Half-Duplex RS-485/RS-422 Transceivers in µDFN

■ Description

The TK13486E +5V, half-duplex, ±15kV ESD-protected RS-485 transceivers feature one driver and one receiver. The device includes 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 TK13486E include a hot-swap capability to eliminate false transitions on the bus during power-up or live-insertion.The TK13486E features a 1/4-unit load receiver input impedance, allowing up to 128 transceivers on the bus. It is intended for half-duplex communications. It is available in 8-pin SOIC packages.

■ Features

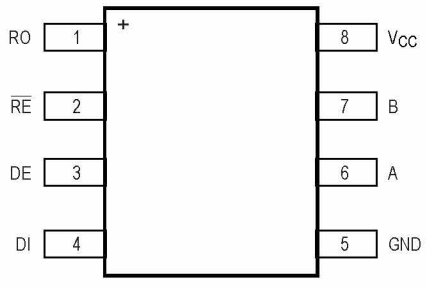
- 1 transmitter and 1 receivers of the serial data of the standard RS-485
- Hot-Swappable for Telecom Applications
- 5V Supply Voltage Range
- Operating temperature range: -40 ~ +85 °C
- Data rate: 16Mbps
- Low 10µA (max) Shutdown Current for Lower Power Consumption
- Allows Up to 128 Transceivers on the Bus
- Enhanced ESD Specifications:
  ±15kV Extended ESD Protection

■ Ordering Information

Part Number	Package	Packing	Temperature(TA)	Package Qty	ESD
TK13486EESA	SOIC-8	Reel	-40°C ~ 85°C	2500	±15KV

Note: Please contact us to customize DIP packaging device.

■ Pin Description



SOIC8

Table 1. **Pin Description**

PIN	NAME	FUNCTION
1	RO	Receiver Output.
2	$\overline{RE}$	Receiver Output Enable. Drive $\overline{RE}$ low to enable RO. Drive $\overline{RE}$ high to disable the receiver. RO is high impedance when $\overline{RE}$ is high. Drive $\overline{RE}$ high and pull DE low to enter low-power shutdown mode.
3	DE	Driver Output Enable. Drive DE high to enable the driver. Drive DE low to disable the driver. Driver outputs are high-impedance when the driver is disabled. Drive $\overline{RE}$ high and pull DE low to enter low-power shutdown mode.
4	DI	Driver Input. Drive DI low to force noninverting output low and inverting output high. Drive DI high to force noninverting output high and inverting output low
5	GND	Ground
6	A	Noninverting RS-485/RS-422 Receiver Input and Driver Output
7	B	Inverting RS-485/RS-422 Receiver Input and Driver Output
8	V_{CC}	Positive Supply.VCC = +5V ±5%. Bypass V_{CC} with a 0.1μF ceramic capacitor to ground.

Functional Diagram

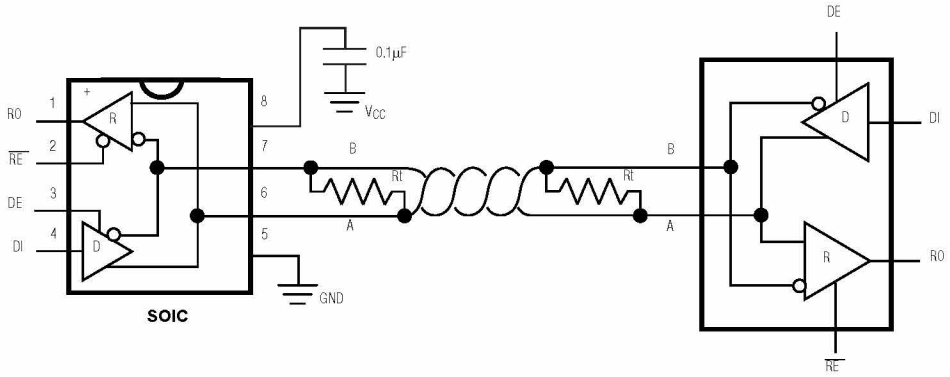


Table 2. Function Tables Transmitter Truth Table

TRANSMITTING					
INPUTS			OUTPUTS		MODE
$\overline{RE}$	DE	DI	B	A	
X	H	H	L	H	Active
X	H	L	H	L	Active
L	L	X	High Impedance		Driver Disabled
H	L	X	High Impedance		Shutdown

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

Table 3. Function Tables Receiver Truth Table

RECEIVING				
INPUTS			OUTPUTS	MODE
$\overline{RE}$	DE	A-B	RO	
L	X	≥ -50mV	H	Active
L	X	≤ -200mV	L	Active
L	X	Open/Shorted	H	Active
H	H	X	High Impedance	Receiver Disabled
H	L	X	High Impedance	Shutdown

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	$\lvert\pm50\rvert$	$\lvert\pm200\rvert$	V
T	Ambient temperature	–40	120	°C

Table 5. **Maximum Ratings**

Symbol	Parameter	Limit		Unit
		min	max	
V_{CC}	Supply voltage	-0.3	6.0	V
V_{IL}	Input voltage on pins DI, DE, $\overline{RE}$	-0.3	6.0	V
V_{OD}	Transmitter output voltage	-8	13	V
V_{IR}	Receiver input voltage	-8	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**

(VCC = +5V ±5%,TA = TMIN to TMAX, Typical values are at V_{CC} = +5V and TA = +25°C.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
DRIVER							
Differential Driver Output	V_{OD}	R_{DIFF} = 100Ω, Figure 1		2.0		V_{CC}	V
		R_{DIFF} = 54Ω, Figure 1		1.5			
		No load				V_{CC}	
Change in Magnitude of Differential Output Voltage	ΔV_{OD}	R_{DIFF} = 100Ω or 54Ω, Figure 1 (Note 1)				0.2	V
Driver Common-Mode Output Voltage	V_{OC}	R_{DIFF} = 100Ω or 54Ω, Figure 1			V_{CC} / 2	3	V
Change in Magnitude of Common-Mode Voltage	ΔV_{OC}	R_{DIFF} = 100Ω or 54Ω, Figure 1 (Note 1)				0.2	V
Input-High Voltage	V_{IH}	DI, DE, $\overline{RE}$		2.0			V
Input-Low Voltage	V_{IL}	DI, DE, $\overline{RE}$				0.8	V
Input Current	I_{IN}	DI, DE, $\overline{RE}$				±1	μA
Driver Short-Circuit Output Current (Note 2)	I_{OSD}	0V ≤ V_{OUT} ≤ +12V		+50		+250	mA
		-7V ≤ V_{OUT} ≤ 0V		-250		-50	
Driver Short-Circuit Foldback Output Current Note 1)	I_{OSDF}	(V_{CC} - 1V) ≤ V_{OUT} ≤ +12V		20			mA
		-7V ≤ V_{OUT} ≤ 0V				-20	
RECEIVER							
Input Current (A and B)	$I_{A, B}$	DE = GND, V_{CC} = GND or +5V	V_{IN} = +12V			250	μA
			V_{IN} = -7V	-200			
Receiver-Differential-Threshold Voltage	V_{TH}	-7V ≤ V_{CM} ≤ +12V		-200		-50	mV
Receiver Input Hysteresis	ΔV_{TH}	V_A + V_B = 0V			25		mV
Output-High Voltage	V_{OH}	I_O = -1.6mA, V_A - V_B > V_{TH}		V_{CC} - 1.5			V
Output-Low Voltage	V_{OL}	I_O = 1mA, V_A - V_B < -V_{TH}				0.4	V
Tri-State Output Current at Receiver	I_{OZR}	0V ≤ V_O ≤ V_{CC}				±1	μA
Receiver Input Resistance	R_{IN}	-7V ≤ V_{CM} ≤ +12V		48			kΩ
Receiver-Output Short-Circuit Current	I_{OSR}	0V ≤ V_{RO} ≤ V_{CC}		±7		±95	mA
POWER SUPPLY							
Supply Voltage	V_{CC}			4.75		5.25	V
Supply Current	I_{CC}	DE = 1, $\overline{RE}$ = 0, no load				4.5	mA
Shutdown Supply Current	I_{SHDN}	DE = 0, $\overline{RE}$ = 1				10	μA
ESD PROTECTION							
ESD Protection (A, B)		Air Gap Discharge IEC61000-4-2 (TK13485E)			±15		kV
		Human Body Model			±15		
ESD Protection (All Other Pins)		Human Body Model			±2		kV

Table 7.Switching Characteristics

(V_{CC} = +5V ±5%, T_A = T_{MIN} to T_{MAX}, . Typical values are at V_{CC} = +5V and T_A = +25°C.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DRIVER						
Driver Propagation Delay	t_{DPLH}	R_{DIFF} = 54Ω, C_L = 50pF, Figures 2 and 3			50	ns
	t_{DPHL}				50	
Driver Differential Output Rise or Fall Time	t_{HL}	R_{DIFF} = 54Ω, C_L = 50pF, Figures 2 and 3			15	ns
	t_{LH}				15	
Differential Driver Output Skew $\|t_{DPLH} - t_{DPHL}\|$	t_{DSKEW}	R_{DIFF} = 54Ω, C_L = 50pF, Figures 2 and 3			8	ns
Maximum Data Rate			16			Mbps
Driver Enable to Output High	t_{DZH}	Figures 4 and 5			50	ns
Driver Enable to Output Low	t_{DZL}	Figures 4 and 5			50	ns
Driver Disable Time from High	t_{DHZ}	Figures 4 and 5			50	ns
Driver Disable Time from Low	t_{DLZ}	Figures 4 and 5			50	ns
Driver Enable from Shutdown to Output High	$t_{DZH(SHDN)}$	Figures 4 and 5			2200	ns
Driver Enable from Shutdown to Output Low	$t_{DZL(SHDN)}$	Figures 4 and 5			2200	ns
Time to Shutdown	t_{SHDN}		50	340	700	ns
RECEIVER						
Receiver Propagation Delay	t_{RPLH}	C_L = 15pF, Figures 6 and 7			80	ns
	t_{RPHL}				80	
Receiver Output Skew	t_{RSKEW}	C_L = 15pF, Figure 7			13	ns
Maximum Data Rate			16			Mbps
Receiver Enable to Output High	t_{RZH}	Figure 8			50	ns
Receiver Enable to Output Low	t_{RZL}	Figure 8			50	ns
Receiver Disable Time from High	t_{RHZ}	Figure 8			50	ns
Receiver Disable Time from Low	t_{RLZ}	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

Note 1: ΔV_{OD} and ΔV_{OC} are the changes in V_{OD} and V_{OC} when the DI input changes states.
Note 2: The short-circuit output current applied to peak current just prior to foldback current limiting. The short-circuit foldback output current applies during current limiting to allow a recovery from bus contention.

Test and Timing Diagrams

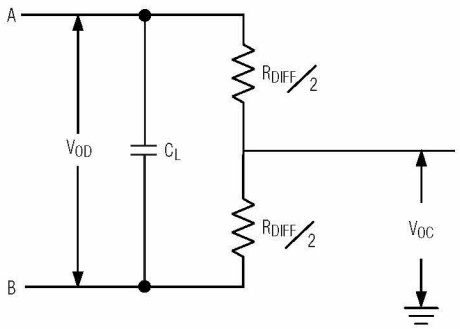


Figure 1. Driver DC Test Load

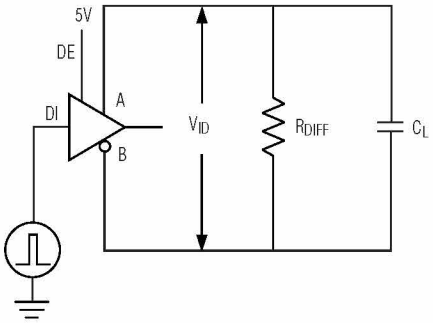


Figure 2. Driver Timing Test Circuit

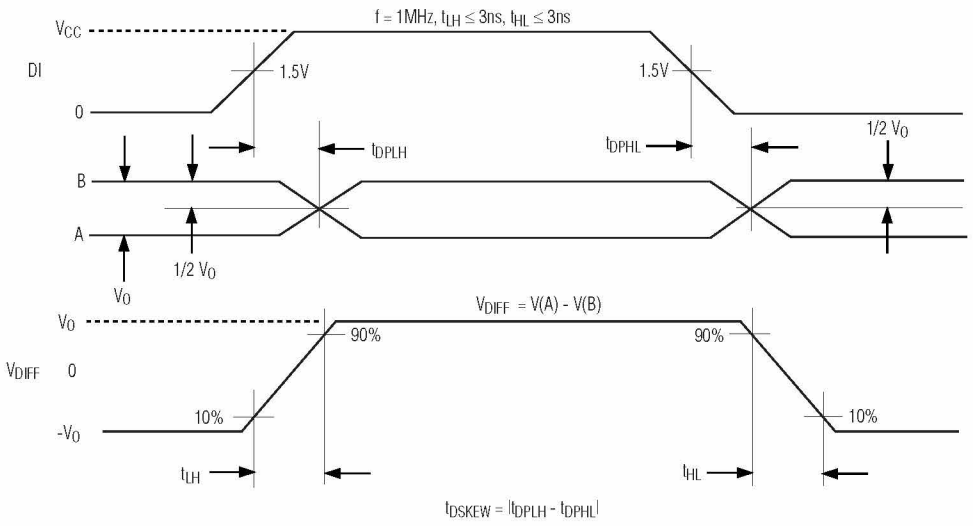


Figure 3. Driver Propagation Delays

Test and Timing Diagrams(continued)

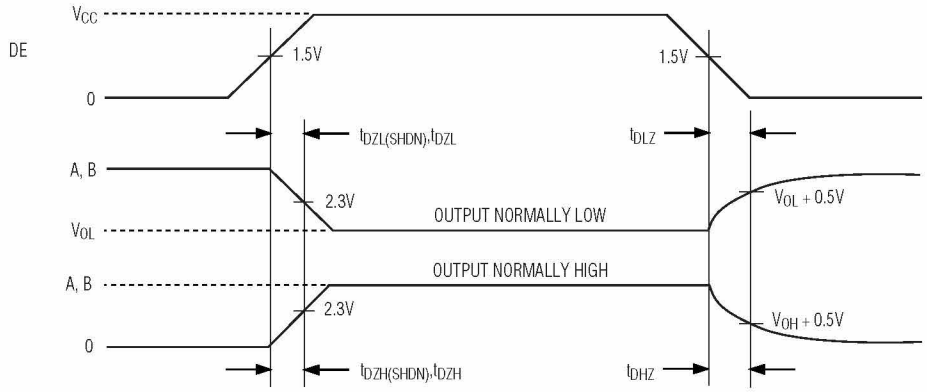


Figure 4. Driver Enable and Disable Times (t_{DZH}, t_{DHZ})

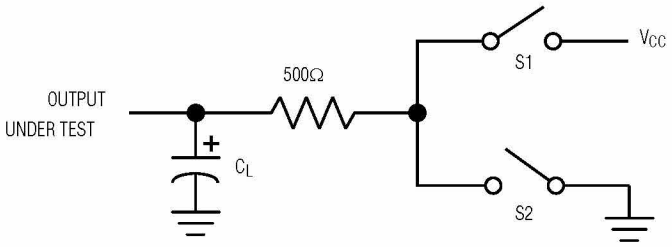


Figure 5. Driver Enable and Disable Times (t_{DZL}, t_{DLZ})

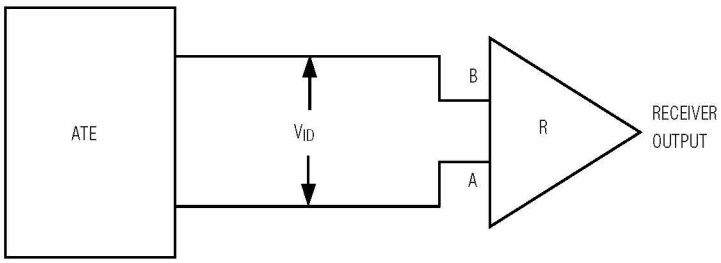


Figure 6. Receiver Propagation Delay Test Circuit

Test and Timing Diagrams(continued)

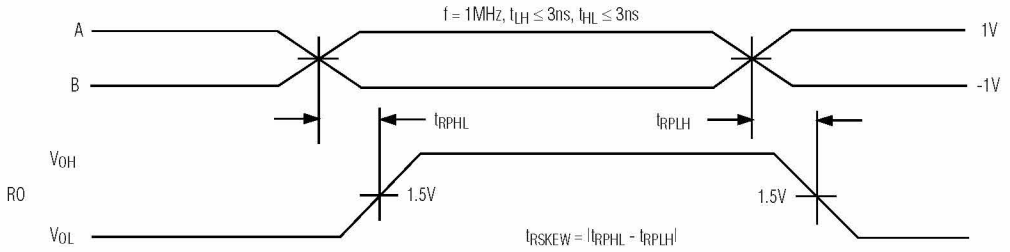


Figure 7. Receiver Propagation Delays

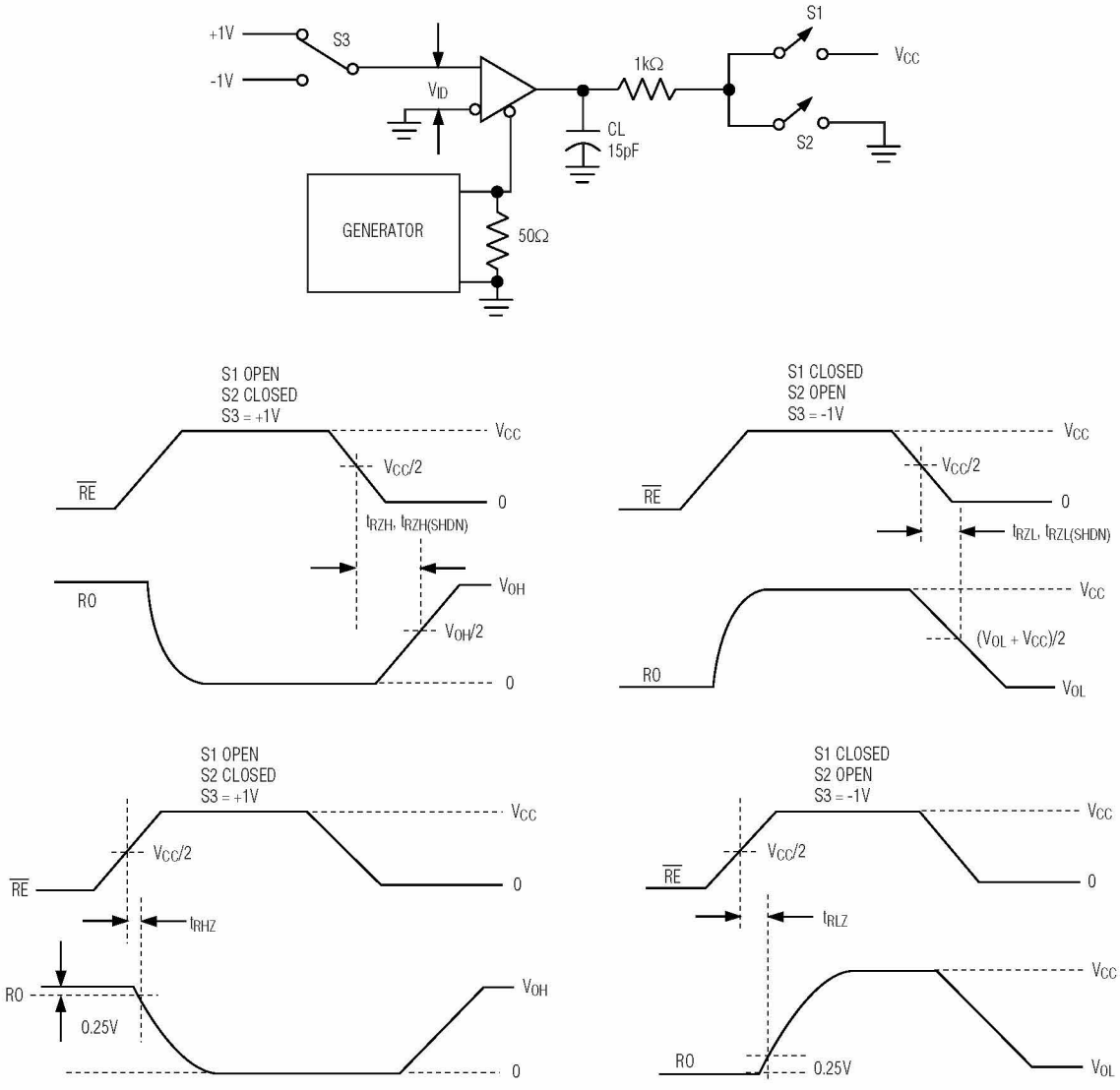
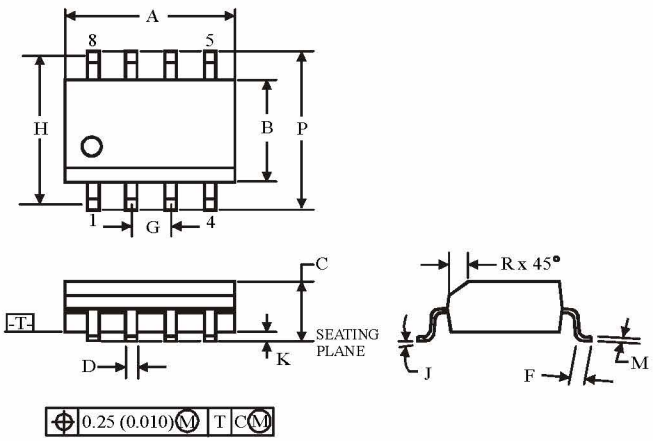


Figure 8. Receiver Enable and Disable Times

■ Package Dimensions

SOIC8



	Dimension, mm	
Symbol	**MIN**	**MAX**
A	4.8	5
B	3.8	4
C	1.35	1.75
D	0.33	0.51
F	0.4	1.27
G	1.27	
H	5.72	
J	0°	8°
K	0.1	0.25
M	0.19	0.25
P	5.8	6.2
R	0.25	0.5

NOTES:

1. Dimensions A and B do not include mold flash or protrusion.
2. Maximum mold flash or protrusion 0.15 mm (0.006) per side for A; for B - 0.25 mm (0.010) per side.