# SDIO PRODUCT SPECIFICATION

**IEEE 802.11 b/g/n 2.4GHz 1T1R WiFi Module**

## TL8189FBA

## Single Module

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# 1.General Description

The Realtek RTL8189FTV is a highly integrated single-chip 802.11n Wireless LAN (WLAN) network SDIO interface (SDIO 1.1/ 2.0 compliant) controller. It is a WLAN MAC, a 1T1R capable WLAN baseband, and WLAN RF in a single chip. The RTL8189FTV provides a complete solution for a high throughput performance integrated wireless LAN device.

The RTL8189FTV WLAN baseband implements Orthogonal Frequency Division Multiplexing (OFDM) with 1 transmit and 1 receive path and is compatible with the IEEE 802.11n specification. Features include one spatial stream transmission, short guard interval (GI) of 400ns, spatial spreading, and transmission over 20MHz and 40MHz bandwidth.

For legacy compatibility, Direct Sequence Spread Spectrum (DSSS), Complementary Code Keying (CCK) and OFDM baseband processing are included to support all IEEE 802.11b and 802.11g data rates. Differential phase shift keying modulation schemes, DBPSK and DQPSK with data scrambling capability, are available, and CCK provides support for legacy data rates, with long or short preamble. The high-speed FFT/IFFT paths, combined with BPSK, QPSK, 16QAM, and 64QAM modulation of the individual subcarriers and rate compatible punctured convolutional coding with coding rate of 1/2, 2/3, 3/4, and 5/6, provide higher data rates of 54Mbps and 150Mbps for IEEE 802.11g and 802.11n OFDM respectively.

The RTL8189FTV WLAN Controller 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.

Efficient IQ-imbalance, DC offset, phase noise, frequency offset, and timing offset compensations are provided for the radio frequency front-end. Selectable digital transmit and receive FIR filters are provided to meet transmit spectrum mask requirements and to reject adjacent channel interference, respectively.

The RTL8189FTV WLAN Controller supports fast receiver Automatic Gain Control (AGC) with synchronous and asynchronous control loops among antennas, antenna diversity functions, and adaptive transmit power control function to obtain the better performance in the analog portions of the transceiver.

The RTL8189FTV WLAN MAC supports 802.11e for multimedia applications, 802.11i for security, and 802.11n for enhanced MAC protocol efficiency. Using packet aggregation techniques such as A-MPDU with BA and A-MSDU, protocol efficiency is significantly improved. Power saving mechanisms such as Legacy Power Save, and U-APSD, reduce the power wasted during idle time, and compensates for the extra power required to transmit OFDM. The RTL8189FTV provides simple legacy and 20MHz/40MHz co-existence mechanisms to ensure backward and network compatibility.

## 2.Features

**General**
- CMOS MAC, Baseband PHY, and RF in a single chip for IEEE 802.11b/g/n compatible WLAN
- Complete 802.11n solution for 2.4GHz band
- 72.2Mbps receive PHY rate and 72.2Mbps transmit PHY rate using 20MHz bandwidth
- 150Mbps receive PHY rate and 150Mbps transmit PHY rate using 40MHz bandwidth
- Compatible with 802.11n specification
- Backward compatible with 802.11b/g devices while operating in 802.11n mode

**Host Interface**
- Complies with SDIO 1.1/ 2.0 for WLAN with clock rate up to 100MHz
- GSPI interface for configurable endian for WLAN

**Standards Supported**
- IEEE 802.11b/g/n compatible WLAN
- IEEE 802.11e QoS Enhancement (WMM)
- 802.11i (WPA, WPA2). Open, shared key,and pair-wise key authentication services
- Switch diversity for DSSS/CCK
- Hardware antenna diversity in per packet base
- Selectable receiver FIR filters
- Programmable scaling in transmitter and receiver to trade quantization noise against increased probability of clipping

**WLAN MAC Features**
- Frame aggregation for increased MAC efficiency (A-MSDU, A-MPDU)
- Low latency immediate High-Throughput Block Acknowledgement (HT-BA)
- PHY-level spoofing to enhance legacy compatibility
- Power saving mechanism
- Channel management and co-existence
- Transmit Opportunity (TXOP) Short Inter-Frame Space (SIFS) bursting for higher multimedia bandwidth

**WLAN PHY Features**
- IEEE 802.11n OFDM
- One Transmit and one Receive path (1T1R)
- 20MHz and 40MHz bandwidth transmission
- Short Guard Interval (400ns)
- DSSS with DBPSK and DQPSK, CCK modulation with long and short preamble
- OFDM with BPSK, QPSK, 16QAM, and 64QAM modulation. Convolutional Coding Rate: 1/2, 2/3, 3/4,and 5/6
- Maximum data rate 54Mbps in 802.11g and 150Mbps in 802.11n
- Fast receiver Automatic Gain Control
- (AGC)
- On-chip ADC and DAC

**Peripheral Interfaces**
- General Purpose Input/Output (4 pins)

# 3.PRODUCT SPECIFICATIONS

**Realtek RTL8189FTV.** Functional Specifications

| | |
|---|---|
| **Standards** | IEEE 802.11b, IEEE 802.11g, Draft IEEE 802.11n, IEEE 802.11d, IEEE 802.11e, IEEE 802.11h, IEEE 802.11i |
| **Bus Interface** | *WiFi:* GSPI/SDIO |
| **Media Access Control** | CSMA/CA with ACK |
| **Network Architecture** | Ad-hoc mode (Peer-to-Peer )<br>Infrastructure mode<br>Scatter Net |
| **Operating Channel** | 11: (Ch. 1-11) – United States<br>13: (Ch. 1-13) – Europe<br>14: (Ch. 1-14) – Japan |
| **Frequency Range** | 2.400GHz ~ 2.484 GHz |
| **Security** | WPA,WPA-PSK,WPA2,WPA2-PSK,WEP64bit&128bit,IEEE802.11x, IEEE 802.11i |
| **Operating Voltage** | 3.3 V ±9% I/O supply voltage |
| **OS supported** | Windows XP/Win7/Linux/Android |

# 4.DC Characteristics

1） Power Supply Characteristics

| Symbol | Parameter | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|
| VDD33(pin#9) | 3.3V Power Supply Voltage | 3.0 | 3.3 | 3.6 | V |
| IDD33 | 3.3V Rating Current | - | - | 600 | mA |

2） Digital IO Pin DC Characteristics

| Symbol | Parameter | | Minimum | Typical | Maximum | Units |
|---|---|---|---|---|---|---|
| VDDIO(pin#22) | 3.3V I/O Power Voltage | $V_{IH}$ | 2.0 | 3.3 | 3.6 | V |
| | | $V_{IL}$ | -- | 0 | 0.9 | V |
| | | $V_{OH}$ | 2.97 | -- | 3.3 | V |
| | | $V_{OL}$ | 0 | -- | 0.33 | V |
| | 1.8V I/O Power Voltage | $V_{IH}$ | 1.7 | 1.8 | 2.0 | V |
| | | $V_{IL}$ | -- | 0 | 0.8 | V |
| | | $V_{OH}$ | 1.62 | -- | 1.8 | V |
| | | $V_{OL}$ | 0 | -- | 0.18 | V |
| CS(PIN#12) | Chip select | $V_{IH}$ | 2.0 | 3.3 | 3.6 | V |
| | | $V_{IL}$ | -- | 0 | 0.9 | V |
| WL_HOST_WAKE (PIN#13) | WLAN wake-up HOST | $V_{OH}$ | 2.97 | -- | 3.3 | V |
| | | $V_{OL}$ | 0 | -- | 0.33 | V |

# 5.RF Electrical Specifications

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

| **Items** | **Contents** | | | |
|---|---|---|---|---|
| Specification | IEEE802.11b | | | |
| Mode | CCK, DQPSK, DBPSK | | | |
| Data Rate | 11, 5.5, 2, 1 Mbps | | | |
| Channel frequency | 2412 ~ 2484 MHz | | | |
| RX (per≤-85dBm@8%) | -85 dBm | | | |
| Freq Err Limit | ±13ppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (17±2 dBm) | | 17 | | dBm |
| EVM (<-18) | | -18 | | dB |

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

| **Items** | **Contents** | | | |
|---|---|---|---|---|
| Specification | IEEE802.11g | | | |
| Mode | *64 QAM, 16 QAM, QPSK, BPSK* | | | |
| Data Rate | 54, 48, 36, 24, 18, 12, 9, 6 Mbps | | | |
| Channel frequency | 2412 ~ 2484 MHz | | | |
| RX (per≤-70dBm@10%) | -70 dBm | | | |
| Freq Err Limit | ±13ppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (14±2 dBm) | | 14 | | dBm |
| EVM (<-28) | | -28 | | dB |

## 3）RF Characteristics for IEEE802.11n

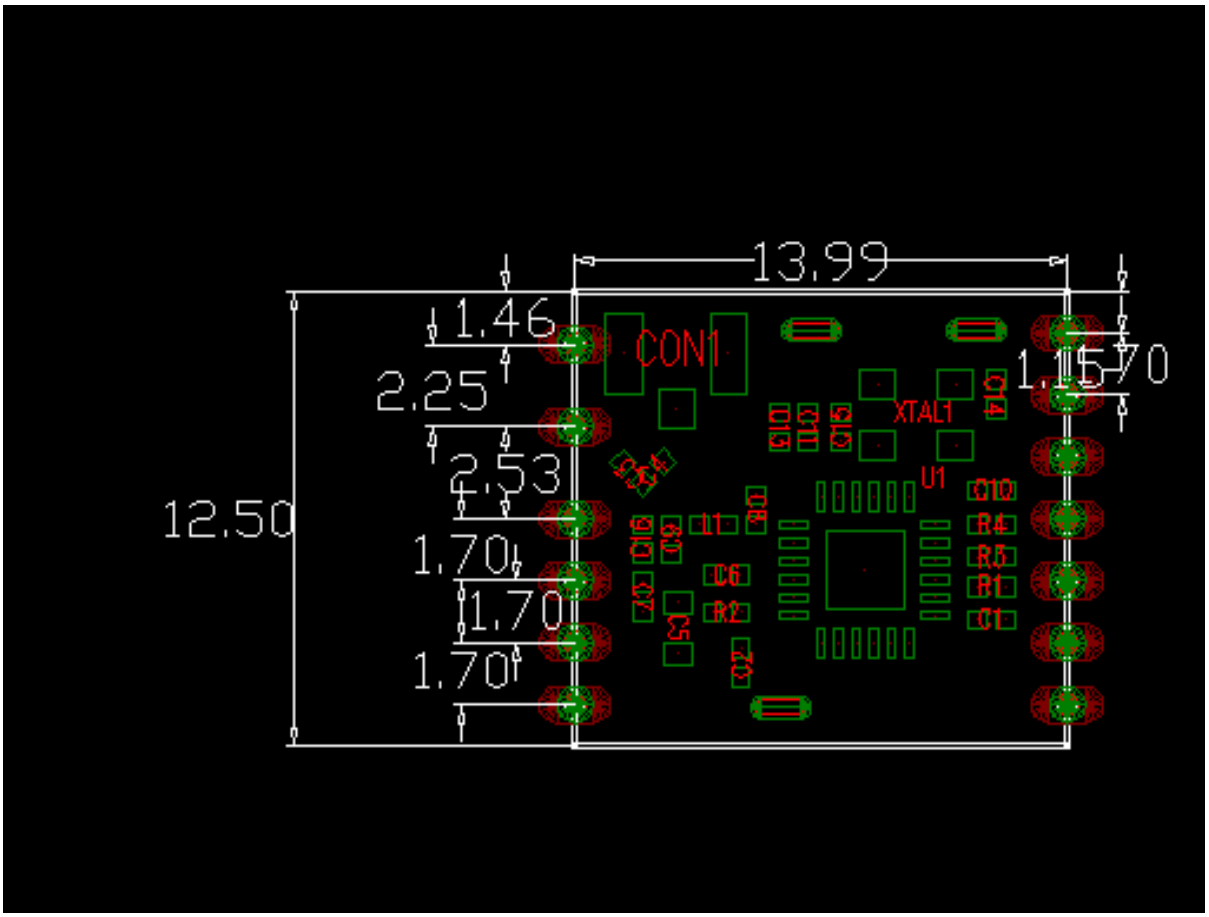
| **Items** | **Contents** | | | |
|---|---|---|---|---|
| Specification | IEEE802.11n （ MCS 0 to 7 for HT20MHz ） | | | |
| Mode | 64 QAM, 16 QAM, QPSK, BPSK | | | |
| Data Rate | 65 Mbps | | | |
| Channel frequency | 2412 ~ 2484 MHz | | | |
| RX (per≤-65dBm@10%) | -65 dBm | | | |
| Freq Err Limit | ±13ppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (13±2 dBm) | | 13 | | dBm |
| EVM (<-28) | | -28 | | dB |

4）RF Characteristics for IEEE802.11n

| Items | Contents | | | |
|---|---|---|---|---|
| Specification | IEEE802.11n （MCS 0 to 7 for HT40MHz ） | | | |
| Mode | 64 QAM, 16 QAM, QPSK, BPSK | | | |
| Data Rate | 135 Mbps | | | |
| Channel frequency | 2412 ~ 2484 MHz | | | |
| RX (per≤-65dBm@10%) | -65 dBm | | | |
| Freq Err Limit | ±13ppm | | | |
| TX Characteristics | Min. | Typ. | Max. | Unit |
| Power Level (13±2 dBm) | | 13 | | dBm |
| EVM (<-28) | | -28 | | dB |

# 6.Mechanical

| Dimensions (mm) | Length | Width | Height |
|---|---|---|---|
| | 13.99 **(Tolerance:±0.2mm)** | 12.50 **(Tolerance:±0.2mm)** | 1.6 **(Tolerance:±0.2mm)** |



# 7.Block Diagram

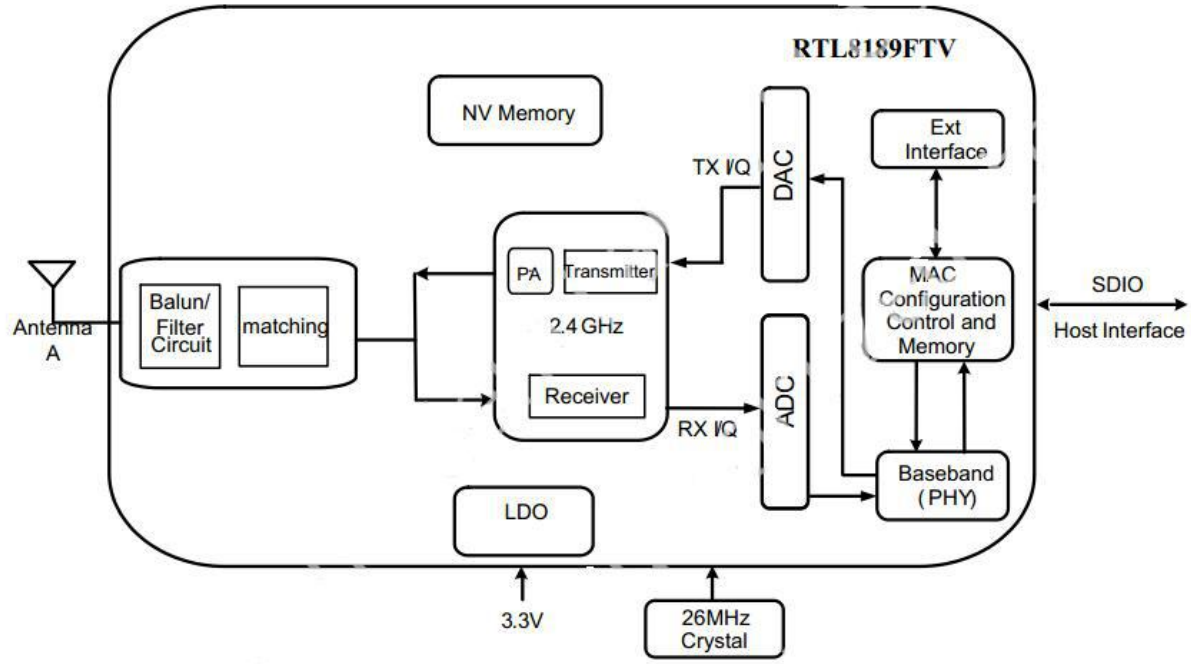
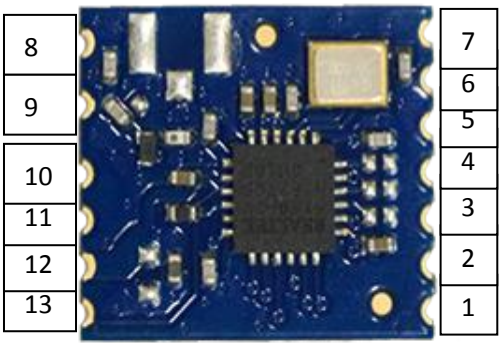
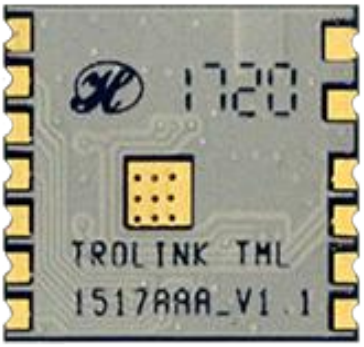



**Figure 1. Single-Band 11n (1x1) Solution**

*Default this module only require 3.3V single power source and core voltage generated by internal voltage regulator.*

# 8.Module PIN feet definition figure

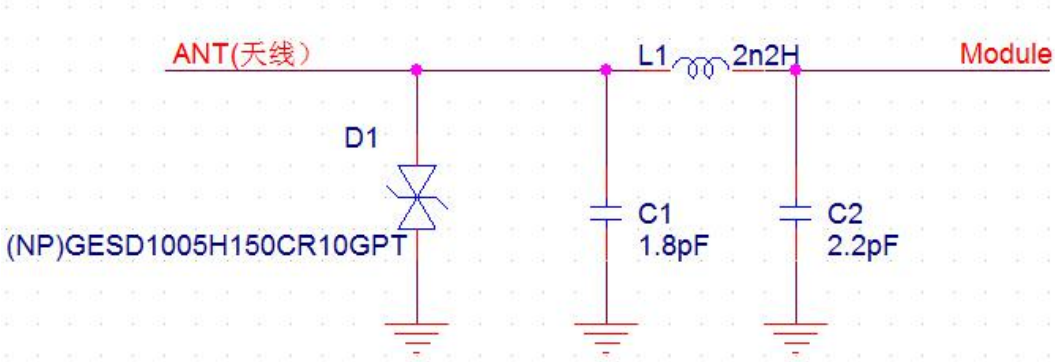


## Pin Definition

| Pin name | Pin number | I/O | Description | Comment |
|---|---|---|---|---|
| **Power supply** | | | | |
| VCC_3V3 | 12 | I | Power supply | 3.3V TYP |
| VIO | 11 | I | Power supply for I/O | 1.62 -3.3V |
| GND | 7 8 14 | | Ground | |
| **Power on/down** | | | | |
| CS | 13 | I | Power down select | |
| WAKE | 10 | I | WLAN wake. | |
| **SDIO interface** | | | | |
| SDIO_CLK | 6 | I/O | SDIO clock / GSPI clock | |
| SDIO_CMD | 1 | I/O | SDIO command / GSPI data input | |
| SDIO_D0 | 5 | I/O | SDIO data 0 / GSPI data output | |
| SDIO_D1 | 4 | I/O | SDIO data 1 / GSPI Data Out | |
| SDIO_D2 | 3 | I/O | SDIO data 2 | |
| SDIO_D3 | 2 | I/O | SDIO data 3 / GSPI chip select | |
| **RF interface** | | | | |
| WL_ANT | 9 | I/O | WLAN radio antenna pad | Impedance must be controlled to 50Ω. |

## 9.1 WIFI\BT RF Circuit reference pictures.

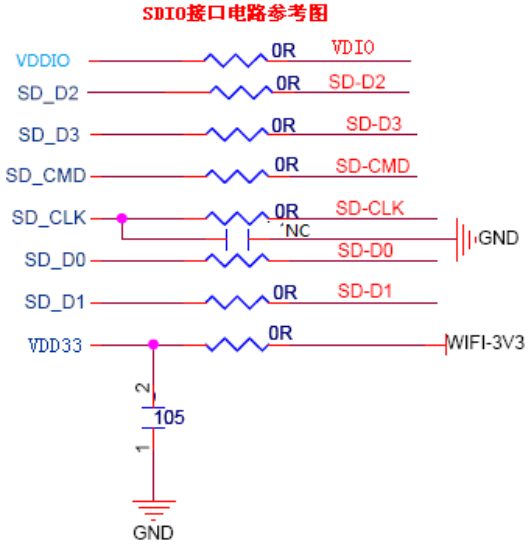



1. Above the dotted box part of the antenna matching is needed, the actual antenna matching electronic parameters shall prevail.

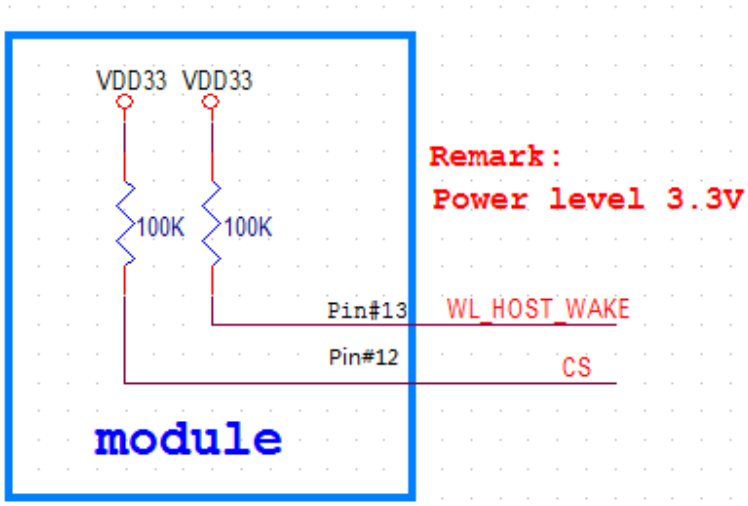
2.For RF part layout to do 50 ohm impedance. can't go on 90° of layout .The line length can't more than 20 mm.

**注明：请一定要在焊天线端加一个 TVS 管，防止 ESD 静电打坏 WIFI 模组（如上图参考电路）.**

## 9.2 SDIO interface Circuit reference pictures.




## 9.3 CS WAKE Reference circuits.




## 10.Recommended Reflow Profile.

Referred to IPC/JEDEC standard.
Peak Temperature : <250°C

# Environmental Requirements and Specifications TP Content

## 1 Temperature

### 1.1 Operating Temperature Conditions

The product shall be capable of continuous reliable operation when operating in ambient temperature of -10℃ to +70℃.

### 1.2 Non-Operating Temperature Conditions

Neither subassemblies shall be damaged nor shall the operational performance be degraded when restored to the operating temperature when exposed to storage temperature in the range of -45℃ to +135℃.

## 2 PCB Bending

The PCB bending spec shall be keep planeness under 0.1mm for both NATER and end assembly customer.

## 3 Handling environment

### 3.1. ESD

| Symbol | Ratings | Max | Unit |
|---|---|---|---|
| $V_{ESD}$(HBM) | Electrostatic discharge voltage (human body model) | 2000 | V |
| $V_{ESD}$(CDM) | Electrostatic discharge voltage (charge device model) | 500 | |

Please handle it under ESD protection environment.

### 3.2. Terminals

The product is mounted with motherboard through half hole. In order to prevent poor soldering, please do not touch the pad by hand.

### 3.3. Falling

It will cause damage on the mounted components when the product is falling or receiving drop shock. It may cause the product mal-function.

# 4 Storage Condition

## 4.1 Moisture barrier bag before opened

Moisture barrier bag must be stored under 30 degree C, humidity under 85% RH. The calculated shelf life for the dry packed product shall be a 12 months from the bag seal date.

## 4.2. Moisture barrier bag open

Humidity indicator cards must be blue, <30%.

# 5 Baking Condition

Products require baking before mounting if

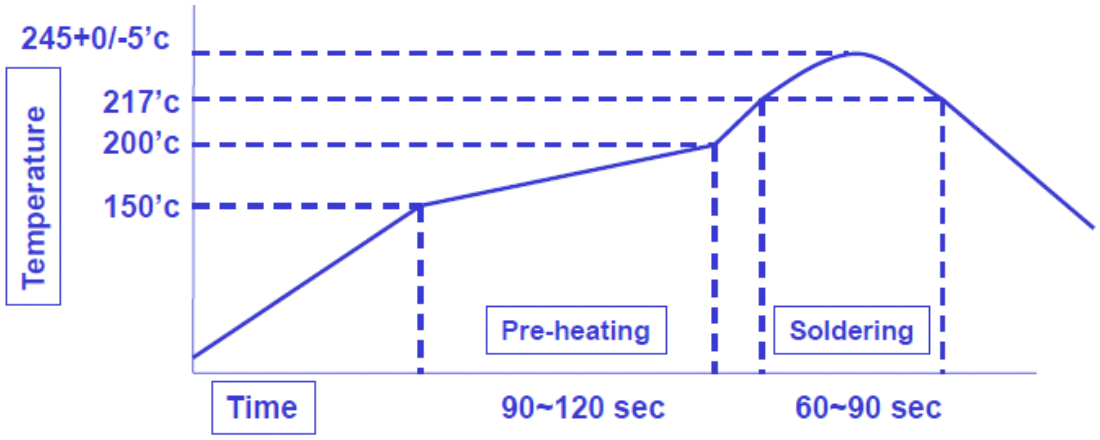
a) humidity indicator cards reads >30%

b) temp <30 degree C, humidity < 70% RH, over 96 hours

Baking condition: 90 degree C, 12-24 hours

Baking times: 1 time

# 6 Soldering and reflow condition




- Follow the solder paste composition to set the reflow profile
- Lead free solder paste(SAC305, SAC387 or SAC405) reflow profile setting as above :
  - Ramp up rate (to Peak temp) : < 1.2'c/sec, typically
  - Time above Liquidus(217'C) : 60~90Sec
  - Peak Temp : 245+0/-5'C
  - Ramp-down rate (Peak to RT) : 1~3'C/sec, typically