



## ST3384E

### ±15KV ESD-PROTECTED, 3 TO 5.5V, LOW POWER, UP TO 250KBPS, RS-232 TRANSCEIVER

- ESD PROTECTIO FOR RS-232 I/O PINS  
±15KV (HUMAN BODY MODEL)
- LATCHUP FREE
- 1μA LOW POWER SHUTDOWN
- 300μA SUPPLY CURRENT
- 250Kbps GUARENTEED DATA RATE
- 20μs TYPICAL TIME TO EXIT SHUTDOWN
- 6V/μs GUARANTEED SLEW RATE
- MEET EIA/TIA-232 SPECIFICATIONS DOWN TO 3V
- PACKAGES: SO-18 AND SSOP-20

#### DESCRIPTION

The ST3384E is a 3V powered EIA/TIA-232 and V.28/V.24 communications interface with low power requirements, high data-rate capabilities and enhanced electrostatic discharge (ESD) protection. All transmitter outputs and receiver inputs are protected to ±15kV using the Human Body Model. The ST3384E has a proprietary low dropout transmitter output stage enabling true RS-232 performance from 3 to 5.5V supplies with a dual charge pump. The charge pump require only four small 0.1μF external capacitors for operation from a 3.3V supply.



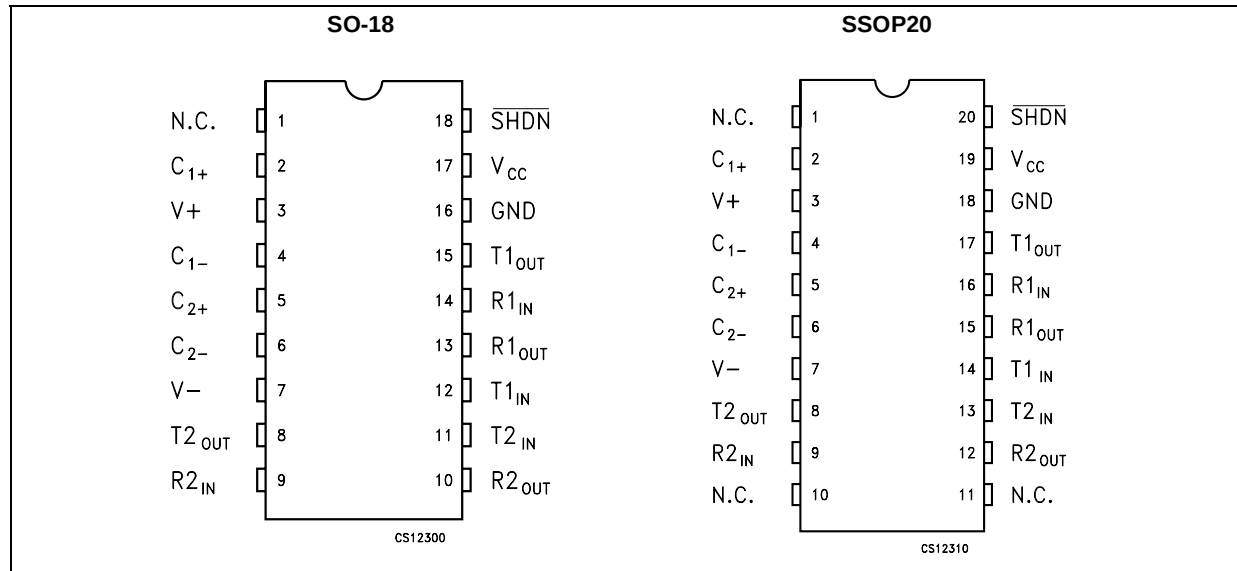
The device is guaranteed to run at data rates of 250Kbps while maintaining RS-232 output levels. The ST3384E has two receivers and two drivers. It features a 1μA shutdown mode that reduces power consumption and extends battery life in portable systems.

Typical applications are in Notebook, Sub-notebook, and Palmtop Computers, Battery Powered Equipment, Hand-Held Equipment, Peripherals, Printers.

#### ORDERING CODES

| Type       | Temperature Range | Package              | Comments                            |
|------------|-------------------|----------------------|-------------------------------------|
| ST3384ECD  | 0 to 70 °C        | SO-18 (Tube)         | 50 parts per tube / 20 tube per box |
| ST3384EBD  | -40 to 85 °C      | SO-18 (Tube)         | 50 parts per tube / 20 tube per box |
| ST3384ECDR | 0 to 70 °C        | SO-18 (Tape & Reel)  | 1000 parts per reel                 |
| ST3384EBDR | -40 to 85 °C      | SO-18 (Tape & Reel)  | 1000 parts per reel                 |
| ST3384ECPR | 0 to 70 °C        | SSOP20 (Tape & Reel) | 1350 parts per reel                 |
| ST3384EBPR | -40 to 85 °C      | SSOP20 (Tape & Reel) | 1350 parts per reel                 |

## PIN CONFIGURATION



## PIN DESCRIPTION

| PIN N°<br>(SO-18) | PIN N°<br>(SSOP20) | SYMBOL            | NAME AND FUNCTION                                                                                |
|-------------------|--------------------|-------------------|--------------------------------------------------------------------------------------------------|
| 1                 | 1, 10, 11          | N.C.              | Not Connected                                                                                    |
| 2                 | 2                  | C <sub>1+</sub>   | Positive Terminal for the first Charge Pump Capacitor                                            |
| 3                 | 3                  | V+                | 5.5V Generated By The Charge Pump                                                                |
| 4                 | 4                  | C <sub>1-</sub>   | Negative Terminal for the first Charge Pump Capacitor                                            |
| 5                 | 5                  | C <sub>2+</sub>   | Positive Terminal for the second Charge Pump Capacitor                                           |
| 6                 | 6                  | C <sub>2-</sub>   | Negative Terminal for the second Charge Pump Capacitor                                           |
| 7                 | 7                  | V-                | -5.5V Generated By The Charge Pump                                                               |
| 8                 | 8                  | T2 <sub>OUT</sub> | Second Transmitter Output Voltage                                                                |
| 9                 | 9                  | R2 <sub>IN</sub>  | Second Receiver Input Voltage                                                                    |
| 10                | 12                 | R2 <sub>OUT</sub> | Second Receiver Output Voltage                                                                   |
| 11                | 13                 | T2 <sub>IN</sub>  | Second Transmitter Input Voltage                                                                 |
| 12                | 14                 | T1 <sub>IN</sub>  | First Transmitter Input Voltage                                                                  |
| 13                | 15                 | R1 <sub>OUT</sub> | First Receiver Output Voltage                                                                    |
| 14                | 16                 | R1 <sub>IN</sub>  | First Receiver Input Voltage                                                                     |
| 15                | 17                 | T1 <sub>OUT</sub> | First Transmitter Output Voltage                                                                 |
| 16                | 18                 | GND               | Ground                                                                                           |
| 17                | 19                 | V <sub>CC</sub>   | 3V to 5.5V Supply Voltage. Connect a 0.1μF capacitor to GND                                      |
| 18                | 20                 | SHDN              | Active Low Shutdown Control Input. Drive Low To Shut-down Transmitters, receiver and Charge Pump |

**ABSOLUTE MAXIMUM RATINGS**

| Symbol      | Parameter                                      | Value                      | Unit |
|-------------|------------------------------------------------|----------------------------|------|
| $V_{CC}$    | Supply Voltage ( $V_{CC}$ to GND)              | -0.3 to 6                  | V    |
| V+          | Doubled Voltage Terminal (V+ to GND) (Note 1)  | ( $V_{CC} - 0.3$ ) to 7    | V    |
| V-          | Inverted Voltage Terminal (V- to GND) (Note 1) | 0.3 to -7                  | V    |
| $V+ +  V- $ | (Note 1)                                       | 13                         | V    |
| $T_{IN}$    | Transmitter Input Voltage                      | -0.3 to 6                  | V    |
| SHDN        | Shutdown Input Voltage (SHDN to GND)           | -0.3 to 6                  | V    |
| $R_{IN}$    | Receiver Input Voltage ( $R_{IN}$ to GND)      | $\pm 25$                   | V    |
| $T_{OUT}$   | Transmitter Output Voltage ( $T_{OUT}$ to GND) | $\pm 13.2$                 | V    |
| $R_{OUT}$   | Receiver Output Voltage                        | -0.3 to ( $V_{CC} + 0.3$ ) | V    |
| $t_{SHORT}$ | 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+ and V- can have a maximum magnitude of +7V, but their absolute addition cannot exceed 13 V.

Note 1: V+ and V- can have maximum magnitude of 7V, but their absolute difference cannot exceed 13V.

**SHUTDOWN TRUTH TABLE**

| SHDN | T-OUT  | R-OUT  |
|------|--------|--------|
| L    | High Z | High Z |
| H    | Active | Active |

**ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu F$ ,  $V_{CC} = 3V$  to 5.5V, tested at  $3.3V \pm 10\%$   $C_1 = 0.047\mu F$ ,  $C_2 - C_4 = 0.33\mu F$  tested at  $5V \pm 10\%$   $-40^\circ C < T_A < 85^\circ C$  unless otherwise noted. Typical values are referred to  $T_A = 25^\circ C$ )

| Symbol     | Parameter                                    | Test Conditions  | Min. | Typ.     | Max. | Unit    |
|------------|----------------------------------------------|------------------|------|----------|------|---------|
| $I_{CC}$   | $V_{CC}$ Power Supply Current                | SHDN = NO LOAD   |      | 0.3      | 1    | mA      |
| $I_{SHDN}$ | SHUTDOWN Supply Current                      | SHDN = GND       |      | 1        | 10   | $\mu A$ |
| ESD        | R-IN, T-OUT Electrostatic Discharge Immunity | Human Body Model |      | $\pm 15$ |      | kV      |

**LOGIC INPUT ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu F$ ,  $V_{CC} = 3V$  to 5.5V, tested at  $3.3V \pm 10\%$   $C_1 = 0.047\mu F$ ,  $C_2 - C_4 = 0.33\mu F$  tested at  $5V \pm 10\%$   $-40^\circ C < T_A < 85^\circ C$  unless otherwise noted. Typical values are referred to  $T_A = 25^\circ C$ )

| Symbol    | Parameter                    | Test Conditions            | Min. | Typ.       | Max.    | Unit    |
|-----------|------------------------------|----------------------------|------|------------|---------|---------|
| $V_{IL}$  | Input Logic Threshold Low    | T-IN, SHDN                 |      |            | 0.8     | V       |
| $V_{IH}$  | Input Logic Threshold High   | T-IN, SHDN $V_{CC} = 3.3V$ | 2    |            |         | V       |
|           |                              | T-IN, SHDN $V_{CC} = 5.0V$ | 2.4  |            |         |         |
| $V_{HYS}$ | Transmitter Input Hysteresis |                            |      | 0.5        |         | V       |
| $I_{IL}$  | Input Leakage Current        | T-IN, SHDN                 |      | $\pm 0.01$ | $\pm 1$ | $\mu A$ |

**TRANSMITTER ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$ ,  $V_{CC} = 3\text{V}$  to  $5.5\text{V}$ , tested at  $3.3\text{V} \pm 10\%$   $C_1 = 0.047\mu\text{F}$ ,  $C_2 - C_4 = 0.33\mu\text{F}$  tested at  $5\text{V} \pm 10\%$   $-40^\circ\text{C} < T_A < 85^\circ\text{C}$  unless otherwise noted. 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 loaded with $3\text{K}\Omega$ to GND                                                    | $\pm 5$ | $\pm 5.4$ |          | V             |
| $R_{\text{TOUT}}$ | Transmitter Output Resistance | $V_{CC} = V_+ = V_- = 0\text{V}$<br>Transmitter output = $\pm 2\text{V}$                                        | 300     | 10M       |          | $\Omega$      |
| $I_{\text{TSC}}$  | Output Short Circuit Current  |                                                                                                                 |         | $\pm 50$  |          | mA            |
| $I_{\text{TOL}}$  | Output Leakage Current        | $V_{CC} = 0\text{V}$ or $3\text{V}$ to $5.5\text{V}$ $V_{\text{OUT}} = \pm 12\text{V}$<br>Transmitters Disabled |         |           | $\pm 25$ | $\mu\text{A}$ |

**RECEIVER DC TARGET ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$ ,  $V_{CC} = 3\text{V}$  to  $5.5\text{V}$ , tested at  $3.3\text{V} \pm 10\%$   $C_1 = 0.047\mu\text{F}$ ,  $C_2 - C_4 = 0.33\mu\text{F}$  tested at  $5\text{V} \pm 10\%$   $-40^\circ\text{C} < T_A < 85^\circ\text{C}$  unless otherwise noted. 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        | R-OUT, Receiver Disabled                        |              | $\pm 0.05$   | $\pm 10$ | $\mu\text{A}$    |
| $V_{\text{RIN}}$  | Input Voltage Operating Range |                                                 | -25          |              | $\pm 25$ | V                |
| $V_{\text{RIL}}$  | Input Threshold Low           | $T_A = 25^\circ\text{C}$ $V_{CC} = 3.3\text{V}$ | 0.6          | 1.2          |          | V                |
|                   |                               | $T_A = 25^\circ\text{C}$ $V_{CC} = 5.5\text{V}$ | 0.8          | 1.5          |          |                  |
| $V_{\text{RITH}}$ | Input Threshold High          | $T_A = 25^\circ\text{C}$ $V_{CC} = 3.3\text{V}$ |              | 1.5          | 2.4      | V                |
|                   |                               | $T_A = 25^\circ\text{C}$ $V_{CC} = 5.5\text{V}$ |              | 1.8          | 2.4      |                  |
| $V_{\text{RIH}}$  | Input Hysteresis              |                                                 |              | 0.5          |          | V                |
| $R_{\text{RIN}}$  | Input Resistance              | $T_A = 25^\circ\text{C}$                        | 3            | 5            | 7        | $\text{K}\Omega$ |
| $V_{\text{ROL}}$  | TTL/CMOS Output Voltage Low   | $I_{\text{OUT}} = 2\text{mA}$                   |              |              | 0.4      | V                |
| $V_{\text{ROH}}$  | TTL/CMOS Output Voltage High  | $I_{\text{OUT}} = -1\text{mA}$                  | $V_{CC}-0.6$ | $V_{CC}-0.1$ |          | V                |

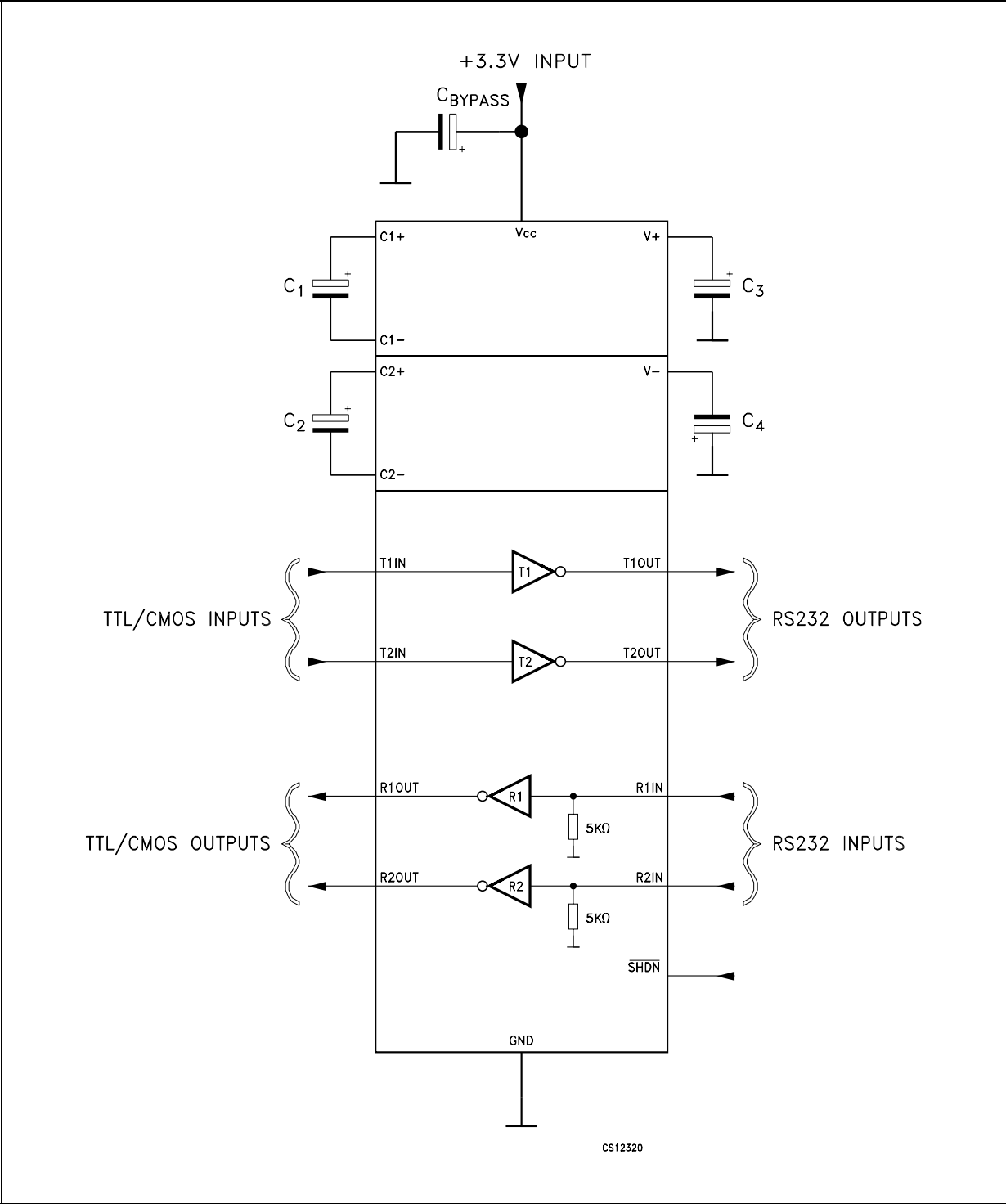
**TIMING TARGET ELECTRICAL CHARACTERISTICS**

( $C_1 - C_4 = 0.1\mu\text{F}$ ,  $V_{CC} = 3\text{V}$  to  $5.5\text{V}$ , tested at  $3.3\text{V} \pm 10\%$   $C_1 = 0.047\mu\text{F}$ ,  $C_2 - C_4 = 0.33\mu\text{F}$  tested at  $5\text{V} \pm 10\%$   $-40^\circ\text{C} < T_A < 85^\circ\text{C}$  unless otherwise noted. Typical values are referred to  $T_A = 25^\circ\text{C}$ )

| Symbol                                 | Parameter                                         | Test Conditions                                                                                                                                                                                                                                                  | Min.   | Typ.   | Max.     | Unit                                             |
|----------------------------------------|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|----------|--------------------------------------------------|
| $D_R$                                  | Maximum Data Rate                                 | $R_L = 3\text{K}\Omega$ $C_{L2} = 1000\text{pF}$<br>one transmitter switching                                                                                                                                                                                    | 250    |        |          | Kbps                                             |
| $t_{\text{PHLR}}$<br>$t_{\text{PLHR}}$ | Receiver Propagation Delay                        | $R_{\text{XIN}}$ to $R_{\text{XOUT}}$ $C_L = 150\text{pF}$                                                                                                                                                                                                       |        | 0.15   |          | $\mu\text{s}$                                    |
| $ t_{\text{PHLT}} - t_{\text{PLHT}} $  | Transmitter Propagation Delay Difference (Note 1) | (Note 1)                                                                                                                                                                                                                                                         |        | 150    |          | ns                                               |
| $ t_{\text{PHLR}} - t_{\text{PLHR}} $  | Receiver Propagation Delay Difference             |                                                                                                                                                                                                                                                                  |        | 100    |          | ns                                               |
| $t_{\text{EX}}$                        | Time to Exit Shutdown                             | $V_{\text{OUT}} \geq 3\text{V}$ , $R_{\text{LOAD}}$ at $V_+ = 3\text{K}\Omega$                                                                                                                                                                                   |        | 20     |          | $\mu\text{s}$                                    |
| $S_{\text{RT}}$                        | Transition 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 $+3\text{V}$ to $-3\text{V}$ or $-3\text{V}$ to $+3\text{V}$<br>$C_L = 150\text{pF}$ to $1000\text{pF}$<br>$C_L = 150\text{pF}$ to $2500\text{pF}$ | 6<br>4 | 8<br>8 | 30<br>30 | $\text{V}/\mu\text{s}$<br>$\text{V}/\mu\text{s}$ |

(Note 1) Transmitter Skew is measured at the transmitter zero cross points.

TYPICAL OPERATING CIRCUIT

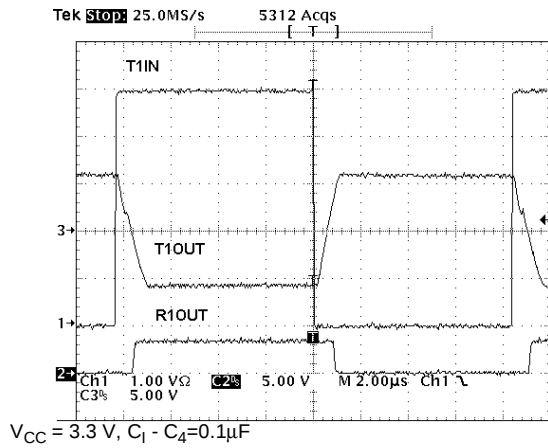


CAPACITANCE VALUE (μF)

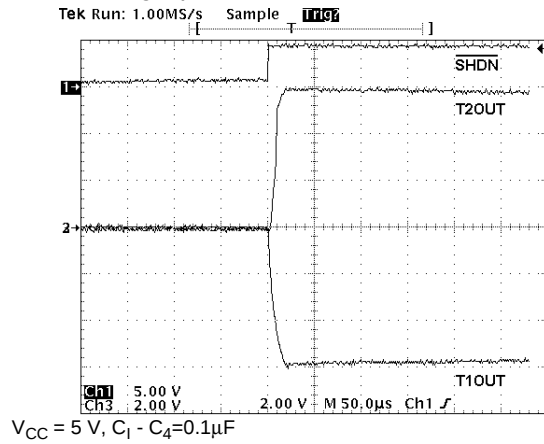
| C1  | C2  | C3  | C4  | Cbypass |
|-----|-----|-----|-----|---------|
| 0.1 | 0.1 | 0.1 | 0.1 | 0.1     |

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

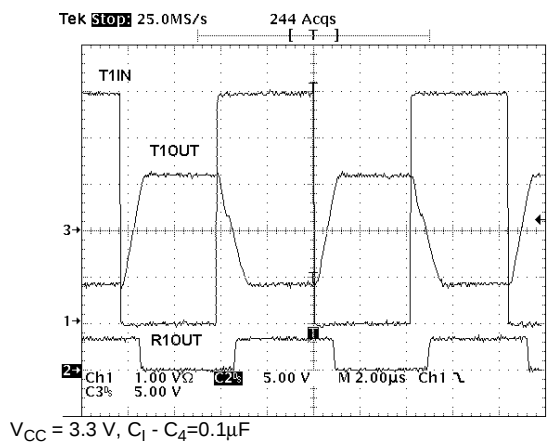
**Figure 1 : Loopback Test Result at 120 kbps**



**Figure 3 : Transmitter Outputs Exiting Shutdown or Powering Up**

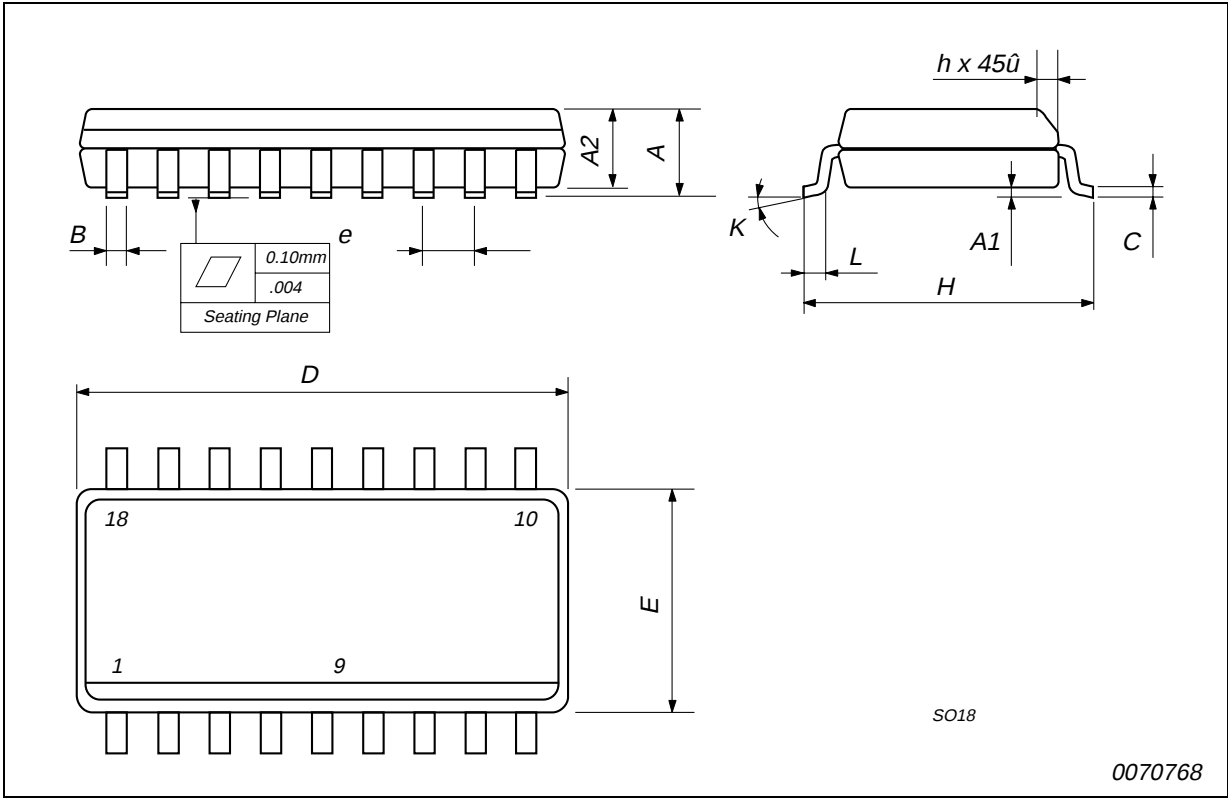


**Figure 2 : Loopback Test Result at 250 kbps**



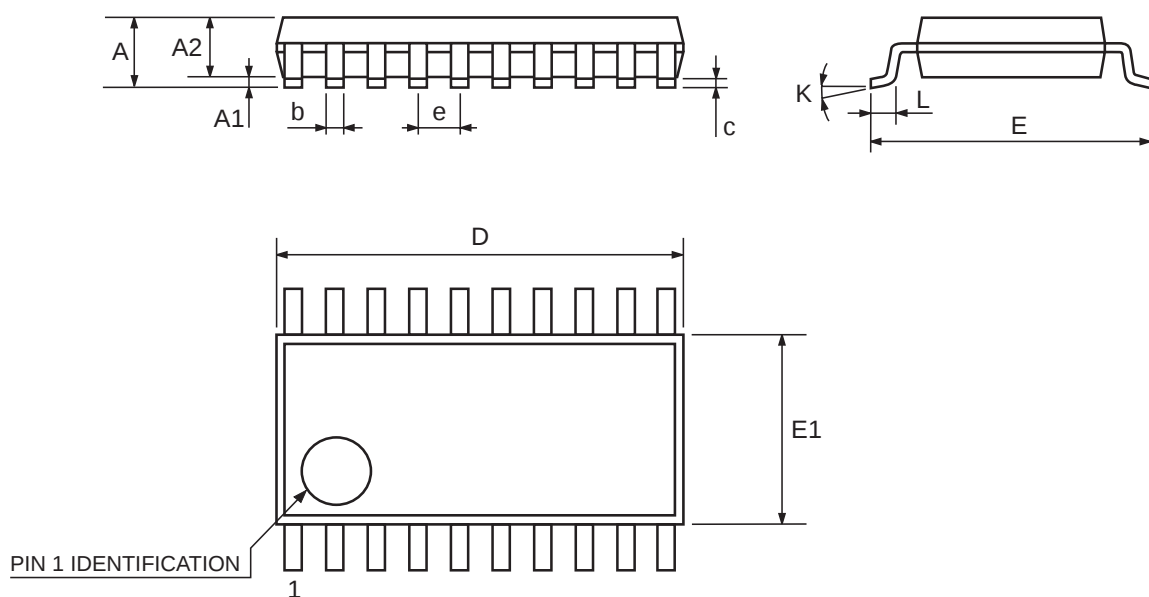
SO-18 MECHANICAL DATA

| DIM. | mm.       |      |       | inch  |       |       |
|------|-----------|------|-------|-------|-------|-------|
|      | MIN.      | TYP  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 2.35      |      | 2.65  | 0.092 |       | 0.104 |
| A1   | 0.1       |      | 0.3   | 0.004 |       | 0.012 |
| A2   |           |      | 2.55  |       |       | 0.100 |
| B    | 0.33      |      | 0.51  | 0.013 |       | 0.020 |
| C    | 0.23      |      | 0.32  | 0.009 |       | 0.012 |
| D    | 11.35     |      | 11.75 | 0.447 |       | 0.462 |
| E    | 7.4       |      | 7.6   | 0.291 |       | 0.299 |
| e    |           | 1.27 |       |       | 0.050 |       |
| H    | 10.00     |      | 10.65 | 0.393 |       | 0.419 |
| h    | 0.25      |      | 0.75  | 0.010 |       | 0.029 |
| k    | 8° (max.) |      |       |       |       |       |
| L    | 0.4       |      | 1.27  | 0.016 |       | 0.050 |



## SSOP20 MECHANICAL DATA

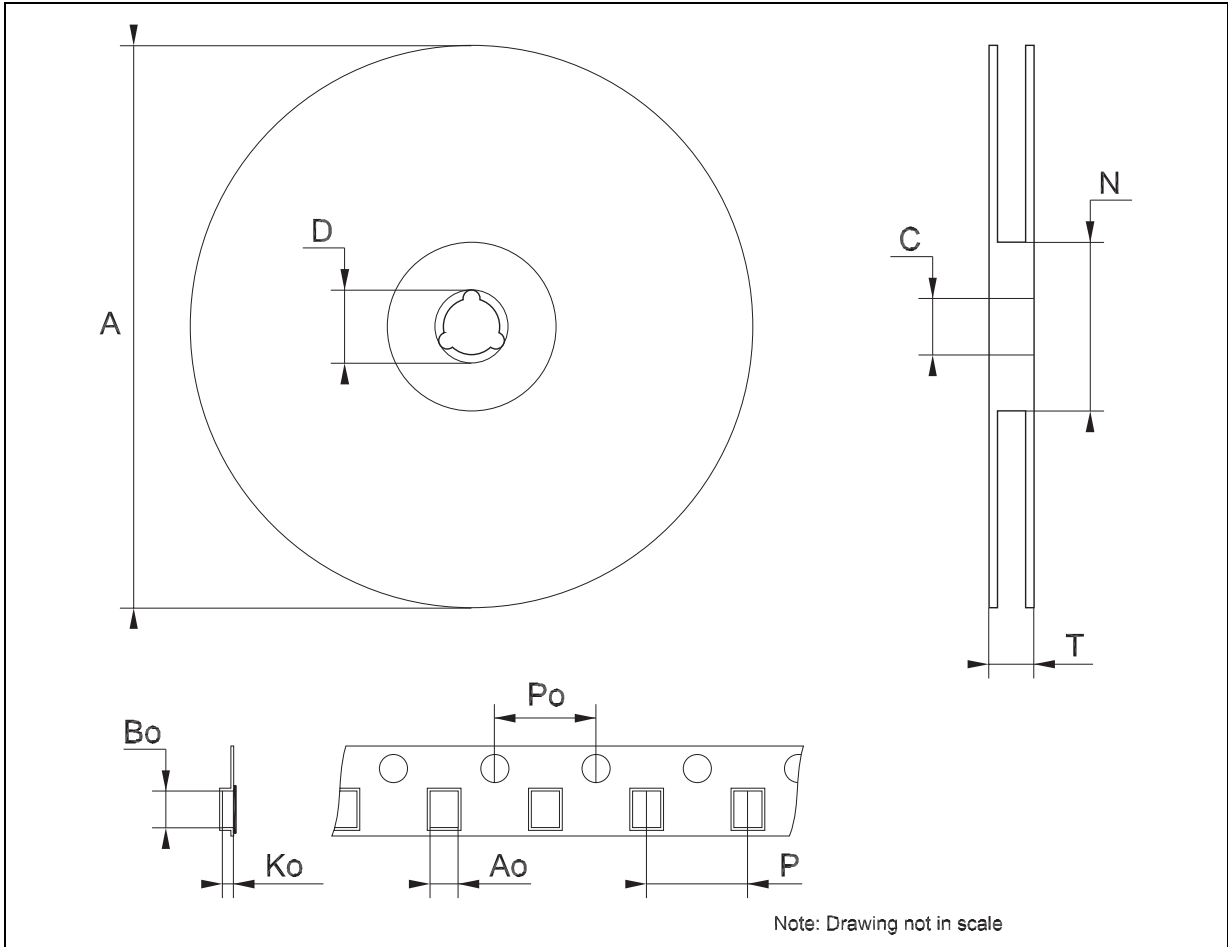
| DIM. | mm.  |          |      | inch  |            |       |
|------|------|----------|------|-------|------------|-------|
|      | MIN. | TYP      | MAX. | MIN.  | TYP.       | MAX.  |
| A    |      |          | 2    |       |            | 0.079 |
| A1   | 0.05 |          |      | 0.002 |            |       |
| 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    | 6.9  | 7.2      | 7.5  | 0.272 | 0.283      | 0.295 |
| 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°   | 4°       | 8°   | 0°    | 4°         | 8°    |
| L    | 0.55 | 0.75     | 0.95 | 0.022 | 0.030      | 0.037 |



0061436C

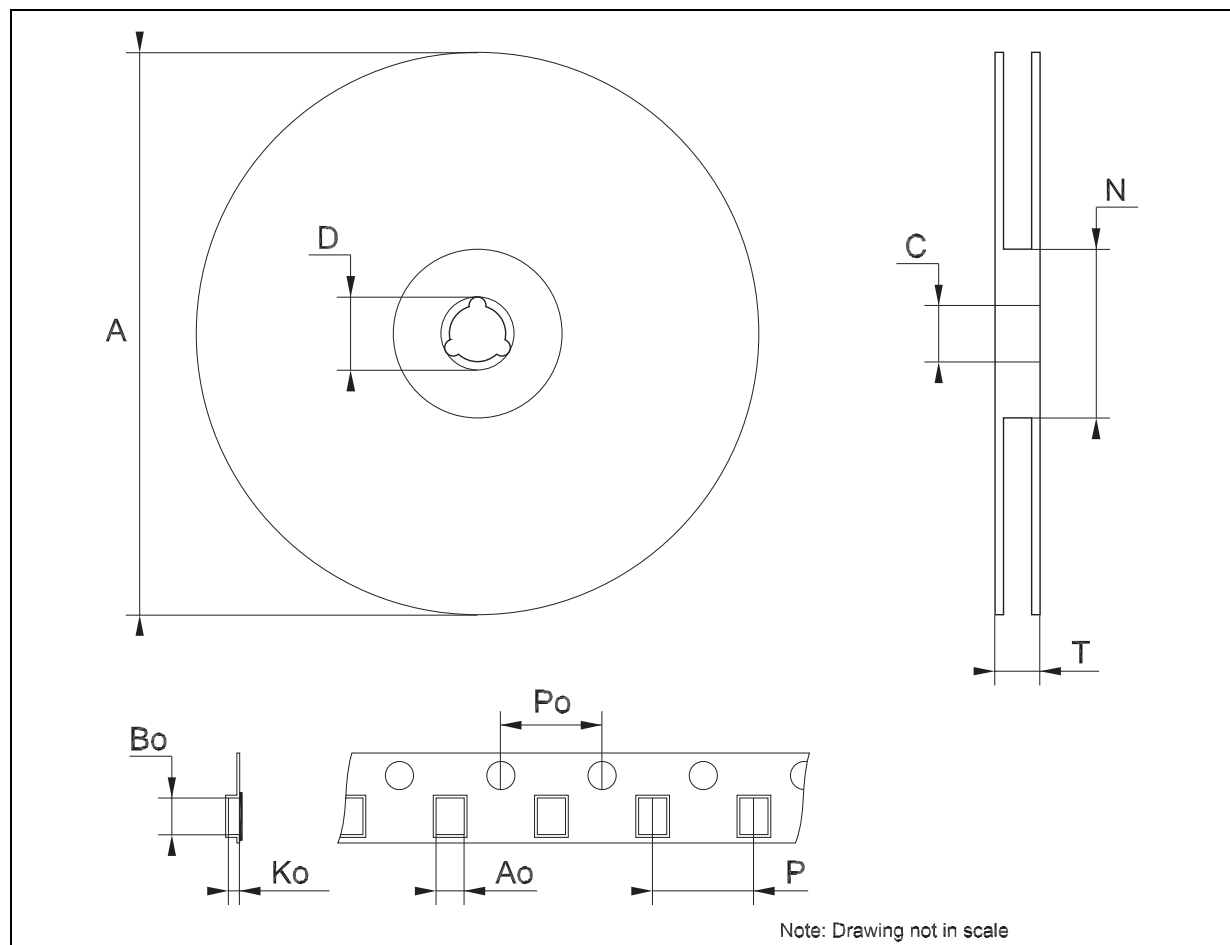
Tape & Reel SO-18 MECHANICAL DATA

| 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   | 10.8 |     | 11.0 | 0.425 |      | 0.433  |
| Bo   | 11.9 |     | 12.1 | 0.468 |      | 0.476  |
| Ko   | 2.9  |     | 3.1  | 0.114 |      | 0.122  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 11.9 |     | 12.1 | 0.468 |      | 0.476  |



## Tape &amp; Reel SSOP20 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   | 8.4  |     | 8.6  | 0.331 |      | 0.339  |
| Bo   | 7.7  |     | 7.9  | 0.303 |      | 0.311  |
| Ko   | 2.9  |     | 3.1  | 0.114 |      | 0.122  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 11.9 |     | 12.1 | 0.468 |      | 0.476  |



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