

Datasheet

Veda™ IF912/13 Integrated Antenna Modules

Version 0.3

Revision History

Version	Date	Notes	Contributors	Approver
0.1	2025/11/25	Preliminary release	Andrew Chen	Andy Ross
0.2	2025/12/10	On section 6: Add the module pin out mapping to IFX main chip pin out	Andrew Chen	Andy Ross
0.3	2025/03/25	Update chip antenna to TDK chip antenna pn: ANT162442DT-2001A2 and add pattern and design information	Andrew Chen	Andy Ross

Contents

1	Scope.....	4
2	Introduction.....	4
2.1	General Description.....	4
3	Veda IF912/13 Integrated Antenna Modules Series Feature Summary	6
4	Specifications	7
5	Block Diagrams.....	13
5.1	Veda IF912/13 Integrated Antenna Modules Block Diagram	13
6	Pin Definitions.....	14
7	Veda IF912/13 Integrated Antenna Modules Implementation Details	17
7.1	Power up sequency timing.....	17
7.2	SDIO and gSPI strapping configuration.....	18
7.2.1	SDIO mode.....	18
7.2.2	gSPI mode	18
7.3	Antenna	19
8	PCB footprint.....	23
9	Mechanical Specifications.....	24
10	Material handling information	25
10.1	Required Storage Conditions	25
10.1.1	Prior to Opening the Dry Packing	25
10.1.2	After Opening the Dry Packing	25
10.1.3	Temporary Storage Requirements after Opening	25
10.2	Baking Conditions.....	26
11	Surface Mount Conditions.....	27
11.1	Recommended Stencil Aperture.....	27
11.2	Soldering profile.....	28
12	Cautions When Removing the SIP from the Platform for RMA.....	28
12.1.1	Precautions for Use.....	29
13	Antenna Performance.....	30
14	Additional Information	31

1 Scope

This document describes key hardware aspects of the Ezurio Veda™ IF912/13 integrated antenna modules series which are an ultra-low power, single chip connected MCUs with 1x1 Wi-Fi 6 (WiFi 6E for IF913), Bluetooth® Low Energy 5.4, Matter and IP networking. Integrated MCU, Radio, PMU, Flash and PSRAM in **19X20 mm** size that targeted at Internet-of- Things (IoT) applications for stand-alone operation or to offload a host-processor.

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 Infineon CYW55913 Reversion C 2024-10-30 data sheet, along with other documents provided by Infineon.

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

2 Introduction

2.1 General Description

The **Veda IF912/13 integrated antenna modules** are a highly integrated, small form factor Wi-Fi/Bluetooth module that is optimized for low-power mobile devices, featuring:

- **MCU:** 192 MHz Arm® Cortex®-CM33, runs the Wi-Fi and Networking Stacks.
- **Memory:**
 - On-Chip memory: 2048-KB ROM and 768-KB RAM. (No Embedded Memory variant)
 - Memory: 8M PSRAM, 16M Flash. Or 4M PSRAM, 8M Flash variant.

Note: For other memory size, please contact Ezurio.
- **Wi-Fi:**
 - 1X1, IEEE 802.11a/b/g/n/ac/ax compliant.
 - Dual band (**IF912:2.4/5GHz**) or Tri-band (**IF913:2.4/5-7 GHz**), 20 MHz channels supporting PHY data rates up to 802.11ax (MCS11 1024-QAM 5/6).
 - Transmit (TX) power with internal PA and LNA.
 - Wi-Fi 6 release feature:
 - OFDMA uplink and downlink as STA
 - Downlink multi-user MIMO as STA
 - Individual target-wake-time (TWT)
- **Bluetooth®:**
 - Bluetooth® 5.4 (Bluetooth® Low Energy)
 - Advertising Coding Selection
 - Encrypted Advertising Data
 - LE Generic Attribute Profile (GATT) Security Levels Characteristic
 - Bluetooth® Low Energy 5.0/5.1/5.2/5.3 features
 - LE long range
 - LE 2 Mbps
 - LE mesh
 - Advertising extensions
- **Security:**
 - Arm® Trustzone Cryptocell 312
 - Life cycle management
 - Crypto key establishment and management Crypto offloads
 - Secure boot
 - Wi-Fi and Bluetooth® independent firmware authentication
 - Firmware encryption
 - Attestation
 - Anti-rollback prevention

The **Veda IF912/13 integrated antenna modules** have all WLAN and Bluetooth functionality in a small package supports a low cost and simple implementation. The radio is pre-calibrated and integrates the complete transmit/receive RF paths including bandpass filter, diplexer, switches, reference crystal oscillator, and power management units (PMU). It is available in **19x20x2.15 mm solder-down LGA form factors** with integrated chip antenna for both Wi-Fi and BT.

Ordering information for **Veda IF912/13 integrated antenna modules** are listed in **Table 1**. Please contact Ezurio Sales/FAE for further information.

Table 1: Product ordering information

Part Number	Description
453-00574R	Module, Veda IF912, 4MB SRAM, 8MB Flash, SMT, Chip Antenna, Tape and Reel
453-00575R	Module, Veda IF912, 8MB SRAM, 16MB Flash, SMT, Chip Antenna, Tape and Reel
453-00573R	Module, Veda IF913, 4MB SRAM, 8MB Flash, SMT, Chip Antenna, Tape and Reel
453-00493R	Module, Veda IF913, 8MB SRAM, 16MB Flash, SMT, Chip Antenna, Tape and Reel
453-00574R	Module, Veda IF912, 4MB SRAM, 8MB Flash, SMT, Chip Antenna, Tape and Reel

3 Veda IF912/13 Integrated Antenna Modules Series Feature Summary

The Ezurio Veda IF912/13 integrated antenna modules series device features are described in Table 2.

Table 2: Veda IF912/13 series wireless module feature

Feature	Description
Radio Front End	<ul style="list-style-type: none"> Integrates the complete transmit/receive RF paths including bandpass filter, diplexer, switches, reference crystal oscillator, and power manage unit (PMU) Supports dual band (IF912:2.4/5G) or tri-band (IF913:2.4/5-7 GHz) Supports 20MHz channel bandwidth Supports 1x1 WLAN/Bluetooth antenna configuration

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One buck regulator, multiple LDO regulators, and a power management unit (PMU) are integrated into the Veda IF912/13 integrated antenna module. All regulators are programmable via the PMU. These blocks simplify power supply design for Bluetooth and WLAN functions in embedded designs.

Pre-Calibration	RF system tested and calibrated in production
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Sleep Clock Internal low-power oscillator accuracy is only adequate for WLAN, and not for Bluetooth®, if low power for Bluetooth® Low Energy required.
 External 32.768 KHz sleep clock is required for Bluetooth® Low Energy to support low power mode.
 The 32.768 kHz precision oscillator which meets the requirements listed following table must be used.

Parameter	LPO Clock	Unit
Nominal input frequency	32.768	kHz
Frequency accuracy	±250	ppm
Duty cycle	30 – 70	%
Input signal amplitude	200 – 3300	mV, p-p
Signal type	Square-wave or sine-wave	-
Input impedance	> 100k	Ω
	< 5	pF
Clock jitter (during initial startup)	< 10,000	ppm

Advanced WLAN	<ul style="list-style-type: none"> IEEE 802.11a/b/g/n/ac/ax compliant, dual-band (IF912:2.4/5G) or tri-band capable (IF913:2.4/5-7 GHz) 1x1 MIMO providing up to 143 Mbps PHY data rate for 2.4/5-7 GHz (1024-QAM modulation) Supports 20 MHz bandwidth with optional SGI (1024-QAM modulation) On-chip power amplifiers and low-noise amplifiers for both bands Support wide variety of WLAN encryption: WPA2(Personal/Enterprise), WPA3 (Personal/Enterprise with 192 bit security).
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Advanced Bluetooth	<ul style="list-style-type: none"> Bluetooth® 5.4 (Bluetooth® Low Energy) <ul style="list-style-type: none"> Advertising Coding Selection Encrypted Advertising Data LE Generic Attribute Profile (GATT) Security Levels Characteristic Bluetooth® Low Energy 5.0/5.1/5.2/5.3 features <ul style="list-style-type: none"> LE long range LE 2 Mbps LE mesh Advertising extensions Host controller interface (HCI) using a high speed UART and PCM/I2S for audio data Low power consumption improves battery life of IoT and embedded devices
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4 Specifications

Table 3: Specifications

Feature	Description
Physical size	19X20x2.15mm in 58-pin LGA package
Network communication interface	Secure Digital I/O 2.0 (1.8V only) /3.0; UART, gSPI, UART, SPI.
Main Chipset	Infineon AIROC™ CYW55912 for IF912; Infineon AIROC™ CYW55913 for IF913
Input Voltage Requirements	Typical DC 3.3 V, operating range from DC 3.13V to 4.8V
I/O Signalling Voltage	Typical DC 1.8 V ± 5%
Operating Temperature	-40° to +85°C (-40° to +185°F)
Operating Humidity	< 85% (non-condensing)
Storage Temperature	-40° to +85°C (-40° to +185°F)
Storage Humidity	5 to 95% (non-condensing)
MSL (Moisture Sensitivity Level)	4
Maximum Electrostatic Discharge	Conductive 8KV; Air coupled 12KV (follows EN61000-4-2)
Weight - g (oz.)	TBD
Network Architecture Types	Infrastructure (client operation)
Wi-Fi Standards	IEEE 802.11ax, 11ac, 11ac, 11a/b/g/n, 11d/h, 11i, 11r, 11w, 11e, 11k, 11ai, 11v
Bluetooth Standards	Bluetooth BLE 5.0, 5.1, 5.2, 5.3, 5.4
Wi-Fi Data Rates Supported	Support 802.11 ax/ac/a/b/g/n 1x1 MU-MIMO. 802.11b (DSSS, CCK) 1, 2, 5.5, 11 Mbps 802.11a/g (OFDM) 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11n (OFDM, HT20, MCS0-7) 802.11ac (OFDM, VHT20, MCS0-8) 802.11ax (2.4 GHz / OFDM / HE20 / MCS0-11; 2.4 GHz / OFDMA / HE20 / MCS0-11) 802.11ax (5 GHz, 6 GHz / OFDM / HE20 / MCS0-11; 5 GHz, 6 GHz / OFDMA / HE20 / MCS0-11)

Feature	Description
Modulation Table	BPSK, QPSK, CCK, 16-QAM, 64-QAM, 256-QAM, 1024-QAM

Modulation Type						OFDM (IEEE 802.11n/ac)		OFDM (IEEE 802.11ax)		
MCS Index			Spatial Stream	Modulation	Coding	20MHz		20MHz		
HT	VHT	HE				0.8us GI	0.4us GI	0.8us GI	1.6us GI	3.2us GI
0	0	0	1	BPSK	1/2	6.5	7.2	8.6	8.1	7.3
1	1	1	1	QPSK	1/2	13	14.4	17.2	16.3	14.6
2	2	2	1	QPSK	3/4	19.5	21.7	25.8	24.4	21.9
3	3	3	1	16-QAM	1/2	26	28.9	34.4	32.5	29.3
4	4	4	1	16-QAM	3/4	39	43.3	51.6	48.8	43.9
5	5	5	1	64-QAM	2/3	52	57.8	68.8	65	58.5
6	6	6	1	64-QAM	3/4	58.5	65	77.4	73.1	65.8
7	7	7	1	64-QAM	5/6	65	72.2	86	81.3	73.1
	8	8	1	256-QAM	3/4	78	86.7	103.2	97.5	87.8
	9	9	1	256-QAM	5/6	N/A	N/A	114.7	108.3	97.5
		10	1	1024-QAM	3/4			129	121.9	109.7
		11	1	1024-QAM	5/6			143.4	135.4	121.9

OFDMA (IEEE 802.11ax)															
MCS Index	Spatial Stream	Modulation	Coding	26-tone RU			52-tone RU			106-tone RU			242-tone RU		
				0.8us GI	1.6us GI	3.2us GI	0.8us GI	1.6us GI	3.2us GI	0.8us GI	1.6us GI	3.2us GI	0.8us GI	1.6us GI	3.2us GI
0	1	BPSK	1/2	0.9	0.8	0.8	1.8	1.7	1.5	3.8	3.5	3.2	8.6	8.1	7.3
1	1	QPSK	1/2	1.8	1.7	1.5	3.5	3.3	3	7.5	7.1	6.4	17.2	16.3	14.6
2	1	QPSK	3/4	2.6	2.5	2.3	5.3	5	4.5	11.3	10.6	9.6	25.8	24.4	21.9
3	1	16-QAM	1/2	3.5	3.3	3	7.1	6.7	6	15	14.2	12.8	34.4	32.5	29.3
4	1	16-QAM	3/4	5.3	5	4.5	10.6	10	9	22.5	21.3	19.1	51.6	48.8	43.9
5	1	64-QAM	2/3	7.1	6.7	6	14.1	13.3	12	30	8.3	25.5	68.8	65	58.5
6	1	64-QAM	3/4	7.9	7.5	6.8	15.9	15	13.5	33.8	31.9	28.7	77.4	73.1	65.8
7	1	64-QAM	5/6	8.8	8.3	7.5	17.6	16.7	15	37.5	35.4	31.9	86	81.3	73.1
8	1	256-QAM	3/4	10.6	10	9	21.2	20	18	45	42.5	38.3	103.2	97.5	87.8
9	1	256-QAM	5/6	11.8	11.1	10	3.5	22.2	20	50	47.2	42.5	114.7	108.3	97.5
10	1	1024-QAM	3/4	13.2	12.5	11.3	26.5	25	22.5	56.3	53.1	47.8	129	121.9	109.7
11	1	1024-QAM	5/6	14.7	13.9	12.5	29.4	27.8	25	62.5	59	53.1	143.4	135.4	121.9

802.11ax/ac/n Spatial Streams 1 (1x1 MU-MIMO)

Bluetooth Modulation GFSK @ 1, 2 Mbps
GFSK @ 125, 500 Kbps


Regulatory Certifications United States (FCC)
EU - Member countries of European Union (ETSI)
Great Britain (UKCA)
Canada (ISED)
Australia/New Zealand (RCM)
Japan (MIC)

2.4 GHz Frequency Bands EU: 2.4 GHz to 2.483 GHz
FCC/ISED: 2.4 GHz to 2.473 GHz
UKCA: 2.4 GHz to 2.483 GHz
MIC: 2.4 GHz to 2.483 GHz
RCM: 2.4 GHz to 2.483 GHz

Feature	Description		
5 GHz Frequency Bands	EU 5.15 GHz to 5.35 GHz 5.47 GHz to 5.725 GHz 5.725 GHz to 5.85 GHz		
	FCC 5.15 GHz to 5.35 GHz 5.47 GHz to 5.725 GHz 5.725 GHz to 5.85 GHz		
	ISED 5.15 GHz to 5.35 GHz 5.47 GHz to 5.725 GHz 5.725 GHz to 5.85 GHz		
	UKCA 5.15 GHz to 5.35 GHz 5.47 GHz to 5.730 GHz 5.725 GHz to 5.850 GHz		
	MIC 5.15 GHz to 5.35 GHz 5.47 GHz to 5.725 GHz		
	RCM 5.15 GHz to 5.35 GHz 5.47 GHz to 5.725 GHz 5.725 GHz to 5.85 GHz		
	6 GHz Frequency Bands (For IF913 only)	FCC / ISED UNII-5, 5.925 GHz to 6.415 GHz UNII-6, 6.435 GHz to 6.515 GHz UNII-7, 6.535 GHz to 6.875 GHz UNII-8, 6.895 GHz to 7.115 GHz	
		EU UNII-5, 5.945 GHz to 6.425 GHz	
		UKCA UNII-5, 5.945 GHz to 6.425 GHz	
		MIC UNII-5, 5.945 GHz to 6.425 GHz	
		RCM UNII-5, 5.945 GHz to 6.425 GHz	
		Transmit Power	802.11a 6 Mbps 17 dBm (50.11 mW) 54 Mbps 16.5 dBm (44.66 mW)
			802.11b 1 Mbps 18 dBm (63.09 mW) 11 Mbps 18 dBm (63.09 mW)
			802.11g 6 Mbps 18 dBm (63.09 mW) 54 Mbps 17 dBm (50.11 mW)
802.11n (2.4 GHz) HT20; MCS0-4 18 dBm (63.09 mW) HT20; MCS5-7 16 dBm (39.81 mW)			
802.11ax (2.4 GHz)			
<i>Note: Transmit power on each channel varies per individual country regulations. All values are nominal with +/-2 dBm tolerance at room temperature. Tolerance could be up to +/-2.5 dBm across operating temperature.</i>			
<i>Note: HT20/VHT20/HE20 – 20 MHz-wide channels</i>			

Feature	Description	
	HE20; MCS0-4	18 dBm (63.09 mW)
	HE20; MCS5-7	16 dBm (39.81 mW)
	HE20; MCS8-9	14 dBm (25,11 mW)
	HE20; MCS13	10.5 dBm (19.95 mW)
	802.11n (5 GHz)	
	HT20; MCS0-4	17 dBm (50.11 mW)
	HT20; MCS5-7	16.5 dBm (44.66 mW)
	802.11ac (5 GHz)	
	VHT20; MCS0-4	17 dBm (50.11 mW)
	VHT20; MCS5-7	16.5 dBm (44.66 mW)
	VHT20; MCS8	14 dBm (25.12 mW)
	802.11ax (5 GHz)	
	HE20; MCS0-4	17 dBm (50.11 mW)
	HE20; MCS5-7	16.5 dBm (44.66 mW)
	HE20; MCS8-9	14 dBm (25.12 mW)
	HE20; MC10-11	13 dBm (19.95 mW)
	802.11ax (6 Hz, UNII-5 / 6) ---IF913 only	
	11a; 6M-24M	15.5 dBm (35.48 mW)
	HE20; MCS0-4	15.5 dBm (35.48 mW)
	HE20; MCS5-7	15 dBm (31.62 mW)
	HE20; MCS8-9	13.5 dBm (22.38 mW)
	HE20; MCS10-11	12 dBm (15.85 mW)
	802.11ax (6 Hz, UNII-7 / 8) ---IF913 only	
	11a; 6M-24M	15 dBm (31.62 mW)
	HE20; MCS0-4	15 dBm (31.62 mW)
	HE20; MCS5-7	13 dBm (19.95 mW)
	HE20; MCS8-9	12 dBm (15.85 mW)
	HE20; MCS10-11	10.5 dBm (11.22 mW)
	Bluetooth	
	LE (1 Mbps, 2 Mbps)	7 dBm (5.01 mW) , Maximum
	LE-LR (S=2, S=8)	7 dBm (5.01 mW) , Maximum

Feature	Description
Typical Receiver Sensitivity (PER < = 10%)	802.11a:
	6 Mbps -92 dBm
<i>Note: All values nominal, +/-2 dBm.</i>	54 Mbps -75 dBm
	802.11b:
	1 Mbps -97 dBm (PER < 8%)
	11 Mbps -90 dBm (PER < 8%)
	802.11g:
	6 Mbps -94 dBm
	54 Mbps -77 dBm
	802.11n (2.4 GHz)
	6.5 Mbps (MCS0; HT20) -94 dBm
	65 Mbps (MCS7; HT20) -75 dBm
	802.11ax (2.4 GHz)
	7.3 Mbps (MCS0; HE20) -94 dBm
	121.9 Mbps (MCS11; HE20) -64 dBm
	7.3 Mbps (MCS0; HE20/RU242) -94 dBm
	802.11n (5 GHz)
	6.5 Mbps (MCS0; HT20) -92 dBm
	65 Mbps (MCS7; HT20) -73 dBm
	802.11ac (5 GHz)
	6.5 Mbps (MCS0; VHT20) -92 dBm
	78 Mbps (MCS8; VHT20) -70 dBm
	802.11ax (5 GHz)
	7.3 Mbps (MCS0; HE20) -92 dBm
	121.9 Mbps (MCS11; HE20) -61 dBm
	7.3 Mbps (MCS0; HE20/RU242) -92 dBm
	802.11ax (6 GHz, UNII-5) ---IF913 only
	6 Mbps -90 dBm
	24 Mbps -83 dBm
	7.3 Mbps (MCS0; HE20) -90 dBm
	121.9 Mbps (MCS11; HE20) -59 dBm
	7.3 Mbps (MCS0; HE20/RU242) -90 dBm
	802.11ax (6 GHz, UNII-6) ---IF913 only
	6 Mbps -90 dBm
	24 Mbps -82 dBm
	7.3 Mbps (MCS0; HE20) -90 dBm
	121.9 Mbps (MCS11; HE20) -59 dBm
	7.3 Mbps (MCS0; HE20/RU242) -90 dBm
	802.11ax (6GHz, UNII-7) ---IF913 only
	6 Mbps -89 dBm
	24 Mbps -81 dBm
	7.3 Mbps (MCS0; HE20) -89 dBm
	121.9 Mbps (MCS11; HE20) -58 dBm
	7.3 Mbps (MCS0; HE20/RU242) -89 dBm
	802.11ax (6 GHz, UNII-8) ---IF913 only
	6 Mbps -88 dBm
	24 Mbps -80 dBm
	7.3 Mbps (MCS0; HE20) -88 dBm
	121.9 Mbps (MCS11; HE20) -56 dBm
	7.3 Mbps (MCS0; HE20/RU242) -88 dBm

Feature	Description
	Bluetooth: LE-1 Mbps -96 dBm LE-2 Mbps -94 dBm LE-LR (S=2) -102 dBm LE-LR (S=8) -107 dBm
Operating Systems Supported	ThreadX RTOS NetX Secure TLS 1.3 NetX Duo (TCP/IP)
Security	WPA, WPA2 (Enterprise) and WPA3 (Enterprise) support for powerful encryption and authentication
Compliance	EU EN 300 328 EN 62368-1:2014 EN 301 489-1 EN 300 440 EN 301 489-17 EN 303 687 EN 301 893 2011/65/EU (RoHS)
	FCC 47 CFR FCC Part 15.247 RSS-247 47 CFR FCC Part 15.407 RSS-248 47 CFR FCC Part 2.1091
	ISED Canada RSS-247 RSS-248
	AS/NZS AS/NZS 4268:2017
	MIC ARIB STD-T66/RCR STD-33 (2.4 GHz) ARIB STD-T71 (5 GHz) Article 2 Paragraph 1 of Item 80 : LPI (ZR), 6 GHz
Certifications	Bluetooth® SIG Qualification TBD 
Warranty	One Year Warranty
All specifications are subject to change without notice	

5 Block Diagrams

5.1 Veda IF912/13 Integrated Antenna Modules Block Diagram

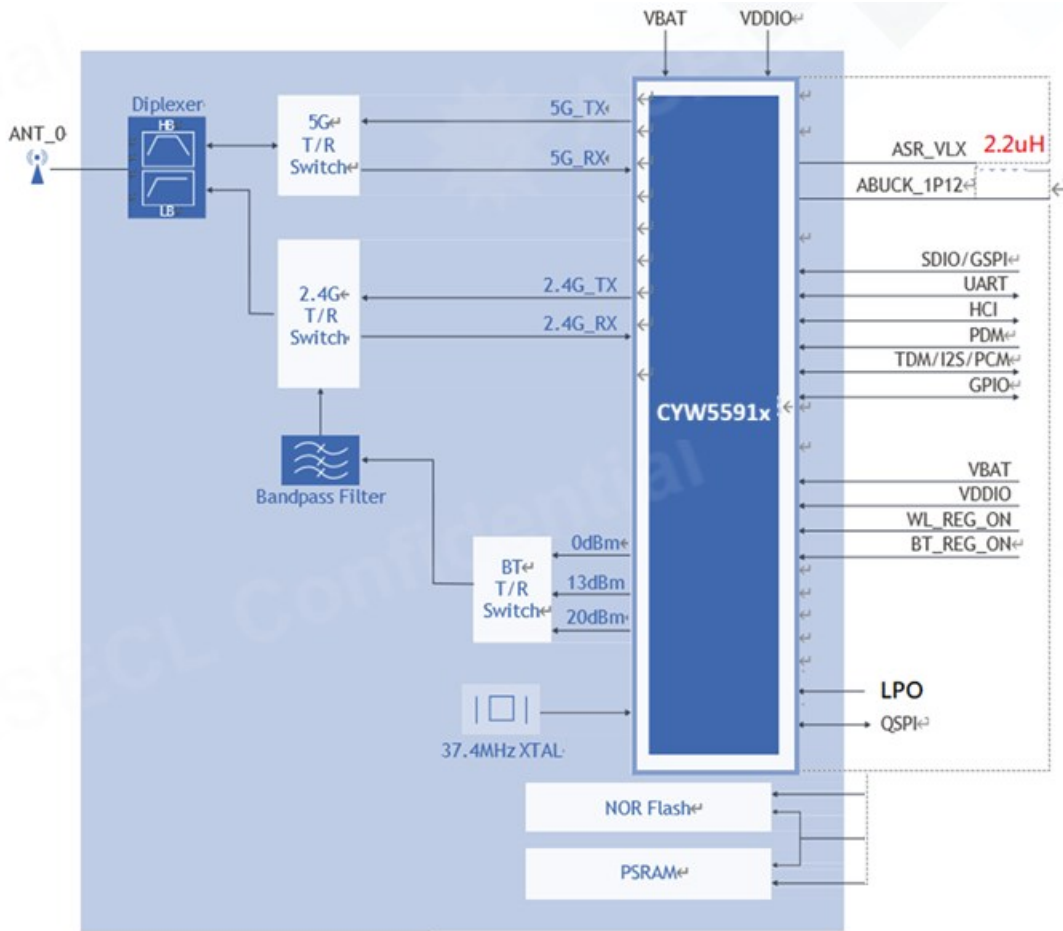


Figure 1: Veda IF912/13 integrated antenna modules block diagram

6 Pin Definitions

Pin #	Name	Type	Voltage Ref.	Function	Main chip pin out	If Not Used
1	GND	-	-	Ground		GND
2	LHL_GPIO_2	I/O	VDDIO	Miscellaneous general purpose GPIO_2	H6	NC
3	LHL_GPIO_4	I/O	VDDIO	Miscellaneous general purpose GPIO_4	H4	NC
4	LHL_GPIO_3	I/O	VDDIO	Miscellaneous general purpose GPIO_3	H5	NC
5	LHL_GPIO_5	I/O	VDDIO	Miscellaneous general purpose GPIO_5	H3	NC
6	LHL_GPIO_0 WL_HOST_WAKE	O	VDDIO	WLAN HOST WAKE / Programmable General purpose I/O	G10	NC
7	LPO_IN (eLPO)	I	VDDIO	External sleep clock input (32.768 KHz) Note: Needed for Bluetooth® Low Energy to support low power mode.	J5	-
8	GND	-	-	Ground	-	GND
9	MIC_P	I	VDDIO	ADC microphone positive input	E8	NC
10	GND	-	-	Ground	-	GND
11	BT_UART_TXD	O	VDDIO	UART Serial Output. Serial data output for the HCI UART interface.	F7	NC
12	BT_UART_RXD	I	VDDIO	UART Serial Input. Serial data input for the HCI UART interface.	G6	NC
13	BT_UART_RTS_N	O	VDDIO	UART request-to-send. Active-low request-to-send signal for the HCI UART interface. Bluetooth® LED control pin.	G7	NC
14	BT_UART_CTS_N	I	VDDIO	UART clear-to-send. Active-low clear-to-send signal for the HCI UART interface.	F6	NC
15	REG_ON	I	VDDIO	Used by the PMU to power up or power down the internal CYW5591x regulators. When deasserted, this pin holds the chip in reset. This pin has an internal 50 kΩ pull-down resistor that is auto enabled and disabled upon recognizing high on this pin.	C8	-
16	GND	-	-	Ground	-	GND
17	TDM2_MCK	I/O	VDDIO	TDM2 Interface Master Clock / I2S Master Clock / PCM interface	B1	NC
18	TDM2_SCK	I/O	VDDIO	TDM2 Interface Slave Clock / I2S Interface Clock / PCM interface	A1	NC
19	TDM2_DI	I/O	VDDIO	TDM2 Interface Data In / I2S Interface Data In / PCM interface	D2	NC

Pin #	Name	Type	Voltage Ref.	Function	Main chip pin out	If Not Used
20	TDM2_DO	I/O	VDDIO	TDM2 Interface Data Out / I2S Interface Data Out / PCM interface	C1	NC
21	TDM2_WS	I/O	VDDIO	TDM2 Interface Word Select / I2S Interface Word Select / PCM interface	A2	NC
22	GND	-	-	Ground	-	GND
23	VBAT	PWR	3.3V	<p>Main DC supply voltage for module. Operational: VBAT is 3.0V to 4.8V</p> <ul style="list-style-type: none"> VBAT and VDDIO should not rise 10%–90% faster than 40 microseconds. VBAT should be up before or at the same time as VDDIO. VDDIO should NOT be present first or be held high before VBAT is high. 	B10/C10/D10	VBAT
24	GND	-	-	Ground	-	GND
25	SDIO_CLK	I	VDDIO	SDIO Clock Input / gSPI Clock Interface	A7	NC
26	SDIO_CMD	I/O	VDDIO	SDIO Command Line/ gSPI MOSI Interface	A6	NC
27	SDIO_DATA_0	I/O	VDDIO	SDIO Data line 0/ gSPI MISO Interface	B6	NC
28	SDIO_DATA_1	I/O	VDDIO	SDIO Data line 1/ gSPI interrupt Interface	B7	NC
29	SDIO_DATA_2	I/O	VDDIO	<p>SDIO Data line 2/ gSPI Interface</p> <p><i>This pin also used for strapping option for SDIO or gSPI. Default pull during strapping="H" for SDIO bus; pull it "L" during for gSPI bus.</i></p>	C7	NC
30	SDIO_DATA_3	I/O	VDDIO	SDIO Data line 3/ gSPICS Interface	C6	NC
31	GND	-	-	Ground	-	GND
32	VDDIO	PWR input	-	<p>1.8 V IO supply for WLAN GPIOs</p> <ul style="list-style-type: none"> VBAT and VDDIO should not rise 10%–90% faster than 40 microseconds. 	D6/E9/F4	NC
33	BT_GPIO_17	I/O	VDDIO	Bluetooth® general purpose I/O	C3	NC
34	BT_GPIO_16	I/O	VDDIO	Bluetooth® general purpose I/O	B3	NC
35	BT_GPIO_7	I/O	VDDIO	Bluetooth® general purpose I/O	A3	NC
36	BT_GPIO_0	I/O	VDDIO	Bluetooth® general purpose I/O	F1	NC
37	GND	-	-	Ground	-	GND
38	BT_GPIO_5	I/O	VDDIO	Bluetooth® general purpose I/O	D7	NC
39	BT_GPIO_6	I/O	VDDIO	Bluetooth® general purpose I/O	E6	NC

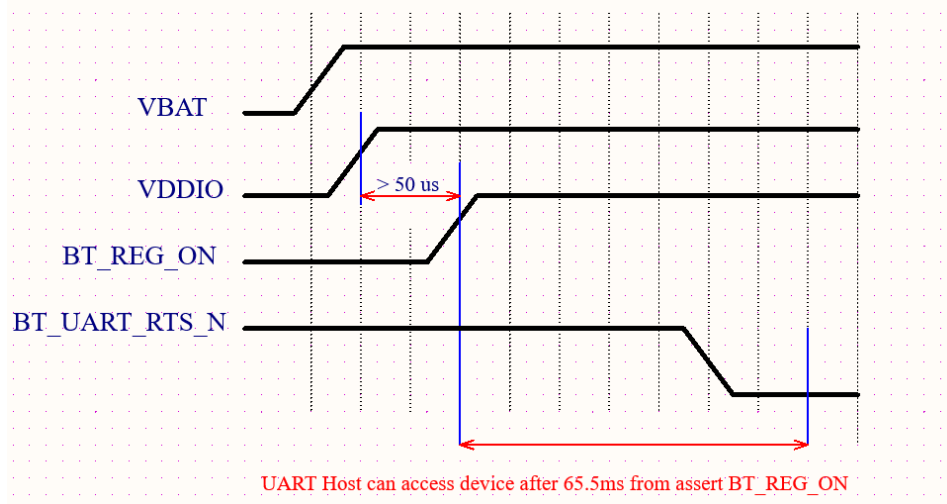
Pin #	Name	Type	Voltage Ref.	Function	Main chip pin out	If Not Used
40	BT_GPIO_3	I/O	VDDIO	Bluetooth® general purpose I/O	E5	NC
41	BT_GPIO_4	I/O	VDDIO	Bluetooth® general purpose I/O	F5	NC
42	BT_GPIO_2	I/O	VDDIO	Bluetooth® general purpose I/O	E4	NC
43	LHL_GPIO_6	I/O	VDDIO	Miscellaneous general purpose GPIO_6	G1	NC
44	LHL_GPIO_9	I/O	VDDIO	Miscellaneous general purpose GPIO_9	H1	NC
45	LHL_GPIO_8	I/O	VDDIO	Miscellaneous general purpose GPIO_8	G2	NC
46	GND	-	-	Ground	-	GND
47	DMIC_CLK	I/O	VDDIO	Digital mic clock	D1	NC
48	DMIC_DATA	I/O	VDDIO	Digital mic data	E1	NC
49	GND	-	-	Ground	-	GND
50	TDM1_SCK	I/O	VDDIO	TDM1 Interface Slave Clock / I2S Interface Clock / PCM interface	E3	NC
51	TDM1_MCK	I/O	VDDIO	TDM1 Interface Master Clock / I2S Master Clock / PCM interface	E2	NC
52	TDM1_WS	I/O	VDDIO	TDM1 Interface Word Select / I2S Interface Word Select / PCM interface	D3	NC
53	TDM1_DO	I/O	VDDIO	TDM1 Interface Data Out / I2S Interface Data Out / PCM interface	F3	NC
54	TDM1_DI	I/O	VDDIO	TDM1 Interface Data In / I2S Interface Data In / PCM interface	D4	NC
55	BT_HOST_WAKE	O	VDDIO	Host wake up	F2	NC
56	BT_DEV_WAKE	I	VDDIO	Bluetooth Device Wake-up	J3	NC
57	WL_DEV_WAKE	I	VDDIO	WLAN Device Wake-up / Programmable General purpose I/O	J2	NC
58	GND	-	-	Ground		GND
G1-G10	GND	-	-	Ground		GND

7 Veda IF912/13 Integrated Antenna Modules Implementation Details

7.1 Power up sequency timing

To maintain stable MCU and Bluetooth starting up, below power up sequency timing is required.

- VBAT and VDDIO should not rise 10%–90% faster than 40 microseconds.
- VBAT should be up before or at the same time as VDDIO. VDDIO should NOT be present first or be held high before VBAT is high.



7.2 SDIO and gSPI strapping configuration

SDIO and gSPI in Veda IF912/13 integrated antenna modules are muxed together on the same pin out, please reference the pin definition table.

A strapping option pin **SDIO_DATA[2]** is used to configure between SDIO and gSPI. Default is in "H" state which is SDIO mode. Pull this pin to "L" will be set in gSPI mode.

7.2.1 SDIO mode

Veda IF912/13 integrated antenna modules provide support for SDIO V3.0, including the new UHS-I modes:

- DS: Default speed (DS) up to 25 MHz, including 1 and 4-bit modes **(1.8 V signaling)**
- HS: High-speed up to 50 MHz **(1.8 V signaling)**
- SDR12: SDR up to 25 MHz (1.8 V signaling)
- SDR25: SDR up to 50 MHz (1.8 V signaling)
- SDR50: SDR up to 100 MHz (1.8 V signaling)
- DDR50: DDR up to 50 MHz (1.8 V signaling)

Notes: 1. The UHS-1 rate SDR104, that is part of the SDIO V 3.0 specification, is not supported.

2. Veda IF913 is backward compatible with SDIO V 2.0 host interfaces. Note however that it can only support 1.8 V signalling. It cannot support 3.3 V signalling during initialization post power cycle and in default/high speed SDIO V 2.0 modes. The host must use 1.8 V signalling.

According to the SDIO specification, pull-ups in the 10 kΩ to 100 kΩ range are required on the four DATA lines and the CMD line. This requirement must be met during all operating states either through the use of external pull-up resistors or through proper programming of the SDIO host's internal pull-ups.

7.2.2 gSPI mode

Veda IF912/13 integrated antenna modules has the option of using the simplified generic SPI (gSPI) interface/protocol.

Characteristics of the gSPI mode include:

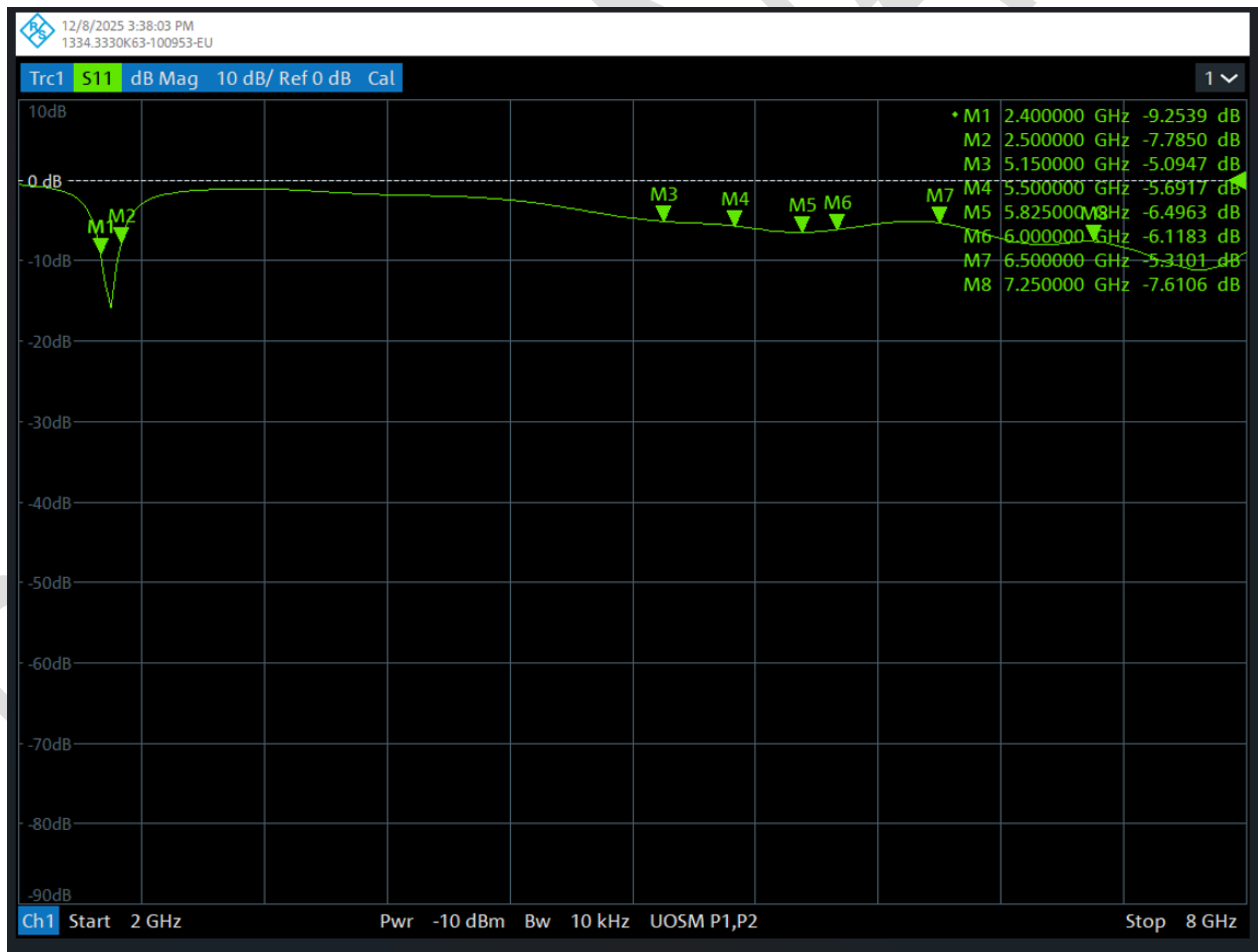
- Up to 50-MHz operation
- Fixed delays for responses and data from the device
- Alignment to host gSPI frames (16 or 32 bits)
- Up to 2-KB frame size per transfer
- Little-endian and big-endian configurations
- A configurable active edge for shifting
- Packet transfer for CCM/CP Traffic/Data Exchange

Note: gSPI mode is enabled using the strapping option pins

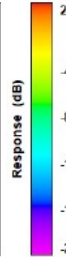
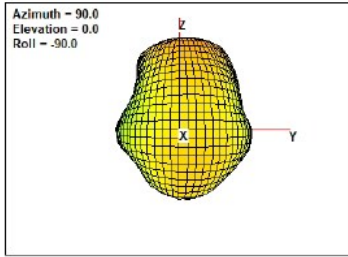
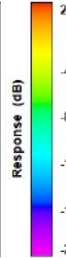
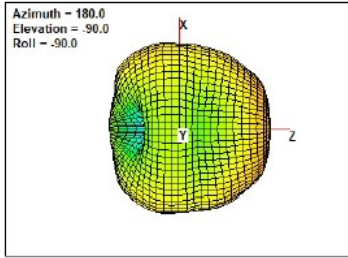
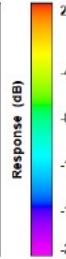
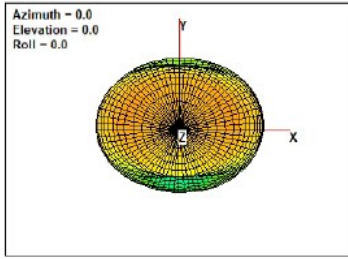
7.3 Antenna

- ✓ Please copy the components, location and keep out area on the DVK to maintain the RF performance and adopt Ezurio certification grant.
- ✓ **Veda IF912/13 integrated antenna modules** should be placed on the **middle edge** of the host PCB to maintain the best performance.
- ✓ The copper keep out area should follow the DVK design. Please reference the PCB footprint on section 8.
- ✓ Antenna detail performances are shown in below.

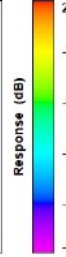
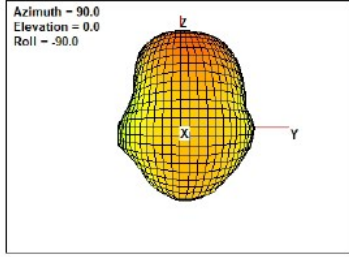
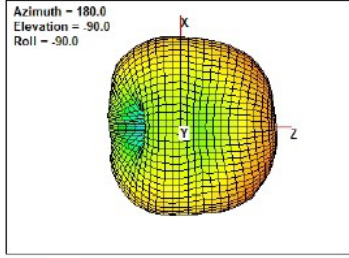
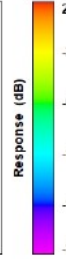
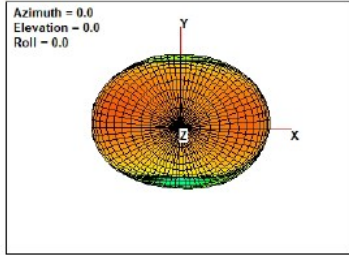
Model	ICC(Ezurio)_Veda IF913_2_A_WWAN_3D_Gain_FS_2400-7125MHz_Step15									
Test / Position	Gain /Free Space									
Frequency	2400	2442	2484	5150	5470	5850	5925	6425	6525	7125
Ant. Port Input Pwr. (dB)	0	0	0	0	0	0	0	0	0	0
Tot. Rad. Pwr. (dB)	-3.40	-2.22	-1.81	-3.49	-2.98	-2.60	-2.55	-2.19	-2.14	-3.04
Peak EIRP (dB)	0.38	1.51	2.17	-0.15	0.59	0.73	0.67	0.68	1.05	1.18
Directivity (dBi)	3.78	3.74	3.99	3.34	3.58	3.33	3.22	2.87	3.19	4.22
Efficiency (dB)	-3.40	-2.22	-1.81	-3.49	-2.98	-2.60	-2.55	-2.19	-2.14	-3.04
Efficiency (%)	45.68	59.93	65.87	44.75	50.35	54.91	55.63	60.41	61.15	49.68
Gain (dBi)	0.38	1.51	2.17	-0.15	0.59	0.73	0.67	0.68	1.05	1.18
NHPRP ±Pi/4 (dB)	-5.18	-4.02	-3.72	-4.83	-4.21	-3.88	-3.83	-3.50	-3.41	-4.27
NHPRP ±Pi/6 (dB)	-6.68	-5.62	-5.42	-6.28	-5.59	-5.39	-5.35	-5.03	-4.89	-5.65



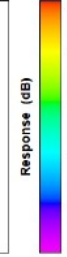
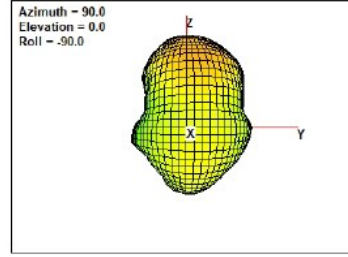
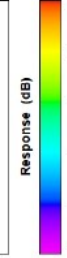
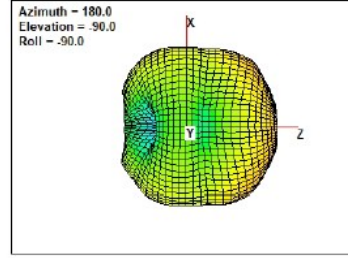
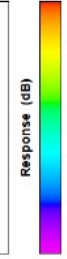
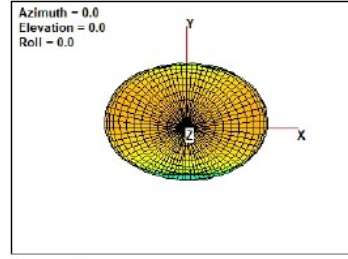
2400MHz



2442MHz

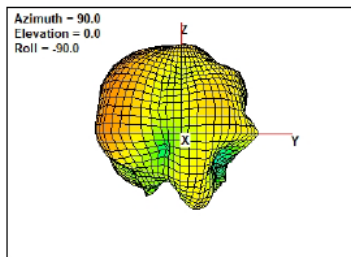
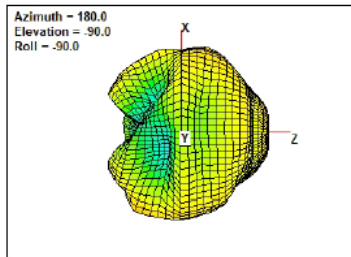
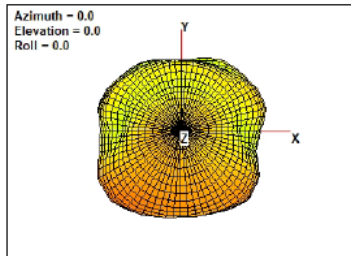


2484MHz

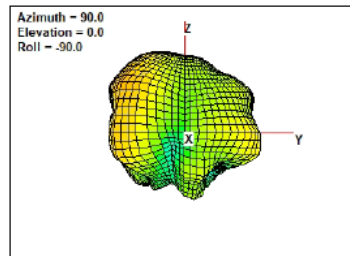
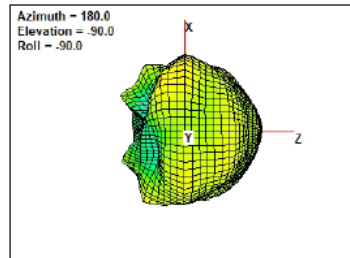
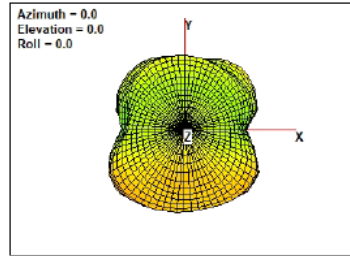


PRELIMINARY

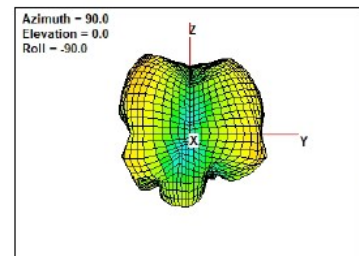
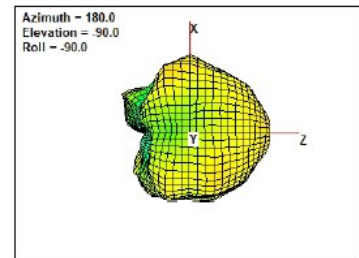
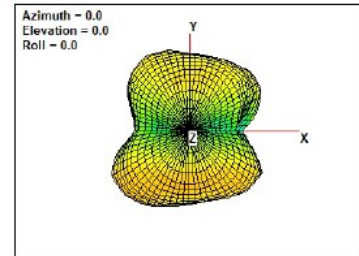
5150MHz



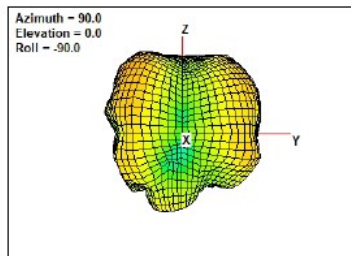
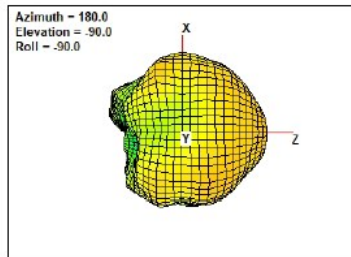
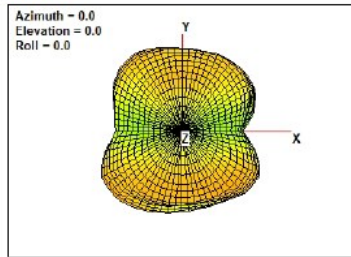
5470MHz



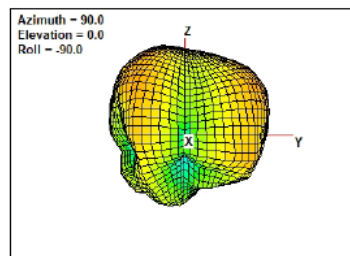
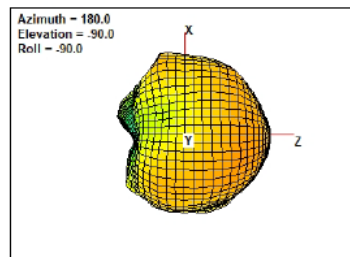
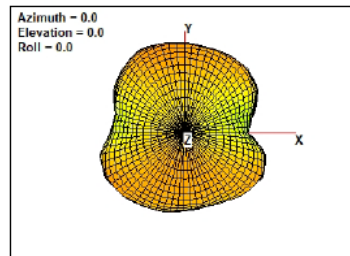
5850MHz



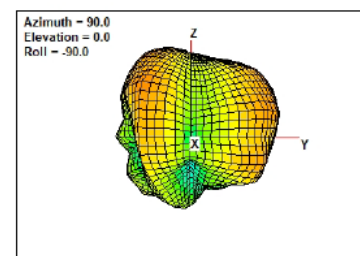
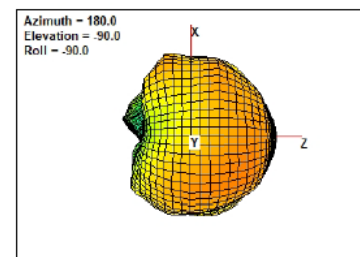
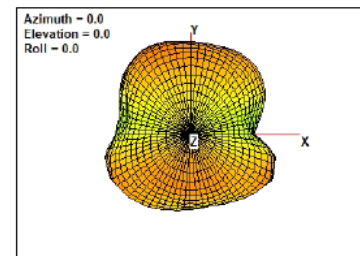
5925MHz



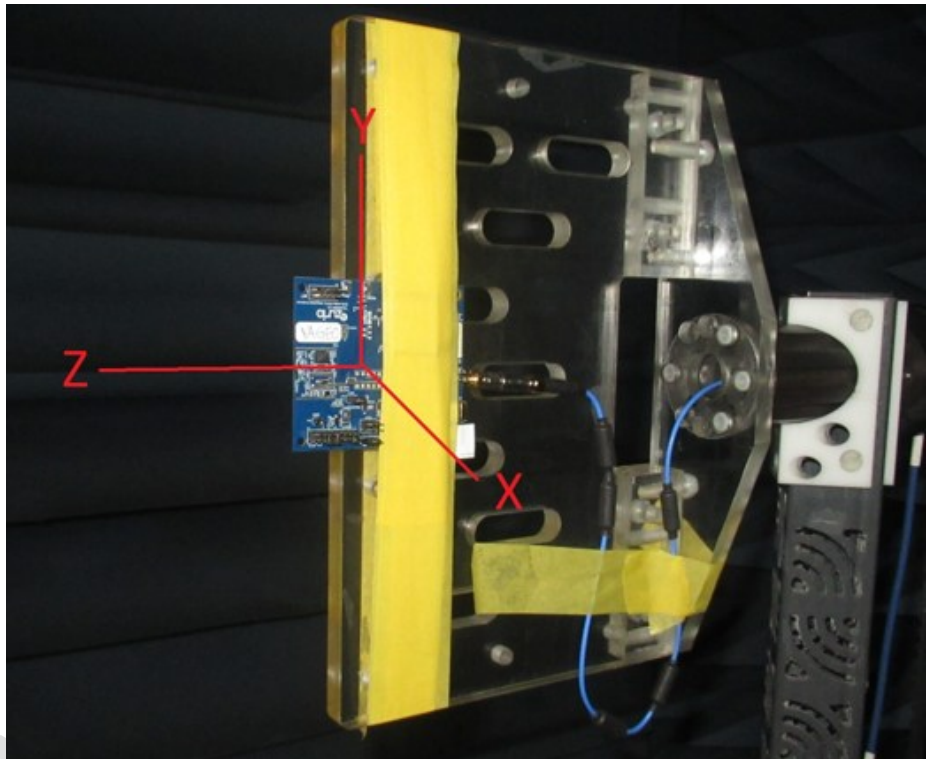
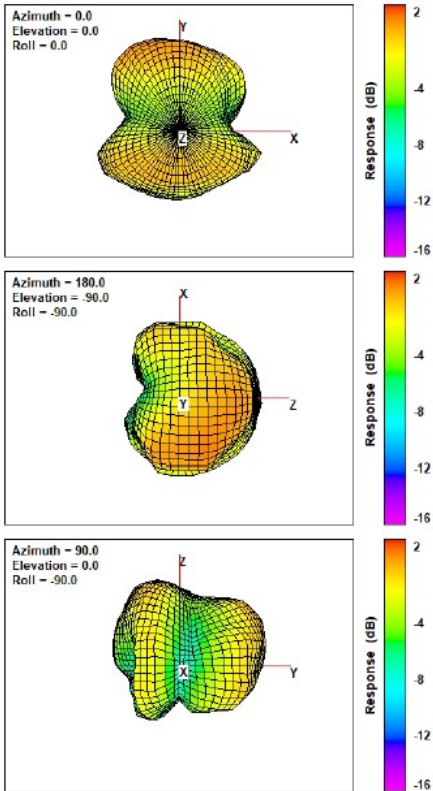
6425MHz



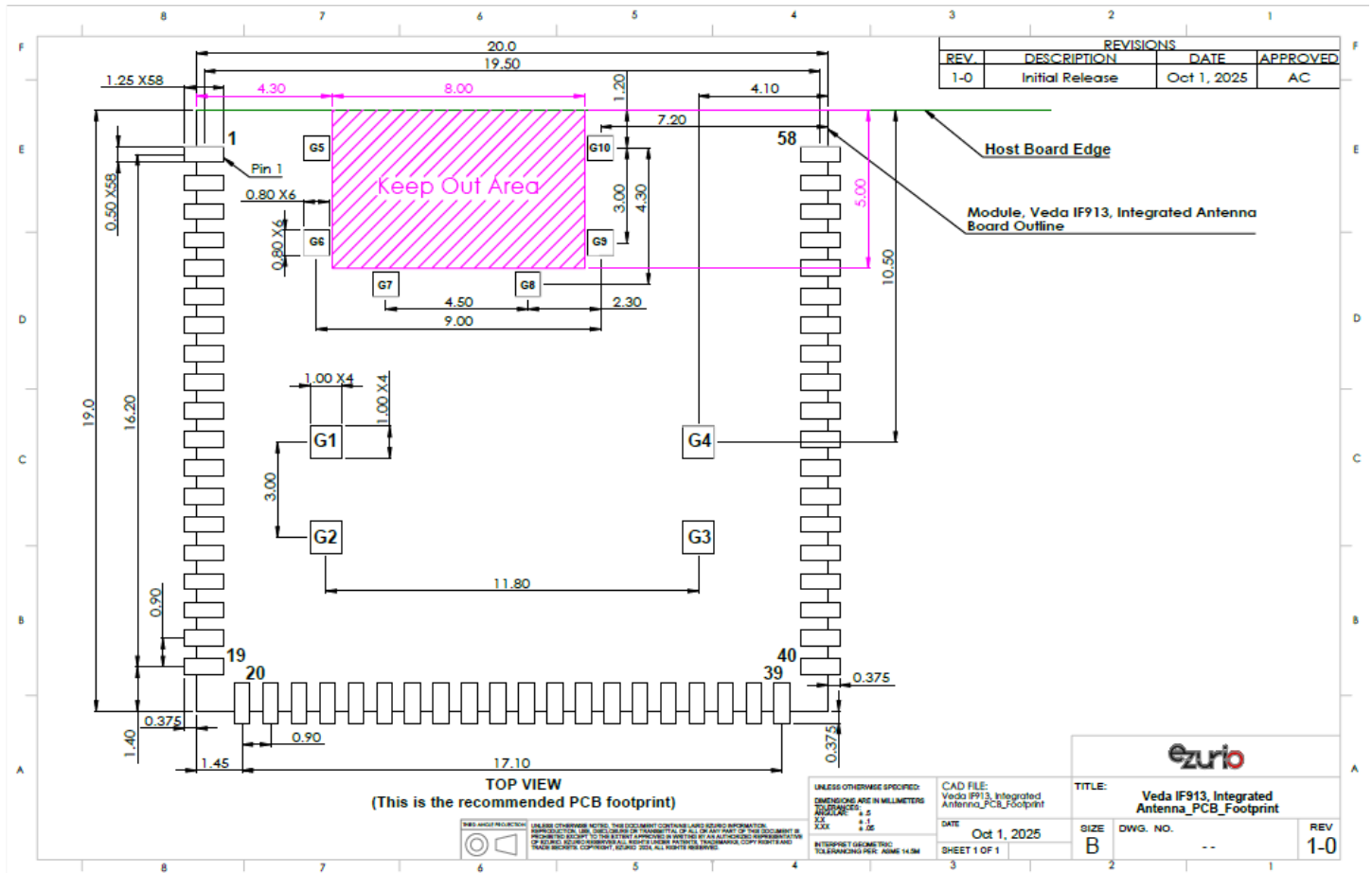
6525MHz



7125MHz



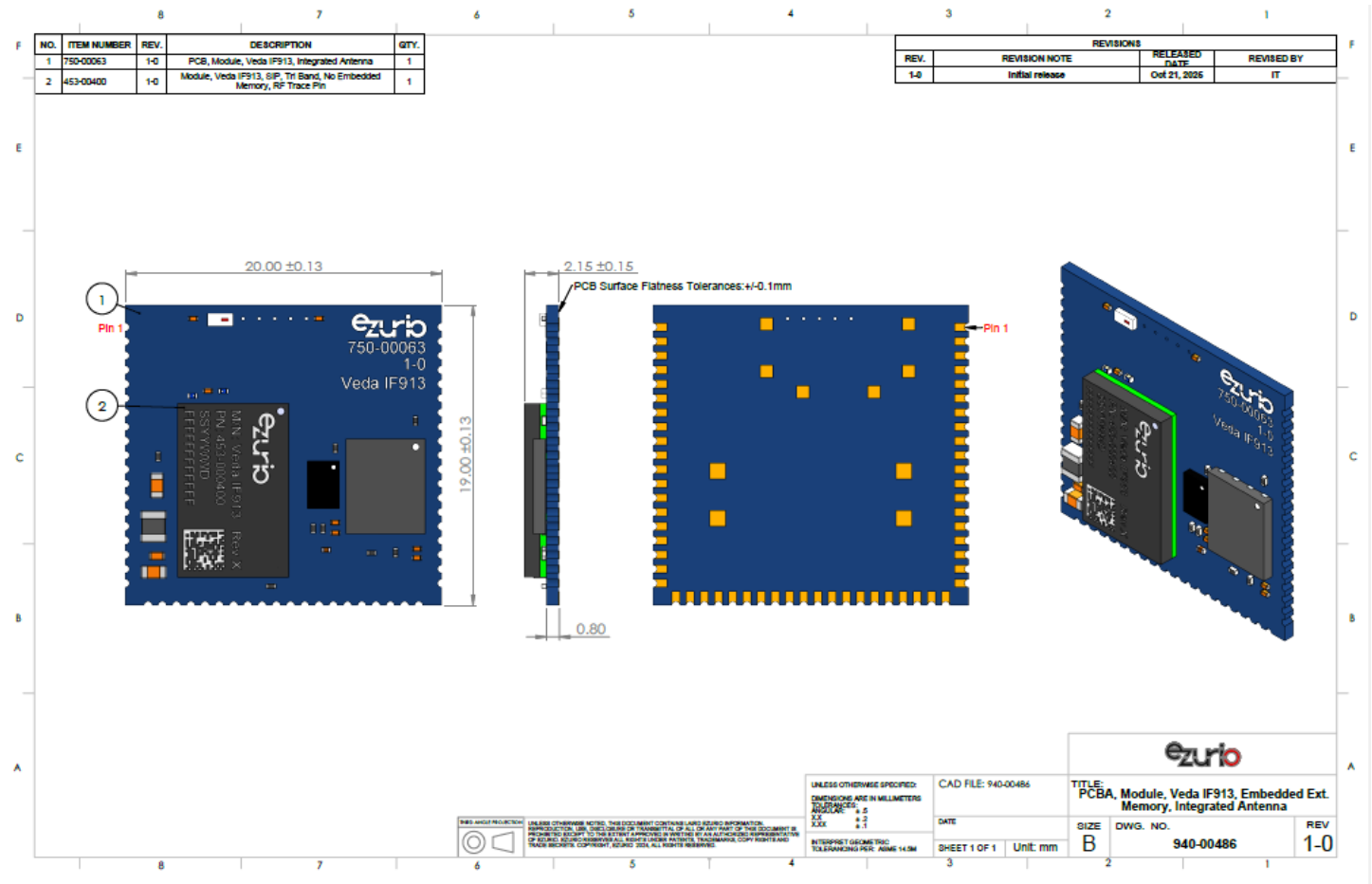
8 PCB footprint



Note: Module should be placed at middle edge of the host PCB. Please reference Ezurio DVK design.

9 Mechanical Specifications

Veda IF912/13 integrated antenna modules package is 20 x 19 x 2.15 mm. Detailed drawings are shown in



10 Material handling information

10.1 Required Storage Conditions

10.1.1 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.

10.1.2 After Opening the Dry Packing

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

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

Note: Should keep A+B within 72 hours.

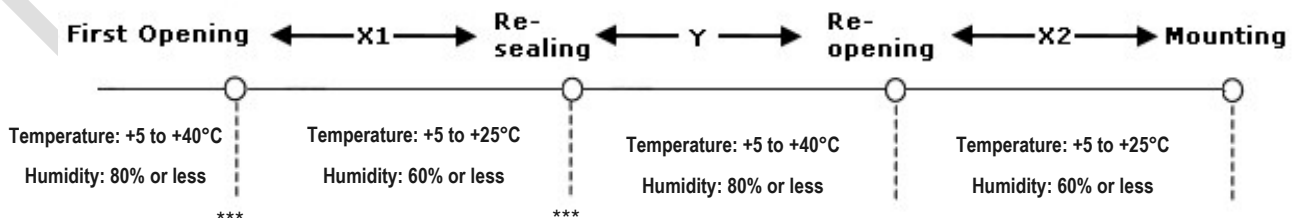
10.1.3 Temporary Storage Requirements after Opening

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 [Material handling information](#)
 - Required Storage Conditions. Keep is X1+X2 within 72 hours.

- Y - Keep within two weeks or less.

10.2 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 module 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).

11 Surface Mount Conditions

The following soldering conditions are recommended to ensure device quality.

11.1 Recommended Stencil Aperture

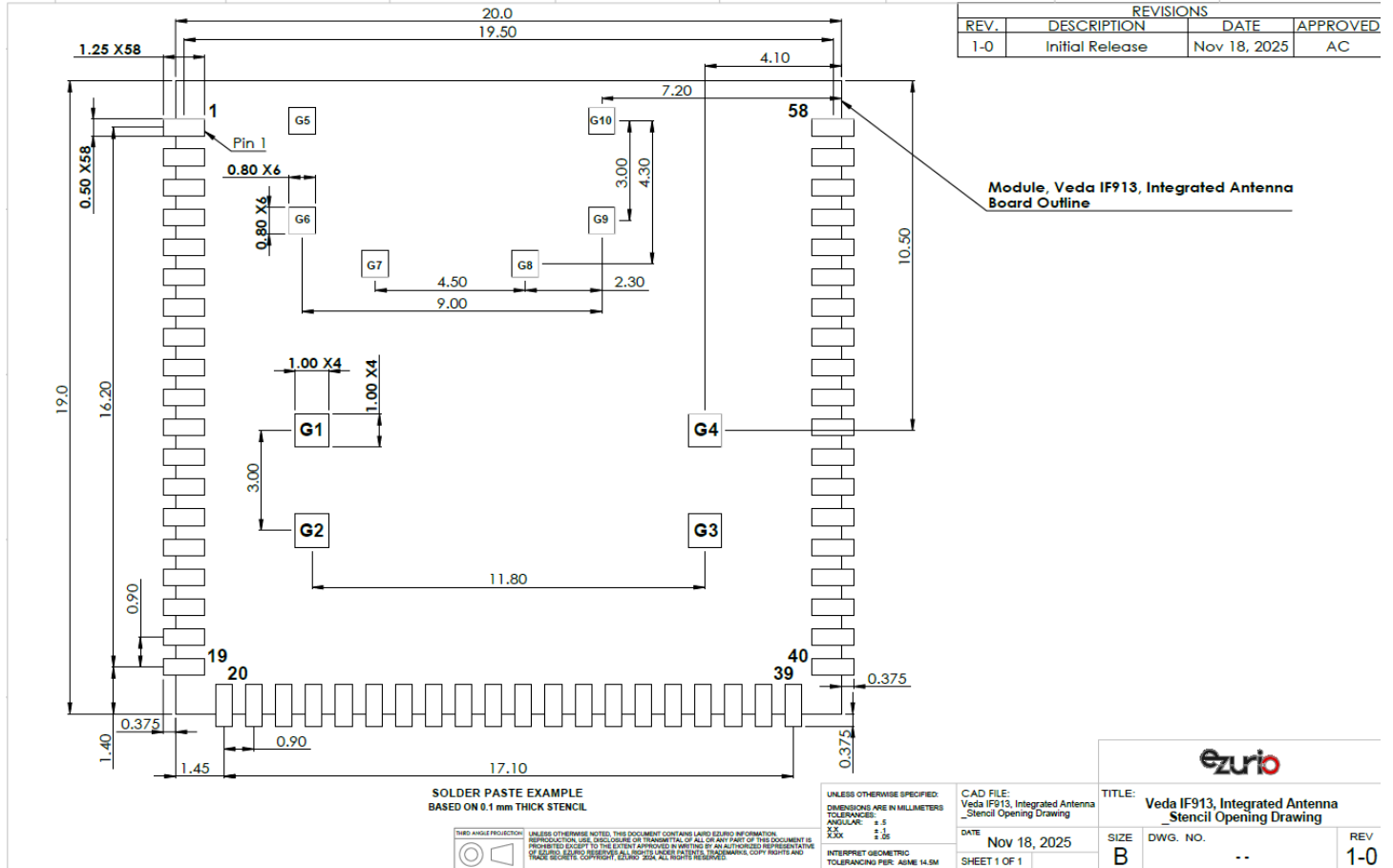


Figure 2: Veda IF913 integrated antenna module stencil aperture

Note: The stencil thickness is 0.10mm.

11.2 Soldering profile

Note: When soldering, the stencil thickness should be 0.12 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:

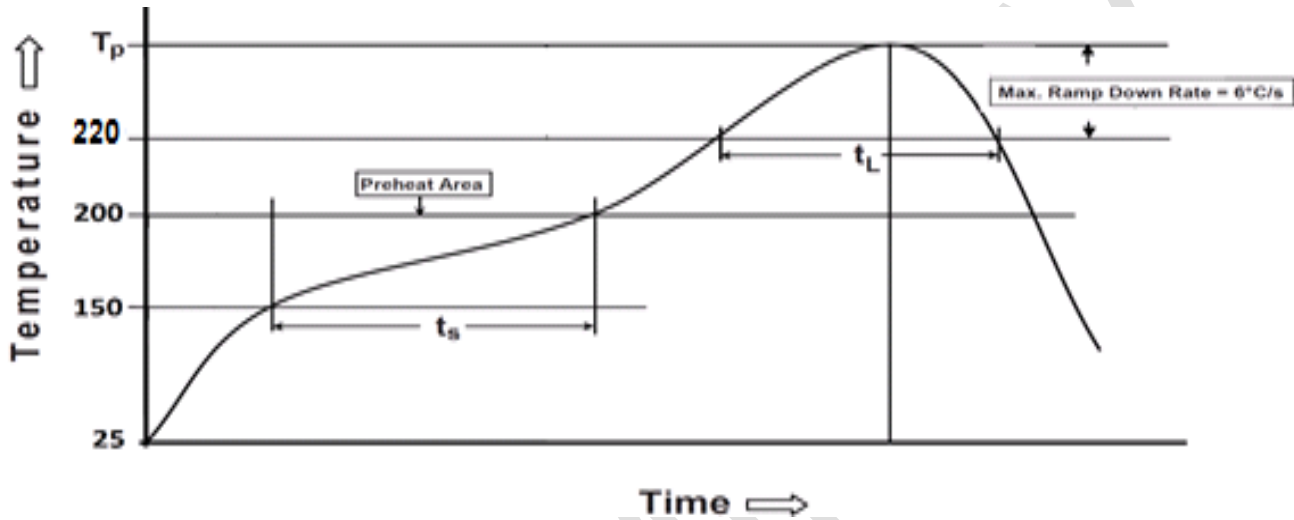


Figure 3: Temperature profile

- Solder paste alloy: SAC305 (Sn96.5 / Ag3.0 / Cu 0.5)
- Pre-heat temperature: 150°C ~ 200°C; Soak time: 60 second ~ 120 second
- Peak temperature: 235°C ~ 250°C
- Time above 220°C: 40 second ~ 90 second
- Optimal cooling rate < 3°C/second
- The oxygen concentration < 2000 ppm

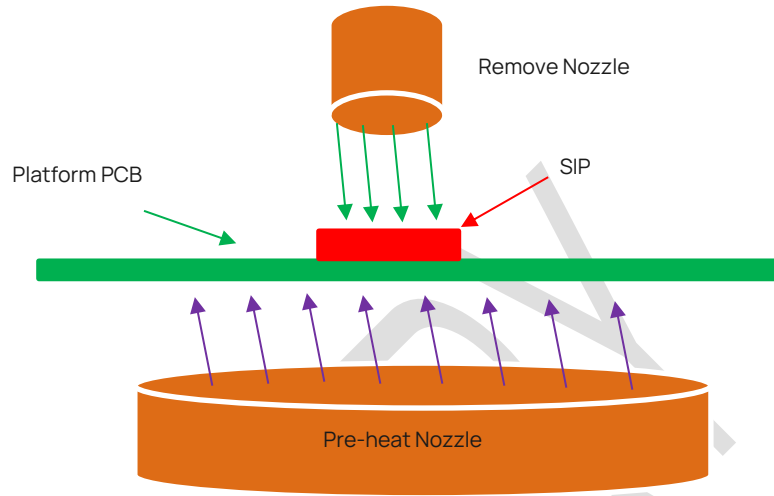
12 Cautions When Removing the SIP from the Platform for RMA

- Bake the platform PCBA before removing the Veda IF913 module from the platform..
- Remove the Sona IF513 module by using a hot air gun. This process should be carried out by a skilled technician.

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





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



(Not accepted for RMA)

Figure 4: Example module with residue solder on the bottom



(Accepted for RMA analysis)

Figure 5: module without residue solder

- Remove and clean the residue flux as needed.

12.1.1 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 Veda IF912/13 integrated antenna modules are MSL level 4 rated.

13 Antenna Performance.

The Veda IF912/13 integrated antenna modules certification was tested with antennas listed in the following table.

Manufacturer	Model	Type	Peak Gain (dBi)			
			2.4GHz	5GHz	6GHz	7GHz
TDK	ANT162442DT-2001A2	Chip Antenna	2.17	0.73	1.05	1.18

Model	ICC(Ezurio)_Veda IF913_2_A_WWAN_3D_Gain_FS_2400-7125MHz_Step15									
Test / Position	Gain /Free Space									
Frequency	2400	2442	2484	5150	5470	5850	5925	6425	6525	7125
Ant. Port Input Pwr. (dB)	0	0	0	0	0	0	0	0	0	0
Tot. Rad. Pwr. (dB)	-3.40	-2.22	-1.81	-3.49	-2.98	-2.60	-2.55	-2.19	-2.14	-3.04
Peak EIRP (dB)	0.38	1.51	2.17	-0.15	0.59	0.73	0.67	0.68	1.05	1.18
Directivity (dBi)	3.78	3.74	3.99	3.34	3.58	3.33	3.22	2.87	3.19	4.22
Efficiency (dB)	-3.40	-2.22	-1.81	-3.49	-2.98	-2.60	-2.55	-2.19	-2.14	-3.04
Efficiency (%)	45.68	59.93	65.87	44.75	50.35	54.91	55.63	60.41	61.15	49.68
Gain (dBi)	0.38	1.51	2.17	-0.15	0.59	0.73	0.67	0.68	1.05	1.18
NHPRP ±Pi/4 (dB)	-5.18	-4.02	-3.72	-4.83	-4.21	-3.88	-3.83	-3.50	-3.41	-4.27
NHPRP ±Pi/6 (dB)	-6.68	-5.62	-5.42	-6.28	-5.59	-5.39	-5.35	-5.03	-4.89	-5.65

14 Additional Information

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

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

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