



Test report No. : 4790038904-US-R4-V0
Page : 1 of 56
Issued date : 2021/11/18
FCC ID : RYK-WPET239ACNBT

RADIO TEST REPORT

Product : 802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 Half Mini PCIe Module

Model Name : WPET-239ACN(BT)

FCC ID : RYK-WPET239ACNBT

Test Regulation : FCC 47 CFR Part 15 Subpart C (Section 15.247)

Received Date : 2021/8/5

Test Date : 2021/8/9 ~ 2021/10/22

Issued Date : 2021/11/18

Applicant : SparkLAN Communications, Inc.
8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City
11493, Taiwan (R.O.C.)

Issued By : Underwriters Laboratories Taiwan Co., Ltd.
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd.,
Zhudong Township, Hsinchu County, Taiwan



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REVISION HISTORY

Original Test Report No.: 4790038904-US-R4-V0

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1. Attestation of Test Results

APPLICANT: SparkLAN Communications, Inc.
8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493,
Taiwan (R.O.C.)

MANUFACTURER: SparkLAN Communications, Inc.
8F., No.257, Sec. 2, Tiding Blvd., Neihu District, Taipei City 11493,
Taiwan (R.O.C.)

EUT DESCRIPTION: 802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 Half Mini PCIe Module

BRAND: SparkLAN

MODEL: WPET-239ACN(BT)

SAMPLE STAGE: Engineering Verification Test sample

DATE of TESTED: 2021/8/9 ~ 2021/10/22

APPLICABLE STANDARDS	
STANDARD	Test Results
FCC 47 CFR PART 15 Subpart C (Section 15.247)	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Sally Lu
Project Handler

Date : 2021/11/18

Approved and Authorized By:

Waternil Guan
Engineer

Date : 2021/11/18

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2. Summary of Test Results

Summary of Test Results		
FCC Clause	Test Items	Result
15.247(a)(2)	6dB Bandwidth	PASS
15.247(b)	Conducted Output Power	PASS
15.247(e)	Power Spectral Density	PASS
15.247(d)	Antenna Port Emission	PASS
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	PASS
15.207	AC Power Conducted Emission	PASS
15.203	Antenna Requirement	PASS

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3. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB558074 D01 Meas Guidance v05r02, KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013.

4. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

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5. Measurement Uncertainty

For statement of conformity, accuracy method (Section 8.2.4 and 8.2.5 of ISO Guide 98-4) was applied as decision rule for measurement in this test report.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k=2$.

Measurement	Frequency	Uncertainty
Conducted disturbance at mains terminals ports	150kHz ~ 30MHz	± 3.1 dB
RF Conducted	9 kHz - 40GHz	± 1.9 dB
Radiated disturbance below 30MHz	9 kHz - 30 MHz	± 1.9 dB
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	± 5.4 dB
Radiated disturbance above 1 GHz	1GHz ~ 40GHz	± 4.7 dB

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6. Equipment under Test

6.1. Description of EUT

Product	802.11ac/a/b/g/n 2T2R Wi-Fi + Bluetooth 5.0 Half Mini PCIe Module
Brand Name	SparkLAN
Model Name	WPET-239ACN(BT)
Operating Frequency	2402MHz ~ 2480MHz
Modulation	GFSK
Transfer Rate	Up to 2 Mbps
Number of Channel	40
Maximum Output Power	4.92 dBm
Normal Voltage	3.3Vdc
Sample ID	4197850

Note:

1. The EUT contains following accessory devices:

Product	Brand	Model	Description
Dipole Antenna 1	SparkLAN	AD-301N	-
Dipole Antenna 2	SparkLAN	AD-103AG	-
Dipole Antenna 3	SparkLAN	AD-305N	-
Dipole Antenna 4	SparkLAN	AD-303N	-
Dipole Antenna 5	SparkLAN	AD-302N	-
Dipole Antenna 6	SparkLAN	AD-315N	-

2. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual.

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6.2. Channel List

40 channels are provided to this EUT:

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

6.3. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Antenna Port Conducted Measurement	SR4	23~26°C/ 60~65%RH	3.3Vdc	2021/08/09~ 2021/10/22	Mike Cai
Radiated Spurious Emission	966-2	23~26°C/ 60~65%RH	3.3Vdc	2021/09/06~ 2021/10/22	Patrick Kuan/ Mike Cai
AC power Line Conducted Emission	SR1	23~26°C/ 60~65%RH	3.3Vdc	2021/10/07~ 2021/10/08	Mike Cai

FCC Test Firm Registration Number: 498077

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6.4. Description of Available Antennas

Ant. No.	Transmitter Circuit	Brand Name	Model Name	Ant. Type	Maximum Gain (dBi)	Remark
1	Chain (0)+(1)	SparkLAN	AD-301N	Dipole	2.4GHz: 4.4 5GHz: 5.8	RP-SMA
2	Chain (0)+(1)	SparkLAN	AD-103AG	Dipole	2.4GHz: 2.02 5GHz: 2.03	RP-SMA
3	Chain (0)+(1)	SparkLAN	AD-305N	Dipole	2.4GHz: 5 5GHz: 5.53	RP-SMA
4	Chain (0)+(1)	SparkLAN	AD-303N	Dipole	2.4GHz: 3.14 5GHz: 3.45	RP-SMA
5	Chain (0)+(1)	SparkLAN	AD-302N	Dipole	2.4GHz: 3.14 5GHz: 2.87	RP-SMA
6	Chain (0)+(1)	SparkLAN	AD-315N	Dipole	2.4GHz: 3 5GHz: 5	MHF

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual.

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6.5. Test Mode Applicability and Tested Channel Detail

- The fundamental of the dipole antenna was investigated in two orthogonal (lay and stand), it was determined that stand mode was worst-case. Therefore, all final radiated testing was performed with the dipole antenna in stand mode.
- For AC power line conducted emissions, the pre-scan has been determined by AC power 120Vac/60Hz. (worst case)
- The antenna AD-305N has the highest gain, the following tests are all carried out using this antenna.
- For Antenna Port Conducted Measurement, this item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.
- For below 1 GHz radiated emission and AC power line conducted emission have performed all modes of operation were investigated and the worst-case emissions are reported.
- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

Test Item	Modulation Type	Available Channel	Test Channel	Data Rate
Radiated Emissions	GFSK	0 to 39	0,19,39	1 Mbps
	GFSK			2 Mbps
Radiated Emissions (Below 1GHz)	GFSK	0 to 39	0	1 Mbps
	GFSK		0	2 Mbps
AC Power Line Conducted Emission	GFSK	0 to 39	0	1 Mbps
	GFSK		0	2 Mbps
Antenna Port Conducted Measurement	GFSK	0 to 39	0,19,39	1 Mbps
	GFSK			2 Mbps

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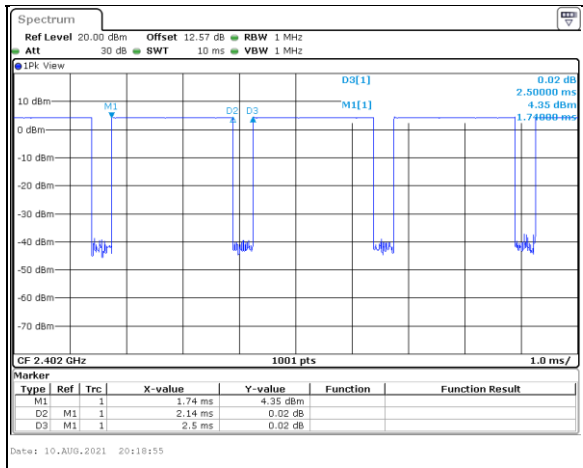
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6.6. Duty cycle

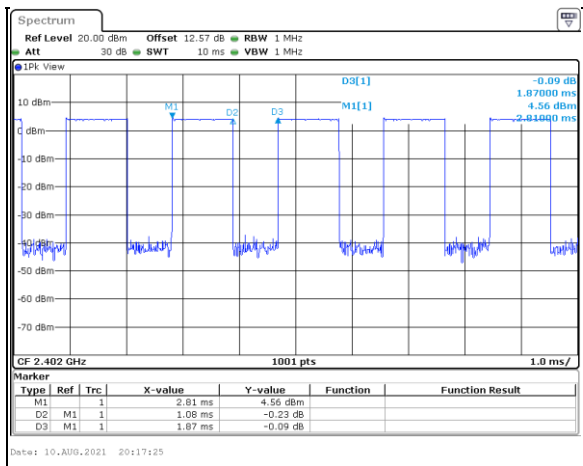
BT LE_1Mbps

Duty cycle = $2.14/2.5 = 0.856$, Duty factor(dB) = $10 * \log(1/0.856) = 0.68$



BT LE_2Mbps

Duty cycle = $1.08/1.87 = 0.578$, Duty factor(dB) = $10 * \log(1/0.578) = 2.39$



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7. Test Equipment

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070827	2020/11/11	2021/11/10
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	2020/12/11	2021/12/10
Loop Antenna	ETS lindgren	6502	00213440	2020/12/25	2021/12/24
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck & EMCI	VULB 9168 & N-6-05	774 & AT-N0538	2021/1/13	2022/1/12
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	2020/12/30	2021/12/29
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	2020/12/30	2021/12/29
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	2021/6/8	2022/6/7
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	2021/2/3	2022/2/2
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	2021/5/19	2022/5/18
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	2021/1/22	2022/1/21
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	2021/1/22	2022/1/21

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Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Expired date
Antenna Port Conducted Measurement					
Spectrum Analyzer	Keysight	N9010A	MY56070834	2020/11/6	2021/11/5
Pulse Power Sensor	Anritsu	MA2411B	1531202	2020/12/21	2021/12/20
Power Meter	Anritsu	ML2495A	1645002	2020/12/21	2021/12/20
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	2020/11/17	2021/11/16
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	2021/8/30	2022/8/29
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	2021/8/26	2022/8/25
Cables	TITAN	CFD200	T0732ACFD20 020A300-1	2021/3/2	2022/3/1

UL Software		
Description	Name	Version
Radiated measurement	e3	6.191211 (V6)
Conducted measurement	RF Conducted Test Tools	ver 2.4.0.620b
AC power Line Conducted Emission	EZ_EMG	UL-3A1.2

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8. Description of Test Setup

Support Equipment

ID	Equipment	Brand Name	Model Name	S/N	Remark
A	Laptop	Lenovo	T460	PC0FWU5Y	Provide by lab
B	Mini PCI-E to ExpressCard board	N/A	N/A	N/A	Provide by lab

Test Setup

Controlled using a bespoke application (RTLBTAPP Version 5.2.2.58) on a test Notebook. The application was used to enable a continuous transmission mode and to select the test channels, data rates, modulation schemes and power setting as required.

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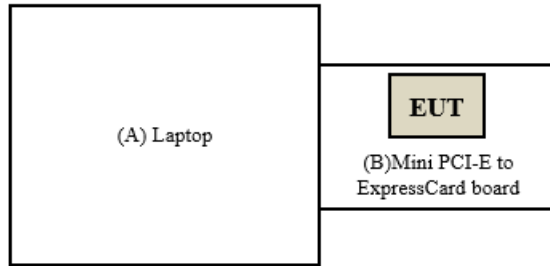
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Setup Diagram for Test



Under Table

Remote Site

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9. Test Results

9.1. 6dB Bandwidth

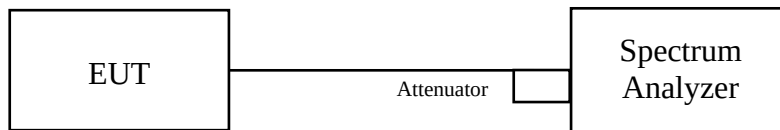
Requirements

The minimum 6 dB bandwidth shall be at least 500 kHz.

Test procedure

- Set resolution bandwidth (RBW) = 100kHz
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

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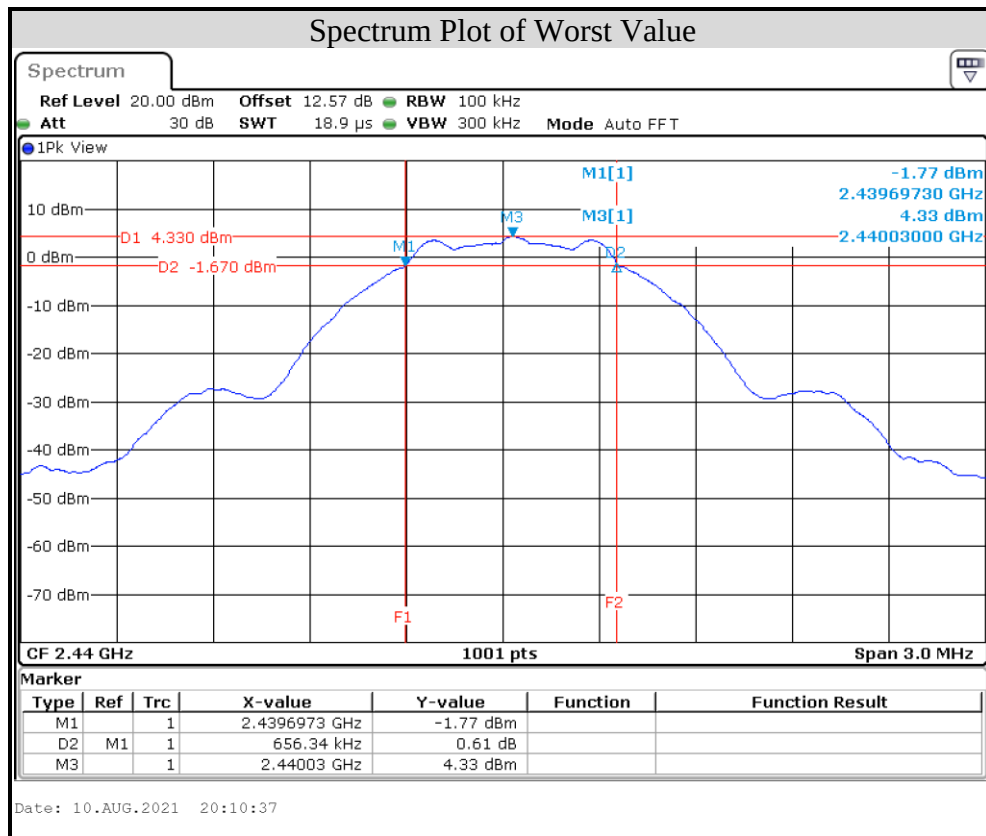
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Test Data

BT LE_1Mbps

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.66	0.5	PASS
19	2440	0.66	0.5	PASS
39	2480	0.66	0.5	PASS



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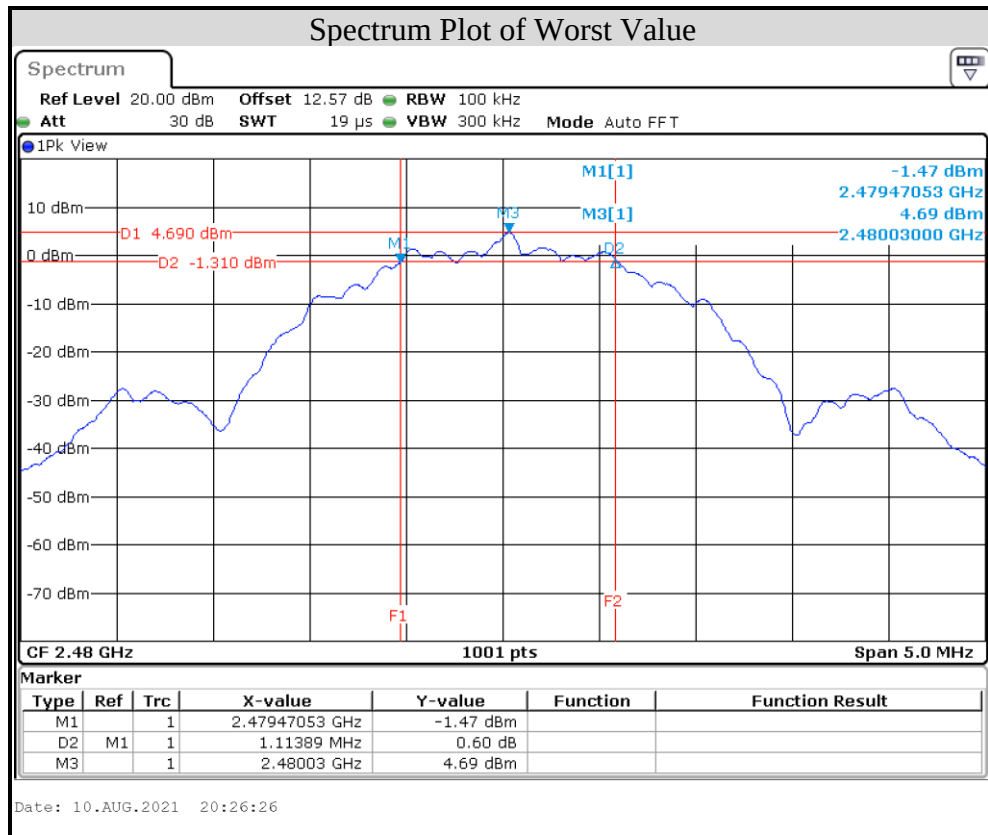
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BT LE_2Mbps

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	1.12	0.5	PASS
19	2440	1.13	0.5	PASS
39	2480	1.11	0.5	PASS



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9.2. Conducted Output Power

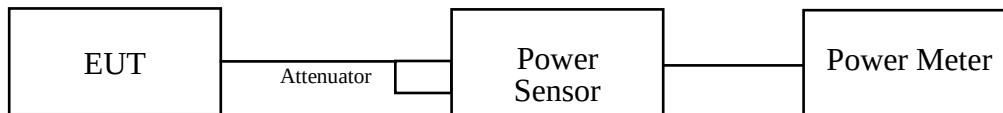
Requirements

For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.

Test Procedure

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.

Test Setup



The loss between RF output port of the EUT and the input port of the Power Meter has been taken into consideration.



Test Data

Peak Power

BT LE_1Mbps

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass/Fail
0	2402	2.786	4.45	30	PASS
19	2440	2.812	4.49	30	PASS
39	2480	3.027	4.81	30	PASS

BT LE_2Mbps

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass/Fail
0	2402	2.904	4.63	30	PASS
19	2440	2.931	4.67	30	PASS
39	2480	3.105	4.92	30	PASS

Average Power (Reference Only)

BT LE_1Mbps

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
0	2402	2.661	4.25
19	2440	2.71	4.33
39	2480	2.851	4.55

BT LE_2Mbps

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)
0	2402	2.773	4.43
19	2440	2.805	4.48
39	2480	2.965	4.72

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9.3. Power Spectral Density

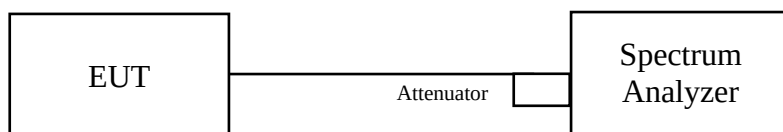
Requirements

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

Test procedure

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

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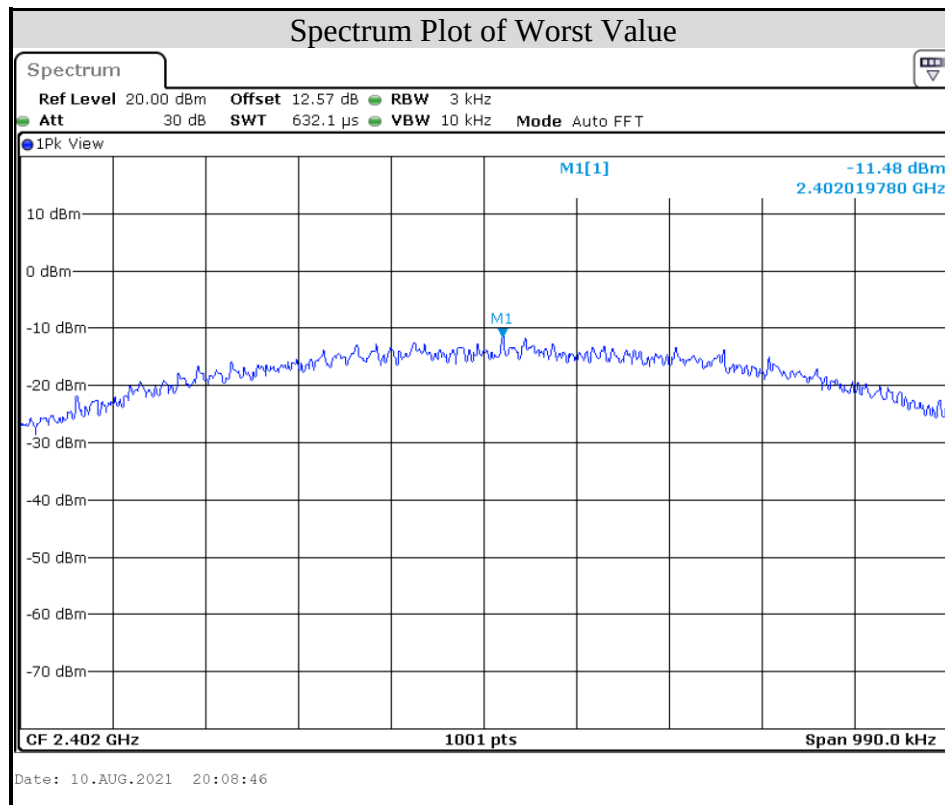
Doc No: 17-EM-F0876 / 6.0



Test Data

BT LE_1Mbps

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass /Fail
0	2402	-11.48	8	PASS
19	2440	-12.19	8	PASS
39	2480	-11.72	8	PASS



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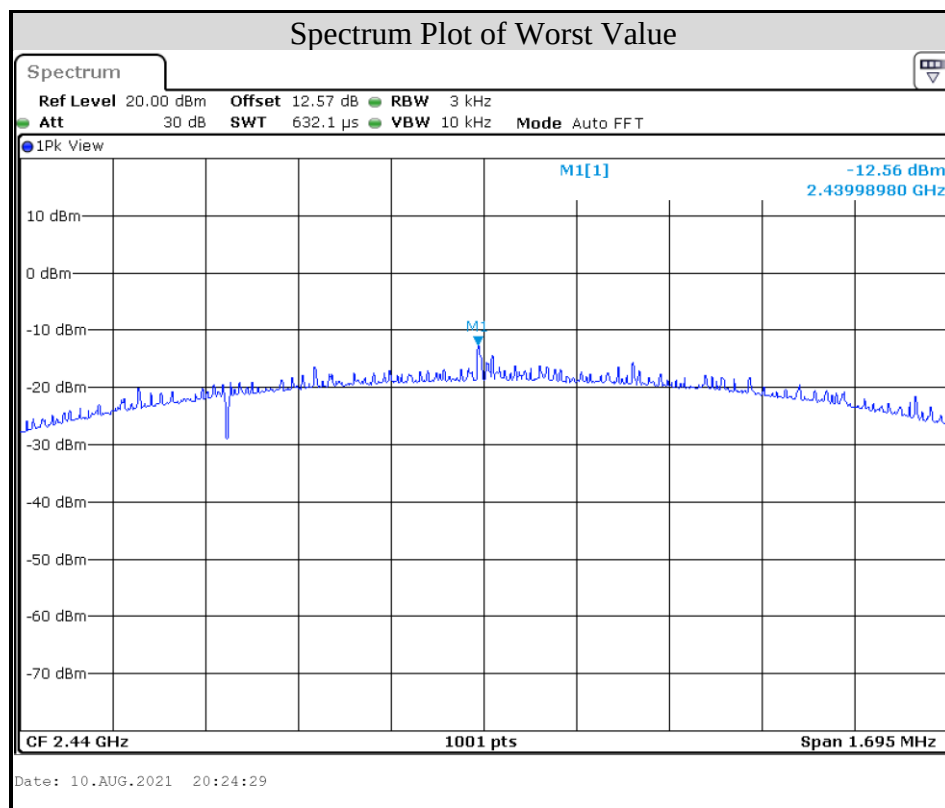
Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 6.0



BT LE_2Mbps

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Pass /Fail
0	2402	-12.91	8	PASS
19	2440	-12.56	8	PASS
39	2480	-12.68	8	PASS



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9.4. Conducted Out of Band Emission

Requirements

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b) (3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209 (a) is not required.

Test procedure

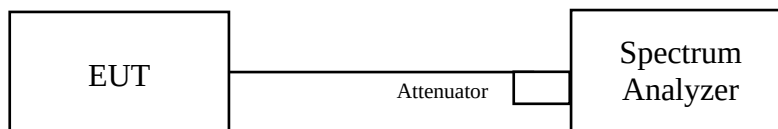
Measurement Procedure REF

- Set the RBW = 100 kHz.
- Set the VBW $\geq$ 300 kHz.
- Set the span to 1.5 times the DTS bandwidth.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Measurement Procedure OOBE

- Set RBW = 100 kHz.
- Set VBW $\geq$ 300 kHz.
- Detector = peak.
- Sweep = auto couple.
- Trace Mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

Test Setup



The loss between RF output port of the EUT and the input port of the Spectrum Analyzer has been taken into consideration.

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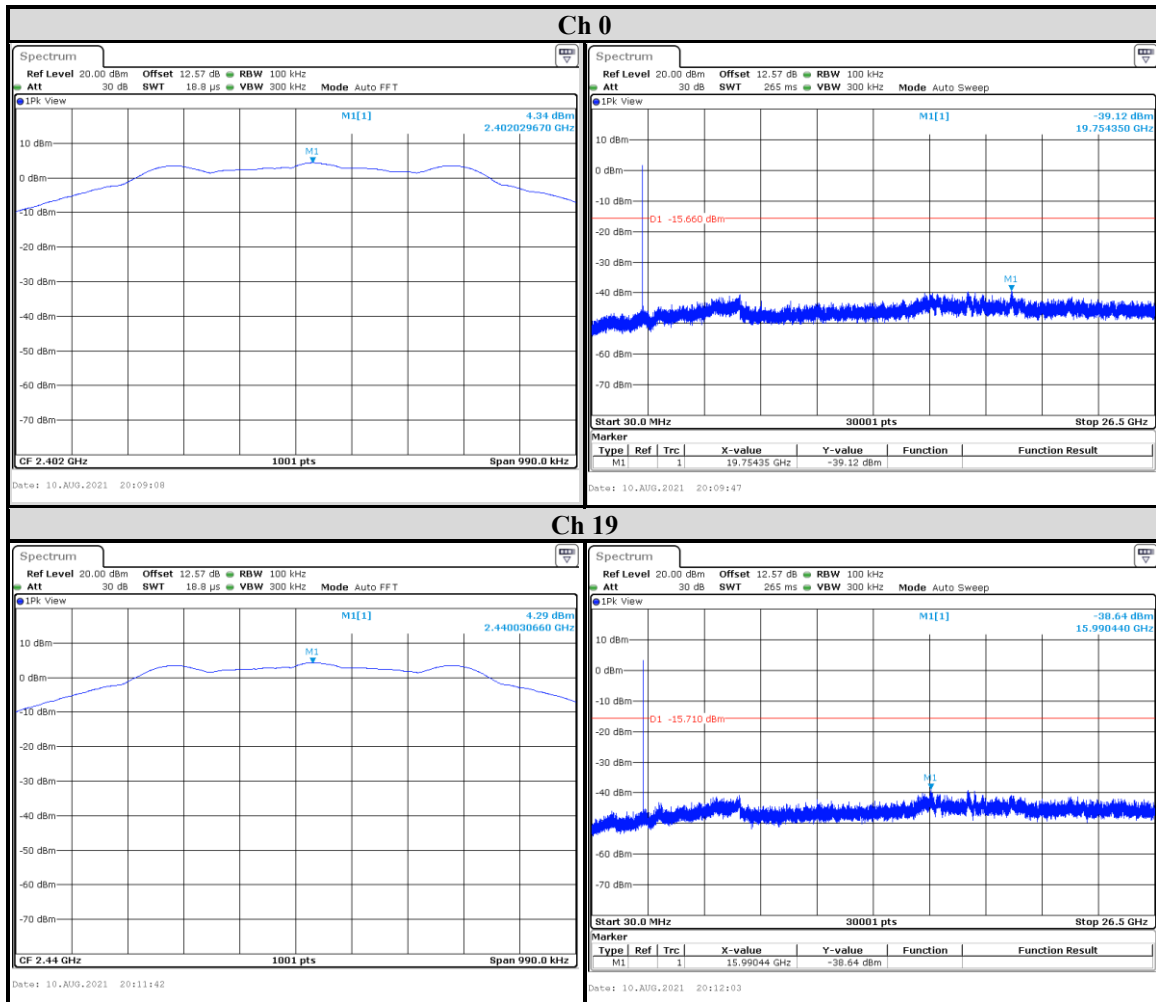
Doc No: 17-EM-F0876 / 6.0



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Test Data

BT LE_1Mbps



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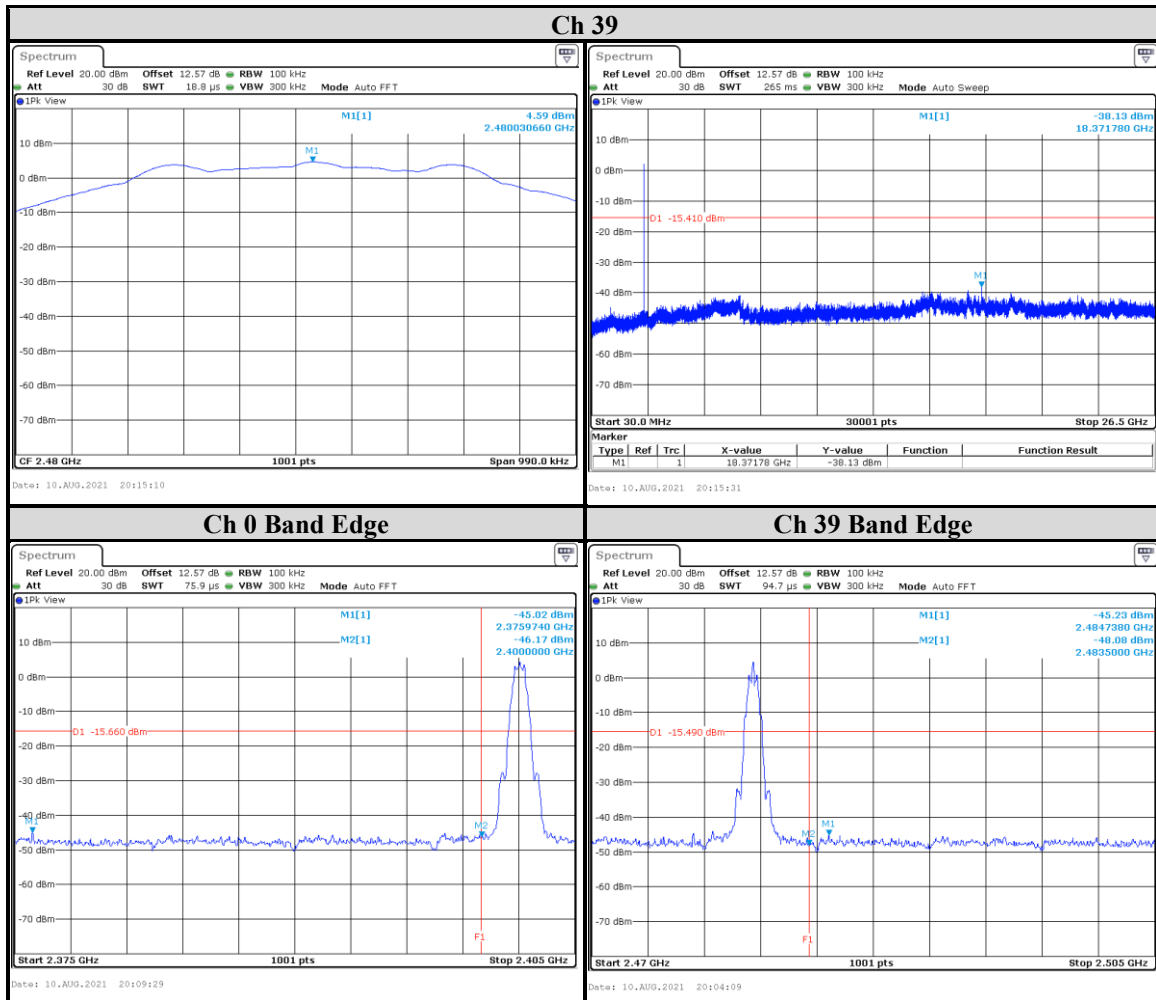
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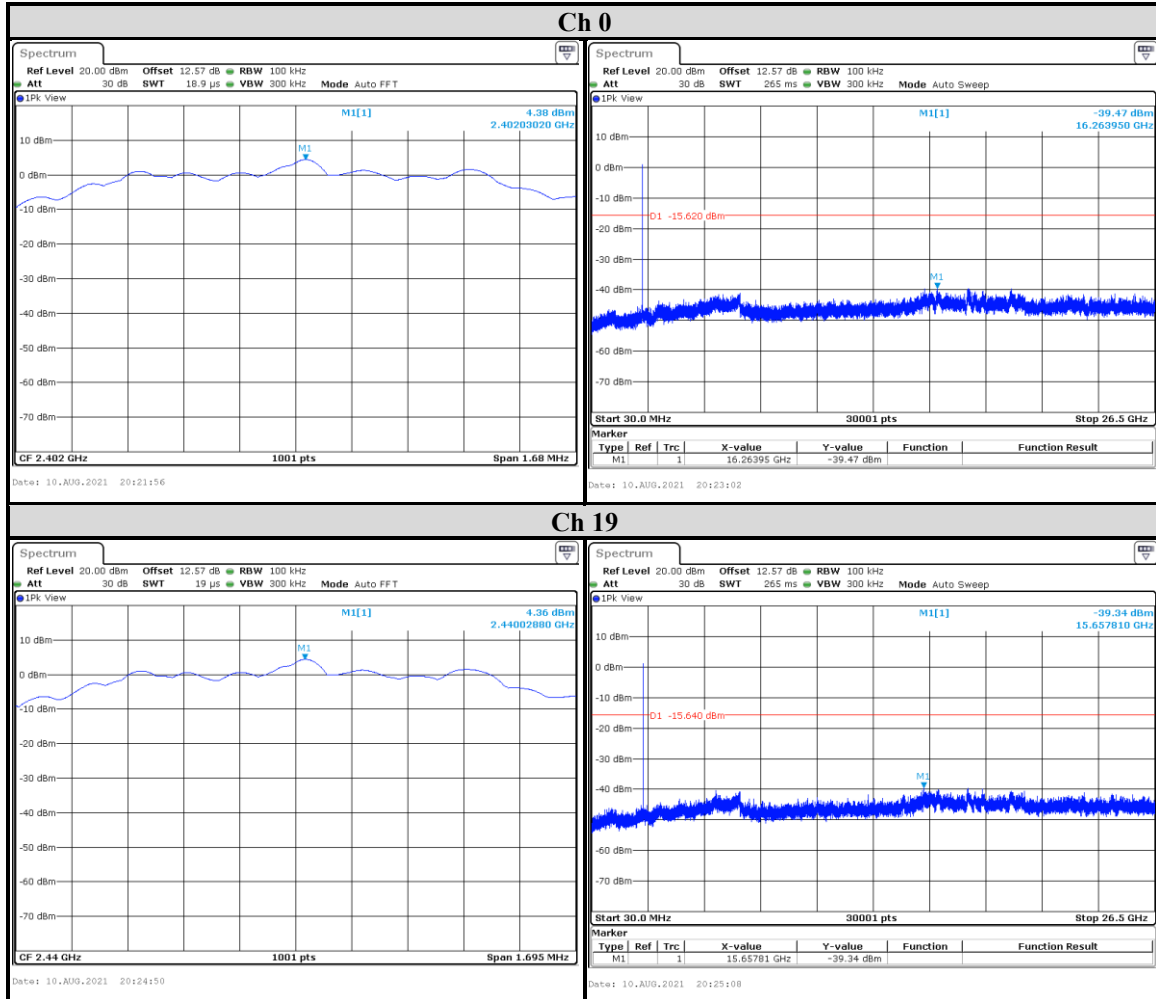
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BT LE_2Mbps



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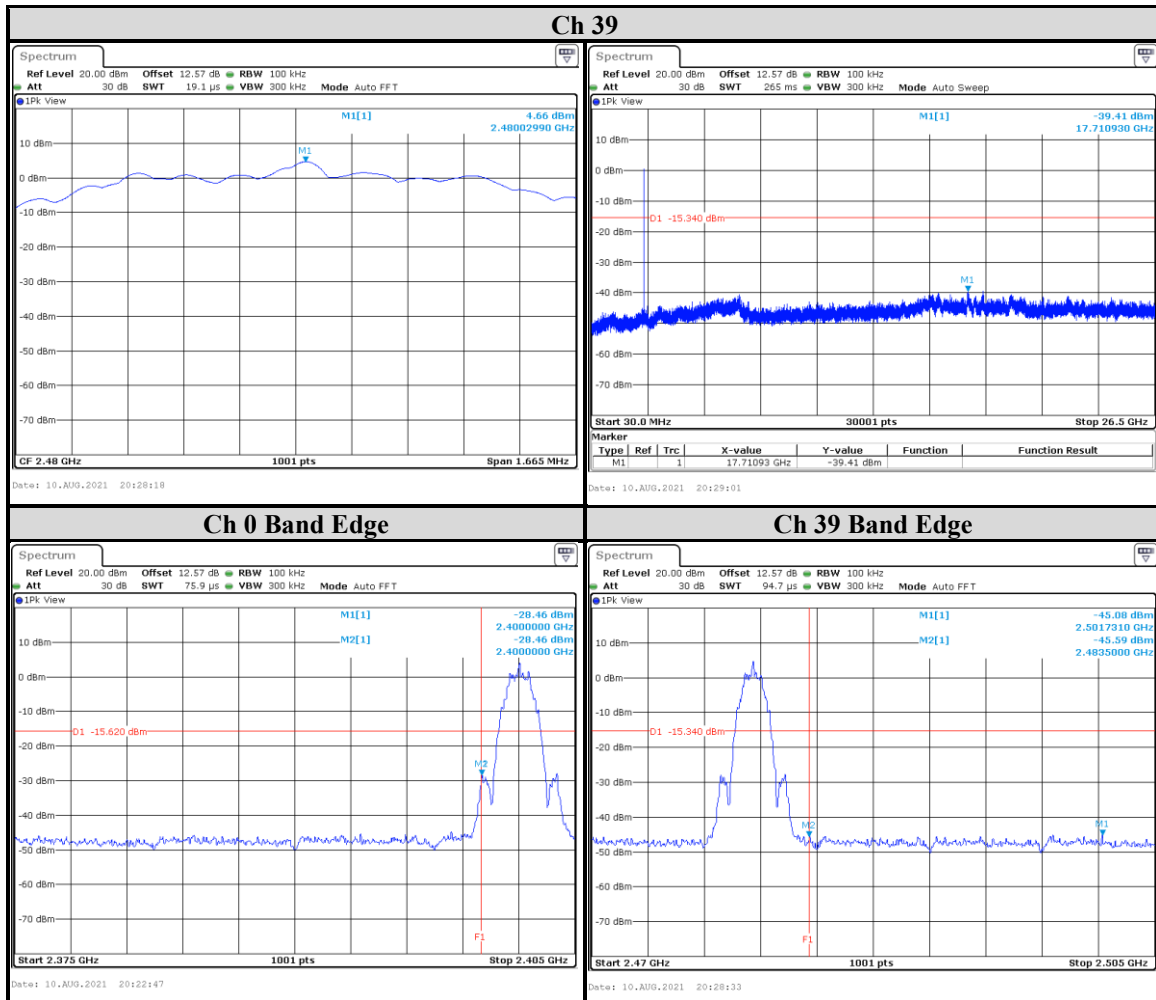
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9.5. Radiated Spurious Emission

Requirements

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

Frequency(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

NOTE:

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 1000MHz, 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 20dB under any condition of modulation.

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Test Procedures

[For 9 kHz ~ 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. 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. For measurement below 30MHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

[For above 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. 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.
- d. 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. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
- f. The test-receiver system 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.

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Note:

- a. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- b. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- c. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.

Configuration	Average	
	RBW	VBW
BT LE_1Mbps	1MHz	510Hz
BT LE_2Mbps	1MHz	1kHz

Note: Refer to section 6.6 for duty cycle.

- d. All modes of operation were investigated (includes all external accessories) and the worst-case emissions are reported.
- e. Test data of Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
- f. Test data of Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
- g. Test data of Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
- h. Test data of Notation "@" = Fundamental Frequency
- i. Test data of Notation "*" = The peak result under 20 dB above and complies with AVG limit, AVG result is deemed to comply with AVG limit.

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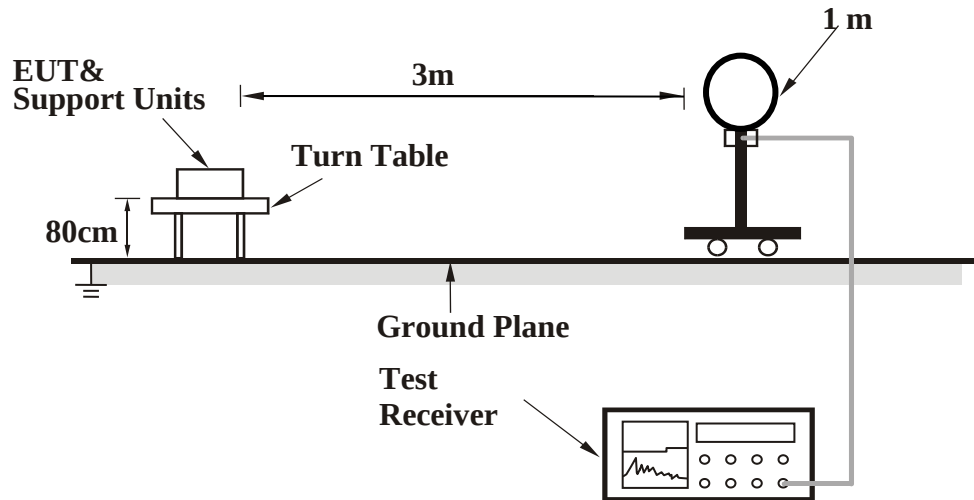
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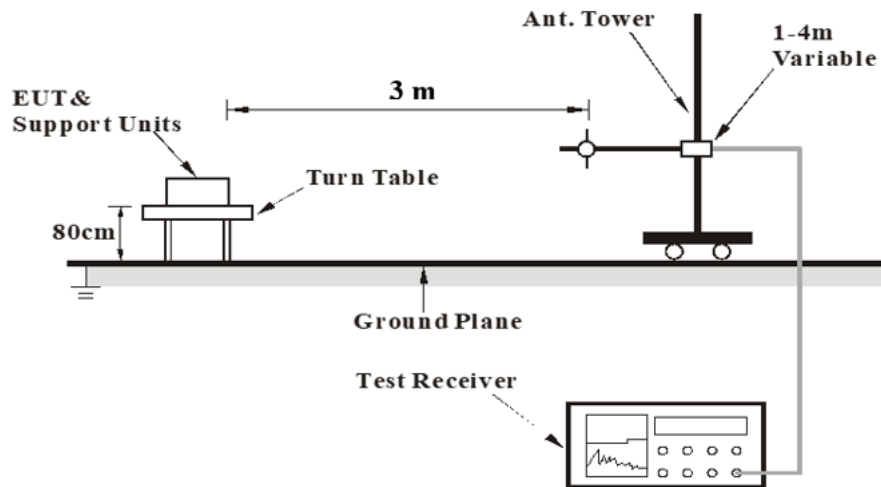
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Test Setup

<Frequency Range 9 kHz ~ 30 MHz>



<Frequency Range 30 MHz ~ 1 GHz >



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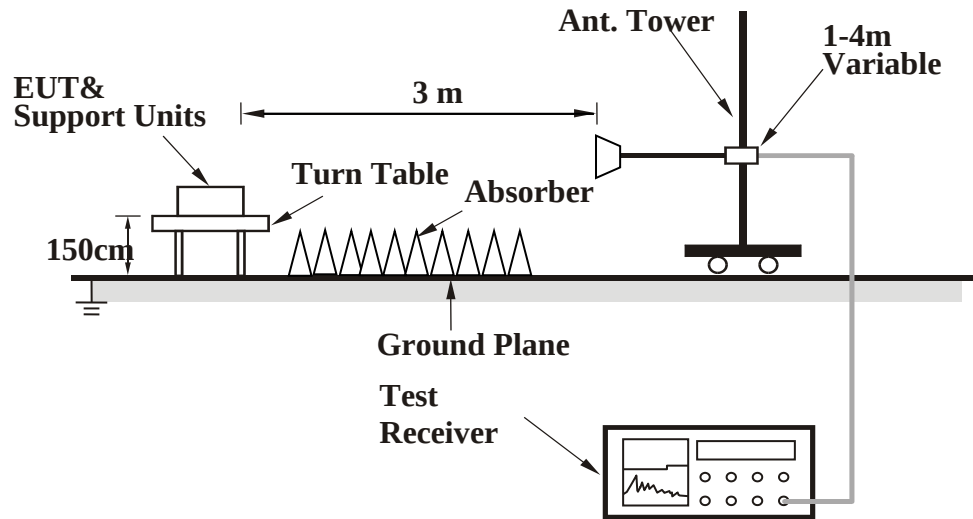
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<Frequency Range above 1 GHz>



For the actual test configuration, please refer to the Setup Configurations.

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Test Data

Above 1G

Mode	BT-LE-1Mbps	Channel	0
------	-------------	---------	---

Polarization	Notation	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
Horizontal		2371.18	40.34	6.07	46.41	74	-27.59	PK
		2388.66	28.91	6.1	35.01	54	-18.99	AVG
	@	2402	78.95	6.13	85.08	N/A	N/A	PK
	@	2402	77.93	6.13	84.06	N/A	N/A	AVG
	*	4804	37.48	2.46	39.94	74	-34.06	PK
Vertical		2350.09	41.11	6.03	47.14	74	-26.86	PK
		2386.95	28.8	6.1	34.9	54	-19.1	AVG
	@	2402	90.16	6.13	96.29	N/A	N/A	PK
	@	2402	89.53	6.13	95.66	N/A	N/A	AVG
	*	4804	38.23	2.46	40.69	74	-33.31	PK

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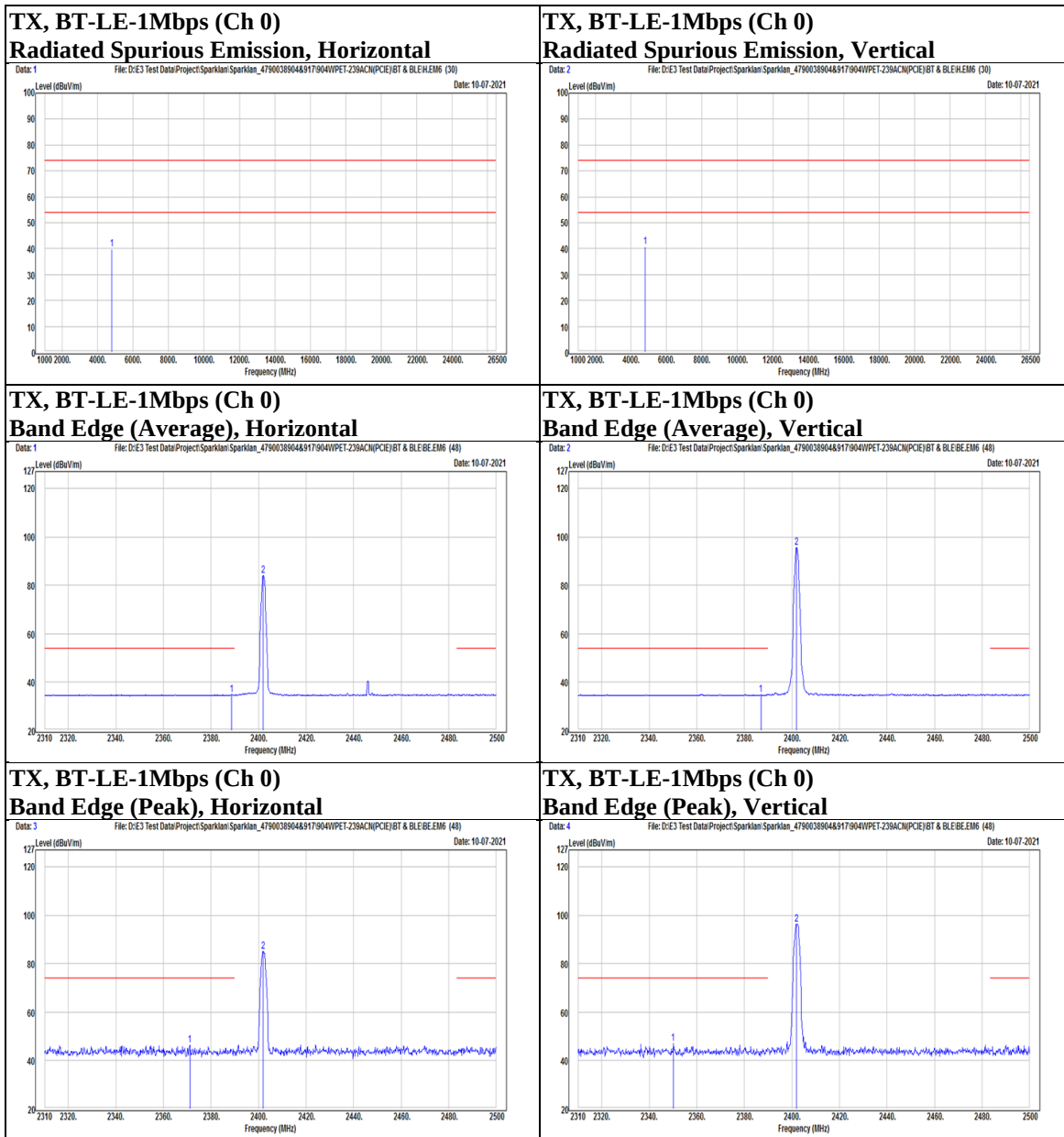
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Mode	BT-LE-1Mbps	Channel	19
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Polarization	Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Horizontal		2366.62	39.95	6.06	46.01	74	-27.99	PK
		2389.42	28.87	6.1	34.97	54	-19.03	AVG
	@	2440	76.57	6.11	82.68	N/A	N/A	PK
	@	2440	75.77	6.11	81.88	N/A	N/A	AVG
		2488.03	28.77	6.1	34.87	54	-19.13	AVG
		2497.72	39.65	6.1	45.75	74	-28.25	PK
Vertical	*	4880	36.17	2.66	38.83	74	-35.17	PK
		2311.9	28.68	6.19	34.87	54	-19.13	AVG
		2379.92	41.17	6.08	47.25	74	-26.75	PK
	@	2440	91.5	6.11	97.61	N/A	N/A	PK
	@	2440	90.57	6.11	96.68	N/A	N/A	AVG
		2486.13	39.97	6.1	46.07	74	-27.93	PK
		2499.81	28.75	6.1	34.85	54	-19.15	AVG
	*	4880	36.53	2.66	39.19	74	-34.81	PK

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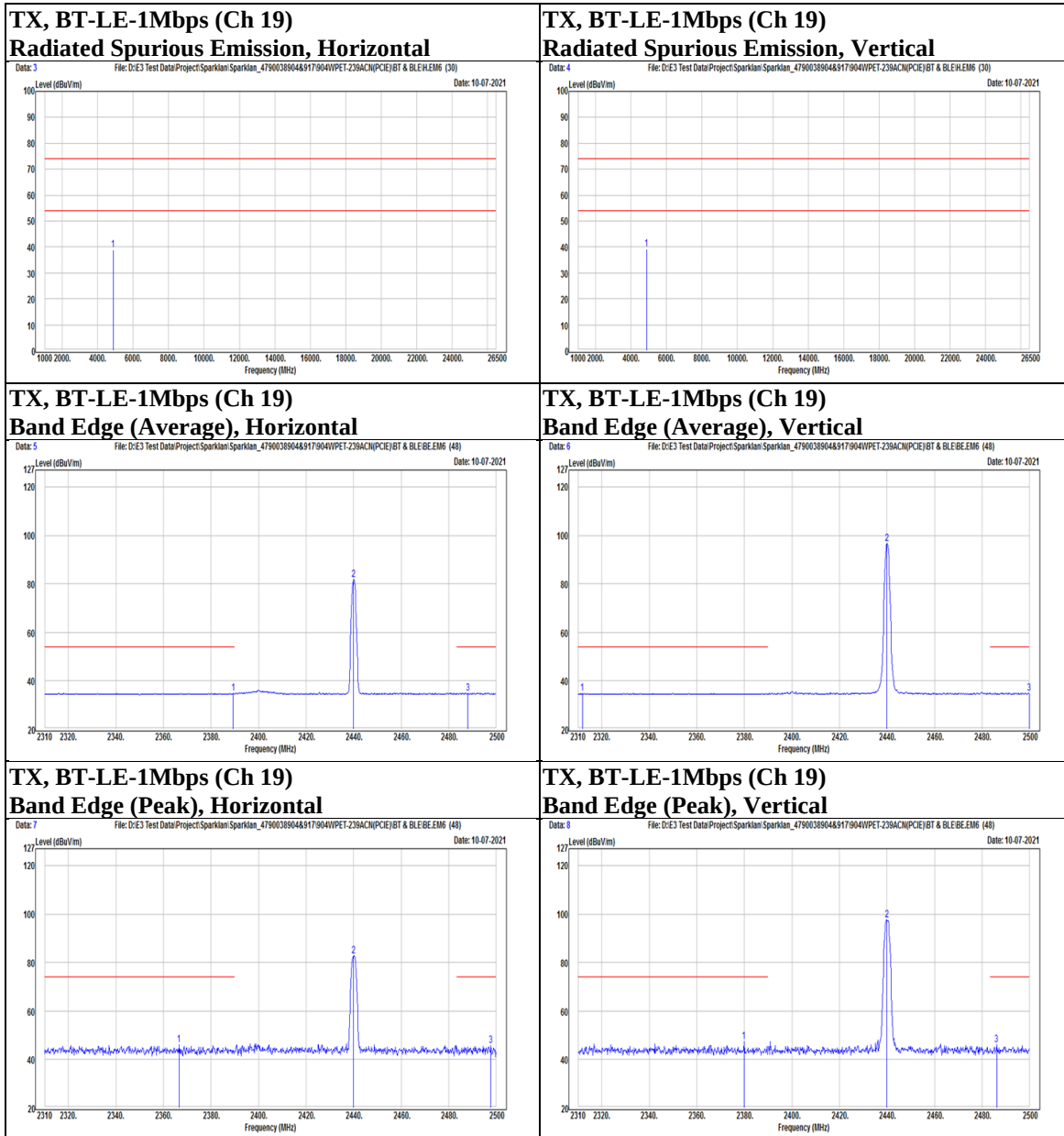
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Mode	BT-LE-1Mbps	Channel	39
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Polarization	Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Horizontal	@	2480	74.34	6.1	80.44	N/A	N/A	PK
	@	2480	73.15	6.1	79.25	N/A	N/A	AVG
		2486.32	28.76	6.1	34.86	54	-19.14	AVG
		2487.08	39.75	6.1	45.85	74	-28.15	PK
	*	4960	36.26	2.62	38.88	74	-35.12	PK
Vertical	@	2480	90.18	6.1	96.28	N/A	N/A	PK
	@	2480	89.79	6.1	95.89	N/A	N/A	AVG
		2484.23	29.33	6.1	35.43	54	-18.57	AVG
		2496.58	40.38	6.1	46.48	74	-27.52	PK
	*	4960	37.53	2.62	40.15	74	-33.85	PK

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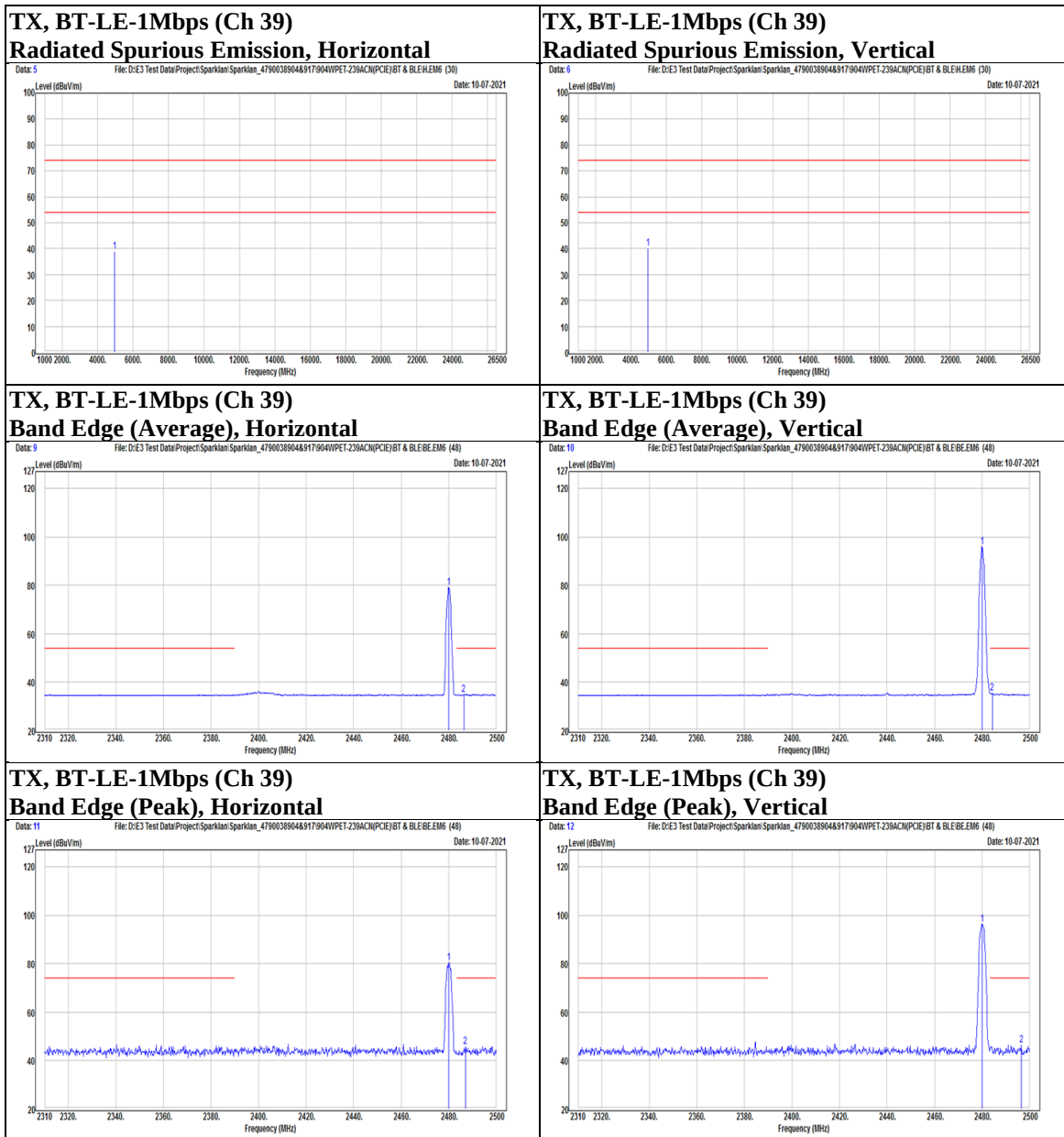
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Mode	BT-LE-2Mbps	Channel	0
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Polarization	Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Horizontal		2323.11	28.8	6.14	34.94	54	-19.06	AVG
		2372.51	40.12	6.08	46.2	74	-27.8	PK
	@	2402	79.15	6.13	85.28	N/A	N/A	PK
	@	2402	75.62	6.13	81.75	N/A	N/A	AVG
	*	4804	36.12	2.46	38.58	74	-35.42	PK
Vertical		2334.32	28.72	6.09	34.81	54	-19.19	AVG
		2374.79	40.58	6.08	46.66	74	-27.34	PK
	@	2402	89.96	6.13	96.09	N/A	N/A	PK
	@	2402	87.67	6.13	93.8	N/A	N/A	AVG
	*	4804	38.47	2.46	40.93	74	-33.07	PK

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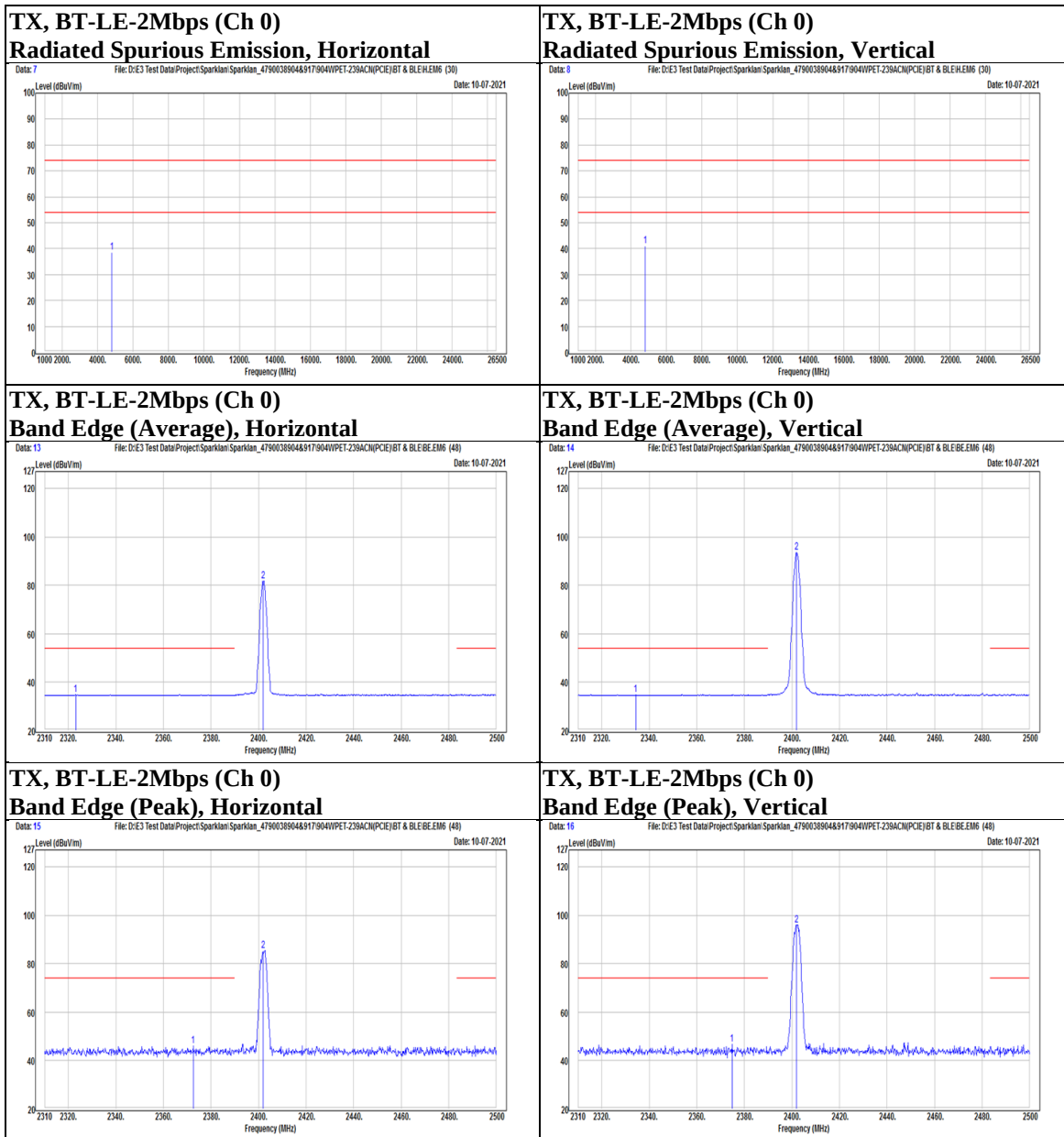
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Mode	BT-LE-2Mbps	Channel	19
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Polarization	Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Horizontal		2310.57	40.22	6.2	46.42	74	-27.58	PK
		2311.52	28.65	6.19	34.84	54	-19.16	AVG
	@	2440	76.24	6.11	82.35	N/A	N/A	PK
	@	2440	73.47	6.11	79.58	N/A	N/A	AVG
		2488.98	28.8	6.1	34.9	54	-19.1	AVG
		2499.62	40.55	6.1	46.65	74	-27.35	PK
Vertical	*	4880	37.15	2.66	39.81	74	-34.19	PK
		2314.75	40.61	6.18	46.79	74	-27.21	PK
		2389.8	28.83	6.1	34.93	54	-19.07	AVG
	@	2440	91.41	6.11	97.52	N/A	N/A	PK
	@	2440	88.51	6.11	94.62	N/A	N/A	AVG
		2485.94	40.72	6.1	46.82	74	-27.18	PK
		2489.17	28.87	6.1	34.97	54	-19.03	AVG
	*	4880	36.47	2.66	39.13	74	-34.87	PK

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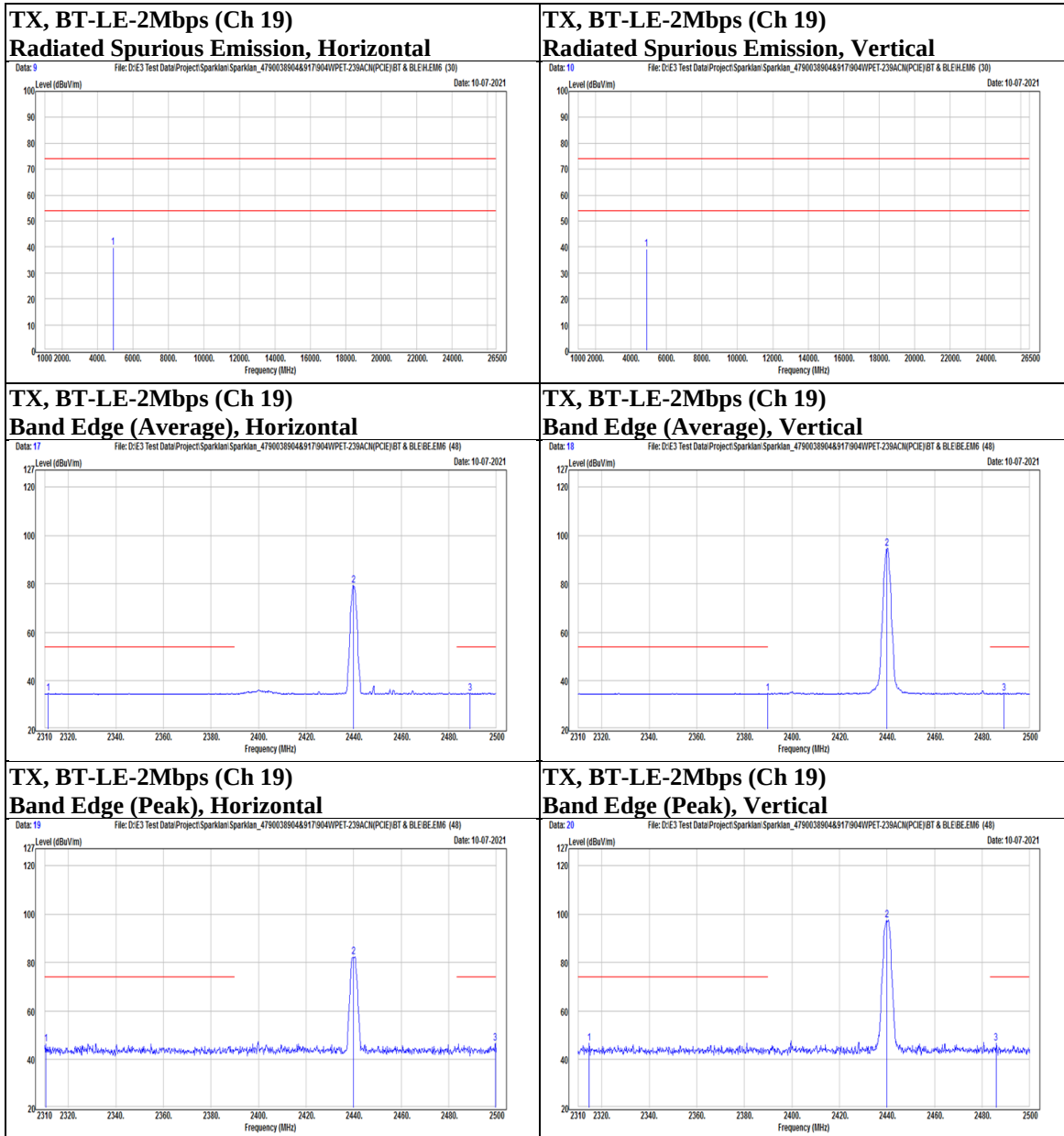
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Mode	BT-LE-2Mbps	Channel	39
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Polarization	Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Horizontal	@	2480	74.16	6.1	80.26	N/A	N/A	PK
	@	2480	71.71	6.1	77.81	N/A	N/A	AVG
		2487.65	39.92	6.1	46.02	74	-27.98	PK
		2490.12	28.74	6.1	34.84	54	-19.16	AVG
	*	4960	36.52	2.62	39.14	74	-34.86	PK
Vertical	@	2480	89.76	6.1	95.86	N/A	N/A	PK
	@	2480	86.2	6.1	92.3	N/A	N/A	AVG
		2483.66	29.65	6.1	35.75	54	-18.25	AVG
		2498.29	40.16	6.1	46.26	74	-27.74	PK
	*	4960	35.91	2.62	38.53	74	-35.47	PK

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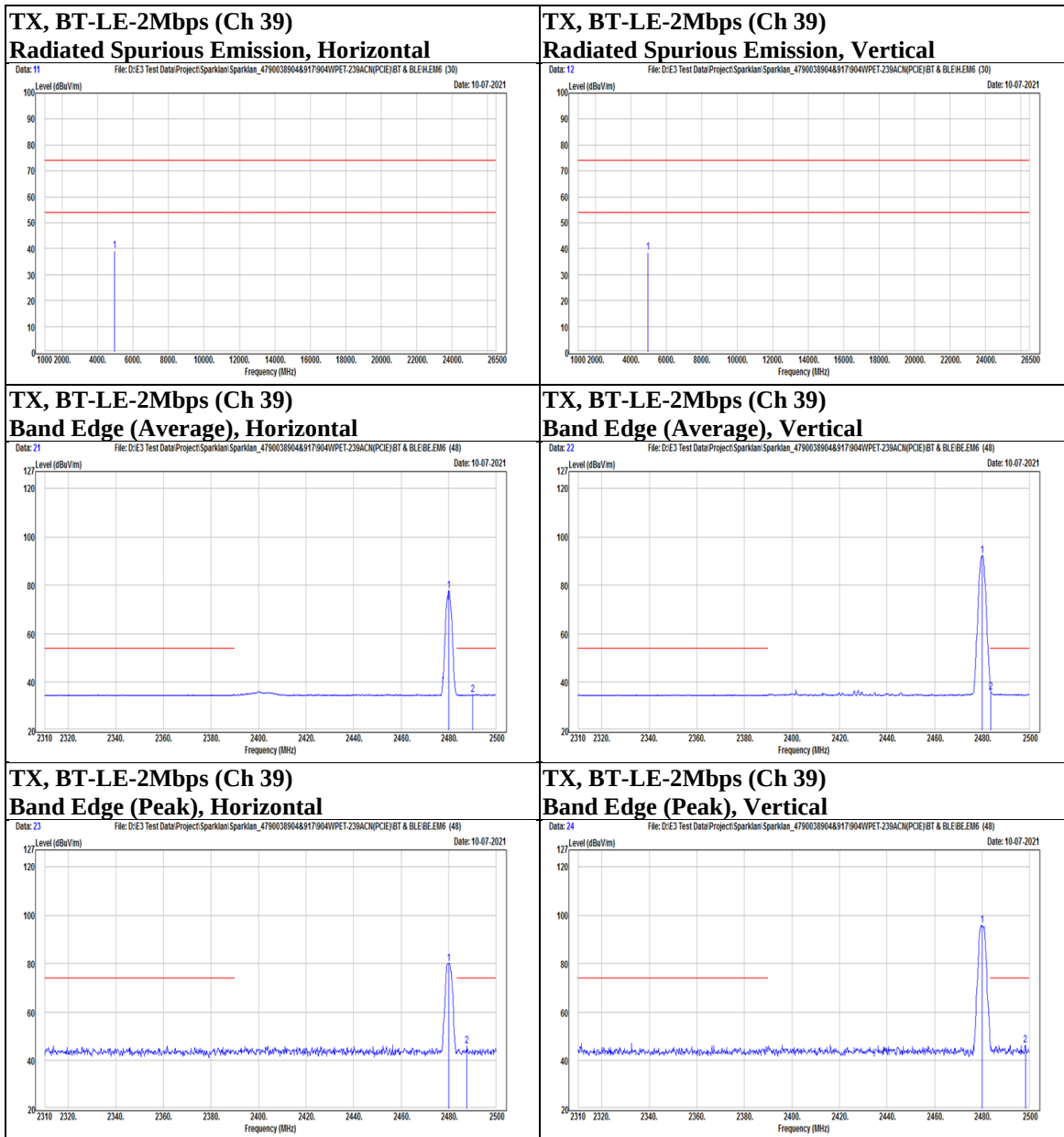
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Below 1G

Mode	BT-LE-1Mbps	Channel	0
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Polarization	Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Horizontal		78.5	43.96	-16	27.96	40	-12.04	PK
		143.49	40.51	-11.81	28.7	43.5	-14.8	PK
		200.72	48.85	-13.91	34.94	43.5	-8.56	PK
		326.82	41.32	-9.1	32.22	46	-13.78	PK
		479.11	38.96	-5.18	33.78	46	-12.22	PK
		959.26	33.4	3.89	37.29	46	-8.71	PK
Vertical		32.91	39.68	-12.4	27.28	40	-12.72	PK
		78.5	41.58	-16	25.58	40	-14.42	PK
		186.17	37.18	-12.89	24.29	43.5	-19.21	PK
		323.91	36.97	-9.18	27.79	46	-18.21	PK
		482.99	42.23	-5.06	37.17	46	-8.83	PK
		960.23	33.16	3.89	37.05	54	-16.95	PK

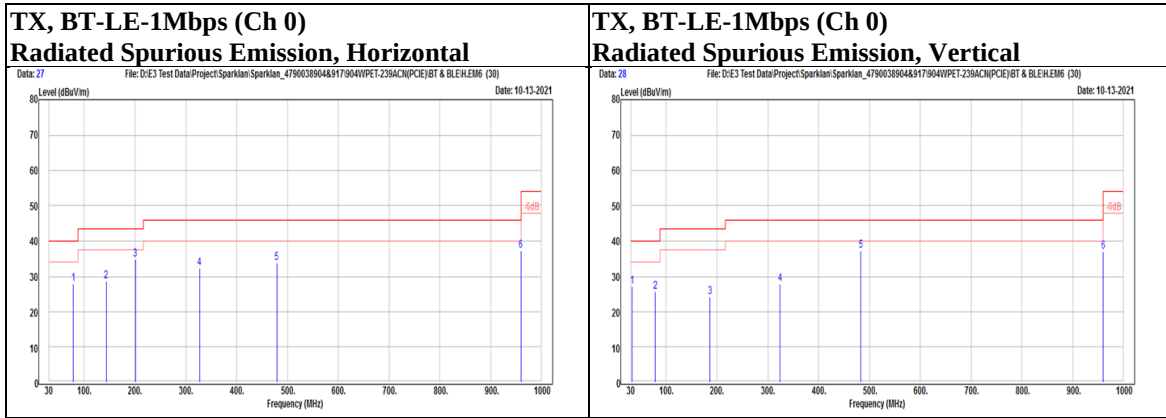
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Mode	BT-LE-2Mbps	Channel	0
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Polarization	Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Horizontal		78.5	41.4	-16	25.4	40	-14.6	PK
		205.57	48.39	-13.94	34.45	43.5	-9.05	PK
		286.08	39.67	-10.39	29.28	46	-16.72	PK
		339.43	40.62	-8.76	31.86	46	-14.14	PK
		480.08	38.21	-5.19	33.02	46	-12.98	PK
		961.2	32.83	3.9	36.73	54	-17.27	PK
Vertical		31.94	38.61	-12.47	26.14	40	-13.86	PK
		78.5	41.99	-16	25.99	40	-14.01	PK
		159.98	37.42	-11.08	26.34	43.5	-17.16	PK
		323.91	36.78	-9.18	27.6	46	-18.4	PK
		481.05	41.65	-5.15	36.5	46	-9.5	PK
		956.35	32.22	3.87	36.09	46	-9.91	PK

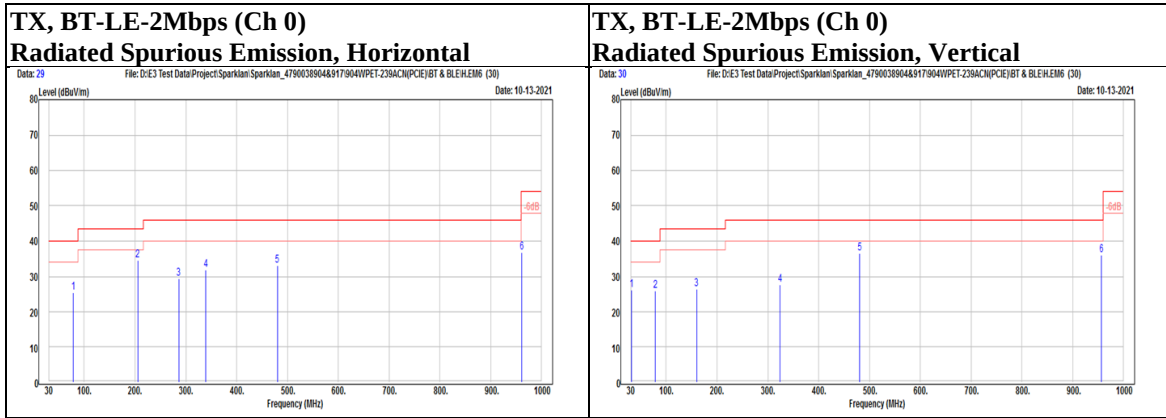
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9.6. AC Power Line Conducted Emission

Requirements

Frequency (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	60	50

Note:

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 0.50MHz.

Test Procedures

- a. The EUT was 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/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.
2. All modes of operation were investigated (includes all external accessories) and the worst-case emissions are reported, the other emission levels were low against the limit.
3. Test data of Result value (dBuV) = Reading value (dBuV) + Correction Factor (dB).
4. Test data of Margin(dB) = Result value (dBuV) - Limit value (dBuV).
5. Test data of Correction Factor (dB) = Insertion loss(dB) + Cable loss(dB).

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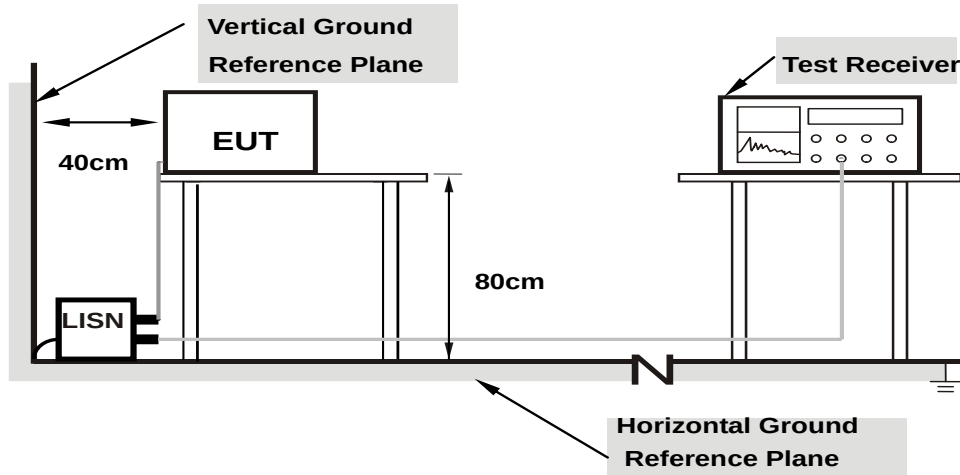
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Test Setup



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

For the actual test configuration, please refer to the Setup Configurations.

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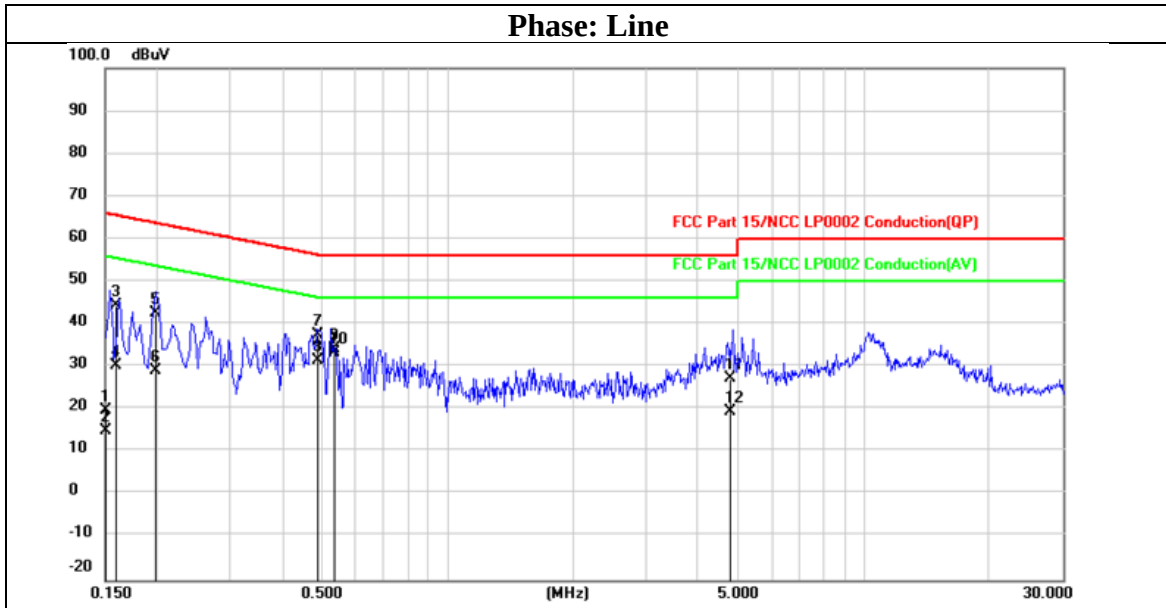
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Test Data

Mode	TX_BLE(1M)	Channel	0
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1491	0.38	19.49	19.87	66.05	-46.18	QP
2	0.1491	-4.41	19.49	15.08	56.05	-40.97	AVG
3	0.1584	24.88	19.49	44.37	65.55	-21.18	QP
4	0.1584	10.73	19.49	30.22	55.55	-25.33	AVG
5	0.1973	23.16	19.49	42.65	63.72	-21.07	QP
6	0.1973	9.60	19.49	29.09	53.72	-24.63	AVG
7	0.4864	18.02	19.49	37.51	56.23	-18.72	QP
8	0.4864	12.03	19.49	31.52	46.23	-14.71	AVG
9	0.5334	14.74	19.50	34.24	56.00	-21.76	QP
10	0.5334	13.80	19.50	33.30	46.00	-12.70	AVG
11	4.7869	7.80	19.60	27.40	56.00	-28.60	QP
12	4.7869	-0.01	19.60	19.59	46.00	-26.41	AVG

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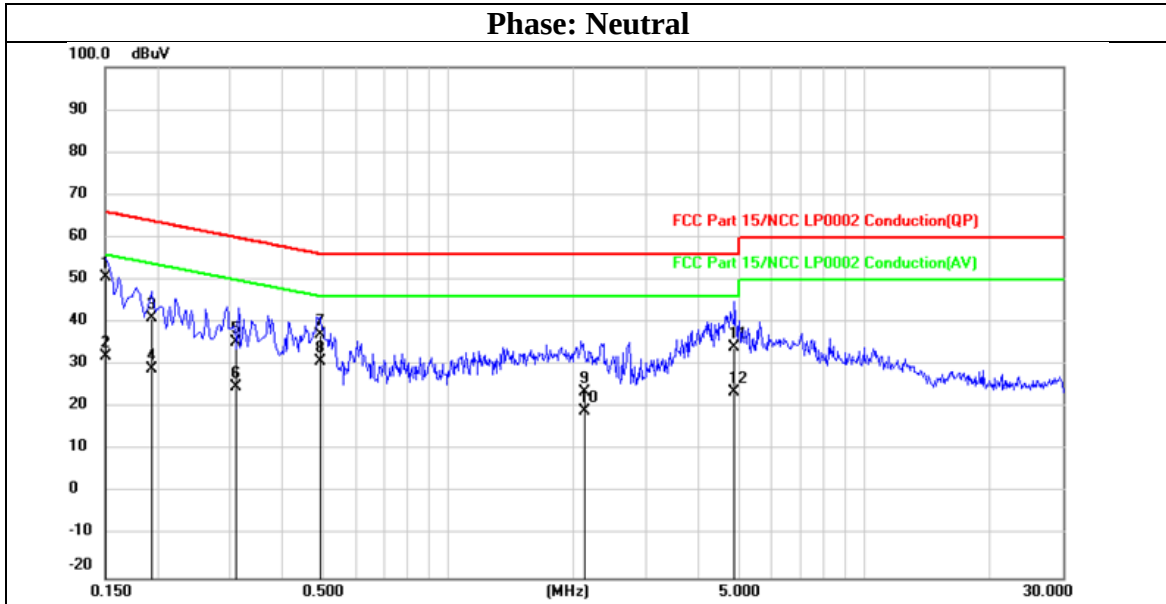
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Mode	TX_BLE(1M)	Channel	0
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1511	31.18	19.49	50.67	65.94	-15.27	QP
2	0.1511	12.68	19.49	32.17	55.94	-23.77	AVG
3	0.1943	21.61	19.49	41.10	63.85	-22.75	QP
4	0.1943	9.67	19.49	29.16	53.85	-24.69	AVG
5	0.3091	15.85	19.49	35.34	59.99	-24.65	QP
6	0.3091	5.47	19.49	24.96	49.99	-25.03	AVG
7	0.4944	17.75	19.49	37.24	56.09	-18.85	QP
8	0.4944	11.37	19.49	30.86	46.09	-15.23	AVG
9	2.1345	4.06	19.52	23.58	56.00	-32.42	QP
10	2.1345	-0.30	19.52	19.22	46.00	-26.78	AVG
11	4.8668	14.44	19.60	34.04	56.00	-21.96	QP
12	4.8668	4.13	19.60	23.73	46.00	-22.27	AVG

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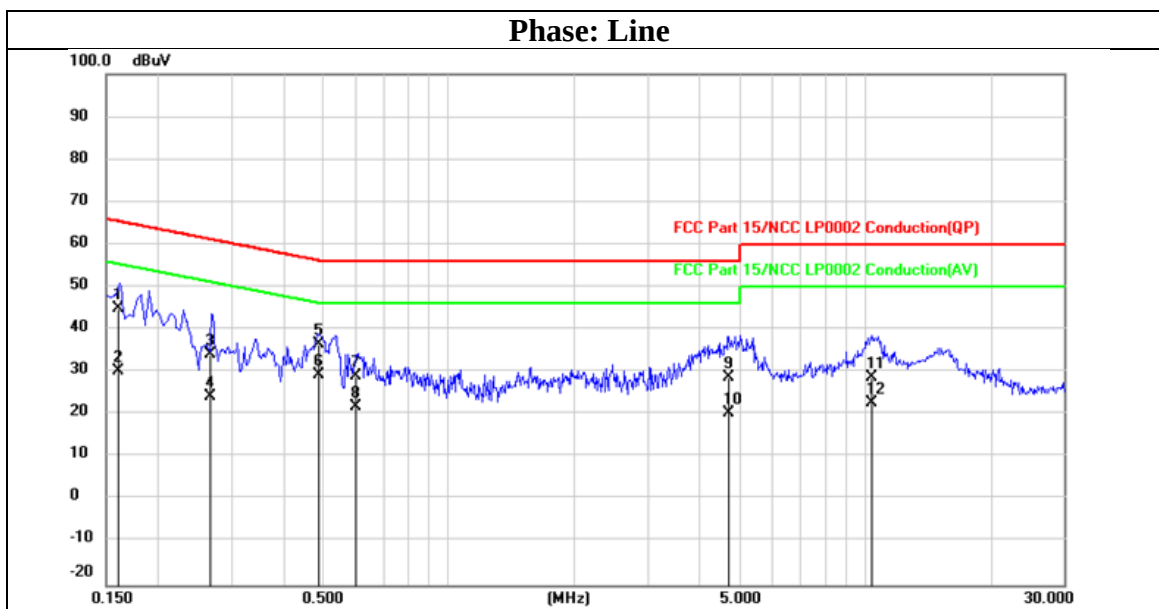
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Mode	TX_BLE(2M)	Channel	0
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1598	25.33	19.49	44.82	65.47	-20.65	QP
2	0.1598	10.73	19.49	30.22	55.47	-25.25	AVG
3	0.2670	14.55	19.49	34.04	61.21	-27.17	QP
4	0.2670	4.76	19.49	24.25	51.21	-26.96	AVG
5	0.4870	17.09	19.49	36.58	56.22	-19.64	QP
6	0.4870	9.78	19.49	29.27	46.22	-16.95	AVG
7	0.5951	9.67	19.50	29.17	56.00	-26.83	QP
8	0.5951	2.35	19.50	21.85	46.00	-24.15	AVG
9	4.7336	9.05	19.59	28.64	56.00	-27.36	QP
10	4.7336	0.66	19.59	20.25	46.00	-25.75	AVG
11	10.3760	9.03	19.70	28.73	60.00	-31.27	QP
12	10.3760	2.93	19.70	22.63	50.00	-27.37	AVG

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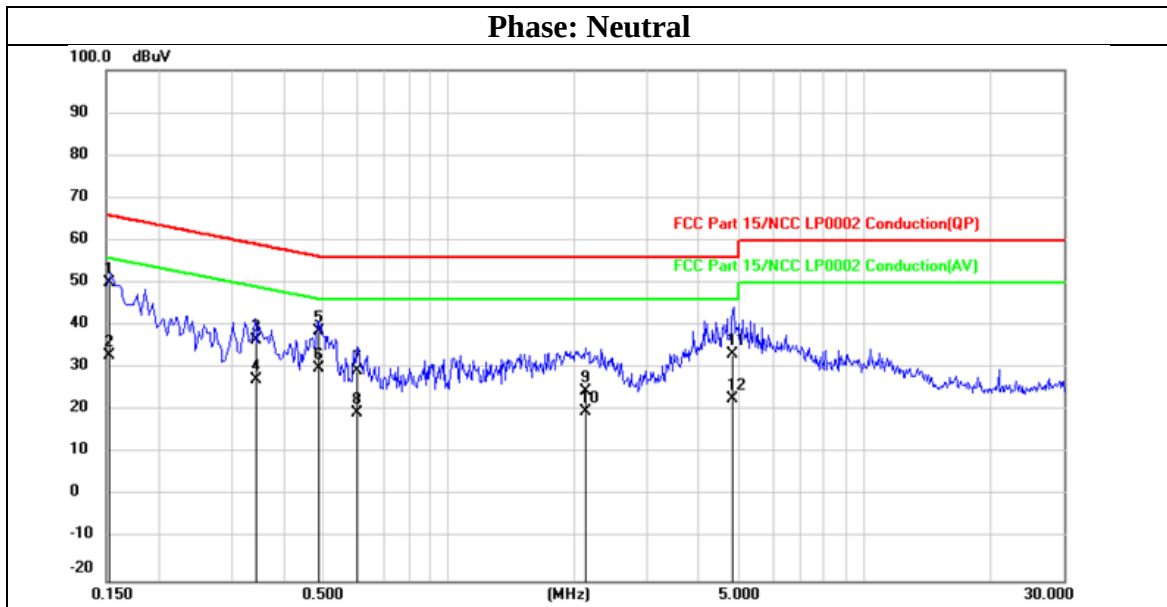
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Mode	TX_BLE(2M)	Channel	0
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1517	30.50	19.49	49.99	65.91	-15.92	QP
2	0.1517	13.46	19.49	32.95	55.91	-22.96	AVG
3	0.3434	17.12	19.49	36.61	59.12	-22.51	QP
4	0.3434	7.73	19.49	27.22	49.12	-21.90	AVG
5	0.4868	19.31	19.49	38.80	56.22	-17.42	QP
6	0.4868	10.47	19.49	29.96	46.22	-16.26	AVG
7	0.6031	9.78	19.50	29.28	56.00	-26.72	QP
8	0.6031	-0.09	19.50	19.41	46.00	-26.59	AVG
9	2.1345	5.18	19.52	24.70	56.00	-31.30	QP
10	2.1345	0.23	19.52	19.75	46.00	-26.25	AVG
11	4.7947	13.55	19.60	33.15	56.00	-22.85	QP
12	4.7947	3.17	19.60	22.77	46.00	-23.23	AVG

END OF REPORT

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