TEST REPORT

of

FCC Part 15 Subpart C §15.247

FCC ID : ZNFD855

Equipment Under Test	:	Cellular/PCS GSM/GPRS/EDGE/WCDMA and LTE phone with Bluetooth, WLAN and RFID
Model Name	:	LG-D855
Alternative models	:	LGD855, D855, LG-D855k, LG-D855K, LGD855k, LGD855K, D855k, D855K
Applicant	:	LG Electronics MobileComm U.S.A., Inc.
Manufacturer	:	LG Electronics MobileComm U.S.A., Inc.
Date of Test(s)	:	2014.04.16 ~ 2014.04.30
Date of Issue	:	2014.05.27

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

Tested By:	Logan Lee	**Date:**	**2014.05.27**
Approved By:	Feel Jeong	**Date:**	**2014.05.27**

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- Wireless Div. 3FL, 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 435-040

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.

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1.2. Details of Applicant

Applicant : LG Electronics MobileComm U.S.A., Inc.
Address : 10101 Old Grove Road, San Diego, CA 92131
Contact Person : Lee, Sang-Myung
Phone No. : +82 2 2033 4606

1.3. Description of EUT

Kind of Product	Cellular/PCS GSM/GPRS/EDGE/WCDMA and LTE phone with Bluetooth, WLAN and RFID
Model Name	LG-D855 (Alternative models: LGD855, D855, LG-D855k, LG-D855K, LGD855k, LGD855K, D855k, D855K)
Power Supply	DC 3.8 V
Frequency Range	13.56 ㎒ (NFC) 2 402 ㎒ ~ 2 480 ㎒ (BT, BT LE), 2 412 ㎒ ~ 2 462 ㎒ (11b/g/n_HT20), 5 745 ㎒ ~ 5 825 ㎒ (Band 3: 11a/n_HT20, 11ac_VHT20), 5 755 ㎒ ~ 5 795 ㎒ (Band 3: 11n_HT40, 11ac_VHT40), 5 775 ㎒ (Band 3: 11ac_VHT80), 5 180 ㎒ ~ 5 240 ㎒ (Band 1: 11a/n_HT20, 11ac_VHT20), 5 190 ㎒ ~ 5 230 ㎒ (Band 1: 11n_HT40, 11ac_VHT40), 5 210 ㎒ (Band 1: 11ac_VHT80), 5 260 ㎒ ~ 5 320 ㎒ (Band 2A: 11a/n_HT20, 11ac_VHT20), 5 270 ㎒ ~ 5 310 ㎒ (Band 2A: 11n_HT40, 11ac_VHT40), 5 290 ㎒ (Band 2A: 11ac_VHT80), 5 500 ㎒ ~ 5 700 ㎒ (Band 2C: 11a/n_HT20, 11ac_VHT20), 5 510 ㎒ ~ 5 670 ㎒ (Band 2C: 11n_HT40, 11ac_VHT40), 5 530 ㎒ (Band 2C: 11ac_VHT80)
Modulation Technique	DSSS, OFDM, GFSK, π/4DQPSK, 8DPSK, ASK
Number of Channels	11 channel (11b/g/n_HT20), 5 channel (Band 3: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 3: 11n_HT40, 11ac_VHT40), 1 channel (Band 3: 11ac_VHT80), 4 channel (Band 1: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 1: 11n_HT40, 11ac_VHT40), 1 channel (Band 1: 11ac_VHT80), 4 channel (Band 2A: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 2A: 11n_HT40, 11ac_VHT40), 1 channel (Band 2A: 11ac_VHT80), 8 channel (Band 2C: 11a/n_HT20, 11ac_VHT20), 3 channel (Band 2C: 11n_HT40, 11ac_VHT40), 1 channel (Band 2C: 11ac_VHT80), 79 channel (BT), 40 channel (BT LE), 1 channel (NFC)
Antenna Type	Internal type (SISO)
Antenna Gain	2 402 ㎒ ~ 2 480 ㎒, 2 412 ㎒ ~ 2 462 ㎒: -3.09 ㏈i, 5 180 ㎒ ~ 5 320 ㎒: -1.58 ㏈i, 5 500 ㎒ ~ 5 700 ㎒: -0.13 ㏈i, 5 745 ㎒ ~ 5 825 ㎒: -0.13 ㏈i

1.4. Declaration by the manufacturer

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

1.5. Information about the FHSS characteristics:

1.5.1. 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.

1.5.2. Equal Hopping Frequency Use

All Bluetooth units participating in the piconet are time and hop-synchronized to the channel.

1.5.3. System Receiver Input Bandwidth

Each channel bandwidth is 1 ㎒

1.5.4. Equipment Description

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

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.

1.6. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	R&S	SMR40	100540	Jan. 08, 2014	Annual	Jan. 08, 2015
Signal Generator	R&S	SMJ 100A	100882	Jul. 03, 2013	Annual	Jul. 03, 2014
Spectrum Analyzer	Agilent	N9030A	MY53120526	Jul. 30, 2013	Annual	Jul. 30, 2014
High Pass Filter	Wainwright	WHK3.0/18G-6SS	4	Jul. 02, 2013	Annual	Jul. 02, 2014
High Pass Filter	Wainwright	WHK7.5/26.5G-6SS	15	Jul. 03, 2013	Annual	Jul. 03, 2014
Low Pass Filter	Mini circuits	NLP-1200+	V9500401023-1	Jul. 02, 2013	Annual	Jul. 02, 2014
Power Sensor	R&S	NRP-Z81	101341	Jul. 04, 2013	Annual	Jul. 04, 2014
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Jul. 02, 2013	Annual	Jul. 02, 2014
Directional Coupler	KRYTAR	152613	127445	Jul. 02, 2013	Annual	Jul. 02, 2014
DC Power Supply	Agilent	U8002A	MY48490027	Jan. 03, 2014	Annual	Jan. 03, 2015
Preamplifier	H.P.	8447D	1726A01265	Sep. 23, 2013	Annual	Sep. 23, 2014
Preamplifier	R&S	SCU 18	10070	Jun. 21, 2013	Annual	Jun. 21, 2014
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	Jun. 13, 2013	Annual	Jun. 13, 2014
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	9163-437	Oct. 04, 2013	Biennial	Oct. 04, 2015
Loop Antenna	SCHWARZBECK MESSELEKTRONIK	FMZB 1519	1519-039	Jul. 09, 2013	Biennial	Jul. 09, 2015
Horn Antenna	R&S	HF906	100608	Aug. 03, 2012	Biennial	Aug. 03, 2014
Horn Antenna	SCHWARZBECK MESSELEKTRONIK	BBHA9170	BBHA9170431	Aug. 24, 2012	Biennial	Aug. 24, 2014
Antenna Master	INN-CO	MA4000-EP	N/A	N.C.R.	N/A	N.C.R.
Turn Table	INN-CO	DT-3000S-3T	N/A	N.C.R.	N/A	N.C.R.
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.
EMI Test Receiver	R&S	ESU26	100194	Sep. 13, 2013	Annual	Sep. 13, 2014
Two-Line V-Network	R&S	ENV216	101120	Jan. 02, 2014	Annual	Jan. 02, 2015
Anechoic Chamber	SY Corporation	L × W × H (21.5 m × 13.0 m × 9.0 m)	N/A	N.C.R.	N/A	N.C.R.

▶ Support equipment

Description	Manufacturer	Model	Serial Number	FCC ID
Wireless Charger	LG Electronics	WCP-300	306HYNY008023	BEJWCP300

1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD:FCC Part15 subpart C		
Section in FCC 15	**Test Item**	**Result**
15.205(a) 15.209 15.247(d)	Radiated Spurious Emissions and Conducted Spurious Emission	Complied
15.247(a)(1)	20 dB Bandwidth	Complied
15.247(b)(1)	Output Power Measurement	Complied
15.247(a)(1)	Carrier Frequency Separation	Complied
15.247(a)(1)(iii)	Number of Hopping Frequency	Complied
15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Complied
15.207	AC Power Line Conducted Emission	Complied

1.8. Test Procedure(s)

The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003) and the guidance provided in DA 00-705 were used in the measurement of the DUT.

1.9. Sample calculation

Where relevant, the following sample calculation is provided:

1.9.1. Conducted test

Offset value (dB) = Directional Coupler(dB) + Cable loss (dB)

1.9.2. Radiation test

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

1.10. Test report revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL007644	2014.05.12	Initial
1	F690501/RF-RTL007644-1	2014.05.27	- Added actual test equipment list in each test result & DUT axis description on page 9.

1.11. Information of Alternative model

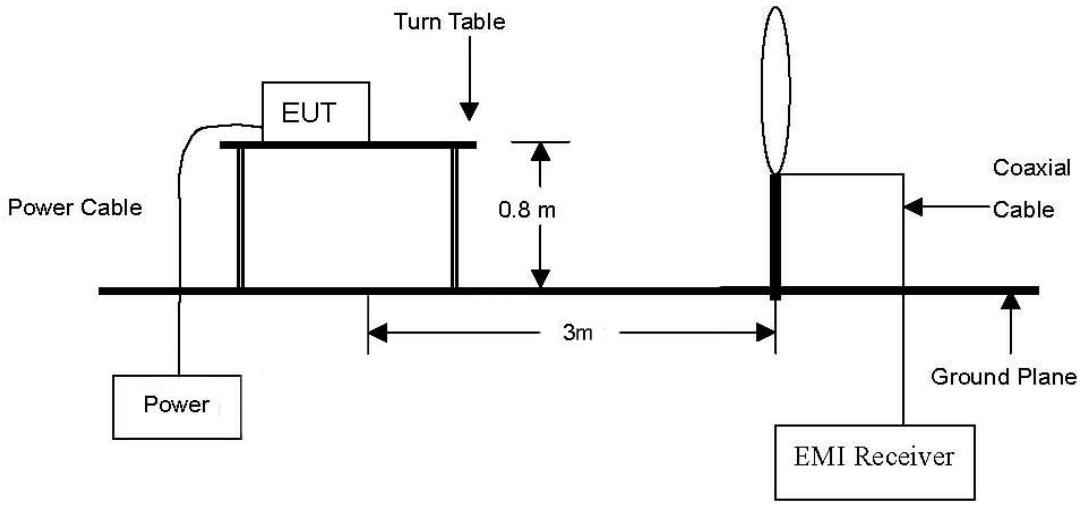
Model	Information
LG-D855	Basic model name.
LG-D855k	H/W and S/W are same to basic model. It is only different model name for marketing purpose
LG-D855K	H/W and S/W are same to basic model. It is only different model name for marketing purpose
LGD855k	H/W and S/W are same to basic model. It is only different model name for marketing purpose
LGD855K	H/W and S/W are same to basic model. It is only different model name for marketing purpose
D855k	H/W and S/W are same to basic model. It is only different model name for marketing purpose
D855K	H/W and S/W are same to basic model. It is only different model name for marketing purpose

2. Radiated Spurious Emissions and Conducted Spurious Emission

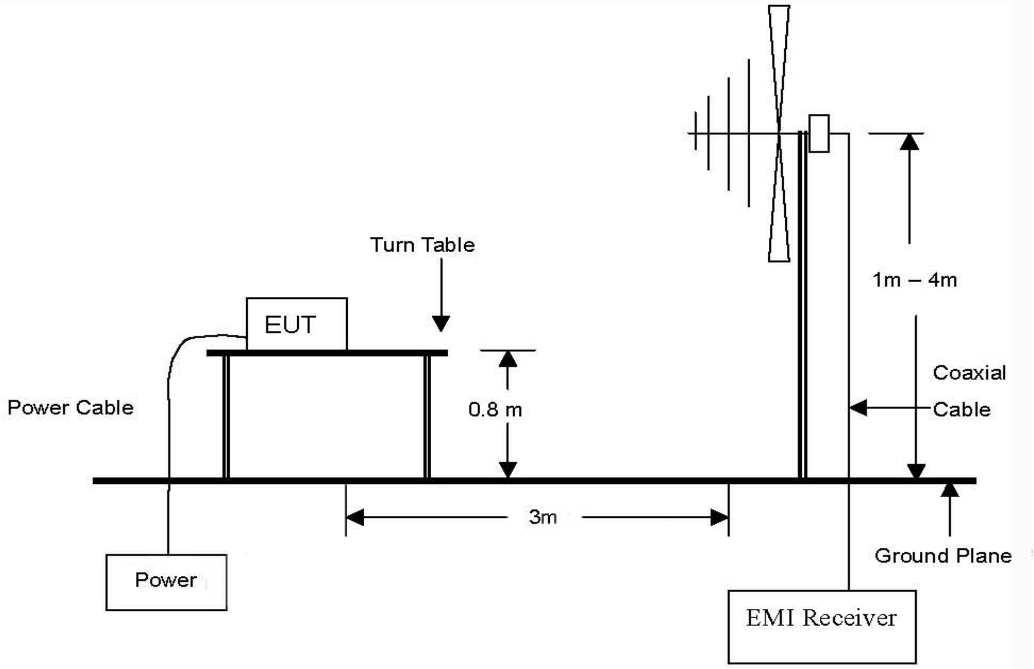
2.1. Test Setup

2.1.1. Radiated Spurious Emissions

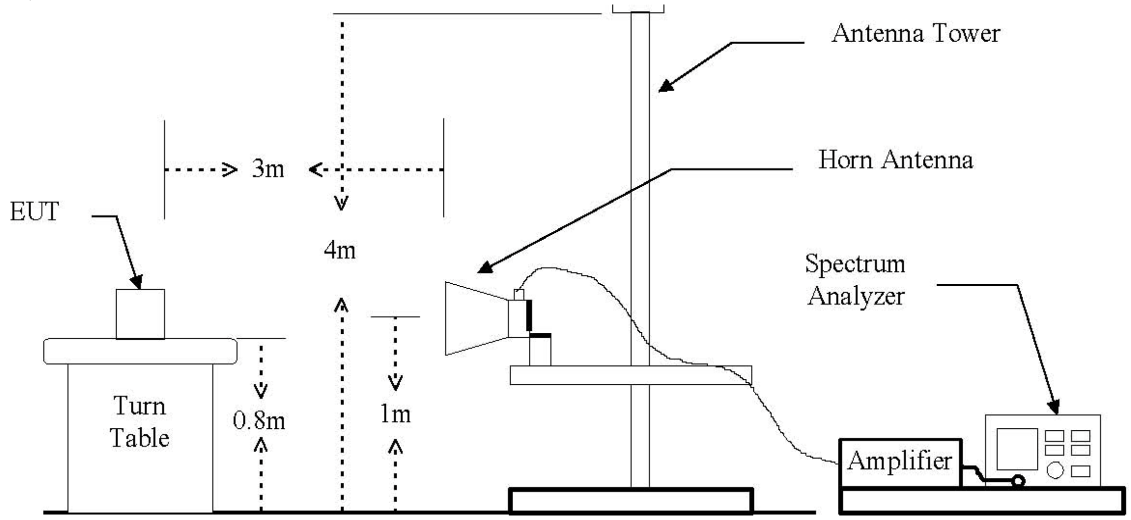
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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.



2.1.1.1. Actual equipment used for Radiated spurious Emissions

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Spectrum Analyzer	Agilent	N9030A	MY53120526	Jul. 30, 2013	Annual	Jul. 30, 2014
Signal Generator	R&S	SMR40	100540	Jan. 08, 2014	Annual	Jan. 08, 2015
Signal Generator	R&S	SMJ 100A	100882	Jul. 03, 2013	Annual	Jul. 03, 2014
EMI Test Receiver	R&S	ESU26	100194	Sep. 13, 2013	Annual	Sep. 13, 2014
High Pass Filter	Wainwright	WHK3.0/18G-6SS	4	Jul. 02, 2013	Annual	Jul. 02, 2014
High Pass Filter	Wainwright	WHK7.5/26.5G-6SS	15	Jul. 03, 2013	Annual	Jul. 03, 2014
Low Pass Filter	Mini circuits	NLP-1200+	V9500401023-1	Jul. 02, 2013	Annual	Jul. 02, 2014
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Jul. 02, 2013	Annual	Jul. 02, 2014
Preamplifier	H.P.	8447D	1726A01265	Sep. 23, 2013	Annual	Sep. 23, 2014
Preamplifier	R&S	SCU 18	10070	Jun. 21, 2013	Annual	Jun. 21, 2014
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	Jun. 13, 2013	Annual	Jun. 13, 2014
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	9163-437	Oct. 04, 2013	Biennial	Oct. 04, 2015
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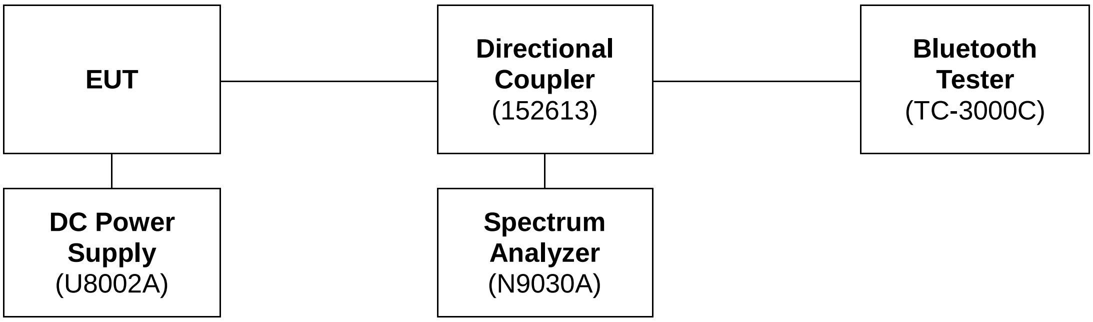
Horn Antenna	R&S	HF906	100608	Aug. 03, 2012	Biennial	Aug. 03, 2014
Horn Antenna	SCHWARZBECK MESSELEKTRONIK	BBHA9170	BBHA9170431	Aug. 24, 2012	Biennial	Aug. 24, 2014
Antenna Master	INN-CO	MA4000-EP	N/A	N.C.R.	N/A	N.C.R.
Turn Table	INN-CO	DT-3000S-3T	N/A	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (21.5 m × 13.0 m × 9.0 m)	N/A	N.C.R.	N/A	N.C.R.

2.1.1.2. Definition of DUT Axis.

- Definition of DUT three orthogonal planes were described in the test setup photo.

2.1.2. Conducted Spurious Emissions



2.1.2.1. Actual equipment used for Conducted spurious Emissions

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	R&S	SMR40	100540	Jan. 08, 2014	Annual	Jan. 08, 2015
Signal Generator	R&S	SMJ 100A	100882	Jul. 03, 2013	Annual	Jul. 03, 2014
Spectrum Analyzer	Agilent	N9030A	MY53120526	Jul. 30, 2013	Annual	Jul. 30, 2014
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Jul. 02, 2013	Annual	Jul. 02, 2014
Directional Coupler	KRYTAR	152613	127445	Jul. 02, 2013	Annual	Jul. 02, 2014
DC Power Supply	Agilent	U8002A	MY48490027	Jan. 03, 2014	Annual	Jan. 03, 2015

2.2. Limit

According to §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))

According to § 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 (2400/F(㎑))	2400/F(㎑)
0.490 – 1.705	30	20 log (24000/F(㎑))	24000/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

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of DA 00-705 and ANSI C63.4 2003.

Battery cover of EUT is supported to battery charging condition with wireless charger.
According to KDB648474 D03 Wireless Chargers Battery Cover v01r02, transmitter spurious emissions measurement had to be adjusted as two kinds of test which are without battery charger and with battery charger during normal charging condition in radiation 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.

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. 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 kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 GHz.

2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz. Both average and peak measurements were made using a peak detector.

3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1 kHz > 1/T Hz, where T = pulse width in seconds for Average detection (AV) at frequency above 1 GHz.

4. To get a maximum emission level from the EUT, the EUT is manipulated through three orthogonal planes. The antenna is manipulated through typical positions, polarity and length during the tests.

5. When Average result is different from peak result over 20 dB (over-averaging), According to 15.35 (c), as a “duty cycle correction factor”, pulse averaging with 20 log(duty cycle) has to be used.

2.3.3. Test Procedures for Conducted Spurious Emissions

2.3.3.1. Band-edge Compliance of RF Conducted Emissions

The transmitter output was connected to the spectrum analyzer.
Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
RBW ≥ 100 ㎑
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

2.3.3.2. Spurious RF Conducted Emissions

The transmitter output was connected to the spectrum analyzer.
RBW = 1 ㎒
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

- RBW was set to 1 ㎒ rather than 100 ㎑ in order to increase the measurement speed.
- The display line shown in section 2.4.3 plots denotes the limit at 20 ㏈ below the fundamental emission level measured in a 100 ㎑ bandwidth. However, since the traces in the plots are measured with a 1 ㎒ RBW, the display line may not necessarily appear to be 20 ㏈ below the level of the fundamental in a 1 ㎒ bandwidth.
- For plots showing conducted spurious emissions near the limits, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.

2.4. Test Results

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

2.4.1. Spurious Radiated Emission below 1 000 ㎒

The frequency spectrum from 9 ㎑ to 1 000 ㎒ was investigated. The spurious emissions were investigated for all data rates and the worst case emissions were found with EUT transmitting at 3 Mbps.

2.4.1.1. Battery Cover without charger

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Below 30.00	Not detected	-	-	-	-	-	-	-
40.96	26.94	Peak	H	13.57	-24.43	16.08	40.00	23.92
90.33	29.62	Peak	V	11.94	-23.92	17.64	43.50	25.86
100.71	25.84	Peak	H	13.06	-23.79	15.11	43.50	28.39
133.40	28.70	Peak	H	8.95	-23.43	14.22	43.50	29.28
134.08	39.43	Peak	V	8.87	-23.43	24.87	43.50	18.63
139.42	40.32	Peak	V	8.26	-23.38	25.20	43.50	18.30
148.92	39.88	Peak	V	8.40	-23.26	25.02	43.50	18.48
157.94	39.02	Peak	V	8.62	-23.15	24.49	43.50	19.01
179.09	35.82	Peak	V	9.63	-22.96	22.49	43.50	21.01
725.68	30.54	Peak	H	19.40	-21.79	28.15	46.00	17.85
786.12	29.62	Peak	H	20.77	-21.55	28.84	46.00	17.16
Above 790.00	Not detected	-	-	-	-	-	-	-

Remark:
1. All spurious emissions at channels are almost the same below 1 ㎓, so that the middle channel was chosen at representative in final test.
2. Radiated spurious emission measurement as below
   (Actual = Reading + AF + Cable Loss – Amplifier factor)
3. All reading values are peak values.

2.4.1.2. Battery Cover with charger

- Emission below 30 ㎒

Radiated Emissions			Ant	Correction Factors		Total		FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	Cable (dB)	Actual (dB㎶/m) at 3 m	Actual (dB㎶/m) at 30 m or 300 m	Limit (dB㎶/m)	Margin (dB)
0.15	41.30	Average	V	19.99	0.04	61.33	-18.67	24.08	42.75
0.44	24.20	Average	H	20.08	0.09	44.37	-35.63	14.74	50.37
0.74	16.40	Quasi Peak	H	20.25	0.14	36.79	-3.21	30.22	33.43
9.00	10.70	Quasi Peak	V	20.14	0.59	31.43	-8.57	29.54	38.11
18.76	9.70	Quasi Peak	V	20.27	0.69	30.66	-9.34	29.54	38.88
Above 19.00	Not detected	-	-	-	-	-	-	-	-

- Emission above 30 ㎒

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
431.19	27.78	Peak	H	15.53	-22.56	20.75	46.00	25.25
489.30	28.01	Peak	H	16.42	-22.68	21.75	46.00	24.25
698.72	27.82	Peak	V	20.04	-21.91	25.95	46.00	20.05
875.55	29.92	Peak	H	20.84	-21.05	29.71	46.00	16.29
876.62	32.00	Peak	V	20.85	-21.04	31.81	46.00	14.19
Above 880.00	Not detected	-	-	-	-	-	-	-

Remark:
1. All spurious emission at channels are almost the same below 1 ㎓, so that the middle channel was chosen at representative in final test.
2. Radiated spurious emission measurement as below
(Actual = Reading + AF + Cable Loss – Amplifier factor)
3. Measurement with wireless charger was performed during actual charging condition.
4. Emissions of the frequency between 0.009 ㎒ and 0.490 ㎒ should be adjusted as 300 m distance.
Distance compensation: 40 log (300/3) = 80 ㏈
5. Emissions of the frequency between 0.490 ㎒ and 1.705 ㎒ should be adjusted as 30 m distance.
Distance compensation: 40 log (30/3) = 40 ㏈

2.4.2. Spurious Radiated Emission

The frequency spectrum above 1 000 ㎒ was investigated.

2.4.2.1. Battery Cover without charger

Operating Mode: GFSK(1 Mbps)

A. Low Channel (2 402 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 390.00	24.22	Peak	H	28.30	8.87	61.39	74.00	12.61
*2 390.00	13.10	Average	H	28.30	8.87	50.27	54.00	3.73

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 804.90	34.92	Peak	H	33.20	-31.74	36.38	74.00	37.62
*4 804.90	25.26	Average	H	33.20	-31.74	26.72	54.00	27.28
Above 4 900.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 883.65	34.58	Peak	H	33.29	-31.72	36.15	74.00	37.85
*4 883.65	24.51	Average	H	33.29	-31.72	26.08	54.00	27.92
Above 4 900.00	Not detected	-	-	-	-	-	-	-

C. High Channel (2 480 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	**Reading (dBμV)**	**Detect Mode**	**Pol.**	**AF (dB/m)**	**CL (dB)**	**Actual (dBμV/m)**	**Limit (dBμV/m)**	**Margin (dB)**
*2 483.50	25.77	Peak	H	28.52	9.15	63.44	74.00	10.56
*2 483.50	13.28	Average	H	28.52	9.15	50.95	54.00	3.05

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	**Reading (dBμV)**	**Detect Mode**	**Pol.**	**AF (dB/m)**	**AMP+CL (dB)**	**Actual (dBμV/m)**	**Limit (dBμV/m)**	**Margin (dB)**
*4 960.75	34.31	Peak	H	33.38	-31.71	35.98	74.00	38.02
*4 960.75	25.63	Average	H	33.38	-31.71	27.30	54.00	26.70
Above 5 000.00	Not detected	-	-	-	-	-	-	-

Operating Mode: 8DPSK(3 Mbps)

A. Low Channel (2 402 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 390.00	22.64	Peak	H	28.30	8.87	59.81	74.00	14.19
*2 390.00	12.88	Average	H	28.30	8.87	50.05	54.00	3.95

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 804.85	32.63	Peak	H	33.20	-31.74	34.09	74.00	39.91
*4 804.85	24.77	Average	H	33.20	-31.74	26.23	54.00	27.77
Above 4 900.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 882.33	35.06	Peak	H	33.29	-31.72	36.63	74.00	37.37
*4 882.33	25.41	Average	H	33.29	-31.72	26.98	54.00	27.02
Above 4 900.00	Not detected	-	-	-	-	-	-	-

C. High Channel (2 480 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	**Reading (dB㎶)**	**Detect Mode**	**Pol.**	**AF (dB/m)**	**CL (dB)**	**Actual (dB㎶/m)**	**Limit (dB㎶/m)**	**Margin (dB)**
*2 483.50	23.15	Peak	H	28.52	9.15	60.82	74.00	13.18
*2 483.50	13.31	Average	H	28.52	9.15	50.98	54.00	3.02

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	**Reading (dB㎶)**	**Detect Mode**	**Pol.**	**AF (dB/m)**	**AMP+CL (dB)**	**Actual (dB㎶/m)**	**Limit (dB㎶/m)**	**Margin (dB)**
*4 960.25	33.97	Peak	H	33.38	-31.71	35.64	74.00	38.36
*4 960.25	24.69	Average	H	33.38	-31.71	26.36	54.00	27.64
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

2.4.2.2. Battery Cover with charger

Operating Mode: GFSK(1 Mbps)

A. Low Channel (2 402 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 390.00	24.22	Peak	H	28.30	8.87	61.39	74.00	12.61
*2 390.00	13.11	Average	H	28.30	8.87	50.28	54.00	3.72

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 804.75	33.78	Peak	H	33.20	-31.74	35.24	74.00	38.76
*4 804.75	26.12	Average	H	33.20	-31.74	27.58	54.00	26.42
Above 4 900.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 881.54	33.15	Peak	H	33.29	-31.72	34.72	74.00	39.28
*4 881.54	24.51	Average	H	33.29	-31.72	26.08	54.00	27.92
Above 4 900.00	Not detected	-	-	-	-	-	-	-

C. High Channel (2 480 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 483.50	25.75	Peak	H	28.30	9.15	63.42	74.00	10.58
*2 483.50	13.33	Average	H	28.30	9.15	51.00	54.00	3.00

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 960.65	34.78	Peak	H	33.38	-31.71	36.45	74.00	37.55
*4 960.65	26.03	Average	H	33.38	-31.71	27.70	54.00	26.30
Above 5 000.00	Not detected	-	-	-	-	-	-	-

Operating Mode: 8DPSK(3 Mbps)

A. Low Channel (2 402 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 390.00	22.62	Peak	H	28.30	8.87	59.79	74.00	14.21
*2 390.00	12.90	Average	H	28.30	8.87	50.07	54.00	3.93

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 804.15	33.75	Peak	H	33.20	-31.74	35.21	74.00	38.79
*4 804.15	24.89	Average	H	33.20	-31.74	26.35	54.00	27.65
Above 4 900.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 882.02	35.11	Peak	H	33.29	-31.72	36.68	74.00	37.32
*4 882.02	25.42	Average	H	33.29	-31.72	26.99	54.00	27.01
Above 4 900.00	Not detected	-	-	-	-	-	-	-

C. High Channel (2 480 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 483.50	23.16	Peak	H	28.52	9.15	60.83	74.00	13.17
*2 483.50	13.32	Average	H	28.52	9.15	50.99	54.00	3.01

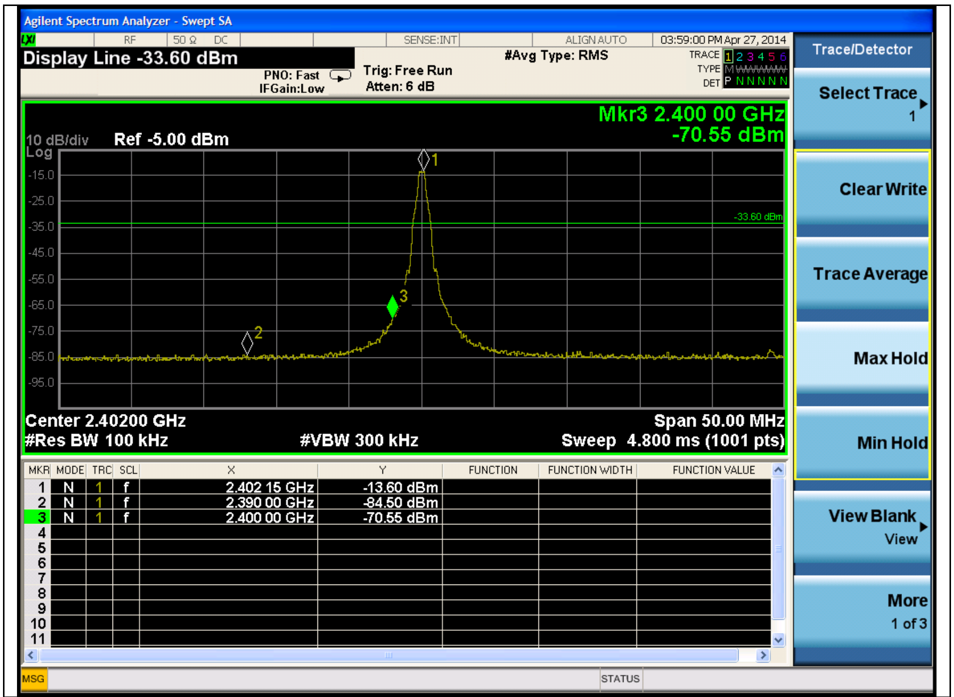
Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 960.26	33.84	Peak	H	33.38	-31.71	35.51	74.00	38.49
*4 960.26	24.50	Average	H	33.38	-31.71	26.17	54.00	27.83
Above 5 000.00	Not detected	-	-	-	-	-	-	-

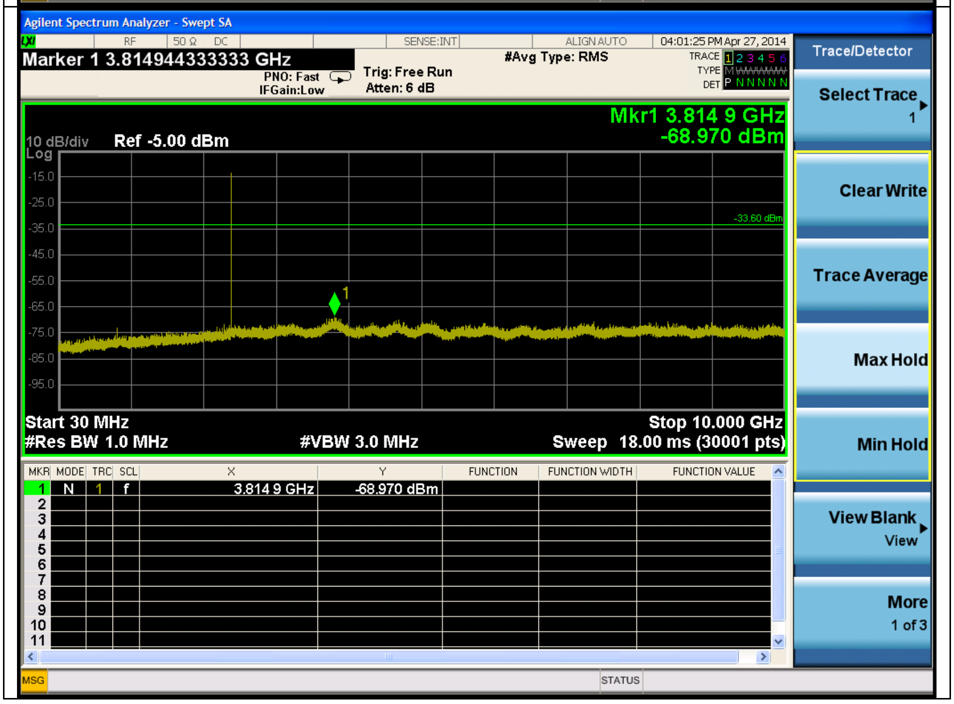
Remarks;
1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + AMP + CL

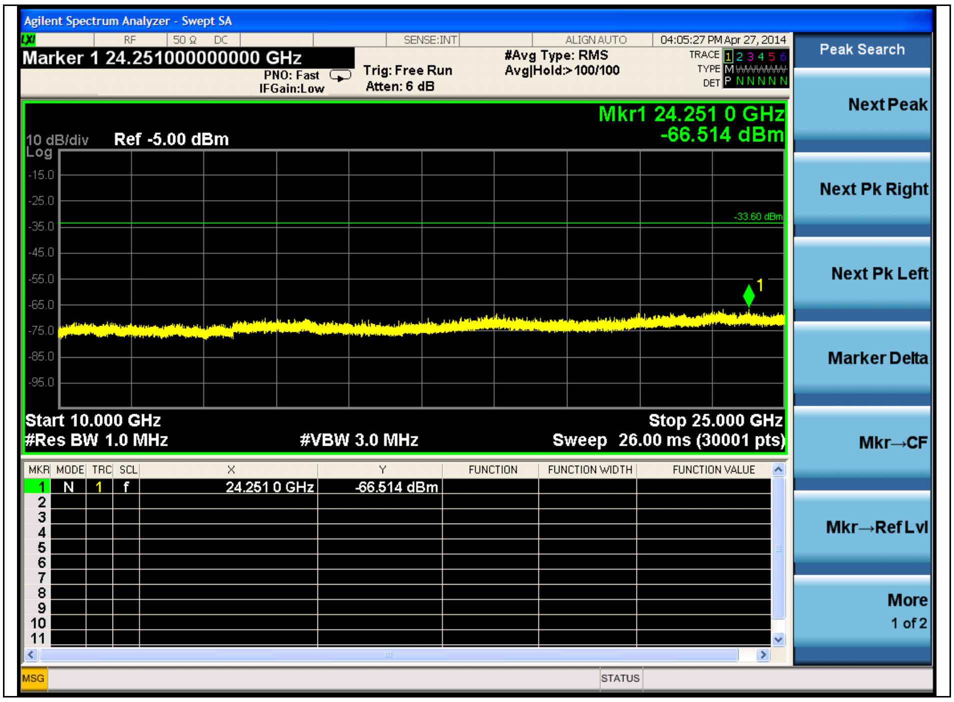
2.4.3. Spurious RF Conducted Emissions: Plot of Spurious RF Conducted Emission

Operating Mode: GFSK(1 Mbps)

Low Channel



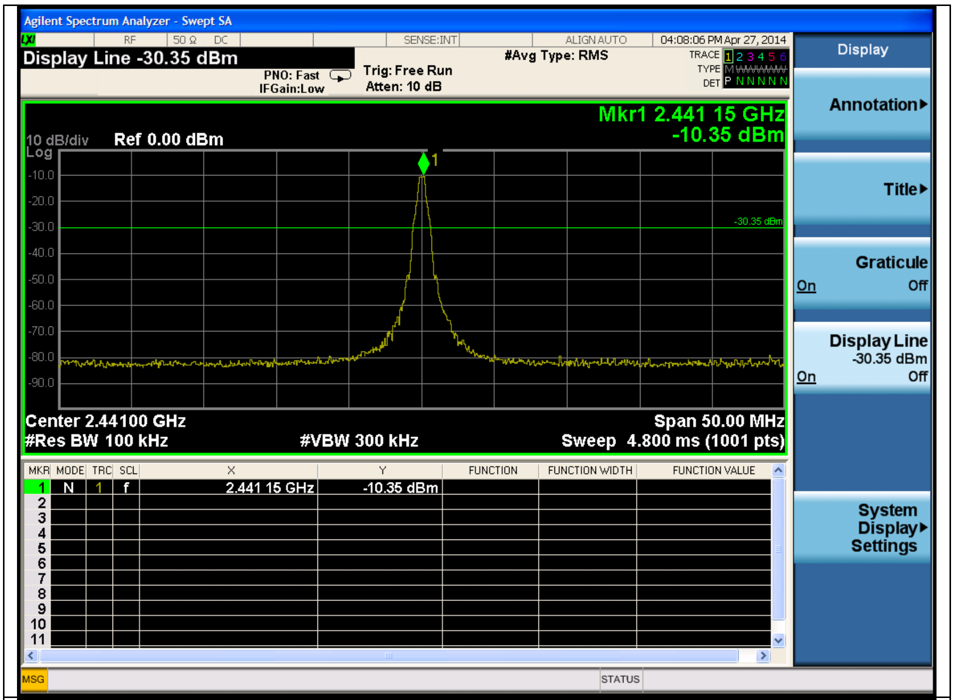


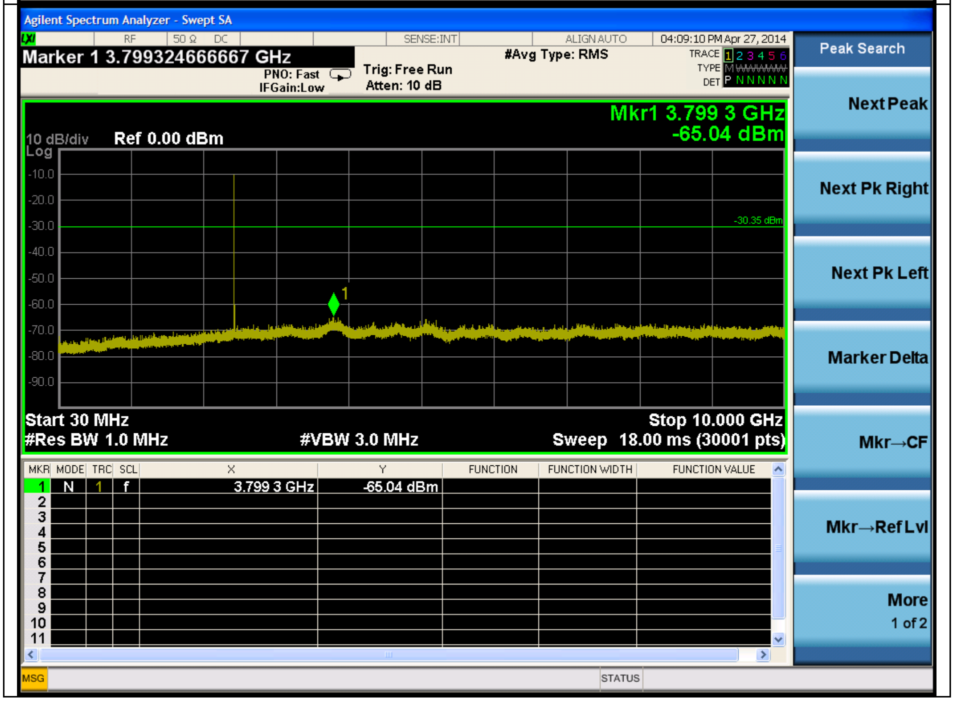


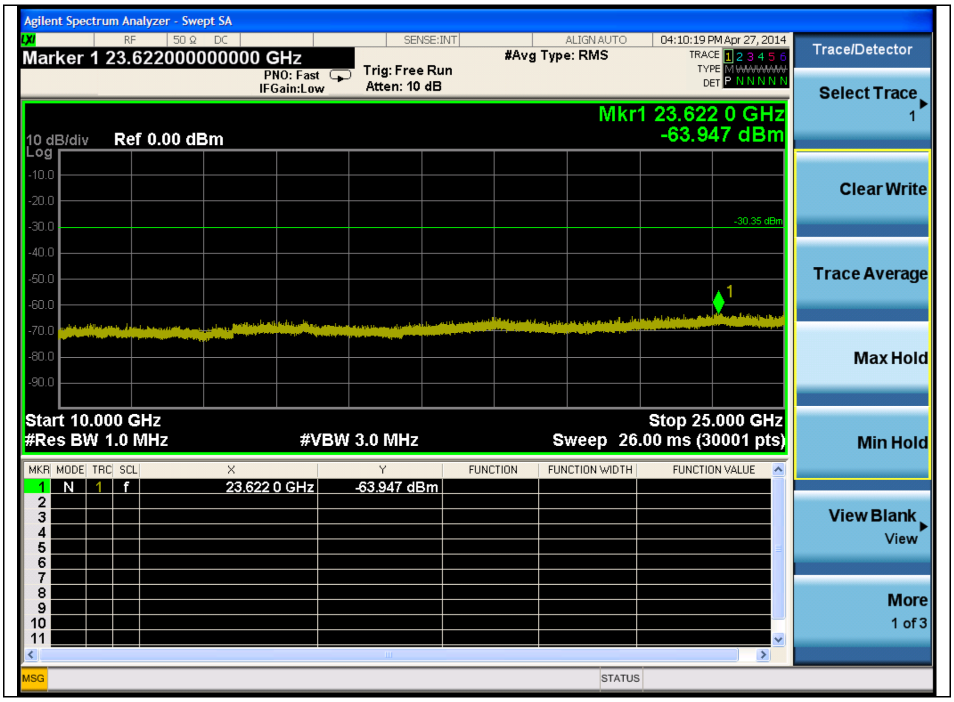
Note:
Offset (㏈) = Directional Coupler(㏈) + Cable loss (㏈)
Result (㏈ m) = Offset (㏈) + Reading values (㏈ m)

Frequency (㎒)	Reading values (㏈ m)	Offset (㏈)	Result (㏈ m)
2 402.15 (fundamental)	-13.60	16.28	2.68
2 390.00	-84.50	16.15	-68.35
2 400.00	-70.55	16.26	-54.29
3 814.90	-68.97	16.74	-52.23
24 251.00	Noise floor	-	-

Middle Channel



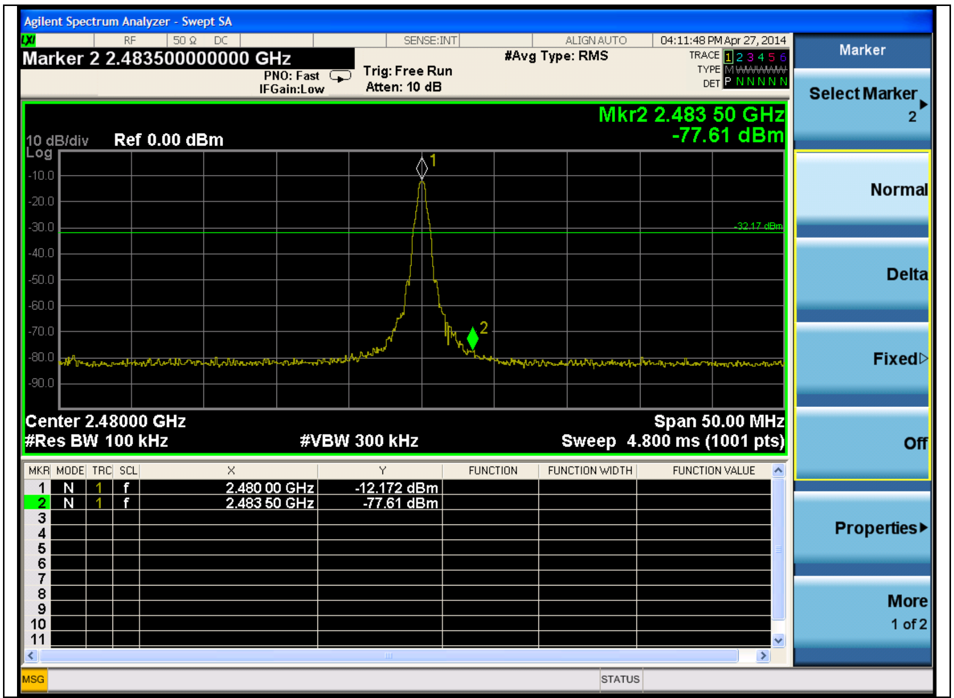


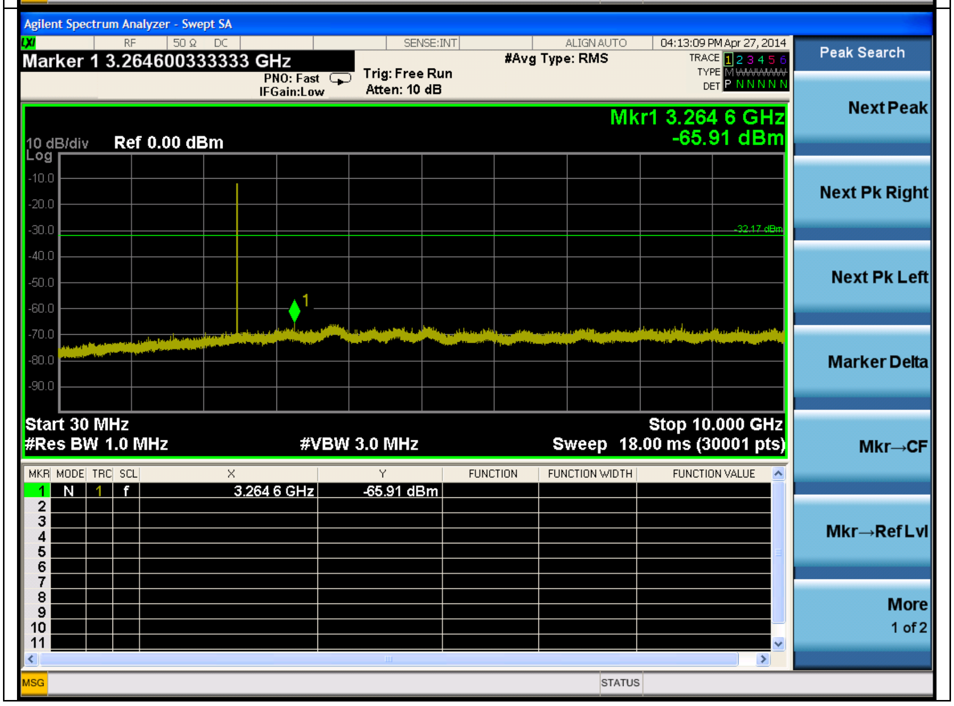


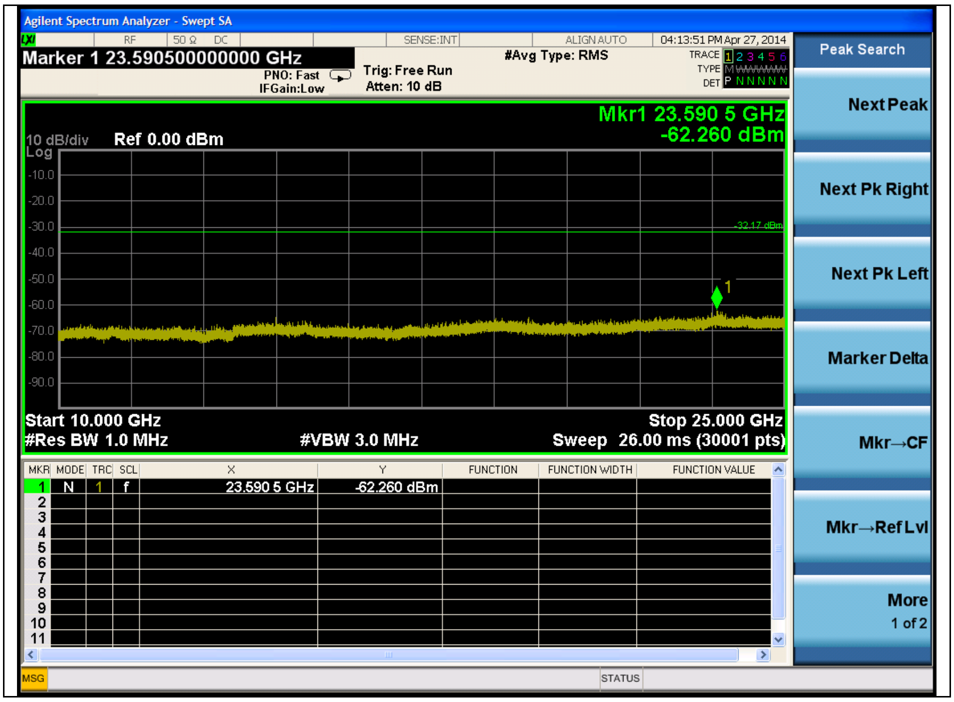
Note:
Offset (dB) = Directional Coupler(dB) + Cable loss (dB)
Result (dB m) = Offset (dB) + Reading values (dB m)

Frequency (MHz)	Reading values (dB m)	Offset (dB)	Result (dB m)
2 441.15 (fundamental)	-10.35	16.36	6.01
3 799.30	-65.04	16.68	-48.36
23 622.00	Noise floor	-	-

High Channel







Note:
Offset (㏈) = Directional Coupler(㏈) + Cable loss (㏈)
Result (㏈ m) = Offset (㏈) + Reading values (㏈ m)

Frequency (㎒)	Reading values (㏈ m)	Offset (㏈)	Result (㏈ m)
2 480.00 (fundamental)	-12.17	16.31	4.14
2 483.50	-77.61	16.33	-61.28
3 264.60	-65.91	16.44	-49.47
23 590.50	Noise floor	-	-

Band edge Compliance with Hopping Enabled

Low channel

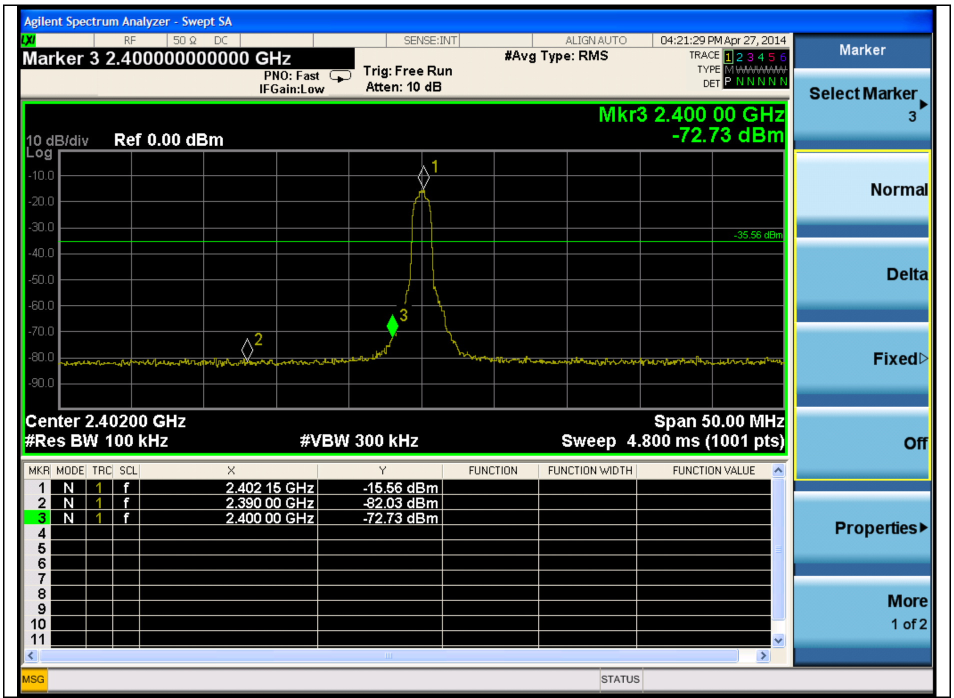
High channel

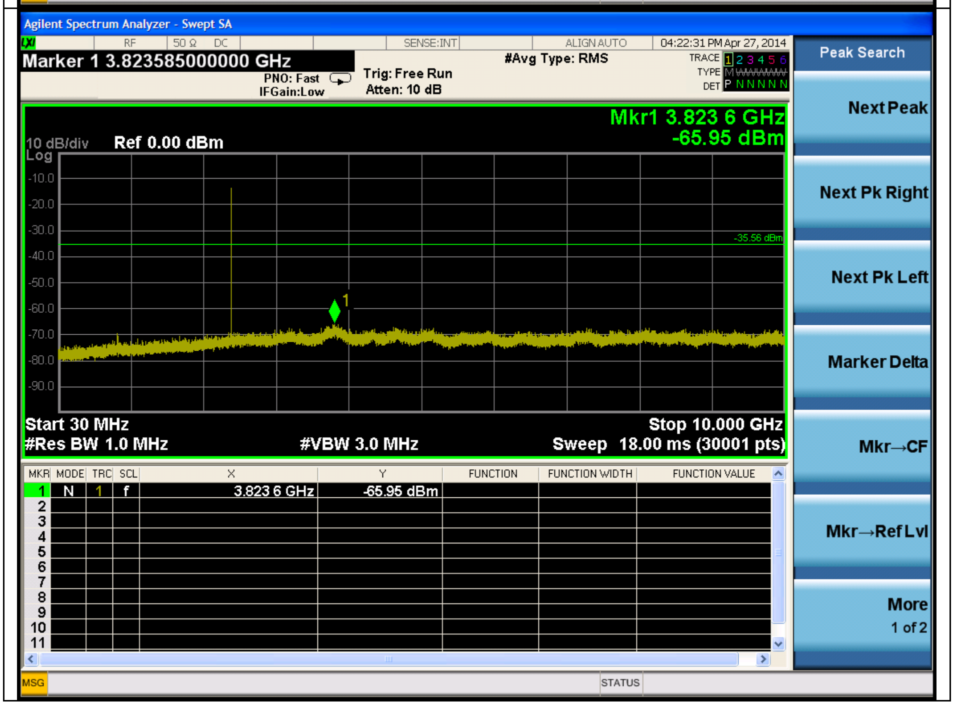
Note:
Offset (㏈) = Directional Coupler(㏈) + Cable loss (㏈)
Result (㏈ m) = Offset (㏈) + Reading values (㏈ m)

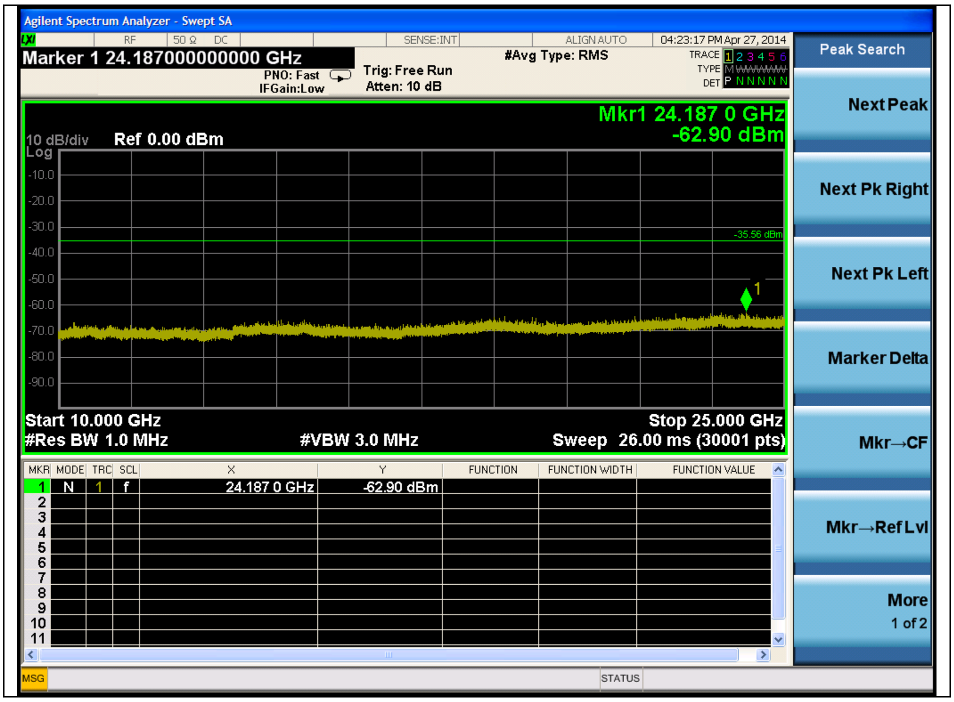
Frequency (㎒)	Reading values (㏈ m)	Offset (㏈)	Result (㏈ m)
2 402.88 (fundamental)	-14.11	16.28	2.17
2 399.88	-73.43	16.25	-57.18
2 480.03 (fundamental)	-12.38	16.31	3.93
2 483.93	-77.72	16.34	-61.38

Operating Mode : 8DPSK(3 Mbps)

Low Channel



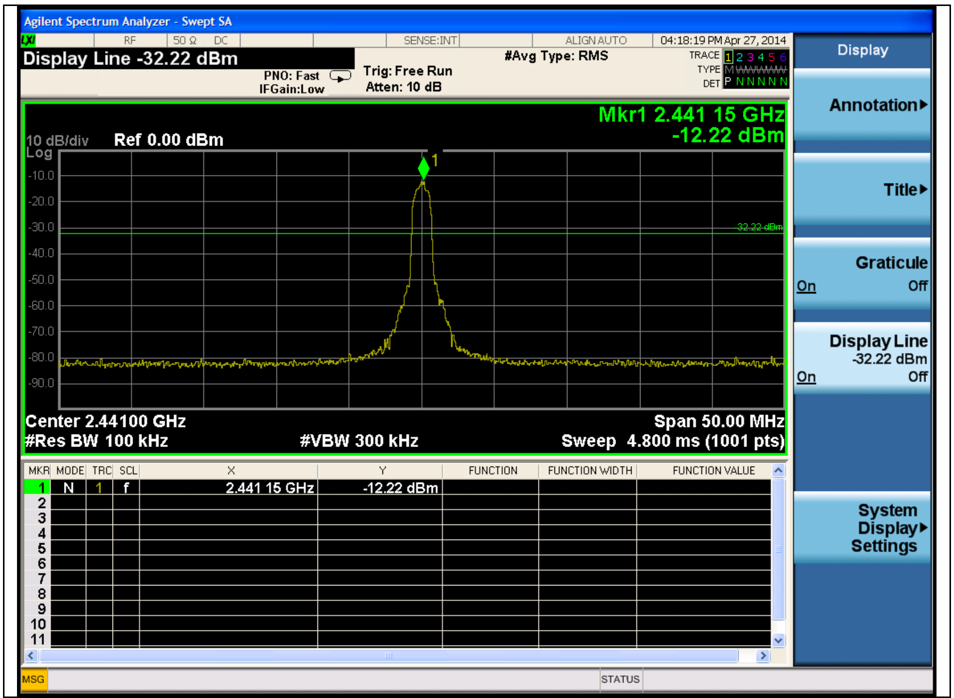


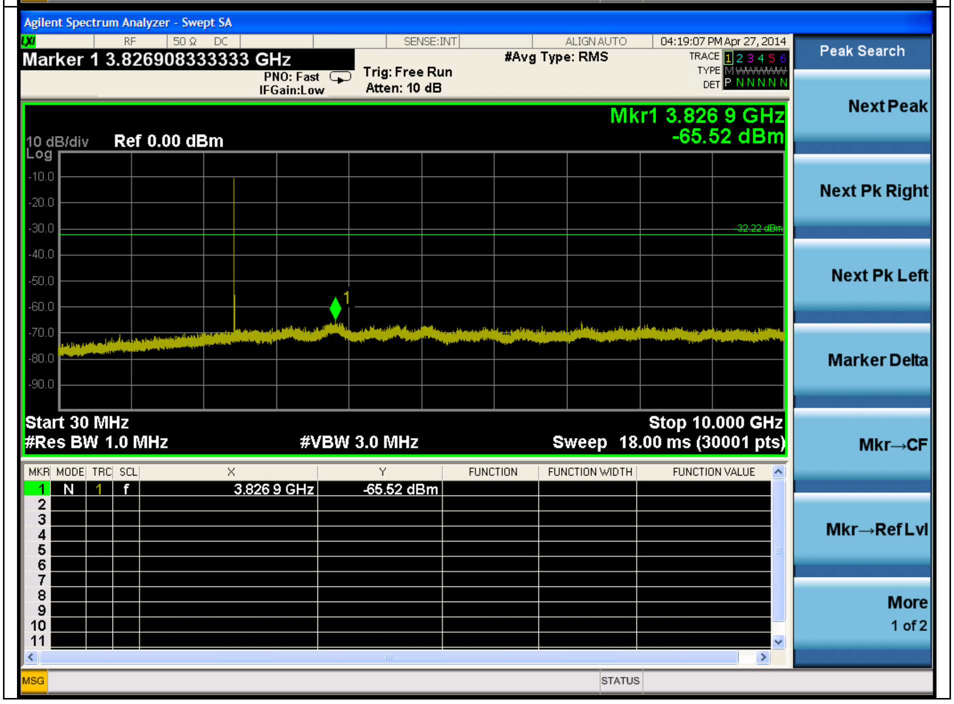


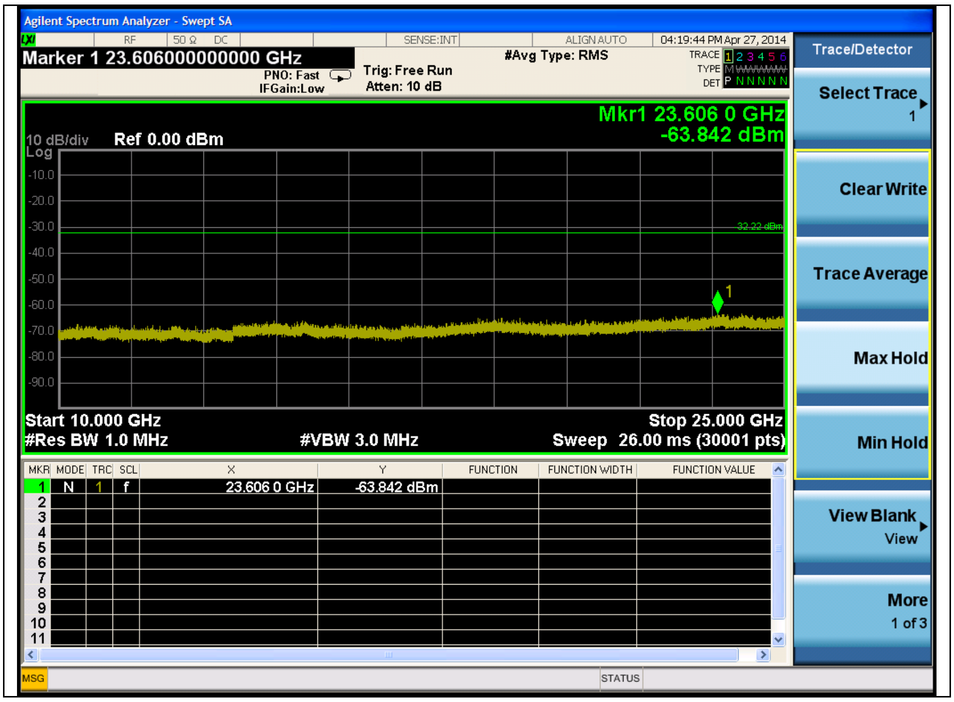
Note:
Offset (dB) = Directional Coupler(dB) + Cable loss (dB)
Result (dB m) = Offset (dB) + Reading values (dB m)

Frequency (MHz)	Reading values (dB m)	Offset (dB)	Result (dB m)
2 402.15 (fundamental)	-15.56	16.28	0.72
2 390.00	-82.03	16.15	-65.88
2 400.00	-72.73	16.26	-56.47
3 823.60	-65.95	16.77	-49.18
24 187.00	Noise floor	-	-

Middle Channel



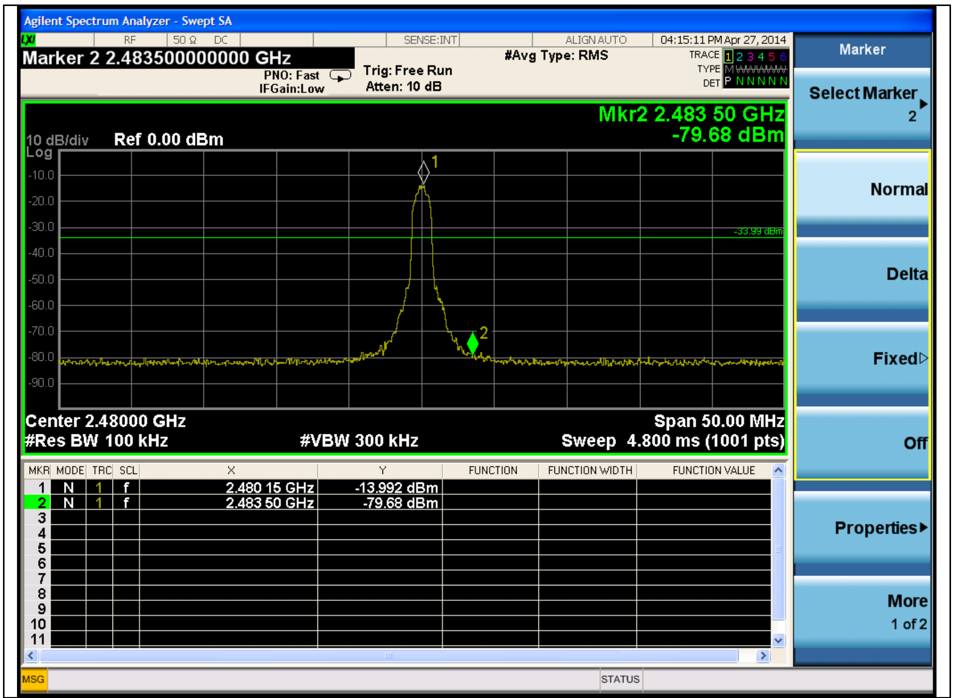


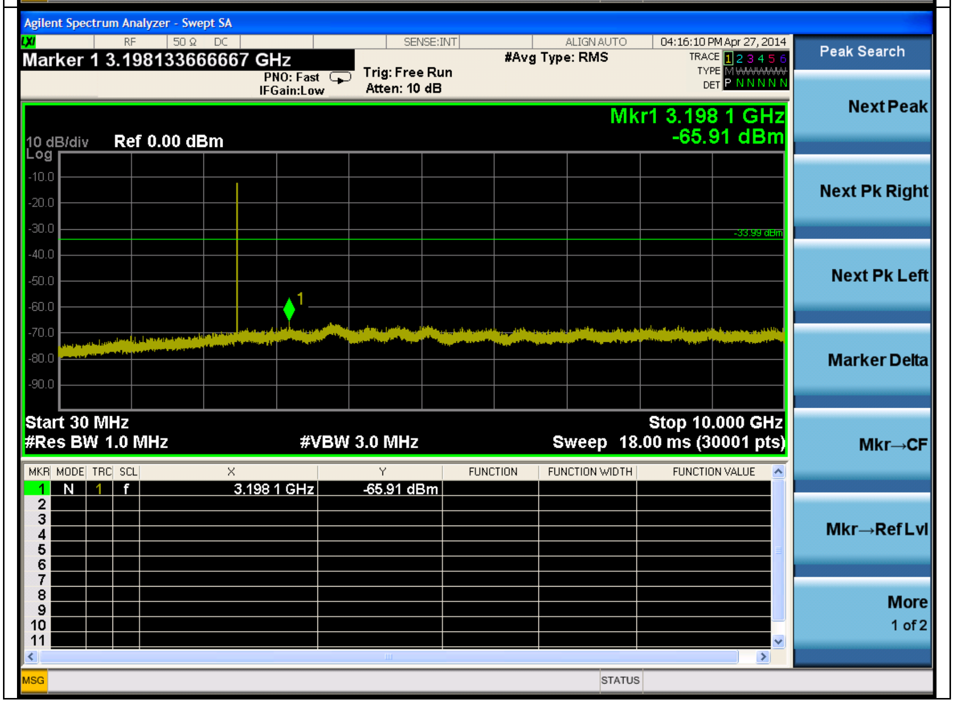


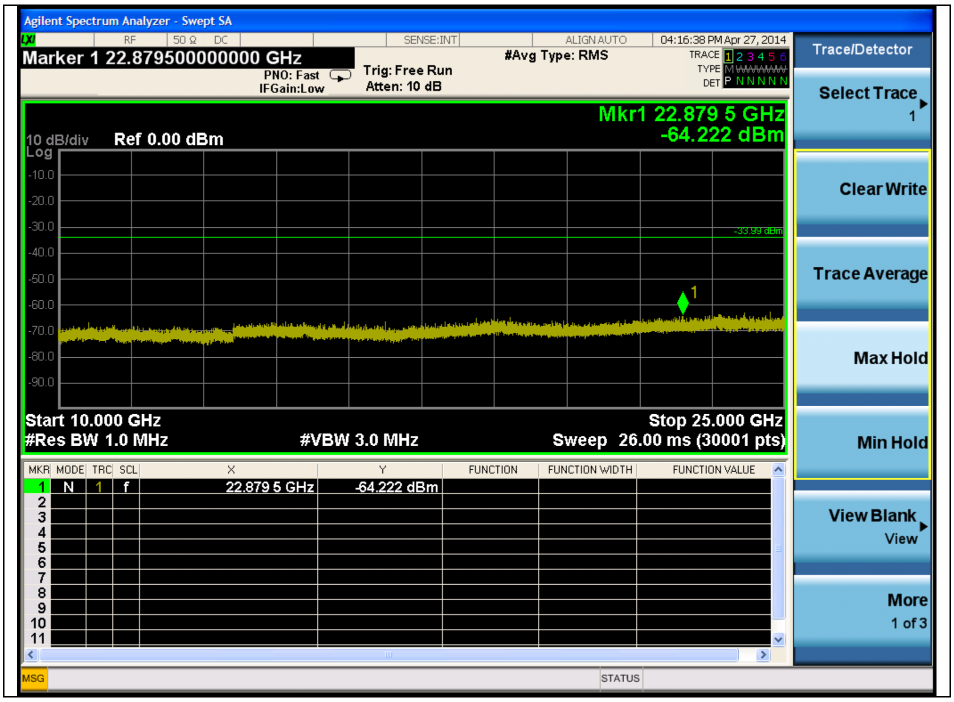
Note:
Offset (dB) = Directional Coupler(dB) + Cable loss (dB)
Result (dB m) = Offset (dB) + Reading values (dB m)

Frequency (MHz)	Reading values (dB m)	Offset (dB)	Result (dB m)
2 441.15 (fundamental)	-12.22	16.36	4.14
3 826.90	-65.52	16.76	-48.76
23 606.00	Noise floor	-	-

High Channel





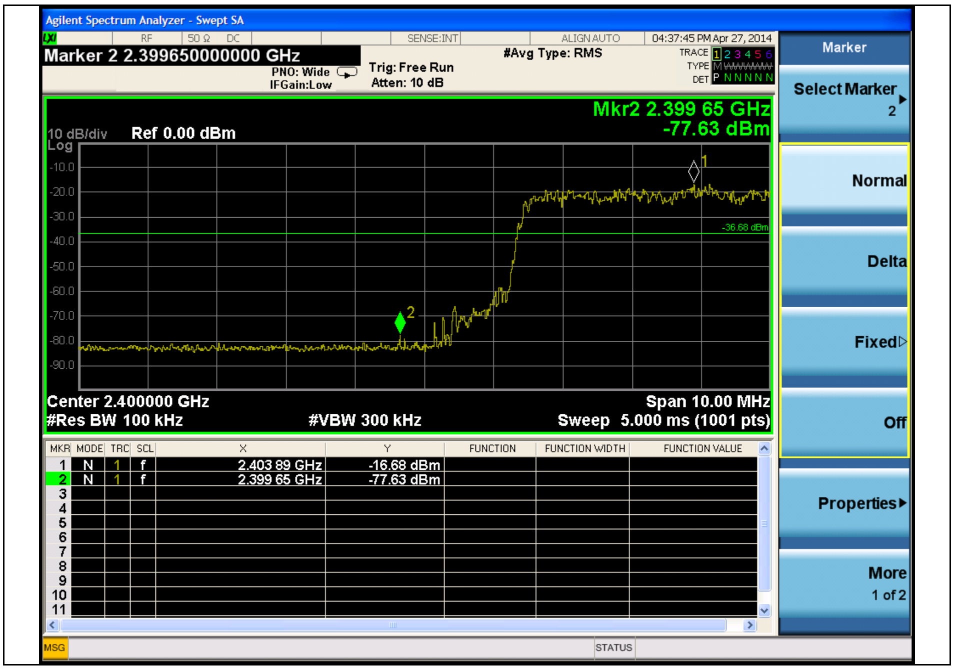


Note:
Offset (dB) = Directional Coupler(dB) + Cable loss (dB)
Result (dB m) = Offset (dB) + Reading values (dB m)

Frequency (MHz)	Reading values (dB m)	Offset (dB)	Result (dB m)
2 480.15 (fundamental)	-13.99	16.31	2.32
2 483.50	-79.68	16.33	-63.35
3 198.10	-65.91	16.40	-49.51
22 879.50	Noise floor	-	-

Band edge Compliance with Hopping Enabled

Low channel



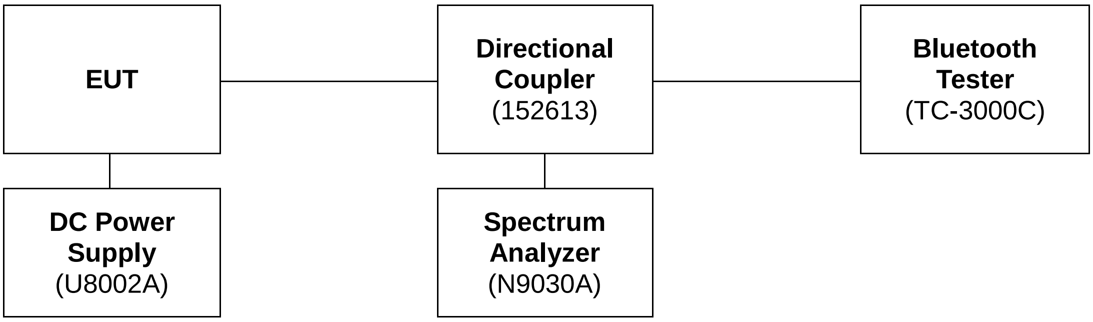
High channel

Note:
Offset (㏈) = Directional Coupler(㏈) + Cable loss (㏈)
Result (㏈ m) = Offset (㏈) + Reading values (㏈ m)

Frequency (㎒)	Reading values (㏈ m)	Offset (㏈)	Result (㏈ m)
2 403.89 (fundamental)	-16.68	16.27	-0.41
2 399.65	-77.63	16.25	-61.38
2 480.17 (fundamental)	-14.79	16.31	1.52
2 483.50	-81.71	16.33	-65.38

3. 20 dB Bandwidth Measurement

3.1. Test Setup



3.1.1. Actual equipment used for 20 dB Bandwidth Measurement

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	R&S	SMR40	100540	Jan. 08, 2014	Annual	Jan. 08, 2015
Signal Generator	R&S	SMJ 100A	100882	Jul. 03, 2013	Annual	Jul. 03, 2014
Spectrum Analyzer	Agilent	N9030A	MY53120526	Jul. 30, 2013	Annual	Jul. 30, 2014
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Jul. 02, 2013	Annual	Jul. 02, 2014
Directional Coupler	KRYTAR	152613	127445	Jul. 02, 2013	Annual	Jul. 02, 2014
DC Power Supply	Agilent	U8002A	MY48490027	Jan. 03, 2014	Annual	Jan. 03, 2015

3.2. Limit

Limit: Not Applicable

3.3. Test Procedure

3.3.1. 20 dB Bandwidth

All data rates and modes were investigated for this test.
The test follows DA 00-705
The 20 dB band width was measured with a spectrum analyzer connected to RF antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency.
Use the following spectrum analyzer setting :
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel.
RBW = greater than 1 % of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto
Detector = peak
Trace = max hold
The marker-to-peak function to set the mark to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is 20 dB bandwidth of the emission.

3.4. Test Results

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

Operation Mode	Data Rate	Channel	Channel Frequency (㎒)	20 ㏈ Bandwidth (㎒)
GFSK	1 Mbps	Low	2 402	0.948
		Middle	2 441	0.957
		High	2 480	1.029
π/4DQPSK	2 Mbps	Low	2 402	1.326
		Middle	2 441	1.323
		High	2 480	1.287
8DPSK	3 Mbps	Low	2 402	1.281
		Middle	2 441	1.308
		High	2 480	1.275

20 dB Bandwidth

Operating Mode: GFSK

Low Channel

Middle Channel

High Channel

Operating Mode: π/4DQPSK

Low Channel

Middle Channel

High Channel

Operating Mode: 8DPSK

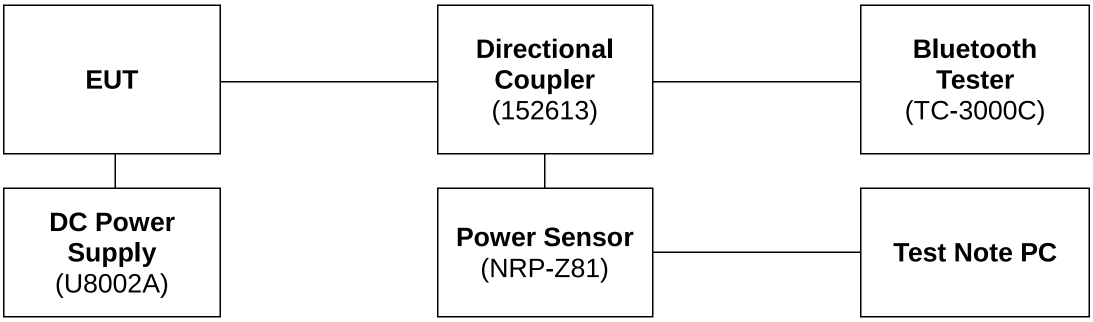
Low Channel

Middle Channel

High Channel

4. Output Power Measurement

4.1. Test Setup



4.1.1. Actual equipment used for Output Power Measurement

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	R&S	SMR40	100540	Jan. 08, 2014	Annual	Jan. 08, 2015
Signal Generator	R&S	SMJ 100A	100882	Jul. 03, 2013	Annual	Jul. 03, 2014
Power Sensor	R&S	NRP-Z81	101341	Jul. 04, 2013	Annual	Jul. 04, 2014
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Jul. 02, 2013	Annual	Jul. 02, 2014
Directional Coupler	KRYTAR	152613	127445	Jul. 02, 2013	Annual	Jul. 02, 2014
DC Power Supply	Agilent	U8002A	MY48490027	Jan. 03, 2014	Annual	Jan. 03, 2015

4.2. Limit

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

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.

4.3. Test Procedure

All data rates and modes were investigated for this test. 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 & average power each channel.

4.4. Test Results

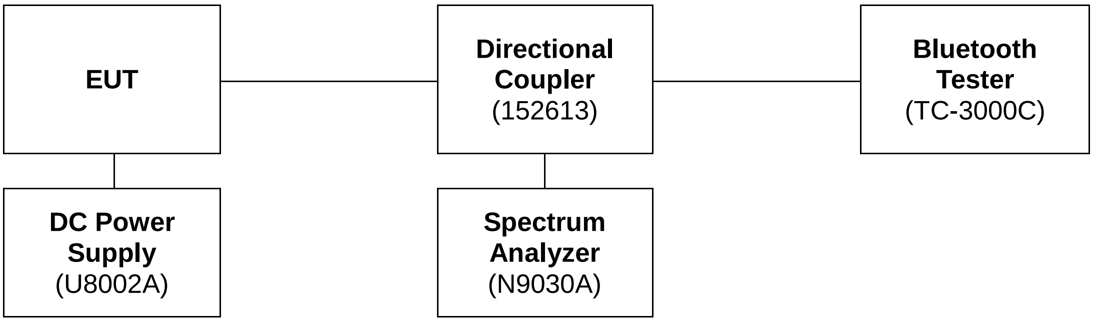
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Operation Mode	Data Rate	Channel	Channel Frequency (㎒)	Attenuator + Cable offset (dB)	Average Power Result (dB m)	Peak Power Result (dB m)	Peak Power Limit (dB m)
GFSK	1 Mbps	Low	2 402	16.25	3.06	3.55	30.00
		Middle	2 441	16.33	6.13	<u>6.42</u>	30.00
		High	2 480	16.35	4.60	4.98	30.00
π/4DQPSK	2 Mbps	Low	2 402	16.25	0.65	3.58	20.97
		Middle	2 441	16.33	3.69	<u>6.54</u>	20.97
		High	2 480	16.35	2.08	5.04	20.97
8DPSK	3 Mbps	Low	2 402	16.25	0.66	3.95	20.97
		Middle	2 441	16.33	3.72	<u>6.96</u>	20.97
		High	2 480	16.35	2.10	5.39	20.97

Remark:
In the case of AFH, the limit for peak power is 0.125 W

5. Carrier Frequency Separation

5.1. Test Setup



5.1.1. Actual equipment used for Carrier Frequency Separation

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	R&S	SMR40	100540	Jan. 08, 2014	Annual	Jan. 08, 2015
Signal Generator	R&S	SMJ 100A	100882	Jul. 03, 2013	Annual	Jul. 03, 2014
Spectrum Analyzer	Agilent	N9030A	MY53120526	Jul. 30, 2013	Annual	Jul. 30, 2014
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Jul. 02, 2013	Annual	Jul. 02, 2014
Directional Coupler	KRYTAR	152613	127445	Jul. 02, 2013	Annual	Jul. 02, 2014
DC Power Supply	Agilent	U8002A	MY48490027	Jan. 03, 2014	Annual	Jan. 03, 2015

5.2. Limit

§15.247(a)(1) Frequency hopping system operating in 2 400 – 2 483.5 ㎒. Band may have hopping channel carrier frequencies that are separated by 25 ㎑ or two-third of 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

5.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section. The test follows DA 00-705.

The device is operating in hopping mode between 79 channels and also supporting Adaptive Frequency Hopping with hopping between 20 channels. As compared with each operating mode, 79 channels are chosen as a representative for test.
Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels.
RBW ≥ 1 % of the span.
VBW ≥ RBW
Sweep = auto
Detector = peak
Trace = max hold.

Allow the trace to stabilize. Use the marker-delta function to determine the between the peaks of the adjacent channels.

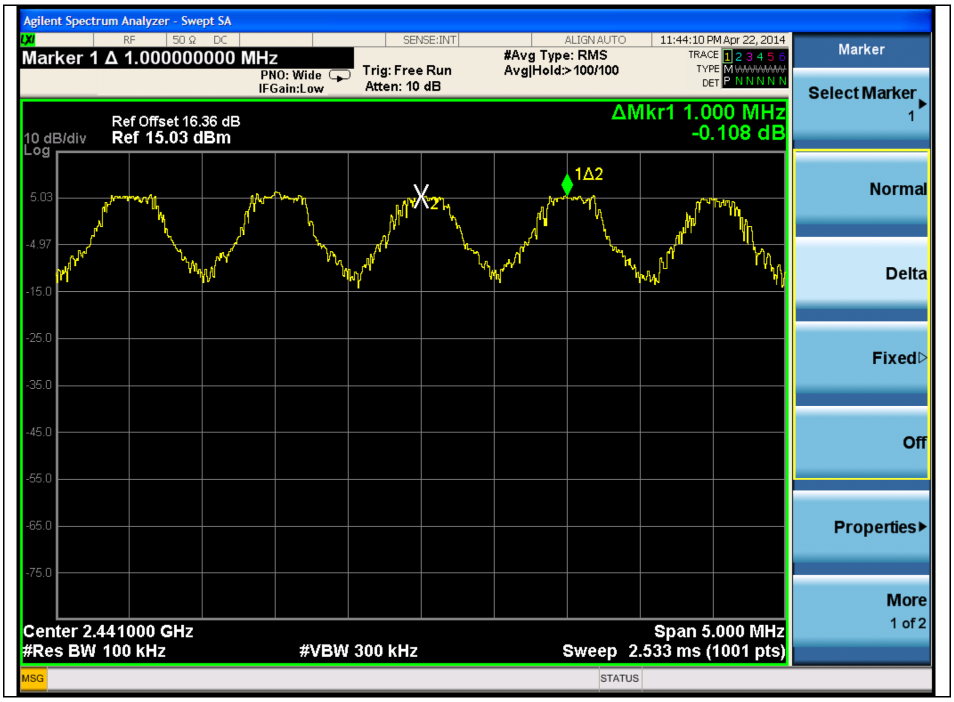
5.4. Test Results

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

Operation Mode	Channel (Middle)	Adjacent Hopping Channel Separation (㎑)	Two-third of 20 ㏈ Bandwidth (㎑)	Minimum Bandwidth (㎑)
GFSK	2 441 ㎒	1 000	638	25
8DPSK	2 441 ㎒	1 000	872	25

Note;
Measurement is made with EUT operating in hopping mode between 79 channels providing a worse case scenario as compared to AFH mode hopping between 20 channels.

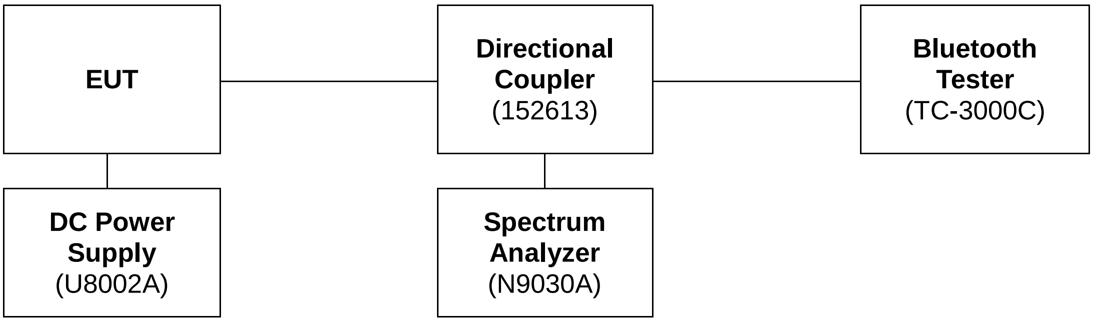
Operating Mode: GFSK



Operating Mode: 8DPSK

6. Number of Hopping Frequency

6.1. Test Setup



6.1.1. Actual equipment used for Number of Hopping Frequency

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	R&S	SMR40	100540	Jan. 08, 2014	Annual	Jan. 08, 2015
Signal Generator	R&S	SMJ 100A	100882	Jul. 03, 2013	Annual	Jul. 03, 2014
Spectrum Analyzer	Agilent	N9030A	MY53120526	Jul. 30, 2013	Annual	Jul. 30, 2014
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Jul. 02, 2013	Annual	Jul. 02, 2014
Directional Coupler	KRYTAR	152613	127445	Jul. 02, 2013	Annual	Jul. 02, 2014
DC Power Supply	Agilent	U8002A	MY48490027	Jan. 03, 2014	Annual	Jan. 03, 2015

6.2. Limit

§15.247(a)(1)(iii), Frequency hopping systems in the 2 400–2 483.5 ㎒ band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

6.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section. The test follows DA 00-705.

The device supports Adaptive Frequency Hopping and will use a minimum of 20 channels of the 79 available channels.

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna the port to the Spectrum analyzer
3. Set spectrum analyzer Start = 2 400 ㎒, Stop = 2 441.5 ㎒, Sweep=sweep and Start = 2 441.5 ㎒, Stop = 2 483.5 ㎒, Sweep = sweep. Detector = peak.
4. Set the spectrum analyzer as RBW, VBW = 510 ㎑.
5. Max hold, allow the trace to stabilize and count how many channel in the band.

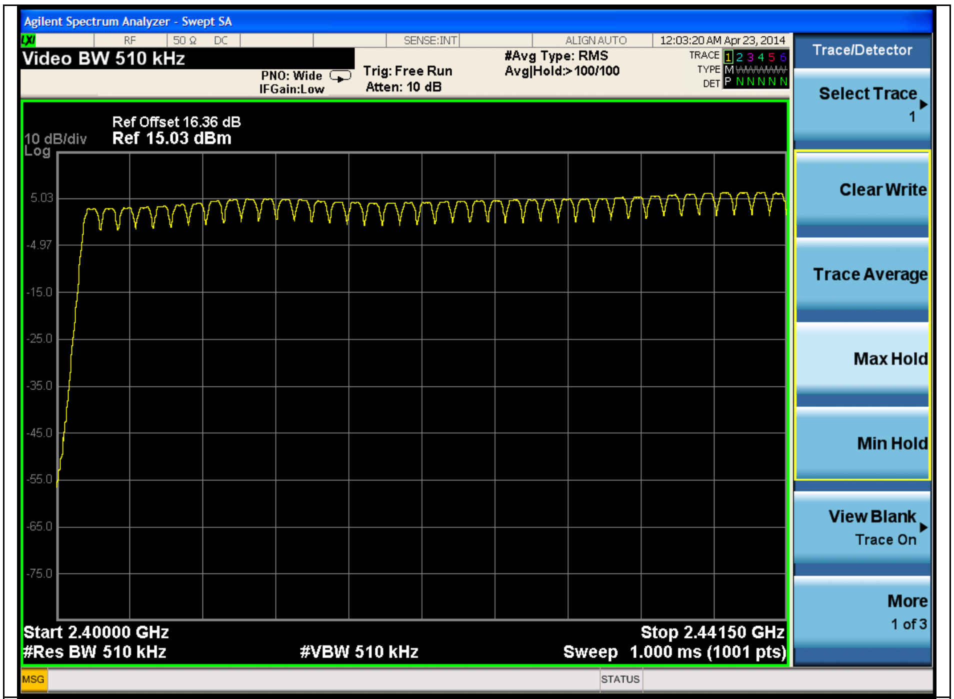
6.4. Test Results

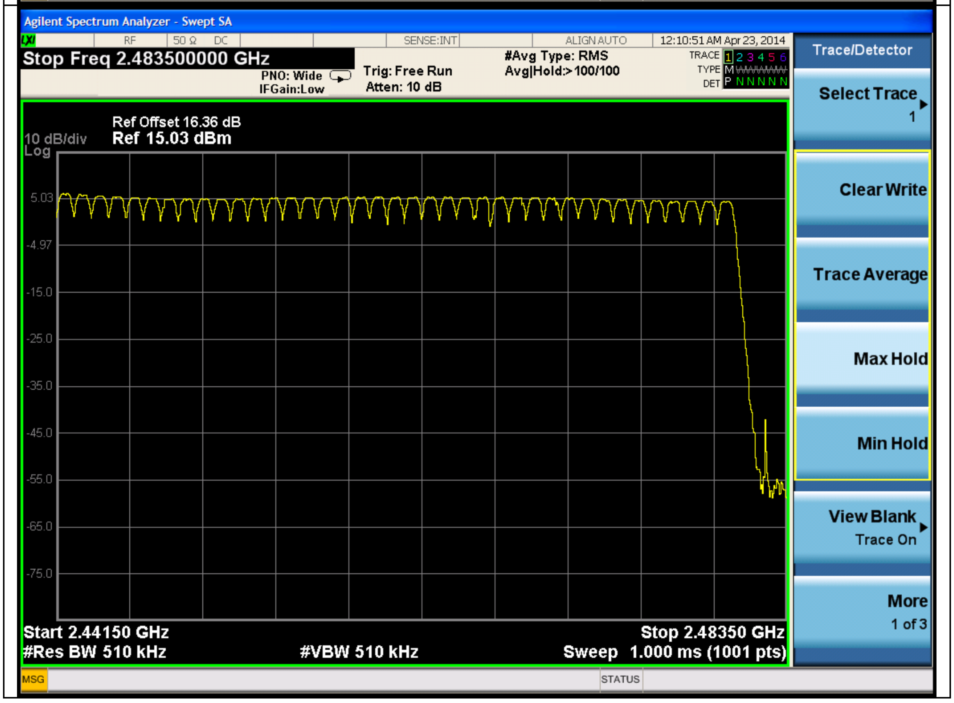
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Operation Mode	Number of Hopping Frequency	Limit
GFSK	79	≥15
8DPSK	79	≥15

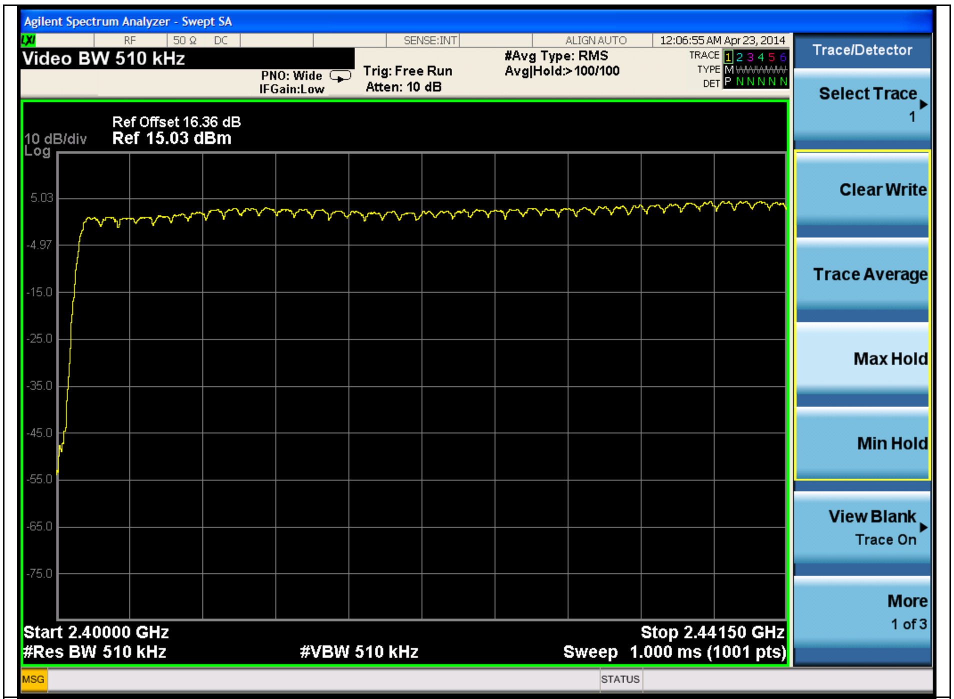
Remark:
Measurement is made with EUT operating in hopping mode between 79 channels providing a worse case scenario as compared to AFH mode hopping between 20 channels.

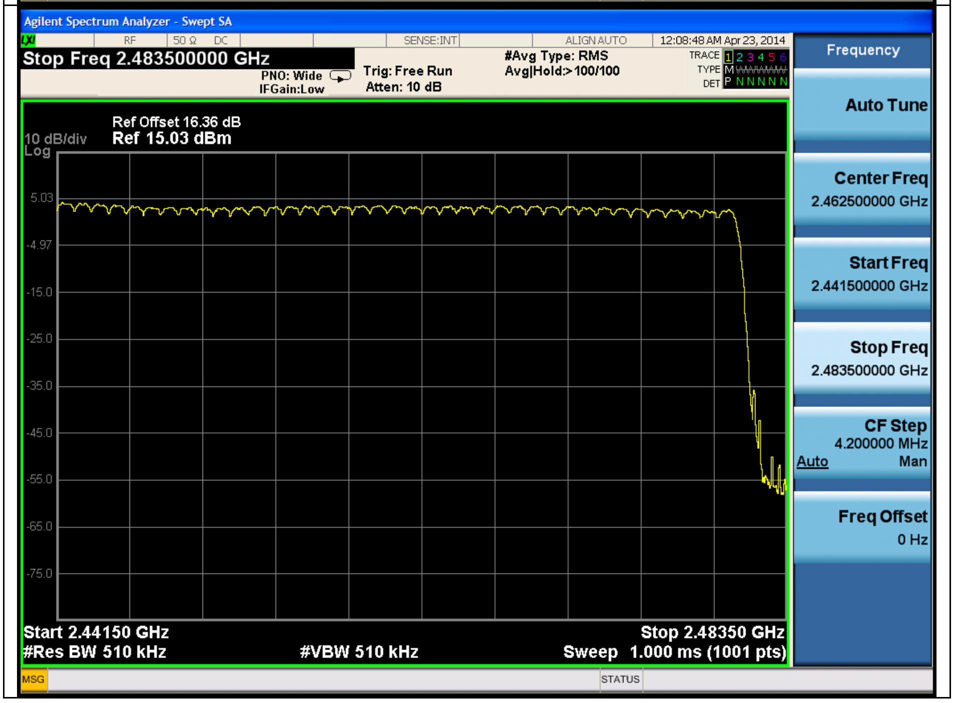
Operating Mode: GFSK





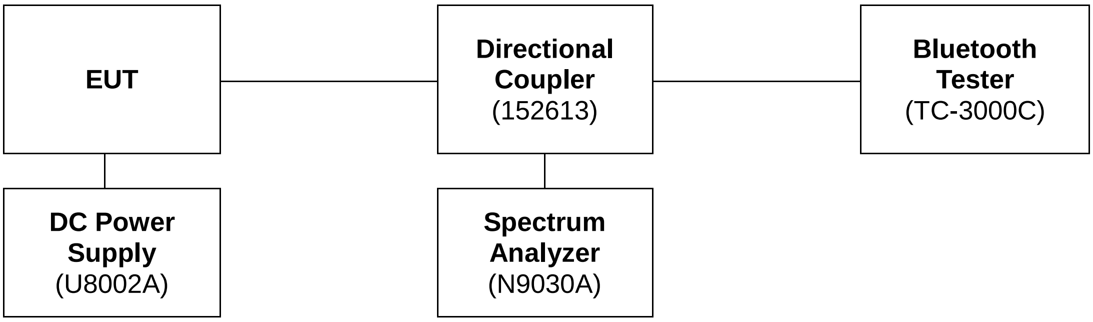
Operating Mode : 8DPSK





7. Time of Occupancy (Dwell Time)

7.1. Test Set up



7.1.1. Actual equipment used for 20 ㏈ Bandwidth Measurement

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	R&S	SMR40	100540	Jan. 08, 2014	Annual	Jan. 08, 2015
Signal Generator	R&S	SMJ 100A	100882	Jul. 03, 2013	Annual	Jul. 03, 2014
Spectrum Analyzer	Agilent	N9030A	MY53120526	Jul. 30, 2013	Annual	Jul. 30, 2014
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Jul. 02, 2013	Annual	Jul. 02, 2014
Directional Coupler	KRYTAR	152613	127445	Jul. 02, 2013	Annual	Jul. 02, 2014
DC Power Supply	Agilent	U8002A	MY48490027	Jan. 03, 2014	Annual	Jan. 03, 2015

7.2. Limit

§15.247(a)(1)(iii) For frequency hopping system operating in the 2 400 – 2 483.5 ㎒ band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 31.6 second period.

A period time = 0.4(s) * 79 = 31.6(s)

***Adaptive Frequency Hopping**

A period time = 0.4(s) * 20 = 8 (s)

7.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section. The test follows DA 00-705.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable.
3. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
4. The Bluetooth has 3 type of payload, DH1, DH3, DH5 and 3-DH1, 3-DH3, 3-DH5.The hopping rate is insisted of 1 600 per second.

The EUT must have its hopping function enabled. Use the following spectrum analyzer setting:

Span = zero span, centered on a hopping channel
RBW = 1 ㎒
VBW ≥ RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector = peak
Trace = max hold
Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation repeat this test for each variation.

7.4. Test Results

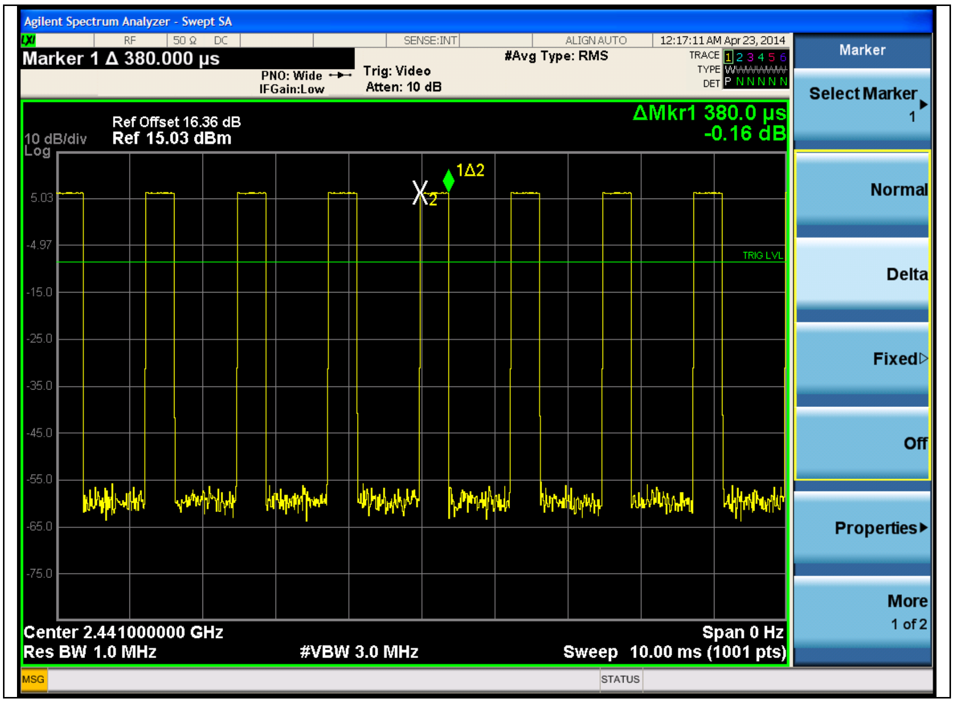
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

7.4.1. Packet Type: DH1, 3-DH1

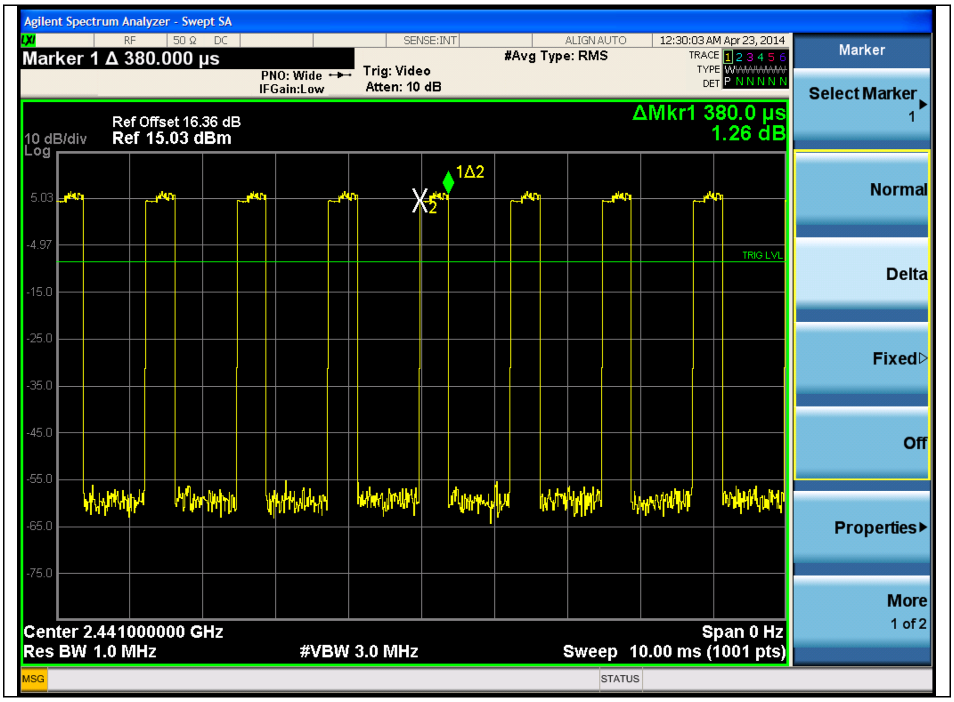
Operation Mode	Frequency	Dwell Time (㎳)	Time of occupancy on the Tx Channel in 31.6 sec (㎳)	Limit for time of occupancy on the Tx Channel in 31.6 sec (㎳)
GFSK	2 441 ㎒	0.38	121.60	400
8DPSK	2 441 ㎒	0.38	121.60	400

Note:
Time of occupancy on the TX channel in 31.6 sec
In case of GFSK & 8DPSK, 0.38 × {(1600 ÷ 2) / 79} × 31.6 = 121.60 ㎳

Operating Mode: GFSK



Operating Mode: 8DPSK

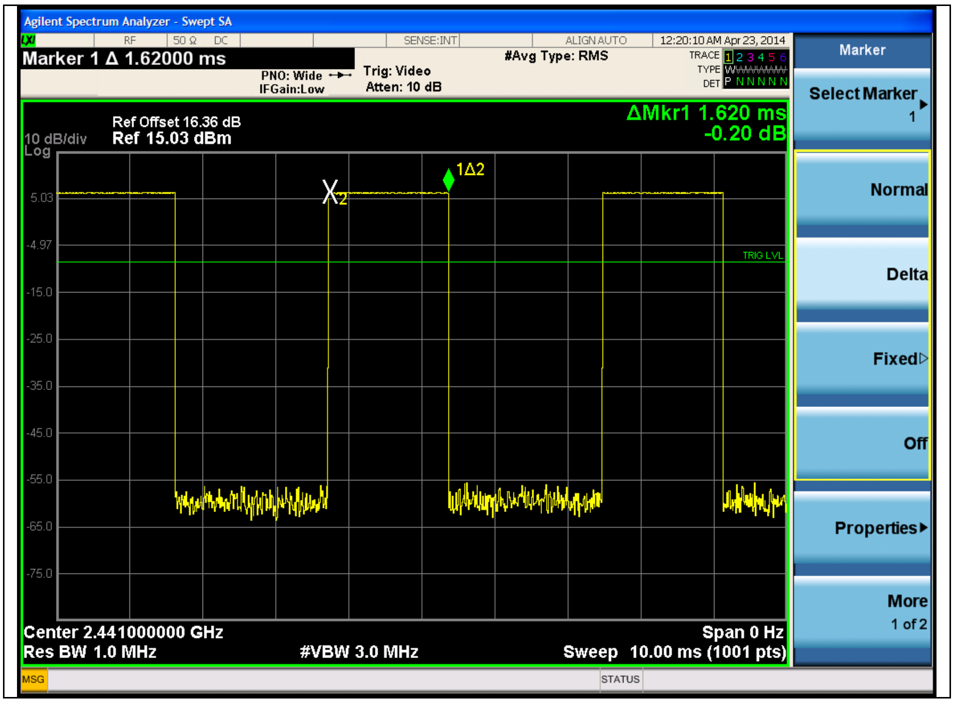


7.4.2. Packet Type: DH3, 3-DH3

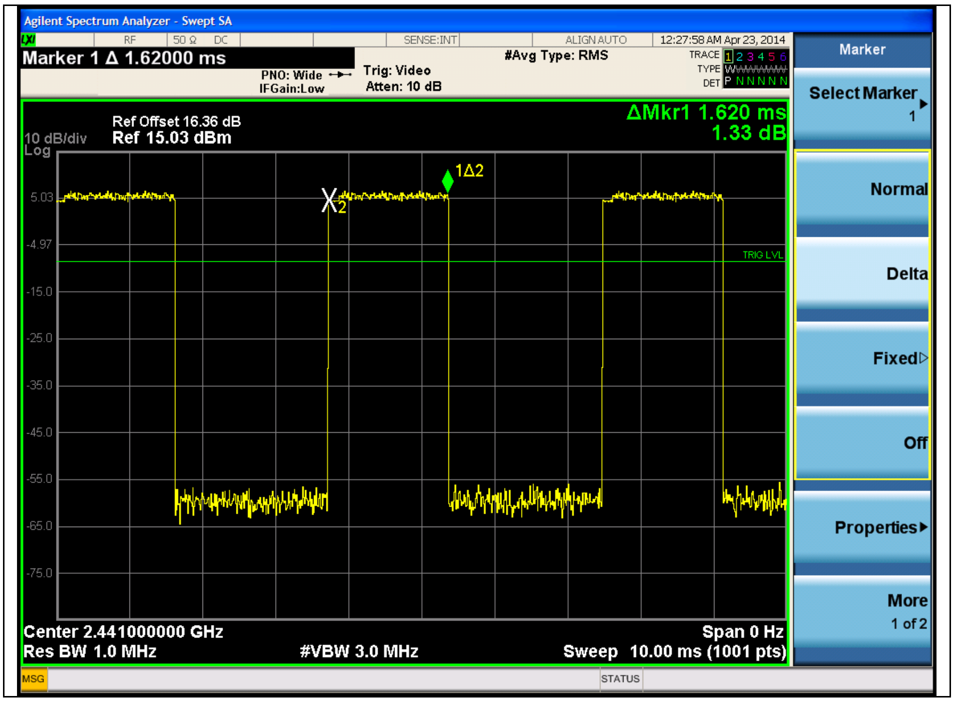
Operation Mode	Frequency	Dwell Time (㎳)	Time of occupancy on the Tx Channel in 31.6 sec (㎳)	Limit for time of occupancy on the Tx Channel in 31.6 sec (㎳)
GFSK	2 441 ㎒	1.62	259.20	400
8DPSK	2 441 ㎒	1.62	259.20	400

Note:
Time of occupancy on the TX channel in 31.6 sec
In case of GFSK & 8DPSK, 1.62 × {(1600 ÷ 4) / 79} × 31.6 = 259.20 ㎳

Operating Mode: GFSK



Operating Mode: 8DPSK

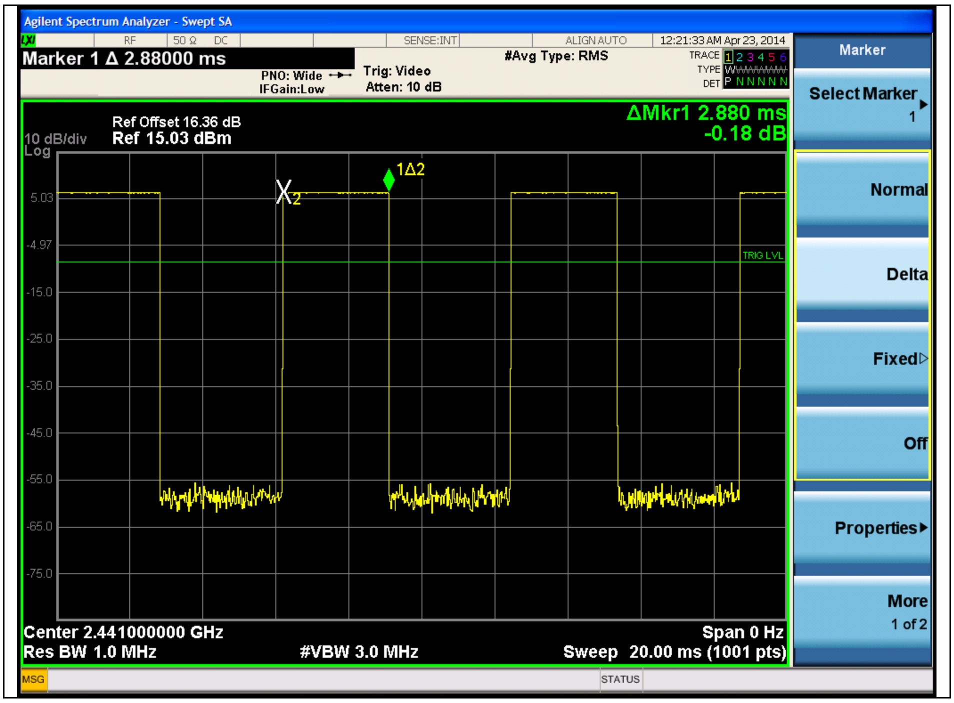


7.4.3. Packet Type: DH5, 3-DH5

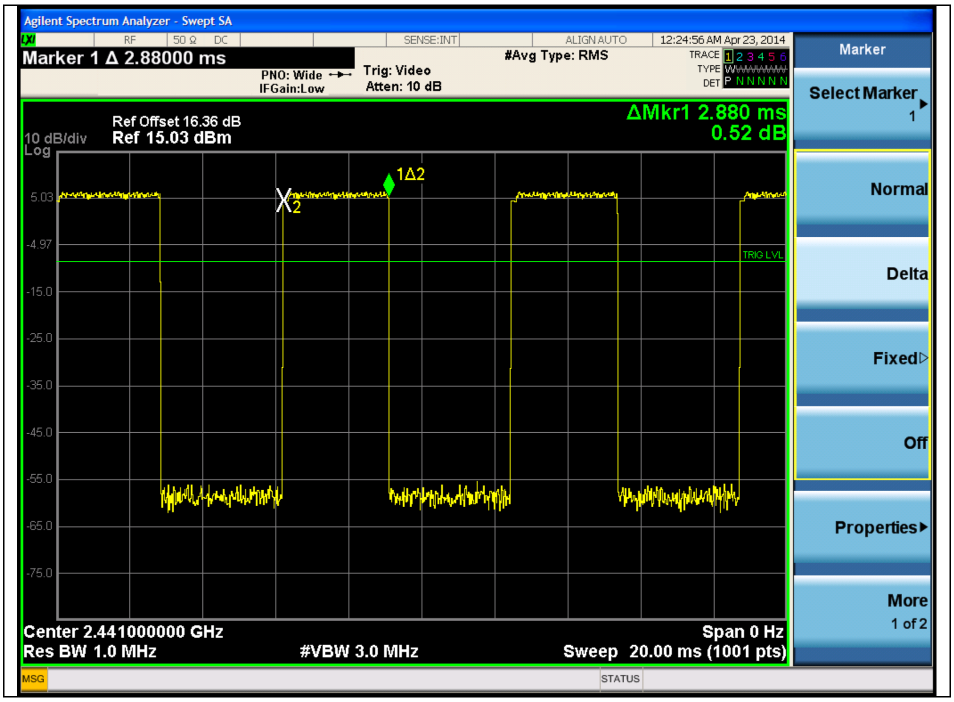
Operation Mode	Frequency	Dwell Time (㎳)	Time of occupancy on the Tx Channel in 31.6 sec (㎳)	Limit for time of occupancy on the Tx Channel in 31.6 sec (㎳)
GFSK	2 441 ㎒	2.88	307.20	400
8DPSK	2 441 ㎒	2.88	307.20	400

Note:
Time of occupancy on the TX channel in 31.6 sec
In case of GFSK & 8DPSK, 2.88 × {(1600 ÷ 6) / 79} × 31.6 = 307.20 ㎳

Operating Mode: GFSK



Operating Mode: 8DPSK

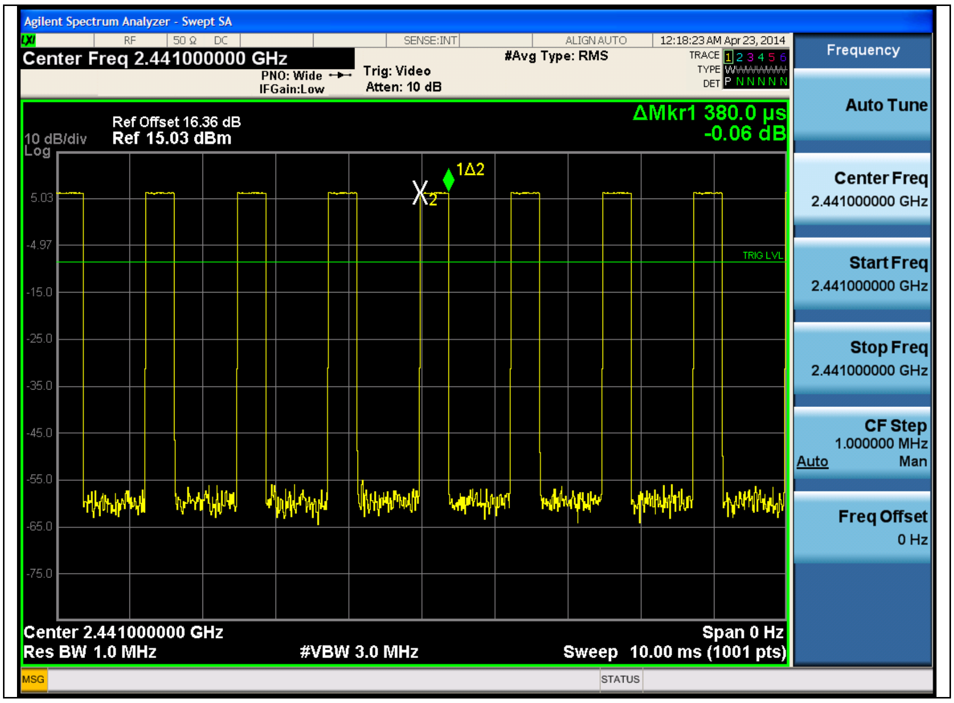


7.4.4. Packet Type: DH1, 3-DH1 (Adaptive Frequency Hopping)

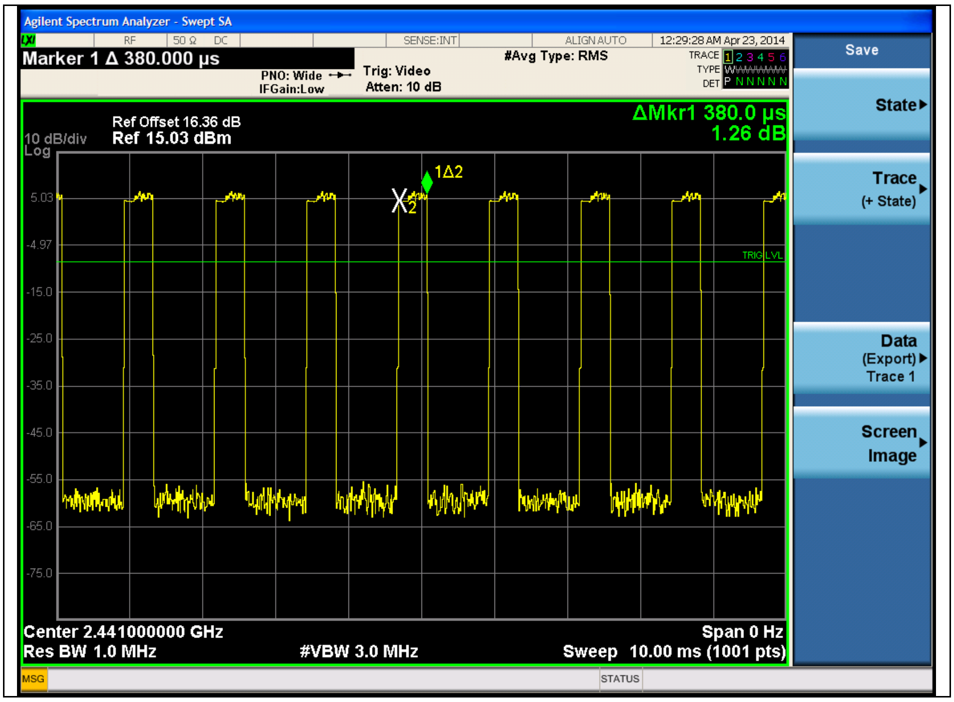
Operation Mode	Frequency	Dwell Time (㎳)	Time of occupancy on the Tx Channel in 8 sec (㎳)	Limit for time of occupancy on the Tx Channel in 8 sec (㎳)
GFSK	2 441 ㎒	0.38	60.80	400
8DPSK	2 441 ㎒	0.38	60.80	400

Note:
Time of occupancy on the TX channel in 8 sec
In case of GFSK & 8DPSK, 0.38 × {(800 ÷ 2) / 20} × 8 = 60.80 ㎳

Operating Mode: GFSK



Operating Mode: 8DPSK

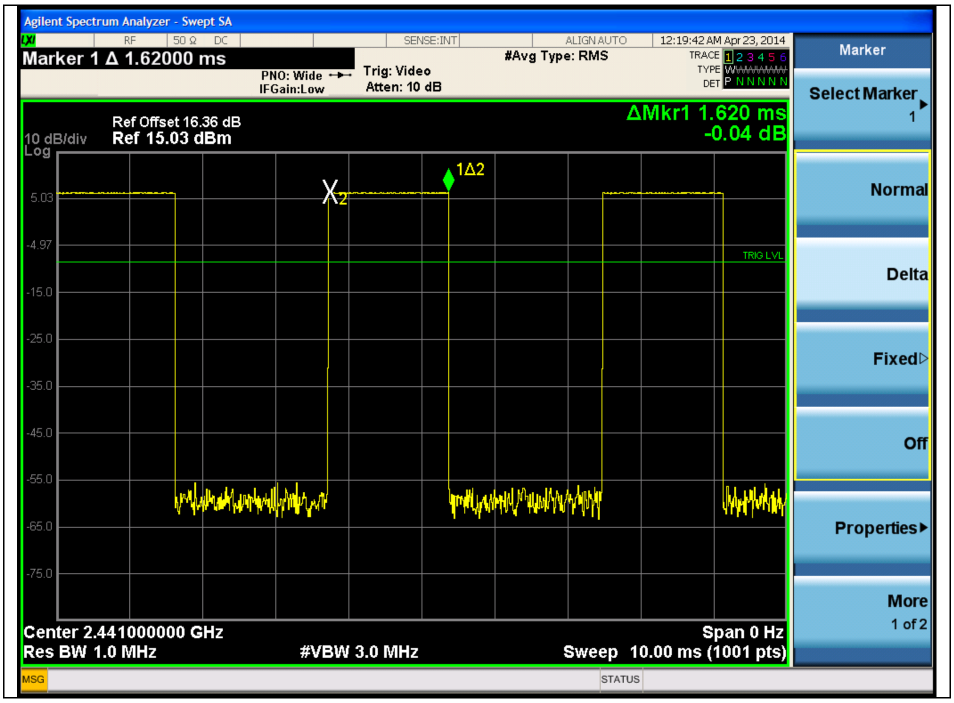


7.4.5. Packet Type: DH3, 3-DH3 (Adaptive Frequency Hopping)

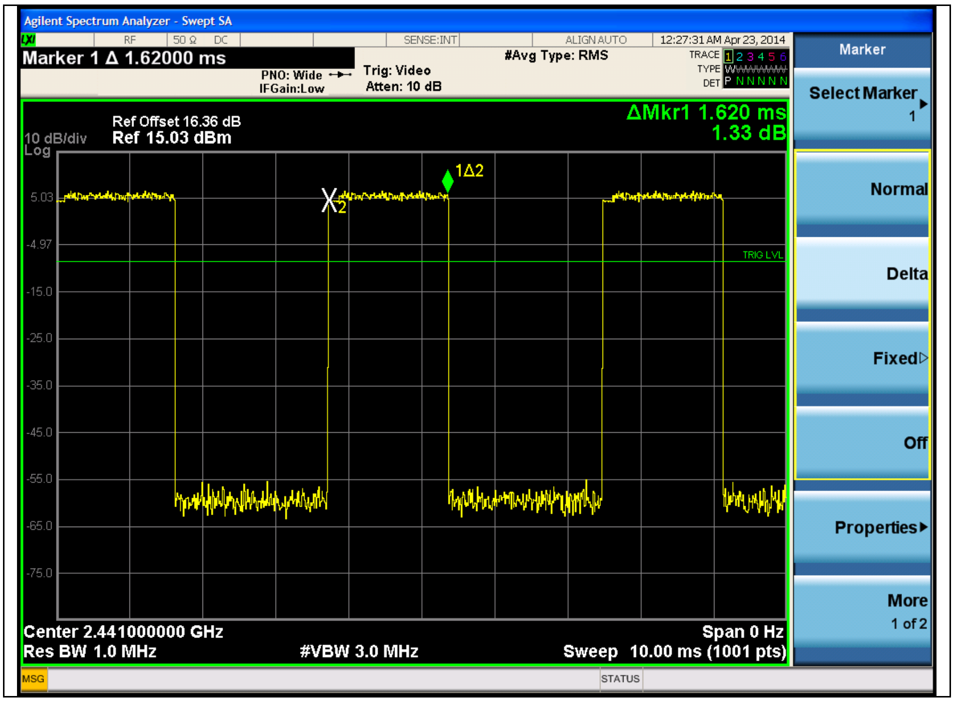
Operation Mode	Frequency	Dwell Time (㎳)	Time of occupancy on the Tx Channel in 8 sec (㎳)	Limit for time of occupancy on the Tx Channel in 8 sec (㎳)
GFSK	2 441 ㎒	1.62	129.60	400
8DPSK	2 441 ㎒	1.62	129.60	400

Note:
Time of occupancy on the TX channel in 8 sec
In case of GFSK and 8DPSK, 1.62 × {(800 ÷ 4) / 20} × 8 = 129.60 ㎳

Operating Mode: GFSK



Operating Mode: 8DPSK

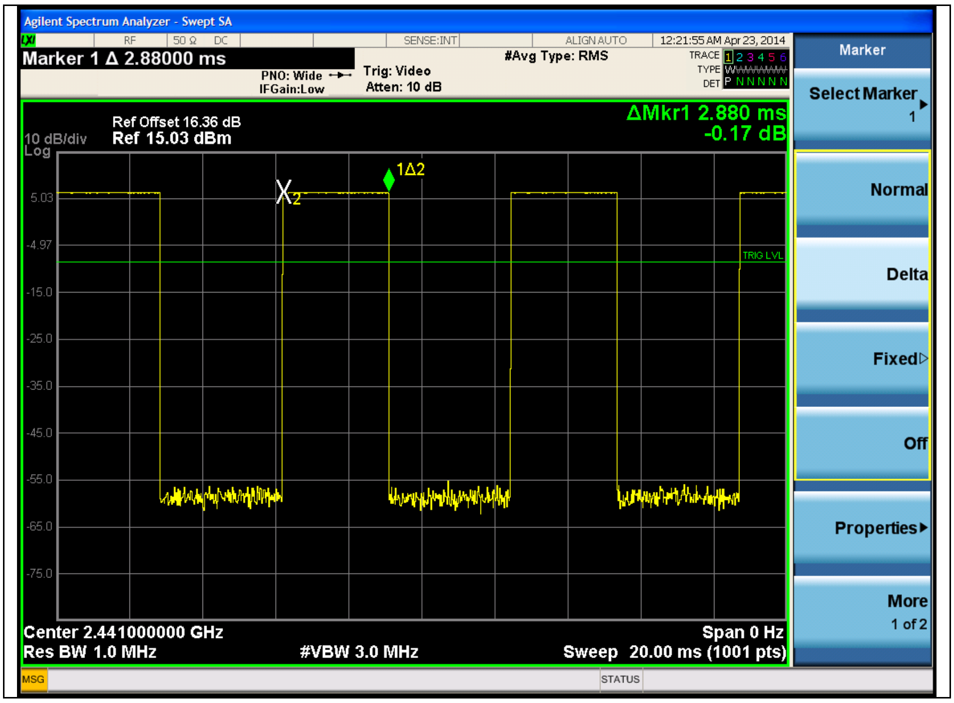


7.4.6. Packet Type: DH5, 3-DH5 (Adaptive Frequency Hopping)

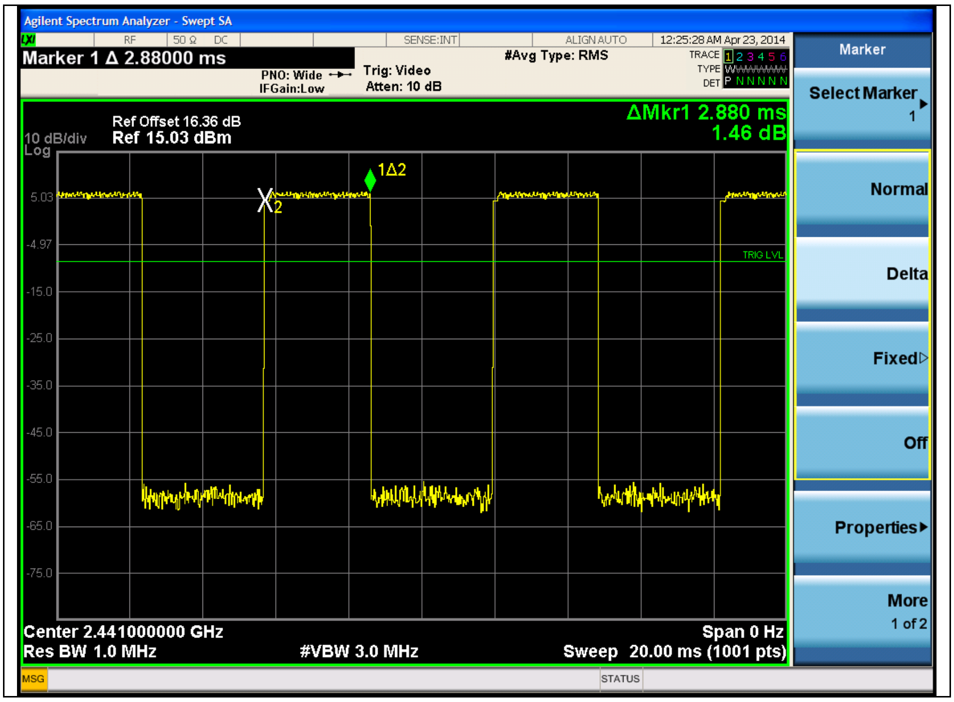
Operation Mode	Frequency	Dwell Time (㎳)	Time of occupancy on the Tx Channel in 8 sec (㎳)	Limit for time of occupancy on the Tx Channel in 8 sec (㎳)
GFSK	2 441 ㎒	2.88	153.60	400
8DPSK	2 441 ㎒	2.88	153.60	400

Note:
Time of occupancy on the TX channel in 8 sec
In case of GFSK & 8DPSK, 2.88 × {(800 ÷ 6) / 20} × 8 = 153.60 ㎳

Operating Mode: GFSK

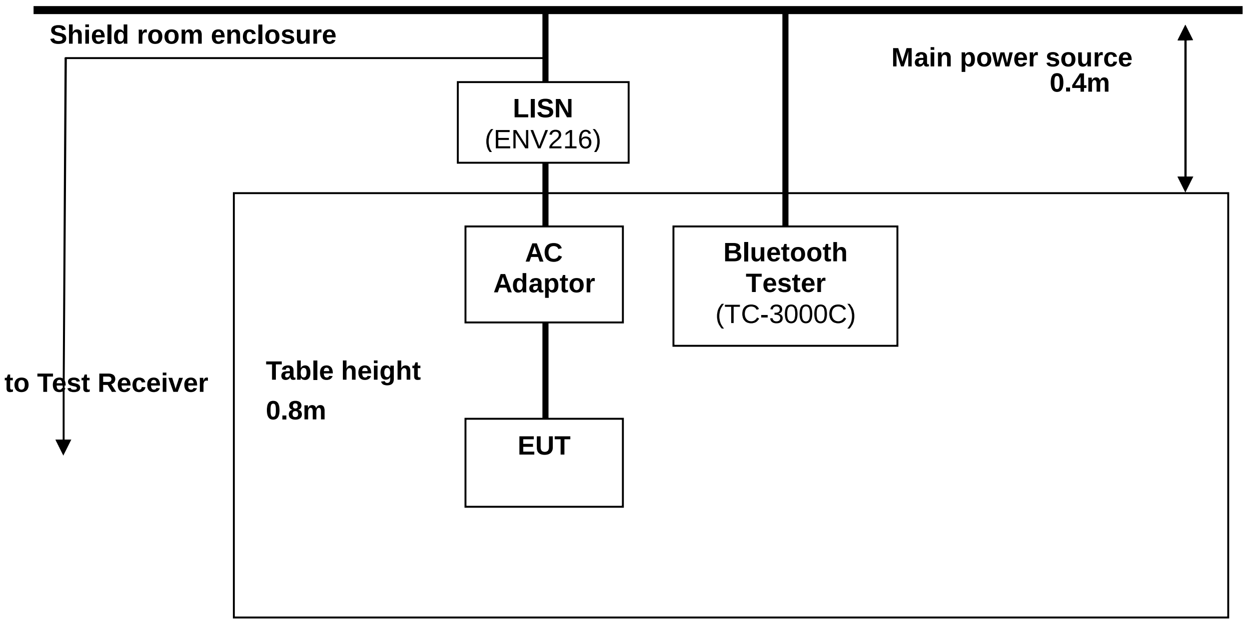


Operating Mode: 8DPSK



8. Transmitter AC Power Line Conducted Emission

8.1. Test Setup



8.1.1. Actual equipment used for Transmitter AC Power Line Conducted Emission

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
EMI Test Receiver	R&S	ESU26	100194	Sep. 13, 2013	Annual	Sep. 13, 2014
Signal Generator	R&S	SMJ 100A	100882	Jul. 03, 2013	Annual	Jul. 03, 2014
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Jul. 02, 2013	Annual	Jul. 02, 2014
Two-Line V-Network	R&S	ENV216	101120	Jan. 02, 2014	Annual	Jan. 02, 2015
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.

8.2. Limit

According to §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 uH/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 (㏈ μV)**	
	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.

8.3. 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 power line conducted emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

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

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.

8.4. Test Results (Worst case configuration_8DPSK mode, 3 Mbps, Middle channel)

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.

8.4.1. Battery Cover without charger

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

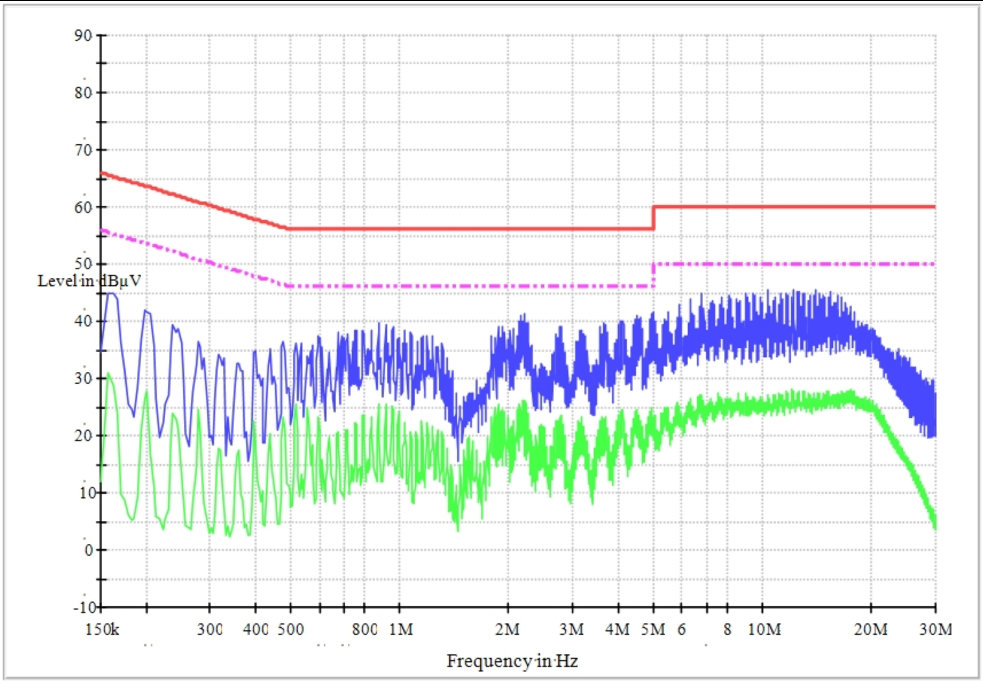
FREQ.	LEVEL(dB㎶)		LINE	LIMIT(dB㎶)		MARGIN(dB)	
(㎒)	Quasi Peak	Average		Quasi Peak	Average	Quasi Peak	Average
0.15	28.08	12.42	H	65.78	55.78	37.70	43.36
0.19	21.72	12.76	H	63.86	53.86	42.14	41.10
0.57	20.46	10.62	H	56.00	46.00	35.54	35.38
1.85	26.18	16.55	H	56.00	46.00	29.82	29.45
6.92	31.55	22.27	H	60.00	50.00	28.45	27.73
10.95	32.75	24.85	H	60.00	50.00	27.25	25.15
0.18	34.25	18.86	N	64.58	54.58	30.33	35.72
0.21	24.06	7.29	N	63.05	53.05	38.99	45.76
0.50	25.69	12.34	N	56.03	46.03	30.34	33.69
0.86	35.11	27.36	N	56.00	46.00	20.89	18.64
2.15	35.31	27.90	N	56.00	46.00	20.69	18.10
17.25	40.37	31.08	N	60.00	50.00	19.63	18.92

Note ;

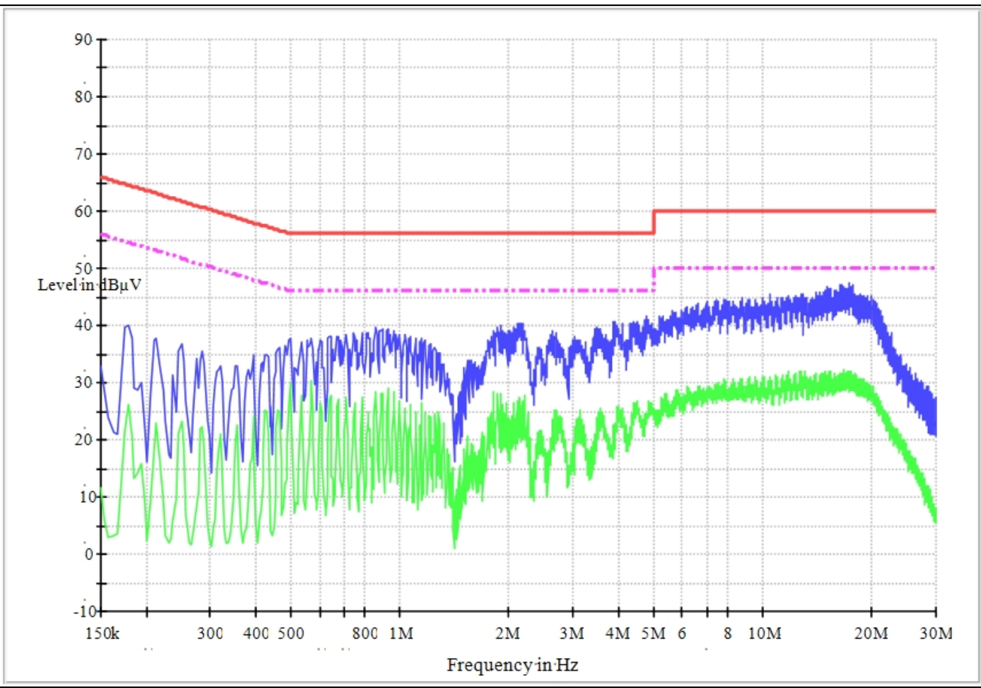
1. Line (H): Hot, Line (N): Neutral
2. All modes of operation were investigated and the worst-case emissions are reported. The above data was taken while the EUT was transmitting on middle channel.
3. The limit for Class B device(s) from 150 ㎑ to 30 ㎒ are specified in Section of the Title 47 CFR.
4.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

Plots of Conducted Power line (Battery Cover without charger)

Test mode : (Hot)



Test mode : (Neutral)



9. Antenna Requirement

9.1. 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 ㏈i are used, the power shall be reduced by the amount in ㏈ that the gain of the antenna exceeds 6 ㏈i.

9.2. Antenna Connected Construction

Antenna used in this product is Integral antenna and peak max gain of antenna as below.

Band	**2 402 ㎒ – 2 480 ㎒ (ISM)**
Mode	**(GFSK, π/4DQPSK , 8DPSK)**
Gain	-3.09 ㏈i