nRF7002 Expansion Board Hardware

v0.9.0

User Guide

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NORDIC® SEMICONDUCTOR

Contents

Revision history

Date	Description
2023-11-29	First release

Environmental and safety notices

Environmental and safety notices for the nRF7002 Expansion Board (EB) and power supply requirements.

Note: The nRF7002 EB must be powered by a PS1 class (IEC 62368-1) power supply with maximum power less than 15 W.

Skilled persons

The nRF7002 EB is intended for use only by skilled persons.

A skilled person is someone with relevant education or experience that enables them to identify potential hazards and takes appropriate action to reduce the risk of injury to themselves and others.

Electrostatic discharge

The nRF7002 EB is susceptible to *Electrostatic Discharge (ESD)*.

To avoid damage to your device, it should be used in an electrostatic free environment, such as a laboratory.

Environmental Protection

Waste electrical products should not be disposed of with household waste.

Please recycle where facilities exist. Check with your local authority or retailer for recycling advice.

1 Introduction

The nRF7002 *Expansion Board (EB)* is used to provide Wi-Fi® connectivity to compatible development or evaluation boards through the nRF7002 Wi-Fi 6 companion *Integrated Circuit (IC)*.

The EB has a *Printed Circuit Board (PCB)* edge connector that can be used with a compatible development board such as the Nordic Thingy:53™ IoT prototyping platform. There are castellated holes on the side of the board that allow the EB to be used as a breakout board that can be soldered to other PCB assemblies.

Key features

- nRF7002 Wi-Fi companion IC
  - Dual-band 2.4 GHz and 5 GHz Wi-Fi 6
  - Compatible with IEEE 802.11ax (known as Wi-Fi 6) and earlier standards IEEE 802.11a/b/g/n/ac
  - 20 MHz wide channels, 1x1 (SISO) operation and up to 86 MHz 802.11 PHY rate
  - Open-source Wi-Fi driver – L2 Network Technologies layer-compatible
  - SPI or QSPI host interface, 3-wire or 4-wire coexistence interface
  - Secure, 64-word *One Time Programmable (OTP) memory* with logical and voltage-level based protection mechanisms
- Onboard dual-band 2.4/5 GHz antenna
- PCB edge connector compatible with the Nordic Thingy:53
- Castellated edge holes to allow soldering EB to other PCB development boards
- *Microwave coaxial connector with switch (SWF)* RF connector for direct RF measurements

For access to firmware source code, hardware schematics, and layout files, see www.nordicsemi.com.

2 Kit content

The nRF7002 *EB* includes hardware, access to software components, reference design files, and documentation.

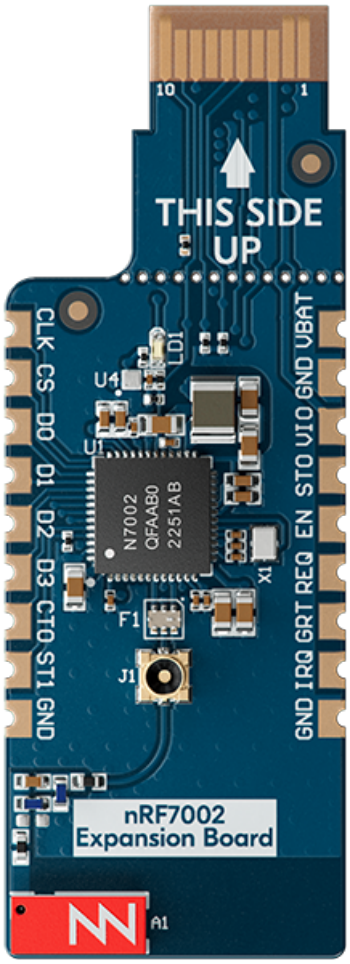

Figure 1: nRF7002 EB, front view

Hardware files

The hardware design files including schematics, *PCB* layout files, bill of materials, and Gerber files for the nRF7002 EB are available on the nRF7002 EB product page.

3 Hardware description

The nRF7002 *EB* (PCA63561) provides Wi-Fi connectivity through the nRF7002 companion *IC*.

Use the *PCB* edge connector to provide Wi-Fi connectivity to a development board with a compatible connector such as the Nordic Thingy:53, where the EB connects nRF7002 to nRF5340, which acts as a host. The castellated edge holes can be used to provide Wi-Fi capabilities to develop Wi-Fi applications with another *System on Chip (SoC)*, *Microprocessor Unit (MPU)*, or *Microcontroller Unit (MCU)* host.

3.1 Hardware drawings

The nRF7002 *EB* hardware drawings show both sides of the PCA63561 board.

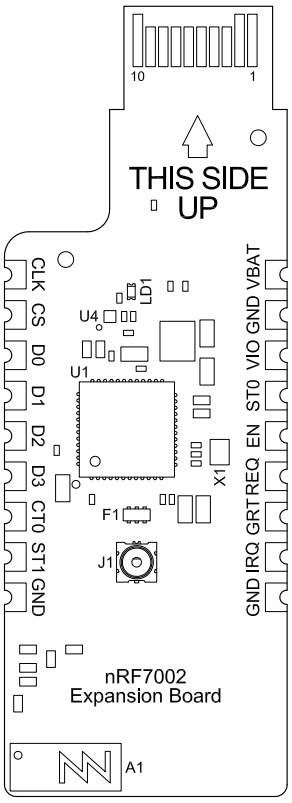

Figure 2: nRF7002 EB (PCA63561), front view

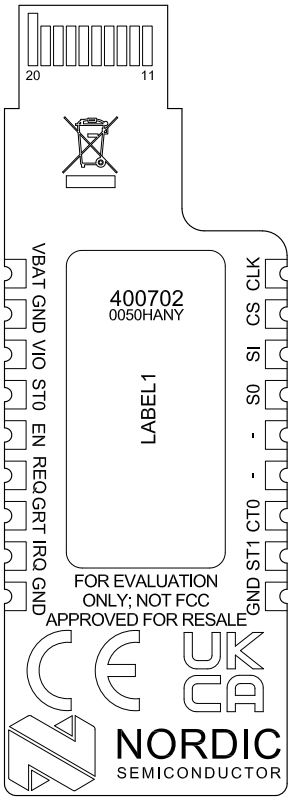

Figure 3: nRF7002 EB (PCA63561), back view

3.2 Block diagram

The block diagram illustrates the nRF7002 *EB* functional architecture.

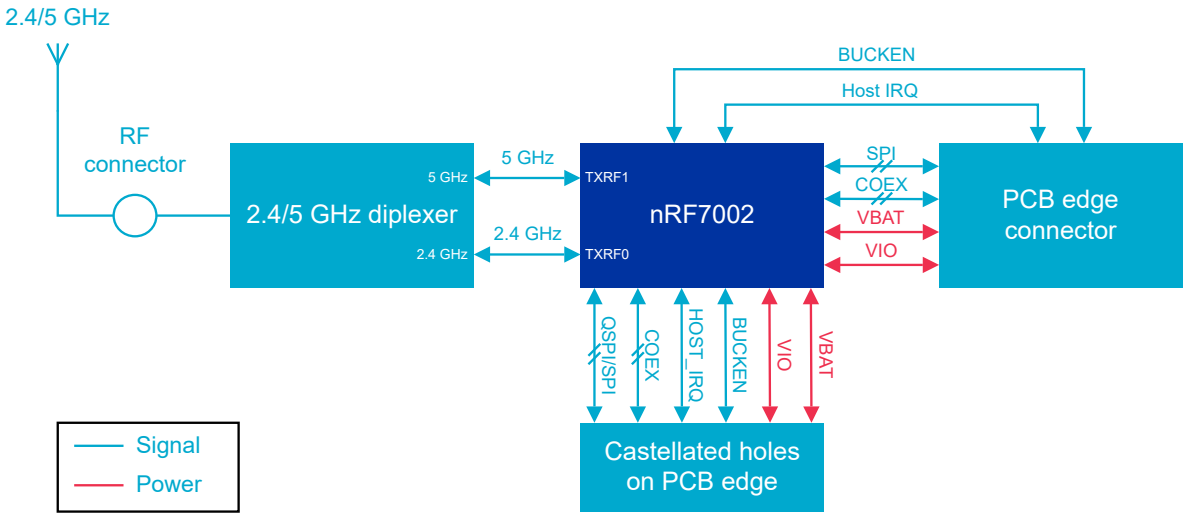

Figure 4: nRF7002 EB block diagram

3.3 nRF7002 Wi-Fi 6 companion IC

nRF7002 is a wireless companion *IC* that adds low-power Wi-Fi 6 capabilities to another *SoC*, *MPU*, or *MCU* host. The IC supports dual-band 2.4 GHz and 5 GHz band operation.

The nRF7002 companion IC pins are connected to the *PCB* edge connector and the castellated holes on the sides of the nRF7002 *EB*.

3.4 RF interface

The nRF7002 *EB* has a single dual-band 2.4/5 GHz antenna that is connected to nRF7002 through a diplexer (**F1**).

An *SWF* (**J1**) for RF measurements is located between the diplexer and the antenna.

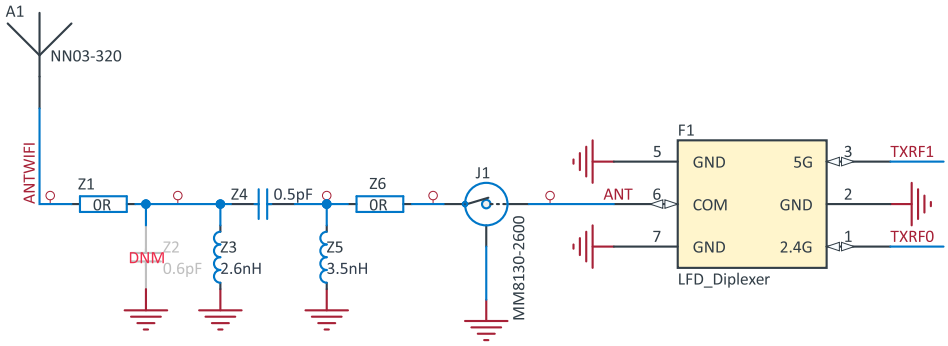

Figure 5: nRF7002 EB RF front-end

3.5 Connector interface

Access the nRF7002 *IC* through the *PCB* edge connector or the castellated edge holes on the sides of the board.

3.5.1 PCB edge connector

The *PCB* edge connector of the nRF7002 *EB* is compatible with the Nordic Thingy:53.

The following table shows the pinout of the PCB edge connector.

Pin	Signal name	Function
1	N.C.	Not used
2	N.C.	Not used
3	**VIO**	IO supply voltage
4	N.C.	Not used
5	**ST0**	Coexistence interface status/priority signal
6	**REQ**	Coexistence interface request signal
7	N.C.	Not used
8	**CLK**	SPI clock signal
9	**EN**	Power enable signal
10	N.C.	Not used
11	N.C.	Not used
12	N.C.	Not used
13	N.C.	Not used
14	**VBAT**	Supply voltage
15	**GRT**	Coexistence interface grant signal
16	**D0**	SPI MOSI signal
17	**D1**	SPI MISO signal
18	**CS**	SPI chip select signal
19	**IRQ**	Host interrupt signal
20	**GND**	Ground

Table 1: PCB edge connector pinout

For connecting the EB to the Nordic Thingy:53, see Using nRF7002 EB with the Nordic Thingy:53 on page 17.

3.5.2 Castellated edge holes

The nRF7002 *EB* has castellated holes on the side of the board that connect to the nRF7002 companion *IC*.

The castellated edge holes have 2.540 mm pitch and 17.778 mm row spacing.

The following figure and table show the pinout for the nRF7002 EB.

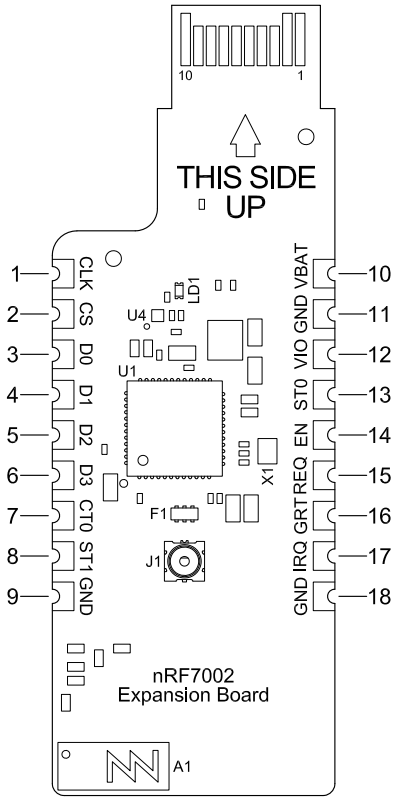

Figure 6: Castellated edge hole numbering

Pin	Signal name	Function
1	**CLK**	QSPI Clock / SPI Clock
2	**CS**	QSPI slave select / SPI slave select
3	**D0**	QSPI DATA0 / SPI_MOSI
4	**D1**	QSPI DATA1 / SPI_MISO
5	**D2**	QSPI DATA2
6	**D3**	QSPI DATA3
7	**CT0**	SW1_CTRL0 (not supported on nRF7002 EB)
8	**ST1**	Coexistence interface priority signal (only applicable for 4-wire coexistence interface)
9	**GND**	Ground
10	**VBAT**	Supply voltage
11	**GND**	Ground
12	**VIO**	IO Supply voltage
13	**ST0**	Coexistence interface status signal
14	**EN**	Power enable signal
15	**REQ**	Coexistence interface request signal
16	**GRT**	Coexistence interface grant signal
17	**IRQ**	Host interrupt signal
18	**GND**	Ground

Table 2: Castellated edge hole pinout

If using the EB only as a breakout board with no need for the PCB edge connector, the PCB edge connector can be broken off. The following figure shows the perforated break-off line at the neck of the connector.

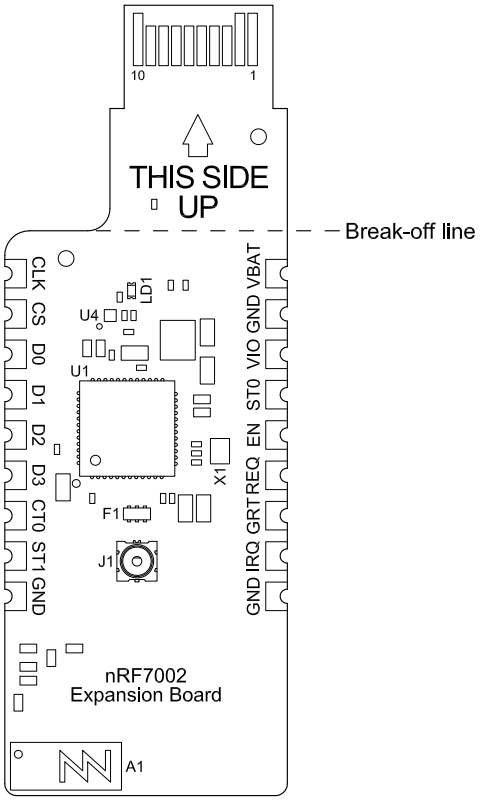

Figure 7: PCB connector break-off line

3.6 Power supply

The nRF7002 *EB* can be powered from two different options.

The power options are:

- *PCB* edge connector (**VBAT** on pin 14 and **VIO** on pin 3)
- Castellated holes (**VBAT** on edge hole 10 and **VIO** on edge hole 12)

The following figures show the power option pins.

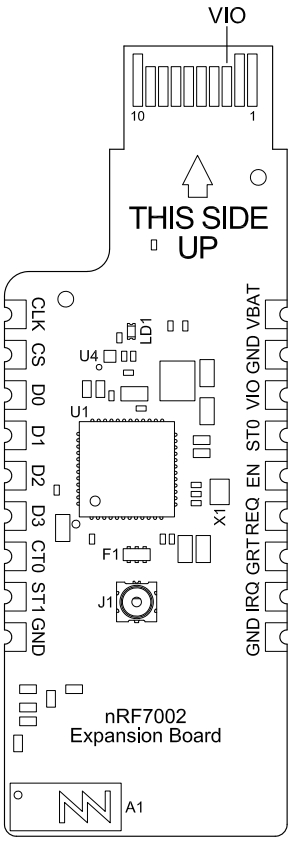

Figure 8: PCB edge connector with VIO on pin 3, front view

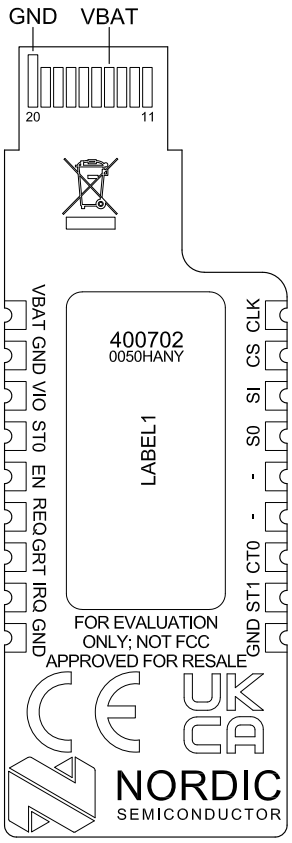

Figure 9: PCB edge connector with VBAT on pin 14 and GND on pin 20, back view

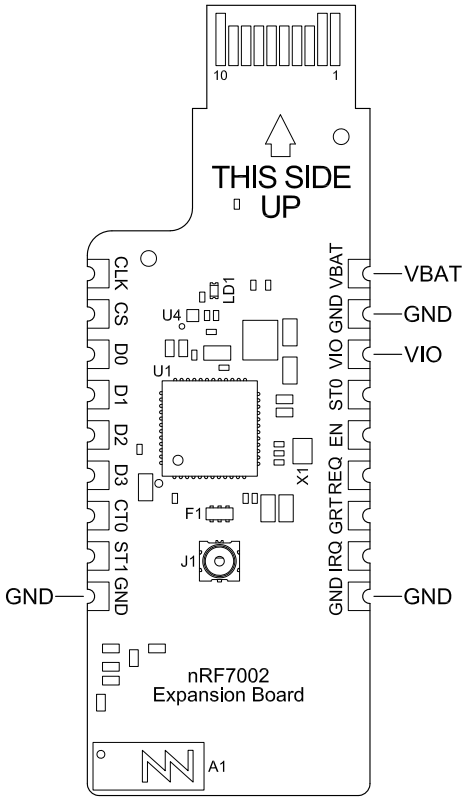

Figure 10: Castellated holes with VBAT on edge hole 10 and VIO on edge hole 12, front view

The following table shows the voltage supply ranges for **VBAT** and **VIO**.

Supply domain	Voltage supply range
VBAT	2.9 V to 4.5 V
VIO	1.8 V to 3.3 V

Table 3: Voltage supply ranges for VBAT and VIO

The BUCKEN signal going to the **BUCKEN** pin on nRF7002 is connected through a Resistor-Capacitor (RC) circuit to the control signal of a load switch (**U4**) as shown in the figure below. This ensures proper start-up of nRF7002, which requires that the VDDIO domain is powered a minimum of 1 ms after the rising edge of the BUCKEN signal.

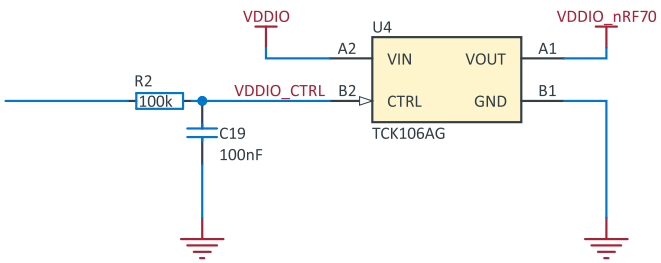

Figure 11: BUCKEN VDDIO timing circuit

3.7 LED

The nRF7002 *EB* has a blue LED (**LD1**) that is connected to the **QSPI_SS** pin on nRF7002 through a 150 Ω resistor.

During QSPI or SPI activity, the **QSPI_SS** pin is active low and otherwise pulled up to VDDIO. **LD1** flashes if there is activity on the QSPI or SPI bus. If the LED is not flashing, there is no active transaction.

4 Using nRF7002 EB with the Nordic Thingy:53

The nRF7002 *EB* features a *PCB* edge connector that is compatible with the Nordic Thingy:53.

The following figure shows the connector (**P9**) on the Nordic Thingy:53.

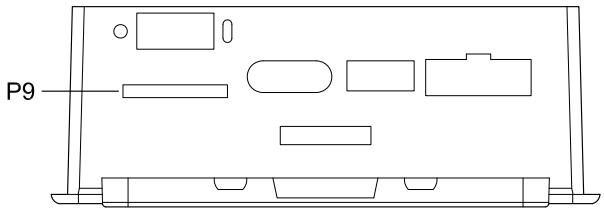

Figure 12: Interface connector P9 on the Nordic Thingy:53

Note: Insert the nRF7002 EB correctly with the text **THIS SIDE UP** facing upwards.

The nRF7002 EB routes the coexistence pins **COEX_REQ**, **COEX STATUS0**, and **COEX_GRANT** to the PCB edge connector. Newer versions of the Nordic Thingy:53 support the nRF7002 coexistence interface. For the Nordic Thingy:53 versions v1.0.0 or older, there are not enough *General-Purpose Input/Output (GPIO)*s available on the **P9** connector to support the coexistence interface.

5 RF measurements

The nRF7002 *EB* is equipped with a small coaxial connector (**J1**) to measure RF signals from nRF7002 using a spectrum analyzer.

The connector is of *SWF* type (Murata part no. MM8130-2600) with an internal switch. By default, when no cable is attached, the RF signal is routed to the onboard chip antenna.

In this example, a test probe (Murata part no. MXHS83QE3000) is used with a standard *SubMiniature Version A (SMA)* connection for instruments (the test probe is not included in the kit). When connecting the test probe, the internal switch in the SWF connector disconnects the onboard antenna and connects the RF signal from the nRF7002 EB to the test probe.

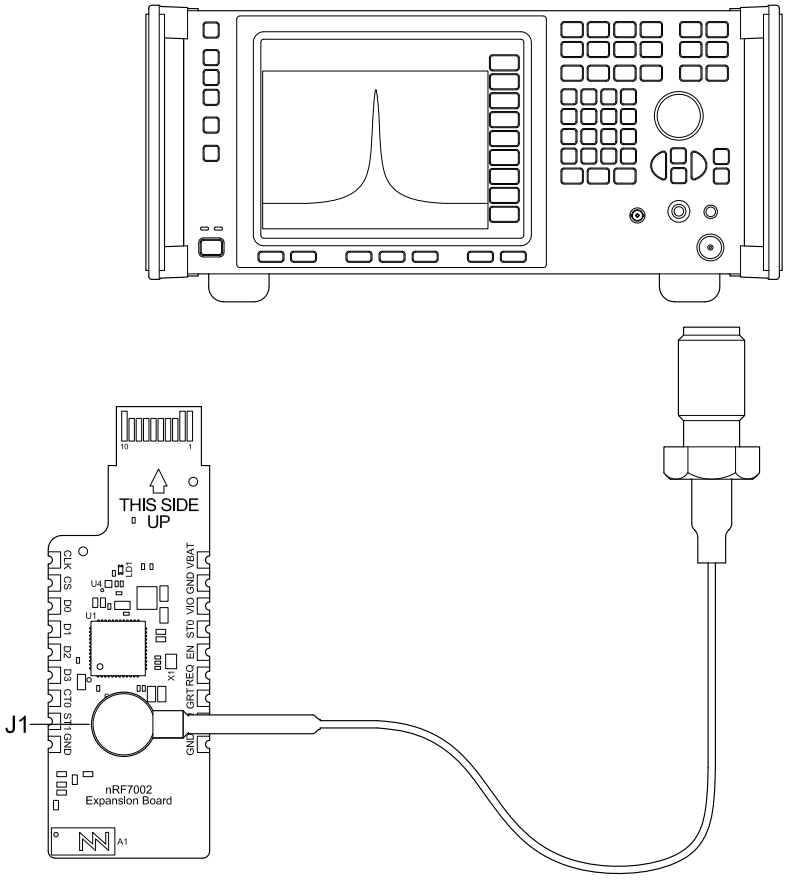

Figure 13: Connecting a spectrum analyzer to J1 on the nRF7002 EB

The connector and test probe add loss to the RF signal that should be taken into account when measuring. See the following table for more information or consult the test probe user guide if you are using another model.

Frequency (MHz)	Loss (dB)
2440	1.0
4880	1.7
7320	2.6

Table 4: Typical loss in connector and test probe (Murata part no. MXHS83QE3000)

Glossary

Electrostatic Discharge (ESD)

A sudden discharge of electric current between two electrically charged objects.

Expansion Board (EB)

A printed circuit board assembly that can be connected to other development hardware to give it added functionalities and features.

General-Purpose Input/Output (GPIO)

A digital signal pin that can be used as input, output, or both. It is uncommitted and can be controlled by the user at runtime.

Integrated Circuit (IC)

A semiconductor chip consisting of fabricated transistors, resistors, and capacitors.

Microcontroller Unit (MCU)

A small computer on a single metal-oxide-semiconductor integrated circuit chip.

Microprocessor Unit (MPU)

A computer processor where the data processing logic and control is included on a single integrated circuit or a small number of integrated circuits.

Microwave coaxial connector with switch (SWF)

A small, RF surface-mount switch connector series for wireless applications.

One Time Programmable (OTP) memory

A type of non-volatile memory that permits data to be written to memory only once.

Printed Circuit Board (PCB)

A board that connects electronic components.

Quad Serial Peripheral Interface (QSPI)

A Serial Peripheral Interface (SPI) controller that allows the use of multiple data lines.

Serial Peripheral Interface (SPI)

Synchronous serial communication interface specification used for short-distance communication.

SubMiniature Version A (SMA)

A semi-precision coaxial RF connector for coaxial cables with a screw-type coupling mechanism.

System on Chip (SoC)

A microchip that integrates all the necessary electronic circuits and components of a computer or other electronic systems on a single integrated circuit.

Recommended reading

In addition to the information in this document, you may need to consult other documents.

Nordic documentation

- nRF7002 product page
- nRF7002 Product Specification
- nRF7002 Errata
- Nordic Thingy:53 Hardware
- Getting started with nRF70 Series

Regulatory notices

The following regulatory notices apply to the nRF7002 EB.

FCC regulatory notice

The following regulatory notices apply to the nRF7002 EB.

This kit has not been authorized under the rules of the FCC and is designed to allow:

- Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product.
- Software developers to write software applications for use with the end product.

This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of 47 CFR Chapter I - FCC, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of the latter chapter.

CE regulatory notice

The nRF7002 EB operates in the 2402–2480 MHz and 5170-5895 MHz bands. The maximum radio frequency power transmitted (EIRP) in both bands is 20 dBm.

EN IEC 62311:2020 and IEC 62479:2021

The nRF7002 EB complies with the EN IEC 62311:2020 and IEC 62479:2021 standards when the minimum distance between the nRF7002 EB's antenna and the user is 20 cm or more.

REACH SVHC statement

To the present and best of our knowledge, and based upon information available from our suppliers, the components used in the nRF7002 EB do not contain substances of very high concern (SVHC), as identified in the ECHA Candidate list, above a limit of 0.1% w/w.

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