

FCC PART 15.249

TEST REPORT

For

Superior Electronics Corporation

No. 10 Lane 31, Chongde St., Sinyi District, Taipei City, 110, Taiwan

FCC ID: K4ER400BQ

Report Type: Original Report	Product Name: Microwave RTE Sensor
Report Number: RGMA190104001-00	
Report Date: 2019-01-22	
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* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*” .

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	Microwave RTE Sensor
EUT Model:	SD-R400-BQ
Rated Input Voltage:	12-24VDC
External Dimension:	80mm(L)*60mm(W)*54mm(H)
Serial Number:	190104001
EUT Received Date:	2019.01.08

Objective

This type approval report is prepared on behalf of **Superior Electronics Corporation** in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Rules Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.249 rules.

Related Submittal(s)/Grant(s)

N/A.

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.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
Unwanted Emissions, radiated	30M~200MHz: 4.58 dB for Horizontal, 4.59 dB for Vertical 200M~1GHz: 4.83 dB for Horizontal, 5.85 dB for Vertical 1G~6GHz: 4.45 dB, 6G~26.5GHz: 5.23 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxihu Industry Area, Tangxia, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

SYSTEM TEST CONFIGURATION

Justification

The EUT was configured in operating mode for testing which was provided by the manufacturer.

The device operates on frequency: 24150 MHz

EUT Exercise Software

No software was used in test.

Equipment Modifications

No modifications were made to the EUT.

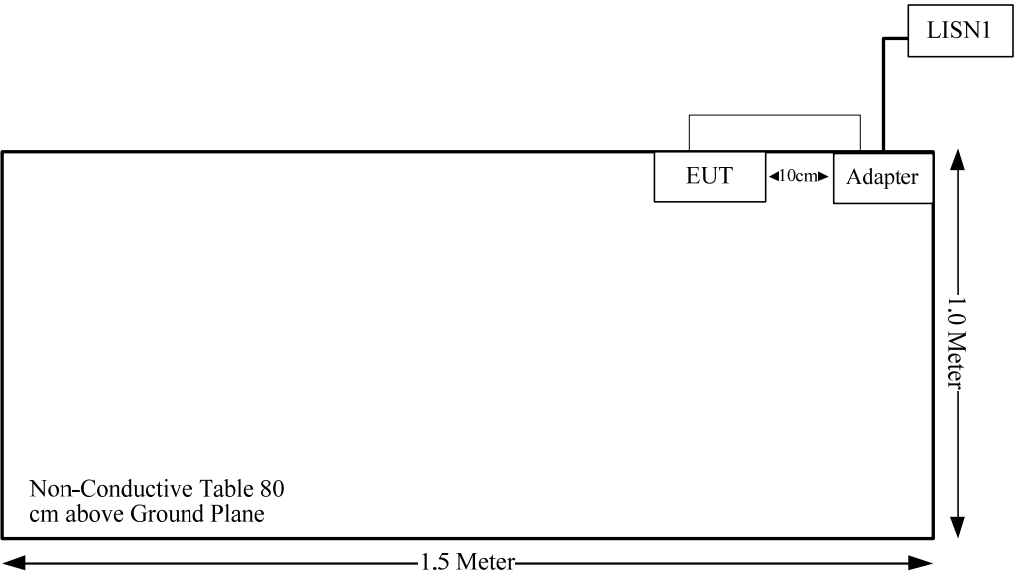
Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
unknown	adapter	2ABB018F	/

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length(m)	From	To
power cable	No	No	4	adapter	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conduction Emissions	Compliance
15.205, §15.209, §15.249	Radiated Emissions	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

For intentional device, 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.

Antenna Connector Construction

The EUT has one internal antenna arrangement, and the antenna gain is 2.15 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

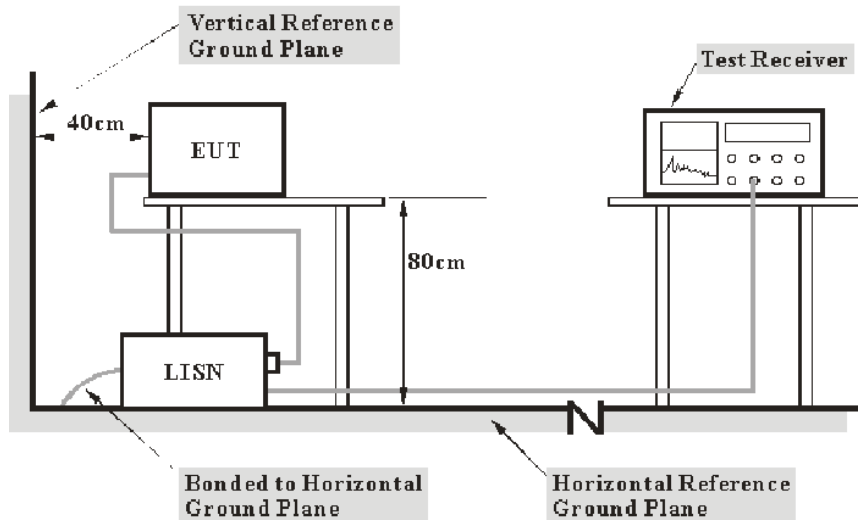
Result: Compliant.

FCC §15.207 (a)– AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207(a)

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.

The spacing between the peripherals was 10 cm.

The adapter was connected to the main LISN with a 120 V/60 Hz AC power source.

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 first LISN.

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

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

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

$$C_f = A_C + VDF$$

Herein,

V_C (cord. Reading): corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF: voltage division factor of AMN

C_f : Correction Factor

The “**Margin**” column of the following data tables indicates the degree of compliance within 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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCS 30	830245/006	2018-12-10	2019-12-10
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-01	2018-09-05	2019-09-05
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A
R&S	Two-line V-network	ENV 216	101614	2018-12-10	2019-12-10

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

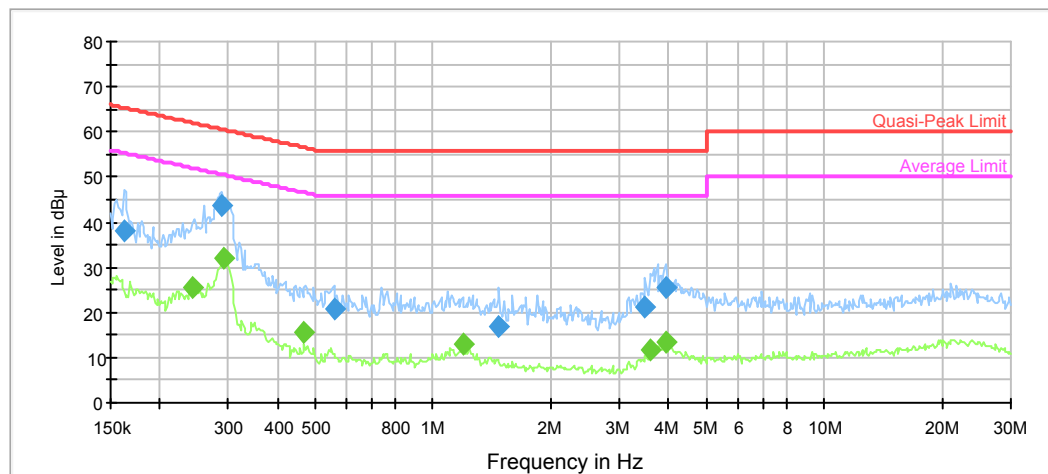
Test Data**Environmental Conditions**

Temperature:	25.8 °C
Relative Humidity:	54 %
ATM Pressure:	100.8 kPa

The testing was performed by Lily Xie on 2019-01-15.

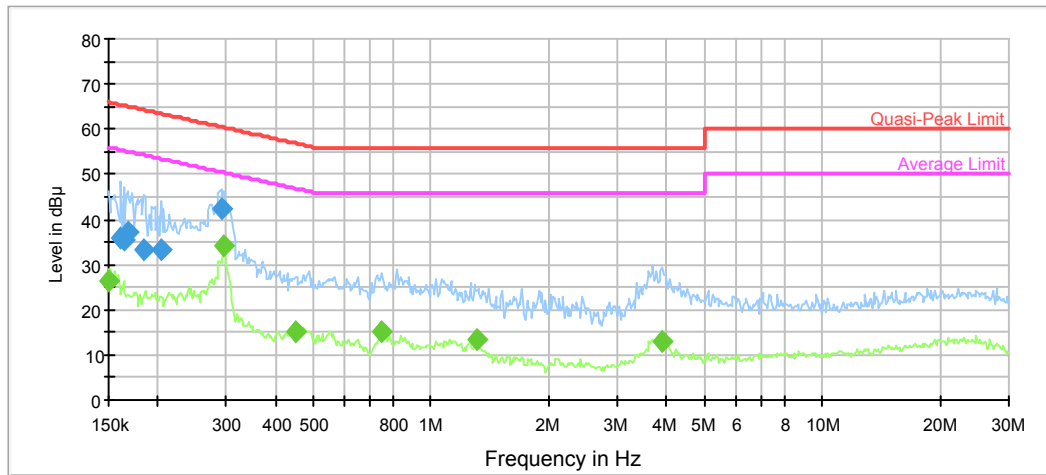
Test Mode: Transmitting

AC120V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.162441	37.9	9.000	L1	11.0	27.4	65.3	Compliance
0.288307	43.6	9.000	L1	10.2	17.0	60.6	Compliance
0.558572	20.6	9.000	L1	9.8	35.4	56.0	Compliance
1.476605	16.9	9.000	L1	9.8	39.1	56.0	Compliance
3.491417	21.0	9.000	L1	9.8	35.0	56.0	Compliance
3.934683	25.4	9.000	L1	9.8	30.6	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.243884	25.5	9.000	L1	10.3	26.5	52.0	Compliance
0.292938	32.2	9.000	L1	10.2	18.2	50.4	Compliance
0.468757	15.6	9.000	L1	9.9	30.9	46.5	Compliance
1.190776	13.1	9.000	L1	9.8	32.9	46.0	Compliance
3.575883	11.7	9.000	L1	9.8	34.3	46.0	Compliance
3.934683	13.2	9.000	L1	9.8	32.8	46.0	Compliance

AC120V, 60 Hz, Neutral:

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.161152	36.0	9.000	N	11.0	29.4	65.4	Compliance
0.163741	35.3	9.000	N	11.0	29.9	65.2	Compliance
0.167702	37.2	9.000	N	10.9	27.9	65.1	Compliance
0.184529	33.5	9.000	N	10.7	30.8	64.3	Compliance
0.204669	33.3	9.000	N	10.6	30.1	63.4	Compliance
0.290613	42.5	9.000	N	10.2	18.0	60.5	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.150000	26.5	9.000	N	11.2	29.5	56.0	Compliance
0.295282	34.3	9.000	N	10.2	16.1	50.4	Compliance
0.450448	15.3	9.000	N	9.9	31.6	46.9	Compliance
0.750100	15.0	9.000	N	9.8	31.0	46.0	Compliance
1.310256	13.4	9.000	N	9.8	32.6	46.0	Compliance
3.903455	13.0	9.000	N	9.8	33.0	46.0	Compliance

FCC§15.205, §15.209&§15.249- RADIATED EMISSIONS**Applicable Standard**

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

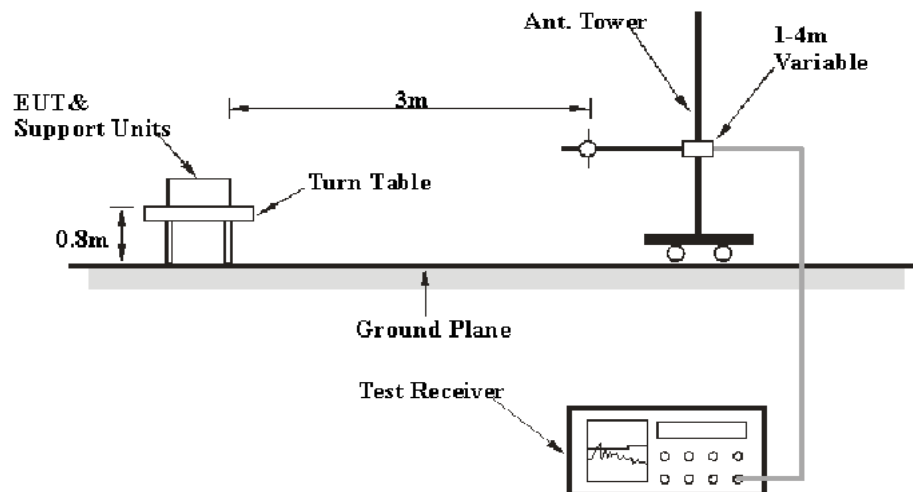
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

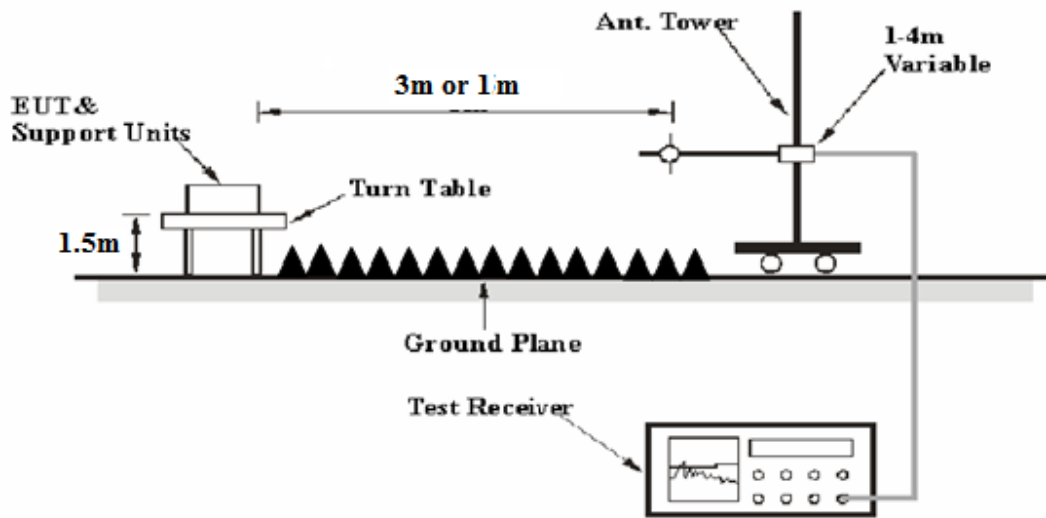
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

EUT Setup

Below 1 GHz:



Above 1 GHz:



The radiated emission tests were performed in the 3 meters chamber, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

According to C63.10, the above 26.5 GHz test result shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade from 3m to 1 m

Distance extrapolation factor = $20 \log (\text{specific distance [3m]}/\text{test distance [1m]})$ dB

Extrapolation result = Corrected Amplitude (dB μ V/m) - distance extrapolation factor (9.54dB)

For above 40GHz, external harmonic mixers are utilized. The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations, at the distance of 0.5m from the EUT. The Mixers and it's RF cables is compose a system for calibration, the conversion factor was added into the test Spectrum Analyzer in testing.

Test Equipment Setup

The system was investigated from 30 MHz to 100 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	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	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.

All data was recorded in the Quasi-peak detection mode from 30 MHz to 1GHz, peak and average detection mode 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:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2018-12-10	2019-12-10
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
HP	Amplifier	8447D	2727A05902	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2018-09-05	2019-09-05
R&S	Spectrum Analyzer	FSU 26	200256	2019-01-04	2020-01-04
R&S	Spectrum Analyzer	8564E	3943A01781	2019-01-04	2020-01-04
TDK RF	Horn Antenna	HRN-0118	130 084	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Ducommun Technologies	Horn Antenna	ARH-2823-02	1007726-01 1302	2016-11-18	2019-11-18
OML	Harmonic Mixer	WR19/M19HWD	U60313-1	2016-10-14	2019-10-14
OML	Horn Antenna	M19RH	11648-01	2016-10-14	2019-10-14
OML	Harmonic Mixer	WR12/M12HWD	E60120-1	2016-10-19	2019-10-19
OML	Horn Antenna	M12RH	E60120-2	2016-10-19	2019-10-19
OML	Harmonic Mixer	WR08/M08HWD	F60313-1	2016-10-24	2019-10-24
OML	Horn Antenna	M08RH	F60313-2	2016-10-24	2019-10-24
MICRO-COAX	Coaxial Cable	UFA147-1-2362- 100100	64639 231029- 001	2018-02-24	2019-02-28
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2018-09-05	2019-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2018-06-27	2019-06-27
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A

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

Test Data**Environmental Conditions**

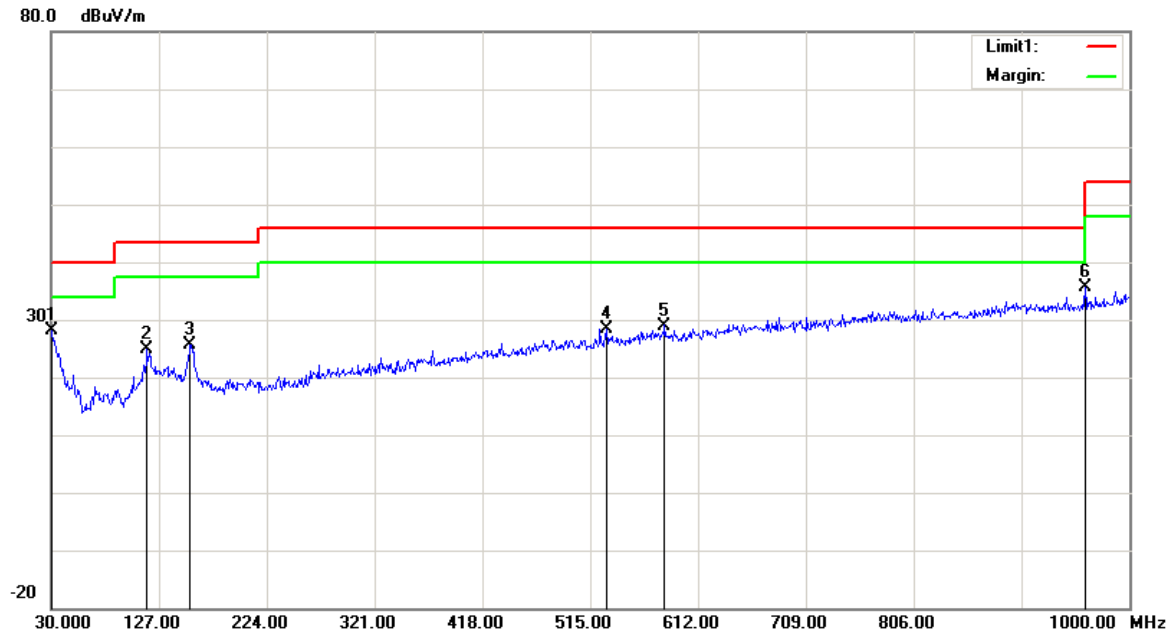
Temperature:	23.4~24.3 °C
Relative Humidity:	43~58 %
ATM Pressure:	100.3~100.8 kPa

The testing was performed by Tyler Pan on 2019-01-15, 2019-01-16.

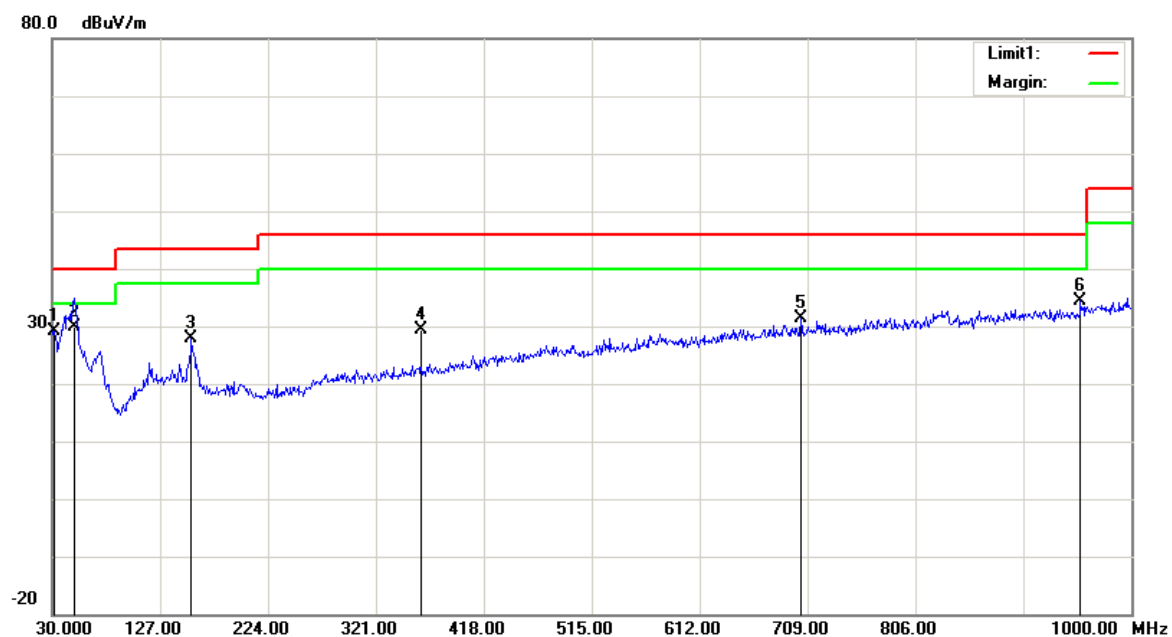
Test Mode: Transmitting

1) 30MHz-1GHz:

Horizontal:



Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.0000	26.29	peak	1.72	28.01	40.00	11.99
116.3300	30.05	peak	-5.13	24.92	43.50	18.58
155.1300	31.59	peak	-5.87	25.72	43.50	17.78
529.5500	27.99	peak	0.39	28.38	46.00	17.62
581.9300	27.98	peak	1.02	29.00	46.00	17.00
960.2300	12.73	peak	22.90	35.63	54.00	18.37

Vertical:

Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
31.9400	29.02	peak	0.19	29.21	40.00	10.79
50.3700	41.06	QP	-11.27	29.79	40.00	10.21
155.1300	33.66	peak	-5.87	27.79	43.50	15.71
361.7400	32.16	peak	-2.80	29.36	46.00	16.64
703.1800	28.35	peak	3.11	31.46	46.00	14.54
954.4100	37.78	peak	-3.31	34.47	46.00	11.53

2) 1GHz-40GHz

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB(1/m))					
24150.00	83.51	PK	H	35.41	10.96	37.12	92.76	127.96	35.20
24150.00	78.25	AV	H	35.41	10.96	37.12	87.50	107.96	20.46
24150.00	100.50	PK	V	35.41	10.96	37.12	109.75	127.96	18.21
24150.00	96.37	AV	V	35.41	10.96	37.12	105.62	107.96	2.34
24000.00	42.54	PK	V	35.35	10.87	37.40	51.36	74.00	22.64
24000.00	32.35	AV	V	35.35	10.87	37.40	41.17	54.00	12.83
24250.00	42.51	PK	V	35.45	11.02	36.94	52.04	74.00	21.96
24250.00	32.47	AV	V	35.45	11.02	36.94	42.00	54.00	12.00

40GHz-100GHz

Frequency (GHz)	Receiver		Rx Antenna		Corrected Amplitude (dBμV/m)	Extrapolation result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB(1/m))				
48.3*	31.29	PK	V	40.08	71.37	61.83	87.96	26.13
48.3*	19.78	AV	V	40.08	59.86	50.32	67.96	17.64
72.45*	32.14	PK	V	43.85	75.99	66.45	87.96	21.51
72.45*	20.11	AV	V	43.85	63.96	54.42	67.96	13.54
96.6*	30.1	PK	V	45.92	76.02	66.48	87.96	21.48
96.6*	18.54	AV	V	45.92	64.46	54.92	67.96	13.04

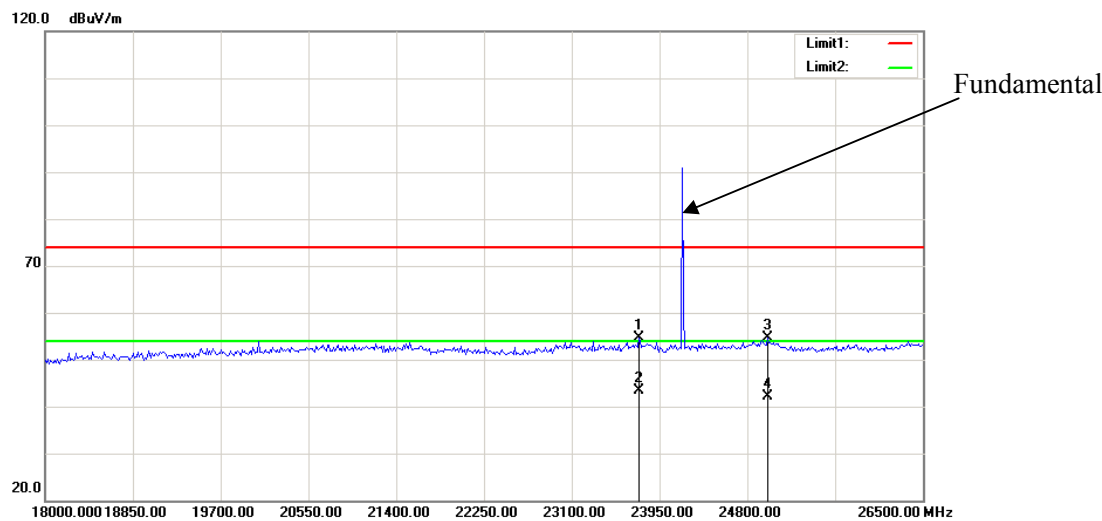
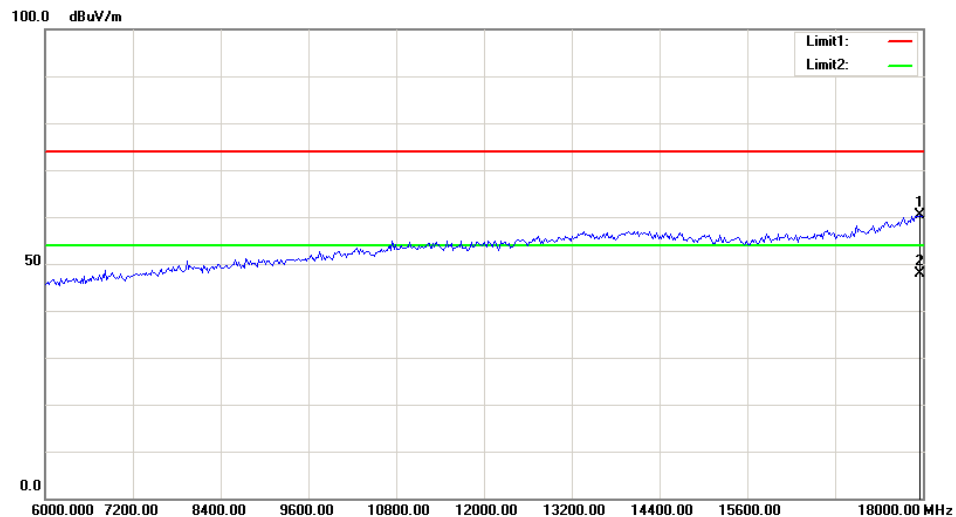
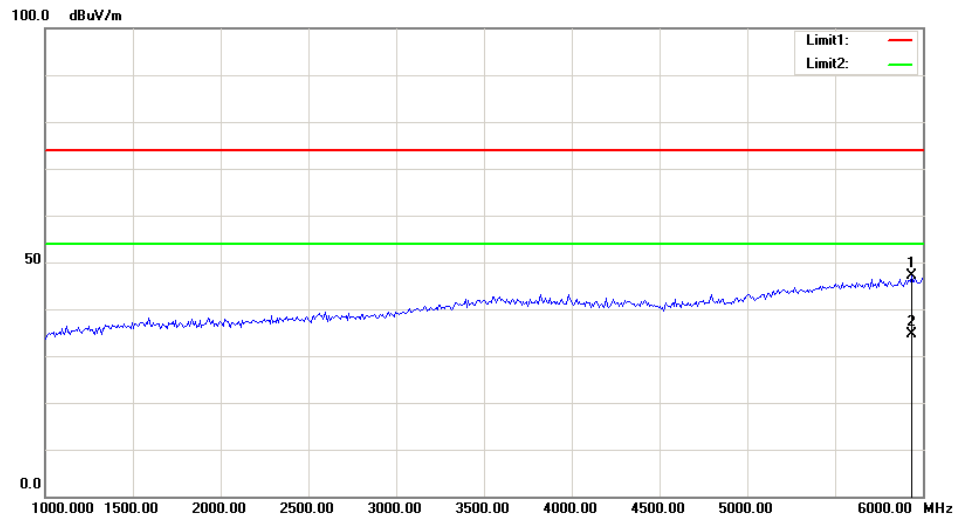
Note:

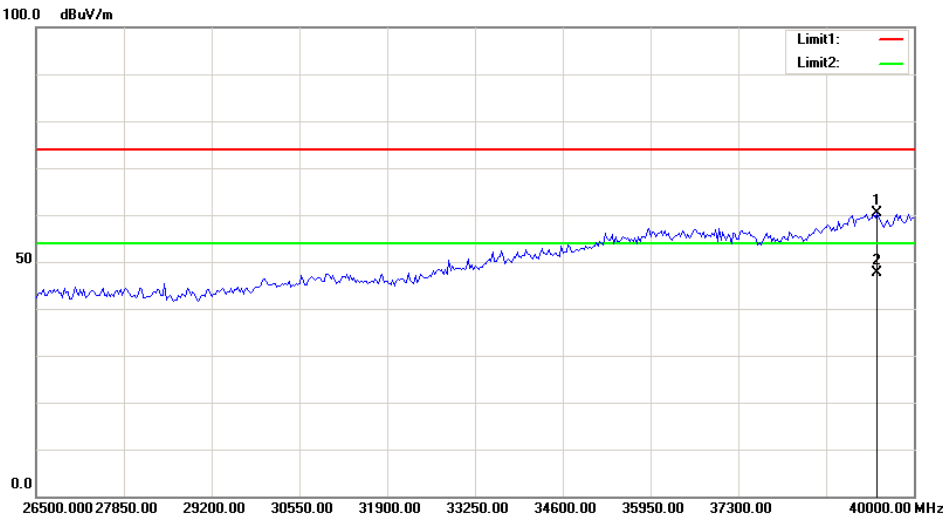
for the range 40-100GHz, the test performed at the distance 1.0 m.

*: Harmonics frequency.

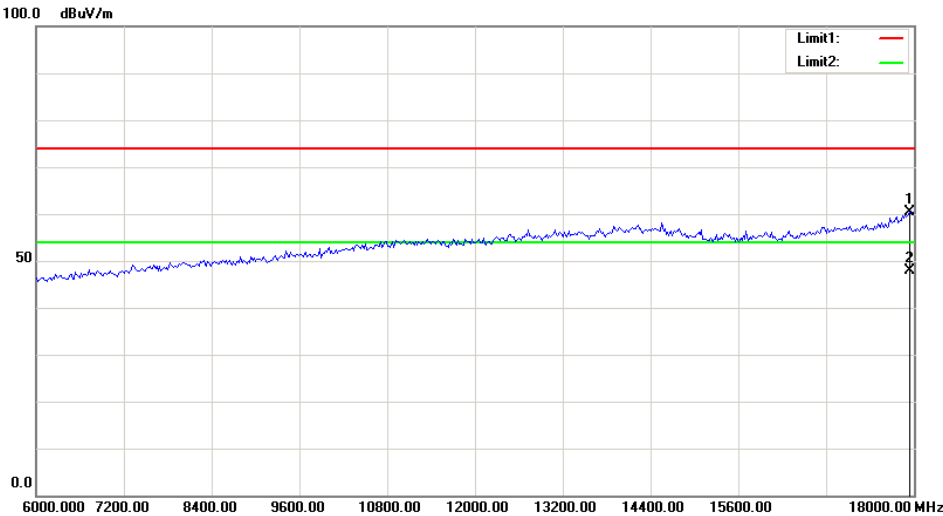
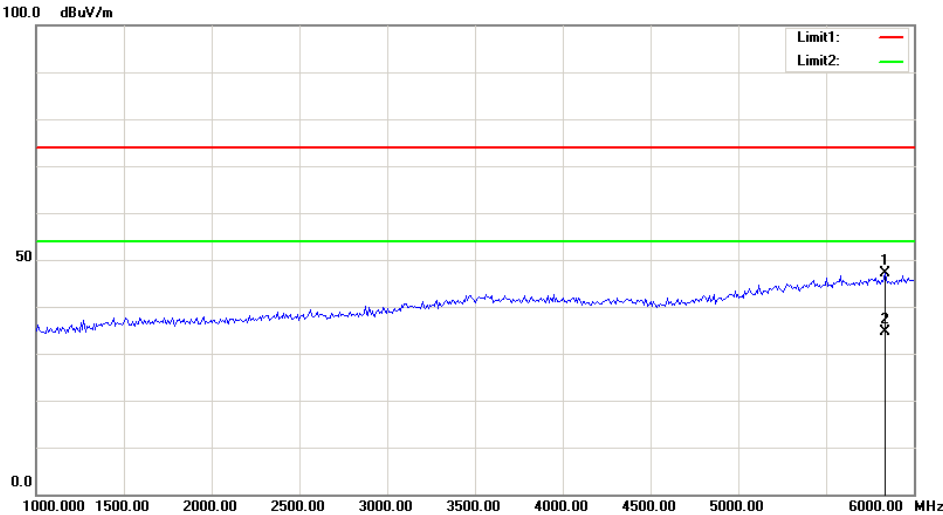
Emissions under the noise floor have not recored.

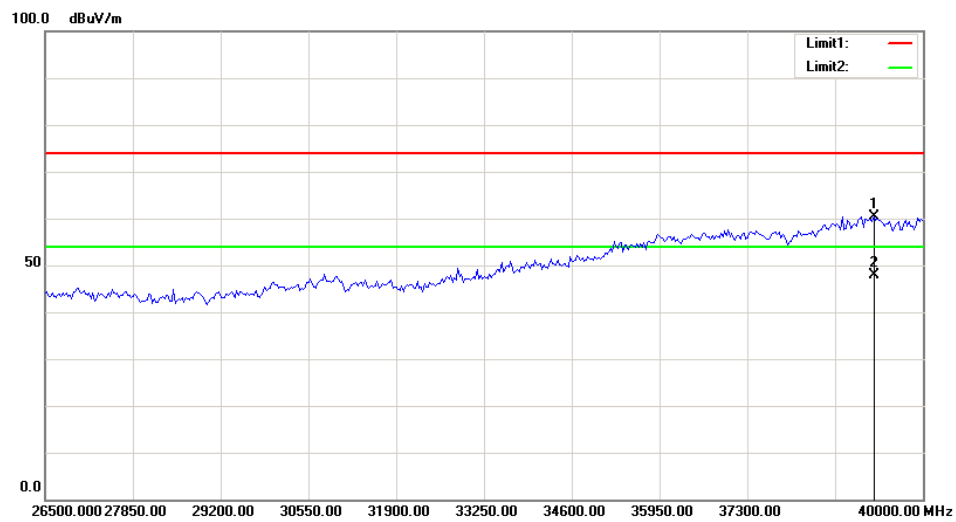
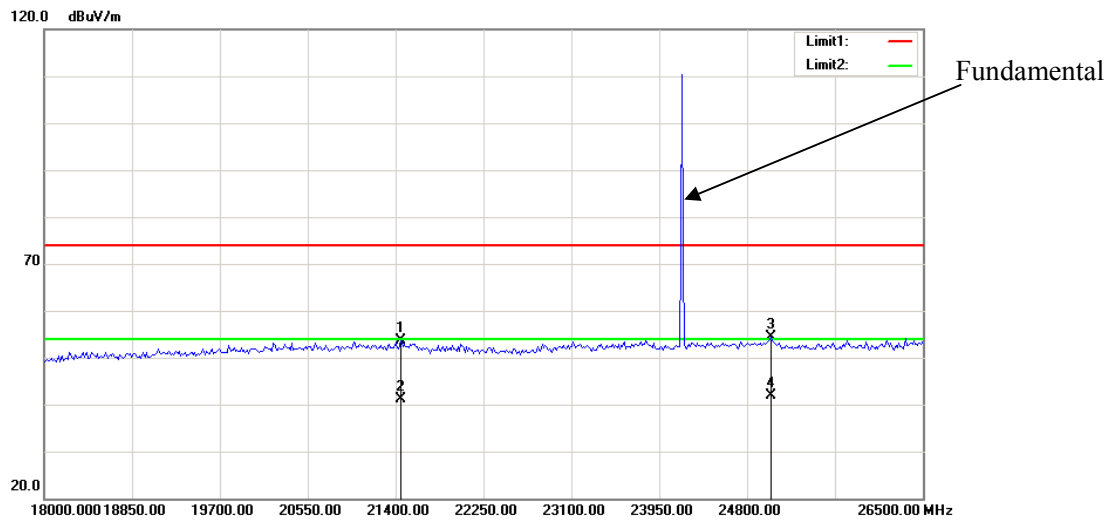
Test plots
Horizontal





Vertical





FCC §15.215(c) – 20 dB BANDWIDTH TESTING

Applicable Standard

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
3. Repeat above procedures until all frequencies measured were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU 26	200256	2019-01-04	2020-01-04
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
MICRO-COAX	Coaxial Cable	UFA147-1- 2362-100100	64639 231029- 001	2018-02-24	2019-02-28
Quinstar	Amplifier	QLW- 18405536-JO	15964001001	2018-06-27	2019-06-27

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

Test Data

Environmental Conditions

Temperature:	23.6 °C
Relative Humidity:	35 %
ATM Pressure:	100.3 kPa

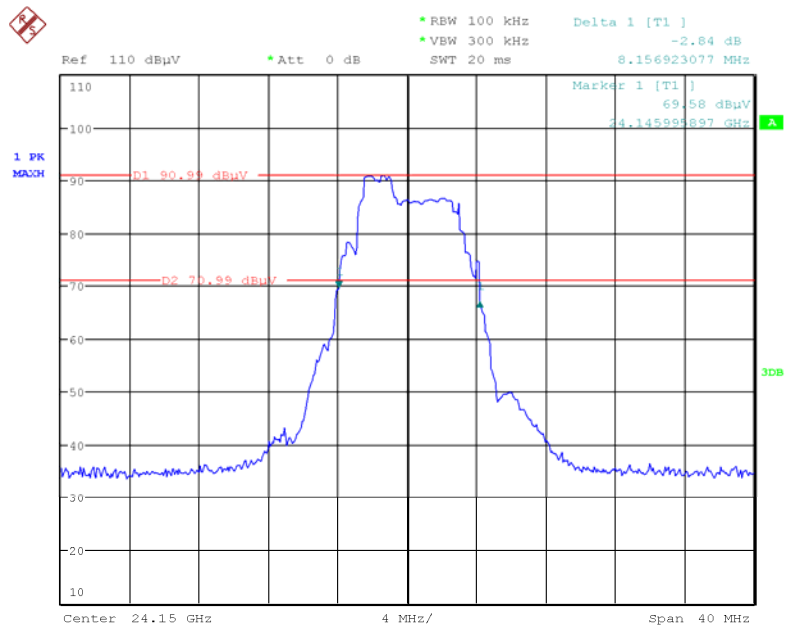
The testing was performed by Tyler Pan on 2019-01-16.

Test Result: Compliant.

Please refer to following tables and plots

Test Mode: Transmitting

Frequency (MHz)	20 dB Bandwidth (MHz)
24150	8.157



Date: 16.JAN.2019 11:16:03

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