

**TMP101-Q1**

**Functional Safety FIT Rate, FMD and Pin FMA**

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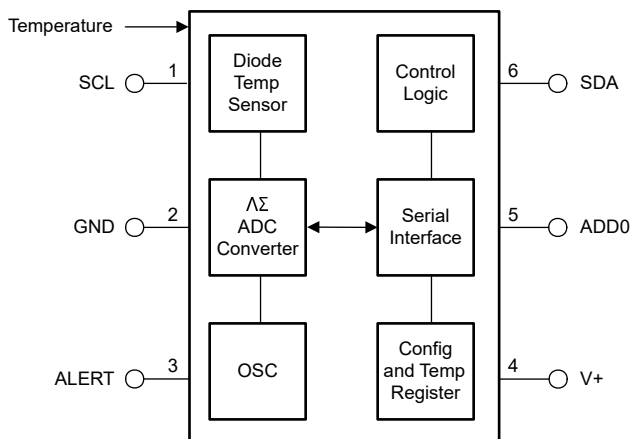
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## 1 Overview

This document contains information for the TMP101-Q1 (SOT-23 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 TMP101-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 TMP101-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     | 4  |
| Die FIT rate                 | 2  |
| Package FIT rate             | 2  |

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: 1mW
- 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<br>Digital, analog, or mixed | 25 FIT             | 55°C                             |

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 TMP101-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 (%) |
|--------------------------------------|-------------------------------|
| Serial communication error           | 15                            |
| ADC offset out of specification      | 20                            |
| ADC gain out of specification        | 25                            |
| ADC conversion output code bit error | 15                            |
| ADC incorrect input channel selected | 5                             |
| Register bank data bit error         | 15                            |
| Alert false trip, fails to trip      | 5                             |

## 4 Pin Failure Mode Analysis (Pin FMA)

This section provides a failure mode analysis (FMA) for the pins of the TMP101-Q1. The failure modes covered in this document include the typical pin-by-pin failure scenarios:

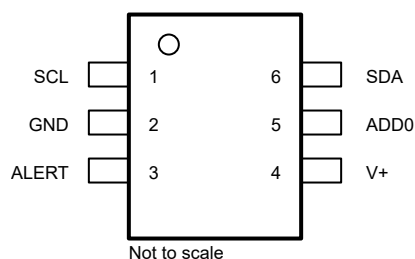
- Pin short-circuited to ground (see [Table 4-2](#))
- Pin open-circuited (see [Table 4-3](#))
- Pin short-circuited to an adjacent pin (see [Table 4-4](#))
- Pin short-circuited to supply (see [Table 4-5](#))

[Table 4-2](#) through [Table 4-5](#) also indicate 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 TMP101-Q1 pin diagram. For a detailed description of the device pins, see the *Pin Configuration and Functions* section in the TMP101-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:

- A bypass capacitor of 0.1μF on the input voltage pin is implemented.

**Table 4-2. Pin FMA for Device Pins Short-Circuited to Ground**

| Pin Name | Pin No. | Description of Potential Failure Effects   | Failure Effect Class |
|----------|---------|--|----------------------|
| SCL      | 1       | I2C communication is not possible.   | B                    |
| GND      | 2       | There is no effect on the device. The device operates as normal.   | D                    |
| ALERT    | 3       | The functionality of the ALERT pin is not available. The ALERT false triggers or fails to trigger, depending on the setting of the POL. If ALERT triggers continuously, the trigger can interrupt other functions of the device. | B                    |
| V+       | 4       | The device is not functional and is potentially damaged.   | A                    |
| ADD0     | 5       | I2C address selection is limited.  | B                    |
| SDA      | 6       | I2C communication is not possible  | B                    |

**Table 4-3. Pin FMA for Device Pins Open-Circuited**

| Pin Name | Pin No. | Description of Potential Failure Effects             | Failure Effect Class |
|----------|---------|--|----------------------|
| SCL      | 1       | I2C communication is not possible.                   | B                    |
| GND      | 2       | The functionality of the device is undetermined.     | B                    |
| ALERT    | 3       | The functionality of the ALERT pin is not available. | B                    |

**Table 4-3. Pin FMA for Device Pins Open-Circuited (continued)**

| Pin Name | Pin No. | Description of Potential Failure Effects         | Failure Effect Class |
|----------|---------|--|----------------------|
| V+       | 4       | The functionality of the device is undetermined. | B                    |
| ADD0     | 5       | I2C address selection is limited.                | B                    |
| SDA      | 6       | I2C communication is not possible.               | B                    |

**Table 4-4. Pin FMA for Device Pins Short-Circuited to Adjacent Pin**

| Pin Name | Pin No. | Shorted to | Description of Potential Failure Effects   | Failure Effect Class |
|----------|---------|------------|--|----------------------|
| SCL      | 1       | GND        | I2C communication is not possible.   | B                    |
| GND      | 2       | ALERT      | The functionality of the ALERT pin is not available. The ALERT false triggers or fails to trigger, depending on the setting of the POL. If ALERT triggers continuously, the trigger can interrupt other functions of the device. | B                    |
| ALERT    | 3       | V+         | The functionality of the ALERT pin is not available. The ALERT false triggers or fails to trigger, depending on the setting of the POL. If ALERT triggers continuously, the trigger can interrupt other functions of the device. | B                    |
| V+       | 4       | ADD0       | I2C address selection is limited.  | B                    |
| ADD0     | 5       | SDA        | I2C communication is not possible.   | B                    |
| SDA      | 6       | SCL        | I2C communication is not possible.   | B                    |

**Table 4-5. Pin FMA for Device Pins Short-Circuited to Supply**

| Pin Name | Pin No. | Description of Potential Failure Effects   | Failure Effect Class |
|----------|---------|--|----------------------|
| SCL      | 1       | I2C communication is not possible.   | B                    |
| GND      | 2       | The device is not functional and is potentially damaged.   | A                    |
| ALERT    | 3       | The functionality of the ALERT pin is not available. The ALERT false triggers or fails to trigger, depending on the setting of the POL. If ALERT triggers continuously, the trigger can interrupt other functions of the device. | B                    |
| V+       | 4       | There is no effect on the device. The device operates as normal.   | D                    |
| ADD0     | 5       | I2C address selection is limited.  | B                    |
| SDA      | 6       | I2C communication is not possible.   | B                    |

## 5 Revision History

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

| DATE          | REVISION | NOTES           |
|---------------|----------|-----------------|
| February 2026 | *        | Initial Release |

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