



## ST3237E

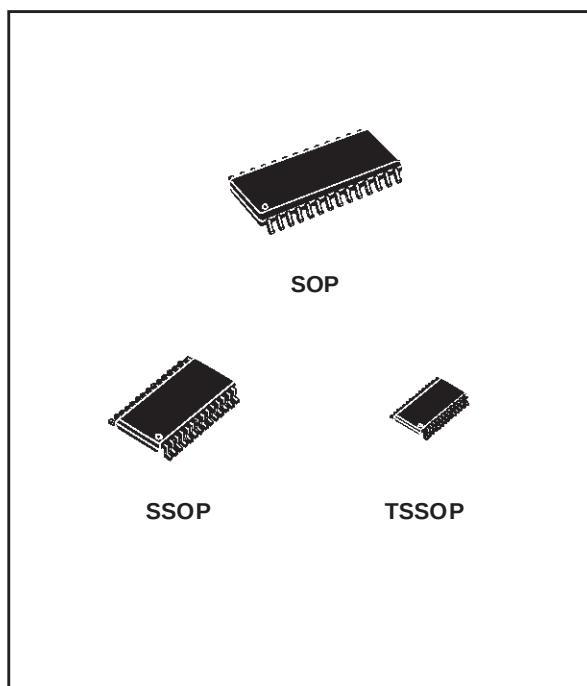
±15KV ESD-PROTECTED, 1μA, 3 TO 5.5V, 250KBPS,  
RS-232 TRANSCEIVER WITH STAND-BY

- EDS PROTECTION FOR RS-232 I/O PINS:  
±15KV HUMAN BODY MODEL  
±8KV IEC 1000-4-2 CONTACT DISCHARGE
- 1μA LOW POWER SHUTDOWN WITH  
RECEIVERS ACTIVE
- GUARENTEED DATA RATE  
250Kbps (Normal Operation)  
1Mbps (Very High Speed Operation)
- GUARANTEED SLEW RATE RANGE  
6V/μs (Normal Operation)  
24V/μs (Very High Speed Operation)
- 0.1μF EXTERNAL CAPACITORS
- FLOW-THROUGH PINOUT
- AVAILABLE IN SO-28, SSOP-28 AND  
TSSOP28
- LOW SUPPLY CURRENT 300μA

### DESCRIPTION

The ST3237E is a 3V to 5.5V powered EIA/ TIA-232 and V.28/V.24 communication interfaces high data-rate capability and enhanced electrostatic discharge (ESD) protection to ±8KV using IEC1000-4-2 contact discharge and ±15kV using Human Body Model. The ST3237C is a transceiver (5 drivers, 3 receivers) for fast modem applications.

The device has a proprietary low-dropout transmitter output stage providing true RS-232 performance from a 3V to 5.5V supply using a



dual charge pump. The device is guaranteed to run at data rates of 250Kbps in the normal operation mode and 1Mbps in the very high speed operation mode while maintaining RS-232 output levels.

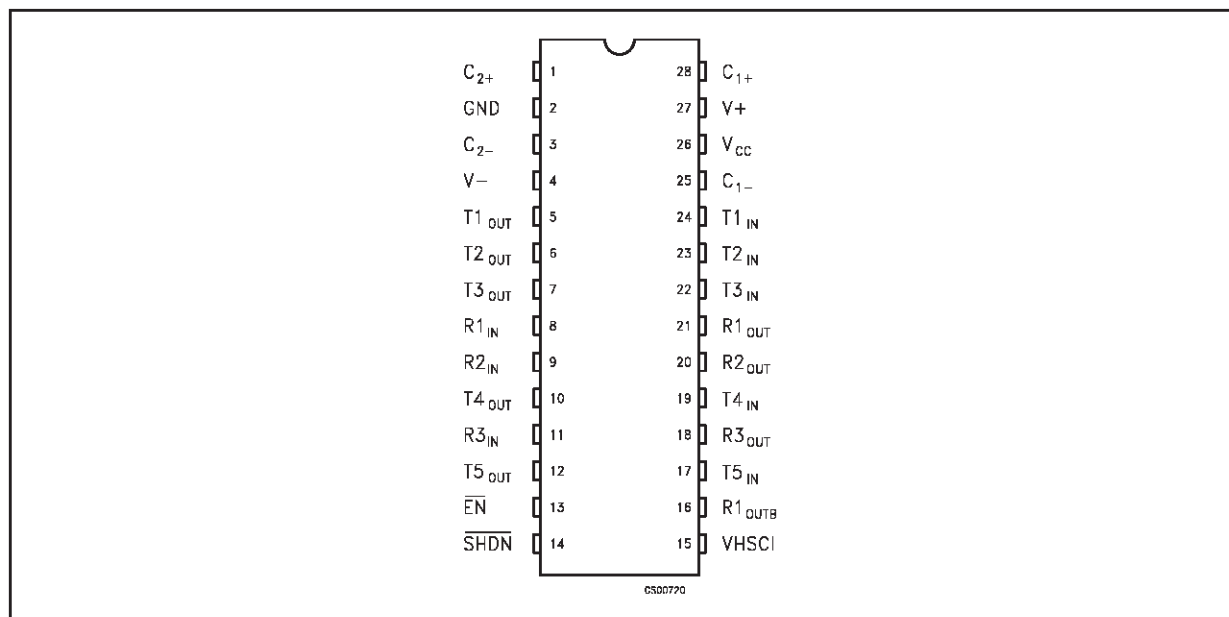
### ORDERING CODES

| Type           | Temperature Range | Package               | Comments                          |
|----------------|-------------------|-----------------------|-----------------------------------|
| ST3237ECD      | 0 to 70 °C        | SO-28 (Tube)          | 27parts per tube / 12tube per box |
| ST3237EBD      | -40 to 85 °C      | SO-28 (Tube)          | 27parts per tube / 12tube per box |
| ST3237ECDR     | 0 to 70 °C        | SO-28 (Tape & Reel)   | 1000 parts per reel               |
| ST3237EBDR     | -40 to 85 °C      | SO-28 (Tape & Reel)   | 1000 parts per reel               |
| ST3237ECPR     | 0 to 70 °C        | SSOP-28 (Tape & Reel) | 1350 parts per reel               |
| ST3237EBPR     | -40 to 85 °C      | SSOP-28 (Tape & Reel) | 1350 parts per reel               |
| ST3237ECTR (*) | 0 to 70 °C        | TSSOP28 (Tape & Reel) | 2500 parts per reel               |
| ST3237EBTR     | -40 to 85 °C      | TSSOP28 (Tape & Reel) | 2500 parts per reel               |

## PIN DESCRIPTION

| PIN N° | SYMBOL                      | NAME AND FUNCTION                                                                                                |
|--------|-----------------------------|------------------------------------------------------------------------------------------------------------------|
| 1      | C <sub>2</sub> <sup>+</sup> | Positive Terminal of Inverting Charge Pump Capacitor                                                             |
| 2      | GND                         | Ground                                                                                                           |
| 3      | C <sub>2</sub> <sup>-</sup> | Negative Terminal of Inverting Charge Pump Capacitor                                                             |
| 4      | V-                          | -5.5V Generated by the Charge Pump                                                                               |
| 5      | T1 <sub>OUT</sub>           | First Transmitter Output Voltage                                                                                 |
| 6      | T2 <sub>OUT</sub>           | Second Transmitter Output Voltage                                                                                |
| 7      | T3 <sub>OUT</sub>           | Third Transmitter Output Voltage                                                                                 |
| 8      | R1 <sub>IN</sub>            | First Receiver Input Voltage                                                                                     |
| 9      | R2 <sub>IN</sub>            | Second Receiver Input Voltage                                                                                    |
| 10     | T4 <sub>OUT</sub>           | Fourth Transmitter Output Voltage                                                                                |
| 11     | R3 <sub>IN</sub>            | Third Receiver Input Voltage                                                                                     |
| 12     | T5 <sub>OUT</sub>           | Fifth Transmitter Output Voltage                                                                                 |
| 13     | EN                          | Receiver Enable, Active Low                                                                                      |
| 14     | SHDN                        | Shutdown Control, Active Low                                                                                     |
| 15     | VHSCI                       | Very High Speed Control Input. Connect to GND for normal operation; connect to VCC for 1Mbps transmission rates. |
| 16     | R1 <sub>OUTB</sub>          | Non Inverting Complementary Receiver Output. Always Active.                                                      |
| 17     | T5 <sub>IN</sub>            | Fifth Transmitter Input Voltage                                                                                  |
| 18     | R3 <sub>OUT</sub>           | Third Receiver Output Voltage                                                                                    |
| 19     | T4 <sub>IN</sub>            | Fourth Transmitter Input Voltage                                                                                 |
| 20     | R2 <sub>OUT</sub>           | Second Receiver Output Voltage                                                                                   |
| 21     | R1 <sub>OUT</sub>           | First Receiver Output Voltage                                                                                    |
| 22     | T3 <sub>IN</sub>            | Third Transmitter Input Voltage                                                                                  |
| 23     | T2 <sub>IN</sub>            | Second Transmitter Input Voltage                                                                                 |
| 24     | T1 <sub>N</sub>             | First Transmitter Input Voltage                                                                                  |
| 25     | C <sub>1</sub> <sup>-</sup> | Negative Terminal of Voltage-Doupler Charge Pump Capacitor                                                       |
| 26     | V <sub>CC</sub>             | Supply Voltage                                                                                                   |
| 27     | V+                          | 5.5V Generated by the Charge Pump                                                                                |
| 28     | C <sub>1</sub> <sup>+</sup> | Positive Terminal of Voltage-Doupler Charge Pump Capacitor                                                       |

## PIN CONFIGURATION



## ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                           | Value                      | Unit |
|---------------------|-----------------------------------------------------|----------------------------|------|
| $V_{CC}$            | Supply Voltage                                      | -0.3 to 6                  | V    |
| V+                  | Doubled Voltage Terminal                            | -0.3 to 7                  | V    |
| V-                  | Inverted Voltage Terminal                           | 0.3 to -7                  | V    |
| $V+ +  V- $         |                                                     | 13                         | V    |
| $T_{IN}$            | Transmitter Input Voltage Range                     | -0.3 to 6                  | V    |
| SHDN, EN            |                                                     | -0.3 to 6                  | V    |
| VHSCI               | Very High Speed Control Input                       | -0.3 to ( $V_{CC} + 0.3$ ) | V    |
| $R_{IN}$            | Receiver Input Voltage Range                        | $\pm 25$                   | V    |
| $T_{OUT}$           | Transmitter Output Voltage Range                    | $\pm 13.2$                 | V    |
| $R_{OUT}, R_{OUTB}$ | Receiver Output Voltage Range                       | -0.3 to ( $V_{CC} + 0.3$ ) | V    |
| $t_{SHORT}$         | Short Circuit Duration on $T_{OUT}$ (one at a time) | Continuous                 |      |
| $T_{stg}$           | 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. V+ and V- can have a maximum magnitude of +7V, but their absolute addition can not exceed 13 V.

## SHUTDOWN AND ENABLE CONTROL TRUTH TABLE

| $\overline{SHDN}$ | $\overline{EN}$ | T-OUT  | R-OUT  | R-OUTB |
|-------------------|-----------------|--------|--------|--------|
| 0                 | 0               | High Z | Active | Active |
| 0                 | 1               | High Z | High Z | Active |
| 1                 | 0               | Active | Active | Active |
| 1                 | 1               | Active | High Z | Active |

**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 | SHDN= $V_{CC}$ No Load                |      | 0.3  | 1    | mA            |
| $I_{\text{SHDN}}$   | Shutdown Supply Current       | SHDN=GND $V_{T\_IN}$ =GND or $V_{CC}$ |      | 1    | 5    | $\mu\text{A}$ |

**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 (Note 1) | T-IN, VHSCI, EN, SHDN                        |      |      | 0.8   | V             |
| $V_{\text{TIH}}$ | Input Logic Threshold High         | T-IN, VHSCI, EN, SHDN $V_{CC} = 3.3\text{V}$ | 2    |      |       | V             |
|                  |                                    | $V_{CC} = 5\text{V}$                         | 2.4  |      |       |               |
| $I_{\text{IL}}$  | Input Leakage Current              | T-IN, VHSCI, EN, SHDN                        |      |      | ± 1.0 | $\mu\text{A}$ |
| $V_{\text{HYS}}$ | Transmitter Input Hysteresis       |                                              |      | 0.25 |       | V             |

Note 1: Transmitter input hysteresis is typically 250mV

**TRANSMITTER ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$  tested at  $3.3\text{V} \pm 10\%$ ,  $V_{CC} = 3\text{V}$  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 | $V_{CC} = 0\text{V}$ $V_{\text{OUT}} = \pm 2\text{V}$                                                         | 300  | 10M   |      | $\Omega$      |
| $I_{\text{SC}}$   | Output Short Circuit Current  |                                                                                                               |      | ± 60  |      | mA            |
| $I_{\text{TOL}}$  | Output Leakage Current        | $V_{CC} = 0\text{V}$ or $3.3\text{V}$ to $5.5\text{V}$ $V_{\text{OUT}} = \pm 12\text{V}$ Transmitters Disable |      |       | ± 25 | $\mu\text{A}$ |

**RECEIVER ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$  tested at  $3.3\text{V} \pm 10\%$ ,  $V_{\text{CC}} = 3\text{V}$  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             |
|--------------------|----------------------------------------|----------------------------------------------------------|-----------------------|-----------------------|----------|------------------|
| $I_{\text{OL}}$    | Output Leakage Current                 | Receiver Disabled $\overline{\text{EN}} = V_{\text{CC}}$ |                       | $\pm 0.05$            | $\pm 10$ | $\mu\text{A}$    |
| $V_{\text{OL}}$    | Output Voltage Low                     | $I_{\text{OUT}} = 1\text{mA}$                            |                       |                       | 0.4      | V                |
| $V_{\text{OH}}$    | Output Voltage High                    | $I_{\text{OUT}} = -1\text{mA}$                           | $V_{\text{CC}} - 0.6$ | $V_{\text{CC}} - 0.1$ |          | V                |
| $V_{\text{RIN}}$   | Receiver Input Voltage Operating Range |                                                          | -25                   |                       | 25       | V                |
| $V_{\text{RIL}}$   | RS-232 Input Threshold Low             | $T_A = 25^\circ\text{C}$ $V_{\text{CC}} = 3.3\text{V}$   | 0.6                   | 1.1                   |          | V                |
|                    |                                        | $T_A = 25^\circ\text{C}$ $V_{\text{CC}} = 5\text{V}$     | 0.8                   | 1.5                   |          |                  |
| $V_{\text{RIH}}$   | RS-232 Input Threshold High            | $T_A = 25^\circ\text{C}$ $V_{\text{CC}} = 3.3\text{V}$   |                       | 1.5                   | 2.4      | V                |
|                    |                                        | $T_A = 25^\circ\text{C}$ $V_{\text{CC}} = 5\text{V}$     |                       | 1.2                   | 2.4      |                  |
| $V_{\text{RIHYS}}$ | Input Hysteresis                       |                                                          |                       | 0.3                   |          | V                |
| $R_{\text{RIN}}$   | Input Resistance                       | $T_A = 25^\circ\text{C}$                                 | 3                     | 5                     | 7        | $\text{K}\Omega$ |

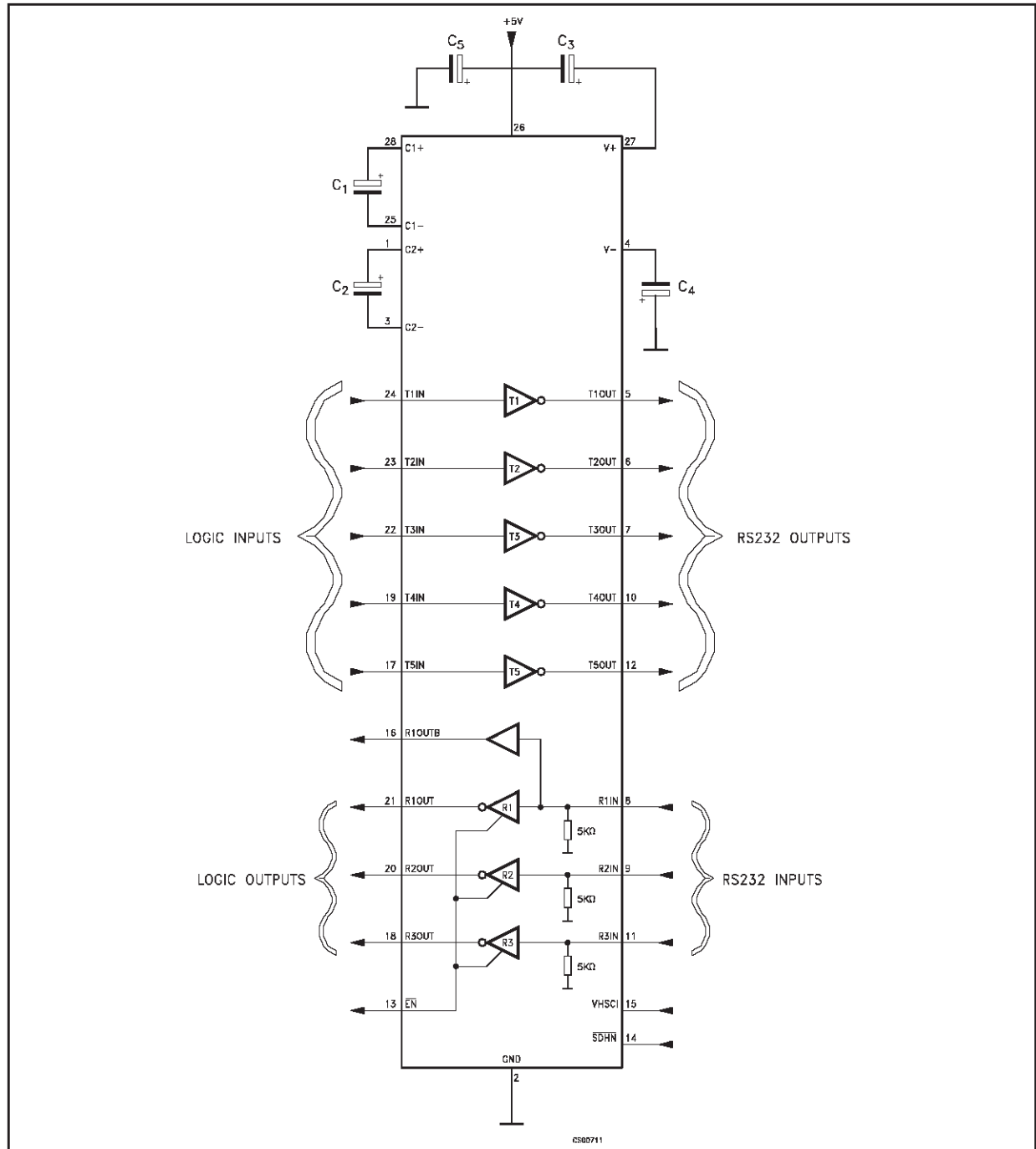
**TIMING CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$  tested at  $3.3\text{V} \pm 10\%$ ,  $V_{\text{CC}} = 3\text{V}$  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                                                                       |
|----------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|-----------------|----------------------------------------------------------------------------|
| $D_R$                                  | Maximum Data Rate                 | $R_L = 3\text{K}\Omega$ $C_L = 1000\text{pF}$<br>one transmitter switching $\text{VHSCI} = \text{GND}$                                                                                                                                                                                                                                                                                      | 250          |             |                 | Kbps                                                                       |
|                                        |                                   | $R_L = 3\text{K}\Omega$ $C_L = 250\text{pF}$<br>one transmitter switching $\text{VHSCI} = V_{\text{CC}}$<br>$V_{\text{CC}} = 3$ to $4.5\text{V}$                                                                                                                                                                                                                                            | 1000         |             |                 | Kbps                                                                       |
|                                        |                                   | $R_L = 3\text{K}\Omega$ $C_L = 1000\text{pF}$<br>one transmitter switching $\text{VHSCI} = V_{\text{CC}}$<br>$V_{\text{CC}} = 4.5$ to $5.5\text{V}$                                                                                                                                                                                                                                         | 1000         |             |                 | Kbps                                                                       |
| $t_{\text{PHLR}}$<br>$t_{\text{PLHR}}$ | Propagation Delay Input to Output | $R_{\text{IN}}$ to $R_{\text{OUT}}$ $C_L = 150\text{pF}$                                                                                                                                                                                                                                                                                                                                    |              | 0.15        |                 | $\mu\text{s}$                                                              |
| $t_{\text{PHLR}}$<br>$t_{\text{PLHR}}$ | Propagation Delay Input to Output | $R_L = 3\text{k}\Omega$ $C_L = 1000\text{pF}$<br>$\text{VHSCI} = V_{\text{CC}}$<br>$\text{VHSCI} = \text{GND}$                                                                                                                                                                                                                                                                              |              | 400<br>1000 |                 | ns<br>ns                                                                   |
| $t_{\text{T\_SKEW}}$                   | Transmitter Skew                  | $ t_{\text{PHL}} - t_{\text{TLH}} $ $\text{VHSCI} = \text{GND}$                                                                                                                                                                                                                                                                                                                             |              | 300         |                 | ns                                                                         |
|                                        |                                   | $ t_{\text{PHL}} - t_{\text{TLH}} $ $\text{VHSCI} = V_{\text{CC}}$                                                                                                                                                                                                                                                                                                                          |              | 50          |                 | ns                                                                         |
| $t_{\text{R\_SKEW}}$                   | Receiver Skew                     | $ t_{\text{PHL}} - t_{\text{TLH}} $                                                                                                                                                                                                                                                                                                                                                         |              | 100         |                 | ns                                                                         |
| $t_{\text{OER}}$                       | Receiver Output Enable Time       | Normal Operation                                                                                                                                                                                                                                                                                                                                                                            |              | 50          |                 | ns                                                                         |
| $t_{\text{ODR}}$                       | Receiver Output Disable Time      | Normal Operation                                                                                                                                                                                                                                                                                                                                                                            |              | 120         |                 | ns                                                                         |
| $S_{\text{RT}}$                        | Transition Slew Rate              | $T_A = 25^\circ\text{C}$ $R_L = 3$ to $7\text{K}\Omega$ $V_{\text{CC}} = 3.3\text{V}$<br>measured from $+3\text{V}$ to $-3\text{V}$ or $-3\text{V}$ to $+3\text{V}$<br>$C_L = 150\text{pF}$ to $1000\text{pF}$ $\text{VHSCI} = \text{GND}$<br>$C_L = 150\text{pF}$ to $1000\text{pF}$ $\text{VHSCI} = V_{\text{CC}}$<br>$C_L = 150\text{pF}$ to $2500\text{pF}$ $\text{VHSCI} = \text{GND}$ | 6<br>24<br>4 |             | 30<br>150<br>30 | $\text{V}/\mu\text{s}$<br>$\text{V}/\mu\text{s}$<br>$\text{V}/\mu\text{s}$ |

Transmitter Skew is measured at the transmitter zero cross points

## APPLICATION CIRCUITS

CAPACITANCE VALUE ( $\mu\text{F}$ )

| $V_{CC}$   | C1    | C2   | C3   | C4   | Cbypass |
|------------|-------|------|------|------|---------|
| 3.0 to 3.6 | 0.22  | 0.22 | 0.22 | 0.22 | 0.1     |
| 3.1 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 | 0.22  | 0.1  | 0.1  | 0.1  | 0.1     |

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

Figure 1 : LOW Level Receiver Output Current

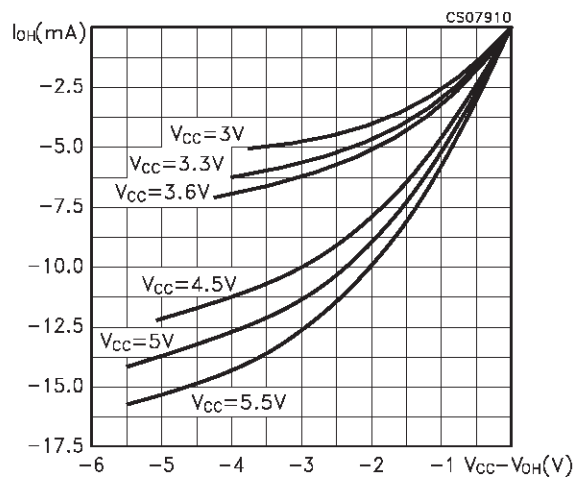
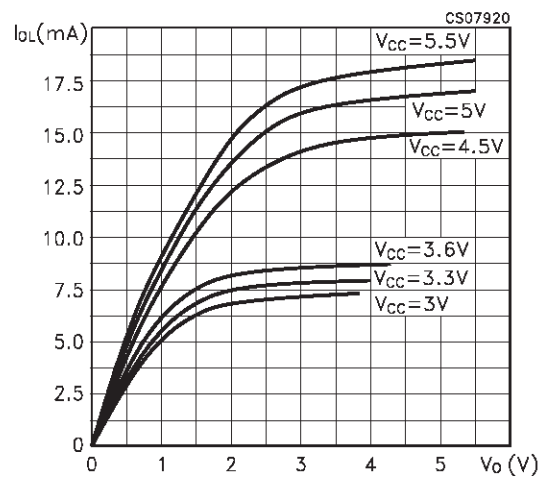
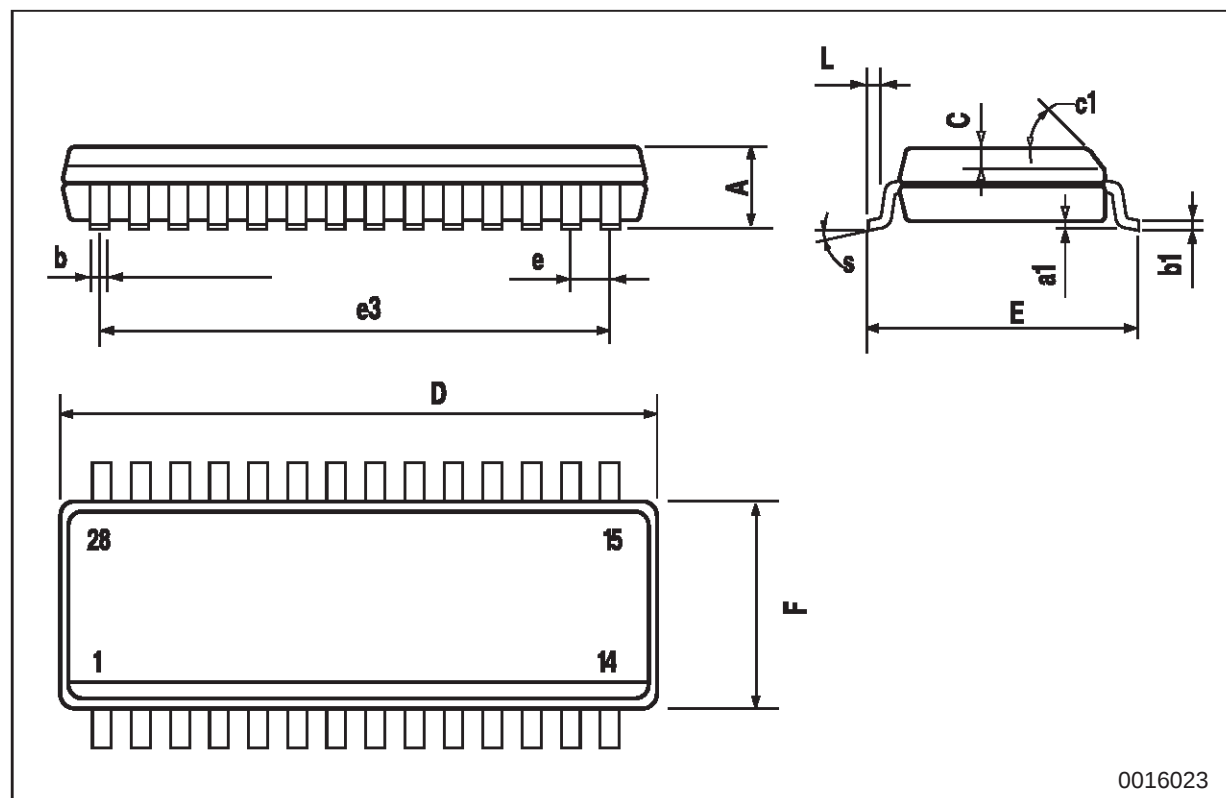


Figure 2 : HIGH Level Receiver Output Current



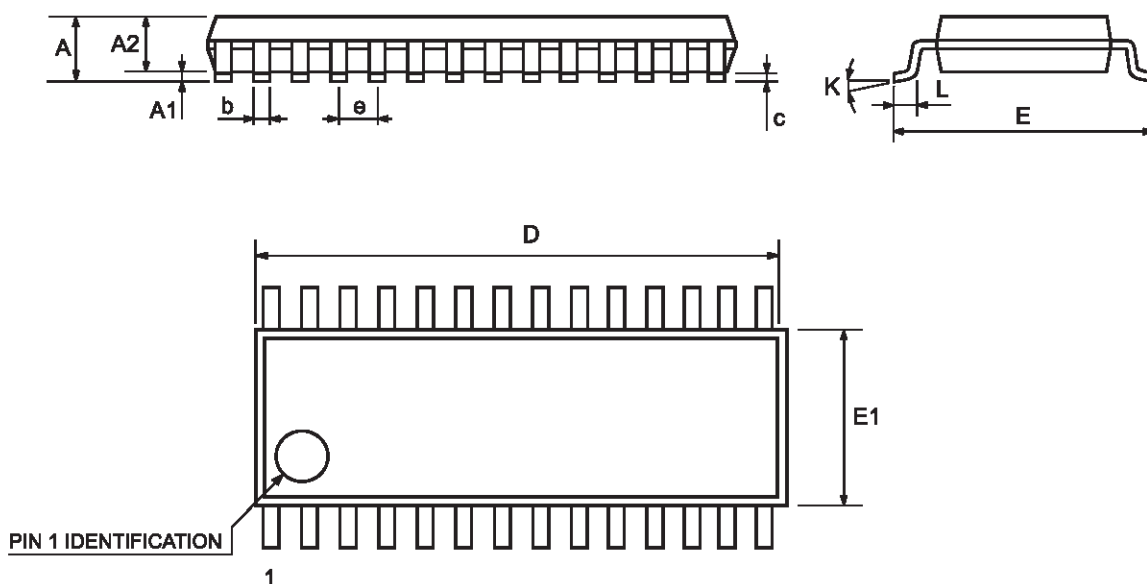
## SO-28 MECHANICAL DATA

| DIM. | mm.        |       |       | inch  |       |       |
|------|------------|-------|-------|-------|-------|-------|
|      | MIN.       | TYP   | MAX.  | MIN.  | TYP.  | MAX.  |
| A    |            |       | 2.65  |       |       | 0.104 |
| a1   | 0.1        |       | 0.3   | 0.004 |       | 0.012 |
| 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    | 17.70      |       | 18.10 | 0.697 |       | 0.713 |
| E    | 10.00      |       | 10.65 | 0.393 |       | 0.419 |
| e    |            | 1.27  |       |       | 0.050 |       |
| e3   |            | 16.51 |       |       | 0.650 |       |
| F    | 7.40       |       | 7.60  | 0.291 |       | 0.300 |
| L    | 0.50       |       | 1.27  | 0.020 |       | 0.050 |
| S    | 8° (max.)  |       |       |       |       |       |



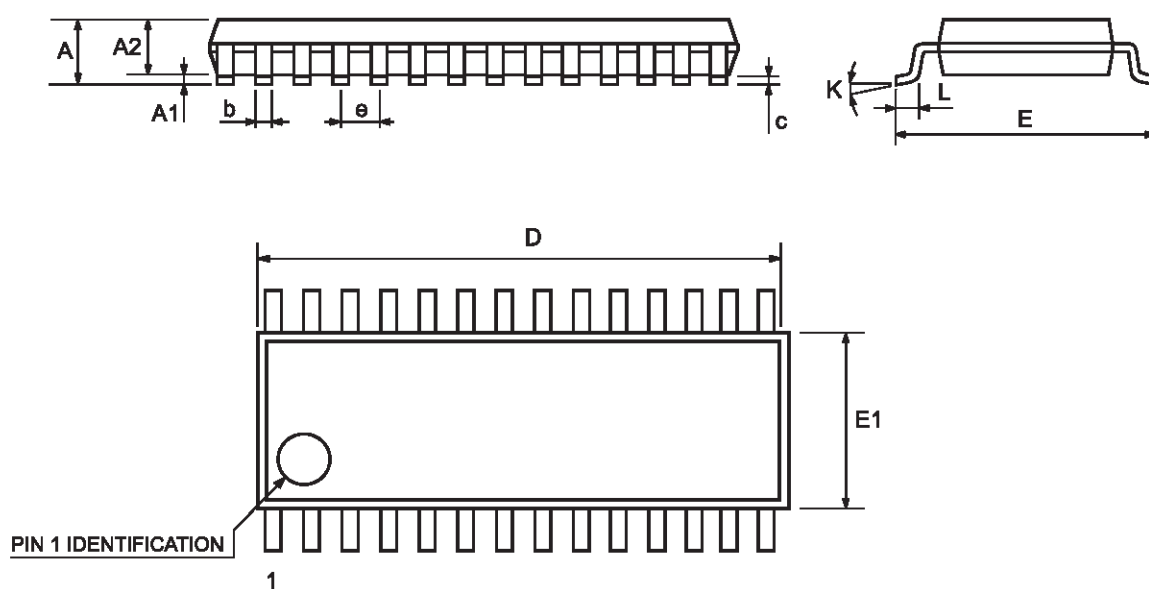
## SSOP28 MECHANICAL DATA

| DIM. | mm.   |          |      | inch  |            |       |
|------|-------|----------|------|-------|------------|-------|
|      | MIN.  | TYP      | MAX. | MIN.  | TYP.       | MAX.  |
| A    |       |          | 2    |       |            | 0.079 |
| A1   | 0.050 |          |      | 0.002 |            |       |
| A2   | 1.65  | 1.75     | 1.85 | 0.065 | 0.069      | 0.073 |
| b    | 0.22  |          | 0.38 | 0.009 |            | 0.015 |
| c    | 0.09  |          | 0.25 | 0.004 |            | 0.010 |
| D    | 9.9   | 10.2     | 10.5 | 0.390 | 0.402      | 0.413 |
| E    | 7.4   | 7.8      | 8.2  | 0.291 | 0.307      | 0.323 |
| E1   | 5     | 5.3      | 5.6  | 0.197 | 0.209      | 0.220 |
| e    |       | 0.65 BSC |      |       | 0.0256 BSC |       |
| K    | 0°    |          | 10°  | 0°    |            | 10°   |
| L    | 0.55  | 0.75     | 0.95 | 0.022 | 0.030      | 0.037 |



## TSSOP28 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    | 9.6  | 9.7      | 9.8  | 0.378 | 0.382      | 0.386  |
| 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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