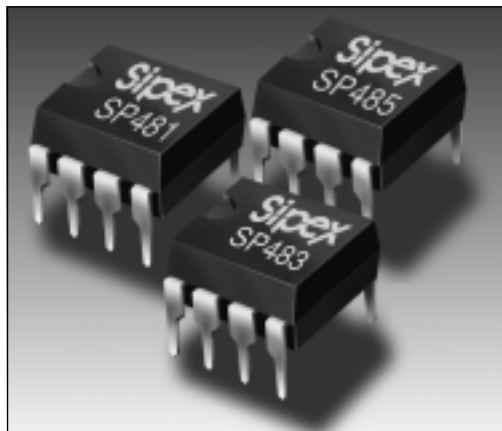


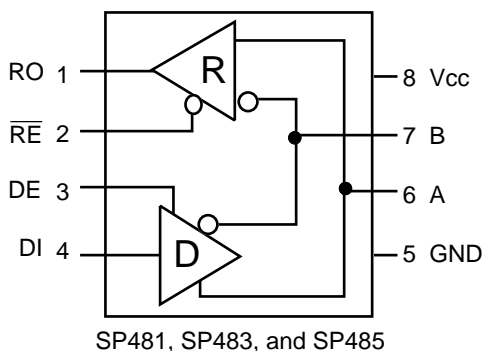
Low Power Half-Duplex RS-485 Transceivers

- +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 _{CC} | ±12V |
| Input Voltages | |
| Logic..... | -0.3V to (V _{CC} +0.5V) |
| Drivers..... | -0.3V to (V _{CC} +0.5V) |
| Receivers..... | ±15V |
| Output Voltages | |
| Logic..... | -0.3V to (V _{CC} +0.5V) |
| Drivers..... | ±15V |
| Receivers..... | -0.3V to (V _{CC} +0.5V) |
| Storage Temperature..... | -65°C to +150°C |
| Power Dissipation..... | 500mW |

SPECIFICATIONS

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

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

SPECIFICATIONS (continued)

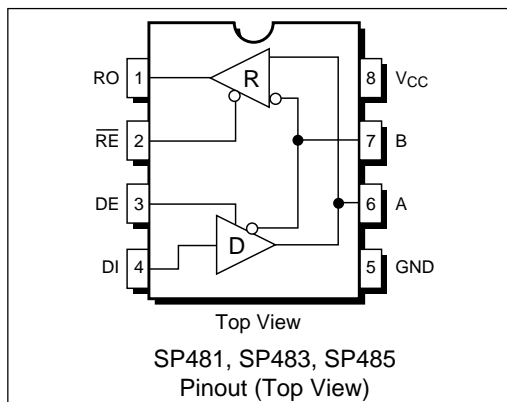
T_{MIN} to T_{MAX} and $V_{CC} = 5V \pm 5\%$ unless otherwise noted.

| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|--|-------|------|-------|-------------|---|
| SP481/SP485 RECEIVER | | | | | |
| AC Characteristics | | | | | |
| Maximum Data Rate | 5 | | | Mbps | $\overline{RE} = 0V$, $DE = 0V$ |
| Receiver Input to Output | 60 | 90 | 200 | ns | t_{PLH} ; $R_{DIFF} = 54\Omega$, $C_{L1} = C_{L2} = 100pF$; <i>Figures 3 & 8</i> |
| Receiver Input to Output | 60 | 90 | 200 | ns | t_{PHL} ; $R_{DIFF} = 54\Omega$, $C_{L1} = C_{L2} = 100pF$; <i>Figures 3 & 8</i> |
| Diff. Receiver Skew $t_{PLH} - t_{PHL}$ | | 13 | | ns | $R_{DIFF} = 54\Omega$; $C_{L1} = C_{L2} = 100pF$; <i>Figures 3 & 8</i> |
| Receiver Enable to Output Low | | 20 | 50 | ns | $C_{RL} = 15pF$; <i>Figures 2 & 9</i> ; S_1 closed |
| Receiver Enable to Output High | | 20 | 50 | ns | $C_{RL} = 15pF$; <i>Figures 2 & 9</i> ; S_2 closed |
| Receiver Disable from Low | | 20 | 50 | ns | $C_{RL} = 15pF$; <i>Figures 2 & 9</i> ; S_1 closed |
| Receiver Disable from High | | 20 | 50 | ns | $C_{RL} = 15pF$; <i>Figures 2 & 9</i> ; S_2 closed |
| SP481 | | | | | |
| Shutdown Timing | | | | | |
| Time to Shutdown | 50 | 200 | 600 | ns | $\overline{RE} = 5V$, $DE = 0V$ |
| Driver Enable from Shutdown to Output High | | 40 | 100 | ns | $C_L = 100pF$; <i>See figures 4 & 7</i> ; S_2 closed |
| Driver Enable from Shutdown to Output Low | | 40 | 100 | ns | $C_L = 100pF$; <i>See figures 4 & 7</i> ; S_1 closed |
| Receiver Enable from Shutdown to Output High | | 300 | 1000 | ns | $C_L = 15pF$; <i>See figures 2 & 9</i> ; S_2 closed |
| Receiver Enable from Shutdown to Output Low | | 300 | 1000 | ns | $C_L = 15pF$; <i>See figures 2 & 9</i> ; S_1 closed |
| POWER REQUIREMENTS | | | | | |
| Supply Voltage | +4.75 | | +5.25 | Volts | |
| Supply Current | | | | | |
| SP481/485 | | | | | |
| No Load | | 900 | | μA | \overline{RE} , $DI = 0V$ or V_{CC} ; $DE = V_{CC}$ |
| | | | | μA | $\overline{RE} = 0V$, $DI = 0V$ or $5V$; $DE = 0V$ |
| SP483 | | | | | |
| No Load | | 600 | | μA | \overline{RE} , $DI = 0V$ or V_{CC} ; $DE = V_{CC}$ |
| | | | | μA | $\overline{RE} = 0V$, $DI = 0V$ or $5V$; $DE = 0V$ |
| SP481/SP483 Shutdown Mode | | | 10 | μA | $DE = 0V$, $\overline{RE} = V_{CC}$ |
| ENVIRONMENTAL AND MECHANICAL | | | | | |
| 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_{MIN} to T_{MAX} and $V_{CC} = 5V \pm 5\%$ unless otherwise noted.

| PARAMETERS | MIN. | TYP. | MAX. | UNITS | CONDITIONS |
|--|------|------|------|-------|---|
| SP483 DRIVER | | | | | |
| AC Characteristics | | | | | |
| Maximum Data Rate | 250 | | | kbps | |
| Driver Input to Output | 250 | 800 | 2000 | ns | t_{PLH} ; $R_{DIFF} = 54\Omega$, $C_{L1} = C_{L2} = 100pF$; see figures 3 & 6 |
| Driver Skew | 250 | 800 | 2000 | ns | t_{PHL} ; $R_{DIFF} = 54\Omega$, $C_{L1} = C_{L2} = 100pF$; see figures 3 & 6 |
| Driver Rise and Fall Time | | 100 | 800 | ns | see figures 3 & 6, |
| | 250 | | 2000 | ns | $t_{SKEW} = t_{DPLH} - t_{DPHL} $ From 10% to 90%; $R_{DIFF} = 54\Omega$, $C_{L1} = C_{L2} = 100pF$, see figures 3 & 6 |
| Driver Enable to Output High | 250 | | 2000 | ns | $C_L = 100pF$; See figures 4 & 7; S_2 closed |
| Driver Enable to Output Low | 250 | | 2000 | ns | $C_L = 100pF$; See figures 4 & 7; S_1 closed |
| Driver Disable Time from Low | 300 | | 3000 | ns | $C_L = 15pF$; See figures 4 & 7; S_1 closed |
| Driver Disable Time from High | 300 | | 3000 | ns | $C_L = 15pF$; See figures 4 & 7; S_2 closed |
| SP483 RECEIVER | | | | | |
| AC Characteristics | | | | | |
| Maximum Data Rate | 250 | | | kbps | |
| Receiver Input to Output | 250 | | 2000 | ns | t_{PLH} ; $R_{DIFF} = 54\Omega$, $C_{L1} = C_{L2} = 100pF$; Figures 3 & 8 |
| Diff. Receiver Skew $ t_{PLH} - t_{PHL} $ | | 100 | | ns | $R_{DIFF} = 54\Omega$, $C_{L1} = C_{L2} = 100pF$; Figures 3 & 8 |
| 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 |
| SP483 Shutdown Timing | | | | | |
| Time to Shutdown | 50 | 200 | 600 | ns | $\overline{RE} = 5V$, $DE = 0V$ |
| Driver Enable from Shutdown to Output High | | | 2000 | ns | $C_L = 100pF$; See figures 4 & 7; S_2 closed |
| Driver Enable from Shutdown to Output Low | | | 2000 | ns | $C_L = 100pF$; See figures 4 & 7; S_1 closed |
| Receiver Enable from Shutdown to Output High | | | 2500 | ns | $C_L = 15pF$; See figures 4 & 7; S_2 closed |
| Receiver Enable from Shutdown to Output Low | | | 2500 | ns | $C_L = 15pF$; See figures 4 & 7; S_1 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 Ω 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 Ω (12k Ω 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 μA .

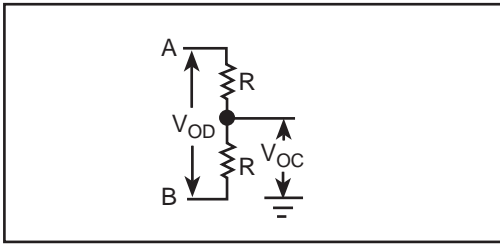


Figure 1. Driver DC Test Load Circuit

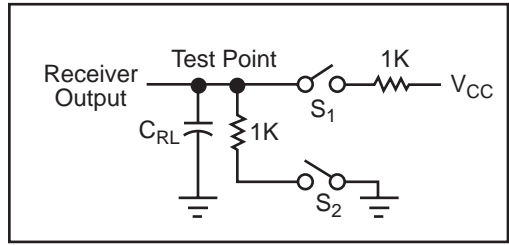


Figure 2. Receiver Timing Test Load Circuit

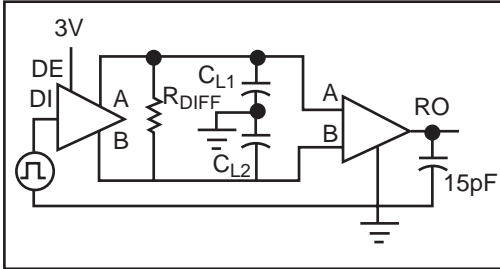


Figure 3. Driver/Receiver Timing Test Circuit

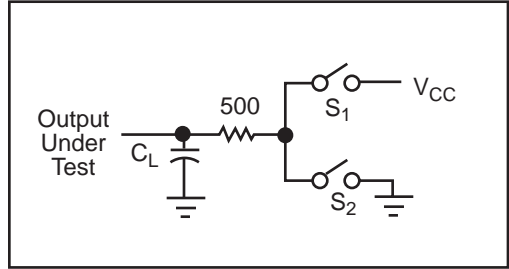


Figure 4. Driver Timing Test Load #2 Circuit

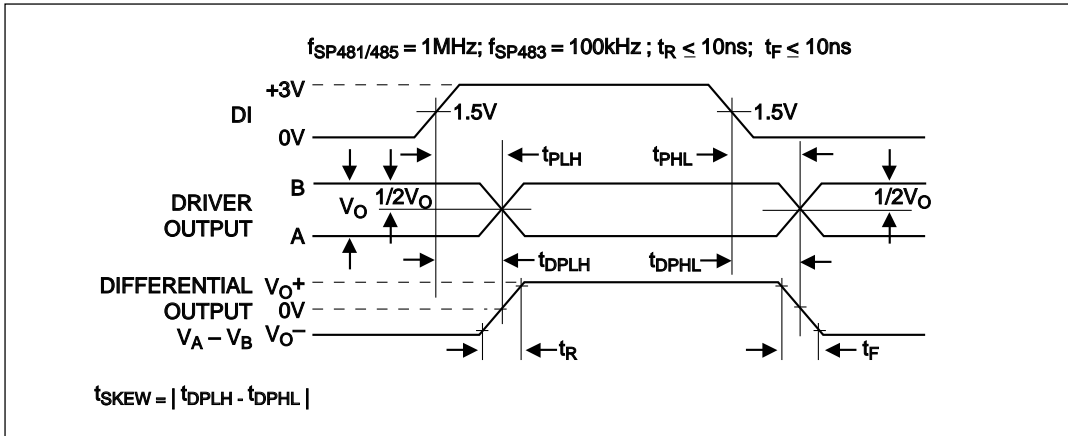


Figure 6. Driver Propagation Delays

| INPUTS | | | OUTPUTS | |
|------------------------|----|----|----------------|-------|
| $\overline{\text{RE}}$ | DE | DI | LINE CONDITION | A - B |
| 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 | | | OUTPUTS |
|------------------------|----|-------------|---------|
| $\overline{\text{RE}}$ | DE | A - B | 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

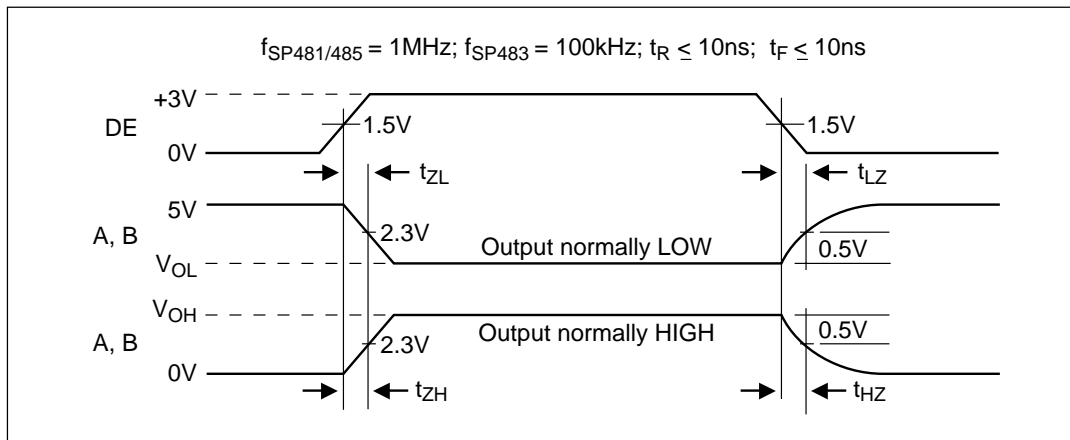


Figure 7. Driver Enable and Disable Times

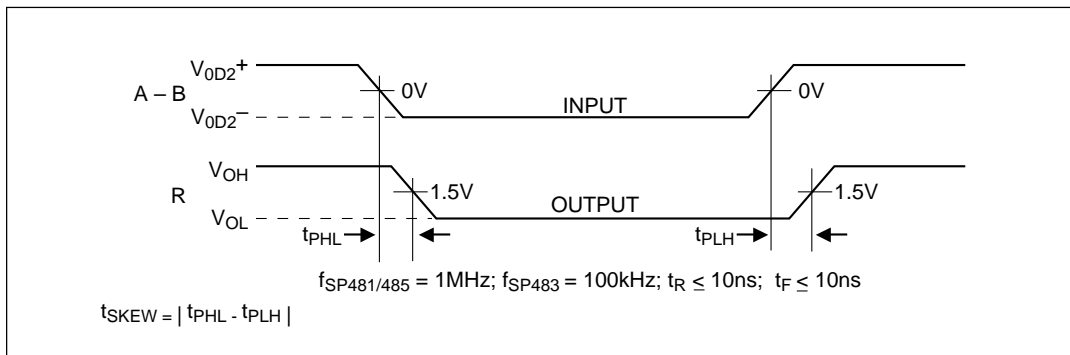


Figure 8. Receiver Propagation Delays

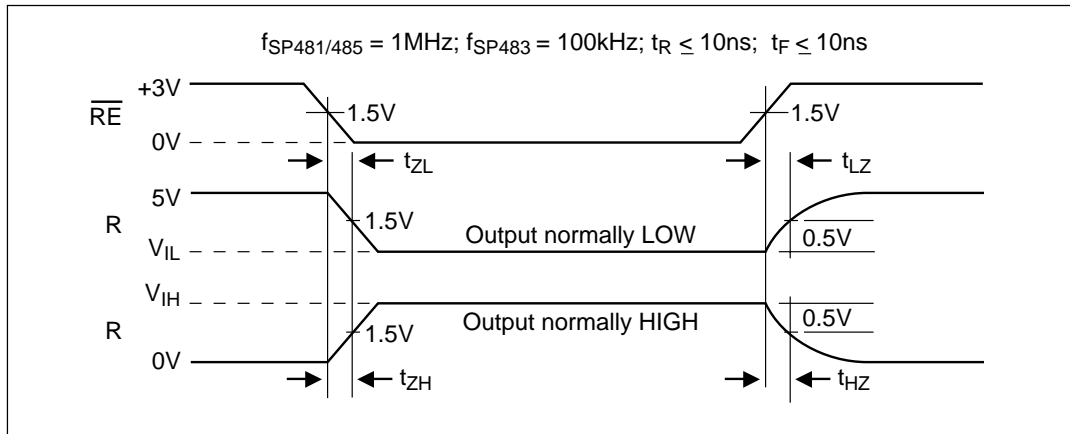
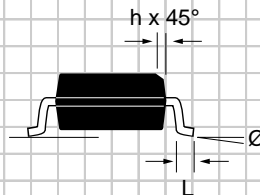
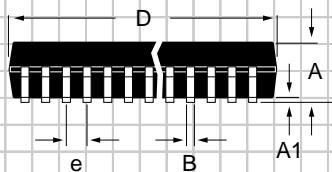
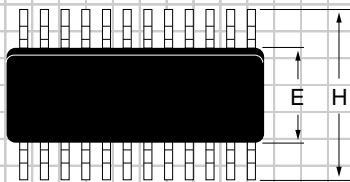


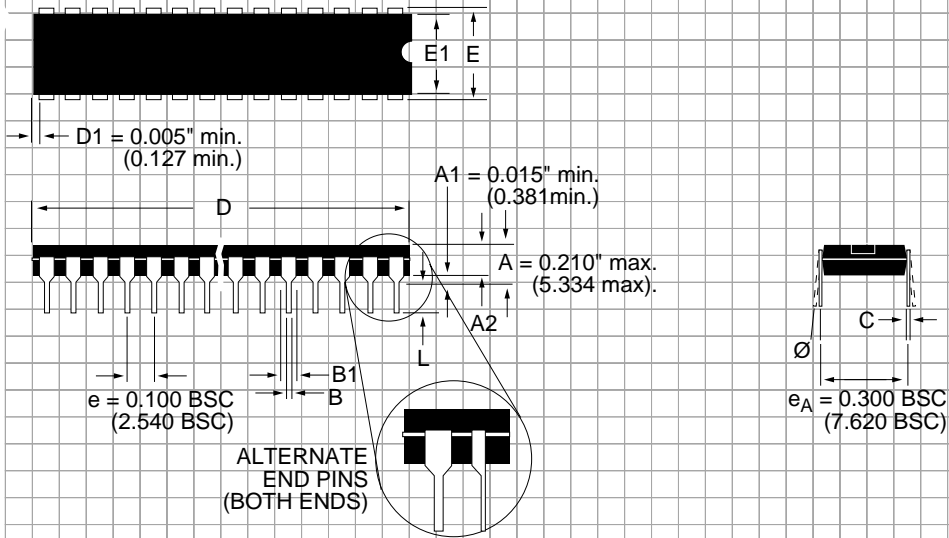
Figure 9. Receiver Enable and Disable Times

**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) |
| \varnothing | 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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