

## 3.3V Low Power Full-Duplex RS-485 Transceivers with 250Kbps Data Rate

### Description

The TK3488 devices are 3.3V low power full-duplex transceivers that meet the specifications of the RS-485 and RS-422 serial protocols. These devices are pin-to-pin compatible with the standard devices as well as popular industry standards. The TK3488 feature allowing low power operation without sacrificing performance. The TK3488 meets the electrical specifications of the RS-485 and RS-422 serial protocols up to 250Kbps under load.

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 both inputs are open circuit.

### Features

- Full-duplex RS-485 and RS-422 transceivers
- Operates from a single 3.3V supply
- Interoperable with 5.0V logic Driver/receiver tri-state enable lines
- 7V to 12V common-mode input voltage range
- ±200mV receiver input sensitivity
- Allows up to 32 transceivers on the serial bus
- Enhanced ESD Specifications: ("EC" and "EE" only)
  - ±15kV IEC61000-4-2 Air Discharge
  - ±8kV IEC61000-4-2 Contact Discharge

### Applications

- Low-Power RS-485/RS-422 Transceivers
- Industrial-Control Local Area Networks
- Telecommunications
- Transceivers for EMI-Sensitive Applications

### Ordering Information

Part Number	Package	Packing	Temperature(TA)	Package Qty	ESD
TK3488CSA	SOIC-8	Reel	0°C ~ 70°C	2500	
TK3488ESA	SOIC-8	Reel	-40°C ~ 85°C	2500	
TK3488ECSA	SOIC-8	Reel	0°C ~ 70°C	2500	±15KV
TK3488EESA	SOIC-8	Reel	-40°C ~ 85°C	2500	±15KV

Note: Please contact us to customize DIP packaging device.

### Absolute Maximum Ratings

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 <sub>CC</sub> .....	6.0V
Input Voltages	
Logic.....	-0.3V to 6.0V
Drivers.....	-0.3V to 6.0V
Receivers.....	±14V
Output Voltages	
Drivers.....	±14V
Receivers.....	-0.3V to 6.0V

Storage Temperature .....	-65°C to +150°C
Maximum Junction Temperature, T <sub>J</sub> .....	125°C
Power Dissipation	
8-pin SOIC .....	481mW
	(derate 6.90mW/°C above +70°C)

### Operating Conditions

Package Power Dissipation	
8-pin NSOIC $\Theta_{JA}$ .....	128.4°C/W

### ESD Rating

Human Body Model (HBM).....	±15kV
-----------------------------	-------

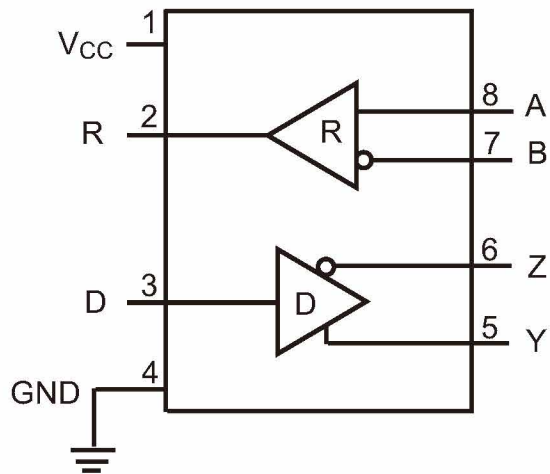
### Electrical Characteristics

T<sub>AMB</sub> = T<sub>MIN</sub> to T<sub>MAX</sub> and V<sub>CC</sub> = 3.3V ±5% unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>TK3488 Driver DC Characteristics</b>					
Differential output voltage			V <sub>CC</sub>	V	Unloaded; R = ∞Ω ; Figure 1
Differential output voltage	2		V <sub>CC</sub>	V	With load; R = 50Ω (RS-422); Figure 1
Differential output voltage	1.5		V <sub>CC</sub>	V	With load; R = 27Ω (RS-485); Figure 1
Change in magnitude of driver differential output voltage for complimentary states			0.2	V	R = 27Ω or R = 50Ω; Figure 1
Driver common-mode output voltage			3	V	R = 27Ω or R = 50Ω; Figure 1
Input high voltage	2.0			V	
Input low voltage			0.8	V	
Input current			±10	μA	
Driver short circuit current V <sub>OUT</sub> = HIGH			±250	mA	-7V ≤ V <sub>O</sub> ≤ 12V; Figure 8
Driver short circuit current V <sub>OUT</sub> = LOW			±250	mA	-7V ≤ V <sub>O</sub> ≤ 12V; Figure 8
<b>TK3488 Driver AC Characteristics</b>					
Maximum data rate	250			Kbps	
Driver input to output, t <sub>PLH</sub>	20	48	60	ns	R = 27Ω, Figures 2 & 9
Driver input to output, t <sub>PHL</sub>	20	48	60	ns	R = 27Ω, Figures 2 & 9

**Electrical Characteristics (Continued)**
 $T_{AMB} = T_{MIN}$  to  $T_{MAX}$  and  $V_{CC} = 3.3V \pm 5\%$  unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>TK3488 Driver AC Characteristics (Continued)</b>					
Differential driver skew		2		ns	$ t_{PHL}(Y) - t_{PLH}(Y) ,  t_{PHL}(Z) - t_{PLH}(Z) $ , Figures 2 and 9
Driver rise or fall time		5	20	ns	From 10%-90%; Figures 3 and 10
<b>TK3488 Receiver DC Characteristics</b>					
Differential input threshold	-0.2		0.2	Volts	$-7V \leq V_{CM} \leq 12V$
Input hysteresis		25		mV	$V_{CM} = 0V$
Output voltage HIGH	$V_{CC} - 0.4$			Volts	$V_{ID} = 200mV, I_O = -1.5mA$
Output voltage LOW			0.4	Volts	$V_{ID} = -200mV, I_O = 2.5mA$
Input resistance	12	15		k $\Omega$	$-7V \leq V_{CM} \leq 12V$
Input current (A, B); $V_{IN} = 12V$			1.0	mA	$V_{IN} = 12V$
Input current (A, B); $V_{IN} = -7V$			-0.8	mA	$V_{IN} = -7V$
Short circuit current			60	mA	$0V \leq V_O \leq V_{CC}$
<b>TK3488 Receiver AC Characteristics</b>					
Maximum data rate	10			Mbps	
Receiver input to output, $t_{PLH}$	40	70	120	ns	Figures 6 and 12
Receiver input to output, $t_{PLH}$			85	ns	$T_{AMB} = 25^\circ C, V_{CC} = 3.3V$ , Figures 6 and 12
Receiver input to output, $t_{PHL}$	40	70	120	ns	Figures 6 and 12
Receiver input to output, $t_{PHL}$			85	ns	$T_{AMB} = 25^\circ C, V_{CC} = 3.3V$ , Figures 6 and 12
Differential receiver skew		4		ns	$ t_{PHL}(A) - t_{PLH}(A) ,  t_{PHL}(B) - t_{PLH}(B) $ , Figures 6 and 12
<b>Power Requirements</b>					
Supply Voltage	3.0	3.3	3.6	V	
Supply Current		1000	2000	$\mu A$	$D = 0V$ or $V_{CC}$
ESD Protection for D, R, A, B, Y and Z pins		$\pm 15$		kV	Human Body Model

**Pin Functions**


TK3488  
Pinout (Top View)

Pin Number	Pin Name	Description
1	V <sub>CC</sub>	Positive supply 3.00V < V <sub>CC</sub> < 3.60V
2	R	Receiver output
3	D	Driver Input
4	GND	Ground connection
5	Y	Non-inverting driver output
6	Z	Inverting driver output
7	B	Inverting receiver Input
8	A	Non-inverting receiver input

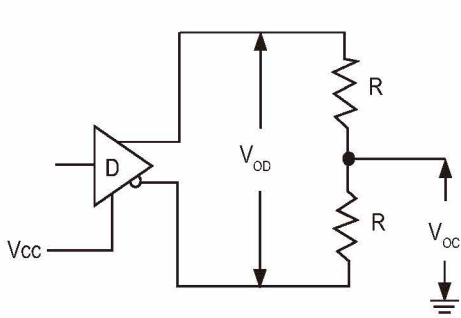
**Test Circuits**


Figure 1: Driver DC Test Load Circuit

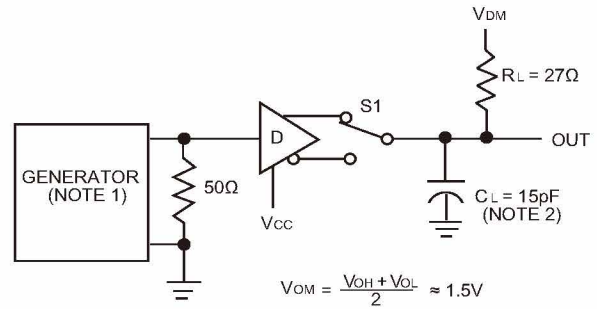


Figure 2: Driver Propagation Delay Test Circuit

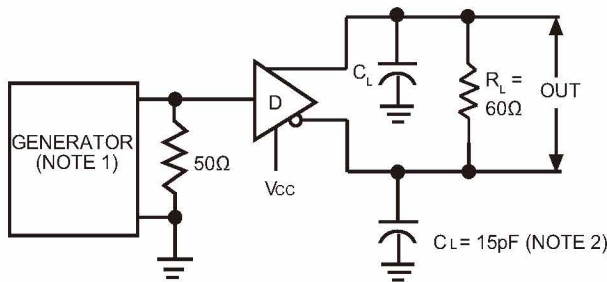


Figure 3: Driver Differential Output Delay and Transition Time Circuit.

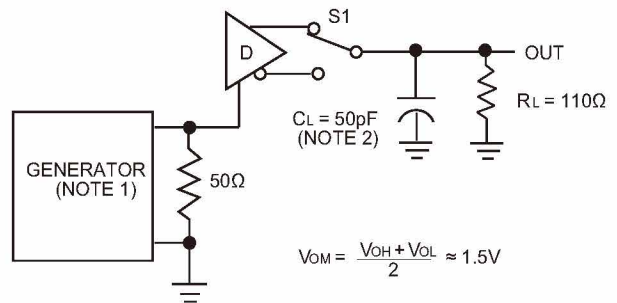


Figure 4: Driver Enable and Disable Timing Circuit, Output High

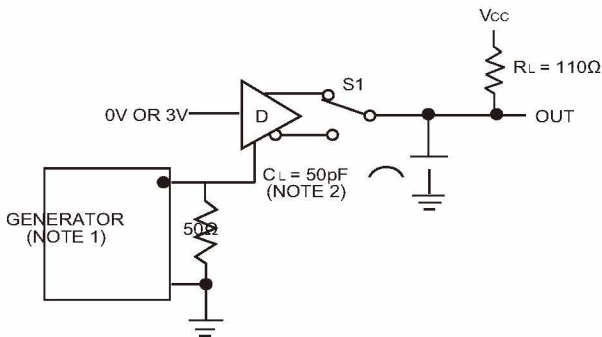


Figure 5: Driver Enable and Disable Timing Circuit, Output Low

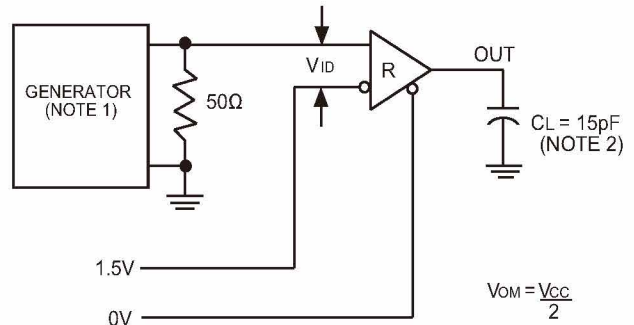


Figure 6: Receiver Propagation Delay Test Circuit

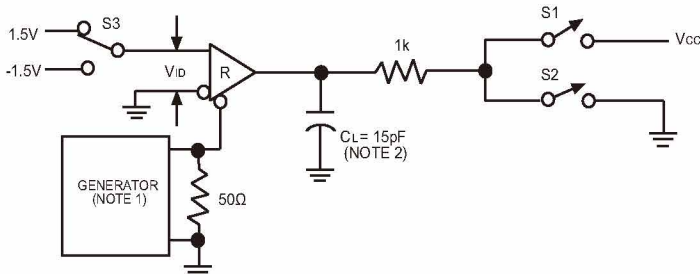


Figure 7: Receiver Enable and Disable Timing Circuit

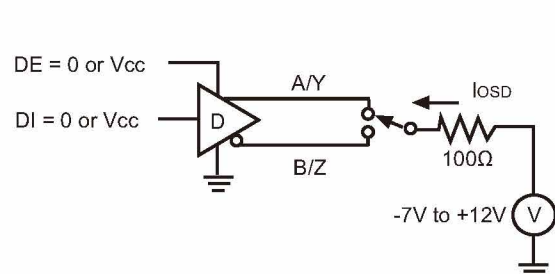


Figure 8: Driver Short Circuit Current Limit Test

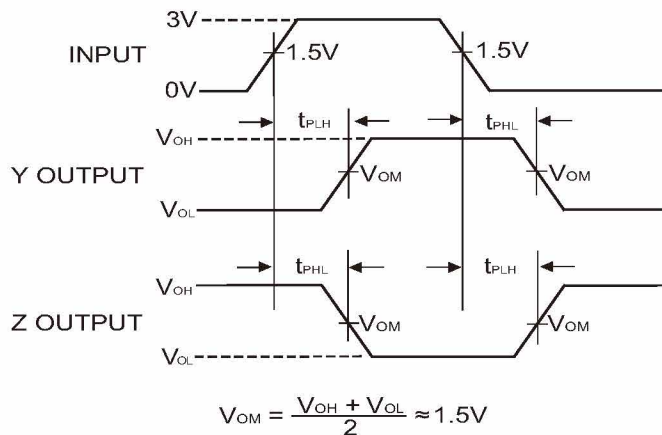
**Switching Waveforms**


Figure 9: Driver Propagation Delay Waveforms

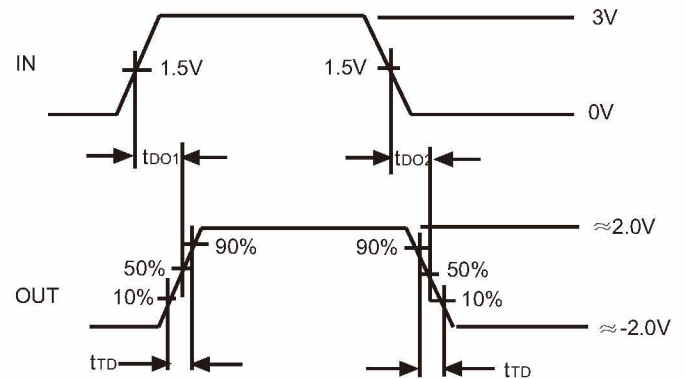


Figure 10: Driver Differential Output Delay and Transition Time Waveforms

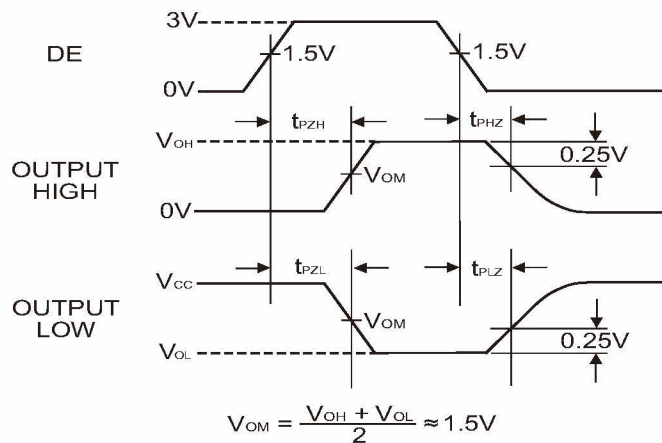


Figure 11: Driver Enable and Disable Timing Waveforms

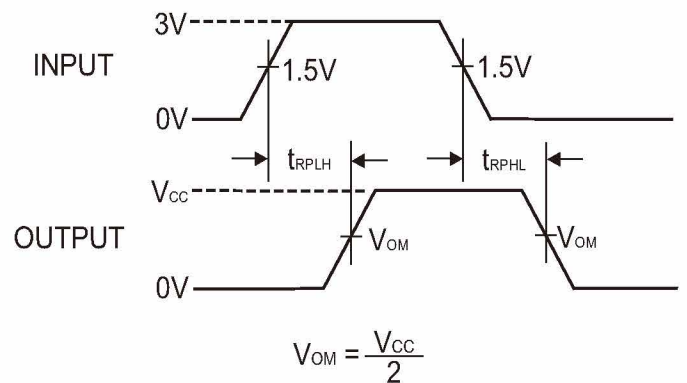


Figure 12: Receiver Propagation Delay Waveforms

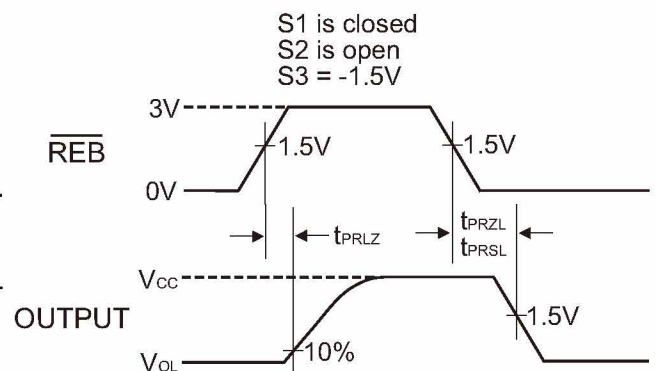
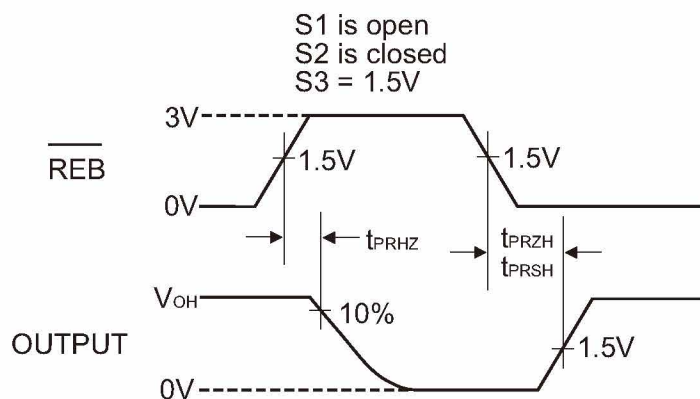


Figure 13: Receiver Enable and Disable Waveforms

**NOTES**

- The input pulse is supplied by a generator with the following characteristics:  
 PRR = 250kHz, 50% duty cycle,  $t_r < 6.0ns$ ,  $Z_o = 50\Omega$ .
- $C_L$  includes probe and stray capacitance.

## Detailed Description

The TK3488 is members in the family of 3.3V low power full-duplex transceivers that meet the electrical specifications of the RS-485 and RS-422 serial protocols. These devices are pin-to-pin compatible with the standard devices as well as popular industry standards. The TK3488 feature allowing low power operation without sacrificing performance.

The RS-485 standard is ideal for multi-drop applications and 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

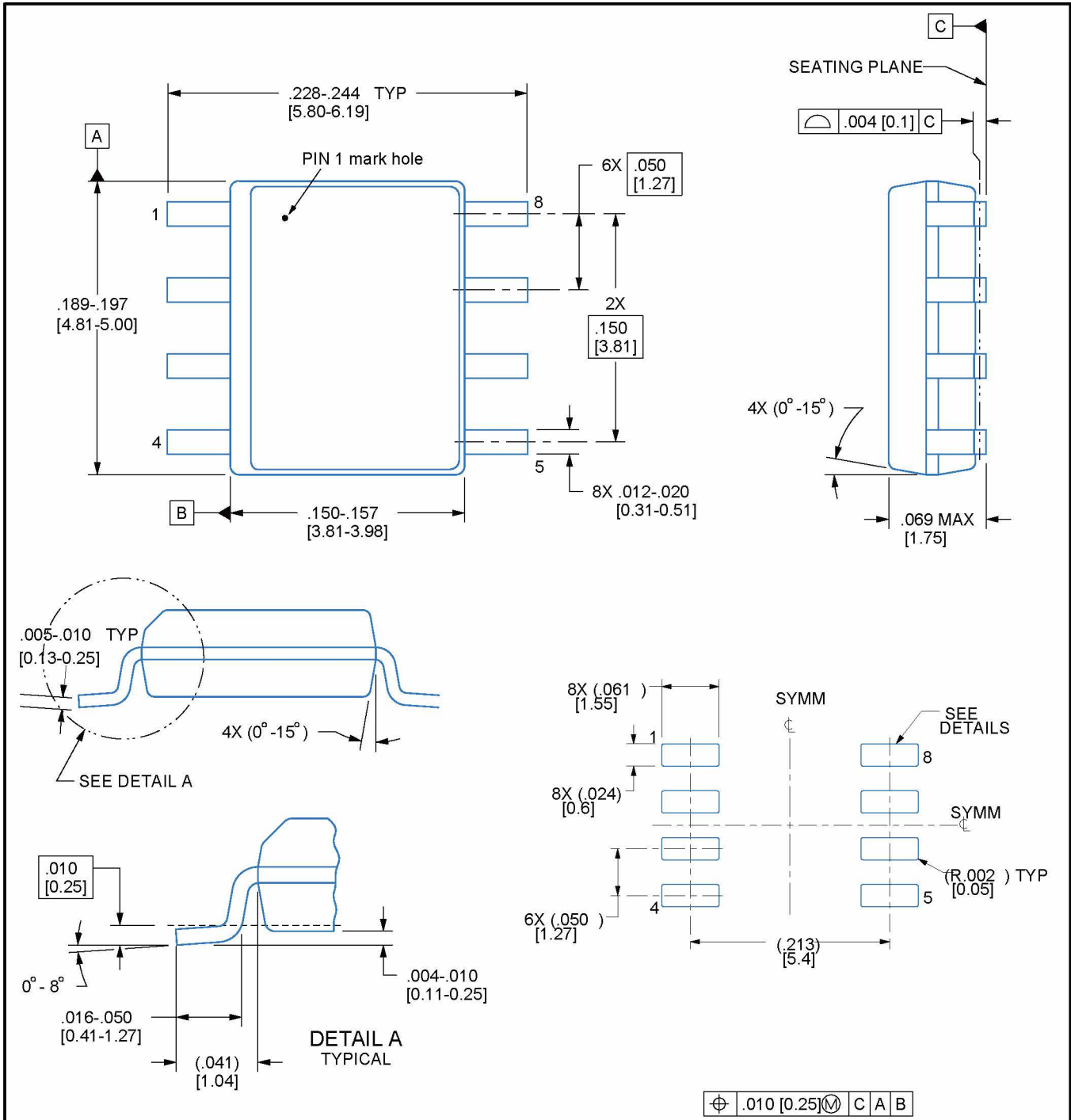
The drivers TK3488 has differential outputs. The typical voltage output swing with no load will be 0 volts to  $V_{cc}$ . With worst case loading of  $54\Omega$  across the differential outputs, the drivers can maintain greater than 1.5V voltage levels. The TK3488 does not have a driver enable.

## Receivers

The receivers of the TK3488 has differential inputs with an input sensitivity of  $\pm 200\text{mV}$ . 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 the TK3488 is equipped with a fail-safe feature that guarantees the receiver output will be in a HIGH state when the input is left unconnected.

**PACKAGE OUTLINE SOIC - 8, 1.75 mm max height**



NOTES: Linear dimensions are in inches [millimeters]. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.