

## STC3232E

## *High ESD-Protected, Low Power, 3.3V to 5.5V, True RS-232 Transceivers*

### **General Description**

The STC3232E is 2 driver, 2 receiver RS-232 transceiver solutions intended for portable or hand-held applications, features low power consumption, high data-rate capabilities, and enhanced ESD protection. The ESD tolerance of the STC3232E devices is over  $\pm 15\text{kV}$  for both human body model and IEC1000-4-2 air discharge test methods.

A low-dropout transmitter output stage delivers true RS-232 performance from a +3.0V to +5.5V power supply, using an internal dual charge pump. The charge pump requires only four small 0.1 $\mu\text{F}$  capacitors for operation from a +3.3V supply. Each device guarantees operation at data rates of 250kbps while maintaining RS-232 output levels.

The STC3232E is pin, package, and functionally compatible with the industry-standard MAX232.

### **Applications**

Notebook, Sub notebook, and Palmtop Computers

Battery-Powered / Hand-Held Equipment

POS terminal / Intelligent Network Switch

DMM / Printers

Smart Phones

xDSL Modems

### **Features**

Interoperable with EIA/TIA - 232 and adheres to EIA/TIA - 562

Enhanced ESD Specifications:

15kV Human Body Model

15kV IEC1000-4-2 Air Discharge

8kV IEC1000-4-2 Contact Discharge

250 kbps Minimum Transmission Rate

Ideal for Handheld, Battery Operated Applications

Latch up Free

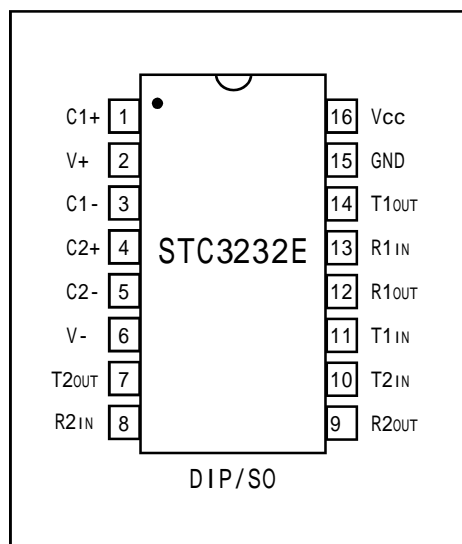
Guaranteed 30V/ $\mu\text{s}$  Max Slew Rate

BiCMOS Technology

### **Ordering Information**

PART	TEMP. RANGE	PIN-PACKAGE
STC3232EESE	-40°C to +85°C	16 Narrow SO
STC3232EEPE	-40°C to +85°C	16 Plastic DIP

## Pin Configurations



## Absolute Maximum Ratings

V <sub>CC</sub> .....	-0.3V to +6V	Short-Circuit Duration, T <sub>OUT</sub> .....	Continuous
V <sub>+</sub> .....	- 0.3V to +7V	Continuous Power Dissipation (TA = +70°C)	
V <sub>-</sub> .....	+0.3V to -7V	16-Pin Plastic DIP (derate 10.53mW/°C above +70°C)	.....842mW
Input Voltages		16-Pin Narrow SO (derate 8.70mW/°C above +70°C)	.....696mW
T <sub>IN</sub> .....	-0.3V to +6V	Operating Temperature Ranges	
R <sub>IN</sub> .....	±25V	STC3232E.....	-40°C to +85°C
Output Voltages		Storage Temperature Range.....	-65°C to +165°C
T <sub>OUT</sub> .....	±13.2V	Lead Temperature (soldering, 10sec)	.....+300°C
R <sub>OUT</sub> .....	-0.3V to (V <sub>CC</sub> + 0.3V)		

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**Electrical Characteristics**(V<sub>CC</sub> = +3V to +5.5V, C1-C4 = 0.1μF, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.)

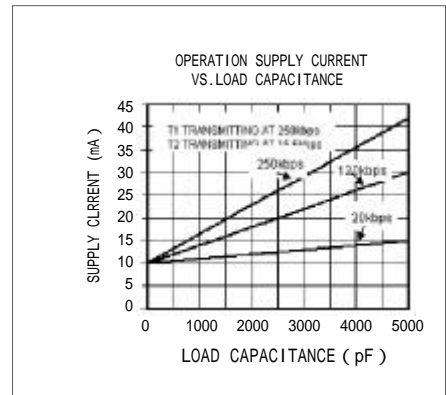
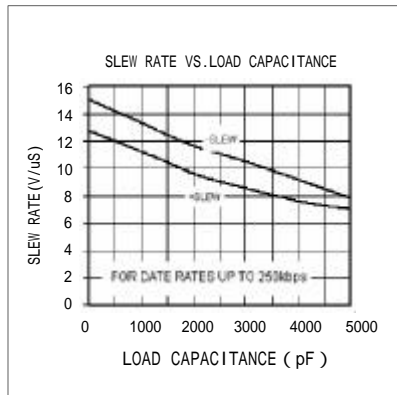
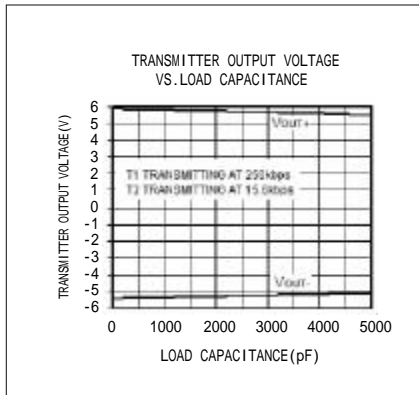
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
<b>DC CHARACTERISTICS (V<sub>CC</sub> = +3.3V OR +5.5V, T<sub>A</sub> = +25°C)</b>						
V <sub>CC</sub> Supply Current	I <sub>CC</sub>	/SHDN = V <sub>CC</sub> , No Load, T <sub>A</sub> = +25°C		0.3	1	mA
Shutdown Supply Current	I <sub>SHDN</sub>	/SHDN = GND, No Load, T <sub>A</sub> = +25°C		1	10	μA
<b>LOGIC</b>						
Input Leakage Current		T <sub>IN</sub> , /SHDN, /EN			±1	μA
Input Threshold Low	V <sub>IL</sub>	T <sub>IN</sub> , /SHDN, /EN			0.8	V
Input Threshold High	V <sub>IH</sub>	T <sub>IN</sub> , /SHDN, /EN	2.0			V
Output Voltage Low	V <sub>OH</sub>	R <sub>OUT</sub> ; I <sub>OUT</sub> = 3.2mA			0.4	V
Output Voltage High	V <sub>OL</sub>	R <sub>OUT</sub> ; I <sub>OUT</sub> = -1.0mA	V <sub>CC</sub> -0.6	V <sub>CC</sub> -0.1		V
<b>EIA/TIA-232E RECEIVER INPUTS</b>						
Input Voltage Range			-25		25	V
Input Threshold Low		T <sub>A</sub> = +25°C, V <sub>CC</sub> = 3.3V	0.6	1.1		V
Input Threshold High		T <sub>A</sub> = +25°C, V <sub>CC</sub> = 3.3V		1.5	2.4	V
Input Hysteresis		V <sub>CC</sub> = 3.3V	0.1		0.2	V
Input Resistance		T <sub>A</sub> = +25°C, V <sub>CC</sub> = 3.3V	3	5	7	kΩ
<b>EIA/TIA-232E TRANSMITTER OUTPUTS</b>						
Output Voltage Swing		All drivers loaded with 3kΩ to ground	±5	±5.4		V
Output Resistance			300	500		Ω
Output Short Circuit Current					±60	mA
<b>TIMING CHARACTERISTICS</b>						
Maximum Data Rate		RL = 3 kΩ to 7 kΩ, CL = 50pF to 1000pF, one transmitter switching	250			kbps
Receiver Propagation Delay	t <sub>PLHR</sub> , t <sub>PHLR</sub>	CL = 150pF		0.15		μs
Transmitter Propagation Delay	t <sub>PLHT</sub> , t <sub>PHLT</sub>	RL = 3 kΩ, CL = 2500pF, all transmitters loaded		0.1		μs
Transition-Region Slew rate		T <sub>A</sub> = +25°C, V <sub>CC</sub> = 3.3V RL = 3 kΩ to 7 kΩ, CL = 50pF to 1000pF, measured from -3V to +3V or +3V to -3V,	3	6	30	V/μs
<b>ESD &amp; LATCH UP PERFORMANCE</b>						
ESD Protection Voltage		Human Body Model		±15		kV
		IEC1000-4-2, Contact Discharge		±8		kV
		IEC1000-4-2, Air-Gap Discharge		±15		kV
Latch up Performance			±200		mA	

**Pin Descriptions**

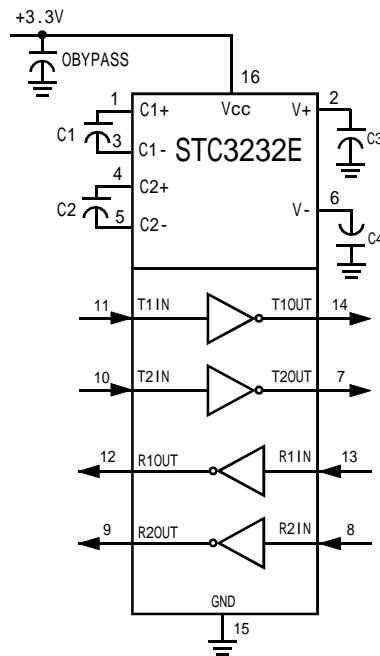
PIN (SO/DIP/SSOP)	NAME	FUNCTION
—	/EN	Receiver Enable. Active low.
1	C1+	Positive Terminal of Voltage-Doubler Charge-Pump Capacitor
2	V+	+5.5V Generated by the Charge Pump
3	C1-	Negative Terminal of Voltage-Doubler Charge-Pump Capacitor
4	C2+	Positive Terminal of Inverting Charge-Pump Capacitor
5	C2-	Negative Terminal of Inverting Charge-Pump Capacitor
6	V-	-5.5V Generated by the Charge Pump
7, 14	T_OUT	RS-232 Transmitter Outputs
8, 13	R_IN	RS-232 Receiver Inputs
9, 12	R_OUT	TTL/CMOS Receiver Outputs
10, 11	T_IN	TTL/CMOS Transmitter Inputs
15	GND	Ground
16	VCC	+3.0V to +5.5V Supply Voltage

**Typical Operating Characteristics**

( $V_{CC} = +3V$  to  $+5.5V$ ,  $C1-C4 = 0.1\mu F$ ,  $T_A = T_{MIN}$  to  $T_{MAX}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ C$ .)



## Typical Operating Circuits



### Detailed Description

#### Dual Charge-Pump Voltage Converter

The STC3232E's internal power supply consists of a regulated dual charge pump that provides output voltages of +5.5V (doubling charge pump) and -5.5V (inverting charge pump) over the +3.0V to +5.5V VCC range. The charge pump operates in discontinuous mode; if the output voltages are less than 5.5V, the charge pump is enabled, and if the output voltages exceed 5.5V, the charge pump is disabled. Each charge pump requires a flying capacitor (C1, C2) and a storage capacitor (C3, C4) to generate the V+ and V- supplies.

#### RS-232 Transmitters

The transmitters are inverting level translators that convert TTL/CMOS-logic levels to  $\pm 5V$  EIA/TIA-232 compliant levels. The STC3232E transmitter guarantees a 250kbps data rate with worst-case loads of 3k $\Omega$  parallel with 1000pF. Transmitters can be paralleled to drive multiple receivers. The STC3232E permits the outputs to be driven up to  $\pm 12V$  in shutdown.

#### RS-232 Receivers

The receivers convert RS-232 signals to CMOS-logic output levels.

#### $\pm 15kV$ ESD Protection

ESD-protection structures are incorporated to protect against electrostatic discharges encountered during handling and assembly. The driver outputs and receiver inputs of the STC3232E have extra protection against static electricity. The ESD structures withstand high ESD in all states: normal operation, shutdown, and powered down. After an ESD event, Circuits keep working without latch up. ESD protection can be tested in various ways; the transmitter outputs and receiver inputs for the STC3232E are characterized for protection to the following limits:

$\pm 15kV$  using the Human Body Model

$\pm 8kV$  using the Contact Discharge method specified in IEC 1000-4-2

$\pm 15kV$  using the Air-Gap Discharge method specified in IEC 1000-4-2.

## Applications Information

### Capacitor Selection

The capacitor type used for C1–C4 is not critical for proper operation; polarized or non-polarized capacitors can be used. The charge pump requires 0.1 $\mu$ F capacitors for 3.3V operation. Increasing the capacitor values (e.g., by a factor of 2) reduces ripple on the transmitter outputs and slightly reduces power consumption. C2, C3, and C4 can be increased without changing C1's value. When using the minimum required capacitor values, make sure the capacitor value does not degrade excessively with temperature. If in doubt, use capacitors with a larger nominal value. The capacitor's equivalent series resistance (ESR), which usually rises at low temperatures, influences the amount of ripple on V+ and V- output voltages.

### Power-Supply Decoupling

In most circumstances, a 0.1 $\mu$ F VCC bypass capacitor is adequate. In applications sensitive to power-supply noise, use a capacitor of the same value as charge pump capacitor C1. Connect bypass capacitors as close to the IC as possible.

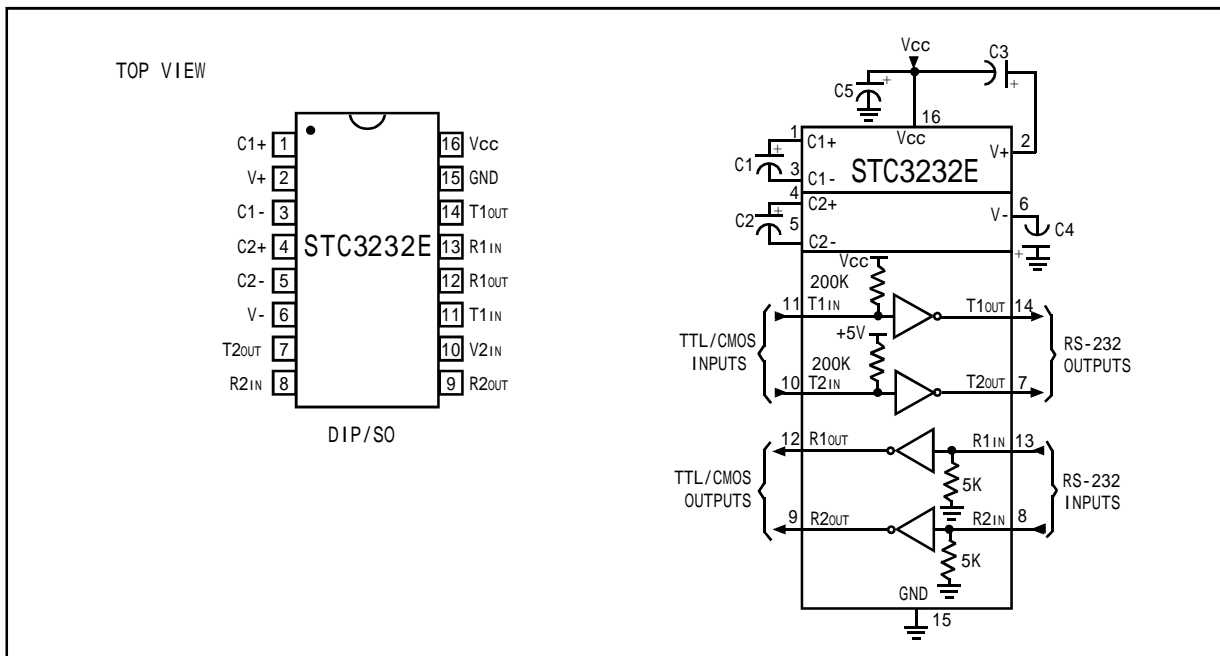
### Operation Down to 2.7V

Transmitter outputs meet EIA/TIA-562 levels of  $\pm 3.7$ V with supply voltages as low as 2.7V.

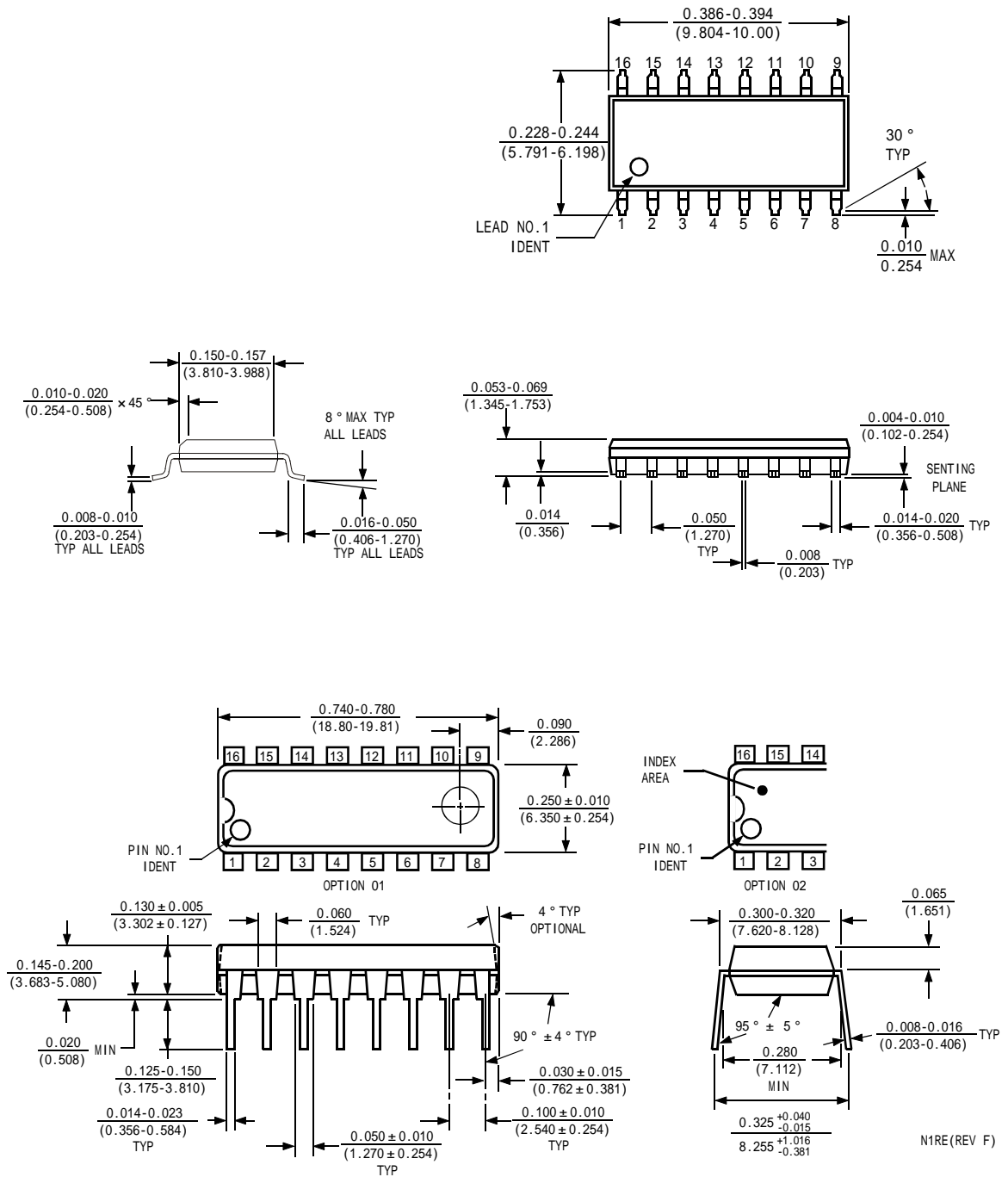
### Interconnection with 3V and 5V Logic

The STC3232E can directly interface with various 3V and 5V logic families, including ACT and HCT CMOS.

### Pin Configurations and Typical Operating Circuits



Physical Dimensions Inches (millimeters) unless otherwise noted



N1RE (REV F)