

Full-Duplex RS-485 Transceivers

Description

The TK489 is a low power differential line driver/receiver meeting RS-485 and RS-422 standards up to 2.5Mbps. The TK489 is identical to the TK488 with the addition of driver and receiver tri-state enable lines. Both products feature $\pm 200\text{mV}$ receiver input sensitivity, over wide common mode range. The TK489 is available in 14-pin SOIC packages for operation over the commercial and industrial temperature ranges.

Drivers are short-circuit current limited and are protected against excessive power dissipation by thermal shutdown circuitry that places the driver outputs into a high-impedance state. The receiver input has a fail-safe feature that guarantees a logic-high output if the input is open circuit.

Features

5V only

Low power BiCMOS

Driver/receiver enable

RS-485 and RS-422 drivers/receivers

Enhanced ESD Specifications ("EC" and "EE" only):

$\pm 15\text{kV}$ IEC61000-4-2 Air Discharge

$\pm 8\text{kV}$ IEC61000-4-2 Contact Discharge

Applications

Low-Power RS-485 Transceivers

Low-Power RS-422 Transceivers

Level Translators

Transceivers for EMI-Sensitive Applications

Industrial-Control Local Area Networks

Ordering Information

Part Number	Package	Packing	Temperature(TA)	Package Qty	ESD
TK489CSD	SOIC-14	Reel	0°C ~ 70°C	2500	
TK489ESD	SOIC-14	Reel	-40°C ~ 85°C	2500	
TK489ECSD	SOIC-14	Reel	0°C ~ 70°C	2500	$\pm 15\text{KV}$
TK489EESD	SOIC-14	Reel	-40°C ~ 85°C	2500	$\pm 15\text{KV}$

Note: Please contact us to customize DIP packaging device.

Absolute Maximum Ratings (TK488)

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

V_{CC}7.0V

Input Voltages

Logic.....-0.5V to ($V_{CC}+0.5V$)

Drivers.....-0.5V to ($V_{CC}+0.5V$)

Receivers..... $\pm 14V$

Output Voltages

Logic.....-0.5V to ($V_{CC}+0.5V$)

Drivers..... $\pm 14V$

Receivers.....-0.5V to ($V_{CC}+0.5V$)

Storage Temperature.....-65°C to +150°C

Power Dissipation.....1000mW

Electrical Characteristics

$T_{AMB} = T_{MIN}$ to T_{MAX} and $V_{CC} = 5V \pm 5\%$ unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
TK489 Driver DC Characteristics					
Differential output voltage			V_{CC}	V	Unloaded; $R = \infty \Omega$; Figure 1
Differential output voltage	2		V_{CC}	V	With load; $R = 50\Omega$ (RS-422); Figure 1
Differential output voltage	1.5		V_{CC}	V	With load; $R = 27\Omega$ (RS-485); Figure 1
Change in magnitude of driver differential output voltage for complimentary states			0.2	V	$R = 27\Omega$ or $R = 50\Omega$; Figure 1
Driver common-mode output voltage			3	V	$R = 27\Omega$ or $R = 50\Omega$; Figure 1
Input high voltage	2.0			V	Applies to DE, D, \overline{REB}
Input low voltage			0.8	V	Applies to DE, D, \overline{REB}
Input current			± 10	μA	Applies to DE, D, \overline{REB}
Driver short circuit current $V_{OUT} = HIGH$			± 250	mA	$-7V \leq V_O \leq 12V$
Driver short circuit current $V_{OUT} = LOW$			± 250	mA	$-7V \leq V_O \leq 12V$

Electrical Characteristics (Continued)
 $T_{AMB} = T_{MIN}$ to T_{MAX} and $V_{CC} = 5V \pm 5\%$ unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
TK489 Driver AC Characteristics					
Maximum data rate	0.25			Mbps	$\overline{REB} = 5V, DE = 5V$
Driver input to output, t_{PLH}		150	300	ns	$R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$; Figures 3 & 5
Driver input to output, t_{PHL}		150	300	ns	$R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$; Figures 3 & 5
Driver skew		5	10	ns	$t_{SKEW} = t_{DPLH} - t_{DPHL} $; Figures 3 & 5
Driver rise or fall time		15	40	ns	From 10%-90%; $R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$; Figures 3 & 5
Driver enable to output HIGH		40	70	ns	$C_{L1} = C_{L2} = 100pF$; Figures 4 & 6, S_2 closed
Driver enable to output LOW		40	70	ns	$C_{L1} = C_{L2} = 100pF$; Figures 4 & 6, S_1 closed
Driver disable time from LOW		40	70	ns	$C_{L1} = C_{L2} = 100pF$; Figures 4 & 6, S_1 closed
Driver disable time from HIGH		40	70	ns	$C_{L1} = C_{L2} = 100pF$; Figures 4 & 6, S_2 closed
TK489 Receiver DC Characteristics					
Differential input threshold	-0.2		0.2	Volts	$-7V \leq V_{CM} \leq 12V$
Input hysteresis		70		mV	$V_{CM} = 0V$
Output voltage HIGH	3.5			Volts	$V_{ID} = 200mV, I_O = -4mA$
Output voltage LOW			0.4	Volts	$V_{ID} = -200mV, I_O = 4mA$
Three-State (High Impedance) Output Current			± 1	μA	$0.4V \leq V_O \leq 2.4V; \overline{REB} = 5V$
Input resistance	12	15		k Ω	$-7V \leq V_{CM} \leq 12V$
Input current (A, B); $V_{IN} = 12V$			± 1.0	mA	$DE = 0V, V_{CC} = 0V$ or $5.25V, V_{IN} = 12V$
Input current (A, B); $V_{IN} = -7V$			-0.8	mA	$DE = 0V, V_{CC} = 0V$ or $5.25V, V_{IN} = -7V$
Short circuit current			85	mA	$0V \leq V_O \leq V_{CC}$
TK489 Receiver AC Characteristics					
Maximum data rate	0.25			Mbps	$\overline{REB} = 0V$
Receiver input to output, t_{PLH}	20	45	150	ns	$R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$; Figures 3 & 7
Receiver input to output, t_{PHL}	20	45	150	ns	$R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$; Figures 3 & 7
Differential receiver skew		13		ns	$ t_{PLH} - t_{PHL} ; R_{DIFF} = 54\Omega, C_{L1} = C_{L2} = 100pF$; Figures 3 & 7
Receiver enable to output LOW		45	70	ns	$C_{RL} = 15pF$; Figures 2 & 8; S_1 closed
Receiver enable to output HIGH		45	70	ns	$C_{RL} = 15pF$; Figures 2 & 8; S_2 closed
Receiver disable time from LOW		45	70	ns	$C_{RL} = 15pF$; Figures 2 & 8; S_1 closed

Electrical Characteristics (Continued)
 $T_{AMB} = T_{MIN}$ to T_{MAX} and $V_{CC} = 5V \pm 5\%$ unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Power Requirements					
Supply voltage	4.75		5.25	V	
Supply current		900		μA	$\overline{REB}, D = 0V$ or $V_{CC}; DE = V_{CC}$
TK489 Environmental and Mechanical					
Operating Temperature					
Commercial (_C_)	0		70	$^{\circ}C$	
Industrial (_E_)	-40		85	$^{\circ}C$	
Storage Temperature	-65		150	$^{\circ}C$	
Package					
SOIC 14					

Test Circuits

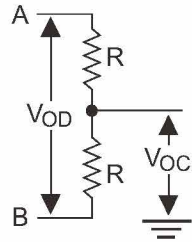


Figure 1: Driver DC Test Load Circuit

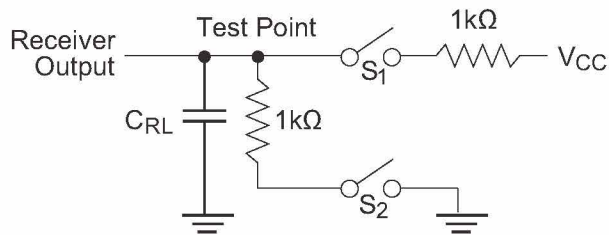


Figure 2: Receiver Timing Test Load Circuit

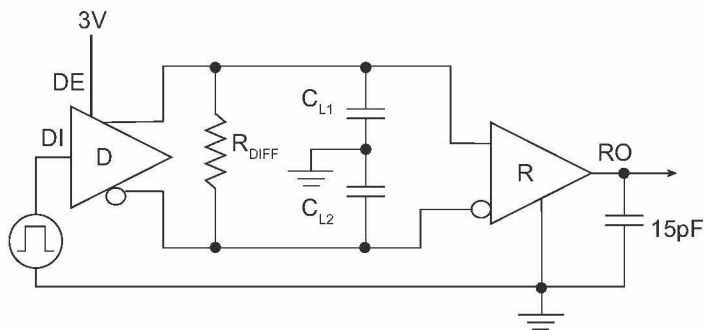


Figure 3: Driver/Receiver Timing Test Circuit

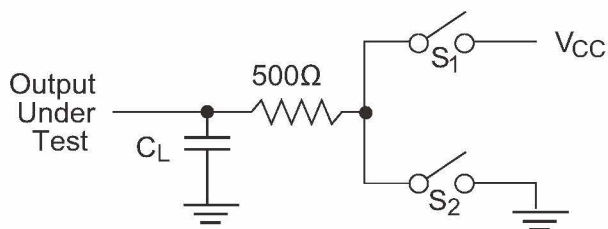


Figure 4: Driver Timing Test Load #2 Circuit

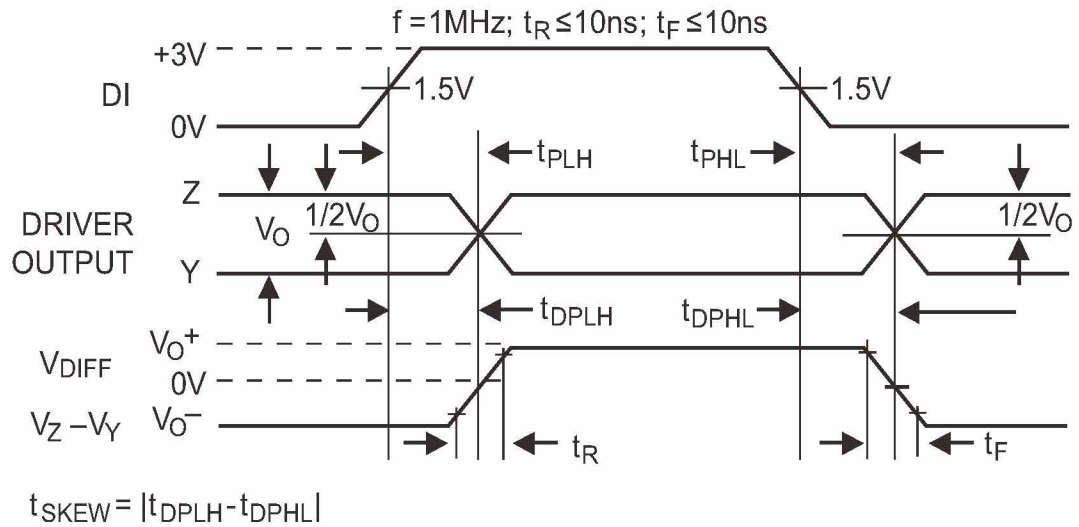
Switching Waveforms


Figure 5: Driver Propagation Delays

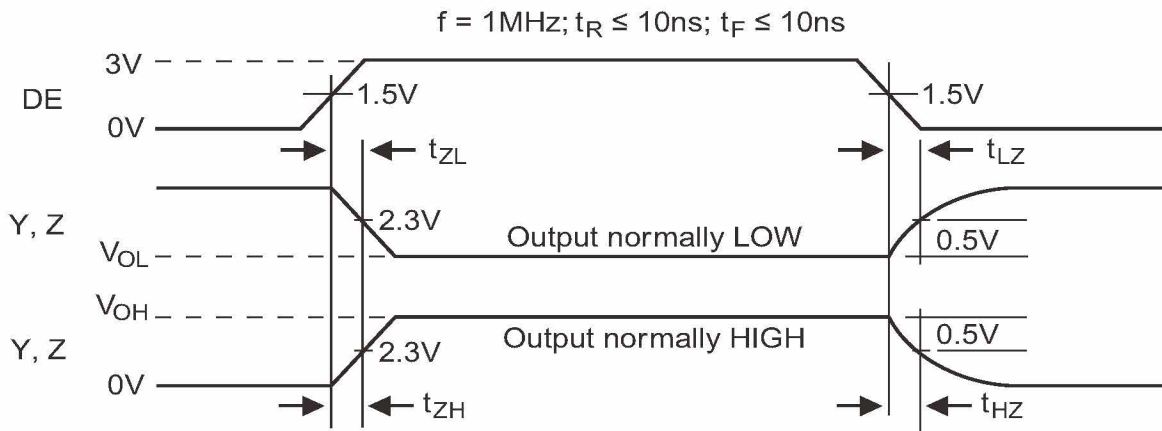


Figure 6: Driver Enable and Disable Times

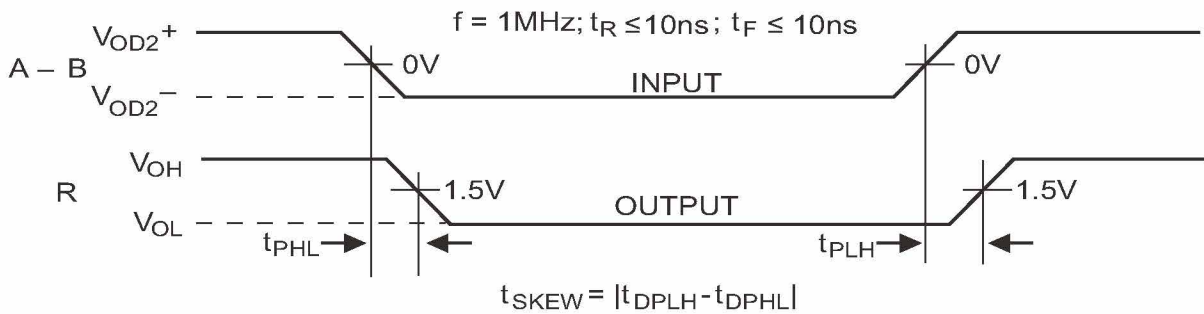


Figure 7: Receiver Propagation Delays

Switching Waveforms

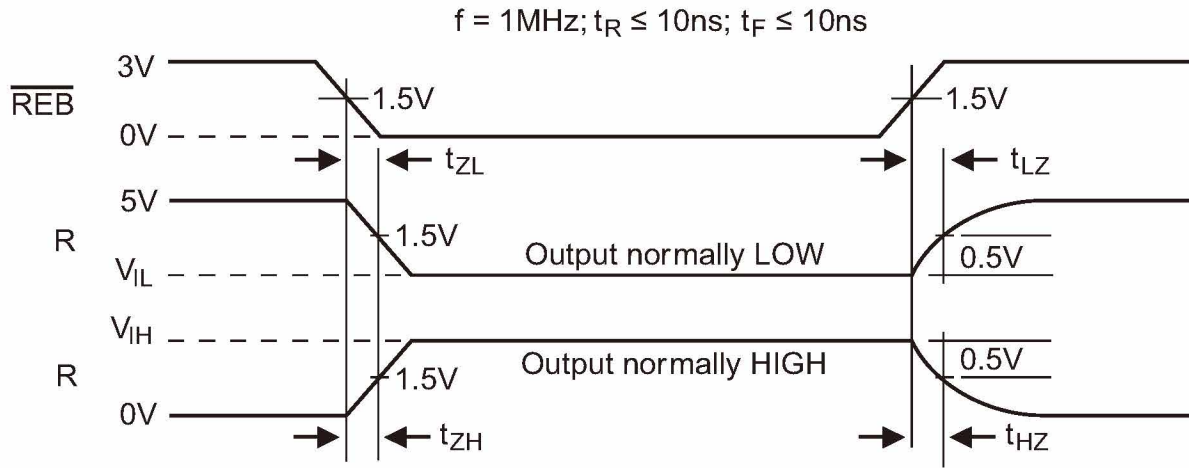
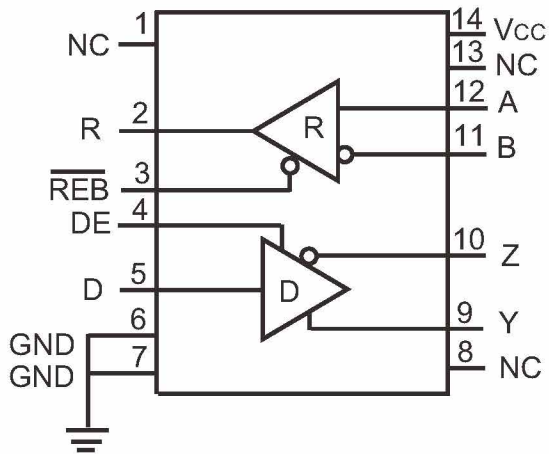


Figure 8: Receiver Enable and Disable Times

Pin Functions


TK489
Pinout (Top View)

Pin Description

Pin Number	Pin Name	Description
1	NC	No connect
2	R	Receiver output
3	$\overline{\text{REB}}$	Receiver output enable active LOW
4	DE	Driver output enable active HIGH
5	D	Driver input
6	GND	Ground connection
7	GND	Ground connection
8	NC	No connect
9	Y	Non-inverting driver output
10	Z	Inverting driver output
11	B	Inverting receiver input
12	A	Non-Inverting receiver input
13	NC	No connect
14	V _{CC}	Positive supply

Description

The TK488 and TK489 are full-duplex differential transceivers that meet the requirements of RS-485 and RS-422. Both products require a fraction of the power of older bipolar designs.

The RS-485 standard is ideal for multi-drop applications or for long-distance interfaces. RS-485 allows up to 32 drivers and 32 receivers to be connected to a data bus, making it an ideal choice for multi-drop applications. Since the cabling can be as long as 4,000 feet, RS-485 transceivers are equipped with a wide (-7V to 12V) common mode range to accommodate ground potential differences. Because RS-485 is a differential interface, data is virtually immune to noise in the transmission line.

Drivers

The drivers for both the TK488 and TK489 have differential outputs. The typical voltage output swing with no load will be 0 volts to +5 volts. With worst case loading of 54Ω across the differential outputs, the driver can maintain greater than 1.5V voltage levels.

The driver of the TK489 has a driver enable control line which is active high. A logic high on DE (pin 4) of the TK489 will enable the differential driver outputs. A logic low on DE (pin 4) of the TK489 will tri-state the driver outputs. The TK488 does not have a driver enable.

Receivers

The receivers for both the TK488 and TK489 have differential inputs with an input sensitivity as low as $\pm 200\text{mV}$. Input impedance of the receivers is typically $15\text{k}\Omega$ ($12\text{k}\Omega$ minimum). A wide common mode range of -7V to 12V allows for large ground potential differences between systems. The receivers for both the TK488 and TK489 are equipped with the fail-safe feature. Fail-safe guarantees that the receiver output will be in a high state when the input is left unconnected.

The receiver of the TK489 has a receiver enable control line which is active low. A logic low on $\overline{\text{REB}}$ (pin 3) of the TK489 will enable the differential receiver. A logic high on $\overline{\text{REB}}$ (pin 3) of the TK489 will tri-state the receiver.

Package diagram

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

