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NF3219PQ

nFore Wi-Fi /BT Combo Module

Hardware Specification Data Sheet

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1. Overview

1.1 Introduction

NF3219PQ is a highly integrated Wi-Fi / Bluetooth combo module to support configurable 2x2 + 2x2. NF3219PQ single-Module provides the highest level of integration for Automotive In-Vehicle Infotainment connectivity systems with integrated two spatial streams IEEE802.11a/b/g/n/ac/ax MAC/baseband/radio, Bluetooth 5.2 enabling the seamless integration of WLAN/BT and Low Energy technology.

MCS11 (up to 1024 QAM) in 20MHz, 40MHz, and 80MHz channels for data rates up to 1774.5Mbps. In addition, all the data rates specified in IEEE802.11a/b/g/n/ac/ax are supported. Included Module are 2.4GHz and 5GHz transmit amplifiers, and receive low-noise amplifiers.

NF3219PQ offers a PCIe interface for high speed 802.11ax connectivity. The Bluetooth host controller is interfaced over a 4-wire high speed UART and includes PCM for audio.

NF3219PQ bring the latest mobile connectivity technology to automotive infotainment, telematics, rear seat entertainment, and industrial applications. Offering automotive Grade 3(-40C to +85C) temperature performance, NF3219PQ is tested to AECQ100 environmental stress guidelines.

NF3219PQ implements highly sophisticated enhanced collaborative coexistence hardware mechanisms and algorithms, which ensure that WLAN and Bluetooth collaboration is optimized for maximum performance. As a result, enhanced overall quality for simultaneous voice, video, and transmission is achieved.

Let all of the system high design flexibility, short development cycle, and quick time-to-market.

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1.2 General Features

- IEEE 802.11a/b/g/n/ac/ax dual-band radio with virtual-simultaneous dual-band operation
- Bluetooth v5.2 and is backward compatible with previous BT standards, supports 2 Mbps, AOA, BLE Long Range.
- BT for class 1 and class 2 power-level transmissions without requiring an external PA (power amplifier) including AOA
- Concurrent Bluetooth and WLAN operation
- STA and Soft AP support up to 32 STAs, 3 port AP/STA concurrency.
- Module WLAN driver execution capable of supporting IEEE 802.11 functionality
- WLAN host interface options
- Low power PCIe (w/L1 sub-state) interface for WLAN and UART/PCM interface for BT
- BT host digital interface(which can be used concurrently with the below interface)
- UART(Max Baud Rate 3.2Mbps)
- Single ended RF port for cleaner and low cost design
- 20/40MHz at 2.4GHz and 20/40/80MHz at 5GHz
- BT-WLAN coexistence and ISM-LTE coexistence
- PCM for BT audio
- LGA module suitable for Surface Mounted Technology (SMT)
- Iron Shielding case
- LGA package
- Dimension(Iron Shielding Case): 23mm(L) x 23mm(W) x 2.9mm(H)
- Operating Voltage : VDD_3V3_WL : 3.14 to 3.46V(Buck Circuit Supply Input) ; VDDIO_1V8: 1.7 to 1.9V
- RoHS / REACH Compliant
- Automotive Level

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2.2 WLAN Features

- Compliant with IEEE 802.11a/b/g/n/ac/ax
- Supports 2x2 Multi-User Multiple-Input Multiple-Output (MU-MIMO)
- Dual Band Simultaneous (DBS) with dual MAC, up to 1774.5 Mbps data rate (2x2+2x2 11ax DBS)
- Dual band 2.4G/5G chains
- 20/40 MHz channel bandwidth for 2.4 GHz and 20/40/80 MHz channel bandwidth for 5 GHz
- Offloading traffic for minimal host utilization at 11ac/ax speeds
- Low power PCIe (w/L1 sub-state) interface
- Integrated close-loop power detector
- Operation frequency: 2412MHz-2462MHz, 5150MHz-5250MHz, 5725MHz-5850MHz

2.3 Bluetooth Features

- Compliant with BT 5.2
- Supports 2 Mbps Bluetooth Low Energy (BLE), BLE long range
- Split ACL support for A2DP true stereo (earbuds)
- Sharing BT antenna with WLAN and concurrent with 5G WLAN
- Dual eSCO and dual A2DP streams
- Supports class 1 and class 2 power-level transmissions without requiring an external PA (power amplifier)
- Backward-compatible with previous BT standards.
- Flexible interface Slimbus/PCM/I2S for BT audio.
- Operation frequency: 2402MHz-2480MHz

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3. MODULE SPECIFICATION

3.1 Absolute Maximum Ratings

Over operating free-air temperature range

Characteristics	Value	Unit
VDD_PA(Supply to PA)	-0.5 to 4.8	V
VDDIO_1V8(DC supply voltage for digital I/O)	-0.5 to 1.9	V
VDD_Core_VH(Main Power)	-0.5 to 2.0	V
VDD_Core_VM(Main Power)	-0.5 to 1.42	V
VDD_Core_VL(Main Power)	-0.5 to 1.0	V
Storage Temperature Range	-55 to +150	˚C
Operating Temperature Range	-40 to +85	˚C

3.2 Recommended Operating Conditions

The NF3219PQ requires one power supplies

Power Supply	Voltage		
	Min.	Typ.	Max.
VDD_PA	3.4V	3.85V	4.8V
VDDIO_1V8	1.71V	1.8V	1.89V
VDD_Core_VH	1.9V	1.95V	2.0V
VDD_Core_VM	1.28V	1.35V	1.42V
VDD_Core_VL	0.9V	0.95V	1.05V

3.3 The NF3219PQ ESD Specification

Pin Type	Symbol	Condition	ESD Rating	Unit
ESD	ESD_HAND_HBM	Human body model: JESD22-A114-B	+-1000	V
CDM	ESD_HAND_CDM	Charged device model: JESD22-C101-D	+-250	V

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3.4 RF Characteristic

3.4.1 WLAN RF Characteristics

WLAN Transmitter (2.4GHz)						
Characteristics	Condition	Conditions	Min	Typ	Max	Unit
Output Power	BPSK 6 Mbps	Mask compliant	16	20	24	dBm
	CCK 11 Mbps	Mask compliant	16	20	24	
	64QAM 54 Mbps	EVM limited (-25 dB)	13.5	17.5	21.5	
	BPSK MCS0(HT20)	Mask compliant	14.5	18.5	22.5	
	BPSK MCS0(HT40)	Mask compliant	13	17	21	
	64-QAM(HT20)	EVM limited (-27 dB)	12.5	16.5	20.5	
	64-QAM(HT40)	EVM limited (-27 dB)	10.5	14.5	18.5	
	256-QAM MCS9(VHT20)	EVM limited (-32 dB)	11.5	15.5	19.5	
	256-QAM MCS9(VHT40)	EVM limited (-32 dB)	11	15	19	
	1024-QAM MCS11(HE40)	EVM limited (-35 dB)	9.5	13.5	17.5	

WLAN Transmitter (5GHz)						
Characteristics	Condition	Conditions	Min	Typ	Max	Unit
Output Power	64-QAM 54 Mbps	EVM limited (-25 dB)	12.5	16.5	19.5	dBm
	64-QAM MCS7(HT20)	EVM limited (-27 dB)	11.5	15.5	18.5	
	64-QAM MCS7(HT40)	EVM limited (-27 dB)	11	15	18	
	256-QAM MCS9(VHT20)	EVM limited (-32 dB)	10.5	14.5	17.5	
	256-QAM MCS9(VHT40)	EVM limited (-32 dB)	10	14	17	
	256-QAM MCS9(VHT80)	EVM limited (-32 dB)	9.5	13.5	16.5	
	1024-QAM MCS11(HE40)	EVM limited (-35 dB)	8	13	16	
	1024-QAM MCS11(HE80)	EVM limited (-35 dB)	7.5	12.5	15.5	

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WLAN Receive(2.4GHz)					
Characteristics	Condition	Min	Typ	Max	Unit
Sensitivity	11M CCK	-91	-87	-83	dBm
	54M OFDM	-77	-73	-69	
	64-QAM 1SS MCS7(HT20)	-77	-73	-69	
	64-QAM 1SS MCS7(HT40)	-74.5	-70.5	-66.5	
	1024-QAM 1SS MCS11(HE40)	-59	-55	-51	

WLAN Receive(5GHz)					
Characteristics	Condition	Min	Typ	Max	Unit
Sensitivity	64-QAM 54 Mbps	-77	-74	-71	dBm
	64-QAM 1SS MCS7(HT20)	-77	-74	-71	
	64-QAM 1SS MCS7(HT40)	-74.5	-7..5	-66.5	
	64-QAM 1SS MCS7(VHT20)	-74.5	-70.5	-66.5	
	256-QAM 1SS MCS9(VHT40)	-65.5	-61.5	-57.5	
	256-QAM 1SS MCS9(VHT80)	-65.5	-61.5	-57.5	
	1024-QAM 1SS MCS11(HE20)	-59	-55	-51	
	1024-QAM 1SS MCS11(HE40)	-59	-55	-51	
	1024-QAM 1SS MCS11(HE80)	-59	-55	-51	

※ Test by nfore EVB in +25˚C

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3.4.2 Bluetooth RF Characteristics

BT Transmitter, Basic rate				
Characteristics	Min	Typ	Max	Unit
RF output power	-6	12	13	dBm
Power control step	2	-	8	dB

BT Transmitter, EDR rate				
Characteristics	Min	Typ	Max	Unit
RF output power	-6	10	11	dBm
Power control step	2	-	8	dB

BT Receiver Characteristics, Basic rate receiver					
Characteristics		Min	Typ	Max	Unit
Sensitivity	GFSK, BER = 0.1%		-92		dBm
	Pi/4-DQPSK, BER = 0.01%		-92		
	8DPSK, BER = 0.01%		-85		
Max. useable input power	Pi/4-DQPSK, BER = 0.1%	-10			dBm
	8DPSK, BER = 0.1%	-10			

3.4.3 BLE RF Characteristics

BLE Transmitter				
Characteristics	Min	Typ	Max	Unit
RF output power	-6	12	13	dBm

BT Receiver Characteristics, Low energy receiver					
Characteristics		Min	Typ	Max	Unit
Sensitivity	PER<= 30.8%		-96		dBm

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4. AC Specifications

4.1 HCI UART Interface

NF3219PQ supports the HCI UART transport layer as defined in the Bluetooth Core Specification, Version 5.0, Volume 4, Part A. In addition to communication with the host, the HCI UART interface also supports Bluetooth software (in-band) sleep control. The HCI UART interface circuits use digital I/O pins that receive power from the VDDIO_1V8 supply. Their I/O performance specifications meet the requirements stated.

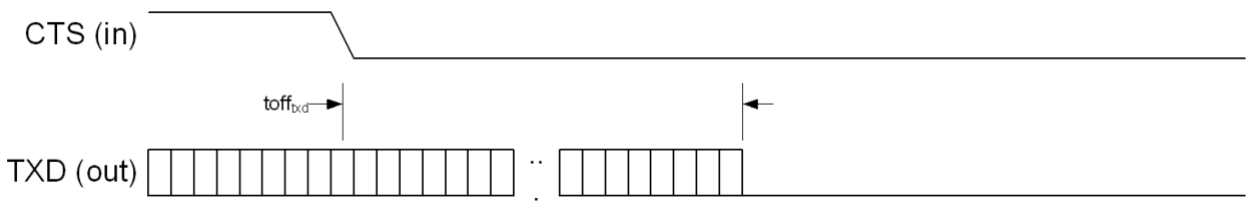
The HCI UART transport layer uses the following setting for RS232.

UART Parameters

UART parameter	Value
Number of data bits	Eight
Parity bit	No parity
Stop bit	One stop bit
Flow control	RTS/CTS (hardware)
Flow off response	Two bytes maximum
Supported transport bit rates (bps)[1]	9.6 K, 19.2 K, 38.4 K, 57.6 K, 115.2 K, 125 K, 230.4 K, 250 K, 460.8 K, 500 K, 720 K, 921.6 K, 1 M, 1.6 M, 2 M, 3 M, 3.2 M, with an accuracy of +1.5/-2.5%
Host baud rate tolerance	±3%

1. UART maximum baud rate is 3.2 Mbps.

The HCI UART transmit timing is showing as follows. The HCI UART receive timing is showing as follows.



HCI UART transmit flow control timing

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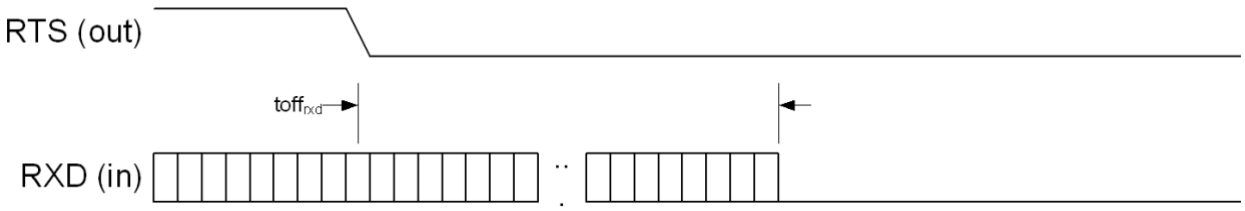
Parameter	Description	Min	Typ	Max	Unit
$toff_{txd}$	Delay from CTS to TXD stop	—	—	1	byte

HCI UART transmit flow control timing



HCI UART receive flow control timing

Parameter	Description	Min	Typ	Max	Unit
$toff_{rxd}$	Delay from RTS to RXD stop	16	—	—	byte

HCI UART receive flow control timing

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4.2 Bluetooth PCM interface

The pulse coded modulation(PCM) interface connects the NF3219PQ to the phone' s audio interface, or to peripheral devices, such as a codec. The PCM interface circuits use digital I/O pins that receive power from the VDDIO_1V8 supply. Their I/O performance specifications meet the requirements stated.

NF3219PQ PCM interface has been designed to minimize audio latency. The typical audio latencies for various packet types as follows.

Packet type	Audio latency
HV3/EV3 T_{eSCO} = 6, W_{eSCO} = 0	4.4 ms
EV3 T_{eSCO} = 6, W_{eSCO} = 2	5.7 ms
EV3 T_{eSCO} = 6, W_{eSCO} = 4	6.9 ms

Typical PCM interface audio latency

The PCM interface is configured to operate as master or slave. In each case, the PCM_IN pin is the data receive terminal(an input), and the PCM_OUT pin is the data transmit terminal(an output). The clock and sync pins function as inputs or outputs, depending on whether NF3219PQ PCM interface is configured as master or slave:

- When NF3219PQ PCM interface is the master : PCM_CLK and PCM_SYNC are outputs from the device to the PCM bus slave(s).
- When NF3219PQ PCM interface is the slave : PCM_CLK and PCM_SYNC are inputs to the device from the PCM bus master.

PCM interface specifications

Parameter	Description	Min	Typ	Max	Units
Clock rate (slave)	Determined by the master	64	–	2,048	kHz
Clock rate (master)	(32 MHz * N/4,000), in which N is an integer, 8 ≤ N ≤ 256	64	–	2,048	kHz
Frame size	–	1	8	256	Bits
Slot size	–	1	13	16	Bits
Slot number	Number of slots that can be configured per frame	1	–	32	Slots/frame

Example timing diagrams and specifications for slave and master configurations are described in the following tables and illustrations.

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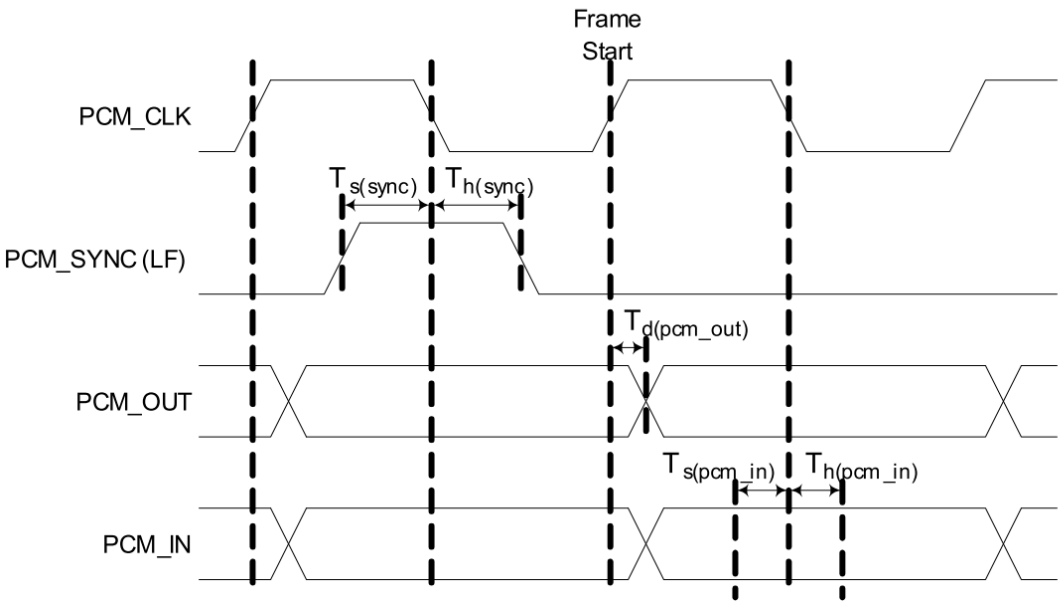

PCM interface timing diagram(slave)

Symbol	Description	Min	Typ	Max	Units
F_{pcm_clk}	PCM_CLK frequency	64	–	2,048	kHz
Ts_{pcm_sync}	Setup time PCM_SYNC to PCM_CLK fall	0	–	–	ns
Th_{pcm_sync}	Hold time PCM_CLK fall to PCM_SYNC fall	150	–	–	ns
Td_{pcm_out}	Delay from PCM_CLK rise to PCM_OUT	0	–	150	ns
Ts_{pcm_in}	Setup time PCM_IN to PCM_CLK fall	0	–	–	ns
Th_{pcm_in}	Hold time PCM_IN after PCM_CLK fall	150	–	–	ns

PCM interface timing in slave mode

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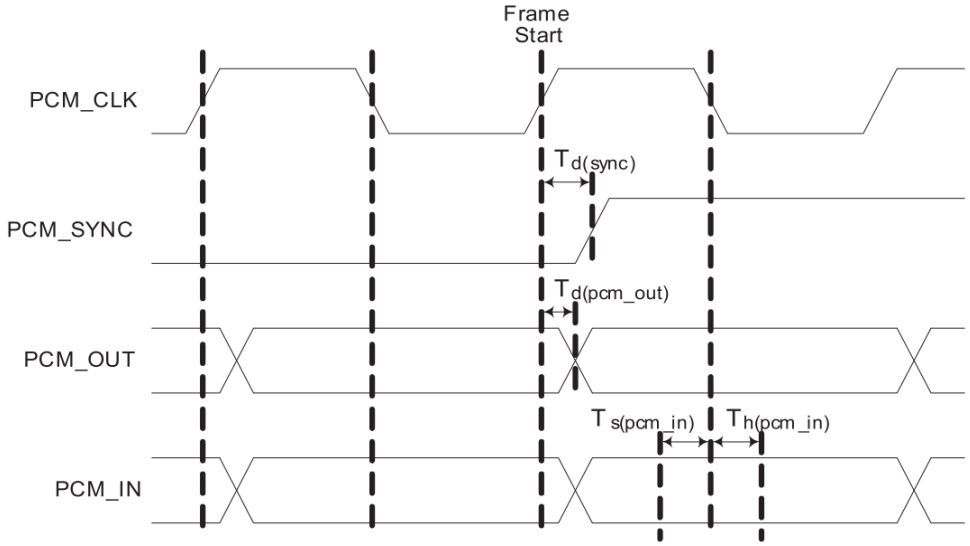

PCM interface timing diagram(master)

Symbol	Description	Min	Typ	Max	Units
Fp_{cm_clk}	PCM_CLK frequency	64	–	2048	kHz
Td_{sync}	Delay from PCM_CLK rise to long SYNC	-10	–	50	ns
Td_{pcm_out}	Delay from PCM_CLK rise to PCM_OUT	-10	–	50	ns
Ts_{pcm_in}	Setup time PCM_IN to PCM_CLK fall	50	–	–	ns
Th_{pcm_in}	Hold time PCM_IN after PCM_CLK fall	150	–	–	ns

PCM interface timing in master mode

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4.3 Electrical Characteristics

4.3.1 Absolute Maximum Ratings and Recommended Operating Conditions

Absolute Maximum Ratings

Characteristics	Value	Unit
VDD_PA(Supply to PA)	-0.5 to 4.8	V
VDDIO_1V8(DC supply voltage for digital I/O)	-0.5 to 1.9	V
VDD_Core_VH(Main Power)	-0.5 to 2.0	V
VDD_Core_VM(Main Power)	-0.5 to 1.42	V
VDD_Core_VL(Main Power)	-0.5 to 1.0	V
Storage Temperature Range	-55 to +150	˚C
Operating Temperature Range	-40 to +85	˚C

Operating conditions(Voltage)

Power Supply	Voltage		
	Min.	Typ.	Max.
VDD_PA	3.4V	3.85V	4.8V
VDDIO_1V8	1.71V	1.8V	1.89V
VDD_Core_VH	1.9V	1.95V	2.0V
VDD_Core_VM	1.28V	1.35V	1.42V
VDD_Core_VL	0.9V	0.95V	1.05V

Operating conditions (Only for reference not for max Current consumption design)

Power Supply	Current(mA)(Average)		
	Min.	Typ.	Max.
VDD_PA	252	637	1139
VDDIO_1V8	0.64	0.72	0.9
VDD_Core_VH	75	111	158
VDD_Core_VM	107	164	264
VDD_Core_VL	190	217	293

TX_1X1(11b_1Mbps_21dBm; 11a_6Mbps_18dBm)
TX_2X2(11b_1Mbps_21dBm; 11a_6Mbps_18dBm)
DBS(11b_1Mbps_21.5dBm; 11a_6Mbps_18.5dBm)

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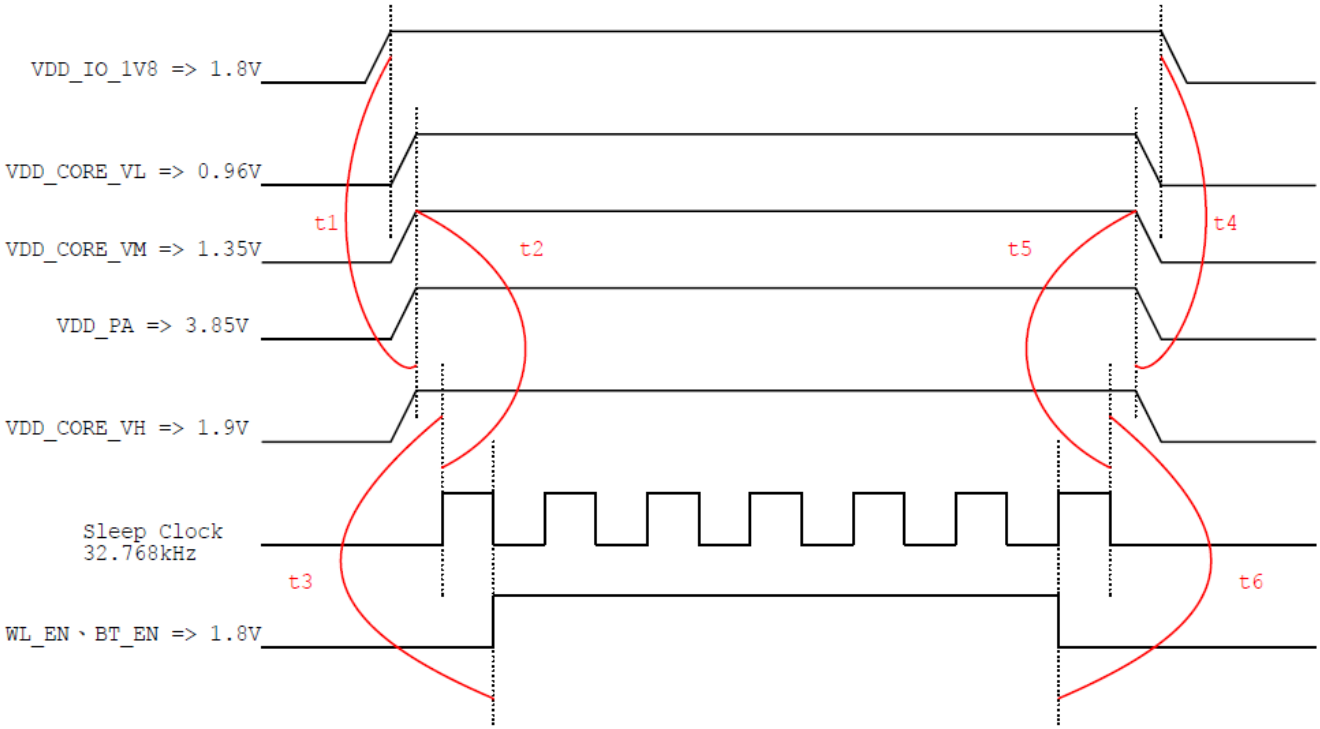
4.3.2 NF3219PQ Power Up/Down Sequence

NF3219PQ power on and power off sequence timing



Symbol	Parameter	Min	Max	Unit
t1	VDD_IO_1V8 valid to VDD_CORE_VL/VM/VH and VDD_PA is asserted	2	-	ms
t2	VDD_CORE_VL/VM/VH and VDD_PA valid to SLEEP_CLK is asserted	2	-	ms
t3	SLEEP_CLK valid to WL_EN、BT_EN is asserted	2	-	ms
t4	VDD_CORE_VL/VM/VH and VDD_PA de-assert to VDD_IO_1V8 ramping-down	2	10	ms
t5	VDD_PA de-assert to VDD_CORE_VL/VM/VH ramping-down	2	10	ms
t6	WL_EN、BT_EN de-assert to SLEEP_CLK ramping-down	2	10	ms

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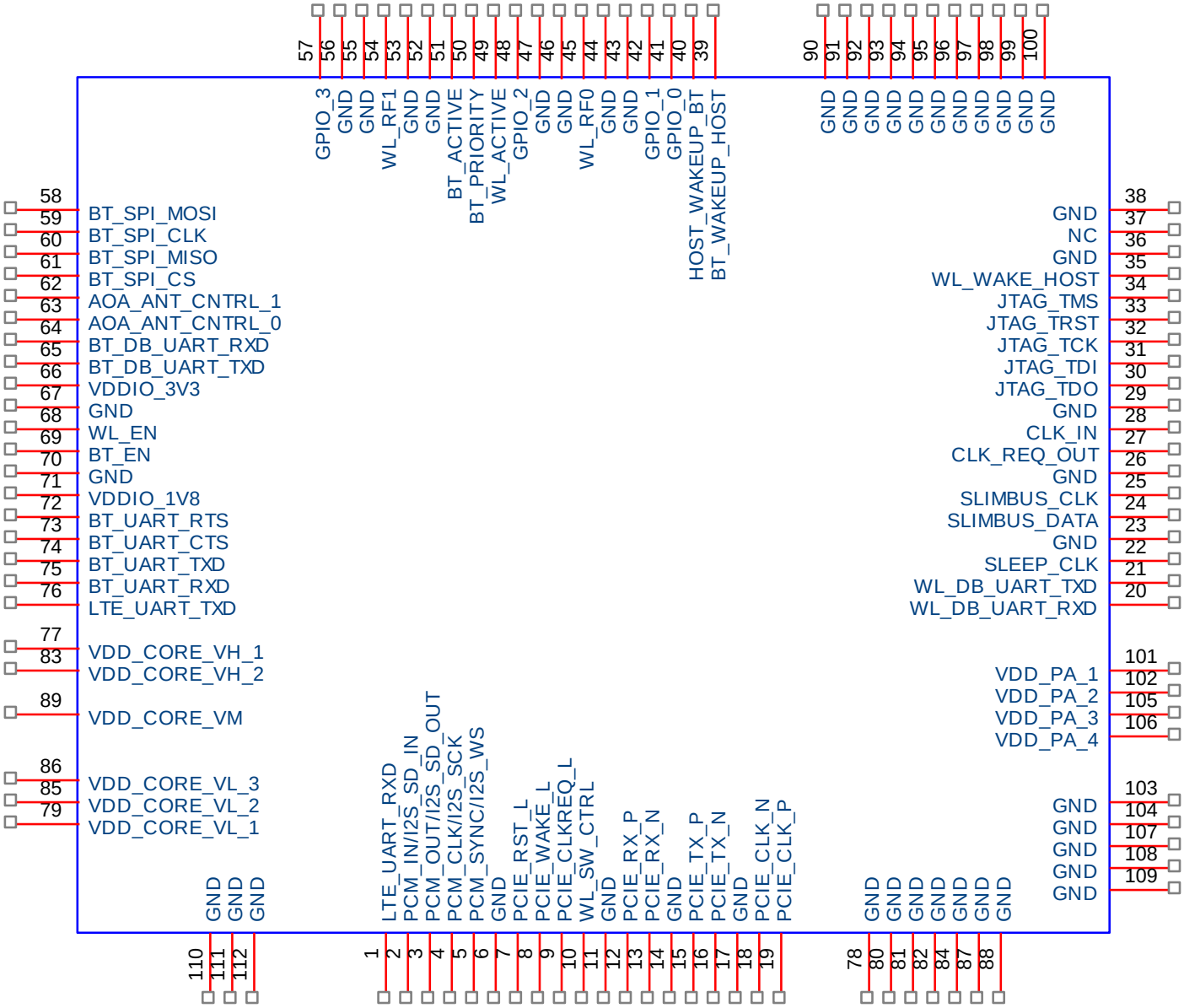
5. Package Information

5.1 Signal Layout (Top View)



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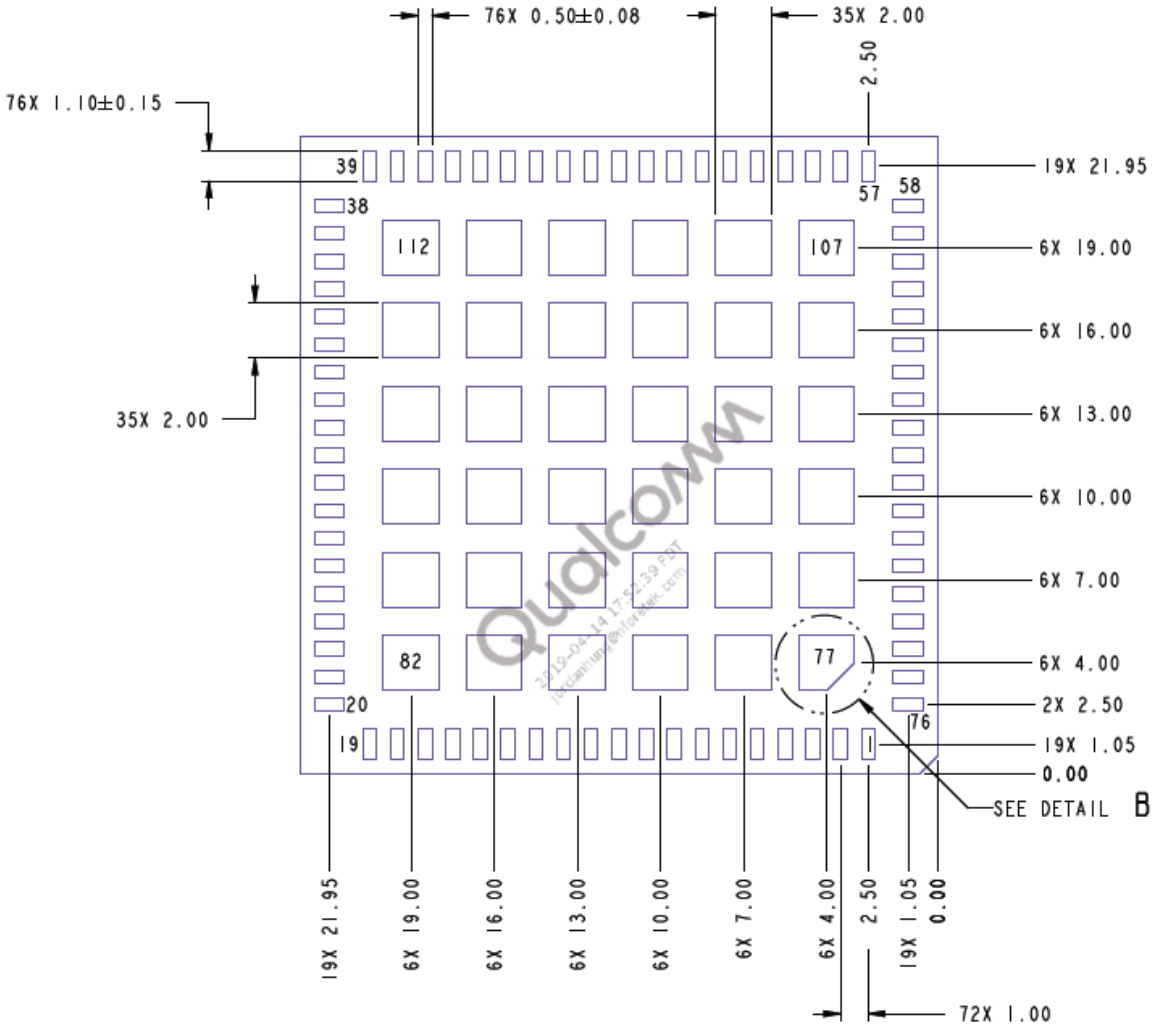
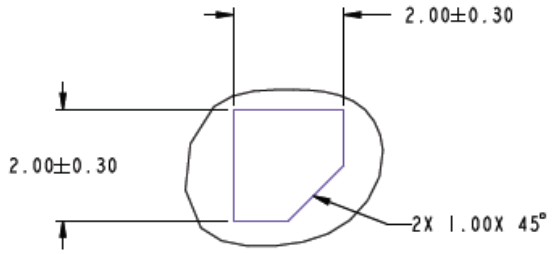
Signal Layout (Bot View)





DETAIL B
SCALE 16.000

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5.2 Pin Description

No.	Name	Type	Description
1	LTE_UART_RXD	I	LTE co-existence signal. LTE_UART_RXD or LTE_FS
2	PCM_IN/I2S_SD_IN	I	BT PCM input signal
3	PCM_OUT/I2S_SD_OUT	O	BT PCM output signal; Must pull 1K(ohm) to VDDIO_1V8
4	PCM_CLK/I2S_SCK	I/O	BT PCM clock signal
5	PCM_SYNC/I2S_WS	O	BT PCM synchronization signal
6	GND	GND	GROUND
7	PCIE_RST_L	I	PCI express reset with weak pull-down
8	PCIE_WAKE_L	O	Request to service a function-initiated wake event(Pull up 10K to VDDIO_1V8)
9	PCIE_CLKREQ_L	O	Reference clock request
10	WL_SW_CTRL	F	NC(Reserved Point)
11	GND	GND	GROUND
12	PCIE_RX_P	I	Differential Receive(Series Capacitor)(0.1uF)
13	PCIE_RX_N	I	Differential Receive(Series Capacitor)(0.1uF)
14	GND	GND	GROUND
15	PCIE_TX_P	O	Differential Transmit
16	PCIE_TX_N	O	Differential Transmit
17	GND	GND	GROUND
18	PCIE_CLK_N	I	Differential reference clock(100MHz)(Series Capacitor)(0.1uF)
19	PCIE_CLK_P	I	Differential reference clock(100MHz)(Series Capacitor)(0.1uF)
20	WL_DB_UART_RXD	I	WLAN Debug Signal(Reserved Point)
21	WL_DB_UART_TXD	O	WLAN Debug Signal(Reserved Point)
22	SLEEP_CLK	I	External low-power clock input(32.768kHz)(1.8V)
23	GND	GND	GROUND
24	SLIMBUS_DATA	F	NC
25	SLIMBUS_CLK	F	NC
26	GND	GND	GROUND
27	CLK_REQ_OUT	O	Clock Request Output(Not Used) ; Must pull 100K(ohm) to GND
28	CLK_IN	F	NC(Reserved Point)
29	GND	GND	GROUND
30	JTAG_TDO	B	JTAG_TDO(Reserved Point)
31	JTAG_TDI	B	JTAG_TDI(Reserved Point)
32	JTAG_TCK	B	JTAG_TCK(Reserved Point)
33	JTAG_TRST	B	JTAG_TRST(Reserved Point)
34	JTAG_TMS	B	JTAG_TMS(Reserved Point)

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35	WL_WAKE_HOST	O	WL_ WAKE _ HOST Signal to wake-up the host from WL; NC if not used.
36	GND	GND	GROUND
37	NC	F	Not Connected
38	GND	GND	GROUND
39	BT_WAKEUP_HOST	O	Bluetooth wakeup the host, active high
40	HOST_WAKEUP_BT	I	Host wakeup Bluetooth, active high
41	GPIO_0	B	No function
42	GPIO_1	B	No function
43	GND	GND	GROUND
44	GND	GND	GROUND
45	WL_RF0	RF	WIFI 2.4G/5G and Bluetooth RF in/out port for chain 0
46	GND	GND	GROUND
47	GND	GND	GROUND
48	GPIO_2	B	No function
49	WL_ACTIVE	O	WLAN_ACTIVE signal to BT chip(Coexistence with BT)
50	BT_PRIORITY	I	BT_PRIORITY signal from BT chip(Coexistence with BT)
51	BT_ACTIVE	I	BT_ACTIVE signal from BT chip(Coexistence with BT)
52	GND	GND	GROUND
53	GND	GND	GROUND
54	WL_RF1	RF	WIFI 2.4G/5G RF in/out port for chain 1
55	GND	GND	GROUND
56	GND	GND	GROUND
57	GPIO_3	B	No function
58	BT_SPI_MOSI	F	NC(Reserved Point)
59	BT_SPI_CLK	F	NC(Reserved Point)
60	BT_SPI_MISO	F	NC(Reserved Point)
61	BT_SPI_CS	F	NC(Reserved Point)
62	AOA_ANT_CNTRL_1	F	NC(Reserved Point)
63	AOA_ANT_CNTRL_0	F	NC(Reserved Point)
64	BT_DB_UART_RXD	I	BT Debug Signal(Reserved Point)
65	BT_DB_UART_TXD	O	BT Debug Signal(Reserved Point)
66	VDDIO_3V3	PI	NC
67	GND	GND	GROUND
68	WL_EN	I	Wi-Fi Function Enable
69	BT_EN	I	Bluetooth Function Enable
70	GND	GND	GROUND
71	VDDIO_1V8	PI	Module Main Power Input (1.8V)

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72	BT_UART_RTS	O	UART request-to-send. Active- low request-to-send signal for the HCI UART interface.
73	BT_UART_CTS	I	UART clear-to-send. Active-low clear-to-send signal for the HCI UART interface.
74	BT_UART_TXD	O	UART serial output. Serial data output for the HCI UART interface.
75	BT_UART_RXD	I	UART serial input. Serial data input for the HCI UART interface.
76	LTE_UART_TXD	O	LTE co-existence signal. LTE_UART_TXD or LTE_PRI
77	VDD_CORE_VH_1	PI	Module Main Power Input (1.9V)
78	GND	GND	GROUND
79	VDD_CORE_VL_1	PI	Module Main Power Input (0.96V)
80	GND	GND	GROUND
81	GND	GND	GROUND
82	GND	GND	GROUND
83	VDD_CORE_VH_2	PI	Module Main Power Input (1.9V)
84	GND	GND	GROUND
85	VDD_CORE_VL_2	PI	Module Main Power Input (0.96V)
86	VDD_CORE_VL_3	PI	Module Main Power Input (0.96V)
87	GND	GND	GROUND
88	GND	GND	GROUND
89	VDD_CORE_VM	PI	Module Main Power Input (1.35V)
90	GND	GND	GROUND
91	GND	GND	GROUND
92	GND	GND	GROUND
93	GND	GND	GROUND
94	GND	GND	GROUND
95	GND	GND	GROUND
96	GND	GND	GROUND
97	GND	GND	GROUND
98	GND	GND	GROUND
99	GND	GND	GROUND
100	GND	GND	GROUND
101	VDD_PA_1	PI	Module PA Power Input (3.85V)
102	VDD_PA_2	PI	Module PA Power Input (3.85V)
103	GND	GND	GROUND
104	GND	GND	GROUND
105	VDD_PA_3	PI	Module PA Power Input (3.85V)

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106	VDD_PA_4	PI	Module PA Power Input (3.85V)
107	GND	GND	GROUND
108	GND	GND	GROUND
109	GND	GND	GROUND
110	GND	GND	GROUND
111	GND	GND	GROUND
112	GND	GND	GROUND

PI= Power Input;
PO=Power Output;
I/O=Bi-directional;
I=Input;
O=Output;
RF=RF Pin;
GND=Ground
F=Floating (Not Connected)

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6. Ordering Information

6.1 The NF3219PQ may be ordered as follows:

NF3219PQ (2.4GHz/5GHz, LGA -112)

6.2 Package Marking

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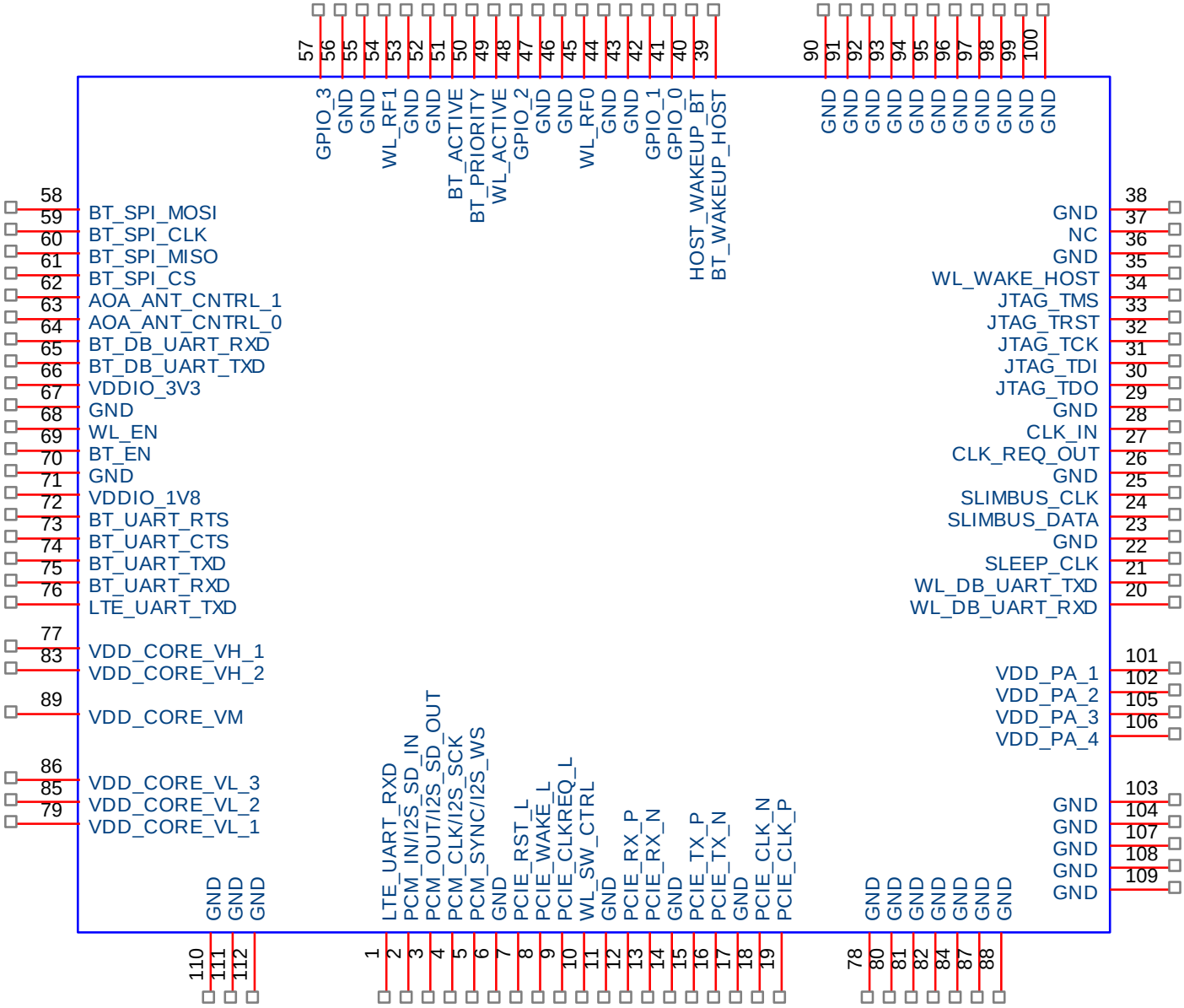
7. MECHANICAL CHARACTERISTICS

7.1 NF3219PQ Top View Side



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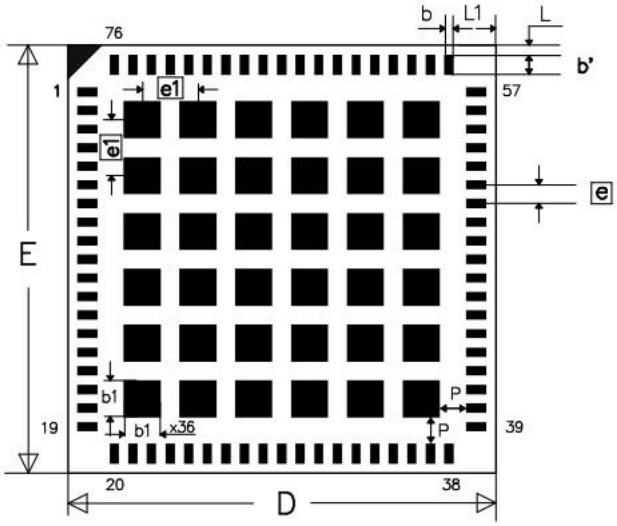
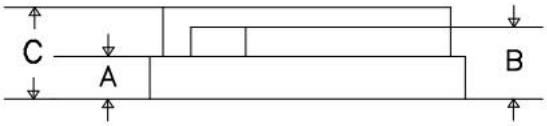


<TOP VIEW>



<SIDE VIEW>

Unit:mm

Symbol	Min	Nom	Max
A	1.15	1.2	1.25
B	1.6	1.7	1.8
C	2.8	2.9	3.0
D	22.9	23.0	23.2
E	22.9	23.0	23.2
b	0.45	0.5	0.55
b'	1.05	1.1	1.15
b1	1.7	2.0	2.3
e	0.95	1.0	1.05
e1	2.95	3.0	3.05
P	1.35	1.4	1.45
L	0.45	0.5	0.55
L1	2.20	2.25	2.3

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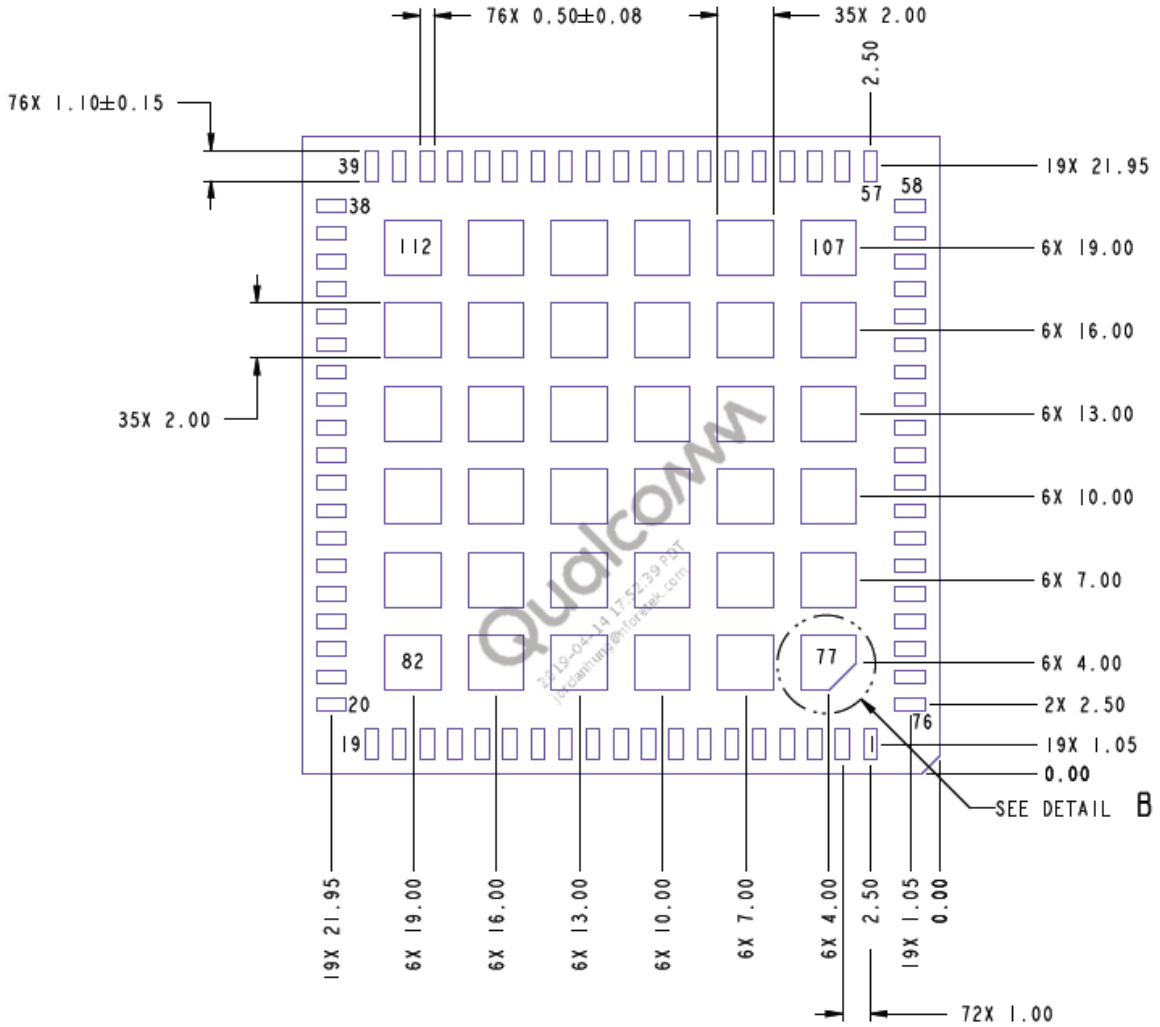
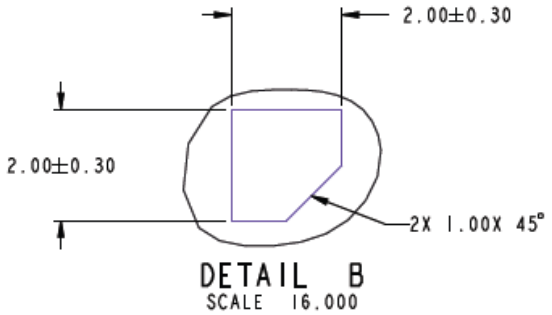
7.2 NF3219PQ Bottom View





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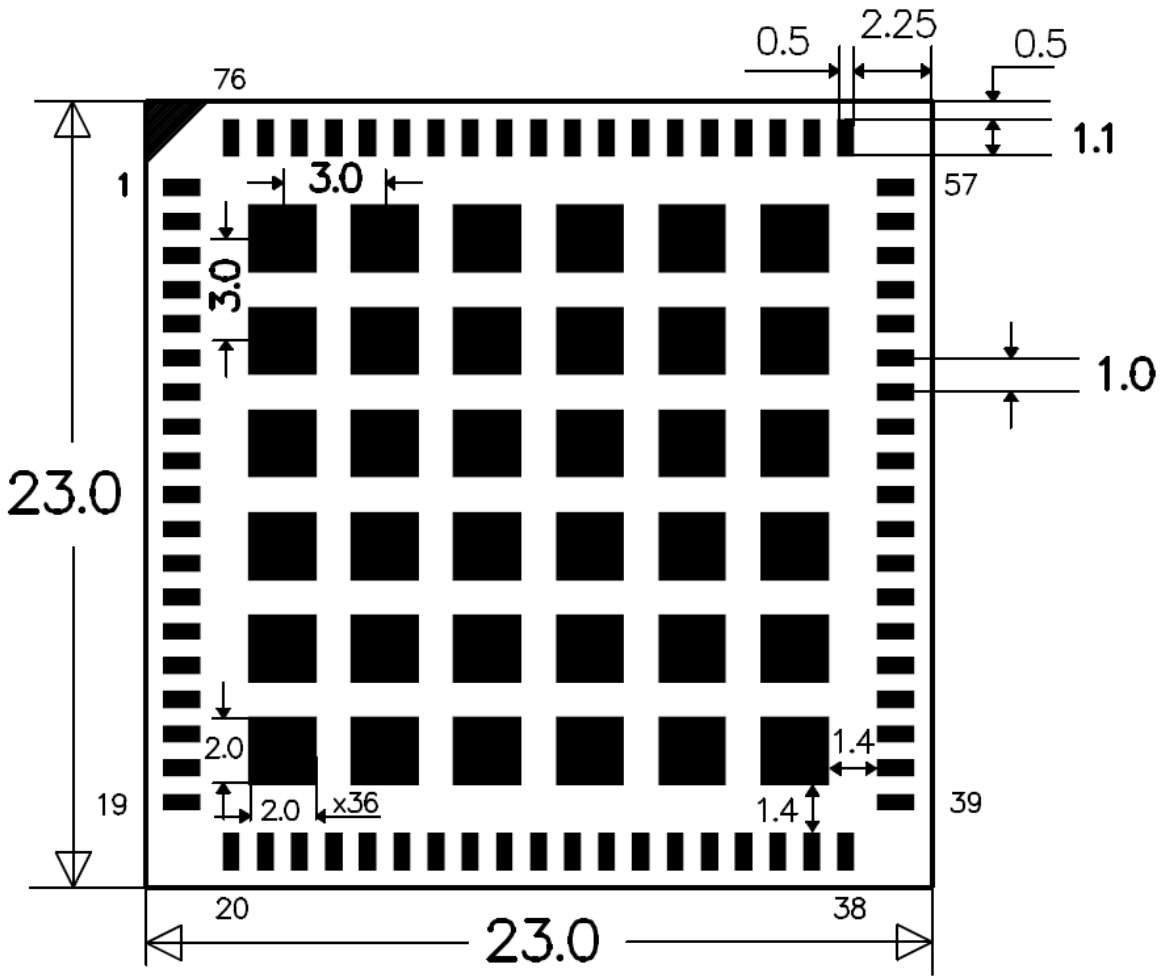
7.3 NF3219PQ Footprint Layout Guide (Top View)



模塊板彎，板翹規範(Module bowing, twisting Criteria) : <0.1mm (Smaller than 0.1mm)

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8. SMT and Baking Recommendation

8.1 Baking Recommendation

■ Baking condition：

-Follow MSL Level 3 to do baking process.

-After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be

a) Mounted within 168 hours of factory conditions ≤ 30°C/60% RH, or

b) Stored at <10% RH.

-Devices require bake, before mounting, if Humidity Indicator Card is >10%, where read at 23± 5℃.

<u>If baking is required, Devices shall be baked for 5 hrs at 100 °C.</u>

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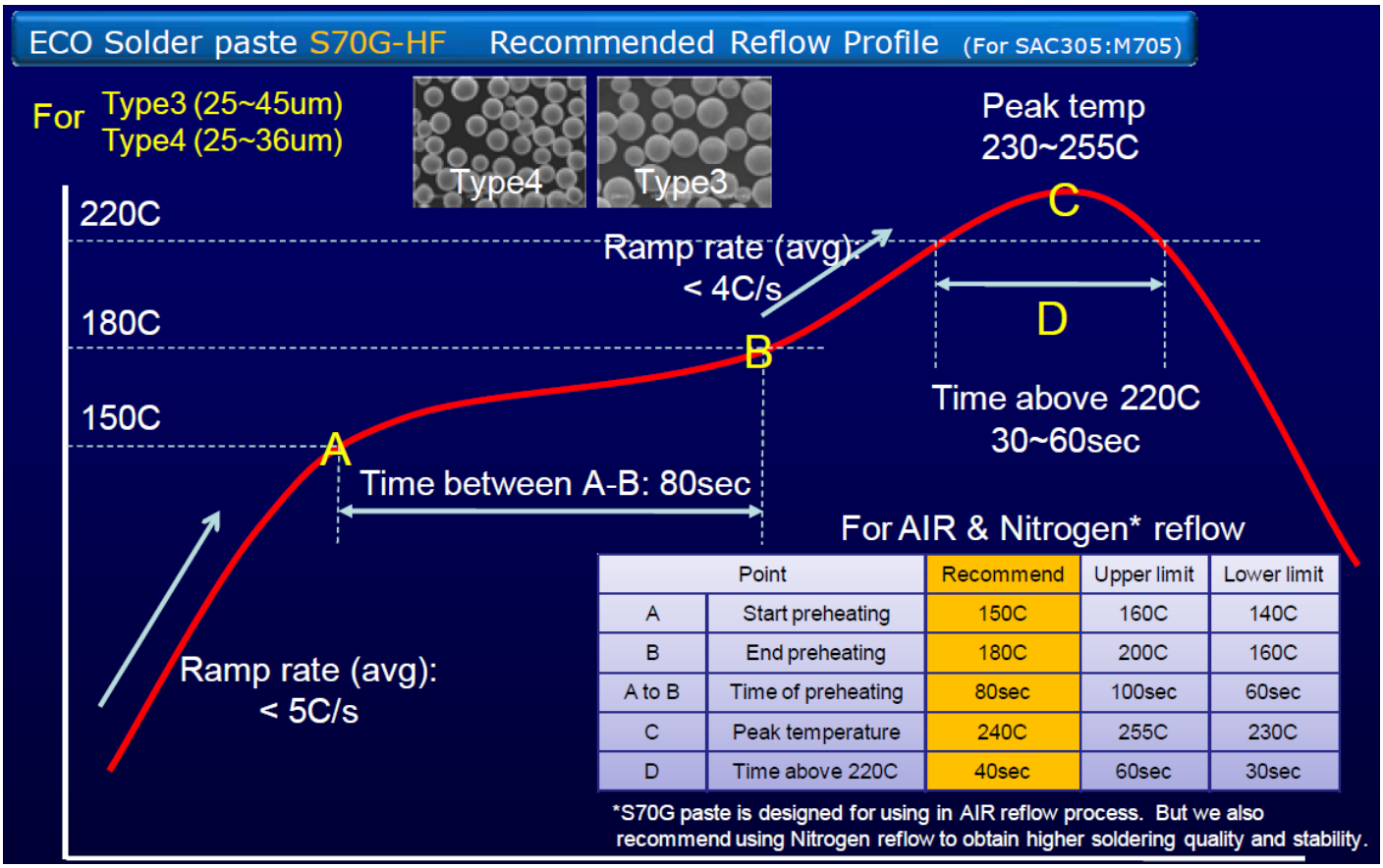
8.2 SMT Recommendation

Recommended Reflow profile：



Point		Recommend	Upper limit	Lower limit
A	Start preheating	150C	160C	140C
B	End preheating	180C	200C	160C
A to B	Time of preheating	80sec	100sec	60sec
C	Peak temperature	240C	255C	230C
D	Time above 220C	40sec	60sec	30sec

Note:
(1) Reflow soldering is recommended 3 times maximum.
(2) Add Nitrogen while Reflow process： SMT solder ability will be better.

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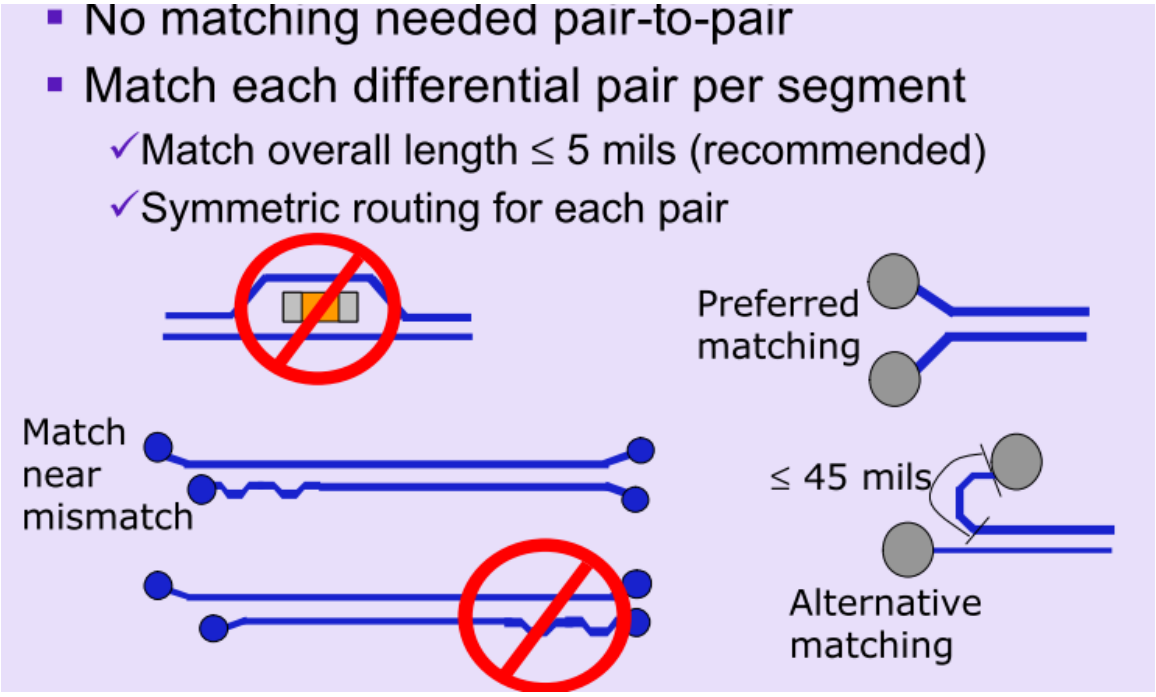
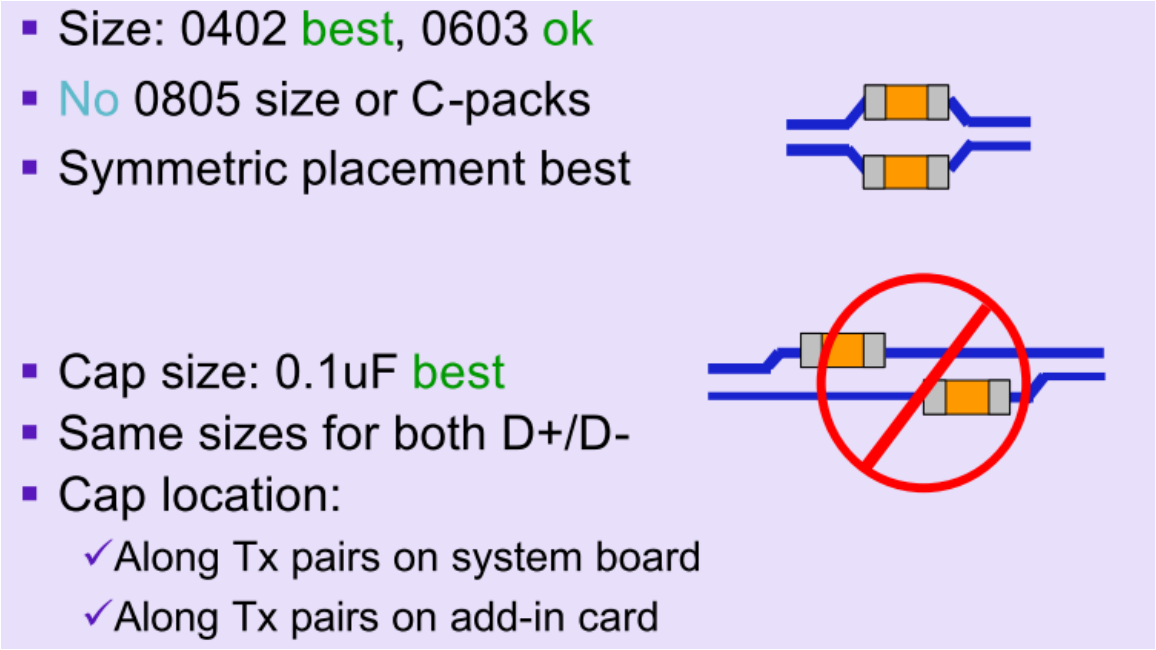
8.3 PCB Layout Recommendation

8.3.1 Antenna

Antenna trace impedance should be adjusted to 50 Ω. The area above (or under) the RF antenna trace should be free from other traces.

8.3.2 PCIE Lines Layout Guideline





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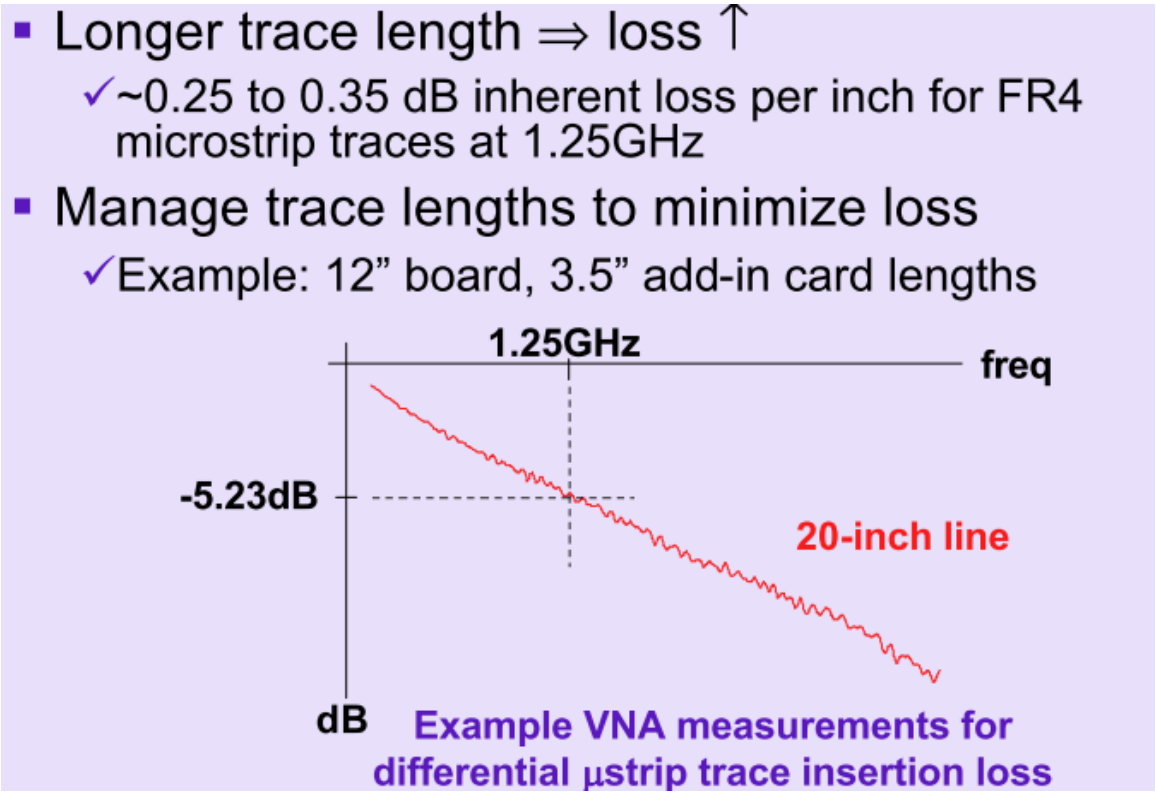

The following PCIE line routing must obey the following rule to prevent overshoot/undershoot, as these lines drive 8mA
PCIE_TXN,PCIE_TXN; PCIE_RXN,PCIE_TXN; PCIE_REFCLKN, PCIE_REFCLKN.
These pins are differential signals.
The route length of these signals be less than 15 cm and the pair line impedance be less than 100Ω

8.3.3 HCI Lines Layout Guideline

The following HCI line routing must obey the following rule to prevent overshoot/undershoot, as these lines drive 4 ~ 8mA
HCI_RX_BT
HCI_TX_BT
HCI_CTS_BT
HCI_RTS_BT
The route length of these signals be less than 15 cm and the line impedance be less than 50Ω

8.3.4 PCM Lines Layout Guideline

The following HCI line routing must obey the following rule to prevent overshoot/undershoot, as these lines drive 4 mA
AUD_FSYNC_BT(PCM_SYNC)
AUD_CLK_BT(PCM_CLK)

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AUD_OUT_BT(PCM_OUT)
AUD _IN_BT(PCM_IN)
The route length of these signals be less than 15 cm and the line impedance be less than 50Ω

8.3.5 RTC Clock(32.768kHz) Lines Layout Guideline

Follow the same guidelines recommended for the fast clock, It is extremely important that the RTC_CLK trace not be routed next to any digital signals and near the analog audio signals. Furthermore, no digital signals should be routed above or below the RTC_CLK trace to avoid coupling.

8.3.6 Power Trace Lines Layout Guideline

- VDD_3V3_WL Trace Width: 40mil
- VDDIO_1V8 Trace Width: 20mil

8.3.7 Ground Lines Layout Guideline

- A Complete Ground in Ground Layer.
- Add Ground Through Holes to NF3219PQ Module Ground Pads
- Decoupling Capacitors close to NF3219PQ Module Power and Ground Pads

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FCC regulatory conformance

FCC ID: W3GNF3219PQ

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

NOTE: Unauthorized changes will result in loss of device operating privileges.

RF Exposure

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

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ORIGINAL EQUIPMENT MANUFACTURER (OEM) NOTES

OEM must certify the final end product to comply with unintentional radiators (FCC Sections 07 and 15.109) before declaring compliance of the final product to Part 15 of the FCC rules and regulations. Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change.

The OEM must comply with the FCC labeling requirements. If the module's label is not visible when installed, then an additional permanent label must be applied on the outside of the finished product which states: "Contains transmitter module FCC ID: W3GNF3219PQ". Additionally, the following statement should be included on the label and in the final product's user manual: "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 interferences, and

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

The module is limited to installation in mobile or fixed applications. Separate approval is required for all other operating configurations, including portable configuration with respect to Part 2.1093 and different antenna configurations.

A module or modules can only be used without additional authorizations if they have been tested and granted under the same intended end-use operational conditions, including simultaneous transmission operations. When they have not been tested and granted in this manner, additional testing and/or FCC application filing may be required. The most straightforward approach to address additional testing conditions is to have the grantee responsible for the certification of at least one of the modules submit a permissive change application. When having a module grantee file a permissive change is not practical or feasible, the following guidance provides some additional options for host manufacturers. Integrations using modules where additional testing and/or FCC application filing(s) may be required are: (A) a module used in devices requiring additional RF exposure compliance information (e.g., MPE evaluation or SAR testing); (B) limited and/or split modules not meeting all of the module requirements; and (C) simultaneous transmissions for independent collocated transmitters not previously granted together.

This Module is full modular approval, it is limited to OEM installation ONLY.

Integration into devices that are directly or indirectly connected to AC lines must add with Class II Permissive Change. (OEM) Integrator has to assure compliance of the entire end product include the integrated Module. Additional measurements (15B) and/or equipment authorizations (e.g. Verification) may need to be addressed depending on co-location or simultaneous transmission issues if applicable. (OEM) Integrator is reminded to assure that these installation instructions will not be made available to the end user

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Requirement per KDB996369 D03

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.3
Explanation: This module meets the requirements of FCC part 15C(15.247). part 15E(15.407)

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.
Explanation: The module has the trace antenna designs, and the antenna use a permanently attached antenna which is unique, The designed antenna meets the hardware module's requirements via the connection between Reverse polarity SMA connector and module.

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions. A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.
This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.
Explanation: The module is not a limited module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:
layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.
a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency,

the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
d) Appropriate parts by manufacturer and specifications;
e) Test procedures for design verification; and
f) Production test procedures for ensuring compliance.
The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.
Explanation: Yes, The module with trace antenna designs, and this manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).
Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: W3GNF3219PQ.

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type")).
For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.
Explanation: The module has the trace antenna designs, and the antenna use a permanently attached antenna which is unique, The designed antenna meets the hardware module's requirements via the connection between Reverse polarity SMA connector and module.

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.
Explanation: The host system using this module, should have label in a visible area indicated the following texts: "Contains FCC ID: W3GNF3219PQ"

2.9 Information on test modes and additional testing requirements5

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.
The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.
Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.
Explanation: Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.
Explanation: The module without unintentional-radiator digital circuity, so the module does not require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.