

Z-Wave Module Specification Sheet

1. Product Overview

1.1 Product Introduction

This module is designed based on the Z-WAVE communication protocol, featuring stable wireless communication capabilities and a rich configuration of hardware interfaces. It is suitable for various wireless communication scenarios such as smart home control and IoT data transmission. The product's hardware design strictly adheres to relevant electrical standards and electromagnetic compatibility requirements, meeting the technical specifications of the FCC for wireless devices and providing reliable support for end products to enter the North American market in compliance with regulations.

1.2 Scope of Application

This specification sheet defines in detail the key indicators of the module, including electrical characteristics, radio frequency parameters, hardware interfaces, mechanical structure, and environmental adaptability. It serves as a core technical basis for module R&D, production, testing, and FCC certification application, while providing comprehensive technical references for end manufacturers' product integration.

2. Referenced Standards and Specifications

- FCC Part 15: Federal Communications Commission "Electromagnetic Compatibility Standards for Radio Frequency Devices"
- Z-Wave Alliance Specification: Z-Wave Alliance Wireless Communication Protocol Specification
- IEC 61000: General Standards for Electromagnetic Compatibility (EMC)
- ASTM D4169: Performance Testing Standards for Transport Packages

3. Core Electrical Parameters

3.1 Power Supply Parameters

Power Supply Type	Voltage Range	Typical Value	Remarks
VMCU	3.0V-3.6V	3.3V	Microcontroller

			Power Supply
VDCDC	5.0V-12.0V	9.0V	DC Conversion Power Supply
PAVDD	3.0V-3.6V	3.3V	Power Supply for RF Power Amplifier

3.2 Power Consumption Parameters

Operating Mode	Power Supply Voltage	Typical Power Consumption	Maximum Power Consumption
Normal Communication Mode	VMCU=3.3V, VDCDC=9.0V	150mA	200mA
Standby Mode	VMCU=3.3V	10mA	15mA
Sleep Mode	VMCU=3.3V	1mA	3mA

3.3 Key Component Parameters

Component ID	Type	Parameter Specification	Function
C203	Capacitor	100nF	Filter Capacitor
C205	Capacitor	10μF	Power Supply Filter and Energy Storage
C117.2	Capacitor	4.7μF	Power Supply Filter for RF Circuit
R210	Resistor	0Ω	Circuit Conduction Jumper
R211	Resistor	NC (Not Connected)	Reserved Debugging

			Resistor
U2	Integrated Circuit	With Pins DVDD, VREGVDD, VREGVSS	Core Control Chip

4. Radio Frequency Characteristics (Compliant with FCC Part 15)

4.1 Operating Frequency Range

- Primary Operating Frequency Band: 908.42 MHz (compliant with Z-WAVE North American frequency standards, covering the core communication band for smart home IoT devices)
- Center Frequency: 908.42 MHz (default working frequency, supports dynamic adjustment within the primary band)
- Frequency Tolerance: $\pm 0.01\%$ (ensures stable communication and avoids interference with adjacent frequency bands)

4.2 Transmission Parameters

Transmission Indicator	Specification Requirement	Test Condition
Output Power	$\leq 1\text{mW}$ (0dBm EIRP)	Normal operating mode, frequency band 908.42 MHz
Modulation Mode	FSK (Frequency Shift Keying)	In accordance with Z-WAVE protocol modulation specifications, using Gaussian filtered FSK
Spurious Emission	Meets FCC Part 15.209 Requirements	$\leq -41.3\text{dBm}/100\text{kHz}$ in 30MHz-1GHz band; $\leq -54\text{dBm}/1\text{MHz}$ in bands above 1GHz (tested across the entire operating frequency range)

4.3 Reception Parameters

Reception Indicator	Specification Requirement	Test Condition
Sensitivity	$\leq -92\text{dBm}$	Data rate 100kbps, bit error rate $\leq 0.1\%$, tested at 908.42 MHz (Frequency)

4.4 Antenna Configuration

- Antenna Type: SUBG_ANT/SUBG_ANT1 External Antenna Interface (optimized for the 908.42 MHz band to ensure optimal signal transmission/reception efficiency)
- Antenna Impedance: 50Ω (matched with the module's RF circuit to minimize signal reflection within the operating frequency range)
- Interface Form: Reserved PAD1-PAD11 Antenna Pads (see Hardware Interface section for specific pad definitions, designed to support antenna installation suitable for the operating frequency band)

5. Hardware Interface Definition

5.1 Overview of Pin Configuration

The core pins of the module include power supply, communication, control, reset, and antenna interfaces. Key pins adopt a dual-channel redundancy design (marked in XX XX format) to improve signal stability and anti-interference capability. The specific pin distribution is as follows:

- Power Supply Pins: VMCU, VDCDC, PAVDD, VREGVDD, VREGVSS
- Communication Pins: TX, RX, CTS, RTS (corresponding to PA00, PA08, PA09, PA10 pins)
- I/O Control Pins: PB00, PB01, PB02, PB03, PD02, PD03, PD04, PD05, PC00, PC05, PC06, PC07, PC08, PC09, PA01-PA07
- Reset Pin: RESET-N (dual-channel redundancy)
- Antenna Pins: SUBG_ANT, SUBG_ANT1 (dual-antenna interface)
- Test Points: TP10, TP11, TP1, TP2
- Reserved Pads: PAD1-PAD11

5.2 Detailed Description of Key Interfaces

Interface Type	Pin ID	Function Description	Electrical Characteristics
UART Communication	TX (PA00)	Data Transmission	Push-pull output, $V_{OH} \geq 3.0V$, $V_{OL} \leq 0.3V$
	RX (PA00)	Data Reception	Schmitt input, input voltage range 0-VMCU
	CTS (PA08)	Clear to Send	Input, active low
	RTS (PA09)	Request to Send	Output, active low
Power Supply Interface	VMCU	Main Power Supply	Input current $\geq 500mA$, ripple $\leq 50mVp-p$
	VDCDC	DC Power Input	Input current $\geq 300mA$
	PAVDD	RF Power Supply	Ripple $\leq 20mVp-p$ (ensures stable RF performance in the 908.42 MHz)

Control Interface	PB00-PB03	General I/O Ports	Configurable as input/output, maximum sink current 20mA
	PC00-PC09	Extended I/O Ports	Support interrupt trigger, PWM output
Reset Interface	RESET-N	Hardware Reset	Low-level reset, reset time $\geq 10\text{ms}$
Antenna Interface	SUBG_ANT/SUBG_ANT1	Wireless Signal Transceiver	50 Ω impedance matching (optimized for 908.42 MHz), external antenna soldering recommended

6. Mechanical Structure and Packaging

6.1 Physical Dimensions

- Length: [To be supplemented with specific value] mm
- Width: [To be supplemented with specific value] mm
- Thickness: [To be supplemented with specific value] mm (including component height)
- Mounting Holes: [Quantity] pieces, hole diameter [value] mm, hole spacing [value] mm

6.2 Packaging Form

- Packaging Type: Surface Mount Technology (SMT) Packaging
- Pin Pitch: [Value] mm (standard pad pitch)

- Weight: ≤[Value] g

7. Environmental Adaptability

7.1 Operating Environment

- Operating Temperature: -40°C ~ +85°C (ensures stable operation of RF circuits in the 908.42 MHz band under extreme temperatures)
- Operating Humidity: 10% ~ 90% RH (no condensation)
- Operating Air Pressure: 86kPa ~ 106kPa

7.2 Storage Environment

- Storage Temperature: -55°C ~ +125°C
- Storage Humidity: 5% ~ 95% RH (no condensation)

7.3 Anti-Interference Capability

- Electrostatic Discharge (ESD) Protection: Contact discharge ±8kV, air discharge ±15kV (compliant with IEC 61000-4-2, protects RF components working in the 908.42 MHz band)
- Electromagnetic Radiation Immunity: Compliant with IEC 61000-4-3 Class 3 requirements
- Conducted Immunity: Compliant with IEC 61000-4-6 Class 3 requirements

8. FCC ID Certification-Related Requirements

8.1 Electromagnetic Compatibility (EMC)

- Radiated Emission: Compliant with FCC Part 15.203 requirements, radiation ≤40dBμV/m (3m test) in 30MHz-1GHz band (including the module's 908.42 MHz operating band)
- Conducted Emission: Conducted emission at power port ≤48dBμV (30MHz-300MHz)
- Immunity indicators such as electrostatic discharge, surge, and electrical fast transient/burst comply with relevant limits in FCC Part 15 (tested with the module operating at 908.42 MHz)

8.2 Marking and Labeling

- The module surface shall be marked with FCC certification marks (FCC ID), product model, power supply parameters, and **operating frequency (908.42 MHz)**
 - After integration into end products, the product manual shall indicate the module's FCC ID, compliance statement, and operating frequency range to meet FCC transparency requirements

9. Test Methods

9.1 Electrical Performance Testing

- Power Supply Testing: Use a programmable power supply to provide different voltages and test the module's operating stability and power consumption
- Interface Testing: Verify UART interface communication rate and signal integrity using a signal generator and oscilloscope
- Reset Testing: Trigger the RESET-N pin to verify the module's reset function and reset time

9.2 Radio Frequency Performance Testing

- Operating Frequency Verification: Use a frequency counter to measure the module's actual working frequency across the 908.42 MHz, ensuring compliance with the declared frequency band and $\pm 0.01\%$ tolerance
 - Output Power Testing: Use a spectrum analyzer to measure peak output power and power spectral density in the full operating frequency band (908.42 MHz)
 - Spurious Emission Testing: Test spurious signal strength in 30MHz-1GHz and bands above 1GHz in accordance with FCC Part 15.209 requirements (with the module operating at key frequencies within its working band)
- Sensitivity Testing: Generate attenuated useful signals through a signal source (covering 908.42 MHz) and measure the minimum receivable signal strength using a bit error rate tester
 - Antenna Performance Testing: Test antenna gain, radiation pattern, and voltage standing wave ratio (VSWR ≤ 2.0) in an anechoic chamber (optimized for the 908.42 MHz band)

9.3 Environmental Adaptability Testing

- High and Low Temperature Testing: Simulate $-40^{\circ}\text{C}\sim+85^{\circ}\text{C}$ environment in a constant temperature and humidity chamber to continuously test the module's operating stability (monitoring frequency accuracy and signal quality within 908.42 MHz)
 - Humidity Testing: Place the module in an environment of 40°C and 90% RH for 1000 hours to test that the module's electrical performance and RF characteristics (in the operating band) do not degrade
 - Anti-Interference Testing: Conduct ESD, surge, and other immunity tests in accordance with IEC 61000 series standards (with the module working at its center frequency of 908.42 MHz)

10. Quality and Reliability

- Mean Time Between Failures (MTBF): $\geq 50,000$ hours (under 25°C normal temperature operating environment, based on performance data in the 908.42 MHz band)
- Service Life: ≥ 10 years
- Production Process: Compliant with ISO 9001 quality system requirements, all components have passed RoHS certification (including RF components for the 908.42 MHz band)
- Packaging Standard: Adopt anti-static packaging, meeting ASTM D4169 transport testing requirements to prevent damage during transportation

11. Statements and Disclaimers

- All parameters listed in this specification sheet are results under typical test conditions (including the 908.42 MHz operating band). Actual tests may have slight deviations due to test environment, equipment accuracy, and other factors
- The module shall be used within the electrical, environmental, and frequency range (908.00 MHz - 916.00 MHz) specified in this specification sheet. Use beyond the specified range may cause module damage or performance degradation, and the manufacturer shall not be liable for such damages
- The company reserves the right to upgrade and optimize the module specifications (including minor adjustments to the operating frequency range, if necessary) without prior notice. The final technical parameters shall be subject to the actually delivered products

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

FCC Part 15 Subpart C 15.247 & 15.207 & 15.209

2.3 Specific operational use conditions

The module is a Z-Wave module with Z-Wave.

Operation Frequency: 908.42MHz

Number of Channel: 1

Modulation: FSK

Type: FPC Antenna

Gain: -0.39dBi Max.

The module can be used for mobile or portable applications with a maximum -0.39dBi antenna. The host manufacturer installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer 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 shown in this manual.

2.4 Limited module procedures

Not applicable. The module is a Single module and complies with the requirement of FCC Part 15.212.

2.5 Trace antenna designs

Not applicable. The module has its own antenna, and doesn't need a host's printed board microstrip trace antenna etc.

2.6 RF exposure considerations

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and users' body; and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

2.7 Antennas

Antenna Specification are as follows:

Type: FPC Antenna

Gain: -0.39dBi

This device is intended only for host manufacturers under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna;

The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a 'unique' antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

2.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating "Contains FCC ID: **2BKHH-Z-WAVE**" with their finished product.

2.9 Information on test modes and additional testing requirements

Operation Frequency: 908.42MHz

Number of Channel: 1

Modulation: FSK

Host manufacturer must perform test of radiated & conducted emission and spurious emission, etc according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is **only** FCC authorized for FCC Part 15 Subpart C 15.247 & 15.207 & 15.209 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.

Federal Communication Commission Statement (FCC, U.S.)

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 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 following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Caution:

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

IMPORTANT NOTES

Co-location warning:

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

OEM integration instructions:

This device is intended only for OEM integrators under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the external antenna(s) that has been originally tested and certified with this module.

As long as the conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End product labeling:

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module [FCC ID: 2AFOS-WT5010-S1](#)".

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.

FCC Caution:

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

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, and (2) this device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT NOTE:

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.

FCC Radiation Exposure Statement: This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.