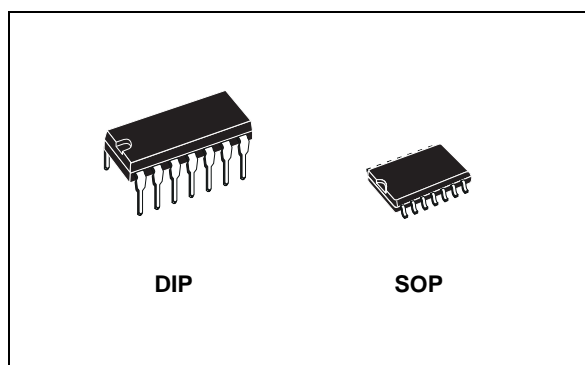


## LOW POWER HIGH SPEED RS-485/RS-422 TRANSCEIVER

- LOW SUPPLY CURRENT: 5mA MAX
- DESIGNED FOR RS485 INTERFACE APPLICATIONS
- -7 TO 12 COMMON MODE INPUT VOLTAGE RANGE
- 70mV TYPICAL INPUT HYSTERESIS
- DESIGNED FOR 25Mbps OPERATION
- OPERATE FROM SINGLE 5 SUPPLY
- $\pm 4$ kV ESD PROTECTION
- CURRENT LIMITING AND THERMAL SHUTDOWN FOR DRIVER OVERLOAD PROTECTION



### DESCRIPTION

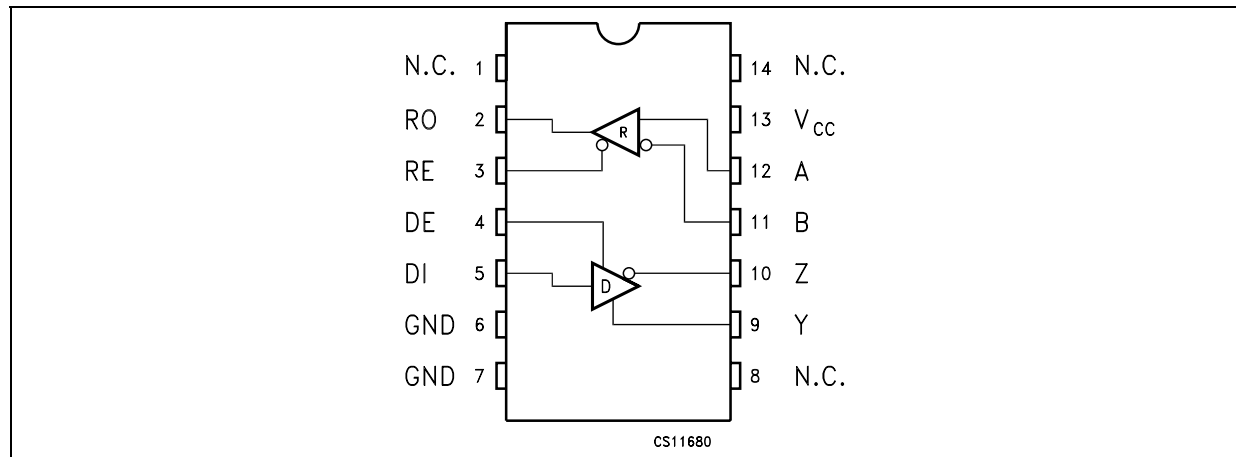
The ST491A is a low power transceiver for RS-485 and RS-422 communications. The device contains one driver and one receiver in full duplex configuration. The ST491A draws 5mA (typ.) of supply current when unloaded and operates from a single 5V supply.

Driver is short-circuit current limited and is protected against excessive power dissipation by thermal shutdown circuitry that place the driver outputs into a high-impedance state. The receiver input has a fail-safe feature that guarantees a logic high output if both inputs are open circuit.

### ORDERING CODES

| Type      | Temperature Range | Package             | Comments                          |
|-----------|-------------------|---------------------|-----------------------------------|
| ST491ACN  | 0 to 70 °C        | DIP-14              | 25parts per tube / 40tube per box |
| ST491ABN  | -40 to 85 °C      | DIP-14              | 25parts per tube / 40tube per box |
| ST491ACD  | 0 to 70 °C        | SO-14 (Tube)        | 50parts per tube / 20tube per box |
| ST491ABD  | -40 to 85 °C      | SO-14 (Tube)        | 50parts per tube / 20tube per box |
| ST491ACDR | 0 to 70 °C        | SO-14 (Tape & Reel) | 2500 parts per reel               |
| ST491ABDR | -40 to 85 °C      | SO-14 (Tape & Reel) | 2500 parts per reel               |

## PIN CONFIGURATION



## PIN DESCRIPTION

| PIN N° | SYMBOL          | NAME AND FUNCTION            |
|--------|-----------------|------------------------------|
| 1      | NC              | Not Connected                |
| 2      | RO              | Receiver Output.             |
| 3      | RE              | Receiver Output Enable       |
| 4      | DE              | Driver Output Enable         |
| 5      | DI              | Inverting Driver Input.      |
| 6      | GND             | Ground                       |
| 7      | GND             | Ground                       |
| 8      | NC              | Not Connected                |
| 9      | Y               | Non-inverting Driver Output  |
| 10     | Z               | Inverting Driver Output      |
| 11     | B               | Inverting Receiver Input     |
| 12     | A               | Non-inverting Receiver Input |
| 13     | NC              | Not Connected                |
| 14     | V <sub>CC</sub> | Supply Voltage               |

## TRUTH TABLE (DRIVER)

| INPUT |    | OUTPUTS |   |
|-------|----|---------|---|
| DI    | DE | Y       | Z |
| L     | H  | L       | H |
| H     | H  | H       | L |
| X     | L  | Z       | Z |

X= Don't Care; Z=High Impedance

## TRUTH TABLE (RECEIVER)

| INPUT                     |    | OUTPUT |
|---------------------------|----|--------|
| A-B                       | RE | RO     |
| $\geq -0.2V$              | L  | H      |
| between $-0.2V$ to $0.2V$ | L  | ?      |
| $\leq -0.2V$              | L  | L      |
| OPEN                      | L  | H      |
| X                         | H  | Z      |

?= Irrelevant; X= Don't Care; Z=High Impedance

**ABSOLUTE MAXIMUM RATINGS**

| Symbol     | Parameter               | Value                      | Unit |
|------------|-------------------------|----------------------------|------|
| $V_{CC}$   | Supply Voltage          | 7                          | V    |
| $V_{DI}$   | Driver Input Voltage    | -0.5 to 7                  | V    |
| $V_Y, V_Z$ | Driver Output Voltage   | -7.5 to 12.5               | V    |
| $V_A, V_B$ | Receiver Input Voltage  | -7.5 to 12.5               | V    |
| $V_{RO}$   | Receiver Output Voltage | -0.3 to ( $V_{CC} + 0.3$ ) | V    |
| ESD        | Human Body Model        | 3.5                        | KV   |

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

**ELECTRICAL CHARACTERISTICS**

$V_{CC} = 4.5V$  to  $5.5V$ ,  $T_A = -40$  to  $85^\circ C$ , unless otherwise specified. Typical values are referred to  $T_A = 25^\circ C$ )

| Symbol       | Parameter                 | Test Conditions | Min. | Typ. | Max. | Unit |
|--------------|---------------------------|-----------------|------|------|------|------|
| $I_{SUPPLY}$ | No Load Supply Current    |                 |      | 2    | 5    | mA   |
| $C_{IN}$     | Input Capacitance         |                 |      | 1.8  |      | pF   |
| $C_{YZ}$     | Driver Output Capacitance |                 |      | 1.2  |      | pF   |
| $C_{OUT}$    | Output Capacitance        |                 |      | 2.3  |      | pF   |

**TRANSMITTER ELECTRICAL CHARACTERISTICS**

$V_{CC} = 4.5V$  to  $5.5V$ ,  $T_A = -40$  to  $85^\circ C$ , unless otherwise specified. Typical values are referred to  $T_A = 25^\circ C$ )

| Symbol          | Parameter   | Test Conditions                            | Min.     | Typ. | Max.      | Unit    |
|-----------------|---|--|----------|------|-----------|---------|
| $V_{OD1}$       | Differential Drive Output (No load)   |  |          |      | $V_{CC}$  | V       |
| $V_{OD2}$       | Differential Drive Output (With Load)   | $R_L = 54\Omega$ (RS-422) (Figure 1)       | 1.5      | 2.6  | 5         | V       |
| $V_{OD3}$       | Differential Drive Output (With Load)   | $R_L = 100\Omega$ (RS-422) (Figure 1)      | 2        | 3    |           | V       |
| $\Delta V_{OD}$ | Change in magnitude of Driver Differential Output Voltage for Complementary Output States (Note1) | $R_L = 54\Omega$ or $100\Omega$ (Figure 1) |          | 0    | 0.2       | V       |
| $V_{OC}$        | Driver Common Mode Output Voltage   | $R_L = 54\Omega$ (Figure 1)                | 1        |      | 3         | V       |
| $\Delta V_{OC}$ | Change in magnitude of Driver Common Mode Output Voltage (Note1)                                  | $R_L = 54\Omega$ (Figure 1)                |          | 0    | 0.2       | V       |
| $I_{OFF}$       | Power Off Output Current  | $V_{CC} = 0V$ $V_O = -7V$ to $12V$         |          |      | $\pm 100$ | $\mu A$ |
| $I_{OSD}$       | Driver Short Circuit Output Current   | $V_O = -7V$ to $12V$                       | $\pm 35$ |      | $\pm 250$ | mA      |
| $V_{IL}$        | Input Logic Threshold Low   |  |          |      | 0.8       | V       |
| $V_{IH}$        | Input Logic Threshold High  |  | 2        |      |           | V       |

**RECEIVER ELECTRICAL CHARACTERISTICS**

$V_{CC} = 4.5V$  to  $5.5V$ ,  $T_A = -40$  to  $85^\circ C$ , unless otherwise specified. Typical values are referred to  $T_a = 25^\circ C$ )

| Symbol          | Parameter                               | Test Conditions                           |              | Min. | Typ.  | Max. | Unit       |
|-----------------|---|---|--------------|------|-------|------|------------|
| $I_{IN}$        | Input Current (A, B)                    | other input=0V<br>$V_{CC} = 0$ or $5.25V$ | $V_{IN}=12V$ |      | 0.5   | 1    | mA         |
|                 |   |   | $V_{IN}=-7V$ |      | -0.35 | -0.8 | mA         |
| $V_{TH}$        | Receiver Differential Threshold Voltage | $V_{CM} = -7V$ to $12V$                   |              | -0.2 |       | 0.2  | V          |
| $\Delta V_{TH}$ | Receiver Input Hysteresis               | $V_{CM} = 0V$                             |              |      | 70    |      | mV         |
| $V_{OH}$        | Receiver Output High Voltage            | $I_{OUT} = -8mA$ , $V_{ID} = 200mV$       |              | 3.5  | 4.7   |      | V          |
| $V_{OL}$        | Receiver Output Low Voltage             | $I_{OUT} = 8mA$ , $V_{ID} = -200mV$       |              |      | 0.3   | 0.5  | V          |
| $R_{RIN}$       | Receiver Input Resistance               | $V_{CM} = -7V$ to $12V$                   |              | 12   | 24    |      | K $\Omega$ |

**DRIVER SWITCHING CHARACTERISTICS**

$V_{CC} = 4.5V$  to  $5.5V$ ,  $T_A = -40$  to  $85^\circ C$ , unless otherwise specified. Typical values are referred to  $T_a = 25^\circ C$ )

| Symbol                 | Parameter                         | Test Conditions  |                                   | Min. | Typ. | Max. | Unit |
|------------------------|-----------------------------------|------------------|-----------------------------------|------|------|------|------|
| $D_R$                  | Maximum Data Rate                 | Jitter <5%       |                                   | 25   | 50   |      | Mbps |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Input to Output | $R_L = 54\Omega$ | $C_{L1}=C_{L2}=50pF$ , (Figure 1) |      | 10   | 16   | ns   |
| $t_{SKEW}$             | Differential Output Delay Skew    | $R_L = 54\Omega$ | $C_{L1}=C_{L2}=50pF$ , (Figure 1) |      | 1    | 3    | ns   |
| $t_{TLH}$<br>$t_{THL}$ | Rise or Fall Differential Time    | $R_L = 54\Omega$ | $C_{L1}=C_{L2}=50pF$ , (Figure 1) |      | 8    | 12   | ns   |
| $t_{PZL}$              | Output Enable Time                | $C_L = 50pF$     | S1 Closed                         |      | 14   | 25   | ns   |
| $t_{PZH}$              | Output Enable Time                | $C_L = 50pF$     | S2 Closed                         |      | 14   | 25   | ns   |
| $t_{PHZ}$              | Output Disable Time               | $C_L = 15pF$     | S2 Closed                         |      | 10   | 25   | ns   |
| $t_{PLZ}$              | Output Disable Time               | $C_L = 15pF$     | S1 Closed                         |      | 16   | 25   | ns   |

**RECEIVER SWITCHING CHARACTERISTICS**

$V_{CC} = 4.5V$  to  $5.5V$ ,  $T_A = -40$  to  $85^\circ C$ , unless otherwise specified. Typical values are referred to  $T_a = 25^\circ C$ )

| Symbol                 | Parameter                                  | Test Conditions |               | Min. | Typ. | Max. | Unit |
|------------------------|--|-----------------|---------------|------|------|------|------|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Input to Output          | $C_L = 15pF$    | (Figures 2,4) |      | 19   | 30   | ns   |
| $t_{SKD}$              | $ t_{PLH} - t_{PHL} $ Receiver Output Skew | $C_L = 15pF$    | (Figures 2,4) |      | 1    | 3    | ns   |
| $t_{TLH}$<br>$t_{THL}$ | Rise or Fall Time                          | $C_L = 15pF$    | (Figures 2,4) |      | 6    |      | ns   |
| $t_{PZL}$              | Output Enable Time                         | $C_{RL} = 15pF$ | S1 Closed     |      | 6    | 12   | ns   |
| $t_{PZH}$              | Output Enable Time                         | $C_{RL} = 15pF$ | S2 Closed     |      | 7    | 12   | ns   |
| $t_{PHZ}$              | Output Disable Time                        | $C_{RL} = 15pF$ | S2 Closed     |      | 6    | 12   | ns   |
| $t_{PLZ}$              | Output Disable Time                        | $C_{RL} = 15pF$ | S1 Closed     |      | 6    | 12   | ns   |

## TEST CIRCUITS AND TYPICAL CHARACTERISTICS

Figure 1 : Driver DC Test Load

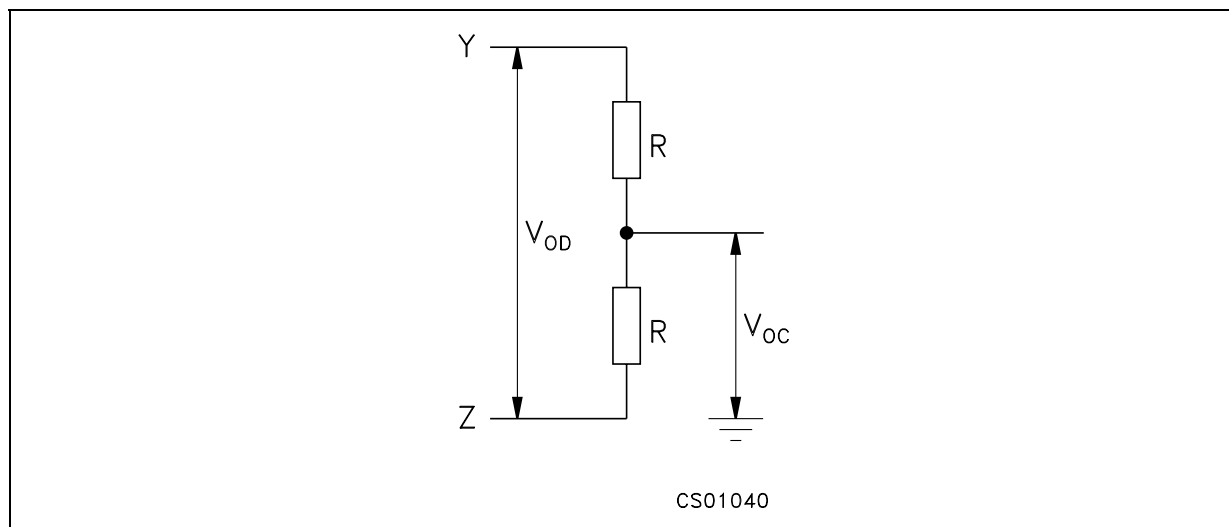


Figure 2 : Receiver Timing Test Load

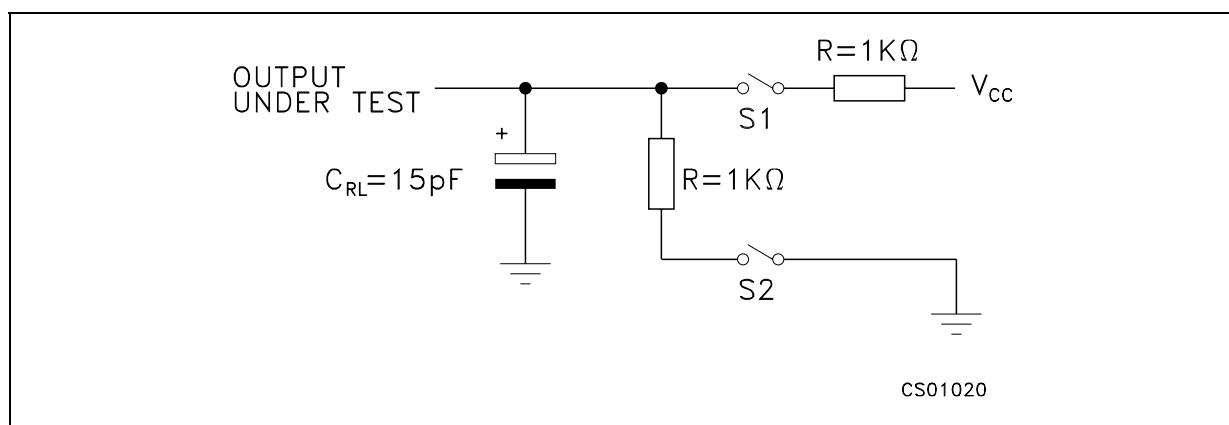


Figure 3 : Driver/Receiver Timing Test Circuit

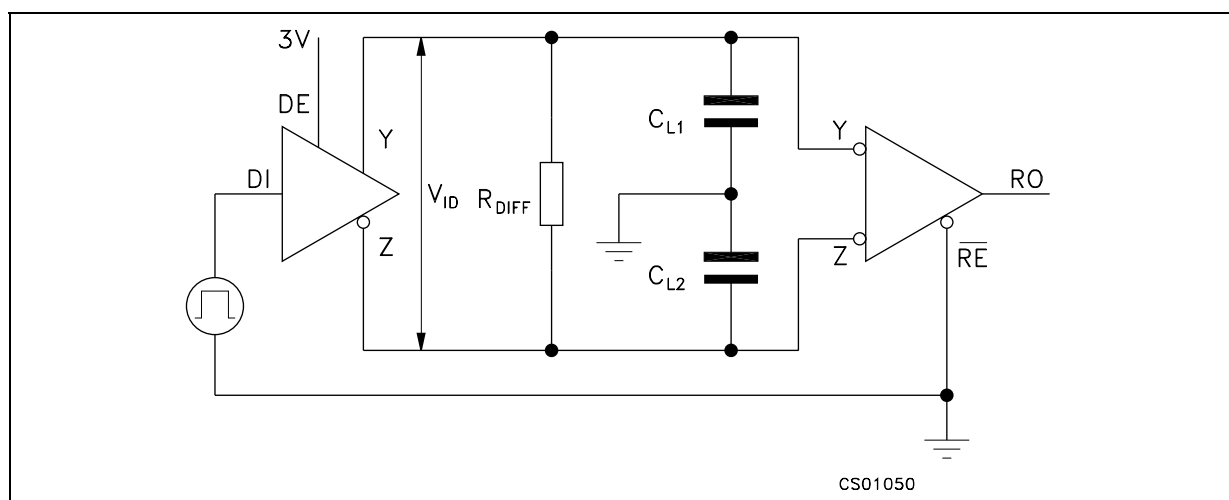


Figure 4 : Driver Timing Test Load

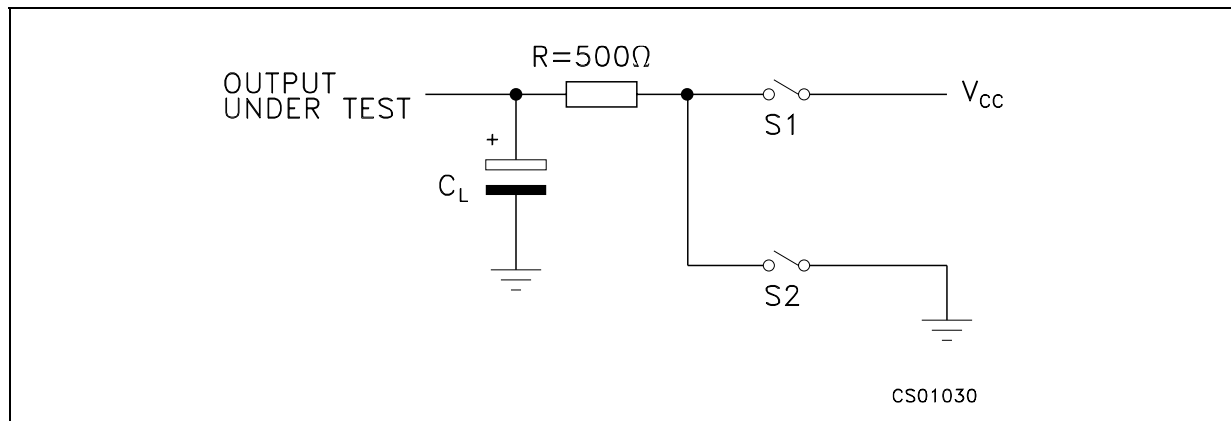
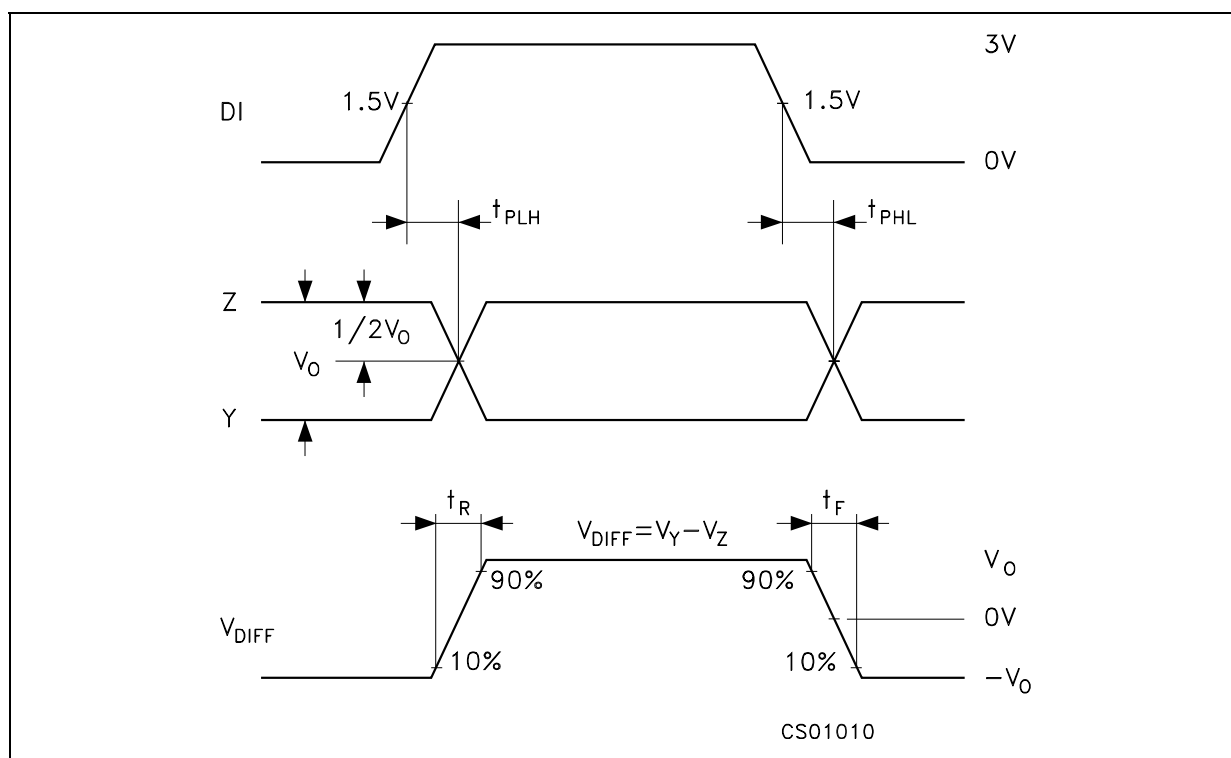
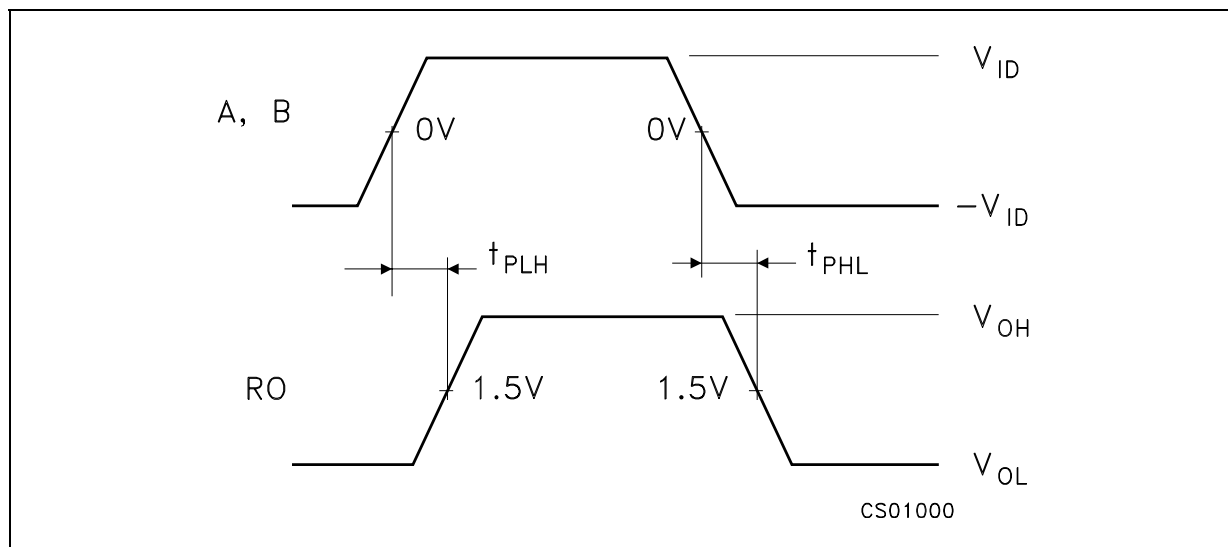
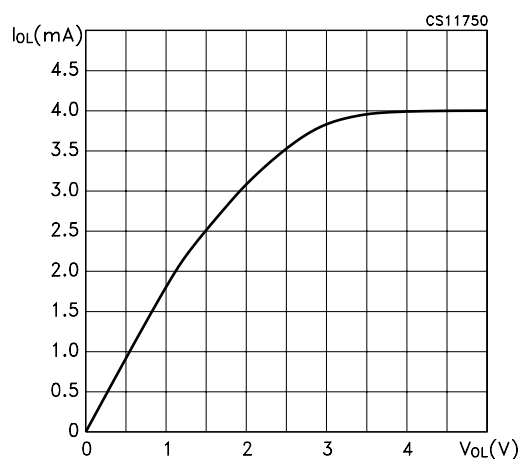
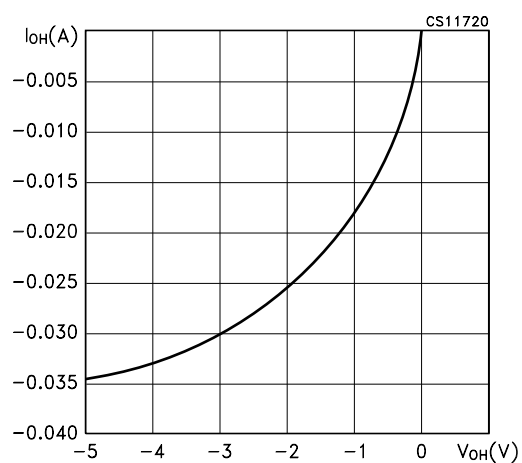
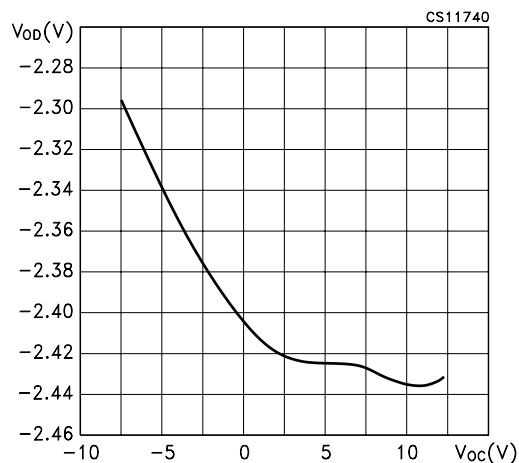
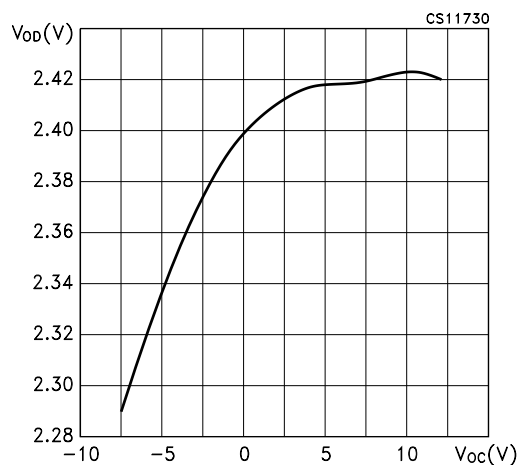
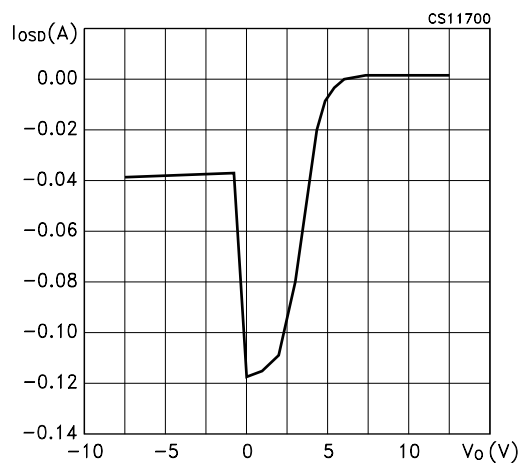
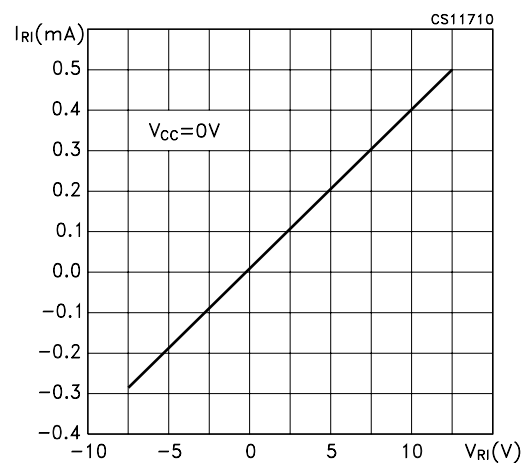
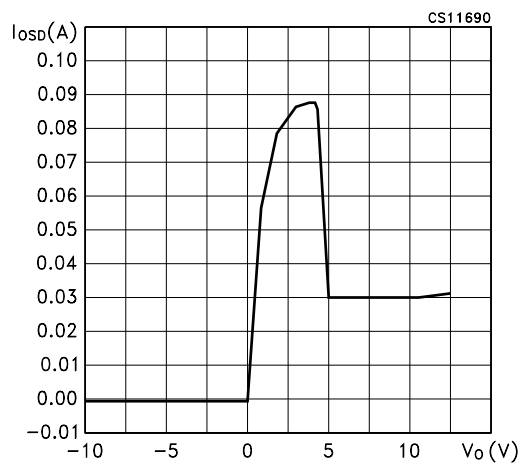


Figure 5 : Driver Propagation Delay



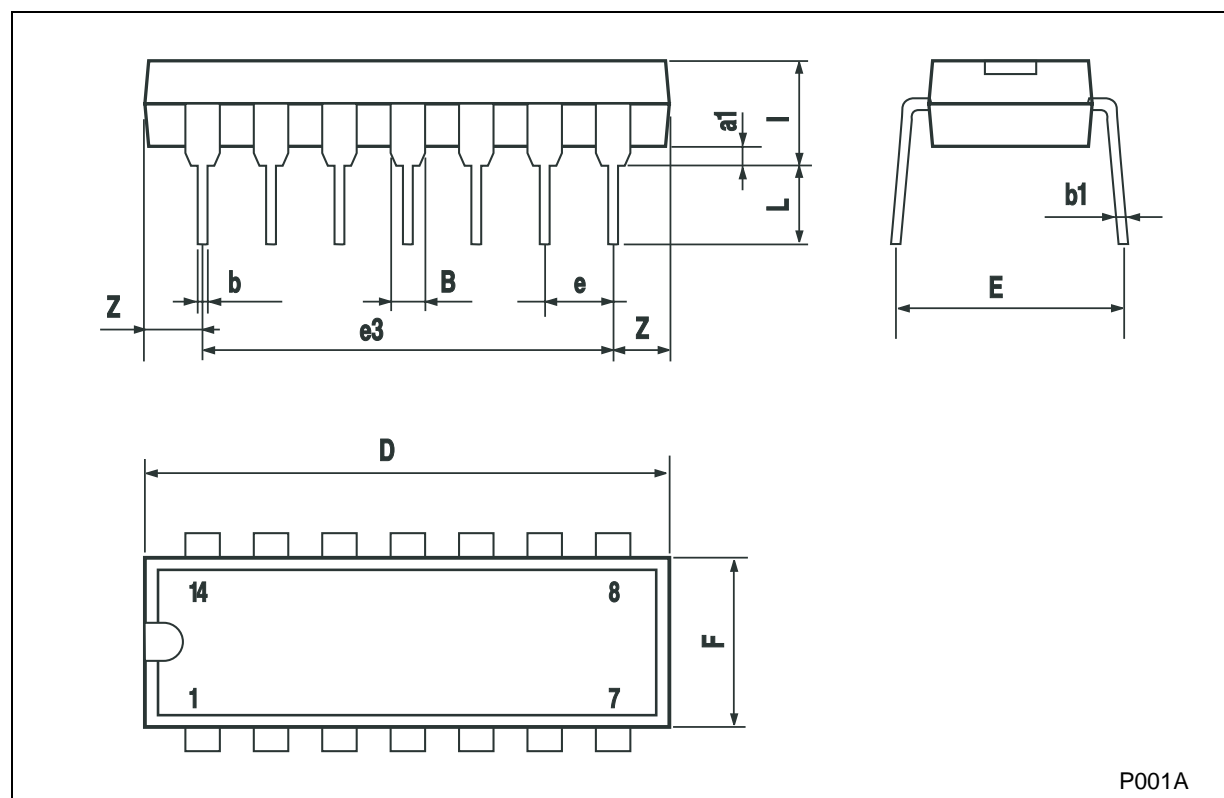
**Figure 6 : Receiver Propagation Delay****Figure 7 : Receiver Output Current vs Output Voltage (Output Low)****Figure 8 : Receiver Output Current vs Output Voltage (Output High)****Figure 9 : Driver Diff. Output Voltage vs Common Mode Voltage (Diff. Output Low)****Figure 10 : Driver Diff. Output Voltage vs Common Mode Voltage (Diff. Output High)**

**Figure 11 : Driver Short Circuit Current vs Line Voltage (Output High)****Figure 13 : Receiver Input Current vs Input Voltage****Figure 12 : Driver Short Circuit Current vs. Line Voltage (Output Low)**



### Plastic DIP-14 MECHANICAL DATA

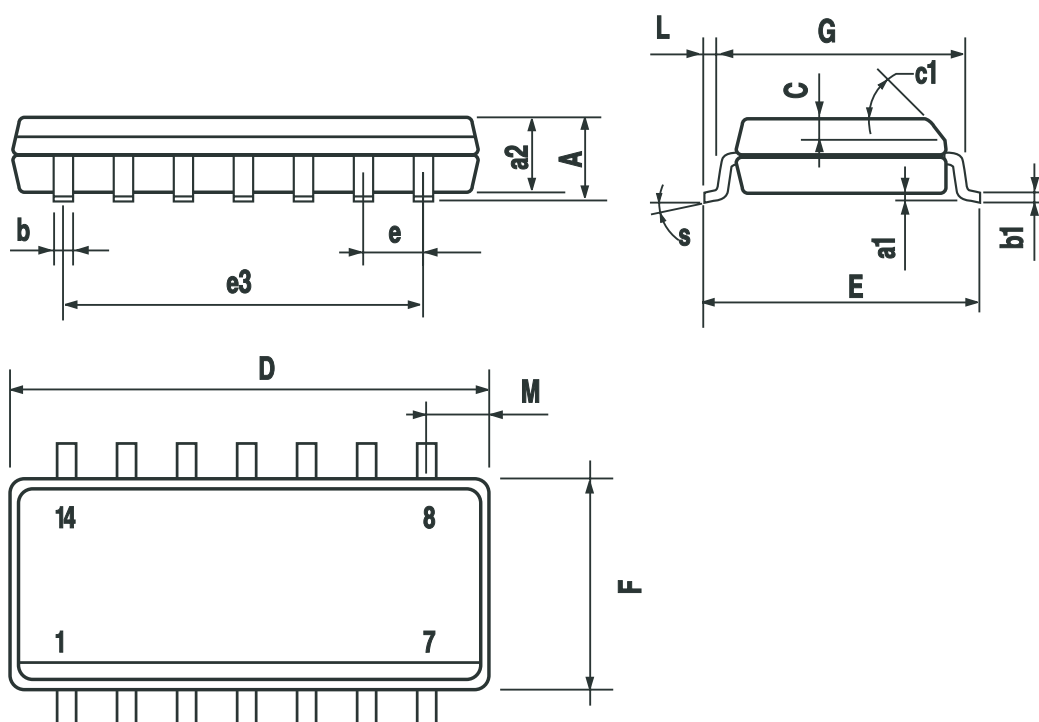
| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 1.39 |       | 1.65 | 0.055 |       | 0.065 |
| b    |      | 0.5   |      |       | 0.020 |       |
| b1   |      | 0.25  |      |       | 0.010 |       |
| D    |      |       | 20   |       |       | 0.787 |
| E    |      | 8.5   |      |       | 0.335 |       |
| e    |      | 2.54  |      |       | 0.100 |       |
| e3   |      | 15.24 |      |       | 0.600 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    | 1.27 |       | 2.54 | 0.050 |       | 0.100 |



P001A

## SO-14 MECHANICAL DATA

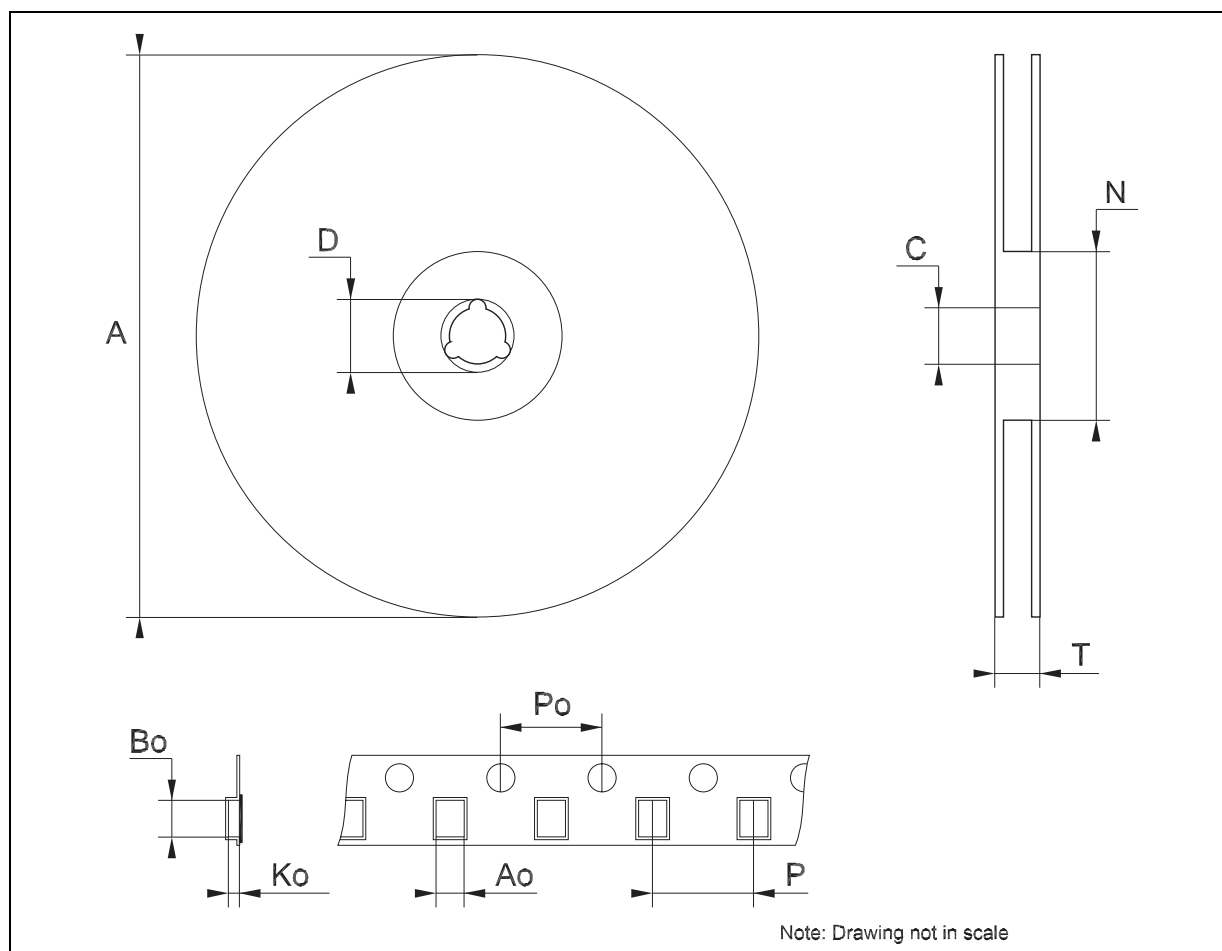
| DIM. | mm.        |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.003 |       | 0.007 |
| 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    | 8.55       |      | 8.75 | 0.336 |       | 0.344 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 7.62 |      |       | 0.300 |       |
| 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    |            |      | 0.68 |       |       | 0.026 |
| S    | 8° (max.)  |      |      |       |       |       |



PO13G

### Tape & Reel SO-14 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   | 6.4  |     | 6.6  | 0.252 |      | 0.260  |
| Bo   | 9    |     | 9.2  | 0.354 |      | 0.362  |
| 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  |



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