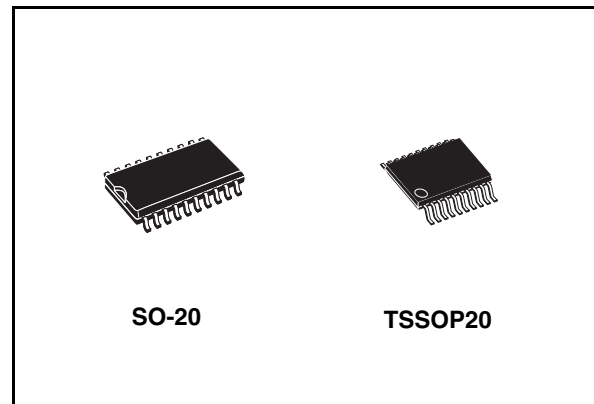# ST75185C

## Multiple RS-232 drivers and receivers

## Features

- Meets and exceeds the requirements of EIA/TIA-232-E and ITUV.28 standard
- Single chip with easy interface between UART and serial port connector of IBM PC/AT™ and compatibles
- Designed to support data rates up to 120 kbps
- Pinout compatible with ST75C185

## Description

The ST75185C contains three drivers and five receivers. The pinout matches the DB9S connector design in order to decrease the part count, reduce the board space required and allow easy interconnection of the UART and serial port connector of IBM PC/AT™ and compatibles. The bipolar circuits and processing of the ST75185C provides a rugged low-cost solution for this function at the expense of quiescent power and external passive components relative to the ST75C185.

The ST75185C complies with the requirements of the EIA/TIA 232-E and ITU (formally CCITT) v.28 standards. These standards are for data interchange between a host computer and peripheral at signalling rates up to 20 k-bits/s. The switching speeds of the ST75185C are fast enough to support rates up to 120 K-bits/s with lower capacitive loads (shorter cables). Inter-operability at the higher signalling rates cannot be assured unless the designer has design control of the cable and the interface circuits at the both ends. For inter-operability at signalling rates to



**SO-20**          **TSSOP20**

120 k-bits/s, use of EIA/ITA-423-B (ITU v.10) and EIA/ITA-422-B (ITU v.11) standards are recommended.

The ST75185C is characterized for operation over the range of 0°C to 70 °C.

**Table 1.  Device summary**

| Order codes | Temperature range | Packages | Packaging |
|---|---|---|---|
| ST75185CTR | 0 to 70 °C | TSSOP20 (tape and reel) | 2500 parts per reel |
| ST75185CDR | 0 to 70 °C | SO-20 (tape and reel) | 1000 parts per reel |

# Contents

# 1 Pin configuration
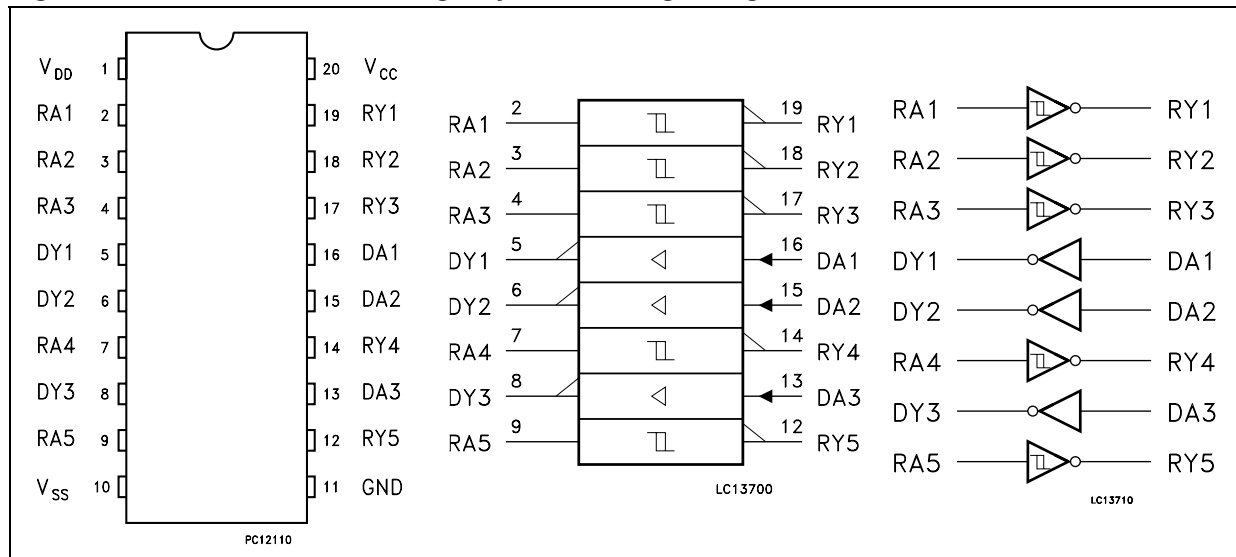
**Figure 1.** Pin connection IEC logic symbol and logic diagram



**Table 2.** Pin description

| Pin n° | Symbol | Name and function |
|--------|--------|-------------------|
| 1 | $V_{DD}$ | Supply voltage (+12 V) |
| 2 | RA1 | First receiver input |
| 3 | RA2 | Second receiver input |
| 4 | RA3 | Third receiver input |
| 5 | DY1 | First driver output |
| 6 | DY2 | Second driver output |
| 7 | RA4 | Fourth receiver input |
| 8 | DY3 | Third driver output |
| 9 | RA5 | Fifth receiver input |
| 10 | $V_{SS}$ | Supply voltage (-12V) |
| 11 | GND | Ground |
| 12 | RY5 | Fifth receiver output |
| 13 | DA3 | Third driver input |
| 14 | RY4 | Fourth receiver output |
| 15 | DA2 | Second driver input |
| 16 | DA1 | First driver input |
| 17 | RY3 | Third receiver output |
| 18 | RY2 | Second receiver output |
| 19 | RY1 | First receiver output |
| 20 | $V_{CC}$ | Supply voltage (+5 V) |

# 2 Maximum ratings

**Table 3. Absolute maximum ratings over operating free-air temperature range**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DD}$ | Supply voltage [1] | 15 | V |
| $V_{SS}$ | Supply voltage [1] | -15 | V |
| $V_{CC}$ | Supply voltage [1] | 10 | V |
| $V_I$ | Input voltage range (Driver) | -15 to 7 | V |
| $V_I$ | Input voltage range (Receiver) | -30 to 30 | V |
| $V_O$ | Output voltage range (Driver) | -15 to 15 | V |
| $I_O$ | Receiver low level output current | 20 | mA |
| $P_D$ | Continuous total power dissipation | See dissipation rating table | |
| $T_A$ | Operating free-air temperature range | 0 to 70 | °C |
| $T_{STG}$ | Storage temperature range | -65 to + 150 | °C |
| $T_L$ | Lead temperature 1.6 mm. from case for 10 sec. | 260 | °C |

1. All voltage are with respect to the network ground terminal.

*Note:* *Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.*

**Table 4. Dissipation rating table**

| Package | Power rating at $T_A \leq 25°C$ | Derating factor above $T_A = 25°C$ | Power rating at $T_A \leq 70°C$ |
|---|---|---|---|
| MICROPACKAGE (D) | 1125 mW | 9.0 mW/°C | 720 mW |

**Table 5. Thermal data**

| Symbol | Parameter | TSSOP20 | Unit |
|---|---|---|---|
| $R_{thJC}$ | Thermal resistance junction-case | 27.22 | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 114.5 [1] | °C/W |

1. This value is referred to single-layer PCB, JEDEC standard test board.

**Table 6.    Recommended operating conditions**

| Symbol | Parameter | | Min. | Max. | Unit. |
|---|---|---|---|---|---|
| $V_{DD}$ | Supply voltage | | 7.5 | 15 | V |
| $V_{SS}$ | Supply voltage | | -7.5 | -15 | V |
| $V_{CC}$ | Supply voltage | | 4.5 | 5.5 | V |
| $V_I$ | Driver input voltage | | 0 | $V_{CC}$ | V |
| $I_{OH}$ | High level output current | Driver | | -6 | mA |
| | | Receiver | | -0.5 | |
| $I_{OL}$ | Low level output current | Driver | | 6 | mA |
| | | Receiver | | 16 | |
| $T_A$ | Operating free-air temperature range | | 0 | 70 | °C |

# 3 Electrical characteristics

**Table 7. Supply currents**

| Symbol | Parameter | Test conditions | | | Value | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | $V_{DD}$ | $V_{SS}$ | | Min. | Typ. | Max. | |
| $I_{DD}$ | Supply current from $V_{DD}$ | 9 | -9 | No load. all inputs at 1.9V | | | 15 | mA |
| | | 12 | -12 | | | | 19 | |
| | | 15 | -15 | | | | 25 | |
| | | 9 | -9 | No load. all inputs at 0.8V | | | 4.5 | mA |
| | | 12 | -12 | | | | 5.5 | |
| | | 15 | -15 | | | | 9 | |
| $I_{SS}$ | Supply current from $V_{SS}$ | 9 | -9 | No load. all inputs at 1.9V | | | -15 | mA |
| | | 12 | -12 | | | | -19 | |
| | | 15 | -15 | | | | -25 | |
| | | 9 | -9 | No load. all inputs at 0.8V | | | -3.2 | mA |
| | | 12 | -12 | | | | -3.2 | |
| | | 15 | -15 | | | | -3.2 | |
| $I_{CC}$ | Supply current from $V_{CC}$ | No load. All inputs at 5V $V_{CC}$ = 5V | | | | | 30 | mA |

$V_{DD}$ = 9 V, $V_{SS}$ = -9 V, $V_{CC}$ = 5 V, unless otherwise specified.

**Table 8.**     **Driver electrical characteristics over operating free-air temperature range**

| Symbol | Parameter | Test conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $V_{OH}$ | High level output voltage | $V_{IL}$ = 0.8 V, $R_L$ = 3k$\Omega$ (See *Figure 3*) | 6 | 7.5 | | V |
| $V_{OL}$ | Low level output voltage (*Note 3*) | $V_{IH}$ = 1.9 V, $R_L$ = 3k$\Omega$ (See *Figure 3*) | | -7.5 | -6 | V |
| $I_{IH}$ | High level input current | $V_I$ = 5 V (See *Figure 4*) | | | 10 | µA |
| $I_{IL}$ | Low level input current | $V_I$ = 0 V (See *Figure 4*) | | | −1.6 | mA |
| $I_{OS(H)}$ | High level short circuit output current (*Note 4*) | $V_{IL}$ = 0.8 V, $V_O$ = 0 V (See *Figure 3*) | -4.5 | −12 | −19.5 | mA |
| $I_{OS(L)}$ | Low level short circuit output current | $V_{IH}$ = 2 V    $V_O$ = 0 V (See *Figure 3*) | 4.5 | 12 | 19.5 | mA |
| $R_O$ | Output resistance | $V_{DD}$ = $V_{SS}$ = $V_{CC}$ = 0 V $V_O$ = -2 to 2 V (*Note 3*) | 300 | | | $\Omega$ |

Note:    1    *The algebraic convention, where the more positive (less negative) limits designated as maximum, is used in this datasheet for logic levels only (e.g. if - 10 V is a maximum, the typical value is a more negative voltage).*

           2    *Output short circuit conditions must maintain the total power dissipation below absolute maximum ratings.*

           3    *Test conditions are those specified by EIA-232-E and as listed above.*

               $V_{DD}$ = 12 V, $V_{SS}$ = -12 V, $V_{CC}$ = 5 V, $T_A$ = 25 °C

**Table 9.**     **Driver switching characteristics**

| Symbol | Parameter | Test conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $t_{PLH}$ | Propagation Delay Time, Low to High Level Output | $R_L$ = 3 to 7 k$\Omega$   $C_L$ = 15 pF (See *Figure 5*, *Figure 6*) | | 315 | 500 | ns |
| $t_{PHL}$ | Propagation Delay Time, High to Low Level Output | $R_L$ = 3 to 7 k$\Omega$   $C_L$ = 15 pF (See *Figure 5*, *Figure 6*) | | 75 | 175 | ns |
| $t_{TLH}$ | Transition Time Low to High Level Output | $R_L$ = 3 to 7 k$\Omega$   $C_L$ = 15 pF (See *Figure 5*, *Figure 6*) | | 60 | 100 | ns |
| | | $R_L$ = 3 to 7 k$\Omega$   $C_L$ = 2500 pF (*Note 4*, *Figure 5*, *Figure 6*) | | 1.7 | 2.5 | µs |
| $t_{THL}$ | Transition Time High to Low Level Output | $R_L$ = 3 to 7 k$\Omega$   $C_L$ = 15 pF (See *Figure 5*, *Figure 6*) | | 40 | 7.5 | ns |
| | | $R_L$ = 3 to 7 k$\Omega$   $C_L$ = 2500 pF (*Note 4*, *Figure 5*, *Figure 6*) | | 1.5 | 2.5 | µs |

           4    *Measured between -3 V and 3 V points of output waveform (EIA-232-E conditions), all unused inputs are tied.*

**Table 10.  Receiver electrical characteristics over operating conditions**

| Symbol | Parameter | Test conditions | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max. | |
| $V_{T+}$ | Positive going threshold voltage | (See *Figure 9*) | | | 2.2 | 2.4 | V |
| $V_{T-}$ | Negative going threshold voltage | $T_A = 25\ °C$ (See *Figure 9*) | | 0.75 | 0.97 | | V |
| $V_{hys}$ | Input hysteresis ($V_T+$ - $V_T$) | | | | 0.5 | | V |
| $V_{OH}$ | High level output voltage | $I_{OH}$ = -0.5mA | $V_{IH}$ = 0.75 V | 2.6 | 4 | 5 | V |
| | | | Inputs Open | 2.6 | | | |
| $V_{OL}$ | Low level output voltage | $V_I$ = 3 V   $I_{OL}$ = 10 mA | | | 0.2 | 0.45 | V |
| $I_{IH}$ | High level input current | $V_I$ = 25 V  (See *Figure 9*) | | 3.6 | | 8.3 | mA |
| | | $V_I$ = 3 V   (See *Figure 9*) | | 0.43 | | | |
| $I_{IL}$ | Low level input current | $V_I$ = -25 V (See *Figure 9*) | | -3.6 | | -8.3 | mA |
| | | $V_I$ = -3 V   (See *Figure 9*) | | -0.43 | | | |
| $I_{OS}$ | Short-circuit output current | $V_I$ = 0 V    $V_O$ = 0 V (See *Figure 7*) | | | -3.4 | -12 | mA |

*Note:*  *All typical values are at $T_A = 25\ °C$, $V_{CC}$ = 5 V, $V_{DD}$ = 9 V and $V_{SS}$ = -9 V*

$V_{DD}$ = 12 V, $V_{SS}$ = -12 V, $V_{CC}$ = 5 V $T_A = 25\ °C$

**Table 11.  Receiver switching characteristics**

| Symbol | Parameter | Test conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $t_{PLH}$ | Propagation delay time low to high level output | $R_L$ = 5 kΩ    $C_L$ = 50 pF (See *Figure 9*) | | 400 | 1000 | ns |
| $t_{PHL}$ | Propagation delay time high to low level output | $R_L$ = 5 kΩ    $C_L$ = 50 pF (See *Figure 9*) | | 70 | 150 | ns |
| $t_{TLH}$ | Transition time low to high level output | $R_L$ = 5 kΩ    $C_L$ = 50 pF (See *Figure 9*) | | 200 | 525 | ns |
| $t_{THL}$ | Transition time high to low level output | $R_L$ = 5 kΩ    $C_L$ = 50 pF (See *Figure 9*) | | 20 | 60 | ns |

# 4 Typical application

**Figure 2. Application circuits**



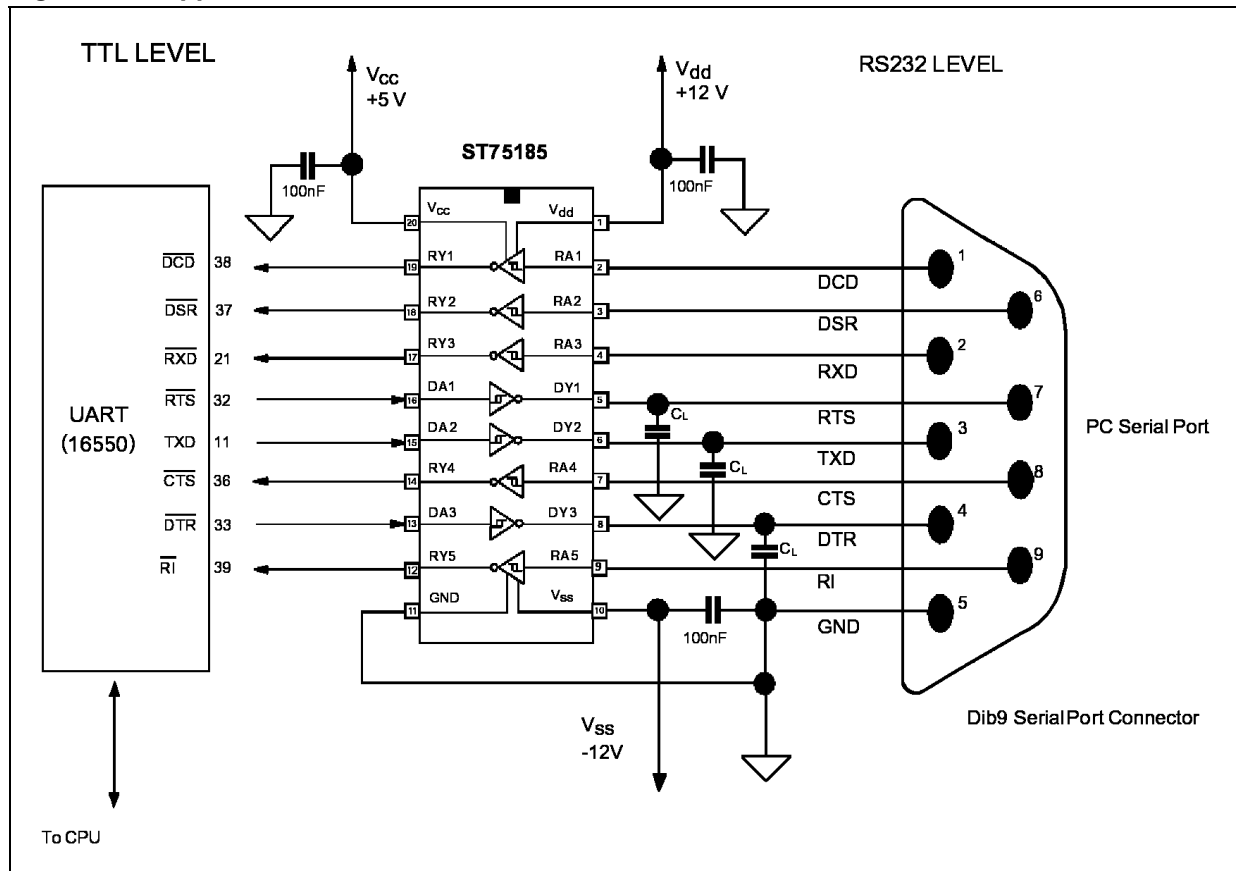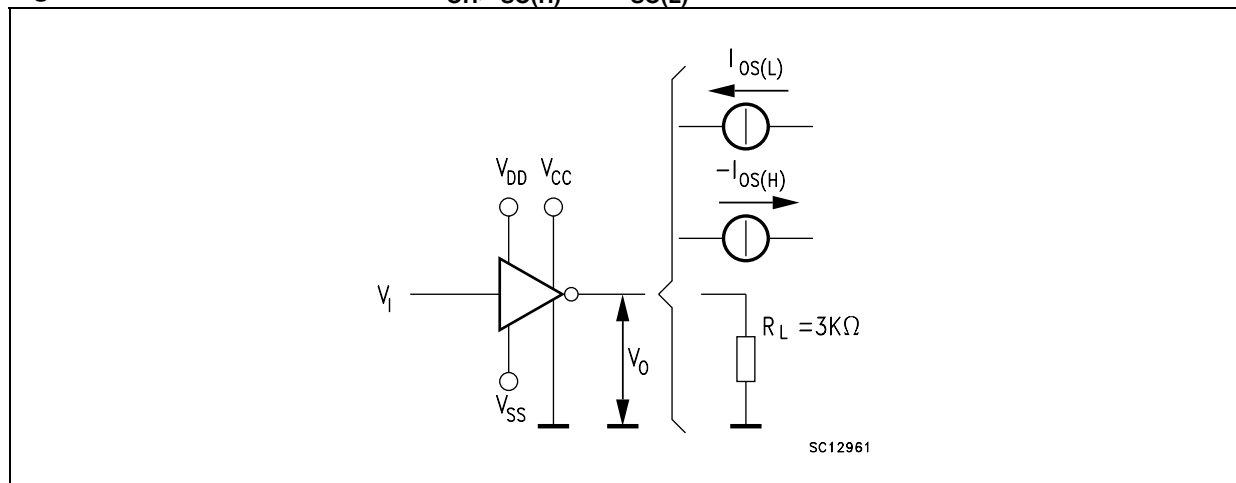**Figure 3. Driver test circuit for $V_{OH}$, $I_{SO(H)}$ and $I_{SO(L)}$**
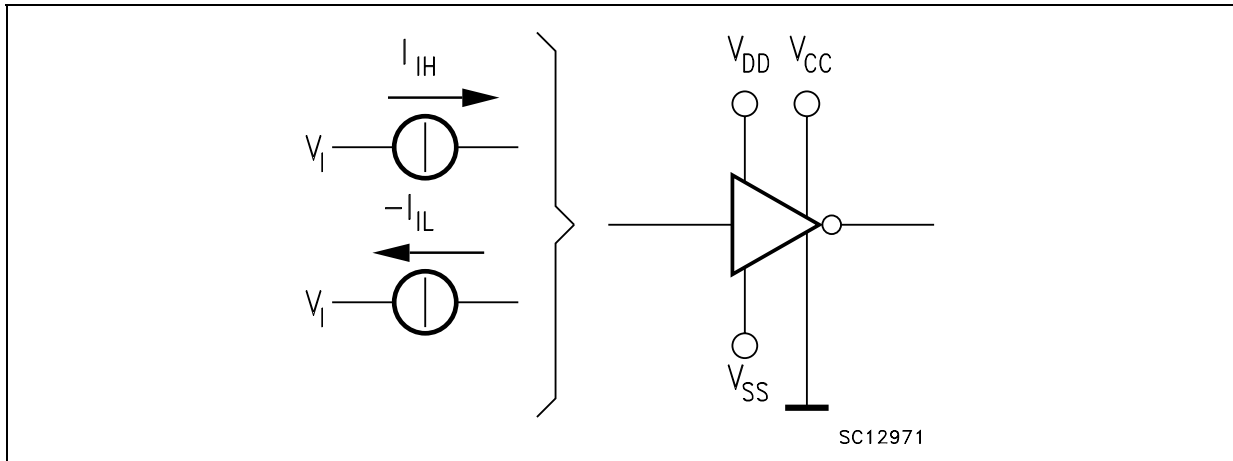
**Figure 4.    Driver test circuit for $I_{IH}$ and $I_{IL}$**



SC12971

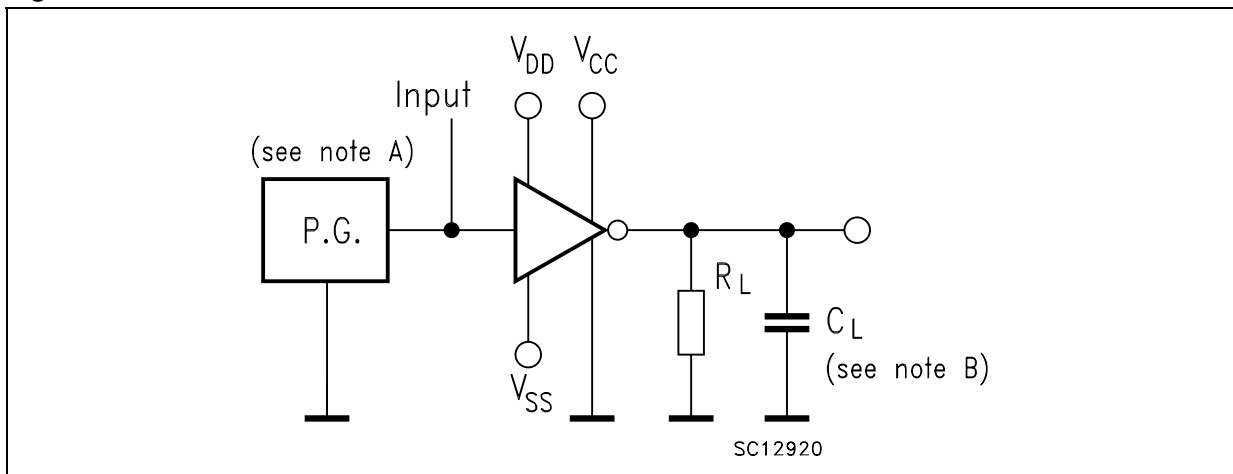**Figure 5.    Driver test circuit**



SC12920

**Figure 6.    Driver voltage waveforms**



SC12910
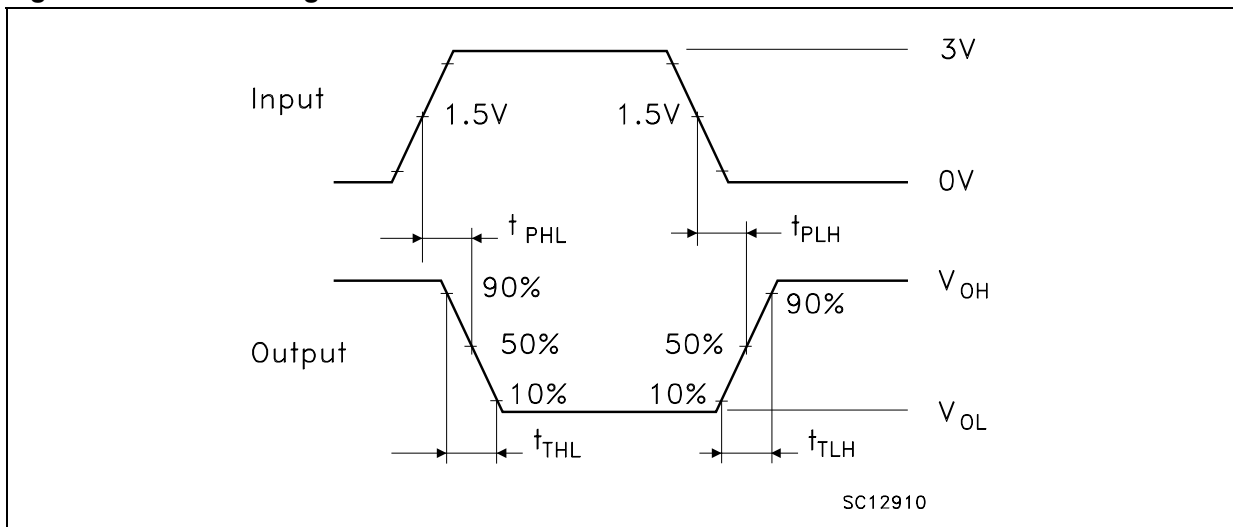
**Figure 7.**     **Receiver test circuit for I$_{OS}$**
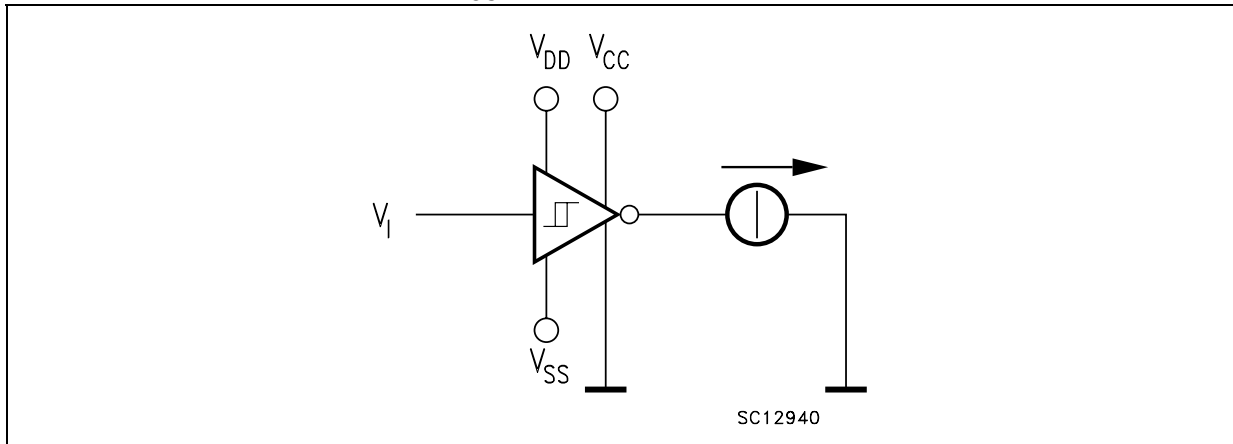


**Figure 8.**     **Receiver test circuit for V$_T$, V$_{OH}$, V$_{OL}$**
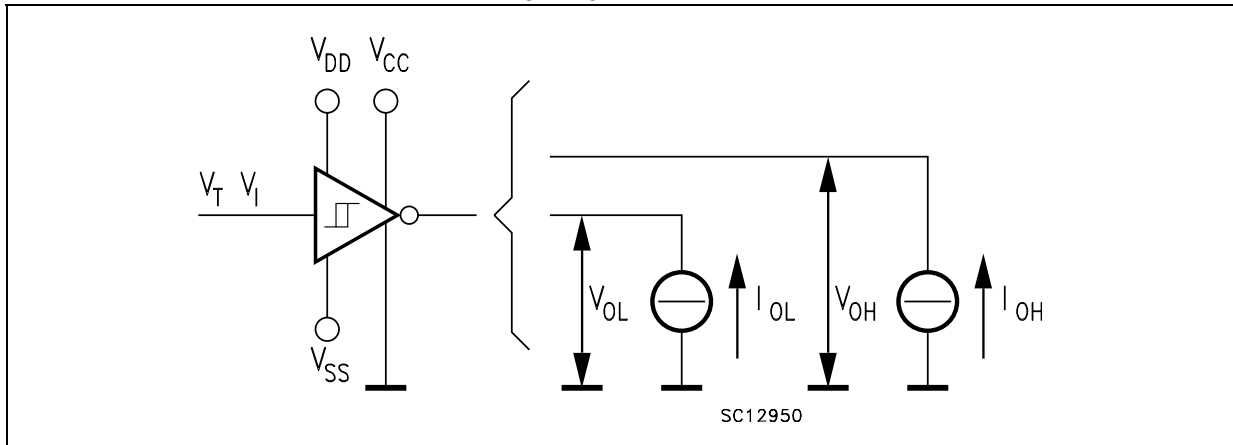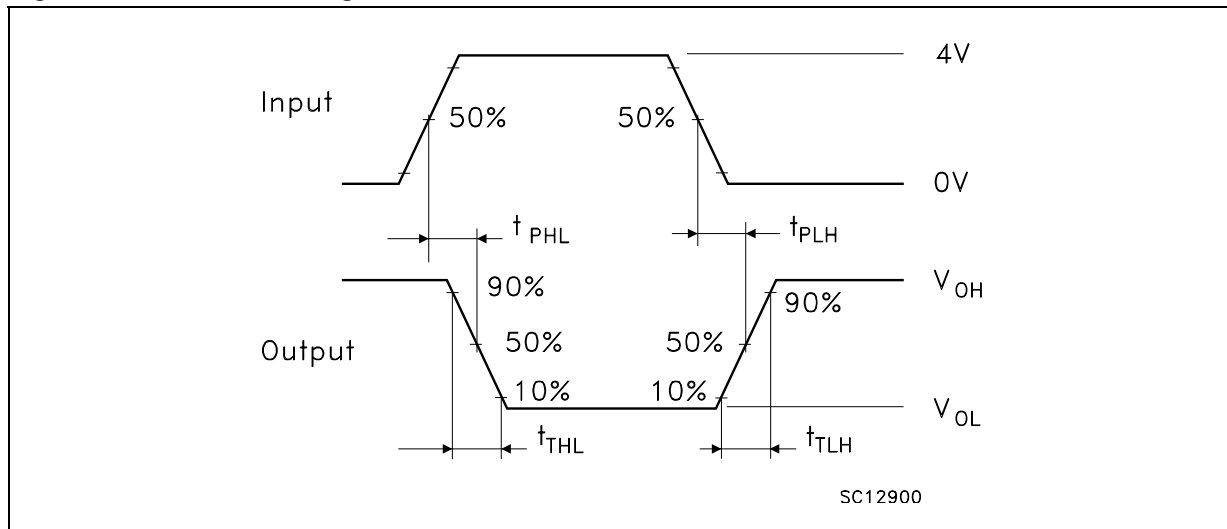


**Figure 9.**     **Receiver test circuit**
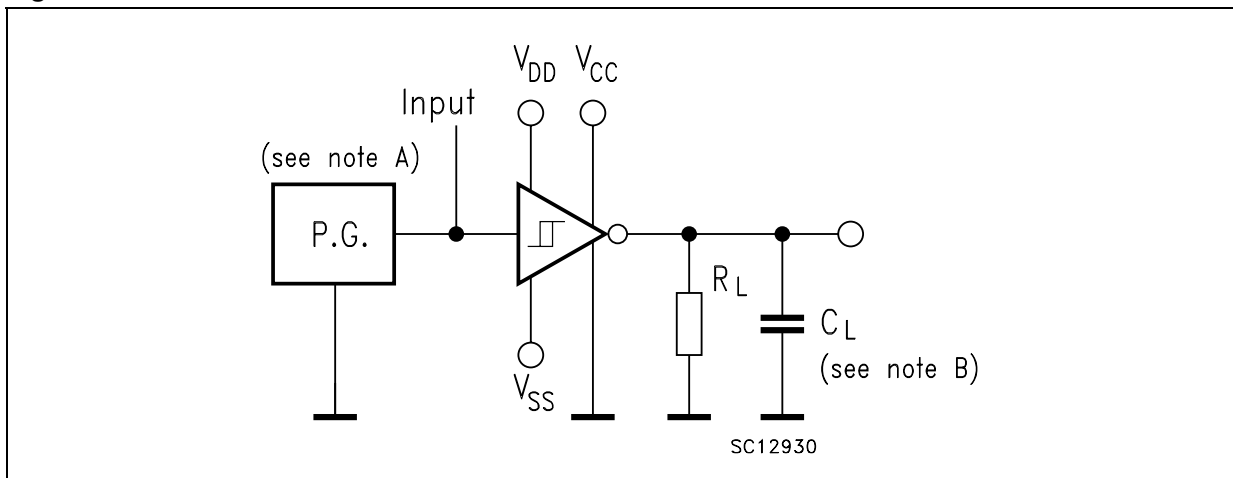
**Figure 10.   Receiver voltage waveforms**



Note:   1    The pulse generator has the following characteristics: $t_W$ = 25 µs, PRR = 20 kHz,
            $Z_O$ = 50 Ω, $t_r$ = $t_f$ < 50 ns

        2    $C_L$ includes probe and jig capacitance.

# 5 Typical characteristics

**Figure 11.** Driver voltage transfer characteristics



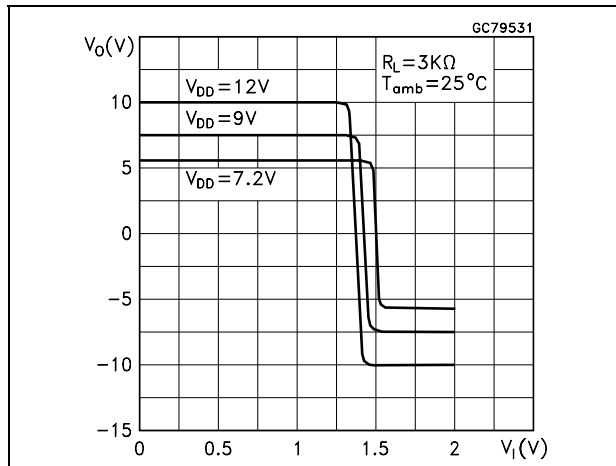**Figure 12.** Driver short circuit output current vs. free-air temperature
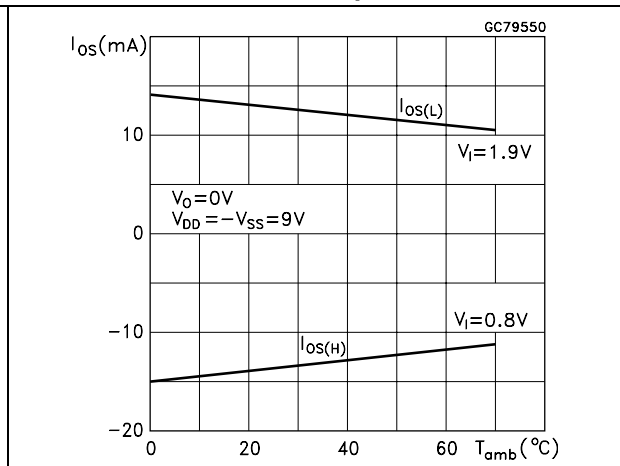


**Figure 13.** Device supply current vs. temperature
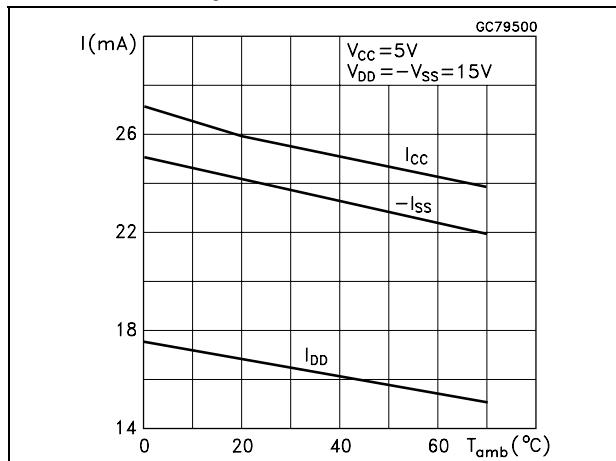


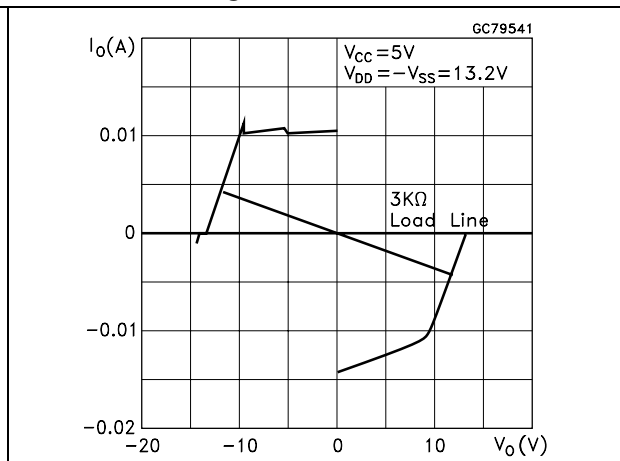**Figure 14.** Driver output current vs. output voltage

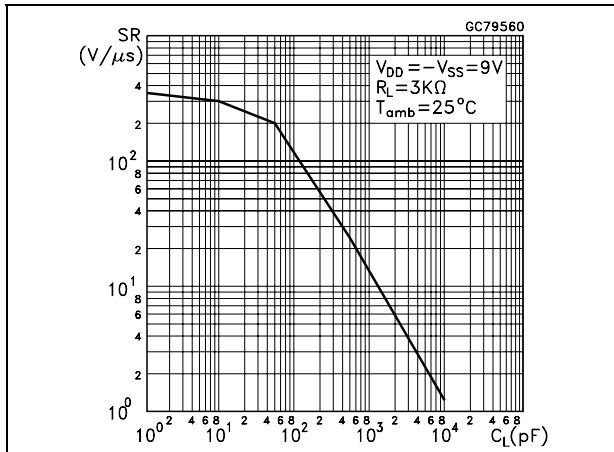**Figure 15.    Driver output slew rate vs. load capacitance**



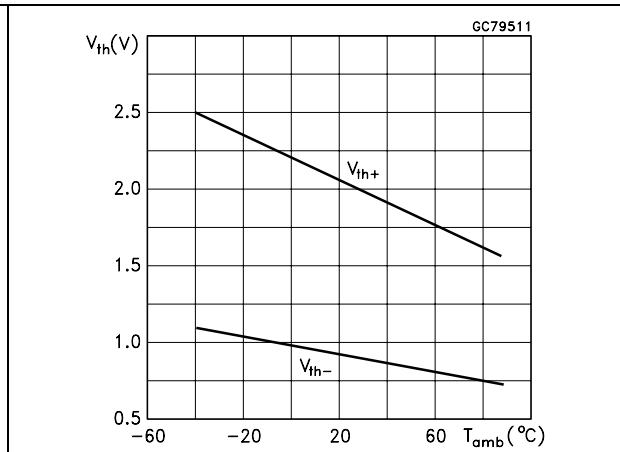**Figure 16.    Receiver threshold vs. temperature**



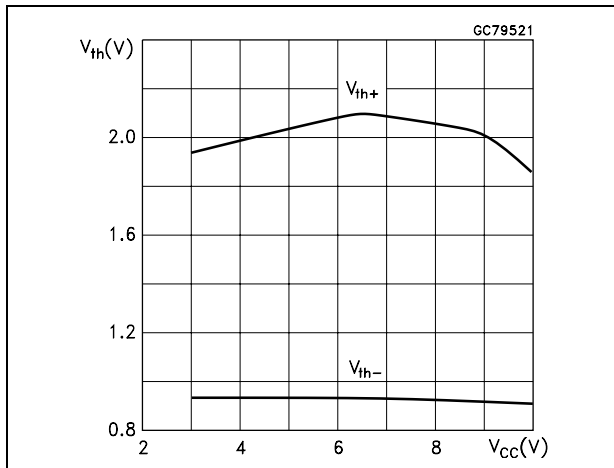**Figure 17.    Receiver threshold vs. supply voltage**

# 6    Application information: diodes on power supply

Diodes placed in series with the $V_{DD}$ and $V_{SS}$ leads protect the ST75185C in the fault condition in which the devices output are shorted to ±15 V and the power supplies are at low state and provide low-impedance path to ground (see *Figure 18*).

**Figure 18.    Diodes on power supply**
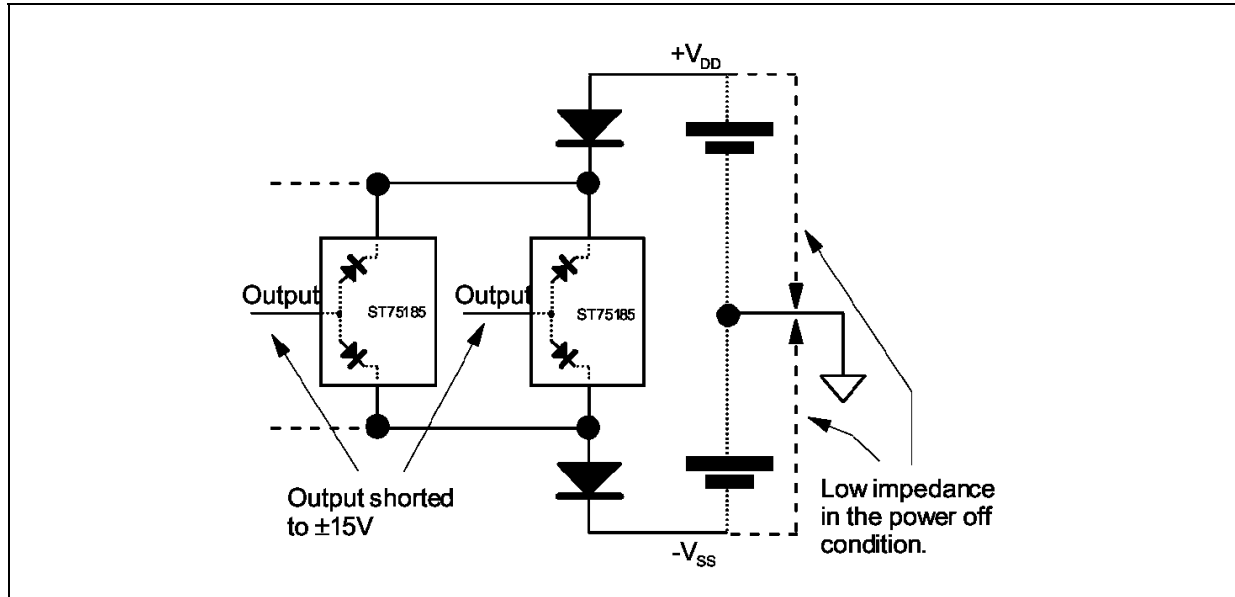
# 7 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK$^®$ packages, depending on their level of environmental compliance. ECOPACK$^®$ specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK$^®$ is an ST trademark.

## SO-20 mechanical data

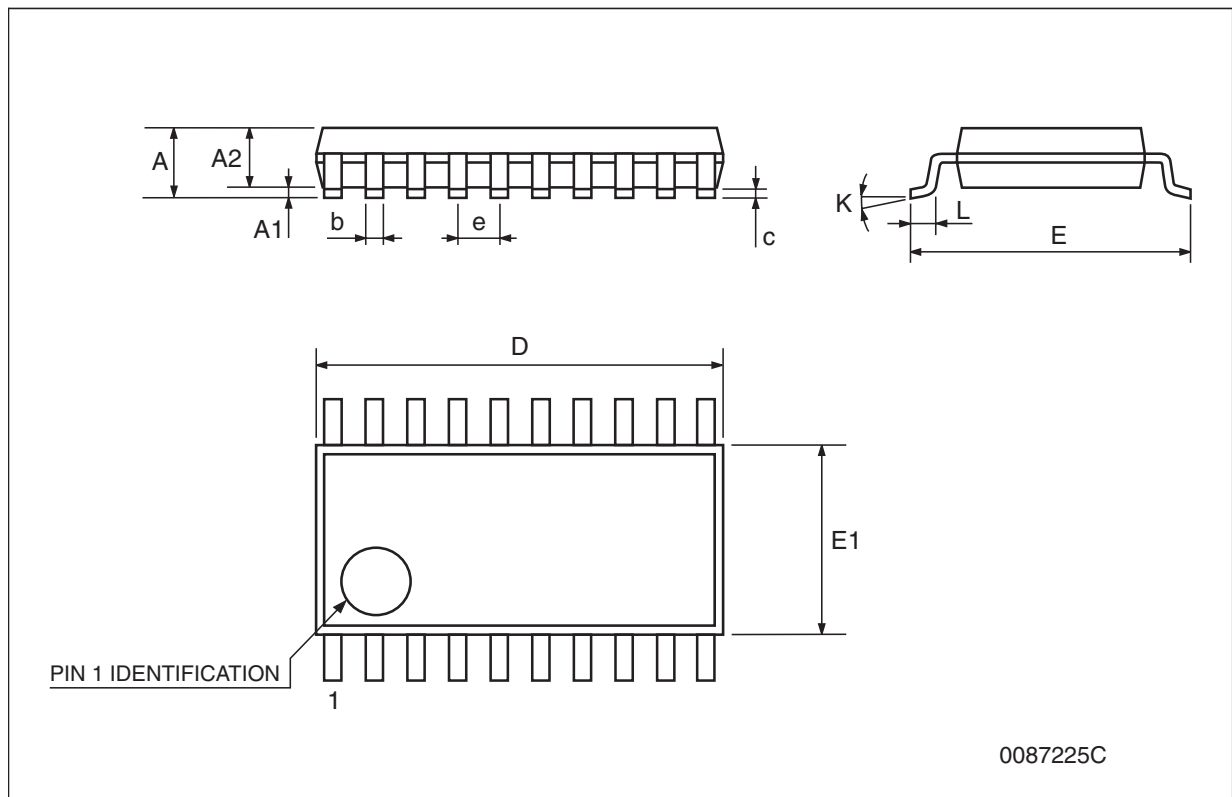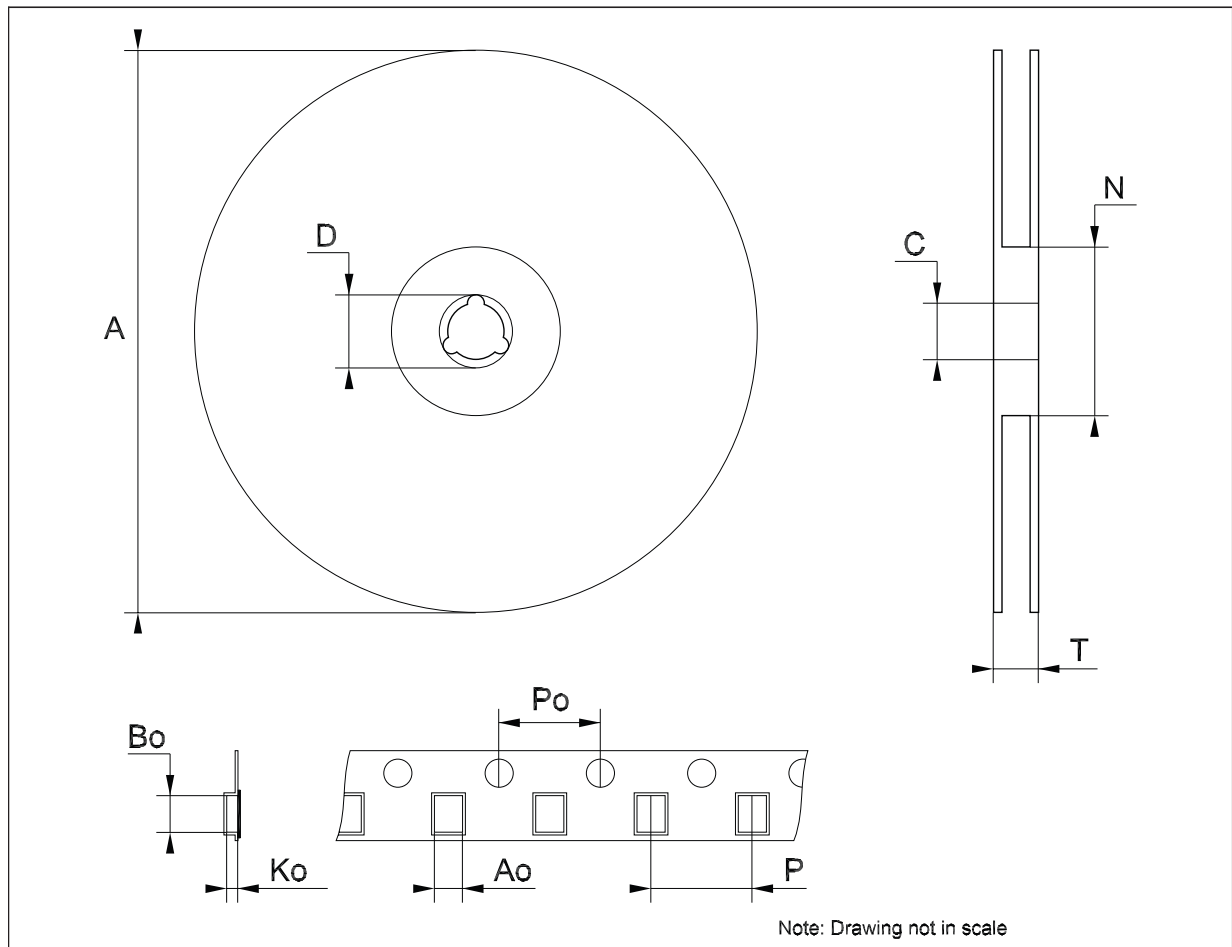| Dim. | mm. | | | inch. | | |
|------|-----|-----|-----|-------|-----|-----|
|      | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A    | 2.35 |     | 2.65 | 0.093 |     | 0.104 |
| A1   | 0.1  |     | 0.30 | 0.004 |     | 0.012 |
| B    | 0.33 |     | 0.51 | 0.013 |     | 0.020 |
| C    | 0.23 |     | 0.32 | 0.009 |     | 0.013 |
| D    | 12.60 |    | 13.00 | 0.496 |    | 0.512 |
| E    | 7.4  |     | 7.6  | 0.291 |     | 0.299 |
| e    |      | 1.27 |     |       | 0.050 |     |
| H    | 10.00 |    | 10.65 | 0.394 |    | 0.419 |
| h    | 0.25 |     | 0.75 | 0.010 |     | 0.030 |
| L    | 0.4  |     | 1.27 | 0.016 |     | 0.050 |
| k    | 0°   |     | 8°   | 0°    |     | 8°   |
| ddd  |      |     | 0.100 |       |     | 0.004 |



0016022D
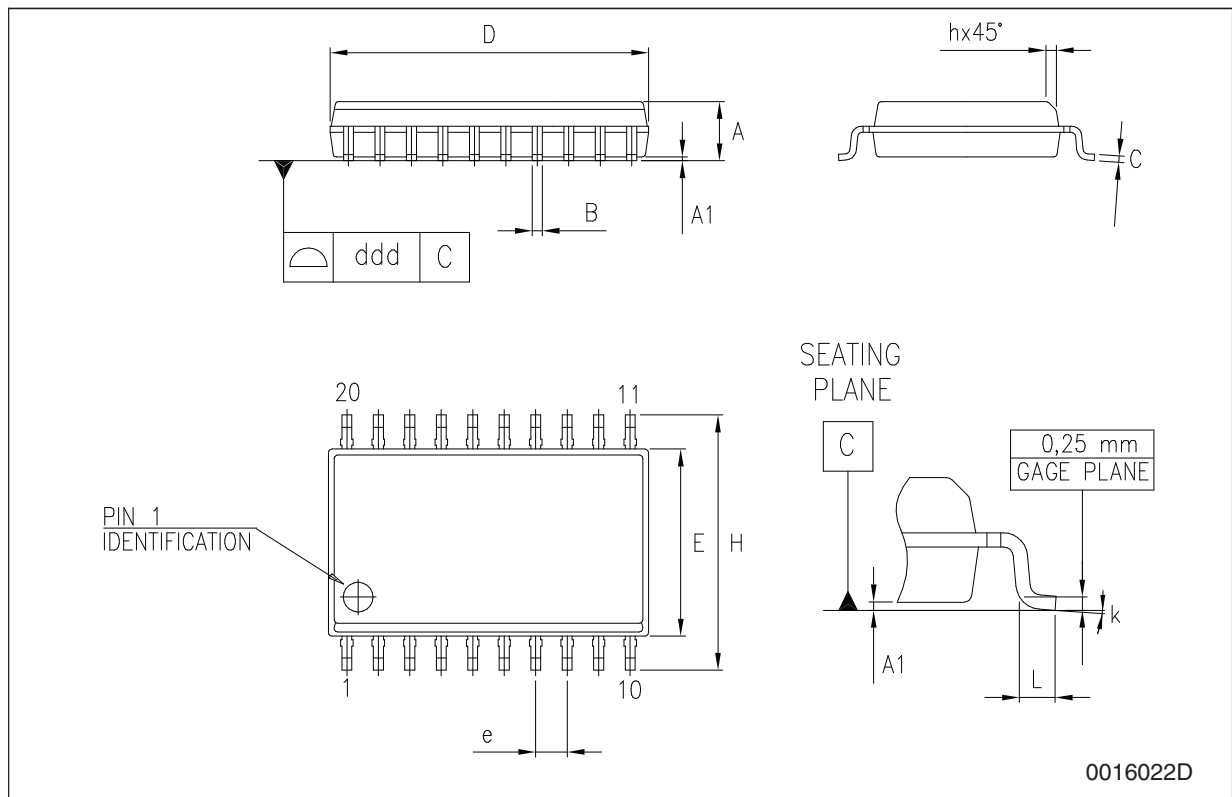
## TSSOP20 mechanical data

| 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 | | 0.0079 |
| D | 6.4 | 6.5 | 6.6 | 0.252 | 0.256 | 0.260 |
| 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 |

PIN 1 IDENTIFICATION

1

0087225C

## Tape & reel SO-20 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    |      |      | 30.4 |       |      | 1.197 |
| Ao   | 10.8 |      | 11   | 0.425 |      | 0.433 |
| Bo   | 13.2 |      | 13.4 | 0.520 |      | 0.528 |
| Ko   | 3.1  |      | 3.3  | 0.122 |      | 0.130 |
| Po   | 3.9  |      | 4.1  | 0.153 |      | 0.161 |
| P    | 11.9 |      | 12.1 | 0.468 |      | 0.476 |



Note: Drawing not in scale

## Tape & reel TSSOP20 mechanical data

| Dim. | mm. | | | inch. | | |
|------|------|------|------|------|------|------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 330 | | | 12.992 |
| C | 12.8 | | 13.2 | 0.504 | | 0.519 |
| D | 20.2 | | | 0.795 | | |
| N | 60 | | | 2.362 | | |
| T | | | 22.4 | | | 0.882 |
| Ao | 6.8 | | 7 | 0.268 | | 0.276 |
| Bo | 6.9 | | 7.1 | 0.272 | | 0.280 |
| Ko | 1.7 | | 1.9 | 0.067 | | 0.075 |
| Po | 3.9 | | 4.1 | 0.153 | | 0.161 |
| P | 11.9 | | 12.1 | 0.468 | | 0.476 |



Note: Drawing not in scale
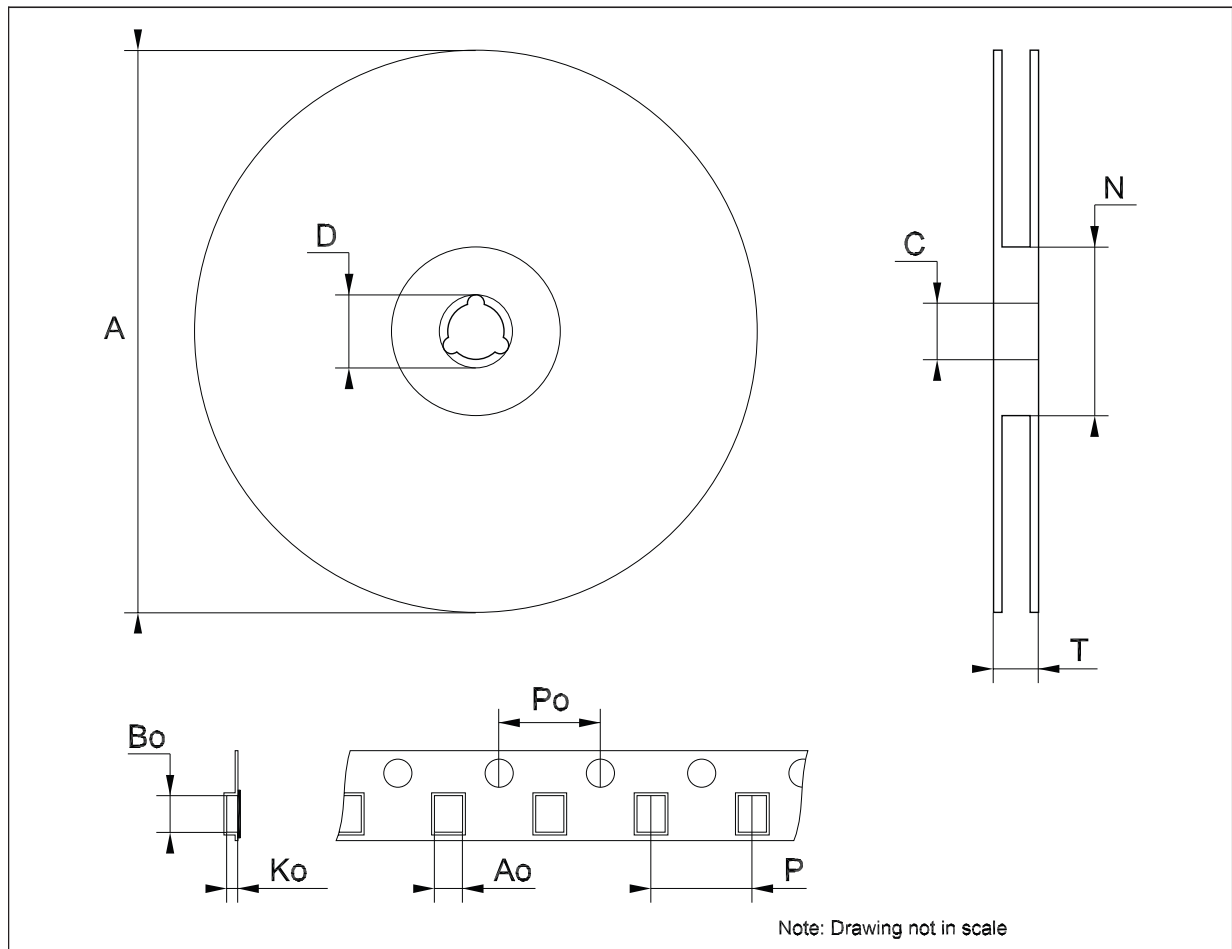
# 8 Revision history

**Table 12.    Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 28-Apr-2006 | 15 | Order codes updated. |
| 01-Jun-2006 | 16 | Modified: *Figure 2*. |
| 19-Dec-2007 | 17 | Added: *Table 5*. |
| 07-Apr-2009 | 18 | Modified *Table 5 on page 4*. |

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