

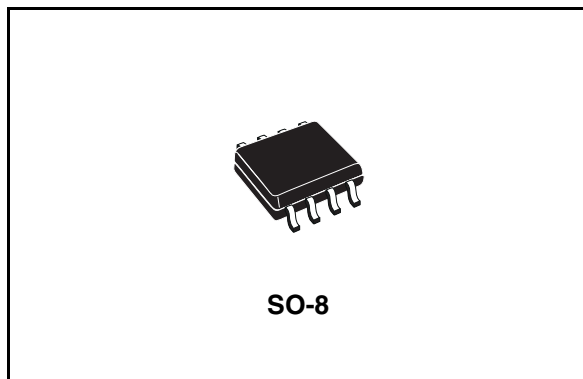


# ST485EB ST485EC - ST485EX

±15 kV ESD protected, low power  
RS-485/RS-422 transceiver

## Features

- Low quiescent current: 300  $\mu$ A
- Designed for RS-485 interface application
- - 7 V to 12 V common mode input voltage range
- Driver maintains high impedance in 3-state or with the power OFF
- 70 mV typical input hysteresis
- 30 ns propagation delay, 5 ns skew
- Operates from a single 5 V supply
- Current limiting and thermal shutdown for driver overload protection
- ESD protection:
  - ± 15 kV (HBM)
  - ± 8 kV (IEC-1000-4-2 contact discharge)
- Allows up to 256 transceivers on the bus



Driver is short-circuit current limited and is protected against excessive power dissipation by thermal shutdown circuitry that place the driver outputs into a high-impedance state.

The ST485E is designed for bi-directional data communications on multipoint bus transmission lines (half-duplex applications).

## Description

The ST485E is a low power transceiver for RS-485 and RS-422 communication. Each driver output and receiver input is protected against ± 15 kV electrostatic discharge (HBM) (ESD) shocks, without latch-up. These parts contain one driver and one receiver in half duplex configuration.

This transceiver draws 300  $\mu$ A (typ.) of supply current when unloaded or fully loaded with disabled drivers.

It operates from a single 5 V supply.

**Table 1. Device summary**

| Order codes | Temperature range | Package              | Packaging                            |
|-------------|-------------------|----------------------|--------------------------------------|
| ST485EBD    | - 40 to 85 °C     | SO-8 (tube)          | 100 parts per tube / 20 tube per box |
| ST485ECDR   | 0 to 70 °C        | SO-8 (tape and reel) | 2500 parts per reel                  |
| ST485EBDR   | - 40 to 85 °C     | SO-8 (tape and reel) | 2500 parts per reel                  |
| ST485EXDR   | - 55 to 125 °C    | SO-8 (tape and reel) | 2500 parts per reel                  |

# Contents

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# 1 Pin configuration

Figure 1. Pin connections (top view)

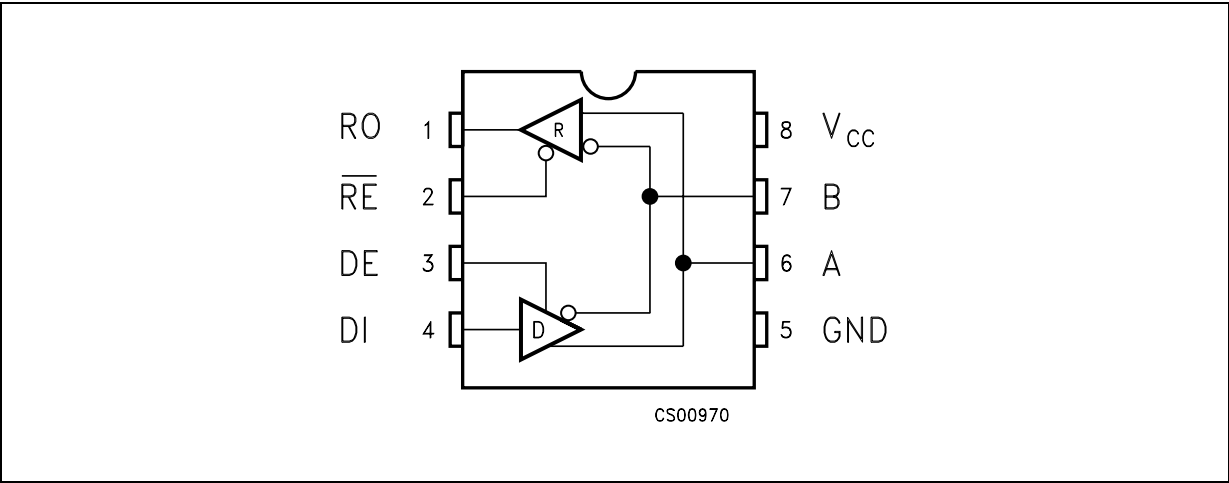


Table 2. Pin description

| Pin n° | Symbol          | Name and function  |
|--------|-----------------|--|
| 1      | RO              | Receiver output  |
| 2      | $\overline{RE}$ | Receiver output enable                                       |
| 3      | DE              | Driver output enable   |
| 4      | DI              | Driver input   |
| 5      | GND             | Ground   |
| 6      | A               | Non-inverting receiver input and non-inverting driver output |
| 7      | B               | Inverting receiver input and inverting driver output         |
| 8      | V <sub>CC</sub> | Supply voltage   |

## 2 Truth tables

**Table 3. Truth table (driver)**

| Inputs |    |    | Outputs |   |
|--------|----|----|---------|---|
| RE     | DE | DI | B       | A |
| X      | H  | H  | L       | H |
| X      | H  | L  | H       | L |
| X      | L  | X  | Z       | Z |

*Note:* X = Don't care; Z = High impedance

**Table 4. Truth table (receiver)**

| Inputs |    |              | Outputs |
|--------|----|--------------|---------|
| RE     | DE | A-B          | RO      |
| L      | L  | $\geq +0.2V$ | H       |
| L      | L  | $\leq -0.2V$ | L       |
| L      | L  | Inputs open  | H       |
| H      | L  | X            | Z       |

*Note:* X = Don't care; Z = High impedance

### 3 Maximum ratings

**Table 5. Absolute maximum ratings**

| Symbol   | Parameter                                     | Value                      | Unit |
|----------|---|----------------------------|------|
| $V_{CC}$ | Supply voltage                                | 7                          | V    |
| $V_I$    | Control input voltage ( $\overline{RE}$ , DE) | -0.5 to ( $V_{CC} + 0.5$ ) | V    |
| $V_{DI}$ | Driver input voltage (DI)                     | -0.5 to ( $V_{CC} + 0.5$ ) | V    |
| $V_{DO}$ | Driver output voltage (A, B)                  | $\pm 14$                   | V    |
| $V_{RI}$ | Receiver input voltage (A, B)                 | $\pm 14$                   | V    |
| $V_{RO}$ | Receiver output voltage (RO)                  | -0.5 to ( $V_{CC} + 0.5$ ) | V    |

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

## 4 Electrical characteristics

**Table 6. 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   |

$V_{CC} = 5\text{ V} \pm 5\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are referred to  $T_A = 25\text{ °C}$

**Table 7. DC electrical characteristics**

| Symbol          | Parameter   | Test conditions <sup>(1)</sup>   | Min. | Typ.       | Max.       | Unit     |
|-----------------|---|--|------|------------|------------|----------|
| $V_{OD1}$       | Differential driver output (no load)  |  |      |            | 5          | V        |
| $V_{OD2}$       | Differential driver output (with load)  | $R_L = 27\ \Omega$ (RS-485) ( <a href="#">Figure 2</a> )<br>$R_L = 50\ \Omega$ (RS-422) ( <a href="#">Figure 2</a> ) | 1.5  |            | 5<br>5     | V<br>V   |
| $\Delta V_{OD}$ | Change in magnitude of driver differential output voltage for complementary output states | $R_L = 27\ \Omega$ or $50\ \Omega$ ( <a href="#">Figure 2</a> )  |      |            | 0.2        | V        |
| $V_{OC}$        | Driver common-mode output voltage   | $R_L = 27\ \Omega$ or $50\ \Omega$ ( <a href="#">Figure 2</a> )  |      |            | 3          | V        |
| $\Delta V_{OC}$ | Change in magnitude of driver common-mode output voltage for complementary output states  | $R_L = 27\ \Omega$ or $50\ \Omega$ ( <a href="#">Figure 2</a> )  |      |            | 0.2        | V        |
| $V_{IH}$        | Input high voltage  | $\overline{RE}$ , DE, DI   | 2.0  |            |            | V        |
| $V_{IL}$        | Input low voltage   | $\overline{RE}$ , DE, DI   |      |            | 0.8        | V        |
| $I_{IN1}$       | Input current   | $\overline{RE}$ , DE, DI   |      |            | ± 2        | μA       |
| $I_{IN2}$       | Input current (A, B)  | $V_{CM} = 0\text{ V}$ or $5.25\text{ V}$ , $V_{DE} = 0\text{ V}$<br>$V_{IN} = 12\text{ V}$<br>$V_{IN} = -7\text{ V}$ |      |            | 1<br>-0.8  | mA<br>mA |
| $V_{TH}$        | Receiver differential threshold voltage   | $V_{CM} = -7$ to $12\text{ V}$   | -0.2 |            | 0.2        | V        |
| $\Delta V_{TH}$ | Receiver input hysteresis   | $V_{CM} = 0\text{ V}$  |      | 70         |            | mV       |
| $V_{OH}$        | Receiver output high voltage  | $I_O = -4\text{ mA}$ , $V_{ID} = 200\text{ mV}$  | 3.5  |            |            | V        |
| $V_{OL}$        | Receiver output low voltage   | $I_O = 4\text{ mA}$ , $V_{ID} = -200\text{ mV}$  |      |            | 0.4        | V        |
| $I_{OZR}$       | 3-State (high impedance) output current at receiver                                       | $V_O = 0.4$ to $2.4\text{ V}$  |      |            | ± 1        | μA       |
| $R_{IN}$        | Receiver input resistance   | $V_{CM} = -7$ to $12\text{ V}$   | 96   |            |            | kΩ       |
| $I_{CC}$        | No load supply current <sup>(2)</sup>   | $V_{RE} = 0\text{ V}$ or $V_{CC}$<br>$V_{DE} = V_{CC}$<br>$V_{DE} = 0\text{ V}$                                      |      | 400<br>300 | 900<br>500 | μA<br>μA |

**Table 7. DC electrical characteristics (continued)**

| Symbol     | Parameter   | Test conditions <sup>(1)</sup>            | Min. | Typ. | Max. | Unit |
|------------|---|---|------|------|------|------|
| $I_{OSD1}$ | Driver short-circuit current, $V_O = \text{High}$ | $V_O = -7 \text{ to } 12 \text{ V}^{(3)}$ | 35   |      | 250  | mA   |
| $I_{OSD2}$ | Driver short-circuit current, $V_O = \text{Low}$  | $V_O = -7 \text{ to } 12 \text{ V}^{(3)}$ | 35   |      | 250  | mA   |
| $I_{OSR}$  | Receiver short-circuit current                    | $V_O = 0 \text{ V to } V_{CC}$            | 7    |      | 95   | mA   |

1. All currents into device pins are positive; all out of device pins are negative; all voltages are referenced to device ground unless specified.
2. Supply current specification is valid for loaded transmitters when  $V_{DE} = 0 \text{ V}$
3. Applies to peak current. See typical Operating Characteristics.

$V_{CC} = 5 \text{ V} \pm 5 \%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are referred to  $T_A = 25 \text{ }^\circ\text{C}$

**Table 8. Driver switching characteristics**

| Symbol                 | Parameter                         | Test conditions <sup>(1)</sup>   | Min. | Typ. | Max. | Unit |
|------------------------|-----------------------------------|--|------|------|------|------|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay input to output | $R_{DIFF} = 54 \text{ } \Omega$ , $C_{L1} = C_{L2} = 100 \text{ pF}$<br>(See <a href="#">Figure 4</a> and <a href="#">Figure 6</a> ) |      | 25   | 45   | ns   |
| $t_{SK}$               | Output skew to output             | $R_{DIFF} = 54 \text{ } \Omega$ , $C_{L1} = C_{L2} = 100 \text{ pF}$<br>(See <a href="#">Figure 4</a> and <a href="#">Figure 6</a> ) |      | 2    | 5    | ns   |
| $t_{TLH}$<br>$t_{THL}$ | Rise or fall time                 | $R_{DIFF} = 54 \text{ } \Omega$ , $C_{L1} = C_{L2} = 100 \text{ pF}$<br>(See <a href="#">Figure 4</a> and <a href="#">Figure 6</a> ) |      | 15   | 40   | ns   |
| $t_{PZH}$              | Output enable time                | $C_L = 100 \text{ pF}$ , $S2 = \text{Closed}$<br>(See <a href="#">Figure 5</a> and <a href="#">Figure 7</a> )                        |      | 35   | 50   | ns   |
| $t_{PZL}$              | Output enable time                | $C_L = 100 \text{ pF}$ , $S1 = \text{Closed}$<br>(See <a href="#">Figure 5</a> and <a href="#">Figure 7</a> )                        |      | 25   | 40   | ns   |
| $t_{PLZ}$              | Output disable time               | $C_L = 15 \text{ pF}$ , $S1 = \text{Closed}$<br>(See <a href="#">Figure 5</a> and <a href="#">Figure 7</a> )                         |      | 25   | 40   | ns   |
| $t_{PHZ}$              | Output disable time               | $C_L = 15 \text{ pF}$ , $S2 = \text{Closed}$<br>(See <a href="#">Figure 5</a> and <a href="#">Figure 7</a> )                         |      | 35   | 50   | ns   |

1. All currents into device pins are positive; all out of device pins are negative; all voltages are referenced to device ground unless specified.

$V_{CC} = 5\text{ V} \pm 5\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are referred to  $T_A = 25\text{ }^{\circ}\text{C}$

**Table 9. Receiver switching characteristics**

| Symbol                 | Parameter                         | Test conditions <sup>(1)</sup>  | Min. | Typ. | Max. | Unit |
|------------------------|-----------------------------------|---|------|------|------|------|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay input to output | $R_{DIFF} = 54\text{ }\Omega$ , $C_{L1} = C_{L2} = 100\text{ pF}$<br>(See <a href="#">Figure 4</a> and <a href="#">Figure 8</a> ) |      | 110  | 130  | ns   |
| $t_{SKD}$              | Differential receiver skew        | $R_{DIFF} = 54\text{ }\Omega$ , $C_{L1} = C_{L2} = 100\text{ pF}$<br>(See <a href="#">Figure 4</a> and <a href="#">Figure 8</a> ) |      | 5    | 10   | ns   |
| $t_{PZH}$              | Output enable time                | $C_{RL} = 15\text{ pF}$ , S1 = Closed<br>(See <a href="#">Figure 2</a> and <a href="#">Figure 9</a> )                             |      | 11   | 35   | ns   |
| $t_{PZL}$              | Output enable time                | $C_{RL} = 15\text{ pF}$ , S2 = Closed<br>(See <a href="#">Figure 2</a> and <a href="#">Figure 9</a> )                             |      | 13   | 35   | ns   |
| $t_{PLZ}$              | Output disable time               | $C_{RL} = 15\text{ pF}$ , S1 = Closed<br>(See <a href="#">Figure 2</a> and <a href="#">Figure 9</a> )                             |      | 13   | 35   | ns   |
| $t_{PHZ}$              | Output disable time               | $C_{RL} = 15\text{ pF}$ , S2 = Closed<br>(See <a href="#">Figure 2</a> and <a href="#">Figure 9</a> )                             |      | 11   | 35   | ns   |
| $f_{MAX}$              | Maximum data rate                 |   | 5    |      |      | Mbps |

1. All currents into device pins are positive; all out of device pins are negative; all voltages are referenced to device ground unless specified



# 5 Test circuit and typical characteristics

Figure 2. Driver DC test load

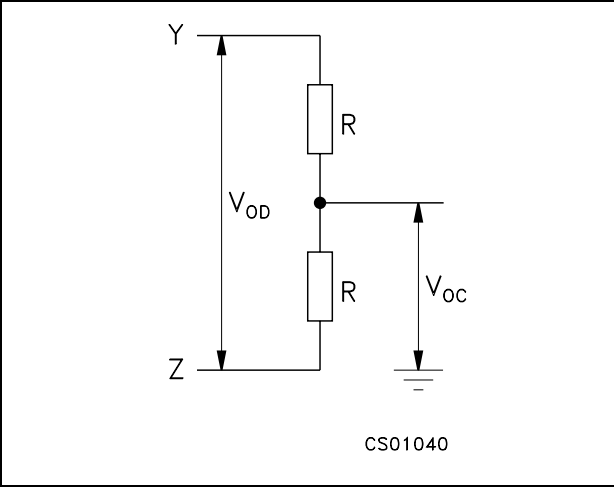


Figure 3. Receiver timing test load

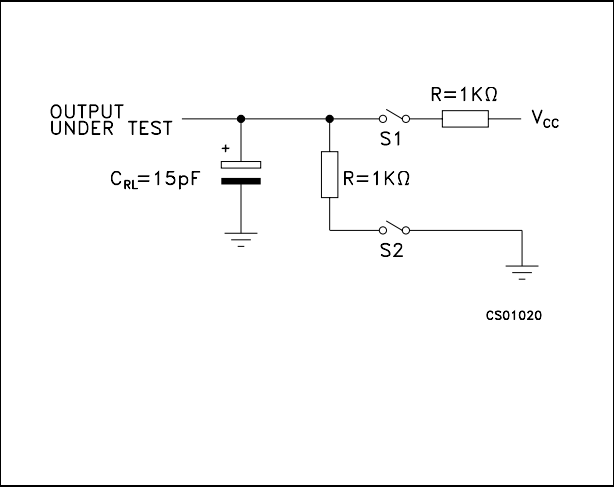


Figure 4. Drive/receiver timing test circuit

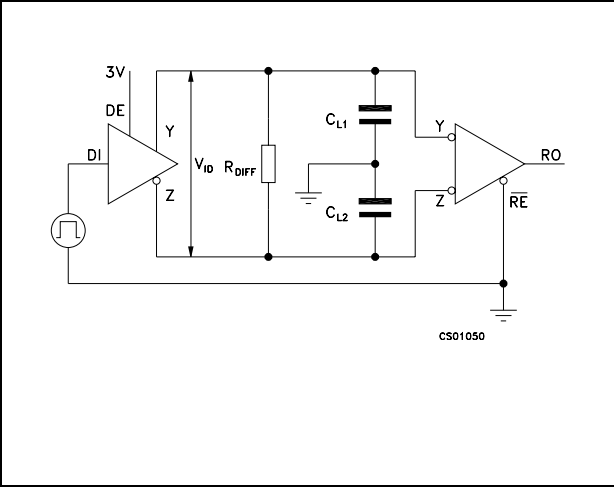
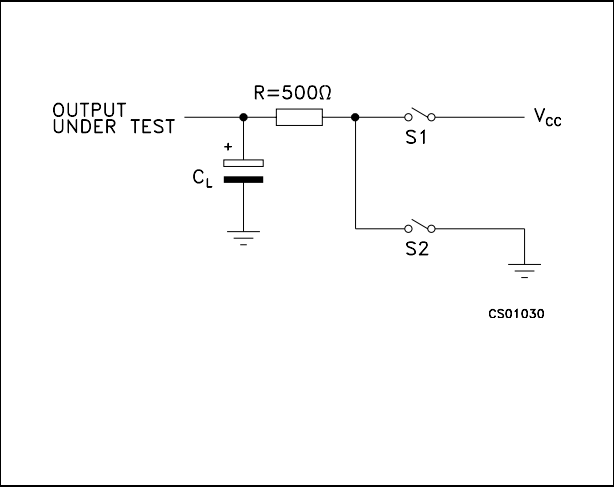
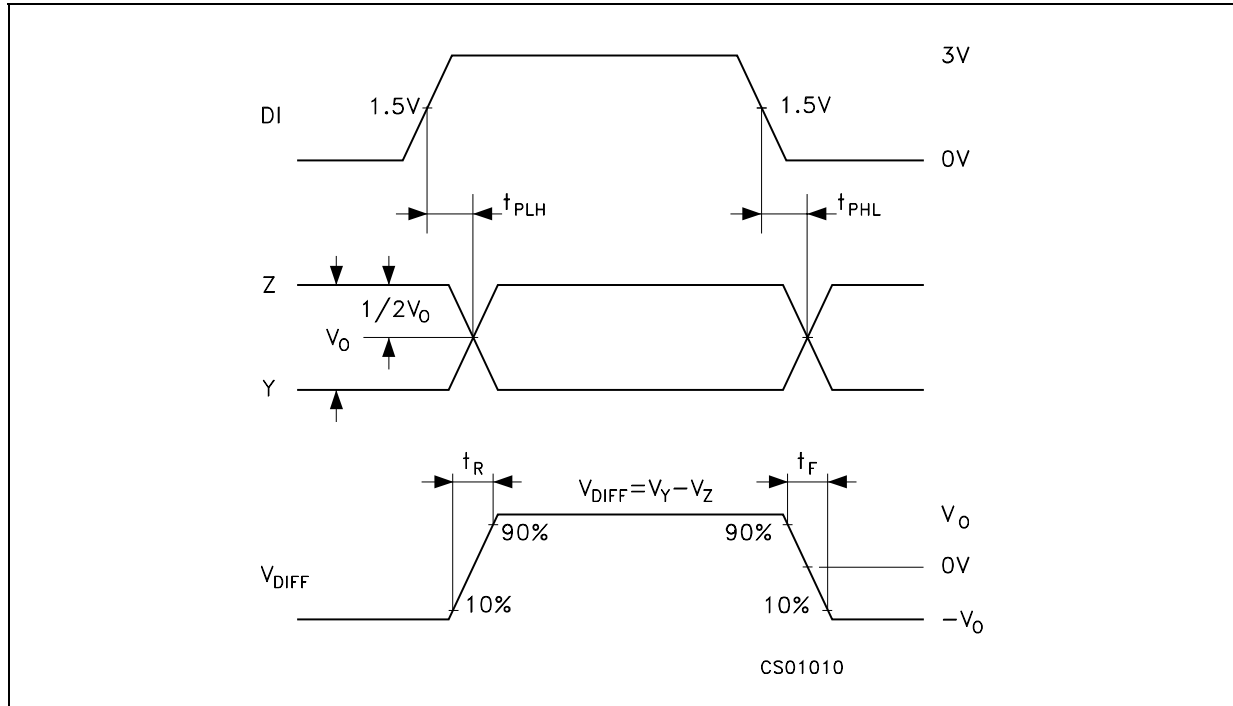
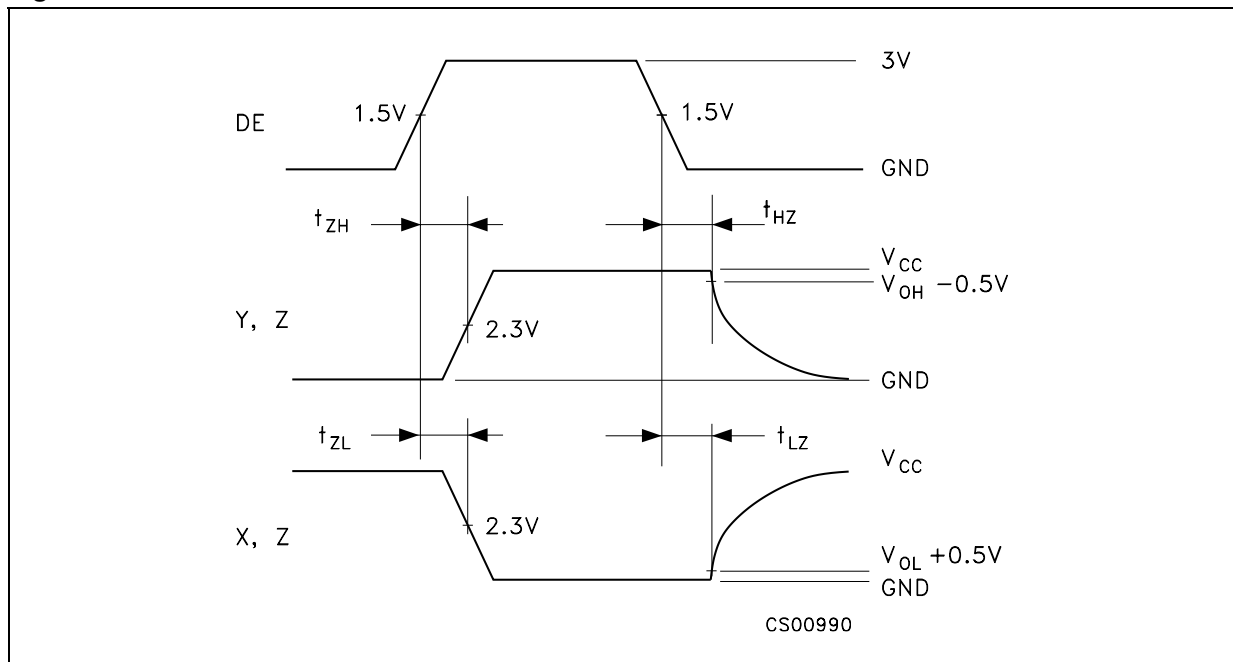


Figure 5. Driver timing test load



**Figure 6. Driver propagation delay****Figure 7. Driver enable and disable time**

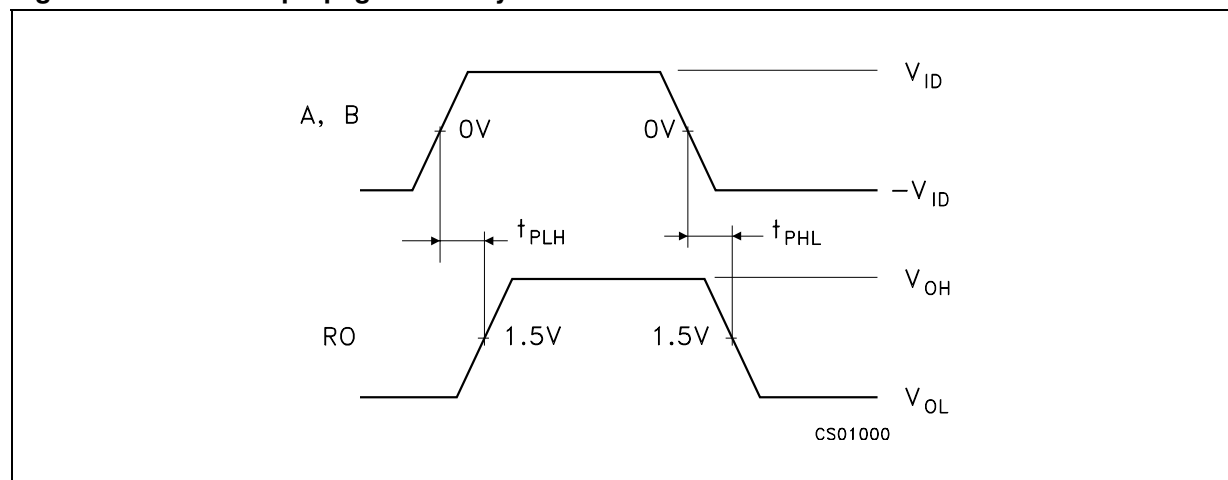
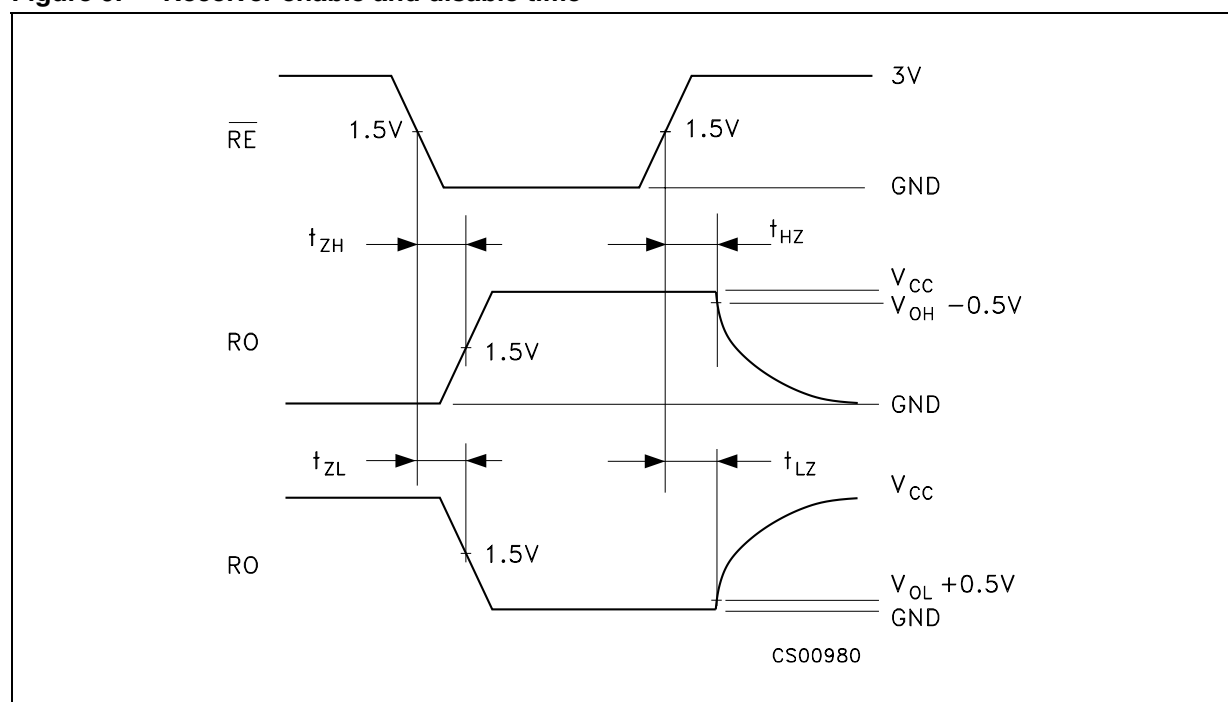
**Figure 8. Receiver propagation delay****Figure 9. Receiver enable and disable time**

Figure 10. Receiver output current vs. output low voltage

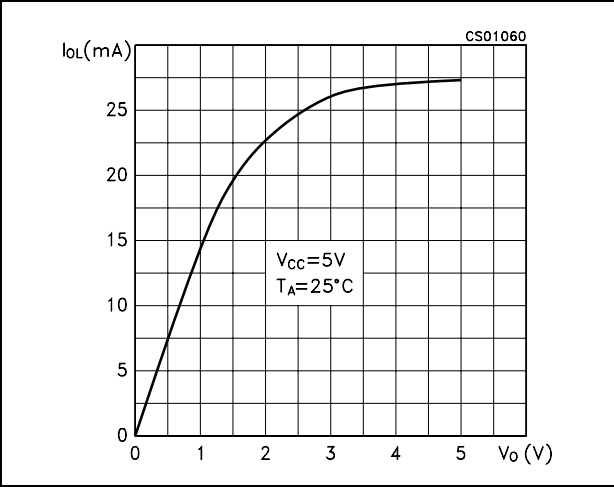


Figure 11. Receiver output current vs. output high voltage

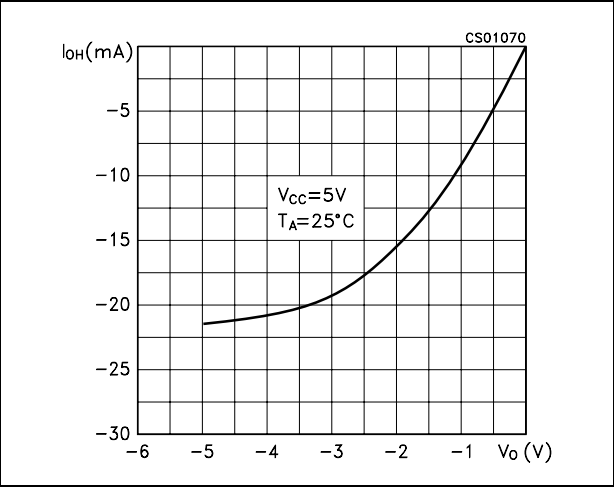


Figure 12. Driver output current vs. output low voltage

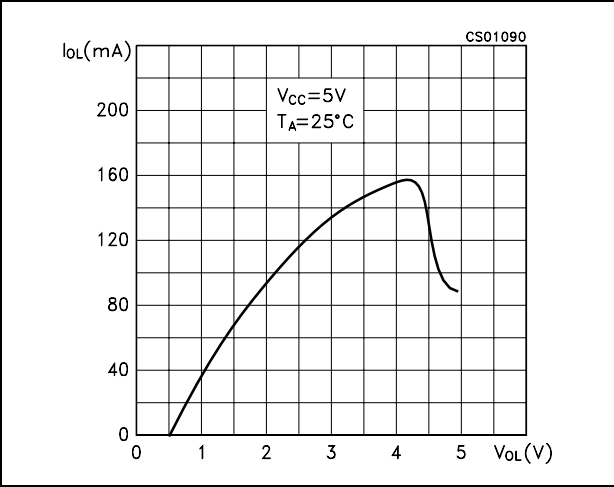


Figure 13. Driver output current vs. output high voltage

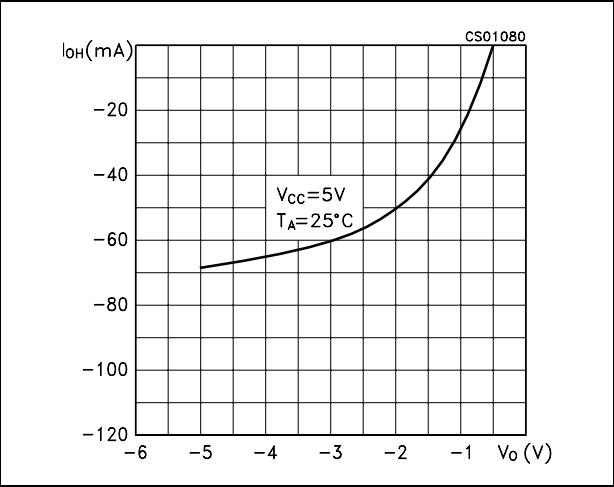


Figure 14. Supply current vs. temperature

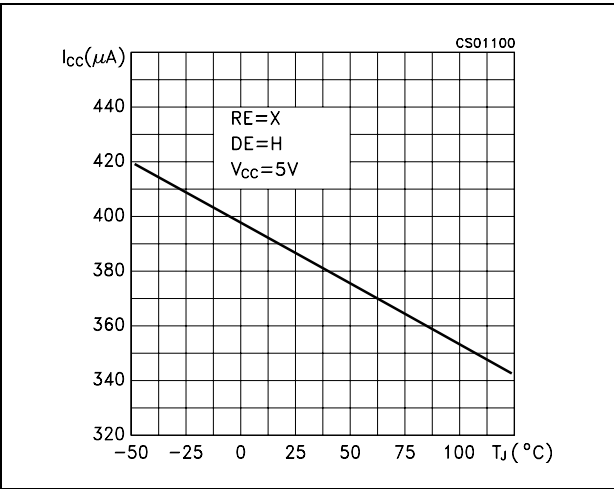


Figure 15. Receiver high level output voltage vs. temperature

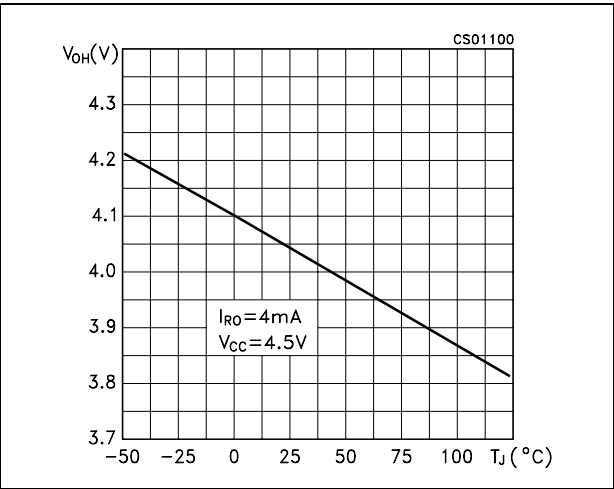


Figure 16. Receiver low level output voltage vs. temperature

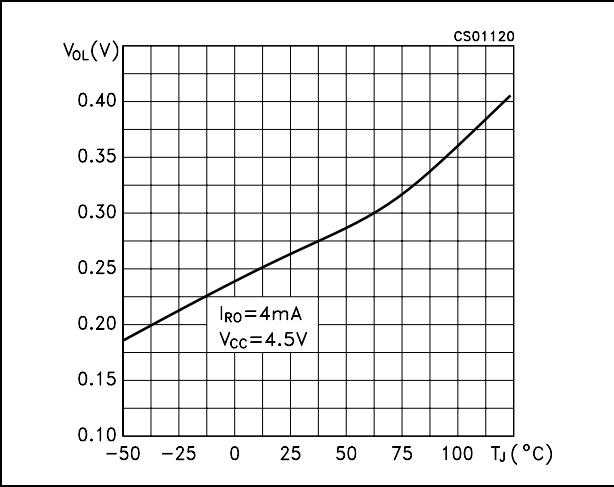
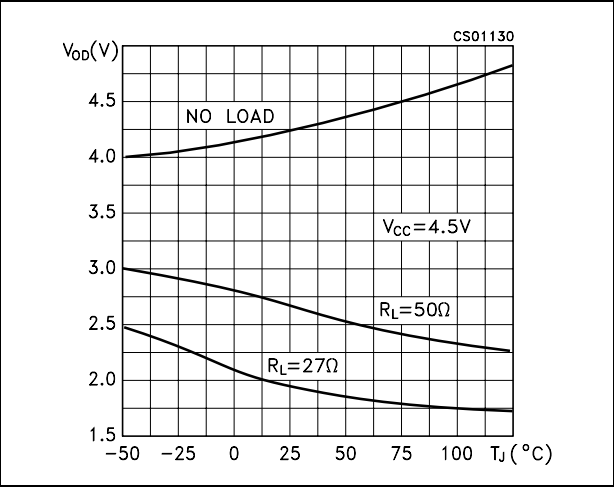


Figure 17. Differential driver output voltage vs. temperature

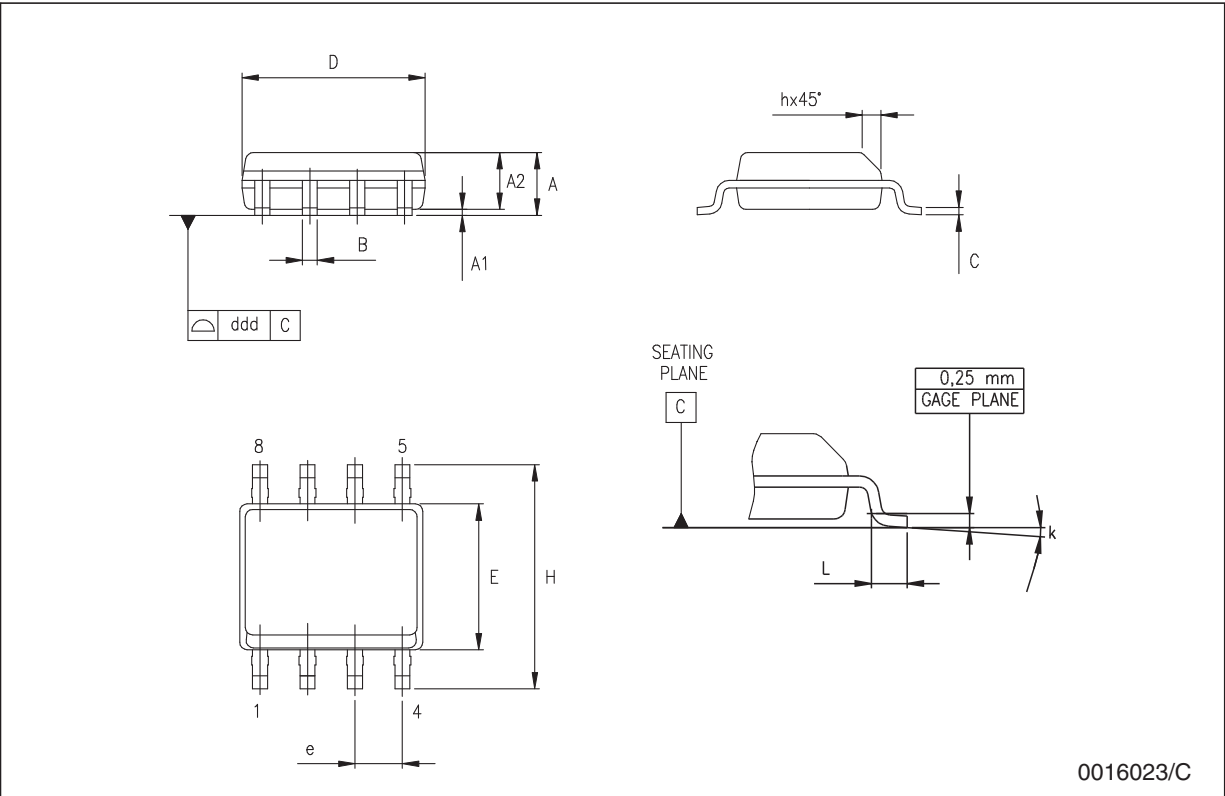


## 6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

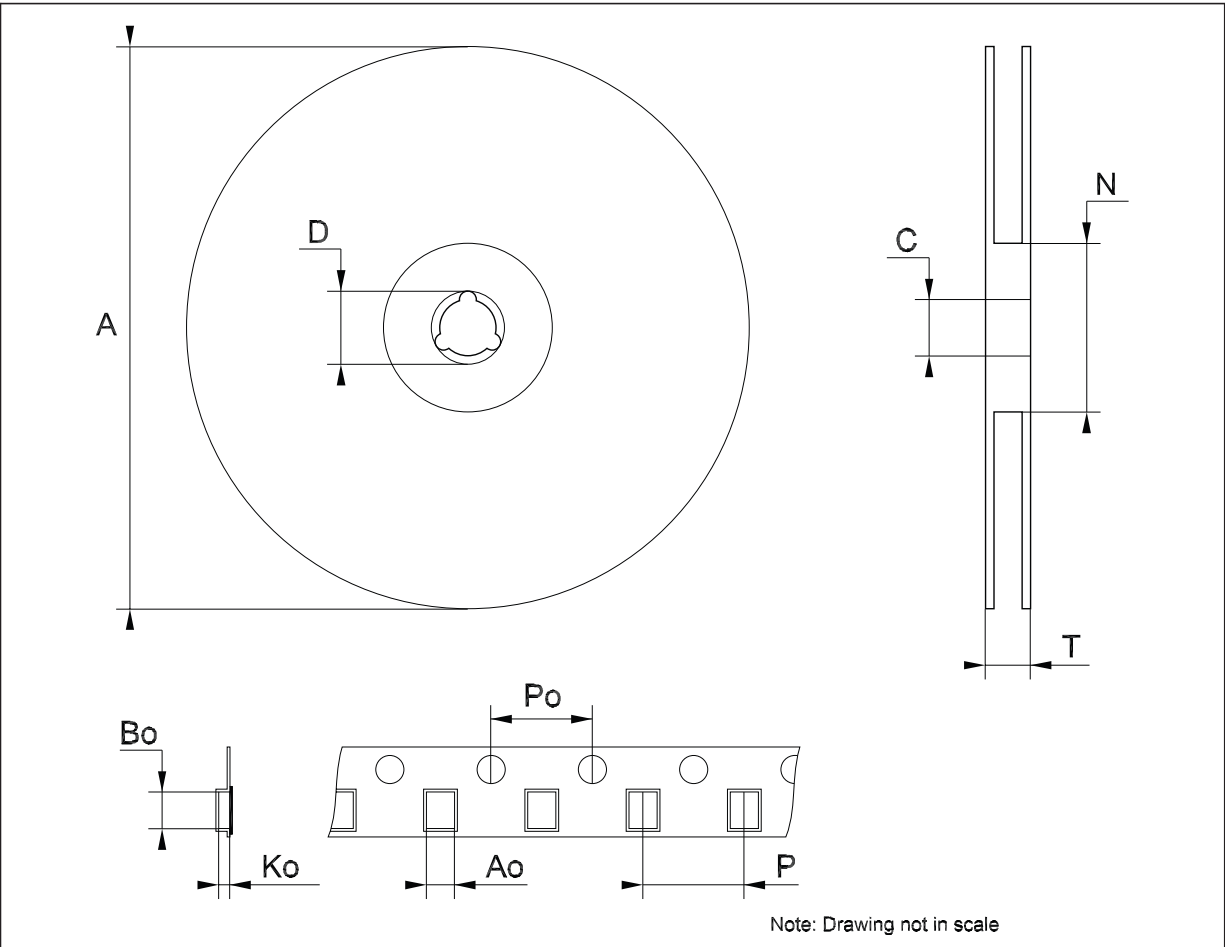
SO-8 mechanical data

| Dim. | mm.       |      |      | inch. |       |       |
|------|-----------|------|------|-------|-------|-------|
|      | Min.      | Typ. | Max. | Min.  | Typ.  | Max.  |
| A    | 1.35      |      | 1.75 | 0.053 |       | 0.069 |
| A1   | 0.10      |      | 0.25 | 0.04  |       | 0.010 |
| A2   | 1.10      |      | 1.65 | 0.043 |       | 0.065 |
| B    | 0.33      |      | 0.51 | 0.013 |       | 0.020 |
| C    | 0.19      |      | 0.25 | 0.007 |       | 0.010 |
| D    | 4.80      |      | 5.00 | 0.189 |       | 0.197 |
| E    | 3.80      |      | 4.00 | 0.150 |       | 0.157 |
| e    |           | 1.27 |      |       | 0.050 |       |
| H    | 5.80      |      | 6.20 | 0.228 |       | 0.244 |
| h    | 0.25      |      | 0.50 | 0.010 |       | 0.020 |
| L    | 0.40      |      | 1.27 | 0.016 |       | 0.050 |
| k    | 8° (max.) |      |      |       |       |       |
| ddd  |           |      | 0.1  |       |       | 0.04  |



Tape & reel SO-8 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   | 8.1  |      | 8.5  | 0.319 |      | 0.335  |
| Bo   | 5.5  |      | 5.9  | 0.216 |      | 0.232  |
| Ko   | 2.1  |      | 2.3  | 0.082 |      | 0.090  |
| Po   | 3.9  |      | 4.1  | 0.153 |      | 0.161  |
| P    | 7.9  |      | 8.1  | 0.311 |      | 0.319  |





## 7 Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 21-Mar-2006 | 9        | Order codes has been updated and new template.                                |
| 05-Jun-2006 | 10       | Change value row 10 on the features and $R_{IN}$ in <a href="#">Table 7</a> . |
| 29-Jan-2007 | 11       | Typo mistake on page 1.   |
| 29-Aug-2007 | 12       | Change value $R_{IN}$ min. on <a href="#">Table 7</a> .                       |
| 07-Feb-2008 | 13       | Modified: <a href="#">Table 1 on page 1</a> .                                 |
| 16-Feb-2009 | 14       | Modified: <a href="#">Note: on page 5</a> .                                   |

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