Hardware Application Note

Type 2EA Wi-Fi® + Bluetooth® Module

Infineon CYW55573 Chipset for 802.11a/b/g/n/ac/ax 2x2 MIMO + Bluetooth 5.3 Hardware Application Note - Rev. 1.0

- Design Name: Type 2EA
- P/N: LBEE5XV2EA-802

Table of Contents

Figures

Tables

About This Document

Murata's Type 2EA is a small and high-performance module based on Infineon's CYW55573 combo chipset, supporting IEEE 802.11a/b/g/n/ac/ax 2x2 MIMO + Bluetooth 5.3 BR/EDR/LE. This application note provides RF and hardware design guidance. Refer to Type 2EA 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**: Embedded Artists AB  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 2EA Datasheet for module specification.

2 Module Introduction

Type 2EA is a small and high-performance module based on Infineon CYW55573 combo chipset which supports IEEE 802.11a/b/g/n/ac/ax 2x2 MIMO + Bluetooth 5.3 up to 1.2 Gbps PHY data rate on Wi-Fi and 3 Mbps PHY data rate on Bluetooth.

The WLAN section supports PCIe 3.0 Gen2 interface, with optional support for SDIO 3.0. The Bluetooth section supports high-speed 4-wire UART interface and PCM for audio data.

The CYW55573 implements sophisticated enhanced collaborative coexistence hardware mechanisms and algorithms, which ensure that WLAN and Bluetooth is optimized for maximum performance.

In IEEE 802.11ax mode, the WLAN operation supports rates of MCS0 – MCS11 in 20 MHz and 40 MHz and 80 MHz channels for data rate up to 1.2 Gbps.

2.1 Features

- WLAN 802.11a/b/g/n/ac/ax 2xx MIMO + Bluetooth Classic and Low Energy (Version 5.3) combo SMD module with Infineon CYW55573
- Small size LGA package with resin molding and metal shielding.
- Host interfaces: PCIe 3.0 Gen2 and SDIO 3.0 for WLAN;
  HCI UART, PCM, and I2S for Bluetooth.
- WLAN MAC address and BD address are stored in OTP

2.2 Hardware Block Diagrams

This section shows the difference between the shared-antenna configuration and the dedicated-antenna configuration modules. The key difference is shown in : the dedicated-antenna configuration has a dedicated Bluetooth antenna “ANT2”. WLAN has its dedicated antenna “ANT0”. By comparison, the shared-antenna configuration has a single shared WLAN-Bluetooth antenna” ANT0”.

Figure 1: Block Diagram - Type 2EA for SANT(Two antenna) configuration

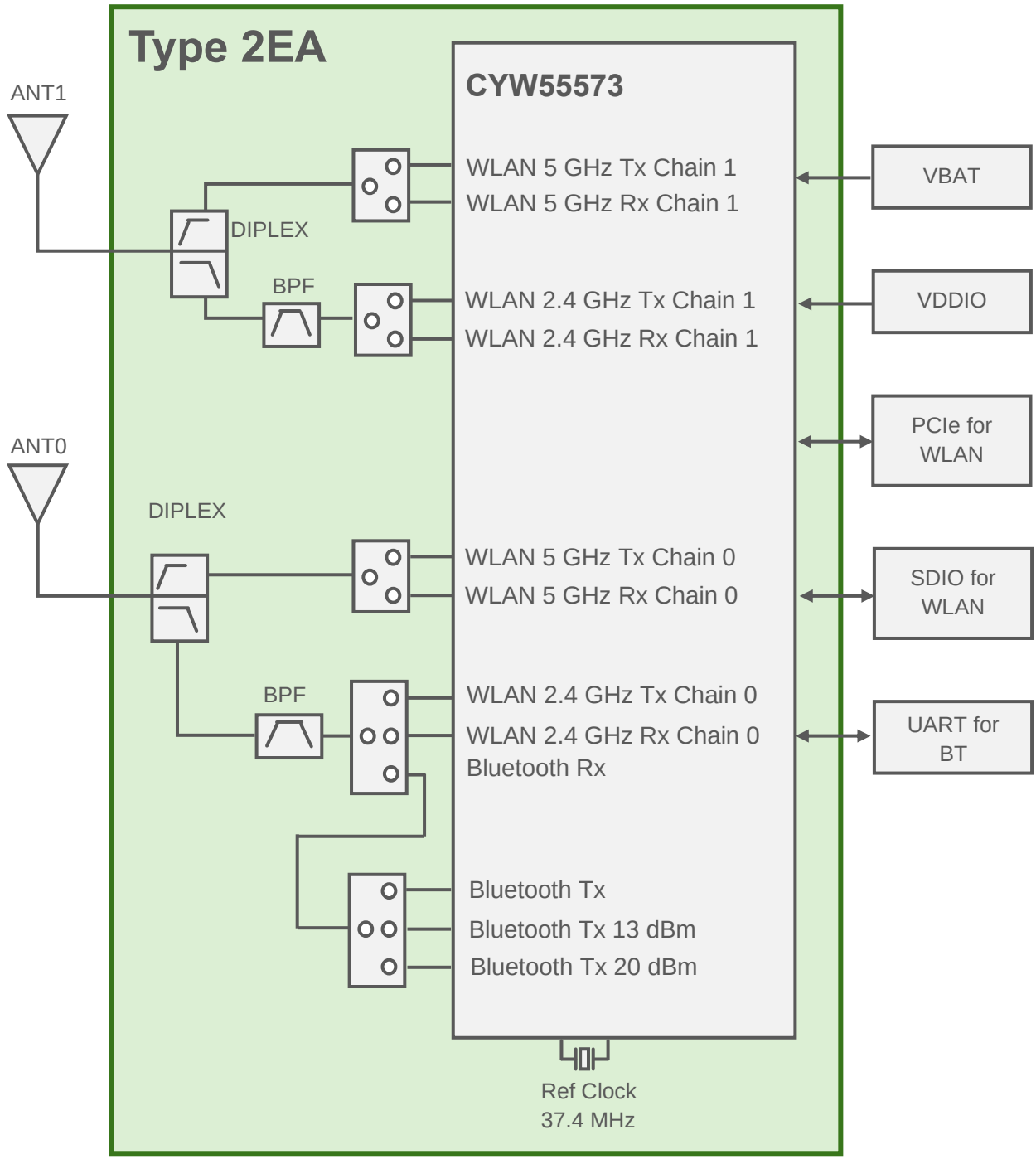
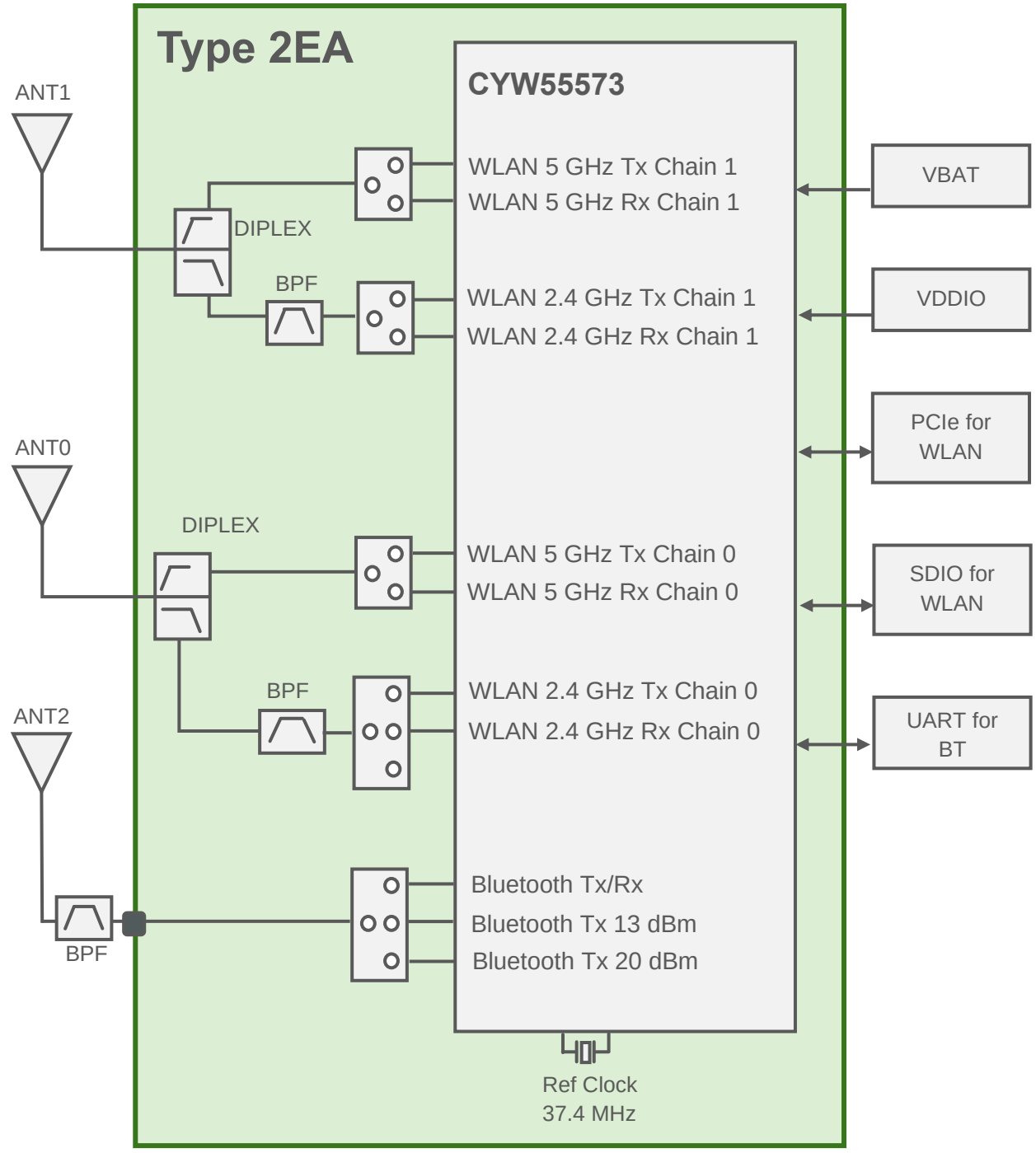


Figure 2: Block Diagram - Type 2EA for DANT(three antenna) configuration



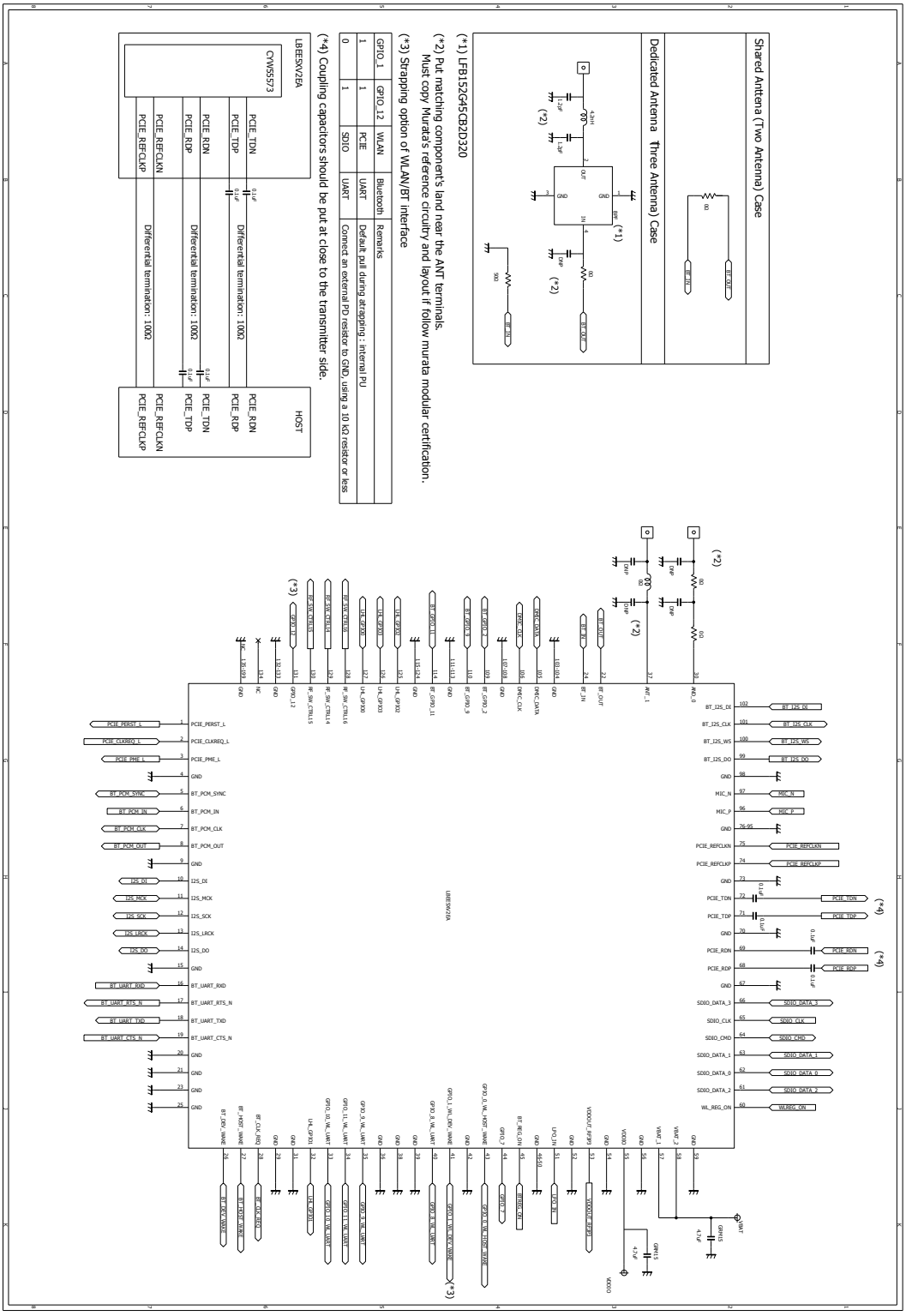
3 Reference Design

This section details reference schematics which the end user can leverage for designing their own hardware.

3.1 Reference Circuit

Figure 3 shows the u.FL/MHF connector for Type 2EA module.

Figure 3: Reference Circuit - Type 2EA



3.2 Requirement for High-Speed Digital Signals

- SDIO: 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.

- PCIe: TxP/N, RxP/N and CLKP/N signals should be differential 100 Ω impedance. DC blockers are necessary on TxP/N and RxP/N (these should be located very close to the transmission point).

3.3 Requirements for Unused Signals

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

3.4 Module Footprint Design

Refer to dimensions in the Type 2EA Datasheet. The DXF File of module footprint is provided via website.

3.5 Recommended Antenna

This module is certified with two types of 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.

3.5.1 PCB Type Di-pole Antenna with the Co-axial Connector

- Users must use recommended antennas. However, user can use any equivalent type of antenna with less antenna gain than antenna gain of recommended antennas for US and EU under approval of Class I Permissive Change by Murata.

Table 2: Cable Options for Antenna Gains

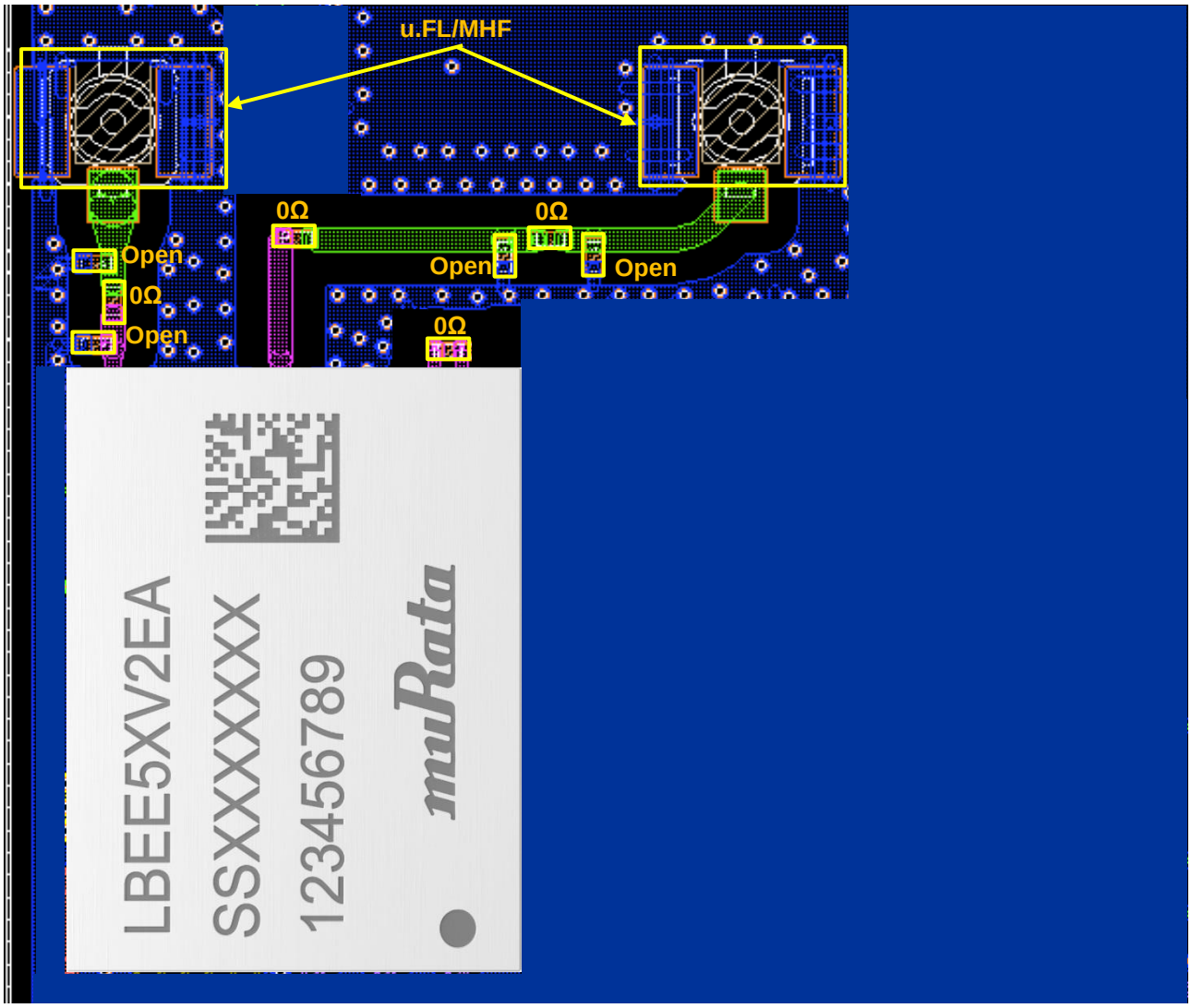
P/N	Vendor	Form factor	Type	2.4 GHz Gain	5 GHz Gain	6 GHz Gain	Cable Options
219611	Molex	u.FL/PCB	Di-pole	2.5 dBi	3.1 dBi	3.9dBi	050, 100, 150, 200, 250 and 300
WT32D1-KX	Unictron	u.FL/PCB	Di-pole	3.0 dBi	4.0 dBi	4.0dBi	119
W24P-U	Inventek	u.FL/PCB	Di-pole	3.2 dBi	N/A	N/A	90

206994: Only for Japan

- Users must copy RF trace to u.FL/MHF connector from the trace layout file provided by Murata in adherence to the guidelines on:
  - Trace width accuracy within +/- 0.25 mm.
  - Stack height between GND layer and RF trace of 230 ~ 240 µm (Exclude inaccuracy of PCB).
  - Passive component location matching Murata design.
  - Necessary “Keep out” area around u.FL/MHF connector.

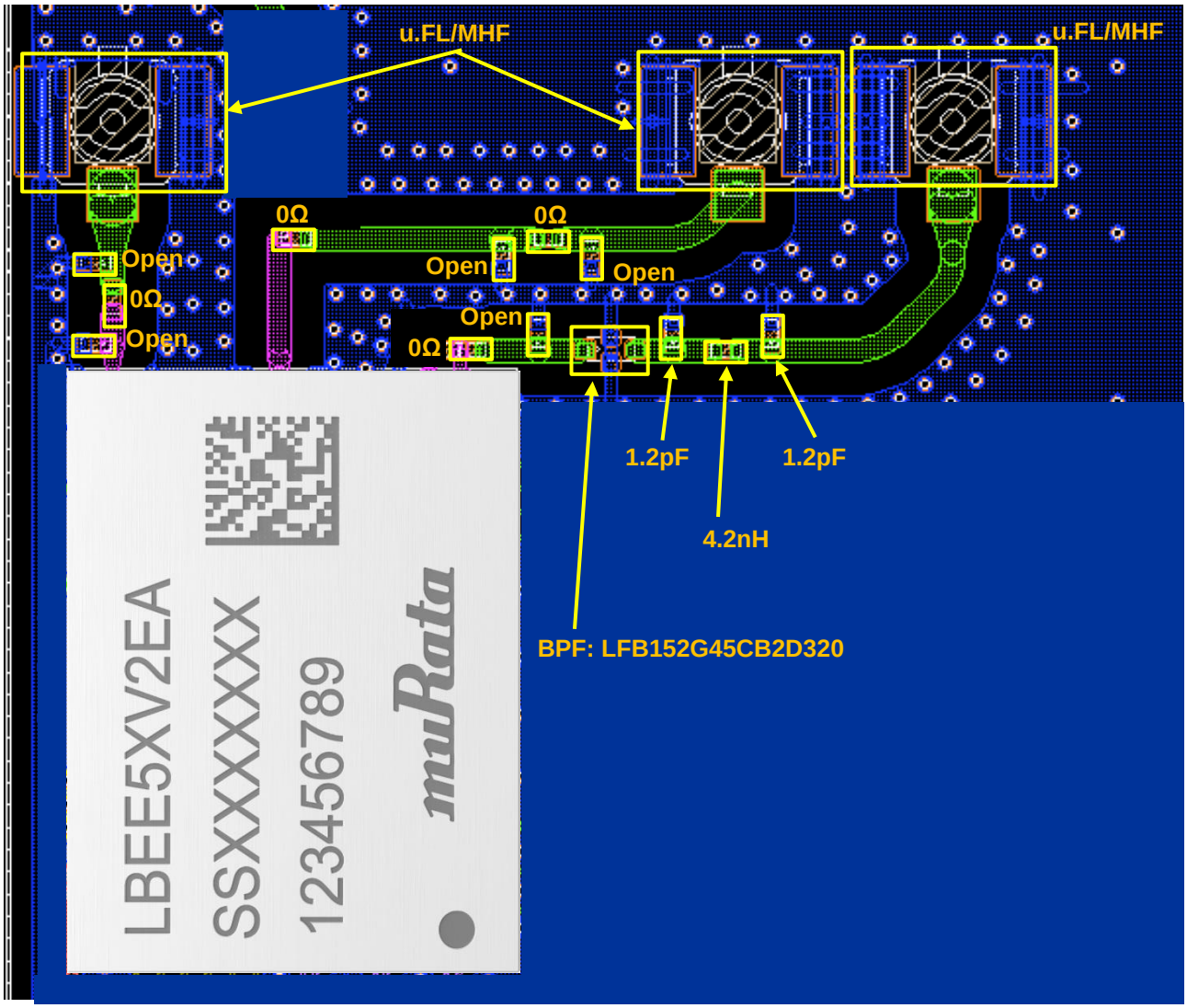
Figure 4 and shows the PCB Type di-pole antenna for Type 2EA module.

Figure 4: PCB Type Di-pole Antenna - Type 2EA SANT (Two Antenna)



Size: 0603 LQP03 / GRM03 / Resistor

Figure 5: PCB Type Di-pole Antenna - Type 2EA DANT (Three Antenna)

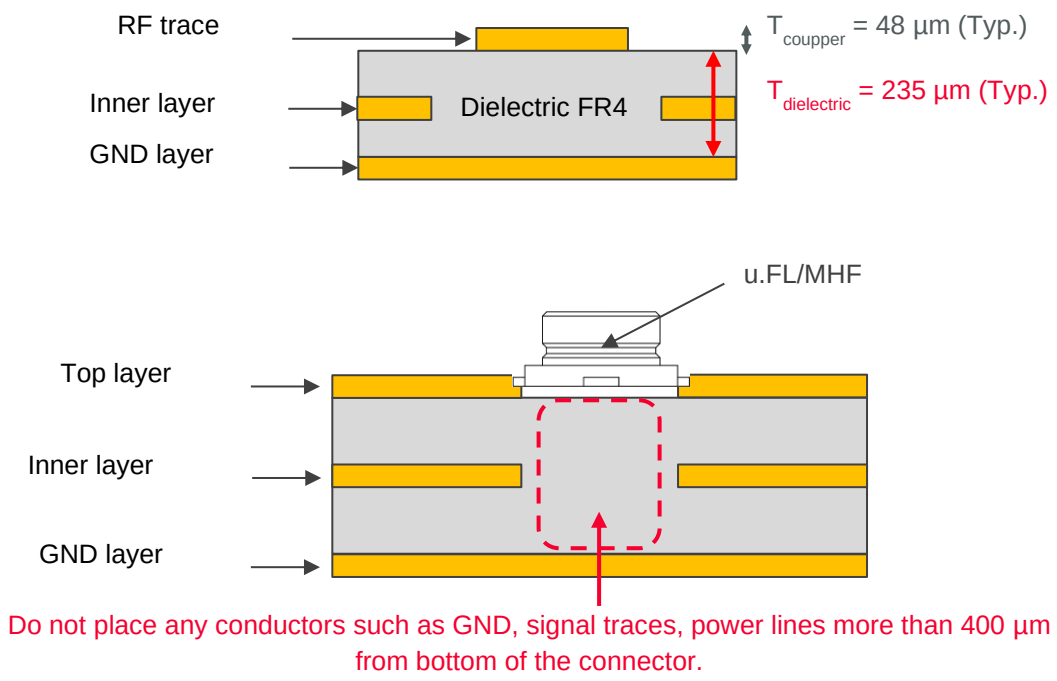


Size: 0603 LQP03 / GRM03 / Resistor

3.5.2 PCB Stack-Up

Figure 6 shows the PCB stack-up layers.

Figure 6: PCB Stack-Up Layers



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 3** shall be used to satisfy regulatory requirements if user wants to use Murata regulatory certification. For more regulatory information, refer to Section 11 of Linux User Guide.

Table 3: WLAN Configuration Files – Linux

Names	Configuration Files
WLAN configuration file	TBD
WLAN regulatory configuration file	TBD

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 4** shall be used to satisfy regulatory requirements if user wants to use Murata regulatory certification.

Table 4: Bluetooth Configuration Files – Linux

Names	Country	Configuration Files
Bluetooth configuration files	USA	TBD
	Canada	TBD
	Europe	TBD
	Japan	TBD

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: 18.53.157.2

Table 5 describe the typical Rx minimum sensitivity level at module antenna port for WLAN at 2.4 GHz for 20 MHz bandwidth. **Table 6**, **Table 7** and **Table 8** describe the typical Rx minimum sensitivity level at module antenna port for WLAN at 5 GHz for 20 MHz, 40 MHz and 80 MHz bandwidth. **Table 9, Table 10** and **Table 11** describe the typical Rx minimum sensitivity level at module antenna port for WLAN 6GHz for 20 MHz, 40 MHz and 80 MHz bandwidth.

Table 5: Rx Minimum Sensitivity Level - WLAN 2.4 GHz (20 MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]							
	11b		11g		11n (HT 20)		11ax (HE 20)	
	1 Mbps	11 Mbps	6 Mbps	54 Mbps	MCS0	MCS7	MCS0	MCS11
2412	-97	-89	-94	-76	-93	-75	-93	-63
2442	-97	-89	-94	-76	-93	-75	-93	-63
2472	-97	-89	-94	-76	-93	-75	-93	-63

Table 6: Rx Minimum Sensitivity Level - WLAN at 5 GHz (20 MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]							
	11a		11n (HT 20)		11ac (VHT 20)		11ax (HE 20)	
	6 Mbps	54 Mbps	MCS0	MCS7	MCS0	MCS8	MCS0	MCS11
5180	-93	-75	-93	-73	-93	-69	-93	-62
5500	-93	-75	-93	-73	-93	-69	-93	-62
5825	-93	-75	-93	-73	-93	-69	-93	-62

Table 7: Rx Minimum Sensitivity Level - WLAN at 5 GHz (40 MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]					
	11n (HT 40)		11ac (VHT 40)		11ax (HE 40)	
	MCS0	MCS7	MCS0	MCS9	MCS0	MCS11
5190	-90	-70	-90	-64	-91	-59
5510	-90	-70	-90	-64	-91	-59
5795	-90	-70	-90	-64	-91	-59

Table 8: Rx Minimum Sensitivity Level - WLAN at 5 GHz (80 MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]			
	11ac (VHT 80)		11ax (HE 80)	
	MCS0	MCS9	MCS0	MCS11
5210	-87	-62	-88	-56
5530	-87	-62	-88	-56
5775	-87	-62	-88	-56

Table 9: Rx Minimum Sensitivity Level - WLAN at 6 GHz (20MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]		
	11a	11ax (HE 20)	
	6 Mbps	MCS0	MCS11
5955	-94	-94	-62
6515	-92	-92	-61
7115	-90	-90	-59

Table 10: Rx Minimum Sensitivity Level - WLAN at 6 GHz (40MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]	
	11ax (HE 40)	
	MCS0	MCS11
5965	-92	-59
6525	-90	-57
7085	-89	-56

Table 11: Rx Minimum Sensitivity Level - WLAN at 6 GHz (80MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]	
	11ax (HE 80)	
	MCS0	MCS11
5985	-89	-57
6545	-87	-55
7025	-86	-54

5.1.2 Bluetooth

- Conditions
  - VBAT = 3.3V, VDDIO = 1.8V
  - Hcd file: CYW55560A1_001.002.087.0159.0008_wlcsp_iPA_sLNA.hcd

Table 12 describes the typical Rx minimum sensitivity level for Bluetooth.

Table 12: Rx Minimum Sensitivity Level - Bluetooth

Frequency in MHz	Rx Minimum Sensitivity Level[dBm]						
	DH5	2DH5	3DH5	LE 125K	LE 500K	LE 1M	LE 2M
2402	-91	-94	-88	-108	-102	-96	-93
2441	-91	-94	-88	-108	-102	-96	-93
2480	-91	-94	-88	-108	-102	-96	-93

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: 18.53.157.2
  - Current definition

Figure 7: Typical Tx/Rx Current Consumption for WLAN

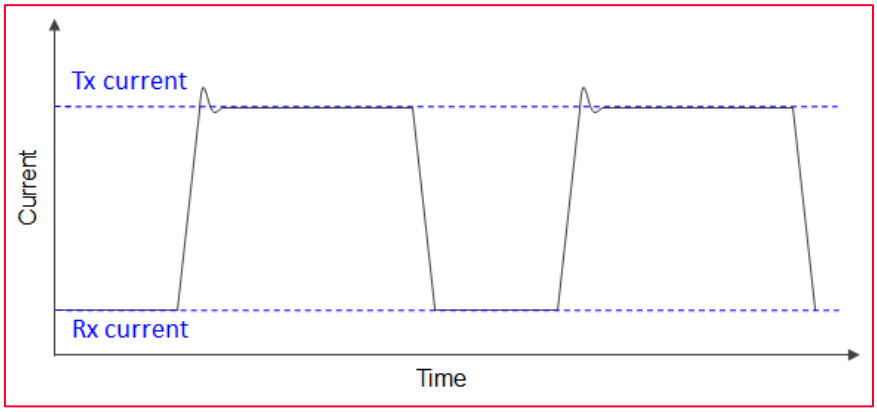


Table 13: Typical Tx/Rx Current Consumption - WLAN at 2.4 GHz (1SS)

Mode	Data Rate	Setting Tx Power [dBm]	Current [mA]	
			Tx	Rx
			VBAT	VBAT
11b	1 Mbps	18	290	40
11g	6 Mbps	17	280	40
11n (HT20)	MCS0	17	280	40
11ax (HE20)	MCS0	14	230	40

Table 14: Typical Tx/Rx Current Consumption - WLAN at 2.4 GHz (2SS)

Mode	Data Rate	Setting Tx Power [dBm]	Current [mA]	
			Tx	Rx
			VBAT	VBAT
11n (HT20)	MCS8	13	370	55
11ax (HE20)	MCS0	11	330	55

Table 15 and **Table 16** describes the typical Tx/Rx current consumption for WLAN at 5 GHz.

Table 15: Typical Tx/Rx Current Consumption - WLAN at 5 GHz (1SS)

Mode	Data Rate	Setting Tx Power [dBm]	Current [mA]	
			Tx	Rx
			VBAT	VBAT
11a	6 Mbps	16	400	50
11n (HT20)	MCS0	14	360	50
11ac (VHT20)	MCS0	14	360	50
11ax (HE20)	MCS0	12	330	50
11n (HT40)	MCS0	14	380	55
11ac (VHT40)	MCS0	14	380	55
11ax (HE40)	MCS0	12	340	55
11ac (VHT80)	MCS0	14	390	65
11ax (HE80)	MCS0	12	370	65

Table 16: Typical Tx/Rx Current Consumption - WLAN at 5 GHz (2SS)

Mode	Data Rate	Setting Tx Power [dBm]	Current [mA]	
			Tx	Rx
			VBAT	VBAT
11n (HT20)	MCS8	11	580	65
11ac (VHT20)	MCS0	11	580	65
11ax (HE20)	MCS0	9	520	65
11n (HT40)	MCS8	11	600	75
11ac (VHT40)	MCS0	11	560	75
11ax (HE40)	MCS0	9	540	75
11ac (VHT80)	MCS0	11	620	90
11ax (HE80)	MCS0	9	570	90

Table 17 and **Table 18** describes the typical Tx/Rx current consumption for WLAN at 6 GHz.

Table 17: Typical Tx/Rx Current Consumption - WLAN at 6 GHz (1SS)

Mode	Data Rate	Setting Tx Power [dBm]	Current [mA]	
			Tx	Rx
			VBAT	VBAT
11a	6Mbps	12	240	45
11ax (HE20)	MCS0	12	350	45
11ax (HE40)	MCS0	12	350	55
11ax (HE80)	MCS0	12	360	60

Table 18: Typical Tx/Rx Current Consumption - WLAN at 6 GHz (2SS)

Mode	Data Rate	Setting Tx Power [dBm]	Current [mA]	
			Tx	Rx
			VBAT	VBAT
11ax (HE20)	MCS0	9	530	65
11ax (HE40)	MCS0	9	540	80
11ax (HE80)	MCS0	9	550	90

5.2.2 Bluetooth

- Conditions
  - VBAT = 3.3V, VDDIO = 1.8V
  - Hcd file: CYW55560A1_001.002.087.0159.0008_wlcsp_iPA_sLNA.hcd
  - Current definition

Figure 8: Typical Tx/Rx Current Consumption for Bluetooth

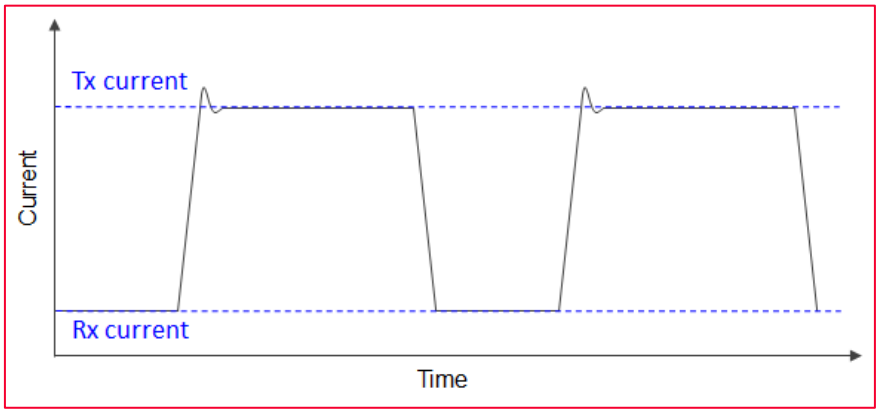


Table 19 describes the typical Tx/Rx current consumption for Bluetooth.

Table 19: Typical Tx/Rx Current Consumption - Bluetooth at 2.4 GHz

Mode	Setting Tx Power [dBm]	Current [mA]	
		Tx	Rx
		VBAT	VBAT
BR (1DH5)	8	25	11
EDR (3DH5)	4	25	11
LE 125K	8	25	11
LE 500K	8	25	11
LE 1M	8	25	11
LE 2M	8	25	11

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 = 1.8V
  - WL_REG_ON: ON, BT_REG_ON: OFF
  - Platform: BRIX
  - Combo FW: 18.53.180.7
  - WLAN I/F: PCIe
  - Beacon Interval = 100 ms

Table 20 describes the typical sleep current consumption for WLAN.

Table 20: Typical Sleep Current Consumption - WLAN

Band	Mode	Current consumption VBAT [mA]
-	Chip deep sleep (L1.2)	0.1
2.4 GHz	IEEE Power Save: DTIM1	2.28
	IEEE Power Save: DTIM3	0.85
	IEEE Power Save: DTIM5	0.55
5 GHz	IEEE Power Save: DTIM1	1.15
	IEEE Power Save: DTIM3	0.45
	IEEE Power Save: DTIM5	0.31
6 GHz	IEEE Power Save: DTIM1	1.15
	IEEE Power Save: DTIM3	0.44
	IEEE Power Save: DTIM5	0.30

5.3.2 Bluetooth

- Conditions
  - VBAT = 3.3V, VDDIO = 1.8V
  - WL_REG_ON: OFF, BT_REG_ON: ON
  - Platform: Windows PC/CyBluetool
  - Hcd file: CYW55560A1_001.002.087.0159.0017_wlcsp_iPA_dLNA_Murata_Type2EA.hcd
  - Bluetooth I/F: UART

Table 21 describes the typical sleep current consumption for Bluetooth.

Table 21: Typical Sleep Current Consumption - Bluetooth

Mode	Current consumption VBAT [uA]
Deep Sleep (BT Only)	37
BT Page Scan 1.28 s	112
BT Page & Inquiry Scan 1.28 s	146
BT Master Sniff mode 500 ms	70
Advertise 1.28 s	45
BLE Scan 1.28 s	108
LE Link Master 1 s	58

5.4 Throughput

This section describes the typical and concurrent throughput communications.

5.4.1 Typical Throughput PCIe Interface

The typical throughput test configurations are:

- VBAT = 3.3V, VDDIO = 1.8V
- Platform: Embedded Artists iMX8M Mini uCOM
- Combo FW: 18.53.212.8
- WLAN I/F: PCIe
- Access Point: AXE11000 (NETGEAR)
- 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 22 shows the typical throughput data for the modules.

Table 22: WLAN Typical Throughput Data (PCIe)

Mode	TCP Throughput in Mbps		UDP Throughput in Mbps	
	Tx	Rx	Tx	Rx
2.4 GHz 11ax HE20 MIMO	237	235	250	251
5 GHz 11ax HE80 MIMO	787	638	800	919
6 GHz 11ax HE80 MIMO	747	600	836	891

5.4.2 Typical Throughput SDIO Interface

The typical throughput test configurations are:

- VBAT = 3.3V, VDDIO = 1.8V
- Platform: NXP IMX8M-EVKB
- Combo FW: 18.53.212.8
- WLAN I/F: SDIO
- Access Point: AXE11000 (NETGEAR)
- 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 23 shows the typical throughput data for the modules.

Table 23: WLAN Typical Throughput Data (SDIO)

Mode	TCP Throughput in Mbps		UDP Throughput in Mbps	
	Tx	Rx	Tx	Rx
2.4 GHz 11ax HE20 MIMO	227	218	236	235
5 GHz 11ax HE80 MIMO	389	366	493	503
6 GHz 11ax HE80 MIMO	389	370	493	500

6 References

Table 24 reviews all the key reference documents that the user may like to refer to.

Table 24: Reference Table

Support Site	Notes
Murata Type 2EA Module Datasheet	Murata Type 2EA module datasheet (TYPE2EA.pdf)
Murata Type 2EA Module Footprint	Murata Type 2EA module footprint
Murata Type 2EA PCB Type Di-pole Antenna	Murata Type 2EA module trace antenna (type2EA-u-FL.dxf)
Linux	Murata GitHub link for Linux transmit power files for 2EA
wireless-regdb	Regulatory database used by Linux
Linux User Guide	Murata Linux User Guide for Infineon modules (Murata Wi-Fi & BT (IFX) Solution for i.MX Linux User Guide.pdf). Murata website to be updated soon.

In case Murata website does not have the updated document, please refer to the Connectivity Module page on the Murata Community Forum. This contains a pinned post with all the updated documents.

7 Technical Support Contacts

Table 25 lists all the support resources available for the Murata Wi-Fi/BT solution.

Table 25: 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	Change	Change Description
1.0	Jul 26, 2023	First Issue	