User's Guide

WL1837MODCOM8I WLAN MIMO and Bluetooth® Module Evaluation Board for TI Sitara™ Platform

ABSTRACT

The WL1837MODCOM8I is a Wi-Fi® dual-band, *Bluetooth*®, and BLE module evaluation board (EVB) with the TI WL1837 module (WL1837MOD, with Bluetooth) or WL1807 module (WL1807MOD, without Bluetooth). The WL18x7MOD is a certified WiLink™ 8 module from TI that offers high throughput and extended range along with Wi-Fi and Bluetooth coexistence in a power-optimized design. The WL1807MOD offers A 2.4- and 5-GHz module solution with two antennas supporting industrial temperature grade. The module is FCC, IC, ETSI/CE, and TELEC certified for AP (with DFS support) and client. TI offers drivers for high-level operating systems, such as Linux®, Android™, WinCE, and RTOS.TI.

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Android™ is a trademark of Google, Inc.
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Wi-Fi® is a registered trademark of Wi-Fi Alliance.
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Warning

The WL1837MODCOM8I board is tested to comply with ETSI/R&TTE over temperatures from –40°C to +85°C.

This board must not be modified to operate in other frequency bands other than designed for.

FCC Licensing Requirements for the Wi-Fi and Bluetooth Radio Module of the EVM:

For evaluation only; not FCC approved for resale. This kit is designed to allow:

1. Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product
2. Software developers to write software applications for use with the end product. This kit is not a finished product and when assembled cannot be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18, or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

Per TI's Regulatory Compliance Information located in the WL1837MODCOM8I User's Guide's "Evaluation Board/Kit/Module (EVM) Additional Terms," this EVM cannot be used for production purposes and is explicitly restricted from end-product introduction.

Use of this EVM requires the developer to provide a minimum distance of at least 20 cm from the antenna to all persons to minimize risk of potential radiation hazards.

CAUTION

Do not leave the EVM powered when unattended.

NCC Statement

1. 取得審驗證明之低功率射頻器材，非經核准，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

   For low-power radio frequency equipment that has obtained certification, no company, firm or user can change the frequency, increase the power, or change the characteristics and functions of the original design without approval.
2. 低功率射頻器材之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前述合法通信，指依電信管理法規定作業之無線電通信。低功率射頻器材須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

   The use of low-power radio frequency equipment must not affect flight safety or interfere with legitimate communications; if interference is found, then the interference must be stopped immediately and improved until there is no interference before continued use. The aforementioned legal communications refer to radio communications operated in accordance with the provisions of the Telecommunications Management Act. Low-power radio frequency equipment must endure interference from electromagnetic equipment that radiates electromagnetic waves for legitimate communications or industrial, scientific and medical purposes.
3. 無線資訊傳輸設備必須避免影響附近雷達系統的運行。

   Wireless information transmission equipment must avoid affecting the operation of nearby radar systems.

NCC Labeling Requirements

If using a permanently affixed label, then the modular transmitter must be labeled with the NCC identification number. If the NCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module.

This exterior label can use wording such as the following:

"Contains Transmitter Module NCC ID: CC XX xx YY yyy Z z W" or "Contains NCC ID: CC XX xx YY yyy Z z W." Any similar wording that expresses the same meaning can be used.

1 Overview

Figure 1-1 shows the WL1837MODCOM8I EVB.

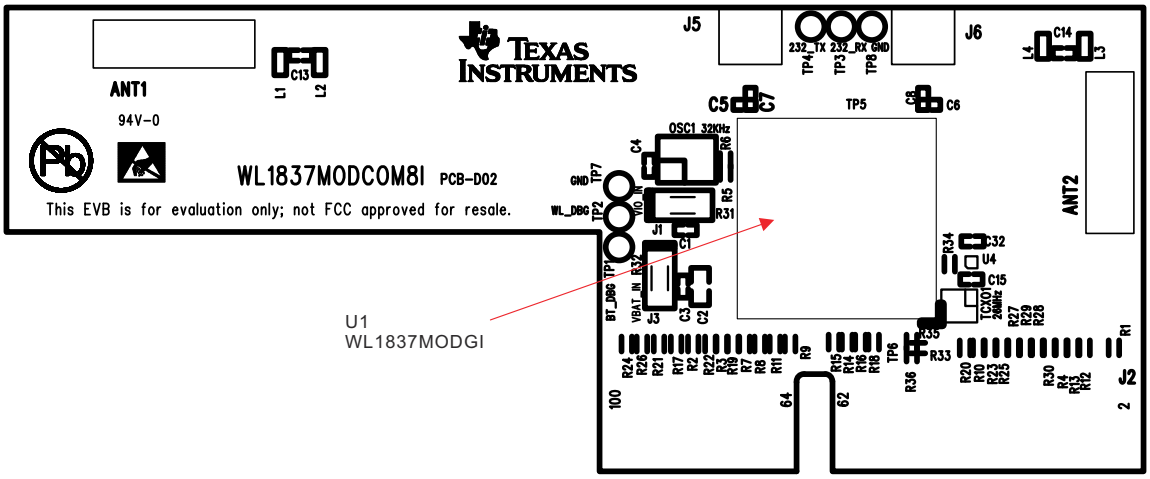

Figure 1-1. WL1837MODCOM8I EVB (Top View)

1.1 General Features

The WL1837MODCOM8I EVB includes the following features:

- WLAN, *Bluetooth*, and BLE on a single module board
- 100-pin board card
- Dimensions: 76.0 mm (L) x 31.0 mm (W)
- WLAN 2.4- and 5-GHz SISO (20- and 40-MHz channels), 2.4-GHz MIMO (20-MHz channels)
- Support for BLE dual mode
- Seamless integration with TI Sitara and other application processors
- Design for the TI AM335X general-purpose evaluation module (EVM)
- WLAN and *Bluetooth*, BLE, and ANT cores that are software- and hardware-compatible with prior WL127x, WL128x, and BL6450 offerings for smooth migration to device
- Shared host-controller-interface (HCI) transport for *Bluetooth*, BLE, and ANT using UART and SDIO for WLAN
- Wi-Fi and *Bluetooth* single-antenna coexistence
- Built-in chip antenna
- Optional U.FL RF connector for external antenna
- Direct connection to the battery using an external switched-mode power supply (SMPS) supporting 2.9- to 4.8-V operation
- V_{IO} in the 1.8-V domain

1.2 Key Benefits

The WL18x7MOD offers the following benefits:

- Reduces design overhead: Single WiLink 8 module scales across Wi-Fi and *Bluetooth*
- WLAN high throughput: 80Mbps (TCP), 100Mbps (UDP)
- *Bluetooth* 4.2 (5.1 compliant) + BLE (Smart Ready)
- Wi-Fi and *Bluetooth* single-antenna coexistence
- Low power at 30% to 50% less than the previous generation
- Available as an easy-to-use FCC-, ETSI-, and Telec-certified module
- Lower manufacturing costs saves board space and minimizes RF expertise.
- AM335x Linux and Android reference platform accelerates customer development and time to market.

1.3 Applications

The WL1837MODCOM8I device is designed for the following applications:

- Portable consumer devices
- Home electronics
- Home appliances and white goods
- Industrial and home automation
- Smart gateway and metering
- Video conferencing
- Video camera and security

2 Board Pin Assignment

Figure 2-1 shows the top view of the EVB.

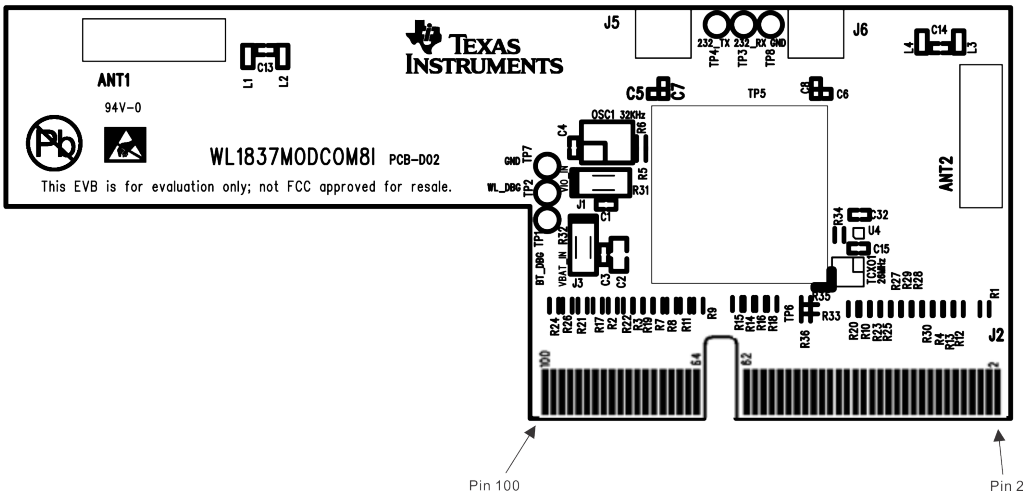

Figure 2-1. EVB Top View

Figure 2-2 shows the bottom view of the EVB.

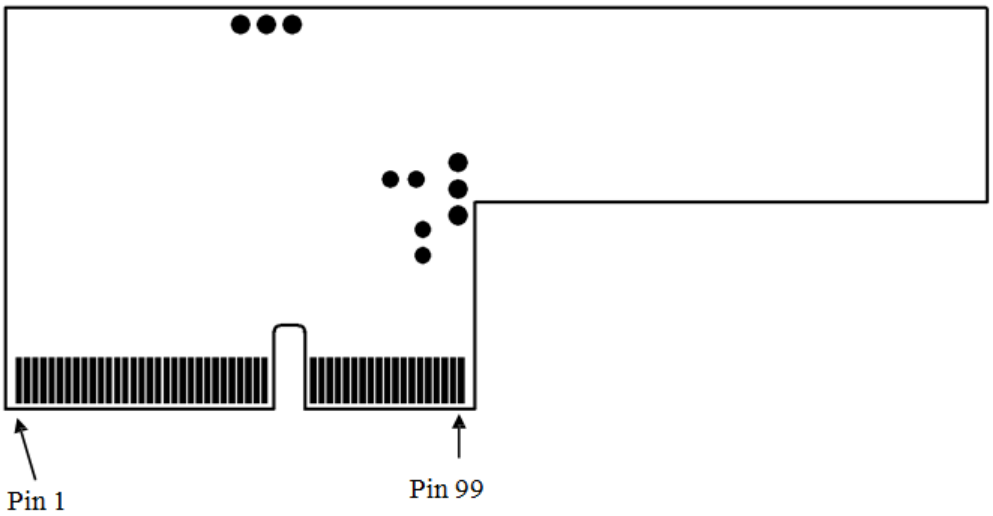

Figure 2-2. EVB (Bottom View)

2.1 Pin Description

Table 2-1 describes the board pins.

Table 2-1. Pin Description

No.	Name	Type	Description
1	SLOW_CLK	I	Slow clock input option (default: NU)
2	GND	G	Ground
3	GND	G	Ground
4	WL_EN	I	WLAN enable
5	V_{BAT}	P	3.6-V typical voltage input
6	GND	G	Ground
7	V_{BAT}	P	3.6-V typical voltage input
8	V_{IO}	P	V_{IO} 1.8-V (I/O voltage) input
9	GND	G	Ground
10	N.C.		No connection
11	WL_RS232_TX	O	WLAN tool RS232 output
12	N.C.		No connection
13	WL_RS232_RX	I	WLAN tool RS232 input
14	N.C.		No connection
15	WL_UART_DBG	O	WLAN Logger output
16	N.C.		No connection
17	N.C.		No connection
18	GND	G	Ground
19	GND	G	Ground
20	SDIO_CLK	I	WLAN SDIO clock
21	N.C.		No connection
22	GND	G	Ground
23	N.C.		No connection
24	SDIO_CMD	I/O	WLAN SDIO command
25	N.C.		No connection
26	SDIO_D0	I/O	WLAN SDIO data bit 0
27	N.C.		No connection
28	SDIO_D1	I/O	WLAN SDIO data bit 1
29	N.C.		No connection
30	SDIO_D2	I/O	WLAN SDIO data bit 2
31	N.C.		No connection
32	SDIO_D3	I/O	WLAN SDIO data bit 3
33	N.C.		No connection
34	WLAN_IRQ	O	WLAN SDIO interrupt out
35	N.C.		No connection
36	N.C.		No connection
37	GND	G	Ground
38	N.C.		No connection
39	N.C.		No connection
40	N.C.		No connection
41	N.C.		No connection
42	GND	G	Ground
43	N.C.		No connection
44	N.C.		No connection

Table 2-1. Pin Description (continued)

No.	Name	Type	Description
45	N.C.		No connection
46	N.C.		No connection
47	GND	G	Ground
48	N.C.		No connection
49	N.C.		No connection
50	N.C.		No connection
51	N.C.		No connection
52	PCM_IF_CLK	I/O	Bluetooth PCM clock input or output
53	N.C.		No connection
54	PCM_IF_FSYNC	I/O	Bluetooth PCM frame sync input or output
55	N.C.		No connection
56	PCM_IF_DIN	I	Bluetooth PCM data input
57	N.C.		No connection
58	PCM_IF_DOUT	O	Bluetooth PCM data output
59	N.C.		No connection
60	GND	G	Ground
61	N.C.		No connection
62	N.C.		No connection
63	GND	G	Ground
64	GND	G	Ground
65	N.C.		No connection
66	BT_UART_IF_TX	O	Bluetooth HCI UART transmit output
67	N.C.		No connection
68	BT_UART_IF_RX	I	Bluetooth HCI UART receive input
69	N.C.		No connection
70	BT_UART_IF_CTS	I	*Bluetooth* HCI UART Clear-to-Send input
71	N.C.		No connection
72	BT_UART_IF_RTS	O	Bluetooth HCI UART Request-to-Send output
73	N.C.		No connection
74	RESERVED1	O	Reserved
75	N.C.		No connection
76	BT_UART_DEBUG	O	Bluetooth Logger UART output
77	GND	G	Ground
78	GPIO9	I/O	General-purpose I/O
79	N.C.		No connection
80	N.C.		No connection
81	N.C.		No connection
82	N.C.		No connection
83	GND	G	Ground
84	N.C.		No connection
85	N.C.		No connection
86	N.C.		No connection
87	GND	G	Ground
88	N.C.		No connection
89	BT_EN	I	Bluetooth enable
90	N.C.		No connection
91	N.C.		No connection

Table 2-1. Pin Description (continued)

No.	Name	Type	Description
92	GND	G	Ground
93	RESERVED2	I	Reserved
94	N.C.		No connection
95	GND	G	Ground
96	GPIO11	I/O	General-purpose I/O
97	GND	G	Ground
98	GPIO12	I/O	General-purpose I/O
99	TCXO_CLK_COM	I	Option to supply 26 MHz externally
100	GPIO10	I/O	General-purpose I/O

2.2 Jumper Connections

The WL1837MODCOM8I EVB includes the following jumper connections:

- J1: Jumper connector for V_{IO} power input
- J3: Jumper connector for V_{BAT} power input
- J5: RF connector for 2.4- and 5-GHz WLAN and *Bluetooth*
- J6: Second RF connector for 2.4-GHz WLAN

3 Electrical Characteristics

For electrical characteristics, see the (*WL18xxMOD WiLink™ Single-Band Combo Module – Wi-Fi®, Bluetooth®, and Bluetooth Low Energy (BLE) Data Sheet*).

4 Approved Antenna Types and Maximum Gain Values

This device is intended only for OEM integrators under the following conditions:

- The antenna must be installed so that 20 cm is maintained between the antenna and users.
- The transmitter module cannot be co-located with any other transmitter or antenna.
- The radio transmitter can operate only using an antenna of a type and maximum (or lesser) gain approved by TI. Table 4-1 lists the antennas approved by TI for use with the radio transmitter along with maximum allowable gain values. Antenna types not included in the list or having a gain greater than the maximum indicated are strictly prohibited for use with this transmitter.

Table 4-1. Approved Antenna Types and Maximum Gain Values

Brand	Antenna Type	Model	2.4 GHz	4.9 to 5.9 GHz (1)
Ethetronics (2)	PCB	1000423	-0.6 dBi	4.5 dBi
Pulse	Dipole	W1039B030	1 dBi	2 dBi
LSR	Rubber Antenna/Dipole	001-0012	2 dBi	2 dBi
		080-0013	2 dBi	2 dBi
		080-0014	2 dBi	2 dBi
	PIFA	001-0016	2.5 dBi	3 dBi
		001-0021	2.5 dBi	3 dBi
Laird	PCB	CAF94504	2 dBi	4 dBi
		CAF94505	2 dBi	4 dBi
Pulse	Chip	W3006	3.2 dBi	4.2 dBi
TDK	Chip	ANT016008	2.4 dBi	3.96 dBi

(1) Range is approximate.
(2) Not approved for KCC.

Note

If these conditions cannot be met (for example, with certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization is not considered valid and the FCC ID/IC ID cannot be used on the final product. In these circumstances, the OEM integrator is responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC/IC authorization.

5 Antenna Characteristics

5.1 VSWR

Figure 5-1 shows the antenna VSWR characteristics.

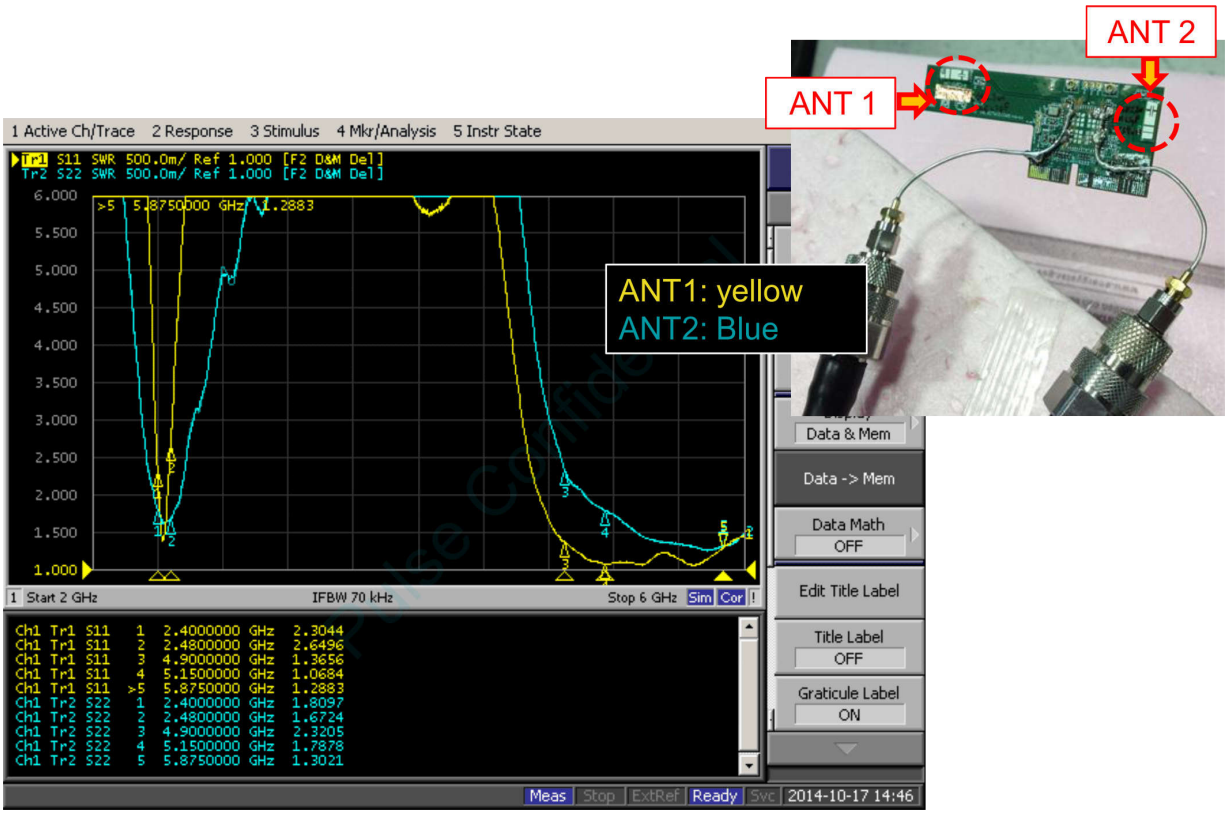

Figure 5-1. Antenna VSWR Characteristics

5.2 Efficiency

Figure 5-2 shows the antenna efficiency.

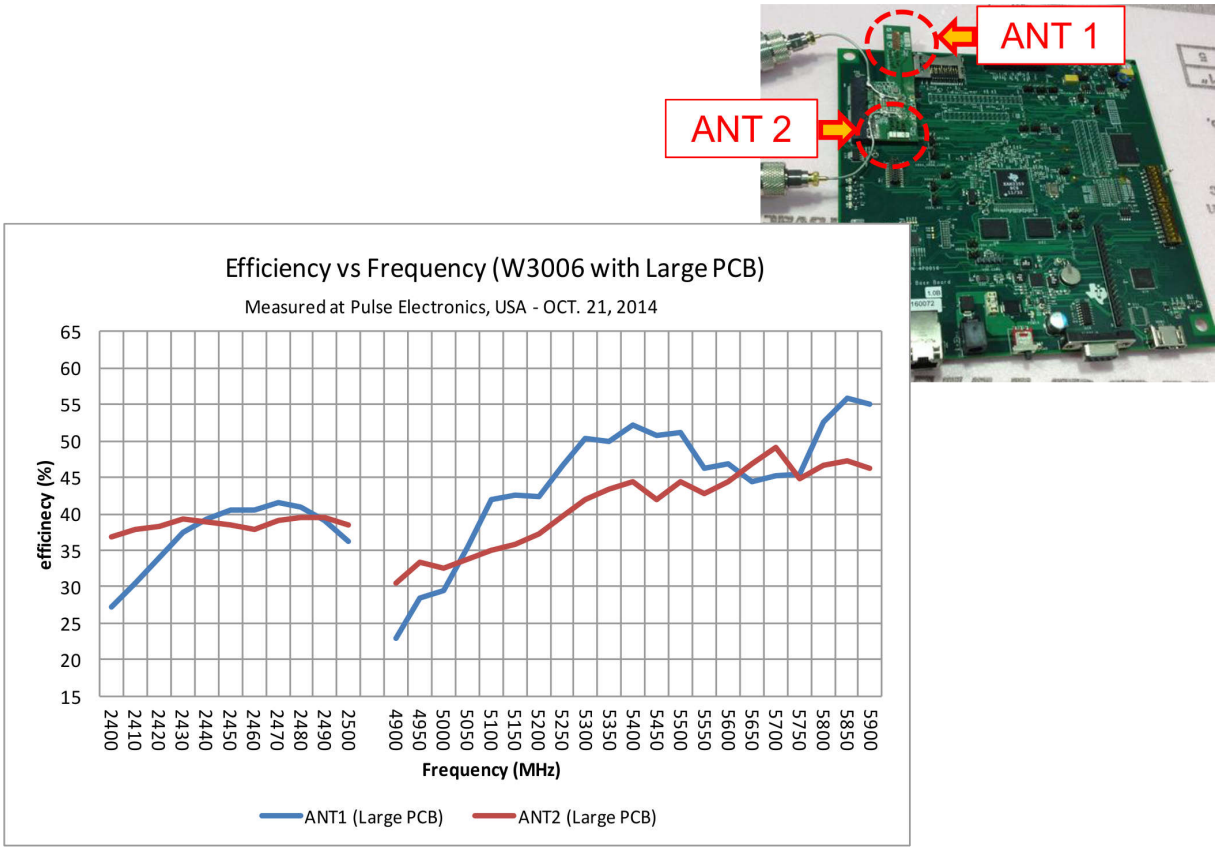

Figure 5-2. Antenna Efficiency

5.3 Radio Pattern

For information on the antenna radio pattern and other related information, see productfinder.pulseeng.com/product/W3006.

6 Circuit Design

6.1 EVB Reference Schematics

Figure 6-1 shows the reference schematics for the EVB.

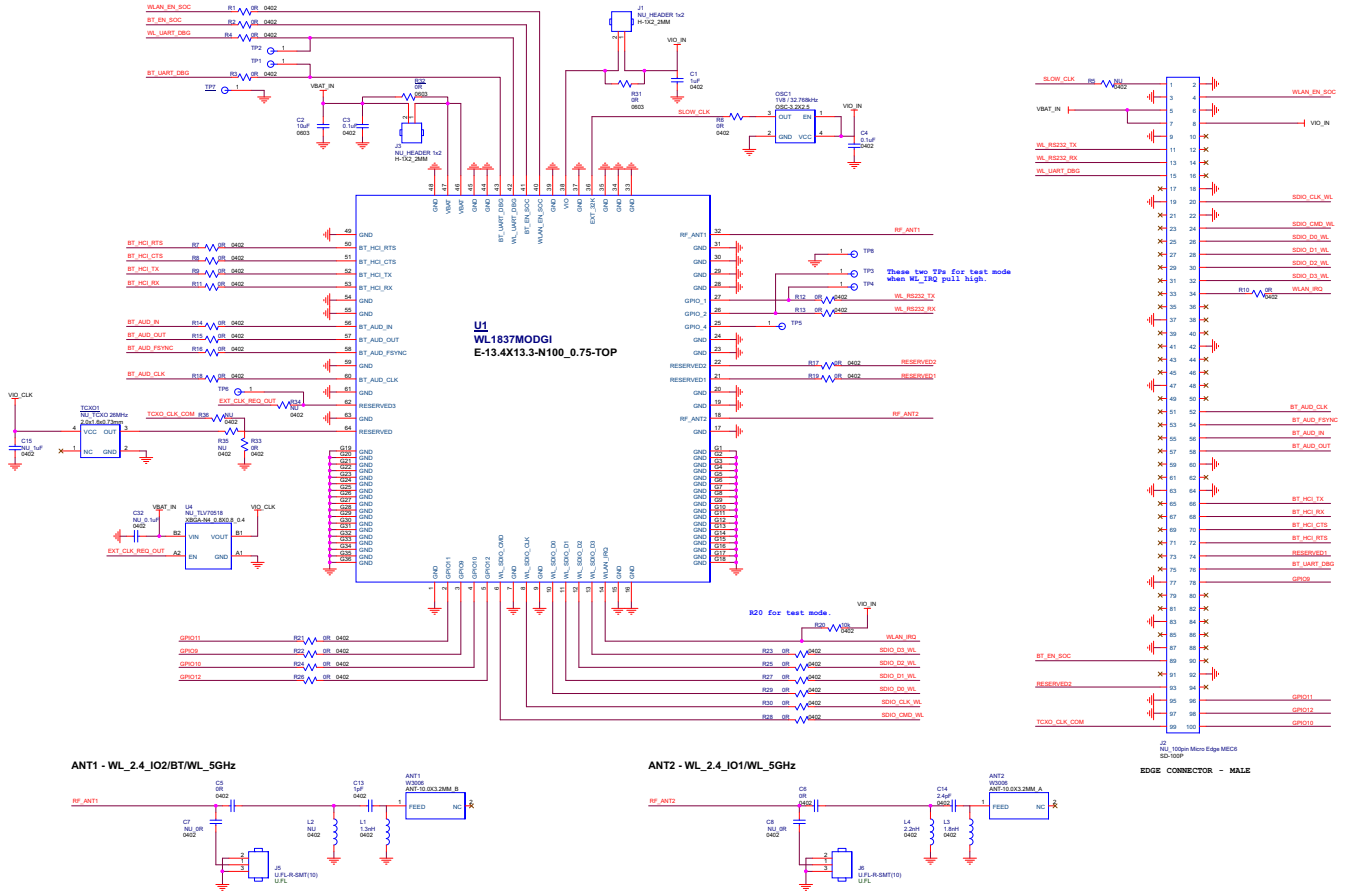

Figure 6-1. EVB Reference Schematics

6.2 Bill of Materials (BOM)

Table 6-1 lists the BOM for the EVB.

Table 6-1. BOM

Item	Description	Part Number	Package	Reference	Qty	Mfr
1	TI WL1837 Wi-Fi / *Bluetooth* module	WL1837MODGI	13.4 mm x 13.3 mm x 2.0 mm	U1	1	Jorjin
2	XOSC 3225 / 32.768KHZ / 1.8 V / ±50 ppm	7XZ3200005	3.2 mm × 2.5 mm × 1.0 mm	OSC1	1	TXC
3	Antenna / Chip / 2.4 and 5 GHz	W3006	10.0 mm × 3.2 mm × 1.5 mm	ANT1, ANT2	2	Pulse
4	Mini RF header receptacle	U.FL-R-SMT-1(10)	3.0 mm × 2.6 mm × 1.25 mm	J5, J6	2	Hirose
5	Inductor 0402 / 1.3 nH / ±0.1 nH / SMD	LQP15MN1N3B02	0402	L1	1	Murata
6	Inductor 0402 / 1.8 nH / ±0.1 nH / SMD	LQP15MN1N8B02	0402	L3	1	Murata
7	Inductor 0402 / 2.2 nH / ±0.1 nH / SMD	LQP15MN2N2B02	0402	L4	1	Murata
8	Capacitor 0402 / 1 pF / 50 V / C0G / ±0.1 pF	GJM1555C1H1R0BB01	0402	C13	1	Murata
9	Capacitor 0402 / 2.4 pF / 50 V / C0G / ±0.1 pF	GJM1555C1H2R4BB01	0402	C14	1	Murata
10	Capacitor 0402 / 0.1 µF / 10 V / X7R / ±10%	0402B104K100CT	0402	C3, C4	2	Walsin
11	Capacitor 0402 / 1 µF / 6.3 V / X5R / ±10% / HF	GRM155R60J105KE19D	0402	C1	1	Murata
12	Capacitor 0603 / 10 µF / 6.3 V / X5R / ±20%	C1608X5R0J106M	0603	C2	1	TDK
13	Resistor 0402 / 0R / ±5%	WR04X000 PTL	0402	R1 to R4, R6 to R19, R21 to R30, R33, C5, C6(1)	31	Walsin
14	Resistor 0402 / 10K / ±5%	WR04X103 JTL	0402	R20	1	Walsin
15	Resistor 0603 / 0R / ±5%	WR06X000 PTL	0603	R31, R32	2	Walsin

(1) C5 and C6 are mounted with a 0-Ω resistor by default.

7 Layout Guidelines

7.1 Board Layout

Figure 7-1 through Figure 7-4 show the four layers of the WL1837MODCOM8I EVB.

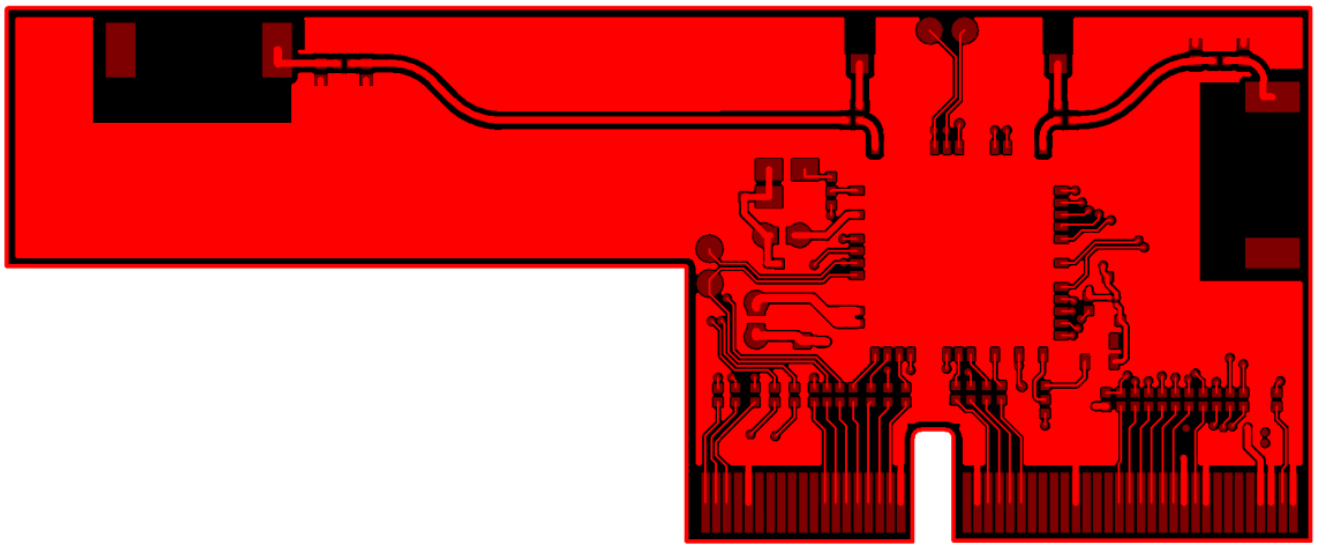

Figure 7-1. WL1837MODCOM8I Layer 1 Layout

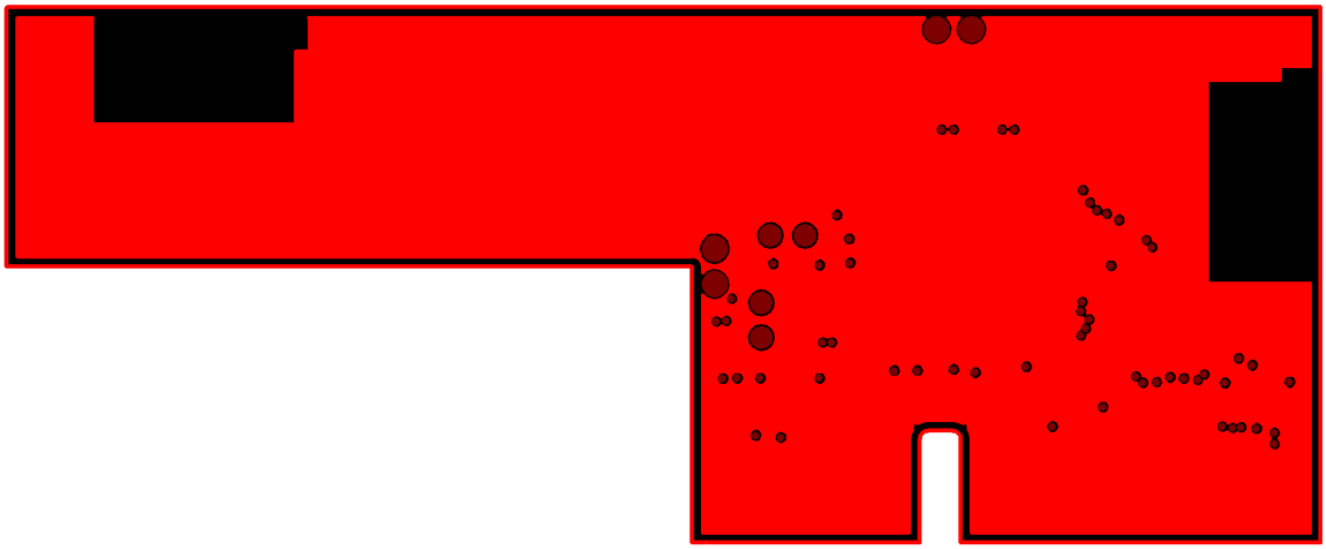

Figure 7-2. WL1837MODCOM8I Layer 2 Layout

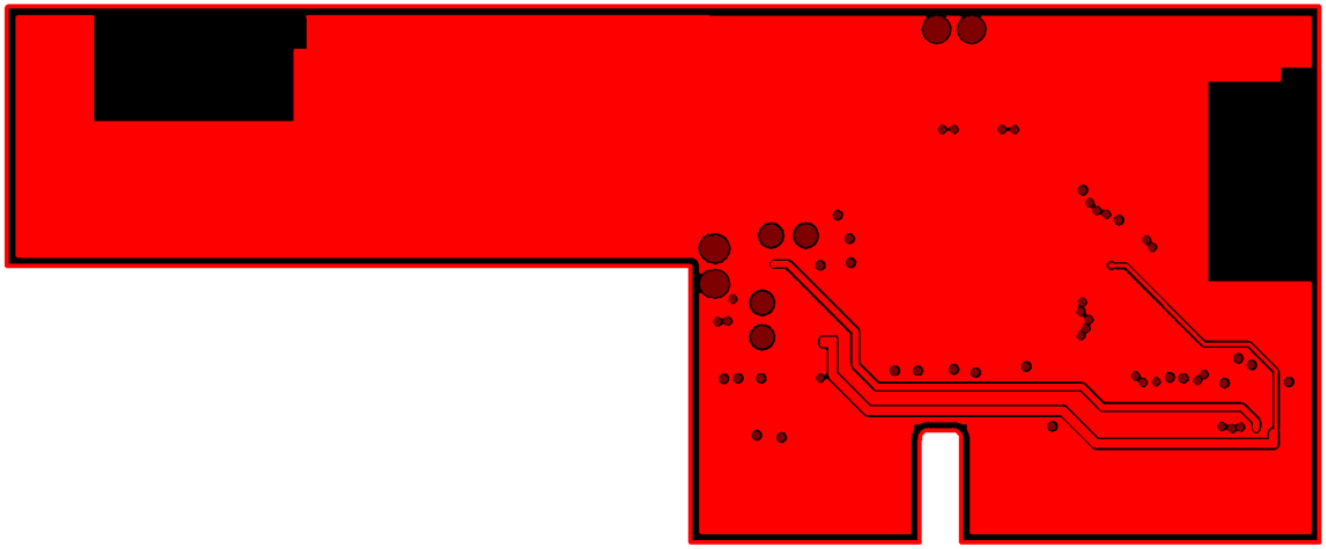

Figure 7-3. WL1837MODCOM8I Layer 3 Layout

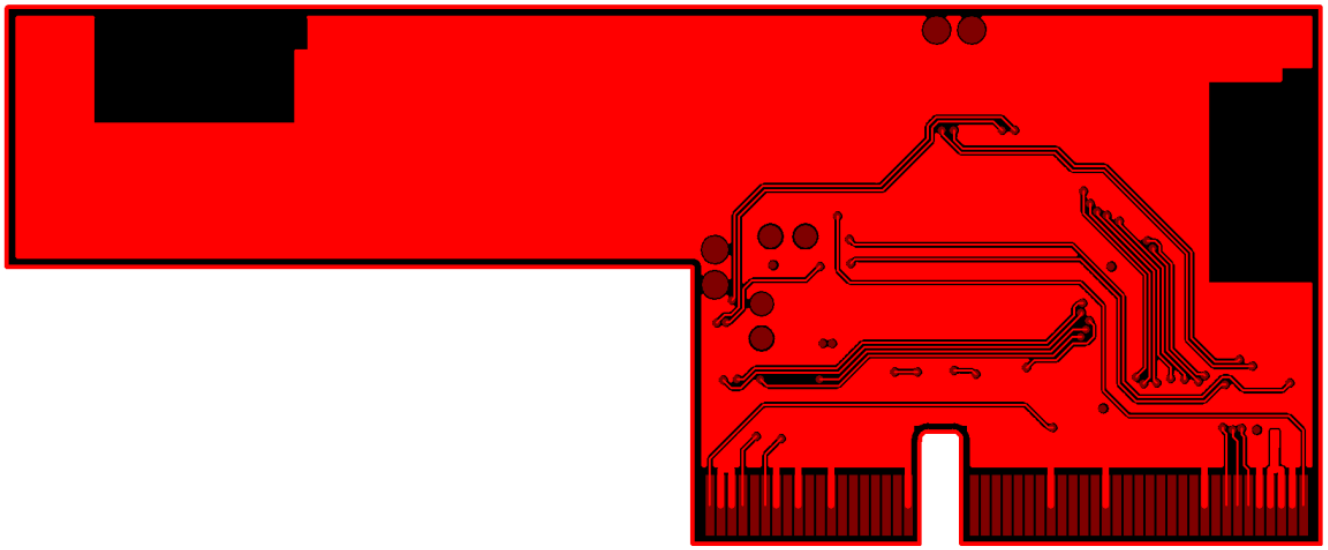

Figure 7-4. WL1837MODCOM8I Layer 4 Layout

Figure 7-5 and Figure 7-6 show instances of good layout practices.

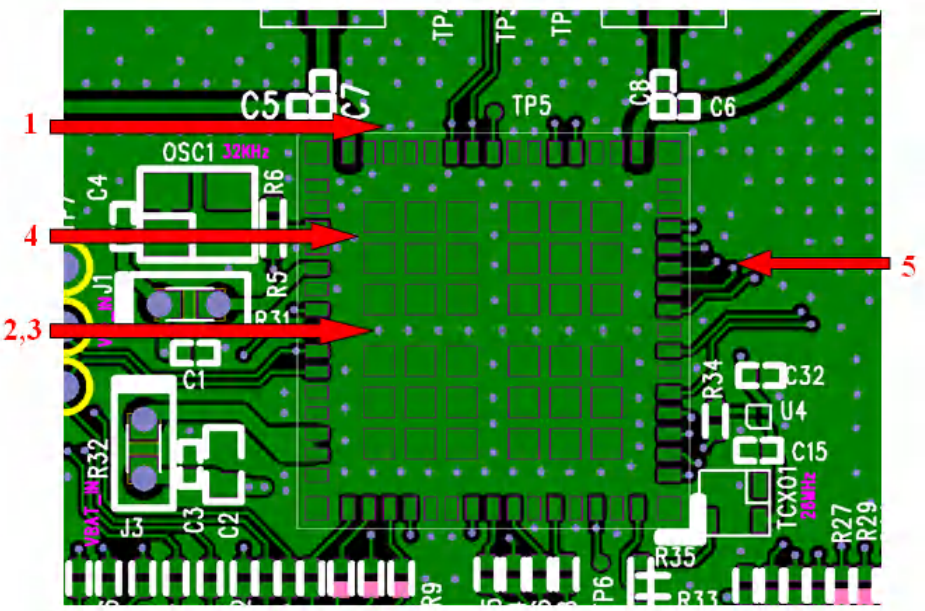

Figure 7-5. Module Layout Guidelines (Top Layer)

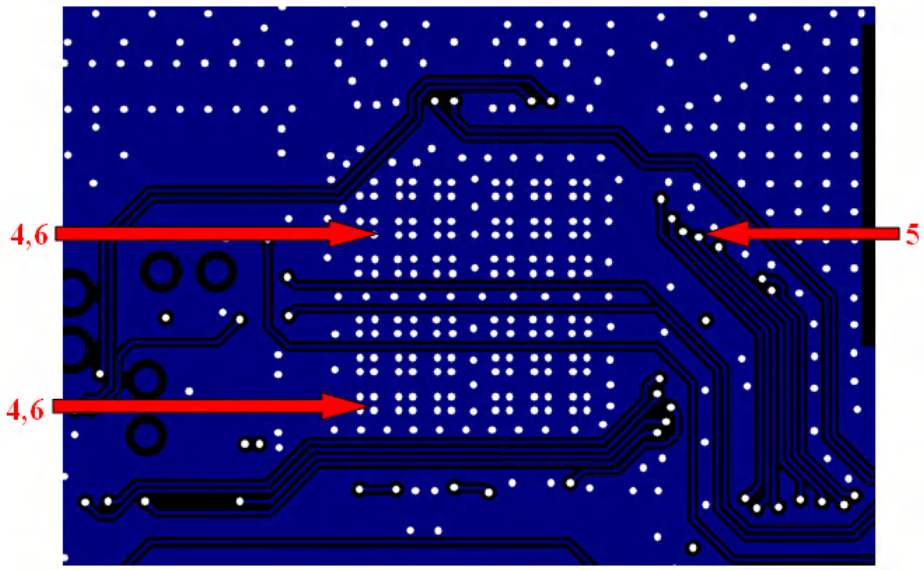

Figure 7-6. Module Layout Guidelines (Bottom Layer)

Table 7-1 describes the guidelines corresponding to the reference numbers in Figure 7-5 and Figure 7-6.

Table 7-1. Module Layout Guidelines

Reference	Guideline Description
1	Keep the proximity of ground vias close to the pad.
2	Do not run signal traces underneath the module on the layer where the module is mounted.
3	Have a complete ground pour in layer 2 for thermal dissipation.
4	Make sure to have a solid ground plane and ground vias under the module for stable system and thermal dissipation.
5	Increase ground pour in the first layer and have all traces from the first layer on the inner layers, if possible.
6	Signal traces can be run on a third layer under the solid ground layer and the module mounting layer.

Figure 7-7 shows the trace design for the PCB. TI recommends using a 50-Ω impedance match on the trace to the antenna and 50-Ω traces for the PCB layout.

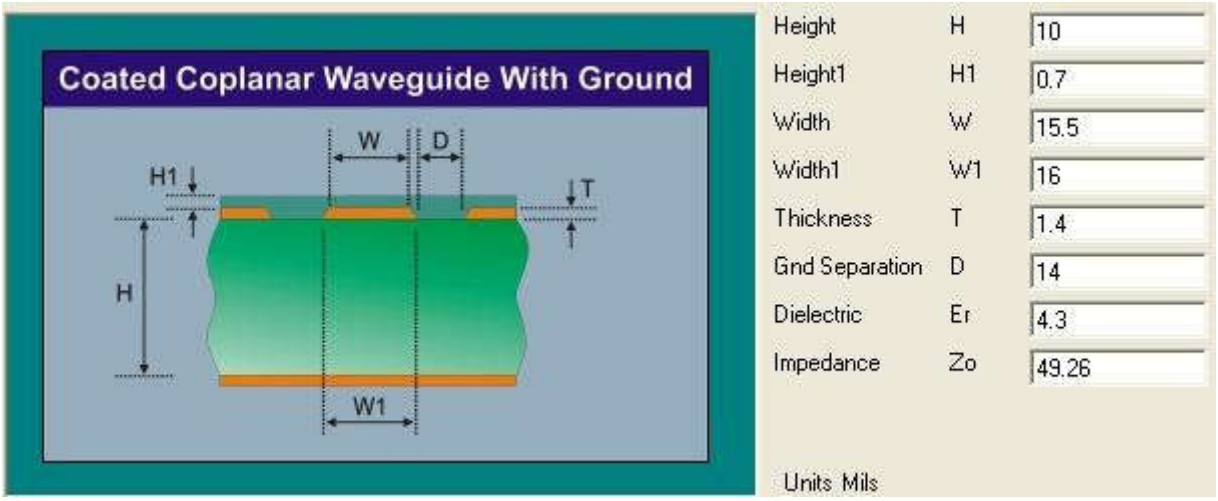

Figure 7-7. Trace Design for the PCB Layout

Figure 7-8 shows layer 1 with the trace to the antenna over ground layer 2.

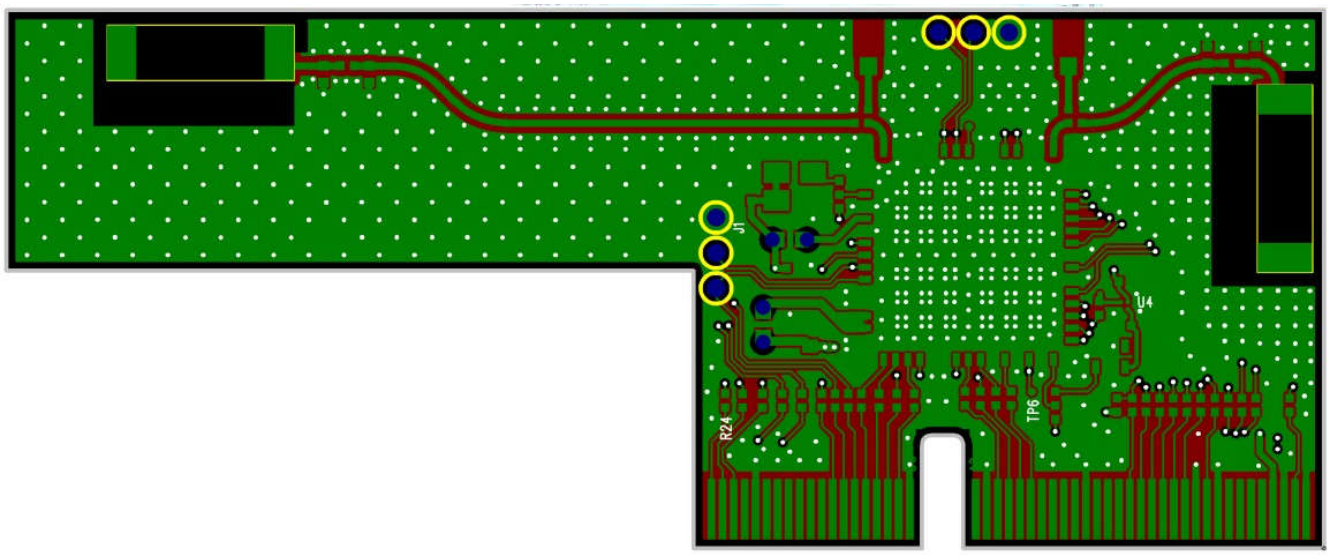

Figure 7-8. Layer 1 Combined With Layer 2

Figure 7-9 and Figure 7-10 show instances of good layout practices for the antenna and RF trace routing.

Note

RF traces must be as short as possible. The antenna, RF traces, and modules must be on the edge of the PCB product. The proximity of the antenna to the enclosure and the enclosure material must also be considered.

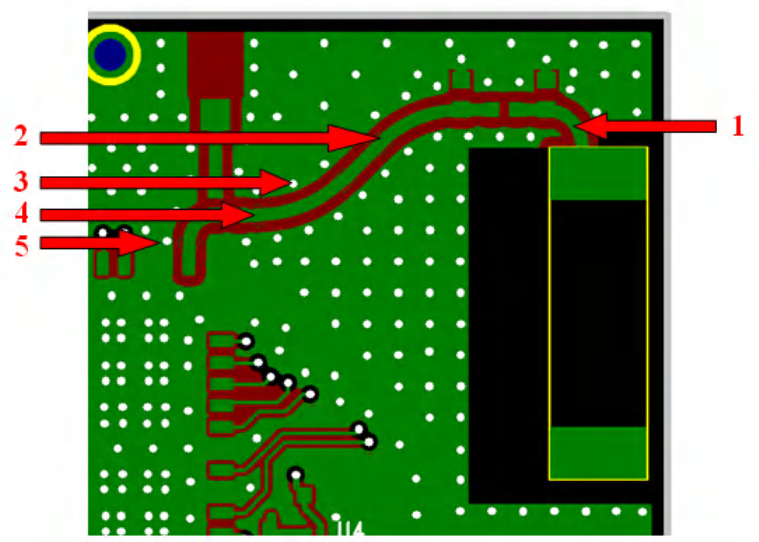

Figure 7-9. Top Layer – Antenna and RF Trace Routing Layout Guidelines

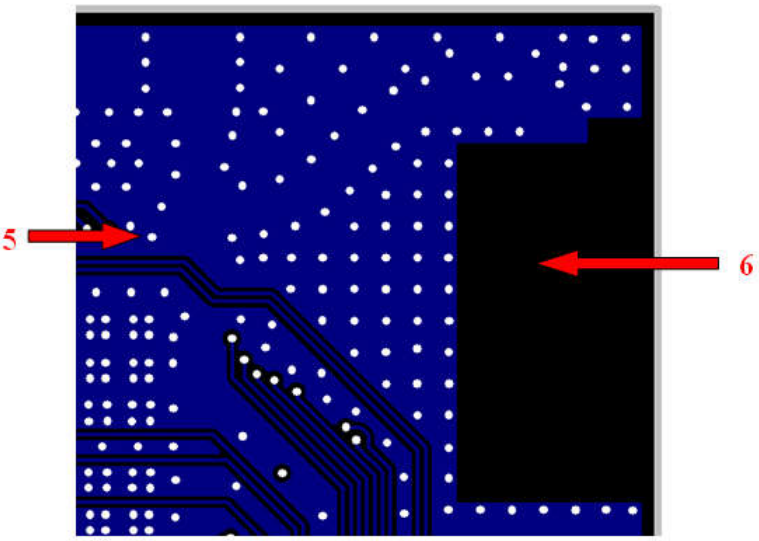

Figure 7-10. Bottom Layer – Antenna and RF Trace Routing Layout Guidelines

Table 7-2 describes the guidelines corresponding to the reference numbers in Figure 7-9 and Figure 7-10.

Table 7-2. Antenna and RF Trace Routing Layout Guidelines

Reference	Guideline Description
1	The RF trace antenna feed must be as short as possible beyond the ground reference. At this point, the trace starts to radiate.
2	RF trace bends must be gradual with an approximate maximum bend of 45 degrees with trace mitered. RF traces must not have sharp corners.
3	RF traces must have via stitching on the ground plane beside the RF trace on both sides.
4	RF traces must have constant impedance (microstrip transmission line).
5	For best results, the RF trace ground layer must be the ground layer immediately below the RF trace. The ground layer must be solid.
6	There must be no traces or ground under the antenna section.

Figure 7-11 shows the MIMO antenna spacing. The distance between ANT1 and ANT2 must be greater than half the wavelength (62.5 mm at 2.4 GHz).

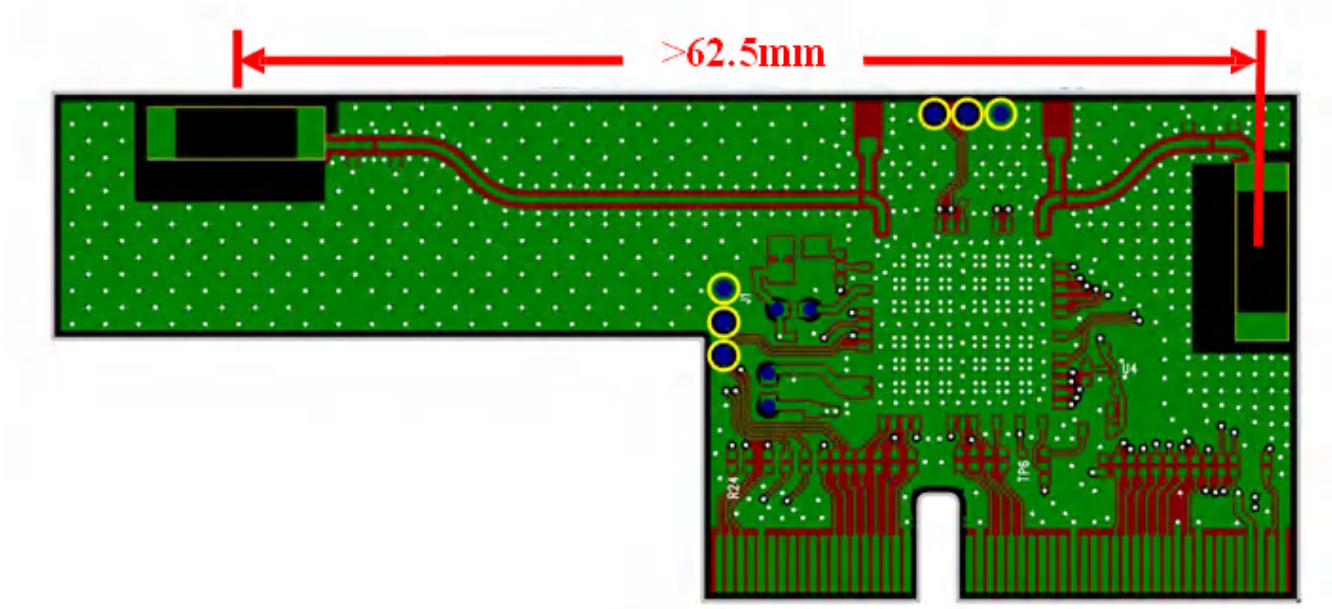

Figure 7-11. MIMO Antenna Spacing

Follow these supply routing guidelines:

- For power supply routing, the power trace for V_{BAT} must be at least 40-mil wide.
- The 1.8-V trace must be at least 18-mil wide.
- Make V_{BAT} traces as wide as possible to make sure that reduced inductance and trace resistance.
- If possible, then shield V_{BAT} traces with ground above, below, and beside the traces.

Follow these digital-signal routing guidelines:

- Route SDIO signal traces (CLK, CMD, D0, D1, D2, and D3) in parallel to each other and as short as possible (less than 12 cm). In addition, each trace must be the same length. Make sure there is enough space between traces (greater than 1.5 times the trace width or ground) to verify signal quality, especially for the SDIO_CLK trace. Remember to keep these traces away from the other digital or analog signal traces. TI recommends adding ground shielding around these buses.
- Digital clock signals (SDIO clock, PCM clock, and so on) are a source of noise. Keep the traces of these signals as short as possible. Whenever possible, maintain a clearance around these signals.

8 Ordering Information

Part number:	WL1837MODCOM8I

9 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision D (February 2022) to Revision E (November 2023)	Page
• Added NCC Statement to *Warning* section	2

Changes from Revision C (December 2021) to Revision D (February 2022)	Page
• Updated Section 4	8

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

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.

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

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

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.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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2. 実験局の免許を取得後ご使用いただく。
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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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