

TEST REPORT

of

FCC Part 15 Subpart C §15.247

FCC ID : ZNFL05D

Equipment Under Test : Mobile Phone
Model Name : L-05D
Serial No. : N/A
Applicant : LG Electronics MobileComm U.S.A., Inc.
Manufacturer : LG Electronics MobileComm U.S.A., Inc.
Date of Test(s) : 2012.03.20 ~ 2012.04.12
Date of Issue : 2012.04.13

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

Tested By:



Date

2012.04.13

Logan Lee

Approved By:



Date

2012.04.13

Feel Jeong

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- 413-15, Gomae-Dong Giheung-Gu, Yongin-Si, Gyeonggi-Do, South Korea.
- Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040

www.ee.sgs.com/korea

Telephone : +82 +31 428 5700

FAX : +82 +31 427 2371

1.2. Details of Applicant

Applicant : LG Electronics MobileComm U.S.A., Inc.
 Address : 10101 Old Grove Road, San Diego, CA 92131
 Contact Person : An, Heeju
 Phone No. : +86 +10 2846 2750

1.3. Description of EUT

Kind of Product	Mobile Phone
Model Name	L-05D
Serial Number	N/A
Power Supply	DC 3.8 V (Li-Ion Battery)
Frequency Range	2 402 MHz ~ 2 480 MHz
Modulation Technique	GFSK, $\pi/4$ DQPSK, 8DPSK
Number of Channels	79
Antenna Type	Internal type
Antenna Gain	-1.05 dB i

1.4. Declaration by the manufacturer

- N/A

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1.5. Requirements for Bluetooth transmitter

1. This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:

- a) The hopping sequence is pseudorandom.
- b) All channels are used equally on average.
- c) The receiver input bandwidth equals the transmit bandwidth.
- d) The receiver hops in sequence with the transmit signal.

2. Equipment Description

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 its 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.

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1.6. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal Due.
Signal Generator	R & S	SMR40	100272	Jul. 15, 2012
Signal Generator	Agilent	8648D	3847M00534	Mar. 29, 2013
Spectrum Analyzer	R & S	FSV30	100955	Mar. 29, 2013
Attenuator	Mini-Circuits	BW-N20W5+	0950-1	Mar. 30, 2013
Power Sensor	R & S	NRP-Z81	100669	Apr. 03, 2013
Directional Coupler	KRYTAR	152613	127445	Aug. 31, 2012
Bluetooth Tester	TESCOM	TC-3000C	3000C000296	Aug. 22, 2012
Low Pass Filter	Mini-Circuits	NLP-1200+	V9500401023-3	Aug. 22, 2012
High Pass Filter	Wainwright	WHKX3.0/18G-6SS	4	Sep. 14, 2012
High Pass Filter	Wainwright	WHNX7.5/26.5G-6SS	11	Sep. 15, 2012
DC power Supply	Agilent	U8002A	MY50020026	Mar. 29, 2013
Preamplifier	H.P.	8447F	2944A03909	Jul. 04, 2012
Preamplifier	R&S	SCU18	10117	Jan. 12, 2013
Preamplifier	SCHWARZBECK MESSELEKTRONIK	JS44-18004000-35-8P	1546891	Jul. 04, 2012
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	396	May 12, 2013
Horn Antenna	R&S	HF906	100326	Nov. 23, 2012
Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170223	Jun. 30, 2012
Test Receiver	R&S	ESU26	100109	Feb. 21, 2013
Antenna Master	INNCO	MM4000	N.C.R.	N.C.R.
Turn Table	INNCO	DS 1200S	N.C.R.	N.C.R.
EMI Test Receiver	R&S	ESHS10	863365/018	Jul. 07, 2012
Two-Line V-Network	R&S	ENV216	100190	Jan. 09, 2013
Anechoic Chamber	SY Corporation	L x W x H (9.6 m x 6.4 m x 6.4 m)	N.C.R.	N.C.R.

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1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD:FCC Part15		
Section	Test Item	Result
15.205(a) 15.209 15.247(d)	Transmitter Radiated Spurious Emissions Conducted Spurious Emission	Complied
15.247(a)(1)	20 dB Bandwidth	Complied
15.247(b)(1)	Maximum Peak Output Power	Complied
15.247(a)(1)	Frequency Separation	Complied
15.247(b)(1)	Number of Hopping Frequency	Complied
15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Complied
15.207	Transmitter AC Power Line Conducted Emission	Complied

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1.8. Conclusion of worst-case and operation mode

The EUT has three type of modulation (GFSK, $\pi/4$ DQPSK and 8DPSK). Each output power as following:

Modulation Type	Output power(dB m)	Output power(mW)	Symbol rate
GFSK(2 441 MHz)	10.52	11.27	1 Mbps
$\pi/4$ DQPSK(2 441 MHz)	11.05	12.74	2 Mbps
8DPSK(2 441 MHz)	11.09	12.85	3 Mbps

Therefore all applicable requirements were tested to the two type of higher output power modulation (GFSK and 8DPSK) at middle channel (2 441 MHz).

The field strength of spurious emission was measured in three orthogonal EUT positions(x-axis, y-axis and z-axis). Worst case is x-axis.

1.9. Test report revision

Revision	Report number	Description
0	F690501/RF-RTL005458	Initial

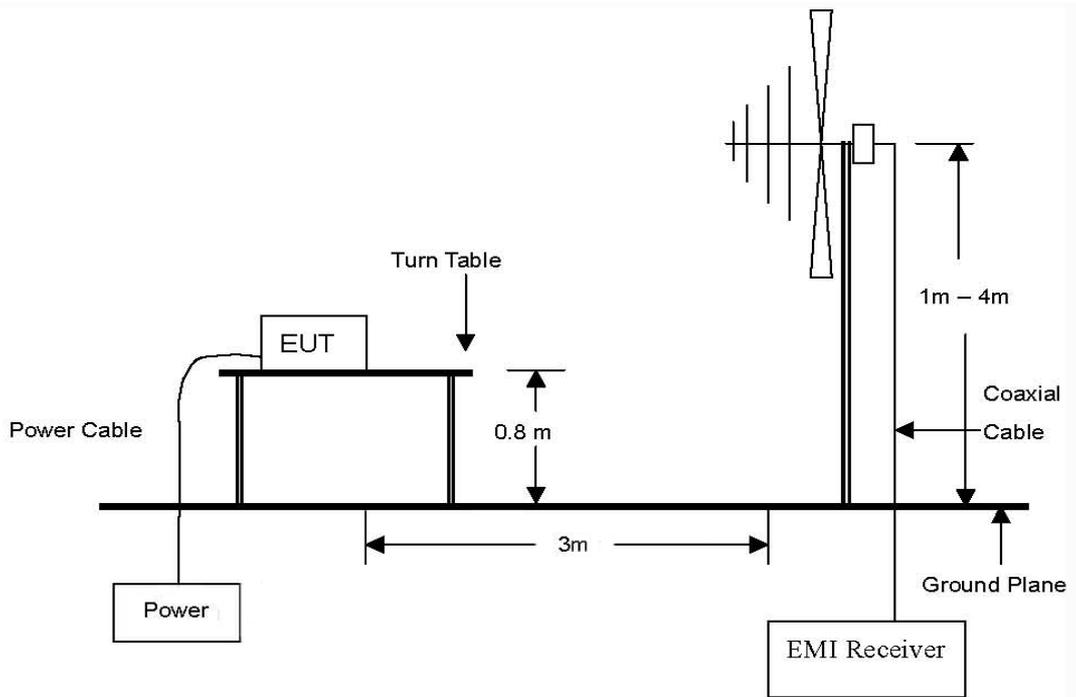
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2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

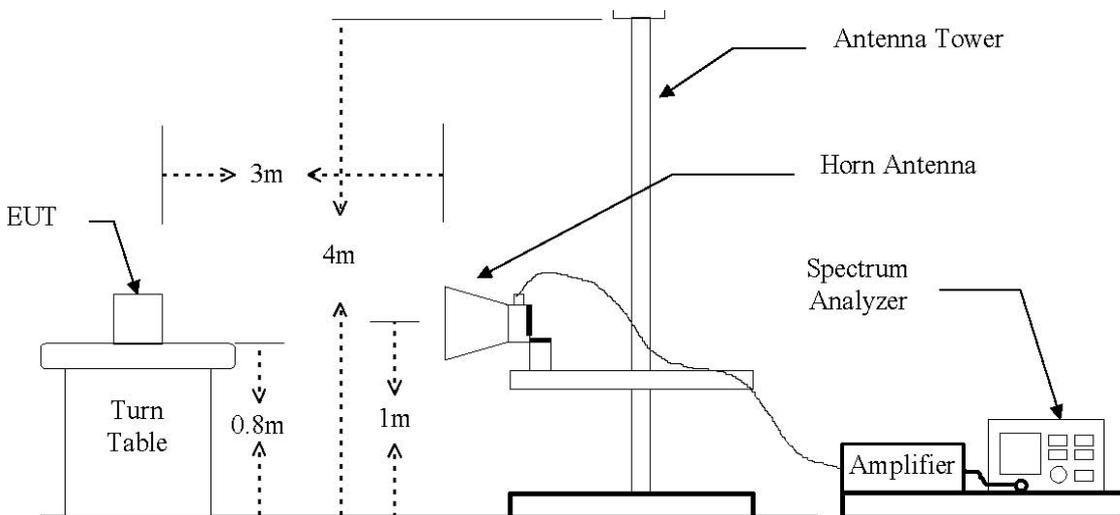
2.1. Test Setup

2.1.1. Transmitter Radiated Spurious Emissions

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

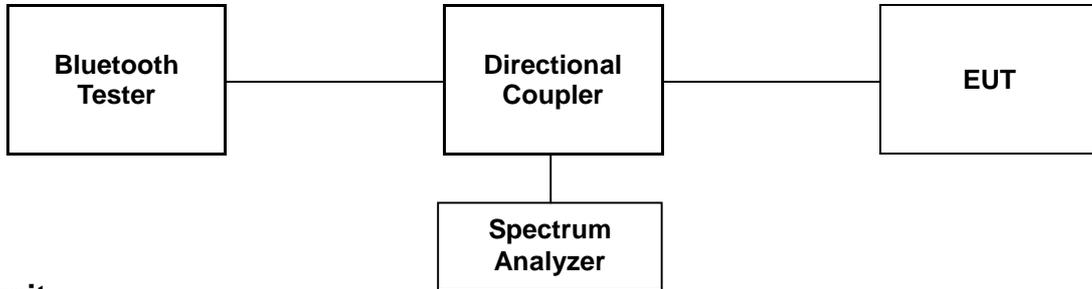


The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 26.5 GHz Emissions.



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2.1.2. Conducted Spurious Emissions



2.2. Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in 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 (MHz)	Distance (Meters)	Field Strength (dB µV/m)	Field Strength (µV/m)
30 - 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

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2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of DA000705.

2.3.1. Test Procedures for Radiated Spurious Emissions

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 GHz, 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 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a broadband 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 dB 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 dB 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 ;

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.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

2.3.2. Test Procedures for Conducted Spurious Emissions

1. The transmitter output was connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=100 kHz, VBW=100 kHz.

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2.4. Test Results

Ambient temperature : (24 ± 2) °C
 Relative humidity : 47 % R.H.

2.4.1. Spurious Radiated Emission (Worst case configuration_GFSK mode)

The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 30 dB. All reading values are peak values.

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
30.93	40.60	Peak	V	10.60	-26.60	24.60	40.0	15.40
31.94	44.50	Peak	H	11.10	-26.60	29.00	40.0	11.00
Above 100.00	Not detected	-	-	-	-	-	-	-

Remark:

1. All spurious emission at channels are almost the same below 1 GHz, so that middle channel was chosen at representative in final test.
2. Actual = Reading + AF + AMP + CL

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2.4.2. Spurious Radiated Emission

The frequency spectrum above 1 000 MHz was investigated.

Operating Mode: GFSK

A. Low Channel (2 402 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 390.00	28.17	Peak	H	28.05	5.14	61.36	74.00	12.64
*2 390.00	16.07	Average	H	28.05	5.14	49.26	54.00	4.74

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
4 803.87	42.78	Peak	H	32.28	-34.91	40.15	74.00	33.85
Above 4 900.00	Not detected	-	-	-	-	-	-	-

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B. Middle Channel (2 441 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
4 881.87	43.40	Peak	H	32.85	-34.93	41.32	74.00	32.68
Above 4 900.00	Not detected	-	-	-	-	-	-	-

C. High Channel (2 480 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 483.50	27.34	Peak	H	28.31	5.19	60.84	74.00	13.16
*2 483.50	15.97	Average	H	28.31	5.19	49.47	54.00	4.53

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
4 960.30	40.33	Peak	H	33.31	-34.88	38.76	74.00	35.24
Above 5 000.00	Not detected	-	-	-	-	-	-	-

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Operating Mode: 8DSPK

A. Low Channel (2 402 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 390.00	27.58	Peak	H	28.05	5.14	60.77	74.00	13.23
*2 390.00	16.03	Average	H	28.05	5.14	49.22	54.00	4.78

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
4 804.23	41.88	Peak	H	32.28	-34.91	39.25	74.00	34.75
Above 4 900.00	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
4 881.94	42.13	Peak	H	32.85	-34.93	40.05	74.00	33.95
Above 4 900.00	Not detected	-	-	-	-	-	-	-

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C. High Channel (2 480 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 483.50	27.55	Peak	H	28.31	5.19	61.05	74.00	12.95
*2 483.50	15.98	Average	H	28.31	5.19	49.48	54.00	4.52

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
4 961.97	41.20	Peak	H	33.32	-34.88	39.64	74.00	34.36
Above 5 000.00	Not detected	-	-	-	-	-	-	-

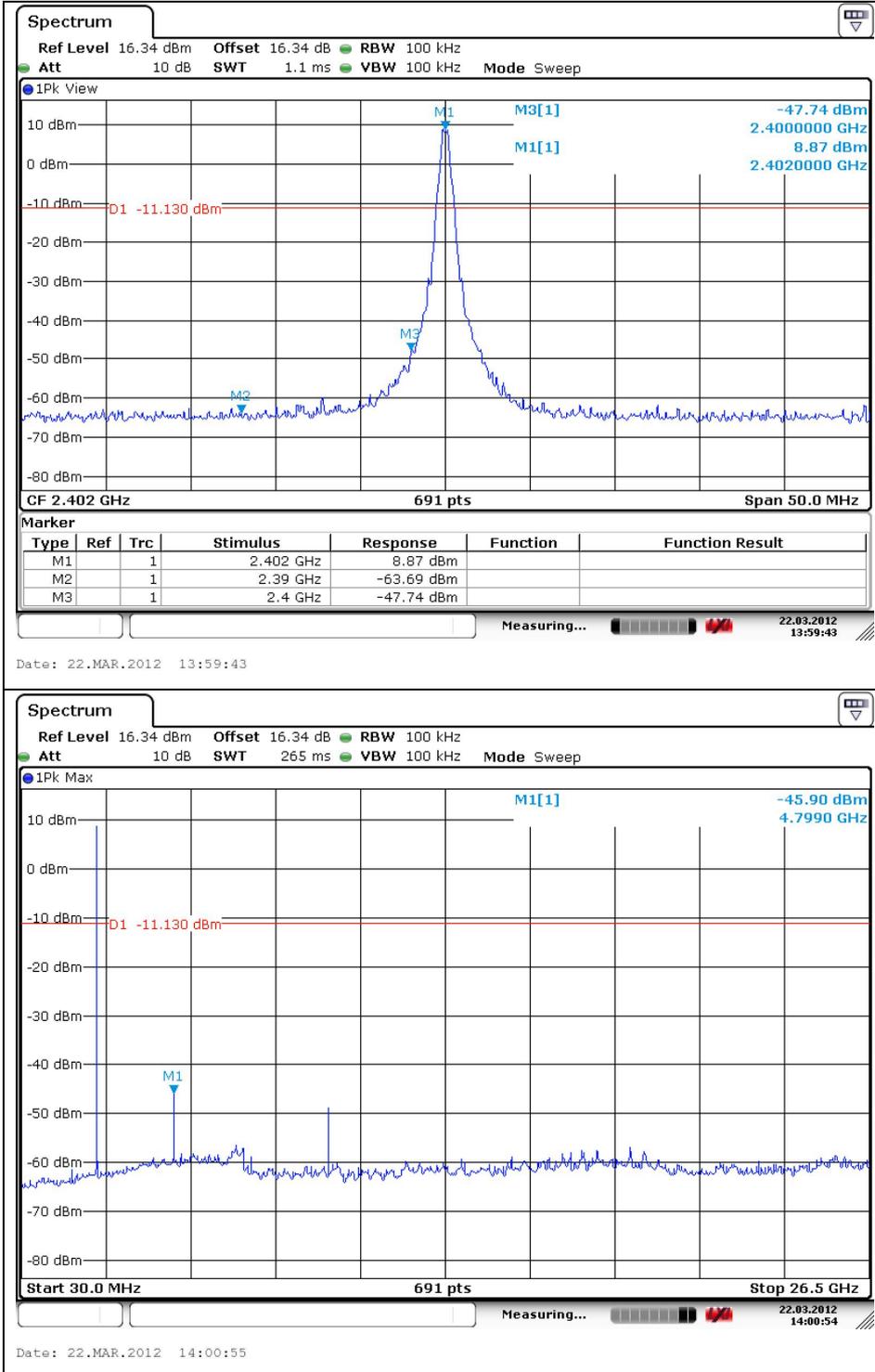
Remarks ;

1. “*” means the restricted band.
2. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
3. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
4. Average test would be performed if the peak result were greater than the average limit.
5. Actual = Reading + AF + AMP + CL

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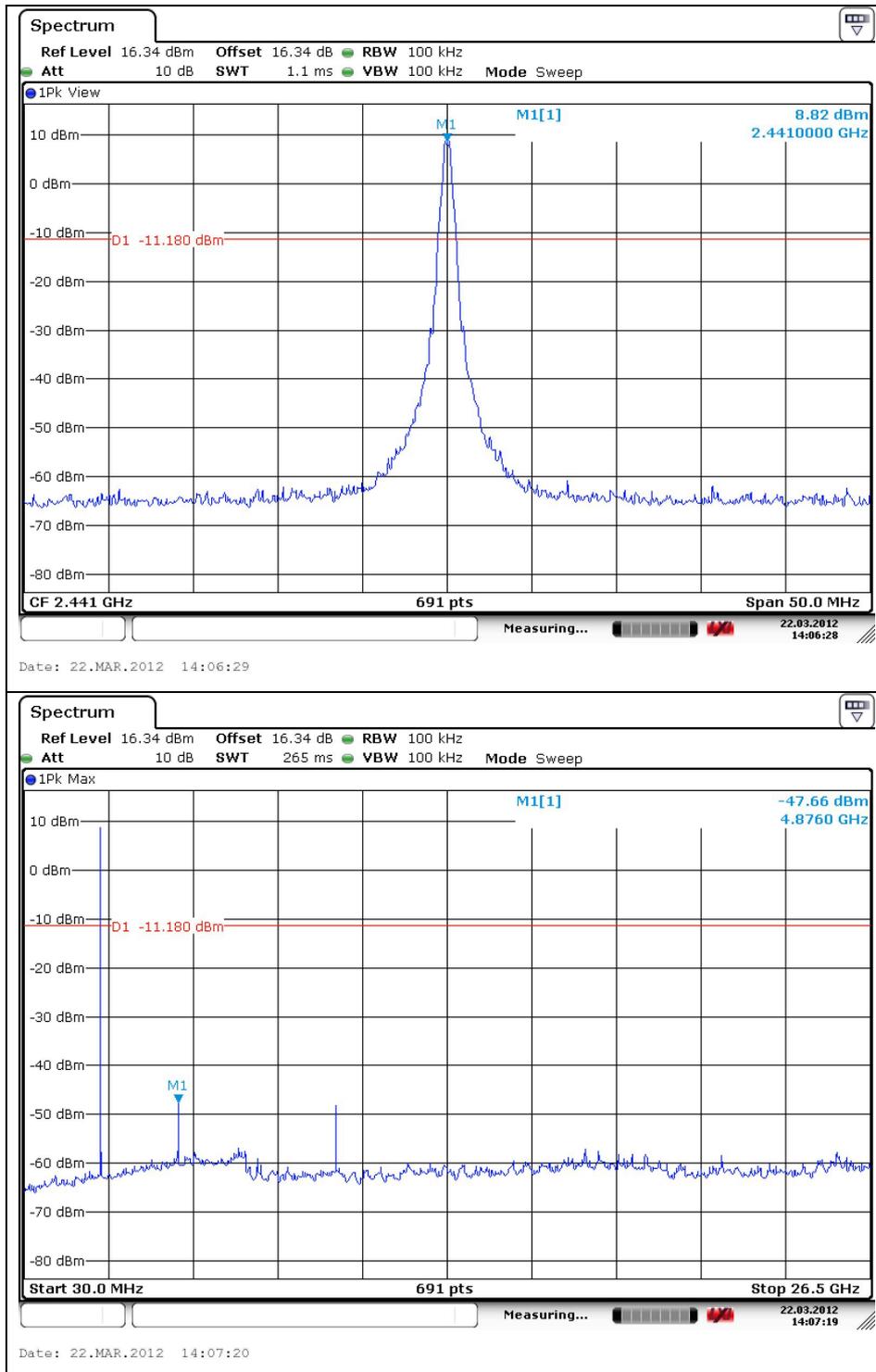
2.4.3. Spurious RF Conducted Emissions: Plot of Spurious RF Conducted Emission Operating Mode: GFSK

Low Channel



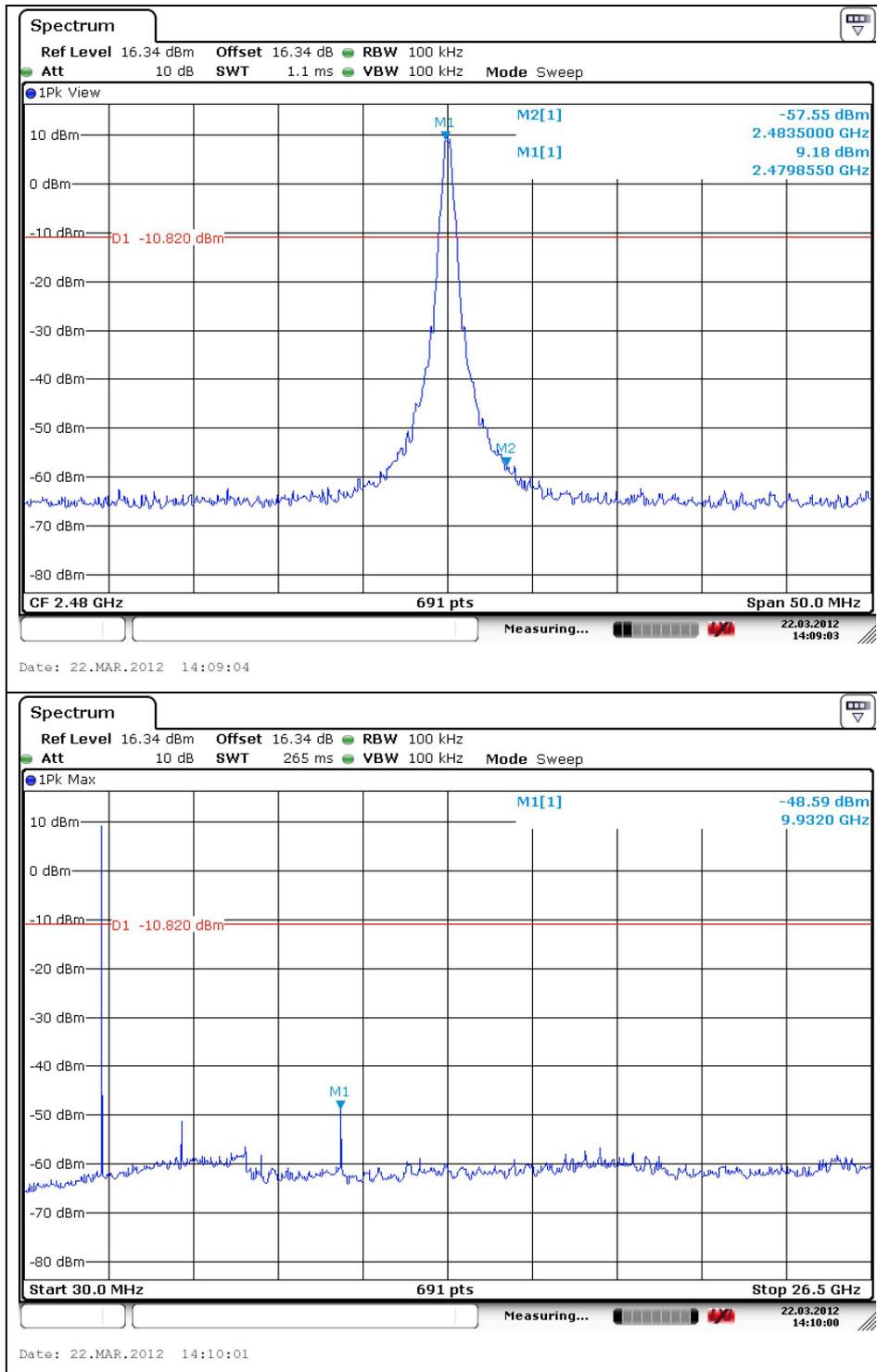
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Middle Channel



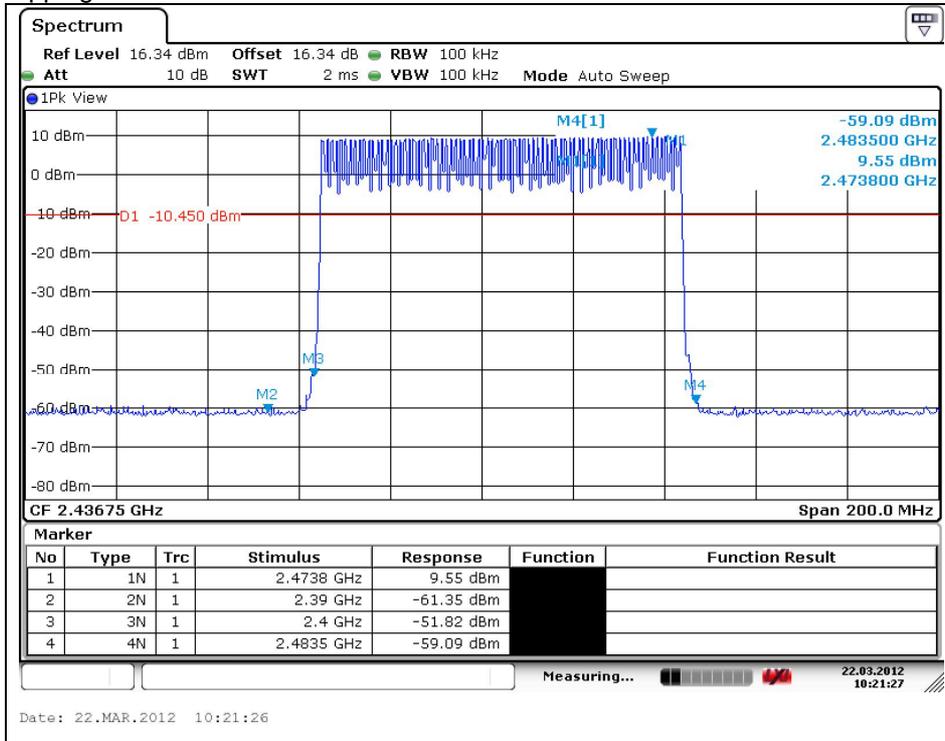
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High Channel



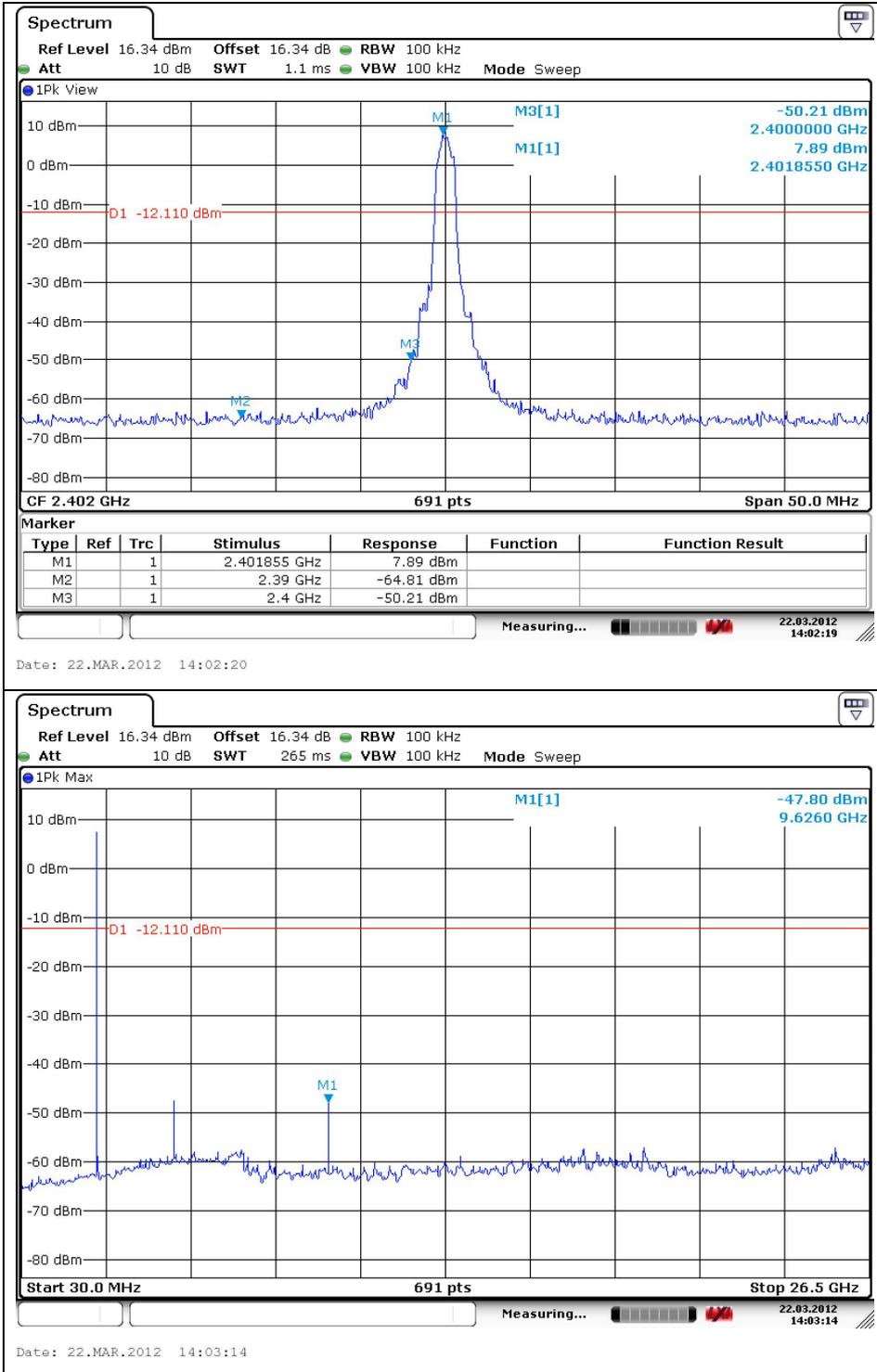
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Bandedge at Hopping



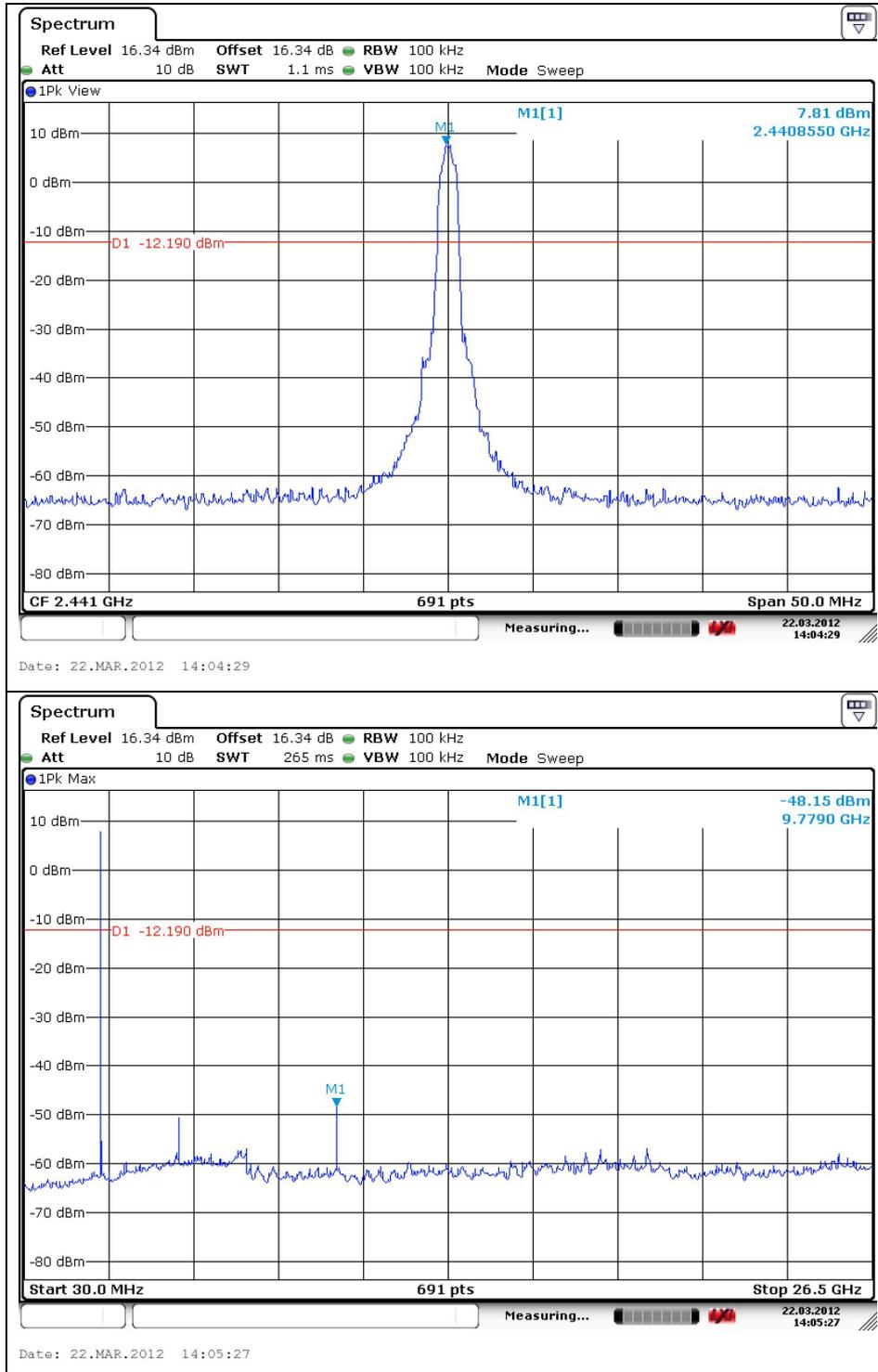
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Operating Mode : 8DPSK
Low Channel



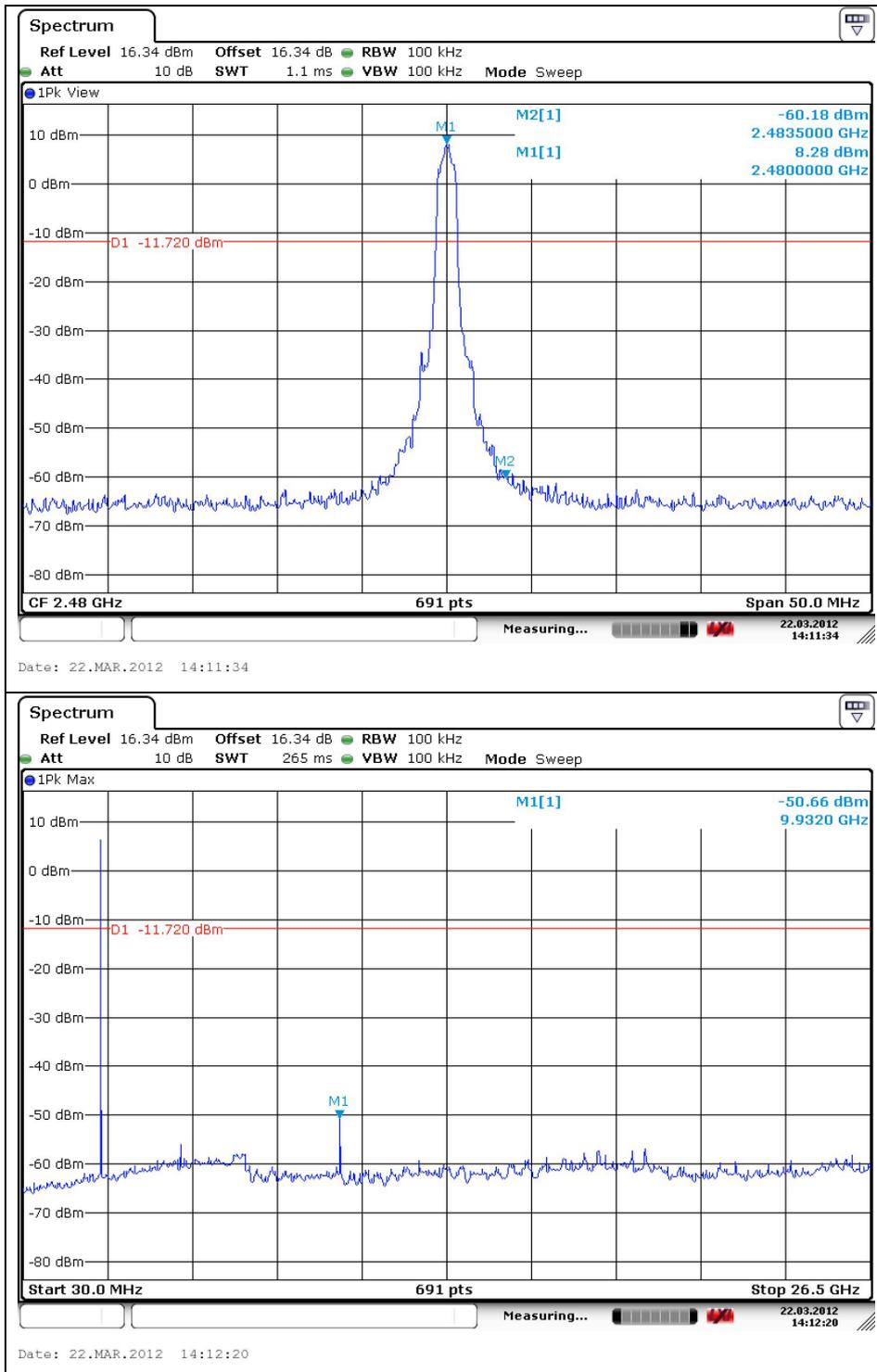
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Middle Channel



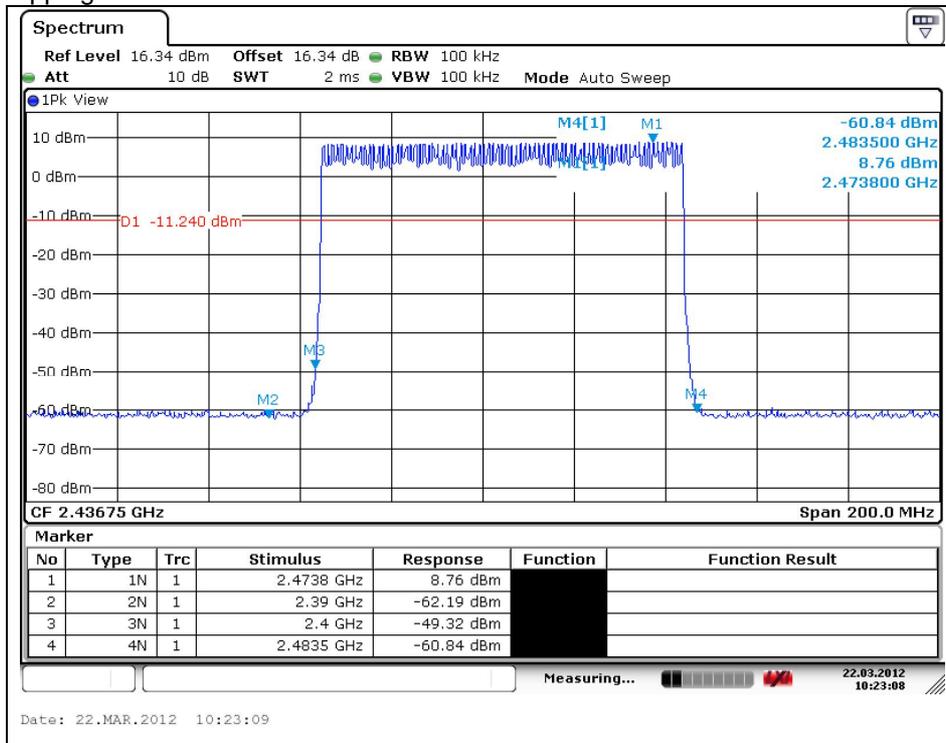
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High Channel



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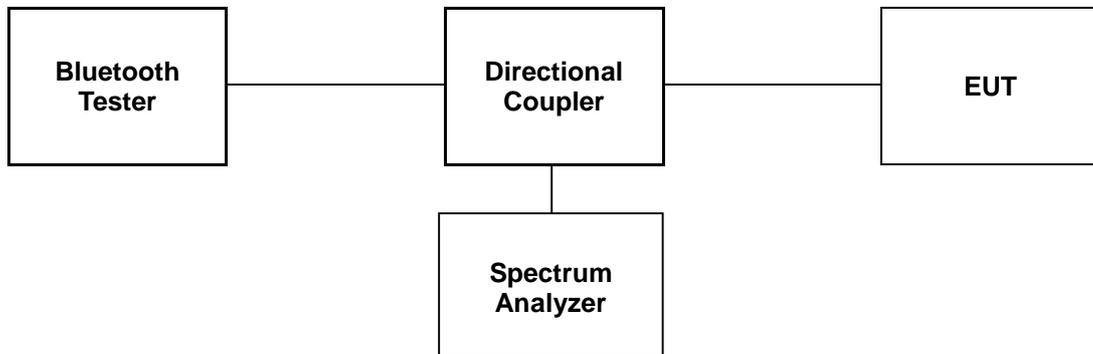
Bandedge at Hopping



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3. 20 dB Bandwidth Measurement

3.1. Test Setup



3.2. Limit

Limit: Not Applicable

3.3. Test Procedure

1. 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. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer. Display Line and Marker Delta functions, the 20 dB band width of the emission was determined.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 30 kHz, VBW = 30 kHz, Span = 5 MHz.

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3.4. Test Results

Ambient temperature : (24 ± 2) °C
 Relative humidity : 47 % R.H.

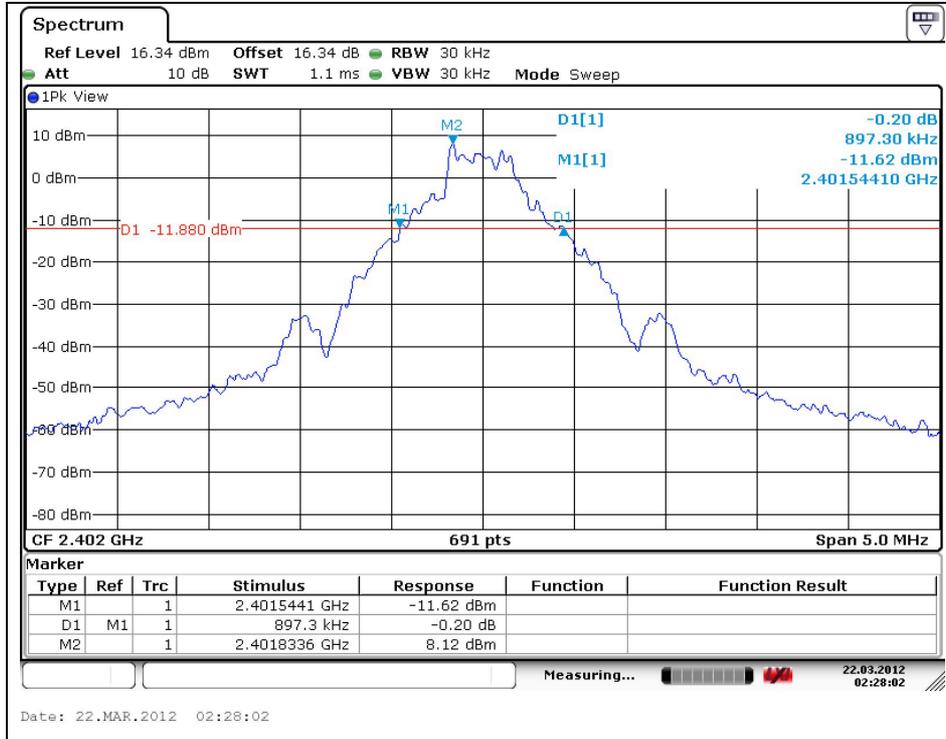
Operation Mode	Channel	Channel Frequency (MHz)	20 dB Bandwidth (MHz)
GFSK	Low	2 402	0.897
	Middle	2 441	0.897
	High	2 480	0.897
8DPSK	Low	2 402	1.266
	Middle	2 441	1.266
	High	2 480	1.266

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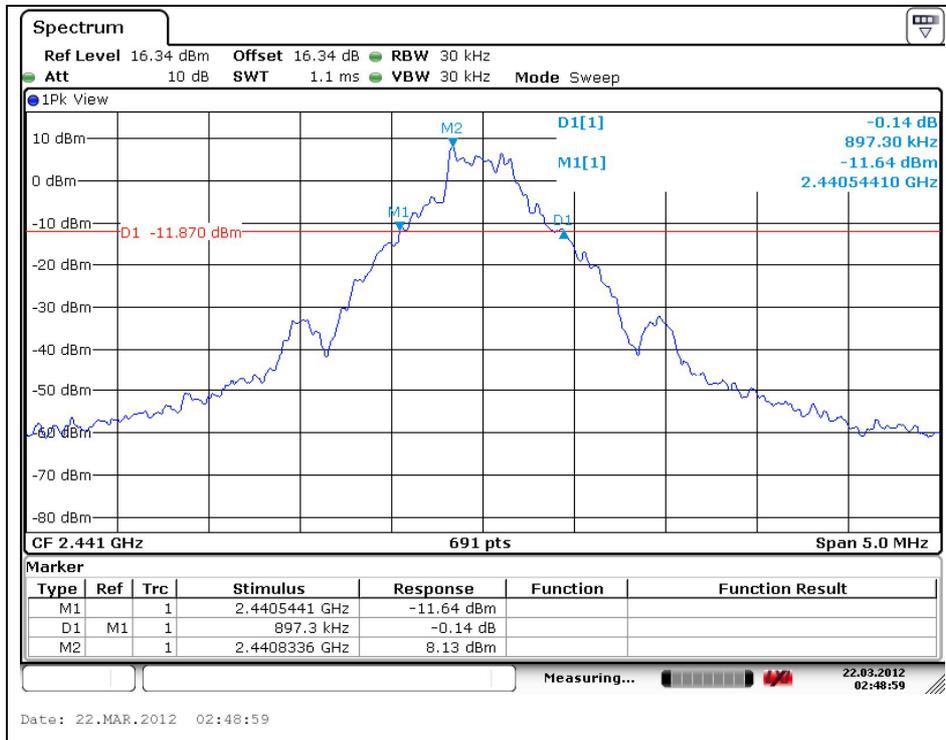
20 dB Bandwidth

Operating Mode: GFSK

Low Channel

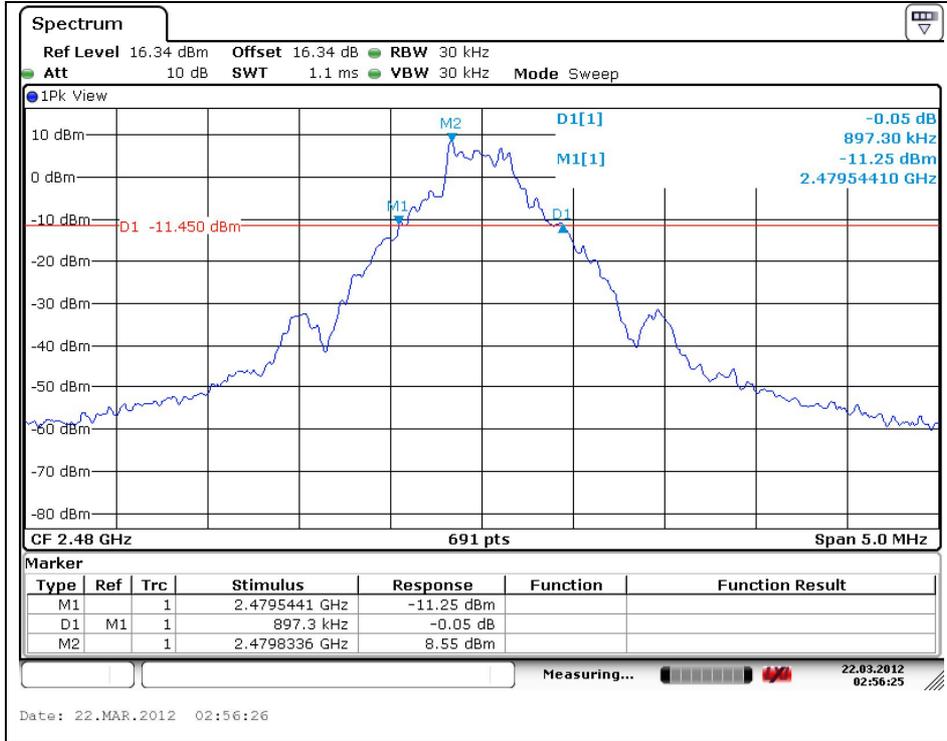


Middle Channel



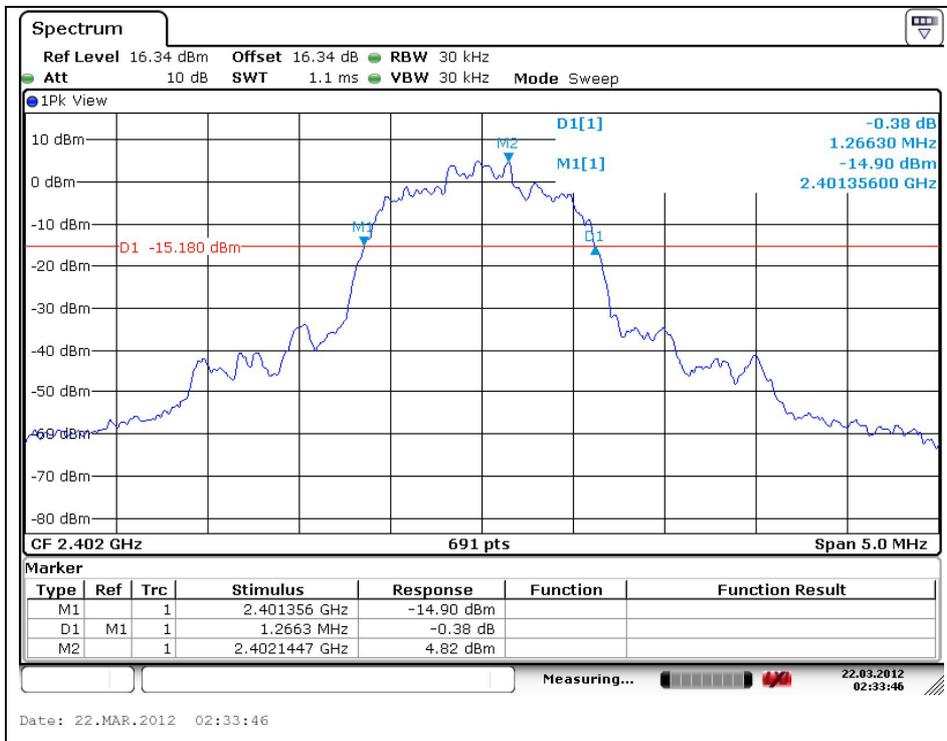
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High Channel



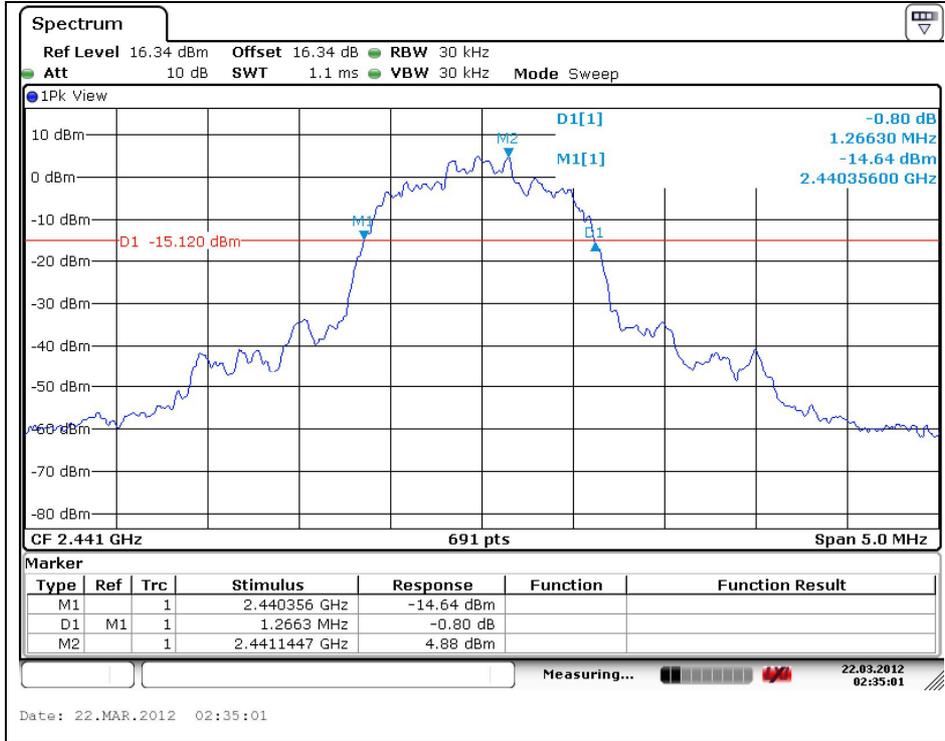
Operating Mode: 8DPSK

Low Channel

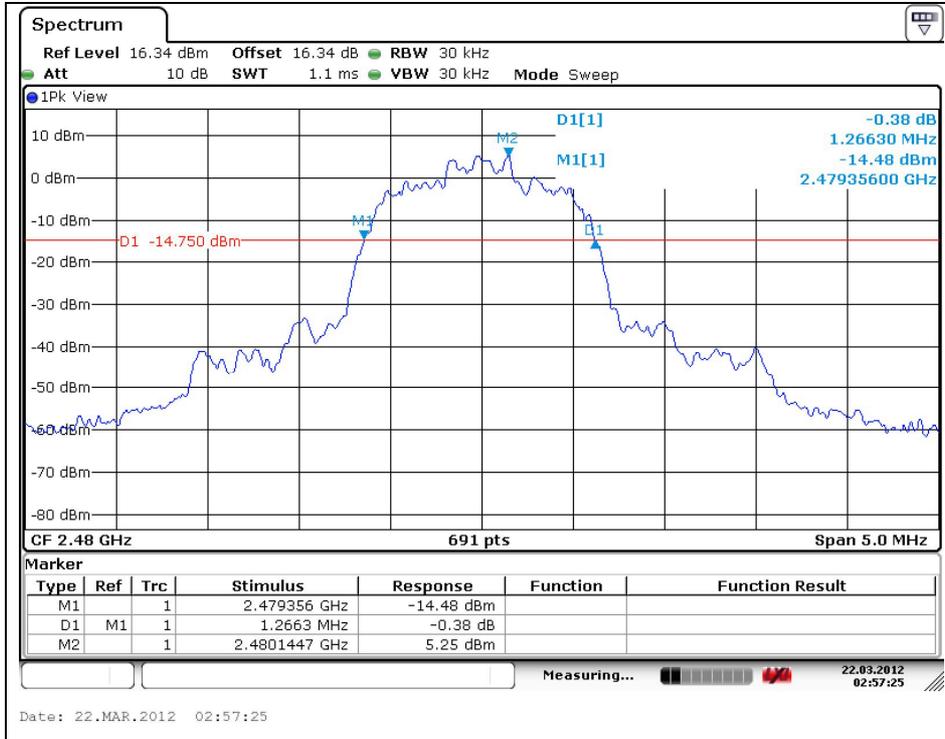


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Middle Channel



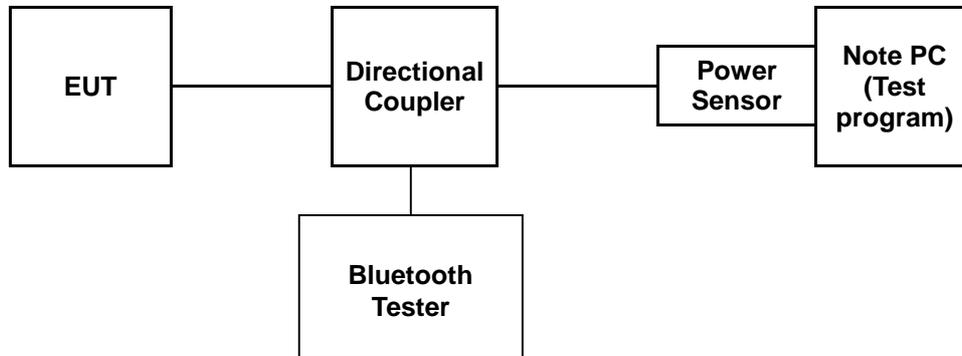
High Channel



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4. Maximum Peak Output Power Measurement

4.1. Test Setup



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

4.3. Test Procedure

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect the low loss RF cable & directional coupler from the antenna port to the Power sensor.
3. Adjust the period of operating transmission in test program in order to use power sensor and then measure average power and peak power about three type of modulation at the appropriate frequencies.
4. Test program : (S/W name : R&S Power Viewer, Version : 3.2.0)
5. Record in the test report.

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4.4. Test Results

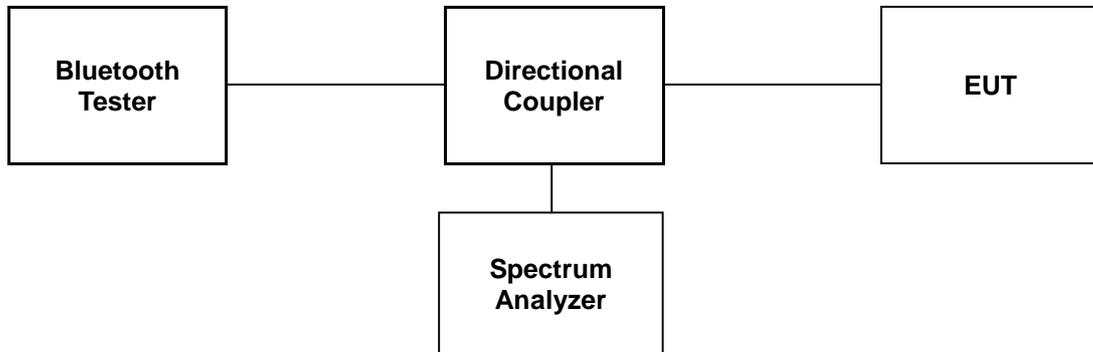
Ambient temperature : (24 ± 2) °C
 Relative humidity : 47 % R.H.

Operation Mode	Channel	Channel Frequency (MHz)	Attenuator + Cable offset (dB)	Peak Power Result (dB m)	Peak Power Limit (dB m)
GFSK	Low	2 402	15.94	10.51	30.00
	Middle	2 441	15.77	10.52	30.00
	High	2 480	15.49	10.27	30.00
8DPSK	Low	2 402	15.94	11.11	20.97
	Middle	2 441	15.77	11.09	20.97
	High	2 480	15.49	10.82	20.97

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5. Hopping Channel Separation

5.1. Test Setup



5.2. Limit

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

5.3. Test Procedure

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 it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the MaxHold function record the separation of adjacent channels.
4. Measure the frequency difference of these two adjacent channels by spectrum analyzer MARK function. And then plot the result on spectrum analyzer screen.
5. Repeat above procedures until all frequencies measured were complete.
6. Set center frequency of spectrum analyzer = middle of hopping channel.
7. Set the spectrum analyzer as RBW = 100 kHz, VBW = 100 kHz, Span = 5 MHz and Sweep = auto.

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5.4. Test Results

Ambient temperature : (24 ± 2) °C
 Relative humidity : 47 % R.H.

Operation Mode	Channel (Middle)	Adjacent Hopping Channel Separation (kHz)	Two-third of 20 dB Bandwidth (kHz)	Minimum Bandwidth (kHz)
GFSK	2 441 MHz	1 000	598.0	25
8DPSK	2 441 MHz	1 000	844.0	25

Note ;

20 dB bandwidth measurement, the measured channel separation should be greater than two-third of 20 dB bandwidth or Minimum bandwidth.

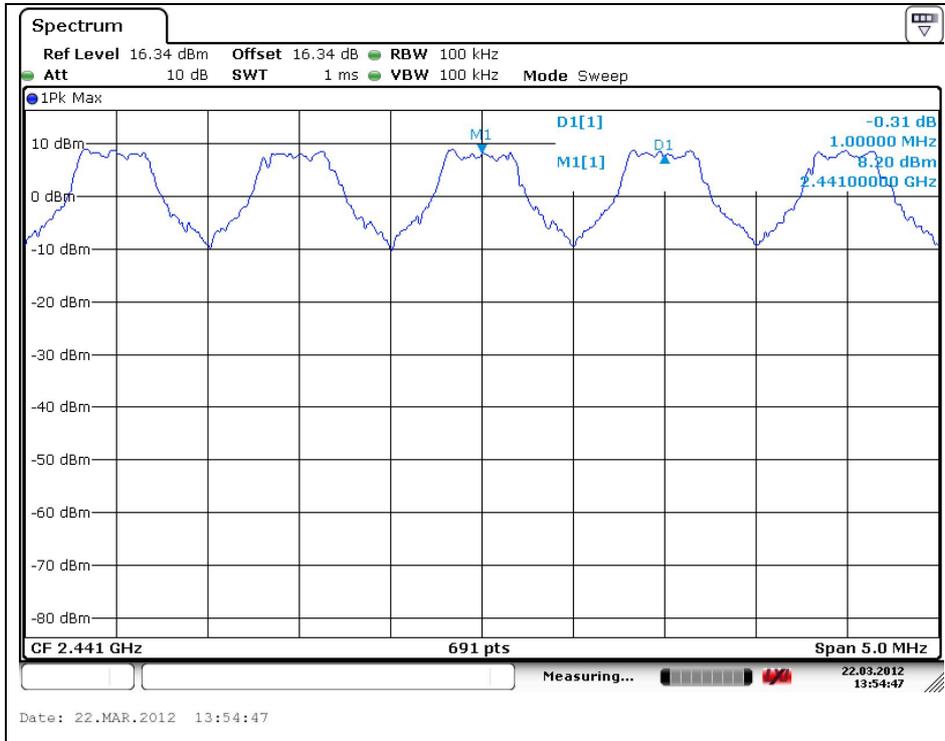
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SGS Korea Co., Ltd. (Gunpo Laboratory) 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea, 435-040

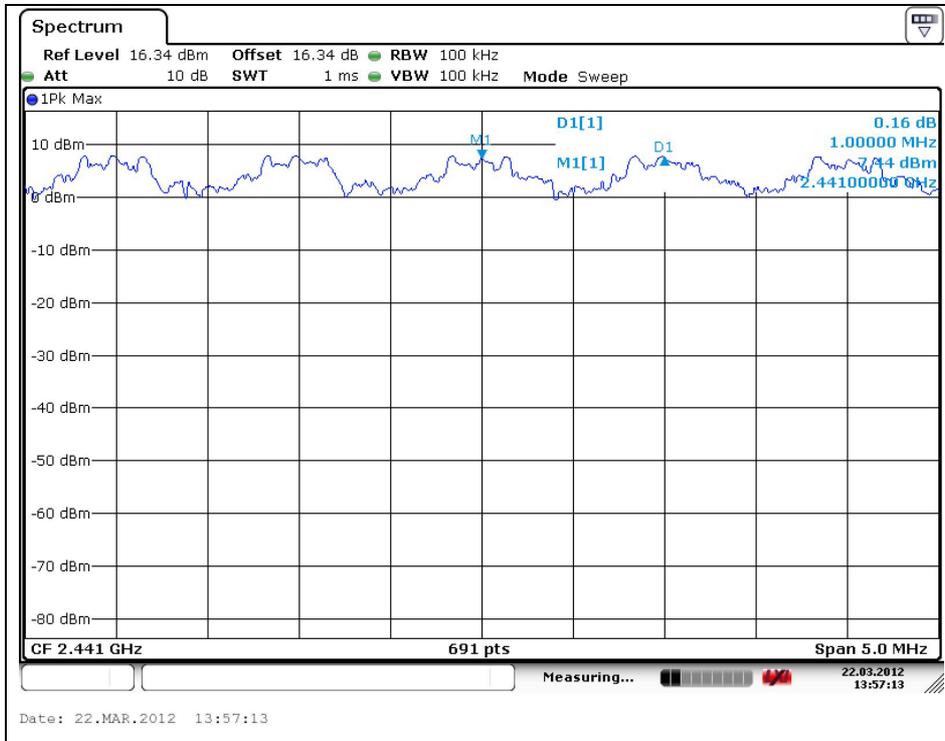
Tel. +82 31 428 5700 / Fax. +82 31 427 2371

www.ee.sgs.com/korea

Operating Mode: GFSK



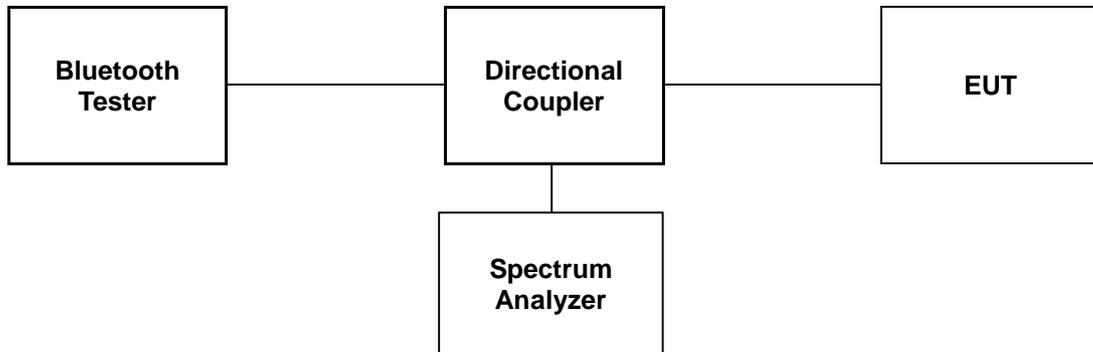
Operating Mode: 8DPSK



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6. Number of Hopping Frequency

6.1. Test Setup



6.2. Limit

§15.247(b)(1), For frequency hopping systems operating in the 2 400 – 2 483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 805 MHz band: 1 Watt.

6.3. Test Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. 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 MHz, Stop = 2 441.5 MHz, Sweep=auto and Start = 2 441.5 MHz, Stop = 2 483.5 MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW, VBW = 300 kHz.
5. Max hold, view and count how many channel in the band.

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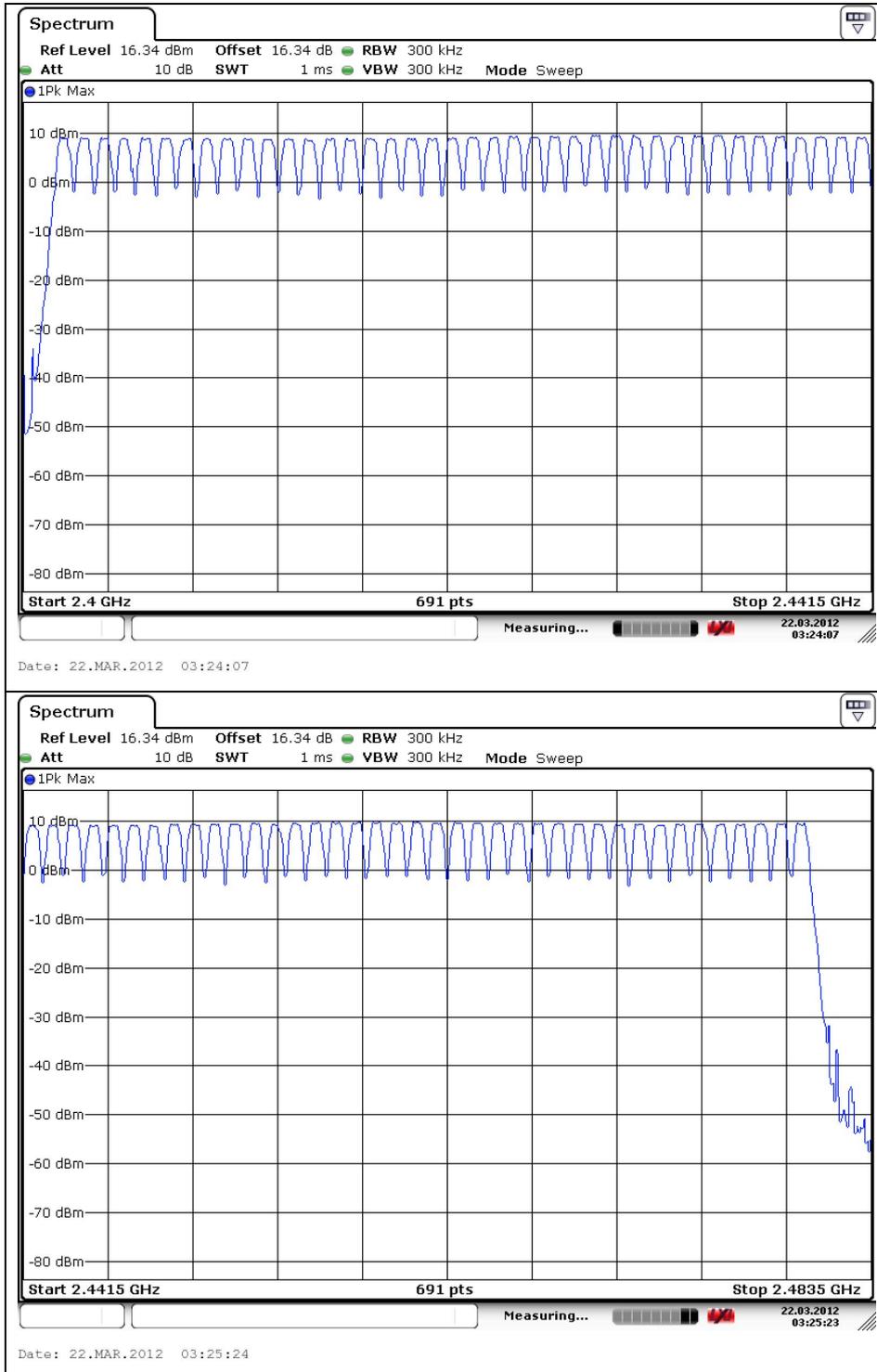
6.4. Test Results

Ambient temperature : (24 ± 2) °C
 Relative humidity : 47 % R.H.

Operation Mode	Number of Hopping Frequency	Limit
GFSK	79	≥ 75
8DPSK	79	≥ 75

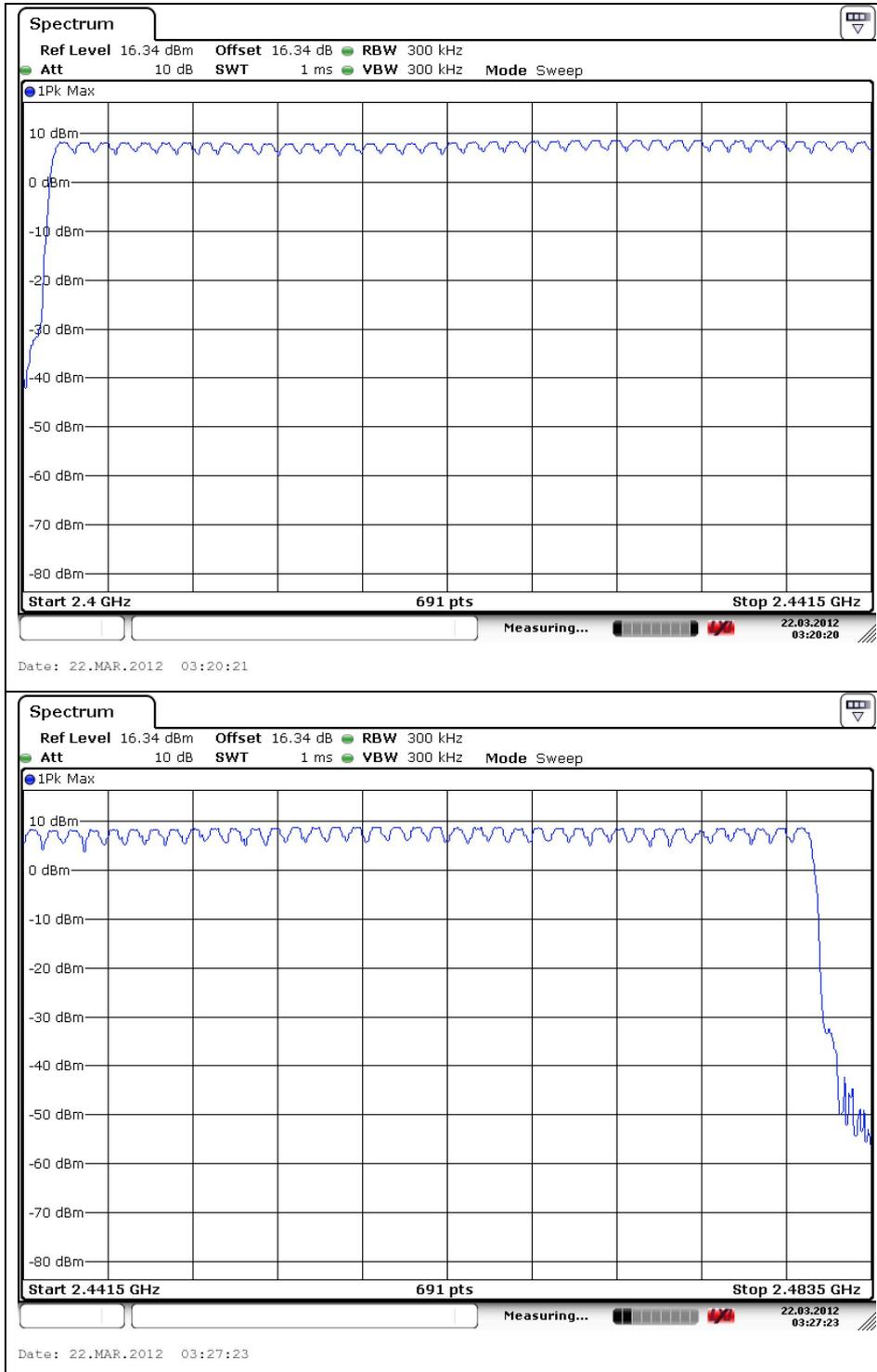
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

Operating Mode: GFSK



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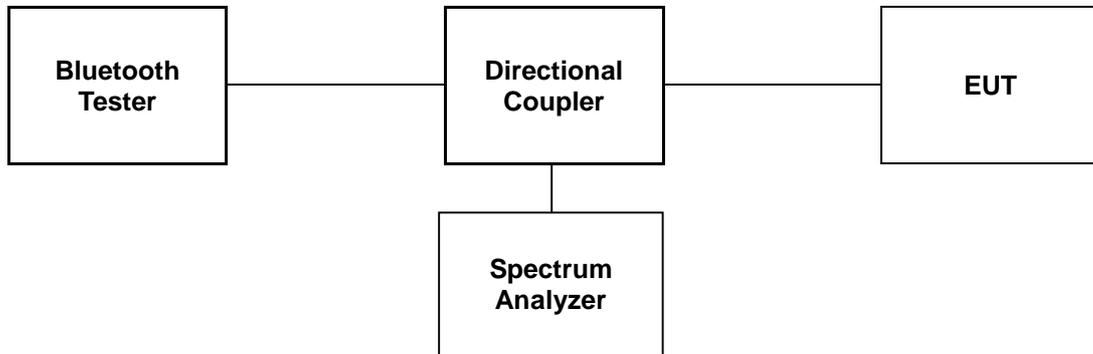
Operating Mode : 8DPSK



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7. Time Of Occupancy (Dwell Time)

7.1. Test Set up



7.2. Limit

§15.247(a)(1)(iii) For frequency hopping system operating in the 2 400 – 2 483.5 MHz 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)

7.3. Test Procedure

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. Adjust the center frequency of spectrum analyzer on any frequency be measured and set spectrum analyzer to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.
6. The Bluetooth has 3 type of payload, DH1, DH3, DH5 and 3-DH1, 3-DH3, 3-DH5. The hopping rate is 1 600 per second.

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7.4. Test Results

Ambient temperature : (24 ± 2) °C
 Relative humidity : 47 % R.H.

7.4.1. Packet Type: DH1, 3-DH1

Operation Mode	Frequency	Dwell Time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2 441 MHz	0.39	124.84	400
8DPSK	2 441 MHz	0.39	124.84	400

Note:

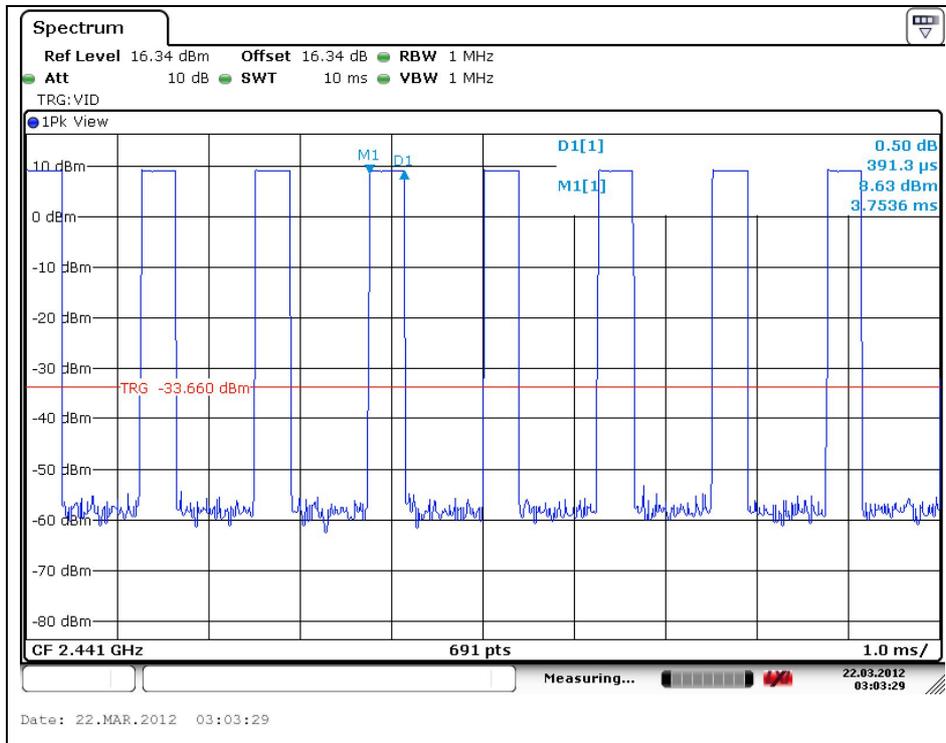
The system makes worst case 1600 hops per second or 1 time slot has a length of 625 μ s with 79 channels. A DH1 Packet need 1 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 800 hops per second with 79 channels. So you have each channel 10.13 times per second and so for 31.6 seconds you have 320.108 times of appearance.

Each Tx-time per appearance is 0.39 ms.

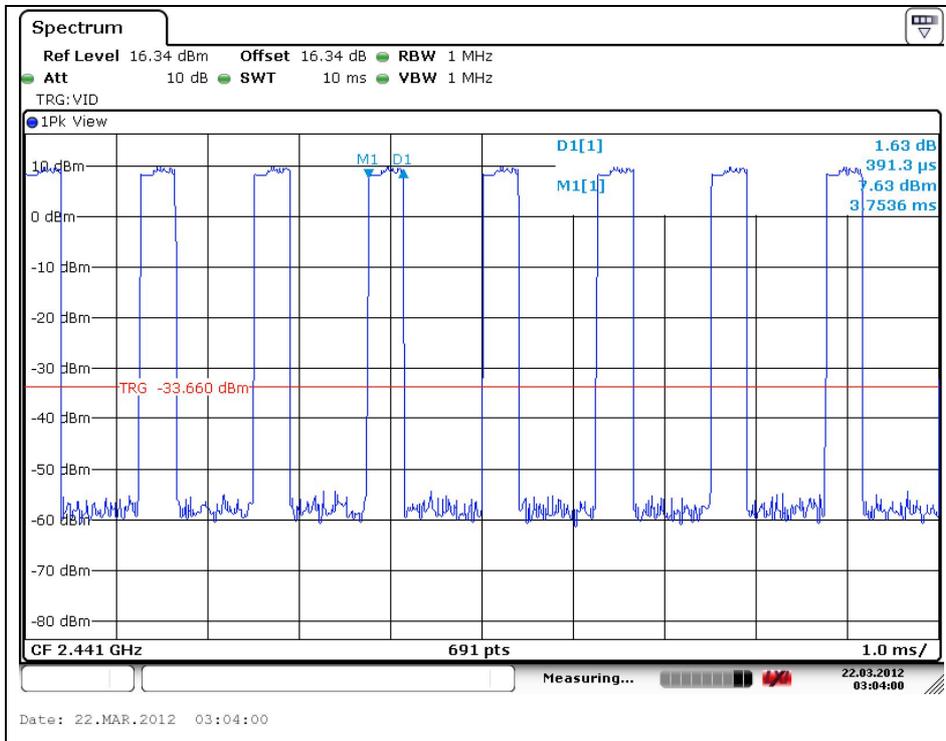
So we have $320.108 \times 0.39 \text{ ms} = 124.84 \text{ ms}$ per 31.6 seconds.

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Operating Mode: GFSK



Operating Mode: 8DPSK



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7.4.2. Packet Type: DH3, 3-DH3

Operation Mode	Frequency	Dwell Time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2 441 MHz	1.64	264.30	400
8DPSK	2 441 MHz	1.64	264.30	400

Note:

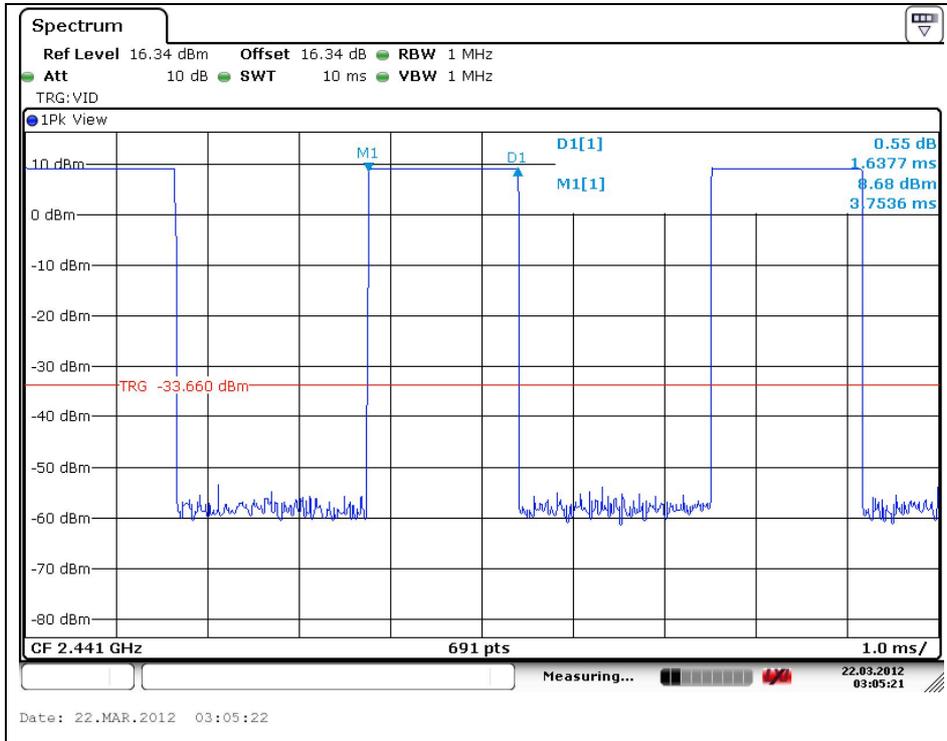
The system makes worst case 1600 hops per second or 1 time slot has a length of 625 μ s with 79 channels. A DH3 Packet need 3 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 400 hops per second with 79 channels. So you have each channel 5.1 times per second and so for 31.6 seconds you have 161.16 times of appearance.

Each Tx-time per appearance is 1.64 ms.

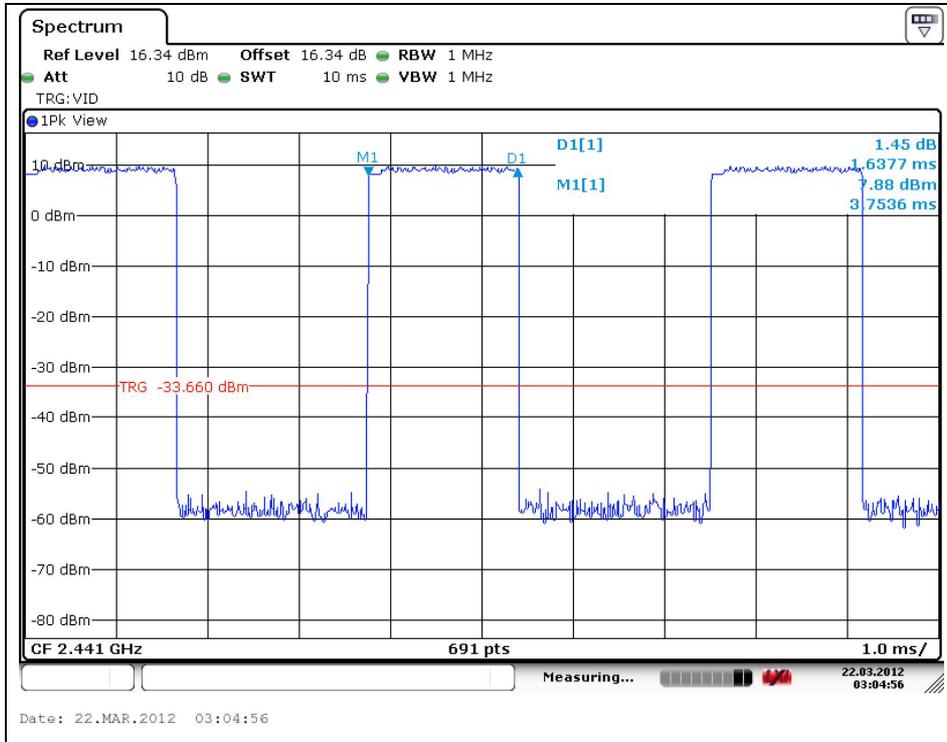
So we have $161.16 \times 1.64 \text{ ms} = 264.30 \text{ ms}$ per 31.6 seconds.

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Operating Mode: GFSK



Operating Mode: 8DPSK



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7.4.3. Packet Type: DH5, 3-DH5

Operation Mode	Frequency	Dwell Time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2 441 MHz	2.88	307.61	400
8DPSK	2 441 MHz	2.88	307.61	400

Note:

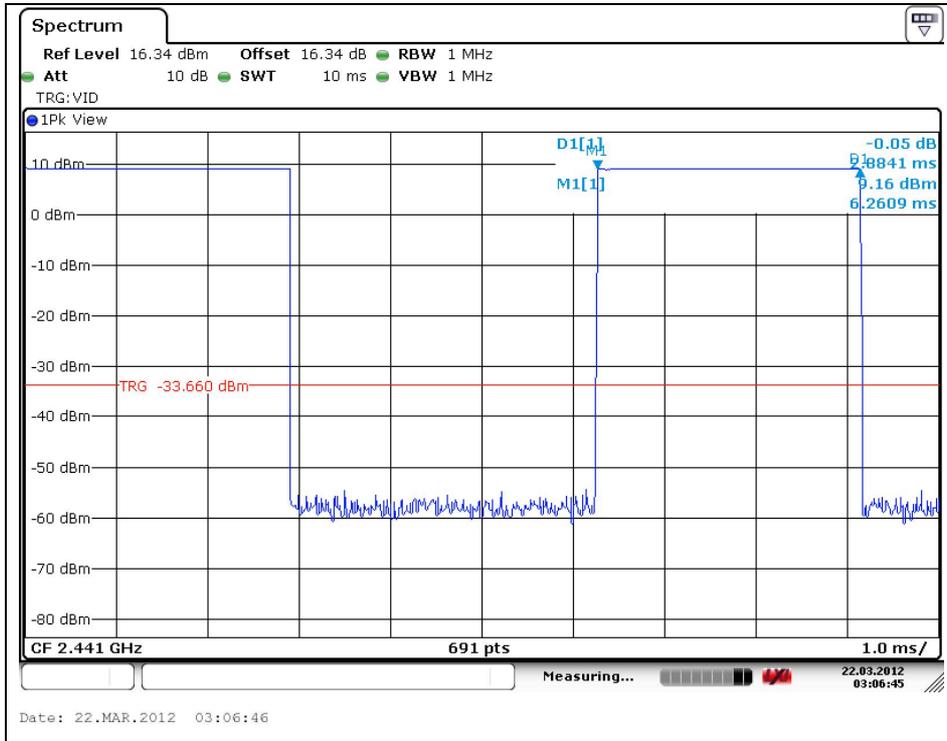
The system makes worst case 1600 hops per second or 1 time slot has a length of 625 μ s with 79 channels. A DH5 Packet need 5 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 266.7 hops per second with 79 channels. So you have each channel 3.38 times per second and so for 31.6 seconds you have 106.81 times of appearance.

Each Tx-time per appearance is 2.88 ms.

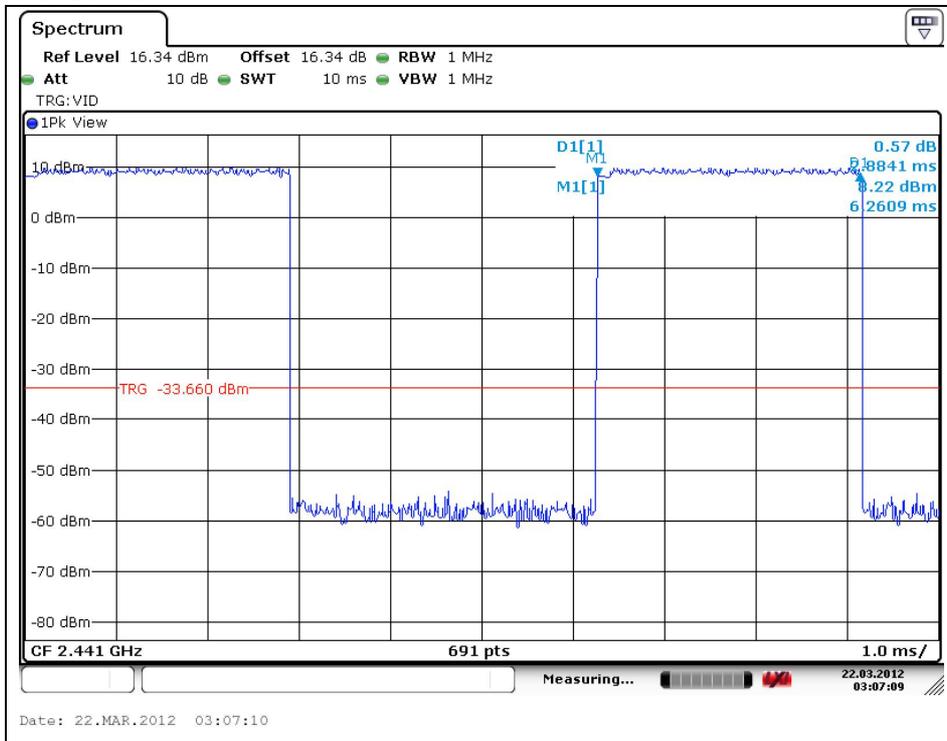
So we have $106.81 \times 2.88 \text{ ms} = 307.61 \text{ ms}$ per 31.6 seconds.

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Operating Mode: GFSK



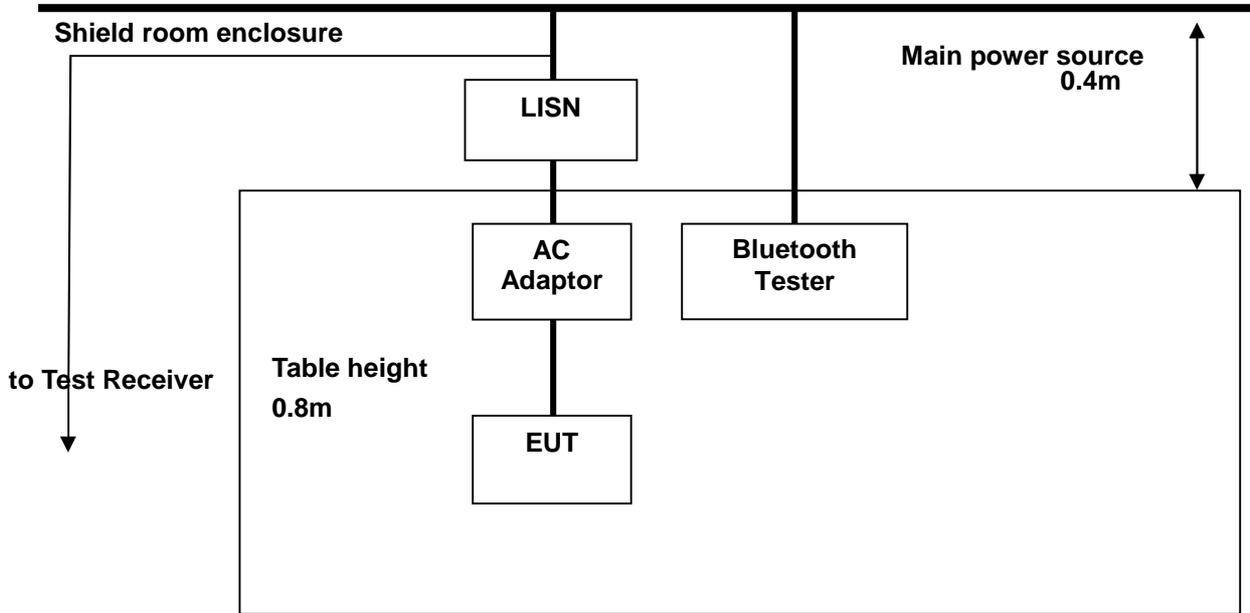
Operating Mode: 8DPSK



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8. Transmitter AC Power Line Conducted Emission

8.1. Test Setup



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 kHz to 30 MHz, 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 (MHz)	Conducted limit (dB 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.

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8.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

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. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

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8.4. Test Results (Worst case configuration_GFSK mode)

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

Ambient temperature : (24 ± 2) °C
 Relative humidity : 47 % R.H.

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

FREQ. (MHz)	LEVEL(dB μ V)		LINE	LIMIT(dB μ V)		MARGIN(dB)	
	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.51	43.77	38.37	H	56.00	46.00	12.23	7.63
1.18	40.04	32.14	H	56.00	46.00	15.96	13.86
1.81	41.02	34.62	H	56.00	46.00	14.98	11.38
2.44	42.38	35.88	H	56.00	46.00	13.62	10.12
3.70	44.99	38.29	H	56.00	46.00	11.01	7.71
4.95	45.90	37.10	H	56.00	46.00	10.10	8.90
0.23	43.78	34.58	N	62.45	52.45	18.67	17.87
0.50	42.87	38.87	N	56.08	46.08	13.21	7.21
1.81	38.40	33.80	N	56.00	46.00	17.60	12.20
2.49	39.66	34.46	N	56.00	46.00	16.34	11.54
3.04	39.86	34.96	N	56.00	46.00	16.14	11.04
4.45	41.86	36.06	N	56.00	46.00	14.14	9.94

Note ;

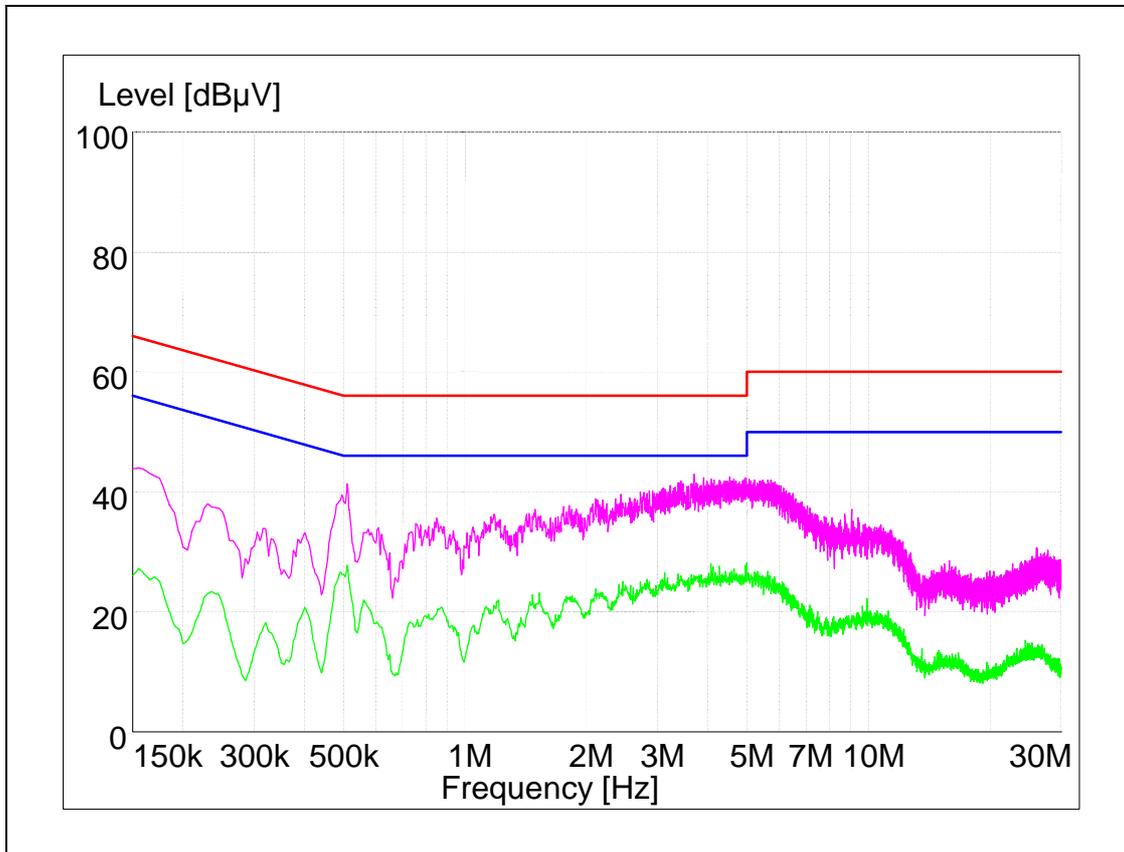
Line (H) : Hot

Line (N) : Neutral

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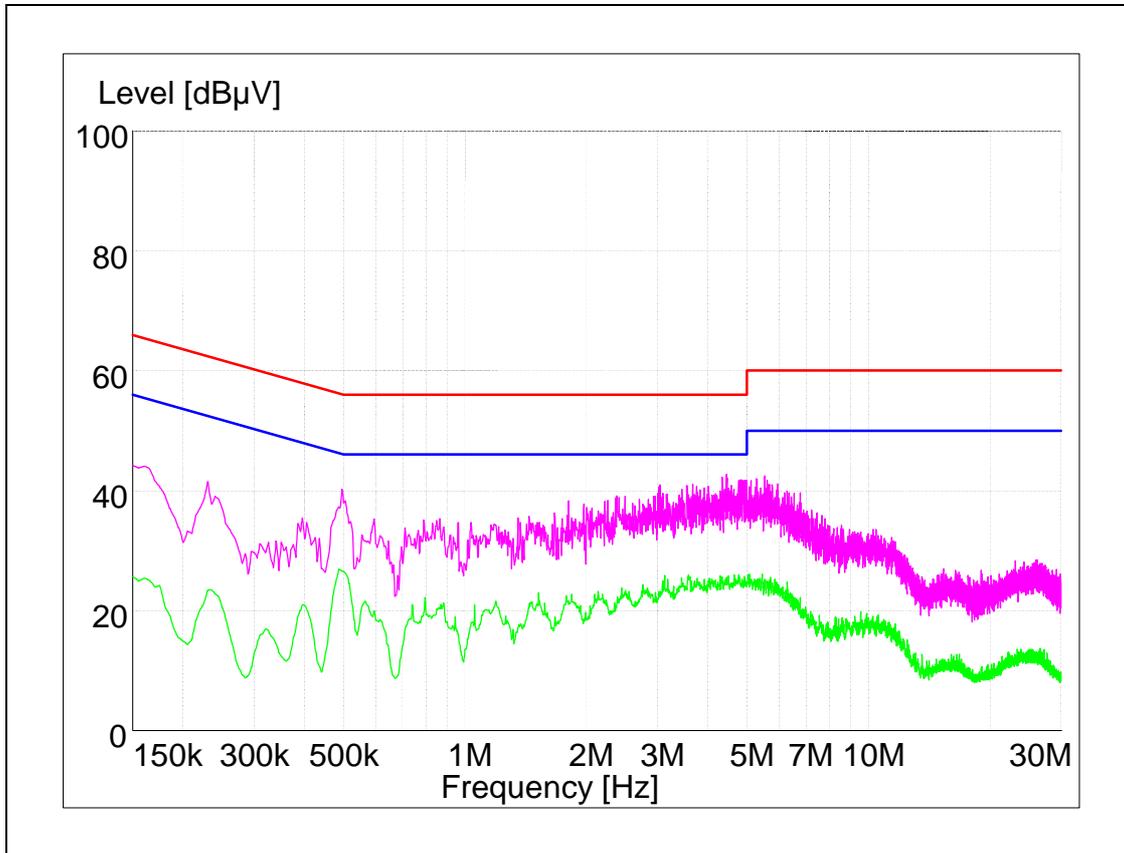
Plot of Conducted Power line

Test mode : (Hot)



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Test mode : (Neutral)



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

9.2. Antenna Connected Construction

Antenna used in this product is Internal type antenna gain of -1.05 dB i.

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