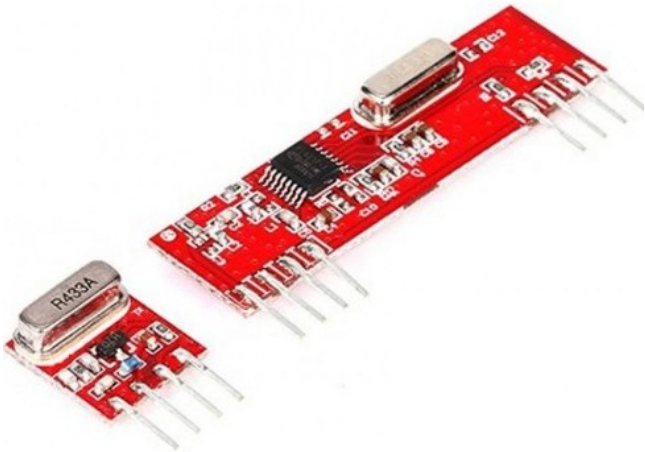
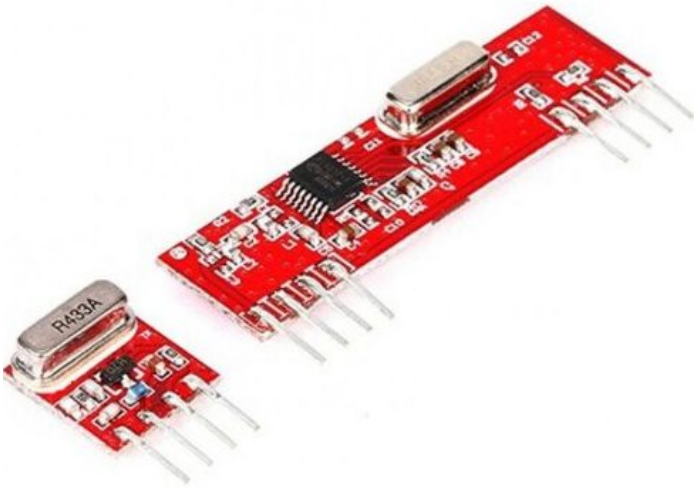


NOMVDIC ND10005 RF Module User Manual

Contents

NOMVDIC

NOMVDIC ND10005 RF Module



General Description

- The RTL8821CU-CG is a highly-integrated IEEE 802.11 a/b/g/n/ac MAC/Baseband/RF WLAN and Bluetooth Baseband/RF single chip. For Wireless LAN (WLAN) operation, it supports 1-stream 802.11ac solution with Multi-user MIMO (Multiple-Input, Multiple-Output) STA mode with USB2.0 network interface controller. For Bluetooth operation, it supports Bluetooth 2.1/4.2 with USB interface controller.
- The RTL8821CU-CG baseband implements multiuser Multiple-Input Multiple-Output (MIMO) Orthogonal Frequency Division Multiplexing (OFDM) STA mode with one transmit and one receive path (1T1R). Features include one spatial stream transmission, short Guard Interval (GI) of 400ns, spatial spreading, and support for variant channel bandwidths. Moreover, RTL8821CU-CG provides one spatial stream Space-Time Block Code (STBC) and Low Density Parity Check (LDPC) to extend the range of transmission. As the recipient, the RTL8821CU-CG also supports explicit sounding packet feedback that helps senders with beamforming capability.
- For legacy compatibility, Direct Sequence Spread Spectrum (DSSS), Complementary Code Keying (CCK) and OFDM baseband processing are included to support all IEEE 802.11a, 802.11b and 802.11g data rates. Differential phase shift keying modulation schemes, DBPSK and DQPSK with data scrambling capability, are available. CCK provides support for legacy data rates, with long or short preamble. The high speed FFT/IFFT paths are combined with BPSK, QPSK, 16QAM, 64QAM and 256QAM modulation of the individual subcarriers. The compatible coding rate of 1/2, 2/3, 3/4, and 5/6 provides up to 433.3Mbps for IEEE 802.11ac with MIMO-OFDM.
- The RTL8821CU-CG builds in an enhanced signal detector, an adaptive frequency domain equalizer, and a soft-decision Viterbi decoder to alleviate severe multi-path effects and mutual interference in the reception of multiple streams. Robust interference detection and suppression are provided to protect against Bluetooth, cordless phone, and microwave oven interference.
- Receive vector diversity for multi-stream application is implemented for efficient utilization of the MIMO channel. Efficient IQ-imbalance, DC offset, phase noise, frequency offset, and timing offset compensations are provided for the radio frequency front-end.
- The RTL8821CU-CG supports fast receiver Automatic Gain Control (AGC) with synchronous and asynchronous control loops among antennas, antenna diversity functions, and adaptive transmit power control functions to obtain better performance in the analog portions of the transceiver.
- The RTL8821CU-CG MAC supports 802.11e for multimedia applications, 802.11i and WAPI (Wireless Authentication Privacy Infrastructure) for security, and 802.11n/ac for enhanced MAC protocol efficiency.

Protocol efficiency is significantly improved by using packet aggregation techniques, such as A-MPDU with BA and A-MSDU. Power saving mechanisms, such as Legacy Power Save, U-APSD, and MIMO, can reduce the power wasted during idle time. They can also compensate for the extra power required to transmit MIMO-OFDM. The RTL8821CU-CG provides simple legacy and 20MHz/40MHz/80MHz co-existence mechanism to ensure backward and network compatibility.

- The RTL8821CU-CG Bluetooth controller complies with Bluetooth core specification v4.2, and supports dual mode (BR/EDR + AMP + Low Energy Controllers). It is backward compatible with previous versions including v2.1 + EDR and v3.0 + HS. For BR/EDR, it can support scatternet topology up to four active links in slave mode, and seven active links in master mode. For Low Energy, it supports multiple states and allows eight active links in master mode. Both BR/EDR and LE can operate simultaneously.

Features

- **General Information**
  - CMOS MAC, Baseband PHY and RF in a single chip for IEEE 802.11a/b/g/n/ac compatible WLAN
  - Support 802.11ac 1×1,Wave-2 compliant with MU-MIMO STA mode
  - Complete 802.11n MIMO solution for 2.4GHz and 5Ghz band
- **Host Interface**
  - Complies with USB 2.0 for WLAN and BT controller
  - USB Multi-Function for both BT (USB function 0) and WLAN (USB function 1)
- **Standards Supported**
  - IEEE 802.11a/b/g/n/ac compatible WLAN n IEEE 802.11e QoS Enhancement (WMM) n IEEE 802.11i (WPA, WPA2). Open, shared key, and pair-wise key authentication services
  - IEEE 802.11h DFS, TPC, Spectrum Measurement
- **MAC Features**
  - Frame aggregation for increased MAC efficiency (A-MSDU, A-MPDU) n Low latency immediate Block Acknowledgement (BA)
  - Long NAV for media reservation with
  - Maximum PHY data rate up to 86.7Mbps using 20MHz bandwidth, 200Mbps using 40MHz bandwidth, and 433.3Mbps using
    80MHz bandwidth.
  - Backward compatible with 802.11a/b/g devices while operating at 802.11n data rates
  - Backward compatible with 802.11a/n devices while operating at 802.11ac data rates.
  - USB LPM/Selective Suspend supported
  - IEEE 802.11k Radio Resource Measurement
  - WAPI (Wireless Authentication Privacy Infrastructure) certified.
  - Cisco Compatible Extensions (CCX) for WLAN devices
  - PHY-level spoofing to enhance legacy compatibility
  - Channel management and co-existence n Multiple BSSID feature allows the RTL8821CU-CG to assume multiple MAC CF-End for NAV release
  - Transmit Opportunity (TXOP) Short Inter-Frame Space (SIFS) bursting for higher multimedia bandwidth
  - WiFi Direct supports wireless peer to peer applications.
  - WiFi NAN (Neighborhood Area Network) support
- **Other Features**

- Supports Wake-On-WLAN via Magic Packet and Wake-up frame
- Transmit Beamforming
- Support S3/S4 AES/TKIP group key update

- **Peripheral Interfaces**
  - Up to 15 General Purpose Input/Output pins n Three configurable LED pins (mux with GPIO pins)
- **PHY Features**
  - IEEE 802.11ac OFDM
  - IEEE 802.11n OFDM
  - One Transmit and One Receive path
  - 5MHz / 10MHz / 20MHz / 40MHz / 80MHz bandwidth transmission
  - Support 2.4GHz and 5GHz band channels n Short Guard Interval (400ns)
  - Sounding packet.
  - DSSS with DBPSK and DQPSK, CCK modulation with long and short preamble n OFDM with BPSK, QPSK, 16QAM, 64QAM and 256QAM modulation.
- **Bluetooth Controller**
  - Compatible with Bluetooth 2.1+EDR n Support Bluetooth 4.2 system
  - Integrated MCU to execute Bluetooth protocol stack
  - Supports all packet types in basic rate and enhanced data rate
  - Supports piconets in a scatternet identities when used as a wireless bridge n WiFi FTM (Fine Time Measurement) supported
  - WiFi TDLS (Tunneled Direct Link Setup) Supported
  - Support Network List Offload
  - CCA on secondary through RTS/CTS handshake.
  - Support TCP/UDP/IP checksum offload
  - Generates 40MHz clock for peripheral chip. n Single external power source 3.3V only Convolutional Coding Rate: 1/2, 2/3, 3/4,
    and 5/6
  - Maximum data rate 54Mbps in 802.11g, 150Mbps in 802.11n and 433.3bps in 802.11ac.
  - Switch diversity used for DSSS/CCK n Support STBC Receiving
  - Support LDPC Transmitting
  - Hardware antenna diversity
  - Fast receiver Automatic Gain Control (AGC)
  - On-chip ADC and DAC
  - Build-in both 2.4GHz and 5GHz PA
  - Build-in both 2.4GHz and 5GHz LNA
  - Supports Low Power Mode (Sniff/Sniff Sub-rating)
  - Enhanced BT/WIFI Coexistence Control to improve transmission quality in different profiles
  - Bluetooth 4.0 Dual Mode support: Simultaneous LE and BR/EDR
  - Supports Secure Simple Pairing
- **Bluetooth Transceiver**
  - Fast AGC control to improve receiving dynamic range
  - Supports AFH to dynamically detect channel quality to improve transmission quality
  - Integrated internal Class 1, Class 2, and Class 3 PA

- Supports multiple Low Energy states
- Supports Enhanced Power Control
- Supports Bluetooth Low Energy
- Integrated 32K oscillator for power management

General Specification

Model	RL-UM02WBS-8821CU-V1.0
Product Name	802.11a/b/g/n/ac USB module

Major Chipset	Realtek RTL8821CU
Standard	WIFI: 802.11a/b/g/n/ac/e/i/h BT : V2.1+ EDR and V4.2, For BR/EDR,V4.0BLE
Bus Interface	WiFi USB2.0 BT: USB2.0
Modulation Method	DSSS,DBPSK, DQPSK, CCK and OFDM (BPSK, QPSK, 16QAM, 64QAM and 256-QAM)
Frequency Band	2.4GHz ~ 2.484 GHz 4.9GHz ~ 6.0GHz
Operating Channel	WiFi 2.4GHz: 11: (Ch. 1-11) – United States 13: (Ch. 1-13) – Europe 14: (Ch. 1-14) – Japan BT 2.4GHz: Ch. 0 ~78
OS Support	Linux/Android/Windows32,64
Security	WMM, WPA, WPA2
Operating Temperature	0 ~ +60° C ambient temperature
Storage Temperature	-20 ~ 70°C ambient temperature
Humidity	5 to 90 % maximum (non-condensing)
Dimension	12.9x 12.2 x 1.6mm (LxWxH) ±0.2MM

DC Characteristics

Power Supply Characteristics

Symbol	Parameter	Minimum	Typical	Maximum	Units
VDD33	3.3V I/O Supply Voltage	3.0	3.3	3.6	V
VD10	1.05V Core Supply Voltage	0.945	1.05	1.155	V

DC Characteristics

Module	Voltage	Current Consumption (linking)
RL-UM02WBS-8821CU-V1.0	2.4G	( )
	5G	( )

Electrical Specifications

RF Characteristics for IEEE802.11b (11Mbps mode unless otherwise specified)

Items	Contents			
Specification	IEEE802.11b			
Mode	CCK 11 Mbps			
Channel frequency	2412 ~ 2484 MHz			
RX (per≤85 dBm@8%)	-85 dBm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±2 dBm)		17		dBm
EVM (≤-18)		-18		dB

RF Characteristics for IEEE802.11g (54Mbps mode unless otherwise specified)

Items	Contents			
Specification	IEEE802.11g			
Mode	OFDM 54 Mbps			
Channel frequency	2412 ~ 2484 MHz			
RX (per≤70 dBm@10%)	-70 dBm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±2dBm)		14		dBm
EVM (≤-25)		-28		dB

RF Characteristics for IEEE802.11n (BW20_MCS7)

Items	Contents			
Specification	IEEE802.11n (BW20_MCS7)			
Mode	OFDM 65 Mbps			
Channel frequency	2412 ~ 2484 MHz			
RX (per≤65 dBm@10%)	-65 dBm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±2 dBm)		13		dBm
EVM (≤-28)		-28		dB

RF Characteristics for IEEE802.11n (BW40_MCS7)

Items	Contents			
Specification	IEEE802.11n (BW40_MCS7)			
Mode	OFDM 135 Mbps			
Channel frequency	2412 ~ 2484 MHz			
RX (per≤65 dBm@10%)	-65 dBm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±2 dBm)		13		dBm
EVM (≤-28)		-28		dB

RF Characteristics for IEEE802.11ac (BW40_MCS7)

Items	Contents			
Specification	IEEE802.11ac (BW40_MCS7)			
Channel frequency	4.9GHz ~ 6.0GHz			
RX (per≤61 dBm@10%)	-60 dBm			
Freq.Error(±10ppm)	±10ppm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±2 dBm)		11		dBm
EVM (≤-30)		-30		dB

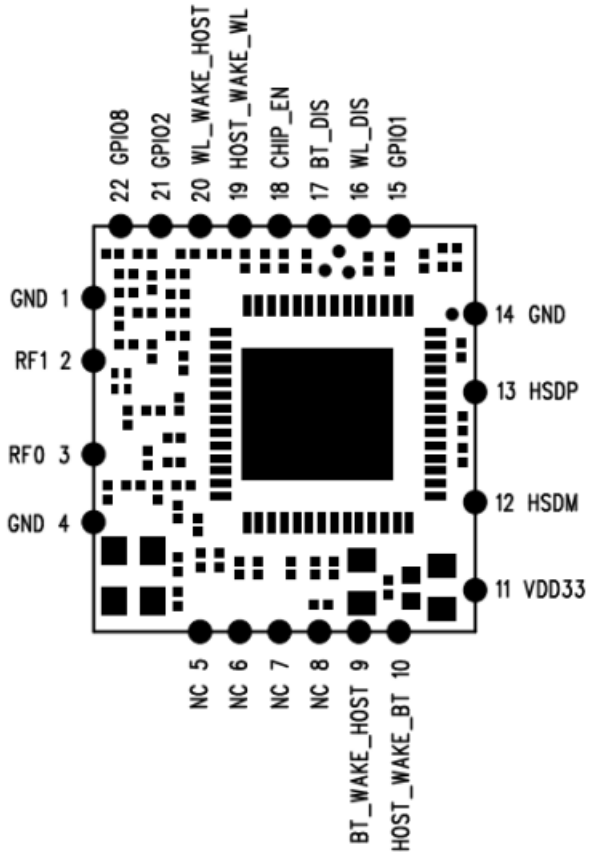
RF Characteristics for IEEE802.11ac (BW80_MCS9)

Items	Contents			
Specification	IEEE802.11ac (BW80_MCS9)			
Channel frequency	4.9GHz ~ 6.0GHz			
RX (per≤59 dBm@10%)	-57 dBm			
Freq.Error(±10ppm)	±10ppm			
TX Characteristics	Min.	Typ.	Max.	Unit
Power Level (±2 dBm)		11		dBm
EVM (≤-32)		-32		dB

Bluetooth Specification

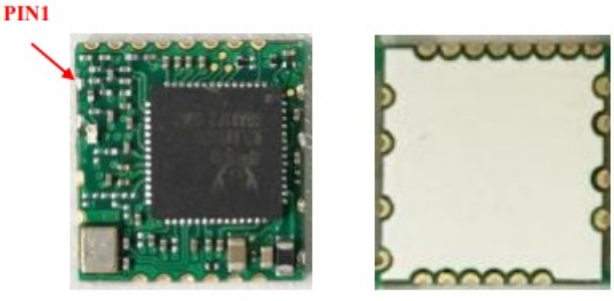
Feature	Description		
General Specification			
Bluetooth Standard	Bluetooth V3.3 of 1, 2 and 3 Mbps.		
Host Interface	USB 2.0		
Antenna Reference	Small antennas with 0~2 dBi peak gain		
Frequency Band	2.400 GHz ~ 2483.5 GHz		
Number of Channels	79 channels		
Modulation	FHSS, GFSK, DPSK, DQPSK		
RF Specification			
	Min	Typical	Max
Output Power (Class 1.5)	-6	8	10
Output Power (Class 2)		2	
Sensitivity @ BER=0.1% for GFSK (1Mbps)		-89	
Sensitivity @ BER=0.01% for π/4-DQPSK (2Mbps)		-85	
Sensitivity @ BER=0.01% for 8DPSK		-83	

Pin Definition



Pin	Definition	Description
1	GND	GND
2	RF1	WIFI 2.4G ANT /BT&5G ANT
3	RF0	NC
4	GND	GND

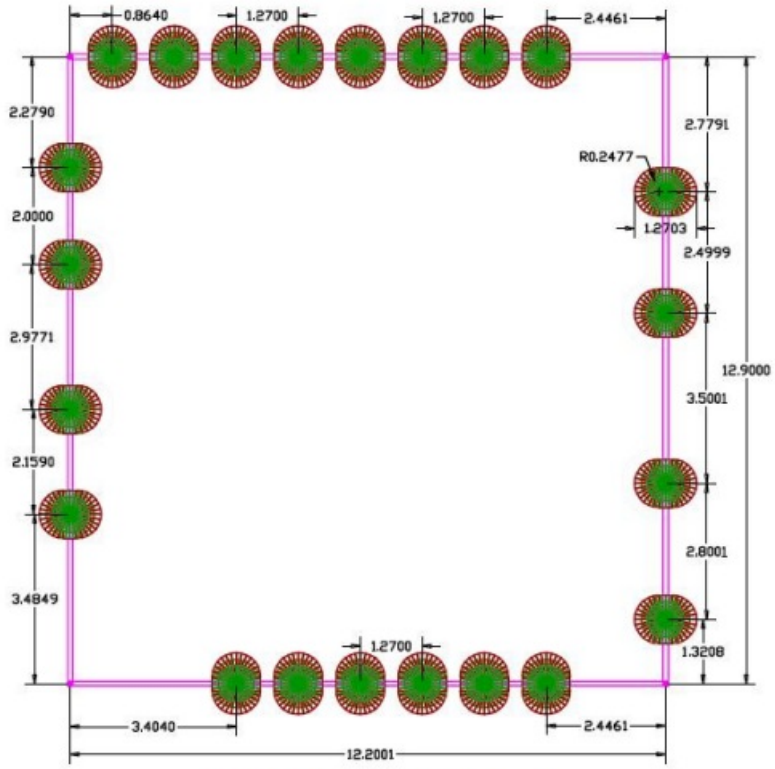
5~8	NC	NC
9	BT_WAKE_HOST	GPIO14
10	HOST_WAKE_BT	GPIO13
11	VDD33	3.3V
12	HSDM	High-Speed USB D- Signal
13	HSDP	High-Speed USB D+ Signal
14	GND	GND
15	GPIO1	PCM data Out, shared with GPIO1
16	WL_DIS	Shared with GPIO9. This pin can externally shut down the RTL8821CU-CG WLAN function when WL_DIS# is pulled low. When this pin is pulled low, USB interface will be disabled. This pin can also be configured as the WLAN Radio-off function with host interface remaining connected.
17	BT_DIS	Shared with GPIO11. This pin can externally shut down the RTL8821CU-CG BT function when BT_DIS# is pulled Low. When this pin is pulled low, USB interface will be also disabled. This pin can be also defined as the BT Radio-off function with host interface remaining connected.
18	CHIP_EN	This Pin Can externally shut down the RTL8821CU-CG (No Extra Power Switch Required). When this function is not required, external pull high is required
19	HOST_WAKE_WL	GPIO7
20	WL_WAKE_HOST	GPIO6
21	GPIO2	PCM Synchronization control, shared with GPIO2
22	GPIO8	GPIO8



The picture of top The picture of bottom

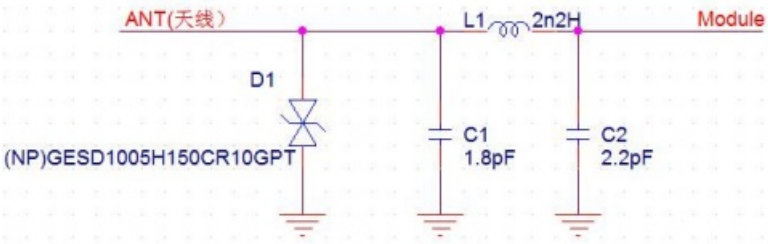
Size reference

Dimensions (mm)	Length	Width	Height
	12.9	12.2	1.6
	(Tolerance:±0.2mm)	**(Tolerance:±0.2mm)**	**(Tolerance:±0.2mm)**



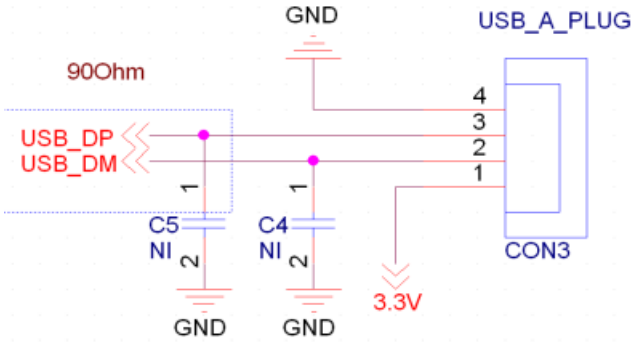
The PCB tolerances within + / -0.2 or so

WIFI RF Circuit reference pictures



1. Above the dotted box part of the antenna matching is needed, the actual antenna matching electronic parameters shall prevail.
2. For RF part layout to do 50 ohm impedance. can’t go on 90°of layout .The line length can’t more than 20 mm.

USB interface electrical characteristics



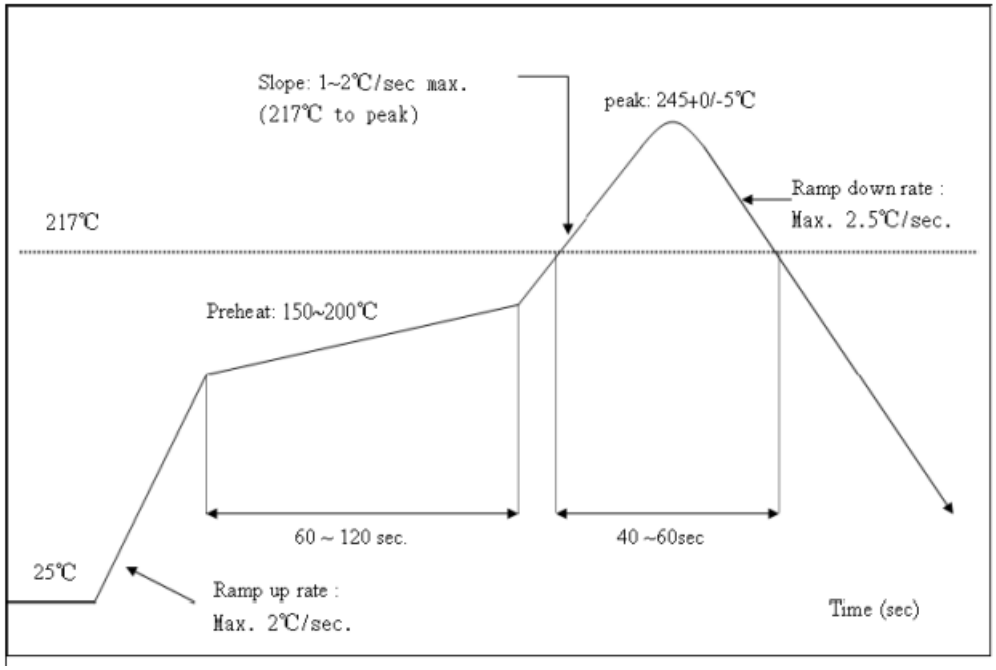
Note:

1. Two root go line do difference , but also required to make 90Ohm the impedance test.e get lock can do
2. Suggested that leave a power switch power supply input terminal ,every tim a electric power is on

Recommended Reflow Profile

Referred to IPC/JEDEC standard.

- Peak Temperature : <250°C
- Number of Times : ≤2 times



ENVIRONMENTAL

- **Operating**
  - Operating Temperature: 0°C to +60 °C
  - Relative Humidity: 90% (non-condensing)
- **Storage**
  - Temperature: -20°C to +70°C (non-operating)
  - Relevant Humidity: 5-95% (non-condensing)

RoHS compliance

This product is RoHS compliance.

- **Wireless module before the SMT note:**
  - When customers Open stencil must be sure the hole bigger to the Wireless module plate, please press 1 to 1 and 0.7 mm is widened to open outward, the thickness of 0.12 mm.
  - Can’t get the wifi module bare hands when needs,must we wear the gloves and static ring.
  - The furnace temperature according to the size of the customer the mainboard ,generally like to stick on a tablet standard temperature of 250 + – 5,can do 260 + – 5.
- **Storage and use Wifi module control should pay attention to the following matters:**
- Module of the storage life of vacuum packaging
  - Storage life 12 months. Storage conditions:<40℃. Relative humidity:<90%R.H.
  - After this bag is opened , devices that will be subjected to infrared reflow, vWIFIor-phase reflow, or equivalent processing must be :
  - .Check the humidity card :stored at ≦20%RH.If :30%~40%(pink)or greater than 40%(red).Labeling module has moisture absorption.
    - Mounthed within 168 hours at factory conditions of: t≦30%℃ ≦ 60%R.H.
    - Once opened, the workshop the preservation of life for 168 hours. 1-4.If baking is required,devices may be baked for:
      - Modules must be to remove module moisture problem.
      - Baking temperature: 125 ℃, 8 hours.
      - After baking, put proper amount of desiccant to seal packages.
  - The actual number of module vacuum packing which is based on the actual number of packages to the customer requirements.
- **Module reel packaging items as follows.**
  - .Storage life 12 months. Storage conditions:<40℃. Relative humidity:<90%R.H.
  - .Module WIFIart packing after 168 hours To launch patch need to bake, to remove the module hygroscopic, baking temperature conditions 125℃ 8hours.
  - The actual number of module reel packing which is based on the actual number of packages to the customer requirements.
- **Module pallet packaging items as follows**
  - .Storage life 3 months. Storage conditions:<40℃. Relative humidity:<90%R.H.
  - .Module if not used within 48 hours, before launch the need for baking, baking temperature: 125 ℃, 8 hours.
  - Pallet packaging each plate is 100 PCS.The actual number of module pallet packing which is based on the actual number of packages to the customer requirements.

Federal Communication Commission Interference Statement

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 canradiate 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 particularinstallation. 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.IIncrease 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 Caution (15.19 statement)**
  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 Radiation Exposure Statement:**
  This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment
  should be installed and operated with minimum distance 20cm between the radiator & your body.
- **RF exposure statement:**
  - IC Radiation Exposure Statement
    This equipment complies with IC RSS-102 radiation exposure limit set forth for an uncontrolled environment. This
    equipment should be installed and operated with minimum distance 20cm between the radiator and your body.
- **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. Custom design antennas may be used, however the OEM installer must following the FCC 15.21 requirements and verify if new FCC approval will be necessary.
- **End product labeling**
  This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains FCC ID: XXXYYYYYYYYYY”.
- **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.
- **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 antenna must be installed such that 20 cm is maintained between the antenna and users, and 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.

- For all products market in US, OEM has to limit the operation channels in Channel 1 to Channel 11 or 3-9 as specified above
  by the supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory
  Domain change.
- As long as 3 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.).

- **Important Notes:**
  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

Documents / Resources

	NOMVDIC ND10005 RF Module [pdf] User Manual ND10005, 2A4GSND10005, VS17803, RF Module, ND10005 RF Module