AW-CB295NF

IEEE 802.11a/b/g/n/ac Wireless LAN 2T2R and Bluetooth 4.2 Combo Module (M.2 2230)

Datasheet

Rev. 10

B1

(Standard)

Revision History

Revision	*Date*	*Description*	*Initials*	*Approved*
Version 0.1	2016/9/19	Initial Version	N.C. Chen	Chihhao Liao
Version 0.2	2016/11/01	Update Specifications Table Output power Receive Sensitivity	N.C. Chen	Chihhao Liao
Version 0.3	2017/02/21	Update Specifications Table Bluetooth Receive Sensitivity	N.C. Chen	Chihhao Liao
Version 0.4	2017/04/17	Update Specifications Table WLAN Receive Sensitivity ESD Specifications	N.C. Chen	Chihhao Liao
Version 0.5	2017/07/05	Update Specifications Table	N.C. Chen	Chihhao Liao
Version 0.6	2017/09/15	Update Mechanical Information	N.C. Chen	Chihhao Liao
Version 0.7	2017/09/25	Update General Description	N.C. Chen	Chihhao Liao
Version 0.8	2017/10/11	Add 5.5 PCIe PERST# Timing Sequence	N.C. Chen	Chihhao Liao
Version 0.9	2017/12/15	Changed document format Add power off sequence	N.C. Chen	Chihhao Liao
Version 10	2018/6/06	Update power off sequence	N.C. Chen	Chihhao Liao

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1. Introduction

1.1 Product Overview

AzureWave Technologies, Inc. introduces the pioneer of the IEEE 802.11 a/b/g/n/ac WIFI with Bluetooth 4.2 combo M.2 module --- **AW-CB295NF**. The AW-CB295NF IEEE 802.11 a/b/g/n/ac PCIE WIFI with Bluetooth 4.2 combo M.2 module is a highly integrated single-chip MIMO (Multiple In, Multiple Out) wireless local area network (WLAN) solution to let users enjoy the digital content through the latest wireless technology without using the extra cables and cords. It combines a WLAN MAC, a 2T2R capable WLAN baseband, and RF in s single chip. It enables a **high performance, cost effective, low power, compact solution** that easily fits onto the PCI Express and USB M.2 module.

The AW-CB295NF baseband implements Multi-user Multiple Input, Multiple Output (MU-MIMO) Orthogonal Frequency Division Multiplexing (OFDM) with two transmit and two receive paths (2T2R). Features include two spatial stream transmissions, short Guard Interval (GI) of 400ns, spatial spreading, and support for variant channel bandwidth. Moreover, AW-CB295NF provides one spatial stream space-time block code (STBC), Transmit Beamforming (TxBF) and Low Density Parity Check (LDPC) to extend the range of transmission. At the receiver, extended range and good minimum sensitivity is achieved by having receiver diversity up to 2 antennas. As the recipient, the AW-CB295NF 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 802.11b, 802.11g and 802.11a 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, 64QAM and 256QAM modulation of the individual subcarriers, and rate compatible coding rate of 1/2, 2/3, 3/4, and 5/6, provide up to 866.7Mbps for IEEE 802.11ac MIMO OFDM.

The RTL8822BE-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. For better detection quality, receive diversity with Maximal-Ratio-Combine (MRC) applying up to two receive paths, and Maximum-Likelihood Detection (MLD) are implemented. 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.

1.2 Features

1.2.1 WLAN

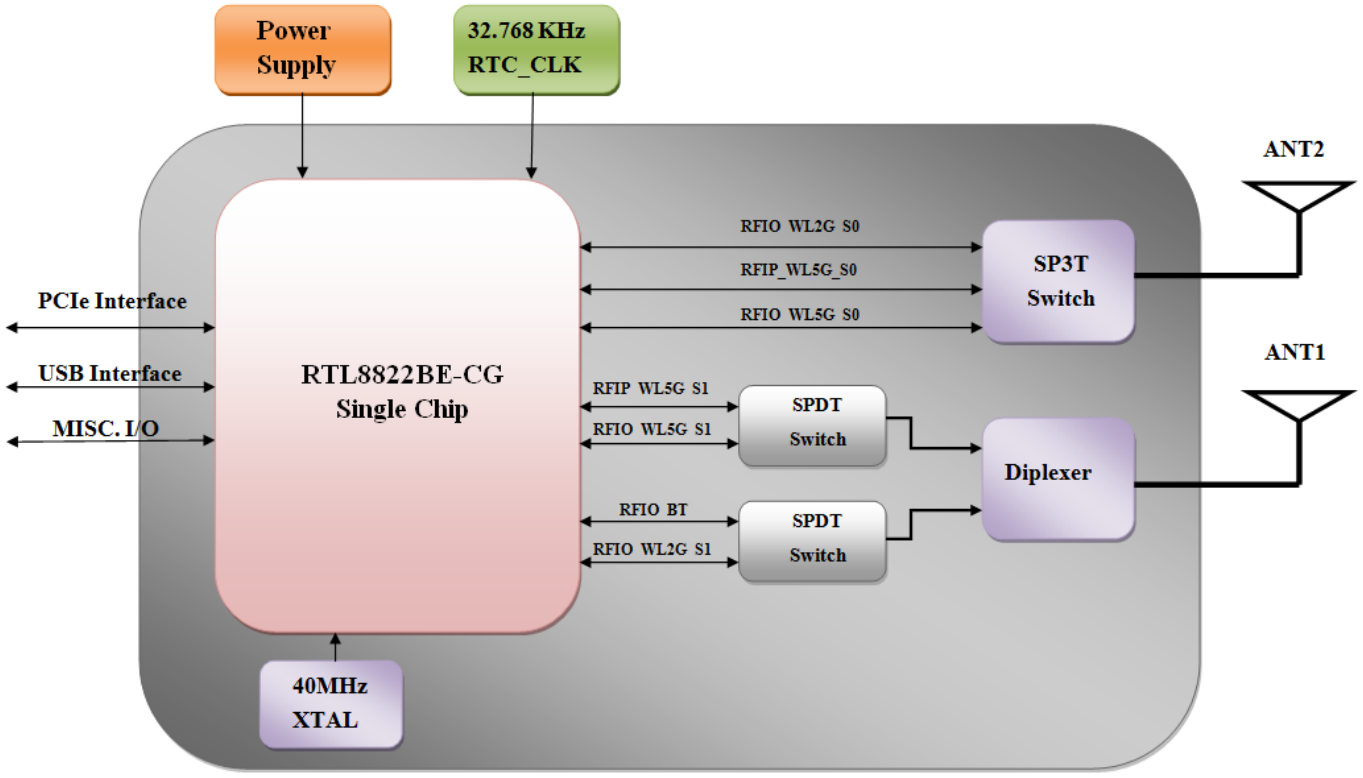
- Support 802.11ac 2x2,Wave-2 compliant with MU-MIMO
- Complete 802.11n MIMO solution for 2.4GHz and 5Ghz band
- Maximum PHY data rate up to 173.3 Mbps using 20MHz bandwidth, 400Mbps using 40MHz bandwidth, and 866.7Mbps using 80MHz bandwidth.
- Backward compatible with 802.11a/b/g devices while operating at 802.11n data rates
- Backward compatible with 802.11a/n devices while operating at 802.11ac data rates.
- Complies with PCI Express Base Specification Revision 1.1
- PCIe LTR/L1.Off state supported
- IEEE 802.11a/b/g/n/ac compatible WLAN
- IEEE 802.11e QoS Enhancement (WMM)
- IEEE 802.11i (WPA, WPA2). Open, shared key, and pair-wise key authentication services
- IEEE 802.11h DFS, TPC, Spectrum Measurement
- WAPI (Wireless Authentication Privacy Infrastructure) certified.
- Cisco Compatible Extensions (CCX) for WLAN devices
- Frame aggregation for increased MAC efficiency (A-MSDU, A-MPDU)
- Low latency immediate Block Acknowledgement (BA)
- Multiple BSSID feature allows the RTL8822BE-CG to assume multiple MAC identities when used as a wireless bridge
- WiFi Direct supports wireless peer to peer applications.
- Supports Wake-On-WLAN via Magic Packet and Wake-up frame
- Transmit Beamforming
- Support S3/S4 AES/TKIP group key update
- Support Network List Offload
- CCA on secondary through RTS/CTS handshake.
- Support TCP/UDP/IP checksum offload
- Support LDPC
- Support STBC
- OFDM receive diversity with MRC using up to 2 receive paths. Switch diversity used for DSSS/CCK
- Fast receiver Automatic Gain Control (AGC)
- Maximum data rate 54Mbps in 802.11g, 300Mbps in 802.11n and 866.7bps in 802.11ac

1.2.2 Bluetooth

- Compatible with Bluetooth v2.1 and v3.0+EDR
- Support Bluetooth 4.1 system
- Support Bluetooth 4.2 LE Secure Connection by upper layer software upgrade
- Integrated MCU to execute Bluetooth protocol stack
- Supports all packet types in basic rate and enhanced data rate
- Supports piconets in a scatternet
- Supports Secure Simple Pairing
- Supports Low Power Mode (Sniff/Sniff Sub-rating)
- Enhanced BT/WIFI Coexistence Control to improve transmission quality in different profiles
- Dual Mode support: Simultaneous LE and BR/EDR
- Supports multiple Low Energy states
- Fast AGC control to improve receiving dynamic range
- Supports AFH to dynamically detect channel quality to improve transmission quality
- ntegrated internal Class 1, Class 2, and Class 3 PA
- Supports Bluetooth Low Energy
- Integrated 32K oscillator for power management

1.3 Block Diagram

A simplified block diagram of the AW-CB295NF module is depicted in the figure below



1.4 Specifications Table

1.4.1 General

Features	Description
Product Description	Wireless LAN & Bluetooth Combo M.2 Module
Major Chipset	RTL8822BE-CG
Host Interface	Wi-Fi : PCI-E , Bluetooth : USB
Dimension	22mm x30mm x 2.33mm(Max) (Tolerance remarked in mechanical drawing)
Package	M.2 2230 (AE Key)
Antenna	I-PEX MHF4 Connector Receptacle (20449) 1 : WiFi/Bluetooth → Tx/Rx 2 : WiFi → TX/RX
Weight	2.3g

1.4.2 WLAN

Features	Description
WLAN Standard	IEEE 802.11 a/b/g/n/ac
WLAN VID/PID	10EC / B822
WLAN SVID/SPID	1A3B / 2951
Frequency Rage	WLAN: 2.4 GHz : 2.412 ~ 2.484 GHz 5 GHz: 4.915 ~5.925Ghz
Modulation	DSSS, OFDM, DBPSK, DQPSK, CCK, 16-QAM, 64-QAM for WLAN
Number of Channels	2.4GHz: USA, NORTH AMERICA, Canada and Taiwan – 1 ~ 11 China, Australia, Most European Countries – 1 ~ 13 Japan – 1 ~ 14(CH14 only for 802.11b) 802.11g: USA, Canada and Taiwan – 1 ~ 11 China, Australia, Most European Countries – 1 ~ 13

<table>
<tr><td></td><td>5GHz:
USA, EUROPE – 36, 40, 44, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161, 165</td></tr>
<tr><td>Output Power
(Board Level Limit)*</td><td>2.4G
<table>
<tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr>
<tr><td>11b (11Mbps)
@EVM<35%</td><td>14</td><td>16</td><td>18</td><td>dBm</td></tr>
<tr><td>11g (54Mbps)
@EVM≦-27 dB</td><td>12</td><td>14</td><td>16</td><td>dBm</td></tr>
<tr><td>11n (HT20 MCS7)
@EVM≦-28 dB</td><td>11</td><td>13</td><td>15</td><td>dBm</td></tr>
<tr><td>11n (HT40 MCS7)
@EVM≦-28 dB</td><td>11</td><td>13</td><td>15</td><td>dBm</td></tr>
</table>
5G
<table>
<tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr>
<tr><td>11a (54Mbps) @EVM
≦-27 dB</td><td>11</td><td>13</td><td>15</td><td>dBm</td></tr>
<tr><td>11n (HT20 MCS7)
@EVM≦-28 dB</td><td>10</td><td>12</td><td>14</td><td>dBm</td></tr>
<tr><td>11n (HT40 MCS7)
@EVM≦-28 dB</td><td>10</td><td>12</td><td>14</td><td>dBm</td></tr>
<tr><td>11ac (VHT20 MCS8)
@EVM≦-30 dB</td><td>9</td><td>11</td><td>13</td><td>dBm</td></tr>
<tr><td>11ac (VHT40 MCS9)
@EVM≦-32 dB</td><td>8</td><td>10</td><td>12</td><td>dBm</td></tr>
<tr><td>11ac (VHT80 MCS9)
@EVM≦-32 dB</td><td>8</td><td>10</td><td>12</td><td>dBm</td></tr>
</table></td></tr>
<tr><td>Receiver Sensitivity</td><td>2.4G
<table>
<tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr>
<tr><td>11b (11Mbps)</td><td></td><td>-80</td><td>-77</td><td>dBm</td></tr>
<tr><td>11g (54Mbps)</td><td></td><td>-69</td><td>-66</td><td>dBm</td></tr>
<tr><td>11n (HT20 MCS7)</td><td></td><td>-68</td><td>-65</td><td>dBm</td></tr>
<tr><td>11n (HT40 MCS7)</td><td></td><td>-65</td><td>-62</td><td>dBm</td></tr>
</table>
5G
<table>
<tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr>
<tr><td>11a (54Mbps)</td><td>-</td><td>-68</td><td>-</td><td>dBm</td></tr>
<tr><td>11n (HT20 MCS7)</td><td>-</td><td>-67</td><td>-</td><td>dBm</td></tr>
<tr><td>11n (HT40 MCS7)</td><td>-</td><td>-64</td><td>-</td><td>dBm</td></tr>
<tr><td>11ac (VHT80 MCS9)</td><td>-</td><td>-54</td><td>-</td><td>dBm</td></tr>
</table></td></tr>
</table>

Data Rate	802.11b: 1, 2, 5.5, 11Mbps 802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54Mbps 802.11n: up to 150Mbps-single 802.11n: up to 300Mbps-2x2 MIMO 802.11ac:up to 192.6Mbps (20MHz channel) 802.11ac:up to 400Mbps (40MHz channel) 802.11ac:up to 866.7Mbps (80MHz channel)
Security	◆ WAPI ◆ WEP 64-bit and 128-bit encryption with H/W TKIP processing ◆ WPA/WPA2 (Wi-Fi Protected Access) ◆ AES-CCMP hardware implementation as part of 802.11i security standard

* If you have any certification questions about output power please contact FAE directly.

1.4.3 Bluetooth

Features	Description
Bluetooth Standard	Bluetooth 2.1+Enhanced Data Rate (EDR) + BT4.2
Bluetooth VID/PID	13D3 / 3531
Frequency Rage	2402~2480MHz
Modulation	GFSK (1Mbps), Π/4 DQPSK (2Mbps) and 8DPSK (3Mbps) for Bluetooth
Output Power	0~6 dBm
Receiver Sensitivity	BER < 0.1% (Anritsu 8852B Tx -70 Bm)

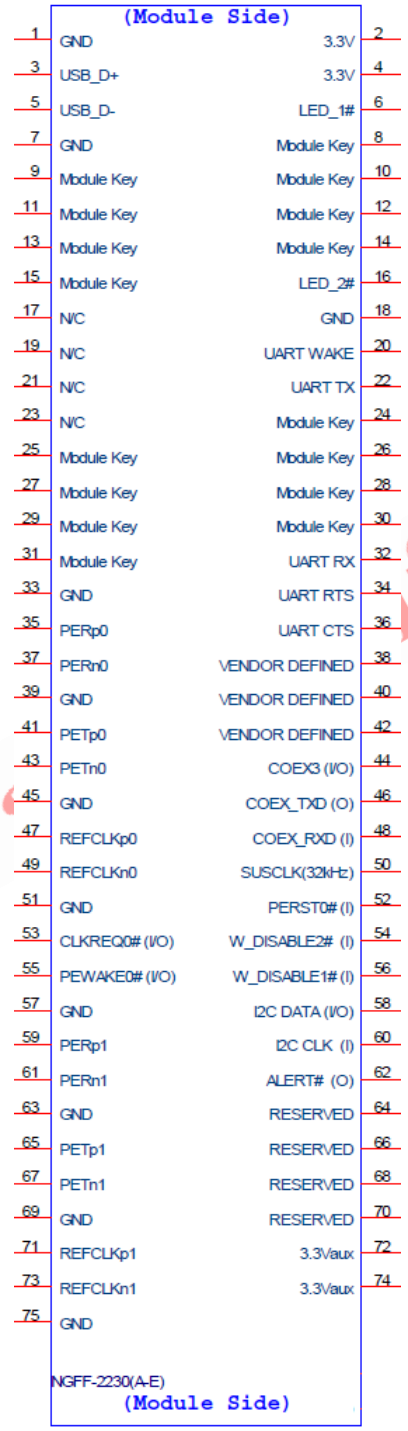
1.4.4 Operating Conditions

Features	Description
Operating Conditions	
Voltage	power supply for host:3.3V
Operating Temperature	0~70 ℃
Operating Humidity	< 60 %

Storage Temperature	-40~85 ℃
Storage Humidity	< 85%
ESD Protection	
Human Body Model	>1.5KV
Changed Device Model	

2. Pin Definition

2.1 Pin Map



2.2 Pin Table

Pin No	Definition	Basic Description	Voltage	Type
1	GND	Ground.	GND	
2	3.3V	3.3V power supply	VCC	3.3V
3	USB_D_P	USB Differential signal	Output/ Input	
4	3.3V	3.3V power supply	VCC	3.3V
5	USB_D_N	USB Differential signal	Output/ Input	
6	LED_WLAN_L	Active low signal. The signal is used to provide status indicators via LED.	Output	3.3V
7	GND	Ground.	GND	
16	LED_BT_L	Active low signal. The signal is used to provide status indicators via LED.	Output	3.3V
17	NC	Floating Pin, No connect to anything.	Floating	
18	GND	Ground.	GND	
19	NC	Floating Pin, No connect to anything.	Floating	
20	NC	Floating Pin, No connect to anything.	Floating	
21	NC	Floating Pin, No connect to anything.	Floating	
22	NC	Floating Pin, No connect to anything.	Floating	
23	NC	Floating Pin, No connect to anything.	Floating	
32	NC	Floating Pin, No connect to anything.	Floating	
33	GND	Ground.	GND	
34	NC	Floating Pin, No connect to anything.	Floating	
35	PERp0	PCIe Receive differential pair	Input	
36	NC	Floating Pin, No connect to anything.	Floating	
37	PERn0	PCIe Receive differential pair	Input	
38	NC	Floating Pin, No connect to anything.	Floating	
39	GND	Ground.	GND	
40	NC	Floating Pin, No connect to anything.	Floating	
41	PETp0	PCIe Transmit differential pair	Output	
42	NC	Floating Pin, No connect to anything.	Floating	

Pin No	Definition	Basic Description	Voltage	Type
43	PETn0	PCIe Transmit differential pair	Output	
44	NC	Floating Pin, No connect to anything.	Floating	
45	GND	Ground.	GND	
46	NC	Floating Pin, No connect to anything.	Floating	
47	REFCLKP	PCIe Differential reference clock source: 100MHz+/- 300ppm	Input	
48	NC	Floating Pin, No connect to anything.	Floating	
49	REFCLKN	PCIe Differential reference clock source: 100MHz+/- 300ppm	Input	
50	SUSCLK	32.768KHz clock input	input	
51	GND	Ground.	GND	
52	PERST0	PCIe Reset signal: active low. When PERST# is asserted at power-on state, AW-CB295NF returns to a pre-defined reset state and is ready for initialization and configuration after the de-assertion of the PERST#	Input	3.3V
53	CLKREQn	Reference clock request signal.	Output	3.3V
54	BT_DISABLE	BT disable control.	Input	3.3V
55	PEWAKE0	Power management event: open drain, active low. Used to reactivate the PCIe slot's main power rails and reference clocks.	Output Open-Drain	3.3V
56	W_DISABLE	WLAN disable control.	Input	3.3V
57	GND	Ground.	GND	
58	NC	Floating Pin, No connect to anything.	Floating	
59	NC	Floating Pin, No connect to anything.	Floating	
60	NC	Floating Pin, No connect to anything.	Floating	
61	NC	Floating Pin, No connect to anything.	Floating	
62	NC	Floating Pin, No connect to anything.	Floating	
63	GND	Ground.	GND	
64	NC	Floating Pin, No connect to anything.	Floating	
65	NC	Floating Pin, No connect to anything.	Floating	
66	NC	Floating Pin, No connect to anything.	Floating	
67	NC	Floating Pin, No connect to anything.	Floating	

Pin No	Definition	Basic Description	Voltage	Type
68	NC	Floating Pin, No connect to anything.	Floating	
69	GND	Ground.	GND	
70	NC	Floating Pin, No connect to anything.	Floating	
71	NC	Floating Pin, No connect to anything.	Floating	
72	3.3V	3.3V power supply	VCC	3.3V
73	NC	Floating Pin, No connect to anything.	Floating	
74	3.3V	3.3V power supply	VCC	3.3V
75	GND	Ground.	GND	

3. Electrical Characteristics

3.1 Absolute Maximum Ratings

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{dd33}	I/O voltage	3.0	3.3	3.6	V

3.2 Recommended Operating Conditions

V_{dd33}	I/O voltage	3.0	3.3	3.6	V
V_{dd33}	I/O voltage	3.0	3.3	3.6	V

3.3 Digital IO Pin DC Characteristics

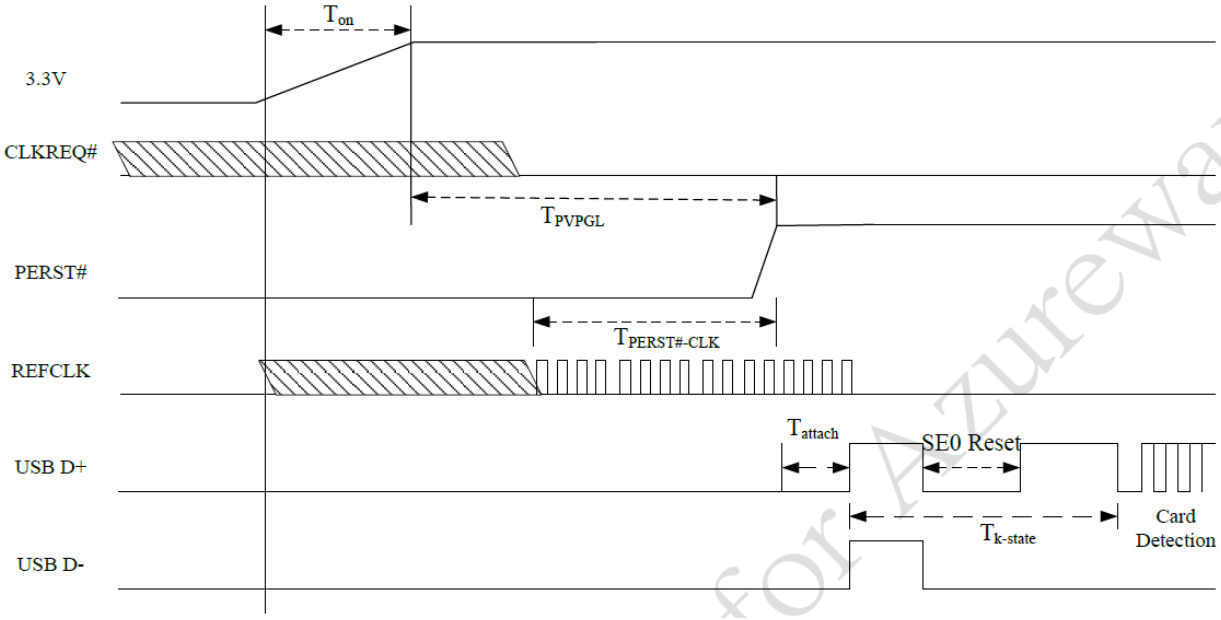
Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	2.0	3.3	3.6	V
V_{IL}	Input low voltage	--	0	0.9	V
V_{OH}	Output high voltage	2.97	--	3.3	V
V_{OL}	Output low voltage	0	--	0.33	V

3.4 LED Mode Behavior

State	Definition	Interpretation
OFF	**The LED is emitting no light.**	**Radio is incapable of transmitting.** This state is indicated when the card is not powered, the W_Disable# signal is asserted to disable the radio, or when the radio is disabled by software.
ON	**The LED is emitting light.**	**Radio is capable of transmitting.** The LED should remain ON even if the radio is bit actually transmitting. For example, the LED remains ON during temporary radio disablements performed by the Mini Card of its own volition to do scanning, switching radios/bands, power-management, etc. If the card is in a state wherein it is possible that radio can begin transmitting without the system user performing any action, this LED should remain ON.

3.5 Power up Timing Sequence

3.5.1. PCIe Bus during power on sequence



T_{on}: The main power ramp up duration.

T_{PVPGL}: Power valid PERST# input inactive.

$T_{PERST\#-CLK}$: Reference clock stable before PERST# inactive.

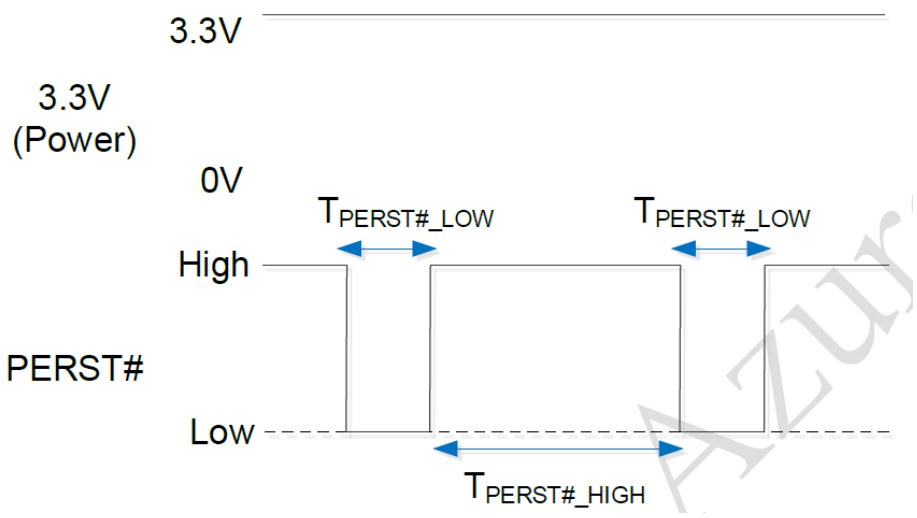
T_{attach}: The interval to turn on BT after PERST# de-asserted.

$T_{k-state}$: the duration from resister attached to USB host starting card detection procedure.

The typical timing range

Symbol	Unit	Min	Typical	Max
T_{on}	ms	0.5	1.5	5
T_{PVPGL}	ms	Implementation specific; recommended		--
$T_{PERST\#-CLK}$	us	100		--
T_{attach}	ms	0.5	2	5
$T_{k-state}$	ms	50	250	--

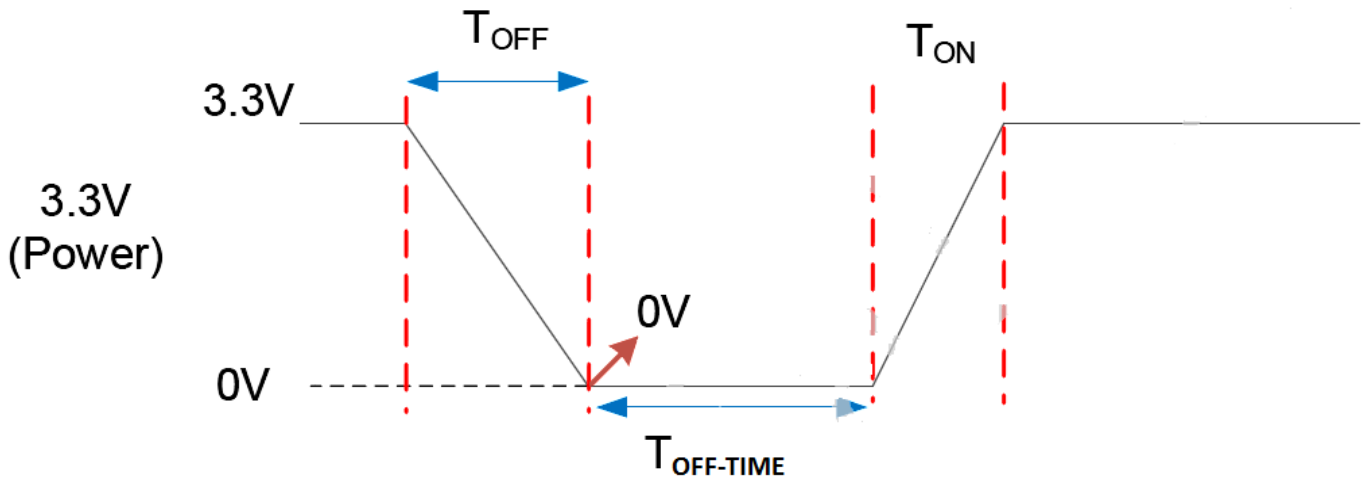
3.5.2 PCIe PERST# Timing Sequence



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

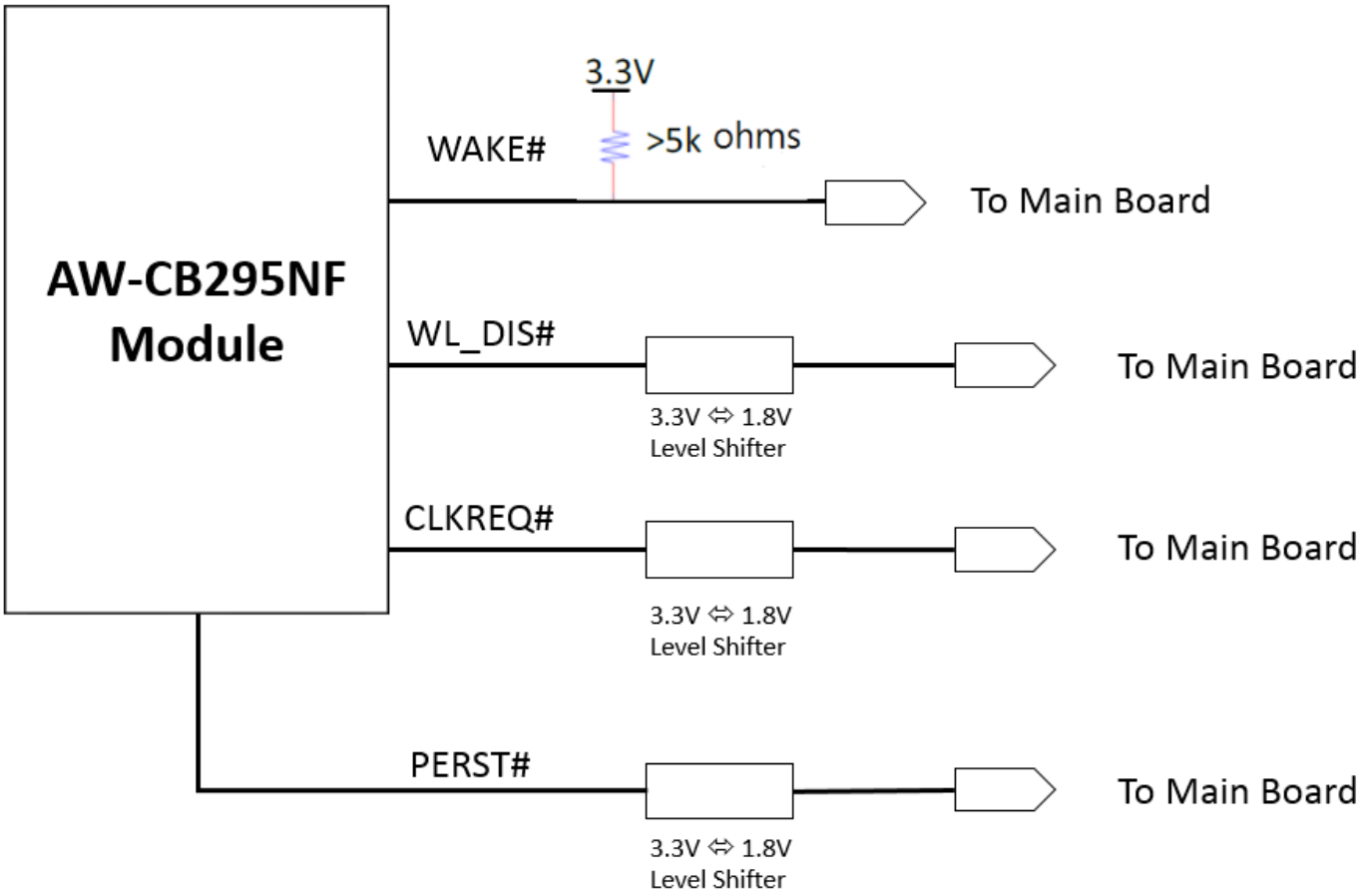
3.5.3 Power off Sequence



Power off Timing Timing Parameters

Symbol	Unit	Min	Typical	Max
T_{OFF}	ms	5	20	50
$T_{OFF-TIME}$	Ms	500	--	--
T_{ON}	Ms	0.5	1.5	5

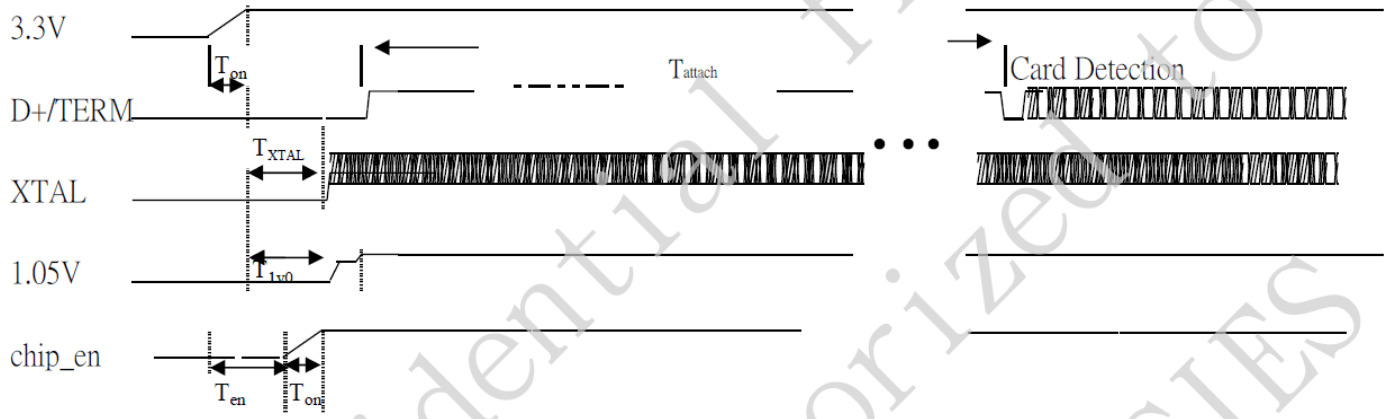
3.5.4 Application circuit for 1.8V I/O platform



3.5.5 PCIe platform power rail requirements

3.3V Power range	3.3V Ripple	3.3V Note	Rise time	
			Min	Max
+/- 0.165V	300mVpp@ switching frequency > 1MHz		1ms	5ms

3.5.6 USB Power on Sequence



Ton: The main power/chip_en ramp up duration.

Tattach: USB attach state. The duration from resistor attached to USB host starting card detection procedure.

Txtal: XTAL starts.

Ten: Interval between the rising point of 3.3V and chip_en.

Power on Flow Description

After the main 3.3V ramp up, the internal power on reset is released by the power ready detection circuit and the power management unit is enabled. The power management unit enables the internal regulator and clock circuits.

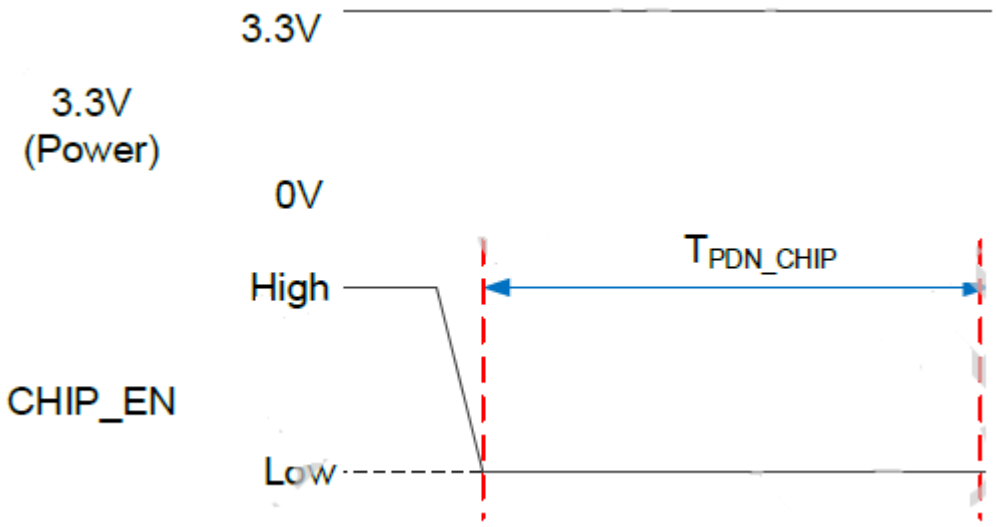
The power management unit also enables the USB circuits.

USB analog circuits attach resisters to indicate the insertion of the USB device.

	Unit	Min	Typical	Max
Ton	ms	-	1.5	5
Txtal	ms	-	1.5	8
Tattach	ms	100	250	-
T1v0	Ms	-	3	11
Ten	ms	0	0	5

USB Power on timing parameters

3.5.7 USB Power off Sequence



	Min	Typical	Max	Unit	Description
T_{PDN_CHIP}	100	100	X	ms	CHIP_EN keep low duration

3.5.8 Platform State Transitions

3.3V Power range	3.3V Ripple	3.3V Noise	Rise time	
			Min	Max
+/-0.165V	300mVpp@ switching frequency > 1MHz		1ms	5ms

USB Platform power rail requirements

3.6 Power Consumption*

3.6.1 WLAN

Static Test

Mode		Disable ASPM		L1 Mode	
		2.4G	5G	2.4G	5G
WLAN RF OFF		32.5		6.7	
No connection with wireless AP	AVG	40.6		15.3	
	MAX	255.1		209.4	
Connection AP	AVG	88.1	58.4	67.5	39
	MAX	162.5	166.5	154.3	123.7

Unit: mA

Dynamic Test

Band (GHz)	Mode	BW (MHz)	Link Speed	Transmit		Receive	
				Max.	Avg.	Max.	Avg.
2.4	802.11b	20	11M	270.0	257.9	168.1	162.7
	802.11n	20	144.5M	444.6	433.3	193.2	184.5
		40	300M	455.1	432.8	208.2	197.3
5	802.11n	20	144.5M	504.4	483.7	188.2	177.3
		40	300M	513.7	492.3	200.4	195.3
	802.11ac	20	173.5M	492.8	473.0	196.6	188.0
		40	400M	512.1	485.6	219.6	208.4
		80	867.0M	467.8	424.0	265.3	247.5

Unit: mA

3.6.2 Bluetooth

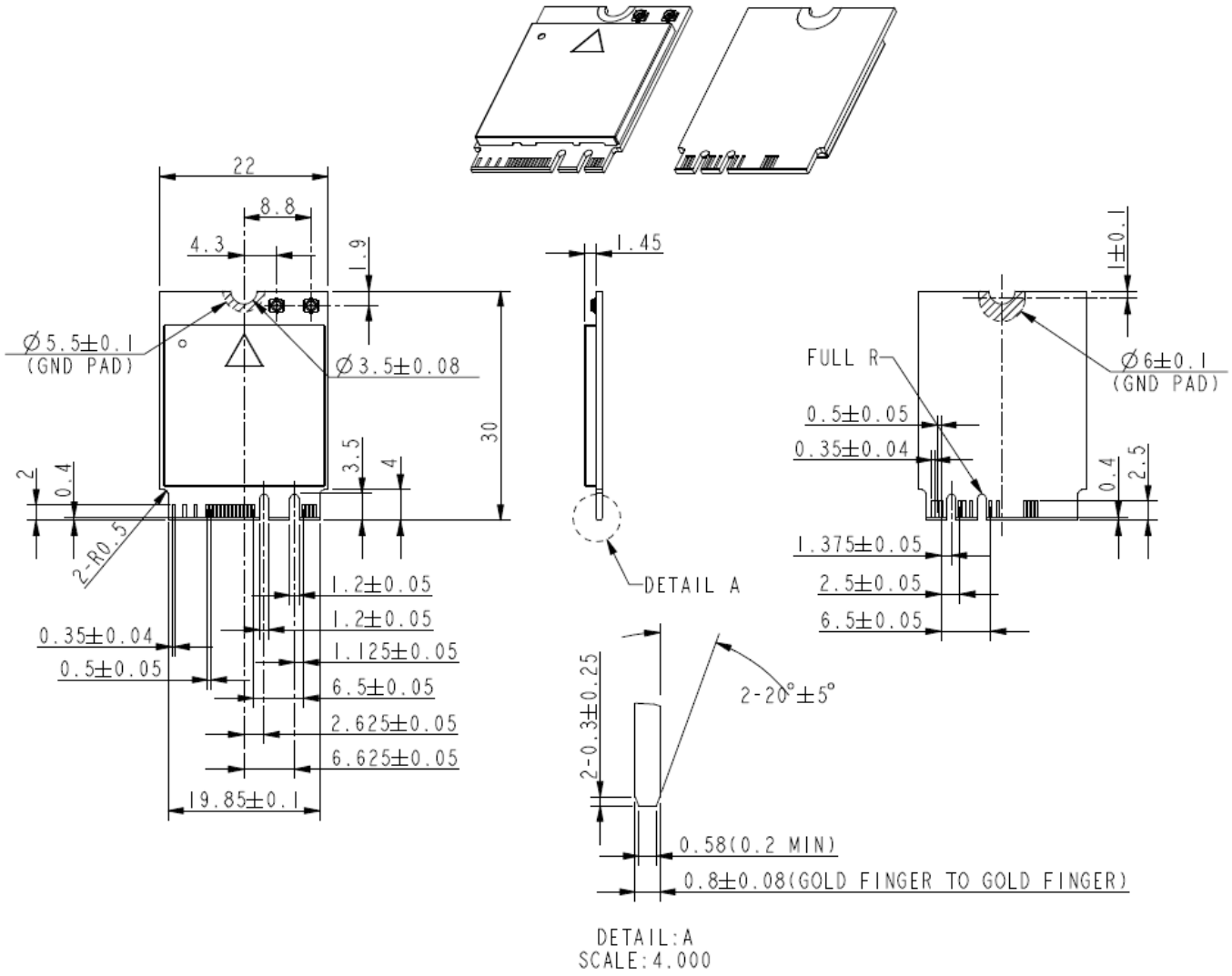
No.	Mode	Voltage=3.3 V	
		Max.	Avg.
1	Bluetooth RF Off	11.5	7.3
2	No Connection with any BT device	27.0	11.8
3	Connect BT Device	35.5	22.7
4	Transmit by BER 2.1	59.0	55.7
5	Receiver by BER 2.1	48.8	46.2

Unit: mA

* The power consumption is based on Azurewave test environment, these data for reference only.

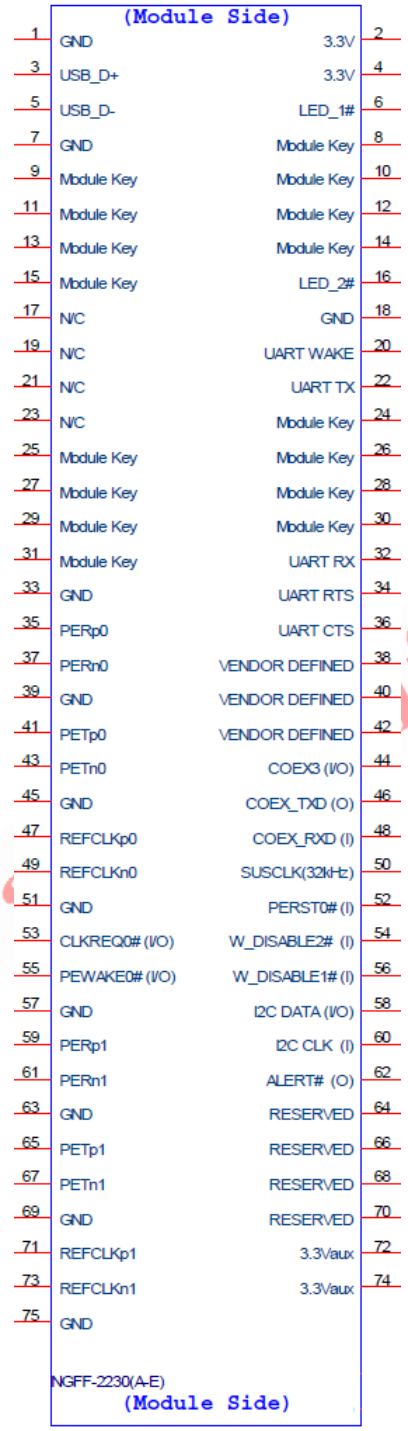
4. Mechanical Information

4.1 Mechanical Drawing



TOLERANCES UNLESS OTHERWISE SPECIFIED:±0.15mm

4.2 PCB Footprint



5. Packaging Information