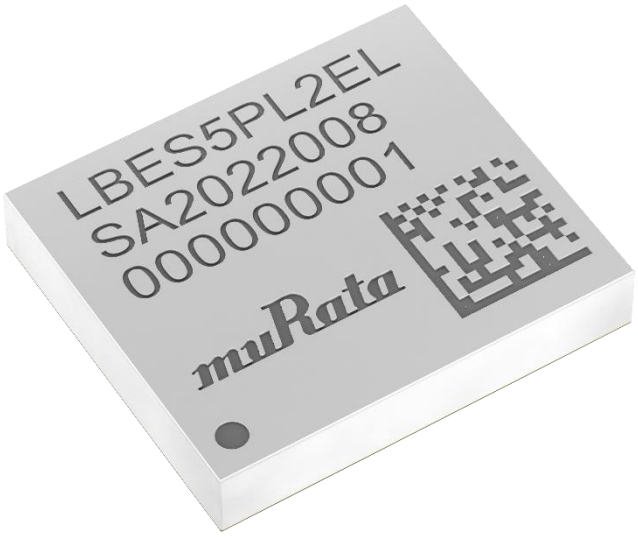
Hardware Application Note

Type 2EL/2DL
Wi-Fi® + Bluetooth® + 802.15.4 Module(2EL only)

NXP IW612/IW611 Chipset for
802.11a/b/g/n/ac/ax + Bluetooth 5.3 + IEEE802.15.4(IW612 only)
Hardware Application Note - Rev. 3.0

- NXP Chipset: IW612 / IW611
- Design Name: Type 2EL / Type 2DL
- P/N: LBES5PL2EL-923 / LBEE5PL2DL-921



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About This Document

Murata's Type 2EL is a small and high-performance module based on NXP's IW612 combo chipset, supporting IEEE 802.11a/b/g/n/ac/ax + Bluetooth 5.3 BR/EDR/LE + 802.15.4.
Murata's Type 2DL is a small and high-performance module based on NXP's IW611 combo chipset, supporting IEEE 802.11a/b/g/n/ac/ax + Bluetooth 5.3 BR/EDR/LE.
This application note provides RF and hardware design guidance. Refer to Type 2EL Datasheet and Type 2DL 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 2EL Datasheet and Type 2DL Datasheet for module specification.

2 Module Introduction

Type 2EL/2DL is a small and high-performance module based on NXP IW612/IW611 combo chipset which supports Wi-Fi 802.11a/b/g/n/ac/ax + Bluetooth 5.3 BR/EDR/LE + 802.15.4(2EL only) up to 600 Mbps PHY data rate on Wi-Fi and 3 Mbps PHY data rate on Bluetooth.

The WLAN section supports SDIO 3.0 interface. The Bluetooth section supports high-speed 4-wire UART interface and PCM for audio data. The 802.15.4 section supports SPI interface.

The IW612/IW611 implements sophisticated enhanced collaborative coexistence hardware mechanisms and algorithms, which ensure that WLAN and Bluetooth and 802.15.4(IW612 only) collaboration 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 600 Mbps.

2.1 Features

- WLAN 802.11a/b/g/n/ac/ax 1x1 SISO + Bluetooth Classic and Low Energy (Version 5.3) + 802.15.4 combo SMD module with NXP IW612
- Small size LGA package with resin molding and metal shielding.
- Host interfaces: SDIO 3.0 for WLAN; HCI UART, PCM, and I2S for Bluetooth; SPI for 802.15.4.
- WLAN MAC address and BD address and 802.15.4 MAC address are stored in OTP

802.15.4 only for 2EL/IW612

2.2 Hardware Block Diagrams

Figure 1 and **Figure 2** shows the Type 2EL/2DL module block diagram.

Figure 1: Block Diagram - Type 2EL

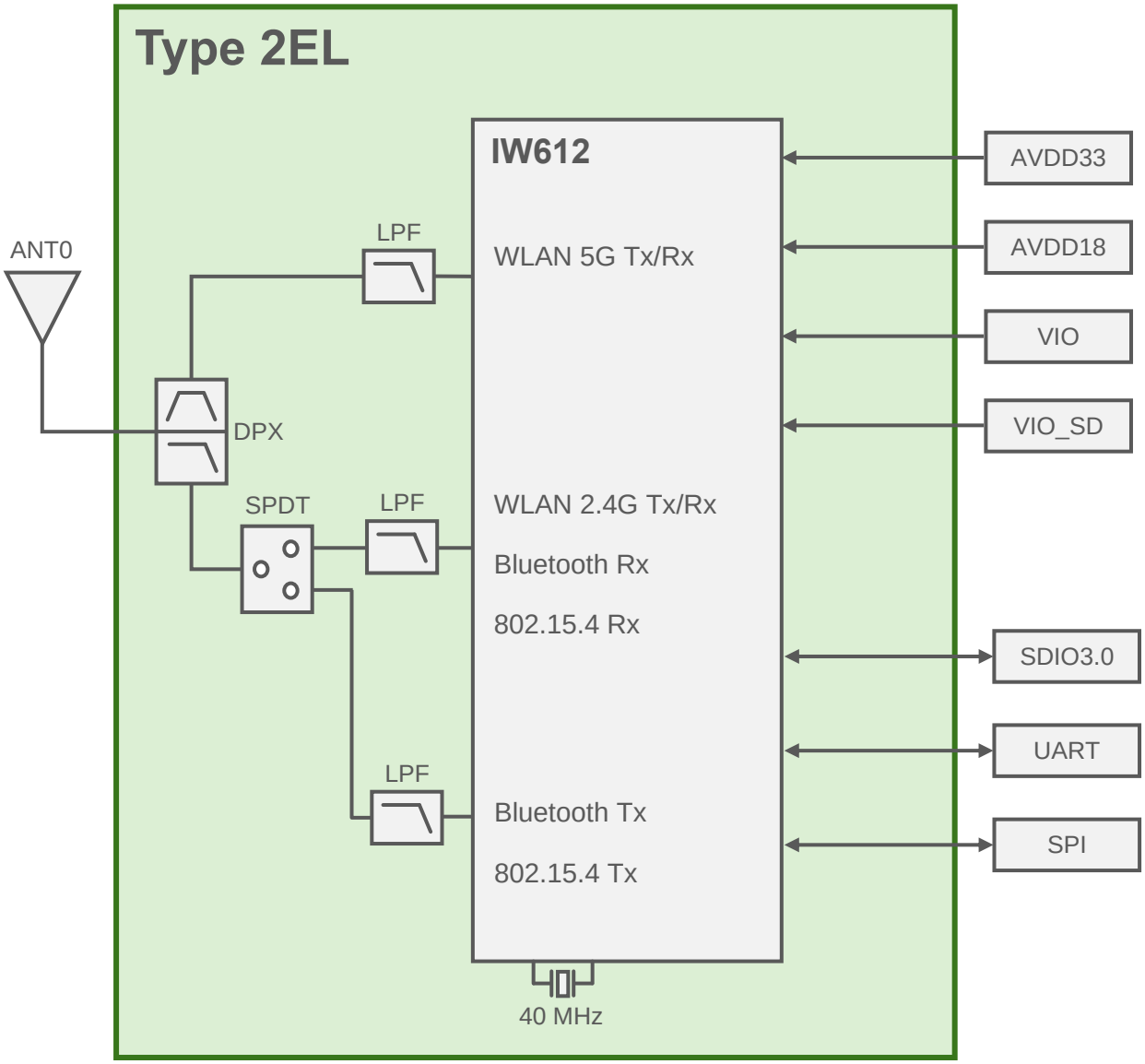
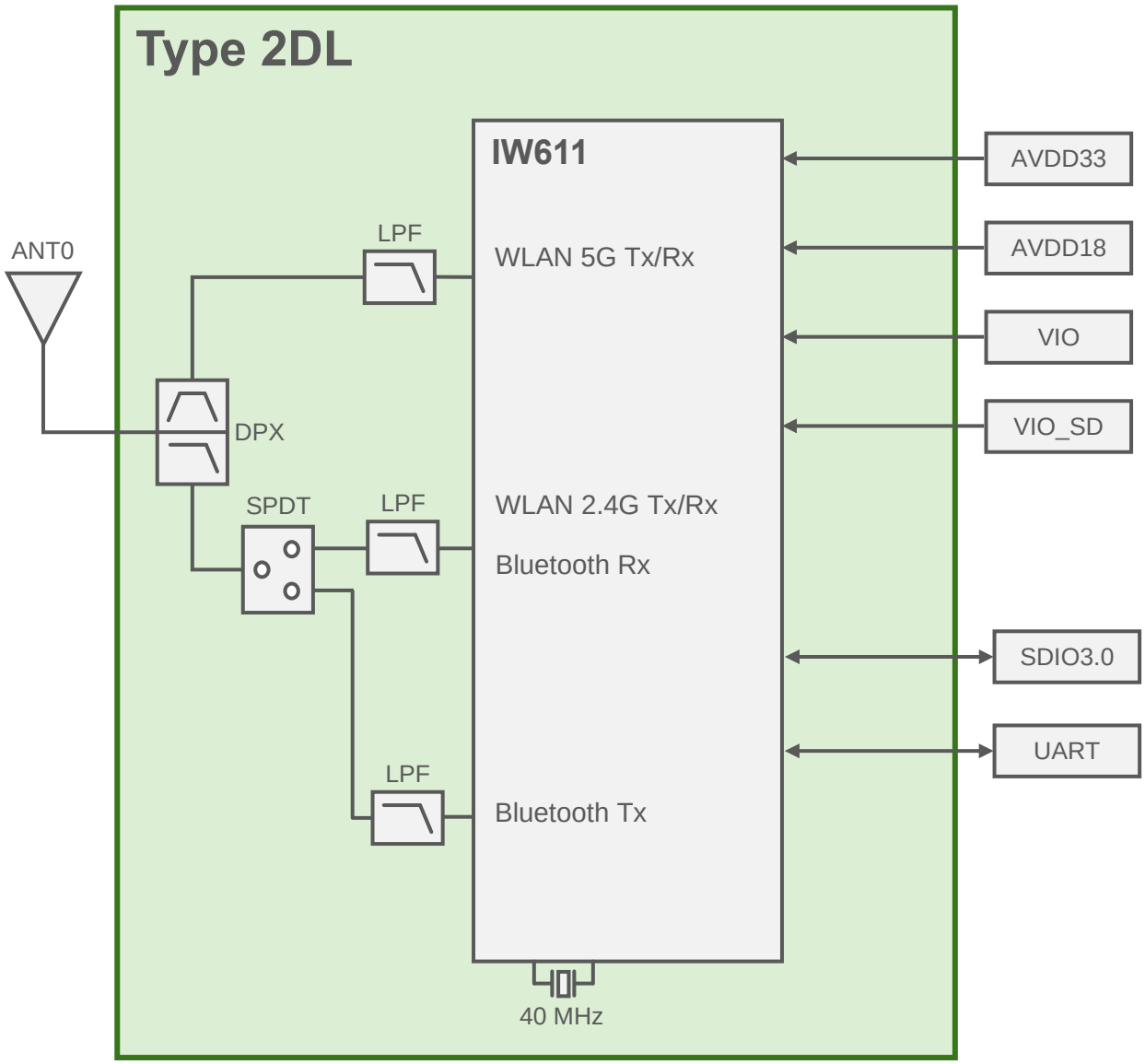


Figure 2: Block Diagram - Type 2DL



3 Reference Design

This section details reference schematics which the end user can leverage for designing their own hardware. Two implementations are shown: one using the PCB trace antenna; the other using u.FL or MHF connectors. Note that in both instances, Type 2EL/2DL for the dual-antenna configuration uses u.FL or MHF connector for independent Bluetooth.

3.1 Reference Circuit

Figure 3 shows the u.FL/MHF connector for Type 2EL module.
Figure 4 shows the trace antenna for Type 2EL module.
Figure 5 shows the u.FL/MHF connector for Type 2DL module.
Figure 6 shows the trace antenna for Type 2DL module.

Figure 3: u.FL/MHF Connector - Type 2EL

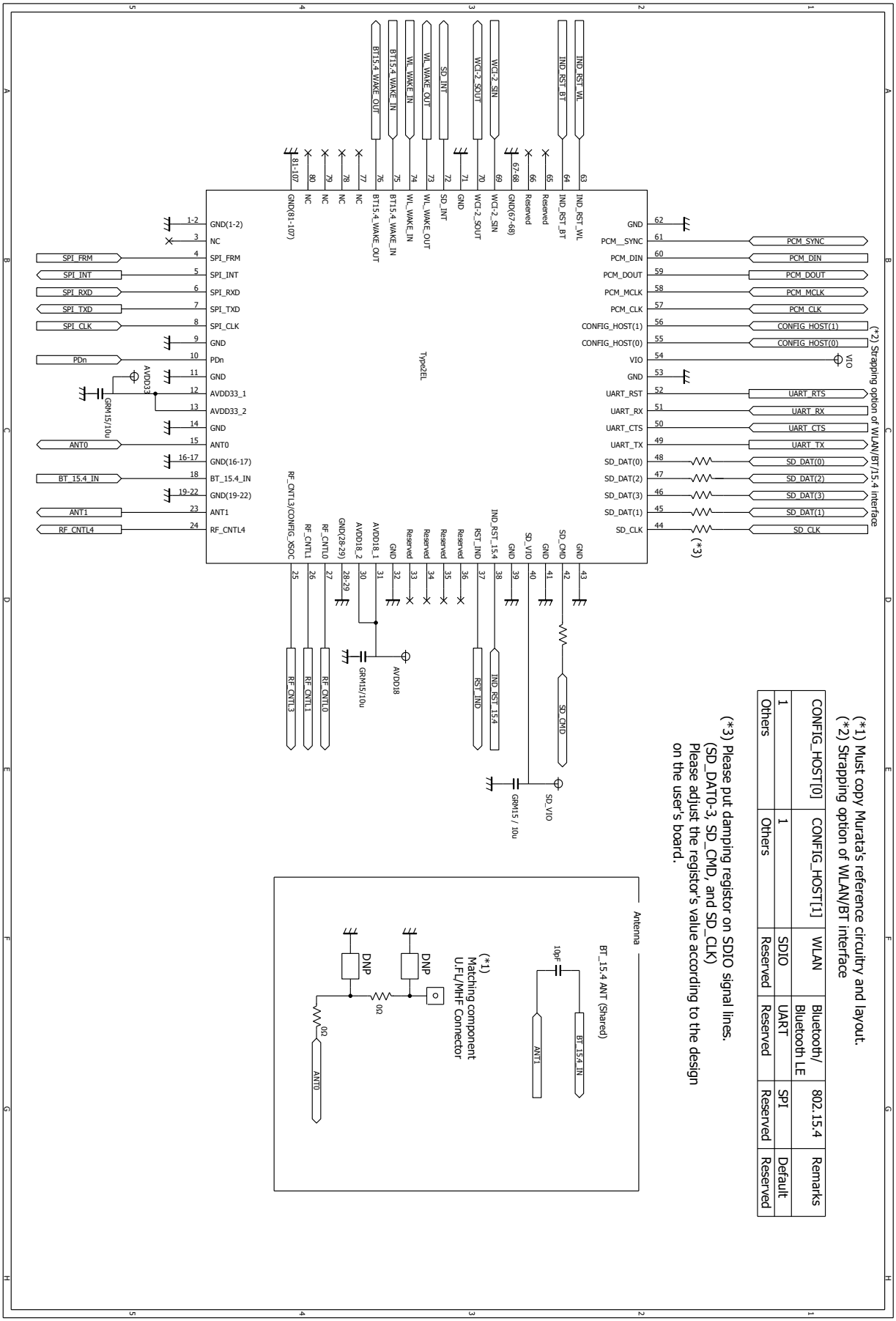
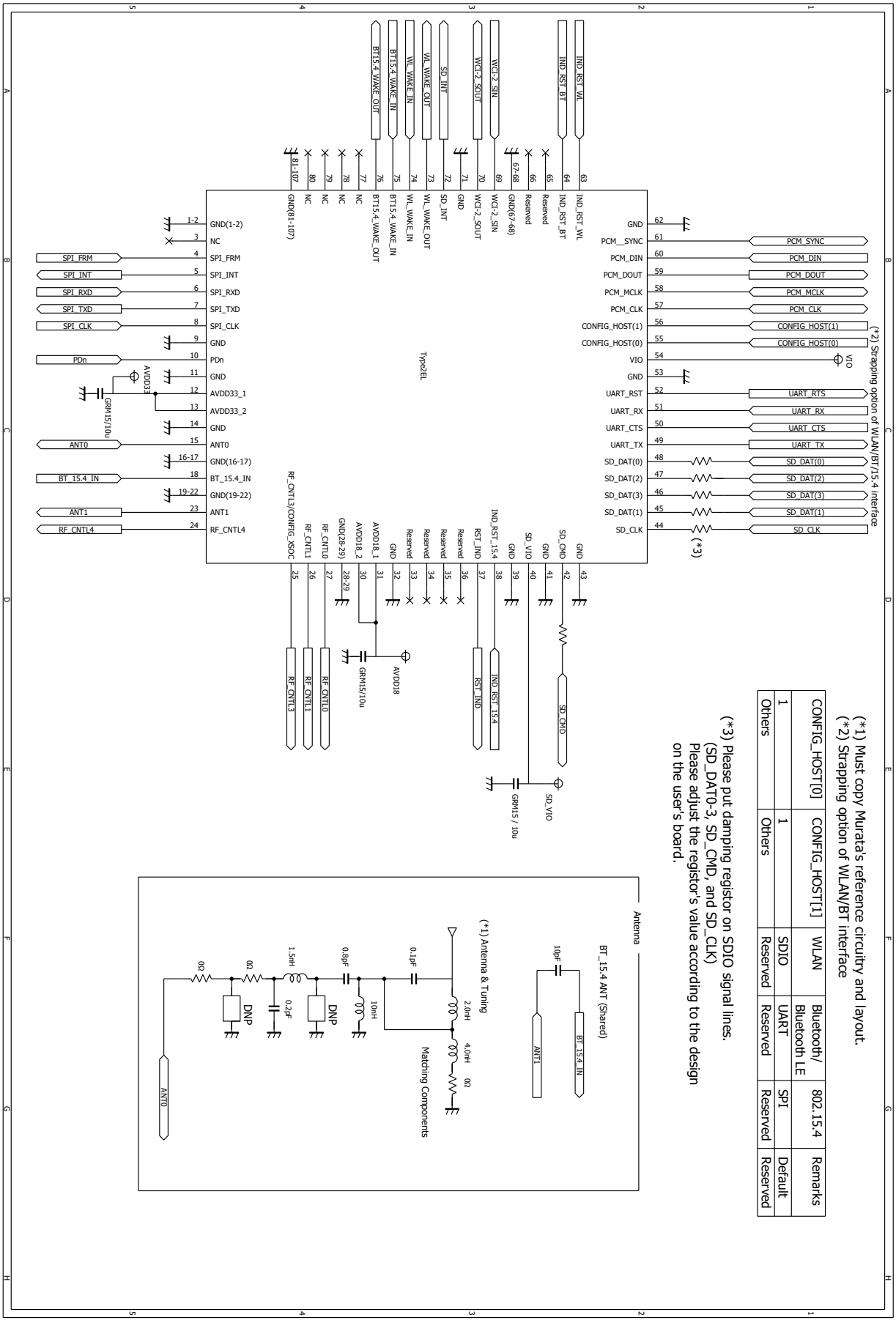
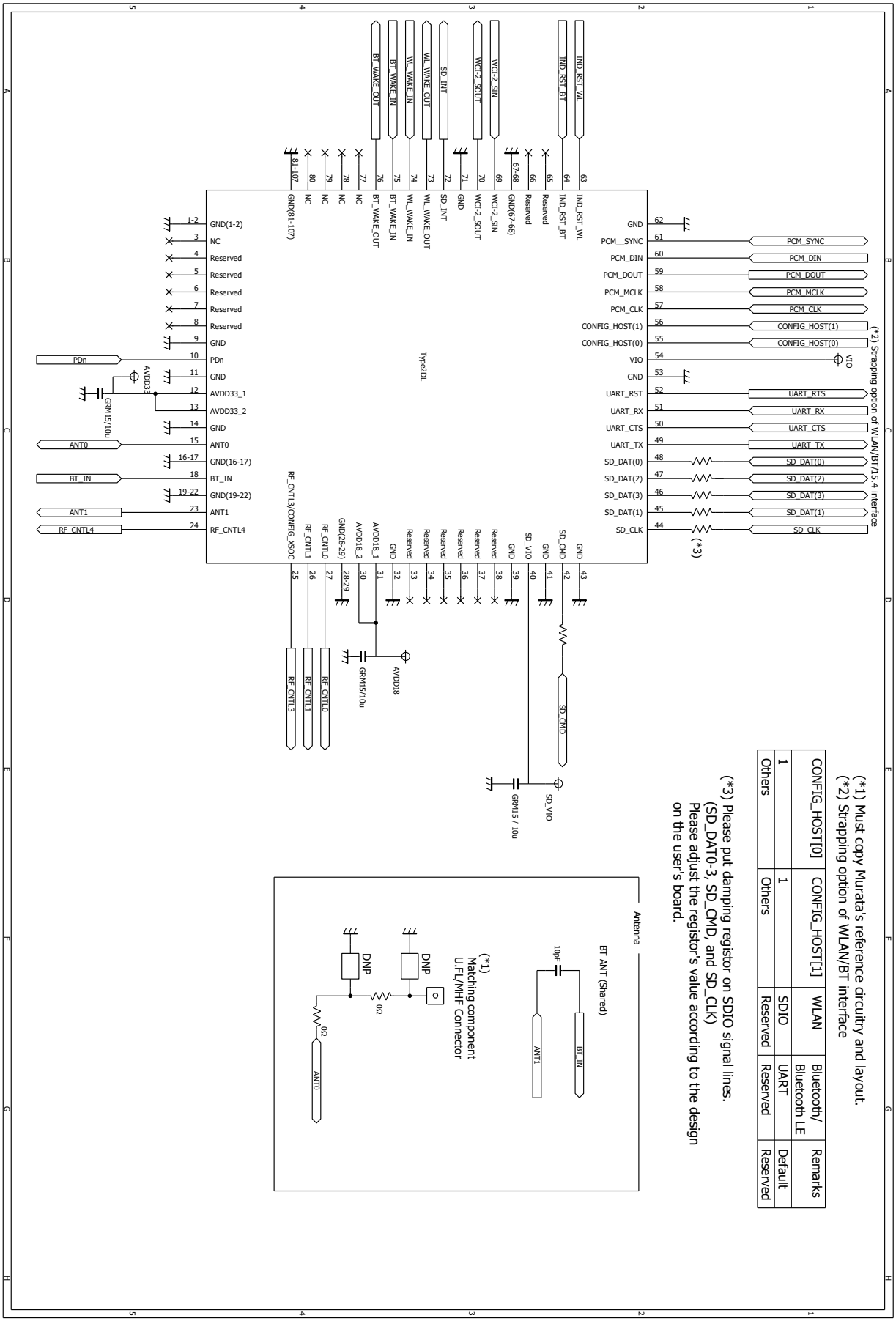


Figure 4: Trace Antenna - Type 2EL



CONFIG_HOST[0]	CONFIG_HOST[1]	WLAN	Bluetooth/ Bluetooth LE	802.15.4	Remarks
1	1	SDIO	UART	SPI	Default
Others	Others	Reserved	Reserved	Reserved	Reserved

Figure 5: u.FL/MHF Connector - Type 2DL

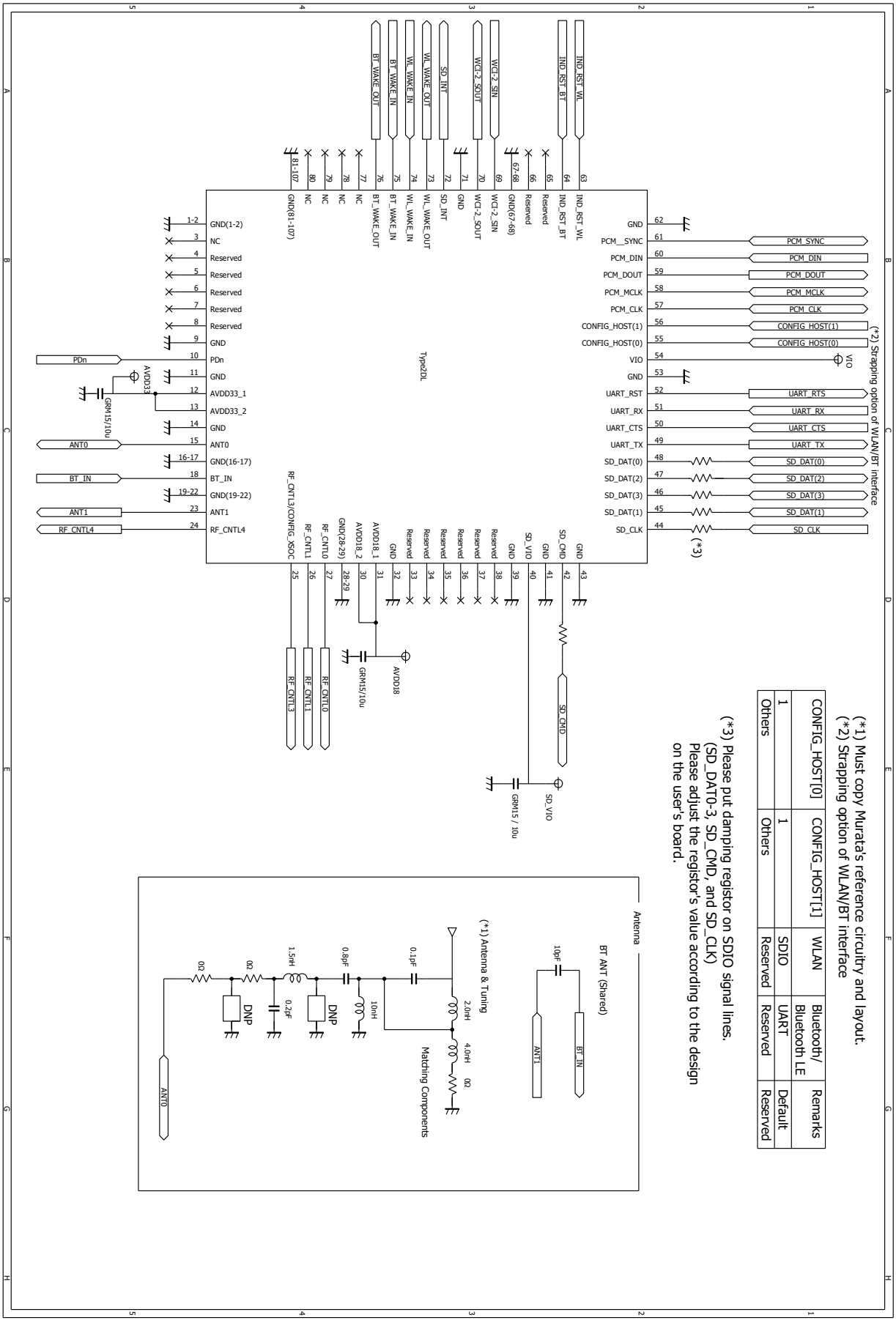


(*1) Must copy Murata's reference circuitry and layout.
(*2) Strapping option of WLAN/BT interface

CONFIG_HOST[0]	CONFIG_HOST[1]	WLAN	Bluetooth/ Bluetooth LE	Remarks
1	1	SDIO	UART	Default
Others	Others	Reserved	Reserved	Reserved

(*3) Please put damping registor on SDIO signal lines.
(SD_DAT0-3, SD_CMD, and SD_CLK)
Please adjust the registor's value according to the design on the user's board.

Figure 6: Trace Antenna - Type 2DL



(*1) Must copy Murata's reference circuitry and layout.
(*2) Strapping option of WLAN/BT interface

CONFIG_HOST[0]	CONFIG_HOST[1]	WLAN	Bluetooth/ Bluetooth LE	Remarks
1	1	SDIO	UART	Default
Others	Others	Reserved	Reserved	Reserved

(*3) Please put damping registor on SDIO signal lines.
(SD_DAT0-3, SD_CMD, and SD_CLK)
Please adjust the registor's value according to the design on the user's board.

3.2 Requirement for SDIO Signals

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

Table 2: SDIO internal pull-up/pull-down specifications

Parameter	Min	Typ	Max	Unit
Internal nominal pull-up/pull-down resistance	70	100	140	kΩ

3.3 Requirements for Unused Signals

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

- GPIO [0…31]
- RF_CNTL0,1,3,4

3.4 Module Footprint Design

Refer to dimensions in the Type 2EL Datasheet / Type 2DL 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 3: Cable Options for Antenna Gains

P/N	Vendor	Form factor	Type	2.4 GHz Gain	5 GHz Gain	Cable Options
146153	Molex	u.FL/PCB	Di-pole	3.2 dBi	4.25 dBi	050, 100, 150, 200, 250 and 300
219611	Molex	u.FL/PCB	Di-pole	2.67 dBi	3.67 dBi	050, 100, 150, 200, 250 and 300
WT32D1-KX	Unictron	u.FL/PCB	Di-pole	3.0 dBi	4.0 dBi	119
W24P-U	Inventek	u.FL/PCB	Di-pole	3.2 dBi	N/A	90

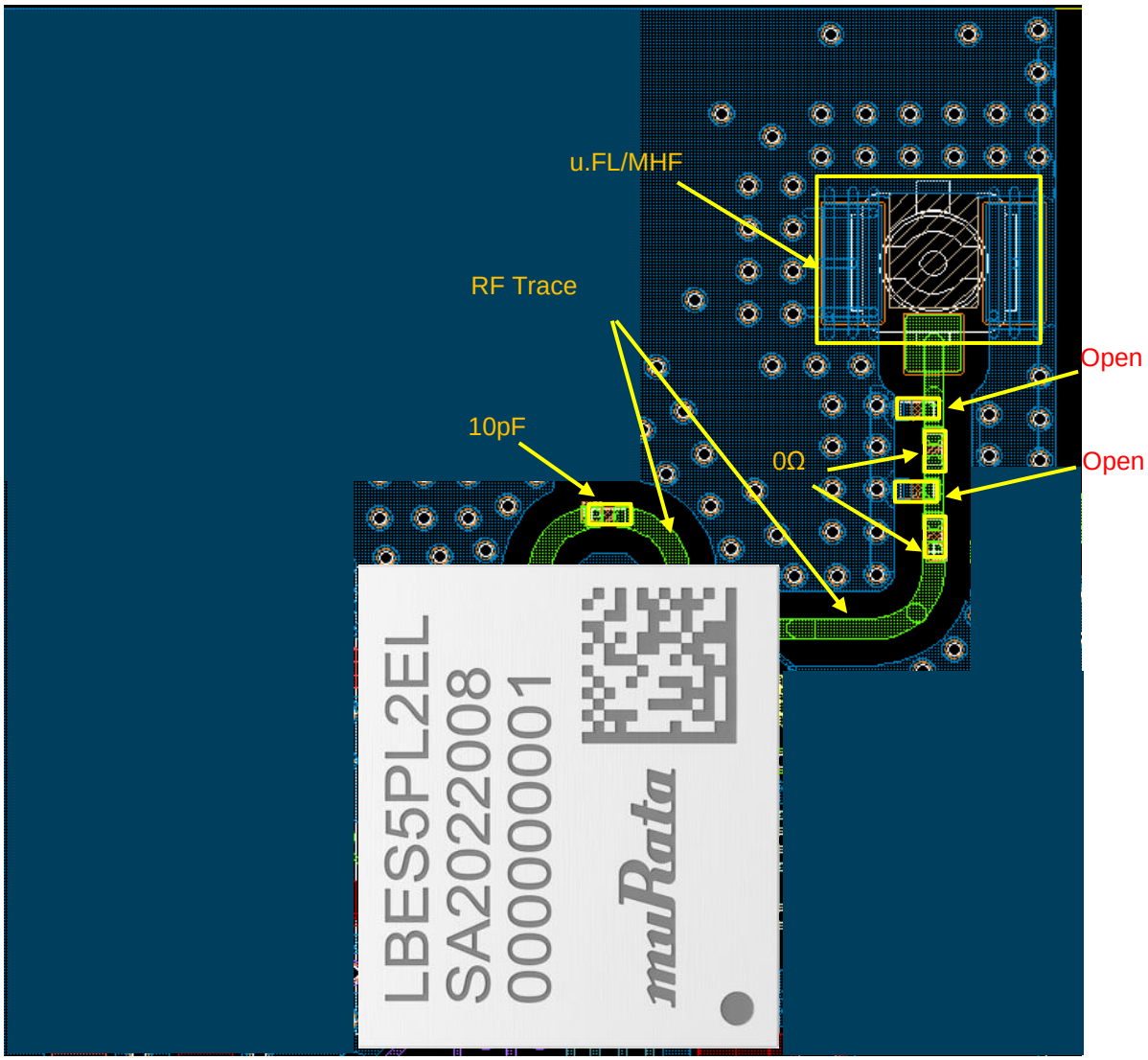
206994: Only for Japan

- 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 7 shows the PCB Type di-pole antenna for Type 2EL/2DL module.

Figure 7: PCB Type Di-pole Antenna - Type 2EL/2DL



Size: 0603 LQP03 / GRM03 / Resistor

3.5.2 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 235 µm; keeping inaccuracy within +/-0.5 µm.
    - Passive component location matching Murata design.

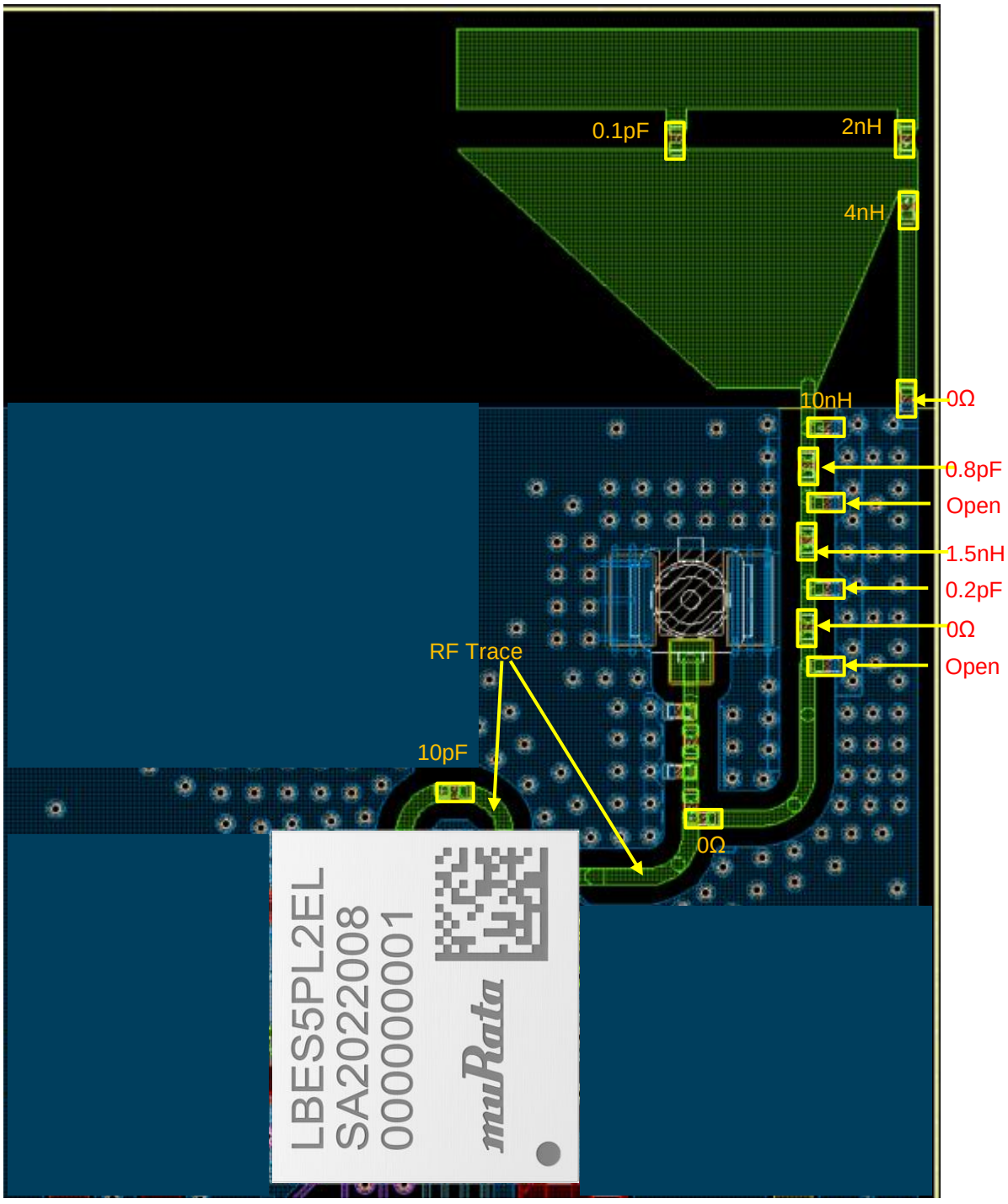
Table 4: Trace Antenna Gain

Part number	Vendor	Peak Gain [dBi]		Type	Connector
		2.4GHz	5GHz		
Type2EL_Antenna	Murata	3.6	4.6	Monopole	Trace

Size: 0603 LQP03 / GRM03 / Resistor

Figure 8 shows the trace antenna for Type 2EL/2DL module.

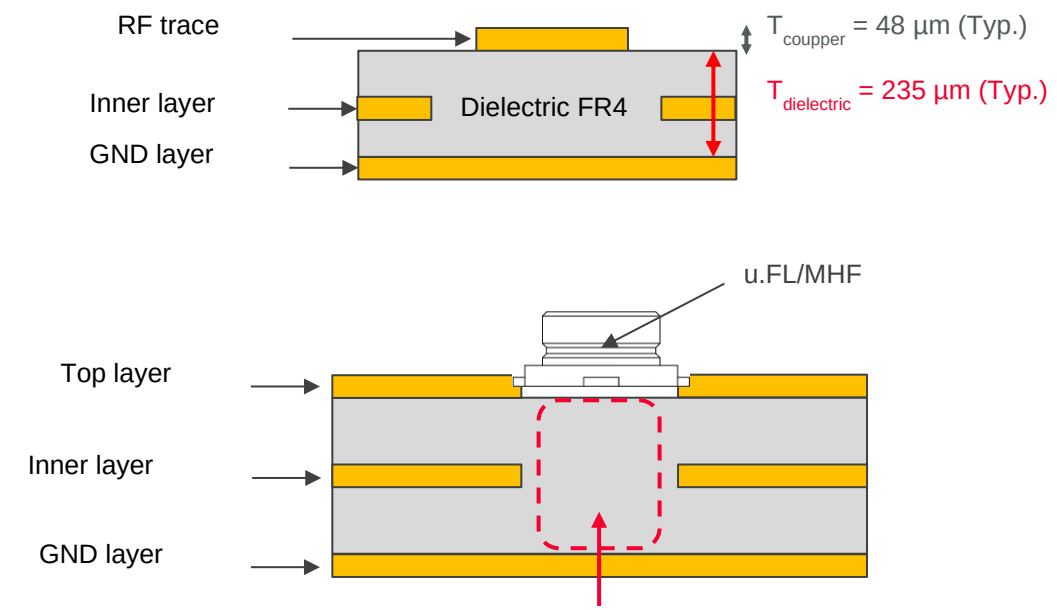
Figure 8: Trace Antenna Guidelines - Type 2EL/2DL



3.5.3 PCB Stack-Up

Figure 9 shows the PCB stack-up layers.

Figure 9: PCB Stack-Up Layers



3.5.4 Trace Antenna Performance

This section illustrates the trace antenna performance results as shown in **Figure 10**.

Figure 10: Trace Antenna Performance

Gain and Efficiency

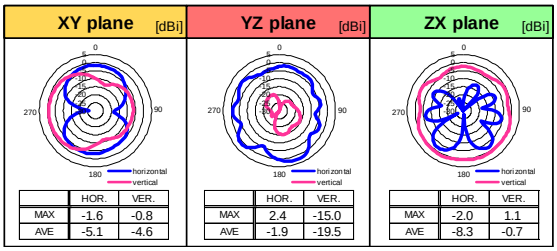
[dBi] [dB]

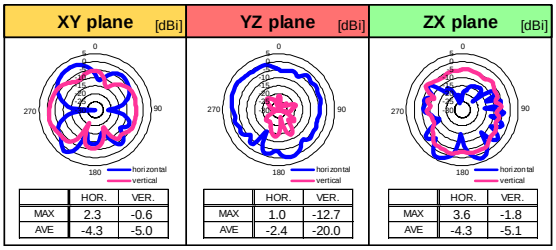
LINEAR POLARIZATION		XY-plane hor.	XY-plane ver.	YZ-plane hor.	YZ-plane ver.	ZX-plane hor.	ZX-plane ver.	Total Efficiency
2400 MHz	MAX.	-1.6	-0.9	2.6	-16.3	-2.2	1.0	
	AVE.	-4.9	-4.6	-2.0	-20.4	-8.3	-0.9	-1.0
2442 MHz	**MAX.**	**-1.6**	**-0.8**	**2.4**	**-15.0**	**-2.0**	**1.1**	
	AVE.	**-5.1**	**-4.6**	**-1.9**	**-19.5**	**-8.3**	**-0.7**	**-1.0**
2484 MHz	MAX.	-1.7	-0.7	2.5	-13.6	-1.7	1.6	
	AVE.	-5.2	-4.5	-1.6	-18.7	-8.2	-0.5	-0.9

[dBi] [dB]

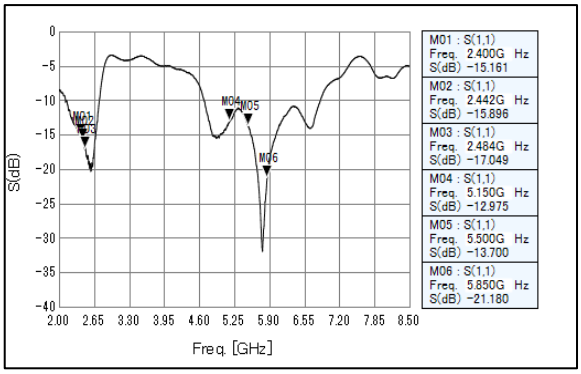
LINEAR POLARIZATION		XY-plane hor.	XY-plane ver.	YZ-plane hor.	YZ-plane ver.	ZX-plane hor.	ZX-plane ver.	Total Efficiency
5150 MHz	MAX.	2.3	0.1	2.2	-11.4	3.5	-0.2	
	AVE.	-4.1	-4.5	-2.0	-19.2	-3.9	-3.9	-1.3
5500 MHz	**MAX.**	**2.3**	**-0.6**	**1.0**	**-12.7**	**3.6**	**-1.8**	
	AVE.	**-4.3**	**-5.0**	**-2.4**	**-20.0**	**-4.3**	**-5.1**	**-1.6**
5850 MHz	MAX.	2.3	-0.7	1.0	-12.9	3.5	-1.6	
	AVE.	-4.1	-5.4	-2.4	-19.8	-4.2	-5.5	-1.5

Directivity





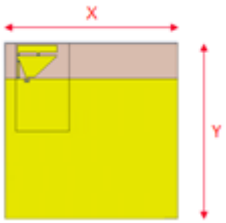
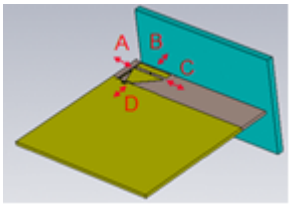
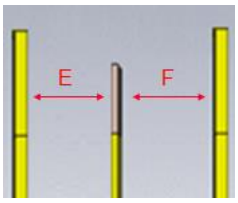
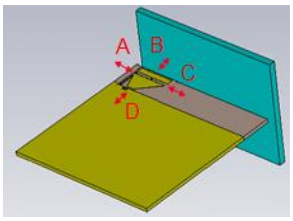
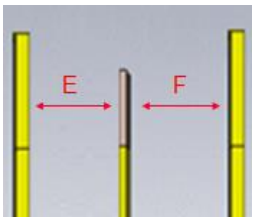
Return Loss



3.5.5 Trace Antenna Installation

Keep board size and clearance to Metal/GND and dielectric around the trace antenna for good antenna performance. **Table 5** lists the antenna installation details.

Table 5: 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 6** 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 6: WLAN Configuration Files – Linux

Names	Country	Country Code	Configuration Files
WLAN Tx power configuration files	USA	US	txpower_US.bin
	Canada	CA	txpower_CA.bin
	Europe	DE	txpower_EU.bin
	Japan	JP	txpower_JP.bin
WLAN OFDMA RU Tx power configuration files	USA	US	rutxpower_US.bin
	Canada	CA	rutxpower_CA.bin
	Europe	DE	rutxpower_EU.bin
	Japan	JP	rutxpower_JP.bin
WLAN Carrier Sense / Adaptivity threshold configuration file			ed_mac.bin
WLAN regulatory limitation configuration file			db.txt

NXP IC based module shall use CRDA mechanism which is provided by Linux-wireless. Compile the new regulatory.bin file from "db.txt" which is provided by Murata as explained in wireless-regdb.

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

Table 7: Bluetooth Configuration Script Files – Linux

Names	Country	Country Code	Script Files
Bluetooth Tx power configuration script files	USA	US	bt_power_config_US_CA_JP.sh
	Canada	CA	bt_power_config_US_CA_JP.sh
	Europe	DE	bt_power_config_EU.sh
	Japan	JP	bt_power_config_US_CA_JP.sh

- Bluetooth Tx power configuration files
  - bt_power_config_US_CA_JP.sh
    - Command examples are as below:

```
# sh bt_power_config_US_CA_JP.sh
```

    - Content of shell script file “bt_power_config_US_CA_JP.sh”

```
hcitool -i hci0 cmd 0x3f 0x00ee 0x01 0x0D
hcitool -i hci0 cmd 0x03 0x003
```

  - bt_power_config_EU.sh
    - Command examples are as below:

```
# sh bt_power_config_EU.sh
```

    - Content of shell script file “bt_power_config_EU.sh”

```
hcitool -i hci0 cmd 3F 61 00 00 01 1C 37 43 1C 00 1C 00 00 00 01 7F 03
07 08 00 00 00 00 C2 01 00 00 00 00 00 00 00 00 00
hcitool -i hci0 cmd 0x03 0x003
hcitool -i hci0 cmd 3f ff 64 87 10 00 FF FF FF FF 01 00 04 00 01 00 04
00
hcitool -i hci0 cmd 0x03 0x003
hcitool -i hci0 cmd 0x3f 0x00ee 0x01 0x03
hcitool -i hci0 cmd 0x03 0x003
```

Bluetooth Tx power is configured by using hcitool.

4.3 802.15.4 power setting command for Linux(2EL only)

802.15.4 Tx power setting command shall be implemented after 802.15.4 device initialization.

Tx power setting command shall be used to satisfy regulatory requirements if user wants to use Murata regulatory certification.

- US/CA/JP
  - Command examples are as below:

```
Ot-ctl txpower 15
```

- EU
  - Command examples are as below:

```
Ot-ctl txpower 3
```

4.4 WLAN Configuration Files for FreeRTOS

TBD

4.5 Bluetooth Configuration for FreeRTOS

TBD

4.6 802.15.4 Configuration for FreeRTOS

TBD

5 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
  - AVDD18=1.8V, AVDD33=3.3V, SD_VIO/VIO = 1.8V
  - Combo FW: 18.80.1.p154.38

Table 8, **Table 9**: Rx Minimum Sensitivity Level - WLAN at 2.4 GHz (40MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]					
	11n (HT 40)		11ac (VHT 40)		11ax (HE 40)	
	MCS0	MCS7	MCS0	MCS9	MCS0	MCS11
2412	-88	-70	-88	-65	-88	-60
2442	-88	-70	-88	-65	-88	-60
2472	-88	-69	-88	-64	-88	-60

Table 10
, Table 11, **Table 11, Table 12** describes the typical Rx minimum sensitivity level at module antenna port for WLAN at 2.4 GHz and 5 GHz.

Table 8: Rx Minimum Sensitivity Level - WLAN at 2.4 GHz (20 MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]									
	11b		11g		11n (HT 20)		11ac (VHT 20)		11ax (HE 20)	
	1 Mbps	11 Mbps	6 Mbps	54 Mbps	MCS0	MCS7	MCS0	MCS8	MCS0	MCS11
2412	-98	-88	-92	-75	-91	-72	-91	-69	-92	-63
2442	-97	-89	-92	-75	-91	-72	-91	-69	-92	-63
2472	-97	-88	-92	-75	-91	-72	-91	-69	-92	-62

Table 9: Rx Minimum Sensitivity Level - WLAN at 2.4 GHz (40MHz)

Frequency in MHz	Rx Minimum Sensitivity Level [dBm]					
	11n (HT 40)		11ac (VHT 40)		11ax (HE 40)	
	MCS0	MCS7	MCS0	MCS9	MCS0	MCS11
2412	-88	-70	-88	-65	-88	-60
2442	-88	-70	-88	-65	-88	-60
2472	-88	-69	-88	-64	-88	-60

Table 10: Rx Minimum Sensitivity Level - WLAN at 5 GHz (20 MHz)

Frequency	Rx Minimum Sensitivity Level [dBm]

in MHz	11a		11n (HT 20)		11ac (VHT 20)		11ax (HE 20)	
	6 Mbps	54 Mbps	MCS0	MCS7	MCS0	MCS8	MCS0	MCS11
5180	-91	-74	-91	-71	-91	-69	-91	-62
5500	-92	-75	-91	-71	-91	-69	-91	-61
5825	-92	-74	-90	-71	-90	-68	-90	-61

Table 11: 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	-88	-69	-88	-65	-89	-59
5510	-88	-69	-88	-65	-89	-59
5795	-87	-69	-87	-64	-88	-59

Table 12: 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	-84	-61	-85	-57
5530	-84	-61	-85	-57
5775	-83	-60	-84	-57

5.1.2 Bluetooth

- Conditions
  - AVDD18=1.8V, AVDD33=3.3V, SD_VIO/VIO = 1.8V
  - Combo FW: 18.80.1.p154.38

Table 13 describes the typical Rx minimum sensitivity level for Bluetooth.

Table 13: Rx Minimum Sensitivity Level – Bluetooth

Frequency in MHz	Rx Minimum Sensitivity level[dBm]						
	DH5	2DH5	3DH5	LE 1M	LE 2M	125K	500K
2412	-94	-94	-89	-102	-100	-107	-106
2442	-95	-95	-89	-101	-99	-106	-105
2472	-95	-95	-89	-102	-100	-107	-106

5.1.3 802.15.4

- Conditions
  - AVDD18=1.8V, AVDD33=3.3V, SD_VIO/VIO = 1.8V
  - Combo FW: 18.80.1.p154.38

Table 14 describes the typical Rx minimum sensitivity level for 802.15.4.

Table 14: Rx Minimum Sensitivity Level – 802.15.4

Frequency in MHz	Rx Minimum Sensitivity level[dBm]
	802.15.4
2412	-101
2442	-100
2472	-100

5.2 Typical Tx/Rx Current Consumption

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

5.2.1 WLAN

Typical Tx/Rx current consumption for Wi-Fi has certain conditions as described below.

- Conditions
  - AVDD18=1.8V, AVDD33=3.3V, SD_VIO/VIO = 1.8V
  - Combo FW: 18.80.1.p154.38

Figure 11: Typical Tx/Rx Current Consumption for Wi-Fi

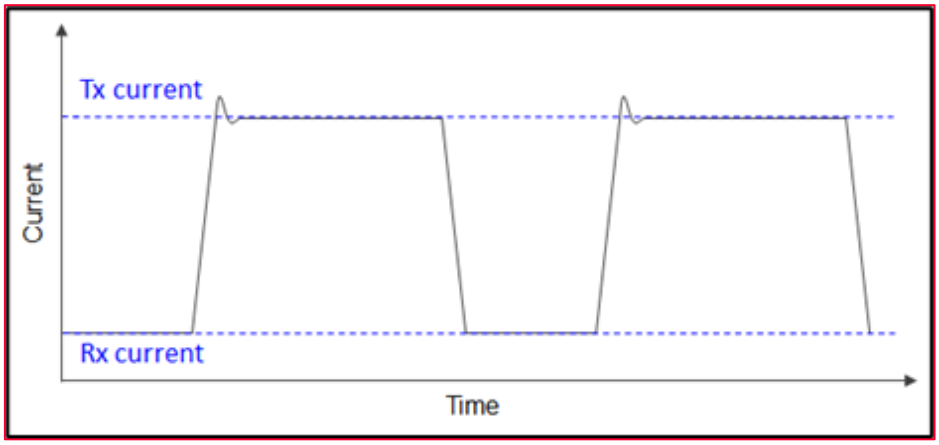


Table 15 describes the typical Tx/Rx current consumption for WLAN at 2.4 GHz.

Table 15: Typical Tx/Rx Current Consumption - WLAN at 2.4 GHz

Mode	Data Rate	Setting Tx Power [dBm]	Current [mA]			
			Tx		Rx	
			AVDD18	AVDD33	AVDD18	AVDD33
11b	1 Mbps	18	150	235	100	0.2
11g	6 Mbps	16	165	200	100	0.2
11n (HT20)	MCS0	15	165	190	100	0.2
11ac (VHT20)	MCS0	15	165	190	100	0.2
11ax (HE20)	MCS0	15	165	190	100	0.2
11n (HT40)	MCS0	15	170	190	110	0.2

11ac (VHT40)	MCS0	15	170	190	110	0.2
11ax (HE40)	MCS0	15	170	190	110	0.2

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

Table 16: Typical Tx/Rx Current Consumption - WLAN at 5 GHz

Mode	Data Rate	Setting Tx Power [dBm]	Current [mA]			
			Tx		Rx	
			AVDD18	AVDD33	AVDD18	AVDD33
11a	6 Mbps	16	250	240	120	0.2
11n (HT20)	MCS0	14	220	210	120	0.2
11ac (VHT20)	MCS0	14	220	210	120	0.2
11ax (HE20)	MCS0	14	220	215	120	0.2
11n (HT40)	MCS0	14	230	205	140	0.2
11ac (VHT40)	MCS0	14	230	205	140	0.2
11ax (HE40)	MCS0	14	235	210	140	0.2
11ac (VHT80)	MCS0	14	250	210	170	0.2
11ax (HE80)	MCS0	14	255	210	170	0.2

5.2.2 Bluetooth

Typical Tx/Rx current consumption for Bluetooth has certain conditions as described below.

- Conditions
  - AVDD18=1.8V, AVDD33=3.3V, SD_VIO/VIO = 1.8V
  - Combo FW: 18.80.1.p154.38

Figure 12: Typical Tx/Rx Current Consumption for Bluetooth

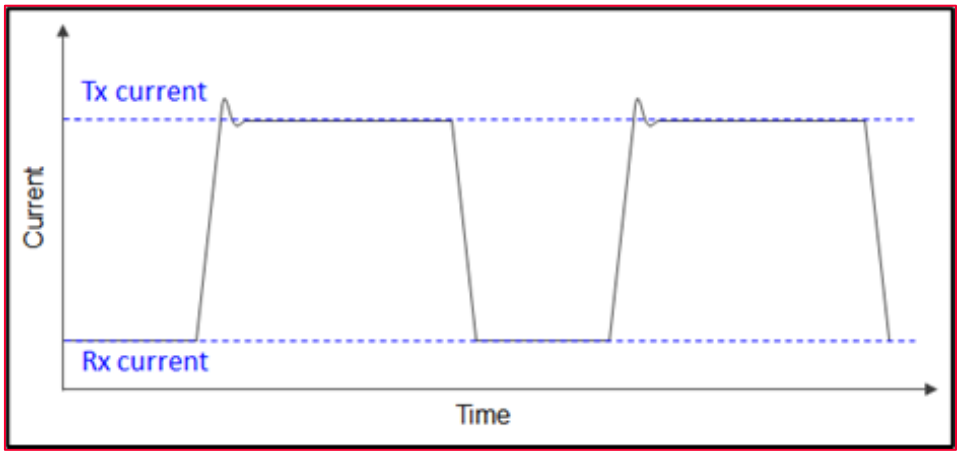


Table 17 describes the typical Tx/Rx current consumption for Bluetooth.

Table 17: Typical Tx/Rx Current Consumption - Bluetooth

Mode	Setting Tx Power [dBm]	Current [mA]			
		Tx		Rx	
		AVDD18	AVDD33	AVDD18	AVDD33
BR (1DH5)	13	323	0.2	125	0.2
EDR (3DH5)	5	190	0.2	125	0.2
LE 1M	13	325	0.2	125	0.2
LE 2M	13	345	0.2	125	0.2

5.2.3 802.15.4(2EL only)

Typical Tx/Rx current consumption for Bluetooth has certain conditions as described below.

- Conditions
  - AVDD18=1.8V, AVDD33=3.3V, SD_VIO/VIO = 1.8V
  - Combo FW: 18.80.1.p154.38

Figure 13: Typical Tx/Rx Current Consumption for 802.15.4

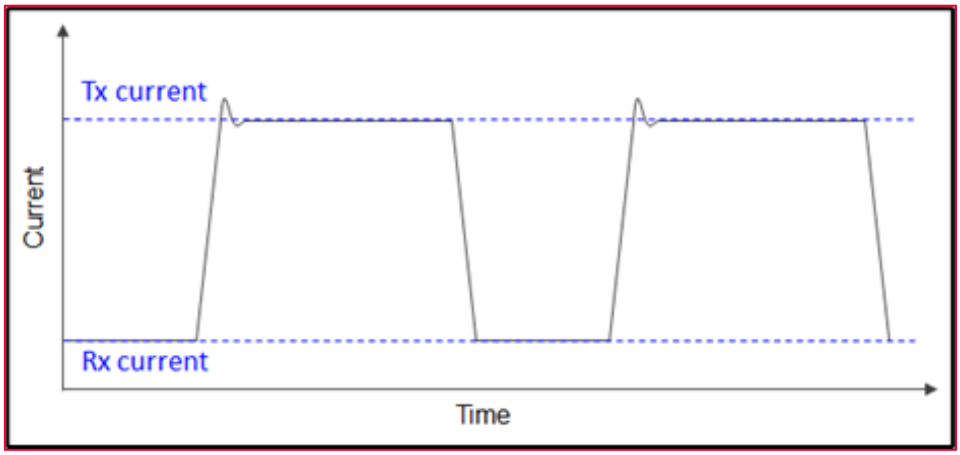


Table 18 describes the typical Tx/Rx current consumption for 802.15.4.

Table 18: Typical Tx/Rx Current Consumption – 802.15.4

Mode	Setting Tx Power [dBm]	Current [mA]			
		Tx		Rx	
		AVDD18	AVDD33	AVDD18	AVDD33
802.15.4	13	390	0.2	125	0.2

5.3 Typical Sleep Current Consumption

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

5.3.1 WLAN

- Conditions
  - AVDD18=1.8V, AVDD33=3.3V, SD_VIO/VIO = 1.8V
  - Target: NXP 8MMINILPD4-EVKB
  - WLAN FW: 18.99.1.p154.72
  - Beacon Interval = 100 ms
  - SDIO Signal Level = 1.8V
    SD Clock off/on (# mlanutl mlan0 sdioclock 0, #mlanutl mlan0 sdioclock 1)

Table 19 describes the typical sleep current consumption for WLAN.

Table 19: Typical Sleep Current Consumption – WLAN

Current Consumption AVDD18 (1.8V) in mA					
Band	**SD clock speed**	**25 MHz**		**200 MHz**	
	Clock enablement	**Disable**	**Enable**	**Disable**	**Enable**
-	Chip deep sleep	0.6	0.7	1.1	1.6
2.4 GHz	IEEE Power Save: DTIM1	3.2	3.3	3.6	4.1
	IEEE Power Save: DTIM3	1.5	1.6	1.9	2.5
	IEEE Power Save: DTIM5	1.2	1.2	1.6	2.1
5 GHz	IEEE Power Save: DTIM1	2.0	2.0	2.4	2.9
	IEEE Power Save: DTIM3	1.1	1.1	1.5	2.0
	IEEE Power Save: DTIM5	0.9	0.9	1.4	1.9

5.3.2 Bluetooth

- Conditions
  - AVDD18=1.8V, AVDD33=3.3V, SD_VIO/VIO = 1.8V
  - Target: NXP 8MMINILPD4-EVKB
  - Bluetooth/15.4 FW: 18.99.1.p154.72

Table 20 describes the typical sleep current consumption for Bluetooth.

Table 20: Typical Sleep Current Consumption – Bluetooth

Current Consumption AVDD (1.8V) in mA	
Bluetooth and 802.15.4 only in deep sleep mode	0.25

5.4 Typical Bluetooth Current Consumption

This section describes the typical Bluetooth current consumption.

- Conditions
  - AVDD18=1.8V, AVDD33=3.3V, SD_VIO/VIO = 1.8V
  - Target: NXP 8MMINILPD4-EVKB
  - Bluetooth/15.4 FW: 18.99.1.p154.72

Table 21 describes the typical Bluetooth advertise current consumption.

Table 21: Typical Bluetooth Current Consumption

Current Consumption AVDD18 (1.8V) in mA	
Bluetooth page scan	0.58
Bluetooth page and inquiry scan	0.80
Bluetooth ACL / Sniff mode interval = 1.28sec	0.35
Bluetooth LE advertise / Interval = 1.28sec	0.32
Bluetooth LE scan / interval = 1.28sec	0.46

5.5 Typical Throughput

The typical throughput test configurations are:

- AVDD18=1.8V, AVDD33=3.3V, SD_VIO/VIO = 1.8V
- Target: NXP 8MMINILPD4-EVKB
- Combo FW: 18.99.1.p154.72
- 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 22 shows the typical throughput data for the modules.

Table 22: WLAN Typical Throughput Data

Mode	TCP Throughput in Mbps		UDP Throughput in Mbps	
	Tx	Rx	Tx	Rx
2.4 GHz 11ax HE20	119	116	125	122
5 GHz 11ax HE80	419	384	465	503

6 References

Table 23 reviews all the key reference documents that the user may like to refer to.

Table 23: Reference Table

Support Site	Notes
Murata Type 2EL Module Datasheet	Murata Type 2EL module datasheet (TYPE2EL.pdf)
Murata Type 2DL Module Datasheet	Murata Type 2DL module datasheet (TYPE2DL.pdf)
Murata Type 2EL 2DL Module Footprint	Murata Type 2EL / 2DL module footprint (type2el-2dl-module-footprint-topview.dxf)
Murata Type 2EL 2DL PCB Type Di-pole and Trace Antenna	Murata Type 2EL / 2DL module trace antenna (type2el-2dl-u-fl.dxf)
Linux	Murata GitHub link for Linux transmit power files for 2EL /2DL
FreeRTOS	TBD
wireless-regdb	Regulatory database used by Linux
Linux User Guide	Murata Linux User Guide for NXP modules (Murata Wi-Fi & BT (NXP) 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 24 lists all the support resources available for the Murata Wi-Fi/BT solution.

Table 24: 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	Jun 12, 2023	First Issue	
2.0	Jul 04, 2023	Added 2DL	Revision 1.0 only 2EL. Added 2DL in Revision 2.0.
3.0	Oct 10, 2023	3.1 Reference Circuit 5.1 Typical Rx Minimum Sensitivity Level at Module Antenna port	Format change / corrected a pin name (Pin79) Added

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