



## ST3232E

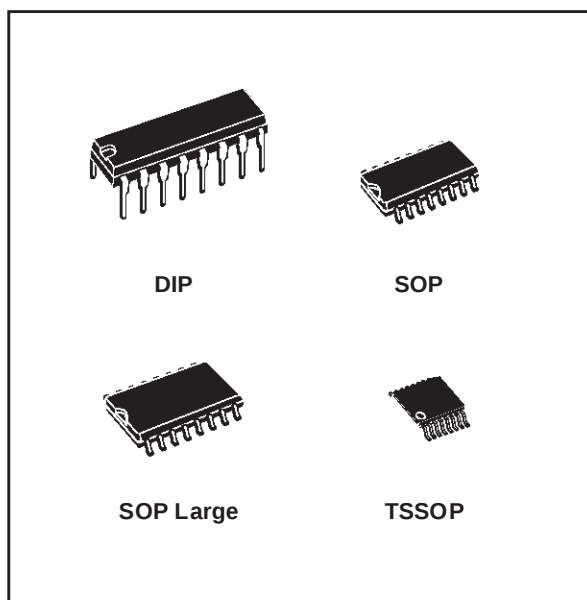
**±15KV ESD-PROTECTED, 3 TO 5.5V, LOW POWER,  
UP TO 250KBPS, RS-232 DRIVERS AND RECEIVERS**

- ESD PROTECTION FOR RS-232 I/O PINS  
±15KV HUMAN BODY MODEL  
±8KV IEC 1000-4-2 CONTACT DISCHARGE
- 300µA SUPPLY CURRENT
- 250Kbps MINIMUM GUARANTEED DATA RATE
- 6V/µs MINIMUM GUARANTEED SLEW RATE
- MEET EIA/TIA-232 SPECIFICATIONS DOWN TO 3V
- AVAILABLE IN DIP-16, SO-16, SO-16 LARGE AND TSSOP16

### DESCRIPTION

The ST3232E is a 3V powered EIA/TIA-232 and V.28/V.24 communication interfaces with low power requirements, high data-rate capabilities and enhanced electrostatic discharge (ESD) protection to ±8kV using IEC1000-4-2 Contact Discharge and ±15kV using the Human Body Model. ST3232E has a proprietary low dropout transmitter output stage providing true RS-232 performance from 3 to 5V supplies with a dual charge pump. The charge pump requires only four small 0.1µF standard external capacitors for operations from 3V supply.

The ST3232E has two receivers and two drivers.

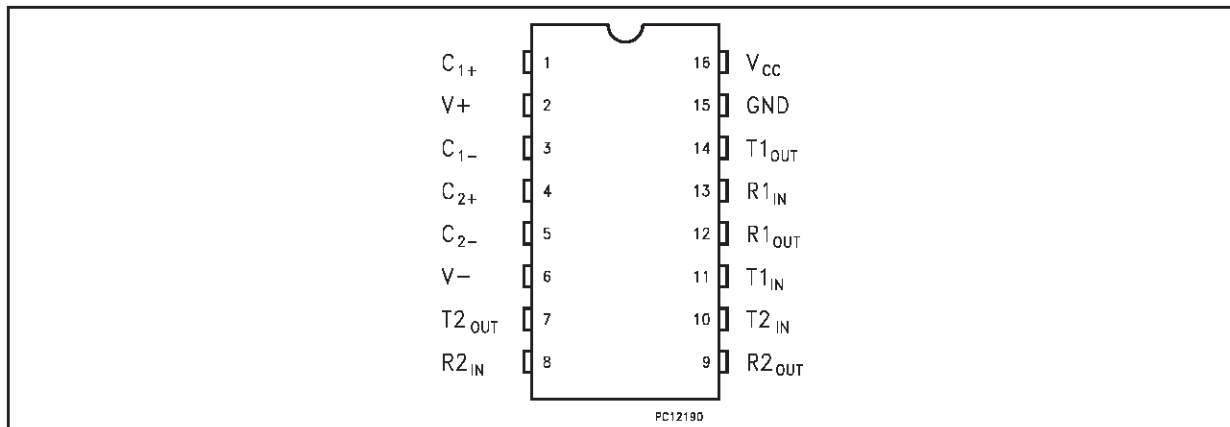


The device is guaranteed to run at data rates of 250Kbps while maintaining RS-232 output levels. Typical applications are Notebook, Subnotebook and Palmtop Computers, Battery Powered Equipment, Hand-Held Equipment, Peripherals and Printers.

### ORDERING CODES

| Type       | Temperature Range | Package                   | Comments                          |
|------------|-------------------|---------------------------|-----------------------------------|
| ST3232ECN  | 0 to 70 °C        | DIP-16                    | 25parts per tube / 40tube per box |
| ST3232EBN  | -40 to 85 °C      | DIP-16                    | 25parts per tube / 40tube per box |
| ST3232ECD  | 0 to 70 °C        | SO-16 (Tube)              | 50parts per tube / 20tube per box |
| ST3232EBD  | -40 to 85 °C      | SO-16 (Tube)              | 50parts per tube / 20tube per box |
| ST3232ECDR | 0 to 70 °C        | SO-16 (Tape & Reel)       | 2500 parts per reel               |
| ST3232EBDR | -40 to 85 °C      | SO-16 (Tape & Reel)       | 2500 parts per reel               |
| ST3232ECW  | 0 to 70 °C        | SO-16 Large (Tube)        | 50parts per tube / 20tube per box |
| ST3232EBW  | -40 to 85 °C      | SO-16 Large (Tube)        | 50parts per tube / 20tube per box |
| ST3232ECWR | 0 to 70 °C        | SO-16 Large (Tape & Reel) | 1000 parts per reel               |
| ST3232EBWR | -40 to 85 °C      | SO-16 Large (Tape & Reel) | 1000 parts per reel               |
| ST3232ECTR | 0 to 70 °C        | TSSOP16 (Tape & Reel)     | 2500 parts per reel               |
| ST3232EBTR | -40 to 85 °C      | TSSOP16 (Tape & Reel)     | 2500 parts per reel               |

## PIN CONFIGURATION



## PIN DESCRIPTION

| PIN N° | SYMBOL                        | NAME AND FUNCTION                                      |
|--------|-------------------------------|--------------------------------------------------------|
| 1      | C <sub>1</sub> <sup>+</sup>   | Positive Terminal for the first Charge Pump Capacitor  |
| 2      | V <sup>+</sup>                | Doubled Voltage Terminal                               |
| 3      | C <sub>1</sub> <sup>-</sup>   | Negative Terminal for the first Charge Pump Capacitor  |
| 4      | C <sub>2</sub> <sup>+</sup>   | Positive Terminal for the second Charge Pump Capacitor |
| 5      | C <sub>2</sub> <sup>-</sup>   | Negative Terminal for the second Charge Pump Capacitor |
| 6      | V <sup>-</sup>                | Inverted Voltage Terminal                              |
| 7      | T <sub>2</sub> <sup>OUT</sup> | Second Transmitter Output Voltage                      |
| 8      | R <sub>2</sub> <sup>IN</sup>  | Second Receiver Input Voltage                          |
| 9      | R <sub>2</sub> <sup>OUT</sup> | Second Receiver Output Voltage                         |
| 10     | T <sub>2</sub> <sup>IN</sup>  | Second Transmitter Input Voltage                       |
| 11     | T <sub>1</sub> <sup>IN</sup>  | First Transmitter Input Voltage                        |
| 12     | R <sub>1</sub> <sup>OUT</sup> | First Receiver Output Voltage                          |
| 13     | R <sub>1</sub> <sup>IN</sup>  | First Receiver Input Voltage                           |
| 14     | T <sub>1</sub> <sup>OUT</sup> | First Transmitter Output Voltage                       |
| 15     | GND                           | Ground                                                 |
| 16     | V <sub>CC</sub>               | Supply Voltage                                         |

## ABSOLUTE MAXIMUM RATINGS

| Symbol                           | Parameter                            | Value                           | Unit |
|----------------------------------|--------------------------------------|---------------------------------|------|
| V <sub>CC</sub>                  | Supply Voltage                       | -0.3 to 6                       | V    |
| V <sup>+</sup>                   | Doubled Voltage Terminal             | (V <sub>CC</sub> - 0.3) to 7    | V    |
| V <sup>-</sup>                   | Inverted Voltage Terminal            | 0.3 to -7                       | V    |
| V <sup>+</sup> +  V <sup>-</sup> |                                      | 13                              | V    |
| T <sub>IN</sub>                  | Transmitter Input Voltage Range      | -0.3 to 6                       | V    |
| R <sub>IN</sub>                  | Receiver Input Voltage Range         | ± 25                            | V    |
| T <sub>OUT</sub>                 | Transmitter Output Voltage Range     | ± 13.2                          | V    |
| R <sub>OUT</sub>                 | Receiver Output Voltage Range        | -0.3 to (V <sub>CC</sub> + 0.3) | V    |
| t <sub>SHORT</sub>               | Transmitter Output Short to GND Time | Continuous                      |      |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied. V<sup>+</sup> and V<sup>-</sup> can have a maximum magnitude of +7V, but their absolute addition can not exceed 13 V.

**ESD PERFORMANCE: TRANSMITTER OUTPUTS, RECEIVER INPUTS**

| Symbol | Parameter              | Test Conditions  | Min. | Typ. | Max. | Unit |
|--------|------------------------|------------------|------|------|------|------|
| ESD    | ESD Protection Voltage | Human Body Model | ±15  |      |      | kV   |
| ESD    | ESD Protection Voltage | IEC-1000-4-2     | ±8   |      |      | kV   |

**ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$ ,  $V_{CC} = 3\text{V}$  to  $5.5\text{V}$ ,  $T_A = -40$  to  $85^\circ\text{C}$ , unless otherwise specified.

Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol              | Parameter                     | Test Conditions                                                      | Min. | Typ. | Max. | Unit |
|---------------------|-------------------------------|----------------------------------------------------------------------|------|------|------|------|
| $I_{\text{SUPPLY}}$ | $V_{CC}$ Power Supply Current | No Load $V_{CC} = 3\text{V}$ or $5\text{V}$ $T_A = 25^\circ\text{C}$ |      | 0.3  | 1    | mA   |

**LOGIC INPUT ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$ ,  $V_{CC} = 3\text{V}$  to  $5.5\text{V}$ ,  $T_A = -40$  to  $85^\circ\text{C}$ , unless otherwise specified.

Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol           | Parameter                    | Test Conditions        | Min. | Typ.   | Max. | Unit |
|------------------|------------------------------|------------------------|------|--------|------|------|
| $V_{\text{TIL}}$ | Input Logic Threshold Low    | T-IN                   |      |        | 0.8  | V    |
| $V_{\text{HYS}}$ | Transmitter Input Hysteresys |                        |      | 0.25   |      | V    |
| $V_{\text{TIH}}$ | Input Logic Threshold High   | $V_{CC} = 3.3\text{V}$ | 2    |        |      | V    |
|                  |                              | $V_{CC} = 5\text{V}$   | 2.4  |        |      |      |
| $I_{\text{IL}}$  | Input Leakage Current        | T-IN                   |      | ± 0.01 | ± 1  | μA   |

**TRANSMITTER ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$  tested at  $V_{CC} = 3\text{V}$  to  $5.5\text{V}$ ,  $T_A = -40$  to  $85^\circ\text{C}$ , unless otherwise specified.

Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol            | Parameter                     | Test Conditions                                                                                             | Min. | Typ.  | Max. | Unit |
|-------------------|-------------------------------|-------------------------------------------------------------------------------------------------------------|------|-------|------|------|
| $V_{\text{TOUT}}$ | Output Voltage Swing          | All Transmitter outputs are loaded with $3\text{K}\Omega$ to GND                                            | ± 5  | ± 5.4 |      | V    |
| $R_{\text{TOUT}}$ | Transmitter Output Resistance | $V_{CC} = V_+ = V_- = 0\text{V}$ $V_{\text{OUT}} = \pm 2\text{V}$                                           | 300  | 10M   |      | Ω    |
| $I_{\text{TSC}}$  | Output Short Circuit Current  |                                                                                                             |      | ± 60  |      | mA   |
| $I_{\text{TOL}}$  | Output Leakage Current        | $V_{CC} = 0\text{V}$ or $3\text{V}$ to $5.5\text{V}$ $V_{\text{OUT}} = \pm 12\text{V}$ Transmitters Disable |      |       | ± 25 | μA   |

**RECEIVER ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$  tested at  $V_{CC} = 3\text{V}$  to  $5.5\text{V}$ ,  $T_A = -40$  to  $85^\circ\text{C}$ , unless otherwise specified.  
Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol      | Parameter                              | Test Conditions                                 | Min.         | Typ.         | Max. | Unit             |
|-------------|----------------------------------------|-------------------------------------------------|--------------|--------------|------|------------------|
| $V_{RIN}$   | Receiver Input Voltage Operating Range |                                                 | -25          |              | 25   | V                |
| $V_{RIL}$   | RS-232 Input Threshold Low             | $T_A = 25^\circ\text{C}$ $V_{CC} = 3.3\text{V}$ | 0.6          | 1.1          |      | V                |
|             |                                        | $T_A = 25^\circ\text{C}$ $V_{CC} = 5\text{V}$   | 0.8          | 1.5          |      |                  |
| $V_{RIH}$   | RS-232 Input Threshold High            | $T_A = 25^\circ\text{C}$ $V_{CC} = 3.3\text{V}$ |              | 1.4          | 2.4  | V                |
|             |                                        | $T_A = 25^\circ\text{C}$ $V_{CC} = 5\text{V}$   |              | 1.8          | 2.4  |                  |
| $V_{RIHYS}$ | Input Hysteresis                       |                                                 |              | 0.5          |      | V                |
| $R_{RIN}$   | Input Resistance                       | $T_A = 25^\circ\text{C}$                        | 3            | 5            | 7    | $\text{K}\Omega$ |
| $V_{ROL}$   | TTL/CMOS Output Voltage Low            | $I_{OUT} = 1.6\text{mA}$                        |              |              | 0.4  | V                |
| $V_{ROH}$   | TTL/CMOS Output Voltage High           | $I_{OUT} = -1\text{mA}$                         | $V_{CC}-0.6$ | $V_{CC}-0.1$ |      | V                |

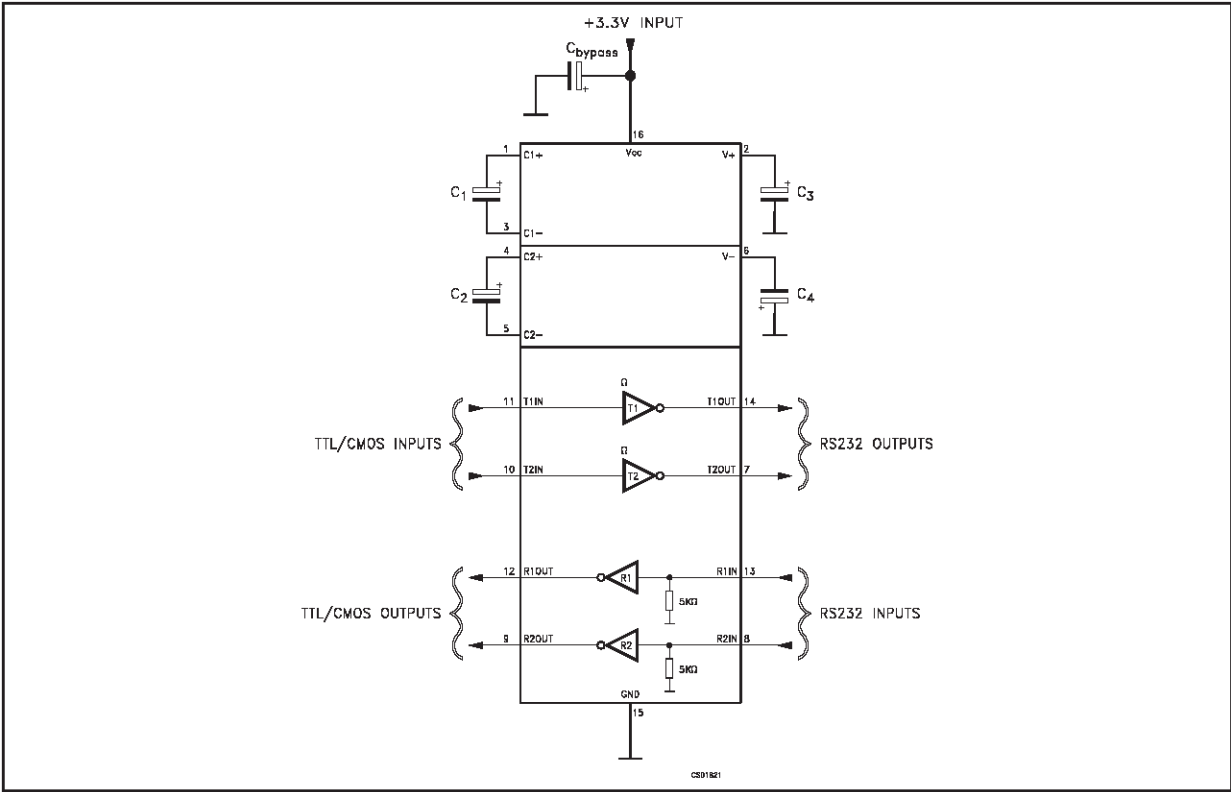
**TIMING CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$ ,  $V_{CC} = 3\text{V}$  to  $5.5\text{V}$ ,  $T_A = -40$  to  $85^\circ\text{C}$ , unless otherwise specified.  
Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol                   | Parameter                                | Test Conditions                                                                                                                                                                                                              | Min.   | Typ. | Max.     | Unit                                             |
|--------------------------|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|----------|--------------------------------------------------|
| $D_R$                    | Data Transfer Rate                       | $R_L = 3\text{K}\Omega$ $C_{L2} = 1000\text{pF}$<br>one trasmitter switching                                                                                                                                                 | 250    |      |          | Kbps                                             |
| $t_{PHLR}$<br>$t_{PLHR}$ | Propagation Delay Input to Output        | $R_{XIN} = R_{XOUT}$ $C_L = 150\text{pF}$                                                                                                                                                                                    |        | 0.15 |          | $\mu\text{s}$                                    |
| $t_{OER}$                | Receiver Output Enable Time              | Normal Operation                                                                                                                                                                                                             |        | 50   |          | ns                                               |
| $t_{ODR}$                | Receiver Output Disable Time             | Normal Operation                                                                                                                                                                                                             |        | 50   |          | ns                                               |
| $ t_{PHLT} - t_{THL} $   | Transmitter Propagation Delay Difference | (Note 1)                                                                                                                                                                                                                     |        | 200  |          | ns                                               |
| $ t_{PHLR} - t_{THR} $   | Receiver Propagation Delay Difference    |                                                                                                                                                                                                                              |        | 50   |          | ns                                               |
| $S_{RT}$                 | Trnasion Slew Rate                       | $T_A = 25^\circ\text{C}$ $R_L = 3\text{K}\Omega$ to $7\text{K}\Omega$ $V_{CC} = 3.3\text{V}$<br>measured from +3V to -3V or -3V to +3V<br>$C_L = 150\text{pF}$ to $1000\text{pF}$<br>$C_L = 150\text{pF}$ to $2500\text{pF}$ | 6<br>4 |      | 30<br>30 | $\text{V}/\mu\text{s}$<br>$\text{V}/\mu\text{s}$ |

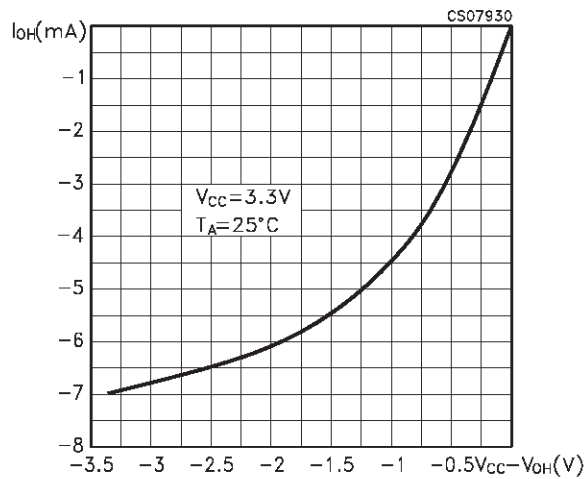
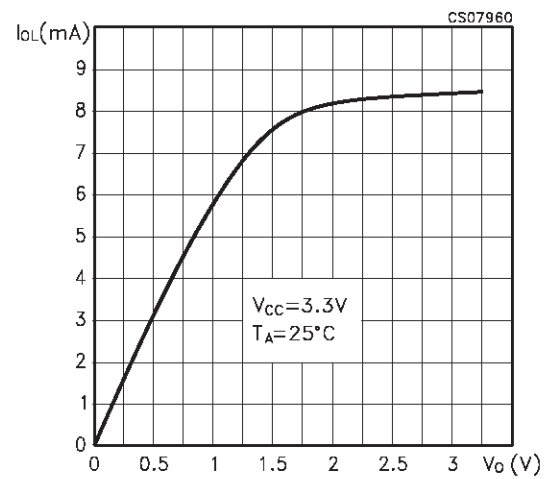
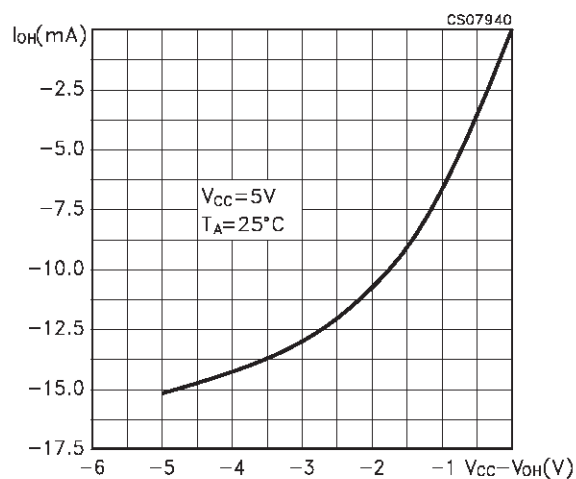
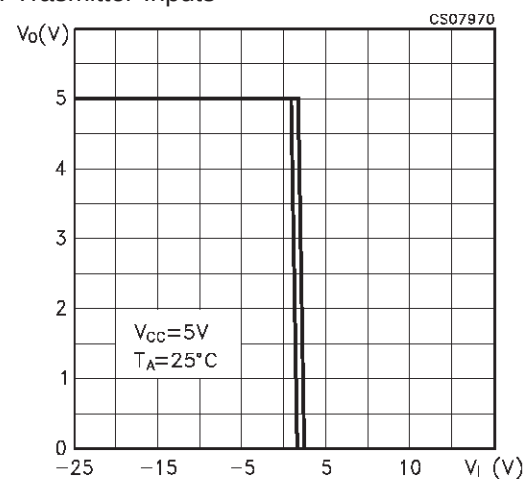
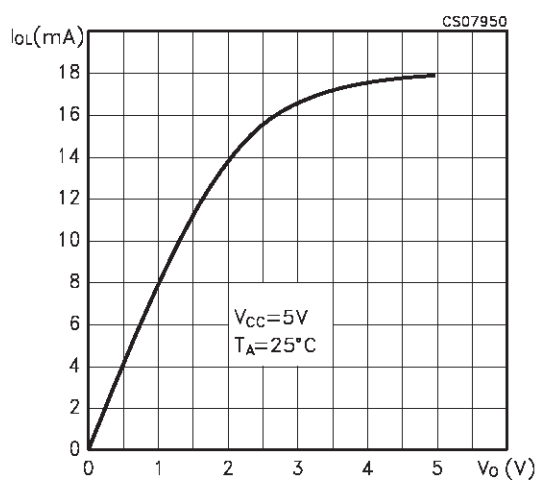
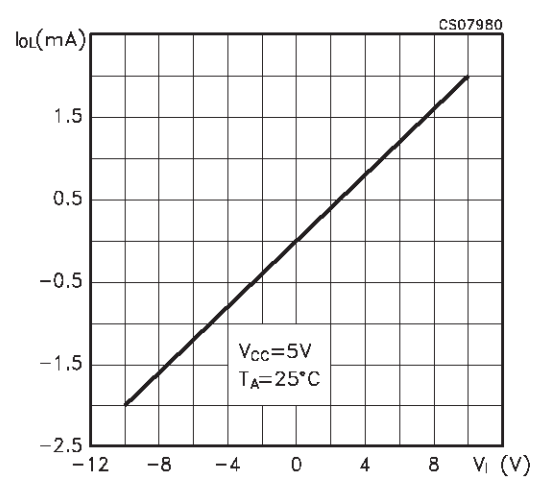
Transmitter Skew is measured at the transmitter zero cross points

APPLICATION CIRCUITS



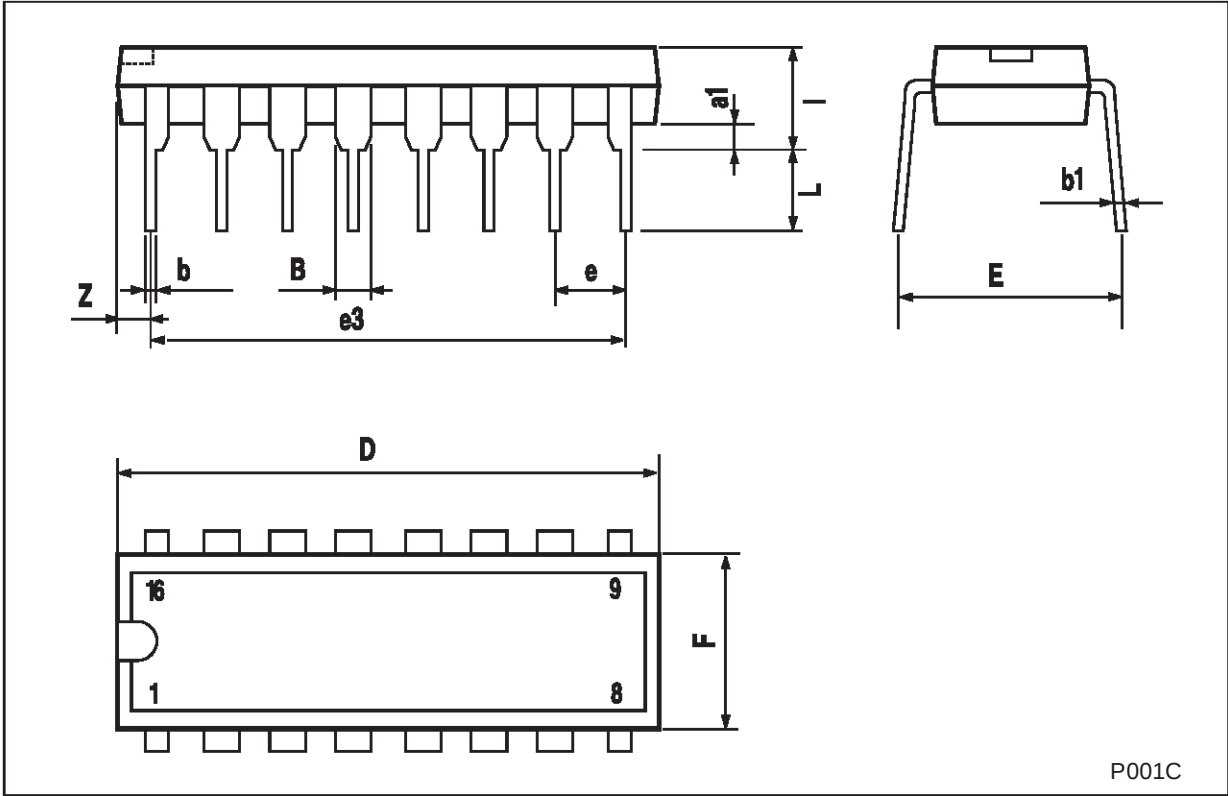
CAPACITANCE VALUE (μF)

| V <sub>CC</sub> | C1    | C2   | C3   | C4   | C <sub>bypass</sub> |
|-----------------|-------|------|------|------|---------------------|
| 3.0 to 3.6      | 0.1   | 0.1  | 0.1  | 0.1  | 0.1                 |
| 4.5 to 5.5      | 0.047 | 0.33 | 0.33 | 0.33 | 0.1                 |
| 3.0 to 5.5      | 0.1   | 0.47 | 0.47 | 0.47 | 0.1                 |

**TYPICAL PERFORMANCE CHARACTERISTICS** (unless otherwise specified  $T_j = 25^\circ\text{C}$ )**Figure 1** : Output Current vs Output High Voltage**Figure 4** : Output Current vs Output Low Voltage**Figure 2** : Output Current vs Output High Voltage**Figure 5** : Voltage Transfer Characteristics for Transmitter Inputs**Figure 3** : Output Current vs Output Low Voltage**Figure 6** : Receiver Input Resistance

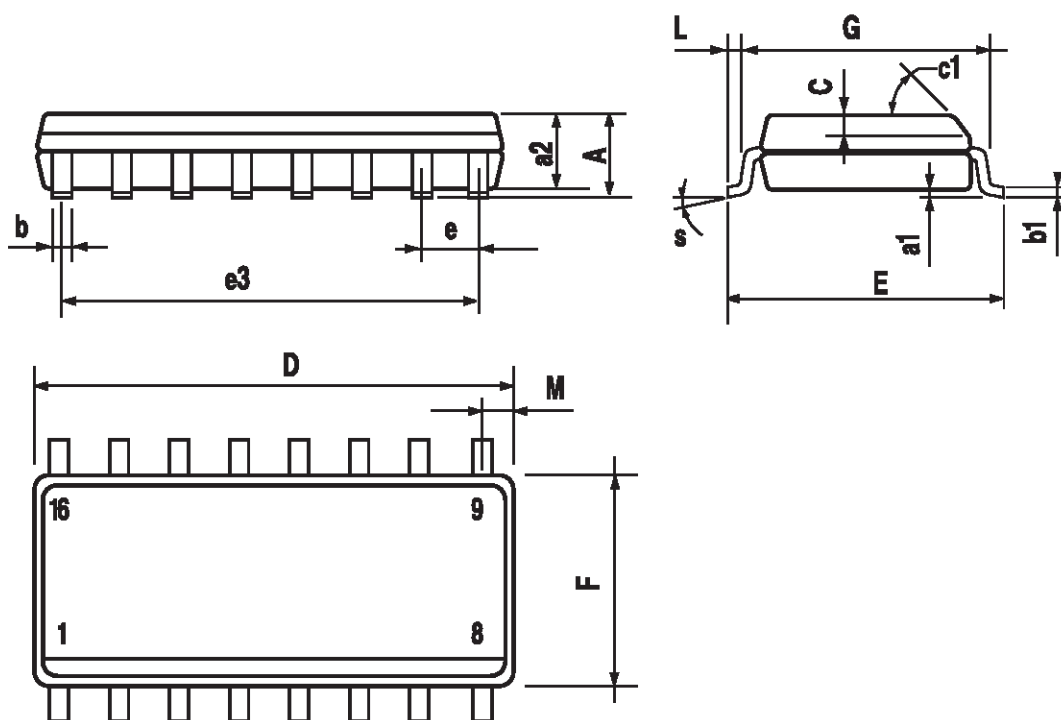
Plastic DIP-16 (0.25) MECHANICAL DATA

| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 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   |      | 17.78 |      |       | 0.700 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    |      |       | 1.27 |       |       | 0.050 |



## SO-16 MECHANICAL DATA

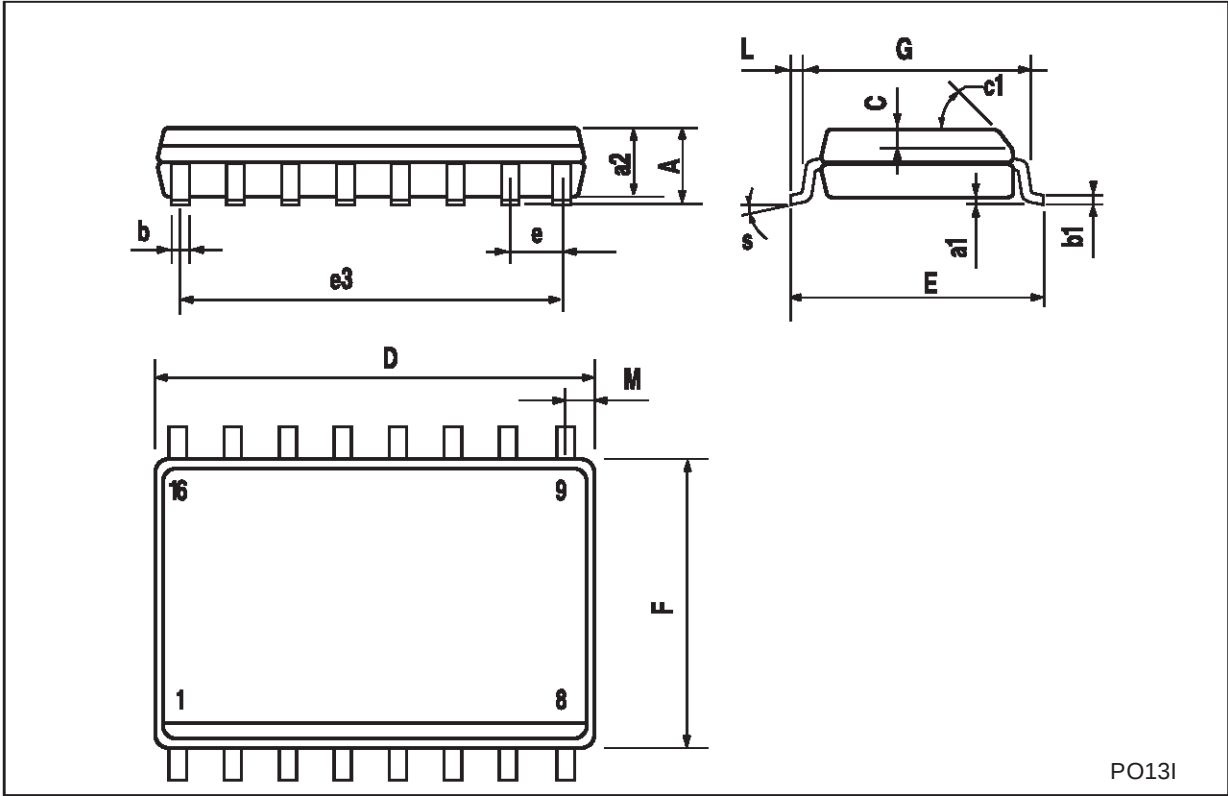
| DIM. | mm.        |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.003 |       | 0.007 |
| 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    | 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.)  |      |      |       |       |       |



PO13H

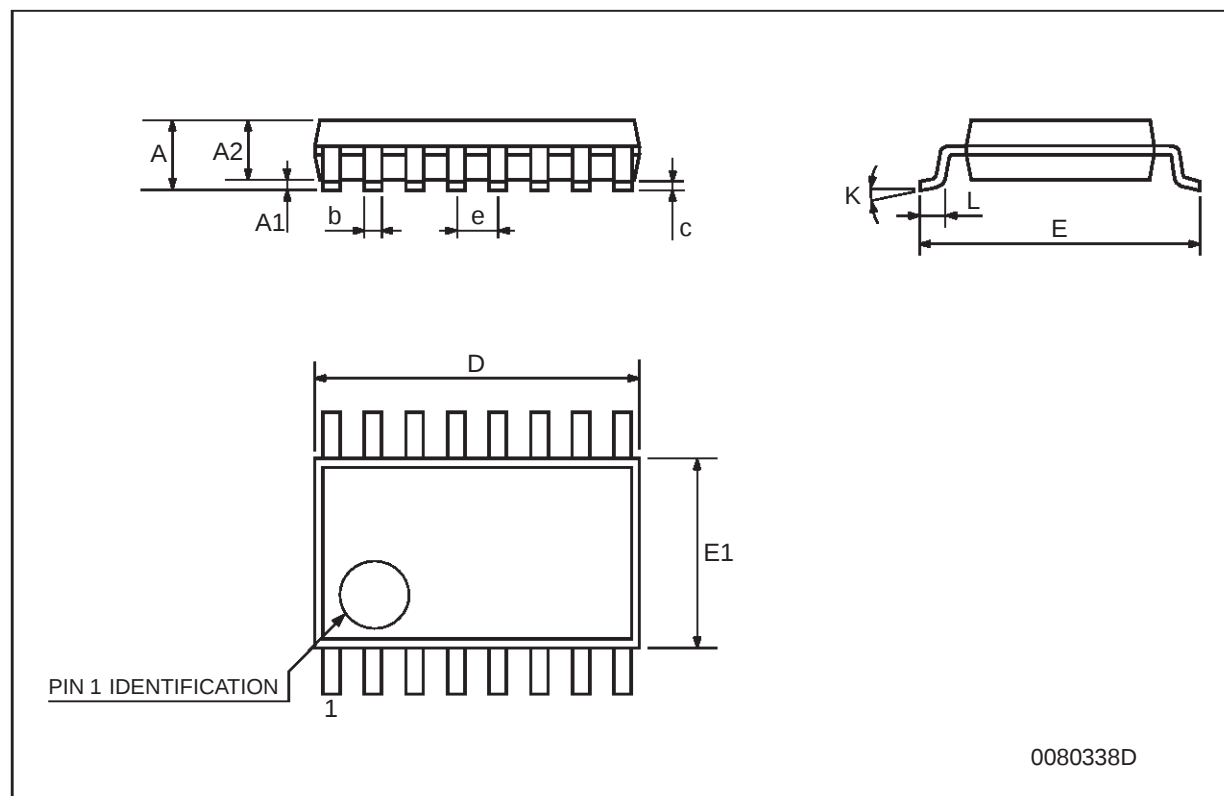
SO-16L MECHANICAL DATA

| DIM. | mm.        |      |       | inch  |       |       |
|------|------------|------|-------|-------|-------|-------|
|      | MIN.       | TYP  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |            |      | 2.65  |       |       | 0.104 |
| a1   | 0.1        |      | 0.2   | 0.004 |       | 0.008 |
| a2   |            |      | 2.45  |       |       | 0.096 |
| b    | 0.35       |      | 0.49  | 0.014 |       | 0.019 |
| b1   | 0.23       |      | 0.32  | 0.009 |       | 0.012 |
| C    |            | 0.5  |       |       | 0.020 |       |
| c1   | 45° (typ.) |      |       |       |       |       |
| D    | 10.1       |      | 10.5  | 0.397 |       | 0.413 |
| E    | 10.0       |      | 10.65 | 0.393 |       | 0.419 |
| e    |            | 1.27 |       |       | 0.050 |       |
| e3   |            | 8.89 |       |       | 0.350 |       |
| F    | 7.4        |      | 7.6   | 0.291 |       | 0.300 |
| G    |            |      |       |       |       |       |
| L    | 0.5        |      | 1.27  | 0.020 |       | 0.050 |
| M    |            |      | 0.75  |       |       | 0.029 |
| 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 |            | 0.0089 |
| 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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