

# Datasheet

## Sona™ NX611 Modules

*Version 0.2*

---

Revision History

| Version | Date          | Notes                      | Contributors | Approver  |
|---------|---------------|----------------------------|--------------|-----------|
| 0.1     | 23 March 2023 | Preliminary version        | PGS          | Andy Ross |
| 0.2     | 04 June 2024  | Updated RF Characteristics | Brian Petted | Andy Ross |
|         |               |                            |              |           |
|         |               |                            |              |           |
|         |               |                            |              |           |
|         |               |                            |              |           |

PRELIMINARY

## Contents

|       |                                                                    |    |
|-------|--------------------------------------------------------------------|----|
| 1     | Scope.....                                                         | 6  |
| 2     | General description .....                                          | 6  |
| 3     | Key Features Summary.....                                          | 7  |
| 3.1   | Wi-Fi key features .....                                           | 7  |
| 3.2   | Bluetooth key features .....                                       | 7  |
| 3.3   | Operating characteristics .....                                    | 7  |
| 3.4   | General features .....                                             | 7  |
| 3.5   | Internal block diagrams.....                                       | 8  |
| 3.5.1 | Sona NX611 SIP- 2 RF Trace Pin.....                                | 8  |
| 3.5.2 | Sona NX611 SIP- 1 RF Trace Pin.....                                | 8  |
| 3.5.3 | Sona NX611 1216 - 2 Trace Pin/MH4 Connector .....                  | 9  |
| 4     | Pin Information.....                                               | 12 |
| 4.1   | Pin List Sona NX611 SIP Package.....                               | 12 |
| 4.2   | Pin List Sona NX611 1216 and 1218 Chip Antenna Package .....       | 15 |
| 4.3   | Pin List Sona NX61x M.2 2230 Key E Module.....                     | 17 |
| 5     | Pin Information.....                                               | 20 |
| 5.1   | Sona NX611 SIP Module .....                                        | 20 |
| 5.1.1 | Sona NX611 SIP Module .....                                        | 20 |
| 5.1.2 | Mechanical Specifications Sona NX611 SIP Module.....               | 21 |
| 5.1.3 | SIP PCB Footprint.....                                             | 22 |
| 5.2   | Sona NX611 1216 Modules .....                                      | 23 |
| 5.2.1 | Sona NX611 1216 2 Port.....                                        | 23 |
| 5.2.2 | Sona NX611 1216 1 Port.....                                        | 23 |
| 5.2.3 | Mechanical Specifications Sona NX611 M.2 1216 Module.....          | 24 |
| 5.2.4 | Sona 1216 PCB Footprint.....                                       | 25 |
| 5.3   | Sona NX611 1218 Chip Antenna Module .....                          | 26 |
| 5.3.1 | Sona NX611 1218 Chip Antenna Module .....                          | 26 |
| 5.3.2 | Mechanical Specifications Sona NX611 1218 Chip Antenna Module..... | 27 |
| 5.3.3 | Mechanical Specifications Sona 1218 Chip Antenna Module.....       | 28 |
| 5.4   | Sona NX611 M.2 2230 Key E Module .....                             | 29 |
| 5.4.1 | Sona NX611 2230 1 Port .....                                       | 29 |
| 5.4.2 | Sona NX611 2230 2 Port.....                                        | 29 |
| 5.4.3 | M.2 2230 Pinout .....                                              | 30 |
| 5.4.4 | Mechanical Specifications Sona NX611 M.2 2230 Module .....         | 31 |
| 5.4.5 | M.2 2230 Key E Mounting .....                                      | 32 |
| 5.4.6 | Mounting Connectors and Standoffs .....                            | 32 |
| 6     | Specifications .....                                               | 32 |
| 7     | Wi-Fi Subsystem.....                                               | 35 |

|        |                                                                 |    |
|--------|-----------------------------------------------------------------|----|
| 7.1    | IEEE 802.11 standards .....                                     | 35 |
| 7.2    | Wi-Fi MAC .....                                                 | 35 |
| 7.3    | Wi-Fi baseband .....                                            | 35 |
| 7.4    | Wi-Fi radio .....                                               | 36 |
| 7.5    | RF channels .....                                               | 37 |
| 7.5.1  | RF conversion values for 2.4 GHz and 5 GHz Wi-Fi channels ..... | 37 |
| 7.6    | Wi-Fi encryption .....                                          | 37 |
| 7.7    | Transmit Beamforming (TxBF) .....                               | 37 |
| 7.8    | Wi-Fi host interface .....                                      | 37 |
| 8      | Bluetooth Subsystem .....                                       | 38 |
| 8.1    | Bluetooth features .....                                        | 38 |
| 8.2    | Bluetooth Low Energy (LE) features .....                        | 38 |
| 8.3    | Bluetooth Host interface .....                                  | 39 |
| 8.4    | Digital Audio interfaces .....                                  | 39 |
| 8.4.1  | I2S/PCM interface .....                                         | 39 |
| 8.4.2  | I2S/PCM interface signals .....                                 | 39 |
| 8.4.3  | Clock frequency and audio data resolutions .....                | 39 |
| 9      | Electrical Characteristics .....                                | 40 |
| 9.1    | Absolute Maximum Ratings .....                                  | 40 |
| 9.2    | Recommended Operating Conditions .....                          | 40 |
| 9.3    | General DC Electrical Characteristics .....                     | 40 |
| 9.4    | Sona NX611 SIP Module Current Consumption .....                 | 41 |
| 9.5    | Sona NX611 1216/M.2 2230 Module Current Consumption .....       | 42 |
| 10     | RF Characteristics .....                                        | 44 |
| 10.1   | WLAN Radio Receiver Characteristics .....                       | 44 |
| 10.2   | WLAN Transmitter Characteristics .....                          | 46 |
| 11     | Bluetooth subsystem .....                                       | 48 |
| 11.1   | Bluetooth/Bluetooth LE receiver performance .....               | 48 |
| 11.2   | Bluetooth/Bluetooth LE Transmitter performance .....            | 50 |
| 12     | Host Interface Specifications .....                             | 51 |
| 12.1   | SDIO Specifications .....                                       | 51 |
| 12.1.1 | Default Speed, High-Speed Modes .....                           | 51 |
| 12.1.2 | SDR12, SDR25, SDR50 Mode (up to 100 MHz) (1.8V) .....           | 52 |
| 12.1.3 | SDR104 Mode (208 MHz) (1.8V) .....                              | 52 |
| 12.1.4 | DDR50 Mode (50 MHz) (1.8V) .....                                | 53 |
| 12.2   | High-Speed UART Specifications .....                            | 54 |
| 12.3   | PCM Interface Specifications .....                              | 55 |
| 13     | Application Note for Surface Mount Modules .....                | 56 |
| 13.1   | Introduction .....                                              | 56 |

|        |                                                                |    |
|--------|----------------------------------------------------------------|----|
| 13.2   | Base SIP Module Shipping .....                                 | 56 |
| 13.3   | Base 1216 Module Shipping .....                                | 59 |
| 13.4   | Base 2230 Module Shipping .....                                | 62 |
| 13.5   | Labelling .....                                                | 65 |
| 13.6   | Required Storage Conditions .....                              | 66 |
| 13.6.1 | Prior to Opening the Dry Packing .....                         | 66 |
| 13.6.2 | After Opening the Dry Packing .....                            | 66 |
| 13.6.3 | Temporary Storage Requirements after Opening .....             | 67 |
| 13.7   | Baking Conditions.....                                         | 67 |
| 13.8   | Surface Mount Conditions SIP Modules .....                     | 68 |
| 13.8.1 | Soldering .....                                                | 68 |
| 13.8.2 | Cautions When Removing Modules from the Platform for RMA ..... | 68 |
| 13.8.3 | Precautions for Use.....                                       | 69 |
| 14     | Reliability Test.....                                          | 70 |
| 14.1   | Climatic And Dynamic Reliability Test .....                    | 70 |
| 14.2   | Reliability MTBF Prediction .....                              | 71 |
| 15     | Regulatory .....                                               | 72 |
| 16     | Additional Information .....                                   | 73 |

# 1 Scope

This document describes key hardware aspects of the Ezurio Sona™NX61X series wireless modules providing either SDIO for WLAN connection and 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™NX61x 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 series wireless modules include several product SKUs with different form factor, integration levels and RF paths. Please contact Ezurio Sales/FAE for further information. Ordering information is listed in [Table 1](#).

**Table 1: Product ordering information**

| Part Number  | Description                                                 |
|--------------|-------------------------------------------------------------|
| 453-00155R   | Module, Sona NX611 SIP, 2 RF Trace Pin, Tape and Reel       |
| 453-00155C   | Module, Sona NX611 SIP, 2 RF Trace Pin, Cut Tape            |
| 453-00156R   | Module, Sona NX611 SIP, 1 RF Trace Pin, Tape and Reel       |
| 453-00156C   | Module, Sona NX611 SIP, 1 RF Trace Pin, Cut Tape            |
| 453-00157R   | Module, Sona NX611 M.2 1216, 2 MHF4, Tape and Reel          |
| 453-00157C   | Module, Sona NX611 M.2 1216, 1 MHF4, Cut Tape               |
| 453-00158R   | Module, Sona NX611 M.2 1216, 1 MHF4, Tape and Reel          |
| 453-00158C   | Module, Sona NX611 M.2 1216, 1 MHF4, Cut Tape               |
| 453-00165    | Module, Sona NX611 M.2 2230, 2 MHF4                         |
| 453-00166    | Module, Sona NX611 M.2 2230, 1 MHF4                         |
| 453-00180R   | Module, Sona NX611, 1218, Integrated Antenna, Tape and Reel |
| 453-00180C   | Module, Sona NX611, 1218, Integrated Antenna, Cut Tape      |
| 453-00155-K1 | Development Kit, Module, Sona NX611 SIP, 2 RF Trace Pin     |
| 453-00156-K1 | Development Kit, Module, Sona NX611 SIP, 1 RF Trace Pin     |
| 453-00165-K1 | Development Kit, Module, Sona NX611 M.2 2230, 2 MHF4        |
| 453-00166-K1 | Development Kit, Module, Sona NX611 M.2 2230, 1 MHF4        |

## 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 BDR1 , 2 , 3
- Integrated high power PA up to +10 dBm transmit power for EDR
- BDR/EDR packet types—1 Mbps (GFSK), 2 Mbps (1/4-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:
  - SIP – 3.3V and 1.8V
  - 1216 – 3.3V
  - 2230 – 3.3V
- Operating temperature: -40 to 85°C
- Storage temperature: -55 to 125°C

### 3.4 General features

- Package options
  - SIP 76 Pin LGA – 11 mm x 11 mm
  - 1216 96 Pin LGA – 12mm x 16 mm
  - 2230 75 Pin PCIe M.2 – 22mm x 30 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 diagrams

### 3.5.1 Sona NX611 SIP- 2 RF Trace Pin

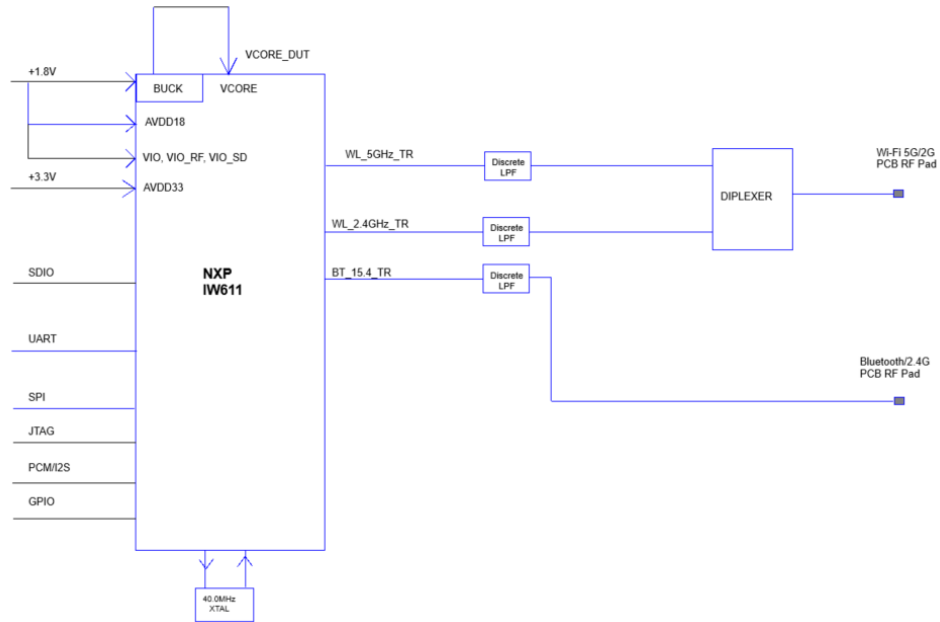


Figure 1: Sona NX611 SIP- 2 RF Trace Pin

### 3.5.2 Sona NX611 SIP- 1 RF Trace Pin

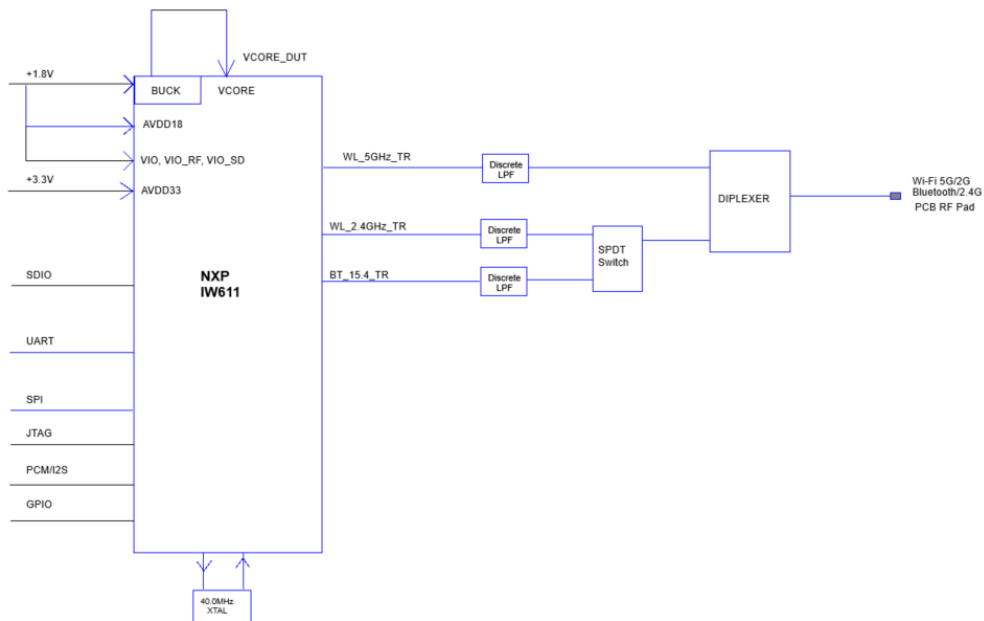


Figure 2: Sona NX611 SIP- 1 RF Trace Pin

### 3.5.3 Sona NX611 1216 - 2 Trace Pin/MH4 Connector

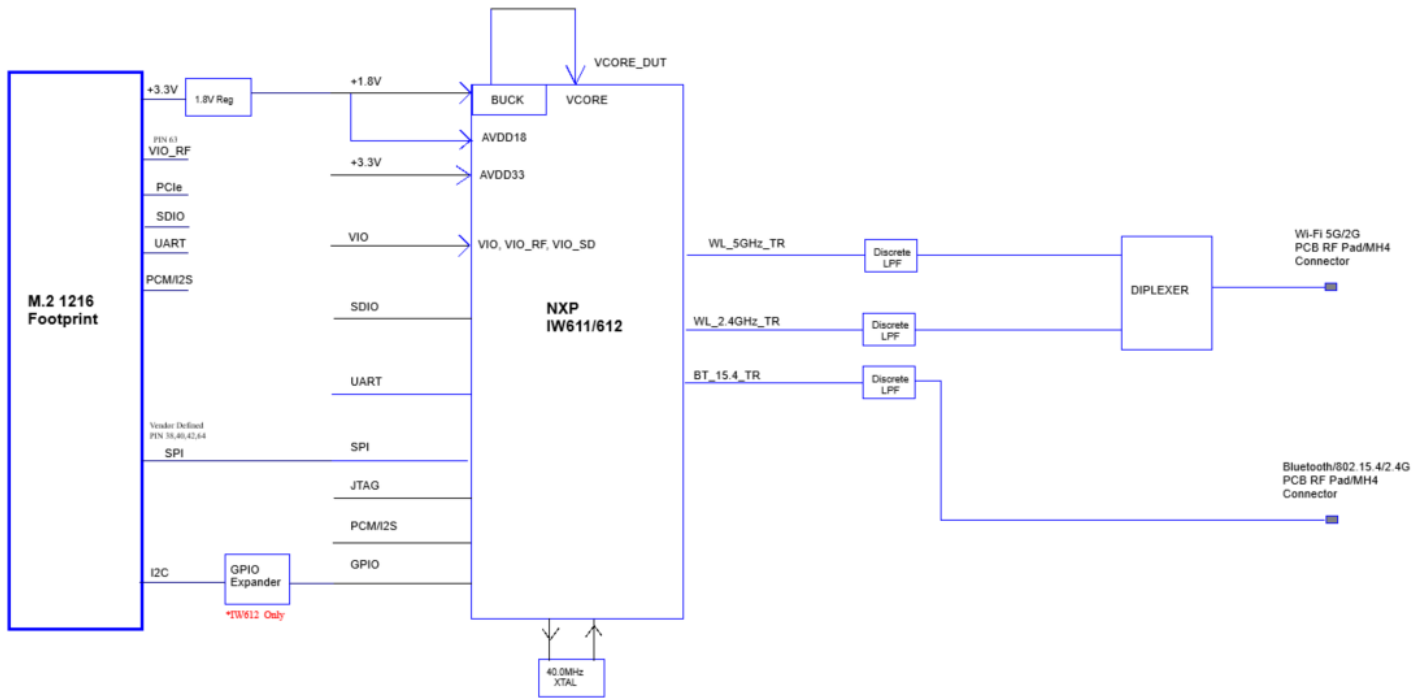


Figure 3: Sona NX611 1216 2 RF Trace Pin/MH4 Connector

#### 3.5.3.1 Sona NX611 1216- 1 RF Trace Pin/MH4 Connector

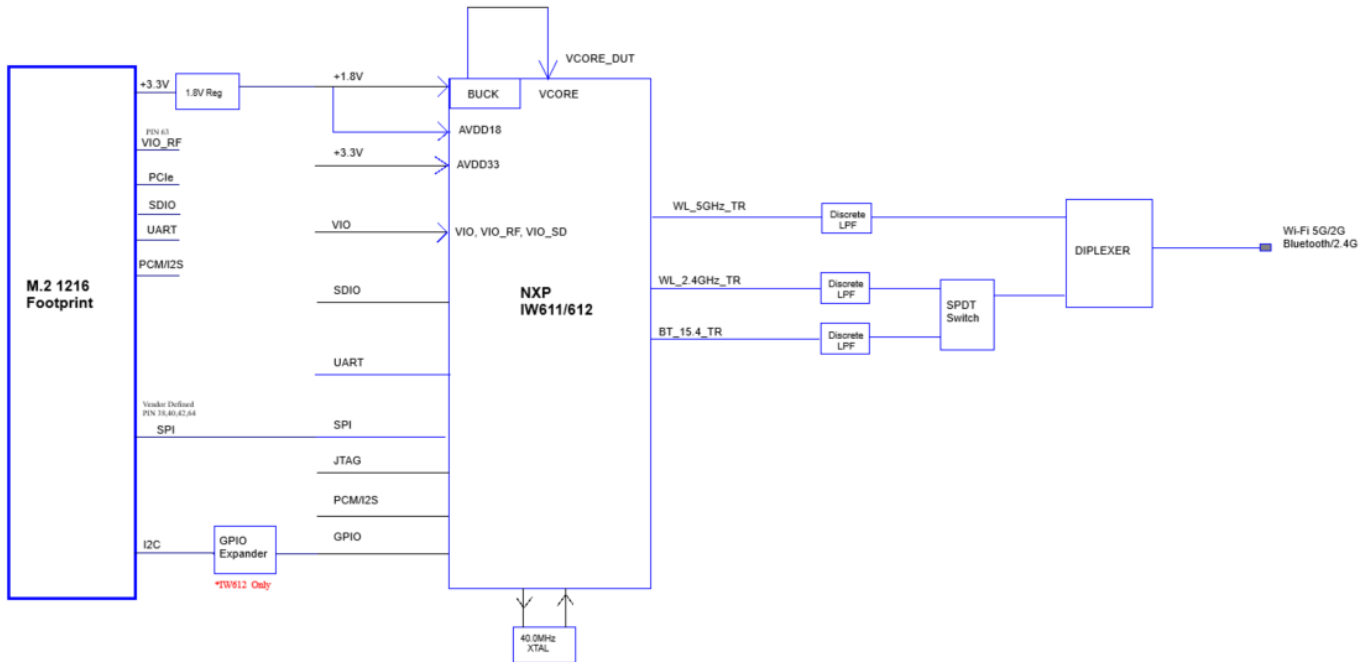


Figure 4: Sona NX611 1216 1 RF Trace Pin/MH4 Connector

### 3.5.3.2 Sona NX611 1218 Chip Antenna

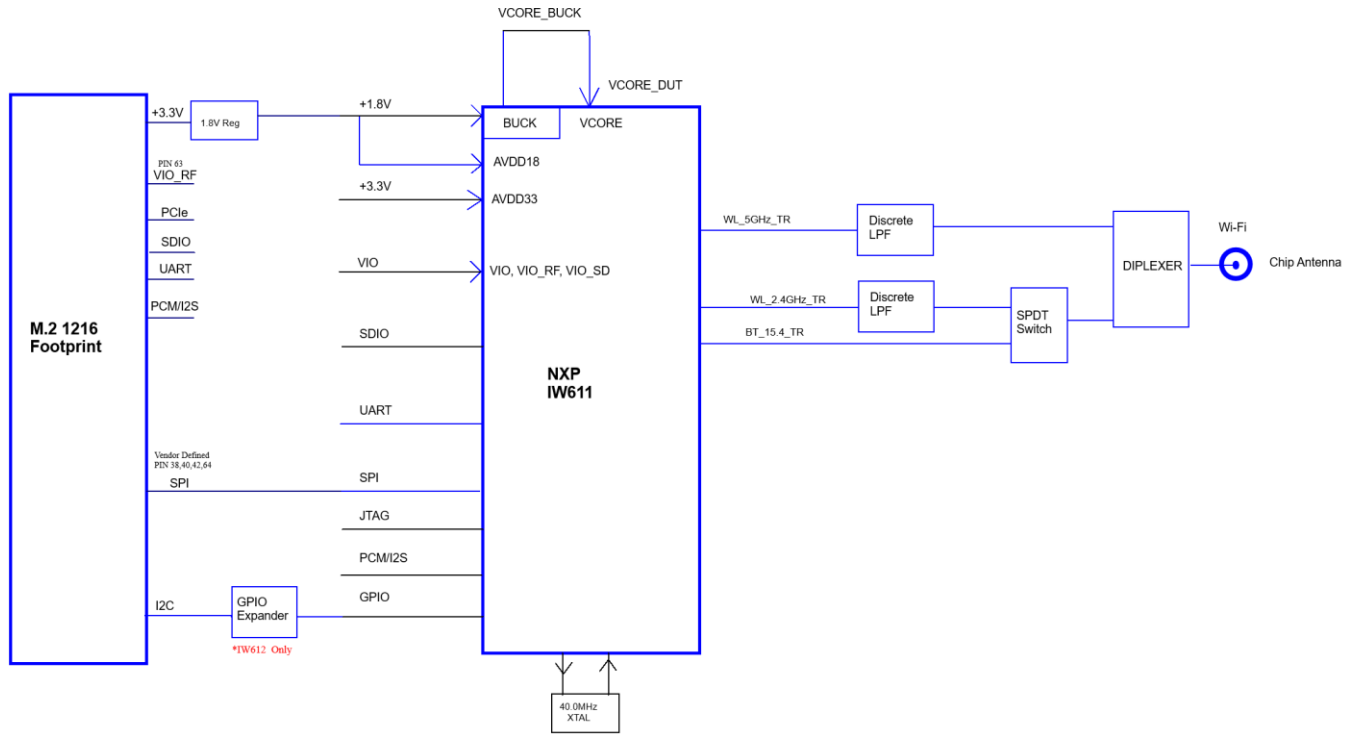


Figure 5: Sona NX611 1218 Chip Antenna

### 3.5.3.3 Sona NX611 M.2 2230 - 2 MH4 Connector

#### M.2 2230 E-KEY PCB Edge Finger

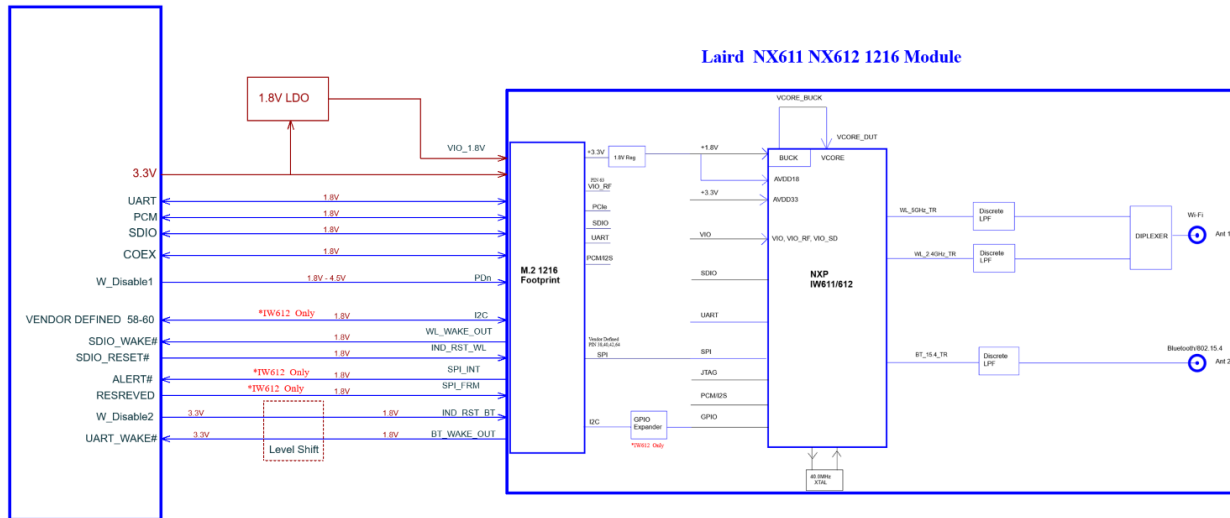
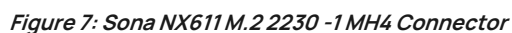


Figure 6: Sona NX611 M.2 2230 - 2 MH4 Connector

## M.2 2230 E-KEY PCB Edge Finger



## 4 Pin Information

### 4.1 Pin List Sona NX611 SIP Package

Table 2: Pin List Sona NX611 SIP

| Pin # | Pin Name           | Description                                       |
|-------|--------------------|---------------------------------------------------|
| 1     | GND                | Ground                                            |
| 2     | VIO_SD             | SDIO Power Supply                                 |
| 3     | GND                | Ground                                            |
| 4     | SD_CMD             | SD Command/response (input/output)                |
| 5     | SD_CLK             | SD Clock input                                    |
| 6     | SD_DAT[1]          | SD Data line bit[1]                               |
| 7     | SD_DAT[3]          | SD Data line bit[3]                               |
| 8     | GND                | Ground                                            |
| 9     | SD_DAT[2]          | SD Data line bit[2]                               |
| 10    | SD_DAT[0]          | SD Data line bit[0]                               |
| 11    | GPIO[21]/SD_INT    | SDIO interrupt signal (output).                   |
| 12    | BUCK_SENSE         | Internal buck voltage. (for troubleshooting only) |
| 13    | VIO                | 1.8V/3.3V digital I/O power supply                |
| 14    | GPIO[8]/UART_CTS   | UART clear-to-send input signal (active low)      |
| 15    | GPIO[10]/UART_RX   | UART serial input signal.                         |
| 16    | GPIO[9]/UART_RTS   | UART request-to-send output signal (active low).  |
| 17    | GPIO[11]/UART_TX   | UART serial output signal.                        |
| 18    | GPIO[13]/EXT_REQ   | External radio request input signal (COEX)        |
| 19    | GPIO[12]/EXT_STATE | External radio state input signal (COEX)          |
| 20    | GND                | Ground                                            |
| 21    | GPIO[14]/EXT_GNT   | External radio grant output signal (COEX)         |
| 22    | GPIO[15]/EXT_PRI   | External radio input priority signal (COEX)       |
| 23    | GPIO[0]/XOSC_EN    | Oscillator enable (output)                        |
| 24    | GPIO[20]/EXT_FREQ  | External radio frequency input signal (COEX)      |
| 25    | CONFIG_HOST[1]     | NC                                                |
| 26    | CONFIG_HOST[0]     | NC                                                |
| 27    | GND                | Ground                                            |
| 28    | GPIO[4]/PCM_CLK    | PCM data clock (output if master, input if slave) |
| 29    | GPIO[3]/PCM_MCLK   | PCM clock output signal (optional)                |
| 30    | GPIO[5]/PCM_DOUT   | PCM transmit data signal (output)                 |
| 31    | GPIO[6]/PCM_DIN    | PCM receive data signal (input)                   |
| 32    | GPIO[7]/PCM_SYNC   | PCM frame sync (output if master, input if slave) |
| 33    | GPIO[2]/IND_RST_BT | Independent software reset for Bluetooth (input)  |
| 34    | GPIO[1]/IND_RST_WL | Independent software reset for Wi-Fi (input)      |
| 35    | GND                | Ground                                            |

|    |                      |                                                   |
|----|----------------------|---------------------------------------------------|
| 36 | AVDD18               | 1.8V analog power supply                          |
| 37 | AVDD18               | 1.8V analog power supply                          |
| 38 | GND                  | Ground                                            |
| 39 | GND                  | Ground                                            |
| 40 | PDn                  | Full Power-down (input) (active low)              |
| 41 | GND                  | Ground                                            |
| 42 | GND                  | Ground                                            |
| 43 | GND                  | Ground                                            |
| 44 | RF_TR_5              | Wi-Fi transmit/receive (5 GHz)                    |
| 45 | GND                  | Ground                                            |
| 46 | AVDD33               | 3.3V analog power supply                          |
| 47 | AVDD33               | 3.3V analog power supply                          |
| 48 | GND                  | Ground                                            |
| 49 | GND                  | Ground                                            |
| 50 | GND                  | Ground                                            |
| 51 | GND                  | Ground                                            |
| 52 | BRF_ANT              | Bluetooth radio transmit/receive interface        |
| 53 | GND                  | Ground                                            |
| 54 | GND                  | Ground                                            |
| 55 | GND                  | Ground                                            |
| 56 | GPIO[26]/WCI-2_SOUT  | Receive signal from external radio (input) (COEX) |
| 57 | GPIO[25]/WCI-2_SIN   | Transmit signal to external radio (output) (COEX) |
| 58 | GND                  | Ground                                            |
| 59 | RF_CNTL4             | RF control line 4                                 |
| 60 | RF_CNTL3             | RF control line 3                                 |
| 61 | RF_CNTL2             | RF control line 2                                 |
| 62 | RF_CNTL1             | RF control line 1                                 |
| 63 | RF_CNTL0             | RF control line 0                                 |
| 64 | GPIO[18]/BT_WAKE_IN  |                                                   |
| 65 | GPIO[19]/BT_WAKE_OUT | Bluetooth wake-up signal (output).                |
| 66 | GPIO[17]/WL_WAKE_OUT | Wi-Fi radio wake-up signal (output).              |
| 67 | GPIO[16]/WL_WAKE_IN  | Wi-Fi radio wake-up signal (input)                |
| 68 | GND                  | Ground                                            |
| 69 | GPIO[22]             | I/O                                               |
| 70 | GPIO[23]             | I/O                                               |
| 71 | GPIO[24]             | I/O                                               |
| 72 | GPIO[27]             | I/O                                               |
| 73 | GPIO[29]/JTAG_TMS    | JTAG controller select (input)                    |
| 74 | GPIO[31]/JTAG_TDO    | JTAG test data signal (output)                    |
| 75 | GPIO[28]/JTAG_TCK    | JTAG test clock signal (input)                    |

|    |                   |                               |
|----|-------------------|-------------------------------|
| 76 | GPIO[30]/JTAG_TDI | JTAG test data signal (input) |
| G1 | GND               | Ground                        |

PRELIMINARY

## 4.2 Pin List Sona NX611 1216 and 1218 Chip Antenna Package

**Table 3: Pin List Sona NX611 1216/1218 Chip Antenna**

| Pin # | PCIe M.2 Name        | Pin Name NX611 1216 | Pin Name NX611 1218 | Comment       |
|-------|----------------------|---------------------|---------------------|---------------|
| 1     | UIM_POWER_SRC/GP IO1 | UNUSED              | UNUSED              | NO CONNECTION |
| 2     | UIM_POWER_SNK        | UNUSED              | UNUSED              | NO CONNECTION |
| 3     | UIM_SWP              | UNUSED              | UNUSED              | NO CONNECTION |
| 4     | 3.3V                 | 3.3V                | 3.3V                |               |
| 5     | 3.3V                 | 3.3V                | 3.3V                |               |
| 6     | GND                  | Ground              | Ground              |               |
| 7     | RESERVED             | UNUSED              | UNUSED              | NO CONNECTION |
| 8     | ALERT#               | UNUSED              | UNUSED              | NO CONNECTION |
| 9     | I2C_CLK              | UNUSED              | UNUSED              | NO CONNECTION |
| 10    | I2C_DATA             | UNUSED              | UNUSED              | NO CONNECTION |
| 11    | COEX_RXD             | COEX_RXD            | COEX_RXD            |               |
| 12    | COEX_TXD             | COEX_TXD            | COEX_TXD            |               |
| 13    | COEX3                | UNUSED              | UNUSED              |               |
| 14    | SYSCLK/GNSS_0        | UNUSED              | UNUSED              |               |
| 15    | TX_BLANKING/GNSS_1   | UNUSED              | UNUSED              |               |
| 16    | RESERVED             | UNUSED              | UNUSED              |               |
| 17    | GND                  | Ground              | Ground              |               |
| 18    | RESERVED             | UNUSED              | UNUSED              |               |
| 19    | RESERVED             | UNUSED              | UNUSED              |               |
| 20    | GND                  | Ground              | Ground              |               |
| 21    | PETn1                | UNUSED              | UNUSED              |               |
| 22    | PETp1                | UNUSED              | UNUSED              |               |
| 23    | GND                  | Ground              | Ground              |               |
| 24    | PERn1                | UNUSED              | UNUSED              |               |
| 25    | PERp1                | UNUSED              | UNUSED              |               |
| 26    | GND                  | Ground              | Ground              |               |
| 27    | SUSCLK(32kHz)        | UNUSED              | UNUSED              |               |
| 28    | W_DISABLE1#          | PDn                 | PDn                 |               |
| 29    | PEWAKE#              | UNUSED              | UNUSED              |               |
| 30    | CLKREQ#              | UNUSED              | UNUSED              |               |
| 31    | PERST#               | UNUSED              | UNUSED              |               |
| 32    | GND                  | Ground              | Ground              |               |
| 33    | REFCLKn0             | UNUSED              | UNUSED              |               |
| 34    | REFCLKp0             | UNUSED              | UNUSED              |               |
| 35    | GND                  | Ground              | Ground              |               |

|    |                    |                    |                    |               |
|----|--------------------|--------------------|--------------------|---------------|
| 36 | PETn0              | UNUSED             | UNUSED             |               |
| 37 | PETp0              | UNUSED             | UNUSED             |               |
| 38 | GND                | Ground             | Ground             |               |
| 39 | PERn0              | UNUSED             | UNUSED             | NO CONNECTION |
| 40 | PERp0              | UNUSED             | UNUSED             | NO CONNECTION |
| 41 | GND                | Ground             | Ground             |               |
| 42 | VENDOR DEFINED     | EXT_PRI            | EXT_PRI            |               |
| 43 | VENDOR DEFINED     | BT_WAKE_IN         | BT_WAKE_IN         |               |
| 44 | VENDOR DEFINED     | WL_WAKE_IN         | WL_WAKE_IN         |               |
| 45 | SDIO RESET#        | IND_RST_WL         | IND_RST_WL         |               |
| 46 | SDIO WAKE#         | WL_WAKE_OUT        | WL_WAKE_OUT        |               |
| 47 | SDIO DATA3         | SDIO DATA3         | SDIO DATA3         |               |
| 48 | SDIO DATA2         | SDIO DATA2         | SDIO DATA2         |               |
| 49 | SDIO DATA1         | SDIO DATA1         | SDIO DATA1         |               |
| 50 | SDIO DATA0         | SDIO DATA0         | SDIO DATA0         |               |
| 51 | SDIO CMD           | SDIO CMD           | SDIO CMD           |               |
| 52 | SDIO CLK           | SDIO CLK           | SDIO CLK           |               |
| 53 | UART WAKE#         | BT_WAKE_OUT        | BT_WAKE_OUT        |               |
| 54 | UART CTS           | UART CTS           | UART CTS           |               |
| 55 | UART Tx            | UART Tx            | UART Tx            |               |
| 56 | UART Rx            | UART Rx            | UART Rx            |               |
| 57 | UART RTS           | UART RTS           | UART RTS           |               |
| 58 | PCM_SYNC/I2S_WS    | PCM_SYNC/I2S_WS    | PCM_SYNC/I2S_WS    |               |
| 59 | PCM_IN/I2S_SD_IN   | PCM_IN/I2S_SD_IN   | PCM_IN/I2S_SD_IN   |               |
| 60 | PCM_OUT/I2S_SD_OUT | PCM_OUT/I2S_SD_OUT | PCM_OUT/I2S_SD_OUT |               |
| 61 | PCM_CLK/I2S_SCK    | PCM_CLK/I2S_SCK    | PCM_CLK/I2S_SCK    |               |
| 62 | GND                | Ground             | Ground             |               |
| 63 | W_DISABLE2#        | IND_RST_BT         | IND_RST_BT         |               |
| 64 | LED_2#             | UNUSED             | UNUSED             | NO CONNECTION |
| 65 | LED_1#             | UNUSED             | UNUSED             | NO CONNECTION |
| 66 | RESERVED/VIO_1.8   | VIO_1.8            | VIO_1.8            |               |
| 67 | RESERVED           | UNUSED             | UNUSED             | NO CONNECTION |
| 68 | GND                | Ground             | Ground             |               |
| 69 | USB_D-             | UNUSED             | UNUSED             | NO CONNECTION |
| 70 | USB_D+             | UNUSED             | UNUSED             | NO CONNECTION |
| 71 | GND                | Ground             | Ground             |               |
| 72 | 3.3V               | 3.3V               | 3.3V               |               |
| 73 | 3.3V               | 3.3V               | 3.3V               |               |
| 74 | GND                | Ground             | Ground             |               |

|    |             |        |        |                       |
|----|-------------|--------|--------|-----------------------|
| 75 | GND         | Ground | Ground |                       |
| 76 | GND/VIO_CFG | UNUSED | UNUSED | NO CONNECTION         |
| 77 | GND         | Ground | NA     | No Pin On 1218 Module |
| 78 | GND         | Ground | NA     | No Pin On 1218 Module |
| 79 | GND         | Ground | NA     | No Pin On 1218 Module |
| 80 | GND         | Ground | NA     | No Pin On 1218 Module |
| 81 | WL_C2       | UNUSED | NA     | No Pin On 1218 Module |
| 82 | GND         | Ground | NA     | No Pin On 1218 Module |
| 83 | GND         | Ground | NA     | No Pin On 1218 Module |
| 84 | GND         | Ground | NA     | No Pin On 1218 Module |
| 85 | GND         | Ground | NA     | No Pin On 1218 Module |
| 86 | WL_C0       | UNUSED | NA     | No Pin On 1218 Module |
| 87 | GND         | Ground | NA     | No Pin On 1218 Module |
| 88 | GND         | Ground | NA     | No Pin On 1218 Module |
| 89 | GND         | Ground | NA     | No Pin On 1218 Module |
| 90 | GND         | Ground | NA     | No Pin On 1218 Module |
| 91 | GND         | Ground | NA     | No Pin On 1218 Module |
| 92 | WL_C1       | UNUSD  | NA     | No Pin On 1218 Module |
| 93 | GND         | Ground | NA     | No Pin On 1218 Module |
| 94 | GND         | Ground | NA     | No Pin On 1218 Module |
| 95 | GND         | Ground | NA     | No Pin On 1218 Module |
| 96 | GND         | Ground | NA     | No Pin On 1218 Module |
| G1 | GND         | Ground | Ground |                       |

### 4.3 Pin List Sona NX611x M.2 2230 Key E Module

**Table 4: NX611 M.2 2230 Key E Pin Definition**

| Pin # | PCIe M.2 2230 Name              | Pin Name NX611 2230             | Comment        |
|-------|---------------------------------|---------------------------------|----------------|
| 1     | GND                             | GND                             |                |
| 2     | 3.3 V                           | 3.3 V                           |                |
| 3     | USB_D+                          | UNUSED                          | Do Not Connect |
| 4     | 3.3 V                           | 3.3 V                           |                |
| 5     | USB_D-                          | UNUSED                          | Do Not Connect |
| 6     | LED_1# (I) (OD)                 | UNUSED                          | Do Not Connect |
| 7     | GND                             | GND                             |                |
| 8     | PCM_CLK/I2S_SCK (I/O) (0/1.8V)  | PCM_CLK/I2S_SCK (I/O) (0/1.8V)  |                |
| 9     | SDIO_CLK/SYSCLK (I) (0/1.8V)    | SDIO_CLK/SYSCLK (I) (0/1.8V)    |                |
| 10    | PCM_SYNC/I2S_WS (I/O) (0/1.8V)  | PCM_SYNC/I2S_WS (I/O) (0/1.8V)  |                |
| 11    | SDIO_CMD (I/O) (0/1.8V)         | SDIO_CMD (I/O) (0/1.8V)         |                |
| 12    | PCM_OUT/I2S_SD_OUT (O) (0/1.8V) | PCM_OUT/I2S_SD_OUT (O) (0/1.8V) |                |
| 13    | SDIO_DATA0 (I/O) (0/1.8V)       | SDIO_DATA0 (I/O) (0/1.8V)       |                |

|       |                               |                               |               |
|-------|-------------------------------|-------------------------------|---------------|
| 14    | PCM_IN/I2S_SD_IN (I) (0/1.8V) | PCM_IN/I2S_SD_IN (I) (0/1.8V) |               |
| 15    | SDIO_DATA1 (I/O) (0/1.8V)     | SDIO_DATA1 (I/O) (0/1.8V)     |               |
| 16    | LED_2# (I) (OD)               | UNUSED                        | NO CONNECTION |
| 17    | SDIO_DATA2 (I/O) (0/1.8V)     | SDIO_DATA2 (I/O) (0/1.8V)     |               |
| 18    | VIO_CFG/GND                   | VIO_CFG/GND                   |               |
| 19    | SDIO_DATA3 (I/O) (0/1.8V)     | SDIO_DATA3 (I/O) (0/1.8V)     |               |
| 20    | BT_15.4_WAKE_OUT              | BT_15.4_WAKE_OUT              |               |
| 21    | WL_WAKE_OUT:                  | WL_WAKE_OUT:                  |               |
| 22    | UART_RXD (I) (0/1.8V)         | UART_RXD (I) (0/1.8V)         |               |
| 23    | IND_RST_WL (I)                | IND_RST_WL (I)                |               |
| 24-31 | CONNECTOR KEY E               | CONNECTOR KEY E               | No Pins       |
| 32    | UART_RXD (I) (0/1.8V)         | UART_RXD (I) (0/1.8V)         |               |
| 33    | GND                           | GND                           |               |
| 34    | UART_RTS (O) (0/1.8V)         | UART_RTS (O) (0/1.8V)         |               |
| 35    | PETp0                         | UNUSED                        |               |
| 36    | VENDOR DEFINED                | UART_CTS (I) (0/1.8V)         |               |
| 37    | PERn0                         | UNUSED                        | NO CONNECTION |
| 38    | VENDOR DEFINED                | UNUSED                        | NO CONNECTION |
| 39    | GND                           | GND                           |               |
| 40    | VENDOR DEFINED                | WL_WAKE_IN                    |               |
| 41    | PETp0                         | UNUSED                        | NO CONNECTION |
| 42    | VENDOR DEFINED                | BT_WAKE_IN                    |               |
| 43    | PETn0                         | UNUSED                        | NO CONNECTION |
| 44    | COEX3 (I/O) (0/1.8V)          | UNUSED                        | NO CONNECTION |
| 45    | GND                           | GND                           |               |
| 46    | COEX_TXD (O) (0/1.8V)         | COEX_TXD (O) (0/1.8V)         |               |
| 47    | REFCLKp0                      | UNUSED                        | NO CONNECTION |
| 48    | COEX_RXD (I) (0/1.8V)         | COEX_RXD (I) (0/1.8V)         |               |
| 49    | REFCLKn0                      | UNUSED                        | NO CONNECTION |
| 50    | SUSCLK (I) (0/1.8V/3.3V)      | UNUSED                        | NO CONNECTION |
| 51    | GND                           | GND                           |               |
| 52    | PERST0# (I) (0/1.8V/3.3V)     | UNUSED                        | NO CONNECTION |
| 53    | CLKREQ0# (I/O) (0/1.8V/3.3V)  | UNUSED                        | NO CONNECTION |
| 54    | IND_RST_BT (I)                | IND_RST_BT (I)                |               |
| 55    | PEWAKE0# (I/O) (0/1.8V/3.3V)  | UNUSED                        | NO CONNECTION |
| 56    | PDn (I)                       | PDn (I)                       |               |
| 57    | GND                           | GND                           |               |
| 58    | I2C_DATA (I/O) (0/1.8 V)      | I2C_DATA (I/O) (0/1.8 V)      |               |
| 59    | RESERVED                      | UNUSED                        | NO CONNECTION |
| 60    | I2C_CLK (O) (0/1.8 V)         | I2C_CLK (O) (0/1.8 V)         |               |

|    |                               |          |               |
|----|-------------------------------|----------|---------------|
| 61 | RESERVED                      | UNUSED   | NO CONNECTION |
| 62 | ALERT# (I) (0/1.8 V)          | UNUSED   | NO CONNECTION |
| 63 | GND                           | GND      |               |
| 64 | RESERVED/VIO 1.8V             | VIO 1.8V |               |
| 65 | RESERVED                      | UNUSED   | NO CONNECTION |
| 66 | UIM_SWP/PERST1#               | UNUSED   | NO CONNECTION |
| 67 | RESERVED                      | UNUSED   | NO CONNECTION |
| 68 | UIM_POWER_SNK/CLKREQ1#        | UNUSED   | NO CONNECTION |
| 69 | GND                           | GND      |               |
| 70 | UIM_POWER_SRC/GPIO_1/PEWAKE1# | UNUSED   | NO CONNECTION |
| 71 | RESERVED                      | UNUSED   | NO CONNECTION |
| 72 | 3.3 V                         | 3.3 V    |               |
| 73 | RESERVED                      | UNUSED   | NO CONNECTION |
| 74 | 3.3 V                         | 3.3 V    |               |
| 75 | GND                           | GND      |               |

## 5 Pin Information

### 5.1 Sona NX611 SIP Module

#### 5.1.1 Sona NX611 SIP Module

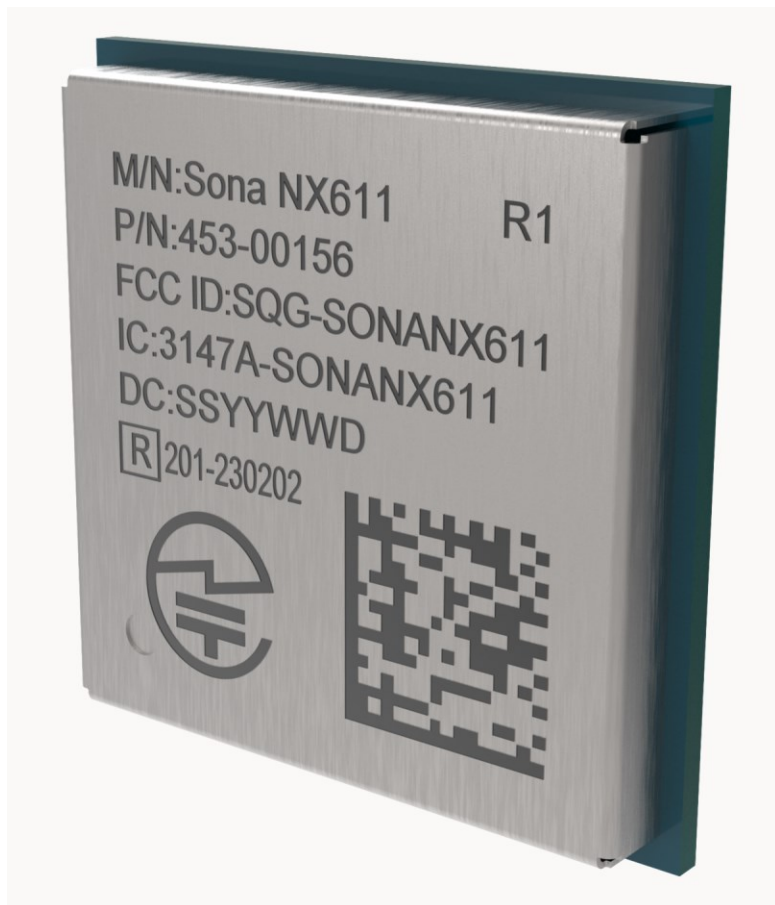


Figure 8: Top Side (453-00156 shown)

### 5.1.2 Mechanical Specifications Sona NX611 SIP Module

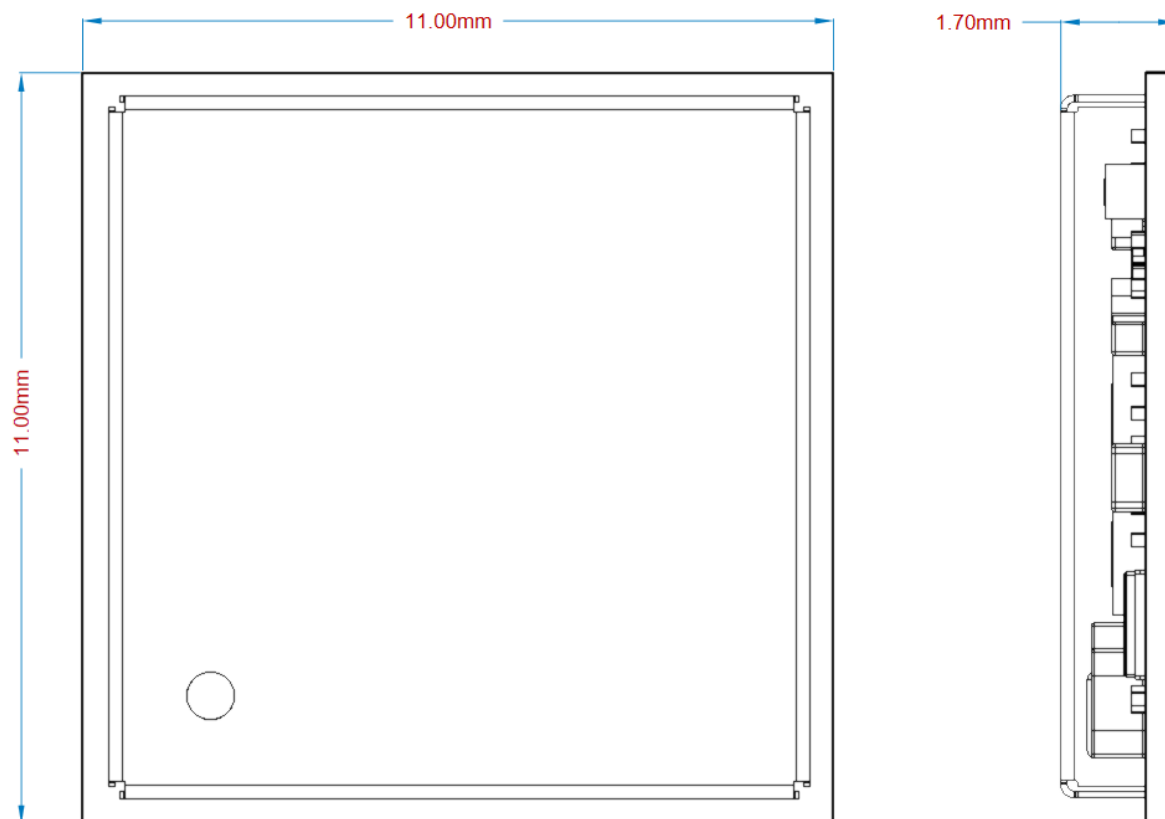


Figure 9: Sona SIP Module Dimensions

### 5.1.3 SIP PCB Footprint

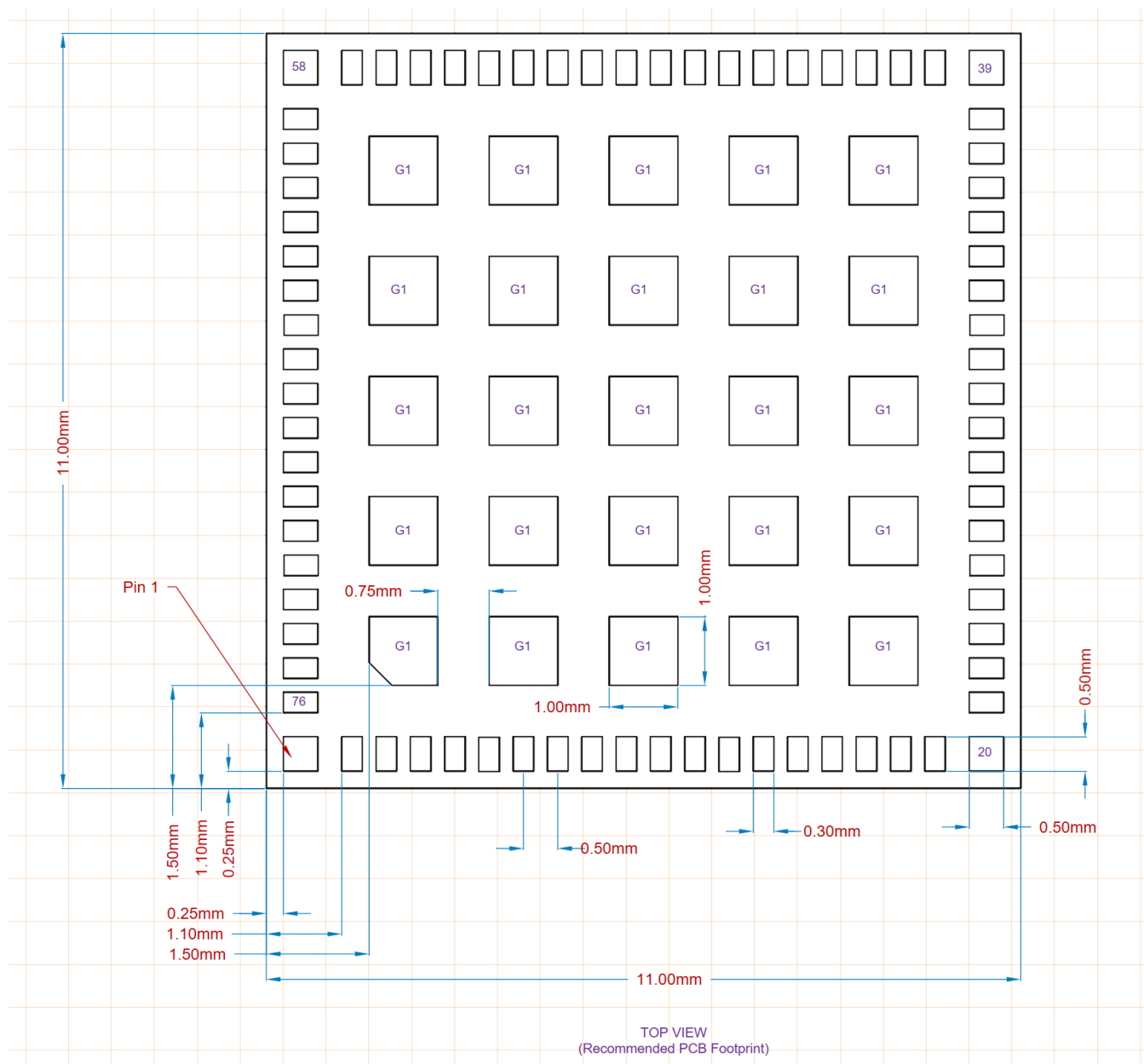


Figure 10: SIP PCB Footprint

## 5.2 Sona NX611 1216 Modules

### 5.2.1 Sona NX611 1216 2 Port



Figure 11: Sona 453-00157

### 5.2.2 Sona NX611 1216 1 Port



Figure 12: Sona 453-00158

5.2.3 Mechanical Specifications Sona NX611 M.2 1216 Module

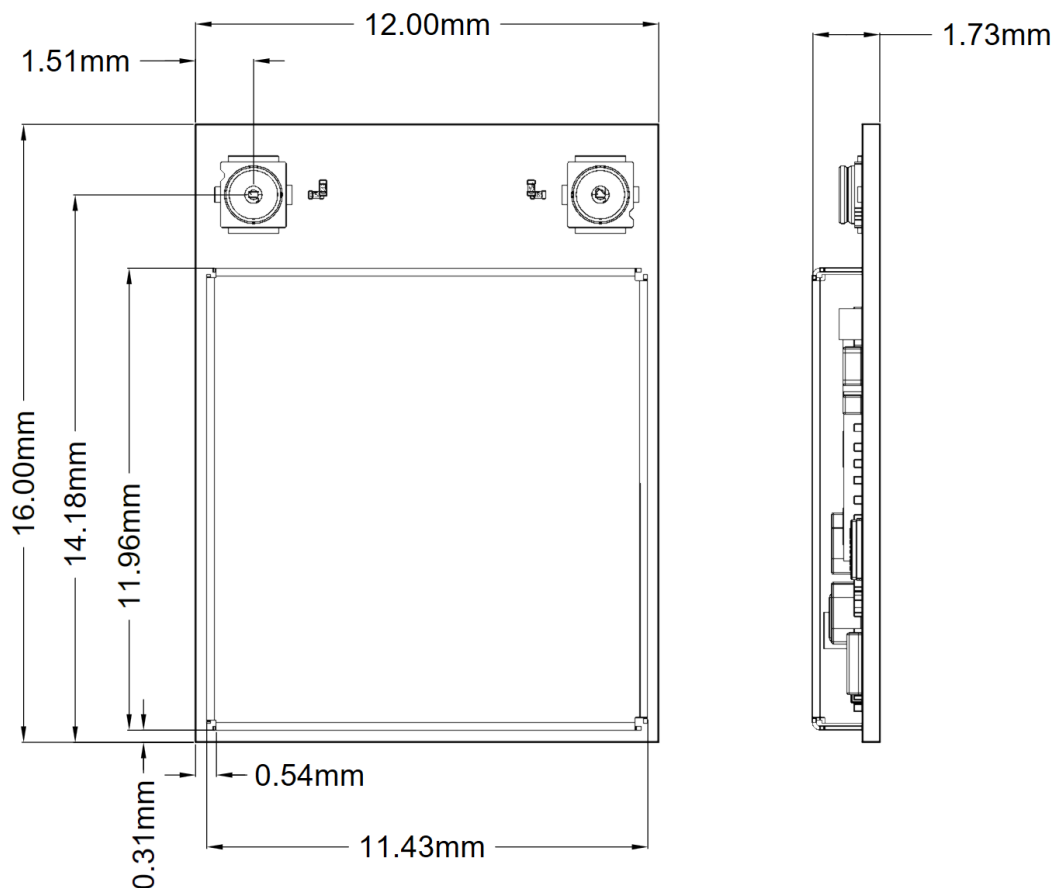


Figure 13: Sona M.2 1216 Module Dimensions

## 5.2.4 Sona 1216 PCB Footprint

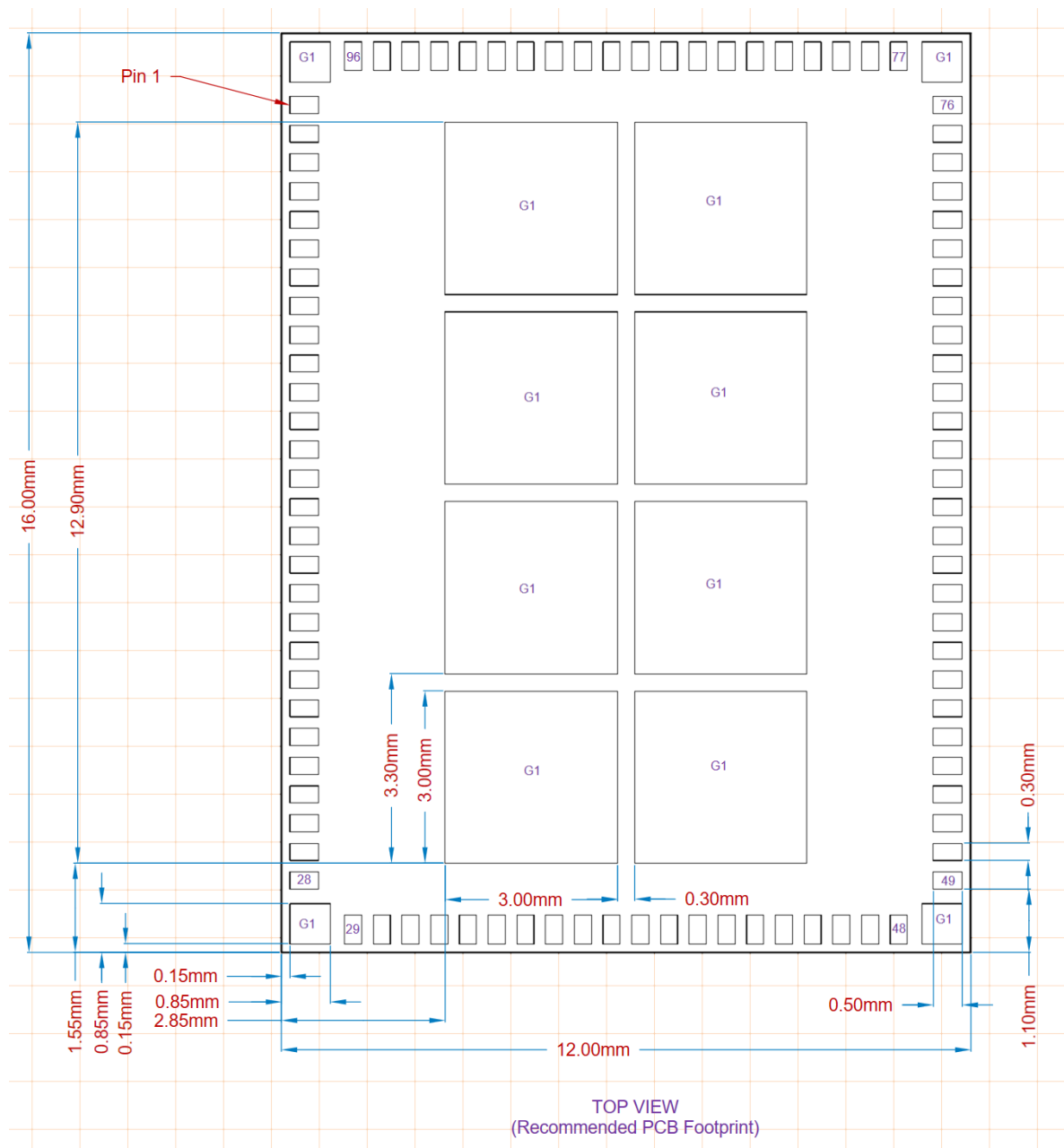


Figure 14: Sona M.2 1216 Footprint

## 5.3 Sona NX611 1218 Chip Antenna Module

### 5.3.1 Sona NX611 1218 Chip Antenna Module



Figure 15: Sona 453-00158

### 5.3.2 Mechanical Specifications Sona NX611 1218 Chip Antenna Module

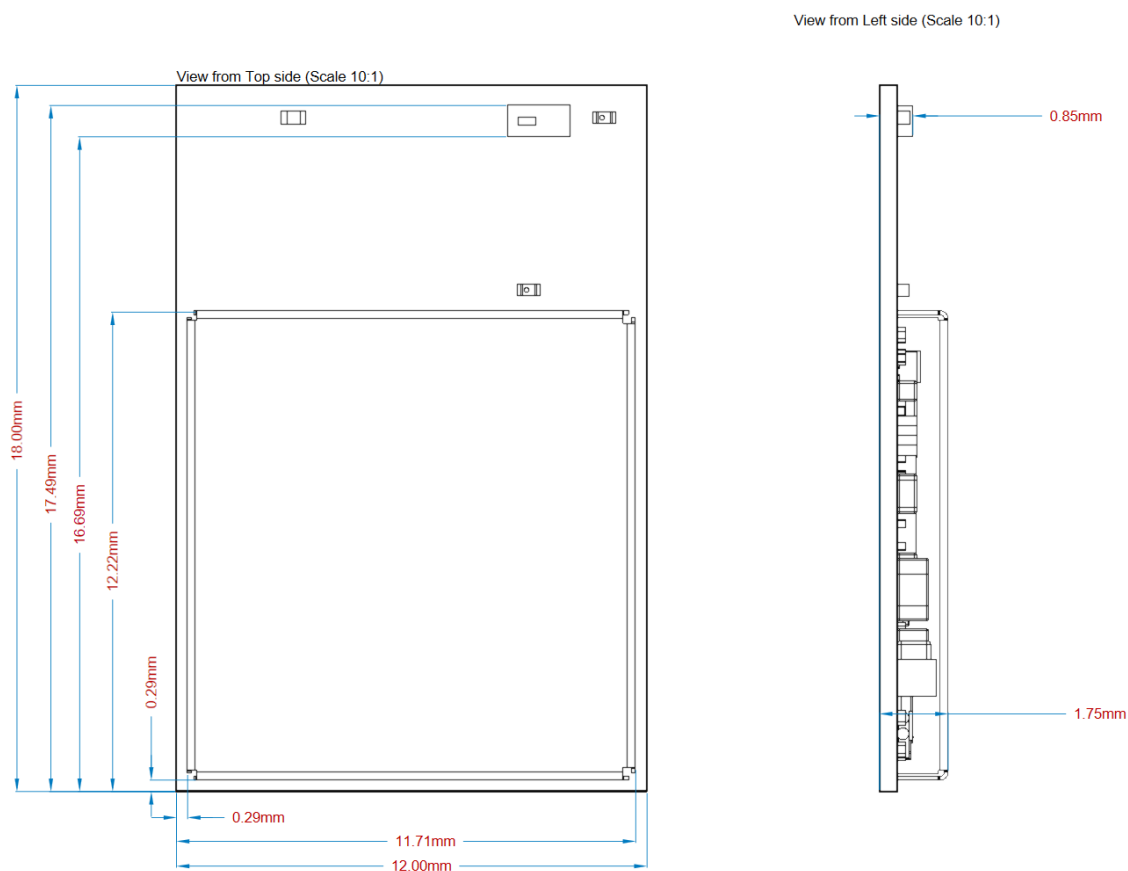


Figure 16: Sona 1218 Chip Antenna Module Dimensions

### 5.3.3 Mechanical Specifications Sona 1218 Chip Antenna Module

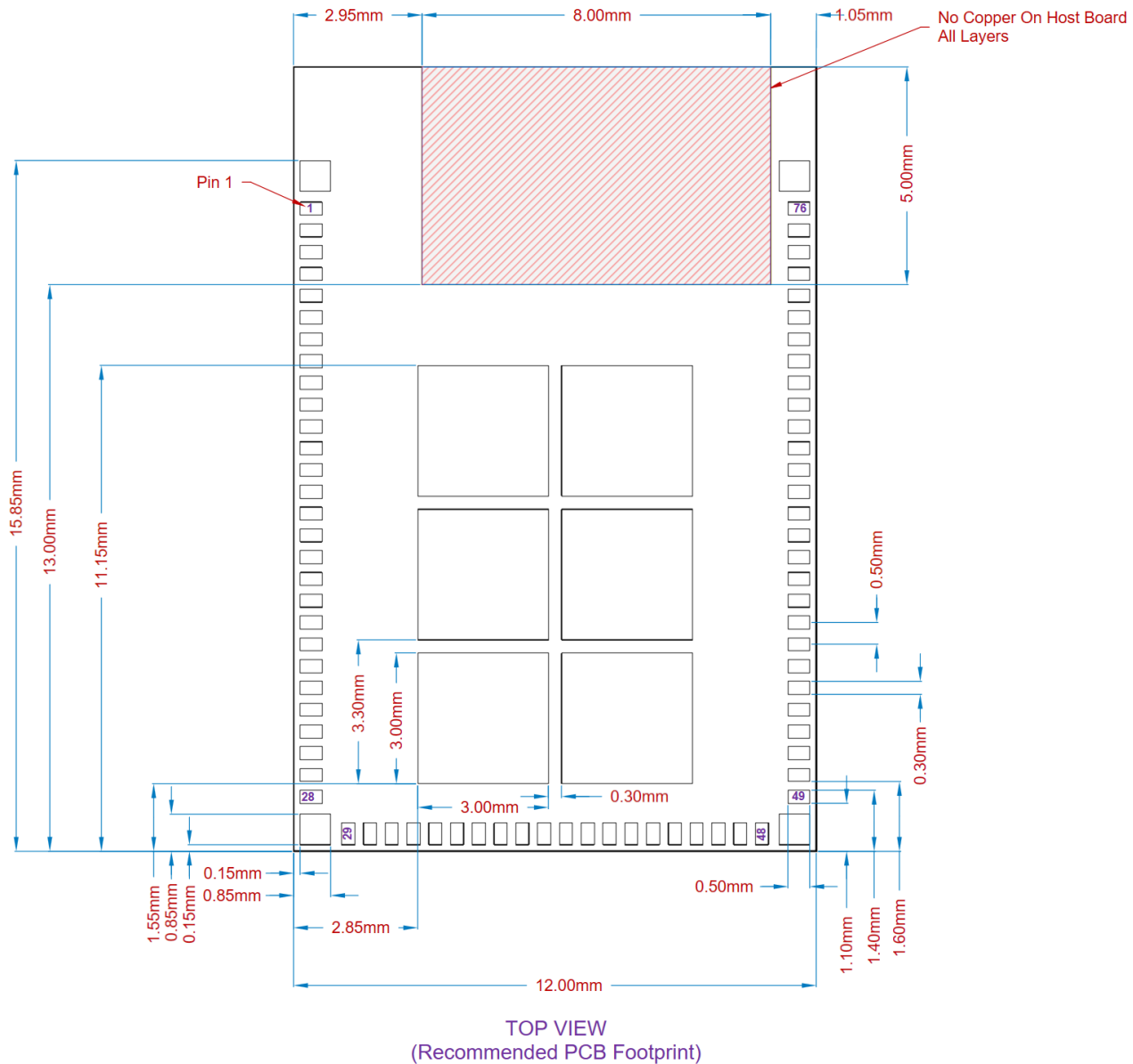


Figure 17: Sona 1218 Chip Antenna Footprint

## 5.4 Sona NX611 M.2 2230 Key E Module

### 5.4.1 Sona NX611 2230 1 Port



Figure 18: Top Side (453-00166 shown)

### 5.4.2 Sona NX611 2230 2 Port



Figure 19: Top Side (453-00165 shown)

### 5.4.3 M.2 2230 Pinout

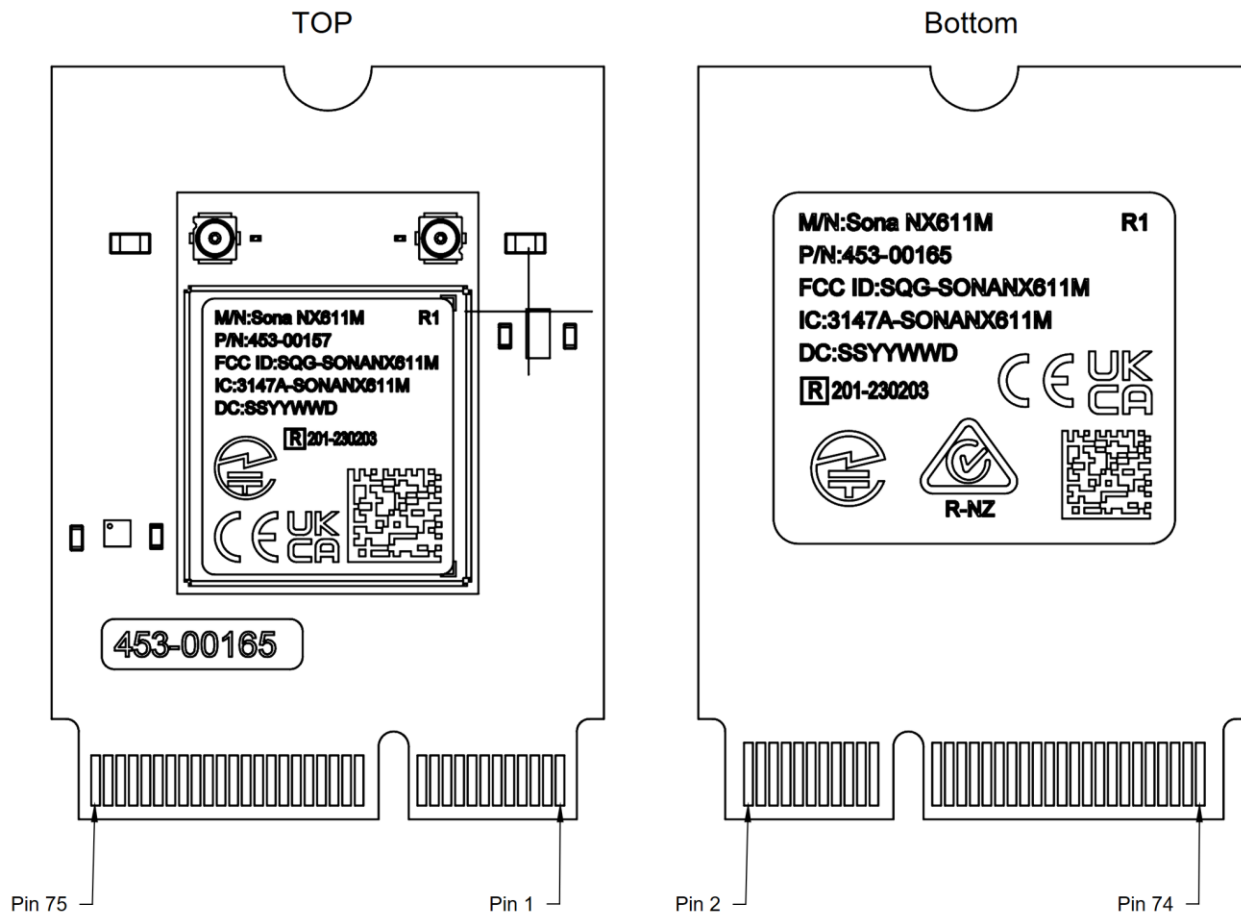


Figure 20: Sona M.2 2230 Module

#### 5.4.4 Mechanical Specifications Sona NX611 M.2 2230 Module

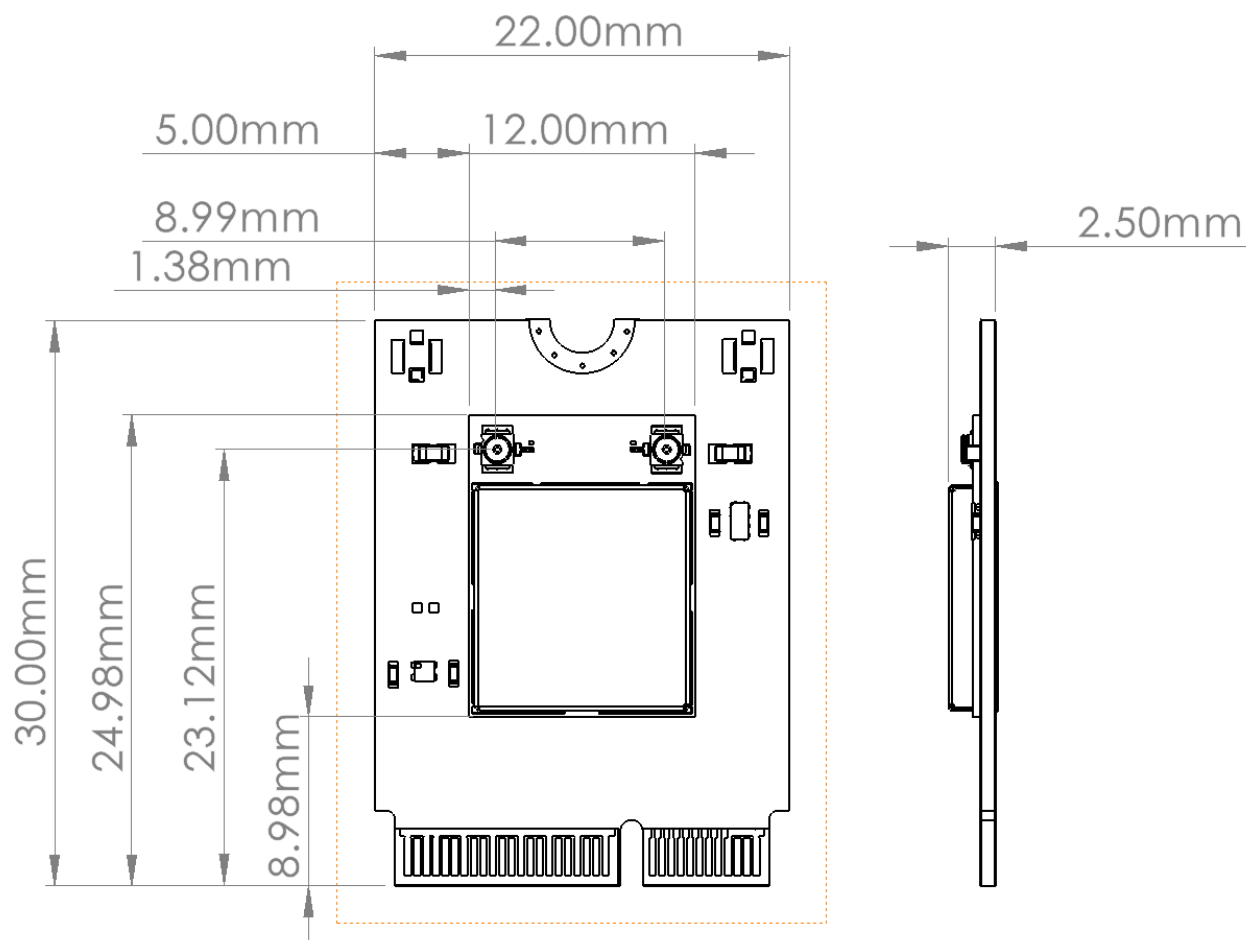


Figure 21: Sona M.2 2230 Module Dimensions

#### 5.4.5 M.2 2230 Key E Mounting

The Sona NX611 M.2 2230 Module connects to the host via a standard PCI EXPRESS M2 connector.

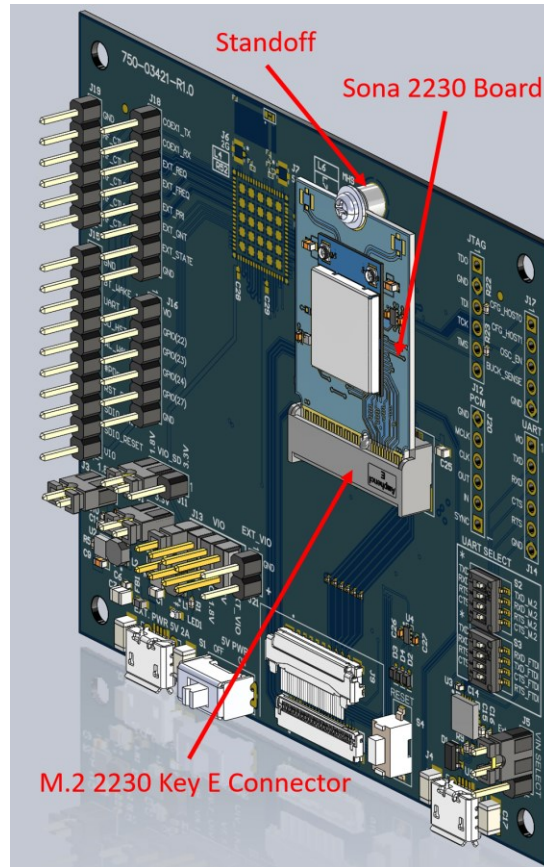


Figure 22: Sona NX611 Module Mounted to Dev Board

#### 5.4.6 Mounting Connectors and Standoffs

Table 5: M.2 2230 Key E Connectors and Standoffs

| M.2 Key-E Connector          | Connector Height | Stand-off                   |
|------------------------------|------------------|-----------------------------|
| KYOCERA 24-6411-067-101-894E | 2.3 mm           | EMI STOP F50M16-041525P1D4M |
| AMP MDT420E01001             | 2.5 mm           | Alink, N0254020A            |
| JAE SM3ZS067U310AERxxxx      | 3.1 mm           | JAE SM3ZS067U310-NUT1-Rxxxx |

## 6 Specifications

Table 6: SONA™NX61X Specifications

| Feature                 | Description                                                                                                                                                                                                       |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Physical Interface      | SIP- 76-pin LGA package (plus 25 thermal ground pads under the package)<br>1216- 96-pin LGA, Meets PCIe M.2 Type 1216-S3 Mechanical Outline<br>2230 Key E package Meets PCIe M.2 Type 2230 Key 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 or NX612                                                                                                                                                                                                |

|                                  |                                                                                                                                                                                                                                                               |
|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Voltage Requirements       | SIP- 76-pin LGA package<br>3.3V nominal 3.3V Typ, 3.14V Min, 3.46V Max<br>1.8V nominal 1.8V Typ, 1.71V Min, 1.89V Max<br>1216- 96-pin LGA<br>3.3V nominal 3.3V Typ, 3.14V Min, 3.46V Max<br>2230 Key E package<br>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) | MSL4 (SIP), MSL1 (M2)                                                                                                                                                                                                                                         |
| Maximum Electrostatic Discharge  | Conductive 4KV; Air coupled 8KV<br>(follow EN61000-4-2)                                                                                                                                                                                                       |
| Size – mm (in.)                  | SIP- 76-pin LGA package<br>Length: 11mm<br>Width: 11mm<br>Thickness: 1.7mm<br><br>1216- 96-pin LGA<br>Length: 16mm<br>Width: 12mm<br>Thickness: 1.72mm<br>2230 Key E package<br>Length: 30mm<br>Width: 22mm<br>Thickness: 2.8mm                               |
| Weight – g (oz.)                 | SIP- 76-pin LGA package<br>TBD<br>1216- 96-pin LGA<br>TBD<br>2230 Key E package<br>TBD                                                                                                                                                                        |
| Regulatory Certifications        | United States (FCC)<br>EU - Member countries of European Union (ETSI)<br>ISED (Canada)<br>Australia<br>New Zealand<br>Japan                                                                                                                                   |
| 2.4 GHz Frequency Bands          | EU: 2.4 GHz to 2.483 GHz<br>FCC/ISED: 2.4 GHz to 2.473 GHz<br>MIC: 2.4 GHz to 2.495 GHz<br>RCM: 2.4 GHz to 2.483 GHz                                                                                                                                          |
| 2.4 GHz Operating Channels       | EU: 13 (3 non-overlapping)                                                                                                                                                                                                                                    |

|                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| (Wi-Fi)                          | FCC/ISED: 11 (3 non-overlapping)<br>MIC: 14 (4 non-overlapping)<br>RCM: 13 (3 non-overlapping)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| 5 GHz Frequency Bands            | EU<br>5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64)<br>5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/132/136/140)<br>5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165)<br>FCC<br>5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64)<br>5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/132/136/140/144)<br>5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165)<br>ISED<br>5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64)<br>5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/132/136/140/144)<br>5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165)<br>MIC<br>5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64)<br>5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/132/136/140)<br>RCM<br>5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64)<br>5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/132/136/140)<br>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<br>ISED: 22 non-overlapping; MIC: 19 non-overlapping<br>RCM: 21 non-overlapping                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| Operating Systems Supported      | Linux<br>Android                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
| Compliance                       | <b>EU</b><br>EN 300 328                      EN 62368-1:2014<br>EN 301 489-1                      EN 300 440<br>EN 301 489-17                      2011/65/EU (RoHS)<br>EN 301 893<br><b>FCC</b><br>47 CFR FCC Part 15.247                      47 CFR FCC Part 2.1091<br>47 CFR FCC Part 15.407<br><b>ISED Canada</b><br>RSS-247<br><b>AS/NZS</b><br>AS/NZS 4268:2017                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| Certifications (Pending)         | Bluetooth® SIG Qualification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
| Warranty                         | One Year Warranty                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |

## 7 Wi-Fi Subsystem

### 7.1 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
- 802.11h DFS radar pulse detection
- 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

### 7.2 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

### 7.3 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

## 7.4 Wi-Fi radio

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

## 7.5 RF channels

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

Table 7: 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            | 5865 MHz        |

## 7.6 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

## 7.7 Transmit Beamforming (TxBF)

- 802.11ax/ac/n Explicit Beamform
  - Supports sounding feedback for up to 4x4 Beamformer

## 7.8 Wi-Fi host interface

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

## 8 Bluetooth Subsystem

The SONA™NX61X series wireless module includes a fully integrated Bluetooth baseband/radio.

### 8.1 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 (1/4-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

### 8.2 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<sup>1</sup>

<sup>1</sup> Bluetooth LE audio supported with external host running Low Complexity Communication codec (LC3) through HCI interface.

### 8.3 Bluetooth Host interface

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

### 8.4 Digital Audio interfaces

#### 8.4.1 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

#### 8.4.2 I2S/PCM interface signals

Table 8: 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_BCLK   | 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] |

#### 8.4.3 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).

## 9 Electrical Characteristics

### 9.1 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 9: Absolute maximum ratings**

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

### 9.2 Recommended Operating Conditions

**Table 10: 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   |

### 9.3 General DC Electrical Characteristics

Table 11 and Table 12 list the general DC electrical characteristics over recommended operating conditions (unless otherwise specified).

**Table 11: 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 12: 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    |

## 9.4 Sona NX611 SIP 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 SIP, 1 RF Trace Pin Part Number 453-00156-K1.

*Table 13: 25 MHz clock (4-bit mode).*

| Mode                                     | Conditions                   | 1.8V  | 3.3V  | Unit |
|------------------------------------------|------------------------------|-------|-------|------|
| <b>Power down</b>                        |                              |       |       |      |
| Power Down                               | -                            | 0.019 | 0.007 | mA   |
| <b>Sleep Mode</b>                        |                              |       |       |      |
| Bluetooth only in deep sleep mode        | -                            | TBD   | TBD   | 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   | -                            | TBD   | TBD   | mA   |
| <b>Bluetooth LE current consumption</b>  |                              |       |       |      |
| Bluetooth LE peak transmit [3]           | 1 Mbps @ 6 dBm               | 177   | .179  | mA   |
| Bluetooth LE peak receive [4] [5]        | 1 Mbps                       | TBD   | TBD   | mA   |
| <b>Bluetooth current consumption [2]</b> |                              |       |       |      |
| Bluetooth peak transmit [6]              | @ 6 dBm DH5                  | 167   | .116  | mA   |
| Bluetooth peak receive [4] [7]           | BDR , DH5                    | TBD   | TBD   | mA   |
| <b>2.4 GHz Wi-Fi receive [8]</b>         |                              |       |       |      |
| 2.4 GHz 802.11b 11 Mbps                  | —                            | 94    | 0.065 | mA   |
| 2.4 GHz 802.11g 54 Mbps                  | —                            | 102   | 0.065 | mA   |
| 2.4 GHz 802.11n 20 MHz MCS7              | —                            | 102   | 0.065 | mA   |
| 2.4 GHz 802.11n 40 MHz MCS7              | —                            | 117   | 0.065 | mA   |
| 2.4 GHz 802.11ax 20 MHz MCS11            | —                            | 105   | 0.065 | mA   |
| 2.4 GHz 802.11ax 40 MHz MCS11            | —                            | 119   | 0.065 | mA   |
| <b>5 GHz Wi-Fi receive [8]</b>           |                              |       |       |      |
| 5 GHz 802.11a 54 Mbps                    | —                            | 117   | 0.065 | mA   |
| 5 GHz 802.11n 20 MHz MCS7                | —                            | 117   | 0.065 | mA   |
| 5 GHz 802.11n 40 MHz MCS7                | —                            | 126   | 0.065 | mA   |
| 5 GHz 802.11ac 40 MHz MCS9               | —                            | 146   | 0.065 | mA   |
| 5 GHz 802.11ac 80 MHz MCS9               | —                            | 167   | 0.065 | mA   |
| 5 GHz 802.11ax 20 MHz MCS11              | —                            | 117   | 0.065 | mA   |
| 5 GHz 802.11ax 40 MHz MCS11              | —                            | 146   | 0.065 | mA   |
| 5 GHz 802.11ax 80 MHz MCS11              | —                            | 1     | 0.065 | mA   |
| <b>2.4 GHz Wi-Fi transmit [8]</b>        |                              |       |       |      |
| 2.4 GHz 802.11b 11 Mbps @ 18 dBm         | —                            | 149   | 220   | mA   |
| 2.4 GHz 802.11g 54 Mbps @ 16 dBm         | —                            | 160   | 178   | mA   |
| 2.4 GHz 802.11n 20 MHz MCS7 @ 15 dBm     | —                            | 159   | 163   | mA   |
| 2.4 GHz 802.11n 40 MHz MCS7 @ 15 dBm     | —                            | 163   | 156   | mA   |
| 2.4 GHz 802.11ax 20 MHz MCS11 @ 13 dBm   | —                            | 163   | 149   | mA   |

|                                           |   |     |     |    |
|-------------------------------------------|---|-----|-----|----|
| 2.4 GHz 802.11ax 40 MHz MCS11 @ 13 dBm    | — | 163 | 174 | mA |
| <b>5 GHz Wi-Fi transmit[8]</b>            |   |     |     |    |
| 5 GHz 802.11a 6 Mbps @ 16 dBm             | — | 226 | 261 | mA |
| 5 GHz 802.11a 54 Mbps @ 16 dBm            | — | 218 | 244 | mA |
| 5 GHz 802.11n 20 MHz MCS7 @ 14 dBm        | — | 213 | 201 | mA |
| 5 GHz 802.11n 40 MHz MCS7 @ 14 dBm        | — | 214 | 202 | mA |
| 5 GHz 802.11ac 20 MHz MCS8 @ 14 dBm       | — | 213 | 201 | mA |
| 5 GHz 802.11ac 40 MHz MCS9 @ 12 dBm       | — | 203 | 163 | mA |
| 5 GHz 802.11ac 80 MHz MCS9 @ 12 dBm       | — | 216 | 156 | mA |
| 5 GHz 802.11ax 20 MHz MCS11 @ 10 dBm      | — | 197 | 140 | mA |
| 5 GHz 802.11ax 40 MHz MCS11 @ 10 dBm      | — | 202 | 142 | mA |
| 5 GHz 802.11ax 80 MHz MCS11 @ 10 dBm      | — | 218 | 144 | mA |
| <b>Peak current</b>                       |   |     |     |    |
| Peak current during device initialization | — | 371 | 139 | 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

## 9.5 Sona NX611 1216/M.2 2230 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 14: 25 MHz clock (4-bit mode).**

| Mode                                     | Conditions                   | 1.8V_VIO | 3.3V | Unit |
|------------------------------------------|------------------------------|----------|------|------|
| <b>Power down</b>                        |                              |          |      |      |
| Power Down                               | -                            | 1.7      | .348 | mA   |
| <b>Sleep Mode</b>                        |                              |          |      |      |
| Bluetooth only in deep sleep mode        | -                            | TBD      | TBD  | mA   |
| Wi-Fi only in deep sleep mode            | SDIO 3.0 200 MHz VIO = 1.8 V | TBD      | TBD  | mA   |
| Wi-Fi and Bluetooth in deep sleep Mode   | -                            | TBD      | TBD  | mA   |
| <b>Bluetooth LE current consumption</b>  |                              |          |      |      |
| Bluetooth LE peak transmit [3]           | 1 Mbps @ 6 dBm               | 0.014    | 106  | mA   |
| Bluetooth LE peak receive[4][5]          | 1 Mbps                       | .009     | 75   | mA   |
| <b>Bluetooth current consumption [2]</b> |                              |          |      |      |
| Bluetooth peak transmit[6]               | @ 6 dBm DH5                  | .009     | 113  | mA   |
| Bluetooth peak receive[4][7]             | BDR, DH5                     | .009     | 75   | mA   |
| <b>2.4 GHz Wi-Fi receive[8]</b>          |                              |          |      |      |
| 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 |
| <b>5 GHz Wi-Fi receive[8]</b>             |   |      |      |    |
| 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 |
| <b>2.4 GHz Wi-Fi transmit[8]</b>          |   |      |      |    |
| 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 |
| <b>5 GHz Wi-Fi transmit[8]</b>            |   |      |      |    |
| 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 |
| 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 MHz MCS11 @ 10 dBm      | — | .009 | 262  | mA |
| <b>Peak current</b>                       |   |      |      |    |
| 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

## 10 RF Characteristics

### 10.1 WLAN Radio Receiver Characteristics

**Table 15: 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 | 2-Port | Unit |
|---------------------------------------------------------|---------------------------|--------|--------|------|
| 2.4 GHz 802.11b 1 Mbps                                  | 8% PER                    | -96.5  | -97.5  | dBm  |
| 2.4 GHz 802.11b 11 Mbps                                 | 8% PER                    | -88.0  | -89.0  | dBm  |
| 2.4 GHz 802.11g 6 Mbps                                  | 10% PER                   | -91.0  | -92.0  | dBm  |
| 2.4 GHz 802.11g 54 Mbps                                 | 10% PER                   | -74.5  | -75.5  | dBm  |
| 2.4 GHz 802.11n 20 MHz MCS0                             | 10% PER                   | -90.5  | -91.5  | dBm  |
| 2.4 GHz 802.11n 20 MHz MCS7                             | 10% PER                   | -71    | -72    | dBm  |
| 2.4 GHz 802.11n 40 MHz MCS0                             | 10% PER                   | -87.5  | -88.5  | dBm  |
| 2.4 GHz 802.11n 40 MHz MCS7                             | 10% PER                   | -68.5  | -69.5  | dBm  |
| 2.4 GHz 802.11ax 20 MHz MCS0                            | 10% PER                   | -91    | -92    | dBm  |
| 2.4 GHz 802.11ax 20 MHz MCS11                           | 10% PER                   | -61.5  | -62.5  | dBm  |
| 2.4 GHz 802.11ax 40 MHz MCS0                            | 10% PER                   | -87.5  | -88.5  | dBm  |
| 2.4 GHz 802.11ax 40 MHz MCS11                           | 10% PER                   | -59.5  | -60.5  | dBm  |
| 2.4 GHz Receiver maximum input level (MIL)              | Conditions                | 1-port | 2-port | Unit |
| Receiver maximum input level DSSS                       | 802.11b DSSS MIL          | 0      | 0      | dBm  |
| Receiver maximum input level CCK                        | 802.11b CCK MIL           | 0      | 0      | dBm  |
| Receiver maximum input level OFDM                       | OFDM MIL                  | -10    | -10    | dBm  |
| Receiver adjacent channel interference (ACI)            | Conditions                | 1-port | 2-port | Unit |
| Receiver ACI 802.11b                                    | 20 MHz 1 Mbps             | 53     | 53     | dB   |
| Receiver ACI 802.11b                                    | 20 MHz 11 Mbps            | 47.7   | 47.7   | dB   |
| Receiver ACI 802.11g                                    | 20 MHz 6 Mbps             | 30.3   | 30.3   | dB   |
| Receiver ACI 802.11g                                    | 20 MHz 54 Mbps            | 27.3   | 27.3   | dB   |
| Receiver ACI 802.11n                                    | 20 MHz MCS0 Nss1 BCC      | 41     | 41     | dB   |
| Receiver ACI 802.11n                                    | 20 MHz MCS7 Nss1 BCC      | 27.3   | 27.3   | dB   |
| Receiver ACI 802.11ax                                   | 20 MHz MCS0 Nss1 LDPC[1]  | 30.3   | 30.3   | dB   |
| Receiver ACI 802.11ax                                   | 20 MHz MCS11 Nss1 LDPC[1] | 7      | 7      | dB   |
| Receiver Alternate Adjacent channel interference (AACI) | Conditions                | 1-port | 2-port | Unit |
| Receiver AACI 802.11b                                   | 20 MHz 1 Mbps             | 53     | 53     | dB   |
| Receiver AACI 802.11b                                   | 20 MHz 11 Mbps            | 49     | 49     | dB   |
| Receiver AACI 802.11g                                   | 20 MHz 6 Mbps             | 49     | 49     | dB   |
| Receiver AACI 802.11g                                   | 20 MHz 54 Mbps            | 33.3   | 33.3   | dB   |
| Receiver AACI 802.11n                                   | 20 MHz MCS0 Nss1 BCC      | 49.7   | 49.7   | dB   |
| Receiver AACI 802.11n                                   | 20 MHz MCS7 Nss1 BCC      | 32.3   | 32.3   | dB   |
| Receiver AACI 802.11ax                                  | 20 MHz MCS0 Nss1 LDPC[1]  | 48.7   | 48.7   | dB   |
| Receiver AACI 802.11ax                                  | 20 MHz MCS11 Nss1 LDPC[1] | 23.3   | 23.3   | dB   |

**Table 16: 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- and 2-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- and 2-port | Unit |
| 5 GHz Receiver maximum input level OFDM      | OFDM MIL              | -10           | dBm  |
| Receiver adjacent channel interference (ACI) | Conditions            | 1- and 2-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- and 2-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   |

## 10.2 WLAN Transmitter Characteristics

**Table 17: 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 | 2-Port | Unit |
|-------------------------------|-------------------------------|--------|--------|------|
| 2.4 GHz 802.11b 1 Mbps        | -9.1 dB, EVM, Mask Compliance | 18     | 18     | dBm  |
| 2.4 GHz 802.11b 11 Mbps       | -9.1 dB, EVM, Mask Compliance | 18     | 18     | dBm  |
| 2.4 GHz 802.11g 6 Mbps        | - 5 dB, EVM, Mask Compliance  | 14     | 14     | dBm  |
| 2.4 GHz 802.11g 54 Mbps       | -25 dB, EVM, Mask Compliance  | 14     | 14     | dBm  |
| 2.4 GHz 802.11n 20 MHz MCS0   | - 5 dB, EVM, Mask Compliance  | 14     | 14     | dBm  |
| 2.4 GHz 802.11n 20 MHz MCS7   | -27 dB, EVM, Mask Compliance  | 14     | 14     | dBm  |
| 2.4 GHz 802.11n 40 MHz MCS0   | - 5 dB, EVM, Mask Compliance  | 12     | 12     | dBm  |
| 2.4 GHz 802.11n 40 MHz MCS7   | - 27 dB, EVM, Mask Compliance | 12     | 12     | dBm  |
| 2.4 GHz 802.11ax 20 MHz MCS0  | - 5 dB, EVM, Mask Compliance  | 13     | 13     | dBm  |
| 2.4 GHz 802.11ax 20 MHz MCS11 | - 35 dB, EVM, Mask Compliance | 13     | 13     | dBm  |
| 2.4 GHz 802.11ax 40 MHz MCS0  | - 5 dB, EVM, Mask Compliance  | 13     | 13     | dBm  |
| 2.4 GHz 802.11ax 40 MHz MCS11 | - 35 dB, EVM, Mask Compliance | 11     | 11     | dBm  |

**Table 18: 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- and 2-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  |

## 11 Bluetooth subsystem

### 11.1 Bluetooth/Bluetooth LE receiver performance

**Table 19: 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 |     | 2-Port | Unit |
| BDR 1 Mbps                                            | 0.1% BER, 1DH5                                  | -92    |     | -93    | dBm  |
| EDR 2 Mbps                                            | 0.01% BER, 2DH5                                 | -91    |     | -92    | dBm  |
| EDR 3 Mbps                                            | 0.01% BER, 3DH5                                 | -86    |     | -87    | dBm  |
| Bluetooth LE 1 Mbps                                   | 0.1% BER, 37 Packet Payload, TX Impairments [1] | -95.5  |     | -96.5  | dBm  |
| Bluetooth LE 2 Mbps                                   | 0.1% BER, 37 Packet Payload, TX Impairments [1] | -93    |     | -94    | dBm  |
| Bluetooth LR 500 Kbps                                 | 0.1% BER, 37 Packet Payload, TX Impairments [1] | -97    |     | -98    | dBm  |
| Bluetooth LR 125 Kbps                                 | 0.1% BER, 37 Packet Payload, TX Impairments [1] | -102   |     | -103   | dBm  |
| Receiver maximum input level (MIL)                    | Conditions                                      | 1-Port |     | 2-Port | Unit |
| BDR 1 Mbps                                            | [2]                                             | -2     |     | -3     | dBm  |
| EDR 2 Mbps                                            | [3]                                             | -5     |     | -6     | dBm  |
| EDR 3 Mbps                                            | [4]                                             | -5     |     | -6     | dBm  |
| Bluetooth LE 1 Mbps                                   | [5]                                             | -2     |     | -3     | dBm  |
| Bluetooth LE 2 Mbps                                   | [6]                                             | -2     |     | -3     | dBm  |
| Bluetooth LR 500 Kbps                                 | [7]                                             | -2     |     | -3     | dBm  |
| Bluetooth LR 125 Kbps                                 | [8]                                             | -2     |     | -3     | dBm  |
| Receiver Adjacent-/Co- Channel Interference (ACI/CCI) |                                                 |        |     |        |      |
| BDR 1 Mbps                                            |                                                 |        |     |        |      |
| Receiver ACI @ -5 MHz (image -1)                      | BDR 1 Mbps                                      | -38    |     | -38    | dB   |
| Receiver ACI @ -4 MHz (image)                         | BDR 1 Mbps                                      | -26    |     | -26    | dB   |
| Receiver ACI @ -3 MHz (image +1)                      | BDR 1 Mbps                                      | -41    |     | -41    | dB   |
| Receiver ACI @ -2 MHz                                 | BDR 1 Mbps                                      | -46    |     | -46    | dB   |
| Receiver ACI @ -1 MHz                                 | BDR 1 Mbps                                      | -9     |     | -9     | dB   |
| Receiver CCI                                          | BDR 1 Mbps                                      | 11     |     | 11     | dB   |
| Receiver ACI @ +1 MHz                                 | BDR 1 Mbps                                      | -11    |     | -11    | dB   |
| Receiver ACI @ +2 MHz                                 | BDR 1 Mbps                                      | -49    |     | -49    | dB   |
| Receiver ACI @ +3 MHz                                 | BDR 1 Mbps                                      | -52    |     | -52    | dB   |
| BDR 2 Mbps                                            |                                                 |        |     |        |      |
| Receiver ACI @ -5 MHz (image -1)                      | BDR 2 Mbps                                      | -42    |     | -42    | dB   |
| Receiver ACI @ -4 MHz (image)                         | BDR 2 Mbps                                      | -28    |     | -28    | dB   |
| Receiver ACI @ -3 MHz (image +1)                      | BDR 2 Mbps                                      | -41    |     | -41    | dB   |
| Receiver ACI @ -2 MHz                                 | BDR 2 Mbps                                      | -46    |     | -46    | dB   |
| Receiver ACI @ -1 MHz                                 | BDR 2 Mbps                                      | -9     |     | -9     | dB   |
| Receiver CCI                                          | BDR 2 Mbps                                      | 10     |     | 10     | dB   |
| Receiver ACI @ +1 MHz                                 | BDR 2 Mbps                                      | -11    |     | -11    | dB   |
| Receiver ACI @ +2 MHz                                 | BDR 2 Mbps                                      | -49    |     | -49    | dB   |
| Receiver ACI @ +3 MHz                                 | BDR 2 Mbps                                      | -52    |     | -52    | dB   |

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

|                       |                       |     |     |    |
|-----------------------|-----------------------|-----|-----|----|
| Receiver ACI @ 1 Mbps | Bluetooth LR 125 kbps | -12 | -12 | dB |
| Receiver ACI @ 2 Mbps | Bluetooth LR 125 kbps | -55 | -55 | dB |
| Receiver ACI @ 3 Mbps | Bluetooth LR 125 kbps | -60 | -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

## 11.2 Bluetooth/Bluetooth LE Transmitter performance

**Table 20: 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 | 2-Port | Unit   |      |
| BDR 1 Mbps            | Mask Compliant         | 5      | 6      | dBm    |      |
| EDR 2 Mbps            | Mask and EVM Compliant | 2      | 3      | dBm    |      |
| EDR 3 Mbps            | Mask and EVM Compliant | 2      | 3      | dBm    |      |
| Bluetooth LE 1 Mbps   | -                      | 5      | 6      | dBm    |      |
| Mask Compliant        | -                      | 5      | 6      | dBm    |      |
| Bluetooth LR 500 Kbps | -                      | 5      | 6      | dBm    |      |
| Bluetooth LR 125 Kbps | -                      | 5      | 6      | dBm    |      |

## 12 Host Interface Specifications

### 12.1 SDIO Specifications

The SONA™NX61X 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.

#### 12.1.1 Default Speed, High-Speed Modes

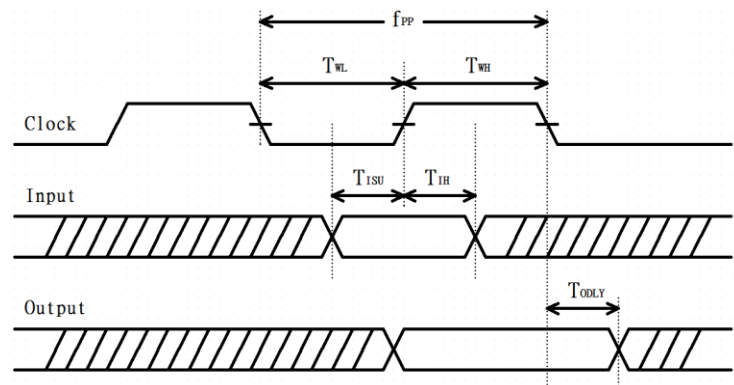


Figure 23: SDIO protocol timing diagram--- default mode (3.3V)

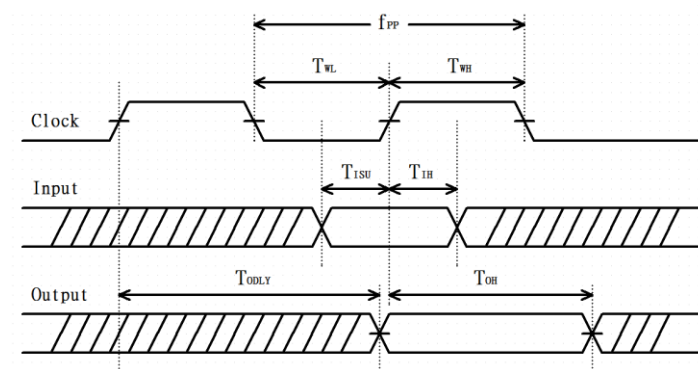


Figure 24: SDIO protocol timing diagram--- High-Speed mode (3.3V)

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

Table 21: SDIO timing requirements

| Symbol            | Parameter          | Condition     | Min. | Typ. | Max. | Unit |
|-------------------|--------------------|---------------|------|------|------|------|
| f <sub>PP</sub>   | Clock Frequency    | Default Speed | 0    | -    | 25   | MHz  |
|                   |                    | High-Speed    | 0    | -    | 50   |      |
| T <sub>WL</sub>   | Clock low time     | Default Speed | 10   | -    | -    | ns   |
|                   |                    | High-Speed    | 7    | -    | -    |      |
| T <sub>WH</sub>   | Clock high time    | Default Speed | 10   | -    | -    | ns   |
|                   |                    | High-Speed    | 7    | -    | -    |      |
| T <sub>ISU</sub>  | Input Setup time   | Default Speed | 5    | -    | -    | ns   |
|                   |                    | High-Speed    | 6    | -    | -    |      |
| T <sub>IH</sub>   | Input Hold time    | Default Speed | 5    | -    | -    | ns   |
|                   |                    | High-Speed    | 2    | -    | -    |      |
| T <sub>ODLY</sub> | Output delay time  | Default Speed | -    | -    | 14   | ns   |
|                   | CL ≤ 40pF (1 card) | High-Speed    | -    | -    | 14   |      |
| T <sub>OH</sub>   | Output hold time   | High-Speed    | 2.5  | -    | -    | ns   |

### 12.1.2 SDR12, SDR25, SDR50 Mode (up to 100 MHz) (1.8V)

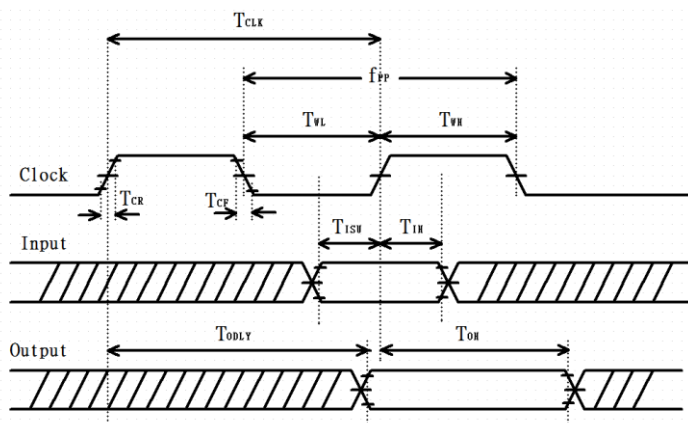


Figure 25: SDIO protocol timing diagram--- SDR12, SDR25, SDR50 modes (up to 100 MHz) (1.8V)

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

Table 22: SDIO timing requirements--- SDR12, SDR25, SDR50 modes (up to 100 MHz) (1.8V)

| Symbol                            | Parameter                                                                                       | Condition   | Min. | Typ. | Max.                 | Unit |
|-----------------------------------|-------------------------------------------------------------------------------------------------|-------------|------|------|----------------------|------|
| f <sub>PP</sub>                   | Clock Frequency                                                                                 | SDR12/25/50 | 25   | -    | 100                  | MHz  |
| T <sub>ISU</sub>                  | Input setup time                                                                                | SDR12/25/50 | 3    | --   | -                    | ns   |
| T <sub>IH</sub>                   | Input Hold time                                                                                 | SDR12/25/50 | 0.8  | -    | -                    | ns   |
| T <sub>CLK</sub>                  | Clock Time                                                                                      | SDR12/25/50 | 10   | -    | 40                   | ns   |
| T <sub>CR</sub> , T <sub>CF</sub> | Raise time, Fall time<br>T <sub>CR</sub> , T <sub>CF</sub> < 2ns (max) at 100 MHz<br>CCARD=10pF | SDR12/25/50 | -    | -    | 0.2*T <sub>CLK</sub> | ns   |
| T <sub>ODLY</sub>                 | Output delay time<br>CL ≤ 30pF                                                                  | SDR12/25/50 | -    | -    | 7.5                  | ns   |
| T <sub>OH</sub>                   | Output hold time<br>CL=15pF                                                                     | SDR12/25/50 | 1.5  | -    | -                    | ns   |

### 12.1.3 SDR104 Mode (208 MHz) (1.8V)

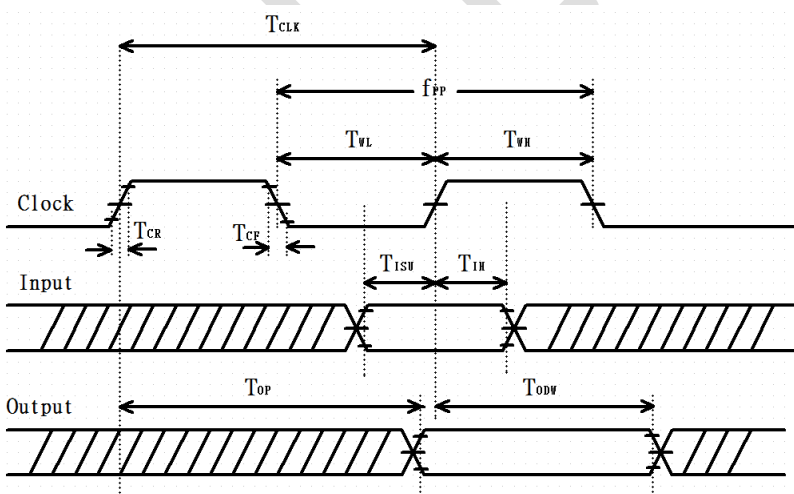


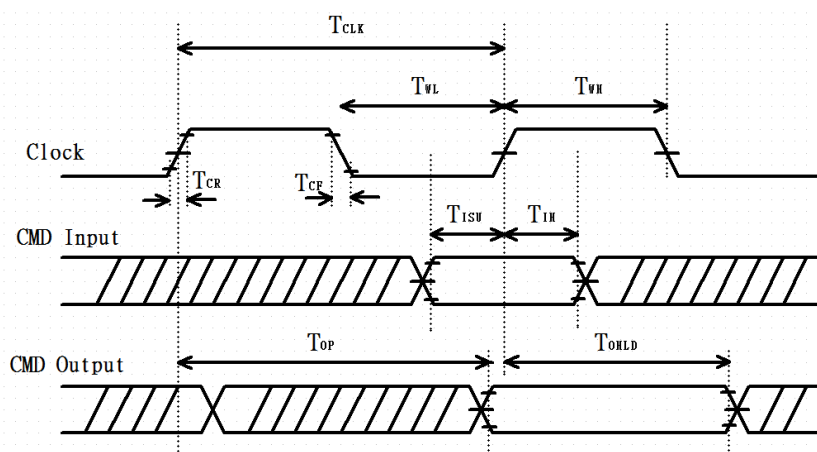
Figure 26: SDIO protocol timing diagram--- SDR104 modes (up to 208 MHz) (1.8V)

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

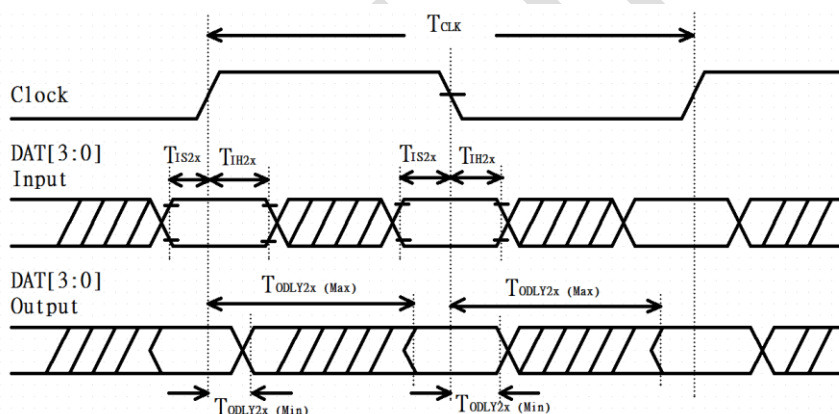
**Table 23: SDIO timing requirements -- SDR104 modes (up to 208MHz) (1.8V)**

| 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<br>TCR, TCF < 0.96ns (max) at 208 MHz<br>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   |

#### 12.1.4 DDR50 Mode (50 MHz) (1.8V)



**Figure 27: SDIO CMD timing diagram--- DDR50 modes (50 MHz) (1.8V)**



**Figure 28: 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 24: SDIO timing requirements – DDR50 modes (50 MHz)

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

Table 25: SDIO internal pull-up/pull-down specifications

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

## 12.2 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.

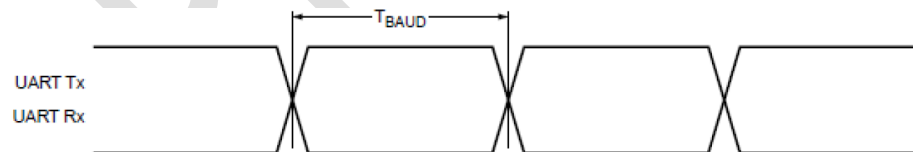


Figure 29: UART timing diagram

Table 26: PCM timing specification – master mode

| Symbol            | Parameter | Condition         | Min. | Typ. | Max. | Unit |
|-------------------|-----------|-------------------|------|------|------|------|
| T <sub>BAUD</sub> | Baud rate | 26MHz input clock | 250  | --   | --   | ns   |

## 12.3 PCM Interface Specifications

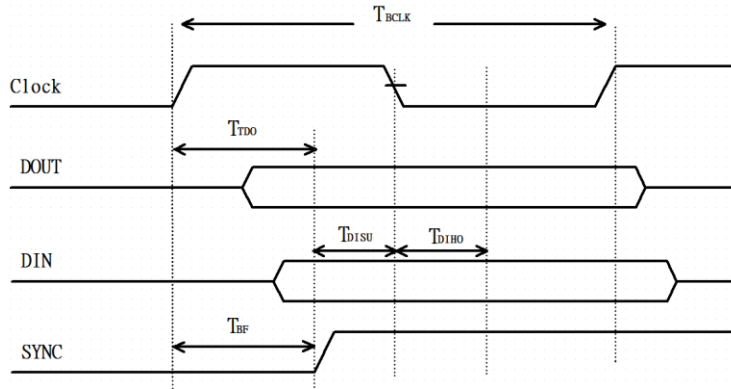


Figure 30: PCM timing specification - master mode

Table 27: PCM timing specification - master mode

| Symbol                      | Parameter | Min. | Typ.    | Max. | Unit |
|-----------------------------|-----------|------|---------|------|------|
| FBCLK                       | -         | -    | 2/2.048 | -    | MHz  |
| Duty Cycle <sub>BCLK</sub>  | -         | 0.4  | 0.5     | 0.6  | -    |
| T <sub>BCLK</sub> rise/fall | -         | -    | 3       | -    | ns   |
| T <sub>DO</sub>             | -         | -    | -       | 15   | ns   |
| T <sub>DISU</sub>           | -         | 20   | -       | -    | ns   |
| T <sub>DIHO</sub>           | -         | 15   | -       | -    | ns   |
| T <sub>BF</sub>             | -         | -    | -       | 15   | ns   |

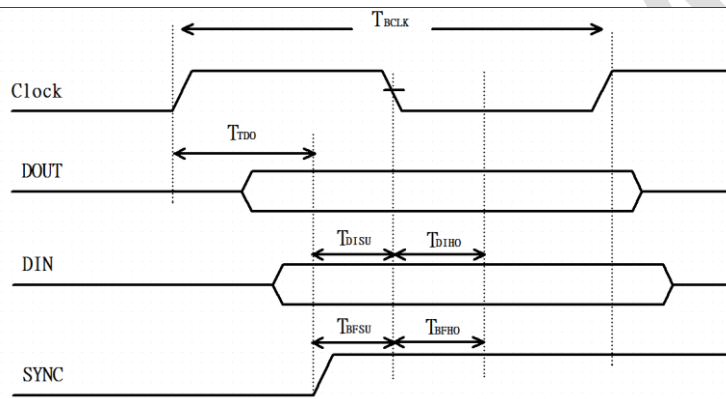


Figure 31: PCM timing specification - slave mode

Table 28: PCM timing specification - slave mode

| Symbol                      | Parameter | Min. | Typ.    | Max. | Unit |
|-----------------------------|-----------|------|---------|------|------|
| FBCLK                       | -         | -    | 2/2.048 | -    | MHz  |
| Duty Cycle <sub>BCLK</sub>  | -         | 0.4  | 0.5     | 0.6  | -    |
| T <sub>BCLK</sub> rise/fall | -         | -    | 3       | -    | ns   |
| T <sub>DO</sub>             | -         | -    | -       | 30   | ns   |
| T <sub>DISU</sub>           | -         | 15   | -       | -    | ns   |
| T <sub>DIHO</sub>           | -         | 10   | -       | -    | ns   |
| T <sub>BFSU</sub>           | -         | 15   | -       | -    | ns   |
| T <sub>BFHO</sub>           | -         | 10   | -       | -    | ns   |



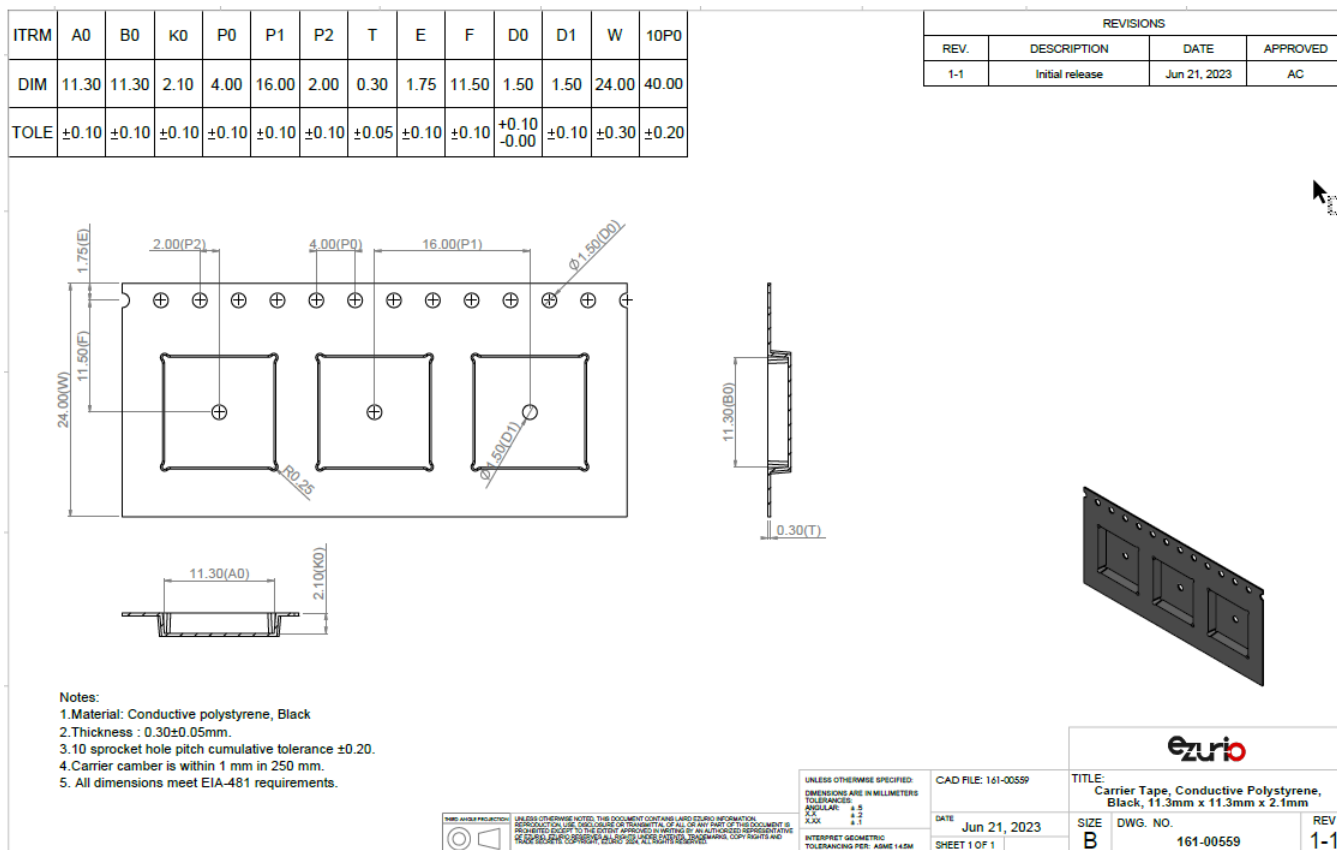
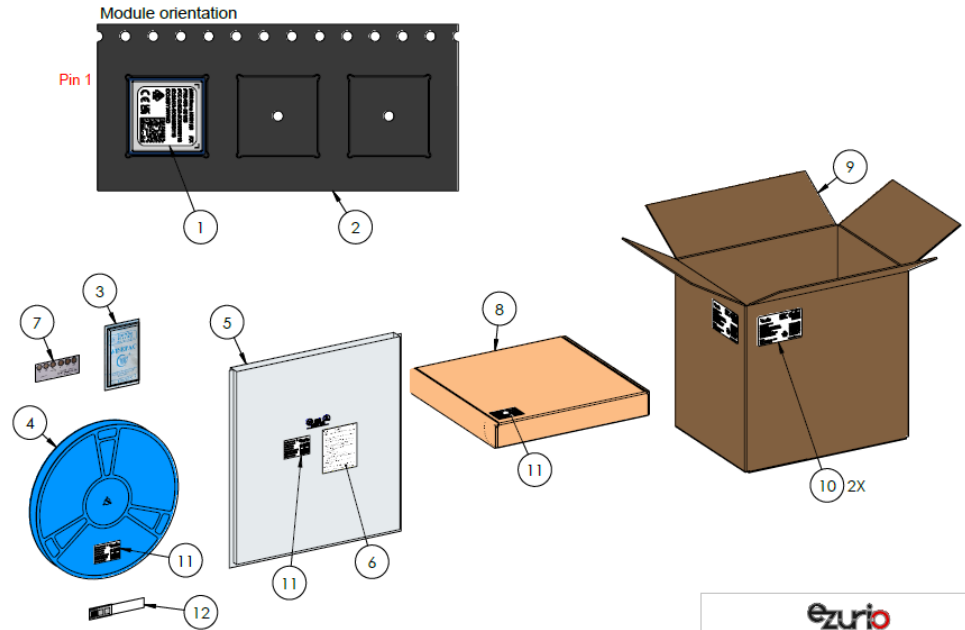


Figure 33: Tape specifications (Sona NX611 SIP)

There are 1,000 SONA™NX61X SIP 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   | 453-00155   | 1-1  | Module, Sona NX611 SIP, 2 RF Trace Pin                                     | 1000 |
| 2   | 161-00559   | 1-1  | Carrier Tape, Conductive Polystyrene, Black, 11.3mm x 11.3mm x 2.1mm       | 1    |
| 3   | 161-00282   | 1-1  | Desiccant, Silica Gel, 60g, 140mm x 80mm                                   | 1    |
| 4   | 161-00494   | 1-1  | Reel, 13inch Rotating Type, Blue, 330mm x 100mm x 24mm                     | 1    |
| 5   | 161-00389   | 1-1  | Bag, ESD and Moisture Barrier, Silver, 400mm x 430mm x 0.14mm              | 1    |
| 6   | 160-01816   | 1-1  | Label, Blank Moisture Sensitivity Level, 95mm x 80mm                       | 1    |
| 7   | 161-00281   | 1-1  | Humidity Indicator Card, Minimum 60% RH, Six Spot Indication, 58mm x 102mm | 1    |
| 8   | 161-00391   | 1-1  | Box, Single-Wall Corrugated B Flute, 355mm x 338mm x 50mm                  | 1    |
| 9   | 161-00392   | 1-1  | Carton, Double-Wall Corrugated AB Flute, 375mm x 285mm x 360mm             | 1    |
| 10  | 160-00036   | 1-0  | Label, Standard Shipping Box, CE Mark, Pictogram, LKCA, PCM, 4in x 2.5in   | 2    |
| 11  | 160-00007   | 1-0  | Label, Product Identifier, NX611 Series, 60mm x 40mm                       | 3    |
| 12  | 161-00561   | 1-1  | Cover Tape, Anti-static Polyester, 21.5mm x 0.05mm                         | 1    |

| REVISIONS |                 |              |            |
|-----------|-----------------|--------------|------------|
| REV.      | REVISION NOTE   | RELEASE DATE | REVISED BY |
| 1-0       | Initial release | Dec 26, 2023 | 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 than 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: 5000PCS



UNLESS OTHERWISE NOTED, THIS DOCUMENT CONTAINS LATENT EZURIO INFORMATION. REPRODUCTION, USE, DISCLOSURE OR TRANSMISSION OF ALL OR ANY PART OF THIS DOCUMENT IS PROHIBITED WITHOUT THE WRITTEN APPROVAL OF EZURIO. EZURIO ACCEPTS NO LIABILITY FOR ANY LOSS OR DAMAGE, INCLUDING BUT NOT LIMITED TO, DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, ARISING OUT OF OR IN CONNECTION WITH THE USE OF THIS DOCUMENT. TRADE SECRET/PROPRIETARY: EZURIO 2024. ALL RIGHTS RESERVED.

UNLESS OTHERWISE SPECIFIED:  
 DIMENSIONS ARE IN MILLIMETERS  
 TOLERANCES:  
 ANGULAR: ± 0.5  
 LINEAR: ± 0.1  
 HOLE: ± 0.1  
 INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

CAD FILE: 453-00155R  
 DATE  
 SHEET 1 OF 1

|                                                                        |                               |                   |
|------------------------------------------------------------------------|-------------------------------|-------------------|
|                                                                        |                               |                   |
| <b>TITLE:</b><br>Module, Sona NX611 SIP, 2 RF Trace Pin, Tape and Reel |                               |                   |
| <b>SIZE</b><br>B                                                       | <b>DWG. NO.</b><br>453-00155R | <b>REV</b><br>1-0 |

Figure 34: Sona™NX611 SIP module packaging process, 453-00155R

## Module orientation

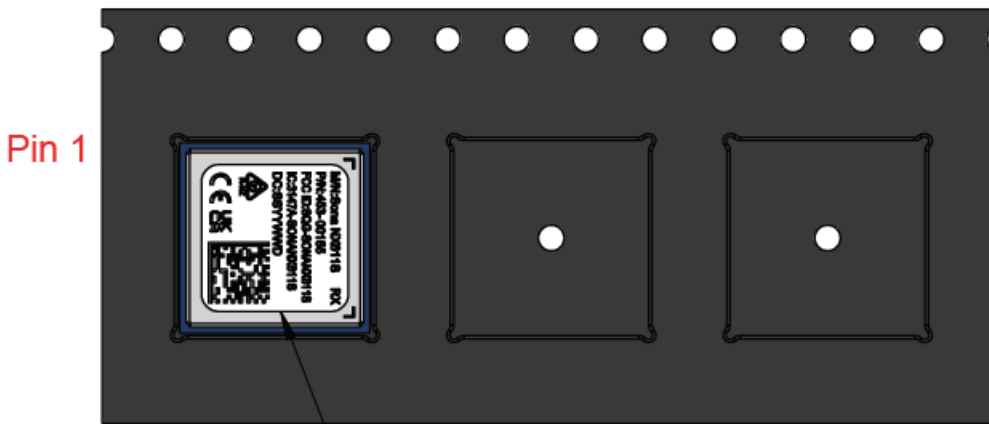


Figure 35: Sona NX611 SIP Module Orientation in Carrier Tape Pocket



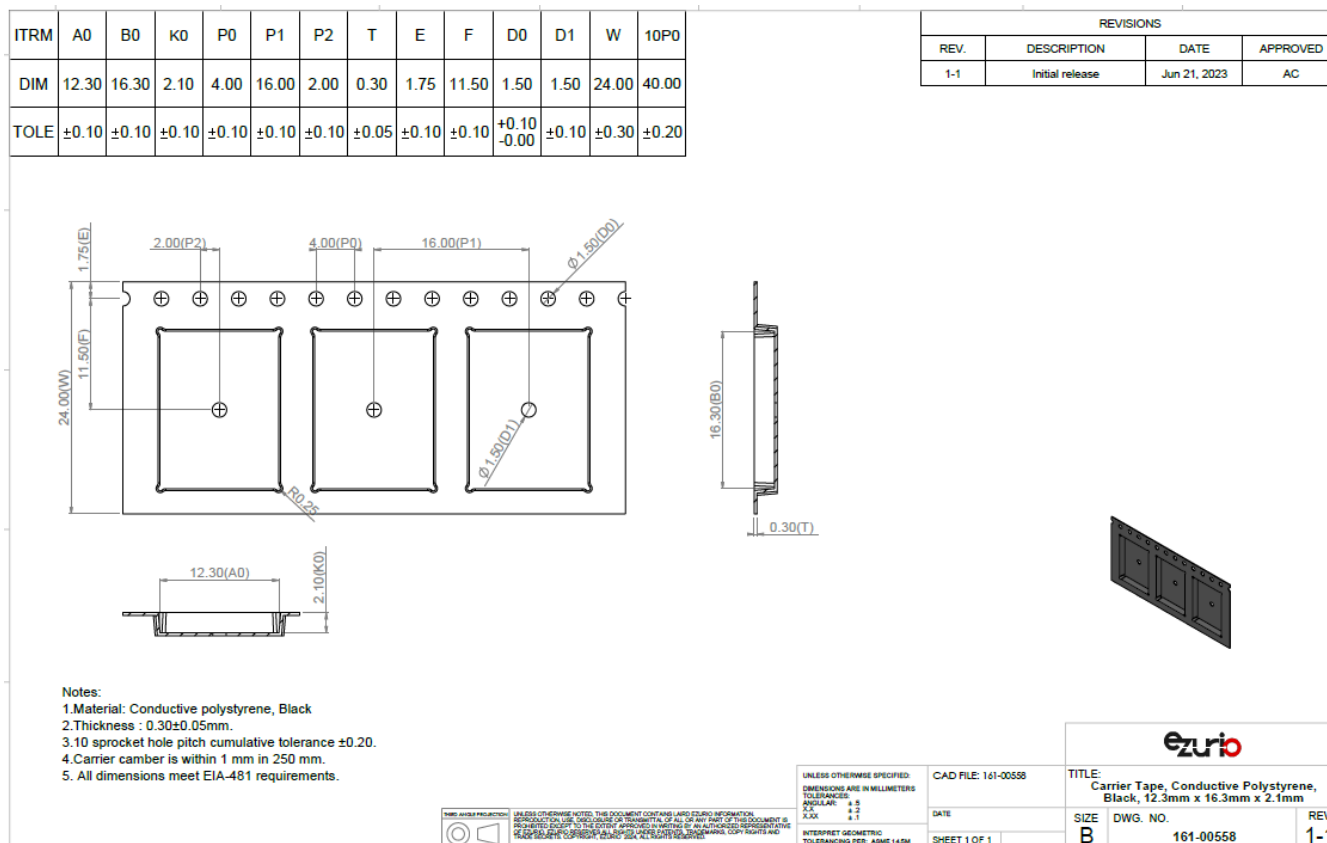
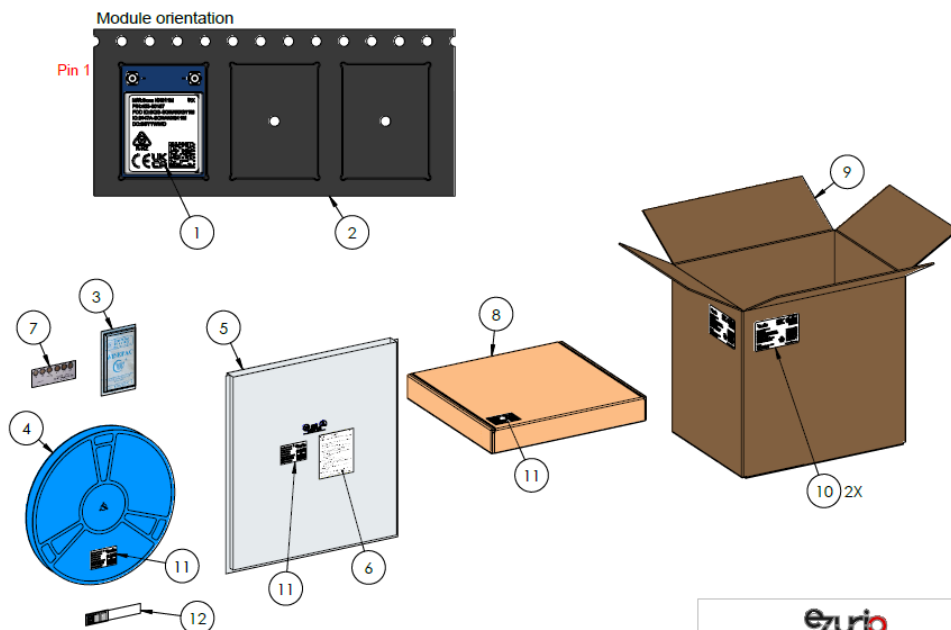


Figure 37: Tape specifications (Sona NX611 1216)

There are 1,000 SONA™NX61X 1216 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   | 453-00157   | 1-2  | Module, Sona NX611 M.2 1216, 2 MHF4                                        | 1000 |
| 2   | 161-00558   | 1-1  | Carrier Tape, Conductive Polyethylene, Black, 12.3mm x 16.3mm x 2.1mm      | 1    |
| 3   | 161-00282   | 1-1  | Desiccant, Silica Gel, 60g, 140mm x 80mm                                   | 1    |
| 4   | 161-00494   | 1-1  | Reel, 13inch Rotating Type, Blue, 330mm x 100mm x 24mm                     | 1    |
| 5   | 161-00389   | 1-1  | Bag, ESD and Moisture Barrier, Silver, 400mm x 430mm x 0.14mm              | 1    |
| 6   | 160-01816   | 1-1  | Label, Blank Moisture Sensitivity Level, 95mm x 80mm                       | 1    |
| 7   | 161-00281   | 1-1  | Humidity Indicator Card, Minimum 80% RH, Six Spot Indication, 38mm x 102mm | 1    |
| 8   | 161-00391   | 1-1  | Box, Single-Wall Corrugated B Flute, 355mm x 338mm x 50mm                  | 1    |
| 9   | 161-00392   | 1-1  | Carton, Double-Wall Corrugated AB Flute, 375mm x 355mm x 360mm             | 1    |
| 10  | 160-00036   | 1-0  | Label, Standard Shipping Box, CE Mark, Pictogram, UK/CA, RCM, 4in x 2.5in  | 2    |
| 11  | 160-00007   | 1-0  | Label, Product Identifier, NX611 Series, 60mm x 40mm                       | 3    |
| 12  | 161-00561   | 1-1  | Cover Tape, Anti-static Polyester, 21.5mm x 0.05mm                         | 1    |

| REVISIONS |                 |              |            |
|-----------|-----------------|--------------|------------|
| REV.      | REVISION NOTE   | RELEASE DATE | REVISED BY |
| 1-0       | Initial release | Dec 26, 2023 | 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 than 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: 5000PCS



UNLESS OTHERWISE NOTED, THIS DOCUMENT CONTAINS LAYO ESD INFORMATION.  
 REPRODUCTION, USE, OR TRANSMISSION OF ALL OR ANY PART OF THIS DOCUMENT,  
 WITHOUT THE WRITTEN PERMISSION OF EZURIO, IS PROHIBITED. ALL RIGHTS ARE RESERVED.  
 TRADE MARKS, COPYRIGHT, DESIGN AND ALL RIGHTS RESERVED.

UNLESS OTHERWISE SPECIFIED:  
 DIMENSIONS ARE IN MILLIMETERS  
 TOLERANCES:  
 ANGULAR: ± 5  
 X.X: ± 0.2  
 X.XX: ± 0.1  
 INTERPRET GEOMETRIC  
 TOLERANCING PER: ASME Y14.5M

CAD FILE: 453-00157R  
 DATE  
 SHEET 1 OF 1

| ezurio                                                    |                     |         |  |
|-----------------------------------------------------------|---------------------|---------|--|
| TITLE: Module, Sona NX611 M.2 1216, 2 MHF4, Tape and Reel |                     |         |  |
| SIZE B                                                    | DWG. NO. 453-00157R | REV 1-0 |  |

Figure 38: Sona NX611 1216 module packaging process, 453-00157R

## Module orientation

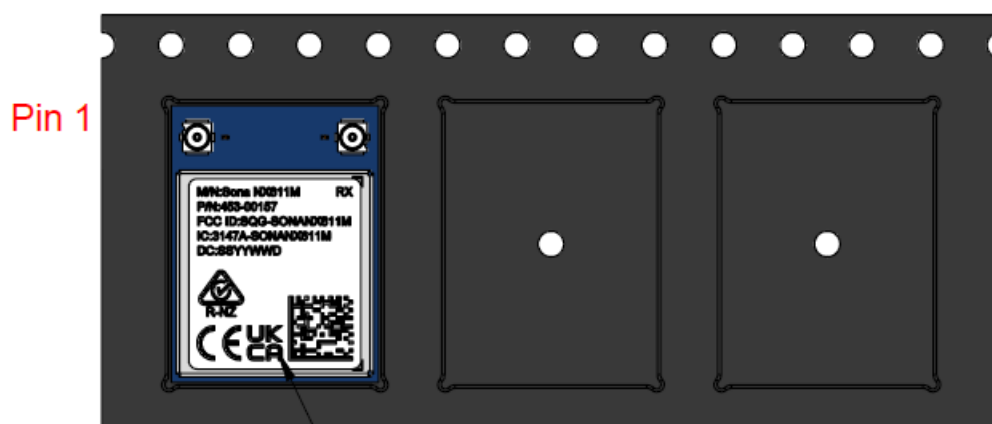


Figure 39: Sona NX611 1216 Module Orientation in Tape Carrier Pocket

## 13.4 Base 2230 Module Shipping

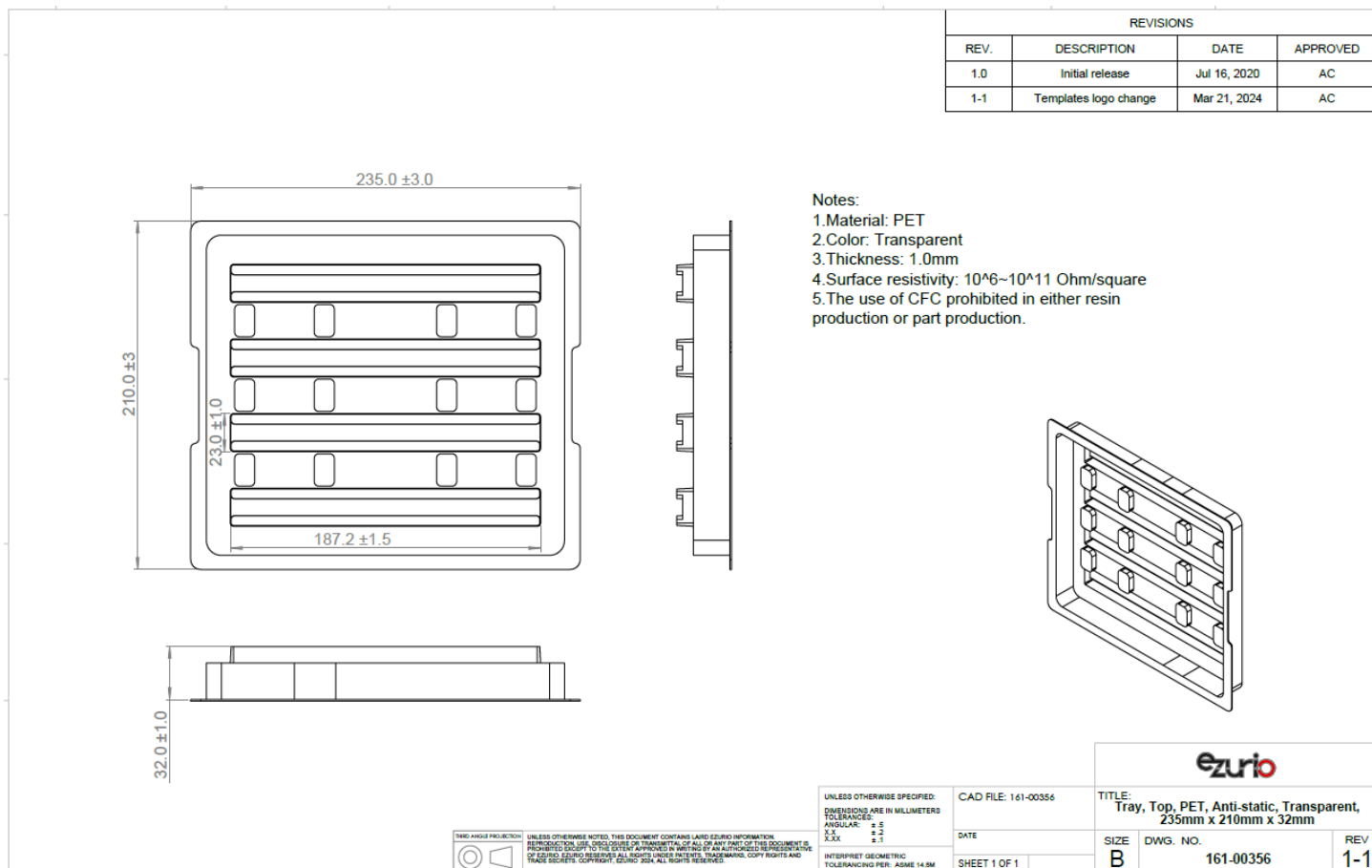


Figure 40: Shipping Tray, Top (Sona NX611 M.2 2230)

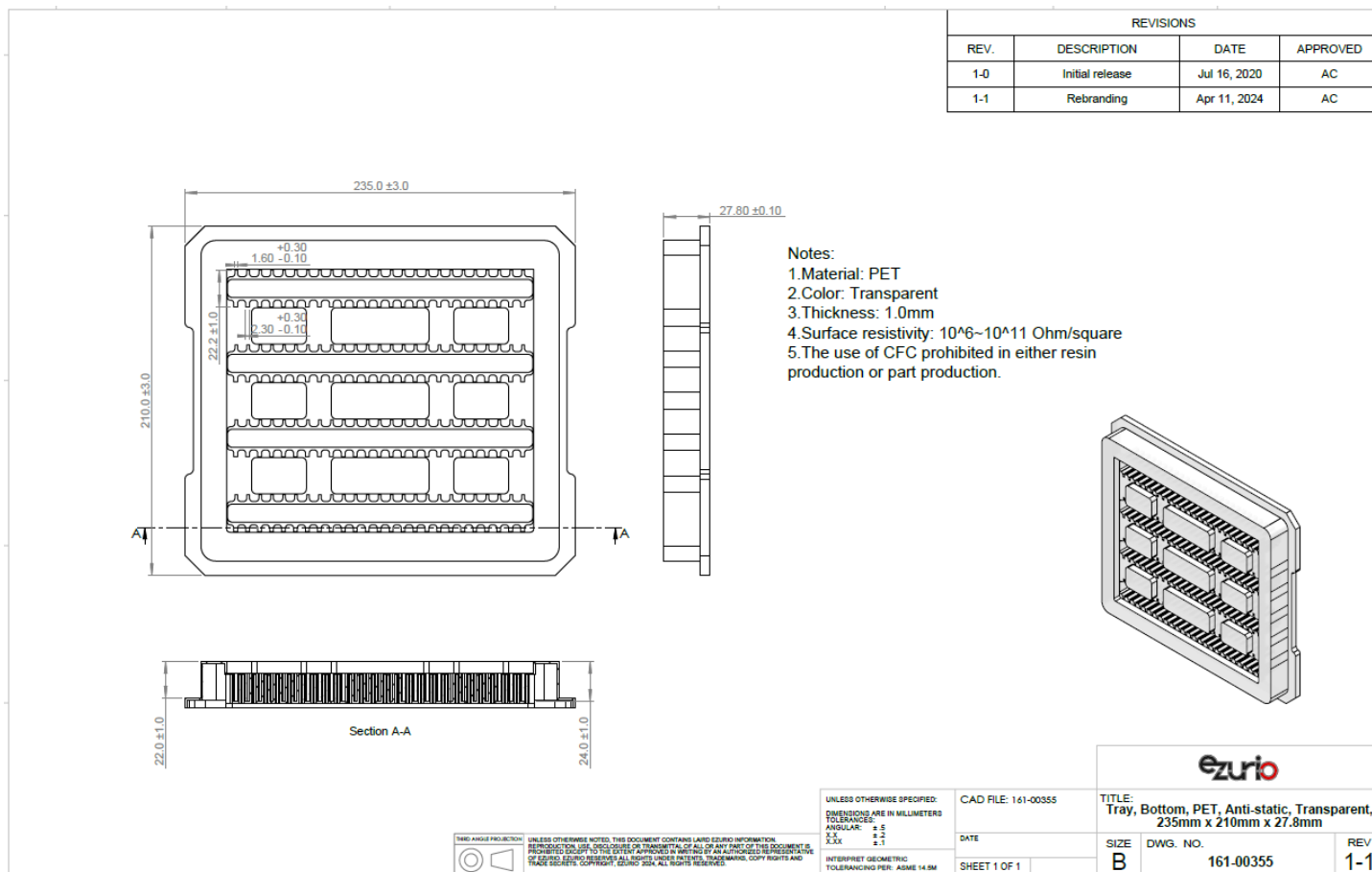


Figure 41: Shipping Tray, Bottom (Sona NX611 M.2 2230)

| NO. | ITEM NUMBER | REV. | DESCRIPTION                                                         | QTY. |
|-----|-------------|------|---------------------------------------------------------------------|------|
| 1   | 453-00165   | 1-1  | Module, Sona NX611 M.2 2230, 2 MHF4                                 | 600  |
| 2   | 161-00355   | 1-1  | Tray, Bottom, PET, Anti-static, Transparent, 235mm x 210mm x 27.8mm | 6    |
| 3   | 161-00356   | 1-1  | Tray, Top, PET, Anti-static, Transparent, 235mm x 210mm x 32mm      | 6    |
| 4   | 161-00007   | 1-0  | Box, Kraft, B Flute, 265mm x 233mm x 45mm                           | 6    |
| 5   | 161-00381   | 1-0  | Desiccant, Silica Gel, 10g, 58mm x 80mm                             | 6    |
| 6   | 161-00358   | 1-1  | Bag, ESD and Moisture Barrier, Silver, 270mm x 360mm x 0.08mm       | 6    |
| 7   | 161-00010   | 1-0  | Carton, Kraft, BC Flute, 485mm x 280mm x 163mm                      | 1    |
| 8   | 160-00007   | 1-0  | Label, Product Identifier, NX611 Series, 60mm x 40mm                | 12   |
| 9   | 160-02053   | 3-4  | Label, Standard Shipping Box, CE Mark, Pictogram, 4in x 2.5in       | 2    |

| REVISIONS |                 |               |            |
|-----------|-----------------|---------------|------------|
| REV.      | REVISION NOTE   | RELEASED DATE | REVISED BY |
| 0-1       | Initial release | Mar 5, 2024   | IT         |

Notes:  
1.Put the Module in the bottom tray.  
2.Cover the top tray.  
3.Put the packed tray and Desiccant in the ESD bag.  
4.Put the packed ESD bag (vacuum) in the box.  
5.Put six boxes in the carton.  
6.Module packaging quantity:  
Per Tray: 100 PCS  
Per Carton: 600PCS

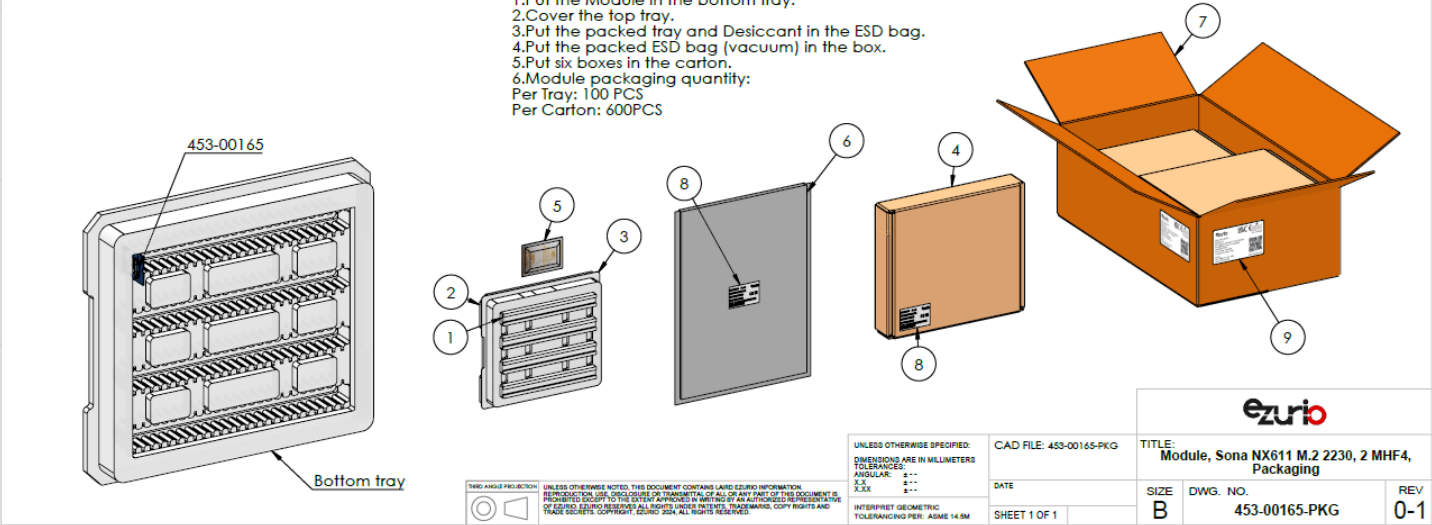


Figure 42: SONA™NX611X M.2 2230 module packaging process, 453-00165

### 13.5 Labelling

The following labels are located on the anti-static bag. Sona NX611 SIPs and 1216 modules are MSL4 modules.

**Caution**  
This bag contains  
**MOISTURE-SENSITIVE DEVICES**

LEVEL

If blank, see adjacent bar code label

1. Calculated shelf life in sealed bag : 12 months at <40°C and <90% relative humidity (RH)
2. Peak package body temperature: \_\_\_\_\_ °C  
If blank, see adjacent bar code label
3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be
  - a) Mounted within: \_\_\_\_\_ hours of factory conditions  
If blank, see adjacent bar code label  
≤30°C/60% RH, or
  - b) Stored per J-STD-033
4. Devices require bake, before mounting, if:
  - a) Humidity Indicator Card reads > 10% for level 2a - 5a devices or > 60% for level 2 devices when read at 23 ± 5 °C
  - b) 3a or 3b are not met.
5. If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure.

Bag Seal Date: \_\_\_\_\_  
If blank, see adjacent bar code label

Note: Level and body temperature defined by IPC/JEDEC J-STD-020

Figure 43: Anti-static bag label, 160-01816

The following label is located on the pizza box.

**M/N:Sona NX611X RX**

**P/N:XXX-XXXXX-X**

**D/C:SSYYWWD**

**Q'TY:XXXXPCS**

**BOX\_ID:BXXXXXXYMDXXXXXX**

**MADE IN VIETNAM**

|    |    |    |      |    |    |
|----|----|----|------|----|----|
| BE | BG | CZ | NL   | AT | PL |
| DK | DE | EE | PT   | RO | SI |
| IE | EL | ES | SK   | FI | SE |
| FR | HR | IT | UKNI | LI | IS |
| CY | LV | LT | NO   | TR | CH |
| LU | HU | MT |      |    |    |

Figure 44: Product identifier box label, 160-00007

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

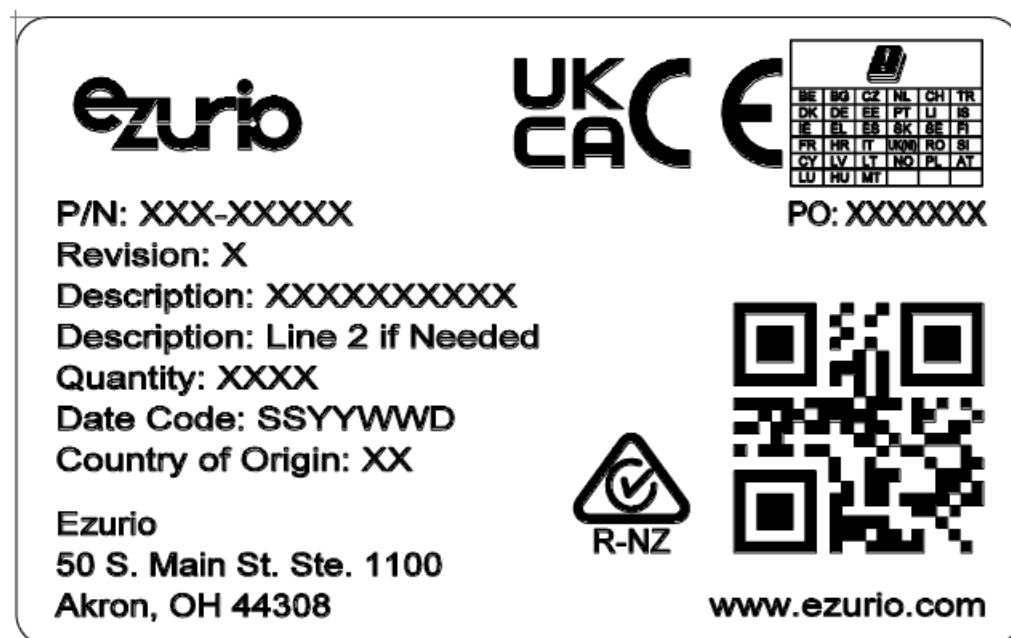


Figure 45: Master carton package label, 160-00036

## 13.6 Required Storage Conditions

### 13.6.1 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.

### 13.6.2 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 1<sup>st</sup> reflow:
    - Temperature: 5-25°C
    - Humidity: 60% or less
    - Period: A hours or less after opening
  - Storage conditions following completion of the 1<sup>st</sup> reflow and prior to performing the 2<sup>nd</sup> reflow
    - Temperature: 5-25°C
    - Humidity: 60% or less
    - Period: B hours or less after completion of the 1<sup>st</sup> reflow

**Note:** Should keep A+B within 72 hours.

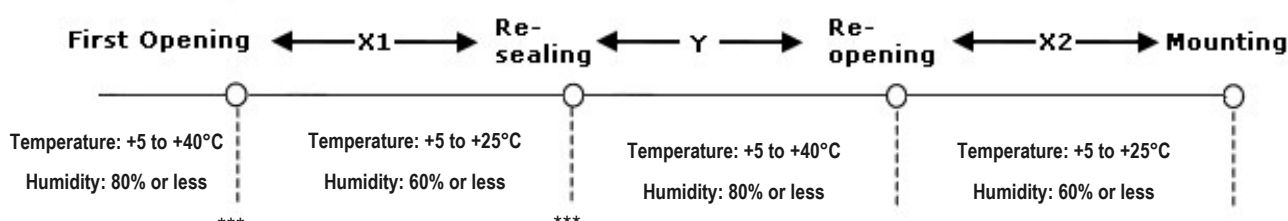
### 13.6.3 Temporary Storage Requirements after Opening

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.

## 13.7 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 SiP must be mounted (per MSL4/Moisture Sensitivity Level 4) within 72 hours at <30 °C and <60% relative humidity.
- If the SiP 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).

## 13.8 Surface Mount Conditions SIP Modules

The following soldering conditions are recommended to ensure device quality.

### 13.8.1 Soldering

**Note:** When soldering, the stencil thickness should be  $\geq 0.1$  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:

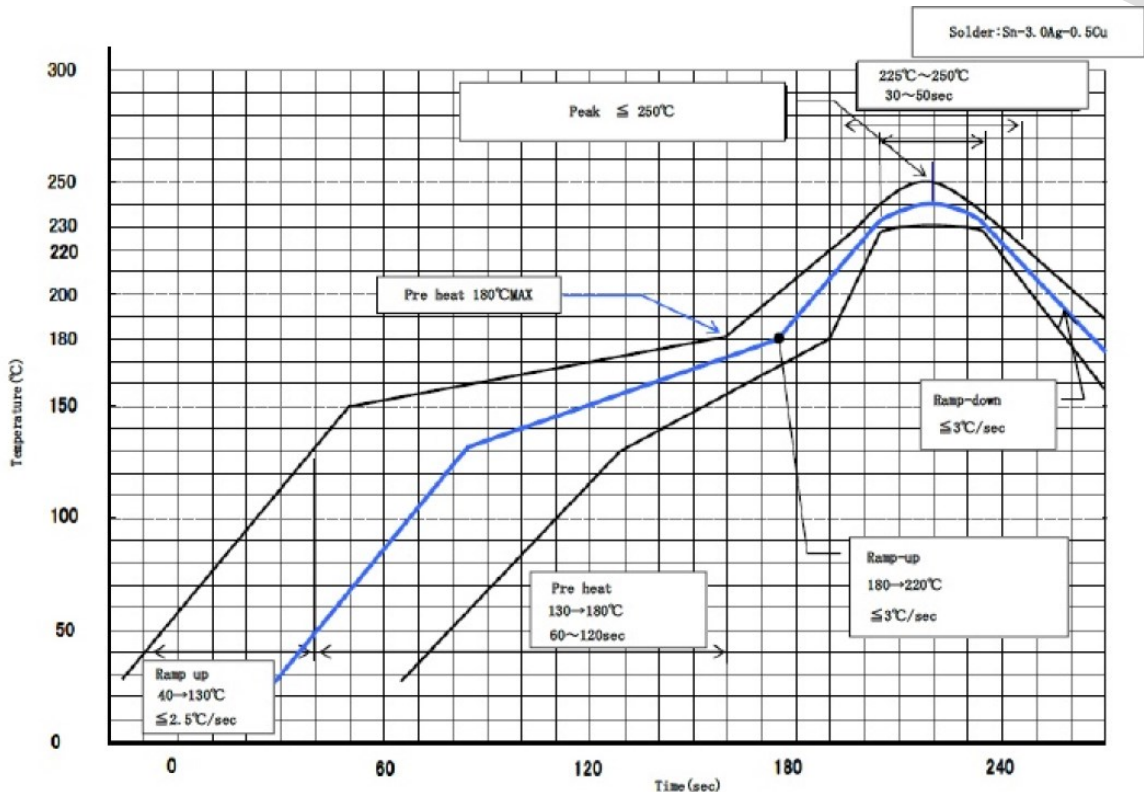


Figure 46: Temperature profile

- 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

### 13.8.2 Cautions When Removing Modules from the Platform for RMA

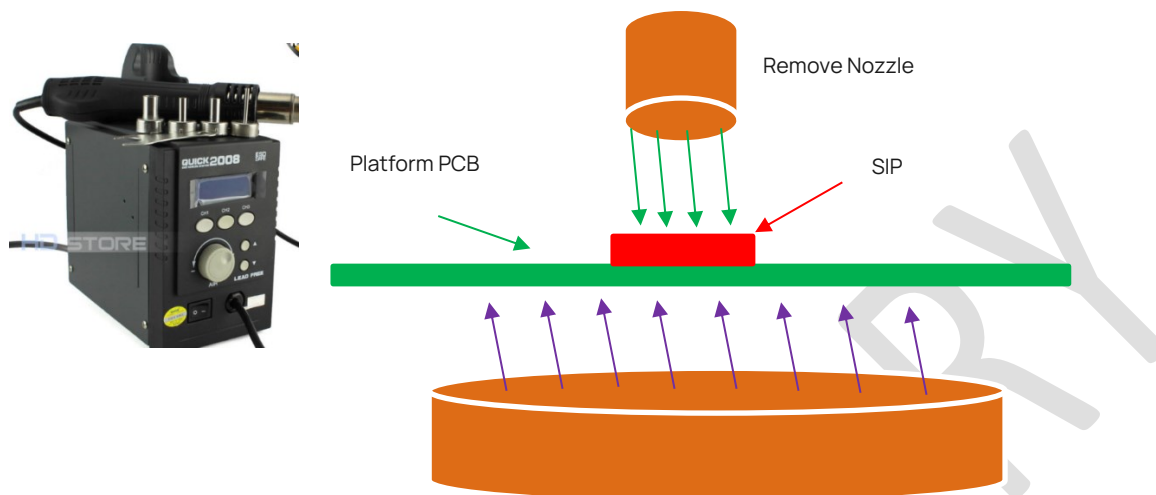
- Bake the platform before removing the SIP from the platform. Reference baking conditions.
- Remove the SIP by using a hot air gun. This process should be carried out by a skilled technician.

Suggestion conditions:

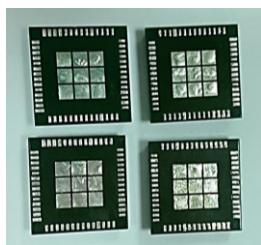
- One-side component platform:
  - Set the hot plate at 280 °C.
  - Put the platform on the hot plate for 8~10 seconds.
  - Remove the SIP from platform.
- Two-side components platform:



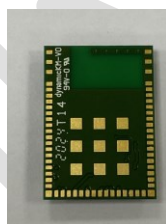
- Use two hot air guns
- On the bottom side, use a pre-heated nozzle (temperature setting of 200~250 °C) at a suitable distance from the platform PCB.
- On the top side, apply a remove nozzle (temperature setting of 330 °C). Heat the SIP until it can be removed from platform PCB.



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



(Not accepted for RMA)



(Accepted for RMA analysis)

*Example SIP with residue solder on the bottom      Example Module, not SONA™NX61X module without residue solder*

- Remove and clean the residue flux as needed.

### 13.8.3 Precautions for Use

- Opening/handling/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™NX61X SIP modules are MSL level 4.
- The SONA™NX61X M2 modules are MSL level 1.

## 14 Reliability Test

### 14.1 Climatic And Dynamic Reliability Test

Table 29: Climatic and Dynamic Reliability Test Results for Sona NX611 Modules

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

## 14.2 Reliability MTBF Prediction

**Table 30: MTBF Predictions for Sona NX611 Modules**

| Ezurio Part Number | Environment                 | Standard          | Test Result 45 °C (Hours) |
|--------------------|-----------------------------|-------------------|---------------------------|
| 453-00155R         | Ground, Fixed, Uncontrolled | Telcordia Issue 3 | 4,020,768                 |
| 453-00155C         |                             |                   |                           |
| 453-00156R         |                             |                   |                           |
| 453-00156C         |                             |                   |                           |
| 453-00157R         | Ground, Fixed, Uncontrolled | Telcordia Issue 3 | 2,668,324                 |
| 453-00157C         |                             |                   |                           |
| 453-00158R         |                             |                   |                           |
| 453-00158C         |                             |                   |                           |
| 453-00165          | Ground, Fixed, Uncontrolled | Telcordia Issue 3 | 3,600,089                 |
| 453-00166          |                             |                   |                           |
| 453-00155R         | Mobile, Fixed, Uncontrolled | Telcordia Issue 3 | 1,507,788                 |
| 453-00155C         |                             |                   |                           |
| 453-00156R         |                             |                   |                           |
| 453-00156C         |                             |                   |                           |
| 453-00157R         | Mobile, Fixed, Uncontrolled | Telcordia Issue 3 | 1,000,622                 |
| 453-00157C         |                             |                   |                           |
| 453-00158R         |                             |                   |                           |
| 453-00158C         |                             |                   |                           |
| 453-00165          | Mobile, Fixed, Uncontrolled | Telcordia Issue 3 | 1,350,033                 |
| 453-00166          |                             |                   |                           |

| Ezurio Part Number | Environment                 | Standard          | Test Result 85 °C (Hours) |
|--------------------|-----------------------------|-------------------|---------------------------|
| 453-00155R         | Ground, Fixed, Uncontrolled | Telcordia Issue 3 | 865,986                   |
| 453-00155C         |                             |                   |                           |
| 453-00156R         |                             |                   |                           |
| 453-00156C         |                             |                   |                           |
| 453-00157R         | Ground, Fixed, Uncontrolled | Telcordia Issue 3 | 567,761                   |
| 453-00157C         |                             |                   |                           |
| 453-00158R         |                             |                   |                           |
| 453-00158C         |                             |                   |                           |
| 453-00165          | Ground, Fixed, Uncontrolled | Telcordia Issue 3 | 772,686                   |
| 453-00166          |                             |                   |                           |
| 453-00155R         | Mobile, Fixed, Uncontrolled | Telcordia Issue 3 | 324,745                   |
| 453-00155C         |                             |                   |                           |
| 453-00156R         |                             |                   |                           |
| 453-00156C         |                             |                   |                           |
| 453-00157R         | Mobile, Fixed, Uncontrolled | Telcordia Issue 3 | 210,660                   |
| 453-00157C         |                             |                   |                           |
| 453-00158R         |                             |                   |                           |
| 453-00158C         |                             |                   |                           |
| 453-00165          | Mobile, Fixed, Uncontrolled | Telcordia Issue 3 | 289,757                   |
| 453-00166          |                             |                   |                           |

## 15 Regulatory

**Note:** For complete regulatory information, refer to the [SONA™ NX61X Regulatory Information](#) document (coming soon) which is also available from the [SONA™ NX61X product page](#).

The SONA™NX61X holds current certifications in the following countries:

**Table 31: SONA™NX61X countries with certification (SIP)**

| Country/Region | Regulatory ID    |
|----------------|------------------|
| USA (FCC)      | SQG-SONANX611S   |
| EU             | N/A              |
| Canada (ISED)  | 3147A-SONANX611S |
| Japan (MIC)    | TBD              |
| Australia      | N/A              |
| New Zealand    | N/A              |

**Table 32: SONA™NX61X countries with certification (M.2 1216 Module and M.2 2230 Module)**

| Country/Region | Regulatory ID    |
|----------------|------------------|
| USA (FCC)      | SQG-SONANX611M   |
| EU             | N/A              |
| Canada (ISED)  | 3147A-SONANX611M |
| Japan (MIC)    | TBD              |
| Australia      | N/A              |
| New Zealand    | N/A              |

**Table 33: SONA™NX61X Approved Antenna**

| Manufacturer                   | Model                     | Ezurio Part Number | Type         | Connector | Peak Gain (dBi) |       |       |
|--------------------------------|---------------------------|--------------------|--------------|-----------|-----------------|-------|-------|
|                                |                           |                    |              |           | 2.4 GHz         | 5 GHz | 6 GHz |
| Ezurio<br>(Laird Connectivity) | FlexMIMO 6E               | EFD2471A3S-10MH4L  | PIFA         | MHF4L     | 2.2             | 3.8   | 3.3   |
| Ezurio<br>(Laird Connectivity) | FlexPIFA 6E               | EFB2471A3S-10MH4L  | PIFA         | MHF4L     | 2.2             | 3.9   | 3.8   |
| Ezurio<br>(Laird Connectivity) | Mini NanoBlade Flex 6 GHz | EMF2471A3S-10MH4L  | PCB Dipole   | MHF4L     | 2.4             | 4.4   | 5.2   |
| Joymax Inc.                    | Dipole 6E                 | TWX-100BRS3B       | Dipole       | RP-SMA    | 2.0             | 4.0   | 4.0   |
| Ezurio<br>(Laird Connectivity) | FlexPIFA                  | 001-0021           | PIFA         | MHF4L     | 2.5             | 3.0   | N/A   |
| TDK                            | Multilayer Antenna        | ANT162442DT-2001A2 | Chip Antenna | N/A       | 2.0             | 1.0   | N/A   |

## 16 Additional Information

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

|                          |                                                                                               |
|--------------------------|-----------------------------------------------------------------------------------------------|
| <b>Headquarters</b>      | Ezurio<br>50 S. Main St. Suite 1100<br>Akron, OH 44308 USA                                    |
| <b>Phone</b>             | Americas: +1-800-492-2320<br>Europe: +44-1628-858-940<br>Hong Kong: +852-2762-4823            |
| <b>Website</b>           | <a href="http://www.ezurio.com">http://www.ezurio.com</a>                                     |
| <b>Technical Support</b> | <a href="http://www.ezurio.com/resources/support">http://www.ezurio.com/resources/support</a> |
| <b>Sales Contact</b>     | <a href="http://www.ezurio.com/contact">http://www.ezurio.com/contact</a>                     |

**Note:** Information contained in this document is subject to change.

Ezurio's products are subject to standard [Terms & Conditions](#).

<http://www.ezurio.com>

© Copyright 2024 Ezurio. All Rights Reserved. Any information furnished by Ezurio and its agents is believed to be accurate but cannot be guaranteed. All specifications are subject to change without notice. Responsibility for the use and application of Ezurio materials or products rests with the end user since Ezurio and its agents cannot be aware of all potential uses. Ezurio makes no warranties as to non-infringement nor as to the fitness, merchantability, or sustainability of any Ezurio materials or products for any specific or general uses. Ezurio or any of its affiliates or agents shall not be liable for incidental or consequential damages of any kind. All Ezurio products are sold pursuant to the Ezurio Terms and Conditions of Sale in effect from time to time, a copy of which will be furnished upon request. Nothing herein provides a license under any Ezurio or any third-party intellectual property right. Ezurio and its associated logos are trademarks owned by Ezurio and/or its affiliates.