

TEST REPORT



DT&C Co., Ltd.

42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2003-0060(1)

2. Customer

- Name : eWBM Co., Ltd.
- Address (FCC) : 1-405, 134-16, Jungni-cheon-ro, Icheon-si, Gyeonggi-do, South Korea
- Address (IC) : 1-405, 134-16, Jungni-cheon-ro, Icheon-si Gyeonggi-do 17373 Korea (Republic Of)

3. Use of Report : FCC & IC Original Grant

4. Product Name / Model Name : eLR100-UL-00 / eLR100-UL-00

FCC ID : 2ARG9-ELR100 / IC : 25891-ELR100

5. Test Method Used : KDB558074 D01v05r02, ANSI C63.10-2013



Test Specification : FCC Part 15.247

RSS-247 Issue 2 (2017-02), RSS-GEN Issue 5 (2019-03)

6. Date of Test : 2020.01.02 ~ 2020.03.05

7. Testing Environment : See appended test report.

8. Test Result : Refer to the attached test result.

Affirmation	Tested by	Reviewed by
	Name : JaeHyeok Bang 	Name : JaeJin Lee  (Signature)

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DT&C Co., Ltd.

2020 . 03 . 16 .

DT&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description	Revised by	Reviewed by
DRTFCC2003-0060	Mar.06, 2020	Initial issue	JaeHyeok Bang	JaeJin Lee
DRTFCC2003-0060(1)	Mar.16, 2020	Product Name Changed	JaeHyeok Bang	JaeJin Lee

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1. General Information

1.1 Testing Laboratory

DT&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014.		
- FCC/IC MRA Accredited Test Firm No. : KR0034		
- ISED# : 5740A		
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1.2 Testing Environment

Ambient Condition	
▪ Temperature	22 °C ~ 24 °C
▪ Relative Humidity	42 % ~ 45 %

1.3 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

Test items	Measurement uncertainty
Transmitter Output Power	0.9 dB (The confidence level is about 95 %, $k = 2$)
Conducted spurious emission	1.0 dB (The confidence level is about 95 %, $k = 2$)
AC conducted emission	2.4 dB (The confidence level is about 95 %, $k=2$)
Radiated spurious emission (1 GHz Below)	5.1 dB (The confidence level is about 95 %, $k = 2$)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.4 dB (The confidence level is about 95 %, $k = 2$)
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, $k = 2$)

1.4 Details of Applicant

Applicant : eWBM Co., Ltd.
Address(FCC) : 1-405, 134-16, Jungni-cheon-ro, Icheon-si, Gyeonggi-do, South Korea
Address(IC) : 1-405, 134-16, Jungni-cheon-ro, Icheon-si, Gyeonggi-do, 17373 Korea (Republic Of)
Contact person(FCC/IC) : Kyu Hyun Jung

1.5 Description of EUT

EUT	eLR100-UL-00
Model Name	eLR100-UL-00
Add Model Name	NA
Hardware Version	Ver 0.06
Software Version	Ver 1.0
Serial Number	Identical prototype
Power Supply	DC 3.3 V
Frequency Range	903.0 MHz ~ 914.2 MHz
Max. RF Output Power	14.80 dBm
Modulation Technique	LoRa
Antenna Specification	Antenna Type: DIPOLE ANTENNA Gain: 1.85 dBi (PK)

1.6 Declaration by the applicant / manufacturer

N/A

1.7 Test Equipment List

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	19/06/26	20/06/26	MY50410163
Spectrum Analyzer	Agilent Technologies	N9020A	19/12/16	20/12/16	MY48010133
DC Power Supply	Agilent Technologies	66332A	19/06/25	20/06/25	MY43001172
Multimeter	FLUKE	17B+	19/12/16	20/12/16	36390701WS
Signal Generator	Rohde Schwarz	SMBV100A	19/12/16	20/12/16	255571
Signal Generator	ANRITSU	MG3695C	19/12/16	20/12/16	173501
Thermohygrometer	BODYCOM	BJ5478	19/12/18	20/12/18	120612-1
Thermohygrometer	BODYCOM	BJ5478	19/12/18	20/12/18	120612-2
ANEROID BAROMETER	SATO	790 mmHg	19/05/27	20/05/27	891827
Loop Antenna	Schwarzbeck	FMZB1513	20/02/19	22/02/19	1513-128
BILOG ANTENNA	Schwarzbeck	VULB 9160	19/04/23	21/04/23	9160-3362
Horn Antenna	ETS-Lindgren	3117	18/05/10	20/05/10	00140394
PreAmplifier	tsj	8447D	19/12/16	20/12/16	2944A07774
PreAmplifier	tsj	8449B	19/06/27	20/06/27	3008A02108
Highpass Filter	Wainwright Instruments	WHKX12-935- 1000-15000-40SS	19/06/24	20/06/24	7
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2496A MA2411B	19/06/27	20/06/27	1338004 1306053
LISN	ROHDE&SCHWARZ	ENV216	19/12/06	20/12/06	101979
RECEIVER	ROHDE&SCHWARZ	ESR	19/12/17	20/12/17	101767
TRANSIENT LIMITER	EMCIS	TL-B0930A	19/08/30	20/08/30	11002
SINGLE-PHASE MASTER	NF	4420	19/09/17	20/09/17	3049354420023
Cable	DT&C	Cable	20/01/16	21/01/16	RF-56
Cable	DTNC	Cable	20/01/16	21/01/16	M-01
Cable	HUBER+SUHNER	SUCOFLEX 104	20/01/16	21/01/16	M-03
Cable	Junkosha	MWX315	20/01/16	21/01/16	M-05
Cable	Junkosha	MWX221	20/01/16	21/01/16	M-06

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.

Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

1.8 Summary of Test Results

FCC Part	RSS Std.	Parameter	Limit	Test Condition	Status Note 1
15.247(a)	RSS-247 [5.2]	6 dB Bandwidth	> 500 kHz	Conducted	C
15.247(b)	RSS-247 [5.4]	Transmitter Output Power	< 1 Watt		C
15.247(d)	RSS-247 [5.5]	Out of Band Emissions / Band Edge	20 dBc in any 100 kHz BW		C
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8 dBm/3 kHz		C
-	RSS-Gen [6.7]	Occupied Bandwidth (99 %)	NA		C
15.247(d) 15.205 15.209	RSS-247 [5.5] RSS-GEN [8.9] RSS-GEN [8.10]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	FCC 15.209 limits	Radiated	C
15.207	RSS-Gen [8.8]	AC Line Conducted Emissions	FCC 15.207 limits	AC Line Conducted	C
15.203	-	Antenna Requirements	FCC 15.203	-	C
<p>Note 1: C=Comply NC=Not Comply NT=Not Tested NA=Not Applicable</p> <p>Note 2: For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.</p>					

2. Test Methodology

The measurement procedures described in the ANSI C63.10-2013 and the guidance provided in KDB558074 D01v05r02 were used in measurement of the EUT.

The EUT was tested per the guidance of KDB558074 D01v05r02. And ANSI C63.10-2013 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing.

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The EUT was operated in the test mode to fix the TX frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

2.3 General Test Procedures

Conducted Emissions

The power-line conducted emission test procedure is not described on the KDB558074 D01v05r02.

So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10-2013.

The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

Basically the radiated tests were performed with KDB558074 D01v05r02. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10-2013 as stated on section 12.1 of the KDB558074 D01v05r02.

The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

2.4 Description of Test Modes

The EUT has been tested with the operating condition for maximizing the emission characteristics. A test program is used to control the EUT for staying in continuous transmitting. The Bluetooth low energy mode with below low, middle and high channels were tested and reported.

Test Mode	Description	Frequency [MHz]		
		Lowest Frequency	Middle Frequency	Highest Frequency
TM1	LoRa(BW:500 kHz)	903	907.8	914.2

Operation test setup for EUT

- Test Software Version: Tera Term Version 4.87(SVN#5897)
- Power setting: 14

2.5 Instrument Calibration

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

3. Test Result

3.1 Maximum Peak Conducted Output Power

■ Test Requirements and limit, §15.247(b) & RSS-247 [5.4]

A transmitter antenna terminal of EUT is connected to the input of a spectrum analyzer.

Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

3.1.1 Test Setup

Refer to the APPENDIX I.

3.1.2 Test Procedures

Maximum Peak Conducted Output Power is measured using Measurement Procedure Option 1 of **KDB558074 D01v05r02 - Section 8.3.1.3**

1. Set the RBW \geq DTS bandwidth. **Actual RBW = 2 MHz**
2. Set VBW $\geq 3 \times$ RBW. **Actual VBW = 6 MHz**
3. Set span $\geq 3 \times$ RBW.
4. Sweep time = **auto couple**
5. Detector = **peak**
6. Trace mode = **max hold**
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level.

3.1.3 Test Results

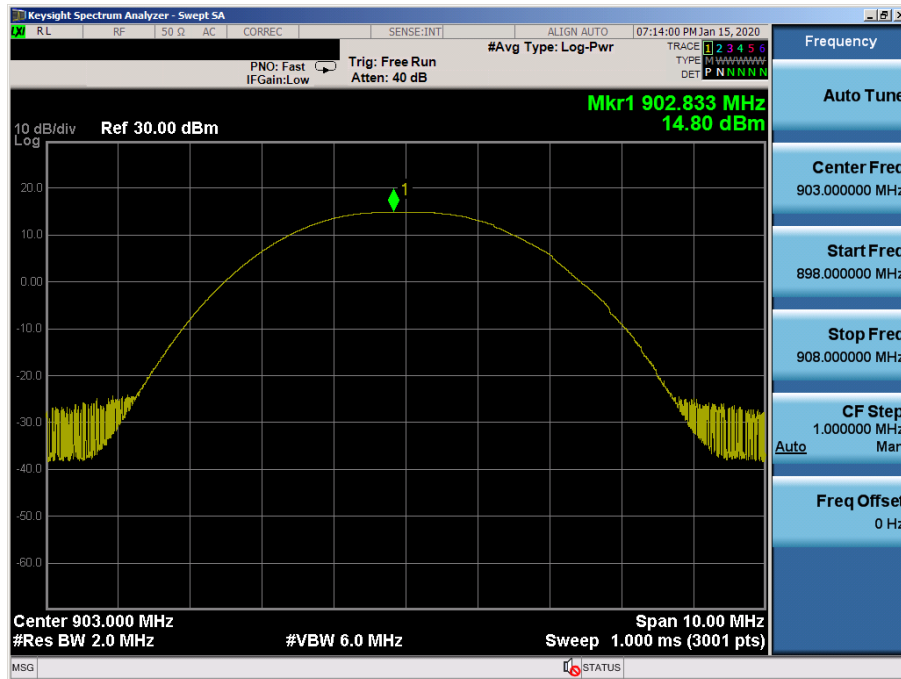
Test mode	Tested Channel	Burst Average Output Power	Peak Output Power
		dBm	dBm
TM 1	Lowest	14.07	14.80
	Middle	14.05	14.79
	Highest	14.02	14.75

Note 1 : The Burst average output power was tested using an average power meter for reference only.

Note 2 : See next pages for actual measured spectrum plots.

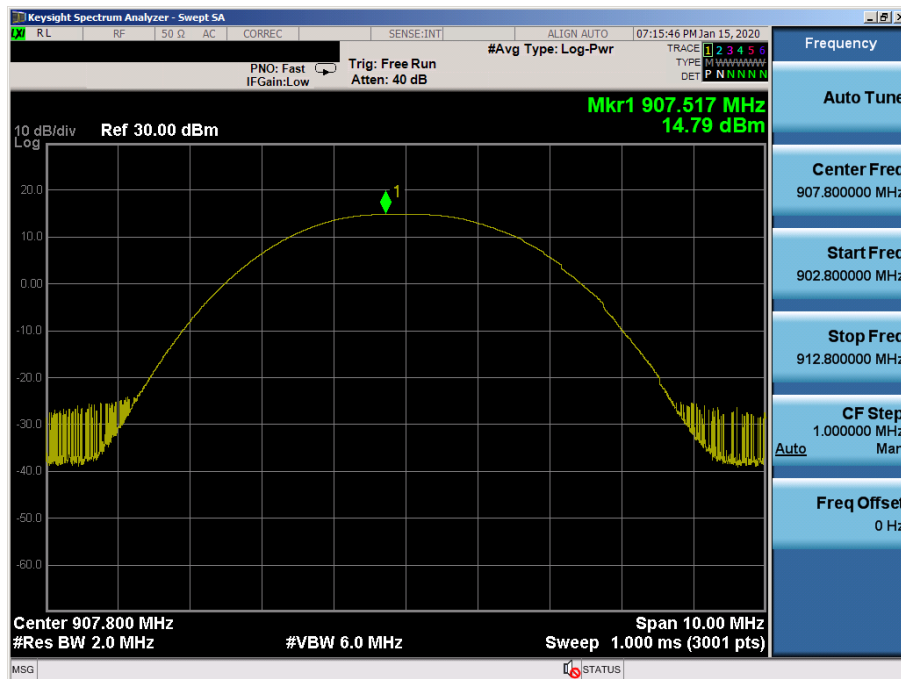
Peak Output Power

TM1 Test Channel : Lowest



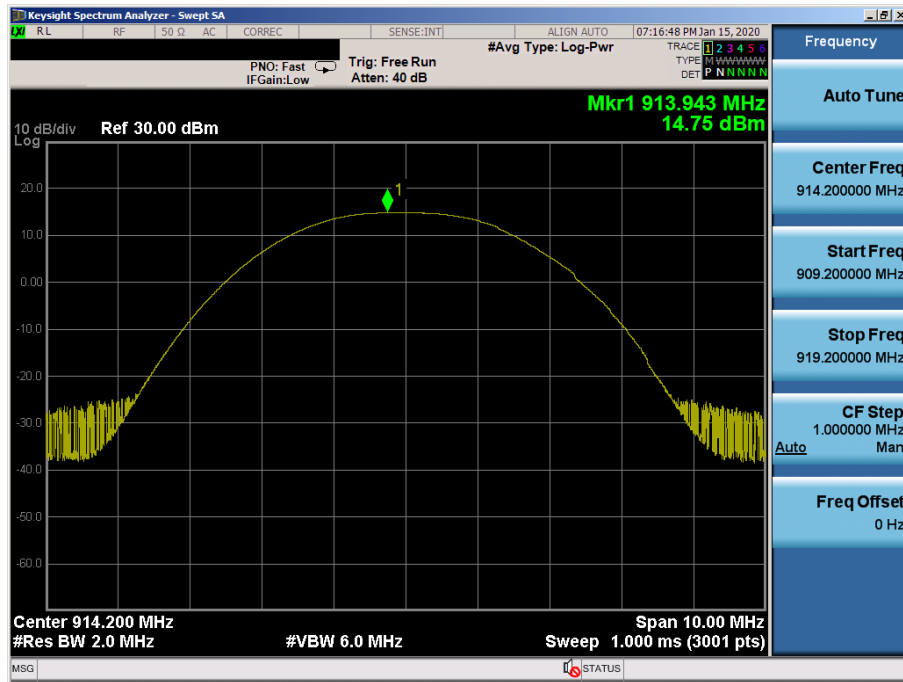
Peak Output Power

TM1 Test Channel : Middle



Peak Output Power

TM1 Test Channel : Highest



3.2 6 dB Bandwidth Measurement

■ Test Requirements and limit, §15.247(a) & RSS-247 [5.2]

The bandwidth at 6 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the EUT's antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6 dB bandwidth is 500 kHz.

3.2.1 Test Setup

Refer to the APPENDIX I.

3.2.2 Test Procedures

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB558074 D01v05r02 - Section 8.2**

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.

(RBW : 100 kHz / VBW : 300 kHz)

3. Detector = **peak**.
4. Trace mode = **max hold**.
5. Sweep = **auto couple**.
6. Allow the trace to stabilize.
7. Option 1 - Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

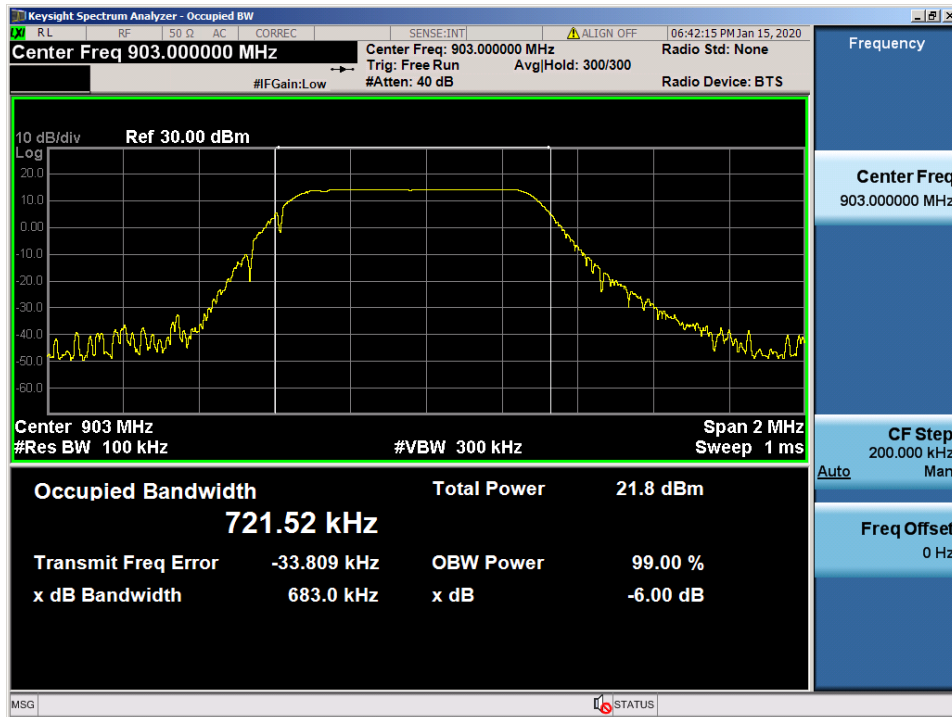
Option 2 - The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW $\geq 3 \times$ RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

3.2.3 Test Results

Test Mode	Tested Channel	Test Results [MHz]
TM 1	Lowest	0.683
	Middle	0.694
	Highest	0.684

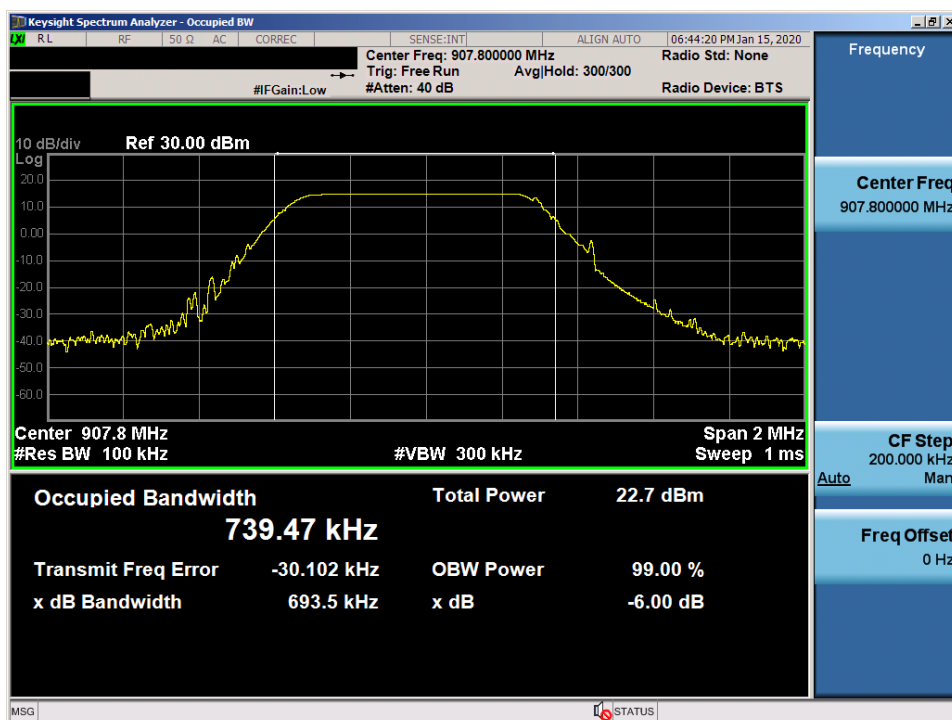
6 dB Bandwidth

TM1 Test Channel : Lowest



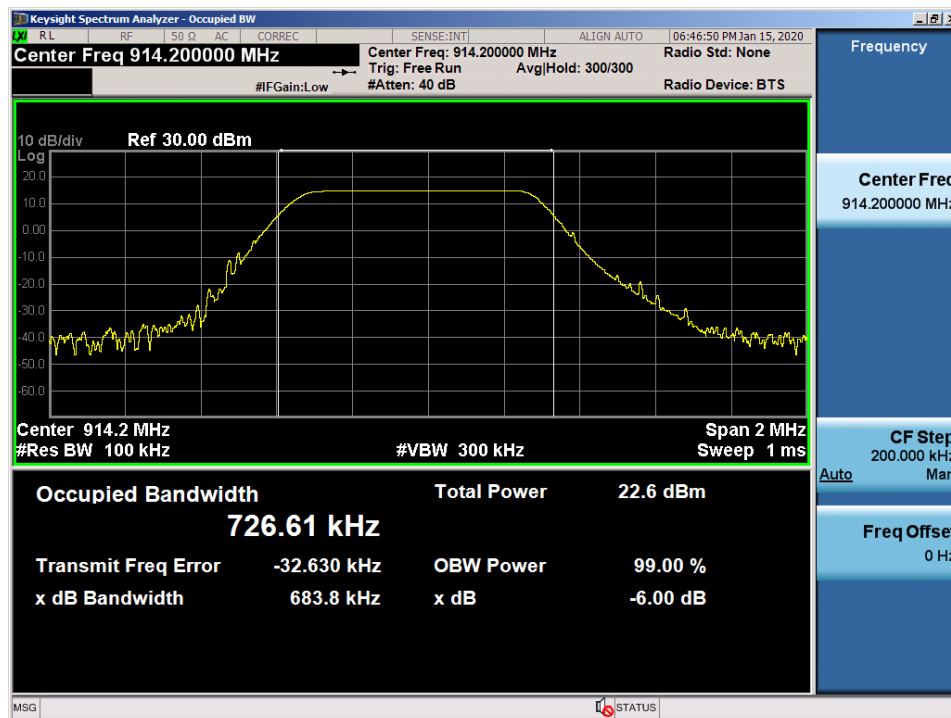
6 dB Bandwidth

TM1 Test Channel : Middle



6 dB Bandwidth

TM1 Test Channel : Highest



3.3 Maximum Power Spectral Density.

■ Test requirements and limit, §15.247(e) & RSS-247 [5.2]

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard

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

3.3.1 Test Setup

Refer to the APPENDIX I.

3.3.2 Test Procedures

- Method PKPSD of KDB558074 D01v05r02 - Section 8.4

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to **1.5 times** the DTS bandwidth.
3. Set the RBW : **3 kHz ≤ RBW ≤ 100 kHz**.
4. Set the VBW ≥ **3 x RBW**.
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.

3.3.3 Test Results

Test Mode	Tested Channel	PKPSD [dBm]
TM 1	Lowest	5.36
	Middle	5.40
	Highest	4.89

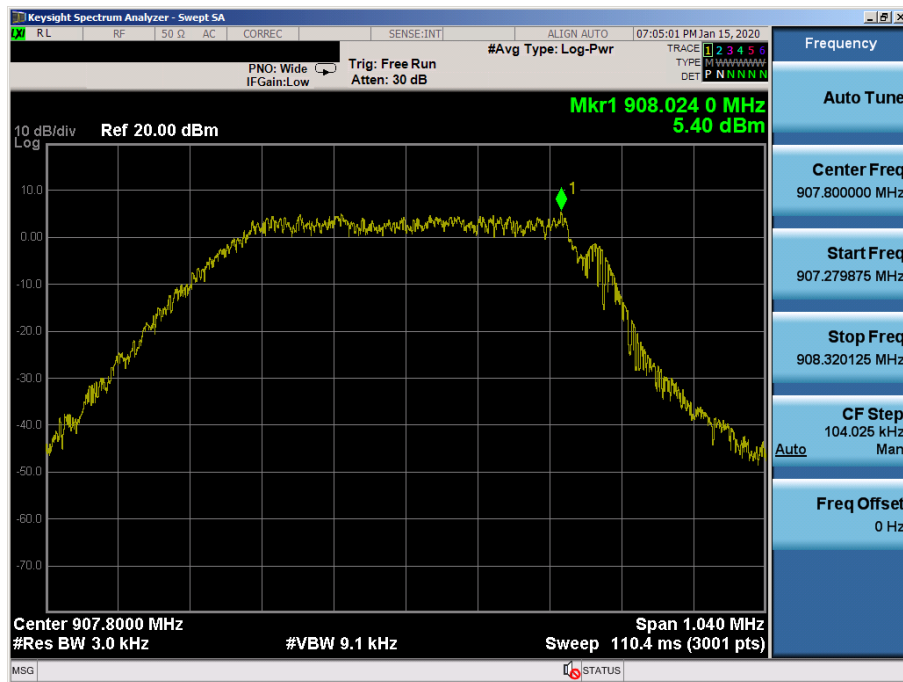
Maximum PKPSD

TM1 Test Channel : Lowest



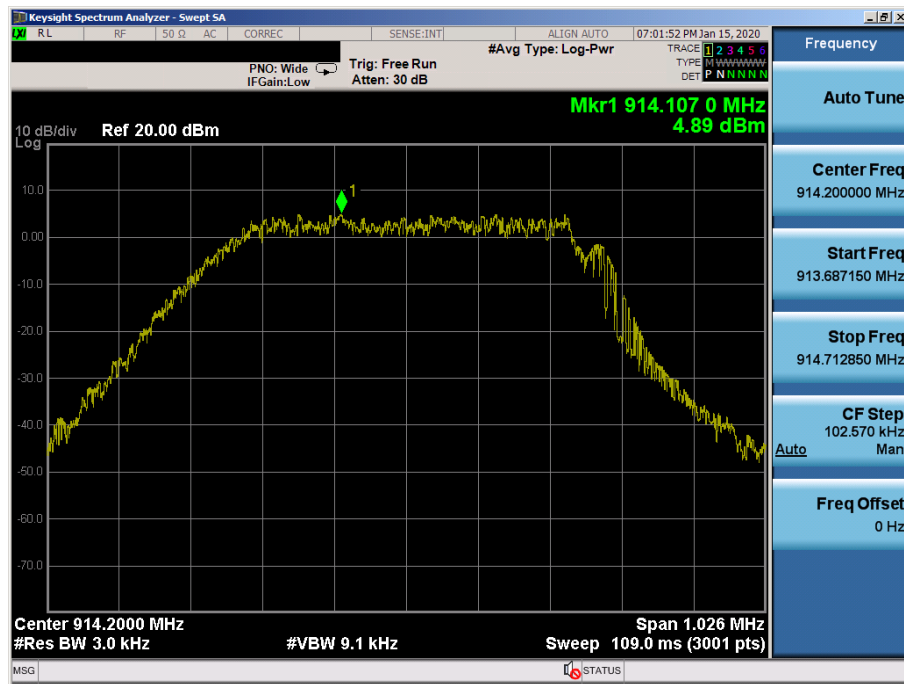
Maximum PKPSD

TM1 Test Channel : Middle



Maximum PKPSD

TM1 Test Channel : Highest



3.4 Unwanted Emissions (Conducted)

■ Test requirements and limit, §15.247(d) & RSS-247 [5.5]

§15.247(d) specifies that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions :

If **the peak output power procedure** is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated **by at least 20 dB** relative to the maximum measured in-band peak PSD level.

If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured inband average PSD level.

In either case, attenuation to levels below the general emission limits specified in **§15.209(a)** is not required.

3.4.1 Test Setup

Refer to the APPENDIX I including path loss

3.4.2 Test Procedures

- KDB558074 D01v05r02 - Section 8.5

Reference level measurement

1. Set instrument center frequency to DTS channel center frequency.
2. Set the span to ≥ 1.5 times the DTS bandwidth.
3. Set the RBW = 100 kHz.
4. Set the VBW $\geq 3 \times$ RBW.
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 PSD level

LIMIT LINE = 20 dB below of the reference level.

Emission level measurement

1. Set the center frequency and span to encompass frequency range to be measured.
2. Set the RBW = **100 kHz.(Actual 1 MHz , See below note)**
3. Set the VBW $\geq 3 \times$ RBW.(Actual 3 MHz, See below note)
4. Detector = **peak**.
5. Ensure that the number of measurement points \geq span / RBW
6. Sweep time = **auto couple**.
7. Trace mode = **max hold**.
8. **Allow the trace to stabilize** (this may take some time, depending on the extent of the span).
9. Use the peak marker function to determine the maximum amplitude level.

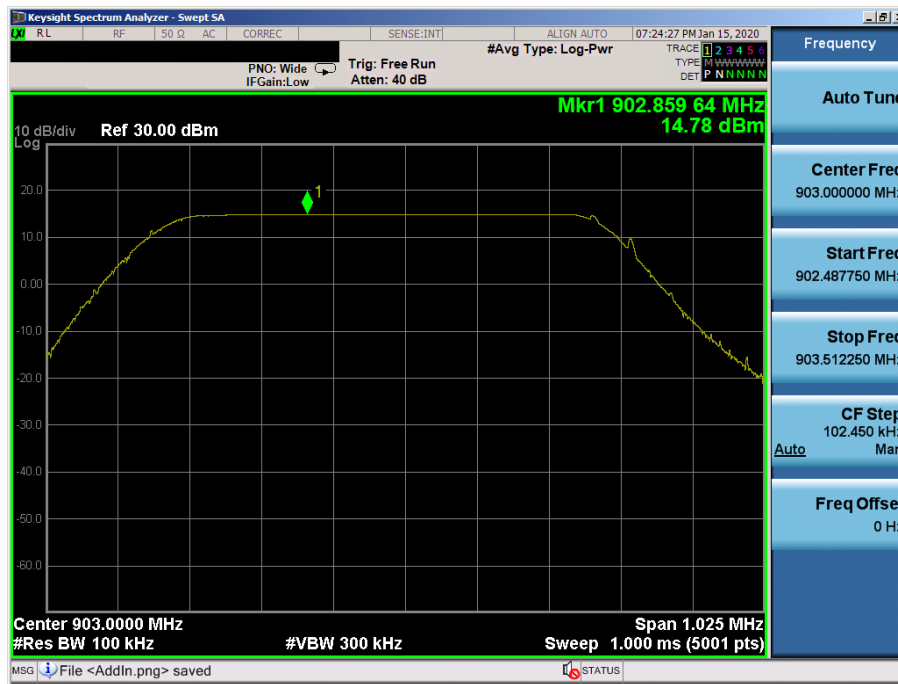
Note : The conducted spurious emission was tested with below settings.

Frequency range	RBW	VBW	Detector	Trace	Sweep Point
9 kHz ~ 30 MHz	100 kHz	300 kHz	Peak	Max Hold	40001
30 MHz ~ 10 GHz	1 MHz	3 MHz			
10 GHz ~ 25 GHz	1 MHz	3 MHz			

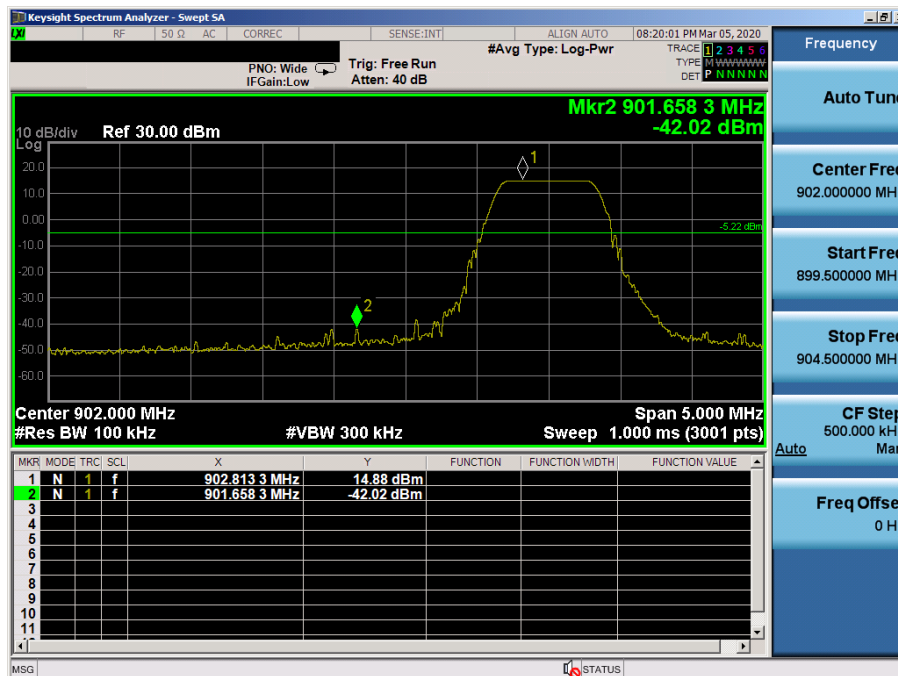
If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2001 to get accurate emission level within 100 kHz BW.

3.4.3 Test Results

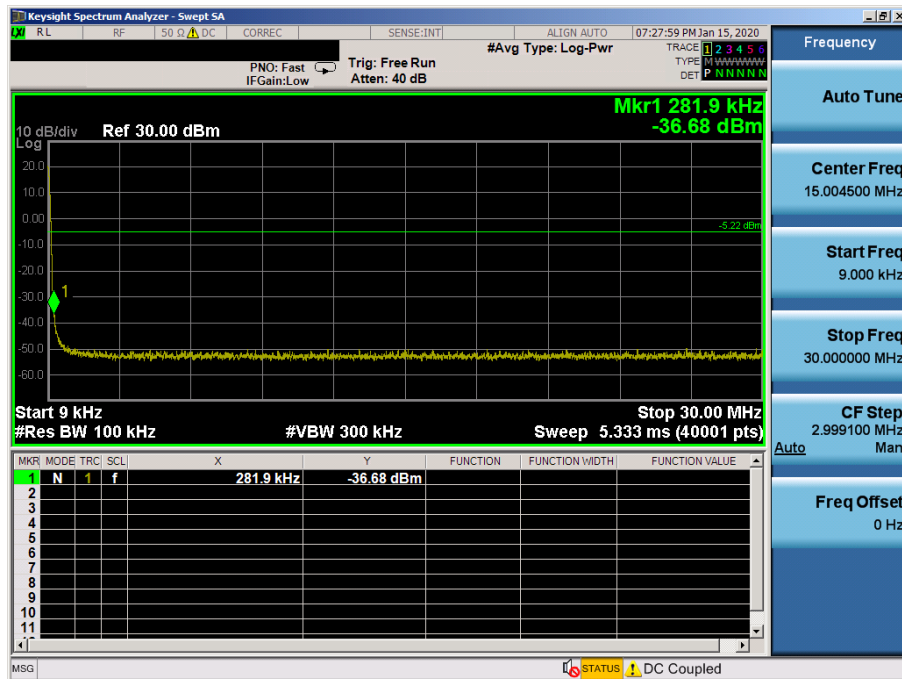
TM 1 Reference (Test Channel : Lowest)



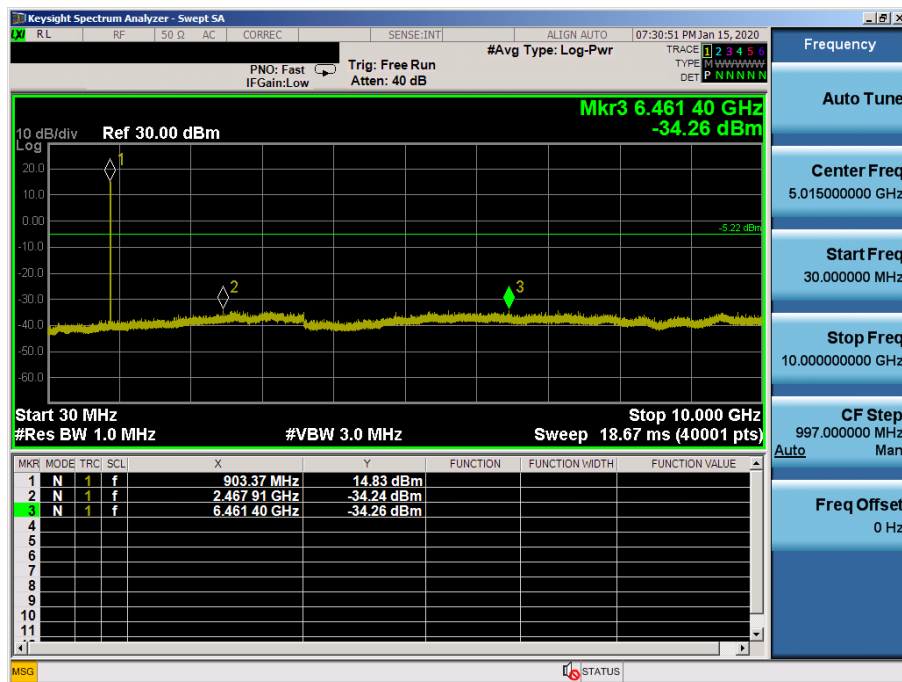
TM 1 Low Band-edge (Test Channel : Lowest)



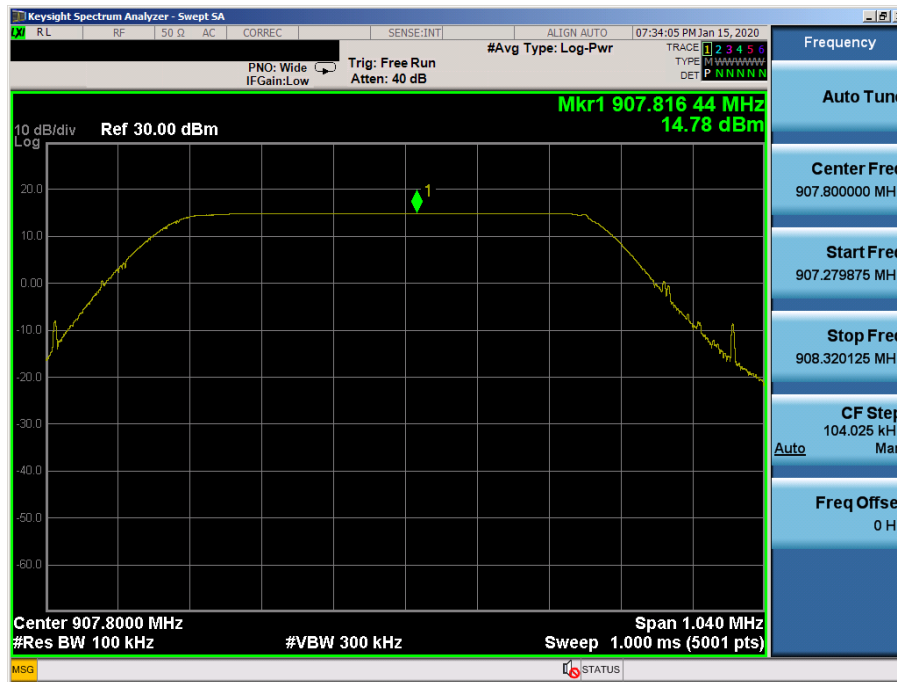
TM 1 Conducted Spurious Emissions 1 (Test Channel : Lowest)



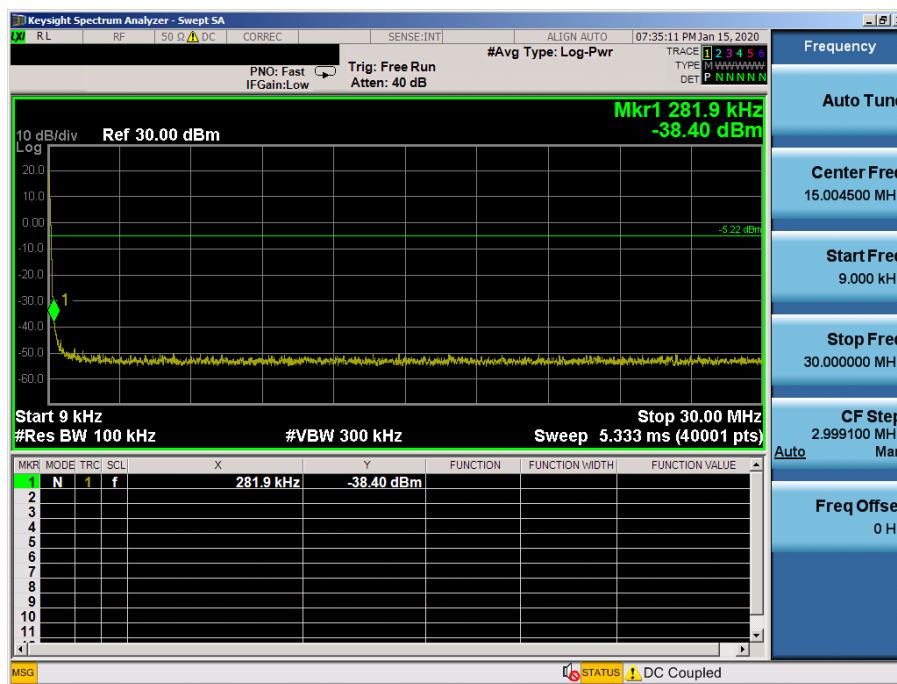
TM 1 Conducted Spurious Emissions 2 (Test Channel : Lowest)



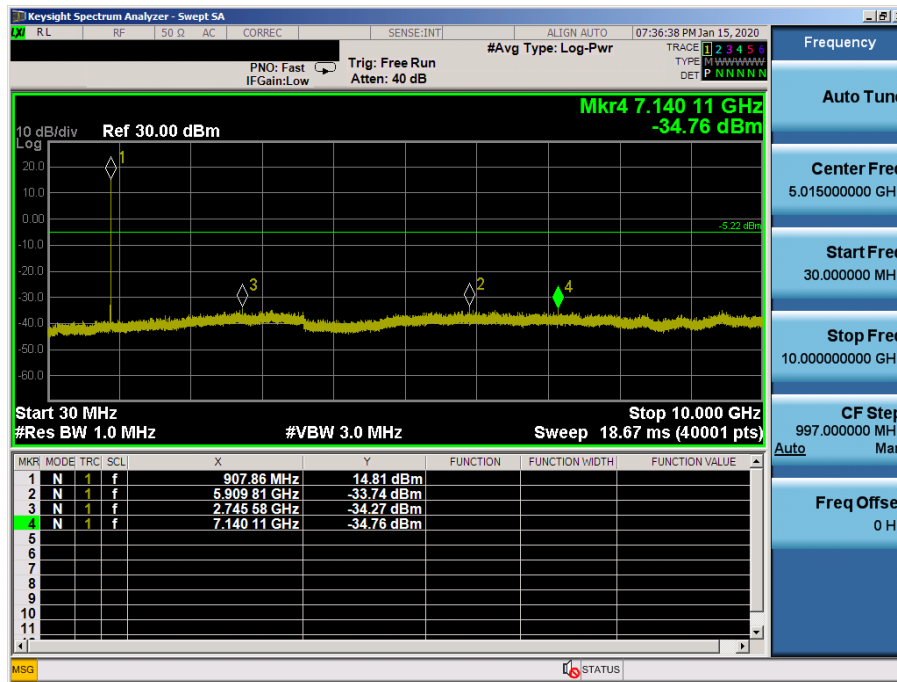
TM 1 Reference (Test Channel : Middle)



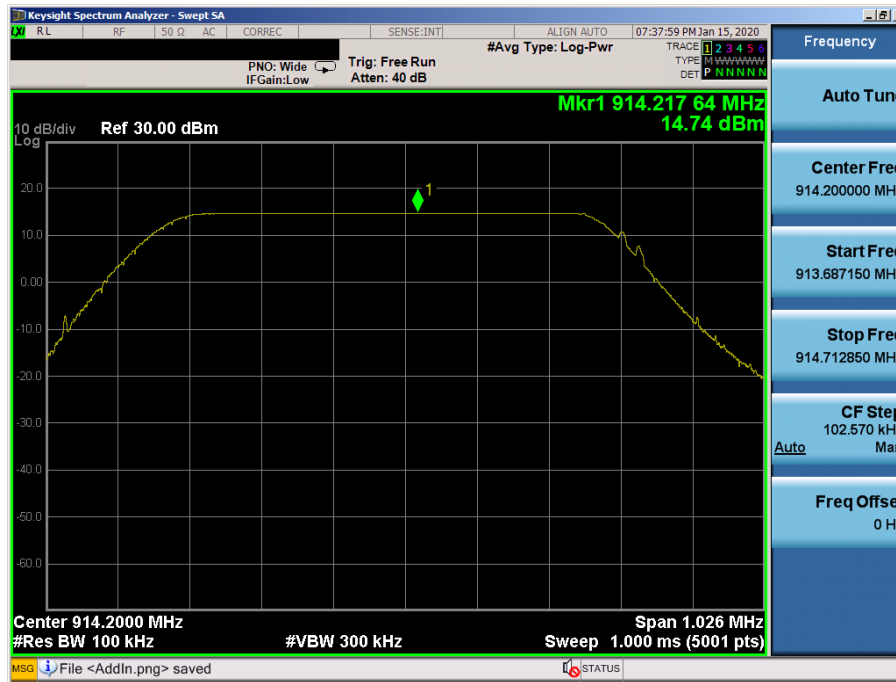
TM 1 Conducted Spurious Emissions 1 (Test Channel : Middle)



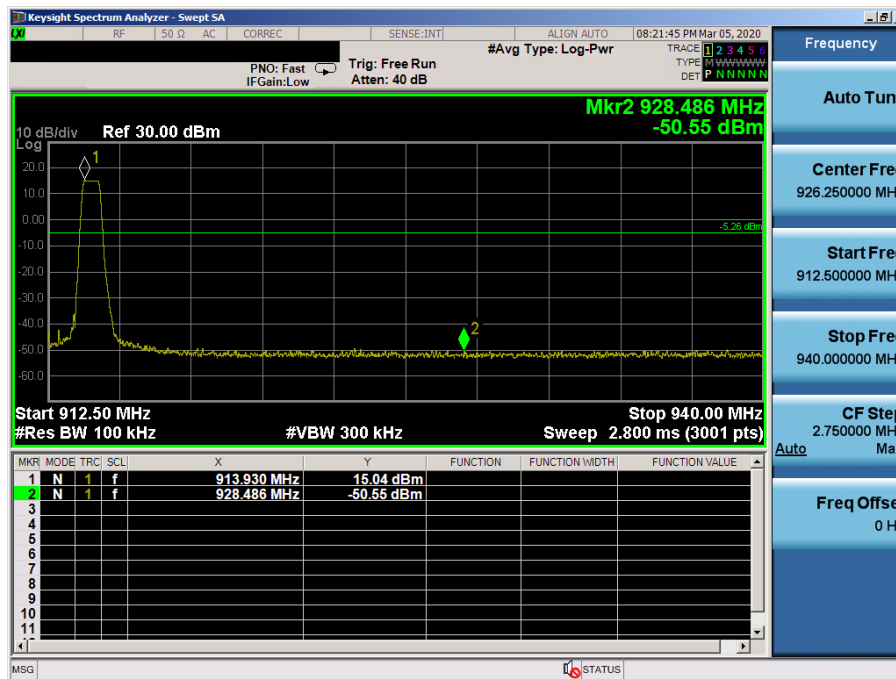
TM 1 Conducted Spurious Emissions 2 (Test Channel : Middle)



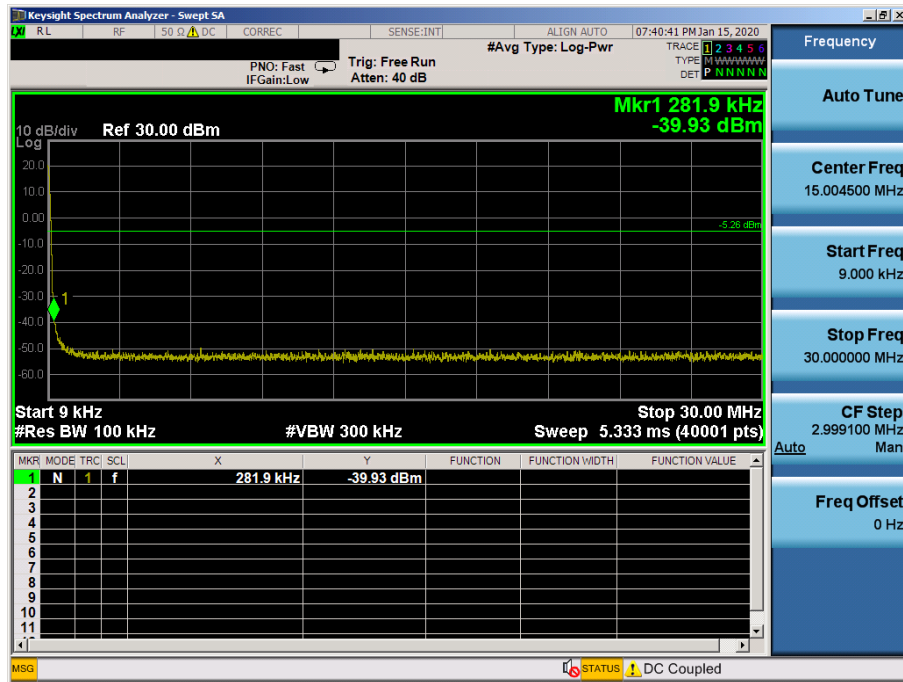
TM 1 Reference (Test Channel : Highest)



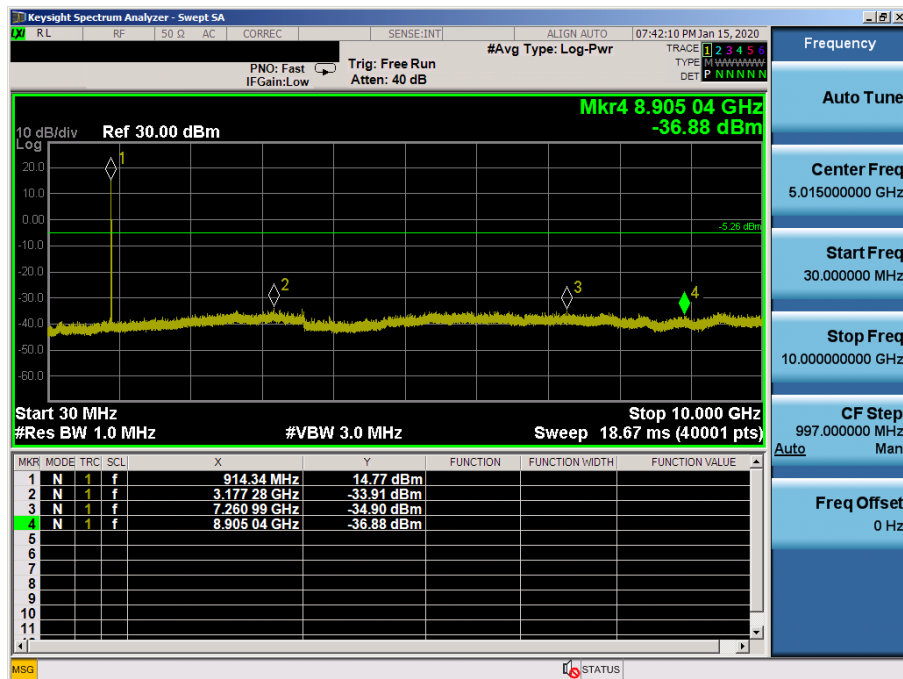
TM 1 High Band-edge (Test Channel : Highest)



TM 1 Conducted Spurious Emissions 1 (Test Channel : Highest)



TM 1 Conducted Spurious Emissions 2 (Test Channel : Highest)



3.5 Unwanted Emissions (Radiated)

■ Test Requirements and limit,

§15.247(d), §15.205, §15.209 & RSS-247 [5.5], RSS-Gen [8.9], RSS-Gen [8.10]

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a) and (b), then the 15.209(a) limit in the table below has to be followed.

▪ FCC Part 15.209(a) and (b)

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
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

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 MHz, 76 ~ 88 MHz, 174 ~ 216 MHz or 470 ~ 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

▪ FCC Part 15.205 (a) : Only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~ 12.52025	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.57675 ~ 12.57725	156.52475 ~ 156.52525	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	13.36 ~ 13.41	156.7 ~ 156.9	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	16.42 ~ 16.423	162.0125 ~ 167.17	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	16.69475 ~ 16.69525	167.72 ~ 173.2	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.80425 ~ 16.80475	240 ~ 285	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	25.5 ~ 25.67	322 ~ 335.4	2690 ~ 2900		
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3260 ~ 3267		
8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3332 ~ 3339		
8.37625 ~ 8.38675	74.8 ~ 75.2	960 ~ 1240	3345.8 ~ 3358		
			3600 ~ 4400		

▪ **FCC Part 15.205(b)** : The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

3.5.1 Test Setup

Refer to the APPENDIX I.

3.5.2 Test Procedures

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

Note: Measurement Instrument Setting for Radiated Emission Measurements.

1. Frequency Range Below 1 GHz

RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak

2. Frequency Range > 1 GHz

Peak Measurement > 1 GHz

RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes

Average Measurement > 1GHz

1. RBW = 1 MHz (unless otherwise specified).
2. VBW $\geq 3 \times$ RBW.
3. Detector = RMS (Number of points $\geq 2 \times$ Span / RBW)
4. Averaging type = power (i.e., RMS).
5. Sweep time = auto.
6. Perform a trace average of at least 100 traces.
7. A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
 - 1) If power averaging (RMS) mode was used in step 4, then the applicable correction factor is $10 \log(1/x)$, where x is the duty cycle.
 - 2) If linear voltage averaging mode was used in step 4, then the applicable correction factor is $20 \log(1/x)$, where x is the duty cycle.
 - 3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

Test Mode	Duty Cycle (%)	T _{on} (ms)	T _{on} + T _{off} (ms)	DCF = 10 log(1/Duty) (dB)
TM 1	98.70	174.0	176.3	0.06

Note : Refer to appendix II for duty cycle measurement procedure and plots

3.5.3 Test Results

Frequency Range : 9 kHz ~ 10 GHz

▪ Lowest Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2708.64	V	Y	PK	51.22	2.84	N/A	N/A	54.06	74.00	19.94
2708.86	V	Y	AV	44.19	2.84	0.06	N/A	47.09	54.00	6.91
3611.13	H	Y	PK	51.27	3.55	N/A	N/A	54.82	74.00	19.18
3612.32	H	Y	AV	44.08	3.55	0.06	N/A	47.69	54.00	6.31
4516.31	V	Y	PK	47.14	5.59	N/A	N/A	52.73	74.00	21.27
4515.24	V	Y	AV	38.54	5.58	0.06	N/A	44.18	54.00	9.82
8127.22	H	Z	PK	45.98	9.52	N/A	N/A	55.50	74.00	18.50
8127.61	H	Z	AV	35.87	9.52	0.06	N/A	45.45	54.00	8.55

▪ Middle Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2723.42	V	Y	PK	49.92	2.83	N/A	N/A	52.75	74.00	21.25
2723.39	V	Y	AV	43.50	2.83	0.06	N/A	46.39	54.00	7.61
3632.19	H	Y	PK	49.62	3.48	N/A	N/A	53.10	74.00	20.90
3631.10	H	Y	AV	41.78	3.48	0.06	N/A	45.32	54.00	8.68
4538.97	V	Y	PK	47.92	5.73	N/A	N/A	53.65	74.00	20.35
4539.42	V	Y	AV	39.62	5.73	0.06	N/A	45.41	54.00	8.59
8171.06	H	Z	PK	46.35	9.57	N/A	N/A	55.92	74.00	18.08
8171.03	H	Z	AV	36.33	9.57	0.06	N/A	45.96	54.00	8.04

▪ Highest Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2742.97	V	Y	PK	49.07	2.81	N/A	N/A	51.88	74.00	22.12
2742.45	V	Y	AV	42.67	2.81	0.06	N/A	45.54	54.00	8.46
3657.07	H	Y	PK	49.18	3.39	N/A	N/A	52.57	74.00	21.43
3656.65	H	Y	AV	42.22	3.40	0.06	N/A	45.68	54.00	8.32
4570.02	V	Y	PK	47.48	5.92	N/A	N/A	53.40	74.00	20.60
4570.56	V	Y	AV	38.31	5.93	0.06	N/A	44.30	54.00	9.70
8227.20	H	Z	PK	46.74	9.63	N/A	N/A	56.37	74.00	17.63
8226.74	H	Z	AV	35.70	9.63	0.06	N/A	45.39	54.00	8.61

▪ Note.

1. The radiated emissions were investigated 9kHz to 10GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, the test distance might be reduced from 3 m to 1 m. In this case, the distance factor (-9.54 dB) is applied to the result.

- Calculation of distance factor = $20 \log(\text{applied distance} / \text{required distance}) = 20 \log(1 \text{ m} / 3 \text{ m}) = \underline{\underline{-9.54 \text{ dB}}}$

When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. Sample Calculation.

Margin = Limit – Result / Result = Reading + T.F + D.C.F / T.F = AF + CL – AG

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

DCF = Duty Cycle Correction Factor.

3.6 Power line Conducted Emissions

■ Test Requirements and limit, §15.207 & RSS-Gen [8.8]

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

3.6.1 Test Setup

See test photographs for the actual connections between EUT and support equipment.

3.6.2 Test Procedures

Conducted emissions from the EUT were measured according to the ANSI C63.10-2013.

1. The test procedure is performed in a 6.5 m \times 3.5 m \times 3.5 m (L \times W \times H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) \times 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

3.6.3 Test Results

Refer to next page. (The worst data was reported.)

AC Line Conducted Emissions (Graph) = TM 1 & 907.8 MHz

DT&C

Date 2020-01-22

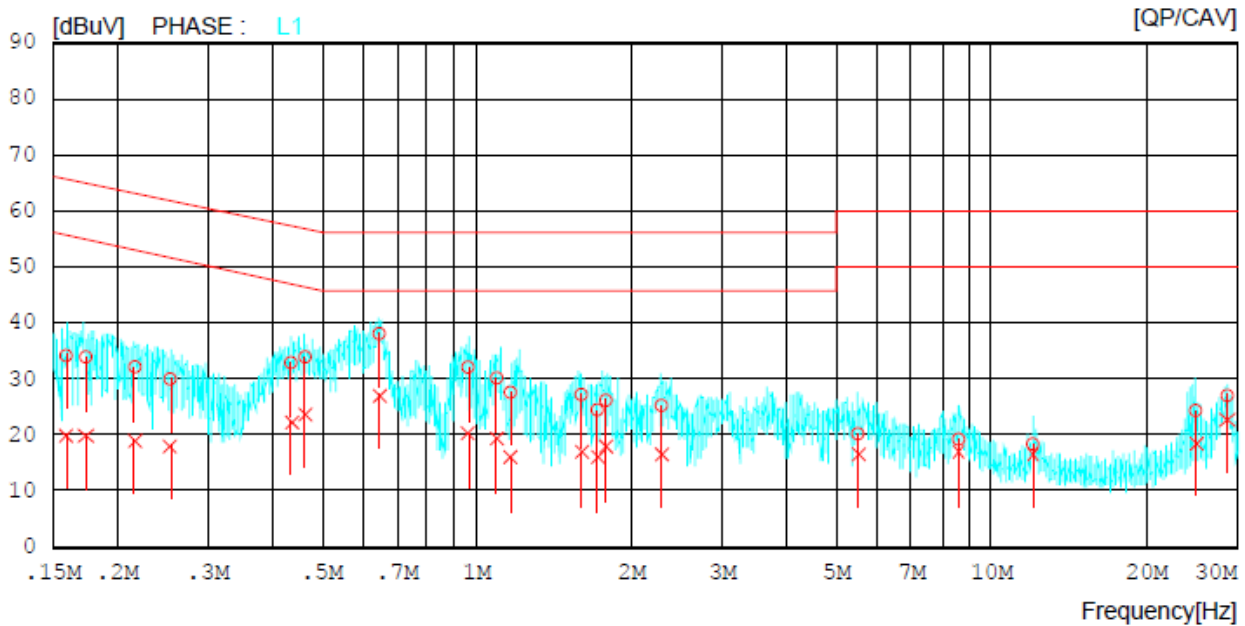
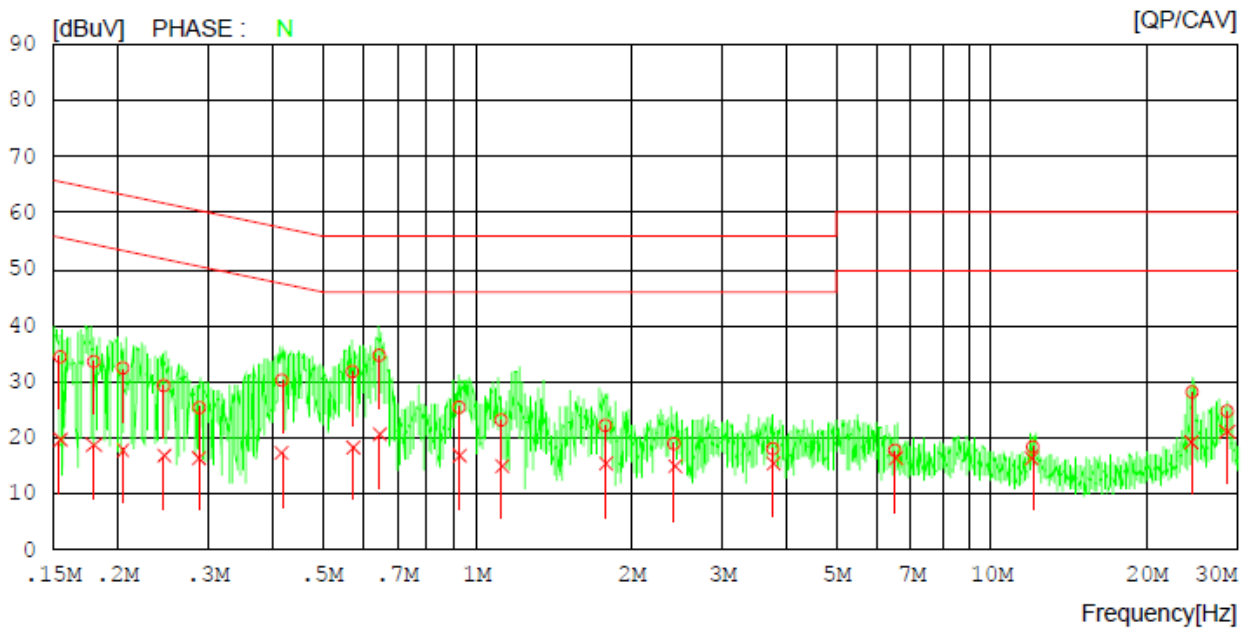
Model eLR100-UL-00
Power Supply 120 V 60 Hz
Temp/Humi/Atm 23°C / 45 %
Test Condition 500 kHz

operator

JaeHyeok Bang

Note

LIMIT : FCC P15.207 QP
FCC P15.207 AV



AC Line Conducted Emissions (List) = TM 1 & 907.8 MHz

AC Line Conducted Emission

DT&C

Date 2020-01-22

Model eLR100-UL-00
Power Supply 120 V 60 Hz
Temp/Humi/Atm 23°C / 45 %
Test Condition 500 kHz

operator

JaeHyeok Bang

Note

LIMIT : FCC P15.207 QP
FCC P15.207 AV

NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	CAV [dBuV]		QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	QP [dBuV]	CAV [dBuV]	
1	0.15528	14.42	-0.40	19.99	34.41	19.59	65.71	55.71	31.30	36.12	N
2	0.18044	13.42	-1.45	20.13	33.55	18.68	64.47	54.47	30.92	35.79	N
3	0.20550	12.43	-2.04	19.98	32.41	17.94	63.39	53.39	30.98	35.45	N
4	0.24650	9.53	-3.10	19.82	29.35	16.72	61.87	51.87	32.52	35.15	N
5	0.28908	5.52	-3.31	19.89	25.41	16.58	60.55	50.55	35.14	33.97	N
6	0.41834	10.11	-2.93	20.19	30.30	17.26	57.48	47.48	27.18	30.22	N
7	0.57324	11.60	-1.80	20.24	31.84	18.44	56.00	46.00	24.16	27.56	N
8	0.64604	14.52	0.27	20.19	34.71	20.46	56.00	46.00	21.29	25.54	N
9	0.92324	5.32	-3.27	20.14	25.46	16.87	56.00	46.00	30.54	29.13	N
10	1.11478	3.10	-5.11	20.08	23.18	14.97	56.00	46.00	32.82	31.03	N
11	1.77657	2.17	-4.78	20.07	22.24	15.29	56.00	46.00	33.76	30.71	N
12	2.41602	-1.12	-5.22	20.12	19.00	14.90	56.00	46.00	37.00	31.10	N
13	3.75945	-2.03	-4.55	20.12	18.09	15.57	56.00	46.00	37.91	30.43	N
14	6.48951	-2.57	-4.08	20.35	17.78	16.27	60.00	50.00	42.22	33.73	N
15	12.02857	-2.58	-4.56	21.00	18.42	16.44	60.00	50.00	41.58	33.56	N
16	24.53324	7.51	-1.25	20.65	28.16	19.40	60.00	50.00	31.84	30.60	N
17	28.68574	4.22	0.79	20.54	24.76	21.33	60.00	50.00	35.24	28.67	N
18	0.15917	14.20	0.02	20.05	34.25	20.07	65.51	55.51	31.26	35.44	L1
19	0.17409	13.84	-0.43	20.18	34.02	19.75	64.76	54.76	30.74	35.01	L1
20	0.21663	12.31	-0.86	19.93	32.24	19.07	62.95	52.95	30.71	33.88	L1
21	0.25361	10.25	-1.61	19.82	30.07	18.21	61.64	51.64	31.57	33.43	L1
22	0.43550	12.78	2.29	20.20	32.98	22.49	57.15	47.15	24.17	24.66	L1
23	0.46445	13.76	3.55	20.22	33.98	23.77	56.61	46.61	22.63	22.84	L1
24	0.64695	17.93	7.07	20.19	38.12	27.26	56.00	46.00	17.88	18.74	L1
25	0.96150	12.02	0.20	20.14	32.16	20.34	56.00	46.00	23.84	25.66	L1
26	1.09390	10.17	-0.65	20.09	30.26	19.44	56.00	46.00	25.74	26.56	L1
27	1.16264	7.64	-4.06	20.07	27.71	16.01	56.00	46.00	28.29	29.99	L1
28	1.59700	7.21	-3.01	20.06	27.27	17.05	56.00	46.00	28.73	28.95	L1
29	1.71474	4.52	-3.91	20.07	24.59	16.16	56.00	46.00	31.41	29.84	L1
30	1.78317	6.18	-2.15	20.07	26.25	17.92	56.00	46.00	29.75	28.08	L1
31	2.28513	5.26	-3.42	20.11	25.37	16.69	56.00	46.00	30.63	29.31	L1
32	5.49869	-0.07	-3.52	20.34	20.27	16.82	60.00	50.00	39.73	33.18	L1
33	8.62716	-1.36	-3.67	20.72	19.36	17.05	60.00	50.00	40.64	32.95	L1
34	12.03266	-2.52	-4.30	21.00	18.48	16.70	60.00	50.00	41.52	33.30	L1
35	24.89777	3.84	-1.93	20.61	24.45	18.68	60.00	50.00	35.55	31.32	L1
36	28.68579	6.59	2.43	20.54	27.13	22.97	60.00	50.00	32.87	27.03	L1

3.7 Occupied Bandwidth

■ Test Requirements, RSS-Gen [6.7]

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 % emission bandwidth, as calculated or measured.

3.7.1 Test Setup

Refer to the APPENDIX I.

3.7.2 Test Procedures

The 99 % power bandwidth was measured with a calibrated spectrum analyzer.

The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately $3 \times \text{RBW}$.

Spectrum analyzer plots are included on the following pages.

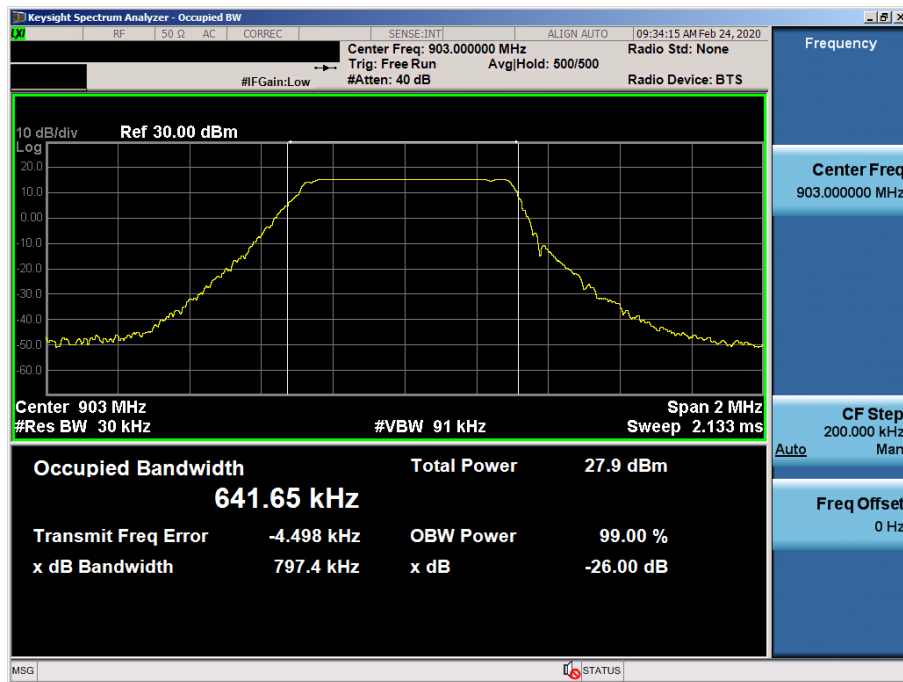
3.7.3 Test Results

Test Mode	Tested Channel	Test Results (MHz)
TM 1	Lowest	0.642
	Middle	0.642
	Highest	0.643

Note : See next pages for actual measured spectrum plots.

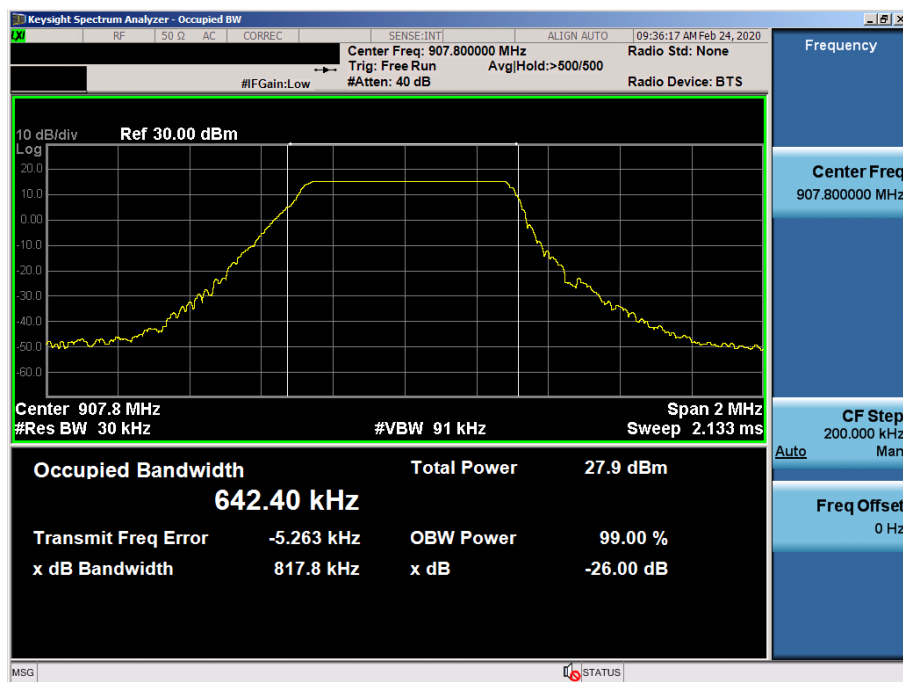
Occupied Bandwidth

TM 1 Test Channel : Lowest



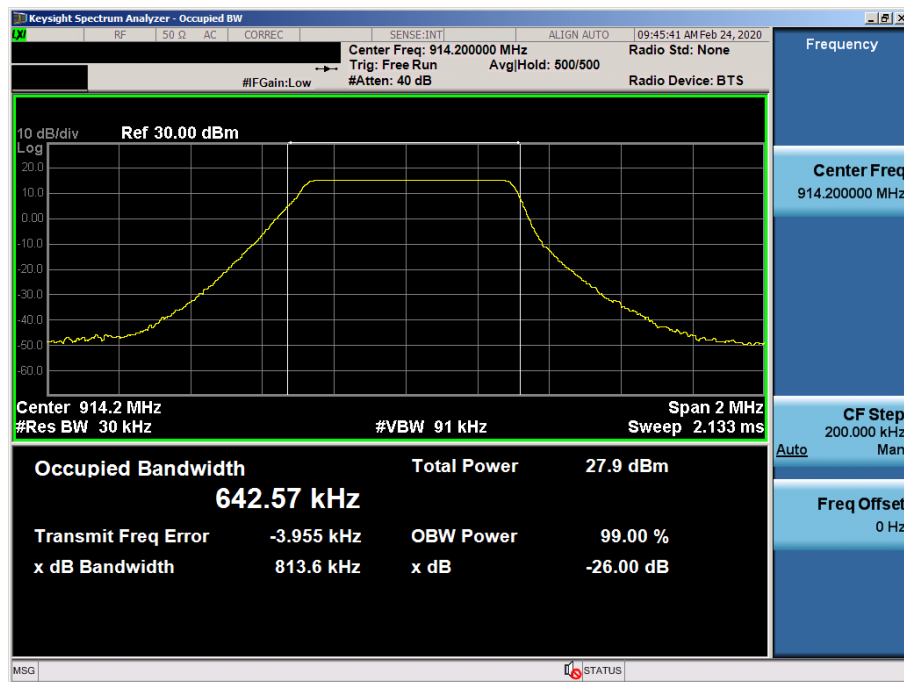
Occupied Bandwidth

TM 1 Test Channel : Middle



Occupied Bandwidth

TM 1 Test Channel : Highest



4. ANTENNA REQUIREMENTS

▣ **According to FCC 47 CFR §15.203**

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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.”

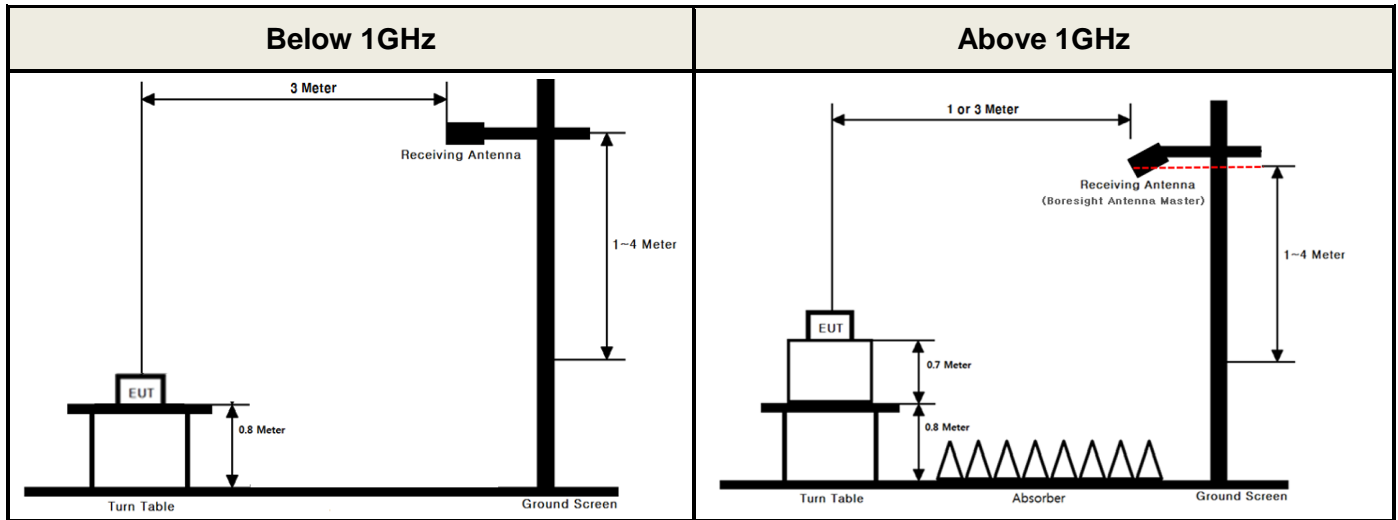
The antenna employs a unique antenna connector.

Therefore this E.U.T Complies with the requirement of §15.203

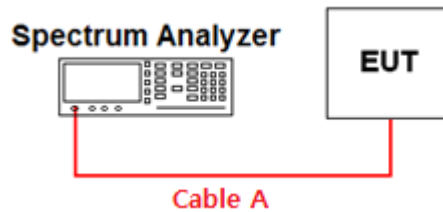
APPENDIX I

Test set up diagrams

▪ Radiated Measurement



▪ Conducted Measurement



Path loss information

Frequency (MHz)	Path Loss (dB)	Frequency (MHz)	Path Loss (dB)
30	0.66	5000	1.33
500	0.74	10000	2.09
903 & 907.8 & 914.2	0.95	-	-
1000	0.97	-	-

Note 1: The path loss from EUT to Spectrum analyzer was measured and used for test.
 Path loss (S/A's correction factor) = Cable A

APPENDIX III

Unwanted Emissions (Radiated) Test Plot

Worst case

Lowest & Y & Hor

Detector Mode : AV

