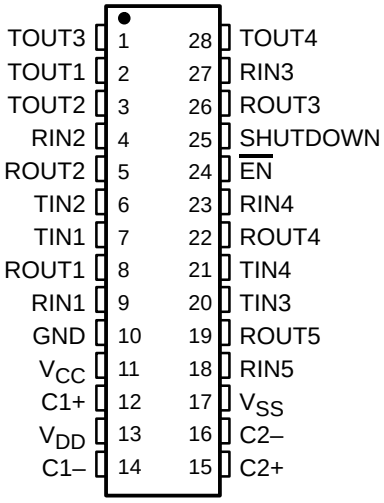
SLLS137F – MAY 1992 – REVISED FEBRUARY 2001

- **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 . . . ≤1 μA Typ**
- **LinBiCMOS™ Process Technology**
- **Four Drivers and Five Receivers**
- **±30-V Input Levels**
- **3-State TTL/CMOS Receiver Outputs**
- **±9-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 ±30-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 $\overline{EN}$ line is high, receiver outputs are placed in the high-impedance state. When $\overline{EN}$ is low, normal operation is enabled.

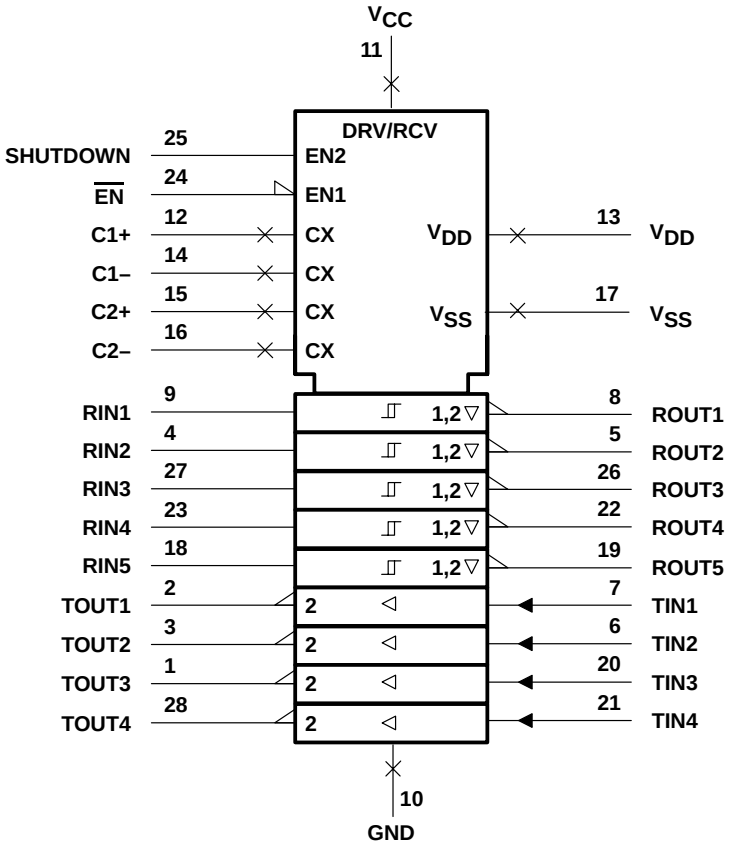
The shutdown mode reduces power dissipation to less than 5 μW, typically. In this mode, receiver outputs have high impedance, driver outputs are turned off, and the charge-pump circuit is turned off. When SHUTDOWN is high, the shutdown mode is enabled. When SHUTDOWN is low, normal operation is enabled.

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.

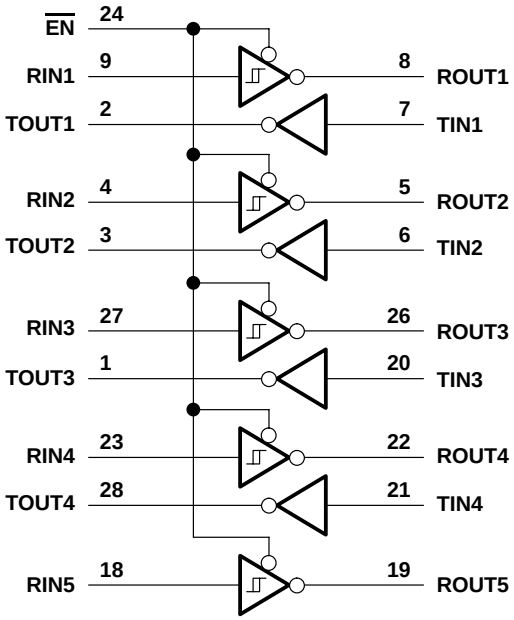
The SN75LBC241 is characterized for operation from 0°C to 70°C.

## 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)†

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 | $T_A \le 25°C$ POWER RATING | OPERATING FACTOR ABOVE $T_A = 25°C$ | $T_A = 70°C$ POWER RATING |
|---|---|---|---|
| DW | 1603 mW | 12.8 mW/°C | 1026 mW |

## recommended operating conditions

| | | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | Supply voltage, $V_{CC}$ | 4.5 | 5 | 5.5 | V |
| $V_{IH}$ | High-level input voltage | TIN | 2 | | | V |
| | | $\overline{EN}$, SHUTDOWN | 2.4 | | | |
| $V_{IL}$ | Low-level input voltage | TIN, $\overline{EN}$, 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 | | | |
| $V_I$ | Receiver input voltage | | | | ±30 | V |
| $T_A$ | Operating free-air temperature | | 0 | | 70 | °C |

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

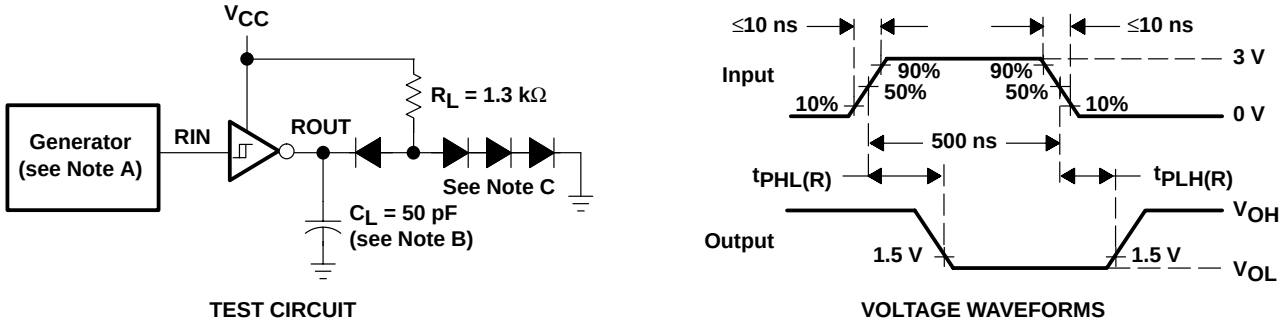
| PARAMETER | | | TEST CONDITIONS | MIN | TYP† | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | TOUT | $R_L$ = 3 kΩ to GND, See Note 3 | 5 | 9 | | V |
| | | ROUT | $I_{OH}$ = –1 mA | 3.5 | | | |
| $V_{OL}$ | Low-level output voltage | TOUT | $R_L$ = 3 kΩ to GND, See Note 4 | | –9‡ | –5 | V |
| | | ROUT | $I_{OL}$ = 3.2 mA | | | 0.4 | |
| $V_{IT+}$ | Receiver positive-going input threshold voltage | RIN | $V_{CC}$ = 5 V, $T_A$ = 25°C | | 1.7 | 2.4 | V |
| $V_{IT–}$ | Receiver negative-going input threshold voltage | RIN | $V_{CC}$ = 5 V, $T_A$ = 25°C | 0.8 | 1.2 | | V |
| $V_{hys}$ | Input hysteresis voltage ($V_{IT+} – V_{IT–}$) | RIN | $V_{CC}$ = 5 V | | 0.5 | 1 | V |
| $r_i$ | Receiver input resistance | RIN | $V_{CC}$ = 5 V, $T_A$ = 25°C | 3 | 5 | 7 | kΩ |
| $r_o$ | Output resistance | TOUT | $V_{DD} = V_{SS} = V_{CC} = 0$, $V_O$ = ±2 V | 300 | | | Ω |
| $I_{OS}$ | Short-circuit output current§ | TOUT | $V_{CC}$ = 5.5 V, $V_O$ = 0 | | ±10 | | mA |
| $I_{IS}$ | Short-circuit input current | TIN | $V_I$ = 0 | | | 200 | µA |
| $I_{CC}$ | Supply current | | $V_{CC}$ = 5.5 V, $T_A$ = 25°C, All outputs open | | 4 | 8 | mA |
| | | | All outputs open, $T_A$ = 25°C, SHUTDOWN high | | 1 | 10 | |

† All typical values are at $V_{CC}$ = 5 V, $T_A$ = 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 $I_{OH}$ drawn from TOUT1, TOUT2, TOUT3, TOUT4, and $V_{DD}$ terminals should not exceed 12 mA.
4. Total $I_{OL}$ drawn from TOUT1, TOUT2, TOUT3, TOUT4, and $V_{SS}$ terminals should not exceed –12 mA.

## switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C

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

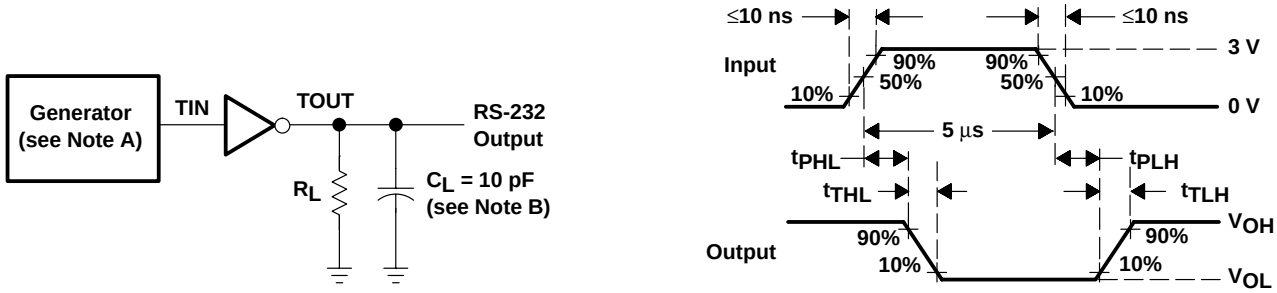
## PARAMETER MEASUREMENT INFORMATION




TEST CIRCUIT VOLTAGE WAVEFORMS

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

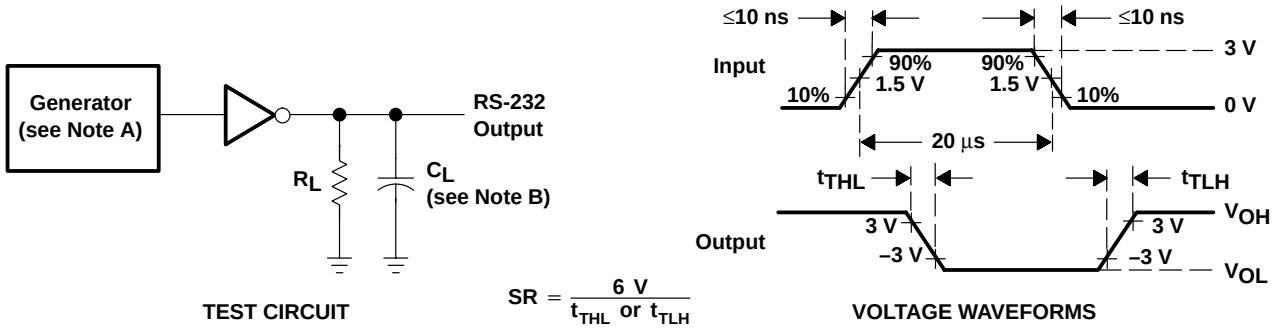
**Figure 1. Receiver Test Circuit and Waveforms for $t_{PHL}$ and $t_{PLH}$ Measurement**




TEST CIRCUIT VOLTAGE WAVEFORMS

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

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




TEST CIRCUIT

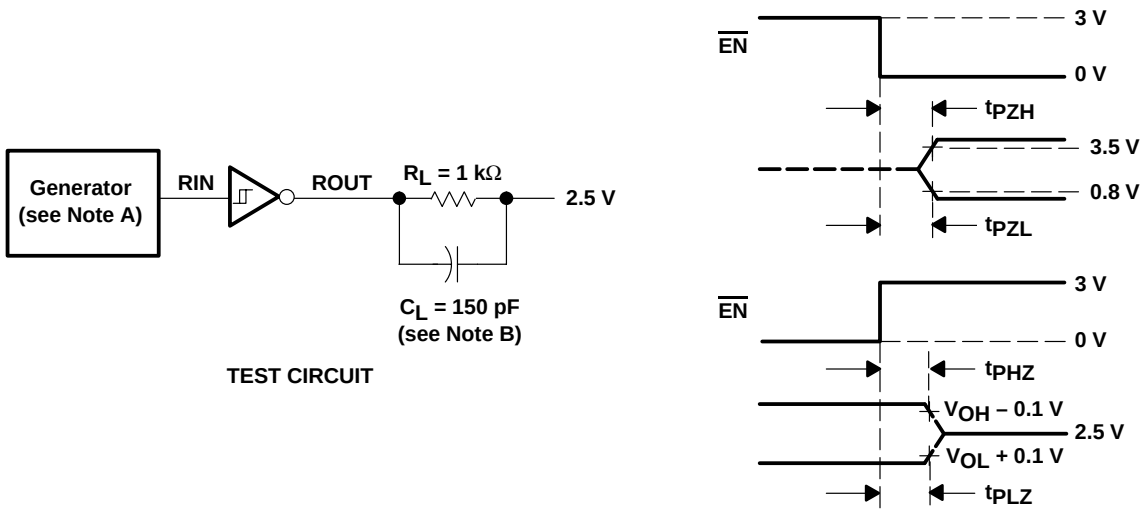
$$SR = \frac{6\ V}{t_{THL}\ \text{or}\ t_{TLH}}$$

VOLTAGE WAVEFORMS

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

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

## PARAMETER MEASUREMENT INFORMATION




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

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

## APPLICATION INFORMATION

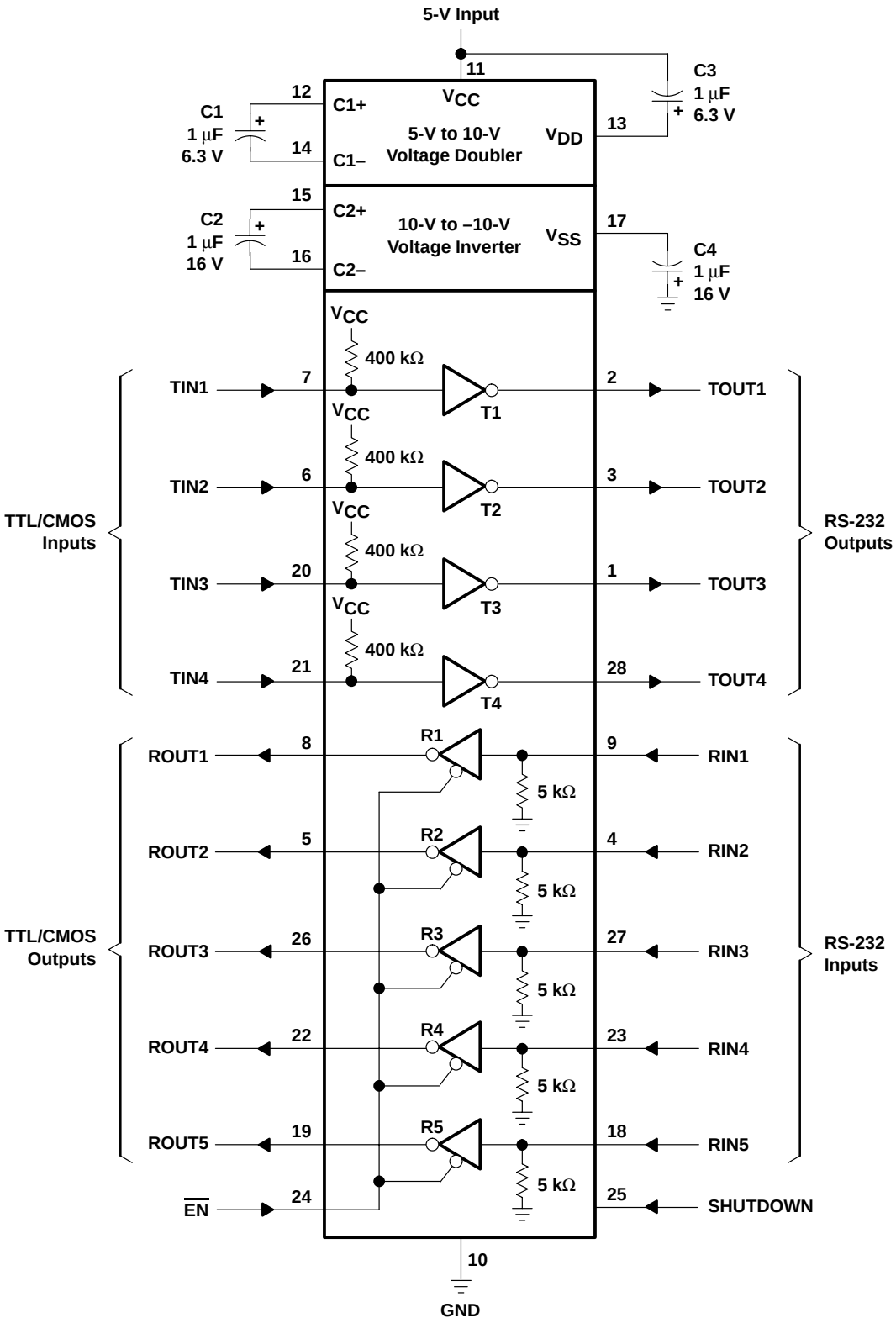



**Figure 5. Typical Operating Circuit**

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SN75LBC241DW | ACTIVE | SOIC | DW | 28 | 20 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | SN75LBC241 | Samples |
| SN75LBC241DWG4 | ACTIVE | SOIC | DW | 28 | 20 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | SN75LBC241 | Samples |
| SN75LBC241DWR | ACTIVE | SOIC | DW | 28 | 1000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | SN75LBC241 | Samples |

(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 - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), 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.
**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.
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
**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)

(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.

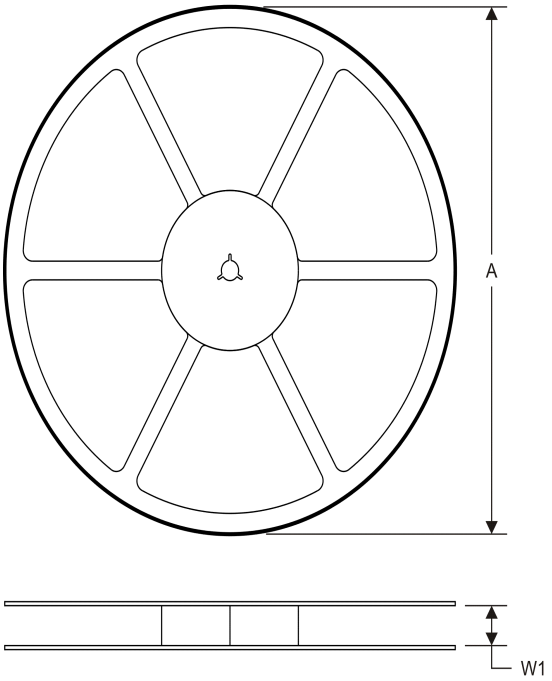
**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information.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

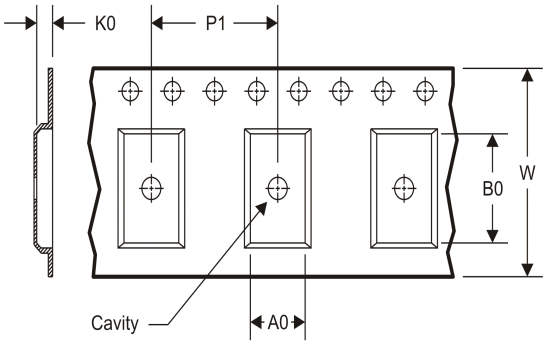
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS




### TAPE DIMENSIONS



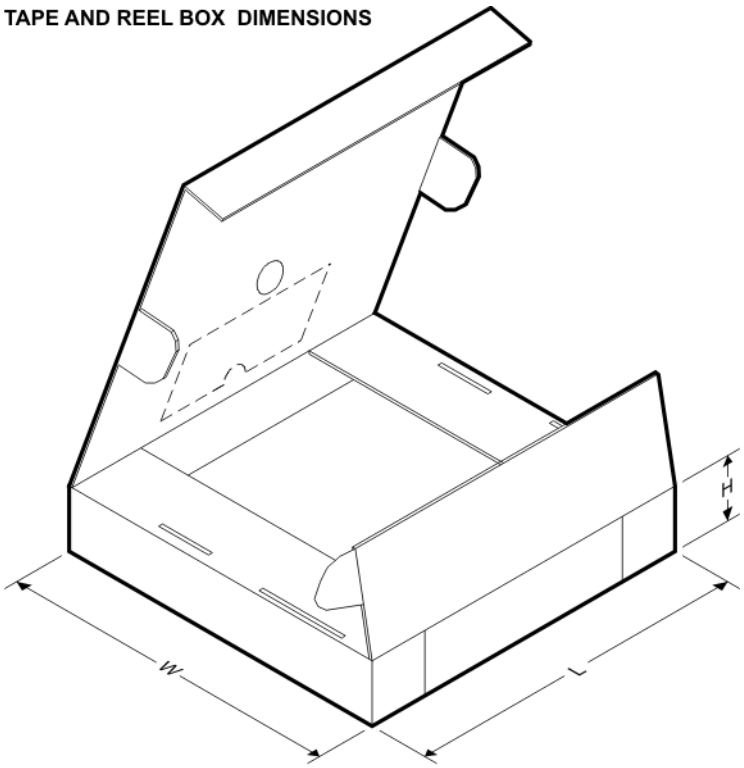

| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

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

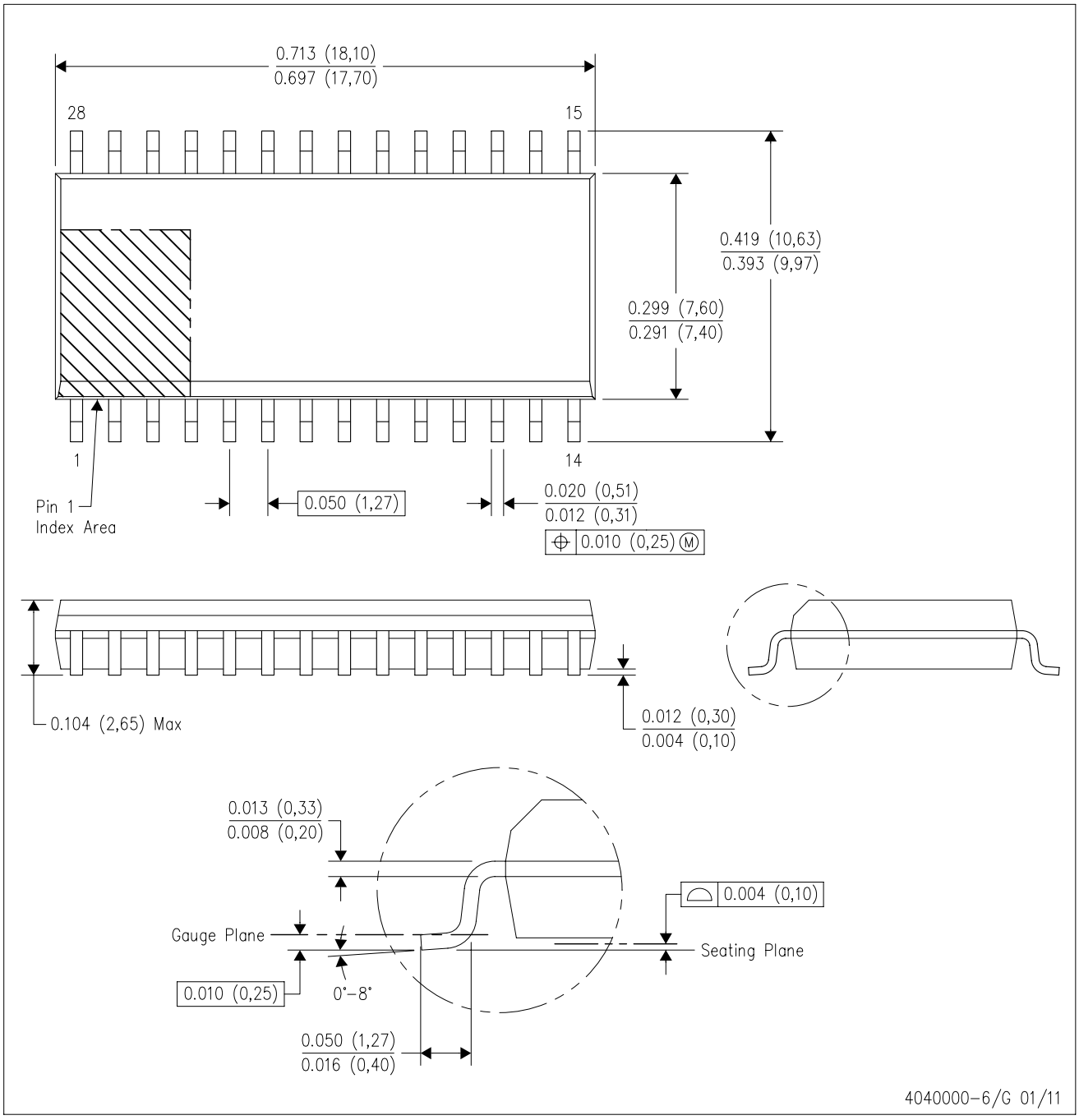
TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| SN75LBC241DWR | SOIC | DW | 28 | 1000 | 367.0 | 367.0 | 55.0 |

DW (R–PDSO–G28) 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 AE.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions of TI 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

| **Products** | | **Applications** | |
|---|---|---|---|
| Audio | www.ti.com/audio | Automotive and Transportation | www.ti.com/automotive |
| Amplifiers | amplifier.ti.com | Communications and Telecom | www.ti.com/communications |
| Data Converters | dataconverter.ti.com | Computers and Peripherals | www.ti.com/computers |
| DLP® Products | www.dlp.com | Consumer Electronics | www.ti.com/consumer-apps |
| DSP | dsp.ti.com | Energy and Lighting | www.ti.com/energy |
| Clocks and Timers | www.ti.com/clocks | Industrial | www.ti.com/industrial |
| Interface | interface.ti.com | Medical | www.ti.com/medical |
| Logic | logic.ti.com | Security | www.ti.com/security |
| Power Mgmt | power.ti.com | Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Microcontrollers | microcontroller.ti.com | Video and Imaging | www.ti.com/video |
| RFID | www.ti-rfid.com | | |
| OMAP Applications Processors | www.ti.com/omap | **TI E2E Community** | e2e.ti.com |
| Wireless Connectivity | www.ti.com/wirelessconnectivity | | |

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