

# nRF51822 specification for Industrial Temperature Range

Multiprotocol *Bluetooth*<sup>®</sup> 4.1 low energy/2.4 GHz RF SoC

## Specification v1.3

### Addendum to nRF51822 Product Specification v3.1

This addendum describes the deviations that apply when operating the nRF51822 chip in the Industrial Temperature Range.

For information on the specifications when operating the nRF51822 chip in the Consumer Temperature Range, see the *nRF51822 Product Specification v3.1*.

This document applies to the following chip variants:

| nRF51822 variant | Build code       |
|------------------|------------------|
| QFAA             | Hx0 <sup>1</sup> |
| CEAA             | Ex0 <sup>1</sup> |
| QFAB             | Cx0 <sup>1</sup> |
| CDAB             | Ax0 <sup>1</sup> |

1. The x in the build code can be any digit between 0..9.

**Table 1** nRF51822 variants qualified for the Industrial Temperature Range

# 1 Introduction

The nRF51822 chip variants mentioned in *Table 1* on page 1 has been qualified for operating in the Industrial Temperature Range.

This document specifies the performance when operating in the Industrial Temperature Range. The values in this document replace the corresponding values in the *nRF51822 Product Specification* v3.1 when operating outside the Consumer Temperature Range but inside the Industrial Temperature Range.

## 2 Deviations from the nRF51822 Product Specification v3.1

This chapter lists where there are differences from *nRF51822 Product Specification v3.1*, and the chapter or section name and number is referring to the chapter or section in the *nRF51822 Product Specification v3.1*. Changed values are written with bold font, and values or information that is not valid in the Industrial Temperature Range are written with strikethrough font.

### Key features on the front page:

- Flexible power management
  - Supply voltage range **1.9 V** to 3.6 V

### 3.4.1 Power supply

nRF51 supports three different power supply alternatives:

- Internal LDO setup
- DC/DC converter setup
- ~~Low voltage mode setup~~

#### 3.4.1.3 Low voltage mode setup

~~Devices can be used in low voltage mode where a steady 1.8 V supply is available externally.~~

## 7 Operating conditions

Changes in Table 20 (within the Consumer Temperature Range the specifications remains unchanged):

- New value for Min. voltage in the *Supply voltage, internal LDO setup* row.
- Added a note on the row *Supply voltage, DC/DC converter setup* saying that the DC/DC specifications is only valid between -25 to +85°C for the QFAB Cx0 and the CDAB Ax0 chip variants.
- The row *Supply voltage, low voltage mode setup* is not valid.
- New values for Min. and Max. temperature in the *Operating temperature* row.

| Symbol         | Parameter   | Notes | Min.            | Typ.           | Max.            | Units        |
|----------------|---|-------|-----------------|----------------|-----------------|--------------|
| VDD            | Supply voltage, internal LDO setup                |       | <b>1.9</b>      | 3.0            | 3.6             | V            |
| VDD            | Supply voltage, DC/DC converter setup             | 1     | 2.1             | 3.0            | 3.6             | V            |
| <del>VDD</del> | <del>Supply voltage, low voltage mode setup</del> | 2     | <del>1.75</del> | <del>1.8</del> | <del>1.95</del> | <del>V</del> |
| T <sub>A</sub> | Operating temperature                             |       | <b>-40</b>      | 25             | <b>85</b>       | °C           |

1. The DC/DC converter specifications is only valid between -25 to +85°C for the QFAB Cx0 and the CDAB Ax0 chip variant.
2. DEC2 shall be connected to VDD in this mode.

**Table 20** Operating conditions

## 8.2 Power management

Footnote no. 1 on Table 32 is not valid for Industrial Temperature Range.

### 8.5.4 Transmitter specifications

New value for Max. frequency in the *20 dB bandwidth for modulated carrier (250 kbps)* row in Table 38 (within the Consumer Temperature Range the specifications remains unchanged):

| Symbol             | Description                                       | Min. | Typ. | Max.        | Units | Test level |
|--------------------|---|------|------|-------------|-------|------------|
| P <sub>BW250</sub> | 20 dB bandwidth for modulated carrier (250 kbps). |      | 700  | <b>1000</b> | kHz   | 2          |

**Table 38** Transmitter specifications

### 8.12 Analog to Digital Converter (ADC) specifications

Changes in Table 51 (within the Consumer Temperature Range the specifications remains unchanged):

- New values for Min. and Max. in the *Gain error* row
- New values for Min. and Max. in the *Internal Band Gap reference voltage error* row
- References to 1.8 V are not valid for Industrial Temperature Range.

| Symbol                   | Description  | Note | Min.      | Typ.         | Max.      | Units          | Test level   |
|--------------------------|--|------|-----------|--------------|-----------|----------------|--------------|
| e <sub>G</sub>           | Gain error.  | 1    | <b>-3</b> |              | <b>+3</b> | %              | 2            |
| V <sub>REF_VBG_ERR</sub> | Internal Band Gap reference voltage error.   |      | <b>-2</b> |              | <b>+2</b> | %              | 2            |
| <del>ADC_ERR_1V8</del>   |  |      |           | <del>3</del> |           | <del>LSB</del> | <del>2</del> |
| ADC_ERR_2V2              | Absolute error when used for battery measurement at 1.8 V, 2.2 V, 2.6 V, 3.0 V, and 3.4 V. | 2    |           | 2            |           | LSB            | 2            |
| ADC_ERR_2V6              |  |      |           | 1            |           | LSB            | 2            |
| ADC_ERR_3V0              |  |      |           | 1            |           | LSB            | 2            |
| ADC_ERR_3V4              |  |      |           | 1            |           | LSB            | 2            |

1. Source impedance less than 5 kΩ.
2. Internal reference, input from VDD/3, 10 bit mode.

**Table 51** Analog to Digital Converter (ADC) specifications

### 8.15 Temperature sensor (TEMP)

New values for Min. and Max. in the *Temperature sensor range* row in Table 54 (within the Consumer Temperature Range the specifications remains unchanged):

| Symbol             | Description               | Note | Min.       | Typ. | Max.      | Units | Test level |
|--------------------|---------------------------|------|------------|------|-----------|-------|------------|
| T <sub>RANGE</sub> | Temperature sensor range. |      | <b>-40</b> |      | <b>85</b> | °C    | N/A        |

**Table 54** Temperature sensor

**11.3.2 QFAA QFN48 schematic with low voltage mode setup**

Not valid for Industrial Temperature Range.

**11.4.2 QFAB QFN48 schematic with low voltage mode setup**

Not valid for Industrial Temperature Range.

**11.6.2 CDAB WLCSP schematic with low voltage mode setup**

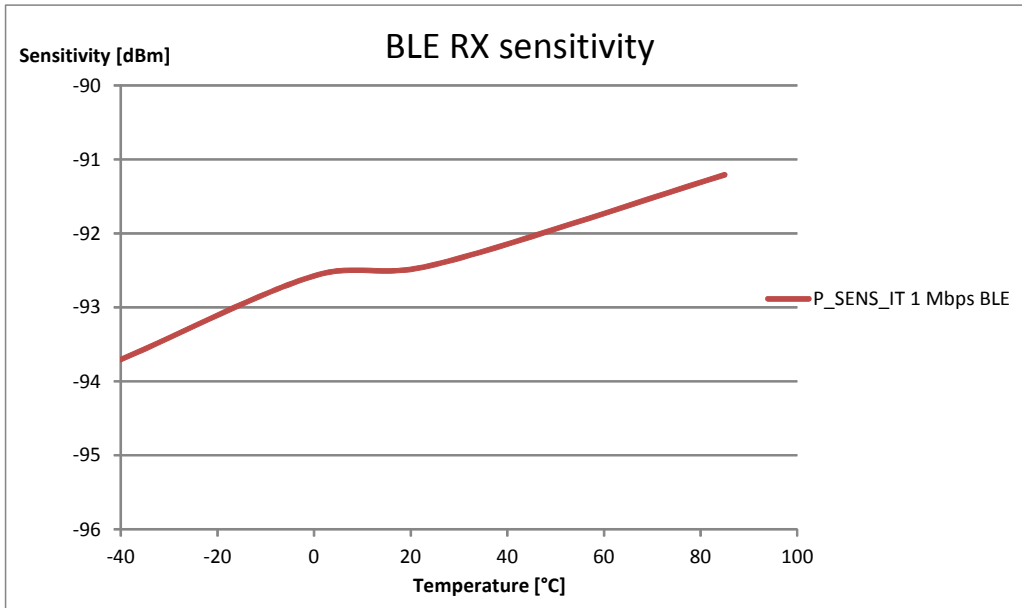
Not valid for Industrial Temperature Range.

**11.7.2 CEAA WLCSP schematic with low voltage mode setup**

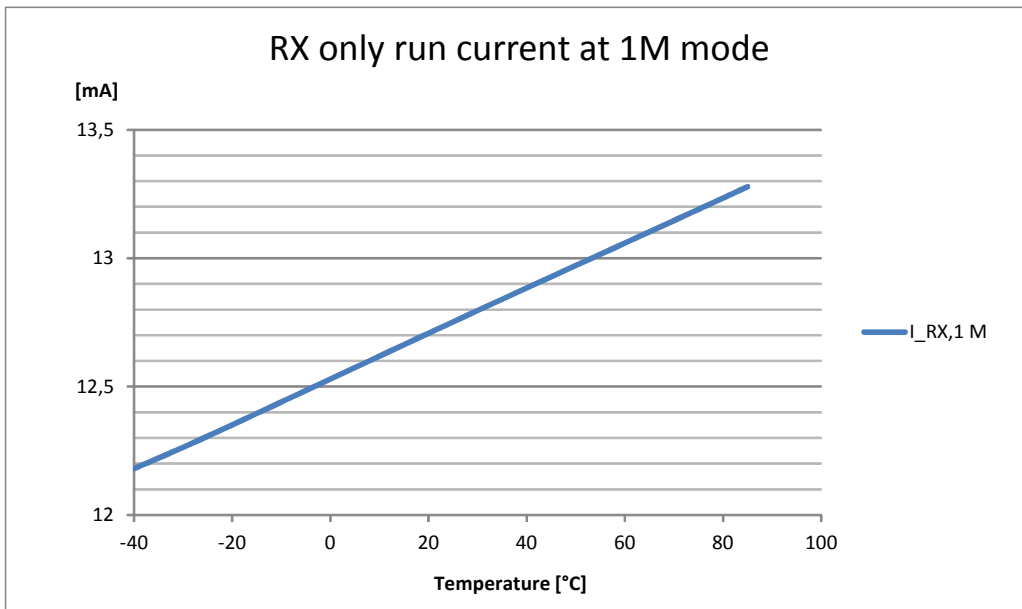
Not valid for Industrial Temperature Range.

### 3 Typical characteristics

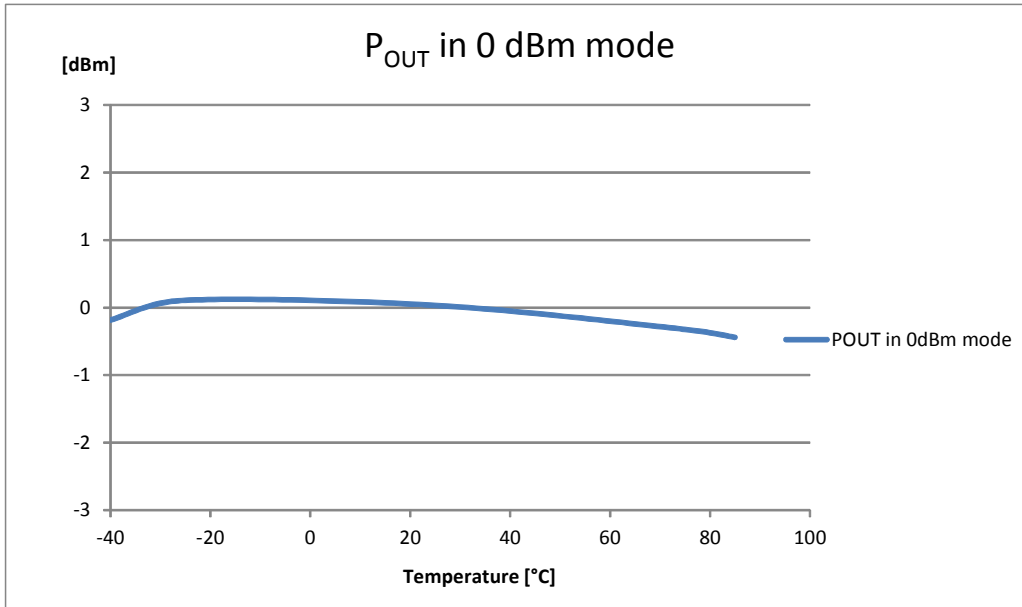
All plots are at VDD = 3 V, DC/DC disabled.



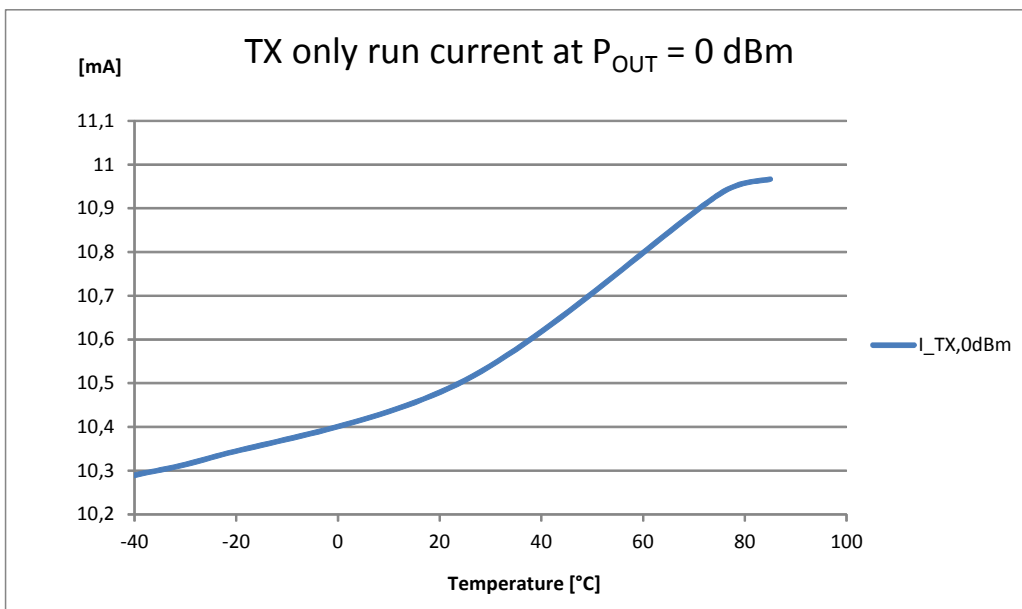
**Figure 1** BLE RX sensitivity vs. temperature



**Figure 2** RX only run current at 1M mode



**Figure 3** P<sub>OUT</sub> in 0 dBm mode.



**Figure 4** TX only run current at P<sub>OUT</sub> = 0 dBm.

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## Revision History

| <b>Date</b>   | <b>Version</b> | <b>Description</b>                                       |
|---------------|----------------|--|
| May 2015      | 1.3            | Removed temperature range definitions on the front page. |
| February 2015 | 1.2            | Added the QFAB Cx0 and the CDAB Ax0 variant of the chip. |
| December 2014 | 1.1            | Added the CEAA Ex0 variant of the chip.                  |
| December 2014 | 1.0            | First release.   |