/V/ /IXI /VI

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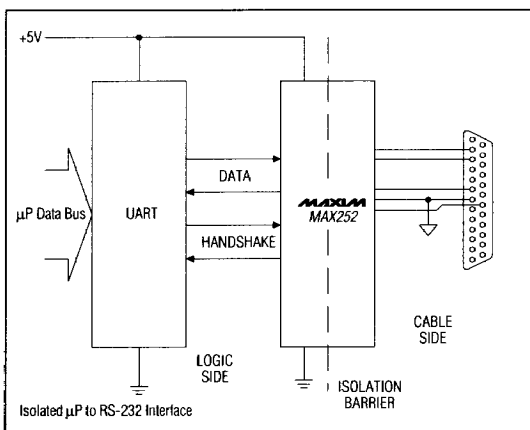
The MAX252A withstands 130VRMS (continuous), 1260VRMS (1 min.) or 1520VRMS (1 sec.) and is intended for applications where very high transient voltages, differential ground potentials or noise may be encountered. The MAX252A is UL recognized. The MAX252B is intended for less stringent applications and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

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

Applications

High-Noise Environments

Automatic Test Equipment

Differential Ground Potentials

Pin Configuration

TOP VIEW

R1OUT	1	40	AC
D2	2	39	V-
SHDN	3	38	ISO GND
D1	4	37	V+
VCC	5	36	T1OUT
T2LDR	6	35	T2OUT
T2IN	7	34	R1IN
T1IN	8	33	R2IN
T1LDR	9	32	V+
GND	10	31	BYP
EN	11	30	R2LDR
R2OUT	12	29	R1LDR
R2DIN	13	28	T2DIN
R1DIN	14	27	T1DIN
T1LED	15	26	T1DET
LED COM	16	25	ISO DET COM
T2LED	17	24	T2DET
R1DET	18	23	R1LED
DET COM	19	22	ISO LED COM
R2DET	20	21	R2LED

MAX252A
MAX252B

Typical Application

Isolated µP to RS-232 Interface

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Maxim Integrated Products 2-69

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

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}
			1 min. (Note 2)		1260			
			Continuous (Note 2)		130			
		MAX252B	1 sec.		600			
			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	T1IN, T2IN, R1IN, R2IN = V_{CC}			60	90	mA
			T1IN, T2IN, R1IN, R2IN = 0			8	15	
Shutdown Supply Current	I_{CS}	SHDN = 1V				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}	T1IN, T2IN, $\overline{EN}$, SHDN				1.8	2.4	V
Input Logic Threshold Low	V_{IL}	T1IN, T2IN, $\overline{EN}$, SHDN			0.8	1.3		V
Input Hysteresis		T1IN, T2IN				0.5		V
Leakage Current, Output Disabled	I_L	T1IN, T2IN; $\overline{EN}$ or SHDN = V_{CC}					10	µA
Input Capacitance	C_{IN}	T1IN, T2IN				5		pF

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

MAXIM

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}	T1OUT, T2OUT, R_L = 3kΩ to ISO	±5	±7.2		V
RS-232 Output Leakage Current		V+ = V- = 0V or SHDN = V_{CC}, T1OUT, T2OUT = ±15V	-10		+10	µA
RS-232 Input Threshold High		R1IN, R2IN		1.8	3.0	V
RS-232 Input Threshold Low		R1IN, R2IN	0.6	1.2		V
RS-232 Input Hysteresis		R1IN, R2IN		0.6		V
RS-232 Input Resistance		R1IN, R2IN, 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.

MAX252

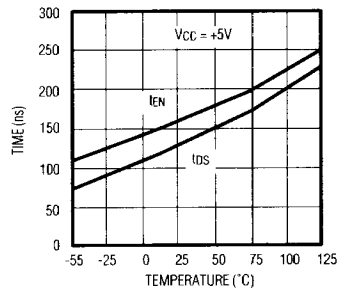**2**

Typical Operating Circuit
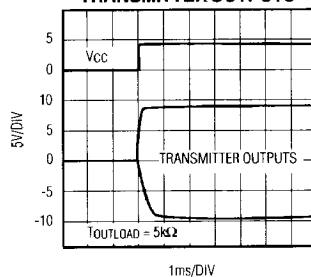
MAX252 TRANSMITTER SLEW RATE vs. TEMPERATURE
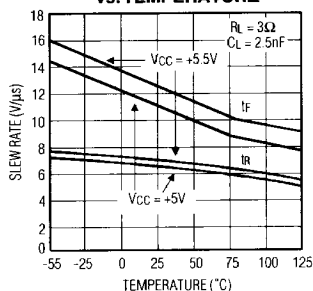
MAX252 TRANSMITTER SLEW RATE vs. LOAD CAPACITANCE
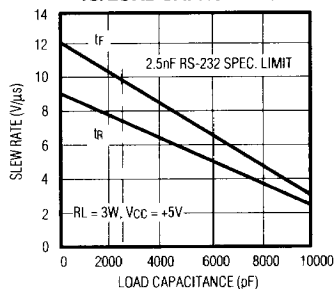
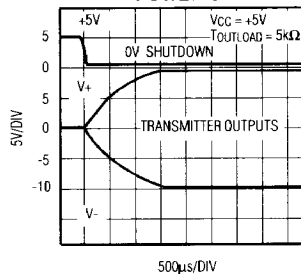**MAX252 ENABLE, DISABLE TIME vs. TEMPERATURE**

POWER-UP DELAY TO TRANSMITTER OUTPUTS

TIME FROM SHUTDOWN TO POWER-UP

MAX252

PIN #	NAME	FUNCTION
1	R1OUT	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	Vcc	+5V Supply Voltage
6	T2LDR	Transmitter #2 LED Driver
7	T2IN	Transmitter #2 Input; TTL/CMOS logic levels
8	T1IN	Transmitter #1 Input; TTL/CMOS logic levels
9	T1LDR	Transmitter #1 LED Driver
10	GND	Ground
11	EN	Output Enable. If High, T1LDR, T2LDR, R1OUT, and R2OUT go to high-impedance state. Ground for normal operation.
12	R2OUT	Receiver #2 Output; TTL/CMOS logic levels
13	R2DIN	Receiver #2 Detector Input
14	R1DIN	Receiver #1 Detector Input
15	T1LED	T1 LED Anode Input
16	LED COM	Common T1LED, T2LED Cathode. Tie to Ground.
17	T2LED	T2 LED Anode Input
18	R1DET	R1 Photodiode Cathode Output
19	DET COM	Common R1DET, R2DET Anode. Tie to Ground.
20	R2DET	R2 Photodiode Cathode Output

PIN #	NAME	FUNCTION
21	R2LED	R2 LED Cathode Input
22	ISO LED COM	Common R1LED, R2LED Cathode. Tie to Isolated Ground.
23	R1LED	R1 LED Cathode Input
24	T2DET	T2 Photodiode Anode Output
25	ISO DET COM	Common T1DET, T2DET LED Anode. Tie to Isolated Ground.
26	T1DET	T1 Photodiode Anode Output
27	T1DIN	Transmitter #1 Detector Input
28	T2DIN	Transmitter #2 Detector Input
29	R1LDR	Receiver #1 LED Driver
30	R2LDR	Receiver #2 LED Driver
31	BYP	Internal Connection. Leave this pin unconnected. Do not ground.
32	V+	Isolated Positive Supply
33	R2IN	RS-232 Receiver #2 Input
34	R1IN	RS-232 Receiver #1 Input
35	T2OUT	RS-232 Transmitter #2 Output
36	T1OUT	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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Complete, +5V-Powered, Isolated, Dual RS-232 Transceiver Module

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
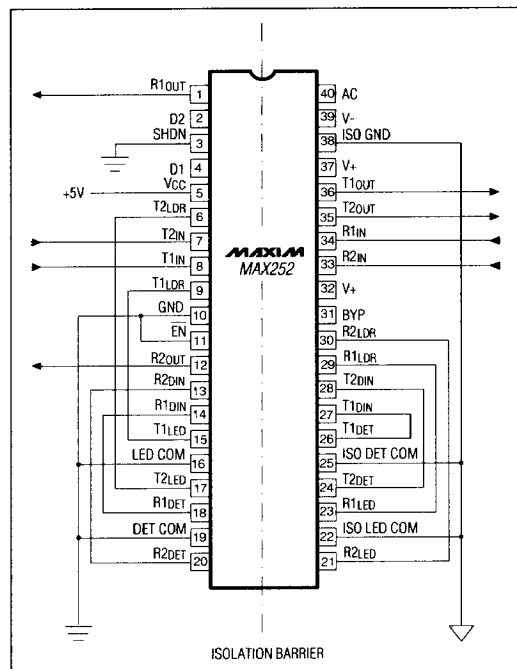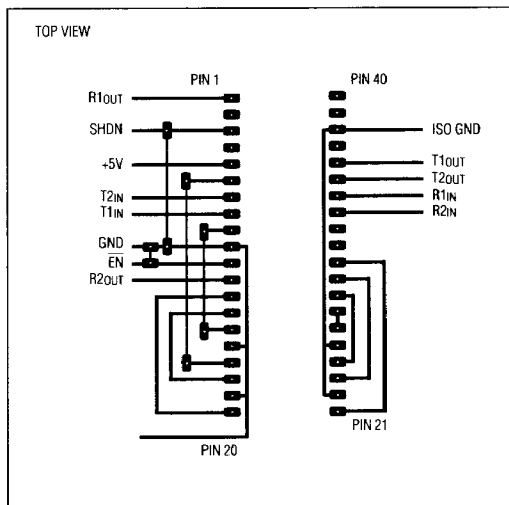

Figure 1. Typical Interconnections

Figure 2. Preferred Layout

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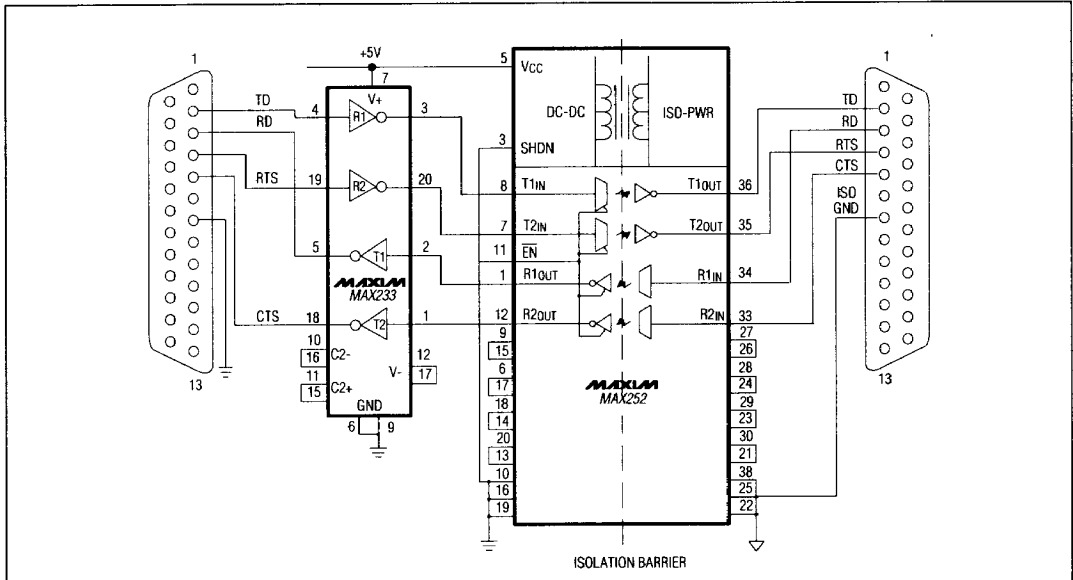

Figure 3. RS-232 Isolation Adapter from a Single +5V Supply

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 ($\overline{EN}$) 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:
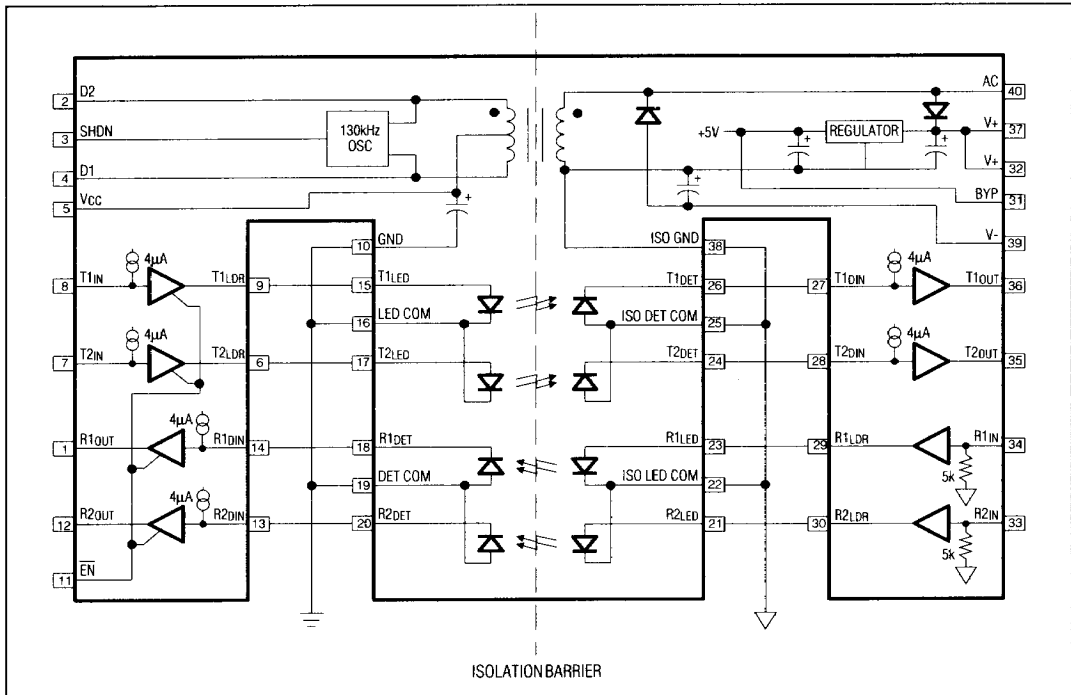
1) Turns off the 130kHz oscillator, removing power from the RS-232 side of the interface.
2) Places T1$_{OUT}$ and T2$_{OUT}$ in a high-impedance state.
3) Disables the 4μA pull-up currents at the logic-side driver inputs (T1$_{IN}$, T2$_{IN}$, R1$_{DIN}$, R2$_{DIN}$).
4) Resets logic-side driver outputs (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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ISOLATION BARRIER

/VI/I X I /VI