TEST REPORT

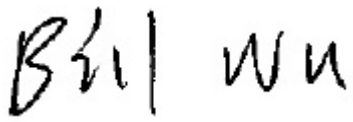
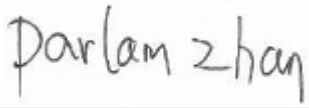
Application No.:	SHEM1912020209CR
FCC ID:	PS4MGTG1
Applicant:	Rain Harvesting Pty Ltd.
Address of Applicant:	12 Mayneview Street,Milton Qld 4064,AUSTRALIA
Manufacturer:	Rain Harvesting Pty Ltd.
Address of Manufacturer:	12 Mayneview Street,Milton Qld 4064,AUSTRALIA
Equipment Under Test (EUT):	
EUT Name:	Tank Gauge Plus
Model No.:	MGTG1RC2
Trade Mark:	Rain Harvesting
Standard(s) :	47 CFR Part 15, Subpart C 15.247
Date of Receipt:	2019-12-30
Date of Test:	2020-03-01 to 2020-06-30
Date of Issue:	2020-06-30
Test Result:	**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Parlam Zhan
E&E Section Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

Revision Record			
Version	**Description**	**Date**	**Remark**
00	Original	2020-06-30	/

Authorized for issue by:				
				
		Bill Wu / Project Engineer		
				
		Parlam Zhan / Reviewer		

2 Test Summary

Item	FCC Requirement	Method	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	N/A	Customer Declaration
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)	N/A	Pass

N/A: Not applicable

Item	FCC Requirement	Method	Result
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247(b)(1)	ANSI C63.10 (2013) Section 7.8.5	Pass
20dB Bandwidth	47 CFR Part 15, Subpart C 15.247(a)(1)(i)	ANSI C63.10 (2013) Section 7.8.7	Pass
Carrier Frequencies Separation	47 CFR Part 15, Subpart C 15.247a(1)	ANSI C63.10 (2013) Section 7.8.2	Pass
Hopping Channel Number	47 CFR Part 15, Subpart C 15.247a(1)(i)	ANSI C63.10 (2013) Section 7.8.3	Pass
Dwell Time	47 CFR Part 15, Subpart C 15.247a(1)(i)	ANSI C63.10 (2013) Section 7.8.4	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247(d)	ANSI C63.10 (2013) Section 7.8.6	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247(d)	ANSI C63.10 (2013) Section 7.8.8	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.205 & 15.209	ANSI C63.10 (2013) Section 6.10.5	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.205 & 15.209	ANSI C63.10 (2013) Section 6.4,6.5,6.6	Pass

3 Contents

4 General Information

4.1 Details of E.U.T.

Power supply:	DC 3V By 2*AA size batteries
Test voltage:	DC 3V
Antenna Gain	1.68dBi (Provided by the manufacturer)
Antenna Type	PCB Antenna
Modulation Type	DBPSK
Number of Channels	54 (9 Macro channels x 6 Micro channels)
Operation Frequency	902.1375MHz-904.6625MHz
Spectrum Spread Technology	Frequency Hopping Spread Spectrum(FHSS)

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Laptop	Lenovo	ThinkPad X100e	/

4.3 Power level setting using in test:

Channel	Macro channel	Micro channel
Low	Default	Default
Middle	Default	Default
High	Default	Default

4.4 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	±8.4 x 10^{-8}
2	Timeout	±2s
3	Duty cycle	±0.37%
4	Occupied Bandwidth	±3%
5	RF conducted power	±0.6dB
6	Conducted Spurious emissions	±0.75dB
7	RF Radiated power	±4.6dB (Below 1GHz)
		±4.1dB (Above 1GHz)
8	Radiated Spurious emission test	±4.2dB (Below 30MHz)
		±4.4dB (30MHz-1GHz)
		±4.8dB (1GHz-18GHz)
		±5.2dB (Above 18GHz)
9	Temperature test	±1°C
10	Humidity test	±3%
11	Supply voltages	±1.5%
12	Time	±3%

Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shanghai Branch

588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China

Tel: +86 21 6191 5666 Fax: +86 21 6191 5678

No tests were sub-contracted.

4.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• CNAS (No. CNAS L0599)

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• NVLAP (LAB CODE: 201034-0)

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

• FCC (Designation Number: CN5033)

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been recognized as an accredited testing laboratory.

• ISED (CAB Identifier: CN0020)

SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. EMC Laboratory has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory.

• VCCI (Member No.: 3061)

The 3m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-13868, C-14336, T-12221, G-10830 respectively.

4.7 Deviation from Standards

None

4.8 Abnormalities from Standard Conditions

None

5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
RF Conducted Test					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2019-12-20	2020-12-19
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2019-08-13	2020-08-12
Signal Generator	R&S	SMR20	SHEM006-1	2019-08-13	2020-08-12
Signal Generator	Agilent	N5182A	SHEM182-1	2019-08-13	2020-08-12
Communication Tester	R&S	CMW270	SHEM183-1	2019-08-13	2020-08-12
Switcher	Tonscend	JS0806	SHEM184-1	2019-08-13	2020-08-12
Power Sensor	Keysight	U2021XA * 4	SHEM184-1	2019-08-13	2020-08-12
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2017-09-25	2020-09-24
AC Power Stabilizer	APC	KDF-31020T-V0-F0	SHEM216-1	2019-12-20	2020-12-19
DC Power Supply	MCH	MCH-303A	SHEM210-1	2019-12-20	2020-12-19
Conducted test Cable	/	RF01~RF04	/	2019-12-20	2020-12-19
Test software	Tonscend	JS Tonscend BT/WIFI System	Version: 2.6	/	/
RF Radiated Test					
EMI test Receiver	R&S	ESU40	SHEM051-1	2019-12-20	2020-12-19
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2019-12-20	2020-12-19
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2019-12-20	2020-12-19
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2019-10-14	2021-10-13
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM202-1	2019-04-30	2021-04-29
Horn Antenna (1-18GHz)	Schwarzbeck	HF906	SHEM009-1	2017-10-24	2020-10-23
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2019-10-14	2021-10-13
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2017-10-31	2020-10-30
Pre-amplifier (9KHz-2GHz)	CLAVIIO	BDLNA-0001	SHEM164-1	2019-08-13	2020-08-12
Pre-amplifier (1-18GHz)	CLAVIIO	BDLNA-0118	SHEM050-2	2019-08-13	2020-08-12
High-amplifier (14-40GHz)	Schwarzbeck	10001	SHEM049-2	2019-12-20	2020-12-19
Signal Generator	R&S	SMR40	SHEM058-1	2019-08-13	2020-08-12
Band Filter	LORCH	9BRX-875/X150	SHEM156-1	/	/
Band Filter	LORCH	13BRX-1950/X500	SHEM083-2	/	/
Band Filter	LORCH	5BRX-2400/X200	SHEM155-1	/	/
Band Filter	LORCH	5BRX-5500/X1000	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2017-07-22	2020-07-21
RE test Cable	/	RE01, RE02, RE06	/	2019-12-20	2020-12-19
Test software	ESE	E3	Version: 6.111221a	/	/

6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(c)

6.1.2 Conclusion

Standard Requirement:

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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is PCB Antenna and no consideration of replacement. The best case gain of the antenna is 1.68dBi.

Antenna location: Refer to Appendix (Internal Photos)

6.2 Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence

6.2.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247(a)(1),(g),(h)

6.2.2 Conclusion

Standard Requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Compliance for section 15.247(a)(1):

According to Technical Specification, When transmitting continuously, device radios will hop over 54 frequency channels. They will select the transmit frequency from a pseudorandom sequence (PRBS-7 generator) stored in a frequency hopping table. This ensures the equally usage of all channels

An example of Pseudorandom Frequency Hopping Sequence as follow:

Each frequency used equally on the average by each transmitter.

According to Technical Specification, the receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any transmitters and shift frequencies in synchronization with the transmitted signals.

Compliance for section 15.247(g):

According to Technical Specification, The device uses a single side band modulation with a fully suppressed carrier, where a subcarrier is modulated by a 600 bps BPSK data modulation. The offset of this SSB subcarrier is related to the central frequency “F0” of each declared 25 KHz channel in

which the device is hopping 54 channels for continuous transmission.

Compliance for section 15.247(h):

According to Technical specification, When the radio switches on, it starts on the first channel of the declared hopping list.Transmission can stop before going over the 54 channels if the message is short. No individual channel will ever be used more often than it is allowed.

7 Radio Spectrum Matter Test Results

7.1 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(1)

Test Method: ANSI C63.10 (2013) Section 7.8.5

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥50 hopping channels
	0.25 for 25≤ hopping channels <50
	1 for digital modulation
2400-2483.5	1 for ≥75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

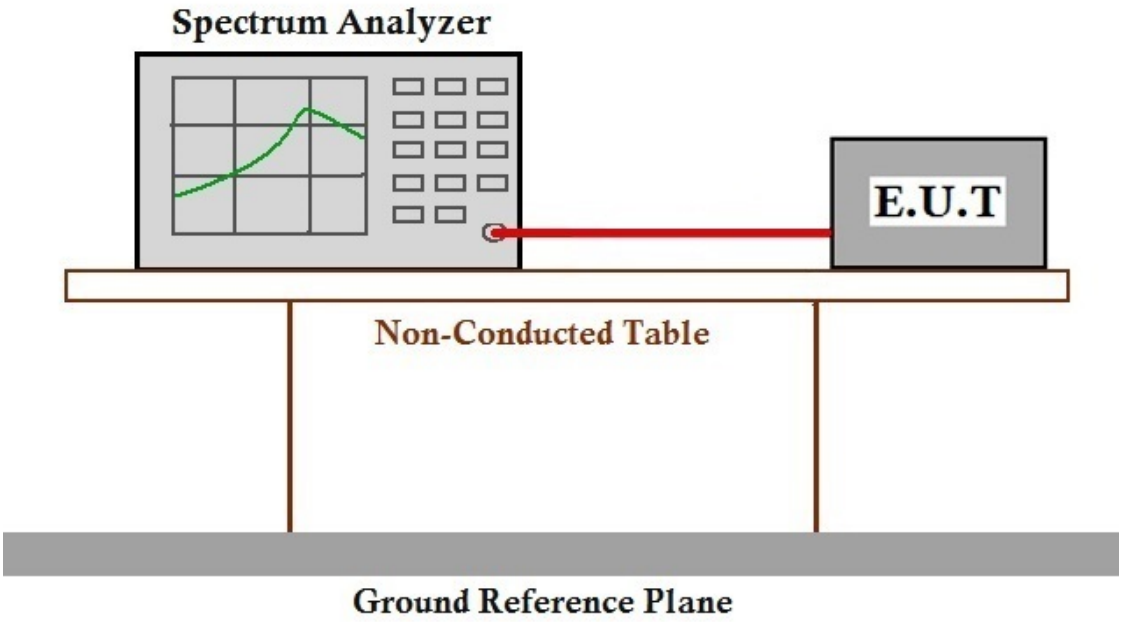
7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode.

7.1.2 Test Setup Diagram



7.1.3 Measurement Procedure and Data

Test Data:

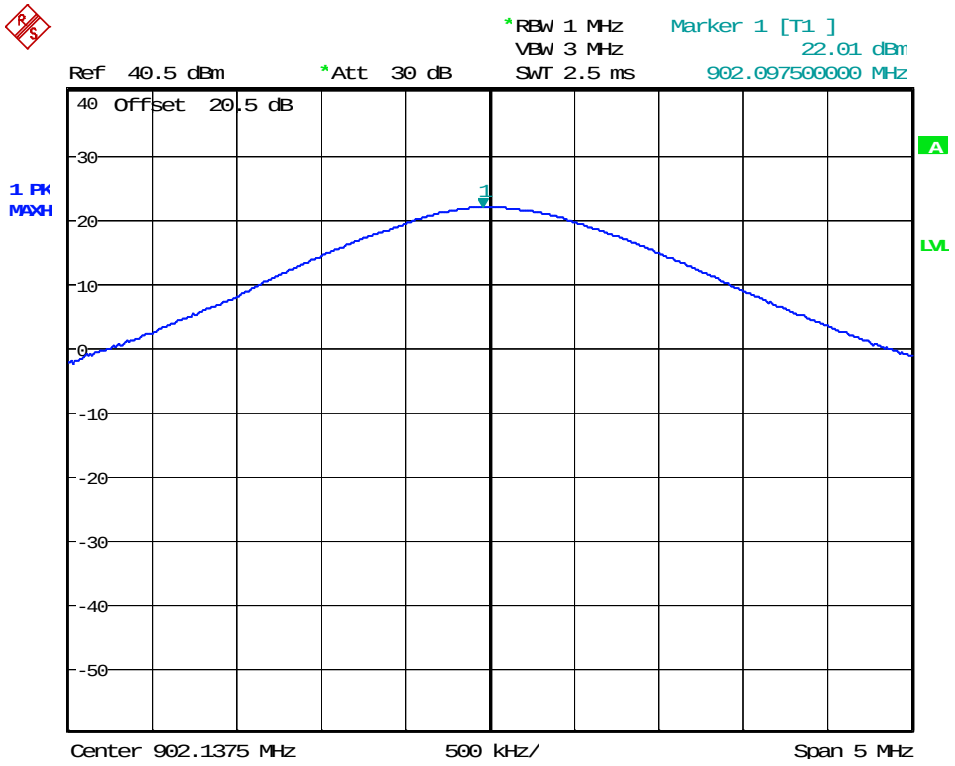
Test Channel	Test Frequency (MHz)	Reading Power (dBm)	Output Power (dBm)	Limit (dBm)	Result
Lowest	902.1375	22.01	22.51	30	Pass
Middle	903.4125	21.76	22.26	30	Pass
Highest	904.6625	21.69	22.19	30	Pass

Remark: 1) Output Peak Power = Reading Power + Cable loss

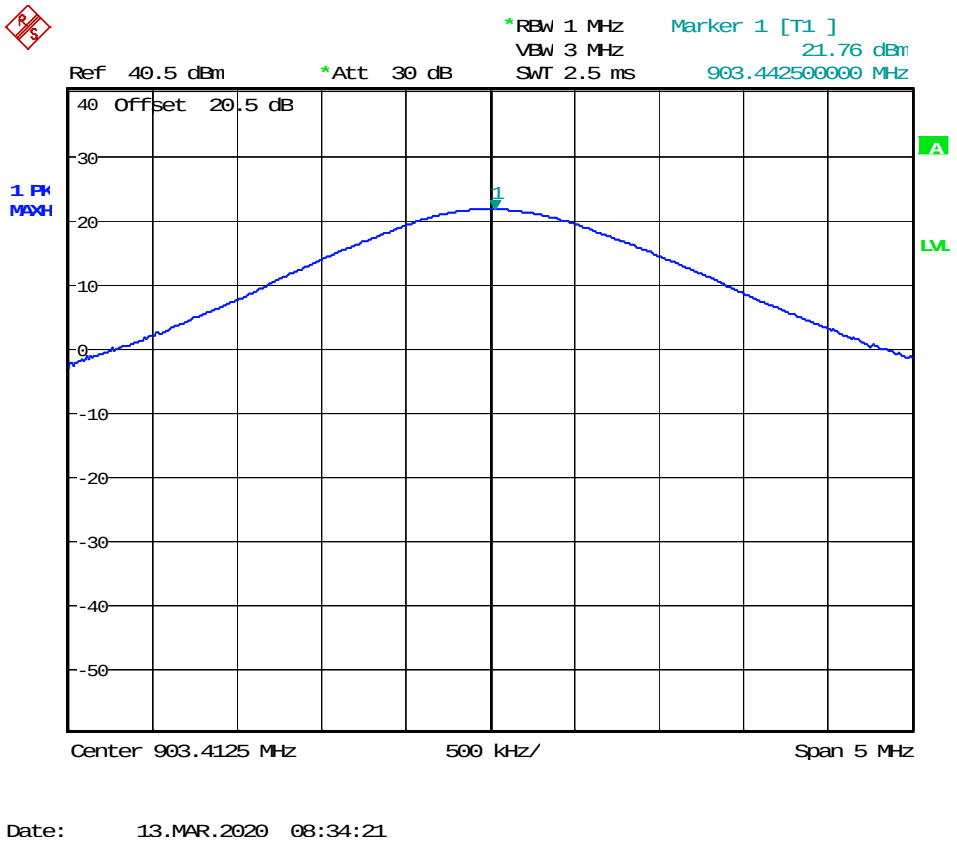
2) Cable loss=0.5dB

Test plot as follows:

Low Channel



Middle Channel



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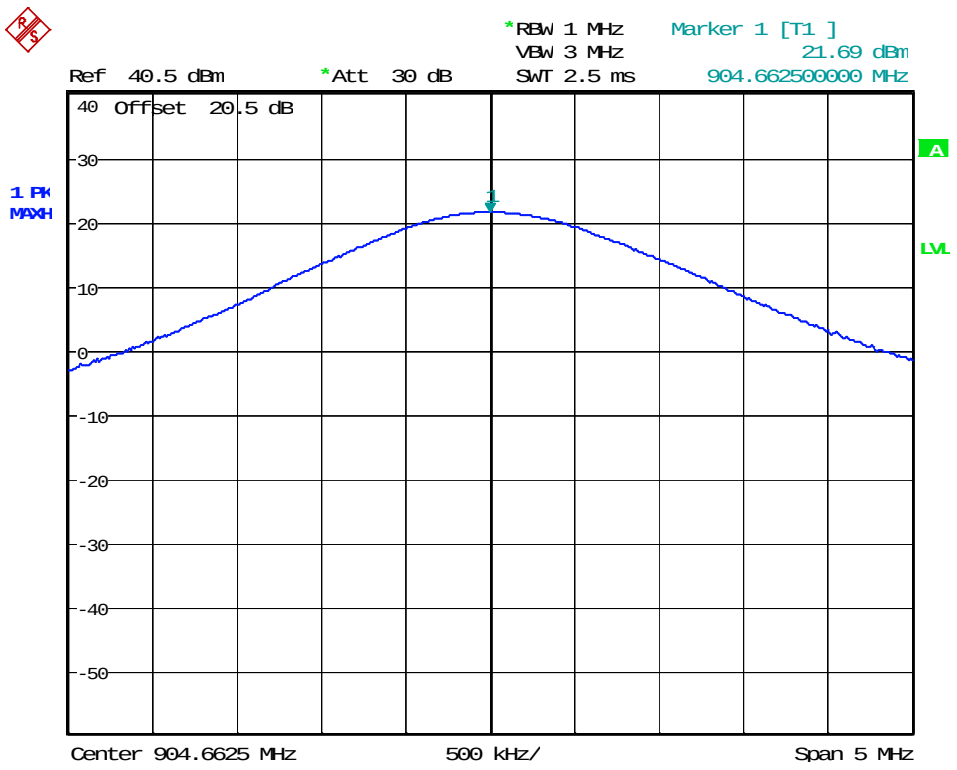
High Channel



Date: 13.MAR.2020 08:36:54

7.2 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247(a)(1)(i)

Test Method: ANSI C63.10 (2013) Section 7.8.7

7.2.1 E.U.T. Operation

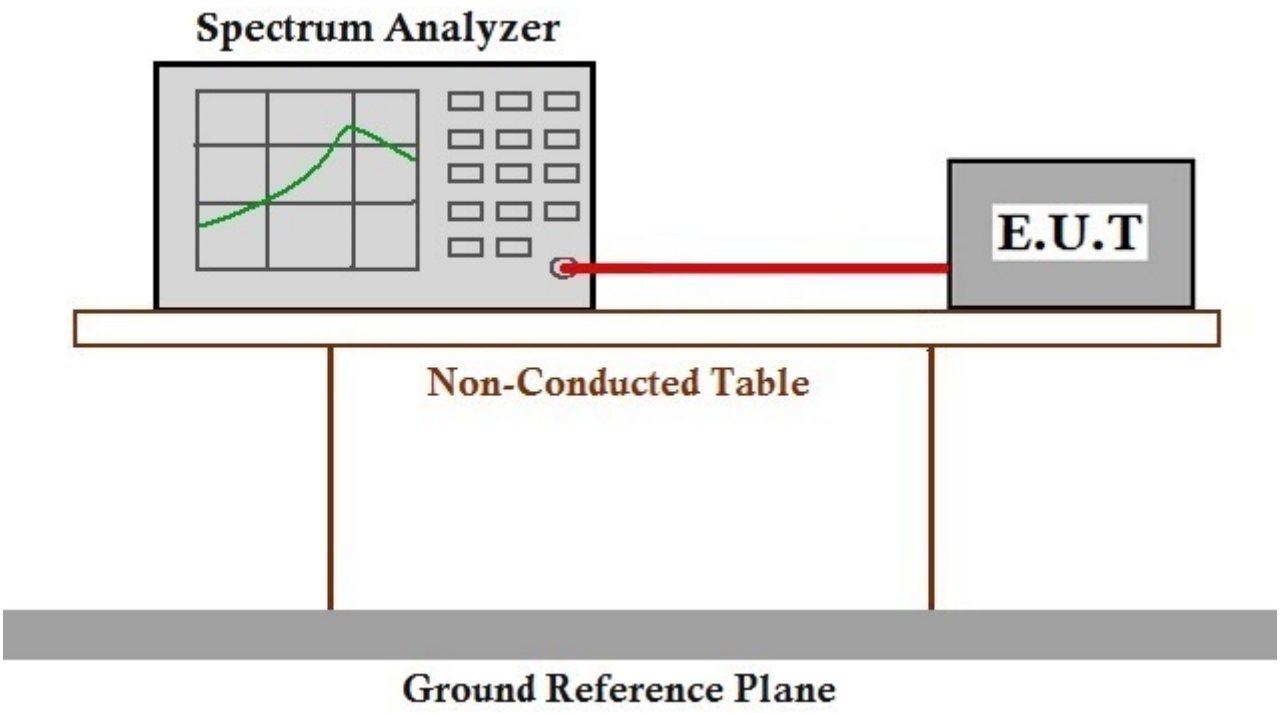
Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode a:TX_Hop mode_Keep the EUT in frequency hopping mode.

b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode.

7.2.2 Test Setup Diagram



7.2.3 Measurement Procedure and Data

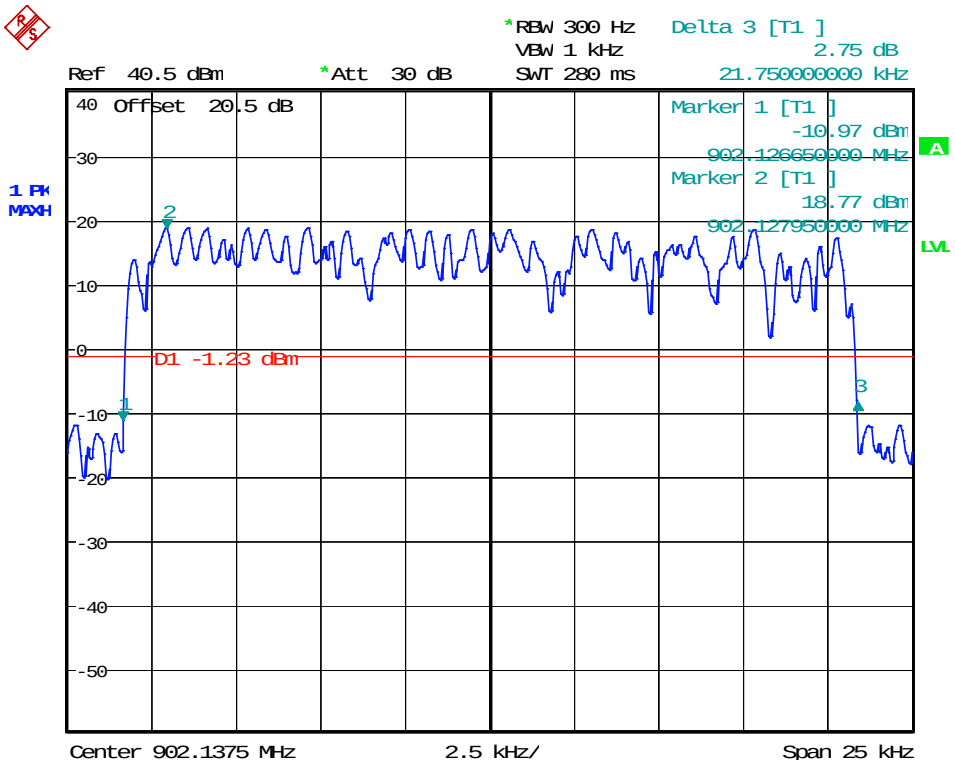
Test Data:

Test Channel	Test Frequency (MHz)	EBW[KHz] Micro Channel	Limit[KHz]	Result
Lowest	902.1375	21.75	---	PASS
Middle	903.4125	21.95	---	PASS
Highest	904.6625	21.85	---	PASS

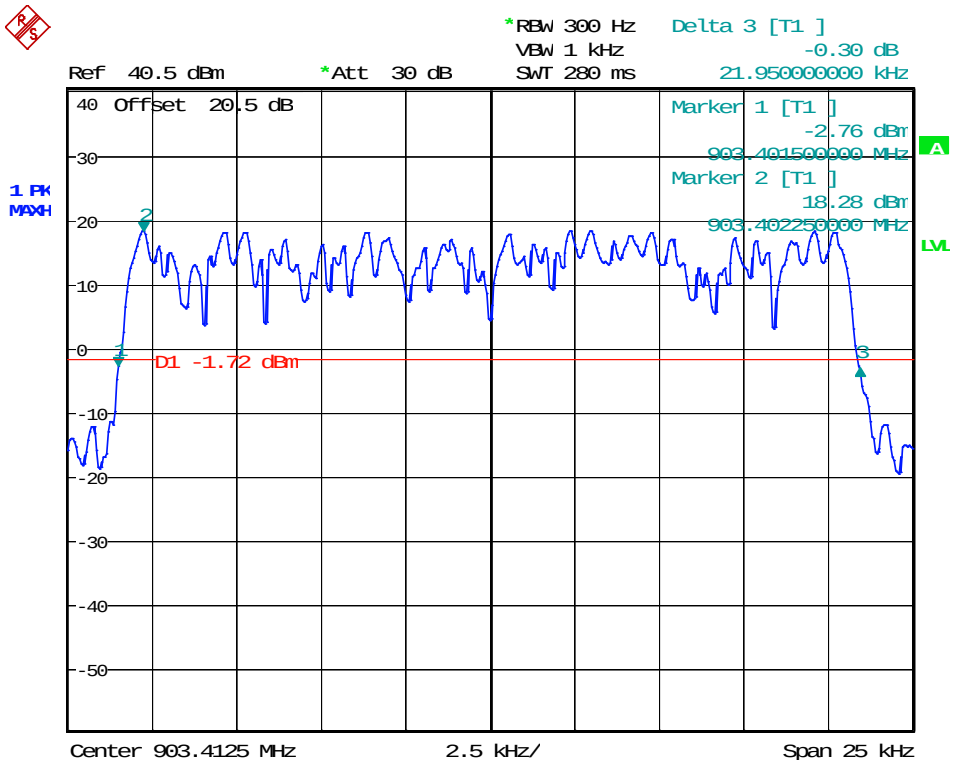
Test Channel	Test Frequency (MHz)	EBW[KHz] Macro Channel	Limit[KHz]	Result
Lowest	902.2	154.40	---	PASS
Middle	903.4	155.20	---	PASS
Highest	904.6	155.20	---	PASS

Test plot as follows: Micro Channel

Low Channel

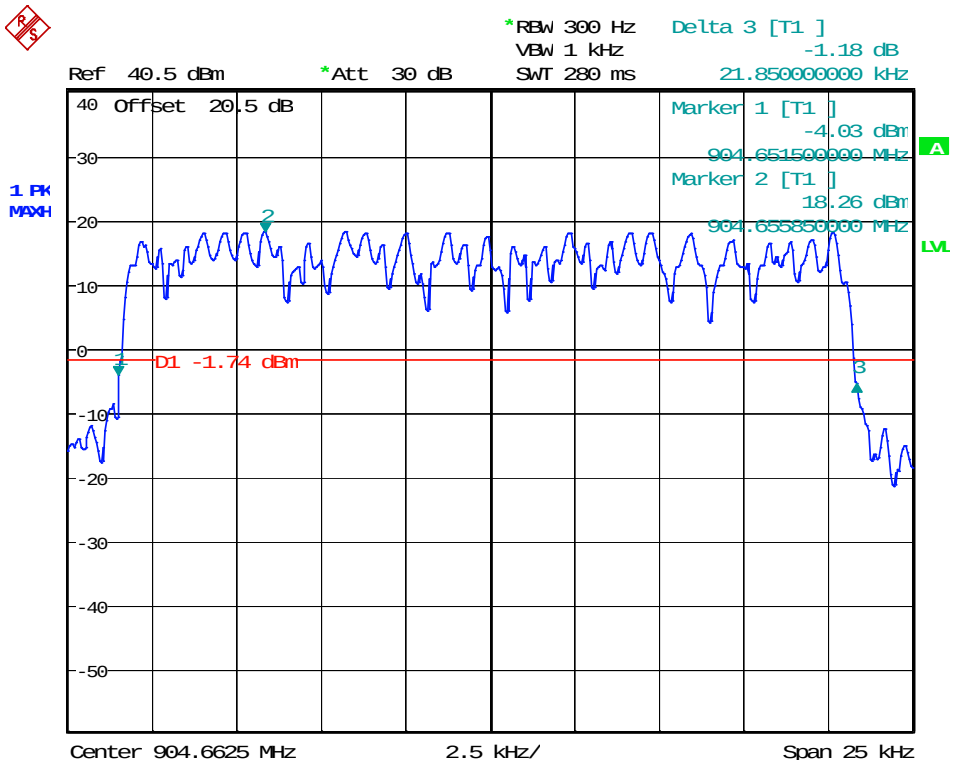


Middle Channel



Date: 19.MAR.2020 09:57:37

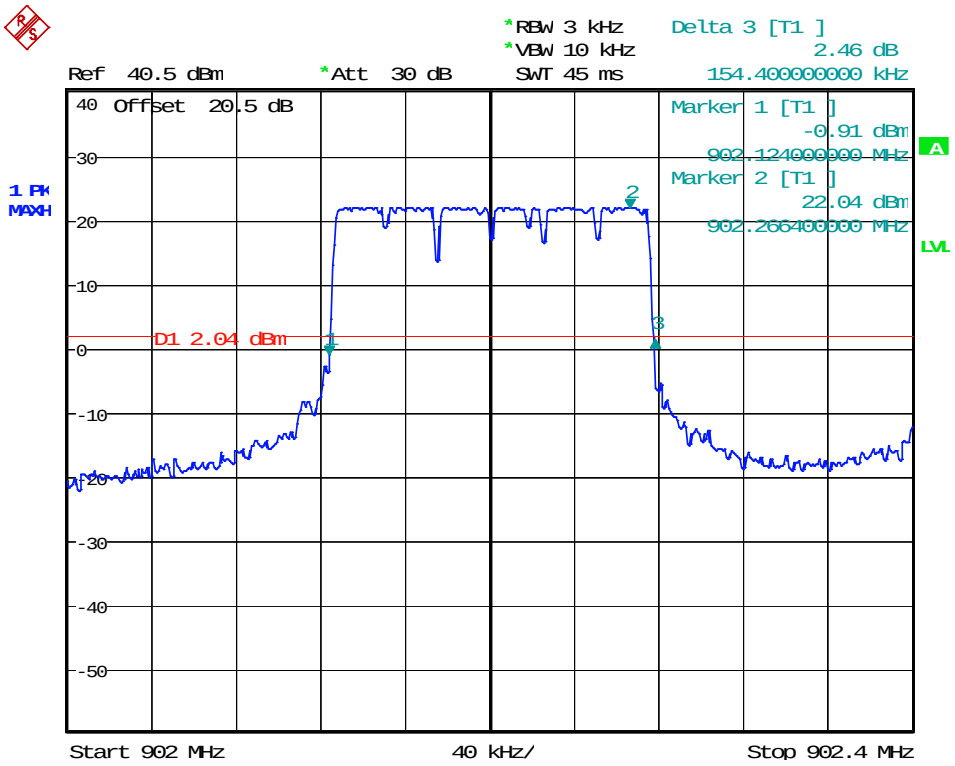
High Channel



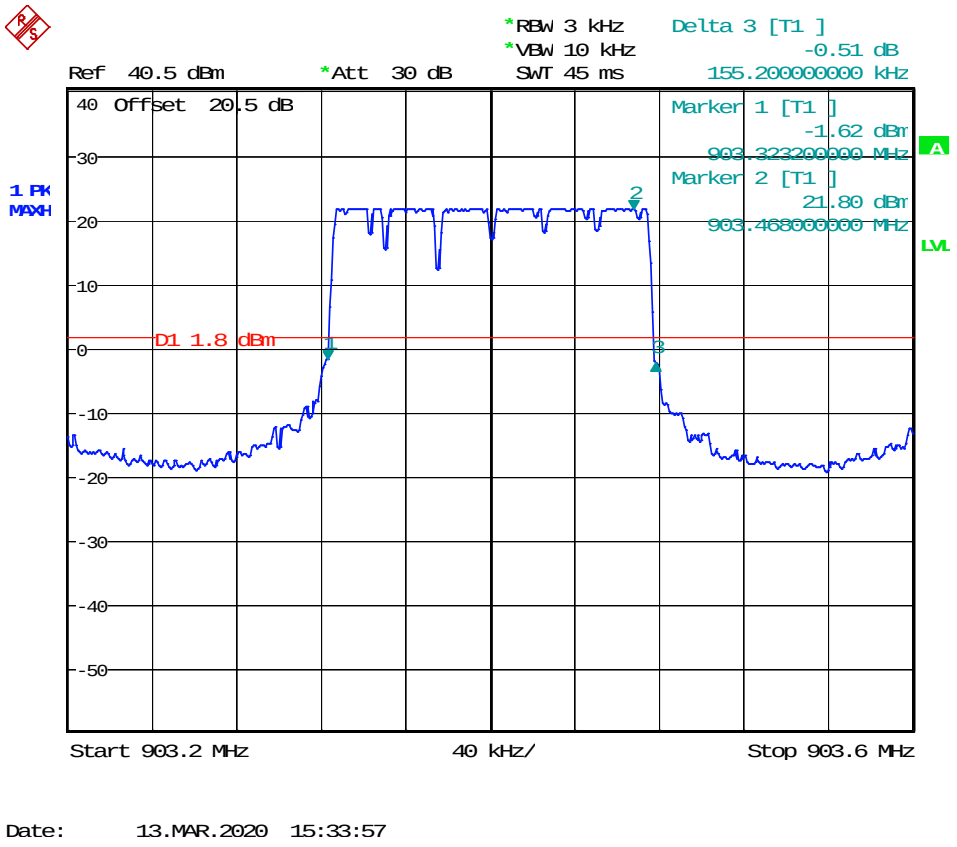
Date: 19.MAR.2020 11:12:18

Test plot as follows: Macro Channel

Low Channel

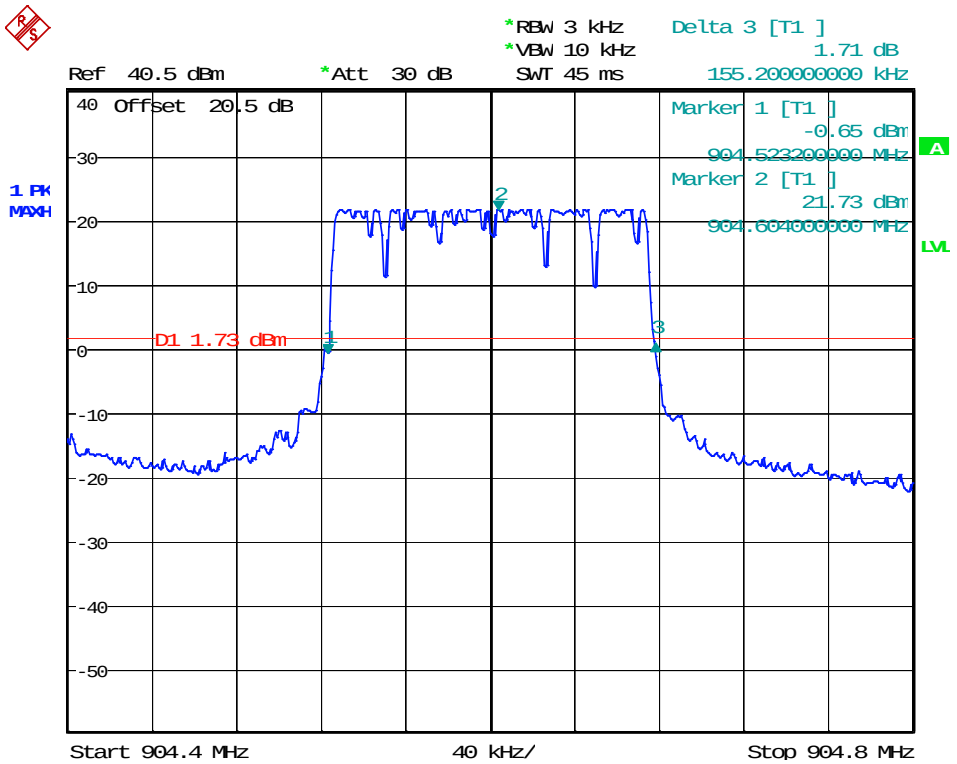


Middle Channel



Date: 13.MAR.2020 15:33:57

High Channel



Date: 13.MAR.2020 16:14:13

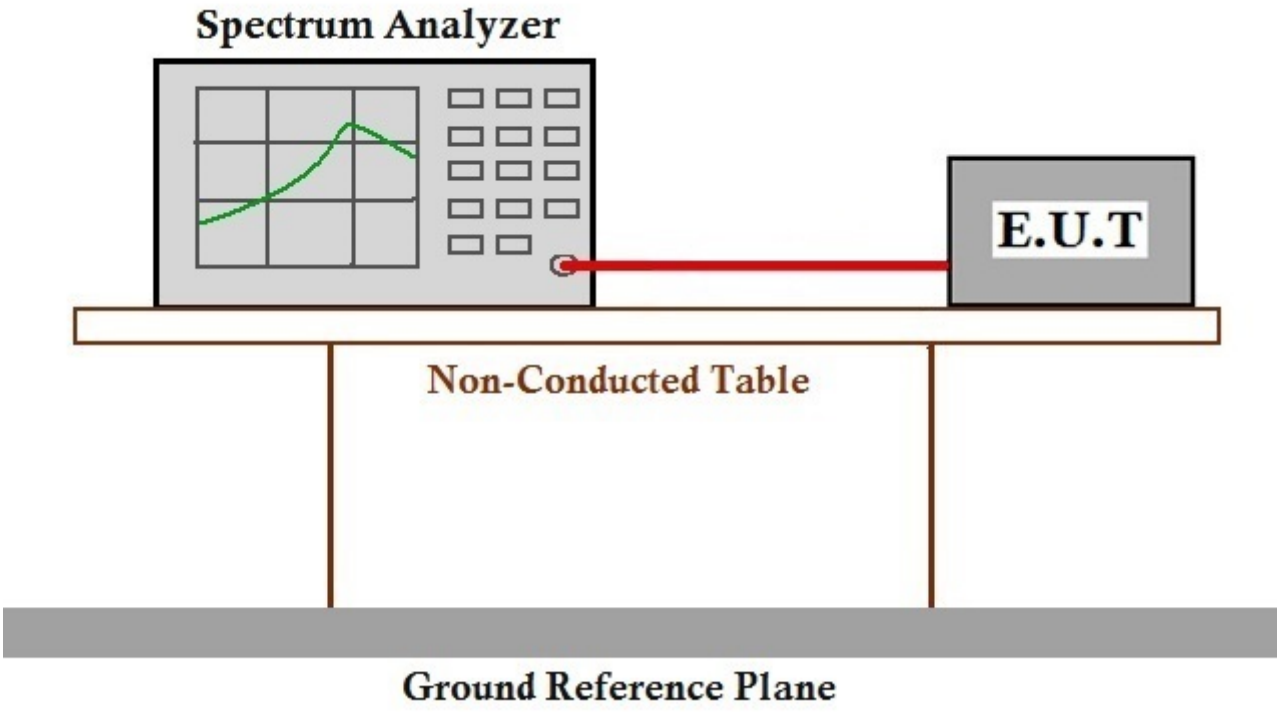
7.3 Carrier Frequencies Separation

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)
Test Method: ANSI C63.10 (2013) Section 7.8.2
Limit: 25KHz or the 20 dB bandwidth of the hopping channel whichever is greater.

7.3.1 E.U.T. Operation

Operating Environment:
Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar
Test mode a:TX_Hop mode_Keep the EUT in frequency hopping mode.

7.3.2 Test Setup Diagram

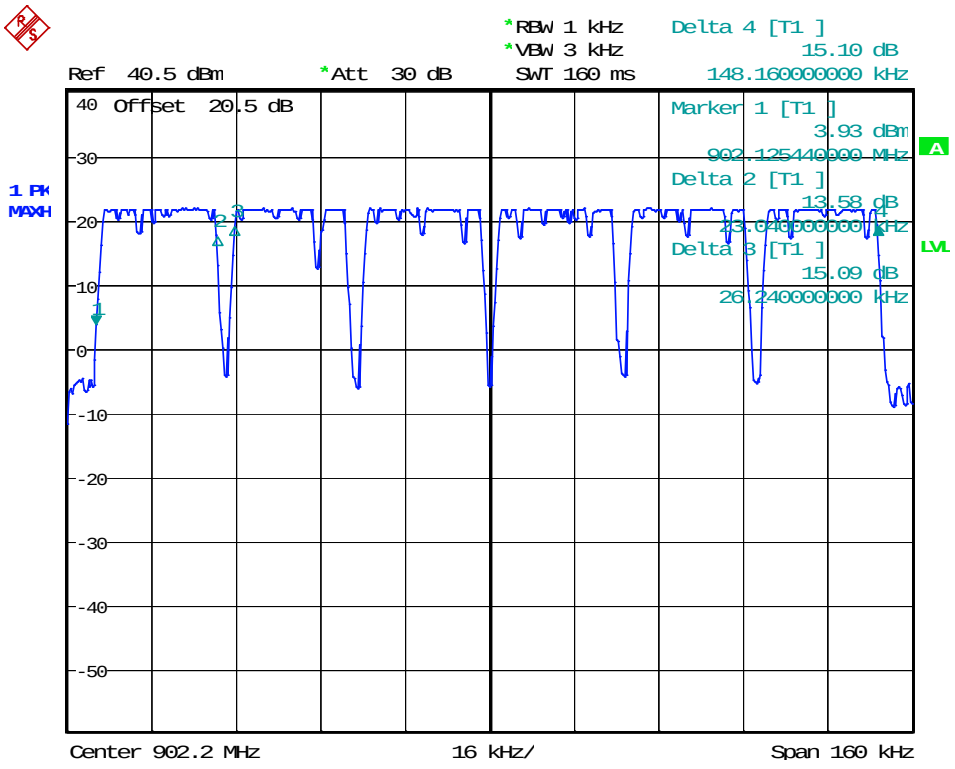


7.3.3 Measurement Procedure and Data

Test Data:

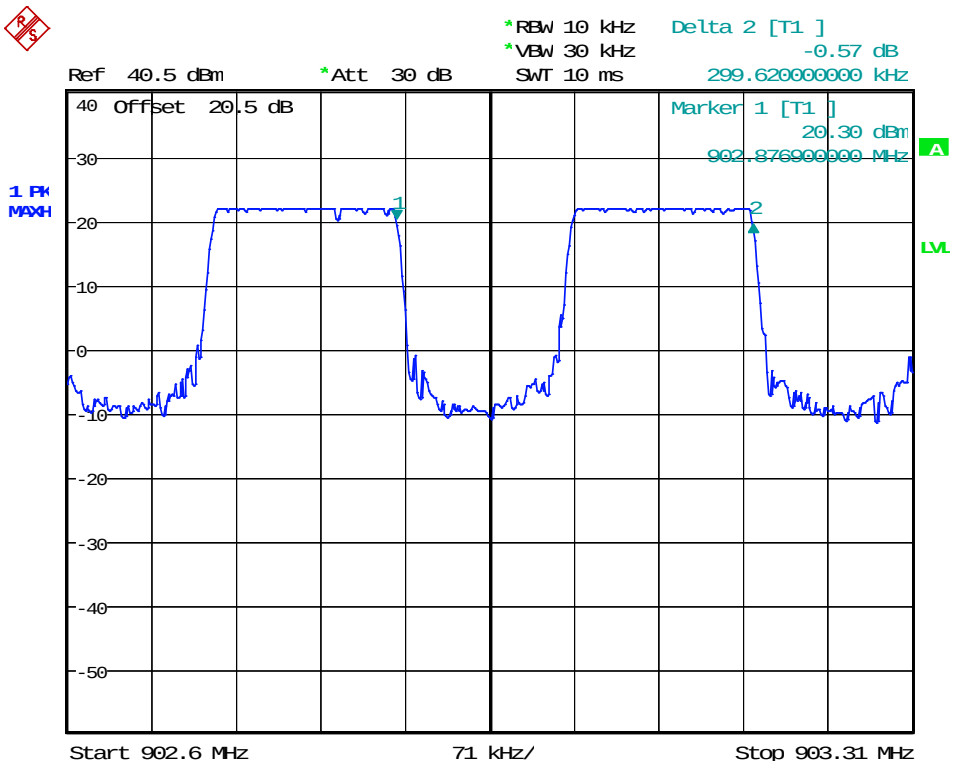
Test Channel	Carrier Frequencies Separated (kHz)	Limit (kHz)	Test Result
Macro channels- hopping	299.62	155.20	Pass
Micro channels- hopping	26.24	25.00	Pass

Test plot as follows: Micro Channel



Date: 13.MAR.2020 10:36:26

Test plot as follows: Macro Channel



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7.4 Hopping Channel Number

Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(i)
Test Method: ANSI C63.10 (2013) Section 7.8.3
Limit:

Frequency range(MHz)	Number of hopping channels (minimum)
902-928	50 for 20dB bandwidth <250kHz
	25 for 20dB bandwidth ≥250kHz
2400-2483.5	15
5725-5850	75

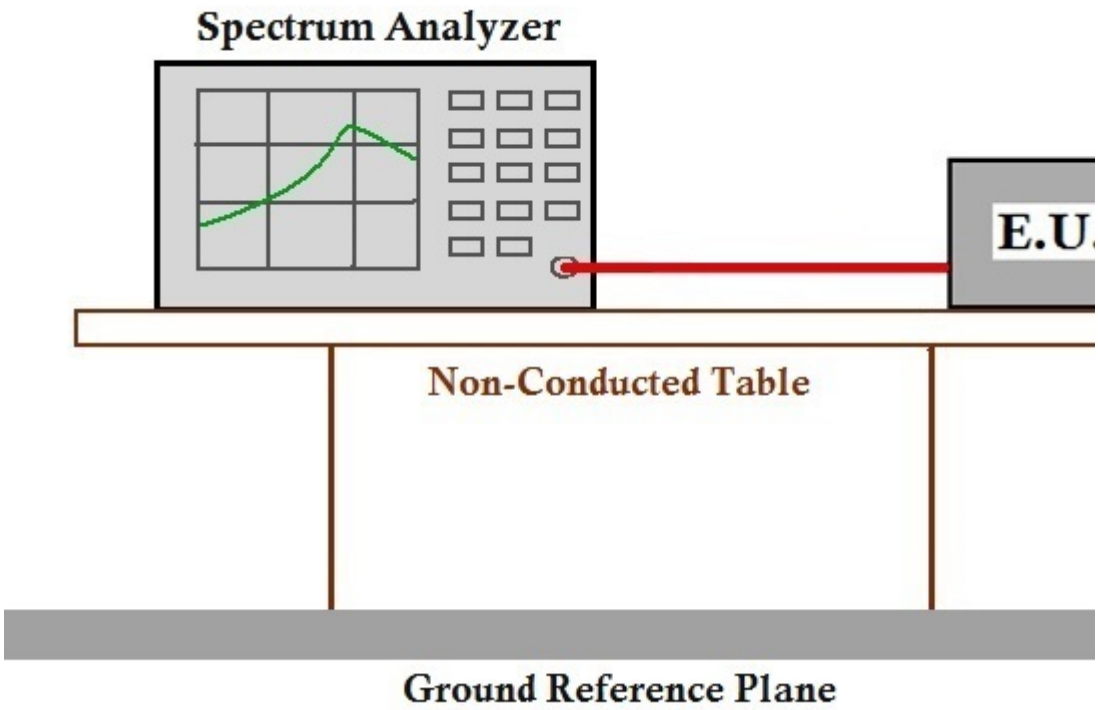
7.4.1 E.U.T. Operation

Operating Environment:

Temperature:	22 °C	Humidity:	Humi	50 % RH	Atmospheric Pressure:	1002 mbar	

Test mode a:TX_Hop mode_Keep the EUT in frequency hopping mode.

7.4.2 Test Setup Diagram

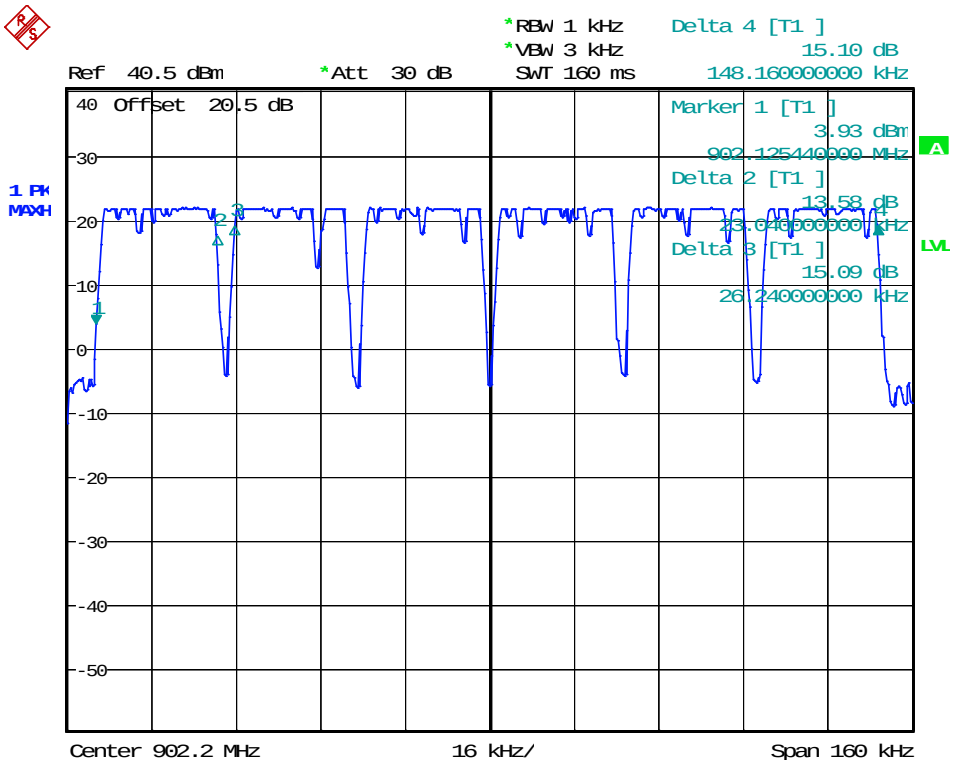


7.4.3 Measurement Procedure and Data

Test Data:

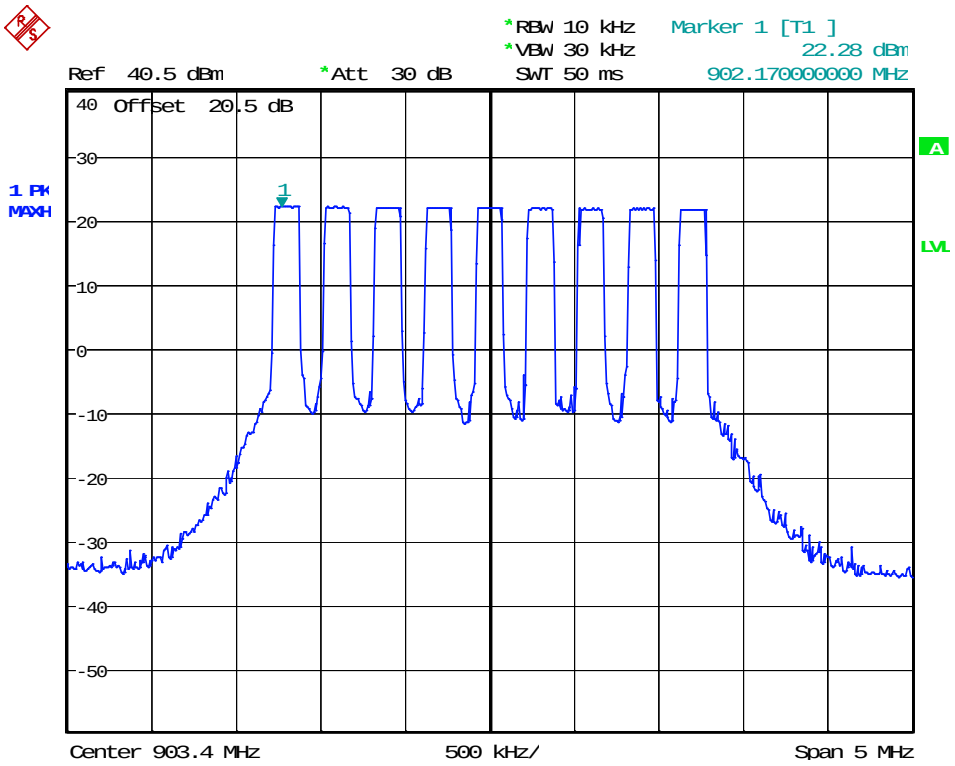
Hopping channel numbers(Macro CH)	Hopping channel numbers(Micro CH)	Hopping channel numbers(Total CH)	Test Result
9	6	54	Pass

Test plot as follows: Micro Channel



Date: 13.MAR.2020 10:36:45

Test plot as follows: Macro Channel



Date: 13.MAR.2020 10:45:37

7.5 Dwell Time

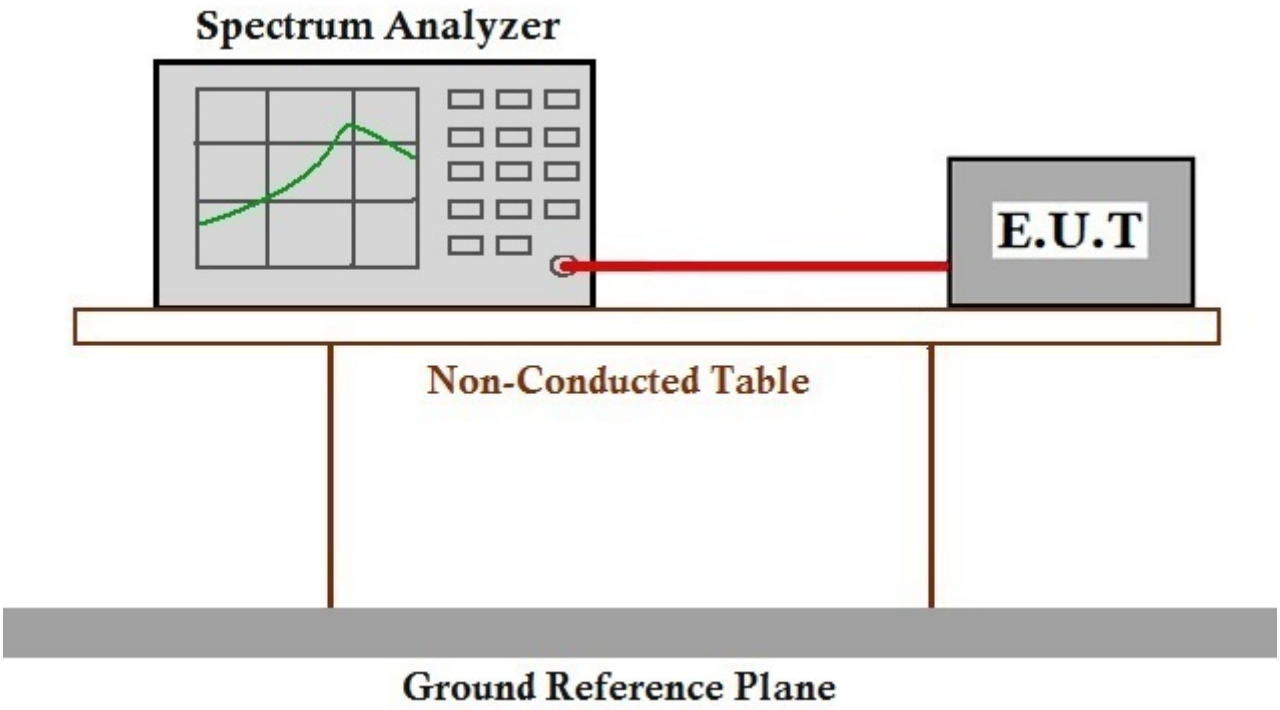
Test Requirement 47 CFR Part 15, Subpart C 15.247a(1)(i)
Test Method: ANSI C63.10 (2013) Section 7.8.4
Limit:

Frequency(MHz)	Limit
902-928	0.4S within a 20S period(20dB bandwidth<250kHz)
	0.4S within a 10S period(20dB bandwidth≥250kHz)
2400-2483.5	0.4S within a period of 0.4S multiplied by the number of hopping channels
5725-5850	0.4S within a 30S period

7.5.1 E.U.T. Operation

Operating Environment:
Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar
Test mode a:TX_Hop mode_Keep the EUT in frequency hopping mode.

7.5.2 Test Setup Diagram

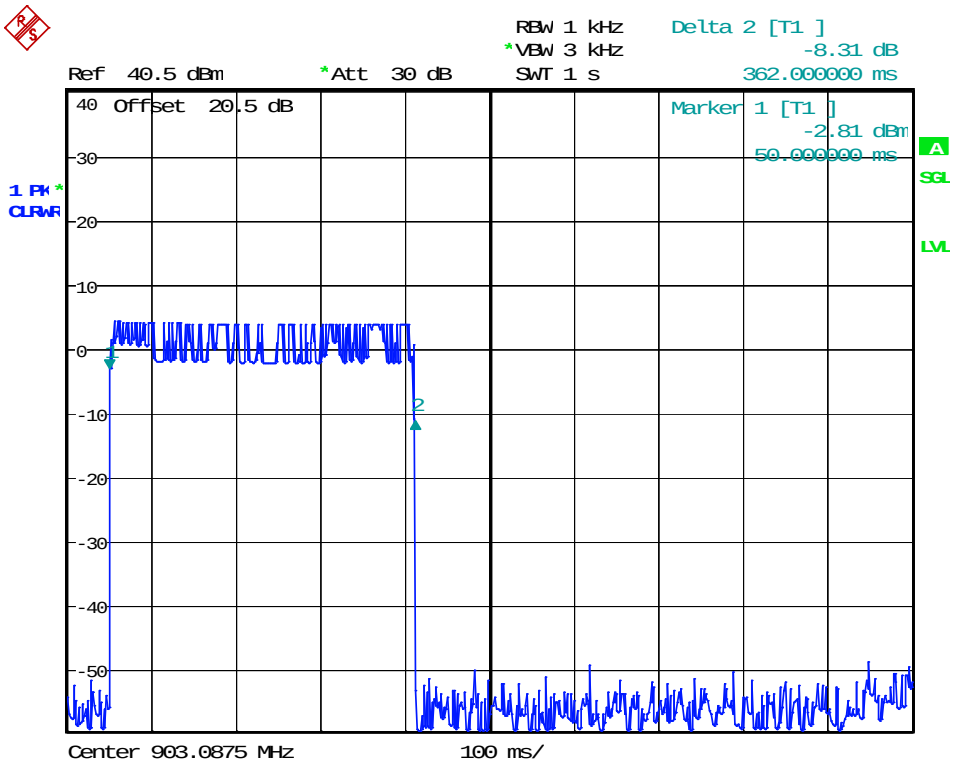


7.5.3 Measurement Procedure and Data

Test Data:

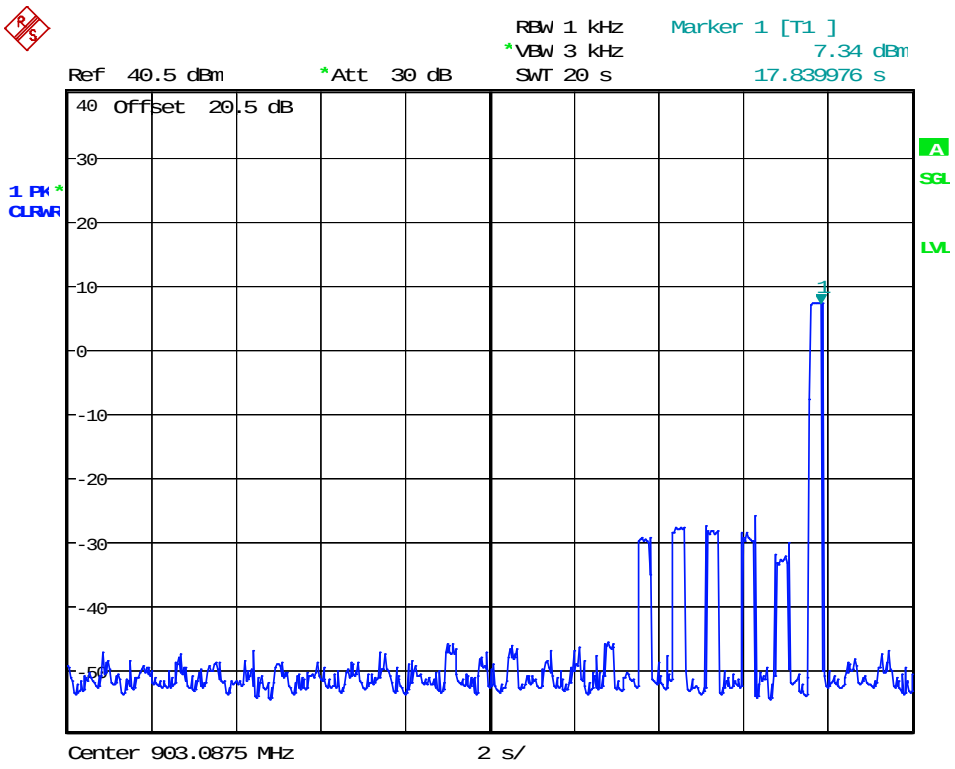
Test Frequency (MHz)	Emission Width (ms)	Number of Hopping Channel in 20s	Average Occupancy Time (s)	Limit (s)	Test Result
903.0875	362.00	1	0.362	0.4	Pass

Test plot as follows:



Date: 19.MAR.2020 16:45:58

Test plot as follows:



Date: 19.MAR.2020 17:08:52

7.6 Conducted Band Edges Measurement

Test Requirement	47 CFR Part 15, Subpart C 15.247(d)
Test Method:	ANSI C63.10 (2013) Section 7.8.6
Limit:	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)

7.6.1 E.U.T. Operation

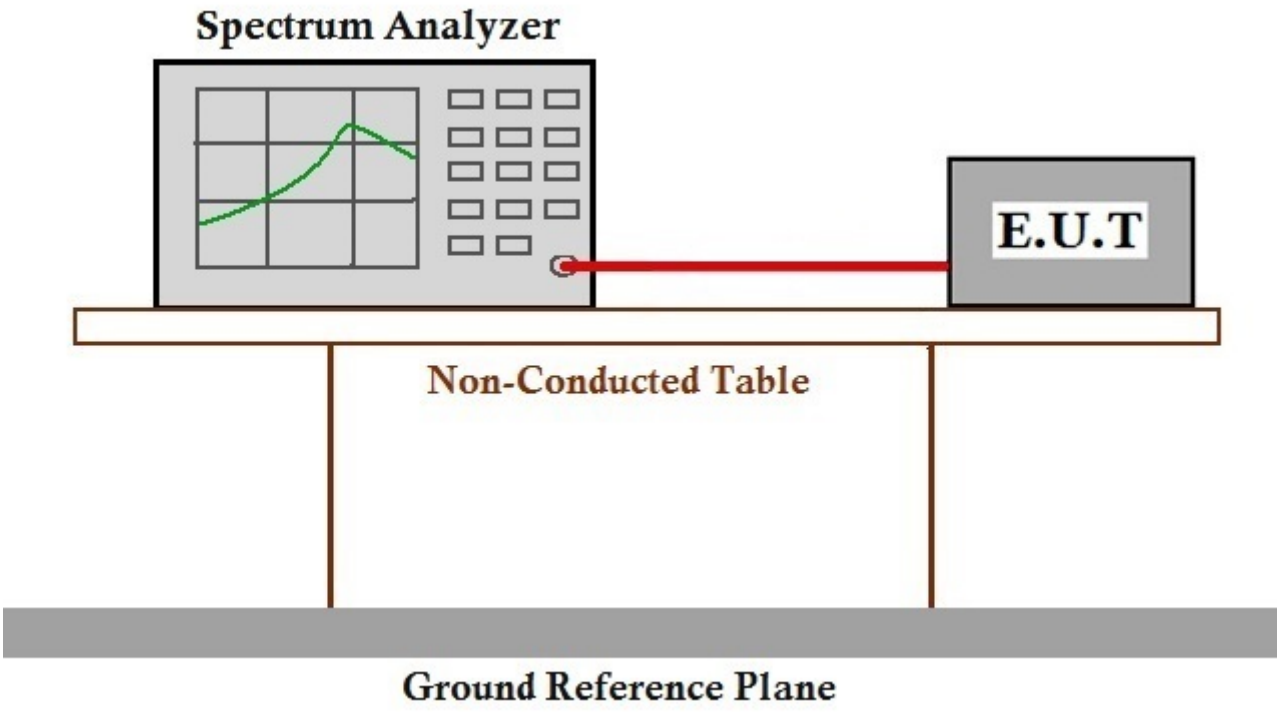
Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode: a:TX_Hop mode_Keep the EUT in frequency hopping mode.

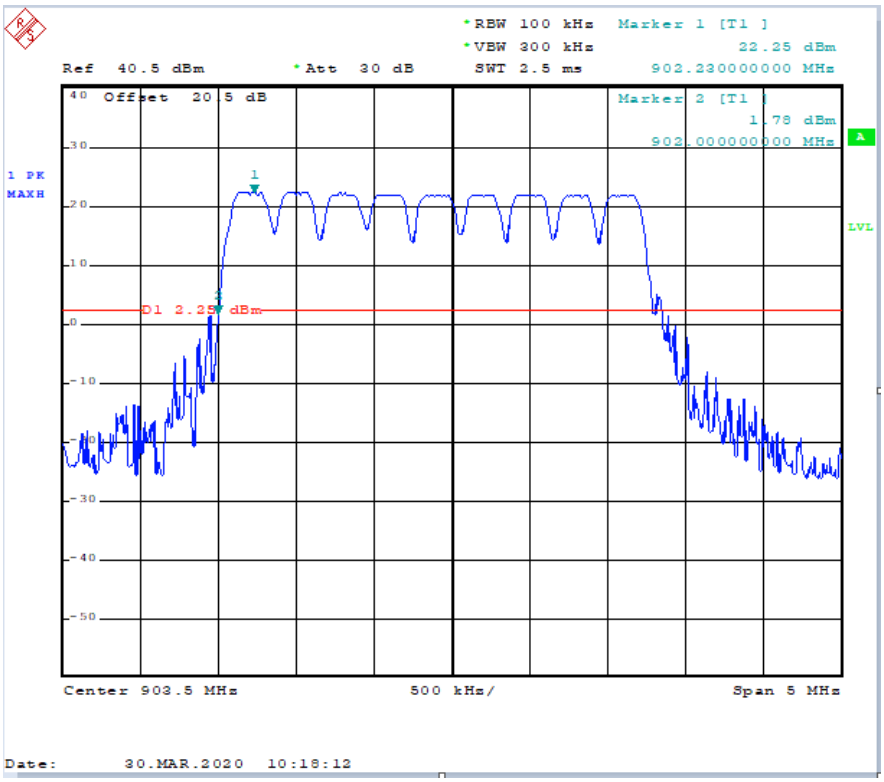
b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode.

7.6.2 Test Setup Diagram

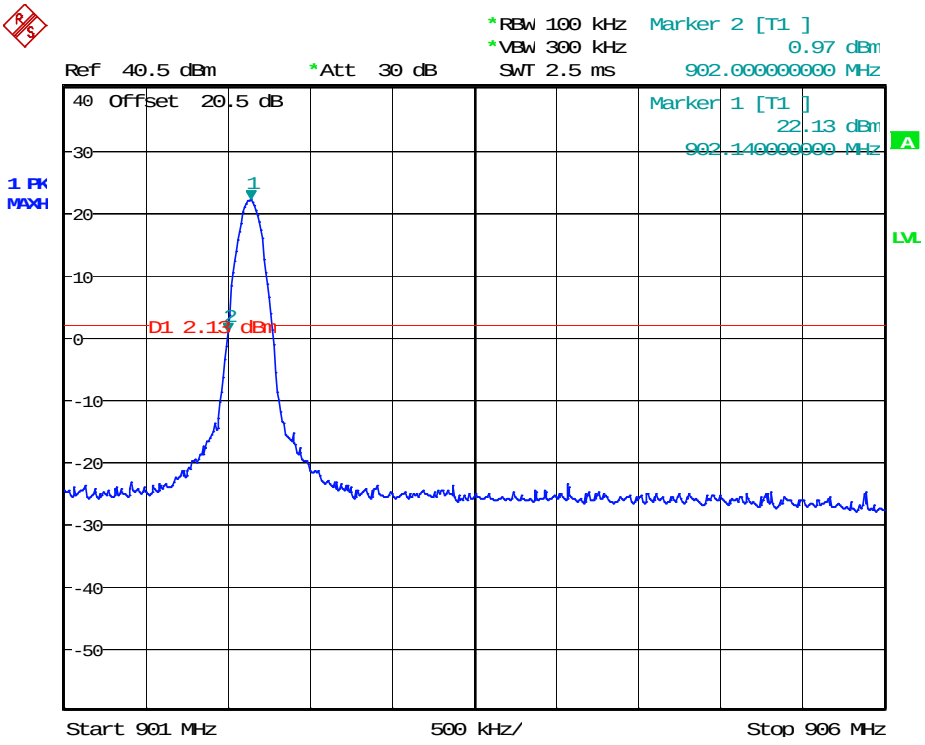


7.6.3 Measurement Procedure and Data

Test plot as follows: Hopping mode



Test plot as follows: non-Hoppping mode



Date: 30.MAR.2020 10:12:22

7.7 Conducted Spurious Emissions

Test Requirement	47 CFR Part 15, Subpart C 15.247(d)
Test Method:	ANSI C63.10 (2013) Section 7.8.8
Limit:	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)

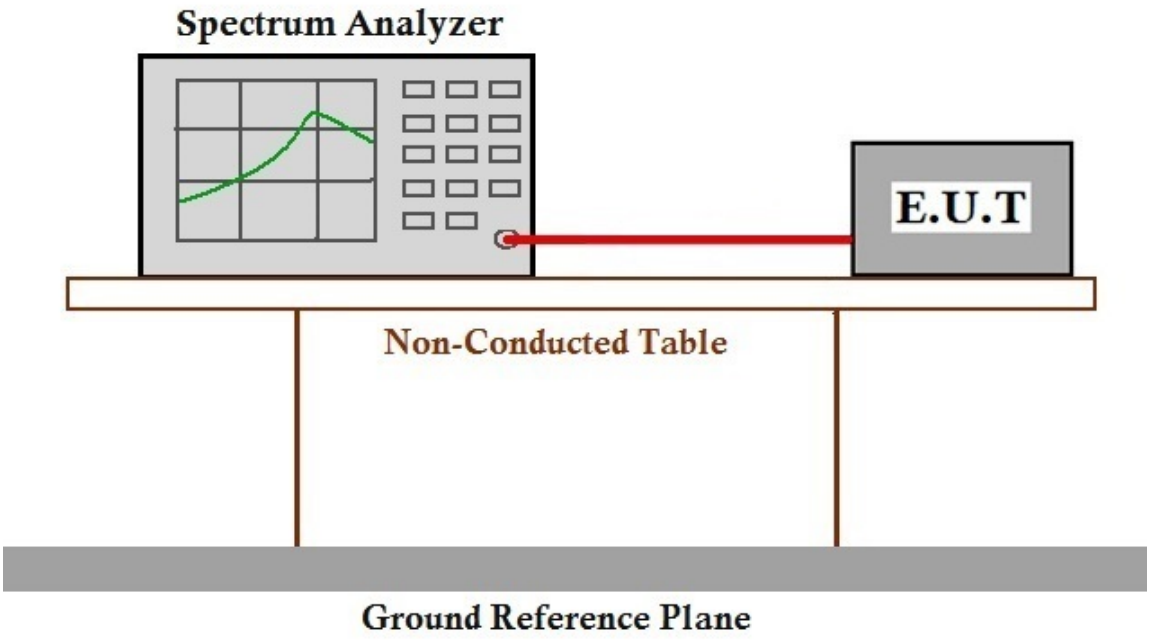
7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode.

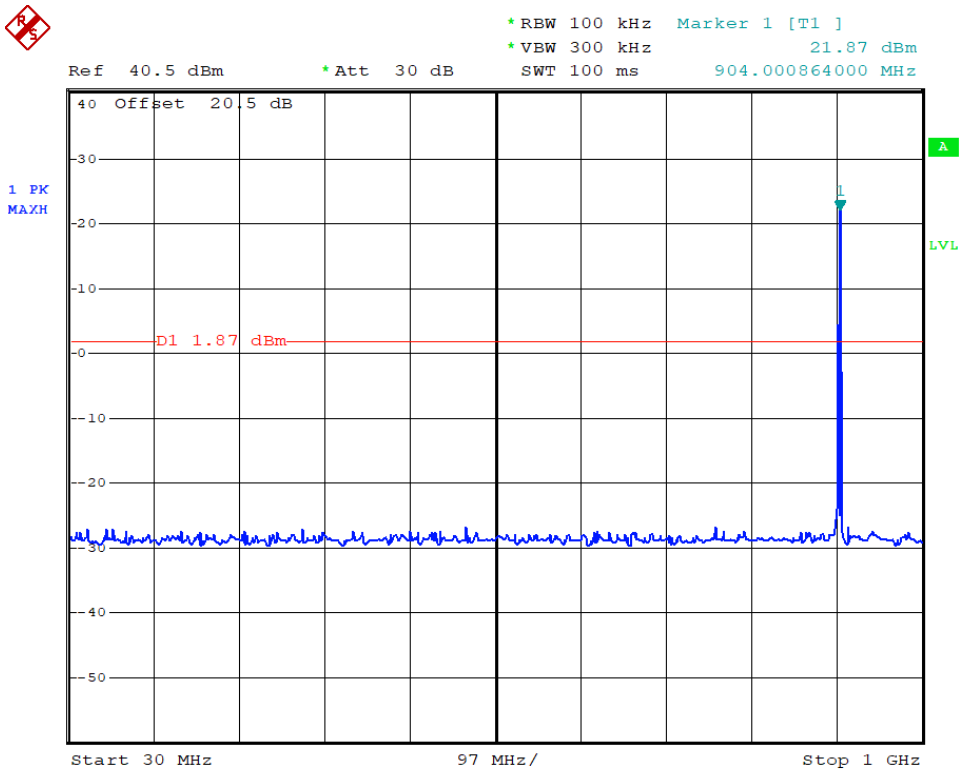
7.7.2 Test Setup Diagram



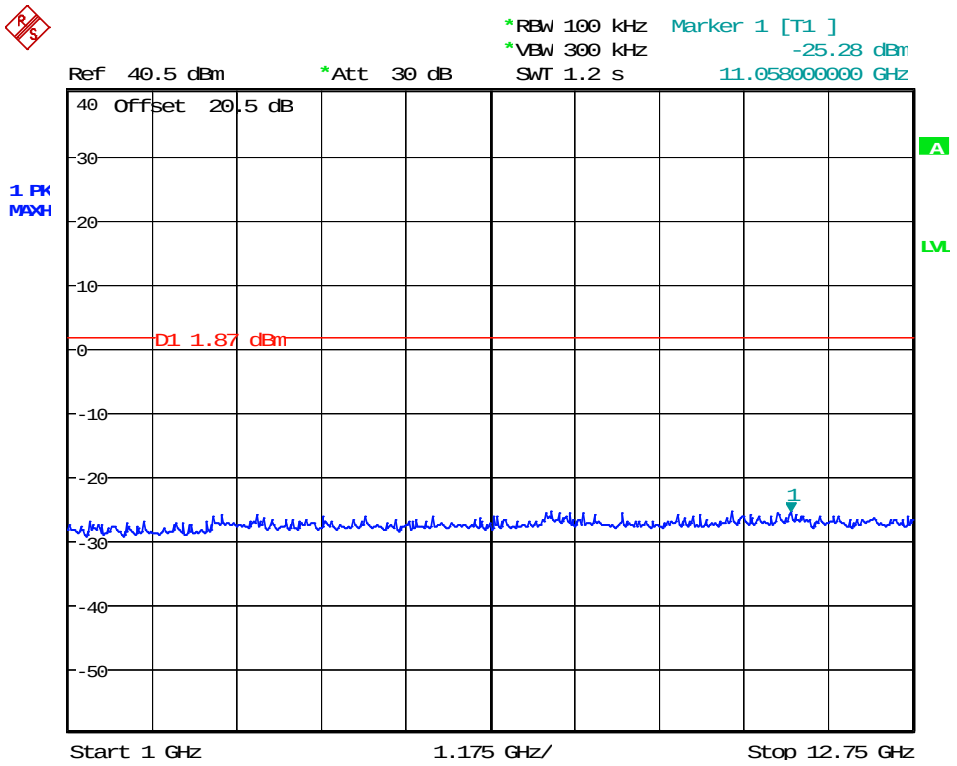
7.7.3 Measurement Procedure and Data

Test plot as follows:

Low Channel - 902.1375MHz

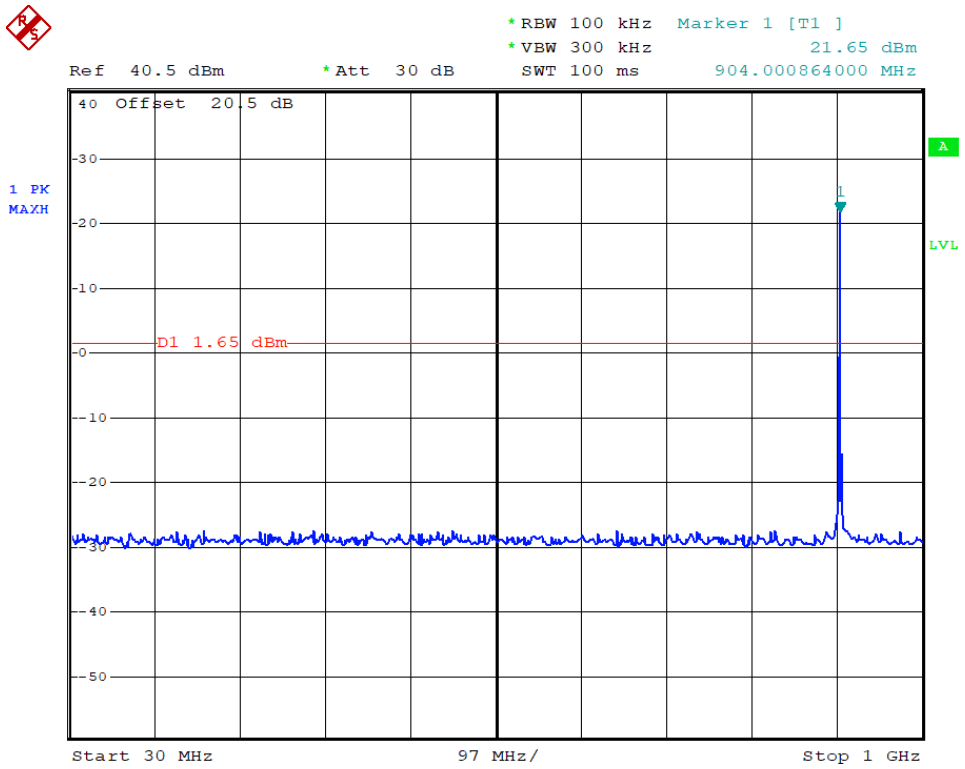


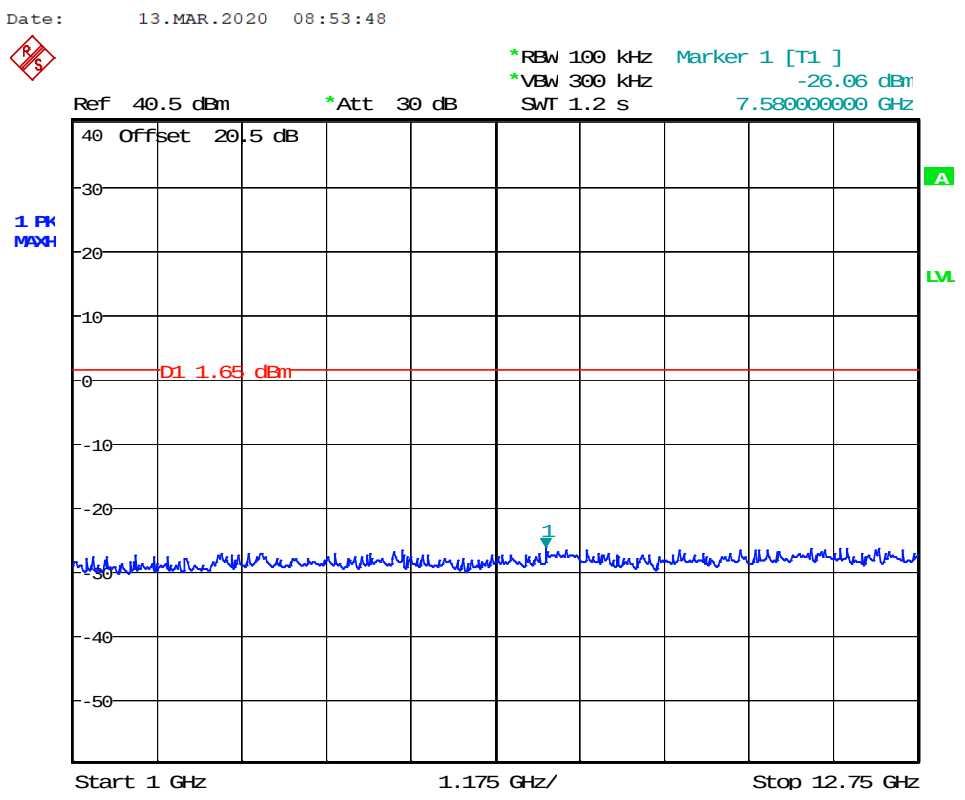
Date: 13.MAR.2020 08:46:55



Date: 13.MAR.2020 08:50:48

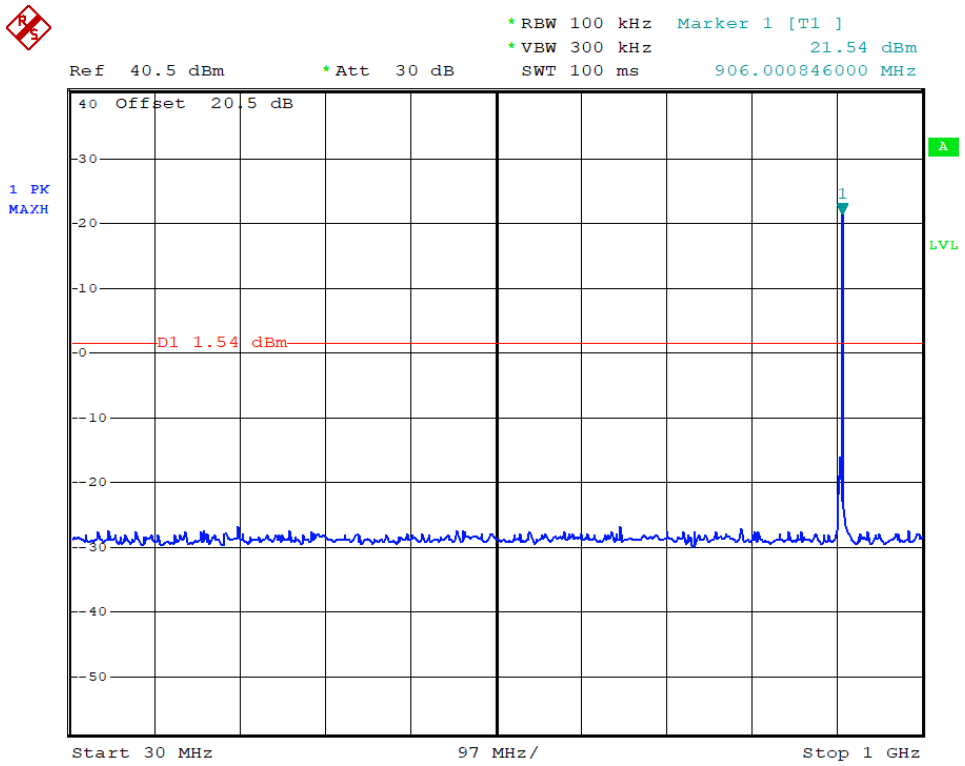
Middle Channel – 903.4125 MHz



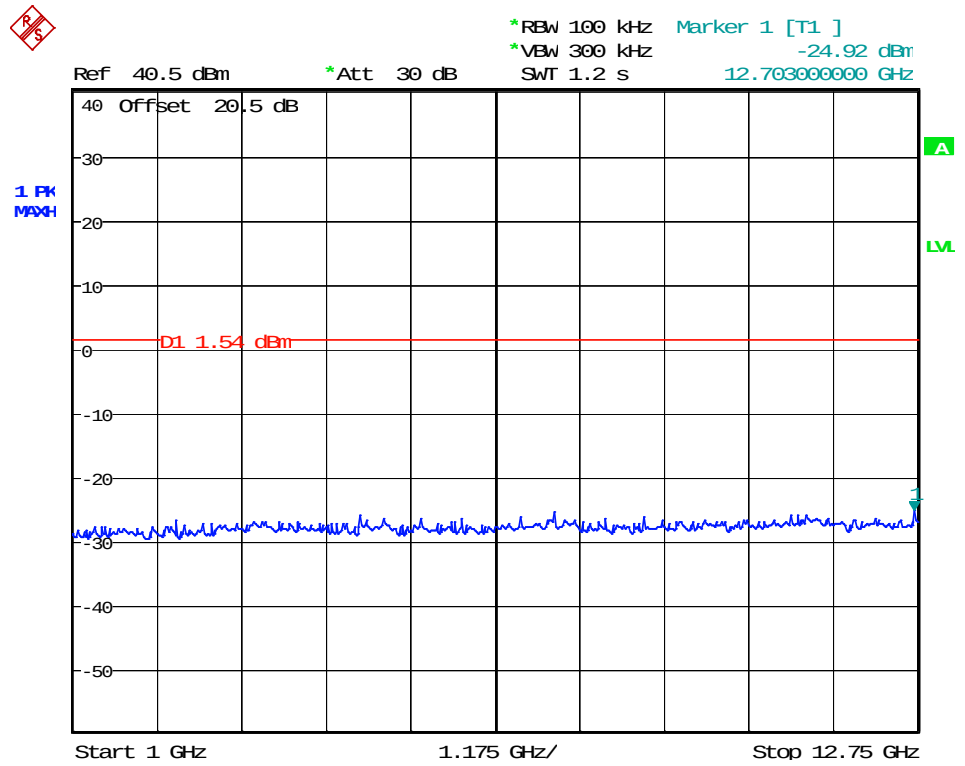


Date: 13.MAR.2020 08:54:59

High Channel - 904.6625MHz



Date: 13.MAR.2020 08:57:29



Date: 13.MAR.2020 08:59:29

7.8 Radiated Emissions which fall in the restricted bands

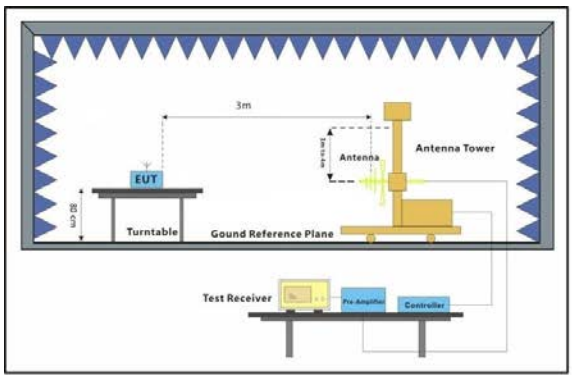
Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209
Test Method: ANSI C63.10 (2013) Section 6.10.5
Limit:

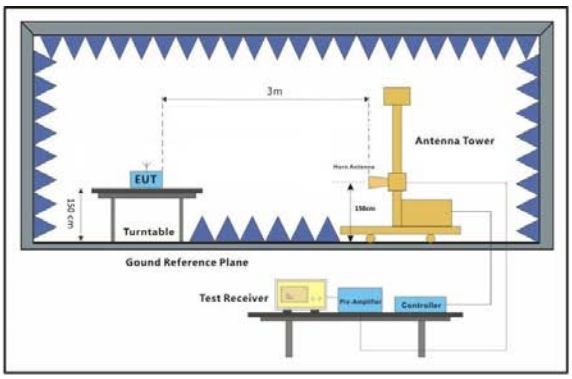
Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.		

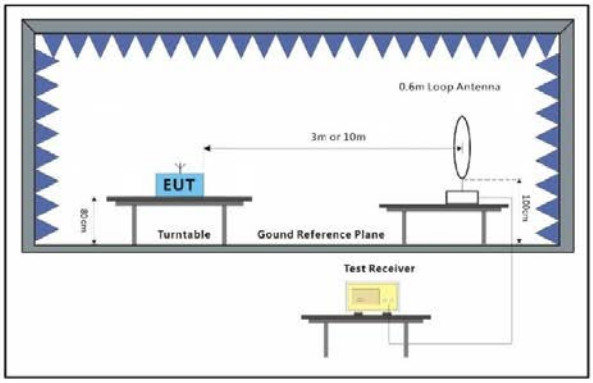
7.8.1 E.U.T. Operation

Operating Environment:
Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar
Test mode b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode.

7.8.2 Test Setup Diagram







7.8.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

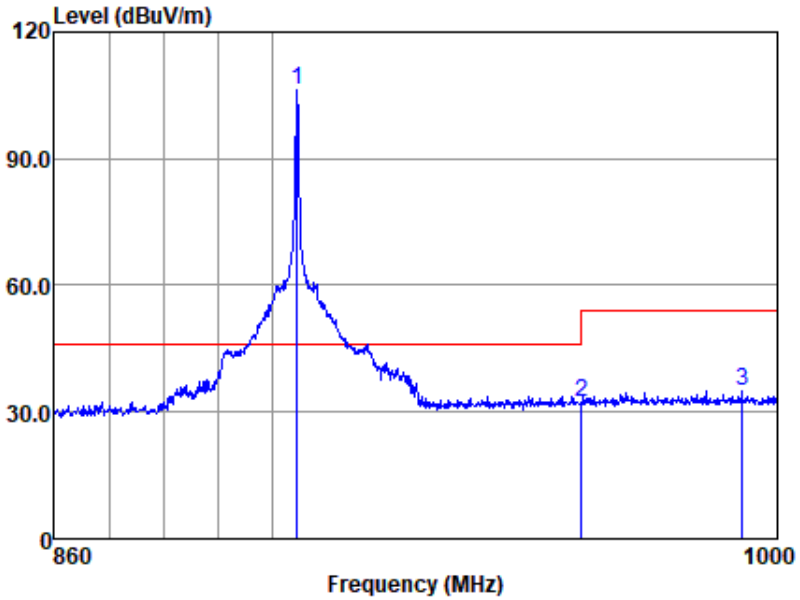
i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Mode:b; Polarization:Horizontal; Channel:High – 904.6625MHz

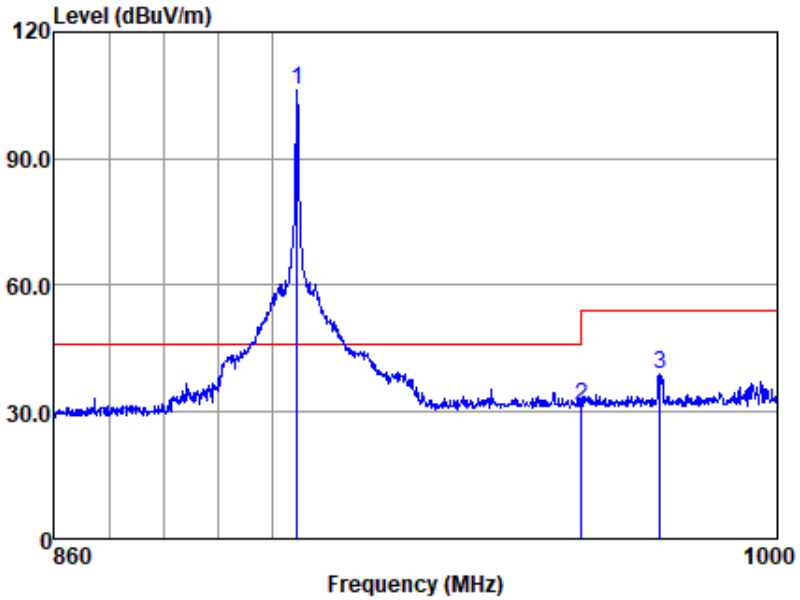


Antenna Polarity :HORIZONTAL
EUT/Project :0209CR
Test mode :904.6625

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	904.705	120.73	23.44	3.92	41.67	106.42	46.00	60.42	Peak
2	960.000	45.49	24.00	4.02	41.38	32.13	46.00	-13.87	QP
3	992.787	48.07	24.00	4.08	41.06	35.09	54.00	-18.91	QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical;Channel:High – 904.6625MHz



Antenna Polarity :VERTICAL
EUT/Project :0209CR
Test mode :904.6625

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	904.705	120.55	23.44	3.92	41.67	106.24	46.00	60.24	Peak
2	960.000	44.70	24.00	4.02	41.38	31.34	46.00	-14.66	QP
3	975.863	52.01	24.00	4.06	41.17	38.90	54.00	-15.10	QP

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

7.9 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3
Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.		

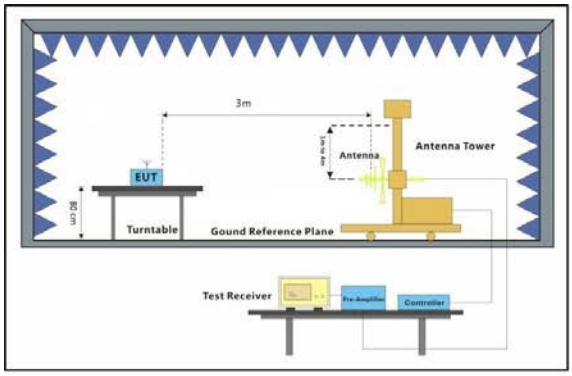
7.9.1 E.U.T. Operation

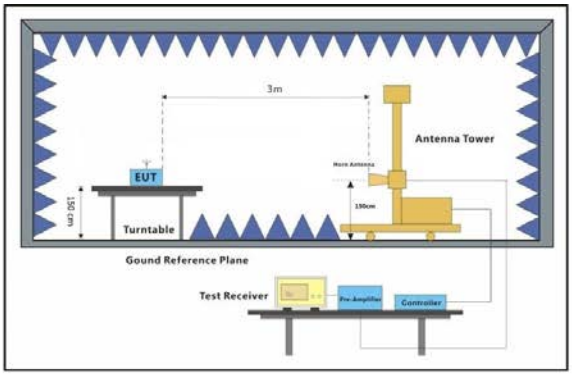
Operating Environment:

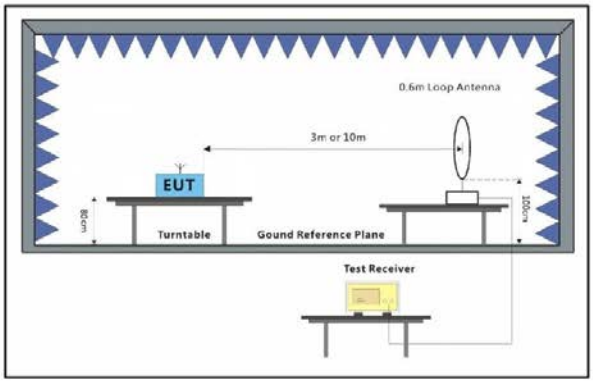
Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1002 mbar

Test mode b:TX_non-Hop mode_Keep the EUT in continuously transmitting mode.

7.9.2 Test Setup Diagram







7.9.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

h. Test the EUT in the lowest channel, the middle channel, the Highest channel.

i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

j. Repeat above procedures until all frequencies measured was complete.

Remark:

1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.

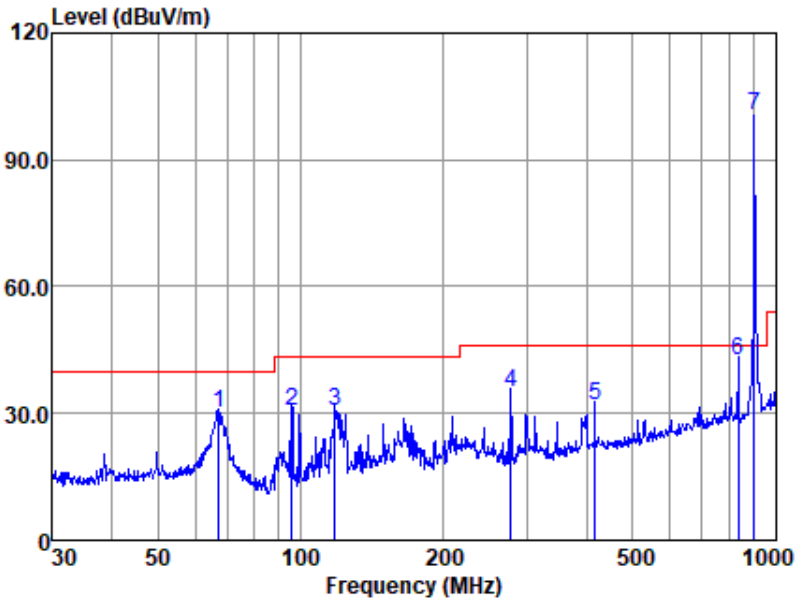
2) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown

Below 1GHz:
Mode:b; Polarization:Horizontal

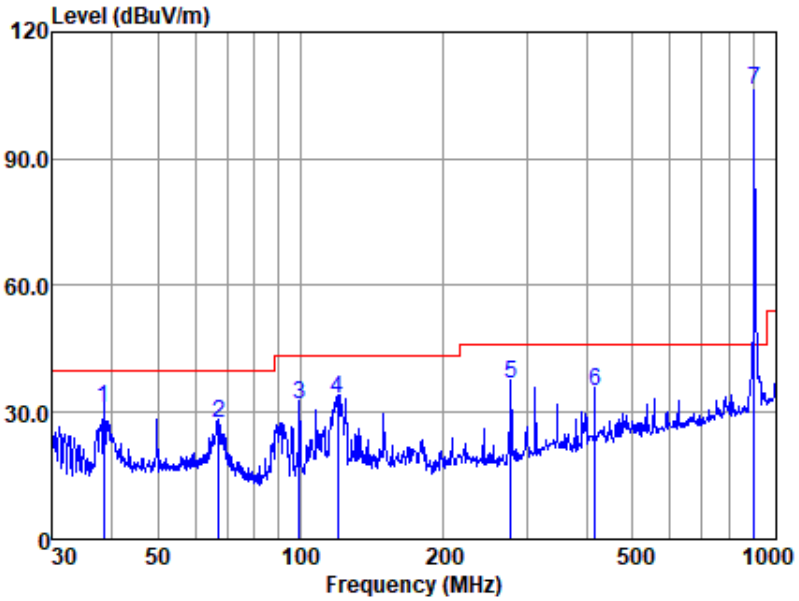


Antenna Polarity :HORIZONTAL
EUT/Project :0209CR
Test mode :a

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	67.202	59.14	12.08	1.16	42.28	30.10	40.00	-9.90	QP
2	95.762	63.11	8.30	1.29	42.31	30.39	43.50	-13.11	QP
3	118.186	60.71	10.85	1.48	42.28	30.76	43.50	-12.74	QP
4	277.094	61.87	12.75	2.31	42.11	34.82	46.00	-11.18	QP
5	416.179	54.82	16.02	2.70	41.86	31.68	46.00	-14.32	QP
6	836.244	57.93	22.52	3.77	41.83	42.39	46.00	-3.61	QP
7	903.309	114.99	23.44	3.92	41.67	100.68	46.00	54.68	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical

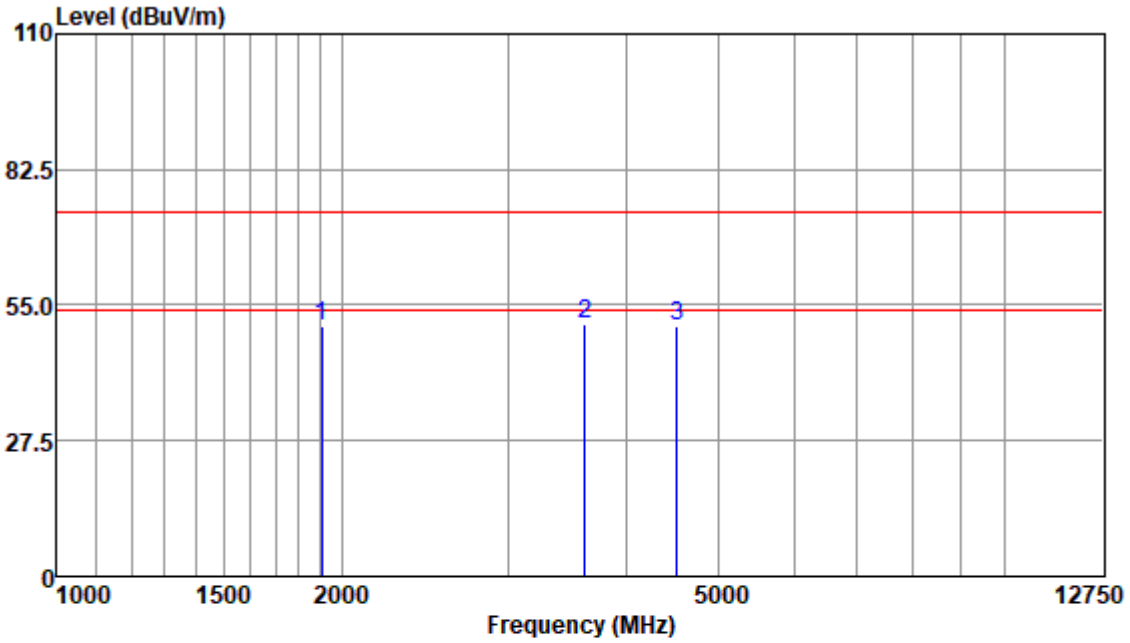


Antenna Polarity :VERTICAL
EUT/Project :0209CR
Test mode :a

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	38.481	59.57	12.97	0.94	42.34	31.14	40.00	-8.86	QP
2	67.202	56.45	12.08	1.16	42.28	27.41	40.00	-12.59	QP
3	99.528	64.19	8.67	1.31	42.32	31.85	43.50	-11.65	QP
4	119.436	63.06	10.96	1.48	42.28	33.22	43.50	-10.28	QP
5	277.094	63.78	12.75	2.31	42.11	36.73	46.00	-9.27	QP
6	416.179	57.92	16.02	2.70	41.86	34.78	46.00	-11.22	QP
7	903.309	120.37	23.44	3.92	41.67	106.06	46.00	60.06	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Above 1GHz
Mode:b; Polarization:Horizontal; Channel:Low - 902.1375MHz

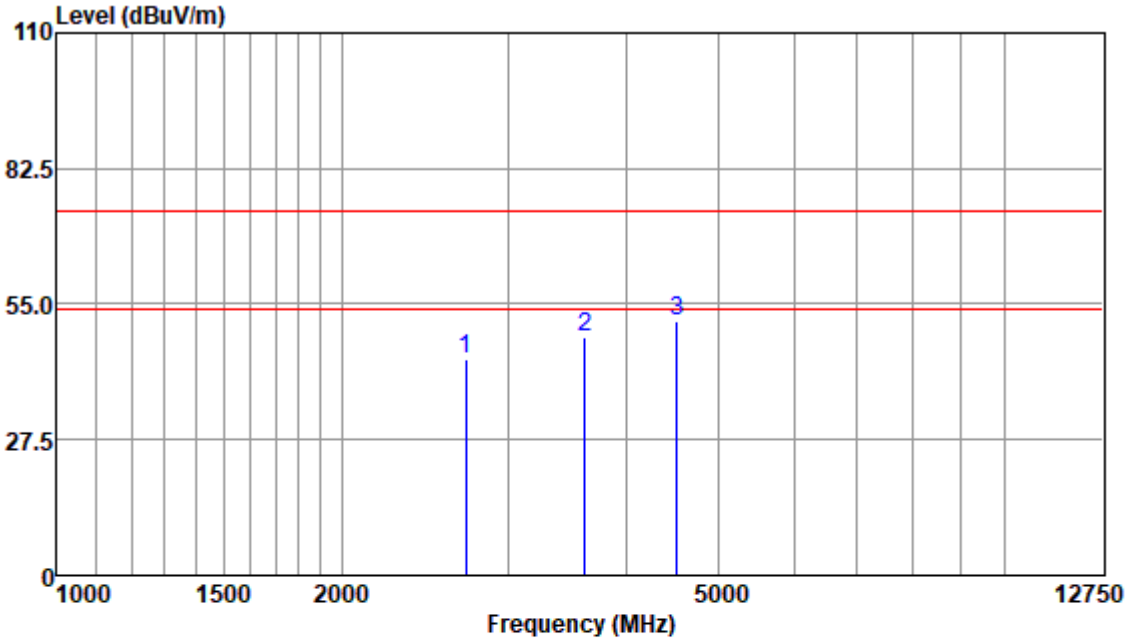


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
1904.12	60.04	25.03	2.73	37.15	50.65	74.00	-23.35	Peak
3607.26	56.36	29.00	4.04	38.36	51.04	74.00	-22.96	Peak
4512.97	54.52	30.04	4.64	38.42	50.78	74.00	-23.22	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Channel:Low - 902.1375MHz

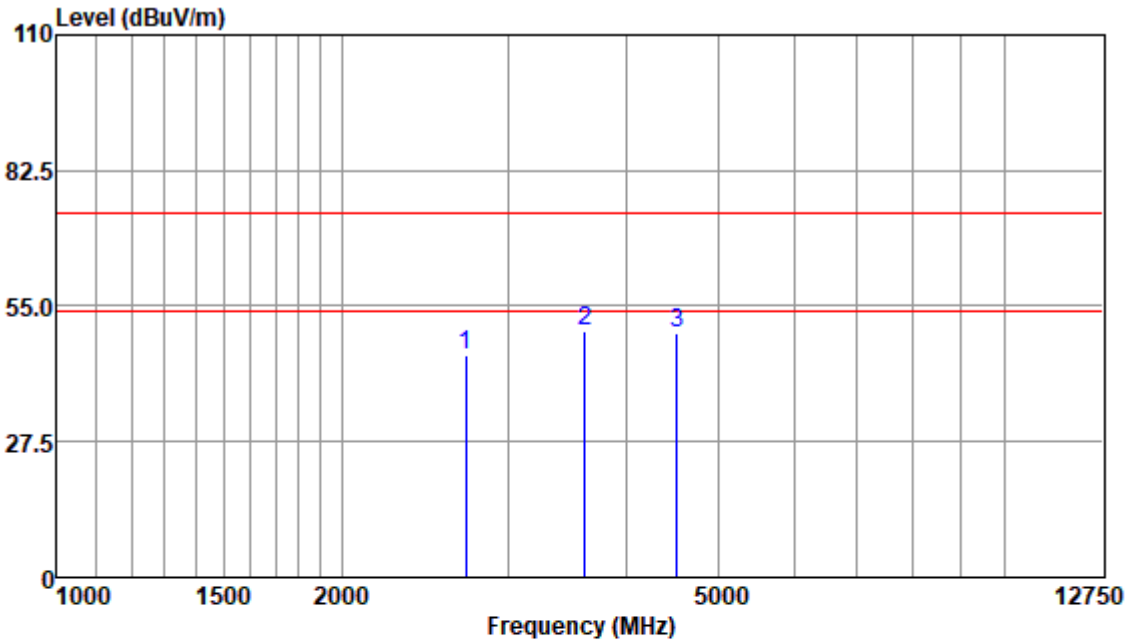


Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2705.54	51.61	26.80	3.34	37.72	44.03	74.00	-29.97	Peak
3607.26	53.70	29.00	4.04	38.36	48.38	74.00	-25.62	Peak
4512.97	55.11	30.04	4.64	38.42	51.37	74.00	-22.63	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Channel:middle – 903.4125MHz

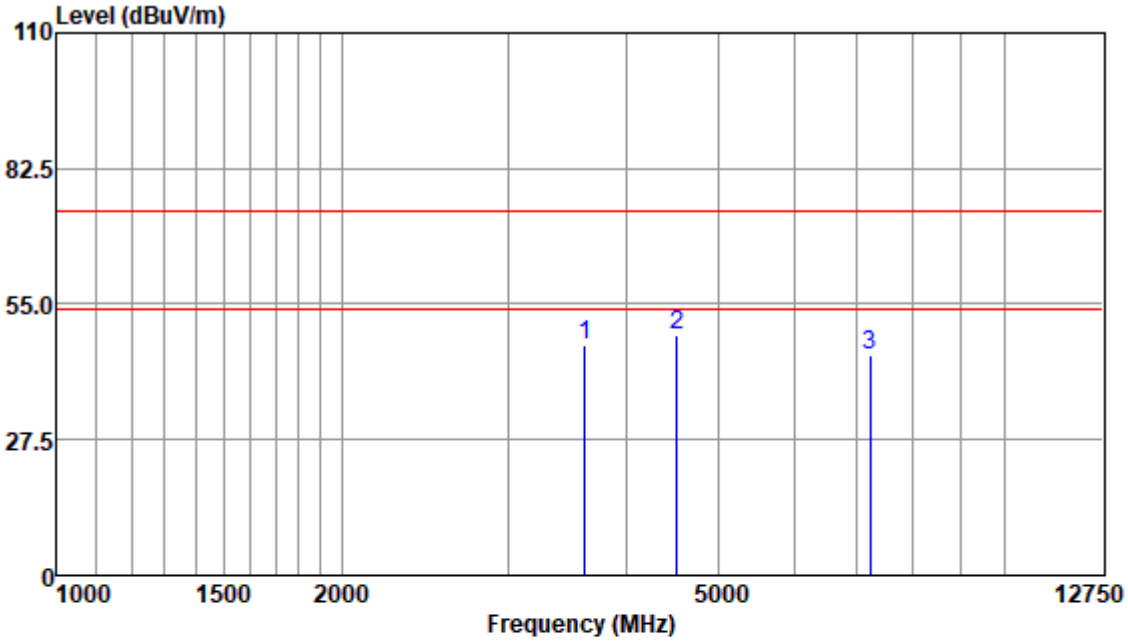


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
2705.54	52.51	26.80	3.34	37.72	44.93	74.00	-29.07	Peak
3607.26	55.34	29.00	4.04	38.36	50.02	74.00	-23.98	Peak
4512.97	53.27	30.04	4.64	38.42	49.53	74.00	-24.47	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Channel:middle – 903.4125MHz

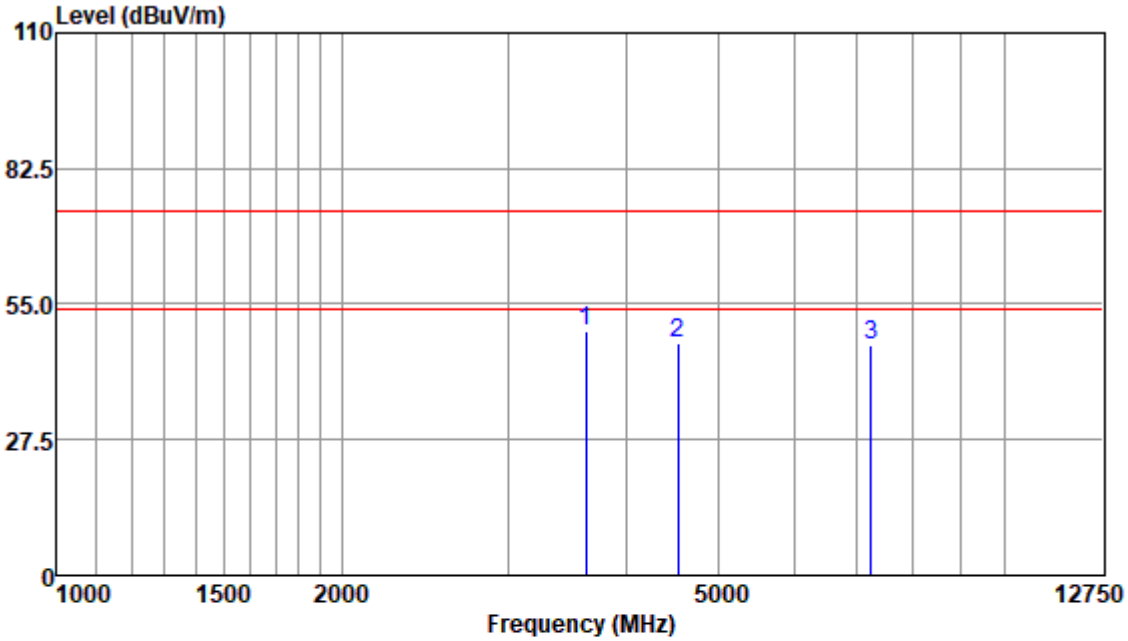


Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
3607.26	51.92	29.00	4.04	38.36	46.60	74.00	-27.40	Peak
4512.97	52.29	30.04	4.64	38.42	48.55	74.00	-25.45	Peak
7227.39	42.51	33.38	5.77	37.17	44.49	74.00	-29.51	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Horizontal; Channel:High – 904.6625MHz

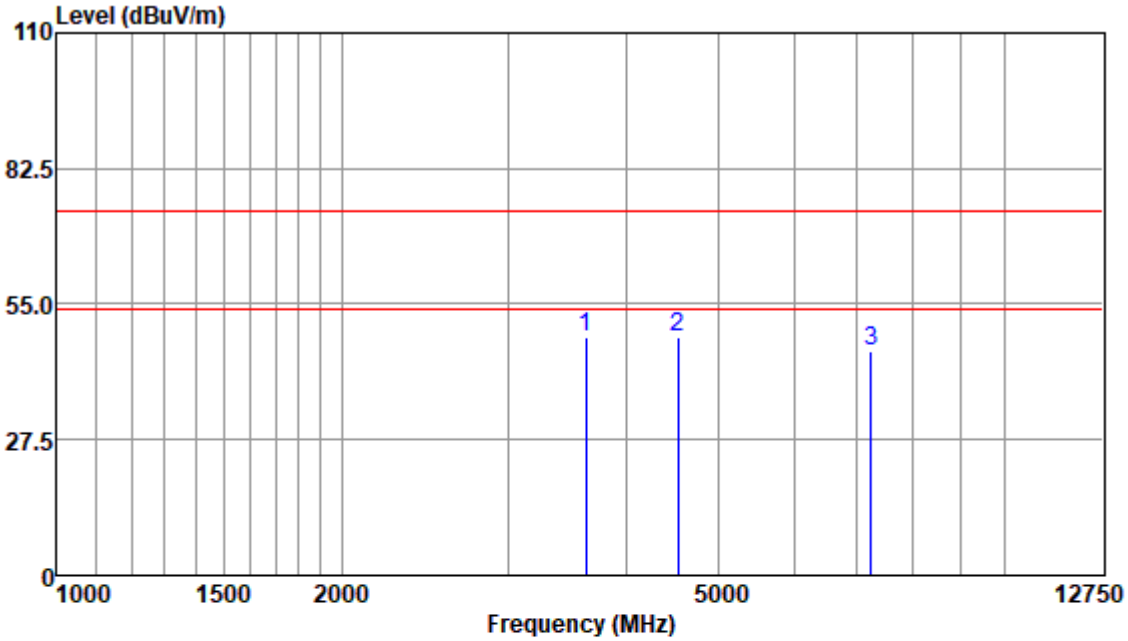


Antenna Polarity :HORIZONTAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
3616.45	54.60	29.03	4.06	38.35	49.34	74.00	-24.66	Peak
4524.47	50.45	30.08	4.88	38.42	46.99	74.00	-27.01	Peak
7245.81	44.53	33.40	5.78	37.16	46.55	74.00	-27.45	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

Mode:b; Polarization:Vertical; Channel:High – 904.6625MHz



Antenna Polarity :VERTICAL

Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Emission Level	Limit Line	Over Limit	Remark
MHz	dBuv	dB/m	dB	dB	dBuv/m	dBuv/m	dB	
3616.45	53.61	29.03	4.06	38.35	48.35	74.00	-25.65	Peak
4524.47	51.67	30.08	4.88	38.42	48.21	74.00	-25.79	Peak
7245.81	43.44	33.40	5.78	37.16	45.46	74.00	-28.54	Peak

Note:Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

8 Test Setup Photographs

Refer to the < Test Setup photos-FCC>.

9 EUT Constructional Details

Refer to the < External Photos > & < Internal Photos >.

- End of the Report -