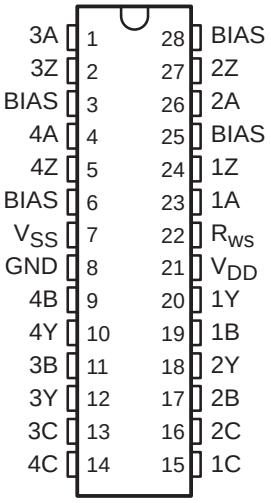
- **Four Independent Drivers and Receivers**
- **Driver Slew Rate Controlled by a Single Resistor**
- **Fast Driver Transition Times Down to 1.5 μs and Receiver Transition Times of 20 ns Typ**
- **Internal Thermal-Overload Protection**
- **RS-423-B Inputs and Outputs Designed to Withstand ±25 V**
- **ESD Protection Exceeds 2000 V Per MIL-STD-833C Method 3015**
- **LinBICMOS™ Process Technology**

**DW PACKAGE**
**(TOP VIEW)**




## description

The SN75LBC784 performs as four independent RS-423-B driver/receiver pairs designed to interface data terminal equipment (DTE) with data circuit-terminating equipment (DCE) at rates up to 120 kbps and distances to 1.2 km. The SN75LBC784 provides an upgrade to the RS-232 serial interface and can be backward compatible with existing serial ports while offering the higher performance required by new faster peripherals, such as v.34 (v.fast) modems. The RS-232 standard, and subsequent revisions, only support data rates up to 20 kbps over about 15 meters of cable. For RS-423-B the data rate is increased to 120 kbps and transmission distance to 1.2 km by reducing the maximum output signal swing, increasing the driver output current, and reducing the receiver input voltage thresholds.

**FUNCTION TABLE**

| INPUTS | | | OUTPUTS | |
|---|---|---|---|---|
| **A** | **B** | **C** | **Z** | **Y** |
| L | L | H | H | H |
| H | L | H | H | L |
| L | H | L | L | H |
| H | H | L | L | L |
| L | L | L | ? | H |
| H | L | L | ? | L |
| L | H | H | ? | H |
| H | H | H | ? | L |

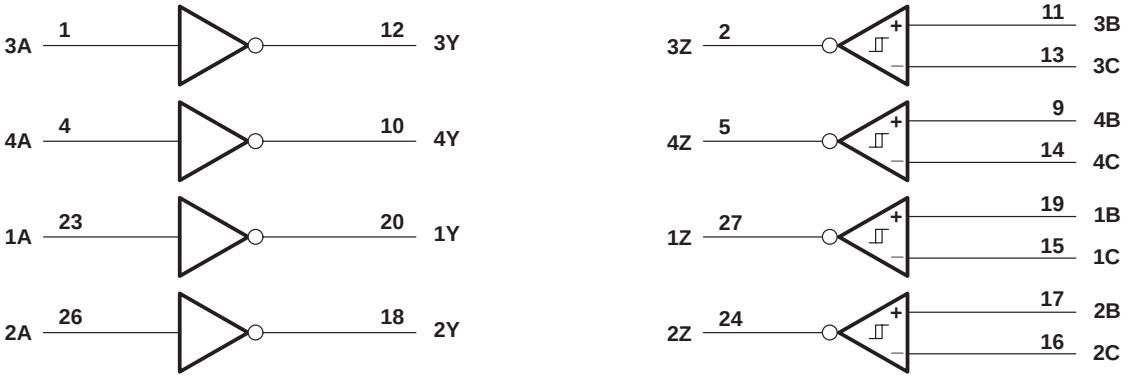
H = high level, L = low level,
X = irrelevant, Z = high impedance (off)
? = indeterminate

The receivers consist of differential comparators with hysteresis and resistive attenuation on the inputs. The resistive attenuation improves the input common mode range and also provides additional protection from ESD and over-voltage stress. The differential and common mode input impedances are sufficiently high to meet RS-423-B. When a differential voltage input of 500 mV is applied across the entire common mode range ( see Figure 5), the receiver characteristics and bias voltage allow the receiver to remain in its intended binary state.

The drivers meet all RS-423-B specifications with built-in current limits and thermal-overload protection. Slew-rate controlling circuitry is included in the design, which is adjusted to suit the application by means of an external resistor ($R_{WS}$). The slew rate controlling circuitry also has a default mode – if the $R_{WS}$ pin is shorted to 5 V externally, the transistion time defaults to approximately 1.5 ms. The BIAS input, when shorted to 5 V externally, provides the internal node voltages. The receiver is compatible to RS-232 with the use of external input resistors to meet the RS-232 input resistance specification of 3 kΩ to 7 kΩ.

The SN75LBC784 is characterized for operation over the temperature range of 0°C to 70°C.

## logic diagram (positive logic)




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

Positive supply voltage, $V_{DD}$ (see Note 1) . . . . . 14 V
Negative supply voltage, $V_{SS}$ . . . . . –14 V
Bias voltage, $V_{bias}$ . . . . . 5.75 V
Receiver input voltage range . . . . . –30 V to 30 V
Driver input voltage range . . . . . –0.5 V to 5.75 V
Driver output voltage range (supplies at 0 V) . . . . . –30 V to 30 V
Driver output voltage range (supplies at ±12 V) . . . . . –25 V to 25 V
Continuous power dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, $T_A$ . . . . . 0°C to 70°C
Storage temperature range . . . . . –65°C to 150°C
Case temperature for 10 seconds . . . . . 260°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

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

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATING FACTOR† ABOVE $T_A = 25°C$ | $T_A = 70°C$ POWER RATING |
|---|---|---|---|
| DW | 1348 mW | 10.8 mW/°C | 862 mW |

† Derating factors are the inverse of the junction-to-ambient thermal resistance when board-mounted with no air flow.

## recommended operating conditions

| | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|
| Supply voltage, $V_{DD}$ | | 10.8 | 12 | 13.2 | V |
| Supply voltage, $V_{SS}$ | | –10.8 | –12 | –13.2 | V |
| Bias voltage, $V_{bias}$ | | 2 | 5 | 5.5 | V |
| High-level input voltage, $V_{IH}$ | Driver | 2 | | | V |
| Low-level input voltage, $V_{IL}$ | Driver | | | 0.8 | V |
| High-level output current, $I_{OH}$ | Receiver | | | –4 | mA |
| Low-level output current, $I_{OL}$ | Receiver | | | 4 | mA |
| Rws slew rate control resistor | | 20 | 82 | 820 | kΩ |
| Operating free-air temperature, $T_A$ | | 0 | | 70 | °C |

## DRIVER SECTION

### electrical characteristics over recommended ranges of supply voltage and operating free-air temperature, $V_{DD}$ = 10.8 V to 13.2 V, $V_{SS}$ = –10.8 V to –13.2 V, $T_A$ = 0°C to 70°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | Open circuit or $R_L$ = 450 Ω | | 4 | 5.5 | 6 | V |
| $V_{OL}$ | Low-level output voltage | Open circuit or $R_L$ = 450 Ω | | –6 | –5.5 | –4 | V |
| $I_{IH}$ | High-level input current | $V_I$ = 2.4 V to 5.5 V | | | | 100 | µA |
| $I_{IL}$ | Low-level input current | $V_I$ = 0 V to 0.8 V | | –100 | | | µA |
| $I_O$ | Output leakage current | $V_{DD}$ = $V_{SS}$ = 0, | $V_O$ = ±6 V | –100 | | 100 | µA |
| $I_{OS(H)}$ | High-level short circuit output current | $V_I$ = 5 V, | $V_O$ = 0 | 15 | | 45 | mA |
| $I_{OS(L)}$ | Low-level short circuit output current | $V_I$ = 0, | $V_O$ = 0 | –45 | | –15 | mA |
| $I_{DD}$ | Supply current | No load | | | 10 | 12 | mA |
| | | $R_L$ = 450 Ω | | | 60 | 70 | |
| $I_{SS}$ | Supply current | No load | | | –10 | –12 | mA |
| | | $R_L$ = 450 Ω | | | –60 | –70 | |
| $I_{bias}$ | Bias current | | | | | 400 | µA |

### switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $V_{DD}$ = 10.8 V to 13.2 V, $V_{SS}$ = –10.8 V to –13.2 V, $T_A$ = 0°C to 70°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $t_{TLH}$ | Transition time, low-to-high level (see Figure 1) | $R_L$ = 450 Ω, $V_{WS}$ = 5 V | $C_L$ = 50 pF, | $R_{WS}$ = 0 kΩ | | 1.5 | | µs |
| | | | | $R_{WS}$ = 20 kΩ | 1.5 | 2.1 | 2.7 | |
| | | | | $R_{WS}$ = 82 kΩ | 5 | 8 | 11 | |
| | | | | $R_{WS}$ = 820 kΩ | | 80 | | |
| $t_{THL}$ | Transition time, high-to-low level (see Figure 1) | | | $R_{WS}$ = 0 kΩ | | 1.5 | | µs |
| | | | | $R_{WS}$ = 20 kΩ | 1.5 | 2.1 | 2.7 | |
| | | | | $R_{WS}$ = 82 kΩ | 5 | 8 | 11 | |
| | | | | $R_{WS}$ = 820 kΩ | | 80 | | |
| SR | Output slew rate | | | Rws = 20 kΩ | | | 15 | V/µs |
| $t_{sk}$ | Output skew (see Figure 4) $\lvert t_{PHL} - t_{PLH} \rvert$ | | | $R_{WS}$ = 82 kΩ | | | 1 | µs |

## RECEIVER SECTION

### electrical characteristics over recommended ranges of supply voltage and operating free-air temperature, $V_{DD}$ = 10.8 V to 13.2 V, $V_{SS}$ = –10.8 V to –13.2 V, $T_A$ = 0°C to 70°C (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{IT+}$ | Positive input threshold voltage | | | | | 200 | mV |
| | | With 500 Ω series resistor | | | | 400 | |
| $V_{IT–}$ | Negative input threshold voltage | | | | | –200 | mV |
| | | With 500 Ω series resistor | | | | –400 | |
| $I_I$ | Input current | $V_I$ = 10 V | Other input to GND | | 1.3 | 3.25 | mA |
| | | $V_I$ = –10 V | | –3.25 | –1.3 | | |
| $V_{hys}$ | Hysteresis ($V_{IT+} – V_{IT–}$) | | | 20 | 40 | 150 | mV |
| $V_{OH}$ | High-level output voltage (see Note 2) | $I_O$ = –20 μA | | 3.5 | | 5 | V |
| | | $I_O$ = –4 mA | | 2.4 | | 5 | |
| $V_{OL}$ | Low-level output voltage | $I_O$ = 20 μA to 4 mA | | | | 0.4 | V |
| $I_{RX}$ | RX short circuit current | | | | | 50 | mA |
| $V_{ID}$ | Differential input voltage | Receiver inputs open circuit | | 1.6 | 2.1 | 2.6 | V |
| $V_{ofs}$ | Fail safe output voltage | See Note 3 | | 3.5 | | | V |

NOTES: 2. Device has an internal RX supply regulator. Maximum RX logic output voltage under no load is thus defined by an internal voltage value. This is nominally set to 4.5 V with a tolerance of ±5%.
3. One input at ground, other input open circuit, $I_O$ = –20 μA, or both open circuit.

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

**test conditions: $V_{DD}$ = 10.8 V to 13.2 V, $V_{SS}$ = –10.8 V to –13.2 V, $T_A$ = 0°C to 70°C (unless otherwise noted)**

| PARAMETER | | TEST CONDITIONS | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation Delay time low-to-high (see Figure 2) | $C_L$ = 50 pF | | 0.15 | 1 | μs |
| $t_{PHL}$ | Propagation delay time high-to-low (see Figure 2) | | | | | |
| $t_{THL}$ | Transition time high-to-low (see Figure 3) | | | 20 | 200 | ns |
| $t_{TLH}$ | Transition time low-to-high (see Figure 3) | | | | | |

## PARAMETER MEASUREMENT INFORMATION

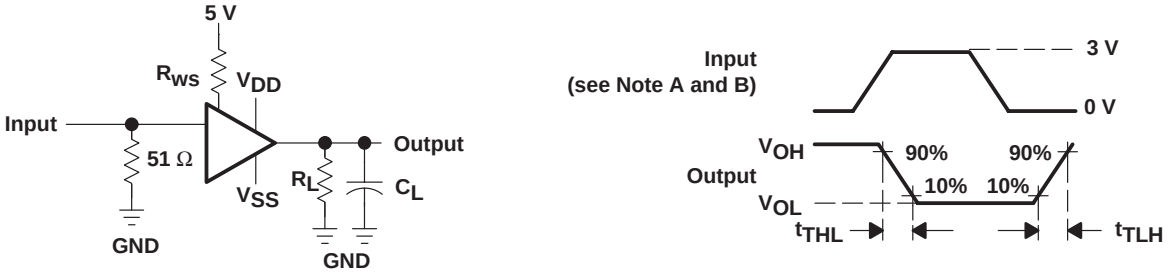



**Figure 1. Driver Transition Times**

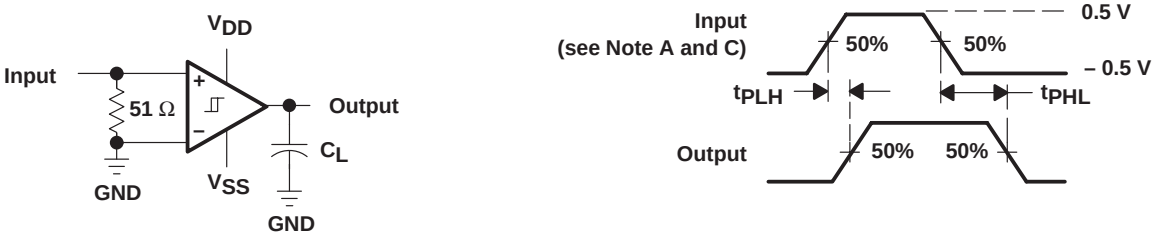



**Figure 2. Receiver Propagation Delay Times**

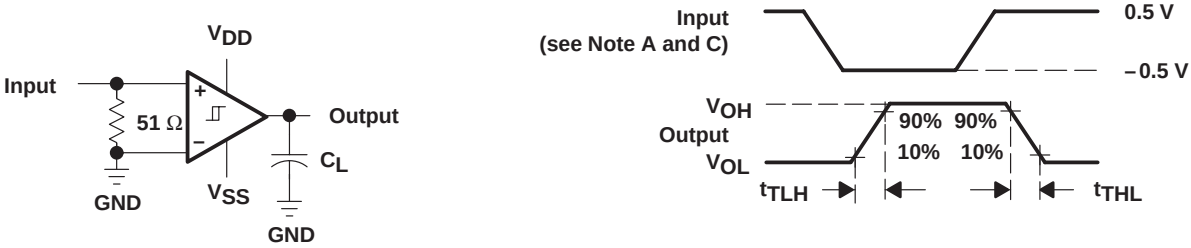



**Figure 3. Receiver Transition Times**

NOTES: A. $C_L$ includes probe and jig capacitance.
B. The input pulse is supplied by a generator having the following characteristics: $t_r \le 10$ nS, $t_f < 10$ nS, $Z_O = 50\ \Omega$, PRR ≥ 5 kHz, duty cycle 50%, $V_{max} = 3$ V, $V_{min} = 0$ V.
C. The input pulse is supplied by a generator having the following characteristics: $t_r \le 10$ nS, $t_f < 10$ nS, $Z_O = 50\ \Omega$, PRR ≥ 5 kHz, duty cycle 50%, $V_{max} = 0.5$ V, $V_{min} = -0.5$ V.

## PARAMETER MEASUREMENT INFORMATION

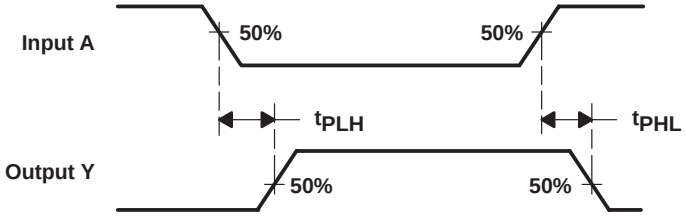



**Figure 4. Skew Definition Times**

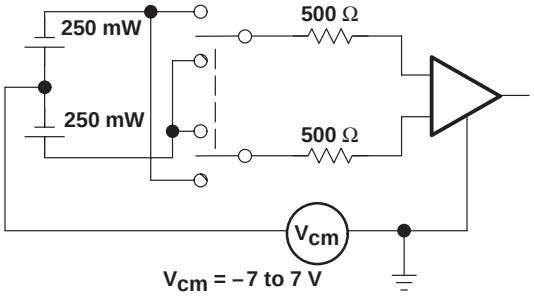



**Figure 5. Receiver Input Balance Test**

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