Wireless LAN Module

Frequently Asked Questions

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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: Design guide for using the module.
  For the MCU-embedded module, this guideline is included in Data Sheet.
- Evaluation Board/ Kit Manual: Operation manual of the evaluation board to evaluate our modules.

These materials are available on the respective product pages at the following URL.

KAGA FEI Wireless LAN Module Lineup
https://www.kagafei.com/jp/eng/products/wireless-modules/wlan/

1. About Wireless LAN ("WLAN") and *Bluetooth®*

Q1-1: What is WLAN?

A1-1: At present, various IEEE 802.11 standards are in place, and a network consisting of devices that comply with the technical standards is generally called a Wireless LAN. IEEE 802.11 has seen the addition and revision of standards over time, enabling achievement of higher speeds.
The first standardization was done as IEEE 802.11, and then IEEE 802.11 b was standardized with a maximum transmission speed of 11Mbps using the 2.4GHz band. After that, IEEE 802.11 a with a transmission speed of 54 Mbps using the 5 GHz band was also standardized. Subsequently, the IEEE 802.11 g standard of 54 Mbps in the 2.4 GHz band compatible with IEEE 802.11 b was also defined.
In 2009, IEEE 802.11 n, which achieves the maximum transmission speed of 600 Mbps on the outline, was standardized, and from 2014, IEEE 802.11 ac, which theoretically enables high-speed communication of 6.93 Gbps, was standardized. Following this, IEEE 802.11 ax was standardized in 2019, achieving a theoretical maximum transmission speed of 9.6 Gbps. IEEE 802.11 ax was then extended to the relatively uncrowded 6 GHz band in 2021.

Please refer to the table below and the documents of Overview or Data Sheet to see which standards above KAGA FEI's modules support.

Part No.	Standard	Interface	Antenna	Embedded MCU / Memory
WKI611AA1	11 a/b/g/n/ac/ax	SDIO for Wi-Fi UART for Bluetooth	Built-in	N/A
WK8887AA1	11 a/b/g/n/ ac	SDIO	Built-in	N/A
WKR612AA1	11 a/b/g/n/ac/ax	UART/ I2C/ SPI	Built-in	ARM Cortex-M33 260MHz / 1.2MB RAM and 8MB Flash ROM
WKM320AA1	11 b/g/n	UART/ I2C/ SPI	Built-in	ARM Cortex-M4F 200MHz / 512KB RAM and 4MB Flash ROM

Q1-2: What WLAN function do the KAGA FEI's WLAN modules have?

A1-2: KAGA FEI's WLAN modules support major functions such as STA, uAP, WPA3/WPA2, WPS and Power Save mode. For details, please refer to the Overview document of each module and NXP GitHub site below.
https://github.com/nxp-imx/mwifiex/blob/doc_WCT_release/doc/Release_Notes/Linux_RN/index.md

Q1-3: What *Bluetooth®* functions do the KAGA FEI's WLAN modules have?

A1-3: WK8887AA1 supports *Bluetooth®* Core 4.2 with *Bluetooth®* Classic and *Bluetooth®* Low Energy.
WKI611AA1 supports *Bluetooth®* Core 5.4 with *Bluetooth®* Classic and *Bluetooth®* Low Energy.
WKR612AA1, which is an MCU-embedded module, supports *Bluetooth®* Core 5.4 with *Bluetooth®* Low Energy. For details, please refer to the Overview document of each module.
WKM320AA1, which is another MCU-embedded module does not support *Bluetooth®*.

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Q1-4: Are KAGA FEI's modules with WLAN and *Bluetooth*® functions capable of transmitting and receiving WLAN and *Bluetooth*® at the same time? If yes, how is radio wave interference considered?

A1-4: It is possible to use them at the same time. For WLAN communication and *Bluetooth*® communication, the communication timing is switched by time division control mechanism inside the module to prevent radio wave interference. However, because of this mechanism, the throughput may be decreased.

Q1-5: Can *Bluetooth*® Classic and *Bluetooth*® Low Energy be used at the same time?

A1-5: It is possible for KAGA FEI's combo modules to operate both *Bluetooth*® modes at the same time due to the time division control function which is the same as A1-4.

2. About WLAN Module.

Q2-1: How can I get the documents of Overview, Data Sheet and Application Note of each module?

A2-1: They are available on the individual product pages linked from the URL below.
https://www.kagafei.com/jp/eng/products/wireless-modules/wlan/

Q2-2: What is the difference between KAGA FEI's WLAN module products. What types of WLAN modules are available from KAGA FEI?

A2-2: KAGA FEI has a lineup of two types of products according to the customer's application.
One is module with SDIO interface that is capable of high-speed communication and there are two modules. WK8887AA1 that is based on NXP 88W8887 SoC compatible with 802.11 ac Wi-Fi 5 and WKI611AA1 that is based on NXP IW611 SoC compatible with 802.11 ax Wi-Fi 6.
The other is MCU-embedded module and there are two modules. WKM320AA1 that is based on NXP 88MW320 SoC compatible with 802.11 b/g/n Wi-Fi 4 and WKR612AA1 that is based on NXP RW612 SoC compatible with 802.11 ax Wi-Fi 6.

Q2-3: Is the antenna embedded on each module?

A2-3: Yes. Please refer to the table in A1-1.

Q2-4: What type of MCUs are installed in the MCU-embedded modules?

A2-4: Please refer to the table in A1-1.

Q2-5: What is the benefit of MCU-embedded modules?

A2-5: By using the MCU-embedded module, it is possible to embed and operate application software in the module other than software for wireless LAN function.

Q2-6: What are the features of MCU-embedded modules?

A2-6: In the case of MCU-embedded module, it depends on the software. For more details, please visit the following website and refer to the Overview document.
https://www.kagafei.com/jp/eng/products/wireless-modules/wlan/WKR612AA1.html
https://www.kagafei.com/jp/eng/products/wireless-modules/wlan/WKM320AA1.html

Q2-7: Which interface is supported on each module?

A2-7: Please refer to the table in A1-1. MCU-embedded modules have capability to support UART, I2C, SPI, etc. depending on the software.
For details, please refer to the Overview document of each module on KAGA FEI's website.

Q2-8: Do KAGA FEI's WLAN modules support uAP mode? What is the maximum number of units that can be connected?

A2-8: - The WLAN modules with SDIO.
uAP mode is supported. The WK8887AA1 is capable of connecting up to 10 stations. WKI611AA1 has the capability to connect up to 16 stations.
- The MCU-embedded modules.
The WKM320AA1 module is capable of connecting up to 8 stations. WKR612AA1 has the capability to connect up to 8 stations.

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Q2-9: When the host is in sleep mode, is it possible to wake up the host from the module when WLAN communication occurs? Conversely, is it possible to wake up the module from the host when the module is in sleep mode?

A2-9: Regarding the SDIO WLAN modules, when the module receives data while the host is in sleep mode, a signal is output from specified GPIO and then it wakes the host up.
Also, when the module is in sleep mode, the command via SDIO or a signal from specified GPIO can wake the module up.
In the MCU-embedded modules, the wake-up functions depend on the software.

Q2-10: What is the max SDIO clock supported on SDIO WLAN modules?

A2-10: Please refer to the SDIO interface specifications in Electrical Characteristics section in Data Sheet of each SDIO WLAN module.

3. About evaluation board and evaluation kit.

Q3-1: How can I get the module, evaluation board (EVB) and evaluation kit (EVK)?

A3-1: Please contact our sales representative or E-mail address or "Contact Form" below.
E-mail address: ml-module_contact@jp.kagafei.com
Contact Form: https://ma.kagafei.com/l/1073031/2024-09-06/nd36x3
You can also purchase from online distributors listed at the link below.
https://www.kagafei.com/jp/eng/products/wireless-modules/wheretobuy/

Q3-2: What is the part number of evaluation board and evaluation kit?

A3-2: Please refer to the table below.

Module Part No.	EVB Part No.	EVK Part No.
WKI611AA1	WKI611AA1-EVB	N/A
WK8887AA1	WK8887AA1-EVB	WK8887AA1-EVK
WKR612AA1	WKR612AA1-EVB	WKR612AA1-EVK
WKM320AA1	WKM320AA1-EVB	WKM320AA1-EVK

Q3-3: What is included in the evaluation board and evaluation kit?

A3-3: The evaluation board of the SDIO WLAN module includes the evaluation board with the module and a document that describes how to obtain software of Evaluation Object Package, etc. The Evaluation Object Package contains a driver and RF test tool that runs on a Linux PC. The Linux PC is required to support SDIO interface, not SDIO memory slot.
The evaluation kit of WK8887AA1 comes with a single board computer called ESPRESSObin equipped with ARM processor in addition to an evaluation board. Since ESPRESSObin can be used as a replacement for a Linux PC, if you do not have a Linux PC with SDIO interface, we recommend utilizing the evaluation kit.
For WKI611AA1, only the evaluation board can be provided by us. If you would like to evaluate the module from a board computer, please prepare NXP's i.MX 8M Mini LPDDR4 EVKB on your own.

The evaluation board of the MCU-embedded module is equipped with a USB-to-Serial Interface conversion IC. This makes it possible to verify the operation via the USB port using a PC. The evaluation kit of the MCU-embedded module is a set of the evaluation board and the debug tool which is called J-Link LITE (*).

*** J-Link LITE is only delivered and supported as part of an evaluation kit, which includes an evaluation board. It may only be used with the evaluation board it came with, and not to be used for commercial product development.**

Please see the list of contents below and refer to Overview and Evaluation Board/Kit Manual for the details.

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EVB/EVK		Contents				
		Evaluation Board	Information Card	Power Cable	J-Link Lite	ESPRESSObin
WK8887AA1	EVB	✓	✓	✓	-	-
	EVK	✓	✓	✓	-	✓
WKM320AA1	EVB	✓	✓	✓	-	-
	EVK	✓	✓	✓	✓	-
WKI611AA1	EVB	✓	✓	✓	-	-
WKR612AA1	EVB	✓	✓	✓	-	-
	EVK	✓	✓	✓	✓	-

Q3-4: What can I do with the evaluation board?

A3-4: The evaluation board (EVB) is a development board that allows customers to evaluate, verify and measure the module performance before designing customers' products. A module and peripheral circuit required for the module operation are contained in the circuit board, and it allows any customers to evaluate the module as it is without any circuit design. In addition, the circuit diagram of the evaluation board is provided to customers as reference information for designing their products. For details, please refer to the Evaluation Board/ Kit Manual.

Q3-5: Is software included for operating the evaluation board or evaluation kit?

A3-5: - The SDIO WLAN modules.

The evaluation board includes an instruction document that describes how to obtain software for Linux OS.

For the WK8887AA1 evaluation kit, control software is pre-installed in ESPRESSObin, which is a CPU board included in the kit, at the time of shipment.

- The MCU-embedded modules.

The evaluation board includes an instruction document that describes how to obtain SDK as these modules are products that the software development is necessary by customers.

4. About Software.

Q4-1: I am considering adopting KAGA FEI's module. What kind of software support can I expect?

A4-1: - The SDIO WLAN modules.

Upon agreeing and signing SLA, Software License Agreement with KAGA FEI, we will provide the source code package of Linux Ubuntu base. Customers can develop their software based on the package.

Please note that the contents of SLA cannot be modified.

The source code package and any of its contents cannot be redistributed to third parties.

It is possible for KAGA FEI to introduce our software development partners to customers seeking to outsource software development.

- The MCU-embedded modules.

Software development environments such as SDK can be obtained by concluding NDA with NXP. Please contact NXP.

By having a signed SLA with KAGA FEI, NXP's SDK can be provided by KAGA FEI. Please note that KAGA FEI does not provide any support for NXP's SDK.

Q4-2: Which Linux Kernel versions does the source code package support?

A4-2: From Linux 2.6.32 to 5.2.9.

Q4-3: What is included in the source code package of Linux base?

A4-3: It includes WLAN and *Bluetooth*® communication Driver Source Code, Firmware and User Manual. Also, it comes with software called MFG for RF evaluation. MFG includes RF Evaluation Firmware and Application Software.

Q4-4: How to obtain the source code package?

A4-4: It can be obtained by entering into SLA, Software License Agreement, with KAGA FEI. Following are the steps for concluding the SLA and how to obtain the related information.

1) Please provide us with your company name, mailing address, email address of the person

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who communicates with KAGA FEI regarding SLA and the package, application information that uses our module, name and title of the person who signs the SLA. All the information should be provided in English.

2) KAGA FEI will send you the SLA document for your review and sign. Please return the signed electronic copy of the agreement by email.
3) After confirming receipt of the signed agreement, KAGA FEI registers your information and sends you an email with a URL where you can access the source code package.

Please kindly note that if the destination of the package is other than Japan, it will take time to complete the parameter sheet for custom declaration. After the process above, when the package is updated to a new version, an update notification will be sent to your contact.

Q4-5: How should I prepare the driver for OS other than Linux?

A4-5: KAGA FEI does not prepare drivers for OSs other than Linux. KAGA FEI may be able to introduce third party software partners. Please feel free to contact KAGA FEI for further information.

Q4-6: In case of modules with SDIO interface, is it possible to evaluate in environment other than Linux PC or evaluation kit (ESPRESSObin)?

A4-6: If customer wants to evaluate our module in an environment other than those introduced by KAGA FEI, the customer needs to prepare the environment themselves.

Q4-7: Which MCUs and OSs have been verified to work with KAGA FEI's WLAN modules?

A4-7: MCUs that have been verified with our modules are;

- ESPRESSObin
- NXP's i.MX8M Mini
- PC with SDIO interface

The operating system that has been verified is Linux. For other OSs, please contact KAGA FEI for the information.

5. Frequently asked questions.

Q5-1: How should I design the peripheral circuit when using the module?

A5-1: Please refer to the following materials. * The information provided may vary by product.

- Block Diagram and Reference Circuit Diagram in Data Sheet.
- Design Guides and Recommended Circuit Diagram in Application Note.
- Evaluation Board Schematic in Evaluation Board Manual.

We can review your circuit design upon request.

Q5-2: How should I design the area around the module antenna?

A5-2: Please refer to the antenna application note on each Data Sheet.
We can review the design of your circuit board and housing if you send us the drawings as needed.

Q5-3: How should I handle the size of the land patterns and the amount of solder when mounting the module?

A5-3: Please refer to Recommended Land Pattern Dimensions and Recommended Solder Paste Stencil Dimensions or Recommended Metal Mask (Solder Mask) Conditions in Mechanical Outline or Outline/Appearance section on Data Sheet of each module.

Q5-4: How should unused pins of the module be handled?

A5-4: Please keep the unused pins and the unconnected pins open.

Q5-5: What is the power consumption of the module?

A5-5: The Electrical Characteristics section in Data Sheet provides reference values for power consumption during transmitting/ receiving at each data rate, as well as power consumption in low power consumption mode, when using our evaluation board and RF test tool.
Since the power consumption during actual operations varies depending on the communication conditions and standards, please evaluate it in the actual operating environment after installing the module in your product.

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Q5-6: How much is the throughput of the modules?

A5-6: The throughput varies depending on the operating conditions such as host MCU processing power, processing volume, interface speed, surrounding radio environment, etc. Please contact us for the information on the data transfer rate.
The eventual throughput must be evaluated on the customer's usage environment.

Q5-7 What kind of radio certifications have the modules obtained?

A5-7: All our modules listed on the website have been certified with the FCC (USA), ISED (Canada) and MIC (Japan). For CE certification, the RF conduction test reports have been released on each module's web page. Except for the conduction test, all tests shall be performed using the customer's end product.
For details on the conditions for obtaining certifications, refer to the related articles of the Radio Law in Data Sheet or Application Note of each module.

Q5-8: How can I get the RF testing tool when I apply to the Radio Law certification?

A5-8: It is necessary to use MFG that is included in the source code package, which is subject to the SLA. MFG contains several testing tools that can perform tests according to test items and conditions. Labtool, which is a CUI tool running on a Windows PC, and Testing Firmware, which is a firmware to operate testing from your product CPU, are available. When you control the module from external PC you need to pull out interface lines, and when you control the module from your product CPU you need to port the driver and firmware into it. We recommend that you discuss the test conditions with your certification agency in advance.

Q5-9: Do you have Wi-Fi Alliance certification?

A5-9: KAGA FEI's module does not come with the certification. If customer needs the certification on their product, please consult with an authorized test lab.

Q5-10: What are the packaging specifications and regular order quantity?

A5-10: The standard packaging method for all the WLAN modules is tray. For details on standard order quantity and detailed packaging specifications, please refer to Packaging Specification on Data Sheet of each module.

Q5-11: What is the lead time for purchasing the module?

A5-11: Please contact your KAGA FEI's sales representative or our distributor.

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