

Wi-Fi6+BT5.3 Combo Module

EWN-8852DET3CA

IEEE 802.11ax/ac/a/b/g/n compatible 2T2R DBCC WLAN + Bluetooth 5.3
with PCI Express/HS-UART mixed interface Module



APPROVAL

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1 General Specifications

The module provides a complete solution for a high-performance integrated wireless and Bluetooth device. It supports 2-stream 802.11ax solutions with Multi-user MIMO (Multiple- Input, Multiple-Output) with Wireless LAN (WLAN) PCI Express network interface controller with Bluetooth 5 HS-UART interface controller. The module complies with IEEE 802.11 ax/ac/a/b/g/n 2T2R MIMO standard, and Provides up to 2402Mbps for IEEE802.11ax MIMO OFDM. The module supports both 2.4GHz and 5GHz band channels, with the 2.4GHz band using the RTL8852DE's internal integrated FEM and the 5GHz band using external FEM (Front End Module).

2 Features

2.1 WLAN

- ❖ IEEE802.11a/b/g/n/ac/ax compatible WLAN
- ❖ Supports 802.11ac 2x2, Wave-2 compliant with MU-MIMO
- ❖ Support 2.4GHz and 5GHz band channels, nonsupport the 6GHz band
- ❖ Support Dual band concurrent (2.4GHz 1x1 SISO + 5GHz 1x1 SISO)
- ❖ Complies with PCI Express Base Specification Revision 2.1
- ❖ PCIe LTR/L1. Off state supported
- ❖ Maximum PHY data rate up to 286.8Mbps using 20MHz bandwidth, 573.5Mbps using 40MHz bandwidth, and 1201Mbps using 80MHz bandwidth, and 2402Mbps using 160MHz bandwidth
- ❖ Maximum data rate 54Mbps in 802.11g, 300Mbps in 802.11n and 866.7Mbps in 802.11ac, 2402Mbps in 802.11ax
- ❖ Backward compatible with 802.11a/b/g devices while operating at 802.11n data rates
- ❖ Backward compatible with 802.11a/n/ac devices while operating at 802.11ax data rates
- ❖ IEEE802.11e QoS Enhancement(WMM)
- ❖ IEEE802.11i (WPA, WPA2, WPA3). Open, shared key, and pair-wise key authentication services
- ❖ IEEE 802.11h DFS, TPC, Spectrum Measurement
- ❖ IEEE 802.11k Radio Resource Measurement
- ❖ Channel management and co-existence
- ❖ Wi-Fi Direct supports wireless peer to peer applications. Support BSR and queue size of Qos
- ❖ Support DFS, Channel info, PPDU state by RX path
- ❖ Support TWT function for power saving

- ❖ Support S3/S4 AES/TKIP group key update
- ❖ FTM support distance measurement
- ❖ Support Network List Offload
- ❖ Supports TCP/UDP/IP checksum offload
- ❖ DSSS with DBPSK and DQPSK, CCK modulation with long and short preamble
- ❖ OFDM with BPSK, QPSK, 16QAM, 64QAM, 256QAM and 1024QAM modulation. Convolutional Coding Rate: 1/2, 2/3, 3/4 and 5/6

2.2 Bluetooth

- ❖ Complies with HS-UART with configurable baud rate for Bluetooth
- ❖ Supports Bluetooth 5 Systems (BT 5.3 Logo compliant)
- ❖ Compatible with Bluetooth v2.1+EDR
- ❖ Supports all packet type in basic rate and enhanced data rate
- ❖ Supports Secure Simple Pairing
- ❖ Dual Mode support: Simultaneous LE and BR/EDR
- ❖ Supports multiple Low Energy states
- ❖ Supports Enhanced Power Control
- ❖ Integrated 32K oscillator for power management
- ❖ Supports LE Audio(BIS/CIS)

3 System Block Diagram

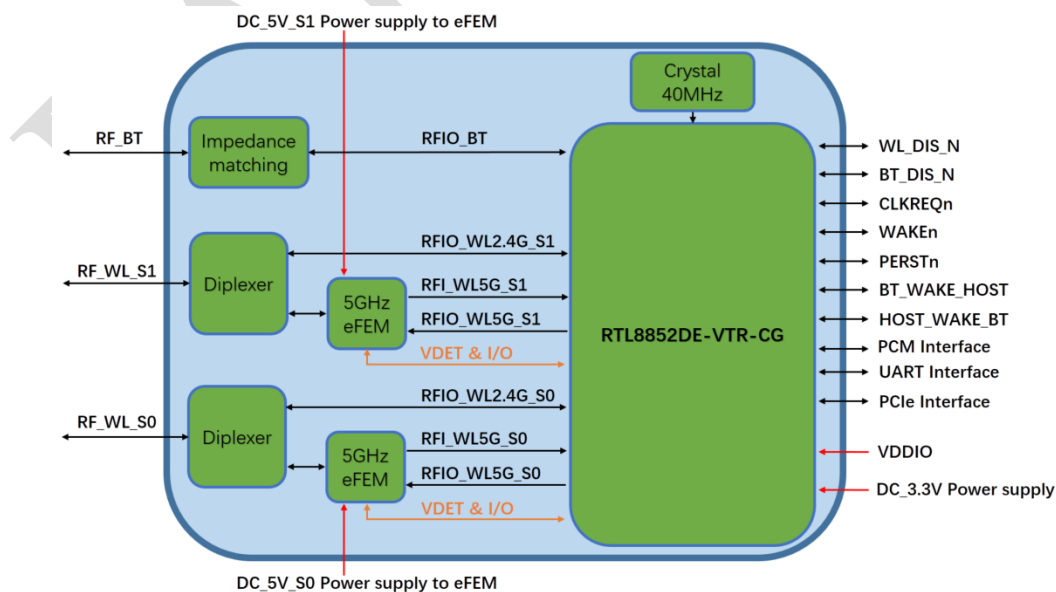


FIG 1 EWN-8852DET3CA Block Diagram

4 PHY Specification

4.1 Wi-Fi Specification

Table 1 EWN-8852DET3CA Wi-Fi RF Parameters

Protocol	IEEE 802.11b/g/n/a/ac/ax	
Interface	PCIE2.1	
Modulation	BPSK/QPSK/16QAM/64QAM/256QAM/1024QAM/DQPSK/DBPSK/CCK	
Frequency	2.4GHz band	CH1~CH13/2400 -2483.5MHz
	5GHz Band	CH36~CH48/5150-5250MHz CH52~CH64/5250-5350MHz CH100~CH144/5470-5725MHz CH149~CH165/5725-5850MHz
	2.4G & 5G Band Refer to Channel Plan Domain Code	
Bandwidth	20/40/80/160 MHz	
PHY Rate	Maximum PHY data rate up to 286.8 Mbps using 20MHz bandwidth;	
	Maximum PHY data rate up to 573.5 Mbps using 40MHz bandwidth;	
	Maximum PHY data rate up to 1201 Mbps using 80MHz bandwidth .	
	Maximum PHY data rate up to 2402 Mbps using 160MHz bandwidth .	
Frequency Error	<±10ppm	
Mask	-20dB/±11MHz/OFDM;	
	-28dB/±20MHz/OFDM;	
	-30dB/±11MHz/DSSS, CCK;	
	-50dB/±20MHz/DSSS, CCK.	
2.4G Transmit Power	802.11b (2.4G 1Mbps):	20±2dBm
	802.11b (2.4G 11Mbps):	20±2dBm
	802.11g (2.4G 6Mbps):	20±2dBm
	802.11g (2.4G 54Mbps):	18±2dBm
	802.11n (2.4G HT20 MCS0):	20±2dBm
	802.11n (2.4G HT20 MCS7):	17±2dBm
	802.11n (2.4G HT40 MCS7):	17±2dBm
	802.11ax (2.4G HE20 MCS0):	20±2dBm
	802.11ax (2.4G HE20 MCS11):	14±2dBm
	802.11ax (2.4G HE40 MCS11):	14±2dBm

All rate's TX power based on the driver configuration		
2.4G EVM	802.11b (2.4G 1Mbps):	$\leq -12\text{dB}$
	802.11b (2.4G 11Mbps):	$\leq -12\text{dB}$
	802.11g (2.4G 6Mbps):	$\leq -5\text{dB}$
	802.11g (2.4G 54Mbps):	$\leq -25\text{dB}$
	802.11n (2.4G HT20 MCS0):	$\leq -5\text{dB}$
	802.11n (2.4G HT20 MCS7):	$\leq -27\text{dB}$
	802.11n (2.4G HT40 MCS7):	$\leq -27\text{dB}$
	802.11ax (2.4G HE20 MCS0):	$\leq -5\text{dB}$
	802.11ax (2.4G HE20 MCS11):	$\leq -35\text{dB}$
	802.11ax (2.4G HE40 MCS11):	$\leq -35\text{dB}$
5G Transmit Power	802.11a(5G 6Mbps):	$20\pm 2\text{dBm}$
	802.11a(5G 54Mbps):	$18\pm 2\text{dBm}$
	802.11n (5G HT20 MCS0):	$20\pm 2\text{dBm}$
	802.11n (5G HT20 MCS7):	$18\pm 2\text{dBm}$
	802.11n (5G HT40 MCS7):	$18\pm 2\text{dBm}$
	802.11ac (5G VHT20 MCS0):	$20\pm 2\text{dBm}$
	802.11ac (5G VHT20 MCS8):	$17\pm 2\text{dBm}$
	802.11ac (5G VHT40 MCS9):	$16\pm 2\text{dBm}$
	802.11ac (5G VHT80 MCS9):	$16\pm 2\text{dBm}$
	802.11ac (5G VHT160 MCS9):	$16\pm 2\text{dBm}$
	802.11ax (5G HE20 MCS0):	$20\pm 2\text{dBm}$
	802.11ax (5G HE20 MCS11):	$16\pm 2\text{dBm}$
	802.11ax (5G HE40 MCS11):	$16\pm 2\text{dBm}$
	802.11ax (5G HE80 MCS11):	$16\pm 2\text{dBm}$
	802.11ax (5G HE160 MCS11):	$13\pm 2\text{dBm}$
	All rate's TX power based on the driver configuration	
5G EVM	802.11a(5G 6Mbps):	$\leq -5\text{dB}$
	802.11a(5G 54Mbps):	$\leq -25\text{dB}$
	802.11n(5G HT20 MCS0):	$\leq -5\text{dB}$
	802.11n(5G HT20 MCS7):	$\leq -27\text{dB}$
	802.11n(5G HT40 MCS7):	$\leq -27\text{dB}$
	802.11ac(5G VHT20 MCS0):	$\leq -5\text{dB}$

	802.11ac(5G VHT20 MCS8):	≤-30dB	
	802.11ac(5G VHT40 MCS9):	≤-32dB	
	802.11ac(5G VHT80 MCS9):	≤-32dB	
	802.11ac (5G VHT160 MCS9):	≤-32dB	
	802.11ax(5G HE20 MCS0):	≤-5dB	
	802.11ax(5G HE20 MCS11):	≤-35dB	
	802.11ax(5G HE40 MCS11):	≤-35dB	
	802.11ax(5G HE80 MCS11):	≤-35dB	
	802.11ax(5G HE160 MCS11):	≤-35dB	
2.4G Receive Sensitivity @ PER<10%	802.11b (2.4G 1Mbps):	-91dBm (Max.)	-96dBm (Typ.)
	802.11b (2.4G 11Mbps):	-85dBm (Max.)	-90dBm (Typ.)
	802.11g (2.4G 6Mbps):	-87dBm (Max.)	-92dBm (Typ.)
	802.11g (2.4G 24Mbps):	-79dBm (Max.)	-84dBm (Typ.)
	802.11g (2.4G 54Mbps):	-70dBm (Max.)	-75dBm (Typ.)
	802.11n (2.4G HT20 MCS0):	-87dBm (Max.)	-92dBm (Typ.)
	802.11n (2.4G HT20 MCS4):	-75dBm (Max.)	-80dBm (Typ.)
	802.11n (2.4G HT20 MCS7):	-69dBm (Max.)	-74dBm (Typ.)
	802.11n (2.4G HT40 MCS0):	-84dBm (Max.)	-89dBm (Typ.)
	802.11n (2.4G HT40 MCS4):	-72dBm (Max.)	-77dBm (Typ.)
	802.11n (2.4G HT40 MCS7):	-66dBm (Max.)	-71dBm (Typ.)
	802.11ax (2.4G HE20 MCS0):	-87dBm (Max.)	-92dBm (Typ.)
	802.11ax (2.4G HE20 MCS11):	-57dBm (Max.)	-62dBm (Typ.)
	802.11ax (2.4G HE40 MCS0):	-84dBm (Max.)	-89dBm (Typ.)
	802.11ax (2.4G HE40 MCS11):	-54dBm (Max.)	-59dBm (Typ.)
5G Receive Sensitivity @ PER<10%	802.11a (5G 6Mbps):	-87dBm (Max.)	-91dBm (Typ.)
	802.11a (5G 24Mbps):	-79dBm (Max.)	-83dBm (Typ.)
	802.11a (5G 54Mbps):	-70dBm (Max.)	-74dBm (Typ.)
	802.11n (5G HT20 MCS0):	-87dBm (Max.)	-91dBm (Typ.)
	802.11n (5G HT20 MCS4):	-75dBm (Max.)	-79dBm (Typ.)
	802.11n (5G HT20 MCS7):	-69dBm (Max.)	-73dBm (Typ.)
	802.11n (5G HT40 MCS0):	-84dBm (Max.)	-88dBm (Typ.)
	802.11n (5G HT40 MCS4):	-72dBm (Max.)	-76dBm (Typ.)
	802.11n (5G HT40 MCS7):	-66dBm (Max.)	-70dBm (Typ.)

	802.11ac (5G VHT20 MCS0):	-87dBm (Max.)	-91dBm (Typ.)
	802.11ac (5G VHT20 MCS5):	-71dBm (Max.)	-75dBm (Typ.)
	802.11ac (5G VHT20 MCS8):	-64dBm (Max.)	-68dBm (Typ.)
	802.11ac (5G VHT40 MCS0):	-84dBm (Max.)	-88dBm (Typ.)
	802.11ac (5G VHT40 MCS5):	-68dBm (Max.)	-72dBm (Typ.)
	802.11ac (5G VHT40 MCS9):	-59dBm (Max.)	-63dBm (Typ.)
	802.11ac (5G VHT80 MCS0):	-81dBm (Max.)	-85dBm (Typ.)
	802.11ac (5G VHT80 MCS5):	-65dBm (Max.)	-69dBm (Typ.)
	802.11ac (5G VHT80 MCS9):	-56dBm (Max.)	-60dBm (Typ.)
	802.11ac (5G VHT160 MCS0):	-78dBm (Max.)	-82dBm (Typ.)
	802.11ac (5G VHT160 MCS5):	-62dBm (Max.)	-66dBm (Typ.)
	802.11ac (5G VHT160 MCS9):	-53dBm (Max.)	-57dBm (Typ.)
	802.11ax (5G HE20 MCS0):	-87dBm (Max.)	-91dBm (Typ.)
	802.11ax (5G HE20 MCS11):	-57dBm (Max.)	-61dBm (Typ.)
	802.11ax (5G HE40 MCS0):	-84dBm (Max.)	-88dBm (Typ.)
	802.11ax (5G HE40 MCS11):	-54dBm (Max.)	-58dBm (Typ.)
	802.11ax (5G HE80 MCS0):	-81dBm (Max.)	-85dBm (Typ.)
	802.11ax (5G HE80 MCS11):	-51dBm (Max.)	-55dBm (Typ.)
	802.11ax (5G HE160 MCS0):	-78dBm (Max.)	-82dBm (Typ.)
	802.11ax (5G HE160 MCS11):	-48dBm (Max.)	-52dBm (Typ.)

4.2 BT Specification

Table 2 EWN-8852DET3CA Bluetooth RF Parameters

Protocol	BTv2.1+EDR/BT v3.0/BT v4.2/BT v5.3 (BT 5.3 Logo compliant)
Interface	UART
Frequency	2400 MHz ~ 2483.5 MHz (79 channels)
Modulation	GFSK, $\pi/4$ -DQPSK, 8-DPSK
PHY Rate	1 Mbps for Basic Rate; 2、 3 Mbps for Enhanced Data Rate; 1、 2 Mbps for BLE
Transmit Power	6dBm, typical
Receive Sensitivity	<-89dBm @ BER=0.1% for GFSK (1Mbps); <-86dBm @ BER=0.01% for $\pi/4$ -DQPSK (2Mbps); <-83dBm @ BER=0.01% for 8-DPSK (3Mbps); <-90dBm @ PER=30.8% for BLE

5 Other Specifications

Table 3 Other Specification

Operating Temperature	0℃~+70℃
Storage Temperature	Module: -20℃~+125℃ Package: -20℃~+70℃
Operating Humidity	Less than RH 95%(Non-Condensing)
Storage Humidity	Less than RH 95%(Non-Condensing)
Humidity level	Level 3
Security	WEP 64/128bit,WPA,WPA2,WPA3,TKIP,AES
Other characteristics:	QoS-WMM, WMM-PS
Operation System	Linux/Android
ESD(IEC61000-4-2)	TBD(Contact) @ RF Port

6 DC Characteristics

Table 4 DC_3.3V Power Supply Characteristics

Symbol	Parameter	Min.	Typical	Max.	Unit
DC_3.3V	3.3V Supply Voltage	3.0	3.3	3.6	V
	3.3V Rating Current	-	-	2000	mA

Table 5 DC_5V Power Supply Characteristics

Symbol	Parameter	Min.	Typical	Max.	Unit
DC_5V_S0	5V Supply Voltage	4.75	5	5.25	V
	5V Rating Current	-	-	1000	mA
DC_5V_S1	5V Supply Voltage	4.75	5	5.25	V
	5V Rating Current	-	-	1000	mA

(Note: DC_5V is the power for EFEM, so in the state of power on, DC_5V power should earlier than DC_3.3V, in the state of power off, DC_5V power should slower or than DC_3.3V)

Table 6 VDDIO Power Supply Characteristics

Symbol	Parameter	Min.	Typical	Max.	Unit
VDDIO_1.8V	1.8V Supply Voltage	1.62	1.8	1.98	V
VDDIO_3.3V	3.3V Supply Voltage	3.0	3.3	3.6	V

Table 7 3.3V IO Pin DC Characteristics

Symbol	Parameter	Min.	Typical	Max.	Unit
V _{IH}	Input high Voltage	1.4	3.3	3.6	V
V _{IL}	Input low Voltage	-	0	0.8	V
V _{OH}	Output high Voltage	2.97	-	3.3	V
V _{OL}	Output low Voltage	0	-	0.33	V

Table 8 1.8V IO Pin DC Characteristics

Symbol	Parameter	Min.	Typical	Max.	Unit
V _{IH}	Input high Voltage	1.0	1.8	3.6	V
V _{IL}	Input low Voltage	-	0	0.45	V
V _{OH}	Output high Voltage	1.62	-	1.8	V
V _{OL}	Output low Voltage	0	-	0.18	V

7 Module configurations

Module Dimension (stamp hole to stamp hole) (L*W*T): $17.5 \pm 0.2\text{mm} \times 20 \pm 0.2\text{mm} \times 2.4 \pm 0.2\text{mm}$

Module Outline Dimension (CNC splitter size) (L*W*T): $17.7 \pm 0.2\text{mm} \times 20.2 \pm 0.2\text{mm} \times 2.4 \pm 0.2\text{mm}$

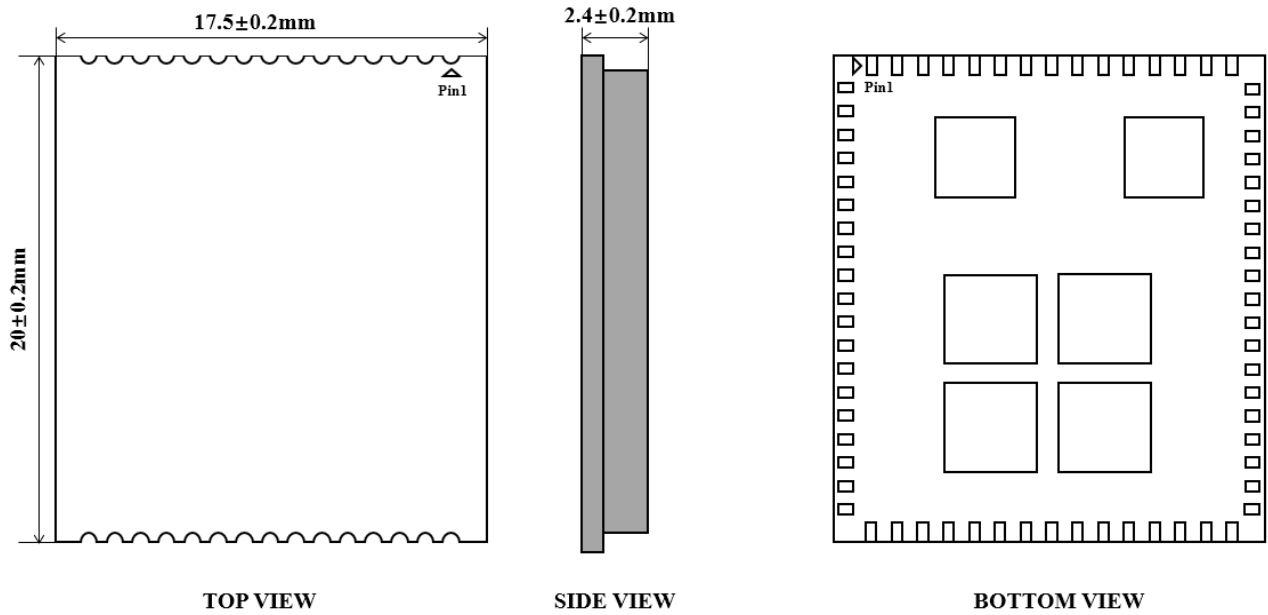


FIG 2 EWN-8852DET3CA Module Dimension

Recommended Footprint:

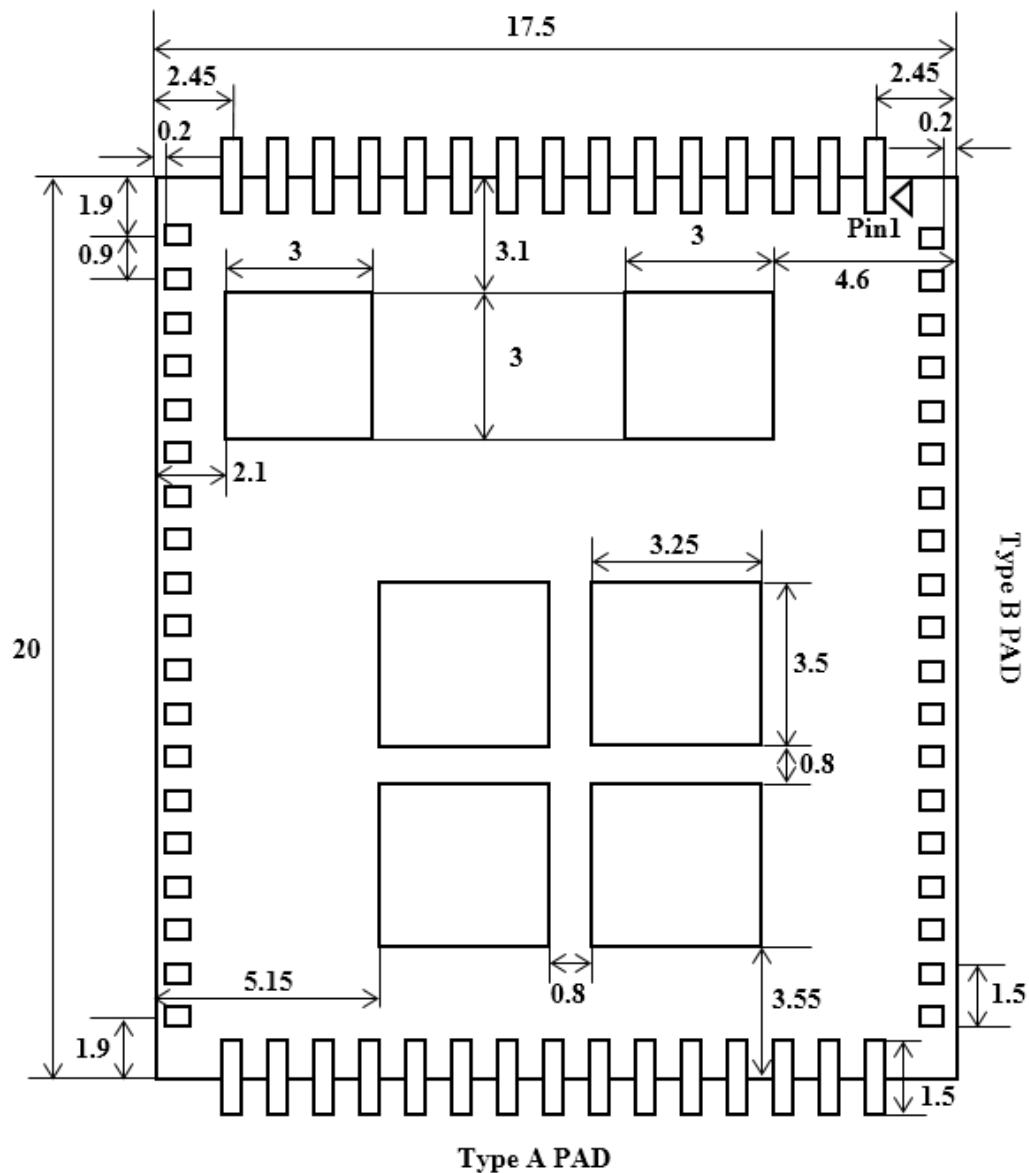


FIG 3 EWN-8852DET3CA Recommended Footprint

PAD Dimension:

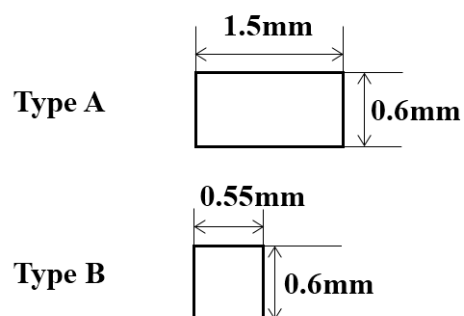


FIG 4 PAD Recommended Footprint

8 Pin Definition

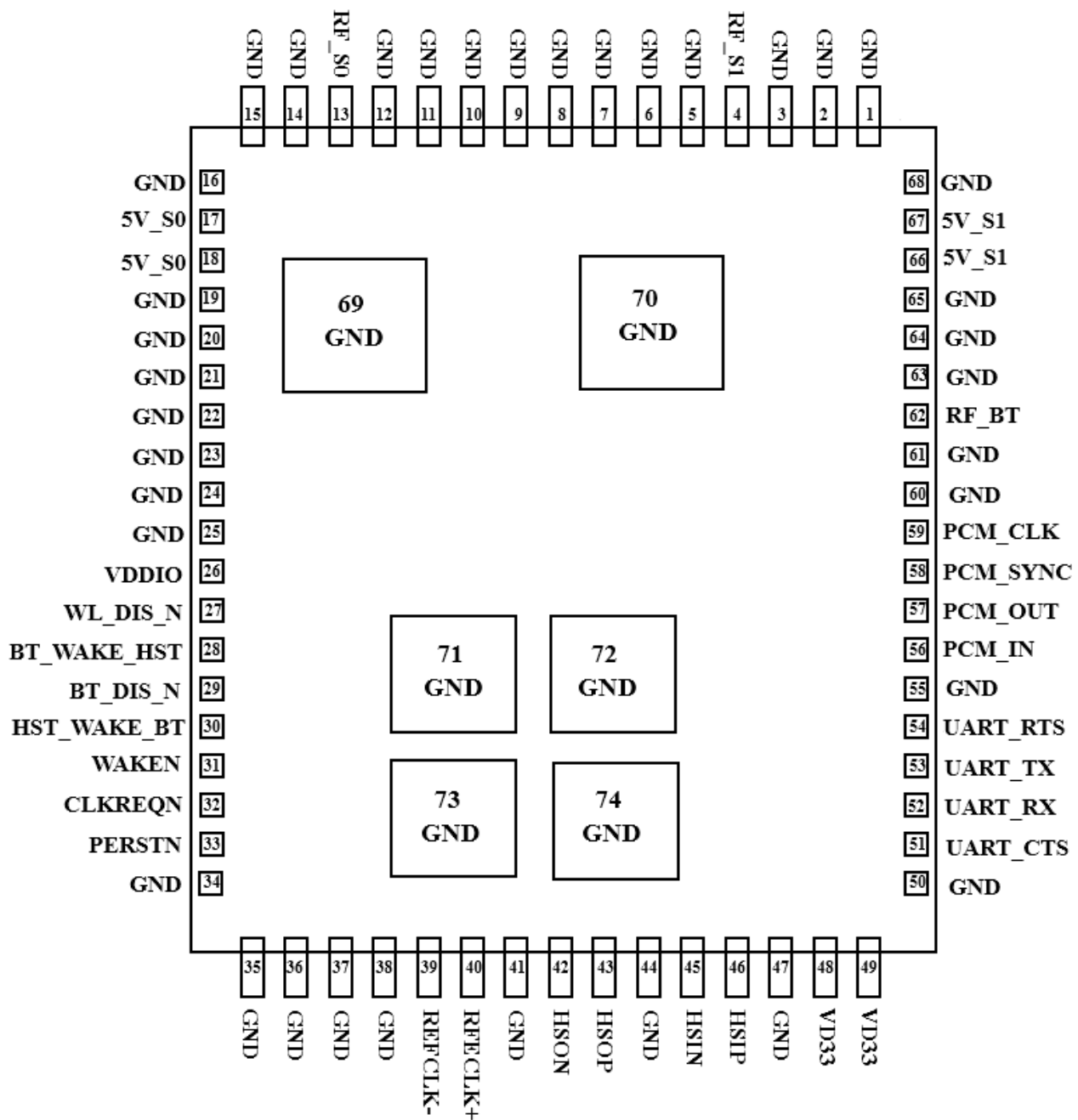


FIG 5 TOP VIEW

See table 9 for the module hardware pin definition.

Table 9 EWN-8852DET3CA Pin Description

Pin	Definition	Type	Description	Default Pull	Power level
1	GND	-	Ground	-	-
2	GND	-	Ground	-	-

Pin	Definition	Type	Description	Default Pull	Power level
3	GND	-	Ground	-	-
4	RF_WL_S1	I/O	Wi-Fi Path S1 ANT I/O port	-	-
5	GND	-	Ground	-	-
6	GND	-	Ground	-	-
7	GND	-	Ground	-	-
8	GND	-	Ground	-	-
9	GND	-	Ground	-	-
10	GND	-	Ground	-	-
11	GND	-	Ground	-	-
12	GND	-	Ground	-	-
13	RF_WL_S0	I/O	Wi-Fi Path S0 ANT I/O port	-	-
14	GND	-	Ground	-	-
15	GND	-	Ground	-	-
16	GND	-	Ground	-	-
17	DC_5V_S0	P	Wi-Fi Path S0 external FEM power voltage source input (5V±0.25V)	-	DC 5V±0.25V
18					
19	GND	-	Ground	-	-
20	GND	-	Ground	-	-
21	GND	-	Ground	-	-
22	GND	-	Ground	-	-
23	GND	-	Ground	-	-
24	GND	-	Ground	-	-
25	GND	-	Ground	-	-
26	VDDIO	P	I/O voltage supply input	-	DC 1.8V or 3.3V
27	WL_DIS_N	I	Shut down the WLAN when is pulled low (Shared with GPIO9,suggest configuring the control pin in platform side as open-drain.)	Internal PU (~100K)	Depend On VDDIO
28	BT_WAKE_HST	O	Bluetooth to wake-up the host (Shared with GPIO7,suggest configuring the control pin in platform side as open-drain.)	-	Depend On VDDIO
29	BT_DIS_N	I	Enable pin for Bluetooth device ON: pull high; OFF: pull low External pull low to shut down BT (Shared with GPIO11)	Internal PU (~100K)	Depend On VDDIO

Pin	Definition	Type	Description	Default Pull	Power level
30	HST_WAKE_BT	I	Host to wake-up the Bluetooth (Shared with GPIO10, suggest configuring the control pin in platform side as open-drain.)	-	Depend On VDDIO
31	WAKEn	O/D	Used to reactivate the PCIE slot's main power rails and reference The host pull-up voltage can support 3.3V or 1.8V	-	3.3V/1.8V
32	CLKREQn	I/O/D	The module to request for the PCIE clock The host pull-up voltage can support 3.3V or 1.8V	-	3.3V/1.8V
33	PERSTn	I	PCIE reset, active low. Need glitch-free implement. The host pull-up voltage can support 3.3V or 1.8V	-	3.3V/1.8V
34	GND	-	Ground	-	-
35	GND	-	Ground	-	-
36	GND	-	Ground	-	-
37	GND	-	Ground	-	-
38	GND	-	Ground	-	-
39	REFCLK-	I	PCIE difference Reference clock – (100MHz±300ppm)	-	-
40	REFCLK+	I	PCIE difference Reference clock + (100MHz±300ppm)	-	-
41	GND	-	Ground	-	-
42	HS0N	O	PCIE Transmit difference pair -	-	-
43	HS0P	O	PCIE Transmit difference pair +	-	-
44	GND	-	Ground	-	-
45	HS1N	I	PCIE Receive difference pair -	-	-
46	HS1P	I	PCIE Receive difference pair +	-	-
47	GND	-	Ground	-	-
48	DC_3.3V	P	RTL8852DE Main power voltage source input (3.3V±0.3V)	-	DC 3.3V±0.3V
49	DC_3.3V	P	RTL8852DE Main power voltage source input (3.3V±0.3V)	-	DC 3.3V±0.3V
50	GND	-	Ground	-	-
51	UART_CTS	I	Bluetooth UART interface	-	Depend On VDDIO
52	UART_RXD	I	Bluetooth UART interface(connect to host UART TX)	-	Depend On VDDIO
53	UART_TXD	O	Bluetooth UART interface(connect to host UART RX)	-	Depend On VDDIO

Pin	Definition	Type	Description	Default Pull	Power level
54	UART_RTS	O	Bluetooth UART interface	-	Depend On VDDIO
55	GND	-	Ground	-	-
56	PCM_IN	I	PCM data input, shared with GPIO0 (Suggest configuring the control pin in platform side as open-drain)	-	Depend On VDDIO
57	PCM_OUT	O	PCM data output, shared with GPIO1 (Suggest configuring the control pin in platform side as open-drain)	-	Depend On VDDIO
58	PCM_SYNC	O	PCM SYNC signal, shared with GPIO2 (Suggest configuring the control pin in platform side as open-drain)	-	Depend On VDDIO
59	PCM_CLK	I/O	PCM clock, shared with GPIO3 (Suggest configuring the control pin in platform side as open-drain)	-	Depend On VDDIO
60	GND	-	Ground	-	-
61	GND	-	Ground	-	-
62	RF_BT	I/O	Bluetooth ANT I/O port	-	-
63	GND	-	Ground	-	-
64	GND	-	Ground	-	-
65	GND	-	Ground	-	-
66	DC_5V_S1	P	Wi-Fi Path S1 external FEM power voltage source input (5V±0.25V)	-	DC 5V±0.25V
67					
68	GND	-	Ground	-	-
69	GND	-	Ground	-	-
70	GND	-	Ground	-	-
71	GND	-	Ground	-	-
72	GND	-	Ground	-	-
73	GND	-	Ground	-	-
74	GND	-	Ground	-	-

Note 1: For WL_DIS_N and BT_DIS_N, please refer to Section 10.5

Note 2: If GPIO add external pull high at platform side, Pull high power source need the same with Module power source, otherwise it will be the potential leakage risk if the power source is different

Note 3: PERSTn, WAKEn, CLKREQn is powered by VDD_3.3V, and input/pull-up voltage can support 3.3V or 1.8V

9 Key material list

Table 10 EWN-8852DET3CA Key material list

Type	Model	Footprint	QTY.
IC	RTL8852DE-VTR-CG	QFN88	1 PCS
Crystal	40MHz (CX/JWT/TJ)	X2016	1 PCS
5G FEM	QPF4526	QFN16 3x3mm	2PCS
Diplexers	LD18D2450LAN-D86/N	1608	2PCS

10 Module Photos



FIG 6 TOP View

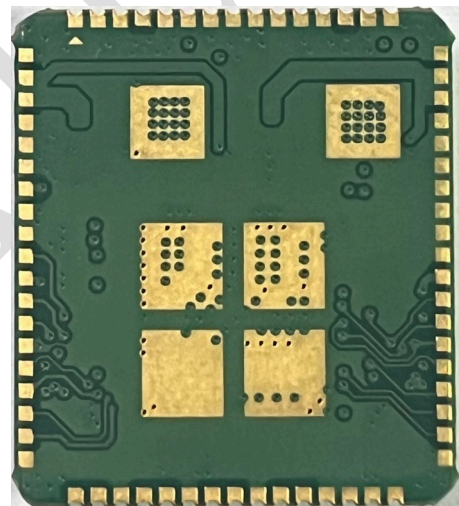


FIG 7 TOP View

11 Package Information

Carrier dimension: (Unit : mm)

符号	A0	B0	K0	P0	P1	P2
规格	18.20 ± 0.1	20.70 ± 0.1	2.90 ± 0.1	4.0 ± 0.1	24.0 ± 0.1	2.0 ± 0.1
符号	W	T	E	F	D0	D1
规格	32.0 ± 0.3	0.35 ± 0.05	1.75 ± 0.1	14.2 ± 0.1	$\phi 1.5^{+0.1}_{-0}$	$\phi 2.0^{+0.1}_{-0}$

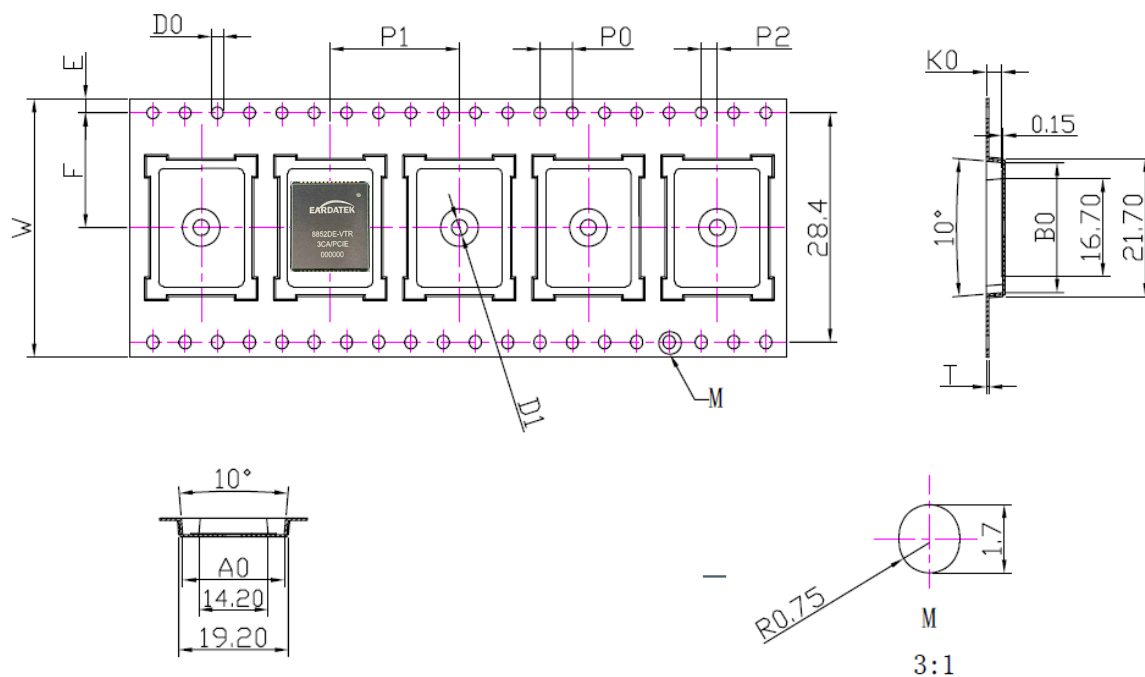


FIG 8 Carrier size

Modules Per Reel:1000PCS

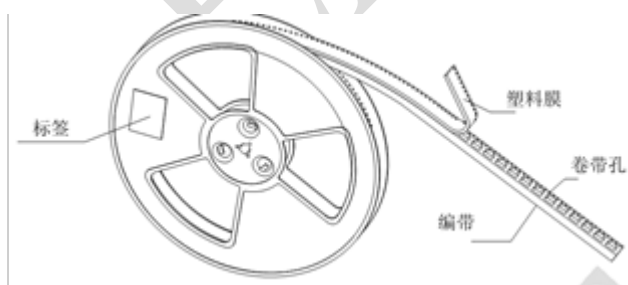


FIG 9 Reel



FIG 10 Reel figure

12 Reference design

12.1 Interface Timing Specification

12.1.1 PCIe Bus during Power On Sequence

a. When WLAN is power off

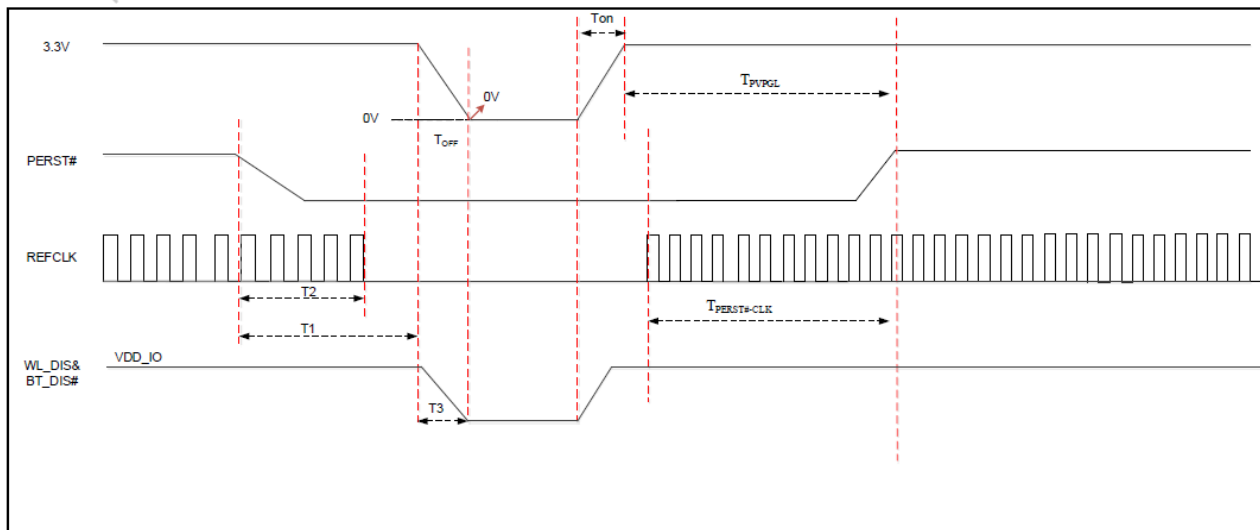


FIG 11 PCIe Bus during Power On Sequence (When WLAN is power off)

b. When WLAN is NOT power off

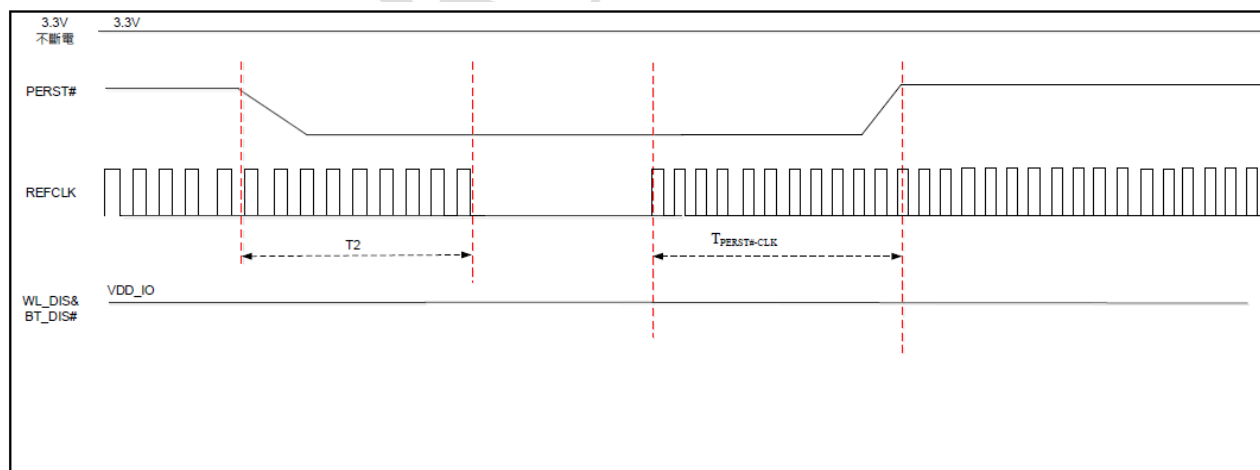


FIG 12 PCIe Bus during Power On Sequence (When WLAN is NOT power off)

T_{on}: The main power ramp up duration

T_{off}: The main power off duration

TPVPGL: Power valid to PERST# input inactive

TPERST#-CLK: Reference clock stable before PERST# inactive

Note:

1. T1: PERST# goes active before the power on the connector is removed.
2. T2: Clock to inactive after PERST# goes active.
3. T3: WL_DIS# and BT_DIS# goes asserted when the power on the connector is removed.
4. T1/T2/T3/T4 timing value should large than 0.

Table 11 The typical timing range

Symbol	Unit	Min.	Typical	Max.
T _{on} :	ms	0.5	1.5	5
T _{off} :	ms	1.5		
TPVPGL	ms	Implementation specific; recommended 50ms		-
TPERST#-CLK	us	100	-	-

12.1.2 PCIe PERST# Timing Sequence (if need at least twice)

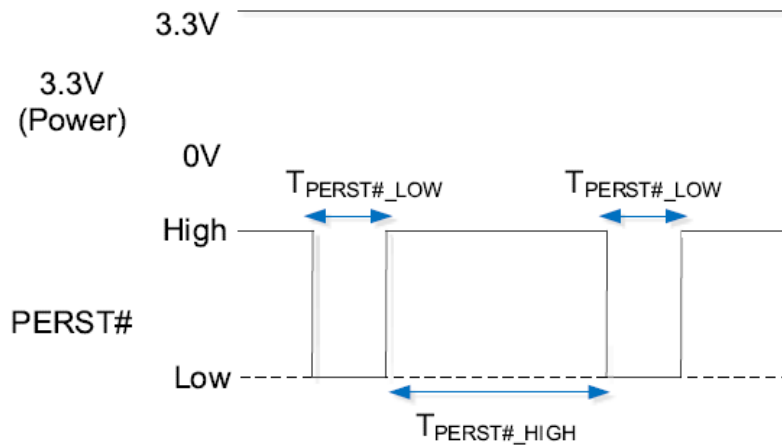


FIG 13 PCIe PERST# Timing Sequence (if need at least twice)

Table 12 PCIE PERST# Timing Parameters

	Min.	Typical	Max.	Unit	Description
T _{PERST#_LOW}	6	10	X	ms	PERST# low duration
T _{PERST#_HIGH}	400	500	X	ms	PERST# high duration

12.1.3 Power Off Sequence

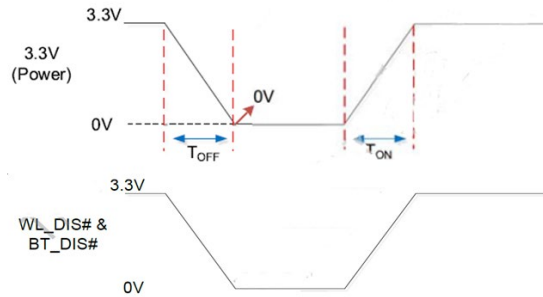


FIG 14 Power Off Sequence of 3.3V platform

Table 13 Power Off Timing Parameters

Symbol	Min.	Typical	Max.	Unit	Description
T_{OFF}	1.5	-	-	ms	Measure point start on 100% Measure point end on 0% (must be 0V)
T_{ON}	0.5	1.5	5	ms	Measure point start on 0% (must be 0V) Measure point end on 100%

Note: If BT_DIS# can't connect to the same power source with 3.3V, it need to be de-asserted before PERST# with 100ms in power on sequence.

12.1.4 BT_DIS Timing Sequence

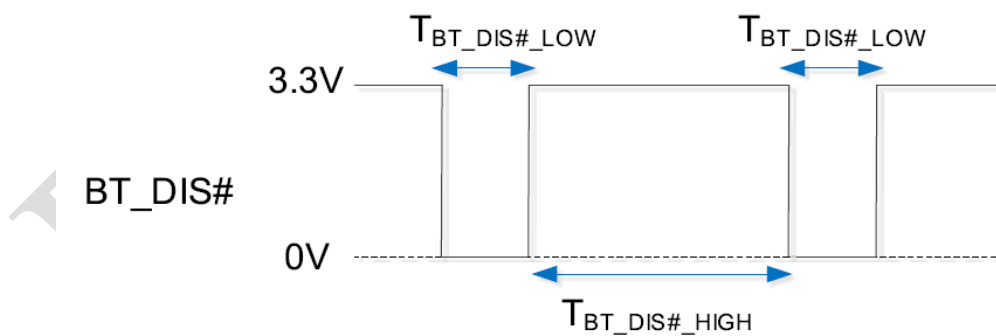


FIG 15 BT_DIS Timing Sequence

Table 14 BT_DIS Timing Parameters

	Min.	Typical	Max.	Unit	Description
BT_DIS#_LOW	200	-	-	ms	BT_DIS# low duration
BT_DIS#_HIGH	500	-	-	ms	BT_DIS# high duration

12.1.5 Power on sequence between VD33 and VDD_IO

a. 3.3V Single Power



b. 3.3V and 1.8V Dual Power

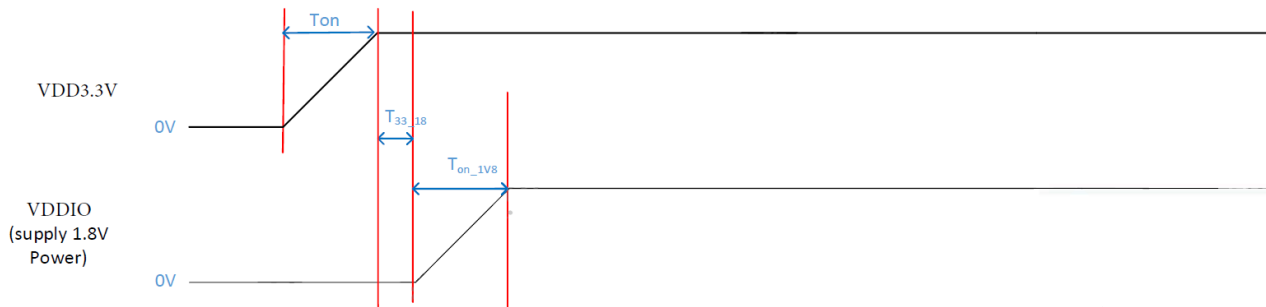


FIG 16 Power on sequence between VDD_3V3 and VDDIO

Table 15 System Power on Timing between VD33 and VDD_IO

	Min.	Typical	Max.	Unit	Description
T _{on_1V8}	0.5	1.5	5	ms	The 1.8V power ramp up duration
T _{on}	0.5	1.5	5	ms	The 3.3V power ramp up duration
T _{33_18}	0	5	X	ms	If 1.8V power is applied, it needs to be equal or slower than 3.3V power

12.2 Power supply requirement

The RTL8852DE power supply voltage is DC+3.3V, and the maximum module current is 2000mA. The power supply design needs to consider the output current and power interference. To avoid the +3.3V power supply from interfering with other circuits on the motherboard, it is recommended to supply to the module using the regulator circuit alone. If you need to share +3.3V with other circuits, consider whether the current of the shared power supply is sufficient.

Table 16 DC Characteristics

Symbol	Parameter	Minimum	Typical	Maximum	Peak Current
VDD_3.3V	3.3V Supply Voltage	3.0V	3.3V	3.6V	2000mA

1. To use a dedicated power supply circuit for Wi-Fi (and BT)
2. The VD33 power ripple shall be <300mVpp for ripple frequency <200KHz
3. <0.05% line regulation and <0.5%/A load regulation are required for ripple frequency below 100KHz.
4. Transient-response:①the ripple raised from 100/800mA step-response test should be small than 200mVpp.②The ripple swing shall settle down within 1~2 cycles,2 cycles for the worst case.
5. Power supply spur: make sure the spurs from switching mode power supply or other noisy circuits are reasonable small. Once issue concerned with such a power supply spur, alternative power supply filtering might be needed.

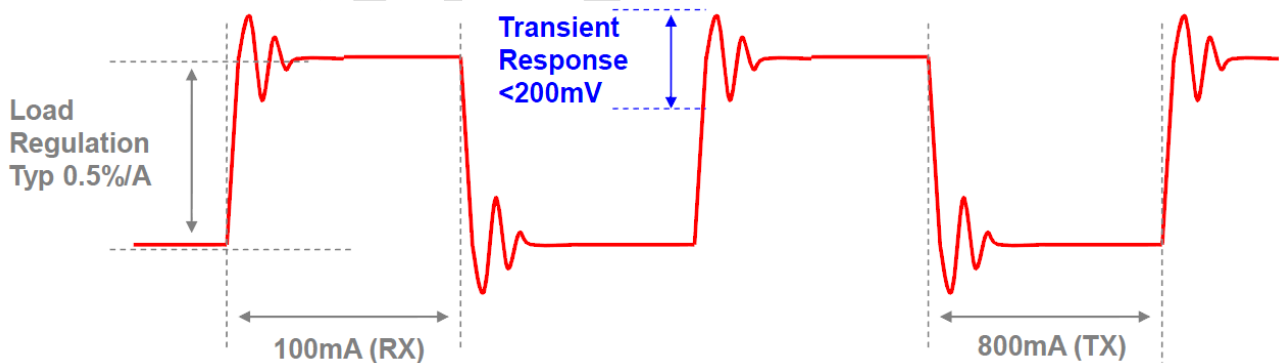


FIG 17 Power supply Requirements

Table 17 DC_3.3V Platform Power Rail Requirements

Power range	Ripple	Noise	Rise time	
			Min	Max
+/-0.165V	300mVpp@switching frequency > 100KHz		0.5ms	5ms

12.3 PCIE Interface

The PCIE interface has 3 differential pairs (TX/RX/CLK), It must be designed as difference line and Surround the data line with ground copper.

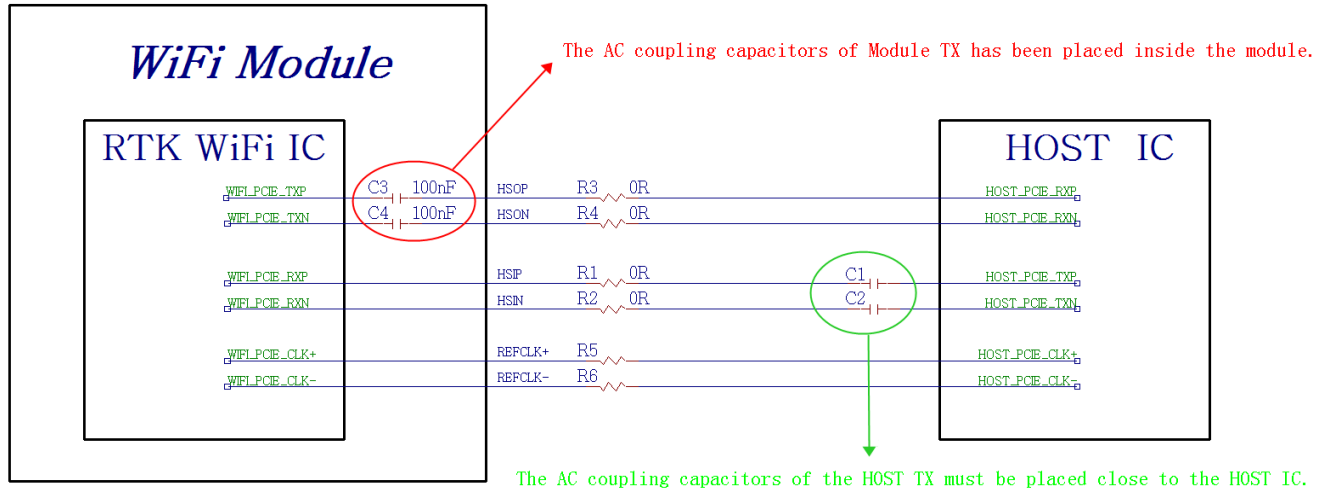


FIG 18 PCIe interface Circuit schematic

12.3.1 AC coupled Cap. Circuit & Layout Consideration

- AC Couple Cap. Requirement for TX differential pairs:
Gen2: 75nF~175nF, 100nF typ.
- Place AC coupling capacitors near output pins of TX differential

12.3.2 PCIe Reference Clock Requirements

- PCI Express Differential Reference Clock Source: 100MHz $\pm$ 300ppm.
- The typical value of R5/R6 is 0R. please test close to the module end to ensure that the following timing requirements are met. If the test result does not meet the timing requirements, please adjust it.

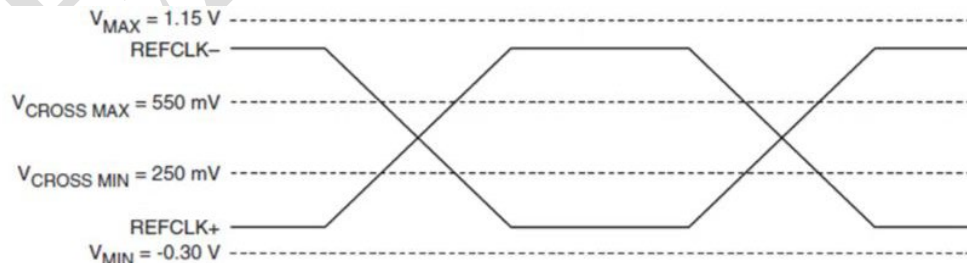


FIG 19 Single-Ended Measurement Points for Absolute Cross Point and Swing

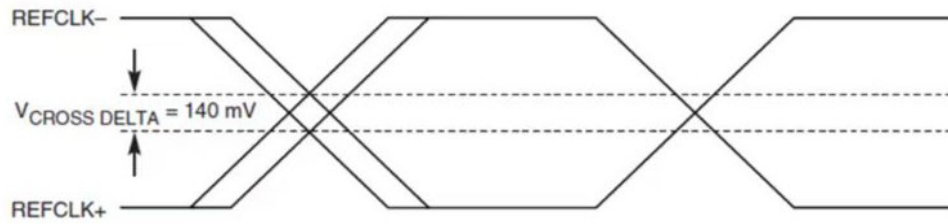


FIG 20 Single-Ended Measurement Points for Delta Cross Point

12.3.3 Layout trace impedance control

- TX/RX (HSOP/HSON and HSIP /HSIN):
Gen2: 85 Ohms +/- 10%
- CLK(RFECLK+/RFECLK-):
100 Ohms +/- 10%

12.3.4 Differential trace Intra-Pair Skew Layout requirement

- Mismatch Requirement:
Host (Both TX/RX pairs): < 10mil
Device (Both TX/RX pairs): < 5mil
- Serpentine lines routing can be permitted, but should be routed as the following rules.

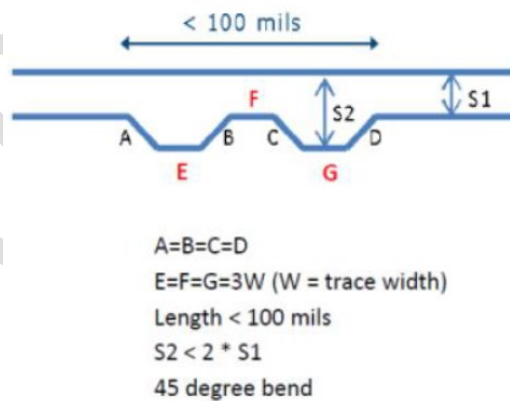


FIG 21 Serpentine lines Routing Rules

12.4 RF circuit

Due to the SMD package, the RF port impedance must be offset after the module is soldered to the motherboard. In order to achieve the best performance, it is recommended to add a PI-type matching network to the motherboard, as shown below (C11, R21, C6). The value of the PI type matching network needs to be debugged according to the actual motherboard to match RF port impedance to 50 Ohm.

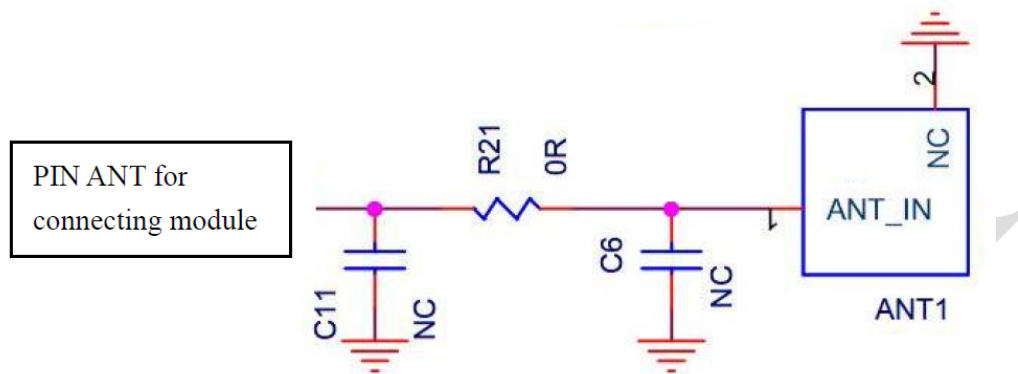


FIG 22 Connect 50 Ohm matching antenna reference circuit

The antenna ANT1 in the figure above must be 50 Ohm. If the antenna is not matched, it is recommended to add a set of PI type matching network at the front of the antenna to match the antenna. Generally, the antenna manufacturers will give Suggestions on matching parameters.

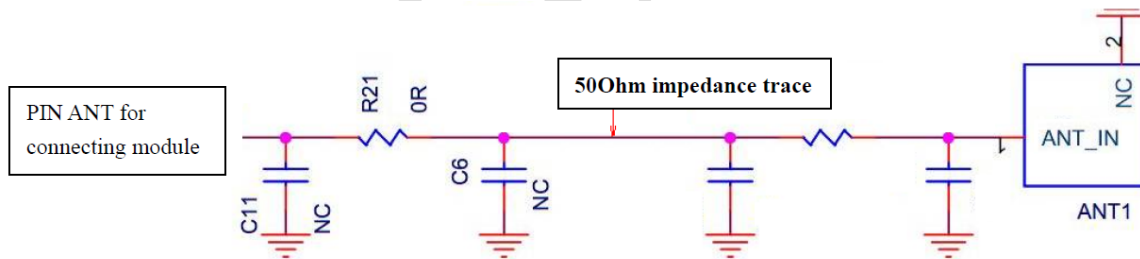


FIG 23 Connect the unmatched antenna reference circuit

The RF line layout should be matched according to 50ohm. The line impedance is related to the plate, plate thickness, line width and copper spacing. Professional software can be used to calculate the line width. Note: for multilayer plates, the plate thickness should calculate the distance from RF routing layer to GND of the next layer. There are RF lines Layout principles :

1. RF line layout needs to match 50 ohms. The line width can be calculated by professional software. (Note: If it is a multi-layer board, The board thickness should calculate the distance from the RF trace layer to the next ground layer.)
2. The RF line must be surrounded by ground copper and ground holes.
3. The PI-type matching circuit for adjusting the impedance of the module is placed close to the module. The

PI type matching circuit for matching the antenna is placed close to the antenna.

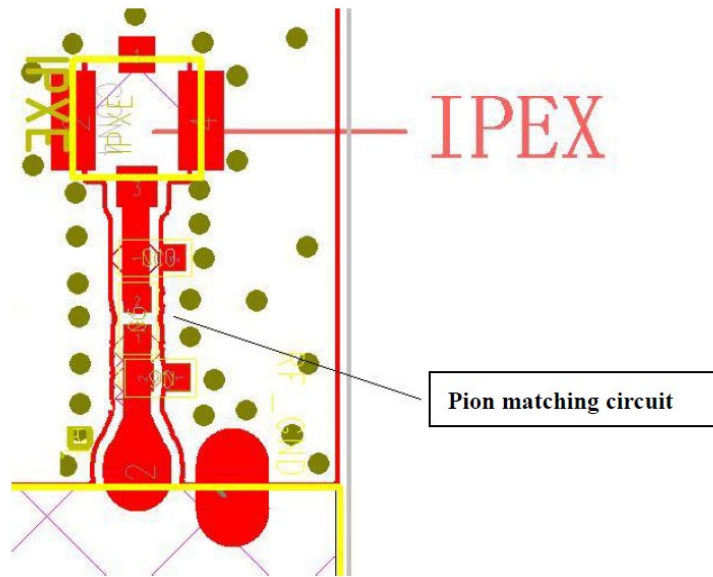


FIG 24 The PI type matching circuit Layout

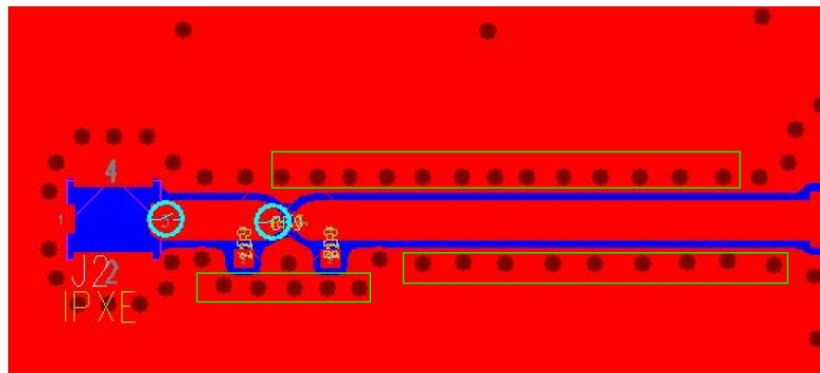


FIG 25 The RF line Layout

4. 4-layer PCB, RF pad must be kept out $\geq 10\text{mil}$ at the TOP layer, and pads with larger widths (> 1.3 times line), the second layer GND needs to be kept out in equal area.

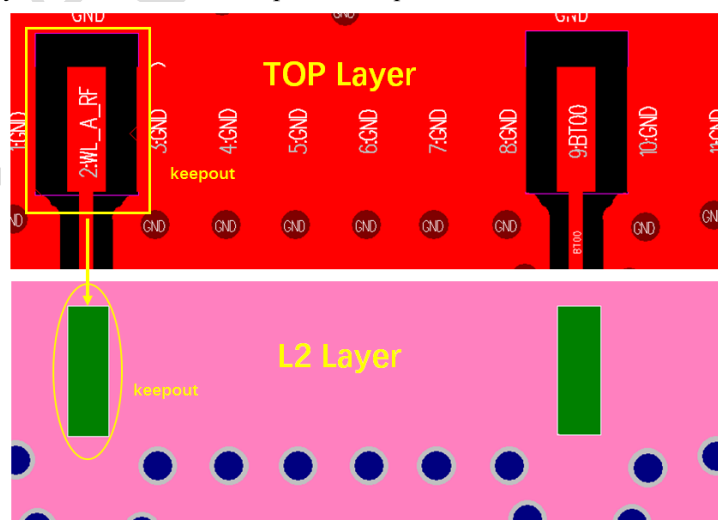


FIG 26 The RF Pads keepout design

12.5 Application Circuit for WL_DIS_N and BT_DIS_N with Platform

There is internal pull-up, about 100K, resistor design in WL_DIS_N and BT_DIS_N pad.

If Host SOC need to control these two pins, choose host GPIO without pull capability to avoid voltage divider. Middle range of IO voltage would affect Wi-Fi booting up (FIG 27).

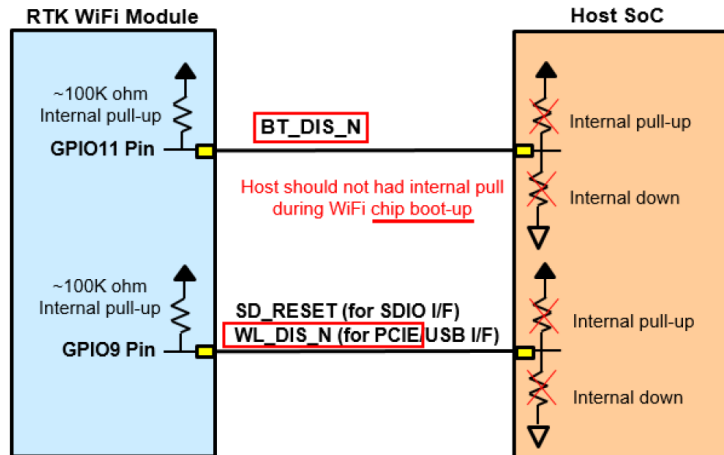


FIG 27 Host GPIO control WL_DIS_N and BT_DIS_N

If Host GPIO has pull-down capability and it can't be avoided, suggest to add 10K pull down resistor in circuit to ensure IO is in low level. In this way, Wi-Fi chip internal pull-up 100K could be neglected (FIG 28). Please note external pull-down will cause additional static current.

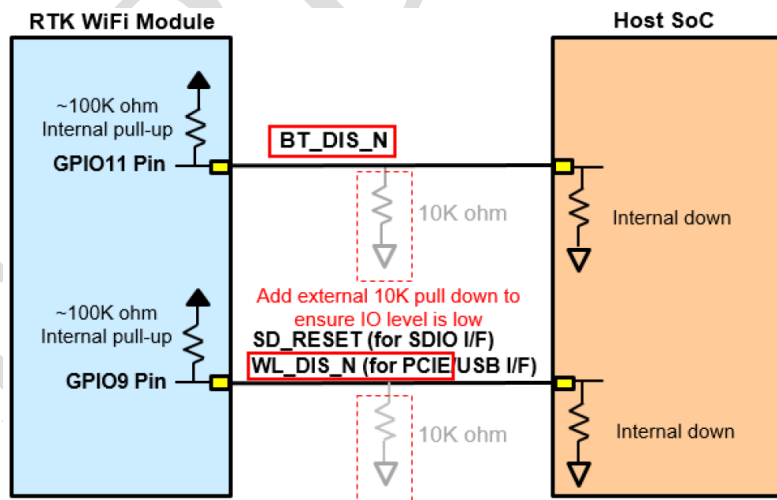


FIG 28 Host WL_DIS_N and BT_DIS_N pin, add external pull down resistor to ensure low level

12.6 Motherboard interference avoidance

Motherboard interference comes from: high-speed data interface (HDMI), the Operating frequency of main chip, DDR, DC-DC power supply. The method of avoiding interference according to the characteristics of various signals is also different. The main methods of interference avoidance include:

1. keeping away from the source of interference;
2. Adding shields to avoid interference leakage;
3. Reasonable layout to eliminate interference.

12.6.1 Interface interference

When HDMI uses the 74.2MHz frequency, its 33x frequency is in the 2.4G band of Wi-Fi, which will seriously interfere with the Wi-Fi signal. If the HDMI frequency is 148.5MHz, although the 16x frequency is not in the Wi-Fi band, the isolation of the frequency is not good, and the Wi-Fi signal will be interfered to some extent. If the distance between the HDMI interface and the Wi-Fi module on the PCB is less than 5cm, the HDMI output display will interfere with the Wi-Fi signal, resulting in problems such as Wi-Fi connection failure and throughput drop. Therefore, keep the location of the Wi-Fi module away from the HDMI port on the hardware layout to avoid interference.

At the same time, if the Wi-Fi antenna is built-in the motherboard, its placement must also be carefully considered to be far from the interface interference. If the antenna is placed in an incorrect position, even if the module is shielded, the interference signal is coupled through the antenna, which will eventually result in a lower Wi-Fi throughput. (Note: In addition to interference, the placement of the internal antenna should also evaluate the effect of the metal interface, motherboard, and housing material on the antenna impedance.)

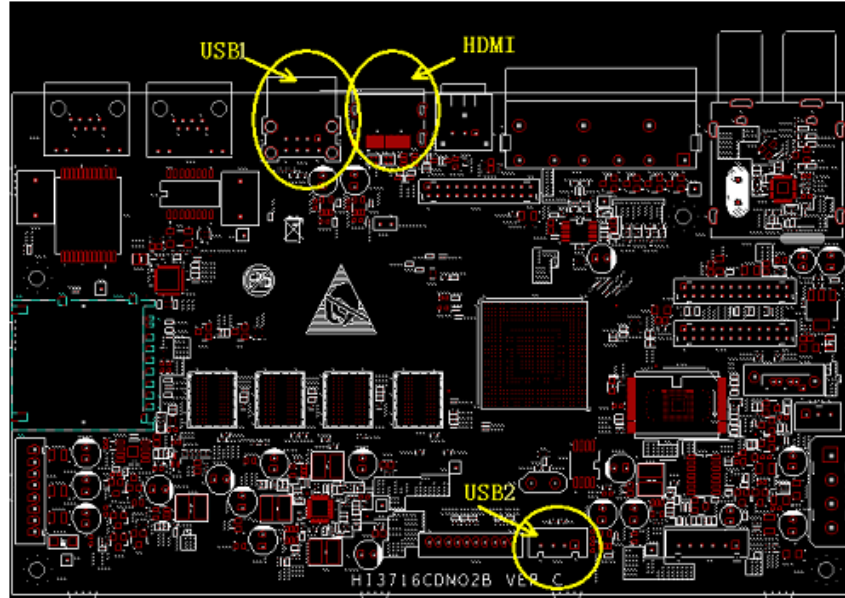


FIG 29 HDMI and USB interference

12.6.2 The main chip interferes with DDR

Because the main chips operate at about 800MHz or DDR2 operate at 667MHz, 3x frequency of 800MHz and 4x frequency of 667MHz are near 2.4GHz band. It must to place Wi-Fi modules and antennas far away from the main chip and DDR. It is strongly recommended that the main chip be isolated from the DDR by a shield. As shown in the figure below.

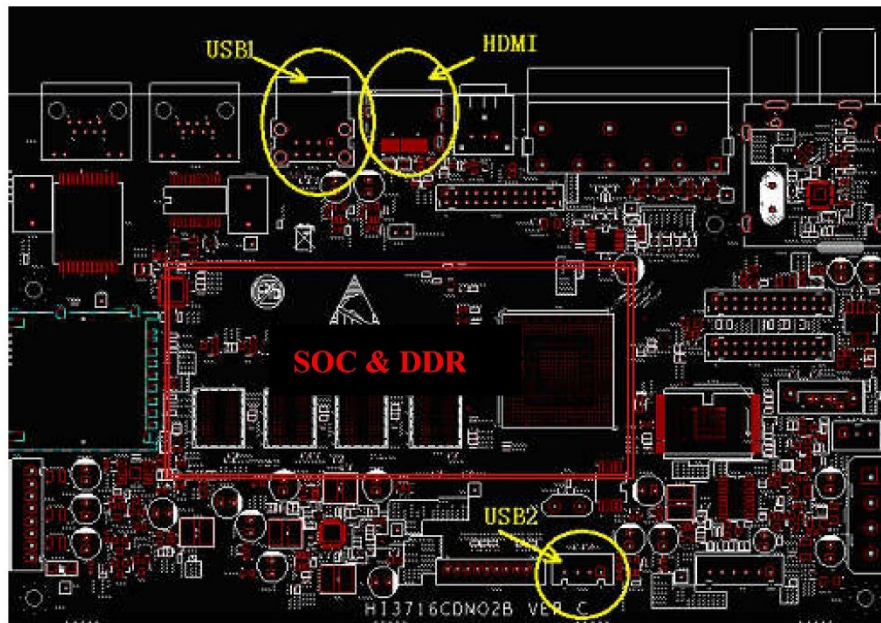


FIG 30 Main chip and DDR interference

12.7 Recommended secondary reflux temperature curve

The number of reflux shall not exceed 2 times, and the tin feeding height of the half hole of the module shall be no less than 1/4.

The lead-free reflux curve requirements of Wi-Fi module products are shown in figure:

Stage	Note	Pb-free assembly
Average ramp-up rate	T_L to T_p	3 °C / second max.
Preheat	Temperature min (T_{smin})	150°C
	Temperature max (T_{smax})	200°C
	Time (t_{smin} to t_{smax})	60 – 120 seconds
Time maintained above	Temperature(T_L)	217°C
	Time (t_L)	60 – 150 seconds
Peak package body temperature (T_p)		T_p must not exceed the specified classification temp($T_c=245$ °C).
Time(t_p) within 5°C of the specified classification temperature (T_c)		30 seconds
Ramp-down rate (T_p to T_L)		6 °C / seconds max.
Time 25°C to peak temperature		8 minutes max.

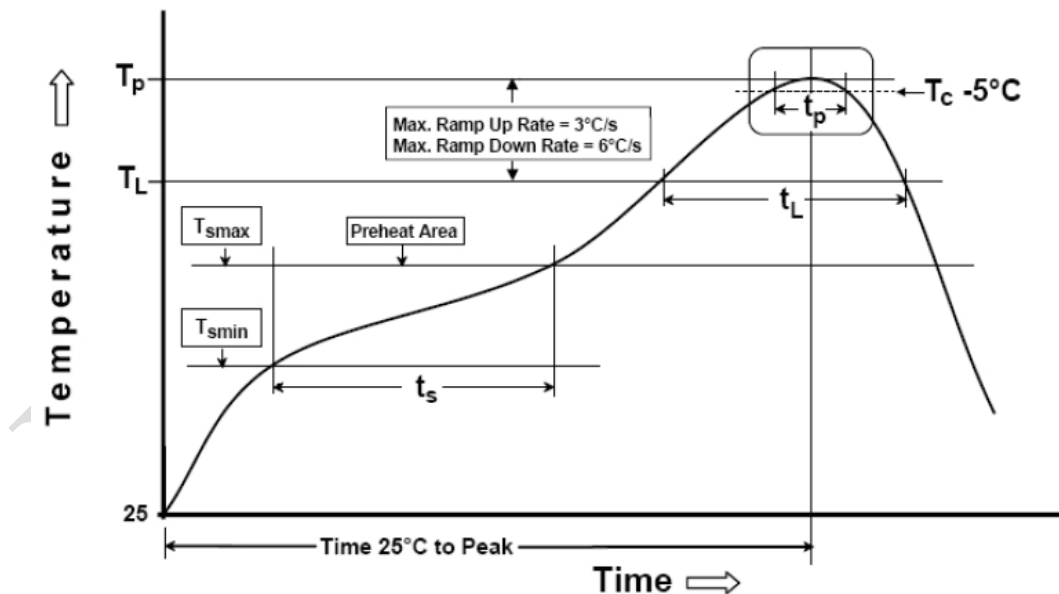


FIG 31 Furnace temperature curve

NOTE:

- 1.The maximum furnace temperature of the module is 260°C, don't exceed this temperature.
- 2.The gold plating thickness of the module pad is 2u".

13 Revision History

Revision	Release Date	Summary	Revised By
V1.0	2025-08-13	First release	ZG Wu
V1.1	2025-08-19	Update the Recommended Footprint and pad dimensions	ZG Wu
V1.2	2025-11-21	Update the module configurations, the module photos, the pin definition, the reference design and the package information	ZG Wu

FCC Statement

FCC standards: FCC CFR Title 47 Part 15 Subpart C Section 15.407,15.247

Device is equipped with External antenna, Antenna gain: 4.99dBi(5G Hz)、 **-0.94 (2.4GHz)**

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

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.

We will retain control over the final installation of the modular such that compliance of the end product is assured. In such cases, an operating condition on the limit modular approval for the module must be only approved for use when installed in devices produced by a specific manufacturer. If any hardware modify or RF control software modify will be made by host manufacturer, C2PC or new certificate should be apply to get approval,if those change and modification made by host manufacturer not expressly approved by the party responsible for compliance ,then it is illegal.

FCC Radiation Exposure Statement

The modular can be installed or integrated in mobile or fix devices . This modular cannot be installed in any portable device if without further certification such as C2PC with SAR. 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: 2AMM6-EWN8852DET3CA Or Contains FCC ID: 2AMM6-EWN8852DET3CA"

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

1. 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.

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.

2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. 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. Any company of the host device which install the modular with limit modular approval should perform the test of radiated & conducted emission and spurious emission, etc. according to FCC part 15C : 15.407,15.247 and 15.209 & 15.207 ,15B Class B requirement, Only if the test result comply with FCC part 15C : 15.407,15.247 and 15.209 & 15.207 ,15B Class B requirement, then the host can be sold legally.

Antenna manufacturer:Shenzhen Zhongtianxun Communication Technology Co., Ltd.

Antenna model: ZTX-RTK-WIFI-5-V2

Antenna Gain: 4.96dBi(5G Hz)、 **-0.04 (2.4GHz)**