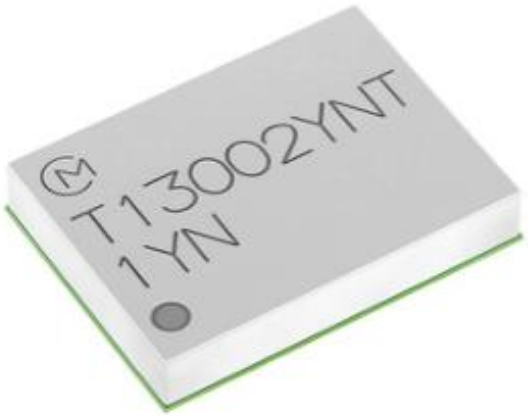
Hardware Application Note

Type 1YN Wi+Fi™ + Bluetooth® Module

Infineon CYW43439 Chipset for 802.11b/g/n + Bluetooth 5.1

Hardware Application Note - Rev. 4.0

- Design Name: Type 1YN
- Module P/N: LBEE5KL1YN



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About This Document

Murata's Type 1YN is a small module based on Infineon's CYW43439 combo chipset, supporting IEEE 802.11b/g/n + Bluetooth 5.1 BR/EDR/LE. This application note provides RF and hardware design guidance. Refer to Type 1YN Datasheet for module specification.

Audience & Purpose

Intended audience includes any customer looking to integrate this module into their product. In particular, RF, hardware, systems, and software engineers.

Document Conventions

Table 1 describes the document conventions.

Table 1: Document Conventions

Conventions	Description
	**Warning Note** Indicates very important note. Users are strongly recommended to review.
	**Info Note** Intended for informational purposes. Users should review.
	**Menu Reference** Indicates menu navigation instructions. **Example**: Insert➔Tables➔Quick Tables➔Save Selection to Gallery
	**External Hyperlink** This symbol indicates a hyperlink to an external document or website. **Example**: Murata Click on the text to open the external link.
	**Internal Hyperlink** This symbol indicates a hyperlink within the document. **Example**: Scope Click on the text to open the link.
`Console input/output or code snippet`	**Console I/O or Code Snippet** This text ***Style*** denotes console input/output or a code snippet.
`# Console I/O comment` `// Code snippet comment`	**Console I/O or Code Snippet Comment** This text ***Style*** denotes a console input/output or code snippet comment. • Console I/O comment (preceded by "#") is for informational purposes only and does not denote actual console input/output. • Code Snippet comment (preceded by "//") may exist in the original code.

1 Scope

This application note provides detailed information on schematic/layout design, and references RF performance benchmarks. Refer to Type 1YN Datasheet for module specification.

2 Module Introduction

Type 1YN is a very small module based on Infineon CYW43439 combo chipset which supports IEEE 802.11b/g/n + Bluetooth 5.1 up to 72.2 Mbps PHY data rate on Wi-Fi and 3 Mbps PHY data rate on Bluetooth.

The WLAN section supports SDIO 2.0 interface. The Bluetooth section supports high-speed 4-wire UART interface and PCM for audio data.

The CYW43439 implements sophisticated enhanced collaborative coexistence hardware mechanisms and algorithms, which ensure that WLAN and Bluetooth is optimized for maximum performance.

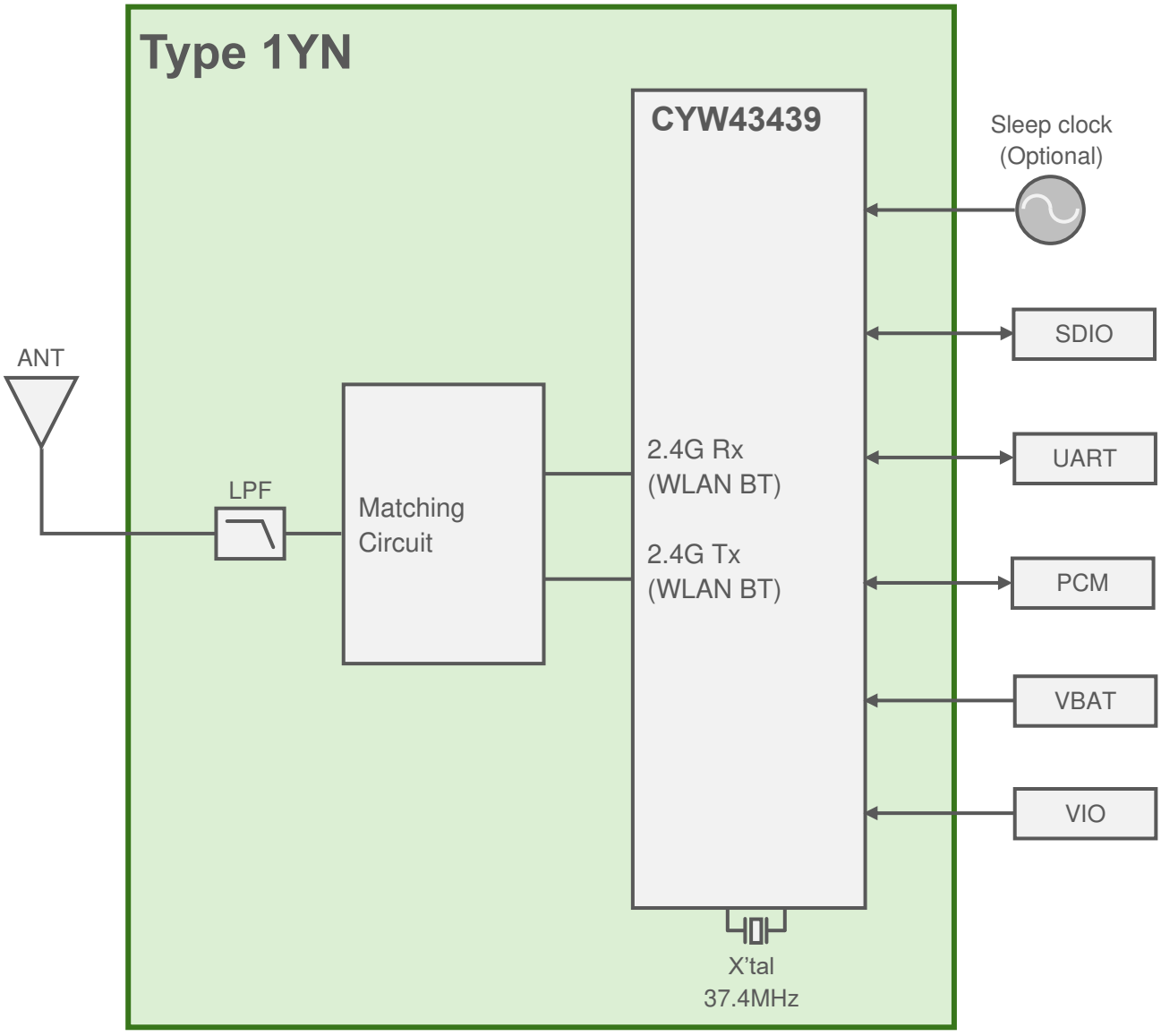
2.1 Features

- WLAN 802.11b/g/n + Bluetooth Classic and Low Energy (Version 5.1) combo SMD module with Infineon CYW43439
- Small size LGA package with resin molding and metal shielding.
- Host interfaces: SDIO 2.0 for WLAN;
  HCI UART, PCM for Bluetooth.
- WLAN MAC address and BD address are stored in OTP

2.2 Hardware Block Diagram

The module internal block diagram is shown in **Figure 1**.

Figure 1: Block Diagram



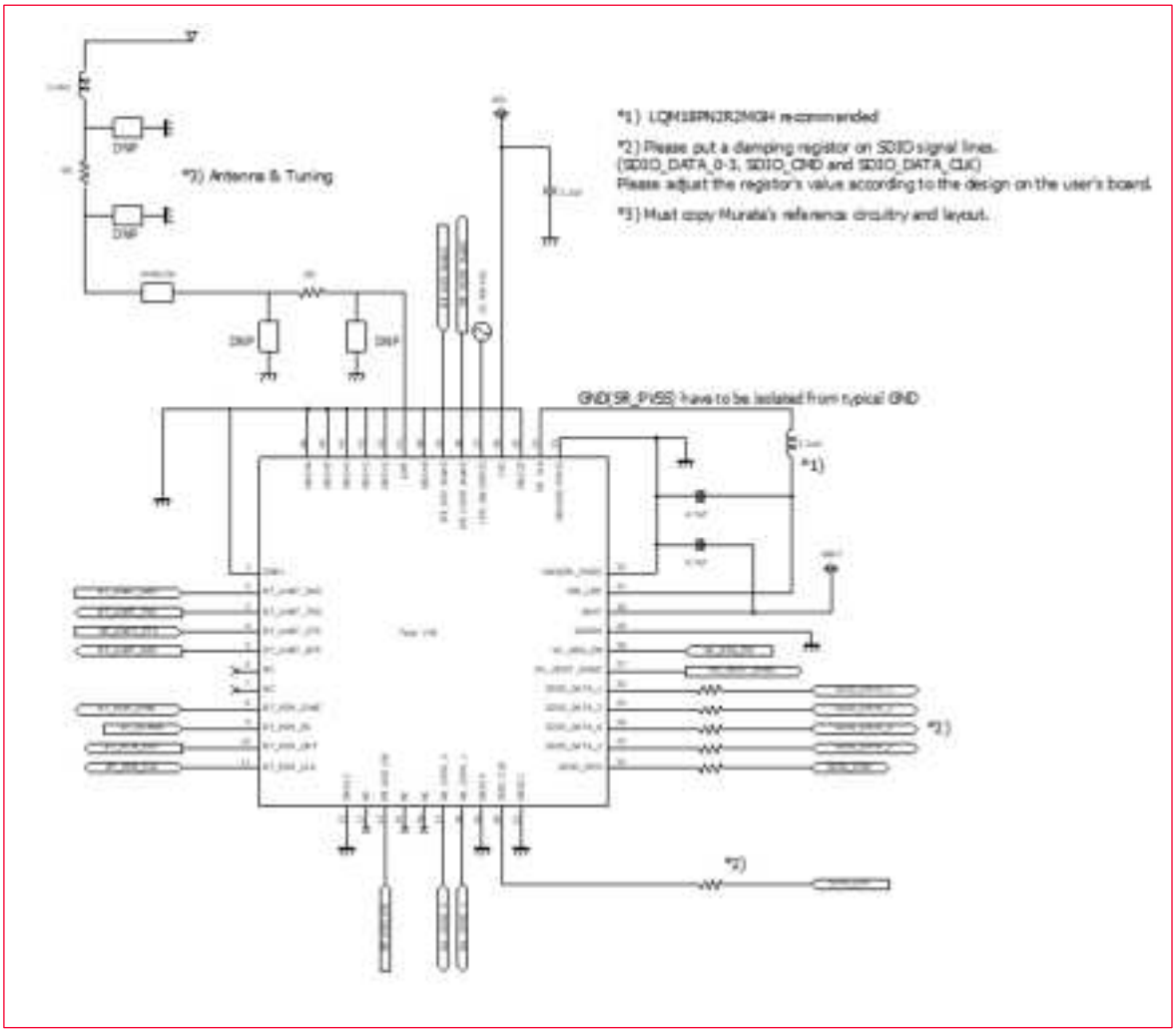
3 Reference Design

This section details reference schematics which the end user can leverage for designing their own hardware. You can find a detail description of each module pin in module data sheet.

3.1 Reference Circuit

This section details reference schematics which the end user can leverage for designing their own hardware. **Figure 2** shows a reference circuit for Type 1YN module.

Figure 2: Reference Circuit - Type 1YN



3.2 Requirement for High-Speed Digital Signals

SDIO traces should be isometric zero delay routing with 50 Ω impedance.

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.

3.3 Requirements for Unused Signals

If these signals are not used, no pull-up/down is necessary (floating) for

- WL/BT_HOST_WAKE
- BT_DEV_WAKE
- WL_GPIO_*
- BT_PCM

3.4 Module Footprint Design

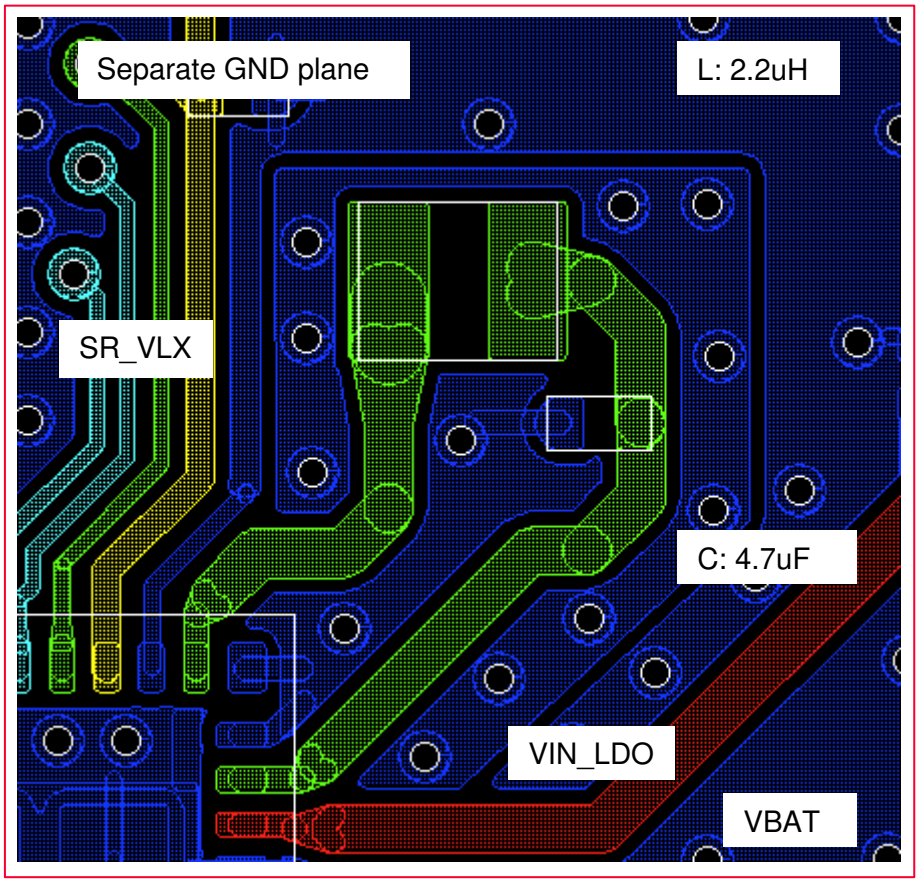
Refer to dimensions in the Type 1YN Datasheet. The DXF File of module footprint is provided via website.

3.5 Design Guide: VBAT/CBUCK Line

The guidelines are:

- Make the line from SR_VLX to VIN_LDO as short as possible. The 4.7uF capacitor should be as close to VIN_LDO as possible.
- If the main board is multilayer PCB type, it's better to separate the GND place for this area on the top later, then connect it to the main GND thru the via hole on the lower layer.
- On VBAT line, 4.7uF bypass capacitor should be located as close to the module as possible.

Figure 3: VBAT/CBUCK Line



3.6 Recommended Antenna

This module is certified with the trace antenna solution by regulatory certification body. To use Murata's regulatory certification, any user must follow below instructions. The DXF File of the trace antenna is provided via website.

3.6.1 Trace Antenna

Users must follow the antenna guidelines listed below:

- Copy antenna design from the antenna layout file provided by Murata.
- Copy RF trace to PCB trace antenna from the trace layout file provided by Murata adhering to the guidelines listed below:
  - Trace width accuracy within +/- 0.25 mm.
  - PCB thickness within 0.6 ~ 1.6 mm range (0.8 mm typ.).
  - Stack height between GND layer and RF trace of 200 µm; keeping inaccuracy within +/- 0.5 µm.
  - Passive component location matching Murata design.

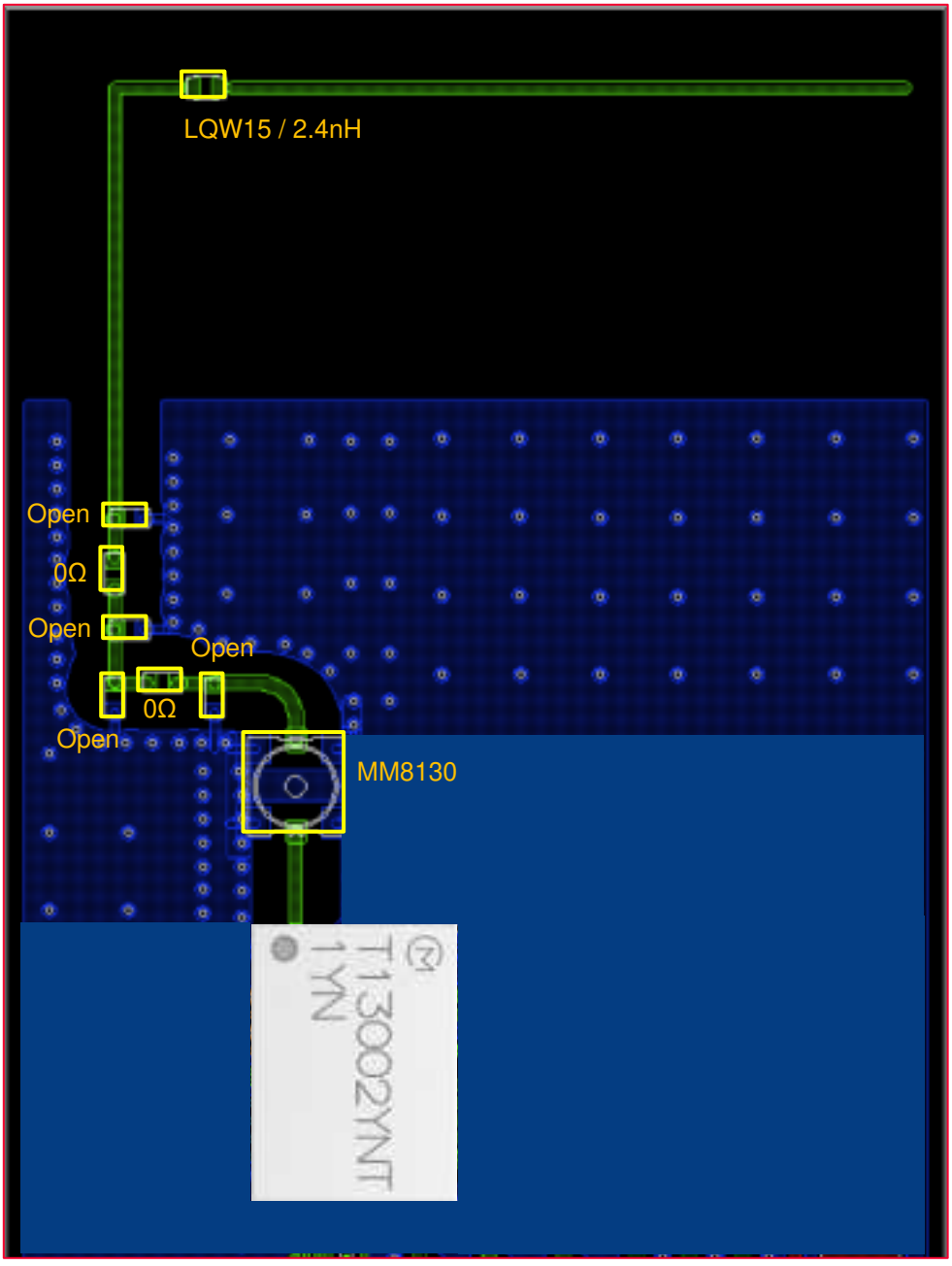
Table 2 shows the trace antenna gains for Type 1YN module.

Table 2: Trace Antenna Gain

No.	Vendor	Peak Gain [dBi]	Type	Connector
		2.4 GHz		
1	Murata	1.4	Monopole	Trace

Figure 4 shows the Type1YN antenna guidelines.

Figure 4: Trace Antenna Guideline - Type 1YN

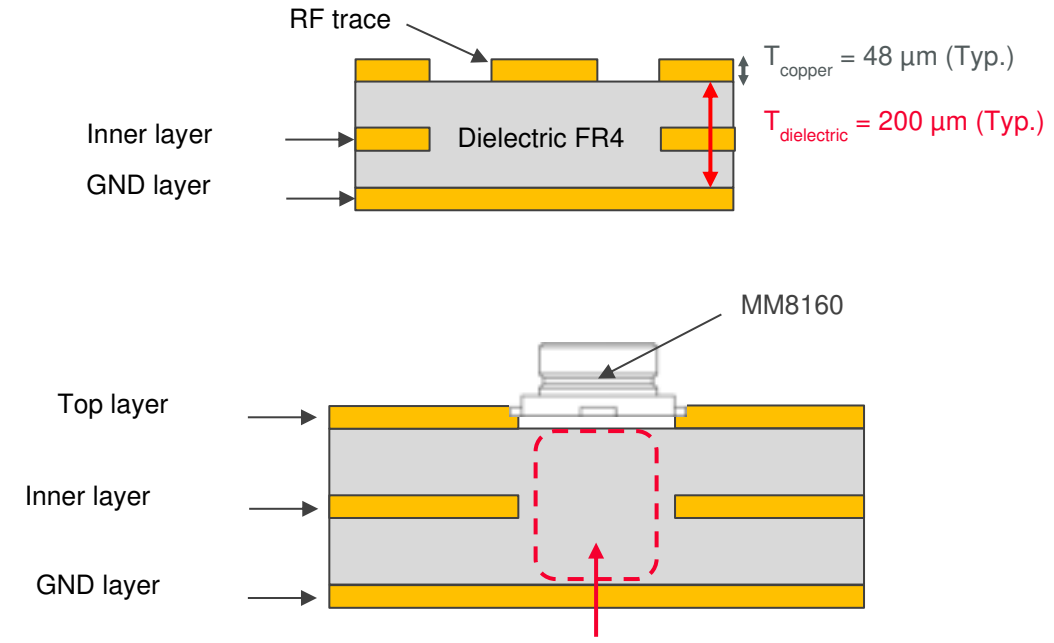


Size: 1005 LQW15 / Resistor

3.6.2 PCB Stack-Up

Figure 5 shows the PCB stack-up layers.

Figure 5: PCB Stack-Up Layers



3.6.3 Trace Antenna Performance

This section illustrates the trace antenna performance results. **Figure 6** show the antenna performances of Type1YN module.

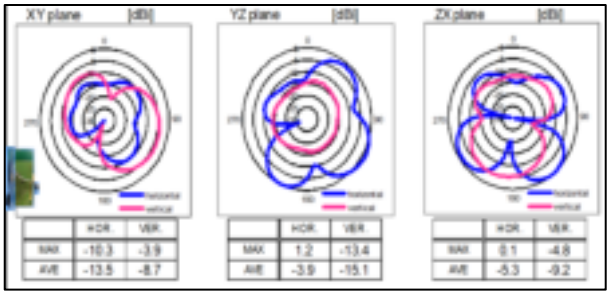
Figure 6: Trace Antenna Performance - Type 1YN

Gain and Efficiency

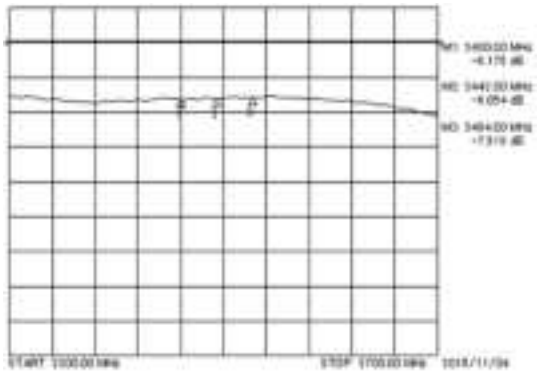
[dBi] [dB]

LINEAR POLARIZATION		XY-plane hor.	XY-plane ver.	YZ-plane hor.	YZ-plane ver.	ZX-plane hor.	ZX-plane ver.	Total Efficiency
2400 MHz	MAX.	-10.8	-4.0	0.9	-14.2	-0.2	-5.3	
	AVE.	-14.3	-8.9	-4.1	-15.4	-5.4	-9.6	-3.7
2442 MHz	**MAX.**	**-10.3**	**-3.9**	**1.2**	**-13.4**	**0.1**	**-4.8**	
	AVE.	**-13.5**	**-8.7**	**-3.9**	**-15.1**	**-5.3**	**-9.2**	**-3.5**
2484 MHz	MAX.	-9.3	-3.7	1.4	-13.6	0.3	-4.1	
	AVE.	-12.8	-8.5	-3.8	-14.7	-5.2	-8.7	-3.3

Directivity



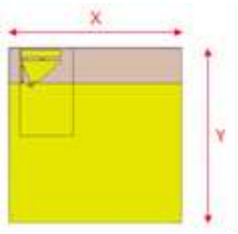
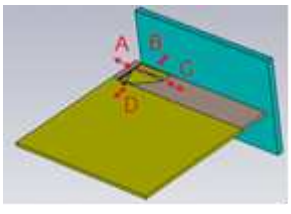
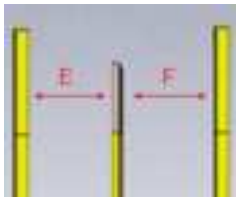
Return Loss

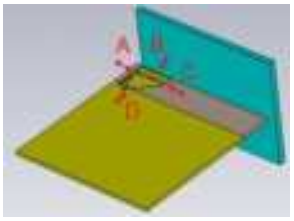
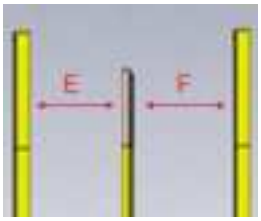


3.6.4 Trace Antenna Installation

Keep board size and clearance to Metal/GND and dielectric around the trace antenna for good antenna performance. **Table 3** lists the antenna installation details.

Table 3: Trace Antenna Installation

Board Size		X ≥ 40 mm Y ≥ 40 mm
Clearance to Metal/GND	 	A ≥ 20 mm B ≥ 20 mm C ≥ 20 mm D ≥ 20 mm E/F ≥ 20 mm

Clearance to Dielectric	 	A ≥ 4 mm B ≥ 4 mm C ≥ 4 mm D ≥ 4 mm E/F ≥ 4 mm

4 Setup Configuration Files

To enable Murata's regulatory certification, below configuration file shall be loaded initially. The transmit power files are hosted at Murata GitHub for Linux.

4.1 WLAN Configuration Files for Linux

The files listed in **Table 4** shall be used to satisfy regulatory requirements if user wants to use Murata regulatory certification. For more information, refer to Linux User Guide.

Table 4: WLAN Configuration Files – Linux

Names	Configuration Files
WLAN configuration file	cyfmac43430-sdio.1LN.txt
WLAN regulatory configuration file	cyfmac43439-sdio.1YN.clm_blob

The following country codes are defined in "WLAN regulatory configuration file ".

- US: United States of America
- CA: Canada
- DE: Europe
- JP: Japan

4.2 Bluetooth Configuration Files for Linux

Bluetooth Tx power configuration script files shall be loaded after Bluetooth device initialization.

The files listed in **Table 5** shall be used to satisfy regulatory requirements if user wants to use Murata regulatory certification.

Table 5: Bluetooth Configuration Files - Linux

Names	Configuration Files
Bluetooth configuration files	CYW4343A2_001.003.016.0031.0000.1YN.hcd

5 Reference Performance Data

This section describes the reference performance data.

5.1 Typical Rx Minimum Sensitivity Level at Module Antenna Port

This section describes the typical Rx Minimum Sensitivity Level at module antenna port for WLAN and Bluetooth.

5.1.1 WLAN

- Conditions
  - VBAT = 3.3V, VDDIO = 1.8V
  - FW version: 7.95.35

Table 6 describes the typical Rx minimum sensitivity level at module antenna port for WLAN at 2.4 GHz for 20 MHz bandwidth.

Table 6: Rx Minimum Sensitivity Level - WLAN 2.4 GHz (20 MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]					
	11b		11g		11n (HT 20)	
	1 Mbps	11 Mbps	6 Mbps	54 Mbps	MCS0	MCS7
2412	-95	-88	-91	-75	-90	-73
2442	-95	-88	-91	-75	-90	-73
2472	-95	-88	-91	-75	-90	-73

5.1.2 Bluetooth

- Conditions
  - VBAT = 3.3V, VDDIO = 1.8V
  - Hcd file: CYW4343A2_001.003.016.0031.0000.1YN.hcd

Table 7 describes the typical Rx minimum sensitivity level for Bluetooth.

Table 7: Rx Minimum Sensitivity Level - Bluetooth

Frequency in MHz	Rx Minimum Sensitivity Level[dBm]		
	DH5	3DH5	LE
2402	-90	-88	-95
2440	-91	-88	-95
2480	-91	-88	-95

5.2 Typical Tx/Rx Current Consumption

This section describes the typical Tx/Rx current consumption for WLAN and Bluetooth.

5.2.1 WLAN

- Conditions
  - VBAT = 3.3V, VDDIO = 1.8V
  - FW version: 7.95.35
  - Current definition: 1024byte, 20usec interval

Table 8 describe the typical Tx/Rx current consumption for WLAN at 2.4GHz and 5 GHz.

Table 8: Typical Tx/Rx Current Consumption - WLAN at 2.4 GHz

Mode	Data Rate	Setting Tx Power [dBm]	Current [mA]	
			Tx	Rx
			VBAT	VBAT
11b	11 Mbps	17	330	45
11g	54 Mbps	13	279	45
11n (HT20)	MCS7	12	260	45

5.2.2 Bluetooth

- Conditions
  - VBAT = 3.3V, VDDIO = 1.8V
  - Hcd file: CYW4343A2_001.003.016.0031.0000.1YN.hcd
  - Current definition: Tx/Rx fully occupied.

Table 9 describes the typical current consumption for Bluetooth.

Table 9: Typical Tx/Rx Current Consumption - Bluetooth at 2.4 GHz

Mode	Setting Tx Power [dBm]	Current [mA]
		VBAT
BR (1DH5)	8.0	28
EDR (3DH5)	5.0	25

Table 10 describes the typical current consumption for Bluetooth Low Energy.

Table 10: Typical Tx/Rx Current Consumption - Bluetooth Low Energy at 2.4 GHz

Mode	Setting Tx Power [dBm]	Current [mA]	
		Tx	Rx
LE	8.0	35	13

5.3 Typical Sleep Current Consumption

This section describes the typical sleep current consumption for Wi-Fi and Bluetooth.

5.3.1 WLAN

- Conditions
  - VBAT = 3.3V, VDDIO = 3.3V
  - WL_REG_ON: ON, BT_REG_ON: OFF
  - Platform: 8MMINILPD4-EVKB
  - Combo FW: 7.95.75
  - WLAN I/F: SDIO
  - Beacon Interval = 100 ms

Table 11 describes the typical sleep current consumption for WLAN.

Table 11: Typical Sleep Current Consumption - WLAN

Band	Mode	Current consumption VBAT [mA]
	Chip Sleep	0.024
2.4 GHz	IEEE Power Save: DTIM1	1.99
	IEEE Power Save: DTIM3	0.82
	IEEE Power Save: DTIM5	0.59

5.3.2 Bluetooth

- Conditions
  - VBAT = 3.3V, VDDIO = 1.8V
  - WL_REG_ON: OFF, BT_REG_ON: ON
  - Platform: Windows PC/AIROC™ Bluetooth® Test and Debug Tool
  - Hcd file: CYW4343A2_001.003.016.0031.0000.1YN.hcd
  - Bluetooth I/F: UART

Table 12 describes the typical sleep current consumption for Bluetooth.

Table 12: Typical Sleep Current Consumption - Bluetooth

Mode	Current consumption VBAT [uA]
Deep Sleep	4
BT Page Scan 1.28 s	100
BT Page & Inquiry Scan 1.28 s	204
BT Master Sniff mode 1.28 s	85
Advertise 1.28 s	32
BLE Scan 1.28 s	100
LE Link Master 1 s	27

5.4 Typical Throughput

This section describes the typical and concurrent throughput communications. The typical throughput test configurations are:

- VBAT = 3.3V, VDDIO = 1.8V
- Platform: 8MMINILPD4-EVKB
- Firmware: 7.95.48
- WLAN I/F: SDIO
- Access Point: RT-AX88U(ASUS)
- Distance between Access Point and the Target is around 3 ft.
- UDP commands：Bit rate was set at more than 20% of observed corresponding TCP throughput.

  Sample UDP command:

```
iperf3 <server-ip-addr> -u -b <20%-of-TCP>M -P1 -t 60
```

Table 13 shows the typical throughput data for the modules.

Table 13: WLAN Typical Throughput Data

Mode	TCP Throughput in Mbps		UDP Throughput in Mbps	
	Tx	Rx	Tx	Rx
2.4 GHz 11n MCS7	44	53	51	52

6 References

Table 14 reviews all the key reference documents that the user may like to refer to.

Table 14: Reference Table

Support Site	Notes
Murata Type 1YN Module Datasheet	Murata Type 1YN module datasheet (type1yn.pdf)
Murata Type 1YN Module Footprint	Murata Type 1YN module footprint (type1yn-module-footprint-topview.dxf)
Murata Type 1YN Antenna	Murata Type 1YN module trace antenna (type1YN-antenna-p2ml4452-1.dxf)
Linux WLAN Configuration	Murata GitHub link for Linux NVRAM file for 1YN
Linux WLAN Regulatory Configuration	Murata GitHub link for Linux CLM_BLOB file for 1YN
Linux User Guide	Murata Linux User Guide for Infineon modules (Murata Wi-Fi & BT (IFX) Solution for i.MX Linux User Guide.pdf).

7 Technical Support Contacts

Table 15 lists all the support resources available for the Murata Wi-Fi/BT solution.

Table 15: List of Support Resources

Support Site	Notes
Murata Community Forum	Primary support point for technical queries. This is an open forum for all customers. Registration is required.
Murata i.MX Landing Page	No login credentials required. Murata documentation covering hardware, software, testing, etc. is provided here.
Murata uSD-M.2 Adapter Landing Page	Landing page for uSD-M.2 Adapter. In conjunction with Murata i.MX Landing Page, this should provide the user with comprehensive getting started documentation.
Murata Module Landing Page	No login credentials required. Murata documentation covering all Infineon-based Wi-Fi/BT modules is provided here.

Revision History

Revision	Date	Section	Change Description
1.0	Nov 3, 2021		First Issue
2.0	Feb 21, 2022	Table of Contents	The table and contents corrected.
3.0	Nov 28, 2023		Converted to new format.
4.0	Jan 25, 2025	3.1 Reference Circuit 4 External BOM List 3.6 Recommended Antenna 3.6.2 PCB Stack-Up 4 Setup Configuration Files 5.3.2 Bluetooth Sleep Current 5.4 Typical Throughput	• Revised • Removed • Added • Modify the wording: Underneath RF connector. • Added • Added • Added