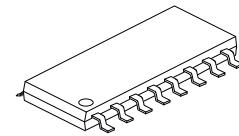


## DESCRIPTION

The **SP3232EEN** has two receivers and two drivers, and a dual charge-pump circuit. The device meets the requirements of TIA/EIA-232-F and provides the electrical interface between an asynchronous communication controller and the serial-port connector. The charge pump and four small external capacitors allow operation from a single 3.0V to 5.5V supply. The device operates at data signaling rates up to 250kbit/s and a maximum of 35V/ $\mu$ s driver output slew rate.

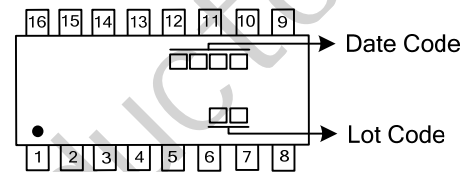


SOP-16

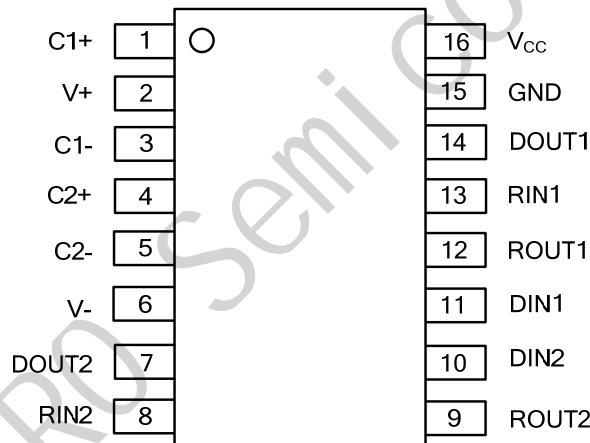
## FEATURES

- \* Exceeds  $\pm$ 8KV ESD Protection(HBM) for RS-232 I/O Pins
- \* Meets the Requirements of TIA/EIA-232-F and ITU V.28 Standards
- \* Operates With 3.0V to 5.5V  $V_{CC}$  Supply
- \* Operates Up To 250kbit/s Data Rate
- \* Two Drivers and Two Receivers
- \* External Capacitors  $4 \times 0.1\mu$ F
- \* Accepts 5.0V Logic Input With 3.3V Supply

## MARKING



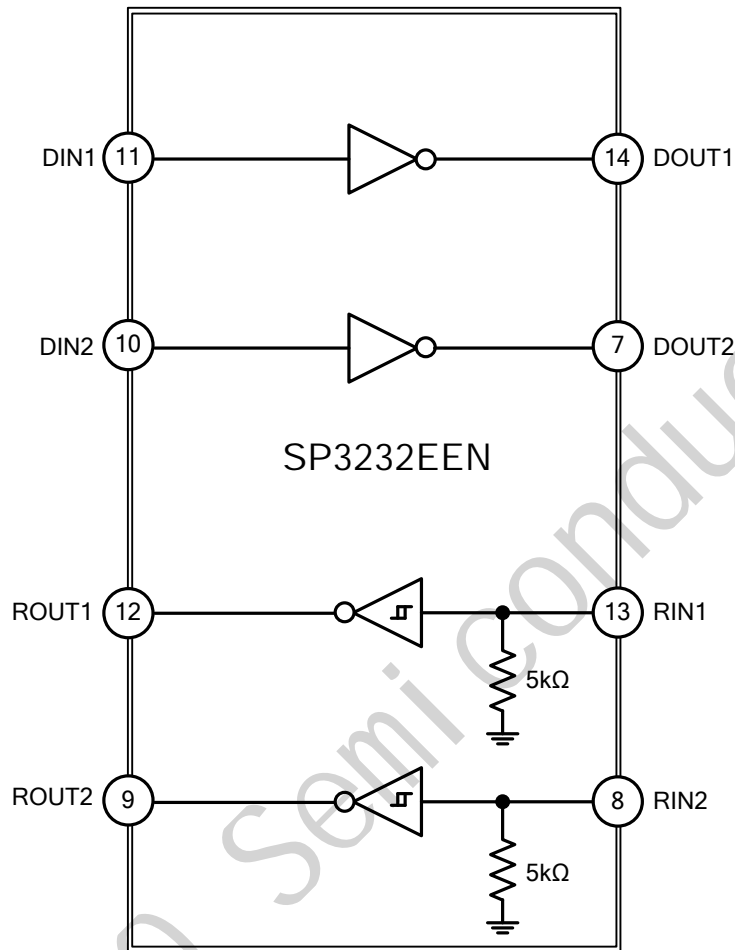
## PIN CONFIGURATION



## PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	C1+	Positive Terminal of Voltage-Doubler Charge-Pump Capacitor
2	V+	+5.5V Generated by the Charge Pump
3	C1-	Negative Terminal of Voltage-Doubler Charge-Pump Capacitor
4	C2+	Positive Terminal of Inverting Charge-Pump Capacitor
5	C2-	Negative Terminal of Inverting Charge-Pump Capacitor
6	V-	-5.5V Generated by the Charge Pump
7	DOUT2	RS-232 Driver Outputs
8	RIN2	RS-232 Receiver Inputs
9	ROUT2	TTL/CMOS Receiver Outputs
10	DIN2	TTL/CMOS Driver Inputs
11	DIN1	TTL/CMOS Driver Inputs
12	ROUT1	TTL/CMOS Receiver Outputs
13	RIN1	RS-232 Receiver Inputs
14	DOUT1	RS-232 Driver Outputs
15	GND	Ground
16	$V_{CC}$	+3.0V to +5.5V Supply Voltage

■ **BLOCK DIAGRAM**



**■ ABSOLUTE MAXIMUM RATING** [Over operating free-air temperature range (unless otherwise noted)]

PARAMETER		SYMBOL	RATINGS	UNIT
Supply Voltage Range		$V_{CC}$	-0.3 ~ +6.0	V
Positive Output Supply Voltage Range (Note 2)		V+	-0.3 ~ +7.0	V
Negative Output Supply Voltage Range (Note 2)		V-	+0.3 ~ -7.0	V
Supply Voltage Difference (Note 2)		V+ - V-	+13	V
Input Voltage	Drivers	$V_{IN}$	-0.3 ~ +6.0	V
	Receivers		-25 ~ +25	V
Output Voltage	Drivers	$V_{OUT}$	-13.2 ~ +13.2	V
	Receivers		-0.3 ~ $V_{CC}+0.3$	V
Operating Virtual Junction Temperature		$T_J$	+150	°C
Storage Temperature		$T_{STG}$	-65 ~ + 150	°C

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. All voltages are with respect to network GND.

**■ THERMAL DATA**

PARAMETER		SYMBOL	RATING	UNIT
Junction to Ambient	SOP-16	$\theta_{JA}$	105	°C/W
	TSSOP-16		118	

**■ RECOMMENDED OPERATING CONDITIONS** (See Note & Table 1)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage	$V_{CC}$	$V_{CC}=3.3V$	3.0	3.3	3.6	V
		$V_{CC}=5.0V$	4.5	5.0	5.5	V
Driver and Control High-level Input Voltage	$V_{IH}$	DIN	$V_{CC}=3.3V$	2.0		V
			$V_{CC}=5.5V$	2.4		
Driver and Control Low-level Input Voltage	$V_{IL}$	DIN			0.8	V
Driver and Control Input Voltage	$V_{IN}$	DIN			5.5	V
Receiver Input Voltage	$V_{RIN}$		-25		25	V
Operating Free-Air Temperature	$T_A$		0		70	°C

Notes: Test conditions are C1~C4=0.1 $\mu$ F at  $V_{CC}=3.3V\pm 0.3V$ ; C1=0.047 $\mu$ F, C2~C4=0.33 $\mu$ F at  $V_{CC}=5.0V\pm 0.5V$ .

■ **ELECTRICAL CHARACTERISTICS** [(over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 & Table 1)]

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP (Note 1)	MAX	UNIT
Supply Current	$I_{CC}$	No load		0.3	1.0	mA
<b>DRIVER SECTION</b>						
High-Level Output Voltage	$V_{OH}$	DOOUT at $R_L=3k\Omega$ to GND, DIN=GND	+5.0	+5.4		V
Low-Level Output Voltage	$V_{OL}$	DOOUT at $R_L=3k\Omega$ to GND, DIN= $V_{CC}$	-5.0	-5.4		V
High-Level Input Current	$I_{OH}$	$V_I=V_{CC}$		$\pm 0.01$	$\pm 1$	$\mu A$
Low-Level Input Current	$I_{OL}$	$V_I$ at GND		$\pm 0.01$	$\pm 1$	$\mu A$
Short-Circuit Output Current (Note 2)	$I_{OS}$	$V_{CC}=3.6V, V_{OUT}=0V$		$\pm 35$	$\pm 60$	mA
		$V_{CC}=5.5V, V_{OUT}=0V$		$\pm 35$	$\pm 60$	mA
Output Resistance	$r_O$	$V_{CC}, V+$ and $V- =0V, V_{OUT}=\pm 2.0V$	300	10M		$\Omega$
<b>RECEIVER SECTION</b>						
High-Level Output Voltage	$V_{OH}$	$I_{OH}=-1.0mA$	$V_{CC}-0.6V$	$V_{CC}-0.1V$		V
Low-Level Output Voltage	$V_{OL}$	$I_{OL}=1.6mA$			0.4	V
Positive-Going Input Threshold Voltage	$V_{IT+}$	$V_{CC}=3.3V$		1.5	2.4	V
		$V_{CC}=5.0V$		1.8	2.4	V
Negative-Going Input Threshold Voltage	$V_{IT-}$	$V_{CC}=3.3V$	0.6	1.2		V
		$V_{CC}=5.0V$	0.8	1.5		V
Input Hysteresis	$V_{HYS}$	$V_{IT+}-V_{IT-}$		0.3		V
Input Resistance	$R_I$	$V_I=\pm 3.0V\sim\pm 25V$	3	5	7	k $\Omega$

Notes: 1. All typical values are at  $V_{CC}=3.3V$  or  $V_{CC}=5.0V$ , and  $T_A=25^\circ C$ .

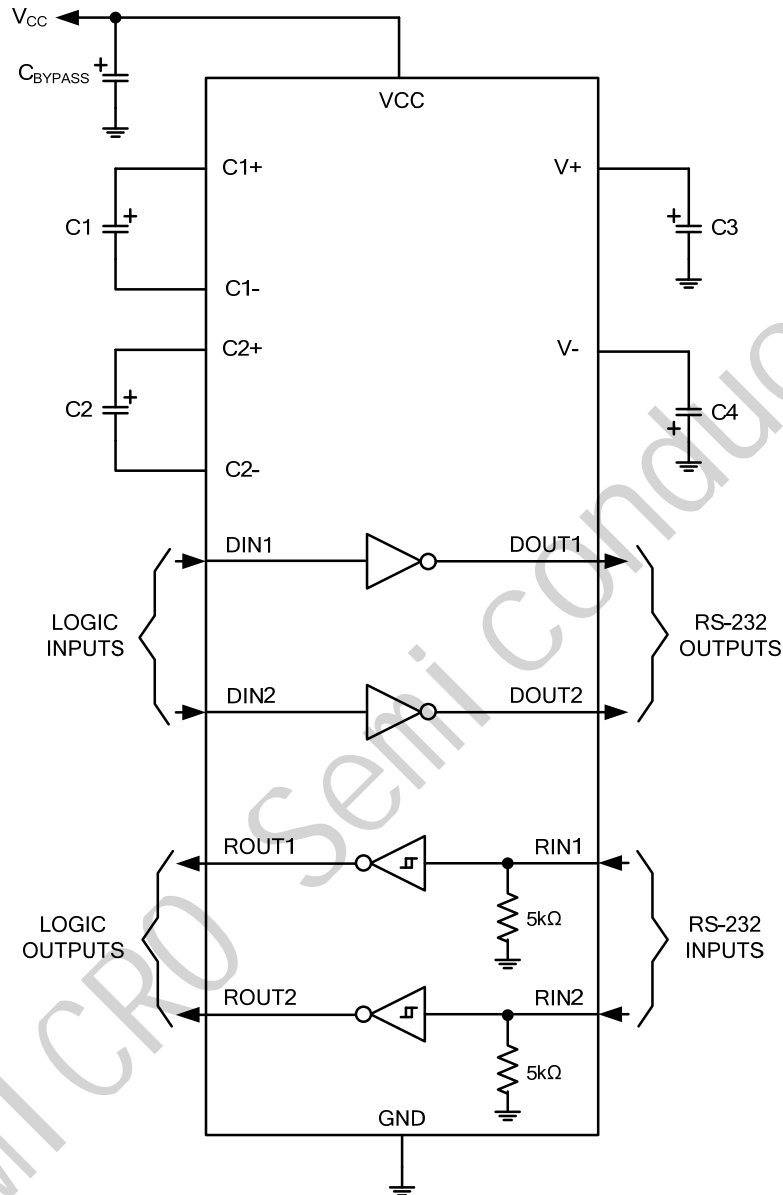
2. Short-circuit durations should be controlled to prevent exceeding the device absolute power-dissipation ratings, and not more than one output should be shorted at a time.
3. Test conditions are  $C1\sim C4=0.1\mu F$  at  $V_{CC}=3.3V\pm 0.3V$ ;  $C1=0.047\mu F, C2\sim C4=0.33\mu F$  at  $V_{CC}=5.0V\pm 0.5V$ .
4. Pulse skew is defined as  $|t_{PLH}-t_{PHL}|$  of each channel of the same device.

■ **SWITCHING CHARACTERISTICS** [(over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 3 and Table 1)]

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP (Note 1)	MAX	UNIT
<b>DRIVER SECTION</b>						
Maximum Data Rate		$C_L=1000pF, R_L=3k\Omega$ , One Driver Switching	150	250		Kbit/s
Pulse Skew (Note 4)	$t_{SK(P)}$	$C_L=220pF\sim 2500pF, R_L=3k\Omega\sim 7k\Omega$		300		ns
Slew Rate, Transition Region	SR(tr)	$R_L=3k\Omega\sim 7k\Omega, C_L=220pF\sim 1000pF$	5		35	V/ $\mu s$
		$V_{CC}=3.3V, C_L=220pF\sim 2500pF$	3		35	
<b>RECEIVER SECTION</b>						
Propagation Delay Time, Low-to High-Level Output	$t_{PLH}$	$C_L=150pF$		300		ns
Propagation Delay Time, High-to Low-Level Output	$t_{PHL}$	$C_L=150pF$		300		ns
Output Enable Time	$t_{EN}$	$C_L=150pF, R_L=3k\Omega$		200		ns
Output Disable Time	$t_{DIS}$	$C_L=150pF, R_L=3k\Omega$		200		ns
Pulse Skew (Note 4)	$t_{SK(P)}$	$ t_{PLH}-t_{PHL} $		300		ns

Notes: 1. All typical values are at  $V_{CC}=3.3V$  or  $V_{CC}=5.0V$ , and  $T_A=25^\circ C$ .

2. Short-circuit durations should be controlled to prevent exceeding the device absolute power-dissipation ratings, and not more than one output should be shorted at a time.
3. Test conditions are  $C1\sim C4=0.1\mu F$  at  $V_{CC}=3.3V\pm 0.3V$ ;  $C1=0.047\mu F, C2\sim C4=0.33\mu F$  at  $V_{CC}=5.0V\pm 0.5V$ .
4. Pulse skew is defined as  $|t_{PLH}-t_{PHL}|$  of each channel of the same device.

**■ TYPICAL APPLICATION CIRCUIT**


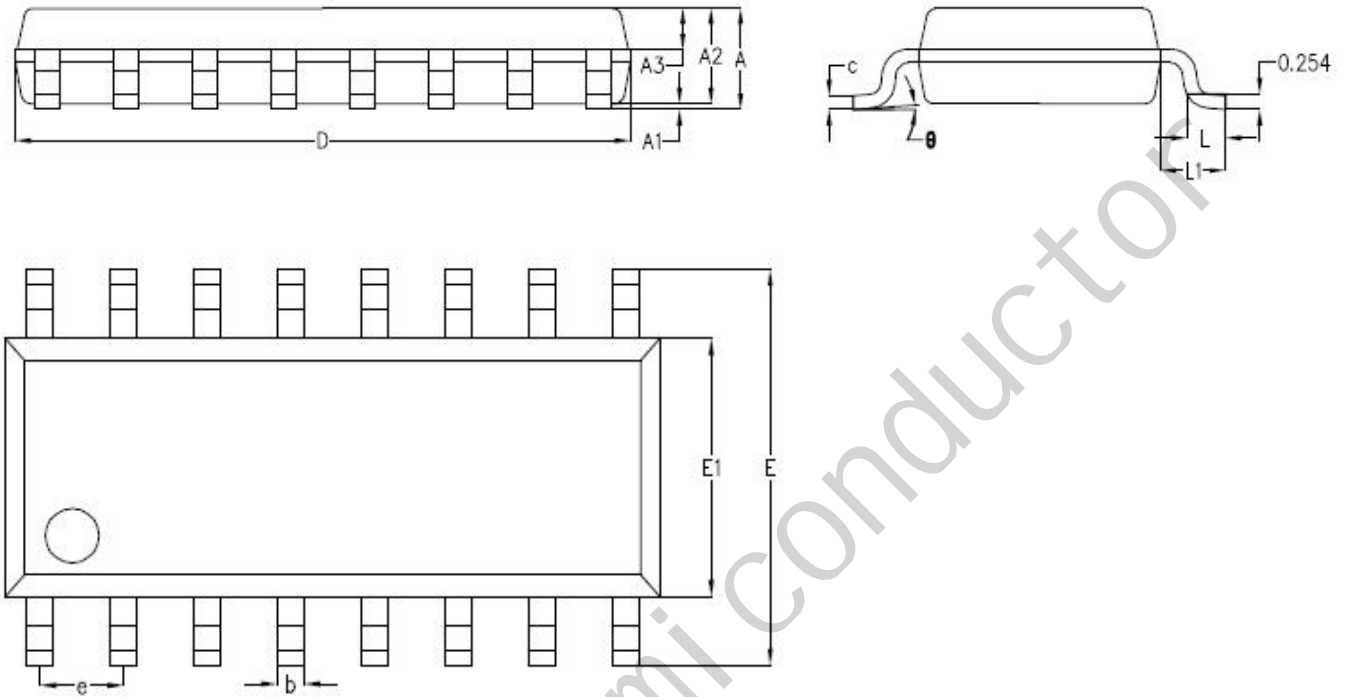
- Notes: 1. C3 can be connected to V<sub>CC</sub> or GND.  
 2. Resistor values shown are nominal.  
 3. NC: No internal connection.  
 4. Nonpolarized ceramic capacitors are acceptable. If polarized tantalum or electrolytic capacitors are used, they should be connected as shown.

Table1. Typical Operating Circuit and Capacitor Values

V <sub>CC</sub> (V)	C1 (μF)	C2, C3, C4 (μF)	C <sub>BYPASS</sub> (μF)
3.0~3.6	0.22	0.22	0.22
3.15~3.6	0.1	0.1	0.1
4.5~5.5	0.047	0.33	0.047
3.0~5.5	0.22	1.0	0.22

**Package Dimensions**

&gt; SOP-16



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	--	1.61	1.66
A1	--	0.10	0.25
A2	1.47	1.52	1.57
A3	0.61	0.66	0.71
b	0.35	0.40	0.45
c	0.17	0.22	0.25
D	9.80	9.90	10.0
E	5.90	6.00	6.10
E1	3.80	3.90	4.00
e	1.27BSC		
L	0.60	0.65	0.70
L1	1.05BSC		
$\theta$	0°	4°	6°

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