

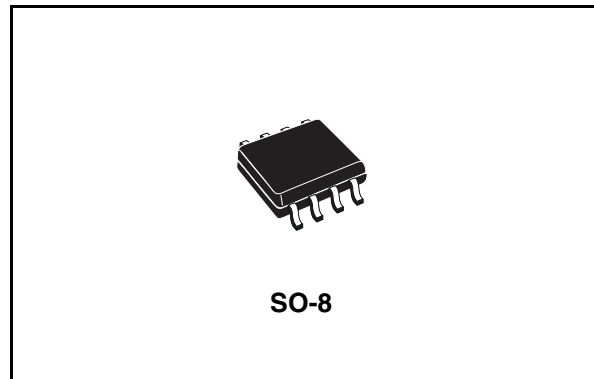


# ST485EB ST485EC - ST485EX

±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 (H.B.M.)
  - ±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 (H.B.M.) (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)	100parts per tube / 20tube 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

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# 1 Pin configuration

Figure 1. Pin connections (top view)

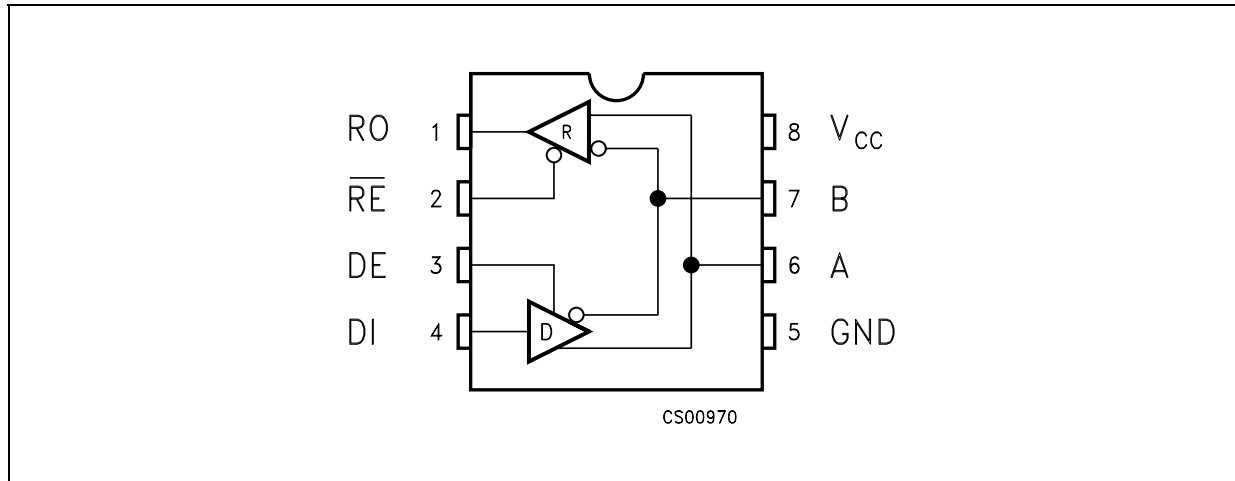


Table 2. Pin description

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	$V_{CC}$	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.  $V+$  and  $V-$  can have a maximum magnitude of +7 V, but their absolute addition exceed 13 V.

## 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

**Table 7. DC electrical characteristics** ( $V_{CC} = 5\text{ V} \pm 5\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are referred to  $T_A = 25\text{ °C}$ )

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) ( <i>Figure 2</i> ) $R_L = 50\ \Omega$ (RS-422) ( <i>Figure 2</i> )	1.5		5 5	V V
$\Delta V_{OD}$	Change in magnitude of driver differential output voltage for complementary output states	$R_L = 27\ \Omega$ or $50\ \Omega$ ( <i>Figure 2</i> )			0.2	V
$V_{OC}$	Driver common-mode output voltage	$R_L = 27\ \Omega$ or $50\ \Omega$ ( <i>Figure 2</i> )			3	V
$\Delta V_{OC}$	Change in magnitude of driver common-mode output voltage for complementary output states	$R_L = 27\ \Omega$ or $50\ \Omega$ ( <i>Figure 2</i> )			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 $5.25\text{ V}$ , $V_{DE} = 0\text{ V}$ $V_{IN} = 12\text{ V}$ $V_{IN} = -7\text{ V}$			1 -0.8	mA 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 $V_{CC}$ $V_{DE} = V_{CC}$ $V_{DE} = 0\text{ V}$		400 300	900 500	μA μA
$I_{OSD1}$	Driver short-circuit current, $V_O = \text{High}$	$V_O = -7$ to $12\text{ V}$ <sup>(3)</sup>	35		250	mA

**Table 7. DC electrical characteristics (continued)** ( $V_{CC} = 5\text{ V} \pm 5\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are referred to  $T_A = 25\text{ }^\circ\text{C}$ )

Symbol	Parameter	Test conditions <sup>(1)</sup>	Min.	Typ.	Max.	Unit
$I_{OSD2}$	Driver short-circuit current, $V_O = \text{Low}$	$V_O = -7$ to $12\text{ V}$ <sup>(3)</sup>	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.

**Table 8. Driver switching characteristics** ( $V_{CC} = 5\text{ V} \pm 5\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are referred to  $T_A = 25\text{ }^\circ\text{C}$ )

Symbol	Parameter	Test conditions <sup>(1)</sup>	Min.	Typ.	Max.	Unit
$t_{PLH}$ $t_{PHL}$	Propagation delay input to output	$R_{DIFF} = 54\ \Omega$ , $C_{L1} = C_{L2} = 100\text{ pF}$ (See <a href="#">Figure 4</a> and <a href="#">Figure 6</a> )		25	45	ns
$t_{SK}$	Output skew to output	$R_{DIFF} = 54\ \Omega$ , $C_{L1} = C_{L2} = 100\text{ pF}$ (See <a href="#">Figure 4</a> and <a href="#">Figure 6</a> )		2	5	ns
$t_{TLH}$ $t_{THL}$	Rise or fall time	$R_{DIFF} = 54\ \Omega$ , $C_{L1} = C_{L2} = 100\text{ pF}$ (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 = Closed (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 = Closed (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 = Closed (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 = Closed (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.

**Table 9. Receiver switching characteristics** ( $V_{CC} = 5\text{ V} \pm 5\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise specified. Typical values are referred to  $T_A = 25\text{ }^\circ\text{C}$ )

Symbol	Parameter	Test conditions <sup>(1)</sup>	Min.	Typ.	Max.	Unit
$t_{PLH}$ $t_{PHL}$	Propagation delay input to output	$R_{DIFF} = 54\ \Omega$ , $C_{L1} = C_{L2} = 100\text{ pF}$ (See <a href="#">Figure 4</a> and <a href="#">Figure 8</a> )		110	130	ns
$t_{SKD}$	Differential receiver skew	$R_{DIFF} = 54\ \Omega$ , $C_{L1} = C_{L2} = 100\text{ pF}$ (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 (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 (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 (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 (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

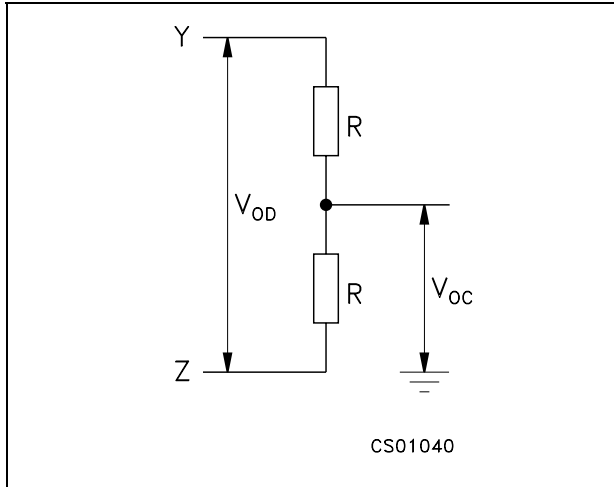


Figure 3. Receiver timing test load

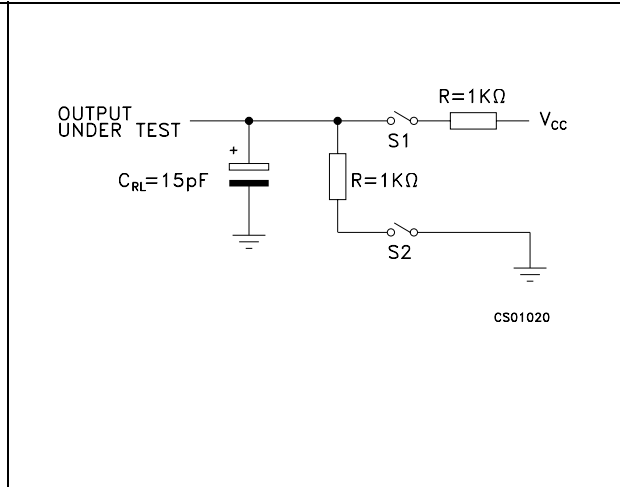


Figure 4. Drive/receiver timing test circuit

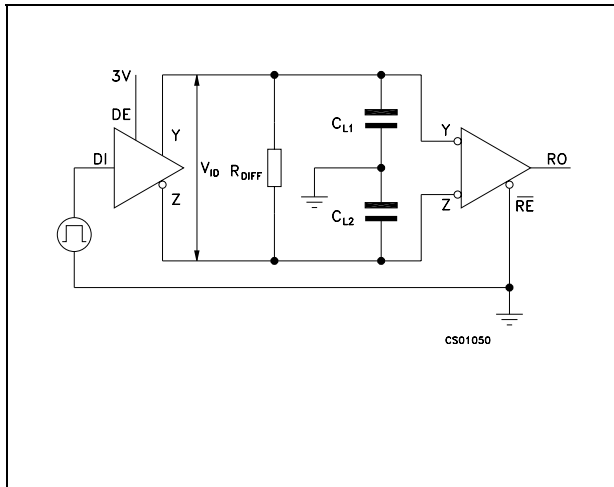


Figure 5. Driver timing test load

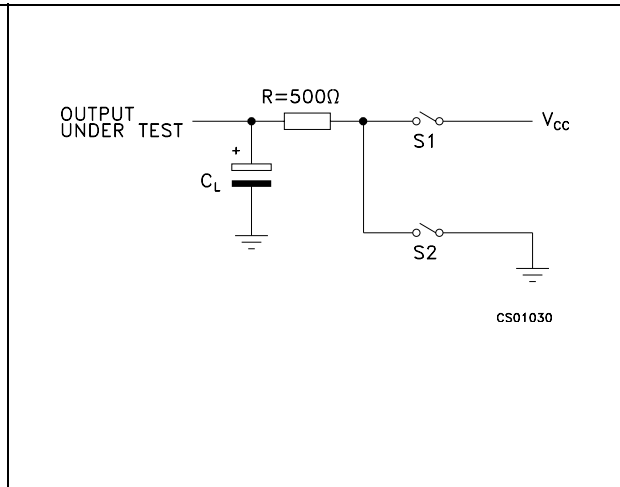


Figure 6. Driver propagation delay

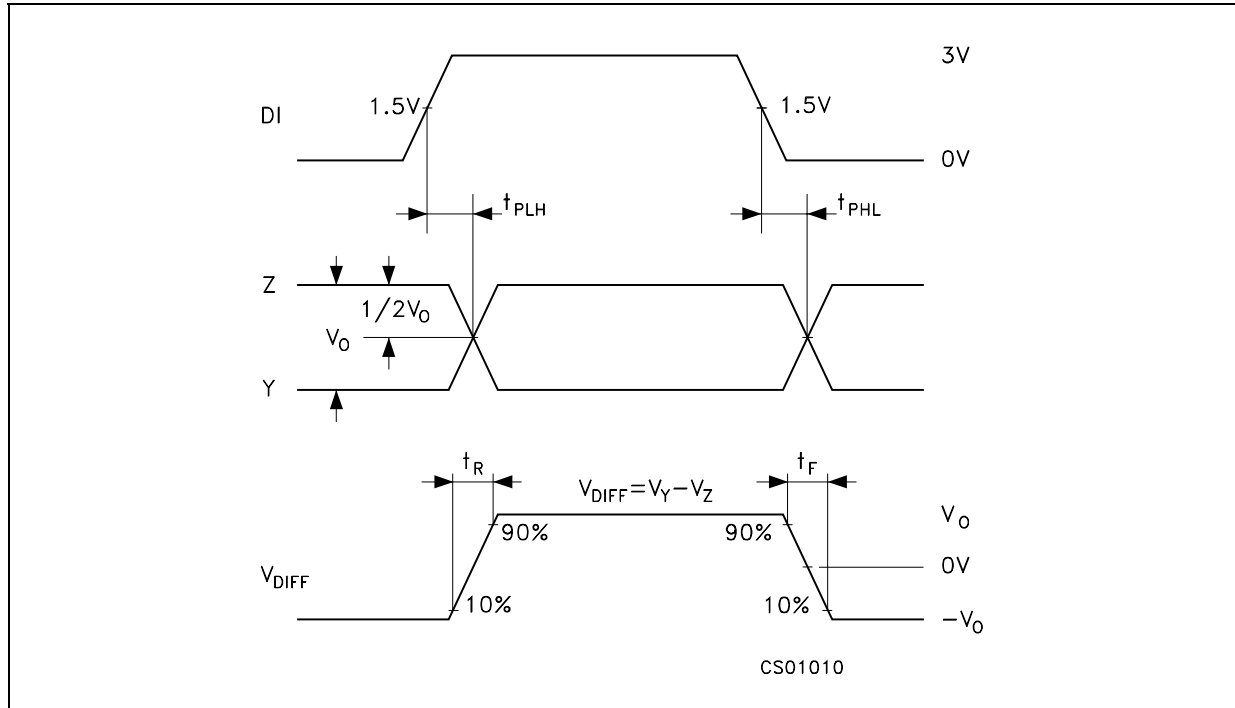


Figure 7. Driver enable and disable time

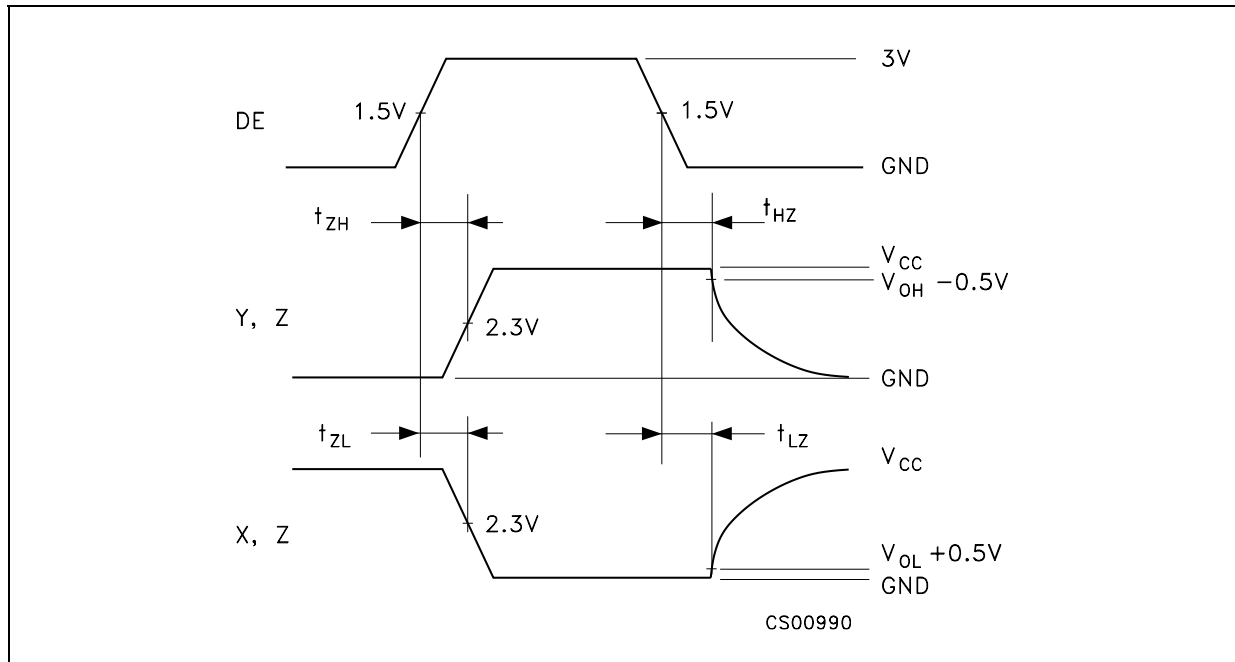


Figure 8. Receiver propagation delay

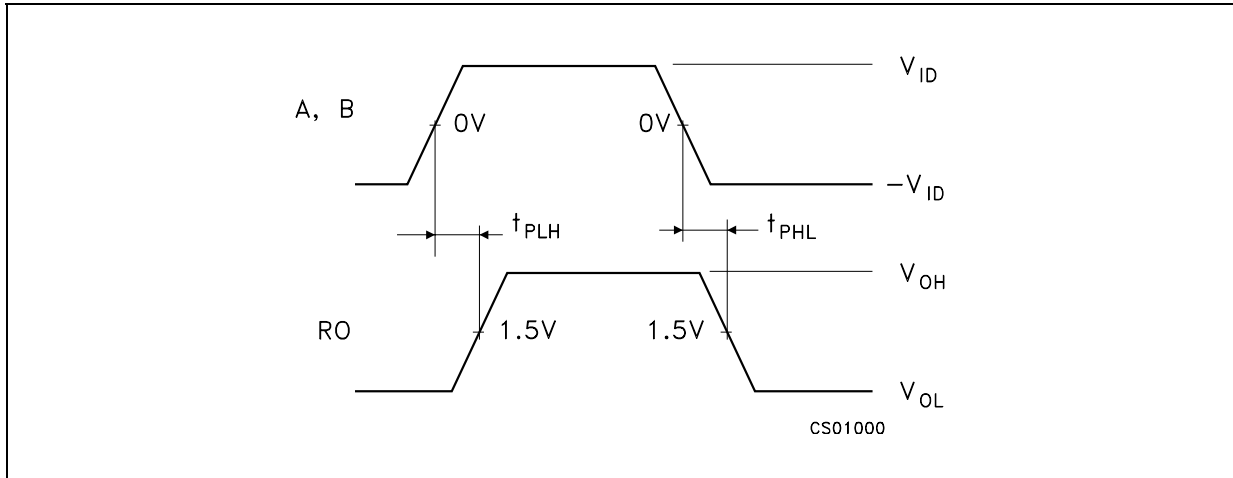


Figure 9. Receiver enable and disable time

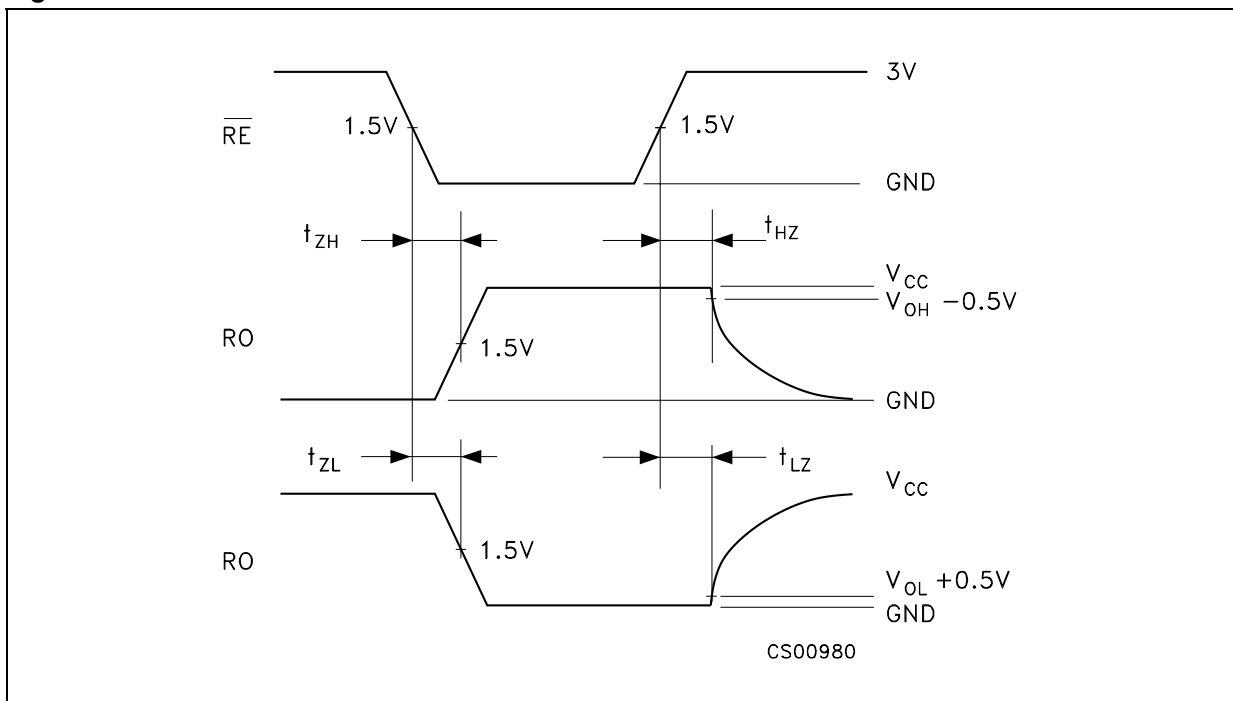


Figure 10. Receiver output current vs output low voltage

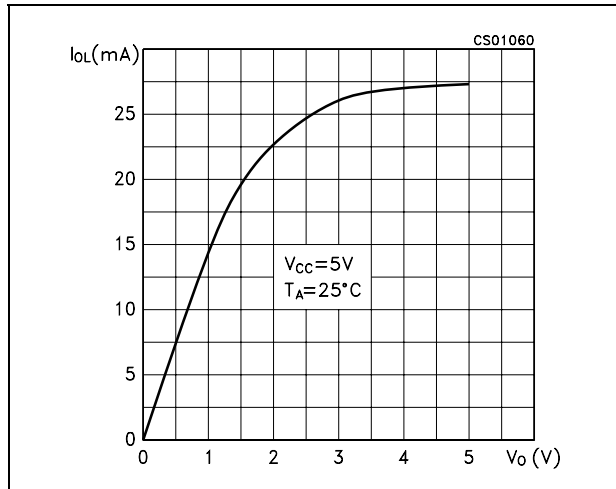


Figure 11. Receiver output current vs output high voltage

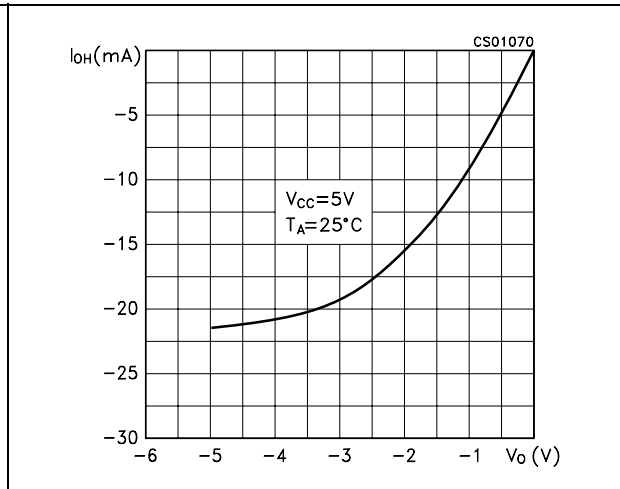


Figure 12. Driver output current vs output low voltage

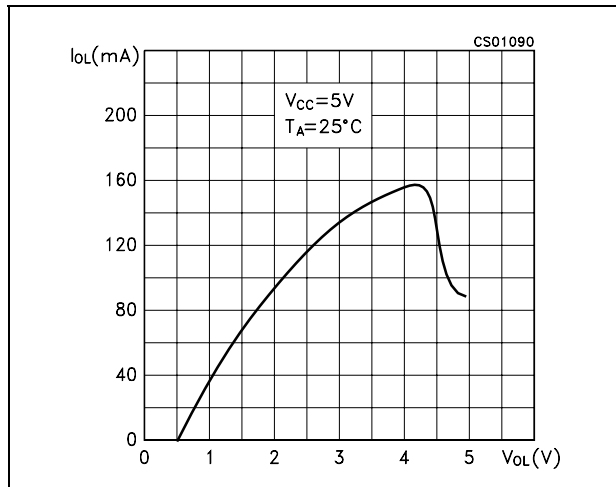


Figure 13. Driver output current vs output high voltage

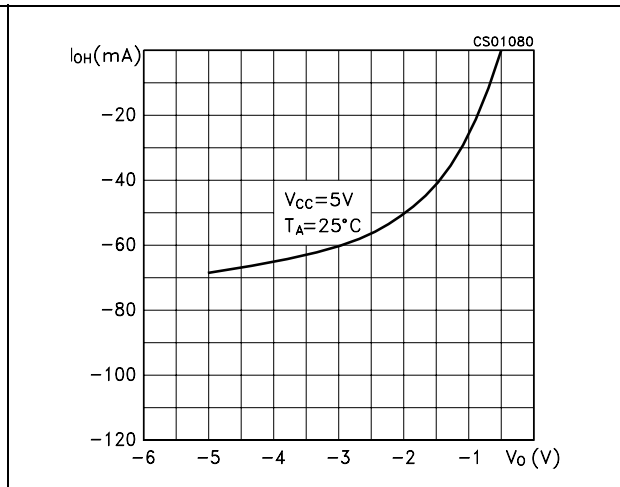


Figure 14. Supply current vs temperature

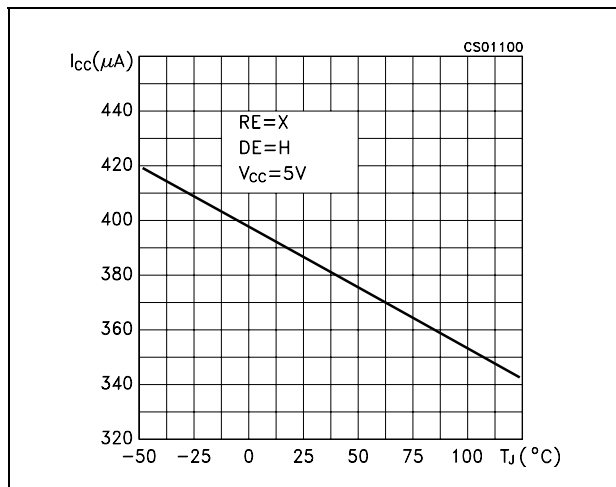


Figure 15. Receiver high level output voltage vs temperature

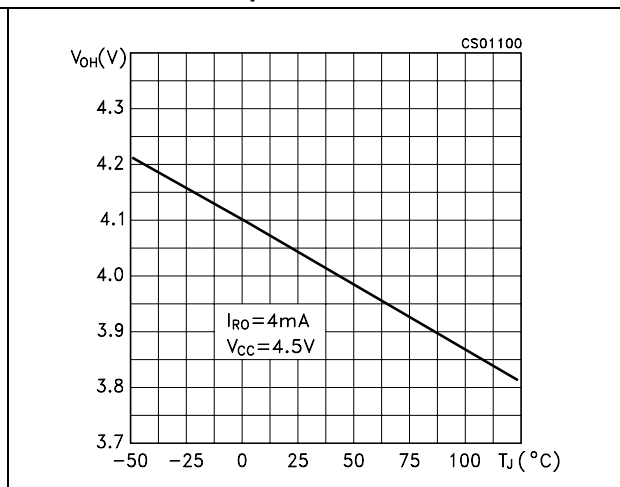


Figure 16. Receiver low level output voltage vs temperature

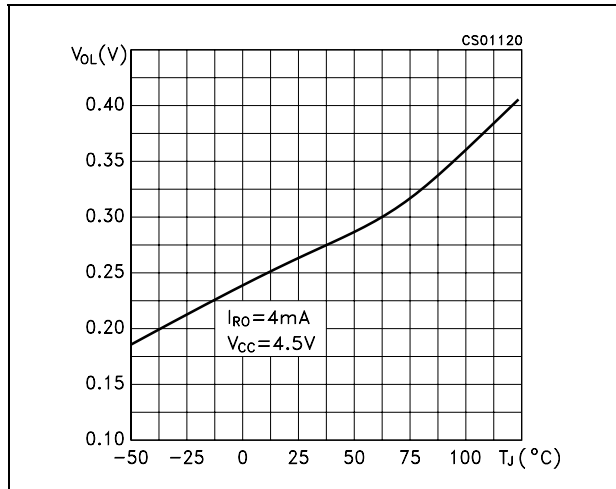
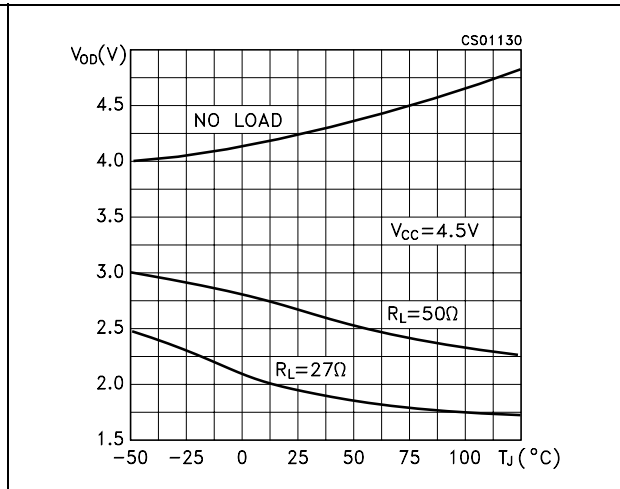


Figure 17. Differential driver output voltage vs temperature

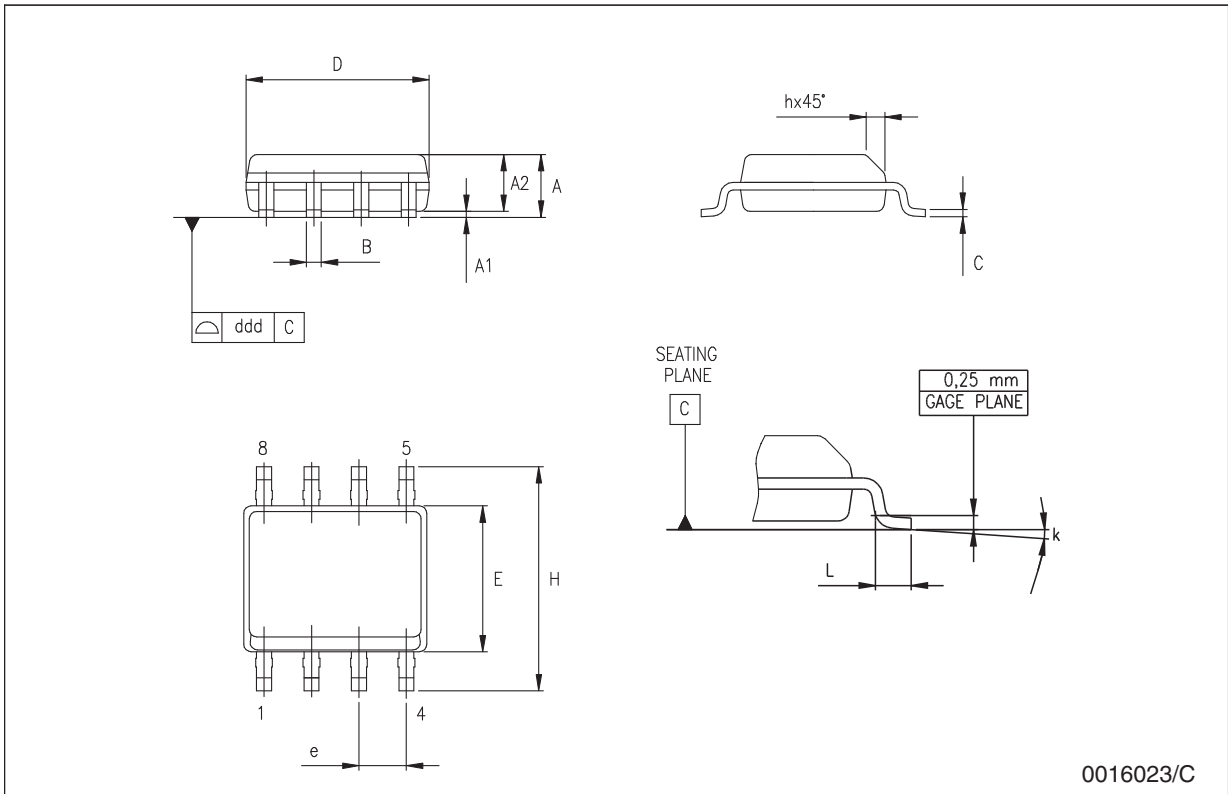


## 6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

**SO-8 mechanical data**

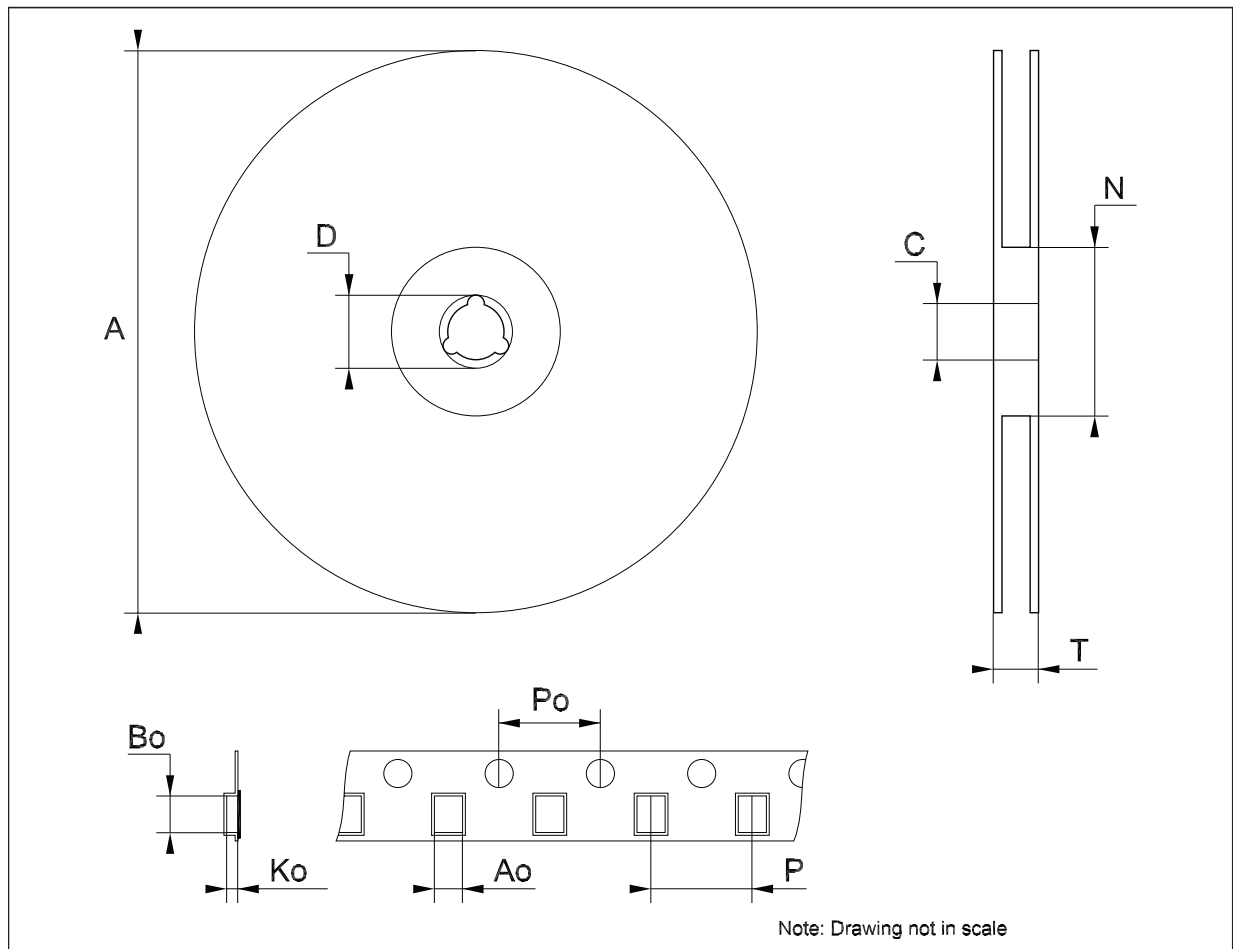
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020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



0016023/C

**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> .

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