



EFR32ZG14 Z-Wave 700 Modem SoC Data Sheet



The Silicon Labs Z-Wave 700 Modem SoC, EFR32ZG14, is an ideal solution for gateways and controllers in smart home applications such as smart home gateways, smart speakers, set top boxes, USB sticks and more.

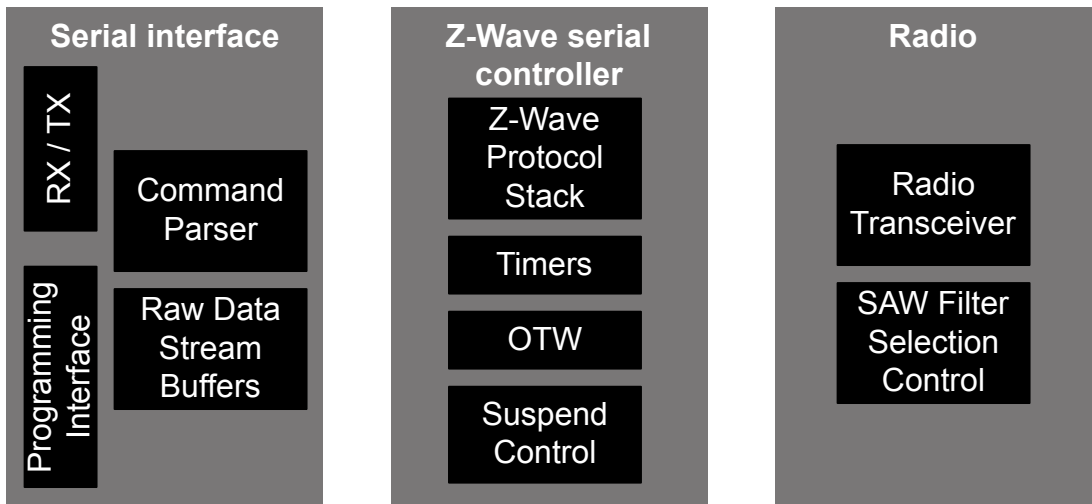
The single-die solution provides industry-leading low-power Gecko technology. The EFR32ZG14 features excellent radio sensitivity, improving the range of the Z-Wave mesh network.

EFR32ZG14 applications include Z-Wave controllers and gateways for:

- Smart Home
- Security
- Lighting
- Health and Wellness
- Metering
- Building Automation

This modem SoC part is suitable for Z-Wave controllers and gateways only, and cannot be used for end-devices.

| KEY FEATURES |
|---|
| • TX power up to 13 dBm |
| • RX sensitivity @ 100 kbps: -98.8 dBm |
| • 32-bit ARM® Cortex®-M4 core at 39 MHz |



1. Feature List

The EFR32ZG14 highlighted features are listed below.

- **Low Power Wireless System-on-Chip.**
 - High Performance 32-bit 39 MHz ARM Cortex®-M4 with DSP instruction and floating-point unit for efficient signal processing
 - Sub-GHz radio operation
 - Transmit power: Up to 13 dBm
- **Low Energy Consumption**
 - 10.5 mA active radio RX current
 - 10.5 mA idle / listening radio RX current
 - 38.8 mA active radio TX current at 13 dBm output power
 - 12.9 mA active radio TX current at 0 dBm output power
 - USB-compliant in low-power suspend mode
- **High Receiver Performance**
 - -98.6 dBm sensitivity at 100 kbit/s GFSK, 868 MHz
 - -98.8 dBm sensitivity at 100 kbit/s GFSK, 915 MHz
- **Supported Modulation Formats**
 - 2/4 (G)FSK with fully configurable shaping
- **Supported Protocols:**
 - Z-Wave
- **Wide selection of MCU peripherals**
 - 5 Dedicated GPIO's for : UART communication, suspend mode operation and optional SAW filter selection
 - Built-in supply monitor
 - UART serial interface
- **Wide Operating Range**
 - 1.8 to 3.8 V single power supply with integrated DC-DC
 - -40 °C to 85 °C
- **QFN32 5x5 mm Package**

2. Ordering Information

Table 2.1. Ordering Information

| Ordering Code | Protocol Stack | Frequency Band @ Max TX Power | Flash (kB) | RAM (kB) | GPIO | Package |
|-------------------------|----------------|----------------------------------|---------------|-------------|------|---------|
| EFR32ZG14P231F256GM32-B | Z-Wave | Sub-GHz @ 13 dBm | 256 | 32 | 16 | QFN32 |

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3. System Overview

3.1 Introduction

The Z-Wave 700 EFR32ZG14 is a serial modem device which takes advantage of Silicon Labs EFR32 SoC technology to provide a low-power, high-performance Z-Wave gateway. The EFR32ZG14 consists of a simple serial port to communicate with the host controller, and a sub-GHz radio for RF communications to Z-Wave end devices. The Z-Wave protocol stack is fully implemented on chip, and a simple serial API is used for data and control.

3.2 Power Configuration

The EFR32ZG14 is powered from a single external supply voltage. An on-chip DC-DC converter provides energy efficiency for the radio and digital subsystems. On-chip supply monitors safely manage power-up, power-down, and brown-out conditions.

Typical power supply circuitry for the EFR32ZG14 is shown below. The main system supply should be attached to VREGVDD, AVDD and IOVDD, while the DC-DC regulates the digital (DVDD) and radio (RFVDD) supplies.

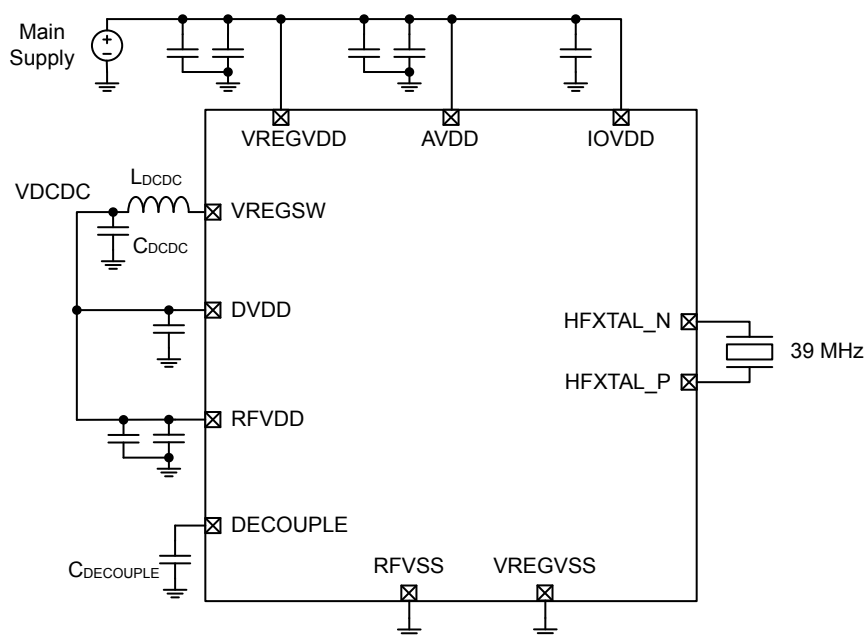


Figure 3.1. Power Supply Connections

3.2.1 Power Modes

The EFR32ZG14 uses different power modes during operation to minimize the energy consumed by the system. When the radio is active, either listening, receiving, or transmitting, the EFR32ZG14 manages these power modes automatically, without requiring instruction from the host controller.

The host can also place the device into a low power standby state using the SUSPEND pin. When standby is active, the radio and serial interfaces are shut down and any RF connections are terminated. The system will re-establish communication when standby is released.

3.3 Radio Interface

The EFR32ZG14 includes a sub-GHz radio capable of implementing Z-Wave protocol. The differential radio interface connects to an external IPD circuit and antenna, as shown in [Figure 3.2 Radio Interface on page 6](#).

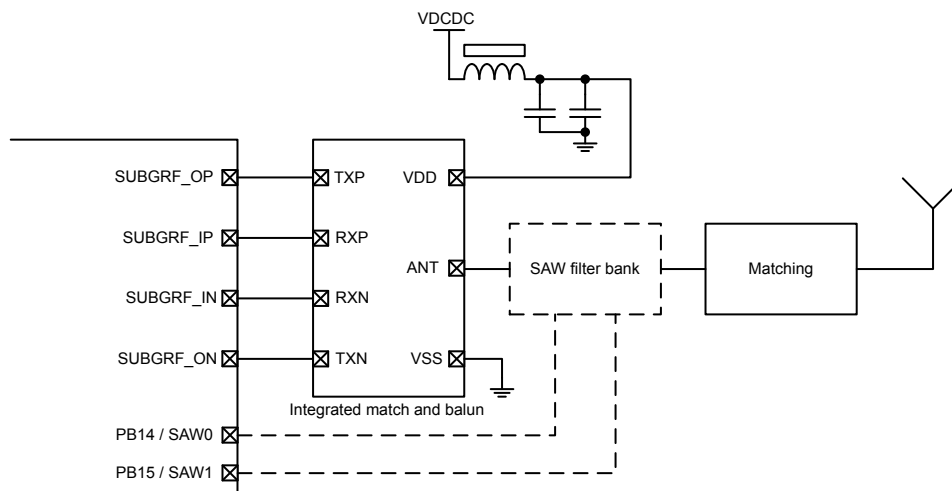


Figure 3.2. Radio Interface

For Z-Wave gateways outside EU frequency and with LTE embedded, it is recommended to analyze the specific need for a SAW filter in depth.

Optionally, a SAW filter bank can be added and controlled via the SAW0 and SAW1 output pins for operation in different regions. [Table 3.1 SAW Filter Selection on page 6](#) details the logic output levels for different SAW filters.

Table 3.1. SAW Filter Selection

| SAW1 / PB15 | SAW0 / PB14 | Saw Filter |
|-------------|-------------|-----------------------|
| 0 | 0 | H SAW Filter Selected |
| 0 | 1 | E SAW Filter Selected |
| 1 | 0 | U SAW Filter Selected |

Note: The state 1, 1 for SAW1, SAW0 is undefined.

Consult with Z-Wave Global Regions frequency list to identify country specific frequency and corresponding SAW filter.

In systems where switchable filtering is not required, SAW0 and SAW1 should be left unconnected, and the appropriate RF filtering should be used.

3.4 Embedded Interface

A host controller communicates with the EFR32ZG14 using a serial API over a standard 115,200 baud UART serial interface, shown in [Figure 3.3 Host Interface Connections on page 7](#). The RESETn signal is an active-low reset which brings the EFR32ZG14 back to its initial power-on state. An optional SUSPEND signal may also be used to place the EFR32ZG14 modem in a low power mode when radio functions are not required. The host may also supply a programming interface to update EFR32ZG14 firmware.

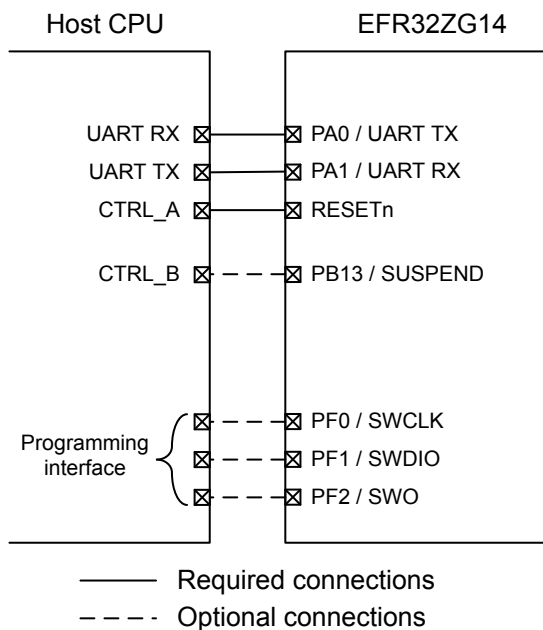


Figure 3.3. Host Interface Connections

More details of the serial API are found in INS12350 “Serial API Host Appl. Prg. Guide”.

3.5 Device Software

The EFR32ZG14 is based on a re-programmable system-on-chip MCU + radio solution. Software is provided as a pre-compiled binary image that may be installed through a standard ARM SWD interface. The binary is available for download at <https://www.silabs.com>.

4. Electrical Specifications

4.1 Electrical Characteristics

All electrical parameters in all tables are specified under the following conditions, unless stated otherwise:

- Typical values are based on $T_{AMB}=25\text{ }^{\circ}\text{C}$ and $V_{DD}=3.3\text{ V}$, by production test and/or technology characterization.
- Radio performance numbers are measured in conducted mode, based on Silicon Laboratories reference designs using output power-specific external RF impedance-matching networks for interfacing to a $50\ \Omega$ source or load.
- Minimum and maximum values represent the worst conditions across supply voltage, process variation, and operating temperature, unless stated otherwise.

Refer to for more details about operational supply and temperature limits.

4.1.1 Absolute Maximum Ratings

Stresses above those listed below may cause permanent damage to the device. This is a stress rating only and functional operation of the devices at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability. For more information on the available quality and reliability data, see the Quality and Reliability Monitor Report at <http://www.silabs.com/support/quality/pages/default.aspx>.

Table 4.1. Absolute Maximum Ratings

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---------------------------------------|-----------------|-------------------------------|------|-----|-------------|--------------------|
| Storage temperature range | T_{STG} | | -50 | — | 150 | $^{\circ}\text{C}$ |
| Voltage on any supply pin | V_{DDMAX} | | -0.3 | — | 3.8 | V |
| Voltage ramp rate on any supply pin | $V_{DDRAMPMAX}$ | | — | — | 1 | V / μs |
| DC voltage on I/O pins | V_{DIGPIN} | | -0.3 | — | $IOVDD+0.3$ | V |
| Voltage on HFXTAL_N and HFXTAL_P pins | V_{HFXTAL} | | -0.3 | — | 1.4 | V |
| Absolute voltage on Sub-GHz RF pins | $V_{MAXSUBG}$ | Pins SUBGRF_OP and SUBGRF_ON | -0.3 | — | 3.3 | V |
| | | Pins SUBGRF_IP and SUBGRF_IN, | -0.3 | — | 0.3 | V |
| Total current into VDD power lines | I_{VDDMAX} | Source | — | — | 200 | mA |
| Total current into VSS ground lines | I_{VSSMAX} | Sink | — | — | 200 | mA |
| Current per I/O pin | I_{IOMAX} | Sink | — | — | 50 | mA |
| | | Source | — | — | 50 | mA |
| Current for all I/O pins | $I_{IOALLMAX}$ | Sink | — | — | 200 | mA |
| | | Source | — | — | 200 | mA |
| Junction temperature | T_J | -G grade devices | -40 | — | 105 | $^{\circ}\text{C}$ |

4.1.2 Operating Conditions

When assigning supply sources, the following requirements must be observed:

- VREGVDD must be greater than or equal to AVDD, DVDD, RFVDD and all IOVDD supplies.
- VREGVDD = AVDD
- DVDD ≤ AVDD
- IOVDD ≤ AVDD
- RFVDD ≤ AVDD

4.1.2.1 General Operating Conditions

Table 4.2. General Operating Conditions

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|-----------------------|---------------------------|------|-----|----------------------|------|
| Operating ambient temperature range ¹ | T _A | -G temperature grade | -40 | 25 | 85 | °C |
| AVDD supply voltage ² | V _{AVDD} | | 1.8 | 3.3 | 3.8 | V |
| VREGVDD operating supply voltage ^{2 3} | V _{VREGVDD} | DCDC in regulation | 2.4 | 3.3 | 3.8 | V |
| | | DCDC in bypass, 50mA load | 1.8 | 3.3 | 3.8 | V |
| RFVDD operating supply voltage | V _{RFVDD} | | 1.62 | — | V _{VREGVDD} | V |
| DVDD operating supply voltage | V _{DVDD} | | 1.62 | — | V _{VREGVDD} | V |
| IOVDD operating supply voltage | V _{IOVDD} | All IOVDD pins | 1.62 | — | V _{VREGVDD} | V |
| DECOUPLE output capacitor ^{4 5} | C _{DECOUPLE} | | 0.75 | 1.0 | 2.75 | μF |
| Difference between AVDD and VREGVDD, ABS(AVDD-VREGVDD) ² | dV _{DD} | | — | — | 0.1 | V |

Note:

1. The maximum limit on T_A may be lower due to device self-heating, which depends on the power dissipation of the specific application. T_A (max) = T_J (max) - (THETA_{JA} × PowerDissipation). Refer to the Absolute Maximum Ratings table and the Thermal Characteristics table for T_J and THETA_{JA}.
2. VREGVDD must be tied to AVDD. Both VREGVDD and AVDD minimum voltages must be satisfied for the part to operate.
3. The minimum voltage required in bypass mode is calculated using R_{BYP} from the DCDC specification table. Requirements for other loads can be calculated as V_{DVDD_min} + I_{LOAD} * R_{BYP_max}.
4. The system designer should consult the characteristic specs of the capacitor used on DECOUPLE to ensure its capacitance value stays within the specified bounds across temperature and DC bias.
5. VSCALE0 to VSCALE2 voltage change transitions occur at a rate of 10 mV / usec for approximately 20 usec. During this transition, peak currents will be dependent on the value of the DECOUPLE output capacitor, from 35 mA (with a 1 μF capacitor) to 70 mA (with a 2.7 μF capacitor).

4.1.3 Thermal Characteristics

Table 4.3. Thermal Characteristics

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|-----------------------------------|---------------------------|-----------------------------------|-----|------|-----|------|
| Thermal resistance, QFN32 Package | THETA _{JA_QFN32} | 2-Layer PCB, Air velocity = 0 m/s | — | 82.1 | — | °C/W |
| | | 2-Layer PCB, Air velocity = 1 m/s | — | 64.7 | — | °C/W |
| | | 2-Layer PCB, Air velocity = 2 m/s | — | 56.3 | — | °C/W |
| | | 4-Layer PCB, Air velocity = 0 m/s | — | 36.8 | — | °C/W |
| | | 4-Layer PCB, Air velocity = 1 m/s | — | 32 | — | °C/W |
| | | 4-Layer PCB, Air velocity = 2 m/s | — | 30.6 | — | °C/W |

4.1.4 DC-DC Converter

Table 4.4. DC-DC Converter

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|-------------------|----------------|-----|-----|-----|------|
| DCDC nominal output capacitor ¹ | C _{DCDC} | 25% tolerance | 4.7 | 4.7 | 4.7 | μF |
| DCDC nominal output inductor ¹ | L _{DCDC} | 20% tolerance | 4.7 | 4.7 | 4.7 | μH |

Note:
1. Refer to the Z-Wave Hardware Implementation Guidelines for component selection to achieve optimal performance.

4.1.5 Current Consumption

Unless otherwise indicated, typical conditions are: VREGVDD = AVDD = IOVDD = 3.3 V, DVDD = RFVDD = 1.8 V. T = 25 °C. Minimum and maximum values in this table represent the worst conditions across process variation at T = 25 °C.

Table 4.5. Current Consumption

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|------------------------|--|-----|------|-----|------|
| Current During Active Radio Reception | I _{ACTIVE_RX} | | — | 10.5 | — | mA |
| Current With Radio Listening, No Active Reception | I _{LISTEN_RX} | | — | 10.5 | — | mA |
| Current During Active Radio Transmission | I _{ACTIVE_TX} | Radio transmitter output power at 13 dBm | — | 38.8 | — | mA |
| | | Radio transmitter output power at 4 dBm | — | 17.2 | — | mA |
| | | Radio transmitter output power at 0 dBm | — | 12.9 | — | mA |
| CPU-Only Current | I _{CPU_ONLY} | CPU active without radio active | — | 3.1 | — | mA |

4.1.6 Brown Out Detector (BOD)

Table 4.6. Brown Out Detector (BOD)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|------------------------|----------------------------|------------------------------|------|-----|------|------|
| DVDD BOD threshold | V _{DVddbOD} | DVDD rising | — | — | 1.62 | V |
| | | DVDD falling (EM0/EM1) | 1.35 | — | — | V |
| | | DVDD falling (EM2/EM3) | 1.3 | — | — | V |
| DVDD BOD hysteresis | V _{DVddbOD_HYST} | | — | 18 | — | mV |
| DVDD BOD response time | t _{DVddbOD_DELAY} | Supply drops at 0.1V/μs rate | — | 2.4 | — | μs |
| AVDD BOD threshold | V _{AVddbOD} | AVDD rising | — | — | 1.8 | V |
| | | AVDD falling (EM0/EM1) | 1.62 | — | — | V |
| | | AVDD falling (EM2/EM3) | 1.53 | — | — | V |
| AVDD BOD hysteresis | V _{AVddbOD_HYST} | | — | 20 | — | mV |
| AVDD BOD response time | t _{AVddbOD_DELAY} | Supply drops at 0.1V/μs rate | — | 2.4 | — | μs |
| EM4 BOD threshold | V _{EM4dBOD} | AVDD rising | — | — | 1.7 | V |
| | | AVDD falling | 1.45 | — | — | V |
| EM4 BOD hysteresis | V _{EM4BOD_HYST} | | — | 25 | — | mV |
| EM4 BOD response time | t _{EM4BOD_DELAY} | Supply drops at 0.1V/μs rate | — | 300 | — | μs |

4.1.7 Sub-GHz RF Transceiver Characteristics

4.1.7.1 Sub-GHz RF Transmitter characteristics for 915 MHz Band

Unless otherwise indicated, typical conditions are: T = 25 °C, VREGVDD = AVDD = IOVDD = 3.3 V, DVDD = RFVDD = External RF Supply. RFVDD and RF supply paths are filtered using ferrites. Crystal frequency = 39 MHz. RF frequency band 915 MHz.

Table 4.7. Sub-GHz RF Transmitter characteristics for 915 MHz Band

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|-----------------------------|---|-----|-------|-----|----------|
| RF tuning frequency range | F _{RANGE} | | 902 | — | 930 | MHz |
| Maximum TX Power ¹ | POUT _{MAX} | 4 dBm output power setting | — | 4 | — | dBm |
| Minimum active TX Power | POUT _{MIN} | | — | -30 | — | dBm |
| Output power step size | POUT _{STEP} | output power > 0 dBm | — | 0.5 | — | dB |
| Output power variation vs supply at POUT _{MAX} | POUT _{VAR_V} | 1.8 V < V _{VREGVDD} < 3.3 V, T = 25 °C | — | 1.9 | — | dB |
| Output power variation vs temperature, peak to peak | POUT _{VAR_T} | -40 to +85 °C | — | 1.3 | — | dB |
| Output power variation vs RF frequency | POUT _{VAR_F} | T = 25 °C, Over specified RF tuning frequency range | — | 0.5 | — | dB |
| Spurious emissions of harmonics at 3 dBm output power, Conducted measurement, 3dBm match, Test Frequency = 908.4 MHz | SPUR _{HARM_FCC_14} | In restricted bands, per FCC Part 15.205 / 15.209 | — | -60.0 | -42 | dBm |
| | | In non-restricted bands, per FCC Part 15.231 | — | -58.0 | -20 | dBc |
| Spurious emissions out-of-band at 3 dBm output power, Conducted measurement, 3dBm match, Test Frequency = 908.4 MHz | SPUR _{OOB_FCC_14} | In non-restricted bands, per FCC Part 15.231 | — | -74.0 | -20 | dBc |
| | | In restricted bands (30-88 MHz), per FCC Part 15.205 / 15.209 | — | -59.2 | -46 | dBm |
| | | In restricted bands (88-216 MHz), per FCC Part 15.205 / 15.209 | — | -72.6 | -56 | dBm |
| | | In restricted bands (216-960 MHz), per FCC Part 15.205 / 15.209 | — | -72.1 | -52 | dBm |
| | | In restricted bands (>960 MHz), per FCC Part 15.205 / 15.209 | — | -66.1 | -42 | dBm |
| Power spectral density limit | PSD | PSD per FCC Part 15.247, 9.6Kbps | — | -0.7 | — | dBm/3kHz |
| | | PSD per FCC Part 15.247, 40Kbps | — | 2.2 | — | dBm/3kHz |
| | | PSD per FCC Part 15.247, 100Kbps | — | -4.2 | — | dBm/3kHz |

Note:

1. The output power level can be adjusted to suit specific regulatory requirements for the region in which the device is used.

4.1.7.2 Sub-GHz RF Receiver Characteristics for 915 MHz Band

Unless otherwise indicated, typical conditions are: T = 25 °C, VREGVDD = AVDD = IOVDD = 3.3 V, DVDD = RFVDD = External RF Supply. RFVDD and RF supply paths are filtered using ferrites. Crystal frequency = 39 MHz. RF frequency band 915 MHz.

Table 4.8. Sub-GHz RF Receiver Characteristics for 915 MHz Band

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|----------------------------|---|-----|--------|-----|------|
| Tuning frequency range | F _{RANGE} | | 902 | — | 930 | MHz |
| Max usable input level, 1% FER | SAT _{100K} | Desired is reference 100 kbps GFSK signal ¹ | — | 10 | — | dBm |
| Sensitivity ^{2 3} | SENS | Desired is reference 100 kbps GFSK signal ¹ , 1% FER, frequency = 916 MHz, T ≤ 85 °C | — | -98.8 | — | dBm |
| | | Desired is reference 40 kbps 2FSK signal ⁴ , 1% FER, frequency = 908.4 MHz, T ≤ 85 °C | — | -102.8 | — | dBm |
| | | Desired is reference 9.6 kbps 2FSK signal ⁵ , 1% FER, frequency = 908.42 MHz, T ≤ 85 °C | — | -103.9 | — | dBm |
| Level above which RFSENSE will trigger ⁶ | RFSENSE _{TRIG} | CW at 915 MHz | — | -28.1 | — | dBm |
| Level below which RFSENSE will not trigger ⁶ | RFSENSE _{THRES} | CW at 915 MHz | — | -50 | — | dBm |
| Image rejection, Interferer is CW at image frequency | C/I _{IMAGE} | Desired is 100 kbps GFSK signal ¹ at 3dB above sensitivity level, 1% FER, frequency = 916 MHz | — | 33 | — | dB |
| | | Desired is reference 40 kbps 2FSK signal ⁴ at 3dB above sensitivity level, 1% FER, frequency = 908.4 MHz | — | 34.3 | — | dB |
| | | Desired is reference 9.6 kbps 2FSK signal ⁵ at 3dB above sensitivity level, 1% FER, frequency = 908.42 MHz | — | 34.7 | — | dB |
| Blocking selectivity, 1% FER. Desired is 100 kbps GFSK signal ¹ at 3dB above sensitivity level, frequency = 916 MHz | C/I _{BLOCKER_100} | Interferer CW at Desired ± 1 MHz | — | 47.1 | — | dB |
| | | Interferer CW at Desired ± 2 MHz | — | 52.7 | — | dB |
| | | Interferer CW at Desired ± 5 MHz | — | 61.3 | — | dB |
| | | Interferer CW at Desired ± 10 MHz ⁷ | — | 65.7 | — | dB |
| | | Interferer CW at Desired ± 100 MHz ⁷ | — | 78.0 | — | dB |

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|----------------------------|--|-----|-------|-------|------|
| Blocking selectivity, 1% FER. Desired is 40 kbps 2FSK signal ⁴ at 3dB above sensitivity level, frequency = 908.4 MHz | C/I _{BLOCKER_40} | Interferer CW at Desired \pm 1 MHz | — | 53.1 | — | dB |
| | | Interferer CW at Desired \pm 2 MHz | — | 59.3 | — | dB |
| | | Interferer CW at Desired \pm 5 MHz | — | 71.6 | — | dB |
| | | Interferer CW at Desired \pm 10 MHz ⁷ | — | 79.3 | — | dB |
| | | Interferer CW at Desired \pm 100 MHz ⁷ | — | 82.2 | — | dB |
| Blocking selectivity, 1% FER. Desired is 9.6 kbps 2FSK signal ⁵ at 3dB above sensitivity level, frequency = 908.42 MHz | C/I _{BLOCKER_9p6} | Interferer CW at Desired \pm 1 MHz | — | 54.3 | — | dB |
| | | Interferer CW at Desired \pm 2 MHz | — | 60.4 | — | dB |
| | | Interferer CW at Desired \pm 5 MHz | — | 72.7 | — | dB |
| | | Interferer CW at Desired \pm 10 MHz ⁷ | — | 80.1 | — | dB |
| | | Interferer CW at Desired \pm 100 MHz ⁷ | — | 83.5 | — | dB |
| Intermod selectivity, 1% FER. CW interferers at 400 kHz and 800 kHz offsets | C/I _{IM} | Desired is 100 kbps GFSK signal ¹ at 3dB above sensitivity level, frequency = 916 MHz | — | 31.0 | — | dB |
| Upper limit of input power range over which RSSI resolution is maintained | RSSI _{MAX} | | — | — | 5 | dBm |
| Lower limit of input power range over which RSSI resolution is maintained | RSSI _{MIN} | | -98 | — | — | dBm |
| RSSI resolution | RSSI _{RES} | Over RSSI _{MIN} to RSSI _{MAX} range | — | 0.25 | — | dBm |
| Max spurious emissions during active receive mode, per FCC Part 15.109(a) | SPUR _{RX_FCC} | 216-960 MHz | — | -59.9 | -49.2 | dBm |
| | | Above 960 MHz | — | -55.7 | -41.2 | dBm |
| Max spurious emissions during active receive mode, per ARIB STD-T108 Section 3.3 | SPUR _{RX_ARIB} | Below 710 MHz, RBW=100kHz | — | -66.3 | -54 | dBm |
| | | 710-900 MHz, RBW=1MHz | — | -70.8 | -55 | dBm |
| | | 900-915 MHz, RBW=100kHz | — | -70.4 | -55 | dBm |
| | | 915-930 MHz, RBW=100kHz | — | -70.7 | -55 | dBm |
| | | 930-1000 MHz, RBW=100kHz | — | -70.8 | -54 | dBm |
| | | Above 1000 MHz, RBW=1MHz | — | -69.3 | -47 | dBm |

Note:

1. Definition of reference signal is 100 kbps 2GFSK, BT=0.6, $\Delta f = 58$ kHz, NRZ, '0' = $F_{center} + \Delta f/2$, '1' = $F_{center} - \Delta f/2$
2. Minimum Packet Error Rate floor will be $\sim 0.5\%$ for desired input signal levels between specified datasheet sensitivity level and -10dBm.
3. Minimum Packet Error Rate floor will be $\sim 1\%$ for desired input signal levels > -10 dBm.
4. Definition of reference signal is 40 kbps 2FSK, $\Delta f = 40$ kHz, NRZ, '0' = $F_{center} + \Delta f/2$, '1' = $F_{center} - \Delta f/2$
5. Definition of reference signal is 9.6 kbps 2FSK, $\Delta f = 40$ kHz, Manchester, '0' = Transition from ($F_{center} + 20k + \Delta f/2$), '1' = Transition from ($F_{center} + 20k - \Delta f/2$)
6. RFSENSE performance is only valid from 0 to 85 °C. RFSENSE should be disabled outside this temperature range.
7. Minimum Packet Error Rate floor for signals in presence of blocker will increase above 1% for blocker levels above -30dBm.

4.1.7.3 Sub-GHz RF Transmitter characteristics for 868 MHz Band

Unless otherwise indicated, typical conditions are: T = 25 °C, VREGVDD = AVDD = IOVDD = 3.3 V, DVDD = RFVDD = External RF Supply. RFVDD and RF supply paths are filtered using ferrites. Crystal frequency = 39 MHz. RF frequency band 868 MHz.

Table 4.9. Sub-GHz RF Transmitter characteristics for 868 MHz Band

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|---------------------------|--|-----|-------|-----|------|
| RF tuning frequency range | F _{RANGE} | | 863 | — | 876 | MHz |
| Maximum TX Power ¹ | POUT _{MAX} | 13 dBm output power setting | — | 13 | — | dBm |
| Minimum active TX Power | POUT _{MIN} | | — | -30 | — | dBm |
| Output power step size | POUT _{STEP} | output power > 0 dBm | — | 0.5 | — | dB |
| Output power variation vs supply at POUT _{MAX} | POUT _{VAR_V} | 1.8 V < V _{VREGVDD} < 3.3 V, T = 25 °C | — | 2.4 | — | dB |
| Output power variation vs temperature, peak to peak | POUT _{VAR_T} | -40 to +85 °C | — | 1.3 | — | dB |
| Output power variation vs RF frequency | POUT _{VAR_F} | T = 25 °C, Over specified RF tuning frequency range | — | 0.4 | — | dB |
| Spurious emissions of harmonics, Conducted measurement, Test Frequency = 868.4 MHz | SPUR _{HARM_ETSI} | Per ETSI EN 300-220, Section 7.8.2.1 | — | -39 | -30 | dBm |
| Spurious emissions out-of-band, Conducted measurement, Test Frequency = 868.4 MHz | SPUR _{OOB_ETSI} | Per ETSI EN 300-220, Section 7.8.2.1 (47-74 MHz, 87.5-118 MHz, 174-230 MHz, and 470-862 MHz) | — | -69.6 | -54 | dBm |
| | | Per ETSI EN 300-220, Section 7.8.2.1 (other frequencies below 1 GHz) | — | -69.8 | -36 | dBm |
| | | Per ETSI EN 300-220, Section 7.8.2.1 (frequencies above 1 GHz) | — | -64.9 | -30 | dBm |
| Note: | | | | | | |
| 1. The output power level can be adjusted to suit specific regulatory requirements for the region in which the device is used. | | | | | | |

4.1.7.4 Sub-GHz RF Receiver Characteristics for 868 MHz Band

Unless otherwise indicated, typical conditions are: T = 25 °C, VREGVDD = AVDD = IOVDD = 3.3 V, DVDD = RFVDD = External RF Supply. RFVDD and RF supply paths are filtered using ferrites. Crystal frequency = 39 MHz. RF frequency band 868 MHz.

Table 4.10. Sub-GHz RF Receiver Characteristics for 868 MHz Band

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|----------------------------|---|-----|--------|-----|------|
| Tuning frequency range | F _{RANGE} | | 863 | — | 876 | MHz |
| Max usable input level, 1% FER | SAT _{100k} | Desired is reference 100 kbps GFSK signal ¹ | — | 10 | — | dBm |
| Sensitivity ^{2 3} | SENS | Desired is reference 100 kbps GFSK signal ¹ , 1% FER, frequency = 869.85 MHz, T ≤ 85 °C | — | -98.6 | — | dBm |
| | | Desired is reference 40 kbps 2FSK signal ⁴ , 1% FER, frequency = 868.4 MHz, T ≤ 85 °C | — | -102.3 | — | dBm |
| | | Desired is reference 9.6 kbps 2FSK signal ⁵ , 1% FER, frequency = 868.42 MHz, T ≤ 85 °C | — | -103.3 | — | dBm |
| Level above which RFSENSE will trigger ⁶ | RFSENSE _{TRIG} | CW at 868 MHz | — | -28.1 | — | dBm |
| Level below which RFSENSE will not trigger ⁶ | RFSENSE _{THRES} | CW at 868 MHz | — | -50 | — | dBm |
| Image rejection, Interferer is CW at image frequency | C/I _{IMAGE} | Desired is 100kbps GFSK signal ¹ at 3dB above sensitivity level, 1% FER, frequency = 869.85 MHz | — | 33.6 | — | dB |
| | | Desired is reference 40 kbps 2FSK signal ⁴ at 3dB above sensitivity level, 1% FER, frequency = 868.4 MHz | — | 35.4 | — | dB |
| | | Desired is reference 9.6 kbps 2FSK signal ⁵ at 3dB above sensitivity level, 1% FER, frequency = 868.42 MHz | — | 35.5 | — | dB |
| Blocking selectivity, 1% FER. Desired is 100 kbps GFSK signal ¹ at 3 dB above sensitivity level, frequency = 869.85 MHz | C/I _{BLOCKER_100} | Interferer CW at Desired ± 1 MHz | — | 49.2 | — | dB |
| | | Interferer CW at Desired ± 2 MHz | — | 55.6 | — | dB |
| | | Interferer CW at Desired ± 5 MHz | — | 67.3 | — | dB |
| | | Interferer CW at Desired ± 10 MHz ⁷ | — | 74.3 | — | dB |
| | | Interferer CW at Desired ± 100 MHz ⁷ | — | 79.0 | — | dB |

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|----------------------------|---|-----|-------|-----|------|
| Blocking selectivity, 1% FER. Desired is 40 kbps 2FSK signal ⁴ at 3 dB above sensitivity level, frequency = 868.4 MHz | C/I _{BLOCKER_40} | Interferer CW at Desired \pm 1 MHz | — | 53.4 | — | dB |
| | | Interferer CW at Desired \pm 2 MHz | — | 59.4 | — | dB |
| | | Interferer CW at Desired \pm 5 MHz | — | 71.9 | — | dB |
| | | Interferer CW at Desired \pm 10 MHz ⁷ | — | 79.4 | — | dB |
| | | Interferer CW at Desired \pm 100 MHz ⁷ | — | 83.2 | — | dB |
| Blocking selectivity, 1% FER. Desired is 9.6 kbps 2FSK signal ⁵ at 3 dB above sensitivity level, frequency = 868.42 MHz | C/I _{BLOCKER_9p6} | Interferer CW at Desired \pm 1 MHz | — | 54.5 | — | dB |
| | | Interferer CW at Desired \pm 2 MHz | — | 60.4 | — | dB |
| | | Interferer CW at Desired \pm 5 MHz | — | 73.0 | — | dB |
| | | Interferer CW at Desired \pm 10 MHz ⁷ | — | 80.0 | — | dB |
| | | Interferer CW at Desired \pm 100 MHz ⁷ | — | 84.3 | — | dB |
| Upper limit of input power range over which RSSI resolution is maintained | RSSI _{MAX} | | — | — | 5 | dBm |
| Lower limit of input power range over which RSSI resolution is maintained | RSSI _{MIN} | | -98 | — | — | dBm |
| RSSI resolution | RSSI _{RES} | Over RSSI _{MIN} to RSSI _{MAX} range | — | 0.25 | — | dBm |
| Max spurious emissions during active receive mode | SPUR _{RX} | 30 MHz to 1 GHz | — | -54.4 | — | dBm |
| | | 1 GHz to 12 GHz | — | -63.8 | — | dBm |

Note:

1. Definition of reference signal is 100 kbps 2GFSK, BT=0.6, $\Delta f = 58$ kHz, NRZ, '0' = $F_{center} + \Delta f/2$, '1' = $F_{center} - \Delta f/2$
2. Minimum Packet Error Rate floor will be ~0.5% for desired input signal levels between specified datasheet sensitivity level and -10dBm.
3. Minimum Packet Error Rate floor will be ~ 1% for desired input signal levels > -10dBm.
4. Definition of reference signal is 40 kbps 2FSK, $\Delta f = 40$ kHz, NRZ, '0' = $F_{center} + \Delta f/2$, '1' = $F_{center} - \Delta f/2$
5. Definition of reference signal is 9.6 kbps 2FSK, $\Delta f = 40$ kHz, Manchester, '0' = Transition from ($F_{center} + 20k + \Delta f/2$), '1' = Transition from ($F_{center} + 20k - \Delta f/2$)
6. RFSENSE performance is only valid from 0 to 85 °C. RFSENSE should be disabled outside this temperature range.
7. Minimum Packet Error Rate floor for signals in presence of blocker will increase above 1% for blocker levels above -30dBm.

4.1.8 High-Frequency Crystal Oscillator (HFXO)

Table 4.11. High-Frequency Crystal Oscillator (HFXO)

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|-------------------------------------|--------------------|--------------------------------|-----|-----|-----|------|
| Crystal frequency ¹ | f_{HFXO} | | 39 | 39 | 39 | MHz |
| Frequency tolerance for the crystal | FT_{HFXO} | -40 to 85 °C, 5 years of aging | -25 | — | 25 | ppm |

Note:

1. Refer to the Z-Wave Hardware Implementation Guidelines for recommended crystals.

4.1.9 I/O Characteristics

Table 4.12. I/O Characteristics

| Parameter | Symbol | Test Condition | Min | Typ | Max | Unit |
|--|-----------------------|--|--------------------------|-----|--------------------------|------------|
| Input low voltage | V_{IL} | All inputs | — | — | $\text{IOVDD} \cdot 0.3$ | V |
| Input high voltage | V_{IH} | All inputs | $\text{IOVDD} \cdot 0.7$ | — | — | V |
| Output high voltage relative to IOVDD | V_{OH} | Sourcing 20 mA, $\text{IOVDD} \geq 3 \text{ V}$ | $\text{IOVDD} \cdot 0.8$ | — | — | V |
| | | Sourcing 8 mA, $\text{IOVDD} \geq 1.62 \text{ V}$ | $\text{IOVDD} \cdot 0.6$ | — | — | V |
| Output low voltage relative to IOVDD | V_{OL} | Sinking 20 mA, $\text{IOVDD} \geq 3 \text{ V}$ | — | — | $\text{IOVDD} \cdot 0.2$ | V |
| | | Sinking 8 mA, $\text{IOVDD} \geq 1.62 \text{ V}$ | — | — | $\text{IOVDD} \cdot 0.4$ | V |
| Input leakage current | I_{IOLEAK} | Input pin voltage $\leq \text{IOVDD}$, $T \leq 85 \text{ }^\circ\text{C}$ | — | 0.1 | 30 | nA |
| I/O pin pull-up/pull-down resistor ¹ | R_{PUD} | | 30 | 40 | 65 | k Ω |
| Pulse width of pulses removed by the glitch suppression filter | t_{IOGLITCH} | | 15 | 25 | 45 | ns |
| Output fall time, From 70% to 30% of V_{IOVDD} | t_{IOOF} | All outputs, $C_{\text{L}} = 50 \text{ pF}$ | — | 1.8 | — | ns |
| Output rise time, From 30% to 70% of V_{IOVDD} | t_{IOOR} | All outputs, $C_{\text{L}} = 50 \text{ pF}$ | — | 2.2 | — | ns |

Note:

1. GPIO pull-ups are referenced to the IOVDD supply, except for RESETn, which connects to AVDD.

4.2 Typical Performance Curves

Typical performance curves indicate typical characterized performance under the stated conditions.

4.2.1 Supply Current

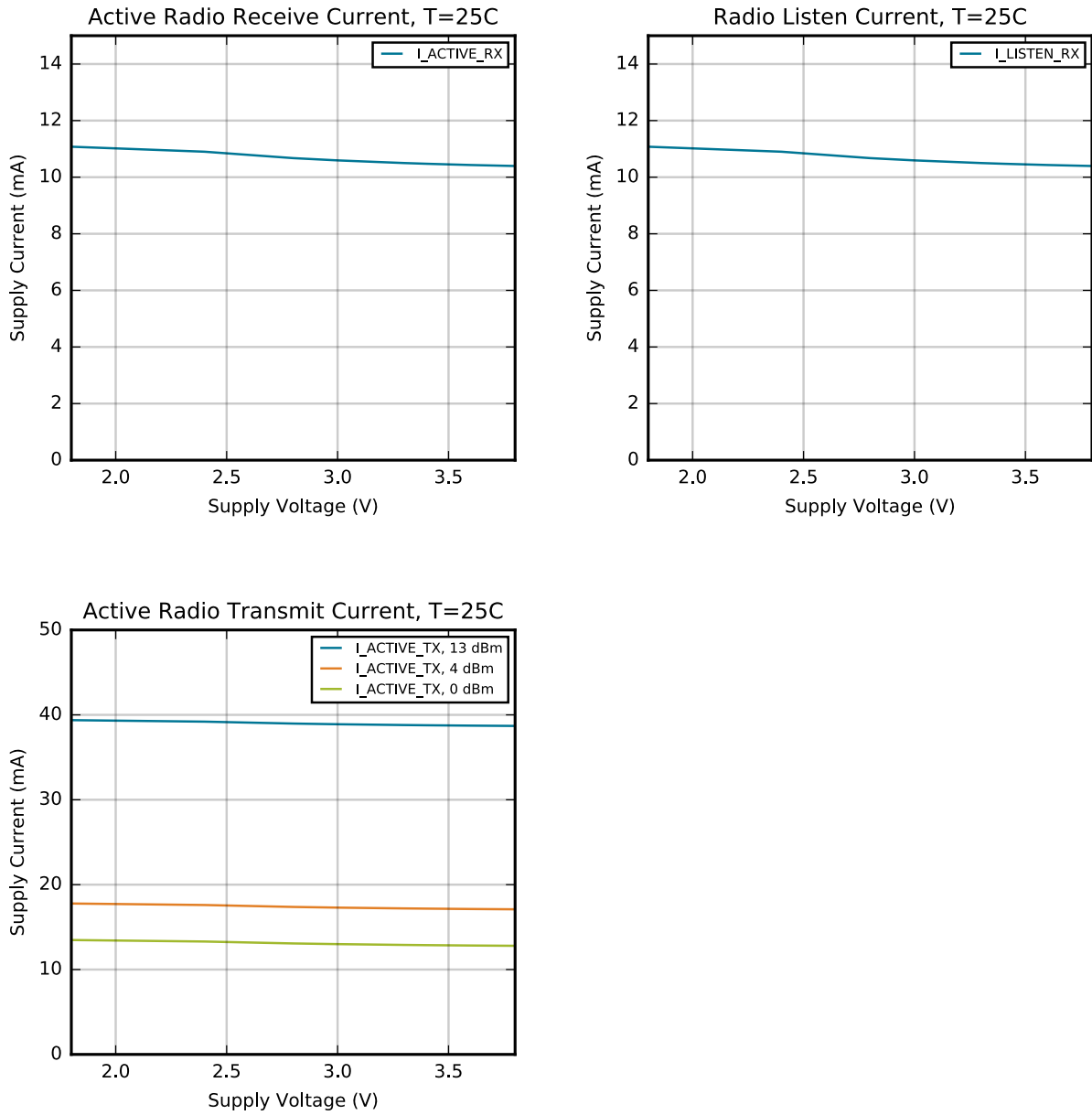


Figure 4.1. Supply Current vs. Supply Voltage

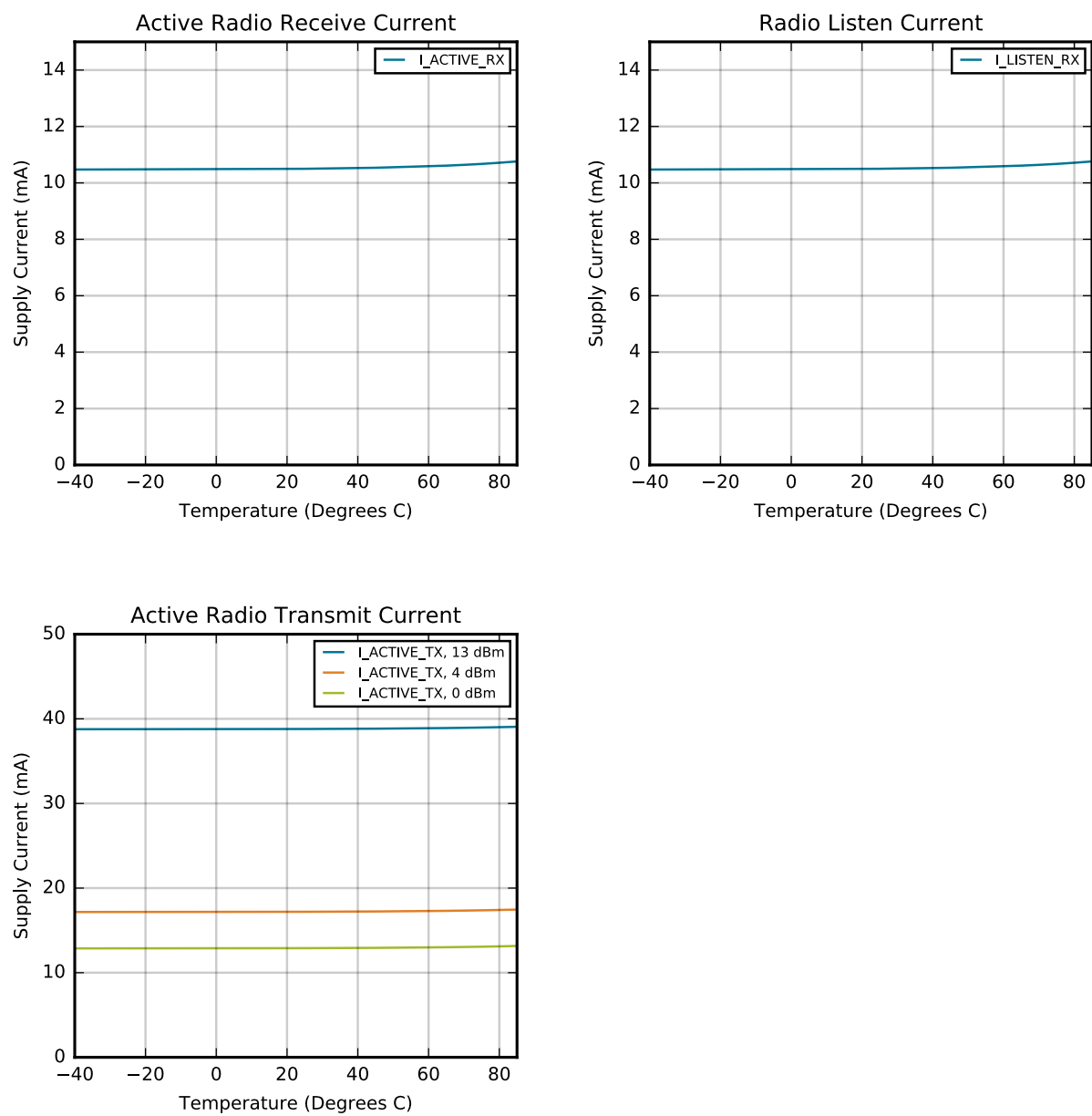


Figure 4.2. Supply Current vs. Temperature

4.2.2 Z-Wave Radio

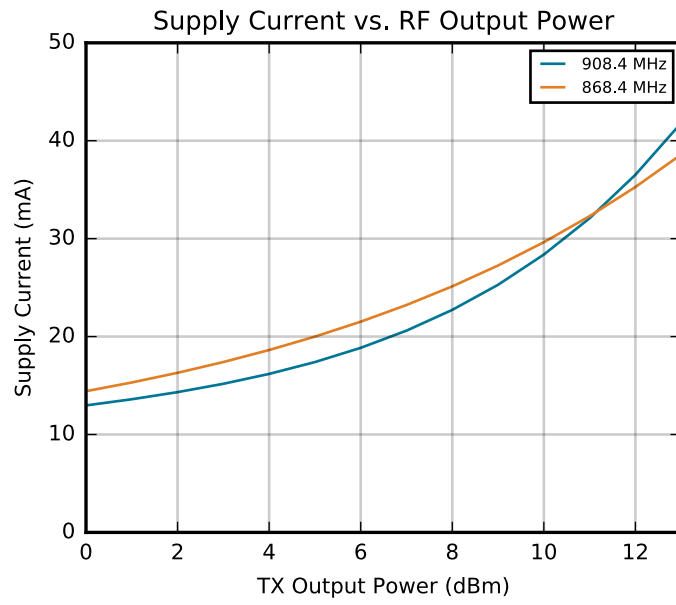


Figure 4.3. RF Transmitter Output Power

5. Typical Connection Diagrams

Typical connections for the EFR32ZG14 are shown in [Figure 5.1 Typical System Connections](#) on page 22. Refer to the design files for BRD4201 for more specific details on component choice.

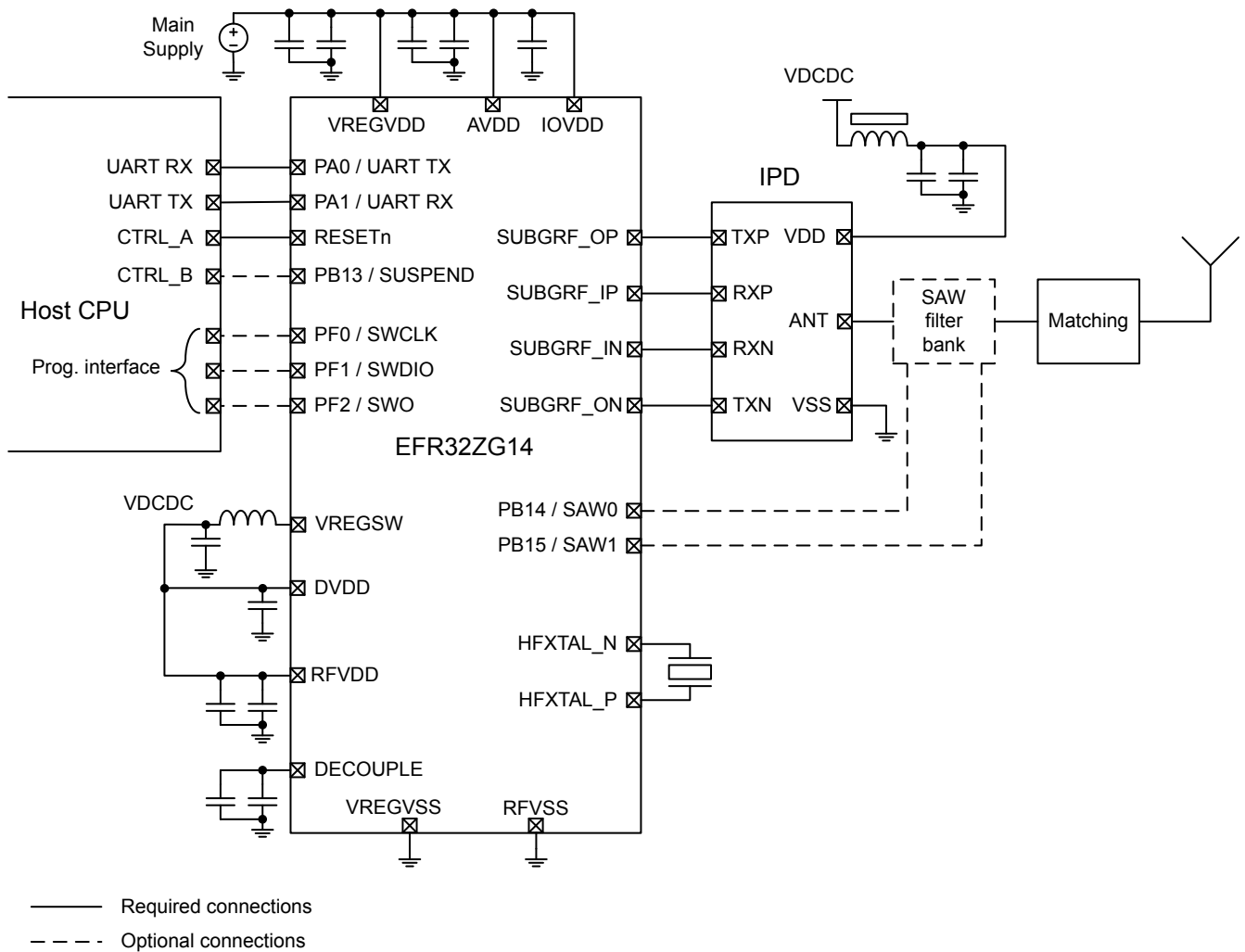


Figure 5.1. Typical System Connections

6. EFR32ZG14 Device Pinout

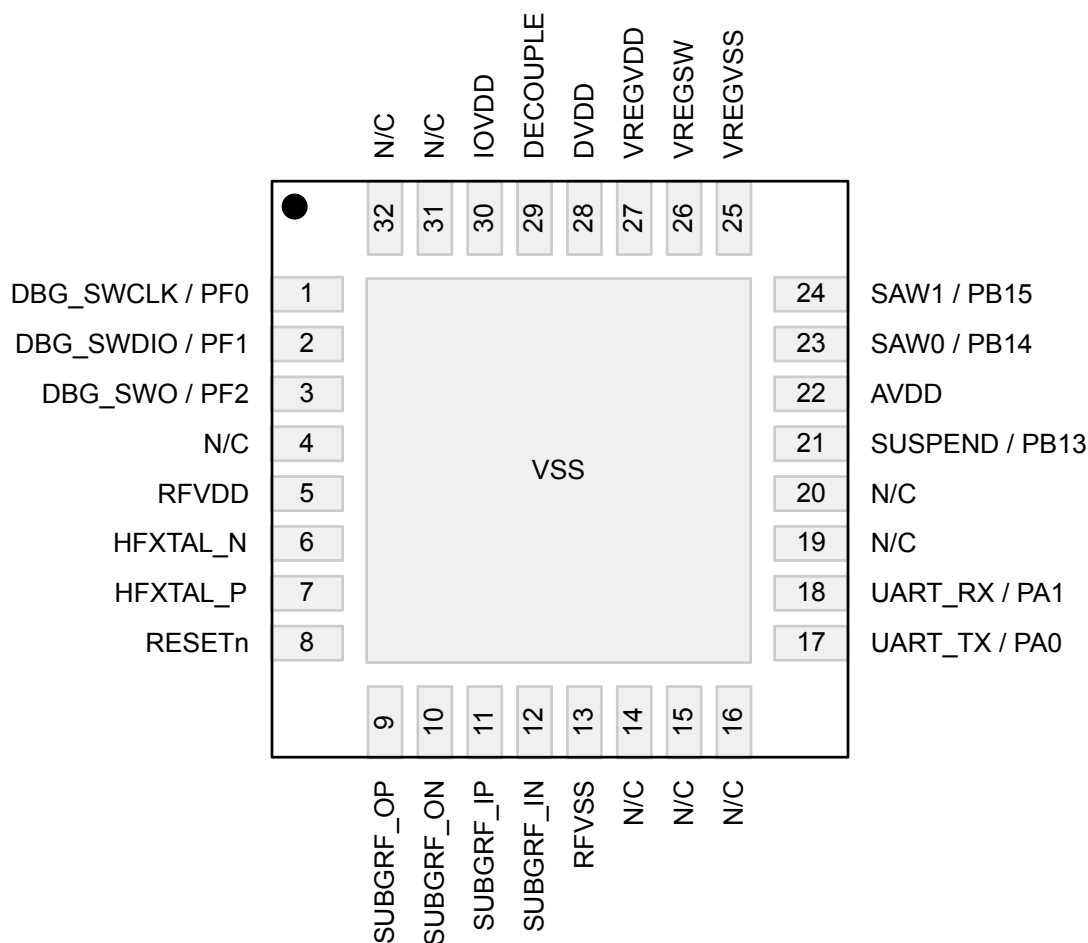


Figure 6.1. EFR32ZG14 Device Pinout

Table 6.1. EFR32ZG14 Device Pinout

| Pin Name | Pin(s) | Description | Pin Name | Pin(s) | Description |
|----------|-------------------------------|--|----------|--------|-------------------------------------|
| VSS | 0 | Ground | PF0 | 1 | DBG_SWCLK - Serial Wire Debug Clock |
| PF1 | 2 | DBG_SWDIO - Serial Wire Debug Data I/O | PF2 | 3 | DBG_SWO - Serial Wire Viewer Output |
| N/C | 4, 14, 15, 16, 19, 20, 31, 32 | No Connect | RFVDD | 5 | Radio power supply |
| HFXTAL_N | 6 | High Frequency Crystal input pin. | HFXTAL_P | 7 | High Frequency Crystal output pin. |

| Pin Name | Pin(s) | Description | Pin Name | Pin(s) | Description |
|-----------|--------|---|-----------|--------|--|
| RESETn | 8 | Reset input, active low. To apply an external reset source to this pin, it is required to only drive this pin low during reset, and let the internal pull-up ensure that reset is released. | SUBGRF_OP | 9 | Sub GHz Differential RF output, positive path. |
| SUBGRF_ON | 10 | Sub GHz Differential RF output, negative path. | SUBGRF_IP | 11 | Sub GHz Differential RF input, positive path. |
| SUBGRF_IN | 12 | Sub GHz Differential RF input, negative path. | RFVSS | 13 | Radio Ground |
| PA0 | 17 | UART_TX - UART Serial Data Output | PA1 | 18 | UART_RX - UART Serial Data Input |
| PB13 | 21 | SUSPEND - Suspend Input | AVDD | 22 | Analog power supply. |
| PB14 | 23 | SAW0 - Saw Filter Select 0 Output | PB15 | 24 | SAW1 - Saw Filter Select 1 Output |
| VREGVSS | 25 | Voltage regulator VSS | VREGSW | 26 | DCDC regulator switching node |
| VREGVDD | 27 | Voltage regulator VDD input | DVDD | 28 | Digital power supply. |
| DECOUPLE | 29 | Decouple output for on-chip voltage regulator. An external decoupling capacitor is required at this pin. | IOVDD | 30 | Digital IO power supply. |

7. QFN32 Package Specifications

7.1 QFN32 Package Dimensions

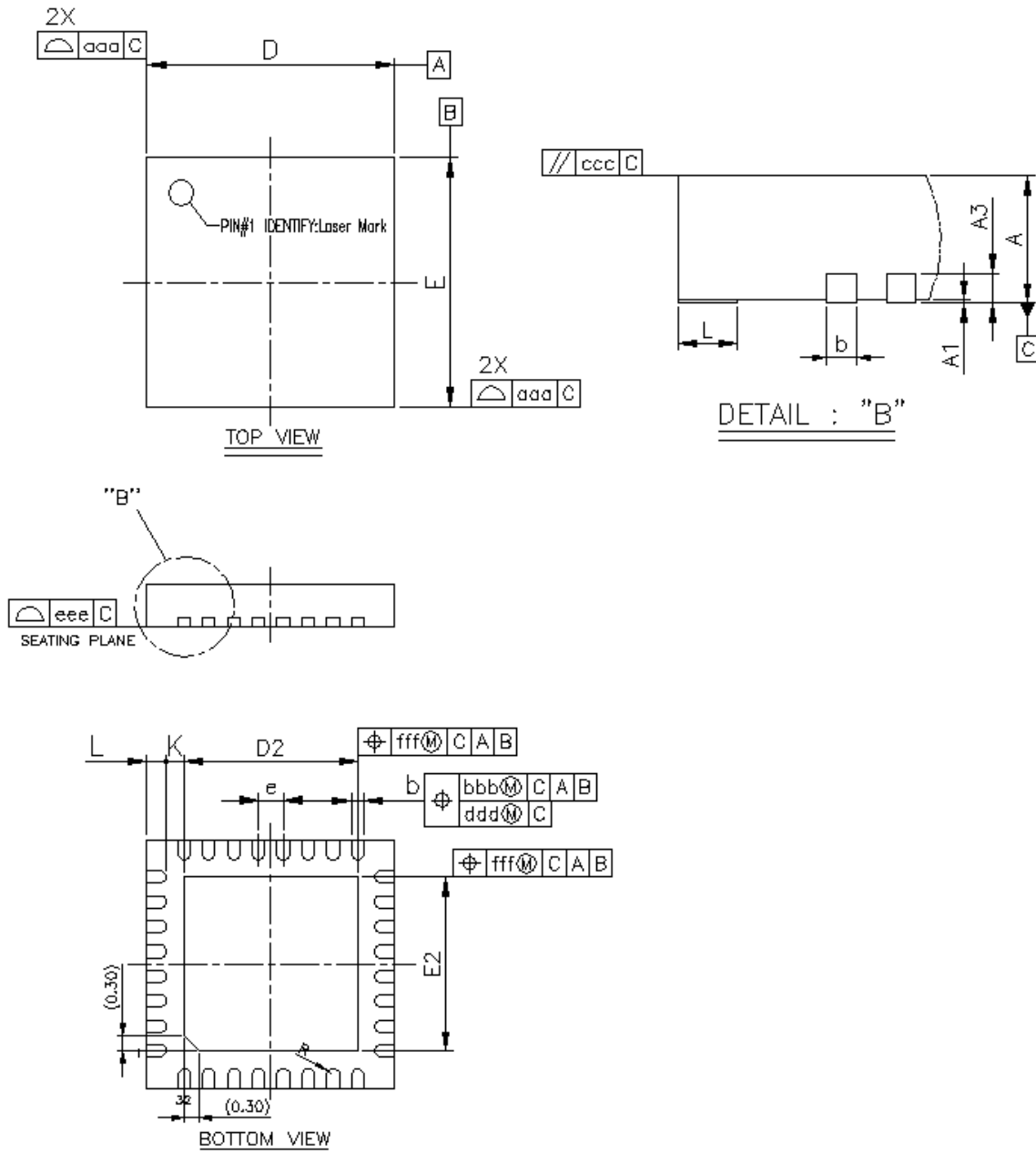


Figure 7.1. QFN32 Package Drawing

Table 7.1. QFN32 Package Dimensions

| Dimension | Min | Typ | Max |
|-----------|----------|------|------|
| A | 0.80 | 0.85 | 0.90 |
| A1 | 0.00 | 0.02 | 0.05 |
| A3 | 0.20 REF | | |
| b | 0.18 | 0.25 | 0.30 |
| D/E | 4.90 | 5.00 | 5.10 |
| D2/E2 | 3.40 | 3.50 | 3.60 |
| E | 0.50 BSC | | |
| L | 0.30 | 0.40 | 0.50 |
| K | 0.20 | — | — |
| R | 0.09 | — | 0.14 |
| aaa | 0.15 | | |
| bbb | 0.10 | | |
| ccc | 0.10 | | |
| ddd | 0.05 | | |
| eee | 0.08 | | |
| fff | 0.10 | | |

Note:

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to the JEDEC Solid State Outline MO-220, Variation VKKD-4.
4. Recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.

7.2 QFN32 PCB Land Pattern

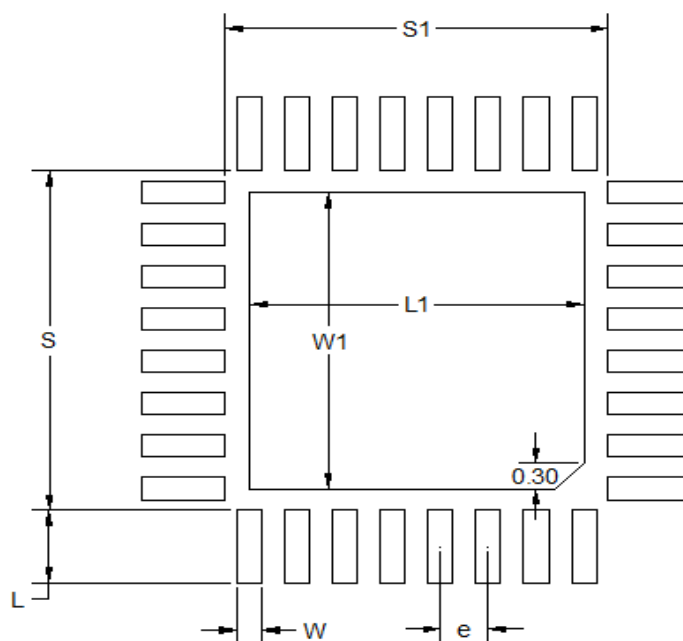


Figure 7.2. QFN32 PCB Land Pattern Drawing

Table 7.2. QFN32 PCB Land Pattern Dimensions

| Dimension | Typ |
|-----------|------|
| S1 | 4.01 |
| S | 4.01 |
| L1 | 3.50 |
| W1 | 3.50 |
| e | 0.50 |
| W | 0.26 |
| L | 0.86 |

Note:

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. This Land Pattern Design is based on the IPC-7351 guidelines.
3. All metal pads are to be non-solder mask defined (NSMD). Clearance between the solder mask and the metal pad is to be 60 μ m minimum, all the way around the pad.
4. A stainless steel, laser-cut and electro-polished stencil with trapezoidal walls should be used to assure good solder paste release.
5. The stencil thickness should be 0.125 mm (5 mils).
6. The ratio of stencil aperture to land pad size can be 1:1 for all perimeter pads.
7. A 3x3 array of 0.85 mm square openings on a 1.00 mm pitch can be used for the center ground pad.
8. A No-Clean, Type-3 solder paste is recommended.
9. The recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.

7.3 QFN32 Package Marking



Figure 7.3. QFN32 Package Marking

The package marking consists of:

- P P P P P P P P P P – The part number designation.
 1. Family Code (Z)
 2. G (Gecko)
 3. Series (1)
 4. Device Configuration (4)
 5. Performance Grade (P)
 6. Feature Code (2)
 7. TRX Code (3 = TXRX)
 8. Band (1 = Sub-GHz)
 9. Flash (G = 256K)
 10. Temperature Grade (G = -40 to 85)
- YY – The last 2 digits of the assembly year.
- WW – The 2-digit workweek when the device was assembled.
- T T T T T T – A trace or manufacturing code. The first letter is the device revision.

8. Revision History

Revision 1.0

January 2019

- Updated electrical characteristics with latest characterization results.

Revision 0.2

December 2018

- Required crystal frequency changed to 39 MHz.
- Updated electrical characteristics with latest characterization estimates.
- [Table 4.7 Sub-GHz RF Transmitter characteristics for 915 MHz Band on page 12](#): PSD conditions updated to specify PSD at each data rate.

Revision 0.1

September, 2018

Initial release.

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