

RADIO TEST REPORT

FCC 47 CFR PART 15 SUBPART C

Test Standard	FCC Part 15.247
Product name	BLE Gateway Antenna
Brand Name	Vantage
Model No.	05-0069
Test Result	Pass
Statements of Conformity	Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report.

The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory)

Approved by:



Kevin Tsai
Deputy Manager

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

除非另有說明，此報告結果僅對測試之樣品負責，同時此樣品僅保留90天。本報告未經本公司書面許可，不可部份複製。

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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	May 28, 2021	Initial Issue	ALL	Allison Chen
01	June 3, 2021	See the following Note Rev.(01)	P.9-10, P.13, P.29	Allison Chen

Note:

Rev.(01)

1. Added adapter of NB in section 1.7 and remark for clause 15.203.
2. Modified test data to match test plots in duty cycle and PSD of BLE-1M at CH mid.

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1. GENERAL INFORMATION

1.1 EUT INFORMATION

Applicant	WhiteWater West, INC. 1110 Boston Avenue, Suite 100Longmont, CO 80501, USA
Manufacturer	Altasec Technology Corporation 12F-5, No. 75, Sec. 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 221, Taiwan (R.O.C.)
Equipment	BLE Gateway Antenna
Model No.	05-0069
Model Discrepancy	N/A
Trade Name	Vantage
Received Date	April 13, 2021
Date of Test	April 28 ~ May 4, 2021
Power Supply	EUT power from USB.

Remark:

1. For more details, refer to the User's manual of the EUT.
2. Disclaimer: Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.



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1.2 EUT CHANNEL INFORMATION

Frequency Range	2402MHz-2480MHz
Modulation Type	GFSK for BLE 1 Mbps & 2 Mbps
Number of channels	40 Channels

Remark:

Refer as ANSI C63.10: 2013 clause 5.6.1 Table 4 for test channels

Number of frequencies to be tested		
Frequency range in which device operates	Number of frequencies	Location in frequency range of operation
☐ 1 MHz or less	1	Middle
☐ 1 MHz to 10 MHz	2	1 near top and 1 near bottom
☒ More than 10 MHz	3	1 near top, 1 near middle, and 1 near bottom

1.3 ANTENNA INFORMATION

Antenna Type	☐ PIFA ☒ PCB ☐ Dipole ☐ Chip
Antenna Gain	8.26 dBi
Antenna Connector	N/A

Remark:

1. The antenna(s) of the EUT are permanently attached and there are no provisions for connection to an external antenna. So the EUT complies with the requirements of §15.203.



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1.4 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	+/- 1.2575
Emission bandwidth, 20dB bandwidth	+/- 0.0014
RF output power, conducted	+/- 1.14
Power density, conducted	+/- 1.40
3M Semi Anechoic Chamber / 9kHz~30MHz	+/- 2.30
3M Semi Anechoic Chamber / 30MHz~200MHz	+/- 4.12
3M Semi Anechoic Chamber / 200MHz~1000MHz	+/- 4.68
3M Semi Anechoic Chamber / 1GHz~8GHz	+/- 5.18
3M Semi Anechoic Chamber / 8GHz~18GHz	+/- 5.47
3M Semi Anechoic Chamber / 18GHz~26GHz	+/- 3.81
3M Semi Anechoic Chamber / 26GHz~40GHz	+/- 3.87

Remark:

- 1.This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2
2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.

1.5 FACILITIES AND TEST LOCATION

All measurement facilities used to collect the measurement data are located at No.11, Wugong 6th Rd., Wugu Dist., New Taipei City, Taiwan. (R.O.C.)

Test site	Test Engineer	Remark
AC Conduction Room	Jerry Chang	-
Radiation	Ray Li	-
RF Conducted	Jerry Chang	-

Remark: The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

1.6 INSTRUMENT CALIBRATION

RF Conducted Test Site					
Equipment	Manufacturer	Model	Serial Number	Cal Date	Cal Due
Coaxial Cable	Woken	WC12	CC003	06/29/2020	06/28/2021
Signal Analyzer	R&S	FSV 40	101073	09/17/2020	09/16/2021
Power Meter	Anritsu	ML2487A	6K00003260	05/21/2020	05/20/2021
Power Seneor	Anritsu	MA2490A	032910	05/21/2020	05/20/2021
Software	N/A				

AC power line Conduction Test Room					
Equipment	Manufacturer	Model	Serial Number	Cal Date	Cal Due
CABLE	EMCI	CFD300-NL	CERF	06/29/2020	06/28/2021
EMI Test Receiver	R&S	ESCI	100064	07/17/2020	07/16/2021
LISN	SCHAFFNER	NNB 41	03/10013	02/02/2021	02/01/2022
Software	EZ-EMC(CCS-3A1-CE-wugu)				

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. N.C.R. = No Calibration Required.

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3M 966 Chamber Test Site					
Equipment	Manufacturer	Model	Serial Number	Cal Date	Cal Due
Band Reject Filters	MICRO TRONICS	BRM 50702	120	02/08/2021	02/07/2022
Bilog Antenna	Sunol Sciences	JB3	A030105	07/24/2020	07/23/2021
Horn Antenna	ETS LINDGREN	3116	00026370	12/11/2020	12/10/2021
Coaxial Cable	HUBER SUHNER	SUCOFLEX 104PEA	20995	02/24/2021	02/23/2022
Coaxial Cable	EMCI	EMC105	190914+327109/4	09/19/2020	09/18/2021
K Type Cable	Huber+Suhner	SUCOFLEX 102	29406/2	12/09/2020	12/08/2021
K Type Cable	Huber+Suhner	SUCOFLEX 102	22470/2	12/09/2020	12/08/2021
Digital Thermo-Hygro Meter	WISEWIND	1206	D07	01/06/2021	01/05/2022
double Ridged Guide Horn Antenna	ETC	MCTD 1209	DRH13M02003	09/30/2020	09/29/2021
Loop Ant	COM-POWER	AL-130	121051	04/07/2021	04/06/2022
Pre-Amplifier	EMEC	EM330	060609	02/24/2021	02/23/2022
Pre-Amplifier	HP	8449B	3008A00965	12/25/2020	12/24/2021
Pre-Amplifier	MITEQ	AMF-6F-18004000-37-8P	985646	09/02/2020	09/01/2021
PSA Series Spectrum Analyzer	Agilent	E4446A	MY46180323	07/24/2020	07/23/2021
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Software	e3 6.11-20180419c				

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. N.C.R. = No Calibration Required.



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1.7 SUPPORT AND EUT ACCESSORIES EQUIPMENT

EUT Accessories Equipment					
No.	Equipment	Brand	Model	Series No.	FCC ID
	N/A				

Support Equipment					
No.	Equipment	Brand	Model	Series No.	FCC ID
1	NB	Lenovo	80U0	N/A	N/A
2	Adapter	Lenovo	ADLX65CDGU2A	N/A	N/A

1.8 TEST METHODOLOGY AND APPLIED STANDARDS

The test methodology, setups and results comply with all requirements in accordance with ANSI C63.10:2013, FCC Part 2, FCC Part 15.247.

2. TEST SUMMARY

FCC Standard Section	Report Section	Test Item	Result
15.203	1.3	Antenna Requirement	Pass
15.207(a)	4.1	AC Conducted Emission	Pass
15.247(a)(2)	4.2	6 dB Bandwidth	Pass
-	4.2	Occupied Bandwidth (99%)	Pass
15.247(b)(3)	4.3	Output Power Measurement	Pass
15.247(e)	4.4	Power Spectral Density	Pass
15.247(d)	4.5	Conducted Band Edge	Pass
15.247(d)	4.5	Conducted Spurious Emission	Pass
15.247(d)	4.6	Radiation Band Edge	Pass
15.247(d)	4.6	Radiation Spurious Emission	Pass



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3. DESCRIPTION OF TEST MODES

3.1 THE WORST MODE OF OPERATING CONDITION

Operation mode	BLE Mode (1Mbps) BLE Mode (2Mbps)
Test Channel Frequencies	1.Lowest Channel : 2402MHz 2.Middle Channel : 2442MHz 3.Highest Channel : 2480MHz

Remark:

1. EUT pre-scanned data rate of output power for each mode, the worst data rate were recorded in this report.

3.2 THE WORST MODE OF MEASUREMENT

AC Power Line Conducted Emission	
Test Condition	AC Power line conducted emission for line and neutral
Power supply Mode	Mode 1: EUT power by Host System Mode 2: EUT power by Adapter
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Remark:

1. The worst mode was record in this test report.
2. AC power line conducted emission and for below 1G radiation emission were performed the EUT transmit at the highest output power channel as worse case.

Radiated Emission Measurement Above 1G	
Test Condition	Radiated Emission Above 1G
Power supply Mode	Mode 1: EUT power by USB
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4
Worst Position	☐ Placed in fixed position. ☐ Placed in fixed position at X-Plane (E2-Plane) ☐ Placed in fixed position at Y-Plane (E1-Plane) ☒ Placed in fixed position at Z-Plane (H-Plane)

Radiated Emission Measurement Below 1G	
Test Condition	Radiated Emission Below 1G
Power supply Mode	Mode 1: EUT power by USB
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Remark:

1. The worst mode was record in this test report.
2. EUT pre-scanned in three axis ,X,Y, Z and two polarity, for radiated measurement.
The worst case(Z-Plane) were recorded in this report

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3.3 EUT DUTY CYCLE

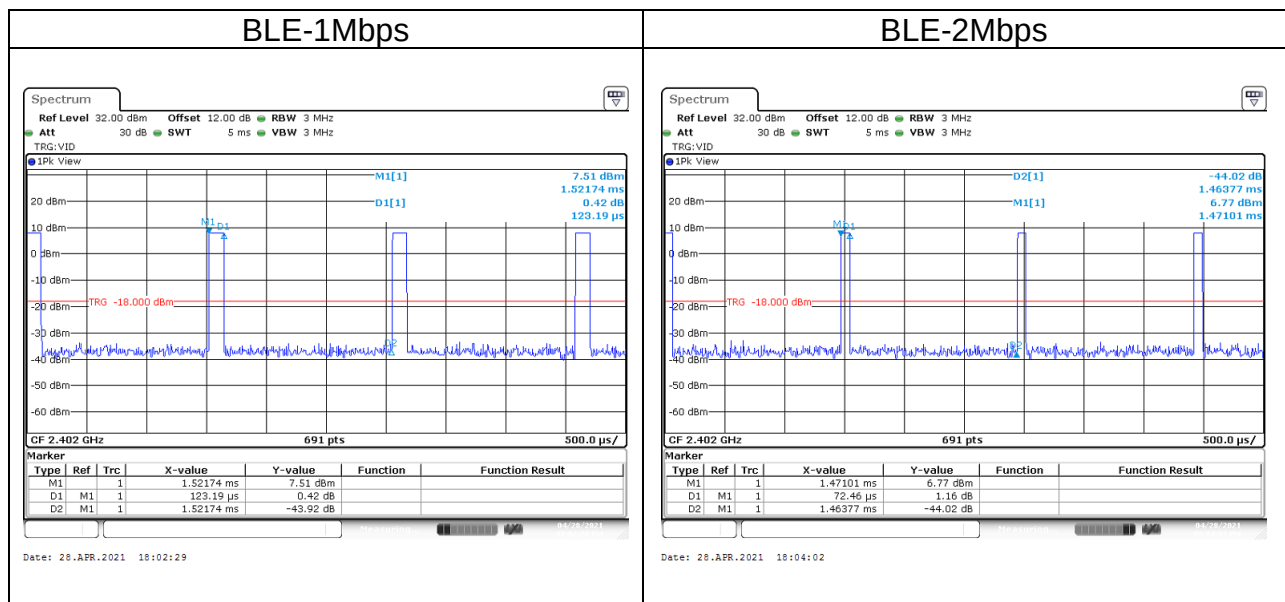
Temperature: 23.6°C

Test Date: April 28, 2021

Humidity: 60% RH

Tested by: Jerry Chang

Duty Cycle				
Configuration	Duty Cycle (%)	Duty Factor (dB)	1/T (kHz)	VBW Setting (kHz)
BLE-1Mbps	8.10%	10.92	13.80	14.00
BLE-2Mbps	4.95%	13.05	8.12	9.00



4. TEST RESULT

4.1 AC POWER LINE CONDUCTED EMISSION

4.1.1 Test Limit

According to §15.207(a),

Frequency Range (MHz)	Limits(dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

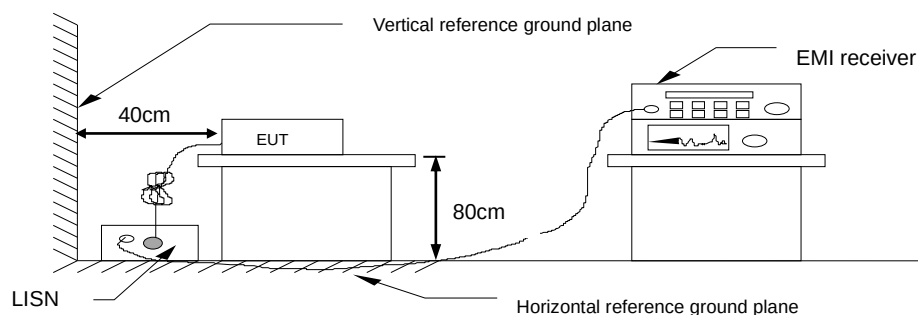
* Decreases with the logarithm of the frequency.

4.1.2 Test Procedure

Test method Refer as ANSI C63.10: 2013 clause 6.2,

1. The EUT was placed above horizontal ground plane and 0.4m above vertical ground plane
2. EUT connected to the line impedance stabilization network (LISN)
3. Receiver set RBW of 9kHz and Detector Peak, and note as quasi-peak and average.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Recorded Line for Neutral and Line.

4.1.3 Test Setup

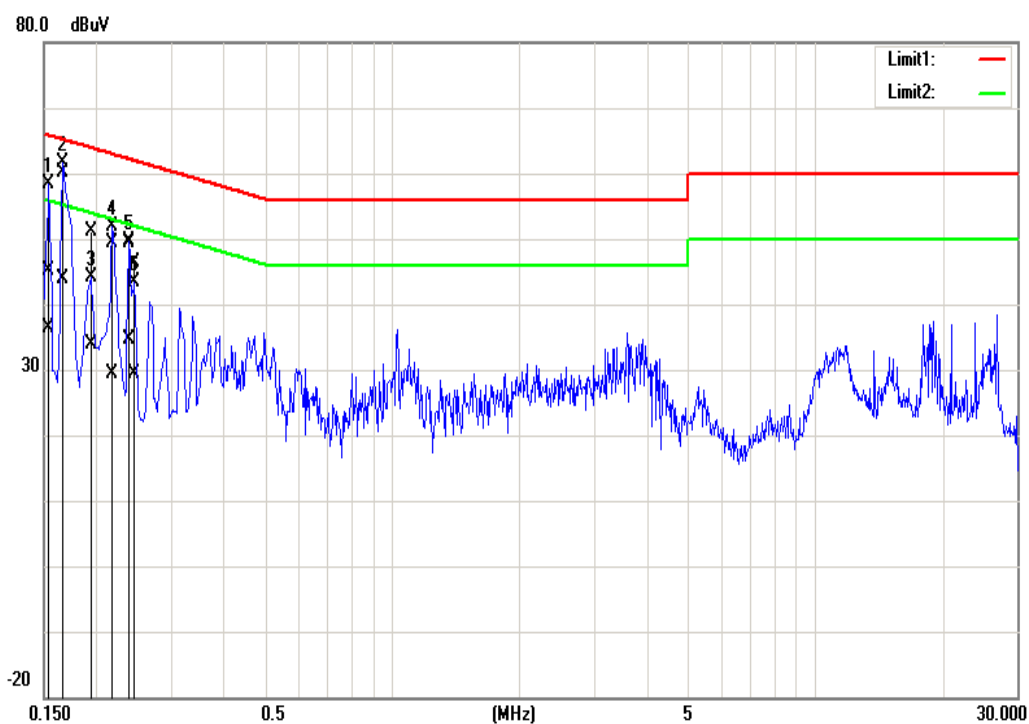


4.1.4 Test Result

PASS.

Test Data

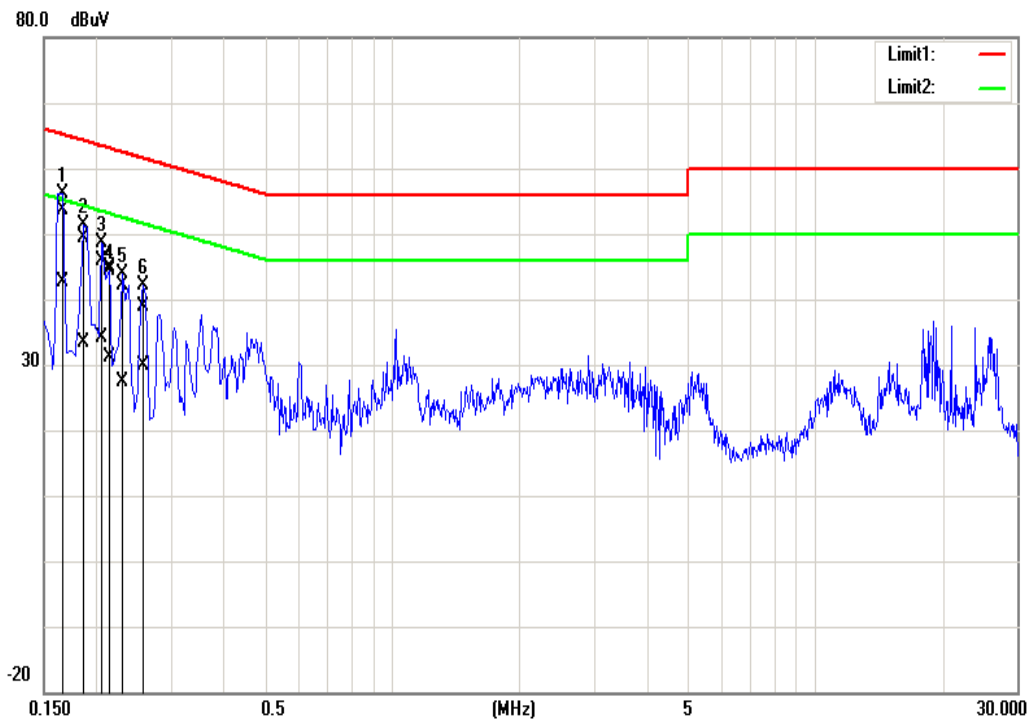
Test Mode:	Mode 1 / BLE 1Mbps	Temp/Hum	23.9(°C)/ 61%RH
Phase:	Line	Test Date	April 29, 2021
Test Voltage:	120Vac, 60Hz	Test Engineer	Jerry Chang



Frequency (MHz)	Quasi Peak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	Quasi Peak result (dBuV)	Average result (dBuV)	Quasi Peak limit (dBuV)	Average limit (dBuV)	Quasi Peak margin (dB)	Average margin (dB)	Remark
0.1540	34.78	26.07	10.26	45.04	36.33	65.78	55.78	-20.74	-19.45	Pass
0.1660	49.95	33.67	10.26	60.21	43.93	65.16	55.16	-4.95	-11.23	Pass
0.1940	40.96	23.72	10.26	51.22	33.98	63.86	53.86	-12.64	-19.88	Pass
0.2180	39.13	19.18	10.26	49.39	29.44	62.89	52.89	-13.50	-23.45	Pass
0.2380	39.01	24.32	10.26	49.27	34.58	62.17	52.17	-12.90	-17.59	Pass
0.2460	36.00	19.22	10.26	46.26	29.48	61.89	51.89	-15.63	-22.41	Pass

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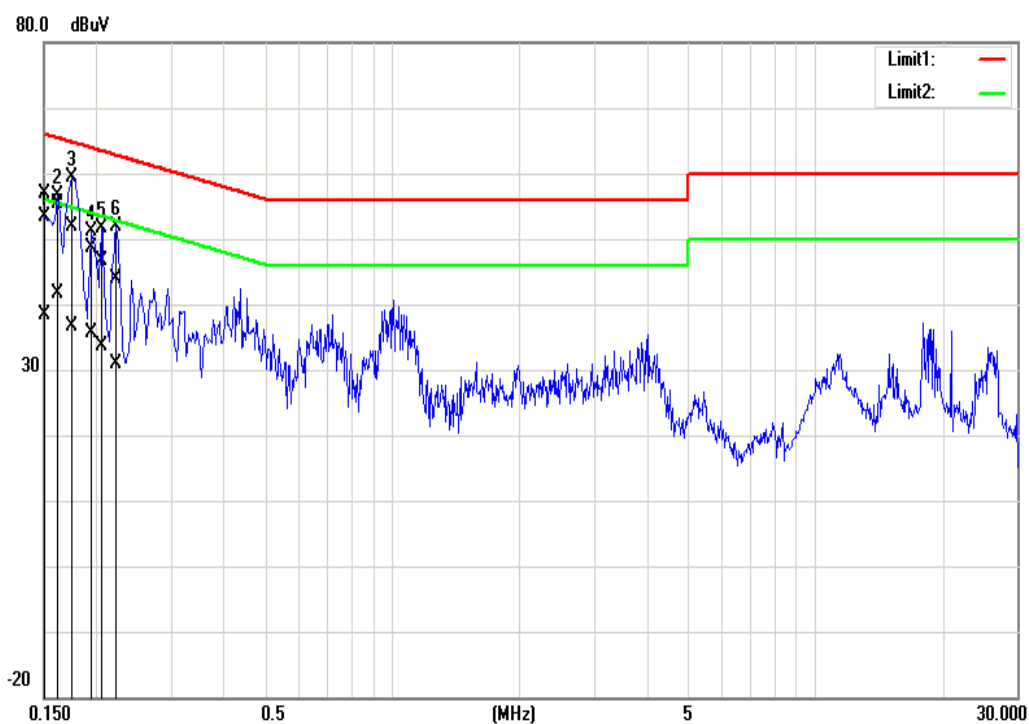
Test Mode:	Mode 1 / BLE 1Mbps	Temp/Hum	23.9(°C)/ 61%RH
Phase:	Neutral	Test Date	December 28, 2020
Test Voltage:	120Vac, 60Hz	Test Engineer	Rick Lee



Frequency (MHz)	Quasi Peak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	Quasi Peak result (dBuV)	Average result (dBuV)	Quasi Peak limit (dBuV)	Average limit (dBuV)	Quasi Peak margin (dB)	Average margin (dB)	Remark
0.1660	43.45	32.25	10.29	53.74	42.54	65.16	55.16	-11.42	-12.62	Pass
0.1860	39.17	23.17	10.29	49.46	33.46	64.21	54.21	-14.75	-20.75	Pass
0.2060	35.55	23.79	10.29	45.84	34.08	63.37	53.37	-17.53	-19.29	Pass
0.2140	34.66	20.83	10.29	44.95	31.12	63.05	53.05	-18.10	-21.93	Pass
0.2300	31.90	17.15	10.29	42.19	27.44	62.45	52.45	-20.26	-25.01	Pass
0.2580	28.67	19.61	10.29	38.96	29.90	61.50	51.50	-22.54	-21.60	Pass

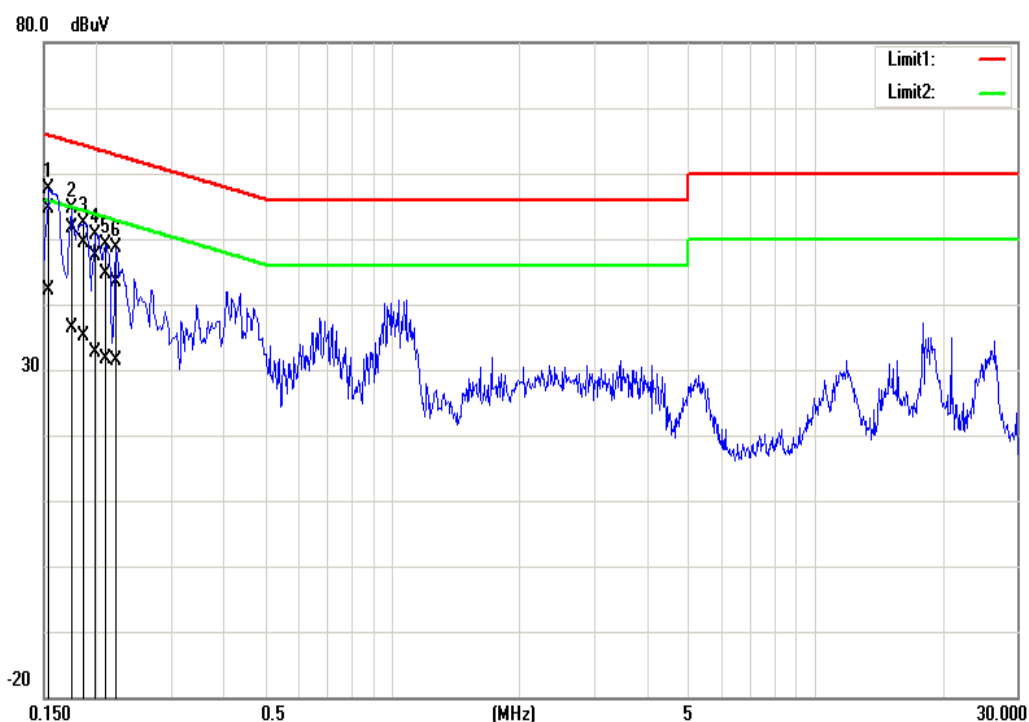
Test Data

Test Mode:	Mode 1 / BLE 2Mbps	Temp/Hum	23.9(°C)/ 61%RH
Phase:	Line	Test Date	April 29, 2021
Test Voltage:	120Vac, 60Hz	Test Engineer	Jerry Chang



Frequency (MHz)	Quasi Peak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	Quasi Peak result (dBuV)	Average result (dBuV)	Quasi Peak limit (dBuV)	Average limit (dBuV)	Quasi Peak margin (dB)	Average margin (dB)	Remark
0.1500	46.74	28.02	10.26	57.00	38.28	66.00	56.00	-9.00	-17.72	Pass
0.1620	45.21	31.41	10.26	55.47	41.67	65.36	55.36	-9.89	-13.69	Pass
0.1740	41.60	26.42	10.26	51.86	36.68	64.77	54.77	-12.91	-18.09	Pass
0.1940	38.41	25.43	10.26	48.67	35.69	63.86	53.86	-15.19	-18.17	Pass
0.2060	36.29	23.27	10.26	46.55	33.53	63.37	53.37	-16.82	-19.84	Pass
0.2220	33.50	20.54	10.26	43.76	30.80	62.74	52.74	-18.98	-21.94	Pass

Test Mode:	Mode 1 / BLE 2Mbps	Temp/Hum	23.9(°C)/ 61%RH
Phase:	Neutral	Test Date	April 29, 2021
Test Voltage:	120Vac, 60Hz	Test Engineer	Jerry Chang



Frequency (MHz)	Quasi Peak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	Quasi Peak result (dBuV)	Average result (dBuV)	Quasi Peak limit (dBuV)	Average limit (dBuV)	Quasi Peak margin (dB)	Average margin (dB)	Remark
0.1540	44.39	31.74	10.29	54.68	42.03	65.78	55.78	-11.10	-13.75	Pass
0.1740	41.32	25.97	10.29	51.61	36.26	64.77	54.77	-13.16	-18.51	Pass
0.1860	39.18	24.84	10.29	49.47	35.13	64.21	54.21	-14.74	-19.08	Pass
0.1980	37.03	22.41	10.29	47.32	32.70	63.69	53.69	-16.37	-20.99	Pass
0.2100	34.37	21.34	10.29	44.66	31.63	63.21	53.21	-18.55	-21.58	Pass
0.2220	33.19	20.97	10.29	43.48	31.26	62.74	52.74	-19.26	-21.48	Pass

4.2 6dB BANDWIDTH AND OCCUPIED BANDWIDTH (99%)

4.2.1 Test Limit

According to §15.247(a)(2)

6 dB Bandwidth :

Limit	Shall be at least 500kHz
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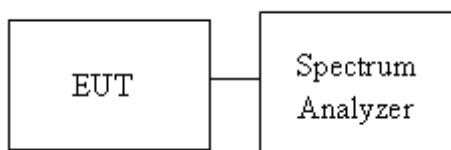
Occupied Bandwidth(99%) : For reporting purposes only.

4.2.2 Test Procedure

Test method Refer as ANSI C63.10: 2013,

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT.
3. SA set RBW =100KHz, VBW = 300KHz and Detector = Peak, to measurement 6dB Bandwidth.
4. SA set RBW = 1% ~ 5% OBW, VBW = three times the RBW and Detector = Peak, to measurement 99% Bandwidth.
5. Measure and record the result of 6 dB Bandwidth and 99% Bandwidth. in the test report.

4.2.3 Test Setup





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4.2.4 Test Result

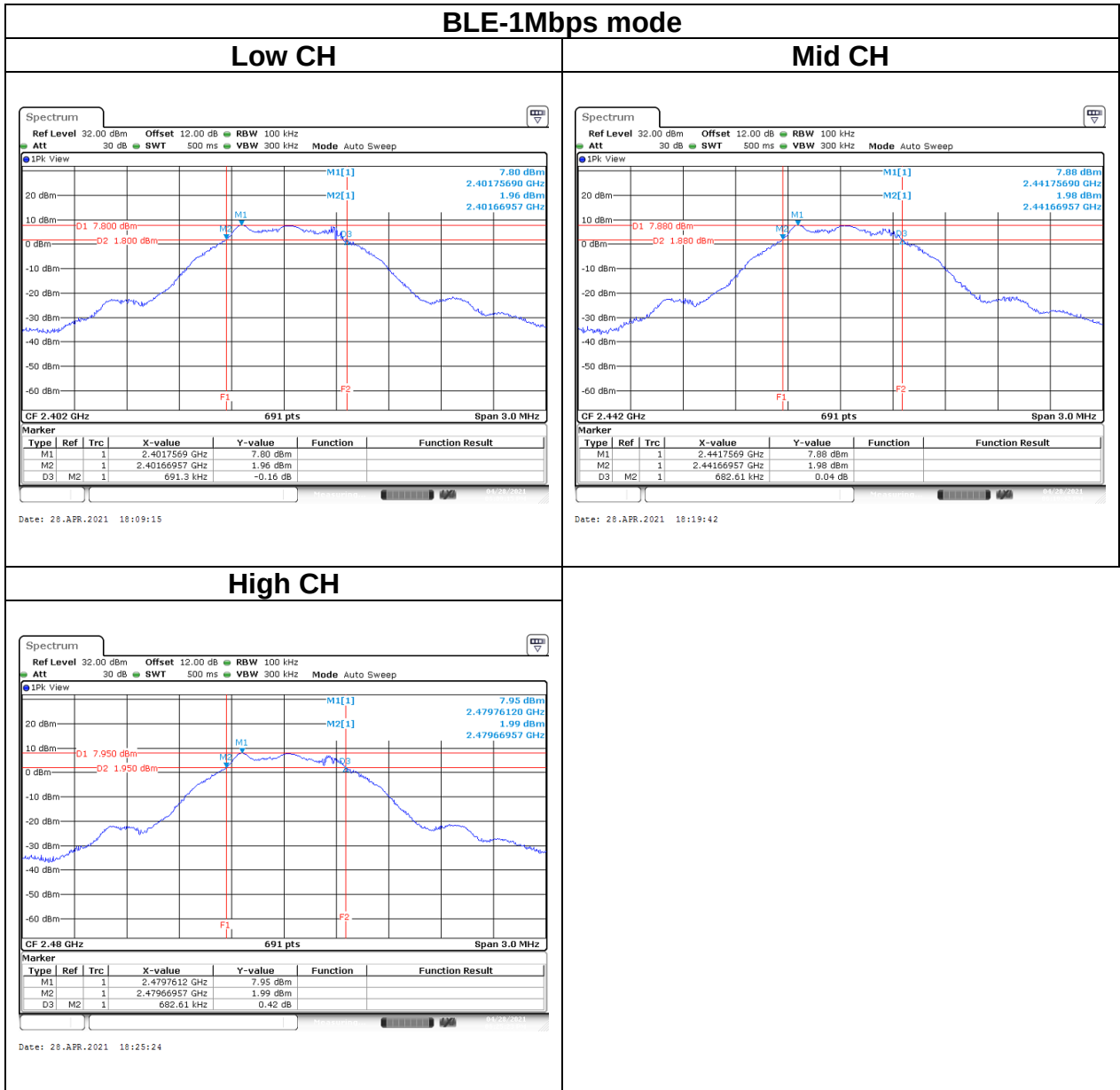
Temperature: 23.6°C Test Date: April 28, 2021
Humidity: 60% RH Tested by: Jerry Chang

Temperature: 23.4°C Test Date: April 29, 2021
Humidity: 62% RH Tested by: Jerry Chang

Test mode: BLE-1Mbps mode / 2402-2480 MHz				
Channel	Frequency (MHz)	OBW (99%) (MHz)	6dB BW (MHz)	6dB limit (kHz)
Low	2402	1.0289	0.6913	≥ 500
Mid	2442	1.0376	0.6826	
High	2480	1.0376	0.6826	
Test mode: BLE-2Mbps mode / 2402-2480 MHz				
Low	2402	2.0043	1.1739	≥ 500
Mid	2442	2.0115	1.1522	
High	2480	2.0188	1.2029	

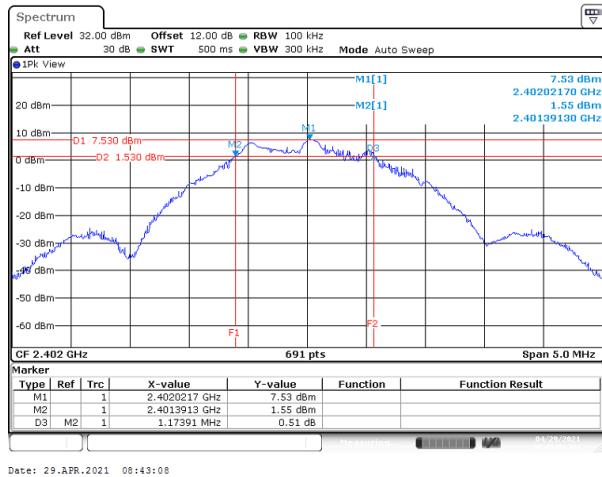
Test Data

6dB BANDWIDTH

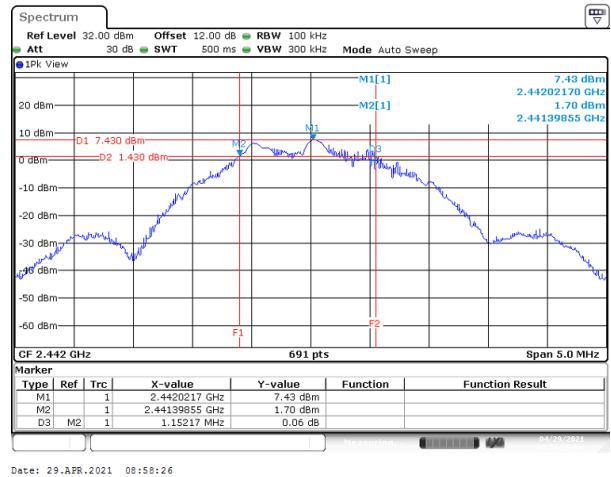


BLE-2Mbps mode

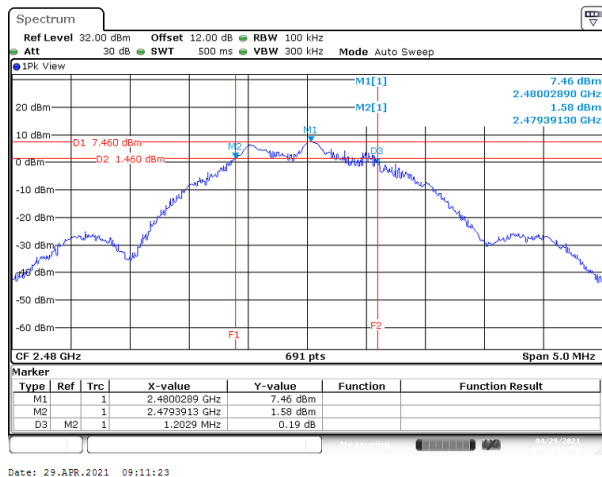
Low CH



Mid CH

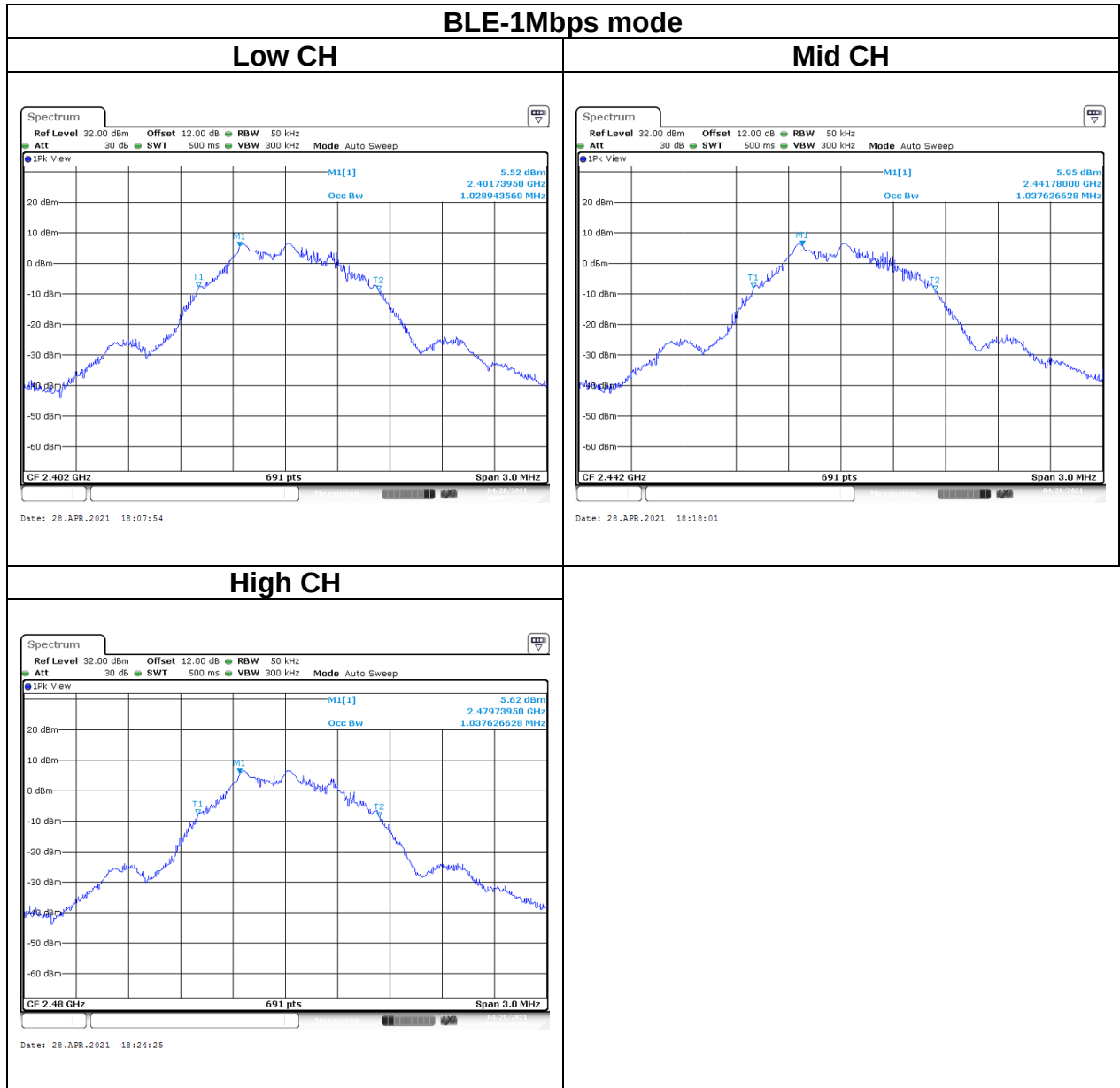


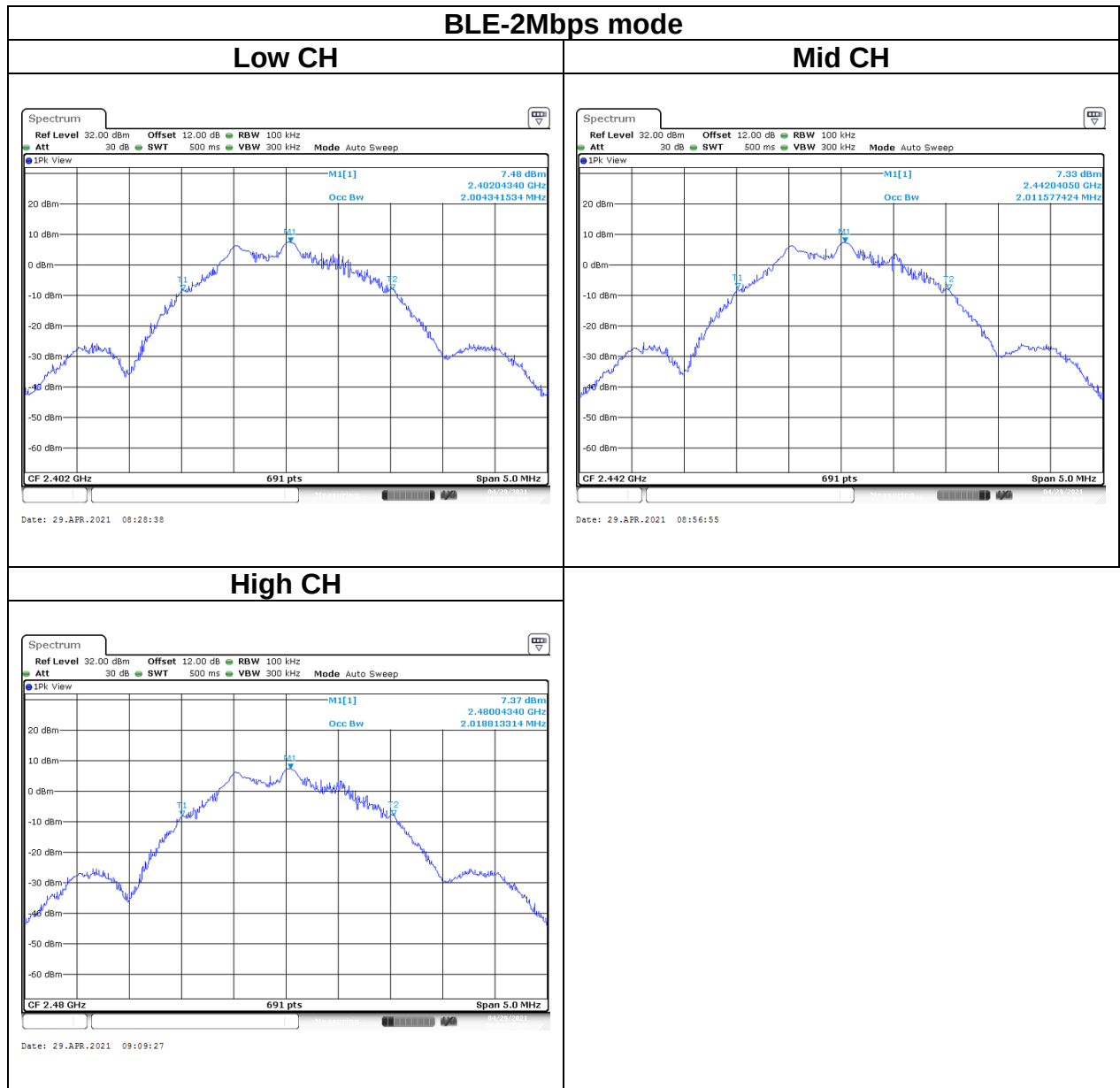
High CH



Test Data

BANDWIDTH (99%)





4.3 OUTPUT POWER MEASUREMENT

4.3.1 Test Limit

According to §15.247(b)(3)

Peak output power :

FCC

Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Limit	☐ Antenna not exceed 6 dBi : 30dBm ☒ Antenna with Ant. Gain greater than 6 dBi [Limit = 30 – (Ant.Gain – 6)] ☐ Point-to-point operation
-------	--

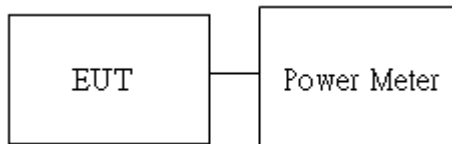
Average output power : For reporting purposes only.

4.3.2 Test Procedure

Test method Refer as ANSI C63.10: 2013.

1. The EUT RF output connected to the power meter by RF cable.
2. Setting maximum power transmit of EUT.
3. The path loss was compensated to the results for each measurement.
4. Measure and record the result of Peak output power and Average output power. in the test report.

4.3.3 Test Setup



4.3.4 Test Result

Temperature: 23.4°C

Test Date:

April 29, 2021

Humidity: 62% RH

Tested by:

Jerry Chang

Peak output power :

BLE Mode						
Config.	CH	Freq. (MHz)	Power Setting	PK Power (dBm)	PK Power (W)	Limit (dBm)
BLE Data rate: 1Mbps	0	2402	Default	8.13	0.0065	27.74
	19	2442	Default	8.10	0.0065	
	39	2480	Default	7.91	0.0062	
BLE Data rate: 2Mbps	0	2402	Default	8.06	0.0064	27.74
	19	2442	Default	8.16	0.0065	
	39	2480	Default	7.93	0.0062	

Average output power :

BLE Mode			
Config.	CH	Freq. (MHz)	AV Power (dBm)
BLE Data rate: 1Mbps	0	2402	7.72
	19	2442	7.71
	39	2480	7.68
BLE Data rate: 2Mbps	0	2402	5.31
	19	2442	5.28
	39	2480	5.08

4.4 POWER SPECTRAL DENSITY

4.4.1 Test Limit

According to §15.247(e)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Limit	☐ Antenna not exceed 6 dBi : 8dBm ☒ Antenna with Ant. Gain greater than 6 dBi [Limit = 8 – (Ant.Gain – 6)] ☐ Point-to-point operation :
-------	--

4.4.2 Test Procedure

Test method Refer as ANSI C63.10: 2013.

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 3kHz, VBW = 10kHz, Span = 1.5 times DTS Bandwidth (6 dB BW), Detector = Peak, Sweep Time = Auto and Trace = Max hold.
4. The path loss and Duty Factor were compensated to the results for each measurement by SA.
5. Mark the maximum level.
6. Measure and record the result of power spectral density. in the test report.

4.4.3 Test Setup



4.4.4 Test Result

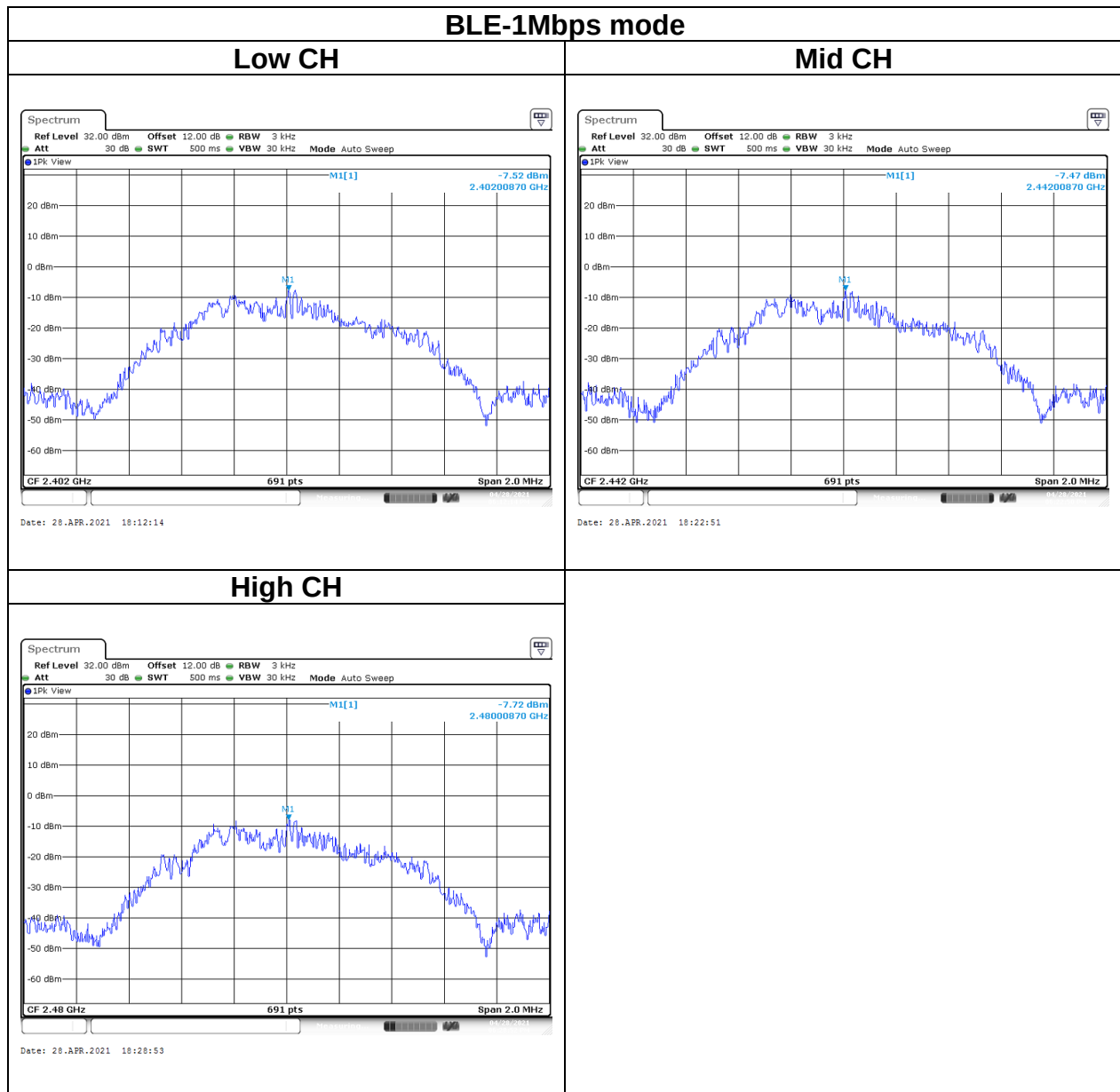
Temperature: 23.6°C Test Date: April 28, 2021
Humidity: 60% RH Tested by: Jerry Chang

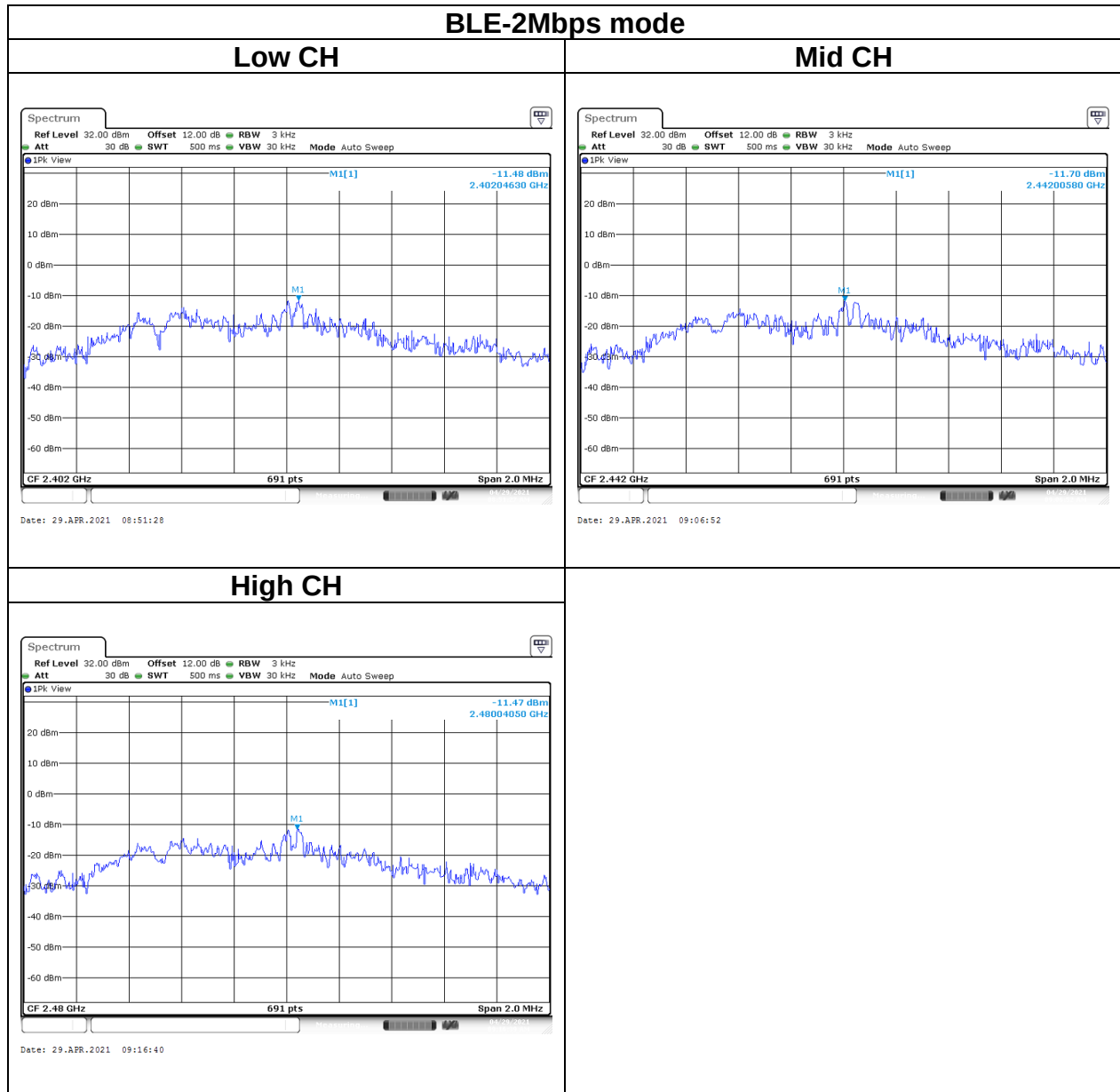
Temperature: 23.4°C Test Date: April 29, 2021
Humidity: 62% RH Tested by: Jerry Chang

Test mode: BLE-1Mbps mode / 2402-2480 MHz			
Channel	Frequency (MHz)	PSD (dBm)	FCC limit (dBm)
Low	2402	-7.52	5.74
Mid	2442	-7.47	
High	2480	-7.72	

Test mode: BLE-2Mbps mode / 2402-2480 MHz			
Channel	Frequency (MHz)	PSD (dBm)	FCC limit (dBm)
Low	2402	-11.48	5.74
Mid	2442	-11.70	
High	2480	-11.47	

Test Data





4.5 CONDUCTED BAND EDGE AND SPURIOUS EMISSION

4.5.1 Test Limit

According to §15.247(d)

FCC: In any 100 kHz bandwidth outside the authorized frequency band,

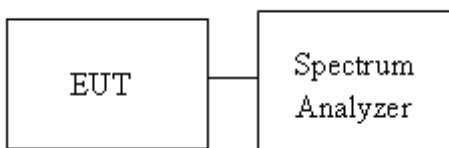
Non-restricted bands shall be attenuated at least 20 dB/30 dB relative to the maximum PSD level in 100 kHz by RF conducted or a radiated measurement which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

4.5.2 Test Procedure

Test method Refer as ANSI C63.10: 2013.

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.
2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.
3. In any 100 kHz bandwidth outside the authorized frequency band, shall be attenuated at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when conducted power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

4.5.3 Test Setup



Report No.: T210413W06-RP

4.5.4 Test Result

Test Data

Temperature: 23.6°C

Test Date: April 28, 2021

Humidity: 60% RH

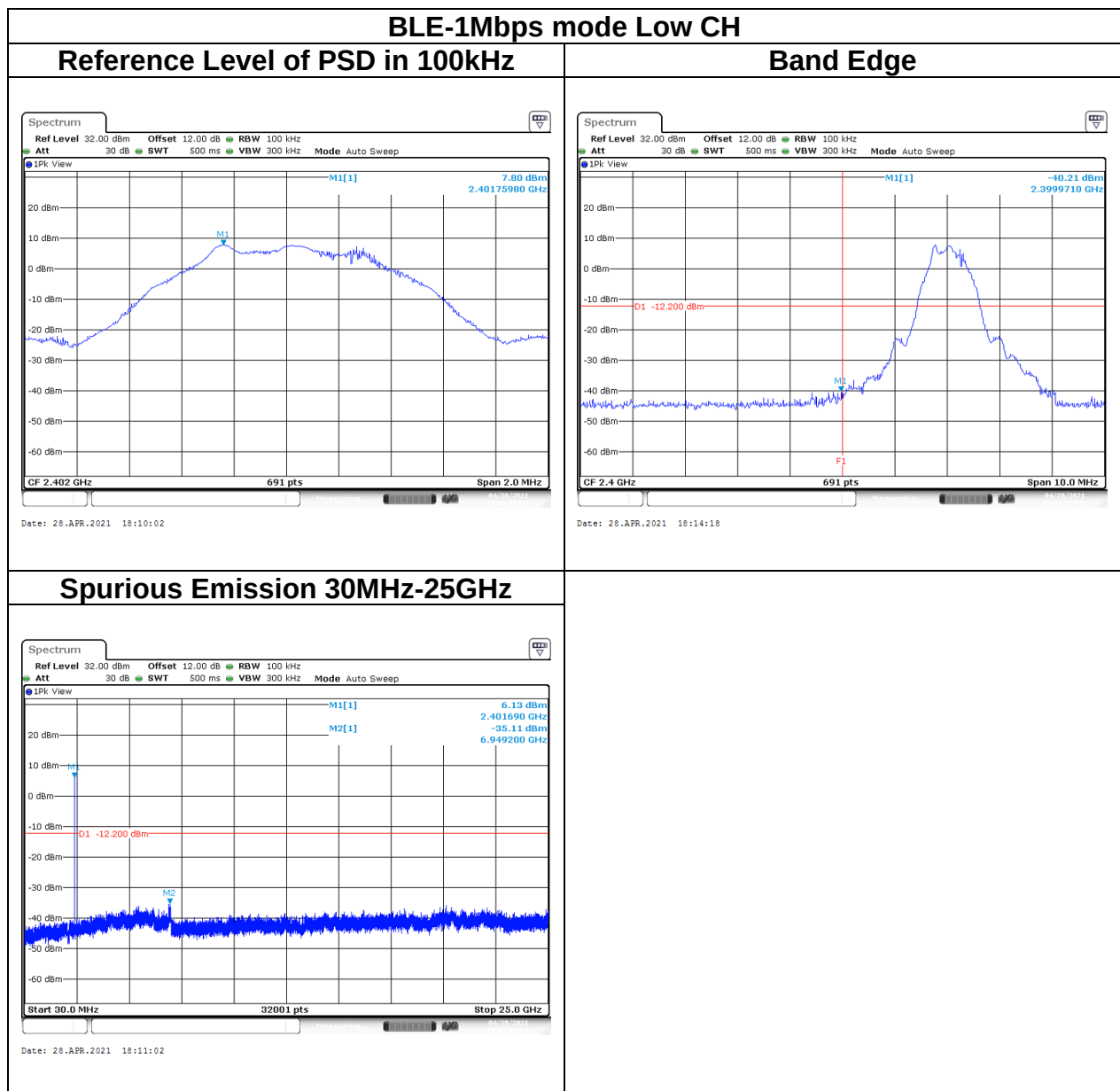
Tested by: Jerry Chang

Temperature: 23.4°C

Test Date: April 29, 2021

Humidity: 62% RH

Tested by: Jerry Chang

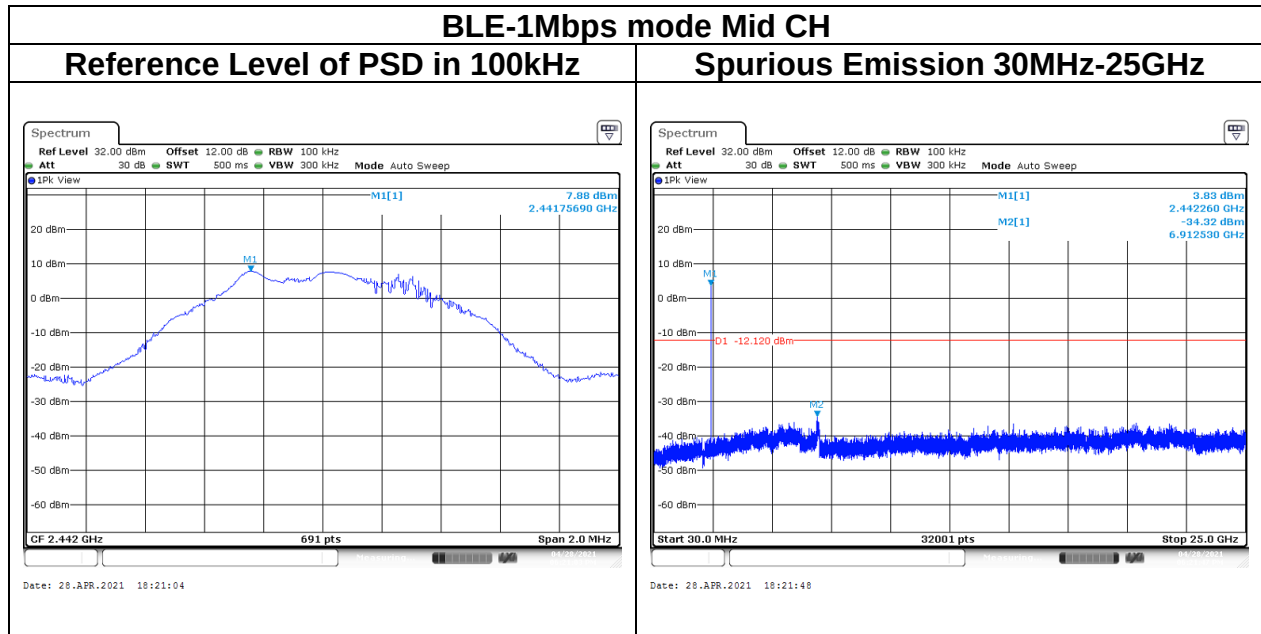


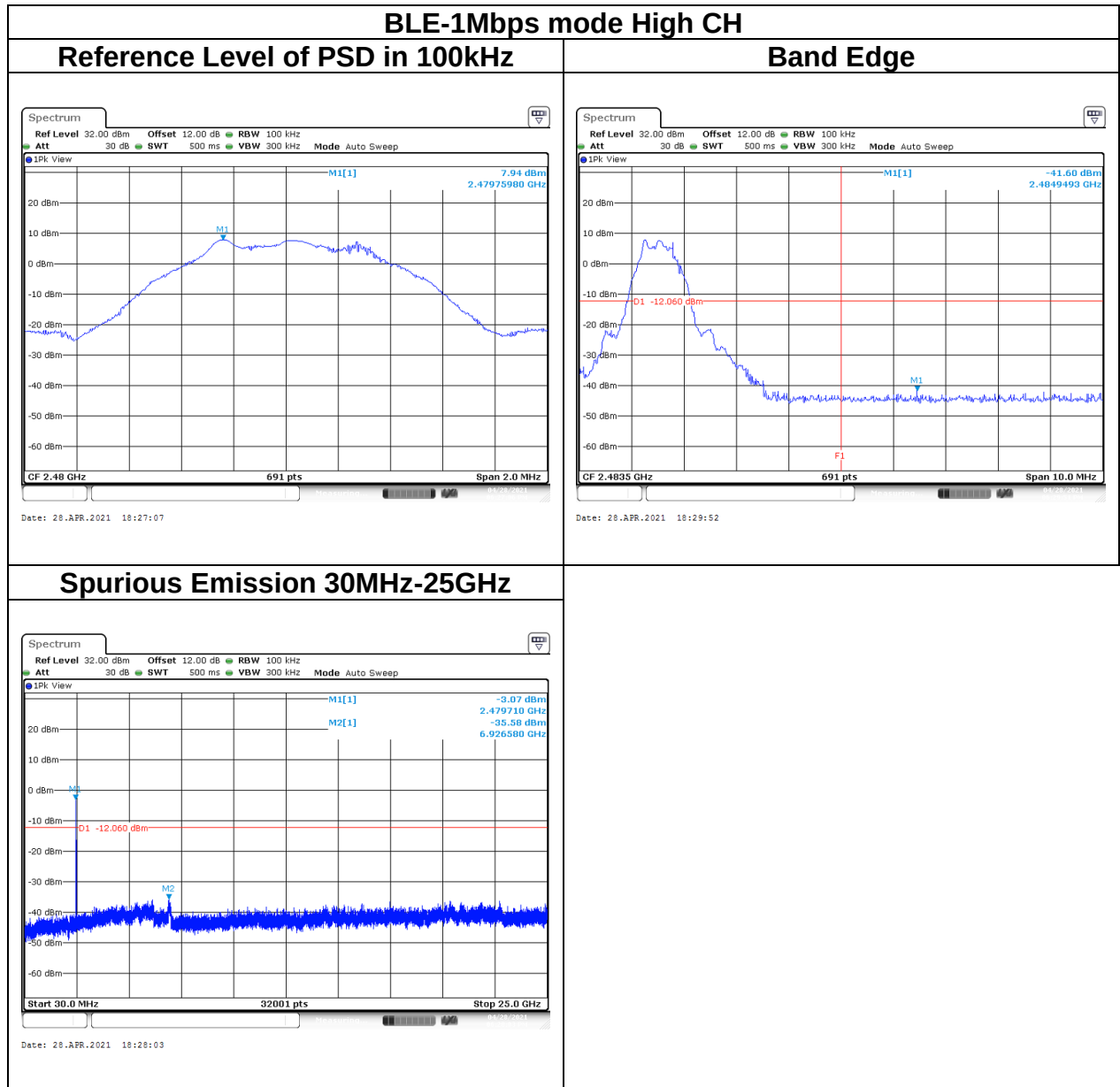


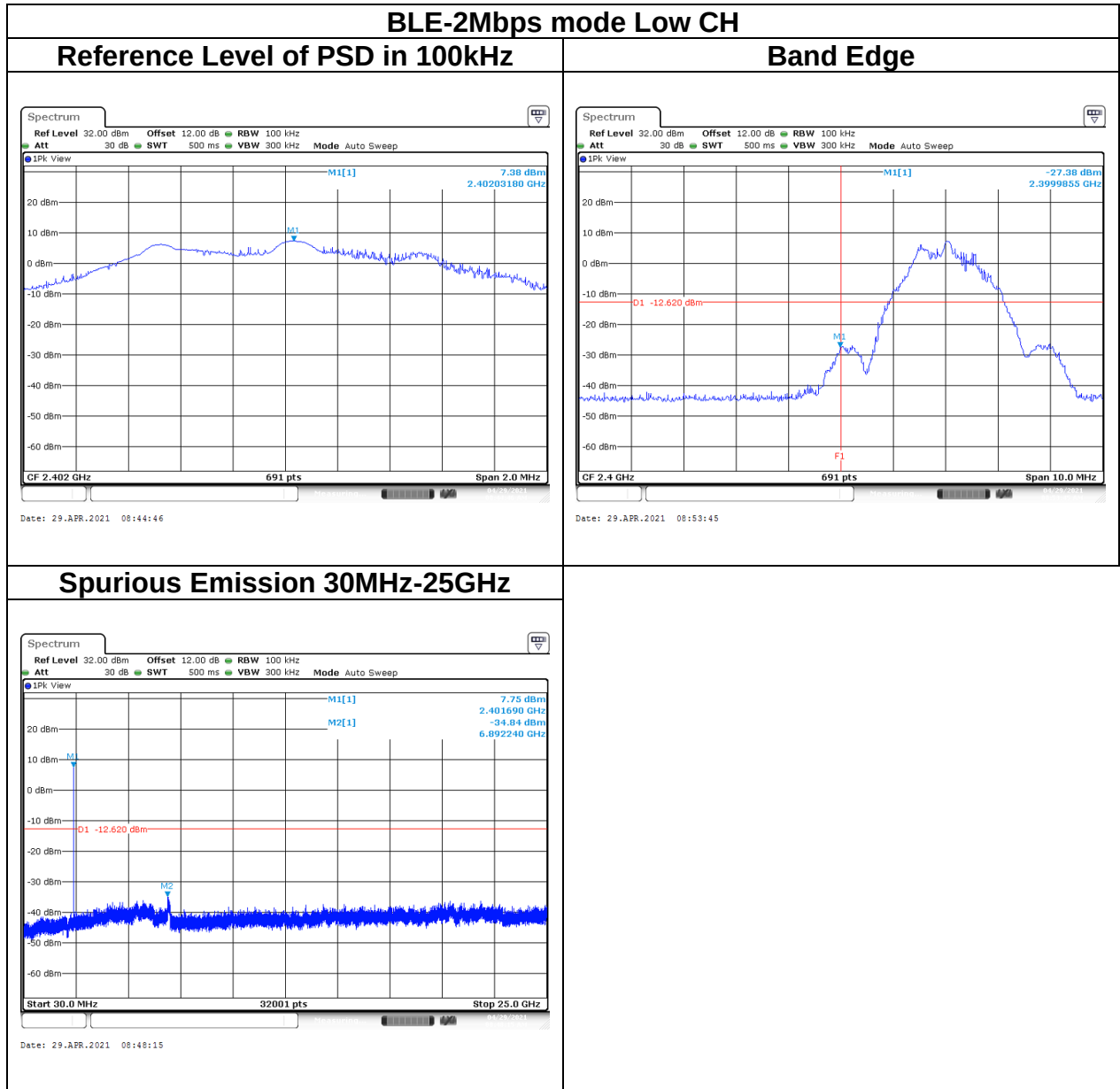
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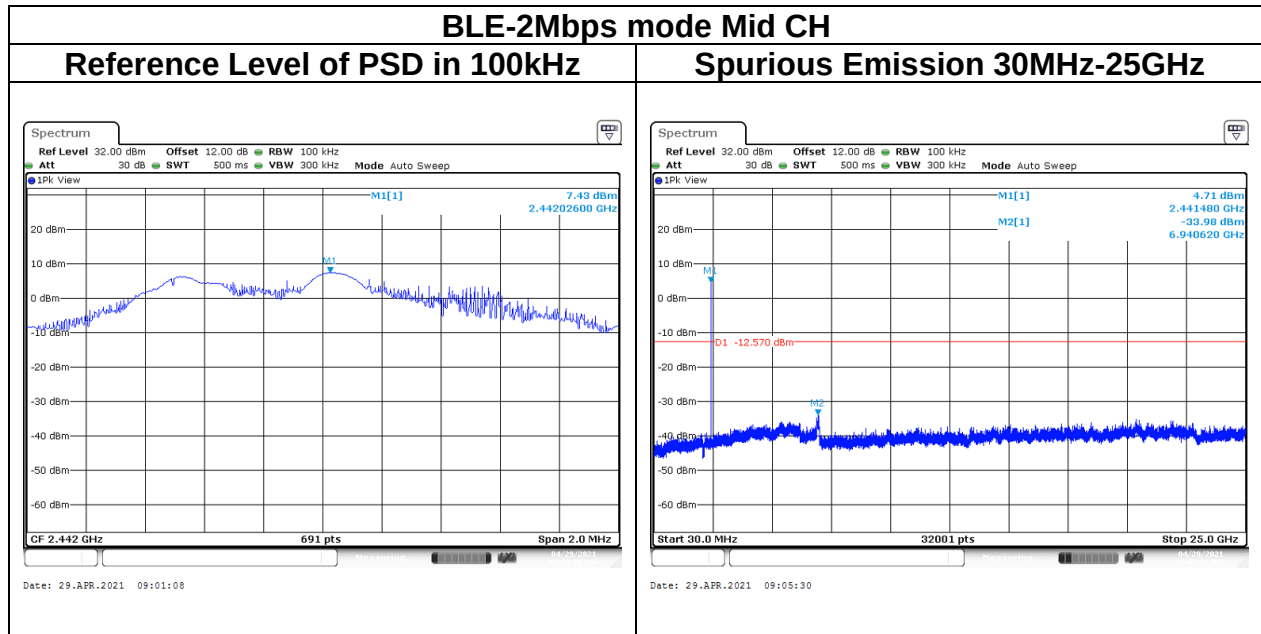


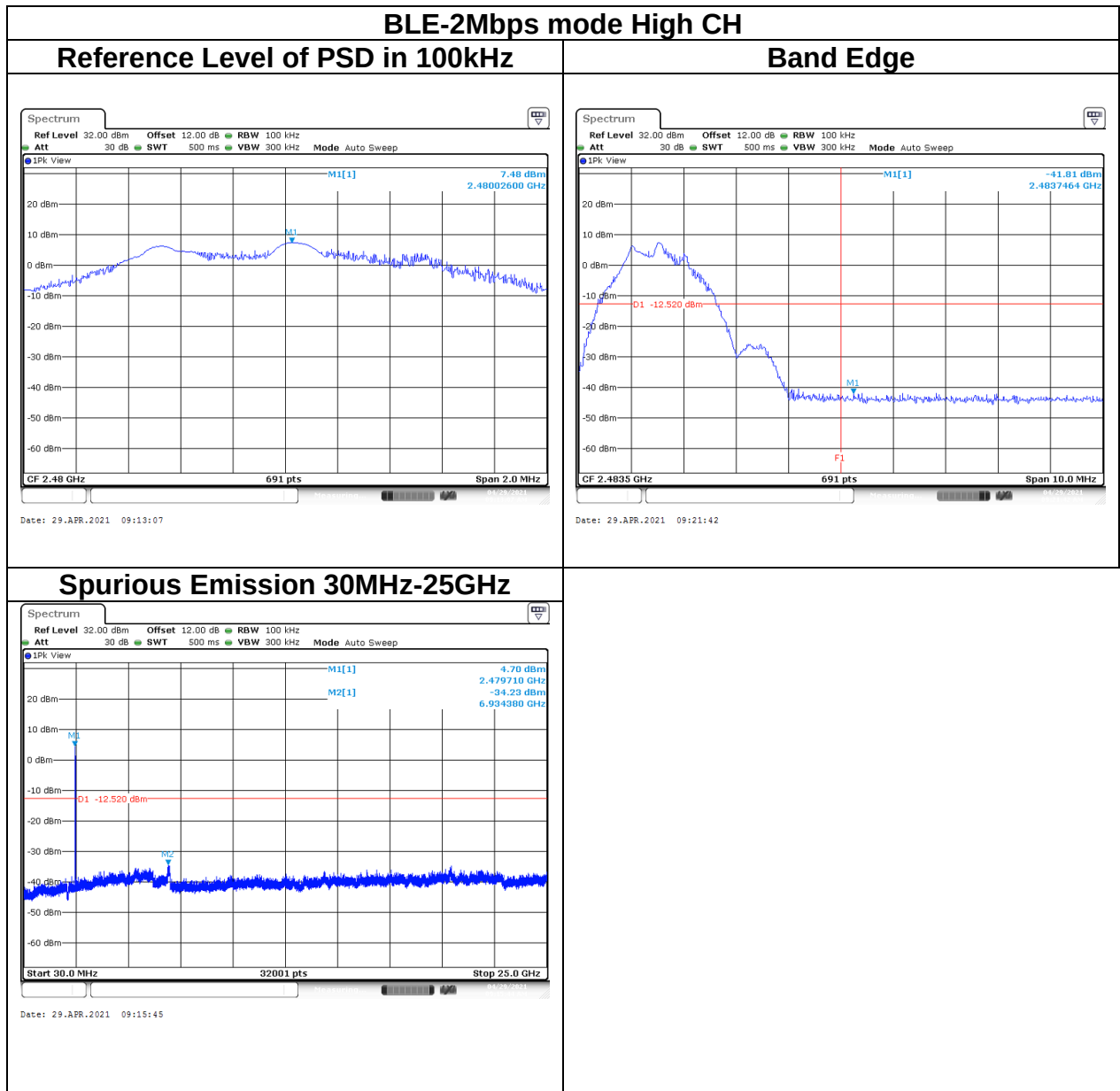


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4.6 RADIATION BANDEDGE AND SPURIOUS EMISSION

4.6.1 Test Limit

FCC according to §15.247(d), §15.209 and §15.205,

In any 100 kHz bandwidth outside the authorized frequency band, all harmonic and spurious must be least 20 dB below the highest emission level with the authorized frequency band. Radiation emission which fall in the restricted bands must also follow the FCC section 15.209 as below limit in table.

Below 30 MHz

Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/F (F in kHz)	30
1.705-30 MHz	30	N/A	30

Above 30 MHz

Frequency (MHz)	Field Strength microvolts/m at 3 metres (watts, e.i.r.p.)	
	Transmitters	Receivers
30-88	100 (3 nW)	100 (3 nW)
88-216	150 (6.8 nW)	150 (6.8 nW)
216-960	200 (12 nW)	200 (12 nW)
Above 960	500 (75 nW)	500 (75 nW)

Remark:

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

4.6.2 Test Procedure

Test method Refer as ANI C63.10: 2013.

1. The EUT is placed on a turntable, Above 1 GHz is 1.5m and below 1 GHz is 0.8m above ground plane. The EUT Configured un accordance with ANSI C63.10: 2013, and the EUT set in a continuous mode.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. And EUT is set 3m away from the receiving antenna, which is scanned from 1m to 4m above the ground plane to find out the highest emissions. Measurement are made polarized in both the vertical and the horizontal positions with antenna.
3. Span shall wide enough to full capture the emission measured. The SA from 9KHz to 26.5GHz set to the low, Mid and High channels with the EUT transmit.

Remark:

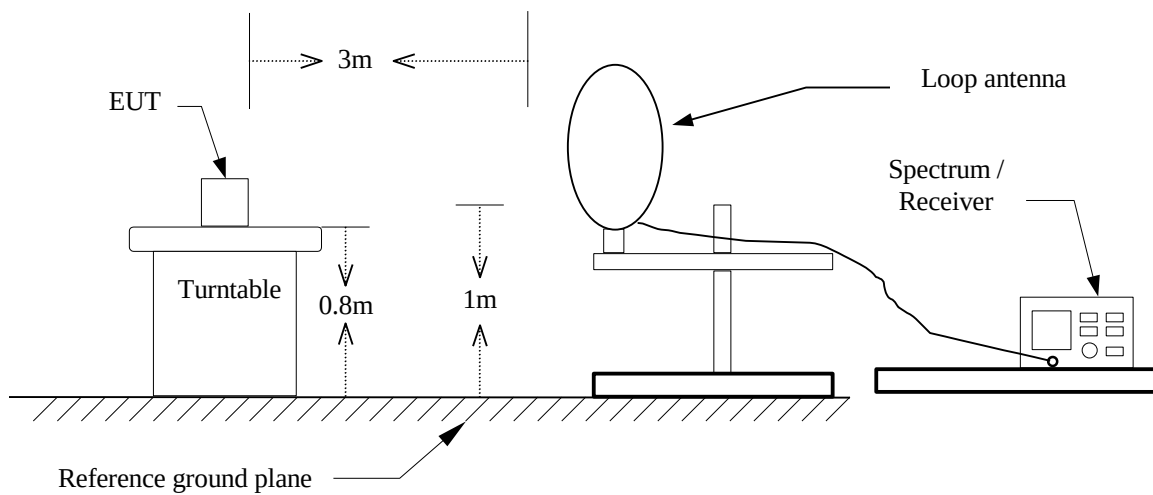
1. Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
2. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).

4. The SA setting following :

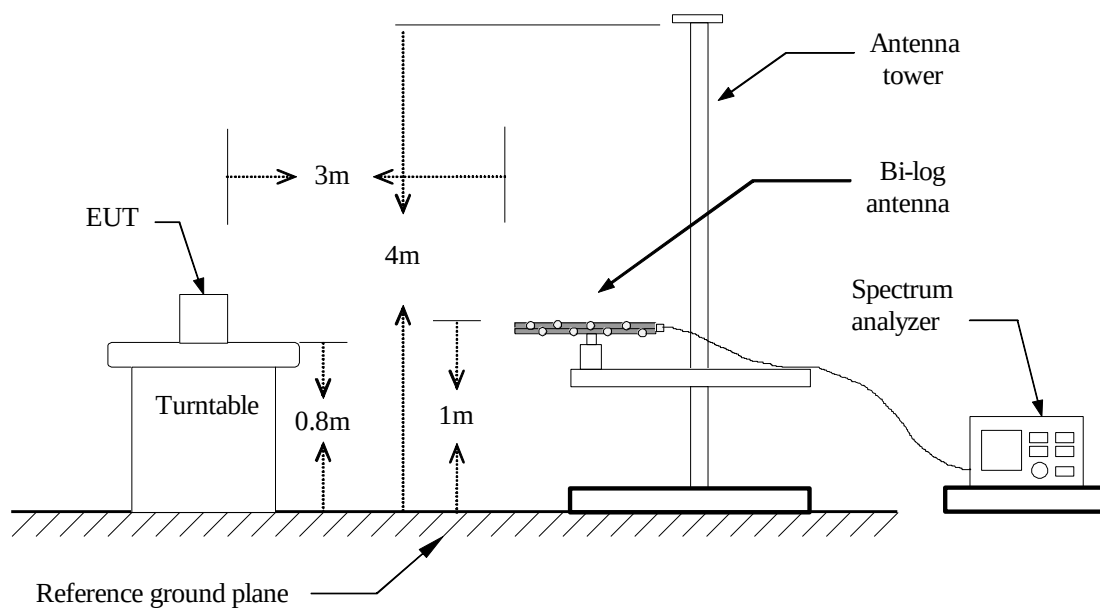
- (1) Below 1G : RBW = 100kHz, VBW $\geq$ 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.
- (2) Above 1G :
 - (2.1) For Peak measurement : RBW = 1MHz, VBW $\geq$ 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.
 - (2.2) For Average measurement : RBW = 1MHz, VBW
If Duty Cycle $\geq$ 98%, VBW=10Hz.
If Duty Cycle < 98%, VBW=1/T.

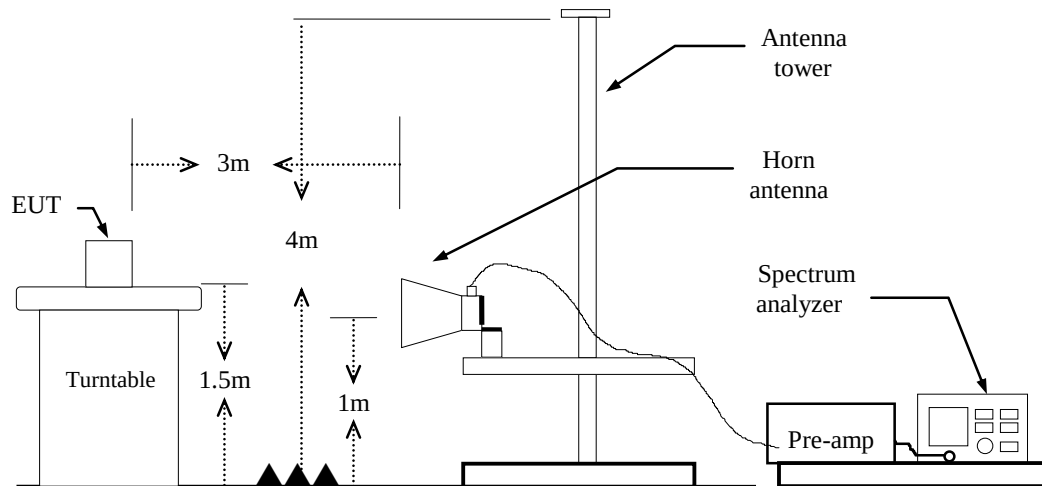
4.6.3 Test Setup

9kHz ~ 30MHz



30MHz ~ 1GHz

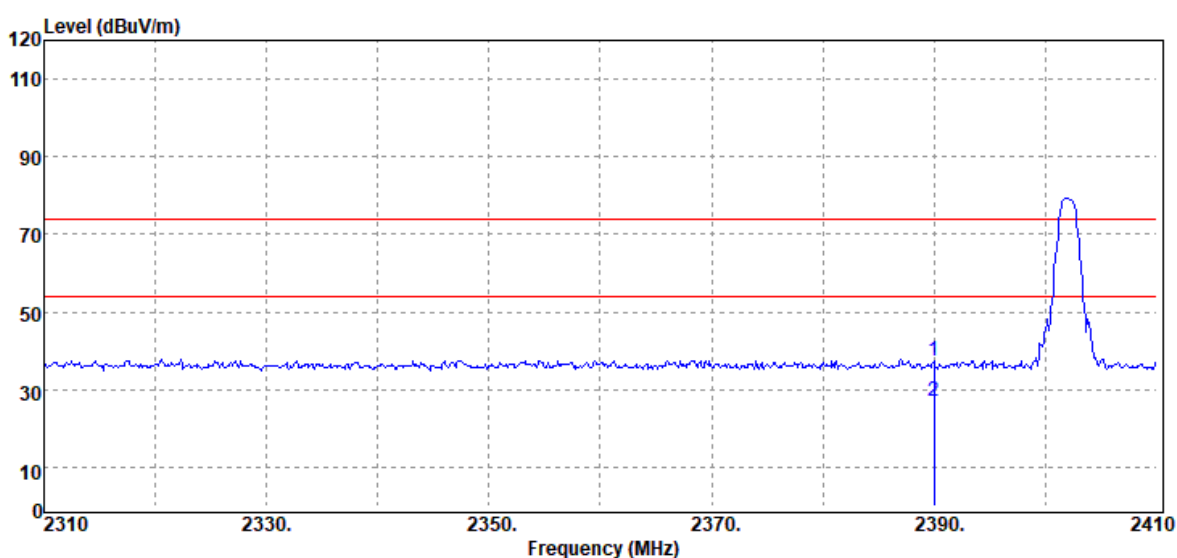


Above 1 GHz

4.6.4 Test Result

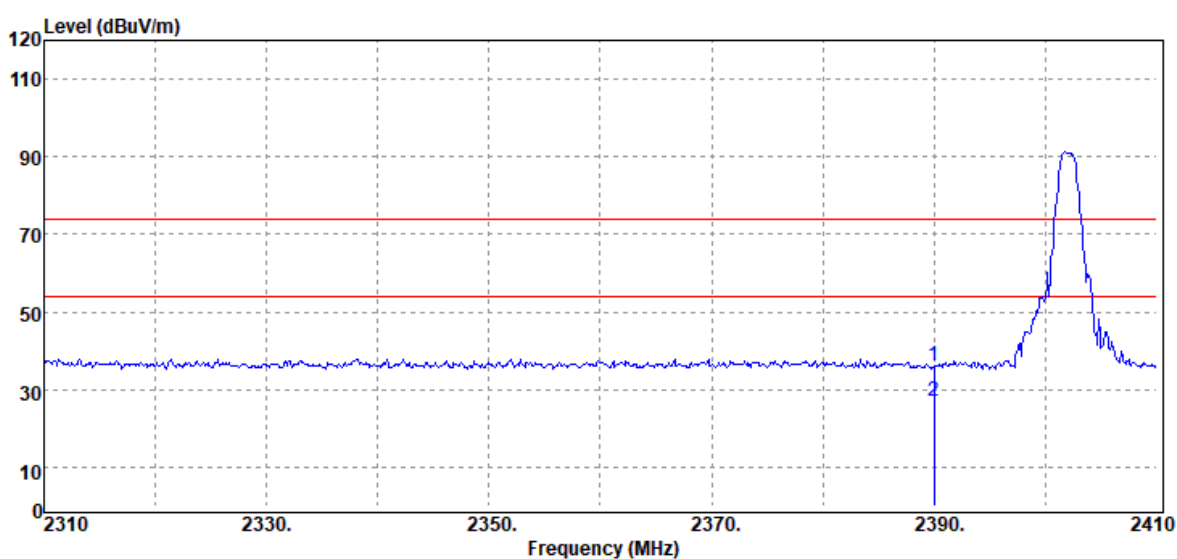
Band Edge Test Data

Test Mode:	BLE-1Mbps Low CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Band Edge	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak / Average		



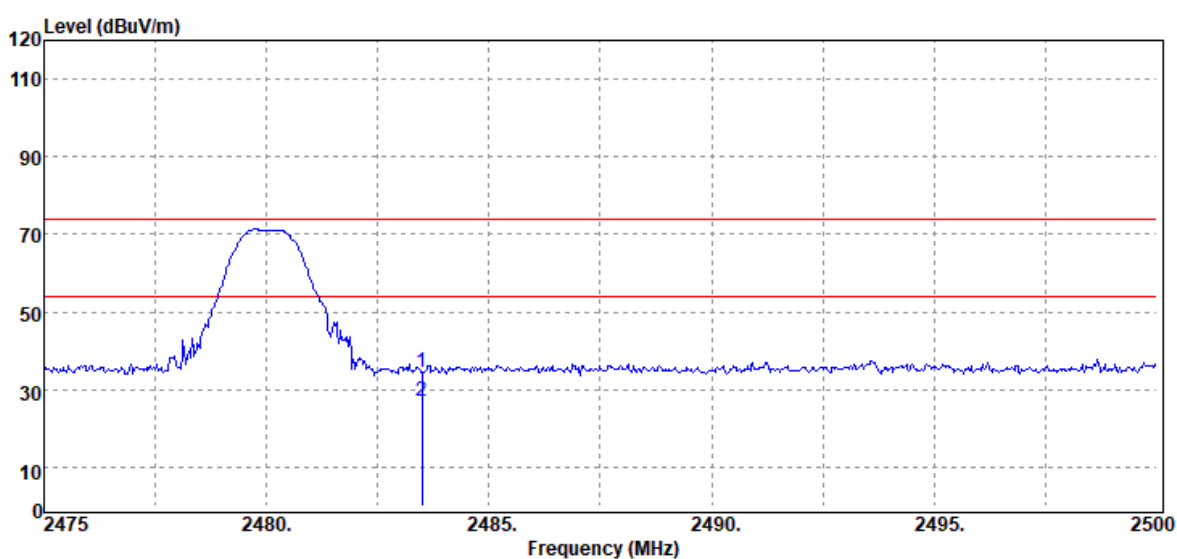
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Peak	46.93	-9.60	37.33	74.00	-36.67
2390.00	Average	36.75	-9.60	27.15	54.00	-26.85

Test Mode:	BLE-1Mbps Low CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Band Edge	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak / Average		



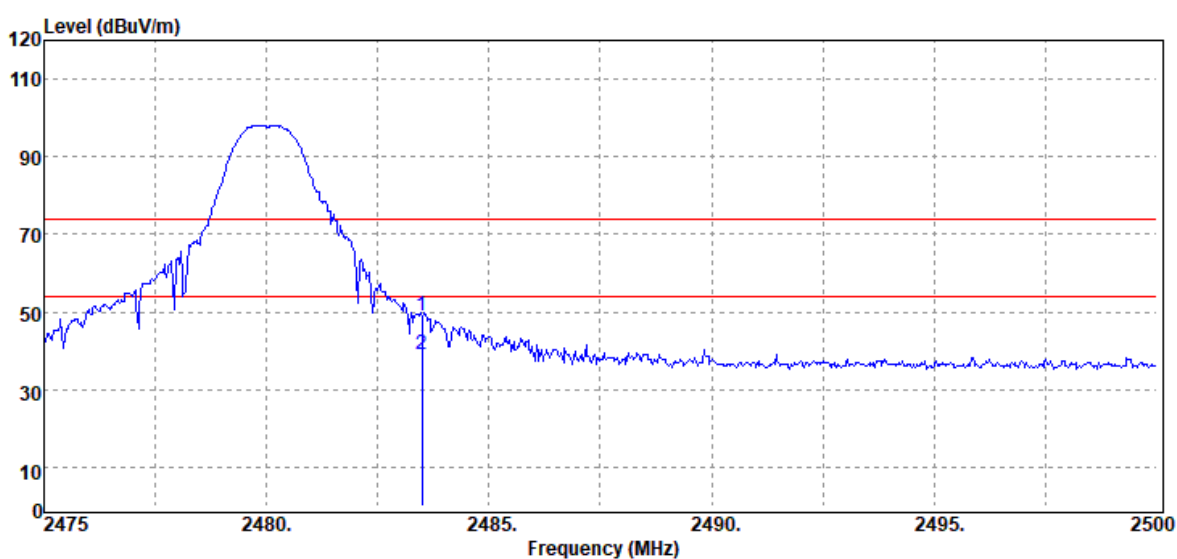
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Peak	45.59	-9.60	35.99	74.00	-38.01
2390.00	Average	36.65	-9.60	27.05	54.00	-26.95

Test Mode:	BLE-1Mbps High CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Band Edge	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak / Average		



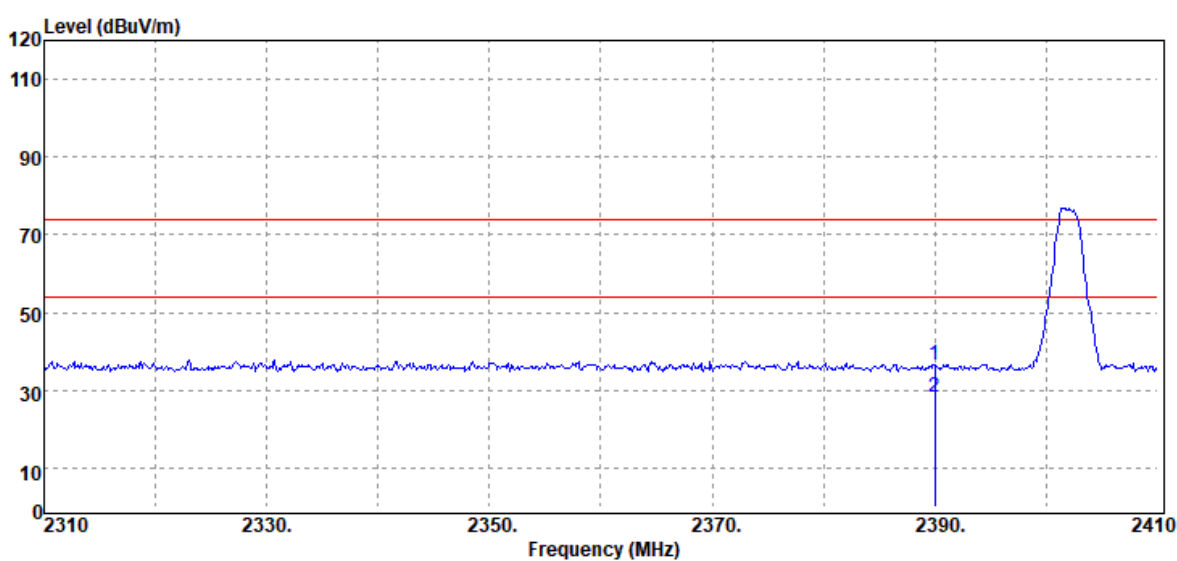
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Peak	43.64	-9.18	34.46	74.00	-39.54
2483.50	Average	36.18	-9.18	27.00	54.00	-27.00

Test Mode:	BLE-1Mbps High CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Band Edge	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak / Average		



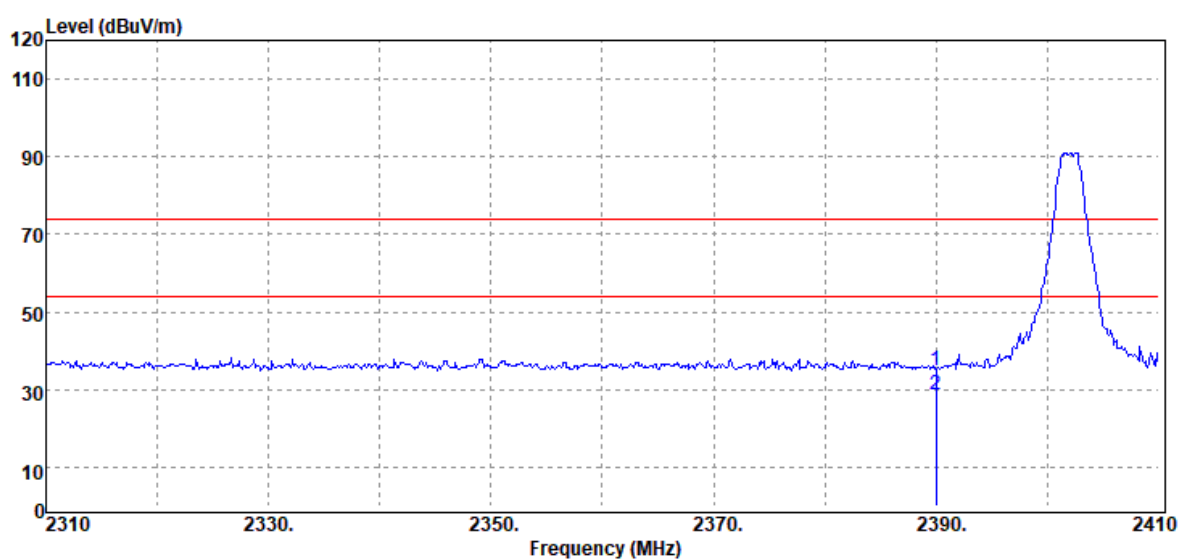
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
2483.50	Peak	58.17	-9.18	48.99	74.00	-25.01
2483.50	Average	48.10	-9.18	38.92	54.00	-15.08

Test Mode:	BLE-2Mbps Low CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Band Edge	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak / Average		



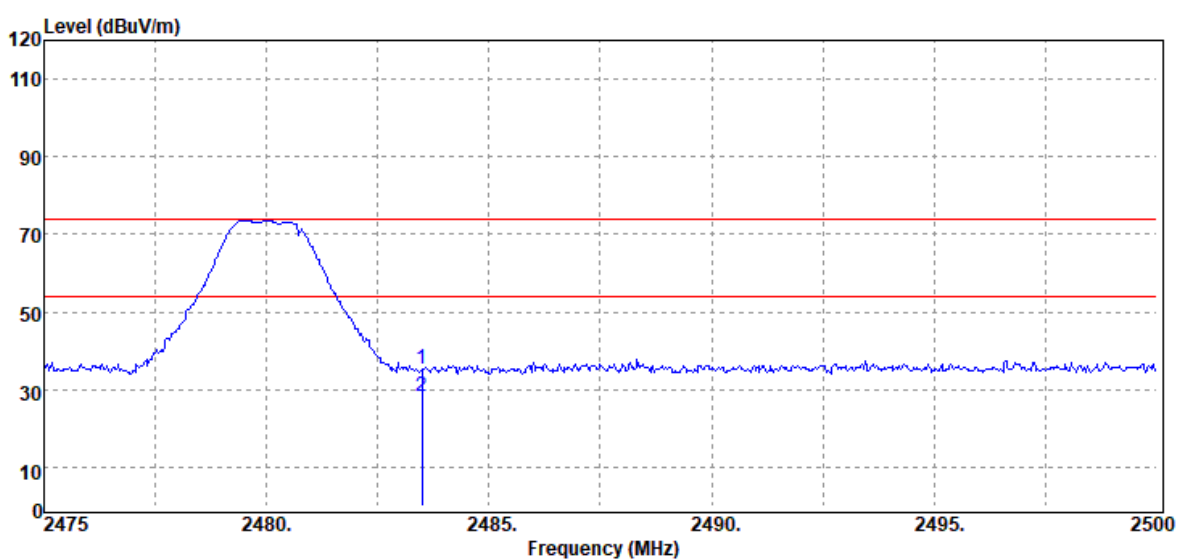
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Peak	46.08	-9.60	36.48	74.00	-37.52
2390.00	Average	37.82	-9.60	28.22	54.00	-25.78

Test Mode:	BLE-2Mbps Low CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Band Edge	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak / Average		



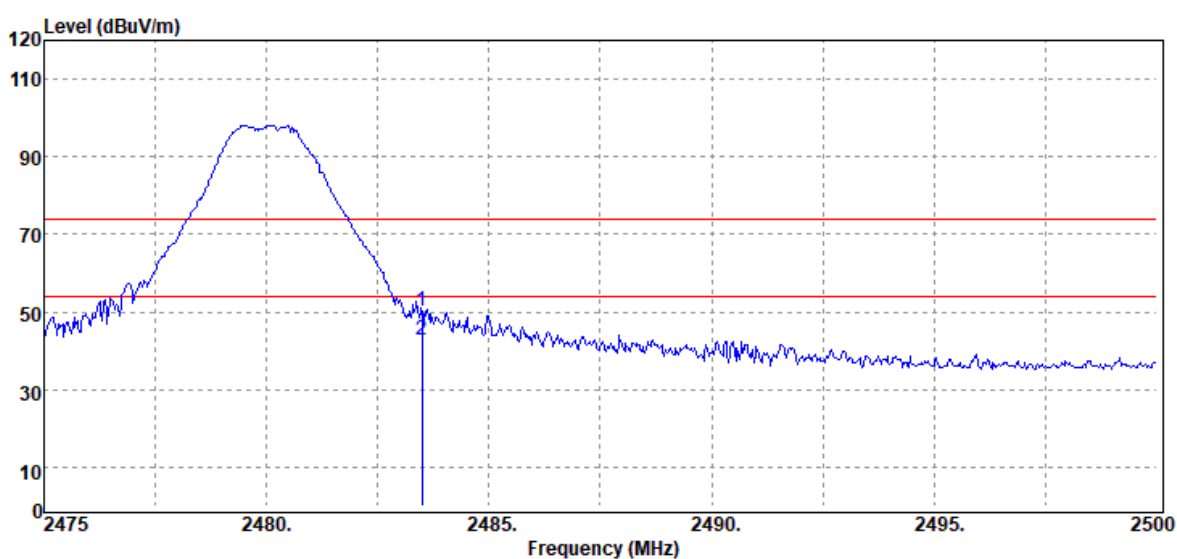
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2390.00	Peak	44.66	-9.60	35.06	74.00	-38.94
2390.00	Average	38.22	-9.60	28.62	54.00	-25.38

Test Mode:	BLE-2Mbps High CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Band Edge	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak / Average		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Peak	44.47	-9.18	35.29	74.00	-38.71
2483.50	Average	37.28	-9.18	28.10	54.00	-25.90

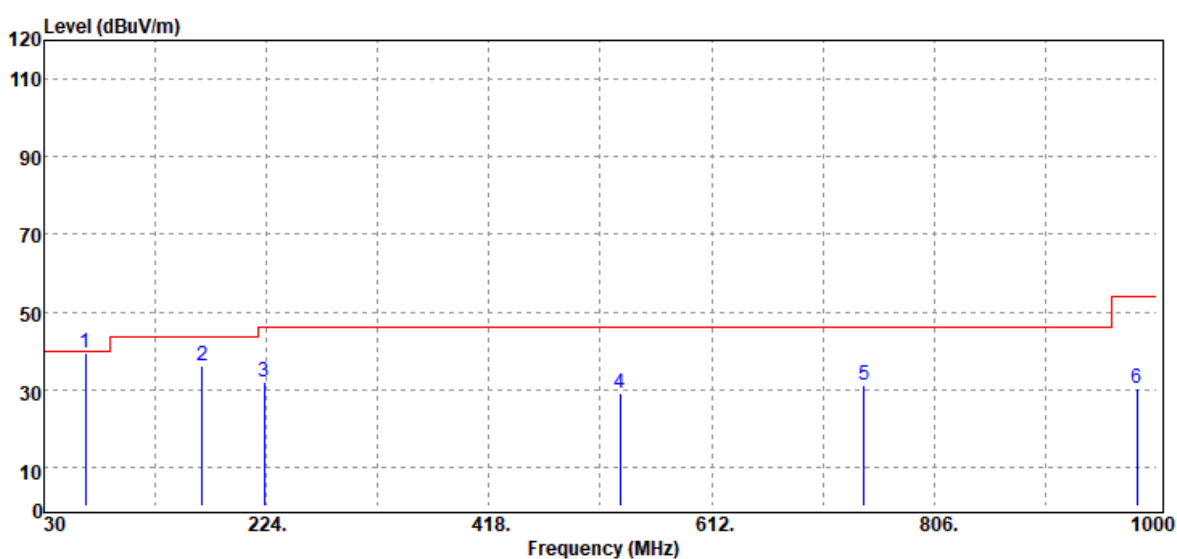
Test Mode:	BLE-2Mbps High CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Band Edge	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak / Average		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
2483.50	Peak	59.29	-9.18	50.11	74.00	-23.89
2483.50	Average	52.15	-9.18	42.97	54.00	-11.03

Below 1G Test Data

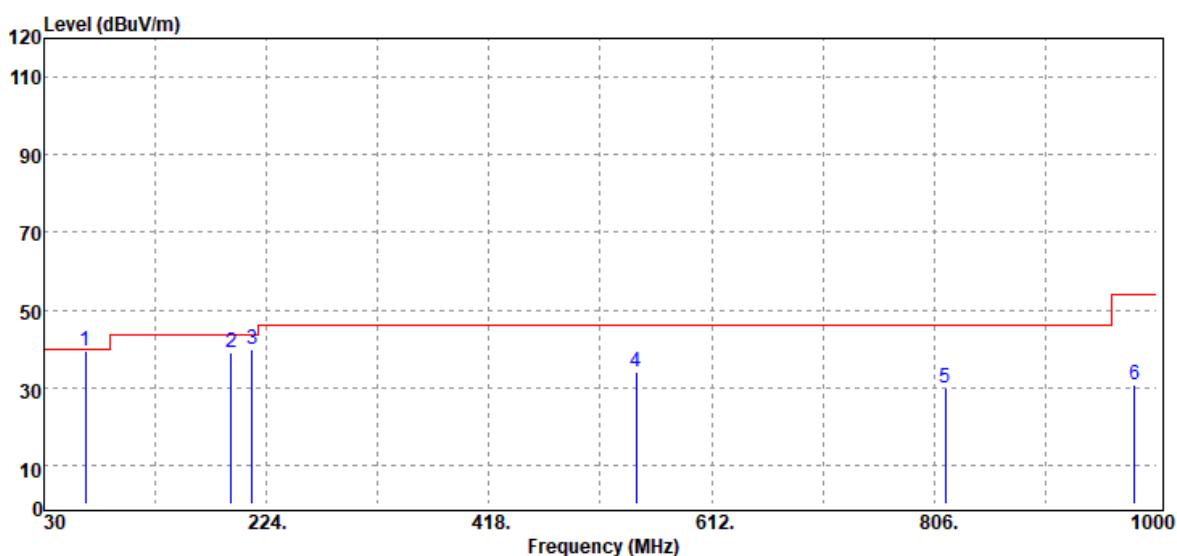
Test Mode:	BLE-1Mbps Mode	Temp/Hum	22.2(°C)/ 50%RH
Test Item	30MHz-1GHz	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
65.89	Peak	55.01	-15.47	39.54	40.00	-0.46
167.74	Peak	46.78	-10.53	36.25	43.50	-7.25
222.06	Peak	43.23	-11.27	31.96	46.00	-14.04
532.46	Peak	31.12	-2.19	28.93	46.00	-17.07
744.89	Peak	28.84	2.13	30.97	46.00	-15.03
982.54	Peak	25.00	5.52	30.52	54.00	-23.48

Note: No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).

Test Mode:	BLE-1Mbps Mode	Temp/Hum	22.2(°C)/ 50%RH
Test Item	30MHz-1GHz	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak		

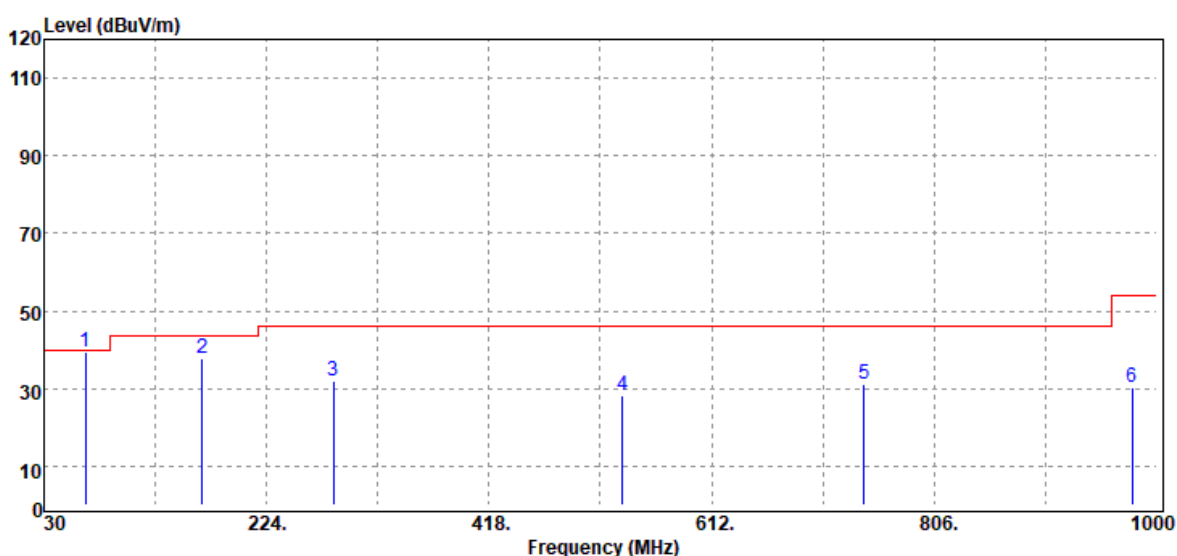


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
65.89	Peak	54.77	-15.47	39.30	40.00	-0.70
192.96	Peak	49.34	-10.25	39.09	43.50	-4.41
211.39	Peak	51.44	-11.60	39.84	43.50	-3.66
546.04	Peak	36.19	-2.08	34.11	46.00	-11.89
815.70	Peak	27.35	2.64	29.99	46.00	-16.01
980.60	Peak	25.08	5.71	30.79	54.00	-23.21

Note: No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).

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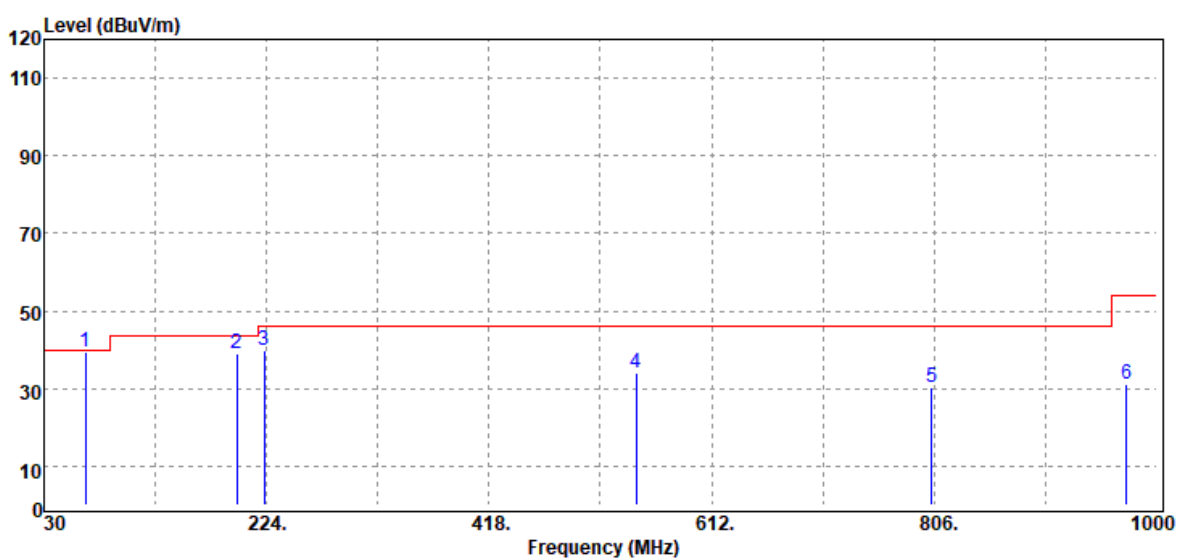
Test Mode:	BLE-2Mbps Mode	Temp/Hum	22.2(°C)/ 50%RH
Test Item	30MHz-1GHz	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
65.89	Peak	54.81	-15.47	39.34	40.00	-0.66
167.74	Peak	48.19	-10.53	37.66	43.50	-5.84
282.20	Peak	40.33	-8.38	31.95	46.00	-14.05
534.40	Peak	30.59	-2.21	28.38	46.00	-17.62
744.89	Peak	29.02	2.13	31.15	46.00	-14.85
978.66	Peak	24.57	5.58	30.15	54.00	-23.85

Note: No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).

Test Mode:	BLE-2Mbps Mode	Temp/Hum	22.2(°C)/ 50%RH
Test Item	30MHz-1GHz	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak		

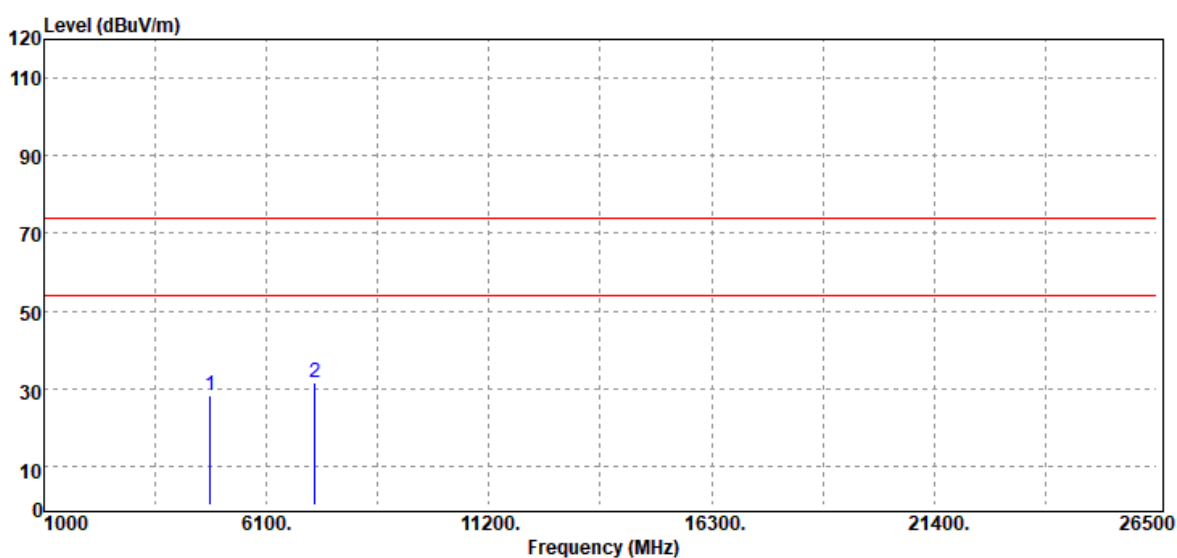


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
65.89	Peak	54.77	-15.47	39.30	40.00	-0.70
197.81	Peak	48.50	-9.26	39.24	43.50	-4.26
222.06	Peak	51.13	-11.27	39.86	46.00	-6.14
546.04	Peak	35.98	-2.08	33.90	46.00	-12.10
804.06	Peak	28.11	2.07	30.18	46.00	-15.82
973.81	Peak	25.50	5.57	31.07	54.00	-22.93

Note: No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).

Above 1G Test Data

Test Mode:	BLE-1Mbps Low CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak		



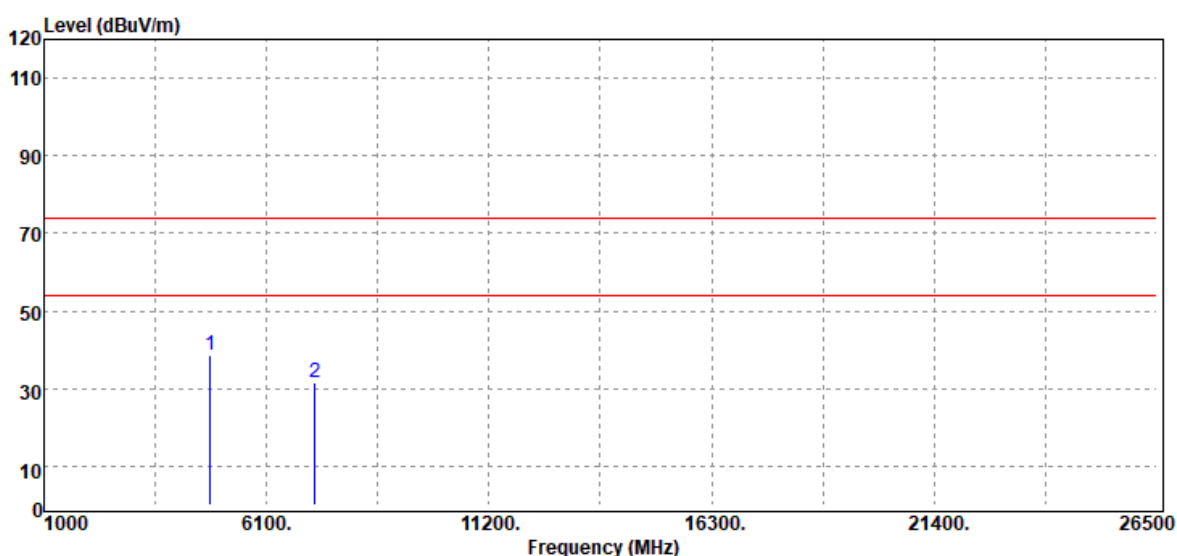
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Peak	34.18	-6.13	28.05	74.00	-45.95
7206.00	Peak	32.62	-0.91	31.71	74.00	-42.29
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Report No.: T210413W06-RP

Test Mode:	BLE-1Mbps Low CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak		

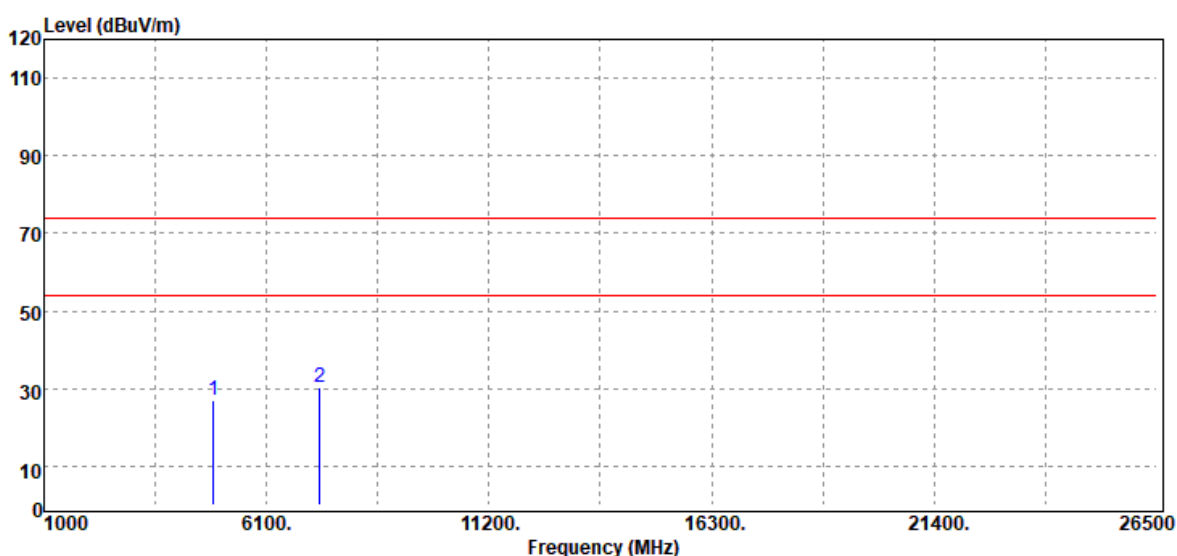


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Peak	44.56	-6.13	38.43	74.00	-35.57
7206.00	Peak	32.62	-0.91	31.71	74.00	-42.29
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Test Mode:	BLE-1Mbps Mid CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak		

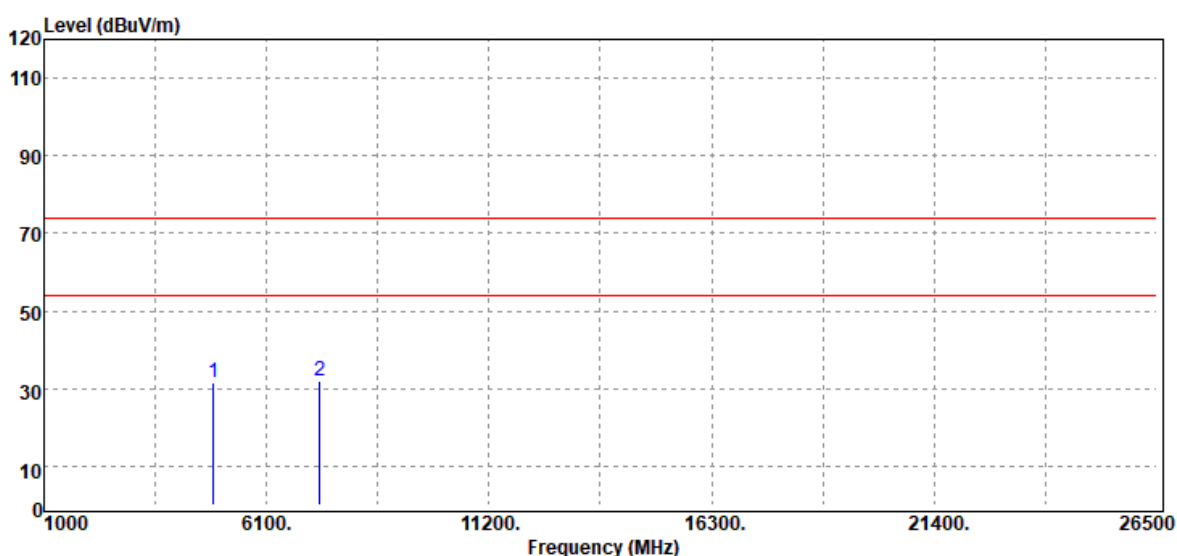


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4880.00	Peak	33.04	-5.98	27.06	74.00	-46.94
7320.00	Peak	31.32	-0.88	30.44	74.00	-43.56
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Test Mode:	BLE-1Mbps Mid CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak		



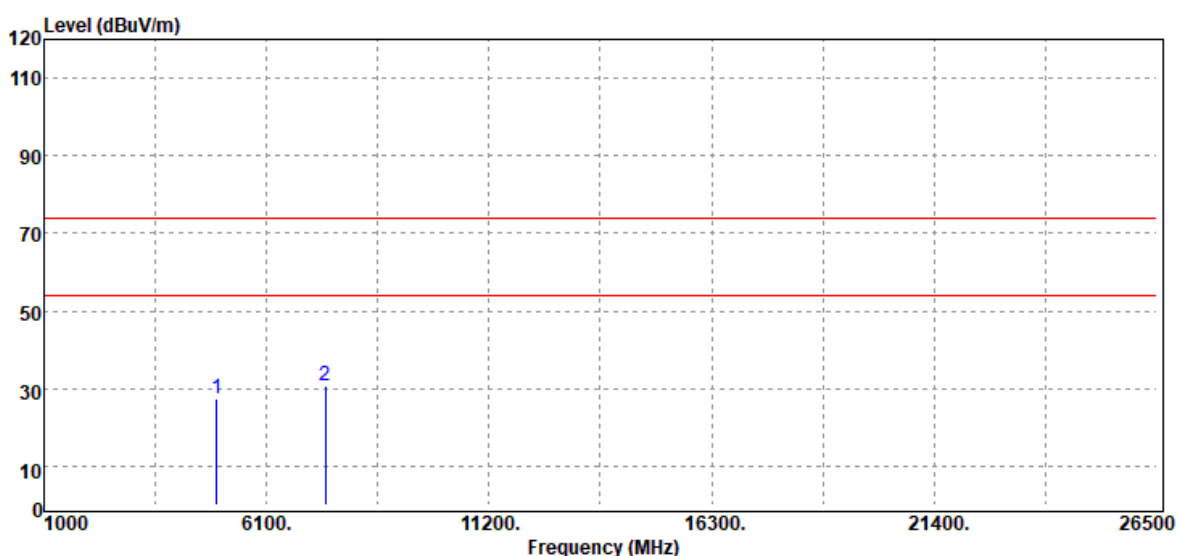
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4880.00	Peak	37.59	-5.98	31.61	74.00	-42.39
7320.00	Peak	32.92	-0.88	32.04	74.00	-41.96
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Report No.: T210413W06-RP

Test Mode:	BLE-1Mbps High CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak		

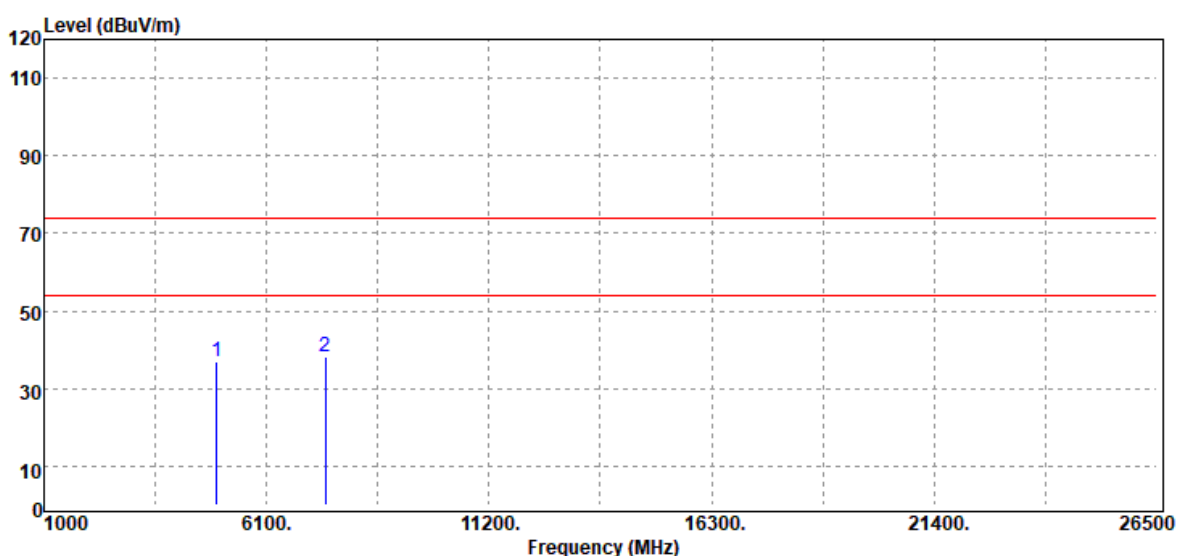


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Peak	32.61	-5.27	27.34	74.00	-46.66
7440.00	Peak	31.26	-0.71	30.55	74.00	-43.45
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Test Mode:	BLE-1Mbps High CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak		

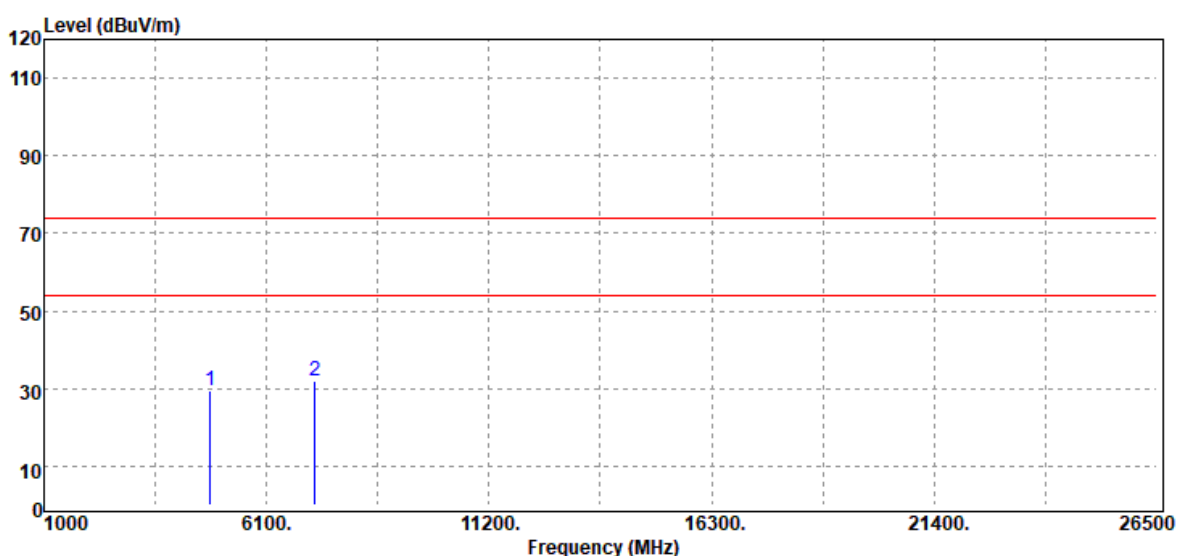


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Peak	42.20	-5.27	36.93	74.00	-37.07
7440.00	Peak	38.74	-0.71	38.03	74.00	-35.97
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Test Mode:	BLE-2Mbps Low CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak		

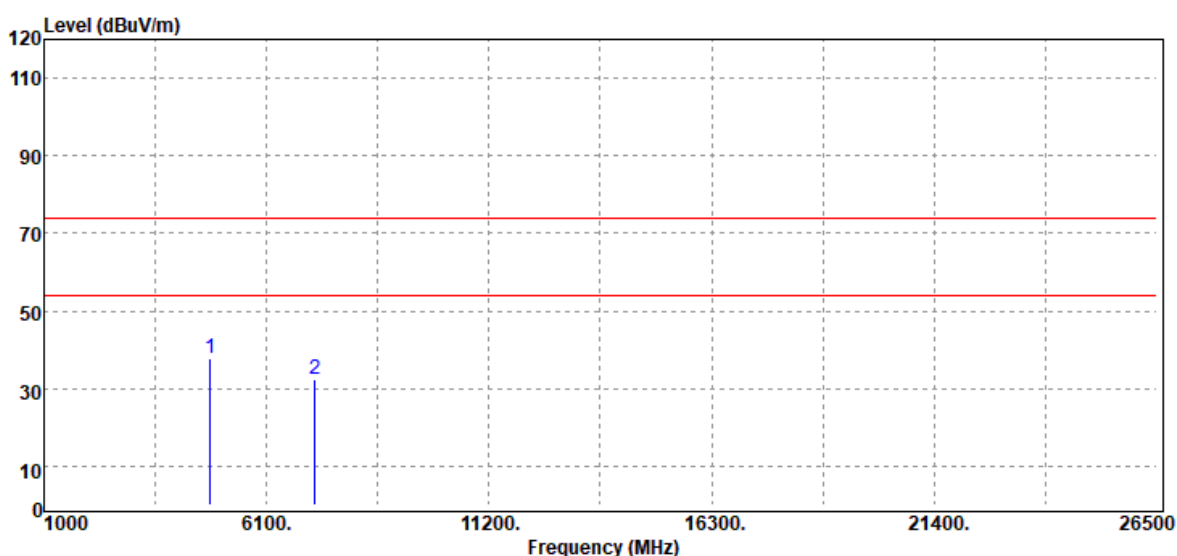


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Peak	35.60	-6.13	29.47	74.00	-44.53
7206.00	Peak	32.86	-0.91	31.95	74.00	-42.05
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Test Mode:	BLE-2Mbps Low CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak		

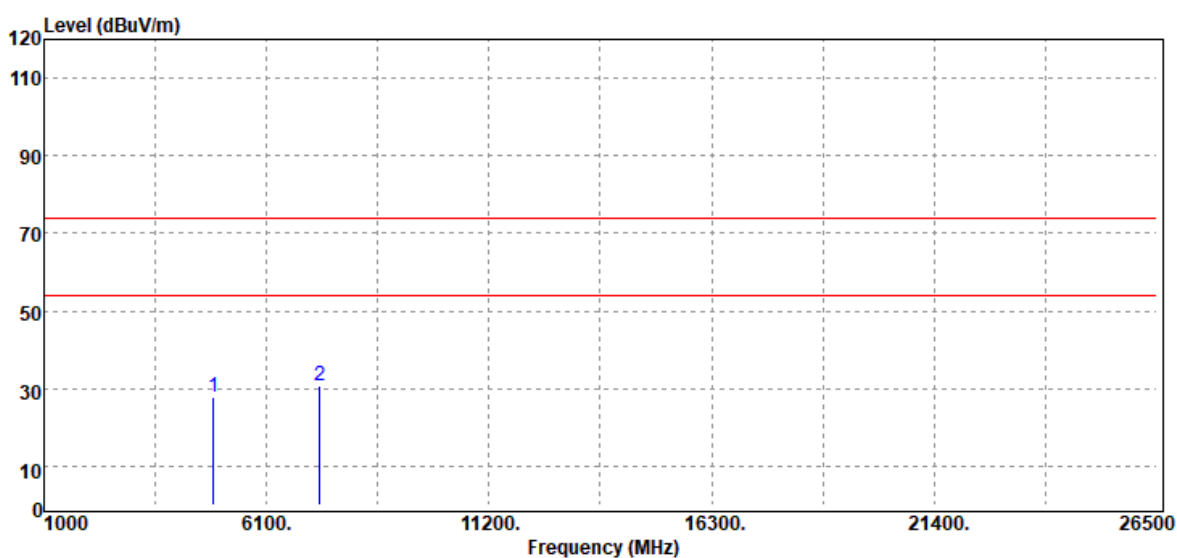


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4804.00	Peak	43.72	-6.13	37.59	74.00	-36.41
7206.00	Peak	33.28	-0.91	32.37	74.00	-41.63
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Test Mode:	BLE-2Mbps Mid CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak		

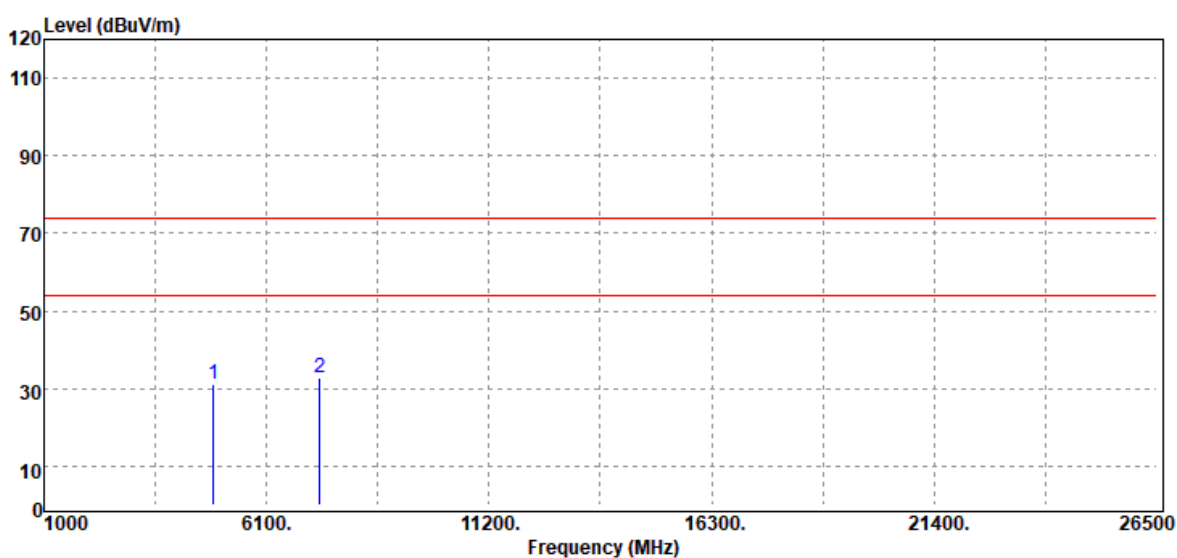


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4880.00	Peak	33.60	-5.98	27.62	74.00	-46.38
7320.00	Peak	31.57	-0.88	30.69	74.00	-43.31
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Test Mode:	BLE-2Mbps Mid CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak		

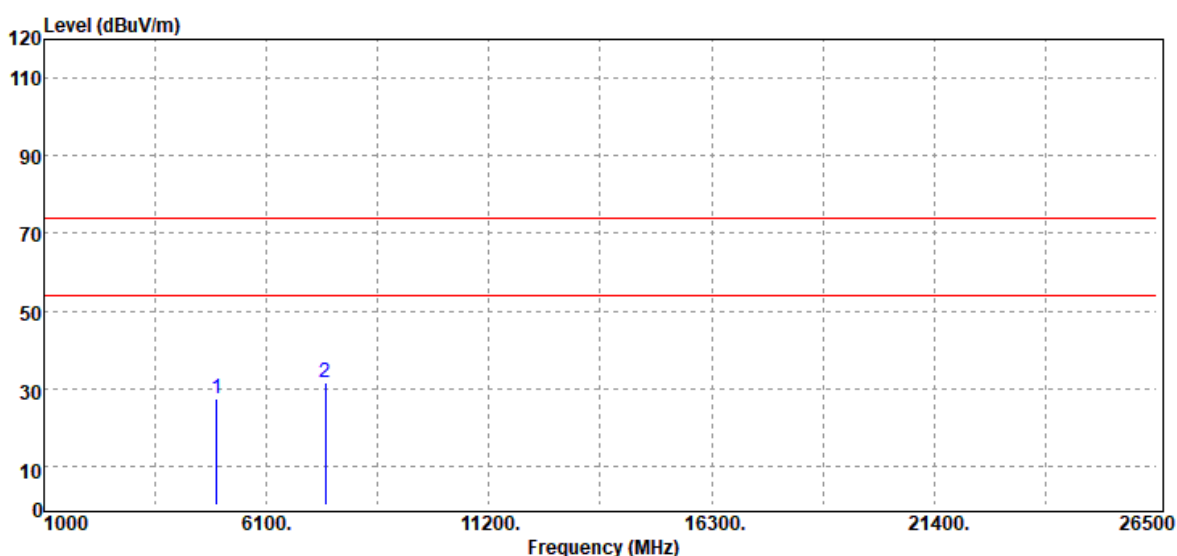


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4880.00	Peak	37.19	-5.98	31.21	74.00	-42.79
7320.00	Peak	33.76	-0.88	32.88	74.00	-41.12
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Test Mode:	BLE-2Mbps High CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Vertical	Test Engineer	Ray Li
Detector	Peak		

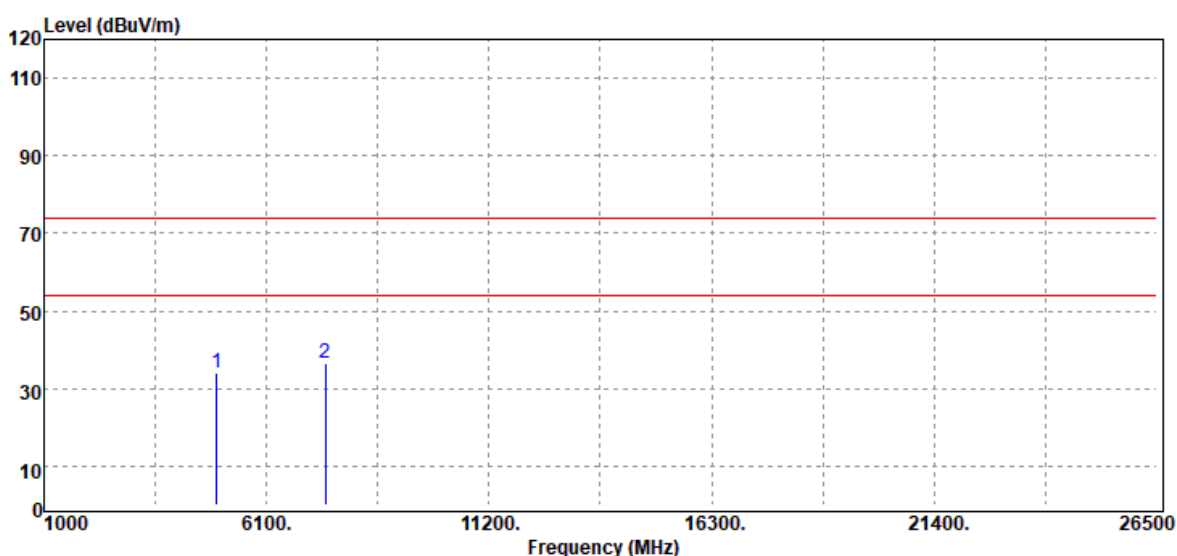


Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Peak	32.71	-5.27	27.44	74.00	-46.56
7440.00	Peak	32.26	-0.71	31.55	74.00	-42.45
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

Test Mode:	BLE-2Mbps High CH	Temp/Hum	22.2(°C)/ 50%RH
Test Item	Harmonic	Test Date	May 4, 2021
Polarize	Horizontal	Test Engineer	Ray Li
Detector	Peak		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
4960.00	Peak	39.12	-5.27	33.85	74.00	-40.15
7440.00	Peak	37.33	-0.71	36.62	74.00	-37.38
N/A						

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

--End of Test Report--