19-2370; Rev 2; 10/91

MAXIM

Complete, +5V-Powered, Isolated, Dual RS-232 Transceiver Module

MAX252

General Description

The MAX252 complete, electrically-isolated, dual RS-232 transmitter/receiver system requires no external components. By combining many functions in one package, the cost and complexity of an isolated digital interface are greatly reduced.

A single +5V supply powers both sides of the interface. Transceivers, optocouplers, and a transformer in one low-cost package provide a complete interface up to 9600 bits/sec. Additional pins provide low-power shutdown and a high-impedance state for both transmitter outputs.

The MAX252A withstands 130V_{RMS} (continuous), 1260V_{RMS} (1 min.) or 1520V_{RMS} (1 sec.) and is intended for applications where very high transient voltages, differential ground potentials or noise may be encountered. The MAX252A is UL recognized. The MAX252B is intended for less stringent applications and is rated for 500V_{RMS} (1 min.) or 600V_{RMS} (1 sec.).

Receivers and line drivers (transmitters) meet EIA RS-232D and CCITT V.28 specifications. The MAX252 is supplied in 40-pin plastic DIP packages in commercial (0°C to +70°C) and extended (-40°C to +85°C) temperature ranges.

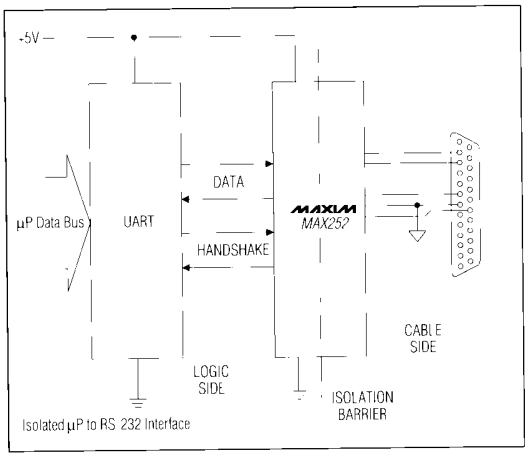
Applications

High-Noise Environments

Automatic Test Equipment

Differential Ground Potentials

Typical Application



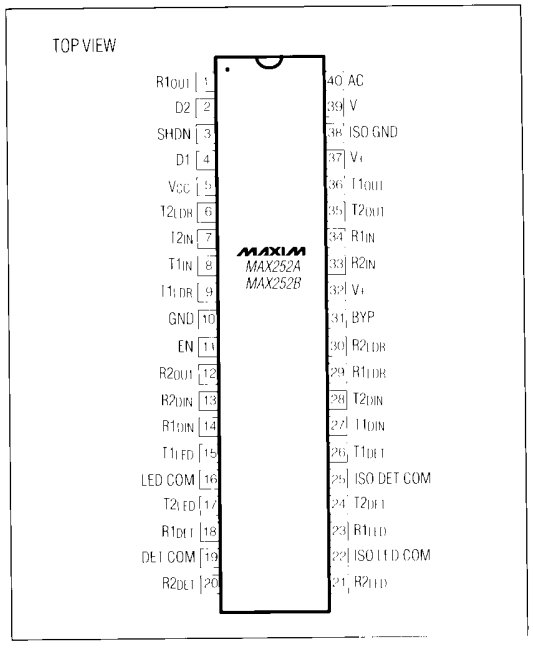
Features

- ♦ Isolated Data Interface
- ♦ No External Components
- ♦ Single +5V Supply
- ♦ 50µW Low-Power Shutdown
- ♦ Two Transmitters and Two Receivers
- ♦ UL Recognized (MAX252A) - File E118032 to UL1577

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX252ACHL	0°C to +70°C	40 Plastic Module
MAX252BCHL	0°C to +70°C	40 Plastic Module
MAX252AEHL	-40°C to +85°C	40 Plastic Module
MAX252BEHL	-40°C to +85°C	40 Plastic Module

Pin Configuration



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ABSOLUTE MAXIMUM RATINGS

Voltages with respect to GND (pin 10)
- Supply Voltage, V_{CC} ..... -0.3V to +6V
- Input Voltage
  - Pins 3, 7, 8, 11, 13, 14, 18, 20 ..... -0.3V to (V_{CC} +0.3V)

Voltages with respect to ISO GND (pin 38)
- RS-232 Input Voltage (pins 33, 34) ..... -30V to +30V
- RS-232 Applied Output Voltage (pins 35, 36) ... -15V to +15V
- Pins 32, 37 (V+) ..... +15V
- Pins 24, 26, 31 ..... V+
- RS-232 Transmitter outputs may be shorted individually and indefinitely to ISO GND.

LED Forward Continuous Current (pins 15, 17, 21, 23) 30mA

Power Dissipation
- Plastic DIP (derate 10mW/°C above +70°C) 650mW

Operating Temperature Ranges:
- MAX252ACHL/BCHL ..... 0°C to +70°C
- MAX252AEHL/BEHL ..... -40°C to +85°C

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

Lead Temperature (soldering, 10 sec.) ..... +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 section of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{CC} = +5V ±10%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
ISOLATION (Note 1)						
Test Voltage	V_{ISO}	T_A = +25°C, MAX252A, 1sec.	1520			V_{RMS}
		T_A = +25°C, MAX252A, 1 min. (Note 2)	1260			
		T_A = +25°C, MAX252A, Continuous (Note 2)	130			
		MAX252B, 1 sec.	600			
		MAX252B, 1 min. (Note 2)	500			
Leakage Current		10 sec., V_{ISO} = 500V_{RMS}, 60Hz, T_A = +25°C		10	50	μA_{RMS}
Isolation Resistance		T_A = +25°C, 500V_{DC}		10^{10}		Ω
Capacitance		0V		10		pF
POWER SUPPLY						
Operating Supply Current	I_{CC}	T_A = +25°C, SHDN = 0V, $T1_{IN}$, $T2_{IN}$, $R1_{IN}$, $R2_{IN}$ = V_{CC}		60	90	mA
		$T1_{IN}$, $T2_{IN}$, $R1_{IN}$, $R2_{IN}$ = 0		8	15	
Shutdown Supply Current	I_{CS}	SHDN = V_{CC}, T_A = +25°C		1	10	µA
$\overline{EN}$, SHDN Input Current	I_{EN}, I_{SHDN}	Input = GND to V_{CC}		0.001	1	µA
TTL/CMOS INPUTS/OUTPUTS						
TTL/CMOS Input Pull-Up Current	I_P	V_{IN} = 0V		4	20	µA
TTL/CMOS Output Voltage Low	V_{OL}	I_{OUT} = 3.2mA			0.4	V
TTL/CMOS Output Voltage High	V_{OH}	I_{OUT} = -1.0mA	3.5			V
Input Logic Threshold High	V_{IH}	$T1_{IN}$, $T2_{IN}$, $\overline{EN}$, SHDN		1.8	2.4	V
Input Logic Threshold Low	V_{IL}	$T1_{IN}$, $T2_{IN}$, $\overline{EN}$, SHDN	0.8	1.3		V
Input Hysteresis		$T1_{IN}$, $T2_{IN}$		0.5		V
Leakage Current, Output Disabled	I_L	$T1_{IN}$, $T2_{IN}$; $\overline{EN}$ or SHDN = V_{CC}			10	µA
Input Capacitance	C_{IN}	$T1_{IN}$, $T2_{IN}$		5		pF

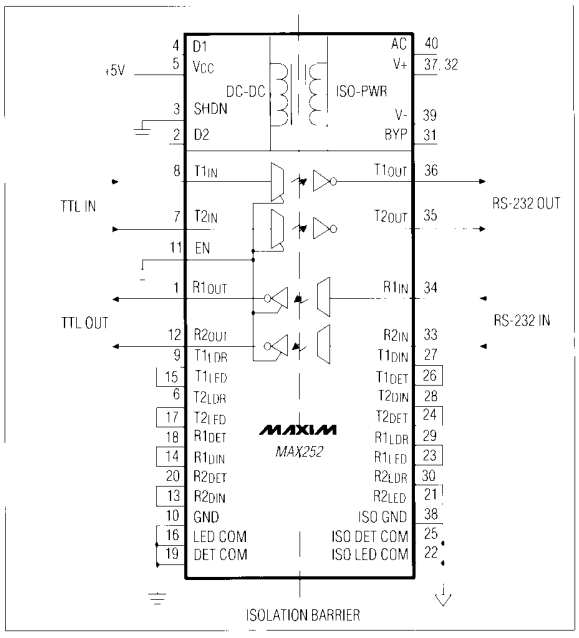
Note 1: Pins 1-20 tied together and pins 21-40 tied together.
Note 2: Value derived from 1 sec. test.

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +5V ±10%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
RS-232 CHARACTERISTICS						
RS-232 Output Voltage Swing	V_{PP}	$T1_{OUT}$, $T2_{OUT}$, R_L = 3kΩ to ISO	±5	±7.2		V
RS-232 Output Leakage Current		V+ = V- = 0V or SHDN = V_{CC}, $T1_{OUT}$, $T2_{OUT}$ = ±15V	-100		+100	µA
RS-232 Input Threshold High		$R1_{IN}$, $R2_{IN}$		1.8	3.0	V
RS-232 Input Threshold Low		$R1_{IN}$, $R2_{IN}$	0.6	1.2		V
RS-232 Input Hysteresis		$R1_{IN}$, $R2_{IN}$		0.6		V
RS-232 Input Resistance		$R1_{IN}$, $R2_{IN}$, T_A = +25°C	3		7	kΩ
Transmitter Output Slew Rate	SR	R_L = 3kΩ, C_L = 2500pF Sample Tested Measured from +3v to -3V or -3V to +3V		3	30	V/µs
Propagation Delay	t_R	RS-232 to TTL		24		µs
	t_T	TTL to RS-232		20		
Transmission Rate		Sample Tested R_L = 3kΩ C_L = 2500pF	9600	19200		Bits/sec.

Typical Operating Circuit



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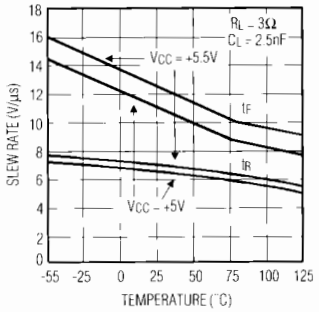
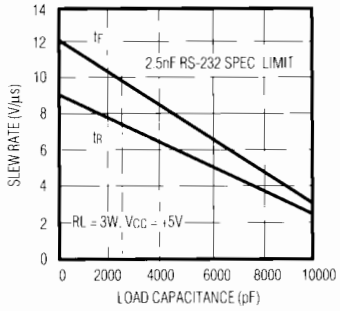
Typical Operating Characteristics

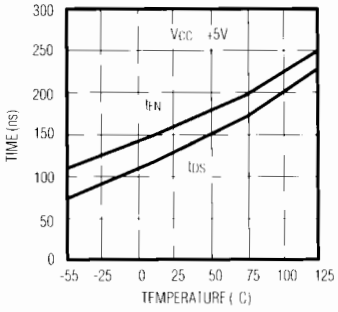
MAX252 TRANSMITTER SLEW RATE vs. TEMPERATURE



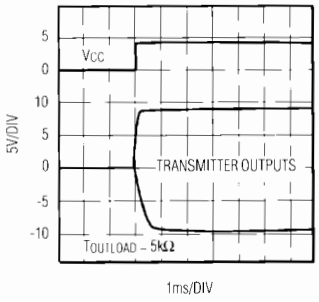
MAX252 TRANSMITTER SLEW RATE vs. LOAD CAPACITANCE



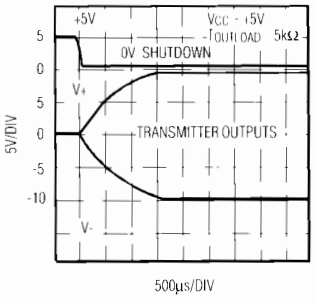
MAX252 ENABLE, DISABLE TIME vs. TEMPERATURE



POWER-UP DELAY TO TRANSMITTER OUTPUTS



TIME FROM SHUTDOWN TO POWER-UP



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Pin Description

PIN #	NAME	FUNCTION
1	$R1_{OUT}$	Receiver #1 Output; TTL/CMOS logic levels
2	D2	Internal Connection. Leave this pin unconnected. Do not ground.
3	SHDN	Shutdown. When high, turns off the oscillator and disconnects driver inputs. Ground for normal operation.
4	D1	Internal Connection. Leave this pin unconnected. Do not ground.
5	V_{CC}	+5V Supply Voltage
6	$T2_{LDR}$	Transmitter #2 LED Driver
7	$T2_{IN}$	Transmitter #2 Input; TTL/CMOS logic levels
8	$T1_{IN}$	Transmitter #1 Input; TTL/CMOS logic levels
9	$T1_{LDR}$	Transmitter #1 LED Driver
10	GND	Ground
11	$\overline{EN}$	Output Enable. If High, $T1_{LDR}$, $T2_{LDR}$, $R1_{OUT}$, and $R2_{OUT}$ go to high-impedance state. Ground for normal operation.
12	$R2_{OUT}$	Receiver #2 Output; TTL/CMOS logic levels
13	$R2_{DIN}$	Receiver #2 Detector Input
14	$R1_{DIN}$	Receiver #1 Detector Input
15	$T1_{LED}$	T1 LED Anode Input
16	LED COM	Common $T1_{LED}$, $T2_{LED}$ Cathode. Tie to Ground.
17	$T2_{LED}$	T2 LED Anode Input
18	$R1_{DET}$	R1 Photodiode Cathode Output
19	DET COM	Common $R1_{DET}$, $R2_{DET}$ Anode. Tie to Ground.
20	$R2_{DET}$	R2 Photodiode Cathode Output

PIN #	NAME	FUNCTION
21	$R2_{LED}$	R2 LED Cathode Input
22	ISO LED COM	Common $R1_{LED}$, $R2_{LED}$ Cathode. Tie to Isolated Ground.
23	$R1_{LED}$	R1 LED Cathode Input
24	$T2_{DET}$	T2 Photodiode Anode Output
25	ISO DET COM	Common $T1_{DET}$, $T2_{DET}$ LED Anode. Tie to Isolated Ground.
26	$T1_{DET}$	T1 Photodiode Anode Output
27	$T1_{DIN}$	Transmitter #1 Detector Input
28	$T2_{DIN}$	Transmitter #2 Detector Input
29	$R1_{LDR}$	Receiver #1 LED Driver
30	$R2_{LDR}$	Receiver #2 LED Driver
31	BYP	Internal Connection. Leave this pin unconnected. Do not ground.
32	V+	Isolated Positive Supply
33	$R2_{IN}$	RS-232 Receiver #2 Input
34	$R1_{IN}$	RS-232 Receiver #1 Input
35	$T2_{OUT}$	RS-232 Transmitter #2 Output
36	$T1_{OUT}$	RS-232 Transmitter #1 Output
37	V+	Isolated Positive Supply
38	ISO GND	Isolated Ground
39	V-	Isolated Negative Supply Voltage
40	AC	Internal Connection. Leave this pin unconnected. Do not ground.

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Isolation Applications

The MAX252 is intended for industrial communications and control applications where voltage transients, differential ground potentials or high noise may be encountered. The MAX252A withstands 130V_{RMS} (continuous), 1260V_{RMS} (1 min.) or 1520V_{RMS} (1 sec.). For less stringent applications, the MAX252B is rated at 500V_{RMS} (1 min.) or 600V_{RMS} (1 sec.). For applications requiring higher isolation ratings or transmission rates greater than 9600 baud, Maxim recommends the MAX250 and MAX251 device set that uses external optocouplers and transformer.

Figure 1 shows the typical interconnection for a complete 9600 bits/sec. transceiver. Important layout considerations include:

* For maximum isolation, the isolation line through the center of Figure 1 should not be breached; connections from each side should be kept separate.

* Optocoupler outputs (pins 18, 20, 24, and 26) are high-impedance nodes, so connecting traces should be as short as possible to minimize stray capacitance and maximize data transfer rate; shunt capacitance seen by each pin should not exceed 10pF.

The MAX252 pin out enables optimal printed circuit board layout by minimizing interconnect lengths and crossovers. Figure 2 shows the preferred layout, which is strongly recommended for 9600 bits/sec. applications. Note the position of the ground traces, particularly the protection of pin 20 by the wraparound from pin 19.

Isolation Example

Figure 3 illustrates how to isolate an existing RS-232 interface by inserting a MAX252 and MAX233 in series. Both devices invert while translating RS-232 to TTL and TTL to RS-232 levels. Since there is no net inversion, the circuit functions like two plain pieces of wire, but with 1520V_{RMS} (at 1 sec.) isolation between the ports.

Detailed Description

The MAX252 contains two integrated circuits, four optocouplers, four capacitors, two diodes, and a small transformer. Together, these provide a complete, isolated, dual RS-232 transmitter and receiver. The non-isolated or logic side of the interface transfers logic signals to and from the optocouplers, while the isolated or cable side transfers data between the optocouplers and RS-232

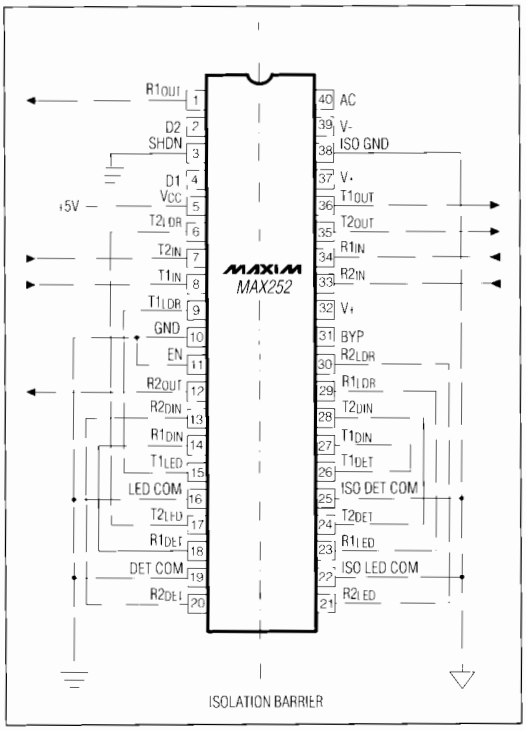

Figure 1. Typical Interconnections

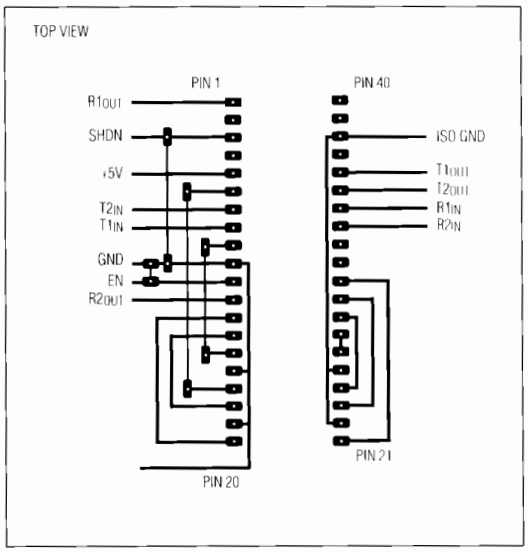

Figure 2. Preferred Layout

Complete, +5V-Powered, Isolated, Dual RS-232 Transceiver Module

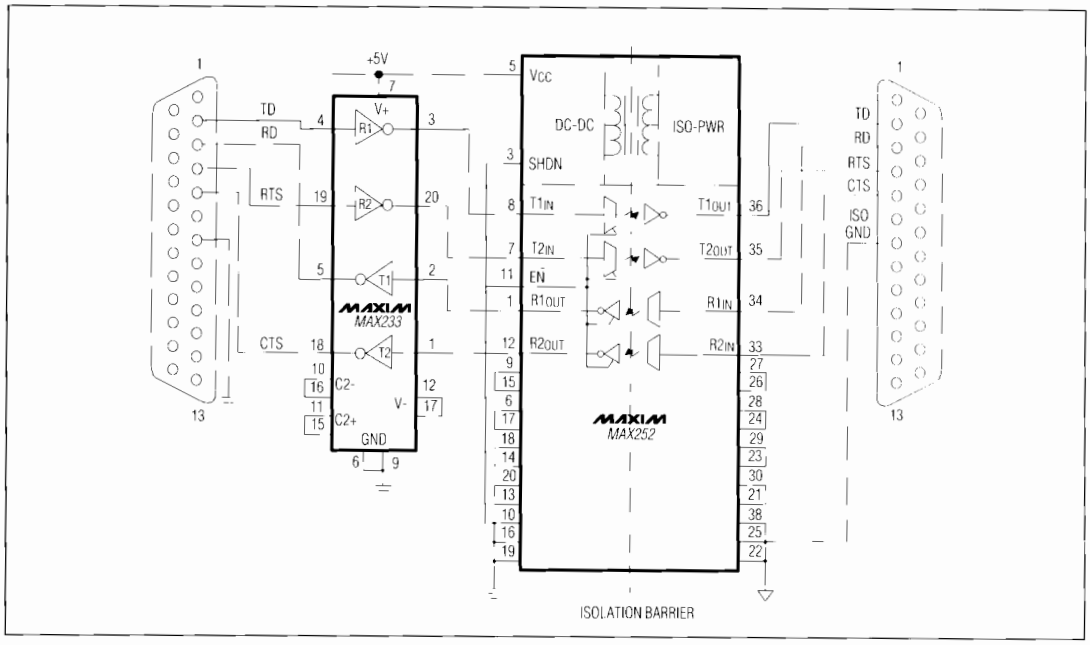

Figure 3. RS-232 Isolation Adapter from a Single +5V Supply

transmitters (line drivers) and receivers. The MAX252 also contains an isolation transformer and drive circuitry to supply power to the isolated side of the interface.

On the logic side of the MAX252 are four identical non-inverting drivers whose outputs may be used either as optocoupler LED drivers or as TTL/CMOS logic outputs. Each driver input ($T1_{IN}$, $T2_{IN}$, $R1_{DIN}$, $R2_{DIN}$) has a weak 4µA internal pull-up current source, and 0.5V hysteresis to improve noise rejection; logic thresholds for the driver inputs conform to standard TTL/CMOS specifications.

The RS-232 side of the interface includes two line drivers and receivers along with circuitry to translate these levels to optocoupler signals. The RS-232 inputs ($R1_{IN}$, $R2_{IN}$) and outputs ($T1_{OUT}$, $T2_{OUT}$) conform to EIA RS-232D and CCITT V.28 specifications. The inputs to the RS-232 line drivers ($T1_{DIN}$, $T2_{DIN}$), which are normally strapped to the internal optoisolators, are TTL/CMOS compatible.

Also included are an OUTPUT ENABLE control (EN) and a SHUTDOWN pin (SHDN). $\overline{EN}$ places all driver outputs in a high-impedance state when driven high. SHDN, when pulled high, performs the following functions:

1) Turns off the 130kHz oscillator, removing power from the RS-232 side of the interface.
2) Places $T1_{OUT}$ and $T2_{OUT}$ in a high-impedance state.
3) Disables the 4µA pull-up currents at the logic-side driver inputs ($T1_{IN}$, $T2_{IN}$, $R1_{DIN}$, $R2_{DIN}$).
4) Resets logic-side driver outputs ($T1_{LDR}$, $T2_{LDR}$, $R1_{OUT}$, $R2_{OUT}$) to low.
5) Reduces power consumption to 50µW.

Module Product Reliability

For reliability data on Maxim's Module Product Line, see Reliability Report RR-3A .

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MAX252 Block Diagram