Half-Duplex RS-485-/RS-422-Compatible Transceiver with AutoDirection Control

■ Description

The TK13488 +5V, half-duplex, ±15kV ESD-protected RS-485/RS-422-compatible transceivers feature one driver and one receiver. It includes a hot-swap capability to eliminate false transitions on the bus during power-up or live insertion.
The TK13488 feature propri-etary AutoDirection control. This architecture makes the devices ideal for applications, such as isolated RS-485 ports, where the driver input is used in conjunction with the driver-enable signal to drive the differential bus.It is intended for half-duplex communications. It is available in an 8-pin SOIC package.

■ Features

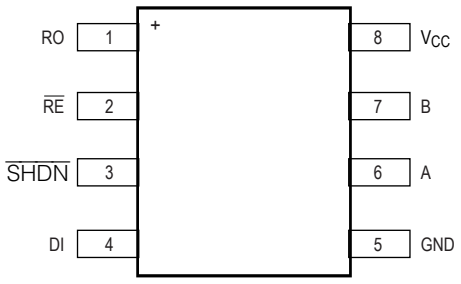
- 1 transmitter and 1 receivers of the serial data of the standard RS-485
- Robust Protection Features for Telecom, Industrial, and Isolated Applications
- 5V Supply Voltage Range
- Operating temperature range: -40 ~ +85 °C
- Data rate: 16Mbps
- AutoDirection Saves Space and BOM Cost
- Allows Up to 128 Transceivers on the Bus, 1/4-unit load receiver
- Enhanced ESD Specifications:
  ±15kV Extended ESD Protection

■ Ordering Information

Part Number	Package	Packing	Temperature(TA)	Package Qty	ESD
TK13488FSR	SOIC-8	Reel	-40°C ~ 85°C	2500	±15KV

Note: Please contact us to customize other packaging devices.

■ Pin Description



SOIC8

Table 1. **Pin Description**

PIN	NAME	FUNCTION
1	RO	Receiver Output.When receiver is enabled and V(A) - V(B) > +200mV, RO is high. If V(A) - V(B) < -200mV, RO is low.
2	$\overline{RE}$	Receiver Output Enable. Drive $\overline{RE}$ low to enable RO. Drive $\overline{RE}$ high to let the AutoDirection circuit control the receiver. $\overline{RE}$ is a hot-swap input.
3	$\overline{SHDN}$	Shutdown. Drive $\overline{SHDN}$ high to let the device operate in normal operation. Drive $\overline{SHDN}$ low to put the part in shutdown.
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,DI is an input to the internal state machine.
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

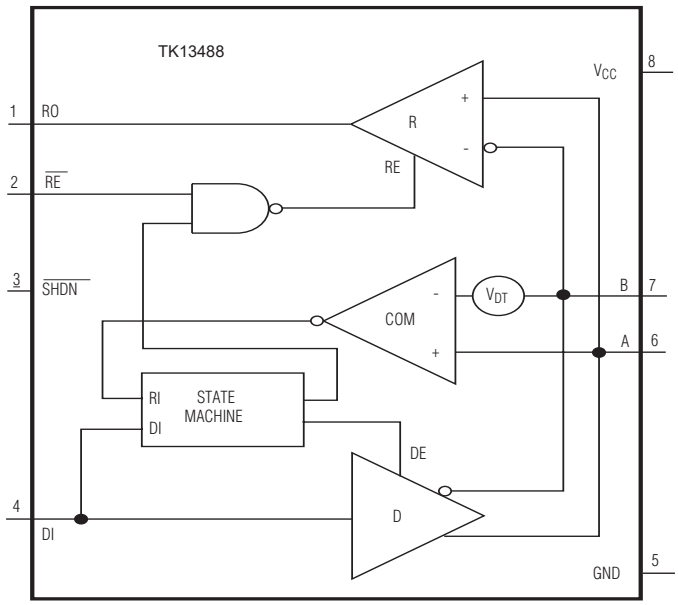


Table 2. Function Tables Transmitter Truth Table

TRANSMITTING					
INPUTS				OUTPUTS	
$\overline{SHDN}$	DI	A-B > V_{DT}	ACTION	A	B
H	L	X	Turn driver ON	L	H
H	H	False	If driver was OFF, keep it OFF	HIGH IMPEDANCE	HIGH IMPEDANCE
H	H	False	If driver was ON, keep it ON	H	L
H	H	True	Turn driver OFF	HIGH IMPEDANCE	HIGH IMPEDANCE
L	X	X	X	SHUTDOWN	

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

Table 3. Function Tables Receiver Truth Table

RECEIVING					
INPUTS					OUTPUT
$\overline{SHDN}$	$\overline{RE}$	A-B	DRIVER STATE	RECEIVER STATE	RO
H	L	≥+200mV	X	ON	H
H	L	≤-200mV	X	ON	L
H	H	X	ON	OFF	HIGH IMPEDANCE
H	H	≥+200mV	OFF	ON	H
H	H	≤-200mV	OFF	ON	L
L	X	X	X	X	SHUTDOWN

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

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 $\overline{SHDN}$, $\overline{RE}$, DI	0	0.8	V
V_{IH}	Input high voltage $\overline{SHDN}$, $\overline{RE}$, DI	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	85	°C

Table 5. **Maximum Ratings**

Symbol	Parameter	Limit		Unit
		min	max	
V_{CC}	Supply voltage	-0.3	6.0	V
V_{IL}	$\overline{SHDN}$, $\overline{RE}$, DI	-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}	
Driver Common-Mode Output Voltage	V_{OC}	R_L = 100Ω or 54Ω, Figure 1		V_{CC} / 2	3	V
Driver Disable Threshold	V_{DT}	Figure 2 (Note 1)	+0.6		+1	V
Input-High Voltage	V_{IH}	DI, $\overline{SHDN}$, $\overline{RE}$	2.0			V
Input-Low Voltage	V_{IL}	DI, $\overline{SHDN}$, $\overline{RE}$			0.8	V
Input Current	I_{IN}	DI, $\overline{SHDN}$, $\overline{RE}$			±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 2)	I_{OSDF}	(V_{CC} - 1V) ≤ V_{OUT} ≤ +12V	20			mA
		-7V ≤ V_{OUT} ≤ 0V			-20	
RECEIVER						
Input Current (A and B)	$I_{A, B}$	DI = V_{CC}, V_{CC} = GND or +5V; V_{IN} = +12V			250	µA
		DI = V_{CC}, V_{CC} = GND or +5V; V_{IN} = -7V	-200			
Receiver Differential Threshold Voltage	V_{TH}	-7V ≤ V_{CM} ≤ +12V	-200		+200	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}	$\overline{SHDN}$ = 1, $\overline{RE}$ = 0, no load			4.5	mA
Shutdown Supply Current	$I_{\overline{SHDN}}$	$\overline{SHDN}$ = 0			10	µA
ESD PROTECTION						
ESD Protection (A, B)		Air Gap Discharge IEC 61000-4-2 (TK13487E)		±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_L = 110Ω, C_L = 50pF, Figures 2 and 3			50	ns
	t_{DPHL}				50	
Driver Differential Output Rise or Fall Time	t_{HL}	R_L = 110Ω, C_L = 50pF, Figures 2 and 3			15	ns
	t_{LH}				15	
Maximum Data Rate			16			Mbps
Driver Disable Delay	t_{DDD}	Figure 3			70	ns
Driver Enable from Shutdown to Output High	$t_{DZH(SHDN)}$	Figure 4			2.2	μs
Driver Enable from Shutdown to Output Low	$t_{DZL(SHDN)}$	Figure 4			2.2	μs
Time to Shutdown	t_{SHDN}		50	340	700	ns
RECEIVER						
Receiver Propagation Delay	t_{RPLH}	C_L = 15pF, Figures 5 and 6			80	ns
	t_{RPHL}				80	
Receiver Output Skew	t_{RSKEW}	C_L = 15pF, Figure 6			13	ns
Maximum Data Rate			16			Mbps
Receiver Enable to Output High	t_{RZH}	Figure 7			50	ns
Receiver Enable to Output Low	t_{RZL}	Figure 7			50	ns
Receiver Disable Time from High	t_{RHZ}	Figure 7			50	ns
Receiver Disable Time from Low	t_{RLZ}	Figure 7			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
Receiver Enable Delay	t_{RED}	Figure 3			70	ns
Time to Shutdown	t_{SHDN}		50	340	700	ns

Note 1: This is a differential voltage from A to B that the driving device must see on the bus to disable its driver.
Note 2: The short-circuit output current applied to peak current just prior to foldback current limiting. The short-circuit foldback out-put current applies during current limiting to allow a recovery from bus contention.

Test and Timing Diagrams

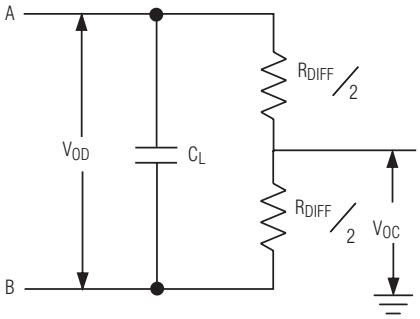


Figure 1. Driver DC Test Load

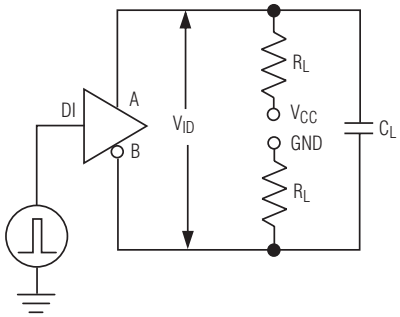


Figure 2. Driver Timing Test Circuit

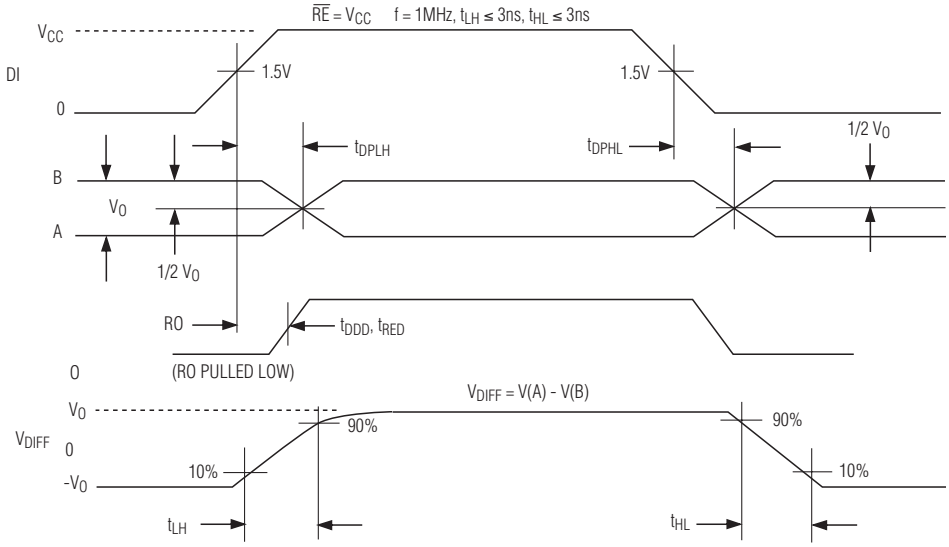


Figure 3. Driver Propagation Delays

Test and Timing Diagrams(continued)

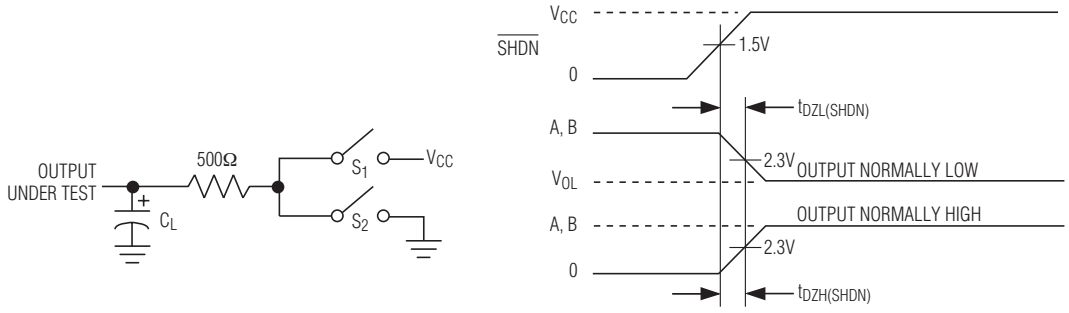


Figure 4. Driver Enable and Disable Times (t_{DZH}, t_{DHZ})

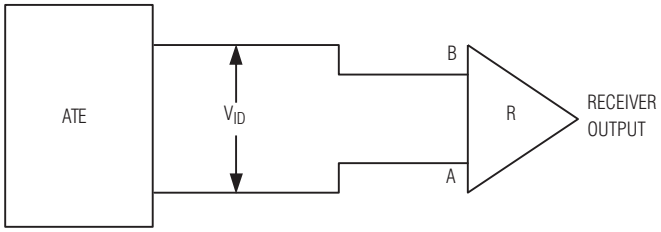


Figure 5. Driver Enable and Disable Times (t_{DZL}, t_{DLZ})

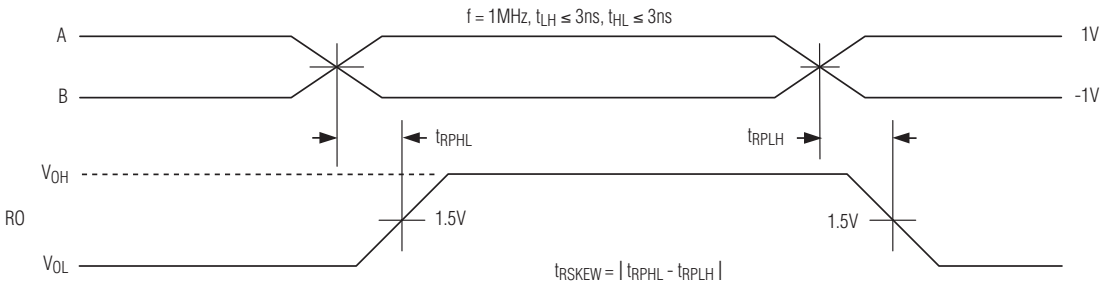


Figure 6. Receiver Propagation Delay Test Circuit

Test and Timing Diagrams(continued)

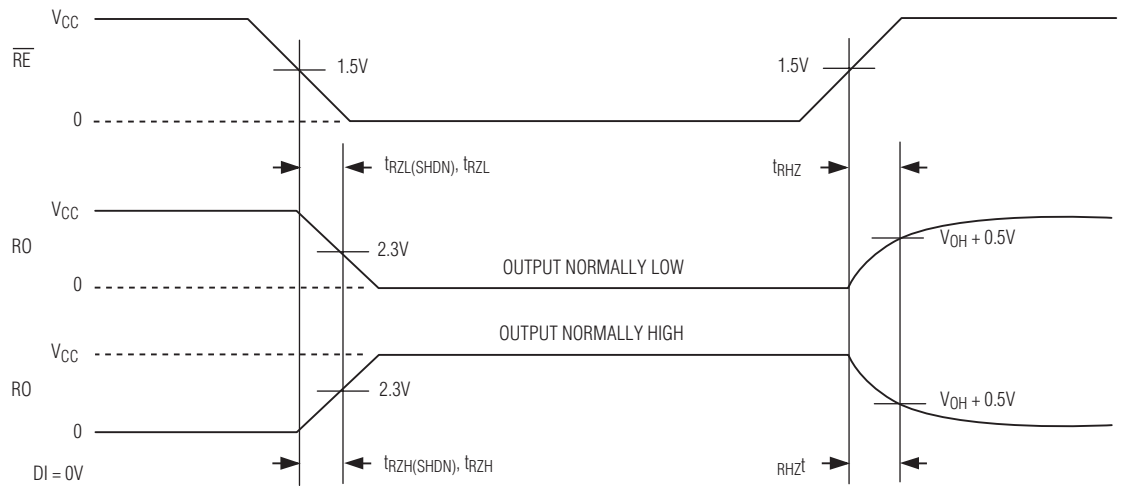


Figure 7. Receiver Propagation Delays

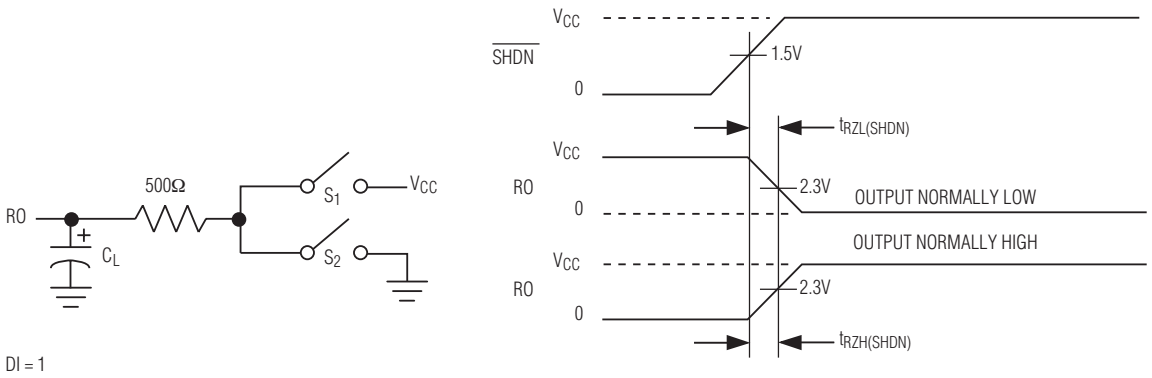
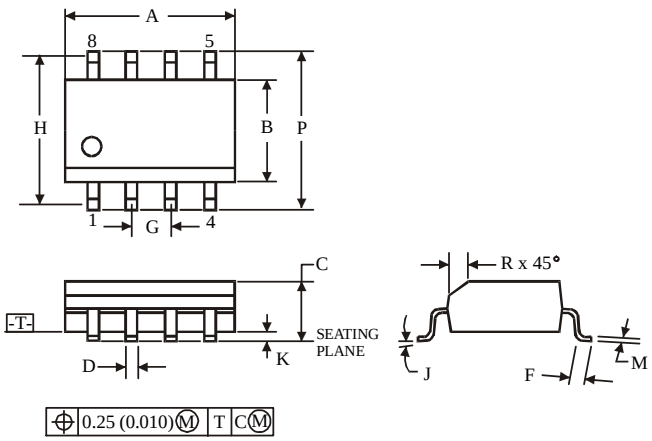


Figure 8. Receiver Enable and Disable Times

■ 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.