

Interface Transceiver of the Serial Data of the Standard RS-485/RS-422

■ Description

The TK3089 high-speed transceivers for RS-485/RS-422 communication contain one driver and one receiver. These devices feature fail-safe circuitry, which guarantees a logic-high receiver output when the receiver inputs are open or shorted.

The TK3089's slew rate is selectable between 115kbps, 500kbps, and 10Mbps by driving a selector pin with a single three-state driver. The TK3089 is selectable between half-duplex and full-duplex operation. It also features independently programmable receiver and transmitter output phase via separate pins.

■ Features

- 1 transmitter and 1 receivers of the serial data of the standard RS-485
- Auto Shutdown function provide low power consumption
- Supply voltage range: $5.0V \pm 5\%$
- Operating temperature range: $-40 \sim +85^{\circ}C$
- Data rate: 10Mbps
- 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)
- Latch current, min – 300mA at normal climatic condition
- Enhanced ESD Specifications(EC&EE_ only):
 $\pm 15kV$ IEC61000-4-2 Air Discharge
 $\pm 8kV$ IEC61000-4-2 Contact Discharge

■ Ordering Information

Part Number	Package	Packing	Temperature(TA)	Package Qty	ESD
TK3089CSD	SOIC-14	Reel	$0^{\circ}C \sim 70^{\circ}C$	2500	
TK3089ESD	SOIC-14	Reel	$-40^{\circ}C \sim 85^{\circ}C$	2500	
TK3089ECSD	SOIC-14	Reel	$0^{\circ}C \sim 70^{\circ}C$	2500	$\pm 15KV$
TK3089EESD	SOIC-14	Reel	$-40^{\circ}C \sim 85^{\circ}C$	2500	$\pm 15KV$

■ Pin Description

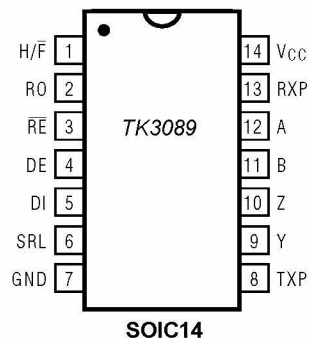


Table 1. Pin Description

Pin Num	Symbol	Pin Description
01	H/ \bar{F}	Half/Full-Duplex Selector Pin. Connect H/ \bar{F} to V _{CC} for half-duplex mode; connect to GND or leave unconnected for full-duplex mode.
02	RO	Receiver Output. When $\bar{R}\bar{E}$ is low and if A - B \geq -50mV, RO will be high; if A - B \leq -200mV, RO will be low.
03	$\bar{R}\bar{E}$	Receiver Output Enable. Drive $\bar{R}\bar{E}$ low to enable RO; RO is high impedance when $\bar{R}\bar{E}$ is high. Drive $\bar{R}\bar{E}$ 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 $\bar{R}\bar{E}$ 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	SRL	Slew-Rate-Limit Selector Pin. Connect SRL to GND for 10Mbps communication rate; connect to V _{CC} for 500kbps communication rate. Leave unconnected for 115kbps communication rate.
07	GND	Ground
08	TXP	Transmitter Phase. Connect TXP to GND, or leave floating for normal transmitter phase/polarity. Connect to V _{CC} to invert the transmitter phase/polarity.
09	Y	Noninverting Driver Output
10	Z	Inverting Driver Output
11	B	Inverting Receiver Input
12	A	Noninverting Receiver Input
13	RXP	Receiver Phase. Connect RXP to GND, or leave unconnected for normal transmitter phase/polarity. Connect to V _{CC} to invert the receiver phase/polarity.
14	V _{CC}	Positive Supply; 4.75V \leq V _{CC} \leq 5.25V

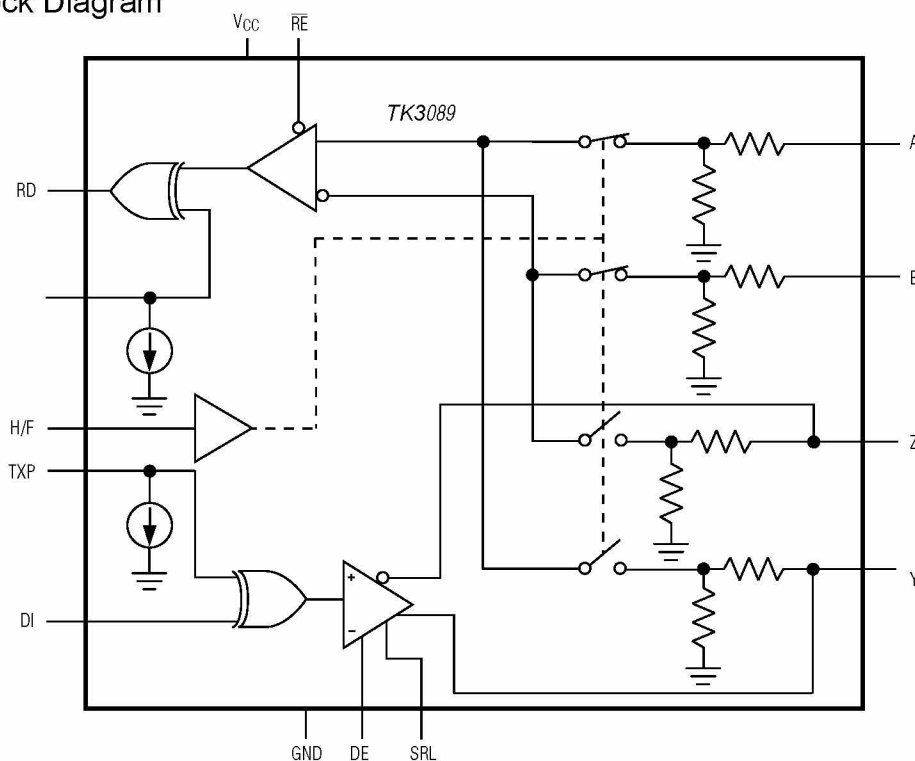
Table 2. Block Diagram


Table 3. Function Tables

TRANSMITTING					
INPUTS				OUTPUTS	
TXP	\overline{RE}	DE	DI	Z	Y
0	X	1	1	0	1
0	X	1	0	1	0
1	X	1	1	1	0
1	X	1	0	0	1
X	0	0	X	High-Z	High-Z
X	1	0	X	Shutdown	

RECEIVING						
INPUTS						OUTPUT
H/ \overline{F}	RXP	\overline{RE}	DE	A-B	Y-Z	RO
0	0	0	X	$\geq -0.05V$	X	1
0	0	0	X	$\leq -0.2V$	X	0
0	1	0	X	$\geq -0.05V$	X	0
0	1	0	X	$\leq -0.2V$	X	1
1	0	0	0	X	$\geq -0.05V$	1
1	0	0	0	X	$\leq -0.2V$	0
1	1	0	0	X	$\geq -0.05V$	0
1	1	0	0	X	$\leq -0.2V$	1
0	0	0	X	Open/ shorted	X	1
1	0	0	0	X	Open/ shorted	1
0	1	0	X	Open/ shorted	X	0
1	1	0	0	X	Open/ shorted	0
X	X	1	1	X	X	High-Z
X	X	1	0	X	X	Shutdown

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,	-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 ± 5%)

Symbol	Parameter	Mode	Limit		T _A , °C	Unit
			Min	Max		
I _{CC}	Idle mode supply current	V _{RE} = 0 B or V _{CC} V _{DI} = 0 B or V _{CC} V _{DE} = V _{CC}	-	800	25 ± 10	μA
		900		-40; 85		
I _{SHDN}	Shutdown mode supply current	V _{RE} = 0 V V _{DI} = 0 V or V _{CC} V _{DE} = 0	-	500	25 ± 10	μA
		600		-40; 85		
I _{SHDN}	Shutdown mode supply current	V _{DE} = 0V V _{RE} = V _{CC}	-	9.0	25 ± 10	μA
		10		-40; 85		
I _{ILL}	Input low leakage current on control pin	V _{DE} = V _{DI} = V _{RE} = 0 V	-	-0.2	25 ± 10	μA
		-2.0		-40; 85		
I _{ILH}	Input high leakage current on control pin	V _{DE} = V _{DI} = V _{RE} = V _{CC}	-	0.2	25 ± 10	μA
		2.0		-40; 85		
t _{SHDN}	Shutdown time	-	50	600	25 ± 10	ns
Receiver						
V _{OLR}	Output low voltage	V _{ID} = -200 mV I _{OL} = 4.0 mA	-	0.36	25 ± 10	V
		0.4		-40; 85		
V _{OHR}	Output high voltage	V _{ID} = -50 mV I _{OH} = -4.0 mA	V _{CC} - 1.5	-	25 ± 10; -40; 85	V
		-		-40; 85		
R _I	Input resistance	-7.0 V ≤ V _{IR} ≤ 12 V	96	-	25 ± 10; -40; 85	kΩ
I _I	Input current	V _{IR} = 12 V	-	114	25 ± 10	μA
		V _{IR} = -7.0 V		-66	-40; 85	
		V _{IR} = 12 V		125		
		V _{IR} = -7.0 V		-75		
I _{OZLR}	Output low current for OFF-state	V _{OR} = 0.4 V	-	-0.5	25 ± 10	μA
		-1.0		-40; 85		
I _{OZHR}	Output high current for OFF-state	V _{OR} = 2.4 V	-	0.5	25 ± 10	μA
		1.0		-40; 85		

Table 6. Electrical Parameters (continued)

Symbol	Parameter	Mode	Limit		T _A , °C	Unit
			Min	Max		
Receiver						
I _{OSHR}	Output high short circuit current	V _{OR} = V _{CC}	8.0	87	25 ± 10	mA
			7.0	95	-40; 85	
I _{OSLR}	Output low short circuit current	V _{OR} = 0 V	-8.0	-87	25 ± 10	mA
			-7.0	-95	-40; 85	
V _{hR}	Hysteresis	-	-	50	25 ± 10	mV
t _{PHLR} , t _{PLHR}	Receiver input to output switching delay	V _{ID} ≥ 2.0 V t _{LH} = t _{HL} ≤ 15 ns	-	185	25 ± 10	ns
				200	-40; 85	
t _{SKDR}	Differential receiver skew	V _{ID} ≥ 2.0 V t _{LH} = t _{HL} ≤ 15 ns	-	28	25 ± 10	ns
				30	-40; 85	
t _{PZHR} , t _{PZLR}	Receiver enable from OFF to output high (low)	C _L = 100 pF	-	45	25 ± 10	ns
				50	-40; 85	
t _{LR (SHDN)} , t _{HR (SHDN)}	Receiver enable from shutdown to output high (low)	C _L = 100 pF	-	3150	25 ± 10	ns
				3500	-40; 85	
Transmitter						
V _{OD1}	Differential output voltage (no load)	-	5.0	-	25 ± 10; -40; 85	V
V _{OD2}	Differential output voltage (no load)	R _L = 50 Ω (RS-422)	2.08	-	25 ± 10	V
			2.00	-	-40; 85	
		R _L = 27 Ω (RS-485)	1.56	-	25 ± 10	
			1.50	-	-40; 85	
ΔV _{OD}	Change in magnitude of differential output voltage for complementary output states	R _L = 50; 27 Ω	-	0.18	25 ± 10	V
				0.2	-40; 85	
V _{OC}	Output bias voltage refer to common pin	R _L = 50; 27 Ω	-	2.9	25 ± 10	V
				3.0	-40; 85	
ΔV _{OC}	Change in magnitude of bias output voltage for complementary output states	R _L = 50; 27 Ω	-	0.18	25 ± 10	V
				0.20	-40; 85	

Table 6. Electrical Parameters (continued)

Symbol	Parameter	Mode	Limit		T _A , °C	Unit
			Min	Max		
Transmitter						
I _{OSD}	Short circuit current	- 7.0 V ≤ V _{OD} ≤ V _{CC}	-	±240	25 ± 10	mA
				±250	-40; 85	
		0 V ≤ V _{OD} ≤ 12 V		240	25 ± 10	
				250	-40; 85	
		0 V ≤ V _{OD} ≤ V _{CC}		±26	25 ± 10	
			±25	-40; 85		
V _{hD}	Hysteresis	-	-	200	25±10	V
t _{P_{HL}D} , t _{P_{LH}D}	Transmitter input to output switching delay	C _{L1} = C _{L2} = 100 pF R _{DIFF} = 54 Ω	330	800	25 ± 10	ns
			250	1000	-40; 85	
t _{SKEW D}	Transmitter output skew	C _{L1} = C _{L2} = 100 pF R _{DIFF} = 54 Ω	-	90	25 ± 10	ns
				100	-40; 85	
t _{P_{ZH}D} , t _{P_{ZL}D}	Transmitter enable time from OFF to output high (low)	C _L = 100 pF	-	2200	25 ± 10	ns
				2500	-40; 85	
t _{P_{HZ}D} , t _{P_{LZ}D}	Transmitter disable time from output high (low) to OFF	C _L = 15 pF	-	90	25 ± 10	ns
				100	-40; 85	
t _{RD} , t _{FD}	Rise or fall time of differential output signal	R _{DIFF} = 54 Ω C _{L1} = C _{L2} = 100 pF	220	620	25 ± 10	ns
			200	750	-40; 85	
t _{LD (SHDN)} , t _{HD (SHDN)}	Transmitter enable time from shutdown to output high (low)	C _L = 15 pF	-	4000	25 ± 10	ns
				4500	-40; 85	
ST	Data rate	-	12	-	25 ± 10	Mb/s
			10		-40; 85	

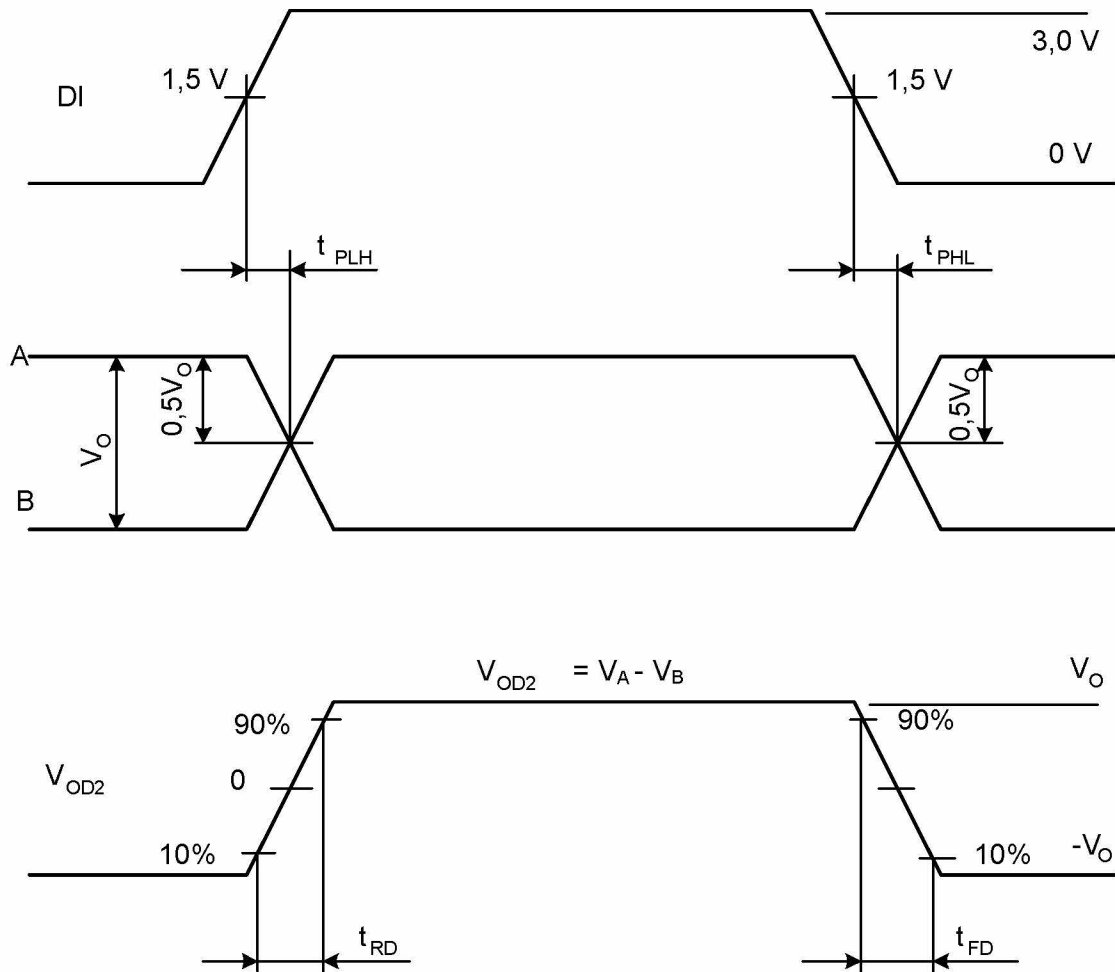
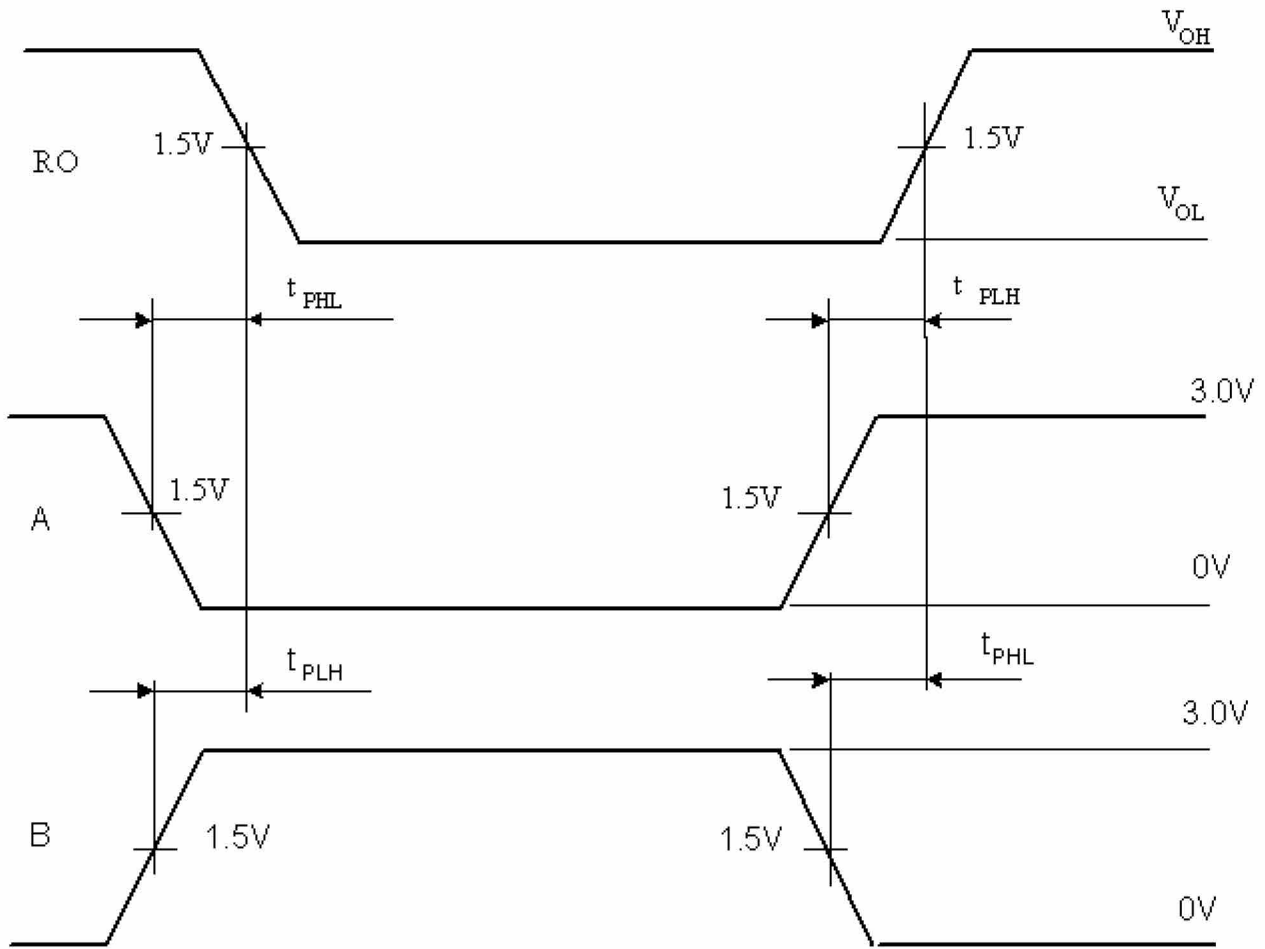


Figure 4. Transmitter output & input signals time diagram



During the input signal A is changing DC voltage 1.5 V is supplied to input B
 During the input signal B is changing DC voltage 1.5 V is supplied to input A

Figure 5. Receiver output & input signals time diagram

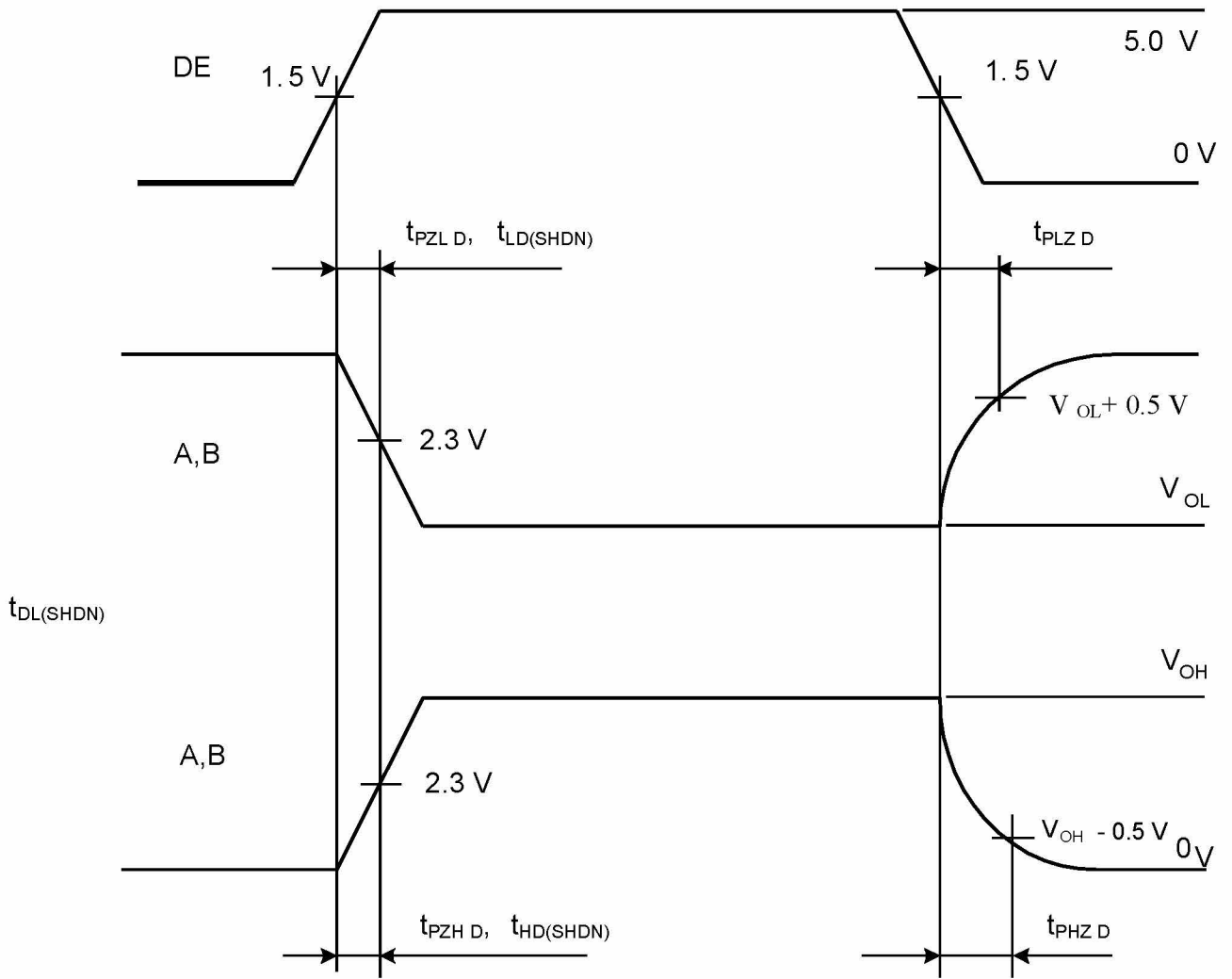


Figure 6. Transmitter output & input signals time diagram

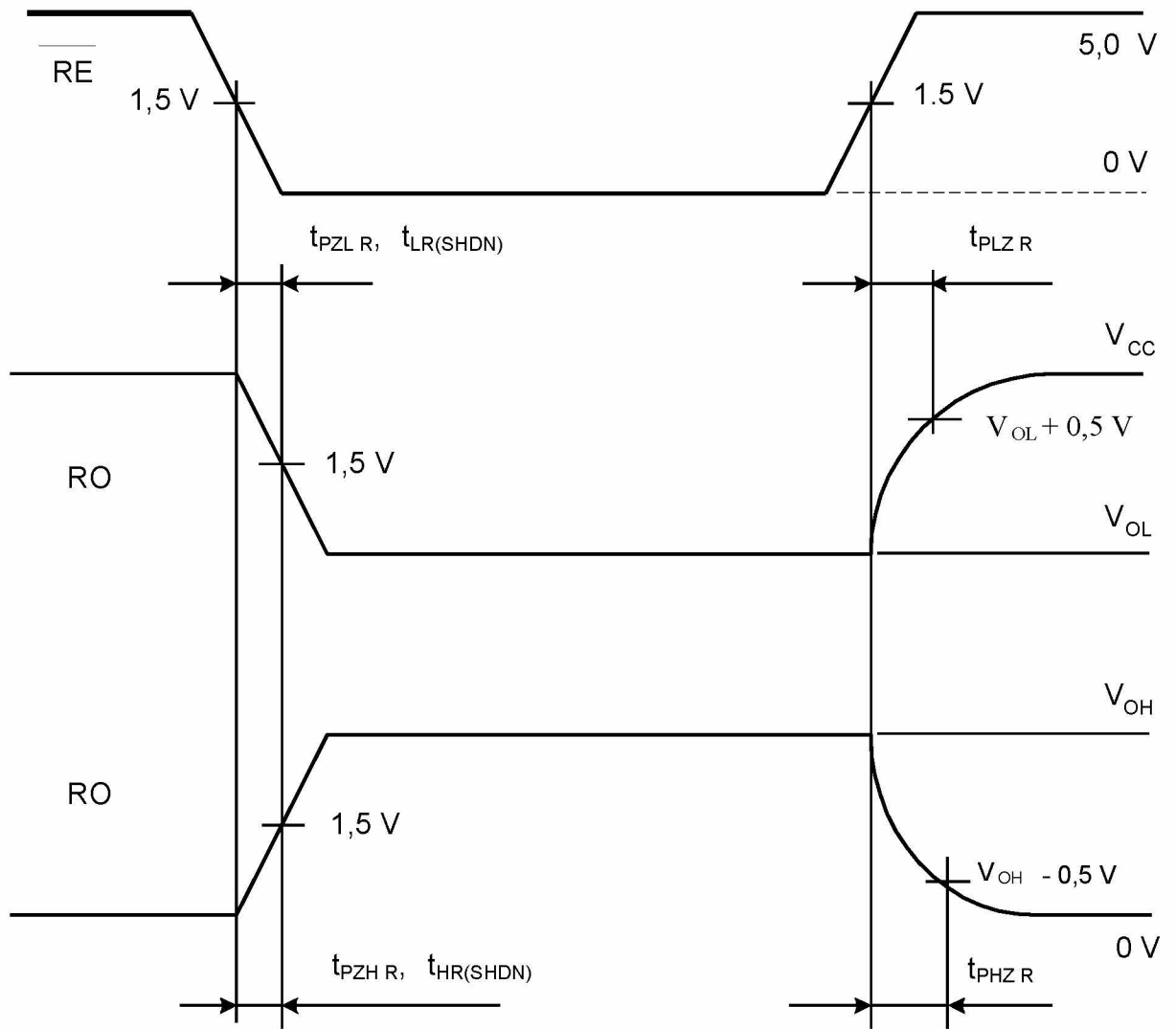


Figure 7. Receiver output & input signals time diagram

Package diagram

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

