

FCC Part 15C

Measurement and Test Report

For

Sec-Eng Systems Pty Ltd.

20/65-75 Captain cook Drive, Caringbah, Sydney 2229 NSW, Australia

FCC ID: 2ASK9-MX001W4814

FCC Rule(s):	<u>FCC Part 15.247</u>
Product Description:	<u>Sed Lawra-R1</u>
Tested Model:	<u>Mx 001 W4814</u>
Report No.:	<u>WTX19X02009133W</u>
Sample Receipt Date:	<u>2019-03-20</u>
Tested Date:	<u>2019-03-20 to 2019-04-11</u>
Issued Date:	<u>2019-04-12</u>
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Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by Shenzhen SEM Test Technology Co., Ltd.

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: Sec-Eng Systems Pty Ltd.
Address of applicant: 20/65-75 Captain cook Drive, Caringbah, Sydney 2229
NSW, Australia

Manufacturer: Sec-Eng Systems Pty Ltd.
Address of manufacturer: 20/65-75 Captain cook Drive, Caringbah, Sydney 2229
NSW, Australia

General Description of EUT	
Product Name:	Sed Lawra-R1
Brand Name:	Sec-Eng Systems Pty
Model No.:	Mx 001 W4814
Adding Model(s):	/
Rated Voltage:	DC5V
Power Adapter:	/
<i>Note: The test data is gathered from a production sample, provided by the manufacturer.</i>	

Technical Characteristics of EUT	
Frequency Range:	916-927MHz
RF Output Power:	18.59dBm (Conducted)
Modulation:	LoRa
Type of Antenna:	TNC type Antenna
Antenna Gain:	3.0dBi

1.2 Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.

558074 D01 15.247 Meas Guidance v05r01: Guidance For Compliance Measurements On Digital Transmission System, Frequency Hopping Spread Spectrum System, And Hybrid System Devices Operating Under Section 15.247 Of The Fcc Rules.

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r01.

The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

1.4 Test Facility

FCC – Registration No.: 125990

Shenzhen SEM Test Technology Co., Ltd. Laboratory has been recognized to perform compliance testing on equipment subject to the Commissions Declaration Of Conformity (DOC). The Designation Number is CN5010, and Test Firm Registration Number is 125990.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Shenzhen SEM Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low	916MHz
TM2	Middle	922MHz
TM3	High	927MHz

Test Conditions	
Temperature:	22~25 °C
Relative Humidity:	50~55 %.
ATM Pressure:	1019 mbar

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
DC Cable	1.7	Unshielded	Without Ferrite

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Adapter	/	12J050200P	/
Radio Passive test board	/	R1	/

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	$\pm 0.42\text{dB}$
Occupied Bandwidth	Conducted	$\pm 1.5\%$
Power Spectral Density	Conducted	$\pm 1.8\text{dB}$
Conducted Spurious Emission	Conducted	$\pm 2.17\text{dB}$
Conducted Emissions	Conducted	9-150kHz $\pm 3.74\text{dB}$
		0.15-30MHz $\pm 3.34\text{dB}$
		30-200MHz $\pm 4.52\text{dB}$
		0.2-1GHz $\pm 5.56\text{dB}$
		1-6GHz $\pm 3.84\text{dB}$
Transmitter Spurious Emissions	Radiated	6-18GHz $\pm 3.92\text{dB}$

1.7 Test Equipment List and Details

No.	Description	Manufacturer	Model	Serial No.	Cal Date	Due Date
SEMT-1072	Spectrum Analyzer	Agilent	E4407B	MY41440400	2018-05-22	2019-05-21
SEMT-1031	Spectrum Analyzer	Rohde & Schwarz	FSP30	836079/035	2018-05-22	2019-05-21
SEMT-1007	EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2018-05-22	2019-05-21
SEMT-1008	Amplifier	Agilent	8447F	3113A06717	2018-05-22	2019-05-21
SEMT-1043	Amplifier	C&D	PAP-1G18	2002	2018-05-22	2019-05-21
SEMT-1011	Broadband Antenna	Schwarz beck	VULB9163	9163-333	2017-06-08	2020-06-07
SEMT-1042	Horn Antenna	ETS	3117	00086197	2017-06-08	2020-06-07
SEMT-1121	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170582	2017-06-08	2020-06-07
SEMT-1069	Loop Antenna	Schwarz beck	FMZB 1516	9773	2017-06-08	2020-06-07
SEMT-1001	EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2018-05-22	2019-05-21
SEMT-1003	L.I.S.N	Schwarz beck	NSLK8126	8126-224	2018-05-22	2019-05-21
SEMT-1002	Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2018-05-22	2019-05-21
SEMT-1168	Pre-amplifier	Direction Systems Inc.	PAP-0126	14141-12838	2018-05-22	2019-05-21
SEMT-1169	Pre-amplifier	Direction Systems Inc.	PAP-2640	14145-14153	2018-05-22	2019-05-21
SEMT-1163	Spectrum Analyzer	Rohde & Schwarz	FSP40	100612	2018-05-22	2019-05-21
SEMT-1170	DRG Horn Antenna	A.H. SYSTEMS	SAS-574	571	2018-03-19	2021-03-18
SEMT-1166	Power Limiter	Agilent	N9356B	MY45450376	2018-05-22	2019-05-21
SEMT-1048	RF Limiter	ATTEN	AT-BSF-2400~2500	/	2018-05-22	2019-05-21
SEMT-1076	RF Switcher	Top Precision	RCS03-A2	/	2018-05-22	2019-05-21
SEMT-C001	Cable	Zheng DI	LL142-07-07-10M(A)	/	2019-03-18	2020-03-17
SEMT-C002	Cable	Zheng DI	ZT40-2.92J-2.92J-6M	/	2019-03-18	2020-03-17
SEMT-C003	Cable	Zheng DI	ZT40-2.92J-2.92J-2.5M	/	2019-03-18	2020-03-17
SEMT-C004	Cable	Zheng DI	2M0RFC	/	2019-03-18	2020-03-17
SEMT-C005	Cable	Zheng DI	1M0RFC	/	2019-03-18	2020-03-17
SEMT-C006	Cable	Zheng DI	1M0RFC	/	2019-03-18	2020-03-17

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 2.1091	RF Exposure	Compliant
§ 15.203; § 15.247(b)(4)(i)	Antenna Requirement	Compliant
§15.205	Restricted Band of Operation	Compliant
§ 15.207(a)	Conducted Emission	Compliant
§ 15.247(e)	Power Spectral Density	Compliant
§ 15.247(a)(2)	DTS Bandwidth	Compliant
§ 15.247(b)(3)	RF Output Power	Compliant
§ 15.209(a)	Radiated Emission	Compliant
§ 15.247(d)	Band Edge (Out of Band Emissions)	Compliant

N/A: not applicable



3. RF Exposure

3.1 Standard Applicable

According to § 1.1307 and § 2.1091, the mobile transmitter must comply the RF exposure requirements.

3.2 Test Result

This product complied with the requirement of the RF exposure, please see the RF Exposure Report.

4. Antenna Requirement

4.1 Standard Applicable

According to FCC Part 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

4.2 Evaluation Information

This product has a TNC type antenna, fulfill the requirement of this section.

5. Power Spectral Density

5.1 Standard Applicable

According to §15.247(a)(1)(iii), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.2 Test Procedure

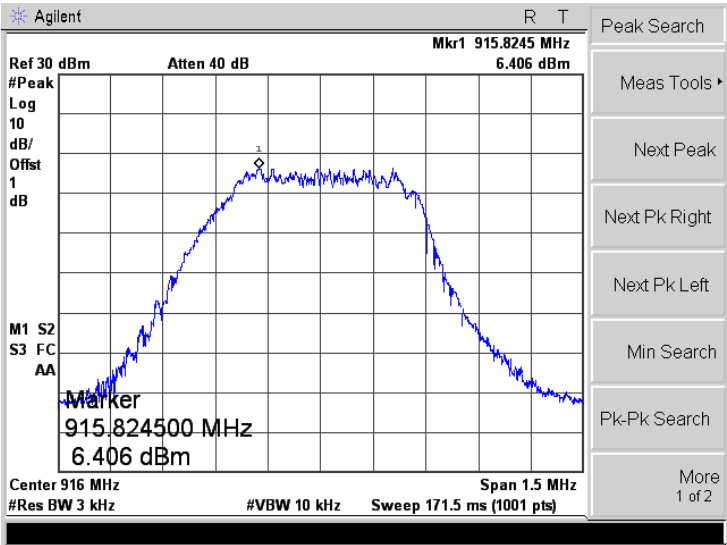
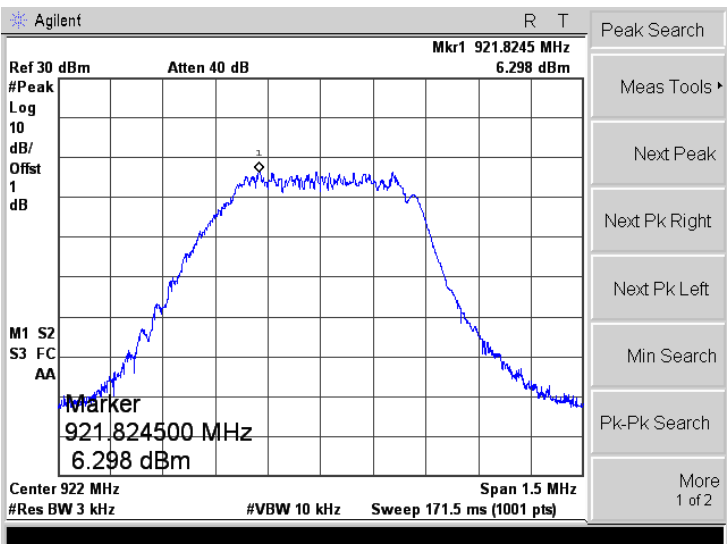
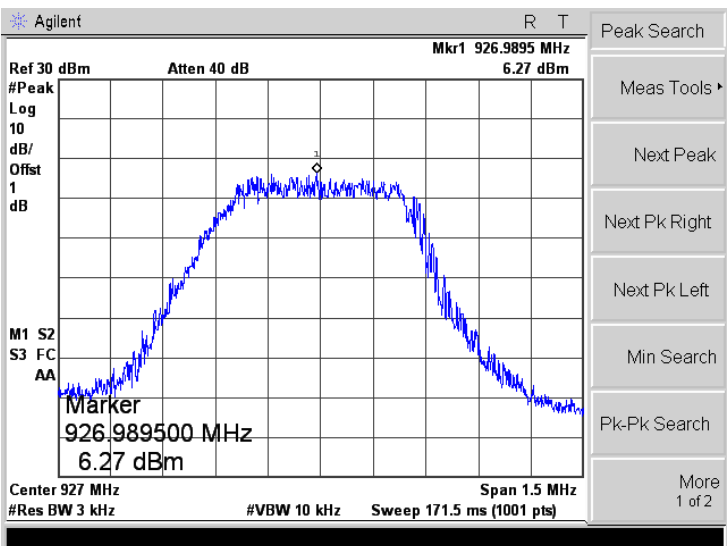
According to the KDB 558074 D01 v05r01 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.2, the test method of power spectral density as below:

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3 Summary of Test Results/Plots

Test Channel	Power Spectral Density dBm/3kHz	Limit dBm/3kHz
Low	6.406	8
Middle	6.298	8
High	6.27	8

Please refer to the following test plots:

Low	 Agilent R T Peak Search Meas Tools ▶ Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2 Ref 30 dBm Atten 40 dB Mkr1 915.8245 MHz 6.406 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 915.824500 MHz 6.406 dBm Center 916 MHz Span 1.5 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 171.5 ms (1001 pts)
Middle	 Agilent R T Peak Search Meas Tools ▶ Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2 Ref 30 dBm Atten 40 dB Mkr1 921.8245 MHz 6.298 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 921.824500 MHz 6.298 dBm Center 922 MHz Span 1.5 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 171.5 ms (1001 pts)
High	 Agilent R T Peak Search Meas Tools ▶ Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2 Ref 30 dBm Atten 40 dB Mkr1 926.9895 MHz 6.27 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 926.989500 MHz 6.27 dBm Center 927 MHz Span 1.5 MHz #Res BW 3 kHz #VBW 10 kHz Sweep 171.5 ms (1001 pts)

6. DTS Bandwidth

6.1 Standard Applicable

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

6.2 Test Procedure

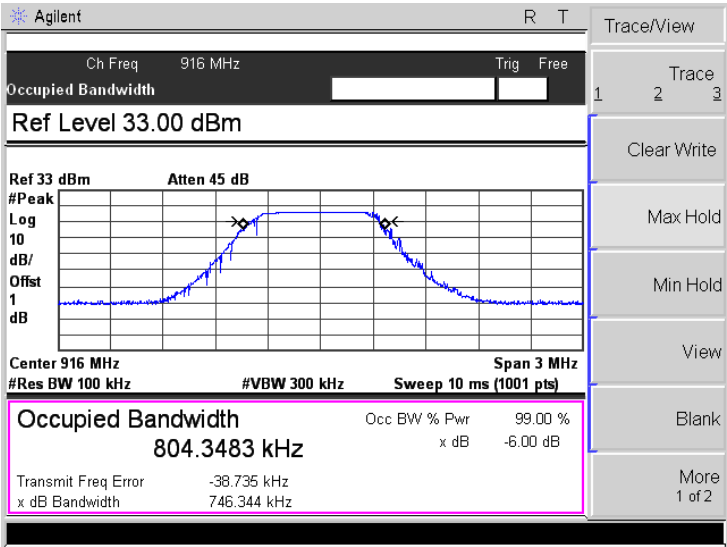
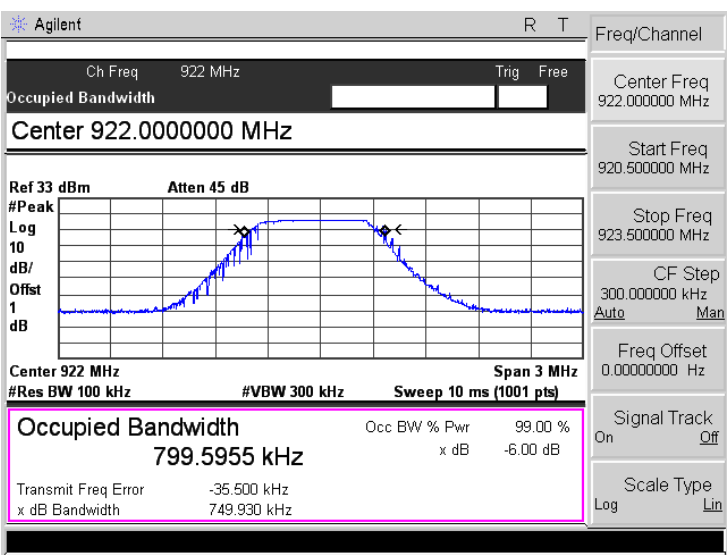
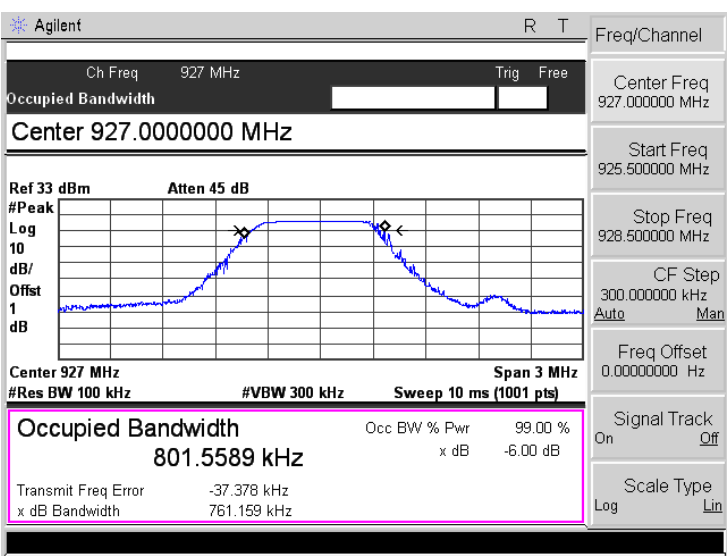
According to the KDB 558074 D01 v05r01 Subclause 8.2 and ANSI C63.10-2013 Subclause 11.8.1, the test method of DTS Bandwidth as below:

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

6.3 Summary of Test Results/Plots

Test Channel	6 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz
Low	746.344	804.3483	≥ 500
Middle	749.930	799.5955	≥ 500
High	761.159	801.5589	≥ 500

Please refer to the following test plots:

Low	 Agilent R T Ch Freq 916 MHz Trig Free Occupied Bandwidth Ref Level 33.00 dBm Ref 33 dBm Atten 45 dB #Peak Log 10 dB/Offset 1 dB Center 916 MHz Span 3 MHz #Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts) Occupied Bandwidth 804.3483 kHz Occ BW % Pwr 99.00 % x dB -6.00 dB Transmit Freq Error -38.735 kHz x dB Bandwidth 746.344 kHz Trace/View Trace 1 2 3 Clear Write Max Hold Min Hold View Blank More 1 of 2
Middle	 Agilent R T Ch Freq 922 MHz Trig Free Occupied Bandwidth Center 922.000000 MHz Ref 33 dBm Atten 45 dB #Peak Log 10 dB/Offset 1 dB Center 922 MHz Span 3 MHz #Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts) Occupied Bandwidth 799.5955 kHz Occ BW % Pwr 99.00 % x dB -6.00 dB Transmit Freq Error -35.500 kHz x dB Bandwidth 749.930 kHz Freq/Channel Center Freq 922.000000 MHz Start Freq 920.500000 MHz Stop Freq 923.500000 MHz CF Step 300.000000 kHz Auto Man Freq Offset 0.0000000 Hz Signal Track On Off Scale Type Log Lin
High	 Agilent R T Ch Freq 927 MHz Trig Free Occupied Bandwidth Center 927.000000 MHz Ref 33 dBm Atten 45 dB #Peak Log 10 dB/Offset 1 dB Center 927 MHz Span 3 MHz #Res BW 100 kHz #VBW 300 kHz Sweep 10 ms (1001 pts) Occupied Bandwidth 801.5589 kHz Occ BW % Pwr 99.00 % x dB -6.00 dB Transmit Freq Error -37.378 kHz x dB Bandwidth 761.159 kHz Freq/Channel Center Freq 927.000000 MHz Start Freq 925.500000 MHz Stop Freq 928.500000 MHz CF Step 300.000000 kHz Auto Man Freq Offset 0.0000000 Hz Signal Track On Off Scale Type Log Lin

7. RF Output Power

7.1 Standard Applicable

According to §15.247(b)(3), for systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

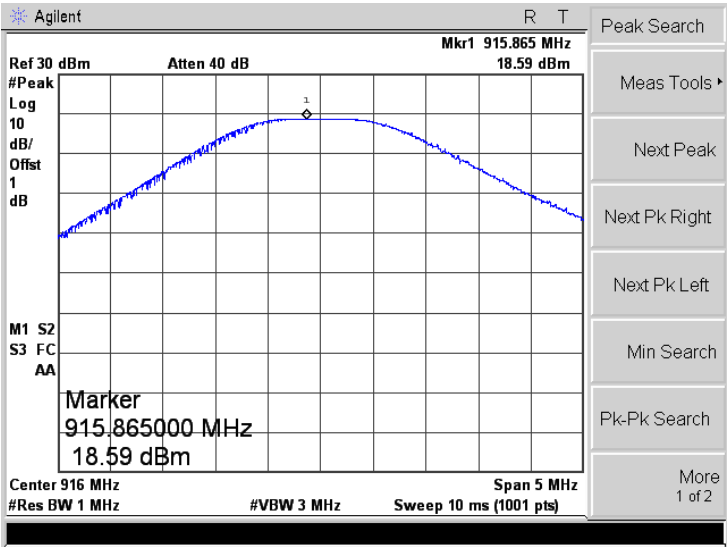
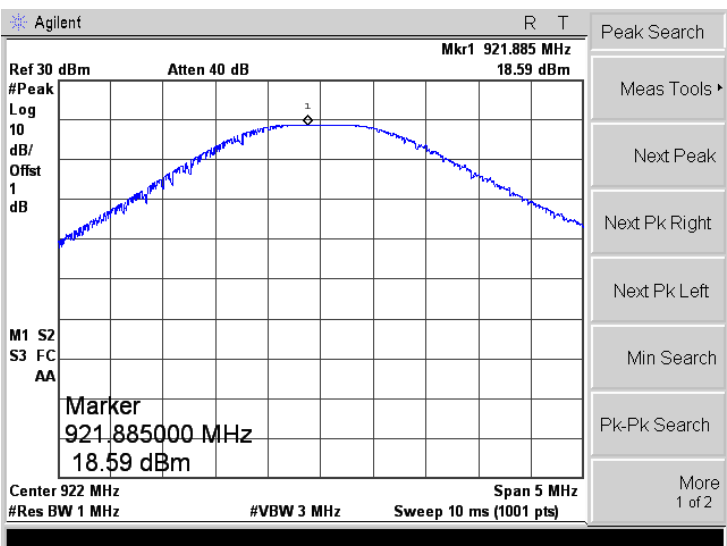
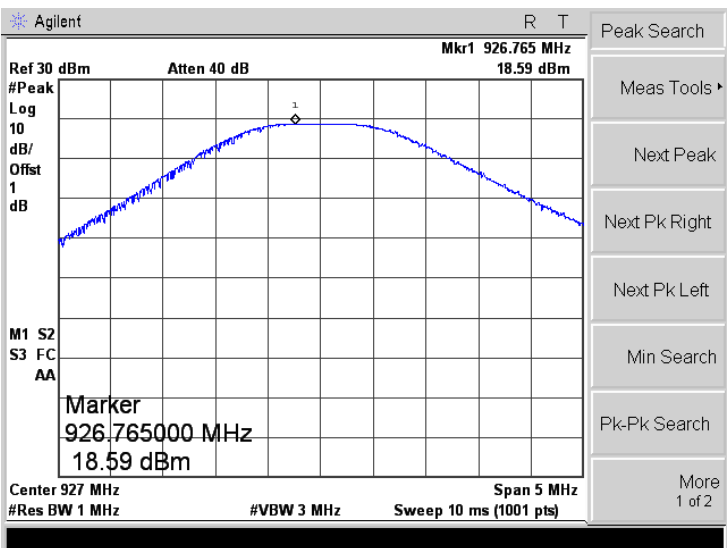
7.2 Test Procedure

According to the KDB-558074 D01 v05r01 Subclause 8.3.1.1 and ANSI C63.10-2013 Subclause 11.9.1.1, this procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

- a) Set the RBW $\geq$ DTS bandwidth.
- b) Set VBW $\geq 3 \times$ RBW.
- c) Set span $\geq 3 \times$ RBW.
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

7.3 Summary of Test Results/Plots

Test Channel	Reading dBm	Output Power mW	Limit mW
Low	18.59	72.28	1000
Middle	18.59	72.28	1000
High	18.59	72.28	1000

Low	 Agilent R T Ref 30 dBm Atten 40 dB Mkr1 915.865 MHz 18.59 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 915.865000 MHz 18.59 dBm Center 916 MHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 10 ms (1001 pts) Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2
Middle	 Agilent R T Ref 30 dBm Atten 40 dB Mkr1 921.885 MHz 18.59 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 921.885000 MHz 18.59 dBm Center 922 MHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 10 ms (1001 pts) Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2
High	 Agilent R T Ref 30 dBm Atten 40 dB Mkr1 926.765 MHz 18.59 dBm #Peak Log 10 dB/ Offst 1 dB M1 S2 S3 FC AA Marker 926.765000 MHz 18.59 dBm Center 927 MHz Span 5 MHz #Res BW 1 MHz #VBW 3 MHz Sweep 10 ms (1001 pts) Peak Search Meas Tools Next Peak Next Pk Right Next Pk Left Min Search Pk-Pk Search More 1 of 2

8. Field Strength of Spurious Emissions

8.1 Standard Applicable

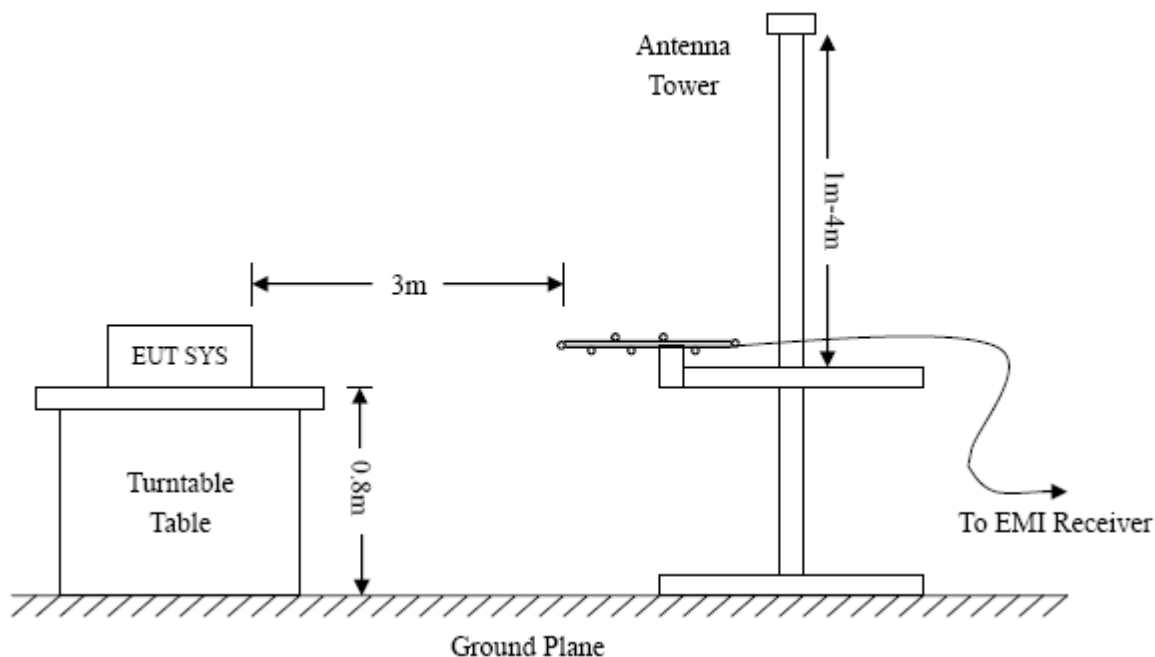
According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within 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).

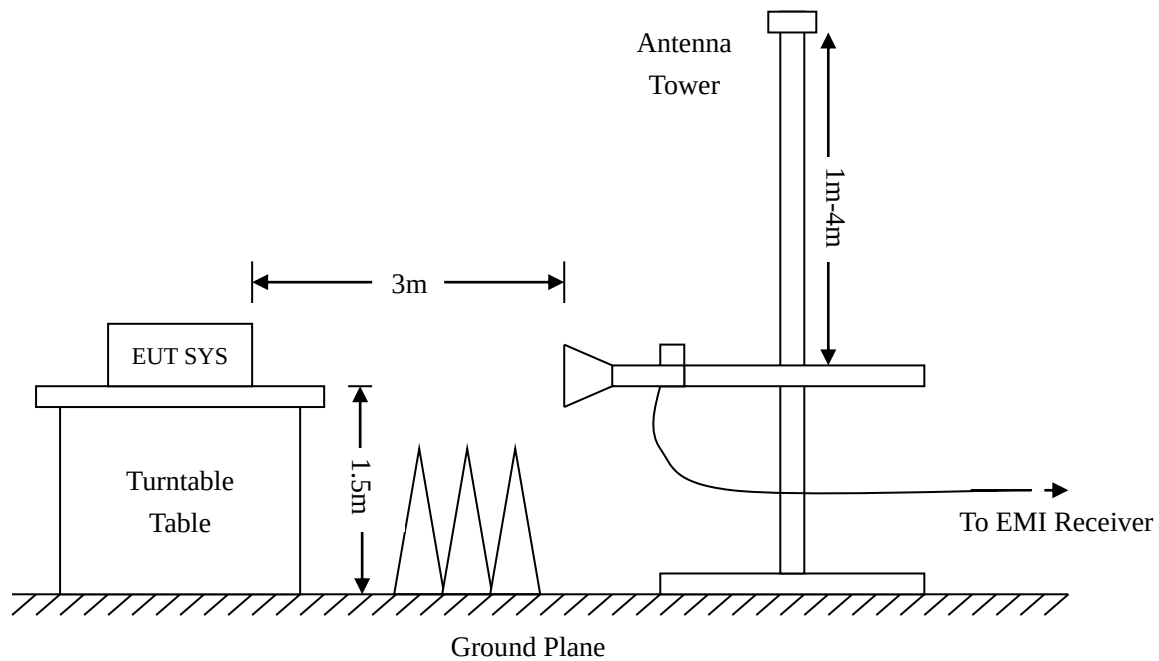
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

8.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm.





Frequency :9kHz-30MHz

RBW=10KHz,

VBW =30KHz

Sweep time= Auto

Trace = max hold

Detector function = peak

Frequency :30MHz-1GHz

RBW=120KHz,

VBW=300KHz

Sweep time= Auto

Trace = max hold

Detector function = peak, QP

Frequency :Above 1GHz

RBW=1MHz,

VBW=3MHz(Peak), 10Hz(AV)

Sweep time= Auto

Trace = max hold

Detector function = peak, AV

8.3 Corrected Amplitude & Margin Calculation

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

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dB μ V means the emission is 6dB μ V below the maximum limit. The equation for margin calculation is as follows:

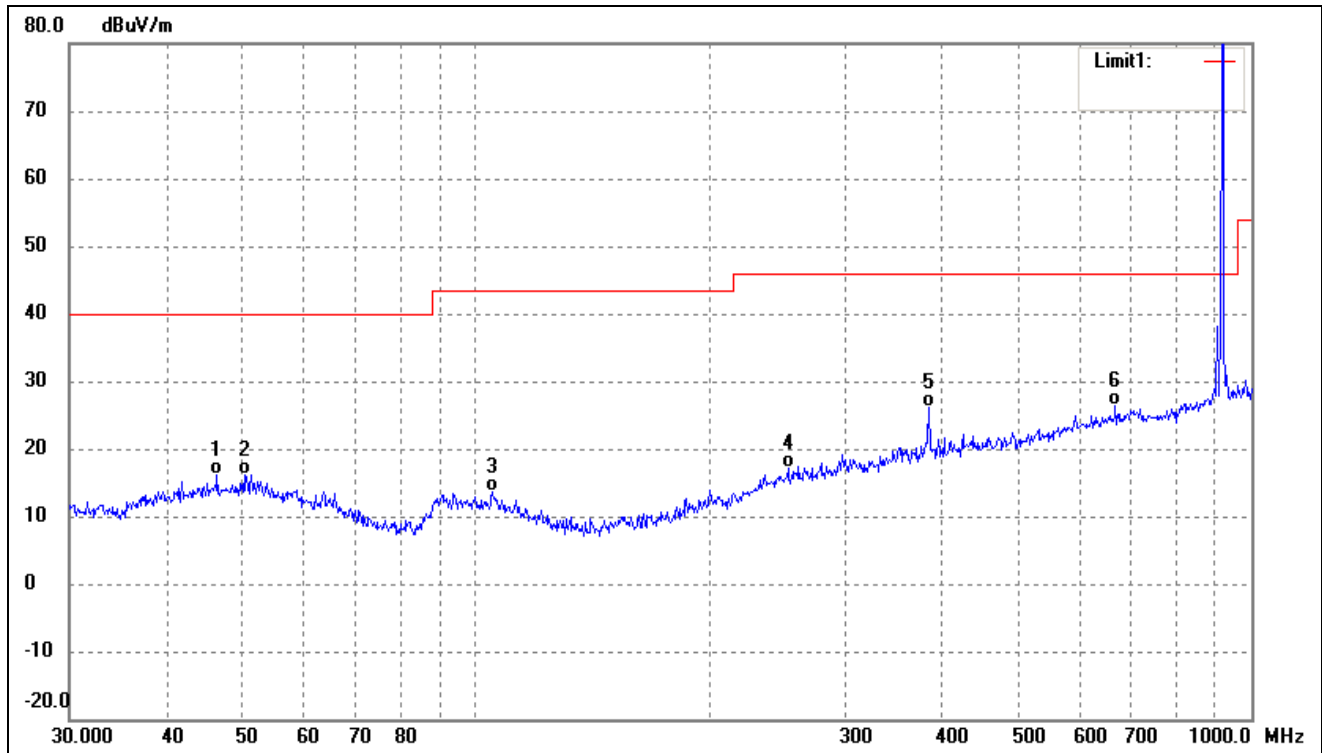
$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

8.4 Summary of Test Results/Plots

Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

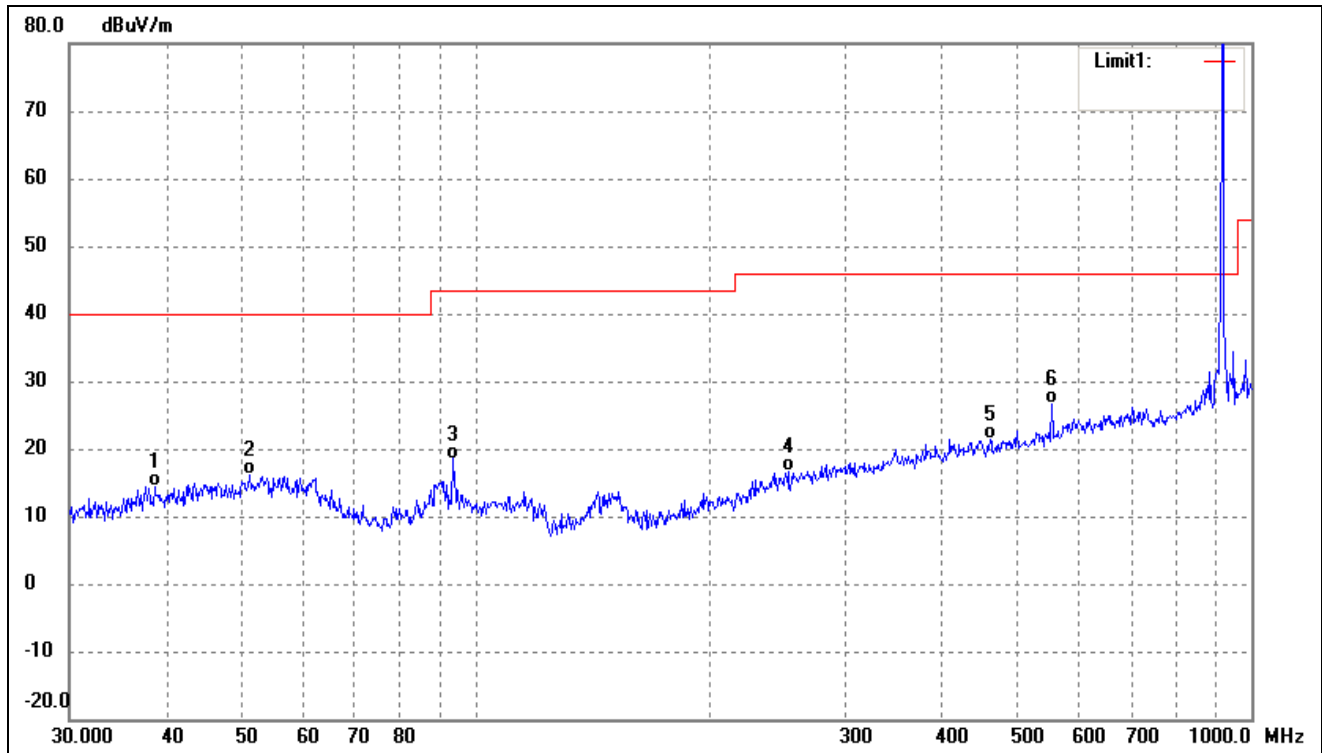
➤ Spurious Emissions Below 1GHz

Test Channel	Low	Polarity:	Horizontal
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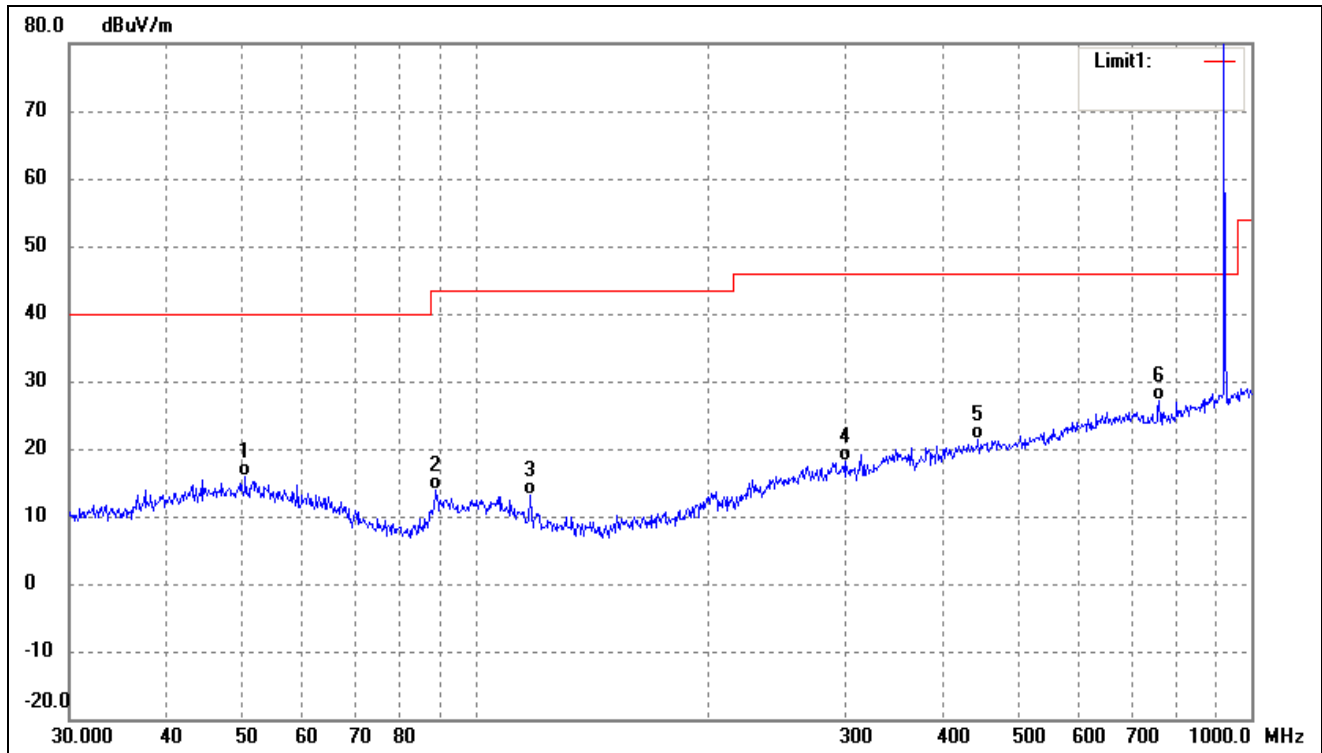
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	46.5030	27.91	-11.77	16.14	40.00	-23.86	344	100	QP
2	50.4089	27.65	-11.60	16.05	40.00	-23.95	157	100	QP
3	105.2718	26.97	-13.41	13.56	43.50	-29.94	118	100	QP
4	252.9482	26.85	-9.67	17.18	46.00	-28.82	144	100	QP
5	383.9318	33.24	-7.01	26.23	46.00	-19.77	77	100	QP
6	668.1423	28.97	-2.58	26.39	46.00	-19.61	315	100	QP

Test Channel	Low	Polarity:	Vertical
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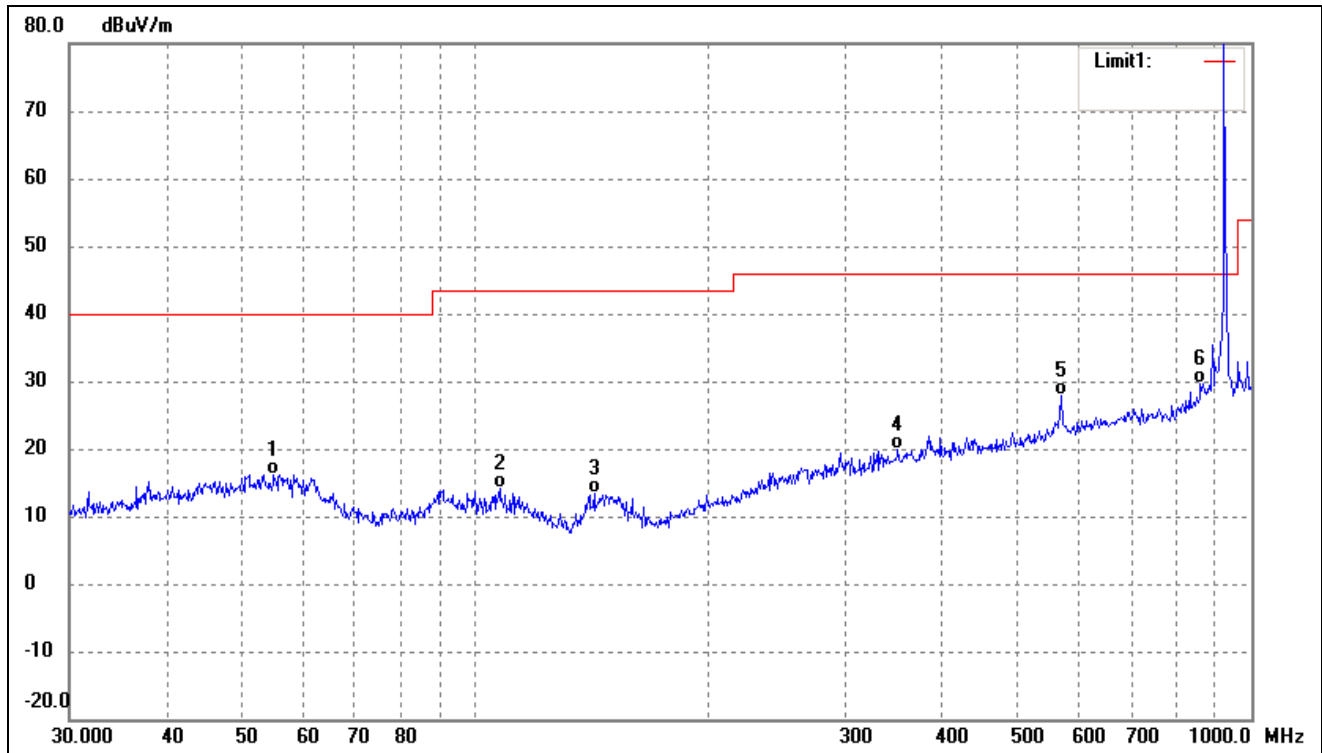
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	38.6161	27.53	-13.04	14.49	40.00	-25.51	66	100	QP
2	51.3005	27.63	-11.59	16.04	40.00	-23.96	107	100	QP
3	93.4402	32.59	-14.09	18.50	43.50	-25.00	85	100	QP
4	252.9482	26.18	-9.67	16.51	46.00	-29.49	130	100	QP
5	460.7271	27.38	-6.00	21.38	46.00	-24.62	336	100	QP
6	552.8833	31.26	-4.71	26.55	46.00	-19.45	90	100	QP

Test Channel	Middle	Polarity:	Horizontal
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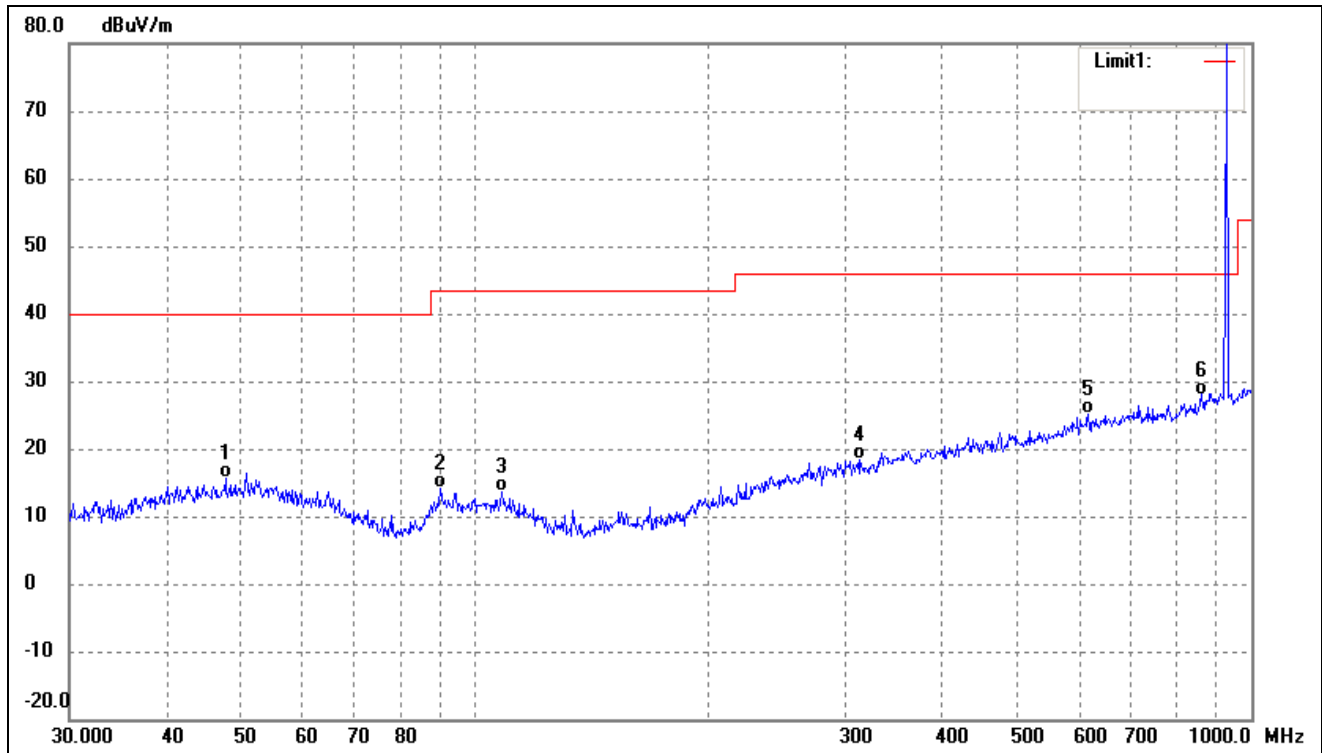
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	50.5860	27.53	-11.60	15.93	40.00	-24.07	135	100	QP
2	88.9639	28.04	-14.21	13.83	43.50	-29.67	235	100	QP
3	117.7725	28.23	-15.22	13.01	43.50	-30.49	62	100	QP
4	300.3673	26.30	-8.15	18.15	46.00	-27.85	301	100	QP
5	444.8514	27.46	-6.16	21.30	46.00	-24.70	117	100	QP
6	760.7036	28.68	-1.58	27.10	46.00	-18.90	174	100	QP

Test Channel	Middle	Polarity:	Vertical
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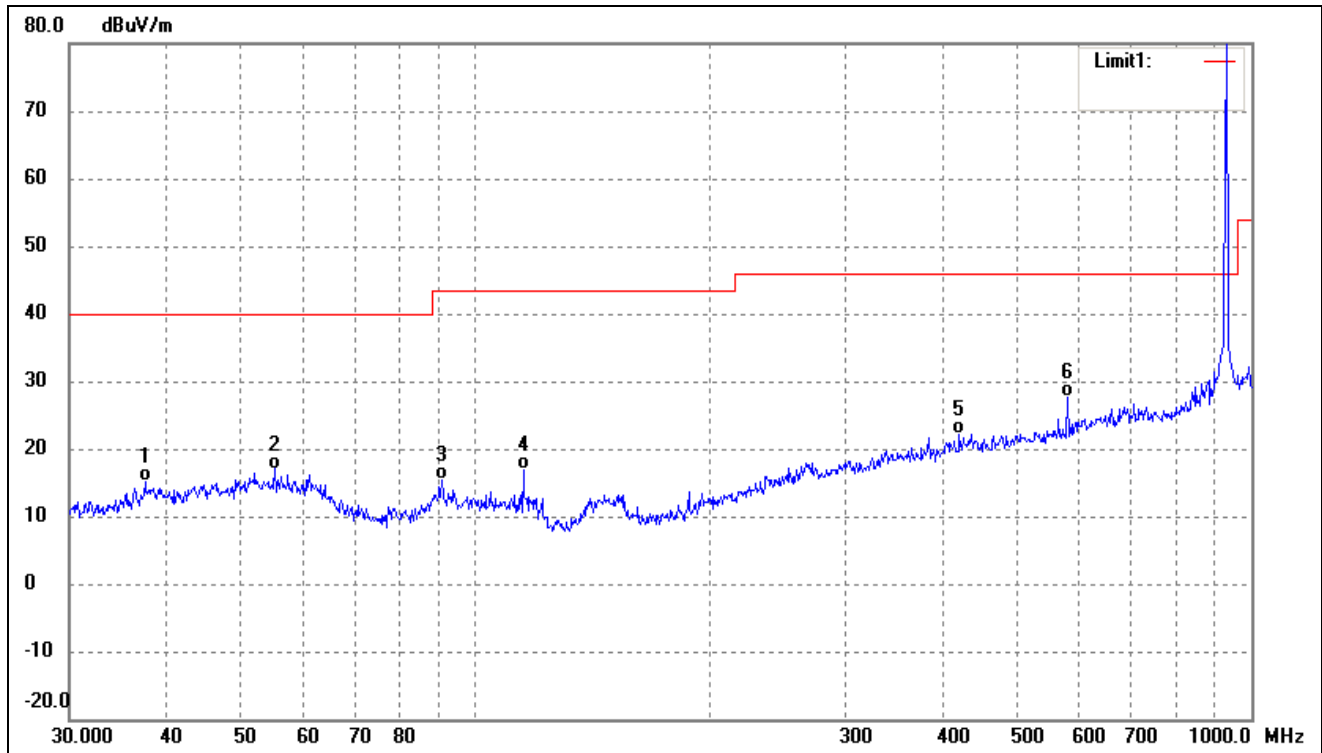
No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	55.0274	28.33	-12.13	16.20	40.00	-23.80	204	100	QP
2	107.5101	27.63	-13.62	14.01	43.50	-29.49	97	100	QP
3	142.3244	30.72	-17.37	13.35	43.50	-30.15	133	100	QP
4	350.4768	26.69	-6.89	19.80	46.00	-26.20	107	100	QP
5	568.6127	32.24	-4.28	27.96	46.00	-18.04	303	100	QP
6	860.0352	29.46	0.09	29.55	46.00	-16.45	166	100	QP

Test Channel	High	Polarity:	Horizontal
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	47.6586	27.21	-11.69	15.52	40.00	-24.48	165	100	QP
2	90.2205	27.50	-13.44	14.06	43.50	-29.44	207	100	QP
3	108.2667	27.29	-13.70	13.59	43.50	-29.91	96	100	QP
4	313.2760	26.77	-8.27	18.50	46.00	-27.50	146	100	QP
5	616.3718	28.28	-3.12	25.16	46.00	-20.84	304	100	QP
6	863.0562	27.81	0.19	28.00	46.00	-18.00	130	100	QP

Test Channel	High	Polarity:	Vertical
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No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree ()	Height (cm)	Remark
1	37.5479	28.62	-13.39	15.23	40.00	-24.77	260	100	QP
2	55.2207	29.18	-12.18	17.00	40.00	-23.00	95	100	QP
3	90.5374	28.88	-13.51	15.37	43.50	-28.13	71	100	QP
4	115.3205	31.79	-14.88	16.91	43.50	-26.59	94	100	QP
5	420.5803	28.51	-6.30	22.21	46.00	-23.79	295	100	QP
6	578.6699	31.48	-3.78	27.70	46.00	-18.30	100	100	QP

➤ Spurious Emissions Below 1GHz

Frequency	Reading	Correct	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	dB	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-916MHz							
1832	60.09	-11.33	48.76	74	-25.24	H	PK
1832	50.32	-11.33	38.99	54	-15.01	H	AV
2748	59.50	-6.26	53.24	74	-20.76	H	PK
2748	48.94	-6.26	42.68	54	-11.32	H	AV
1832	57.83	-11.33	46.50	74	-27.50	V	PK
1832	48.47	-11.33	37.14	54	-16.86	V	AV
2748	59.73	-6.26	53.47	74	-20.53	V	PK
2748	47.15	-6.26	40.89	54	-13.11	V	AV
Middle Channel-922MHz							
1844	59.74	-11.21	48.53	74	-25.47	H	PK
1844	48.74	-11.21	37.53	54	-16.47	H	AV
2766	57.65	-6.23	51.42	74	-22.58	H	PK
2766	47.31	-6.23	41.08	54	-12.92	H	AV
1844	60.33	-11.21	49.12	74	-24.88	V	PK
1844	48.44	-11.21	37.23	54	-16.77	V	AV
2766	58.82	-6.23	52.59	74	-21.41	V	PK
2766	49.01	-6.23	42.78	54	-11.22	V	AV
High Channel-927MHz							
1854	59.80	-11.12	48.68	74	-25.32	H	PK
1854	50.61	-11.12	39.49	54	-14.51	H	AV
2781	57.95	-6.22	51.73	74	-22.27	H	PK
2781	48.43	-6.22	42.21	54	-11.79	H	AV
1854	59.91	-11.12	48.79	74	-25.21	V	PK
1854	49.46	-11.12	38.34	54	-15.66	V	AV
2781	60.09	-6.22	53.87	74	-20.13	V	PK
2781	47.50	-6.22	41.28	54	-12.72	V	AV

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

9. Out of Band Emissions

9.1 Standard Applicable

According to §15.247 (d), 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).

9.2 Test Procedure

According to the KDB 558074 D01 v05r01 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.11, the Emissions in nonrestricted frequency bands test method as follows:

- a) Set the center frequency and span to encompass frequency range to be measured.
- b) Set the RBW = 100 kHz.
- c) Set the VBW $\geq [3 \times \text{RBW}]$.
- d) Detector = peak.
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use the peak marker function to determine the maximum amplitude level.

According to the KDB 558074 D01 v05r01 Subclause 8.5 and ANSI C63.10-2013 Subclause 11.12, the Emissions in restricted frequency bands test method as follows:

A. Radiated emission measurements:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2420MHz for low bandedge, 2460MHz to 2500MHz for the high bandedge)

RBW = 1MHz, VBW = 1MHz for peak value measured

RBW = 1MHz, VBW = 10Hz for average value measured

Sweep = auto; Detector function = peak/average; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement KDB publication number: 913591 may be used for the radiated bandedge measurements.

B. Antenna-port conducted measurements

Peak emission levels are measured by setting the instrument as follows:

- a) RBW = as specified in Table 9/
- b) $VBW \geq [3 \times RBW]$.
- c) Detector = peak.
- d) Sweep time = auto.
- e) Trace mode = max hold.
- f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be lengthened for low-duty-cycle applications.)

Table 9—RBW as a function of frequency

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1000 MHz	100 kHz to 120 kHz
>1000 MHz	1 MHz

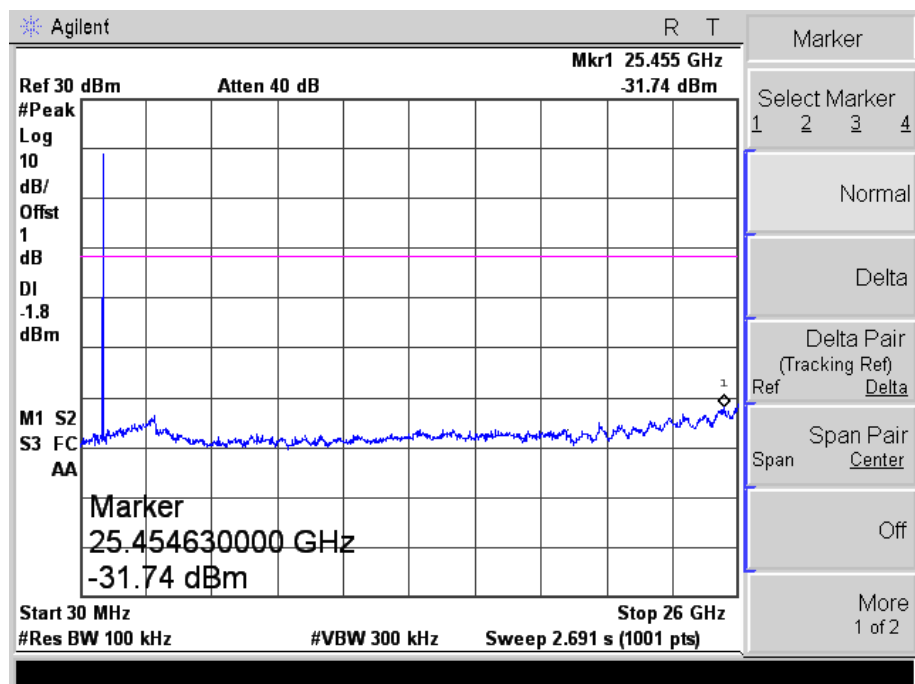
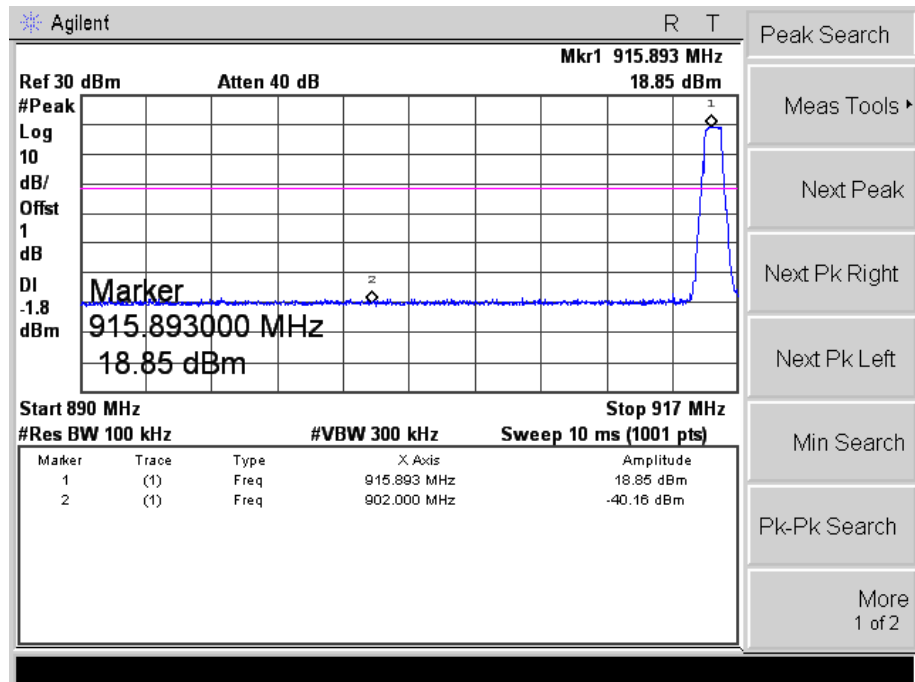
If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in section 8.1. Report the three highest emissions relative to the limit.

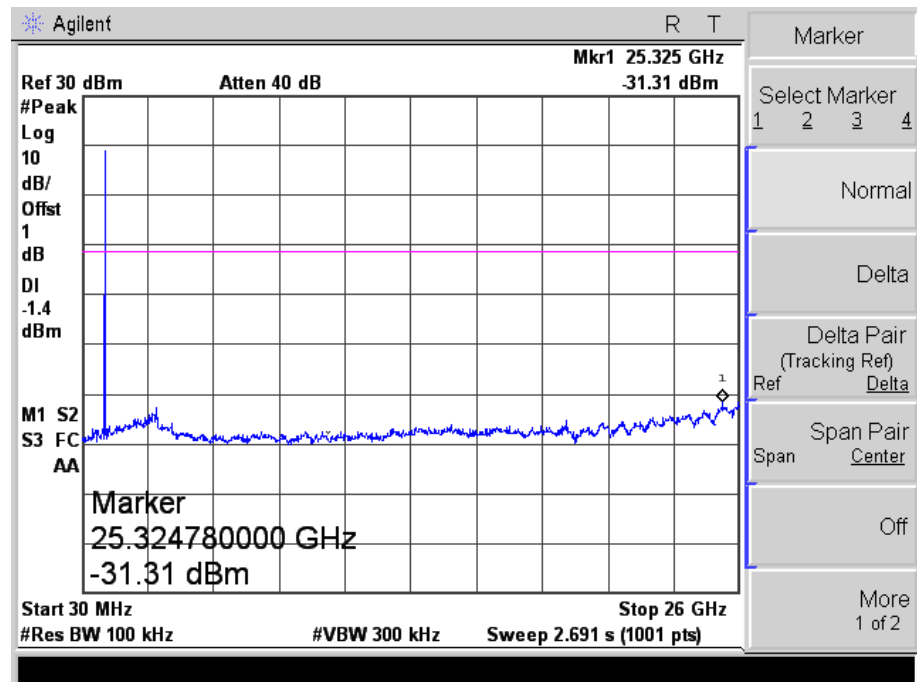
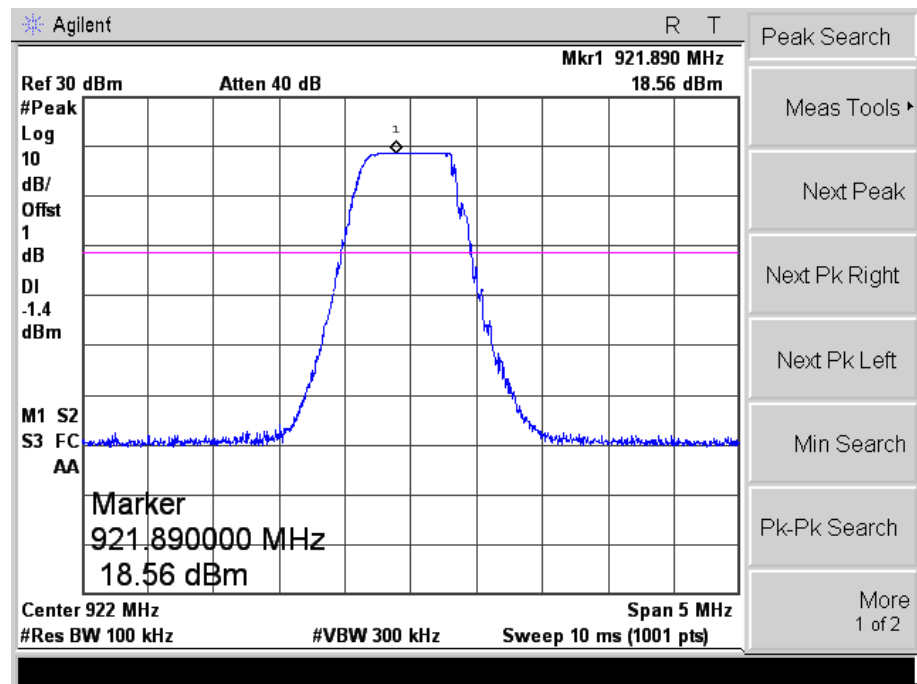
9.3 Summary of Test Results/Plots

➤ Conducted test

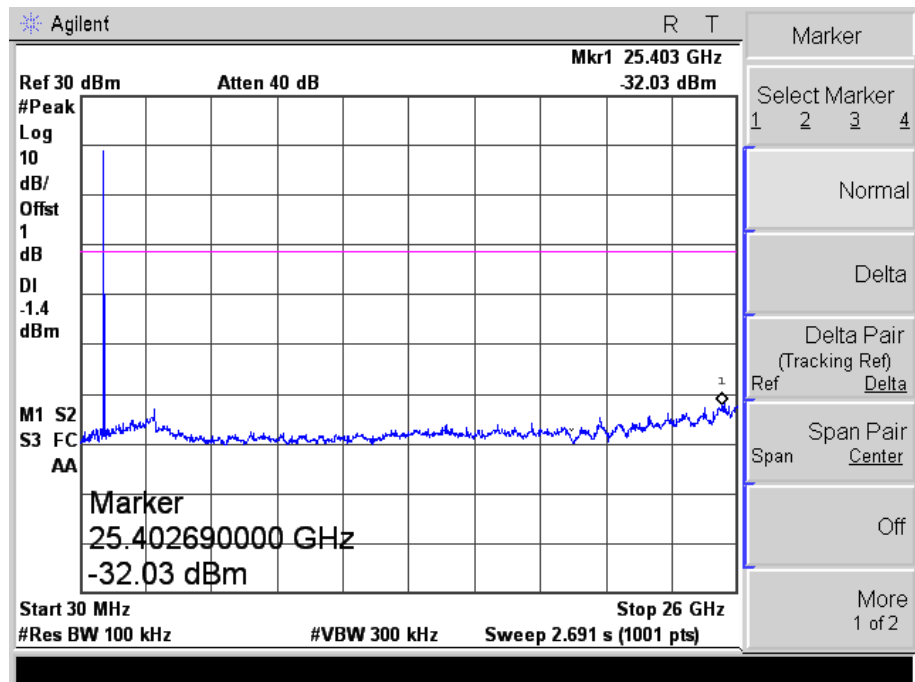
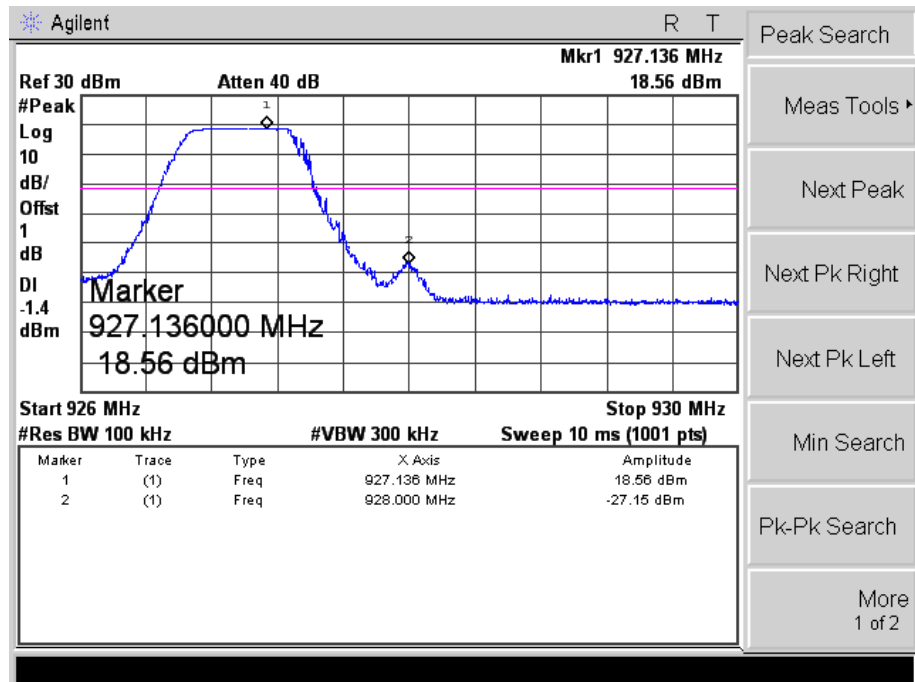
Low



Middle



High



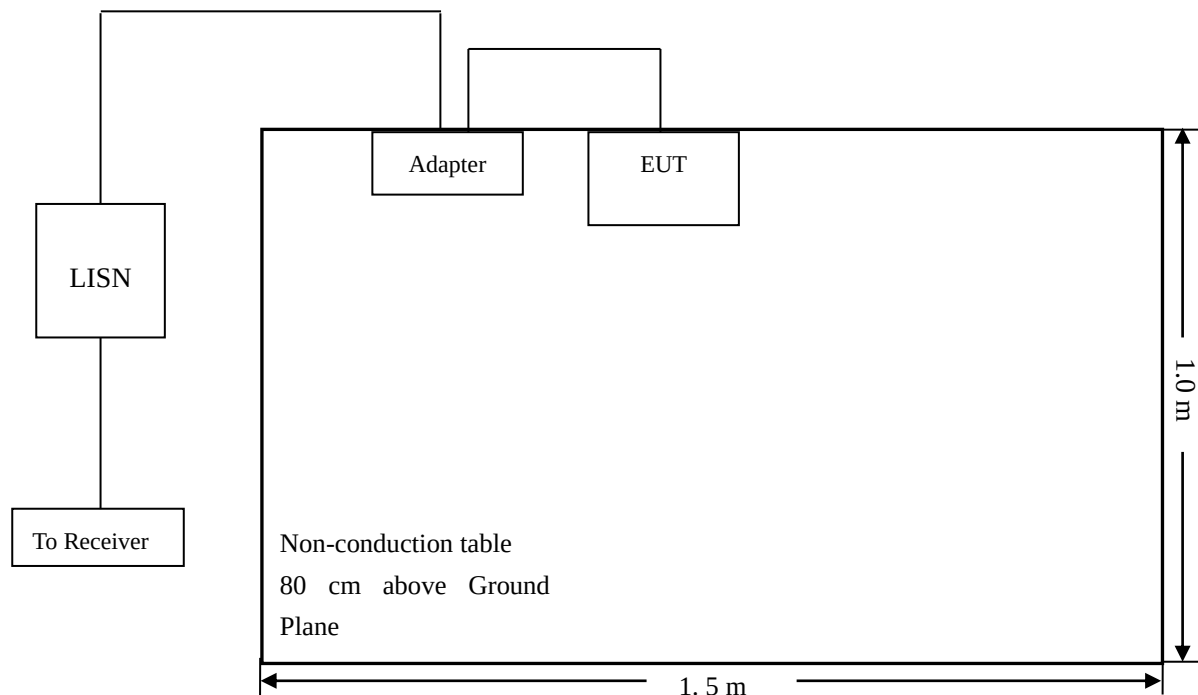
10. Conducted Emissions

10.1 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 measurement procedure. The specification used was with the FCC Part 15.207 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle. The spacing between the peripherals was 10 cm.

10.2 Basic Test Setup Block Diagram



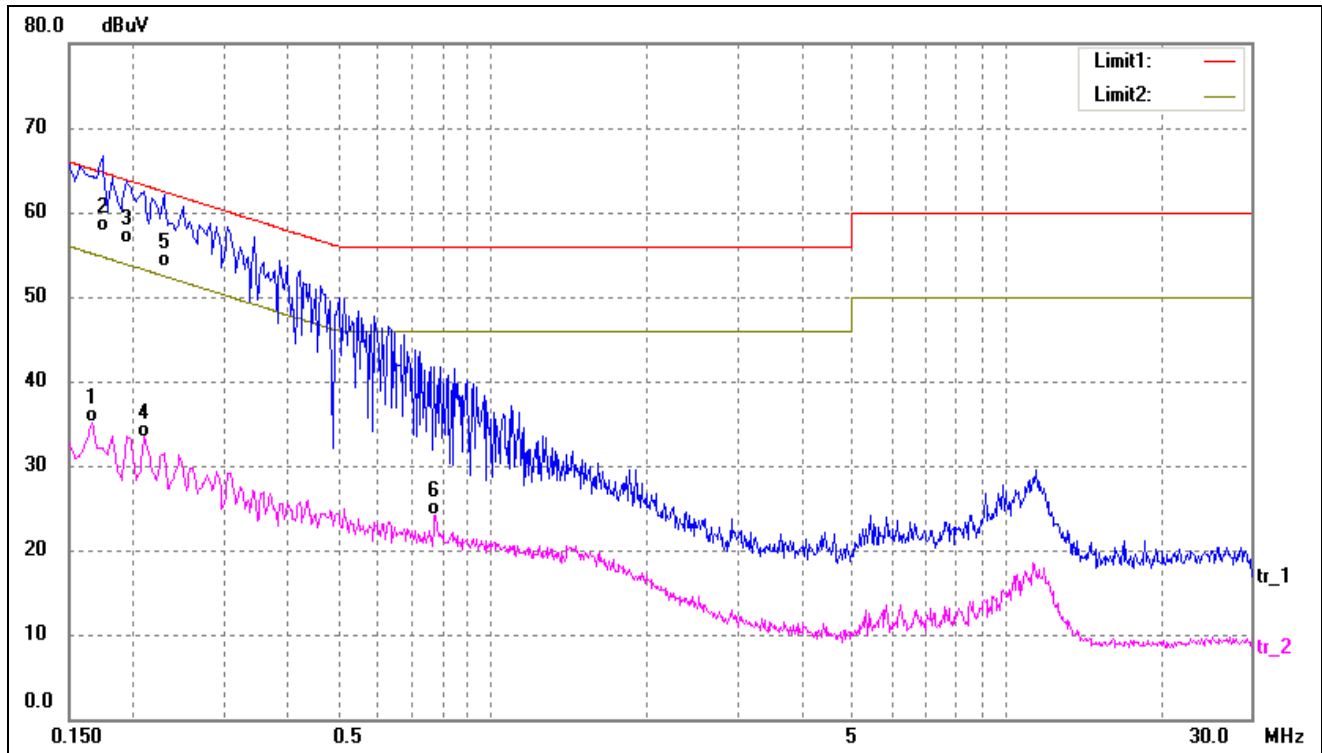
10.3 Test Receiver Setup

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

Start Frequency 150 kHz
Stop Frequency 30 MHz
Sweep Speed Auto
IF Bandwidth..... 10 kHz
Quasi-Peak Adapter Bandwidth 9 kHz
Quasi-Peak Adapter Mode Normal

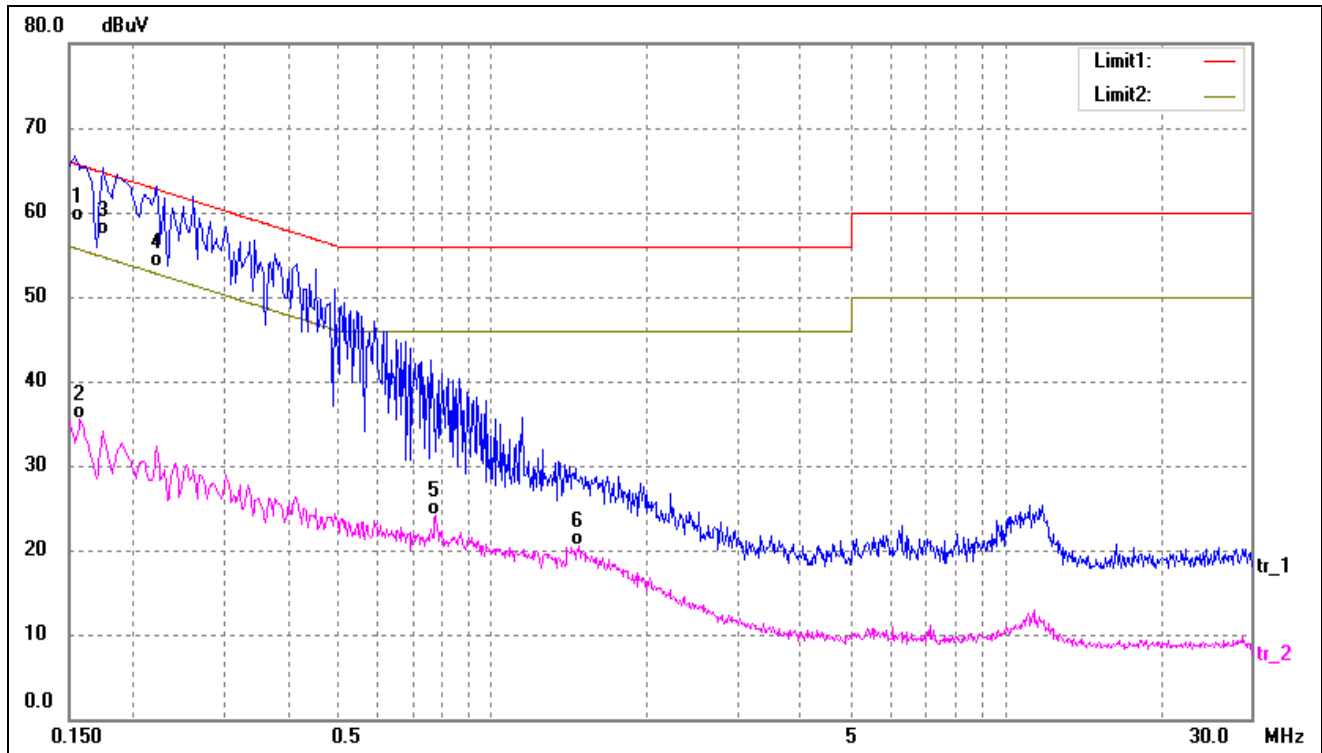
10.4 Summary of Test Results/Plots

Test Mode	Communication	AC120V 60Hz	Polarity:	Neutral
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1	0.1660	24.96	10.11	35.07	55.16	-20.09	AVG
2*	0.1740	47.53	10.11	57.64	64.77	-7.13	QP
3	0.1940	46.14	10.12	56.26	63.86	-7.60	QP
4	0.2100	23.27	10.13	33.40	53.21	-19.81	AVG
5	0.2300	43.31	10.14	53.45	62.45	-9.00	QP
6	0.7780	13.72	10.42	24.14	46.00	-21.86	AVG

Test Mode	Communication	AC120V 60Hz	Polarity:	Line
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No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Detector
1*	0.1540	48.83	10.10	58.93	65.78	-6.85	QP
2	0.1580	25.39	10.10	35.49	55.57	-20.08	AVG
3	0.1740	47.20	10.11	57.31	64.77	-7.46	QP
4	0.2220	43.37	10.14	53.51	62.74	-9.23	QP
5	0.7780	13.61	10.42	24.03	46.00	-21.97	AVG
6	1.4780	9.88	10.56	20.44	46.00	-25.56	AVG

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