



Is Now A Part Of



Visit www.maxlinear.com
for more information about
MaxLinear Inc.



How Robust is Your High Fault Tolerant RS-485?

Debbie Brandenburg
Senior Manager
Marketing Communications
MaxLinear, Inc.

Dat Dang
Sr. Staff Applications Engineer
High Performance Analog
MaxLinear, Inc.

Not all Fault Tolerance Transceivers are Created Equal

High fault tolerant RS-485/RS-422 transceivers are available from several manufacturers today. These transceivers are designed for improved performance in noisy industrial environments and offer an increased tolerance to system faults. Many high fault tolerant transceivers, including the XR33x5x family from MaxLinear, claim their analog bus pins can withstand direct shorts up to $\pm 60V$. However, there are no fault tolerant tests, procedures, or conditions stated in the data sheets of these “robust” transceivers. Interrupted data communication during a fault condition is tolerable, but if your RS-485 can’t withstand $\pm 60V$ under real-world conditions, the resulting field failures can be costly. 12 different RS-485 high fault tolerant transceivers have been tested using three different techniques. This paper summarizes the test results to see how many transceivers hold up to their fault tolerant claims.

Introduction

RS-485/RS-422 data communication applications such as industrial control networks utilize 24V and even 48V power supplies. Installation wiring faults, ground voltage faults and even direct shorts are potential field failures in these systems. A transceiver with a $\pm 60V$ fault tolerance provides adequate tolerance and protection for both 24V and 48V systems.

Multiple vendors offer $\pm 60V$ fault tolerant RS-485 transceivers, many even offer $\pm 70V$ and $\pm 80V$ tolerance levels. There are no fault tolerant tests, procedures, or conditions stated in the data sheets of these “robust” transceivers. So just how “robust” is your fault tolerant RS-485?

To answer this question, 12 different RS-485 high fault tolerant transceivers were put to the test. Two tests actually:

- Transient Fault Voltage Test
- Sweep Voltage Test

Transient Fault Voltage Test

A transient fault voltage was applied to the driver output pins (Y/Z) at 5V increments. $V_{cc} = V_L = 5V$; $DI = H$. Point of failure was recorded. Test was repeated with $DI = L$.

Sweep Voltage Test

The driver output pins (Y/Z) were connected to a power

supply. $V_{cc} = V_L = 5V$; $DI = H$. The voltage was slowly swept from 0V to 80V, then repeated from 0V to -80V. Point of failure was recorded. Test was repeated with $DI = L$.

Table 1 below shows a summary of those tests along with the published fault tolerance value listed in each product’s data sheet. The Sweep Voltage test was less demanding on the transceiver; most of the tested devices passed this test. The Transient Fault Voltage Test put the device into conditions that better resembled those found in real-life applications. Of the parts tested, the MaxLinear XR33x5x devices were the only ones that passed this test. Refer to the MaxLinear application note ANI-23 for more detail.

Conclusion

Not all $\pm 60V$ transceivers are created equal. Protect your systems by using a truly robust RS-485/RS-422 high fault tolerant transceiver like those from MaxLinear.

For More Information

- Download the product data sheets: [XR33053](#) [XR33152](#) [XR33156](#) [XR33158](#)
- Review the Fault Tolerant Testing Application Note: [ANI-23](#)

| Vendor | Device | Fault Tolerance Claim ($\pm V$) | Transient Fault Test Summary ($\pm V$) | Sweep Voltage Test Summary ($\pm V$) |
|-----------|---------|-----------------------------------|--|--|
| MaxLinear | XR33152 | 60 | 61 | 70 |
| | XR33156 | 60 | 61 | 70 |
| | XR33158 | 60 | 61 | 70 |
| | XR33053 | 60 | 61 | 70 |
| Vendor A | 1 | 60 | 45 | 60 |
| | 2 | 60 | 55 | 60 |
| Vendor B | 1 | 60 | 25 | 60 |
| | 2 | 60 | 35 | 60 |
| Vendor C | 1 | 70 | 65 | 70 |
| Vendor D | 1 | 80 | 70 | 70 |
| | 2 | 80 | 65 | 70 |
| | 3 | 80 | 70 | 80 |

Figure 1: Fault Tolerance Test Results



Corporate Headquarters:
5966 La Place Court
Suite 100
Carlsbad, CA 92008
Tel.: +1 (760) 692-0711
Fax: +1 (760) 444-8598
www.maxlinear.com

High Performance Analog:
48720 Kato Road
Fremont, CA 94538
Tel.: +1 (510) 668-7000
Fax: +1 (510) 668-7001
Email: uarttechsupport@exar.com
www.exar.com

The content of this document is furnished for informational use only, is subject to change without notice, and should not be construed as a commitment by MaxLinear, Inc.. MaxLinear, Inc. assumes no responsibility or liability for any errors or inaccuracies that may appear in the informational content contained in this guide. Complying with all applicable copyright laws is the responsibility of the user. Without limiting the rights under copyright, no part of this document may be reproduced into, stored in, or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), or for any purpose, without the express written permission of MaxLinear, Inc.

Maxlinear, Inc. does not recommend the use of any of its products in life support applications where the failure or malfunction of the product can reasonably be expected to cause failure of the life support system or to significantly affect its safety or effectiveness. Products are not authorized for use in such applications unless MaxLinear, Inc. receives, in writing, assurances to its satisfaction that: (a) the risk of injury or damage has been minimized; (b) the user assumes all such risks; (c) potential liability of MaxLinear, Inc. is adequately protected under the circumstances.

MaxLinear, Inc. may have patents, patent applications, trademarks, copyrights, or other intellectual property rights covering subject matter in this document. Except as expressly provided in any written license agreement from MaxLinear, Inc., the furnishing of this document does not give you any license to these patents, trademarks, copyrights, or other intellectual property.

Company and product names may be registered trademarks or trademarks of the respective owners with which they are associated.

© 2017 MaxLinear, Inc. All rights reserved



The content of this document is furnished for informational use only, is subject to change without notice, and should not be construed as a commitment by MaxLinear, Inc.. MaxLinear, Inc. assumes no responsibility or liability for any errors or inaccuracies that may appear in the informational content contained in this guide. Complying with all applicable copyright laws is the responsibility of the user. Without limiting the rights under copyright, no part of this document may be reproduced into, stored in, or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), or for any purpose, without the express written permission of MaxLinear, Inc.

Maxlinear, Inc. does not recommend the use of any of its products in life support applications where the failure or malfunction of the product can reasonably be expected to cause failure of the life support system or to significantly affect its safety or effectiveness. Products are not authorized for use in such applications unless MaxLinear, Inc. receives, in writing, assurances to its satisfaction that: (a) the risk of injury or damage has been minimized; (b) the user assumes all such risks; (c) potential liability of

MaxLinear, Inc. is adequately protected under the circumstances.

MaxLinear, Inc. may have patents, patent applications, trademarks, copyrights, or other intellectual property rights covering subject matter in this document. Except as expressly provided in any written license agreement from MaxLinear, Inc., the furnishing of this document does not give you any license to these patents, trademarks, copyrights, or other intellectual property.

Company and product names may be registered trademarks or trademarks of the respective owners with which they are associated.

© 2017 MaxLinear, Inc. All rights reserved