

±15kV ESD-Protected, 0.5μA, +3V to +5.5V, 1.5Mbps RS-232 Receivers in SOT23-5

General Description

_____ Features

The MAX3180E–MAX3183E single RS-232 receivers in a SOT23-5 package are designed for space- and costconstrained applications requiring minimal RS-232 communications. The receiver inputs are protected to ± 15 kV using IEC 1000-4-2 Air-Gap Discharge, to ± 8 kV using IEC 1000-4-2 Contact Discharge, and to ± 15 kV per the Human Body Model, ensuring compliance with international standards.

The devices minimize power and heat dissipation by consuming only 0.5μ A supply current from a +3.0V to +5.5V supply, and they guarantee true RS-232 performance up to a 1.5Mbps data rate. The MAX3180E/MAX3182E feature a three-state TTL/CMOS receiver output that is controlled by an EN logic input. The MAX3181E/MAX3183E feature an INVALID output that indicates valid RS-232 signals at the receiver input for applications requiring automatic system wake-up. The MAX3182E/MAX3183E have a noninverting output, while the MAX3180E/MAX3181E have a standard inverting output.

Applications

Diagnostic Ports

Telecommunications

Networking Equipment

Set-Top Boxes

Digital Cameras

Hand-Held Equipment

 Tiny SOT23-5 Package
ESD-Protected RS-232 Input ±15kV—Human Body Model ±8kV—IEC 1000-4-2, Contact Discharge ±15kV—IEC 1000-4-2, Air-Gap Discharge
0 5uA Supply Current

- 0.5µA Supply Current
- 1.5Mbps Guaranteed Data Rate
- Meets EIA/TIA-232 and V.28/V.24 Specifications Down to V_{CC} = +3.0V
- INVALID Output Indicates Valid RS-232 Signal at Receiver Input (MAX3181E/MAX3183E)
- Three-State TTL/CMOS Receiver Output (MAX3180E/MAX3182E)
- Noninverting RS-232 Output (MAX3182E/MAX3183E)

Ordering Information

PART	TEMP. RANGE	PIN- PACKAGE	TOP MARK
MAX3180EEUK-T	-40°C to +85°C	5 SOT23-5	ACHB
MAX3181EEUK-T	-40°C to +85°C	5 SOT23-5	ACHC
MAX3182EEUK-T	-40°C to +85°C	5 SOT23-5	ACHD
MAX3183EEUK-T	-40°C to +85°C	5 SOT23-5	ACHE

Pin Configurations/Functional Diagrams appear at end of data sheet.

Selector Guide

PART	ESD PROTECTION (kV)	PACKAGE	SUPPLY CURRENT (µA)	EN INPUT	INVALID OUTPUT	INVERTING ROUT	NON- INVERTING ROUT
MAX3180E	±15	SOT23-5	0.5	✓		1	
MAX3181E	±15	SOT23-5	0.5		1	1	_
MAX3182E	±15	SOT23-5	0.5	1			1
MAX3183E	±15	SOT23-5	0.5	_	1		✓

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ABSOLUTE MAXIMUM RATINGS

Vcc to GND	0.3V to +6V
RIN to GND	±25V
EN, ROUT, INVALID to GND	0.3V to (V _{CC} + 0.3V)
Continuous Power Dissipation ($T_A = +$	70°C)
SOT23-5 (derate 7.1mW/°C above +	

Operating Temperature Range	40°C to +85°C
Storage Temperature Range	65°C to +150°C
Lead Temperature (soldering, 10sec)	+300°C

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

 $(V_{CC} = +3.0V \text{ to } +5.5V, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise noted. Typical values are at } V_{CC} = +5.0V, T_A = +25^{\circ}C.)$ (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
DC CHARACTERISTICS	-		1			1	
Supply Voltage	VCC		3.0		5.5	V	
Supply Current	Icc	$V_{CC} = 3.3V$ or 5V, RIN = V_{CC} or GND, no load		0.5	5.0	μA	
LOGIC INPUT (EN)							
Logic Threshold Low	VIL				0.8	V	
Logic Threshold High	Mu i	$V_{CC} = 3.3V$	2.0			- V	
Logic miesnola High	VIH	$V_{CC} = 5.0V$	2.4				
Leakage Current	IEN			±0.01	±1.0	μA	
LOGIC OUTPUT							
INVALID Output Voltage Low	VIOL	I _{SINK} = 1.6mA			0.4	V	
INVALID Output Voltage High	VIOH	ISOURCE = 1.0mA	Vcc - 0.6			V	
RECEIVER INPUT			1				
Input Voltage Range	VRIN		-25		25	V	
Input Threshold Low		V _{CC} = 3.3V	0.6	1.2		V	
	VITL	$V_{CC} = 5.0V$	0.8	1.5	V	v	
Inc. # Three heads I ligh	VITH	$V_{CC} = 3.3V$		1.5	2.4	V	
Input Threshold High		V _{CC} = 5.0V		1.8	2.7	- V	
Input Hysteresis	VHYST			300		mV	
RIN Threshold to INVALID		Positive threshold			2.7	V	
Output High	VITOH	Negative threshold -2.7					
RIN Threshold to INVALID Output Low	VITOL		-0.3		0.3	V	
Input Resistance	RRIN		3	5	7	kΩ	
RECEIVER OUTPUT							
Output Leakage Current	IROUT	Receiver disabled		±0.05	±10	μA	
Output Voltage Low	Vol	I _{SINK} = 1.6mA			0.4	V	
Output Voltage High	VOH	ISOURCE = 1.0mA	V _{CC} - 0.6	Vcc - 0.1		V	

ELECTRICAL CHARACTERISTICS (continued)

 $(V_{CC} = +3.0V \text{ to } +5.5V, T_A = T_{MIN} \text{ to } T_{MAX}, \text{ unless otherwise noted. Typical values are at } V_{CC} = +5.0V, T_A = +25^{\circ}C.)$ (Note 1)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
TIMING CHARACTERISTICS						
Maximum Data Rate		$C_L = 50 pF$	1.5			Mbps
Receiver Propagation Delay, High-to-Low		RIN to ROUT; $C_L = 150 pF$	0.15			μs
Receiver Propagation Delay, Low-to-High		RIN to ROUT; $C_L = 150 pF$	0.15		μs	
Receiver Skew t _{RS}		tpHL - tpLH , Figure 1		50		ns
Receiver Output Enable Time tROE				200		ns
Receiver Output Disable Time tROD				200		ns
Receiver Positive or Negative Threshold to INVALID High				250		ns
Receiver Positive or Negative tINVL Threshold to INVALID Low tinvL				30		μs

Note 1: Specifications are 100% tested at $T_A = +25$ °C. Limits over temperature are guaranteed by design.

 $(V_{CC} = +5V, T_A = +25^{\circ}C, unless otherwise noted.)$



Typical Operating Characteristics



MAX3180E-MAX3183E

Typical Operating Characteristics (continued)

 $(V_{CC} = +5V, T_A = +25^{\circ}C, unless otherwise noted.)$





Pin Description

PIN		NA	ME		FUNCTION
FIN	MAX3180E	MAX3181E	MAX3182E	MAX3183E	FUNCTION
1	ĒN	-	ĒN	-	Receiver Output Enable
	-	INVALID	-	INVALID	Output of the Valid Input Detector
2	GND	GND	GND	GND	Ground
3	ROUT	ROUT	-	-	Inverting Receiver Output
5	-	-	ROUT	ROUT	Noninverting Receiver Output
4	RIN	RIN	RIN	RIN	Receiver Input
5	V _{CC}	V _{CC}	V _{CC}	V _{CC}	Supply Voltage



Figure 1. Receiver Propagation-Delay Timing

Detailed Description

/N/IXI/N

The MAX3180E–MAX3183E are EIA/TIA-232 and V.28/ V.24 communications receivers that convert RS-232 signals to CMOS logic levels. They operate on a +3V to +5.5V supply, have 1.5Mbps data rate capability, and feature enhanced electrostatic discharge (ESD) protection (see *ESD Protection*). All of these devices achieve a typical supply current of 0.5µA. The MAX3180E/ MAX3182E have a receiver enable control (EN). The MAX3181E/MAX3183E contain a signal invalid output (INVALID). The MAX3180E/MAX3181E invert the ROUT signal relative to RIN (standard RS-232). The MAX3182E/MAX3183E outputs are not inverted. The devices come in tiny SOT23-5 packages.

MAX3180E-MAX3183E

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Figure 2. Input Levels and INVALID Timing

Signal Invalid Detector

If no valid signal levels appear on RIN for 30µs (typ), INVALID goes low. This event typically occurs if the RS-232 cable is disconnected, or if the connected peripheral transmitter is turned off. INVALID goes high when a valid level is applied to the RS-232 receiver input. Figure 2 shows the input levels and timing diagram for INVALID operation.

Enable Input The MAX3180E/MAX3182E feature an enable input (EN). Drive EN high to force ROUT into a high-impedance state. In this state, the devices ignore incoming RS-232 signals. Pull EN low for normal operation.

ESD Protection

As with all Maxim devices, ESD protection structures are incorporated on all pins to protect against ESD encountered during handling and assembly. The receiver inputs of the MAX3180E–MAX3183E have extra protection against static electricity. Maxim's engineers have developed state-of-the-art structures enabling these pins to withstand ESD up to ±15kV without damage or latchup. The receiver inputs of the MAX3180E– MAX3183E are characterized for protection to the following limits:

- ±15kV using the Human Body Model
- ±8kV using the Contact Discharge method specified in IEC 1000-4-2
- ±15kV using the Air-Gap Discharge method specified in IEC 1000-4-2

Human Body Model

Figure 3 shows the Human Body Model, and Figure 4 shows the current waveform it generates when discharged into a low impedance. This model consists of



Figure 3. Human Body ESD Test Model



Figure 4. Human Body Model Current Waveform

a 100pF capacitor charged to the ESD voltage of interest, and then discharged into the test device through a $1.5 \text{k}\Omega$ resistor.



IEC 1000-4-2

The IEC 1000-4-2 standard covers ESD testing and performance of finished equipment; it does not specifically refer to ICs. The MAX3180E–MAX3183E enable the design of equipment that meets the highest level (Level 4) of IEC 1000-4-2 without the need for additional ESD-protection components.

The major difference between tests done using the Human Body Model and IEC 1000-4-2 is higher peak current in IEC 1000-4-2. Because series resistance is lower in the IEC 1000-4-2 model, the ESD withstand voltage measured to this standard is generally lower than that measured using the Human Body. Figure 5 shows the IEC 1000-4-2 model, and Figure 6 shows the

current waveform for the ±8kV IEC 1000-4-2 Level 4 ESD Contact Discharge test.

The Air-Gap test involves approaching the device with a charged probe. The Contact Discharge method connects the probe to the device before the probe is energized.

Power-Supply Decoupling

In most circumstances, a $0.1 \mu F \ V_{CC}$ bypass capacitor is adequate. Connect the bypass capacitor as close to the IC as possible.



Figure 5. IEC 1000-4-2 ESD Test Model



Figure 6. IEC 1000-4-2 ESD Generator Current Waveform





_Chip Information

TRANSISTOR COUNT: 41

Package Information



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