EDT2400X-SAxx

(Thread Module with BLE5.3)

Rev 0.9

Overview

EDT2400X-SA is a highly integrated wireless **thread** module for IoT connectivity. It is based on Silicon Labs, EFR32MG24 SoC, and is ideal for extending the 2.4GHz wireless range using mesh topology. EDT2400X-SA can be used very appropriately for smart home applications such as CSA Matter, and also building and factory automation.

Features

Items	Features
Core MCU	32-bit ARM® Cortex®-M33 core
	78MHz @ Maximum Operating Frequency
	1536 KB @Flash
	256 KB @RAM
	Secure Vault (Secure Boot, TRNG, Secure Key Management, etc…)
Wireless	**Thread** @OpenThread, Matter support
	BLE5.3 @Thread commissioning, mesh support
	ZigBee Support
	-105 dBm @Min Sensitivity
	19.5 dBm @Max TX Power
Operating Condition	1.3uA @ Deep Sleep Mode
	5mA @ RX Mode Current
	19/160mA @ 10/19dBm Output Power
	1.8 V to 3.8 V @ Operating Voltage
	-25 °C to 85 °C, (Optional) -40 °C to 125 °C
Peripherals	GPIO, UART, SPI, I2C, PWM, ADC/DAC
Dimension	15x23mm

Application

- Smart Home – Home appliance, Sensors, switches, door locks, smart plugs, lighting
- Building/Factory Automation
- Device Usage - End-Device, Router, Boarder Router/Hub/Gateway/Controller

Part Code

E	D	T	2	4	0	0	B/R/L	-	S	A	P/E
Part Name1							Option 1	Part Name2			Option 2

B/R/L Options

- B: Border Router, Gateway, Hub Controller Application
- R: Router Application & End-Node (Sleep Mode Not supported)
- L: End-Node Device Application, Sleep Mode support

P/E Antenna Options

- P: On-Board PCB Antenna
- E: UFL Connector for External Antenna

Part Code Example:

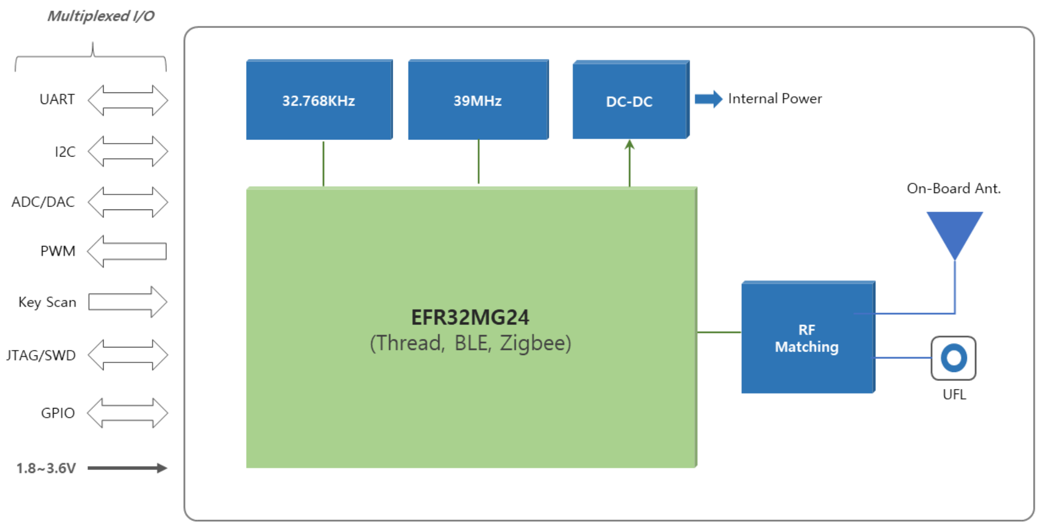
- EDT2400B-SAP → Border Router/Gateway FW flashed, and On-Board PCB antenna is used
- EDT2400R-SAP → Router & end device FW flashed, and On-Board PCB antenna is used
- EDT2400L-SAE → Sleepy end-device FW flashed, and UFL RF connector is used for external antenna

Contents List

1. EDT2400X-SA System

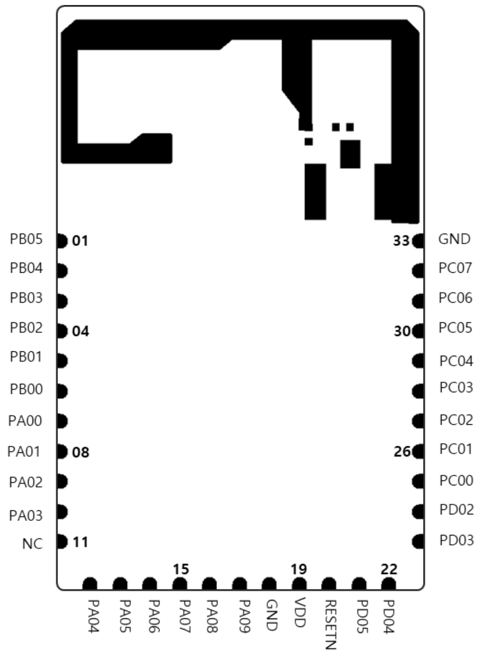
1.1 Block Diagram

The system's internal block and external interface of the EDT2400X-SA are shown in the figure below.



1.2 PIN Map

EDT2400X-SA consists of a total of 33 pins of multiplexed I/O and power.



1.3 Pin Description

I/O pins of EDT2400 are multiplexed with various peripheral functions. Therefore, you can switch to other functions by changing the default settings.

No	Name	I/O	Default Function	
Pin Map on Left Side				
1	PB05	-	GPIO	
2	PB04	O	LED_LIGHT	GPIO output, The output is toggled according to the input of pin 3..
3	PB03	I	SW1	GPIO input, The output of pin 2 toggles by input of this port.
4	PB02	O	LED_STATE	GPIO output, Indicate the operating status of the system.
5	PB01	O	SW0	GPIO input, Controls the mode of operation of the module.
6	PB00	-	GPIO	
7	PA00	-	GPIO	
8	PA01	O	SWCLK	Interface for debug and FW download
9	PA02	I/O	SWDIO	Interface for debug and FW download
10	PA03	O	SWO	Interface for debug and FW download
11	NC	-		
Pin Map on Bottom Side				
12	PA04	O	USR_TXD	UART interface, Baud Rate 115200bps for command/response when using Host MCU
13	PA05	I	USR_RXD	UART interface, Baud Rate 115200bps for command/response when using Host MCU
14	PA06	-	GPIO	
15	PA07	-	GPIO	
16	PA08	O	VCOM_TXD	UART interface, Baud Rate 115200bps for log message and CLI command input
17	PA09	I	VCOM_RXD	UART interface, Baud Rate 115200bps for log message and CLI command input
18	GND	P	GND	Power Ground
19	VDD	P	VDD	Power Input, 1.8V~3.8V
20	RESETN	I	RESETN	Reset input signal, Power-on-reset function supported
21	PD05	-	GPIO	
22	PD04	-	GPIO	
Pin Map on Right Side				

23	PD03	-	GPIO	
24	PD02	-	GPIO	
25	PC00	O	SPI_CS	Master mode, SPI Slave Enable signal
26	PC01	O	SPI_MOSI	Master operation, SPI data output to slave
27	PC02	I	SPI_MISO	Master operation, SPI data input from slave
28	PC03	O	SPI_CLK	Master operation, SPI clock output signal
29	PC04	-	GPIO	
30	PC05	O	I2C_SCL	Master operation, I2C clock signal
31	PC06	-	GPIO	
32	PC07	I/O		Master operation, I2C data Input/Output signal
33	GND	P	GND	Power GND

1.4 Peripherals

GPIO (General Purpose Input/Output)

Each GPIO pin can be individually configured as either an output or input. More advanced configurations including open-drain, open-source, and glitch-filtering can be configured for each individual GPIO pin. The GPIO subsystem supports asynchronous external pin interrupts.

Timer/Counter/PWM

TIMER peripherals keep track of timing, count events, generate PWM outputs and trigger timed actions. The core of each TIMER is a 16-bit or 32-bit counter with up to 3 compare/capture channels. Each channel is configurable in one of three modes. In capture mode, the counter state is stored in a buffer at a selected input event. In compare mode, the channel output reflects the comparison of the counter to a programmed threshold value. In PWM mode, the TIMER supports the generation of pulse-width modulation (PWM) outputs of arbitrary waveforms defined by the sequence of values written to the compare registers

RTC (Real-Time Clock)

The RTC with a 32-bit counter can be clocked by any of the onboard low-frequency oscillators, and it is capable of providing system wake-up at user-defined intervals.

USART/SPI (Universal Synchronous/Asynchronous Receiver/Transmitter)

USART supports full duplex asynchronous UART communication with hardware flow control as well as RS-485, SPI, MicroWire, and 3-wire. It can also interface with devices supporting:

- ISO7816 SmartCards
- IrDA
- I^2S

I^2C (Inter-Integrated Circuit Interface)

The I^2C module provides an interface between the MCU and a serial I^2C bus. It is capable of acting as both a master and a slave and supports multi-drop buses.

ADC (Analog to Digital Converter)

The ADC is a hybrid architecture combining techniques from both SAR and Delta-Sigma style converters. The ADC includes integrated voltage reference options. Inputs are selectable from a wide range of sources, including pins configurable as either single-ended or differential.

The ADC supports three operational modes:

- Normal Mode (all devices): Flexible speed and performance, 12-16 bits output resolution
- High-Speeded Mode (select devices): Doubles output speed of Normal mode with similar performance, 12-16 bits output resolution
- High Accuracy Mode (select devices): Optimized for low-rate, high-performance applications, with 20-bit output resolution

DAC (Digital to Analog Converter)

The Digital to Analog Converter (DAC) can convert a digital value to an analog output voltage. The DAC is a fully differential, 500Ksps, 12-bit converter. The DAC may be used for a number of different applications such as sensor interfaces or sound output. The DAC can generate high-resolution analog signals while the MCU is operating at low frequencies and with low total power consumption. Using DMA and a timer, the DAC can be used to generate waveforms without any CPU intervention.

2. Electrical Characteristics

2.1 Absolute Maximum Ratings

Stresses beyond those listed below may cause permanent damage to the device.

Parameter	Test Condition	Min	Typ	Max	Unit
Storage temperature (TA)	Default Module	-30	-	+120	°C
	Optional Module	-40		+125	
Voltage on VDD		-0.3	-	3.8	V
Voltage on GPIO		-0.3	-	VDD+0.3	V
Voltage on RESETn		-0.3	-	3.8	V
Current per I/O pin	Sink	-	-	50	mA
	Source	-	-	50	mA

2.2 General Operating Conditions

Parameter	Test Condition	Min	Typ	Max	Unit
Operating Ambient temperature	Default Module	-20	-	+85	°C
	Optional Module	-40		+125	°C
VDD Supply Voltage		1.8	3.3	3.8	V
Operating Current	RX Mode	-	5	-	mA
	TX Mode, 19.5 dBm @CW	-	160	-	mA
	Sleep Mode @End-Deve	-	1.3	-	uA
Flash Data Retention	TA ≤ 125 °C	10	-	-	Years
Flash erase cycles before failure	TA ≤ 125 °C	10,000	-	-	Cycles
GPIO Input Low Voltage		-	-	0.3*VDD	V
GPIO Input High Voltage		0.7*VDD	-	-	V
GPIO Output High Voltage	Source 20mA	0.8*VDD			V
GPIO Output Low Voltage	Sink 20mA			0.2*VDD	V
RESETN low time		100			ns

3. Wireless Characteristics

3.1 Transmitter Characteristics

3.1.1 RF Transmitter General Characteristics for the 2.4 GHz Band

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
RF frequency range		2400	—	2483.5	MHz
Maximum TX power		—	19.5	—	dBm

3.1.2 RF Transmitter Characteristics for 802.15.4 DSSS-OQPSK in the 2.4 GHz Band

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
Error vector magnitude per 802.15.4-2011	Average across frequency, signal is DSSS-OQPSK reference pack- et, VDD = 3.3 V, P_{out} = 19.5 dBm	—	3	—	% rms
Power spectral density limit	Relative, at carrier ± 3.5 MHz, VDD = 3.3 V, P_{out} = 19.5DBM	—	-50.2	—	dBc/ 100kHz
	Absolute, at carrier ± 3.5 MHz, VDD = 3.3 V, P_{out} = 19.5 dBm	—	-38.3	—	dBm/ 100kHz
	Per FCC part 15.247, VDD = 3.3 V, P_{out} = 19.5 dBm	—	0.5	—	dBm/ 3kHz
	ETSI 300.328 P_{out} = 10 dBm	—	8	—	dBm
Occupied channel bandwidth per ETSI EN300.328	99% BW at highest and lowest channels in band, P_{out} = 10 dBm	—	2.2	—	MHz

3.1.3 RF Transmitter Characteristics for Bluetooth Low Energy in the 2.4 GHz Band 1 Mbps Data Rate

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit

Transmit 6 dB bandwidth	VDD = 3.3 V, P_{out} = 19.5 dBm	—	718	—	kHz
	P_{out} = 10 dBm	—	714	—	kHz
	P_{out} = 0 dBm	—	715	—	kHz
Power spectral density limit	VDD = 3.3 V, P_{out} = 19.5 dBm, Per FCC part 15.247	—	-0.5	—	dBm/ 3kHz
	Per ETSI 300.328 at 10 dBm/1 MHz	—	9.7	—	dBm
Occupied channel bandwidth per ETSI EN300.328	P_{out} = 10 dBm 99% BW at highest and lowest channels in band	—	1	—	MHz
In-band spurious emissions, with allowed exceptions	VDD = 3.3 V, P_{out} = 19.5 dBm, Inband spurs at ± 2 MHz	—	-26.9	—	dBm
	VDD = 3.3 V, P_{out} = 19.5 dBm Inband spurs at ± 3 MHz	—	-33.2	—	dBm

3.1.4 RF Transmitter Characteristics for Bluetooth Low Energy in the 2.4 GHz Band 2 Mbps Data Rate

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
Transmit 6 dB bandwidth	VDD = 3.3 V, P_{out} = 19.5 dBm	—	1307	—	kHz
Power spectral density limit	VDD = 3.3 V, P_{out} = 19.5 dBm, Per FCC part 15.247	—	1.5	—	dBm/ 3kHz
	Per ETSI 300.328 at 10 dBm/1 MHz	—	8.7	—	dBm
Occupied channel bandwidth per ETSI EN300.328	P_{out} = 10 dBm 99% BW at highest and lowest channels in band	—	2.1	—	MHz
In-band spurious emissions, with allowed exceptions	VDD = 3.3 V, P_{out} = 19.5 dBm, Inband spurs at ± 2 MHz	—	-33.7	—	dBm
	VDD = 3.3 V, P_{out} = 19.5 dBm Inband spurs at ± 6 MHz	—	-38.9	—	dBm

3.1.5 RF Transmitter Characteristics for Bluetooth Low Energy in the 2.4 GHz Band 500 kbps Data Rate

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
Transmit 6 dB bandwidth	VDD = 3.3 V, P_{out} = 19.5 dBm	—	717	—	kHz
Power spectral density limit	VDD = 3.3 V, P_{out} = 19.5 dBm, Per FCC part 15.247	—	-0.5	—	dBm/ 3kHz
	Per ETSI 300.328 at 10 dBm/1 MHz	—	9.7	—	dBm
Occupied channel bandwidth per ETSI EN300.328	P_{out} = 10 dBm 99% BW at highest and lowest channels in band	—	1	—	MHz
In-band spurious emissions, with allowed exceptions	VDD = 3.3 V, P_{out} = 19.5dBm, Inband spurs at ± 2 MHz	—	-26.9	—	dBm
	VDD = 3.3 V, P_{out} = 19.5 dBm Inband spurs at ± 3 MHz	—	-33.2	—	dBm

3.1.6 RF Transmitter Characteristics for Bluetooth Low Energy in the 2.4 GHz Band 125 kbps Data Rate

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
Transmit 6 dB bandwidth	VDD = 3.3 V, P_{out} = 19.5 dBm	—	651	—	kHz
Power spectral density limit	VDD = 3.3 V, P_{out} = 19.5 dBm, Per FCC part 15.247	—	13.7	—	dBm/ 3kHz
	Per ETSI 300.328 at 10 dBm/1 MHz	—	9.7	—	dBm
Occupied channel bandwidth per ETSI EN300.328	P_{out} = 10 dBm 99% BW at highest and lowest channels in band	—	1	—	MHz
	P_{out} = 0 dBm 99% BW at highest and lowest channels in band	—	1	—	MHz
In-band spurious emissions, with allowed exceptions	VDD = 3.3 V, P_{out} = 19.5d Bm, Inband spurs at ± 2 MHz	—	-26.9	—	dBm
	VDD = 3.3 V, P_{out} = 19.5dBm Inband spurs at ± 3 MHz	—	-33.1	—	dBm

3.2 Receiver Characteristics

3.2.1 RF Receiver General Characteristics for the 2.4 GHz Band

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
RF frequency range		2400	—	2483.5	MHz
Radio-only current consumption in receive mode[1]		—	2.8	—	mA

3.2.2 RF Receiver Characteristics for 802.15.4 DSSS-OQPSK in the 2.4 GHz Band

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
Max receiver input level, 1% PER	Signal is reference signal, packet length is 20 octets	—	10	—	dBm
Sensitivity, 1% PER	Signal is reference signal, packet length is 20 octets	—	-105.4	—	dBm

3.2.3 RF Receiver Characteristics for Bluetooth Low Energy in the 2.4 GHz Band 1 Mbps Data Rate

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
Max receiver input level	Signal is reference signal[1]	—	10	—	dBm
Sensitivity	Signal is reference signal, 37 byte payload[2]	—	-97.6	—	dBm
	Signal is reference signal, 255 byte payload[1]	—	-96	—	dBm
	With non-ideal signals[3] [1]	—	-95.7	—	dBm

3.2.4 RF Receiver Characteristics for Bluetooth Low Energy in the 2.4 GHz Band 2 Mbps Data Rate

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
Max receiver input level	Signal is reference signal[1]	—	10	—	dBm
Sensitivity	Signal is reference signal, 37 byte payload[2]	—	-94.8	—	dBm
	Signal is reference signal, 255 byte payload[1]	—	-93.3	—	dBm
	With non-ideal signals[3] [1]	—	-93.1	—	dBm

3.2.5 RF Receiver Characteristics for Bluetooth Low Energy in the 2.4 GHz Band 500 kbps Data Rate

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
Max receiver input level	Signal is reference signal[1]	—	10	—	dBm
Sensitivity	Signal is reference signal, 37 byte payload[2]	—	-101.4	—	dBm
	Signal is reference signal, 255 byte payload[1]	—	-100.1	—	dBm
	With non-ideal signals[3] [1]	—	-99.1	—	dBm
	Interferer is reference signal at -3 MHz offset[1] [5] [4] [6]	—	-54.5	—	dB

3.2.6 RF Receiver Characteristics for Bluetooth Low Energy in the 2.4 GHz Band 125 kbps Data Rate

Unless otherwise indicated, typical conditions are TA = 25 °C, RF center frequency = 2.45 GHz. VDD = 3.3 V

Parameter	Test Condition	Min	Typ	Max	Unit
Max receiver input level	Signal is reference signal[1]	—	10	—	dBm
Sensitivity	Signal is reference signal, 37 byte payload[2]	—	-105.7	—	dBm

	Signal is reference signal, 255 byte payload[1]	—	-105.3	—	dBm
	With non-ideal signals[3] [1]	—	-104.8	—	dBm

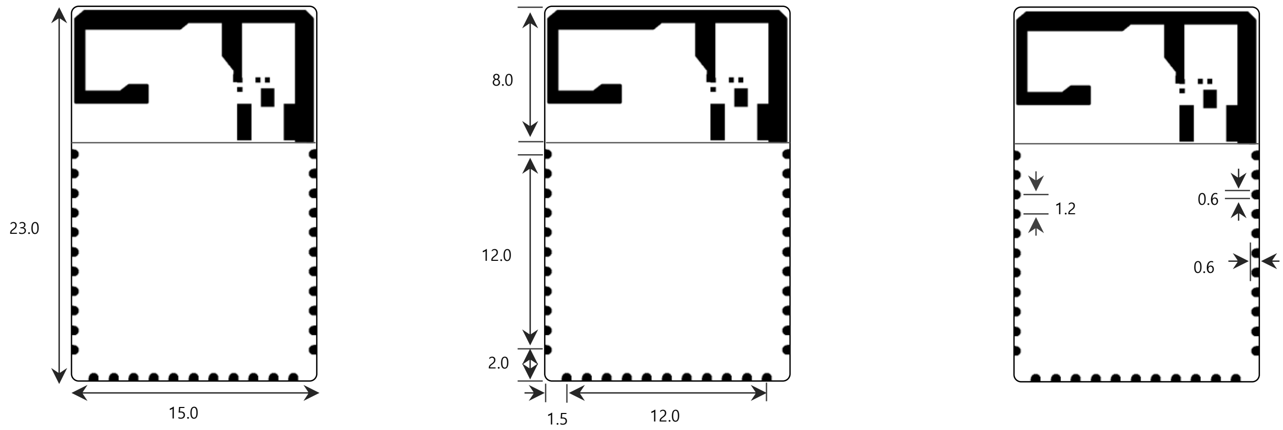
3.3 Antenna Radiation

--- TBD

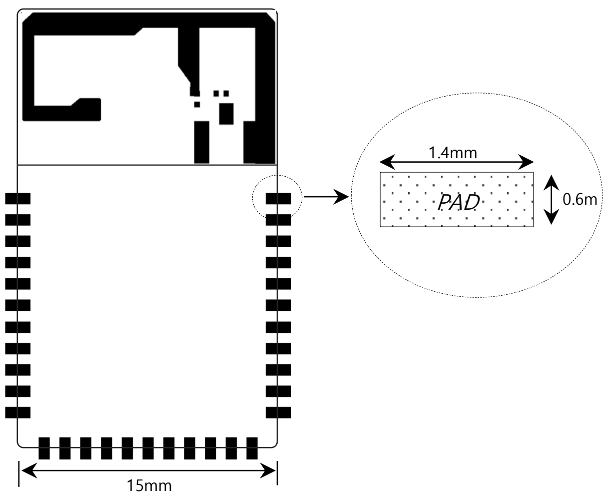
4. Design Consideration

4.1 Dimension

Unit [mm]

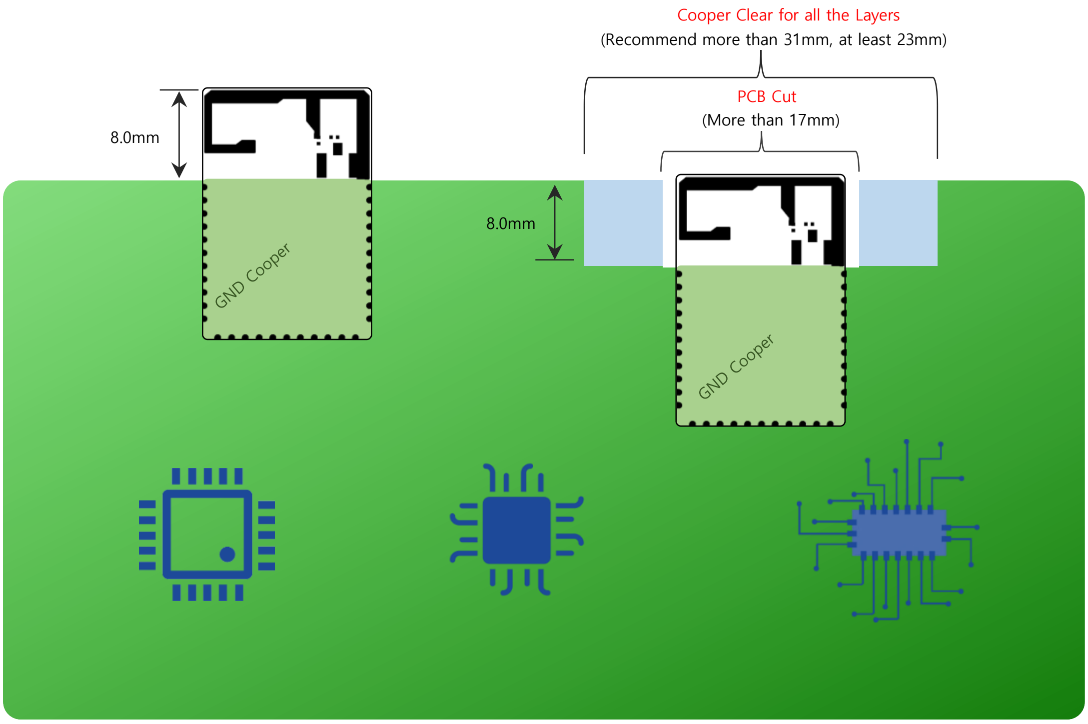


4.2 PCB PAD Recommendation



4.3 Layout Recommendation on Host Board

In applications using the On-board PCB antenna built into the module, refer to the following design guide. If an external antenna is used, it is not necessary to follow the design guide below.



4.4 Example Schematic