

# nRF21540

RF front-end module (FEM) for 2.4 GHz wireless range extension

## Overview

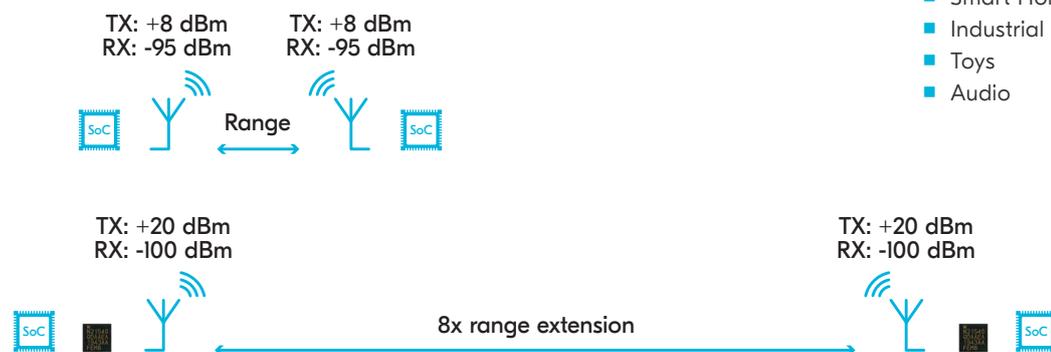
The nRF21540 is an RF front-end module (FEM) that improves range and connection robustness for Nordic Semiconductor's short-range wireless portfolio. As a complementary device, the nRF21540 is a "plug and play" range extender that can be used with the nRF52 and nRF53 Series advanced multiprotocol wireless SoCs with a minimal amount of external components required.

The nRF21540's 13 dB RX gain and low noise figure (2.7 dB), coupled with up to +21 dBm TX output power ensure a superior link budget for between 6.3-10× longer range. When combined with an nRF52840 SoC running Bluetooth Low Energy at 1 Mbps, for example, the nRF21540 improves the RX sensitivity by 5 dBm to -100 dBm. Coupled with the increased output power, the connection link budget is raised by 18 dBm. This equals an 8× theoretical range improvement. For nRF52 and nRF53 Series devices with less than +8 dBm TX power on-chip, the improvements are even larger, reaching up to 10× longer range.

The nRF21540's TX power is dynamically adjustable and output power can be set in small increments. This ensures that designs can run with output power within 1 dBm of the allowable range across all regions and operating conditions. The RF FEM is a valuable addition for all applications that require increased range or robust coverage. In demanding environments, or close to the range limit, it can be more energy efficient to deploy with the nRF21540 than taking a hit on throughput due to continuous retransmissions. The device can also operate across a -40°C to 105°C temperature range, allowing it to complement Nordic's extended temperature qualified nRF52820, nRF52833 and nRF5340 SoCs in industrial applications such as professional lighting.

While the RF FEM can be used with other devices, the ease of use with Nordic SoCs is further enhanced as driver support is included in the nRF Connect SDK and nRF5 SDK for Thread and Zigbee.

## Figure of link budget improvement Overview



Link budget improvement for the nRF21540-DK compared to the nRF52840-DK.

## Key features: nRF21540 RF FEM

- Adjustable output power in small increments up to +21 dBm
- 13 dB receive gain with 2.7 dB noise figure
- Supports:
  - Bluetooth® Low Energy (LE), Bluetooth® mesh
  - Thread and Zigbee (802.15.4)
  - Proprietary 2.4 GHz
- Two antenna ports for antenna diversity
- TX gain control via I/Os, SPI, or a combination of both
- -40 °C to 105 °C extended operating temperature range
- 1.7 V to 3.6 V input supply range
- 4 × 4 mm QFN16 package
- When combined with an nRF52 or nRF53 Series SoC:
  - Between 6.3-10× range increase
  - -100 dBm RX sensitivity (Bluetooth LE, 1 Mbps)
- Current consumption:
  - TX tuned to +20 dBm: 110 mA
  - TX tuned to +10 dBm: 38 mA
  - RX: 2.9 mA
  - Power down mode: 45 nA

## Applications

- Asset tracking and RTLS
- Professional lighting
- Smart Home
- Industrial
- Toys
- Audio

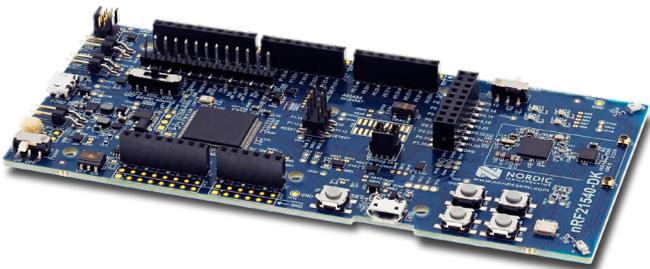
### nRF21540 Development Bundle (DB)

Complementing the release of the nRF21540 RF FEM, Nordic has launched the nRF21540 DB, consisting of an nRF21540 development kit and an nRF21540 evaluation kit.

### nRF21540 Development Kit (DK)

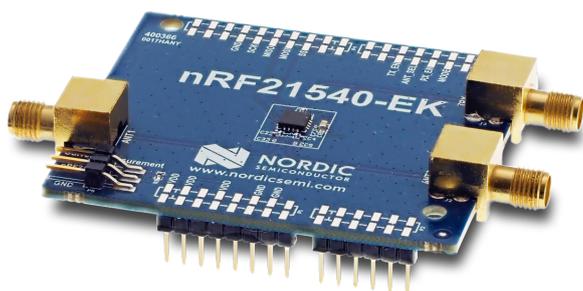
The nRF21540 DK is the perfect tool to develop products that require the range extension capabilities and/or link budget improvements provided by the nRF21540 RF FEM. The nRF21540 DK contains the nRF21540 RF FEM and the nRF52840 SoC. The nRF21540 DK has two antennas with SWF ports for direct RF measurements. The dual antennas can be used in an antenna diversity scenario with for instance Thread or Zigbee (802.15.4) protocols to reduce multipath fading effects. The nRF21540 RF FEM is connected to and controlled by the nRF52840 advanced multi-protocol SoC that supports all Bluetooth 5.2 features relating to Bluetooth LE, mesh networking protocols such as Bluetooth mesh, Thread and Zigbee, as well as 2.4 GHz proprietary protocols.

Sharing many similarities with the [nRF52840 DK](#), the development kit contains an onboard Segger J-LINK debugger accessible through USB, 4 user-programmable LEDs and 4 buttons, an NFC antenna connector and current measurement pins. It is the perfect tool to enable real application performance testing with the extended range offered by the nRF21540.



### nRF21540 Evaluation Kit (EK)

The nRF21540 EK can connect to lab equipment via SMA connectors to monitor the RF FEM's performance. The nRF21540 EK can also be used with nRF52 and nRF53 Series DKs, as well as other devices. On the nRF21540 EK, the RF FEM connects to lab equipment or a radio via an SMA connector. The nRF21540's TX gain control, antenna switching, and modes are controlled via GPIO or SPI or a combination of both, accessible through the Arduino Uno Rev3 compatible headers. The shield also features two additional SMA connectors hooked to the dual antenna ports from the RF FEM, to monitor the performance of the RF FEM using any equipment desired.



### Key features: nRF21540 Development Kit

- Versatile development kit for the nRF21540 RF FEM
- 2 × 2.4 GHz antennas for antenna diversity
- 2 × SWF RF ports for direct RF measurements
- Segger J-Link OB programmer/debugger
- Power and program/debug via USB interface
- Direct USB interface to nRF52840 SoC
- NFC-A tag antenna connector
- Arduino Uno Rev3 compatible
- User-programmable buttons (4) and LEDs (4)
- 1.7-5.5 V supply from USB, external Li-Po battery or external power source
- Pins for measuring power consumption
- nRF52840 SoC w/ Bluetooth LE, Bluetooth mesh, Thread and Zigbee (802.15.4) and 2.4 GHz proprietary protocol support
  - Arm® Cortex™-M4 with floating point unit
  - Arm® CryptoCell-310 cryptographic accelerator

### Key features: nRF21540 Evaluation Kit

- Versatile evaluation kit for the nRF21540 RF FEM that can be used with nRF52 and nRF53 Series DKs, as well as other devices
- ANT1 and ANT2 ports (SMA) for antennas or lab equipment
- TRX port (SMA) for connecting radio or lab equipment
- Pins for measuring power consumption
- Arduino Uno Rev3 compatible

### Related products

<a href="#">nRF5340 SoC</a>	Dual-core Bluetooth 5.2 SoC supporting Bluetooth LE, Bluetooth mesh, NFC, Thread and Zigbee
<a href="#">nRF52 Series</a>	nRF52840, nRF52833, nRF52832, nRF52820, nRF52811, nRF52810, nRF52805 SoCs
<a href="#">Power Profiler Kit II</a>	Easy-to-use power measurement tool

### Order Information

<a href="#">nRF21540 RF FEM</a>	RF Front-end module (FEM)
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