Bluetooth® low energy Module

Frequently Asked Questions

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Revision History

29-Sep. 2023 > Ver.1.0	Initial Release
26-Jul. 2024 > Ver.1.1	Update

General

KAGA FEI has published the following documents describing our modules on the website.

- Overview: Shows an overview of the module.
- Data Sheet: Shows the module specifications.
- Application Note: This is the design guide for using the module.
  For the embedded MCU module, this document is included in Data Sheet.
- Evaluation Board/ Kit Manual: This is the operation manual for the evaluation board to evaluate our modules.

These materials can be downloaded by accessing the following URL and proceed with the related page of each module.

KAGA FEI Wireless Module Lineup
https://www.kagafei.com/jp/eng/wireless_modules/bluetooth/

1. General

Q1-1: How can I order the modules, evaluation boards (EVB) and evaluation kits (EVK)?

A1-1: To order, please contact your local sales office or distributors.

E-mail address: ml-module_contact@jp.kagafei.com
Contact Form: https://www.kagafei.com/jp/wireless_modules/contact/

Please contact KAGA FEI's online distributors below.
Mouser Electronics, DigiKey, Chip One Stop, CoreStaff

Q1-2: What is Bluetooth® low energy (BLE)?

A1-2: It is a wireless personal area network technology featuring low power consumption. It was standardized in the Bluetooth® Core Specification Version 4.0 in 2010. Bluetooth® low energy uses the same 2.4GHz frequency as classic Bluetooth®, but is not compatible with the classic Bluetooth®. The major advantages of Bluetooth® low energy are low power consumption, operating for months or years with a coin cell battery, small size and compatibility with large numbers of smart phones, tablets and computers. The applications include IoT devices, healthcare, fitness, beacons, security and smart home. Bluetooth® SIG released Bluetooth® Core Specification Version 4.1 in 2013 and 4.2 in 2014. The data rate in Bluetooth v4.x is 1Mbps. Bluetooth® SIG also released Bluetooth v5 in 2016 and Bluetooth v5.1 in January 2019. Please see the next item for additional details on Bluetooth v5.x.

Q1-3: What is the difference between Bluetooth® v4.2 and v5.x?

A1-3: Bluetooth® SIG released Bluetooth v5 on December 2016 and Bluetooth v5.1 on January 2019. Bluetooth v5.x gives us several key features: capabilities of 2x the speed, 4x the range and 8x the broadcast capacity of v4.2. Longer range is achieved by increasing receiver sensitivity through error correction coding, which reduces the data rate; therefore 4x the range and 2x the speed cannot be realized at the same time. When a Bluetooth device communicates with another device using any of the three features of Bluetooth v5.x, another device also has to support the features. If any of devices communicating together support only v4.x, the communication will conform to v4.x. The application should select the Bluetooth v5.x feature implementation that will best meet the required performance. These key Bluetooth v5.x features are not mandatory. A product can claim to be Bluetooth v5.x qualified even if it does not support any of these key features; so it's important to make sure you check with your supplier which features are supported. KAGA FEI's Bluetooth v5.x modules support at least some of these key Bluetooth v5.x functions.
See also Table 1 below for the differences between Bluetooth v4.x and v5.x.

Q1-4: What is the status of support for the latest Version of Bluetooth®?

A1-4: Our company is working to obtain the latest version of Component certification * for new products using RF PHY, a module layer.
Functions such as Bluetooth® v5.1, 5.2 and 5.3 are treated as options, and for details of option compatibility of our company modules, please search from the following site.
https://launchstudio.bluetooth.com/Listings/Search

* Customer product must be certified as an End Product, combining the RF PHY with the Soft Device and Application layers. For more information, refer to A1 -12 in the Radio Low FAQ: Radio Law Frequently Asked Questions.

Q1-5: What is the difference between Classic Bluetooth® and Bluetooth® low energy?

A1-5: Compared to Classic Bluetooth®, Bluetooth® low energy has lower data rate, however is intended to provide lower power consumption. There is no compatibility between Bluetooth® low energy and Classic Bluetooth® and they have different use case scenarios. Major applications of Classic Bluetooth® are PC peripherals, mobile phone peripherals and digital consumer electronics and it is used for point-to-point communication such as key boards, mice and headsets.

On the other hand, Bluetooth® low energy is better suited for small data transmission such as data communication with sensors. The application is expanding to healthcare devices, sports equipment, home electric appliances, IoT devices, etc. See Table 1 for technical items.

Table1 Comparison table

Items	Classic Bluetooth technology	Bluetooth® Core Specification Version 4.x	Bluetooth® Core Specification Version 5.x
Spectrum range	2.400–2.4835 GHz	2.400–2.4835 GHz	2.400–2.4835 GHz
Channels	79 ch, BW 1MHz/ch	40 ch, BW 2MHz/ch	40 ch, BW 2MHz/ch
Modulation	GFSK, π/4 DQPSK, 8DPSK	GFSK	GFSK
Over the air data rate	1–3Mbps	1Mbps	2Mbps, 1Mbps, 500kbps, 125kbps **
Active Slaves	7	Not defined. Depends on implementation.	Not defined. Depends on implementation.
Voice capability	Yes	Yes for limited applications *	Yes for limited applications *

* The voice bandwidth usable in the application might be restricted by the over the air data rate of V4.x. Voice application needs to be developed by customer with their own profile.
** Support of 2Mbps, 500kbps and 125kbps is not mandatory.

2. Module

Q2-1: What is the difference of KAGA FEI BLE modules? What types of BLE modules are available from KAGA FEI.

A2-1: KAGA FEI has wide range of line-up to satisfy customer's use case. There are two main types of BLE modules that are based on Nordic Semiconductor's chipset: the nRF52 series and the nRF53 series modules. These modules offer 2 software options: Basic and Software Embedded.

The nRF52 Basic module has the SoftDevice (i.e. protocol stack) depending on the model of modules, The nRF53 Basic module is Blank. preprogrammed into the device and you have to develop your application software to operate BLE function. Therefore your application can be hosted right on the module eliminating the need for an external host processor. These Basic modules are available with various RAM and Flash sizes.

A Software Embedded module has KAGA FEI's application preprogrammed into the module. If you are looking a simple "serial cable replacement", this module would be an excellent option. This

module comes with a simple ASCII-based Application Programming Interface (API) to help you get your project up and running quickly. However, since our application is preprogrammed into the module, your application will have to be hosted on a separate host processor.
For additional details, visit:
https://www.kagafei.com/jp/eng/wireless_modules/bluetooth/

Q2-2: What are the part numbers of the KAGA FEI BLE modules?

A2-2: For a complete list of part numbers visit:
https://www.kagafei.com/jp/eng/wireless_modules/bluetooth/

Q2-3: Is an external system clock necessary?

A2-3: No, each BLE module has an internal 32MHz crystal.

Q2-4: What is the supported interface?

A2-4: All of the Basic modules have configurable GPIOs and the number of supported GPIO depends on the module. Some of the GPIO pins can be configured as UART, SPI, I2C, I2S, PDM or ADC by the application software. Please see Nordic's Website and the documents for details.
https://infocenter.nordicsemi.com/index.jsp

Q2-5: What is pre-programmed in the module?

A2-5: In each nRF52 Basic type module, Nordic's SoftDevice depending on the module, are preprogrammed into the module. Nothing is programmed in the nRF53 Basic type module. The version of SoftDevice depends on the module. See Table 2 for the details. Please also see BLE module Overview document or the Data Sheet when you determine the SoftDevice version. For additional information on the different versions of SoftDevice please see Nordic's website.
https://infocenter.nordicsemi.com/index.jsp

Software Embedded type modules are preprogrammed with KAGA FEI's application software.

Q2-6: What type of processor is inside the module?

A2-6: Though every module has ARM® Cortex® processor, the type depends on the modules and you can select the best match for your application from our line-up. See Table 2 for details.

Q2-7: What memory size does the module have?

A2-7: It depends on the modules and you can select the best match for your application from our line-up. See Table 2 for details.

Table 2 Module Comparison

Module Series	Nordic IC	SoftDevice	Processor	FLASH [Byte]	RAM [Byte]
E*5340BA1	nRF5340	N	Cortex M33 for APP core	1M	512K
			Cortex M33 for NET core	256K	64K
E*2840AA*	nRF52840	S140 V7.2.0	Cortex M4F	1M	256K
E*2833AA*	nRF52833	S140 V7.2.0	Cortex M4F	512K	128K
E*2832AA*	nRF52832	S132 V7.2.0	Cortex M4F	512K	64K
E*2820AA2	nRF52820	S140 V7.2.0	Cortex M4	256K	32K
E*2811AA2	nRF52811	S113 V7.2.0	Cortex M4	192K	24K
E*2810AA*	nRF52810	S112 V7.2.0	Cortex M4	192K	24K
ES2805AA2	nRF52805	S113 V7.2.0	Cortex M4	192K	24K

Q2-8: What is the expected battery life of the BLE module?

A2-8: The power consumption completely depends on the use case and the operational conditions. In scenarios where battery consumption is kept to an absolute minimum, it should be possible to achieve a year or more of battery life with a coin cell battery.
Power Profiler Kit which is released by Nordic for measurement of BLE power consumption can be used with KAGA FEI's BLE module evaluation board. Please visit Nordic's Website below for the details.
https://www.nordicsemi.com/Software-and-Tools/Development-Kits/Power-Profiler-Kit

Also, Online Power Profiler provided by Nordic can be used for estimation of power consumption of nRF52 series and nRF53 series.
Blog
https://devzone.nordicsemi.com/nordic/nordic-blog/b/blog/posts/nrf52-online-power-profiler

Online Power Profiler for Bluetooth LE
https://devzone.nordicsemi.com/power/w/opp/2/online-power-profiler-for-bluetooth-le

Q2-9: What is the output power and communication distance of the module?

A2-9: In the case of the modules with nRF5340, the variable range of Tx power is -20 to 0dBm, and the step is 4dB in the Tx power range of -20 to -8dBm and is 1dB in the Tx power range of -8 to 0dBm. Also, enable VREGRADIO.VREQH to set the output power to +3dBm.
In the case of the modules with nRF52832, nRF52811, nRF52810 or nRF52805, Tx power is -20 to +4dBm in 4dB steps. The output power can also be set to +3dBm.
In the case of the modules with nRF52840, nRF52833 or nRF52820, the variable range of Tx power is -20 to +8dBm, and the step is 4dB in the Tx power range of -20 to 0dBm and is 1dB in the range of +2 to +8dBm. Tx power can not be set to 1dBm.

Due to the increase of receiver sensitivity achieved by error correction coding which is one of the features of Bluetooth v5.x, 4x the communication range of v4.x can be expected.
Please be aware that the actual distance varies depending on the communication environment where the module is used.

Q2-10: Is an external 32.768kHz crystal required?

A2-10: The EC**** series and EB**** series modules come with an internal 32.768kHz crystal; therefore external 32.768kHz clock is not required. For the EJ**** series, ES**** series and ED**** series, you have the option of adding an external 32.768kHz crystal or using the nRF5's built-in internal 32.768kHz RC oscillator. Generating a clock from a 32.768kHz crystal will keep the current consumption lower than using the internal RC oscillator. Using the internal RC oscillator requires the processor to periodically wake up and perform calibration (i.e. current goes up slightly). The method to enable the RC oscillator is described in a paragraph "Important notes" in Evaluation Board/Kit Manual.

Q2-11: Do the modules have Bluetooth® Qualification?

A2-11: The modules are Bluetooth® qualified as Component. The modules are Bluetooth® qualified at the PHY layer only. The QDID is provided in the Data Sheet. Your end products have to be Bluetooth® qualified, when our module is installed into your products. Please consult a qualification test facility or BQC (Bluetooth Qualification Consultant) to determine Bluetooth® qualification requirements for your end product. In the case of the modules with nRF52, the customer can replace the preprogrammed SoftDevice with any version of SoftDevice (i.e. it can be a newer or older SoftDevice as long as it is a valid Nordic SoftDevice for the chip). so if the customer decides to upgrade to a newer SoftDevice, PHY layer Bluetooth® requalification is not necessary.

Q2-12: What regulatory certification do the modules have?

A2-12: The modules are Japan, FCC and ISED (Canada) certified. In the case of the modules with nRF52, the customer can replace the preprogrammed SoftDevice with any version of SoftDevice (i.e. it can be a newer or older SoftDevice as long as it is a valid Nordic SoftDevice for the chip). So if the customer decides to upgrade to a newer SoftDevice, radio recertification is not necessary.
Conducted test report for Europe RE Directive EN 300 328 is available. In this case also, customers should test all of Radio, Safety and Electromagnetic Compatibility except Conducted test and need to comply with RE Directive at the end product level not the module level.

Q2-13: How should we design the schematic and layout the board and the surrounding area of antenna to maximize antenna performance?

A2-13: For schematic design, please refer to the "Reference Circuit" in the Data Sheet and the "Evaluation board circuit schematic" in the Evaluation Board/Kit Manual. For board layout details, please refer to the "Design guide" of the Data Sheet. For the antenna area design, please refer to the "Antenna application note" section of the Data Sheet.

Q2-14: What support does KAGA FEI provide for BLE modules?

A2-14: Hardware support is provided by KAGA FEI. Software support is handled by Nordic on the Basic modules. Software support is handled by KAGA FEI on the Software Embedded modules.

3. EVB/EVK

Q3-1: What are the part numbers of the evaluation boards and evaluation kits?

A3-1: Please see KAGA FEI Website below or see BLE module Overview document.
https://www.kagafei.com/jp/eng/wireless_modules/bluetooth/

Q3-2: What is contained in the evaluation boards and the evaluation kits?

A3-2: Evaluation board contains a circuit board (evaluation board) with a module mounted, and a document with instructions on how to download technical documents (e.g. Data Sheet, Evaluation manual and Quick Start Guide). Quick Start Guide is a document to understand quickly how to develop software and describes about software development environment, SDK, necessary software and basic procedure.
Evaluation kit contains an evaluation board, a document with instructions on how to download technical documents (e.g. Data Sheet, Evaluation manual and Quick Start Guide), and a J-Link Lite board. J-Link Lite is a JTAG/SWD (Serial Wire Debug) debug probe for Cortex-M cores used in KAGA FEI's BLE modules. It is used for software development and debugging. Please see Evaluation Board/Kit Manual for details on how to use J-Link Lite.

Q3-3: What can be done with evaluation board and evaluation kit?

A3-3: The evaluation board and evaluation kit can be used to perform functional and performance testing (e.g. communication and current consumption testing). For Basic modules, J-Link Lite is necessary to program test application software on the module.

Q3-4: Is there a way to easily verify BLE communication using EVB and EVK?

A3-4: Sensor kit is available. It is possible to send sensor data on BLE communication in combination with EVB and the sensor kit. For more information, please visit the following website.
https://www.kagafei.com/jp/eng/wireless_modules/bluetooth/ey1sensor-kit.html

4. Software

Q4-1: What BLE profiles are available for the modules?

A4-1: For information on the corresponding profiles, please visit the following Nordic's website:
https://infocenter.nordicsemi.com/index.jsp
https://developer.nordicsemi.com/nRF_Connect_SDK/doc/latest/nrf/introduction.html

Q4-2: What tools are available for software development and debugging?

A4-2: The software development environment (IDE: Integrated Development Environment) for ARM processors (MDK: Microcontroller Development Kit) is necessary. KAGA FEI's nRF52 BLE modules are supported by four IDEs, Seggar Embedded Studio, Keil MDK, IAR Embedded Workbench and GCC and IAR, shown in Nordic Website below.
https://www.nordicsemi.com/Products/Development-software/nRF5-SDK

Visual Studio Code is available as an IDE for the nRF 53, nRF 52 BLE modules. For more information about Visual Studio Code, visit Nordic's website.
https://www.nordicsemi.com/Products/Development-tools/nRF-Connect-for-VS-Code

Q4-3: How can I get SDK (Software Development Kit) for application development?

A4-3: Please visit the Nordic's website below to download the SDK.
nRF5 SDK
https://www.nordicsemi.com/Products/Development-software/nRF5-SDK
nRF Connect SDK
https://www.nordicsemi.com/Products/Development-software/nRF-Connect-SDK

Q4-4: What resources are available other than SDK?

A4-4: Development tools are released from Nordic. Please visit Nordic's website.
https://www.nordicsemi.com/Products/Bluetooth-Low-Energy/Development-tools
Please make sure to check Errata released by Nordic when you develop application software.

Q4-5: How do I get detailed software information and support?

A4-5: A wealth knowledge and information on RF52/53 application development are available on the following Nordic's websites:
https://www.nordicsemi.com/Products/Bluetooth-Low-Energy/Development-tools
https://github.com/NordicSemiconductor
https://devzone.nordicsemi.com/

Q4-6: How do I get started with the software development?

A4-6: A Quick Start Guide document which describes the software development environment, SDK, necessary software and the basic instructions will be provided for the customers who purchased the evaluation board. Please also see A3-2 about Quick Start Guide.

Q4-7: How do I receive the latest information of BLE chip or software and Errata form Nordic?

A4-7: Please visit Nordic's website below and register entering necessary information and click "Sign in" button.
https://devzone.nordicsemi.com/login
Please make sure to check Errata released by Nordic when you develop application software. Since Errata information is not be always distributed, please voluntarily check the latest information on Nordic's website.