FCC PART 15.247

TEST REPORT

For

TSI Products, Inc.

809 110th St, Arlington TEXAS

Tested Model:TSI-404PCB
FCC ID:2AWD6TSI-404PCB

Report Type:	**Product Name:**
Original Report	Smart Chip PCB

Report Number:	RSC200420001-0B
Date of Report Issue:	2020-05-07
Reviewed By:	Sula Huang
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Chengdu) No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China Tel: +86-28-65525123 Fax: +86-28-65525125 www.baclcorp.com

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	TSI Products, Inc.
Product	Smart Chip PCB
Tested Model	TSI-404PCB
FCC ID	2AWD6TSI-404PCB
Frequency	Bluetooth LE: 2402-2480MHz
Modulation Type:	Bluetooth LE: GFSK
Voltage	DC 3.0V CR2025
Measure approximately	27 mm (D)
Sample serial number	200420001/01 (assigned by the BACL, Chengdu)
Sample/EUT Status	The test sample was in good condition and received: 2020-04-20

Note: Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

Objective

This report is prepared on behalf of **TSI Products, Inc.** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules.

The tests were performed in order to determine the compliance of the EUT with FCC Part 15-Subpart C, section 15.203, 15.205, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

No related submittals.

Measurement Uncertainty

Item			Uncertainty
Radiated Emission(Field Strength)	30MHz-200MHz	H	4.31 dB
		V	4.57 dB
	200MHz-1GHz	H	4.68 dB
		V	5.78 dB
	1GHz-6GHz		4.56 dB
	6GHz-18GHz		4.57 dB
	18GHz-25GHz		5.44 dB

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the corresponding inclusion factor K when the inclusion probability is about 95%.

Test Methodology

All measurements contained in this report were conducted with:

1. ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

2. KDB558074 D01 DTS Meas Guidance v05r02.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Chengdu) to collect test data is located No.5040, Huilongwan Plaza, No. 1, Shawan Road, Jinniu District, Chengdu, Sichuan, China.

Bay Area Compliance Laboratories Corp. (Chengdu) lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4324.01) and the FCC designation No. CN1186 under the FCC KDB 974614 D01. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured in testing mode, which was provided by manufacturer.

For Bluetooth LE mode, 40 channels are provided for testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	…	…
…	…	…	…
…	…	…	…
..	…	38	2478
19	2440	39	2480

EUT was tested with channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

The setting by the software is as following table:

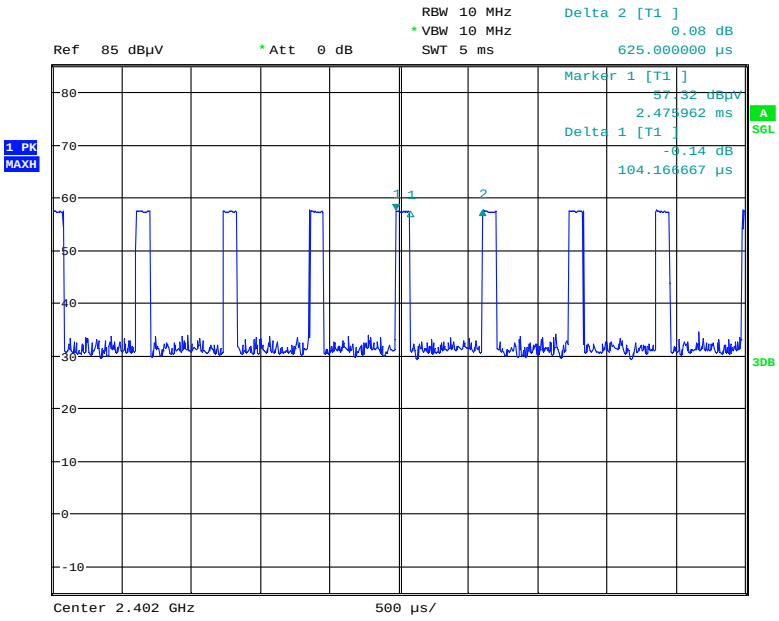
Test Mode	Test Software Version	nRFgo Studio		
BLE (1MHz)	Test Frequency	2402MHz	2440MHz	2480MHz
	Data Rate	Default	Default	Default
	Power Level Setting	Default	Default	Default
BLE (2MHz)	Test Frequency	2402MHz	2440MHz	2480MHz
	Data Rate	Default	Default	Default
	Power Level Setting	Default	Default	Default

Duty Cycle information is below:

Mode	T_{on}	T_p	1/T	Duty Cycle
	(ms)	(ms)	(kHz)	(%)
BLE(1MHz)	0.104	0.625	9.62	16.64
BLE (2MHz)	0.064	0.625	15.63	10.24

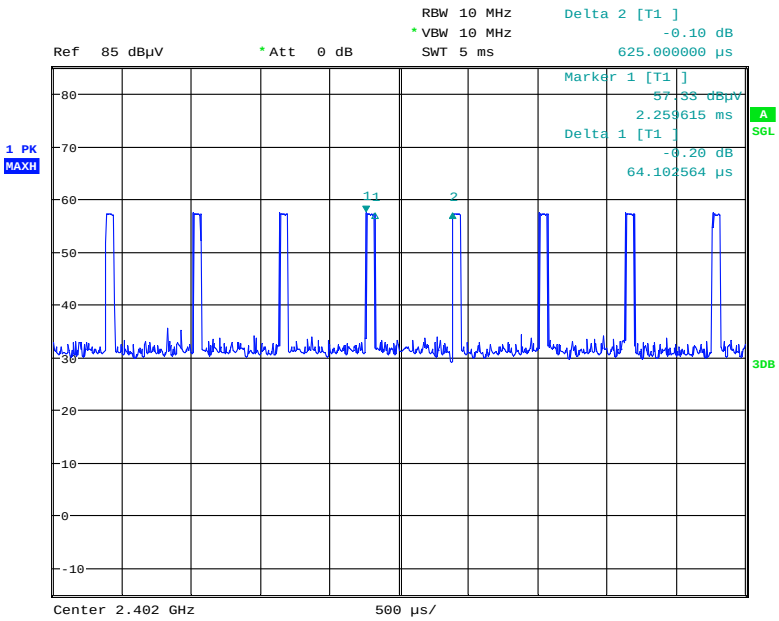
Note：Duty Cycle Factor =10*log (1/x), “x” means Duty Cycle.

BLE (1MHz)



Date: 1.MAY.2020 01:56:06

BLE (2MHz)



Date: 2.MAY.2020 08:25:28

Support Equipment List and Details

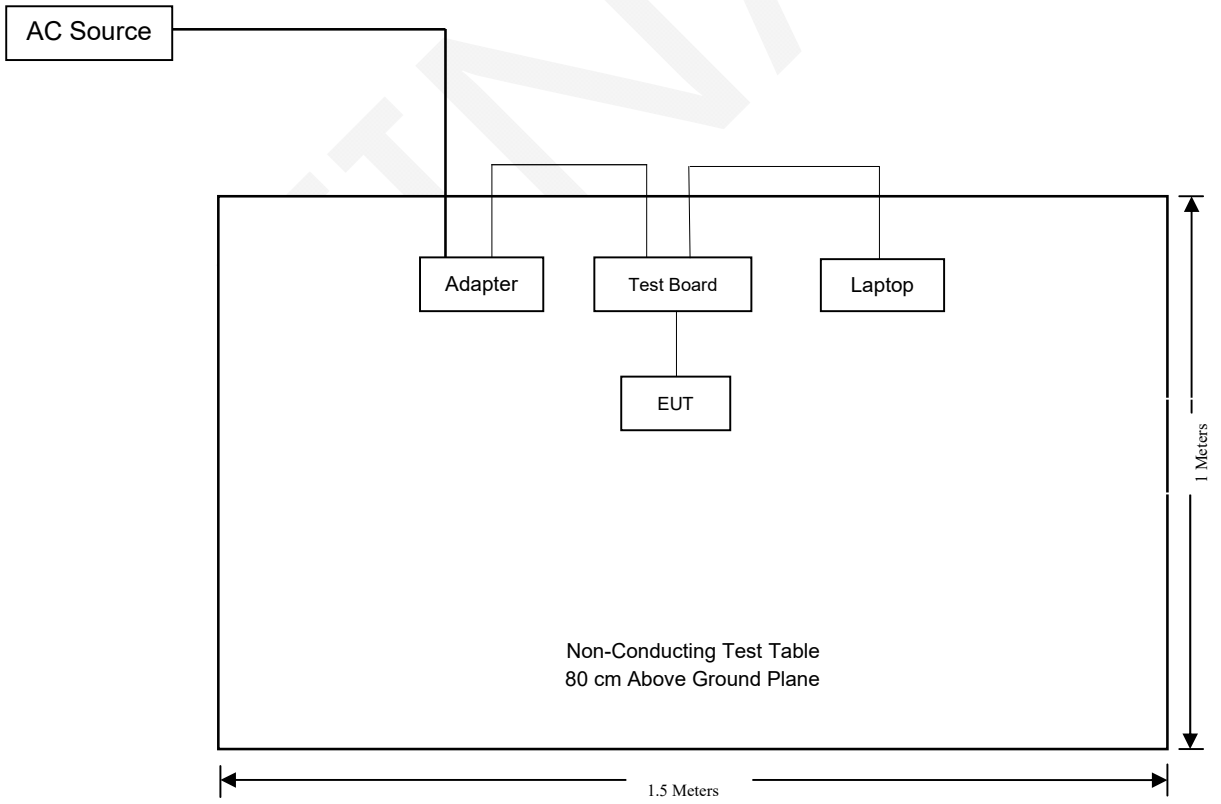
Manufacturer	Description	Model	Serial Number
DELL	Laptop	E75	PCOR364L
Chongqing Jinou	Test Board	Unknown	Unknown
ShanTou Yuewei	Adapter	YW-506	Unknown

External I/O Cable

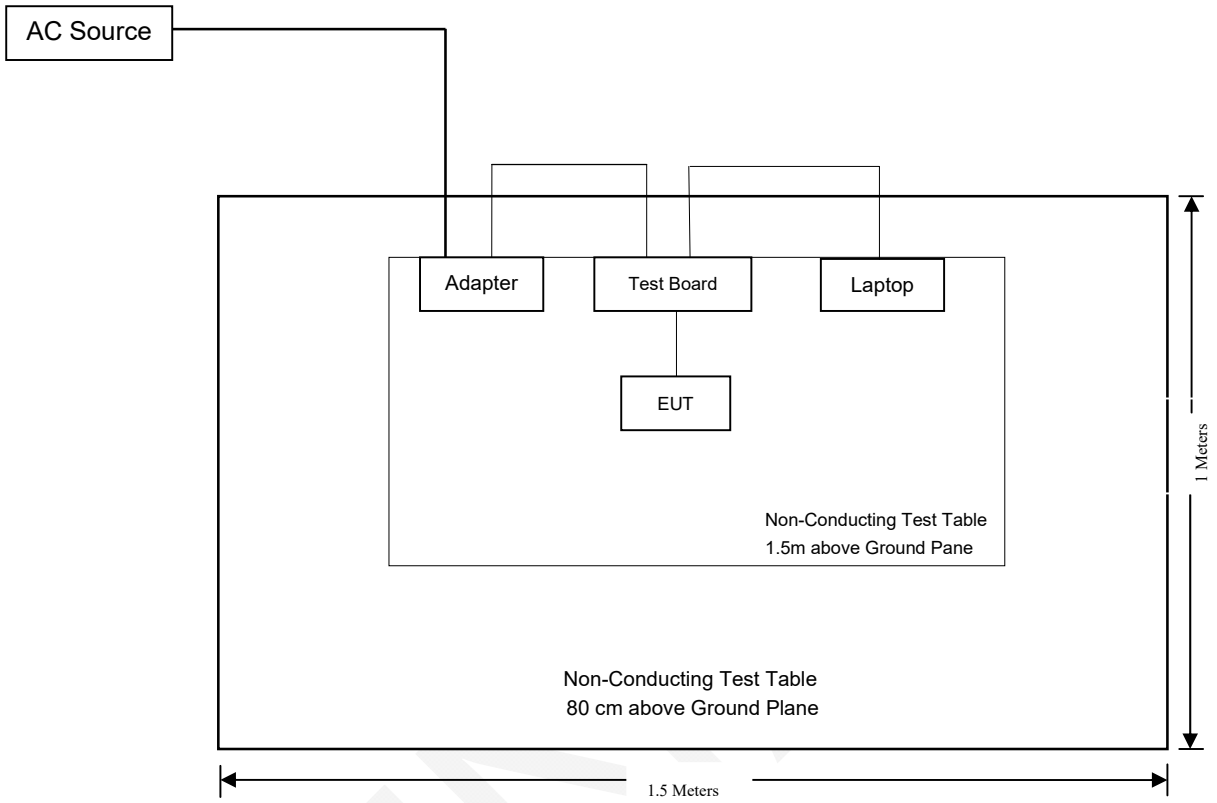
Cable Description	Length (m)	From	To
Unshielded USB Cable	0.70	Test Board	Laptop
Adapter DC Power Cable	1.10	Test Board	Adapter
Controlled Cable	0.10	Test Board	EUT

Block Diagram of Test Setup

Below 1GHz:



Above 1GHz:


AC Source
Adapter
Test Board
Laptop
EUT
Non-Conducting Test Table
1.5m above Ground Pane
Non-Conducting Test Table
80 cm above Ground Plane
1 Meters
1.5 Meters

SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
FCC §15.247 & §1.1310 & §2.1091	Maximum Permissible exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Not Applicable
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliance
§15.247(b)(3)	Maximum conducted output power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

Not Applicable : The device is battery operated equipment.

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

TEST EQUIPMENTS LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission					
EMCT	Semi-Anechoic Chamber	966	001	2017-05-18	2020-05-17
SONOMA INSTRUMENT	Pre-Amplifier	310 N	186684	2019-10-17	2020-10-16
Mini-circuits	Pre-Amplifier	ZVA-183-S+	771001215	2019-09-20	2020-09-19
EM Electronics	RF Pre-Amplifier	EM18G40	060725	2019-07-24	2020-07-23
SUNOL SCIENCES	Broadband Antenna	JB3	A121808	2019-12-10	2022-12-09
INMET	Attenuator	18N-6dB	N/A	2019-12-10	2022-12-09
EMCO	Horn Antenna	3115	2192	2019-09-25	2021-09-24
A.H. Systems, Inc	Horn Antenna	SAS-574	510	2019-09-02	2021-09-01
Rohde & Schwarz	EMI Test Receiver	ESR3	102456	2020-04-13	2021-04-12
Rohde & Schwarz	Spectrum Analyzer	FSU26	200835	2020-04-13	2021-04-12
MICRO-TRONICS	2.4GHz Notch Filter	BRM50702	G396	2020-02-22	2021-02-21
Unknown	RF Cable (Below 1GHz)	L-E005	000005	2019-09-06	2020-09-05
Unknown	RF Cable (Below 1GHz)	T-E128	000128	2019-10-17	2020-10-16
Unknown	RF Cable (Below 1GHz)	T-E237	233522-001	2019-07-19	2020-07-18
Unknown	RF Cable (Above 1GHz)	T-E069	000069	2019-07-24	2020-07-23
UTiFLEX	RF Cable (Above 1GHz)	T-E222	2551/2	2019-07-24	2020-07-23
UTiFLEX	RF Cable (Above 1GHz)	T-E210	1042	2019-07-24	2020-07-23
Rohde & Schwarz	EMC32	EMC32	V9.10.00	NCR	NCR

FCC §15.247 & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE

Applicable Standard

According to subpart 15.247 and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Per 447498 D01 General RF Exposure Guidance v06**,** simultaneous transmission MPE test exclusion applies when the sum of the MPE for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0.
Calculated Formulary:

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where:
S = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	2.5	1.78	-7.0	0.20	20	0.0001	1.0

Result: The device meets RF exposure evaluation at ⩾20cm distance.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

Antenna Connector Construction

The EUT has one integrated antenna and the maximum antenna gain is 2.5dBi, which fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance

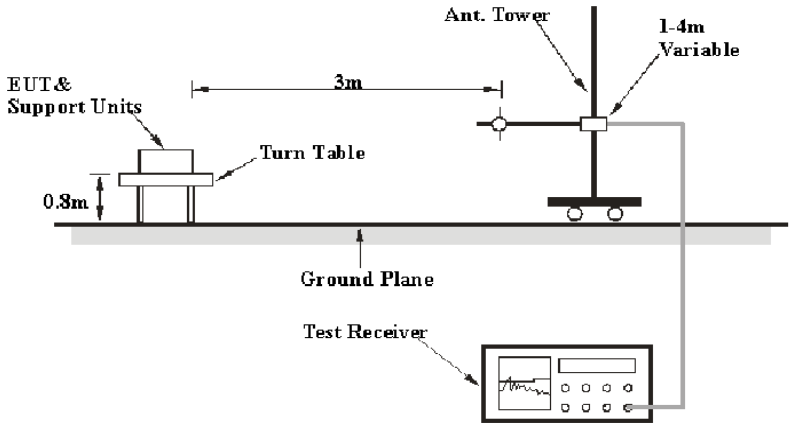
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

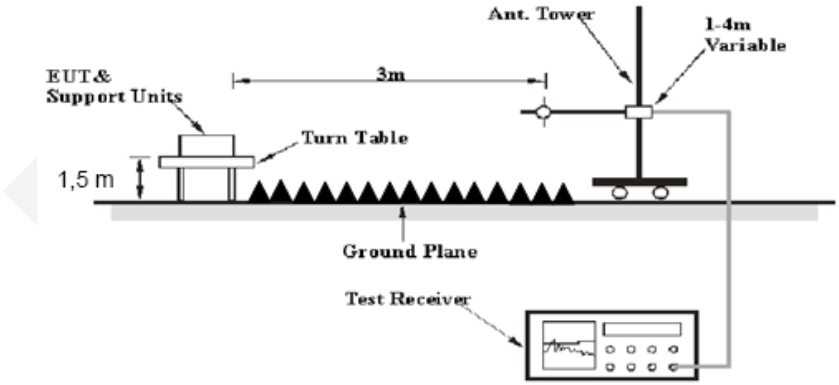
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver Setup or Spectrum Analyzer was set with the following configurations:

Frequency Range	RBW	Video B/W	Duty Cycle	Measurement
30 MHz – 1000 MHz	120 kHz	300 kHz	/	QP
Above 1 GHz	1 MHz	3 MHz	Any	PK
	1 MHz	10 Hz	＞98%	AV
	1 MHz	1/T	＜98%	AV

Note: T is minimum transmission duration.

The test software EMC 32 setting is as below:

Frequency Range	RBW	Video B/W	Measurement
30 MHz – 1000 MHz	120 kHz	300 kHz	QP
Above 1 GHz	1MHz	3 MHz	PK
	1MHz	3 MHz	AV

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Loss and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Loss + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit –Corrected Amplitude

Test Data

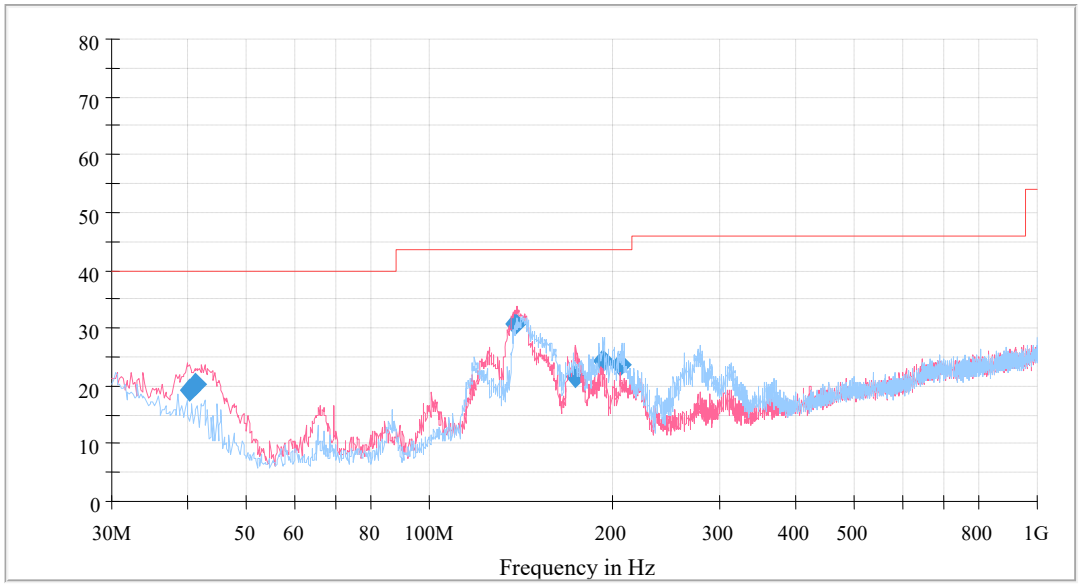
Test Environment Conditions

Temperature:	25 °C
Relative Humidity:	68.5 %
ATM Pressure:	98.2 kPa

The testing was performed by Eric Xiao on 2020-05-01.

Test Mode: Transmitting

1) 30 MHz to 1 GHz_BLE(1MHz) low channel _worst case



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.206000	19.27	40.00	20.73	120.000	124.0	V	310.0	-11.1
41.330200	20.17	40.00	19.83	120.000	105.0	V	158.0	-11.8
138.279500	30.59	43.50	12.91	120.000	113.0	V	184.0	-11.7
173.217900	21.66	43.50	21.84	120.000	103.0	V	110.0	-13.3
192.582900	24.44	43.50	19.06	120.000	101.0	H	274.0	-13.5
206.277700	23.47	43.50	20.03	120.000	107.0	H	283.0	-13.9

Above 1 GHz_BLE (1MHz)

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
frequency:2402 MHz									
2402	57.56	PK	H	29.14	3.55	0.00	90.25	N/A	N/A
2402	56.41	AV	H	29.14	3.55	0.00	89.10	N/A	N/A
2402	55.11	PK	V	29.14	3.55	0.00	87.80	N/A	N/A
2402	54.06	AV	V	29.14	3.55	0.00	86.75	N/A	N/A
2390	28.38	PK	H	29.15	3.54	0.00	61.07	74.00	12.93
2390	14.57	AV	H	29.15	3.54	0.00	47.26	54.00	6.74
2390	28.17	PK	V	29.15	3.54	0.00	60.86	74.00	13.14
2390	14.52	AV	V	29.15	3.54	0.00	47.21	54.00	6.79
4804	40.26	PK	H	32.99	5.05	27.27	51.03	74.00	22.97
4804	26.41	AV	H	32.99	5.05	27.27	37.18	54.00	16.82
7206	32.73	PK	H	35.75	6.43	27.10	47.81	74.00	26.19
7206	20.52	AV	H	35.75	6.43	27.10	35.60	54.00	18.40
frequency:2440 MHz									
2440	55.81	PK	H	29.08	3.58	0.00	88.47	N/A	N/A
2440	54.72	AV	H	29.08	3.58	0.00	87.38	N/A	N/A
2440	53.44	PK	V	29.08	3.58	0.00	86.10	N/A	N/A
2440	52.28	AV	V	29.08	3.58	0.00	84.94	N/A	N/A
4880	39.45	PK	H	33.19	5.09	27.26	50.47	74.00	23.53
4880	30.20	AV	H	33.19	5.09	27.26	41.22	54.00	12.78
7320	32.11	PK	H	36.00	6.49	27.11	47.49	74.00	26.51
7320	20.58	AV	H	36.00	6.49	27.11	35.96	54.00	18.04
frequency:2480 MHz									
2480	55.82	PK	H	29.03	3.61	0.00	88.46	N/A	N/A
2480	54.75	AV	H	29.03	3.61	0.00	87.39	N/A	N/A
2480	51.71	PK	V	29.03	3.61	0.00	84.35	N/A	N/A
2480	50.53	AV	V	29.03	3.61	0.00	83.17	N/A	N/A
2483.5	29.21	PK	H	29.02	3.61	0.00	61.84	74.00	12.16
2483.5	15.11	AV	H	29.02	3.61	0.00	47.74	54.00	6.26
2483.5	28.83	PK	V	29.02	3.61	0.00	61.46	74.00	12.54
2483.5	14.98	AV	V	29.02	3.61	0.00	47.61	54.00	6.39
4960	40.12	PK	H	33.40	5.14	27.24	51.42	74.00	22.58
4960	30.31	AV	H	33.40	5.14	27.24	41.61	54.00	12.39
7440	31.74	PK	H	36.27	6.55	27.13	47.43	74.00	26.57
7440	20.53	PK	H	36.27	6.55	27.13	36.22	74.00	37.78

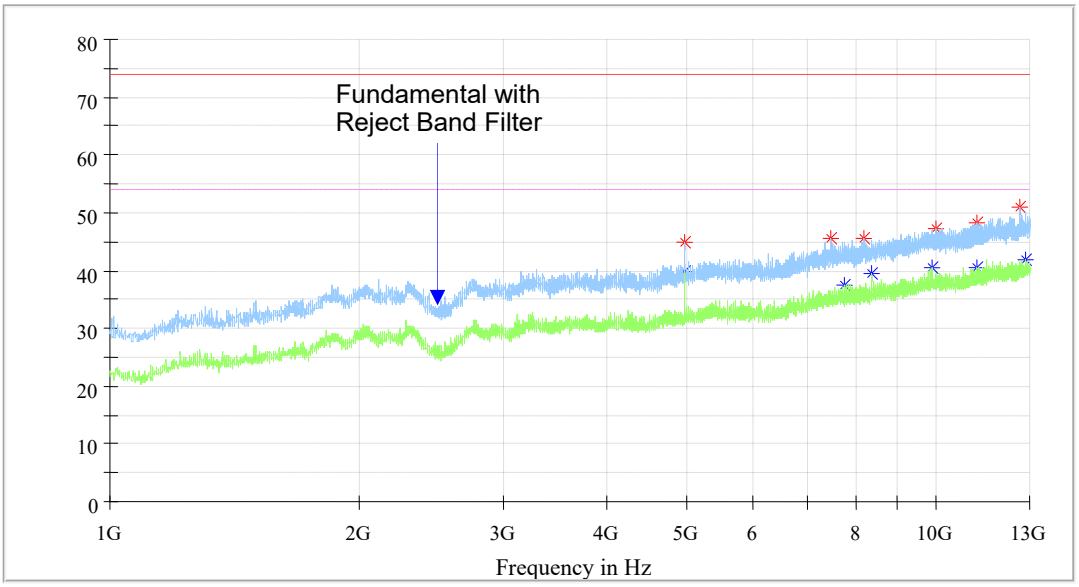
Above 1 GHz_BLE (2MHz)

Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude	Limit	Margin
	Reading	Measurement	Polar	Factor					
MHz	dBµV	PK/AV	H/V	dB(1/m)	dB	dB	dBµV/m	dBµV/m	dB
frequency:2402 MHz									
2402	57.22	PK	H	29.14	3.55	0.00	89.91	N/A	N/A
2402	54.42	AV	H	29.14	3.55	0.00	87.11	N/A	N/A
2402	55.02	PK	V	29.14	3.55	0.00	87.71	N/A	N/A
2402	52.18	AV	V	29.14	3.55	0.00	84.87	N/A	N/A
2390	29.06	PK	H	29.15	3.54	0.00	61.75	74.00	12.25
2390	14.61	AV	H	29.15	3.54	0.00	47.30	54.00	6.70
2390	28.63	PK	V	29.15	3.54	0.00	61.32	74.00	12.68
2390	14.57	AV	V	29.15	3.54	0.00	47.26	54.00	6.74
4804	41.33	PK	H	32.99	5.05	27.27	52.10	74.00	21.90
4804	26.37	AV	H	32.99	5.05	27.27	37.14	54.00	16.86
7206	32.17	PK	V	35.75	6.43	27.10	47.25	74.00	26.75
7206	20.61	AV	V	35.75	6.43	27.10	35.69	54.00	18.31
frequency:2440 MHz									
2440	56.72	PK	H	29.08	3.58	0.00	89.38	N/A	N/A
2440	53.92	AV	H	29.08	3.58	0.00	86.58	N/A	N/A
2440	53.49	PK	V	29.08	3.58	0.00	86.15	N/A	N/A
2440	50.61	AV	V	29.08	3.58	0.00	83.27	N/A	N/A
4880	39.34	PK	H	33.19	5.09	27.26	50.36	74.00	23.64
4880	28.53	AV	H	33.19	5.09	27.26	39.55	54.00	14.45
7320	31.92	PK	H	36.00	6.49	27.11	47.30	74.00	26.70
7320	20.21	AV	H	36.00	6.49	27.11	35.59	54.00	18.41
frequency:2480 MHz									
2480	54.68	PK	H	29.03	3.61	0.00	87.32	N/A	N/A
2480	51.99	AV	H	29.03	3.61	0.00	84.63	N/A	N/A
2480	51.39	PK	V	29.03	3.61	0.00	84.03	N/A	N/A
2480	48.52	AV	V	29.03	3.61	0.00	81.16	N/A	N/A
2483.5	28.51	PK	H	29.02	3.61	0.00	61.14	74.00	12.86
2483.5	14.58	AV	H	29.02	3.61	0.00	47.21	54.00	6.79
2483.5	28.38	PK	V	29.02	3.61	0.00	61.01	74.00	12.99
2483.5	14.62	AV	V	29.02	3.61	0.00	47.25	54.00	6.75
4960	39.08	PK	H	33.40	5.14	27.24	50.38	74.00	23.62
4960	28.72	AV	H	33.40	5.14	27.24	40.02	54.00	13.98
7440	31.99	PK	H	36.27	6.55	27.13	47.68	74.00	26.32
7440	20.58	PK	H	36.27	6.55	27.13	36.27	74.00	37.73

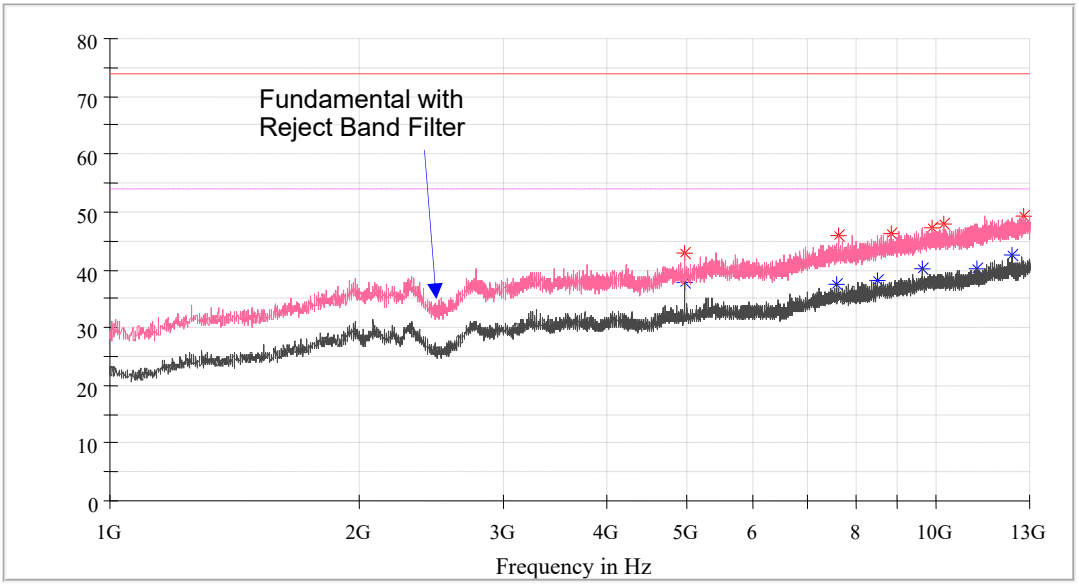
Note:
Corrected Amplitude = Corrected Factor + Reading
Corrected Factor=Antenna factor (RX) + Cable Loss – Amplifier Factor or Antenna factor (RX) + Cable Loss
Margin = Limit- Corr. Amplitude

Please refer to the below pre-scan plot of worst case:

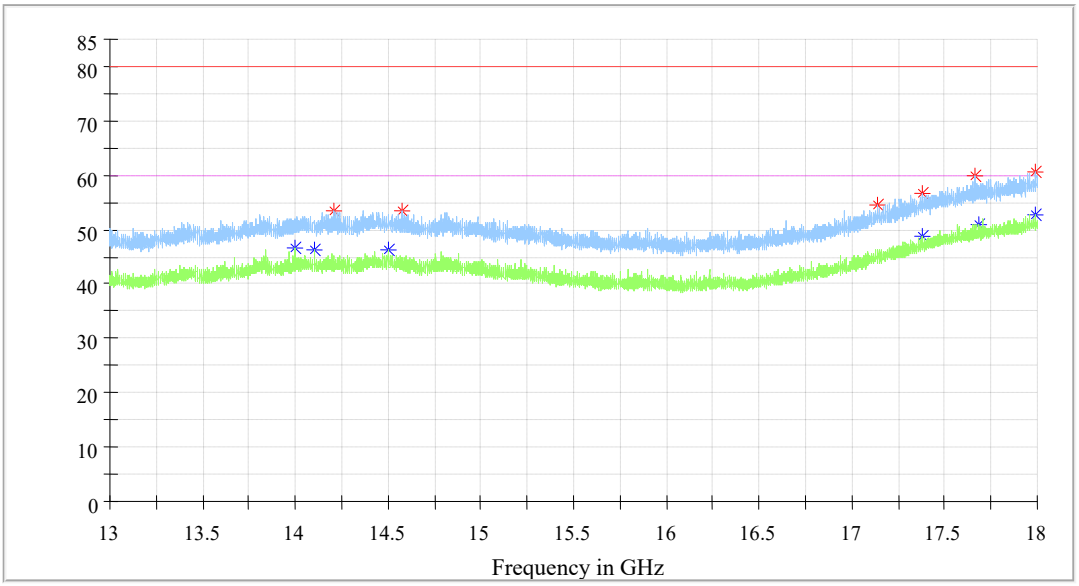
BLE(1MHz)High Channel_Horizontal_1GHz-13GHz



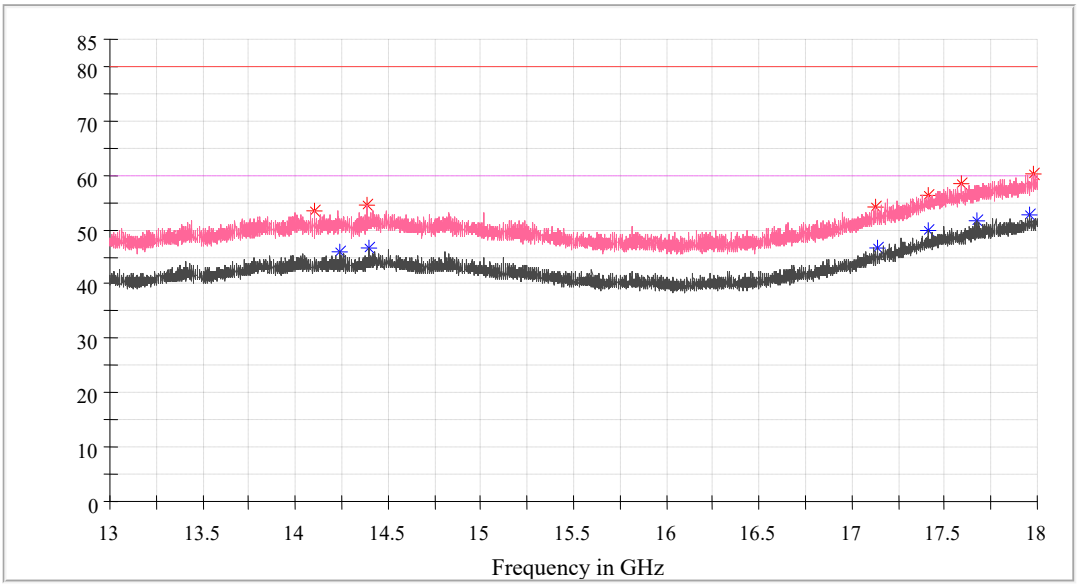
BLE(1MHz)High Channel_Vertical_1GHz-13GHz



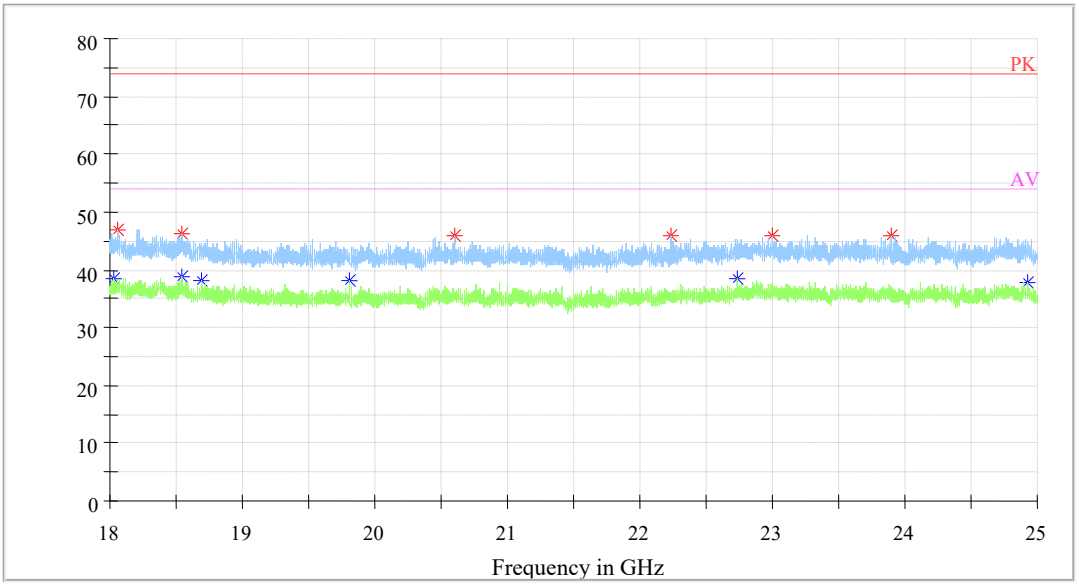
BLE(1MHz)High Channel_Horizontal_13GHz-18GHz



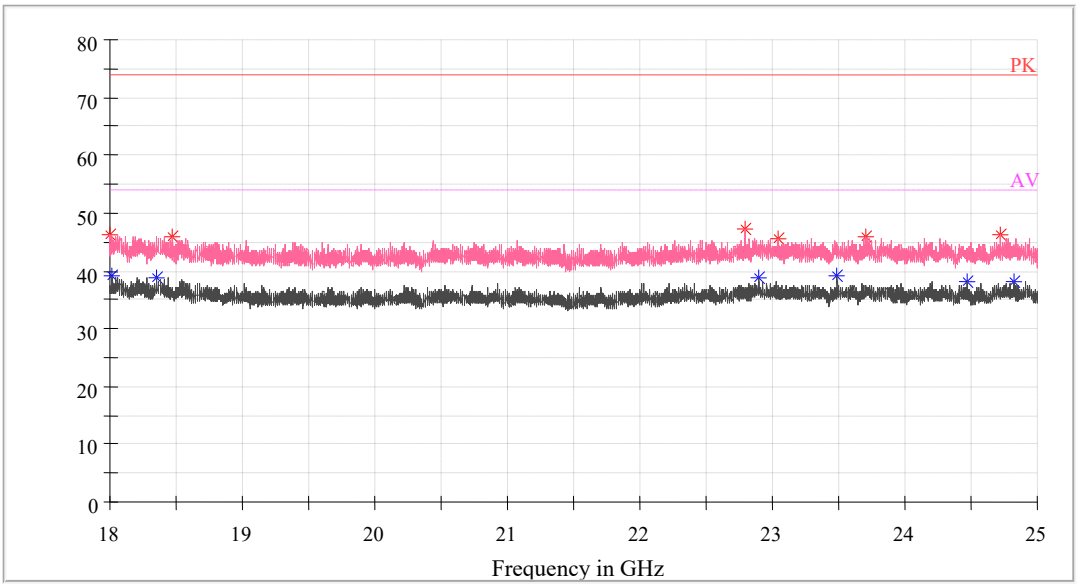
BLE(1MHz)High Channel_Vertical_13GHz-18GHz



BLE(1MHz)High Channel_Horizontal_18GHz-25GHz



BLE(1MHz)High Channel_Vertical_18GHz-25GHz



FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure(Radiated Method)

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3×RBW
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Test Data

Environmental Conditions

Temperature:	22 °C	23 °C
Relative Humidity:	43.7 %	44 %
ATM Pressure:	95.8 kPa	96.1 kPa

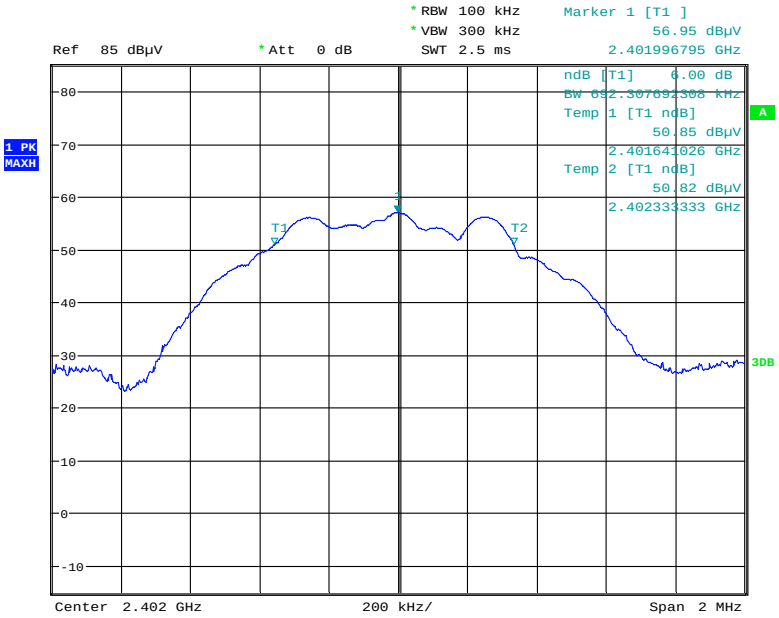
The testing was performed by Eric Xiao on 2020-05-01 and 2020-05-02.

Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table and plots.

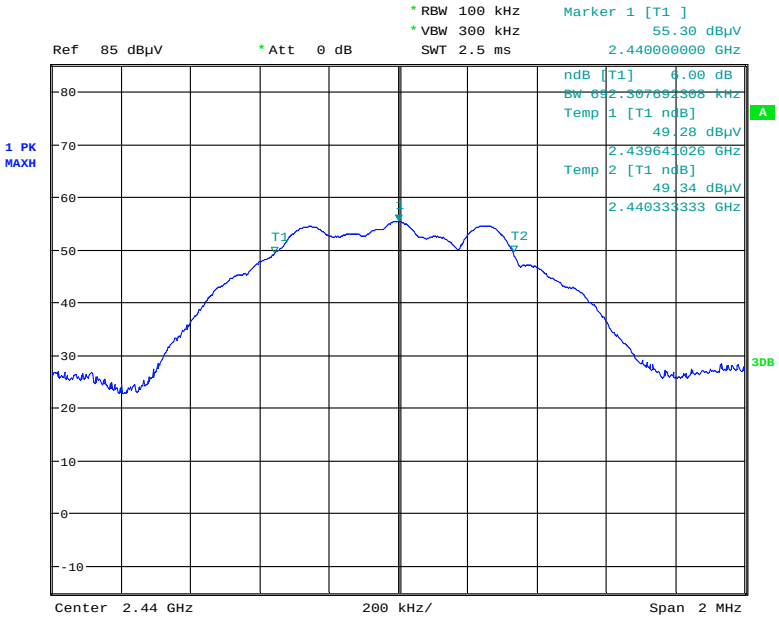
Test Mode	Channel	Frequency (MHz)	6dB Bandwidth （MHz）	Limit （MHz）
BLE(1MHz)	Low	2402	0.692	≥0.50
	Middle	2440	0.692	≥0.50
	High	2480	0.692	≥0.50
BLE(2MHz)	Low	2402	1.199	≥0.50
	Middle	2440	1.199	≥0.50
	High	2480	1.199	≥0.50

BLE(1MHz), Low Channel



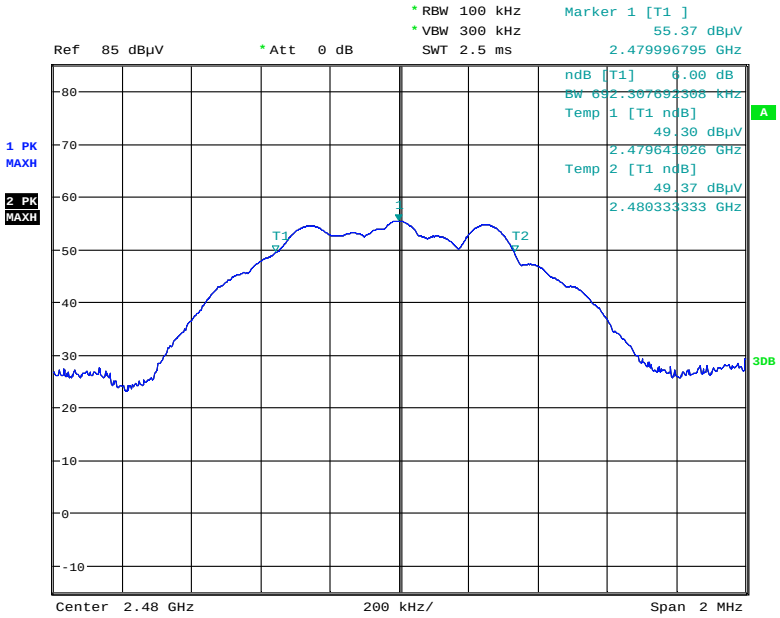
Date: 1.MAY.2020 02:10:55

BLE(1MHz), Middle Channel



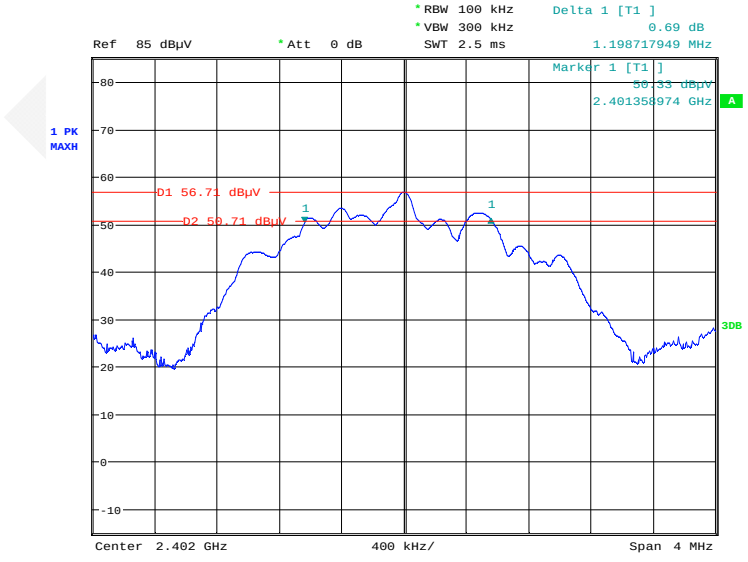
Date: 1.MAY.2020 03:00:35

BLE(1MHz), High Channel



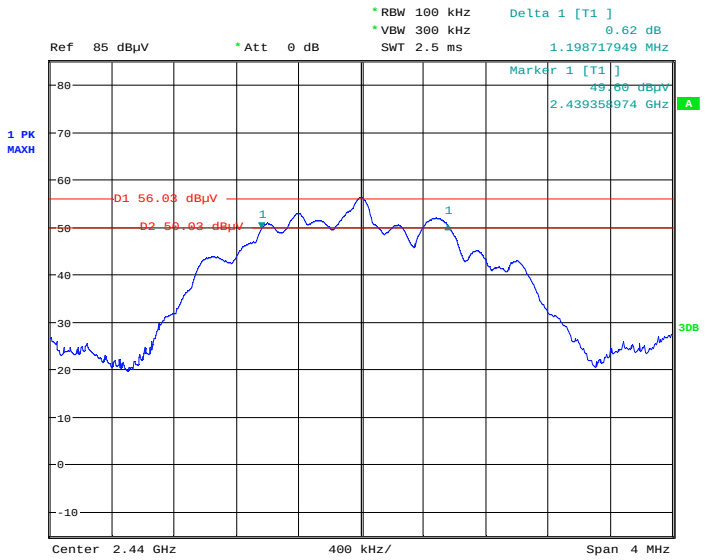
Date: 1.MAY.2020 03:21:59

BLE(2MHz), Low Channel



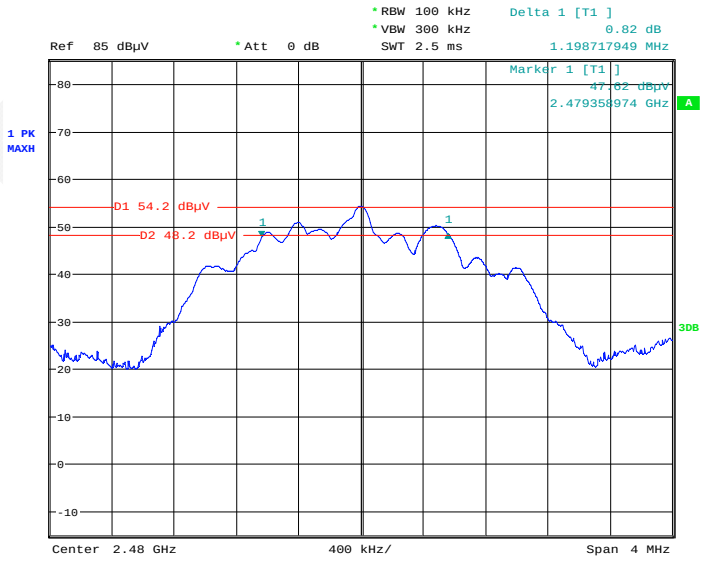
Date: 2.MAY.2020 11:18:32

BLE(2MHz), Middle Channel



Date: 2.MAY.2020 11:25:39

BLE(2MHz), High Channel



Date: 2.MAY.2020 11:35:49

FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure (Radiated Method)

Per ANSI C63.10-2013 Clause 6.6, Clause 11.3, Annex G

If a radiated test configuration is used, then the measured power or field strength levels shall be converted to equivalent conducted power levels for comparison with the applicable output power limit. This may be accomplished by first measuring the radiated field strength or power levels using a methodology from 11.9 for maximum peak conducted power or maximum conducted (average) power as applicable and from 11.10 for peak or average power spectral density as applicable. The radiated field strength or power level is converted to EIRP (see Annex G for guidance). The equivalent conducted output power or power spectral density is then determined by subtracting the EUT transmit antenna gain (guidance applicable to devices using MIMO or beamforming technologies is provided in Clause 13 or Clause 14, respectively) from the EIRP (assuming logarithmic representation). All calculations and parameter assumptions shall be provided in the test report.

Test Data

Environmental Conditions

Temperature:	22 °C
Relative Humidity:	43.7 %
ATM Pressure:	95.8 kPa

The testing was performed by Eric Xiao on 2020-05-01.

Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table.

Test Mode	Frequency (MHz)	Corrected Amplitude (dBμV/m)	EIRP (dBm)	Antenna Gain (dBi)	Conducted Output Power (dBm)	Limit （dBm）
BLE(1MHz)	2402	90.25	-4.95	2.5	-7.45	30
	2440	88.47	-6.73	2.5	-9.23	30
	2480	88.46	-6.74	2.5	-9.24	30
BLE(2MHz)	2402	89.91	-5.29	2.5	-7.79	30
	2440	89.38	-5.82	2.5	-8.32	30
	2480	87.32	-7.88	2.5	-10.38	30

Note: EIRP[dBm] = E[dBμV/m]-95.2 when distance is 3 meter
EIRP[dBm] = Conducted Output Power[dBm] + Antenna Gain

Where: E is the field strength in dBμV/m
EIRP is the equivalent isotropic radiated power in dBm

FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

Applicable Standard

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. In addition, radiated emissions 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) (see §15.205(c)).

Test Procedure (Radiated Method)

1. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
2. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
3. Repeat above procedures until all measured frequencies were complete.

Test Data

Environmental Conditions

Temperature:	22 °C	23 °C
Relative Humidity:	43.7 %	44 %
ATM Pressure:	95.8 kPa	96.1 kPa

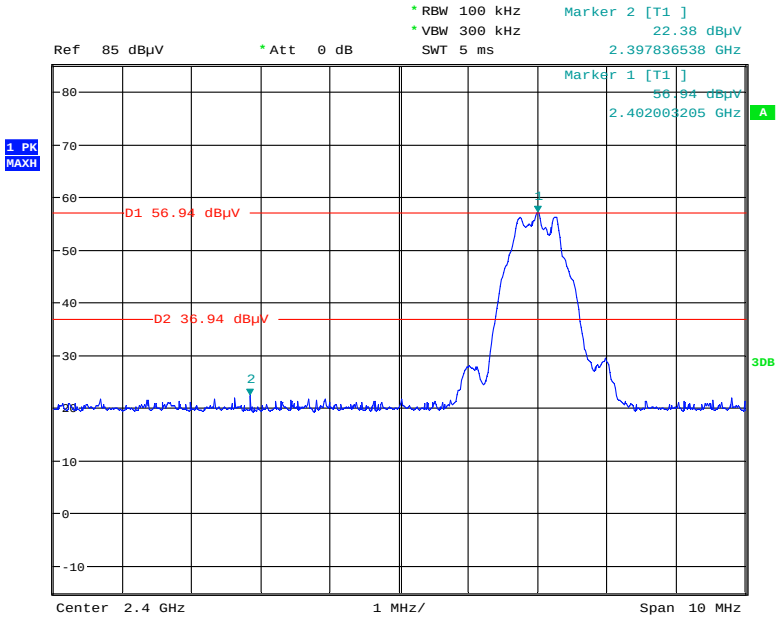
The testing was performed by Eric Xiao on 2020-05-01 and 2020-05-02.

Test mode: Transmitting

Test Result: Compliance. Please refer to following plots.

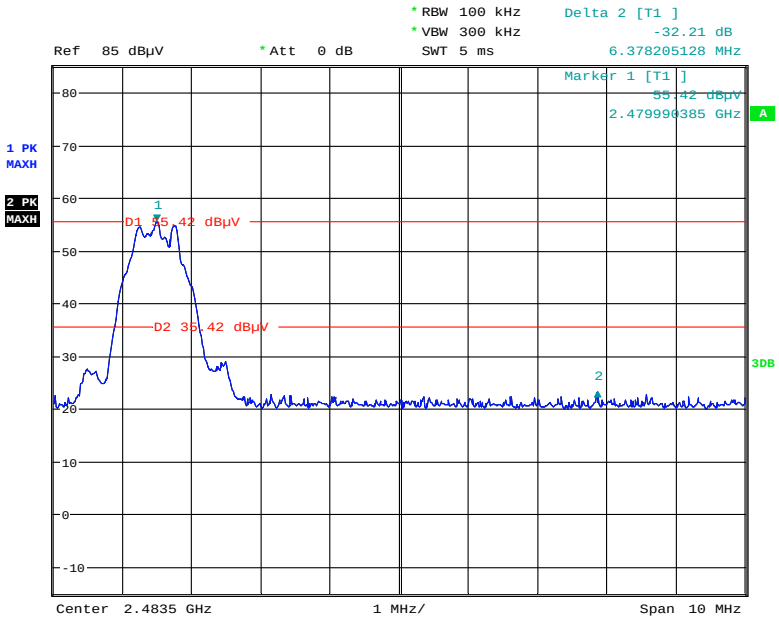
BLE (1MHz)

Band Edge, Left Side



Date: 1.MAY.2020 02:22:23

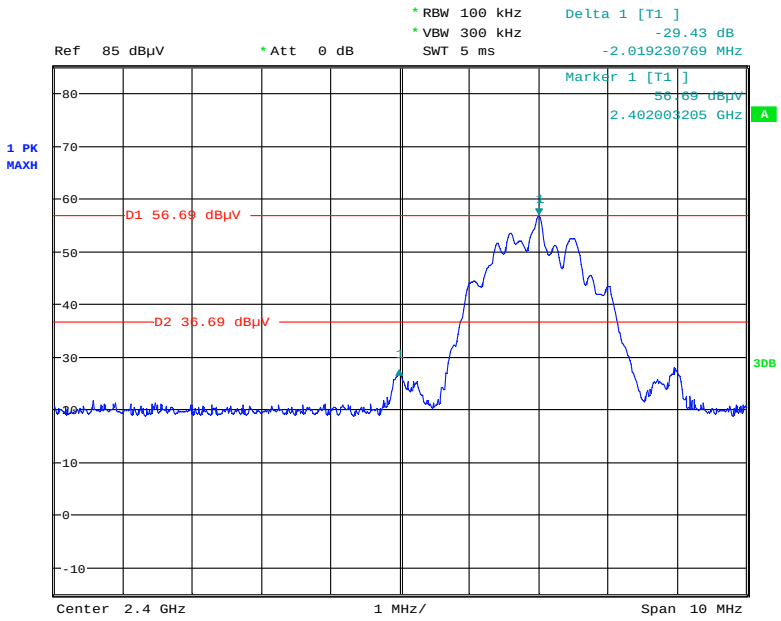
Band Edge, Right Side



Date: 1.MAY.2020 03:33:14

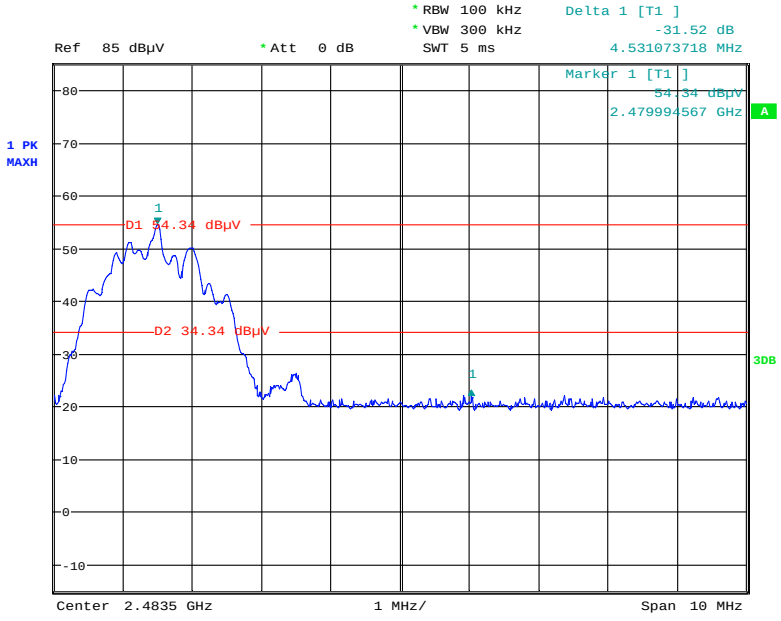
BLE (2MHz)

Band Edge, Left Side



Date: 2.MAY.2020 08:40:52

Band Edge, Right Side



Date: 2.MAY.2020 09:46:45

FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Procedure (Radiated Method)

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3×RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Data

Environmental Conditions

Temperature:	22 °C
Relative Humidity:	43.7 %
ATM Pressure:	95.8 kPa

The testing was performed by Eric Xiao on 2020-05-01.

Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table and plots

Test Mode	Frequency	Receiver		Rx Antenna		Cable loss	Amplifier Gain	Corrected Amplitude
		Reading	Measurement	Polar	Factor			
	MHz	dBµV		H	dB(1/m)	dB	dB	dBµV/m
BLE(1MHz)	2402	39.26	PK	H	29.14	3.55	0.00	71.95
	2440	37.51	PK	H	29.08	3.58	0.00	70.17
	2480	37.65	PK	H	29.03	3.61	0.00	70.29
BLE(2MHz)	2402	37.07	PK	H	29.14	3.55	0.00	69.76
	2440	36.61	PK	H	29.08	3.58	0.00	69.27
	2480	34.74	PK	H	29.03	3.61	0.00	67.38

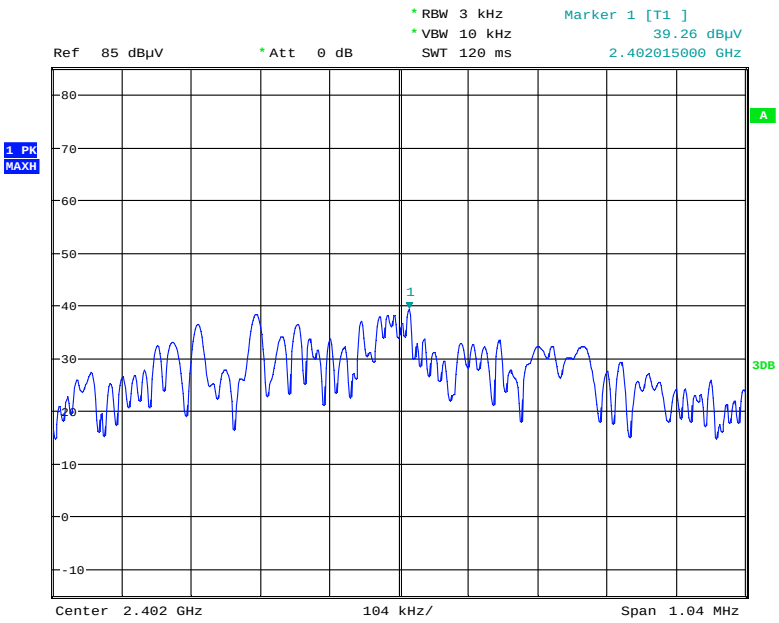
Test Mode	Frequency (MHz)	Corrected Amplitude (dBµV/m)	EIRP (dBm)	Antenna Gain (dBi)	PSD (dBm/3kHz)	Limit （dBm）
BLE(1MHz)	2402	71.95	-23.25	2.5	-25.75	≤8
	2440	70.17	-25.03	2.5	-27.53	≤8
	2480	70.29	-24.91	2.5	-27.41	≤8
BLE(2MHz)	2402	69.76	-25.44	2.5	-27.94	≤8
	2440	69.27	-25.93	2.5	-28.43	≤8
	2480	67.38	-27.82	2.5	-30.32	≤8

Note: EIRP[dBm] = E[dBµV/m]-95.2 when distance is 3 meter
EIRP[dBm] = Conducted Output Power[dBm] + Antenna Gain

Where: E is the field strength in dBµV/m
EIRP is the equivalent isotropic radiated power in dBm

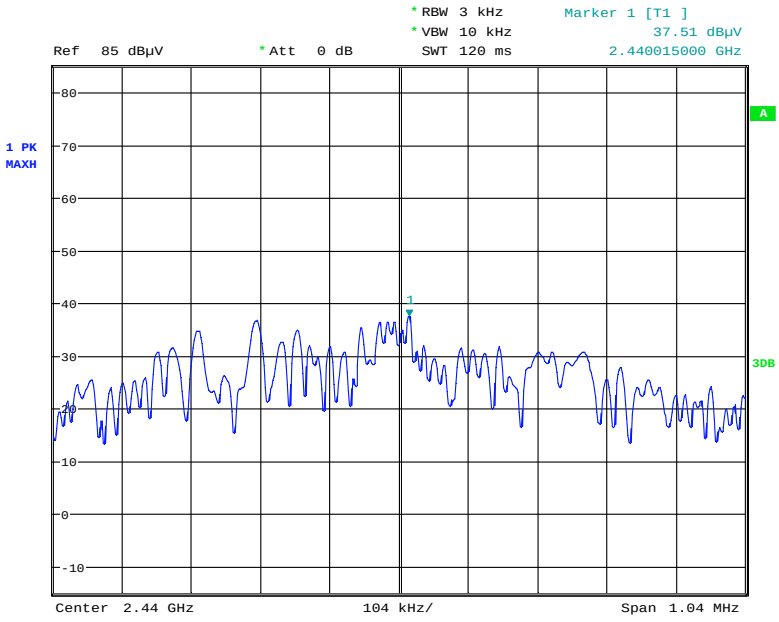
BLE (1MHz)

Power Spectral Density, Low Channel



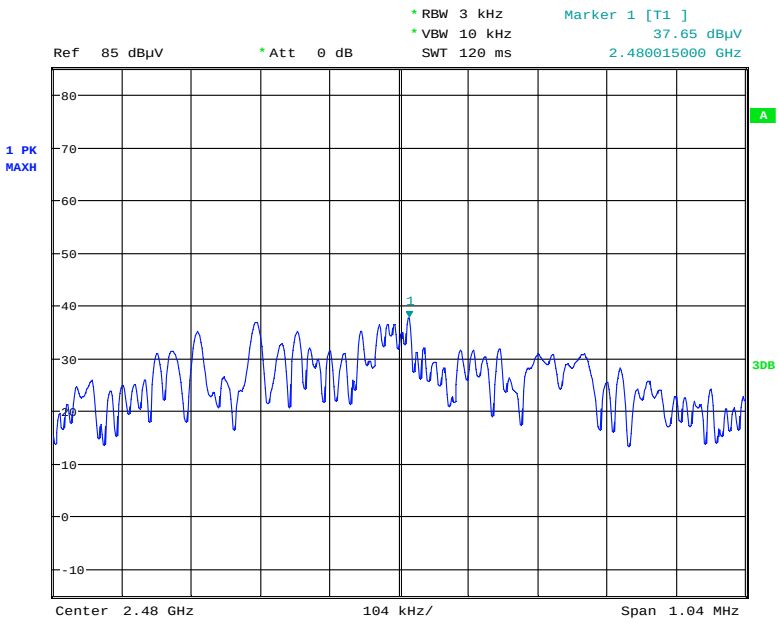
Date: 1.MAY.2020 02:29:34

Power Spectral Density, Middle Channel



Date: 1.MAY.2020 03:05:41

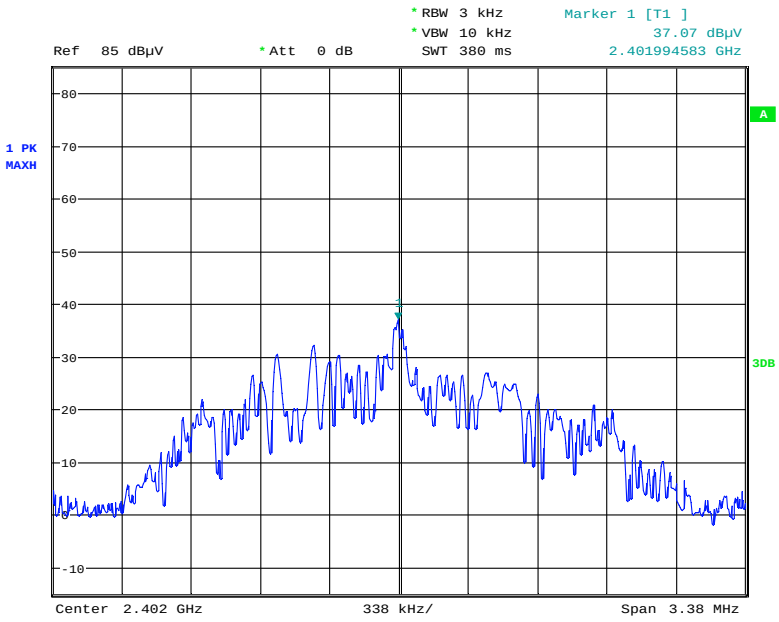
Power Spectral Density, High Channel



Date: 1.MAY.2020 03:24:31

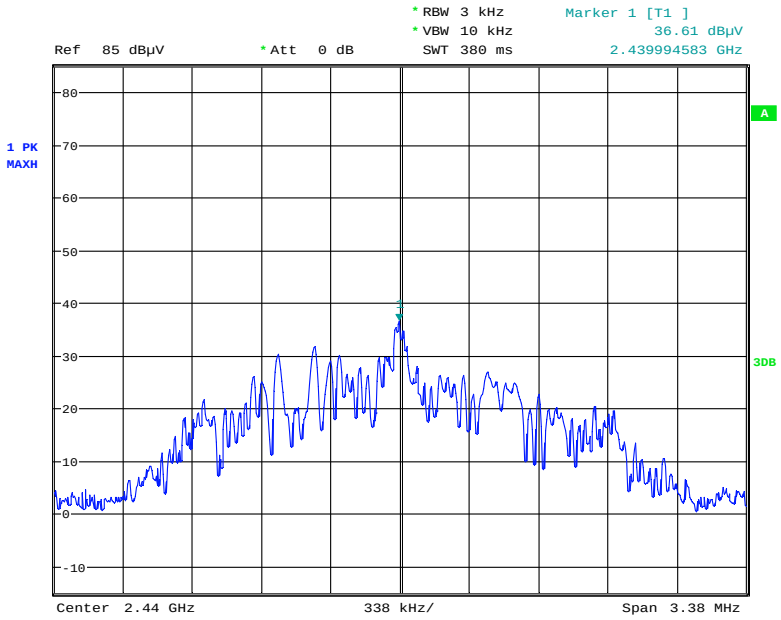
BLE (2MHz)

Power Spectral Density, Low Channel



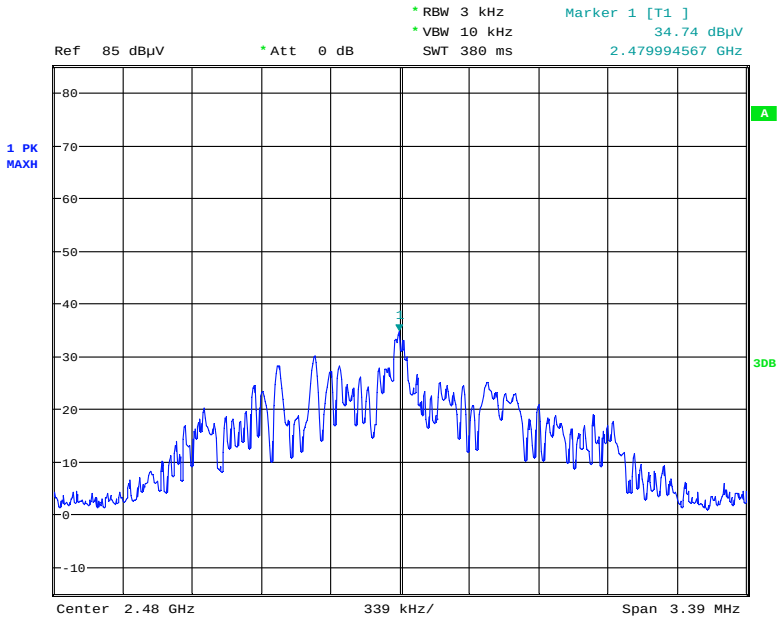
Date: 2.MAY.2020 08:38:31

Power Spectral Density, Middle Channel



Date: 2.MAY.2020 09:13:04

Power Spectral Density, High Channel



Date: 2.MAY.2020 09:42:38

END OF REPORT