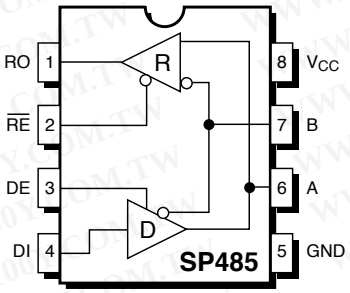
Low Power Half-Duplex RS-485 Transceivers

FEATURES

- +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

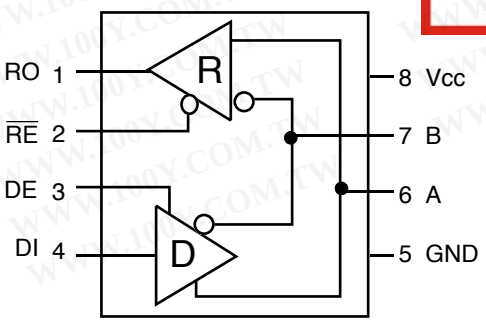


Top View

SP481, SP483, SP485
Pinout (Top View)

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.



SP481, SP483, and SP485

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

ELECTRICAL CHARACTERISTICS

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 = ∞ ; *see figure 1*
Differential Output Voltage	2		V_{CC}	Volts	with load; R = 50Ω; (RS422); *see figure 1*
Differential Output Voltage	1.5		V_{CC}	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, $\overline{RE}$
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		30	60	ns	t_{PLH}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *see figures 3 and 6*
Driver Input to Output		30	60	ns	t_{PHL}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *see figures 3 and 6*
Driver Skew		5	10	ns	*see figures 3 and 6,* t_{SKEW} = l t_{DPLH} - t_{DPHL} l
Driver Rise or Fall Time		15	40	ns	From 10% to 90%; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *see figures 3 and 6*
Driver Enable to Output High		40	70	ns	C_L = 100pF; *see figures 4 & 7;* S_2 closed
Driver Enable to Output Low		40	70	ns	C_L = 100pF; *see figures 4 & 7;* S_1 closed
Driver Disable Time from Low		40	70	ns	C_L = 15pF; *see figures 2 & 9;* S_1 closed
Driver Disable Time from High		40	70	ns	C_L = 15pF; *see figures 2 & 9;* S_2 closed
SP481/SP483/SP485 RECEIVER					
DC Characteristics					
Differential Input Threshold			+0.2	Volts	-7V ≤ V_{CM} ≤ +12V
Input Hysteresis		10		mV	V_{CM} = 0V
Output Voltage High				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		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			95	mA	0V ≤ V_{CM} ≤ V_{CC}

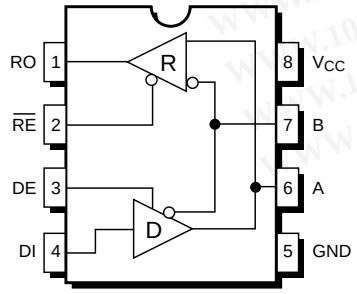
T_{MIN} to T_{MAX} and V_{CC} = 5V ± 5% unless otherwise noted.

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} = 54Ω, C_{L1} = C_{L2} = 100pF; *Figures 3 & 8*
Receiver Input to Output	60	90	200	ns	t_{PHL}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *Figures 3 & 8*
Diff. Receiver Skew $\lvert t_{PLH}-t_{PHL} \rvert$		13		ns	R_{DIFF} = 54Ω; 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
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; *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
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	°C	
Industrial (_E_)	-40		+85	°C	
Storage Temperature	-65		+150	°C	
Package					
Plastic DIP (_S)					
NSOIC (_N)					

SP483 AC SPECIFICATIONS

T_{MIN} to T_{MAX} and V_{CC} = 5V ± 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} = 54Ω, C_{L1} = C_{L2} = 100pF; *see figures 3 & 6*
Driver Skew	250	800	2000	ns	t_{PHL}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *see figures 3 & 6*
Driver Rise and Fall Time		100	800	ns	*see figures 3 & 6,* t_{SKEW} = $\lvert t_{DPLH} - t_{DPHL} \rvert$
	250		2000	ns	From 10% to 90%; R_{DIFF} = 54Ω, 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} = 54Ω, C_{L1} = C_{L2} = 100pF; *Figures 3 & 8*
Diff. Receiver Skew $\lvert t_{PLH} - t_{PHL} \rvert$		100		ns	R_{DIFF} = 54Ω, 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



Top View

SP481, SP483, SP485
Pinout (Top View)

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 54Ω 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 ±200mV. Input impedance of the receivers is typically 15kΩ (12kΩ 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 $\overline{RE}$ (pin 4) will enable the receiver, a logic HIGH on $\overline{RE}$ (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 and floating.

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 $\overline{RE}$ (pin 4) will put the **SP481** or **SP483** into Shutdown mode. In Shutdown, supply current will drop to typically 1µA.

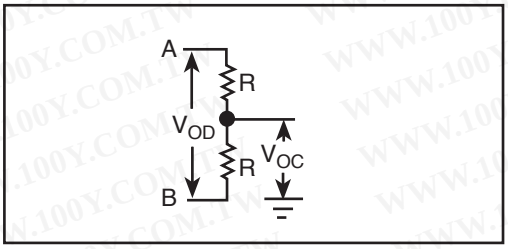


Figure 1. Driver DC Test Load Circuit

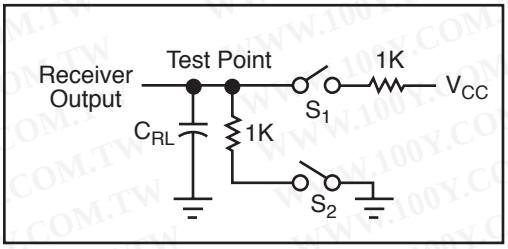


Figure 2. Receiver Timing Test Load Circuit

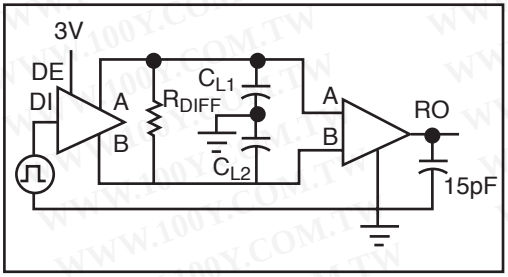


Figure 3. Driver/Receiver Timing Test Circuit

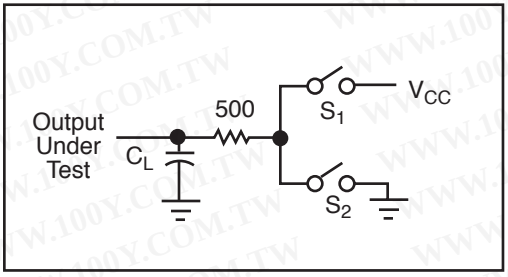


Figure 4. Driver Timing Test Load #2 Circuit

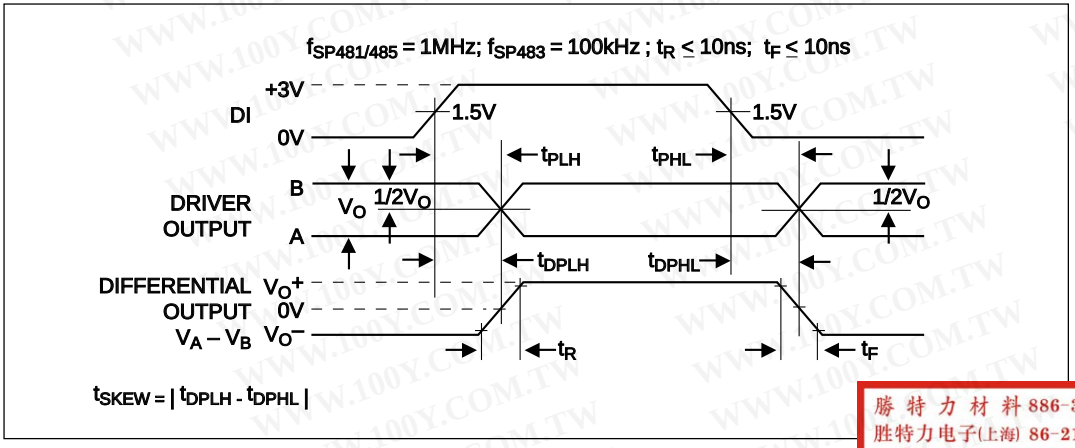


Figure 6. Driver Propagation Delays

INPUTS				OUTPUTS	
$\overline{RE}$	DE	DI	LINE CONDITION	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			OUTPUTS
$\overline{RE}$	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

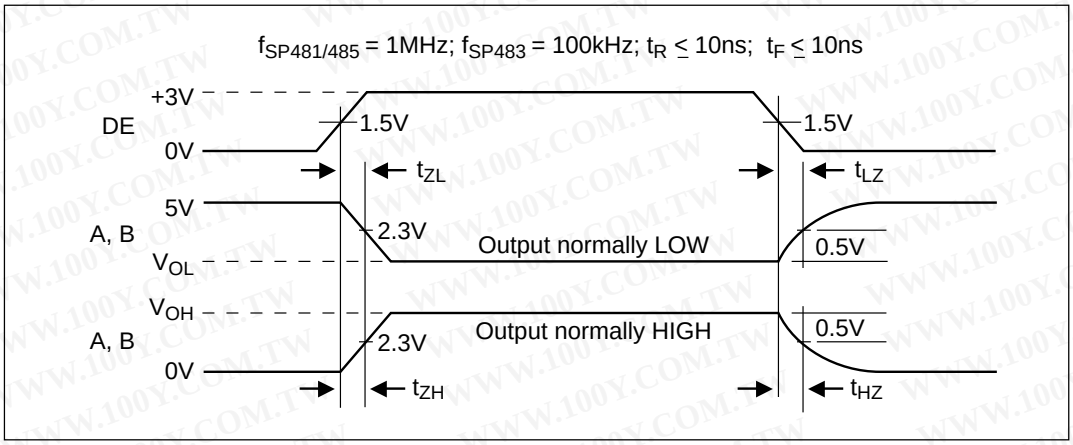


Figure 7. Driver Enable and Disable Times

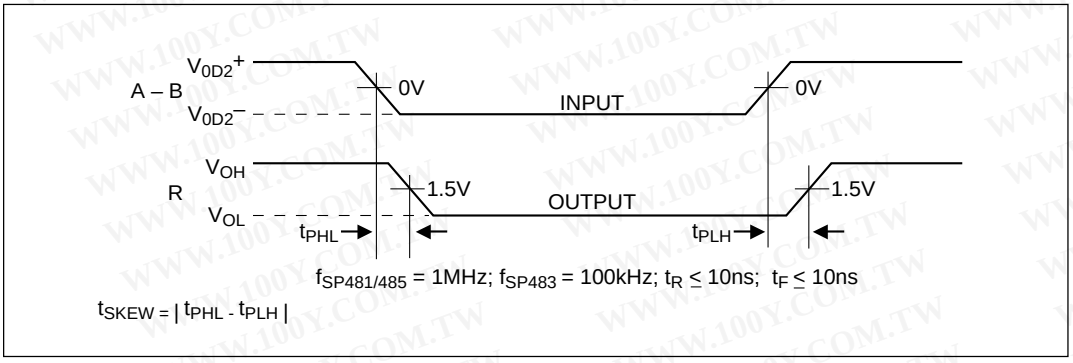


Figure 8. Receiver Propagation Delays

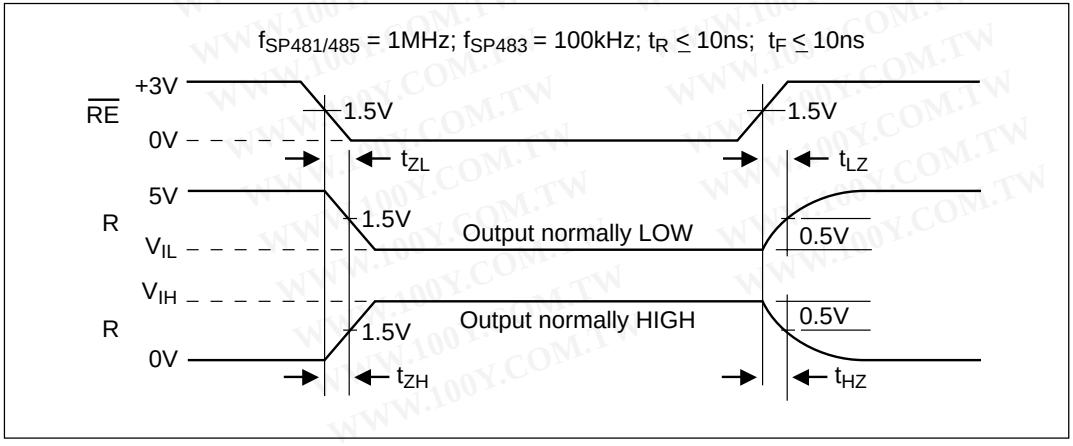
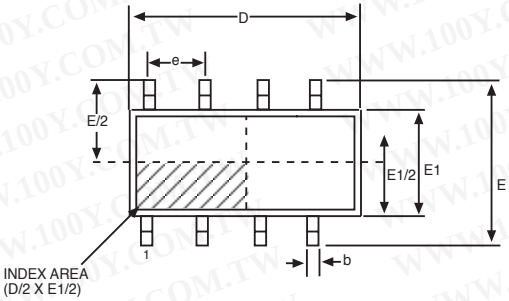
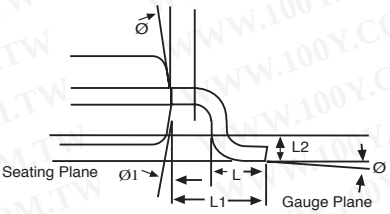


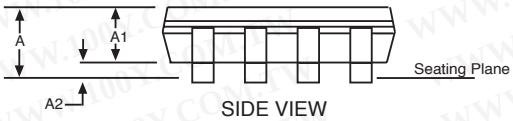
Figure 9. Receiver Enable and Disable Times



TOP VIEW



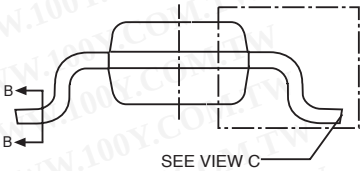
VIEW C

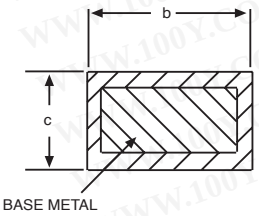


SIDE VIEW

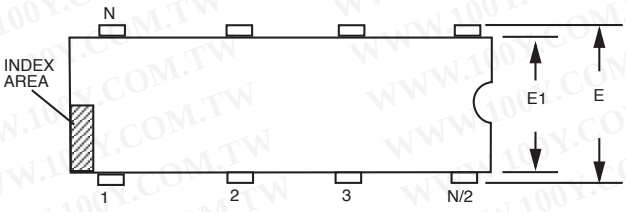
8 Pin NSOIC JEDEC MO-012 (AA) Variation			
SYMBOL	MIN	NOM	MAX
A	1.35	-	1.75
A1	0.1	-	0.25
A2	1.25	-	1.65
b	0.31	-	0.51
c	0.17	-	0.24
D		4.90 BSC	
E		6.00 BSC	
E1		3.90 BSC	
e		1.27 BSC	
L	0.4	-	1.27
L1		1.04 REF	
L2		0.25 BSC	
ø	0º	-	8º
ø1	5º	-	15º

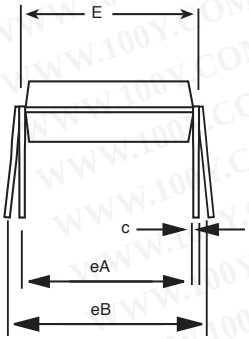
Note: Dimensions in (mm)

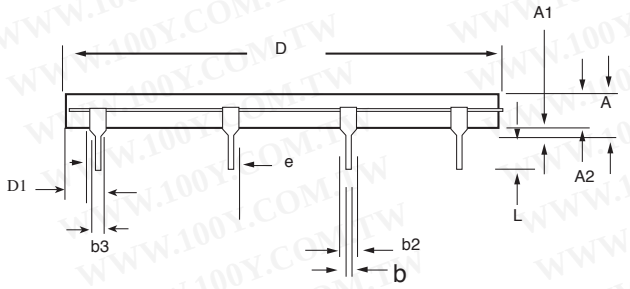


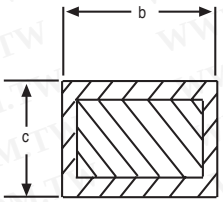


SECTION B-B
WITH PLATING









8 PIN PDIP JEDEC MS-001 (BA) Variation			
SYMBOL	MIN	NOM	MAX
A	-	-	0.21
A1	0.15	-	-
A2	0.115	0.13	0.195
b	0.014	0.018	0.022
b2	0.045	0.06	0.07
b3	0.3	0.039	0.045
c	0.008	0.01	0.014
D	0.355	0.365	0.4
D1	0.005	-	-
E	0.3	0.31	0.325
E1	0.24	0.25	0.28
e	.100 BSC		
eA	.300 BSC		
eB	-	-	0.43
L	0.115	0.13	0.15

Note: Dimensions in (mm)

ORDERING INFORMATION

Model	Temperature Range	Package
SP481CN	0˚C to +70˚C	8-pin NSOIC
SP481CN/TR	0˚C to +70˚C	8-pin NSOIC
SP481CS	0˚C to +70˚C	8-pin PDIP
SP481EN	-40˚C to +85˚C	8-pin NSOIC
SP481EN/TR	-40˚C to +85˚C	8-pin NSOIC
SP481ES	-40˚C to +85˚C	8-pin PDIP
SP483CN	0˚C to +70˚C	8-pin NSOIC
SP483CN/TR	0˚C to +70˚C	8-pin NSOIC
SP483CS	0˚C to +70˚C	8-pin PDIP
SP483EN	-40˚C to +85˚C	8-pin NSOIC
SP483EN/TR	-40˚C to +85˚C	8-pin NSOIC
SP483ES	-40˚C to +85˚C	8-pin PDIP
SP485CN	0˚C to +70˚C	8-pin NSOIC
SP485CN/TR	0˚C to +70˚C	8-pin NSOIC
SP485CS	0˚C to +70˚C	8-pin PDIP
SP485EN	-40˚C to +85˚C	8-pin NSOIC
SP485EN/TR	-40˚C to +85˚C	8-pin NSOIC
SP485ES	-40˚C to +85˚C	8-pin PDIP

For lead-free packages, improved ESD protection and performance: upgrade to SP485E, SP481E, SP483E

Example: SP485EN/TR = upgrade to SP485EEN-L/TR

/TR = Tape and Reel

Pack quantity is 2,500 for NSOIC.

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