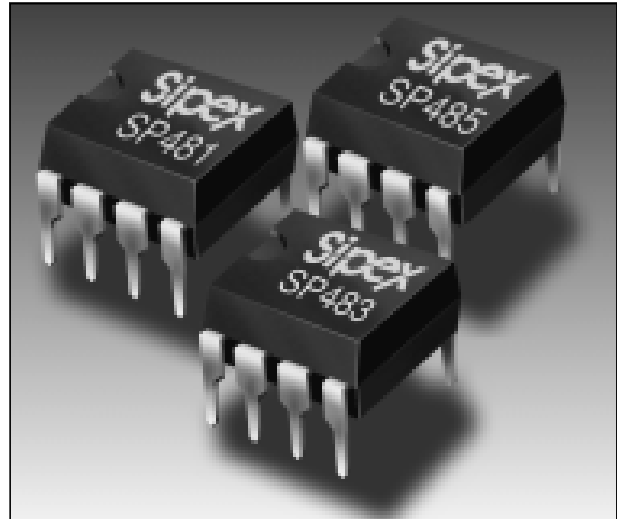


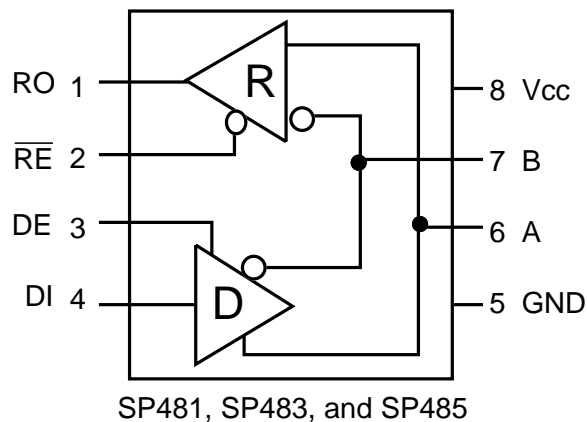
## Low Power Half-Duplex RS-485 Transceivers

- +5V Only
- Low Power BiCMOS
- Driver/Receiver Enable
- Slew Rate Limited Driver for Low EMI (SP483)
- Low Power Shutdown Mode (SP481 and SP483)
- RS-485 and RS-422 Drivers/Receivers



### DESCRIPTION

The **SP481**, **SP483**, and the **SP485** are a family of half-duplex transceivers that meet the requirements of RS-485 and RS-422. Their BiCMOS design allows low power operation without sacrificing performance. The **SP481** and **SP485** meet the requirements of RS-485 and RS-422 up to 5Mbps. Additionally, the **SP481** is equipped with a low power Shutdown mode. The **SP483** is internally slew rate limited to reduce EMI and can meet the requirements of RS-485 and RS-422 up to 250kbps. The **SP483** is also equipped with a low power Shutdown mode.



# 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> .....	±12V
Input Voltages	
Logic.....	-0.3V to (V <sub>CC</sub> +0.5V)
Drivers.....	-0.3V to (V <sub>CC</sub> +0.5V)
Receivers.....	±15V
Output Voltages	
Logic.....	-0.3V to (V <sub>CC</sub> +0.5V)
Drivers.....	±15V
Receivers.....	-0.3V to (V <sub>CC</sub> +0.5V)
Storage Temperature.....	-65°C to +150°C
Power Dissipation.....	500mW

# SPECIFICATIONS

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP481/SP483/SP485 DRIVER</b>					
<b>DC Characteristics</b>					
Differential Output Voltage	GND		V <sub>CC</sub>	Volts	Unloaded; R = ∞ ; see figure 1 with load; R = 50Ω; (RS422); see figure 1
Differential Output Voltage	2		V <sub>CC</sub>	Volts	
Differential Output Voltage	1.5		V <sub>CC</sub>	Volts	with load; R = 27Ω; (RS485); see figure 1
Change in Magnitude of Driver Differential Output Voltage for Complimentary States			0.2	Volts	R = 27Ω or R = 50Ω; see figure 1
Driver Common-Mode Output Voltage			3	Volts	R = 27Ω or R = 50Ω; see figure 1
Input High Voltage	2.0			Volts	Applies to DE, DI, $\overline{RE}$
Input Low Voltage			0.8	Volts	Applies to DE, DI, $\overline{RE}$
Input Current			±10	µA	Applies to DE, DI, RE
Driver Short-Circuit Current					
V <sub>OUT</sub> = HIGH	35		250	mA	-7V ≤ V <sub>O</sub> ≤ +12V
V <sub>OUT</sub> = LOW	35		250	mA	-7V ≤ V <sub>O</sub> ≤ +12V
<b>SP481/SP485 DRIVER</b>					
<b>AC Characteristics</b>					
Maximum Data Rate	5			Mbps	$\overline{RE}$ = 5V, DE = 5V
Driver Input to Output	20	30	60	ns	t <sub>PLH</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6
Driver Input to Output	20	30	60	ns	t <sub>PFL</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6
Driver Skew		5	10	ns	see figures 3 and 6,
Driver Rise or Fall Time	3	15	40	ns	t <sub>SKREW</sub> =   t <sub>DPLH</sub> - t <sub>DPFL</sub>   From 10% to 90%; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 and 6
Driver Enable to Output High		40	70	ns	C <sub>L</sub> = 100pF; see figures 4 & 7; S <sub>2</sub> closed
Driver Enable to Output Low		40	70	ns	C <sub>L</sub> = 100pF; see figures 4 & 7; S <sub>1</sub> closed
Driver Disable Time from Low		40	70	ns	C <sub>L</sub> = 15pF; see figures 2 & 9; S <sub>1</sub> closed
Driver Disable Time from High		40	70	ns	C <sub>L</sub> = 15pF; see figures 2 & 9; S <sub>2</sub> closed
<b>SP481/SP483/SP485 RECEIVER</b>					
<b>DC Characteristics</b>					
Differential Input Threshold	-0.2		+0.2	Volts	-7V ≤ V <sub>CM</sub> ≤ +12V
Input Hysteresis		10		mV	V <sub>CM</sub> = 0V
Output Voltage High	3.5			Volts	I <sub>O</sub> = -4mA, V <sub>ID</sub> = +200mV
Output Voltage Low			0.4	Volts	I <sub>O</sub> = +4mA, V <sub>ID</sub> = -200mV
Three-State (High Impedance) Output Current			±1	µA	0.4V ≤ V <sub>O</sub> ≤ 2.4V; $\overline{RE}$ = 5V
Input Resistance	12	15		kΩ	-7V ≤ V <sub>CM</sub> ≤ +12V
Input Current (A, B); V <sub>IN</sub> = 12V			+1.0	mA	DE = 0V, V <sub>CC</sub> = 0V or 5.25V, V <sub>IN</sub> = 12V
Input Current (A, B); V <sub>IN</sub> = -7V			-0.8	mA	DE = 0V, V <sub>CC</sub> = 0V or 5.25V, V <sub>IN</sub> = -7V
Short-Circuit Current	7		95	mA	0V ≤ V <sub>CM</sub> ≤ V <sub>CC</sub>

## SPECIFICATIONS (continued)

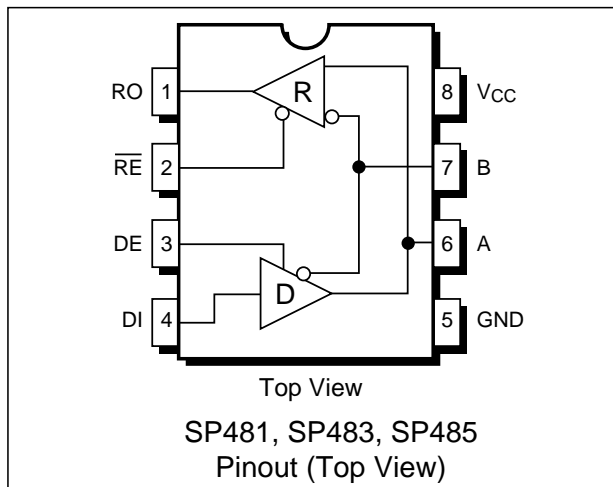
$T_{MIN}$  to  $T_{MAX}$  and  $V_{CC} = 5V \pm 5\%$  unless otherwise noted.

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP481/SP485 RECEIVER</b>					
<b>AC Characteristics</b>					
Maximum Data Rate	5			Mbps	$\overline{RE} = 0V, DE = 0V$
Receiver Input to Output	60	90	200	ns	$t_{PLH}; R_{DIFF} = 54\Omega,$ $C_{L1} = C_{L2} = 100pF; Figures 3 \& 8$
Receiver Input to Output	60	90	200	ns	$t_{PHL}; R_{DIFF} = 54\Omega,$ $C_{L1} = C_{L2} = 100pF; Figures 3 \& 8$
Diff. Receiver Skew $ t_{PLH} - t_{PHL} $		13		ns	$R_{DIFF} = 54\Omega; C_{L1} = C_{L2} = 100pF;$ <i>Figures 3 &amp; 8</i>
Receiver Enable to Output Low		20	50	ns	$C_{RL} = 15pF; Figures 2 \& 9; S_1$ closed
Receiver Enable to Output High		20	50	ns	$C_{RL} = 15pF; Figures 2 \& 9; S_2$ closed
Receiver Disable from Low		20	50	ns	$C_{RL} = 15pF; Figures 2 \& 9; S_1$ closed
Receiver Disable from High		20	50	ns	$C_{RL} = 15pF; Figures 2 \& 9; S_2$ closed
<b>SP481</b>					
<b>Shutdown Timing</b>					
Time to Shutdown	50	200	600	ns	$\overline{RE} = 5V, DE = 0V$
Driver Enable from Shutdown to Output High		40	100	ns	$C_L = 100pF; See figures 4 \& 7; S_2$ closed
Driver Enable from Shutdown to Output Low		40	100	ns	$C_L = 100pF; See figures 4 \& 7; S_1$ closed
Receiver Enable from Shutdown to Output High		300	1000	ns	$C_L = 15pF; See figures 2 \& 9; S_2$ closed
Receiver Enable from Shutdown to Output Low		300	1000	ns	$C_L = 15pF; See figures 2 \& 9; S_1$ closed
<b>POWER REQUIREMENTS</b>					
Supply Voltage	+4.75		+5.25	Volts	
Supply Current					
<b>SP481/485</b>					
No Load		900		$\mu A$	$\overline{RE}, DI = 0V$ or $V_{CC}; DE = V_{CC}$
				$\mu A$	$\overline{RE} = 0V, DI = 0V$ or $5V; DE = 0V$
<b>SP483</b>					
No Load		600		$\mu A$	$\overline{RE}, DI = 0V$ or $V_{CC}; DE = V_{CC}$
				$\mu A$	$\overline{RE} = 0V, DI = 0V$ or $5V; DE = 0V$
<b>SP481/SP483</b>					
Shutdown Mode			10	$\mu A$	$DE = 0V, \overline{RE} = V_{CC}$
<b>ENVIRONMENTAL AND MECHANICAL</b>					
Operating Temperature					
Commercial ( $_{C}$ )	0		+70	$^{\circ}C$	
Industrial ( $_{E}$ )	-40		+85	$^{\circ}C$	
Storage Temperature	-65		+150	$^{\circ}C$	
Package					
Plastic DIP ( $_{S}$ )					
NSOIC ( $_{N}$ )					

# SP483 AC SPECIFICATIONS

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>SP483 DRIVER</b>					
<b>AC Characteristics</b>					
Maximum Data Rate	250			kbps	
Driver Input to Output	250	800	2000	ns	t <sub>PLH</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 & 6
Driver Skew	250	800	2000	ns	t <sub>PHL</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; see figures 3 & 6
Driver Rise and Fall Time		100	800	ns	see figures 3 & 6,
	250		2000	ns	t <sub>SKEW</sub> =  t <sub>DPLH</sub> - t <sub>DPHL</sub>   From 10% to 90%; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF, see figures 3 & 6
Driver Enable to Output High	250		2000	ns	C <sub>L</sub> = 100pF; See figures 4 & 7; S <sub>2</sub> closed
Driver Enable to Output Low	250		2000	ns	C <sub>L</sub> = 100pF; See figures 4 & 7; S <sub>1</sub> closed
Driver Disable Time from Low	300		3000	ns	C <sub>L</sub> = 15pF; See figures 4 & 7; S <sub>1</sub> closed
Driver Disable Time from High	300		3000	ns	C <sub>L</sub> = 15pF; See figures 4 & 7; S <sub>2</sub> closed
<b>SP483 RECEIVER</b>					
<b>AC Characteristics</b>					
Maximum Data Rate	250			kbps	
Receiver Input to Output	250		2000	ns	t <sub>PLH</sub> ; R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; Figures 3 & 8
Diff. Receiver Skew  t <sub>PLH</sub> - t <sub>PHL</sub>		100		ns	R <sub>DIFF</sub> = 54Ω, C <sub>L1</sub> = C <sub>L2</sub> = 100pF; Figures 3 & 8
Receiver Enable to Output Low		20	50	ns	C <sub>RL</sub> = 15pF; Figures 2 & 9; S <sub>1</sub> closed
Receiver Enable to Output High		20	50	ns	C <sub>RL</sub> = 15pF; Figures 2 & 9; S <sub>2</sub> closed
Receiver Disable from Low		20	50	ns	C <sub>RL</sub> = 15pF; Figures 2 & 9; S <sub>1</sub> closed
Receiver Disable from High		20	50	ns	C <sub>RL</sub> = 15pF; Figures 2 & 9; S <sub>2</sub> closed
<b>SP483</b>					
<b>Shutdown Timing</b>					
Time to Shutdown	50	200	600	ns	$\overline{RE} = 5V, DE = 0V$
Driver Enable from Shutdown to Output High			2000	ns	C <sub>L</sub> = 100pF; See figures 4 & 7; S <sub>2</sub> closed
Driver Enable from Shutdown to Output Low			2000	ns	C <sub>L</sub> = 100pF; See figures 4 & 7; S <sub>1</sub> closed
Receiver Enable from Shutdown to Output High			2500	ns	C <sub>L</sub> = 15pF; See figures 4 & 7; S <sub>2</sub> closed
Receiver Enable from Shutdown to Output Low			2500	ns	C <sub>L</sub> = 15pF; See figures 4 & 7; S <sub>1</sub> closed



## PIN FUNCTION

Pin#	Name	Description
1	RO	Receiver Output.
2	$\overline{RE}$	Receiver Output Enable Active LOW.
3	DE	Driver Output Enable Active HIGH.
4	DI	Driver Input.
5	GND	Ground Connection.
6	A	Driver Output/Receiver Input Non-inverting.
7	B	Driver Output/Receiver Input Inverting.
8	Vcc	Positive Supply 4.75V < Vcc < 5.25V.

## DESCRIPTION

### SP481, SP483, SP485

The **SP481**, **SP483**, and **SP485** are half-duplex differential transceivers that meet the requirements of RS-485 and RS-422. Fabricated with a Sipex proprietary BiCMOS process, all three products require a fraction of the power of older bipolar designs.

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

#### SP481, SP483, SP485

The driver outputs of the **SP481**, **SP483**, and **SP485** are differential outputs meeting the RS-485 and RS-422 standards. The typical voltage output swing with no load will be 0 volts to +5 volts. With worst case loading of 54 $\Omega$  across the differential outputs, the drivers can maintain greater than 1.5V voltage levels. The drivers of the **SP481**, **SP483** and **SP485** have an enable control line which is active HIGH. A logic HIGH on DE (pin 5) will enable the differential driver outputs. A logic LOW on DE (pin 5) will tri-state the driver outputs.

The transmitters of the **SP481** and **SP485** will operate up to at least 5Mbps. The **SP483** has internally slew rate limited driver outputs to minimize EMI. The maximum data rate for the **SP483** driver is 250kbps.

### Receivers

#### SP481, SP483, SP485

The **SP481**, **SP483**, and **SP485** receivers have differential inputs with an input sensitivity as low as  $\pm 200\text{mV}$ . Input impedance of the receivers is typically 15k $\Omega$  (12k $\Omega$  minimum). A wide common mode range of -7V to +12V allows for large ground potential differences between systems. The receivers of the **SP481**, **SP483** and **SP485** have a tri-state enable control pin. A logic LOW on  $\overline{\text{RE}}$  (pin 4) will enable the receiver, a logic HIGH on  $\overline{\text{RE}}$  (pin 4) will disable the receiver.

The receiver for the **SP481** and **SP485** will operate up to at least 5Mbps. The **SP483** receiver is rated for data rates up to 250kbps. The receiver for each of the three devices is 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.

### Shutdown Mode

#### SP481/SP483

The **SP481** and **SP483** are equipped with a Shutdown mode. To enable the Shutdown state, both the driver and receiver must be disabled simultaneously. A logic LOW on DE (pin 5) and a logic HIGH on  $\overline{\text{RE}}$  (pin 4) will put the **SP481** or **SP483** into Shutdown mode. In Shutdown, supply current will drop to typically 1 $\mu\text{A}$ .

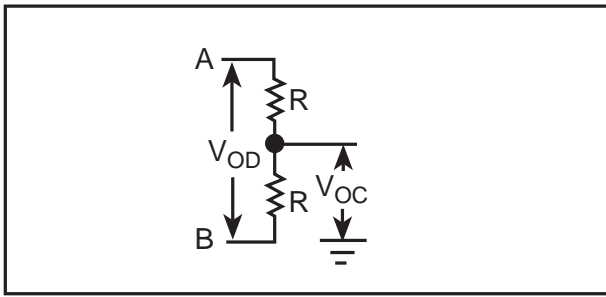


Figure 1. Driver DC Test Load Circuit

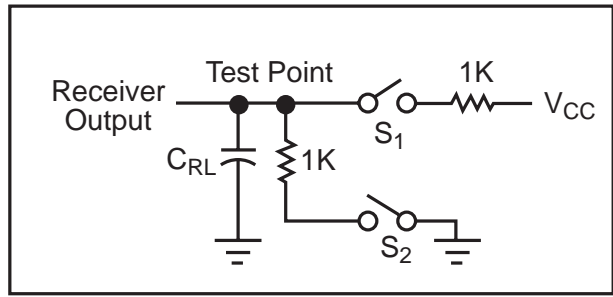


Figure 2. Receiver Timing Test Load Circuit

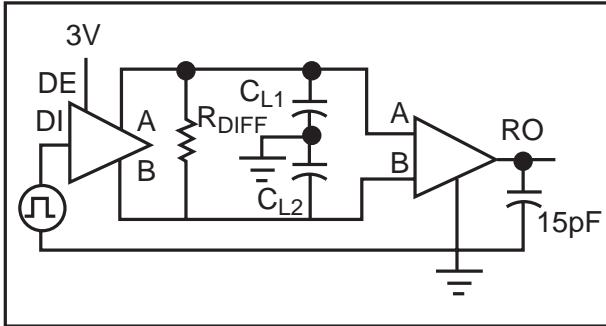


Figure 3. Driver/Receiver Timing Test Circuit

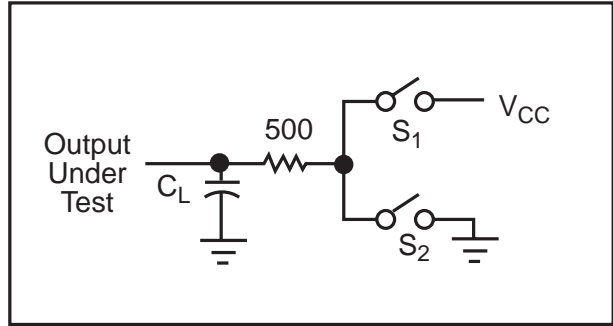


Figure 4. Driver Timing Test Load #2 Circuit

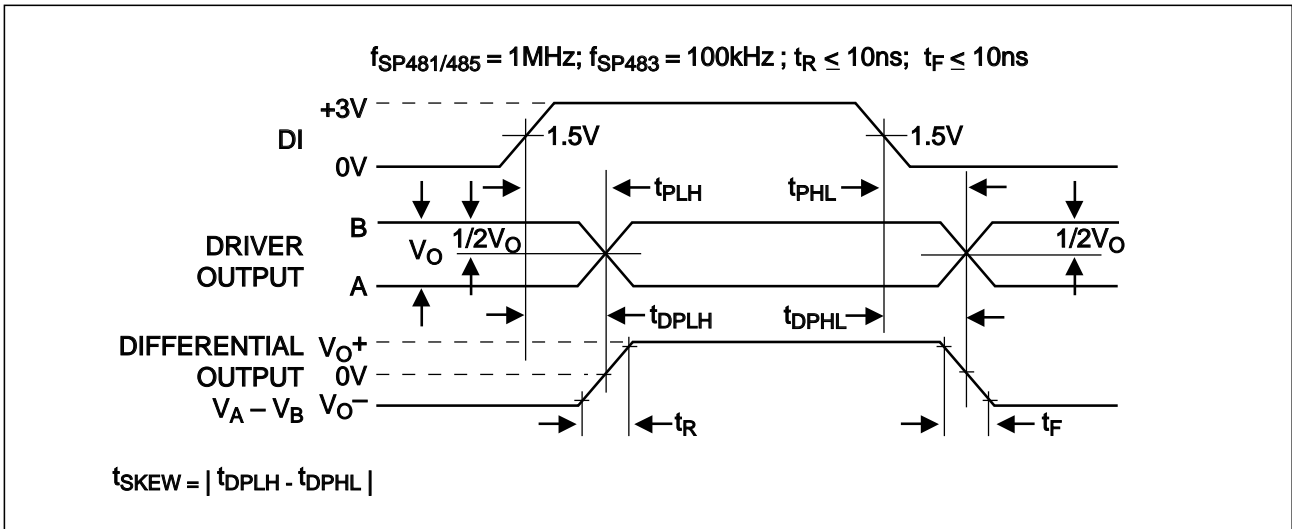


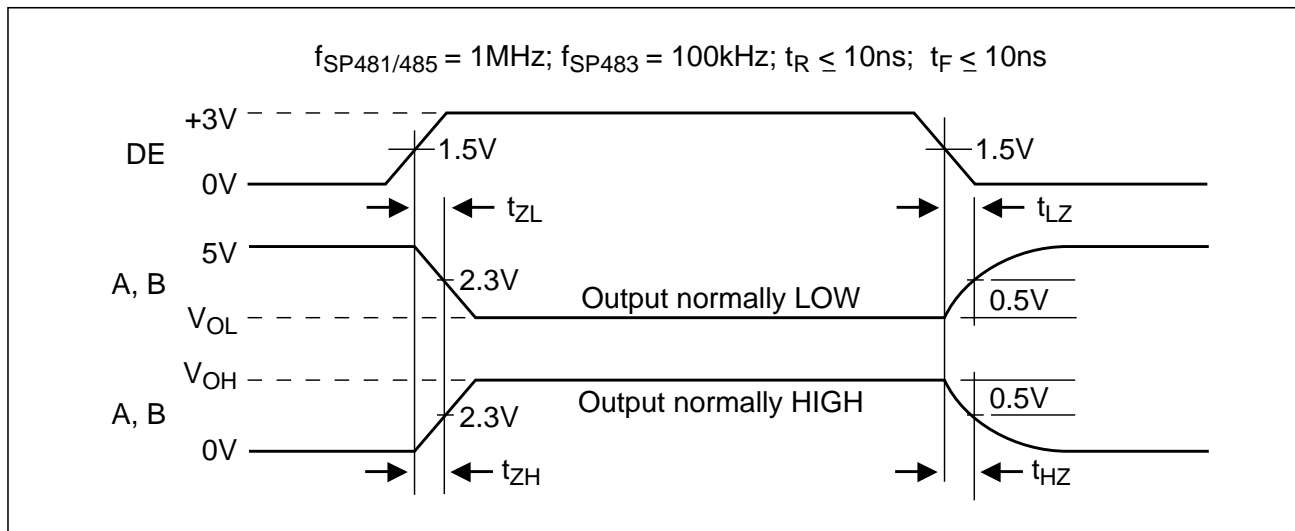
Figure 6. Driver Propagation Delays

INPUTS			LINE CONDITION	OUTPUTS	
$\overline{\text{RE}}$	DE	DI		B	A
X	1	1	No Fault	0	1
X	1	0	No Fault	1	0
X	0	X	X	Z	Z
X	1	X	Fault	Z	Z

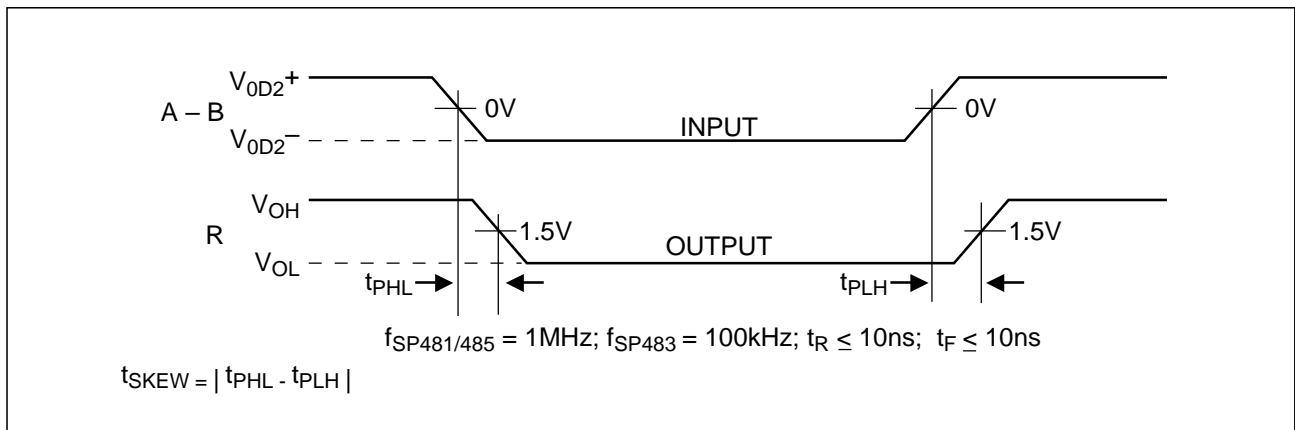
Table 1. Transmit Function Truth Table

INPUTS		A - B	OUTPUTS
$\overline{\text{RE}}$	DE		R
0	0	+0.2V	1
0	0	-0.2V	0
0	0	Inputs Open	1
1	0	X	Z

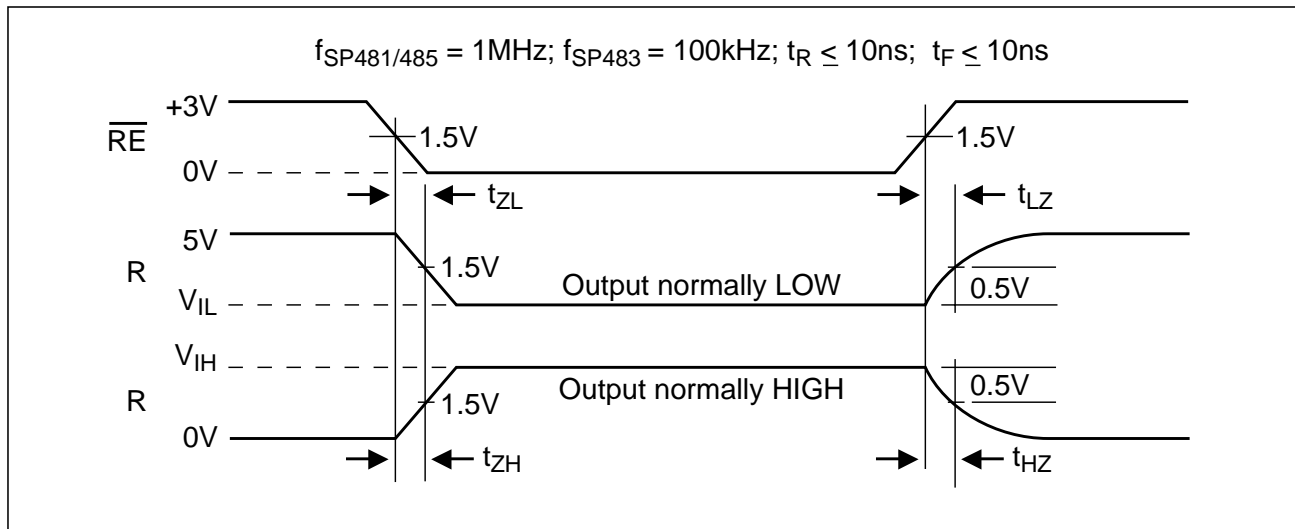
Table 2. Receive Function Truth Table



**Figure 7. Driver Enable and Disable Times**

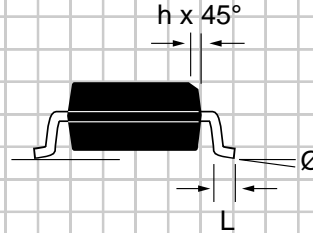
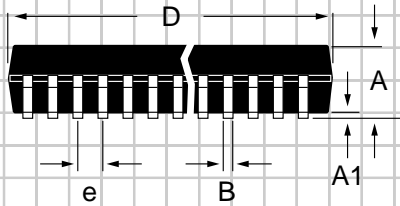
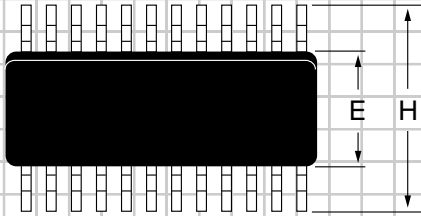


**Figure 8. Receiver Propagation Delays**



**Figure 9. Receiver Enable and Disable Times**

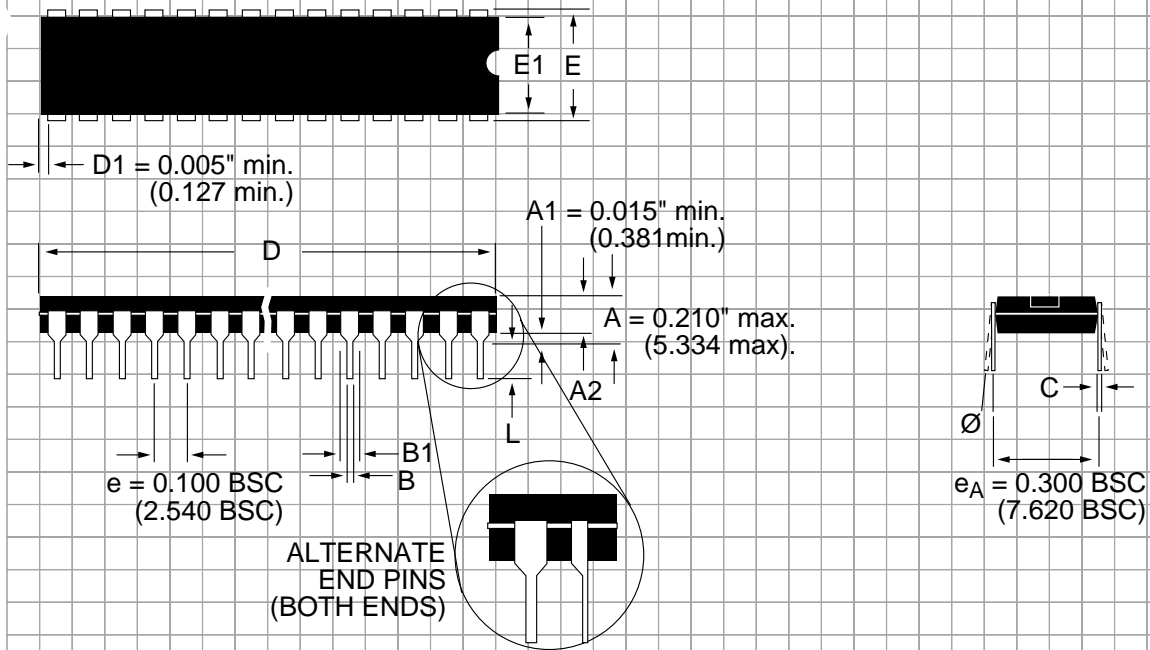
**PACKAGE: PLASTIC  
SMALL OUTLINE (SOIC)  
(NARROW)**



DIMENSIONS (Inches) Minimum/Maximum (mm)	8-PIN
A	0.053/0.069 (1.346/1.748)
A1	0.004/0.010 (0.102/0.249)
B	0.014/0.019 (0.35/0.49)
D	0.189/0.197 (4.80/5.00)
E	0.150/0.157 (3.802/3.988)
e	0.050 BSC (1.270 BSC)
H	0.228/0.244 (5.801/6.198)
h	0.010/0.020 (0.254/0.498)
L	0.016/0.050 (0.406/1.270)
Ø	0°/8° (0°/8°)



# PACKAGE: PLASTIC DUAL-IN-LINE (NARROW)



DIMENSIONS (Inches) Minimum/Maximum (mm)	8-PIN
A2	0.115/0.195 (2.921/4.953)
B	0.014/0.022 (0.356/0.559)
B1	0.045/0.070 (1.143/1.778)
C	0.008/0.014 (0.203/0.356)
D	0.355/0.400 (9.017/10.160)
E	0.300/0.325 (7.620/8.255)
E1	0.240/0.280 (6.096/7.112)
L	0.115/0.150 (2.921/3.810)
$\emptyset$	0°/ 15° (0°/15°)

## ORDERING INFORMATION

Model	Temperature Range	Package
SP481CN .....	0°C to +70°C .....	8-pin Narrow SOIC
SP481CS .....	0°C to +70°C .....	8-pin Plastic DIP
SP481EN .....	-40°C to +85°C .....	8-pin Narrow SOIC
SP481ES .....	-40°C to +85°C .....	8-pin Plastic DIP
SP483CN .....	0°C to +70°C .....	8-pin Narrow SOIC
SP483CS .....	0°C to +70°C .....	8-pin Plastic DIP
SP483EN .....	-40°C to +85°C .....	8-pin Narrow SOIC
SP483ES .....	-40°C to +85°C .....	8-pin Plastic DIP
SP485CN .....	0°C to +70°C .....	8-pin Narrow SOIC
SP485CS .....	0°C to +70°C .....	8-pin Plastic DIP
SP485EN .....	-40°C to +85°C .....	8-pin Narrow SOIC
SP485ES .....	-40°C to +85°C .....	8-pin Plastic DIP

Please consult the factory for pricing and availability on a Tape-On-Reel option.



SIGNAL PROCESSING EXCELLENCE

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