ST1480AB
ST1480AC

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

Datasheet - production data

SO-8

Features

- ESD protection
  - ±15 kV human body model
  - ±8 kV IEC 1000-4-2 contact discharge
- Operates 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 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, shorted or terminated inputs with no signal present
- Allows up to 64 transceivers on the bus

Description

The ST1480Ax 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 ST1480Ax 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.

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.

The ST1480Ax input has a true fail-safe feature that guarantees a logic high output if both inputs are open circuit, shorted together or in the presence of a termination with no signal on the bus.

Table 1. Device summary

Order codes	Temperature range	Package	Packaging
ST1480ACDR	0 to 70 °C	SO-8 (tape & reel)	2500 parts per reel
ST1480ABDR	- 40 to 85 °C	SO-8 (tape & reel)	2500 parts per reel

Contents

1 Pin configuration

Figure 1. Pin connections

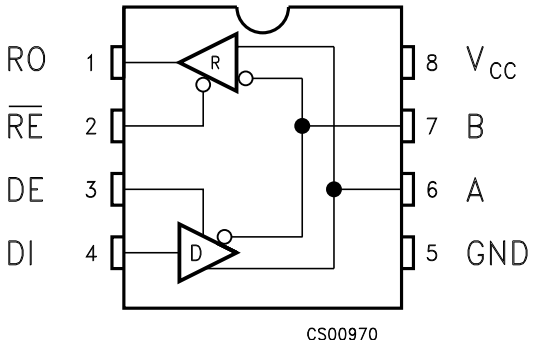


Figure 2. Pin description

Pin n°	Symbol	Name and function
1	RO	Receiver output. If A>B by 200 mV, RO is high; if A< B by 200 mV, RO is 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 enters 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 enters 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}= 3 V to 3.6 V

2 Truth tables

Table 2. Truth table (driver)

Inputs			Outputs		Mode
$\overline{RE}$	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 3. Truth table (receiver)

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

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

3 Maximum ratings

Table 4. 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
ESD	ESD protection voltage	Human body model	± 15	kV
		IEC-1000-4-2 contact discharge	± 8	

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

4 Electrical characteristics

V_{CC} = 3 V to 3.6 V, TA = -40 to 85 °C, unless otherwise specified. Typical values are referred to TA = 25 °C).

Table 5. Electrical characteristics

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
			$\overline{DE}$=0 V, $\overline{RE}$=0 V		1.2	1.9	mA
I_{SHDN}	Shutdown supply current	DE=0 V, RE=V_{CC}, DI=0 V or V_{CC}			0.002	1	µA

Table 6. Logic input electrical characteristics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
V_{IL}	Input logic threshold low	DE, DI, RE				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}=12 V			1	mA
			V_{IN}=-7 V			-0.8	mA

Table 7. Transmitter electrical characteristics

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

Table 8. Receiver electrical characteristics

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		-0.015	V
ΔV_{TH}	Receiver input hysteresis	V_{CM} = 0 V		30		µV
V_{OH}	Receiver output high voltage	I_{OUT} = -4 mA, V_{ID} = 200 mV, (*Figure 9*)	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 9. Driver switching characteristics

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}	$\lvert t_{PLH} - t_{PHL} \rvert$ propagation delay skew (*Note 2*)	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
$t_{ZH(SHDN)}$	Driver enable from shutdown to output high			30	50	ns
$t_{ZL(SHDN)}$	Driver enable from shutdown to output low			19	35	ns

Table 10. Receiver switching characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{PLH} t_{PHL}	Propagation delay	V_{ID}= 0 V to 3 V, C_{L1} =15 pF (*Figure 13* and *Figure 14*)		30	50	ns
t_{RPDS}	$\|t_{PLH} - t_{PHL}\|$ propagation delay skew	V_{ID}= 0 V to 3 V, C_{L1} = 15 pF (*Figure 13* and *Figure 14*)		1	3	ns
t_{PZL}	Output enable time	C_{RL} = 15 pF, (*Figure 15* and *Figure 19*)		10	20	ns
t_{PZH}	Output enable time	C_{RL} = 15 pF, (*Figure 15* and *Figure 19*)		10	20	ns
t_{PHZ}	Output disable time	C_{RL} = 15 pF, (*Figure 15* and *Figure 19*)		10	20	ns
t_{PLZ}	Output disable time	C_{RL} = 15 pF, (*Figure 15* and *Figure 19*)		10	20	ns
$t_{ZH(SHDN)}$	Receiver enable from shutdown to output high	C_{RL} = 15 pF, (*Figure 15* and *Figure 19*)		10	20	ns
$t_{ZL(SHDN)}$	Receiver enable from shutdown to output low	C_{RL} = 15 pF, (*Figure 15* and *Figure 19*)		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 3. Driver and V_{OC} test load

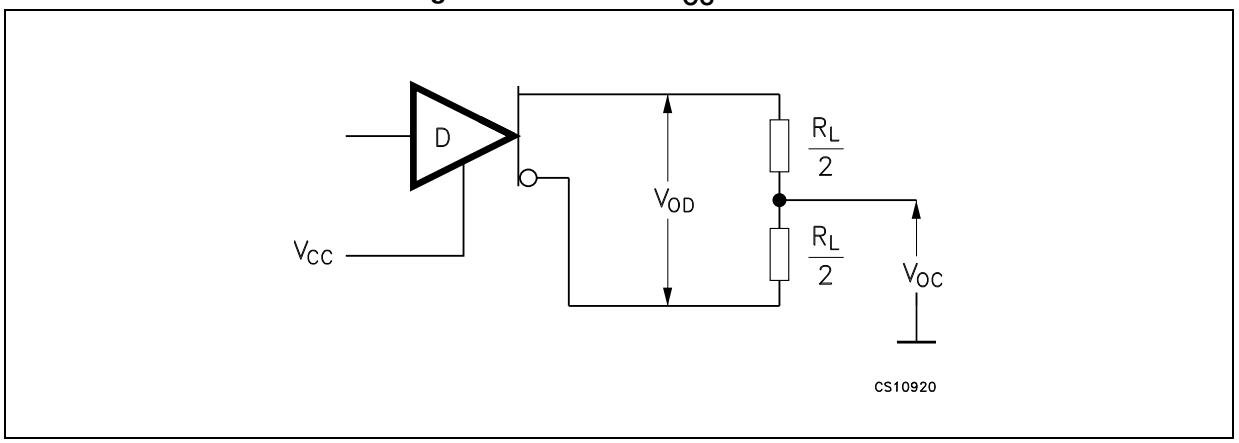


Figure 4. Driver V_{OD} with varying common mode voltage test load

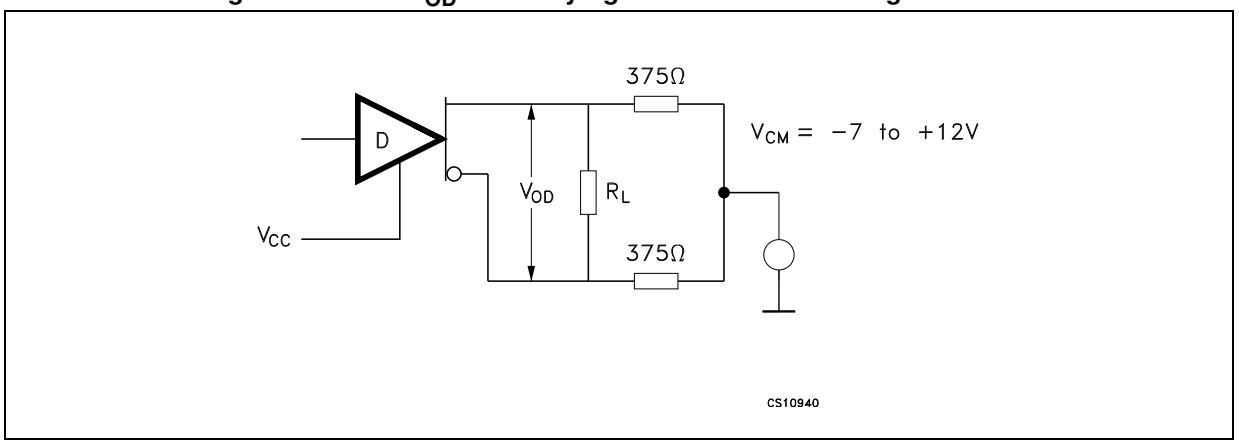


Figure 5. Receiver V_{OH} and V_{OL} test circuit

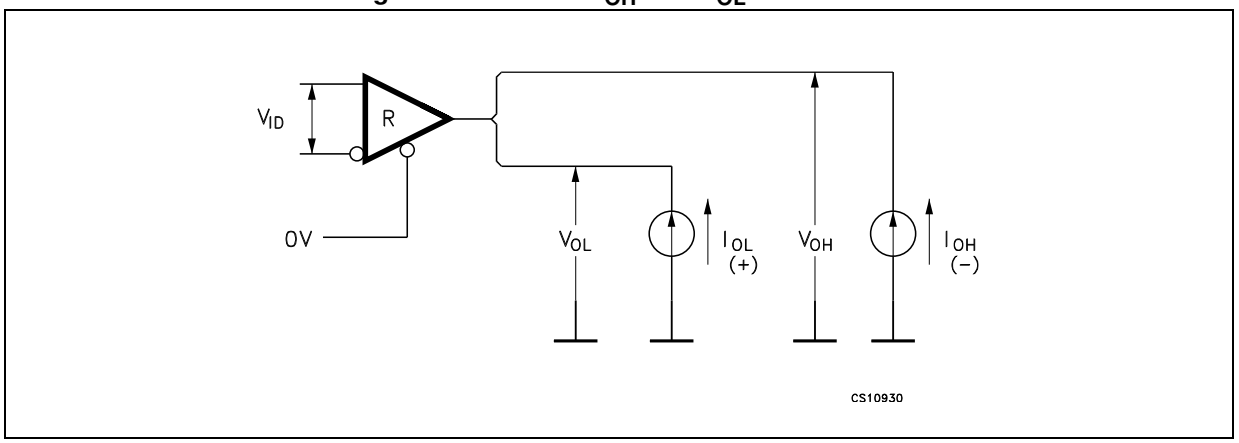


Figure 6. Drive differential output delay transition time test circuit

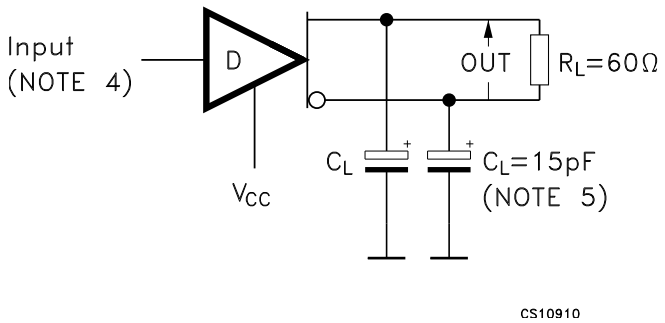


Figure 7. Drive differential output delay transition time waveform

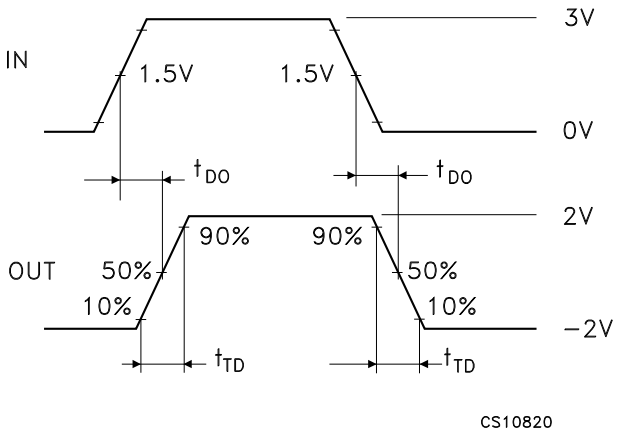


Figure 8. Drive enable and disable times test circuit

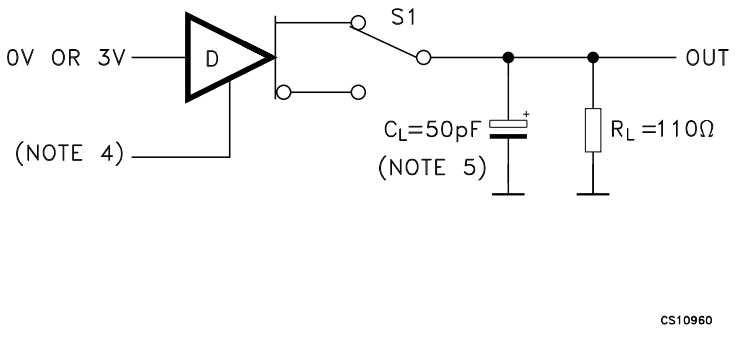


Figure 9. Drive enable and disable times waveforms

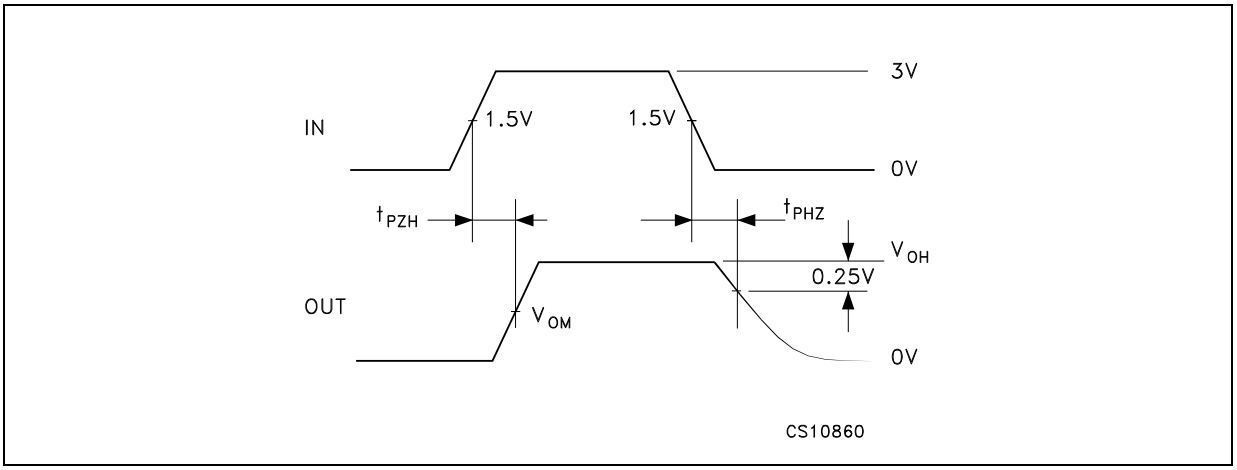


Figure 10. Drive propagation time test circuit

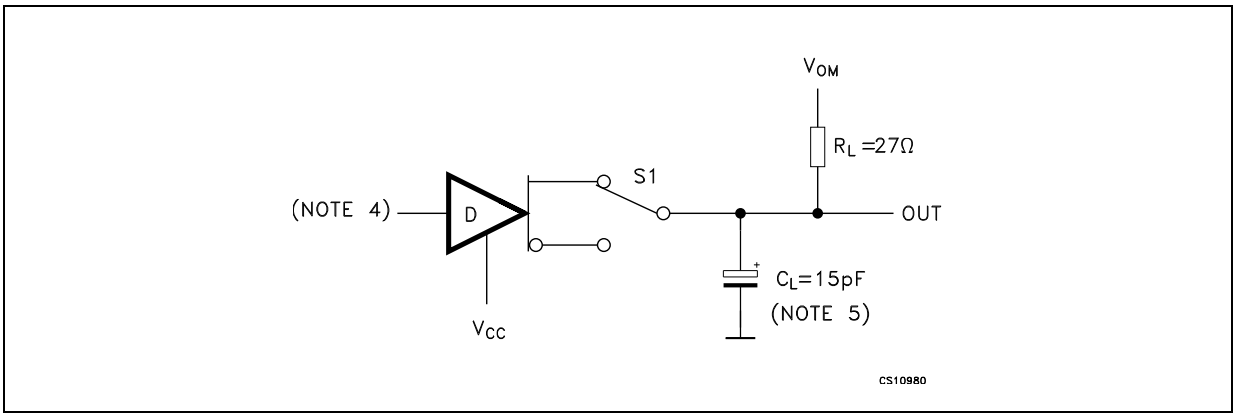


Figure 11. Drive propagation time waveform

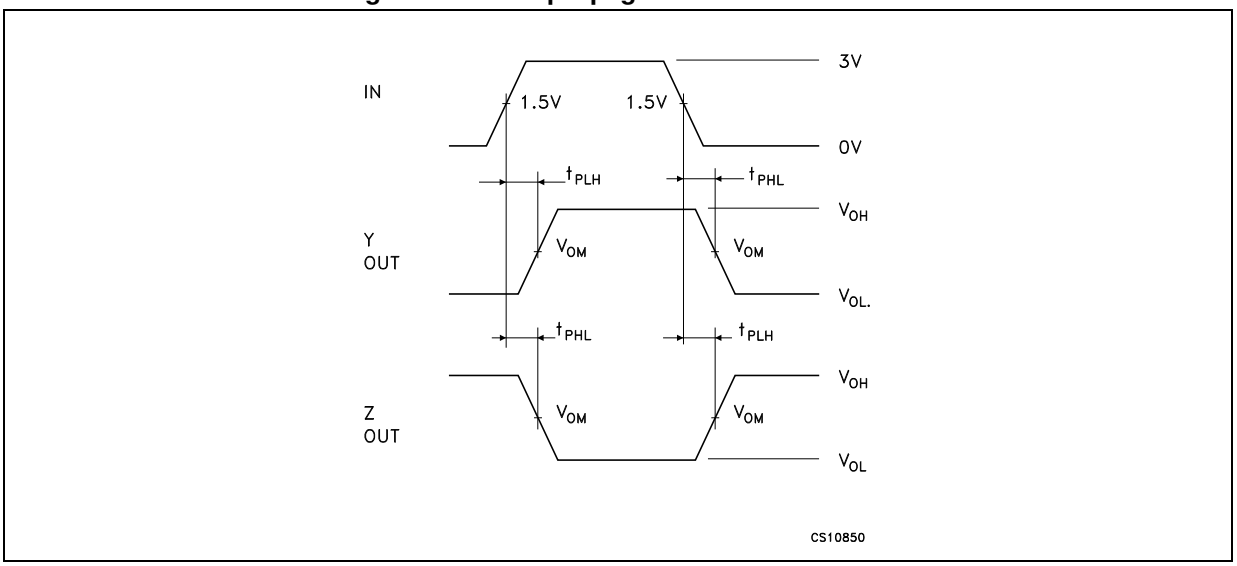


Figure 12. Drive enable and disable times test circuit

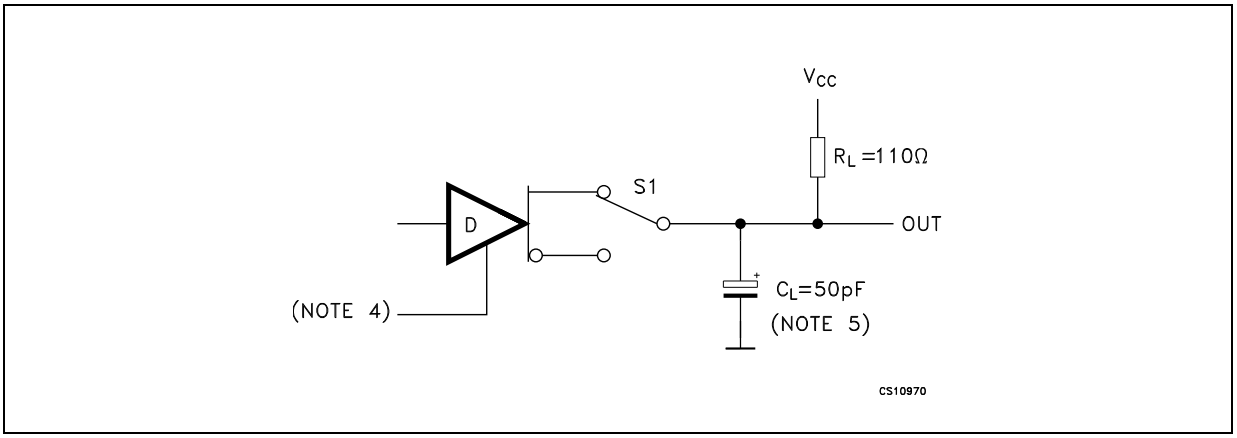


Figure 13. Drive enable and disable times waveforms

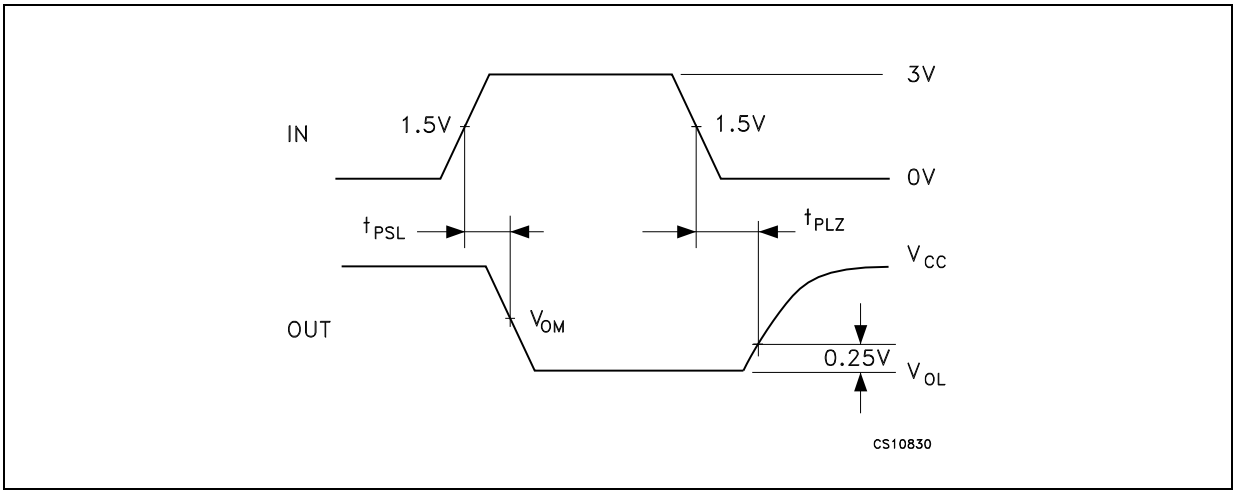


Figure 14. Receiver propagation delay time test circuit

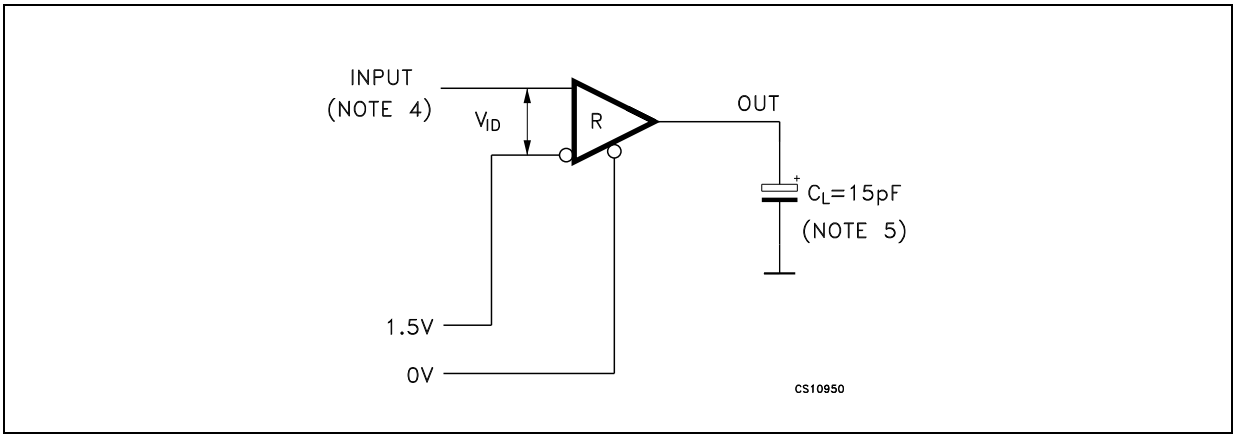


Figure 15. Receiver propagation delay time waveforms

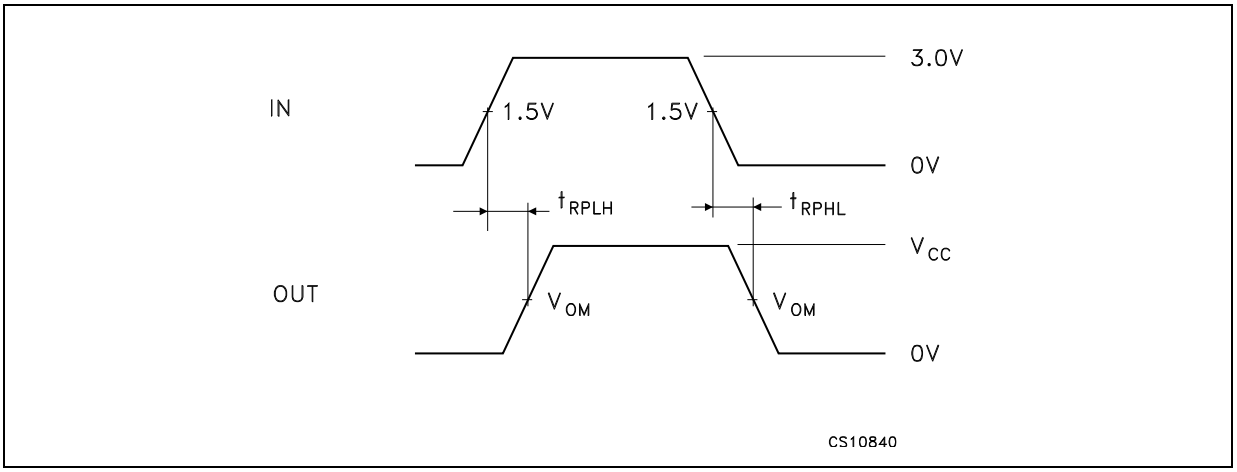


Figure 16. Receiver enable and disable times test circuit

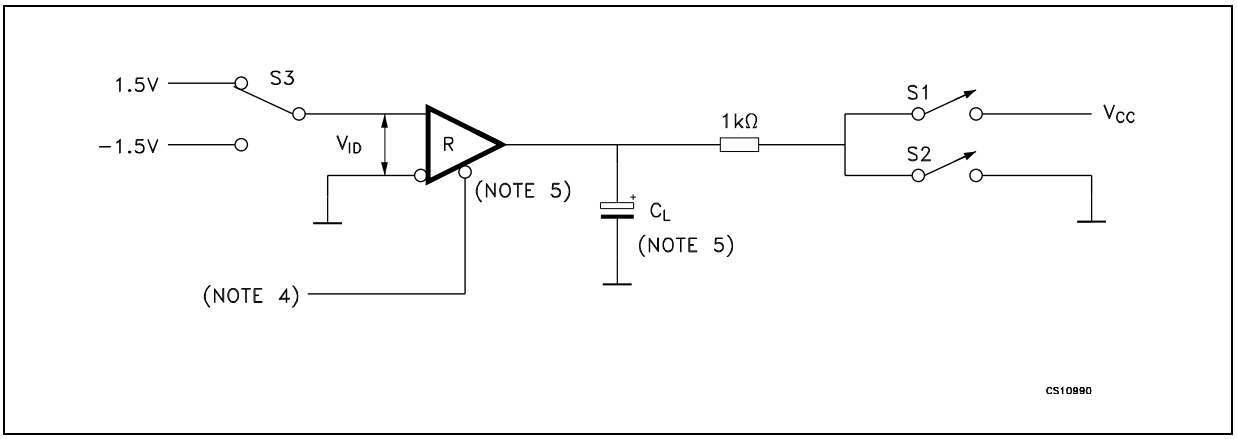


Figure 17. Receiver enable and disable times waveform

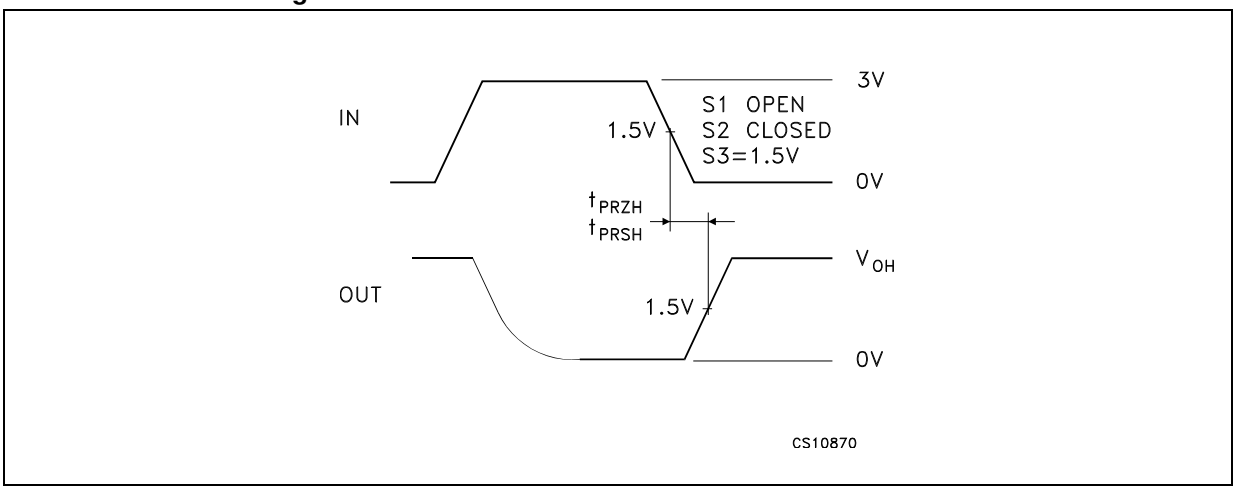


Figure 18. Receiver enable and disable times waveform

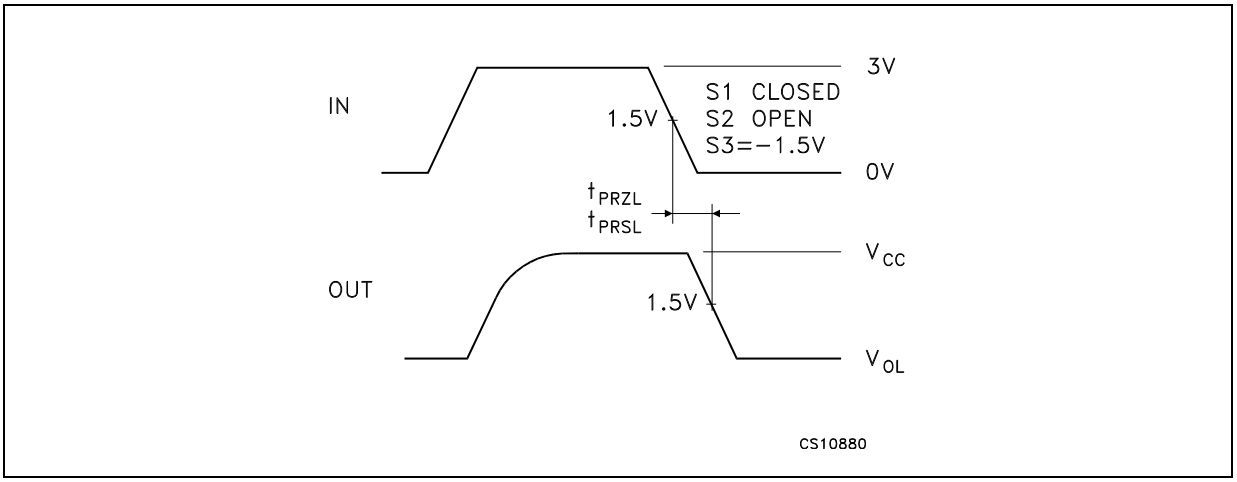


Figure 19. Receiver enable and disable times waveform

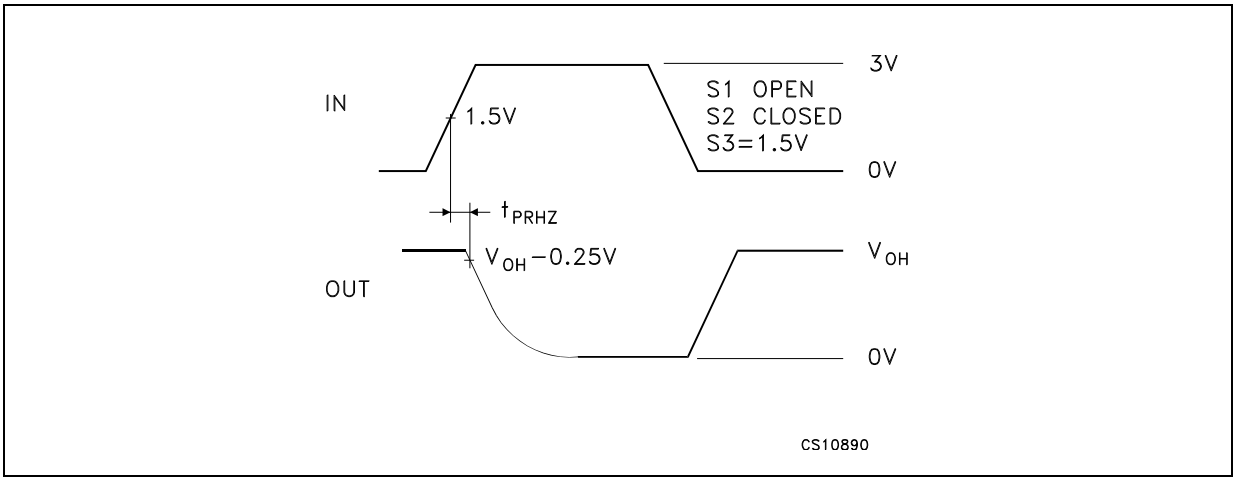


Figure 20. Receiver enable and disable times waveform

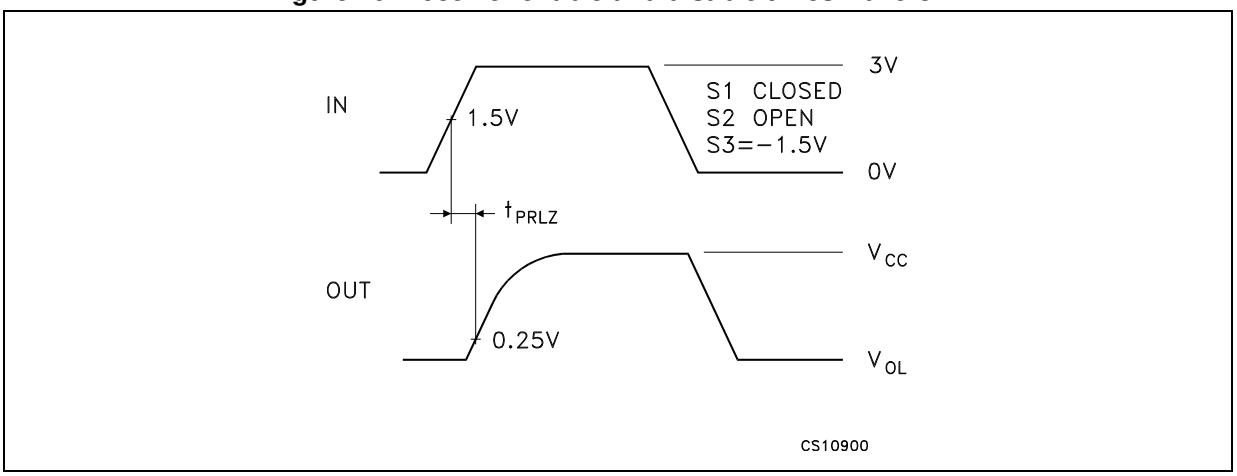


Figure 21. Receiver output current vs output low voltage

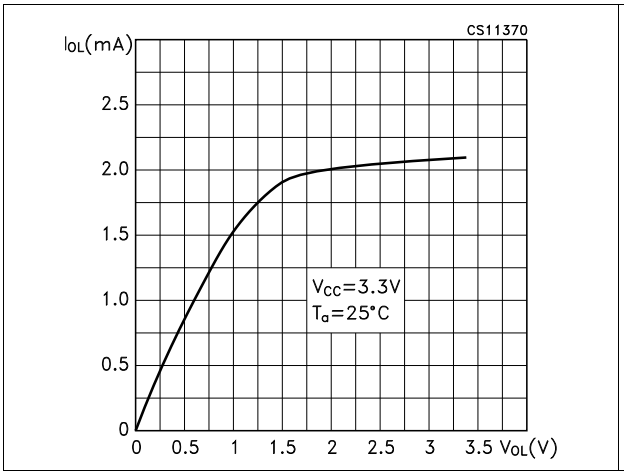


Figure 22. Receiver output current vs output high voltage

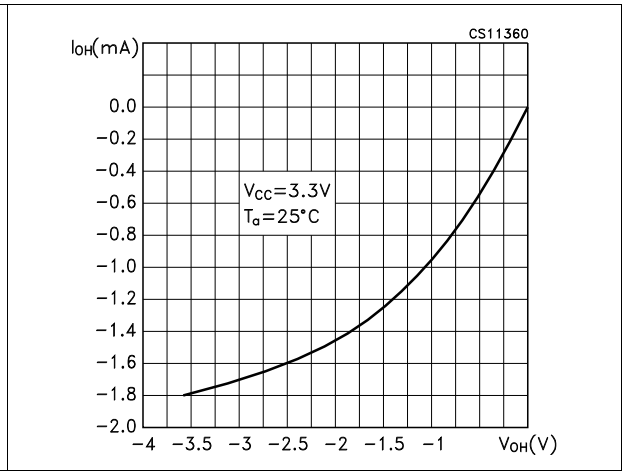


Figure 23. Low level driver output capability

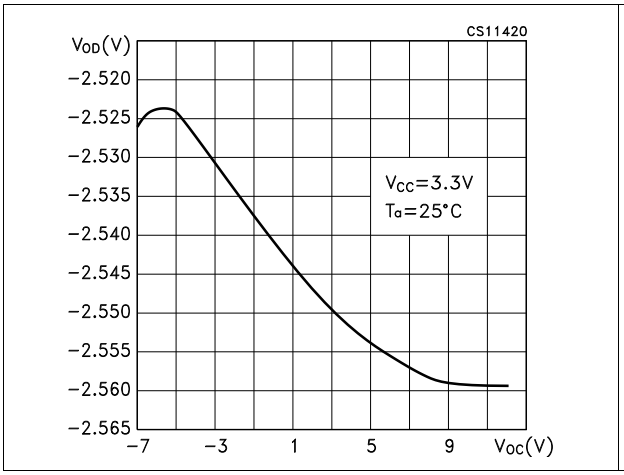


Figure 24. High level driver output capability

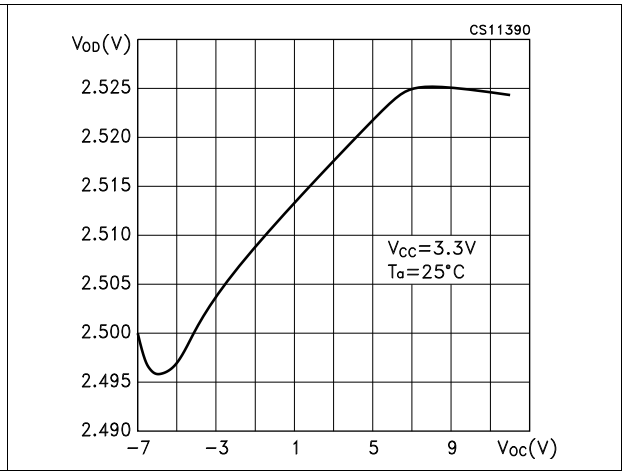


Figure 25. Receiver input characteristics

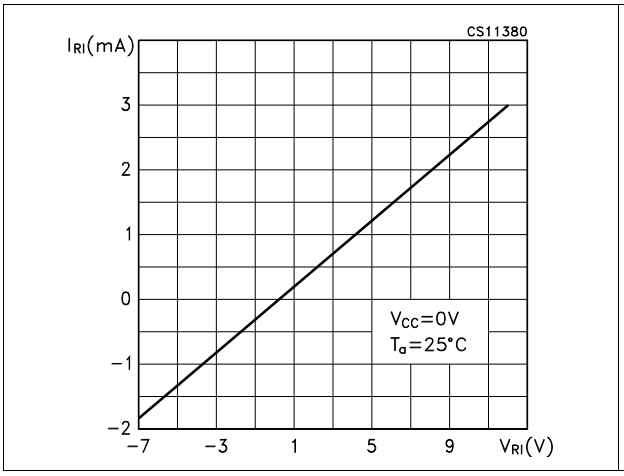


Figure 26. Driver short circuit current

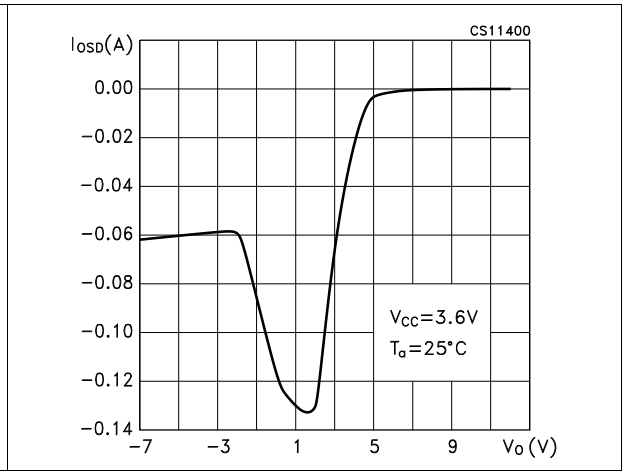
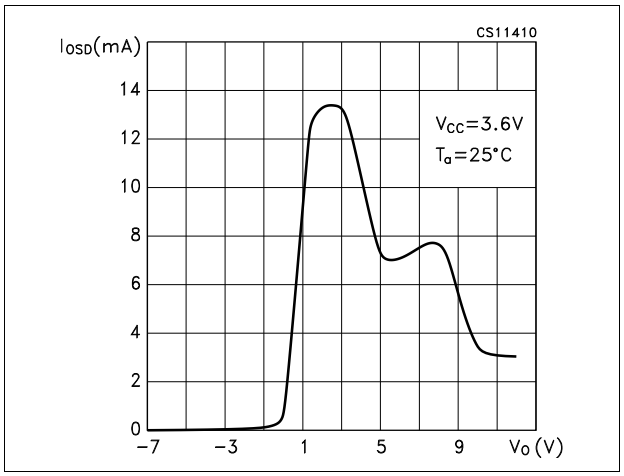


Figure 27. Driver short circuit current



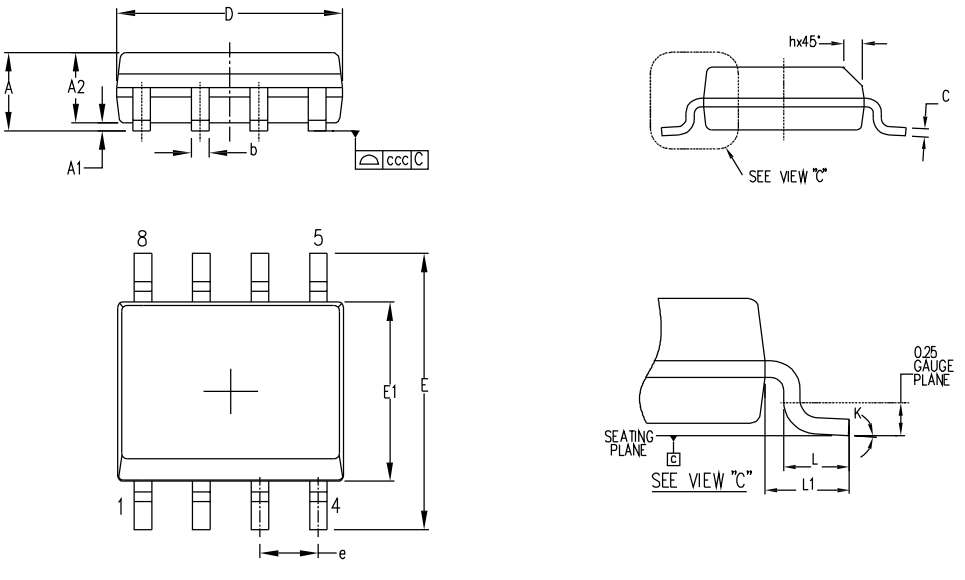
6 Package mechanical data

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.

Table 11. SO-8 mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.75
A1	0.10		0.25
A2	1.25		
b	0.28		0.48
c	0.17		0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e		1.27	
h	0.25		0.50
L	0.40		1.27
L1		1.04	
k	0°		8°
ccc			0.10

Figure 28. Drawing dimension SO-8



7 Revision history

Table 12. Document revision history

Date	Revision	Changes
02-May-2006	2	Order codes updated.
19-Nov-2007	3	Added Table 2.
24-Jul-2013	4	Updated: ECOPACK section in Chapter 6. Corrected: unit of measurement in Table 9 (Receiver input hysteresis from V to µV). Minor text changes.
18-Mar-2020	5	Updated *Table 1*, *Table 3* and V_{IL} parameter in *Table 6*. Removed DIP-8 package.