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A New Direction in Mixed-Signal

SP490E/491E

Enhanced Full Duplex RS-485 Transceivers

FEATURES

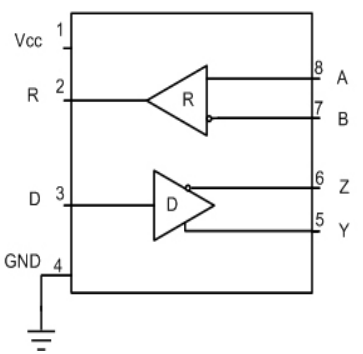
- +5V Only
- Low Power BiCMOS
- Driver/Receiver Enable (SP491E)
- RS-485 and RS-422 Drivers/Receivers
- Pin Compatible with LTC490 and SN75179 (SP490E)
- Pin Compatible with LTC491 and SN75180 (SP491E)
- Improved ESD Specifications:
  - ±15kV Human Body Model
  - ±15kV IEC61000-4-2 Air Discharge

Now Available in Lead Free Packaging

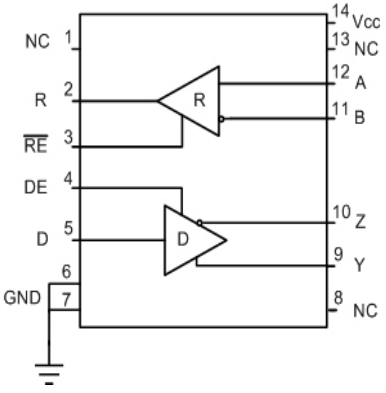
DESCRIPTION

The **SP490E** is a low power differential line driver/receiver meeting RS-485 and RS-422 standards up to 10Mbps. The **SP491E** is identical to the **SP490E** with the addition of driver and receiver tri-state enable lines. Both products feature ±200mV receiver input sensitivity, over wide common mode range. The **SP490E** is available in 8-pin plastic DIP and 8-pin NSOIC packages for operation over the commercial and industrial temperature ranges. The **SP491E** is available in 14-pin DIP and 14-pin NSOIC packages for operation over the commercial and industrial temperature ranges.

BLOCK DIAGRAMS



SP490E



SP491E

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

ELECTRICAL CHARACTERISTICS

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; (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 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	
Driver Input to Output		30	60	ns	t_{PLH}; R_{DIFF} = 54Ω, C_{L1} = C_{L2} = 100pF; *see figures 3 and 5*
Driver Input to Output		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		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}

ELECTRICAL CHARACTERISTICS

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)					

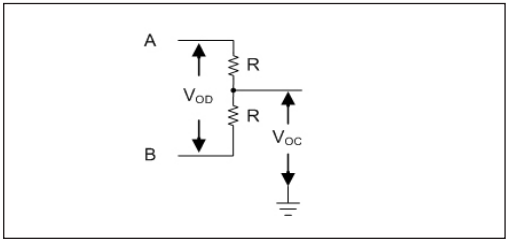


Figure 1. Driver DC Test Load Circuit

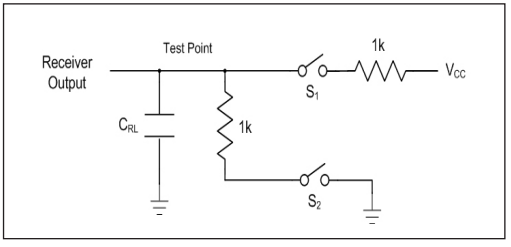


Figure 2. Receiver Timing Test Load Circuit

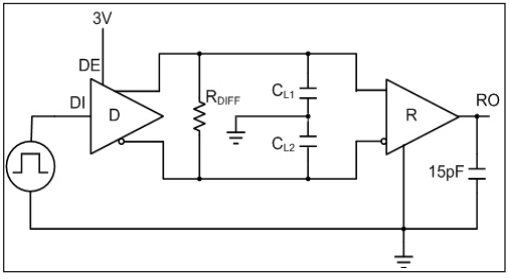


Figure 3. Driver/Receiver Timing Test Circuit

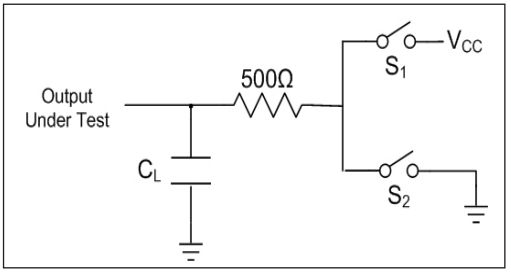


Figure 4. Driver Timing Test Load #2 Circuit

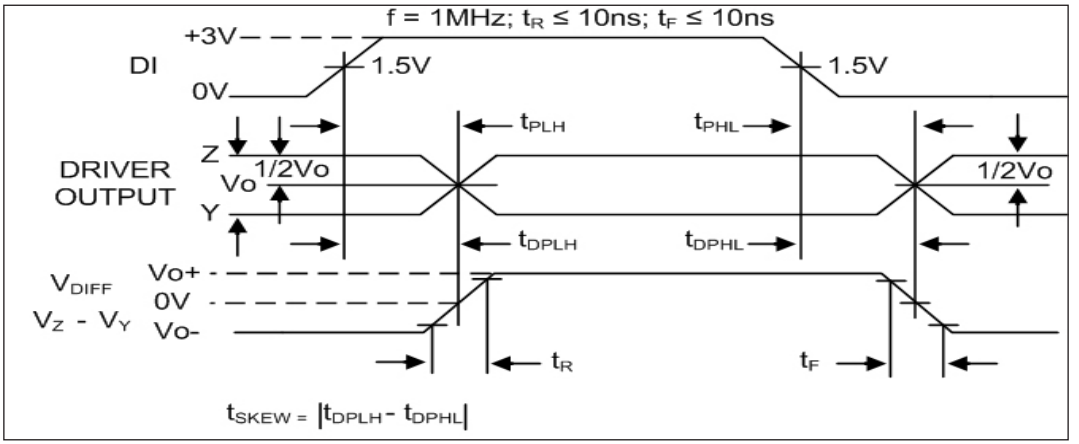


Figure 5. Driver Propagation Delays

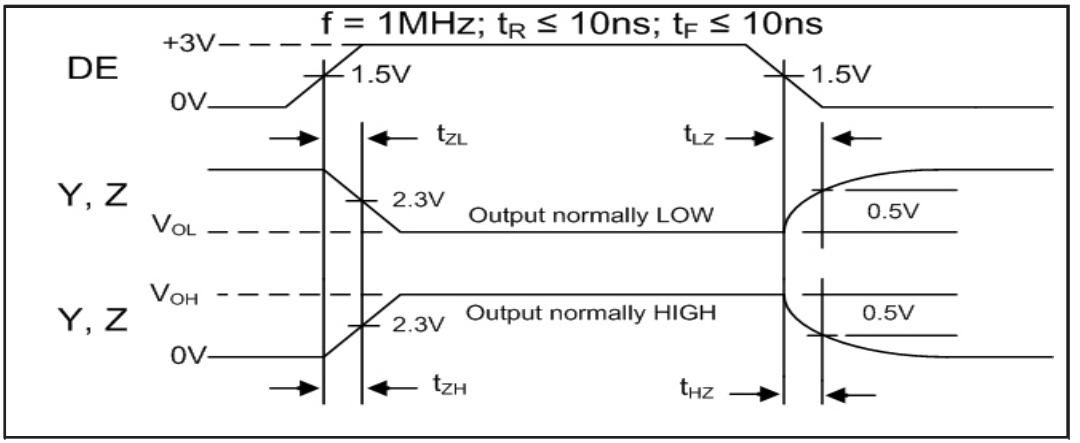


Figure 6. Driver Enable and Disable Times

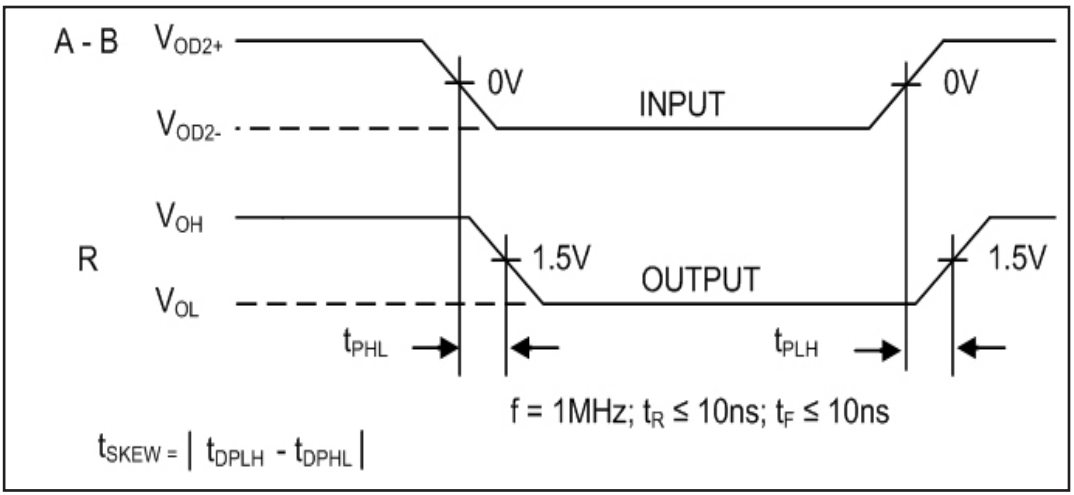


Figure 7. Receiver Propagation Delays

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

ELECTRICAL CHARACTERISTICS

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; (RS422); *see figure 1*
Differential Output Voltage	1.5		V_{CC}	Volts	With Load; R = 27Ω; (RS485); *see figure*
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, $\overline{RE}$, DE
Input Low Voltage			0.8	Volts	Applies to D, $\overline{RE}$, DE
Input Current			±10	µA	Applies to D, $\overline{RE}$, DE
Driver Short-Circuit Current					
V_{OUT} = HIGH			250	mA	-7V ≤ V_O ≤ 12V
V_{OUT} = LOW			250	mA	-7V ≤ V_O ≤ 12V
SP491E DRIVER					
AC Characteristics					
Maximum Data Rate	10			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 5*
Driver Input to Output		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		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} = 100pF; *see figures 4 and 6;* S_1 closed
Driver Disable Time from High		40	70	ns	C_{L1} = C_{L2} = 100pF; *see figures 4 and 6;* S_2 closed

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 ≤ 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
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			85	mA	0V ≤ V_O ≤ V_{CC}
SP491E RECEIVER AC Characteristics					
Maximum Data Rate	10			Mbps	$\overline{RE}$ = 0V
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 $It_{PLH}-t_{PHL}I$		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	$\overline{RE}$, 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)					

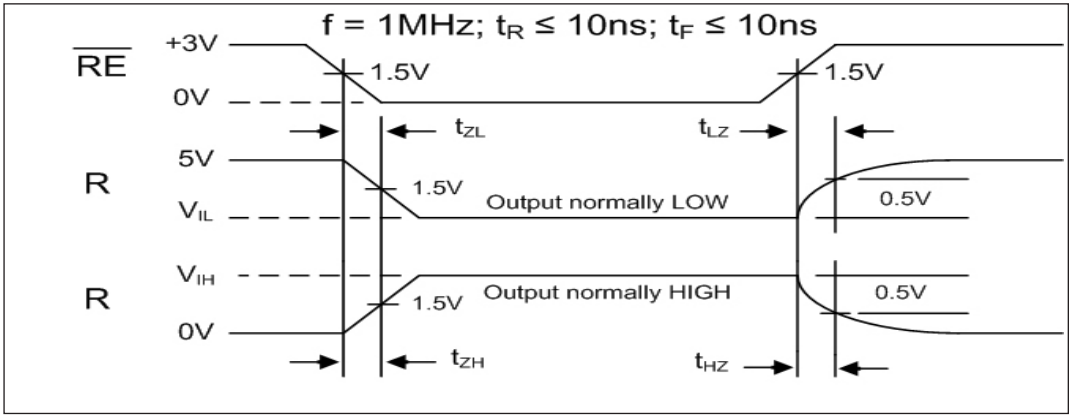


Figure 8. Receiver Enable and Disable Times

DESCRIPTION

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

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.

Driver...

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.

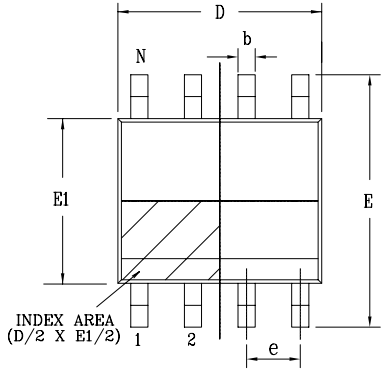
The driver of the **SP491E** has a driver enable control line which is active high. A logic high on DE (pin 4) of the **SP491E** will enable the differential driver outputs. A logic low on DE (pin 4) of the **SP491E** will tri-state the driver outputs. The **SP490E** does not have a driver enable.

Receiver...

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.

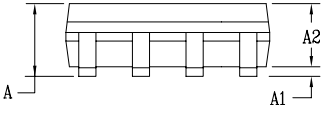
The receiver of the **SP491E** has a receiver enable control line which is active low. A logic low on $\overline{REB}$ (pin 3) of the **SP491E** will enable the differential receiver. A logic high on $\overline{REB}$ (pin 3) of the **SP491E** will tri-state the receiver.

REVISION HISTORY			
REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	08/16/05	JL
B	DRAWING FORMAT MODIFICATION	07/19/06	JL
C	CHANGE DRAWING LOGO ADN COMPANY NAME	11/16/07	JL

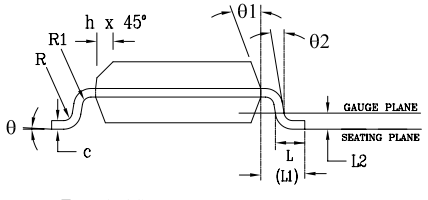


Top View

8 Pin SOICN JEDEC MS-012 Variation AA						
SYMBOLS	DIMENSIONS IN MM (Control Unit)			DIMENSIONS IN INCH (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	—	1.75	0.053	—	0.069
A1	0.10	—	0.25	0.004	—	0.010
A2	1.25	—	1.65	0.049	—	0.065
b	0.31	—	0.51	0.012	—	0.020
c	0.17	—	0.25	0.007	—	0.010
E	6.00 BSC			0.236 BSC		
E1	3.90 BSC			0.154 BSC		
e	1.27 BSC			0.050 BSC		
h	0.25	—	0.50	0.010	—	0.020
L	0.40	—	1.27	0.016	—	0.050
L1	1.04 REF			0.041 REF		
L2	0.25 BSC			0.010 BSC		
R	0.07	—	—	0.003	—	—
R1	0.07	—	—	0.003	—	—
θ	0°	—	8°	0°	—	8°
θ1	5°	—	15°	5°	—	15°
θ2	0°	—	—	0°	—	—
D	4.90 BSC			0.193 BSC		
N	8			8		



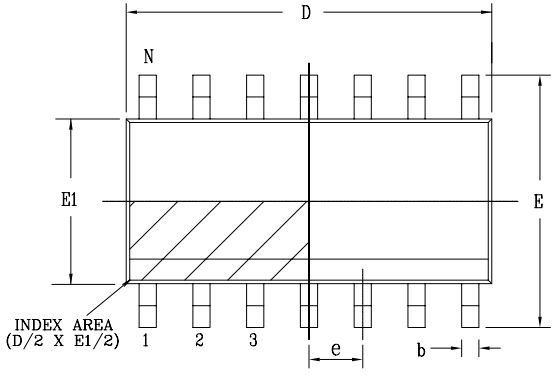
Side View



Front View

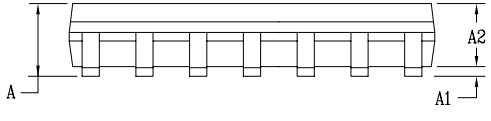
EXAR Powering Connectivity	EXAR CORPORATION		
	8 PIN SOICN PACKAGE OUTLINE		
Packaging Approval:	Drawing No: 8-PIN SOICN		
By: JL / Date: 11/16/07	Revision: C	Sheet: 1 OF 1	

REVISION HISTORY			
REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	04/17/06	JL
B	CHANGE DRAWING LOGO AND COMPANY NAME	11/21/07	JL

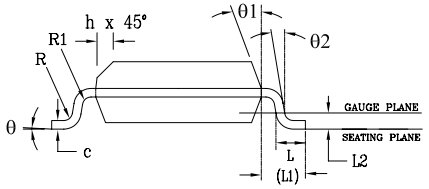


Top View

14 Pin SOICN JEDEC MS-012 Variation AB						
SYMBOLS	DIMENSIONS IN MM (Control Unit)			DIMENSIONS IN INCH (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	—	1.75	0.053	—	0.069
A1	0.10	—	0.25	0.004	—	0.010
A2	1.25	—	1.65	0.049	—	0.065
b	0.31	—	0.51	0.012	—	0.020
c	0.17	—	0.25	0.007	—	0.010
E	6.00 BSC			0.236 BSC		
E1	3.90 BSC			0.154 BSC		
e	1.27 BSC			0.050 BSC		
h	0.25	—	0.50	0.010	—	0.020
L	0.40	—	1.27	0.016	—	0.050
L1	1.04 REF			0.041 REF		
L2	0.25 BSC			0.010 BSC		
R	0.07	—	—	0.003	—	—
R1	0.07	—	—	0.003	—	—
θ	0°	—	8°	0°	—	8°
θ1	5°	—	15°	5°	—	15°
θ2	0°	—	—	0°	—	—
D	8.65 BSC			0.341 BSC		
N	14			14		



Side View

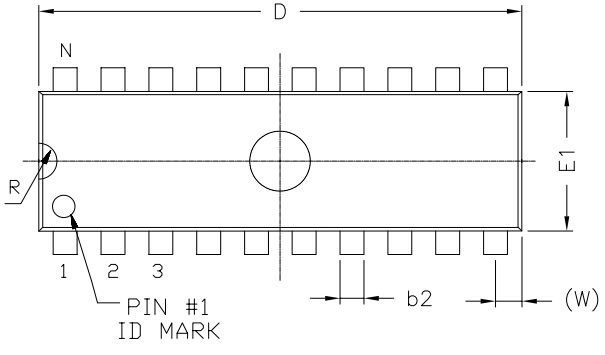


Front View

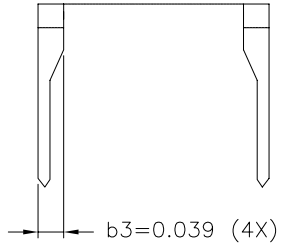
EXAR Powering Connectivity	EXAR CORPORATION		
	14 PIN SOICN PACKAGE OUTLINE		
Packaging Approval:		Drawing No:	14-PIN SOICN
By: JL	Date: 11/21/07	Revision: B	Sheet: 1 OF 1

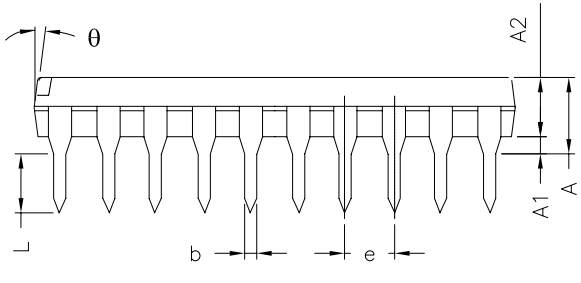
REVISION HISTORY			
REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	04/26/06	JL
B	CHNAGE DRAWING LOGO AND COMPANY NAME	11/28/07	JL

REMARKS:
FOR 8LD AND 16LD
ALL END LEADS (4X)
ARE HALF LEAD TYPES

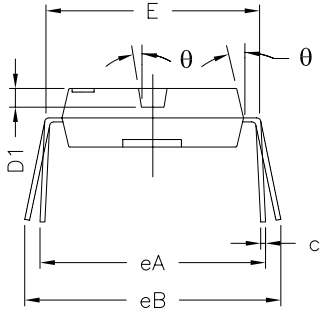


Top View





Side View

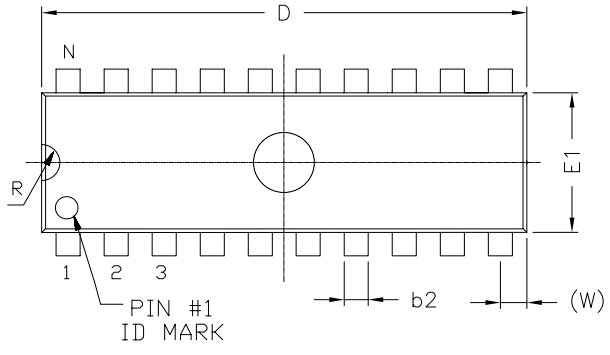


Front View

8 Pin PDIP JEDEC MS-001 Variation BA						
SYMBOLS	DIMENSIONS IN INCH (Control Unit)			DIMENSIONS IN MM (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	—	—	0.210	—	—	5.33
A1	0.015	—	—	0.38	—	—
A2	0.115	0.130	0.195	2.92	3.30	4.95
b	0.014	0.018	0.022	0.36	0.46	0.56
b2	0.045	0.060	0.070	1.14	1.52	1.78
c	0.008	0.010	0.014	0.20	0.25	0.36
D1	0.030	—	0.060	0.76	—	1.52
E	0.300	0.310	0.325	7.62	7.87	8.26
E1	0.240	0.250	0.280	6.10	6.35	7.11
e	0.100 BSC			2.54 BSC		
eA	0.300 BSC			7.62 BSC		
eB	—	—	0.430	—	—	10.92
L	0.115	0.130	0.150	2.92	3.30	3.81
W	0.075 REF			1.91 REF		
R	0.030 BSC			0.76 BSC		
θ	4°	7°	10°	4°	7°	10°
D	0.355	0.365	0.400	9.02	9.27	10.16
N	8			8		

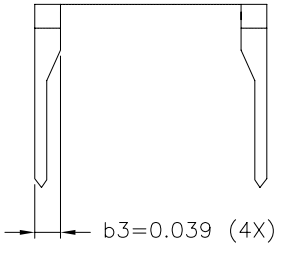
EXAR Powering Connectivity	EXAR CORPORATION		
	8 PIN PDIP PACKAGE OUTLINE		
Packaging Approval:	Drawing No: 8-PIN PDIP		
By: JL / Date: 11/28/07	Revision: B	Sheet: 1 OF 1	

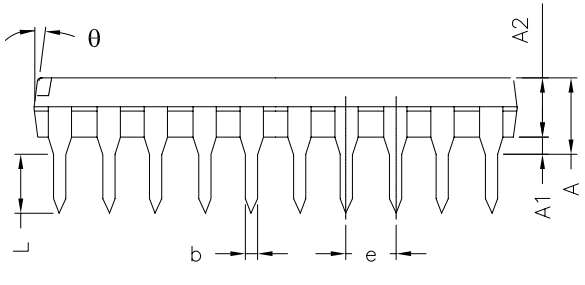
REVISION HISTORY			
REV.	DISCRIPTION	DATE	APP'D
A	DRAWING ORIGINATION	04/26/06	JL
B	CHANGE DRAWING LOGO AND COMPANY NAME	11/21/07	JL



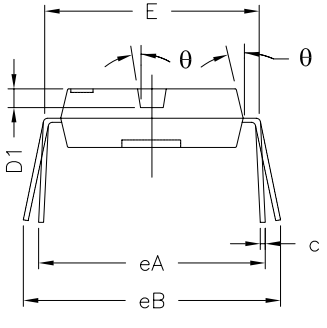
Top View

REMARKS:
FOR 8LD AND 16LD
ALL END LEADS (4X)
ARE HALF LEAD TYPES





Side View



Front View

14 Pin PDIP JEDEC MS-001 Variation AA						
SYMBOLS	DIMENSIONS IN INCH (Control Unit)			DIMENSIONS IN MM (Reference Unit)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	—	—	0.210	—	—	5.33
A1	0.015	—	—	0.38	—	—
A2	0.115	0.130	0.195	2.92	3.30	4.95
b	0.014	0.018	0.022	0.36	0.46	0.56
b2	0.045	0.060	0.070	1.14	1.52	1.78
c	0.008	0.010	0.014	0.20	0.25	0.36
D1	0.030	—	0.060	0.76	—	1.52
E	0.300	0.310	0.325	7.62	7.87	8.26
E1	0.240	0.250	0.280	6.10	6.35	7.11
e	0.100 BSC			2.54 BSC		
eA	0.300 BSC			7.62 BSC		
eB	—	—	0.430	—	—	10.92
L	0.115	0.130	0.150	2.92	3.30	3.81
W	0.075 REF			1.91 REF		
R	0.030 BSC			0.76 BSC		
θ	4°	7°	10°	4°	7°	10°
D	0.735	0.750	0.775	18.67	19.05	19.69
N	14			14		

	EXAR CORPORATION		
	14 PIN PDIP PACKAGE OUTLINE		
Packaging Approval:		Drawing No:	14-PIN PDIP
By: JL	Date: 11/21/07	Revision: B	Sheet: 1 OF 1

ORDERING INFORMATION

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

Note: /TR = Tape and Reel

REVISION HISTORY

Date	Revision	Description
2000	14	Sipex Legacy Data Sheet
May 2011	1.0.0	Convert to Exar format. Remove driver propagation delay minimum and driver rise/fall time minimum entry for SP490E and SP491E. Update ESD rating to IEC61000-4-2. Update ordering information.
May 2013	1.0.1	Correct type errors per PCN 13-0503-01 ECN: 1322-03 05/29/13

Datasheet May 2013

Send your serial transceiver technical inquiry with technical details to: serialtechsupport@exar.com