



# ST202E ST232E

## ± 15KV ESD PROTECTED 5V RS-232 TRANSCEIVER

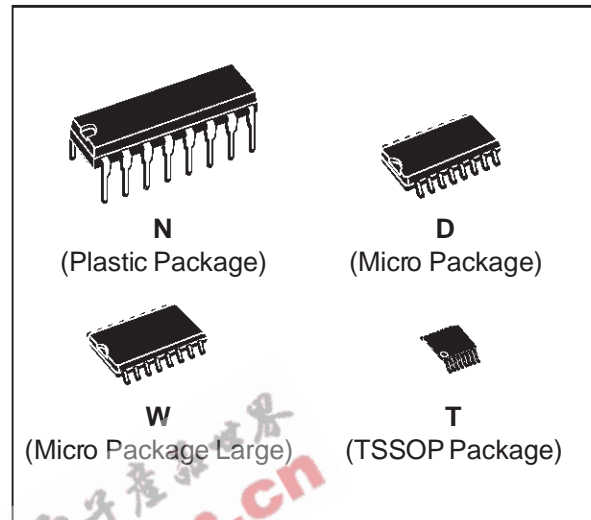
- ESD PROTECTION FOR RS-232 I/O PINS:  
± 15 KV HUMAN BODY MODEL
- GUARANTEED 120 kbps DATA RATE
- GUARANTEED SLEW RATE RANGE 3 to 30V/μs
- OPERATE FROM A SINGLE 5V POWER SUPPLY

### DESCRIPTION

The ST202E/ST232E are a 2 driver 2 receiver devices designed for RS-232 and V.28 communications in harsh environments. Each transmitter output and receiver input is protected against ± 15KV electrostatic discharge (ESD) shocks. The drivers meet all EIA/TIA-232E and CCITT V.28 specifications at data rates up to 120Kbps, when loaded in accordance with the EIA/TIA-232E specification.

The ST202E/232E use a single 5V supply voltage.

The ST232E operates with four 1μF capacitors,

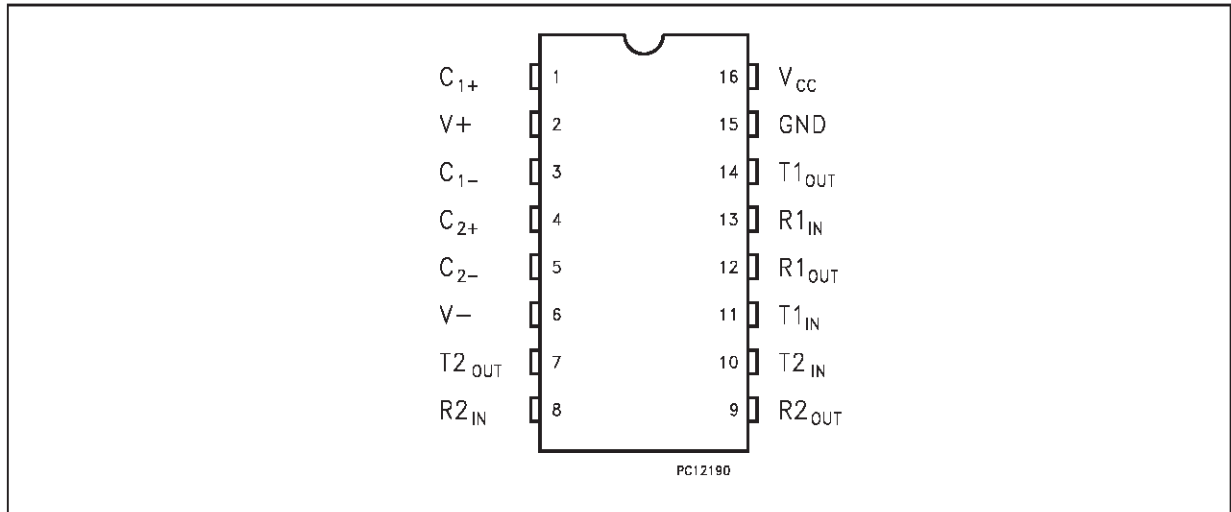


while the ST202E operates with four 0.1μF capacitors, further reducing cost and board space.

### ORDER CODES

| Type      |           | Temperature Range | Package                   | Comments                            |
|-----------|-----------|-------------------|---------------------------|-------------------------------------|
| ST202ECN  | ST232ECN  | 0 to 70 °C        | DIP-16                    | 25 parts per tube / 40 tube per box |
| ST202EBN  | ST232EBN  | -40 to 85 °C      | DIP-16                    | 25 parts per tube / 40 tube per box |
| ST202ECD  | ST232ECD  | 0 to 70 °C        | SO-16 (Tube)              | 50 parts per tube / 20 tube per box |
| ST202EBD  | ST232EBD  | -40 to 85 °C      | SO-16 (Tube)              | 50 parts per tube / 20 tube per box |
| ST202ECDR | ST232ECDR | 0 to 70 °C        | SO-16 (Tape & Reel)       | 2500 parts per reel                 |
| ST202EBDR | ST232EBDR | -40 to 85 °C      | SO-16 (Tape & Reel)       | 2500 parts per reel                 |
| ST202ECW  | ST232ECW  | 0 to 70 °C        | SO-16 Large (Tube)        | 50 parts per tube / 20 tube per box |
| ST202EBW  | ST232EBW  | -40 to 85 °C      | SO-16 Large (Tube)        | 50 parts per tube / 20 tube per box |
| ST202ECWR | ST232ECWR | 0 to 70 °C        | SO-16 Large (Tape & Reel) | 1000 parts per reel                 |
| ST202EBWR | ST232EBWR | -40 to 85 °C      | SO-16 Large (Tape & Reel) | 1000 parts per reel                 |
| ST202ECTR | ST232ECTR | 0 to 70 °C        | TSSOP16 (Tape & Reel)     | 2500 parts per reel                 |
| ST202EBTR | ST232EBTR | -40 to 85 °C      | TSSOP16 (Tape & Reel)     | 2500 parts per reel                 |

PIN CONFIGURATION



PIN DESCRIPTION

| PIN No | SYMBOL            | NAME AND FUNCTION                                      |
|--------|-------------------|--|
| 1      | C <sub>1+</sub>   | Positive Terminal for the first Charge Pump Capacitor  |
| 2      | V+                | Doubled Voltage Terminal                               |
| 3      | C <sub>1-</sub>   | Negative Terminal for the first Charge Pump Capacitor  |
| 4      | C <sub>2+</sub>   | Positive Terminal for the second Charge Pump Capacitor |
| 5      | C <sub>2-</sub>   | Negative Terminal for the second Charge Pump Capacitor |
| 6      | V-                | Inverted Voltage Terminal                              |
| 7      | T <sub>2OUT</sub> | Second Transmitter Output Voltage                      |
| 8      | R <sub>2IN</sub>  | Second Receiver Input Voltage                          |
| 9      | R <sub>2OUT</sub> | Second Receiver Output Voltage                         |
| 10     | T <sub>2IN</sub>  | Second Transmitter Input Voltage                       |
| 11     | T <sub>1IN</sub>  | First Transmitter Input Voltage                        |
| 12     | R <sub>1OUT</sub> | First Receiver Output Voltage                          |
| 13     | R <sub>1IN</sub>  | First Receiver Input Voltage                           |
| 14     | T <sub>1OUT</sub> | First Transmitter Output Voltage                       |
| 15     | GND               | Ground   |
| 16     | V <sub>CC</sub>   | Supply Voltage   |

**ABSOLUTE MAXIMUM RATINGS** (Note 1)

| Symbol              | Parameter                                  | Value  | Unit |
|---------------------|--|--|------|
| V <sub>CC</sub>     | Supply Voltage                             | -0.3 to 6  | V    |
| V <sub>+</sub>      | Extra Positive Voltage                     | (V <sub>CC</sub> - 0.3) to 14                    | V    |
| V <sub>-</sub>      | Extra Negative Voltage                     | -14 to 0.3                                       | V    |
| T <sub>IN</sub>     | Transmitter Input Voltage Range            | -0.3 to (V <sub>+</sub> + 0.3)                   | V    |
| R <sub>IN</sub>     | Receiver Input Voltage Range               | ±30  | V    |
| T <sub>OUT</sub>    | Transmitter Output Voltage Range           | (V <sub>-</sub> - 0.3) to (V <sub>+</sub> + 0.3) | V    |
| R <sub>OUT</sub>    | Receiver Output Voltage Range              | -0.3 to (V <sub>CC</sub> + 0.3)                  | V    |
| T <sub>SCTOUT</sub> | Short Circuit Duration on T <sub>OUT</sub> | infinite   |      |
| 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.

**ELECTRICAL CHARACTERISTICS**

(C<sub>1</sub> -C<sub>4</sub> = 0.1μF for ST202E, C<sub>1</sub> -C<sub>4</sub> = 1μF for ST232E, V<sub>CC</sub> = 5V ± 10% T<sub>A</sub> = -40 to 85 °C, unless otherwise specified. Typical Valus are referred to T<sub>A</sub> = 25 °C)

| Symbol              | Parameter                            | Test Conditions                 | Value |      |      | Unit |
|---------------------|--------------------------------------|---------------------------------|-------|------|------|------|
|                     |                                      |                                 | Min.  | Typ. | Max. |      |
| I <sub>SUPPLY</sub> | V <sub>CC</sub> Power Supply Current | No Load, T <sub>A</sub> = 25 °C |       | 5    | 10   | mA   |

**TRANSMITTER ELECTRICAL CHARACTERISTICS**

(C<sub>1</sub> -C<sub>4</sub> = 0.1μF for ST202E, C<sub>1</sub> -C<sub>4</sub> = 1μF for ST232E, V<sub>CC</sub> = 5V ± 10%, T<sub>A</sub> = -40 to 85 °C, unless otherwise specified. Typical Valus are referred to T<sub>A</sub> = 25 °C)

| Symbol            | Parameter                                | Test Conditions  | Value |      |      | Unit    |
|-------------------|--|--|-------|------|------|---------|
|                   |  |  | Min.  | Typ. | Max. |         |
| V <sub>TOUT</sub> | Output Voltage Swing                     | All Transmitter outputs are loaded with 3KΩ to GND   | ±5    | ±9   |      | V       |
| I <sub>TIL</sub>  | Logic Pull-Up Current                    | T <sub>IN</sub> = 0 V to V <sub>CC</sub>   |       |      | ±10  | μA      |
| V <sub>TIL</sub>  | Input Logic Threshold Low                |  | 0.8   |      |      | V       |
| V <sub>TIH</sub>  | Input Logic Threshold High               |  |       |      | 2    | V       |
| SR <sub>T</sub>   | Transition Slew Rate                     | T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 5 V,<br>R <sub>L</sub> = 3 to 7 KΩ,<br>C <sub>L</sub> = 50 to 1000 pF (Note 1) | 3     | 6    | 30   | V/μs    |
| D <sub>R</sub>    | Data Rate                                | R <sub>L</sub> = 3 to 7 KΩ, C <sub>L</sub> = 50 to 1000 pF<br>one trasmitter switching                                   | 230   | 400  |      | Kbits/s |
| R <sub>TOUT</sub> | Transmitter Output Resistance            | V <sub>CC</sub> = V <sub>+</sub> = V <sub>-</sub> = 0V<br>V <sub>OUT</sub> = ± 2 V                                       | 300   |      |      | Ω       |
| I <sub>SC</sub>   | Transmitter Output Short Circuit Current |  |       | ±10  | ±60  | mA      |
| t <sub>DT</sub>   | Trasmitter Propagation Delay             | R <sub>L</sub> = 3 KΩ, C <sub>L</sub> = 2500 pF<br>All trasmitter loaded   |       | 2    |      | μA      |

Note 1: Measured from 3V to -3V or from -3V to 3V.

Note 2: One trasmitter output is loaded with R<sub>L</sub> = 3KΩ to 7KΩ, C<sub>L</sub> = 50 to 1000pF

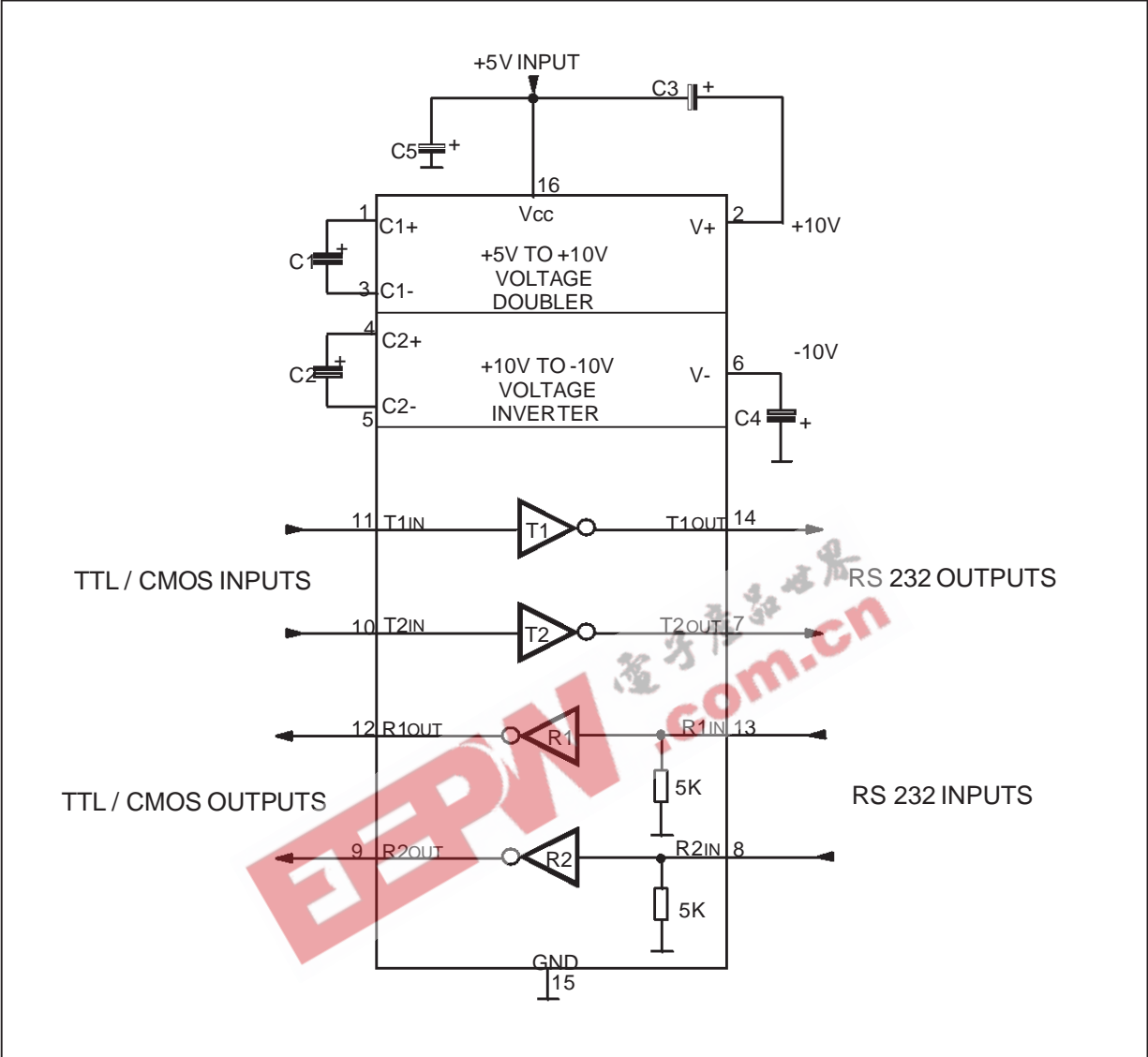
## RECEIVER ELECTRICAL CHARACTERISTICS

( $C_1 - C_4 = 0.1\mu\text{F}$  for ST202E,  $C_1 - C_4 = 1\mu\text{F}$  for ST232E,  $V_{CC} = 5\text{V} \pm 10\%$ ,  $T_A = -40$  to  $85\text{ }^\circ\text{C}$ , unless otherwise specified. Typical Values are referred to  $T_A = 25\text{ }^\circ\text{C}$ )

| Symbol      | Parameter                              | Test Conditions  | Value |              |      | Unit             |
|-------------|--|--|-------|--------------|------|------------------|
|             |  |  | Min.  | Typ.         | Max. |                  |
| $V_{RIN}$   | Receiver Input Voltage Operating Range |  | -30   |              | 30   | V                |
| $R_{RIN}$   | RS-232 Input Resistance                | $T_A = 25\text{ }^\circ\text{C}$ , $V_{CC} = 5\text{ V}$ | 3     | 5            | 7    | $\text{K}\Omega$ |
| $V_{RIL}$   | RS-232 Input Logic Threshold Low       | $T_A = 25\text{ }^\circ\text{C}$ , $V_{CC} = 5\text{ V}$ | 0.8   | 1.2          |      | V                |
| $V_{RIH}$   | RS-232 Input Logic Threshold High      | $T_A = 25\text{ }^\circ\text{C}$ , $V_{CC} = 5\text{ V}$ |       | 1.7          | 2.4  | V                |
| $V_{RIHYS}$ | RS-232 Input Hysteresis                | $V_{CC} = 5\text{ V}$                                    | 0.2   | 0.5          | 1    | V                |
| $V_{ROL}$   | TTL/CMOS Output Voltage Low            | $I_{OUT} = 3.2\text{mA}$                                 |       |              | 0.4  | V                |
| $V_{ROH}$   | TTL/CMOS Output Voltage High           | $I_{OUT} = -1\text{mA}$                                  | 3.5   | $V_{CC}-0.4$ |      | V                |
| $t_{dR}$    | Propagation Delay Time                 | $C_L = 150\text{pF}$                                     |       | 0.5          | 10   | $\mu\text{s}$    |

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APPLICATION CIRCUITS (note 1, note 2)

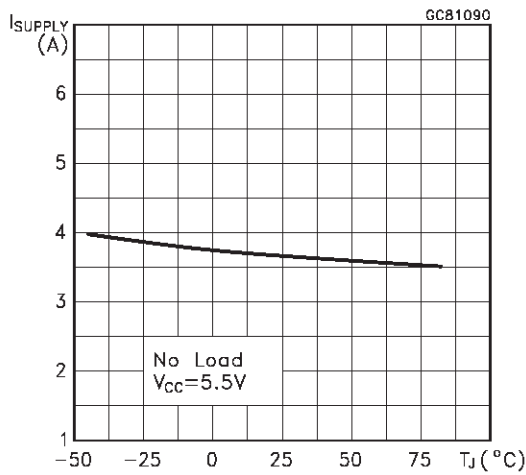


Note 1: C1-4 capacitors can even be 1 μF ones.  
 Note 2: C1-4 can be common or biased capacitors.

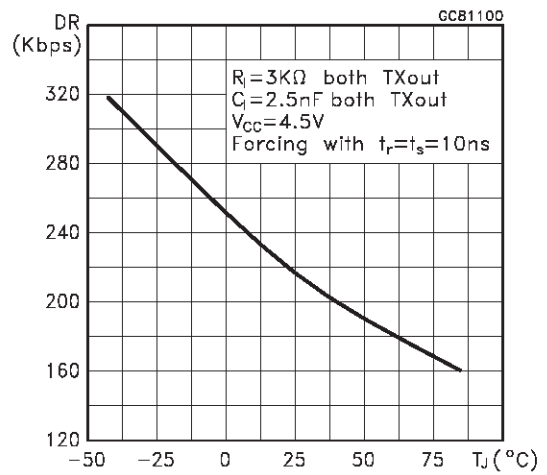
Capacitance Value (μF)

| DEVICES | C1  | C2  | C3  | C4  | C5  |
|---------|-----|-----|-----|-----|-----|
| ST202E  | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| ST232E  | 1   | 1   | 1   | 1   | 1   |

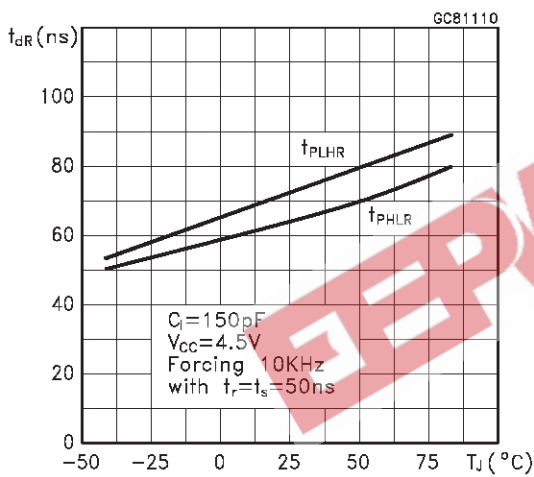
Supply Current vs Temperature



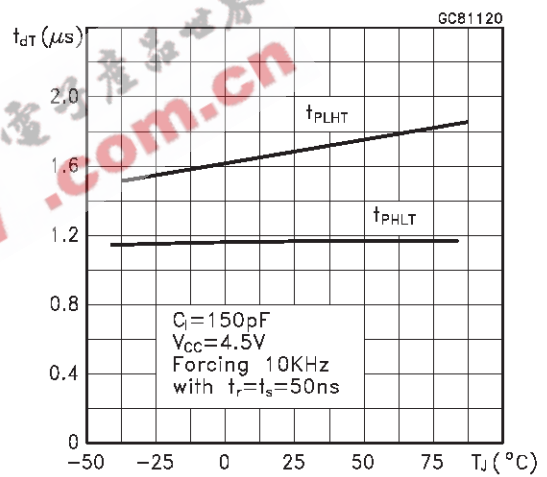
Data Rate vs Temperature



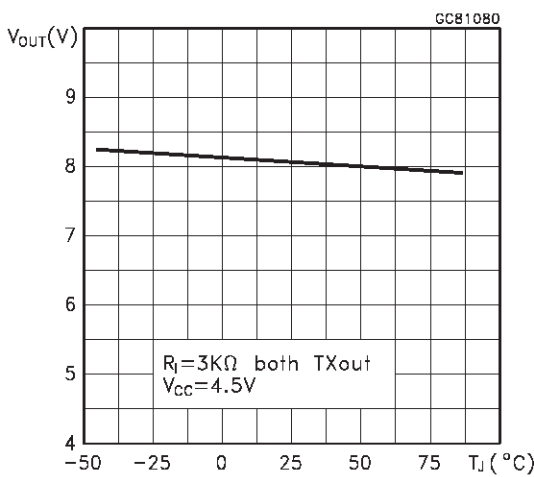
Receiver Propagation Delay



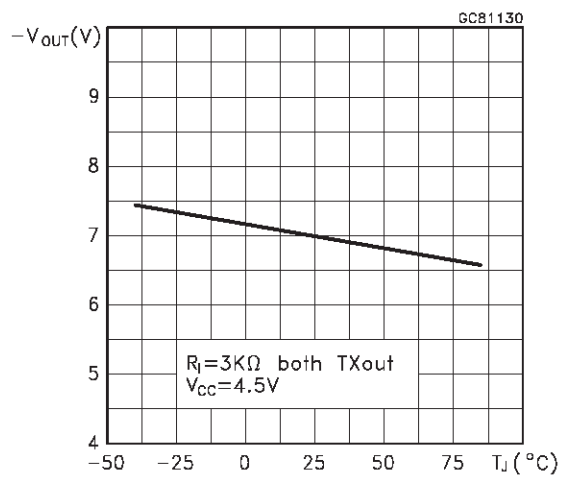
Driver Propagation Delay



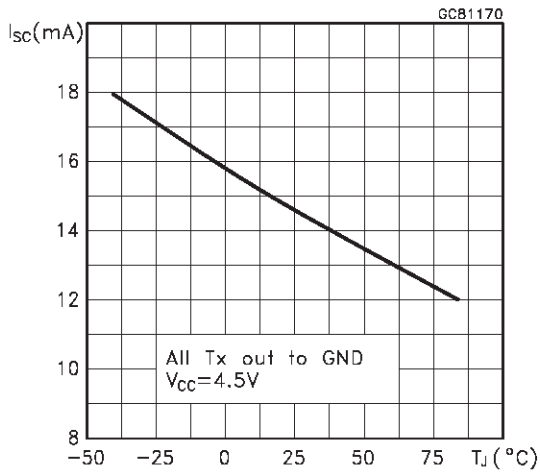
High Level Output Voltage Swing vs Temperature



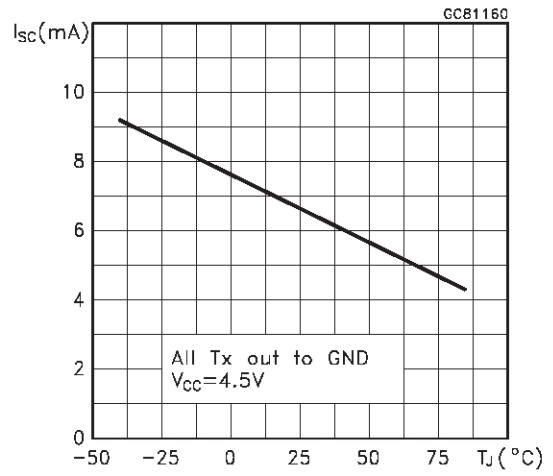
Low Level Output Voltage Swing vs Temperature



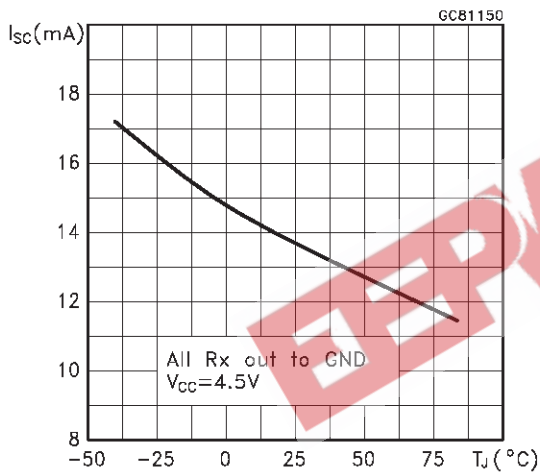
High Level Trasmmitter Output Short Circuit Current vs Temperature



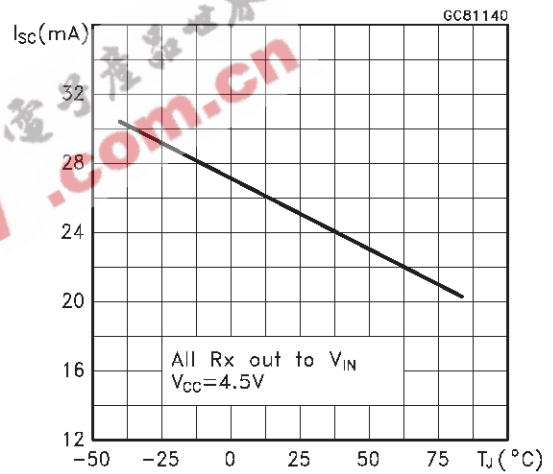
Low Level Trasmmitter Output Short Circuit Current vs Temperature



High Level Receiver Output Short Circuit Current vs Temperature

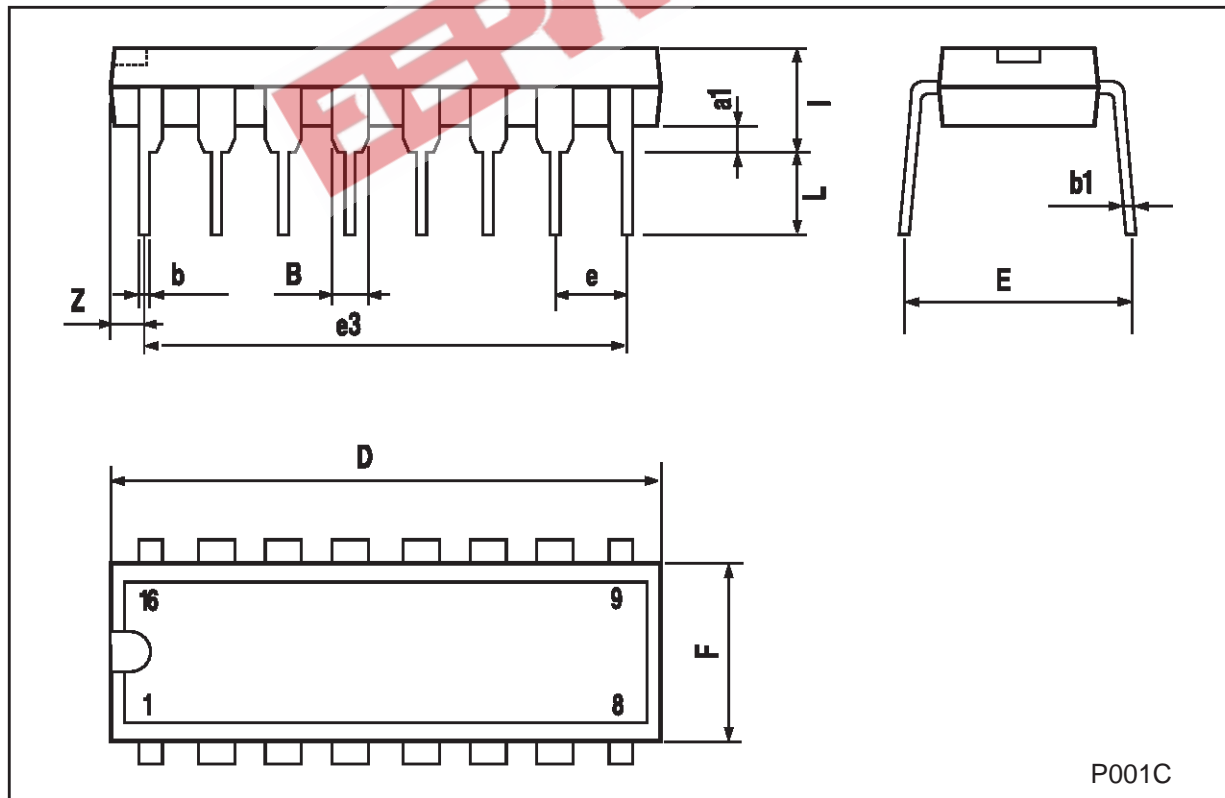


Low Level Receiver Output Short Circuit Current vs Temperature



## 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 |
| l    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    |      |       | 1.27 |       |       | 0.050 |

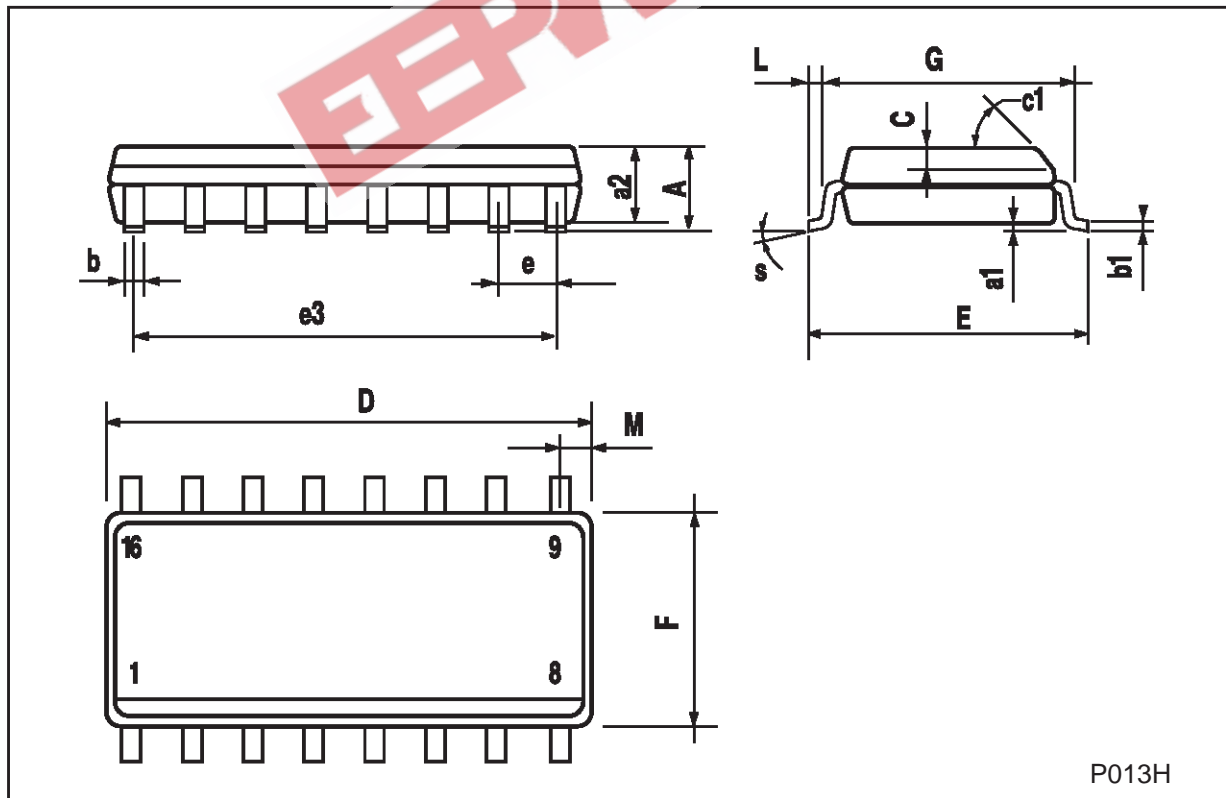


P001C



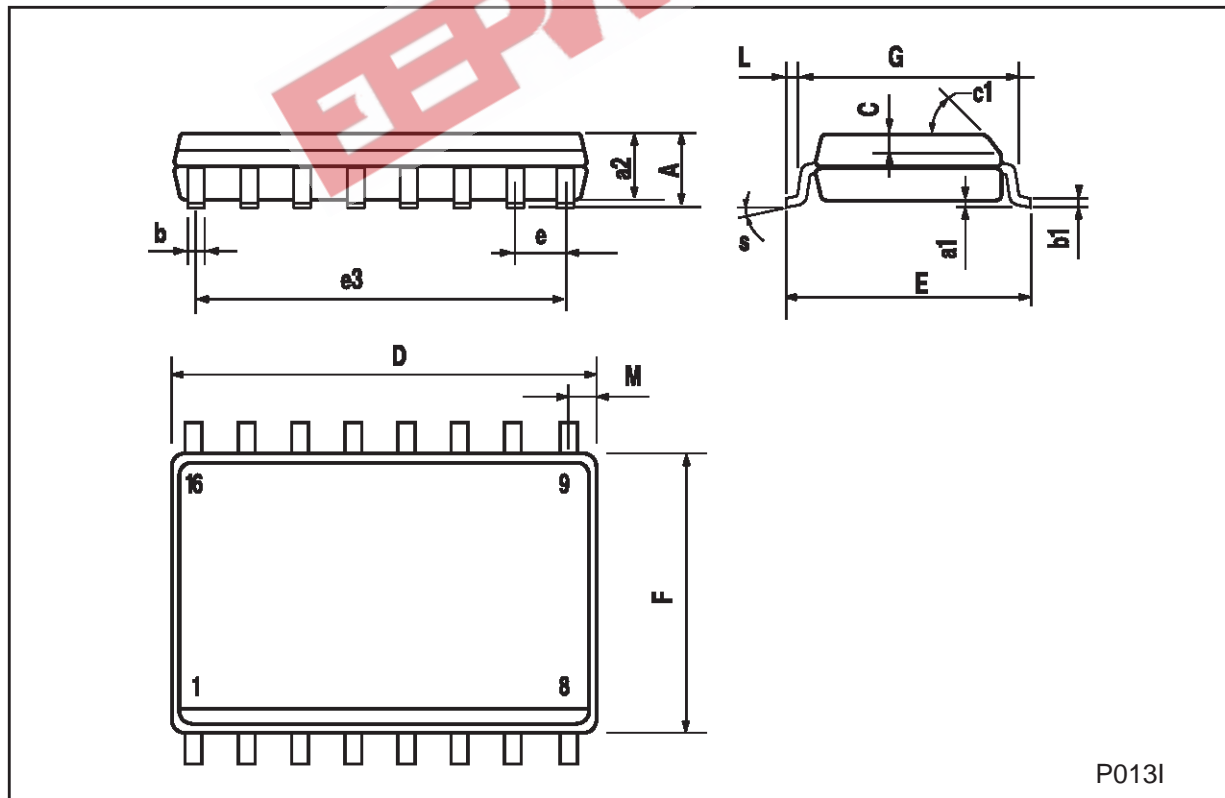
## SO-16 MECHANICAL DATA

| DIM. | mm        |      |      | inch  |       |       |
|------|-----------|------|------|-------|-------|-------|
|      | MIN.      | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |           |      | 1.75 |       |       | 0.068 |
| a1   | 0.1       |      | 0.2  | 0.004 |       | 0.007 |
| 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.)  |      |      |       |       |       |



## SO16L MECHANICAL DATA

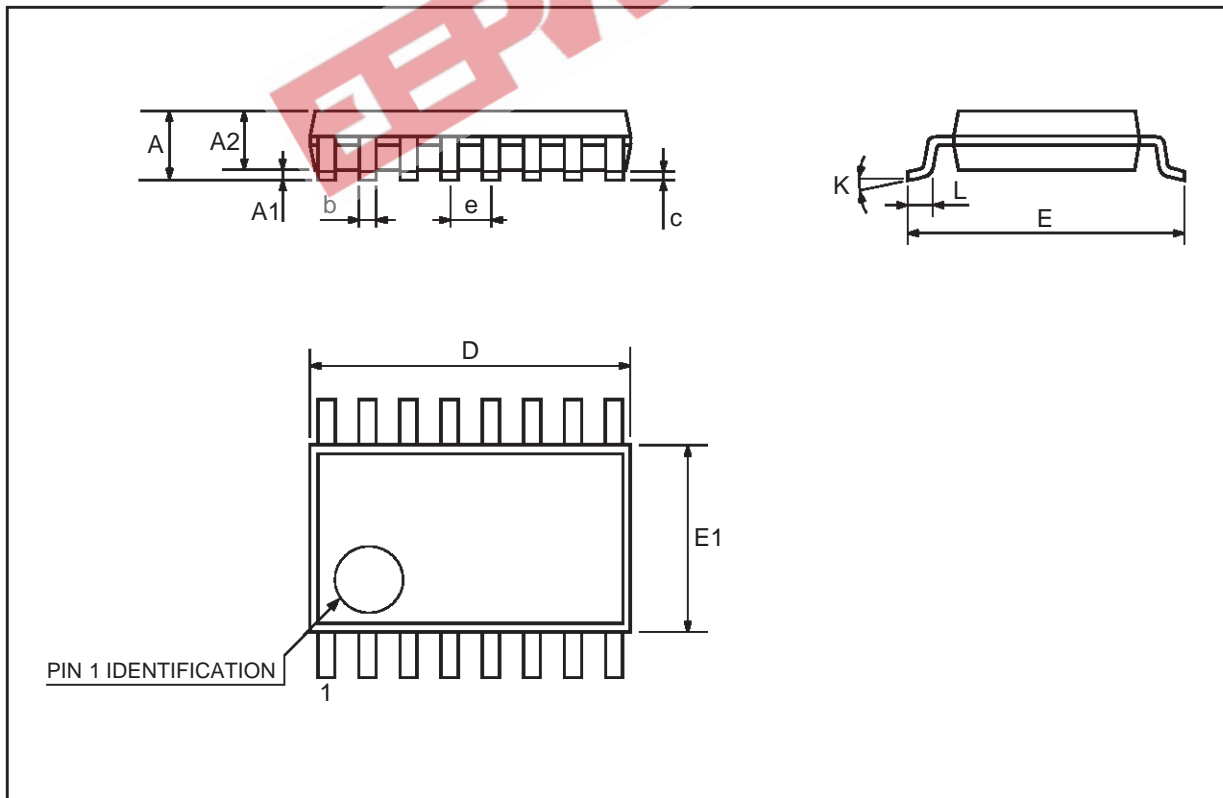
| DIM. | mm        |      |       | inch   |       |       |
|------|-----------|------|-------|--------|-------|-------|
|      | MIN.      | TYP. | MAX.  | MIN.   | TYP.  | MAX.  |
| A    |           |      | 2.65  |        |       | 0.104 |
| a1   | 0.1       |      | 0.2   | 0.004  |       | 0.008 |
| 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 | 0.3.93 |       | 0.419 |
| e    |           | 1.27 |       |        | 0.050 |       |
| e3   |           | 8.89 |       |        | 0.350 |       |
| F    | 7.4       |      | 7.6   | 0.291  |       | 0.300 |
| L    | 0.5       |      | 1.27  | 0.020  |       | 0.050 |
| M    |           |      | 0.75  |        |       | 0.029 |
| S    | 8 (max.)  |      |       |        |       |       |



P0131

## TSSOP16 MECHANICAL DATA

| DIM. | mm   |          |      | inch   |            |        |
|------|------|----------|------|--------|------------|--------|
|      | MIN. | TYP.     | MAX. | MIN.   | TYP.       | MAX.   |
| A    |      |          | 1.1  |        |            | 0.433  |
| A1   | 0.05 | 0.10     | 0.15 | 0.002  | 0.004      | 0.006  |
| A2   | 0.85 | 0.9      | 0.95 | 0.335  | 0.354      | 0.374  |
| b    | 0.19 |          | 0.30 | 0.0075 |            | 0.0118 |
| c    | 0.09 |          | 0.20 | 0.0035 |            | 0.0079 |
| D    | 4.9  | 5        | 5.1  | 0.193  | 0.197      | 0.201  |
| E    | 6.25 | 6.4      | 6.5  | 0.246  | 0.252      | 0.256  |
| E1   | 4.3  | 4.4      | 4.48 | 0.169  | 0.173      | 0.176  |
| e    |      | 0.65 BSC |      |        | 0.0256 BSC |        |
| K    | 0°   | 4°       | 8°   | 0°     | 4°         | 8°     |
| L    | 0.50 | 0.60     | 0.70 | 0.020  | 0.024      | 0.028  |



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