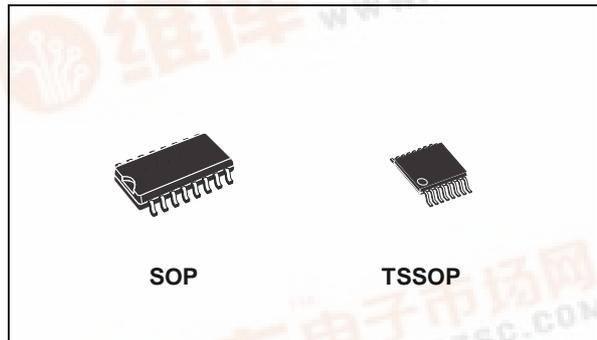




# STLVDS050

## HIGH SPEED DIFFERENTIAL LINE DRIVERS AND RECEIVERS

- MEETS OR EXCEEDS THE REQUIREMENTS OF ANSI EIA/TIA-644-1995 STANDARD
- SIGNALING RATES UP TO 400Mbit/s
- BUS TERMINAL ESD EXCEEDS 6KV
- OPERATES FROM A SINGLE 3.3V SUPPLY
- LOW-VOLTAGE DIFFERENTIAL SIGNALING WITH TYPICAL OUTPUT VOLTAGE OF 350mV AND A 100Ω LOAD
- PROPAGATION DELAY TIMES:  
DRIVER: 2ns (TYP)  
RECEIVER: 3ns (TYP)
- POWER DISSIPATION AT 200MHz:  
DRIVER: 25mW (TYP)  
RECEIVER: 60mW (TYP)
- LVTTTL INPUT LEVELS ARE 5V TOLERANT
- RECEIVER HAS OPEN-CIRCUIT FAIL-SAFE



### DESCRIPTION

The STLVDS050 is differential line drivers and receivers that use low-voltage differential signaling (LVDS) to achieve signaling rate as high as 400Mbps.

The EIA/TIA-644 standard compliant electrical interface provides a minimum differential output voltage magnitude of 247 mV into a 100 Ω load and receipt of 100 mV signals with up to 1 V of

ground potential difference between a transmitter and receiver.

The intended application of this device an signaling technique is for point-to-point baseband data transmission over controlled impedance media of approximately 100 Ω characteristic impedance.

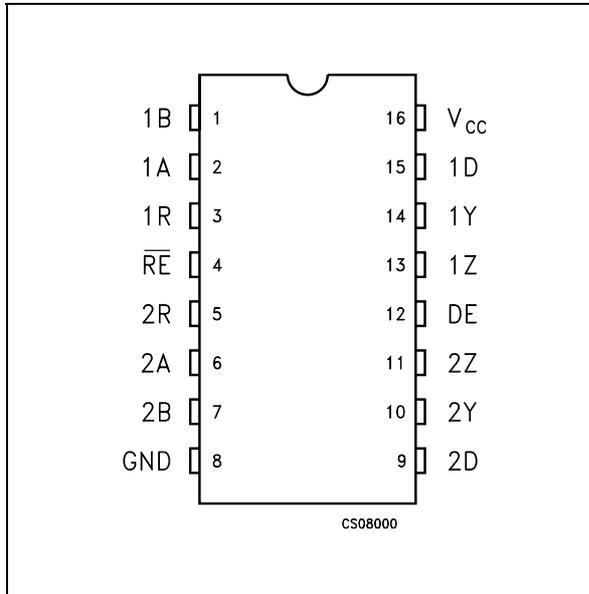
The transmission media may be printed-circuit board traces, backplanes, or cables. (Note: The ultimate rate and distance of data transfer is dependent upon the attenuation characteristics of the media, the noise coupling to the environment, and other application specific characteristics).

### ORDERING CODES

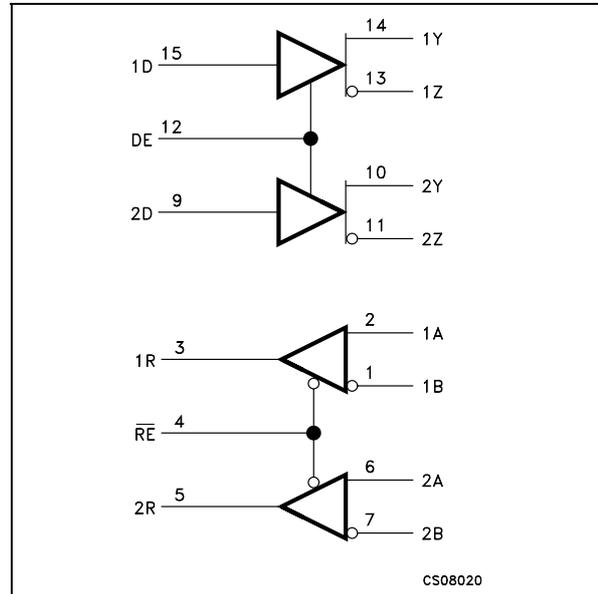
| Type         | Temperature Range | Package               | Comments                            |
|--------------|-------------------|-----------------------|-------------------------------------|
| STLVDS050BD  | -40 to 85 °C      | SO-16 (Tube)          | 50 parts per tube / 20 tube per box |
| STLVDS050BDR | -40 to 85 °C      | SO-16 (Tape & Reel)   | 2500 parts per reel                 |
| STLVDS050BTR | -40 to 85 °C      | TSSOP16 (Tape & Reel) | 2500 parts per reel                 |

# STLVDS050

## PIN CONFIGURATION



## FUNCTIONAL DIAGRAM



## PIN DESCRIPTION

| PIN N°         | SYMBOL          | NAME AND FUNCTION |
|----------------|-----------------|-------------------|
| 1,2, 6, 7      | 1A, 1B, 2A, 2B  | Receiver Inputs   |
| 3, 5           | 1R, 2R          | Receiver Outputs  |
| 4              | RE              | Receiver Enable   |
| 9, 15          | 2D, 1D          | Driver Inputs     |
| 12             | DE              | Driver Enable     |
| 10, 11, 13, 14 | 2Y, 2Z, 1Y, 1Z  | Driver Outputs    |
| 8              | GND             | Ground            |
| 16             | V <sub>CC</sub> | Supply Voltage    |

## TRUTH TABLE FOR RECEIVER

| $V_{ID}=V_A-V_B$          | $\overline{RE}$ | R |
|---------------------------|-----------------|---|
| $V_{ID} \geq 100mV$       | L               | H |
| $-100mV < V_{ID} < 100mV$ | L               | ? |
| $V_{ID} \leq -100mV$      | L               | L |
| OPEN                      | L               | H |
| X                         | H               | Z |

## TRUTH TABLE FOR DRIVER

| D    | DE | Y | Z |
|------|----|---|---|
| L    | H  | L | H |
| H    | H  | H | L |
| OPEN | H  | L | H |
| X    | L  | Z | Z |

L=Low level, H=High Level, X=Don't care, Z= High Impedance

## ABSOLUTE MAXIMUM RATINGS

| Symbol           | Parameter                    |                     | Value       | Unit |
|------------------|------------------------------|---------------------|-------------|------|
| V <sub>CC</sub>  | Supply Voltage               |                     | -0.5 to 4   | V    |
| V <sub>I</sub>   | Voltage Range                | D, R, DE, RE        | -0.5 to 6   | V    |
| ESD              | ESD Protection Voltage (HBM) | Y, Z, A, B, and GND | ± 6         | KV   |
|                  |                              | All Pins            | ± 3         |      |
| T <sub>stg</sub> | Storage Temperature Range    |                     | -65 to +150 | °C   |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

## RECOMMENDED OPERATING CONDITIONS

| Symbol     | Parameter                               | Min.         | Typ. | Max.                                  | Unit |
|------------|---|--------------|------|---------------------------------------|------|
| $V_{CC}$   | Supply Voltage                          | 3.0          | 3.3  | 3.6                                   | V    |
| $V_{IH}$   | HIGH Level Input Voltage                | 2.0          |      |                                       | V    |
| $V_{IL}$   | LOW Level Input Voltage                 |              |      | 0.8                                   | V    |
| $ V_{ID} $ | Magnitude Of Differential Input Voltage | 0.1          |      | 0.6                                   | V    |
| $V_{IC}$   | Common Mode Input Voltage               | $ V_{ID} /2$ |      | $24 \cdot  V_{ID} /2$<br>$V_{CC}-0.8$ | V    |
| $T_A$      | Operating Temperature Range             | -40          |      | 85                                    | °C   |

**ELECTRICAL CHARACTERISTICS** (Typical values are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 10\%$ ,  $T_A = -40$  to  $85^\circ\text{C}$  unless otherwise specified)

| Symbol   | Parameter      | Test Conditions  | Min. | Typ. | Max. | Unit |
|----------|----------------|--|------|------|------|------|
| $I_{CC}$ | Supply Current | Drivers and Receivers enabled, No receiver loads, Driver $R_L=100\Omega$ |      | 12   | 20   | mA   |
|          |                | Driver enabled, Receivers disabled, $R_L=100\Omega$                      |      | 10   | 16   |      |
|          |                | Drivers Disabled, Receiver enabled, No load                              |      | 4    | 6    |      |
|          |                | Disabled   |      | 0.5  | 1    |      |

**DRIVER ELECTRICAL CHARACTERISTICS** (Typical values are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 10\%$ ,  $T_A = -40$  to  $85^\circ\text{C}$  unless otherwise specified)

| Symbol              | Parameter  | Test Conditions                          | Min.  | Typ. | Max.    | Unit          |
|---------------------|--|--|-------|------|---------|---------------|
| $ V_{OD} $          | Differential Output Voltage Magnitude                                  | $R_L = 100\Omega$                        | 247   | 340  | 454     | mV            |
| $\Delta V_{OD} $    | Change in Differential Output Voltage Magnitude Between Logic States   | $R_L = 100\Omega$                        | -50   |      | 50      | mV            |
| $\Delta V_{OC(SS)}$ | Change in Steady-state Common Mode Output Voltage Between Logic States |  | -50   |      | 50      | mV            |
| $V_{OC(SS)}$        | Steady-state Common Mode Output Voltage                                |  | 1.125 | 1.2  | 1.375   | V             |
| $V_{OC(PP)}$        | Peak to Peak Common mode Output Voltage                                |  |       | 50   | 150     | mV            |
| $I_{IH}$            | High Level Input Current   | $V_{IH} = 5\text{V}$                     | DE    | -0.5 | -20     | $\mu\text{A}$ |
|                     |  |  | D     | 2    | 20      | $\mu\text{A}$ |
| $I_{IL}$            | Low Level Input Current  | $V_{IL} = 0.8\text{V}$                   | DE    | -0.5 | -10     | $\mu\text{A}$ |
|                     |  |  | D     | 1    | 10      | $\mu\text{A}$ |
| $I_{OS}$            | Short Circuit Output Current   | $V_{O(Y)}$ or $V_{O(Z)} = 0\text{V}$     |       | 6    | 10      | mA            |
|                     |  | $V_{OD} = 0$                             |       | 4    | 10      | mA            |
| $I_{OZ}$            | High Impedance Output Current  | $V_O = 600\text{mV}$                     |       |      | $\pm 1$ | $\mu\text{A}$ |
|                     |  | $V_O = 0\text{V}$ or $V_{CC}$            |       |      | $\pm 1$ | $\mu\text{A}$ |
| $I_{O(OFF)}$        | Power OFF Output Current   | $V_{CC} = 0\text{V}$ $V_O = 3.6\text{V}$ |       |      | $\pm 1$ | $\mu\text{A}$ |
| $C_{IN}$            | Input Capacitance  |  |       | 3    |         | pF            |

## STLVDS050

**RECEIVER ELECTRICAL CHARACTERISTICS** (Typical values are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 10\%$ ,  $T_A = -40$  to  $85^\circ\text{C}$  unless otherwise specified)

| Symbol       | Parameter   | Test Conditions          | Min. | Typ. | Max.     | Unit          |
|--------------|---|--------------------------|------|------|----------|---------------|
| $V_{ITH+}$   | Positive-going Differential Input Voltage Threshold |                          |      |      | 100      | mV            |
| $V_{ITH-}$   | Negative-going Differential Input Voltage Threshold |                          | -100 |      |          | mV            |
| $V_{OH}$     | High Level Output Voltage                           | $I_{OH} = -8\text{mA}$   | 2.4  |      |          | V             |
| $V_{OL}$     | Low Level Output Voltage                            | $I_{OL} = 2\text{mA}$    |      |      | 0.4      | V             |
| $I_I$        | Input Current (A or B Inputs)                       | $V_I = 0\text{V}$        | -2   | -11  | -20      | $\mu\text{A}$ |
|              |   | $V_I = 2.4\text{V}$      | -1   | -3   |          | $\mu\text{A}$ |
| $I_{I(OFF)}$ | Power OFF Input Current (A or B Inputs)             | $V_{CC} = 0\text{V}$     |      |      | $\pm 20$ | $\mu\text{A}$ |
| $I_{IH}$     | High Level Input Current (Enable)                   | $V_{IH} = 5\text{V}$     |      |      | $\pm 10$ | $\mu\text{A}$ |
| $I_{IL}$     | Low Level Input Current (Enable)                    | $V_{IL} = 0.8\text{V}$   |      |      | $\pm 10$ | $\mu\text{A}$ |
| $I_{OZ}$     | High Impedance Output Current                       | $V_O = 0$ or $5\text{V}$ |      |      | $\pm 10$ | $\mu\text{A}$ |
| $C_{IN}$     | Input Capacitance                                   |                          |      | 3    |          | pF            |

**DRIVER SWITCHING CHARACTERISTICS** (Typical values are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 10\%$ ,  $T_A = -40$  to  $85^\circ\text{C}$  unless otherwise specified)

| Symbol      | Parameter   | Test Conditions                       | Min. | Typ. | Max. | Unit |    |
|-------------|---|---------------------------------------|------|------|------|------|----|
| $t_{PLH}$   | Propagation Delay Time, Low to High Output                  | $R_L = 100\Omega$ $C_L = 10\text{pF}$ |      | 2    | 2.7  | ns   |    |
| $t_{PHL}$   | Propagation Delay Time, High to Low Output                  |                                       |      | 2    | 2.7  | ns   |    |
| $t_r$       | Differential Output Signal Rise Time                        |                                       |      | 0.4  | 1    | ns   |    |
| $t_f$       | Differential Output Signal Fall Time                        |                                       |      | 0.4  | 1    | ns   |    |
| $t_{sk(P)}$ | Pulse Skew ( $ t_{THL} - t_{TLH} $ ) (note1)                |                                       |      |      | 50   | ps   |    |
| $t_{sk(O)}$ | Channel-to-channel Output Skew (note2)                      |                                       |      |      | 40   | ps   |    |
| $t_{PZH}$   | Propagation Delay Time, High Impedance to High Level Output |                                       |      |      | 6    | 10   | ns |
| $t_{PZL}$   | Propagation Delay Time, High Impedance to Low Level Output  |                                       |      |      | 6    | 10   | ns |
| $t_{PHZ}$   | Propagation Delay Time, High Level to High Impedance Output |                                       |      | 3    | 10   | ns   |    |
| $t_{PLZ}$   | Propagation Delay Time, Low Level to High Impedance Output  |                                       |      | 3    | 10   | ns   |    |

**RECEIVER SWITCHING CHARACTERISTICS** (Typical values are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 10\%$ ,  $T_A = -40$  to  $85^\circ\text{C}$  unless otherwise specified)

| Symbol      | Parameter   | Test Conditions     | Min. | Typ. | Max. | Unit |
|-------------|---|---------------------|------|------|------|------|
| $t_{PLH}$   | Propagation Delay Time, Low to High Output                  | $C_L = 10\text{pF}$ |      | 3.0  | 4.0  | ns   |
| $t_{PHL}$   | Propagation Delay Time, High to Low Output                  |                     |      | 3.0  | 4.0  | ns   |
| $t_r$       | Differential Output Signal Rise Time                        |                     |      | 0.6  | 1    | ns   |
| $t_f$       | Differential Output Signal Fall Time                        |                     |      | 0.6  | 1    | ns   |
| $t_{sk(P)}$ | Pulse Skew ( $ t_{THL} - t_{TLH} $ ) (Note 1)               |                     |      | 0.25 |      | ns   |
| $t_{PZH}$   | Propagation Delay Time, High Impedance to High Level Output |                     |      | 2.5  |      | ns   |
| $t_{PZL}$   | Propagation Delay Time, High Impedance to Low Level Output  |                     |      | 2.5  |      | ns   |
| $t_{PHZ}$   | Propagation Delay Time, High Level to High Impedance Output |                     |      | 7    |      | ns   |
| $t_{PLZ}$   | Propagation Delay Time, Low Level to High Impedance Output  |                     |      | 4    |      | ns   |

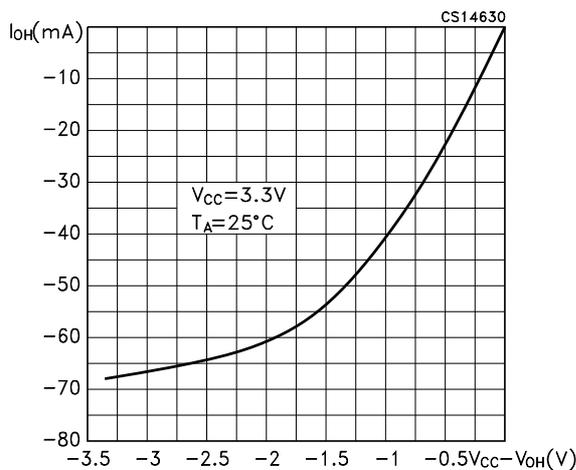
Note 1:  $t_{sk(P)}$  is the magnitude of the time difference between the high to low and low to high propagation delay times at an output

Note 2:  $t_{sk(O)}$  is the magnitude of the time difference between the output of a single device with all their inputs connected together.

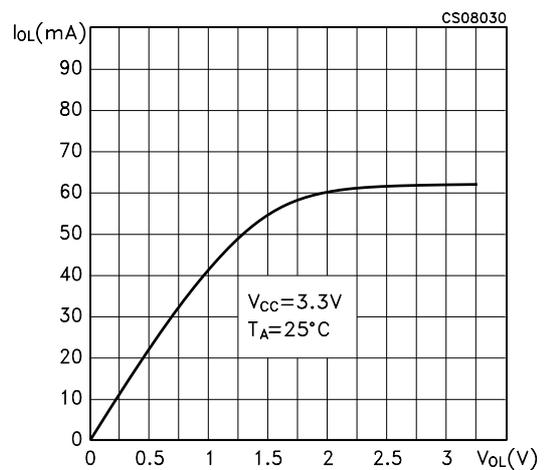
Note 3:  $t_{sk(PP)}$  is the magnitude of the difference between any specified terminals of two devices when both devices operate with the same supply voltages, same temperature, and have identical packages and test circuit.

**TYPICAL PERFORMANCE CHARACTERISTICS** (unless otherwise specified  $T_J = 25^\circ\text{C}$ )

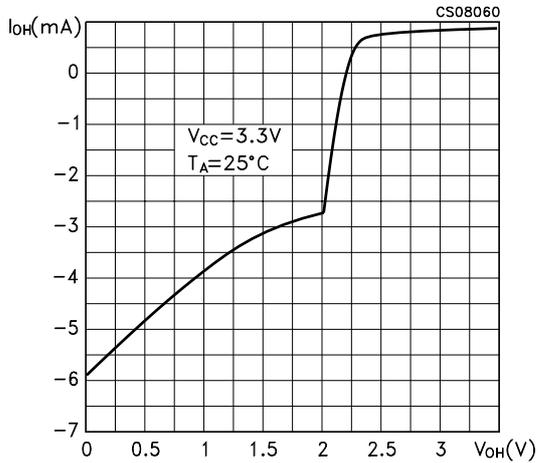
**Figure 1** : Output Current vs Output High Voltage for Receiver



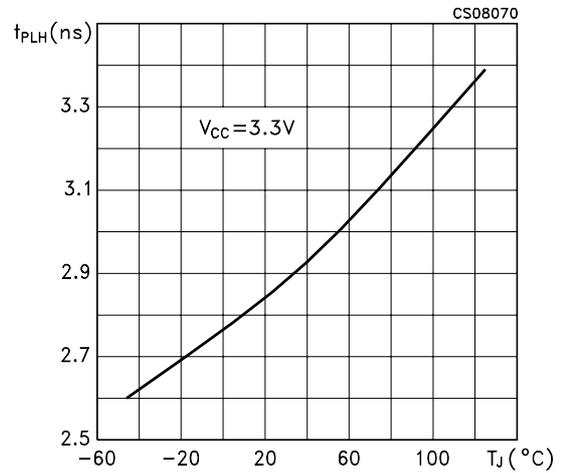
**Figure 2** : Output Current vs Output Low Voltage for Receiver



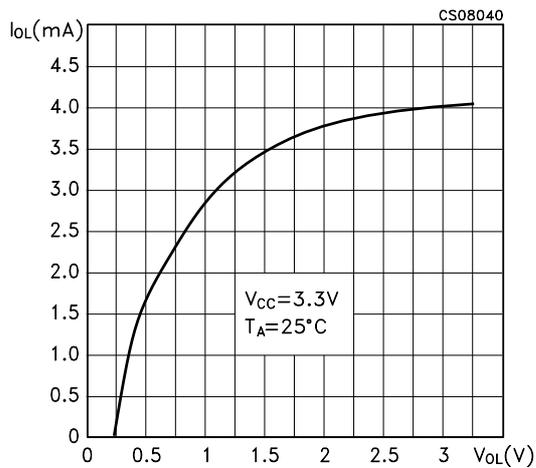
**Figure 3 :** Output Current vs Output High Voltage for Driver



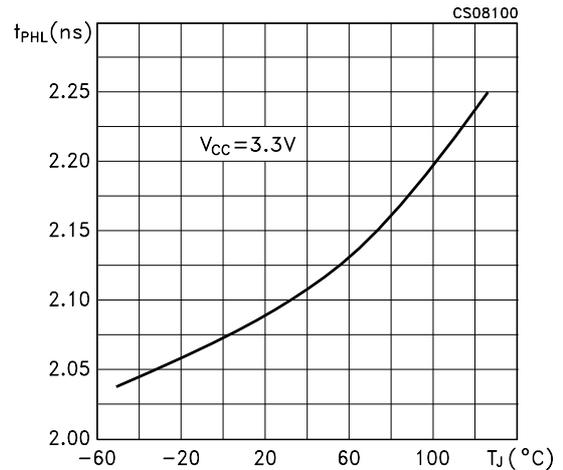
**Figure 6 :** Low to High Propagation Delay Time for Receiver



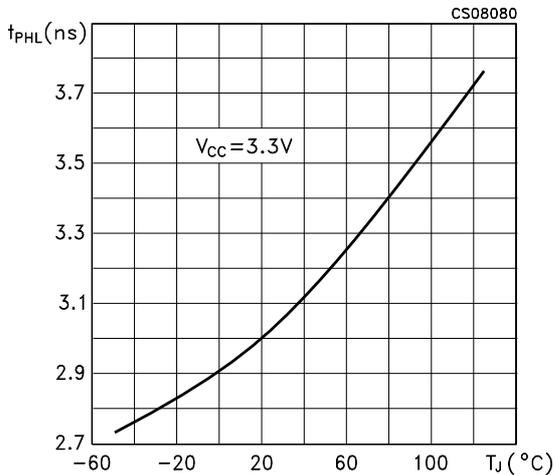
**Figure 4 :** Output Current vs Output Low Voltage for Driver



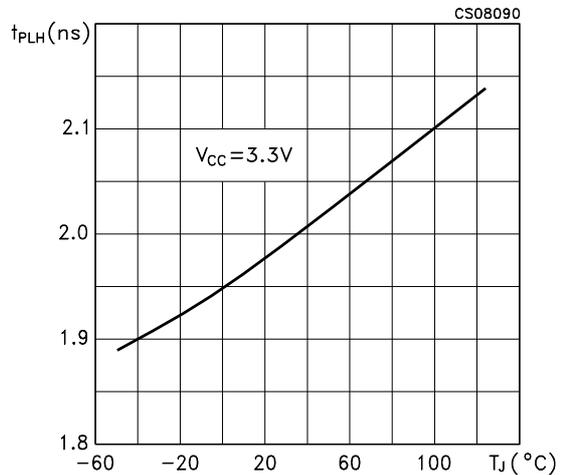
**Figure 7 :** High to Low Propagation Delay Time for Driver



**Figure 5 :** High to Low Propagation Delay Time for Receiver

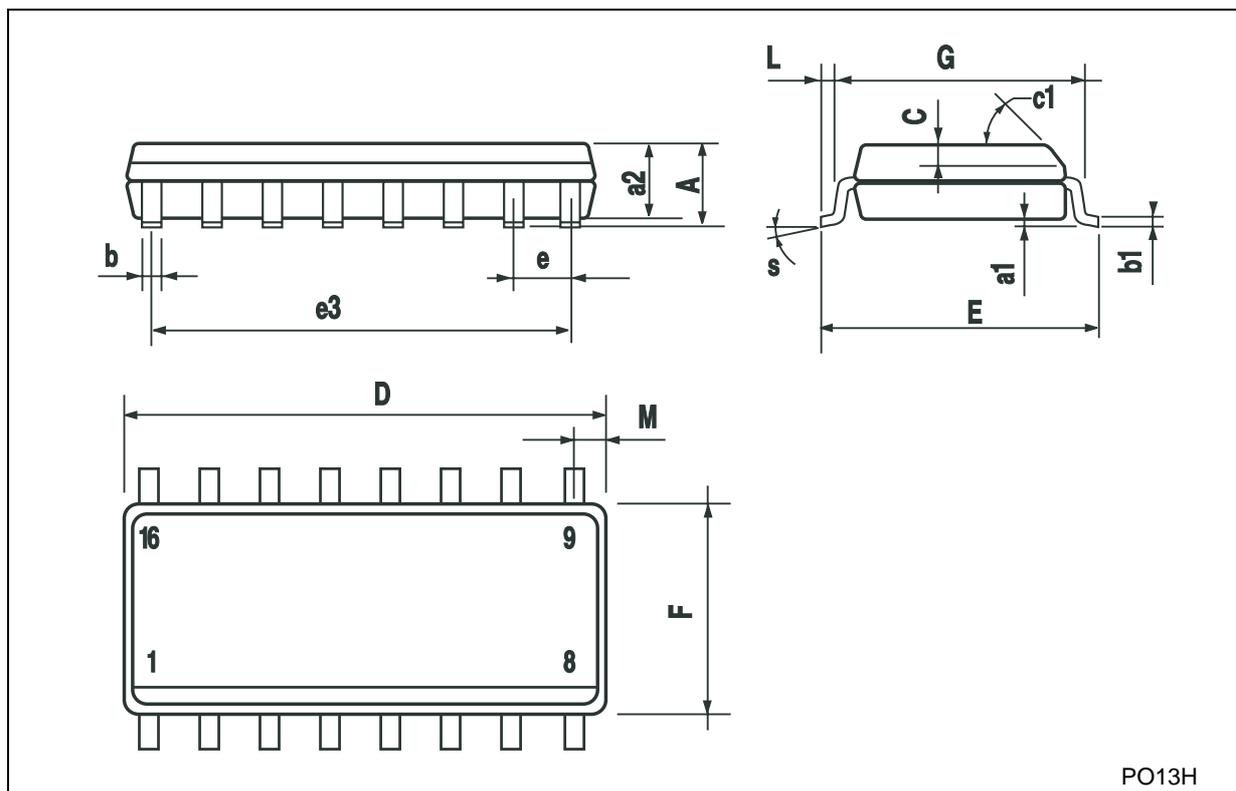


**Figure 8 :** Low to High Propagation Delay Time for Driver



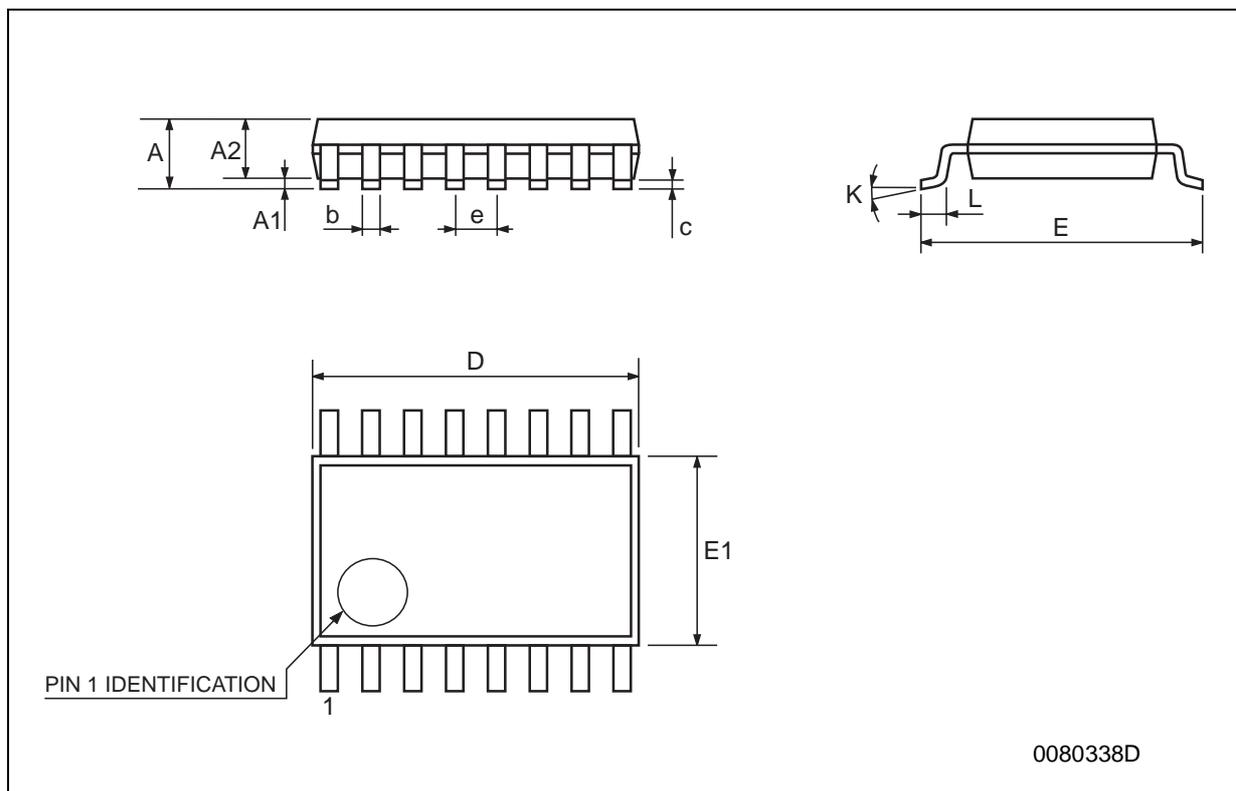
## SO-16 MECHANICAL DATA

| DIM. | mm.        |      |      | inch     |       |       |
|------|------------|------|------|----------|-------|-------|
|      | MIN.       | TYP  | MAX. | MIN.     | TYP.  | MAX.  |
| A    |            |      | 1.75 |          |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.004    |       | 0.008 |
| a2   |            |      | 1.65 |          |       | 0.064 |
| b    | 0.35       |      | 0.46 | 0.013    |       | 0.018 |
| b1   | 0.19       |      | 0.25 | 0.007    |       | 0.010 |
| C    |            | 0.5  |      |          | 0.019 |       |
| c1   | 45° (typ.) |      |      |          |       |       |
| D    | 9.8        |      | 10   | 0.385    |       | 0.393 |
| E    | 5.8        |      | 6.2  | 0.228    |       | 0.244 |
| e    |            | 1.27 |      |          | 0.050 |       |
| e3   |            | 8.89 |      |          | 0.350 |       |
| F    | 3.8        |      | 4.0  | 0.149    |       | 0.157 |
| G    | 4.6        |      | 5.3  | 0.181    |       | 0.208 |
| L    | 0.5        |      | 1.27 | 0.019    |       | 0.050 |
| M    |            |      | 0.62 |          |       | 0.024 |
| S    | 8          |      |      | ° (max.) |       |       |



## TSSOP16 MECHANICAL DATA

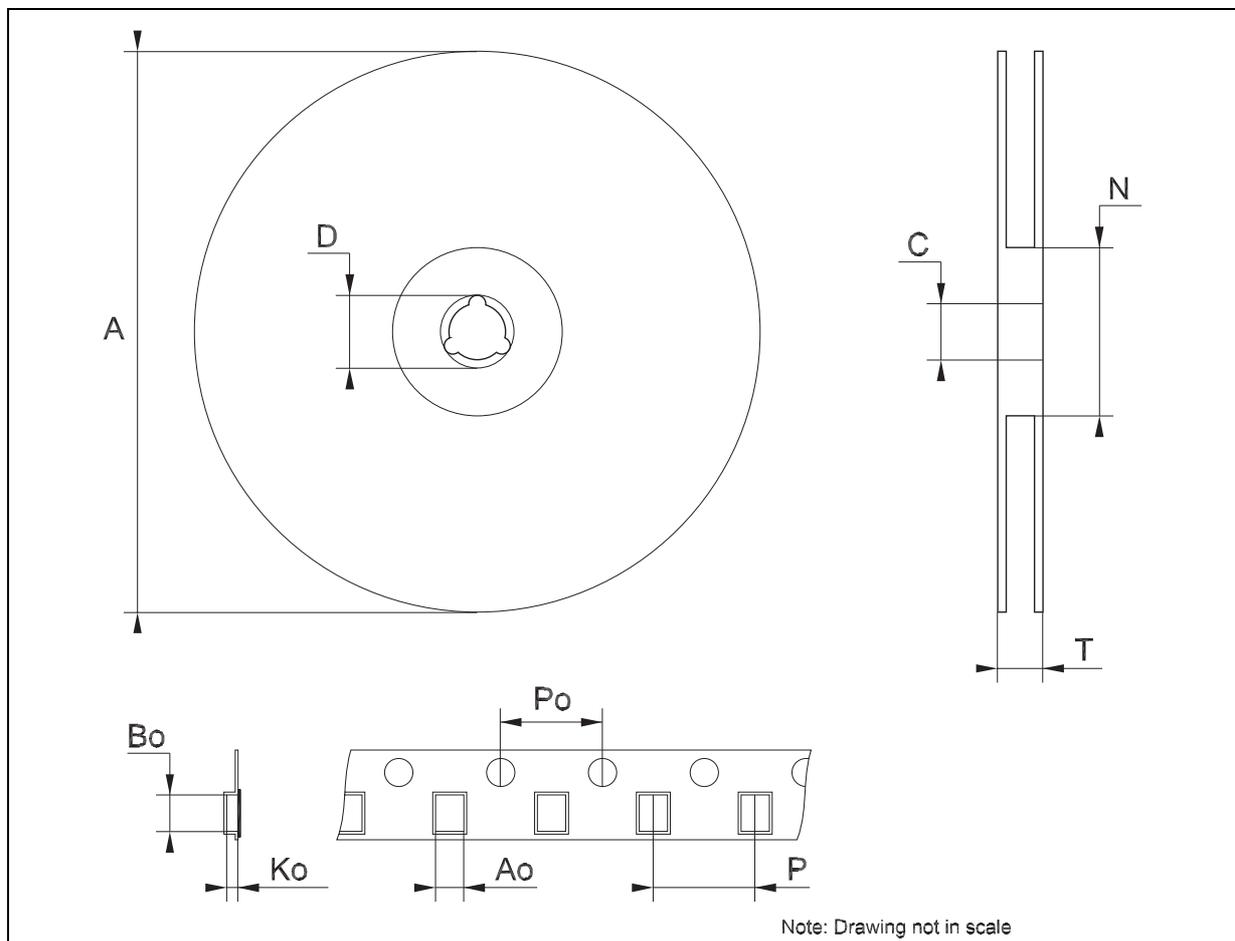
| DIM. | mm.  |          |      | inch  |            |        |
|------|------|----------|------|-------|------------|--------|
|      | MIN. | TYP      | MAX. | MIN.  | TYP.       | MAX.   |
| A    |      |          | 1.2  |       |            | 0.047  |
| A1   | 0.05 |          | 0.15 | 0.002 | 0.004      | 0.006  |
| A2   | 0.8  | 1        | 1.05 | 0.031 | 0.039      | 0.041  |
| b    | 0.19 |          | 0.30 | 0.007 |            | 0.012  |
| c    | 0.09 |          | 0.20 | 0.004 |            | 0.0079 |
| D    | 4.9  | 5        | 5.1  | 0.193 | 0.197      | 0.201  |
| E    | 6.2  | 6.4      | 6.6  | 0.244 | 0.252      | 0.260  |
| E1   | 4.3  | 4.4      | 4.48 | 0.169 | 0.173      | 0.176  |
| e    |      | 0.65 BSC |      |       | 0.0256 BSC |        |
| K    | 0°   |          | 8°   | 0°    |            | 8°     |
| L    | 0.45 | 0.60     | 0.75 | 0.018 | 0.024      | 0.030  |



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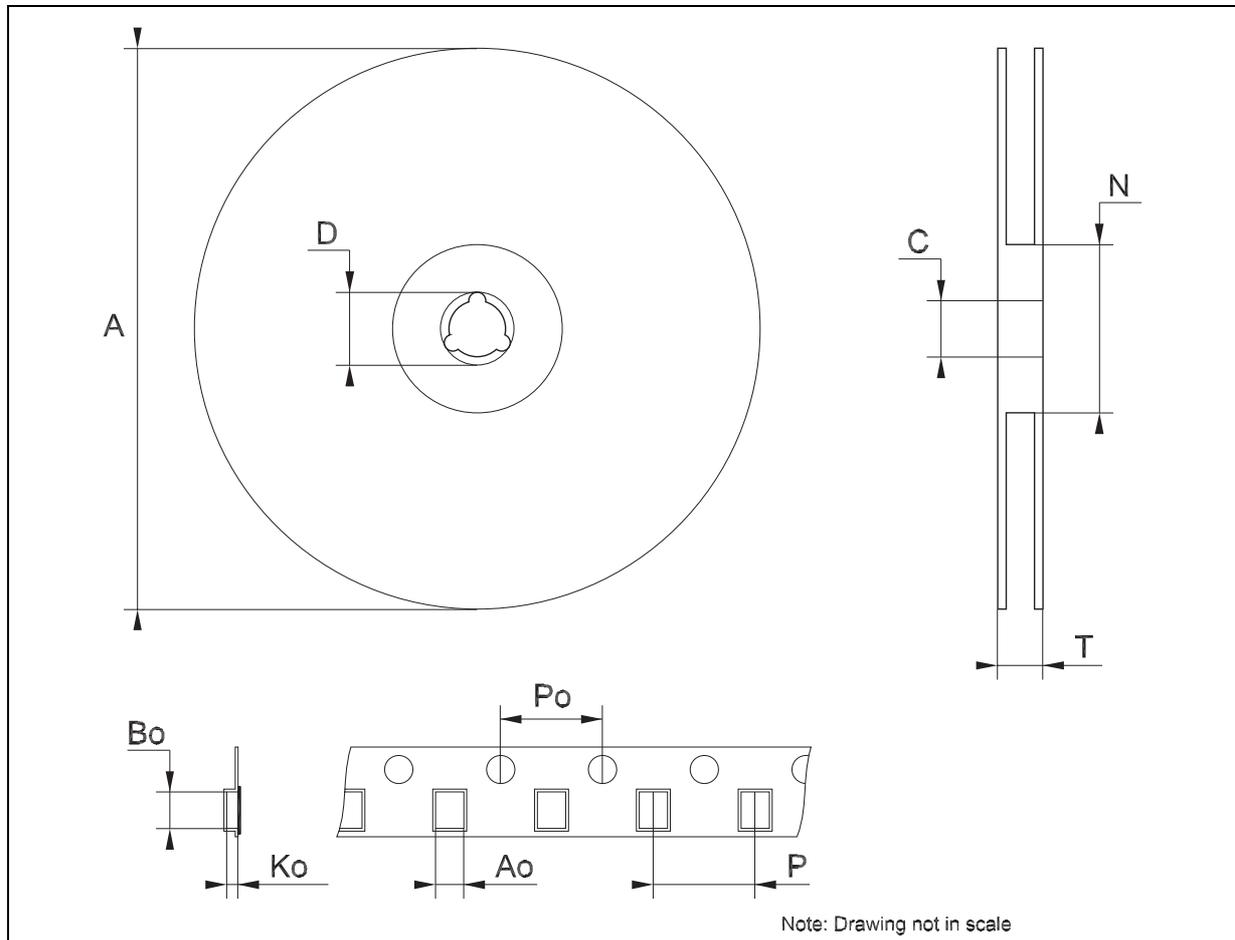
## Tape &amp; Reel SO-16 MECHANICAL DATA

| DIM. | mm.  |      |      | inch  |      |        |
|------|------|------|------|-------|------|--------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP. | MAX.   |
| A    |      |      | 330  |       |      | 12.992 |
| C    | 12.8 |      | 13.2 | 0.504 |      | 0.519  |
| D    | 20.2 |      |      | 0.795 |      |        |
| N    | 60   |      |      | 2.362 |      |        |
| T    |      |      | 22.4 |       |      | 0.882  |
| Ao   | 6.45 |      | 6.65 | 0.254 |      | 0.262  |
| Bo   | 10.3 |      | 10.5 | 0.406 |      | 0.414  |
| Ko   | 2.1  |      | 2.3  | 0.082 |      | 0.090  |
| Po   | 3.9  |      | 4.1  | 0.153 |      | 0.161  |
| P    | 7.9  |      | 8.1  | 0.311 |      | 0.319  |



**Tape & Reel TSSOP16 MECHANICAL DATA**

| DIM. | mm.  |     |      | inch  |      |        |
|------|------|-----|------|-------|------|--------|
|      | MIN. | TYP | MAX. | MIN.  | TYP. | MAX.   |
| A    |      |     | 330  |       |      | 12.992 |
| C    | 12.8 |     | 13.2 | 0.504 |      | 0.519  |
| D    | 20.2 |     |      | 0.795 |      |        |
| N    | 60   |     |      | 2.362 |      |        |
| T    |      |     | 22.4 |       |      | 0.882  |
| Ao   | 6.7  |     | 6.9  | 0.264 |      | 0.272  |
| Bo   | 5.3  |     | 5.5  | 0.209 |      | 0.217  |
| Ko   | 1.6  |     | 1.8  | 0.063 |      | 0.071  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 7.9  |     | 8.1  | 0.311 |      | 0.319  |



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