ISOLATED 3.3V RS-232 DESIGN

1.0 INTRODUCTION

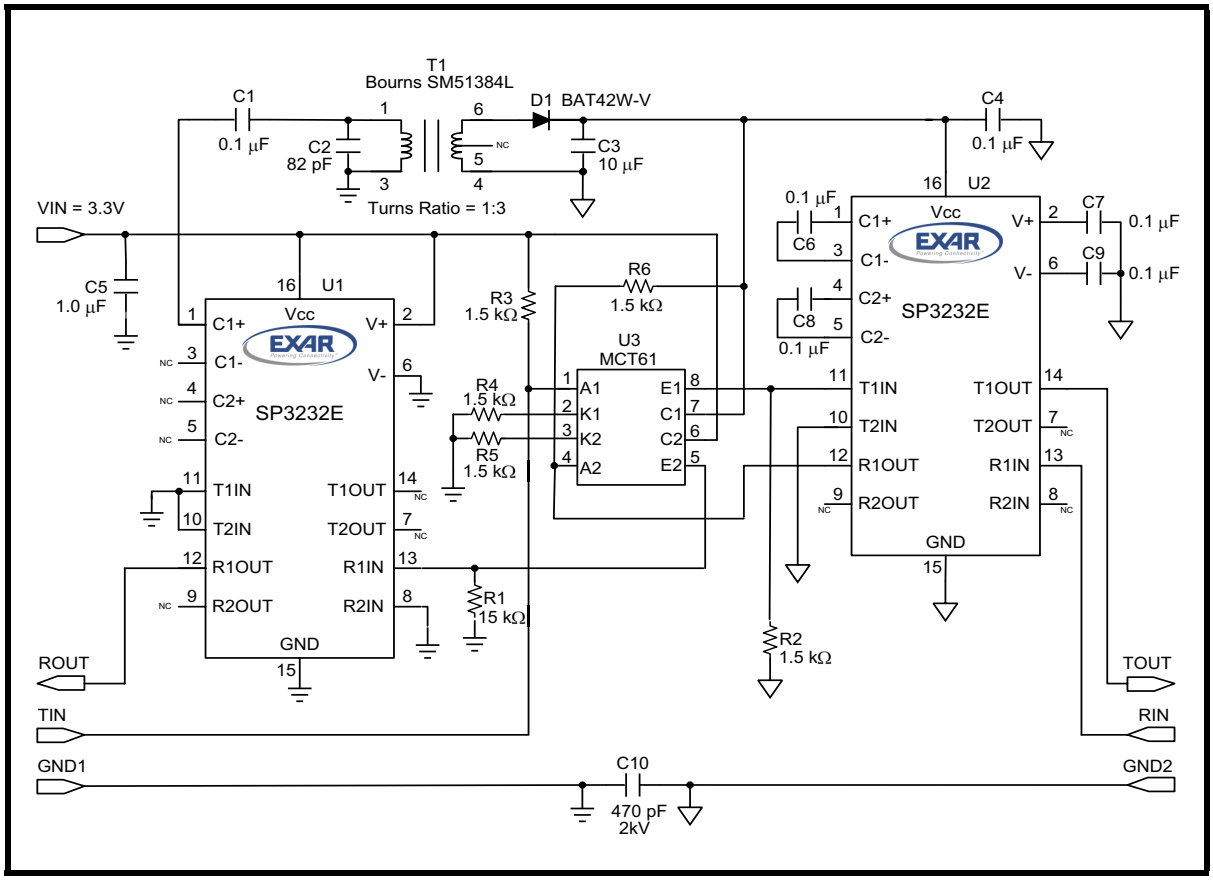
Exar's SP3232E transceiver can be used to create a low cost 4kV isolated RS-232 interface using only a few components. This design operates from a single 3.3V source and provides a single isolated driver and receiver that can operate up to 20kbps. This design can be used for the following applications:

- Smart Metering
- Industrial Controls
- Medical Equipment
- Factory Automation

2.0 GENERAL DESCRIPTION

The schematic diagram of Figure 1 shows how the primary transceivers's charge pump can be used to provide isolated power to the secondary transceiver using a 4kV isolation transformer from Bourns p/n SM51384L. The primary charge pump is configured for continuous pump operation. The resulting constant switching C1+ signal is applied to the primary input of the isolation transformer for generating the isolated supply rail. The output voltage of the power supply varies under load but is in the range of allowable operation for the Exar SP3232E transceiver and optocoupler from Fairchild when Vin is 3.3V +/-5% for this application. The C10 capacitor is used to protect the device from ESD discharge between the primary and secondary grounds and should have a voltage rating of 2kV minimum. The isolated RS-232 driver output and receiver input signals are 15kV ESD protected by the SP3232E.

FIGURE 1. SCHEMATIC



3.0 COMPONENTS

TABLE 1: PARTS LIST

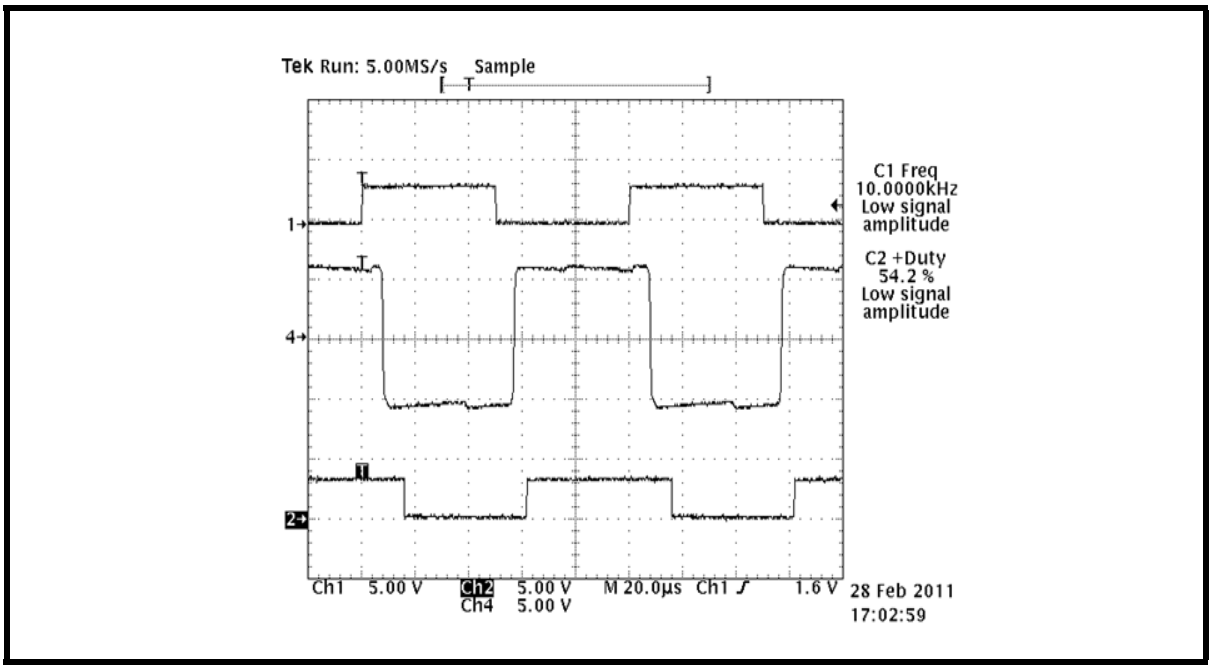
ITEM	QUANTITY	REFERENCE	VALUE	MANUFACTURER	COMMENTS
1	2	U1, U2	SP3232E	Exar	RS-232 Transceiver
2	1	U3	MCT61	Fairchild Semi	Optocoupler
3	1	T1	SM51384L	Bourns	4kV Isolation Transformer
4	1	D1	BAT42W-V	Vishay	Diode
5	6	C1, 4, 6, 7, 8 and 9	0.1uF		Capacitor, 16V, X7R
6	1	C2	82pF		Capacitor, 16V, X7R
7	1	C3	10uF		Capacitor, 16V, X7R
8	1	C5	1.0uF		Capacitor, 16V, X7R
9	1	C10	470pF		Capacitor, 2kV min.
10	1	R1	15k ohms		Resistor
11	5	R2, 3, 4, 5, 6	1.5k ohms		Resistor

4.0 DESIGN NOTES

- The data rate is limited to 20kbps due to the low voltage operation of the optocoupler. For faster speeds an alternative optocoupler would be needed for improved operation below 5V
- For best performance, a circuit board with ground planes is required. The primary and secondary ground planes should have a wide separation space to prevent high voltage breakdown.
- The SP3232E's Vcc bypass capacitors (C4 and C5) and charge pump capacitors (C6-9) should be placed as close as possible to the device.
- Trace widths should be as wide as possible for transceiver power, ground and pump capacitors.
- Ceramic type capacitors with their low ESR properties are ideal for the charge pump.

5.0 LOOPBACK BENCH TEST RESULTS

The following waveform shows the loopback performance when sending and receiving a clock pulse at 10kHz when the driver output (TOUT) is connected to receiver input (RIN) with a 2500pF capacitive load. CH1 is the driver input, CH4 is the RS-232 signal (driver output / receiver input) and CH2 is the resultant receiver output.



6.0 SUMMARY

This reference circuit provides a cost effective low component count solution for isolated RS-232 single channel applications such as for a utility meter reader.

The features of the circuit discussed in this application note are:

- 4kV Isolated RS-232
- 3.3V single supply operation
- 1 TX and 1 RX
- 15kV ESD protection for RS-232 I/O
- 20kbps data rate

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