



## DIFFERENTIAL TRANSLATOR/REPEATER

### FEATURES

- Designed for Signaling Rates <sup>(1)</sup>  $\geq 2$  Gbps
- Total Jitter < 65 ps
- Low-Power Alternative for the MC100EP16
- Low 100 ps (Max) Part-To-Part Skew
- 25 mV of Receiver Input Threshold Hysteresis Over 0-V to 4-V Common-Mode Range
- Inputs Electrically Compatible With LVPECL, CML, and LVDS Signal Levels
- 3.3-V Supply Operation
- LVDT Integrates 110- $\Omega$  Terminating Resistor
- Offered in SOIC and MSOP

### APPLICATIONS

- 622 MHz Central Office Clock Distribution
- High-Speed Network Routing
- Wireless Basestations
- Low Jitter Clock Repeater
- Serdes LVPECL Output to FPGA LVDS Input Translator

- (1) The signaling rate of a line is the number of voltage transitions that are made per second expressed in the units bps (bits per second).

### DESCRIPTION

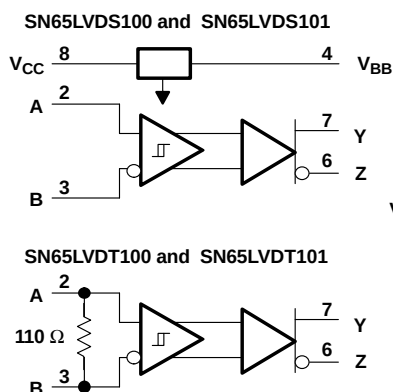
The SN65LVDS100, SN65LVDT100, SN65LVDS101, and SN65LVDT101 are a high-speed differential receiver and driver connected as a repeater. The receiver accepts low-voltage differential signaling (LVDS), positive-emitter-coupled logic (PECL), or current-mode logic (CML) input signals at rates up to 2 Gbps and repeats it as either an LVDS or PECL output signal. The signal path through the device is differential for low radiated emissions and minimal added jitter.

The outputs of the SN65LVDS100 and SN65LVDT100 are LVDS levels as defined by TIA/EIA-644-A. The outputs of the SN65LVDS101 and SN65LVDT101 are compatible with 3.3-V PECL levels. Both drive differential transmission lines with nominally 100- $\Omega$  characteristic impedance.

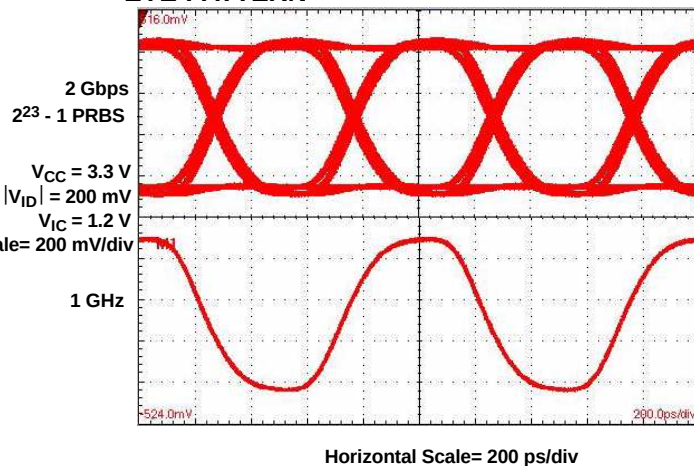
The SN65LVDT100 and SN65LVDT101 include a 110- $\Omega$  differential line termination resistor for less board space, fewer components, and the shortest stub length possible. They do not include the  $V_{BB}$  voltage reference found in the SN65LVDS100 and SN65LVDS101.  $V_{BB}$  provides a voltage reference of typically 1.35 V below  $V_{CC}$  for use in receiving single-ended input signals and is particularly useful with single-ended 3.3-V PECL inputs. When not used,  $V_{BB}$  should be unconnected or open.

All devices are characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

### FUNCTIONAL DIAGRAM



### EYE PATTERN



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.



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## ORDERING INFORMATION

| OUTPUT | TERMINATION RESISTOR | V <sub>BB</sub> | PART NUMBER <sup>(1)</sup> | PART MARKING | PACKAGE |
|--------|----------------------|-----------------|----------------------------|--------------|---------|
| LVDS   | No                   | Yes             | SN65LVDS100D               | DL100        | SOIC    |
| LVDS   | No                   | Yes             | SN65LVDS100DGK             | AZK          | MSOP    |
| LVDS   | Yes                  | No              | SN65LVDT100D               | DE100        | SOIC    |
| LVDS   | Yes                  | No              | SN65LVDT100DGK             | AZL          | MSOP    |
| LVPECL | No                   | Yes             | SN65LVDS101D               | DL101        | SOIC    |
| LVPECL | No                   | Yes             | SN65LVDS101DGK             | AZM          | MSOP    |
| LVPECL | Yes                  | No              | SN65LVDT101D               | DE101        | SOIC    |
| LVPECL | Yes                  | No              | SN65LVDT101DGK             | BAF          | MSOP    |

(1) Add the suffix R for taped and reeled carrier (i.e. SN65LVDS100DR).

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

over operating free-air temperature range unless otherwise noted

|                 |                                                                                       |                     | UNIT                         |
|-----------------|---------------------------------------------------------------------------------------|---------------------|------------------------------|
| V <sub>CC</sub> | Supply voltage range <sup>(2)</sup>                                                   |                     | –0.5 V to 4 V                |
| I <sub>BB</sub> | V <sub>BB</sub> Output current                                                        |                     | ±0.5 mA                      |
| V <sub>I</sub>  | Voltage range, (A, B, Y, Z)                                                           |                     | 0 V to 4.3 V                 |
| V <sub>O</sub>  |                                                                                       |                     |                              |
| V <sub>ID</sub> | Differential voltage,  V <sub>A</sub> – V <sub>B</sub>   ('LVDT100 and 'LVDT101 only) |                     | 1 V                          |
| ESD             | Human Body Model <sup>(3)</sup>                                                       | A, B, Y, Z, and GND | ±5 kV                        |
|                 |                                                                                       | All pins            | ±2 kV                        |
|                 | Charged-Device Model <sup>(4)</sup>                                                   | All pins            | ±1500 V                      |
| P <sub>D</sub>  | Continuous power dissipation                                                          |                     | See Dissipation Rating Table |

(1) 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.

(2) All voltage values, except differential I/O bus voltages, are with respect to network ground terminal.

(3) Tested in accordance with JEDEC Standard 22, Test Method A114-A.7.

(4) Tested in accordance with JEDEC Standard 22, Test Method C101.

## POWER DISSIPATION RATINGS

| PACKAGE | T <sub>A</sub> ≤ 25°C<br>POWER RATING | DERATING FACTOR <sup>(1)</sup><br>ABOVE T <sub>A</sub> = 25°C | T <sub>A</sub> = 85°C<br>POWER RATING |
|---------|---------------------------------------|---------------------------------------------------------------|---------------------------------------|
| DGK     | 377 mW                                | 3.8 mW/°C                                                     | 151 mW                                |
| D       | 481 mW                                | 4.8 mW/°C                                                     | 192 mW                                |

(1) This is the inverse of the junction-to-ambient thermal resistance with no air flow installed on the JESD51-3 low effective thermal conductivity test board for leadless surface mount packages.

## RECOMMENDED OPERATING CONDITIONS

|                                                                        |                      | MIN                 | NOM | MAX | UNIT    |
|------------------------------------------------------------------------|----------------------|---------------------|-----|-----|---------|
| Supply voltage, $V_{CC}$                                               |                      | 3                   | 3.3 | 3.6 | V       |
| Magnitude of differential input voltage $ V_{ID} $                     | 'LVDS100 or 'LVDS101 | 0.1                 |     | 1   | V       |
|                                                                        | 'LVDT100 or 'LVDT101 | 0.1                 |     | 0.8 |         |
| Input voltage (any combination of common-mode or input signals), $V_I$ |                      | 0                   |     | 4   | V       |
| $V_{BB}$ output current, $I_{O(VBB)}$                                  |                      | –400 <sup>(1)</sup> |     | 12  | $\mu$ A |
| Operating free-air temperature, $T_A$                                  |                      | –40                 |     | 85  | °C      |

(1) The algebraic convention, in which the less positive (more negative) limit is designated minimum, is used in this data sheet.

## ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise specified)

| PARAMETER                                                               |                                                     | TEST CONDITIONS                                                      | MIN          | TYP <sup>(1)</sup> | MAX          | UNIT     |
|-------------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------|--------------|--------------------|--------------|----------|
| $I_{CC}$                                                                | Supply current, 'LVDx100                            | No load or input                                                     |              | 25                 | 30           | mA       |
|                                                                         | Supply current, 'LVDx101                            | $R_L = 50 \Omega$ to 1 V, No input                                   |              | 50                 | 61           |          |
| $P_D$                                                                   | Device power dissipation, 'LVDx100                  | $R_L = 100 \Omega$ , No input                                        |              |                    | 110          | mW       |
|                                                                         | Device power dissipation, 'LVDx101                  | Y and Z to $V_{CC} - 2$ V through $50 \Omega$ , No input             |              | 116                | 142          |          |
| $V_{BB}$                                                                | Reference voltage output, 'LVDS100 or 'LVDS101      | $I_O = -400 \mu$ A or $12 \mu$ A                                     | $V_{CC}-1.4$ | $V_{CC}-1.35$      | $V_{CC}-1.3$ | mV       |
| <b>SN65LVDS100 and SN65LVDS101 INPUT CHARACTERISTICS (see Figure 1)</b> |                                                     |                                                                      |              |                    |              |          |
| $V_{IT+}$                                                               | Positive-going differential input voltage threshold | See Figure 1 and Table 1                                             |              |                    | 100          | mV       |
| $V_{IT-}$                                                               | Negative-going differential input voltage threshold |                                                                      | –100         |                    |              |          |
| $I_I$                                                                   | Input current                                       | $V_I = 0$ V or 2.4 V, Second input at 1.2 V                          | –20          |                    | 20           | $\mu$ A  |
|                                                                         |                                                     | $V_I = 4$ V, Second input at 1.2 V                                   |              |                    | 33           | $\mu$ A  |
| $I_{I(OFF)}$                                                            | Power off input current                             | $V_{CC} = 1.5$ V, $V_I = 0$ V or 2.4 V, Second input at 1.2 V        | –20          |                    | 20           | $\mu$ A  |
|                                                                         |                                                     | $V_{CC} = 1.5$ V, $V_I = 4$ V, Second input at 1.2 V                 |              |                    | 33           |          |
| $I_{IO}$                                                                | Input offset current ( $ I_{IA} - I_{IB} $ )        | $V_{IA} = V_{IB}$ , $0 \leq V_{IA} \leq 4$ V                         | –6           |                    | 6            | $\mu$ A  |
| $C_i$                                                                   | Small-signal input capacitance to GND               | $V_I = 1.2$ V                                                        |              | 0.6                |              | pF       |
| <b>SN65LVDT100 and SN65LVDT101 INPUT CHARACTERISTICS (see Figure 1)</b> |                                                     |                                                                      |              |                    |              |          |
| $V_{IT+}$                                                               | Positive-going differential input voltage threshold | See Figure 1 and Table 1                                             |              |                    | 100          | mV       |
| $V_{IT-}$                                                               | Negative-going differential input voltage threshold |                                                                      | –100         |                    |              |          |
| $I_I$                                                                   | Input current                                       | $V_I = 0$ V or 2.4 V, Other input open                               | –40          |                    | 40           | $\mu$ A  |
|                                                                         |                                                     | $V_I = 4$ V, Other input open                                        |              |                    | 66           |          |
| $I_{I(OFF)}$                                                            | Power off input current                             | $V_{CC} = 1.5$ V, $V_I = 0$ V or 2.4 V, Other input open             | –40          |                    | 40           | $\mu$ A  |
|                                                                         |                                                     | $V_{CC} = 1.5$ V, $V_I = 4$ V, Other input open                      |              |                    | 66           |          |
| $R_{(T)}$                                                               | Differential input resistance                       | $V_{ID} = 300$ mV or 500 mV, $V_{IC} = 0$ V or 2.4 V                 | 90           | 110                | 132          | $\Omega$ |
|                                                                         |                                                     | $V_{CC} = 0$ V, $V_{ID} = 300$ mV or 500 mV, $V_{IC} = 0$ V or 2.4 V | 90           | 110                | 132          |          |
| $C_i$                                                                   | Small-signal differential input capacitance         | $V_I = 1.2$ V                                                        |              | 0.6                |              | pF       |

(1) Typical values are with a 3.3-V supply voltage and room temperature

## ELECTRICAL CHARACTERISTICS (continued)

over recommended operating conditions (unless otherwise specified)

| PARAMETER                                                                |                                                                        | TEST CONDITIONS                                            | MIN             | TYP <sup>(1)</sup> | MAX             | UNIT |
|--------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------|-----------------|--------------------|-----------------|------|
| <b>SN65LVDS100 and SN65LVDT100 OUTPUT CHARACTERISTICS (see Figure 1)</b> |                                                                        |                                                            |                 |                    |                 |      |
| $ V_{OD} $                                                               | Differential output voltage magnitude                                  | See Figure 2                                               | 247             | 340                | 454             | mV   |
| $\Delta V_{OD} $                                                         | Change in differential output voltage magnitude between logic states   |                                                            | –50             |                    | 50              |      |
| $V_{OC(SS)}$                                                             | Steady-state common-mode output voltage                                | See Figure 3                                               | 1.125           |                    | 1.375           | V    |
| $\Delta V_{OC(SS)}$                                                      | Change in steady-state common-mode output voltage between logic states |                                                            | –50             |                    | 50              | mV   |
| $V_{OC(PP)}$                                                             | Peak-to-peak common-mode output voltage                                |                                                            |                 | 50                 | 150             | mV   |
| $I_{OS}$                                                                 | Short-circuit output current                                           | $V_{O(Y)} \text{ or } V_{O(Z)} = 0 \text{ V}$              | –24             |                    | 24              | mA   |
| $I_{OS(D)}$                                                              | Differential short-circuit output current                              | $V_{OD} = 0 \text{ V}$                                     | –12             |                    | 12              | mA   |
| <b>SN65LVDS101 and SN65LVDT101 OUTPUT CHARACTERISTICS (see Figure 1)</b> |                                                                        |                                                            |                 |                    |                 |      |
| $V_{OH}$                                                                 | High-level output voltage                                              | 50 $\Omega$ to $V_{CC} - 2 \text{ V}$ , See Figure 4       | $V_{CC} - 1.25$ | $V_{CC} - 1.02$    | $V_{CC} - 0.9$  | V    |
|                                                                          |                                                                        | $V_{CC} = 3.3 \text{ V}$ , 50- $\Omega$ load to 2.3 V      | 2055            | 2280               | 2405            | mV   |
| $V_{OL}$                                                                 | Low-level output voltage                                               | 50 $\Omega$ to $V_{CC} - 2 \text{ V}$ , See Figure 4       | $V_{CC} - 1.83$ | $V_{CC} - 1.61$    | $V_{CC} - 1.53$ | V    |
|                                                                          |                                                                        | $V_{CC} = 3.3 \text{ V}$ , 50- $\Omega$ load to 2.3 V      | 1475            | 1690               | 1775            | mV   |
| $ V_{OD} $                                                               | Differential output voltage magnitude                                  | 50- $\Omega$ load to $V_{CC} - 2 \text{ V}$ , See Figure 4 | 475             | 575                | 750             | mV   |

## SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

| PARAMETER             |                                                                    |          | TEST CONDITIONS                                                                                            |  | MIN                                   | TYP <sup>(1)</sup> | MAX | UNIT |    |
|-----------------------|--------------------------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------|--|---------------------------------------|--------------------|-----|------|----|
| t <sub>PLH</sub>      | Propagation delay time, low-to-high-level output                   | 'LVDx100 | See Figure 5                                                                                               |  | 300                                   | 470                | 800 | ps   |    |
|                       |                                                                    | 'LVDx101 |                                                                                                            |  | 400                                   | 630                | 900 |      |    |
| t <sub>PHL</sub>      | Propagation delay time, high-to-low-level output                   | 'LVDx100 |                                                                                                            |  | 300                                   | 470                | 800 | ps   |    |
|                       |                                                                    | 'LVDx100 |                                                                                                            |  | 400                                   | 630                | 900 |      |    |
| t <sub>r</sub>        | Differential output signal rise time (20%–80%)                     |          |                                                                                                            |  |                                       |                    | 220 | ps   |    |
| t <sub>f</sub>        | Differential output signal fall time (20%–80%)                     |          |                                                                                                            |  |                                       |                    | 220 | ps   |    |
| t <sub>sk(p)</sub>    | Pulse skew ( t <sub>PHL</sub> – t <sub>PLH</sub>  ) <sup>(2)</sup> |          |                                                                                                            |  |                                       |                    | 5   | 50   | ps |
| t <sub>sk(pp)</sub>   | Part-to-part skew <sup>(3)</sup>                                   |          |                                                                                                            |  | V <sub>ID</sub> = 0.2 V, See Figure 5 |                    |     | 100  | ps |
| t <sub>jit(per)</sub> | RMS period jitter <sup>(4)</sup>                                   |          | 1 GHz 50% duty cycle square wave input,                                                                    |  | 1                                     | 3.7                | ps  |      |    |
| t <sub>jit(cc)</sub>  | Peak cycle-to-cycle jitter <sup>(5)</sup>                          |          | V <sub>ID</sub> = 200 mV, V <sub>IC</sub> = 1.2 V, See Figure 6                                            |  | 6                                     | 23                 | ps  |      |    |
| t <sub>jit(pp)</sub>  | Peak-to-peak jitter                                                |          | 2 GHz PRBS, 2 <sup>23</sup> –1 run length, V <sub>ID</sub> = 200 mV, V <sub>IC</sub> = 1.2 V, See Figure 6 |  | 28                                    | 65                 | ps  |      |    |
| t <sub>jit(det)</sub> | Peak-to-peak deterministic jitter <sup>(6)</sup>                   |          | 2 GHz PRBS, 2 <sup>7</sup> –1 run length, V <sub>ID</sub> = 200 mV, V <sub>IC</sub> = 1.2 V, See Figure 6  |  | 17                                    | 48                 | ps  |      |    |

(1) All typical values are at 25°C and with a 3.3 V supply.

(2)  $t_{sk(p)}$  is the magnitude of the time difference between the  $t_{PLH}$  and  $t_{PHL}$  of any output of a single device.

(3)  $t_{sk(pp)}$  is the magnitude of the time difference in propagation delay time between any specified terminals of two devices when both devices operate with the same supply voltages, at the same temperature, and have identical packages and test circuits.

(4) Period jitter is the deviation in cycle time of a signal with respect to the ideal period over a random sample of 1000,000 cycles.

(5) Cycle-to-cycle jitter is the variation in cycle time of a signal between adjacent cycles, over a random sample of 1,000 adjacent cycle pairs.

(6) Deterministic jitter is the sum of pattern-dependent jitter and pulse-width distortion.

## PARAMETER MEASUREMENT INFORMATION

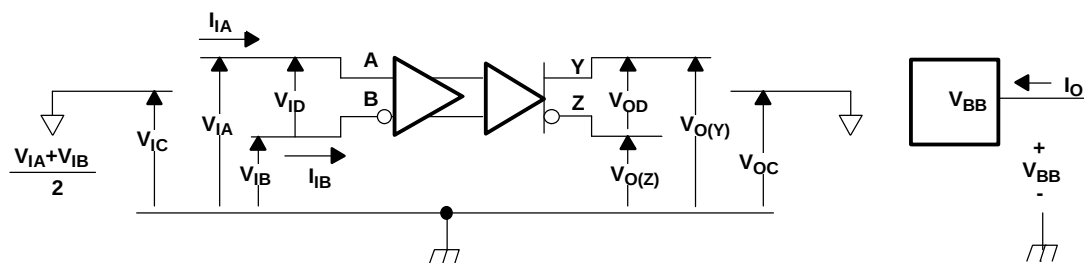


Figure 1. Voltage and Current Definitions

Table 1. Receiver Input Voltage Threshold Test

| APPLIED VOLTAGES |                 | RESULTING DIFFERENTIAL INPUT VOLTAGE | RESULTING COMMON-MODE INPUT VOLTAGE | OUTPUT <sup>(1)</sup> |
|------------------|-----------------|--------------------------------------|-------------------------------------|-----------------------|
| V <sub>IA</sub>  | V <sub>IB</sub> | V <sub>ID</sub>                      | V <sub>IC</sub>                     |                       |
| 1.25 V           | 1.15 V          | 100 mV                               | 1.2 V                               | H                     |
| 1.15 V           | 1.25 V          | –100 mV                              | 1.2 V                               | L                     |
| 4.0 V            | 3.9 V           | 100 mV                               | 3.95 V                              | H                     |
| 3.9 V            | 4.0 V           | –100 mV                              | 3.95 V                              | L                     |
| 0.1 V            | 0.0 V           | 100 mV                               | 0.05 V                              | H                     |
| 0.0 V            | 0.1 V           | –100 mV                              | 0.05 V                              | L                     |
| 1.7 V            | 0.7 V           | 1000 mV                              | 1.2 V                               | H                     |
| 0.7 V            | 1.7 V           | –1000 mV                             | 1.2 V                               | L                     |
| 4.0 V            | 3.0 V           | 1000 mV                              | 3.5 V                               | H                     |
| 3.0 V            | 4.0 V           | –1000 mV                             | 3.5 V                               | L                     |
| 1.0 V            | 0.0 V           | 1000 mV                              | 0.5 V                               | H                     |
| 0.0 V            | 1.0 V           | –1000 mV                             | 0.5 V                               | L                     |

(1) H = high level, L = low level

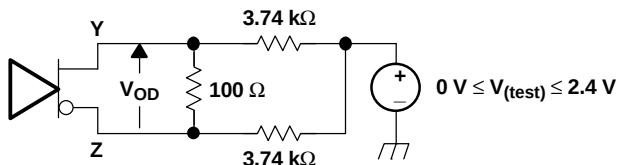
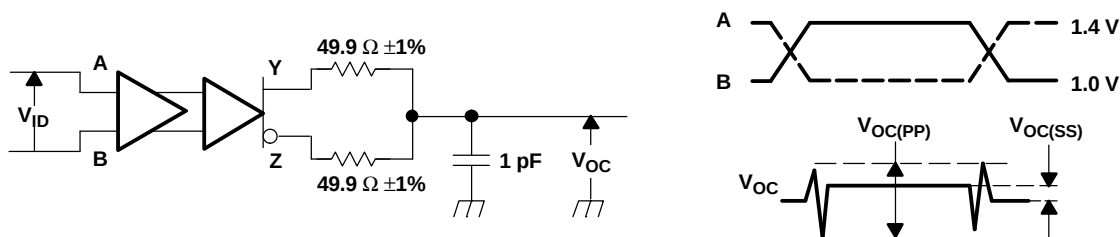


Figure 2. SN65LVDS100 Differential Output Voltage (V<sub>OD</sub>) Test Circuit



NOTE: All input pulses are supplied by a generator having the following characteristics:  $t_r$  or  $t_f \leq 0.25$  ns, pulse repetition rate (PRR) = 0.5 Mpps, pulse width =  $500 \pm 10$  ns.  $C_L$  includes instrumentation and fixture capacitance within 0.06 mm of the D.U.T. The measurement of  $V_{OC(PP)}$  is made on test equipment with a –3 dB bandwidth of at least 300 MHz.

Figure 3. Test Circuit and Definitions for the SN65LVDS100 Driver Common-Mode Output Voltage

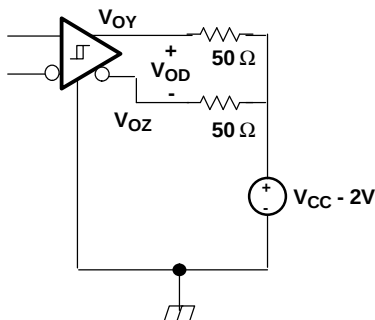
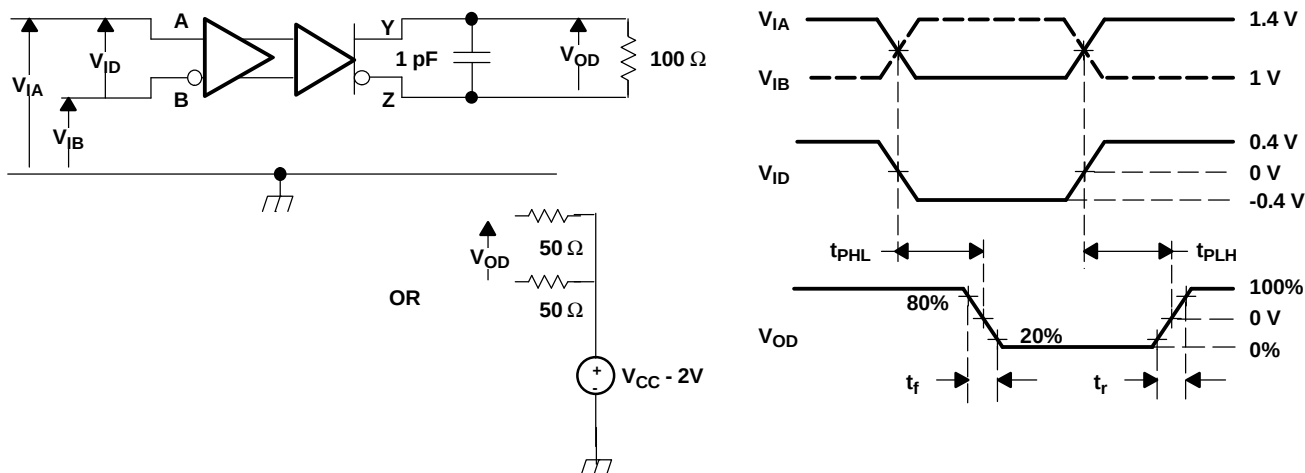


Figure 4. Typical Termination for LVPECL Output Driver (65LVDTx101)



NOTE: All input pulses are supplied by a generator having the following characteristics:  $t_r$  or  $t_f \leq 0.25$  ns, pulse repetition rate (PRR) = 50 Mpps, pulse width =  $10 \pm 0.2$  ns.  $C_L$  includes instrumentation and fixture capacitance within 0,06 mm of the D.U.T. Measurement equipment provides a bandwidth of 5 GHz minimum.

Figure 5. Timing Test Circuit and Waveforms

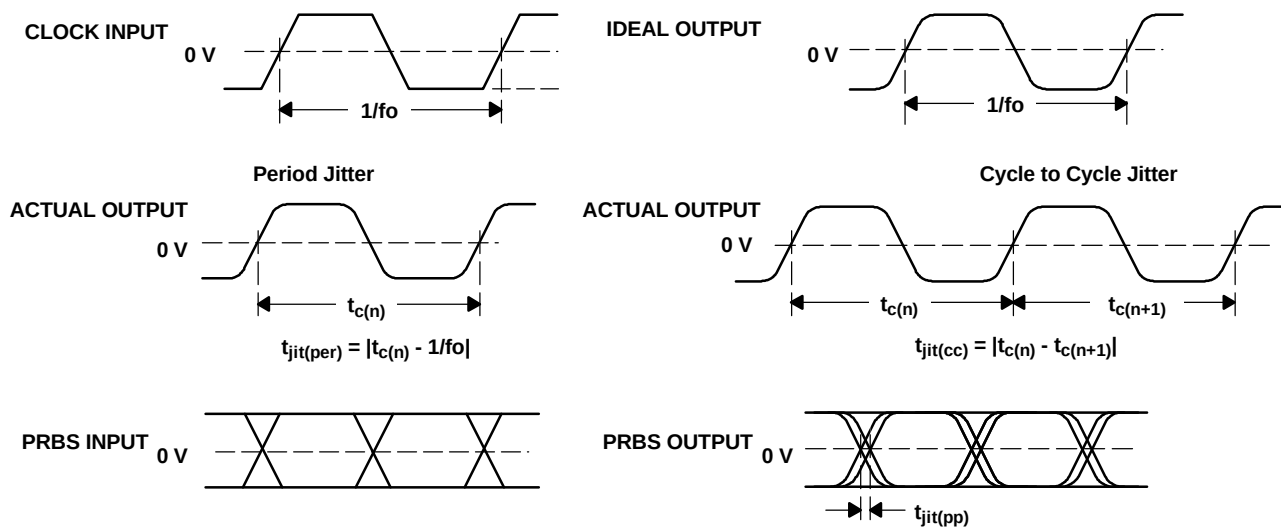
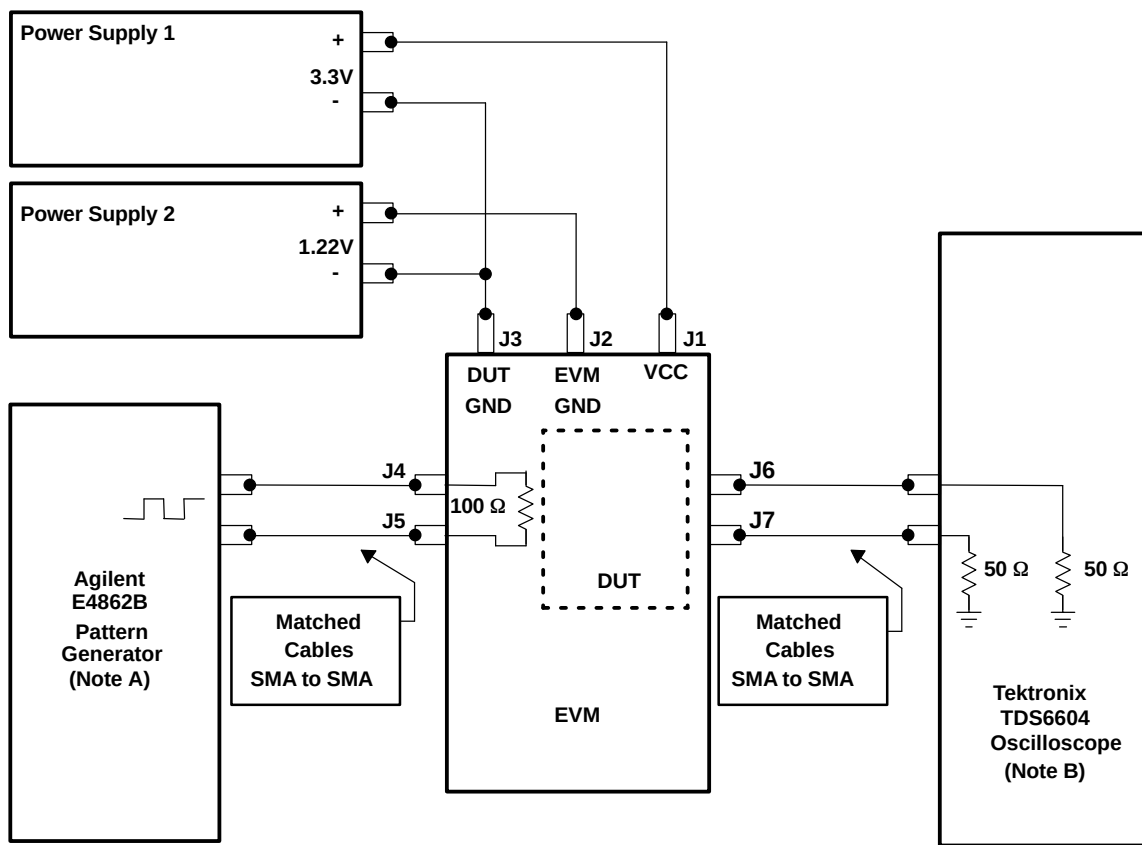


Figure 6. Driver Jitter Measurement Waveforms

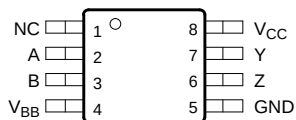


- A. Source jitter is subtracted from the measured values.  
B. TDS JIT3 jitter analysis software installed

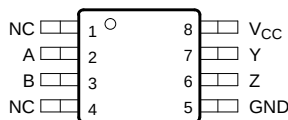
**Figure 7. Jitter Setup Connections for SN65LVDS100 and SN65LVDS101**

## PIN ASSIGNMENTS

SN65LVDS100 and SN65LVDS101  
D AND DGK PACKAGE  
(TOP VIEW)



SN65LVDT100 and SN65LVDT101  
D AND DGK PACKAGE  
(TOP VIEW)



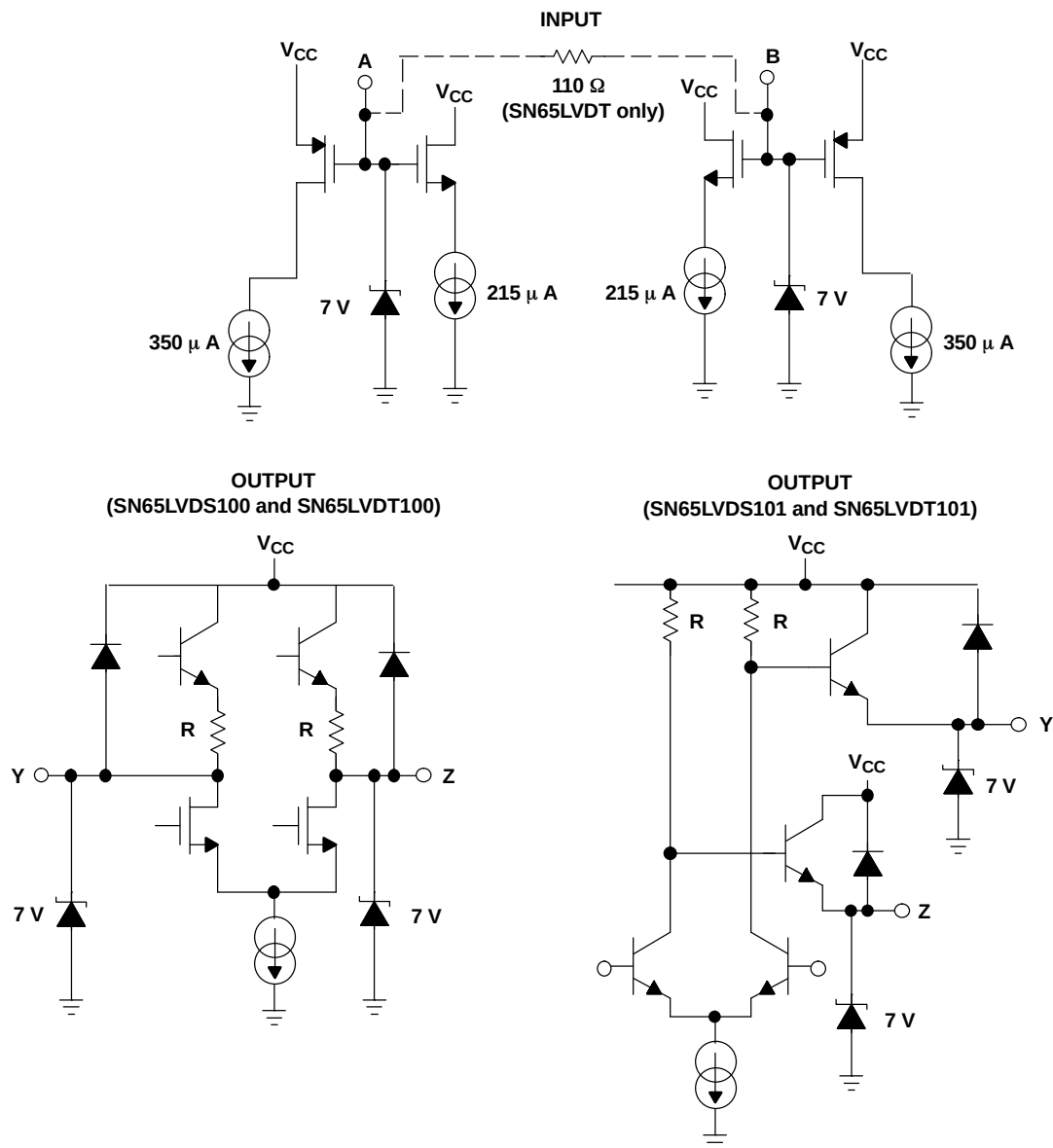
NC = Not Connected

## FUNCTION TABLE

| DIFFERENTIAL INPUT                          | OUTPUTS <sup>(1)</sup> |   |
|---------------------------------------------|------------------------|---|
| $V_{ID} = V_A - V_B$                        | Y                      | Z |
| $V_{ID} \geq 100 \text{ mV}$                | H                      | L |
| $-100 \text{ mV} < V_{ID} < 100 \text{ mV}$ | ?                      | ? |
| $V_{ID} \leq -100 \text{ mV}$               | L                      | H |
| Open                                        | ?                      | ? |

(1) H = high level, L = low level, ? = indeterminate

## EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS





## TYPICAL CHARACTERISTICS

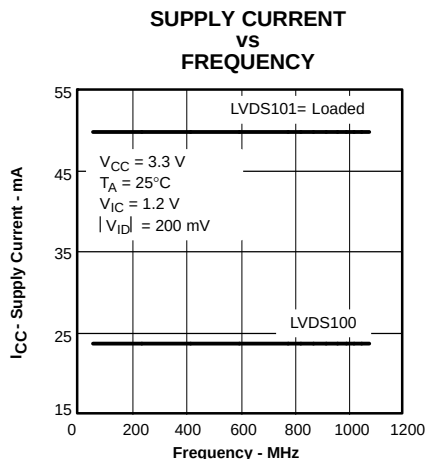


Figure 8.

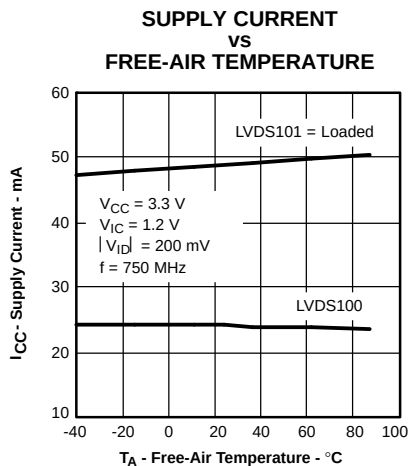


Figure 9.

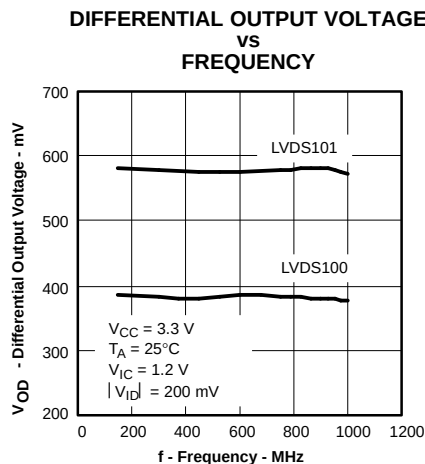


Figure 10.

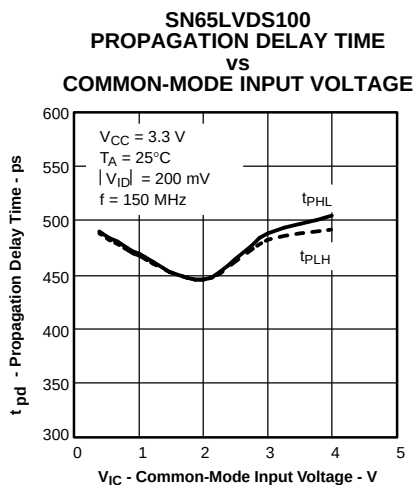


Figure 11.

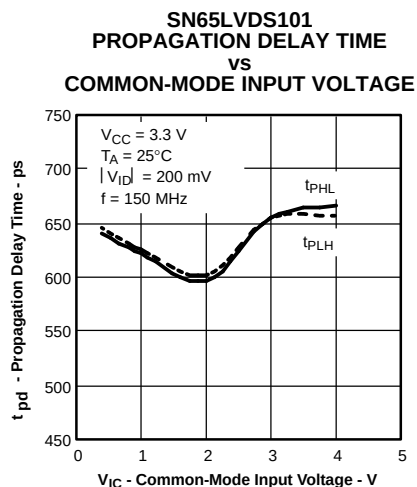


Figure 12.

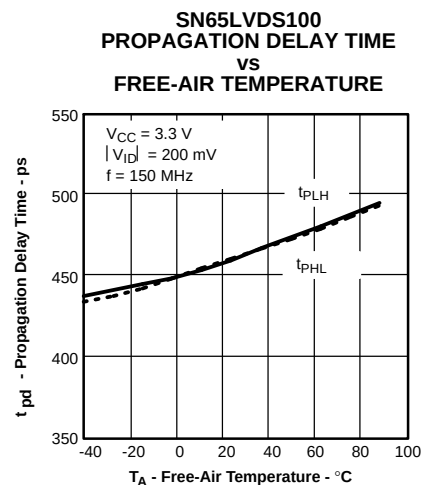


Figure 13.

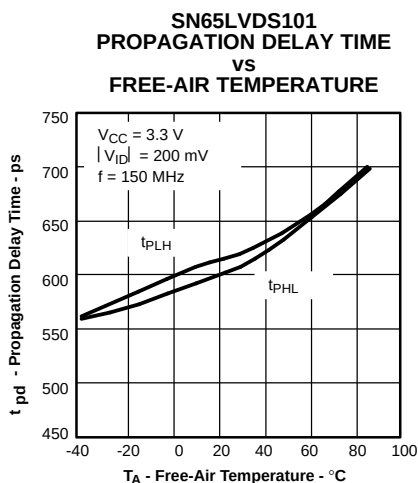


Figure 14.

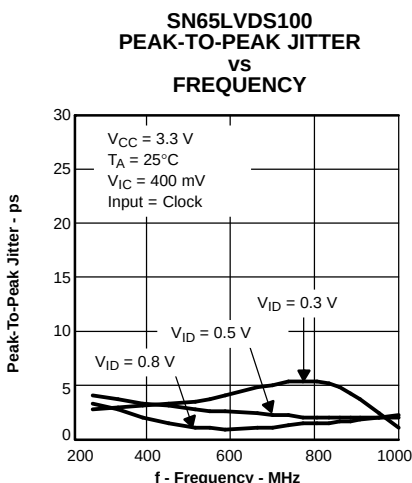


Figure 15.

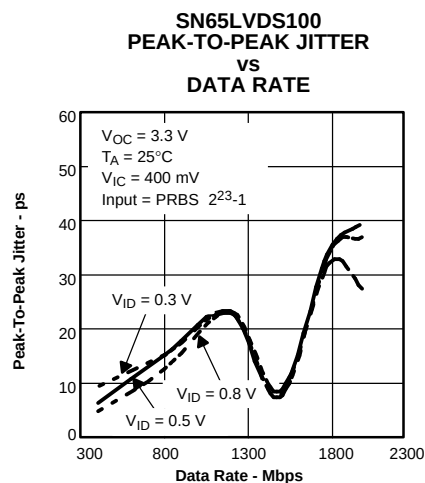


Figure 16.

TYPICAL CHARACTERISTICS (continued)

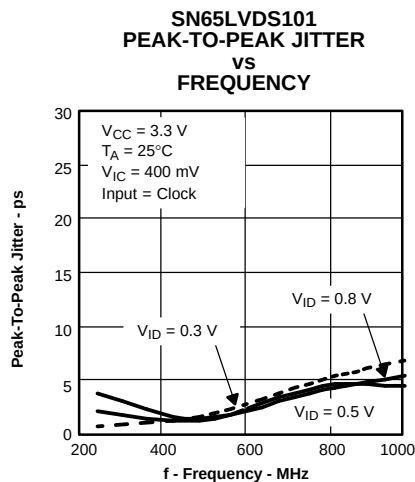


Figure 17.

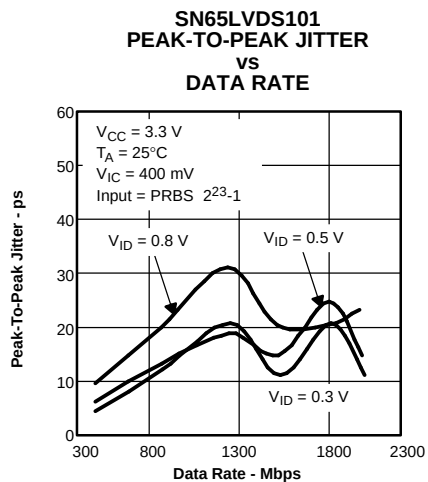


Figure 18.

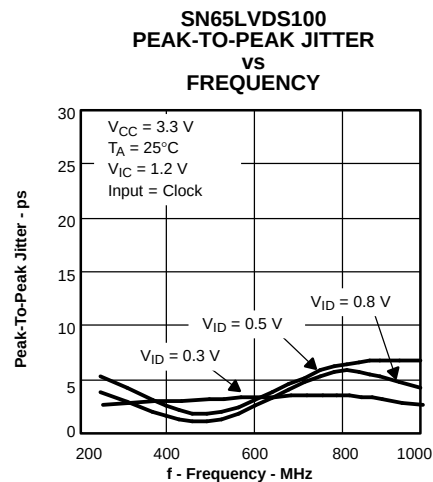


Figure 19.

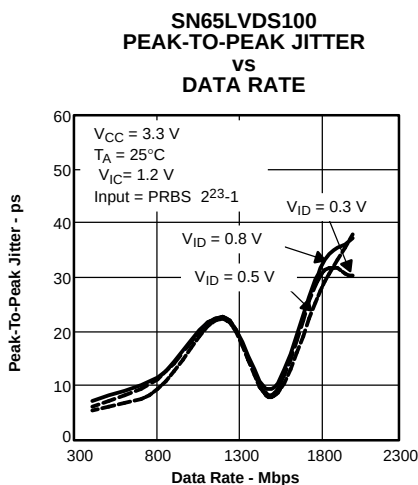


Figure 20.

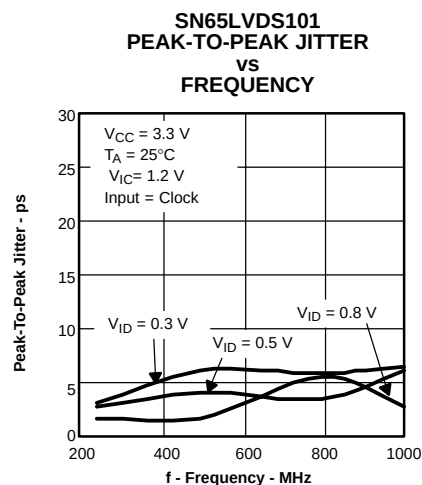


Figure 21.

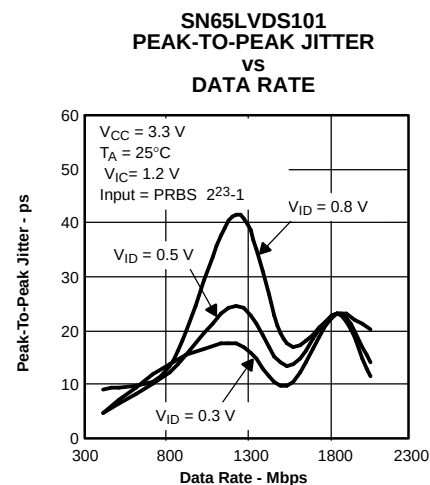


Figure 22.

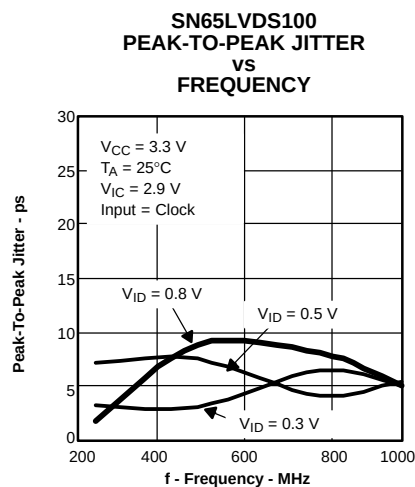


Figure 23.

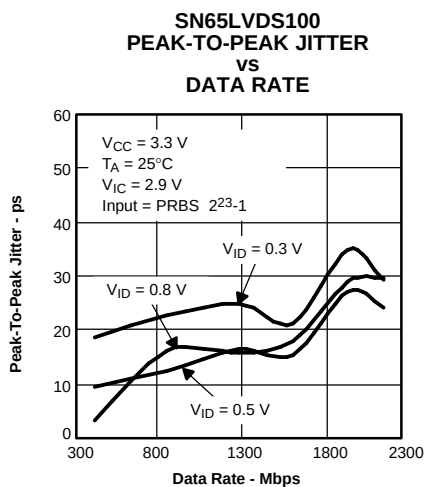


Figure 24.

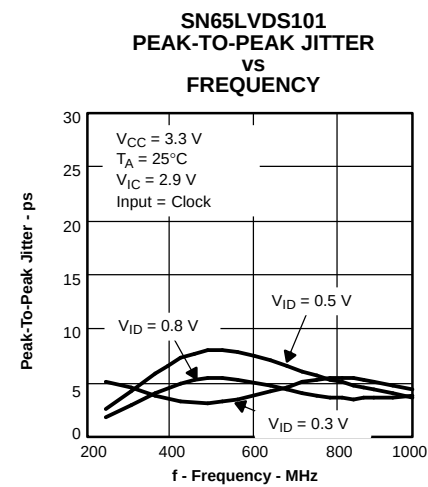


Figure 25.

## TYPICAL CHARACTERISTICS (continued)

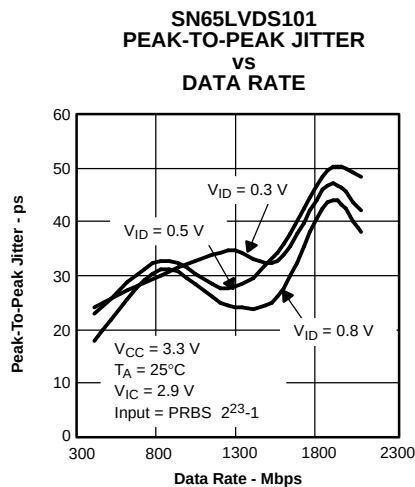


Figure 26.

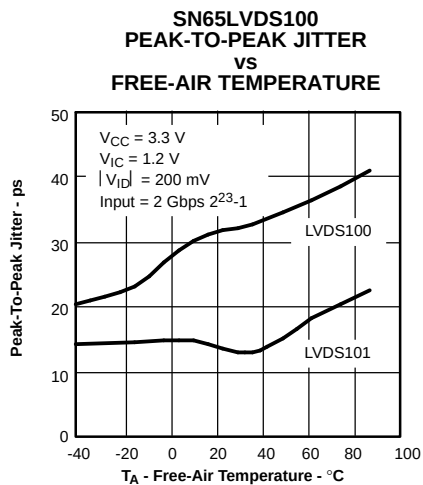


Figure 27.

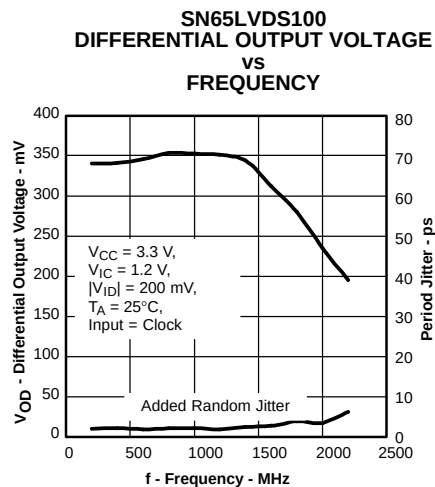


Figure 28.

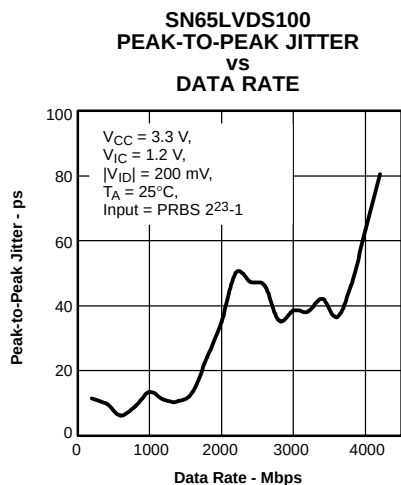


Figure 29.

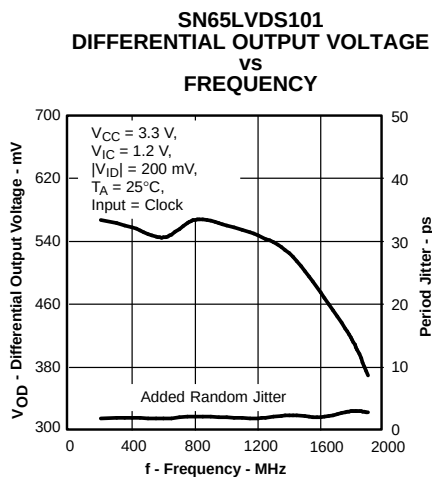


Figure 30.

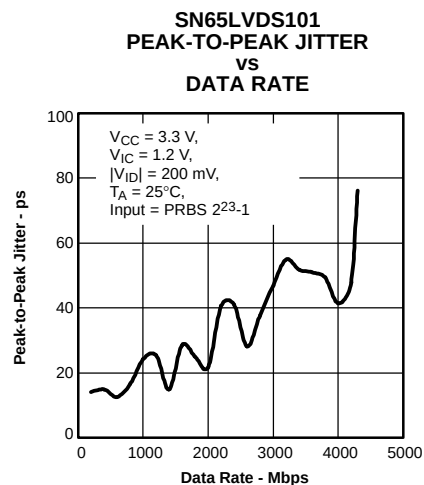
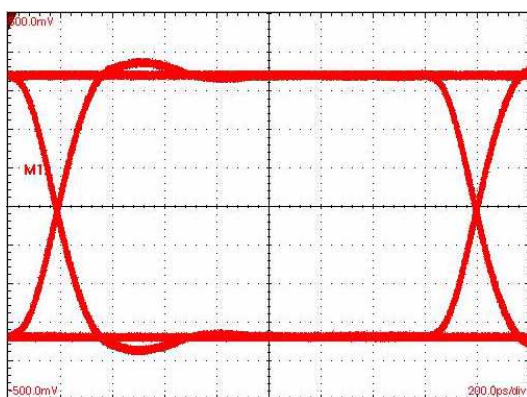


Figure 31.

**TYPICAL CHARACTERISTICS (continued)**

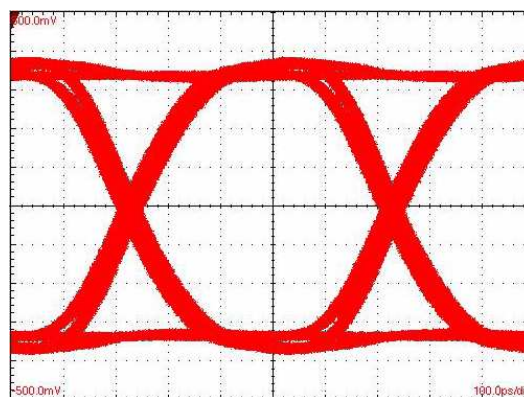
SN65LVDS100  
622 Mbps,  $2^{23}-1$  PRBS



Horizontal Scale= 200 ps/div  
LVPECL-to-LVDS

Figure 32.

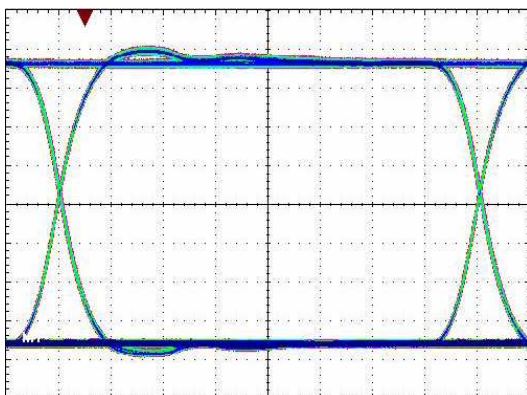
SN65LVDS100  
2 Gbps,  $2^{23}-1$  PRBS



Horizontal Scale= 100 ps/div  
LVPECL-to-LVDS

Figure 33.

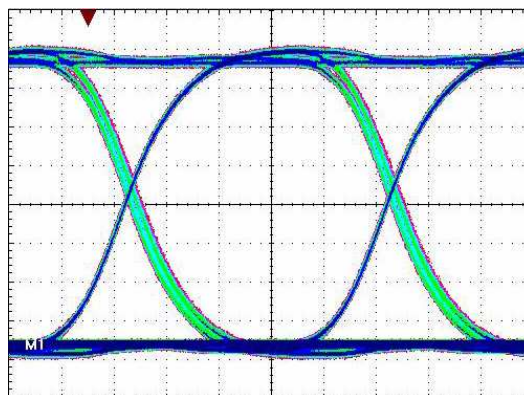
SN65LVDS101  
622 Mbps,  $2^{23}-1$  PRBS



Horizontal Scale= 200 ps/div  
LVDS-to-LVPECL

Figure 34.

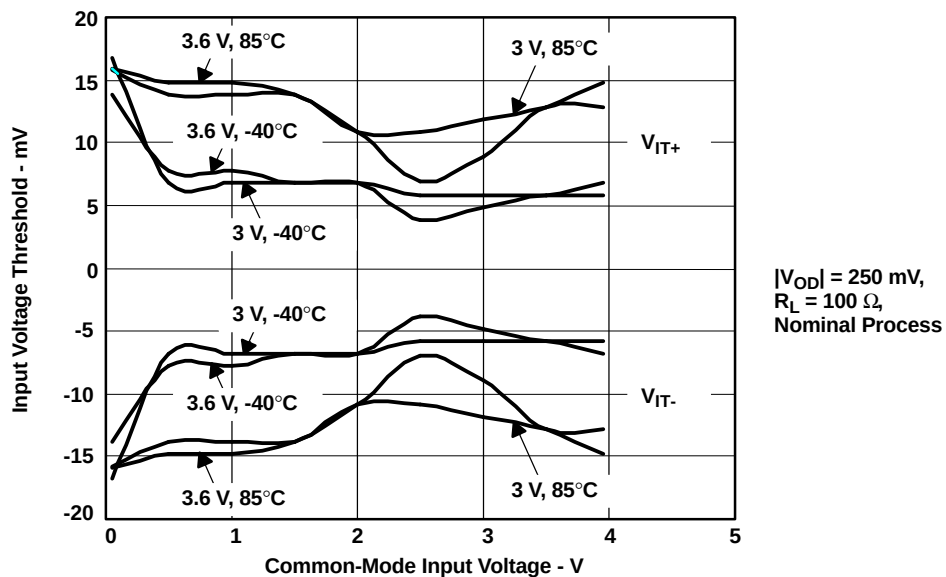
SN65LVDS101  
2 Gbps,  $2^{23}-1$  PRBS



Horizontal Scale= 100 ps/div  
LVDS-to-LVPECL

Figure 35.

## TYPICAL CHARACTERISTICS (continued)



NOTE:  $V_{IT}$  is a steady-state parameter. The switching time is influenced by the input overdrive above this steady-state threshold up to a differential input voltage magnitude of 100 mV.

**Figure 36. SN65LVDS100 Simulated Input Voltage Threshold vs Common-Mode Input Voltage, Supply Voltage, and Temperature**

## APPLICATION INFORMATION

The SN65LVDS100, SN65LVDT100, SN65LVDS101, and SN65LVDT101 inputs will detect a 100-mV difference between any two signals between 0 V and 4 V. This range will allow receipt of many different single-ended and differential signals. Following are some of the more common connections.

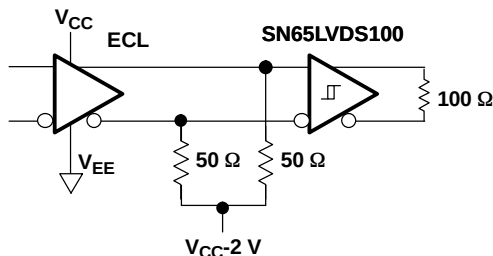


Figure 37. PECL-to-LVDS Translation

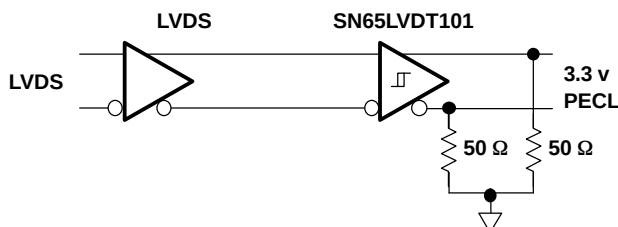


Figure 38. LVDS-to-3.3 V PECL Translation

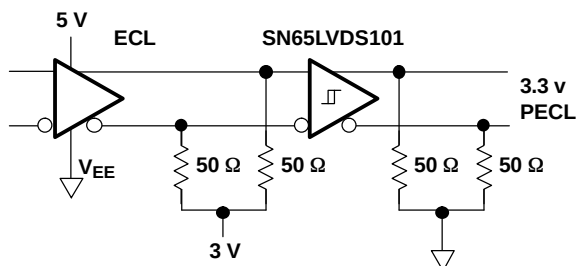


Figure 39. 5-V PECL to 3.3-V PECL Translation

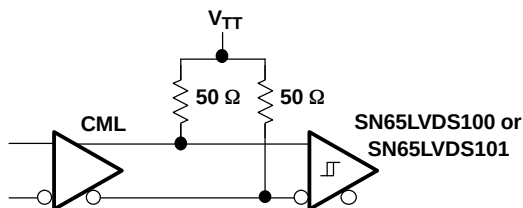


Figure 40. CML-to-LVDS or 3.3-V PECL Translation

## APPLICATION INFORMATION (continued)

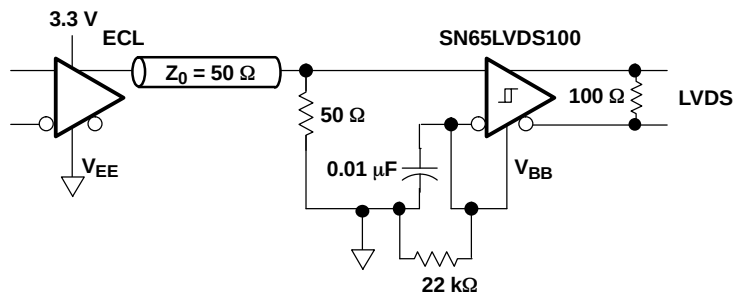


Figure 41. Single-Ended 3.3-V PECL-to-LVDS Translation

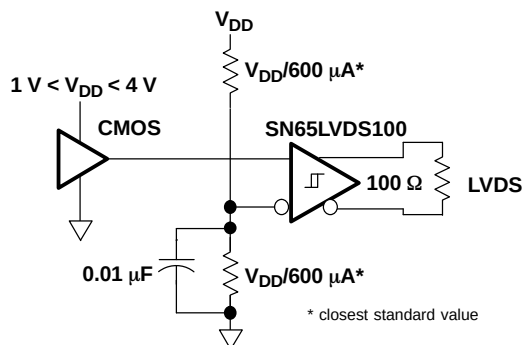


Figure 42. Single-Ended CMOS-to-LVDS Translation

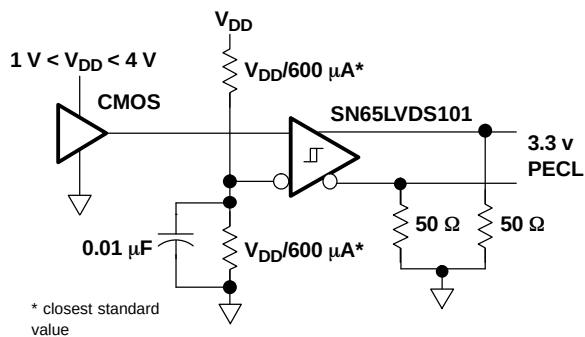


Figure 43. Single-Ended CMOS-to-3.3-V PECL Translation

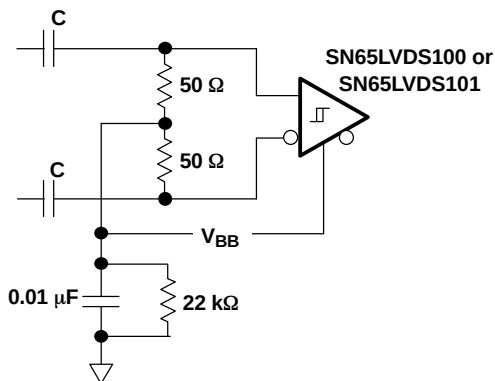


Figure 44. Receipt of AC-Coupled Signals

## APPLICATION INFORMATION (continued)

### FAILSAFE CONSIDERATIONS

Failsafe, in regard to a line receiver, usually means that the output goes to a defined logical state with no input signal. To keep added jitter to an absolute minimum, the SN65LVDS100 does not include this feature. It does exhibit 25 mV of input voltage hysteresis to prevent oscillation and keep the output in the last state prior to input-signal loss (assuming the differential noise in the system is less than the hysteresis).

Should failsafe be required, it may be added externally with a 1.6-k $\Omega$  pull-up resistor to the 3.3-V supply and a 1.6-k $\Omega$  pull-down resistor to ground as shown in Figure 45. The default output state is determined by which line is pulled up or down and is the user's choice. The location of the 1.6-k $\Omega$  resistors is not critical. However the 100- $\Omega$  resistor should be located at the end of the transmission line.

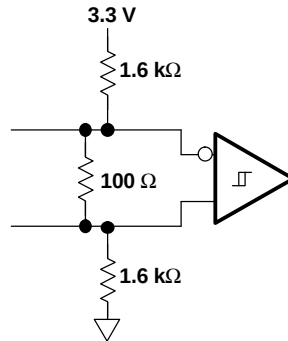


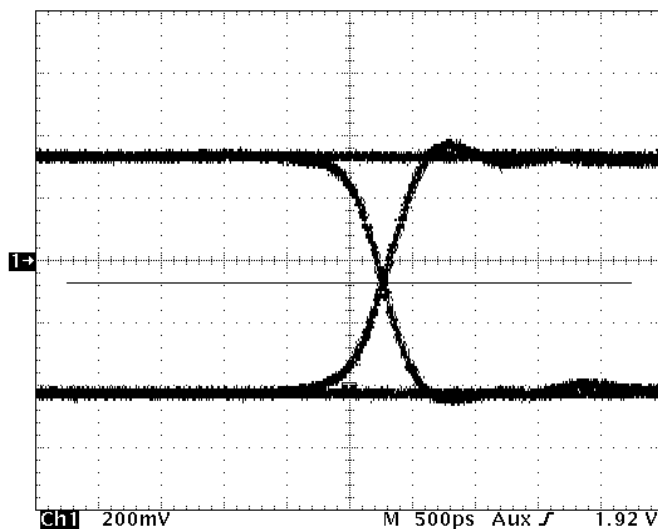
Figure 45. External Failsafe Circuit

Addition of this external failsafe will reduce the differential noise margin and add jitter to the output signal. The roughly 100-mV steady-state voltage generated across the 100- $\Omega$  resistor adds (or subtracts) from the signal generated by the upstream line driver. If the line driver's differential output is symmetrical about zero volts, then the input at the receiver will appear asymmetrical with the external failsafe. Perhaps more important, is the extra time it takes for the input signal to overcome the added failsafe offset voltage.

In Figure 46 and using an external failsafe, the high-level differential voltage at the input of the SN65LVDS100 reaches 340 mV and the low-level –400 mV indicating a 60-mV differential offset induced by the external failsafe circuitry. The figure also reveals that the lowest peak-to-peak time jitter does not occur at zero-volt differential (the nominal input threshold of the receiver) but at –60 mV, the failsafe offset.

The added jitter from external failsafe increases as the signal transition times are slowed by cable effects. When a ten-meter CAT-5 UTP cable is introduced between the driver and receiver, the zero-crossing peak-to-peak jitter at the receiver output adds 250 ps when the external failsafe is added with this specific test set up. If external failsafe is used in conjunction with the SN65LVDS100, the noise margin and jitter effects should be budgeted.





**Figure 46. Receiver Input Eye Pattern With External Failsafe**

**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> |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN65LVDS100D      | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS100DG4    | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS100DGK    | ACTIVE                | MSOP         | DGK             | 8    | 80          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS100DGKG4  | ACTIVE                | MSOP         | DGK             | 8    | 80          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS100DGKR   | ACTIVE                | MSOP         | DGK             | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS100DGKRG4 | ACTIVE                | MSOP         | DGK             | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS100DR     | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS100DRG4   | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS101D      | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS101DG4    | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS101DGK    | ACTIVE                | MSOP         | DGK             | 8    | 80          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS101DGKG4  | ACTIVE                | MSOP         | DGK             | 8    | 80          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS101DGKR   | ACTIVE                | MSOP         | DGK             | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS101DGKRG4 | ACTIVE                | MSOP         | DGK             | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS101DR     | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDS101DRG4   | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT100D      | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT100DG4    | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT100DGK    | ACTIVE                | MSOP         | DGK             | 8    | 80          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT100DGKG4  | ACTIVE                | MSOP         | DGK             | 8    | 80          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT100DGKR   | ACTIVE                | MSOP         | DGK             | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT100DGKRG4 | ACTIVE                | MSOP         | DGK             | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT100DR     | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT100DRG4   | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT101D      | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

| 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> |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN65LVDT101DG4    | ACTIVE                | SOIC         | D               | 8    | 75          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT101DGK    | ACTIVE                | MSOP         | DGK             | 8    | 80          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT101DGKG4  | ACTIVE                | MSOP         | DGK             | 8    | 80          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT101DGKR   | ACTIVE                | MSOP         | DGK             | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT101DGKRG4 | ACTIVE                | MSOP         | DGK             | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT101DR     | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN65LVDT101DRG4   | ACTIVE                | SOIC         | D               | 8    | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

<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), 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.

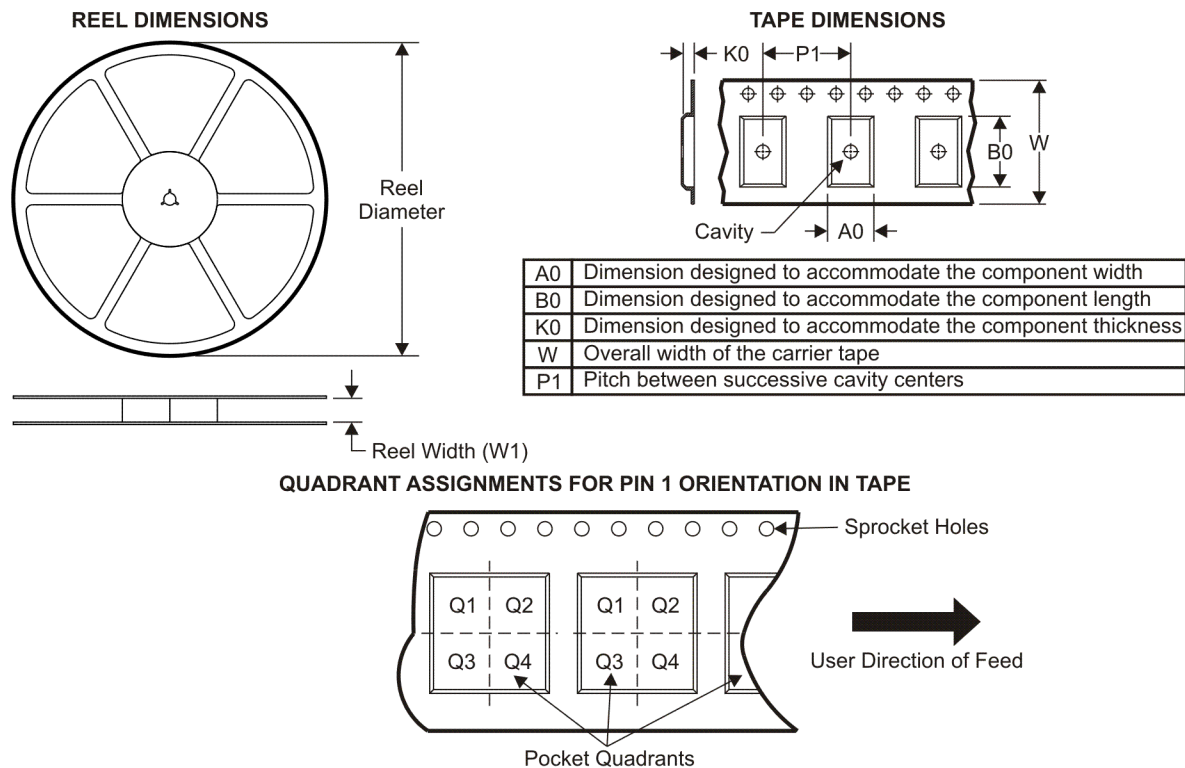
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**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)

<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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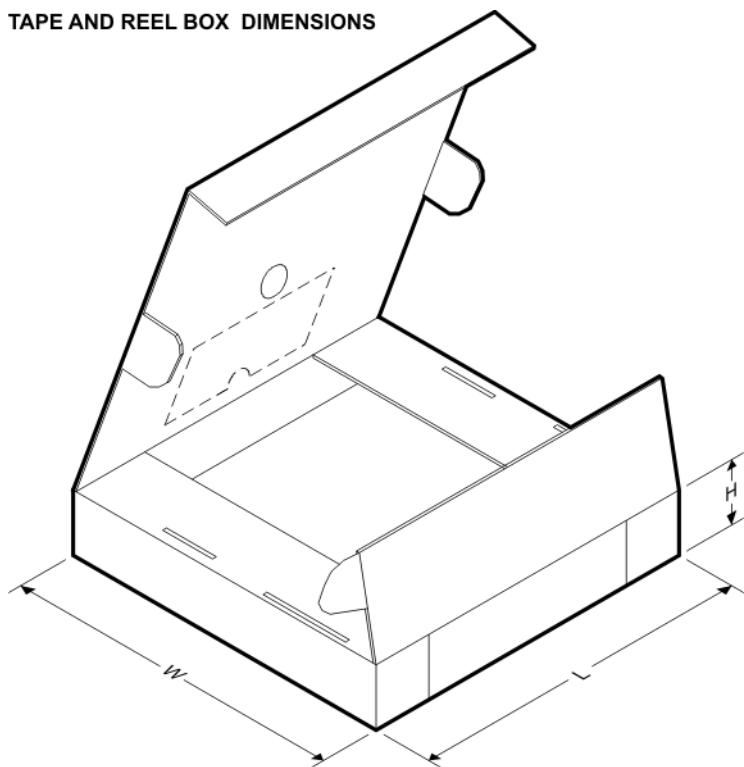
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**TAPE AND REEL INFORMATION**


\*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 |
|-----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN65LVDS100DGKR | MSOP         | DGK             | 8    | 2500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| SN65LVDS100DR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| SN65LVDS101DGKR | MSOP         | DGK             | 8    | 2500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| SN65LVDS101DR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| SN65LVDT100DGKR | MSOP         | DGK             | 8    | 2500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| SN65LVDT100DR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |
| SN65LVDT101DGKR | MSOP         | DGK             | 8    | 2500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| SN65LVDT101DR   | SOIC         | D               | 8    | 2500 | 330.0              | 12.4               | 6.4     | 5.2     | 2.1     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS

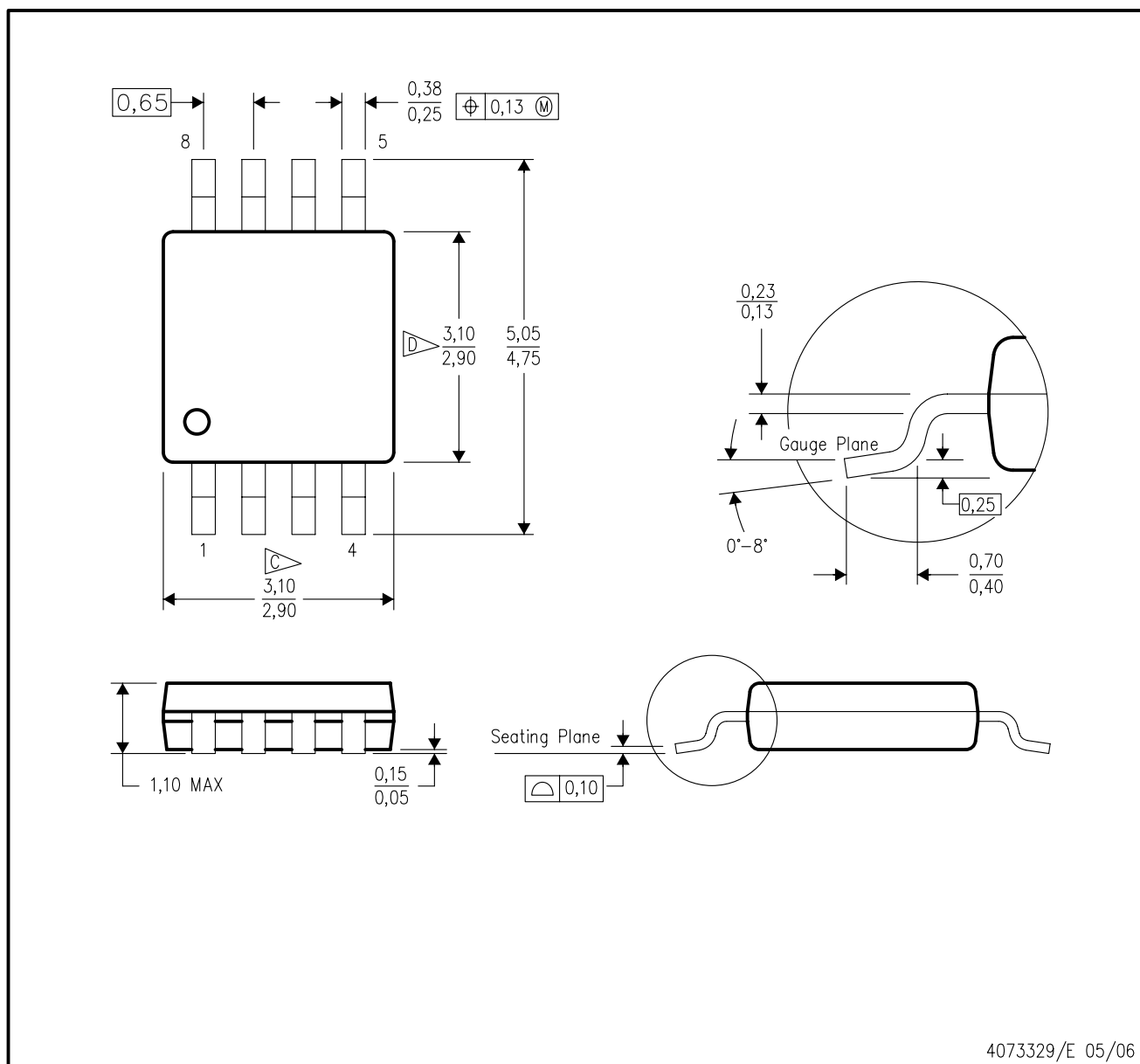


\*All dimensions are nominal

| Device          | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN65LVDS100DGKR | MSOP         | DGK             | 8    | 2500 | 358.0       | 335.0      | 35.0        |
| SN65LVDS100DR   | SOIC         | D               | 8    | 2500 | 346.0       | 346.0      | 29.0        |
| SN65LVDS101DGKR | MSOP         | DGK             | 8    | 2500 | 358.0       | 335.0      | 35.0        |
| SN65LVDS101DR   | SOIC         | D               | 8    | 2500 | 346.0       | 346.0      | 29.0        |
| SN65LVDT100DGKR | MSOP         | DGK             | 8    | 2500 | 358.0       | 335.0      | 35.0        |
| SN65LVDT100DR   | SOIC         | D               | 8    | 2500 | 346.0       | 346.0      | 29.0        |
| SN65LVDT101DGKR | MSOP         | DGK             | 8    | 2500 | 358.0       | 335.0      | 35.0        |
| SN65LVDT101DR   | SOIC         | D               | 8    | 2500 | 346.0       | 346.0      | 29.0        |

DGK (S-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE

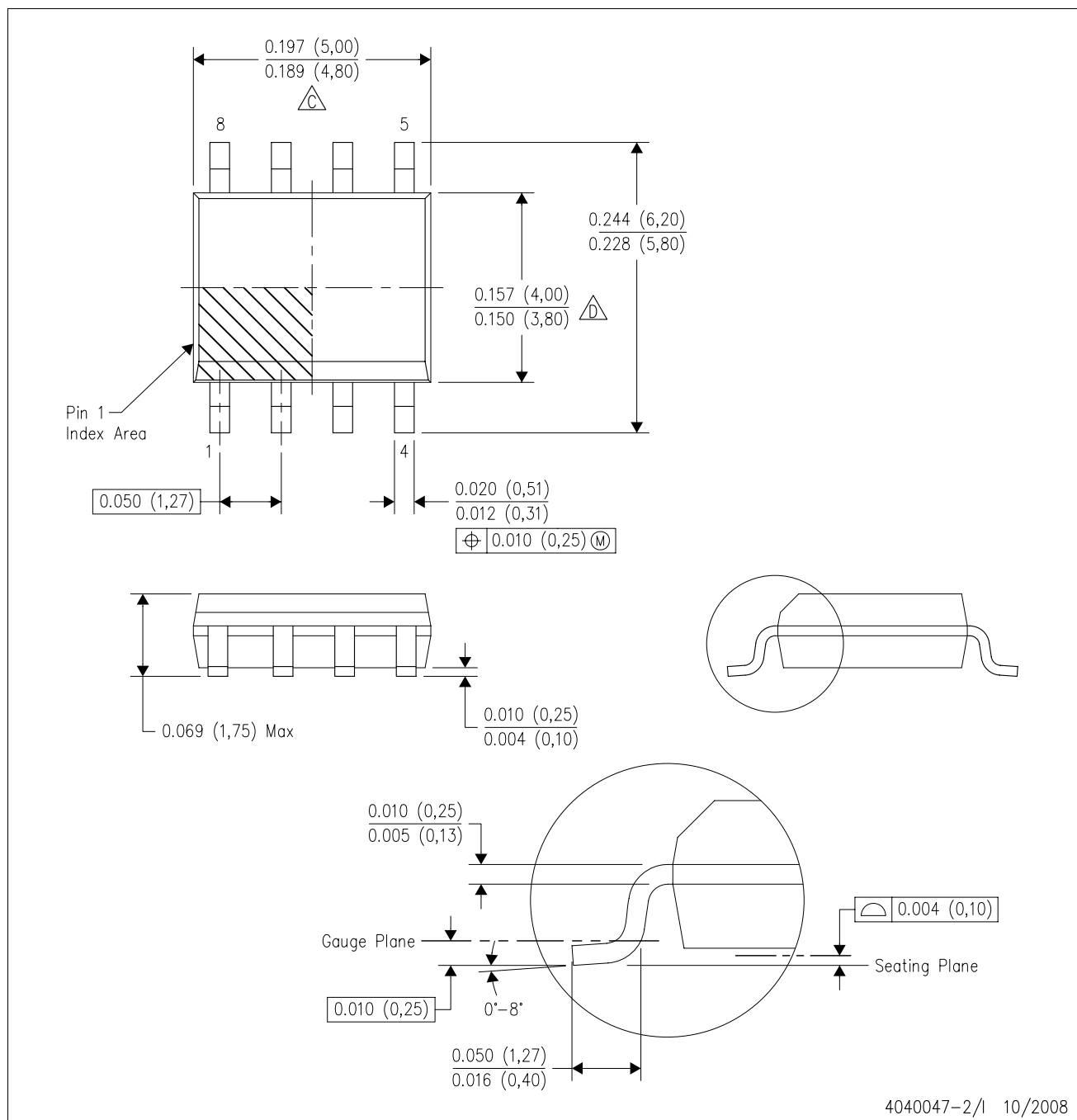


## NOTES:

- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
- D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
- E. Falls within JEDEC MO-187 variation AA, except interlead flash.

D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



## NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
- D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
- E. Reference JEDEC MS-012 variation AA.

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