

# AS8221

## FlexRay Standard Transceiver



### AN2: Bus Failure Detection

The following describes the capabilities of the AS8221 FlexRay Standard Transceiver to detect bus failures like short circuit to GND or Vcc or VBAT and open loads on the bus pins in a FlexRay system.

## 1 Generic FlexRay System Contemplation

The detection of bus failures supports the early recognition of limited operation at the physical layer which are caused by short circuit or open load conditions at the bus pins BP and BM.

In today's FlexRay nodes, Common Mode Chokes and Split-Termination are applied. Thus the components at the bus pins between the Transceiver and the connector show a direct impact on the failure detection capability. However, cabling and the distance of possible failures to the Transceiver due to its impact on signal timing have the strongest influence on the detection capabilities and limits the bus diagnostic feature.

Transceiver devices can only detect failures on the bus, if they are in sending mode. Nodes that are not intended to perform a cold start will wait until communication starts. After a successful cold start of the system, all nodes will operate as receivers and transmitters. After a cold-start, while transmitting, the so-called non-cold-start-nodes might be able to detect failures on the bus.

If permanent short circuits and open loads are present in the very beginning of a drive cycle, only cold-start-nodes will be able to detect failures, as these nodes are initiating the communication and are in transmitting mode at first.

Permanent bus failures appearing during FlexRay communication or sporadic failures might be detected by all nodes in the network.

In both cases, the capability of detecting failures depends on the implementation. It is a trade off between detecting a wide range of physical layer abnormalities and the safe detection of failures. The previous has the risk that failures and abnormalities are incorrectly signalled to the microcontroller and the safe detection of failures shows the risk of not to cover the detection of a wider range of abnormalities at the physical layer.

## 2 Implementation of the AS8221

The AS8221 FlexRay Standard Transceiver implements the following two independent mechanisms for failure detection.

- Comparison of TxD and RxD
- Detection of high and low current at the two bus pins

### 2.1 Comparison of TxD and RxD

The internal error flag Bus Error (BUSERR) (chapter 8.12.2 from the device datasheet) is set if two consecutive rising edges on the TxD pin without any rising edge on the RxD pin is detected or if two consecutive falling edges on the TxD pin without any falling edge on the RxD pin is detected. The BUSERR flag is reset if a rising edge on the TxD pin is followed by a rising edge on the RxD pin before the next TxD rising edge or if a falling edge on the TxD pin is followed by a falling edge on RxD pin before the next TxD falling edge.

### 2.2 Detection of high and low current at the two bus pins

The following flags according to the device datasheet are set and reset if high, low current or a combination is detected on the respective bus pins:

- Chapter 8.12.3 BP Open Line (BP\_OL)
- Chapter 8.12.4 BM Open Line (BM\_OL)
- Chapter 8.12.5 BP Short Circuit to VCC (BP\_VCC)
- Chapter 8.12.6 BP Short Circuit to GND (BP\_GND)
- Chapter 8.12.7 BM Short Circuit to VCC (BM\_VCC)

- Chapter 8.12.8 BM Short Circuit to GND (BM\_GND)
- Chapter 8.12.9 Short Circuit between BP and BM (BP\_BM)

Flags are set or reset after  $t_{BUS\_ERROR}$ .

In order to make this mechanism work properly, the transmitting node will send permanent Data0 and Data1 signals for a time longer than  $t_{BUS\_ERROR}$ . The FlexRay protocol does not offer symbols with the length of  $t_{BUS\_ERROR}$ .

## 2.3 Usage of AS8221 Bus Failure Diagnosis

The combination of above described failure detection mechanism makes the AS8221 very stable in failure detection and avoids incorrectly detected failures.

The comparison of TxD and RxD detects bus failures very fast. If a Common Mode Choke is used failures will be detected if they are within 0.5m to the ECU connector. In this way sporadic failures can be detected.

For permanent failure detection, the high and low current measurement at the bus pins shall be applied. From system behavior, a permanent Data0 and Data1 signal will be sent for a time longer than  $t_{BUS\_ERROR}$ . In this way, failures with distances up to 8m to the ECU connectors even with usage of Common Mode Chokes will be safely detected. This mechanism is suitable for cold-start nodes or in general FlexRay system layouts where the transmission of Data0 and Data1 signals for longer than  $t_{BUS\_ERROR}$  are implemented.

The FlexRay standard does not support symbols with the length of  $t_{BUS\_ERROR}$ . Therefore, to use the safe failure detection method, special patterns for activation shall be supported by the sending nodes.

## Copyrights

Copyright © 1997-2009, austriamicrosystems AG, Tobelbaderstrasse 30, 8141 Unterpremstaetten, Austria-Europe. Trademarks Registered ®. All rights reserved. The material herein may not be reproduced, adapted, merged, translated, stored, or used without the prior written consent of the copyright owner.

All products and companies mentioned are trademarks or registered trademarks of their respective companies.

## Disclaimer

Devices sold by austriamicrosystems AG are covered by the warranty and patent indemnification provisions appearing in its Term of Sale. austriamicrosystems AG makes no warranty, express, statutory, implied, or by description regarding the information set forth herein or regarding the freedom of the described devices from patent infringement. austriamicrosystems AG reserves the right to change specifications and prices at any time and without notice. Therefore, prior to designing this product into a system, it is necessary to check with austriamicrosystems AG for current information. This product is intended for use in normal commercial applications. Applications requiring extended temperature range, unusual environmental requirements, or high reliability applications, such as military, medical life-support or life-sustaining equipment are specifically not recommended without additional processing by austriamicrosystems AG for each application. For shipments of less than 100 parts the manufacturing flow might show deviations from the standard production flow, such as test flow or test location.

The information furnished here by austriamicrosystems AG is believed to be correct and accurate. However, austriamicrosystems AG shall not be liable to recipient or any third party for any damages, including but not limited to personal injury, property damage, loss of profits, loss of use, interruption of business or indirect, special, incidental or consequential damages, of any kind, in connection with or arising out of the furnishing, performance or use of the technical data herein. No obligation or liability to recipient or any third party shall arise or flow out of austriamicrosystems AG rendering of technical or other services.



## Contact Information

### Headquarters

austriamicrosystems AG  
Tobelbaderstrasse 30  
A-8141 Unterpremstaetten, Austria  
Tel: +43 (0) 3136 500 0  
Fax: +43 (0) 3136 525 01

For Sales Offices, Distributors and Representatives, please visit:

<http://www.austriamicrosystems.com/contact>