

FOXX_IQ40_User Manual

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1 Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the FOXX module. With the help of this document and other software application notes/user guides, users can understand and use module to design and develop applications quickly.

1.1 Product Outline

Aimed at the global market, the module support WCDMA, LTE-TDD. Users can choose the module according to the wireless network configuration. The supported radio frequency bands are described in the following table.

Table1: Module frequency bands

Standard	Frequency
GSM	850MHz
	1900M Hz
WCDMA	B2
	B4
	B5
LTE	FDD B2
	FDD B4
	FDD B5
	FDD B7
	FDD B12
	FDD B13
	FDD B25
	FDD B26
	FDD B38
	FDD B41
	FDD B66

With a small physical dimension of 30*30*2.9 mm and with the functions integrated, the module can meet almost any space requirement in users’ applications, such as smart phone, PDA, industrial handheld, machine-to-machine and vehicle application, etc.

1.2 Hardware Interface Overview

The interfaces are described in detail in the next chapters include:

- Power Supply
- USB2.0 Interface
- UART Interface
- MMC/SD Interface
- SDIO Interface
- USIM Interface
- SPI Interface
- GPIO
- ADC
- LDO Power Output
- Current Sink Source
- PCM Interface
- SPI Interface
- I2C Interface
- HSIC Interface
- SGMII Interface

1.3 Functional Overview

Table2: General features

Feature	Implementation
Power supply	Single supply voltage 3.4 ~ 4.2V, Recommend supply voltage 3.8V
Power saving	Current in sleep mode : <5mA
Radio frequency bands	Please refer to the table 1
Transmitting power	UMTS power class: --WCDMA :3 (24dBm) LTE power class: 3 (23dBm)
Data Transmission Throughput	UMTS R99 speed: 384 kbps DL/UL HSPA+: 5.76 Mbps(UL), 42 Mbps(DL) HSDPA/HSUPA: 2.2 Mbps(UL), 2.8 Mbps(DL) FDD LTE CAT 4: 150 Mbps(DL) ,50Mbps(UL) TDD LTE CAT 4: 130 Mbps(DL) ,35Mbps(UL)
Antenna	UMTS/LTE main antenna. UMTS/LTE auxiliary antenna GNSS antenna
GNSS	GNSS engine (GPS,GLONASS,BD,QZSS and GALILEO) Protocol: NMEA 0183
SMS	MT, MO, CB, Text and PDU mode SMS storage: USIM card or ME(default) Transmission of SMS alternatively over CS or PS.

USIM interface	Support identity card: 1.8V/ 3V
USIM application toolkit	Support SAT class 3, GSM 11.14 Release 98 Support USAT
Phonebook management	Support phonebook types: DC,MC,RC,SM,ME,FD,ON,LD,EN
Audio feature	Support PCM interface Only support PCM master mode and short frame sync, 16-bit linear data formats
UART interface	A full modem serial port by default Baud rate: 300bps to 4Mbps(default:115200bps) Can be used as the AT commands or data stream channel Support RTS/CTS hardware handshake Multiplex ability according to GSM 07.10 Multiplexer Protocol
MMC/SD	Support MMC and SD cards with 2.85 V on SD port
SDIO	Support SDIO with 1.8 V only on SDIO port
USB	USB 2.0 high speed interface, Can used be send AT command, Software update, GNSS NMEA,USB voice function etc.
Firmware upgrade	Firmware upgrade over USB interface or FOTA
Physical characteristics	Size:30*30*2.9m Weight:5.7 g
Temperature range	Normal operation temperature: -30°C to +80°C Extended operation temperature: -40°C to +85°C* Storage temperature -45°C to +90°C

2 RF Specifications

2.1. GSM/UMTS/LTE RF Specifications

Table 3: Conducted transmission power

Frequency	Power	Min.
GSM850	33dBm ±2dB	5dBm ± 5dB
PCS1900	30dBm ±2dB	0dBm ± 5dB
GSM850 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
PCS1900 (8-PSK)	26dBm +3/-4dB	0dBm ±5dB
WCDMA B2	24dBm +1/-3dB	< -50dBm
WCDMA B4	24dBm +1/-3dB	< -50dBm
WCDMA B5	24dBm +1/-3dB	< -50dBm
LTE-FDD B2	23dBm +2/-1dB	< -40dBm
LTE-FDD B4	23dBm +2/-1dB	< -40dBm
LTE-FDD B5	23dBm +2/-1dB	< -40dBm
LTE-FDD B7	23dBm +2/-1dB	< -40dBm
LTE-FDD B12	23dBm +2/-1dB	< -40dBm

LTE-FDD B13	23dBm +2/-1dB	< -40dBm
LTE-FDD B25	23dBm +2/-1dB	< -40dBm
LTE-FDD B26	23dBm +2/-1dB	< -40dBm
LTE-FDD B66	23dBm +2/-1dB	< -40dBm
LTE-TDD B38	23dBm +2/-1dB	< -40dBm
LTE-TDD B41	23dBm +2/-1dB	< -40dBm

Table 4: Operating frequencies

Frequency	Receiving	Transmission
GSM850	869 ~ 894MHz	824 ~ 849 MHz
PCS1900	1930~1990 MHz	1850~1910 MHz
WCDMA B2	1930~1990 MHz	1850~1910 MHz
WCDMA B4	2110~2155MHz	1710~1755MHz
WCDMA B5	869 ~ 894 MHz	824 ~ 849 MHz

The LTE Operating frequencies are shown in the following table 3.

Note: Operating frequencies of LTE TDD B41 for the MODULE is 200MHz BW, 2496~2690 MHz

GPS	1574.4 ~ 1576.44 MHz	-
GLONASS	1598 ~ 1606 MHz	-
BD	1559 ~ 1563 MHz	

Table 5: E-UTRA operating bands

E-UTRA	Uplink (UL) operating	Downlink (DL) operating	Duplex
Operating Band	band	band	Mode
2	1850~1910 MHz	1930~1990 MHz	FDD
4	1710~1755MHz	2110~2155MHz	FDD
5	824 ~ 849 MHz	869 ~ 894MHz	FDD
7	2500~2570MHz	2620~2690MHz	FDD
12	699~716MHz	728~746MHz	FDD
13	777~787MHz	746~757MHz	FDD
25	1850~1915MHz	1930~1995MHz	FDD
26	814~849MHz	859~894MHz	FDD
66	1710~1780MHz	2110~2200MHz	FDD
38	2570 ~ 2620 MHz	2570 ~ 2620 MHz	TDD
41	2496~2696 MHz	2496~2696 MHz	TDD

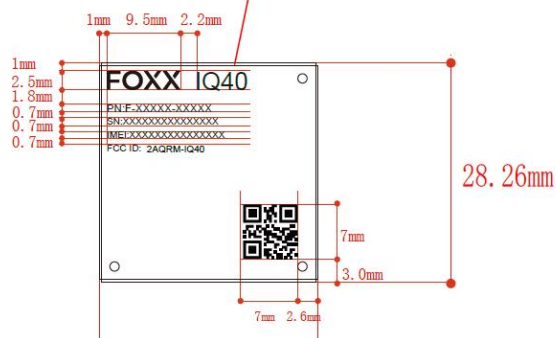
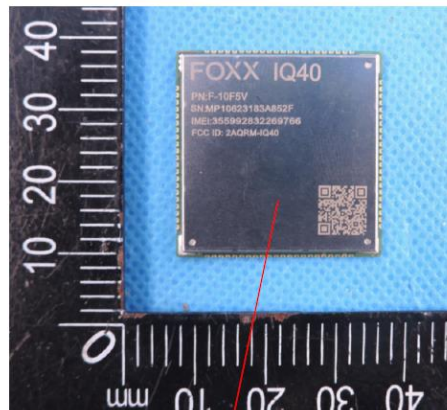
Table 6: Conducted receive sensitivity

Frequency	Receive sensitivity(Typical)
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GSM850	< -109dBm
PCS1900	< -109dBm
WCDMA B2	< -110dBm
WCDMA B4	< -110dBm
WCDMA B5	< -110dBm
LTE FDD/TDD	See table 28.

Table 7: Reference sensitivity (QPSK)

E-UTR A band	3GPP Standard						Duplex Mode
	1.4 MHz	3 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
2	-102	-99	-97.3	-94.3	-92.5	-91.3	FDD
4	-104	-101	-99.3	-96.3	-94.5	-93.3	FDD
5	-102	-99	-97.3	-94.3	-	-	FDD
7	-	-	-97.3	-94.3	-92.5	-91.3	FDD
12	-101	-98	-96.3	-93.3	-	-	FDD
13	-	-	-96.3	-93.3	-	-	FDD
25	-100.5	-97.5	-95.8	-92.8	-91	-89.8	FDD
26	-101.5	-98.5	-96.8	-93.8	-92	-	FDD
66	-103.5	-100.5	-98.8	-95.8	-94	-92.8	FDD
38	-	-	-99.3	-96.3	-94.5	-93.3	TDD
41	-	-	-97.3	-94.3	-92.5	-91.3	TDD



Antenna Specification

Brand	Model Name	Antenna Type	Connector	Gain (dBi)	Note
SPEED	MF25D	External	N/A	GSM850:0.47 dBi, PCS1900:1.63 dBi WCDMA B2:1.63 dBi WCDMA B4:3.12dBi WCDMA B5:0.64 dBi LTE B2:1.63 dBi LTE B4:3.12 dBi LTE B5:0.64 dBi LTE B7:2.9 dBi LTE B12:0.95 dBi LTE B13:2.23 dBi LTE B25:1.87 dBi LTE B26:0.91 dBi LTE B38:1.64 dBi LTE B41: 2.9 dBi LTE B66:3.12 dBi	N/A

FCC Statement

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The modular can be installed or integrated in mobile or fix devices only. This modular cannot be installed in any portable device.

FCC Radiation Exposure Statement

This modular complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: 2AQRM-IQ40 Or Contains FCC ID: 2AQRM-IQ40"

When the module is installed inside another device, the user manual of the host must contain below warning statements;

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Information that must be placed in the end user manual:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below

concerning the need to notify host manufacturers that further testing is required.3

Explanation: This module meets the requirements of FCC part 22H, part 24E and part 27.

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands. Explanation: The EUT No Antenna, the External antenna was used for the test. The module is mainly installed on terminal products, Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device. In addition, the description module is mainly installed on Grantee's products and will also be sold to the general public. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

Brand	Model Name	Antenna Type	Connector	Gain (dBi)	Note
SPEED	MF25D	External	N/A	GSM850:0.47 dBi, PCS1900:1.63 dBi WCDMA B2:1.63 dBi WCDMA B4:3.12dBi WCDMA B5:0.64 dBi LTE B2:1.63 dBi LTE B4:3.12 dBi LTE B5:0.64 dBi	N/A

				LTE B7:2.9 dBi LTE B12:0.95 dBi LTE B13:2.23 dBi LTE B25:1.87 dBi LTE B26:0.91 dBi LTE B38:1.64 dBi LTE B41: 2.9 dBi LTE B66:3.12 dBi	
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2.4 Limited module procedures

If a modular transmitter is approved as a “limited module,” then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The Module is a single module, Not Applicable.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;

- e) Test procedures for design verification; and
- f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: Not Applicable.

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: 2AQRM-IQ40.

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type")).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: This radio transmitter FCC ID: 2AQRM-IQ40 has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Brand	Model Name	Antenna Type	Connector	Gain (dBi)	Note
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SPEED	MF25D	External	N/A	GSM850:0.47 dBi, PCS1900:1.63 dBi WCDMA B2:1.63 dBi WCDMA B4:3.12dBi WCDMA B5:0.64 dBi LTE B2:1.63 dBi LTE B4:3.12 dBi LTE B5:0.64 dBi LTE B7:2.9 dBi LTE B12:0.95 dBi LTE B13:2.23 dBi LTE B25:1.87 dBi LTE B26:0.91 dBi LTE B38:1.64 dBi LTE B41: 2.9 dBi LTE B66:3.12 dBi	N/A
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2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: 2AQRM-IQ40"

2.9 Information on test modes and additional testing requirements⁵

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

Explanation: Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized

for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuitry, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.