



# Low-Power AppleTalk Interface Transceiver

MAX216

## General Description

The MAX216 transceiver is designed specifically for communicating with AppleTalk™ interfaces. The MAX216 has one differential and one single-ended driver, plus one differential and two single-ended receivers, all of which meet the AppleTalk transceiver specifications.

The single-ended and differential drivers have a ±5V output voltage range when they are active, and have thermal shutdown protection against short circuits. The drivers remain in a high-impedance state when disabled or shut down.

One single-ended receiver is configured as an inverter, and the other is configured as a buffer. The input thresholds of the single-ended receivers are TTL-compatible, but the input voltages can vary between ±7V. The input thresholds of the differential receiver are ±200mV, and have a common-mode range of ±7V.

The MAX216 uses only 3mA max when fully operational. The drivers and receivers are disabled during shutdown mode, when the quiescent current is reduced to only 30µA.

## Features

- ◆ Differential Driver/Receiver Compatible with RS-422
- ◆ Single-Ended Driver/Receiver Compatible with EIA/TIA-562 and EIA/TIA-232E
- ◆ Low, 3mA Max Operational Supply Current
- ◆ Low, 30µA Shutdown-Mode Supply Current

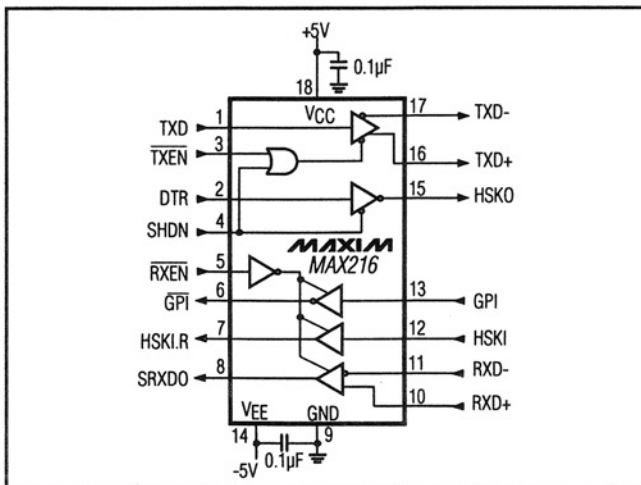
## Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX216CWN	0°C to +70°C	18 Wide SO

## Applications

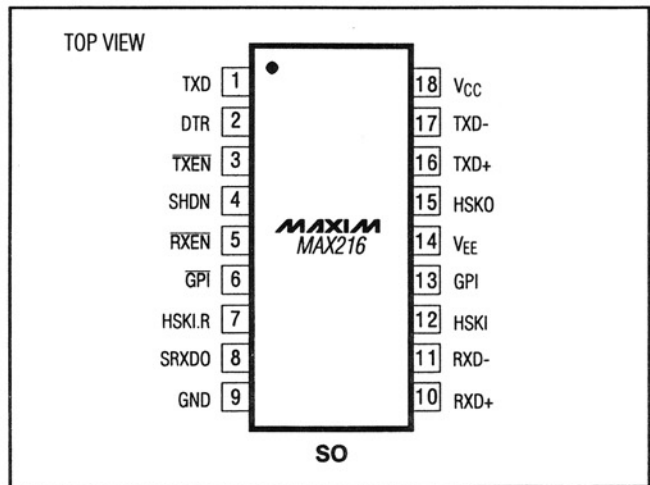
- AppleTalk Interfaces
- Apple Printer Interfaces
- Apple Peripheral Interface
- EIA/TIA-232/562 to RS-422 Conversion

## Typical Operating Circuit



™AppleTalk is a trademark of Apple Computer, Inc.

## Pin Configuration



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## ABSOLUTE MAXIMUM RATINGS

$V_{CC}$ .....	+7V	Short-Circuit Duration	
$V_{EE}$ .....	-7V	Driver Outputs (to $V_{CC}$ or $V_{EE}$ ).....	Continuous
Input Voltages		Receiver Outputs (to $V_{CC}$ or GND).....	Continuous
Driver Inputs.....	-0.5V to ( $V_{CC} + 0.5V$ )	Continuous Power Dissipation ( $T_A = +70^\circ C$ )	
Receiver Inputs.....	$\pm 15V$	SO (derate 9.52mW/ $^\circ C$ above $+70^\circ C$ ).....	762mW
Control Input Voltages.....	-0.5V to ( $V_{CC} + 0.5V$ )	Operating Temperature Range.....	$0^\circ C$ to $+70^\circ C$
Output Voltages		Storage Temperature Range.....	$-65^\circ C$ to $+160^\circ C$
Driver Outputs.....	$\pm 15V$	Lead Temperature (soldering, 10sec).....	$+300^\circ C$
Receiver Outputs.....	-0.5V to ( $V_{CC} + 0.5V$ )		

Stresses beyond those listed under "Absolute 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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS – DC PARAMETERS

( $V_{CC} = 5V \pm 5\%$ ,  $V_{EE} = -5V \pm 5\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. See Figures 1 and 5.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>POWER SUPPLY</b>						
Positive Supply Current	$I_{CC}$	No load, SHDN = 0V		1.2	3	mA
		No load, SHDN = $V_{CC}$		30	100	$\mu A$
Negative Supply Current	$I_{EE}$	No load			100	$\mu A$
<b>DIFFERENTIAL DRIVER</b>						
TTL/CMOS Input Levels	$V_{IL}$	TXD, TXEN, SHDN			0.8	V
	$V_{IH}$		2.0			
Input Current		TXD, TXEN, SHDN			$\pm 20$	$\mu A$
Differential Driver Output Voltage	$V_{OD1}$	No load, $I_O = 0A$ , $V_{D1}$	8.0			V
	$V_{OD2}$	$R = 50\Omega$ , $V_{D2}$	2.0			
Change in Magnitude of Differential Output Voltage	$\Delta V_{OD2}$	$R = 50\Omega$ , $V_{D2}$			0.2	V
Common-Mode Output Voltage	$V_{OC}$	$R = 50\Omega$ , $V_{D2}$			3	V
Change in Magnitude of Common-Mode Output Voltage	$\Delta V_{OC}$	$R = 50\Omega$ , $V_{D2}$			0.2	V
Output Common-Mode Range	$V_{CMR}$	SHDN > 2.0V or power off			$\pm 10$	V
Short-Circuit Current		$-5V \leq V_O \leq 5V$	35		450	mA
Off-State Output Current		SHDN > 2.0V or power off, $-10V < V_O < 10V$			$\pm 100$	$\mu A$

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## ELECTRICAL CHARACTERISTICS – DC PARAMETERS (continued)

( $V_{CC} = 5V \pm 5\%$ ,  $V_{EE} = -5V \pm 5\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. See Figures 1 and 5.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>SINGLE-ENDED DRIVER</b>						
Input High Voltage	$V_{IH}$	DTR	2.0			V
Input Low Voltage	$V_{IL}$	DTR			0.8	V
Input Current		DTR			$\pm 20$	$\mu A$
Output Voltage	$V_{O1}$	No load	DTR = 0.8V	4.0		V
			DTR = 2.0V	-4.0		
	$V_{O2}$	$R_L = 400\Omega$	DTR = 0.8V	3.4		
			DTR = 2.0V	-3.4		
Off-State Output Current		SHDN > 2.0V or power off, -10V < $V_O$ < 10V			$\pm 100$	$\mu A$
Output Short-Circuit Current		$-5V \leq V_O \leq 5V$	35		450	mA
<b>DIFFERENTIAL RECEIVER</b>						
Receiver Input Current		$V_{IN} = 7V$			1.5	mA
		$V_{IN} = -7V$			-1.5	
Receiver Input Resistance		$-7V \leq V_{IN} \leq 7V$	12			k $\Omega$
Receiver Output High Voltage	$V_{OH}$	$I_O = -4mA$	3.5			V
Receiver Output Low Voltage	$V_{OL}$	$I_O = 4mA$			0.4	V
Receiver Short-Circuit Current		$0V \leq V_O \leq 5V$	7.0		85	mA
Disabled Receiver Output Current		$0V \leq V_O \leq 5V$			$\pm 100$	$\mu A$
Differential Input Threshold Voltage		$-7V \leq V_{CM} \leq 7V$	-0.2		0.2	V
<b>SINGLE-ENDED RECEIVER</b>						
Receiver Input Current		$V_{IN} = 7V$			1.5	mA
		$V_{IN} = -7V$			-1.5	
Receiver Input Resistance		$-7V \leq V_{IN} \leq 7V$	12			k $\Omega$
Receiver Output High Voltage	$V_{OH}$	$I_O = -4mA$	3.5			V
Receiver Output Low Voltage	$V_{OL}$	$I_O = 4mA$			0.4	V
Receiver Short-Circuit Current		$0V \leq V_O \leq 5V$	7		85	mA
Disabled Receiver Output Current		$0V \leq V_O \leq 5V$			$\pm 100$	$\mu A$
Input Low Voltage	$V_{IL}$				0.8	V
Input High Voltage	$V_{IH}$		2.0			V

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## ELECTRICAL CHARACTERISTICS – AC PARAMETERS

( $V_{CC} = 5V \pm 5\%$ ,  $V_{EE} = -5V \pm 5\%$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. See Figures 2 and 5.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DIFFERENTIAL DRIVER</b>						
Driver Input to Output	$t_{PLH}$	$R_L = 100\Omega$ , $C_{L1} = 100pF$ , $C_{L2} = 100pF$			120	ns
	$t_{PHL}$				120	
Driver Output to Output	$t_{SKEW}$	$R_L = 100\Omega$ , $C_{L1} = 100pF$ , $C_{L2} = 100pF$			30	ns
Driver Rise Time	$t_R$	$R_L = 100\Omega$ , $C_{L1} = 100pF$ , $C_{L2} = 100pF$			60	ns
Driver Fall Time	$t_F$	$R_L = 100\Omega$ , $C_{L1} = 100pF$ , $C_{L2} = 100pF$			60	ns
Driver Enable to Output High	$t_{ZH}$	$C_L = 100pF$ , Figure 4			150	ns
Driver Enable to Output Low	$t_{ZL}$	$C_L = 100pF$ , Figure 3			150	ns
Driver Disable Time from Low	$t_{LZ}$	$C_L = 15pF$ , Figure 3			150	ns
Driver Disable Time from High	$t_{HZ}$	$C_L = 15pF$ , Figure 4			150	ns
<b>SINGLE-ENDED DRIVER</b>						
Driver Input to Output	$t_{PLH}$	$R_L = 450\Omega$ , $C_L = 100pF$			120	ns
	$t_{PHL}$				120	
Driver Rise Time	$t_R$	$R_L = 450\Omega$ , $C_L = 100pF$			60	ns
Driver Fall Time	$t_F$	$R_L = 450\Omega$ , $C_L = 100pF$			60	ns
<b>DIFFERENTIAL RECEIVER</b>						
Receiver Input to Output	$t_{PLH}$	$C_L = 15pF$			160	ns
	$t_{PHL}$				160	
Receiver Disable Time from Low	$t_{LZ}$	$C_L = 15pF$ , Figure 6			100	ns
Receiver Disable Time from High	$t_{HZ}$	$C_L = 15pF$ , Figure 7			100	ns
Receiver Enable to Output High	$t_{ZH}$	$C_L = 100pF$ , Figure 7			100	ns
Receiver Enable to Output Low	$t_{ZL}$	$C_L = 100pF$ , Figure 6			100	ns
<b>SINGLE-ENDED RECEIVER</b>						
Receiver Input to Output	$t_{PLH}$	$C_L = 15pF$			160	ns
	$t_{PHL}$				160	
Receiver Disable Time from Low	$t_{LZ}$	$C_L = 15pF$ , Figure 6			100	ns
Receiver Disable Time from High	$t_{HZ}$	$C_L = 15pF$ , Figure 7			100	ns
Receiver Enable to Output High	$t_{ZH}$	$C_L = 100pF$ , Figure 7			100	ns
Receiver Enable to Output Low	$t_{ZL}$	$C_L = 100pF$ , Figure 6			100	ns

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## Pin Description

PIN	NAME	FUNCTION
1	TXD	TTL-compatible differential driver input
2	DTR	TTL-compatible single-ended inverting driver input
3	TXEN	TTL-compatible differential driver output enable. A high input forces the differential driver output into a high-impedance state. A low input enables the differential driver output. This input does not affect the single-ended driver.
4	SHDN	TTL-compatible shutdown input. A high input forces the chip into shutdown, with both driver outputs forced into three-state and the supply current reduced to 20 $\mu$ A typ. The receivers are not functional, but their outputs remain enabled unless $\overline{\text{RXEN}}$ is pulled high. A low input forces the chip into normal operation.
5	$\overline{\text{RXEN}}$	TTL-compatible receiver enable input. A low input enables the outputs of the receivers and a high input forces the receiver outputs into a high-impedance state. To prevent unwanted noise at the output of the receivers in shutdown mode, $\overline{\text{RXEN}}$ should be pulled high along with SHDN.
6	GPI	Inverting single-ended receiver output
7	HSKI.R	Noninverting single-ended receiver output
8	SRXDO	Differential receiver output
9	GND	Ground
10	RXD+	Noninverting input to the differential receiver. If RXD+ is greater than RXD- by more than 200mV, then the differential receiver output, SRXDO, will be high. If RXD+ is less than RXD- by more than 200mV, SRXDO will be low – meets RS-422 thresholds.
11	RXD-	Inverting input to the differential receiver – meets RS-422 thresholds.
12	HSKI	Noninverting receiver input – meets EIA/TIA-562 and EIA/TIA-232E thresholds.
13	GPI	Inverting receiver input – meets EIA/TIA-562 and EIA/TIA-232E thresholds.
14	$V_{EE}$	Negative supply
15	HSKO	Single-ended inverting driver output – meets EIA/TIA-562 and EIA/TIA-232E voltage levels.
16	TXD+	Noninverting differential driver output – meets RS-422 voltage levels.
17	TXD-	Inverting differential driver output – meets RS-422 voltage levels.
18	$V_{CC}$	Positive supply

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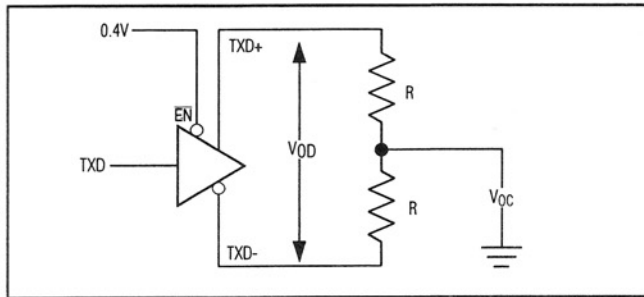


Figure 1. Differential and Common-Mode Output Voltages

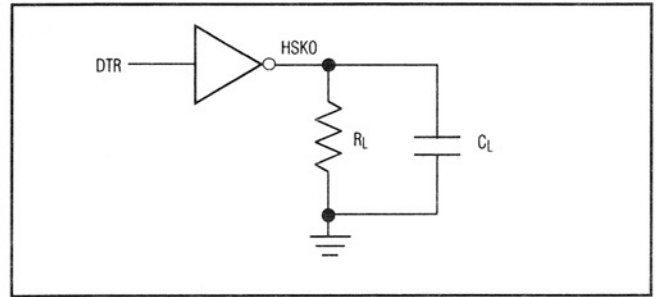


Figure 5. Single-Ended Driver Timing Test Circuit

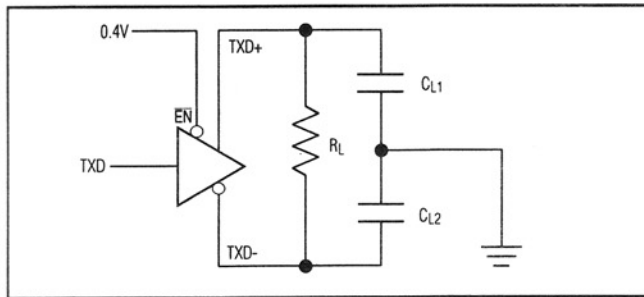


Figure 2. Differential Driver Timing Test Circuit

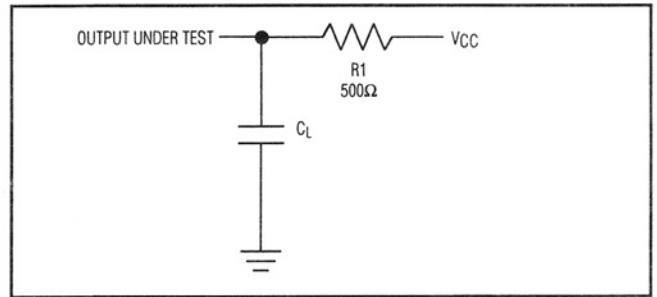


Figure 6. Receiver Enable/Disable Test Circuit 1

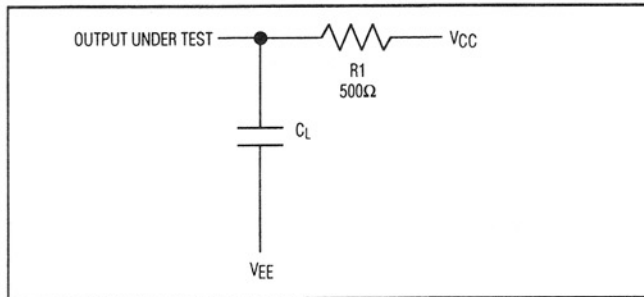


Figure 3. Driver Enable/Disable Test Circuit 1

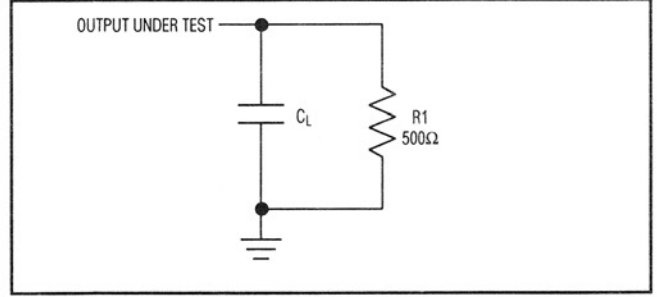


Figure 7. Receiver Enable/Disable Test Circuit 2

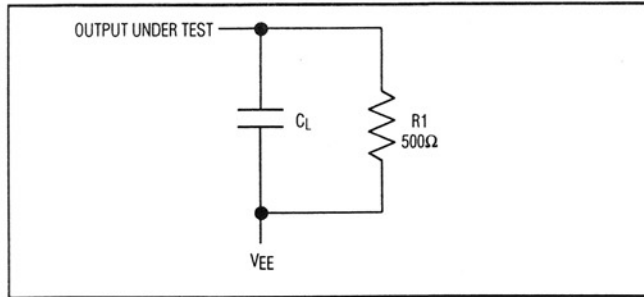


Figure 4. Driver Enable/Disable Test Circuit 2

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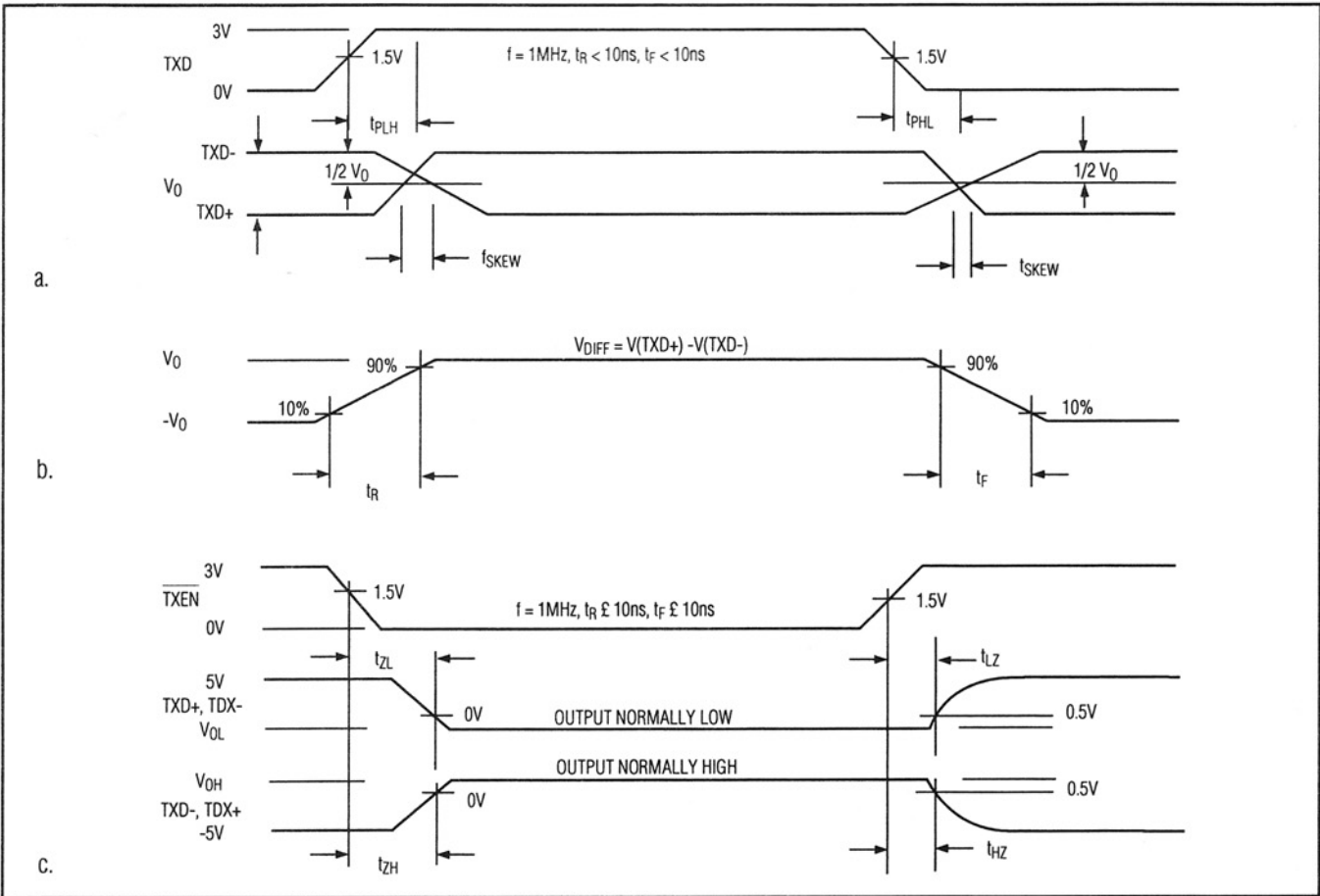


Figure 8. Differential Driver Switching Times: a) Propagation Delay and Skew; b) Rise and Fall Times; c) Enable/Disable Timing.

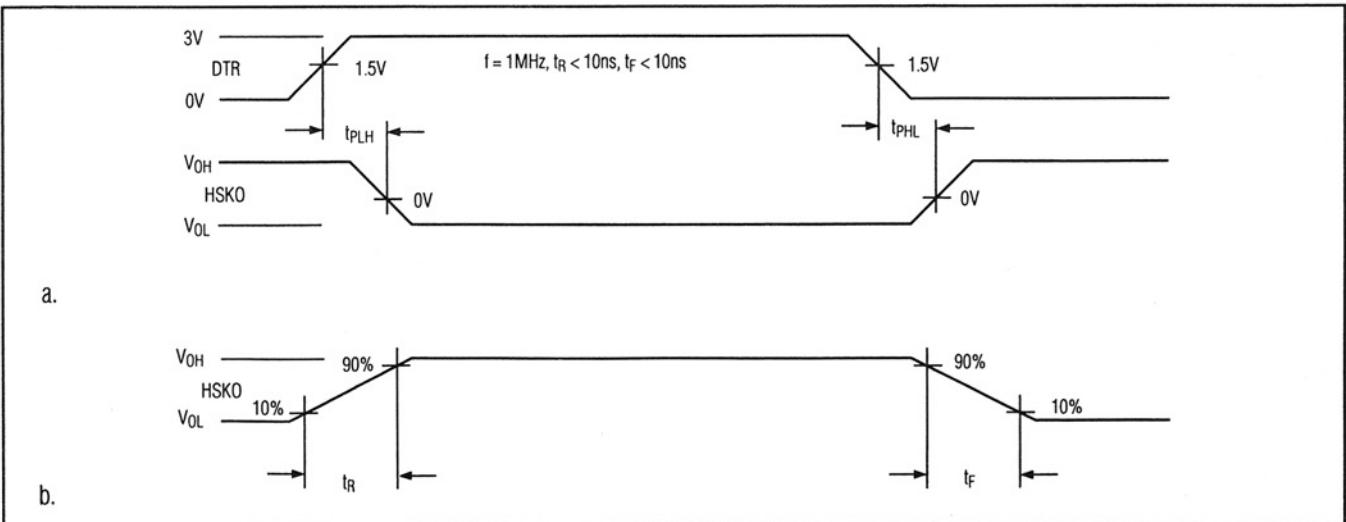


Figure 9. Single-Ended Driver Switching Times: a) Propagation Delay; b) Rise and Fall Times.

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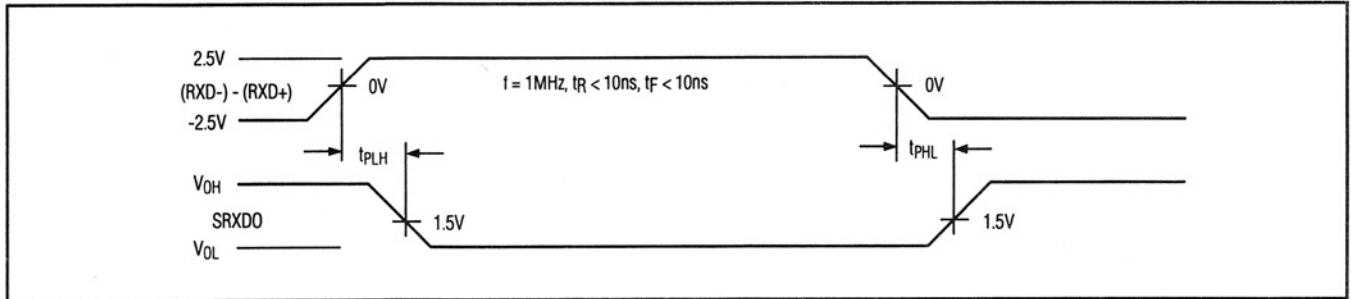


Figure 10. Differential Receiver Switching Times

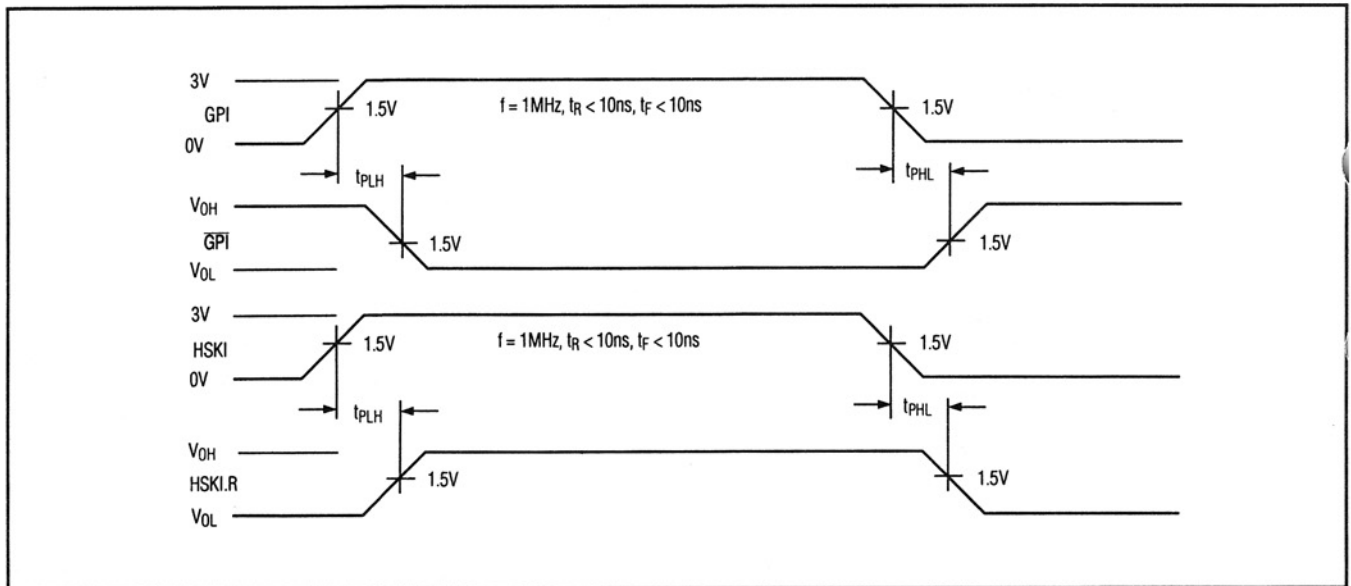


Figure 11. Single-Ended Receiver Switching Times

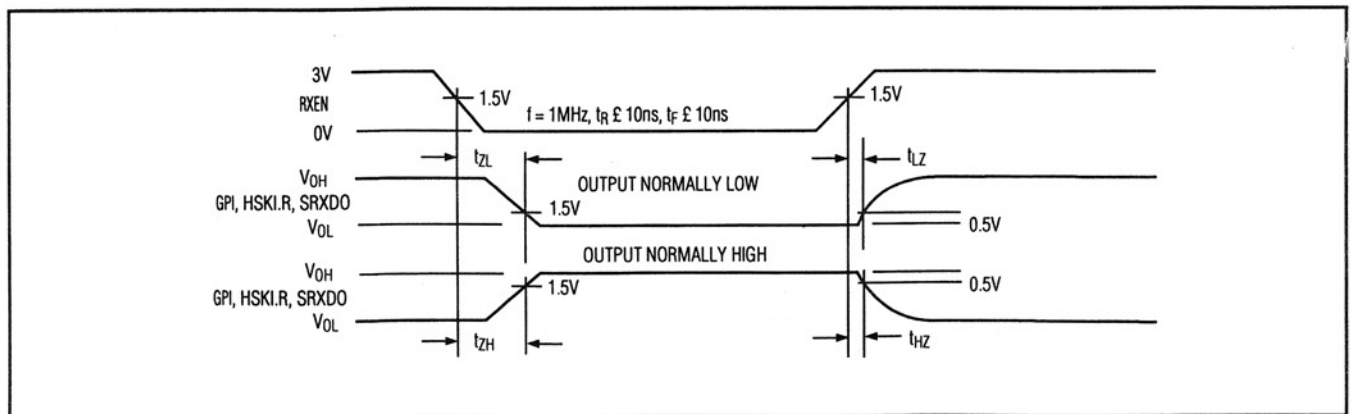


Figure 12. Receiver Enable/Disable Switching Times

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