

TEST REPORT

of

FCC Part 15 Subpart C §15.247

FCC ID : A3LEIAN920

Equipment Under Test : Charm by Samsung
Model Name : EI-AN920
Applicant : Samsung Electronics Co., Ltd.
Manufacturer : Samsung Electronics Co., Ltd.
Date of Test(s) : 2016. 01. 25. ~ 2016. 01. 29.
Date of Issue : 2016. 02. 17.

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

Tested By:



Wonjun Sim

Date:

2016. 02. 17.

Approved By:



Hyunchae You

Date:

2016. 02. 17.

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RTT5041-20(2015.10.01)(3)

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A4(210mm x 297mm)

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

-Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

Phone No. : + 82 31 688 0901

Fax No. : + 82 31 688 0921

1.2. Details of Applicant

Applicant : Samsung Electronics Co., Ltd.

Address : 129, Samsung-ro, Yeongtong-gu Suwon-si, Gyeonggi-do, 16677, Republic of Korea

Contact Person : Seo, Hyun-Seok

Phone No. : + 82 10 3227 4430

1.3. Description of EUT

Kind of Product	Charm by Samsung
Model Name	EI-AN920
Power Supply	DC 3.8 V
Frequency Range	2 402 MHz ~ 2 480 MHz (Bluetooth Low Energy)
Modulation Technique	GFSK
Number of Channels	40 channels (Bluetooth Low Energy)
Antenna Type	Internal type
Antenna Gain	-1.31 dBi

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1.4. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	Agilent	E8257D	MY51501169	Jul. 13, 2015	Annual	Jul. 13, 2016
Spectrum Analyzer	Agilent	N9030A	MY53120526	Jun. 23, 2015	Annual	Jun. 23, 2016
Spectrum Analyzer	R&S	FSW43	100637	Jul. 15, 2015	Annual	Jul. 15, 2016
High Pass Filter	Wainwright	WHK3.0/18G-6SS	4	Jun. 23, 2015	Annual	Jun. 23, 2016
High Pass Filter	Wainwright	WHK7.5/26.5G-6SS	15	Jun. 23, 2015	Annual	Jun. 23, 2016
Low Pass Filter	Mini circuits	NLP-1200+	V 8979400903-2	Mar. 12, 2015	Annual	Mar. 12, 2016
Power Sensor	R&S	NRP-Z81	100669	Mar. 12, 2015	Annual	Mar. 12, 2016
Attenuator	AEROFLEX / INMET	18N-20dB	2	Mar. 13, 2015	Annual	Mar. 13, 2016
DC Power Supply	R&S	HMP2020	019258024	Nov. 19, 2015	Annual	Nov. 19, 2016
Preamplifier	H.P.	8447F	2944A03909	Aug. 27, 2015	Annual	Aug. 27, 2016
Preamplifier	MITEQ Inc.	SCU-18	10117	Sep. 26, 2014	Annual	Apr. 10, 2016
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	May. 07, 2015	Annual	May 07, 2016
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	VULB9163	396	Jun. 18, 2015	Biennial	Jun. 18, 2017
Loop Antenna	R&S	HFH2-Z2	100118	Jun. 04, 2015	Biennial	Jun. 04, 2016
Horn Antenna	SCHWARZBECK MESSELEKTRONIK	HF906	100608	Oct. 16, 2014	Biennial	Oct. 16, 2016
Horn Antenna	SCHWARZBECK MESSELEKTRONIK	BBHA9170	BBHA9170431	May 15, 2014	Biennial	May 15, 2016
Antenna Master	INN-CO	MM4000	N/A	N/A	N/A	N.C.R.
Turn Table	INN-CO	DS 1200 S	N/A	N/A	N/A	N.C.R.
Test Receiver	R&S	ESU26	100109	Mar. 03, 2015	Annual	Mar. 03, 2016
Anechoic Chamber	SY Corporation	L x W x H (9.6 m x 6.4 m x 6.6 m)	N/A	N/A	N/A	N.C.R.

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1.5. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD : FCC Part15 Subpart C		
Standard section	Test Item(s)	Result
15.205 15.209 15.247(d)	Radiated Spurious Emissions	Complied
15.247(b)(3)	Maximum Conducted Output Power	Complied

Note. Some component was changed, EUT was only tested Radiated Spurious Emission and Maximum Conducted Output Power.

1.6. 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 C63.10-2009) and the guidance provided in KDB 558074 v03r04 were used in the measurement of the DUT.

1.7. Sample calculation

Where relevant, the following sample calculation is provided:

1.7.1. Radiation test

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

1.8. Test report revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL009479	2016. 02. 03.	Initial
1	F690501/RF-RTL009479-1	2016. 02. 17.	Revised EUT name

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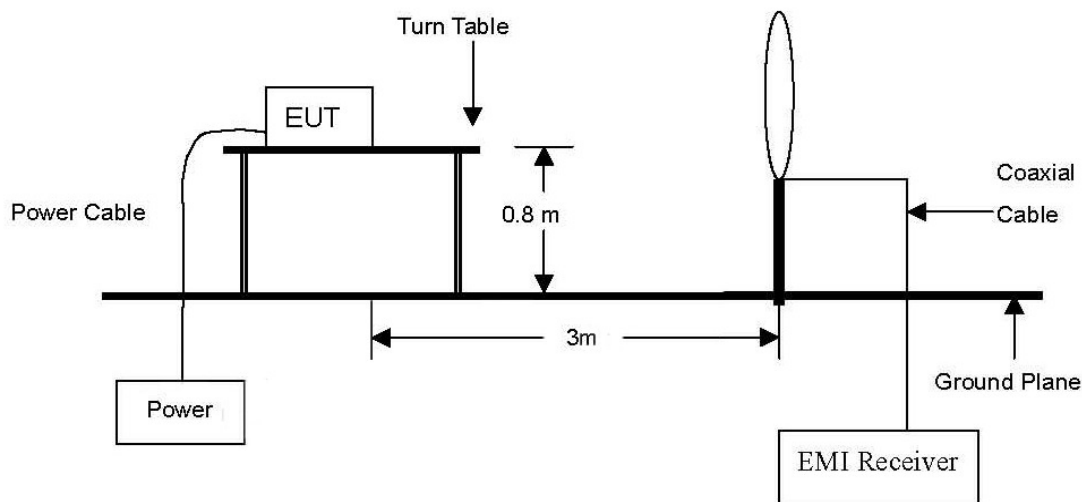
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2. Radiated Spurious Emissions and Conducted Spurious Emission

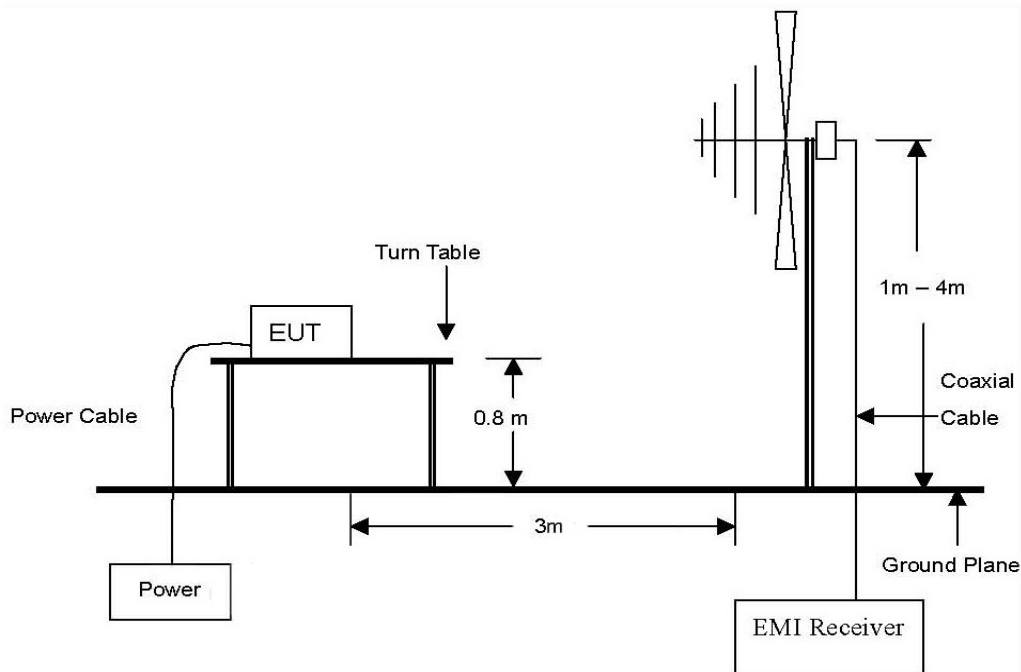
2.1. Test Setup

2.1.1. Radiated Spurious Emissions

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



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



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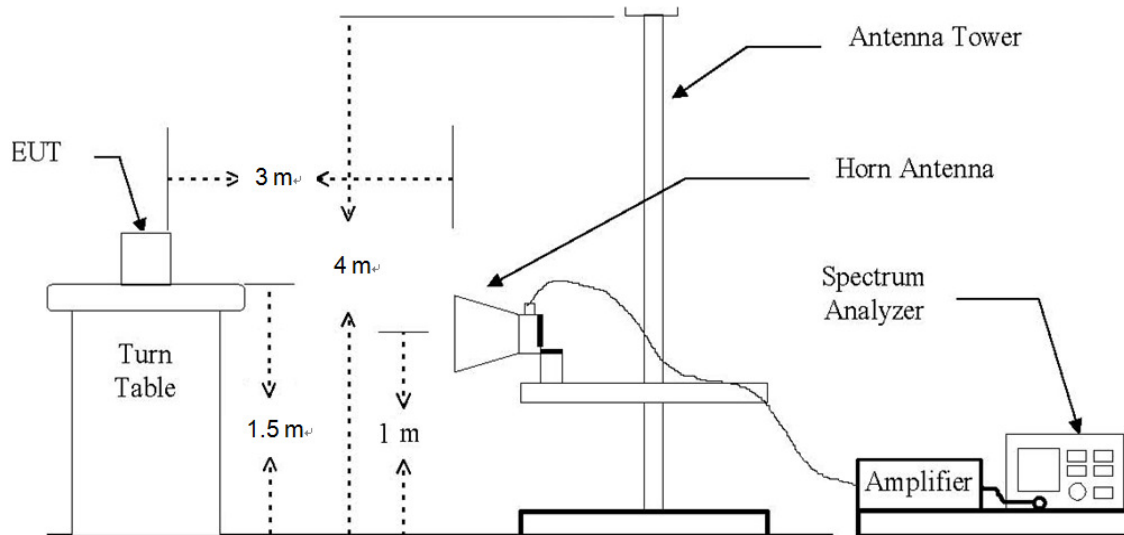
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The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 GHz to the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.



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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 (dBμV/m)	Field Strength (μV/m)
0.009 – 0.490	300	$20 \log (2\,400/F(\text{kHz}))$	$2\,400/F(\text{kHz})$
0.490 – 1.705	30	$20 \log (24\,000/F(\text{kHz}))$	$24\,000/F(\text{kHz})$
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

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2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates in section 11.0 & 12.0 of KDB 558074_v03r04 and ANSI C63.10-2009.

Remark:

Testing for radiated emissions above 1GHz was performed with the EUT elevated at 1.5m instead of 0.8m. 1.5m is the required height in ANSI C63.10:2013 as referenced by RSS GEN issue 4. This test height has been permitted by FCC as discussed in FCC-TCB conference call in December 2014.

2.3.1. Test Procedures for emission below 30 MHz

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 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 GHz and 1.5 meters above the ground at a 3 meter anechoic chamber test site above 1 GHz. 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 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 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.

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1. Unwanted Emissions into Non-Restricted Frequency Bands

- The Reference Level Measurement refer to section 11.2

Set analyzer center frequency to DTS channel center frequency, SPAN ≥ 1.5 times the DTS channel bandwidth, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold

- Unwanted Emissions Level Measurement refer to section 11.3

Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Ensure that the number of measurement points $\geq$ span/RBW, Sweep time = Auto couple, Trace = Max hold

2. Unwanted Emissions into Restricted Frequency Bands

- Peak Power measurement procedure refer to section 12.2.4

Set RBW = as specified in Table 1, VBW $\geq 3 \times$ RBW, SPAN $\geq$ RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold

Table 1- RBW as a function of frequency

Frequency	RBW
9 – 150 kHz	200 – 300 Hz
0.15 – 30 MHz	9 – 10 kHz
30 – 1 000 MHz	100 – 120 kHz
> 1 000 MHz	1 MHz

-Average Power measurements procedure refer to section 12.2.5.2

The EUT shall be configured to operate at the maximum achievable duty cycle.

Measure the duty cycle, x, of the transmitter output signal as described in section 6.0.

Set RBW = 1 MHz, VBW $\geq 3 \times$ RBW, Detector = RMS, if span / (# of points in sweep) $\leq$ (RBW/2).

Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied then the detector mode shall be set to peak,

Averaging type = power (i.e., RMS).

As an alternative the detector and averaging type may be set for linear voltage averaging.

Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used. Sweep time = auto, Perform a trace average of at least 100 traces.

A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

- 1) If power averaging (RMS) mode was used in step f), then the applicable correction factor is $10 \log (1/x)$, where x is the duty cycle.

3. Worst orthogonal plan of EUT is **Z – axis** during radiation test.

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2.4. Test Results

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

2.4.1. Spurious Radiated Emission below 1 000 MHz

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

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
39.82	37.00	Peak	V	13.93	-27.16	23.77	40.00	16.23
345.53	37.90	Peak	H	15.29	-25.25	27.94	46.00	18.06
848.07	38.00	Peak	H	22.29	-24.83	35.46	46.00	10.54
947.46	38.00	Peak	V	23.83	-24.17	37.66	46.00	8.34

Remark:

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

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2.4.2. Spurious Radiated Emission above 1 000 MHz

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

A. Low Channel (2 402 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	FCC Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*2 310.00	22.48	Peak	H	27.82	5.35	-	55.65	74.00	18.35
*2 310.00	14.57	Average	H	27.82	5.35	2.08	49.82	54.00	4.18
*2 378.21	22.55	Peak	H	27.90	5.37	-	55.82	74.00	18.18
*2 378.21	15.22	Average	H	27.90	5.37	2.08	50.57	54.00	3.43
*2 390.00	20.94	Peak	H	27.91	5.38	-	54.23	74.00	19.77
*2 390.00	14.61	Average	H	27.91	5.38	2.08	49.98	54.00	4.02

Radiated Emissions			Ant.	Correction Factors			Total	FCC Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+ CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (2 440 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	FCC Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+ CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	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)	Duty (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*2 483.50	22.03	Peak	H	28.02	5.44	-	55.49	74.00	18.51
*2 483.50	14.92	Average	H	28.02	5.44	2.08	50.46	54.00	3.54
*2 485.67	22.23	Peak	H	28.02	5.45	-	55.70	74.00	18.30
*2 485.67	14.60	Average	H	28.02	5.45	2.08	50.15	54.00	3.85
*2 500.00	21.72	Peak	H	28.04	5.49	-	55.25	74.00	18.75
*2 500.00	14.75	Average	H	28.04	5.49	2.08	50.36	54.00	3.64

Radiated Emissions			Ant.	Correction Factors			Total	FCC Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+ CL (dB)	Duty (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
Above 1 000.00	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. Actual = Reading + AF + AMP + CL or Reading + AF + CL
5. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 dB.

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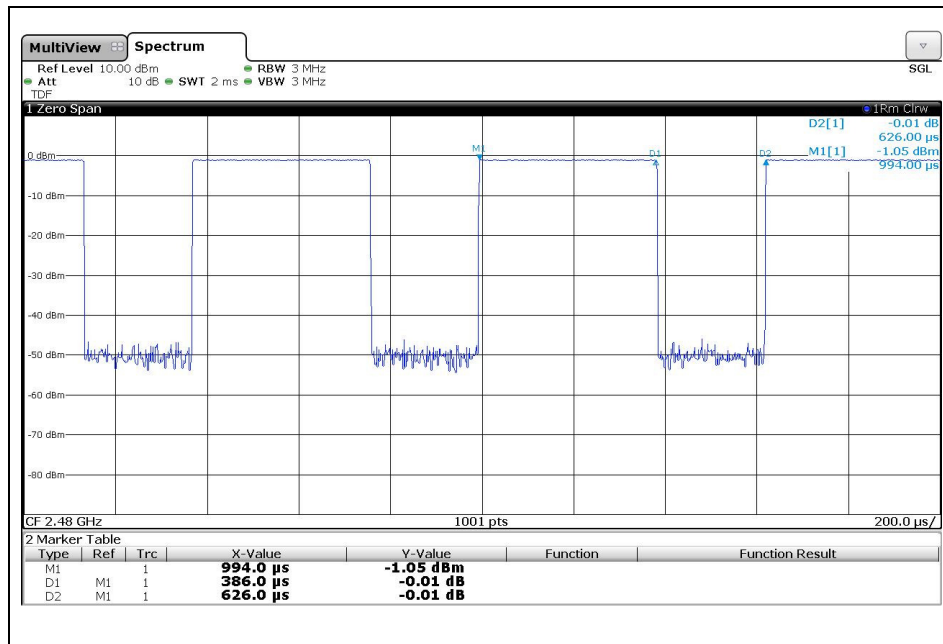
Note;

1. Average power result = Reading + Duty factor

2. Duty cycle measurement of EUT

Duty cycle (x) = Tx(on) / Tx(on+off) = 386.0 μ s / 626.0 μ s = 0.62

Duty factor = 10log(1/x), 10log(1/0.62) = 2.08



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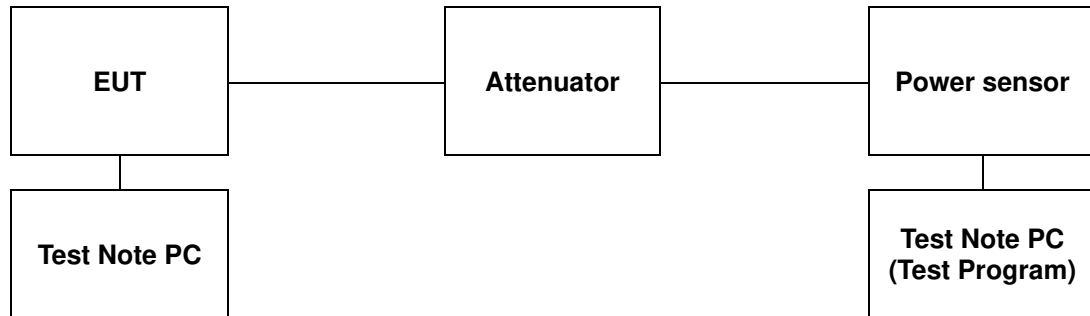
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3. Maximum Conducted Output Power

3.1. Test Setup



Test program : (S/W name : R&S Power Viewer, Version : 3.2.0)

3.2. Limit

According to §15.247(b)(3), for systems using digital modulation in the 902 ~ 928 MHz, 2 400 ~ 2 483.5 MHz, and 5 725 ~ 5 850 MHz band : 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. Maximum Conducted output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antenna elements. The average must not include any intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4), the conducted output power limit specified in paragraph(b) of this section is based on the use of antenna with directional gains that do not exceed 6 dBi. Except as shown in paragraph(c) of this section, if transmitting antenna of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3. Test Procedure

The test follows section 9.1.2 of FCC KDB Publication 558074 v03r04

- Peak power meter method

-The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

Test program: (S/W name : R&S Power Viewer, Version : 3.2.0)

1. Initially overall offset for attenuator and cable loss is measured per frequency.
2. Measured offset is inserted in test program in advance of measurement for output power.
3. Power for each frequency (channel) and data rate of device is investigated as final result.
4. Final result reported on this section from R&S power viewer program includes with several factors and test program shows only final result.

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A4(210mm x 297mm)

3.4. Test Results

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

Mode	Channel	Channel Frequency (MHz)	Attenuator + Cable offset (dB)	Peak Power Result (dB m)	Peak Power Limit (dB m)
GFSK	Low	2 402	10.78	-0.54	30.00
	Middle	2 440	10.79	-0.72	30.00
	High	2 480	10.81	-0.81	30.00

Remark;

Cable offset was compensated in test program (R&S Power Viewer) before measuring.

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