

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

■ Description

The TK13087E +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 TK13087E family include a hot-swap capability to eliminate false transitions on the bus during power-up or hot insertion.

The TK13087E driver slew rates are not limited, making transmit speeds up to 16Mbps possible. It is intended for full-duplex communications.

All devices have a 1/8-unit load receiver input impedance, allowing up to 256 transceivers on the bus. It is available in 8-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
- Free Data Transmission, Allow Up to 256 Transceivers on the Bus
- Supply voltage range: $5.0\text{V} \pm 5\%$
- Operating temperature range: $-40 \sim +85\text{ }^{\circ}\text{C}$
- 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
TK13087EESA	SOIC-8	Reel	$-40^{\circ}\text{C} \sim 85^{\circ}\text{C}$	2500	$\pm 15\text{KV}$
TK13087ECSA	SOIC-8	Reel	$0^{\circ}\text{C} \sim 70^{\circ}\text{C}$	2500	$\pm 15\text{KV}$
TK13087EASA	SOIC-8	Reel	$-40^{\circ}\text{C} \sim 125^{\circ}\text{C}$	2500	$\pm 15\text{KV}$

Note: Please contact us to customize DIP packaging device.

■ Pin Description

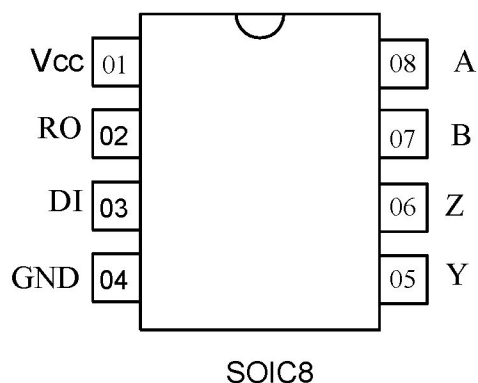


Table 1. Pin Description

Pin Number	Symbol	Pin Description
01	Vcc	Positive Supply Vcc = +5.0V ±10%. Bypass Vcc to GND with a 0.1μF capacitor.
02	RO	Receiver Output. When $\overline{RE}$ is low and if (A - B) ≥ -50mV, RO is high; if (A - B) ≤ -200mV, RO is low.
03	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.
04	GND	Ground
05	Y	Noninverting Driver Output
06	Z	Inverting Driver Output
07	B	Inverting Receiver Input
08	A	Noninverting Receiver Input

Table 2. Transmitter Truth Table

TRANSMITTING		
INPUT	OUTPUTS	
DI	Z	Y
H	L	H
L	H	L

Note : H – high level, L – low level

Table 3. Receiver Truth Table

RECEIVING	
INPUTS	OUTPUT
A, B	RO
$\geq -50\text{mV}$	H
$\leq -200\text{mV}$	L
Open/shorted	H

Note : H – high level, L – low level

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	$ \pm 50 $	$ \pm 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	TTS				175		°C
Thermal-Shutdown Hysteresis	TTSH				15		°C
Input Current (A and B)	IA, B	DE = GND, VCC = GND or VCC	VN = +12V			125	μA
			VN = -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			50	ns
	t _{DPLH}				50	
Driver Differential Output Rise or Fall Time	t _R , t _F	C _L = 50pF, R _L = 54Ω, Figures 2 and 3			15	ns
Differential Driver Output Skew t _{DPLH} - t _{DPLH}	t _{DSKEW}	C _L = 50pF, R _L = 54Ω, Figures 2 and 3			8	ns
Maximum Data Rate			16			Mbps
Driver Enable to Output High	t _{DZH}	Figure 4			150	ns
Driver Enable to Output Low	t _{DZL}	Figure 5			150	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			2200	ns
Driver Enable from Shutdown to Output Low	t _{DZL(SHDN)}	Figure 5			2200	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		50	80	ns
	t _{RPHL}			50	80	
Receiver Output Skew t _{RPLH} - t _{RPHL}	t _{RSKEW}	C _L = 15pF, Figures 6 and 7			13	ns
Maximum Data Rate			16			Mbps
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			2200	ns
Receiver Enable from Shutdown to Output Low	t _{RZL(SHDN)}	Figure 8			2200	ns
Time to Shutdown	t _{SHDN}		50	340	700	ns

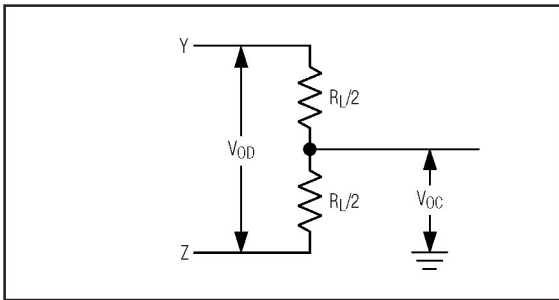


Figure 1. Driver DC Test Load

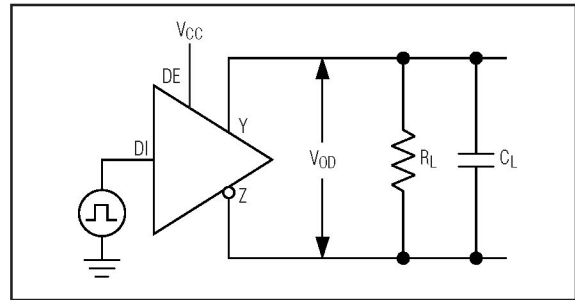


Figure 2. Driver Timing Test Circuit

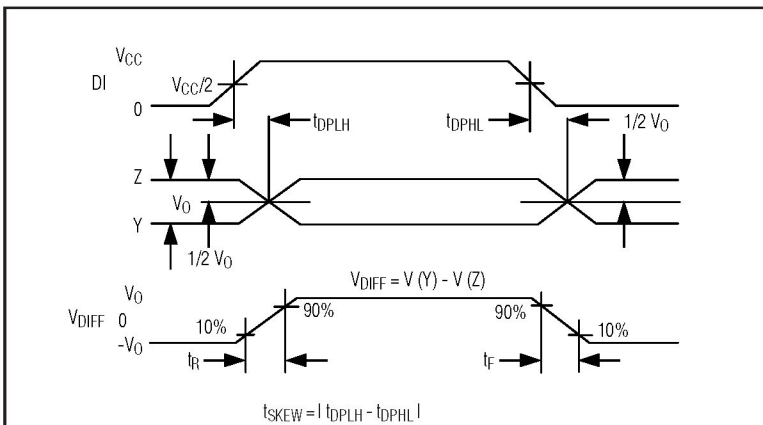


Figure 3. Driver Propagation Delays

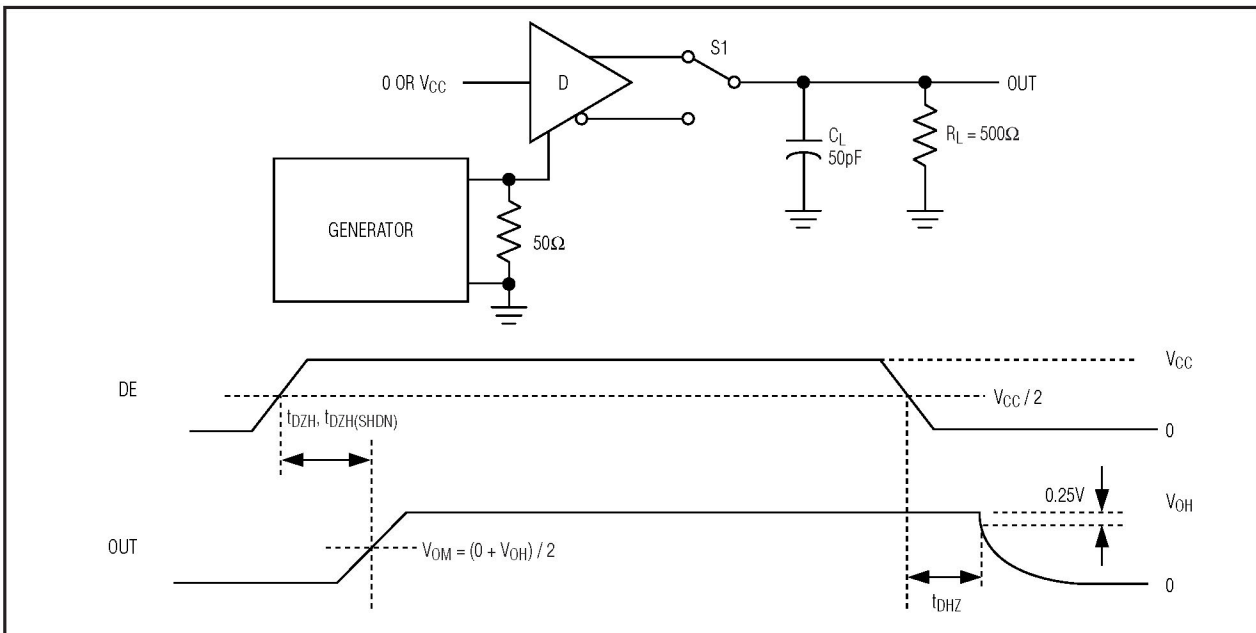


Figure 4. Driver Enable and Disable Times (t_{DZH} , $t_{DZH(SHDN)}$, t_{DHZ})

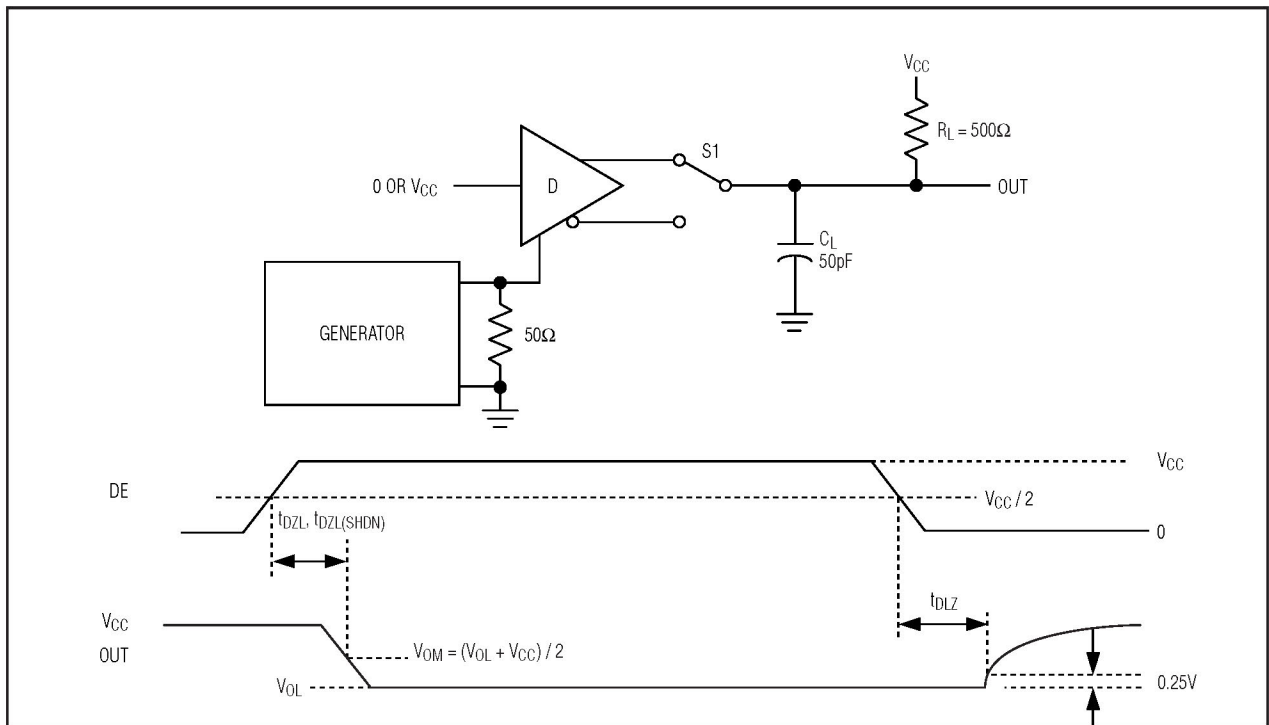


Figure 5. Driver Enable and Disable Times (t_{DZL} , t_{DLZ} , $t_{DLZ(SHDN)}$)

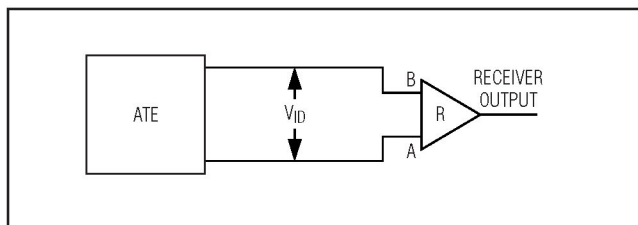


Figure 6. Receiver Propagation Delay Test Circuit

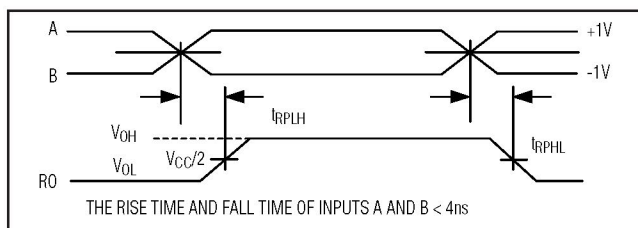


Figure 7. Receiver Propagation Delays

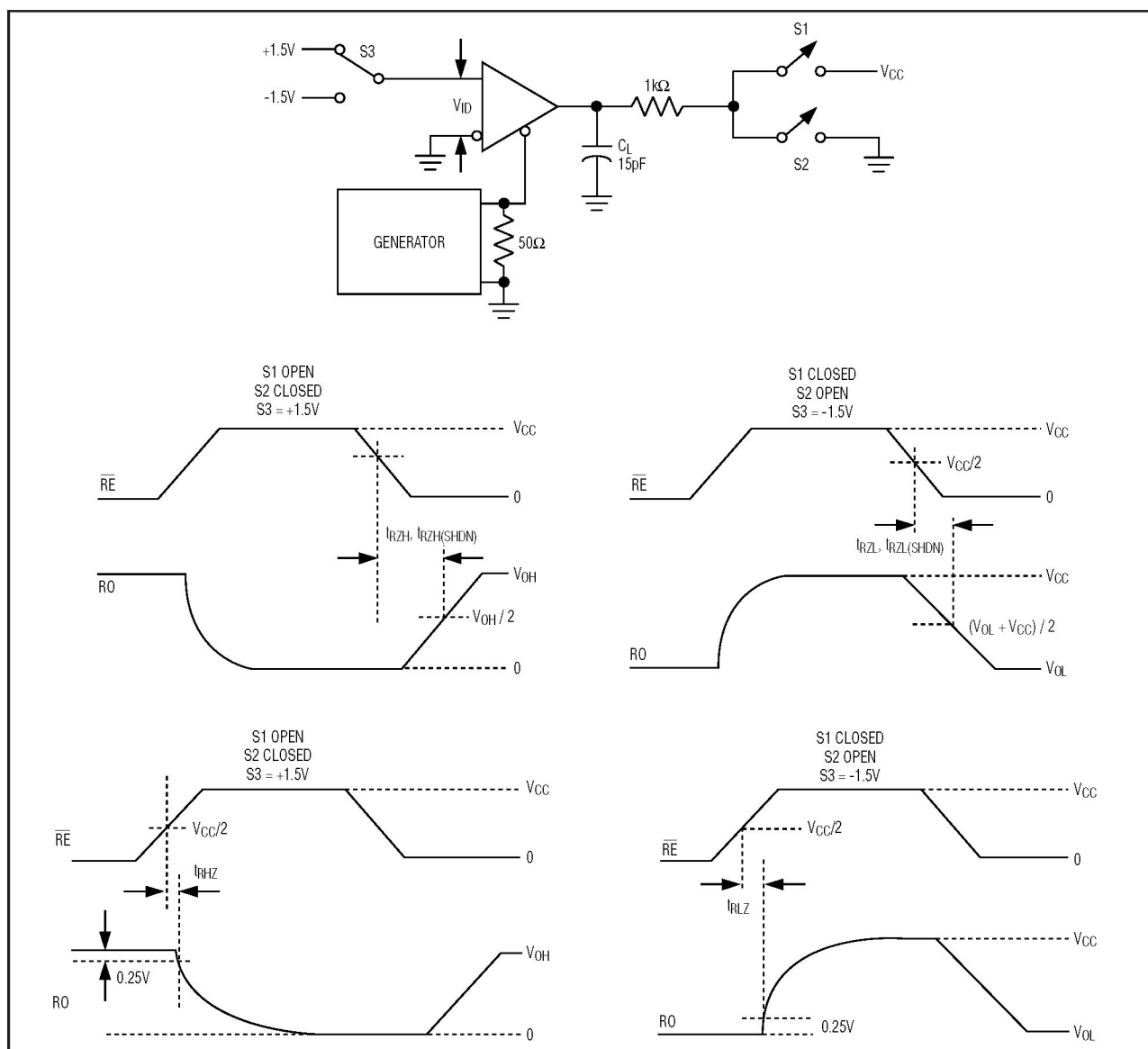


Figure 8. Receiver Enable and Disable Times

PACKAGE OUTLINE SOIC - 8, 1.75 mm max height

