IQAir

Datasheet and User Manual

About This Document

This document provides the specification for the IQAir module.

Revision History

For revision history of this document, please refer to the last page.

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1 Overview

IQAir is a powerful, generic Wi-Fi + Bluetooth + Bluetooth LE MCU modules that target a wide variety of applications, ranging from low-power sensor networks to the most demanding tasks, such as voice encoding, music streaming and MP3 decoding.

IQAir with a connector for an external antenna and external antenna, Taoglas Antenna Solutions, Part No. FXP.830.07.0100C.

At the core of the module is the Espressif Systems ESP32-D0WD-V3 chip. The chip embedded is designed to be scalable and adaptive. There are two CPU cores that can be individually controlled, and the CPU clock frequency is adjustable from 80 MHz to 240 MHz. The chip also has a low-power coprocessor that can be used instead of the CPU to save power while performing tasks that do not require much computing power, such as monitoring of peripherals. Espressif Systems ESP32-D0WD-V3 chip integrates a set of peripherals, UART and I2C.

The integration of Bluetooth®, Bluetooth LE and Wi-Fi ensures that a wide range of applications can be targeted, and that the module is all-around: using Wi-Fi allows a large physical range and direct connection to the Internet through a Wi-Fi router, while using Bluetooth allows the user to conveniently connect to the phone or broadcast low energy beacons for its detection. The sleep current of the Espressif Systems ESP32-D0WD-V3 chip is less than 5 μA, making it suitable for battery powered and wearable electronics applications. The module supports a data rate of up to 150 Mbps, and 20 dBm output power at the antenna to ensure the widest physical range. As such the module does offer industry-leading specifications and the best performance for electronic integration, range, power consumption, and connectivity.

The operating system chosen for Espressif Systems ESP32-D0WD-V3 chip is freeRTOS with LwIP; TLS 1.2 with hardware acceleration is built in as well. Secure (encrypted) over the air (OTA) upgrade is also supported, so that users can upgrade their products even after their release, at minimum cost and effort.

Table 1: IQAir Specifications

Categories	Items	Specifications
Wi-Fi	Protocols	802.11 b/g/n (802.11n up to 150 Mbps)
		A-MPDU and A-MSDU aggregation and 0.4 μs guard interval support
	Frequency range	2412 ~ 2484 MHz
Bluetooth	Protocols	Bluetooth v4.2 BR/EDR and Bluetooth LE specification
	Radio	NZIF receiver with –97 dBm sensitivity
		Class-1, class-2 and class-3 transmitter
		AFH
	Audio	CVSD and SBC
Hardware	Module interfaces	SD card, UART, SPI, SDIO, I2C, LED PWM, Motor PWM, I2S, IR, pulse counter, GPIO, capacitive touch sensor, ADC, DAC, Two-Wire Automotive Interface (TWAI®), compatible with ISO11898-1 (CAN Specification 2.0)
	Integrated crystal	40 MHz crystal
	Integrated SPI flash	16 MB
	Integrated PSRAM	8 MB
	Operating voltage/Power supply	3.0 V ~ 3.6 V
	Minimum current delivered by power supply	500 mA
	Operating Ambient	–40 °C ~ 65 °C
	Package size	(18.00±0.15) mm × (31.40±0.15) mm × (3.30±0.15) mm
	Moisture sensitivity level (MSL)	Level 3

2 Block Diagram

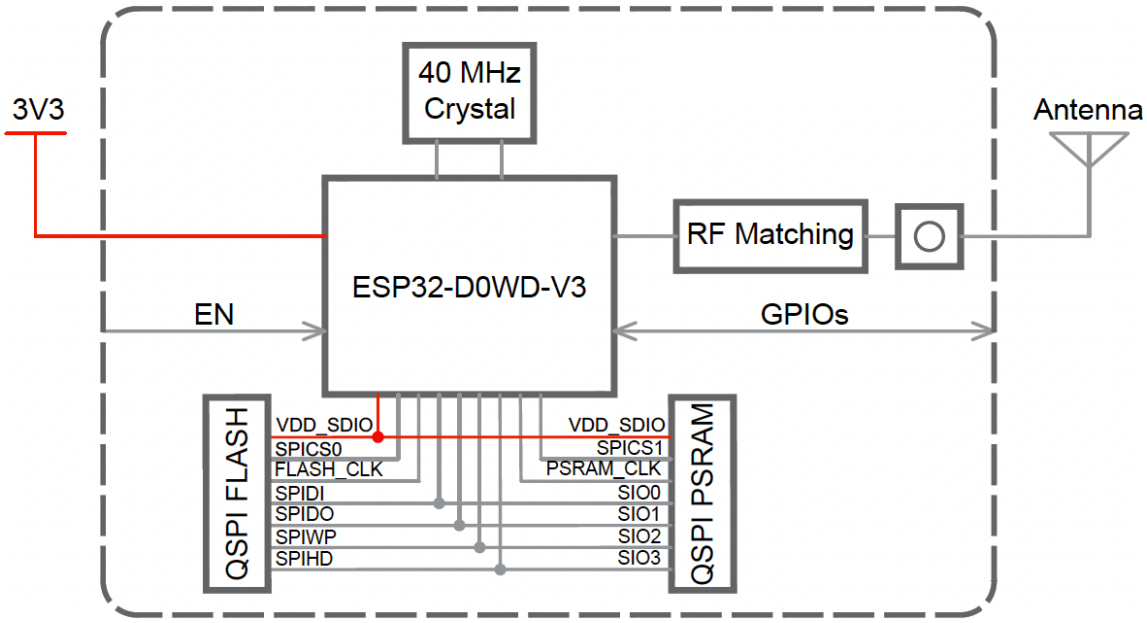

Figure 1: IQAir Block Diagram

3 Pin Definitions

3.1 Pin Layout

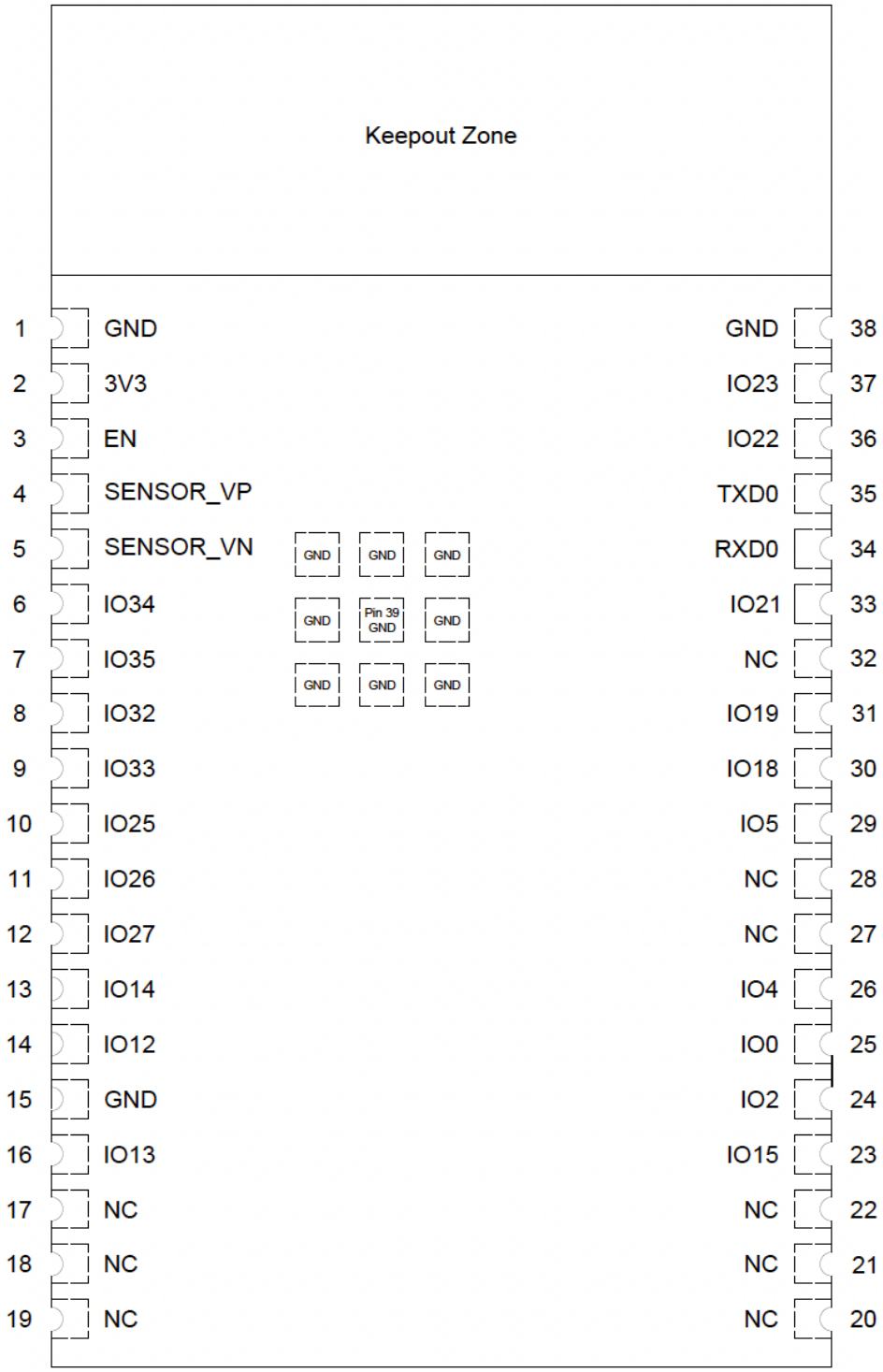

Figure 2: Pin Layout (Top View)

3.2 Pin Description

The module has 38 pins.

Table 2: Pin Definitions

Name	No.	Type	Function
GND	1	P	Ground
3V3	2	P	Power supply
EN	3	I	Module-enable signal. Active high.
SENSORVP	4	I	GPIO36, ADC1CH0, RTCGPIO0
SENSORVN	5	I	GPIO39, ADC1CH3, RTCGPIO3
IO34	6	I	GPIO34, ADC1CH6, RTCGPIO4
IO35	7	I	GPIO35, ADC1CH7, RTCGPIO5
IO32	8	I/O	GPIO32, XTAL32KP (32.768 kHz crystal oscillator input), ADC1CH4, TOUCH9, RTCGPIO9
IO33	9	I/O	GPIO33, XTAL32KN (32.768 kHz crystal oscillator output), ADC1CH5, TOUCH8, RTCGPIO8
IO25	10	I/O	GPIO25, DAC1, ADC2CH8, RTCGPIO6, EMACRXD0
IO26	11	I/O	GPIO26, DAC2, ADC2CH9, RTCGPIO7, EMACRXD1
IO27	12	I/O	GPIO27, ADC2CH7, TOUCH7, RTCGPIO17, EMACRXDV
IO14	13	I/O	GPIO14, ADC2CH6, TOUCH6, RTCGPIO16, MTMS, HSPICLK, HS2CLK, SDCLK, EMACTXD2
IO12	14	I/O	GPIO12, ADC2CH5, TOUCH5, RTCGPIO15, MTDI, HSPIQ, HS2DATA2, SDDATA2, EMACTXD3
GND	15	P	Ground
IO13	16	I/O	GPIO13, ADC2CH4, TOUCH4, RTCGPIO14, MTCK, HSPID, HS2DATA3, SDDATA3, EMACRXER
NC *	17	-	-
NC *	18	-	-
NC *	19	-	-
NC *	20	-	-
NC *	21	-	-
NC *	22	-	-
IO15	23	-	GPIO15, ADC2CH3, TOUCH3, MTDO, HSPICS0, RTCGPIO13, HS2CMD, SDCMD, EMACRXD3
IO2	24	I/O	GPIO2, ADC2CH2, TOUCH2, RTCGPIO12, HSPIWP, HS2DATA0, SDDATA0
IO0	25	I/O	GPIO0, ADC2CH1, TOUCH1, RTCGPIO11, CLKOUT1, EMACTXCLK
IO4	26	I/O	GPIO4, ADC2CH0, TOUCH0, RTCGPIO10, HSPIHD, HS2DATA1, SDDATA1, EMACTXER
NC	27	-	-
NC	28	-	-
IO5	29	I/O	GPIO5, VSPICS0, HS1DATA6, EMACRXCLK
IO18	30	I/O	GPIO18, VSPICLK, HS1DATA7
IO19	31	I/O	GPIO19, VSPIQ, U0CTS, EMACTXD0
NC	32	-	-
IO21	33	I/O	GPIO21, VSPIHD, EMACTXEN
RXD0	34	I/O	GPIO3, U0RXD, CLKOUT2
TXD0	35	I/O	GPIO1, U0TXD, CLKOUT3, EMACRXD2
IO22	36	I/O	GPIO22, VSPIWP, U0RTS, EMACTXD1
IO23	37	I/O	GPIO23, VSPID, HS1STROBE
GND	38	P	Ground

3.3 Strapping Pins

The Espressif Systems ESP32-D0WD-V3 chip has five strapping pins, which can be seen in Chapter 7 Schematics:

- MTDI
- GPIO0
- GPIO2
- MTDO
- GPIO5

Software can read the values of these five bits from register "GPIOSTRAPPING".

During the chip's system reset release (power-on-reset, RTC watchdog reset and brownout reset), the latches of the strapping pins sample the voltage level as strapping bits of "0" or "1", and hold these bits until the chip is powered down or shut down. The strapping bits configure the device's boot mode, the operating voltage of VDDSDIO and other initial system settings.

Each strapping pin is connected to its internal pull-up/pull-down during the chip reset. Consequently, if a strapping pin is unconnected or the connected external circuit is high-impedance, the internal weak pull-up/pull-down will determine the default input level of the strapping pins.

To change the strapping bit values, users can apply the external pull-down/pull-up resistances, or use the host MCU's GPIOs to control the voltage level of these pins when powering on IQAir.

After reset release, the strapping pins work as normal-function pins.

Refer to Table 4 for a detailed boot-mode configuration by strapping pins.

Table 3: Strapping Pins

Voltage of Internal LDO (VDDSDIO)			
Pin	Default	3.3 V	1.8 V
MTDI	Pull-down	0	1
Booting Mode			
Pin	Default	SPI Boot	Download Boot
GPIO0	Pull-up	1	0
GPIO2	Pull-down	Don't-care	0

Enabling/Disabling Debugging Log Print over U0TXD During Booting					
Pin	Default	U0TXD Active		U0TXD Silent	
MTDO	Pull-up	1		0	
Timing of SDIO Slave					
Pin	Default	FE Sampling FE Output	FE Sampling RE Output	RE Sampling FE Output	RE Sampling RE Output
MTDO	Pull-up	0	0	1	1
GPIO5	Pull-up	0	1	0	1

Note:

- FE: falling-edge, RE: rising-edge.
- Firmware can configure register bits to change the settings of "Voltage of Internal LDO (VDDSDIO)" and "Timing of SDIO Slave", after booting.
- The Espressif Systems ESP32-D0WD-V3 chip that contain an embedded flash or PSRAM, users need to note the logic level of MTDI.

The illustration below shows the setup and hold times for the strapping pins before and after the CHIPPU signal goes high. Details about the parameters are listed in Table 5.

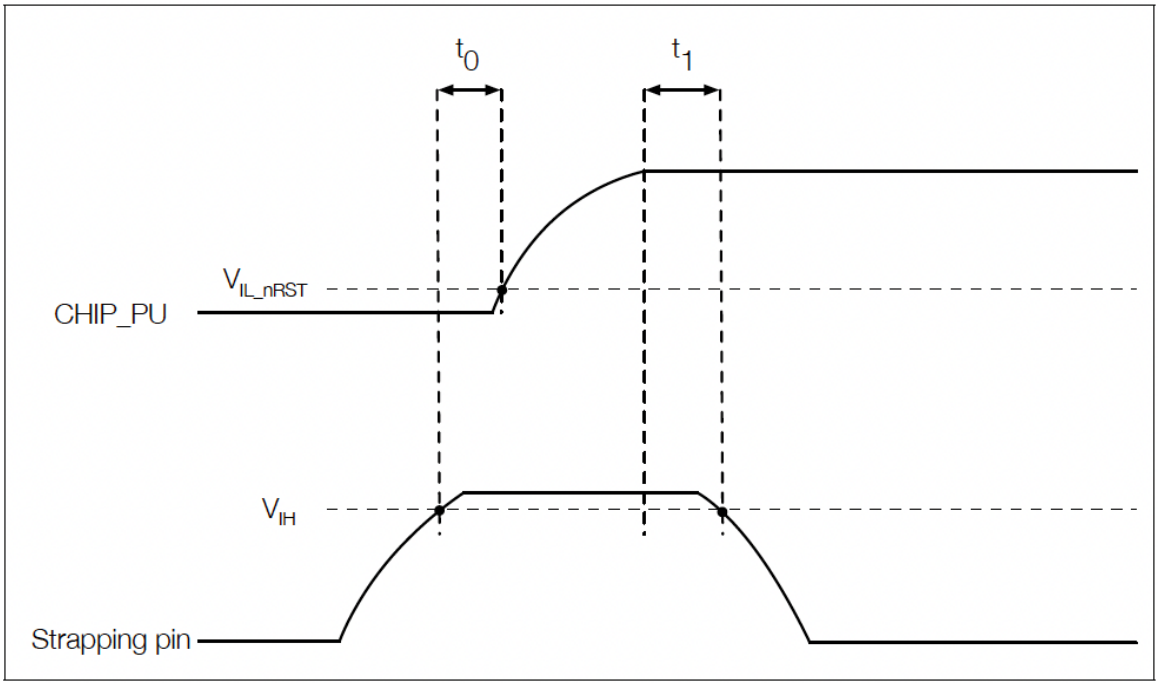

Figure 3: Setup and Hold Times for the Strapping Pins

Table 4: Parameter Descriptions of Setup and Hold Times for the Strapping Pins

Parameters	Description	Min.	Unit
t_0	Setup time before CHIPPU goes from low to high	0	ms
t_1	Hold time after CHIPPU goes high	1	ms

4 Functional Description

This chapter describes the module and functions integrated in IQAir.

4.1 CPU and Internal Memory

The Espressif Systems ESP32-D0WD-V3 chip contains two low-power Xtensa® 32-bit LX6 microprocessors. The internal memory includes:

- 448 KB of ROM for booting and core functions.
- 520 KB of on-chip SRAM for data and instructions.
- 8 KB of SRAM in RTC, which is called RTC FAST Memory and can be used for data storage; it is accessed by the main CPU during RTC Boot from the Deep-sleep mode.
- 8 KB of SRAM in RTC, which is called RTC SLOW Memory and can be accessed by the co-processor during the Deep-sleep mode.
- 1 Kbit of eFuse: 256 bits are used for the system (MAC address and chip configuration) and the remaining 768 bits are reserved for customer applications, including flash-encryption and chip-ID.

4.2 External Flash and SRAM

The Espressif Systems ESP32-D0WD-V3 chip supports multiple external QSPI flash and SRAM chips. The Espressif Systems ESP32-D0WD-V3 chip also supports hardware encryption/decryption based on AES to protect developers' programs and data in flash.

The Espressif Systems ESP32-D0WD-V3 chip can access the external QSPI flash and SRAM through high-speed caches.

- The external flash can be mapped into CPU instruction memory space and read-only memory space simultaneously.
  - When external flash is mapped into CPU instruction memory space, up to 11 MB + 248 KB can be mapped at a time. Note that if more than 3 MB + 248 KB are mapped, cache performance will be reduced due to speculative reads by the CPU.
  - When external flash is mapped into read-only data memory space, up to 4 MB can be mapped at a time. 8-bit, 16-bit and 32-bit reads are supported.
- External SRAM can be mapped into CPU data memory space. Up to 4 MB can be mapped at a time. 8-bit, 16-bit and 32-bit reads and writes are supported.

4.3 Crystal Oscillators

The module uses a 40-MHz crystal oscillator.

5 Peripherals

Note:
External connections can be made to any GPIO except for GPIOs in the range 6-11, 16, or 17. GPIOs 6-11 are connected to the module's integrated SPI flash. GPIOs 16 and 17 are connected to the module's integrated PSRAM.

5.1 Descriptions of Peripherals

5.1.1 General Purpose Input/Output Interface (GPIO)

IQAir has 34 GPIO pins which can be assigned various functions by programming the appropriate registers. There are several kinds of GPIOs: digital-only, analog-enabled, capacitive-touch-enabled, etc. Analog-enabled GPIOs and Capacitive-touch-enabled GPIOs can be configured as digital GPIOs.

Most of the digital GPIOs can be configured as internal pull-up or pull-down, or set to high impedance. When configured as an input, the input value can be read through the register. The input can also be set to edge-trigger or level-trigger to generate CPU interrupts. Most of the digital IO pins are bi-directional, non-inverting and tristate, including input and output buffers with tristate control. These pins can be multiplexed with other functions, such as the SDIO, UART, SPI, etc. For low-power operations, the GPIOs can be set to hold their states.

5.1.2 Universal Asynchronous Receiver Transmitter (UART)

IQAir has three UART interfaces, i.e., UART0, UART1, and UART2, which provide asynchronous communication (RS232 and RS485) and IrDA support, communicating at a speed of up to 5 Mbps. UART provides hardware management of the CTS and RTS signals and software flow control (XON and XOFF). All of the interfaces can be accessed by the DMA controller or directly by the CPU.

5.1.3 I2C Interface

IQAir has two I2C bus interfaces which can serve as I2C master or slave, depending on the user's configuration. The I2C interfaces support:

- Standard mode (100 Kbit/s)
- Fast mode (400 Kbit/s)
- Up to 5 MHz, yet constrained by SDA pull-up strength
- 7-bit/10-bit addressing mode
- Dual addressing mode

Users can program command registers to control I2C interfaces, so that they have more flexibility.

5.2 Peripheral Pin Configurations

Table 5: Peripheral Pin Configurations

Interface	Signal	Pin	Function
UART	U0RXDin	Any GPIO Pins	Three UART devices with hardware flow-control and DMA
	U0CTSin		
	U0DSRin		
	U0TXDout		
	U0RTSout		
	U0DTRout		
	U1RXDin		
	U1CTSin		
	U1TXDout		
	U1RTSout		
	U2RXDin		
	U2CTSin		
	U2TXDout		
	U2RTSout		
I2C	I2CEXT0SCLin	Any GPIO Pins	Two I2C devices in slave or master mode
	I2CEXT0SDAin		
	I2CEXT1SCLin		
	I2CEXT1SDAin		
	I2CEXT0SCLout		
	I2CEXT0SDAout		
	I2CEXT1SCLout		
	I2CEXT1SDAout		

6 Electrical Characteristics

6.1 Absolute Maximum Ratings

Stresses beyond the absolute maximum ratings listed in the table below may cause permanent damage to the device. These are stress ratings only, and do not refer to the functional operation of the device that should follow the recommended operating conditions.

Table 6: Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
VDD33	Power supply voltage	–0.3	3.6	V
I_{output}[1]	Cumulative IO output current	-	1,100	mA
T_{store}	Storage temperature	–40	105	°C

Note: The module worked properly after a 24-hour test in ambient temperature at 25 °C, and the IOs in three domains (VDD3P3RTC, VDD3P3CPU, VDDSDIO) output high logic level to ground. Please note that pins occupied by flash and/or PSRAM in the VDDSDIO power domain were excluded from the test.

6.2 Recommended Operating Conditions

Table 7: Recommended Operating Conditions

Symbol	Parameter	Min	Typical	Max	Unit
VDD33	Power supply voltage	3.0	3.3	3.6	V
I_{VDD}	Current delivered by external power supply	0.5	-	-	A
T	Operating temperature	–40	-	85	°C

6.3 DC Characteristics (3.3 V, 25 °C)

Table 8: DC Characteristics (3.3 V, 25°C)

Symbol	Parameter		Min	Typ	Max	Unit
C_{IN}	Pin capacitance		-	2	-	pF
V_{IH}	High-level input voltage		0.75×VDD1	-	VDD1+0.3	V
V_{IL}	Low-level input voltage		–0.3	-	0.25×VDD1	V
I_{IH}	High-level input current		-	-	50	nA
I_{IL}	Low-level input current		-	-	50	nA
V_{OH}	High-level output voltage		0.8×VDD1	-	-	V
V_{OL}	Low-level output voltage		-	-	0.1×VDD1	V
I_{OH}	High-level source current (VDD1 = 3.3 V, V_{OH} >= 2.64 V, output drive strength set to the maximum)	VDD3P3CPU power domain[1, 2]	-	40	-	mA
		VDD3P3RTC power domain[1, 2]	-	40	-	mA
		VDDSDIO power domain[1, 3]	-	20	-	mA
I_{OL}	Low-level sink current (VDD1 = 3.3 V, V_{OL} = 0.495 V, output drive strength set to the maximum)		-	28	-	mA
R_{PU}	Resistance of internal pull-up resistor		-	45	-	kΩ
R_{PD}	Resistance of internal pull-down resistor		-	45	-	kΩ
V_{ILnRST}	Low-level input voltage of CHIPPU to shut down the chip		-	-	0.6	V

Notes:

1. VDD is the I/O voltage for a particular power domain of pins.
2. For VDD3P3CPU and VDD3P3RTC power domain, per-pin current sourced in the same domain is gradually reduced from around 40 mA to around 29 mA, V_{OH}>=2.64 V, as the number of current-source pins increases.
3. Pins occupied by flash and/or PSRAM in the VDDSDIO power domain were excluded from the test.

6.4 RF Power Consumption Specifications

The power consumption measurements are taken with a 3.3 V supply at 25 °C of ambient temperature at the RF port. All transmitters' measurements are based on a 50% duty cycle.

Table 9: RF Power-Consumption Specifications

Mode	Min	Typ	Max	Unit
Transmit 802.11b, DSSS 1 Mbps, POUT = +19.5 dBm	-	240	-	mA
Transmit 802.11g, OFDM 54 Mbps, POUT = +16 dBm	-	190	-	mA
Transmit 802.11n, OFDM MCS7, POUT = +14 dBm	-	180	-	mA
Receive 802.11b/g/n	-	95 ~ 100	-	mA
Transmit BT/BLE, POUT = 0 dBm	-	130	-	mA
Receive BT/BLE	-	95 ~ 100	-	mA

6.5 WiFi Radio

Table 10: WiFi Radio Characteristics

Parameter	Condition	Min	Typical	Max	Unit
Center frequency range of operating channel *note1*	-	2412	-	2484	MHz
Output impedance	-	-	50	-	Ω
TX power *note2*	11n, MCS7	12	13	14	dBm
	11b mode	18.5	19.5	20.5	dBm
Sensitivity	11b, 1 Mbps	-	–97	-	dBm
	11b, 11 Mbps	-	–88	-	dBm
	11g, 6 Mbps	-	–92	-	dBm
	11g, 54 Mbps	-	–75	-	dBm
	11n, HT20, MCS0	-	–92	-	dBm
	11n, HT20, MCS7	-	–72	-	dBm
	11n, HT40, MCS0	-	–89	-	dBm
	11n, HT40, MCS7	-	–69	-	dBm
Adjacent channel rejection	11g, 6 Mbps	-	27	-	dB
	11g, 54 Mbps	-	13	-	dB
	11n, HT20, MCS0	-	27	-	dB
	11n, HT20, MCS7	-	12	-	dB

Notes:

1. Device should operate in the frequency range allocated by regional regulatory authorities. Target center operating frequency range is configurable by software.
2. Target TX power is configurable based on device or certification requirements.

6.6 Bluetooth LE Radio

6.6.1 Receiver

Table 11: Receiver Characteristics - Bluetooth LE

Parameter	Conditions	Min	Typ	Max	Unit
Sensitivity @30.8% PER	-	–94	–93	–92	dBm
Maximum received signal @30.8% PER	-	0	-	-	dBm
Co-channel C/I	-	-	+10	-	dB
Adjacent channel selectivity C/I	F = F0 + 1 MHz	-	–5	-	dB
	F = F0 – 1 MHz	-	–5	-	dB
	F = F0 + 2 MHz	-	–25	-	dB
	F = F0 – 2 MHz	-	–35	-	dB
	F = F0 + 3 MHz	-	–25	-	dB
	F = F0 – 3 MHz	-	–45	-	dB
Out-of-band blocking performance	30 MHz ~ 2000 MHz	–10	-	-	dBm
	2000 MHz ~ 2400 MHz	–27	-	-	dBm
	2500 MHz ~ 3000 MHz	–27	-	-	dBm
	3000 MHz ~ 12.5 GHz	–10	-	-	dBm
Intermodulation	-	–36	-	-	dBm

6.6.2 Transmitter

Table 12: Transmitter Characteristics - Bluetooth LE

Parameter	Conditions	Min	Typ	Max	Unit
RF eFrequency	-	2402	-	2480	dBm
RF transmit power	-	-	0	-	dBm
Gain control step	-	-	3	-	dBm
RF power control range	-	–12	-	+9	dBm
Adjacent channel transmit power	F = F0 ± 2 MHz	-	–52	-	dBm
	F = F0 ± 3 MHz	-	–58	-	dBm
	F = F0 ± > 3 MHz	-	–60	-	dBm
$\Delta f1_{avg}$	-	-	-	265	kHz
$\Delta f2_{max}$	-	247	-	-	kHz
$\Delta f2_{avg}/\Delta f1_{avg}$	-	-	+0.92	-	-
ICFT	-	-	–10	-	kHz
Drift rate	-	-	0.7	-	kHz/50 μs
Drift	-	-	2	-	kHz

7 Physical Dimensions

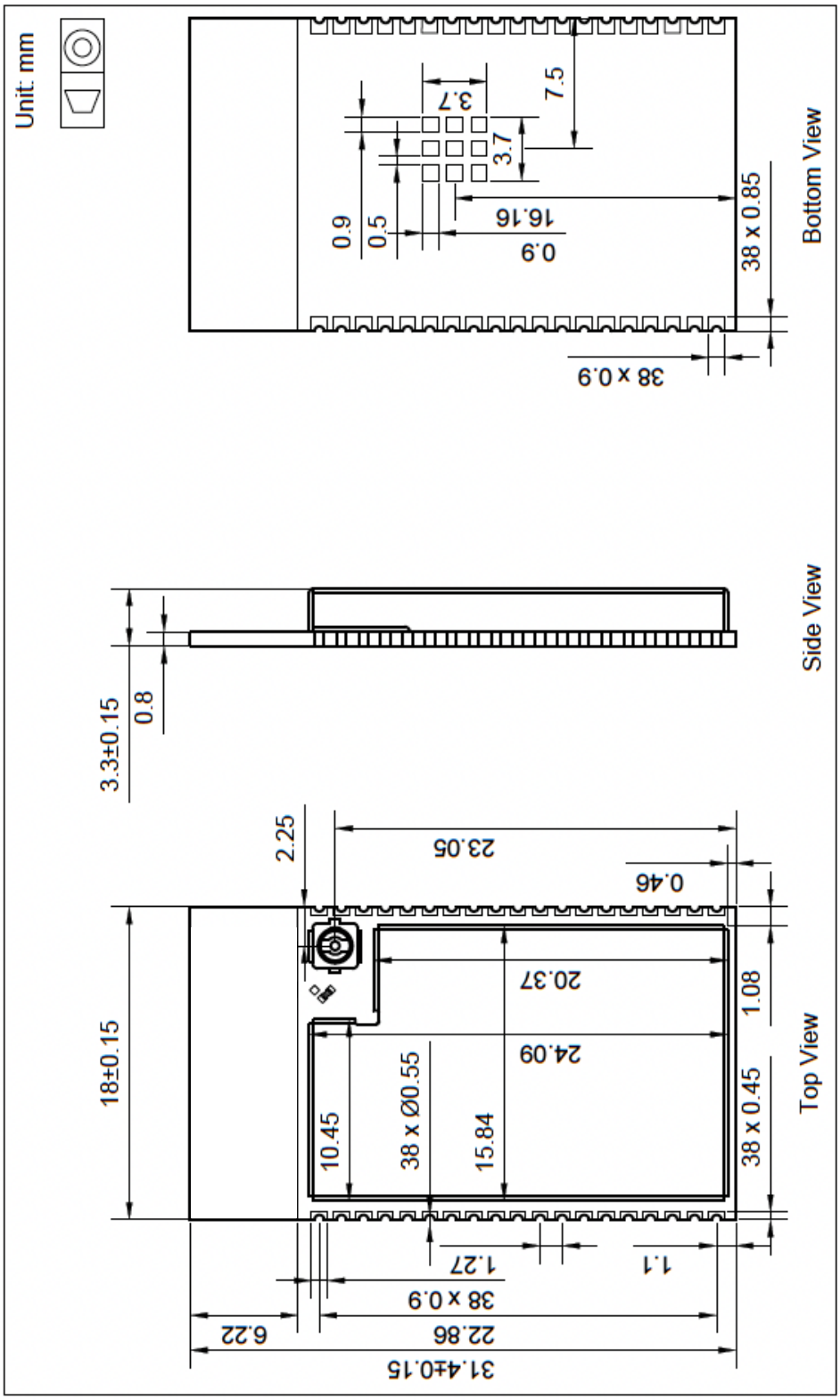

Figure 4: IQAir Dimensions

8 Recommended PCB Land Pattern

This section provides the following resources for your reference:

- Figures for recommended PCB land patterns with all the dimensions needed for PCB design. See *Figure 5 Recommended PCB Land Pattern*.
- Source files of recommended PCB land patterns to measure dimensions not covered in *Figure 5*. You can view the source files for IQAir with Autodesk Viewer.
- 3D models of IQAir. Please make sure that you download the 3D model file in .STEP format (beware that some browsers might add .txt).

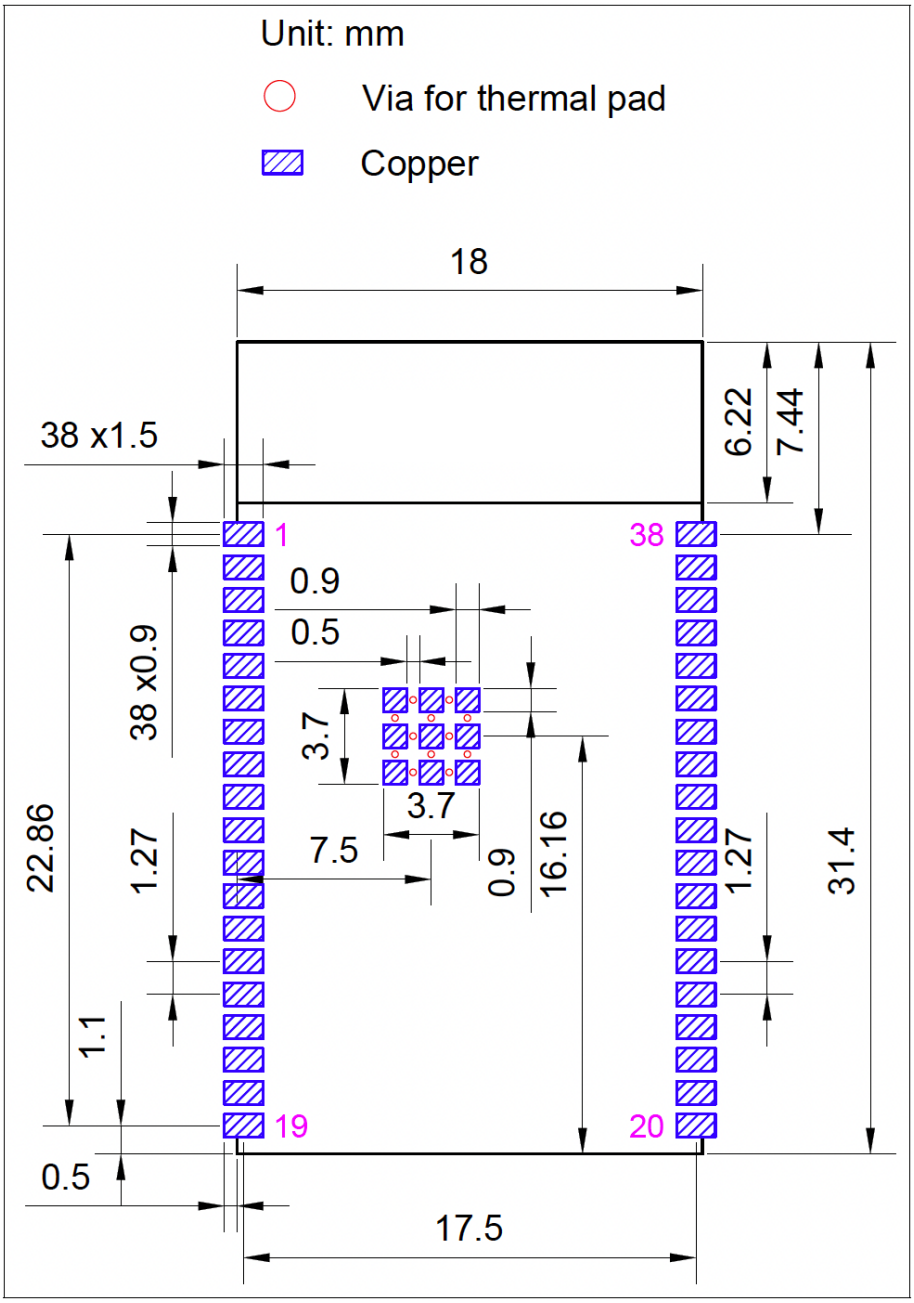

Figure 5: Recommended PCB Land Pattern

9 Dimensions of External Antenna Connector

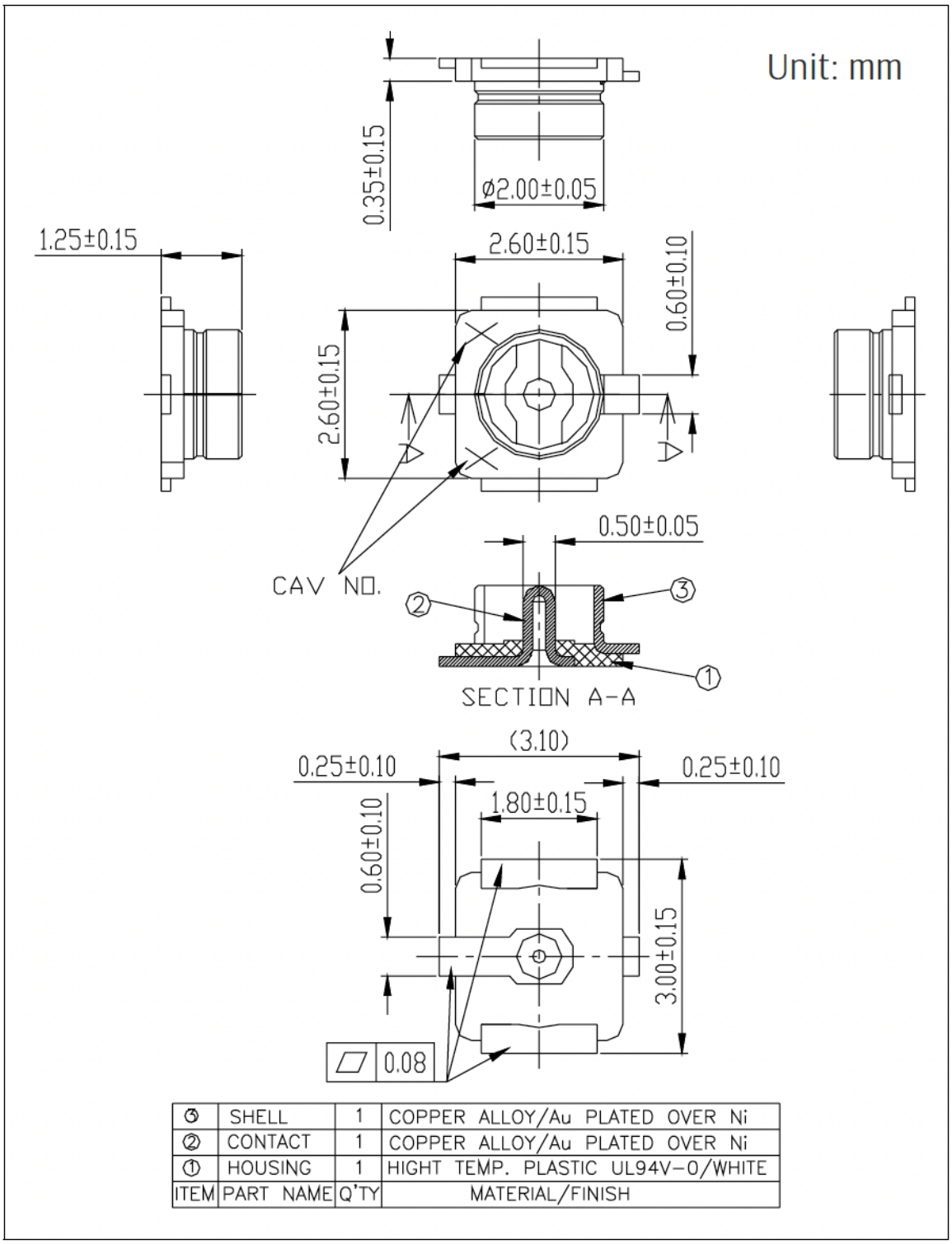

Figure 6: Dimensions of External Antenna Connector

10 Product Handling

10.1 Storage Conditions

The products sealed in moisture barrier bags (MBB) should be stored in a non-condensing atmospheric environment of <40°C and 90%RH. The module is rated at the moisture sensitivity level (MSL) of 3.

After unpacking, the module must be soldered within 168 hours with the factory conditions 25±5°C and 60%RH. If the above conditions are not met, the module needs to be baked.

10.2 Electrostatic Discharge (ESD)

- Human body model (HBM): ±2000 V
- Charged-device model (CDM): ±500 V

10.3 Reflow Profile

Solder the module in a single reflow.

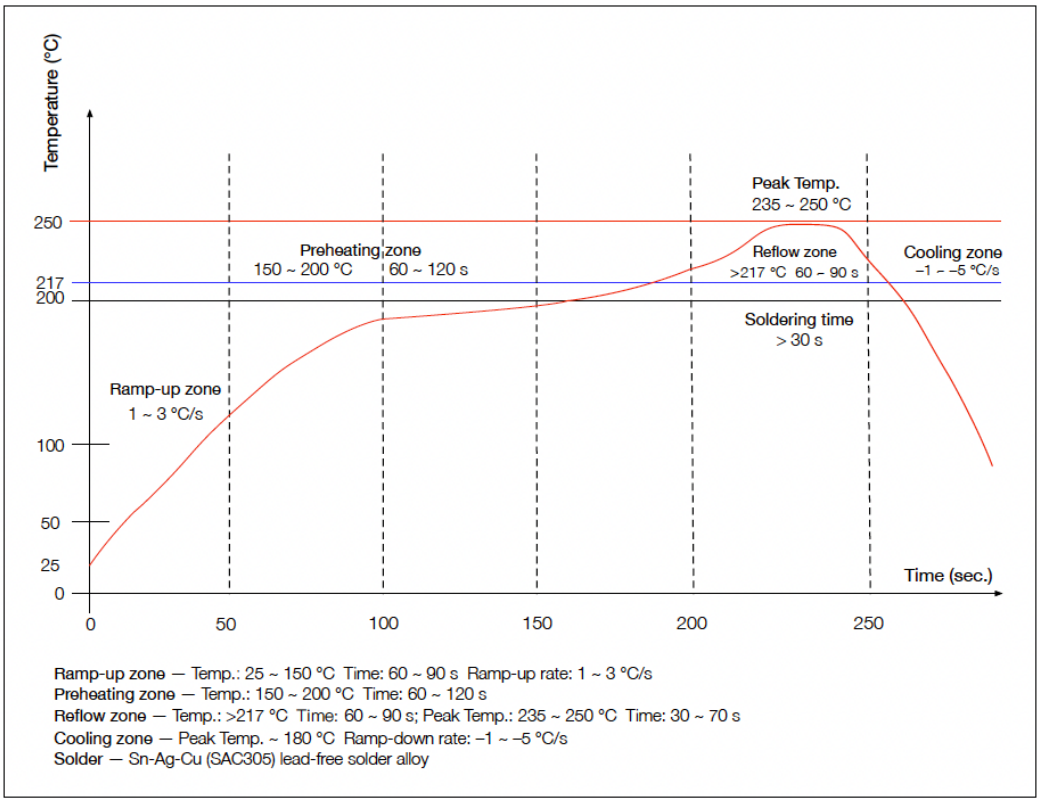

Figure 7: Reflow Profile

10.4 Ultrasonic Vibration

Avoid exposing the IQAir module to vibration from ultrasonic equipment, such as ultrasonic welders or ultrasonic cleaners. This vibration may induce resonance in the in-module crystal and lead to its malfunction or even failure. As a consequence, the module may stop working or its performance may deteriorate.

11 OEM Guide

11.1 Applicable FCC / ISED rules

This module and antenna is granted by Single Modular Approval. It complies to the requirements of FCC Part 15C, Section 15.247 rules; and ISED RSS-247.

11.2 The specific operational use conditions

This module can be used in IoT devices. The input voltage to the module is nominally 3.3V-3.6 V DC. The operational ambient temperature of the module is -40 °C ~ 65 °C. Only Taoglas Antenna Solutions, Part No. FXP.830.07.0100C antenna is allowed. Use of any other external antenna requires additional certification.

11.3 Limited module procedures

Not Applicable

11.4 Trace antenna design

The trace antenna is not provided. An external antenna per paragraph 11.2 and 11.6 is used in this particular design.

11.5 RF exposure considerations

The equipment complies with FCC 47 CFR 2.1091 and ISED RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

11.6 Antenna

- Antenna type: Taoglas Antenna Solutions, Part No. FXP.830.07.0100C
- Peak gain: 1.8dBi at 2.4GHz at 50% efficiency
- Peak gain: 3-4dBi at 5.8GHz at 80-90% efficiency

11.7 Label and compliance information

11.7.1 Module Marking

- Model IQAir
- FCC ID: 2A93H-IQAIR
- IC: 29965-IQAIR

11.7.2 Product / Host Marking

- An exterior label on OEM's end product can use wording such as the following: "Contains Transmitter Module FCC ID: 2A93H-IQAIR" or "Contains FCC ID: 2A93H-IQAIR"
- An exterior label on OEM's end product can use wording such as the following: "Contains Transmitter Module IC: 29965-IQAIR" or "Contains IC: 29965-IQAIR"
- "This device complies with Part 15 of FCC rules. Operation is subjected to the following 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."

11.8 FCC Warning

The following statements apply to this module and are also required to be placed in the finished product users manual:

Any changes or modifications to the module or host not expressly approved by the party responsible for compliance could void the user's authority to operate the 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.

11.9 ISED Warning, RSS-GEN §6.8

The following statements apply to this module and are also required to be placed in the finished product users manual:

> 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

The following statements apply to this module and are also required to be placed in the finished product user's manual only when the antenna is accessible to the end user. In cases where the antenna is integrated within an enclosure such that access to the antenna is limited only to controlled maintenance personnel or authorized representatives, then the following statements are not required to be placed in the finished product's user's manual (however may be voluntarily utilized at the discretion of the integrator):

> This radio transmitter IC: 29965-IQAIR has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, 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: 29965-IQAIR a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous 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.
>
> Show list of approved antennas:

Table 13: List of Approved Antennas

Antenna Part No.	Type and Gain (dBi)
FXP.830.07.0100C	Dual Band, Ground-plane Independent, IPEX MHF1 Connector (U.FL compatible). Peak gain: 1.8dBi at 2.4GHz at 50% efficiency Peak gain: 3-4dBi at 5.8GHz at 80-90% efficiency

11.10 Information on test modes and additional testing requirements

The modular transmitter and antenna has been fully tested by the module grantee on the required number of channels, modulation types, and modes, it should not be necessary for the host installer to re-test all the available transmitter modes or settings. It is recommended that the host product manufacturer, installing the modular transmitter and antenna, perform some investigative measurements to confirm that the resulting composite system does not exceed the spurious emissions limits or band edge limits (e.g., where a different antenna may be causing additional emissions).

The testing should check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. It is important to note that host product manufacturers should not assume that because the modular transmitter is certified that they do not have any responsibility for final product compliance.

If the investigation indicates a compliance concern the host product manufacturer is obligated to mitigate the issue. Host products using a modular transmitter are subject to all the applicable individual technical rules as well as to the general conditions of operation in Sections 15.5, 15.15, and 15.29 to not cause interference. The operator of the host product will be obligated to stop operating the device until the interference have been corrected.

11.11 Additional testing, Part 15 Sub part B disclaimer

The final host / module combination need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

The host integrator installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation and should refer to guidance in KDB 996369. For host products with certified modular transmitter, the frequency range of investigation of the composite system is specified by rule in Sections 15.33(a)(1) through (a)(3), or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation When testing the host product, all the transmitters must be operating.The transmitters can be enabled by using publicly- available drivers and turned on, so the transmitters are active. In certain conditions it might be appropriate to use a technology-specific call box (test set) where accessory 50 devices or drivers are not available. When testing for emissions from the unintentional radiator, the transmitter shall be placed in the receive mode or idle mode, if possible. If receive mode only is not possible then, the radio shall be passive (preferred) and/or active scanning. In these cases, this would need to enable activity on the communication BUS (i.e., PCIe, SDIO, USB) to ensure the unintentional radiator circuitry is enabled. Testing laboratories may need to add attenuation or filters depending on the signal strength of any active beacons (if applicable) from the enabled radio(s). See ANSI C63.4, ANSI C63.10 and ANSI C63.26 for further general testing details.

The product under test is set into a link/association with a partnering device, as per the normal intended use of the product. To ease testing, the product under test is set to transmit at a high duty cycle, such as by sending a file or streaming some media content.

Revision History

Date	Version	Release notes
2023-03-31	v1.0	Official Release

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