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nRF52840 ModuleSpecification

Part No.: VMZ-nRF52840-1
Meandered Inverted F Antenna (IFA)

1. Description

a. Introduction

This module is embedded wireless communication module that supports ZigBee 3.0or Thread. The module is compact, simple in application and can be integrated in system quick and easily. It can help customers to shorten product development cycle and reduce development cost.

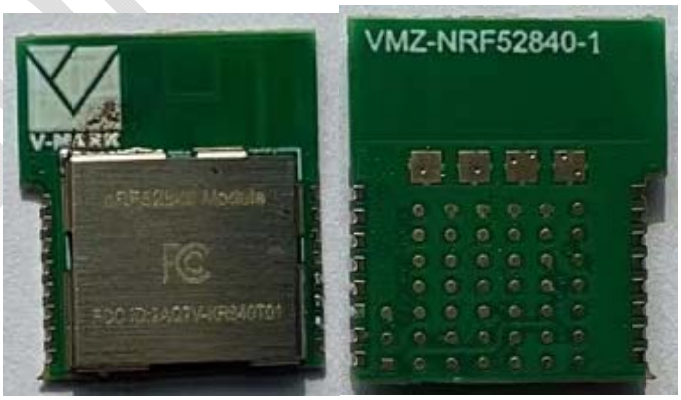
b. Appearance

Module Dimension (Show in Table 1-1)

Table 1-1

	Dimension
Length x width x height	17mm × 15mm ×2.1mm

Note：If the Shield is not used, the thickness is 1.8mm.



Module front view (Figure 1-1)　　Module back view (Figure 1-2)

Figure 1-1　　Figure 1-2

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c. Parameters

Module working parameters and chip-set characteristics table (shown in Table 1-2)

Table 1-2

Technical Parameter	Parameter Value		
Chip-set model	nRF52840-QIAA		
Wireless standard	Support 802.15.4, ZigBeeand Thread		
Operating voltage	3.3V		
Voltage characteristics	Minimum	Typical	Maximum
	1.70V	3.3V	3.6V
Receive current	~5mA, Refer to nRF52840 Product Specificationfor detail		
Transmit current	32.7mA(8dBm),Refer to nRF52840 Product Specificationfor detail		
Standby current	0.4 µA at 3 V in System OFF mode, no RAM retention 1.5 µA at 3 V in System ON mode, no RAM retention, wake on RTC		
Flash	1MB		
RAM	256KB		
Operating frequency	2400~ 2483.5 MHz		
Transmit power output	+8dBm		
Wireless data rate	IEEE 802.15.4-2006 – 250 Kbps		
Interface immunity	DSSS QPSK for IEEE 802.15.4		
Receiver sensitivity	-100dBm ---- In IEEE 802.15.4 mode		
Operating temperature	-40℃~+125℃		
Environment humidity	10%~ 90%No condensation		
Support protocol	ZigBee, Thread		
Approval	FCC (FCC ID: 2AQ7V-KR840T01)		

2. Function

a. Antenna

The module has a meander line inverted F antenna as Figure 2-1. The maximum gain is 1.06dBi. Please refer to the passive report for more detail parameters.

Figure 2-1 Meandered IFPA

b. Pin assignment (as Figure 2-2)

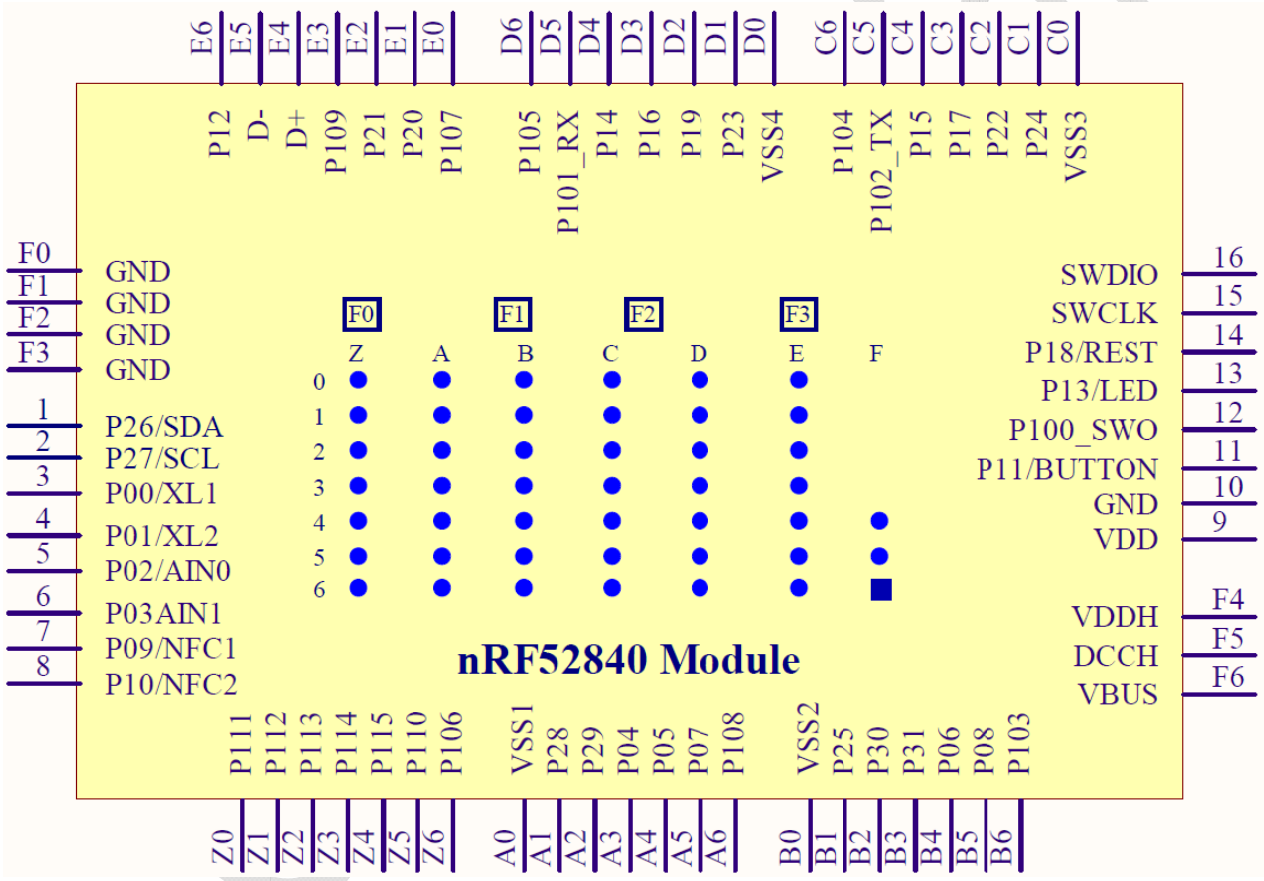


Figure 2-2 Pins assignment

c. Pin function (as Table 2-1)

Table 2-1 Pin function definition

Module Pin #	nRF52840 Pin#	Pin Name	Description
1	G1	P0.26/SDA	GPIO, configured as I2C SDA

2	H2	P0.27/SCL	GPIO, configured as I2C SCL
3	D2	P0.00/XL1	GPIO, connection for 32.768kHz crystal
4	F2	P0.01/XL2	GPIO, connection for 32.768kHz crystal
5	A12	P0.02/AIN0	GPIO, Analog input
6	B13	P0.03/AIN1	GPIO, Analog input
7	L24	P0.09/NFC1	GPIO, NFC antenna connection
8	J24	P0.10/NFC2	GPIO, NFC antenna connection
9	B1	VDD	DC supply 1.7V to 3.6V
10	B7	GND	Ground
11	T2	P0.11	GPIO
12	AD22	P1.00	GPIO
13	AD8	P0.13	GPIO
14	AC13	P0.18/RESET	GPIO, internal RC reset circuit, configurable as RESET pin
15	AA24	SWDCLK	Serial Wire Debug clock input
16	AC24	SWDIO	Serial Wire Debug I/O
Z0	B19	P1.11	GPIO
Z1	B17	P1.12	GPIO
Z2	A16	P1.13	GPIO
Z3	B15	P1.14	GPIO
Z4	A14	P1.15	GPIO
Z5	A20	P1.10	GPIO
Z6	R24	P1.06	GPIO
A0		GND	Ground
A1	B11	P0.28/AIN4	GPIO, Analog input
A2	A10	P0.29/AIN5	GPIO, Analog input
A3	J1	P0.04/AIN2	GPIO, Analog input
A4	K2	P0.05/AIN3	GPIO, Analog input
A5	M2	P0.07	GPIO
A6	P2	P1.08	GPIO
B0		GND	Ground
B1	AC21	P0.25	GPIO
B2	B9	P0.30/AIN6	GPIO
B3	A8	P0.31/AIN7	GPIO
B4	L1	P0.06	GPIO, PA control
B5	N1	P0.08	GPIO, PA control
B6	V23	P1.03	GPIO
C0		GND	Ground
C1	AD20	P0.24	GPIO
C2	AD18	P0.22	GPIO
C3	AD12	P0.17	GPIO, PA control
C4	AD10	P0.15	GPIO

C5	W24	P1.02	GPIO
C6	U24	P1.04	GPIO
D0		GND	Ground
D1	AC19	P0.23	GPIO
D2	AC15	P0.19	GPIO, PA control
D3	AC11	P0.16	GPIO
D4	AC9	P0.14	GPIO
D5	Y23	P1.01	GPIO
D6	T23	P1.05	GPIO
E0	P23	P1.07	GPIO
E1	AD16	P0.20	GPIO
E2	AC17	P0.21	GPIO
E3	R1	P1.09	GPIO
E4	AD6	D+	USB D+
E5	AD4	D-	USB D-
E6	U1	P0.12	GPIO
F0			Ground pad
F1			Ground pad
F2			Ground pad
F3			Ground pad
F4	Y2	VDDH	High Voltage Power Supply.
F5	AB2	DCCH	DC to DC converter output
F6	AD2	VBUS	5V DC power for USB 3.3V regulator

d. Debug function

Using Pin9, Pin10 and Pin14~15for firmware programming, function description is shown in Table 2-2.

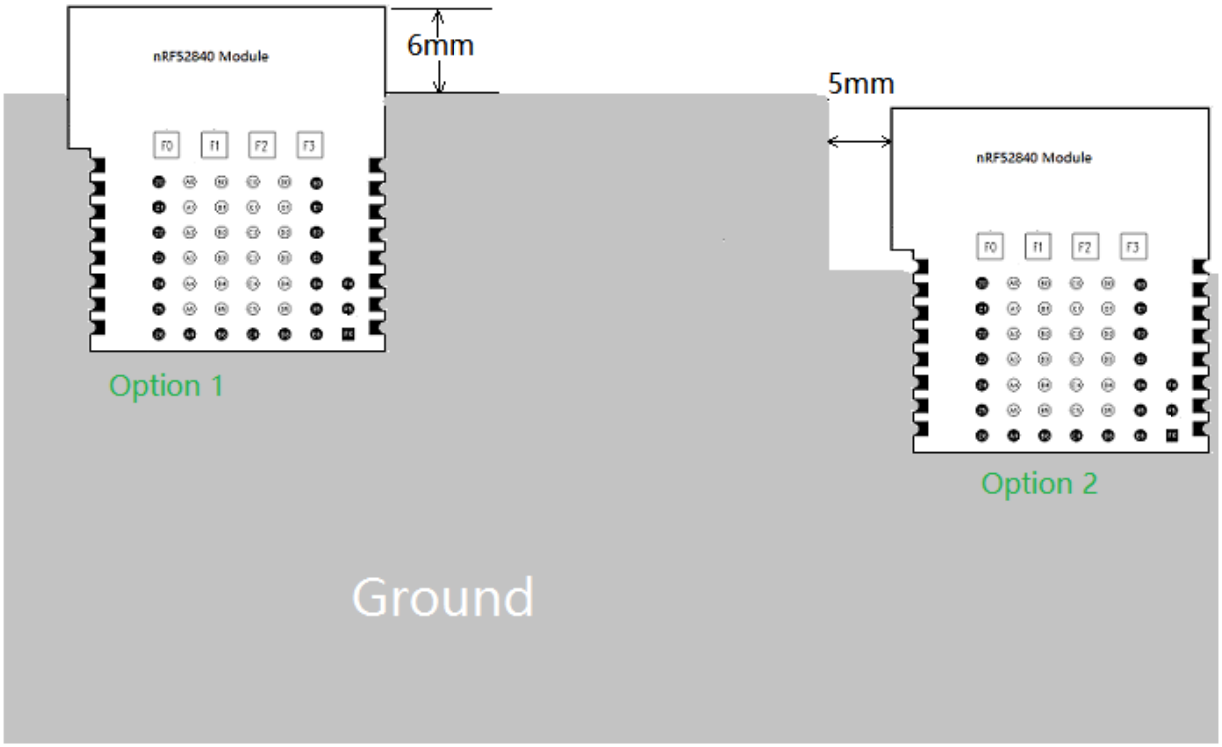
Table 2-2 Firmware programming Pins

Pin #	Pin Name	Function
10	GND	Ground
14	Hardware Reset	Triggered by low voltage signal
15	SWCLK	Debug clock
16	SWD	Debug Data
9	VDD	Power supply (3.3V)

3. Design Reference

- Power supply filter circuit and data transmission line matching resistor should be placed as close as possible to the module.

- Place the module as far away as possible from interference source, for example, Wi-Fi antenna, GSM antenna, DDR CLK, LCD circuitry.
- Ensure that the ground, power, and signal planes are vacant immediately below the antenna section. Option 1 is the best layout for module on the host board. Option 2 is also recommended.



- Try to use an LDO which is suitable for radio frequency applications to provide 5V constant voltage power supply for the module
- Suggest using double-sided PCB design
- Unused IO port can leave floating
- The width of LED driver trace should be designed according to actual current
- The default state of output IO port is high level. It is recommended that the user to add a 1.2KΩ pull low resistor.
- Reset pulse must be at least 200ms, as shown in Figure 3-1.

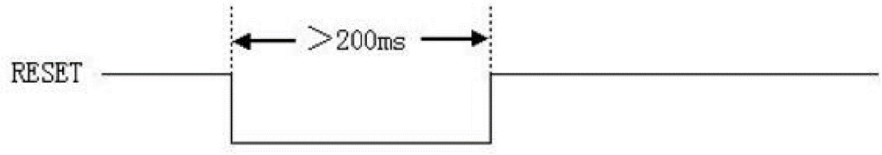


Figure 3-1 Reset pulse longer than 200ms

4. Structure and Assembly

a. Structure

Module dimension is 17mmx15mm and thickness is 2.1mm (with the shield). The module dimension and pad size are shown in Figure 5-1. The antenna size follows module size, and the width is the same.

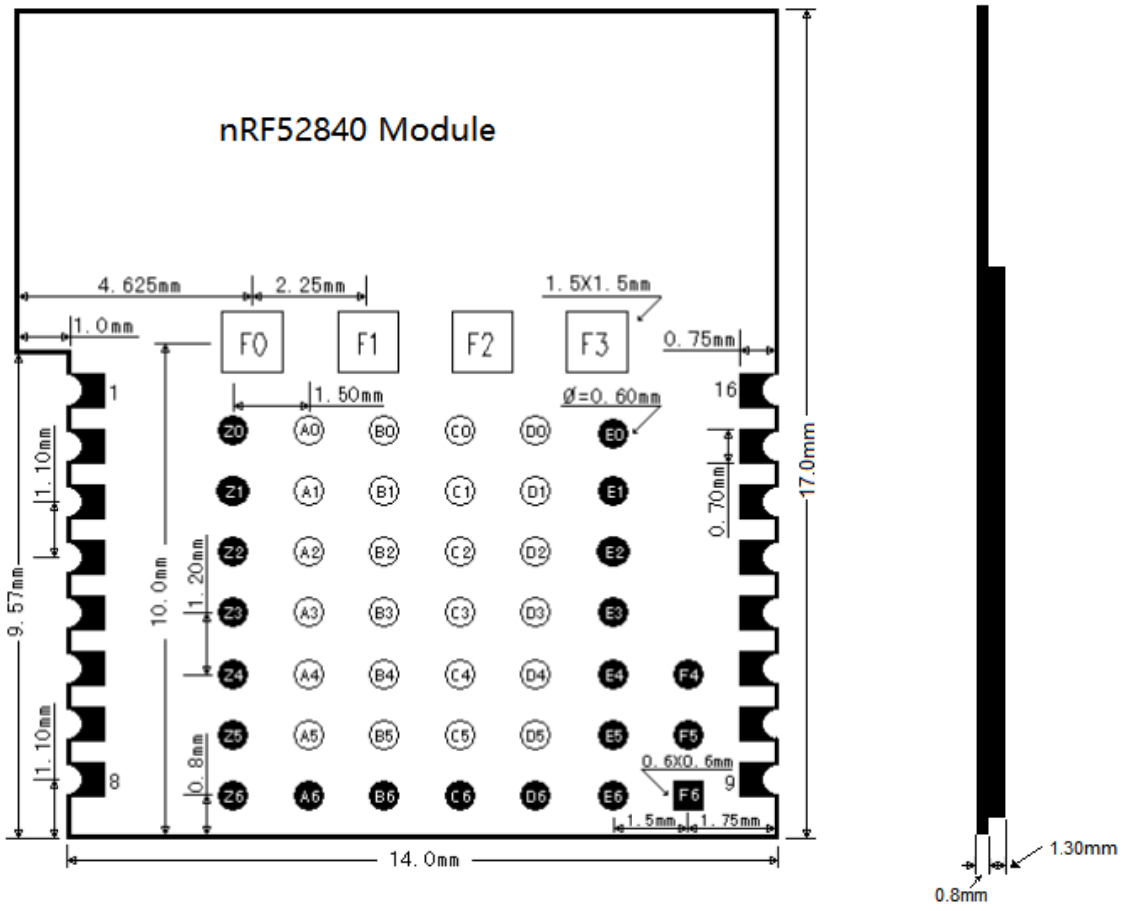
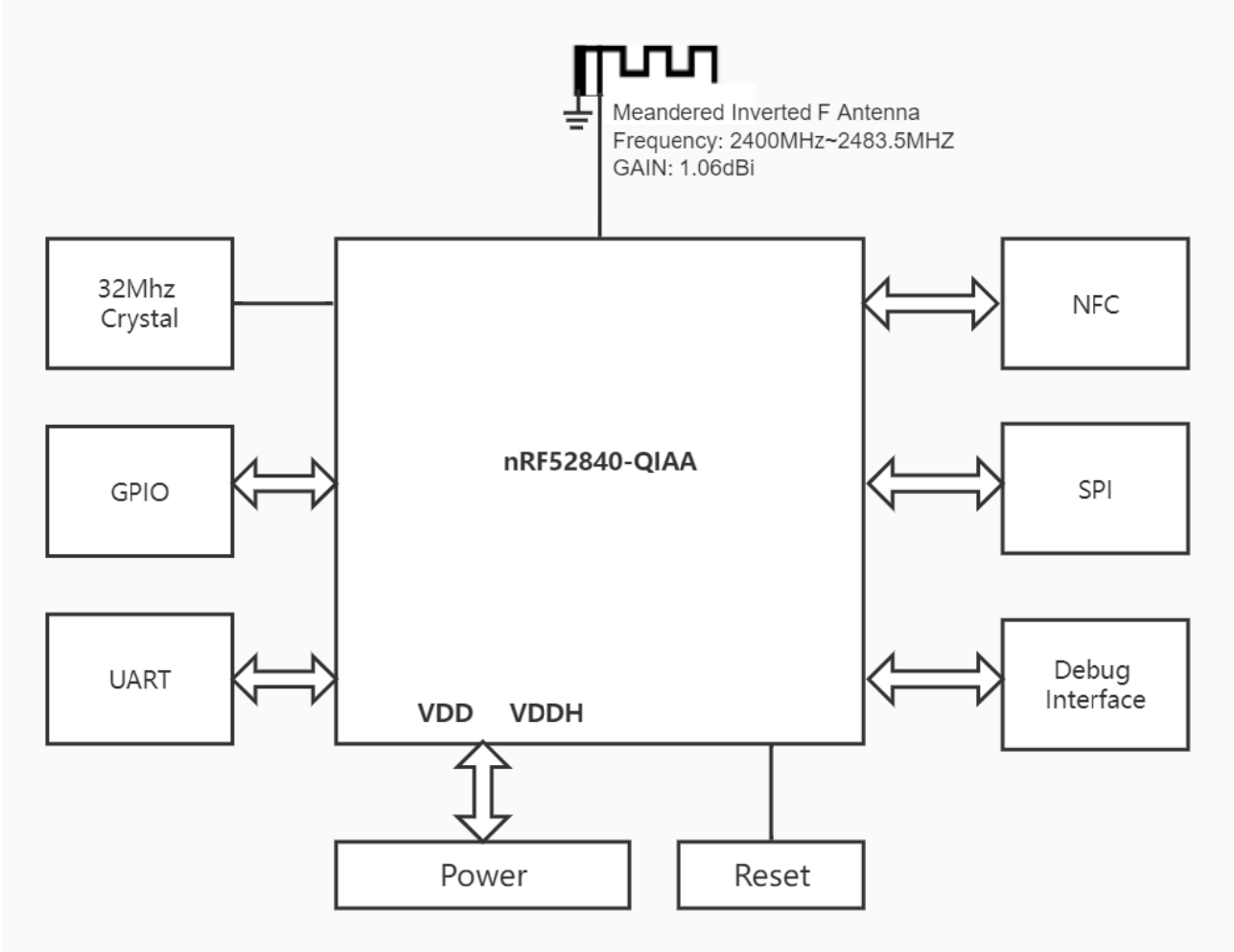


Figure 5-1 Module dimension and pad size (unit is mm)

b. Schematic Diagram



5. Design Notes

a. Module storage instructions

- Packaged module storage period
  - Storage period: 12 months
  - Storage environment conditions: Temperature < 40℃, Humidity < 90% R.H.
  - Inventory control: base on first in first out principle
- Time limit for SMT assembly for unpacked module
  - Check humidity card: blue means humidity < 20%; Red means humidity > 30% (module has absorbed moisture)
  - SMT workshop environment control: Temperature: 22°C (±4°C),Humidity: 60% R.H. (±20%)
  - After baking, use for SMT production immediately or place an appropriate amount of

desiccant, seal the package and store in a drying cabinet.

b. If it is not used up within 48hours after unpacked

- The module must be baked again to remove moisture on module
- Baking temperature conditions
  - High temperature resistant packaging material: 120℃ (±5℃), 24 hours
  - Non-high temperature resistant packaging material: 40℃ (±3℃), 192 hours

c. Module baking temperature, time, operation, and humidity requirements

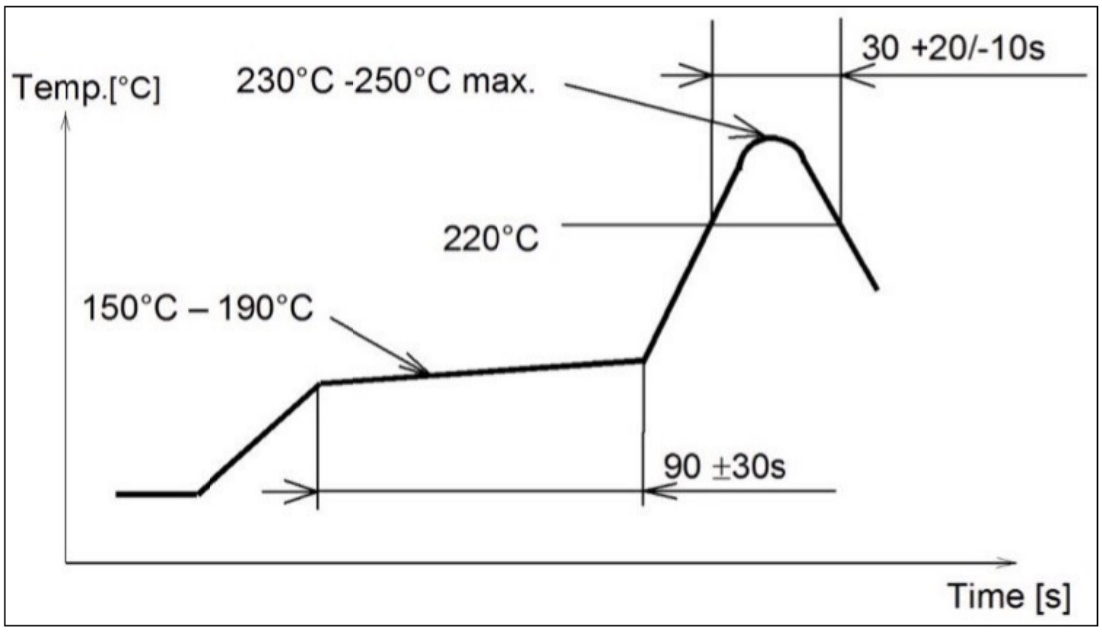
- The requirement on "Incoming Packaging Instruction" shall prevail. If there is no incoming packaging instruction, please refer to this article.

d. Humidity check card on packaging and SMT time limit after unpacked

- After unpacked, the module must complete SMT assembly within 48hours
- Unpacked module must be stored in a drying cabinet where humidity must be lower than 20%R.H.

e. Soldering Temperature-Time Profile for Re-Flow Soldering

- Maximum number of cycles for re-flow is 2. No opposite side re-flow is allowed due to module weight.



A. FCC Warnings Statement

Changes or modifications not expressly approved by the party responsible for compliance couldvoid the user's authority to operate the equipment. This equipment has been tested and found tocomply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. Theselimits are designed to provide reasonable protection against harmful interference in a residentialinstallation. This equipment generates uses and can radiate radio frequency energy and, if notinstalled and used in accordance with the instructions, may cause harmful interference to radiocommunications. 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 tocorrect 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.

This device complies with part 15 of the FCC Rules. Operation is subject to the followingtwo conditions:
(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that maycause undesired operation.

NOTE: This device and its antenna(s) must not be co-located or operation in conjunction with any other antenna or transmitter.

A.1 RF Exposure Statement

To maintain compliance with FCC's RF Exposure guidelines, this equipment should beinstalled and operated with minimum distance of 20cm the radiator your body. This deviceand its antenna(s) must not be co-located or operation in conjunction with any other antenna or transmitter.

A.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specificallyestablish the bands of operation, the power, spurious emissions, and operating fundamentalfrequencies.
DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not aconditionof a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning theneed to notify host manufacturers that further testing is required.3
Explanation: This module meets the requirements of Part 15 Subpart C Section 15.247

A.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example anylimits on antennas, etc. For example, if point-to-point antennas are used that require reduction inpower or compensation for cable loss, then this information must be in the instructions. If the usecondition limitations extend to professional users, then instructions must state that this informationalso extends to the host manufacturer's instruction manual. In addition, certain information mayalso be needed, such as peak gain per frequency band and minimum gain, specifically for masterdevices in 5 GHz DFS bands.
Explanation: The EUT uses PCB Antenna, antenna gain: 1.06dBi. There is no restriction onthe installation method.

A.4 Limited module procedures

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

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

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

Explanation: The module is not a limited module

A.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDBPublication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integrationinformation shall include for the TCB review the integration instructions for the following aspects: layoutof trace design, parts list (BOM), antenna, connectors, and isolation requirements.4

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 beconsidered);

c) The parameters shall be provided in a manner permitting host manufacturers to design the printedcircuit (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 theantenna trace, as described by the instructions, require that the host product manufacturer must notifythemodule grantee that they wish to change the antenna trace design. In this case, a Class II permissivechange application is required to be filed by the grantee, or the host manufacturer can take responsibilitythrough the change in FCC ID (new application) procedure followed by a Class II permissive changeapplication.

Explanation: No. The module with trace antenna designs

A.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit ahost product manufacturer to use the module. Two types of instructions are required for RF exposureinformation: (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 toprovideto end users in their end-product manuals. If RF exposure statements and use conditions are notprovided,then the host product manufacturer is required to take responsibility of the module through a change inFCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for anuncontrolled environment. The device is mobile, portable, and the use distance is 20 cm.This moduleis designed to comply with the FCC statement, FCC ID is: 2AQ7V-KR840T01

A.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 (mono-pole, 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: The EUT uses PCB Antenna, antenna gain: 1.06dBi.

A.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includesadvising host product manufacturers that they need to provide a physical or e-label stating “ContainsFCCID” 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 hefollowing texts: "Contains FCC ID: 2AQ7V-KR840T01

A.9 Information on test modes and additional testing requirements

Additional guidance for testing host products is given in KDB Publication 996369 D04 ModuleIntegration Guide. Test modes should take into consideration different operational conditions for astandalonemodular transmitter in a host, as well as for multiple simultaneously transmitting modules or othertransmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluationfordifferent 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, orinstructions that simulates or characterizes a connection by enabling a transmitter. This can greatlysimplify a host manufacturer’s determination that a module as installed in a host complies with FCCrequirements.

Explanation: Data transfer module demo board can control the EUT work in RF test mode at specifiedtest channel

A.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for thespecific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host productmanufacturer is responsible for

compliance to any other FCC rules that apply to the host not coveredby the modular transmitter grant of certification. If the grantee markets their product as being Part 15Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the granteeshall provide a notice stating that the final host product still requires Part 15 Subpart B compliancetesting with the modular transmitter installed.

Explanation: The module without unintentional-radiator digital circuity, so the module does notrequire an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B