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}..+7V
Input Voltages
Drivers...-0.5V to (V_{CC}+0.5V)
Receivers...±14V
Output Voltages
Drivers...±14V
Receivers..-0.5V to (V_{CC}+0.5V)
Storage Temperature...-65˚C to +150˚
Power Dissipation..1000mW

SPECIFICATIONS

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP490E 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; (RS-422); *see Figure 1*
Differential Output Voltage	1.5		V_{CC}	Volts	With Load; R = 27Ω; (RS-485); *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 D
Input Low Voltage			0.8	Volts	Applies to D
Input Current			±10	µA	Applies to D
Driver Short-Circuit Current					
V_{OUT} = HIGH			±250	mA	-7V ≤ V_O ≤ +12V
V_{OUT} = LOW			±250	mA	-7V ≤ V_O ≤ +12V
SP490E DRIVER					
AC Characteristics					
Maximum Data Rate	10			Mbps	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF
Driver Input to Output	20	30	60	ns	t_{PLH}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *see Figures 3 and 6*
Driver Input to Output	20	30	60	ns	t_{PHL}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *see Figures 3 and 5*
Driver Skew		5		ns	*see Figures 3 and 5,* t_{SKEW} = | 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; *see Figures 3 and 5*
SP490E RECEIVER					
DC Characteristics					
Differential Input Threshold	-0.2		+0.2	Volts	-7V ≤ V_{CM} ≤ 12V
Input Hysteresis		70		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
Input Resistance	12	15		kΩ	-7V ≤ V_{CM} ≤ 12V
Input Current (A, B); V_{IN} = 12V			±1.0	mA	V_{IN} = 12V
Input Current (A, B); V_{IN} = -7V			-0.8	mA	V_{IN} = -7V
Short-Circuit Current			85	mA	0V ≤ V_O ≤ V_{CC}

SPECIFICATIONS (continued)

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP490E RECEIVER					
AC Characteristics					
Maximum Data Rate	10			Mbps	
Receiver Input to Output	20	45	100	ns	t_{PLH}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *Figures 3 & 7*
Receiver Input to Output	20	45	100	ns	t_{PHL}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *Figures 3 & 7*
Diff. Receiver Skew $\lvert t_{PLH}-t_{PHL}\rvert$		13		ns	R_{DIFF} = 54Ω; C_{L1} = C_{L2} = 100pF; *Figures 3 & 7*
POWER REQUIREMENTS					
Supply Voltage	+4.75		+5.25	Volts	
Supply Current		900		µA	
ENVIRONMENTAL AND MECHANICAL					
Operating Temperature					
Commercial (_C_)	0		+70	°C	
Industrial (_E_)	-40		+85	°C	
Storage Temperature	-65		+150	°C	
Package					
Plastic DIP (_P)					
NSOIC (_N)					

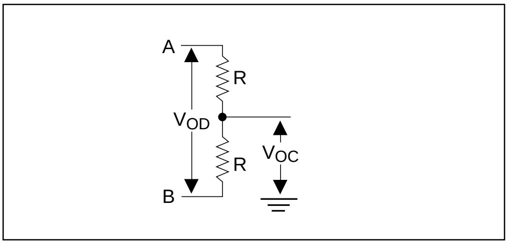


Figure 1. Driver DC Test Load Circuit

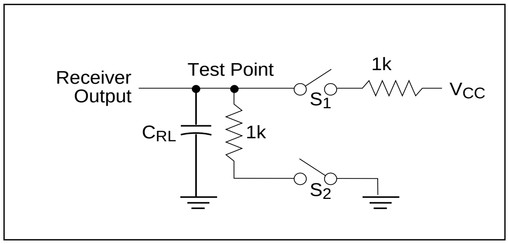


Figure 2. Receiver Timing Test Load Circuit

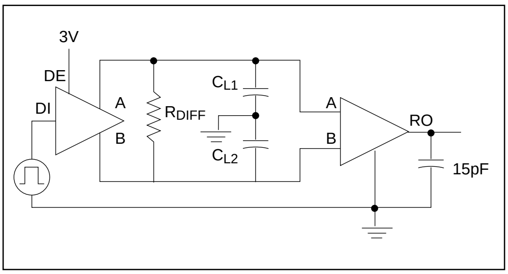


Figure 3. Driver/Receiver Timing Test Circuit

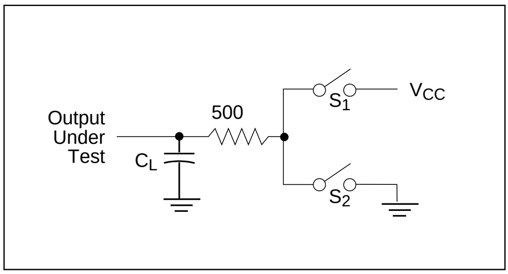


Figure 4. Driver Timing Test Load #2 Circuit

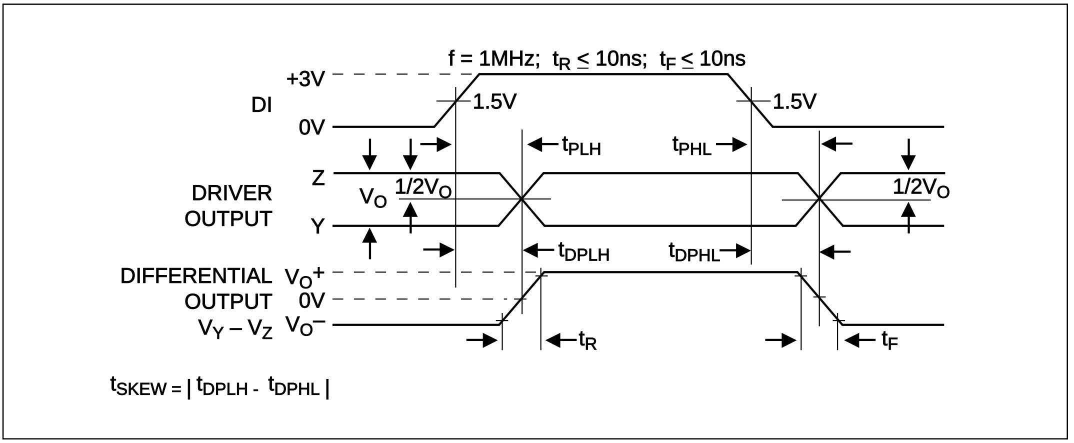


Figure 5. Driver Propagation Delays

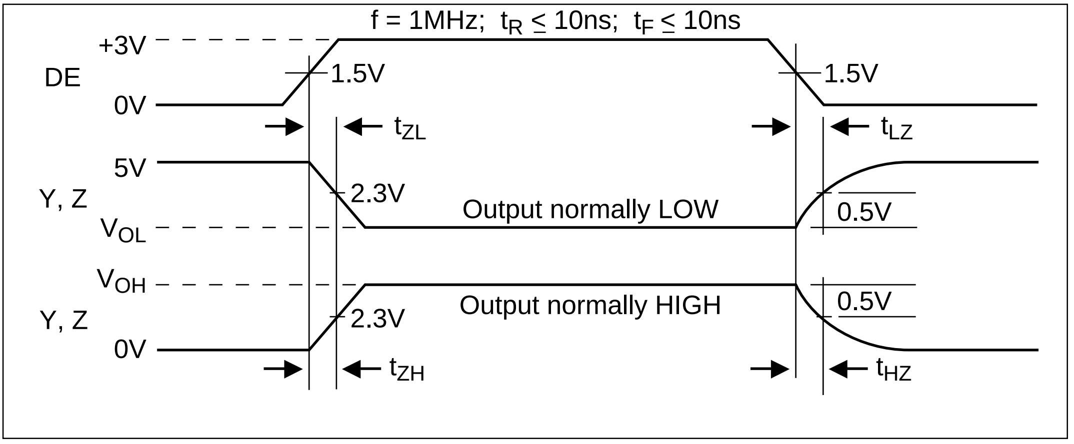


Figure 6. Driver Enable and Disable Times

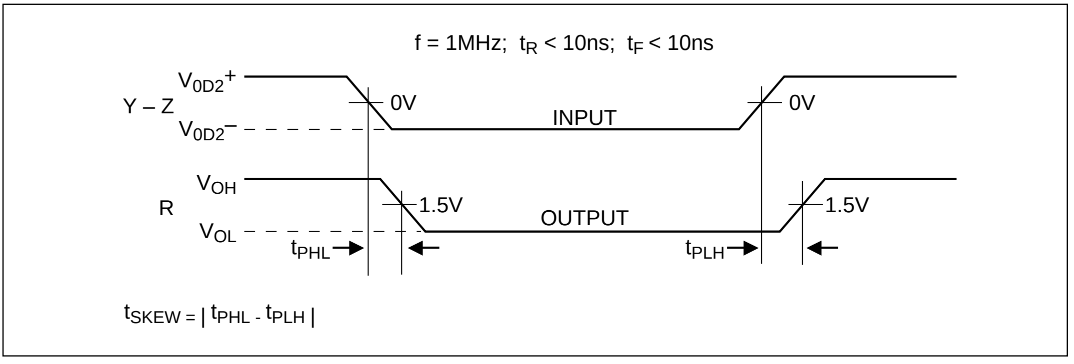


Figure 7. Receiver Propagation Delays

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}..+7V
Input Voltages
Logic.................-0.5V to (V_{CC}+0.5V)
Drivers.................-0.5V to (V_{CC}+0.5V)
Receivers.................±14V
Output Voltages
Logic.................-0.5V to (V_{CC}+0.5V)
Drivers.................±14V
Receivers.................-0.5V to (V_{CC}+0.5V)
Storage Temperature.................-65˚C to +150
Power Dissipation.................1000mW

SPECIFICATIONS

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP491E 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; (RS-422); *see Figure 1*
Differential Output Voltage	1.5		V_{CC}	Volts	With Load; R = 27Ω; (RS-485); *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 D, $\overline{REB}$, DE
Input LOW Voltage			0.8	Volts	Applies to D, $\overline{REB}$, DE
Input Current			±10	µA	Applies to D, $\overline{REB}$, DE
Driver Short-Circuit Current					
V_{OUT} = HIGH			250	mA	-7V ≤ V_O ≤ 10V
V_{OUT} = LOW			250	mA	-7V ≤ V_O ≤ 10V
SP491E DRIVER					
AC Characteristics					
Maximum Data Rate	10			Mbps	R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF
Driver Input to Output	20	30	60	ns	t_{PLH}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *see Figures 3 and 5*
Driver Input to Output	20	30	60	ns	t_{PHL}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *see Figures 3 and 5*
Driver Skew		5	10	ns	*see Figures 3 and 5,* t_{SKEW} = | 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; *see Figures 3 and 5*
Driver Enable to Output HIGH		40	70	ns	C_{L1} = C_{L2} = 100pF; *see Figures 4 and 6;* S_2 closed
Driver Enable to Output LOW		40	70	ns	C_{L1} = C_{L2} = 100pF; *see Figures 4 and 6;* S_1 closed
Driver Disable Time from LOW		40	70	ns	C_{L1} = C_{L2} = 15pF; *see Figures 4 and 6;* S_1 closed
Driver Disable Time from HIGH		40	70	ns	C_{L1} = C_{L2} = 15pF; *see Figures 4 and 6;* S_2 closed

SPECIFICATIONS (continued)

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

PARAMETERS	MIN.	TYP.	MAX.	UNITS	CONDITIONS
SP491E RECEIVER					
DC Characteristics					
Differential Input Threshold	-0.2		+0.2	Volts	$-7V \le V_{CM} \le 12V$
Input Hysteresis		70		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	$0.4V \le V_O \le 2.4V$; $\overline{REB} = 5V$
Input Resistance	12	15		kΩ	$-7V \le V_{CM} \le 12V$
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			85	mA	$0V \le V_O \le V_{CC}$
SP491E RECEIVER					
AC Characteristics					
Maximum Data Rate	10			Mbps	$\overline{REB}$ = 0V, DE = 5V
Receiver Input to Output	20	45	100	ns	t_{PLH}; R_{DIFF} = 54Ω, $C_{L1} = C_{L2}$ = 100pF; *Figures 3 & 7*
Receiver Input to Output	20	45	100	ns	t_{PHL}; R_{DIFF} = 54Ω, $C_{L1} = C_{L2}$ = 100pF; *Figures 3 & 7*
Diff. Receiver Skew $\lvert t_{PLH}-t_{PHL} \rvert$		13		ns	R_{DIFF} = 54Ω; $C_{L1} = C_{L2}$ = 100pF; *Figures 3 & 7*
Receiver Enable to Output LOW		45	70	ns	C_{RL} = 15pF; *Figures 2 and 8;* S_1 closed
Receiver Enable to Output HIGH		45	70	ns	C_{RL} = 15pF; *Figures 2 and 8;* S_2 closed
Receiver Disable from LOW		45	70	ns	C_{RL} = 15pF; *Figures 2 and 8;* S_1 closed
Receiver Disable from HIGH		45	70	ns	C_{RL} = 15pF; *Figures 2 and 8;* S_2 closed
POWER REQUIREMENTS					
Supply Voltage	+4.75		+5.25	Volts	
Supply Current		900		µA	$\overline{REB}$, D = 0V or V_{CC}; DE = V_{CC}
SP491E ENVIRONMENTAL AND MECHANICAL					
Operating Temperature					
Commercial (_C_)	0		+70	°C	
Industrial (_E_)	-40		+85	°C	
Storage Temperature	-65		+150	°C	
Package					
Plastic DIP (_P)					
NSOIC (_N)					

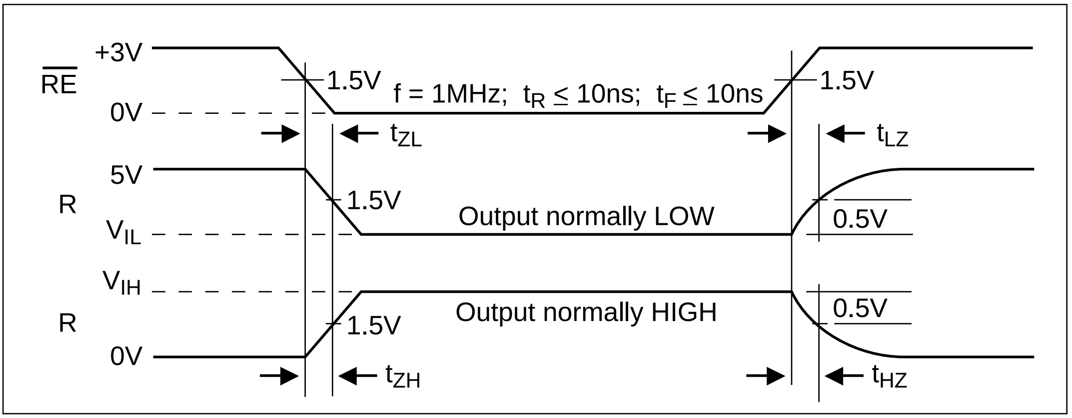


Figure 8. Receiver Enable and Disable Times

FEATURES

The **SP490E** and **SP491E** are full-duplex differential transceivers that meet the requirements of RS-485 and RS-422. Fabricated with a **Sipex** proprietary BiCMOS process, both products require a fraction of the power of older bipolar designs.

THEORY OF OPERATION

The RS-485 standard is ideal for multi-drop applications or 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

The drivers for both the **SP490E** and **SP491E** have differential outputs. 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 driver can maintain greater than 1.5V voltage levels.

The driver of the **SP491E** has a driver enable control line which is active high. A logic high on DE (pin 4) of the **SP491E** will enable the differential driver outputs. A logic low on DE (pin 4) of the **SP491E** will tri-state the driver outputs. The **SP490E** does not have a driver enable.

Receivers

The receivers for both the **SP490E** and **SP491E** 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 for both the **SP490E** and **SP491E** are 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.

The receiver of the **SP491E** has a receiver enable control line which is active low. A logic low on $\overline{REB}$ (pin 3) of the **SP491E** will enable the differential receiver. A logic high on $\overline{REB}$ (pin 3) of the **SP491E** will tri-state the receiver.

ESD Tolerance

The **SP490E/SP491E** devices incorporate ruggedized ESD cells on all driver output and receiver input pins. The ESD structure is improved over our previous family for more rugged applications and environments sensitive to electro-static discharges and associated transients. The improved ESD tolerance is at least ±15kV without damage nor latch-up.

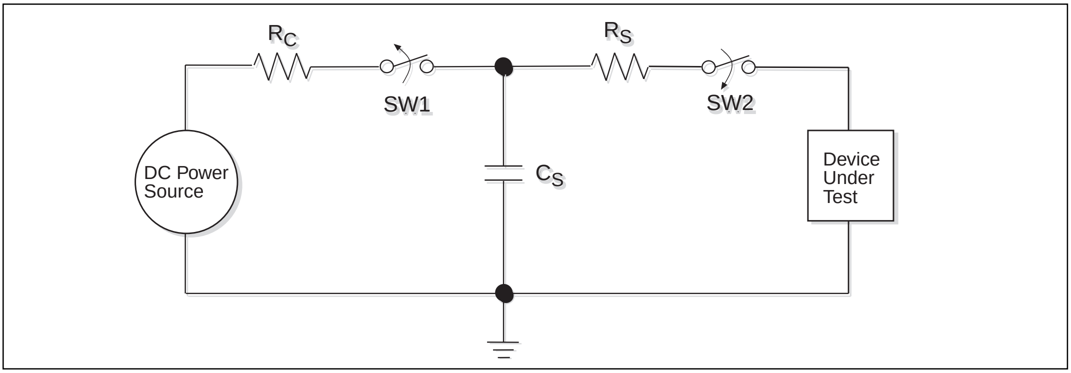


Figure 9. ESD Test Circuit for Human Body Model

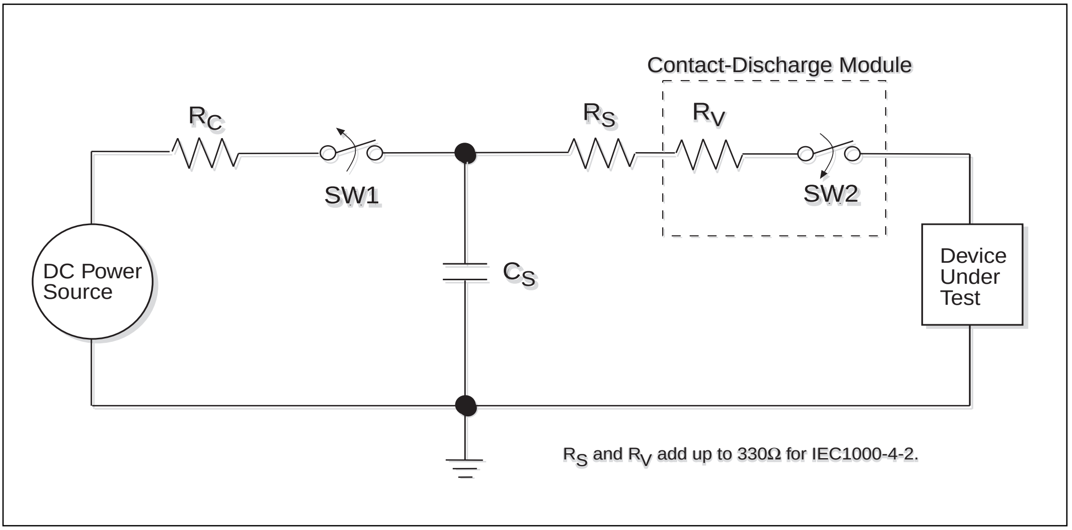


Figure 10. ESD Test Circuit for IEC1000-4-2

There are different methods of ESD testing applied:

a) MIL-STD-883, Method 3015.7
b) IEC1000-4-2 Air-Discharge
c) IEC1000-4-2 Direct Contact

The Human Body Model has been the generally accepted ESD testing method for semiconductors. This method is also specified in MIL-STD-883, Method 3015.7 for ESD testing. The premise of this ESD test is to simulate the human body's potential to store electro-static energy and discharge it to an integrated circuit. The simulation is performed by using a test model as shown in *Figure 9*. This method will test the IC's capability to withstand an ESD transient during normal handling such as in manufacturing areas where the ICs tend to be handled frequently.

The IEC-1000-4-2, formerly IEC801-2, is generally used for testing ESD on equipment and systems. For system manufacturers, they must guarantee a certain amount of ESD protection since the system itself is exposed to the outside environment and human presence. The premise with IEC1000-4-2 is that the system is required to withstand an amount of static electricity when ESD is applied to points and surfaces of the equipment that are accessible to personnel during normal usage. The transceiver IC receives most of the ESD current when the ESD source is applied to the connector pins. The test circuit for IEC1000-4-2 is shown on *Figure 10*. There are two methods within IEC1000-4-2, the Air Discharge method and the Contact Discharge method.

With the Air Discharge Method, an ESD voltage is applied to the equipment under test (EUT) through air. This simulates an electrically charged

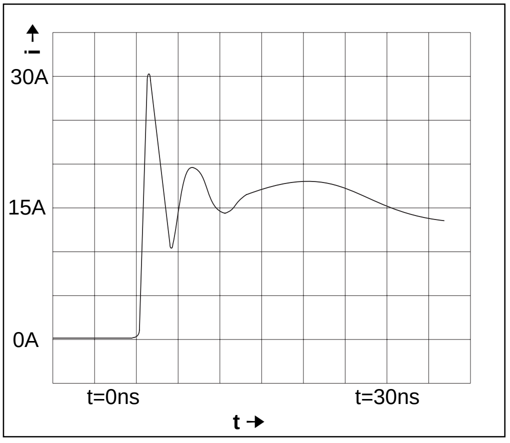


Figure 11. ESD Test Waveform for IEC1000-4-2

person ready to connect a cable onto the rear of the system only to find an unpleasant zap just before the person touches the back panel. The high energy potential on the person discharges through an arcing path to the rear panel of the system before he or she even touches the system. This energy, whether discharged directly or through air, is predominantly a function of the discharge current rather than the discharge voltage. Variables with an air discharge such as approach speed of the object carrying the ESD potential to the system and humidity will tend to change the discharge current. For example, the rise time of the discharge current varies with the approach speed.

The Contact Discharge Method applies the ESD current directly to the EUT. This method was devised to reduce the unpredictability of the ESD arc. The discharge current rise time is constant since the energy is directly transferred without the air-gap arc. In situations such as hand held systems, the ESD charge can be directly discharged to the equipment from a person already holding the equipment. The current is transferred on to the keypad or the serial port of the equipment directly and then travels through the PCB and finally to the IC.

The circuit models in *Figures 9* and *10* represent the typical ESD testing circuits used for all three methods. The C_S is initially charged with the DC power supply when the first switch (SW1) is on. Now that the capacitor is charged, the second switch (SW2) is on while SW1 switches off. The voltage stored in the capacitor is then applied through R_S, the current limiting resistor, onto the device under test (DUT). In ESD tests, the SW2 switch is pulsed so that the device under test receives a duration of voltage.

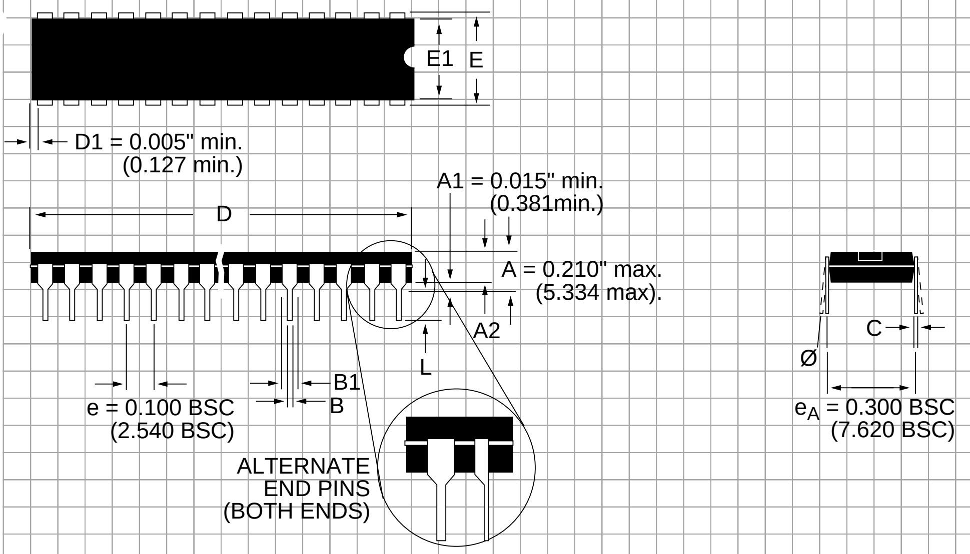
For the Human Body Model, the current limiting resistor (R_S) and the source capacitor (C_S) are 1.5kΩ an 100pF, respectively. For IEC-1000-4-2, the current limiting resistor (R_S) and the source capacitor (C_S) are 330Ω an 150pF, respectively.

The higher C_S value and lower R_S value in the IEC1000-4-2 model are more stringent than the Human Body Model. The larger storage capacitor injects a higher voltage to the test point when SW2 is switched on. The lower current limiting resistor increases the current charge onto the test point.

SP490E/SP491E Family	HUMAN BODY MODEL	IEC1000-4-2		
		Air Discharge	Direct Contact	Level
Driver Outputs	±15kV	±15kV	±8kV	4
Receiver Inputs	±15kV	±15kV	±8kV	4

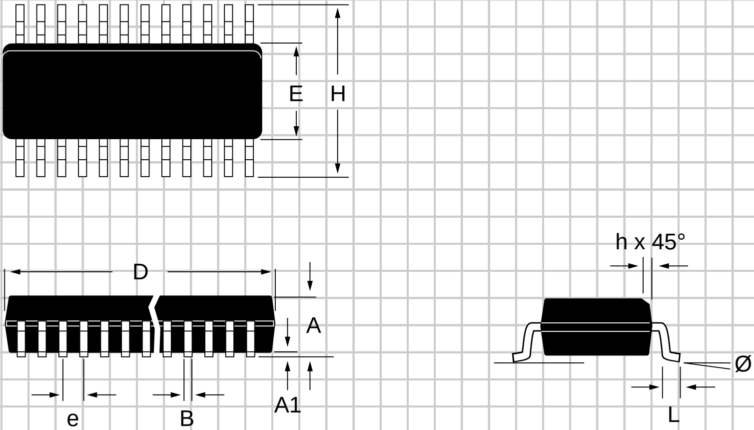
Table 1. Transceiver ESD Tolerance Levels

PACKAGE: PLASTIC DUAL–IN–LINE (NARROW)



DIMENSIONS (Inches) Minimum/Maximum (mm)	8–PIN	14–PIN	16–PIN	18–PIN	20–PIN	22–PIN
A2	**0.115/0.195 (2.921/4.953)**	**0.115/0.195 (2.921/4.953)**	**0.115/0.195 (2.921/4.953)**	**0.115/0.195 (2.921/4.953)**	**0.115/0.195 (2.921/4.953)**	**0.115/0.195 (2.921/4.953)**
B	**0.014/0.022 (0.356/0.559)**	**0.014/0.022 (0.356/0.559)**	**0.014/0.022 (0.356/0.559)**	**0.014/0.022 (0.356/0.559)**	**0.014/0.022 (0.356/0.559)**	**0.014/0.022 (0.356/0.559)**
B1	**0.045/0.070 (1.143/1.778)**	**0.045/0.070 (1.143/1.778)**	**0.045/0.070 (1.143/1.778)**	**0.045/0.070 (1.143/1.778)**	**0.045/0.070 (1.143/1.778)**	**0.045/0.070 (1.143/1.778)**
C	**0.008/0.014 (0.203/0.356)**	**0.008/0.014 (0.203/0.356)**	**0.008/0.014 (0.203/0.356)**	**0.008/0.014 (0.203/0.356)**	**0.008/0.014 (0.203/0.356)**	**0.008/0.014 (0.203/0.356)**
D	**0.355/0.400 (9.017/10.160)**	**0.735/0.775 (18.669/19.685)**	**0.780/0.800 (19.812/20.320)**	**0.880/0.920 (22.352/23.368)**	**0.980/1.060 (24.892/26.924)**	**1.145/1.155 (29.083/29.337)**
E	**0.300/0.325 (7.620/8.255)**	**0.300/0.325 (7.620/8.255)**	**0.300/0.325 (7.620/8.255)**	**0.300/0.325 (7.620/8.255)**	**0.300/0.325 (7.620/8.255)**	**0.300/0.325 (7.620/8.255)**
E1	**0.240/0.280 (6.096/7.112)**	**0.240/0.280 (6.096/7.112)**	**0.240/0.280 (6.096/7.112)**	**0.240/0.280 (6.096/7.112)**	**0.240/0.280 (6.096/7.112)**	**0.240/0.280 (6.096/7.112)**
L	**0.115/0.150 (2.921/3.810)**	**0.115/0.150 (2.921/3.810)**	**0.115/0.150 (2.921/3.810)**	**0.115/0.150 (2.921/3.810)**	**0.115/0.150 (2.921/3.810)**	**0.115/0.150 (2.921/3.810)**
Ø	**0°/ 15° (0°/15°)**	**0°/ 15° (0°/15°)**	**0°/ 15° (0°/15°)**	**0°/ 15° (0°/15°)**	**0°/ 15° (0°/15°)**	**0°/ 15° (0°/15°)**

PACKAGE: PLASTIC SMALL OUTLINE (SOIC) (NARROW)



DIMENSIONS (Inches) Minimum/Maximum (mm)	8–PIN	14–PIN	16–PIN			
A	0.053/0.069 (1.346/1.748)	0.053/0.069 (1.346/1.748)	0.053/0.069 (1.346/1.748)			
A1	0.004/0.010 (0.102/0.249	0.004/0.010 (0.102/0.249)	0.004/0.010 (0.102/0.249)			
B	0.014/0.019 (0.35/0.49)	0.013/0.020 (0.330/0.508)	0.013/0.020 (0.330/0.508)			
D	0.189/0.197 (4.80/5.00)	0.337/0.344 (8.552/8.748)	0.386/0.394 (9.802/10.000)			
E	0.150/0.157 (3.802/3.988)	0.150/0.157 (3.802/3.988)	0.150/0.157 (3.802/3.988)			
e	0.050 BSC (1.270 BSC)	0.050 BSC (1.270 BSC)	0.050 BSC (1.270 BSC)			
H	0.228/0.244 (5.801/6.198)	0.228/0.244 (5.801/6.198)	0.228/0.244 (5.801/6.198)			
h	0.010/0.020 (0.254/0.498)	0.010/0.020 (0.254/0.498)	0.010/0.020 (0.254/0.498)			
L	0.016/0.050 (0.406/1.270)	0.016/0.050 (0.406/1.270)	0.016/0.050 (0.406/1.270)			
Ø	0°/8° (0°/8°)	0°/8° (0°/8°)	0°/8° (0°/8°)			

ORDERING INFORMATION

Model	Temperature Range	Package
SP490ECN	0˚C to +70˚C	8-Pin NSOIC
SP490ECP	0˚C to +70˚C	8-Pin DIP
SP490EEN	-40˚C to +85˚C	8-Pin NSOIC
SP490EEP	-40˚C to +85˚C	8-Pin DIP
SP491ECN	0˚C to +70˚C	14-Pin NSOIC
SP491ECP	0˚C to +70˚C	14-Pin DIP
SP491EEN	-40˚C to +85˚C	14-Pin NSOIC
SP491EEP	-40˚C to +85˚C	14-Pin DIP

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

Now available in Lead Free. To order add "-L' to the part number.
Example: SP488A = normal, SP488A-L = Lead free

SIGNAL PROCESSING EXCELLENCE

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