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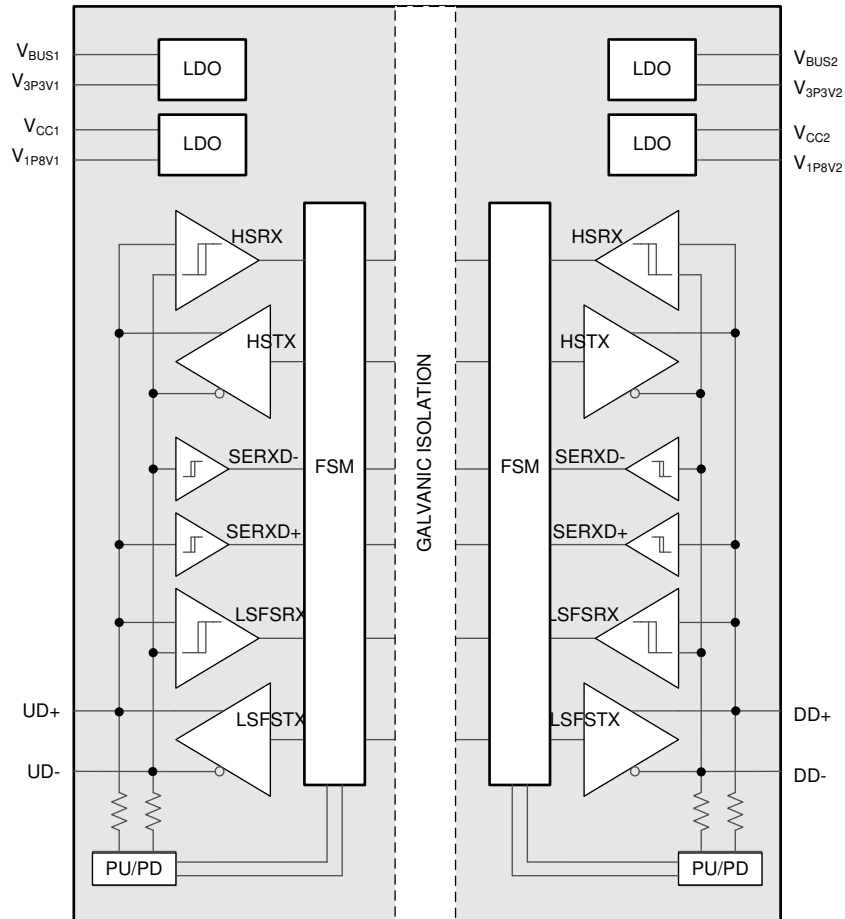
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## 1 Overview

This document contains information for the ISOUSB211-Q1 (SSOP (28) DP package) to aid in a functional safety system design. Information provided are:

- Functional safety failure in time (FIT) rates of the semiconductor component estimated by the application of industry reliability standards
- Component failure modes and distribution (FMD) based on the primary function of the device
- Pin failure mode analysis (pin FMA)

Figure 1-1 shows the device functional block diagram for reference.



**Figure 1-1. Functional Block Diagram**

The ISOUSB211-Q1 was developed using a quality-managed development process, but was not developed in accordance with the IEC 61508 or ISO 26262 standards.

## 2 Functional Safety Failure In Time (FIT) Rates

This section provides functional safety failure in time (FIT) rates for the ISOUSB211-Q1 based on two different industry-wide used reliability standards:

- [Table 2-1](#) provides FIT rates based on IEC TR 62380 / ISO 26262 part 11
- [Table 2-2](#) provides FIT rates based on the Siemens Norm SN 29500-2

**Table 2-1. Component Failure Rates per IEC TR 62380 / ISO 26262 Part 11**

FIT IEC TR 62380 / ISO 26262	FIT (Failures Per 10 <sup>9</sup> Hours)
Total component FIT rate	35
Die FIT rate	7
Package FIT rate	28

The failure rate and mission profile information in [Table 2-1](#) comes from the reliability data handbook IEC TR 62380 / ISO 26262 part 11:

- Mission profile: Motor control from table 11 or figure 16
- Power dissipation: 1210mW
- Climate type: World-wide table 8 or figure 13
- Package factor (lambda 3): From table 17b or figure 15
- Substrate material: FR4
- EOS FIT rate assumed: 0 FIT

**Table 2-2. Component Failure Rates per Siemens Norm SN 29500-2**

Table	Category	Reference FIT Rate	Reference Virtual T <sub>J</sub>
5	CMOS, BICMOS Digital, analog, or mixed	60 FIT	70C

The reference FIT rate and reference virtual T<sub>J</sub> (junction temperature) in [Table 2-2](#) come from the Siemens Norm SN 29500-2 tables 1 through 5. Failure rates under operating conditions are calculated from the reference failure rate and virtual junction temperature using conversion information in SN 29500-2 section 4.

### 3 Failure Mode Distribution (FMD)

The failure mode distribution estimation for the ISOUSB211-Q1 in [Table 3-1](#) comes from the combination of common failure modes listed in standards such as IEC 61508 and ISO 26262, the ratio of sub-circuit function size and complexity, and from best engineering judgment.

The failure modes listed in this section reflect random failure events and do not include failures resulting from misuse or overstress.

**Table 3-1. Die Failure Modes and Distribution**

Die Failure Modes	Failure Mode Distribution (%)
Degraded performance in all speed (LS, FS, HS) modes	11.5
Degraded performance in HS speed mode	6
Device non-operational in any speed mode	38.5
Device non-operational in HS speed mode	44

The FMD in the *Die Failure Modes and Distribution* table excludes short-circuit faults across the isolation barrier. Faults for short circuits across the isolation barrier can be excluded according to IEC 61800-5-2:2016 if the following requirements are fulfilled:

1. The signal isolation component is OVC III according to IEC 61800-5-1. If a safety-separated extra low voltage (SELV) or protective extra low voltage (PELV) power supply is used, pollution degree 2 / OVC II applies. All requirements of IEC 61800-5-1:2007, 4.3.6 apply.
2. Measures are taken to ensure that an internal failure of the signal isolation component cannot result in excessive temperature of its insulating material.

Creepage and clearance requirements should be applied according to the specific equipment isolation standards of an application. Care should be taken to maintain the creepage and clearance distance of a board design to ensure that the mounting pads of the isolator on the printed-circuit board do not reduce this distance.

## 4 Pin Failure Mode Analysis (Pin FMA)

This section provides a failure mode analysis (FMA) for the pins of the ISOUSB211-Q1. The failure modes covered in this document include the typical pin-by-pin failure scenarios, see [Table 4-2](#):

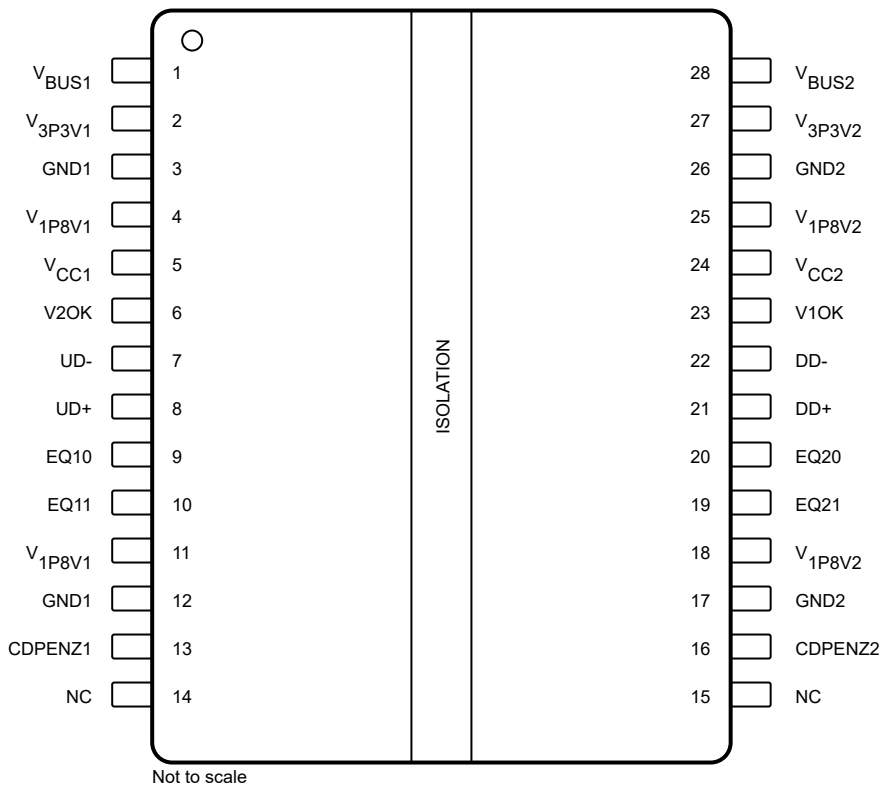
- Pin short-circuited to ground
- Pin open-circuited
- Pin short-circuited to an adjacent pin
- Pin short-circuited to supply

[Table 4-2](#) also indicates how these pin conditions can affect the device as per the failure effects classification in [Table 4-1](#).

**Table 4-1. TI Classification of Failure Effects**

Class	Failure Effects
A	Potential device damage that affects functionality.
B	No device damage, but loss of functionality.
C	No device damage, but performance degradation.
D	No device damage, no impact to functionality or performance.

[Figure 4-1](#) shows the ISOUSB211-Q1 pin diagram. For a detailed description of the device pins, see the *Pin Configuration and Functions* section in the ISOUSB211-Q1 datasheet.



**Figure 4-1. Pin Diagram**

Following are the assumptions of use and the device configuration assumed for the pin FMA in this section:

- For short-to-ground analysis, the ground referenced for the short is the ground on that side of the isolation barrier.
- For short-to-supply analysis, the supply referenced for the short is the supply on that side of the isolation barrier.

**Table 4-2. Pin FMA for Device Pins Short-Circuited to Ground, Open-Circuited, Short-Circuited to Adjacent Pin, and Short-Circuited to Supply**

Pin Name	Pin No.	Potential Failure Mode	Description of Potential Failure Effects	Failure Effect Class
V <sub>BUS1</sub>	1	Short-Circuited to Ground (Side-1)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
V <sub>BUS1</sub>	1	Open-Circuited	The device has no power (one of the supply inputs is open). If V <sub>3P3V1</sub> connects to a power supply, the internal LDO can be damaged from the reverse current. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
V <sub>BUS1</sub>	1	Short-Circuited to Pin 2 (V <sub>3P3V1</sub> )	The device continues to function as expected if the voltage on V <sub>BUS1</sub> is within the absolute maximum ratings for V <sub>3P3V1</sub> ; otherwise, damage to the device is possible.	A
V <sub>BUS1</sub>	1	Short-Circuited to Supply V <sub>BUS1</sub>	The device continues to function as expected. Normal operation.	D
V <sub>BUS1</sub>	1	Short-Circuited to Supply V <sub>CC1</sub> (Side-1)	The device continues to function as expected. Normal operation.	D
V <sub>3P3V1</sub>	2	Short-Circuited to Ground (Side-1)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
V <sub>3P3V1</sub>	2	Open-Circuited	Internal LDO can supply V <sub>3P3V1</sub> if 4.25V to 5.5V is connected on V <sub>BUS1</sub> . However, the 3.3V output can have stability issues without proper external bypass capacitors. Otherwise, the device does not have the power to turn on, and there is a loss of functionality.	B
V <sub>3P3V1</sub>	2	Short-Circuited to Pin 3 (GND1)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
V <sub>3P3V1</sub>	2	Short-Circuited to Supply V <sub>BUS1</sub>	The device continues to function as expected if the voltage on V <sub>BUS1</sub> is within the absolute maximum ratings for V <sub>3P3V1</sub> ; otherwise, damage to the device is possible.	A
V <sub>3P3V1</sub>	2	Short-Circuited to Supply V <sub>CC1</sub>	The device continues to function as expected if the voltage on V <sub>CC1</sub> is within the absolute maximum ratings for V <sub>3P3V1</sub> ; otherwise, damage to the device is possible.	A
GND1	3	Short-Circuited to Ground (Side-1)	The device continues to function as expected. Normal operation.	D
GND1	3	Open-Circuited	The device receives return ground through pin 12 (GND1). Normal operation.	D
GND1	3	Short-Circuited to Pin 4 (V <sub>1P8V1</sub> )	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
GND1	3	Short-Circuited to Supply V <sub>BUS1</sub>	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
GND1	3	Short-Circuited to Supply V <sub>CC1</sub>	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A

**Table 4-2. Pin FMA for Device Pins Short-Circuited to Ground, Open-Circuited, Short-Circuited to Adjacent Pin, and Short-Circuited to Supply (continued)**

Pin Name	Pin No.	Potential Failure Mode	Description of Potential Failure Effects	Failure Effect Class
V <sub>1P8V1</sub>	4	Short-Circuited to Ground (Side-1)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
V <sub>1P8V1</sub>	4	Open-Circuited	Internal LDO can supply V <sub>1P8V1</sub> if 2.4V to 5.5V is connected on V <sub>CC1</sub> . However, the 1.8V output can have stability issues without proper external bypass capacitors. Otherwise, the device does not have the power to turn on, and there is a loss of functionality.	B
V <sub>1P8V1</sub>	4	Short-Circuited to Pin 5 (V <sub>CC1</sub> )	The device continues to function as expected if the voltage on V <sub>CC1</sub> is within the absolute maximum ratings for V <sub>1P8V1</sub> ; otherwise, damage to the device is possible.	A
V <sub>1P8V1</sub>	4	Short-Circuited to Supply V <sub>BUS1</sub>	This short circuit can potentially damage the device as the 1.8V domain circuits get exposed to voltages above the absolute maximum ratings for the circuits.	A
V <sub>1P8V1</sub>	4	Short-Circuited to Supply V <sub>CC1</sub>	The device continues to function as expected if the voltage on V <sub>CC1</sub> is within the absolute maximum ratings for V <sub>1P8V1</sub> ; otherwise, damage to the device is possible.	A
V <sub>CC1</sub>	5	Short-Circuited to Ground (Side-1)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
V <sub>CC1</sub>	5	Open-Circuited	The device has no power (one of the supply inputs is open). If V <sub>1P8V1</sub> connects to a power supply, the internal LDO can be damaged from the reverse current. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
V <sub>CC1</sub>	5	Short-Circuited to Pin 6 (V <sub>2OK</sub> )	This short circuit causes high current to flow between supply and ground during power-up; causing damage to the device.	A
V <sub>CC1</sub>	5	Short-Circuited to Supply V <sub>BUS1</sub>	The device continues to function as expected. Normal operation.	D
V <sub>CC1</sub>	5	Short-Circuited to Supply V <sub>CC1</sub>	The device continues to function as expected. Normal operation.	D
V <sub>2OK</sub>	6	Short-Circuited to Ground (Side-1)	There is a loss of the indication of the power condition of side two. This short circuit causes high current to flow between supply and ground; causing damage to the device.	A
V <sub>2OK</sub>	6	Open-Circuited	The device continues to function as expected. The indication that side two is powered up is not received.	D
V <sub>2OK</sub>	6	Short-Circuited to Pin 7 (UD-)	There is data corruption on UD-. There is a potential path between supply and ground, which can lead to device damage. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
V <sub>2OK</sub>	6	Short-Circuited to Supply V <sub>BUS1</sub>	This short circuit causes high current to flow between supply and ground during power-up; causing damage to the device.	A
V <sub>2OK</sub>	6	Short-Circuited to Supply V <sub>CC1</sub>	This short circuit causes high current to flow between supply and ground during power-up; causing damage to the device.	A
UD-	7	Short-Circuited to Ground (Side-1)	Data corruption on UD-. Damage to the device is possible if UD- is driven high for an extended period of time.	A
UD-	7	Open-Circuited	The output state of UD- is undetermined. Communication is corrupted.	B
UD-	7	Short-Circuited to Pin 8 (UD+)	There is data corruption on UD- and UD+. Damage to the device is possible if opposite polarity is driven on both pins for an extended period of time. Communication is corrupted.	A
UD-	7	Short-Circuited to Supply V <sub>BUS1</sub>	There is data corruption on UD-. Damage to the device is possible if UD- is driven low for an extended period of time.	A
UD-	7	Short-Circuited to Supply V <sub>CC1</sub>	There is data corruption on UD-. Damage to the device is possible if UD- is driven low for an extended period of time.	A

**Table 4-2. Pin FMA for Device Pins Short-Circuited to Ground, Open-Circuited, Short-Circuited to Adjacent Pin, and Short-Circuited to Supply (continued)**

Pin Name	Pin No.	Potential Failure Mode	Description of Potential Failure Effects	Failure Effect Class
UD+	8	Short-Circuited to Ground (Side-1)	There is data corruption on UD+. Damage to the device is possible if UD+ is driven high for an extended period of time.	A
UD+	8	Open-Circuited	The output state of UD+ is undetermined. Communication is corrupted.	B
UD+	8	Short-Circuited to Pin 9 (EQ10)	There is data corruption on UD+. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
UD+	8	Short-Circuited to Supply $V_{BUS1}$	There is data corruption on UD+. Damage to the device is possible if UD+ is driven low for an extended period of time.	A
UD+	8	Short-Circuited to Supply $V_{CC1}$	There is data corruption on UD+. Damage to the device is possible if UD+ is driven low for an extended period of time.	A
EQ10	9	Short-Circuited to Ground (Side-1)	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ10	9	Open-Circuited	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ10	9	Short-Circuited to Pin 10 (EQ11)	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ10	9	Short-Circuited to Supply $V_{BUS1}$	The equalization settings for HS mode do not work as expected. A degradation in performance can occur. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
EQ10	9	Short-Circuited to Supply $V_{CC1}$	The equalization settings for HS mode do not work as expected. A degradation in performance can occur. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
EQ11	10	Short-Circuited to Ground (Side-1)	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ11	10	Open-Circuited	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ11	10	Short-Circuited to Pin 11 ( $V_{1P8V1}$ )	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ11	10	Short-Circuited to Supply $V_{BUS1}$	The equalization settings for HS mode do not work as expected. A degradation in performance can occur. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
EQ11	10	Short-Circuited to Supply $V_{CC1}$	The equalization settings for HS mode do not work as expected. A degradation in performance can occur. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
V1P8V1	11	Short-Circuited to Ground (Side-1)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
V1P8V1	11	Open-Circuited	The device has no power (one of the supply inputs is floating). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	B
V1P8V1	11	Short-Circuited to Pin 12 (GND1)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
V1P8V1	11	Short-Circuited to Supply $V_{BUS1}$	This short circuit can potentially damage the device as the 1.8V domain circuits get exposed to voltages above the absolute maximum ratings of the circuit.	A
V1P8V1	11	Short-Circuited to Supply $V_{CC1}$	The device continues to function as expected if the voltage on $V_{CC1}$ is within the absolute maximum ratings for $V_{1P8V1}$ ; otherwise, damage to the device is possible.	A
GND1	12	Short-Circuited to Ground (Side-1)	The device continues to function as expected. Normal operation.	D
GND1	12	Open-Circuited	The device receives return ground through pin 3 (GND1). Normal operation.	D

**Table 4-2. Pin FMA for Device Pins Short-Circuited to Ground, Open-Circuited, Short-Circuited to Adjacent Pin, and Short-Circuited to Supply (continued)**

Pin Name	Pin No.	Potential Failure Mode	Description of Potential Failure Effects	Failure Effect Class
GND1	12	Short-Circuited to Pin 13 (CDPENZ1)	The device falsely advertises CDP on the UD+ and UD- pins.	B
GND1	12	Short-Circuited to Supply $V_{BUS1}$	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
GND1	12	Short-Circuited to Supply $V_{CC1}$	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND1 pins (pin 3 and pin 12); potentially damaging the device.	A
CDPENZ1	13	Short-Circuited to Ground (Side-1)	The device can falsely advertise CDP on the UD+ and UD- pins.	B
CDPENZ1	13	Open-Circuited	The device is unable to perform CDP advertising on the UD+ and UD- pins.	B
CDPENZ1	13	Short-Circuited to Pin 14 (NC)	The device continues to function as expected. Normal operation.	D
CDPENZ1	13	Short-Circuited to Supply $V_{BUS1}$	The device is unable to perform CDP advertising on the UD+ and UD- pins.	B
CDPENZ1	13	Short-Circuited to Supply $V_{CC1}$	The device is unable to perform CDP advertising on the UD+ and UD- pins.	B
NC	14	Short-Circuited to Ground (Side-1)	The device continues to function as expected. Normal operation.	D
NC	14	Open-Circuited	The device continues to function as expected. Normal operation.	D
NC	14	Short-Circuited to Pin 15 (N/A)	Not applicable (N/A), corner pin.	N/A
NC	14	Short-Circuited to Supply $V_{BUS1}$	The device continues to function as expected if the voltage on $V_{BUS1}$ is within the absolute maximum ratings for $V_{3P3V1}$ ; otherwise, damage to the device is possible.	A
NC	14	Short-Circuited to Supply $V_{CC1}$	The device continues to function as expected if the voltage on $V_{CC1}$ is within the absolute maximum ratings for $V_{3P3V1}$ ; otherwise, damage to the device is possible.	A
NC	15	Short-Circuited to Ground (Side-2)	The device continues to function as expected. Normal operation.	D
NC	15	Open-Circuited	The device continues to function as expected. Normal operation.	D
NC	15	Short-Circuited to Pin 16 (CDPENZ2)	The device continues to function as expected. Normal operation.	D
NC	15	Short-Circuited to Supply $V_{BUS2}$	The device continues to function as expected if the voltage on $V_{BUS2}$ is within the absolute maximum ratings for $V_{3P3V2}$ ; otherwise, damage to the device is possible.	A
NC	15	Short-Circuited to Supply $V_{CC2}$	The device continues to function as expected if the voltage on $V_{CC2}$ is within the absolute maximum ratings for $V_{3P3V2}$ ; otherwise, damage to the device is possible.	A
CDPENZ2	16	Short-Circuited to Ground (Side-2)	The device can falsely advertise CDP on the DD+ and DD- pins.	B
CDPENZ2	16	Open-Circuited	The device is unable to perform CDP advertising on the DD+ and DD- pins.	B
CDPENZ2	16	Short-Circuited to Pin 17 (GND2)	The device falsely advertises CDP on the DD+ and DD- pins.	B
CDPENZ2	16	Short-Circuited to Supply $V_{BUS2}$	The device is unable to perform CDP advertising on the DD+ and DD- pins.	B
CDPENZ2	16	Short-Circuited to Supply $V_{CC2}$	The device is unable to perform CDP advertising on the DD+ and DD- pins.	B

**Table 4-2. Pin FMA for Device Pins Short-Circuited to Ground, Open-Circuited, Short-Circuited to Adjacent Pin, and Short-Circuited to Supply (continued)**

Pin Name	Pin No.	Potential Failure Mode	Description of Potential Failure Effects	Failure Effect Class
GND2	17	Short-Circuited to Ground (Side-2)	The device continues to function as expected. Normal operation.	D
GND2	17	Open-Circuited	The device receives return ground through pin 26 (GND2). Normal operation.	D
GND2	17	Short-Circuited to Pin 18 (V <sub>1P8V2</sub> )	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A
GND2	17	Short-Circuited to Supply V <sub>BUS2</sub>	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A
GND2	17	Short-Circuited to Supply V <sub>CC2</sub>	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A
V1P8V2	18	Short-Circuited to Ground (Side-2)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A
V1P8V2	18	Open-Circuited	The device has no power (one of the supply inputs is floating). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	B
V1P8V2	18	Short-Circuited to Pin 19 (EQ21)	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
V1P8V2	18	Short-Circuited to Supply V <sub>BUS2</sub>	This short circuit can potentially damage the device as the 1.8V domain circuits get exposed to voltages above the absolute maximum ratings of the circuits.	A
V1P8V2	18	Short-Circuited to Supply V <sub>CC2</sub>	The device continues to function as expected if the voltage on VCC2 is within the absolute maximum ratings for V1P8V2; otherwise, damage to the device is possible.	A
EQ21	19	Short-Circuited to Ground (Side-2)	Equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ21	19	Open-Circuited	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ21	19	Short-Circuited to Pin 20 (EQ20)	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ21	19	Short-Circuited to Supply V <sub>BUS2</sub>	The equalization settings for HS mode do not work as expected. A degradation in performance can occur. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
EQ21	19	Short-Circuited to Supply V <sub>CC2</sub>	The equalization settings for HS mode do not work as expected. A degradation in performance can occur. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
EQ20	20	Short-Circuited to Ground (Side-2)	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ20	20	Open-Circuited	The equalization settings for HS mode do not work as expected. A degradation in performance can occur.	C
EQ20	20	Short-Circuited to Pin 21 (DD+)	There is data corruption on DD+. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
EQ20	20	Short-Circuited to Supply V <sub>BUS2</sub>	The equalization settings for HS mode do not work as expected. A degradation in performance can occur. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A

**Table 4-2. Pin FMA for Device Pins Short-Circuited to Ground, Open-Circuited, Short-Circuited to Adjacent Pin, and Short-Circuited to Supply (continued)**

Pin Name	Pin No.	Potential Failure Mode	Description of Potential Failure Effects	Failure Effect Class
EQ20	20	Short-Circuited to Supply $V_{CC2}$	The equalization settings for HS mode do not work as expected. A degradation in performance can occur. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
DD+	21	Short-Circuited to Ground (Side-2)	There is data corruption on DD+. Damage to the device is possible if DD+ is driven high for an extended period of time.	A
DD+	21	Open-Circuited	The output state of DD+ is undetermined. Communication is corrupted.	B
DD+	21	Short-Circuited to Pin 22 (DD-)	There is data corruption on DD+ and DD-. Damage to the device is possible if opposite polarity is driven on both pins for an extended period of time. Communication is corrupted.	A
DD+	21	Short-Circuited to Supply $V_{BUS2}$	There is data corruption on DD+. Damage to the device is possible if DD+ is driven low for an extended period of time.	A
DD+	21	Short-Circuited to Supply $V_{CC2}$	There is data corruption on DD+. Damage to the device is possible if DD+ is driven low for an extended period of time.	A
DD-	22	Short-Circuited to Ground (Side-2)	There is data corruption on DD-. Damage to the device is possible if DD- is driven high for an extended period of time.	A
DD-	22	Open-Circuited	The output state of DD- is undetermined. Communication is corrupted.	B
DD-	22	Short-Circuited to Pin 23 (V1OK)	There is data corruption on DD-. There is a potential path between supply and ground, which can lead to device damage. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
DD-	22	Short-Circuited to Supply $V_{BUS2}$	There is data corruption on DD-. Damage to the device is possible if DD- is driven low for an extended period of time.	A
DD-	22	Short-Circuited to Supply $V_{CC2}$	There is data corruption on DD-. Damage to the device is possible if DD- is driven low for an extended period of time.	A
V1OK	23	Short-Circuited to Ground (Side-2)	There is a loss of the indication of the power condition of side one. This short circuit causes high current to flow between supply and ground; causing damage to the device.	A
V1OK	23	Open-Circuited	The device continues to function as expected. The indication that side 1 is powered up is not received.	D
V1OK	23	Short-Circuited to Pin 24 ( $V_{CC2}$ )	This short circuit causes high current to flow between supply and ground during power-up; causing damage to the device.	A
V1OK	23	Short-Circuited to Supply $V_{BUS2}$	This short circuit causes high current to flow between supply and ground during power-up; causing damage to the device.	A
V1OK	23	Short-Circuited to Supply $V_{CC2}$	This short circuit causes high current to flow between supply and ground during power-up; causing damage to the device.	A
VCC2	24	Short-Circuited to Ground (Side-2)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A
VCC2	24	Open-Circuited	The device has no power (one of the supply inputs is open). If $V_{1P8V2}$ connects to a power supply, the internal LDO can be damaged from the reverse current. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
VCC2	24	Short-Circuited to Pin 25 ( $V_{1P8V2}$ )	The device continues to function as expected if the voltage on $V_{CC2}$ is within the absolute maximum ratings for $V_{1P8V2}$ ; otherwise, damage to the device is possible	A
VCC2	24	Short-Circuited to Supply $V_{BUS2}$	The device continues to function as expected. Normal operation.	D
VCC2	24	Short-Circuited to Supply $V_{CC2}$	The device continues to function as expected. Normal operation.	D
V1P8V2	25	Short-Circuited to Ground (Side-2)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A

**Table 4-2. Pin FMA for Device Pins Short-Circuited to Ground, Open-Circuited, Short-Circuited to Adjacent Pin, and Short-Circuited to Supply (continued)**

Pin Name	Pin No.	Potential Failure Mode	Description of Potential Failure Effects	Failure Effect Class
V1P8V2	25	Open-Circuited	Internal LDO can supply $V_{1P8V2}$ if 2.4V to 5.5V is connected on VCC2. However, the 1.8V output can have stability issues without proper external bypass capacitors. Otherwise, the device does not have the power to turn on, and there is a loss of functionality.	B
V1P8V2	25	Short-Circuited to Pin 26 (GND2)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A
V1P8V2	25	Short-Circuited to Supply $V_{BUS2}$	This short circuit can potentially damage the device as the 1.8V domain circuits get exposed to voltages above the absolute maximum ratings of the circuits.	A
V1P8V2	25	Short-Circuited to Supply $V_{CC2}$	The device continues to function as expected if the voltage on $V_{CC2}$ is within the absolute maximum ratings for $V_{1P8V2}$ ; otherwise, damage to the device is possible.	A
GND2	26	Short-Circuited to Ground (Side-2)	The device continues to function as expected. Normal operation.	D
GND2	26	Open-Circuited	The device receives return ground through pin 17 (GND2). Normal operation.	D
GND2	26	Short-Circuited to Pin 27 ( $V_{3P3V2}$ )	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A
GND2	26	Short-Circuited to Supply $V_{BUS2}$	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A
GND2	26	Short-Circuited to Supply $V_{CC2}$	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin17 and pin26); potentially damaging the device.	A
V3P3V2	27	Short-Circuited to Ground (Side-2)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A
V3P3V2	27	Open-Circuited	The internal LDO can supply $V_{3P3V2}$ if 4.25V to 5.5V is connected on $V_{BUS2}$ . However, the 3.3V output can have stability issues without proper external bypass capacitors. Otherwise, the device does not have the power to turn on, and there is a loss of functionality.	B
V3P3V2	27	Short-Circuited to Pin 28 ( $V_{BUS2}$ )	The device continues to function as expected if the voltage on $V_{BUS2}$ is within the absolute maximum ratings for $V_{3P3V2}$ ; otherwise, damage to the device is possible.	A
V3P3V2	27	Short-Circuited to Supply $V_{BUS2}$	The device continues to function as expected if the voltage on $V_{BUS2}$ is within the absolute maximum ratings for $V_{3P3V2}$ ; otherwise, damage to the device is possible.	A
V3P3V2	27	Short-Circuited to Supply $V_{CC2}$	The device continues to function as expected if the voltage on $V_{CC2}$ is within the absolute maximum ratings for $V_{3P3V2}$ ; otherwise, damage to device is possible.	A
VBUS2	28	Short-Circuited to Ground (Side-2)	The device has no power (one of the supply inputs is shorted to ground). Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible. This short circuit potentially causes high current to flow between the two GND2 pins (pin 17 and pin 26); potentially damaging the device.	A

**Table 4-2. Pin FMA for Device Pins Short-Circuited to Ground, Open-Circuited, Short-Circuited to Adjacent Pin, and Short-Circuited to Supply (continued)**

Pin Name	Pin No.	Potential Failure Mode	Description of Potential Failure Effects	Failure Effect Class
VBUS2	28	Open-Circuited	The device has no power (one of the supply inputs is open). If $V_{3P3V2}$ connects to a power supply, the internal LDO can be damaged from the reverse current. Observe that the absolute maximum ratings for all pins of the device are met; otherwise, damage to the device is possible.	A
VBUS2	28	Short-Circuited to Pin 1 ( $V_{BUS1}$ )	Not applicable (N/A), corner pin.	N/A
VBUS2	28	Short-Circuited to Supply $V_{BUS2}$	The device continues to function as expected. Normal operation.	D
VBUS2	28	Short-Circuited to Supply $V_{CC2}$	The device continues to function as expected. Normal operation.	D

## 5 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DATE	REVISION	NOTES
July 2026	*	Initial Release

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