

+5.0V, $\pm 15\text{kV}$ ESD-Protected, Fail-Safe, Hot-Swap, RS-485/RS-422 Transceivers

■ **Description**

The TK13083E +5.0V, $\pm 15\text{kV}$ ESD-protect-ed, RS-485/RS-422 transceivers feature one driver and one receiver. These devices include fail-safe circuitry, guaranteeing a logic-high receiver output when receiver inputs are open or shorted. The receiver outputs a logic-high if all transmitters on a terminated bus are disabled (high impedance).

The TK13083E driver slew rates is not limited, making transmit speeds up to 0.5Mbps possible. It is intended for full-duplex communications. The TK13083E family transceivers draw 1.2mA of supply current when unloaded or when fully loaded with the drivers disabled. All devices have a 1/8-unit load receiver input impedance, allowing up to 256 transceivers on the bus. It is available in 14-pin SOIC packages. The devices operate over the commercial, extended, and automotive temperature ranges.

■ **Features**

- 1 transmitter and 1 receivers of the serial data of the standard RS-485
- Transmit speeds up to 0.5Mbps
- Auto Shutdown function provide low power consumption
- Supply voltage range: $5.0\text{V} \pm 5\%$
- Operating temperature range: $-40 \sim +85^\circ\text{C}$
- ESD protection up to 2000V for transmitter input and receiver output (TTL/CMOS levels) and up to 15000V for transmitter output and receiver input (RS-485 levels)
- Enhanced ESD Specifications:
 - $\pm 15\text{kV}$ IEC61000-4-2 Air Discharge
 - $\pm 8\text{kV}$ IEC61000-4-2 Contact Discharge

■ **Ordering Information**

Part Number	Package	Packing	Temperature(TA)	Package Qty	ESD
TK13080EASD	SOIC-14	Reel	$-40^\circ\text{C} \sim 85^\circ\text{C}$	2500	$\pm 15\text{KV}$

Note: Please contact us to customize DIP packaging device.

■ Pin Description

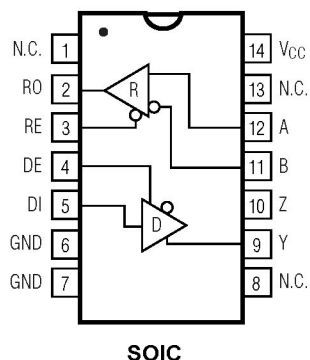


Table 1. Pin Description

Pin Num	Symbol	Pin Description
01	N.C.	No Connect. Not internally connected, can be connected to GND.
02	RO	Receiver Output. When $\overline{RE}$ is low and if $A - B \geq -50\text{mV}$, RO will be high; if $A - B \leq -200\text{mV}$, RO will be low.
03	$\overline{RE}$	Receiver Output Enable. Drive $\overline{RE}$ low to enable RO; RO is high impedance when $\overline{RE}$ is high. Drive $\overline{RE}$ high and DE low to enter low-power shutdown mode.
04	DE	Driver Output Enable. Drive DE high to enable driver outputs. These outputs are high impedance when DE is low. Drive $\overline{RE}$ high and DE low to enter low-power shutdown mode.
05	DI	Driver Input. With DE high, a low on DI forces noninverting output low and inverting output high. Similarly, a high on DI forces noninverting output high and inverting output low.
06	GND	Ground
07	GND	Ground
08	N.C.	No Connect. Not internally connected, can be connected to GND.
09	Y	Noninverting Driver Output
10	Z	Inverting Driver Output
11	B	Inverting Receiver Input
12	A	Noninverting Receiver Input
13	N.C.	No Connect. Not internally connected, can be connected to GND.
14	VCC	Positive Supply; $4.75\text{V} \leq VCC \leq 5.25\text{V}$

Table 2. Transmitter Truth Table

Inputs			Outputs	
$\overline{RE}$	DE	DI	Z	Y
X	H	H	L	H
X	H	L	H	L
L	L	X	Z	Z
H	L	X	ZZ	

Note : H – high level, L – low level , X –don't care, Z – third state

Table 3. Receiver Truth Table

Inputs			Outputs
$\overline{RE}$	DE	A, B	RO
L	X	$\geq -0,05 B$	H
L	X	$\leq -0,2 B$	L
L	X	BH	H
H	H	X	Z
H	L	X	ZZ

Note : H – high level, L – low level , BH – inputs not used, X –don't care, Z – third state,
 ZZ – inputs and outputs are in the third state

Table 4. Recommended Operating Condition

Symbol	Parameter	Limit		Unit
		min	max	
V_{CC}	Supply voltage	4.75	5.25	V
V_{IL}	Input low voltage DI, DE, $\overline{RE}$ pins	0	0.8	V
V_{IH}	Input high voltage DI, DE, $\overline{RE}$ pins	2.0	V_{CC}	V
V_{OD}	Transmitter output voltage	-7.0	12.0	V
V_{IR}	Receiver input voltage	-7.0	12.0	V
V_{OR}	Receiver output voltage	0	V_{CC}	V
V_{TH}	Receiver differential threshold voltage	± 50	± 200	V
T	Ambient temperature	-40	85	°C

Table 5. Maximum Ratings

Symbol	Parameter	Limit		Unit
		min	max	
V_{CC}	Supply voltage	–	7.0	V
V_{IL}	Input voltage on pins DI, DE, $\overline{RE}$	-0.3	7.0	V
V_{OD}	Transmitter output voltage	-13	13	V
V_{IR}	Receiver input voltage	-13	13	V
V_{OR}	Receiver output voltage	-0.3	$V_{CC}+0.3$	V

* Stresses beyond those listed under “maximum ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Table 6. Electrical Parameters

($V_{CC} = 5V \pm 5\%$)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
DRIVER							
VCC Supply-Voltage Range	VCC			4.5		5.5	V
Differential Driver Output	VOD	RL = 100Ω (RS-422), Figure 1		3		VCC	V
		RL = 54Ω (RS-485), Figure 1		2		VCC	
		No load				VCC	
Change in Magnitude of Differential Output Voltage	ΔVOD	RL = 100Ω or 54Ω, Figure 1 (Note 2)				0.2	V
Driver Common-Mode Output Voltage	VOC	RL = 100Ω or 54Ω, Figure 1			VCC / 2	3	V
Change in Magnitude of Common-Mode Voltage	ΔVOC	RL = 100Ω or 54Ω, Figure 1 (Note 2)				0.2	V
Input-High Voltage	VIH	DE, DI, RE, TXP, RXP, H/F		3			V
Input-Low Voltage	VIL	DE, DI, RE, TXP, RXP, H/F				0.8	V
Input Hysteresis	VHYS	DE, DI, RE, TXP, RXP, H/F			100		mV
Input Current	IIN1	DE, DI, RE				±1	μA
Input Impedance First Transition		DE		1		10	kΩ
Input Current	IIN2	TXP, RXP, H/F internal pulldown		10		40	μA
SRL Input-High Voltage				VCC - 0.4			V
SRL Input-Middle Voltage				VCC x 0.3		VCC x 0.7	V
SRL Input-Low Voltage						0.4	V
SRL Input Current		SRL = VCC				75	μA
		SRL = GND		-75			
Output Leakage (Y and Z) Full Duplex	IO	DE = GND, VCC = GND or VCC	VIN = +12V			125	μA
			VIN = -7V	-100			
Driver Short-Circuit Output Current	IOSD	0 ≤ VOUT ≤ +12V (Note 3)		40		250	mA
		-7V ≤ VOUT ≤ VCC (Note 3)		-250		-40	
		0 ≤ VOUT ≤ +12V, +85°C ≤ TA ≤ +125°C (Note 3)		40		270	
		-7V ≤ VOUT ≤ VCC, +85°C ≤ TA ≤ +125°C (Note 3)		-270		-40	
Driver Short-Circuit Foldback Output Current	IOSDF	(VCC - 1V) ≤ VOUT ≤ +12V (Note 3)		20			mA
		-7V ≤ VOUT ≤ +1V (Note 3)				-20	
Thermal-Shutdown Threshold	TS				175		°C
Thermal-Shutdown Hysteresis	TS _H				15		°C
Input Current (A and B)	IA, B	DE = GND, VCC = GND or VCC	VIN = +12V			125	μA
			VIN = -7V	-100			
RECEIVER							
Receiver Differential Threshold Voltage	VTH	-7V ≤ VCM ≤ +12V		-200	-125	-50	mV
Receiver Input Hysteresis	ΔVTH	VA + VB = 0V			15		mV
RO Output-High Voltage	VOH	IO = -1mA		VCC - 0.6			V
RO Output-Low Voltage	VOL	IO = 1mA				0.4	V
Three-State Output Current at Receiver	IOZR	0 ≤ VO ≤ VCC				± 1	μA
Receiver Input Resistance	RIN	-7V ≤ VCM ≤ +12V		96			kΩ
Receiver Output Short-Circuit Current	IOSR	0V ≤ VRO ≤ VCC				±110	mA

Table 6. Electrical Parameters (continued)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SUPPLY CURRENT						
Supply Current	I _{CC}	No load, $\overline{RE} = 0$, DE = V _{CC}		1.2	1.8	mA
		No load, $\overline{RE} = V_{CC}$, DE = V _{CC}		1.2	1.8	
		No load, $\overline{RE} = 0$, DE = 0		1.2	1.8	
Supply Current in Shutdown Mode	I _{SHDN}	$\overline{RE} = V_{CC}$, DE = GND		2.8	10	μA
ESD PROTECTION						
ESD Protection for Y, Z, A, and B		Human Body Model		±15		kV
		Contact Discharge IEC 61000-4-2		±6		kV

DRIVER SWITCHING CHARACTERISTICS

(V_{CC} = +5.0V ±10%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5.0V and T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Propagation Delay	t _{DPLH}	C _L = 50pF, R _L = 54Ω, Figures 2 and 3	200		1000	ns
	t _{DPLH}		200		1000	
Driver Differential Output Rise or Fall Time	t _R , t _F	C _L = 50pF, R _L = 54Ω, Figures 2 and 3	250		900	ns
Differential Driver Output Skew t _{DPLH} - t _{DPLH}	t _{DSKEW}	C _L = 50pF, R _L = 54Ω, Figures 2 and 3			140	ns
Maximum Data Rate			500			kbps
Driver Enable to Output High	t _{DZH}	Figure 4			2500	ns
Driver Enable to Output Low	t _{DZL}	Figure 5			2500	ns
Driver Disable Time from Low	t _{DLZ}	Figure 5			100	ns
Driver Disable Time from High	t _{DHZ}	Figure 4			100	ns
Driver Enable from Shutdown to Output High	t _{DZH(SHDN)}	Figure 4			5500	ns
Driver Enable from Shutdown to Output Low	t _{DZL(SHDN)}	Figure 5			5500	ns
Time to Shutdown	t _{SHDN}		50	340	700	ns

RECEIVER SWITCHING CHARACTERISTICS

V_{CC} = +5.0V ±10%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at V_{CC} = +5.0V and T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Receiver Propagation Delay	t _{RPLH}	C _L = 15pF, Figures 6 and 7			200	ns
	t _{RPHL}				200	
Receiver Output Skew t _{RPLH} - t _{RPHL}	t _{RSKEW}	C _L = 15pF, Figures 6 and 7			30	ns
Maximum Data Rate			500			kbps
Receiver Enable to Output Low	t _{RZL}	Figure 8			50	ns
Receiver Enable to Output High	t _{RZH}	Figure 8			50	ns
Receiver Disable Time from Low	t _{RLZ}	Figure 8			50	ns
Receiver Disable Time from High	t _{RHZ}	Figure 8			50	ns
Receiver Enable from Shutdown to Output High	t _{RZH(SHDN)}	Figure 8			5500	ns
Receiver Enable from Shutdown to Output Low	t _{RZL(SHDN)}	Figure 8			5500	ns
Time to Shutdown	t _{SHDN}		50	340	700	ns

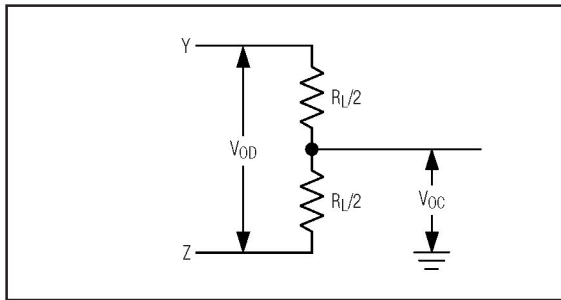


Figure 1. Driver DC Test Load

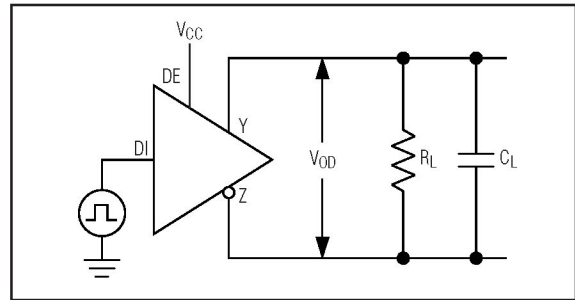


Figure 2. Driver Timing Test Circuit

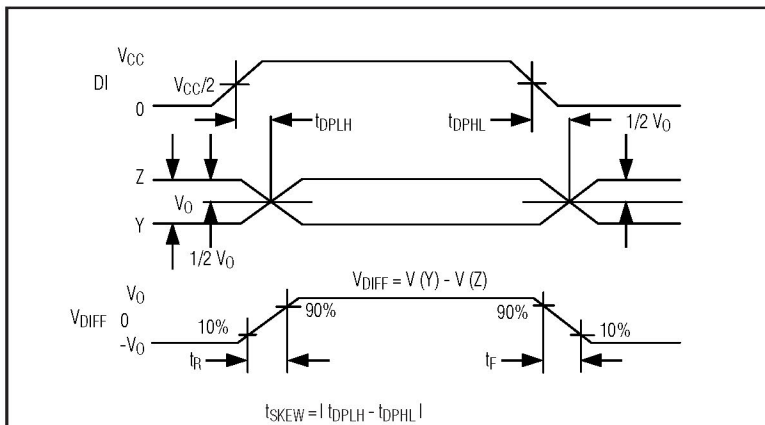


Figure 3. Driver Propagation Delays

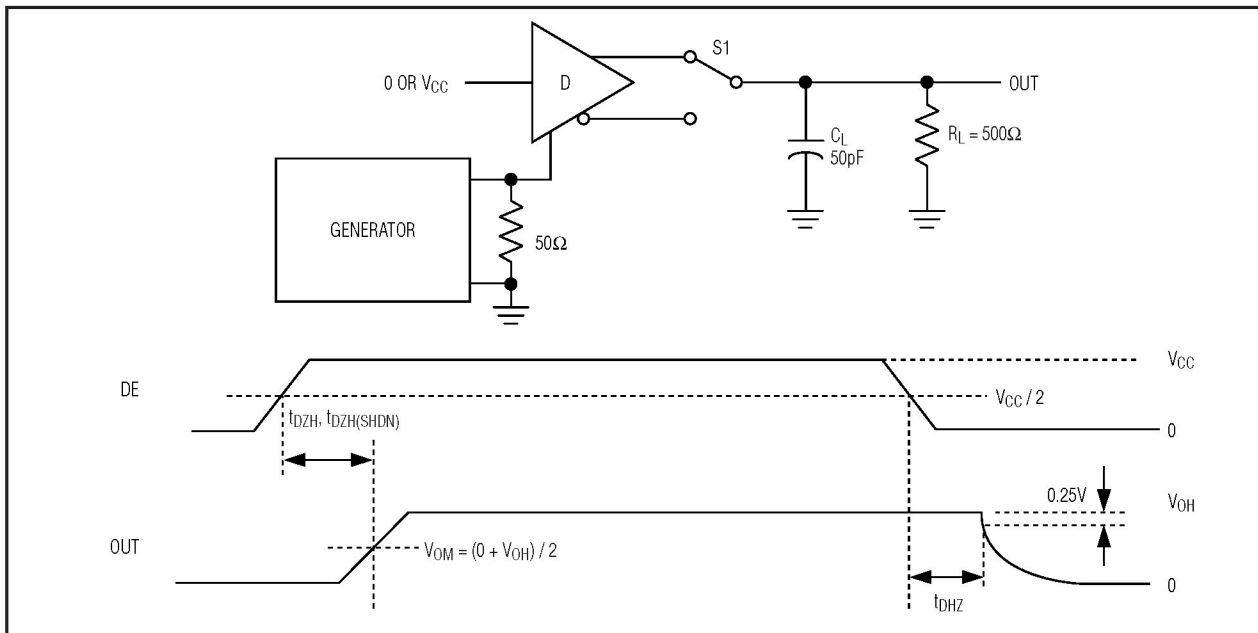


Figure 4. Driver Enable and Disable Times (t_{DZH} , t_{DZH} , $t_{DZH(SHDN)}$)

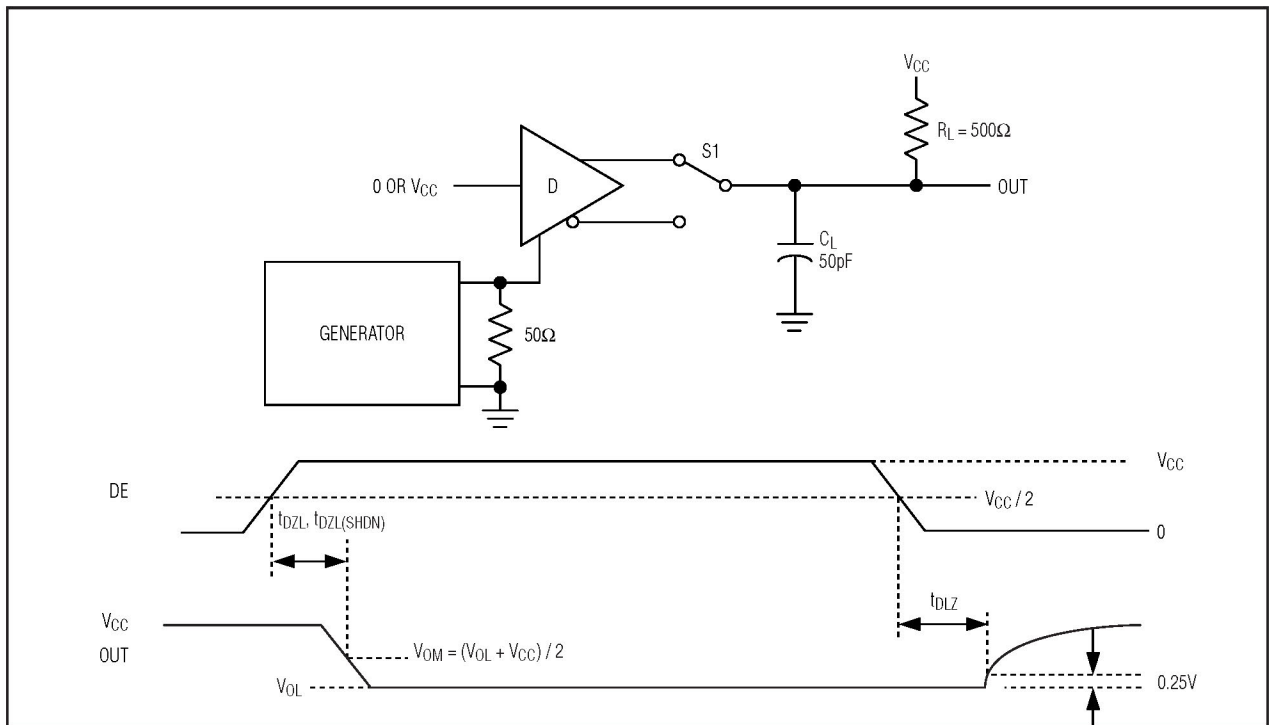


Figure 5. Driver Enable and Disable Times (t_{DZL} , t_{DLZ} , $t_{DLZ(SHDN)}$)

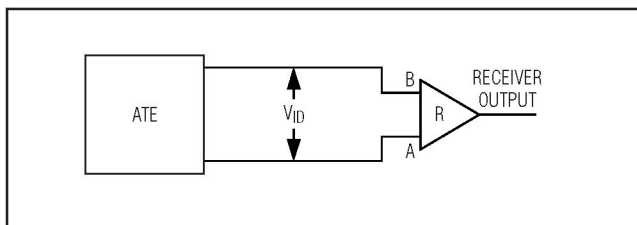


Figure 6. Receiver Propagation Delay Test Circuit

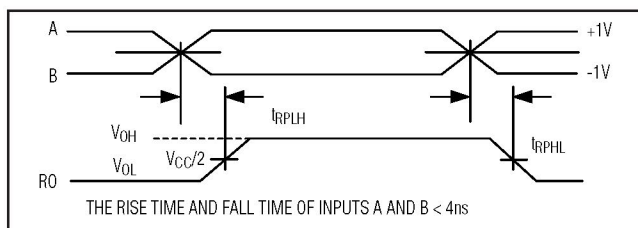


Figure 7. Receiver Propagation Delays

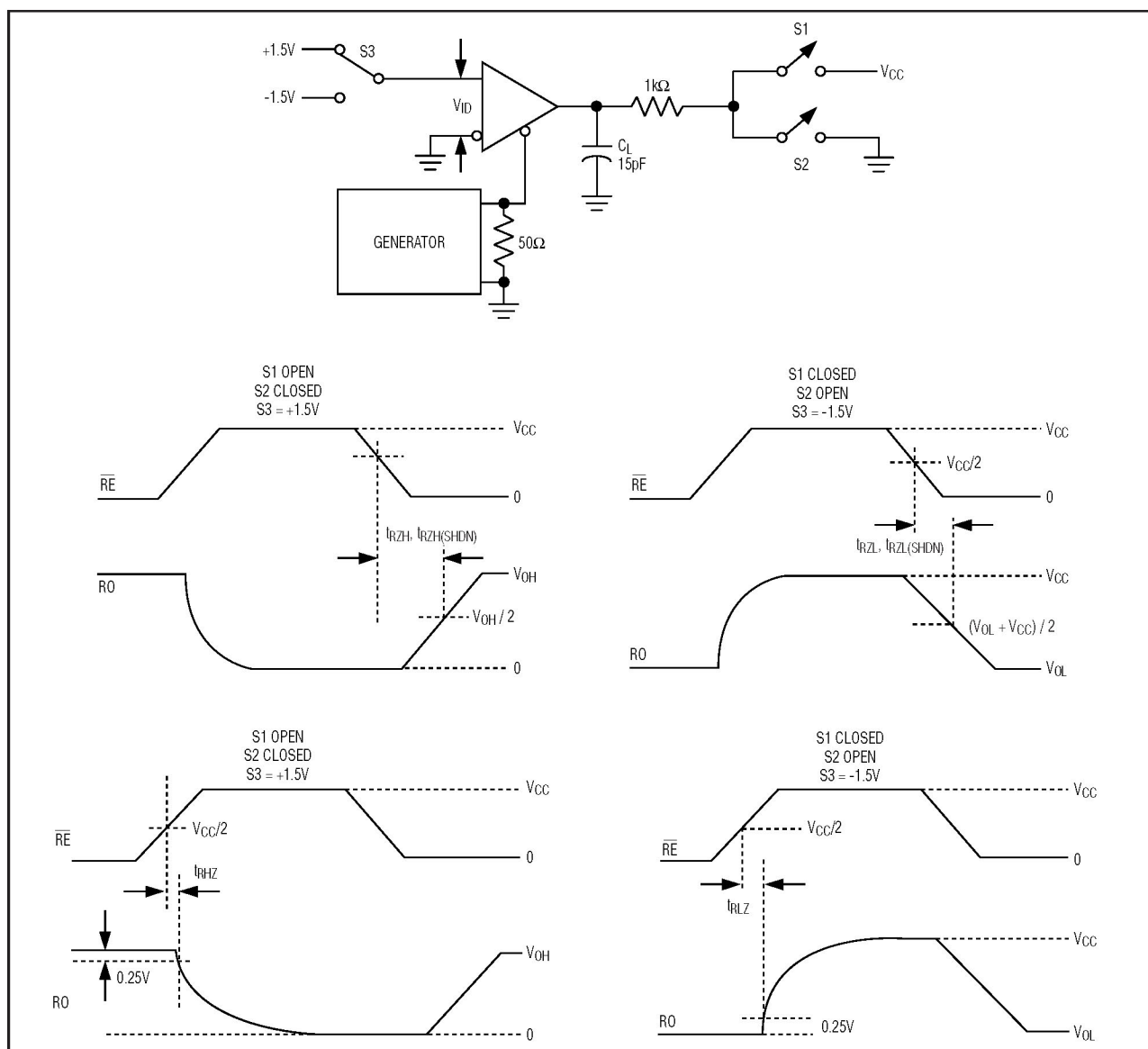
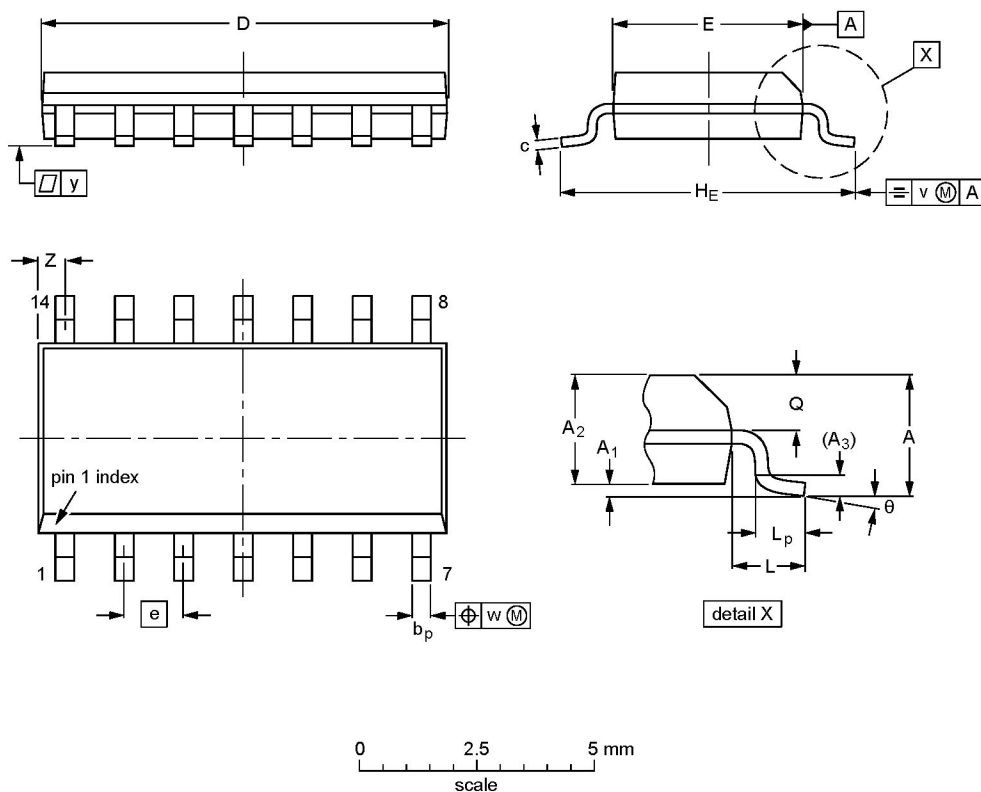


Figure 8. Receiver Enable and Disable Times

Package diagram

SOIC14: plastic small outline package; 14 leads; body width 3.9 mm



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	8.75 8.55	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
TKSOIC14						05-06-19