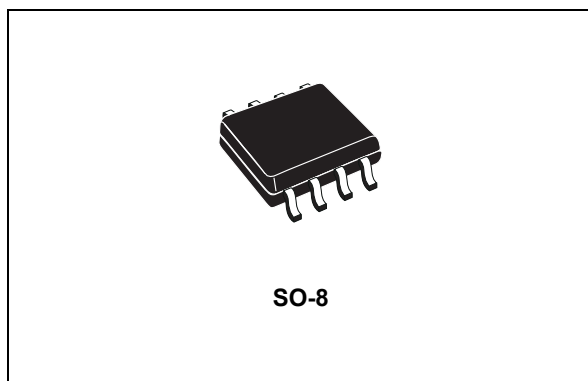# ST3485EB, ST3485EC

3.3 V powered, 15 kV ESD protected, up to 12 Mbps RS-485/ RS-422 transceiver

Datasheet - production data

SO-8

Features

- ESD protection
  - ±15 kV IEC 61000-4-2 air discharge
  - ±8 kV IEC 61000-4-2 contact discharge
- Operate from a single 3.3 V supply - no charge pump required
- Interoperable with 5 V logic
- 1 µA low current shutdown mode max.
- Guaranteed 12 Mbps data rate
- -7 to 12 V common mode input voltage range
- Half duplex versions available

- Industry standard 75176 pinout
- Current limiting and thermal shutdown for driver overload protection
- Guaranteed high receiver output state for floating inputs with no signal present
- Allow up to 64 transceivers on the bus
- Available in SO-8 package

Description

The ST3485EB/EC device is ±15 kV ESD protected, 3.3 V low power transceiver for RS-485 and RS-422 communications. The device contains one driver and one receiver in half duplex configuration.

The ST3485E device transmits and receives at a guaranteed data rate of at least 12 Mbps.

All transmitter outputs and receiver inputs are protected to ±15 kV IEC 61000-4-2 air discharge.

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

Table 1. Device summary

Order code	Temperature range	Package	Packaging
ST3485ECDR	0 to 70 °C	SO-8 (tape and reel)	2500 parts per reel
ST3485EBDR	-40 to 85 °C	SO-8 (tape and reel)	2500 parts per reel

Contents

1 Pin configuration

Figure 1. Pin connections
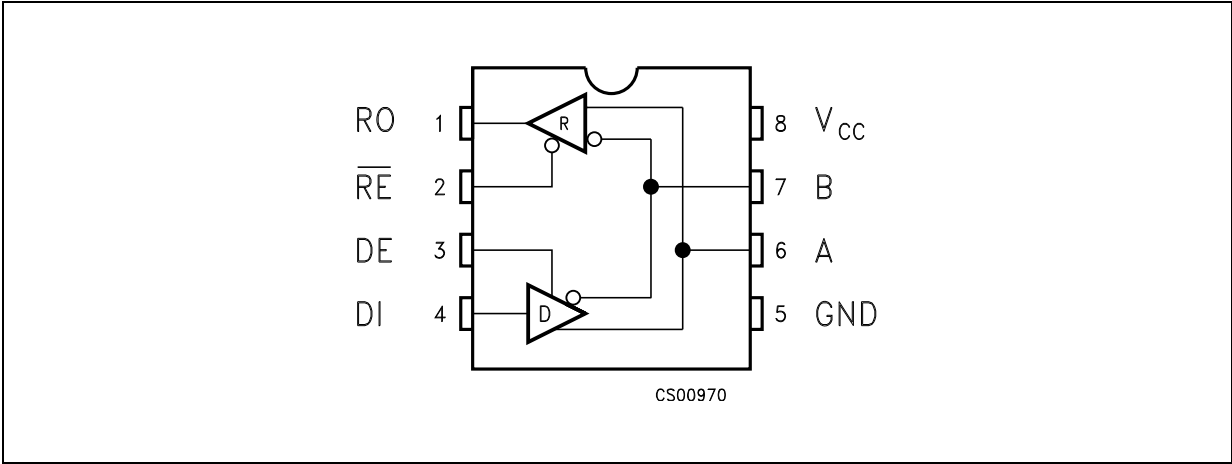
Table 2. Pin description

Pin n°	Symbol	Name and function
1	RO	Receiver output. If A > B by 200 mV, RO will be high; if A < B by 200 mV, RO will be low.
2	$\overline{RE}$	Receiver output enable. RO is enabled when $\overline{RE}$ is low; RO is high impedance when $\overline{RE}$ is high. If $\overline{RE}$ is high and DE is low, the device will enter a low power shutdown mode.
3	DE	Driver output enable. The driver outputs are enabled by bringing DE high. They are high impedance when DE is low. If $\overline{RE}$ is high DE is low, the device will enter a low-power shutdown mode. If the driver outputs are enabled, the part functions as line driver, while they are high impedance, it functions as line receivers if $\overline{RE}$ is low.
4	DI	Driver input. A low on DI forces output A low and output B high. Similarly, a high on DI forces output A high and output B low.
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: V_{CC} = 3 V to 3.6 V.

2   Truth tables

Table 3. Truth table (driver)

Inputs			Outputs		Mode
$\overline{\text{RE}}$	DE	DI	B	A	
X	H	H	L	H	Normal
X	H	L	H	L	Normal
L	L	X	Z	Z	Normal
H	L	X	Z	Z	Shutdown

Note: *X = "don't care"; Z = high impedance.*

Table 4. Truth table (receiver)

Inputs			Output	Mode
$\overline{\text{RE}}$	DE	A-B	RO	
L	L	≥ 0.2 V	H	Normal
L	L	≤ -0.2 V	L	Normal
L	L	Inputs open	H	Normal
H	L	X	Z	Shutdown

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)	-0.3 to 7	V
V_{DI}	Driver input voltage (DI)	-0.3 to 7	V
V_{DO}	Driver output voltage (A, B)	±14	V
V_{RI}	Receiver input voltage (A, B)	±14	V
V_{RO}	Receiver output voltage (RO)	-0.3 to (V_{CC} + 0.3)	V

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

Table 6. ESD performance: transmitter outputs, receiver inputs (A, B)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
ESD	ESD protection voltage	IEC 61000-4-2 air discharge		±15		kV
ESD	ESD protection voltage	IEC 61000-4-2 contact discharge		±8		kV

4 Electrical characteristics

Table 7. Electrical characteristics (V_{CC} = 3 V to 3.6 V, T_A = -40 to 85 °C, unless otherwise specified. Typical values are referred to T_A = 25 °C)

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
I_{SUPPLY}	V_{CC} Power supply current	No load, DI = 0 V or V_{CC}	$\overline{DE}$ = V_{CC}, $\overline{RE}$ = 0 V or V_{CC}		1.3	2.2	mA
			DE = 0 V, $\overline{RE}$ = 0 V		1.2	1.9	mA
I_{SHDN}	Shutdown supply current	DE = 0 V, $\overline{RE}$ = V_{CC}, DI = 0 V or V_{CC}			0.002	1	µA

Table 8. Logic input electrical characteristics (V_{CC} = 3 V to 3.6 V, T_A = -40 to 85 °C, unless otherwise specified. Typical values are referred to T_A = 25 °C)

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
V_{IL}	Input logic threshold low	DE, DI, $\overline{RE}$			1.3	0.8	V
V_{IH}	Input logic threshold high	DE, DI, $\overline{RE}$		2			V
I_{IN1}	Logic input current	DE, DI, $\overline{RE}$				±2.0	µA
I_{IN2}	Input current (A, B)	DE = 0 V, V_{CC}= 0 or 3.6 V	V_{IN} = 12 V			1	mA
			V_{IN} = -7 V			-0.8	mA

Table 9. Transmitter electrical characteristics (V_{CC} = 3 V to 3.6 V, T_A = -40 to 85 °C, unless otherwise specified. Typical values are referred to T_A = 25 °C)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{OD}	Differential drive output	R_L= 100 Ω (RS-422) (*Figure 2*)	2			V
		R_L = 54 Ω (RS-485) (*Figure 2*)	1.5			V
		R_L = 60 Ω (RS-485) (*Figure 3*)	1.5			V
ΔV_{OD}	Change in magnitude of driver differential output voltage for complementary output states[1]	R_L= 54 Ω or 100 Ω (*Figure 2*)			0.2	V
V_{OC}	Driver common mode output voltage	R_L= 54 Ω or 100 Ω (*Figure 2*)			3	V
ΔV_{OC}	Change in magnitude of driver common mode output voltage[1]	R_L= 54 Ω or 100 Ω (*Figure 2*)			0.2	V
I_{OSD}	Driver short-circuit output current				±250	mA

1. ΔV_{OD} and ΔV_{OC} are the changes in V_{OD} and V_{OC}, respectively, when the DI input changes state.

Table 10. Receiver electrical characteristics (V_{CC} = 3 V to 3.6 V, T_A = -40 to 85 °C, unless otherwise specified. Typical values are referred to T_A = 25 °C)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{TH}	Receiver differential threshold voltage	V_{CM} = -7 V to 12 V, DE = 0	-0.2		0.2	V
ΔV_{TH}	Receiver input hysteresis	V_{CM} = 0 V		70		mV
V_{OH}	Receiver output high voltage	I_{OUT} = -4 mA, V_{ID} = 200 mV (*Figure 4*)	2			V
V_{OL}	Receiver output low voltage	I_{OUT} = 4 mA, V_{ID} = -200 mV, (*Figure 4*)			0.4	V
I_{OZR}	3-state (high impedance) output current at receiver	V_{CC} = 3.6 V, V_O = 0 V to V_{CC}			±1	µA
R_{RIN}	Receiver input resistance	V_{CM} = -7 V to 12 V	24			kΩ
I_{OSR}	Receiver short-circuit current	V_{RO} = 0 V to V_{CC}	7		60	mA

Table 11. Driver switching characteristics (V_{CC} = 3 V to 3.6 V, T_A = -40 to 85 °C, unless otherwise specified. Typical values are referred to T_A = 25 °C)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
D_R	Maximum data rate		12	15		Mbps
t_{DD}	Differential output delay	R_L = 60 Ω, C_L = 15 pF, (*Figure 5* and *Figure 6*)		18	30	ns
t_{TD}	Differential output transition time	R_L = 60 Ω, C_L = 15 pF, (*Figure 5* and *Figure 6*)		12	20	ns
t_{PLH} t_{PHL}	Propagation delay	R_L = 27 Ω, C_L = 15 pF, (*Figure 9* and *Figure 10*)		18	30	ns
t_{PDS}	$|t_{PLH} - t_{PHL}|$ driver propagation delay skew[1]	R_L = 27 Ω, C_L = 15 pF, (*Figure 9* and *Figure 10*)		2	5	ns
t_{PZL}	Output enable time	R_L = 110 Ω, (*Figure 11* and *Figure 12*)		19	35	ns
t_{PZH}	Output enable time	R_L = 110 Ω, (*Figure 7* and *Figure 8*)		30	50	ns
t_{PHZ}	Output disable time	R_L = 110 Ω, (*Figure 7* and *Figure 8*)		19	35	ns
t_{PLZ}	Output disable time	R_L = 110 Ω, (*Figure 11* and *Figure 12*)		30	50	ns
t_{SKEW}	Differential output delay skew			1	3	ns
t_{PSH}	Driver enable from shutdown to output high	R_L = 110 Ω (*Figure 7* and *Figure 8*)		30	50	ns
t_{PSL}	Driver enable from shutdown to output low	R_L = 110 Ω (*Figure 11* and *Figure 12*)		19	35	ns

1. Measured on $|t_{PLH}(A)-t_{PHL}(A)|$ and $|t_{PLH}(B)-t_{PHL}(B)|$.

Table 12. Receiver switching characteristics (V_{CC} = 3 V to 3.6 V, T_A = -40 to 85 °C, unless otherwise specified. Typical values are referred to T_A = 25 °C)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
t_{RPLH} t_{RPHL}	Propagation delay	V_{ID} = 0 V to 3 V, C_L = 15 pF (*Figure 13* and *Figure 14*)		30	50	ns
t_{RPDS}	|t_{RPLH} - t_{RPHL}| receiver propagation delay skew	V_{ID} = 0 V to 3 V, C_L = 15 pF (*Figure 13* and *Figure 14*)		1	3	ns
t_{PRZL}	Receiver output enable time to low level	C_L = 15 pF, (*Figure 15* and *Figure 17*)		10	20	ns
t_{PRZH}	Receiver output enable time to high level	C_L = 15 pF, (*Figure 15* and *Figure 16*)		10	20	ns
t_{PRHZ}	Receiver output disable time from high level	C_L = 15 pF, (*Figure 15* and *Figure 18*)		10	20	ns
t_{PRLZ}	Receiver output disable time from low level	C_L = 15 pF, (*Figure 15* and *Figure 19*)		10	20	ns
t_{PRSH}	Receiver output enable time from shutdown to high level	C_L = 15 pF, (*Figure 15* and *Figure 16*)		10	20	ns
t_{PRSL}	Receiver output enable time from shutdown to low level	C_L = 15 pF, (*Figure 15* and *Figure 17*)		20	40	µs

Note: 1. ΔV_{OD} and ΔV_{OC} are the changes in V_{OD} and V_{OC}, respectively, when the DI input changes state.

2. Measured on \|$t_{PLH}(A)$ - $t_{PHL}(A)$\| and \|$t_{PLH}(B)$ - $t_{PHL}(B)$\|.

3. The transceivers are put into shutdown by bring $\overline{RE}$ high and DE low. If the input are in state for less than 80 ns, the part are guaranteed not to enter shutdown. If the inputs are in this state for at least 300 ns, the parts are guaranteed to have entered shutdown.

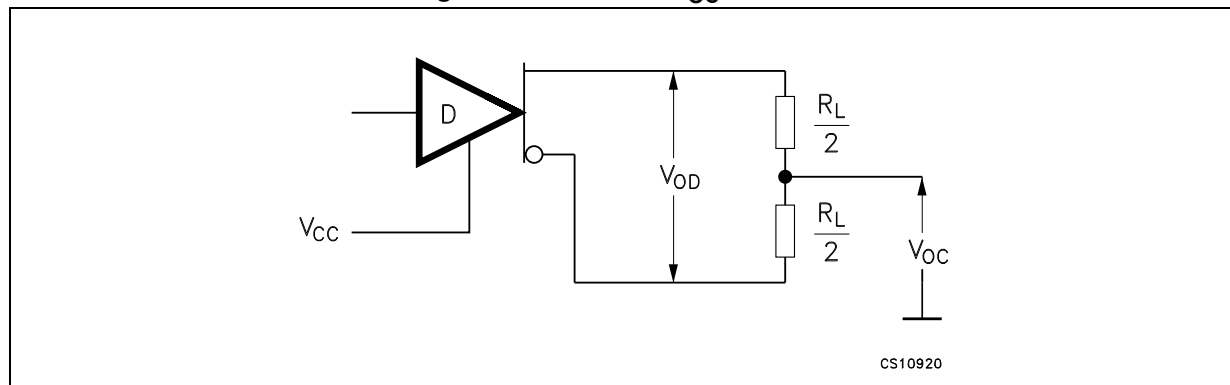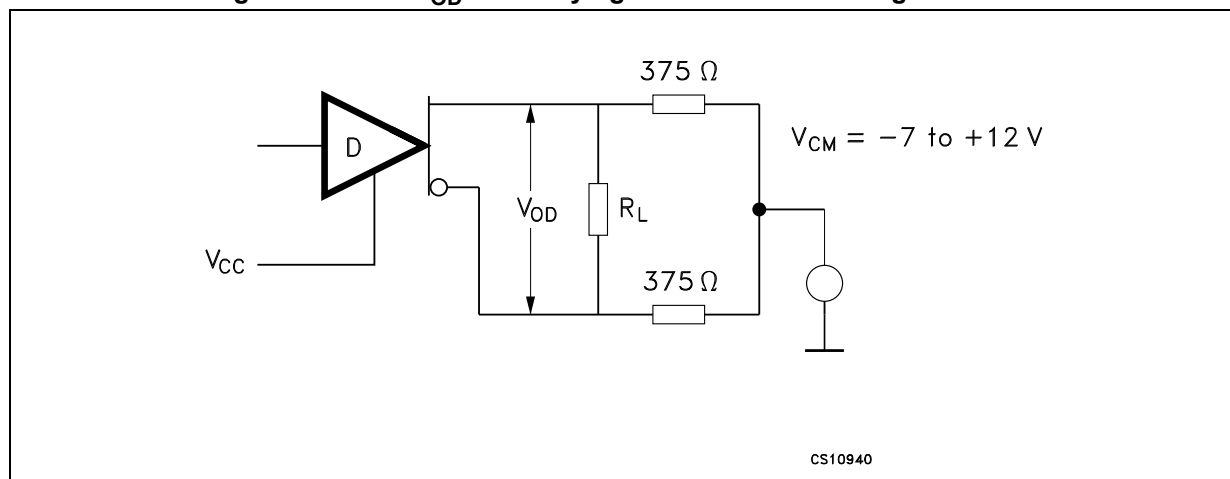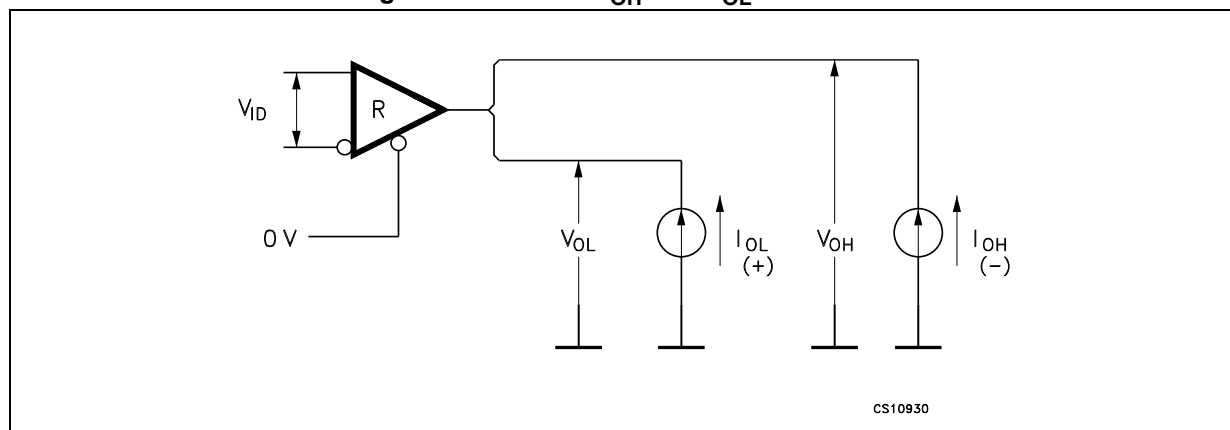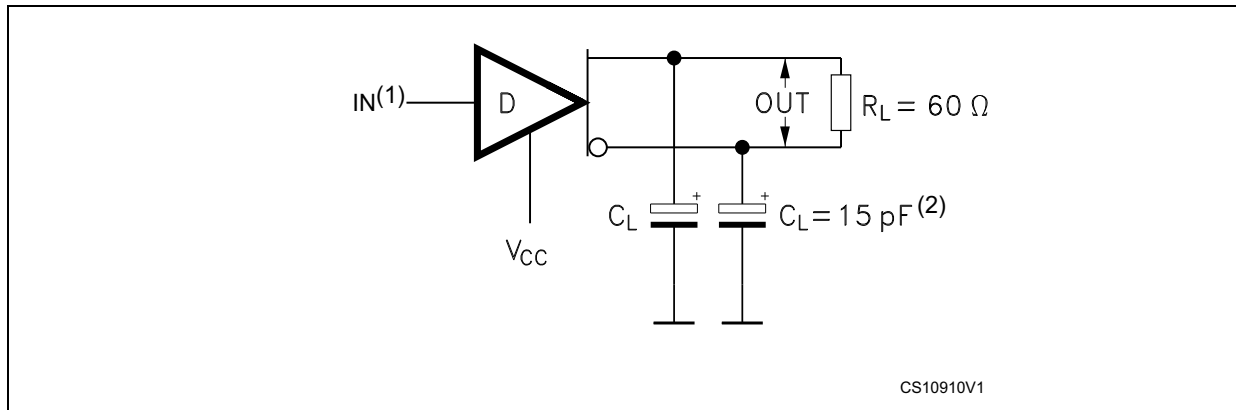# 5 Test circuits and typical characteristics

Figure 2. Driver and V_{OC} test load

Figure 3. Driver V_{OD} with varying common mode voltage test load

Figure 4. Receiver V_{OH} and V_{OL} test circuit

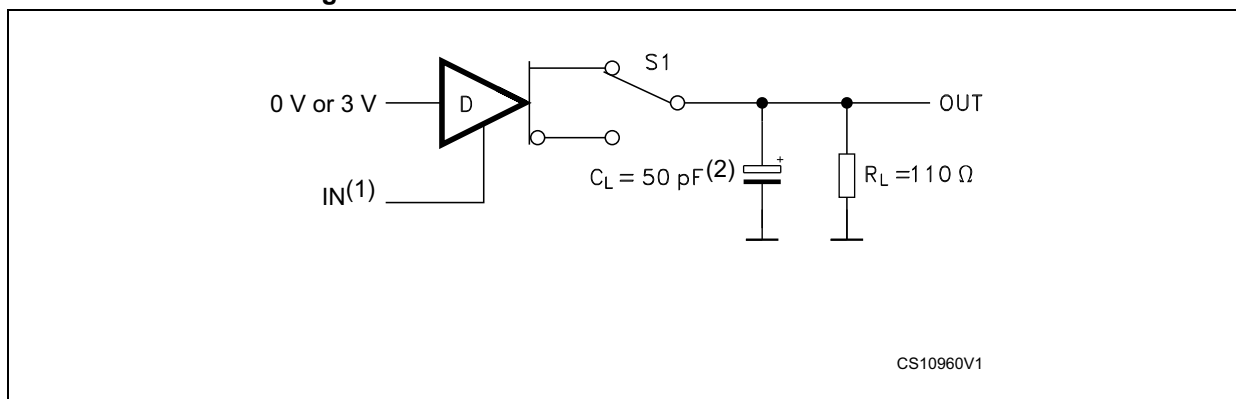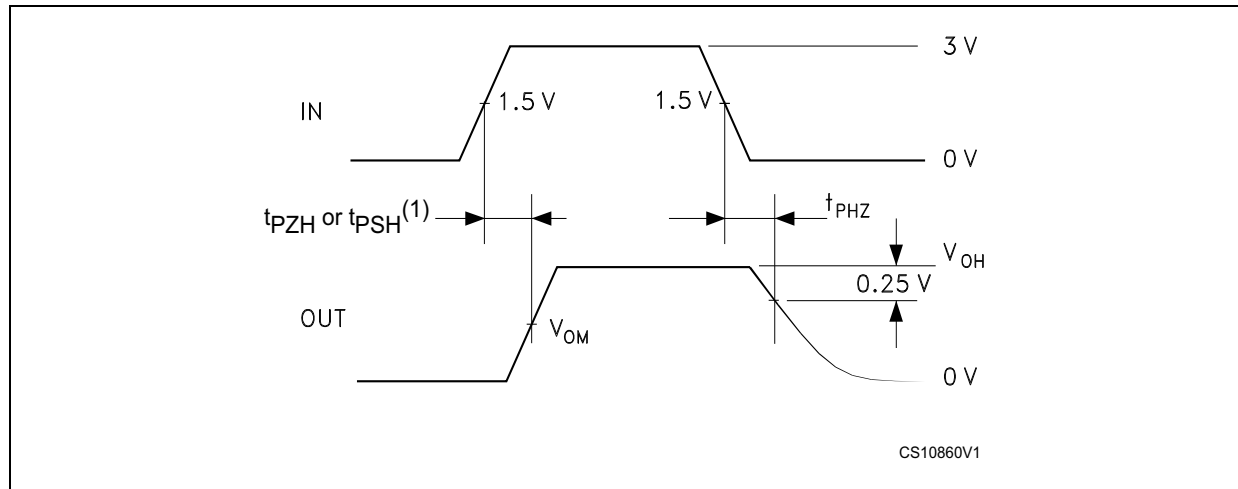**Figure 5. Drive differential output delay transition time test circuit**

1. The input pulse is supplied by a generator with the following characteristics: PRR = 250 kHz, 50% duty cycle, $t_r \leq$ 6.0 ns, Z_O = 50 Ω.
2. C_L includes probe and stray capacitance.

Figure 6. Drive differential output delay transition time waveform
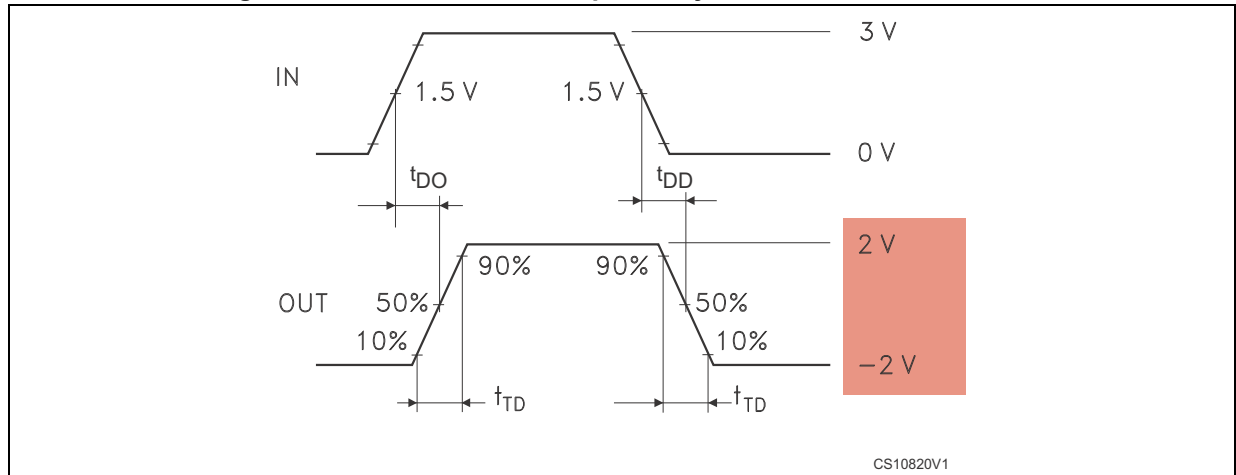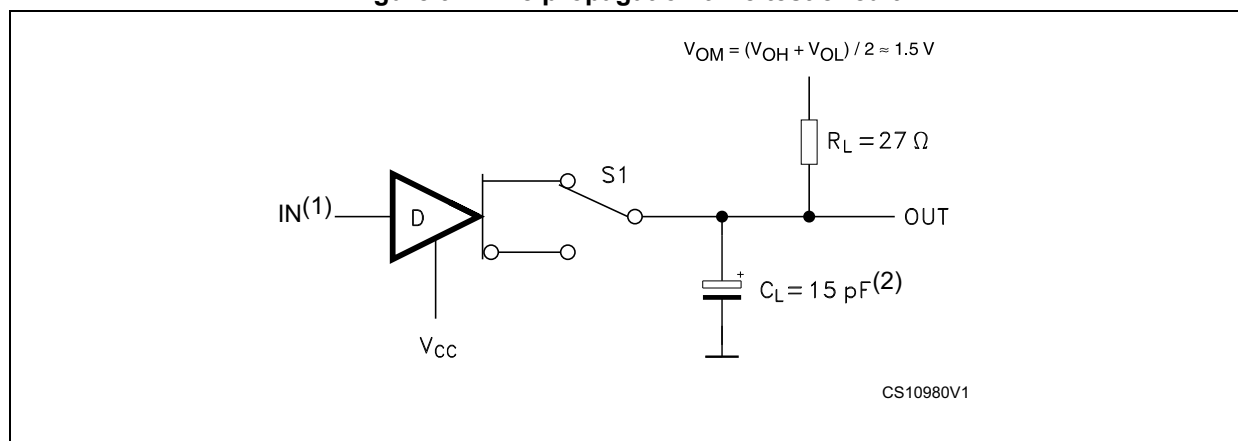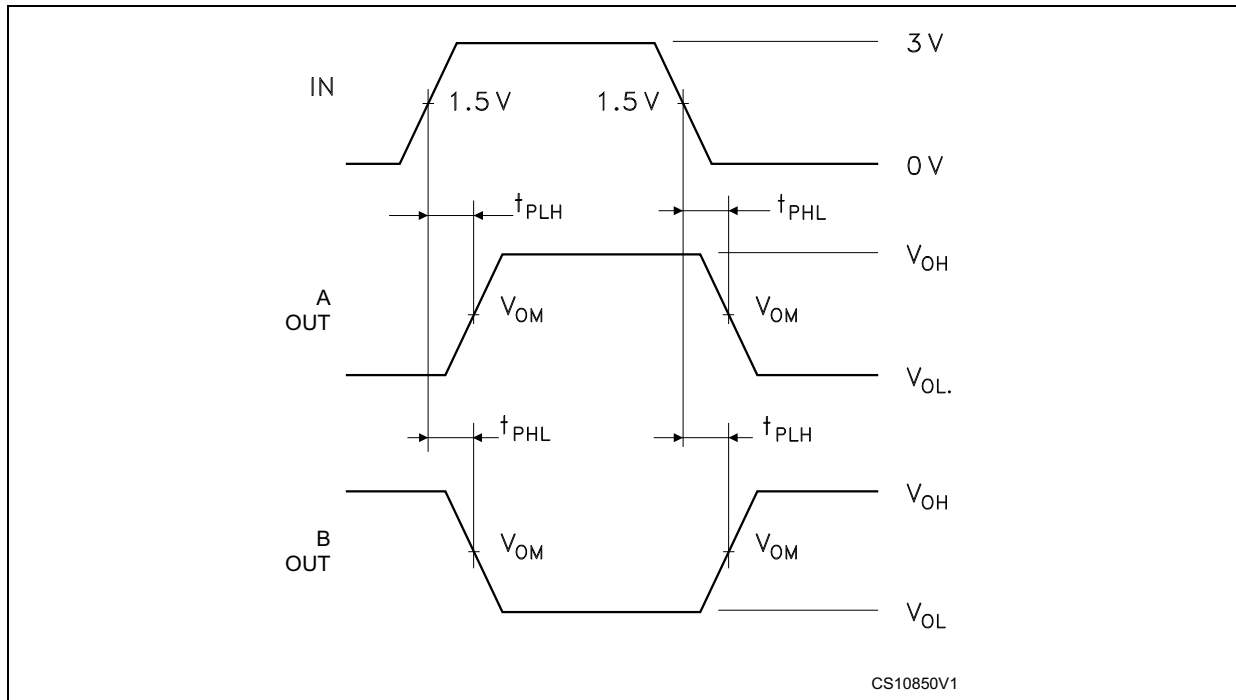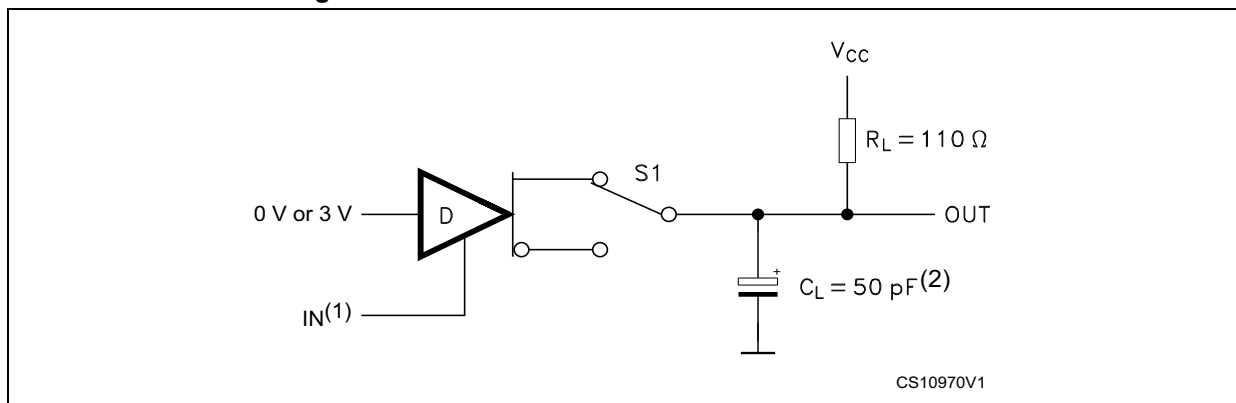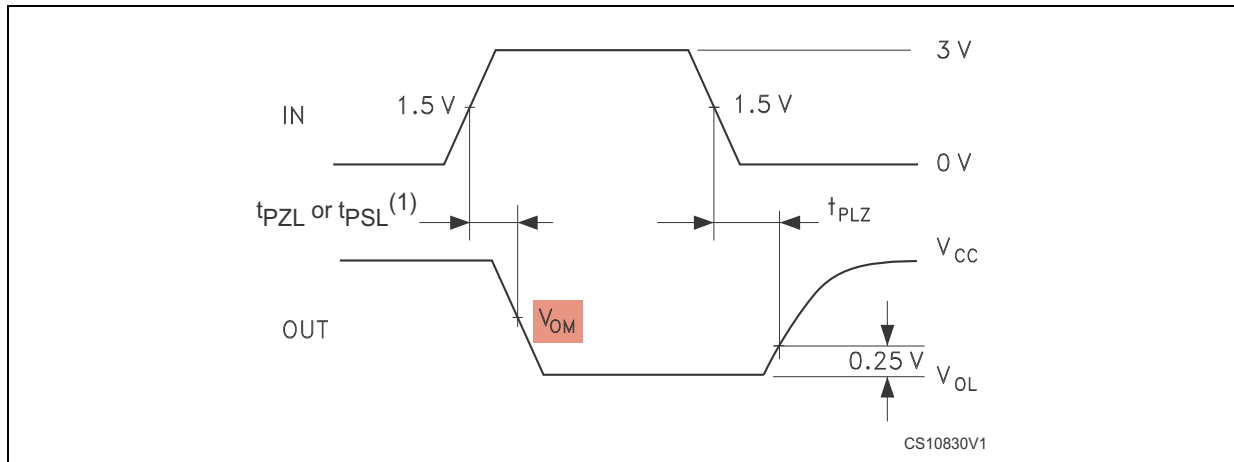

Figure 7. Drive enable and disable times test circuit

1. The input pulse is supplied by a generator with the following characteristics: PRR = 250 kHz, 50% duty cycle, $t_r \leq$ 6.0 ns.
2. C_L includes probe and stray capacitance.

Figure 8. Drive enable and disable times waveforms

1. t_{PZH} is valid if the driver is initially disabled ($\overline{RE}$ is high), t_{PSH} is valid if the driver is initially in shutdown mode ($\overline{RE}$ is low).

Figure 9. Drive propagation time test circuit

1. The input pulse is supplied by a generator with the following characteristics: PRR = 250 kHz, 50% duty cycle, $t_r \leq$ 6.0 ns.
2. C_L includes probe and stray capacitance.

Figure 10. Drive propagation time waveform

CS10850V1

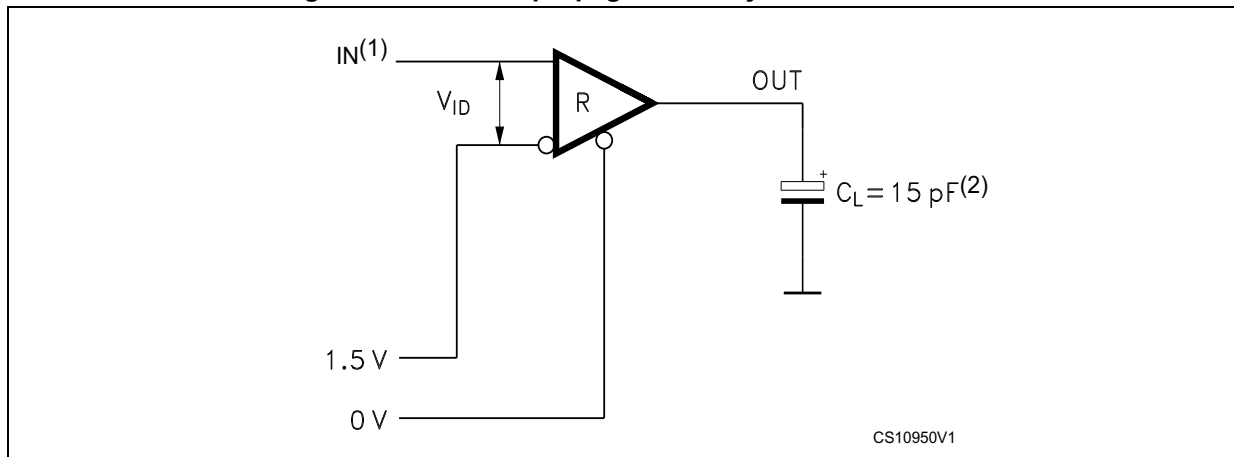**Figure 11. Drive enable and disable times test circuit**

CS10970V1

1. The input pulse is supplied by a generator with the following characteristics: PRR = 250 kHz, 50% duty cycle, $t_r \leq 6.0$ ns.

2. C_L includes probe and stray capacitance.

Figure 12. Drive enable and disable times waveforms

1. t_{PZL} is valid if the driver is initially disabled ($\overline{RE}$ is high), t_{PSL} is valid if the driver is initially in shutdown mode ($\overline{RE}$ is low).

Figure 13. Receiver propagation delay time test circuit

1. The input pulse is supplied by a generator with the following characteristics: PRR = 250 kHz, 50% duty cycle, $t_r \leq 6.0$ ns.
2. C_L includes probe and stray capacitance.

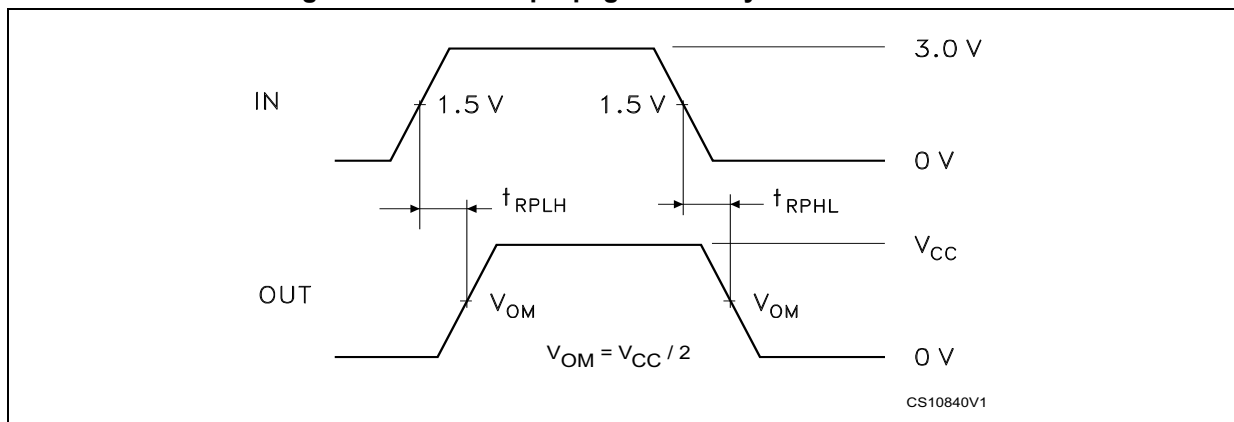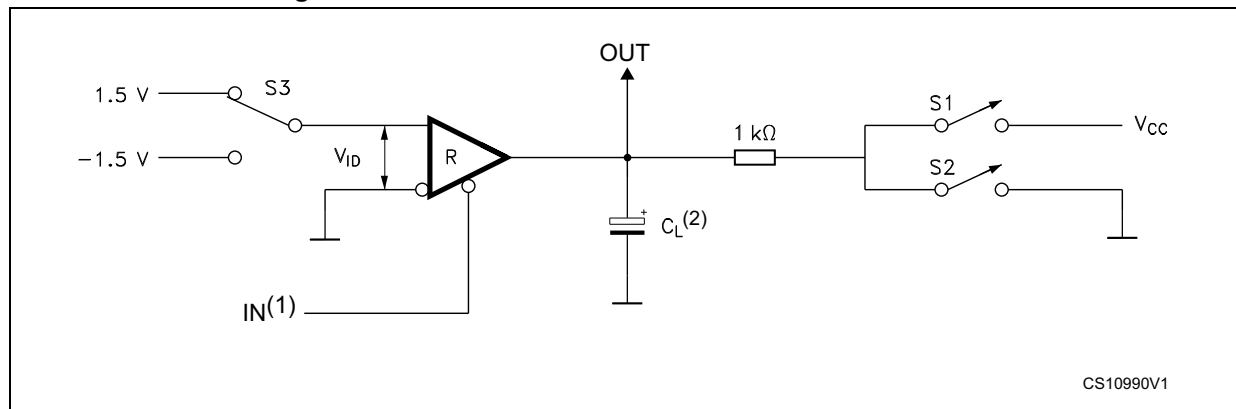### Figure 14. Receiver propagation delay time waveforms

Figure 15. Receiver enable and disable times test circuit

1. The input pulse is supplied by a generator with the following characteristics: PRR = 250 kHz, 50% duty cycle, $t_r \leq 6.0$ ns.
2. C_L includes probe and stray capacitance.

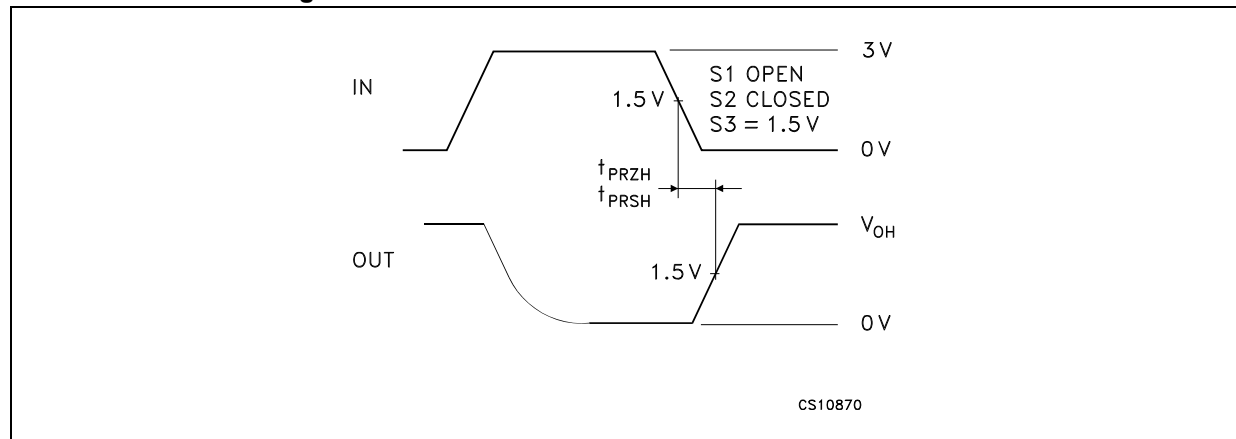#### Figure 16. Receiver enable and disable times waveform

Figure 17. Receiver enable and disable times waveform
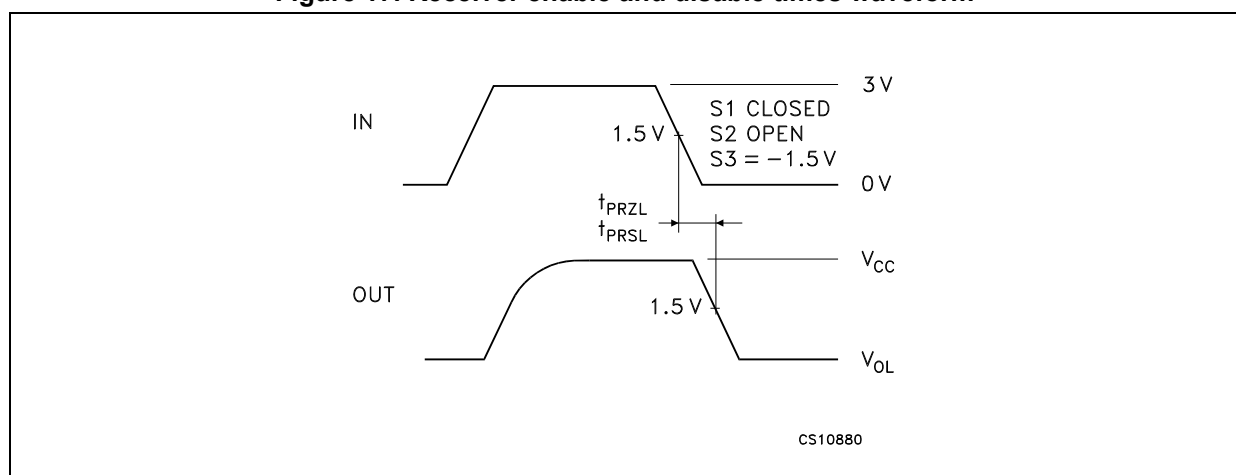
Figure 18. Receiver enable and disable times waveform
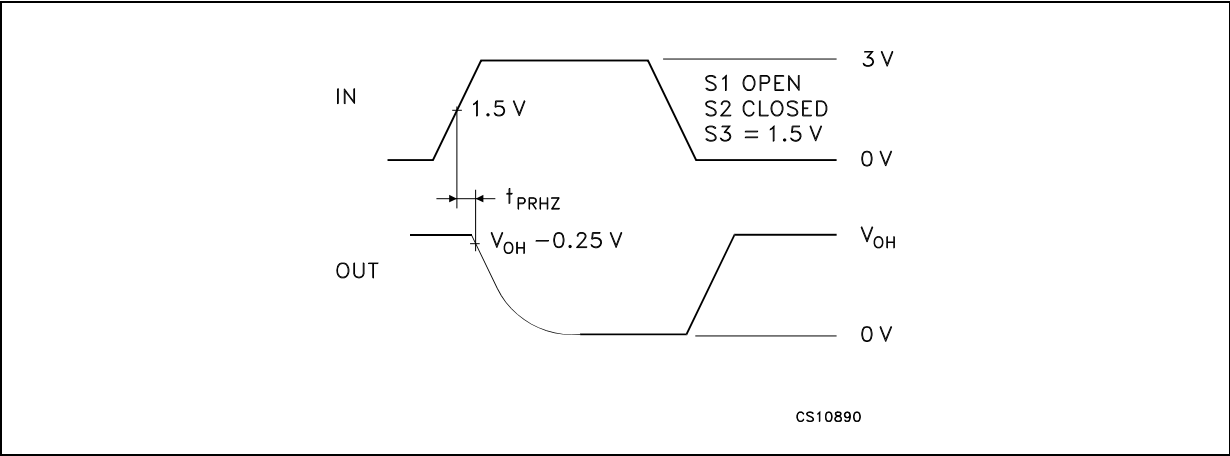
Figure 19. Receiver enable and disable times waveform
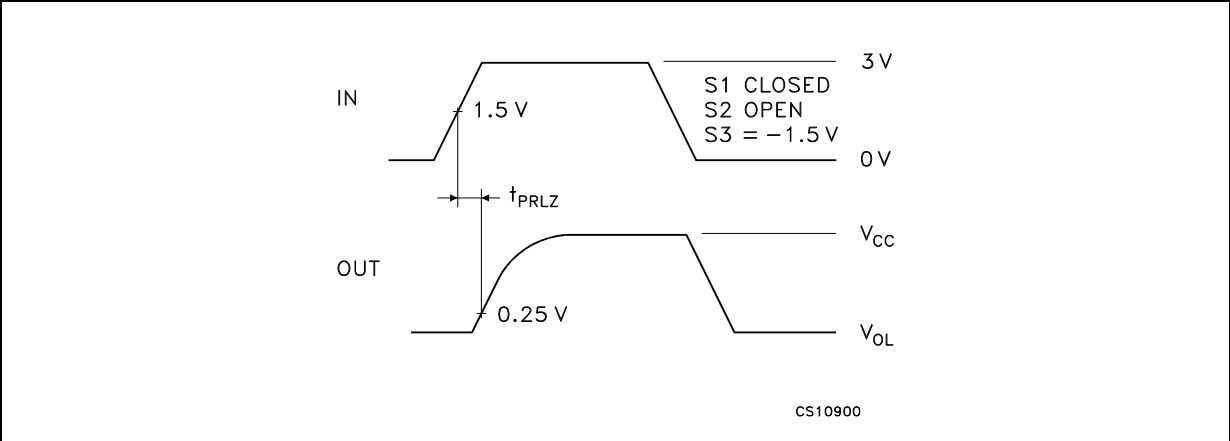
Figure 20. Receiver output current vs. output low voltage	Figure 21. Receiver output current vs. output high voltage

Figure 22. Low level driver output capability

Figure 23. High level driver output capability

Figure 24. Receiver input characteristics

Figure 25. Driver short-circuit current

Figure 26. Driver short-circuit current

6   Package information

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.

Figure 27. SO-8 package outline
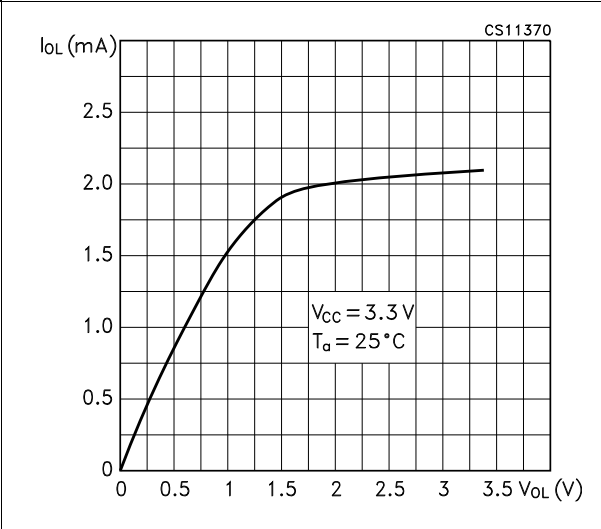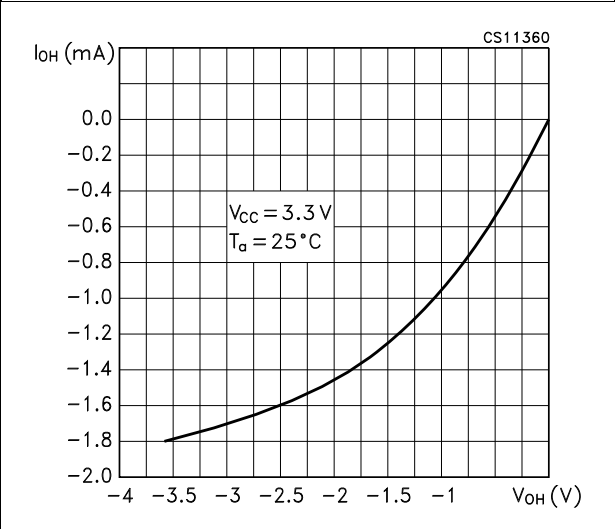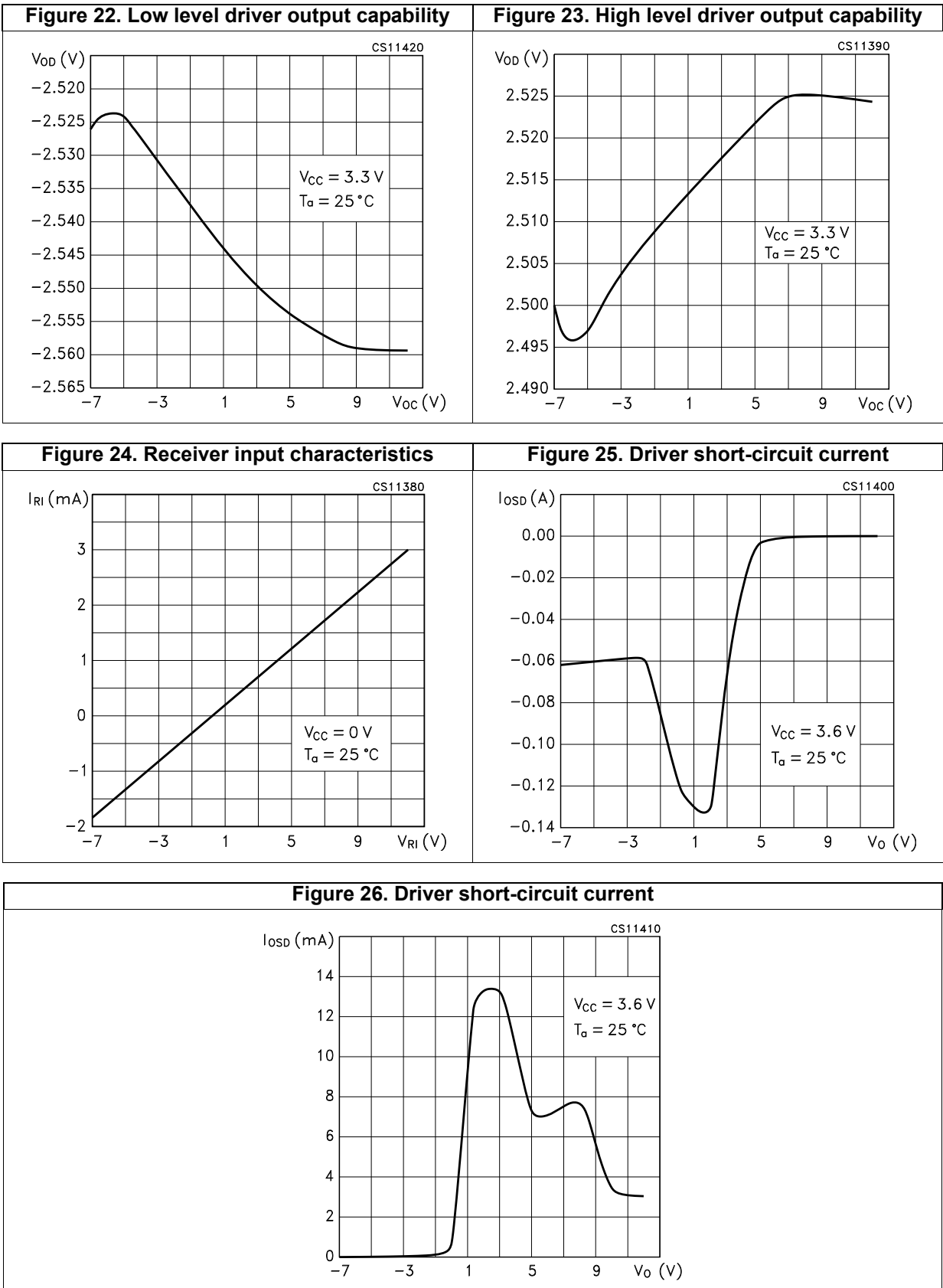

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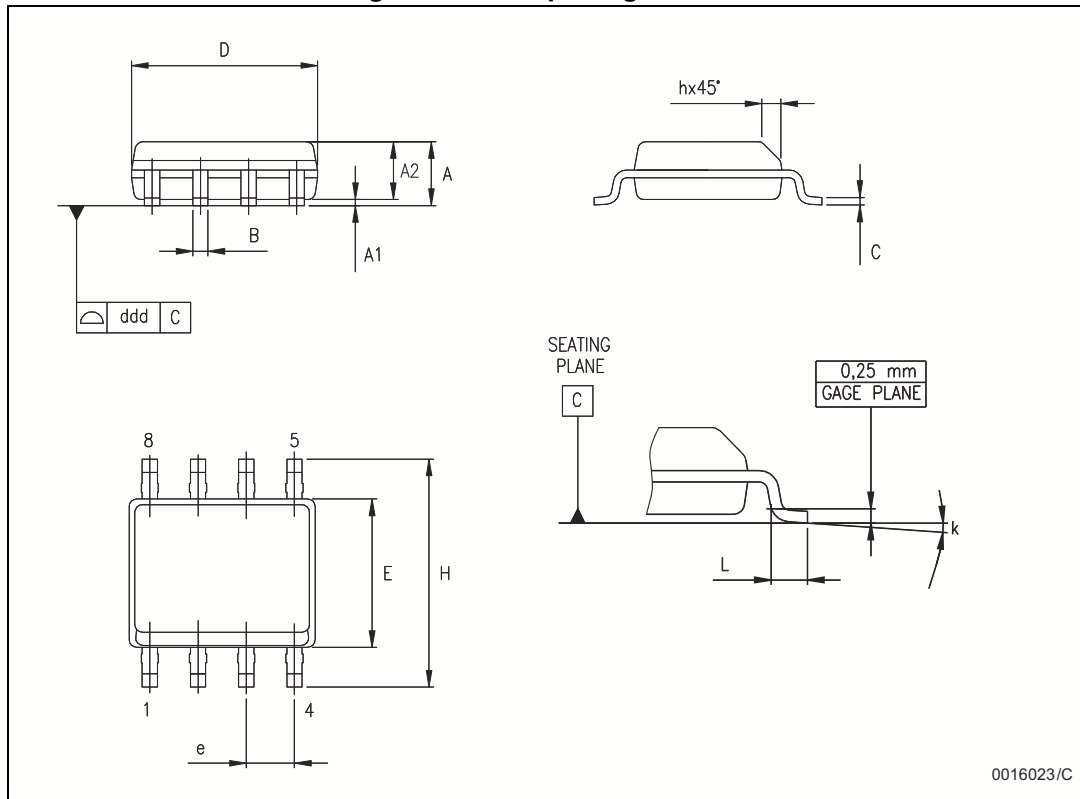
Table 13. SO-8 package mechanical data

Symbol	Dimensions					
	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

Figure 28. Tape and reel SO-8 outline

Note: Drawing not in scale
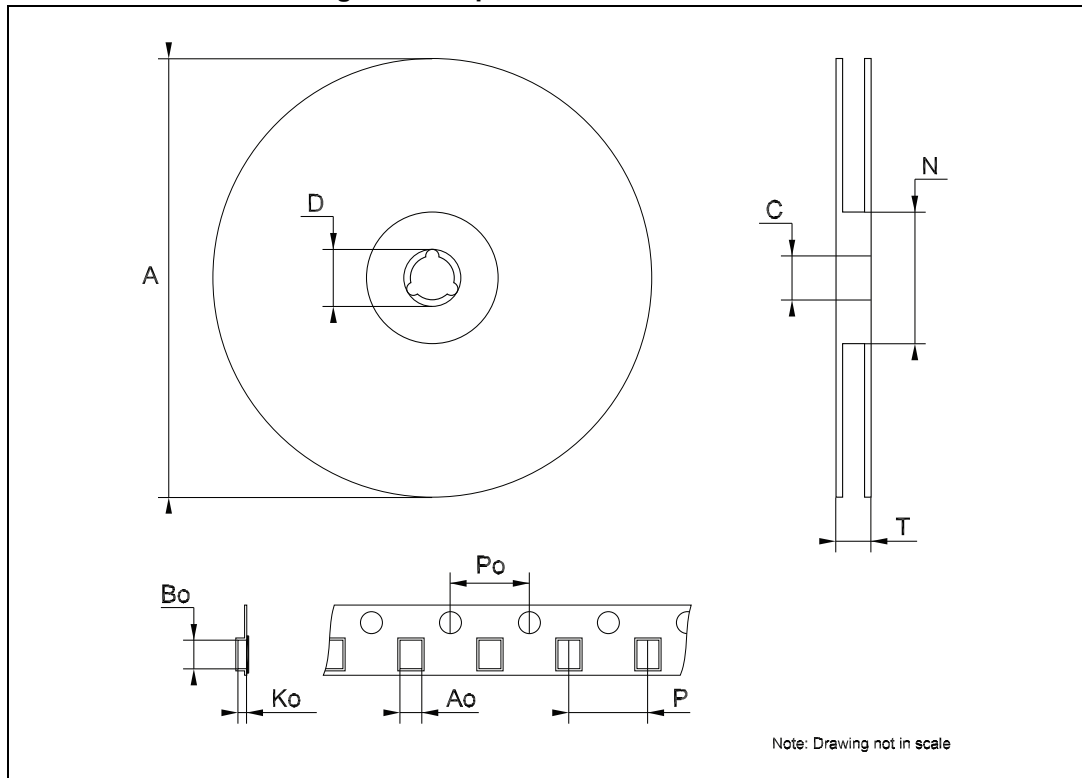
Table 14. Tape and reel SO-8 mechanical data

Symbol	Dimensions					
	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 15. Document revision history

Date	Revision	Changes
20-Jun-2005	2	Mistake on table 12 $t_{ZL(SHDN)}$ ms ==> μs.
30-Aug-2005	3	Remove (TRUE) on title, description has been updated in cover page. The V_{TH} and ΔV_{TH} values are changed in table 10.
07-Apr-2006	4	Order codes updated.
12-Nov-2007	5	Added *Table 1*.
18-Dec-2013	6	Updated *Features on page 1* (added SO-8 package, replaced human body model by ±15 kV IEC 61000-4-2 air discharge and IEC 1000-4-2 by IEC 61000-4-2). Updated *Description on page 1* (renamed device to ST3485EB/EC, replaced human body model by ±15 kV IEC 61000-4-2 air discharge). Removed ST3485ECN device from *Table 1 on page 1*. Updated title of *Table 6*, cross-references, replaced human body model (HBM) by ±15 kV IEC 61000-4-2 air discharge and IEC 1000-4-2 by IEC 61000-4-2. Added notes below *Table 9*. Updated *Table 10* to *Table 12* (updated data, cross-references). Updated *Figure 5* to *Figure 16* (updated data, added notes below figures, highlighted some parts of *Figure 6* and *Figure 12*). Removed DIP-8 package from *Section 6: Package information* and whole document. Reformatted *Section 6* (added *Figure 27*, *Figure 28*, *Table 13* and *Table 14*, reversed order of figures and table). Minor corrections throughout document.

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