TEST REPORT

of

FCC Part 15 Subpart C §15.247
RSS-247 Issue 1, RSS-Gen Issue 4

FCC ID / IC Certification: A3LEOSG710 / 649E-EOSG710

Equipment Under Test	:	Bluetooth Speaker
Model Name	:	EO-SG710
Applicant	:	Samsung Electronics Co., Ltd.
Manufacturer	:	Samsung Electronics Co., Ltd.
Date of Receipt	:	2016.09.09
Date of Test(s)	:	2016.09.09 ~ 2016.10.10
Date of Issue	:	2016.10.19

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

Tested By:  **Date:** **2016.10.19**

Jinhyoung Cho

Technical Manager:  **Date:** **2016.10.19**

Hyunchae You

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
-Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx.
Phone No. : +82 31 688 0901
Fax No. : +82 31 688 0921

1.2. Details of Applicant

Applicant : Samsung Electronics Co., Ltd.
Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Republic of Korea
Contact Person : Choi, Won-Gon
Phone No. : +82 10 3154 1425

1.3. Description of EUT

Kind of Product	Bluetooth Speaker
Model Name	EO-SG710
Power Supply	DC 3.7 V
Frequency Range	2 402 ㎒ ~ 2 480 ㎒ (Bluetooth, Bluetooth Low Energy)
Modulation Technique	GFSK, π/4DQPSK, 8DPSK
Number of Channels	79 channels (Bluetooth), 40 channels (Bluetooth Low Energy)
Antenna Type	PCB antenna
Antenna Gain	1.90 ㏈i
H/W Version	REV1.0
S/W Version	REV1.0

1.4. Declaration by the manufacturer

- The EUT supports with wireless charging function (Receiver).

1.5. Declaration by the manufacturer

- Adaptive Frequency Hopping is supported and use at least 20 channels.

1.6. Information about the FHSS characteristics:

1.6.1. Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

1.6.2. Equal Hopping Frequency Use

The channels of this system will be used equally over the long-term distribution of the hopsets.

1.6.3. Example of a 79 hopping sequence in data mode:

02, 05, 31, 24, 20, 10, 43, 36, 30, 23, 40, 06, 21, 50, 44, 09, 71, 78, 01, 13, 73, 07, 70, 72, 35, 62, 42, 11, 41, 08, 16, 29, 60, 15, 34, 61, 58, 04, 67, 12, 22, 53, 57, 18, 27, 76, 39, 32, 17, 77, 52, 33, 56, 46, 37, 47, 64, 49, 45, 38, 69, 14, 51, 26, 79, 19, 28, 65, 75, 54, 48, 03, 25, 66, 05, 16, 68, 74, 59, 63, 55

1.6.4. System Receiver Input Bandwidth

Each channel bandwidth is 1 ㎒.
The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

1.6.5. Equipment Description

15.247(a)(1) that the rx input bandwidths shift frequencies in synchronization with the transmitted signals.

15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate it channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

1.7. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	Agilent	E8257D	MY51501169	Jul. 07, 2016	Annual	Jul. 07, 2017
Signal Generator	R&S	SMBV100A	255834	Jun. 20, 2016	Annual	Jun. 20, 2017
Spectrum Analyzer	Agilent	N9020A	MY53120526	Jun. 24, 2016	Annual	Jun. 24, 2017
Bluetooth Tester	TESCOM	TC-3000C	3000C000142	Dec. 02, 2015	Annual	Dec. 02, 2016
High Pass Filter	Wainwright Instrument GmbH	WHK3.0/18G-6SS	344	Jun. 03, 2016	Annual	Jun. 03, 2017
High Pass Filter	Wainwright Instrument GmbH	WHNX7.5/26.5G-6SS	15	Jun. 18, 2016	Annual	Jun. 18, 2017
Low Pass Filter	Mini-Circuits	NLP-1200+	V9500401023-2	Jun. 15, 2016	Annual	Jun. 15, 2017
Preamplifier	H.P.	8447F	2944A03909	Aug. 11, 2016	Annual	Aug. 11, 2017
Preamplifier	R&S	SCU-18	10117	Apr. 07, 2016	Annual	Apr. 07, 2017
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	May 12, 2016	Annual	May 12, 2017
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 19, 2015	Biennial	Aug. 19, 2017
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB9163	396	Jun. 18, 2015	Biennial	Jun. 18, 2017
Horn Antenna	R&S	HF906	100326	Feb. 01, 2016	Biennial	Feb. 01, 2018
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA9170	BBHA9170223	Aug. 25, 2016	Biennial	Aug. 25, 2018
Antenna Master	INN-CO GmbH	MM4000	N/A	N.C.R.	N/A	N.C.R.
Turn Table	INNCO systems	CONTROLLER CO3000	N/A	N.C.R.	N/A	N.C.R.
Test Receiver	R&S	ESU26	100109	Mar. 07, 2016	Annual	Mar. 07, 2017
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Test Receiver	R&S	ESCI 7	100911	Dec. 22, 2015	Annual	Dec. 22, 2016
Two-Line V-Network	R&S	ENV216	100190	Dec. 21, 2015	Annual	Dec. 21, 2016
Shield Room	SY Corporation	L × W × H (6.5 m × 3.5 m × 3.5 m)	N/A	N.C.R.	N/A	N.C.R.

▶ Support equipment

Description	Manufacturer	Model	Serial Number	FCC ID
Wireless Charger	Samsung Electronics Co., Ltd.	EP-PN920	RF7G90DN70NCIS	A3LEPPN920

1.8. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part15 subpart C, RSS-247 Issue 1, RSS-Gen Issue 4			
Standard Section		**Test Item**	**Result**
15.205(a) 15.209 15.247(d)	RSS-247 Issue 1 5.5 RSS-Gen Issue 4 8.9	Transmitter Radiated Spurious Emissions Conducted Spurious Emission	Complied
15.247(a)(1)	RSS-247 Issue 1 5.1(2) RSS-Gen Issue 4 6.6	20 dB Bandwidth and 99 % Bandwidth	N/A[1)]
15.247(b)(1)	RSS-247 Issue 1 5.4(2)	Maximum Peak Conducted Output Power	Complied
15.247(a)(1)	RSS-247 Issue 1 5.1(2)	Carrier Frequency Separation	N/A[1)]
15.247(a)(1)(iii)	RSS-247 Issue 1 5.1(4)	Number of Hopping Frequency	N/A[1)]
15.247(a)(1)(iii)	RSS-247 Issue 1 5.1(4)	Time of Occupancy (Dwell Time)	N/A[1)]
15.207	RSS-Gen Issue 4 8.8	AC Power Line Conducted Emissions	Complied

Note;
1) The EUT only performed radiated spurious emission, maximum peak conducted output power and AC power line conducted emission tests because some component was changed.

1.9. Test Procedure(s)

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in DA 00-705 were used in the measurement of the DUT.

1.10. Sample calculation

Where relevant, the following sample calculation is provided:

1.10.1. Radiation test

Field strength level (dBμV/m) = Measured level (dBμV) + Antenna factor (dB) + Cable loss (dB) - Amplifier gain (dB)

1.11. Test report revision

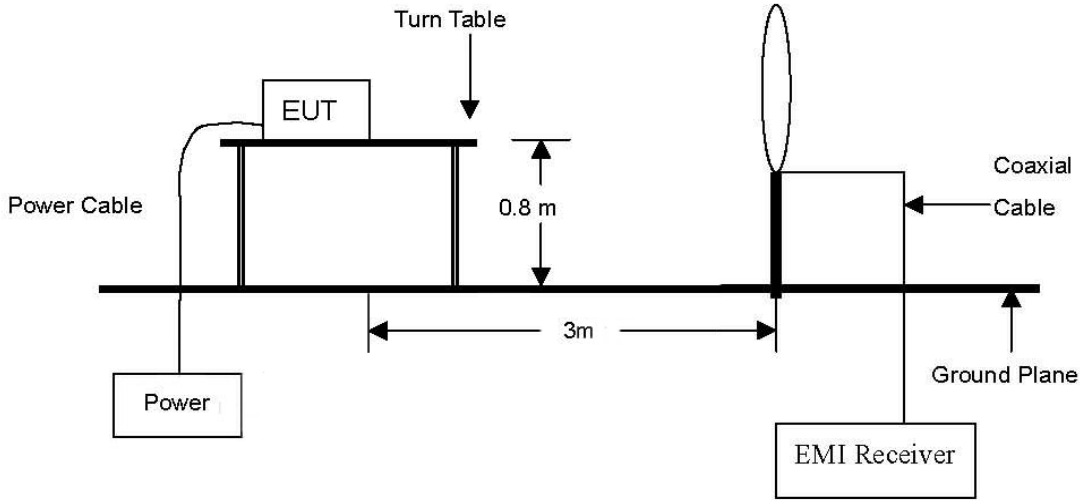
Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL010417	2016.10.19	Initial

2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

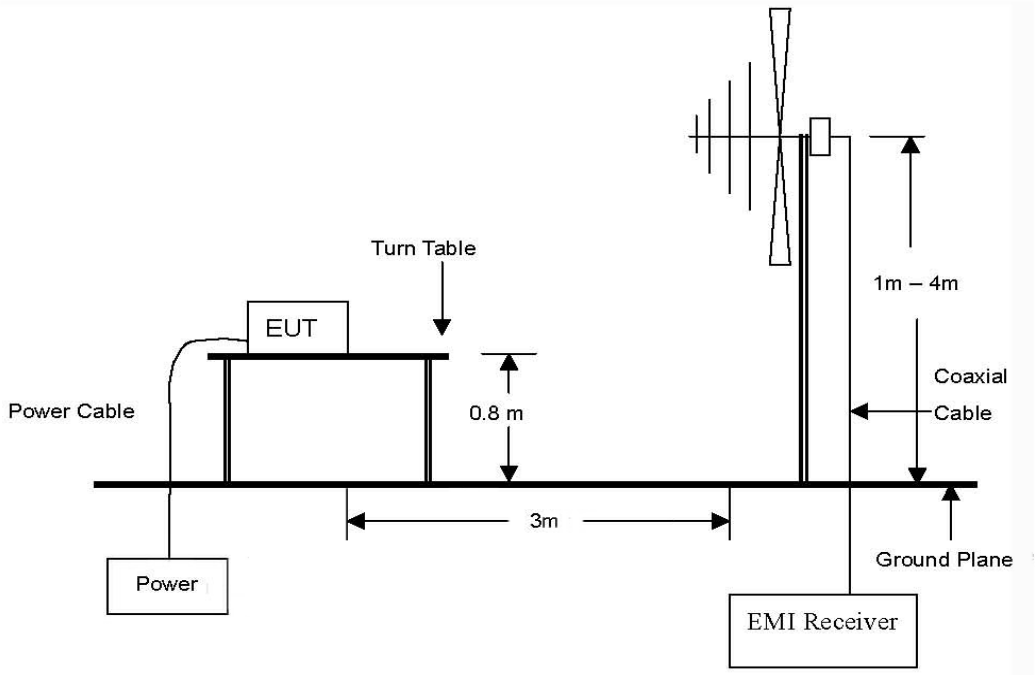
2.1. Test Setup

2.1.1. Transmitter Radiated Spurious Emissions

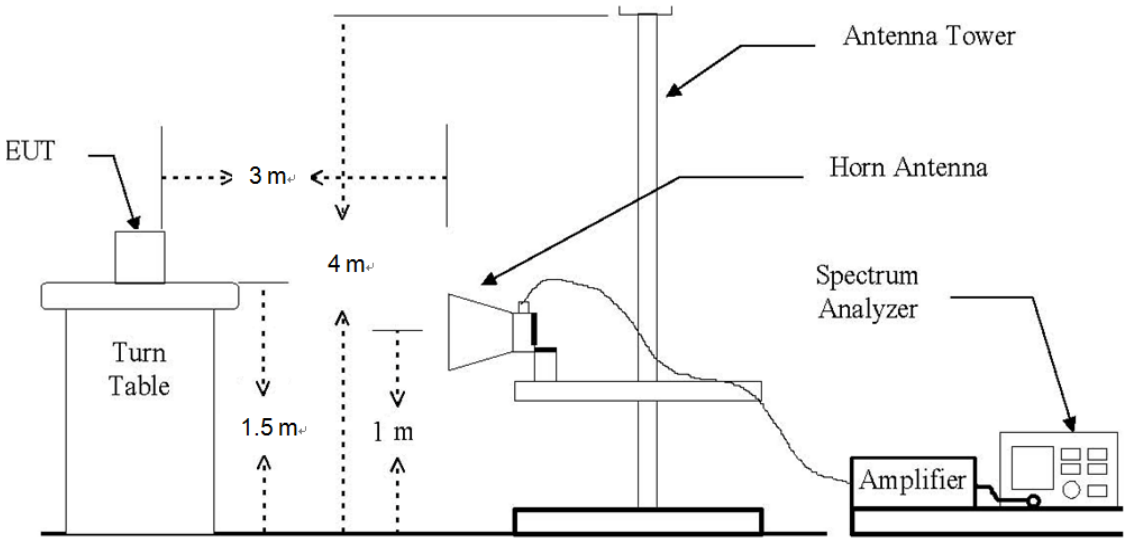
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated form 1 ㎓ to the 10th harmonic of the highest fundamental frequency or 40 ㎓, whichever is lower.



2.2. Limit

FCC

§15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

§15.209(a), Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table：

Frequency (㎒)	Distance (Meters)	Field Strength (㏈㎶/m)	Field Strength (㎶/m)
0.009 – 0.490	300	20 log (2 400/F(㎑))	2 400/F(㎑)
0.490 – 1.705	30	20 log (24 000/F(㎑))	24 000/F(㎑)
1.705 – 30.0	30	29.54	30
30 – 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

IC

RSS-247 Issue 1, 5.5, In any 100 ㎑ bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 ㏈ below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 ㏈ instead of 20 ㏈. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RSS-Gen Issue 4, 8.9

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 ㎒

Frequency (㎒)	Field Strength (㎶/m at 3 metres)
30 - 88	100
88 - 216	150
216 - 960	200
Above 960	500

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

Table 5 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Below 30 ㎒

Frequency	Electric Field Strength (㎶/m)	Magnetic Field Strength (㎂/m)	Measurement Distance (Metres)
0.009 - 0.490 ㎑	2 400/F (F in ㎑)	2 400/377F (F in ㎑)	300
0.490 - 1.705 ㎑	24 000/F (F in ㎑)	24 000/377F (F in ㎑)	30
1.705 - 30 ㎒	30	N/A	30

Note: The emission limits for the bands 9-90 ㎑ and 110-490 ㎑ are based on measurements employing a linear average detector. Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the relevant RSS.

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.10-2013.

Remark;
Battery Cover used on device is supported to operating during battery charging condition with wireless charger. According to KDB 648474 D03 Wireless Chargers Battery Cover v01r04, the transmitter spurious emission measurement has to be adjusted as two kind of test which are without battery charger and with battery charger during normal charging condition in radiated spurious emission.

2.3.1. Test Procedures for emission below 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

Note;
Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 meter open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 937606.

2.3.2. Test Procedures for emission from above 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 ㎓ and 1.5 meter above the ground at a 3 meter anechoic chamber test site above 1 ㎓. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its 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.
4. 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 and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 ㏈ 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 10 ㏈ margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

NOTE;

All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒ and the video bandwidth is $1/T_{on}$ ㎐ (T_{on} = On-time of the Pulsed emission) for Average detection (AV) at frequency above 1 ㎓.
   VBW = 360 ㎐ ≥ $1/T_{on}$ ㎐, pulse width in seconds (T_{on} = 2.90 ㎳). Refer to the DH5, 3DH5 of Time of Occupancy (Dwell Time) test item.
4. When Average result is different from peak result over 20 ㏈ (over-averaging), According to 15.35 (c), as a “duty cycle correction factor”, pulse averaging with 20 log(duty cycle) has to be used.
5. To get a maximum emission level from the EUT, the EUT is manipulated through three orthogonal planes (X, Y, Z). Worst orthogonal plan of EUT is **Z– axis** during radiation test.

2.4. Test Results

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

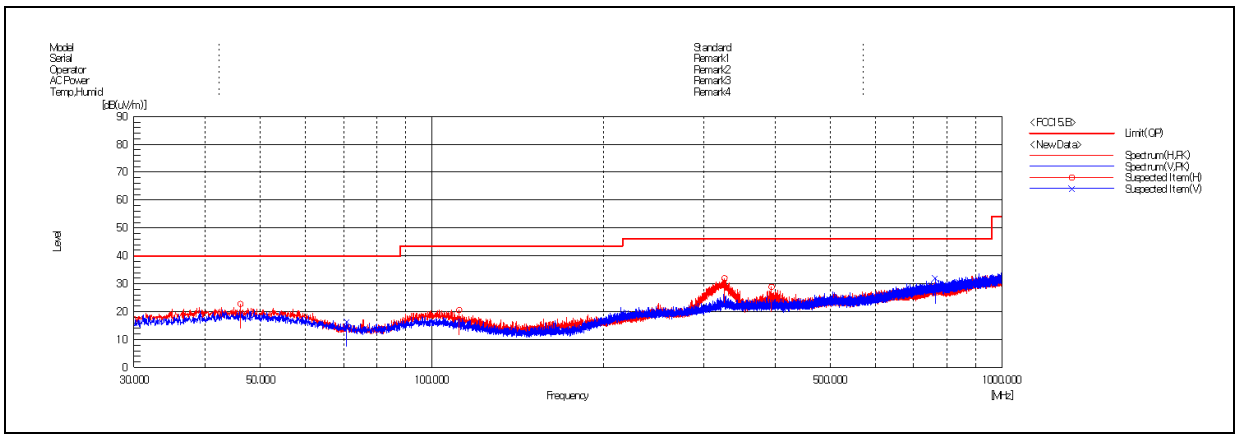
2.4.1. Radiated Spurious Emission below 1 000 ㎒

The frequency spectrum from 9 ㎑ to 1 000 ㎒ was investigated. All reading values are peak values.

EUT (without wireless charging mode)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
46.17	33.80	Peak	H	16.05	-27.11	22.74	40.00	17.26
326.21	42.60	Peak	H	14.72	-25.26	32.06	46.00	13.94
394.28	37.60	Peak	H	16.86	-25.65	28.81	46.00	17.19
763.89	34.60	Peak	V	22.47	-25.15	31.92	46.00	14.08
Above 800.00	Not detected	-	-	-	-	-	-	-

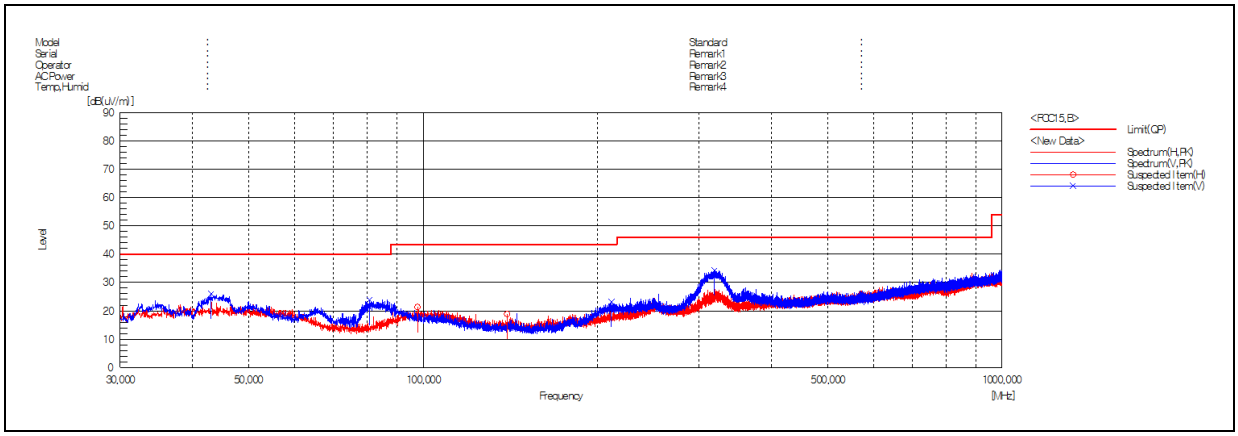
Test plot



EUT (with wireless charging mode)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
43.01	38.60	Peak	V	14.40	-27.14	25.86	40.00	14.14
80.80	40.90	Peak	V	9.86	-26.78	23.98	40.00	16.02
318.45	43.90	Peak	V	15.63	-25.26	34.27	46.00	11.73
Above 400.00	Not detected	-	-	-	-	-	-	-

Test plot



Remark:
1. Spurious emissions for all channels and modes were investigated and almost the same below 1 ㎓.
2. Reported spurious emissions are in **EDR / 3DH5 /Middle channel** as worst case among other modes.
3. Radiated spurious emission measurement as below.
   (Actual = Reading + AF + AMP+ CL)
4. According to §15.31(o), emission levels are not report much lower than the limits by over 20 ㏈.

2.4.2. Radiated Spurious Emission above 1 000 ㎒

The frequency spectrum above 1 000 ㎒ was investigated. All reading values are peak and average values.

EUT (without wireless charging mode)

Operating Mode: GFSK (1 Mbps)

A. Low Channel (2 402 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 310.00	12.75	Peak	V	28.07	5.31	46.13	74.00	27.87
*2 310.00	4.40	Average	V	28.07	5.31	37.78	54.00	16.22
*2 361.30	16.95	Peak	V	28.12	5.57	50.64	74.00	23.36
*2 362.02	11.90	Average	V	28.12	5.58	45.60	54.00	8.40
*2 390.00	13.96	Peak	V	28.15	5.80	47.91	74.00	26.09
*2 390.00	4.80	Average	V	28.15	5.80	38.75	54.00	15.25

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 804.34	45.69	Peak	H	32.66	-30.25	48.10	74.00	25.90
*4 804.13	38.38	Average	H	32.66	-30.26	40.78	54.00	13.22
Above 4 900.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 882.50	44.98	Peak	H	32.87	-29.69	48.16	74.00	25.84
*4 882.04	37.45	Average	H	32.86	-29.69	40.62	54.00	13.38
Above 4 900.00	Not detected	-	-	-	-	-	-	-

C. High Channel (2 480 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 483.50	11.36	Peak	V	28.24	5.54	45.14	74.00	28.86
*2 483.50	5.59	Average	V	28.24	5.54	39.37	54.00	14.63
*2 493.80	13.44	Peak	V	28.25	5.51	47.20	74.00	26.80
*2 493.14	5.47	Average	V	28.25	5.51	39.23	54.00	14.77
*2 500.00	12.69	Peak	V	28.26	5.49	46.44	74.00	27.56
*2 500.00	5.05	Average	V	28.26	5.49	38.80	54.00	15.20

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 959.94	45.05	Peak	H	33.07	-29.47	48.65	74.00	25.35
*4 960.11	37.61	Average	H	33.07	-29.47	41.21	54.00	12.79
Above 5 000.00	Not detected	-	-	-	-	-	-	-

Operating Mode: 8DPSK (3 Mbps)

A. Low Channel (2 402 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 310.00	13.13	Peak	V	28.07	5.31	46.51	74.00	27.49
*2 310.00	4.46	Average	V	28.07	5.31	37.84	54.00	16.16
*2 362.02	17.19	Peak	V	28.12	5.58	50.89	74.00	23.11
*2 362.02	10.32	Average	V	28.12	5.58	44.02	54.00	9.98
*2 390.00	13.55	Peak	V	28.15	5.80	47.50	74.00	26.50
*2 390.00	4.81	Average	V	28.15	5.80	38.76	54.00	15.24

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 804.34	44.50	Peak	H	32.66	-30.25	46.91	74.00	27.09
*4 804.06	36.96	Average	H	32.65	-30.26	39.35	54.00	14.65
Above 4 900.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 881.95	44.47	Peak	H	32.86	-29.69	47.64	74.00	26.36
*4 882.16	36.14	Average	H	32.86	-29.69	39.31	54.00	14.69
Above 4 900.00	Not detected	-	-	-	-	-	-	-

C. High Channel (2 480 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 483.50	15.02	Peak	V	28.24	5.54	48.80	74.00	25.20
*2 483.50	5.91	Average	V	28.24	5.54	39.69	54.00	14.31
*2 492.90	15.65	Peak	V	28.25	5.51	49.41	74.00	24.59
*2 492.54	5.08	Average	V	28.25	5.51	38.84	54.00	15.16
*2 500.00	13.89	Peak	V	28.26	5.49	47.64	74.00	26.36
*2 500.00	5.07	Average	V	28.26	5.49	38.82	54.00	15.18

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 960.01	44.85	Peak	H	33.07	-29.47	48.45	74.00	25.55
*4 960.04	36.33	Average	H	33.07	-29.47	39.93	54.00	14.07
Above 5 000.00	Not detected	-	-					

Remarks;

1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + AMP + CL or Reading + AF + CL
5. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 ㏈.

EUT (with wireless charging mode)

Operating Mode: GFSK (1 Mbps)

A. Low Channel (2 402 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 310.00	14.20	Peak	V	28.07	5.31	47.58	74.00	26.42
*2 310.00	4.38	Average	V	28.07	5.31	37.76	54.00	16.24
*2 362.22	15.75	Peak	V	28.12	5.58	49.45	74.00	24.55
*2 362.12	7.93	Average	V	28.12	5.58	41.63	54.00	12.37
*2 390.00	12.11	Peak	V	28.15	5.80	46.06	74.00	27.94
*2 390.00	4.70	Average	V	28.15	5.80	38.65	54.00	15.35

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 803.98	43.98	Peak	H	32.65	-30.26	46.37	74.00	27.63
*4 804.11	34.42	Average	H	32.66	-30.26	36.82	54.00	17.18
Above 4 900.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 882.26	43.00	Peak	H	32.86	-29.69	46.17	74.00	27.83
*4 882.06	34.90	Average	H	32.86	-29.69	38.07	54.00	15.93
Above 4 900.00	Not detected	-	-	-	-	-	-	-

C. High Channel (2 480 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 483.50	14.15	Peak	V	28.24	5.54	47.93	74.00	26.07
*2 483.50	4.99	Average	V	28.24	5.54	38.77	54.00	15.23
*2 492.45	15.32	Peak	V	28.25	5.51	49.08	74.00	24.92
*2 490.95	4.78	Average	V	28.25	5.52	38.55	54.00	15.45
*2 500.00	13.44	Peak	V	28.26	5.49	47.19	74.00	26.81
*2 500.00	4.81	Average	V	28.26	5.49	38.56	54.00	15.44

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 959.64	43.82	Peak	H	33.07	-29.47	47.42	74.00	26.58
*4 960.03	35.77	Average	H	33.07	-29.47	39.37	54.00	14.63
Above 5 000.00	Not detected	-	-	-	-	-	-	-

Operating Mode: 8DPSK (3 Mbps)

A. Low Channel (2 402 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 310.00	12.72	Peak	V	28.07	5.31	46.10	74.00	27.90
*2 310.00	4.54	Average	V	28.07	5.31	37.92	54.00	16.08
*2 362.81	16.38	Peak	V	28.12	5.58	50.08	74.00	23.92
*2 362.02	7.17	Average	V	28.12	5.58	40.87	54.00	13.13
*2 390.00	13.03	Peak	V	28.15	5.80	46.98	74.00	27.02
*2 390.00	4.63	Average	V	28.15	5.80	38.58	54.00	15.42

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 804.08	42.24	Peak	H	32.65	-30.26	44.63	74.00	29.37
*4 803.96	33.31	Average	H	32.65	-30.26	35.70	54.00	18.30
Above 4 900.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 882.00	42.85	Peak	H	32.86	-29.69	46.02	74.00	27.98
*4 882.14	33.71	Average	H	32.86	-29.69	36.88	54.00	17.12
Above 4 900.00	Not detected	-	-	-	-	-	-	-

C. High Channel (2 480 ㎒)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 483.50	13.71	Peak	V	28.24	5.54	47.49	74.00	26.51
*2 483.50	5.05	Average	V	28.24	5.54	38.83	54.00	15.17
*2 489.93	15.53	Peak	V	28.25	5.52	49.30	74.00	24.70
*2 488.76	4.81	Average	V	28.25	5.53	38.59	54.00	15.41
*2 500.00	13.83	Peak	V	28.26	5.49	47.58	74.00	26.42
*2 500.00	4.88	Average	V	28.26	5.49	38.63	54.00	15.37

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 960.02	43.68	Peak	H	33.07	-29.47	47.28	74.00	26.72
*4 960.03	35.77	Average	H	33.07	-29.47	39.37	54.00	14.63
Above 5 000.00	Not detected	-	-	-	-	-	-	-

Remarks;

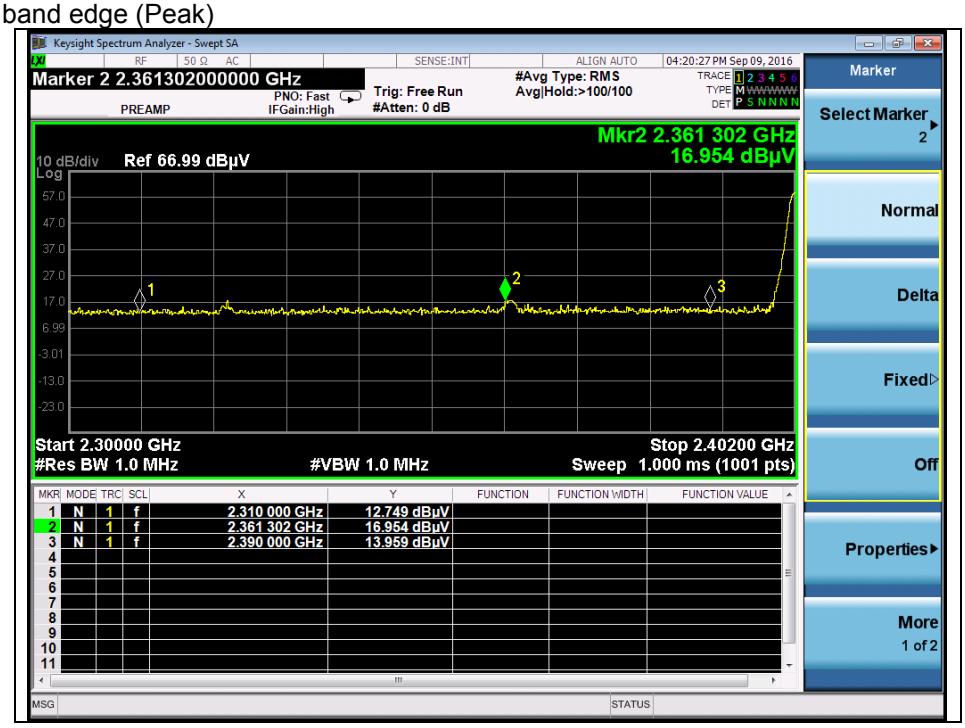
1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + AMP + CL or Reading + AF + CL
5. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 ㏈.

2.4.3. Plot of Transmitter Radiated Spurious Emissions

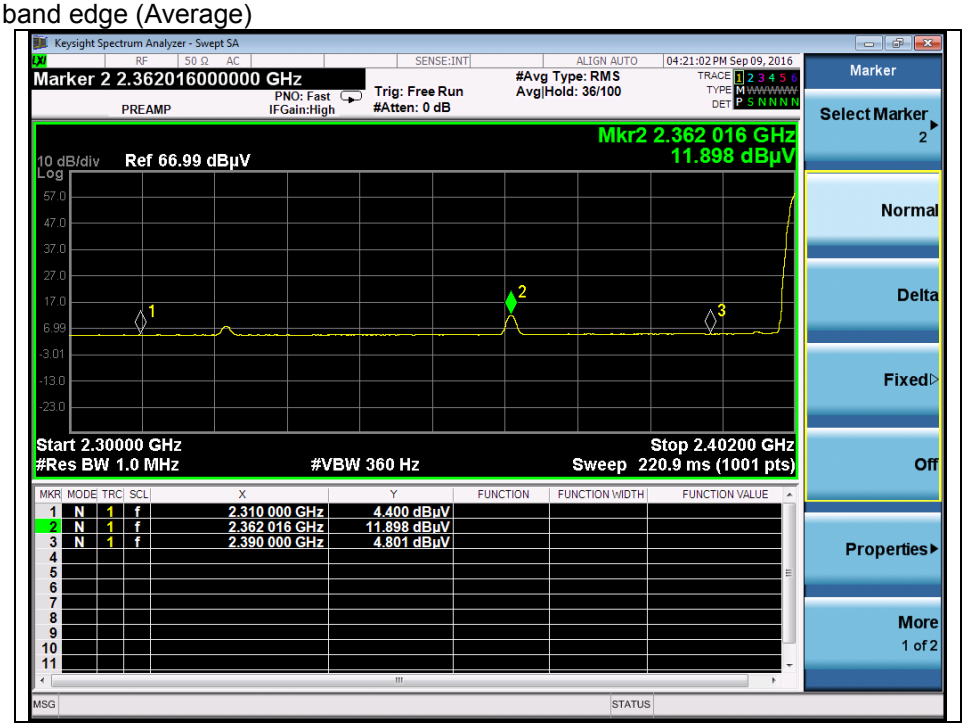
EUT (without wireless charging mode)

Operating Mode: GFSK (1 Mbps)

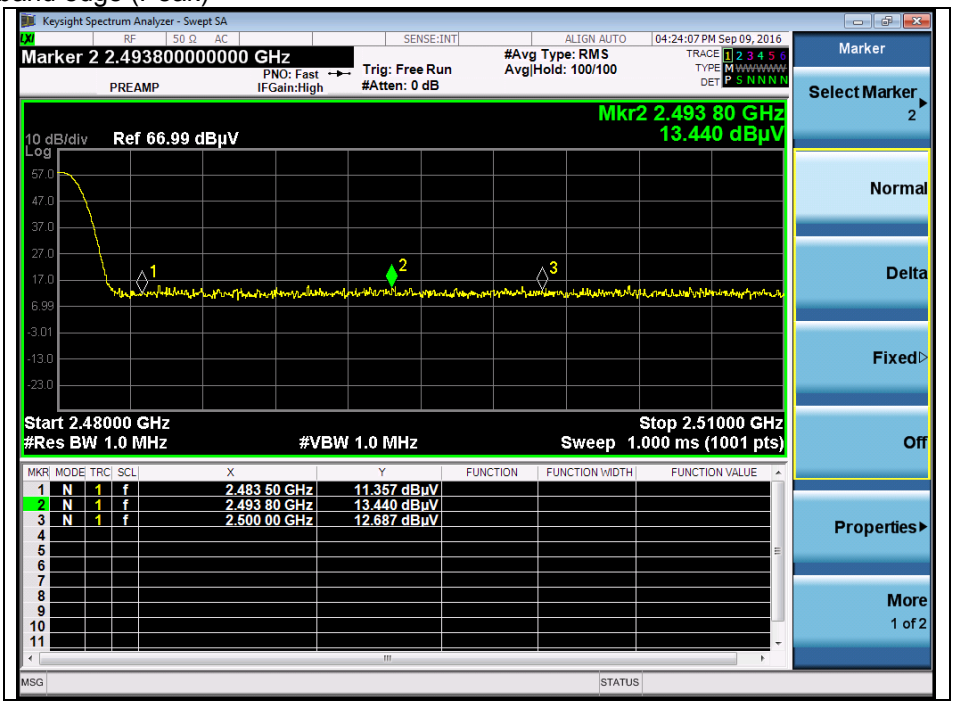
Low channel band edge (Peak)



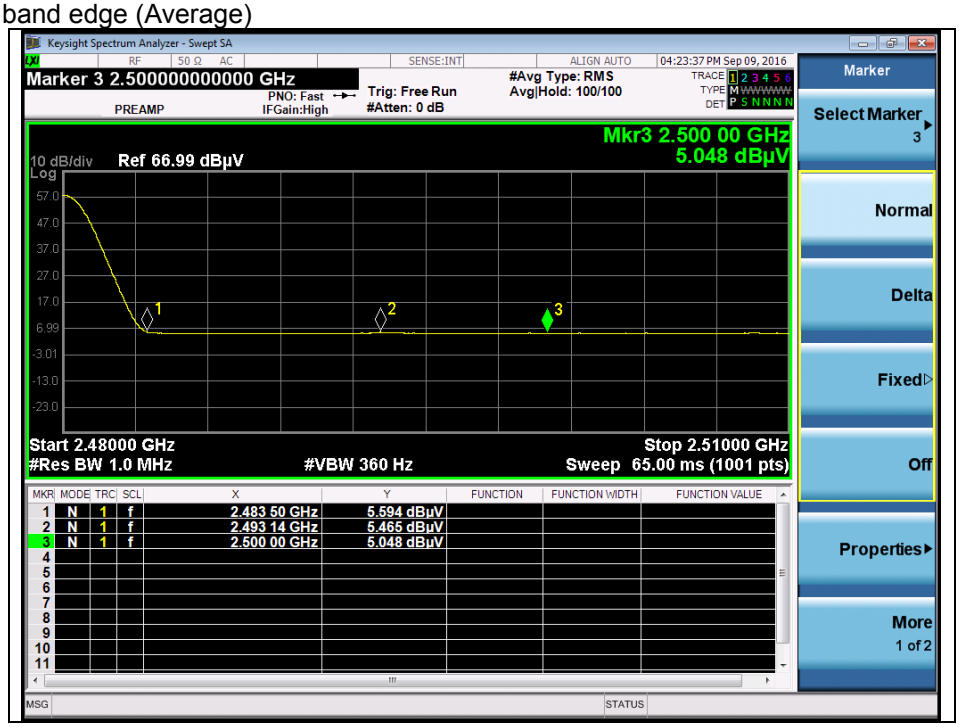
Low channel band edge (Average)



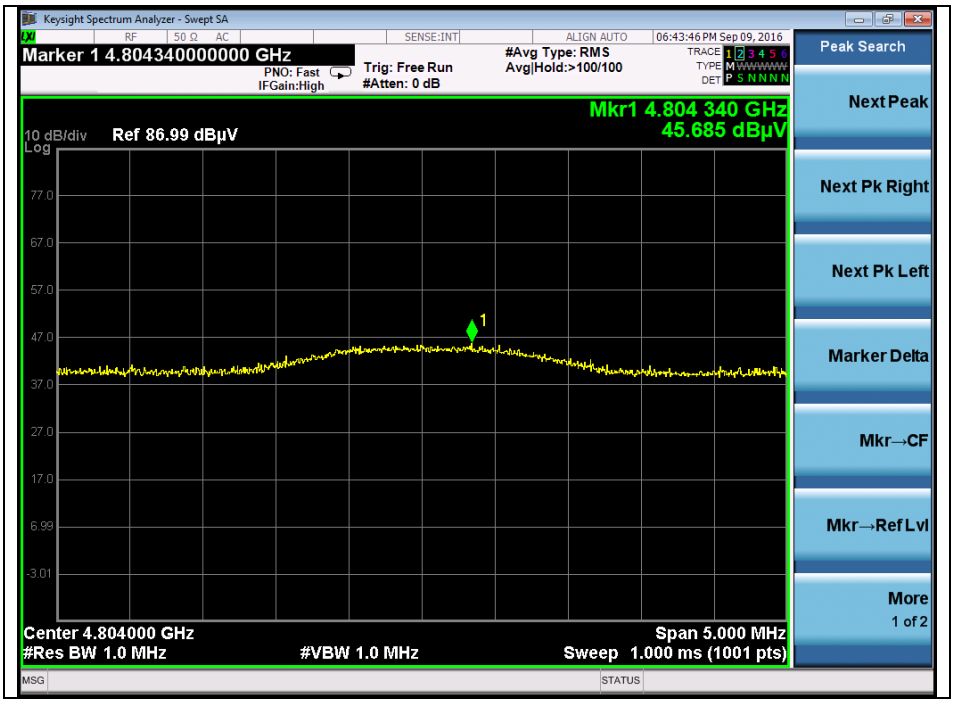
High channel band edge (Peak)



High channel band edge (Average)



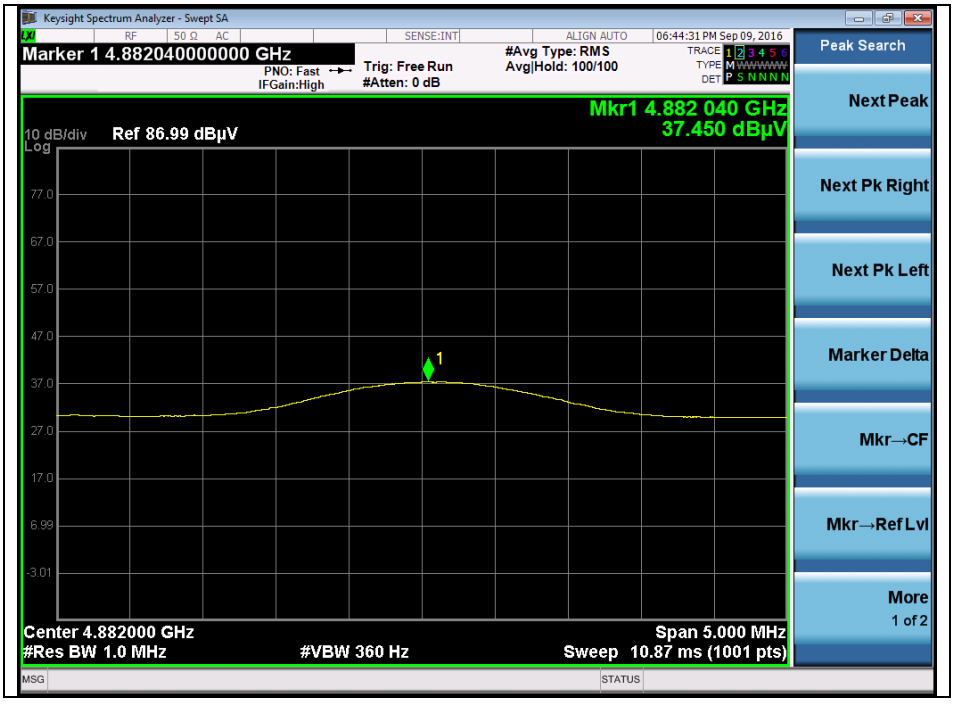
Low channel 2nd harmonic (Peak)



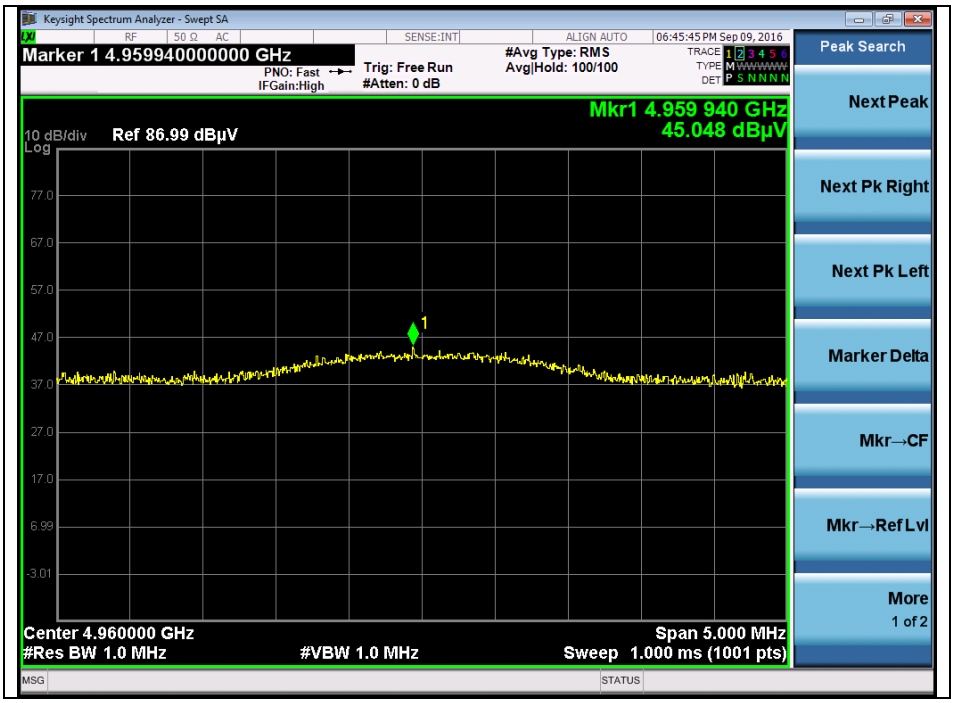
Low channel 2nd harmonic (Average)

Middle channel 2nd harmonic (Peak)

Middle channel 2nd harmonic (Average)



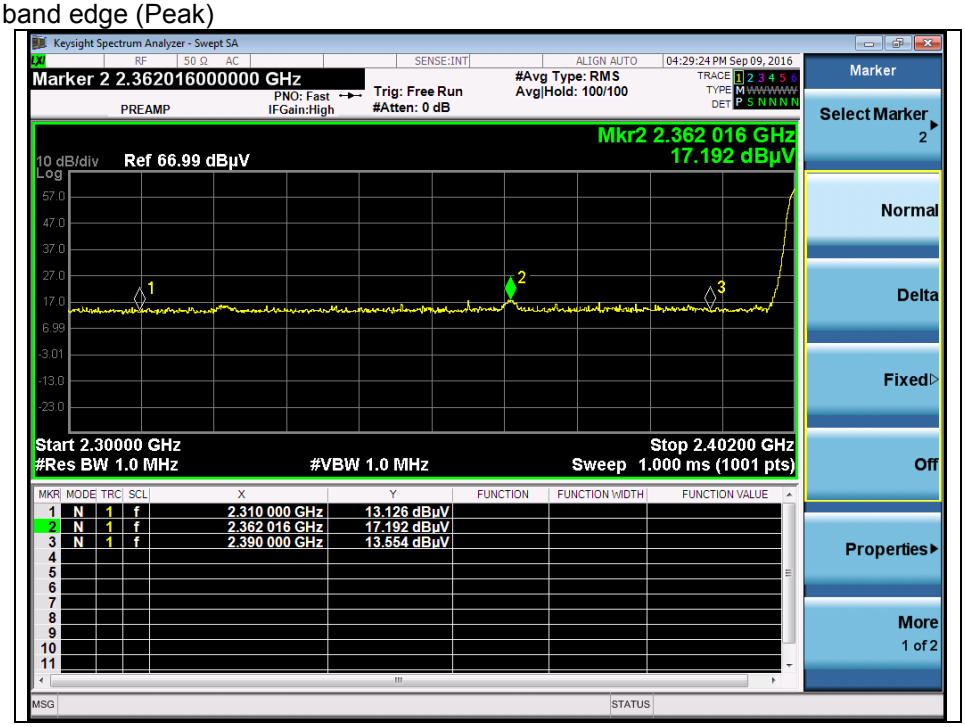
High channel 2nd harmonic (Peak)



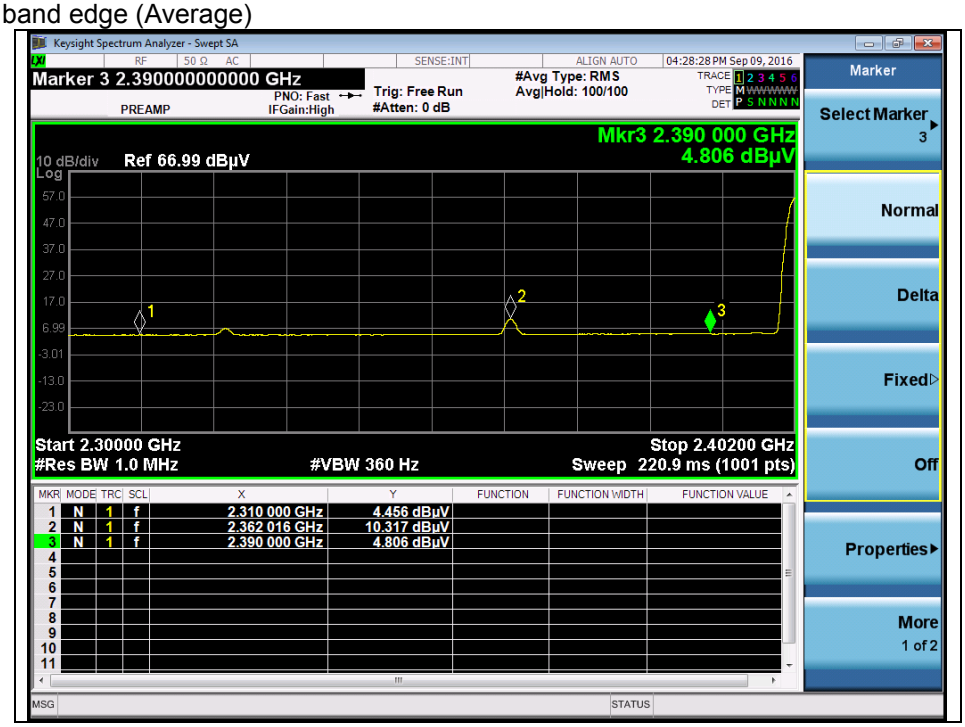
High channel 2nd harmonic (Average)

Operating Mode: 8DPSK (3 Mbps)

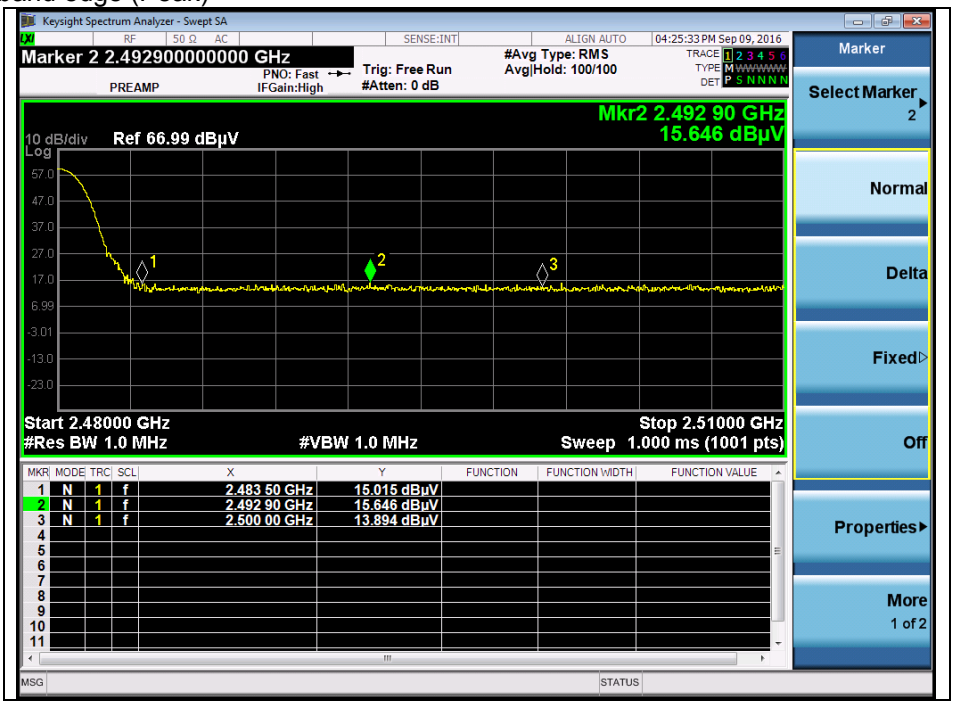
Low channel band edge (Peak)



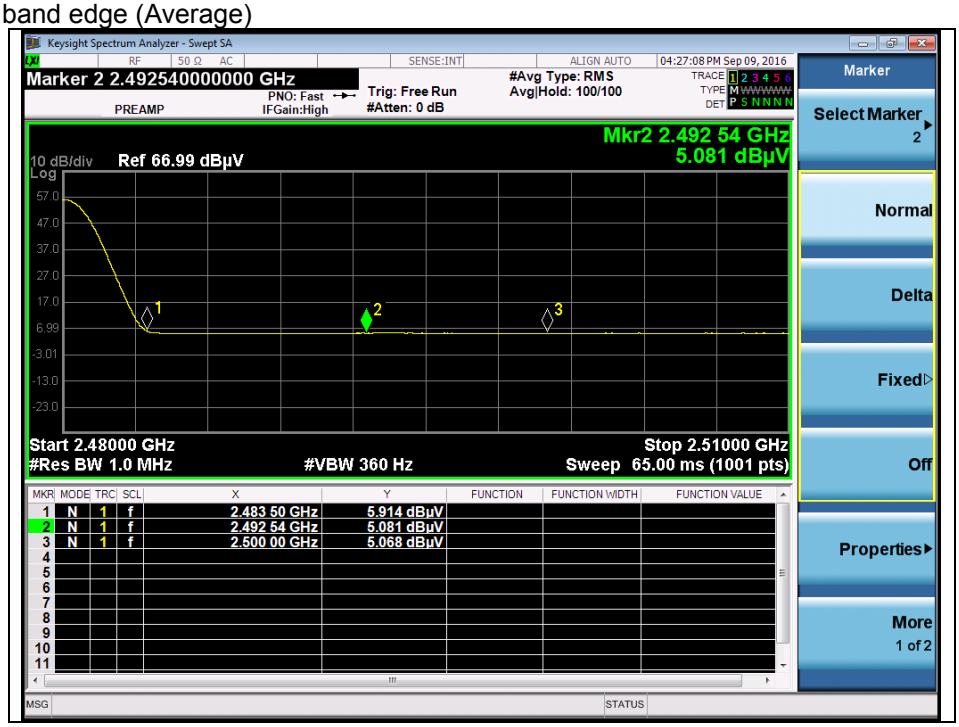
Low channel band edge (Average)



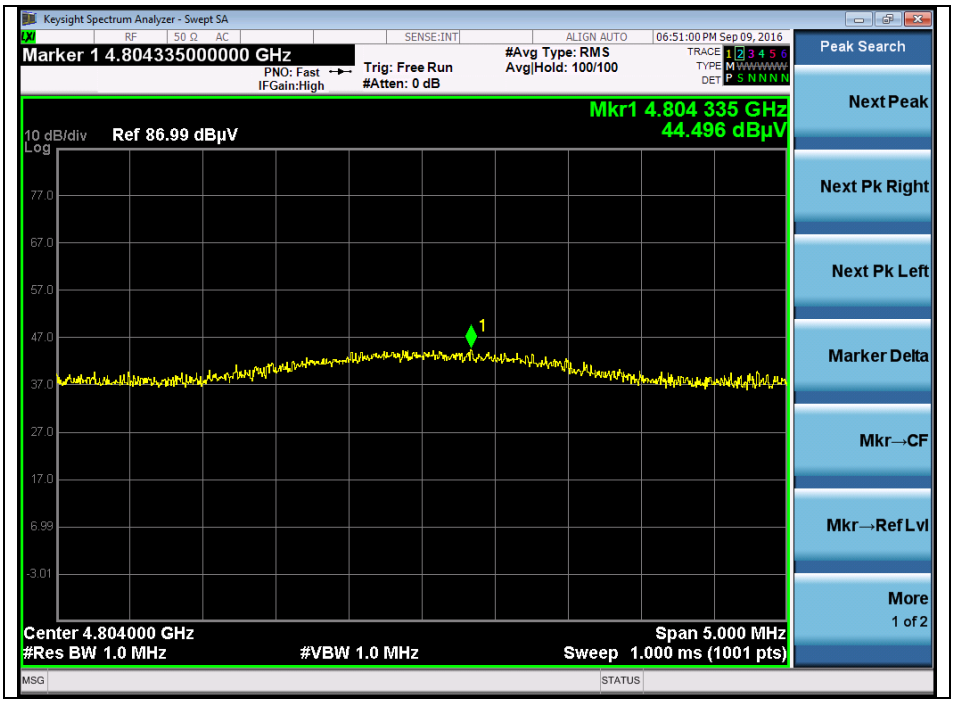
High channel band edge (Peak)



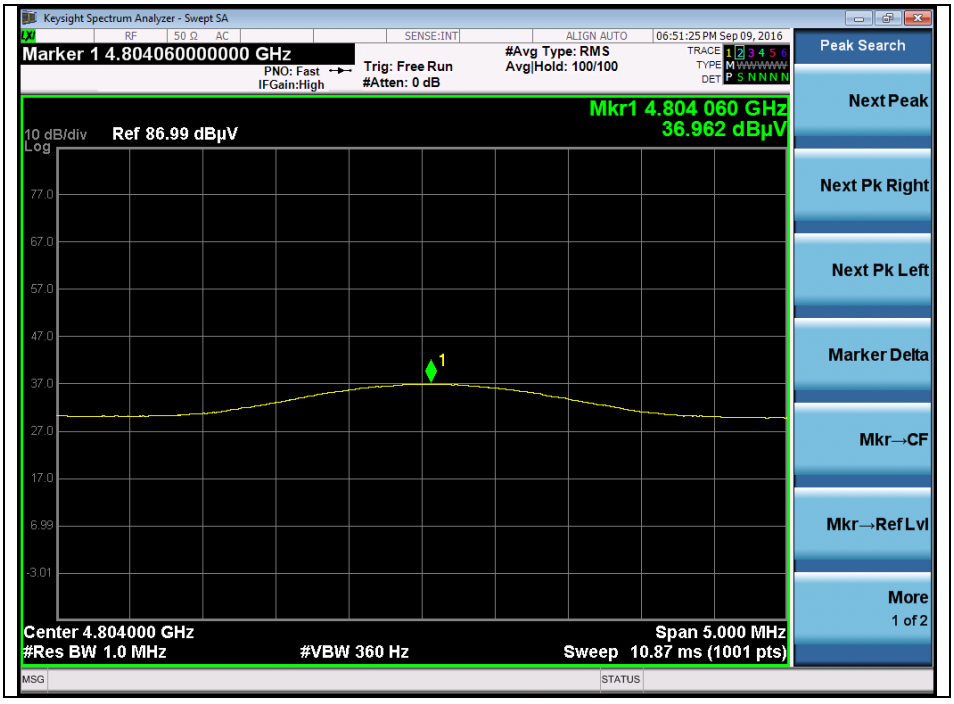
High channel band edge (Average)



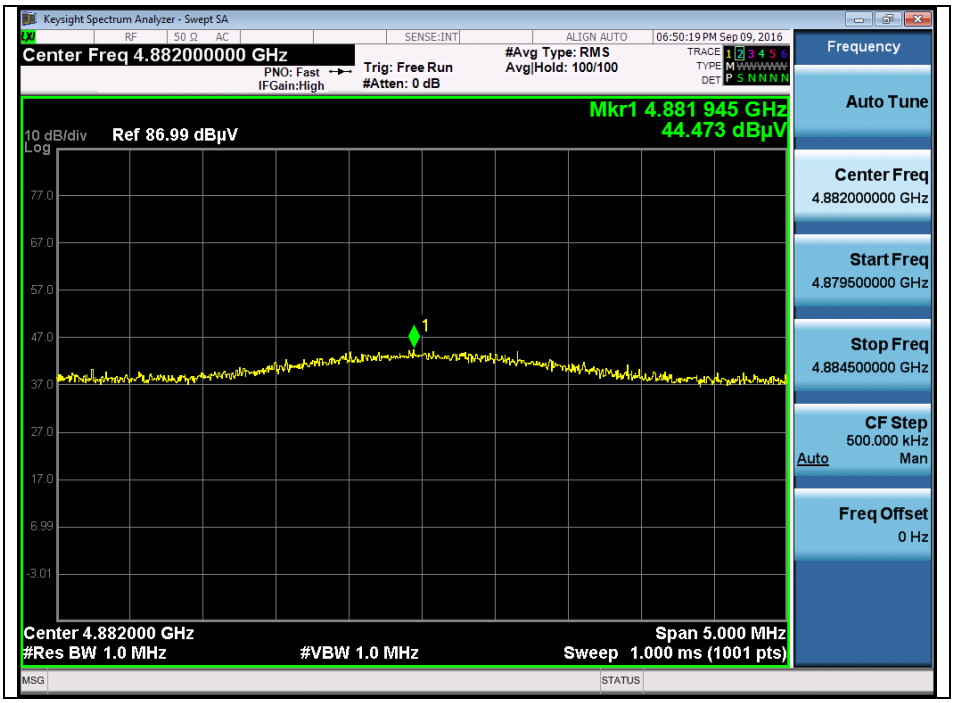
Low channel 2nd harmonic (Peak)



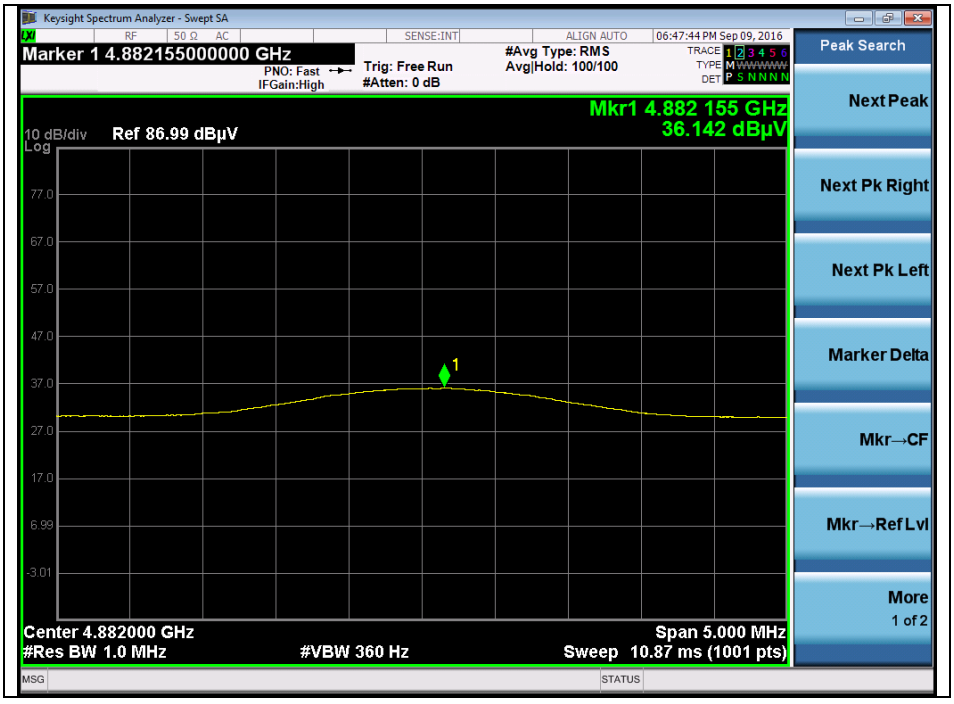
Low channel 2nd harmonic (Average)



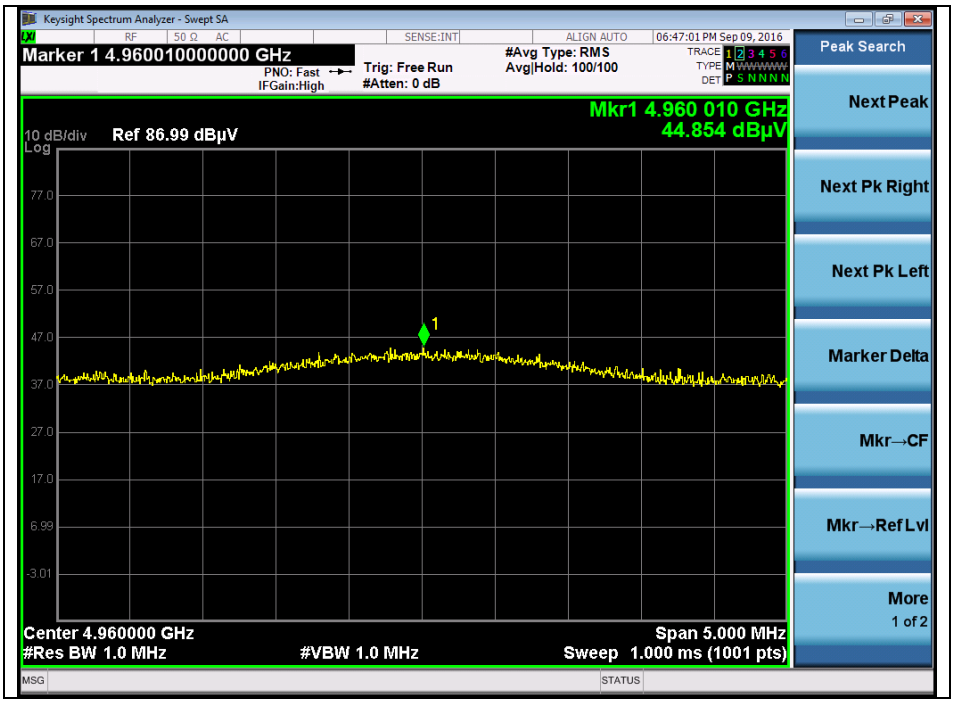
Middle channel 2nd harmonic (Peak)



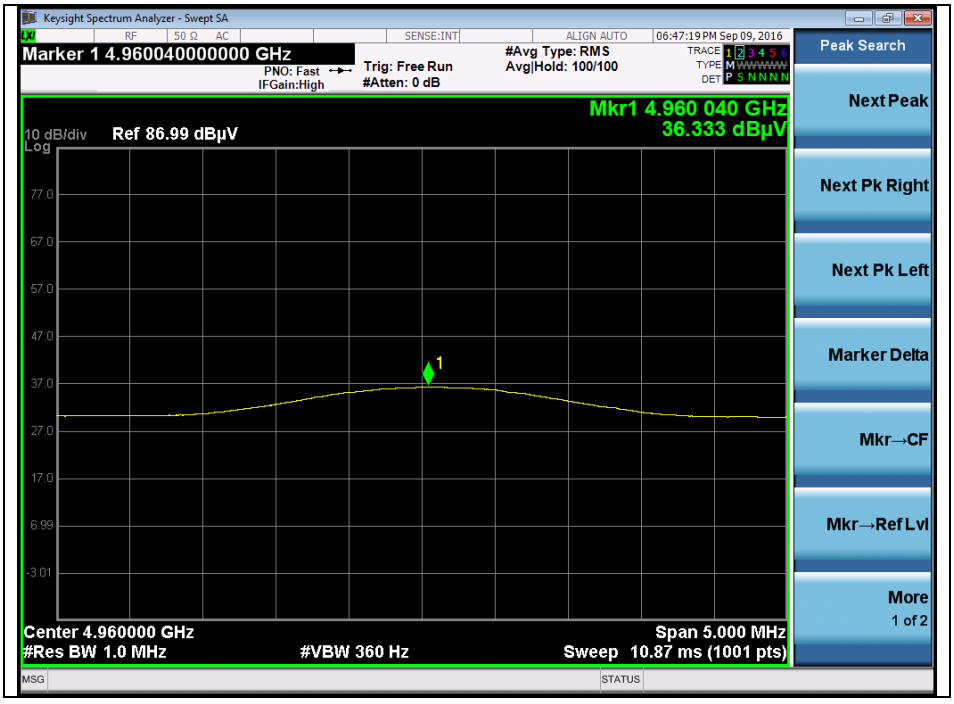
Middle channel 2nd harmonic (Average)



High channel 2nd harmonic (Peak)



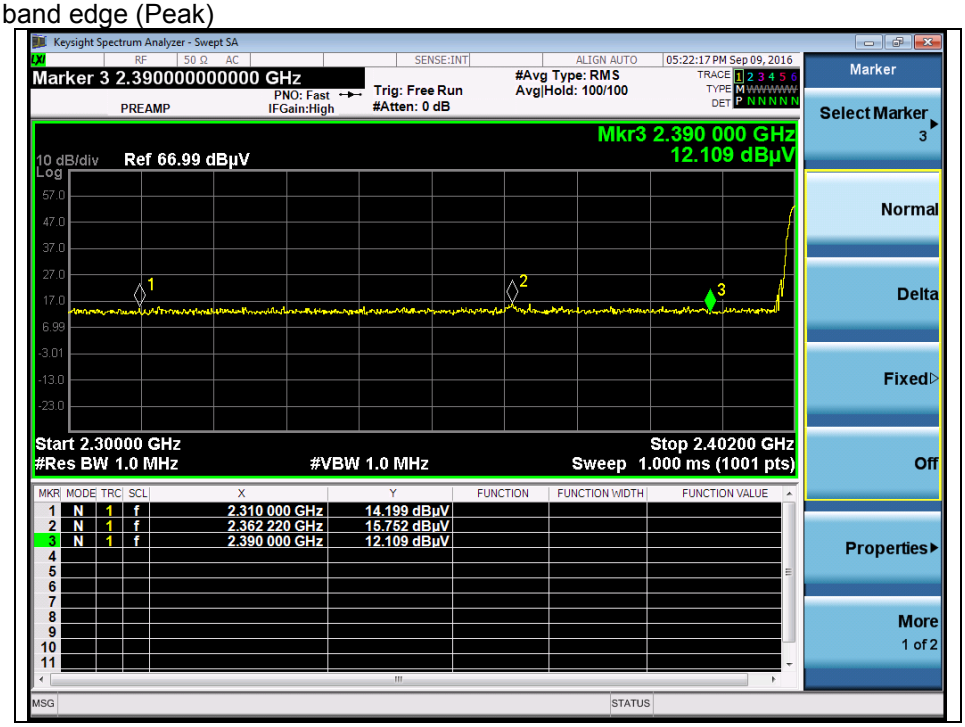
High channel 2nd harmonic (Average)



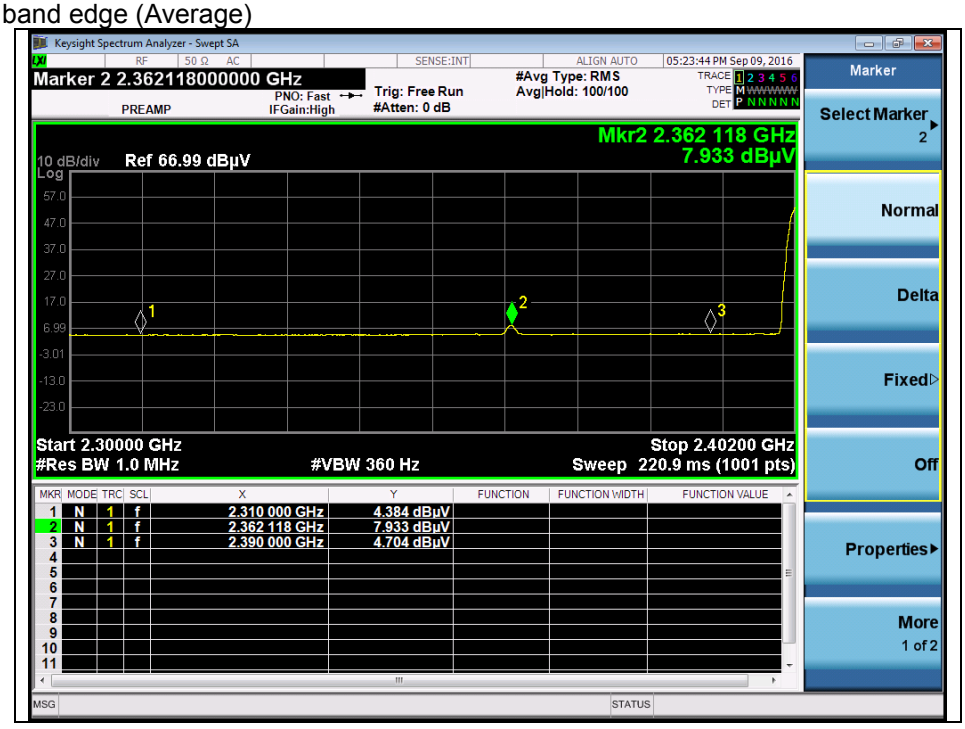
EUT (with wireless charging mode)

Operating Mode: GFSK (1 Mbps)

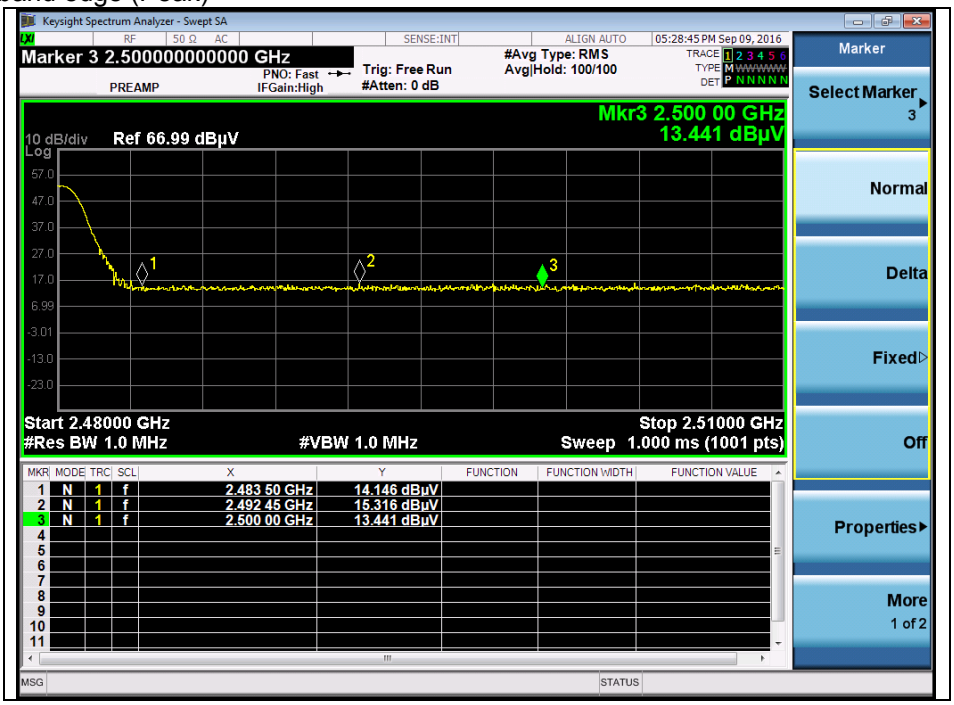
Low channel band edge (Peak)



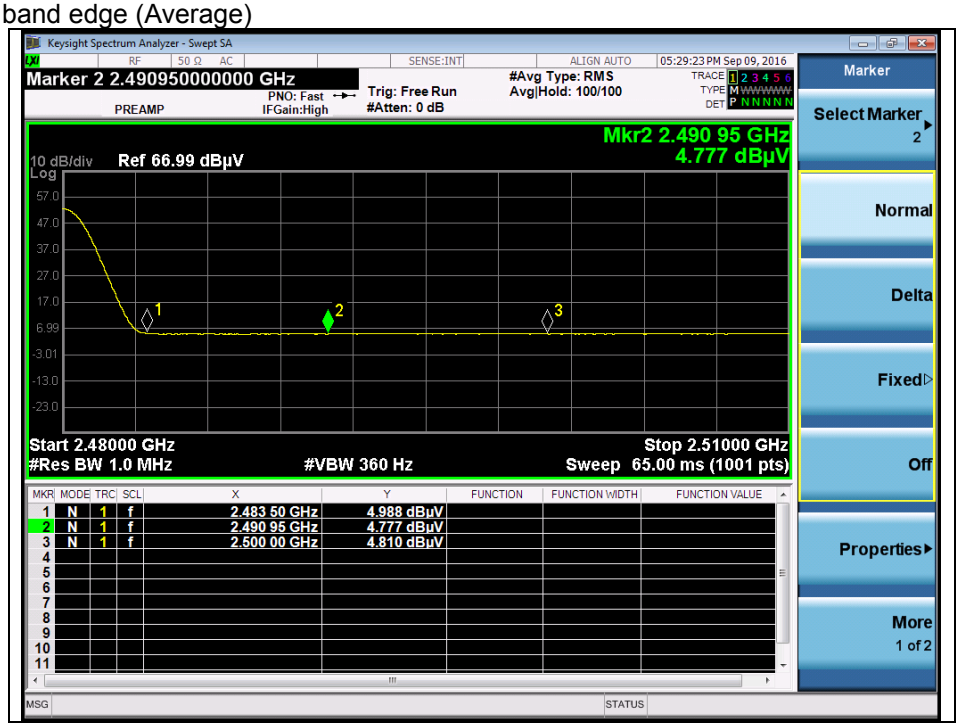
Low channel band edge (Average)



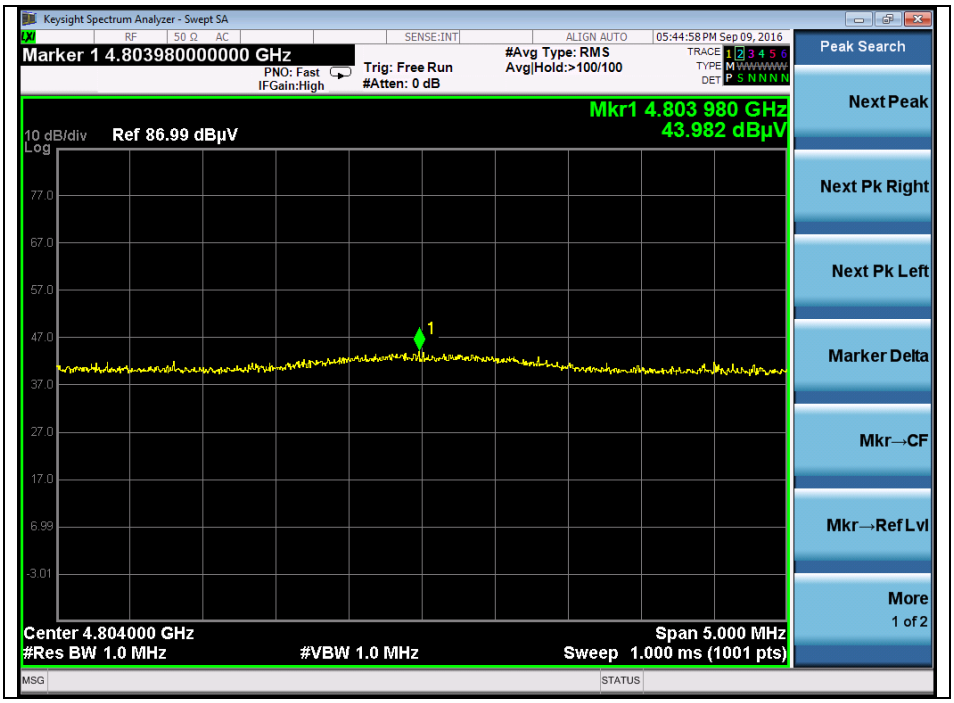
High channel band edge (Peak)



High channel band edge (Average)

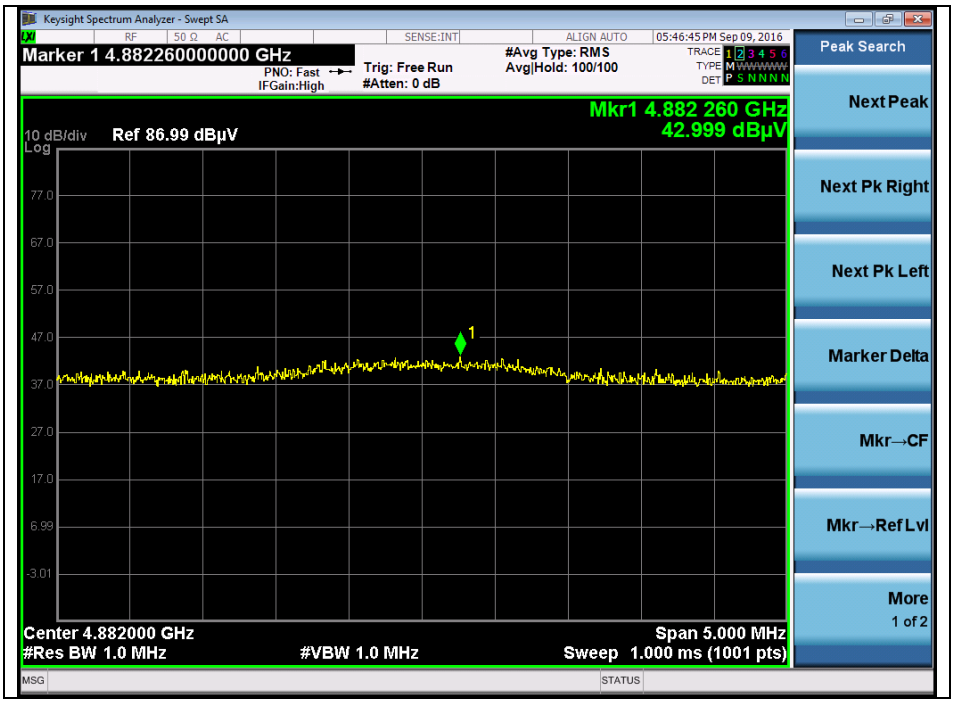


Low channel 2nd harmonic (Peak)

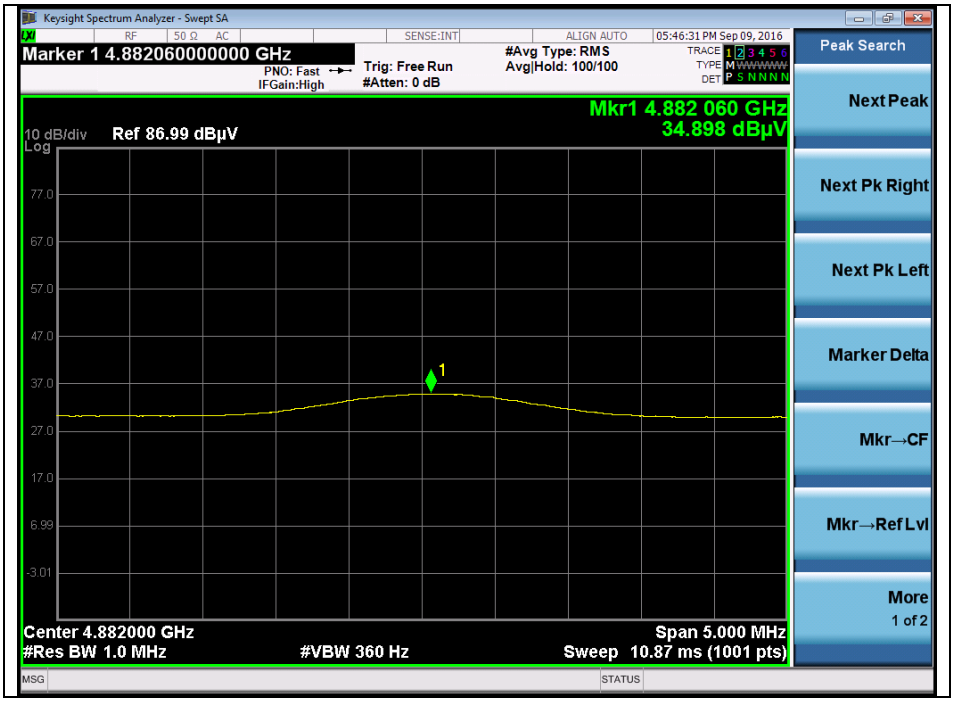


Low channel 2nd harmonic (Average)

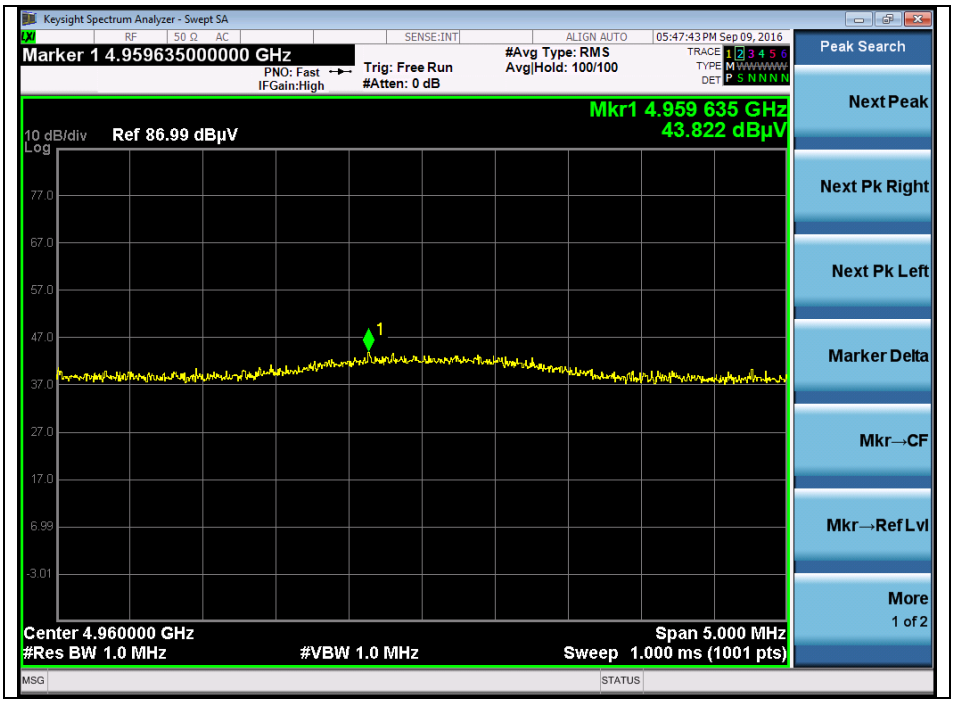
Middle channel 2nd harmonic (Peak)



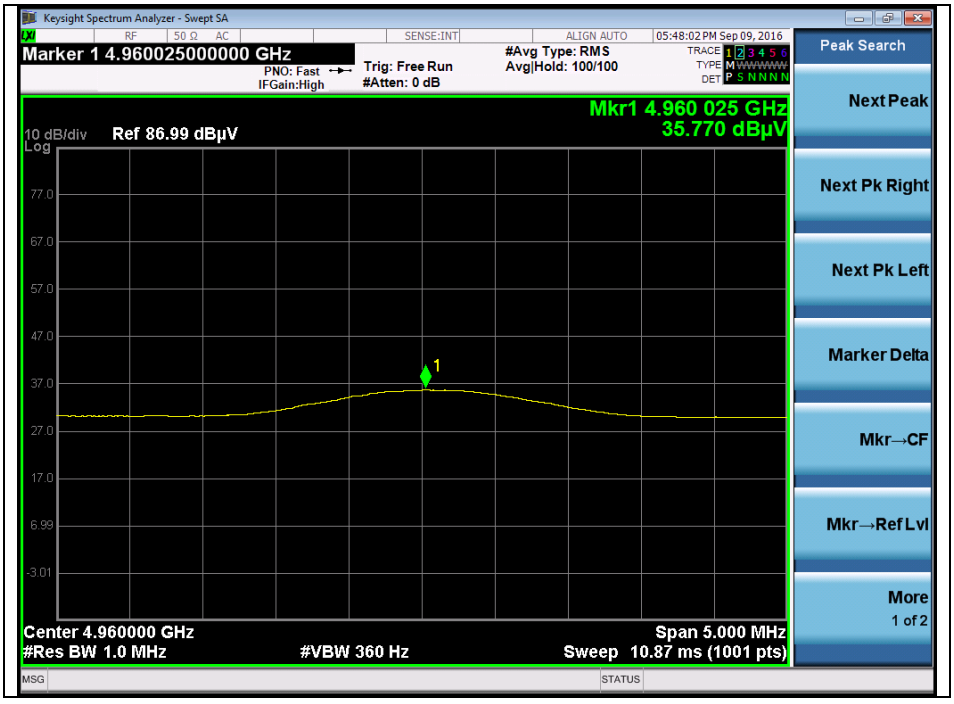
Middle channel 2nd harmonic (Average)



High channel 2nd harmonic (Peak)

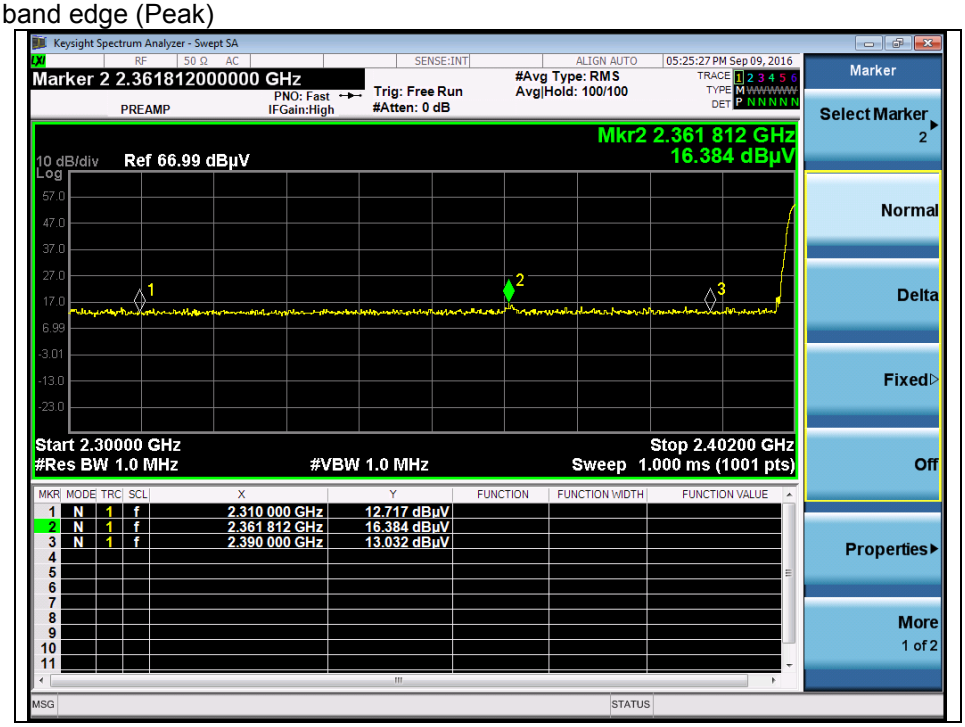


High channel 2nd harmonic (Average)

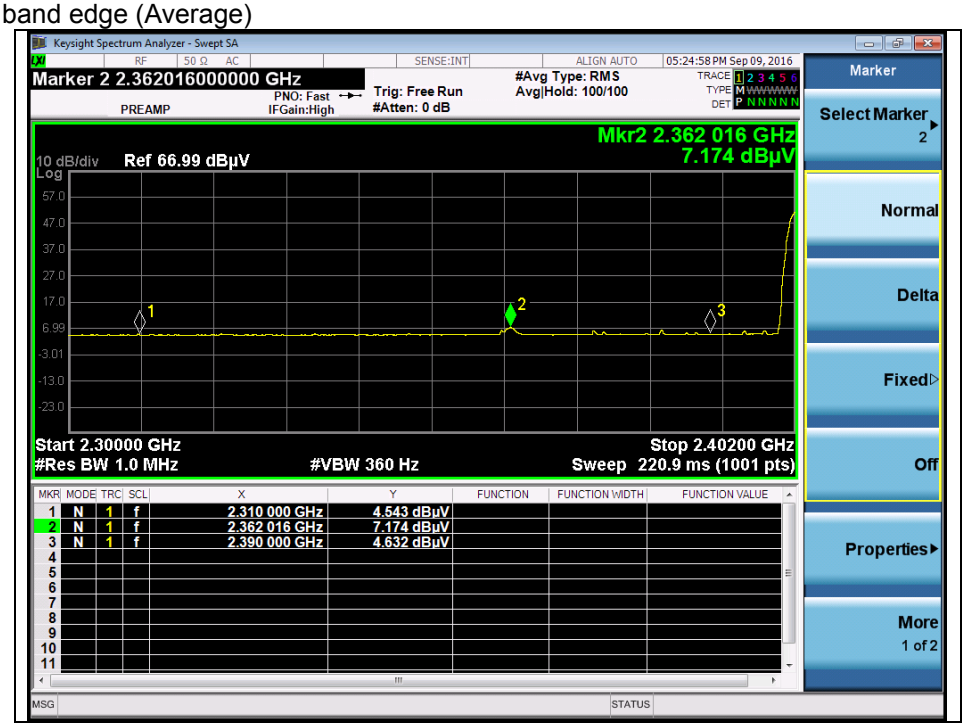


Operating Mode: 8DPSK (3 Mbps)

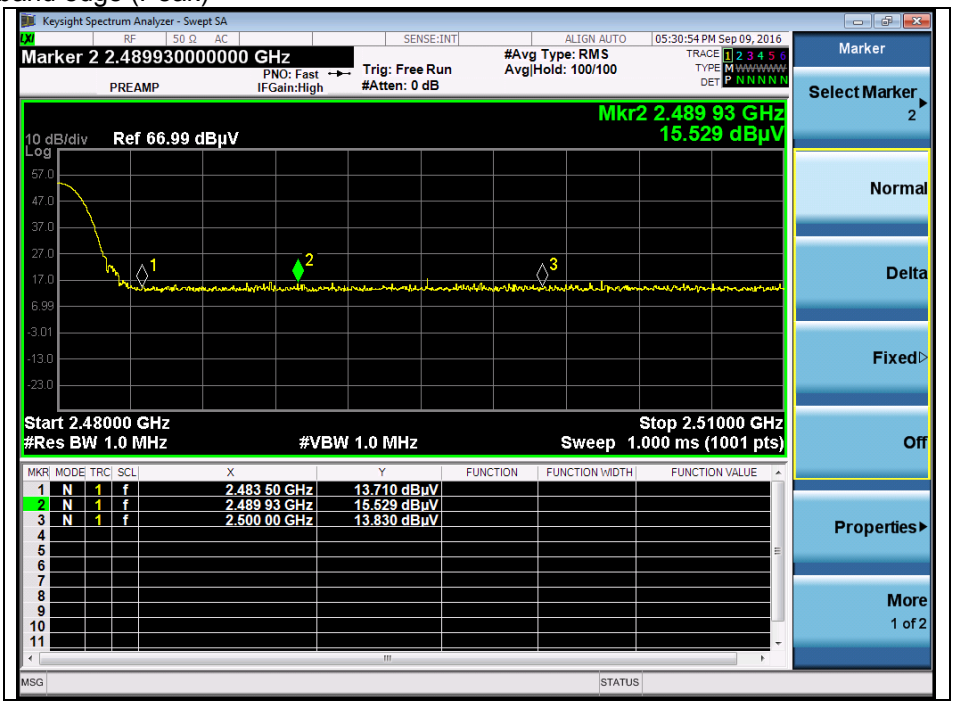
Low channel band edge (Peak)



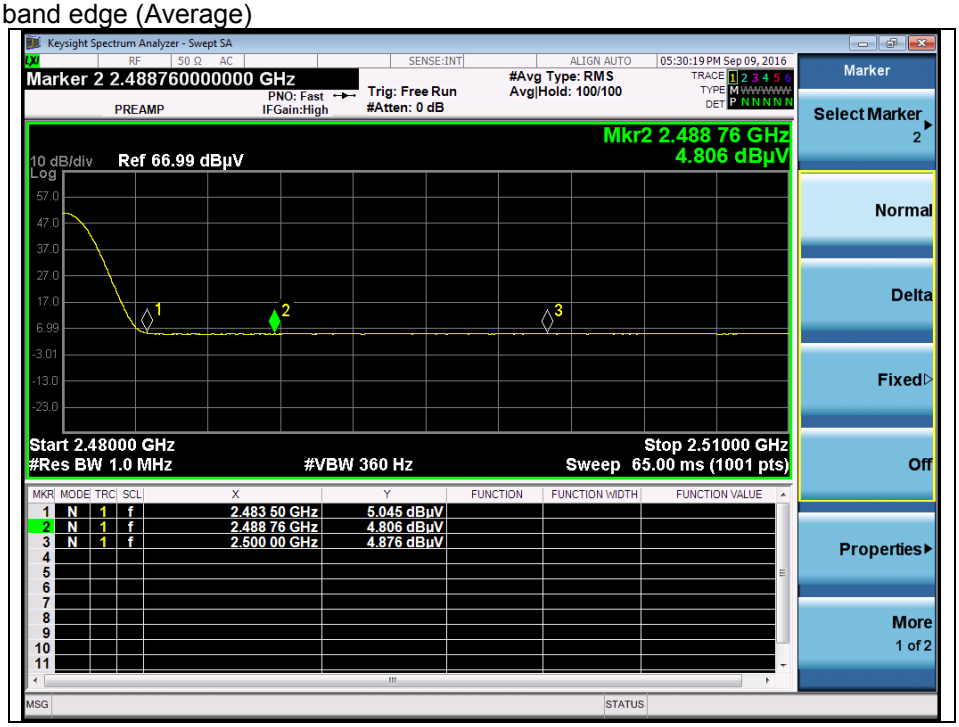
Low channel band edge (Average)



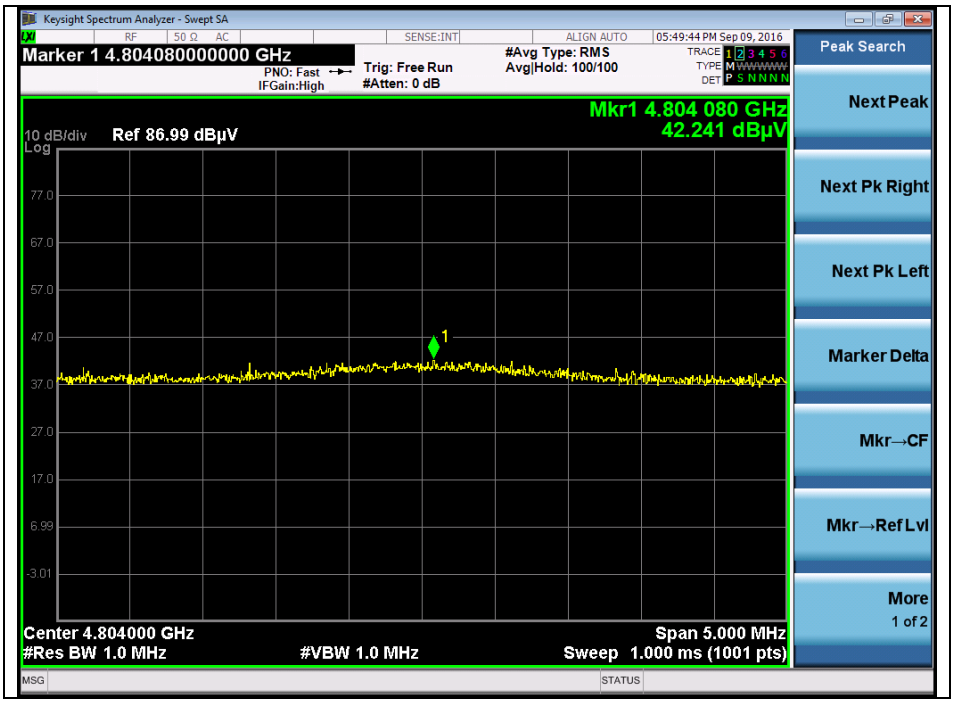
High channel band edge (Peak)



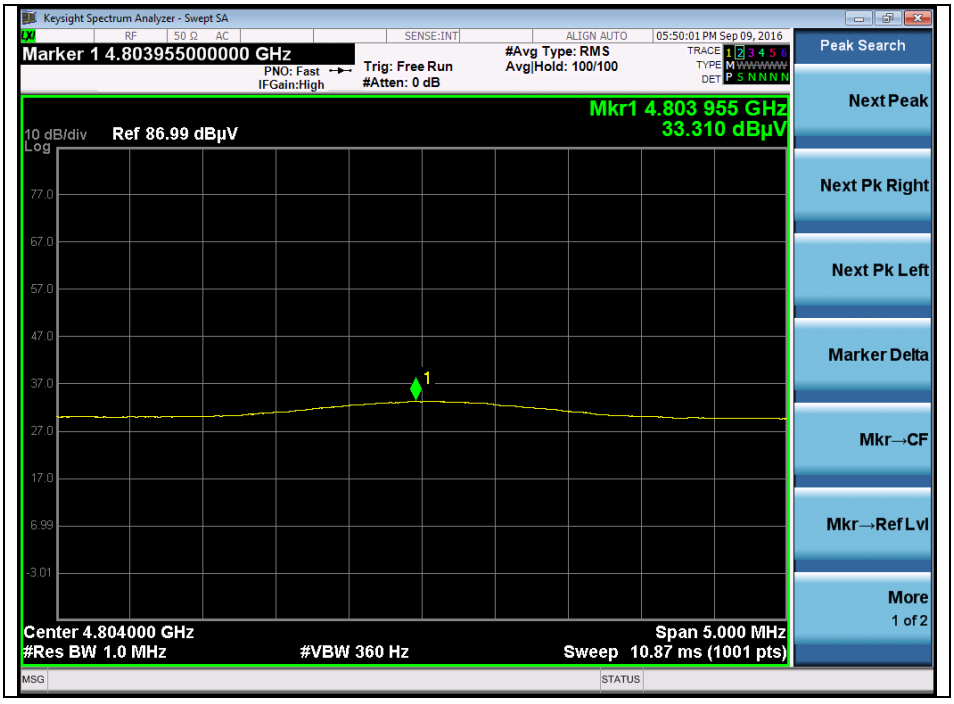
High channel band edge (Average)



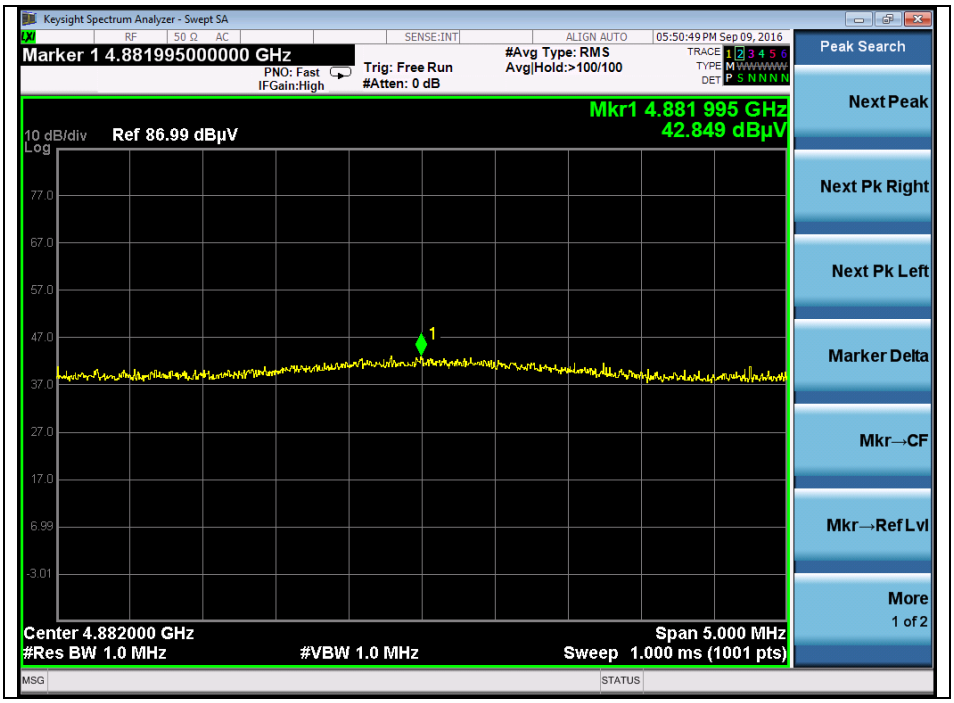
Low channel 2nd harmonic (Peak)



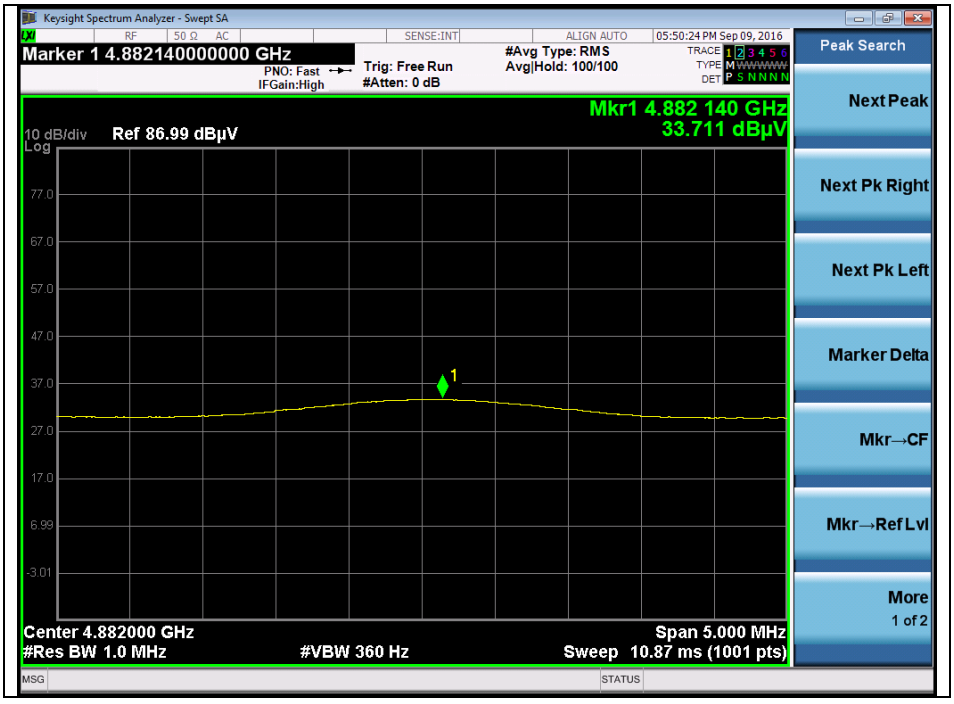
Low channel 2nd harmonic (Average)



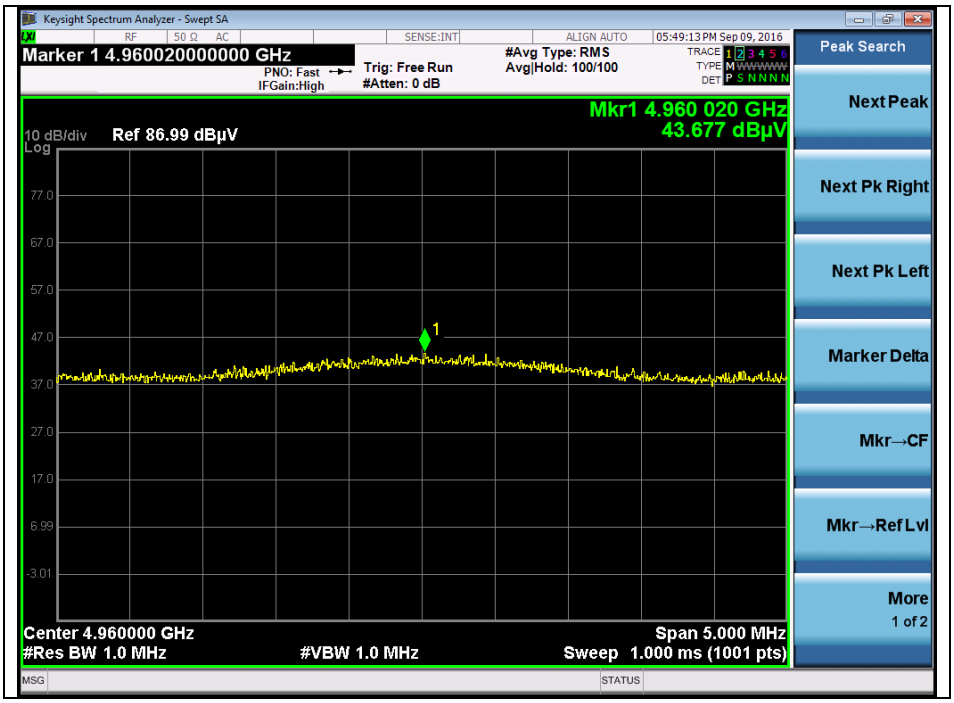
Middle channel 2nd harmonic (Peak)



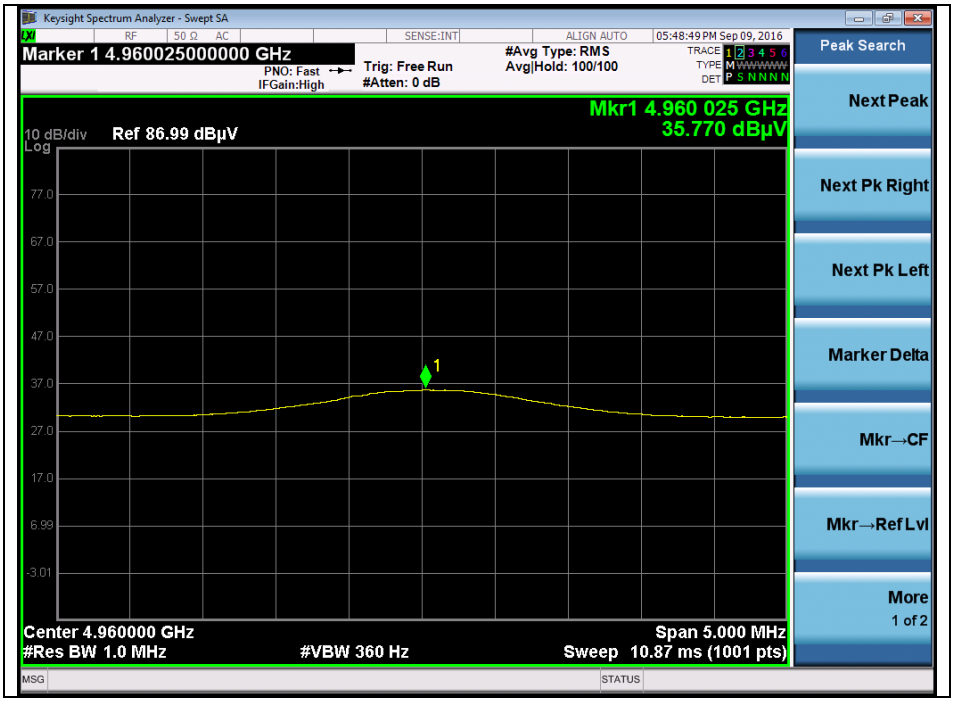
Middle channel 2nd harmonic (Average)



High channel 2nd harmonic (Peak)



High channel 2nd harmonic (Average)



3. Maximum Peak Conducted Output Power

3.1. Test Setup

3.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following :

FCC

1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.
2. §15.247(b)(1), For frequency hopping systems operating in the 2 400-2 483.5 ㎒ employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725-5 805 ㎒ band : 1 Watt.

IC

1. RSS-247 Issue 1, 5.4(2), For FHSs operating in the band 2 400-2 483.5 ㎒, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

3.3. Test Procedure

The test follows DA 00-705. Using the power sensor instead of a spectrum analyzer.

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.
3. Test program : (S/W name : R&S Power Viewer, Version : 3.2.0)
4. Measure peak power each channel.

3.4. Test Results

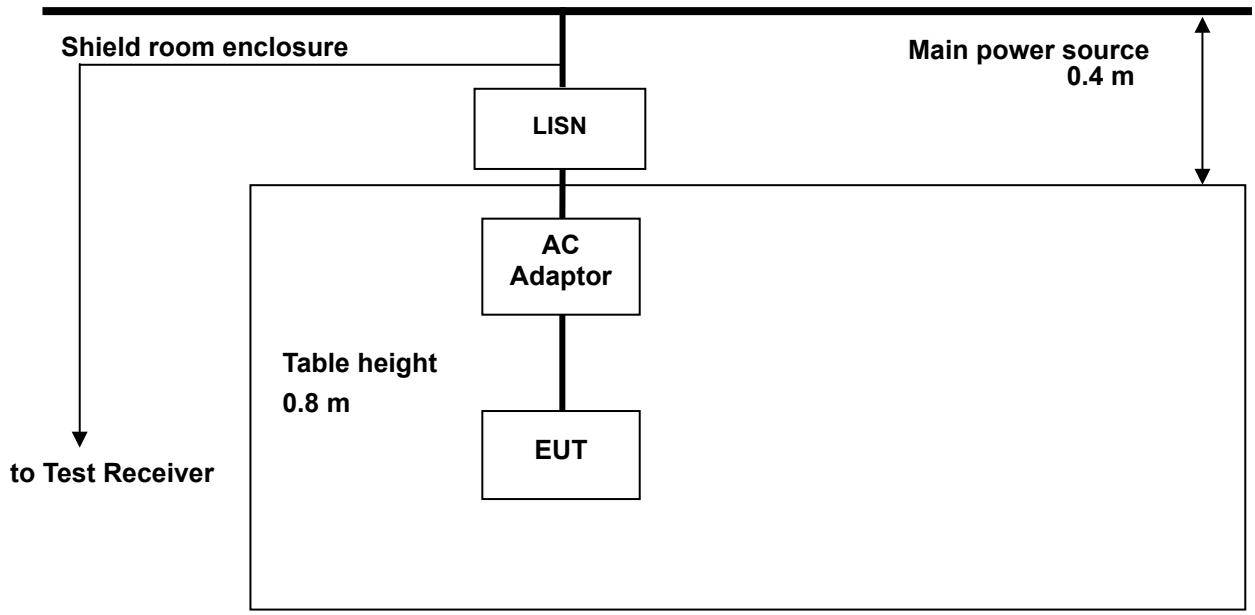
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Operation Mode	Data Rate	Channel	Frequency (㎒)	Attenuator + Cable offset (dB)	Peak Power Result (dB m)	Peak Power Limit (dB m)
GFSK	1 Mbps	Low	2 402	17.11	0.43	30
		Middle	2 441	17.18	0.90	30
		High	2 480	17.21	**1.40**	30
π/4DQPSK	2 Mbps	Low	2 402	17.11	1.56	20.97
		Middle	2 441	17.18	2.14	20.97
		High	2 480	17.21	**2.65**	20.97
8DPSK	3 Mbps	Low	2 402	17.11	2.14	20.97
		Middle	2 441	17.18	2.65	20.97
		High	2 480	17.21	**3.12**	20.97

Remark:
In the case of AFH, the limit for peak power is 0.125 W
Directional coupler and cable offset compensate for test program (R&S Power Viewer) before measuring.

4. AC Power Line Conducted Emission

4.1. Test Setup



4.2. Limit

FCC

§15.207(a) 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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 ㎌ H /50 ohm line impedance stabilization network(LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency of Emission (㎒)	Conducted limit (dB㎶)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

* Decreases with the logarithm of the frequency.

IC

RSS-Gen Issue 4, 8.8, A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in Table 3.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 ㎒ to 30 ㎒ shall not exceed the limits shown in Table 3 below. The more stringent limit applies at the frequency range boundaries.

The conducted emissions shall be measured in accordance with the reference publication mentioned in Section 3.

Table 3 – AC Power Line Conducted Emissions Limits

Frequency (㎒)	Conducted limit (dB㎶)	
	Quasi-peak	Average**
0.15 - 0.50	66 - 56*	56 - 46*
0.50 - 5.00	56	46
5.00 - 30.0	60	50

* Decreases with the logarithm of the frequency.
** A linear average detector is required.

4.3. Test Procedures

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section.

AC line conducted emissions from the EUT were measured according to the dictates of ANSI C63.10-2013

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 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. The excess power cable between the EUT and the LISN was bundled. All connecting cables of EUT were moved to find the maximum emission.

4.4. Test Results

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Frequency range : 0.15 ㎒ – 30 ㎒
Measured Bandwidth : 9 ㎑

EUT (without wireless charging mode)

FREQ.	LEVEL(dB㎶)		LINE	LIMIT(dB㎶)		MARGIN(dB)	
(㎒)	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.27	29.20	15.60	N	61.12	51.12	31.92	35.52
0.40	22.70	11.20	N	57.85	47.85	35.15	36.65
0.69	22.50	11.50	N	56.00	46.00	33.50	34.50
7.93	21.70	15.70	N	60.00	50.00	38.30	34.30
11.78	21.40	15.70	N	60.00	50.00	38.60	34.30
25.14	35.90	35.70	N	60.00	50.00	24.10	14.30
0.27	19.70	6.80	H	61.12	51.12	41.42	44.32
0.41	14.60	6.10	H	57.65	47.65	43.05	41.55
1.94	10.80	2.80	H	56.00	46.00	45.20	43.20
3.33	11.40	3.70	H	56.00	46.00	44.60	42.30
10.89	18.40	11.70	H	60.00	50.00	41.60	38.30
25.14	31.60	31.30	H	60.00	50.00	28.40	18.70

Remark;

1. Line (H): Hot, Line (N): Neutral.
2. All modes of operation were investigated and the worst-case emissions were reported using **EDR, 3DH5, Middle channel**.
3. Traces shown in plot mad using a peak detector and average detector.
4. The limit for Class B device(s) from 150 ㎑ to 30 ㎒ are specified in Section of the Title 47 CFR.
5. Deviations to the Specifications: None.

EUT (with wireless charging mode)

FREQ.	LEVEL(dBμV)		LINE	LIMIT(dBμV)		MARGIN(dB)	
(MHz)	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.27	30.60	10.00	N	61.12	51.12	30.52	41.12
0.71	21.10	9.80	N	56.00	46.00	34.90	36.20
1.05	21.10	9.50	N	56.00	46.00	34.90	36.50
2.45	12.50	5.50	N	56.00	46.00	43.50	40.50
10.70	16.30	5.50	N	60.00	50.00	43.70	44.50
25.14	24.20	10.70	N	60.00	50.00	35.80	39.30
0.27	10.20	5.50	H	61.12	51.12	50.92	45.62
0.68	22.80	14.40	H	56.00	46.00	33.20	31.60
2.05	23.60	8.00	H	56.00	46.00	32.40	38.00
6.00	22.10	10.50	H	60.00	50.00	37.90	39.50
11.21	25.60	9.80	H	60.00	50.00	34.40	40.20
24.85	16.10	18.20	H	60.00	50.00	43.90	31.80

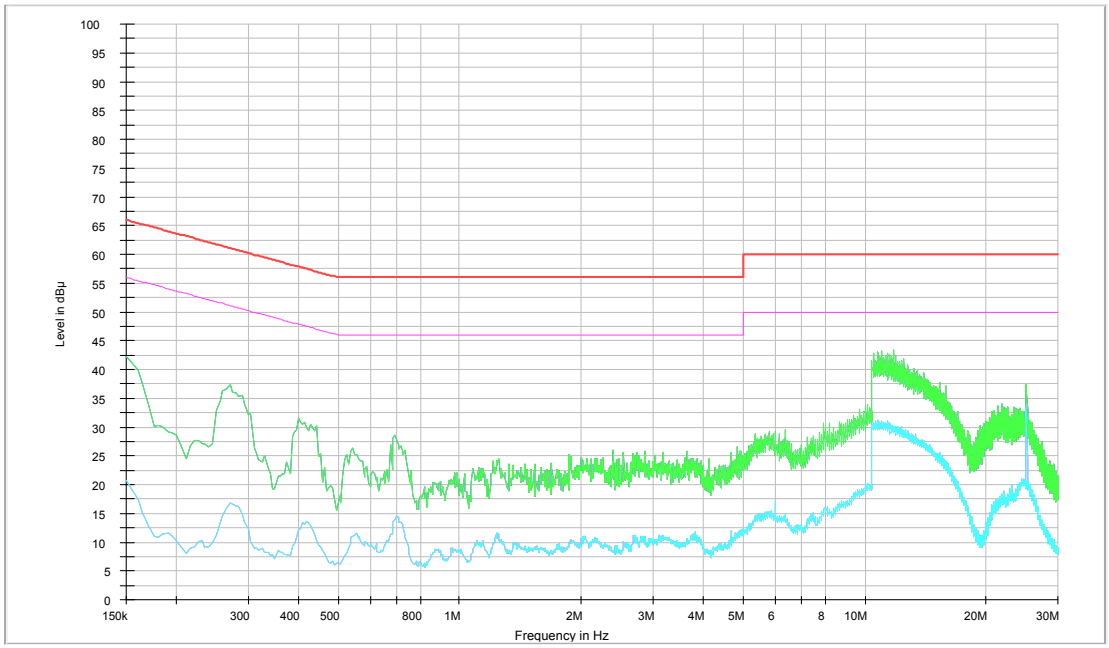
Remark;

1. Line (H): Hot, Line (N): Neutral.
2. All modes of operation were investigated and the worst-case emissions were reported using **EDR, 3DH5, Middle channel.**
3. Traces shown in plot mad using a peak detector and average detector.
4. The limit for Class B device(s) from 150 ㎑ to 30 ㎒ are specified in Section of the Title 47 CFR.
5. Deviations to the Specifications: None.

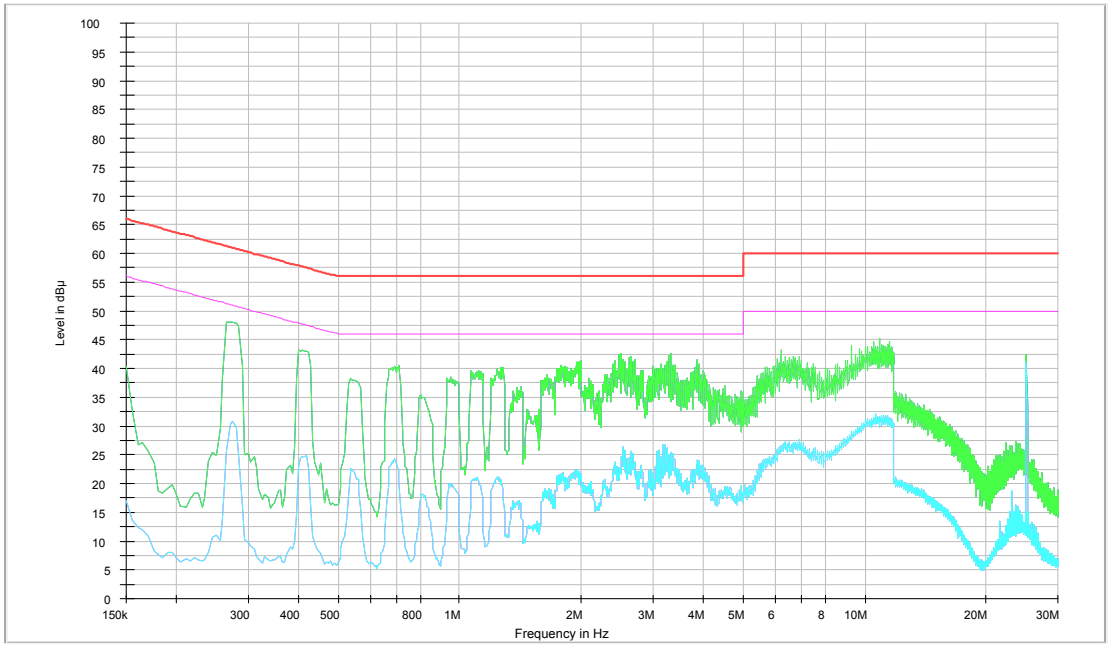
Plots of Conducted Power line

EUT (without wireless charging mode)

Test mode: (Neutral)

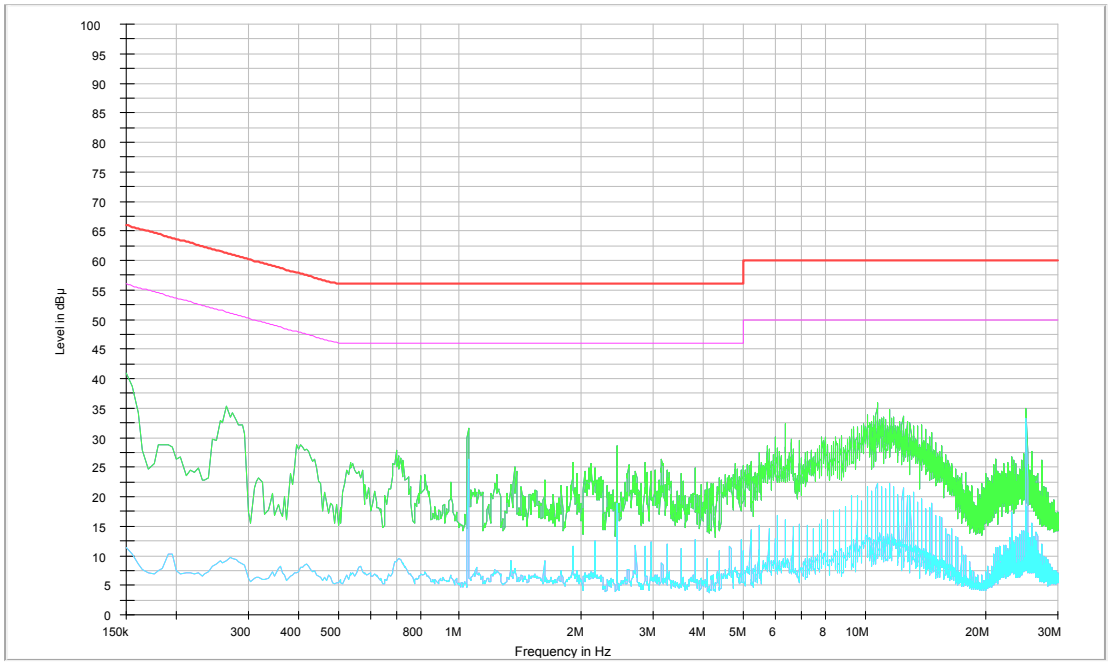


Test mode: (Hot)

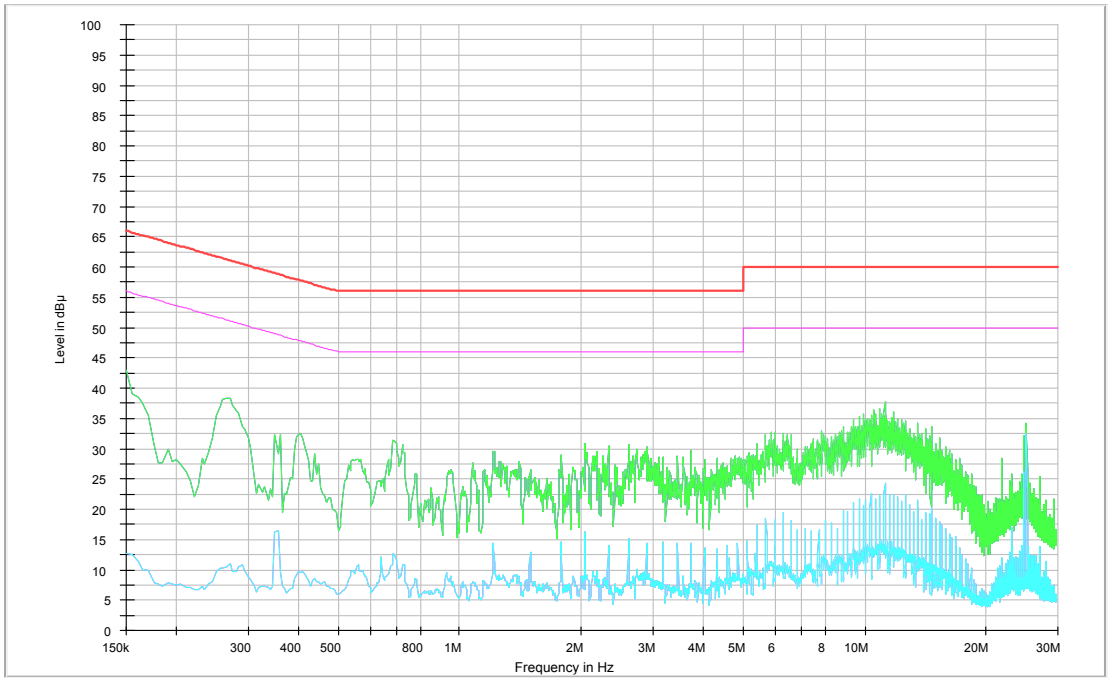


EUT (with wireless charging mode)

Test mode: (Neutral)



Test mode: (Hot)



5. Antenna Requirement

5.1. Standard Applicable

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

5.2. Antenna Connected Construction

Antenna used in this product is PCB type with gain of 1.90 dBi.

- End of the Test Report -