Keywords: MAX3231, voltage rating, charge pump, RS-485, MAX487, MARK state, space level, true fail-safe, IBSCHK, IBIS, MAX3222E

APPLICATION NOTE 4562

FAQs about Interface, RS-232, and RS-485 Circuits

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Abstract: This application note answers frequently asked questions (FAQs) about RS-232 and RS-485 transceivers.

This set of FAQs addresses some of the more common questions that can arise when using interface devices in new or existing designs. The questions are divided into different categories based on specific information areas. It is possible for questions and answers to span multiple categories.

Section 1. RS-232 Questions

1. What voltage rating should I use for the capacitors on the MAX3231?
2. What are the lead-free equivalents for the MAX3228/MAX3229 or MAX3230/MAX3231?
3. When I run IBSCHK on the IBIS model that Maxim provides for the MAX3222E, I get seven warnings. Is this OK?

Section 2. RS-485 Question

1. The RS-485 receiver in my MAX487 properly goes to the MARK state with an open cable, but does not always go to the MARK state with a shorted cable. How do I get it to behave as I want with both shorted and open cables?

Section 1. RS-232 Questions

Q1. What voltage rating should I use for the capacitors on the MAX3231?

A1. The charge pump itself can drive up to about 7V across the flying capacitors. To this, one must add any di/dt-induced voltages caused by fast switching on the traces between the MAX3231 and these capacitors. For a typical layout, capacitors should be rated at least 10V before derating.

Q2. What are the lead-free equivalents for the MAX3228/MAX3229 or MAX3230/MAX3231?

A2. The MAXxxxAEEWV+T is Maxim's RoHS-compliant version of the MAXxxxEEBV. For the MAXxxxAEEWV, we added "dummy" solder bumps that are electrically isolated at pins B2, B3, B4, C2, C3, C4, and D2 through D5. This configuration will be similar to pins B6, D6, E4, and E6 on the existing MAXxxxEEBV data sheet.

Please note that these parts have a 2.5k piece MOQ (minimum ordering quantity).

Q3. When I run IBSCHK on the IBIS model that Maxim provides for the MAX3222E, I get 7 warnings. Is this OK?

A3. Yes, in this case it is OK. IBSCHK understands that there may be circumstances where these messages are necessary and proper in a valid model. This is why IBSCHK flags these as warnings, not errors. With the MAX3222E IBIS model, the two warnings, "Typical value never becomes zero," appear because pulldowns are required for proper RS-232 operation. The five "non-monotonic" warnings appear when a circuit inside the MAX3222E shuts down a driver if the load becomes excessive.

Section 2. RS-485 Question

Q1. The RS-485 receiver in my MAX487 properly goes to the MARK state with an open cable, but does not always go to the MARK state with a shorted cable. How do I get it to behave as I want with both shorted and open cables?

A1. The MAX487, like many similar RS-485 transceiver designs, could detect open cables but not shorts. Later generations of transceivers were improved to handle shorts and opens. For example, the MAX3471 is pin-for-pin compatible with the MAX487, but the newer MAX3471 implements true fail-safe functionality. Use one of these later-generation devices instead.

The MAX487 implements open-cable detection by applying a slight bias to the A receiver input pin. With no termination, this causes the receiver's differential input to bias just as if it were receiving a MARK state from a valid driver. The MAX487 receiver threshold specification, V_{TH}, is set to detect a SPACE when a differential receiver input is under the -200mV threshold, and to detect a MARK when a differential receiver input is over the +200mV threshold. Shorting the A and B inputs places the differential receiver threshold near 0V, exactly midway between the MARK and the SPACE level. Depending on the device and operating environment, the output could be detected as either MARK or SPACE in this condition.

Newer devices implement a receiver technique, in which a receiver differential input between -50mV and +50mV is guaranteed to behave as if the threshold corresponds to a MARK state.

Related Parts		
MAX1487	Low-Power, Slew-Rate-Limited RS-485/RS-422 Transceivers	Free Samples
MAX1487E	±15kV ESD-Protected, Slew-Rate-Limited, Low-Power, RS-485/RS-422 Transceivers	Free Samples
MAX3222E	±15kV ESD-Protected, Down to 10nA, 3.0V to 5.5V, Up to 1Mbps, True RS-232 Transceivers	Free Samples
MAX3230AE	±15kV ESD-Protected +2.5V to +5.5V RS-232 Transceivers in UCSP and WLP	
MAX3230E	±15kV ESD-Protected +2.5V to +5.5V RS-232 Transceivers in UCSP and WLP	

MAX3231AE	±15kV ESD-Protected +2.5V to +5.5V RS-232 Transceivers in UCSP and WLP	Free Samples
MAX3231E	±15kV ESD-Protected +2.5V to +5.5V RS-232 Transceivers in UCSP and WLP	
MAX3323E	±15kV ESD-Protected, RS-232 Transceivers for Multidrop Applications	Free Samples
MAX481	Low-Power, Slew-Rate-Limited RS-485/RS-422 Transceivers	Free Samples
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MAX491E	±15kV ESD-Protected, Slew-Rate-Limited, Low-Power, RS-485/RS-422 Transceivers	Free Samples