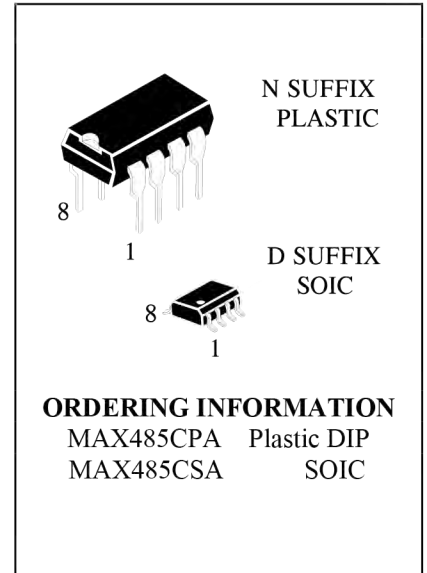


## Low-Power, Slew-Rate-Limited RS-485/RS-422 Transceivers

### General Description

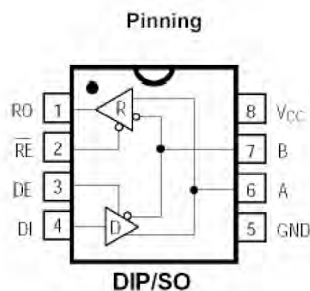
The MAX485 is low-power transceivers for RS-485 and RS-422 communication. IC contains one driver and one receiver. The driver slew rates of the MAX485 is not limited, allowing them to transmit up to 2.5Mbps.

These transceivers draw between 120 $\mu$ A and 500 $\mu$ A of supply current when unloaded or fully loaded with disabled drivers. All parts operate from a single 5V supply. 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. The MAX485 is designed for half-duplex applications.



### Features

- Low Quiescent Current: 300 $\mu$ A
- -7V to +12V Common-Mode Input Voltage Range
- Three-State Outputs
- 30ns Propagation Delays, 5ns Skew
- Full-Duplex and Half-Duplex Versions Available
- Operate from a Single 5V Supply
- Allows up to 32 Transceivers on the Bus
- Data rate: 2,5 Mbps
- Current-Limiting and Thermal Shutdown for Driver Overload Protection
- The transmitter outputs and receiver inputs are protected to  $\pm 15$ kV Air ESD.



## ABSOLUTE MAXIMUM RATINGS

Supply Voltage ( $V_{CC}$ ) 12V	Continuous Power Dissipation ( $T_A = +70^\circ\text{C}$ )
Control Input Voltage -0.5V to ( $V_{CC} + 0.5\text{V}$ )	8-Pin Plastic DIP (derate 9.09mW/ $^\circ\text{C}$ above +70 $^\circ\text{C}$ ) 727mW
Driver Input Voltage (DI) -0.5V to ( $V_{CC} + 0.5\text{V}$ )	8-Pin SOP (derate 5.88mW/ $^\circ\text{C}$ above +70 $^\circ\text{C}$ ) 471mW
Driver Output Voltage (A, B) -8V to +12.5V	Operating Temperature Ranges 0 $^\circ\text{C}$ to +70 $^\circ\text{C}$
Receiver Input Voltage (A, B) -8V to +12.5V	Storage Temperature Range -65 $^\circ\text{C}$ to +160 $^\circ\text{C}$
Receiver Output Voltage (RO) -0.5V to ( $V_{CC} + 0.5\text{V}$ )	Lead Temperature (soldering, 10sec) +300 $^\circ\text{C}$

## DC ELECTRICAL CHARACTERISTICS

( $V_{CC} = 5\text{V} \pm 5\%$ ,  $T_A = T_{\text{MIN}}$  to  $T_{\text{MAX}}$ , unless otherwise noted.) (Notes 1, 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TY P	MAX	UNITS
Differential Driver Output (no load)	$V_{OD1}$				5	V
Differential Driver Output (with load)	$V_{OD2}$	R = 50 $\Omega$ (RS-422)	2			V
		R = 27 $\Omega$ (RS-485), Figure 4	1.5		5	
Change in Magnitude of Driver Differential Output Voltage for Complementary Output States	$\Delta V_{OD}$	R = 27 $\Omega$ or 50 $\Omega$ , Figure 4			0.2	V
Driver Common-Mode Output Voltage	$V_{OC}$	R = 27 $\Omega$ or 50 $\Omega$ , Figure 4			3	V
Change in Magnitude of Driver Common-Mode Output Voltage for Complementary Output States	$\Delta V_{OD}$	R = 27 $\Omega$ or 50 $\Omega$ , Figure 4			0.2	V
Input High Voltage	$V_{IH}$	DE, DI, RE	2.0			V
Input Low Voltage	$V_{IL}$	DE, DI, RE			0.8	V
Input Current	$I_{IN1}$	DE, DI, RE			$\pm 2$	$\mu\text{A}$
Input Current (A, B)	$I_{IN2}$	DE = 0V;	$V_{IN} = 12\text{V}$		1.0	mA
		$V_{CC} = 0\text{V}$ or 5.25V,	$V_{IN} = -7\text{V}$		-0.8	
Receiver Differential Threshold Voltage	$V_{TH}$	$-7\text{V} \leq V_{CM} \leq 12\text{V}$	-0.2		0.2	V
Receiver Input Hysteresis	$\Delta V_{TH}$	$V_{CM} = 0\text{V}$		70		mV
Receiver Output High Voltage	$V_{OH}$	$I_o = -4\text{mA}$ , $V_{ID} = 200\text{mV}$	3.5			V
Receiver Output Low Voltage	$V_{OL}$	$I_o = 4\text{mA}$ , $V_{ID} = -200\text{mV}$			0.4	V
Three-State (high impedance) Output Current at Receiver	$I_{OZR}$	$0.4\text{V} \leq V_o \leq 2.4\text{V}$			$\pm 1$	$\mu\text{A}$
Receiver Input Resistance	$R_{IN}$	$-7\text{V} \leq V_{CM} \leq 12\text{V}$				k $\Omega$

**DC ELECTRICAL CHARACTERISTICS (continued)**(V<sub>CC</sub> = 5V ±5%, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.) (Notes 1, 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
No-Load Supply Current (Note 3)	I <sub>CC</sub>	DE = V <sub>CC</sub>		500	900	μA
		RE = 0V or V <sub>CC</sub>		300	500	
		DE = 0V				
Driver Short-Circuit Current, V <sub>O</sub> = High	I <sub>OSD1</sub>	-7V ≤ V <sub>O</sub> ≤ 12V (Note 4)	35		250	mA
Driver Short-Circuit Current, V <sub>O</sub> = Low	I <sub>OSD2</sub>	-7V ≤ V <sub>O</sub> ≤ 12V (Note 4)	35		250	mA
Receiver Short-Circuit Current	I <sub>OSR</sub>	0V ≤ V <sub>O</sub> ≤ V <sub>CC</sub>	7		95	mA

**SWITCHING CHARACTERISTICS**(V<sub>CC</sub> = 5V ±5%, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted.) (Notes 1, 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Driver Input to Output	t <sub>PLH</sub>	R <sub>DIF</sub> = 54Ω	10	30	60	ns
	t <sub>PHL</sub>	C <sub>L1</sub> = C <sub>L2</sub> = 100pF	10	30	60	
Driver Output Skew to Output	t <sub>SKEW</sub>	R <sub>DIF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF		5	10	ns
Driver Enable to Output High	t <sub>ZH</sub>	C <sub>L</sub> = 100pF, S2 closed		40	70	ns
Driver Enable to Output Low	t <sub>ZL</sub>	C <sub>L</sub> = 100pF, S1 closed		40	70	ns
Driver Disable Time from Low	t <sub>LZ</sub>	C <sub>L</sub> = 15pF, S1 closed		40	70	ns
Driver Disable Time from High	t <sub>HZ</sub>	C <sub>L</sub> = 15pF, S2 closed		40	70	ns
t <sub>PLH</sub> - t <sub>PHL</sub>   Differential	t <sub>SKD</sub>	R <sub>DIF</sub> = 54Ω		13		ns
Receiver Skew		C <sub>L1</sub> = C <sub>L2</sub> = 100pF				
Receiver Enable to Output Low	t <sub>ZL</sub>	C <sub>RL</sub> = 15pF, S1 closed		20	50	ns
Receiver Enable to Output High	t <sub>ZH</sub>	C <sub>RL</sub> = 15pF, S2 closed		20	50	ns
Receiver Disable Time from Low	t <sub>LZ</sub>	C <sub>RL</sub> = 15pF, S1 closed		20	50	ns
Receiver Disable Time from High	t <sub>HZ</sub>	C <sub>RL</sub> = 15pF, S2 closed		20	50	ns
Maximum Data Rate	f <sub>MAX</sub>		2.5			Mbps

**Note 1:** All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to device ground unless otherwise specified.

**Note 2:** All typical specifications are given for V<sub>CC</sub> = 5V and T<sub>A</sub> = +25°C.

**Note 3:** Supply current specification is valid for loaded transmitters when DE = 0V.

**Note 4:** Applies to peak current. See *Typical Operating Characteristics*.

### Test Circuits

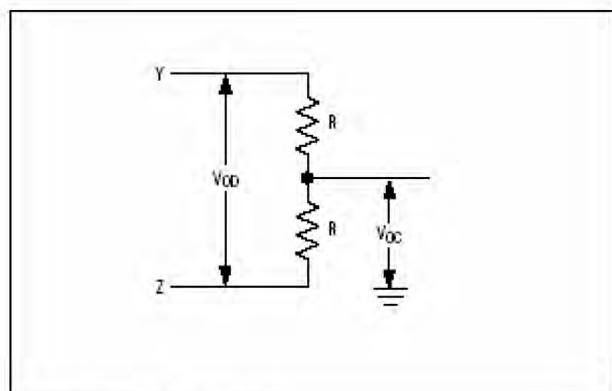


Figure 4. Driver DC Test Load

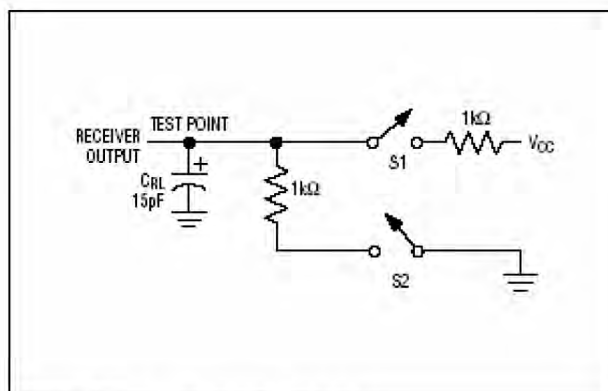


Figure 5. Receiver Timing Test Load

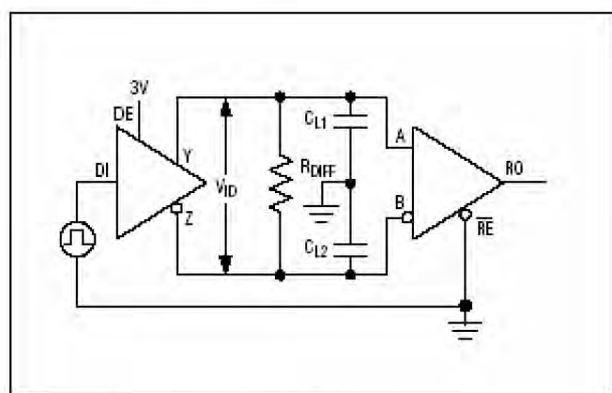


Figure 6. Driver/Receiver Timing Test Circuit

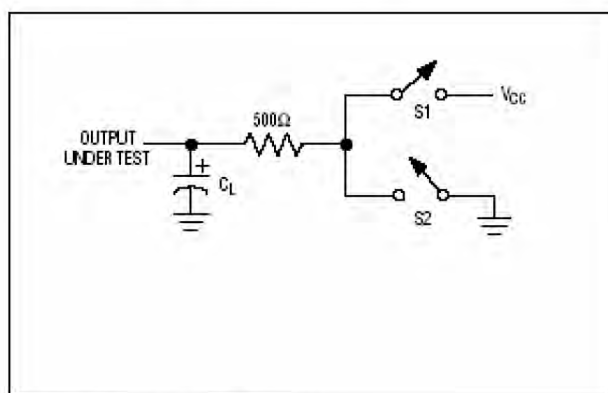


Figure 7. Driver Timing Test Load

Operation timing diagrams of MAX 485

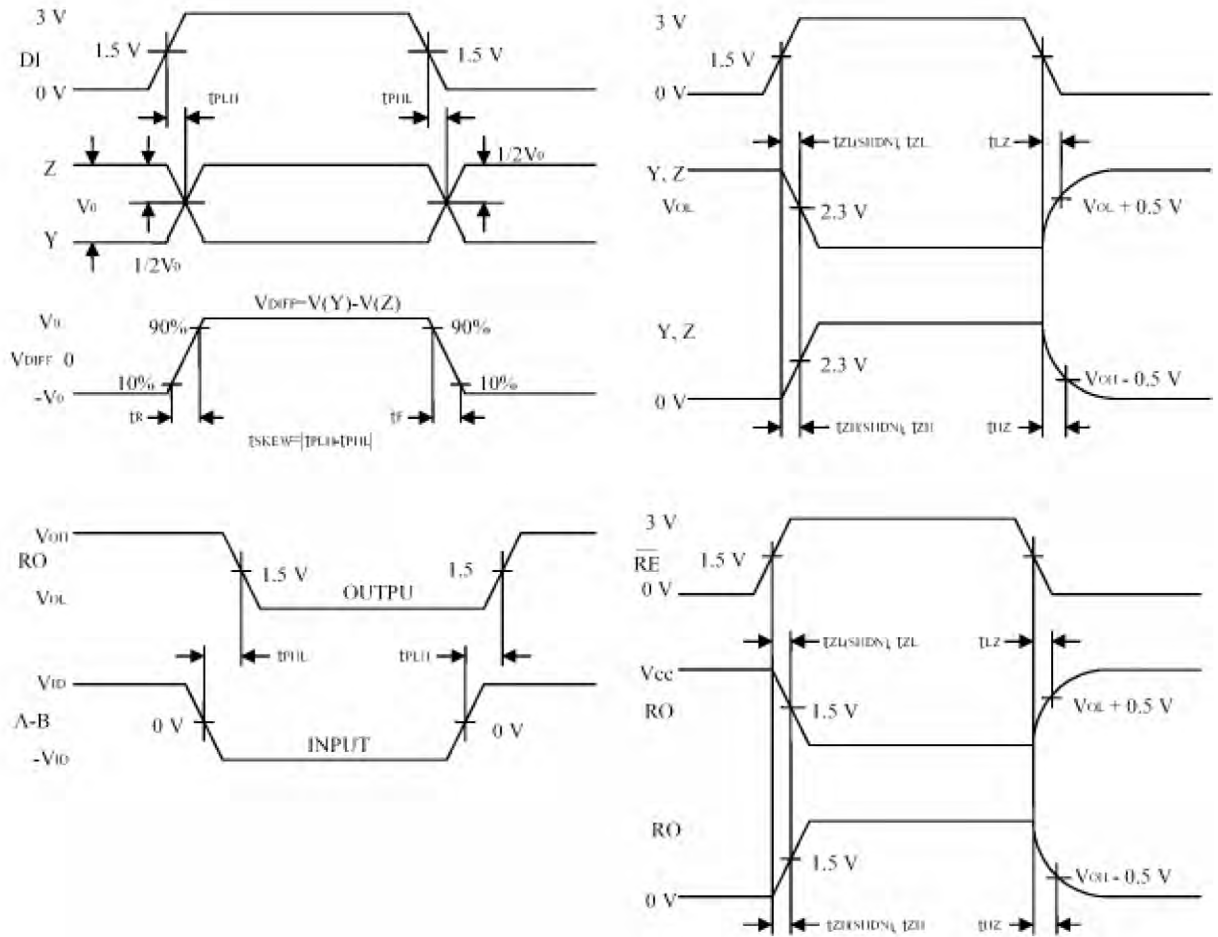
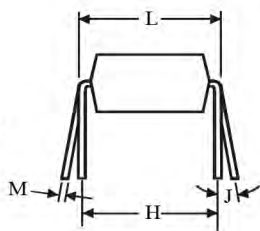
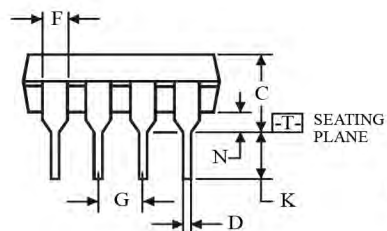
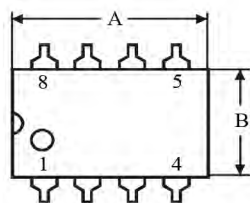
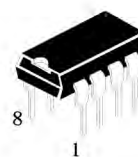


Table of MAX 485 operation

Transmitting					Receiving			
Inputs			Outputs X		Inputs			Outputs
RE	DE	DI	Z	Y	RE	DE	A-B	RO
X	1	1	0	1	0	0	+0.2V	1
X	1	0	1	0	0	0	-0.2V	0
0	0	X	Z	Z	0	0	open	1
1	0	X	Z	Z	1	0	X	Z

X-don't care  
Z-high impedance

**N SUFFIX PLASTIC DIP  
(MS - 001BA)**



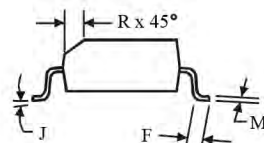
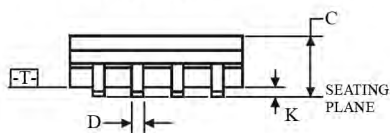
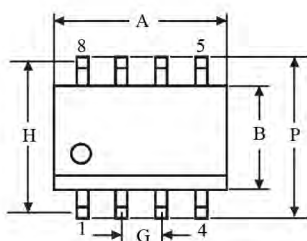
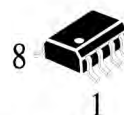
$\oplus 0.25 (0.010) \text{ (M) T}$

Symbol	Dimension, mm	
	MIN	MAX
A	8.51	10.16
B	6.1	7.11
C		5.33
D	0.36	0.56
F	1.14	1.78
G	2.54	
H	7.62	
J	0°	10°
K	2.92	3.81
L	7.62	8.26
M	0.2	0.36
N	0.38	

**NOTES:**

- Dimensions "A", "B" do not include mold flash or protrusions.  
Maximum mold flash or protrusions 0.25 mm (0.010) per side.

**D SUFFIX SOIC  
(MS - 012AA)**



$\oplus 0.25 (0.010) \text{ (M) T C (M)}$

Symbol	Dimension, mm	
	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:**

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side for A; for B - 0.25 mm (0.010) per side.