FCC PART 15.247

TEST REPORT

For

Grandstream Networks, Inc.

126 Brookline Ave., 3rd Floor Boston, MA 02215, USA

FCC ID: YZZGWN7605LR

Report Type:	**Product Type:**
Original Report	Outdoor Long-Range Wi-Fi Access Point

Report Number:	RSZ200305002-00A
Report Date:	2020-04-27
Reviewed By:	Jimmy Xiao RF Engineer
Prepared By:	Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Outdoor Long-Range Wi-Fi Access Point
Model	GWN7605LR
Frequency Range	Wi-Fi: 2412-2462MHz/ 2422-2452MHz
Maximum conducted peak output power	26.52dBm(802.11b), 29.93dBm(802.11g) 28.70dBm(802.11n-HT20), 29.56dBm(802.11n-HT40)
Modulation Technique	Wi-Fi: DSSS, OFDM
Antenna Specification	3.5dBi
Voltage Range	DC 48V from POE
Date of Test	2020/03/11~2020/04/24
Sample serial number	RSZ200305002-RF-S1 (Assigned by BACL, Shenzhen)
Received date	2020-03-05
Sample/EUT Status	Good condition

Objective

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

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Related Submittal(s)/Grant(s)

FCC Part 15B JAB and FCC Part 15.407 NII submission with FCC ID: YZZGWN7605LR.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Output Power with Power meter		±0.73dB
RF conducted test with spectrum		±1.6dB
AC Power Lines Conducted Emissions		±1.95dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1℃
Humidity		±6%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 802.11b, 802.11g and 802.11n-HT20 mode, 11 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	/	/
6	2437	/	/
7	2442	/	/

For 802.11b, 802.11g, 802.11n-HT20 mode, EUT was tested with Channel 1, 6 and 11.

For 802.11n-HT40 mode, EUT was tested with Channel 3, 6 and 9.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

“Putty, QATool” exercise software was used.

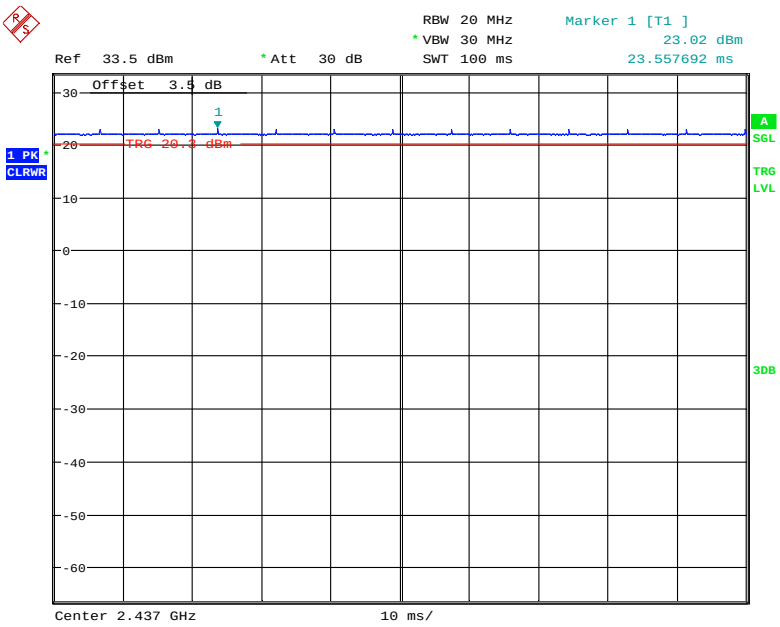
The device was tested with the worst case was performed as below:

Mode	Data rate	Power level		
		Low channel	Middle channel	High channel
802.11b	1 Mbps	17	17	16
802.11g	6 Mbps	14.5	17	14.5
802.11n-HT20	MCS0	15	17	15
802.11n-HT40	MCS0	12	17	13

The worse-case data rates are determined to be as follows for each mode based upon investigations by measuring the output power and PSD across all data rated bandwidths, and modulations.
The device supports SISO and MIMO in all modes, per pretest, the MIMO mode was the worst mode for all the modes.

Duty cycle

802.11b mode



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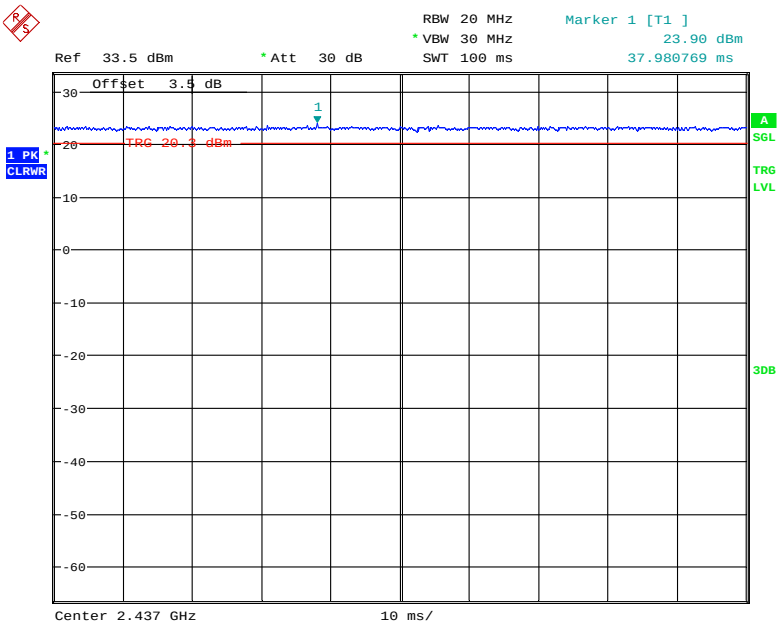
802.11g mode



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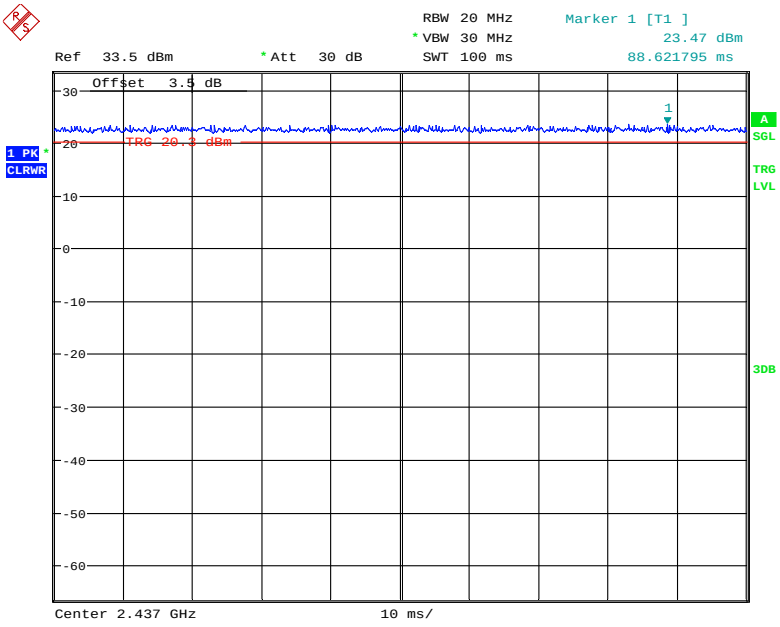
802.11n-HT20 Mode



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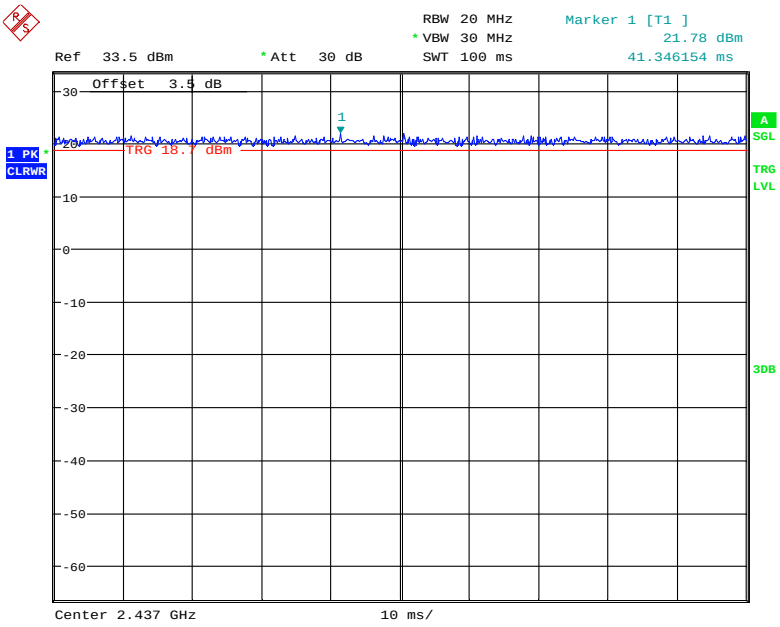
802.11n-HT40 Mode



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Mode	T_{on} (ms)	T_{on+off} (ms)	Duty Cycle (%)
802.11b	100	100	100
802.11g	100	100	100
802.11n-HT20	100	100	100
802.11n-HT40	100	100	100

Support Equipment List and Details

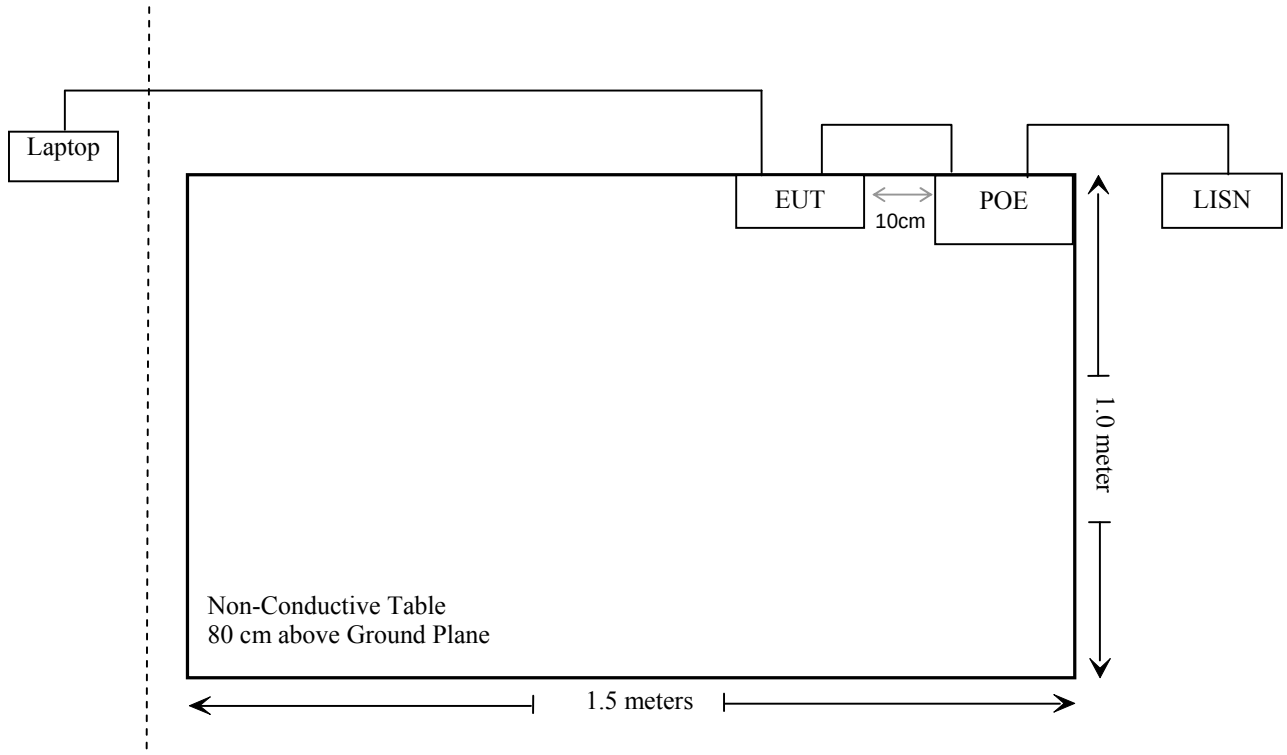
Manufacturer	Description	Model	Serial Number
Unknown	POE	VX-Pl1000GB	Pl1000
HP	Laptop	Compaq CQ45	5CG33407QL

External I/O Cable

Cable Description	Length (m)	From/Port	To
Unshielded detachable AC Cable	1.0	LISN	POE
Unshielded detachable RJ45 Cable	1.2	POE	EUT
Unshielded detachable RJ45 Cable	8.0	EUT	Laptop

Block Diagram of Test Setup

For conducted emission



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§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

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2019/7/9	2020/7/8
Rohde & Schwarz	LISN	ENV216	101613	2020/1/22	2021/1/21
Rohde & Schwarz	Transient Limitor	ESH3Z2	DE25985	2019/11/29	2020/11/28
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2019/11/29	2020/11/28
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2019/7/9	2020/7/8
Sonoma instrument	Pre-amplifier	310 N	186238	2019/4/20	2020/4/20
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017/12/22	2020/12/21
Unknown	Cable 2	RF Cable 2	F-03-EM197	2019/11/29	2020/11/28
Unknown	Cable	Chamber Cable 1	F-03-EM236	2019/11/29	2020/11/28
Rohde & Schwarz	Auto test software	EMC 32	V9.10	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40-N	102259	2019/7/22	2020/07/21
COM-POWER	Pre-amplifier	PA-122	181919	2019/11/29	2020/11/28
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2019/11/29	2020/11/28
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017/12/22	2020/12/21
Insulted Wire Inc.	RF Cable	SPS-2503-3150	02222010	2019/11/29	2020/11/28
Unknown	RF Cable	W1101-EQ1 OUT	F-19-EM005	2019/11/29	2020/11/28
SNSD	Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2019/4/20	2020/4/20
SNSD	Band Reject filter	BSF5150-5850MN-0899-004	5G filter	2019/4/20	2020/4/20
Ducommun Technolagies	Horn antenna	ARH-4223-02	1007726-02 1304	2017/12/6	2020/12/5
Ducommun Technologies	Horn Antenna	ARH-2823-02	1007726-03	2017/12/6	2020/12/5

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Tonscend Corporation	RF control Unit	JS0806-2	19D8060154	2019/7/10	2020/7/9
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40	101473	2019/7/22	2020/7/21
Unknown	RF Cable	Unknown	2301 276	2019/11/29	2020/11/28
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2020/3/2	2021/3/1

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

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	*($180/f^2$)	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

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm2)
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)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \le 1$$

Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
	(dBi)	(numeric)	(dBm)	(mW)			
2412-2462	3.5	2.24	30	1000	20	0.446	1
5150-5250	6.5	4.47	19	79.43	20	0.071	1
5725-5850	6.5	4.47	21	125.89	20	0.112	1

Note: 1. the tune up conducted power was declared by the applicant
2. the 2.4G Wi-Fi can transmit at the same time with the 5G Wi-Fi.
3. For the 5G Wi-Fi, as it can support the beam-forming fucnitoin, so the antenna gain should add the 10lg2, 3.5dBi+10lg2=6.5dBi.

Simultaneous transmitting consideration:

The ratio=$MPE_{2.4G}$/limit + MPE_{5G}/limit=0.446+0.112=0.558＜1.0

So simultaneous exposure comply with the limit.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliance

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.
And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has two external antennas which use non-standard antenna connectors. The antenna gain is 3.5dBi, fulfill the requirement of this section. Please refer to the EUT photos.

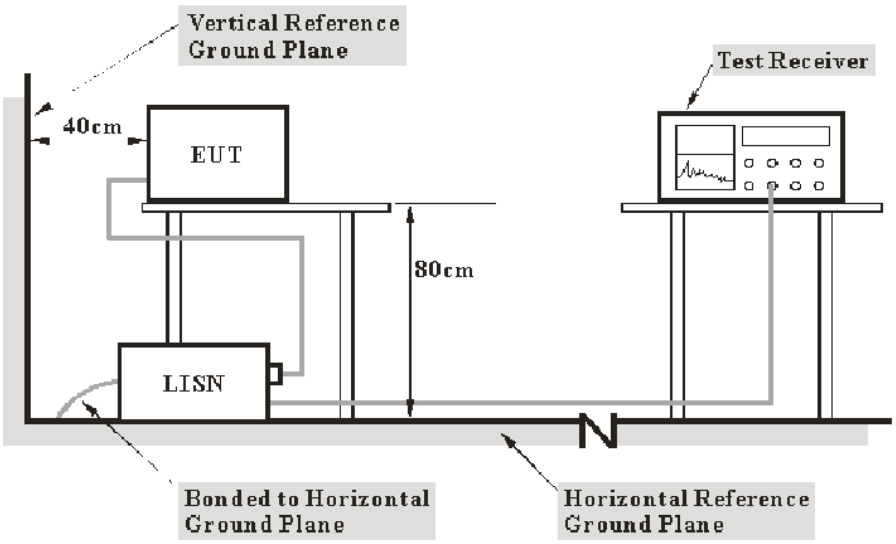
Result: Compliance.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Correction Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

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

Margin = Limit – Corrected Amplitude

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Test Data

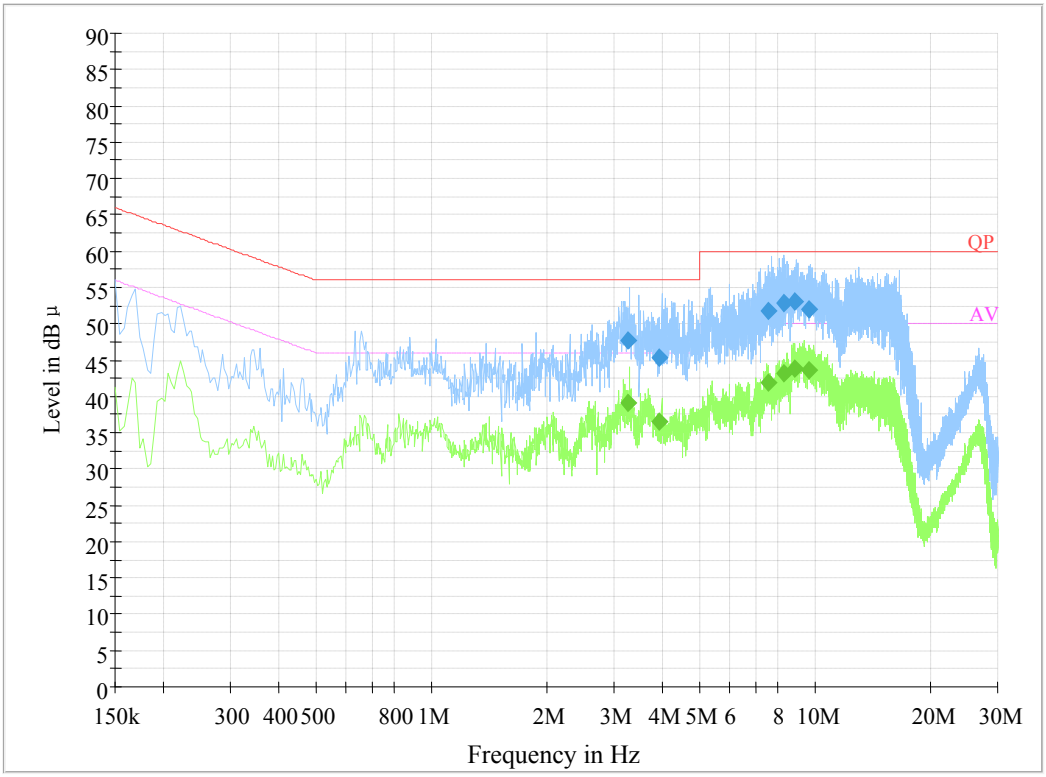
Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Haiguo Li on 2020-03-11.

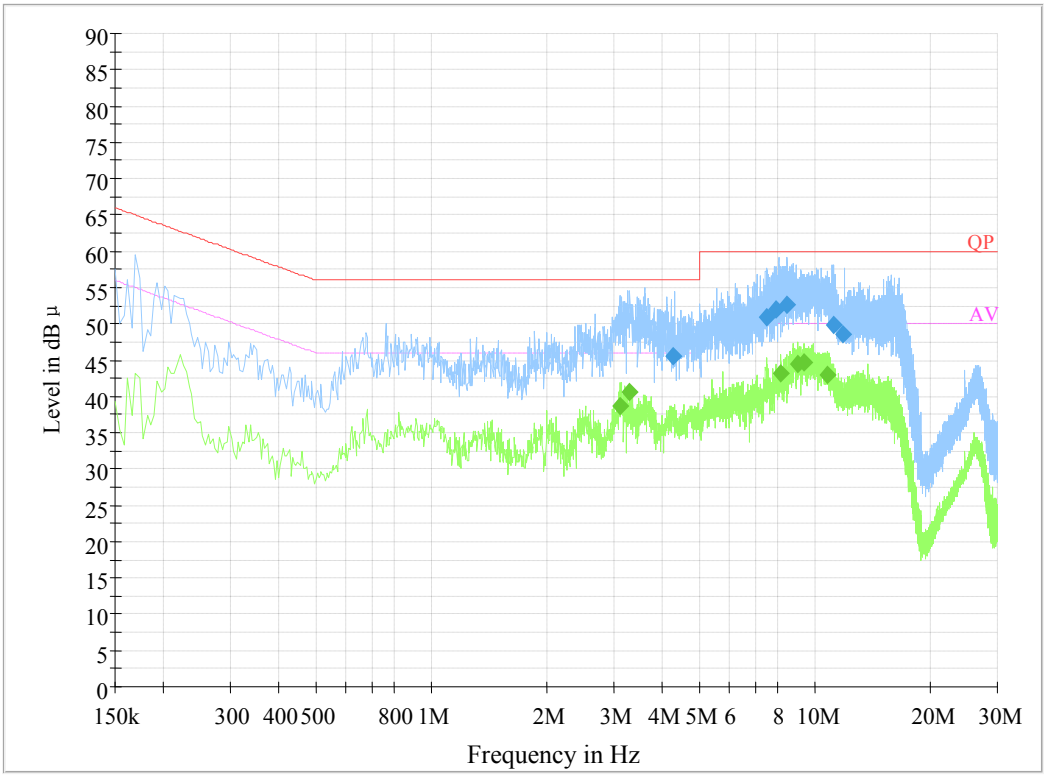
EUT operation mode: Transmitting (the worst case is Wi-Fi 802.11g Mode, Middle Channel)

AC 120 V/60 Hz, Line:



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
3.272530	47.6	19.9	56.0	8.4	QP
3.934090	45.3	19.9	56.0	10.7	QP
7.612630	51.7	19.9	60.0	8.3	QP
8.316990	52.7	20.0	60.0	7.3	QP
8.883750	53.0	20.0	60.0	7.0	QP
9.628170	51.9	20.0	60.0	8.1	QP
3.272530	39.1	19.9	46.0	6.9	Ave.
3.934090	36.5	19.9	46.0	9.5	Ave.
7.612630	41.9	19.9	50.0	8.1	Ave.
8.316990	43.1	20.0	50.0	6.9	Ave.
8.883750	43.9	20.0	50.0	6.1	Ave.
9.628170	43.6	20.0	50.0	6.4	Ave.

AC 120V/ 60 Hz, Neutral:



Frequency (MHz)	Corrected Amplitude (dBµV)	Correction Factor (dB)	Limit (dBµV)	Margin (dB)	Detector (PK/Ave./QP)
4.272990	45.5	19.9	56.0	10.5	QP
7.489590	50.8	19.9	60.0	9.2	QP
7.937190	52.0	19.9	60.0	8.0	QP
8.486290	52.6	19.9	60.0	7.4	QP
11.201190	49.8	20.0	60.0	10.2	QP
11.881730	48.6	20.0	60.0	11.4	QP
3.122000	38.7	19.9	46.0	7.3	Ave.
3.302000	40.6	19.9	46.0	5.4	Ave.
8.170000	43.3	19.9	50.0	6.7	Ave.
9.090000	44.4	19.9	50.0	5.6	Ave.
9.358000	44.7	19.9	50.0	5.3	Ave.
10.850000	42.9	20.0	50.0	7.1	Ave.

Note:

1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
2) Corrected Amplitude = Reading + Correction Factor
3) Margin = Limit – Corrected Amplitude

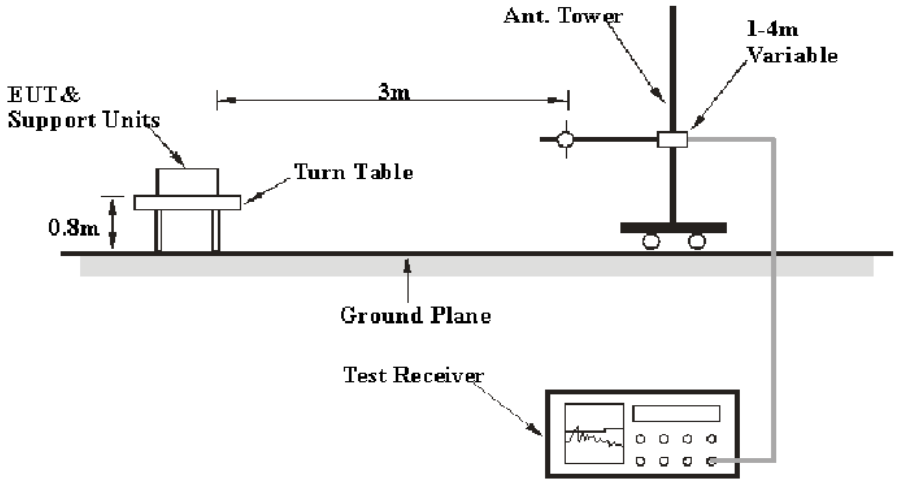
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

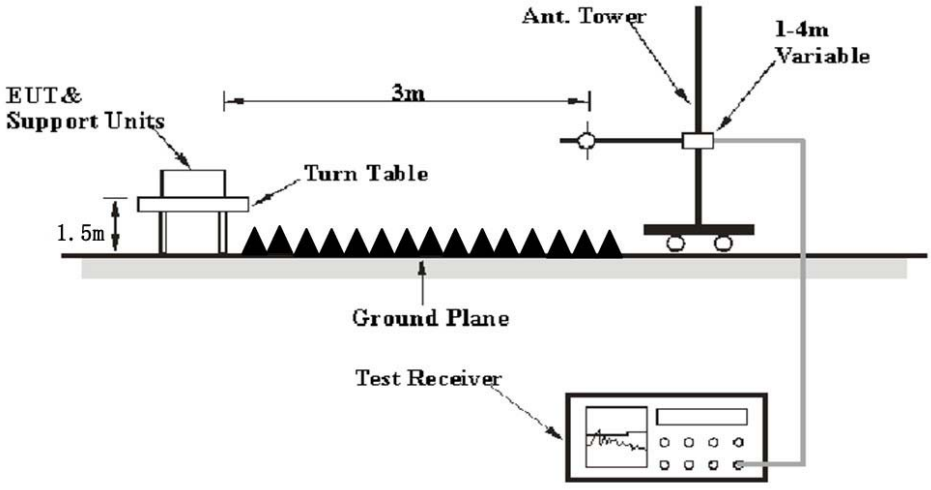
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters 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.

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 & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz Note 1	/	Average
	1MHz	＞1/T Note 2	/	Average

Note 1: when duty cycle is no less than 98%
Note 2: when duty cycle is less than 98%

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 Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + 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 Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

Test Data

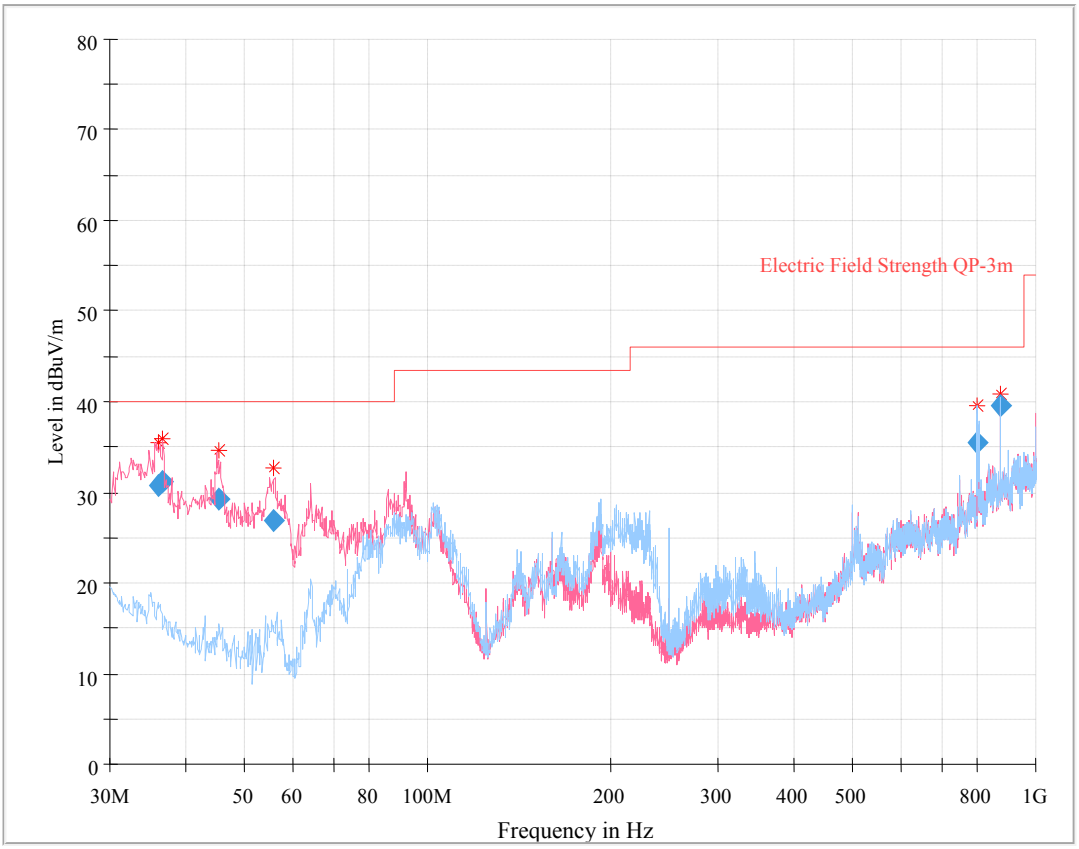
Environmental Conditions

Temperature:	22 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Zero Yan on 2020-04-13 for below 1GHz and by Leo Huang on 2020-03-21 for above 1GHz.

EUT operation mode: Transmitting

30 MHz~1 GHz: (*the worst case is Wi-Fi 802.11g Mode, Middle Channel***)**



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (degree)	Correction Factor (dB/m)	Limit (dBµV/m)	Margin (dB)
36.016375	30.74	149.0	V	85.0	-11.2	40.00	9.26
36.551625	31.20	109.0	V	88.0	-11.6	40.00	8.80
45.191625	29.29	113.0	V	357.0	-17.3	40.00	10.71
55.759000	26.84	118.0	V	44.0	-19.9	40.00	13.16
803.401625	35.53	149.0	H	124.0	1.9	46.00	10.47
874.990250	39.52	108.0	H	229.0	3.6	46.00	6.48

1 GHz-25 GHz:

802.11b Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2386.47	29.66	PK	208	2.1	V	31.87	61.53	74	12.47
2386.47	15.76	Ave.	208	2.1	V	31.87	47.63	54	6.37
2483.62	28.74	PK	282	1.9	V	32.13	60.87	74	13.13
2483.62	14.63	Ave.	282	1.9	V	32.13	46.76	54	7.24
4824.00	44.52	PK	238	1.8	V	6.28	50.80	74	23.20
4824.00	29.45	Ave.	238	1.8	V	6.28	35.73	54	18.27
Middle Channel (2437MHz)									
4874.00	43.66	PK	334	2.2	V	6.76	50.42	74	23.58
4874.00	28.63	Ave.	334	2.2	V	6.76	35.39	54	18.61
High Channel (2462 MHz)									
2389.43	28.96	PK	74	1.7	V	31.87	60.83	74	13.17
2389.43	14.51	Ave.	74	1.7	V	31.87	46.38	54	7.62
2487.83	31.98	PK	20	1.4	V	32.13	64.11	74	9.89
2487.83	20.31	Ave.	20	1.4	V	32.13	52.44	54	1.56
4924.00	43.57	PK	292	2.3	V	6.76	50.33	74	23.67
4924.00	28.35	Ave.	292	2.3	V	6.76	35.11	54	18.89

802.11g Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2389.83	37.84	PK	187	2.3	V	31.87	69.71	74	4.29
2389.83	20.01	Ave.	187	2.3	V	31.87	51.88	54	2.12
2483.62	30.42	PK	25	2.1	V	32.13	62.55	74	11.45
2483.62	14.62	Ave.	25	2.1	V	32.13	46.75	54	7.25
4824.00	43.51	PK	351	2.3	V	6.28	49.79	74	24.21
4824.00	29.70	Ave.	351	2.3	V	6.28	35.98	54	18.02
Middle Channel (2437MHz)									
4874.00	43.97	PK	130	1.1	V	6.76	50.73	74	23.27
4874.00	29.07	Ave.	130	1.1	V	6.76	35.83	54	18.17
High Channel (2462 MHz)									
2389.46	29.42	PK	23	2.2	V	31.87	61.29	74	12.71
2389.46	14.63	Ave.	23	2.2	V	31.87	46.50	54	7.50
2484.11	39.74	PK	97	1.9	V	32.13	71.87	74	2.13
2484.11	19.88	Ave.	97	1.9	V	32.13	52.01	54	1.99
4924.00	43.00	PK	173	1.3	V	6.76	49.76	74	24.24
4924.00	28.39	Ave.	173	1.3	V	6.76	35.15	54	18.85

802.11n-HT20 Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2412 MHz)									
2389.71	40.27	PK	346	1.5	V	31.87	72.14	74	1.86
2389.71	19.66	Ave.	346	1.5	V	31.87	51.53	54	2.47
2486.93	29.11	PK	220	2.2	V	32.13	61.24	74	12.76
2486.93	14.22	Ave.	220	2.2	V	32.13	46.35	54	7.65
4824.00	44.49	PK	333	2.4	V	6.28	50.77	74	23.23
4824.00	28.72	Ave.	333	2.4	V	6.28	35.00	54	19.00
Middle Channel (2437MHz)									
4874.00	43.61	PK	42	1.1	V	6.76	50.37	74	23.63
4874.00	28.69	Ave.	42	1.1	V	6.76	35.45	54	18.55
High Channel (2462 MHz)									
2388.94	28.53	PK	244	1.3	V	31.87	60.40	74	13.60
2388.94	14.39	Ave.	244	1.3	V	31.87	46.26	54	7.74
2484.28	35.79	PK	120	1.7	V	32.13	67.92	74	6.08
2484.28	16.57	Ave.	120	1.7	V	32.13	48.70	54	5.30
4924.00	43.98	PK	54	1.6	V	6.76	50.74	74	23.26
4924.00	28.51	Ave.	54	1.6	V	6.76	35.27	54	18.73

802.11n-HT40 Mode:

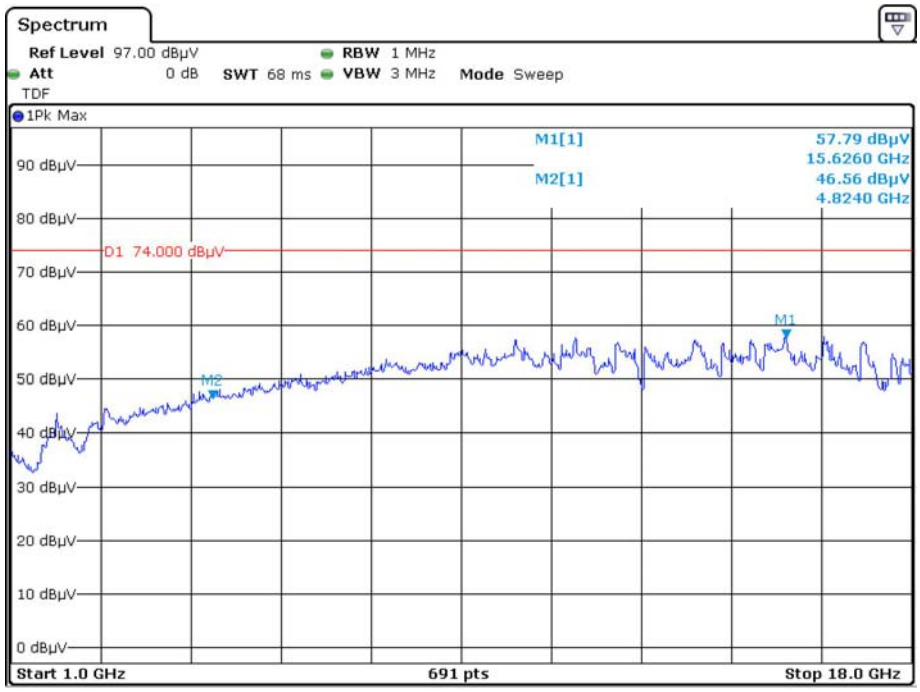
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2422 MHz)									
2389.94	39.55	PK	92	1.2	V	31.87	71.42	74	2.58
2389.94	20.23	Ave.	92	1.2	V	31.87	52.10	54	1.90
2483.69	30.26	PK	145	2.4	V	32.13	62.39	74	11.61
2483.69	14.31	Ave.	145	2.4	V	32.13	46.44	54	7.56
4844.00	43.68	PK	212	2.2	V	6.28	49.96	74	24.04
4844.00	27.96	Ave.	212	2.2	V	6.28	34.24	54	19.76
Middle Channel (2437MHz)									
4874.00	43.56	PK	40	1.2	V	6.76	50.32	74	23.68
4874.00	28.13	Ave.	40	1.2	V	6.76	34.89	54	19.11
High Channel (2452 MHz)									
2388.92	29.36	PK	150	1.6	V	31.87	61.23	74	12.77
2388.92	14.31	Ave.	150	1.6	V	31.87	46.18	54	7.82
2484.56	39.40	PK	349	2.3	V	32.13	71.53	74	2.47
2484.56	18.21	Ave.	349	2.3	V	32.13	50.34	54	3.66
4904.00	43.92	PK	38	1.1	V	6.76	50.68	74	23.32
4904.00	28.82	Ave.	38	1.1	V	6.76	35.58	54	18.42

Simultaneous Transmission (802.11b mode 2412MHz & 802.11a mode 5180MHz):

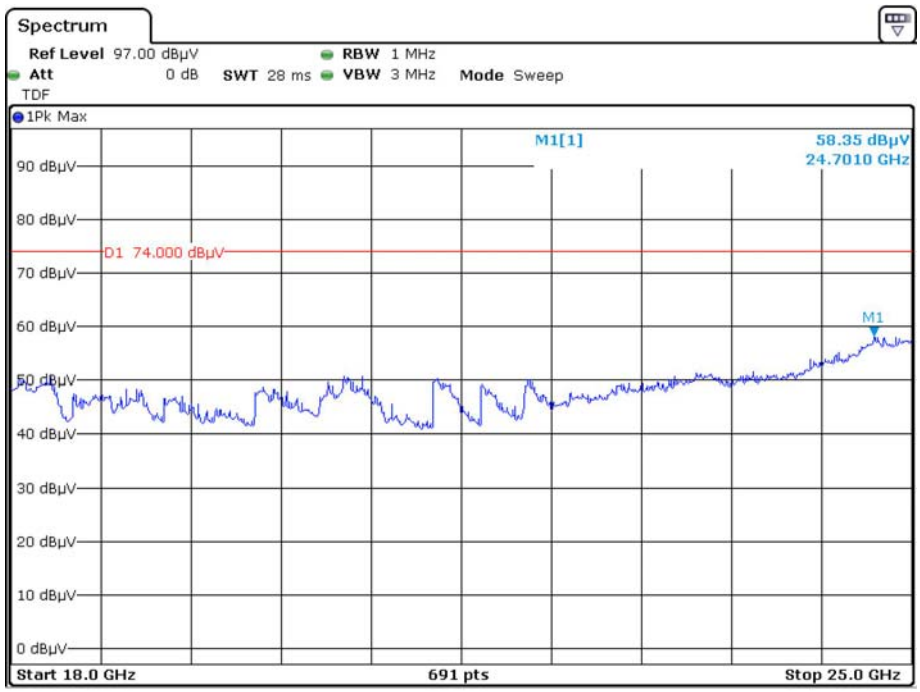
Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Test Distance (m)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)					
875.29	35.66	QP	231	1.1	H	3.6	39.26	46	6.74	3
875.29	32.87	QP	231	1.1	V	3.6	36.47	46	9.53	3
4824.00	43.26	PK	234	1.8	V	6.28	49.54	74	24.46	3
4824.00	28.67	Ave.	234	1.8	V	6.28	34.95	54	19.05	3
10360.00	47.22	PK	20	2.0	V	17.42	64.64	77.7	13.06	1

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is 20dB to the limit was not recorded.

Pre-scan with 802.11b Mode, Low channel
Horizontal

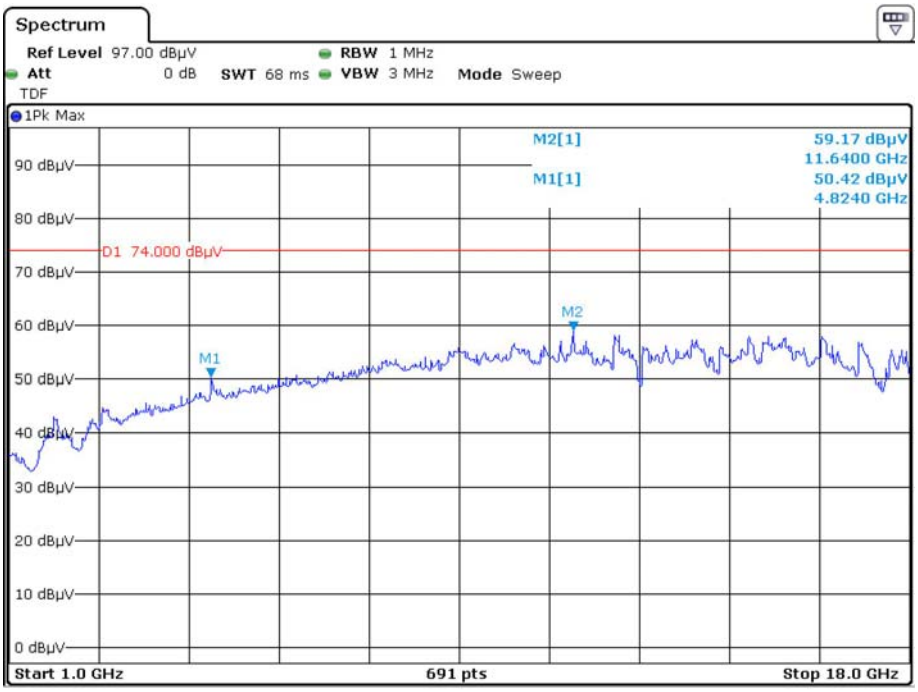


Date: 21.MAR.2020 20:42:20

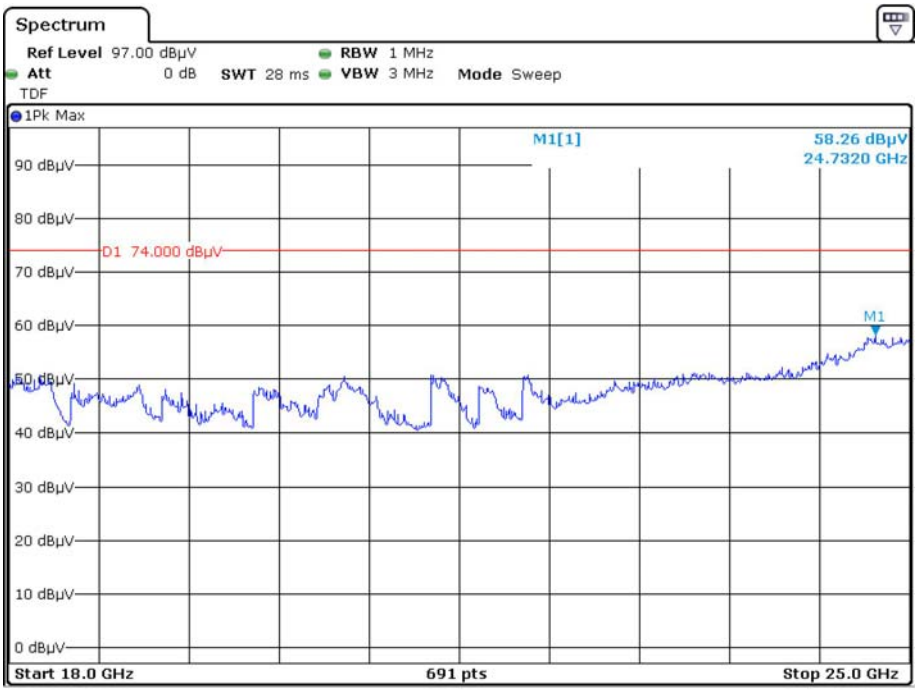


Date: 21.MAR.2020 20:46:19

Vertical

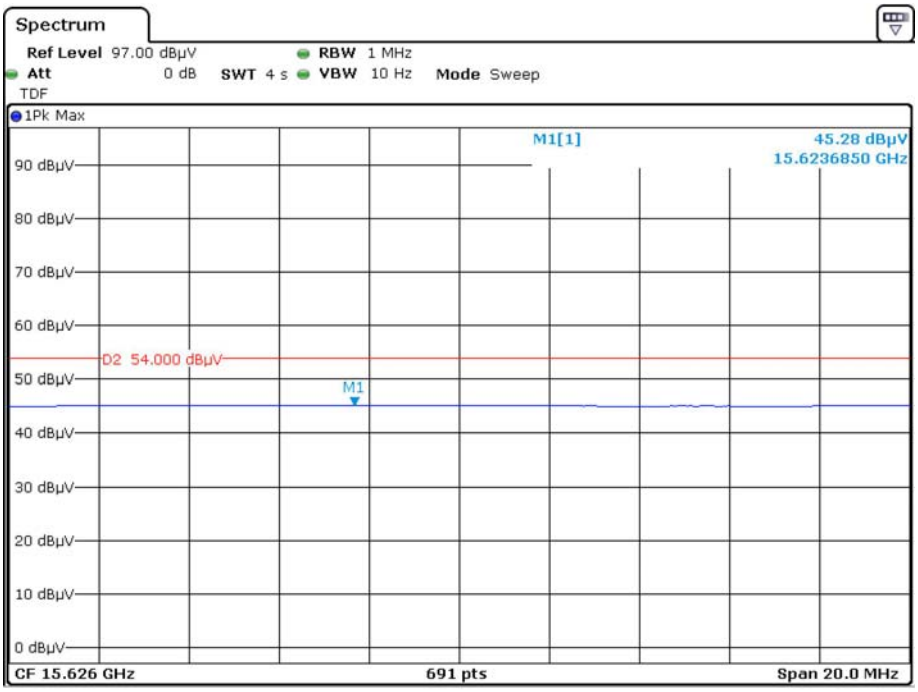


Date: 21.MAR.2020 20:35:54

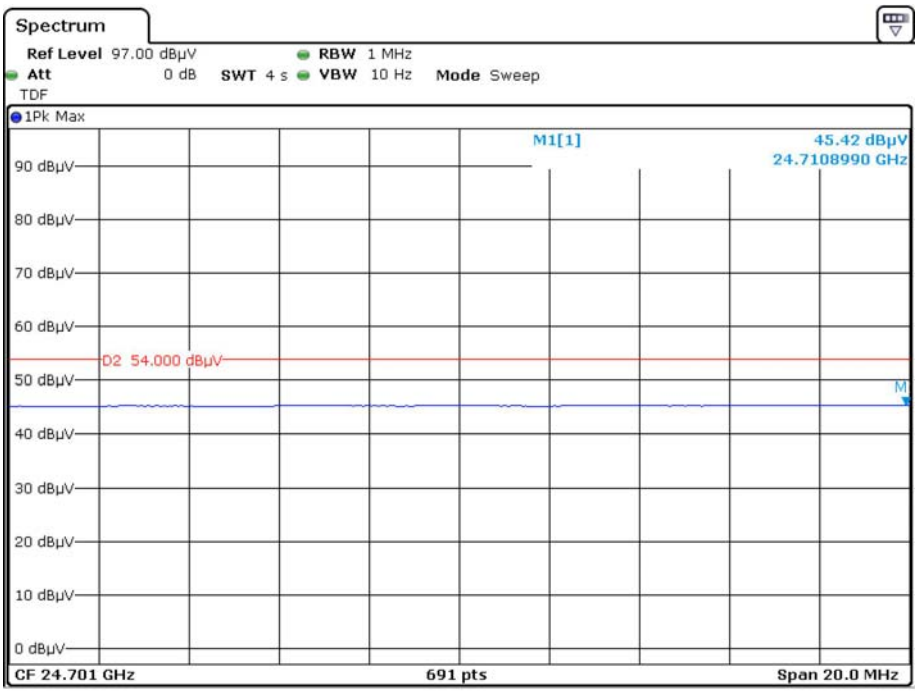


Date: 21.MAR.2020 21:23:17

Pre-scan for Average
Horizontal

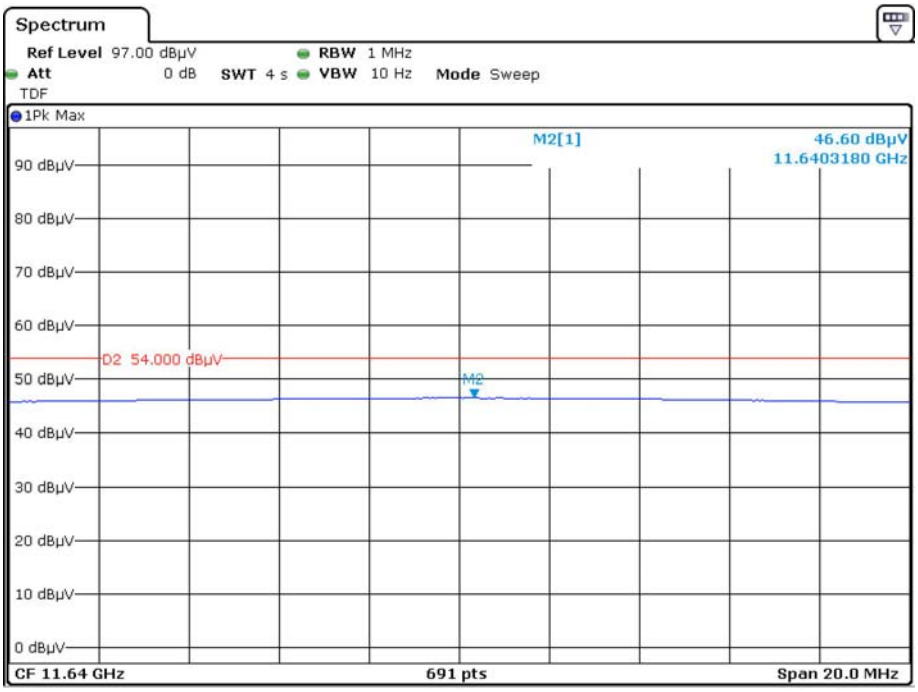


Date: 21.MAR.2020 20:45:31

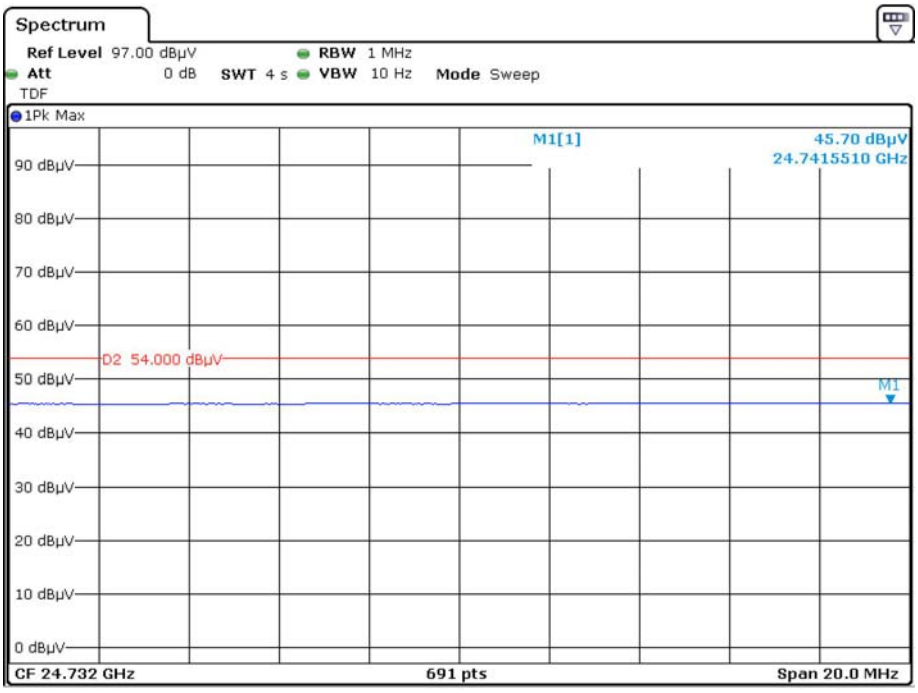


Date: 21.MAR.2020 21:20:04

Vertical



Date: 21.MAR.2020 20:38:38



Date: 21.MAR.2020 21:26:44

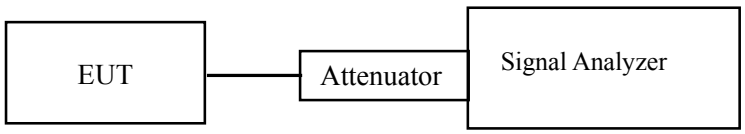
FCC §15.247(a) (2) – 6 dB EMISSION BANDWIDTH

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

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Cary Guan on 2020-03-18.

EUT operation mode: Transmitting (Antenna 1 was chosen for test)

Test Result: Compliant. Please refer to the Appendix 2.4G Wi-Fi.

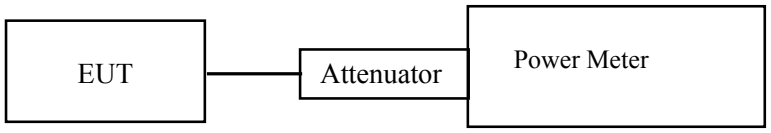
FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

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

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Cary Guan from 2020-03-17 to 2020-03-18.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix 2.4G Wi-Fi.

Note: The maximum antenna gain is 3.5dBi. The device employed cyclic delay diversity (CDD) for 2.4G Wi-Fi.

According to KDB 662911 D01 v02r01, for power measurement on IEEE 802.11 devices:

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

So Directional gain = G_{ANT} + Array Gain=3.5dBi<6dBi

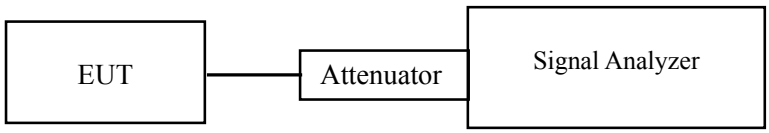
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

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

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. 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.
4. 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.
5. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Cary Guan from 2020-03-17 to 2020-03-18.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix 2.4G Wi-Fi.

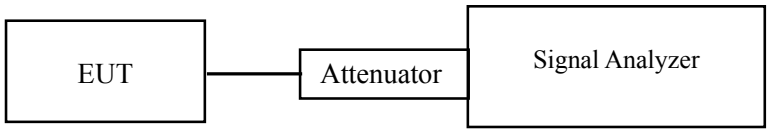
FCC §15.247(e) - POWER SPECTRAL DENSITY

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

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW to: 3kHz≤ RBW≤100 kHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 1.5 times the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Cary Guan from 2020-03-17 to 2020-03-18.

EUT operation mode: Transmitting

Test Result: Compliant. Please refer to the Appendix 2.4G Wi-Fi.

Note: The maximum antenna gain is 3.5dBi. The device employed cyclic delay diversity (CDD) for 2.4G Wi-Fi.

According to KDB 662911 D01 v02r01, for power spectral density (PSD):

Array Gain = 10 lg(N_{ANT}/N_{SS}) dB=10lg(2/1)=3

So Directional gain = G_{ANT} + Array Gain=6.5dBi>6dBi; So the limit should be reduce (6.5-6)dB=0.5dB

******* END OF REPORT *******