



# Isolated Single Channel RS-232 Line Driver/Receiver

Preliminary Technical Data

ADM3251E

## FEATURES

460 kbps Data Rate

1 Tx and 1 Rx

Meets EIA-232E specifications

0.1 $\mu$ F charge pump capacitors

Integrated isolated dc-to-dc converter

ESD protection to IEC1000-4-2(801.2)

on  $R_{IN}$  and  $T_{OUT}$  pins.

$\pm 8$ kV: contact discharge

$\pm 15$ kV: air gap discharge

Integrated isolated dc-to-dc converter

High common-mode transient immunity:  $>25$ kV/us

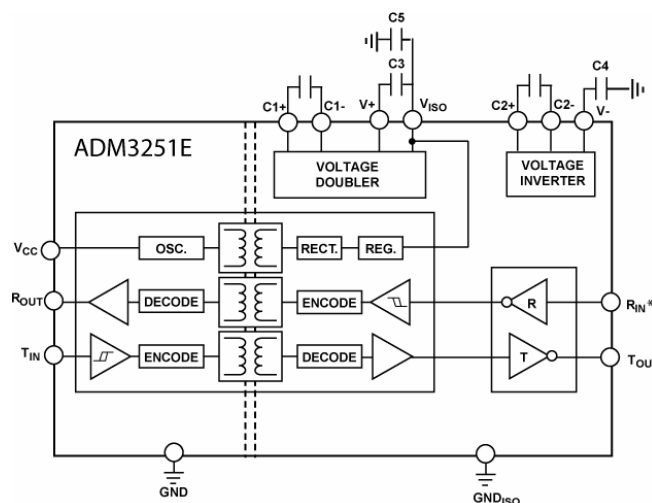
Safety and regulatory approvals (pending)

UL recognition

VDE certificate of conformity

20 Lead WSOIC package

## FUNCTIONAL BLOCK DIAGRAM



\*5k Ohm Pull-down resistor on the RS-232 Input

Figure 1.

## APPLICATIONS

High noise data communications

Industrial Communications

Industrial/Telecom Diagnostic Ports

## GENERAL DESCRIPTION

The ADM3251E is a high speed, single-channel RS-232 transceiver device that operates from a single power supply.

This device is ideally suited to operation in electrically harsh environments or where RS-232 cables are frequently being plugged/unplugged.

The ADM3251E incorporates dual-channel digital isolators with *isoPower* integrated, isolated power. There is no requirement for a separate isolated dc-to-dc converter as the ADM3251E has a chip-scale dc-to-dc converter which is based on Analog Devices, Inc. *iCoupler*® technology.

Analog Devices' chip-scale transformer *iCoupler* technology is used both for the isolation of the logic signals as well as for the dc-to-dc converter. The result is a small form factor, total isolation solution.

Five external 0.1 $\mu$ F charge pump capacitors are used for the voltage doubler/inverter permitting operation from a single supply.

The ADM3251E conforms to the EIA-232E specifications and operates at data rates up to 460 kbps.

The device is ideally suited to operation in electrically harsh environments. RS-232 pins,  $R_{IN}$  and  $T_{OUT}$  are protected against electrostatic discharges (up to  $\pm 15$  kV ESD protection).

The ADM3251E is available in a 20 lead Wide Body SOIC package.

Rev. Pr B

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.  
Tel: 781.329.4700  
Fax: 781.461.3113  
[www.analog.com](http://www.analog.com)  
©2008 Analog Devices, Inc. All rights reserved.

## TARGET SPECIFICATIONS

All voltages are relative to their respective ground. All min/max specifications apply over the entire recommended operating range, unless otherwise noted. All typical specifications in Table 1 are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V}$ , unless otherwise noted.

Table 1.

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
<b>DC CHARACTERISTICS</b>					
$V_{CC}$ Operating Voltage Range	4.5		5.5	V	
DC-to-DC Converter Enable Threshold, $V_{CC(\text{Enable})}$ <sup>1</sup>	4.5			V	
DC-to-DC Converter Disable Threshold, $V_{CC(\text{Disable})}$ <sup>1</sup>			3.7	V	
DC-to-DC CONVERTER ENABLED					
Input Supply Current			TBD	mA	No Load
			TBD	mA	$R_L = 3\text{k}\Omega$
$V_{ISO}$ Output <sup>2</sup>		5.0		V	$I_{ISO} = 0\mu\text{A}$
DC-to-DC CONVERTER DISABLED					
Primary Side Supply Input Current, $I_{CC(\text{Disable})}$			TBD	mA	$V_{ISO} = 3.3\text{V}$ , $V_{CC} \leq 3.7\text{V}$
<b>LOGIC</b>					
Transmitter Input, $T_{IN}$					
Logic Input Current, $I_{TIN}$	-10	+0.01	+10	$\mu\text{A}$	
Logic Low Input Threshold, $V_{TINL}$	$0.3 V_{CC}$			V	
Logic High Input Threshold, $V_{TINH}$			$0.7 V_{CC}$	V	
Receiver Output, $R_{OUT}$					
Logic High Output $V_{ROUTH}$	$V_{CC} - 0.1$	$V_{CC}$		V	$I_{ROUTH} = -20\mu\text{A}$
	$V_{CC} - 0.5$	$V_{CC} - 0.2$		V	$I_{ROUTH} = -4\text{mA}$
Logic Low Output $V_{ROUTL}$		0.0	0.1	V	$I_{ROUTH} = 20\mu\text{A}$
		0.0	0.4	V	$I_{ROUTH} = 4\text{mA}$
<b>RS-232</b>					
<b>RECEIVER</b>					
EIA-232 Input Voltage Range <sup>3</sup>	-30		+30	V	
EIA-232 Input Threshold Low	0.6	1.3		V	
EIA-232 Input Threshold High		1.6	2.4	V	
EIA-232 Input Hysteresis		0.4		V	
EIA-232 Input Resistance	3	5	7	$\text{k}\Omega$	
<b>TRANSMITTER</b>					
Output Voltage Swing (RS-232)	$\pm 5$	$\pm 5.7$		V	$R_L = 3\text{k}\Omega$ to Gnd
Transmitter Output Resistance	300			$\Omega$	$V_{ISO} = 0\text{V}$
RS-232 Output Short Circuit Current		TBD		mA	
<b>TIMING CHARACTERISTICS</b>					
Maximum Data Rate	460			kbps	$R_L = 3\text{k}\Omega$ to $7\text{k}\Omega$ , $C_L = 50\text{pF}$ to $1000\text{pF}$
Receiver Propagation Delay					
$t_{PHL}$		190		$\mu\text{s}$	
$t_{PLH}$		135		$\mu\text{s}$	
Transmitter Propagation Delay		650		$\mu\text{s}$	$R_L = 3\text{k}\Omega$ , $C_L = 1000\text{pF}$
Transmitter Skew		80		ns	
Receiver Skew		70		ns	
Transition Region Slew Rate <sup>3</sup>	5.5	10	30	V/ $\mu\text{s}$	+3V to -3V or -3V to 0.3V, $V_{CC} = +3.3\text{V}$ , $R_L = +3\text{k}\Omega$ , $C_L = 1000\text{pF}$ , $T_A = 25^\circ\text{C}$ .
<b>AC SPECIFICATIONS</b>					
Output Rise, $t_r$ /Fall time, $t_f$ (10% to 90%)		2.3		ns	$C_L = 15\text{pF}$ , CMOS signal levels
Common-Mode Transient Immunity at Logic High Output		TBD		KV/ $\mu\text{s}$	
Common-Mode Transient Immunity at Logic Low Output		TBD		KV/ $\mu\text{s}$	
<b>ESD PROTECTION (<math>R_{IN}</math> and <math>T_{OUT}</math> Pins)</b>					
		$\pm 15$		kV	Human Body Model Air Discharge
		$\pm 8$		kV	Human Body Model Contact Discharge

1 Enable/disable threshold is the  $V_{CC}$  voltage at which the internal DC-to-DC converter is enabled/disabled.

2 To maintain datasheet specifications no current should be drawn from  $V_{ISO}$ .

3 Guaranteed by design

## TARGET SPECIFICATIONS

All voltages are relative to their respective ground. All min/max specifications apply over the entire recommended operating range, unless otherwise noted. All typical specifications in Table 2 are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V}$  (DC-to-DC converter disabled), the secondary side is powered externally by  $V_{ISO}=3.3\text{V}$ , unless otherwise noted.

**Table 2.**

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
DC CHARACTERISTICS					
V <sub>CC</sub> Operating Voltage Range	3.0		3.7	V	No Load R <sub>L</sub> =3kΩ
DC-to-DC Converter Disable Threshold, V <sub>CC(Disable)</sub> <sup>1</sup>			3.7	V	
DC-to-DC CONVERTER DISABLED					
V <sub>ISO</sub>	3.0		5.5	V	
Primary Side Supply Input Current, I <sub>CC(Disable)</sub>			TBD	mA	
Secondary Side Supply Input Current, I <sub>ISO(Disable)</sub>			TBD	mA	
LOGIC					
Transmitter Input, T <sub>IN</sub>					I <sub>ROUTH</sub> = - 20 μA I <sub>ROUTH</sub> = - 4 mA I <sub>ROUTH</sub> = 20 μA I <sub>ROUTH</sub> = 4 mA
Logic Input Current, I <sub>TIN</sub>	-10	+0.01	+10	μA	
Logic Low Input Threshold, V <sub>TINL</sub>	0.3 V <sub>CC</sub>			V	
Logic High Input Threshold, V <sub>TINH</sub>			0.7 V <sub>CC</sub>	V	
Receiver Output, R <sub>OUT</sub>					
Logic High Output V <sub>ROUTH</sub>	V <sub>CC</sub> – 0.1	V <sub>CC</sub>		V	
	V <sub>CC</sub> – 0.5	V <sub>CC</sub> – 0.2		V	
Logic Low Output V <sub>ROUTL</sub>		0.0	0.1	V	
		0.0	0.4	V	
RS-232					
RECEIVER					
EIA-232 Input Voltage Range <sup>2</sup>	–30		+30	V	
EIA-232 Input Threshold Low	0.6	1.3		V	
EIA-232 Input Threshold High		1.6	2.4	V	
EIA-232 Input Hysteresis		0.4		V	
EIA-232 Input Resistance	3	5	7	kΩ	
TRANSMITTER					
Output Voltage Swing (RS-232)	±5	±5.7		V	V <sub>ISO</sub> = 3.3V, R <sub>L</sub> = 3kΩ to Gnd V <sub>ISO</sub> = 0V
Transmitter Output Resistance	300			Ω	
RS-232 Output Short Circuit Current		TBD		mA	
TIMING CHARACTERISTICS					
Maximum Data Rate	460			kbps	V <sub>ISO</sub> = 3.3V, R <sub>L</sub> = 3kΩ to 7kΩ, C <sub>L</sub> =50 pF to 1000pF
Receiver Propagation Delay					
t <sub>PHL</sub>		190		μs	R <sub>L</sub> = 3kΩ, C <sub>L</sub> =1000 pF
t <sub>PLH</sub>		135		μs	
Transmitter Propagation Delay		650		μs	
Transmitter Skew		80		ns	
Receiver Skew		55		ns	
Transition Region Slew Rate <sup>2</sup>	5.5	10	30	V/μs	+3V to -3V, or -3V to +3V, V <sub>CC</sub> = 3.3V, R <sub>L</sub> =3kΩ, C <sub>L</sub> =1000pF, T <sub>A</sub> =25C.
AC SPECIFICATIONS					
Output Rise, t <sub>R</sub> /Fall time, t <sub>F</sub> (10% to 90%)		2.3		ns	C <sub>L</sub> = 15 pF, CMOS signal levels
Common-Mode Transient Immunity at Logic High Output		TBD		KV/ μs	
Common-Mode Transient Immunity at Logic Low Output		TBD		KV/ μs	
ESD PROTECTION (R <sub>IN</sub> and T <sub>OUT</sub> Pins)					
		±15		kV	Human Body Model Air Discharge
		±8		kV	Human Body Model Contact Discharge

1 Enable/disable threshold is the  $V_{CC}$  voltage at which the internal DC-to-DC converter is enabled/disabled.

2 Guaranteed by design

## ABSOLUTE MAXIMUM RATINGS

Table 6.

Parameter	Rating
$V_{CC}$	−0.3 V to +6 V
$V+$	( $V_{CC} - 0.3$ V) to +13 V
$V-$	+0.3 V to −13 V
Input Voltages	
$T_{IN}$	−0.3 V to ( $V+$ , +0.3 V)
$R_{IN}$	±30 V
Output Voltages	
$T_{OUT}$	±15 V
$R_{OUT}$	−0.3 V to ( $V_{CC} + 0.3$ V)
Short Circuit Duration	
$T_{OUT}$	Continuous
Power Dissipation	
Power dissipation CP-12	TBD
$\theta_{JA}$ , Thermal Impedance	TBD
Operating Temperature Range	
Industrial	−40°C to +85°C
Storage Temperature Range	−65°C to +150°C
Pb-Free Temperature (Soldering, 30 sec)	260°C

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

### ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

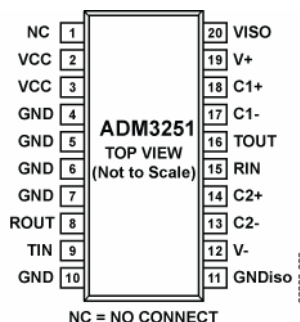
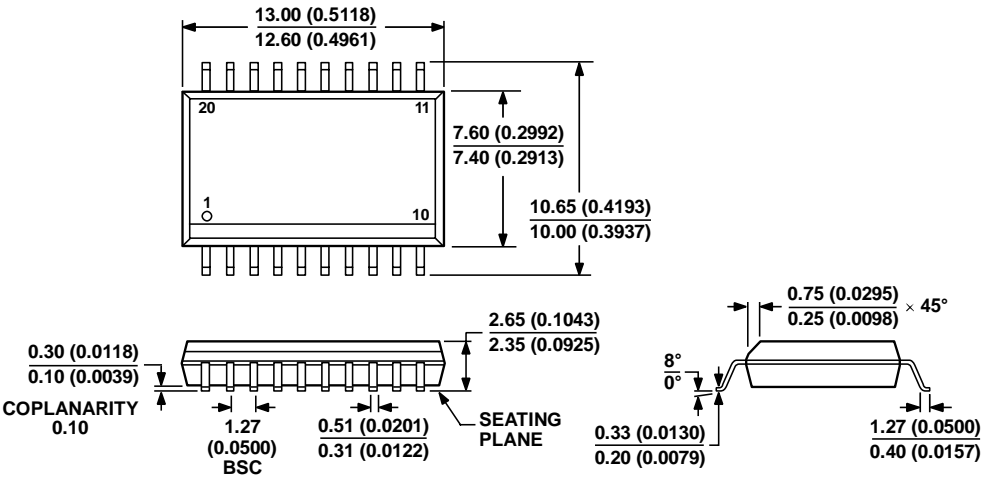


Figure 2. ADM3251E Pin Configuration

Table 7. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	NC	Not Connected
2	V <sub>CC</sub>	Power Supply Input
3	V <sub>CC</sub>	Power Supply Input
4	GND	Ground Pin
5	GND	Ground Pin
6	GND	Ground Pin
7	GND	Ground Pin
8	R <sub>OUT</sub>	Receiver Output. This outputs CMOS output logic levels.
9	T <sub>IN</sub>	Transmitter (Driver) Input. This input accepts TTL/CMOS levels.
10	GND	Ground Pin
11	GND <sub>ISO</sub>	Ground reference for Isolator Primary Side.
12	V-	Internally Generated Negative Supply
13	C2-	External Capacitor 2 is connected between pins 13 and 14. A 0.1μF capacitor is recommended but larger capacitors up to 47μF may be used.
14	C2+	External Capacitor 2 is connected between pins 13 and 14. A 0.1μF capacitor is recommended but larger capacitors up to 47μF may be used.
15	R <sub>IN</sub>	Receiver Input. This input accepts RS-232 signal levels.
16	T <sub>OUT</sub>	Transmitter (Driver) Output. This outputs RS-232 signal levels.
17	C1-	External Capacitor 1 is connected between pins 17 and 18. A 0.1μF capacitor is recommended but larger capacitors up to 47μF may be used.
18	C1+	External Capacitor 1 is connected between pins 17 and 18. A 0.1μF capacitor is recommended but larger capacitors up to 47μF may be used.
19	V+	Internally Generated Positive Supply
20	V <sub>ISO</sub>	Isolated Supply Voltage for Isolator Secondary Side.

OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-013-AC  
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS  
(IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR  
REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

060706-A

Figure 5. 20-Lead Standard Small Outline Package. Dimensions shown in millimeters and (inches).