TEST REPORT

of

FCC Part 15 Subpart C §15.247

FCC ID: WEK-SM-01

Equipment Under Test	:	SMART NUDGE
Model Name	:	SM-01 (Alt. model : SM-01W)
Serial No.	:	N/A
Applicant	:	Semilink Inc.
Manufacturer	:	Semilink Inc.
Date of Test(s)	:	2012.10.20 ~ 2012.10.24
Date of Issue	:	2012.10.25

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

Tested By: **Logan Lee** **Date** **2012.10.25**

Approved By: **Feel Jeong** **Date** **2012.10.25**

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- 705, Dongchun-Dong Sooji-Gu, Yongin-Shi, Kyungki-Do, South Korea.
- Wireless Div. 3FL, 18-34, Sanbon-dong, 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 : Semilink Inc.
Address : #417 Doosan Venture Digm, 126-1, Pyungchon-dong, Dongan-gu, Anyang-si, Gyeonggi-do, Republic of Korea, 431-070
Contact Person : Park, Chang-Sik
Phone No. : +82 31 440 9330

1.3. Description of EUT

Kind of Product	SMART NUDGE
Model Name	SM-01 (Alt. model : SM-01W)
Serial Number	N/A
Power Supply	DC 3.0 V
Frequency Range	2 402 ㎒ ~ 2 480 ㎒
Modulation Technique	GFSK
Number of Channels	40
Channel separation	2 ㎒
Antenna Type	Internal type (PIFA antenna)
Antenna Gain	3.3 ㏈i

1.4. Declaration by the manufacturer

- This product is applied for only Bluetooth LE

- Variant model has only a different color than basic model.

- The output power is <60/f calculate result and RF exposure evaluation is pass.

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	R&S	SMJ100A	100882	Nov. 25, 2011	Annual	Nov. 25, 2012
Signal Generator	R&S	SMR40	100540	Jan, 05, 2012	Annual	Jan, 05, 2013
Spectrum Analyzer	R&S	FSV30	101004	Jul. 05, 2012	Annual	Jul. 05, 2013
High Pass Filter	Wainwright	WHK3.0/18G-6SS	4	Aug. 01, 2012	Annual	Aug. 01, 2013
Low Pass Filter	Mini circuits	NLP-1200+	V9500401023-1	Aug. 01, 2012	Annual	Aug. 01, 2013
Attenuator	AEROFLEX / INMET	26A-10dB	1	Apr. 02, 2012	Annual	Apr. 02, 2013
Power Sensor	R & S	NRP-Z81	101341	Jul. 31. 2012	Annual	Jul. 31. 2013
DC Power Supply	Agilent	U8002A	MY50020026	Mar. 29, 2012	Annual	Mar. 29, 2013
Preamplifier	R & S	8447D	2727A05143	Jul. 18. 2012	Annual	Jul. 18. 2013
Preamplifier	R & S	SCU 18	10117	Jan. 02, 2012	Annual	Jan. 02, 2013
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	Jul. 12, 2012	Annual	Jul. 12, 2013
Test Receiver	R & S	ESU40	100075	Feb. 13, 2012	Annual	Feb. 13, 2013
Trilog Antenna	SCHWARZBECK	VULB9163	9163-390	Apr. 19, 2012	Biennial	Apr. 19, 2014
Horn Antenna	R&S	HF907	100208	Aug. 13, 2012	Biennial	Aug. 13, 2014
Horn Antenna	SCHWARZBECK MESSELEKTRONIK	BBHA9170	BBHA9170431	May 15, 2012	Biennial	May 15, 2014
Antenna Master	INN-CO	MA4000-EP	N/A	N.C.R.	N.C.R.	N.C.R.
Turn Table	INN-CO	DT-3000S	N/A	N.C.R.	N.C.R.	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.C.R.	N.C.R.

1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part15		
Section	**Test Item**	**Result**
15.205 15.209 15.247(d)	Transmitter Radiated Spurious Emissions Conducted Spurious Emission	Complied
15.247(a)(2)	6 dB Bandwidth	Complied
15.247(b)(3)	Maximum Peak Conducted Output Power	Complied
15.247(e)	Power Spectral Density	Complied

1.7. Sample calculation

Where relevant, the following sample calculation is provided:

1.7.1. Conducted test

Offset value (dB) = Attenuator (dB) + Cable loss (dB)

1.7.2. Radiation test

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

1.8. Test report revision

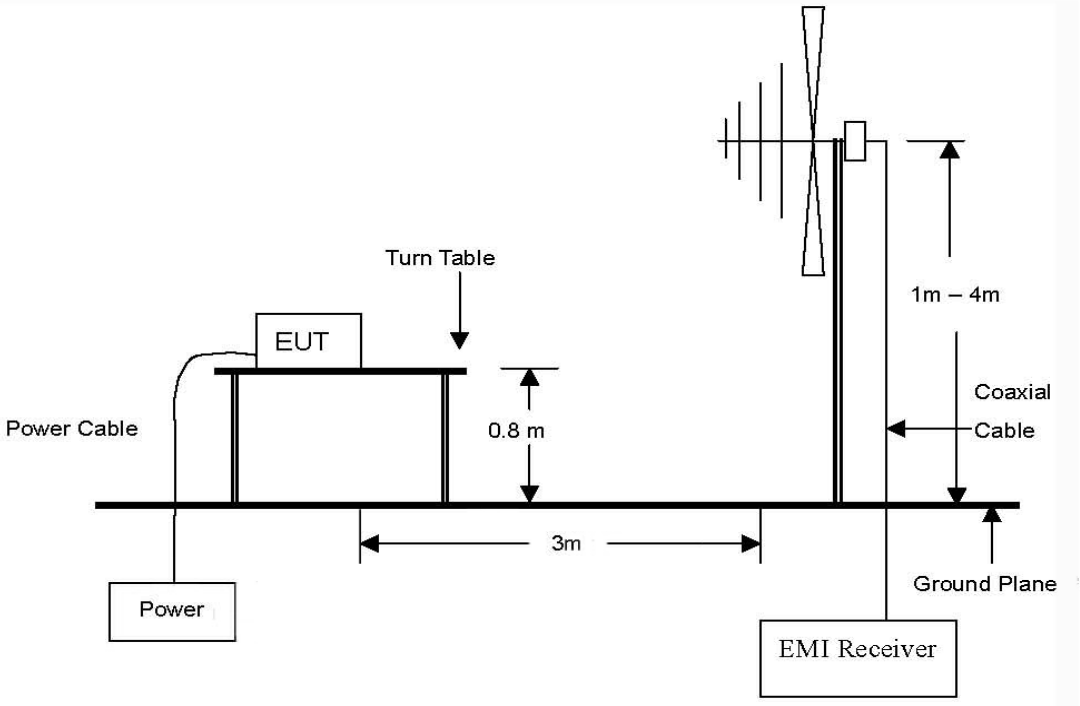
Revision	Report number	Description
0	F690501/RF-RTL005926	Initial

2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

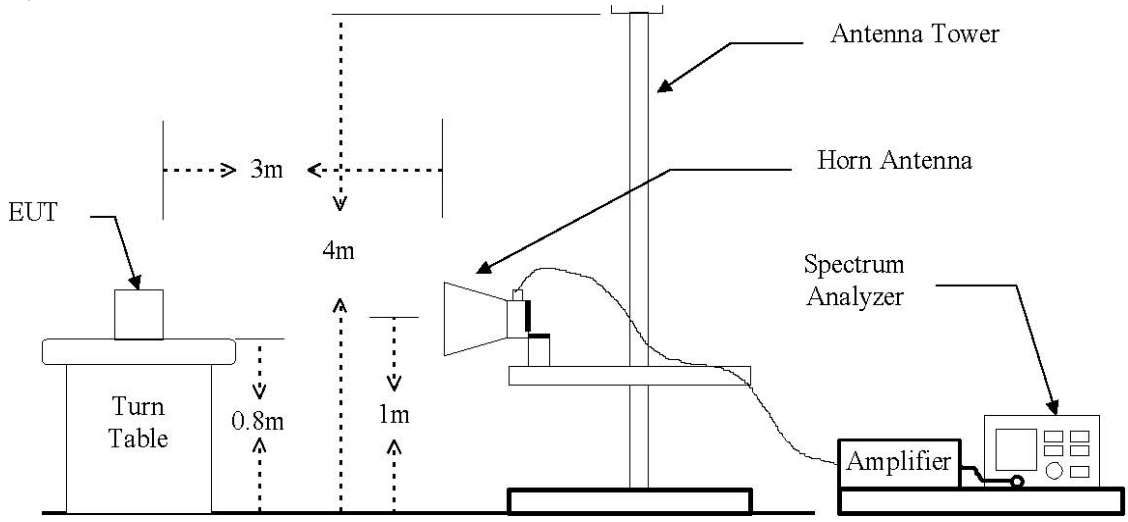
2.1. Test Setup

2.1.1. Transmitter Radiated Spurious Emissions

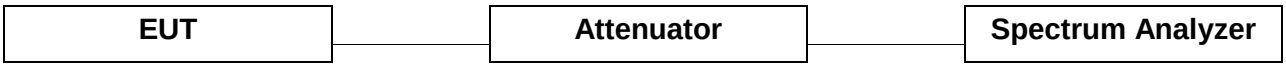
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ Emissions.



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.



2.1.2. Conducted Spurious Emission



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)
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 in section 5.4 of KDB 558074

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 ㎓, 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 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 ㏈ 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 measurements for below 1 ㎓
Set the RBW = 100 - 120 ㎑ and VBW ≥ 3 x RBW of test receiver/spectrum analyzer for Peak detection (PK) or Quasi-peak detection (QP)

2. The measurements for above 1 ㎓
Average measurements are recorded using the RBAVG1 measurement procedure of KDB 558074.
Peak measurements are recorded using RBW = 1 ㎒, VBW = 3 ㎒

3. To get a maximum emission level from the EUT, the EUT is manipulated through three orthogonal planes.

2.3.2. Test Procedures for Conducted Spurious Emissions

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

Per the guidance of KDB 558074, section 5.4.1.1, the reference level for out of band emissions is established from the plots of this section since the band edge emissions are measured with a RBW of 100 ㎑. This reference level is then used as the limit in subsequent plots for out of band spurious emissions shown in section 2.4.3. The limit for out of band spurious emission at the band edge is 30 ㏈ below the fundamental emission level measured in a 100 ㎑ bandwidth.

2.4. Test Results

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

2.4.1. Radiated Spurious Emission

The frequency spectrum from 30 ㎒ to 1 000 ㎒ was investigated. . All reading values are peak values.

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)
33.88	33.65	Peak	H	12.31	-24.54	21.42	40.00	18.58
71.52	28.27	Peak	V	8.63	-24.23	12.67	40.00	27.33
159.98	28.53	Peak	V	8.67	-23.12	14.08	43.50	29.42
175.89	27.51	Peak	V	9.47	-22.99	13.99	43.50	29.51
191.80	37.39	Peak	H	10.21	-22.86	24.74	43.50	18.76
239.91	34.23	Peak	H	11.55	-22.56	23.22	46.00	22.78
255.82	35.37	Peak	H	11.95	-22.46	24.86	46.00	21.14
288.02	28.96	Peak	H	12.76	-22.19	19.53	46.00	26.47
Above 300.00	Not detected	-	-	-	-	-	-	-

Remark

1. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes. XY plane is worst case.
2. All spurious emission at channels are almost the same below 1 ㎓, so that the middle channel was chosen at representative in final test.

2.4.2. Spurious Radiated Emission

The frequency spectrum above 1 000 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 30 ㏈.

Operating Mode: GFSK

Low Channel (2 402 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
*2 390.00	17.22	Peak	H	29.34	8.87	55.43	74.00	18.57
*2 390.00	6.25	Average	H	29.34	8.87	44.46	54.00	9.54

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	AMP+CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
*4 804.39	44.84	Peak	H	34.05	-29.96	48.93	74.00	25.07
*4 804.39	32.29	Average	H	34.05	-29.96	36.38	54.00	17.62
Above 4 900.00	Not detected	-	-	-	-	-	-	-

Middle Channel (2 440 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	AMP+CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
*4 879.96	41.43	Peak	H	34.14	-30.20	45.37	74.00	28.63
*4 879.96	28.37	Average	H	34.14	-30.20	32.31	54.00	21.69
*7 319.74	40.26	Peak	H	35.69	-26.39	49.56	74.00	24.44
*7 319.74	26.55	Average	H	35.69	-26.39	35.85	54.00	18.15
Above 7 400.00	Not detected	-	-	-	-	-	-	-

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	21.66	Peak	H	29.56	9.15	60.37	74.00	13.63
*2 483.50	6.56	Average	H	29.56	9.15	45.27	54.00	8.73

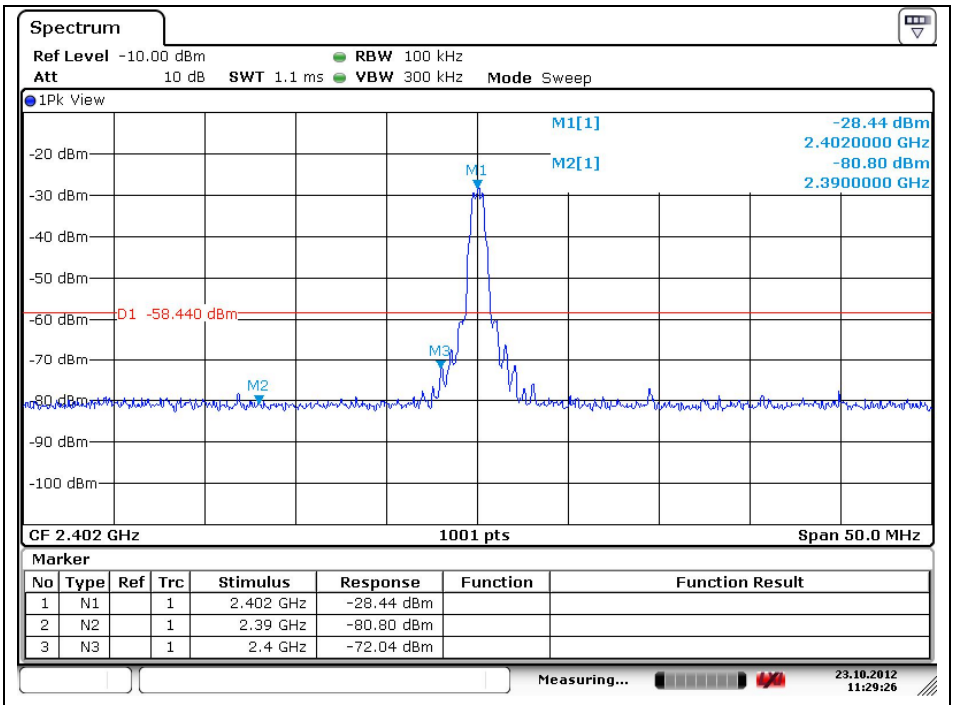
Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*4 960.61	37.25	Peak	H	34.25	-30.47	41.03	74.00	32.97
*4 960.61	24.64	Average	H	34.25	-30.47	28.42	54.00	25.58
*7 439.16	43.20	Peak	H	35.76	-26.19	52.77	74.00	21.23
*7 439.16	29.82	Average	H	35.76	-26.19	39.39	54.00	14.61
Above 7 500.00	Not detected	-	-	-	-	-	-	-

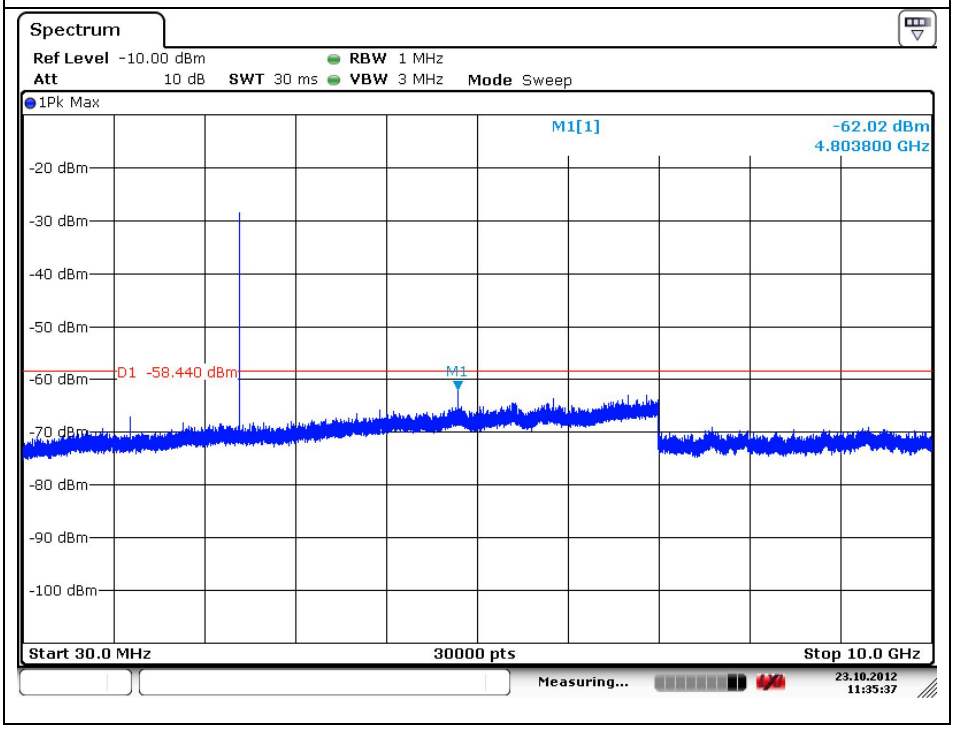
Remarks :

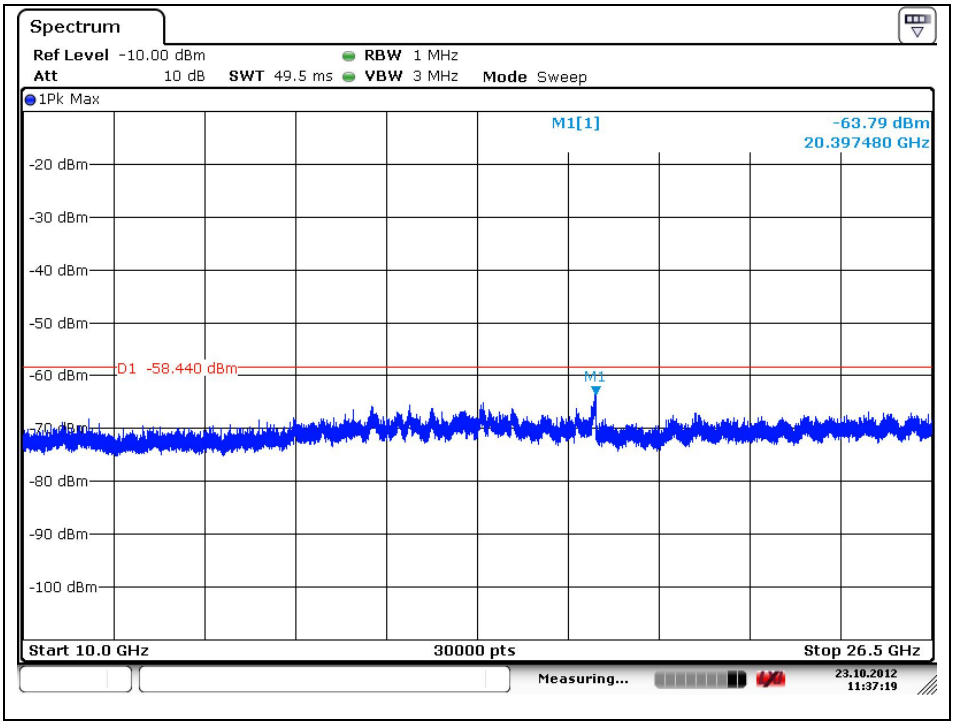
1. "*" means the restricted band.
2. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using peak/average detector mode.
3. Actual = Reading + AF + AMP + CL

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

Low Channel



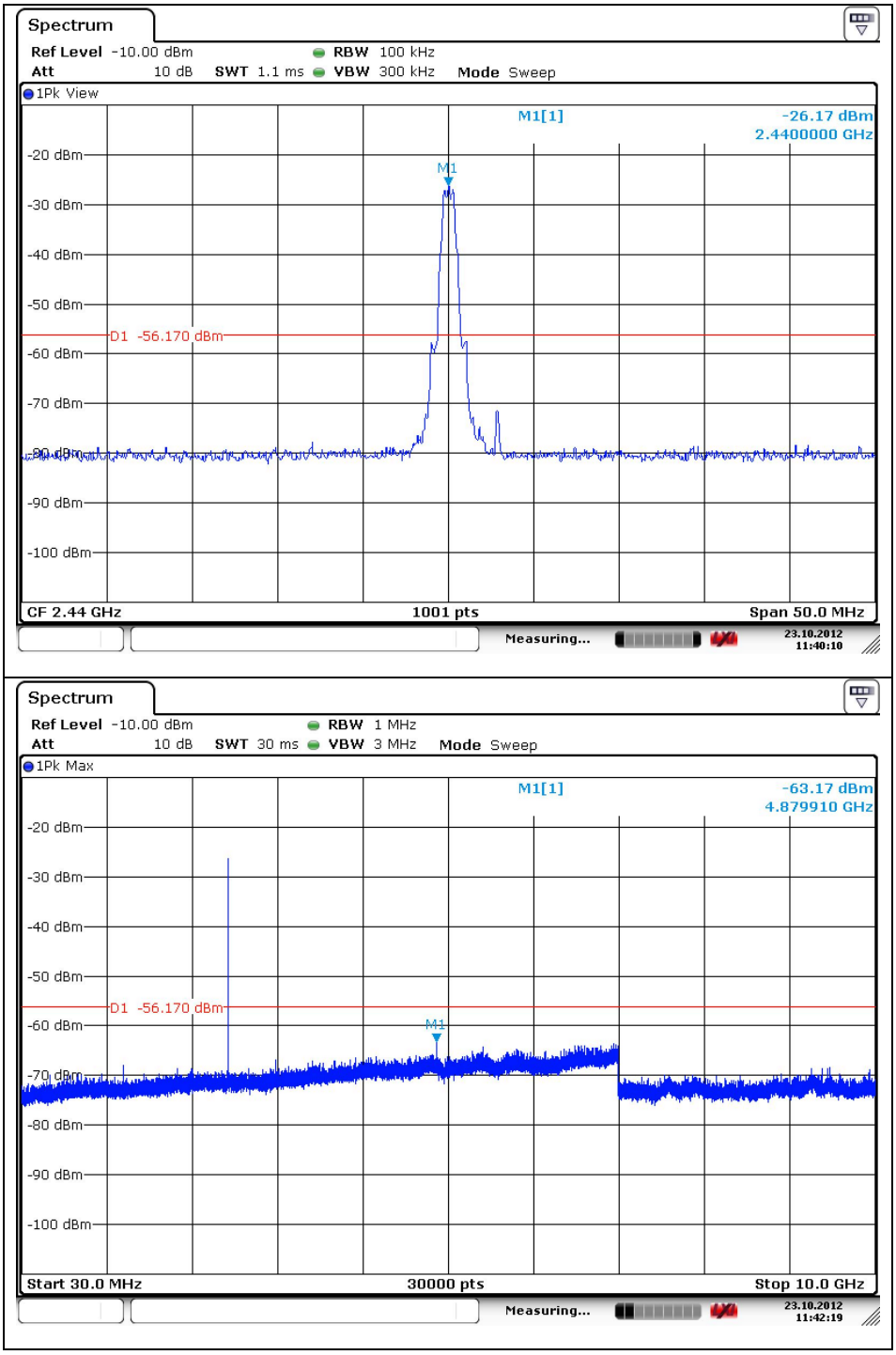


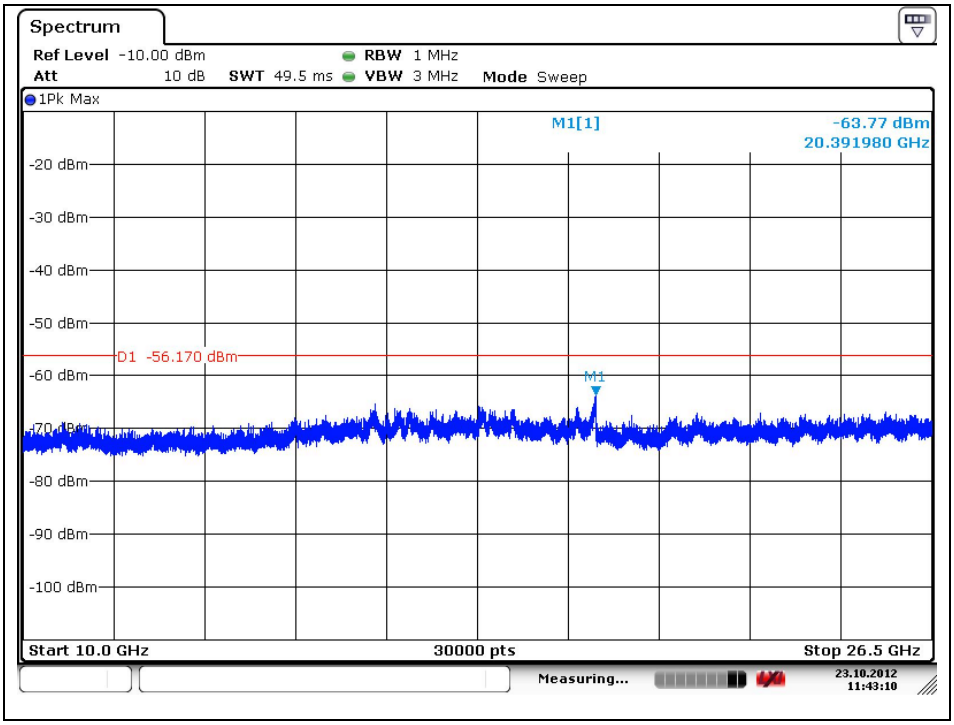


Note:
Offset (dB) = Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
2 390.00	20.68	-80.80	-60.12
2 400.00	20.70	-72.04	-51.34
4 803.80	20.95	-62.02	-41.07
20 397.48	22.34	-63.79	-41.45

Middle Channel

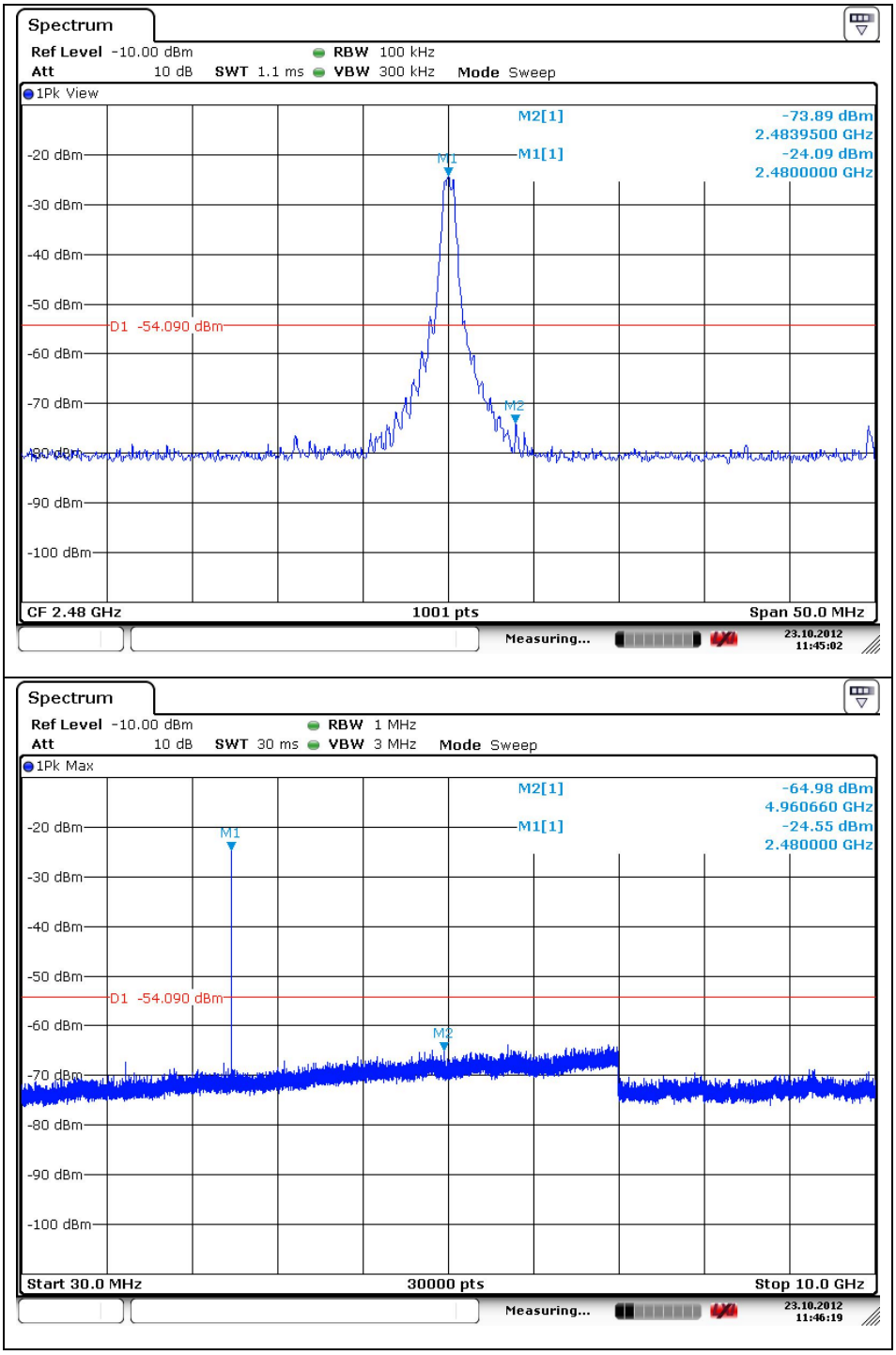


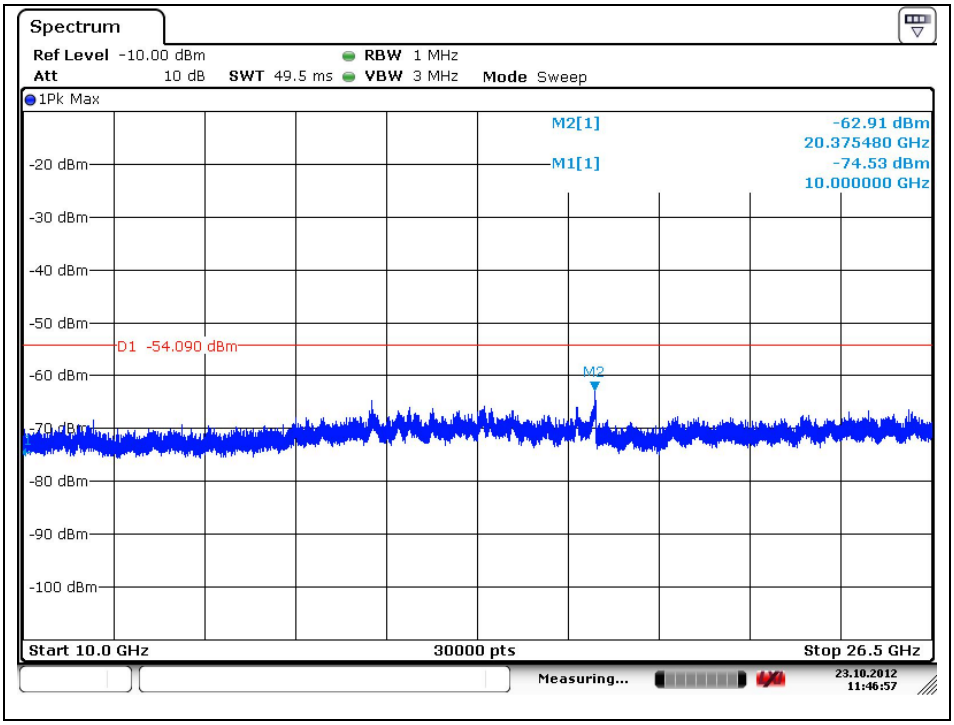


Note:
Offset (dB) = Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
4 879.91	20.91	-63.17	-42.26
20 391.98	22.44	-63.77	-41.33

High Channel





Note:
Offset (dB) = Attenuator(dB) + Cable loss (dB)
Result (dB m) = Spurious offset (dB) + Reading values (dB m)

Frequency (MHz)	Spurious offset (dB)	Reading values (dB m)	Result (dB m)
2 483.95	20.82	-73.89	-53.07
4 960.66	21.01	-64.98	-43.97
20 375.48	22.43	-62.91	-40.48

3. 6 dB Bandwidth of the channel

3.1. Test Setup

3.2. Limit

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 ~928 ㎒ , 2 400 ~ 2 483.5 ㎒, and 5 725 ~ 5 825 ㎒ bands. The minimum of 6 ㏈ Bandwidth shall be at least 500 ㎑

3.3. Test procedure

The test follows section 5.1 of FCC KDB Publication 558074

1. Set resolution bandwidth (RBW) = 1 – 5 % of the emission bandwidth (EBW).
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude point (upper and lower) that are attenuated by 6 ㏈ relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1 – 5 %.

3.4. Test Results

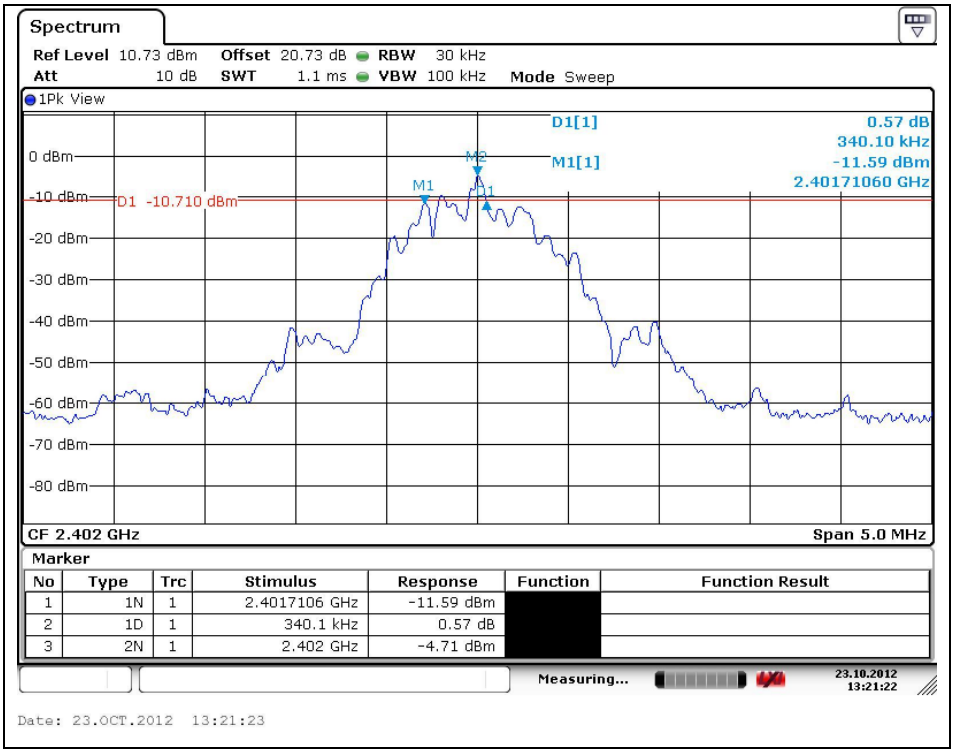
Ambient temperature : (24 ± 2) ℃
Relative humidity : 47 % R.H.

Operation Mode	Channel	Channel Frequency (㎒)	6 ㏈ Bandwidth (㎒)
GFSK	Low	2 402	0.340
	Middle	2 440	0.326
	High	2 480	0.318

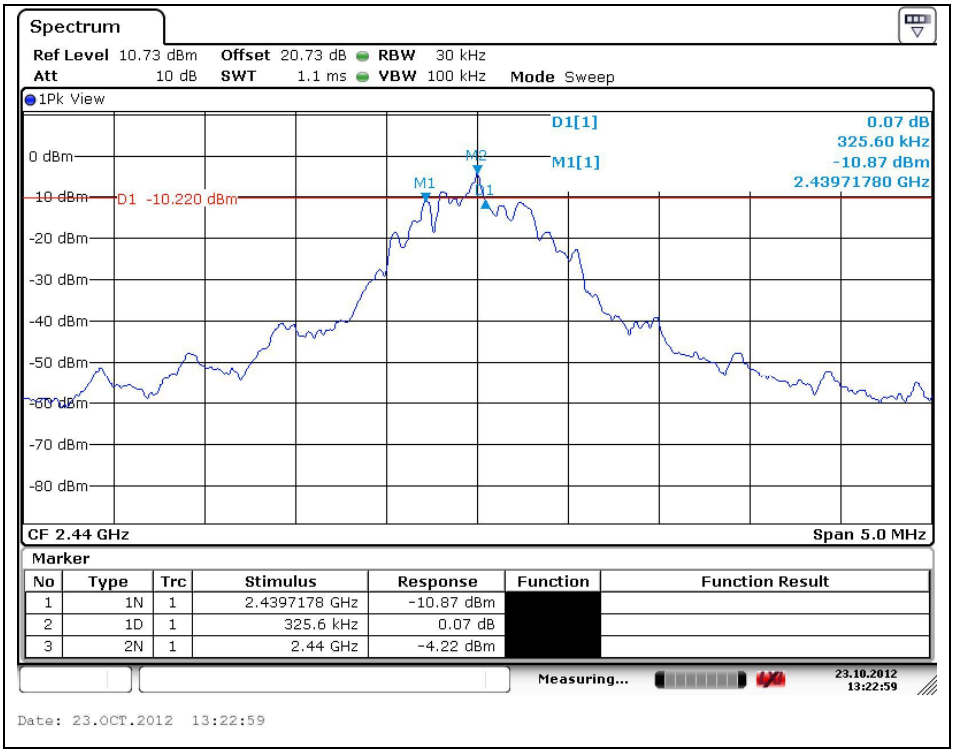
Plots of 6 dB Bandwidth

Operating Mode: GFSK

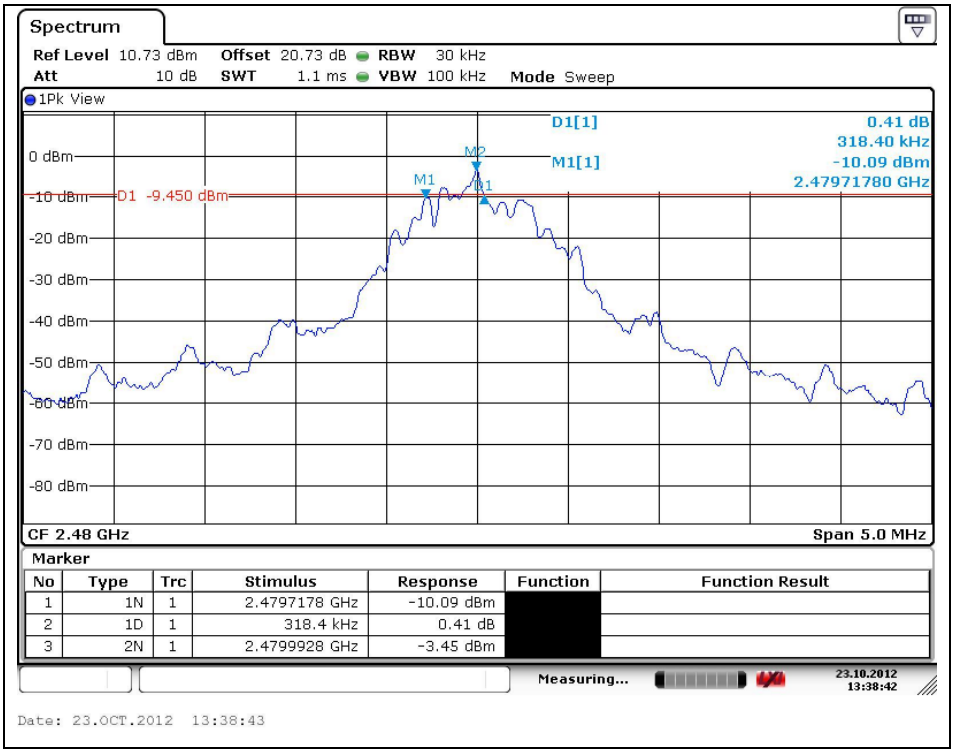
Low Channel



Middle Channel

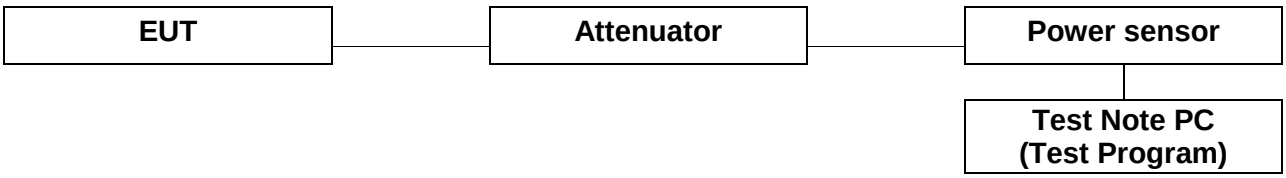


High Channel



4. Maximum Peak Conducted Output Power

4.1. Test Setup



4.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following:
§15.247(b)(3), For systems using digital modulation in the 2400-2483.5 ㎒ bands the limit is 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

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 a low loss RF cable from the antenna port to the wideband 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 : (24 ± 2) ℃
Relative humidity : 47 % R.H.

Operation Mode	Channel	Frequency (㎒)	Attenuator + Cable offset (dB)	Peak Power Result (dB m)	Average Power Result (dB m)	Peak Power Limit (dB m)
GFSK	Low	2 402	20.16	-3.82	-7.55	30
	Middle	2 440	20.18	-2.44	-5.32	30
	High	2 480	20.22	-1.38	-3.64	30

5. Power Spectral Density

5.1. Test Setup

5.2. Limit

According to §15.247(e), For digitally modulated system, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 ㏈m in any 3 ㎑ band any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph(b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density

5.3. Test procedure

The measurements are recorded using the AVGPSD measurement procedure in section 5.3 of KDB 558074.
1. Use this procedure when the maximum conducted output power in the fundamental emission is used to demonstrate compliance. The EUT must be configured to transmit continuously at full power over the measurement duration.
2. Set the analyzer span to 5 – 30 % greater than the EBW.
3. Set the RBW = 100 ㎑
4. Set the VBW ≥ 300 ㎑
5. Detector = power average (RMS).
6. Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW (use of a greater number of measurement points than this minimum requirement is recommended).
7. Manually set the sweep time to : ≥ 10 x (number of measurement points in sweep) x (transmission symbol period).
8. Perform the measurement over a single sweep.
9. Use the peak marker function to determine the maximum level in any 100 ㎑ band segment within the fundamental EBW.
10. Scale the observed power level to an equivalent level in 3 ㎑ by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where : BWCF =10log(3 ㎑/100 ㎑ = -15.2 ㏈).
11. The resulting PSD level must be ≤ 8 ㏈m.

5.4. Test Results

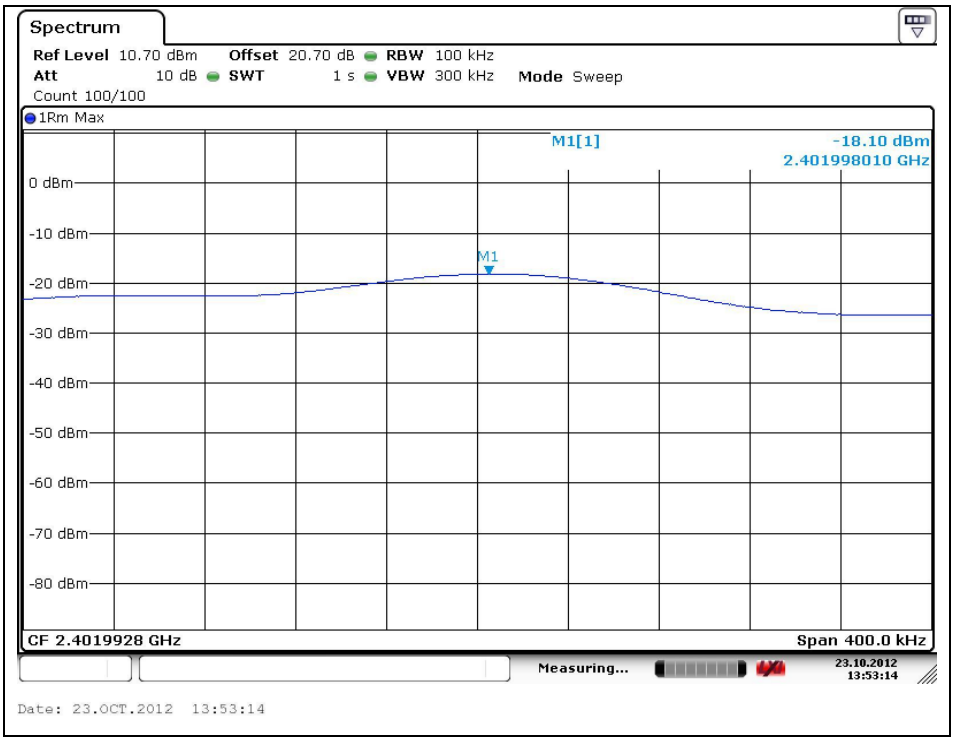
Ambient temperature : (24 ± 2) ℃
Relative humidity : 47 % R.H.

Operation Mode	Channel	Frequency (㎒)	Measured PSD (㏈ m)	Bandwidth Correction Factor (㏈)	Corrected PSD (㏈ m)	Maximum Limit (㏈ m)
GFSK	Low	2 402	-18.10	-15.20	-33.30	8
	Middle	2 440	-14.81	-15.20	-30.01	8
	High	2 480	-13.11	-15.20	-28.31	8

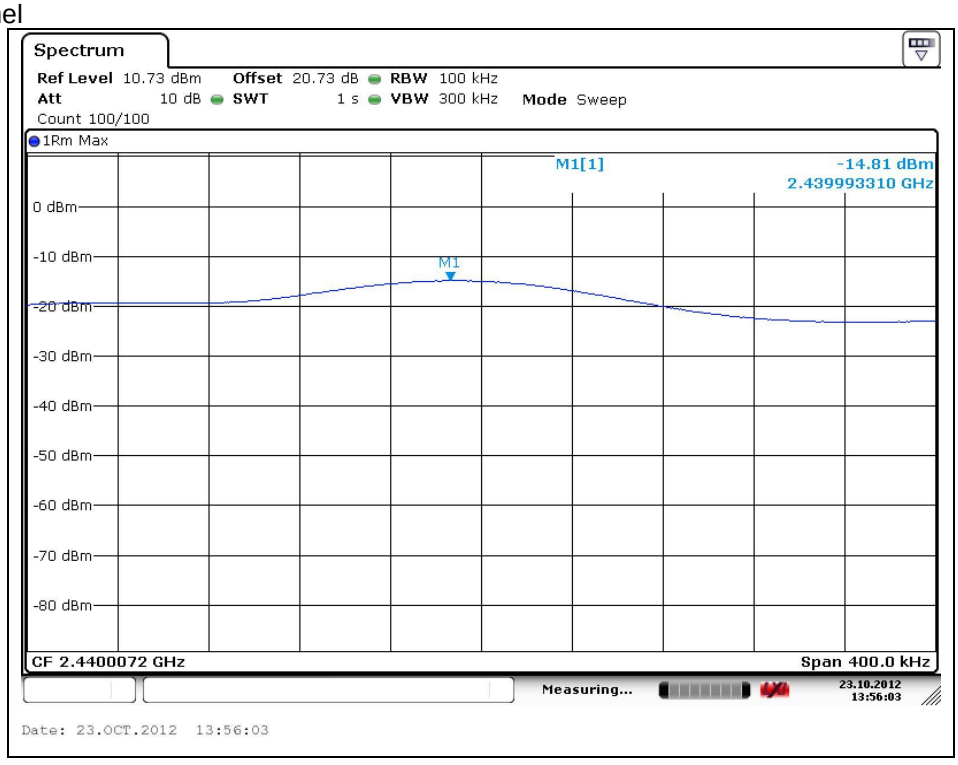
Plots of Power spectral density

Operating Mode: GFSK

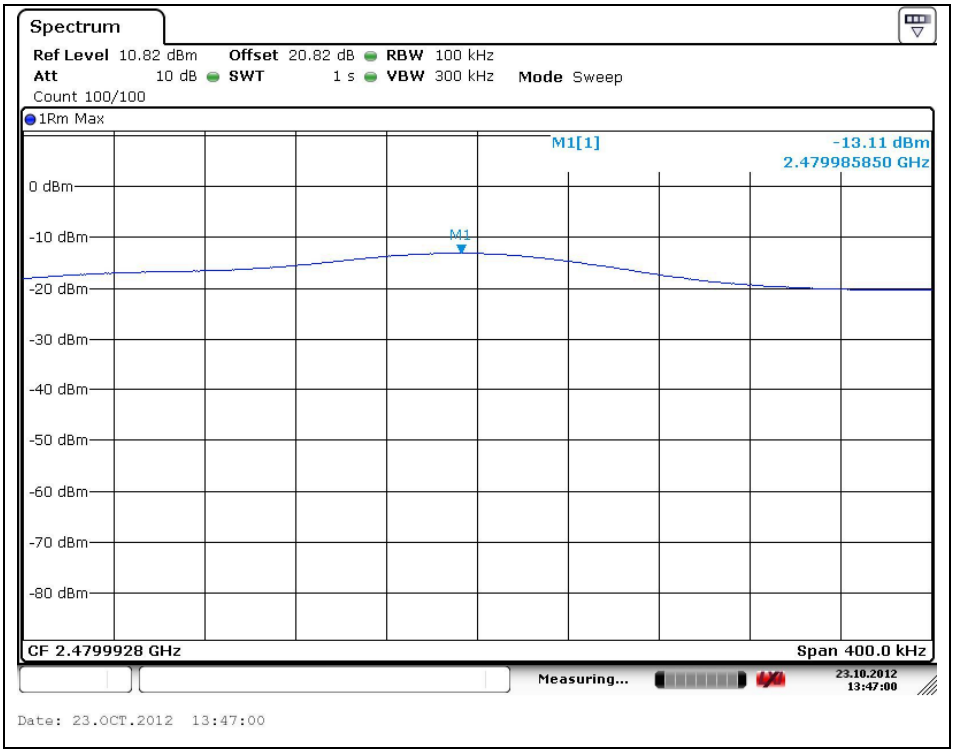
Low Channel



Middle Channel



High Channel



6. Antenna Requirement

6.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section §15.247 (b) if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

6.2. Antenna Connected Construction

Antenna used in this product is Internal PIFA type gain of 3.3 dBi.