Z_O = 50 \Omega$ , duty cycle  $\leq 50\%$ .  
 B.  $C_L$  includes probe and jig capacitance.

**Figure 3. Test Circuit and Waveforms for  $t_{THL}$  and  $t_{TLH}$  Measurement (20- $\mu$ s Input)**

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SLLS137F – MAY 1992 – REVISED FEBRUARY 2001

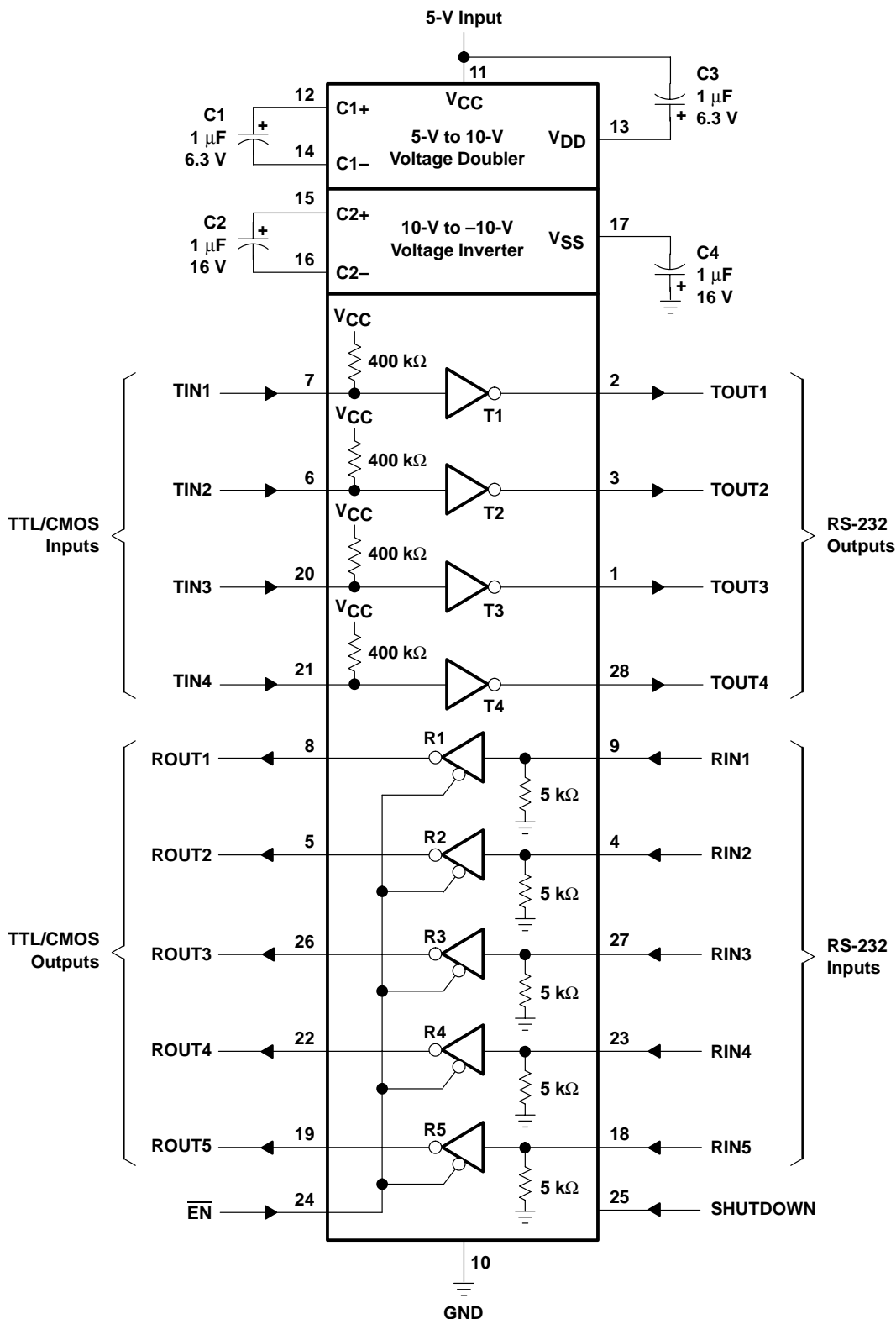
## PARAMETER MEASUREMENT INFORMATION



- NOTES: A. The pulse generator has the following characteristics:  $Z_O = 50\ \Omega$ , duty cycle  $\leq 50\%$ .  
 B.  $C_L$  includes probe and jig capacitance.

**Figure 4. Receiver Output Enable and Disable Timing**

**APPLICATION INFORMATION**



**Figure 5. Typical Operating Circuit**

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---------|
| SN75LBC241DW     | LIFEBUY       | SOIC         | DW              | 28   | 20          | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | SN75LBC241              |         |
| SN75LBC241DWR    | LIFEBUY       | SOIC         | DW              | 28   | 1000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | 0 to 70      | SN75LBC241              |         |

(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.

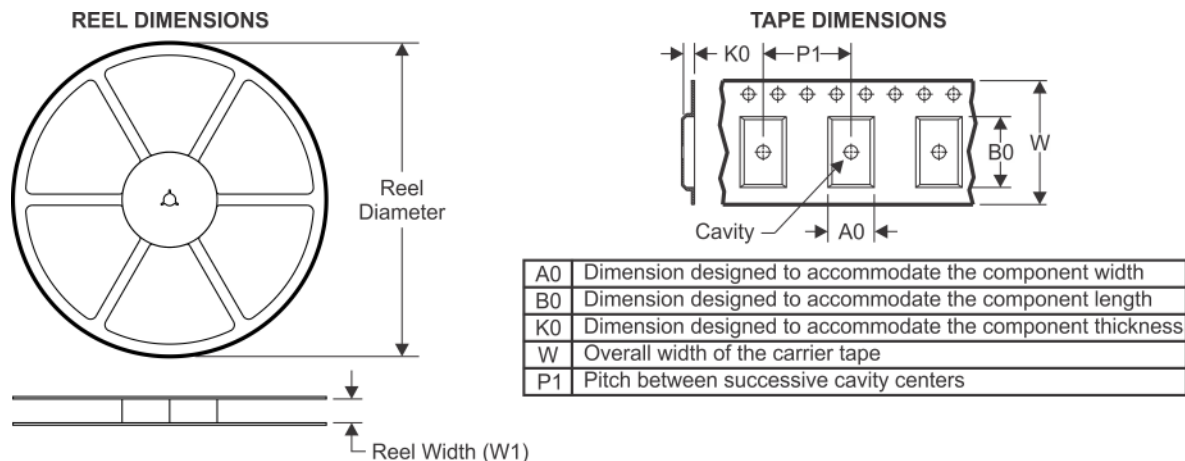
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices 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.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

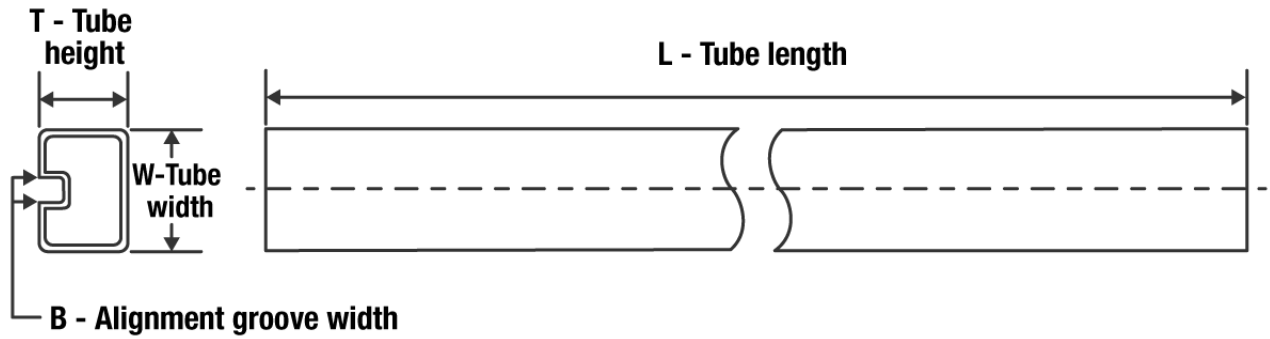

\*All dimensions are nominal

| 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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN75LBC241DWR | SOIC         | DW              | 28   | 1000 | 330.0              | 32.4               | 11.35   | 18.67   | 3.1     | 16.0    | 32.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN75LBC241DWR | SOIC         | DW              | 28   | 1000 | 350.0       | 350.0      | 66.0        |

**TUBE**


\*All dimensions are nominal

| Device       | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|--------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| SN75LBC241DW | DW           | SOIC         | 28   | 20  | 506.98 | 12.7   | 4826   | 6.6    |



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