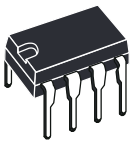
ST3485EB
ST3485EC

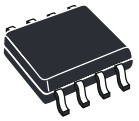
3.3 V powered, 15 kV ESD protected, up to 12 Mbps RS-485/RS-422 transceiver

Features

- ESD protection
  - ±15 kV human body model
  - ±8 kV IEC 1000-4-2 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



DIP-8



SO-8

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.

Description

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

All transmitter outputs and receiver inputs are protected to ±15 kV using Human Body Model.

Table 1. Device summary

Order code	Temperature range	Package	Packaging
ST3485ECN	0 to 70 °C	DIP-8	50 parts per tube / 40 tube per box
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

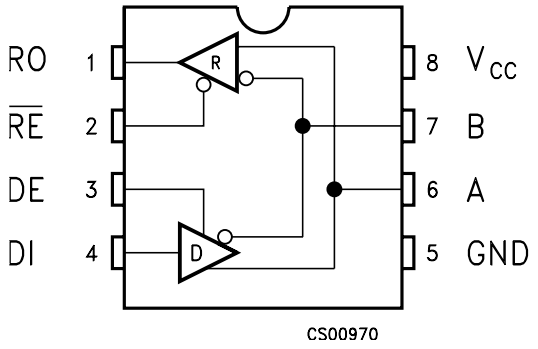


Table 2. Pin description

Pin n°	Symbol	Name and function
1	RO	Receiver output. If A>B by 200mV, RO will be high; if A<B by 200mV, RO will be low
2	$\overline{RE}$	Receiver output enable. RO is enabled when RE is low; RO is high impedance when RE is high. If 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 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 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}= 3V to 3.6V

2 Truth tables

Table 3. Truth table (driver)

Inputs			Outputs		Mode
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
RE	DE	A-B	RO	
L	L	≥ 0.2V	H	Normal
L	L	≤-0.2V	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

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 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=0V or V_{CC}	DE=V_{CC}, $\overline{RE}$=0V or V_{CC}		1.3	2.2	mA
			DE=0V, $\overline{RE}$=0V		1.2	1.9	mA
I_{SHDN}	Shutdown supply current	DE=0V, RE=V_{CC}, DI=0V 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, RE			1.3	0.8	V
V_{IH}	Input logic threshold high	DE, DI, RE		2			V
I_{IN1}	Logic input current	DE, DI, RE				±2.0	µA
I_{IN2}	Input current (A, B)	DE=0V, V_{CC}= 0 or 3.6V	V_{IN}=12V			1	mA
			V_{IN}=-7V			-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= 100Ω (RS-422) (*Figure 1*)	2			V
		R_L= 54Ω (RS-485) (*Figure 1*)	1.5			V
		R_L= 60Ω (RS-485) (*Figure 2*)	1.5			V
ΔV_{OD}	Change in magnitude of driver differential output voltage for complementary output states (*Note: 1*)	R_L= 54Ω or 100Ω (*Figure 1*)			0.2	V
V_{OC}	Driver common mode output voltage	R_L= 54Ω or 100Ω (*Figure 1*)			3	V
ΔV_{OC}	Change in magnitude of driver common mode output voltage (*Note: 1*)	R_L= 54Ω or 100Ω (*Figure 1*)			0.2	V
I_{OSD}	Driver short circuit output current				±250	mA

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} = -7V to 12V, DE = 0	-0.2		0.2	V
ΔV_{TH}	Receiver input hysteresis	V_{CM} = 0V		70		V
V_{OH}	Receiver output high voltage	I_{OUT} = -4mA, V_{ID} = 200mV (*Figure 8* and *Figure 9*)	2			V
V_{OL}	Receiver output low voltage	I_{OUT} = 4mA, V_{ID} = -200mV, (*Figure 3*)			0.4	V
I_{OZR}	3-State (high impedance) output current at receiver	V_{CC} = 3.6V, V_O = 0V to V_{CC}			±1	µA
R_{RIN}	Receiver input resistance	V_{CM} = -7V to 12V	24			kΩ
I_{OSR}	Receiver short-circuit current	V_{RO} = 0V 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= 60Ω, C_L = 15pF, (*Figure 4* and *Figure 5*)		18	30	ns
t_{TD}	Differential output transition time	R_L= 60Ω, C_L = 15pF, (*Figure 4* and *Figure 5*)		12	20	ns
t_{PLH} t_{PHL}	Propagation delay	R_L= 27Ω, C_L = 15pF, (*Figure 8* and *Figure 9*)		18	30	ns
t_{PDS}	$\lvert t_{PLH} - t_{PHL} \rvert$ Propagation delay skew (*Note 2*)	R_L= 27Ω, C_L = 15pF, (*Figure 8* and *Figure 9*)		2	5	ns
t_{PZL}	Output enable time	R_L= 110Ω, (*Figure 10* and *Figure 11*)		19	35	ns
t_{PZH}	Output enable time	R_L= 110Ω, (*Figure 6* and *Figure 7*)		30	50	ns
t_{PHZ}	Output disable time	R_L= 110Ω, (*Figure 6* and *Figure 7*)		19	35	ns
t_{PLZ}	Output disable time	R_L= 110Ω, (*Figure 10* and *Figure 11*)		30	50	ns
t_{SKEW}	Differential output delay skew			1	3	ns
$t_{ZH(SHDN)}$	Driver enable from shutdown to output high			30	50	ns
$t_{ZL(SHDN)}$	Driver enable from shutdown to output low			19	35	ns

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_{PLH} t_{PHL}	Propagation delay	V_{ID} =0V to 3V, C_{L1} = 15pF (*Figure 12* and *Figure 13*)		30	50	ns
t_{RPDS}	$\|t_{PLH} - t_{PHL}\|$ Propagation delay skew	V_{ID} =0V to 3V, C_{L1} = 15pF (*Figure 12* and *Figure 13*)		1	3	ns
t_{PZL}	Output enable time	C_{RL} = 15pF, (*Figure 14* and *Figure 18*)		10	20	ns
t_{PZH}	Output enable time	C_{RL} = 15pF, (*Figure 14* and *Figure 18*)		10	20	ns
t_{PHZ}	Output disable time	C_{RL} = 15pF, (*Figure 14* and *Figure 18*)		10	20	ns
t_{PLZ}	Output disable time	C_{RL} = 15pF, (*Figure 14* and *Figure 18*)		10	20	ns
$t_{ZH(SHDN)}$	Receiver enable from shutdown to output high	C_{RL} = 15pF, (*Figure 14* and *Figure 18*)		10	20	ns
$t_{ZL(SHDN)}$	Receiver enable from shutdown to output low	C_{RL} = 15pF, (*Figure 14* and *Figure 18*)		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 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

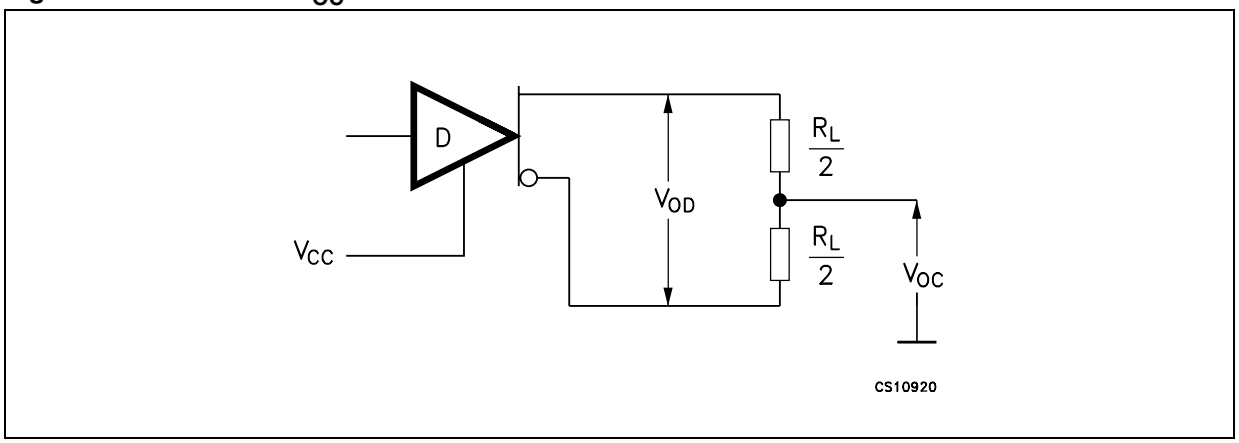


Figure 3. Driver V_{OD} with varying common mode voltage test load

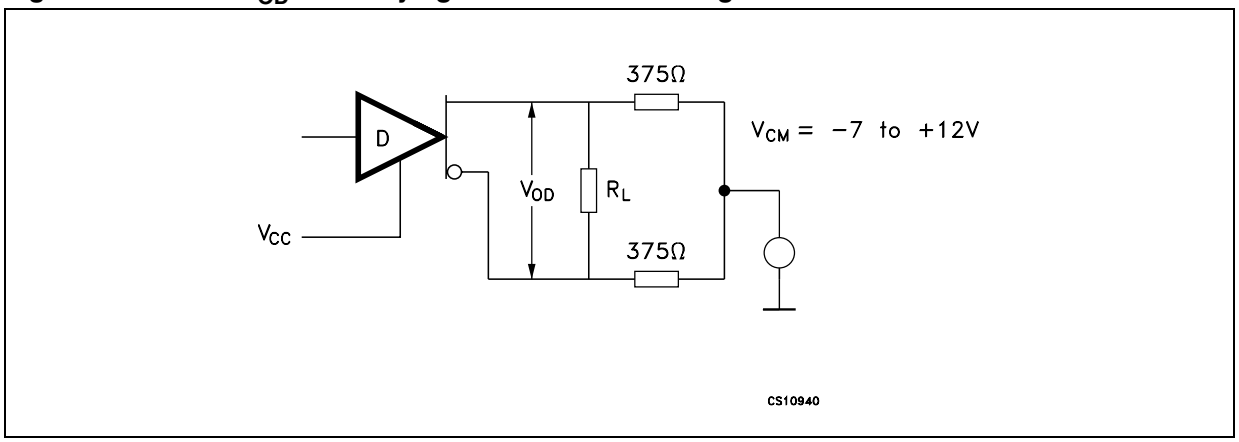


Figure 4. Receiver V_{OH} and V_{OL} test circuit

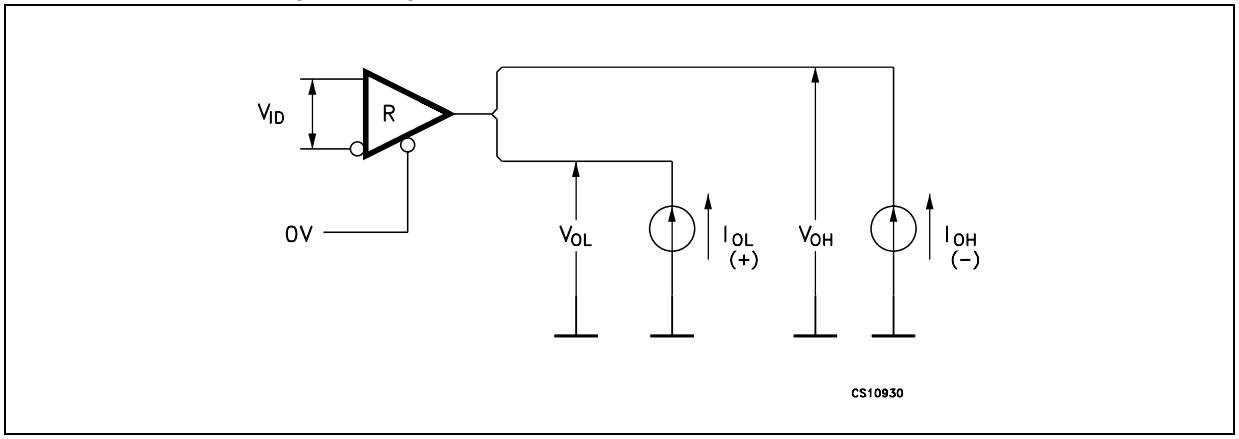


Figure 5. Drive differential output delay transition time test circuit

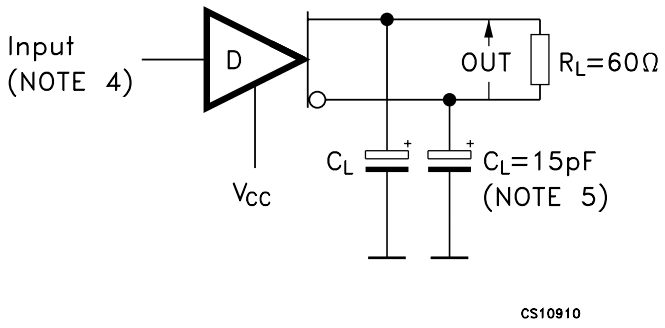


Figure 6. Drive differential output delay transition time waveform

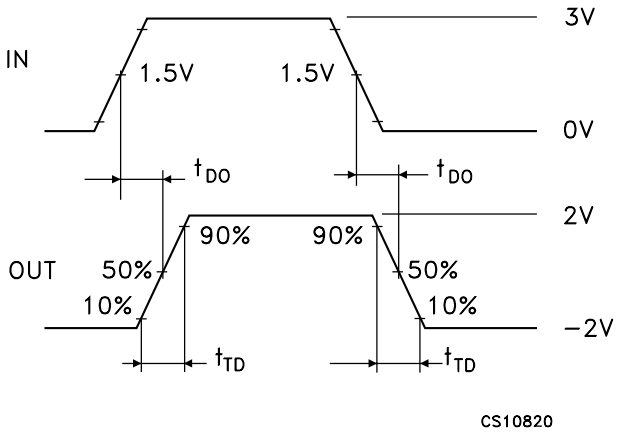


Figure 7. Drive enable and disable times test circuit

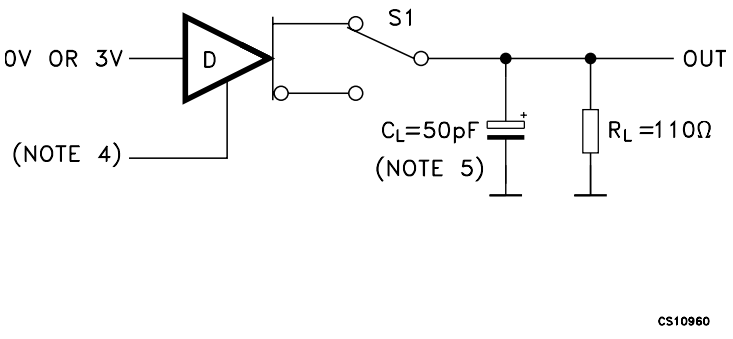


Figure 8. Drive enable and disable times waveforms

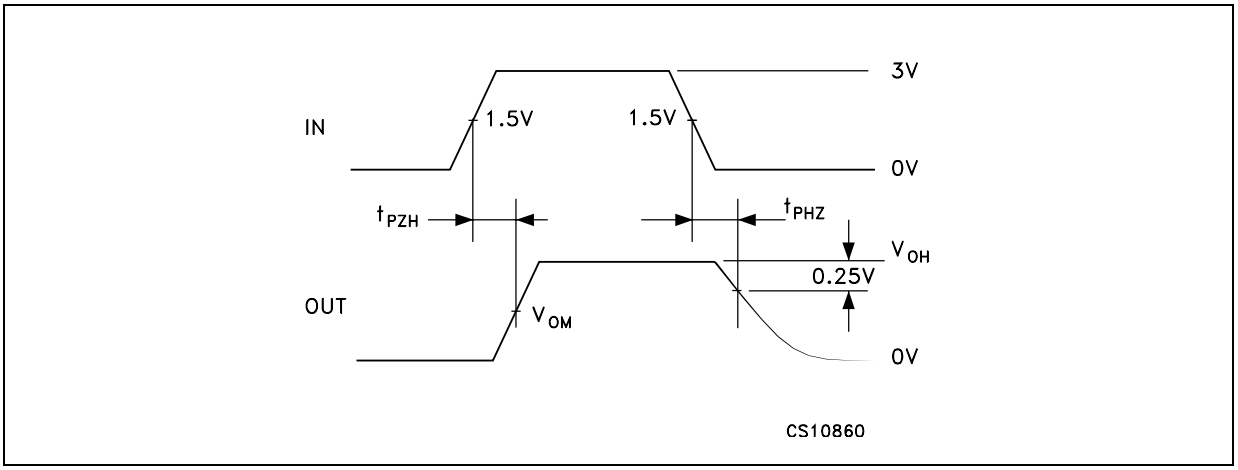


Figure 9. Drive propagation time test circuit

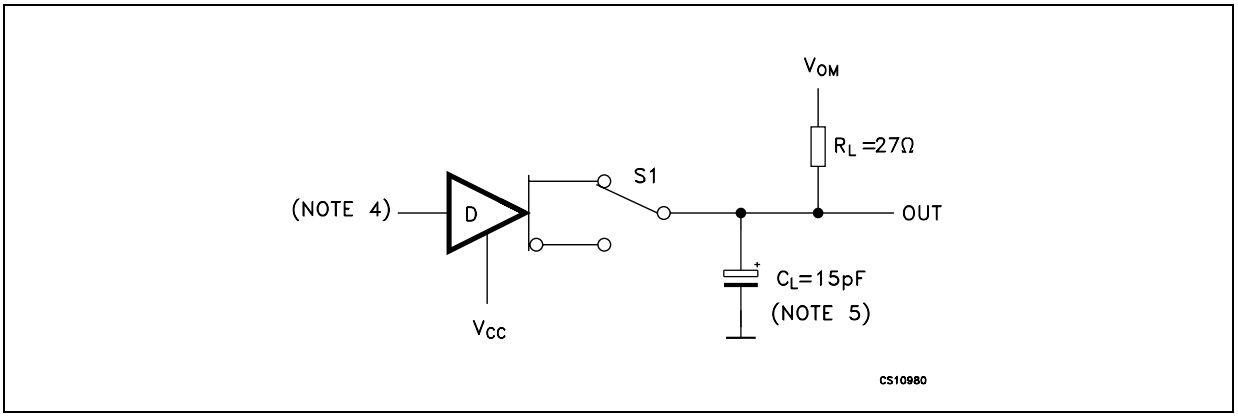


Figure 10. Drive propagation time waveform

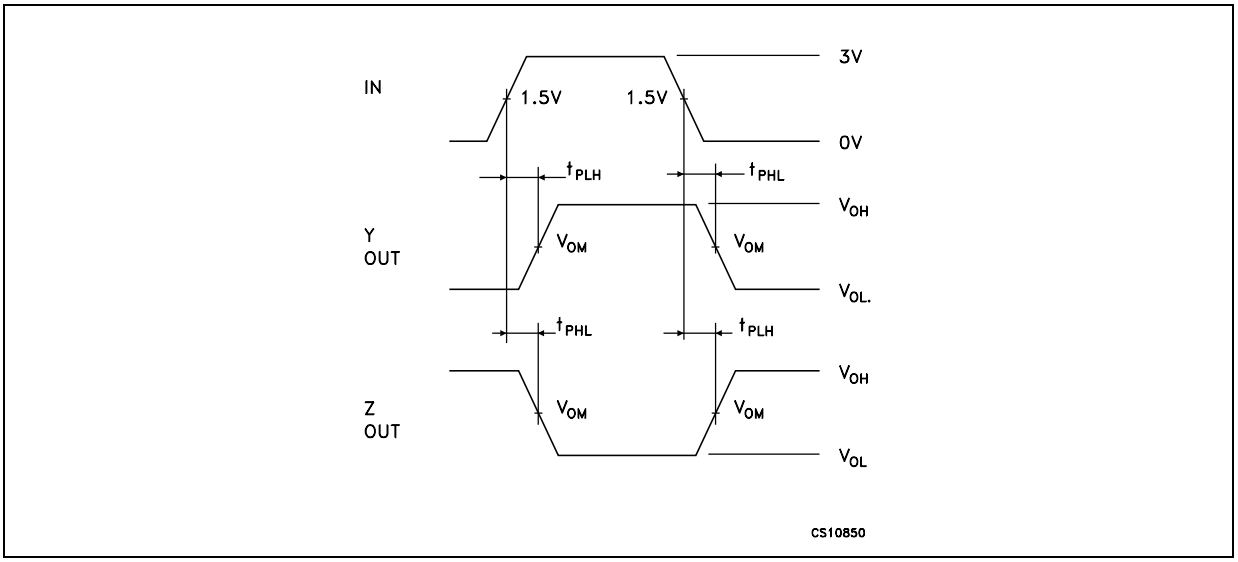


Figure 11. Drive enable and disable times test circuit

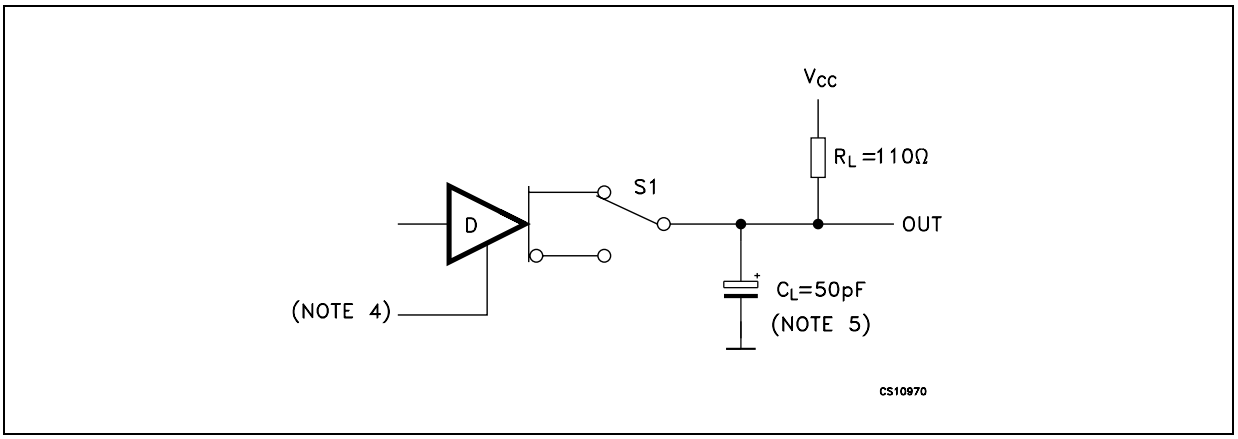


Figure 12. Drive enable and disable times waveforms

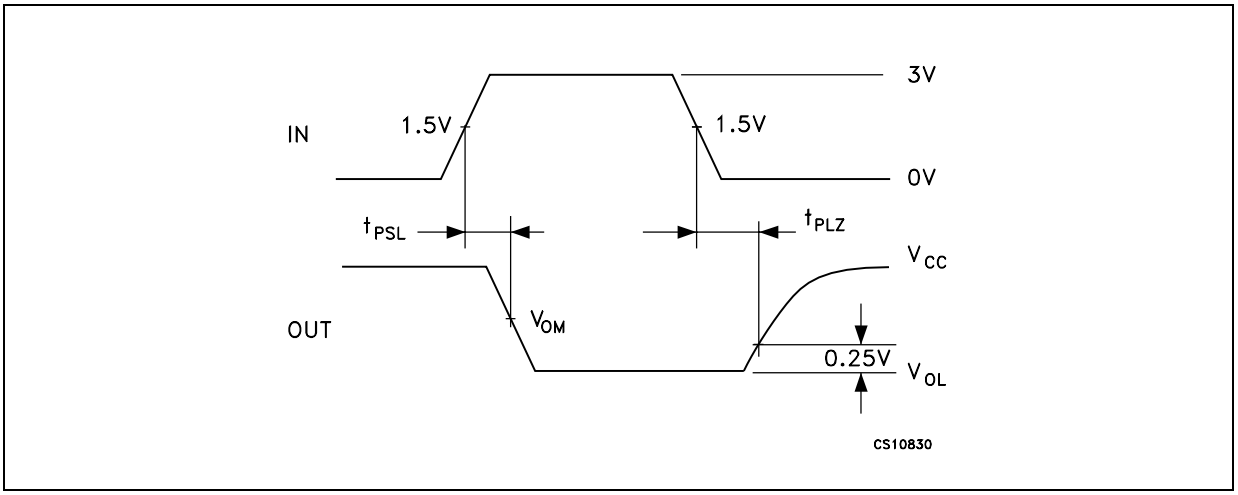


Figure 13. Receiver propagation delay time test circuit

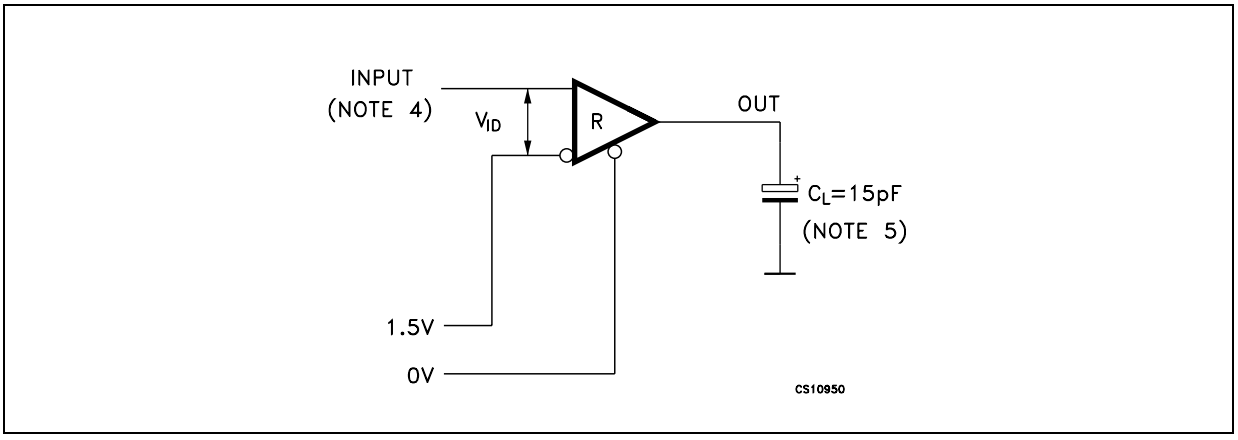


Figure 14. Receiver propagation delay time waveforms

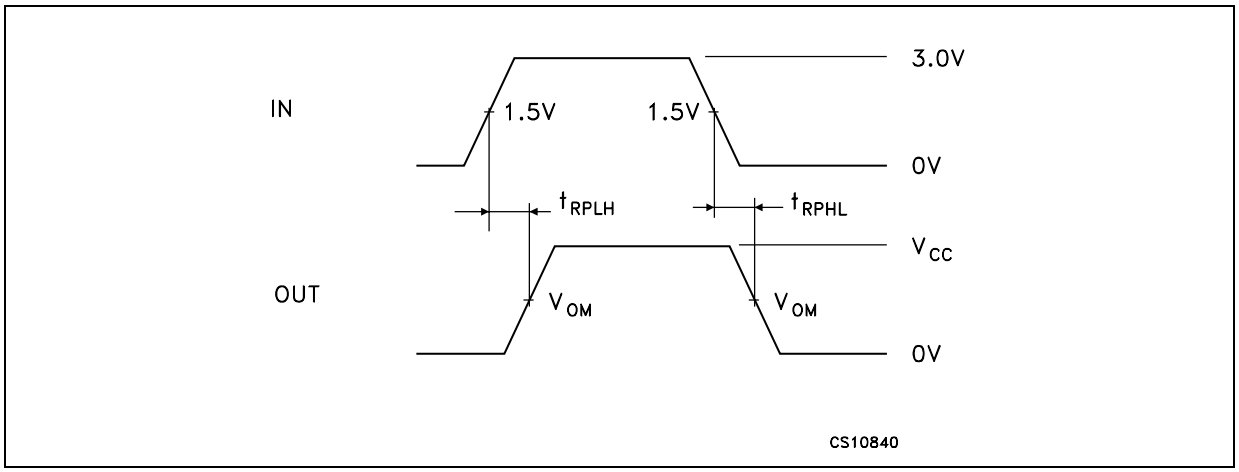


Figure 15. Receiver enable and disable times test circuit

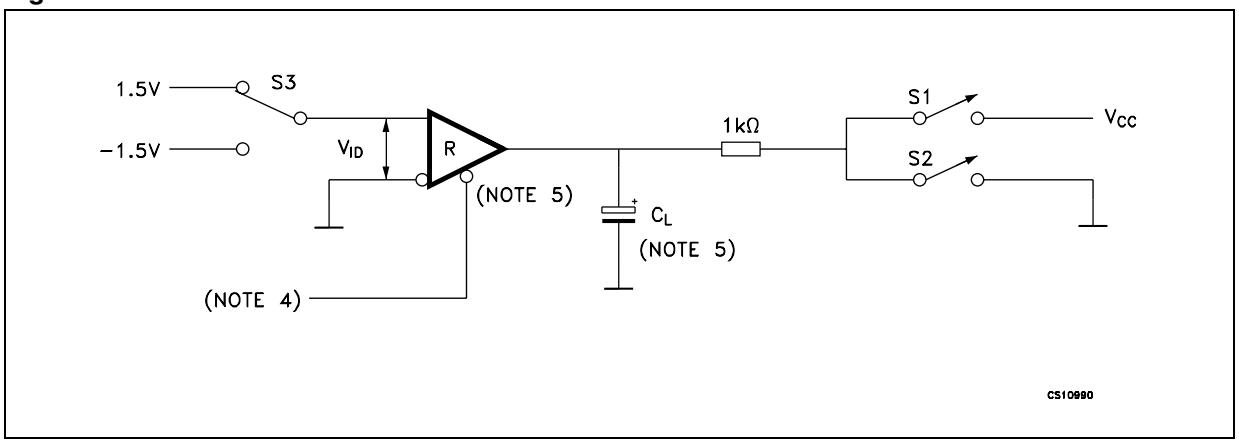


Figure 16. Receiver enable and disable times waveform

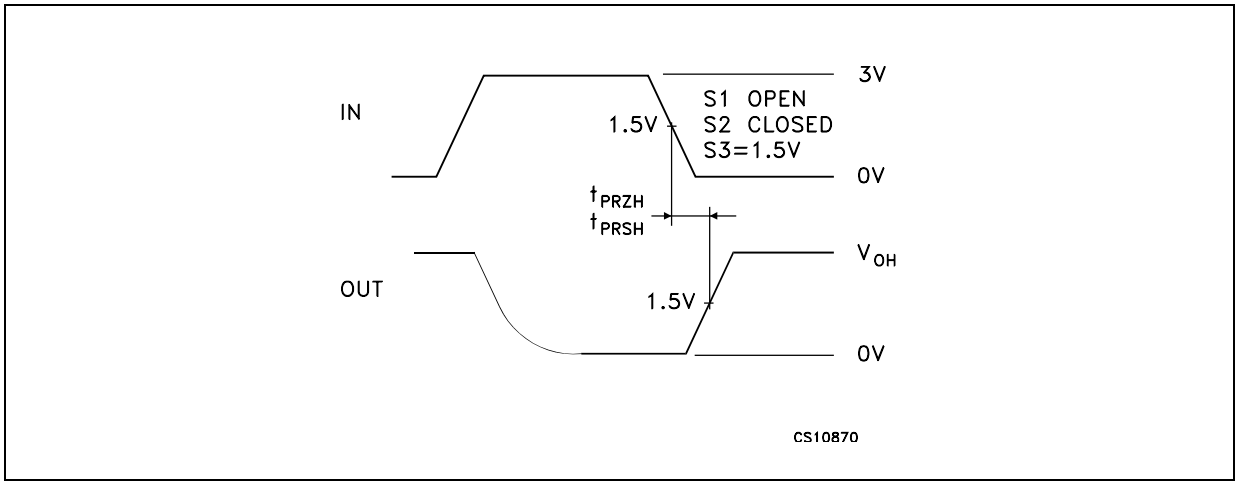


Figure 17. Receiver enable and disable times waveform

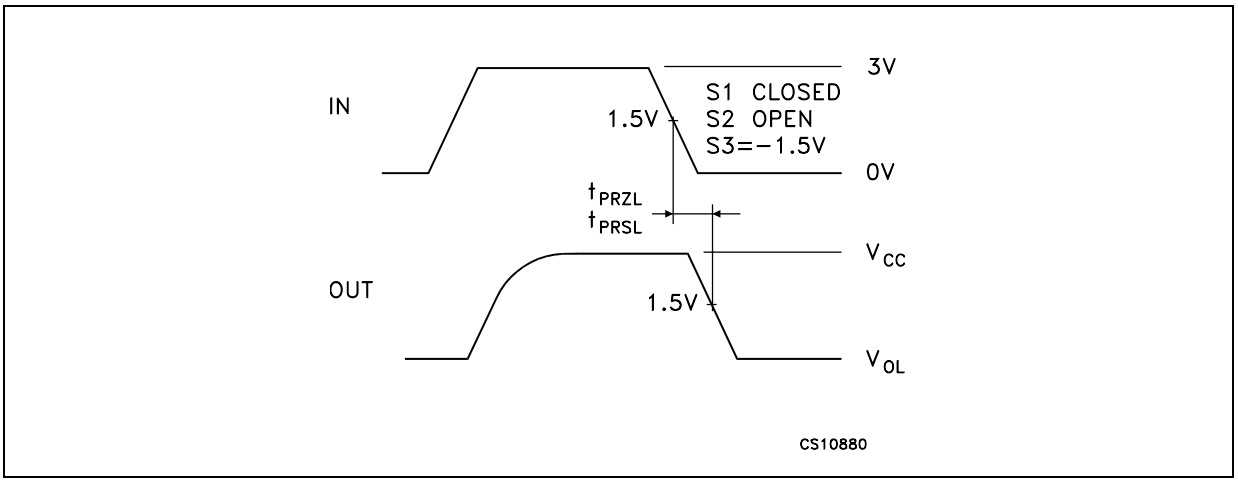


Figure 18. Receiver enable and disable times waveform

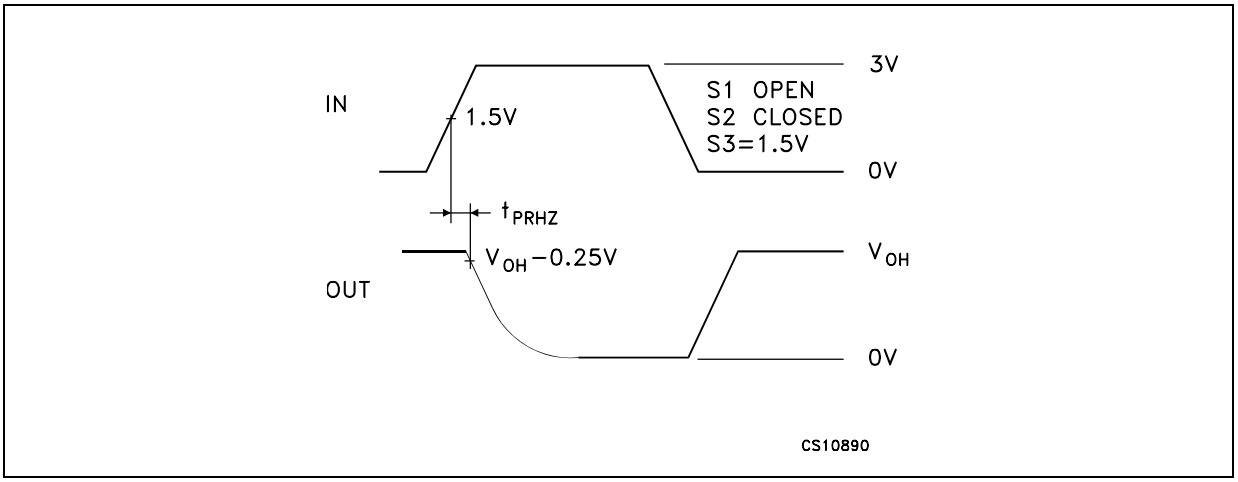


Figure 19. Receiver enable and disable times waveform

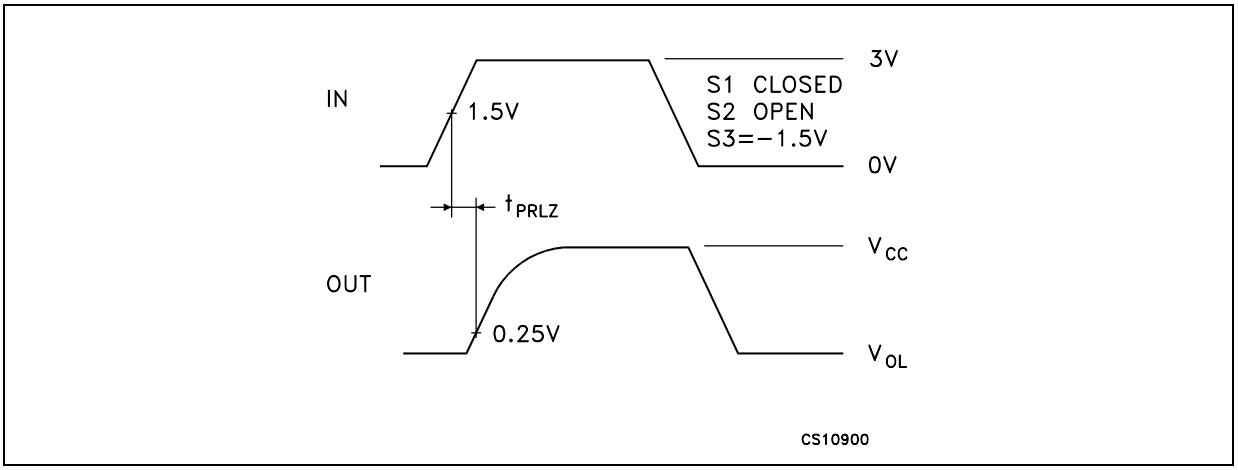


Figure 20. Receiver output current vs output low voltage

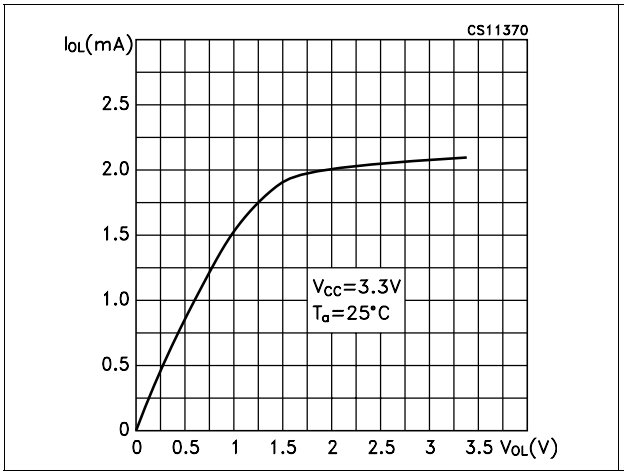


Figure 21. Receiver output current vs output high voltage

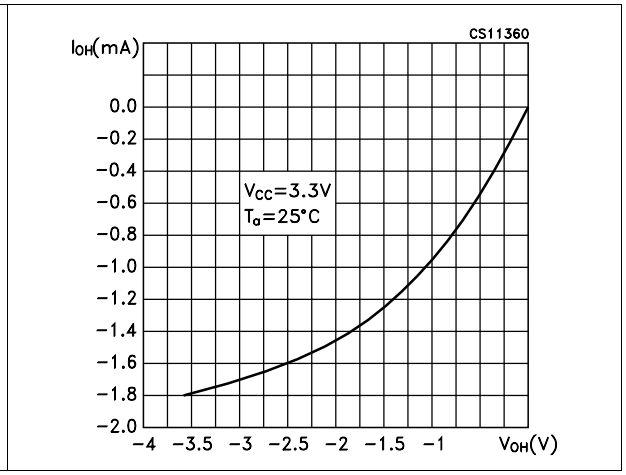


Figure 22. Low level driver output capability

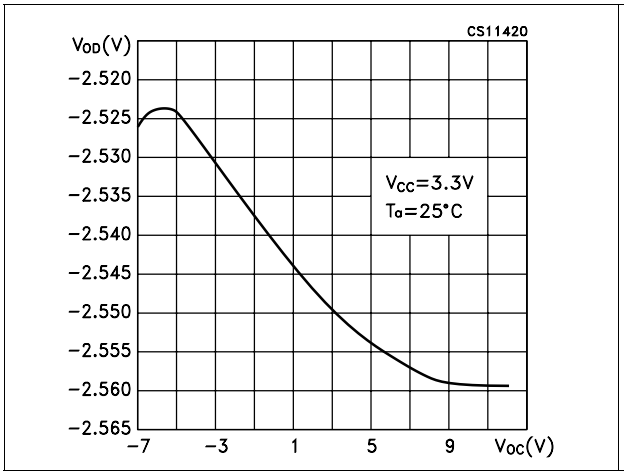


Figure 23. High level driver output capability

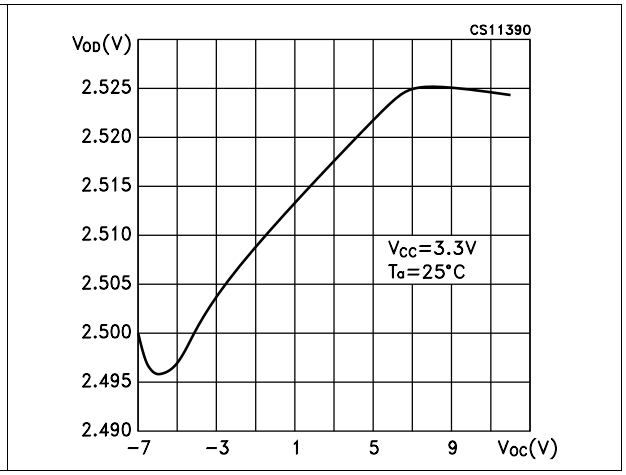


Figure 24. Receiver input characteristics

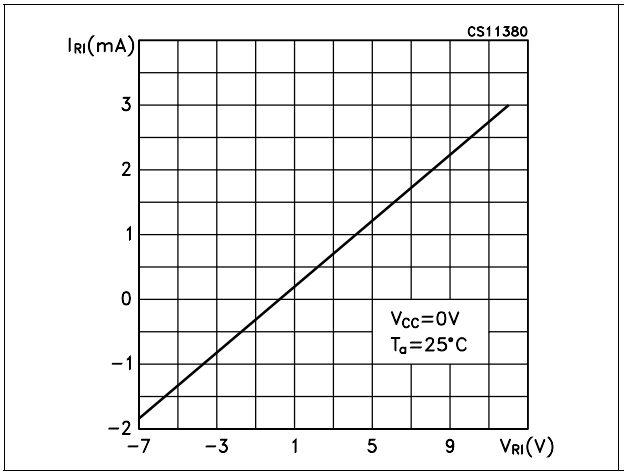


Figure 25. Driver short circuit current

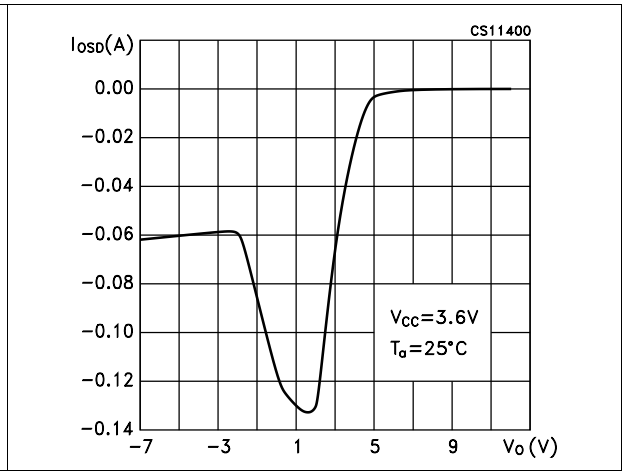
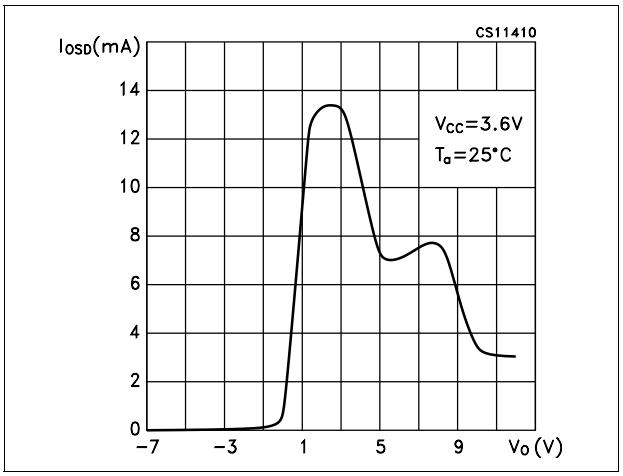


Figure 26. Driver short circuit current

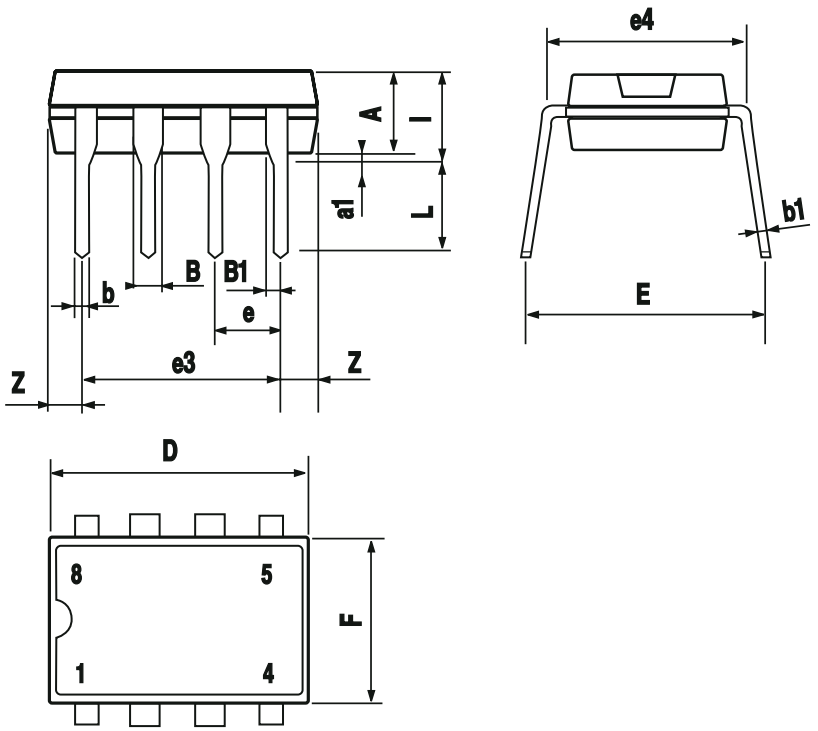


6 Package mechanical data

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

Plastic DIP-8 mechanical data

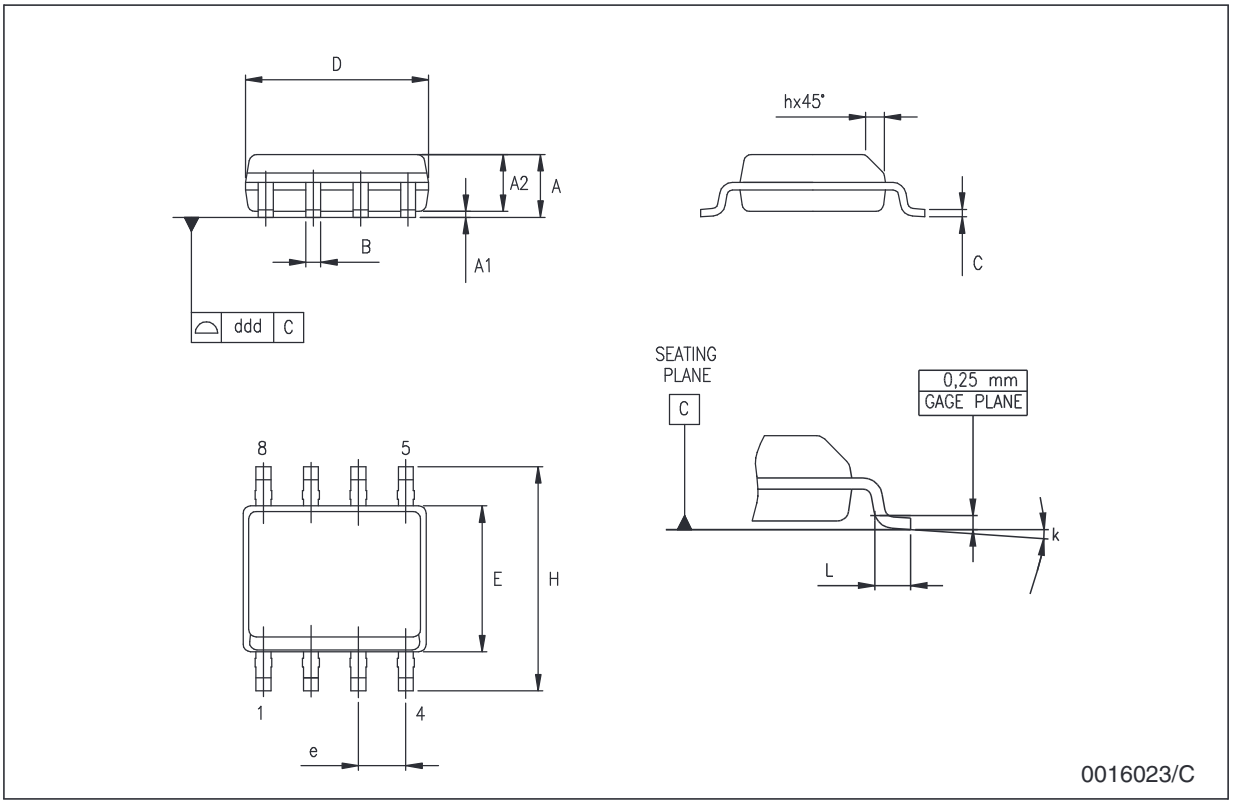
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.3			0.130	
a1	0.7			0.028		
B	1.39		1.65	0.055		0.065
B1	0.91		1.04	0.036		0.041
b		0.5			0.020	
b1	0.38		0.5	0.015		0.020
D			9.8			0.386
E		8.8			0.346	
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			7.1			0.280
I			4.8			0.189
L		3.3			0.130	
Z	0.44		1.6	0.017		0.063



P001F

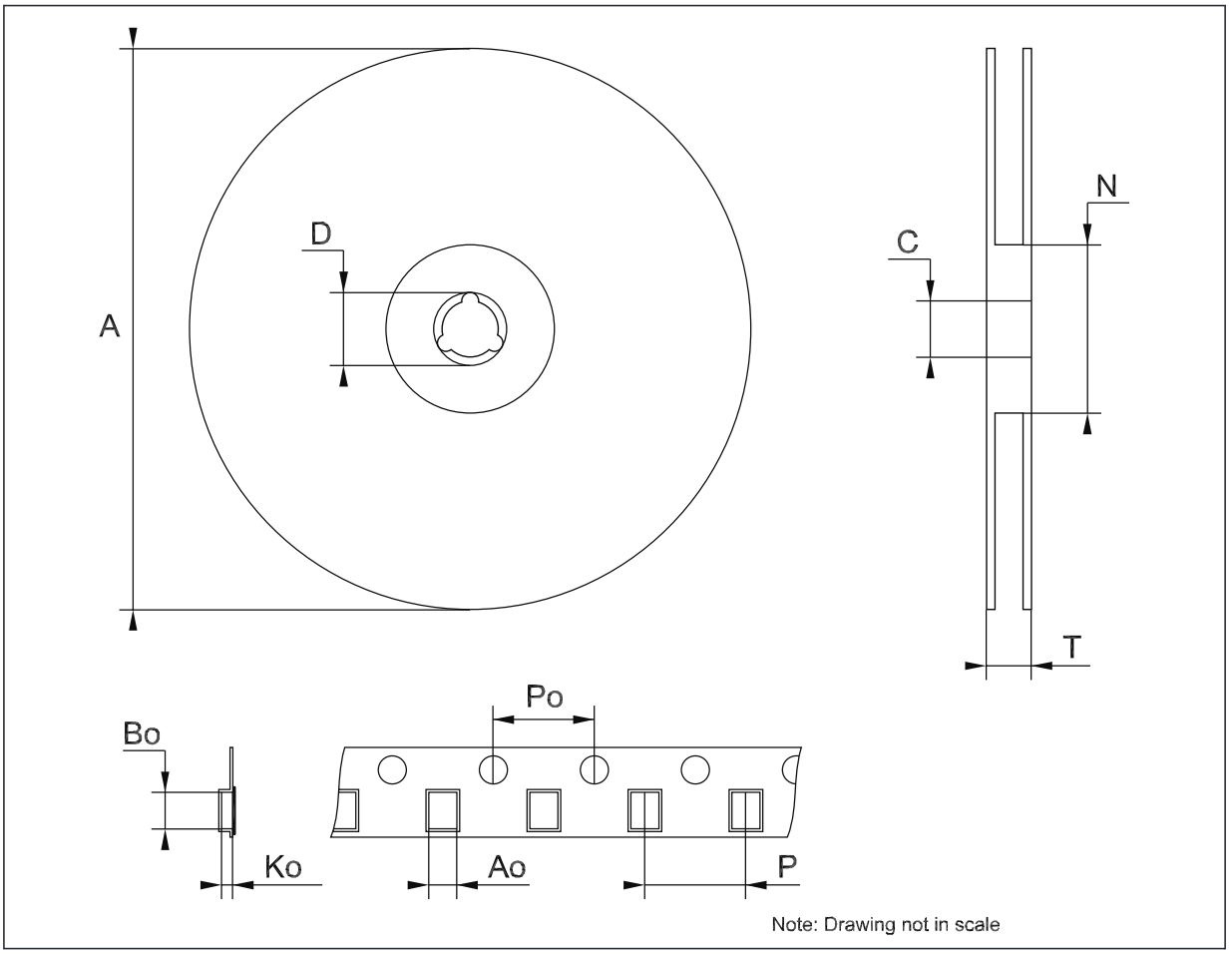
SO-8 mechanical data

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



Note: Drawing not in scale

7 Revision history

Table 13. 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*.