Datasheet

Sona™ NX611 1218 Integrated Antenna Module

Version 1.1

Revision History

Version	Date	Description	Contributors	Approver
0.1	23 March 2023	Preliminary version	Peter Scharpf	Andy Ross
0.2	20 Sept 2024	Removed 2-Port Information	Peter Scharpf	Andy Ross
0.3	30 Oct 2024	Updated Bluetooth Qualification Process	Dave Drogowski	Jonathan Kaye
0.4	11 February 2025	Updated Antenna Performance Table	Brian Petted	Andy Ross
1.0	19 Mar 2025	Initial release	Dave Drogowski	Andy Ross
1.1	20 May 2025	Removed DFS radar pulse detection from 6.1 IEEE 802.11 standards	Dave Drogowski	Andy Ross

Contents

1 Scope

This document describes key hardware aspects of the Ezurio Sona™NX611 1218 series wireless modules providing either SDIO for WLAN connection or UART/PCM for Bluetooth® connection. This document is intended to assist device manufacturers and related parties with the integration of this radio into their host devices. Data in this document is drawn from several sources and includes information found in the NXP NX611 and NX612 data sheets along with other documents provided from NXP.

Note: **The information in this document is subject to change.** Please contact Ezurio to obtain the most recent version of this document.

2 General description

The Sona™NX611 series wireless modules are highly integrated 2.4/5 GHz dual-band 1x1 Wi-Fi 6, Bluetooth/Bluetooth Low Energy 5.4 single-chip solution optimized for a broad array of IoT and industrial applications.

This device is pre-calibrated and integrates the complete transmit/receive RF paths including diplexer, LNA's, RF switches, reference crystal oscillator, and power management units (PMU).

Sona™NX611 include a full-feature Wi-Fi subsystem powered by NXP's 802.11ax (Wi-Fi 6) technology bringing higher throughput, better network efficiency, lower latency, and improved range over previous generation Wi-Fi standards. The Wi-Fi subsystem integrates a Wi-Fi MAC, baseband, and direct-conversion radio with integrated PA, LNA, and transmit/receive switch removing the need for an RF front end module (FEMs), saving cost, and reducing system complexity.

The SONA™NX611 with integrated antenna wireless module ordering information is listed in Table 1.

Table 1: Product ordering information

Part Number	Description
453-00180R	Module, Sona NX611, 1218, Integrated Antenna, Tape and Reel
453-00180C	Module, Sona NX611, 1218, Integrated Antenna, Cut Tape
453-00180-K1	Development Kit, Module, Sona NX611, Integrated Chip Antenna

3 Key Features Summary

3.1 Wi-Fi key features

- IEEE 802.11a/b/g/n/ac/ax, 1x1 SISO 2.4 GHz and 5 GHz, up to 80 MHz channel bandwidth
- Peak data rates up to 480 Mbps
- Integrated high power PA up to +21 dBm transmit power
- Integrated LNA and T/R switches
- UL/DL OFDMA
- 802.11ax TWT (station only)
- 802.11ax ER, DCM
- WPA2 and WPA3 personal and enterprise security
- Support for Matter over Wi-Fi

3.2 Bluetooth key features

- Supports Bluetooth 5.2 (Class 1/Class 2) and Bluetooth Low Energy features
- Bluetooth 5.4 Certified
- Integrated high power PA up to +19 dBm transmit power for Bluetooth LE and BDR[1 ,2 ,3]
- Integrated high power PA up to +10 dBm transmit power for EDR
- BDR/EDR packet types—1 Mbps (GFSK), 2 Mbps (/4-DQPSK), 3 Mbps (8DPSK)
- Bluetooth LE long range (125/500 kbps) support
- Bluetooth LE 2 Mbps
- Bluetooth LE advertising extensions for improved capacity
- Isochronous channels (ISOC) supporting LE Audio and Auracast™ Broadcast Audio

3.3 Operating characteristics

- Supply voltage:
  - 1218 – 3.3V (Pin 66 VIO 1.8V or 3.3V 2230 – 3.3V
- Operating temperature: -40 to 85°C
- Storage temperature: -55 to 125°C

3.4 General features

- Package options
  - 1218 76 Pin LGA– 12mm x 18 mm
- Simultaneous Wi-Fi, Bluetooth receive
  - Single and dual antenna/RF Pad configurations supported.
- • Simultaneous Wi-Fi and Bluetooth transmit
  - Dual antenna/RF pad configuration supported.
- • Coexistence
  - Internal coexistence between Wi-Fi and Bluetooth
  - External coexistence interface for connection to external radios such as LTE
- • Power management
  - Efficient power management system
  - Deep-sleep low-power mode
  - Integrated high-efficiency buck DC-DC converter.
  - Wake-up through GPIO, host interface, and RTC
- • One Time Programmable (OTP) memory to store the MAC address and calibration data
- • Security
  - Hardware root of trust
  - Authenticated and secured boot.
  - OTP-based life-cycle state support

3.5 Internal block diagram

3.5.1.1 Sona NX611 1218 Chip Antenna

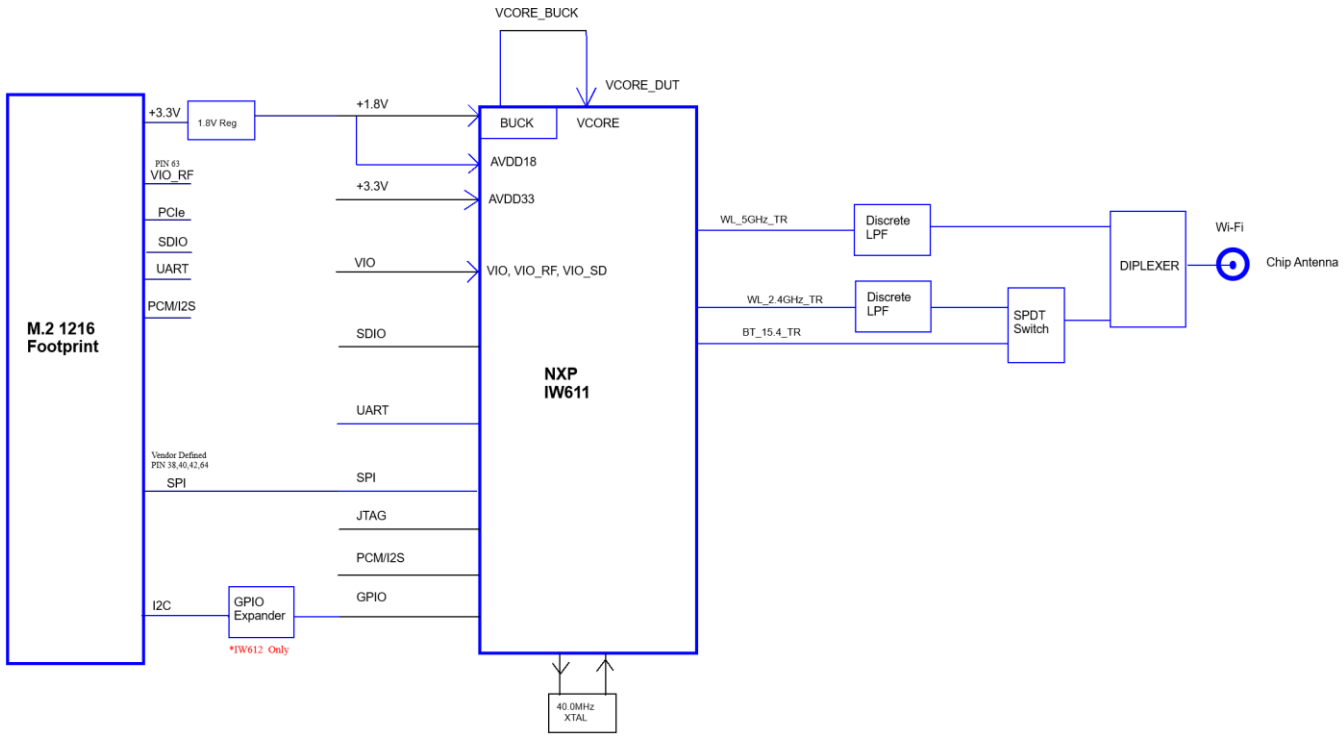


Figure 1: Sona NX611 1218 Chip Antenna

4 Pin Information

4.1 Pin List Sona NX611 1218 Chip Antenna Package

Table 2: Pin List Sona NX611 1218 Chip Antenna

Pins may be Multi-Functional Pins (MFP).

All GPIO can be programmed with PU or PD

Pin #	NX611 Pin Name	Description	Supply Domain	Reset State	HW State	PwrDwn State	PwrDwnProg	Internal PU/PD	Comment
1	UIM_POWER_ SRC/ GPIO1	Not Used	-	-	-	-	-	-	NO CONNECTION
2	UIM_POWER_ SNK	Not Used	-	-	-	-	-	-	NO CONNECTION
3	UIM_SWP	Not Used	-	-	-	-	-	-	NO CONNECTION
4	3.3V	3.3V Supply	-	-	-	-	-	-	
5	3.3V	3.3V Supply	-	-	-	-	-	-	
6	GND	Module Ground	-	-	-	-	-	-	
7	RESERVED	Not Used	-						NO CONNECTION
8	ALERT#	Not Used	-	-	-	-	-	-	NO CONNECTION
9	I2C_CLK	Not Used	-	-	-	-	-	-	NO CONNECTION
10	I2C_DATA	Not Used	-	-	-	-	-	-	NO CONNECTION
11	COEX_RXD	GPIO25/WCI-2_SIN MFP -WCI-2 coexistence serial interface input	VIO	Input	Input	Tristate	Yes	Nominal PU	
12	COEX_TXD	GPIO26/WCI-2_SOUT MFP -WCI-2 coexistence serial interface output	VIO	Input	Input	Drive low	Yes	Nominal PU	
13	COEX3	Not Used	-	-	-	-	-	-	NO CONNECTION
14	SYSCLK/ GNSS_0	Not Used	-	-	-	-	-	-	NO CONNECTION
15	TX_BLANKING/ GNSS_1	Not Used	-	-	-	-	-	-	NO CONNECTION
16	RESERVED	Not Used	-	-	-	-	-	-	NO CONNECTION
17	GND	Module Ground	-	-	-	-	-	-	
18	RESERVED	Not Used	-	-	-	-	-	-	NO CONNECTION
19	RESERVED	GPIO13	VIO	Input	Input	Drive high	Yes	Nominal PU	Can be used as GPIO. No connect if unused
20	GND	Module Ground	-	-	-	-	-		
21	PETn1	Not Used	-	-	-	-	-	-	NO CONNECTION
22	PETp1	Not Used	-	-	-	-	-	-	NO CONNECTION
23	GND	Module Ground	-	-	-	-	-	-	
24	PERn1	Not Used	-	-	-	-	-	-	NO CONNECTION

Pin #	NX611 Pin Name	Description	Supply Domain	Reset State	HW State	PwrDwn State	PwrDwnProg	Internal PU/PD	Comment
25	PERp1	Not Used	-	-	-	-	-	-	NO CONNECTION
26	GND	Module Ground	-	-	-	-	-	-	
27	SUSCLK(32kHz)	Not Used	-	-	-	-	-	-	NO CONNECTION
28	W_DISABLE1#	PDn Full Power-down (input) 0 = full power-down mode 1 = normal mode * PDn can accept an input of 1.8V to 4.5V	1.8V						Module has a weak 51K Ω Pull Up. For increased noise and ESD immunity, connect to host output pin.
29	PEWAKE#	Not Used	-	-	-	-	-	-	NO CONNECTION
30	CLKREQ#	Not Used	-	-	-	-	-	-	NO CONNECTION
31	PERST#	Not Used	-	-	-	-	-	-	NO CONNECTION
32	GND	Module Ground	-	-	-	-	-	-	
33	REFCLKn0	Not Used	-	-	-	-	-	-	NO CONNECTION
34	REFCLKp0	Not Used	-	-	-	-	-	-	NO CONNECTION
35	GND	Module Ground	-	-	-	-	-	-	
36	PETn0	Not Used	-	-	-	-	-	-	NO CONNECTION
37	PETp0	Not Used	-	-	-	-	-	-	NO CONNECTION
38	GND	Module Ground	-	-	-	-	-	-	
39	PERn0	Not Used	-	-	-	-	-	-	NO CONNECTION
40	PERp0	Not Used	-	-	-	-	-	-	NO CONNECTION
41	GND	Module Ground	-	-	-	-	-	-	
42	VENDOR DEFINED	GPIO15	VIO	Output low	Output low	Drive low	Yes	Nominal PU	Can be used as GPIO. No connect if unused
43	VENDOR DEFINED	GPIO18/BT_WAKE_IN MFP -Bluetooth radio wake-up (input)	VIO	Output low	Output low	Drive low	Yes	Nominal PU	
44	VENDOR DEFINED	GPIO16/WL_WAKE_IN MFP -WiFI radio wake-up (input)	VIO	Input	Input	Tristate	Yes	Weak PU	
45	SDIO RESET#	GPIO1/IND_RST_WL MFP -Independent software reset for Wi-Fi (input)	VIO	Input	Input	Tristate	Yes	Nominal PU	
46	SDIO WAKE#	GPIO17/WL_WAKE_OUT Wi-Fi radio to host wake-up (output)	VIO	Input	Input	Drive low	Yes	Nominal PU	
47	SDIO DATA3	SDIO DATA3	VIO	Input	Input	Tristate	No	Nominal PU	

Pin #	NX611 Pin Name	Description	Supply Domain	Reset State	HW State	PwrDwn State	PwrDwnProg	Internal PU/PD	Comment
48	SDIO DATA2	SDIO DATA2	VIO	Input	Input	Tristate	No	Nominal PU	
49	SDIO DATA1	SDIO DATA1	VIO	Input	Input	Tristate	No	Nominal PU	
50	SDIO DATA0	SDIO DATA0	VIO	Input	Input	Tristate	No	Nominal PU	
51	SDIO CMD	SDIO CMD	VIO	Input	Input	Tristate	No	Nominal PU	Input
52	SDIO CLK	SDIO CLK	VIO	Input	Input	Tristate	No	Nominal PU	
53	UART WAKE#	GPIO19/BT_WAKE_OUT# MFP -Bluetooth to host wake-up (output)	VIO	Input	Input	Drive low	Yes	Nominal PU	
54	UART CTS	GPIO8/UART_CTS MFP UART clear to send input (active low)	VIO	Input	Input	Tristate	Yes	Weak PU	
55	UART Tx	GPIO11/UART_TX MFP UART TX output	VIO	Output high	Output high	Drive low	Yes	Nominal PU	
56	UART Rx	GPIO10/UART_RX MFP UART RX input	VIO	Input	Input	Tristate	Yes	Nominal PU	
57	UART RTS	GPIO9/UART_RTS MFP UART request to send output (active low)	VIO	Output high	Output high	Drive high	Yes	Nominal PU	
58	PCM_SYNC/I2S_WS	GPIO7/PCM_SYNC MFP -PCM frame sync -I2S left/right clock	VIO	Input	Input	Tristate	Yes	Nominal PU	
59	PCM_IN/I2S_SD_IN	GPIO6/PCM_DIN MFP PCM/I2S receive data signal (input)	VIO	Input	Input	Tristate	Yes	Weak PU	
60	PCM_OUT/I2S_ SD_OUT	GPIO5/PCM_DOUT MFP PCM/I2S transmit data (output)	VIO	Input	Input	Tristate	Yes	Weak PU	
61	PCM_CLK/I2S_ SCK	GPIO4/PCM_CLK MFP - PCM data clock -I2S_BCLK - I2S bit clock	VIO	Input	Input	Tristate	Yes	Weak PU	
62	GND	Module Ground	-						

Pin #	NX611 Pin Name	Description	Supply Domain	Reset State	HW State	PwrDwn State	PwrDwnProg	Internal PU/PD	Comment
63	W_DISABLE2#	GPIO2/IND_RST_BT# MFP -Independent software reset for Bluetooth	VIO	Input	Input	Tristate	Yes	Nominal PU	
64	LED_2#	Not Used	-		-	-	-		NO CONNECTION
65	LED_1#	Not Used	-		-	-	-		NO CONNECTION
66	RESERVED/ VIO_1.8	GPIO Voltage Sets logic level for all GPIo, UART and SDIO	1.8V or 3.3V		-	-	-		1.8V required for extended SDIO Data rates
67	RESERVED	Not Used	-		-	-	-		NO CONNECTION
68	GND	Module Ground	-		-	-	-		
69	USB_D-	Not Used	-		-	-	-		NO CONNECTION
70	USB_D+	Not Used	-		-	-	-		NO CONNECTION
71	GND	Module Ground	-		-	-	-		
72	3.3V	3.3V Supply	-		-	-	-		
73	3.3V	3.3V Supply	-		-	-	-		
74	GND	Module Ground	-		-	-	-		
75	GND	Module Ground	-		-	-	-		
76	GND/VIO_CFG	Not Used	-		-	-	-		NO CONNECTION
G1	GND	Module Ground	-		-	-	-		

5 Specifications

Table 3: SONA ™NX611 Specifications

Feature	Description
Physical Interface	1218- 76-pin LGA, Meets PCIe M.2 Type 1216-S3 Mechanical Outline
Wi-Fi Interface	SDIO 3.0 - 1-bit or 4-bit Secure Digital I/O
Bluetooth/BLE Interface	Host Controller Interface (HCI) using high speed UART
Main Chip	NXP NX611
Input Voltage Requirements	1218- 76-pin LGA 3.3V nominal 3.3V Typ, 3.14V Min, 3.46V Max 2230 Key E package 3.3V nominal 3.3V Typ, 3.14V Min, 3.46V Max
I/O Signalling Voltage	Set to 3.3V or 1.8V, by the power domains connected to VIO and VIO_SD
Operating Temperature	-40° to +85°C (-40° to +185°F)
Operating Humidity	Less than 85% RH (non-condensing)
Storage Temperature	-40° to +85°C (-40° to +185°F)
Storage Humidity	Less than 60% RH (non-condensing)
MSL (Moisture Sensitivity Level)	MSL1 (M2)
Maximum Electrostatic Discharge	Conductive 4KV; Air coupled 8KV (follow EN61000-4-2)
Size – mm (in.)	1218- 76-pin LGA Length: 18mm Width: 12mm Thickness: 1.72mm
Weight – g (oz.)	1218- 76-pin LGA 8.4
Regulatory Certifications	United States (FCC) EU - Member countries of European Union (ETSI) ISED (Canada) Australia New Zealand Japan
2.4 GHz Frequency Bands	EU: 2.4 GHz to 2.483 GHz FCC/ISED: 2.4 GHz to 2.473 GHz MIC: 2.4 GHz to 2.495 GHz RCM: 2.4 GHz to 2.483 GHz
2.4 GHz Operating Channels (Wi-Fi)	EU: 13 (3 non-overlapping) FCC/ISED: 11 (3 non-overlapping) MIC: 14 (4 non-overlapping) RCM: 13 (3 non-overlapping)
5 GHz Frequency Bands	EU 5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64) 5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/132/136/140)

	5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165) FCC 5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64) 5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/132/136/140/144 5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165) ISED 5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64) 5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/132/136/140/144 5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165) MIC 5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64) 5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/132/136/140) RCM 5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64) 5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/132/136/140 5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165)
5 GHz Operating Channels (Wi-Fi)	EU: 24 non-overlapping; FCC: 25 non-overlapping ISED: 22 non-overlapping; MIC: 19 non-overlapping RCM: 21 non-overlapping
Operating Systems Supported	Linux Android
Compliance	**EU** EN 300 328 EN 301 489-1 EN 301 489-17 EN 301 893 EN 62368-1:2014 EN 300 440 2011/65/EU (RoHS) **FCC** 47 CFR FCC Part 15.247 47 CFR FCC Part 15.407 47 CFR FCC Part 2.1091 **ISED Canada** RSS-247 **AS/NZS** AS/NZS 4268:2017
Certifications (Pending)	Bluetooth® SIG Qualification
Warranty	One Year Warranty

6 WI-Fi Subsystem

6.1 IEEE 802.11 standards

- 802.11ax 1x1 SU OFDMA
- 802.11ac Wave 1/2 backward compatible
- 802.11n/a/g/b backward compatible
- 802.11az accurate ranging
- 802.11e quality of service
- 802.11h transmit power control
- 802.11i enhanced security
- 802.11k radio resource measurement
- 802.11mc precise indoor location positioning
- 802.11r fast hand-off for AP roaming
- 802.11u Hotspot 2.0 (STA mode only)
- 802.11v BTM frame transmission/reception
- 802.11w protected management frames
- 802.11z tunneled direct link setup
- Fully supports clients (stations) implementing IEEE Power Save mode

6.2 Wi-Fi MAC

- 802.11ax
- Trigger Frame Formats
  - Basic trigger frame
  - MU-BAR, MU-RTS, Beamforming Report Poll (BFRP), BSR Poll (BSRP) trigger variant
  - Trigger frame MAC padding
- • HE Variants of HT Control
  - Basic format
  - UL Power Headroom
  - Receive Operation Mode control subfield
- HE MU Frame Exchange Sequences
- MU Acknowledgment (ACK)
- M-BA and C-BA Variants in BA Frames
- MU-RTS/CTS Procedures
- Target Wait Time Scheduling
- HE Dual-NAV
- UL Carrier Sensing
- Buffer Status Reports in response to BSRP trigger frames
- Operating Mode Indication (OMI)
- Multiple-BSS/Station
- A-MPDU Rx (de-aggregation) and Tx (aggregation) (supports single-MPDU A-MPDU)
- Management information base counters
- Transmit rate adaptation
- Mobile hotspot

6.3 Wi-Fi baseband

- 802.11ax backward compatible with 802.11ac/n/a/g/b technology
- Bandwidth support
  - 20 MHz
  - 40 MHz
  - 80 MHz
- Modulation and Coding Schemes (MCS)
  - 802.11ax—MCS0~11
  - 802.11ac—MCS0~9
  - 802.11n—MCS0~7
  - Dual Sub-Carrier Modulation (DCM)
  - MCS0

  - BCC and LDPC coding
- Frame Formats
  - 802.11ax HE_SU (Tx/Rx)
  - 802.11ax HE_MU (Rx)
  - 802.11ax HE_ER_SU (Tx/Rx)
  - 802.11ax HE_TB (Tx)
  - 802.11ac VHT
  - 802.11n HT
  - 802.11a (including dup/quad modes)
  - 802.11g (including dup mode)
  - 802.11b
- Aggressive Packet Extension
- Range Extension
- Receiver Beam Change
- Guard Interval Modes
  - 1x HE-LTF with 0.8 us GI
  - 1x HE-LTF with 1.6 us GI (for UL TB PPDU)
  - 2x HE-LTF with 0.8 us GI
  - 2x HE-LTF with 1.6 us GI
  - 4x HE-LTF with 3.2 us GI
  - 4x HE-LTF with 0.8 us GI
- Dynamic Frequency Selection (DFS) (radar detection)
- Optional 802.11ac and 802.11n features:
  - 20/40/80 MHz coexistence with middle-packet detection (GI detection) for enhanced CCA
  - LDPC transmission and reception for both 802.11ac and 802.11n
  - Short guard interval (0.4 us)
  - RIFS on receive path for 802.11n packets
  - VHT MU-PPDU (receive)
- Spectral intelligence
  - Spectrum monitoring
  - DFS assist to reduce false detections
  - Interference identification/classification
- Power save features

6.4 Wi-Fi radio

- 5 GHz and 2.4 GHz Wi-Fi band operation
- 802.11ax
- Integrated PA, LNA

6.5 RF channels

6.5.1 RF conversion values for 2.4 GHz and 5 GHz Wi-Fi channels

Table 4: RF conversion values for 2.4 GHz and 5 GHz Wi-Fi channels

Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
2.4 GHz Channels					
1	2412 MHz	2	2417 MHz	3	2422 MHz
4	2427 MHz	5	2432 MHz	6	2437 MHz
7	2442 MHz	8	2447 MHz	9	2452 MHz
10	2457 MHz	11	2462 MHz	12	2467 MHz
13	2472 MHz	14(JP)	2484 MHz		
5 GHz Channels					
8(JP)	5040 MHz	12(JP)	5060 MHz	16(JP)	5080 MHz
34(JP)	5170 MHz	38(JP)	5190 MHz	42(JP)	5210 MHz
46(JP)	5230 MHz	184(JP)	5920 MHz	188(JP)	4940 MHz
192(JP)	4960 MHz	196(JP)	4980 MHz		
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	52	5260 MHz	56	5280 MHz
60	5300 MHz	64	5320 MHz	100	5500 MHz
104	5520 MHz	108	5540 MHz	112	5560 MHz
116	5580 MHz	120	5600 MHz	124	5620 MHz
128	5640 MHz	132	5660 MHz	136	5680 MHz
140	5700 MHz	144	5720 MHz	149	5745 MHz
153	5765 MHz	157	5785 MHz	161	5805 MHz
165	5825 MHz	169	5845 MHz	173	5865MHz

6.6 Wi-Fi encryption

- Support WPA3, WPA2 and WPA
- Data Frame Encryption/Decryption
  - Advanced Encryption Standard (AES) / Counter-Mode/CBC-MAC Protocol (CCMP)
  - Advanced Encryption Standard (AES) / Galois/Counter Mode Protocol (GCMP)
  - WLAN Authentication and Privacy Infrastructure (WAPI)
- Management Frame Encryption/Decryption for broadcast/multicast packets
  - Advanced Encryption Standard (AES) / Cipher-based Message Authentication Code (CMAC)
  - BIP-GMAC
- Management Frame Encryption/Decryption for unicast packets
  - AES/CCMP
  - AES/GCMP

6.7 Wi-Fi host interface

- SDIO 3.0 (4-bit SDIO and 1-bit SDIO) with transfer rates up to SDR104 (208 MHz)

7 Bluetooth Subsystem

The SONA™NX611 series wireless module includes a fully integrated Bluetooth baseband/radio.

7.1 Bluetooth features

- Bluetooth 5.2 features
- Bluetooth Class 2
- Bluetooth Class 1
- Single-ended, shared Tx/Rx path for Bluetooth
- I2S/PCM interface for voice applications
- Baseband/radio BDR/EDR packet types—1 Mbps (GFSK), 2 Mbps (/4-DQPSK), 3 Mbps (8DPSK)
- Fully functional Bluetooth baseband—AFH, forward error correction, header error control, access code correlation, CRC, encryption bit stream generation, and whitening
- Interlaced scan for faster connection setup
- Simultaneous active ACL connection support
- Automatic ACL packet type selection
- Full central and peripheral piconet support
- Scatternet support
- Standard UART HCI transport layer
- HCI layer to integrate with profile stack
- SCO/eSCO links with hardware accelerated audio signal processing and hardware supported PPEC algorithm for speech quality improvement
- All standard SCO/eSCO voice coding
- A2DP support
- All standard pairing, authentication, link key, and encryption operations
- Standard Bluetooth power-saving mechanisms (hold, sniff modes, and sniff subrating)
- Enhanced Power Control (EPC)
- Channel Quality Driven Data Rate (CQDDR)
- Wideband Speech (WBS) support (2 WBS links)
- Encryption (AES) support

7.2 Bluetooth Low Energy (LE) features

- Bluetooth LE 5.4
- Supports up to 16 simultaneous central/peripheral connections
- Wi-Fi/Bluetooth coexistence protocol support
- Shared RF with BDR/EDR
- Encryption (AES) support
- Intelligent Adaptive Frequency Hopping (AFH)
- Bluetooth LE Privacy 1.3
- Bluetooth LE Secure Connection
- Bluetooth LE Data Length Extension
- Bluetooth LE Advertising Extension
- Bluetooth LE Long Range
- Bluetooth LE 2 Mbps
- Bluetooth LE power control
- Isochronous channels[4] (ISOC) supporting LE Audio and Auracast™ Broadcast Audio
- Bluetooth LE isochronous channels[1]

[1] Bluetooth LE audio supported with external host running Low Complexity Communication codec (LC3) through HCI interface.

7.3 Bluetooth Host interface

- High-Speed UART with support up to 3 Mbps baud rate

7.4 Digital Audio interfaces

7.4.1 I2S/PCM interface

- PCM pins shared with I2S pins
- Central or peripheral mode
- I2S (Inter-IC Sound) interface for audio data connection to Analog-to-Digital Converters (ADC) and Digital-to-Analog Converters (DAC)
- 3-state I2S interface capability
- I2S central and peripheral modes
- I2S pins shared with PCM pins
- Supports clock speeds of 4.096 MHz, 2.048 MHz, and 2 MHz

7.4.2 I2S/PCM interface signals

Table 5: Audio Interface Pins

Pin Name	Type	Description	GPIO
PCM_DOUT / I2S_DOUT	O	PCM/I2S data out	GPIO[5]
PCM_DIN / I2S_DIN	I	PCM/I2S data in	GPIO[6]
PCM_CLK / I2S_BLCK	I/O	PCM/I2S clock, can be output (if central) or input (if peripheral)	GPIO[4]
PCM_SYNC / I2S_LRCLK	I/O	PCM/I2S sync, can be output (if central) or input (if peripheral)	GPIO[7]
PCM_MCLK / I2S_CCLK	O	Optional clock pins	GPIO[3]

7.4.3 Clock frequency and audio data resolutions

Audio data may arrive with different input data formats with different sampling rates.

In master mode, the I2S interface uses an audio input clock of 4.096 MHz or 2.048 MHz to provide the appropriate M clock (MCLK) and bit clock (I2S_BCLK) frequency to match the sampling rates of each audio data format. The sampling rates can be 8 kHz to 16 kHz.

In slave mode, the I2S interface does not provide the bit clock (I2S_BCLK) but it can provide the M clock (MCLK).

8 Electrical Characteristics

8.1 Absolute Maximum Ratings

Absolute maximum ratings are those values beyond which damage to the device can occur. Functional operation under these conditions, or at any other condition beyond those indicated in the operational sections of this document, is not recommended.

Note: Maximum rating for signals follows the supply domain of the signals.

Table 6: Absolute maximum ratings

Symbol (Domain)	Parameter	Max Rating	Unit
VIO_SD	WLAN host SDIO interface I/O supply (for 1.8V system) (for 3.3V system)	2.16 3.96	V
VIO	I/O configuration power supply (for 1.8V system) (for 3.3V system)	2.16 3.96	V
AVDD33	External DC power supply	3.96	V
Storage	Storage temperature	-55 +125	°C
ESD	Electrostatic discharge tolerance	2000	V

8.2 Recommended Operating Conditions

Table 7: Recommended operating conditions

Symbol (Domain)	Parameter	Min	Typ	Max	Unit
VIO_SD	WLAN and Bluetooth host interface I/O supply	1.71/3.14	1.8/3.3	1.89/3.46	V
VIO	I/O supply for the RF switch control pads	1.71/3.14	1.8/3.3	1.89/3.46	V
AVDD33	External DC power supply	3.14	3.3	3.46	V
T-ambient	Ambient temperature	-40	25	85	°C

8.3 General DC Electrical Characteristics

Table 8 and Table 9 list the general DC electrical characteristics over recommended operating conditions (unless otherwise specified).

Table 8: General DC electrical characteristics (For 1.8V or 3.3V operation VIO)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VIH	High Level Input Voltage	—	0.7*VIO	—	VIO+0.4	V
VIL	Low Level Input Voltage	—	-0.4	—	0.3*VIO	V
VOH	Output high Voltage	—	VIO-0.4	—	—	V
VOL	Output low Voltage	—	—	—	0.4	V

Table 9: General DC electrical characteristics (For 1.8V or 3.3V operation VIO_SD)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VIH	High Level Input Voltage	—	0.7*VIO_SD	—	VIO_SD+0.4	V
VIL	Low Level Input Voltage	—	-0.4	—	0.3*VIO_SD	V
VOH	Output high Voltage	—	VIO_SD-0.4	—	—	V
VOL	Output low Voltage	—	—	—	0.4	V

8.4 Sona NX611 1218 Module Current Consumption

Note: Unless otherwise stated, all specifications are at 25°C, nominal voltage, and typical value with SDIO 3.0, measured on Dev Kit, Sona NX611 M.2 2230, 1 MHF4 Part Number 453-00166-K1.

Table 10: 25 MHz clock (4-bit mode).

Mode	Conditions	1.8V_VIO	3.3V	Unit
Power down				
Power Down	-	1.7	.348	mA
Sleep Mode				
Bluetooth only in deep sleep mode	-	0.25	0.14	mA
Wi-Fi only in deep sleep mode	SDIO 3.0 200 MHz VIO = 1.8 V	0.36	0.02	mA
Wi-Fi and Bluetooth in deep sleep Mode	-	0.41	0.14	mA
Bluetooth LE current consumption				
Bluetooth LE peak transmit [3]	1 Mbps @ 6 dBm	0.014	106	mA
Bluetooth LE peak receive[4][5]	1 Mbps	.009	75	mA
Bluetooth current consumption [2]				
Bluetooth peak transmit[6]	@ 6 dBm DH5	.009	113	mA
Bluetooth peak receive[4][7]	BDR , DH5	.009	75	mA
2.4 GHz Wi-Fi receive[8]				
2.4 GHz 802.11b 11 Mbps	—	.009	56	mA
2.4 GHz 802.11g 54 Mbps	—	.009	59	mA
2.4 GHz 802.11n 20 MHz MCS7	—	.009	61	mA
2.4 GHz 802.11n 40 MHz MCS7	—	.009	62	mA
2.4 GHz 802.11ax 20 MHz MCS11	—	.009	63	mA
2.4 GHz 802.11ax 40 MHz MCS11	—	.009	66	mA
5 GHz Wi-Fi receive[8]				
5 GHz 802.11a 54 Mbps	—	.009	62	mA
5 GHz 802.11n 20 MHz MCS7	—	.009	68	mA
5 GHz 802.11n 40 MHz MCS7	—	.009	65	mA
5 GHz 802.11ac 40 MHz MCS9	—	.009	83	mA
5 GHz 802.11ac 80 MHz MCS9	—	.009	92	mA
5 GHz 802.11ax 20 MHz MCS11	—	.009	70	mA
5 GHz 802.11ax 40 MHz MCS11	—	.009	79	mA
5 GHz 802.11ax 80 MHz MCS11	—	.009	96	mA
2.4 GHz Wi-Fi transmit[8]				
2.4 GHz 802.11b 11 Mbps @ 18 dBm	—	.009	296	mA
2.4 GHz 802.11g 54 Mbps @ 16 dBm	—	.009	258	mA
2.4 GHz 802.11n 20 MHz MCS7 @ 15 dBm	—	.009	252	mA
2.4 GHz 802.11n 40 MHz MCS7 @ 15 dBm	—	.009	248	mA
2.4 GHz 802.11ax 20 MHz MCS11 @ 13 dBm	—	.009	231	mA
2.4 GHz 802.11ax 40 MHz MCS11 @ 13 dBm	—	.009	229	mA
5 GHz Wi-Fi transmit[8]				
5 GHz 802.11a 6 Mbps @ 16 dBm	—	.009	331	mA
5 GHz 802.11a 54 Mbps @ 16 dBm	—	.009	314	mA
5 GHz 802.11n 20 MHz MCS7 @ 14 dBm	—	.009	292	mA
5 GHz 802.11n 40 MHz MCS7 @ 14 dBm	—	.009	293	mA

Mode	Conditions	1.8V_VIO	3.3V	Unit
5 GHz 802.11ac 20 MHz MCS8 @ 14 dBm	—	.009	292	mA
5 GHz 802.11ac 40 MHz MCS9 @ 12 dBm	—	.009	273	mA
5 GHz 802.11ac 80 MHz MCS9 @ 12 dBm	—	.009	268	mA
5 GHz 802.11ax 20 MHz MCS11 @ 10 dBm	—	.009	254	mA
5 GHz 802.11ax 40 MHz MCS11 @ 10 dBm	—	.009	248	mA
5 GHz 802.11ax 80 MH MCS11 @ 10 dBm	—	.009	262	mA
Peak current				
Peak current during device initialization		571	.140	mA

[1] SDIO host interface connected
[2] Wi-Fi enabled, SDIO host interface connected
[3] The peak transmit current remains the same across all Bluetooth LE data rates at the same transmit power level
[4] Single antenna configuration
[5] The peak receive current remains the same across all Bluetooth LE data rates
[6] The peak transmit current remains the same across all Bluetooth data rates at the same transmit power level
[7] The peak receive current remains the same across all Bluetooth data rates
[8] Bluetooth enabled
[9] Frame length in IEEE-PS current measurement: 5 GHz: 207 Bytes, 2.4 GHz: 222 Bytes
[10] Maximum value

9 RF Characteristics

9.1 WLAN Radio Conducted Receiver Characteristics

Table 11: Typical WLAN receiver characteristics for 2.4 GHz Band, WLAN Channels 1-11, single chain operation at 25 degrees C, ambient temperature.

2.4 GHz Wi-Fi Receive Sensitivity	Conditions	1-Port	Unit
2.4 GHz 802.11b 1 Mbps	8% PER	-96.5	dBm
2.4 GHz 802.11b 11 Mbps	8% PER	-88.0	dBm
2.4 GHz 802.11g 6 Mbps	10% PER	-91.0	dBm
2.4 GHz 802.11g 54 Mbps	10% PER	-74.5	dBm
2.4 GHz 802.11n 20 MHz MCS0	10% PER	-90.5	dBm
2.4 GHz 802.11n 20 MHz MCS7	10% PER	-71	dBm
2.4 GHz 802.11n 40 MHz MCS0	10% PER	-87.5	dBm
2.4 GHz 802.11n 40 MHz MCS7	10% PER	-68.5	dBm
2.4 GHz 802.11ax 20 MHz MCS0	10% PER	-91	dBm
2.4 GHz 802.11ax 20 MHz MCS11	10% PER	-61.5	dBm
2.4 GHz 802.11ax 40 MHz MCS0	10% PER	-87.5	dBm
2.4 GHz 802.11ax 40 MHz MCS11	10% PER	-59.5	dBm
2.4 GHz Receiver maximum input level (MIL)	**Conditions**	**1-port**	**Unit**
Receiver maximum input level DSSS	802.11b DSSS MIL	0	dBm
Receiver maximum input level CCK	802.11b CCK MIL	0	dBm
Receiver maximum input level OFDM	OFDM MIL	-10	dBm
Receiver adjacent channel interference (ACI)	**Conditions**	**1-port**	**Unit**
Receiver ACI 802.11b	20 MHz 1 Mbps	53	dB
Receiver ACI 802.11b	20 MHz 11 Mbps	47.7	dB
Receiver ACI 802.11g	20 MHz 6 Mbps	30.3	dB
Receiver ACI 802.11g	20 MHz 54 Mbps	27.3	dB
Receiver ACI 802.11n	20 MHz MCS0 Nss1 BCC	41	dB
Receiver ACI 802.11n	20 MHz MCS7 Nss1 BCC	27.3	dB
Receiver ACI 802.11ax	20 MHz MCS0 Nss1 LDPC[1]	30.3	dB
Receiver ACI 802.11ax	20 MHz MCS11 Nss1 LDPC[1]	7	dB
Receiver Alternate Adjacent channel interference (AACI)	**Conditions**	**1-port**	**Unit**
Receiver AACI 802.11b	20 MHz 1 Mbps	53	dB
Receiver AACI 802.11b	20 MHz 11 Mbps	49	dB
Receiver AACI 802.11g	20 MHz 6 Mbps	49	dB
Receiver AACI 802.11g	20 MHz 54 Mbps	33.3	dB
Receiver AACI 802.11n	20 MHz MCS0 Nss1 BCC	49.7	dB
Receiver AACI 802.11n	20 MHz MCS7 Nss1 BCC	32.3	dB
Receiver AACI 802.11ax	20 MHz MCS0 Nss1 LDPC[1]	48.7	dB
Receiver AACI 802.11ax	20 MHz MCS11 Nss1 LDPC[1]	23.3	dB

Table 12: Typical WLAN receiver characteristics for 5 GHz Channels 36-48, 52-64,100-140,149-165, Band, Channels single chain operation at 25 degrees C ambient temperature.

5 GHz Wi-Fi Receive Sensitivity	Conditions	1- port	Unit
5 GHz 802.11a 6 Mbps	10% PER	-89.5	dBm
5 GHz 802.11a 54 Mbps	10% PER	-72.5	dBm
5 GHz 802.11n 20 MHz MCS0	10% PER	-88.5	dBm
5 GHz 802.11n 20 MHz MCS7	10% PER	-69.0	dBm
5 GHz 802.11n 40 MHz MCS0	10% PER	-85.5	dBm
5 GHz 802.11n 40 MHz MCS7	10% PER	-66.5	dBm
5 GHz 802.11ac 20 MHz MCS0	10% PER	-89.5	dBm
5 GHz 802.11ac 20 MHz MCS8	10% PER	-66.5	dBm
5 GHz 802.11ac 40 MHz MCS0	10% PER	-86.0	dBm
5 GHz 802.11ac 40 MHz MCS9	10% PER	-63.5	dBm
5 GHz 802.11ac 80 MHz MCS0	10% PER	-82.5	dBm
5 GHz 802.11ac 80 MHz MCS9	10% PER	-60.5	dBm
5 GHz 802.11ax 20 MHz MCS0	10% PER	-89.5	dBm
5 GHz 802.11ax 20 MHz MCS11	10% PER	-68.0	dBm
5 GHz 802.11ax 40 MHz MCS0	10% PER	-82.5	dBm
5 GHz 802.11ax 40 MHz MCS11	10% PER	-57.5	dBm
5 GHz 802.11ax 80 MHz MCS0	10% PER	-82.5	dBm
5 GHz 802.11ax 80 MHz MCS11	10% PER	-60.5	dBm
5 GHz Receiver Maximum Input Level (MIL)	**Conditions**	**1- port**	**Unit**
5 GHz Receiver maximum input level OFDM	OFDM MIL	-10	dBm
Receiver adjacent channel interference (ACI)	**Conditions**	**1- -port**	**Unit**
Receiver ACI 802.11a	20 MHz 6 Mbps	23	dBm
Receiver ACI 802.11a	20 MHz 54 Mbps	15.7	dBm
Receiver ACI 802.11n	20 MHz MCS0 Nss1 BCC	28	dBm
Receiver ACI 802.11n	20 MHz MCS7 Nss1 BCC	10	dBm
Receiver ACI 802.11n	40 MHz MCS0 Nss1 BCC	27.3	dBm
Receiver ACI 802.11n	40 MHz MCS7 Nss1 BCC	13	dBm
Receiver ACI 802.11ac	20 MHz MCS0 Nss1 LDPC	31.3	dBm
Receiver ACI 802.11ac	20 MHz MCS9 Nss1 LDPC	15	dBm
Receiver ACI 802.11ac	40 MHz MCS0 Nss1 LDPC	29.7	dBm
Receiver ACI 802.11ac	40 MHz MCS9 Nss1 LDPC	12.3	dBm
Receiver ACI 802.11ac	80 MHz MCS0 Nss1 LDPC	25	dBm
Receiver ACI 802.11ac	80 MHz MCS9 Nss1 LDPC	13	dBm
Receiver AACI 802.11a	20 MHz 6 Mbps	47.3	dB
Receiver AACI 802.11a	20 MHz 54 Mbps	27.7	dB
Receiver AACI 802.11n	20 MHz MCS0 Nss1 BCC	46.3	dB
Receiver AACI 802.11n	20 MHz MCS7 Nss1 BCC	30	dB
Receiver AACI 802.11n	40 MHz MCS0 Nss1 BCC	45	dB

Receiver Alternate Adjacent channel interference (ACI)	Conditions	1- port	Unit
Receiver AACI 802.11a	20 MHz 6 Mbps	47.3	dB
Receiver AACI 802.11a	20 MHz 54 Mbps	27.7	dB
Receiver AACI 802.11n	20 MHz MCS0 Nss1 BCC	46.3	dB
Receiver AACI 802.11n	20 MHz MCS7 Nss1 BCC	30	dB
Receiver AACI 802.11n	40 MHz MCS0 Nss1 BCC	45	dB
Receiver AACI 802.11n	40 MHz MCS7 Nss1 BCC	27	dB
Receiver AACI 802.11ac	20 MHz MCS0 Nss1 LDPC	45.7	dB
Receiver AACI 802.11ac	20 MHz MCS9 Nss1 LDPC	29.3	dB
Receiver AACI 802.11ac	40 MHz MCS0 Nss1 LDPC	44.7	dB
Receiver AACI 802.11ac	40 MHz MCS9 Nss1 LDPC	23	dB
Receiver AACI 802.11ac	80 MHz MCS0 Nss1 LDPC	43.3	dB
Receiver AACI 802.11ac	80 MHz MCS9 Nss1 LDPC	24	dB
Receiver AACI 802.11ax	20 MHz MCS0 Nss1 LDPC[1]	48	dB
Receiver AACI 802.11ax	20 MHz MCS11 Nss1 LDPC[1]	21.3	dB
Receiver AACI 802.11ax	40 MHz MCS0 Nss1 LDPC[1]	45	dB
Receiver AACI 802.11ax	40 MHz MCS11 Nss1 LDPC[1]	19.7	dB
Receiver AACI 802.11ax	80 MHz MCS0 Nss1 LDPC[1]	44	dB
Receiver AACI 802.11ax	80 MHz MCS11 Nss1 LDPC[1]	18.3	dB

9.2 WLAN transmitter characteristics

Table 13: Typical WLAN transmitter characteristics for 2.4 GHz band operation (VDD=3.3V, VIO=1.8V), WLAN Channels 1-11, single chain operation at 25 degrees C, ambient temperature.

2.4 GHz Wi-Fi Transmit Power	Conditions	1-Port	Unit
2.4 GHz 802.11b 1 Mbps	-9.1 dB, EVM, Mask Compliance	18	dBm
2.4 GHz 802.11b 11 Mbps	-9.1 dB, EVM, Mask Compliance	18	dBm
2.4 GHz 802.11g 6 Mbps	- 5 dB, EVM, Mask Compliance	14	dBm
2.4 GHz 802.11g 54 Mbps	-25 dB, EVM, Mask Compliance	14	dBm
2.4 GHz 802.11n 20 MHz MCS0	- 5 dB, EVM, Mask Compliance	14	dBm
2.4 GHz 802.11n 20 MHz MCS7	-27 dB, EVM, Mask Compliance	14	dBm
2.4 GHz 802.11n 40 MHz MCS0	- 5 dB, EVM, Mask Compliance	12	dBm
2.4 GHz 802.11n 40 MHz MCS7	- 27 dB, EVM, Mask Compliance	12	dBm
2.4 GHz 802.11ax 20 MHz MCS0	- 5 dB, EVM, Mask Compliance	13	dBm
2.4 GHz 802.11ax 20 MHz MCS11	- 35 dB, EVM, Mask Compliance	13	dBm
2.4 GHz 802.11ax 40 MHz MCS0	- 5 dB, EVM, Mask Compliance	13	dBm
2.4 GHz 802.11ax 40 MHz MCS11	- 35 dB, EVM, Mask Compliance	11	dBm

Table 14: Typical WLAN Transmitter characteristics for 5 GHz band operation, (VDD=3.3V, VIO=1.8V), Channels 36-48, 52-64,100-140,149-165, Band, Channels single chain operation at 25 degrees C ambient.

5 GHz Wi-Fi Transmit Power	Conditions	1-port	Unit
5 GHz 802.11a 6 Mbps	-5 dB, EVM, Mask Compliance	16	dBm
5 GHz 802.11a 54 Mbps	-25 dB, EVM, Mask Compliance	16	dBm
5 GHz 802.11n 20 MHz MCS0	-5 dB, EVM, Mask Compliance	14	dBm
5 GHz 802.11n 20 MHz MCS7	-5 dB, EVM, Mask Compliance	14	dBm
5 GHz 802.11n 40 MHz MCS0	-5 dB, EVM, Mask Compliance	13	dBm
5 GHz 802.11n 40 MHz MCS7	-27 dB, EVM, Mask Compliance	13	dBm
5 GHz 802.11ac 20 MHz MCS0	-5 dB, EVM, Mask Compliance	14	dBm
5 GHz 802.11ac 20 MHz MCS8	-30 dB, EVM, Mask Compliance	14	dBm
5 GHz 802.11ac 40 MHz MCS0	-5 dB, EVM, Mask Compliance	13	dBm
5 GHz 802.11ac 40 MHz MCS9	-32 dB, EVM, Mask Compliance	13	dBm
5 GHz 802.11ac 80 MHz MCS0	-5 dB, EVM, Mask Compliance	11	dBm
5 GHz 802.11ac 80 MHz MCS9	-32 dB, EVM, Mask Compliance	11	dBm
5 GHz 802.11ax 20 MHz MCS0	-5 dB, EVM, Mask Compliance	13	dBm
5 GHz 802.11ax 20 MHz MCS11	-35 dB, EVM, Mask Compliance	10	dBm
5 GHz 802.11ax 40 MHz MCS0	-5 dB, EVM, Mask Compliance	13	dBm
5 GHz 802.11ax 40 MHz MCS11	-35 dB, EVM, Mask Compliance	10	dBm
5 GHz 802.11ax 80 MHz MCS0	-5 dB, EVM, Mask Compliance	10	dBm
5 GHz 802.11ax 80 MHz MCS11	-35 dB, EVM, Mask Compliance	10	dBm

10 Bluetooth subsystem

10.1 Bluetooth/Bluetooth LE conducted receiver performance

Table 15: Typical Bluetooth/Bluetooth LE receiver performance at AVDD33=3.3 VDC and VIO=1.8 V, 25 degrees C, ambient temperature.

Parameter	Conditions	Min	Typ	Max	Unit
Frequency range	--	2400	--	2483.5	MHz
Receiver sensitivity	**Conditions**	**1-Port**			**Unit**
BDR 1 Mbps	0.1% BER, 1DH5	-92			dBm
EDR 2 Mbps	0.01% BER,2DH5	-91			dBm
EDR 3 Mbps	0.01% BER,3DH5	-86			dBm
Bluetooth LE 1 Mbps	0.1% BER, 37 Packet Payload, TX Impairments [1]	-95.5			dBm
Bluetooth LE 2 Mbps	0.1% BER, 37 Packet Payload, TX Impairments [1]	-93			dBm
Bluetooth LR 500 Kbps	0.1% BER, 37 Packet Payload, TX Impairments [1]	-97			dBm
Bluetooth LR 125 Kbps	0.1% BER, 37 Packet Payload, TX Impairments [1]	-102			dBm
Receiver maximum input level (MIL)	**Conditions**	**1-Port**			**Unit**
BDR 1 Mbps	[2]	-2			dBm
EDR 2 Mbps	[3]	-5			dBm
EDR 3 Mbps	[4]	-5			dBm
Bluetooth LE 1 Mbps	[5]	-2			dBm
Bluetooth LE 2 Mbps	[6]	-2			dBm
Bluetooth LR 500 Kbps	[7]	-2			dBm
Bluetooth LR 125 Kbps	[8]	-2			dBm
Receiver Adjacent-/Co- Channel Interference (ACI/CCI)					
BDR 1 Mbps					
Receiver ACI @ -5 MHz (image -1)	BDR 1 Mbps	-38			dB
Receiver ACI @ -4 MHz (image)	BDR 1 Mbps	-26			dB
Receiver ACI @ -3 MHz (image +1)	BDR 1 Mbps	-41			dB
Receiver ACI @ -2 MHz	BDR 1 Mbps	-46			dB
Receiver ACI @ -1 MHz	BDR 1 Mbps	-9			dB
Receiver CCI	BDR 1 Mbps	11			dB
Receiver ACI @ +1 MHz	BDR 1 Mbps	-11			dB
Receiver ACI @ +2 MHz	BDR 1 Mbps	-49			dB
Receiver ACI @ +3 MHz	BDR 1 Mbps	-52			dB
BDR 2 Mbps					
Receiver ACI @ -5 MHz (image -1)	BDR 2 Mbps	-42			dB
Receiver ACI @ -4 MHz (image)	BDR 2 Mbps	-28			dB
Receiver ACI @ -3 MHz (image +1)	BDR 2 Mbps	-41			dB
Receiver ACI @ -2 MHz	BDR 2 Mbps	-46			dB
Receiver ACI @ -1 MHz	BDR 2 Mbps	-9			dB
Receiver CCI	BDR 2 Mbps	10			dB
Receiver ACI @ +1 MHz	BDR 2 Mbps	-11			dB
Receiver ACI @ +2 MHz	BDR 2 Mbps	-49			dB
Receiver ACI @ +3 MHz	BDR 2 Mbps	-52			dB

Parameter	Conditions	Min	Typ	Max	Unit
BDR 3 Mbps					
Receiver ACI @ -5 MHz (image -1)	BDR 3 Mbps	-38			dB
Receiver ACI @ -4 MHz (image)	BDR 3 Mbps	-20			dB
Receiver ACI @ -3 MHz (image +1)	BDR 3 Mbps	-38			dB
Receiver ACI @ -2 MHz	BDR 3 Mbps	-41			dB
Receiver ACI @ -1 MHz	BDR 3 Mbps	-8			dB
Receiver CCI	BDR 3 Mbps	16			dB
Receiver ACI @ +1 MHz	BDR 3 Mbps	-8			dB
Receiver ACI @ +2 MHz	BDR 3 Mbps	-42			dB
Receiver ACI @ +3 MHz	BDR 3 Mbps	-48			dB
Bluetooth LE 1 Mbps					
Receiver ACI @ -5 MHz (image -1)	BLE 1 Mbps	-39			dB
Receiver ACI @ -4 MHz (image)	BLE 1 Mbps	-28			dB
Receiver ACI @ -3 MHz (image +1)	BLE 1 Mbps	-38			dB
Receiver ACI @ -2 MHz	BLE 1 Mbps	-45			dB
Receiver ACI @ -1 MHz	BLE 1 Mbps	-3			dB
Receiver CCI	BLE 1 Mbps	9			dB
Receiver ACI @ +1 Mbps	BLE 1 Mbps	-9			dB
Receiver ACI @ +2 Mbps	BLE 1 Mbps	-50			dB
Receiver ACI @ +3 Mbps	BLE 1 Mbps	-52			dB
Bluetooth LE 2 Mbps					
Receiver ACI @ -6 MHz (image -2)	BLE 2 Mbps	-51			dB
Receiver ACI @ -4 MHz (image)	BLE 2 Mbps	-29			dB
Receiver ACI @ -2 MHz	BLE 2 Mbps	-19			dB
Receiver CCI	BLE 2 Mbps	8			dB
Receiver ACI @+2 Mbps	BLE 2 Mbps	-29			dB
Receiver ACI @ +4 Mbps	BLE 2 Mbps	-51			dB
Receiver ACI @ +6 Mbps	BLE 2 Mbps	-55			dB
Bluetooth LR 500 kbps					
Receiver ACI @ -5 MHz (image -1)	Bluetooth LR 500 kbps	-40			dB
Receiver ACI @ -4 MHz (image)	Bluetooth LR 500 kbps	-28			dB
Receiver ACI @ -3 MHz (image +1)	Bluetooth LR 500 kbps	-38			dB
Receiver ACI @ -2 MHz	Bluetooth LR 500 kbps	-48			dB
Receiver ACI @ -1 MHz	Bluetooth LR 500 kbps	-5			dB
Receiver CCI	Bluetooth LR 500 kbps	9			dB
Receiver ACI @ 1 Mbps	Bluetooth LR 500 kbps	-11			dB
Receiver ACI @ 2 Mbps	Bluetooth LR 500 kbps	-51			dB
Receiver ACI @ 3 Mbps	Bluetooth LR 500 kbps	-55			dB
Bluetooth LR 125 kbps					
Receiver ACI @ -5 MHz (image -1)	Bluetooth LR 125 kbps	-41			dB
Receiver ACI @ -4 MHz (image)	Bluetooth LR 125 kbps	-28			dB
Receiver ACI @ -3 MHz (image +1)	Bluetooth LR 125 kbps	-39			dB
Receiver ACI @ -2 MHz	Bluetooth LR 125 kbps	-49			dB
Receiver ACI @ -1 MHz	Bluetooth LR 125 kbps	-5			dB

Parameter	Conditions	Min	Typ	Max	Unit
Receiver CCI	Bluetooth LR 125 kbps	9			dB
Receiver ACI @ 1 Mbps	Bluetooth LR 125 kbps	-12			dB
Receiver ACI @ 2 Mbps	Bluetooth LR 125 kbps	-55			dB
Receiver ACI @ 3 Mbps	Bluetooth LR 125 kbps	-60			dB

[1] Bluetooth/Bluetooth LE receiver refers to Dirty Tx. That is, the transmitter has impairments as specified by the Bluetooth SIG standard.
[2] De-sense of 2.7 dB at 2440 MHz, 0.5 dB at 2480 MHz
[3] De-sense of 3.4 dB at 2440 MHz, 1.2 dB at 2480 MHz
[4] De-sense of 3.6 dB at 2440 MHz, 1.1 dB at 2480 MHz
[5] De-sense of 3.8 dB at 2440 MHz, 0.8 dB at 2480 MHz
[6] De-sense of 2.1 dB at 2440 MHz, 0.6 dB at 2480 MHz
[7] De-sense of 3.4 dB at 2440 MHz, 0.6 dB at 2480 MHz
[8] De-sense of 5.3 dB at 2440 MHz, 1 dB at 2480 MHz

10.2 Bluetooth/Bluetooth LE conducted transmitter performance

Table 16: Typical Bluetooth/Bluetooth LE Transmitter performance at AVDD33=3.3 VDC and VIO=1.8 V, 25 degrees C, ambient temperature.

Parameter	Conditions	Min	Typ	Max	Unit
Frequency range	--	2400	--	2483.5	MHz
Transmitter Power	**Conditions**	**1-Port**			**Unit**
BDR 1 Mbps	Mask Compliant	5			dBm
EDR 2 Mbps	Mask and EVM Compliant	2			dBm
EDR 3 Mbps	Mask and EVM Compliant	2			dBm
Bluetooth LE 1 Mbps	-	5			dBm
Mask Compliant	-	5			dBm
Bluetooth LR 500 Kbps	-	5			dBm
Bluetooth LR 125 Kbps	-	5			dBm

10.3 Typical antenna radiation patterns

10.3.1 Antenna Measurement Test Set Up

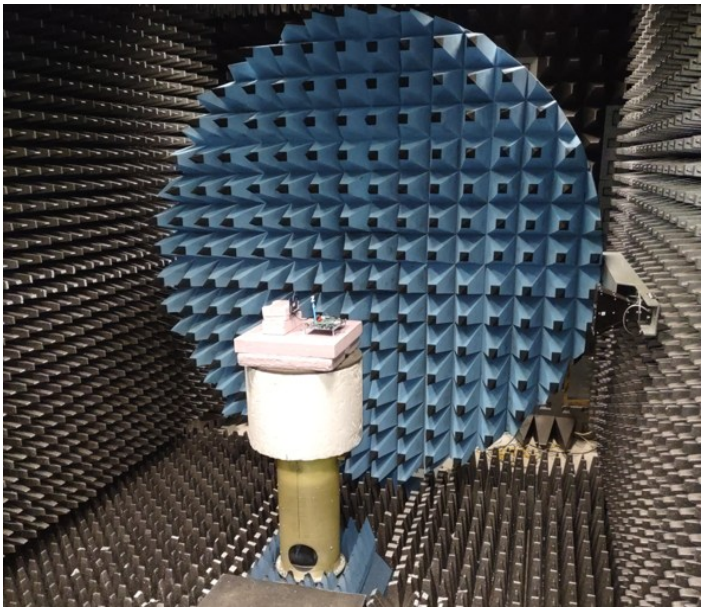


Figure 2: Anechoic Antenna Chamber

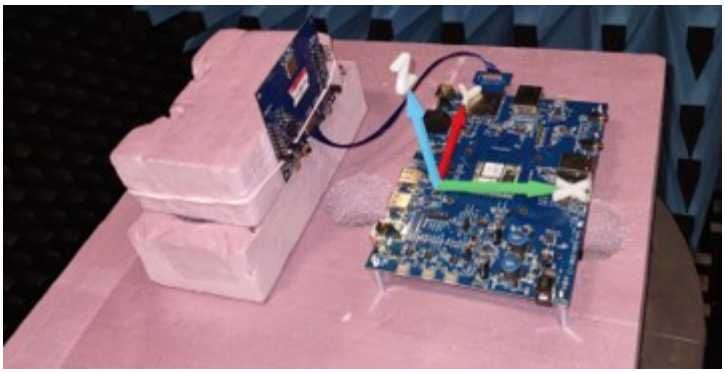
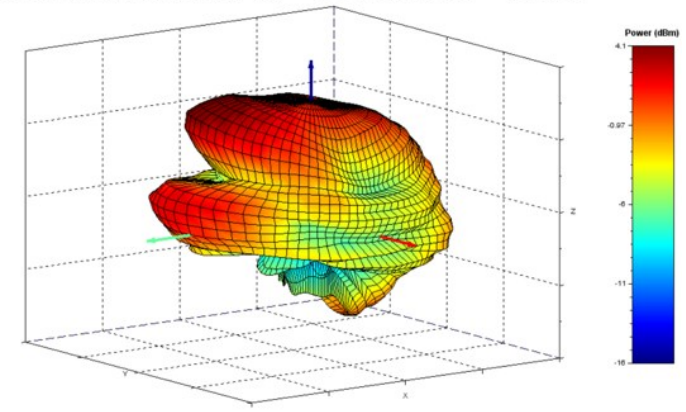


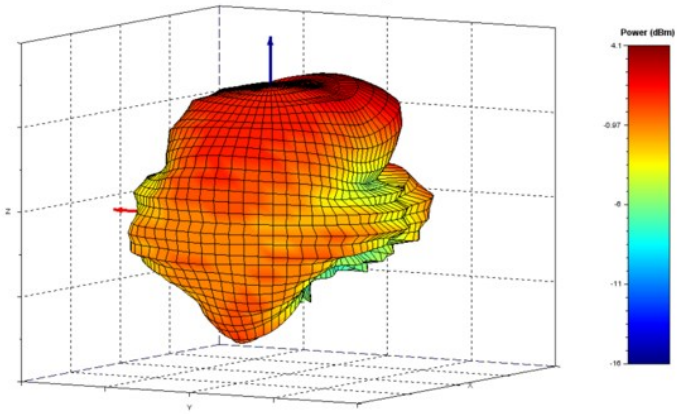
Figure 3: DUT Orientation

10.3.2 2.4GHz

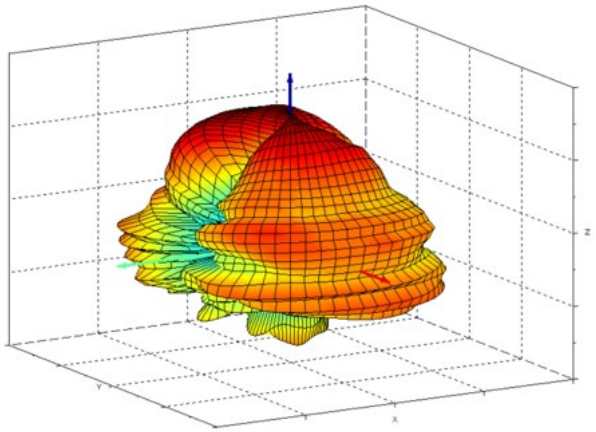
Radiated Power at 2442 MHz, TRP = -1.99 dBm, Max EIRP = 4.07 dBm



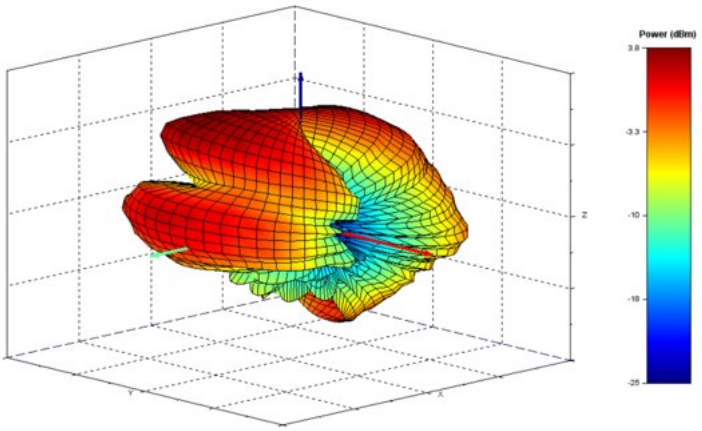
Radiated Power at 2442 MHz, TRP = -1.99 dBm, Max EIRP = 4.07 dBm



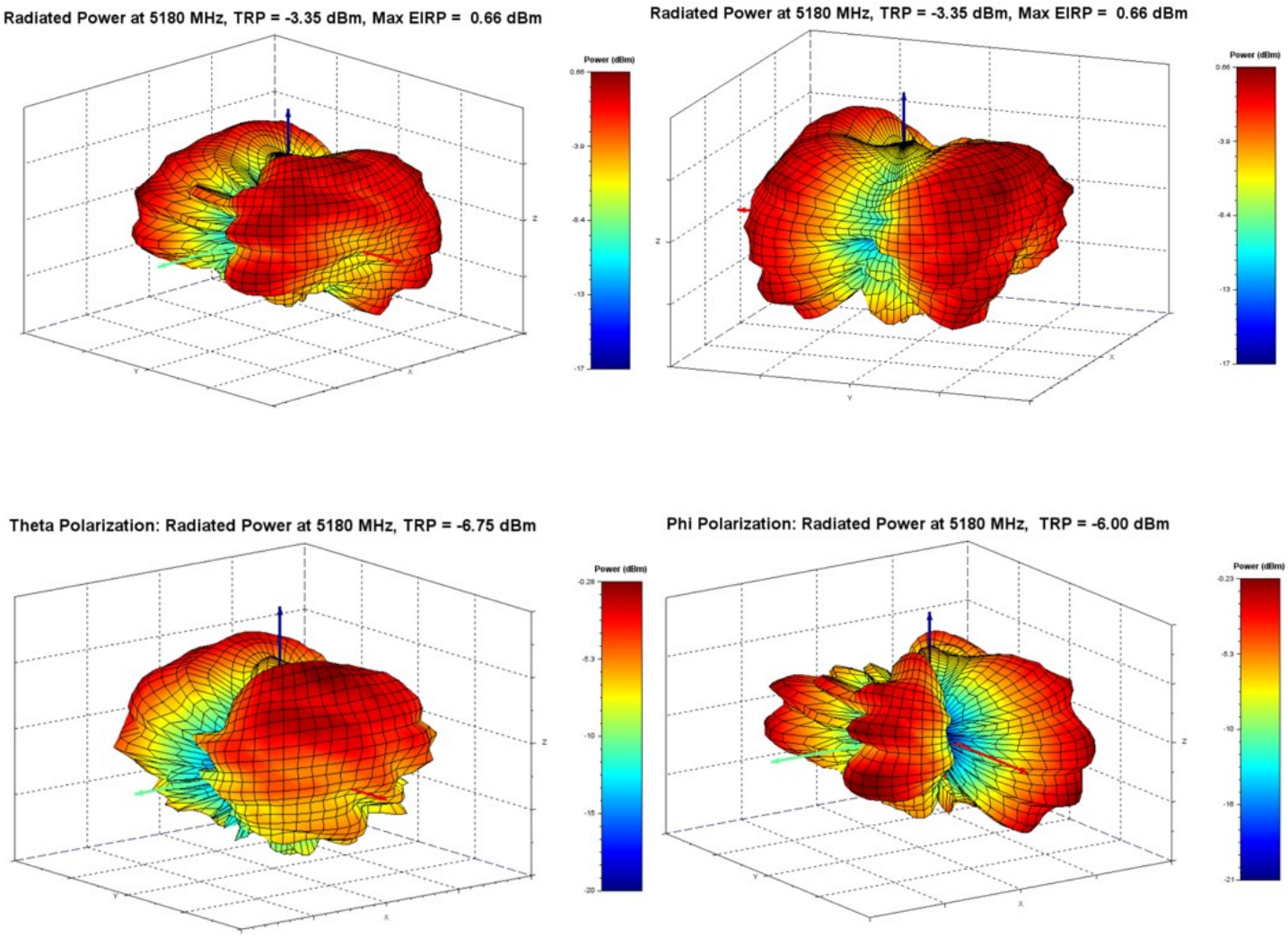
Theta Polarization: Radiated Power at 2442 MHz, TRP = -6.37 dBm



Phi Polarization: Radiated Power at 2442 MHz, TRP = -3.96 dBm



10.3.3 5GHz



Example TRP based on conducted output powers of 0 dBm and -1 dBm at each frequency of 2442 MHz and 5180 MHz.

10.4 Antenna radiation performance summary

Table 17: Antenna Characteristics

Frequency	Peak Gain (dBi)
2.412 GHz	2.5
2.442 GHz	3.3
2.472 GHz	2.8
5.180 GHz	1.6
5.510 GHz	4.1
5.835 GHz	4.2

11 Host Interface Specifications

11.1 Power Supplies

11.1.1 Power-up sequence

The Sona NX611 does not have power-up sequence requirements. The power-down pin (PDn) must be held low (asserted) until all external clock and power supply rails are stable.

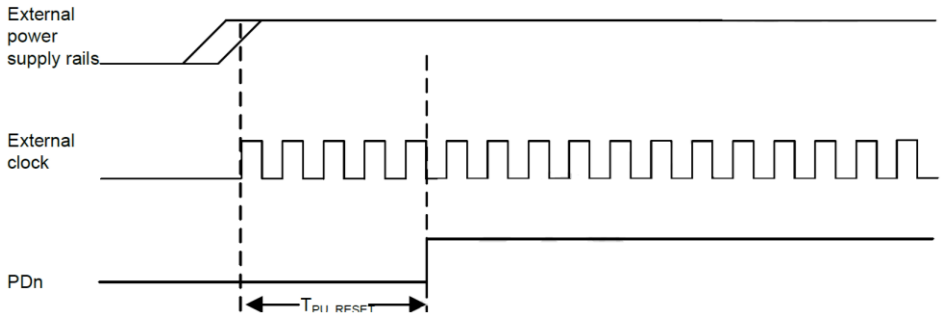


Figure 4: PDn held low (asserted)

11.1.2 Power-down

The Sona NX611 modules can enter the lowest power mode when Wi-Fi and Bluetooth are inactive. To achieve this, you can assert the PDn (Power Down) pin low, which puts the module into power-down mode. The same power-down state can be achieved by powering off 3V3, 1V8, VIO_GPIO and VIO_SD.

After PDn is deasserted (high), the device takes 20 ms to get ready for SDIO enumeration.

NOTE: Firmware download is required again after exiting power-down mode.

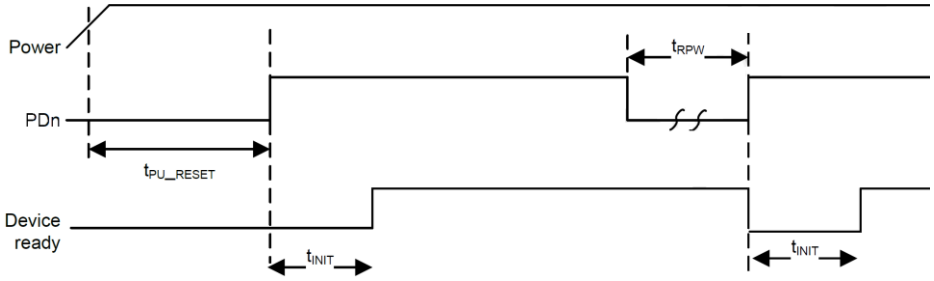


Figure 5: PDn Pin (Power Down Timing)-Power remains high at PDn assertion

Table 18: PDn Pin (Power Down Timing)-Power remains high at PDn assertion

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
tPU_RESET	Valid power to PDn deasserted	-	0	--	--	mS
tRPW	PDn pulse width	-	1	--	--	μs
tINIT	From PDn de-assertion to device ready (SDIO bus enumeration)	-	20	--	--	mS
VIH	Output high voltage	-	1.4	--	4.5	V
VIL	Output low voltage	-	-0.4	--	0.5	V

11.1.3 Wake-up/Interrupt Pins

Deep sleep mode is used to reduce power consumption. Optional wake up input pins are used to wake up the Sona NX611 from sleep. Optional wake up output pins can be used to wake up a host or signal a host that WiFi or Bluetooth data is available.

Table 19: Wake-up/interrupt pins (MFP)

Pin name	I/O type	Supply	Description
BT_WAKE_OUT	O	VIO_GPIO	Bluetooth wake-up output signal. Multi-functional pin: GPIO[19] input/output
BT_WAKE_IN	I	VIO_GPIO	Bluetooth wake-up input signal. Multi-functional pin: GPIO[18] input/output
WL_WAKE_OUT	O	VIO_GPIO	Wi-Fi radio wake-up output signal. Multi-functional pin: GPIO[17] input/output
WL_WAKE_IN	I	VIO_GPIO	Wi-Fi radio wake-up input signal. Multi-functional pin: GPIO[16] input/output
SD_INT	O	VIO_GPIO	Optional SDIO interrupt output signal. Multi-functional pin: GPIO[21] input/output

11.1.4 Software reset pins (MFP)

Software reset pins can be used to independently reset the Wi-Fi and Bluetooth radios.

Pin name	I/O type	Supply	Description
IND_RST_BT	I	VIO_GPIO	Independent software reset for Bluetooth. Multi-functional pin: GPIO[2] input/output
IND_RST_WL	I	VIO_GPIO	Independent software reset for Wi-Fi. Multi-functional pin: GPIO[1] input/output

11.2 SDIO Specifications

The SONA™NX611 series wireless module SDIO host interface pins are powered from the VIO_SD voltage supply.
The SDIO electrical specifications are identical for the 1-bit SDIO and 4-bit SDIO modes.

11.2.1 1.8V Operation

Table 20: DC electricals—1.8V operation (VIO_SD)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
VIH	Input high voltage	-	0.7*VIO_SD	--	VIO_SD+0.4	V
VIL	Input low voltage	-	-0.4	--	0.3*VIO_SD	V
VHYS	Input hysteresis	-	100	--	--	mV
VOH	Output high voltage	-	VIO_SD-0.4	--	--	V
VOL	Output low voltage	-	--	--	0.4	V

11.2.2 3.3V Operation

Table 21: DC electricals — 1.8V operation (VIO_SD)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
VIH	Input high voltage	-	0.7*VIO_SD	--	VIO_SD+0.4	V
VIL	Input low voltage	-	-0.4	--	0.3*VIO_SD	V
VHYS	Input hysteresis	-	100	--	--	mV
VOH	Output high voltage	-	VIO_SD-0.4	--	--	V
VOL	Output low voltage	-	--	--	0.4	V

11.2.3 Default Speed, High-Speed Modes

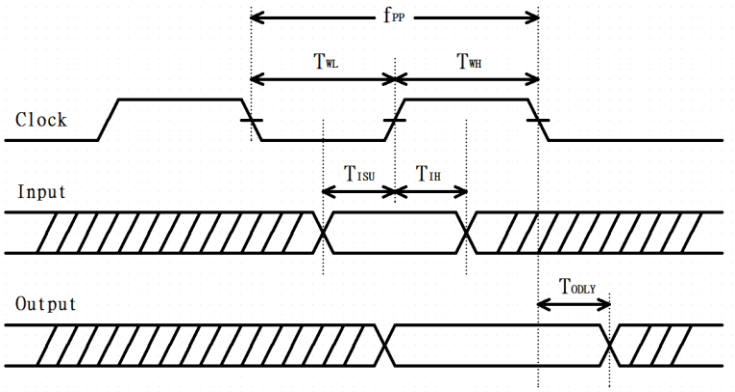


Figure 6: SDIO protocol timing diagram--- default mode (3.3V)

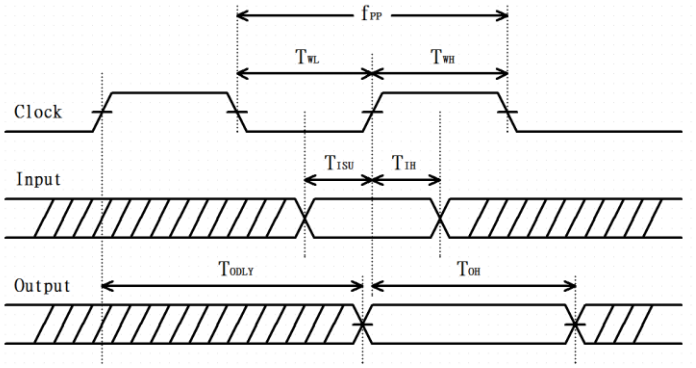


Figure 7: SDIO protocol timing diagram--- High-Speed mode (VIO_SD 3.3V)

Note: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.

Table 22: SDIO timing requirements

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
fPP	Clock Frequency	Default Speed	0	-	25	MHz
		High-Speed	0	-	50	
TWL	Clock low time	Default Speed	10	-	-	ns
		High-Speed	7	-	-	
TWH	Clock high time	Default Speed	10	-	-	ns
		High-Speed	7	-	-	
TISU	Input Setup time	Default Speed	5	-	-	ns
		High-Speed	6	-	-	
TIH	Input Hold time	Default Speed	5	-	-	ns
		High-Speed	2	-	-	
TODLY	Output delay time	Default Speed	-	-	14	ns
	CL≦40pF (1 card)	High-Speed	-	-	14	
TOH	Output hold time	High-Speed	2.5	-	-	ns

11.2.4 SDR12, SDR25, SDR50 Mode (up to 100 MHz) (VIO_SD 1.8V)

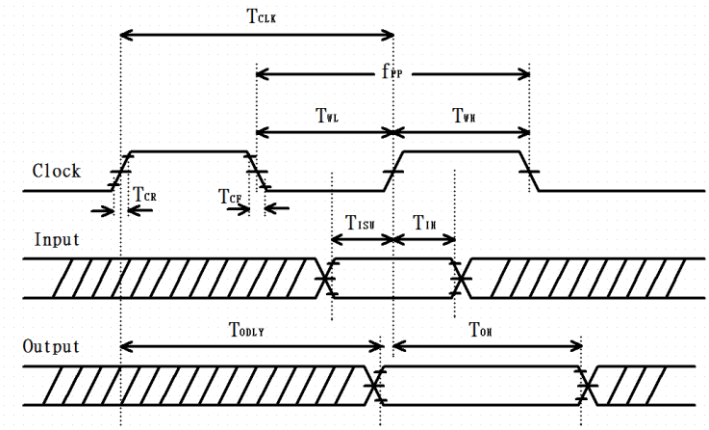


Figure 8: SDIO protocol timing diagram--- SDR12, SDR25, SDR50 modes (up to 100 MHz) (1.8V)

Note: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.

Table 23: SDIO timing requirements--- SDR12, SDR25, SDR50 modes (up to 100 MHz) (VIO_SD 1.8V)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
fPP	Clock Frequency	SDR12/25/50	25	-	100	MHz
TISU	Input setup time	SDR12/25/50	3	--	-	ns
TIH	Input Hold time	SDR12/25/50	0.8	-	-	ns
TCLK	Clock Time	SDR12/25/50	10	-	40	ns
TCR, TCF	Raise time, Fall time TCR, TCF ‹2ns (max) at 100 MHz CCARD=10pF	SDR12/25/50	-	-	0.2*TCLK	ns
TODLY	Output delay time CL≦30pF	SDR12/25/50	-	-	7.5	ns
TOH	Output hold time CL=15pF	SDR12/25/50	1.5	-	-	ns

11.2.5 SDR104 Mode (208 MHz) (VIO_SD 1.8V)

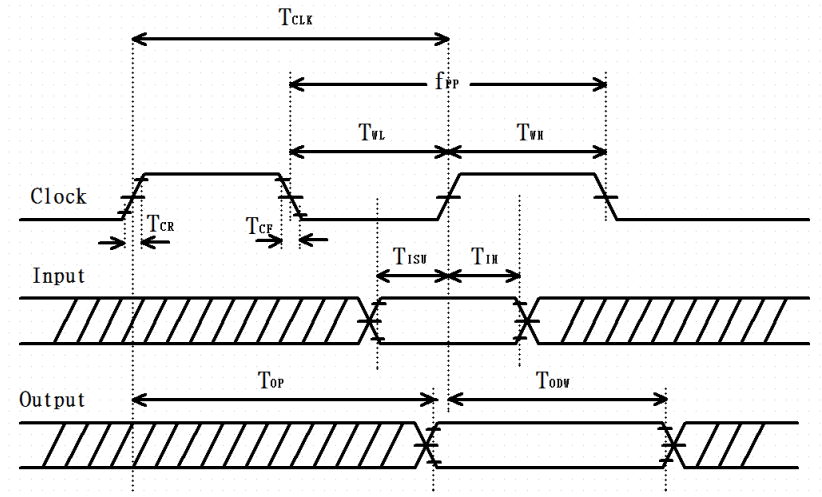


Figure 9: SDIO protocol timing diagram--- SDR104 modes (up to 208 MHz) (1.8V)

Note: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.

Table 24: SDIO timing requirements -- SDR104 modes (up to 208MHz) (VIO_SD 1.8V)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
fPP	Clock Frequency	SDR104	0	-	208	MHz
TISU	Input setup time	SDR104	1.4	--	-	ns
TIH	Input hold time	SDR104	0.8	-	-	ns
TCLK	Clock time	SDR104	4.8	-	-	ns
TCR, TCF	Raise time, Fall time TCR, TCF ‹ 0.96ns (max) at 208 MHz CCARD = 10pF	SDR104	-	-	0.2*TCLK	ns
TOP	Card output phase	SDR104	0	-	10	ns
TODW	Output timing pf variable data window	SDR12/25/SDR50	2.88	-	-	ns

11.2.6 DDR50 Mode (50 MHz) (VIO_SD 1.8V)

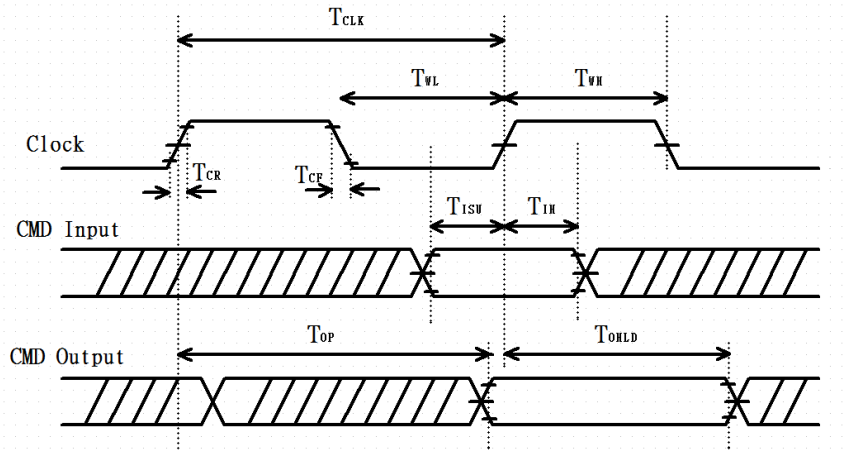


Figure 10: SDIO CMD timing diagram--- DDR50 modes (50 MHz) (1.8V)

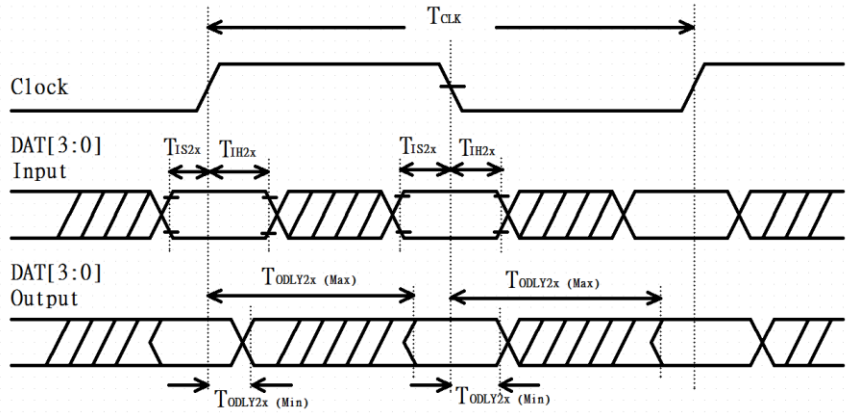


Figure 11: SDIO DAT[3:0] timing diagram--- DDR50 modes (50 MHz) (1.8V)

Note: In DDR50 mode, DAT[3:0] lines are samples on both edges of the clock (not applicable for CMD line)

Table 25: SDIO timing requirements – DDR50 modes (50 MHz)

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
Clock						
TCLK	Clock time 50MHz (max) between rising edge	DDR50	20	--	--	ns
TCR, TCF	Rise time, fall time TCR, TCF ‹4.00ns (max) at 50MHz. CCARD=10pF	DDR50	--	--	0.2*TCLK	ns
Clock Duty	--	DDR50	45	--	55	%
CMD Input (referenced to clock rising edge)						
TIS	Input setup time CCARD≦10pF (1 card)	DDR50	6	--	--	ns
TIH	Input hold time CCARD≦10pF (1 card)	DDR50	0.8	--	--	ns
CMD Output (referenced to clock rising and failing edge)						
TODLY	Output delay time during data transfer mode CL≦30pF (1 card)	DDR50	--	--	13.7	ns
TOHLD	Output hold time CL≥15pF (1 card)	DDR50	1.5	--	--	ns
DAT[3:0] Input (referenced to clock rising and failing edges)						
TIS2X	Input setup time CCARD≦10pF (1 card)	DDR50	3	--	--	ns
TIH2X	Input hold time CCARD≦10pF (1 card)	DDR50	0.8	--	--	ns
DAT[3:0] Output (referenced to clock rising and failing edges)						
TODLY2X (max)	Output delay time during data transfer mode CL≦25pF (1 card)	DDR50	--	--	7.0	ns
TODLY2X (min)	Output hold time CL≥15pF (1 card))	DDR50	1.5	--	--	ns

Table 26: SDIO internal pull-up/pull-down specifications

Parameter	Condition	Min.	Typ.	Max.	Unit
Internal nominal pull-up/pull-down resistance	--	70	100	140	kΩ

11.3 High-Speed UART Specifications

The Sterling 70 supports a high-speed Universal Asynchronous Receiver/Transmitter (UART) interface, compliant to the industry standard 16550 specification. High-speed baud rates are supported to provide the physical transport between the device and the host for exchanging Bluetooth data. The UART Tx and Rx pins are powered from the VIO voltage supply.

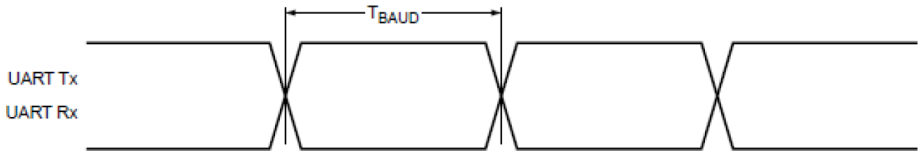


Figure 12: UART timing diagram

Table 27: PCM timing specification – master mode

Symbol	Parameter	Condition	Min.	Typ.	Max.	Unit
T_{BAUD}	Baud rate	26MHz input clock	250	--	--	ns

11.4 External radio coexistence interface specifications

WCI-2 coexistence interface supports the messages defined in Bluetooth Core Specification Vol 7 Part C for request and grant, where:

- The real time message from the external radio to NX611 indicates the request to operate
  - MWS_Rx=1 indicates an external radio request to Rx
  - MWS_Tx=1 indicates an external radio request to Tx

Table 28: WCI-2 Coexistence Interface Pins

Pin name	I/O type	Supply	Description
GPIO25/WCI-2_SIN	I	VIO_GPIO	signal from external radio (input)
GPIO26/WCI-2_SOUT	O	VIO_GPIO	External radio state input signal. External radio traffic direction (Tx/Rx)

11.5 Bluetooth Digital audio interfaces

11.5.1 I2S/PCM Interface Specifications

- Central or peripheral mode
- I2S (Inter-IC Sound) interface for audio data connection to Analog-to-Digital Converters (ADC) and Digital-to- Analog Converters (DAC)
- 3-state I2S interface capability
- I2S pins shared with PCM pins
- Supports clock speeds of 4.096 MHz, 2.048 MHz, and 2 MHz Central or peripheral mode
- PCM bit width size of 8 bits or 16 bits
- Up to 4 slots with configurable bit width and start positions
- 3-state PCM/I2S interface capability
- PCM short frame and long frame5 synchronization
- PCM pins shared with I2S pins
- Supports clock speeds of 4.096 MHz, 2.048 MHz, and 2 MHz

The PCM pins are powered by VIO voltage supply.

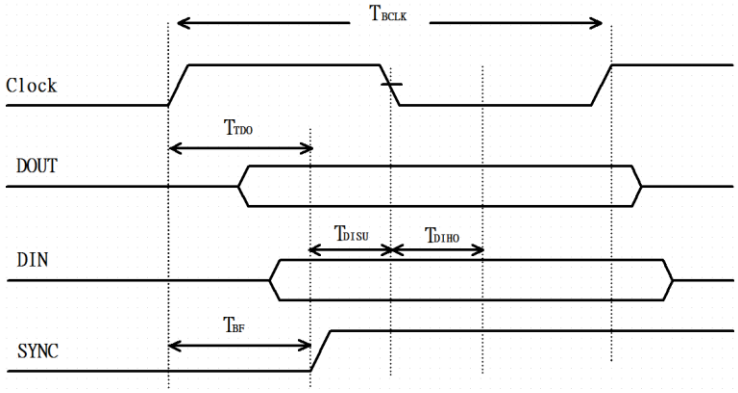


Figure 13: PCM timing specification – master mode

Table 29: PCM timing specification – master mode

Symbol	Parameter	Min.	Typ.	Max.	Unit
FBCLK	-	-	2/2.048	-	MHz
Duty CycleBCLK	-	0.4	0.5	0.6	-
TBCLK rise/fall	-	-	3	-	ns
TDO	-	-	-	15	ns
TDISU	-	20	-	-	ns
TDIHO	-	15	-	-	ns
TBF	-	-	-	15	ns

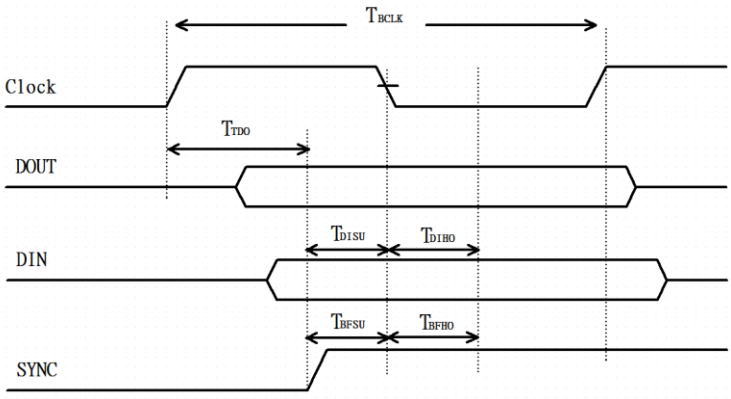


Figure 14: PCM timing specification – slave mode

Table 30: PCM timing specification – slave mode

Symbol	Parameter	Min.	Typ.	Max.	Unit
FBCLK	-	-	2/2.048	-	MHz
Duty CycleBCLK	-	0.4	0.5	0.6	-
TBCLK rise/fall	-	-	3	-	ns
TDO	-	-	-	30	ns
TDISU	-	15	-	-	ns
TDIHO	-	10	-	-	ns
TBFSU	-	15	-	-	Ns
TBFHO	-	10	-	-	Ns

11.6 Sona NX611 1218 Chip Antenna Module

11.6.1 Sona NX611 1218 Chip Antenna Module

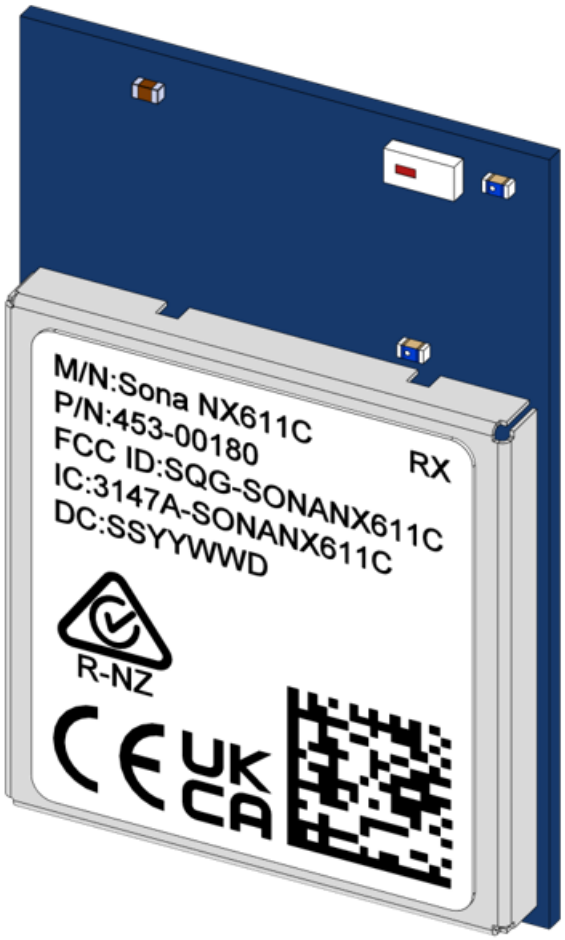


Figure 15: Sona 453-00180

11.6.2 Mechanical Specifications Sona NX611 1218 Chip Antenna Module

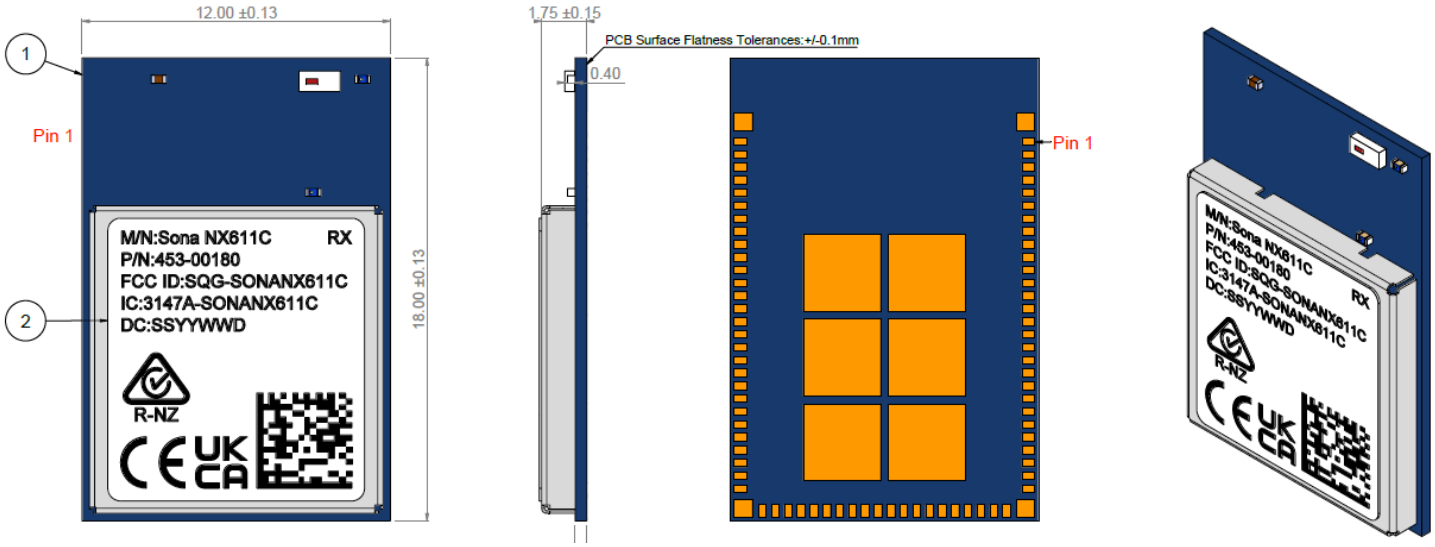


Figure 16: Sona 1218 Chip Antenna Module Dimensions

11.6.3 Mechanical Specifications Sonna 1218 Chip Antenna Module

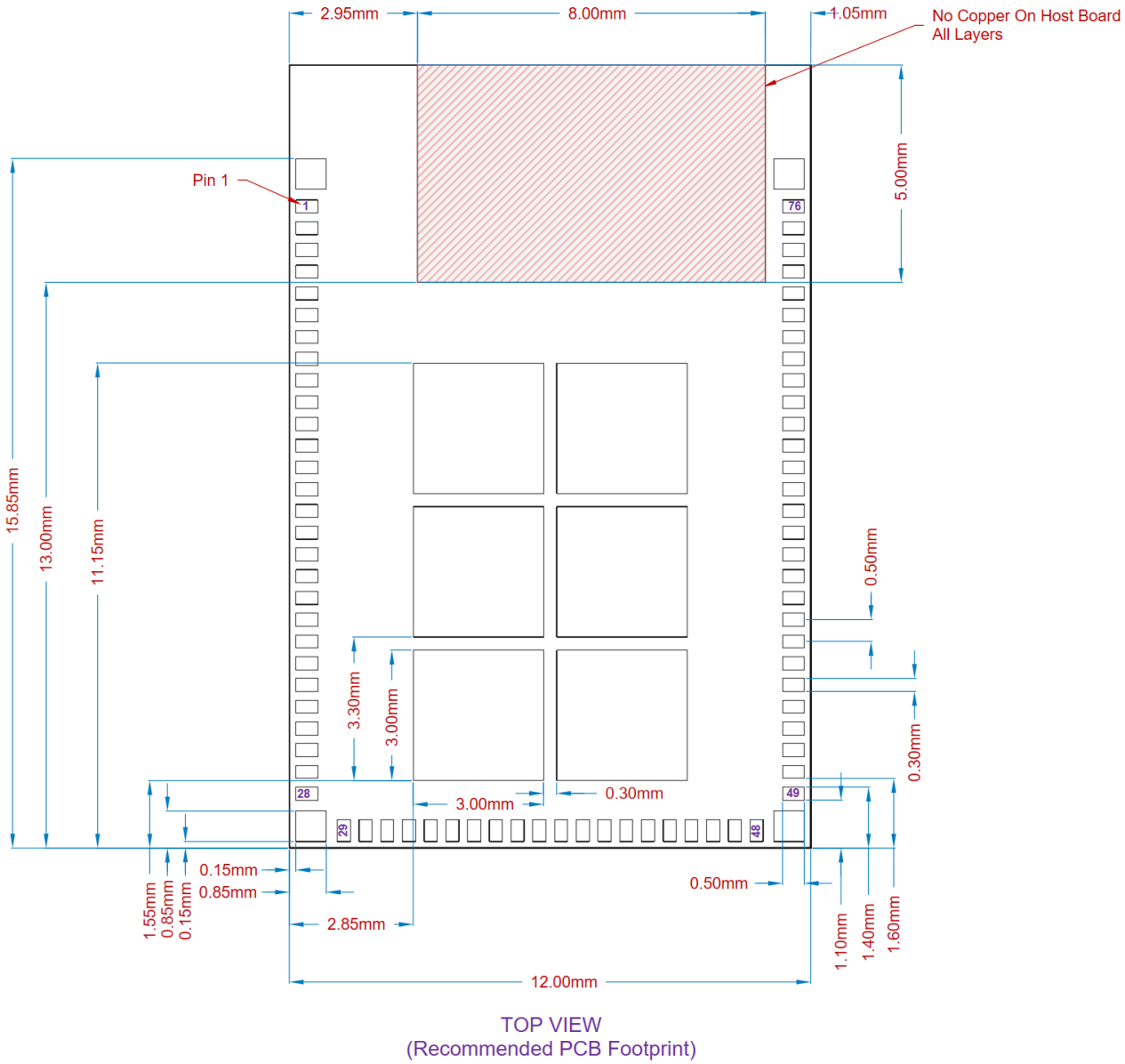


Figure 17: Sona 1218 Chip Antenna Footprint

12 Application Note for Surface Mount Modules

12.1 Introduction

Ezurio's surface mount modules are designed to conform to all major manufacturing guidelines. This application note is intended to provide additional guidance beyond the information that is presented in the user manual. This application note is considered a living document and will be updated as new information is presented.

The modules are designed to meet the needs of several commercial and industrial applications. They are easy to manufacture and conform to current automated manufacturing processes.

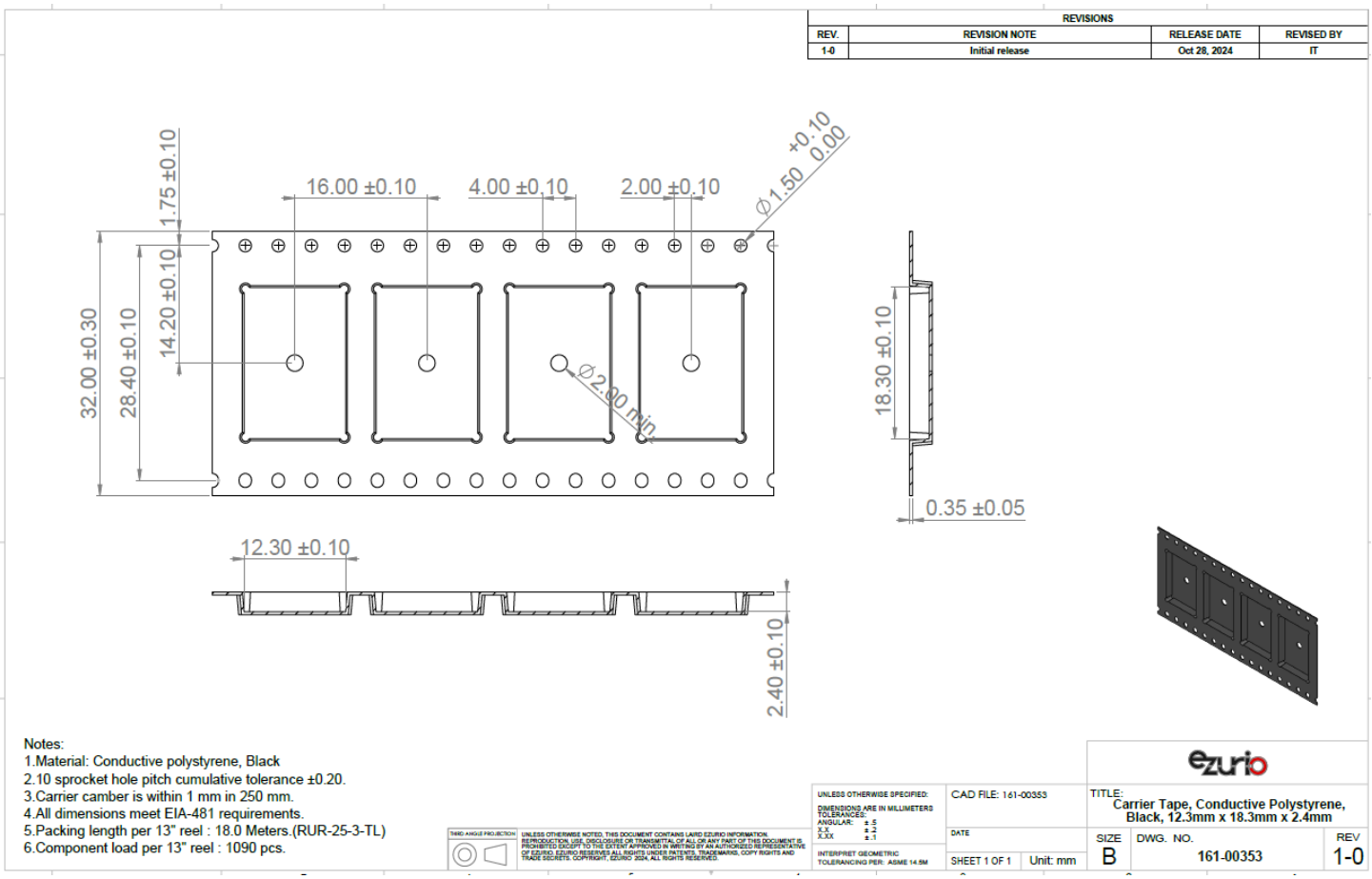
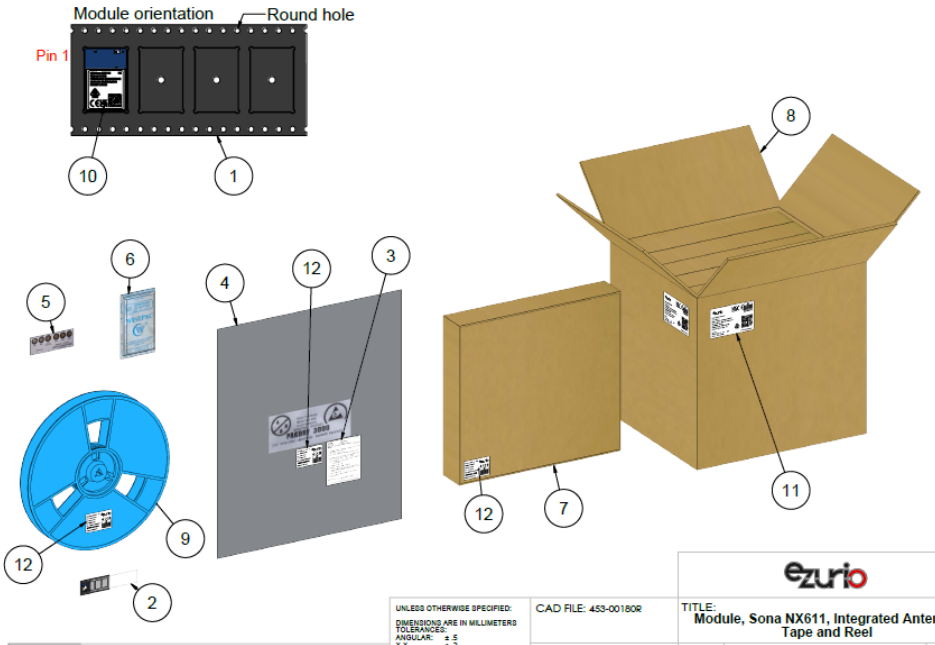


Figure 18: Tape specifications (Sona NX611 1218 Chip Antenna Module)

There are 1,000 SONA™NX611 1218 Chip Antenna modules taped in a reel (and packaged in a pizza box) and five boxes per carton (5,000 modules per carton). Reel, boxes, and carton are labeled with the appropriate labels.

NO.	ITEM NUMBER	REV.	DESCRIPTION	QTY.
1	161-00353	1-0	Carrier Tape, Conductive Polystyrene, Black, 12.3mm x 18.3mm x 2.4mm	1
2	161-00565	1-1	Cover Tape, Anti-static Polyester, 26.5mm x 0.05mm	1
3	160-01816	1-1	Label, Blank Moisture Sensitivity Level, 95mm x 80mm	1
4	161-00280	1-1	Bag, ESD and Moisture Barrier, Silver, 430mm x 500mm x 0.15mm	1
5	161-00281	1-1	Humidity Indicator Card, Minimum 60% RH, Six Spot Indication, 38mm x 102mm	1
6	161-00282	1-1	Desiccant, Silica Gel, 60g, 140mm x 80mm	1
7	161-00283	1-1	Box, Single-Wall Corrugated B Flute, 376mm x 347mm x 65mm	1
8	161-00284	1-1	Carton, Double-Wall, Brown, 395mm x 353mm x 374mm	1
9	161-00418	1-1	Reel, Polystyrene, 330mm Dia. x 32mm, Blue	1
10	453-00180	1-3	Module, Sona NX611, Integrated Antenna	1000
11	160-00036	1-0	Label, Standard Shipping Box, CE Mark, Pictogram, UKCA, RCM, 4in x 2.5in	2
12	160-00007	1-0	Label, Product Identifier, NX611 Series, 60mm x 40mm	3

REVISIONS			
REV.	REVISION NOTE	RELEASE DATE	REVISED BY
1-0	Initial release	Oct 28, 2024	IT



Notes:
1.Put the Module in the carrier tape and cover the tape.
2.Put the Reel, Desiccant and Humidity Indicator Card in the ESD bag.
3.Put the packed ESD bag (vacuum) in the box.
4.Put five boxes in the carton.
(If less that five reels are purchased, insert empty boxes or cardboard to consume the volume of the carton.)
5.Module packaging quantity:
Per Reel: 1000 PCS
Per Carton: 5000 PCS

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS
TOLERANCES:
ANGULAR: ± .5
X.X ± .2
X.XX ± .1
INTERPRET GEOMETRIC TOLERANCING PER: ASME 14.5M

CAD FILE: 453-00180R
DATE
SHEET 1 OF 1 Unit: mm

TITLE: Module, Sona NX611, Integrated Antenna, Tape and Reel
SIZE B | DWG. NO. 453-00180R | REV 1-0

Figure 19: SONA ™NX611 1218 Chip Antenna module packaging process, 453-00180R

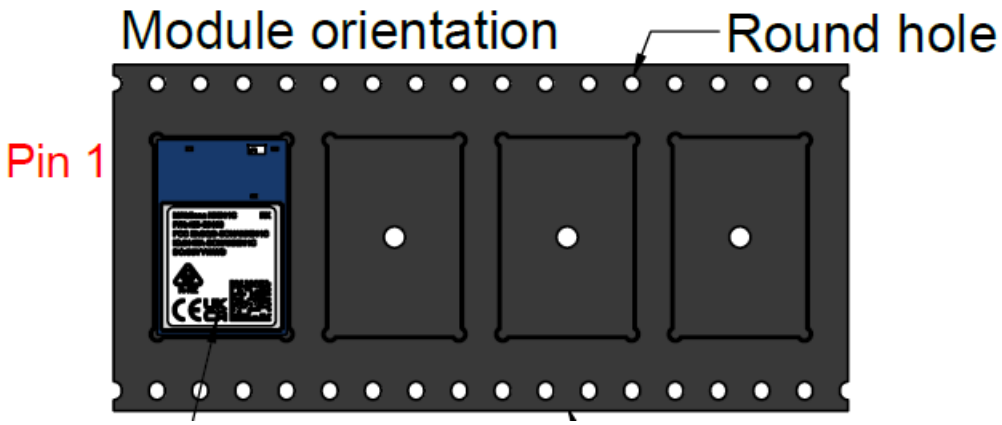


Figure 20: Sona NX611 1218 Chip Antenna Module Orientation in Tape Carrier Pocket

12.2 Labelling

The following labels are located on the anti-static bag. Sona NX611 1218 Chip Antenna modules are MSL4 modules.

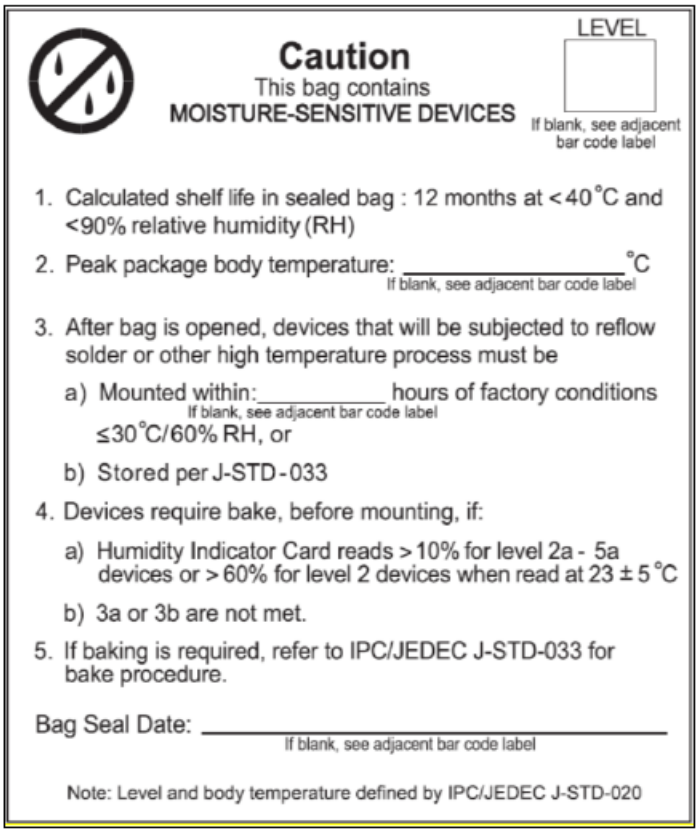


Figure 21: Anti-static bag label, 160-01816

The following label is located on the pizza box.

Figure 22: Product identifier box label, 160-00007

The following package label is located on adjacent sides of the master carton.

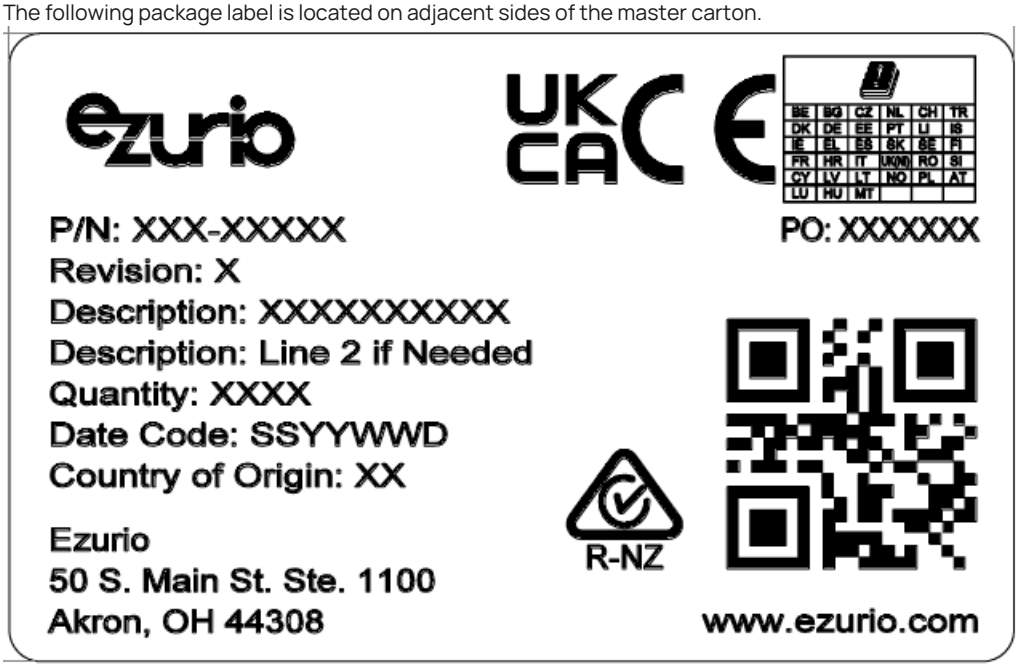


Figure 23: Master carton package label, 160-00036

12.3 Required Storage Conditions

12.3.1 Prior to Opening the Dry Packing

The following are required storage conditions ***prior* to opening the dry packing**:

- Normal temperature: 5~40°C
- Normal humidity: 80% (Relative humidity) or less
- Storage period: One year or less

Note: Humidity means relative humidity.

12.3.2 After Opening the Dry Packing

The following are required storage conditions ***after* opening the dry packing** (to prevent moisture absorption):

- Storage conditions for one-time soldering:
  - Temperature: 5-25°C
  - Humidity: 60% or less
  - Period: 72 hours or less after opening
- Storage conditions for two-time soldering
  - Storage conditions following opening and prior to performing the 1st reflow:
    - Temperature: 5-25°C
    - Humidity: 60% or less
    - Period: A hours or less after opening
  - Storage conditions following completion of the 1st reflow and prior to performing the 2nd reflow
    - Temperature: 5-25°C
    - Humidity: 60% or less
    - Period: B hours or less after completion of the 1st reflow

Note: Should keep A+B within 72 hours.

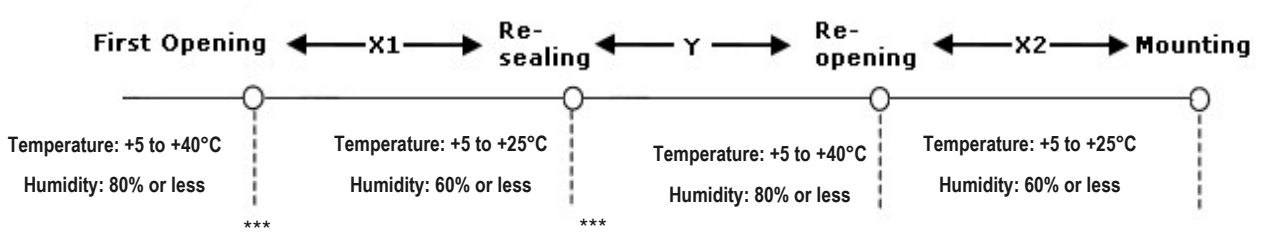
12.3.3 Temporary Storage Requirements after Opening

The following are temporary storage requirements after opening:

- Only re-store the devices *once* prior to soldering.
- Use a dry box or place desiccant (with a blue humidity indicator) with the devices and perform dry packing again using vacuumed heat-sealing.

The following indicate the required storage period, temperature, and humidity for this temporary storage:

- Storage temperature and humidity:



*** - External atmosphere temperature and humidity of the dry packing

- Storage period:
  - X1+X2 – Refer to After Opening the Dry Packing storage requirements. Keep is X1+X2 within 72 hours.
  - Y – Keep within two weeks or less.

12.4 Baking Conditions

Baking conditions and processes for the module follow the J-STD-033 standard which includes the following:

- The calculated shelf life in a sealed bag is 12 months at <40°C and <80% relative humidity.
- Once the packaging is opened, the M2 1218 must be mounted (per MSL4/Moisture Sensitivity Level 4) within 72 hours at <30 °C and <60% relative humidity.
- If the M2 1218 is not mounted within 72 hours or if, when the dry pack is opened, the humidity indicator card displays >10% humidity, then the product must be baked for 48 hours at 125 °C (±5 °C).

12.5 Surface Mount Conditions Modules

The following soldering conditions are recommended to ensure device quality.

12.5.1 Soldering

Note: When soldering, the stencil thickness should be ≥ 0.1 mm.

Convection reflow or IR/Convection reflow (one-time soldering or two-time soldering in air or nitrogen environment)

- Measuring point – IC package surface
- Temperature profile:

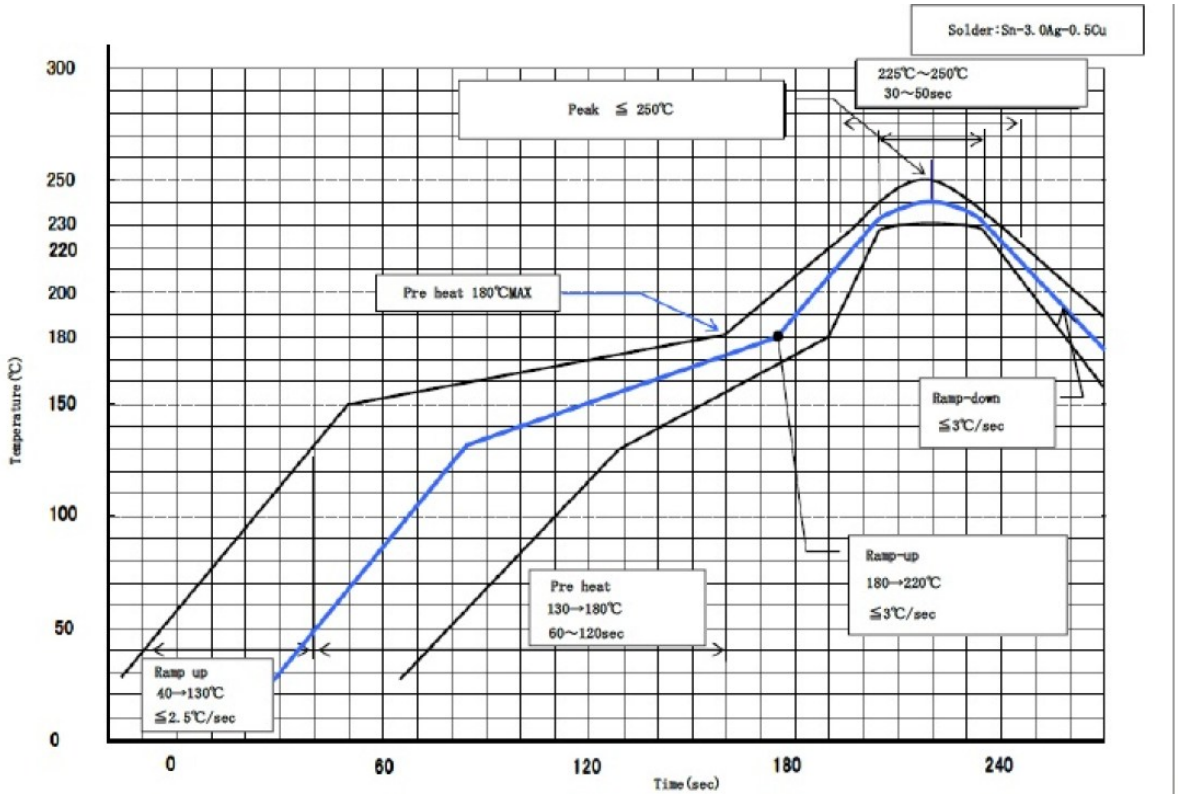


Figure 24: Temperature profile

- Ramp-up: 40-130 °C. Less than 2.5 °C/sec
- Pre heat: 130-180 °C 60-120 sec, 180 °C MAX
- Ramp-up: 180-220 °C. Less than 3 °C/sec
- Peak Temperature: MAX 250 °C
  - 225 °C ~ 250 °C, 30 ~ 50 sec
- Ramp-down: Less than 3 °C/sec

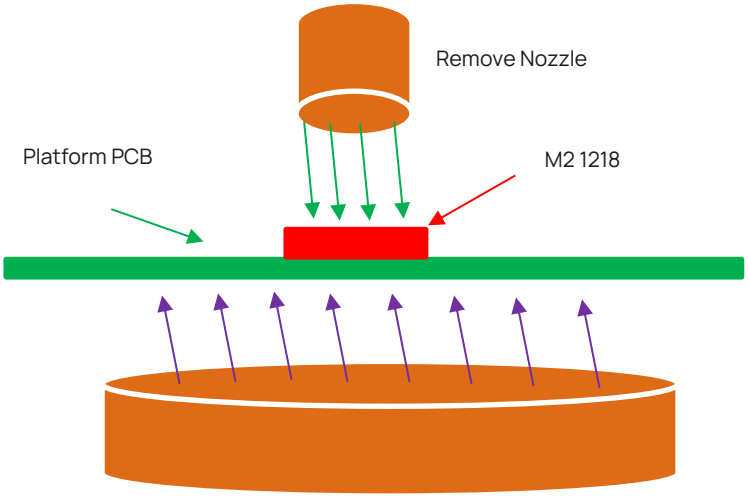
12.5.2 Cautions When Removing Modules from the Platform for RMA

- Bake the platform before removing the M2 1218 from the platform. Reference baking conditions.
- Remove the M2 1218 by using a hot air gun. This process should be carried out by a skilled technician.

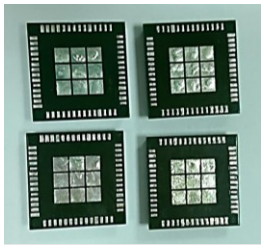
Suggestion conditions:

- One-side component platform:
  - Set the hot plate at 280 °C.
  - Put the platform on the hot plate for 8~10 seconds.
  - Remove the M2 1218 from platform.

- Two-side components platform:
  - Use two hot air guns
  - On the bottom side, use a pre-heated nozzle (temperature setting of 200~250 °C) at a suitable distance from the platform PCB.
  - On the top side, apply a remove nozzle (temperature setting of 330 °C). Heat the M2 1218 until it can be removed from platform PCB.



- Remove the residue solder under the bottom side of M2 1218. (Note: Alternate module pictured as an example)



(Not accepted for RMA)

Example SIP with residue solder on the bottom

(Accepted for RMA analysis)

Example Module, SONA™NX611 module without residue solder

- Remove and clean the residue flux as needed.

12.5.3 Precautions for Use

- Opening/handing/removing must be done on an anti-ESD treated workbench. All workers must also have undergone anti-ESD treatment.
- The devices should be mounted within one year of the date of delivery.
- The SONA™NX611 M2 modules are MSL level 1.

13 Bluetooth Qualification Process

13.1 Overview

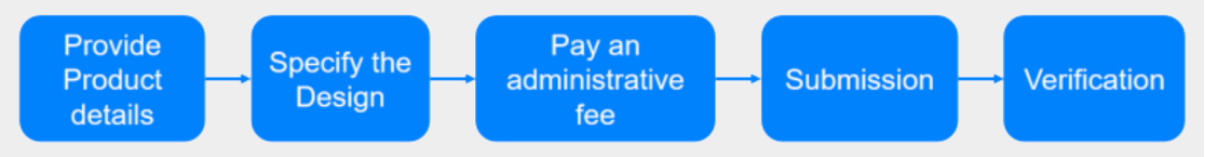
The Bluetooth Qualification Process promotes global product interoperability and reinforces the strength of the Bluetooth® brand and ecosystem to the benefit of all Bluetooth SIG members. The Bluetooth Qualification Process helps member companies ensure their products that incorporate Bluetooth technology comply with the Bluetooth Patent & Copyright License Agreement and the Bluetooth Trademark License Agreement (collectively, the Bluetooth License Agreement) and Bluetooth Specifications.

The Bluetooth Qualification Process is defined by the Qualification Program Reference Document (QPRD) v3.

To demonstrate that a product complies with the Bluetooth Specification(s), each member must for each of its products:

- Identify the product, the design included in the product, the Bluetooth Specifications that the design implements, and the features of each implemented specification
- Complete the Bluetooth Qualification Process by submitting the required documentation for the product under a user account belonging to your company

The Bluetooth Qualification Process consists of the phases shown below:



To complete the Qualification Process the company developing a Bluetooth End Product shall be a member of the Bluetooth SIG. To start the application please use the following link: Apply for Adopter Membership

13.2 Scope

This guide is intended to provide guidance on the Bluetooth Qualification Process for End Products that reference multiple existing designs, that have not been modified, (refer to Section 3.2.2.1 of the Qualification Program Reference Document v3).

For a Product that includes a new Design created by combining two or more unmodified designs that have DNs or QDIDs into one of the permitted combinations in Table 3.1 of the QPRDv3, a Member must also provide the following information:

- DNs or QDIDs for Designs included in the new Design
- The desired Core Configuration of the new Design (if applicable, see Table 3.1 below)
- The active TCRL Package version used for checking the applicable Core Configuration (including transport compatibility) and evaluating test requirements

Any included Design must not implement any Layers using withdrawn specification(s).

When creating a new Design using Option 2a, the Inter-Layer Dependency (ILD) between Layers included in the Design will be checked based on the latest TCRL Package version used among the included Designs.

For the purposes of this document, it is assumed that the member is combining unmodified Core-Controller Configuration and Core-Host Configuration designs, to complete a Core-Complete Configuration.

13.3 Qualification Steps When Referencing multiple existing designs, (unmodified) – Option 2a in the QPRDv3

For this qualification option, follow these steps:

1. To start a listing, go to: https://qualification.bluetooth.com/
2. Select **Start the Bluetooth Qualification Process**.
3. Product Details to be entered:
    - Project Name (this can be the product name or the Bluetooth Design name).
    - Product Description
    - Model Number

- Product Publication Date (the product publication date may not be later than 90 days after submission)
- Product Website (optional)
- Internal Visibility (this will define if the product will be visible to other users prior to publication)
- If you have multiple End Products to list then you can select 'Import Multiple Products', firstly downloading and completing the template, then by 'Upload Product List'. This will populate Qualification Workspace with all your products.

4. Specify the Design:
   - Do you include any existing Design(s) in your Product? Answer Yes, I do.
   - Enter the multiple DNs or QDIDs used in your, (for Option 2a two or more DNs or QDIDs must be referenced)
   - Select 'I'm finished entering DN's
   - Once the DNs or QDIDs are selected they will appear on the left-hand side, indicating the layers covered by the design (should show Core-Controller and Core Host Layers covered).
   - What do you want to do next? Answer, 'Combine unmodified Designs'.
   - The Qualification Workspace Tool will indicate that a new Design will be created and what type of Core-Complete configuration is selected.
   - An active TCRL will be selected for the design.
   - Perform the Consistency Check, which should result in no inconsistencies
   - If there are any inconsistencies these will need to be resolved before proceeding
   - Save and go to Test Plan and Documentation
5. Test Plan and Documentation
   a. As no modifications have been made to the combined designs the tool should report the following message: *'No test plan has been generated for your new Design. Test declarations and test reports do not need to be submitted. You can continue to the next step.'*
   b. Save and go to Product Qualification fee
6. Product Qualification Fee:
   - It's important to make sure a Prepaid Product Qualification fee is available as it is required at this stage to complete the Qualification Process.
   - Prepaid Product Qualification Fee's will appear in the available list so select one for the listing.
   - If one is not available select 'Pay Product Qualification Fee', payment can be done immediately via credit card, or you can pay via Invoice. Payment via credit will release the number immediately, if paying via invoice the number will not be released until the invoice is paid.
   - Once you have selected the Prepaid Qualification Fee, select 'Save and go to Submission'
7. Submission:
   - Some automatic checks occur to ensure all submission requirements are complete.
   - To complete the listing any errors must be corrected
   - Once you have confirmed all design information is correct, tick all of the three check boxes and add your name to the signature page.
   - Now select 'Complete the Submission'.
   - You will be asked a final time to confirm you want to proceed with the submission, select 'Complete the Submission'.
   - Qualification Workspace will confirm the submission has been submitted. The Bluetooth SIG will email confirmation once the submission has been accepted, (normally this takes 1 working day).
8. Download Product and Design Details (SDoC):
   a. You can now download a copy of the confirmed listing from the design listing page and save a copy in your Compliance Folder

For further information, please refer to the following webpage:

https://www.bluetooth.com/develop-with-bluetooth/qualification-listing/

13.4 Example Design Combinations

The following gives an example of a design possible under option 2a:

Ezurio Controller Subsystem + BlueZ 5.50 Host Stack (Ezurio Sona NX611 based design)

Design Name	Owner	Declaration ID	QD ID	Link to listing on the SIG website
Sona NX611	Ezurio	D069010	223670	https://qualification.bluetooth.com/ListingDetails/220312
BlueZ 5.50 Host Stack	Ezurio	D046330	138224	https://qualification.bluetooth.com/ListingDetails/93911

13.5 Qualify More Products

If you develop further products based on the same design in the future, it is possible to add them free of charge. The new product must not modify the existing design i.e add ICS functionality, otherwise a new design listing will be required.

To add more products to your design, select 'Manage Submitted Products' in the Getting Started page, Actions, Qualify More Products. The tool will take you through the updating process.

14 Reliability Test

14.1 Climatic And Dynamic Reliability Test

Table 31: Climatic and Dynamic Reliability Test Results for Sona NX611 Modules

Test Item	Specification	Standard	Test Result
Thermal Shock	Temperature: -40 ~ 85℃ Ramp time: Less than 10 seconds. Dwell Time: 10 minutes Number of Cycles: 350 times	*JESD22-A106 *IEC 60068-2-14 for dwell time and number of cycles	Pass
Vibration Non-operating Unpackaged device	Vibration Wave Form: Sine Waveform Vibration frequency / Displacement: 20-80 Hz/1.5mm Vibration frequency / Acceleration: 80-2000 Hz/20g Cycle Time: 4 min/cycle Number of Cycles: 4 cycle/axis Vibration Axes：X, Y and Z (Rotate each axis on vertical vibration table)	JEDEC 22-B103B (2016)	Pass
Mechanical Shock Non-operating Unpackaged device	Pulse shape: Half-sine waveform Impact acceleration: 1500 g Pulse duration: 0.5 ms Number of shocks: 30 shocks (5 shocks for each face) Orientation: Bottom, top, left, right, front and rear faces	JEDEC 22-B110B.01 (2019)	Pass

14.2 Reliability MTBF Prediction

Table 32: MTBF Predictions for Sona NX611 Modules

Ezurio Part Number	Environment	Standard	Test Result 45 ℃ (Hours)
453-00180R 453-00180C	Ground, Fixed, Uncontrolled	Telcordia Issue 3	3,741,785
453-00180R 453-00180C	Mobile, Fixed, Uncontrolled	Telcordia Issue 3	1,403,170
Ezurio Part Number	**Environment**	**Standard**	**Test Result 85 ℃ (Hours)**
453-00180R 453-00180C	Ground, Fixed, Uncontrolled	Telcordia Issue 3	808,977
453-00180R 453-00180C	Mobile, Fixed, Uncontrolled	Telcordia Issue 3	303,367

15 Regulatory

Note: For complete regulatory information, refer to the SONA™ NX611 Regulatory Information document (coming soon) which is also available from the SONA™ NX611 product page.

The SONA™NX611 holds current certifications in the following countries:

Table 33: SONA ™NX611 countries with certification (M.2 1218 Chip Antenna Module)

Country/Region	Regulatory ID
USA (FCC)	SQG-SONANX611C
EU	N/A
Canada (ISED)	3147A-SONANX611C
Australia	N/A
New Zealand	N/A

16 Additional Information

Please contact your local sales representative or our support team for further assistance:

Headquarters	Ezurio 50 S. Main St. Suite 1100 Akron, OH 44308 USA
Website	http://www.ezurio.com
Technical Support	http://www.ezurio.com/resources/support
Sales Contact	http://www.ezurio.com/contact

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