

TEST REPORT

CERTIFICATE OF CONFORMITY

Standard: 47 CFR FCC Part 15, Subpart C (Section 15.247)
Report No.: RFBENL-WTW-P24060709A-3
FCC ID: RYK-290BEBT
Product: WiFi 7/BT module
Brand: Sparklan
Model No.: WNSQ-293BE(BT)
Series Model: WNFQ-290BE(BT), WNSQ-290BE(BT), WNFQ-293BE(BT)
Received Date: 2025/5/14
Test Date: 2025/6/9 ~ 2025/12/1
Issued Date: 2025/12/17

Applicant: SparkLAN Communications, Inc.

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
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FCC Registration / 723255 / TW2022

Designation Number:

Approved by: _____, **Date:** 2025/12/17
May Chen / Manager

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Prepared by : Phoenix Huang / Specialist

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Release Control Record

Issue No.	Description	Date Issued
RFBENL-WTW-P24060709A-3	Original release.	2025/12/17

1 Certificate

Product: WiFi 7/BT module

Brand: Sparklan

Test Model: WNSQ-293BE(BT)

Series Model: WNFQ-290BE(BT), WNSQ-290BE(BT), WNFQ-293BE(BT)

Sample Status: Engineering sample

Applicant: SparkLAN Communications, Inc.

Test Date: 2025/6/9 ~ 2025/12/1

Standard: 47 CFR FCC Part 15, Subpart C (Section 15.247)

Measurement ANSI C63.10-2020

procedure:

KDB 558074 D01 15.247 Meas Guidance v05r02

KDB 662911 D01 Multiple Transmitter Output v02r01

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
Standard / Clause	Test Item	Result	Remark
15.247(b)	RF Output Power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	N/A	Refer to Note 1 below
15.247(a)(2)	6 dB Bandwidth	N/A	Refer to Note 1 below
15.247(d)	Conducted Out of Band Emissions	N/A	Refer to Note 1 below
15.207	AC Power Conducted Emissions	Pass	Minimum passing margin is -13.72 dB at 0.20469 MHz
15.205 / 15.209 / 15.247(d)	Unwanted Emissions below 1 GHz	Pass	Minimum passing margin is -2.4 dB at 199.53 MHz
15.205 / 15.209 / 15.247(d)	Unwanted Emissions above 1 GHz	Pass	Minimum passing margin is -0.26 dB at 2483.52 MHz
15.203	Antenna Requirement	Pass	Antenna connector is MHF 4L, I-PEX MHF4, RP-SMA (M), MHF4L to SMA-F not a standard connector.

Note:

- Only RF Output Power, AC Power Conducted Emissions and Unwanted Emissions test items were performed for this addendum. The others testing data refer to original test report (Report No.: RFBWIN-WTW-P23020421-3).
- Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Specification	Expanded Uncertainty (k=2) (±)
RF Output Power	-	1.1 dB
AC Power Conducted Emissions	150 kHz ~ 30 MHz	1.9 dB
Unwanted Emissions below 1 GHz	9 kHz ~ 30 MHz	3.1 dB
	30 MHz ~ 1 GHz	5.5 dB
Unwanted Emissions above 1 GHz	1 GHz ~ 18 GHz	5.1 dB
	18 GHz ~ 40 GHz	5.3 dB

The other instruments specified are routine verified to remain within the calibrated levels, no measurement uncertainty is required to be calculated.

2.2 Supplementary Information

There is not any deviation from the test standards for the test method, and no modifications required for compliance.

3 General Information

3.1 General Description

Product	WiFi 7/BT module
Brand	Sparklan
Test Model	WNSQ-293BE(BT)
Series Model	WNFQ-290BE(BT), WNSQ-290BE(BT), WNFQ-293BE(BT)
Status of EUT	Engineering sample
Power Supply Rating	3.3 Vdc from host equipment
Modulation Type	GFSK
Modulation Technology	DTS
Transfer Rate	Up to 2 Mbps
Operating Frequency	2.402 GHz ~ 2.48 GHz
Number of Channel	40
Output Power	24.604 mW (13.91 dBm)

Note:

- This report is prepared for FCC class II permissive change. The difference compared with the original design is as the following: (QCA Report No.: RFBWIN-WTW-P23020421-3)
 - ◆ Add Dipole antenna & Chip antenna. (Refer to section 3.2)
 - ◆ Add variant chip QCC2073 (based on WCN7851) for WNSQ-290BE(BT) and WNFQ-290BE(BT).
 - ◆ Add models WNFQ-293BE(BT) and WNSQ-293BE(BT) with variant chip QCC2076.
 - ◆ The variant chip models QCC2073 and QCC2076 are pin-to-pin compatible and have identical designs to the original chip WCN7851, and program change to disable the WiFi-7 320 MHz bandwidth.
 - ◆ Upgraded ANSI C63.10 standard version.
- According to above conditions, there are RF Output Power, AC Power Conducted Emissions and Unwanted Emissions test items need to be performed. All data for meeting the requirement is verified.
- All models are listed as below.

Brand	Model	Chip model	Variant Chip model	Remark
Sparklan	WNSQ-290BE(BT)	WCN7851	QCC2073	Add variant chip QCC2073 is pin to pin and identical design and disable WiFi-7 bandwidth 320 MHz, DBS/SBS
Sparklan	WNFQ-290BE(BT)	WCN7851	QCC2073	Add variant chip QCC2073 is pin to pin and identical design and disable WiFi-7 bandwidth 320 MHz, DBS/SBS M.2 1620 w/ EVB
Sparklan	WNSQ-293BE(BT)	QCC2076	NA	Newly model, with variant chip QCC2076 is pin to pin and identical design and disable WiFi-7 bandwidth 320 MHz
Sparklan	WNFQ-293BE(BT)	QCC2076	NA	Newly model, with variant chip QCC2076 is pin to pin and identical design and disable WiFi-7 bandwidth 320 MHz M.2 1620 w/ EVB

From the above models, model: WNSQ-293BE(BT) was selected as representative model for the test and its data was recorded in this report.

4. There are Bluetooth (EDR, BLE, QHS) and WLAN (2.4 GHz & 5 GHz & 5.9 GHz & 6 GHz) technology used for the EUT.

5. Simultaneously transmission combination.

Combination	Technology	
1	WLAN(2.4 GHz)_Ant 0+1	WLAN(5 GHz)_Ant 0+1
2	WLAN(2.4 GHz)_Ant 0+1	WLAN(6 GHz)_Ant 0+1
3	WLAN(5 GHz)_Ant 0+1	Bluetooth_Ant 0
4	WLAN(5 GHz)_Ant 0+1	Bluetooth_Ant 1
5	WLAN(5 GHz)_Ant 0+1	Bluetooth_Ant 0+1
6	WLAN(6 GHz)_Ant 0+1	Bluetooth_Ant 0
7	WLAN(6 GHz)_Ant 0+1	Bluetooth_Ant 1
8	WLAN(6 GHz)_Ant 0+1	Bluetooth_Ant 0+1
9	WLAN(2.4 GHz)_Ant 0	Bluetooth_Ant 1
10	WLAN(2.4 GHz)_Ant 1	Bluetooth_Ant 0

Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.

6. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

3.2 Antenna Description of EUT

1. The antenna information is listed as below.

2. The antenna information is listed as below.

Original									
Antenna Set	RF Chain No.	Brand	Model	Antenna Net Gain (dBi)	Frequency Range (GHz)	Cable Loss (dB)	Antenna Type	Connector Type	Cable Length (mm)
1	Chain0/1	Hong-Bo	260-25094	3.53	2.4~2.4835	0.74	PIFA	MHF 4L	300
				3.06	5.15~5.25	1.16			
				3.07	5.25~5.35	1.18			
				4.81	5.47~5.725	1.26			
				4.2	5.725~5.850	1.28			
2	Chain0/1	Hong-Bo	260-25083	5.09	5.850~5.895	1.29	PIFA	MHF 4L	300
				5.14	5.925~6.425	1.35			
				5.09	6.425~6.525	1.38			
				5.16	6.525~6.875	1.45			
				5.12	6.875~7.125	1.50			
3	Chain0/1	Hong-Bo	260-25084	3.22	2.4~2.4835	0.49	Monopole	MHF 4L	200
				3.35	5.150~5.250	0.76			
				3.42	5.250~5.350	0.77			
				4.77	5.470~5.725	0.80			
				4.72	5.725~5.850	0.84			
				4.71	5.850~5.895	0.84			
				4.75	5.925~6.425	0.86			
				4.29	6.425~6.525	0.91			
				4.81	6.525~6.875	0.96			
				4.74	6.875~7.125	0.98			
Newly									
Antenna Set	RF Chain No.	Brand	Model	Antenna Net Gain (dBi)	Frequency Range (GHz)	Antenna Type	Connector Type	Cable Length (mm)	
4	Chain0/1	SparkLAN	AD-513AX	3.11	2.4~2.4835	Dipole	I-PEX MHF4	150	
				4.46	5.150~5.850				
				4.07	5.850~5.895				
				4.53	5.925~6.425				
				4.06	6.425~6.525				
				4.04	6.525~6.875				
				3.97	6.875~7.125				
5	Chain0/1	SparkLAN	AD-510AX	2.27	2.4~2.4835	Dipole	RP-SMA (M)	150	
				2.88	5.150~5.850				
				2.6	5.850~5.895				
				3.23	5.925~6.425				
				3.34	6.425~6.525				
				3.52	6.525~6.875				
				3.52	6.875~7.125				
6	Chain0/1	SparkLAN	AD-512AX	2.35	2.4~2.4835	Dipole	RP-SMA (M)	150	
				3.00	5.150~5.850				
				2.80	5.850~5.895				
				2.87	5.925~6.425				
				3.02	6.425~6.525				
				3.02	6.525~6.875				
				2.61	6.875~7.125				
7	Chain0/1	SparkLAN	AD-516AX	1.65	2.4~2.4835	Dipole	I-PEX MHF4	250	
				4.3	5.150~5.850				
				3.98	5.850~5.895				
				4	5.925~6.425				
				4	6.425~6.525				
				3.91	6.525~6.875				
				3.78	6.875~7.125				
8	Chain0/1	Johanson	2450AD18A6050	2	2.4~2.4835	Chip	MHF4L to SMA-F	250	
				1.5	5.150~5.850				
				2.7	5.850~5.895				
				2.7	5.925~6.425				
				2.7	6.425~6.525				
				2.7	6.525~6.875				
				2.7	6.875~7.125				
Note: Bluetooth has diversity function and transmit chain 0 and chain 1 have been evaluated, the chain 0 will be used as representative test.									

* Detail antenna specification please refer to antenna datasheet and/or antenna measurement report.

3.3 Channel List

40 channels are provided for BT-LE:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

3.4 Test Mode Applicability and Tested Channel Detail

Pre-Scan:	Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.
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Following channel(s) was (were) selected for the final test as listed below:

Test Item	EUT Configure Mode	Mode	Tested Channel	Tx Antenna	Modulation	Data Rate Parameter
RF Output Power	-	BT-LE 1M	0, 19, 39	1Tx / 2Tx	GFSK	1Mb/s
		BT-LE 2M	0, 19, 39		GFSK	2Mb/s
AC Power Conducted Emissions	C	BT-LE 1M	19	1Tx	GFSK	1Mb/s
Unwanted Emissions below 1 GHz	A, B	BT-LE 1M	19	1Tx	GFSK	1Mb/s
Unwanted Emissions above 1 GHz	A, B	BT-LE 2M	19, 39	1Tx / 2Tx	GFSK	2Mb/s
EUT Configure Mode:	A	EUT only (remove 50 ohm terminator and Connect to the appropriate equipment)				
	B	EUT with 50 ohm terminator				
	C	EUT with antenna (Model: 260-25094)				

Note:

1. For unwanted emission test items, the tested channel was chosen the worst case as mode represent to report.
2. For 1Tx diversity configuration the worst chain is: Chain 0

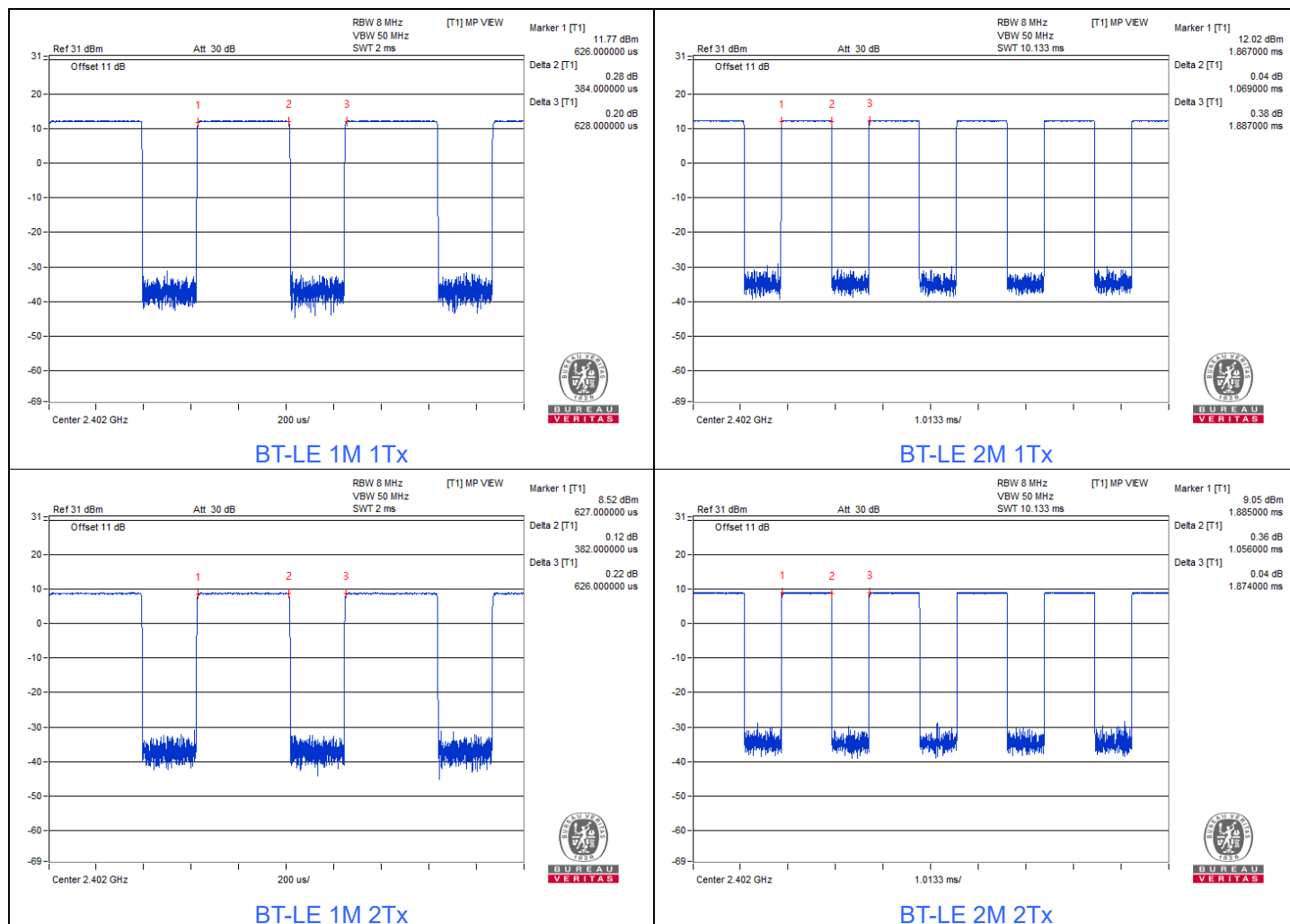
3.5 Duty Cycle of Test Signal

BT-LE 1M 1Tx: Duty cycle = $0.384 \text{ ms} / 0.628 \text{ ms} \times 100\% = 61.1\%$, duty factor = $10 * \log (1/\text{Duty cycle}) = 2.14 \text{ dB}$

BT-LE 2M 1Tx: Duty cycle = $1.069 \text{ ms} / 1.887 \text{ ms} \times 100\% = 56.7\%$, duty factor = $10 * \log (1/\text{Duty cycle}) = 2.47 \text{ dB}$

BT-LE 1M 2Tx: Duty cycle = $0.382 \text{ ms} / 0.626 \text{ ms} \times 100\% = 61.0\%$, duty factor = $10 * \log (1/\text{Duty cycle}) = 2.15 \text{ dB}$

BT-LE 2M 2Tx: Duty cycle = $1.056 \text{ ms} / 1.874 \text{ ms} \times 100\% = 56.4\%$, duty factor = $10 * \log (1/\text{Duty cycle}) = 2.49 \text{ dB}$

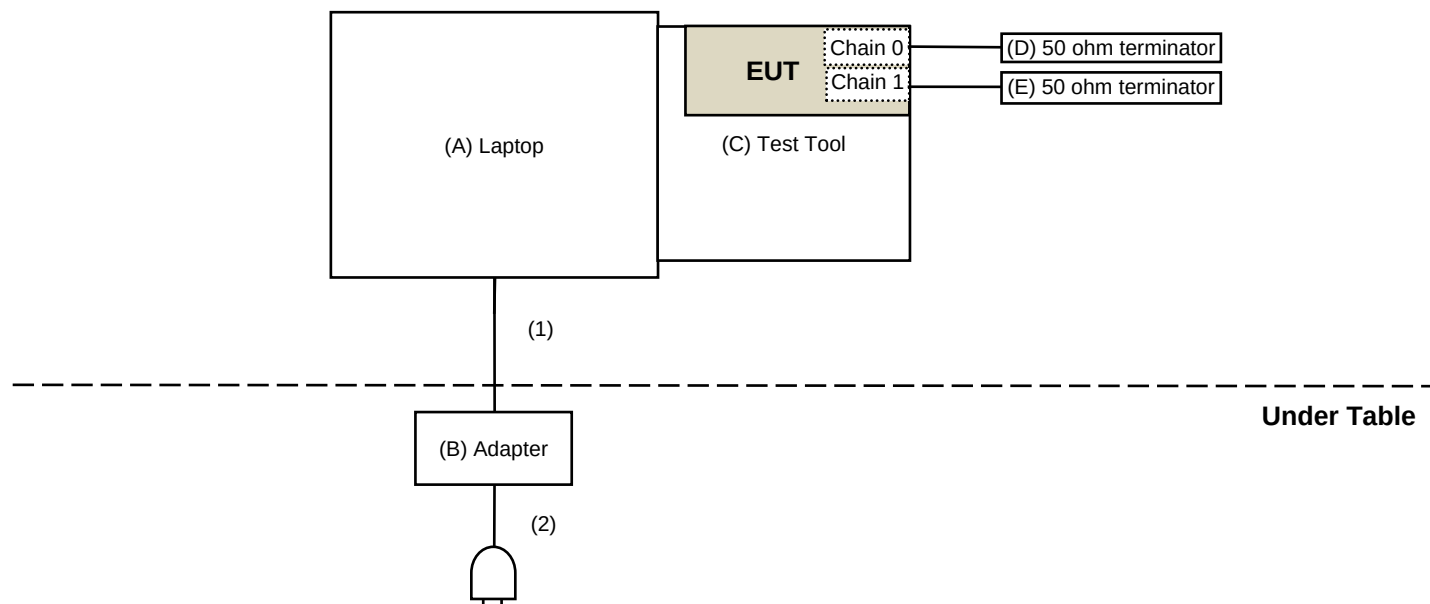


3.6 Test Program Used and Operation Descriptions

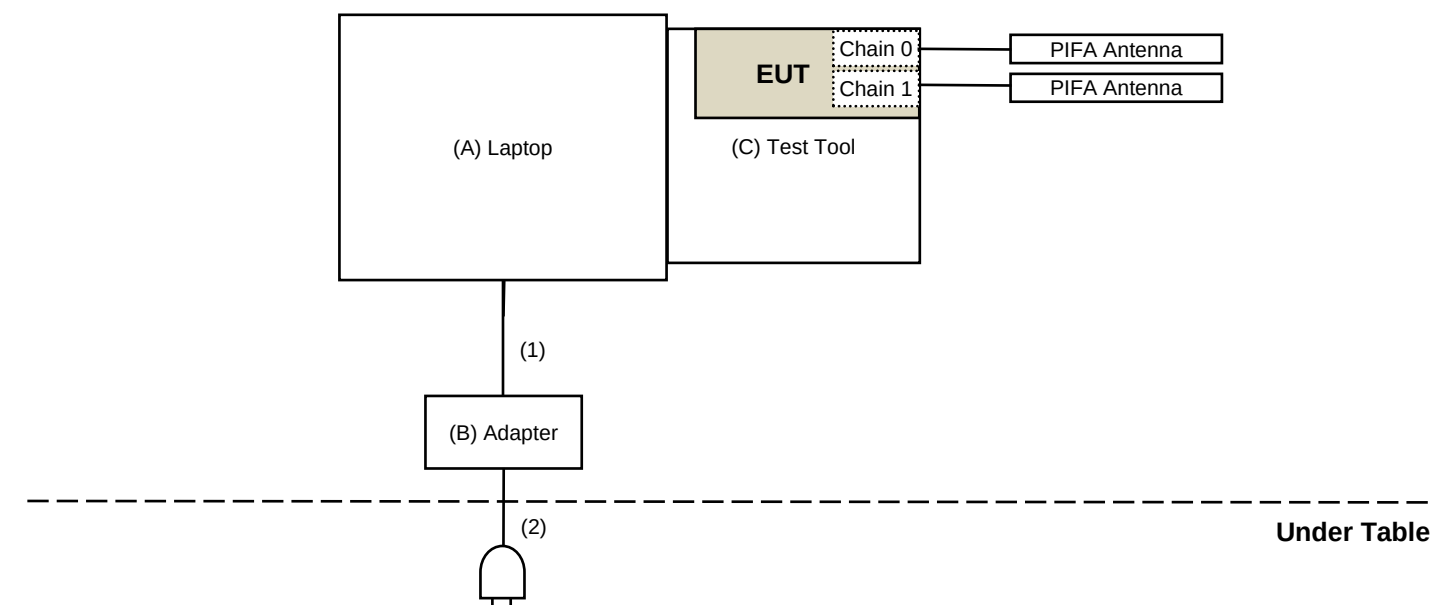
Controlling software (Bluetooth and ANT QRCT Module V4.0.00033.1) has been activated to set the EUT under transmission condition continuously at specific channel frequency.

3.7 Connection Diagram of EUT and Peripheral Devices

For Unwanted Emission test:



For AC Power Conducted Emission test:



3.8 Configuration of Peripheral Devices and Cable Connections

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	Laptop	DELL	E6430	J29SNX1	N/A	Provided by Lab
B	Adapter	DELL	MA65NM130	N/A	N/A	Provided by Lab
C	Test Tool	Qualcomm	N/A	N/A	N/A	Supplied by applicant
D	50 Ohm terminator	WOKEN	WTER-18S2	N/A	N/A	Provided by Lab
E	50 Ohm terminator	WOKEN	WTER-18S2	N/A	N/A	Provided by Lab

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	DC Cable	1	1.8	No	0	Provided by Lab
2	AC Cable	1	1	No	0	Provided by Lab

4 Test Instruments

The calibration interval of the all test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.1 RF Output Power

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Fixed Attenuator Woken	00800A1K01A-20	00800A1K01A-20-02	2025/5/23	2026/5/22
Pulse Power Sensor Anritsu	MA2411B	1726434	2025/6/3	2026/6/2
RF Power Meter Anritsu	ML2495A	1529002	2025/6/3	2026/6/2

Notes:

1. The test was performed in Oven room 2.
2. Tested Date: 2025/8/4

4.2 AC Power Conducted Emissions

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
50 ohm terminal resistance Telegartner	50 ohm	3	2024/11/1	2025/10/31
EMI Test Receiver R&S	ESCS 30	100375	2025/5/21	2026/5/20
Fixed Attenuator STI	STI02-2200-10	005	2025/2/17	2026/2/16
LISN R&S	ESH3-Z5	835239/001	2025/3/27	2026/3/26
		848773/004	2024/10/7	2025/10/6
RF Coaxial Cable JYEBAO	5D-FB	COCCAB-001	2025/2/17	2026/2/16
Software BVADT	BVADT_Cond_V7.3.7.4	N/A	N/A	N/A

Notes:

1. The test was performed in Conduction 1
2. Tested Date: 2025/6/9

4.3 Unwanted Emissions below 1 GHz

Mode A

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Fixed Attenuator Woken	00800A1K01A-10	00800A1K01A-10-01	2025/5/23	2026/5/22
PXA Signal Analyzer Keysight	N9030A	MY55330160	2025/1/16	2026/1/15
Software	ADT_RF Test Software V8	N/A	N/A	N/A

Notes:

1. The test was performed in Oven room 2.
2. Tested Date: 2025/8/18

Mode B

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Bi_Log Antenna Schwarzbeck	VULB 9168	9168-406	2024/10/8	2025/10/7
Boresight Antenna Tower & Turn Table Max-Full	MF-7802BS	MF780208530	N/A	N/A
Fixed Attenuator Mini-Circuits	UNAT-5+	PAD-ATT5-03	2025/2/15	2026/2/14
Loop Antenna TESEQ	HLA 6121	63620	2024/10/17	2025/10/16
MXE EMI Receiver Agilent	N9038A	MY51210202	2024/7/29	2025/7/28
Preamplifier EMCI	EMC330N	980701	2025/2/15	2026/2/14
	EMC001340	980142	2025/2/17	2026/2/16
RF Coaxial Cable mTJ	100100-CFD400LW-200	CFD400-200	2025/2/15	2026/2/14
	100100-CFD400LW-400	CFD400-400	2025/2/15	2026/2/14
	100100-CFD400LW-800	CFD400-800	2025/2/15	2026/2/14
Software	ADT_Radiated_V8.7.08	N/A	N/A	N/A

Notes:

1. The test was performed in 966 Chamber No. 4.
2. Tested Date: 2025/6/9

4.4 Unwanted Emissions above 1 GHz

Mode A

Refer to section 4.3 Mode A to get the tested date and information of the instruments.

Mode B

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Boresight Antenna Tower & Turn Table Max-Full	MF-7802BS	MF780208530	N/A	N/A
Horn Antenna Schwarzbeck	BBHA 9120D	9120D-783	2024/11/10 2025/11/9	2025/11/9 2026/11/8
	BBHA 9170	9170-739	2024/11/10 2025/11/9	2025/11/9 2026/11/8
MXA Signal Analyzer Keysight	N9020B	MY60112410	2025/3/17	2026/3/16
Preamplifier EMCI	EMC12630SE	980688	2025/8/7	2026/8/6
	EMC184045SE	980387	2025/8/7	2026/8/6
RF Coaxial Cable EMCI	EMC102-KM-KM-1200	160924	2025/1/24	2026/1/23
	EMC102-KM-KM-4000	200214	2025/1/24	2026/1/23
	EMC104-SM-SM-1200	160922	2025/1/14	2026/1/13
	EMC104-SM-SM-2000	180502	2025/1/14	2026/1/13
	EMC104-SM-SM-6000	210704	2024/10/30 2025/10/22	2025/10/29 2026/10/21
Software	ADT_Radiated_V8.7.08	N/A	N/A	N/A

Notes:

1. The test was performed in 966 Chamber No. 4.
2. Tested Date: 2025/8/22 ~ 2025/12/1

5 Limits of Test Items

5.1 RF Output Power

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30 dBm)

Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT} ;

Array Gain = $5 \log(N_{ANT}/N_{SS})$ dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.

For power measurements on all other devices: Array Gain = $10 \log(N_{ANT}/N_{SS})$ dB.

5.2 AC Power Conducted Emissions

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Notes:

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

5.3 Unwanted Emissions below 1 GHz

Radiated emissions up to 1 GHz which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = $20 \log$ Emission level (uV/m).

5.4 Unwanted Emissions above 1 GHz

Radiated emissions above 1 GHz which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
Above 960	500	3

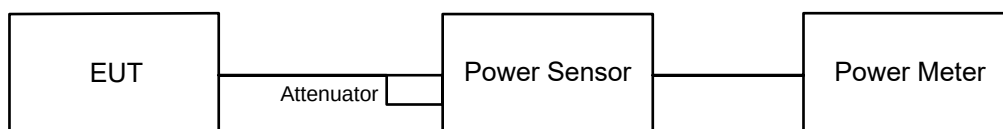
Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

6 Test Arrangements

6.1 RF Output Power

6.1.1 Test Setup



6.1.2 Test Procedure

Peak Power:

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

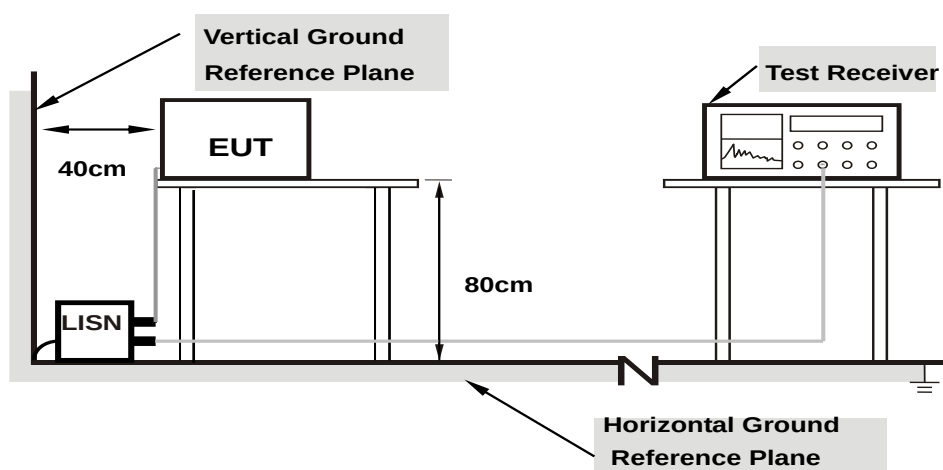
The power meter video bandwidth is greater than or equal to the DTS bandwidth and use a fast responding diode detector

Average Power:

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

6.2 AC Power Conducted Emissions

6.2.1 Test Setup



Note: 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

6.2.2 Test Procedure

- Exploratory ac power-line conducted emission measurements: The EUT shall be operated on the mid channel and in the mode with highest output power unless the fundamental operates in the AC power-line emission test range then the EUT shall be operated in the range of typical modes of operation.
- The EUT was placed on a 0.8 meter to the top of table and placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50 uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

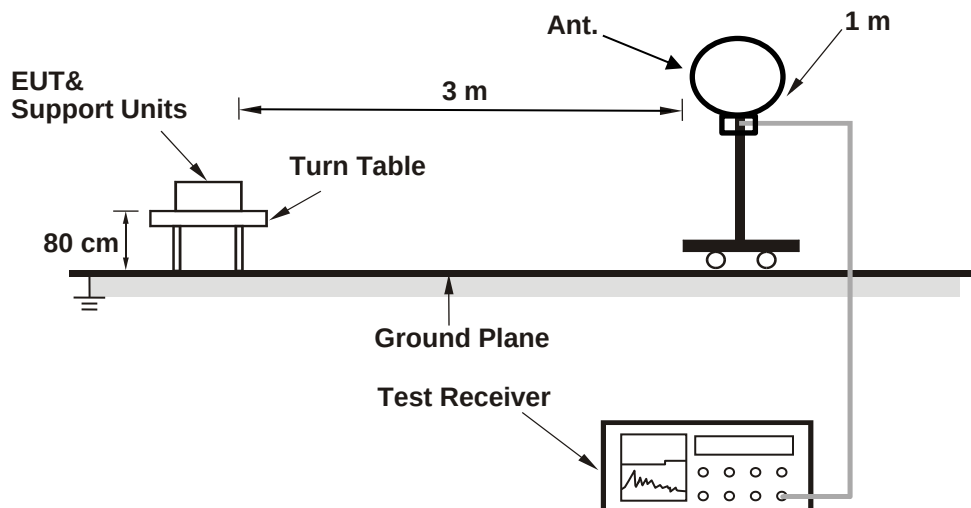
Note: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz-30 MHz.

6.3 Unwanted Emissions below 1 GHz

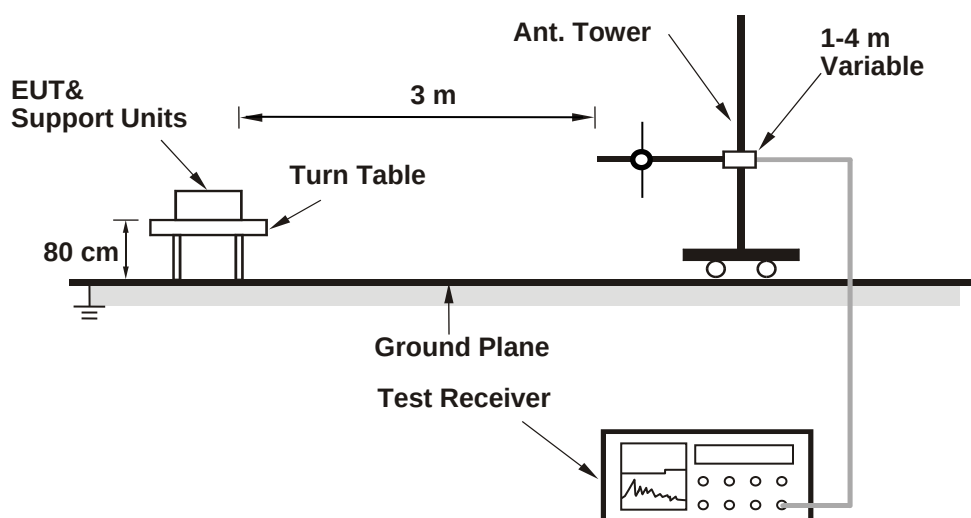
6.3.1 Test Setup

For Radiated Configuration:

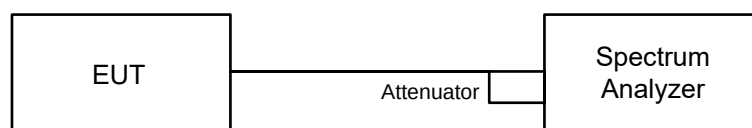
For Radiated emission below 30 MHz



For Radiated emission above 30 MHz



For Conducted Configuration:



For the actual test configuration, please refer to the attached file (Test Setup Photo).

6.3.2 Test Procedure

Radiated versus Conducted Measurement.

The unwanted emission limits in both the restricted and non-restricted bands are based on antenna-port conducted measurements in conjunction with cabinet emissions tests are permitted to demonstrate compliance.

The following steps was performed:

- a. Cabinet emissions measurements. Radiated measurement was performed to ensure that cabinet emissions are below the emission limits. For the cabinet-emission measurements the antenna was replaced by a termination matching the nominal impedance of the antenna.
- b. Conducted tests was performed using equipment that matches the nominal impedance of the antenna assembly used with the EUT.
- c. EIRP calculation. A value representative of an upper bound on out-of-band antenna gain (in dBi) shall be added to the measured antenna-port conducted emission power to compute EIRP within the specified measurement bandwidth. (For emissions in the restricted bands, additional calculations are required to convert EIRP to field strength at the specified distance.) The upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands or 2 dBi, whichever is greater.
- d. EIRP adjustments for multiple outputs. (Follow the procedures specified in FCC KDB Publication 662911)
- e. For all of Radiation emission test

For Radiated emission below 30 MHz

- e-1.1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- e-1.2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- e-1.3. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- e-1.4. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e-1.5. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode, except for the frequency band (9 kHz to 90 kHz and 110 kHz to 490 kHz) set to average detect function and peak detect function.

Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 200 Hz at frequency below 150 kHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz or 10 kHz at frequency (150 kHz to 30 MHz).
3. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated emission above 30 MHz

- e-2.1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- e-2.2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- e-2.3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e-2.4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e-2.5. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

Radiated versus Conducted Measurement

For Radiated measurement:

The level of unwanted emissions was measured when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation).

For Conducted measurement:

The level of unwanted emissions was measured as their power in a specified load (conducted spurious emissions).

Conducted Unwanted Emission Convert Formula

- a. $\text{Emission Level (dBuV/m)} = \text{EIRP Level (dBm)} - 20\log(d) + 104.8$
 d = measurement distance in 3 meters.
- b. $\text{EIRP Level (dBm)} = \text{Raw Value(dBm)} + \text{Correction Factor(dB)}$
- c. Correction Factor is directional gain, and the composite gain will be used when signal support the correlated signal.
 For the out of band spurious the gain for the specific band may have been used rather than the highest gain across all bands.
 For the band edge the gain for the specific band may have been used.

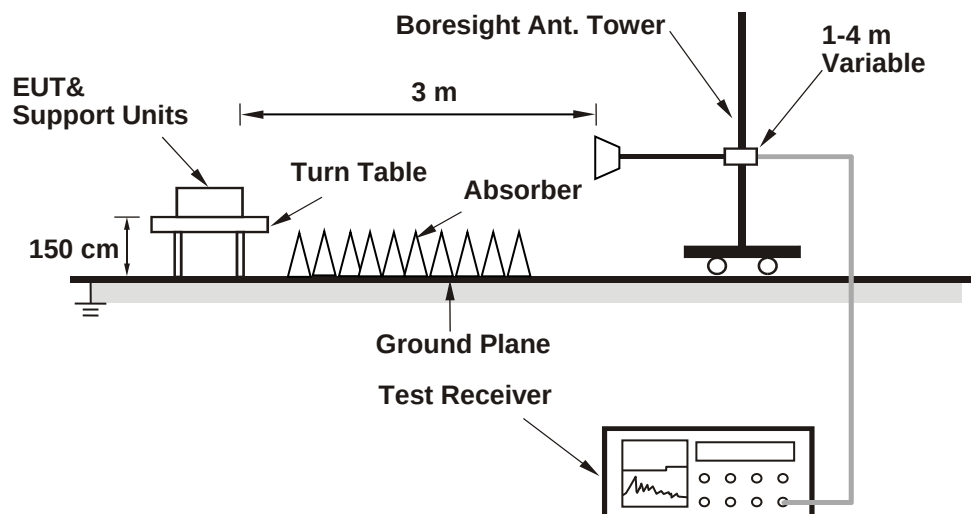
Notes:

1. In restricted bands below 1000 MHz, add upper bound on ground plane reflection:
 For frequencies between 30 MHz and 1000 MHz, add 4.7 dB.
2. The conducted emission test was considered some factor to compute test result.

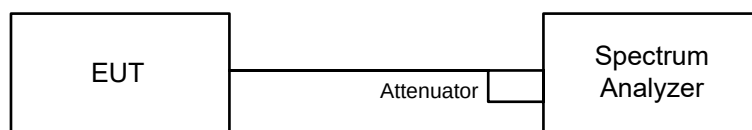
6.4 Unwanted Emissions above 1 GHz

6.4.1 Test Setup

For Radiated Configuration:



For Conducted Configuration:



For the actual test configuration, please refer to the attached file (Test Setup Photo).

6.4.2 Test Procedure

Radiated versus Conducted Measurement.

The unwanted emission limits in both the restricted and non-restricted bands are based on antenna-port conducted measurements in conjunction with cabinet emissions tests are permitted to demonstrate compliance.

The following steps was performed:

- Cabinet emissions measurements. Radiated measurement was performed to ensure that cabinet emissions are below the emission limits. For the cabinet-emission measurements the antenna was replaced by a termination matching the nominal impedance of the antenna.
- Conducted tests was performed using equipment that matches the nominal impedance of the antenna assembly used with the EUT.
- EIRP calculation. A value representative of an upper bound on out-of-band antenna gain (in dBi) shall be added to the measured antenna-port conducted emission power to compute EIRP within the specified measurement bandwidth. (For emissions in the restricted bands, additional calculations are required to convert EIRP to field strength at the specified distance.) The upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands or 2 dBi, whichever is greater.
- EIRP adjustments for multiple outputs. (Follow the procedures specified in FCC KDB Publication 662911)
- For all of Radiation emission test
 - The EUT was placed on the top of a rotating table 1.5 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
 - The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

- e-3. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e-4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e-5. The test-receiver/spectrum analyzer was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Notes:

1. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) and Average detection (AV) at frequency above 1 GHz.
2. For fundamental and harmonic signal measurement, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10 Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1 GHz.
3. All modes of operation were investigated and the worst-case emissions are reported.

Radiated versus Conducted Measurement
<u>For Radiated measurement:</u> The level of unwanted emissions was measured when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation). <u>For Conducted measurement:</u> The level of unwanted emissions was measured as their power in a specified load (conducted spurious emissions). <u>For Verified radiated measurement:</u> The level of unwanted emissions was measured when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation).
Conducted Unwanted Emission Convert Formula
a. Emission Level (dBuV/m) = EIRP Level (dBm) – 20log(d) + 104.8 d = measurement distance in 3 meters. b. EIRP Level (dBm) = Raw Value(dBm) + Correction Factor(dB). c. Correction Factor is directional gain, and the composite gain will be used when signal support the correlated signal. For the out of band spurious the gain for the specific band may have been used rather than the highest gain across all bands. For the band edge the gain for the specific band may have been used. Note: The conducted emission test was considered some factor to compute test result.

7 Test Results of Test Item

7.1 RF Output Power

Input Power:	3.3 Vdc	Environmental Conditions:	25°C, 60% RH	Tested By:	Kevin Ko
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For Peak Power

BT-LE 1M 1Tx

Chan.	Chan. Freq. (MHz)	Peak Power (mW)	Peak Power (dBm)	Power Limit (dBm)	Test Result
0	2402	22.961	13.61	30	Pass
19	2440	24.378	13.87	30	Pass
39	2480	19.724	12.95	30	Pass

Note: The antenna gain is 3.53 dBi $\leq$ 6 dBi, so the output power limit shall not be reduced.

BT-LE 2M 1Tx

Chan.	Chan. Freq. (MHz)	Peak Power (mW)	Peak Power (dBm)	Power Limit (dBm)	Test Result
0	2402	23.335	13.68	30	Pass
19	2440	24.604	13.91	30	Pass
39	2480	20.417	13.10	30	Pass

Note: The antenna gain is 3.53 dBi $\leq$ 6 dBi, so the output power limit shall not be reduced.

BT-LE 1M 2Tx

Chan.	Chan. Freq. (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Test Result
		Chain 0	Chain 1				
0	2402	9.44	9.34	17.38	12.40	29.46	Pass
19	2440	9.58	10.10	19.311	12.86	29.46	Pass
39	2480	8.94	8.78	15.385	11.87	29.46	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 6.54 dBi $>$ 6 dBi, so the output power limit shall be reduced to $30 - (6.54 - 6) = 29.46$ dBm.

BT-LE 2M 2Tx

Chan.	Chan. Freq. (MHz)	Peak Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Test Result
		Chain 0	Chain 1				
0	2402	9.59	9.47	17.95	12.54	29.46	Pass
19	2440	9.59	10.07	19.262	12.85	29.46	Pass
39	2480	9.03	8.85	15.672	11.95	29.46	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 6.54 dBi $>$ 6 dBi, so the output power limit shall be reduced to $30 - (6.54 - 6) = 29.46$ dBm.

For Average Power

BT-LE 1M 1Tx

Chan.	Chan. Freq. (MHz)	Average Power (mW)	Average Power (dBm)
0	2402	21.979	13.42
19	2440	23.768	13.76
39	2480	19.011	12.79

BT-LE 2M 1Tx

Chan.	Chan. Freq. (MHz)	Average Power (mW)	Average Power (dBm)
0	2402	22.029	13.43
19	2440	23.496	13.71
39	2480	19.454	12.89

BT-LE 1M 2Tx

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Average Power (mW)	Total Average Power (dBm)
		Chain 0	Chain 1		
0	2402	9.21	9.04	16.354	12.14
19	2440	9.35	9.80	18.16	12.59
39	2480	8.81	8.60	14.848	11.72

BT-LE 2M 2Tx

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Average Power (mW)	Total Average Power (dBm)
		Chain 0	Chain 1		
0	2402	9.35	9.12	16.776	12.25
19	2440	9.36	9.78	18.136	12.59
39	2480	8.86	8.64	15.003	11.76

7.2 AC Power Conducted Emissions

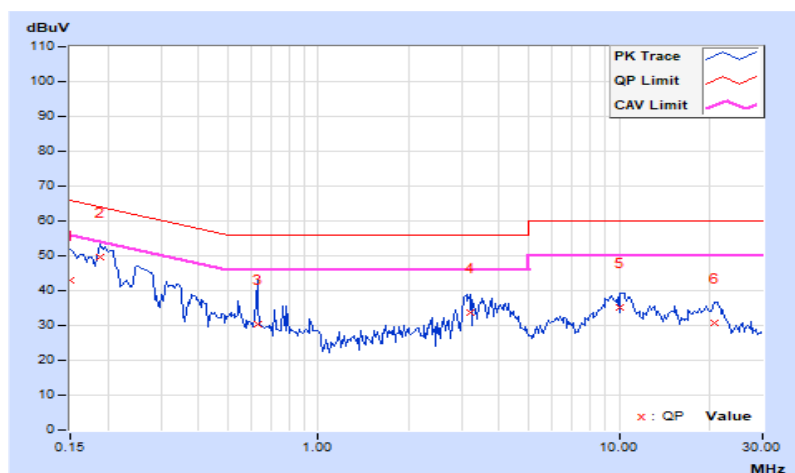
1Tx

RF Mode	BT-LE 1M	Channel	CH 19 : 2440 MHz
Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75% RH
Tested By	Tank Wu		

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15062	9.96	32.98	11.60	42.94	21.56	65.97	55.97	-23.03	-34.41
2	0.18906	9.98	39.53	24.07	49.51	34.05	64.08	54.08	-14.57	-20.03
3	0.62656	10.01	20.34	10.48	30.35	20.49	56.00	46.00	-25.65	-25.51
4	3.19141	10.14	23.71	9.99	33.85	20.13	56.00	46.00	-22.15	-25.87
5	10.04688	10.46	24.68	18.26	35.14	28.72	60.00	50.00	-24.86	-21.28
6	20.85547	10.93	19.69	12.70	30.62	23.63	60.00	50.00	-29.38	-26.37

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

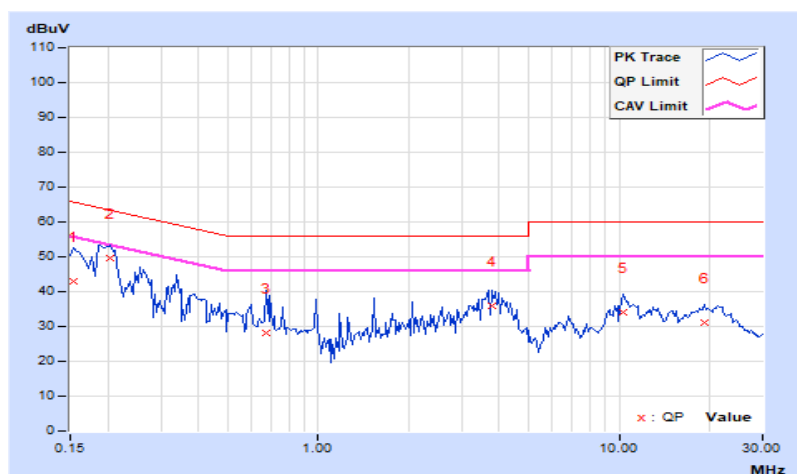


RF Mode	BT-LE 1M	Channel	CH 19 : 2440 MHz
Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75% RH
Tested By	Tank Wu		

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15391	10.01	32.83	11.49	42.84	21.50	65.79	55.79	-22.95	-34.29
2	0.20469	10.02	39.68	25.09	49.70	35.11	63.42	53.42	-13.72	-18.31
3	0.67344	10.02	18.23	10.49	28.25	20.51	56.00	46.00	-27.75	-25.49
4	3.77734	10.16	25.84	15.17	36.00	25.33	56.00	46.00	-20.00	-20.67
5	10.35547	10.42	23.50	17.47	33.92	27.89	60.00	50.00	-26.08	-22.11
6	19.24609	10.75	20.48	13.20	31.23	23.95	60.00	50.00	-28.77	-26.05

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value



7.3 Unwanted Emissions below 1 GHz

Mode A

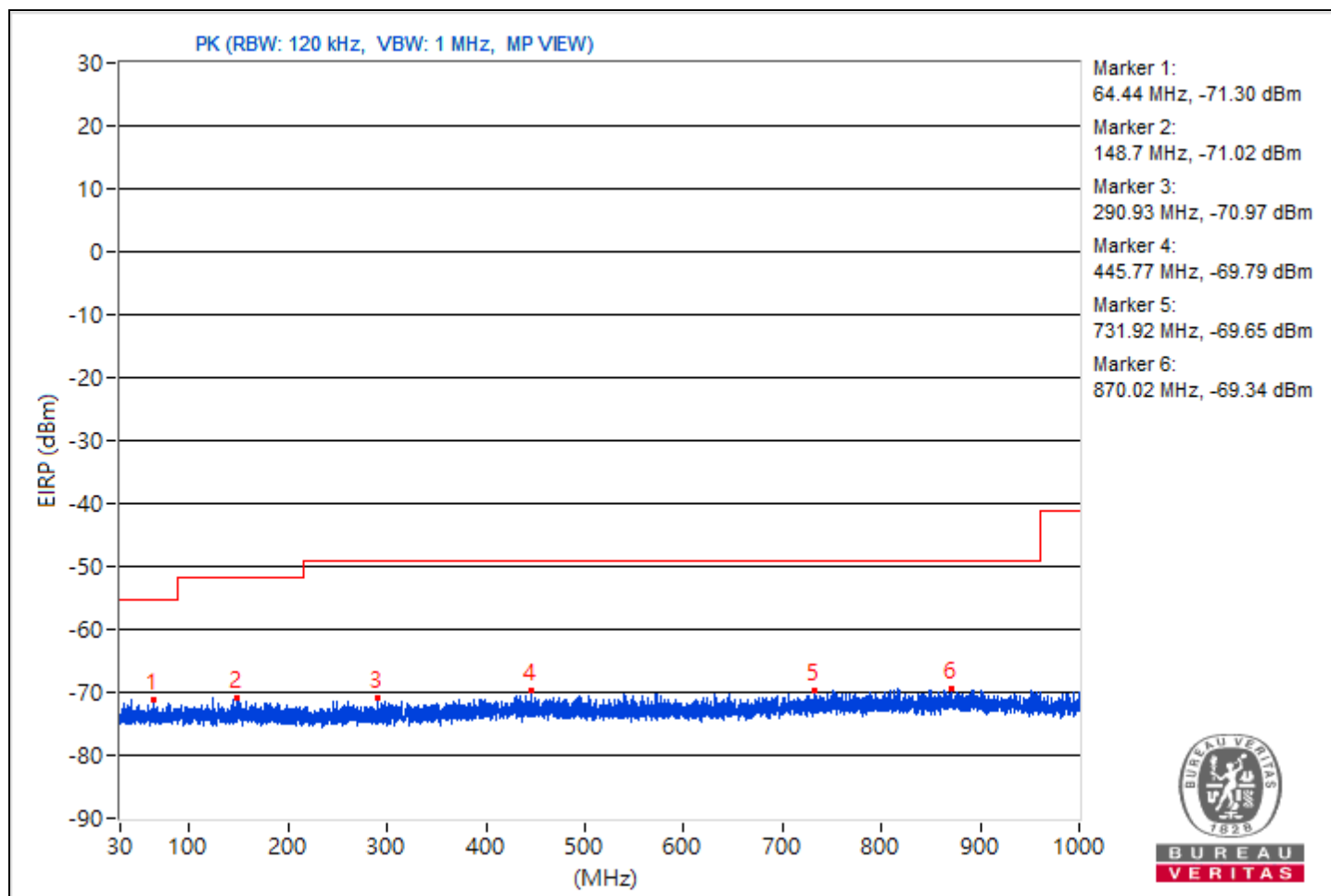
1Tx

RF Mode	BT-LE 1M	Channel	CH 19 : 2440 MHz
Frequency Range	30 MHz ~ 1 GHz	Environmental Conditions	25°C, 60% RH
Tested By	Dolly Chung		

Conducted Unwanted Emissions							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Raw Value Chain 0 (dBm)	Correction Factor (dB)	EIRP Level (dBm)
1	64.44	23.96 PK	40	-16.04	-81.16	9.86	-71.3
2	148.7	24.24 PK	43.5	-19.26	-80.88	9.86	-71.02
3	290.93	24.29 PK	46	-21.71	-80.83	9.86	-70.97
4	445.77	25.47 PK	46	-20.53	-79.65	9.86	-69.79
5	731.92	25.61 PK	46	-20.39	-79.51	9.86	-69.65
6	870.02	25.92 PK	46	-20.08	-79.2	9.86	-69.34

Notes:

1. Margin value = Emission Level - Limit value
2. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.



Mode B

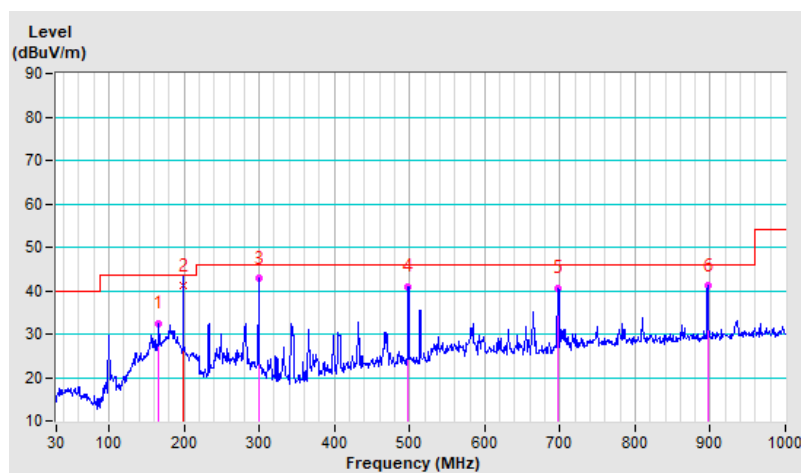
1Tx

RF Mode	BT LE-1M	Channel	CH 19 : 2440 MHz
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	QP: RB=120 kHz, DET=Quasi-Peak
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	25 °C, 65% RH
Tested By	Tank Wu		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	166.19	32.3 QP	43.5	-11.2	2.00 H	356	45.5	-13.2
2	199.53	41.1 QP	43.5	-2.4	1.25 H	360	57.3	-16.2
3	299.32	42.7 QP	46.0	-3.3	1.00 H	182	55.0	-12.3
4	497.88	40.9 QP	46.0	-5.1	2.00 H	129	48.3	-7.4
5	697.02	40.6 QP	46.0	-5.4	1.25 H	136	44.0	-3.4
6	897.98	41.1 QP	46.0	-4.9	1.25 H	277	41.4	-0.3

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.

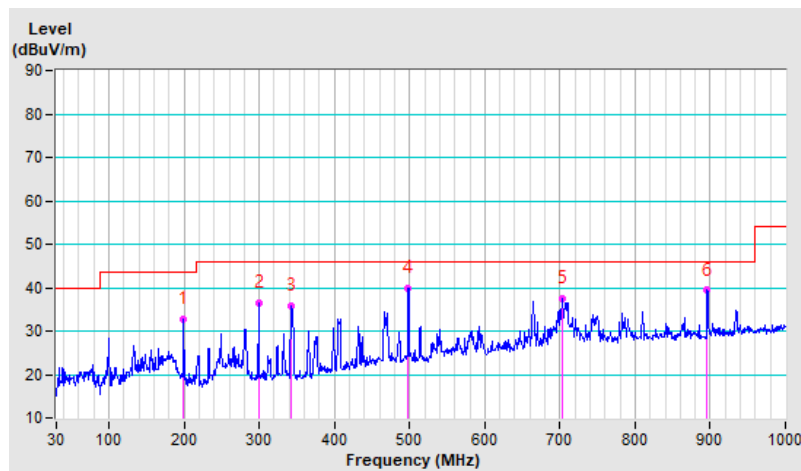


RF Mode	BT LE-1M	Channel	CH 19 : 2440 MHz
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	QP: RB=120 kHz, DET=Quasi-Peak
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	25 °C, 65% RH
Tested By	Tank Wu		

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	199.56	32.7 QP	43.5	-10.8	2.00 V	252	48.9	-16.2
2	299.34	36.6 QP	46.0	-9.4	1.25 V	237	48.9	-12.3
3	342.39	35.8 QP	46.0	-10.2	1.25 V	221	47.2	-11.4
4	497.88	39.9 QP	46.0	-6.1	2.00 V	291	47.3	-7.4
5	703.20	37.6 QP	46.0	-8.4	1.00 V	24	40.9	-3.3
6	896.16	39.4 QP	46.0	-6.6	1.25 V	250	39.7	-0.3

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.



7.4 Unwanted Emissions above 1 GHz

Mode A

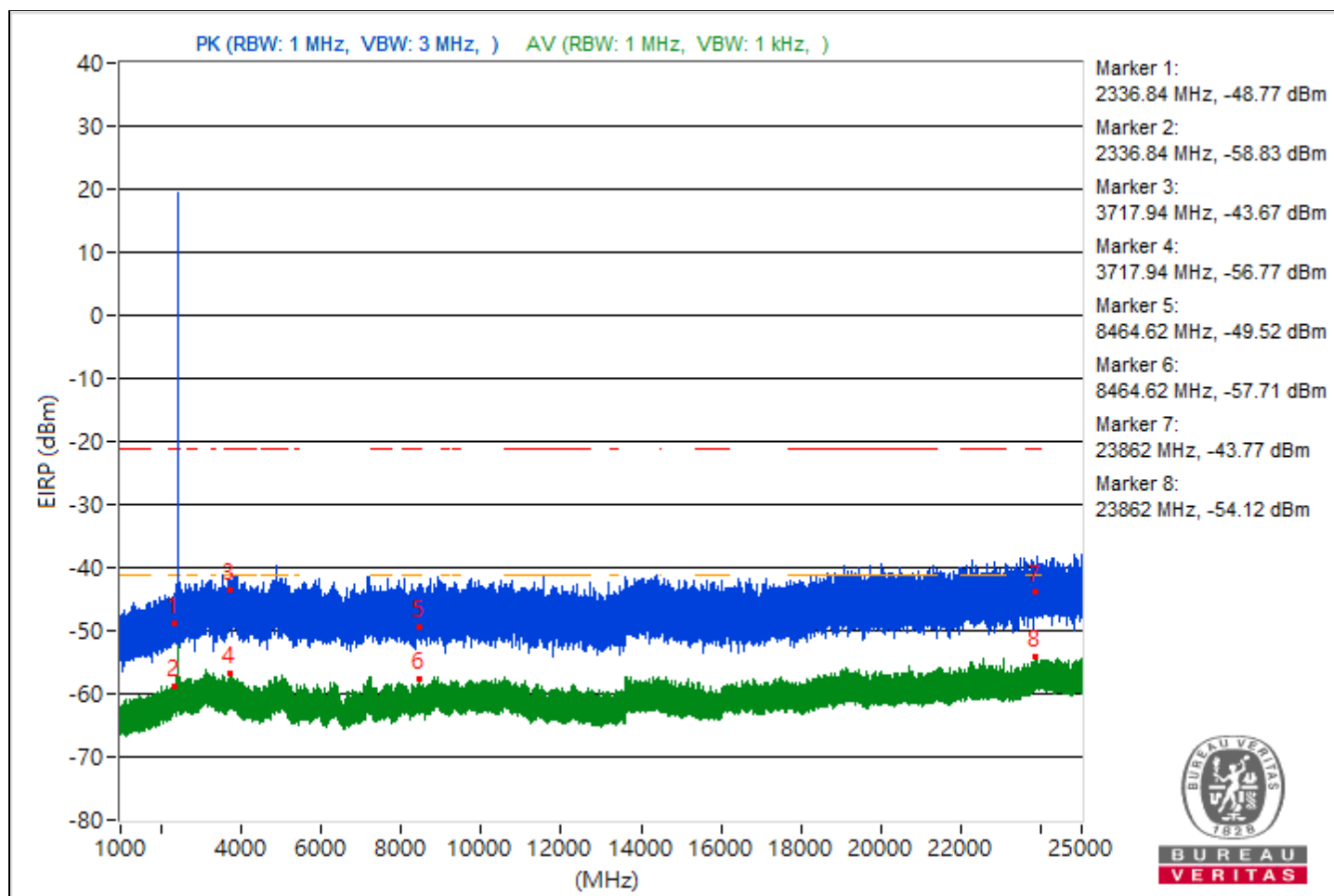
1Tx

Conducted Unwanted Emissions

RF Mode	BT-LE 2M	Channel	CH 19 : 2440 MHz
Frequency Range	1 GHz ~ 25 GHz	Environmental Conditions	25°C, 60% RH
Tested By	Dolly Chung		

Conducted Unwanted Emissions							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Raw Value Chain 0 (dBm)	Correction Factor (dB)	EIRP Level (dBm)
1	2336.84	46.49 PK	74	-27.51	-53.93	5.16	-48.77
2	2336.84	36.43 AV	54	-17.57	-63.99	5.16	-58.83
3	3717.94	51.59 PK	74	-22.41	-48.83	5.16	-43.67
4	3717.94	38.49 AV	54	-15.51	-61.93	5.16	-56.77
5	8464.62	45.74 PK	74	-28.26	-54.68	5.16	-49.52
6	8464.62	37.55 AV	54	-16.45	-62.87	5.16	-57.71
7	23862	51.49 PK	74	-22.51	-48.93	5.16	-43.77
8	23862	41.14 AV	54	-12.86	-59.28	5.16	-54.12

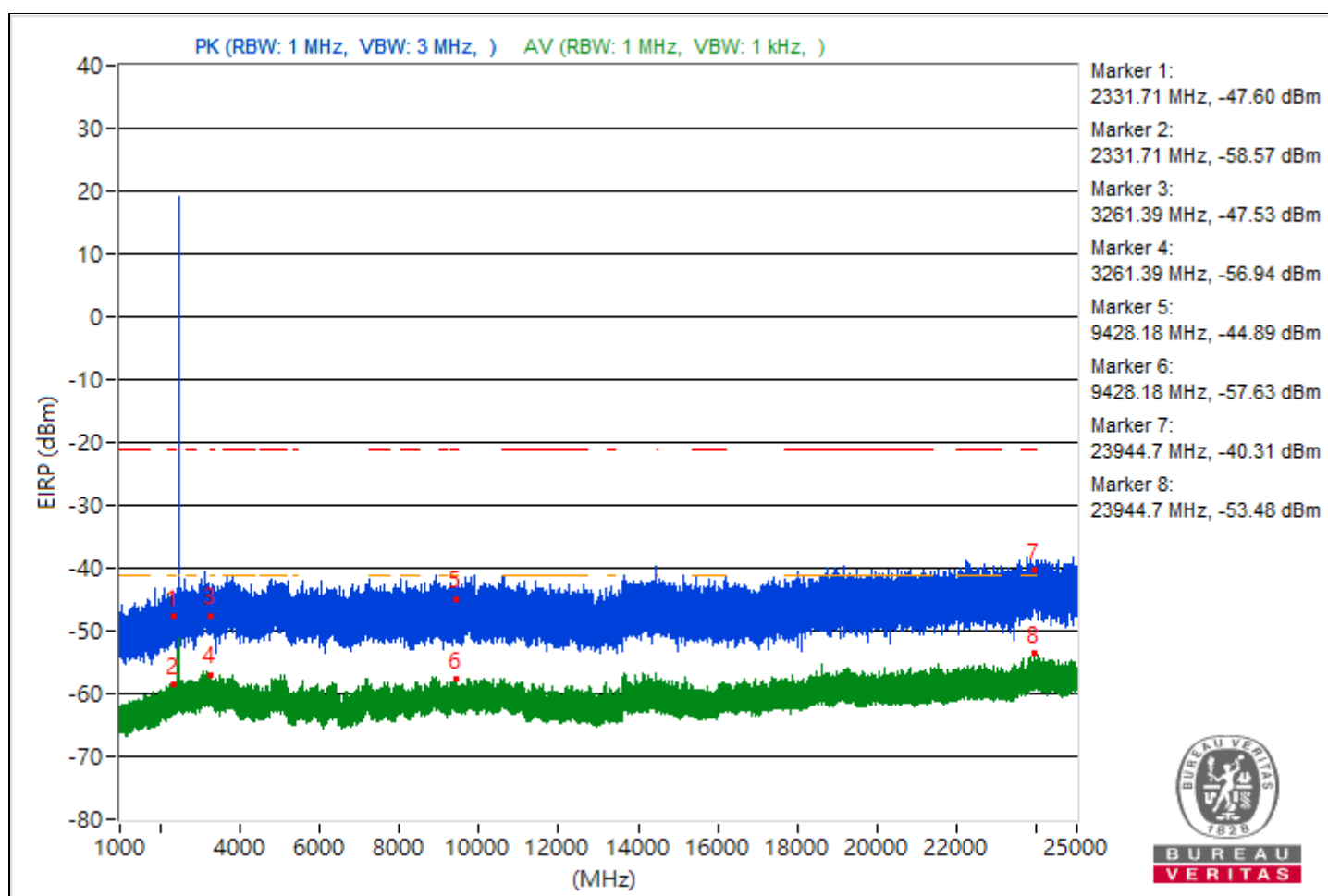
Note: Margin value = Emission Level - Limit value



RF Mode	BT-LE 2M	Channel	CH 39 : 2480 MHz
Frequency Range	1 GHz ~ 25 GHz	Environmental Conditions	25°C, 60% RH
Tested By	Dolly Chung		

Conducted Unwanted Emissions							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Raw Value Chain 0 (dBm)	Correction Factor (dB)	EIRP Level (dBm)
1	2331.71	47.66 PK	74	-26.34	-52.76	5.16	-47.6
2	2331.71	36.69 AV	54	-17.31	-63.73	5.16	-58.57
3	3261.39	47.73 PK	74	-26.27	-52.69	5.16	-47.53
4	3261.39	38.32 AV	54	-15.68	-62.1	5.16	-56.94
5	9428.18	50.37 PK	74	-23.63	-50.05	5.16	-44.89
6	9428.18	37.63 AV	54	-16.37	-62.79	5.16	-57.63
7	23944.7	54.95 PK	74	-19.05	-45.47	5.16	-40.31
8	23944.7	41.78 AV	54	-12.22	-58.64	5.16	-53.48

Note: Margin value = Emission Level - Limit value



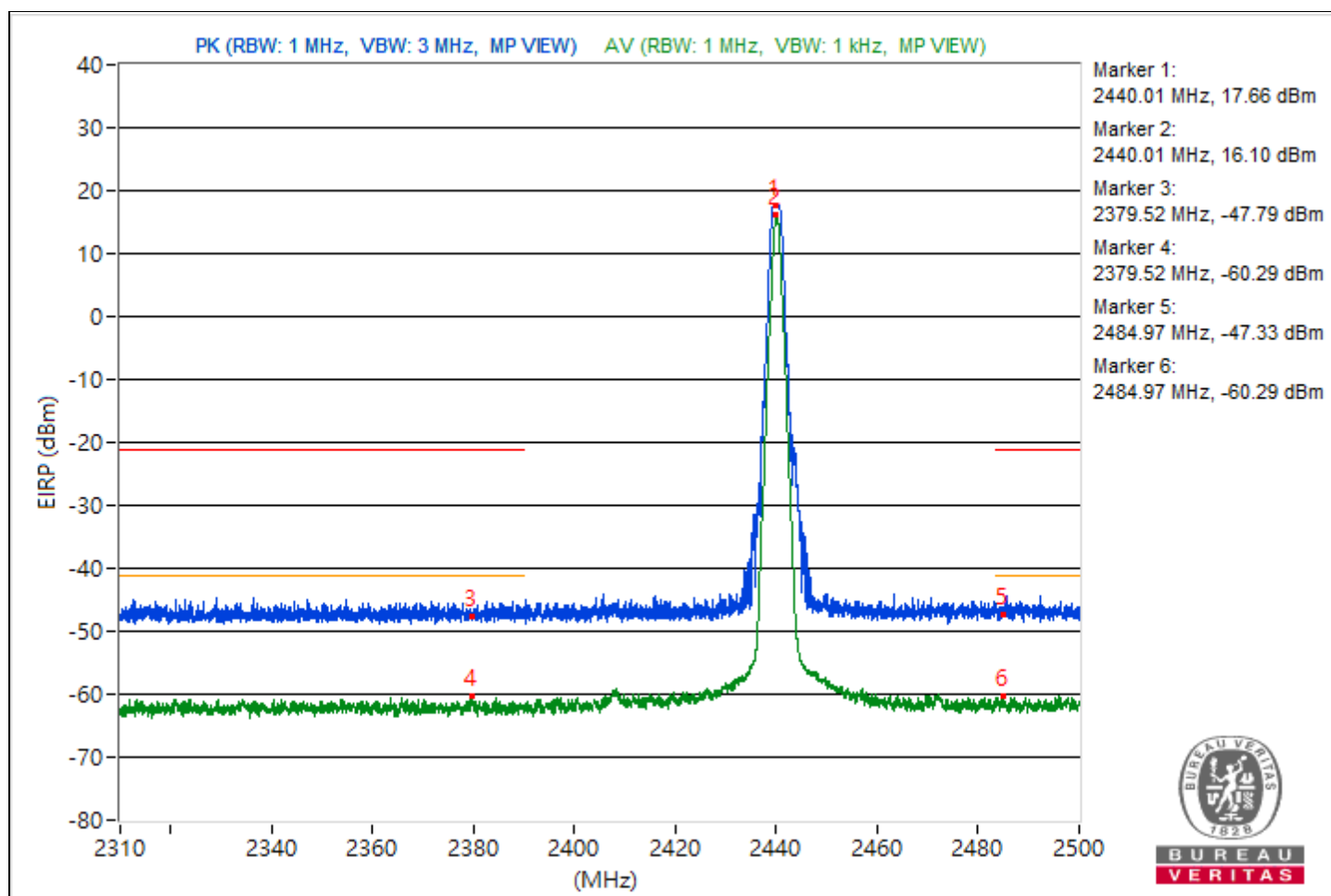
Conducted Band Edges

RF Mode	BT-LE 2M	Channel	CH 19 : 2440 MHz
Frequency Range	2.31 GHz ~ 2.5 GHz	Environmental Conditions	25°C, 60% RH
Tested By	Dolly Chung		

Conducted Band Edge							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Raw Value Chain 0 (dBm)	Correction Factor (dB)	EIRP Level (dBm)
1	*2440.01	112.92 PK			14.13	3.53	17.66
2	*2440.01	111.36 AV			12.57	3.53	16.1
3	2379.52	47.47 PK	74	-26.53	-51.32	3.53	-47.79
4	2379.52	34.97 AV	54	-19.03	-63.82	3.53	-60.29
5	2484.97	47.93 PK	74	-26.07	-50.86	3.53	-47.33
6	2484.97	34.97 AV	54	-19.03	-63.82	3.53	-60.29

Notes:

1. Margin value = Emission Level - Limit value
2. " * " : Fundamental frequency, the limit was restricted at the RF Output Power.

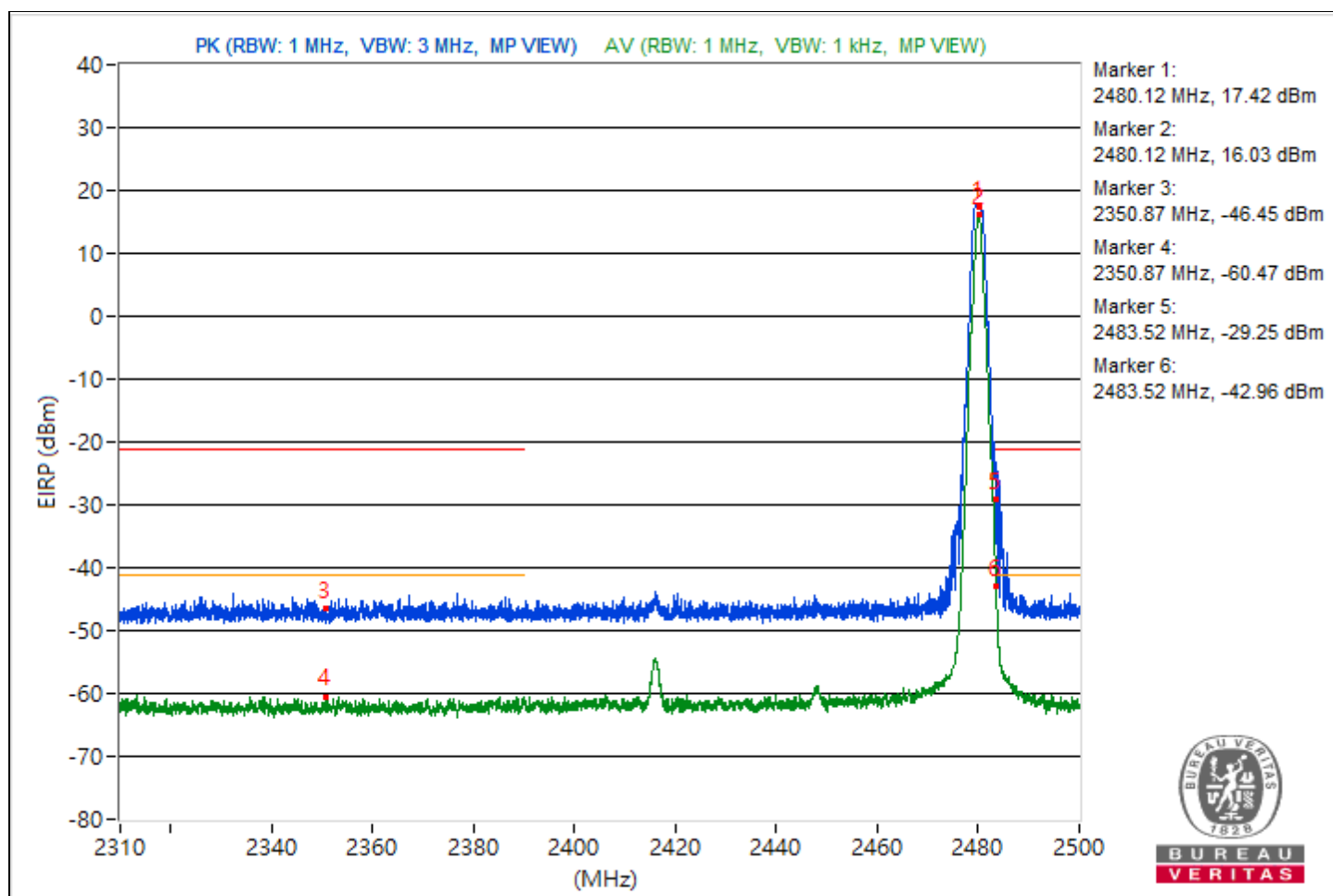


RF Mode	BT-LE 2M	Channel	CH 39 : 2480 MHz
Frequency Range	2.31 GHz ~ 2.5 GHz	Environmental Conditions	25°C, 60% RH
Tested By	Dolly Chung		

Conducted Band Edge							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Raw Value Chain 0 (dBm)	Correction Factor (dB)	EIRP Level (dBm)
1	*2480.12	112.68 PK			13.89	3.53	17.42
2	*2480.12	111.29 AV			12.5	3.53	16.03
3	2350.87	48.81 PK	74	-25.19	-49.98	3.53	-46.45
4	2350.87	34.79 AV	54	-19.21	-64	3.53	-60.47
5	2483.52	66.01 PK	74	-7.99	-32.78	3.53	-29.25
6	2483.52	52.3 AV	54	-1.7	-46.49	3.53	-42.96

Notes:

1. Margin value = Emission Level - Limit value
2. " * " : Fundamental frequency, the limit was restricted at the RF Output Power.



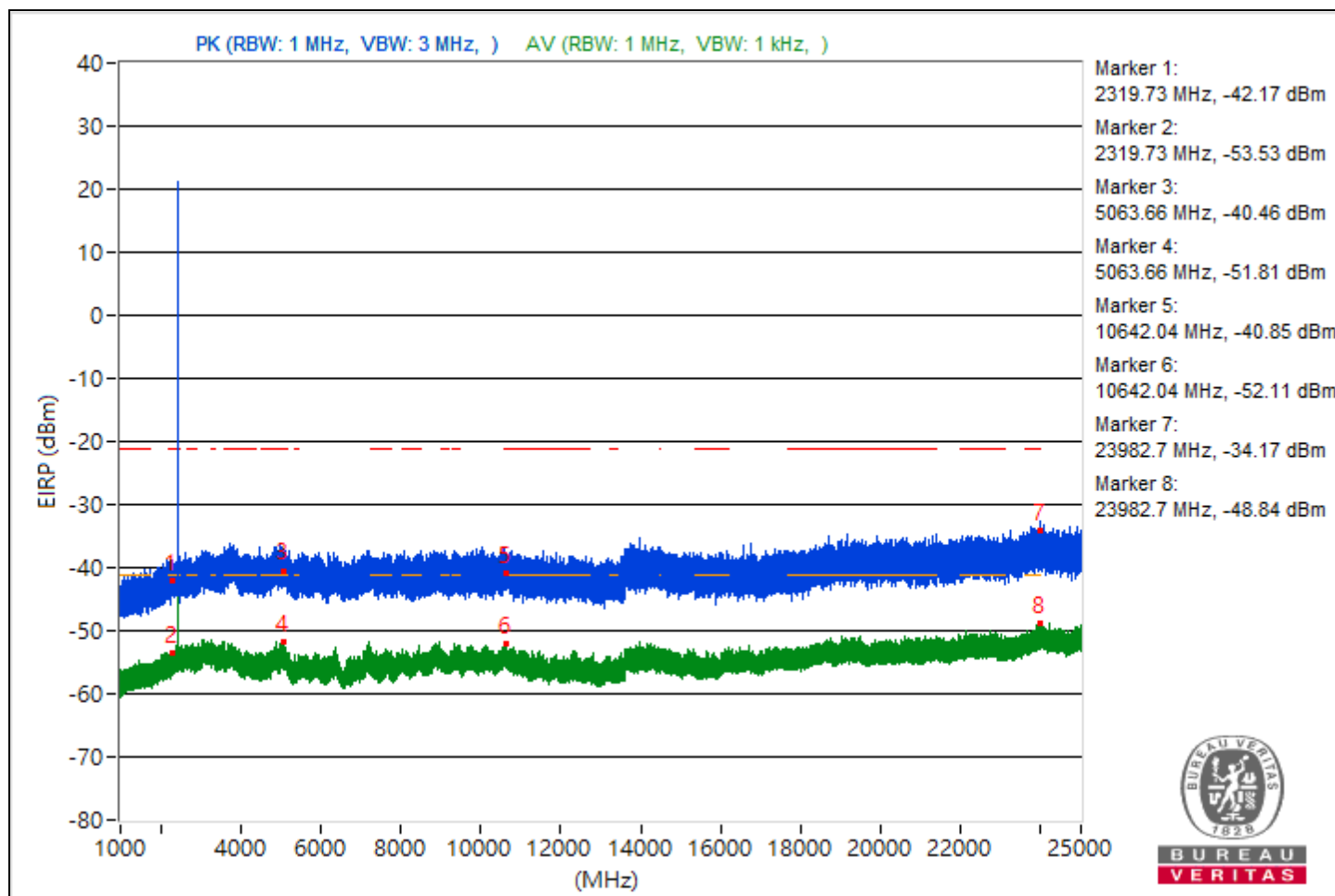
2Tx

Conducted Unwanted Emissions

RF Mode	BT-LE 2M	Channel	CH 19 : 2440 MHz
Frequency Range	1 GHz ~ 25 GHz	Environmental Conditions	25°C, 60% RH
Tested By	Dolly Chung		

Conducted Unwanted Emissions								
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Raw Value Chain 0 (dBm)	Raw Value Chain 1 (dBm)	Correction Factor (dB)	EIRP Level (dBm)
1	2319.73	53.09 PK	74	-20.91	-54.42	-52.49	8.17	-42.17
2	2319.73	41.73 AV	54	-12.27	-66.78	-63.31	8.17	-53.53
3	5063.66	54.8 PK	74	-19.2	-52.87	-50.68	8.17	-40.46
4	5063.66	43.45 AV	54	-10.55	-64.41	-61.93	8.17	-51.81
5	10642.04	54.41 PK	74	-19.59	-52.65	-51.48	8.17	-40.85
6	10642.04	43.15 AV	54	-10.85	-64.32	-62.45	8.17	-52.11
7	23982.7	61.09 PK	74	-12.91	-43.13	-50.12	8.17	-34.17
8	23982.7	46.42 AV	54	-7.58	-59.41	-60.73	8.17	-48.84

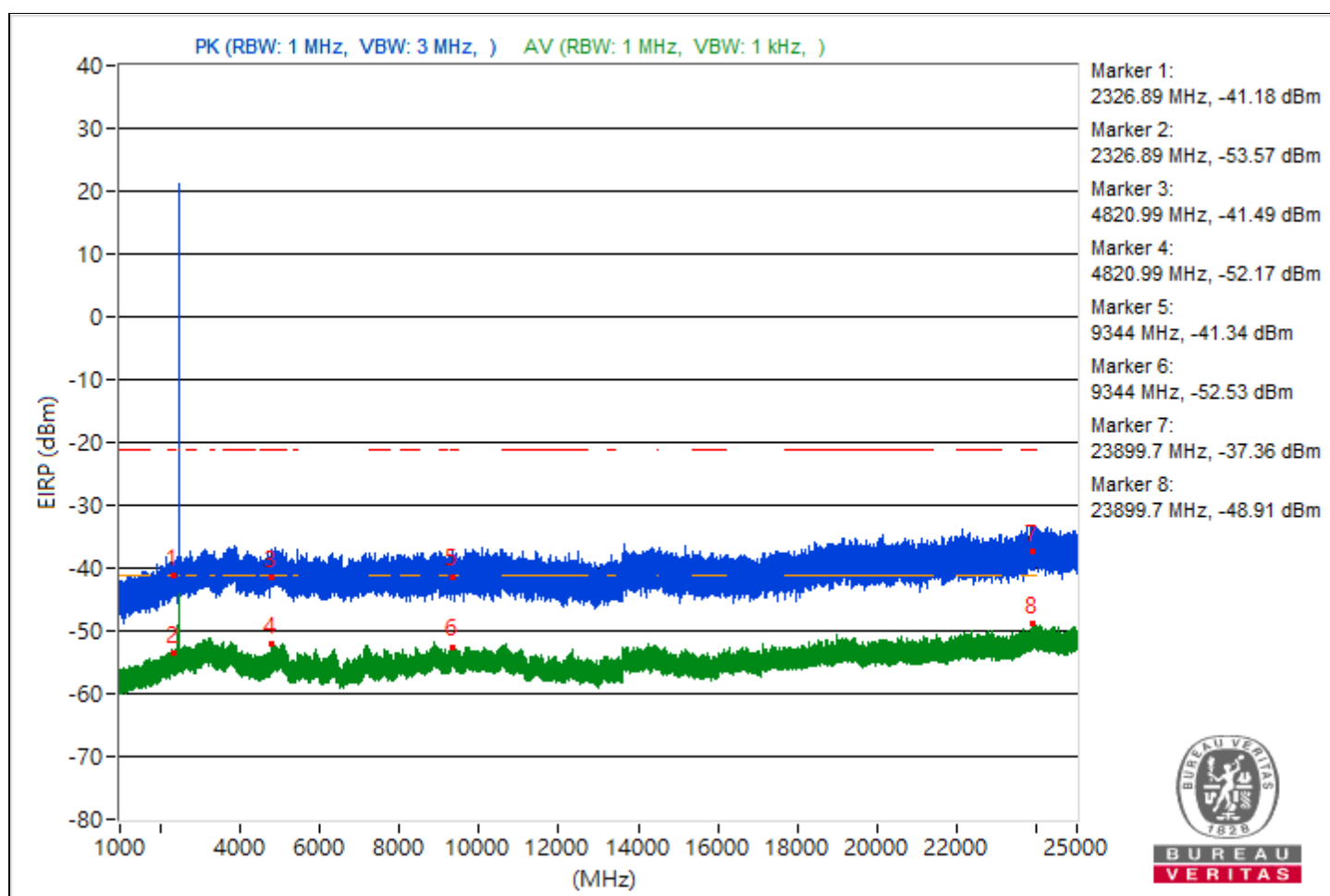
Note: Margin value = Emission Level - Limit value



RF Mode	BT-LE 2M	Channel	CH 39 : 2480 MHz
Frequency Range	1 GHz ~ 25 GHz	Environmental Conditions	25°C, 60% RH
Tested By	Dolly Chung		

Conducted Unwanted Emissions								
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Raw Value Chain 0 (dBm)	Raw Value Chain 1 (dBm)	Correction Factor (dB)	EIRP Level (dBm)
1	2326.89	54.08 PK	74	-19.92	-51.31	-53.74	8.17	-41.18
2	2326.89	41.69 AV	54	-12.31	-65.49	-64.12	8.17	-53.57
3	4820.99	53.77 PK	74	-20.23	-51.77	-53.8	8.17	-41.49
4	4820.99	43.09 AV	54	-10.91	-64.81	-62.25	8.17	-52.17
5	9344	53.92 PK	74	-20.08	-51.68	-53.56	8.17	-41.34
6	9344	42.73 AV	54	-11.27	-66.74	-61.94	8.17	-52.53
7	23899.7	57.9 PK	74	-16.1	-47.27	-50.34	8.17	-37.36
8	23899.7	46.35 AV	54	-7.65	-58.81	-61.92	8.17	-48.91

Note: Margin value = Emission Level - Limit value



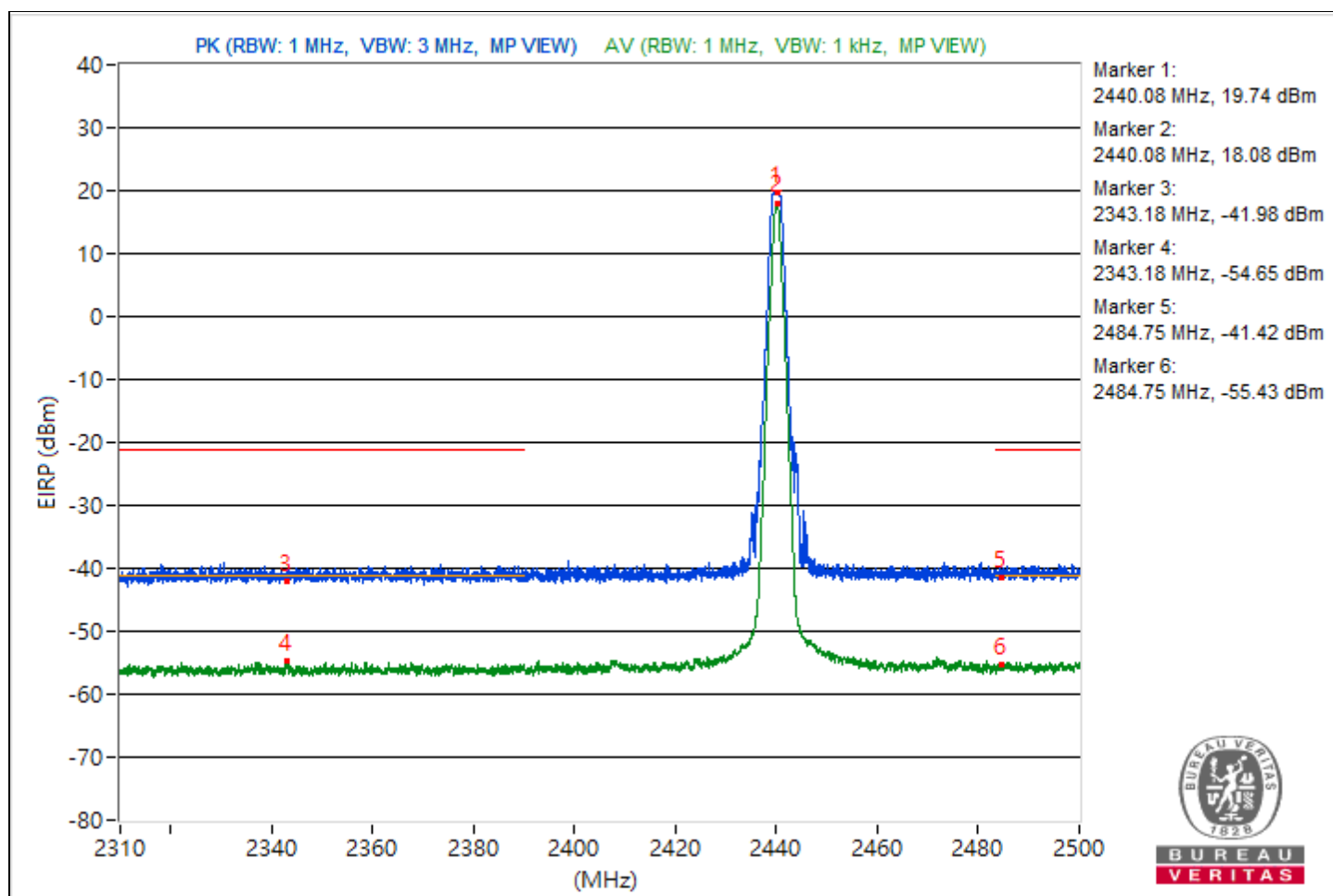
Conducted Band Edges

RF Mode	BT-LE 2M	Channel	CH 19 : 2440 MHz
Frequency Range	2.31 GHz ~ 2.5 GHz	Environmental Conditions	25°C, 60% RH
Tested By	Dolly Chung		

Conducted Band Edge								
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Raw Value Chain 0 (dBm)	Raw Value Chain 1 (dBm)	Correction Factor (dB)	EIRP Level (dBm)
1	*2440.08	115 PK			10.21	10.17	6.54	19.74
2	*2440.08	113.34 AV			8.61	8.45	6.54	18.08
3	2343.18	53.28 PK	74	-20.72	-51.63	-51.44	6.54	-41.98
4	2343.18	40.61 AV	54	-13.39	-65.33	-63.31	6.54	-54.65
5	2484.75	53.84 PK	74	-20.16	-50.77	-51.17	6.54	-41.42
6	2484.75	39.83 AV	54	-14.17	-64.02	-66.22	6.54	-55.43

Notes:

1. Margin value = Emission Level - Limit value
2. " * " : Fundamental frequency, the limit was restricted at the RF Output Power.

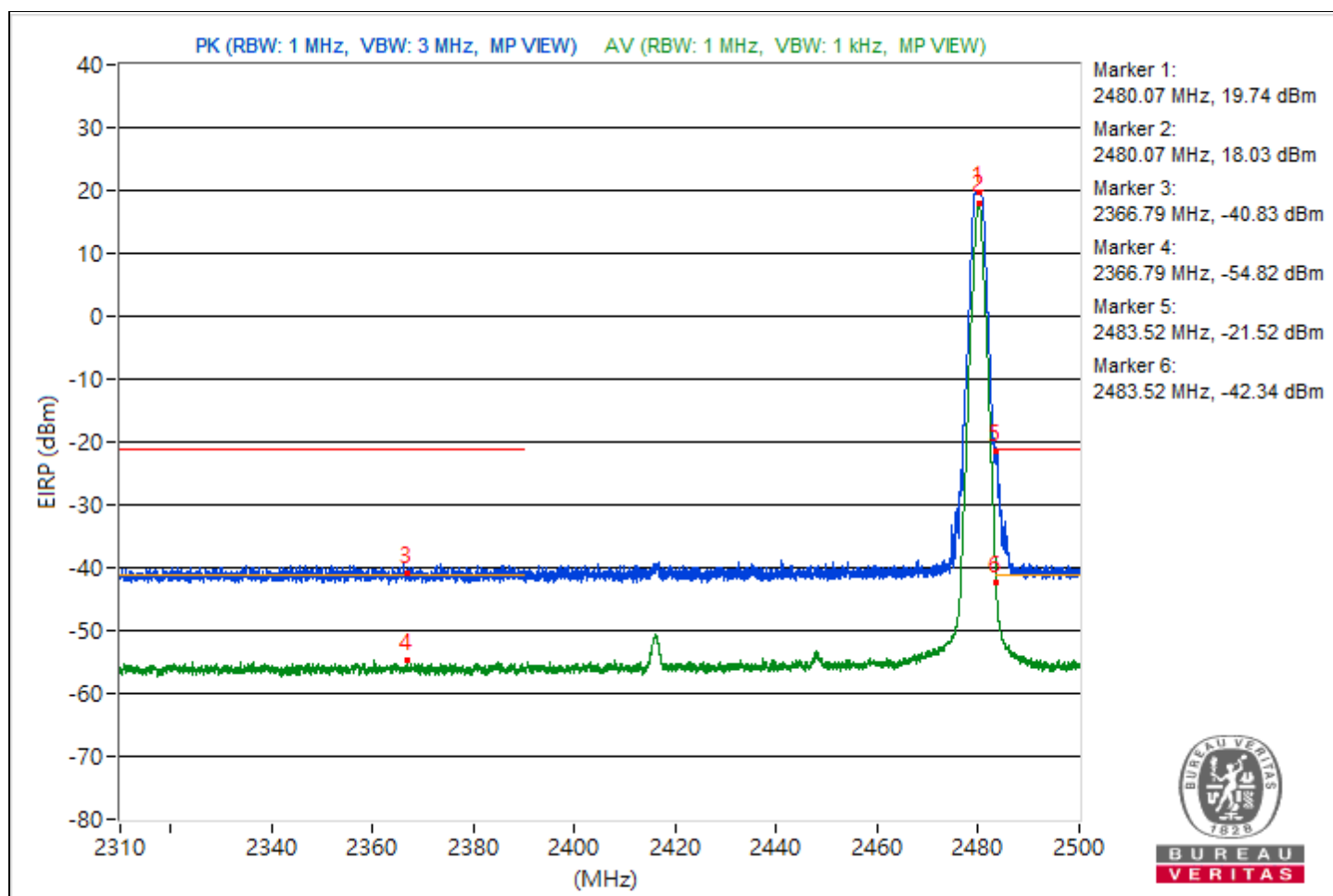


RF Mode	BT-LE 2M	Channel	CH 39 : 2480 MHz
Frequency Range	2.31 GHz ~ 2.5 GHz	Environmental Conditions	25°C, 60% RH
Tested By	Dolly Chung		

Conducted Band Edge								
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Raw Value Chain 0 (dBm)	Raw Value Chain 1 (dBm)	Correction Factor (dB)	EIRP Level (dBm)
1	*2480.07	115 PK			10.54	9.81	6.54	19.74
2	*2480.07	113.29 AV			8.65	8.31	6.54	18.03
3	2366.79	54.43 PK	74	-19.57	-50.43	-50.34	6.54	-40.83
4	2366.79	40.44 AV	54	-13.56	-65.27	-63.63	6.54	-54.82
5	2483.52	73.74 PK	74	-0.26	-31.6	-30.6	6.54	-21.52
6	2483.52	52.92 AV	54	-1.08	-51.79	-51.99	6.54	-42.34

Notes:

1. Margin value = Emission Level - Limit value
2. " * " : Fundamental frequency, the limit was restricted at the RF Output Power.



Mode B

1Tx

RF Mode	BT-LE 2M	Channel	CH 19 : 2440 MHz
Frequency Range	1 GHz ~ 25 GHz	Detector Function & Bandwidth	PK: RB=1 MHz, VB=3 MHz, DET=Peak AV: RB=1 MHz, VB=2 kHz, DET=Peak
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75% RH
Tested By	Tank Wu		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4880.00	42.7 PK	74.0	-31.3	1.44 H	240	38.3	4.4
2	4880.00	32.3 AV	54.0	-21.7	1.44 H	240	27.9	4.4
3	7320.00	47.7 PK	74.0	-26.3	1.08 H	189	36.8	10.9
4	7320.00	35.5 AV	54.0	-18.5	1.08 H	189	24.6	10.9
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4880.00	41.7 PK	74.0	-32.3	2.00 V	165	37.3	4.4
2	4880.00	31.5 AV	54.0	-22.5	2.00 V	165	27.1	4.4
3	7320.00	46.9 PK	74.0	-27.1	1.63 V	290	36.0	10.9
4	7320.00	34.6 AV	54.0	-19.4	1.63 V	290	23.7	10.9

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.

RF Mode	BT-LE 2M	Channel	CH 39 : 2480 MHz
Frequency Range	1 GHz ~ 25 GHz	Detector Function & Bandwidth	PK: RB=1 MHz, VB=3 MHz, DET=Peak AV: RB=1 MHz, VB=2 kHz, DET=Peak
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75% RH
Tested By	Tank Wu		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4960.00	42.9 PK	74.0	-31.1	1.42 H	248	38.3	4.6
2	4960.00	32.7 AV	54.0	-21.3	1.42 H	248	28.1	4.6
3	7440.00	48.1 PK	74.0	-25.9	1.17 H	183	36.7	11.4
4	7440.00	35.7 AV	54.0	-18.3	1.17 H	183	24.3	11.4
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4960.00	41.5 PK	74.0	-32.5	2.00 V	182	36.9	4.6
2	4960.00	31.6 AV	54.0	-22.4	2.00 V	182	27.0	4.6
3	7440.00	46.5 PK	74.0	-27.5	1.65 V	278	35.1	11.4
4	7440.00	34.8 AV	54.0	-19.2	1.65 V	278	23.4	11.4

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.

2Tx

RF Mode	BT-LE 2M	Channel	CH 19 : 2440 MHz
Frequency Range	1 GHz ~ 25 GHz	Detector Function & Bandwidth	PK: RB=1 MHz, VB=3 MHz, DET=Peak AV: RB=1 MHz, VB=2 kHz, DET=Peak
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75% RH
Tested By	Tank Wu		

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4880.00	42.3 PK	74.0	-31.7	1.28 H	282	37.9	4.4
2	4880.00	32.1 AV	54.0	-21.9	1.28 H	282	27.7	4.4
3	7320.00	47.6 PK	74.0	-26.4	1.97 H	212	36.7	10.9
4	7320.00	35.2 AV	54.0	-18.8	1.97 H	212	24.3	10.9
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4880.00	44.2 PK	74.0	-29.8	1.69 V	141	39.8	4.4
2	4880.00	33.4 AV	54.0	-20.6	1.69 V	141	29.0	4.4
3	7320.00	48.4 PK	74.0	-25.6	1.79 V	265	37.5	10.9
4	7320.00	36.4 AV	54.0	-17.6	1.79 V	265	25.5	10.9

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.

RF Mode	BT-LE 2M	Channel	CH 39 : 2480 MHz
Frequency Range	1 GHz ~ 25 GHz	Detector Function & Bandwidth	PK: RB=1 MHz, VB=3 MHz, DET=Peak AV: RB=1 MHz, VB=2 kHz, DET=Peak
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	25 °C, 75% RH
Tested By	Tank Wu		

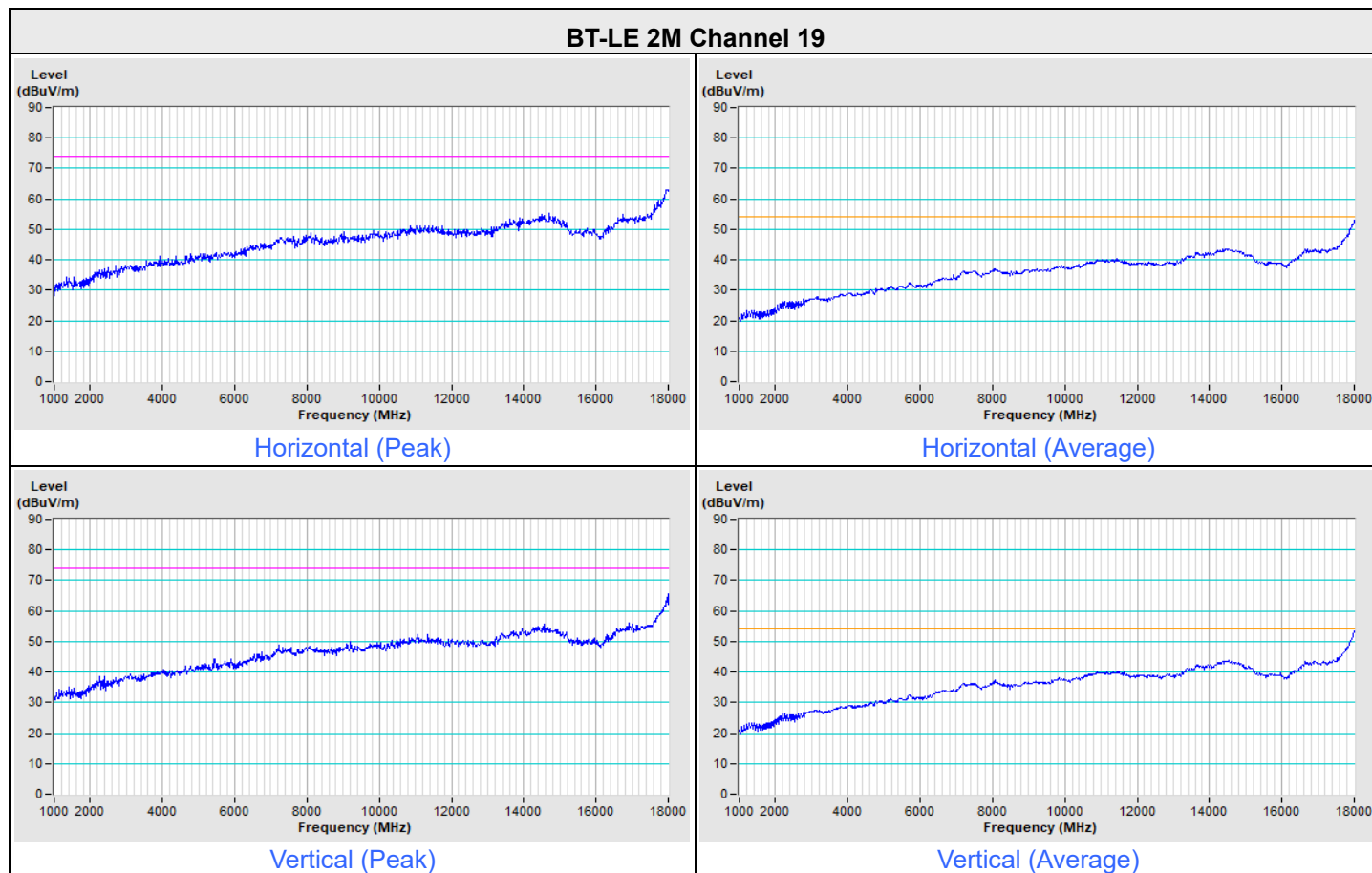
Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4960.00	42.6 PK	74.0	-31.4	1.30 H	269	38.0	4.6
2	4960.00	32.4 AV	54.0	-21.6	1.30 H	269	27.8	4.6
3	7440.00	47.7 PK	74.0	-26.3	1.94 H	226	36.3	11.4
4	7440.00	35.4 AV	54.0	-18.6	1.94 H	226	24.0	11.4
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	4960.00	43.6 PK	74.0	-30.4	1.64 V	150	39.0	4.6
2	4960.00	32.9 AV	54.0	-21.1	1.64 V	150	28.3	4.6
3	7440.00	48.3 PK	74.0	-25.7	1.75 V	268	36.9	11.4
4	7440.00	36.2 AV	54.0	-17.8	1.75 V	268	24.8	11.4

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.

Plot of Other Emission

Frequency Range	1 GHz ~ 18 GHz	Detector Function & Bandwidth	PK: RB=1 MHz, VB=3 MHz, DET=Peak AV: RB=1 MHz, VB=3 MHz, DET=RMS
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Notes:

1. For radiated emission test data, complete spectral plots shall be presented in the report only for the worst-case scenarios of each mode within each operating frequency band.
2. The frequency range 18 GHz ~ 25 GHz: After investigation, no any emissions were found to exist, therefore they are not recorded in this report.

8 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo)

9 Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

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