

# TEST REPORT

## Part 15 Subpart C 15.247

**Equipment under test** Keyless Entry System

**Model name** ANT-2WDSS

**FCC ID** VA5ANB300-2WLS

**Applicant** SEGI LIMITED

**Manufacturer** SEGI ELECTRONICS CO., LTD.

**Date of test(s)** 2015.06.01 ~ 2015.06.12


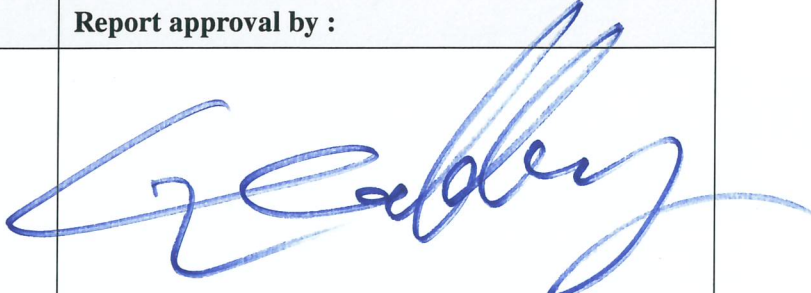
**Date of issue** 2015.06.19

Issued to

**SEGI LIMITED**  
 UNIT F, 7/F, CENTURY INDUSTRIAL CENTER,  
 33-35 AU PUI WAN STREET  
 SHATIN, NT, HONGKONG, CHINA

Issued by

**KES Co., Ltd.**  
 C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si,  
 Gyeonggi-do, 431-716, Korea  
 473-29, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea

Test and report completed by :	Report approval by :
	
Kwang-Yeol Choo Test engineer	Jeff Do Technical manager

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Test report No.:  
KES-RF-15T0050  
Page ( 2 ) of (29)

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**Revision history**

<b>Revision</b>	<b>Date of issue</b>	<b>Test report No.</b>	<b>Description</b>
-	2015.06.19	KES-RF-15T0050	Initial

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## 1. General information

Applicant: SEGI LIMITED  
Applicant address: UNIT F, 7/F, CENTURY INDUSTRIAL CENTER, 33-35 AU PUI WAN STREET  
SHATIN, NT, HONGKONG, CHINA  
Test site: KES Co., Ltd.  
Test site address: C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si, Gyeonggi-do, 431-716, Korea  
473-29, Gayeo-ro, Yeosu-si, Gyeonggi-do, Korea  
FCC rule part(s): 15.247  
Model: ANT-2WDSS  
FCC ID: VA5ANB300-2WLS  
Test device serial No.:  Production  Pre-production  Engineering

### 1.1. EUT description

Equipment under test Keyless Entry System  
Frequency range 903.0 MHz ~ 927.0 MHz  
Modulation technique DSSS  
Number of channels 7  
Antenna specification Antenna type : Helical Antenna // Peak gain: 1.63 dBi  
Power source DC 12.0 V

### 1.2. Frequency/Channel operation

Ch.	Frequency (MHz)
01	903.0
.	.
04	915.0
.	.
07	927.0

### 1.3. Information about derivative model

N/A

### 1.4 Device information

- The device duty cycles are as follows:  
≥ 98 percent.



## 2. Summary of tests

Reference	Parameter	Test results
15.205 15.209	Radiated spurious emission and band edge	Pass
15.247(d)	Conducted spurious emission and band edge	Pass
15.247(a)(2)	6 dB bandwidth	Pass
15.247(b)(3)	Peak output power	Pass
15.247(e)	Power spectral density	Pass

### Test procedures;

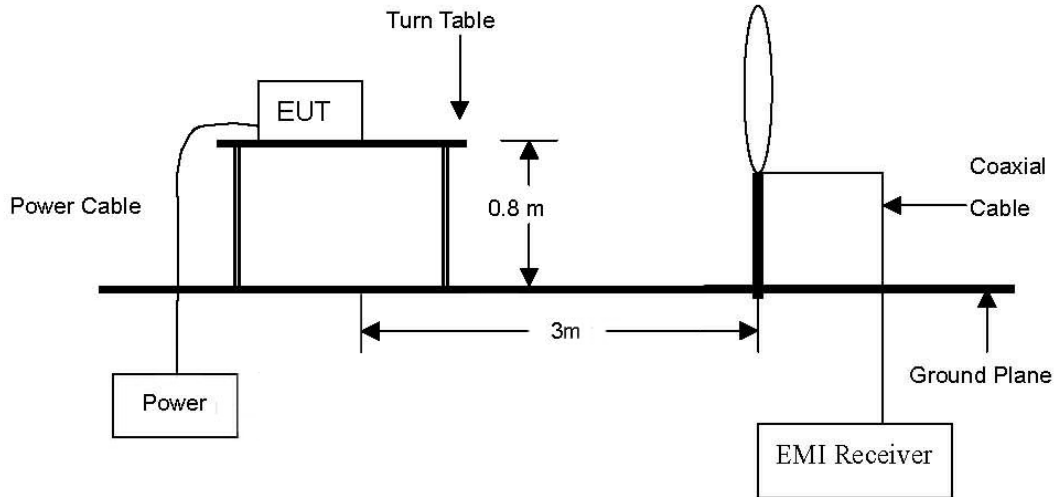
The EUT was tested per the guidance of ANSI C63.10-2009 was used to reference the appropriate EUT setup for radiated spurious emissions testing, the guidance provided in KDB 558074\_v03r03 were used in the measurement of the EUT.

### 3. Test results

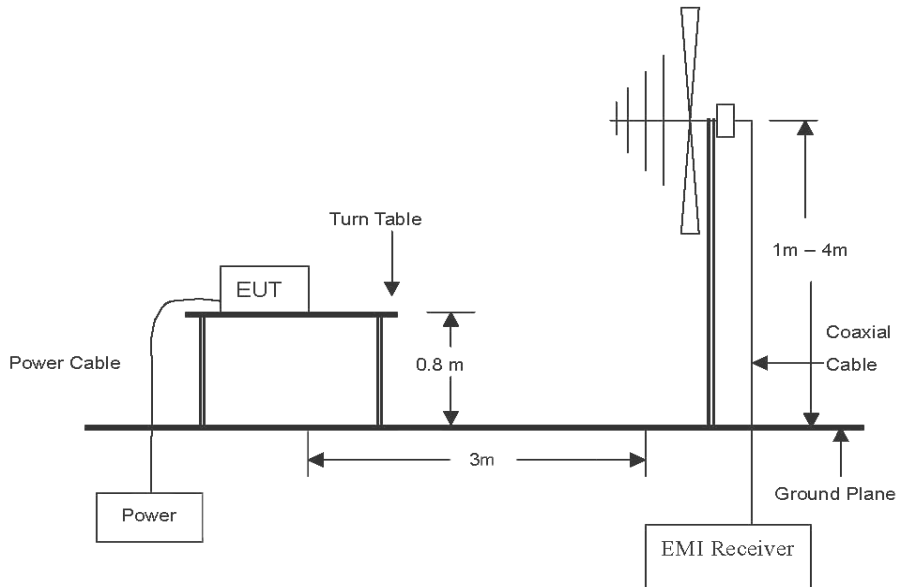
#### 3.1 Radiated spurious emissions & band edge

##### Test setup

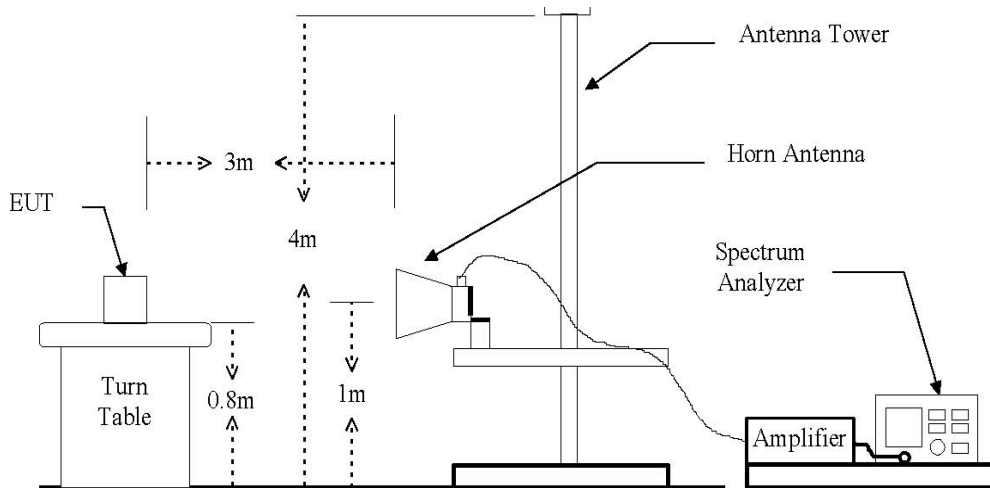
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions.



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



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 24 GHz emissions.



**Test procedure**

Radiated emissions from the EUT were measured according to the dictates in section 11.0 & 12.0 of KDB 558074\_v03r03 and ANSI C63.10-2009

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 or open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1GHz, 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 1 meter to 4 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 retested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet

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**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. Average Field Strength Measurements per Section 12.2.5.1**

Analyzer center frequency was set to the frequency of the radiated spurious emission of interest.

Set RBW = 1 MHz.

Set VBW = 3 MHz ( $\geq 3 \times$  RBW).

Set detector = power average(RMS).

Set sweep time = auto.

Trace (RMS) averaging was performed over at least 100 traces.

**2. Peak Field Strength Measurements per Section 12.2.4**

Analyzer center frequency was set to the frequency of the radiated spurious emission of interest.

Set RBW = 1 MHz.

Set VBW = 3 MHz ( $\geq 3 \times$  RBW).

Set detector = Peak.

Set sweep time = auto.

Trace mode = max hold.

Allow sweeps to continue until the trace stabilizes.

**Limit**

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Distance (Meters)	Radiated ( $\mu\text{V}/\text{m}$ )
0.009 ~ 0.490	300	2 400 / F(kHz)
0.490 ~ 1.705	30	24 000 / F(kHz)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

\*\*Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 MHz, 76 ~ 88 MHz, 174 ~ 216 MHz or 470 ~ 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.





**Test results (Below 30 MHz)**

Channel: 01  
Operating frequency: 903.0 MHz (Worst case)  
Distance of measurement: 3 meter

Frequency (MHz)	Level (dB $\mu$ V)	Ant. Pol.	Correction factors (dB/m)	F <sub>a</sub> (dB)	Field strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
No emission has been detected							

**Test results (Below 1 000 MHz)**

Channel: 01  
Operating frequency: 903.0 MHz (Worst case)  
Distance of measurement: 3 meter

Frequency (MHz)	Level (dB $\mu$ V)	Ant. Pol.	Correction factors (dB/m)	Field strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
Emission levels are not reported much lower than the limits by over 20 dB						

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**Test results (Above 1 000 MHz)**

Channel: 01  
Operating frequency: 903.0 MHz  
Distance of measurement: 3 meter

Frequency (MHz)	Level (dB $\mu$ V)	Detector	Ant. Pol.	Correction factors (dB/m)	Field strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
1806.80	46.98	PK	H	-0.46	46.52	74.00	27.48
1806.80	36.84	AV	V	-0.46	36.38	54.00	17.62
1806.80	43.45	PK	H	-0.46	42.99	74.00	31.01
1806.80	33.29	AV	V	-0.46	32.83	54.00	21.17
2711.30	53.92	PK	H	5.18	59.10	74.00	14.90
2711.30	40.39	AV	V	5.18	45.57	54.00	8.43
2711.30	53.20	PK	H	5.18	58.38	74.00	15.62
2711.30	37.56	AV	V	5.18	42.74	54.00	11.26
3608.50	43.67	PK	H	7.30	50.97	74.00	23.03
3608.50	30.79	AV	V	7.30	38.09	54.00	15.91
3608.50	43.41	PK	H	7.30	50.71	74.00	23.29
3608.50	34.22	AV	V	7.30	41.52	54.00	12.48
4513.00	46.07	PK	H	10.41	56.48	74.00	17.52
4513.00	34.74	AV	V	10.41	45.15	54.00	8.85
4513.00	50.52	PK	H	10.41	60.93	74.00	13.07
4513.00	39.77	AV	V	10.41	50.18	54.00	3.82
5417.50	37.55	PK	H	14.60	52.15	74.00	21.85
5417.50	29.03	AV	V	14.60	43.63	54.00	10.37
5417.50	38.32	PK	H	14.60	52.92	74.00	21.08



Channel: 04  
Operating frequency: 915.0 MHz  
Distance of measurement: 3 meter

Frequency (MHz)	Level (dB $\mu$ V)	Detector	Ant. Pol.	Correction factors (dB/m)	Field strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
1828.50	49.72	PK	H	-0.25	49.47	74.00	24.53
1828.50	38.84	AV	V	-0.25	38.59	54.00	15.41
1828.50	49.10	PK	H	-0.25	48.85	74.00	25.15
1828.50	34.42	AV	V	-0.25	34.17	54.00	19.83
2747.50	55.79	PK	H	5.33	61.12	74.00	12.88
2747.50	39.49	AV	V	5.33	44.82	54.00	9.18
2747.50	55.48	PK	H	5.33	60.81	74.00	13.19
2747.50	37.64	AV	V	5.33	42.97	54.00	11.03
3659.20	42.53	PK	H	7.44	49.97	74.00	24.03
3659.20	30.77	AV	V	7.44	38.21	54.00	15.79
3659.20	42.51	PK	H	7.44	49.95	74.00	24.05
3659.20	33.50	AV	V	7.44	40.94	54.00	13.06
4578.10	46.97	PK	H	10.87	57.84	74.00	16.16
4578.10	38.80	AV	V	10.87	49.67	54.00	4.33
4578.10	50.93	PK	H	10.87	61.80	74.00	12.20
4578.10	40.51	AV	V	10.87	51.38	54.00	2.62
5489.90	35.75	PK	H	14.73	50.48	74.00	23.52
5489.90	25.00	AV	V	14.73	39.73	54.00	14.27

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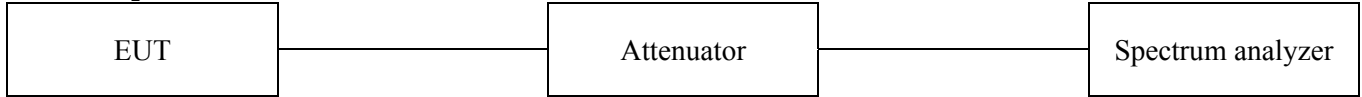


Channel: 07  
Operating frequency: 927.0 MHz  
Distance of measurement: 3 meter

Frequency (MHz)	Level (dB $\mu$ V)	Detector	Ant. Pol.	Correction factors (dB/m)	Field strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)
1850.20	53.89	PK	H	-0.03	53.86	74.00	20.14
1850.20	34.34	AV	V	-0.03	34.31	54.00	19.69
1850.20	41.31	PK	H	-0.03	41.28	74.00	32.72
1850.20	31.60	AV	V	-0.03	31.57	54.00	22.43
2783.60	55.04	PK	H	5.48	60.52	74.00	13.48
2783.60	42.31	AV	V	5.48	47.79	54.00	6.21
2783.60	42.01	PK	H	5.48	47.49	74.00	26.51
2783.60	40.55	AV	V	5.48	46.03	54.00	7.97
3709.80	41.51	PK	H	7.59	49.10	74.00	24.90
3709.80	29.22	AV	V	7.59	36.81	54.00	17.19
3709.80	42.98	PK	H	7.59	50.57	74.00	23.43
3709.80	34.45	AV	V	7.59	42.04	54.00	11.96
4636.00	48.25	PK	H	11.29	59.54	74.00	14.46
4636.00	34.82	AV	V	11.29	46.11	54.00	7.89
4636.00	50.89	PK	H	11.29	62.18	74.00	11.82
4636.00	40.65	AV	V	11.29	51.94	54.00	2.06
5562.20	35.89	PK	H	15.33	51.22	74.00	22.78
5562.20	24.06	AV	V	15.33	39.39	54.00	14.61
5562.20	35.14	PK	H	15.33	50.47	74.00	23.53

### 3.2 Conducted spurious emissions & band edge

#### Test setup



#### Test procedure

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\_v03r03, section 11.2&11.3,

1. Use the following spectrum analyzer setting

Center frequency: Low and high channel.

Set the span to encompass frequency range to be measured.

Set the RBW = 100 kHz.

Set the VBW = 300 kHz ( $\geq 3x$  RBW).

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum PSD level.

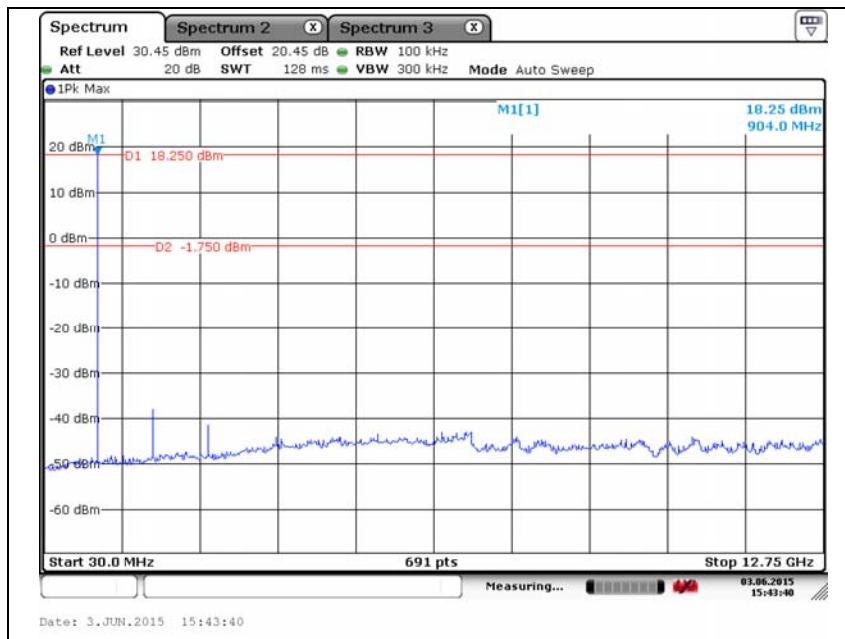
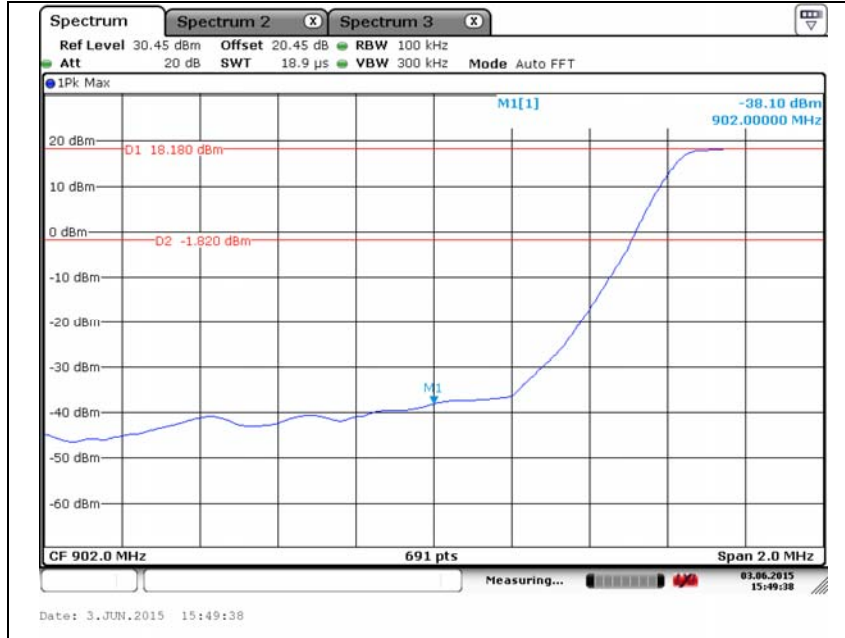
2. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

#### 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 defined in section 15.205(a), must also comply the radiated emission limits specified in section 15.209(a) (see section 15.205(c))

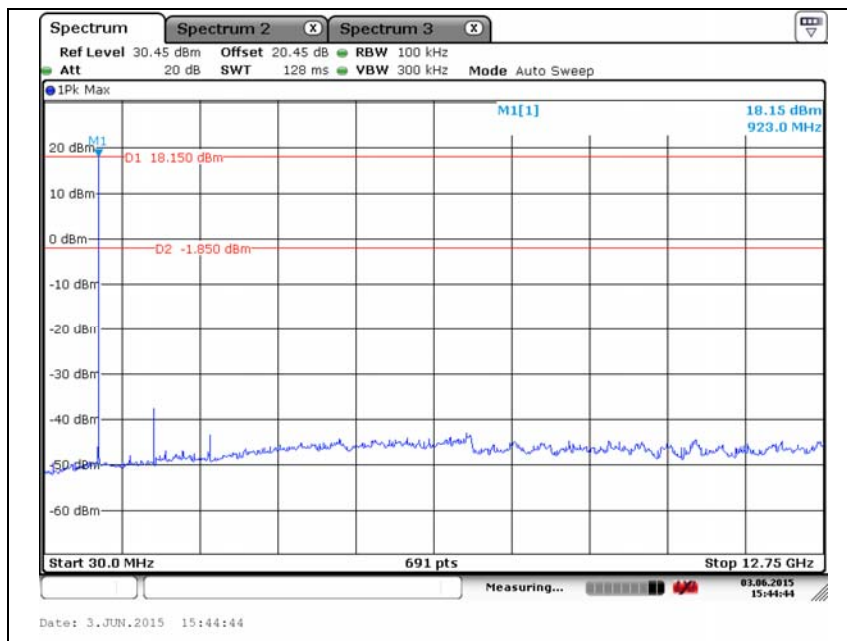
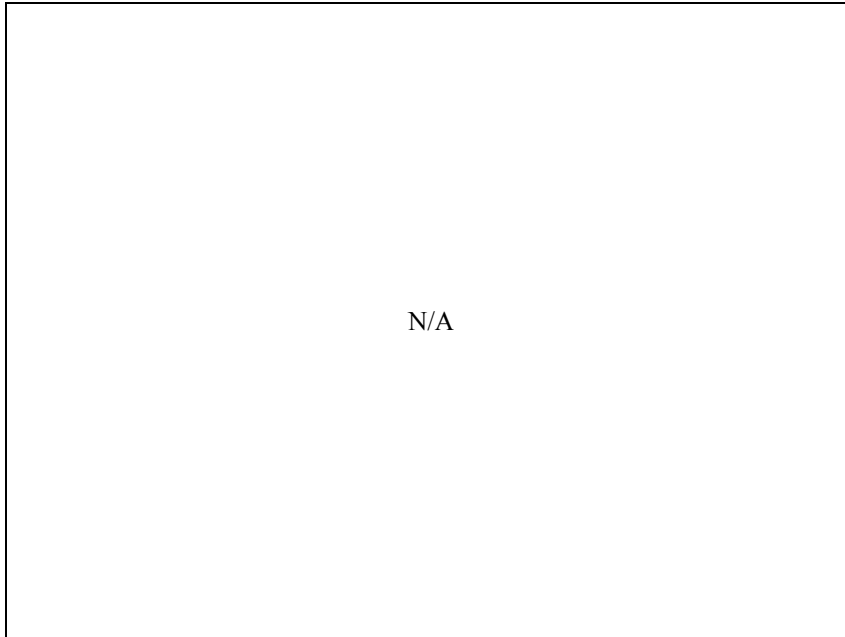
### Test results for conducted spurious emission

#### Low channel



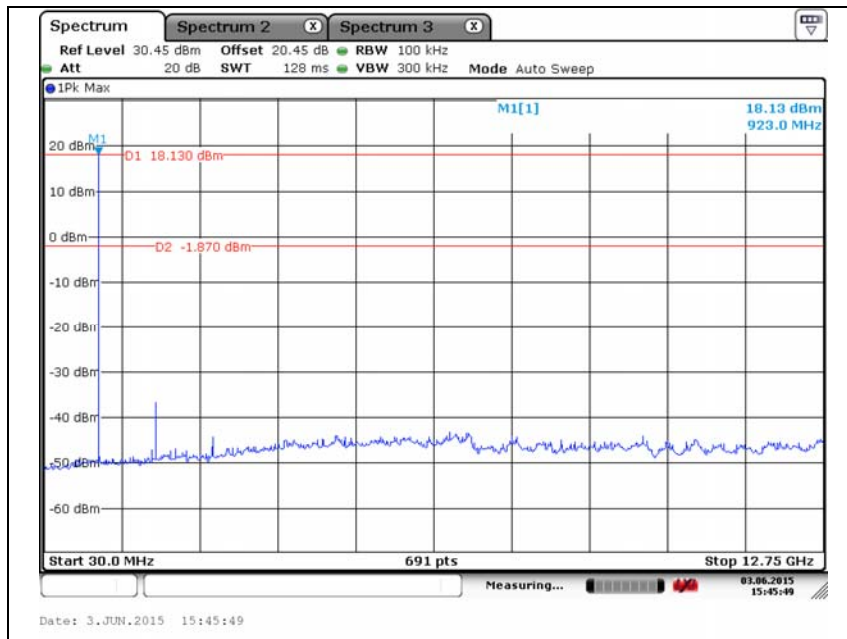
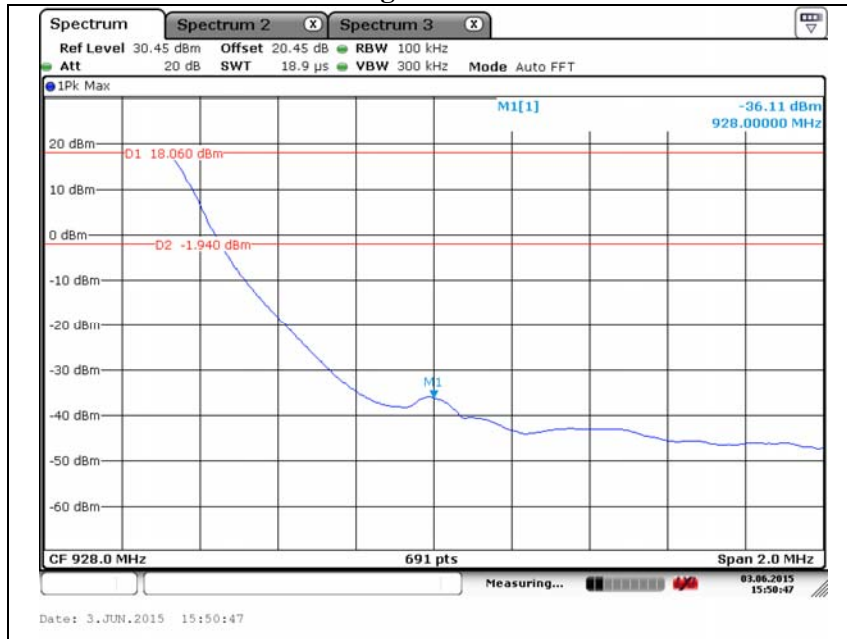
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**Middle channel**



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### High channel

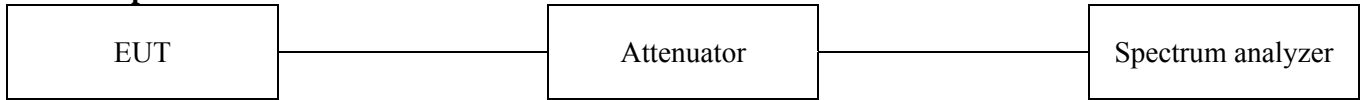


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### 3.3. 6 dB bandwidth

#### Test setup



#### Test procedure

KDB 558074\_v03r03 – section 8.1 option 1 or section 8.2 option 2.

#### Option 1:

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth(VBW)  $\geq 3 \times$  RBW.
- c) Detector = peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

#### Option 2:

The automatic bandwidth measurement capability of an instrument may be employed using the X bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW  $\geq 3 \times$  RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be  $\geq 6$  dB.

#### Limit

According to §15.247(a)(2), systems using digital modulation techniques may operate 902 ~ 928 MHz, 2 400 ~ 2 483.5 MHz, and 5 725 ~ 5 850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

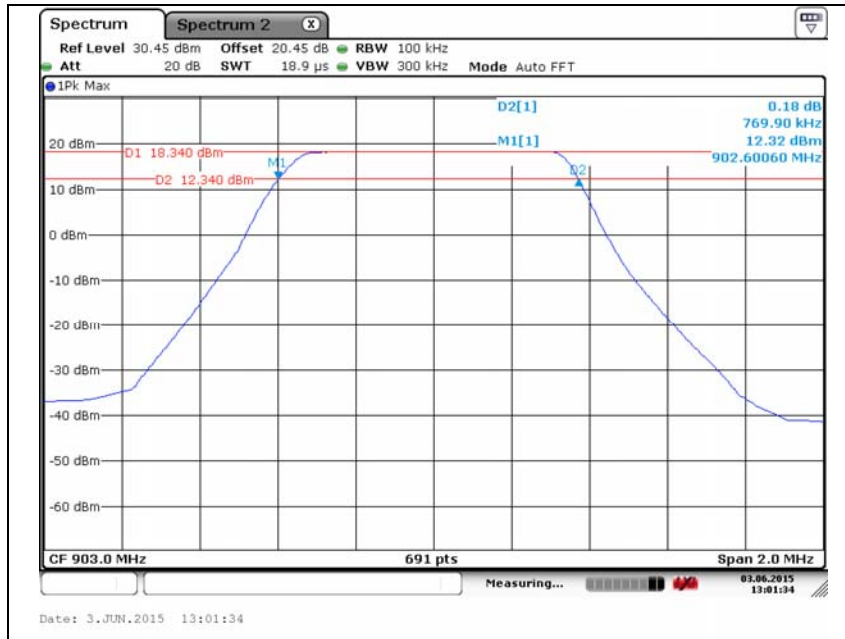


**Test results**

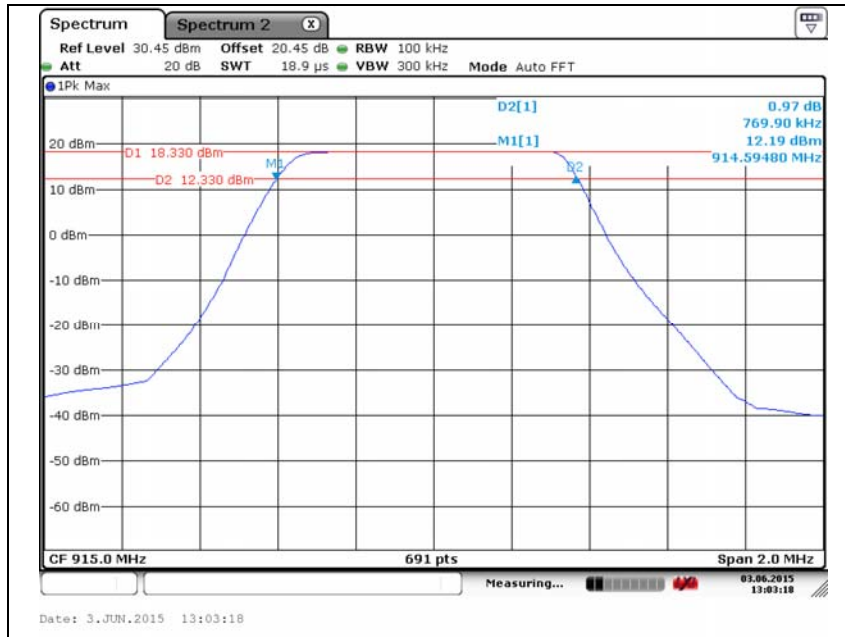
Operation mode	Frequency(MHz)	6 dB bandwidth(MHz)	Limit(MHz)
DSSS	903.0	0.769 9	0.50
	915.0	0.769 9	
	927.0	0.767 0	

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### Low channel

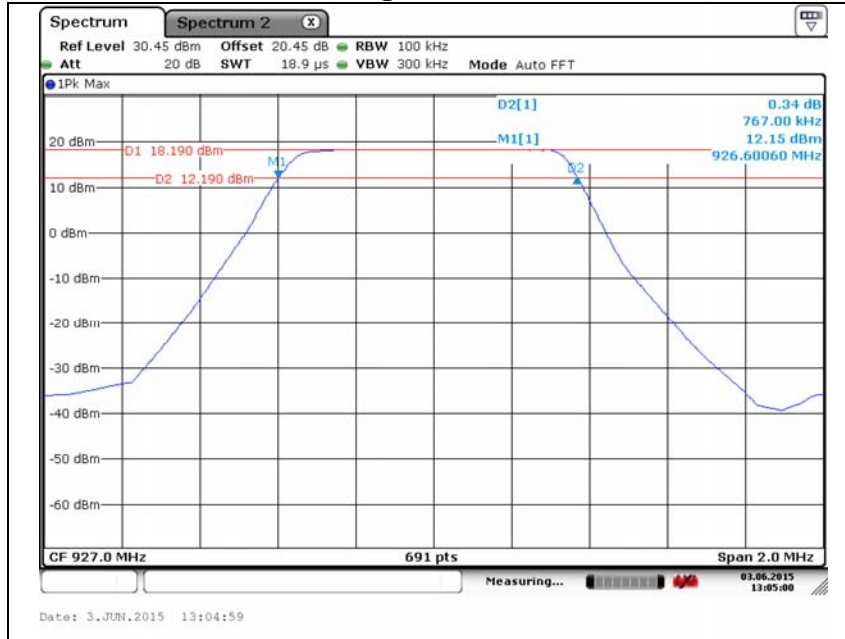


### Middle channel



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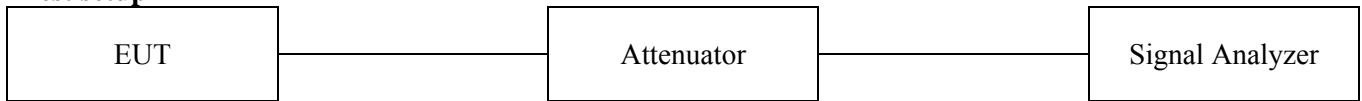
### High channel



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### 3.4. Peak Output power

#### Test setup



#### Test procedure

KDB 558074\_v03r03 – section 9.1.1

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the *DTS bandwidth*.

- a) Set the RBW  $\geq$  DTS bandwidth.
- b) Set VBW  $\geq$  3 x RBW.
- c) Set span  $\geq$  3 x RBW
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

#### Limit

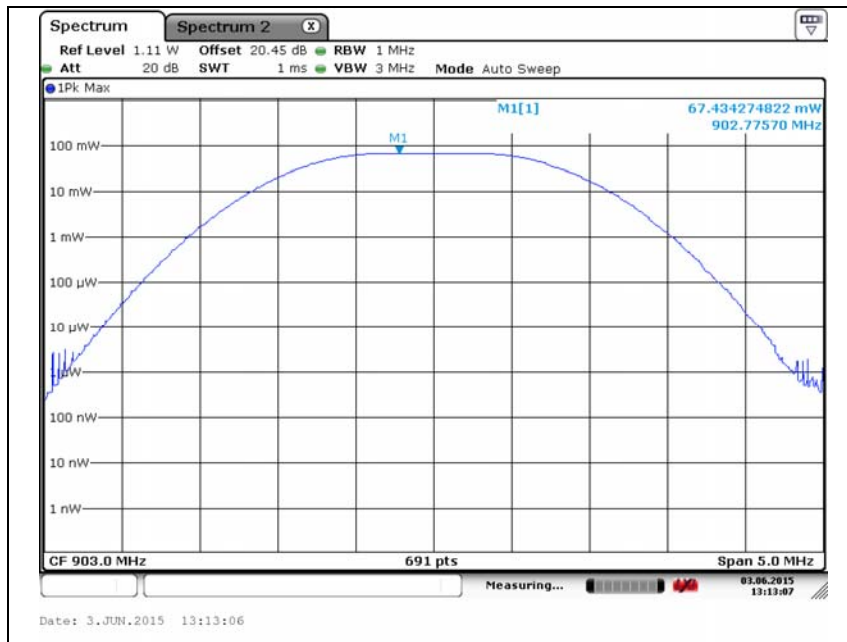
According to §15.247(b)(3), For systems using digital modulation in the 902~928 MHz, 2 400~2 483.5 MHz, and 5 725~5 850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted out-put power. Maximum Conducted Out-put 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 antennas and antenna elements. The average must not include any time 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 antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmit-ting antennas 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 paragraphs (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.

**Test results**

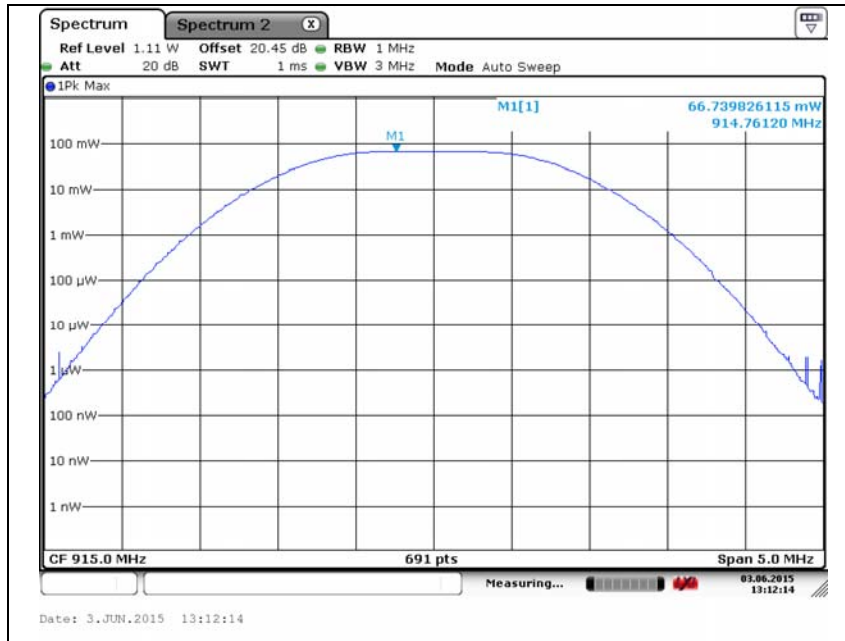
Test mode	Frequency(MHz)	Results (W)	Limit(W)
DSSS	903.0	0.067	1
	915.0	0.066	
	927.0	0.066	

**Low channel**

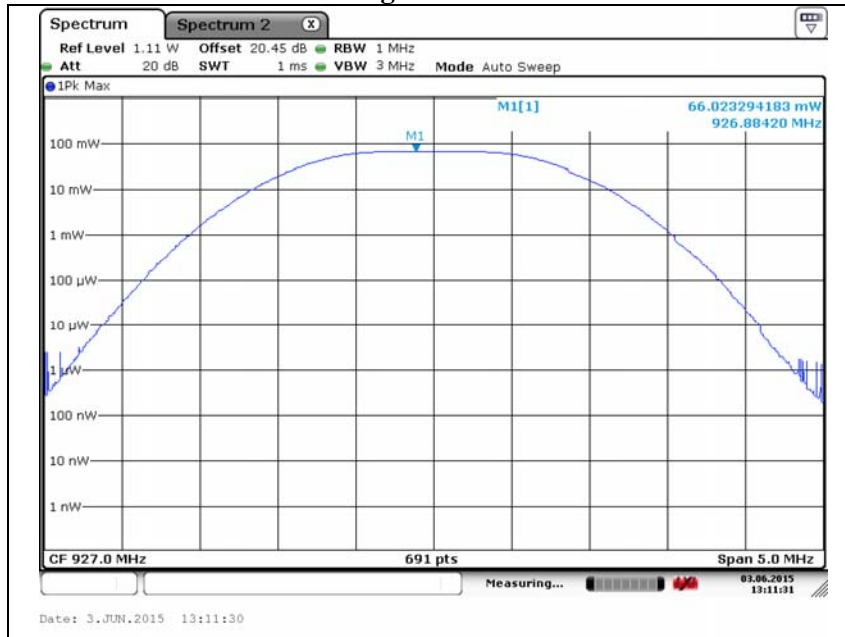


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### Middle channel



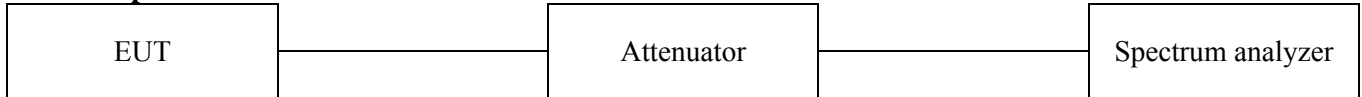
### High channel



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### 3.5. Power spectral density

#### Test setup



#### Test procedure

KDB 558074\_v03r03– section 10.3

##### Measurement procedure

- a) Set instrument center frequency to DTS channel center frequency.
- b) Set span to at least 1.5 times the OBW.
- c) Set RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- d) Set VBW  $\geq 3 \times \text{RBW}$ .
- e) Detector = power averaging (RMS) or sample detector (when RMS not available).
- f) Ensure that the number of measurement points in the sweep  $\geq 2 \times \text{span}/\text{RBW}$ .
- g) Sweep time = auto couple.
- h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
- i) Use the peak marker function to determine the maximum amplitude level.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

#### Limit

According to §15.247e, For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during 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.



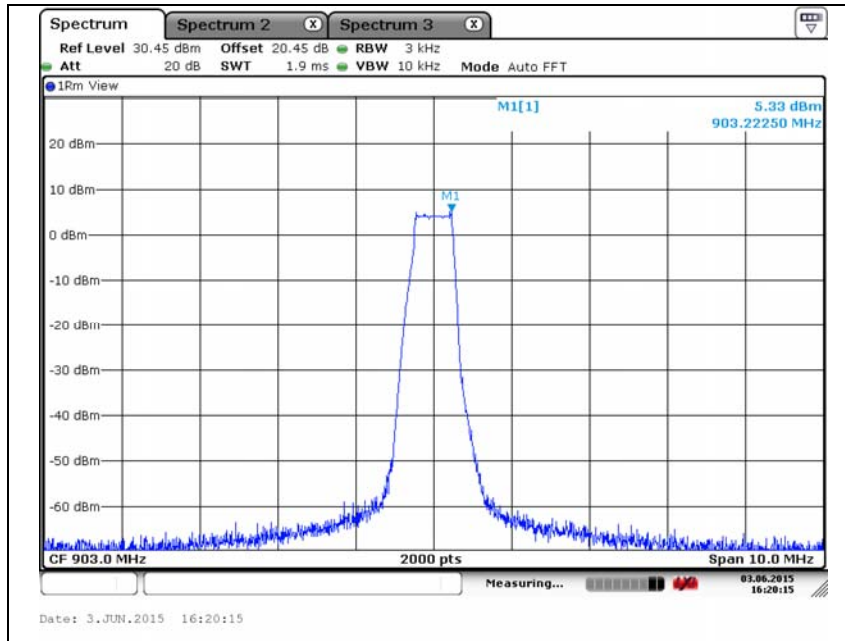


**Test results**

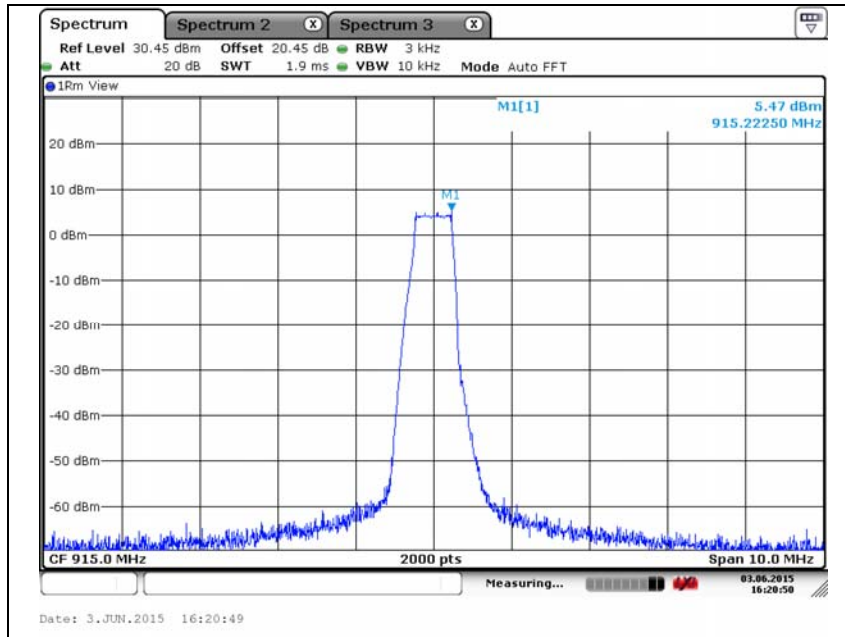
<b>Operation mode</b>	<b>Frequency(MHz)</b>	<b>Measured PSD(dBm)</b>	<b>Limit(dBm)</b>
DSSS	903.0	5.33	8
	915.0	5.47	
	927.0	5.38	

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The test results in the report only apply to the tested sample.

### Low channel

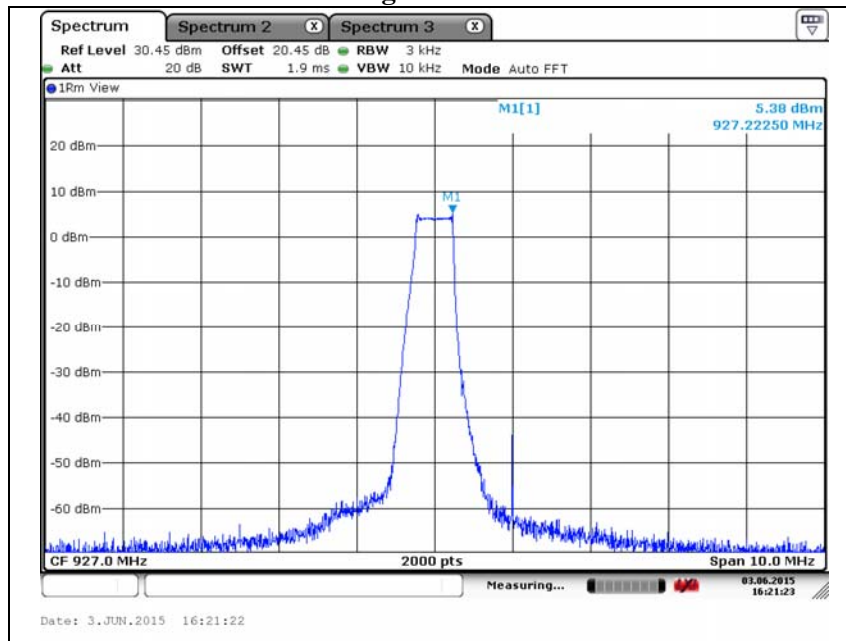


### Middle channel



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 The test results in the report only apply to the tested sample.

### High channel



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### Appendix A. Measurement equipment

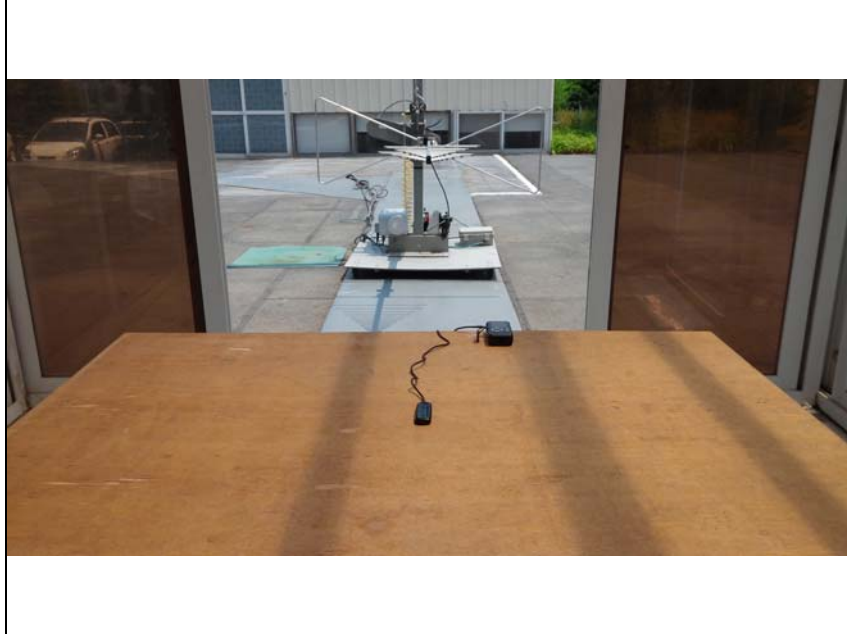
Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	100736	1 year	2015.05.06
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2016.01.23
Attenuator	HP	8494B	2630A12857	1 year	2016.01.22
Loop Antenna	R&S	HFH2-Z2.335.4711.52	826532	2 years	2017.03.03
Trilog-broadband antenna	Schwarzbeck	VULB 9163	9168-713	2 years	2017.05.15
Horn antenna	A.H.	SAS-571	414	2 years	2017.02.09
High pass filter	Weinschel	WHKX1.2/15G-6TT	1	1 year	2015.07.23
Preamplifier	HP	8449B	3008A00538	1 year	2015.07.23
EMI Test Receiver	R&S	ESR3	101781	1 year	2016.05.06
EMI Test Receiver	R&S	ESU26	100552	1 year	2016.05.06

### Peripheral devices

Device	Manufacturer	Model No.	Serial No.
JIG	SEGI ELECTRONICS CO., LTD.	OP500	2

## Appendix B. Test setup photo

**Radiated Emission (30MHz~1GHz)**



**Radiated Emission (Above 1GHz)**

