User / Integration Guide

Sona™ TI351 Modules

Application Note *v1.1*

1 Introduction

The purpose of this document is to introduce the key hardware aspects of Ezurio's Sona™ TI351 Wi-Fi 6/BLE Modules, which are based on the Texas Instruments CC3351 chipset. The document will provide initial hardware integration guidance preliminary to a full module datasheet.

The hardware footprint, hardware pinout and host board requirements are very different between the Sona TI351 MHF4 Connector and the Sona TI351 Chip Antenna versions of the module. It is critical to follow the details and integration directions provided.

The following are covered in this integration guide:

- Sona™ TI351 M.2 1216 MHF4 Connector Module
  - Sona™ TI351 M.2 1216 MHF4 Module PCB Footprint
  - Sona™ TI351 M.2 1216 MHF4 Module Mechanical Drawing
  - Sona™ TI351 M.2 1216 MHF4 Module Pinout
  - Sona™ TI351 M.2 1216 Chip Antenna Module RF Layout Guidelines
- Sona™ TI351 M.2 1216 Integrated Chip Antenna Module
  - Sona™ TI351 M.2 1216 Chip Antenna Module PCB Footprint
  - Sona™ TI351 M.2 1216 Chip Antenna Module Mechanical Drawing
  - Sona™ TI351 M.2 1216 Chip Antenna Module Pinout
  - Sona™ TI351 M.2 1216 Chip Antenna Module RF Layout Guidelines
- Sona™ TI351 M.2 2230 Module
  - Sona™ TI351 M.2 2230 Module Mechanical Drawing
  - Sona™ TI351 M.2 2230 Module Pinout

Note: The data in this document is preliminary and is subject to change.

Figure 1: Sona TI351 M.2 1216 MHF4 Connector Module

Figure 2: Sona TI351 M.2 1216 Integrated Chip Antenna Module

Figure 3: Sona TI351 M.2 2230 Module

2 SONA™ TI351 MHF4 connector SMT Module (453-00199)

This section provides the hardware footprint, mechanical drawing, and hardware pinout for the Sona TI351 MHF4 connector Module. Also provided are details critical to the hardware integration of the module.

Sona TI351 MHF4 module PCB footprint

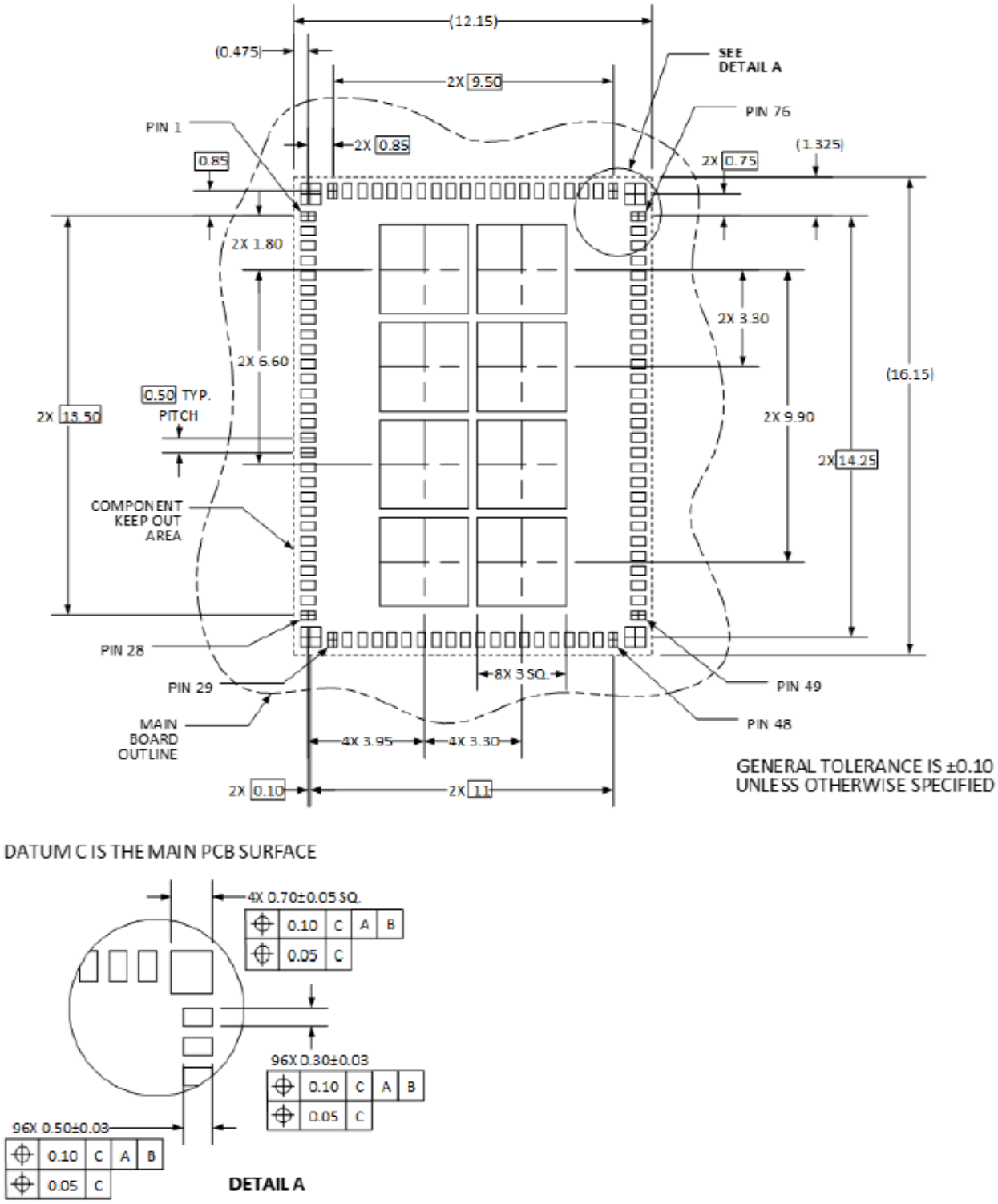

Figure 4: PCB Land Pattern (Top View) – TI351 MHF4 (453-00199) Module

2.1 Sona TI351 MHF4 module Mechanical Drawing

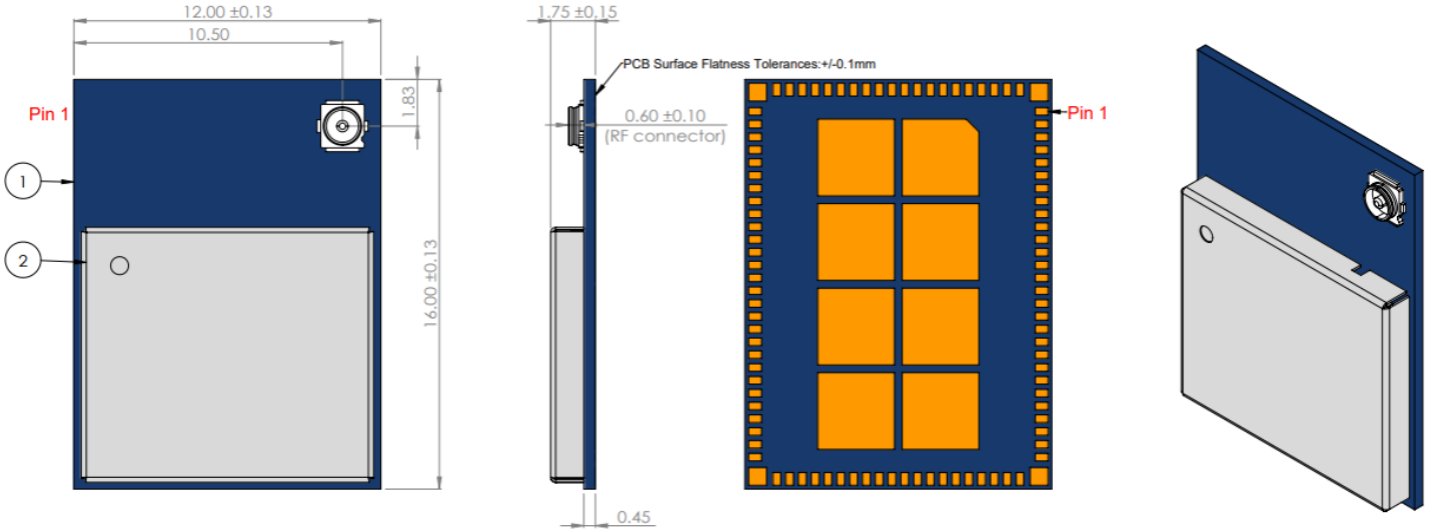

Figure 5: 453-00199 Mechanical Drawing

2.2 Sona TI351 MHF4 module Pinout

Table 1: 453-00199 Pinout

Pin #	Name	Type	Voltage Ref	Function	Comment
1 - 3	-	-	-	UNUSED	NC
4	3.3V	PWR	3.3V	DC Supply for RF Power Amplifier 3.0 – 3.6V	-
5	3.3V	PWR	3.3V	DC Supply for RF Power Amplifier 3.0 – 3.6V	-
6	GND	-	-	Ground	GND
7 - 10	-	-	-	UNUSED	NC
11	COEX1_RXD/COEX_REQ	I	1.8V	External Coexistance Interface	NC if Unused
12	COEX2_TXD/COEX_GRANT	O	1.8V	External Coexistance Interface	NC if Unused
13	COEX3/COEX_PRIORITY	I	1.8V	External Coexistance Interface	NC if Unused
14 - 16	-	-	-	UNUSED	NC
17	GND	-	-	Ground	GND
18 – 19	-	-	-	UNUSED	NC
20	GND	-	-	Ground	GND
21 – 22	-	-	-	UNUSED	NC
23	GND	-	-	Ground	GND
24 – 25	-	-	-	UNUSED	NC
26	GND	-	-	Ground	GND
27	SUSCLK/SLOW_CLK_IN	I	1.8V	External sleep clock (32.768kHz)	NC if Unused
28	W_DISABLE1#/nRESET	I	1.8V	Reset line for enabling/disabling device (active low)	Hold low for >10µs after

Pin #	Name	Type	Voltage Ref	Function	Comment
					power inputs stabilized
29 – 31	-	-	-	UNUSED	NC
32	GND	-	-	Ground	GND
33 – 34	-	-	-	UNUSED	NC
35	GND	-	-	Ground	GND
36 – 37	-	-	-	UNUSED	NC
38	GND	-	-	Ground	GND
39 – 40	-	-	-	UNUSED	NC
41	GND	-	-	Ground	GND
42 – 45	-	-	-	UNUSED	NC
46	SDIO_WAKE#/HOST_IRQ_WL **Important Design Note**[1]	O	1.8V	Host Wake signal Required for Wake on Wireless	Active High Interrupt[2]
47	SDIO_DATA3	I/O	1.8V	SDIO Data Line 3	
48	SDIO_DATA2	I/O	1.8V	SDIO Data Line 2	
49	SDIO_DATA1	I/O	1.8V	SDIO Data Line 1	
50	SDIO_DATA0	I/O	1.8V	SDIO Data Line 0	
51	SDIO_CMD	I/O	1.8V	SDIO Command Line	
52	SDIO_CLK	I	1.8V	SDIO Clock Input	
53	UART_WAKE#/HOST_IRQ_BLE	O	1.8V	Host Wake signal (Shared SDIO mode)	Active High Interrupt[2]
54	UART_CTS	I	1.8V	BLE HCI UART clear to send	
55	UART_TXD	O	1.8V	BLE HCI UART serial output	
56	UART_RXD	I	1.8V	BLE HCI UART serial input	
57	UART_RTS	O	1.8V	BLE HCI UART request to send	
58 – 61	-	-	-	UNUSED	NC
62	GND	-	-	Ground	GND
63 – 65	-	-	-	UNUSED	NC
66	VIO_1.8V	PWR	1.8V	DC Supply for module 1.62 – 1.98V	-
67	-	-	-	UNUSED	NC
68	GND	-	-	Ground	GND
69 – 70	-	-	-	UNUSED	NC
71	GND	-	-	Ground	GND
72	3.3V	PWR	3.3V	DC Supply for RF Power Amplifier 3.0 – 3.6V	-
73	3.3V	PWR	3.3V	DC Supply for RF Power Amplifier 3.0 – 3.6V	-
74	GND	-	-	Ground	GND
75	GND	-	-	Ground	GND

Pin #	Name	Type	Voltage Ref	Function	Comment
76	-	-	-	UNUSED	NC
77 – 80	GND	-	-	Ground	GND
81	-	-	-	UNUSED	NC
82 – 85	GND	-	-	Ground	GND
86	-	-	-	UNUSED	NC
87 – 91	GND	-	-	Ground	GND
92	-	-	-	UNUSED	NC
93 - 96	GND	-	-	Ground	GND
G1 – G12	GND	-	-	Ground	GND

Important Note:

1. The SDIO_WAKE#/HOST_IRQ_WL line on the M.2 1216 module is sensed by the module on power up. The pin is pulled low internally and must remain low when the device powers up. **When this pin is connected to a host device, ensure that the line stays at a logic low level during module power-up and is not pulled high or driven high by the host platform.** Some host implementations may require a buffer device to be placed between the SDIO_WAKE#/HOST_IRQ_WL module pin and the MCU GPIO pin used depending on how the MCU configures the GPIO on power up.

2. Interrupts are active high and need an external inverter to conform to M.2 1216 LGA specification.

2.3 Sona TI351 MHF4 module RF Layout Guidelines

The following is a list of RF layout design guidelines and recommendations when installing an Ezurio radio into your device.

- Do not run any antenna cables directly above or directly below the radio.
- Do not place any parts or run any high-speed digital lines below the radio.
- Ensure that there is the maximum allowable spacing separating the antenna connectors on the Ezurio radio from the antenna. In addition, do not place antennas directly above or directly below the radio.
- Ezurio recommends the use of a double-shielded cable for the connection between the radio and the antenna elements.
- Be sure to put a 10uF/16V/0603 capacitor on EACH 3.3V power pin. Also, place that capacitor as close as possible to the pin to make sure the internal PMU is working correctly.
- Use proper electro-static-discharge (ESD) procedures when installing the Ezurio radio module. To avoid negatively impacting Tx power and receiver sensitivity, do not cover the antennas with metallic objects or components.
- Ezurio's surface mount modules are designed to conform to all major manufacturing guidelines. This application note is intended to provide additional guidance beyond the information that is presented in the user manual. This application note is considered a living document and will be updated as new information is presented.
- The modules are designed to meet the needs of commercial and industrial applications. They are easy to manufacture and conform to current automated manufacturing processes.

3 SONA™ TI351 Integrated Antenna SMT Module (453-00200)

This section provides the hardware footprint, mechanical drawing, and hardware pinout for the Sona TI351 Integrated Chip Antenna Module. Also provided are the details critical to the hardware integration of the module on a host board.

3.1 Sona TI351 Integrated Antenna module PCB footprint

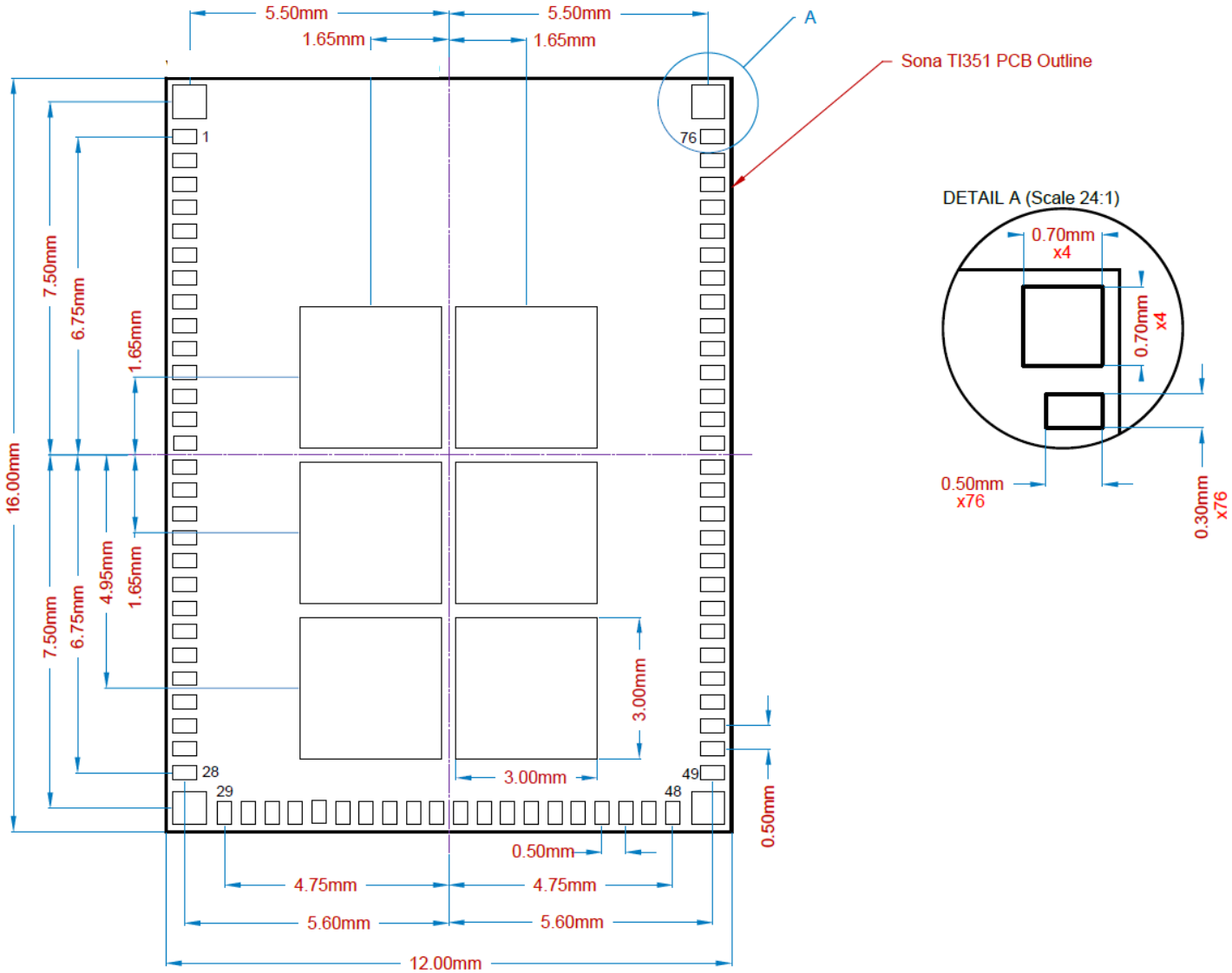

Figure 6: PCB Land Pattern (Top View) – TI351 Integrated Chip Antenna Module (453-00200)

3.2 Sona TI351 Integrated Antenna module Mechanical Drawing

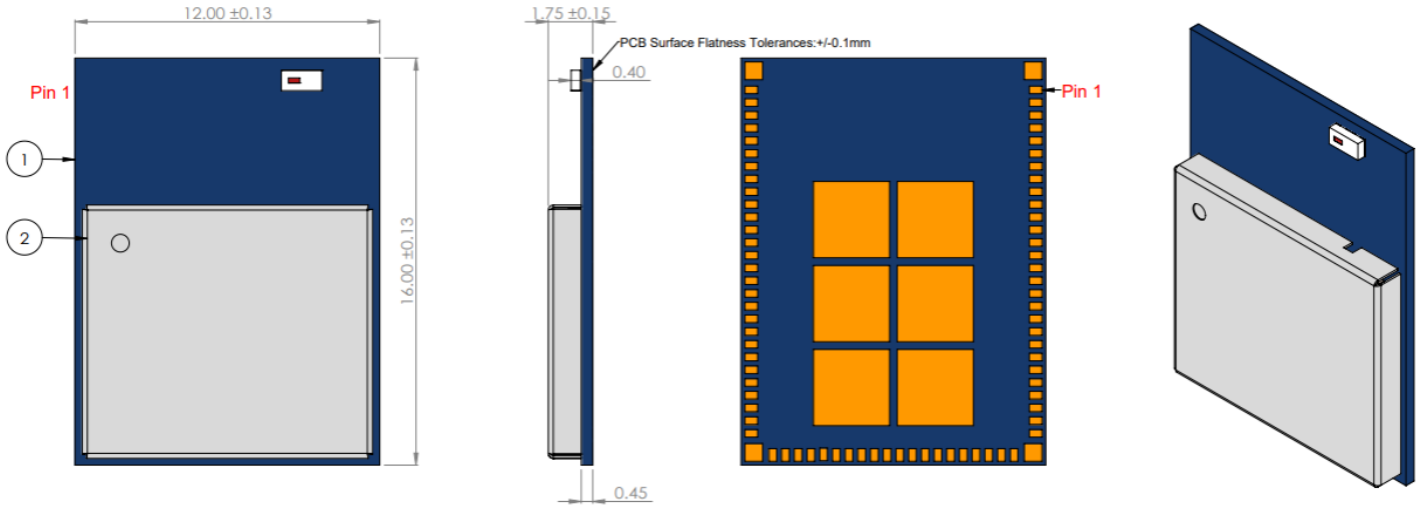

Figure 7: TI351 Integrated Chip Antenna Module Mechanical Drawing

3.3 Sona TI351 Integrated Antenna module Pinout

Table 2: 453-00200 Pinout

Pin #	Name	Type	Voltage Ref	Function	Comment
1 - 3	-	-	-	UNUSED	NC
4	3.3V	PWR	3.3V	DC Supply for RF Power Amplifier 3.0 – 3.6V	-
5	3.3V	PWR	3.3V	DC Supply for RF Power Amplifier 3.0 – 3.6V	-
6	GND	-	-	Ground	GND
7 - 10	-	-	-	UNUSED	NC
11	COEX1_RXD/COEX_REQ	I	1.8V	External Coexistance Interface	NC if Unused
12	COEX2_TXD/COEX_GRANT	O	1.8V	External Coexistance Interface	NC if Unused
13	COEX3/COEX_PRIORITY	I	1.8V	External Coexistance Interface	NC if Unused
14 - 16	-	-	-	UNUSED	NC
17	GND	-	-	Ground	GND
18 – 19	-	-	-	UNUSED	NC
20	GND	-	-	Ground	GND
21 – 22	-	-	-	UNUSED	NC
23	GND	-	-	Ground	GND
24 – 25	-	-	-	UNUSED	NC
26	GND	-	-	Ground	GND
27	SUSCLK/SLOW_CLK_IN	I	1.8V	External sleep clock (32.768kHz)	NC if Unused
28	W_DISABLE1#/nRESET	I	1.8V	Reset line for enabling/disabling device (active low)	Hold low for >10µs after power inputs stabilized

Pin #	Name	Type	Voltage Ref	Function	Comment
29 – 31	-	-	-	UNUSED	NC
32	GND	-	-	Ground	GND
33 – 34	-	-	-	UNUSED	NC
35	GND	-	-	Ground	GND
36 – 37	-	-	-	UNUSED	NC
38	GND	-	-	Ground	GND
39 – 40	-	-	-	UNUSED	NC
41	GND	-	-	Ground	GND
42 – 45	-	-	-	UNUSED	NC
46	SDIO_WAKE#/HOST_IRQ_WL **Important Design Note**[1]	O	1.8V	Host Wake signal Required for Wake on Wireless	Active High Interrupt[2]
47	SDIO_DATA3	I/O	1.8V	SDIO Data Line 3	
48	SDIO_DATA2	I/O	1.8V	SDIO Data Line 2	
49	SDIO_DATA1	I/O	1.8V	SDIO Data Line 1	
50	SDIO_DATA0	I/O	1.8V	SDIO Data Line 0	
51	SDIO_CMD	I/O	1.8V	SDIO Command Line	
52	SDIO_CLK	I	1.8V	SDIO Clock Input	
53	UART_WAKE#/HOST_IRQ_BLE	O	1.8V	Host Wake signal (Shared SDIO mode)	Active High Interrupt[2]
54	UART_CTS	I	1.8V	BLE HCI UART clear to send	
55	UART_TXD	O	1.8V	BLE HCI UART serial output	
56	UART_RXD	I	1.8V	BLE HCI UART serial input	
57	UART_RTS	O	1.8V	BLE HCI UART request to send	
58 – 61	-	-	-	UNUSED	NC
62	GND	-	-	Ground	GND
63 – 65	-	-	-	UNUSED	NC
66	VIO_1.8V	PWR	1.8V	DC Supply for module 1.62 – 1.98V	-
67	-	-	-	UNUSED	NC
68	GND	-	-	Ground	GND
69 – 70	-	-	-	UNUSED	NC
71	GND	-	-	Ground	GND
72	3.3V	PWR	3.3V	DC Supply for module. DC Supply for RF Power Amplifier 3.0 – 3.6V	-
73	3.3V	PWR	3.3V	DC Supply for RF Power Amplifier 3.0 – 3.6V	-
74	GND	-	-	Ground	GND
75	GND	-	-	Ground	GND
76	-	-	-	UNUSED	NC

Pin #	Name	Type	Voltage Ref	Function	Comment
G1 – G4, G6 – G8, G10 – G12	GND	-	-	Ground	GND

Important Note:

1. The SDIO_WAKE#/HOST_IRQ_WL line on the M.2 1216 module is sensed by the module on power up. The pin is pulled low internally and must remain low when the device powers up. **When this pin is connected to a host device, ensure that the line stays at a logic low level during module power-up and is not pulled high or driven high by the host platform.** Some host implementations may require a buffer device to be placed between the SDIO_WAKE#/HOST_IRQ_WL module pin and the MCU GPIO pin used depending on how the MCU configures the GPIO on power up.

2. Interrupts are active high and need an external inverter to conform to M.2 1216 LGA specification.

3.4 Sona TI351 Integrated Antenna module RF Layout Guidelines

The following is a list of RF layout design guidelines and recommendations when installing an Ezurio radio into your device.

- Do not run any cables directly above or directly below the radio.
- Do not place any parts or run any high-speed digital lines below the radio.
- Ensure that there is the maximum allowable spacing separating the antenna connectors on the Ezurio radio from the antenna. In addition, do not place antennas directly above or directly below the radio.
- Ezurio recommends the use of a double-shielded cable for the connection between the radio and the antenna elements.
- Be sure to put a 10uF/16V/0603 capacitor on EACH 3.3V power pin. Also, place that capacitor as close as possible to the pin to make sure the internal PMU is working correctly.
- Use proper electro-static-discharge (ESD) procedures when installing the Ezurio radio module. To avoid negatively impacting Tx power and receiver sensitivity, do not cover the antennas with metallic objects or components.
- Ezurio's surface mount modules are designed to conform to all major manufacturing guidelines. This application note is intended to provide additional guidance beyond the information that is presented in the user manual. This application note is considered a living document and will be updated as new information is presented.
- The modules are designed to meet the needs of commercial and industrial applications. They are easy to manufacture and conform to current automated manufacturing processes.
- The Sona TI351 Integrated antenna variant MUST BE located at the edge of the Host PCB and surrounded by ground on three sides. The antenna keep out region as defined in Figure 8 must be kept clear of copper on all layers of the host PCB. Extending the ground on the Host PCB ≥ 15mm from the module edge in each direction will optimize antenna performance.

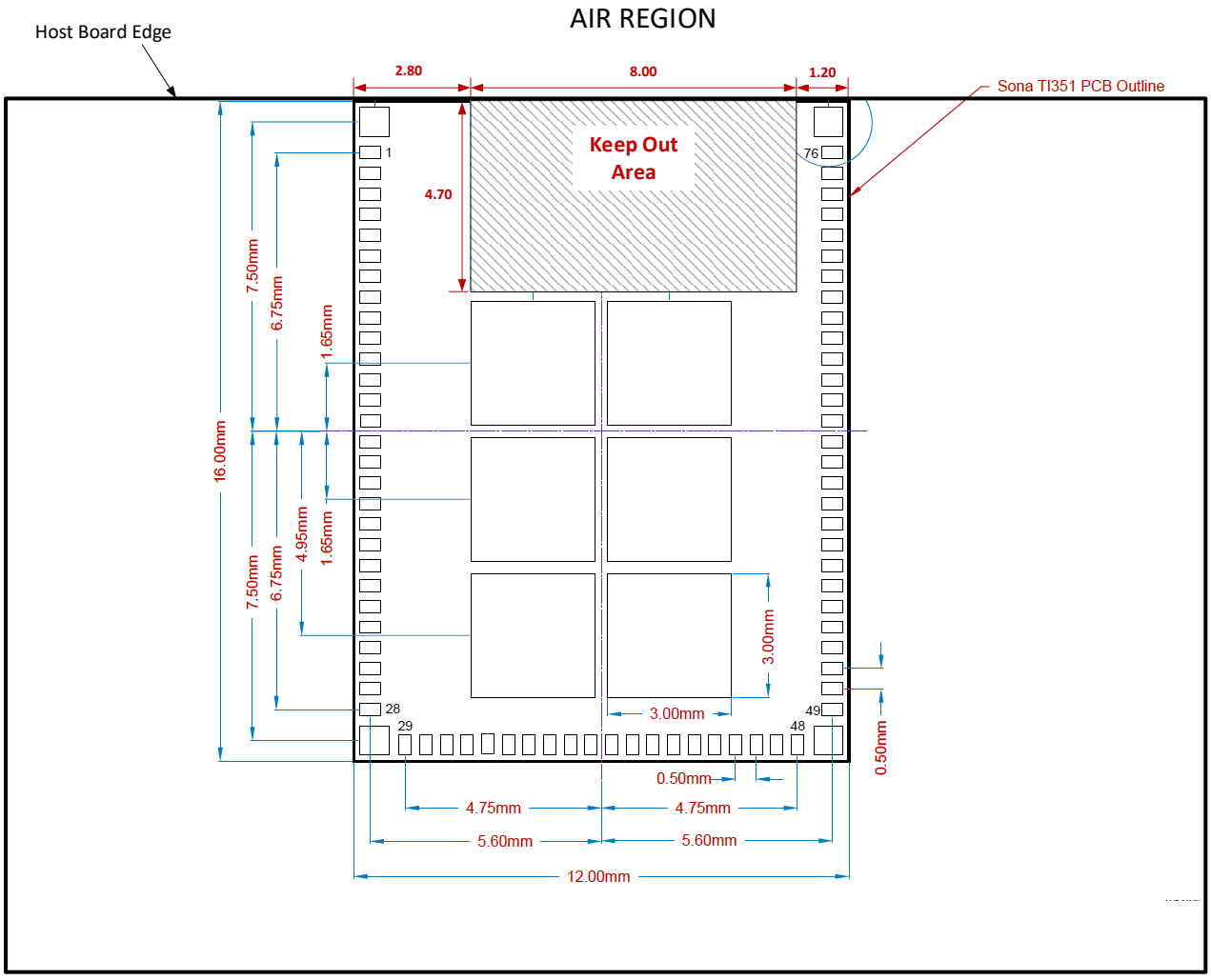

Figure 8: TI351 Integrated Chip Antenna Module Host Board Keep Out requirements.

4 SONA™ TI351 M.2 2230 Module

This section provides the mechanical drawing and hardware pinout for the Sona TI351 M.2 2230 Module. It is presented as a M.2 2230 Key-E PCB Edge Finger Adapter card. All the signals are described from the Adapter point of view.

Also provided are the details critical to the connector needed on a host board.

4.1 Sona TI351 M.2 2230 Module Mechanical Drawing

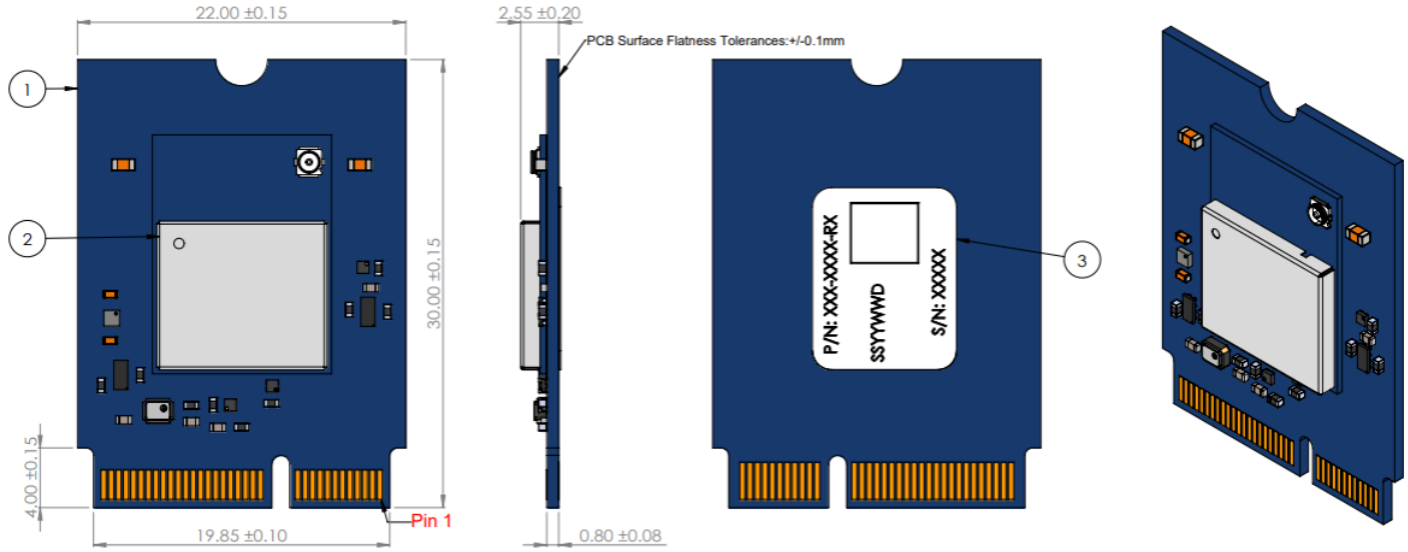

Figure 9: Sona TI351 M.2 2230 Mechanical Drawing

4.2 Sona TI351 M.2 2230 Module Pinout

Table 3: 453-00209 Pinout

Pin #	M.2 Signal Name	Type	Voltage Ref	TI351 Function	Comment
1	GND	-	-	Ground	GND
2	3.3V	PWR	3.3V	DC supply voltage for module. 3.0 – 3.6V recommended	Wait >1ms for module to stabilize after power application
3	USB_D+	-	-	Unused	-
4	3.3 V	PWR	3.3V	DC supply voltage for module. 3.0 – 3.6V recommended	Wait >1ms for module to stabilize after power application
5	USB_D-	-	-	Unused	-
6	LED1#	-	-	Unused	-
7	GND	-	-	Ground	GND
8	PCM_CLK	-	-	Unused	-
9	SDIO CLK	I	1.8V	SDIO clock input	-
10	PCM_SYNC	-	-	Unused	-
11	SDIO CMD	I/O	1.8V	SDIO command line	-

Pin #	M.2 Signal Name	Type	Voltage Ref	TI351 Function	Comment
12	PCM_OUT	-	-	Unused	-
13	SDIO DATA0	I/O	1.8V	SDIO data line 0	-
14	PCM_IN	-	-	Unused	-
15	SDIO DATA1	I/O	1.8V	SDIO data line 1	-
16	LED2#	-	-	Unused	-
17	SDIO DATA2	I/O	1.8V	SDIO data line 2	-
18	VIO_CFG	O	-	Sideband IO voltage indication. Connected to ground for 3.3V on the sideband IO signals. Otherwise, it must be left unconnected.	GND
19	SDIO DATA3	I/O	1.8V	SDIO data line 3	-
20	UART WAKE#	O	3.3V	BT_WAKE_OUT - Output signal to wake Host.	-
21	SDIO WAKE#	O	1.8V	WL_HOST_WAKE - Output signal to wake host.	-
22	UART_TXD	O	1.8V	Serial data output for the HCI UART interface.	-
23	SDIO RESET#	-	-	Unused	-
32	UART_RXD	I	1.8V	Serial data input for the HCI UART interface.	-
33	GND	-	-	Ground	GND
34	UART_RTS	O	1.8V	Active-Low request-to-send signal for the HCI UART interface.	-
35	PERp0	-	-	Unused	-
36	UART_CTS	I	1.8V	Active-Low clear-to-send signal for the HCI UART interface.	-
37	PERn0	-	-	Unused	-
38	VENDOR DEFINED38	-	-	Unused	-
39	GND	-	-	Ground	GND
40	VENDOR DEFINED40	-	-	Unused	-
41	PETp0	-	-	Unused	-
42	VENDOR DEFINED42	-	-	Unused	-
43	PETn0	-	-	Unused	-
44	COEX3	I	1.8V	COEX_PRIORITY	Unused
45	GND	-	-	Ground	GND
46	COEX_TXD	O	1.8V	COEX_GRANT	Unused
47	REFCLKp0	-	-	Unused	-
48	COEX_RXD	I	1.8V	COEX_REQ	Unused
49	REFCLKn0	-	-	Unused	-
50	SUSCLK	I	3.3V	External Sleep Clock input (32.768KHz)	TI351 M.2 2230 card contains TCXO
51	GND	-	-	Ground	GND

Pin #	M.2 Signal Name	Type	Voltage Ref	TI351 Function	Comment
52	PERST0#	-	-	Unused	-
53	CLKREQ0#	-	-	Unused	-
54	W_DISABLE2#	-	-	Unused	-
55	PEWAKE0#	-	-	Unused	-
56	W_DISABLE1#	I	3.3V	Reset line for enabling/disabling device (active low)	Hold low for >10us after power input stabilized
57	GND	-	-	Ground	GND
58	I2C DATA	-	-	Unused	-
59	RESERVED	-	-	Unused	-
60	I2C CLK	-	-	Unused	-
61	RESERVED	-	-	Unused	-
62	ALERT#	-	-	Unused	-
63	GND	-	-	Ground	GND
64	RESERVED	-	-	Unused	-
65	RESERVED	-	-	Unused	-
66	UIM_SWP	-	-	Unused	-
67	RESERVED	-	-	Unused	-
68	UIM_POWER_SNK	-	-	Unused	-
69	GND	-	-	Ground	GND
70	UIM_POWER_SRC	-	-	Unused	-
71	RESERVED	-	-	Unused	-
72	3.3V	PWR	3.3V	DC supply voltage for module. 3.0 – 3.6V recommended	Wait >1ms for module to stabilize after power application
73	RESERVED	-	-	Unused	-
74	3.3V	PWR	3.3V	DC supply voltage for module. 3.0 – 3.6V recommended	Wait >1ms for module to stabilize after power application
75	GND	-	-	Ground	GND

4.3 Sona TI351 M.2 2230 Module Mounting Guidelines

The Sona TI351 M.2 module connects to the host via a standard PCI EXPRESS M2 connector. The Kyocera (www.Kyocera-connector.com) 6411 series provide 1.8 mm, 2.3 mm and 3.2 mm connector heights and the JAE (https://www.jae.com/en/) SM3 series provides 1.2 mm, 2.15 mm, 3.1 mm and 4.1 mm connector heights.

Because the Sona TI351 M.2 module is a single-side component module, we recommend the following part numbers which have 2.3 mm and 3.1 mm connector height:

M.2 Key-E Connector	Connector Height
KYOCERA 24-6411-067-101-894E	2.3 mm
JAE SM3ZS067U310AERxxxx	3.1 mm

The stand-off mating to the recommend 2.3 mm connector from EMI STOP (www.EMISTOP.com) is part number **F50M16-041525P1D4M** and 3.1mm from JAE (https://www.jae.com/en/) is part number **SM3ZS067U310-NUT1-Rxxxx**.

M.2 Key-E Connector	Stand-off
KYOCERA 24-6411-067-101-894E	EMI STOP F50M16-041525P1D4M
JAE SM3ZS067U310AERxxxx	JAE SM3ZS067U310-NUT1-Rxxxx

Detailed layout and stencil opening are shown as follows in Figure 10.

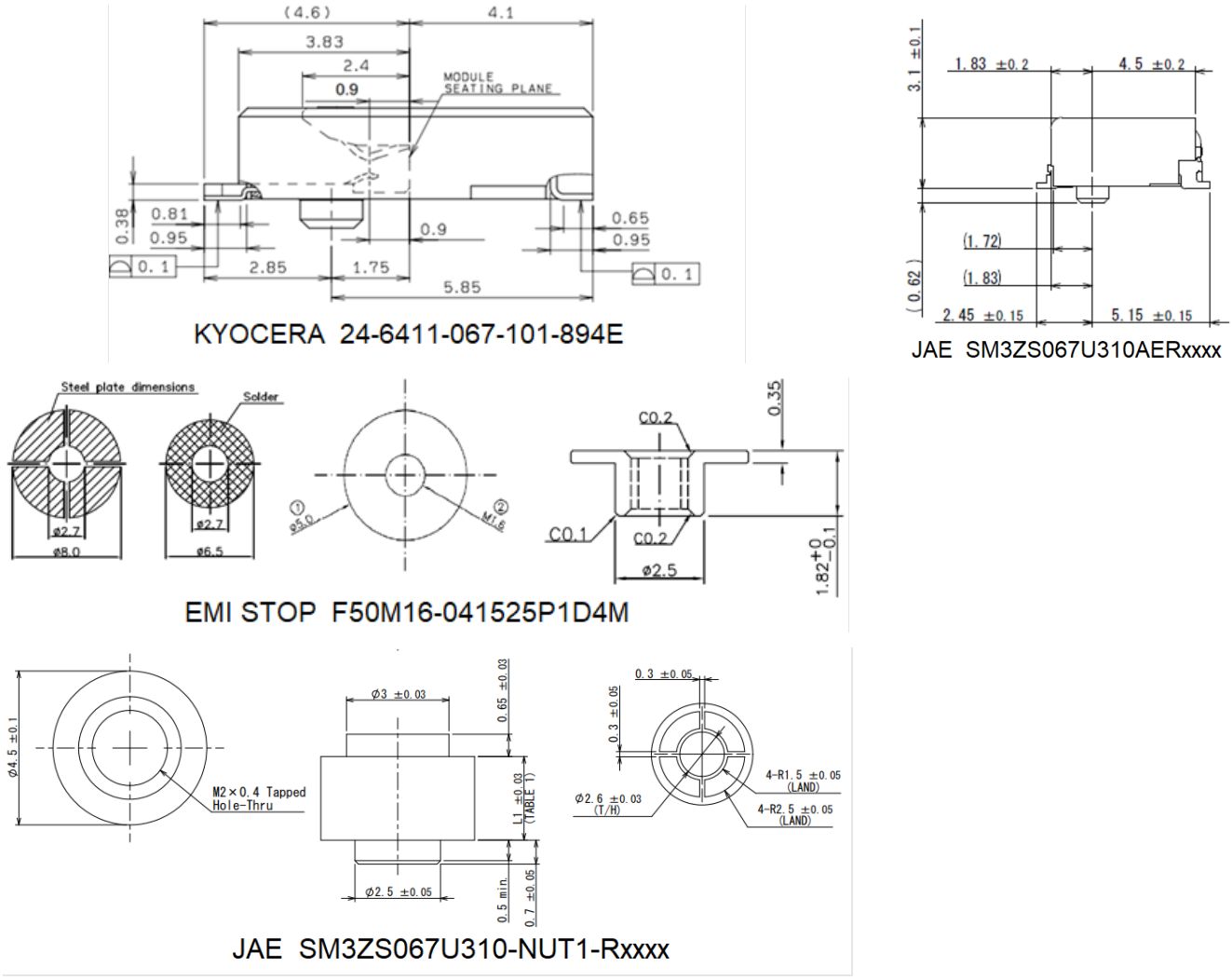

Figure 10: Mounting information for the Sona TI351 M.2 2230 module and recommended layout pattern for the stand-off

5 FCC and ISED Modular Certification Requirements

These modules and their associated set of approved antennas have been certified by the FCC and Innovation, Science and Economic Development, Canada (ISED) as Modular Radios. The end user is authorized to integrate this module into an end-product and is solely responsible for the Unintentional Emissions levels produced by the end-product.

To uphold the Modular Radio certifications, the integrator of the module must abide by the PCB layout recommendations outlined in the following paragraphs. Any divergence from these recommendations will invalidate the modular radio certifications and require the integrator to re-certify the module and/or end-product.

The module must be used with one of the approved antennas:

Table 4: Sona Approved Antenna List

Manufacturer	Model	Ezurio Part Number	Type	Connector	Peak Gain (dBi)	
					2.4GHz	5GHz
Ezurio (Laird Connectivity)	FlexPIFA	001-0021	PIFA	MHF4L	2.5	3.0
Ezurio (Laird Connectivity)	FlexPIFA	EFB2455A3S-15MH4L	PIFA	MHF4L	2.5	3.0
Ezurio (Laird Connectivity)	FlexPIFA 6E	EFB2471A3S-10MH4L	PIFA	MHF4L	2.2	3.9
Ezurio (Laird Connectivity)	Mini NanoBlade Flex	EMF2449A1-10MH4L	PCB Dipole	MHF4L	2.8	3.4
Ezurio (Laird Connectivity)	Mini NanoBlade Flex 6E	EMF2471A3S-10MH4L	PCB Dipole	MHF4L	2.4	4.4
Ezurio (Laird Connectivity)	NanoBlade	ENB2449A1-10MH4L	PCB Dipole	MHF4L	3.19	4.1
Joymax Electronics	Dipole	TWX-100BRSAX-2001 / TWX-100BRS3B	Dipole	RP-SMA	2	4.0

Note:

The OEM is free to choose another vendor's antenna of like type and equal or lesser gain as an antenna appearing in the table and still maintain compliance. Reference FCC Part 15.204(c)(4) for further information on this topic.

To reduce potential radio interference to other users, the antenna type and gain should be chosen so that the equivalent isotropic radiated power(EIRP) is not more than that permitted for successful communication.

Please use the latest CAD files from the Ezurio web site when incorporating the Sona™ module into a new design. CAD files are provided in native Altium as well as Gerber and PDF formats.

5.1 Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radiofrequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Important Note:

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 5.5cm between the radiator & your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Integration Instructions for Host Product Manufacturers

Applicable FCC rules to module:

FCC Part 15.247, FCC Part 15.407

Summarize the specific operational use conditions:

This device is intended only for OEM integrators under the following condition:

- The transmitter module may not be co-located with any other transmitter or antenna

As long as 1 condition above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

IMPORTANT NOTE: In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid, and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end-product (including the transmitter) and obtaining a separate FCC authorization. The OEM integrator must be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end-product which integrates this module.

The end user manual shall include all required regulatory information/warning as shown in this manual.

Limited module procedures

Not applicable

Integrated antenna design

The Sona TI351 Integrated antenna variant MUST BE located at the edge of the Host PCB and surrounded by ground on three sides. The antenna keep out region as defined above in Figure 8 must be kept clear of copper on all layers of the host PCB. Extending the ground on the Host PCB ≥ 15mm from the module edge in each direction will optimize antenna performance.

RF exposure considerations

Co-located issue shall be met as mentioned in Summarize the specific operational use conditions.

Product manufacturer shall provide the following text in the end-product manual:

> ***FCC Radiation Exposure Statement***
>
> ***The product complies with the US portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as***
>
> ***described in this manual. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set***
>
> ***the device to lower output power if such function is available.***

A 20-centimeter separation distance and co-located issue shall be met as mentioned in Summarize the specific operational use conditions.

Product manufacturer shall provide the following text in the end-product manual:

> ***This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and***
>
> ***operated with a minimum distance of 5.5 centimeters between the radiator and your body.***

Label and Compliance Information

Product manufacturers must provide, with the finished product, a physical or e-label that states the following:

Contains FCC ID: SQG-SONATI351

Information on Test Modes and Additional Testing Requirements

Test tool: The Texas Instruments Calibrator Tool shall be used to set the module to transmit continuously. Please contact Ezurio for further information and usage conditions.

Additional Testing, Part 15 Subpart B Disclaimer

The module is only FCC authorized for the specific rule parts listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 SubpartB compliance testing with the modular transmitter installed

5.2 Innovation, Science and Economic Development, Canada (ISED) Statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt

RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) L'appareil ne doit pas produire de brouillage;

(2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This radio transmitter (IC: 3147A-SONATI351) has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed in Table 4 above, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Le présent émetteur radio (IC: 3147A-SONATI351) a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci ci-dessus dans le tableau 4 et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué pour tout type figurant sur la liste, sont strictement interdits pour l'exploitation de l'émetteur.

Radiation Exposure Statement:

This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 5cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé. Cet équipement doit être installé et utilisé à distance minimum de 5cm entre le radiateur et votre corps.

This device is intended only for OEM integrators under the following conditions:

1) The transmitter module may not be co-located with any other transmitter or antenna.

As long as the condition above is met, further transmitter testing is not required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes:

1) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 1 condition ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE: In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

NOTE IMPORTANTE: Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être

utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

The final end product must be labeled in a visible area with the following: “Contains IC: 3147A-SONATI351".

Plaque signalétique du produit final

Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 3147A-SONATI351".

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dansle manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

6 Revision History

Version	Date	Notes	Contributor(s)	Approver
0.1	5 Apr 2024	Initial Draft	Dave Neperud	Andy Ross
0.2	29 Apr 2024	Added signal polarity comment for Pins 46 & 53 in Tables 1 & 2	Dave Neperud	Andy Ross
0.3	22 Oct 2024	Updated UART pin assignments. Added Regulatory Statements	Dave Neperud	Andy Ross
1.0	5 Nov 2024	Initial release	Dave Drogowski	Andy Ross
1.1	28 Feb 2025	Additional implementation guidance on the SDIO_WAKE#/HOST_IRQ_WL line for the M.2 1216 modules in Table 1: 453-00199 Pinout and Table 2: 453-00200 Pinout	Dave Neperud	Andy Ross

Ezurio's products are subject to standard Terms & Conditions.