1. Introduction to P401-DAI

P401-DAI is a 2.4/5.8G dual-band, high-bandwidth, high-power, 2x2 MIMO wireless data transmission module. Based on the principle of TDD, it uses key technologies such as OFDM and MIMO to improve frequency band utilization while providing a longer transmission distance. It supports automatic frequency hopping and autonomous dynamic adjustment of MCS, and has advantages such as long range, strong anti-interference ability, and low latency. As a highly integrated module product, this product can be widely used in fields such as drones, security monitoring, wireless screen projection, wireless audio and video, and special inspections, and can meet the needs of customers for rapid development and application.

P401-DAI can operate in AP and Device modes, enabling stable and reliable long-range wireless communication.

2. Technical Features of P401-DAI Module

- Based on the principle of TDD, key technologies such as OFDM and MIMO are adopted to improve the utilization of frequency bands.
- Supports AES encryption, multiple security policies, and prevents illegal eavesdropping and interception.
- Adopt a frequency hopping scheme, monitor interference in real time, and automatically select the frequency hopping range; based on the interference situation of the current channel, automatically and quickly change the frequency point and adjust the Modulation and Coding Scheme (MCS).
- Supports star networking plus relay networking, enabling the construction of wireless multi-hop networking applications.
- The maximum rate of air interface transmission can reach 40 Mbps.

2.1 Frequency Hopping and Sweeping Mechanism

The frame structure can be configured and supports real-time frequency hopping per frame. If the period of each frame is 5ms (a relatively short frame structure), then 200 hops can be achieved in 1 second. Of course, for one-to-many applications, the frame period is generally around several tens of milliseconds.

It supports two sweep modes, referred to here as short sweep and long sweep.

Short frequency sweep is mainly used to conduct interference testing on frequency points within a frequency band (such as the 2.4G frequency band or 5.8G frequency point), and only requires short frequency sweep testing at the receiving end. The main purpose is to observe whether there are interference signals within the working frequency band, identify the current working frequency point and alternative frequency points with less interference, so that when the current working frequency point is interfered with, frequency hopping can be performed to the alternative frequency points. Generally, we observe interference signals from -90dBm to -60dBm.

Long sweep frequency is mainly used to evaluate the signal quality of two frequency bands (such as a dual-band system with 2.4G and 5.8G frequency bands). The transmitter will time-share select some frequency points from the two frequency bands to transmit known sequences, and the receiver will obtain alternative frequency points based on the received signal to noise ratio, preparing for future frequency hopping.

2.2 Anti-interference performance characteristics

It supports interleaved blocks of 1.25ms, 2.5ms, and 5ms. Taking the 5ms interleaved block as an example, it can resist co-channel interference of about 1ms. This has a good performance advantage for some sudden short WIFI packets. When combined with a highly real-time frequency scanning and hopping mechanism, relatively good anti-interference performance can be obtained.

3. Key Specifications of P401-DAI Module

3.1 Basic Characteristics

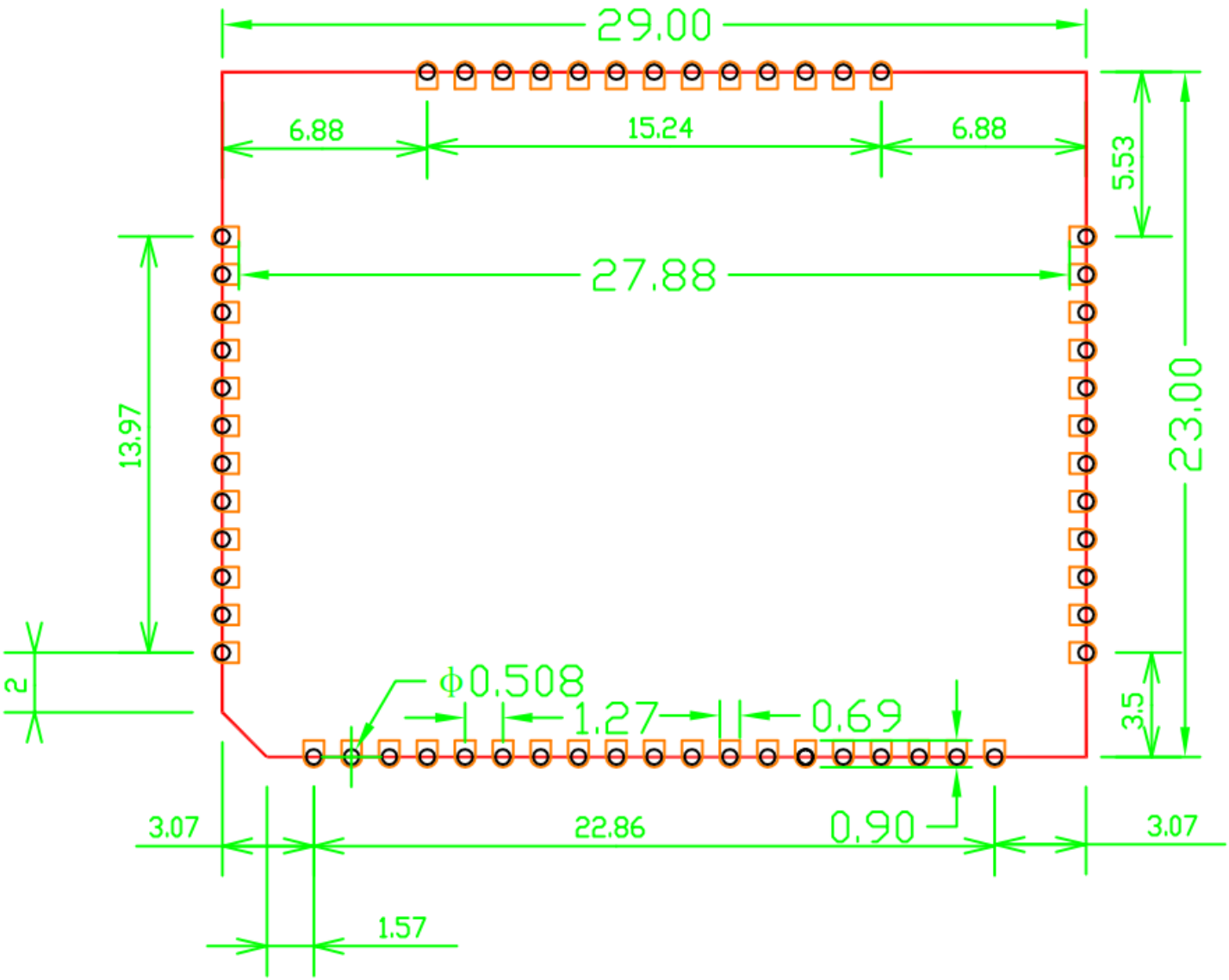
Table 1 Main Specifications of the Module

Category	Parameter	Description
System	Dimensions	23x29x2.85mm (including shield)
	Weight	3.75 grams
	Power Supply	DC5V

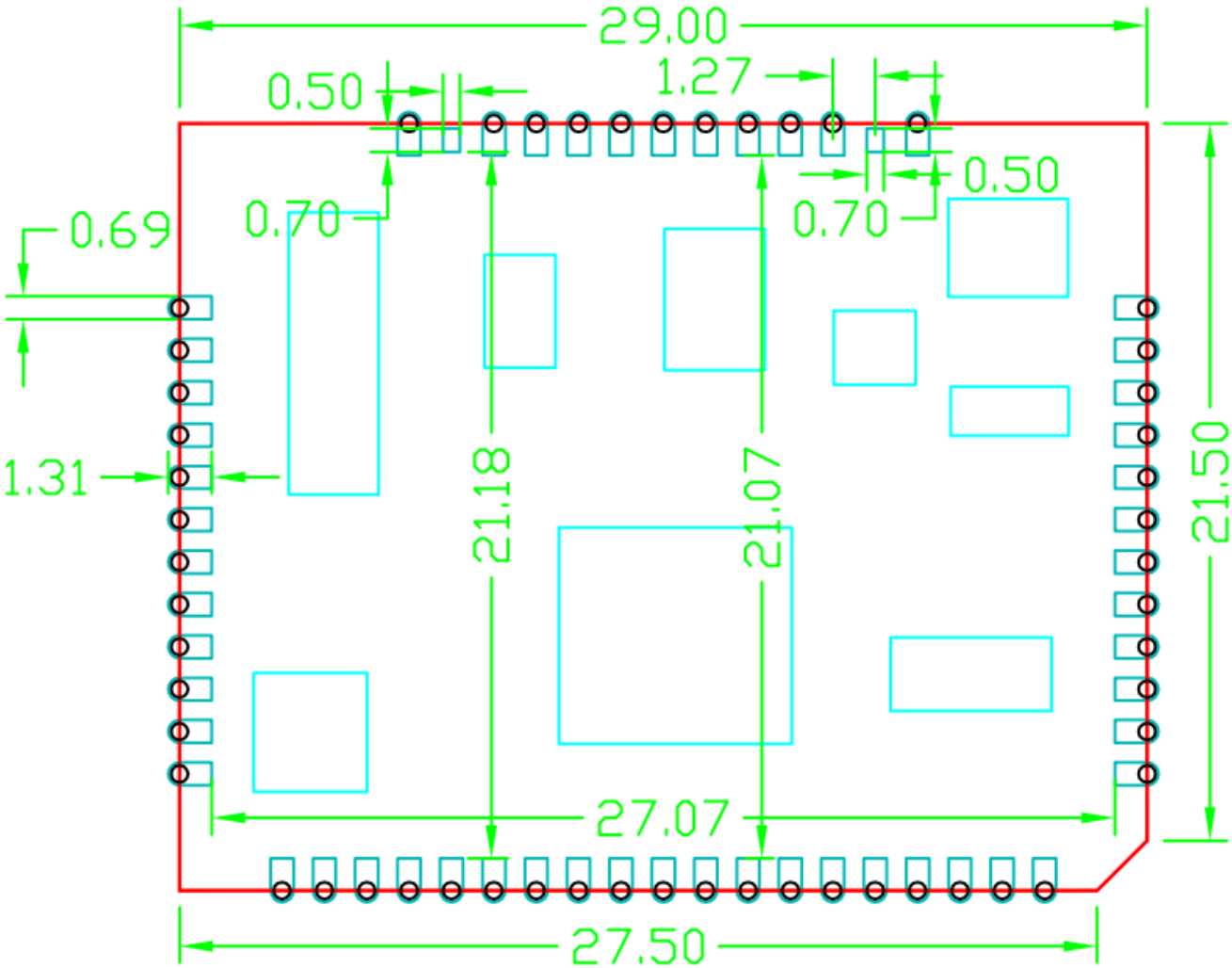
	Pin/Package	65pin/stamp hole (including 9 PGNDPADs)
	Temperature Range	Operating Temperature: -40 to 85°C
		Storage Temperature: -40 to 120°C
Interface	USB	1x USB2.0 Host/Device
	RMII	1x RMII
	DEBUG UART	1x
	UART	2x
Wireless	Maximum Transmit Power	2.4G: 18.33dBm 5G:6.88dBm
	Modulation Mode	2.4G:OFDM-BPSK,QPSK,16QAM,64QAM 5G:OFDM-BPSK,QPSK,16QAM,64QAM,256QAM
	Channel Selection	Self-Adaptation Frequency Hopping
	Wireless Transmission Delay	<10ms
	Air Interface Rate	200Kbps~160Mbps
	Networking Mode	Point-to-Point, Point-to-Multipoint, Multi-Hop Relay
	Main Chip	V3
	Encryption	Supports hardware AES/DES/3DES encryption algorithms
	frequency band	2.4G:2422-2466MHz
		5G:5730-5840MHz

4.1 Module Dimensions

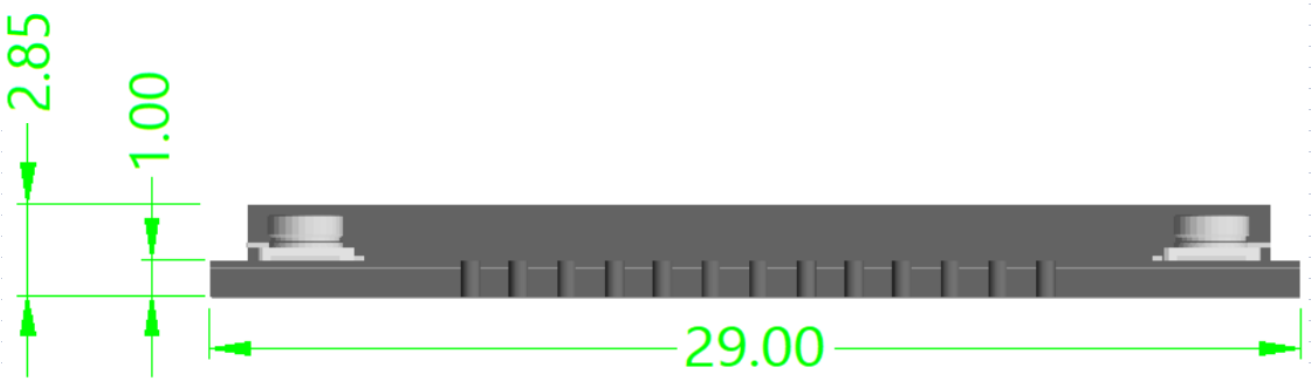
Figure 2.4.2 Module Dimension Diagram



Top

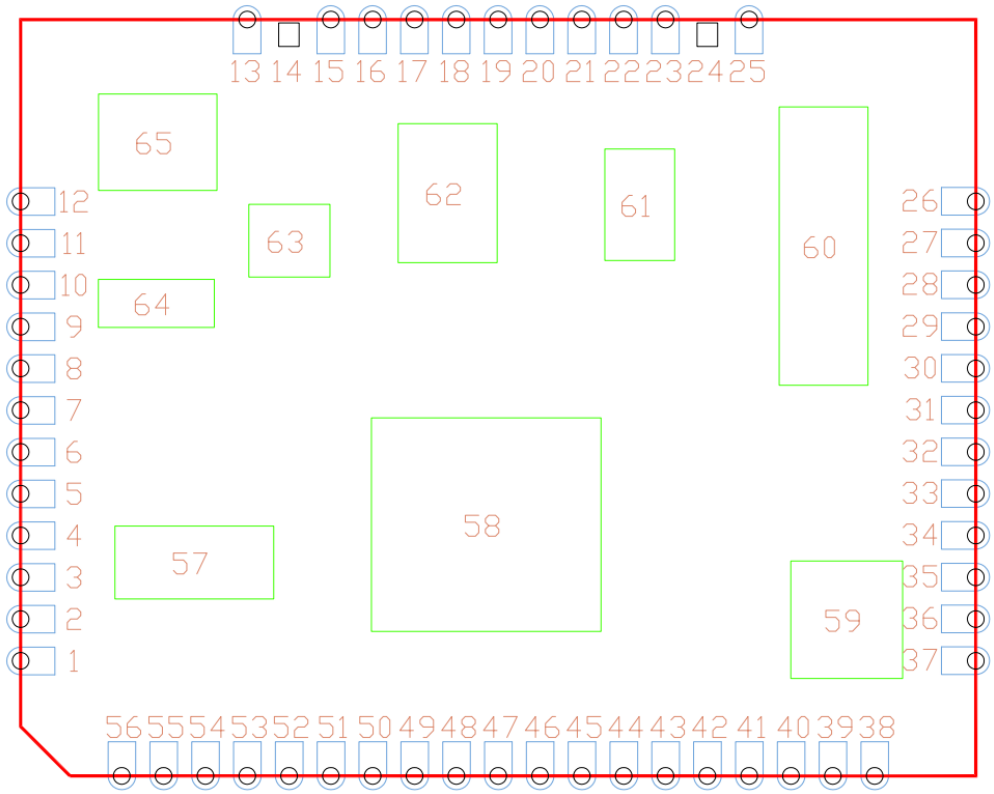


Bottom



4.2 P401-DAI Module Interface Signals

Figure 2.4.4 Schematic Diagram of Module PINs (Top View)



I/O Type Definition

Type	Description
DI	Digital Input
DO	Digital Output
AI	Analog Input
AO	Analog Output
IO	Digital Input/Output
AIO	Analog Input/Output
PI	Power Input
PO	Power Output
PU	Pull up
PD	Drop-down
\	Not applicable

Table 4 Pin Definitions

PINNumber	PINName	Default Status	Type	Description	PowerDomain	GPIO Reuse [1]
14	ANT-B	\	AIO	RF interface	\	\
24	ANT-A	\	AIO	RF interface	\	\
2	CLK_RTC_OUT	\	AO	32.768KHz RTC Clock[2]	\	\
3	CLK_RTC_IN	\	AI		\	\
9	UART2_RX	PU	IO	UART2RX	1.8V	GPIOA_0
5	BB_TX_SYNC	PD	IO	Baseband TX Synchronous Output	1.8V	GPIOA_1
6	UART2_TX	PD	IO	UART2TX	1.8V	GPIOA_3
29	UART3_RX	PD	IO	UART3RX	3.3V	GPIOC_3
27	UART3_TX	PD	IO	UART3TX	3.3V	GPIOC_4
19	TR_SW_2G	PD	DO	2GTR Control Signal	3.3V	\
28	TR_SW_5G	PD	DO	5GTR Control Signal	3.3V	\
30	SYS_RST	PU	DI	System Reset	1.8~3.3	\
31	UART_TX0	PD	DO	DebugUART	1.8V	GPIOB_4
32	UART_RX0	PD	DI		1.8V	GPIOB_3
34	RMII_MDC	PD	DO	RMII Interface	1.8V	GPIOB_1
35	RMII_MDIO	PD	IO		1.8V	GPIOB_2
39	RMII_RESET	PU	DO		1.8V	GPIOD_12
42	RMII_CLKOUT	PD	DO		1.8V	GPIOD_10
47	RMII_TXEN	PD	DO		1.8V	GPIOD_5
48	RMII_TXC	PD	DO		1.8V	GPIOD_4
43	RMII_TXD1	PD	DO		1.8V	GPIOD_9

44	RMII_TXD0	PD	DO		1.8V	GPIOD_8
54	RMII_RXDV	PU	DI		1.8V	GPIOD_11
45	RMII_RXD1	PD	DI		1.8V	GPIOD_7
46	RMII_RXD0	PD	DI		1.8V	GPIOD_6
50	USB_DP	\	IO	USB2.0	\	\
51	USB_DM	\	IO		\	\
52	USB_ID	PU	DI	USBID	1.8V	\
53	USB_VBUS_3V	\	PI	USBVBUS【4】	3.0V	\
18	BOOT_SEL0	PD	DI	Special for entering USB download mode	1.8V	\
26	BOOT_SEL1	PD	DI		1.8V	\
33	VDD_1V8_OUT	\	PO	1.8V Power Supply	1.8V	\
38	VDD_3V3_OUT	\	PO	3.3V Power Supply	3.3V	\
8	VBAT_IN	\	PI	RTC Power Supply, this PIN must be externally connected to 1.8V, refer to the notes after the table for details 3	1.8V	\
11,40,55,56	VDD_IN	\	PI	Module SOC Power Supply	3.3~5.5V	\
16,17,21,22	VDD_RF_IN	\	PI	Module RF FEM Power Supply	5V	\
7,36	NC					
1,4,10,12,13,15,20,23,25,37,41,49	GND	\	\	GND	\	\
57,58,59,60,61,62,63,64,65	PGND	\	\	GND	\	\

Federal Communications Commission (FCC) Statement

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

Note: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 radio frequency 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 or more 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.

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

RF 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 20cm between the radiator&your body.

OEM Guidance

1. Applicable FCC rules

This module has been tested and found to comply with part 15.247 and part 15.407 requirements for Modular Approval.

2. The specific operational use conditions

This module can be used in IoT devices. The input voltage to the module is nominally 5V DC. The operational ambient temperature of the module is -40 to 85 degree C. Only the authorized Monopole antenna is allowed. Any other external antenna is prohibited.

3. Limited module procedures

N/A

4. Trace antenna design

N/A

5. RF exposure considerations

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.

6. Antenna

Antenna type : Monopole Antenna; Antenna Max. Peak Gain:2.4G:3.38dBi,5G:5.52dBi

7. Label and compliance information

When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: “Contains FCC ID: 2BVSJP401-DAI

The FCC ID can be used only when all FCC ID compliance requirements are met.

8. Information on test modes and additional testing requirements

a)The modular transmitter 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,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).

b)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.

c)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 .

9. Additional testing, Part 15 Subpart 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 Part15 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 publiclyavailable 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 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 for further general testing details.