

Theory of Operation

1. Introduction

The JRD-1171 is a Bluetooth Low Energy (BLE) module designed for wireless communication in low-power, embedded applications. It is based on the Nordic Semiconductor nRF52840 System-on-Chip (SoC), which integrates a 2.4 GHz transceiver supporting multiple protocols including BLE 5.3, Thread, Zigbee, IEEE 802.15.4, and ANT. The module enhances the native RF performance of the SoC by integrating a Power Amplifier (PA) and Low Noise Amplifier (LNA), enabling higher transmit power and improved receive sensitivity.

2. RF Operation

The nRF52840 SoC contains a fully integrated RF transceiver that operates in the 2.4 GHz ISM band. The internal PLL synthesizer locks to the required frequencies in the BLE channel plan, using crystal references. The PA boosts the maximum RF output power to +3.8 dBm, while the LNA improves the receive sensitivity to -103 dBm at 1 Mbps BLE. These enhancements extend the communication range and robustness in noisy RF environments.

The module includes an onboard u.FL connector to support external antennas. The RF path is carefully impedance-matched to ensure minimal loss between the transceiver and antenna. The module's RF output is routed through the PA, a band-pass filter, and finally the antenna connector.

3. Microcontroller Operation

The nRF52840 incorporates a 64 MHz ARM Cortex-M4 processor with floating point unit (FPU), which manages BLE protocol stack execution as well as custom user applications. Firmware is typically stored in the 1 MB flash memory, with up to 256 KB of RAM available for real-time operations. The module supports UART, SWD, USB 2.0, and GPIO interfaces for external communication and programming.

4. Power and Control

The module operates from a single power supply input (VIN) ranging from 2.7V to 5.5V. Internally regulated rails (e.g., 1.8V and 3.0V) power the SoC and RF circuitry. A dedicated power enable pin (PWE_EN) allows host systems to control module operation. The module supports USB device functionality and can be powered via the VBUS-IN pin when connected to a USB host.

5. Integration and Control

Host integration is facilitated via UART, USB, or GPIO interfaces. The module can be programmed using the Single Wire Debug (SWD) interface. The firmware manages RF operations, PA/LNA control, and power management functions.

6. Regulatory Considerations

The module is certified under FCC modular approval (LMA) and is not intended for third-party integration. The module operates under FCC Part 15 Subpart C, Section 15.247. The u.FL antenna connector allows flexibility in choosing antennas that meet FCC requirements, subject to host system evaluation if necessary. Any host device will have external labelling, including the following: "Contains FCC ID: 2BNX4-JRD1171 "

The module was tested using the following antennas:

ANT060 - Fanstel Corp.

Puck-5-V1 (Port 1) - Poynting