

Module Reliability for CC2564MODx, CC2650MODA, CC3x00MOD, CC3x20MODx, CC3220MODAx, CC3x35MODx, CC3235MODAx, and WL18xxMOD Devices

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ABSTRACT

The purpose of this application note is to present Texas Instruments™ module reliability data based on an independent assessment of MTBF and FIT rates using the Telcordia SR-332 *Reliability Prediction Procedure for Electronic Equipment* methodology.

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1 Introduction

The purpose of this application note is to present Texas Instruments™ module reliability data based on an independent assessment of MTBF and FIT rates using the Telcordia SR-332 *Reliability Prediction Procedure for Electronic Equipment* methodology.

2 Reliability

Reliability is the probability of meeting specifications or requirements over time. This is often measured in failure in time (FIT). The FIT rate is the number of failures in 1,000,000,000 device operating hours and is a time-dependent value. [Figure 1](#) shows a reliability curve.

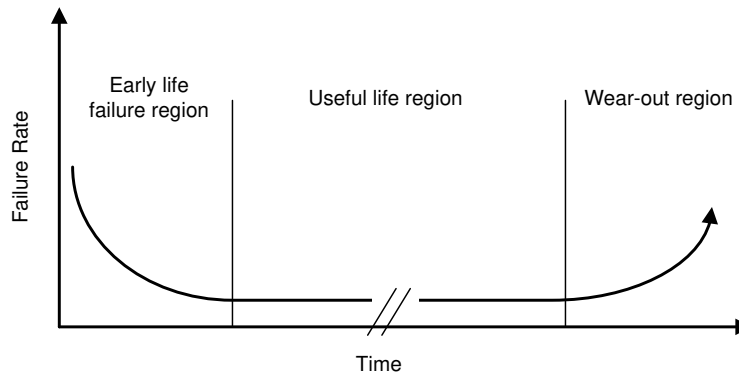


Figure 1. Reliability Curve

Application temperature, voltage, and activity can have a large impact on the intrinsic or wear-out associated with an electronic system. As the temperature, voltage, and activity level increases, the overall product life expectancy would be expected to decrease (see [Figure 2](#)). Finding the proper balance in product performance versus reliability expectations is critical in optimizing the application goals.

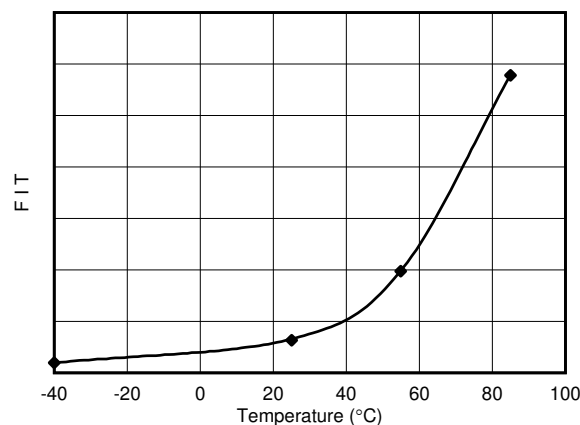


Figure 2. FIT Rate as a Function of Temperature

3 Considerations for Specific Components in the Module

TI and non-TI components are included in the modules' bill of materials and were selected based on their ambient operating temperature range requirements.

In addition, TI performed reliability testing on all TI ICs and their modules. Qualification reports for products are available upon request.

As an independent assessment of MTBF and FIT rates, Telcordia SR-332 *Reliability Prediction Procedure for Electronic Equipment* methodology was applied to the modules' bill of materials. The Telcordia method is based on generic fail rate data based on component types. Limitations of this model are:

- It is based on generic data for component types used in the module
- It is not specific to the actual end equipment design and application

NOTE: This information is provided solely for convenience and does not extend or modify the warranty provided under TI's standard terms and conditions for semiconductor products.

3.1 SimpleLink™ Wi-Fi Modules

3.1.1 CC3x00 Modules

The CC3x00 modules are designed to operate in an ambient temperature range of -20°C to $+70^{\circ}\text{C}$. Design analysis of the CC3x00 SimpleLink™ integrated circuit in the CC3x00 modules shows that the silicon is capable of operating for up to 17,500 hours at an ambient temperature of up to $+85^{\circ}\text{C}$. During this analysis, the TX duty cycle (power amplifier ON time) is assumed to be 20% of the time. For the remaining 80% of the time, the device is assumed to be in sleep mode (refer to [CC3100 SimpleLink™ Wi-Fi® Network Processor, Internet-of-Things Solution for MCU Applications](#) and [CC3200 SimpleLink™ Wi-Fi® and Internet-of-Things Solution, a Single-Chip Wireless MCU](#) for further information).

Note that the IC contains an internal temperature sensor to monitor the critical junction temperatures within the IC for excessive temperatures. At $120^{\circ}\text{C} \pm 5^{\circ}\text{C}$, Wi-Fi activity will reduce to maintain reliability of the IC.

[Table 1](#) lists the links to the steady-state MTBF and FIT rates for the CC3x00MOD modules.

Table 1. MTBF and FIT Rate Links for CC3x00MOD Modules

Module	Document Link
CC3100MOD	CC3100MOD Reliability Data - Reliability Estimate
CC3200MOD	CC3200MOD Reliability Data - Reliability Estimate

3.1.2 CC3x20 Modules

The CC3x20 modules are designed to operate in an ambient temperature range of -40°C to $+85^{\circ}\text{C}$. Design analysis of the CC3x20 SimpleLink™ integrated circuit in the CC3x20 modules shows that the silicon is capable of operating for up to 87,600 hours at an ambient temperature of up to $+85^{\circ}\text{C}$. During this analysis, the TX duty cycle (power amplifier ON time) is assumed to be 10% of the time. For the remaining 90% of the time, the device is assumed to be in sleep, hibernate, or shutdown mode (refer to [CC3120 SimpleLink™ Wi-Fi® Wireless Network Processor, Internet-of-Things Solution for MCU Applications](#) and [CC3220 SimpleLink™ Wi-Fi® Wireless and Internet-of-Things Solution, a Single-Chip Wireless MCU](#) for further information).

Note that the IC contains an internal temperature sensor to monitor the critical junction temperatures within the IC for excessive temperatures. At $120^{\circ}\text{C} \pm 5^{\circ}\text{C}$, Wi-Fi activity will reduce to maintain reliability of the IC.

Table 2 lists the links to the steady-state MTBF and FIT rates for the CC3120MOD, CC3x20MODx, and CC3x20MODAx modules.

Table 2. MTBF and FIT Rate Links for CC3120MOD, CC3x20MODx, and CC3x20MODAx Modules

Module	Document Link
CC3120MOD	CC3120MOD Reliability Data - Reliability Estimate
CC3220MODS	CC3220MODS Reliability Data - Reliability Estimate
CC3220MODAS	CC3220MODAS Reliability Data - Reliability Estimate
CC3220MODSF	CC3220MODSF Reliability Data - Reliability Estimate
CC3220MODASF	CC3220MODASF Reliability Data - Reliability Estimate

3.1.3 CC3x35 Modules

The CC3x35 modules are designed to operate in an ambient temperature range of -40°C to $+85^{\circ}\text{C}$. Design analysis of the CC3x35 SimpleLink™ integrated circuit in the CC3x35 modules shows that the silicon is capable of operating for up to 87,600 hours at an ambient temperature of up to $+85^{\circ}\text{C}$. During this analysis, the TX duty cycle (power amplifier ON time) is assumed to be 10% of the time. For the remaining 90% of the time, the device is assumed to be in sleep, hibernate, or shutdown mode (refer to [CC3135 SimpleLink™ Wi-Fi® Dual-Band Network Processor, Internet-of-Things Solution for MCU Applications](#) and [CC3235 SimpleLink™ Wi-Fi® Dual-Band Single-Chip Wireless MCU](#) for further information).

Note that the IC contains an internal temperature sensor to monitor the critical junction temperatures within the IC for excessive temperatures. At $120^{\circ}\text{C} \pm 5^{\circ}\text{C}$, Wi-Fi activity will reduce to maintain reliability of the IC.

Table 3 lists the links to the steady-state MTBF and FIT rates for the CC3135MOD, CC3x35MODx, and CC3x35MODAx modules.

Table 3. MTBF and FIT Rate Links for CC3135MOD, CC3x35MODx, and CC3x35MODAx Modules

Module	Document Link
CC3135MOD	CC3135MOD Reliability Data - Reliability Estimate
CC3235MODS	CC3235MODS Reliability Data - Reliability Estimate
CC3235MODSF	CC3235MODSF Reliability Data - Reliability Estimate
CC3235MODAS	CC3235MODAS Reliability Data - Reliability Estimate
CC3235MODASF	CC3235MODASF Reliability Data - Reliability Estimate

3.2 Dual-Mode Bluetooth® Modules

3.2.1 CC2564 Modules

The CC2564MODx modules are designed to operate in an ambient temperature range of –30°C to +85°C. The modules are capable of operating for up to 15,400 hours at an ambient temperature of up to +85°C. During this analysis, the TX duty cycle (power amplifier ON time) is assumed to be 25% of the time. For the remaining 75% of the time, the device is assumed to be in sleep mode. Refer to [CC2564MODx Dual-Mode Bluetooth® Module](#) for further information.

Table 4 lists the links to the steady-state MTBF and FIT rates for the CC2564MODx modules.

Table 4. MTBF and FIT Rate Links for CC2564MODx Modules

Module	Document Link
CC2564MODN	CC2564MODN MTBF Estimate
CC2564MODA	CC2564MODA MTBF Estimate

3.2.2 CC2650MODA Modules

The CC2650MODA modules are designed to operate in an ambient temperature range of –40°C to +85°C. The modules are capable of operating for up to 15,400 hours at an ambient temperature of up to +85°C. During this analysis, the TX duty cycle (power amplifier ON time) is assumed to be 25% of the time. For the remaining 75% of the time, the device is assumed to be in sleep mode. Refer to [CC2650MODA SimpleLink™ Bluetooth® low energy Wireless MCU Module](#) for further information.

Table 5 lists the link to the steady-state MTBF and FIT rates for the CC2650MODA module.

Table 5. MTBF and FIT Rate Links for the CC2650MODA Module

Module	Document Link
CC2650MODA	CC2650MODA MTBF Estimate

3.3 WiLink 8 Modules

The WL18xxMOD modules are designed to operate in an ambient temperature range of -20°C to $+70^{\circ}\text{C}$. The modules are capable of operating for up to 20,000 hours at when the internal junction temperature of the WL18xx IC is at 120°C . Refer to [WL18xxMOD WiLink™ 8 Single-Band Combo Module – Wi-Fi®, Bluetooth®, and Bluetooth Low Energy \(LE\)](#) for further information.

Table 6 lists the links to the steady-state MTBF and FIT rates for the WL18xxMOD modules.

Table 6. MTBF and FIT Rate Links for WL18xxMOD Modules

Module	Document Link
WL1801MOD	WL1801MOD MTBF Estimate
WL1805MOD	WL1805MOD MTBF Estimate
WL1831MOD	WL1831MOD MTBF Estimate
WL1835MOD	WL1835MOD MTBF Estimate

Note that the IC contains an internal temperature sensor to monitor the critical junction temperatures within the IC for excessive temperatures. At $120^{\circ}\text{C} \pm 5^{\circ}\text{C}$, Wi-Fi activity will reduce to maintain reliability of the IC.

3.3.1 WL18x7MOD Industrial Dual-Band Modules

The WL18x7MOD modules are designed to operate in an ambient temperature range of -40°C to $+85^{\circ}\text{C}$. The modules are capable of operating for up to 20,000 hours at when the internal junction temperature of the WL18x7 IC is at 120°C . During this analysis, the TX duty cycle (power amplifier ON time) is assumed to be 25% of the time. For the remaining 75% of the time, the device is assumed to be in sleep mode. Additional operating hours for other junction temperatures can be found at [WL18x7MOD WiLink™ 8 Dual-Band Industrial Module – Wi-Fi®, Bluetooth®, and Bluetooth Low Energy \(LE\)](#).

Table 7 lists the links to the steady-state MTBF and FIT rates for the WL18x7MOD modules.

Table 7. MTBF and FIT Rate Links for WL18x7MOD Modules

Module	Document Link
WL1807MOD	WL1807MOD Reliability Data - Reliability Estimate
WL1837MOD	WL1837MOD Reliability Data - Reliability Estimate

Note that the IC contains an internal temperature sensor to monitor the critical junction temperatures within the IC for excessive temperatures. At $120^{\circ}\text{C} \pm 5^{\circ}\text{C}$, Wi-Fi activity will reduce to maintain reliability of the IC.

4 References

[Reliability Prediction Methods for Electronic Products](#)

Revision History

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

Changes from June 27, 2017 to February 6, 2020	Page
• Throughout document, added information for CC3235MODAS and CC3235MODASF	1

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