AN90060

Pin FMEA for NXB family

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Document information

Information	Content
Keywords	Pin FMEA, NXB, Autosense translator
Abstract	This application note provides a Failure Modes and Effects Analysis (FMEA) for the device pins of Nexperia's NXB family under typical failure situations

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1. Introduction

NXB autosense voltage translators comprising of one-shot pull-ups and pull-downs, ideal for use as push-pull drivers for long-trace, capacitive, or high-impedance loads in applications that use SPI, Secure Digital or UART interfaces.

The architecture of one I/O channel of an NXB level translator incorporates a weak buffer with one-shot circuitry to improve the transition speeds of rising and falling edges. As an example, when the A port is connected to a system driver and driven high, the one-shot will trigger when it senses the rising edge and the high-drive buffer drives the B port high. The weaker 4 kΩ will hold B port high once the one-shot pulse is complete. Similarly, the same is true for driving low.

2. NXB family overview

The NXB family comprises of 1-, 2-, 4-, 6- and 8-channel devices. These are directional level translation with auto-direction sensing and open-drain outputs. The NXB family supports the below mentioned features:

- Wide supply voltage range
  - NXB0101, NXB0102, NXB0104, NXB0106 and NXB0108
    - $V_{CC(A)}$: 1.2 V to 3.6 V and $V_{CC(B)}$: 1.65 V to 5.5 V
- Maximum data rates:
  - Push-pull: up to 40 Mbps over voltage- and temperature range
- Inputs accept voltages up to 5.5 V
- I_{OFF} circuitry provides partial Power-down mode operation
- The NXB family is specified from -40 °C to +85 °C and -40 °C to +125 °C

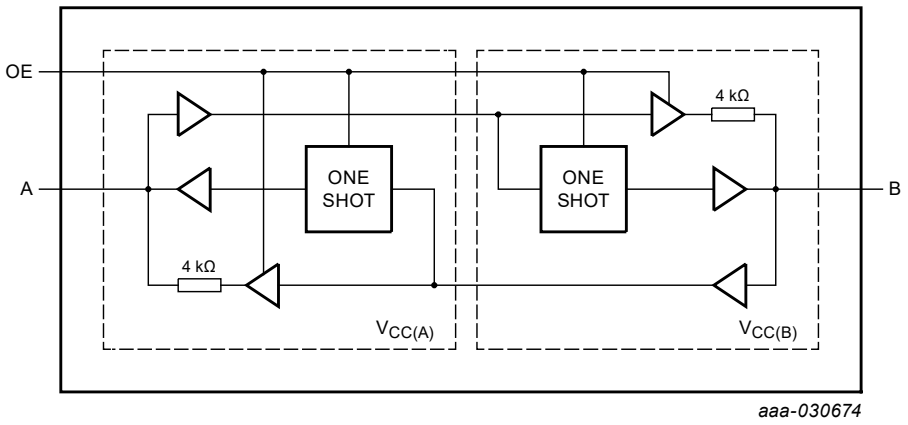

Fig. 1. Functional diagram of the NXB0101

3. Pin FMEA

This application note provides a Failure Modes and Effects Analysis (FMEA) for the device pins of Nexperia's NXB family under typical failure situations such as a short-circuit to V_{CC} or GND or to a neighboring pin, or if a pin is left open.

A failure is classified according to its effect on the NXB device and the functionality of the application; see Table 1.

Table 1. Classification of failure effects

Class	Failure effect
A	damage to device
	affects application functionality
B	no damage to device
	may affect application functionality
C	no damage to device
	no affect to application functionality

Table 2. FMEA matrix for pin short-circuit to V_{CC}

Pin	Class	Remarks
OE	B	Product goes to disabled state like when OE is asserted LOW in a normal fashion
An	B	No static state with excessive high currents.
Bn	B	No static state with excessive high currents.
GND	B	Application short, no risk for damage of the product. I_{OFF} function allows IO bias while V_{CC} = GND.

Table 3. FMEA matrix for pin short-circuit to GND

Pin	Class	Remarks
OE	B	Product goes to enabled state like when OE is asserted HIGH in a normal fashion
An	B	No static state with excessive high currents.
Bn	B	No static state with excessive high currents.
V_{CC}	B	Application short, no risk for damage of the product. I_{OFF} function allows IO bias while V_{CC} = GND.

Table 4. FMEA matrix for pin left open

Pin	Class	Remarks
OE	B	Product goes to undefined state: enabled/disabled. $V_{(OE)}$ may drift in between GND… V_{CCA}. As a result I_{CCA} can be raised. Robust design can cope with these currents.
An	B	$V_{(An)}$ will be controlled by the product. No risk of raised I_{CCA}.
Bn	B	$V_{(Bn)}$ will be controlled by the product. No risk of raised I_{CCB}.
V_{CC}	B	Partial Power down condition, bias on IO pins allowed with I_{OFF} function
GND	B	Product GND may be biased via parasitic diodes to IO pins. If any IO pin is biased at LOW (GND) in the application, the product GND will be biased ~GND +V_{diode} ~0.6 V. No static state with excessive high currents.

Table 5. FMEA matrix for pin short-circuits between neighbor pins

Pin	Class	Remarks
OE	B	On top of scenarios assessed by other sections in this FMEA: An or Bn can be shorted to OE. This may cause undefined state enabled/ disabled. No risk of static state with excessive high currents.
An	B	An can be shorted to other An/Bn This may cause odd cross channel effects. No risk of static state with excessive high currents.
Bn	B	Bn can be shorted to other An/Bn This may cause odd cross channel effects. No risk of static state with excessive high currents.
V_{CC}	B	No additional combination. All assessed combinations classified as B.
GND	B	No additional combination. All assessed combinations classified as B.

4. Revision history

Table 6. Revision history

Rev	Date	Description
AN90060 v.1	20241211	Initial version

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