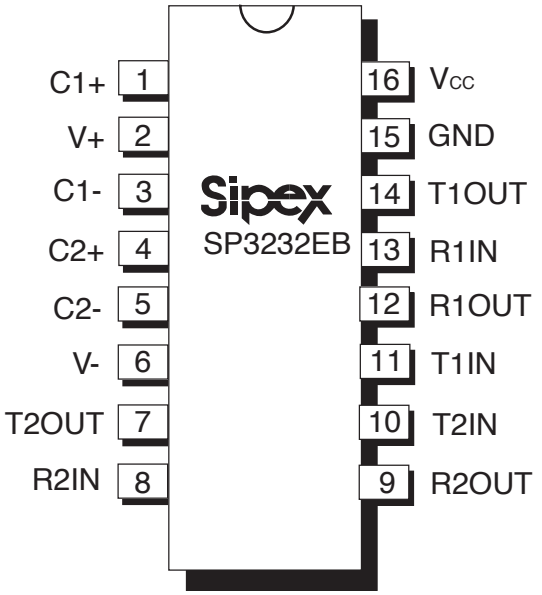
SP3222EB/3232EB

True +3.0V to +5.5V RS-232 Transceivers

FEATURES

- Meets true EIA/TIA-232-F Standards from a +3.0V to +5.5V power supply
- 250kbps Transmission Rate Under Load
- 1μA Low-Power Shutdown with Receivers Active (**SP3222EB**)
- Interoperable with RS-232 down to +2.7V power source
- Enhanced ESD Specifications:
  ±15kV Human Body Model
  ±15kV IEC1000-4-2 Air Discharge
  ±8kV IEC1000-4-2 Contact Discharge



Now Available in Lead Free Packaging

DESCRIPTION

The SP3222EB/3232EB series is an RS-232 transceiver solution intended for portable or hand-held applications such as notebook or palmtop computers. The SP3222EB/3232EB series has a high-efficiency, charge-pump power supply that requires only 0.1μF capacitors in 3.3V operation. This charge pump allows the SP3222EB/3232EB series to deliver true RS-232 performance from a single power supply ranging from +3.0V to +5.5V. The SP3222EB/3232EB are 2-driver/2-receiver devices. This series is ideal for portable or hand-held applications such as notebook or palmtop computers. The ESD tolerance of the SP3222EB/3232EB devices are over ±15kV for both Human Body Model and IEC1000-4-2 Air discharge test methods. The SP3222EB device has a low-power shutdown mode where the devices' driver outputs and charge pumps are disabled. During shutdown, the supply current falls to less than 1μA.

SELECTION TABLE

MODEL	Power Supplies	RS-232 Drivers	RS-232 Receivers	External Components	Shutdown	TTL 3-State	No. of Pins
SP3222EB	+3.0V to +5.5V	2	2	4	Yes	Yes	18, 20
SP3232EB	+3.0V to +5.5V	2	2	4	No	No	16

© Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

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 and cause permanent damage to the device.

V_{CC} ..... -0.3V to +6.0V
V+ (NOTE 1) ..... -0.3V to +7.0V
V- (NOTE 1) ..... +0.3V to -7.0V
V+ + IV-I (NOTE 1) ..... +13V

I_{CC} (DC V_{CC} or GND current) ..... ±100mA

Input Voltages
TxIN, $\overline{EN}$ ..... -0.3V to +6.0V
RxIN ..... ±25V

Output Voltages
TxOUT ..... ±13.2V
RxOUT ..... -0.3V to (V_{CC} + 0.3V)

Short-Circuit Duration
TxOUT ..... Continuous

Storage Temperature ..... -65°C to +150°C

Power Dissipation Per Package
20-pin SSOP (derate 9.25mW/°C above +70°C) 750mW
18-pin PDIP (derate 15.2mW/°C above +70°C) 1220mW
18-pin SOIC (derate 15.7mW/°C above +70°C) 1260mW
20-pin TSSOP (derate 11.1mW/°C above +70°C) 890mW
16-pin SSOP (derate 9.69mW/°C above +70°C) 775mW
16-pin PDIP (derate 14.3mW/°C above +70°C) 1150mW
16-pin Wide SOIC (derate 11.2mW/°C above +70°C) 900mW
16-pin TSSOP (derate 10.5mW/°C above +70°C) 850mW
16-pin nSOIC (derate 13.57mW/°C above +70°C) 1086mW

NOTE 1: V+ and V- can have maximum magnitudes of 7V, but their absolute difference cannot exceed 13V.
NOTE 2: Driver Input hysteresis is typically 250mV.

ELECTRICAL CHARACTERISTICS

Unless otherwise noted, the following specifications apply for V_{CC} = +3.0V to +5.5V with T_{AMB} = T_{MIN} to T_{MAX}, C_1 to C_4=0.1µF

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
DC CHARACTERISTICS					
Supply Current		0.3	1.0	mA	no load, T_{AMB} = +25°C, V_{CC} = 3.3V, TxIN = V_{CC} or GND
Shutdown Supply Current		1.0	10	µA	$\overline{SHDN}$ = GND, T_{AMB} = +25°C, V_{CC} = +3.3V, TxIN = V_{CC} or GND
LOGIC INPUTS AND RECEIVER OUTPUTS					
Input Logic Threshold LOW	GND		0.8	V	TxIN, $\overline{EN}$, $\overline{SHDN}$, Note 2
Input Logic Threshold HIGH	2.0 2.4		V_{CC}	V V	V_{CC} = 3.3V, Note 2 V_{CC} = 5.0V, Note 2
Input Leakage Current		±0.01	±1.0	µA	TxIN, $\overline{EN}$, $\overline{SHDN}$, T_{AMB} = +25°C, V_{IN} = 0V to V_{CC}
Output Leakage Current		±0.05	±10	µA	receivers disabled, V_{OUT} = 0V to V_{CC}
Output Voltage LOW			0.4	V	I_{OUT} = 1.6mA
Output Voltage HIGH	V_{CC}-0.6	V_{CC}-0.1		V	I_{OUT} = -1.0mA
DRIVER OUTPUTS					
Output Voltage Swing	±5.0	±5.4		V	3kΩ load to ground at all driver outputs, T_{AMB} = +25°C
Output Resistance	300			Ω	V_{CC} = V+ = V- = 0V, T_{OUT} = +2V
Output Short-Circuit Current		±35	±60	mA	V_{OUT} = 0V
Output Leakage Current			±25	µA	V_{OUT} = ±12V, V_{CC}= 0V, or 3.0V to 5.5V, drivers disabled

© Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

ELECTRICAL CHARACTERISTICS

Unless otherwise noted, the following specifications apply for V_{CC} = +3.0V to +5.5V with $T_{AMB} = T_{MIN}$ to T_{MAX} , C_1 to C_4=0.1µF. Typical Values apply at V_{CC} = +3.3V or +5.5V and T_{AMB} = 25ºC.

PARAMETER	MIN.	TYP.	MAX.	UNITS	CONDITIONS
RECEIVER INPUTS					
Input Voltage Range	-25		+25	V	
Input Threshold LOW	0.6 0.8	1.2 1.5		V	V_{CC}=3.3V V_{CC}=5.0V
Input Threshold HIGH		1.5 1.8	2.4 2.4	V	V_{CC}=3.3V V_{CC}=5.0V
Input Hysteresis		0.3		V	
Input Resistance	3	5	7	kΩ	
TIMING CHARACTERISTICS					
Maximum Data Rate	250			kbps	R_L=3kΩ, C_L=1000pF, one driver switching
Receiver Propagation Delay		0.15 0.15		µs	t_{PHL}, RxIN to RxOUT, C_L=150pF t_{PLH}, RxIN to RxOUT, C_L=150pF
Receiver Output Enable Time		200		ns	
Receiver Output Disable Time		200		ns	
Driver Skew		100		ns	$\lvert t_{PHL} - t_{PLH} \rvert$, T_{AMB} = 25ºC
Receiver Skew		50		ns	$\lvert t_{PHL} - t_{PLH} \rvert$
Transition-Region Slew Rate			30	V/µs	V_{CC} = 3.3V, R_L = 3KΩ, T_{AMB} = 25ºC, measurements taken from -3.0V to +3.0V or +3.0V to -3.0V

© Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

TYPICAL PERFORMANCE CHARACTERISTICS

Unless otherwise noted, the following performance characteristics apply for V_{CC} = +3.3V, 250kbps data rates, all drivers loaded with 3kΩ, 0.1µF charge pump capacitors, and T_{AMB} = +25°C.

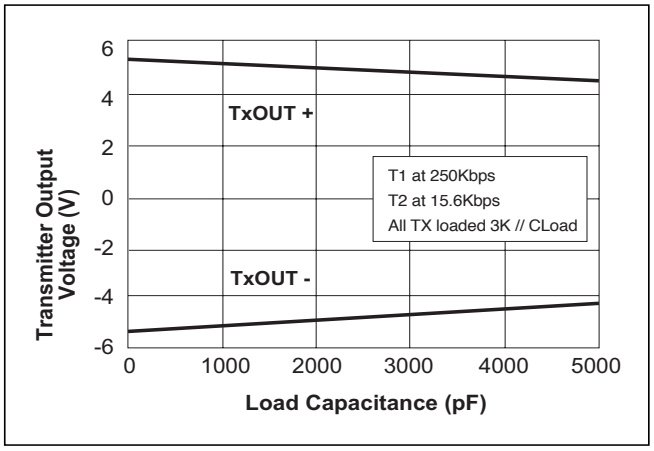


Figure 1. Transmitter Output Voltage vs Load Capacitance.

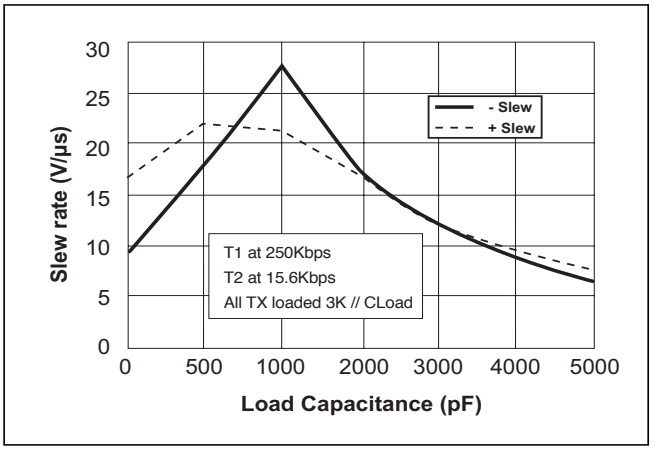


Figure 2. Slew Rate vs Load Capacitance.

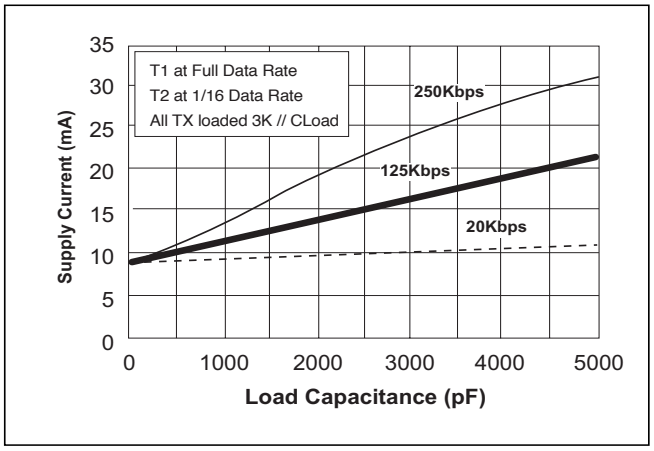


Figure 3. Supply Current vs Load Capacitance when Transmitting Data.

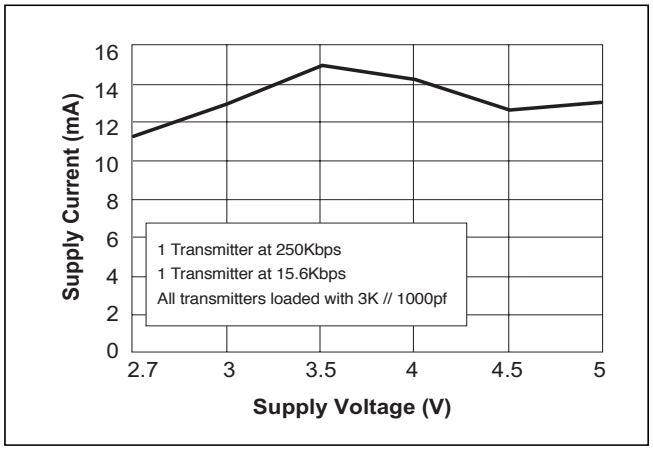


Figure 4. Supply Current vs Supply Voltage.

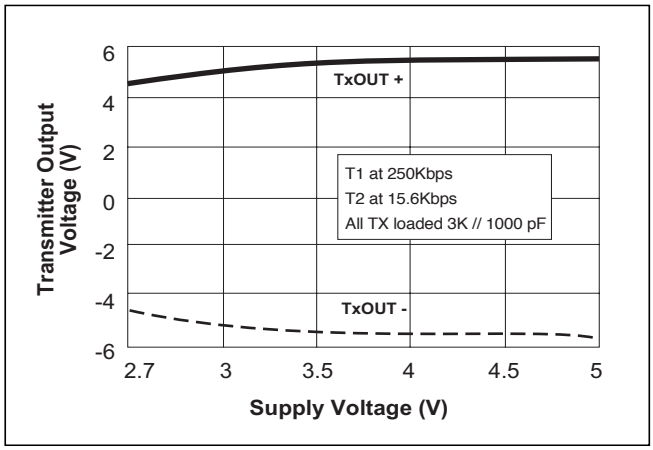


Figure 5. Transmitter Output Voltage vs Supply Voltage.

 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

PIN DESCRIPTION

NAME	FUNCTION	PIN NUMBER		
		SP3222EB		SP3232EB
		DIP/SO	SSOP TSSOP	
$\overline{EN}$	Receiver Enable. Apply logic LOW for normal operation. Apply logic HIGH to disable the receiver outputs (high-Z state).	1	1	-
C1+	Positive terminal of the voltage doubler charge-pump capacitor.	2	2	1
V+	+5.5V generated by the charge pump.	3	3	2
C1-	Negative terminal of the voltage doubler charge-pump capacitor.	4	4	3
C2+	Positive terminal of the inverting charge-pump capacitor.	5	5	4
C2-	Negative terminal of the inverting charge-pump capacitor.	6	6	5
V-	-5.5V generated by the charge pump.	7	7	6
T1OUT	RS-232 driver output.	15	17	14
T2OUT	RS-232 driver output.	8	8	7
R1IN	RS-232 receiver input.	14	16	13
R2IN	RS-232 receiver input.	9	9	8
R1OUT	TTL/CMOS reciever output.	13	15	12
R2OUT	TTL/CMOS reciever output.	10	10	9
T1IN	TTL/CMOS driver input.	12	13	11
T2IN	TTL/CMOS driver input.	11	12	10
GND	Ground.	16	18	15
V_{CC}	+3.0V to +5.5V supply voltage	17	19	16
$\overline{SHDN}$	Shutdown Control Input. Drive HIGH for normal device operation. Drive LOW to shutdown the drivers (high-Z output) and the on-board power supply.	18	20	-
N.C.	No Connect.	-	11, 14	-

Table 1. Device Pin Description

© Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

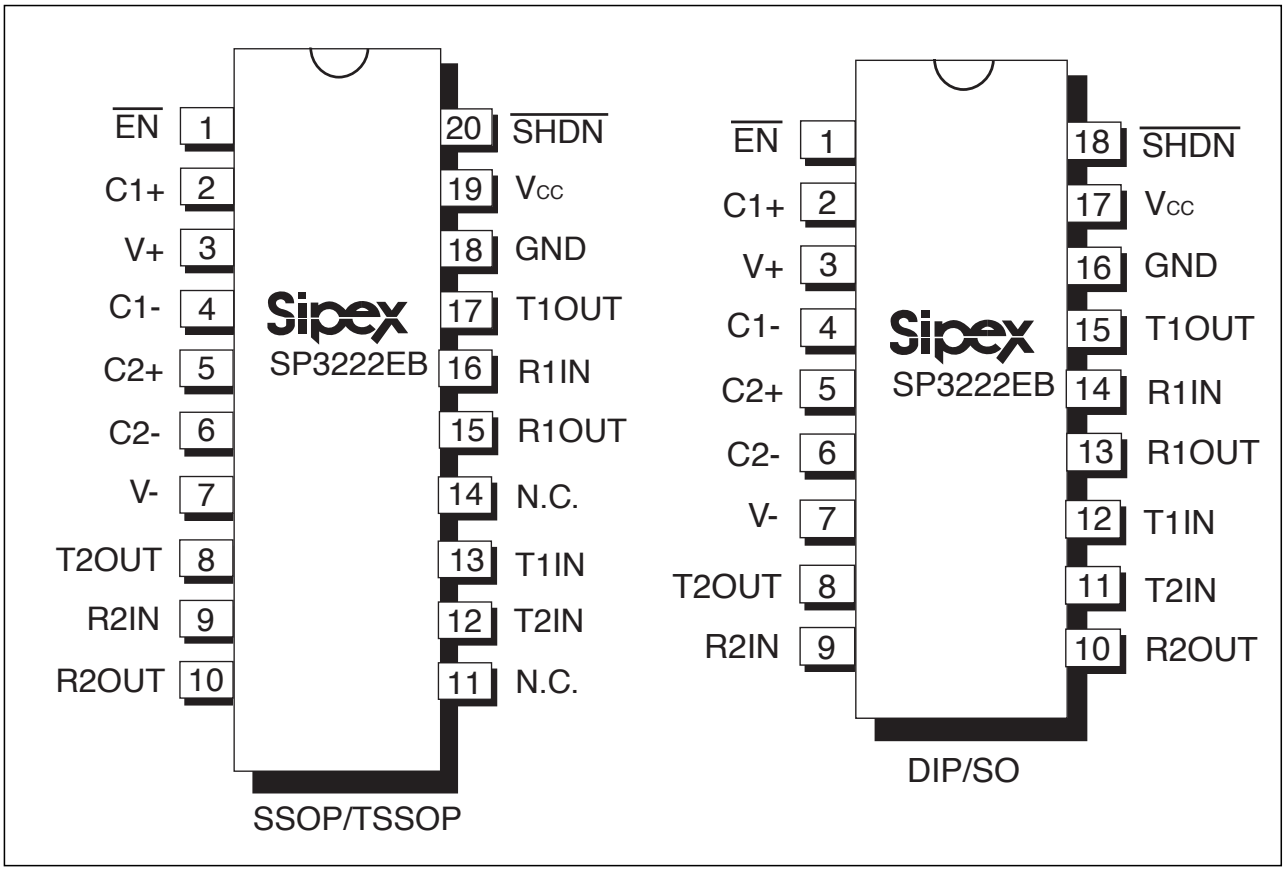


Figure 6. Pinout Configurations for the SP3222EB

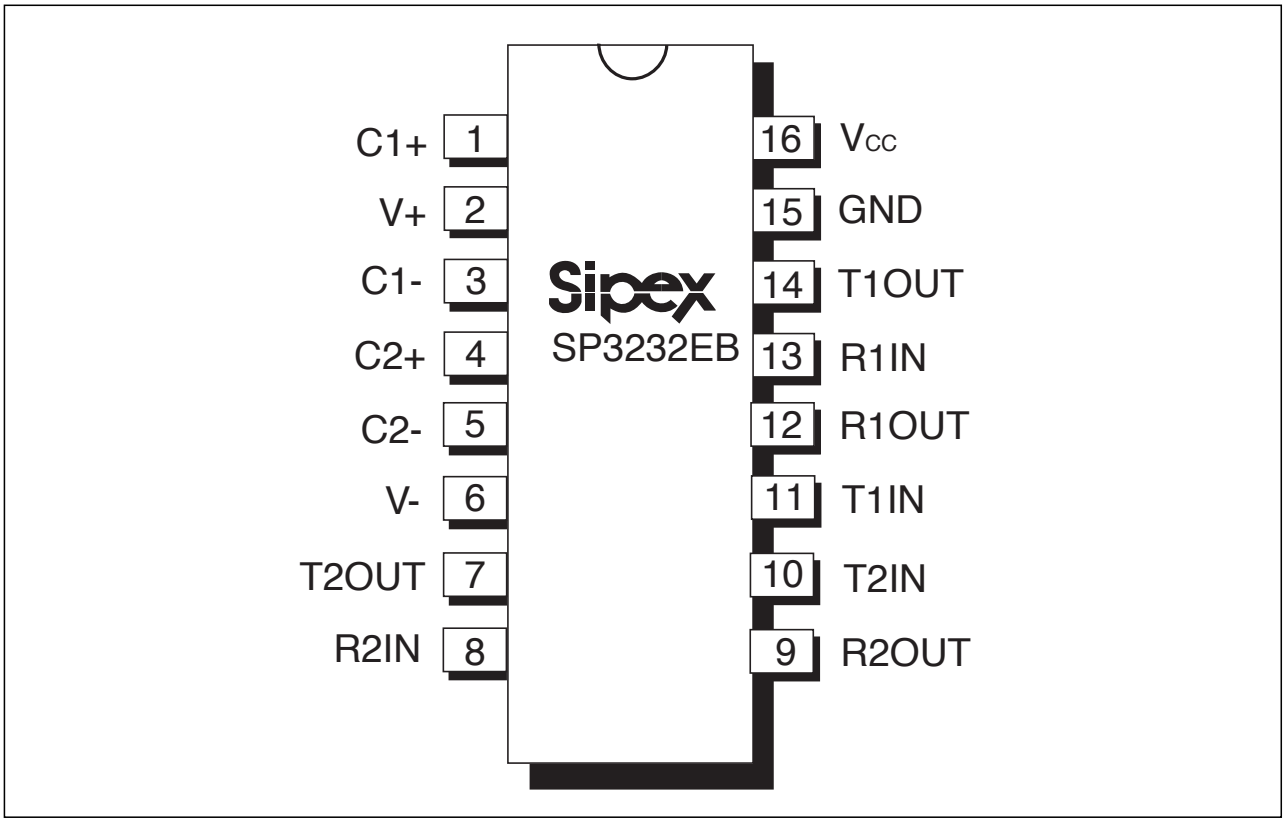


Figure 7. Pinout Configuration for the SP3232EB

 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

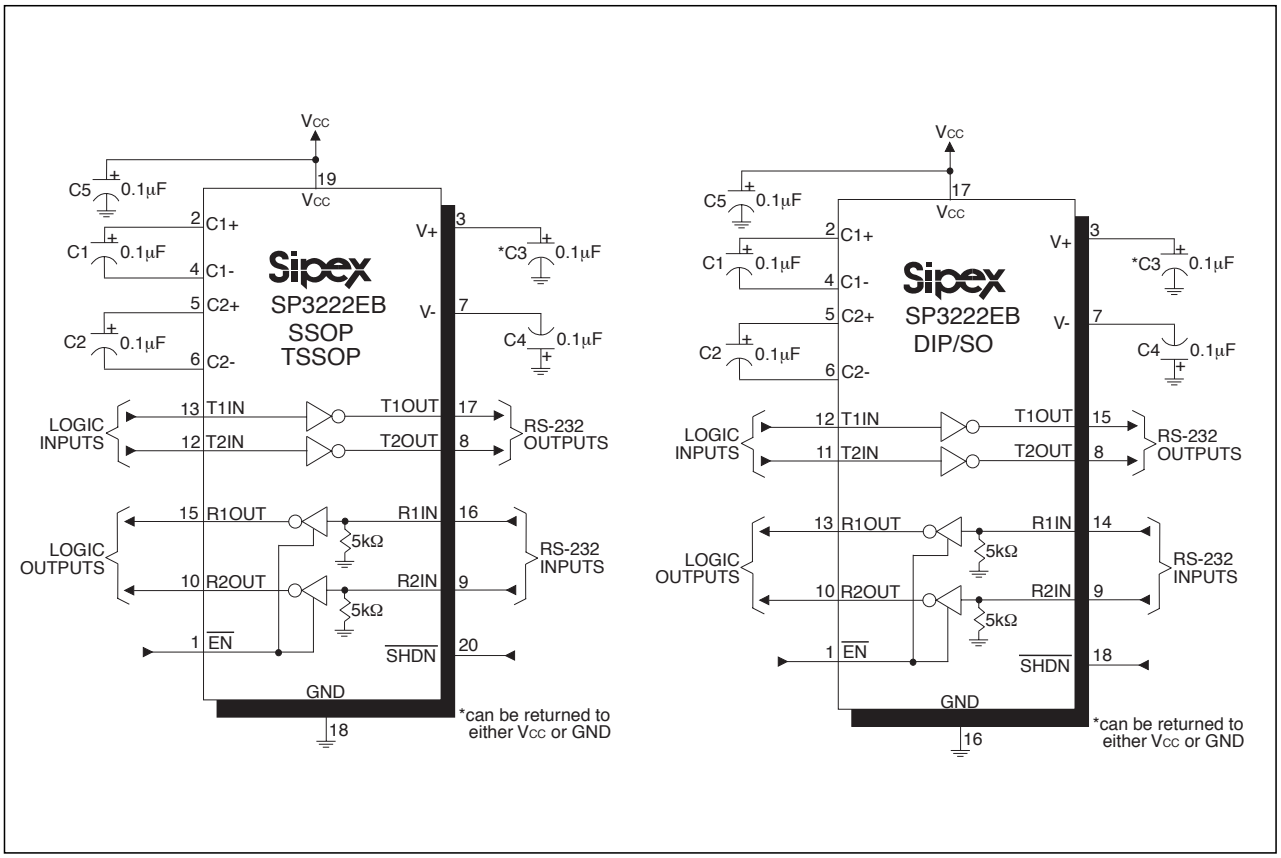


Figure 8. SP3222EB Typical Operating Circuits

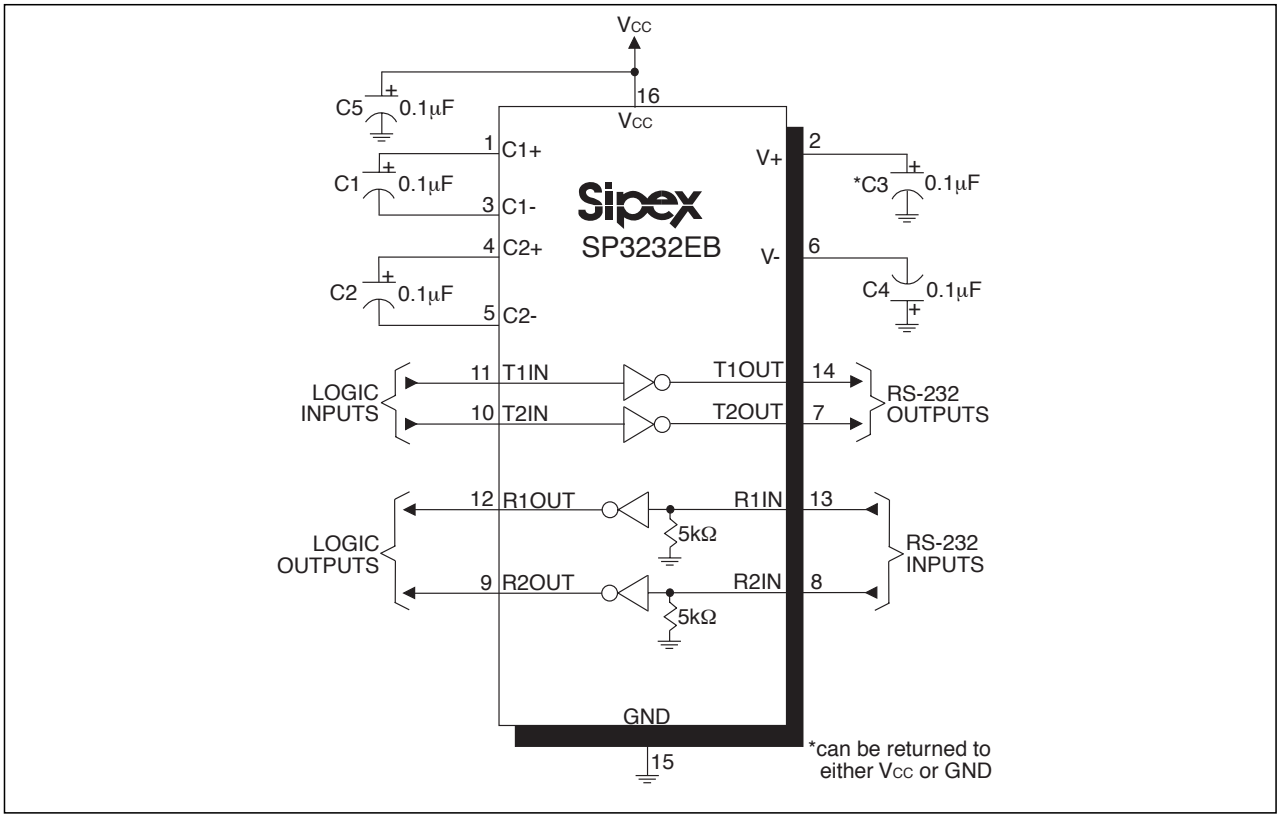


Figure 9. SP3232EB Typical Operating Circuit

 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

DESCRIPTION

The **SP3222EB/3232EB** transceivers meet the EIA/TIA-232 and V.28/V.24 communication protocols and can be implemented in battery-powered, portable, or hand-held applications such as notebook or palmtop computers. The **SP3222EB/3232EB** devices all feature **Sipex's** proprietary on-board charge pump circuitry that generates 2 x V_{CC} for RS-232 voltage levels from a single +3.0V to +5.5V power supply. This series is ideal for +3.3V-only systems, mixed +3.3V to +5.5V systems, or +5.0V-only systems that require true RS-232 performance. The **SP3222EB/3232EB** series have drivers that operate at a typical data rate of 250kbps fully loaded.

The **SP3222EB** and **SP3232EB** are 2-driver/2-receiver devices ideal for portable or hand-held applications. The **SP3222EB** features a 1µA shutdown mode that reduces power consumption and extends battery life in portable systems. Its receivers remain active in shutdown mode, allowing external devices such as modems to be monitored using only 1µA supply current.

THEORY OF OPERATION

The **SP3222EB/3232EB** series are made up of three basic circuit blocks: 1. Drivers, 2. Receivers, and 3. the Sipex proprietary charge pump.

Drivers

The drivers are inverting level transmitters that convert TTL or CMOS logic levels to ±5.0V EIA/TIA-232 levels inverted relative to the input logic levels. Typically, the RS-232 output voltage swing is ±5.5V with no load and at least ±5V minimum fully loaded. The driver outputs are protected against infinite short-circuits to ground without degradation in reliability. Driver outputs will meet EIA/TIA-562 levels of ±3.7V with supply voltages as low as 2.7V.

The drivers can guarantee a data rate of 250kbps fully loaded with 3KΩ in parallel with 1000pF, ensuring compatibility with PC-to-PC communication software.

The slew rate of the driver output is internally limited to a maximum of 30V/µs in order to meet the EIA standards (EIA RS-232D 2.1.7, Paragraph 5). The transition of the loaded output from HIGH to LOW also meets the monotonicity requirements of the standard.

Figure 10 shows a loopback test circuit used to the RS-232 drivers. *Figure 11* shows the test results of the loopback circuit with all drivers active at 120kbps with RS-232 loads in parallel with 1000pF capacitors. *Figure 12* shows the test results where one driver was active at 250kbps and all drivers loaded with an RS-232 receiver in parallel with a 1000pF capacitor. A solid RS-232 data transmission rate of 250kbps provides compatibility with many designs in personal computer peripherals and LAN applications.

The **SP3222EB** driver's output stages are turned off (tri-state) when the device is in shutdown mode. When the power is off, the **SP3222EB** device permits the outputs to be driven up to ±12V. The driver's inputs do not have pull-up resistors. Designers should connect unused inputs to V_{CC} or GND.

In the shutdown mode, the supply current falls to less than 1µA, where $\overline{SHDN}$ = LOW. When the **SP3222EB** device is shut down, the device's driver outputs are disabled (tri-stated) and the charge pumps are turned off with V+ pulled down to V_{CC} and V- pulled to GND. The time required to exit shutdown is typically 100µs. Connect $\overline{SHDN}$ to V_{CC} if the shutdown mode is not used.

© Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

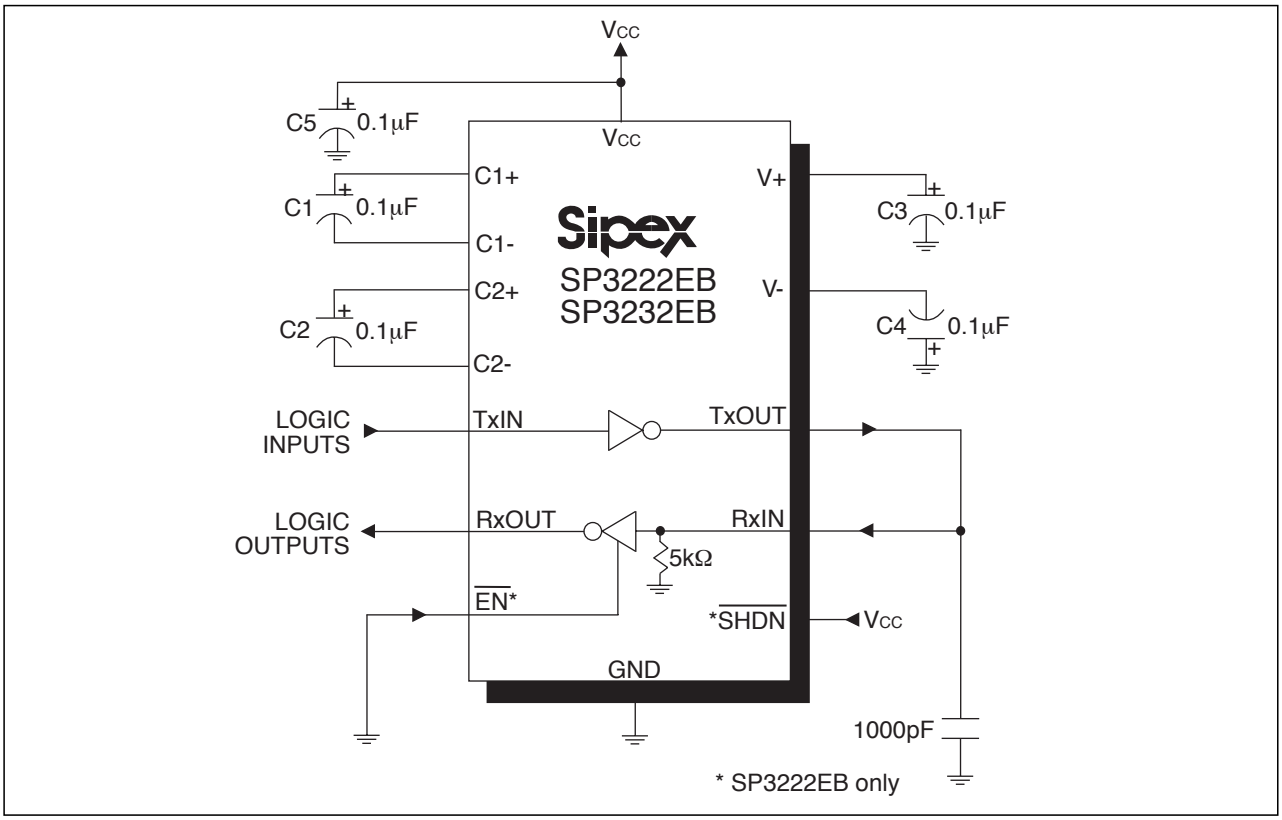


Figure 10. SP3222EB/3232EB Driver Loopback Test Circuit

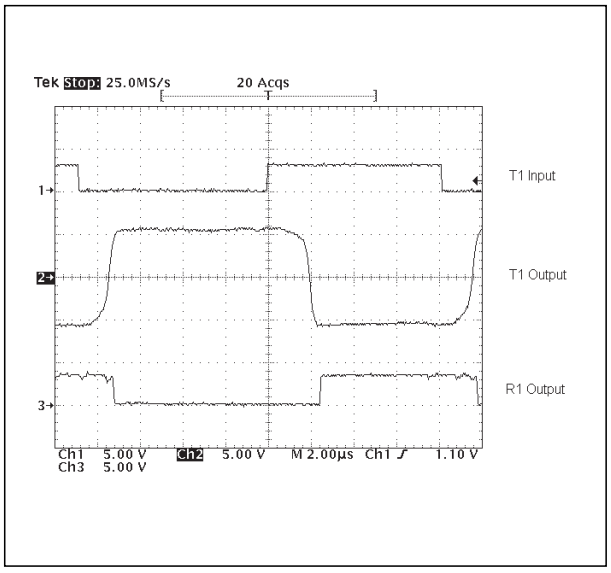


Figure 11. Driver Loopback Test Results at 120kbps

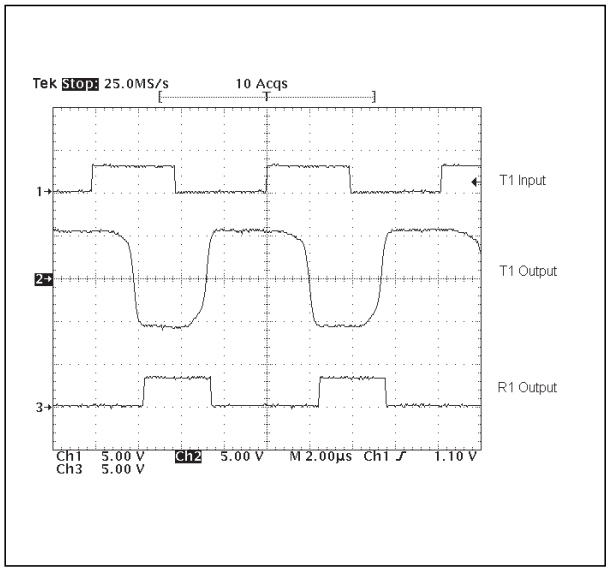


Figure 12. Driver Loopback Test Results at 250 kbps

 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

Receivers

The receivers convert EIA/TIA-232 levels to TTL or CMOS logic output levels. The SP3222EB receivers have an inverting tri-state output. These receiver outputs (RxOUT) are tri-stated when the enable control $\overline{EN}$ = HIGH. In the shutdown mode, the receivers can be active or inactive. $\overline{EN}$ has no effect on TxOUT. The truth table logic of the **SP3222EB** driver and receiver outputs can be found in *Table 2*.

Since receiver input is usually from a transmission line where long cable lengths and system interference can degrade the signal, the inputs have a typical hysteresis margin of 300mV. This ensures that the receiver is virtually immune to noisy transmission lines. Should an input be left unconnected, a 5kΩ pulldown resistor to ground will commit the output of the receiver to a HIGH state.

Charge Pump

The charge pump is a **Sipex**–patented design (5,306,954) and uses a unique approach compared to older less–efficient designs. The charge pump still requires four external capacitors, but uses a four–phase voltage shifting technique to attain symmetrical 5.5V power supplies. The internal power supply consists of a regulated dual charge pump that provides output voltages 5.5V regardless of the input voltage (V_{CC}) over the +3.0V to +5.5V range.

In most circumstances, decoupling the power supply can be achieved adequately using a 0.1µF bypass capacitor at C5 (refer to *Figures 8* and *9*).

$\overline{SHDN}$	$\overline{EN}$	TxOUT	RxOUT
0	0	Tri-state	Active
0	1	Tri-state	Tri-state
1	0	Active	Active
1	1	Active	Tri-state

Table 2. SP3222EB Truth Table Logic for Shutdown and Enable Control

In applications that are sensitive to power-supply noise, decouple V_{CC} to ground with a capacitor of the same value as charge-pump capacitor C1. Physically connect bypass capacitors as close to the IC as possible.

The charge pumps operate in a discontinuous mode using an internal oscillator. If the output voltages are less than a magnitude of 5.5V, the charge pumps are enabled. If the output voltage exceed a magnitude of 5.5V, the charge pumps are disabled. This oscillator controls the four phases of the voltage shifting. A description of each phase follows.

Phase 1

— V_{SS} charge storage — During this phase of the clock cycle, the positive side of capacitors C_1 and C_2 are initially charged to V_{CC}. C_1^+ is then switched to GND and the charge in C_1^- is transferred to C_2^-. Since C_2^+ is connected to V_{CC}, the voltage potential across capacitor C_2 is now 2 times V_{CC}.

Phase 2

— V_{SS} transfer — Phase two of the clock connects the negative terminal of C_2 to the V_{SS} storage capacitor and the positive terminal of C_2 to GND. This transfers a negative generated voltage to C_3. This generated voltage is regulated to a minimum voltage of -5.5V. Simultaneous with the transfer of the voltage to C_3, the positive side of capacitor C_1 is switched to V_{CC} and the negative side is connected to GND.

Phase 3

— V_{DD} charge storage — The third phase of the clock is identical to the first phase — the charge transferred in C_1 produces $-V_{CC}$ in the negative terminal of C_1, which is applied to the negative side of capacitor C_2. Since C_2^+ is at V_{CC}, the voltage potential across C_2 is 2 times V_{CC}.

Phase 4

— V_{DD} transfer — The fourth phase of the clock connects the negative terminal of C_2 to GND, and transfers this positive generated voltage across C_2 to C_4, the V_{DD} storage capacitor.

© Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

This voltage is regulated to +5.5V. At this voltage, the internal oscillator is disabled. Simultaneous with the transfer of the voltage to C_4, the positive side of capacitor C_1 is switched to V_{CC} and the negative side is connected to GND, allowing the charge pump cycle to begin again. The charge pump cycle will continue as long as the operational conditions for the internal oscillator are present.

Since both V^+ and V^- are separately generated from V_{CC}; in a no–load condition V^+ and V^- will be symmetrical. Older charge pump approaches that generate V^- from V^+ will show a decrease in the magnitude of V^- compared to V^+ due to the inherent inefficiencies in the design.

The clock rate for the charge pump typically operates at 250kHz. The external capacitors can be as low as 0.1µF with a 16V breakdown voltage rating.

ESD Tolerance

The **SP3222EB/3232EB** series incorporates 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 electrostatic discharges and associated transients. The improved ESD tolerance is at least ±15kV without damage nor latch-up.

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 electrostatic energy and discharge it to an integrated circuit.

The simulation is performed by using a test model as shown in *Figure 18*. 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 19*. 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 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.

© Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

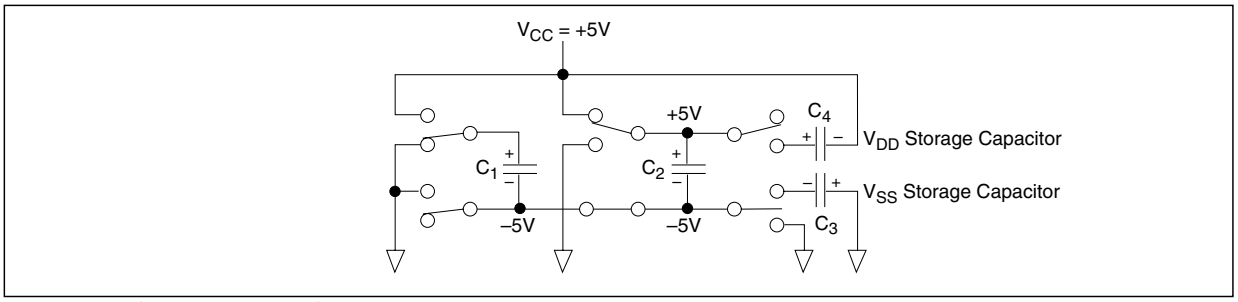


Figure 13. Charge Pump — Phase 1

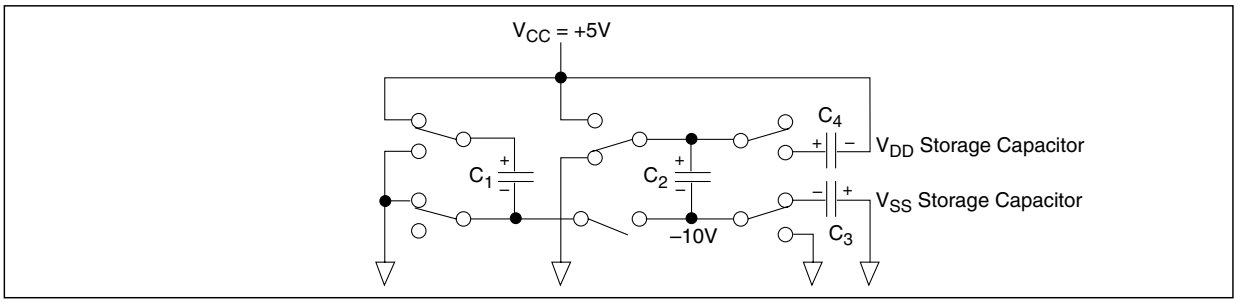


Figure 14. Charge Pump — Phase 2

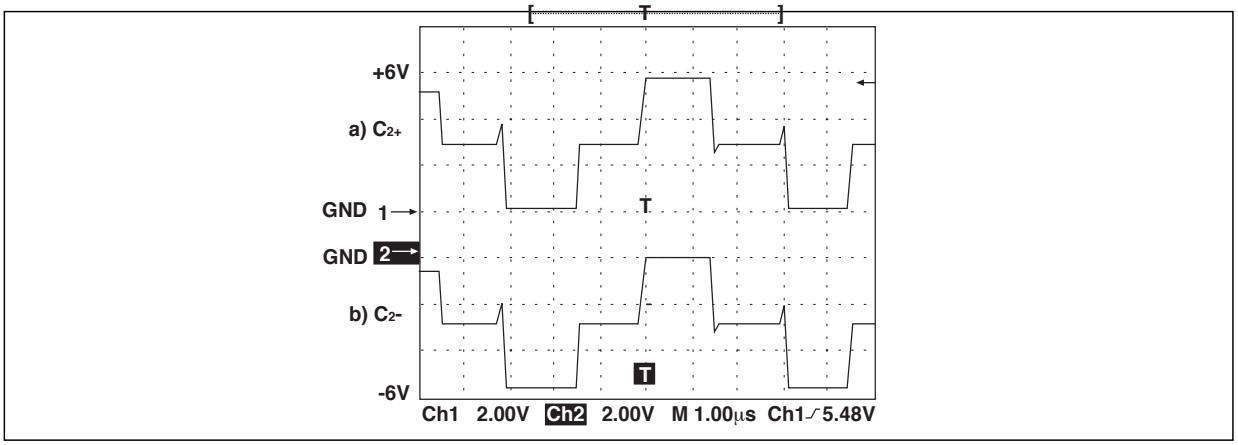


Figure 15. Charge Pump Waveforms

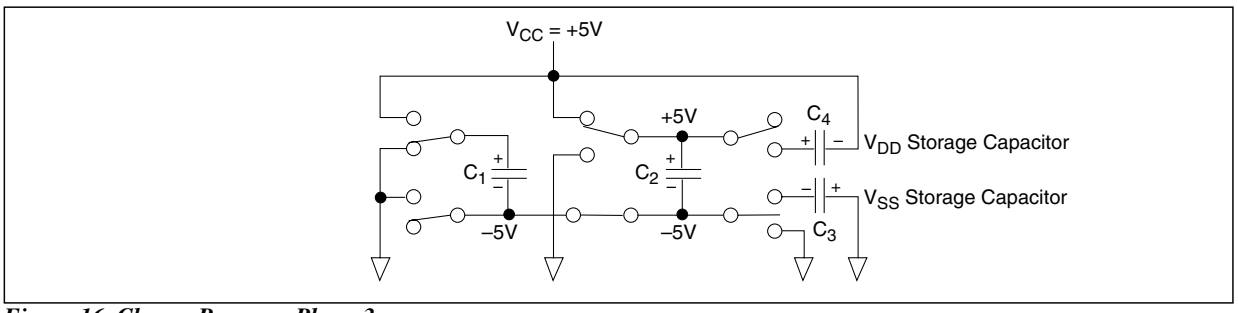


Figure 16. Charge Pump — Phase 3

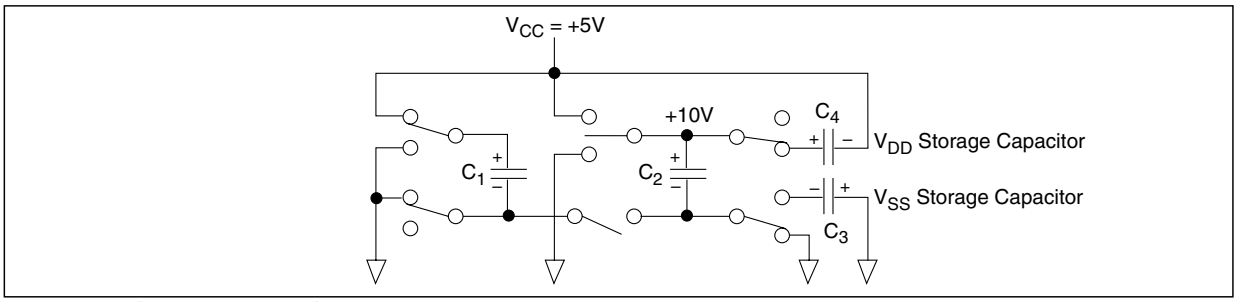


Figure 17. Charge Pump — Phase 4

 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

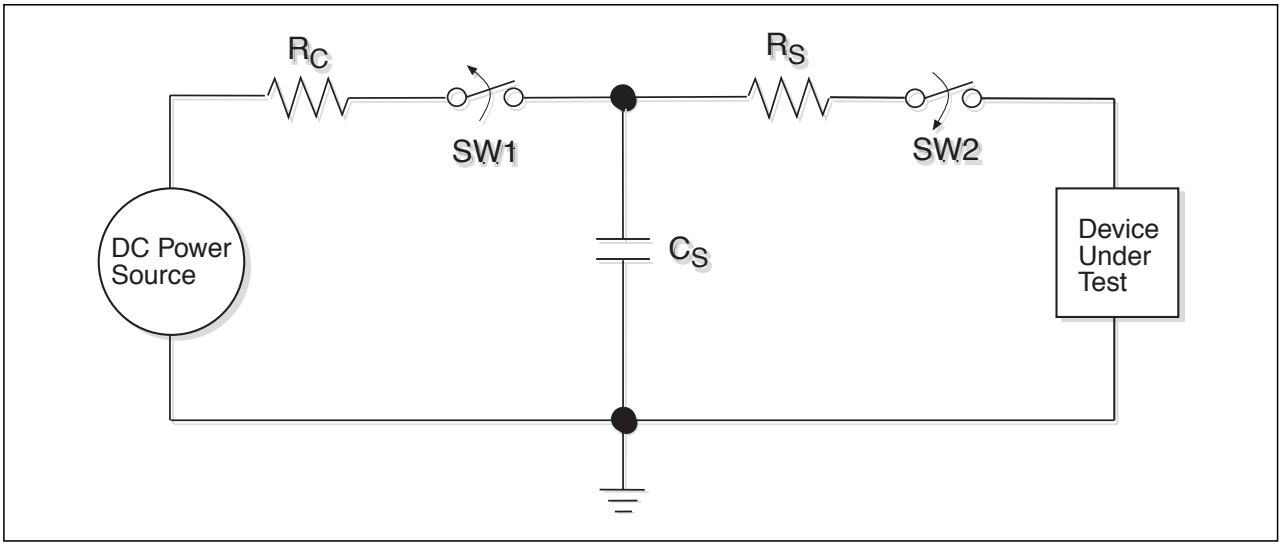


Figure 18. ESD Test Circuit for Human Body Model

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 18* and *19* 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.

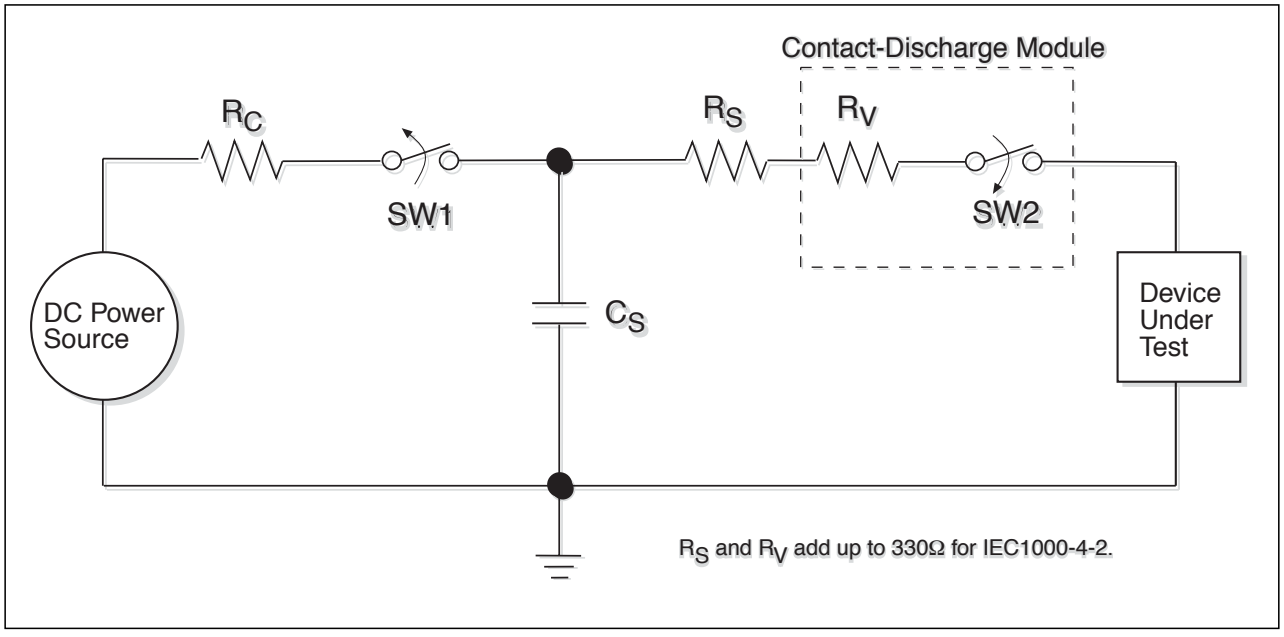


Figure 19. ESD Test Circuit for IEC1000-4-2

 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

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.

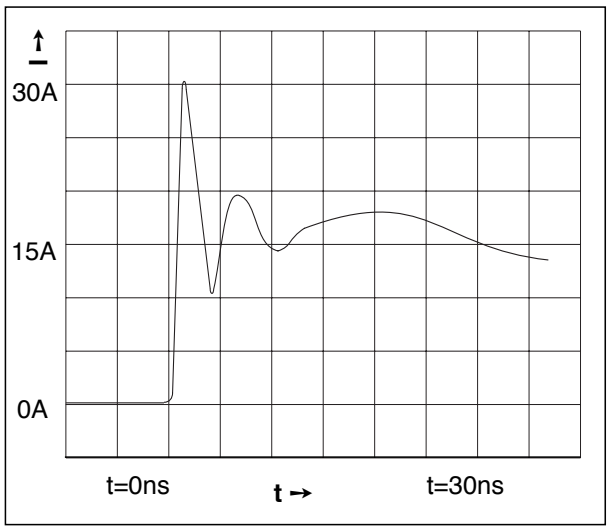


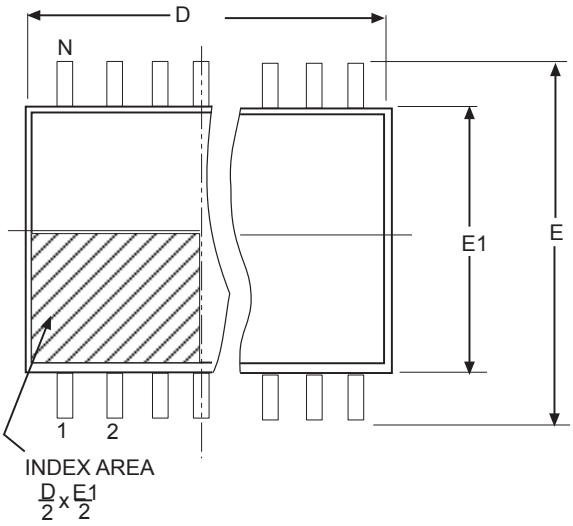
Figure 20. ESD Test Waveform for IEC1000-4-2

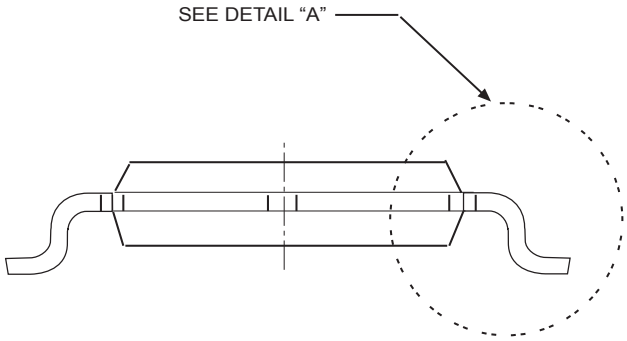
Device Pin Tested	Human Body Model	IEC1000-4-2		
		Air Discharge	Direct Contact	Level
Driver Outputs	±15kV	±15kV	±8kV	4
Receiver Inputs	±15kV	±15kV	±8kV	4

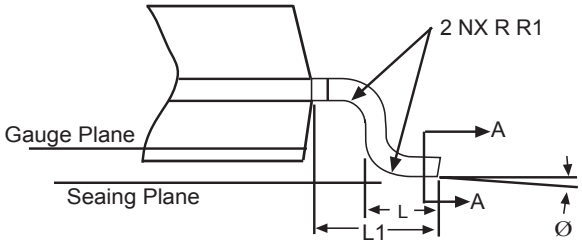
Table 3. Transceiver ESD Tolerance Levels

© Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor



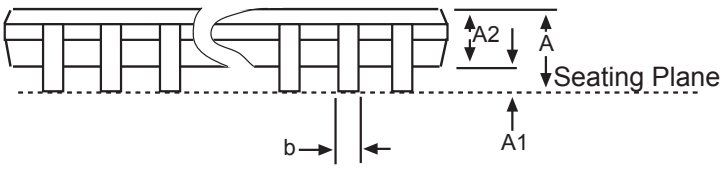


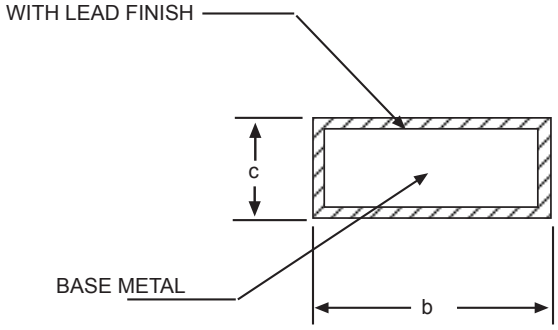


DETAIL A

20 Pin SSOP JEDEC MO-153 (AE) Variation			
SYMBOL	MIN	NOM	MAX
A	-	-	2
A1	0.05	-	-
A2	1.65	1.75	1.85
b	0.22	-	0.38
c	0.09	-	0.25
D	6.9	7.2	7.5
E	7.4	7.8	8.2
E1	5	5.3	5.6
L	0.55	0.75	0.95
L1	1.25 REF		
ø	0º	4º	8º

Note: Dimensions in (mm)



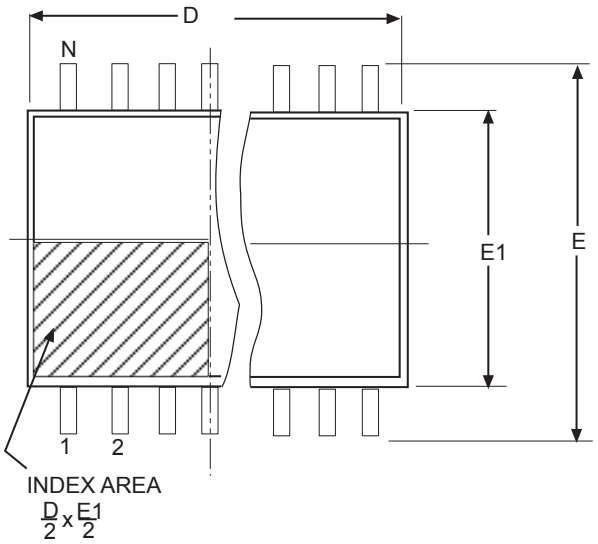


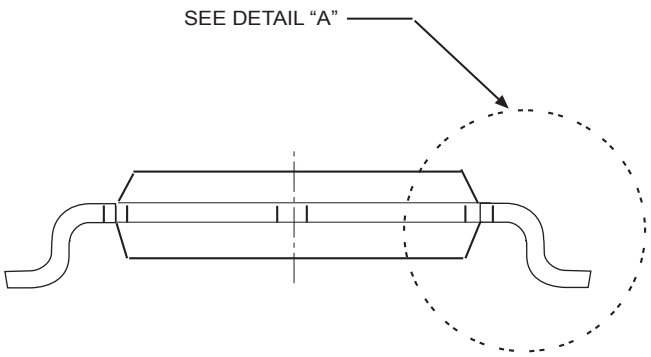
Section A-A

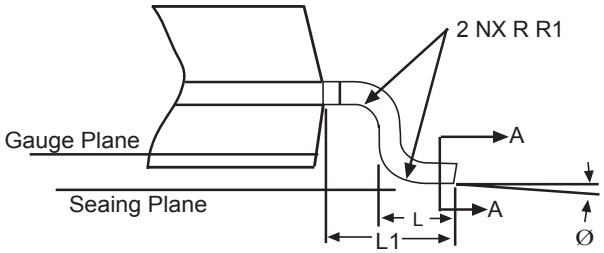
20 PIN SSOP

 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor



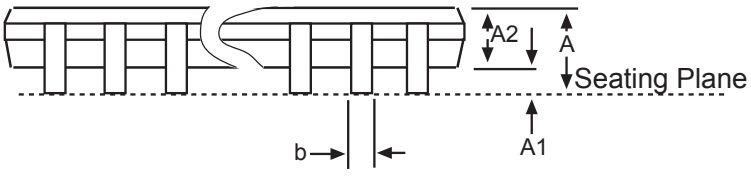


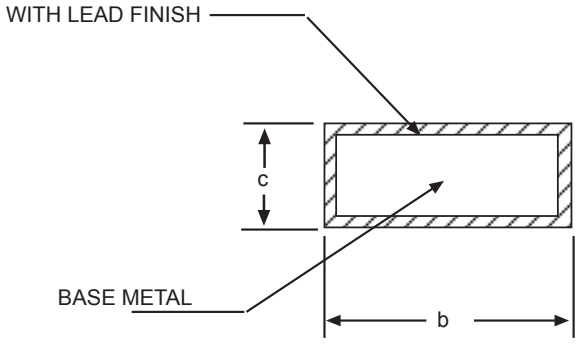


DETAIL A

16 Pin SSOP JEDEC MO-153 (AC) Variation			
SYMBOL	MIN	NOM	MAX
A	-	-	2
A1	0.05	-	-
A2	1.65	1.75	1.85
b	0.22	-	0.38
c	0.09	-	0.25
D	5.9	6.2	6.5
E	7.4	7.8	8.2
E1	5	5.3	5.6
L	0.55	0.75	0.95
L1	1.25 REF		
ø	0º	4º	8º

Note: Dimensions in (mm)

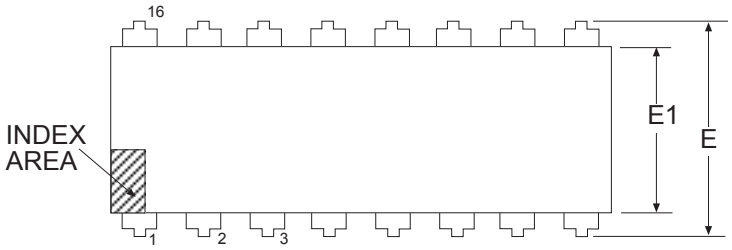




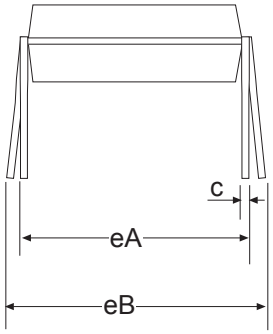
Section A-A

 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

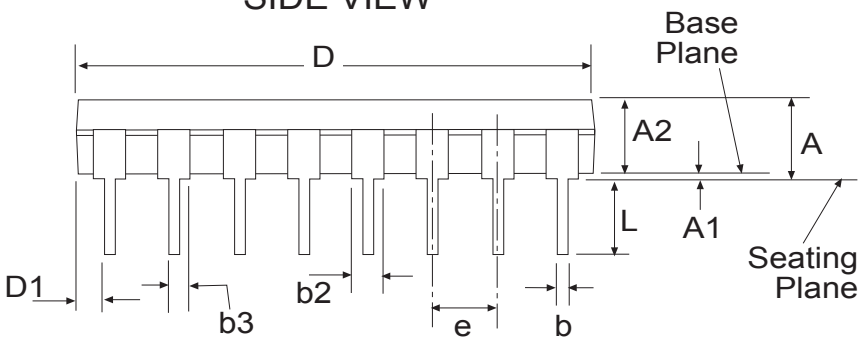


TOP VIEW



FRONT VIEW

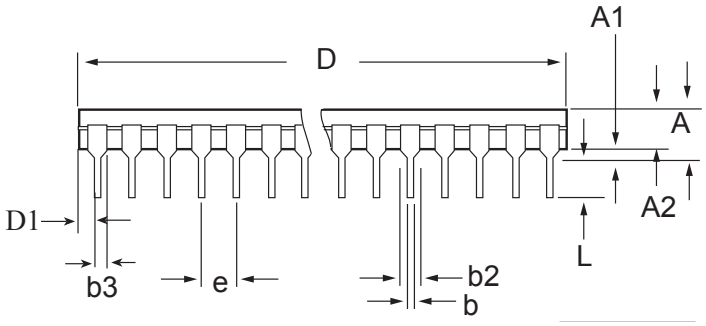
SIDE VIEW

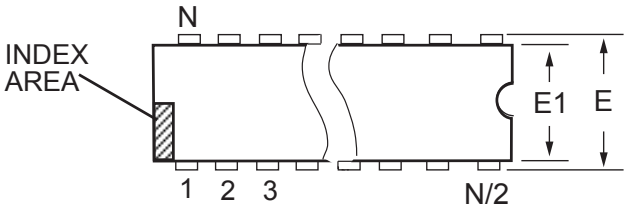


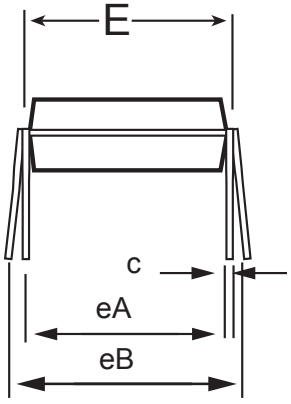
PDIP JEDEC MS-001 VARIATION BB N = 16 Pins						
SYMBOL	Dimensions in Inches: Controlling Dimension			Dimensions in Millimeters Conversion Factor: 1 Inch = 25.40 mm		
	MIN	NOM	MAX	MIN	NOM	MAX
A	-	-	0.210	-	-	5.33
A1	0.015	-	-	0.38	-	-
A2	0.115	0.130	0.195	2.92	3.30	4.95
b	0.014	0.018	0.022	0.36	0.46	0.56
b2	0.045	0.060	0.070	1.14	1.52	1.78
b3	0.030	0.039	0.045	0.76	0.99	1.14
c	0.008	0.010	0.014	0.20	0.25	0.36
D1	0.005	-	-	0.00	-	-
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			0.004 BSC		
eA	0.300 BSC			0.012 BSC		
eB	-	-	0.430	-	-	10.92
L	0.115	0.130	0.150	2.92	3.30	3.81
D	0.735	0.755	0.775	18.67	19.18	19.69
SIPEX Pkg Signoff Date/Rev: JL Nov21-05/ Rev A						

© Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

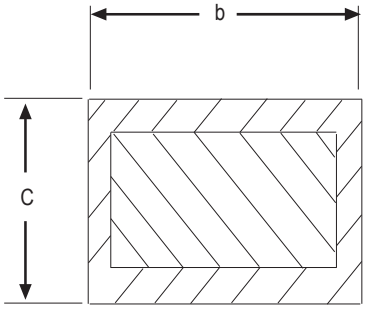






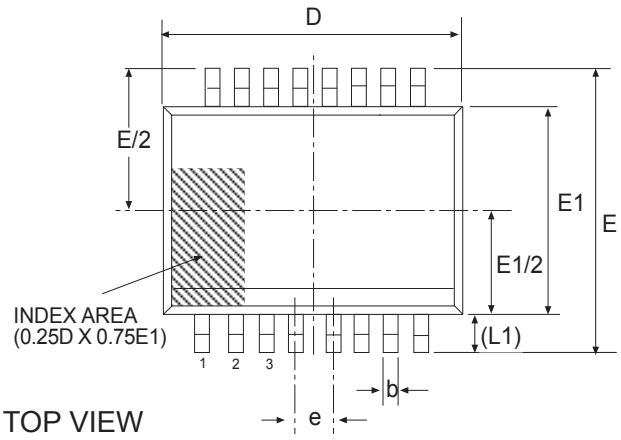
18 PIN PDIP JEDEC MS-001 (AC) Variation			
SYMBOL	MIN	NOM	MAX
A	-	-	0.21
A1	0.15	-	-
A2	0.115	0.13	0.195
b	0.014	0.018	0.022
b2	0.045	0.06	0.07
b3	0.3	0.039	0.045
c	0.008	0.01	0.014
D	0.88	0.9	0.92
D1	0.005	-	-
E	0.3	0.31	0.325
E1	0.24	0.25	0.28
e	.100 BSC		
eA	.300 BSC		
eB	-	-	0.43
L	0.115	0.13	0.15

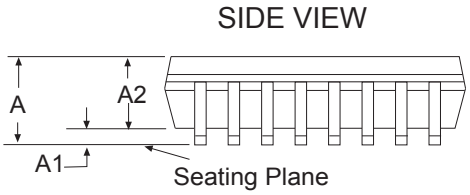
Note: Dimensions in (mm)

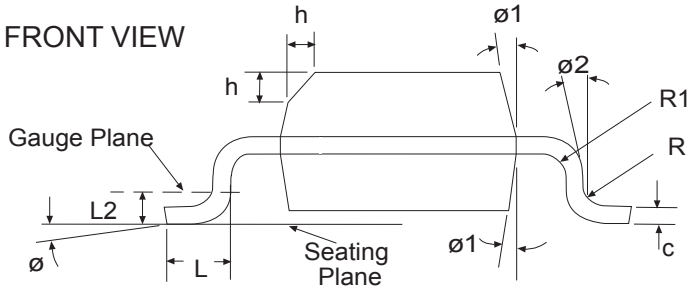


 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor



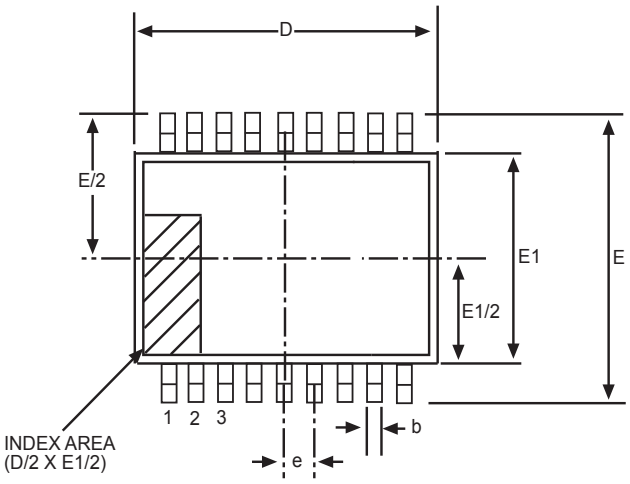




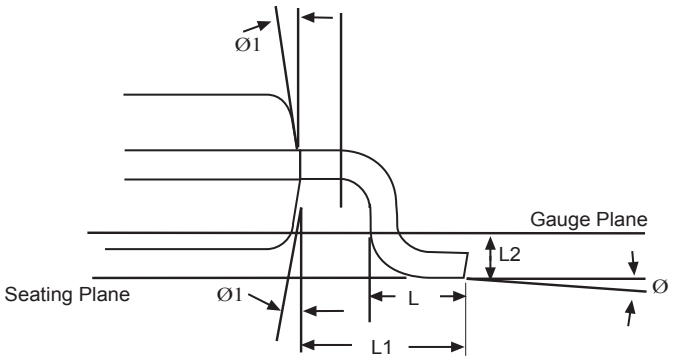
16 PIN WSOIC	JEDEC MS-013			Variation AA		
SYMBOL	Dimensions in Millimeters: Controlling Dimension			Dimensions in Inches Conversion Factor: 1 Inch = 25.40 mm		
	MIN	NOM	MAX	MIN	NOM	MAX
A	2.35	-	2.65	0.093	-	0.104
A1	0.10	-	0.30	0.004	-	0.012
A2	2.05	-	2.55	0.081	-	0.100
b	0.31	-	0.51	0.012	-	0.020
c	0.20	-	0.33	0.008	-	0.013
E	10.30 BSC			0.406 BSC		
E1	7.50 BSC			0.295 BSC		
e	1.27 BSC			0.050 BSC		
h	0.25	-	0.75	0.010	-	0.030
L	0.40	-	1.27	0.016	-	0.050
L1	1.40 REF			0.055 REF		
L2	0.25 BSC			0.010 BSC		
R	0.07	-	-	0.003	-	-
R1	0.07	-	-	0.003	-	-
ø	0º	-	8º	0º	-	8º
ø1	5º	-	15º	5º	-	15º
ø2	0º	-	-	0º	-	-
D	10.30 REF			0.405 REF		
SIPEX Pkg Signoff Date/Rev:				JL Oct11-05/ Rev A		

© Copyright 2005 Sipex Corporation

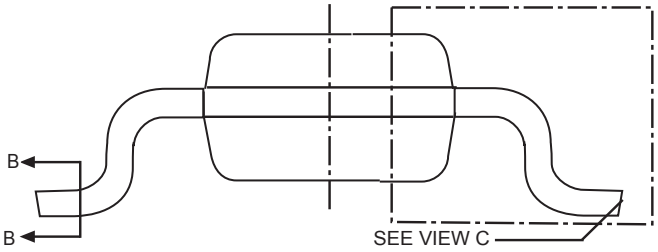
Downloaded from Elcodis.com electronic components distributor

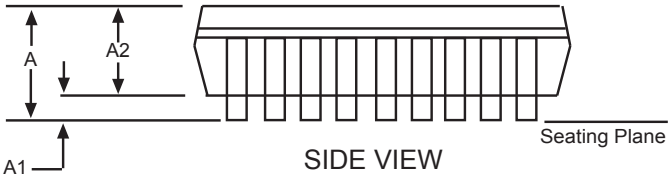


TOP VIEW



VIEW C

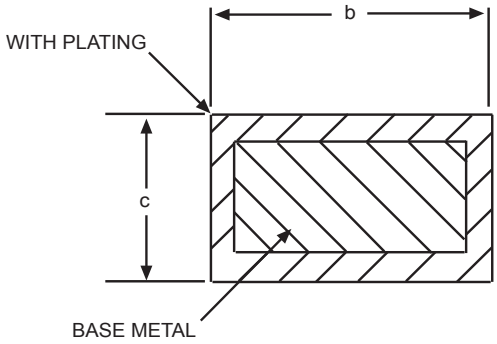




SIDE VIEW

18 Pin WSOIC JEDEC MS-013 (AB) Variation			
SYMBOL	MIN	NOM	MAX
A	2.350	-	2.650
A1	0.100	-	0.300
A2	2.050	-	2.550
b	0.310	-	0.510
c	0.200	-	0.330
D	11.55 BSC		
E	10.30 DSC		
E1	7.50 BSC		
e	1.27 BSC		
L	0.400	-	1.270
L1	1.04 REF		
L2	0.25 BSC		
ø	0º	-	8º
ø1	5º	-	15º

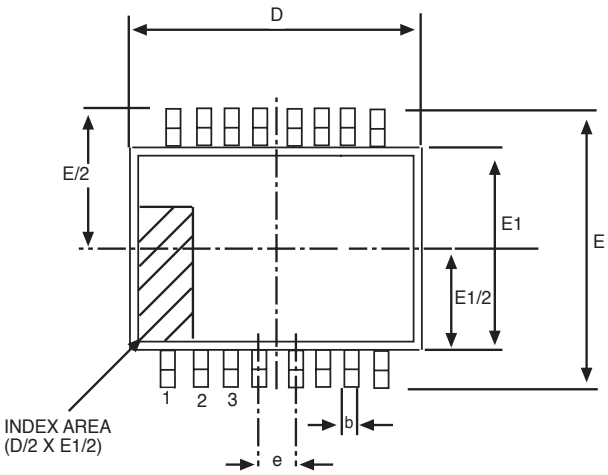
Note: Dimensions in (mm)



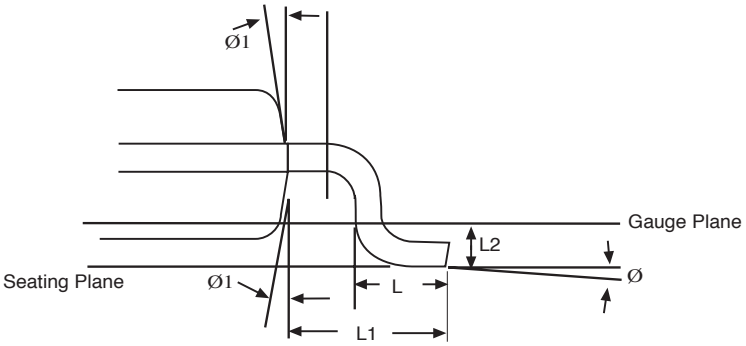
SECTION B-B

 © Copyright 2005 Sipex Corporation

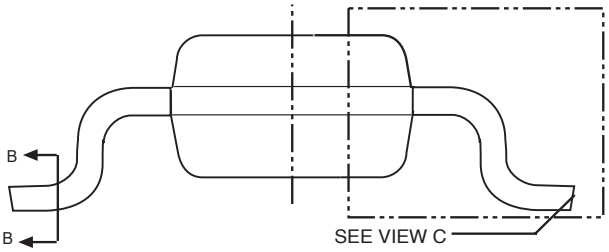
Downloaded from Elcodis.com electronic components distributor



TOP VIEW

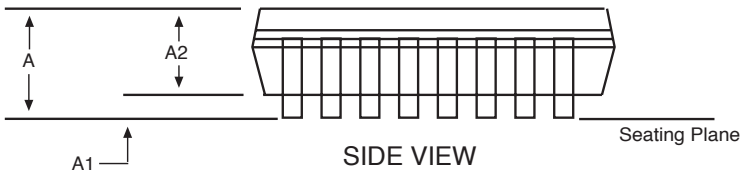


VIEW C

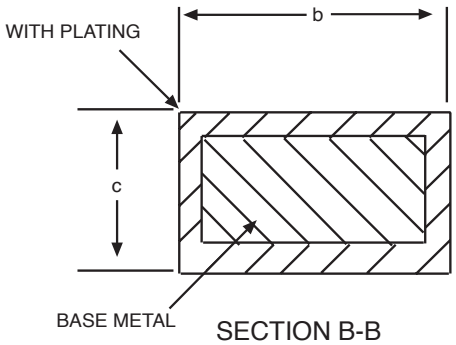


16 Pin SOIC JEDEC MS-013 (AA) Variation			
SYMBOL	MIN	NOM	MAX
A	2.35	-	2.65
A1	0.1	-	0.3
A2	2.05	-	2.55
b	0.31	-	0.51
c	0.2	-	0.33
D	10.30 BSC		
E	10.30 DSC		
E1	7.50 BSC		
e	1.27 BSC		
L	0.4	-	1.27
L1	1.04 REF		
L2	0.25 BSC		
ø	0º	-	8º
ø1	5º	-	15º

Note: Dimensions in (mm)



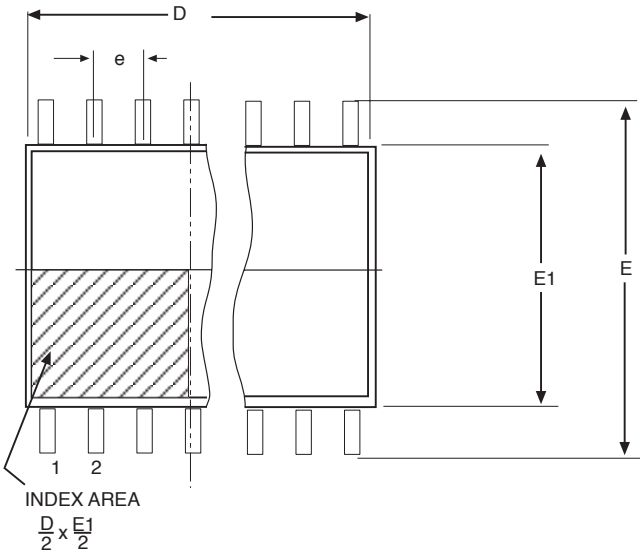
SIDE VIEW

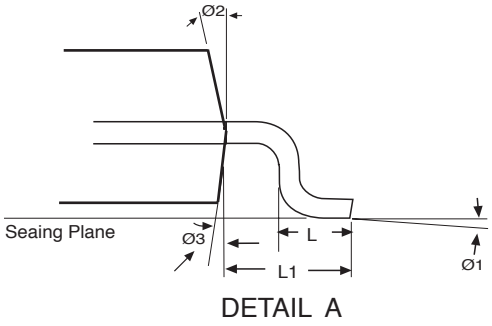


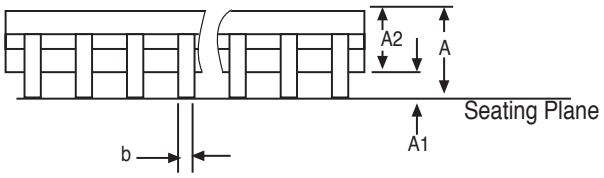
SECTION B-B

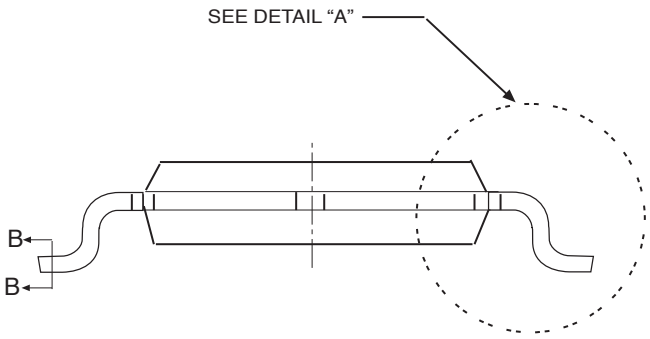
 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

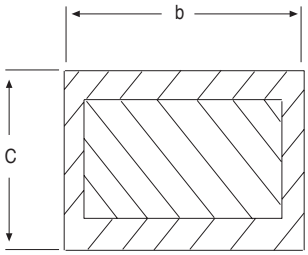








16 Pin TSSOP JEDEC MO-153 (AB) Variation			
SYMBOL	MIN	NOM	MAX
A	-	-	1.2
A1	0.05	-	0.15
A2	0.8	1	1.05
b	0.19	-	0.3
c	0.09	-	0.2
D	4.9	5	5.1
E		6.40 BSC	
E1	4.3	4.4	4.5
e		0.65 BSC	
Ø1	0º	4º	8º
ø2		12º REF	
ø3		12º REF	
L	0.45	0.6	0.75
L1		1.00 REF	

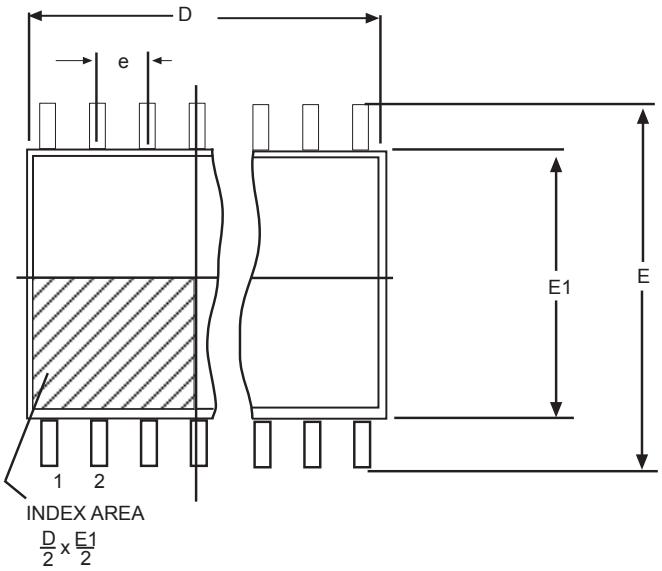


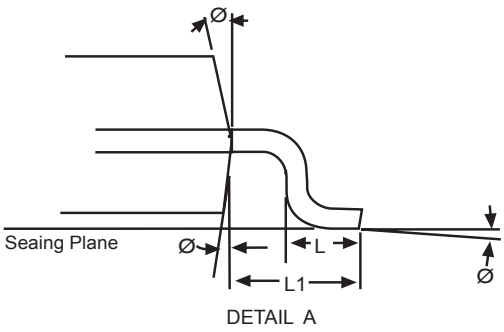
Section B-B

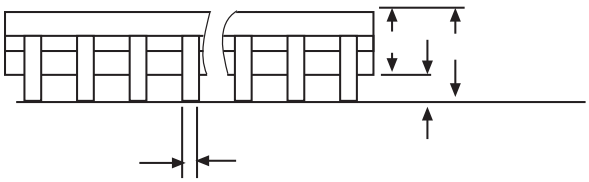
Note: Dimensions in (mm)

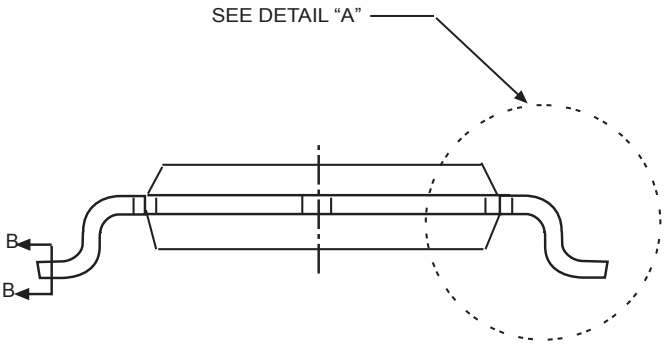
 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

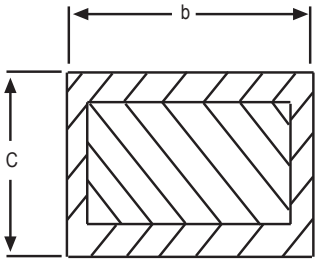








20 Pin TSSOP JEDEC MO-153 (AC) Variation			
SYMBOL	MIN	NOM	MAX
A	-	-	1.2
A1	0.05	-	0.15
A2	0.8	1	1.05
b	0.19	-	0.3
c	0.09	-	0.2
D	6.4	6.5	6.6
E		6.40 BSC	
E1	4.3	4.4	4.5
e		0.65 BSC	
Ø1	0º	-	8º
ø2		12º REF	
ø3		12º REF	
L	0.45	0.6	0.75
L1		1.00 REF	

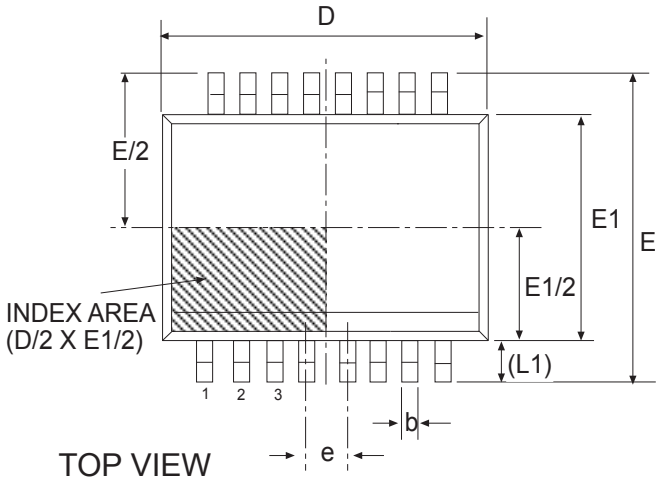


Section B-B

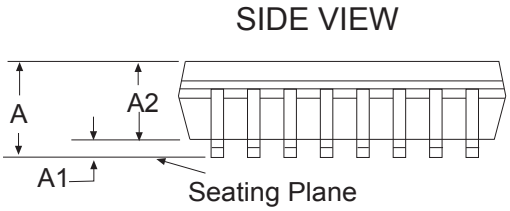
Note: Dimensions in (mm)

 © Copyright 2005 Sipex Corporation

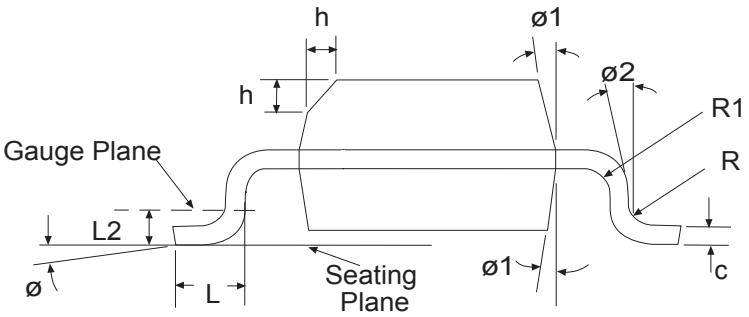
Downloaded from Elcodis.com electronic components distributor



TOP VIEW



SIDE VIEW



FRONT VIEW

16 Pin NSOIC			JEDEC MS-012		Variation AC	
SYMBOL	Dimensions in Millimeters: Controlling Dimension			Dimensions in Inches Conversion Factor: 1 Inch = 25.40 mm		
	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	-	-
ø	0º	-	8º	0º	-	8º
ø1	5º	-	15º	5º	-	15º
ø2	0º	-	-	0º	-	-
D	9.90 BSC			0.390 BSC		
SIPEX Pkg Signoff Date/Rev:			JL Oct12 -05 / Rev A			

© Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor

ORDERING INFORMATION

Part Number	Temperature Range	Package Type
SP3222EBCA	0˚C to +70˚C	20-Pin SSOP
SP3222EBCA/TR	0˚C to +70˚C	20-Pin SSOP
SP3222EBCP	0˚C to +70˚C	18-Pin PDIP
SP3222EBCT	0˚C to +70˚C	18-Pin WSOIC
SP3222EBCT/TR	0˚C to +70˚C	18-Pin WSOIC
SP3222EBCY	0˚C to +70˚C	20-Pin TSSOP
SP3222EBCY/TR	0˚C to +70˚C	20-Pin TSSOP
SP3222EBEA	-40˚C to +85˚C	20-Pin SSOP
SP3222EBEA/TR	-40˚C to +85˚C	20-Pin SSOP
SP3222EBEP	-40˚C to +85˚C	18-Pin PDIP
SP3222EBET	-40˚C to +85˚C	18-Pin WSOIC
SP3222EBET/TR	-40˚C to +85˚C	18-Pin WSOIC
SP3222EBEY	-40˚C to +85˚C	20-Pin TSSOP
SP3222EBEY/TR	-40˚C to +85˚C	20-Pin TSSOP
SP3232EBCA	0˚C to +70˚C	16-Pin SSOP
SP3232EBCA/TR	0˚C to +70˚C	16-Pin SSOP
SP3232EBCP	0˚C to +70˚C	16-Pin PDIP
SP3232EBCT	0˚C to +70˚C	16-Pin WSOIC
SP3232EBCT/TR	0˚C to +70˚C	16-Pin WSOIC
SP3232EBCN	0˚C to +70˚C	16-Pin NSOIC
SP3232EBCN/TR	0˚C to +70˚C	16-Pin NSOIC
SP3232EBCY	0˚C to +70˚C	16-Pin TSSOP
SP3232EBCY/TR	0˚C to +70˚C	16-Pin TSSOP
SP3232EBEA	-40˚C to +85˚C	16-Pin SSOP
SP3232EBEA/TR	-40˚C to +85˚C	16-Pin SSOP
SP3232EBEP	-40˚C to +85˚C	16-Pin PDIP
SP3232EBET	-40˚C to +85˚C	16-Pin WSOIC
SP3232EBET	-40˚C to +85˚C	16-Pin WSOIC
SP3232EBEN	-40˚C to +85˚C	16-Pin NSOIC
SP3232EBEN/TR	-40˚C to +85˚C	16-Pin NSOIC
SP3232EBEY	-40˚C to +85˚C	16-Pin TSSOP
SP3232EBEY/TR	-40˚C to +85˚C	16-Pin TSSOP

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SP3232EBEN/TR = standard; SP3232EBEN-L/TR = lead free

/TR = Tape and Reel

Pack quantity is 1,500 for WSOIC, SSOP or 20 pin TSSOP and 2,500 for NSOIC or 16 pin TSSOP.

CLICK HERE TO ORDER SAMPLES

Sipex Corporation

ANALOG EXCELLENCE

Headquarters and Sales Office
233 South Hillview Drive
Milpitas, CA 95035
TEL: (408) 934-7500
FAX: (408) 935-7600

Sipex Corporation reserves the right to make changes to any products described herein. Sipex does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights nor the rights of others.

 © Copyright 2005 Sipex Corporation

Downloaded from Elcodis.com electronic components distributor