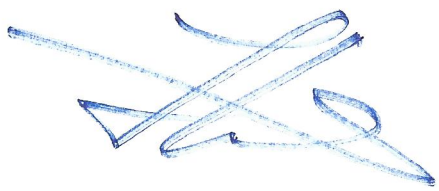
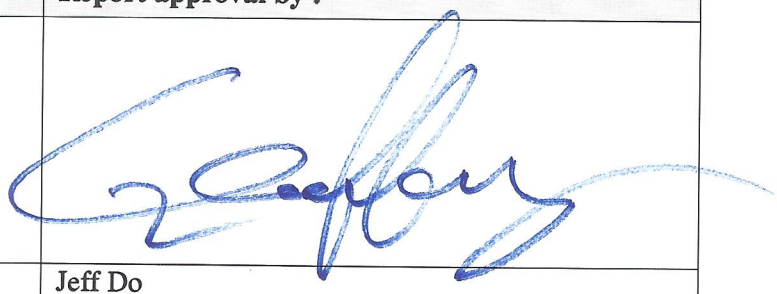
TEST REPORT

Part 15 Subpart C 15.247

Equipment under test	Wireless Transmitter
Model name	GPWM-900T
FCC ID	ZGPGPWM-900T
Derivative model	GPWM-900A2DA, GPWM-900A2GN
Applicant	GPI KOREA, Inc
Manufacturer	GPI KOREA, Inc
Date of test(s)	2014.11.26 ~ 2014.12.05
Date of issue	2014.12.05

Issued to
GPI KOREA, Inc
Daebang Triplaon B-dong 201, 158 Haneulmaeul-ro, Ilsandong-gu,
Goyang-si, Gyeonggi-do, KOREA

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

Test and report completed by :	**Report approval by :**
	
Hyeon-Su Jang Test engineer	Jeff Do Technical manager

Revision history

Revision	Date of issue	Test report No.	Description
-	2014.12.05	KES-RF-14T0054	Initial

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1. General information

Applicant:	GPI KOREA, Inc
Applicant address:	Daebang Triplaon B-dong 201, 158 Haneulmaeul-ro, Ilsandong-gu, Goyang-si, Gyeonggi-do, KOREA
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, Yeoju-si, Gyeonggi-do, Korea
FCC rule part(s):	15.247
Model:	GPWM-900T
Derivative model:	GPWM-900A2DA, GPWM-900A2GN
FCC ID:	ZGPGPWM-900T
Test device serial No.:	☐ Production ☒ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	Wireless Transmitter
Frequency range	902.5 ㎒ ~ 927.0 ㎒
Modulation technique	FHSS
Number of channels	50
Antenna specification	Antenna type : Chip Antenna // Peak gain: 1.7 ㏈i
Power source	DC 3.7 V Battery

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

15.247(g): 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): The system does not coordinate it channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

Pseudorandom frequency hopping sequence
The channel is represented by a pseudo-random hopping sequence hopping through the 50 RF channels.

Equal hopping frequency use
All channels are used equally on average.

Example of a 50 hopping sequence in data mode:
48, 22, 17, 34, 11, 09, 40, 05, 32, 06, 03, 49, 33, 38, 26, 01, 07, 42, 36, 21, 25, 45, 29, 23, 18, 43, 37, 14, 41, 15, 10, 35, 02, 46, 27, 39, 13, 08, 04, 28, 47, 12, 16, 31, 50, 20, 24, 19, 44, 30

System receiver input bandwidth
Each channel bandwidth is 0.5 ㎒

1.2. Frequency/channel operations

Ch.	Frequency (㎒)
01	902.50
. .	. .
26	915.00
. .	. .
50	927.00

1.3. Information about derivative model

Derivative model is same as basic model for the purchaser treatment.

2. Summary of tests

Reference	Test description	Test results
15.247(a)(1)(i)	20 dB bandwidth	Pass
15.247(b)(2)	Output power	Pass
15.247(a)(1)	Channel separation	Pass
15.247(b)(2)	Number of channels	Pass
15.247(a)(1)(i)	Time of occupancy	Pass
15.205, 15.209	Radiated restricted band and emission	Pass
15.207(d)	Conducted band edge and out of band emissions	Pass

Note:

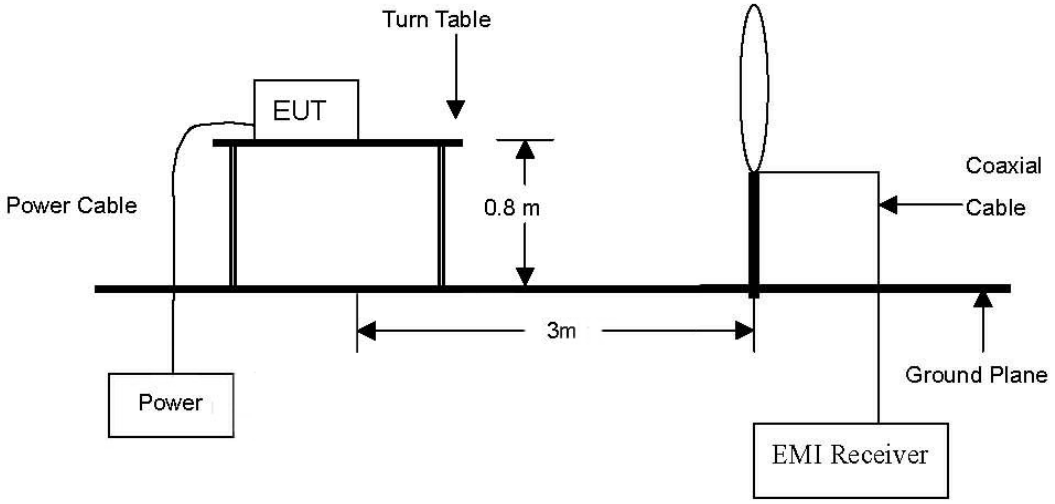
1. The EUT was tested per the guidance of DA 00-705, ANSI C63.10-2009 was used to reference the appropriate EUT setup for radiated spurious emissions testing.

3. Test results

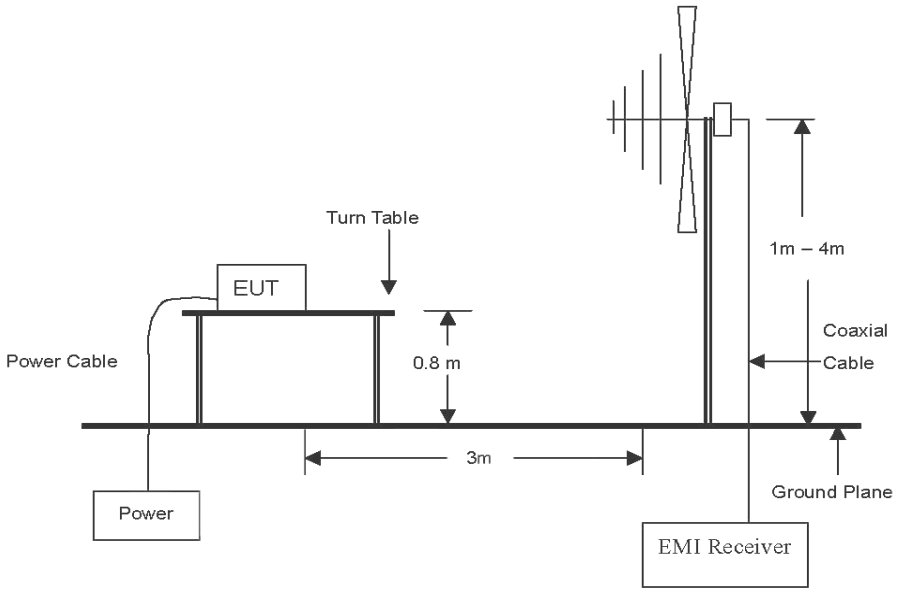
3.1. Radiated restricted band and emissions

Test setup

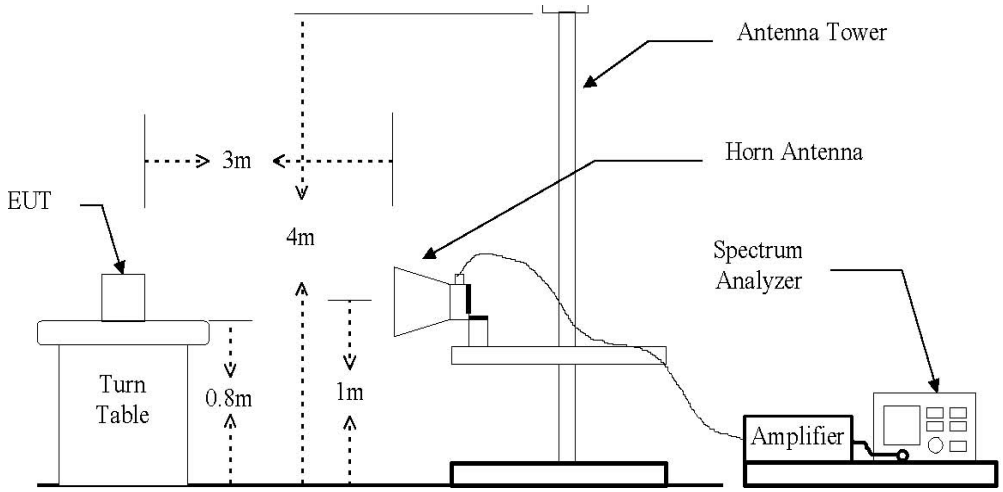
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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



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



Test procedure

1. The EUT is placed on a turntable, which is 0.8 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. Average measurements > 1 ㎓ using RBW = 1 ㎒ and VBW = 3 ㎑. Peak measurements > 1 ㎓ using RBW = 1 ㎒ and VBW = 3 ㎒. Both average and peak measurements were made using a peak detector.

Note:

1. The spectrum is measured from 9 ㎑ to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1 ㎓. Above 1 ㎓, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20 ㏈ of the respective limits were not reported.
2. When Average result is different from peak result over 20 ㏈ (over-averaging), according to 15.35 (c), as a “duty cycle correction factor”, pulse averaging with 20 log(duty cycle) has to be used.
3. Emissions below 18 ㎓ were measured at a 3 meter test distance while emissions above 18 ㎓ were measured at a 1 meter test distance with the application of a distance correction factor.
4. Average test would be performed if the peak result were greater than the average limit.
5. “*” means restricted band edge.
5. Field strength(㏈㎶/m) = Level(㏈㎶) + Correction factors(㏈/m) + Cable loss(㏈) + F_d(㏈)
6. Correction factors(㏈/m) = Antenna factor(㏈/m) + Cable loss(㏈) + or Amp. gain(㏈)
7. Margin(㏈) = Limit(㏈㎶/m) - Field strength(㏈㎶/m)
8. $F_d = 40\log(D_m / D_s)$

   Where:

   F_d = Distance factor in ㏈
   D_m = Measurement distance in meters
   D_s = Specification distance in meters

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 (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2 400 / F(㎑)
0.490 ~ 1.705	30	24 000 / F(㎑)
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 ㎒, 76 ~ 88 ㎒, 174 ~ 216 ㎒ or 470 ~ 806 ㎒. 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 ㎒)

Channel: 26

Operating frequency: 915.0 ㎒ (Worst case)

Distance of measurement: 3 meter

Frequency (㎒)	Level (dB㎶)	Ant. Pol.	Correction factors (dB/m)	F_d (dB)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
No emission has been detected							

Test results (Below 1 000 ㎒)

Channel: 26

Operating frequency: 915.0 ㎒ (Worst case)

Distance of measurement: 3 meter

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

Test results (Above 1 000 ㎒)

Channel: 01

Operating frequency: 902.5 ㎒

Distance of measurement: 3 meter

Frequency (㎒)	Level (dB㎶)	Detector	Ant. Pol.	Correction factors (dB/m)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1805.00	58.70	PK	H	-2.53	56.17	74.00	17.83
1805.00	47.89	AV	H	-2.53	45.36	54.00	8.64
1805.00	55.31	PK	V	-2.53	52.78	74.00	21.22
1805.00	40.13	AV	V	-2.53	37.60	54.00	16.40
2707.50	57.06	PK	H	0.86	57.92	74.00	16.08
2707.50	40.65	AV	H	0.86	41.51	54.00	12.49
2707.50	57.26	PK	V	0.86	58.12	74.00	15.88
2707.50	38.52	AV	V	0.86	39.38	54.00	14.62
3610.00	46.41	PK	H	3.08	49.49	74.00	24.51
3610.00	49.15	PK	V	3.08	52.23	74.00	21.77
4512.50	42.98	PK	H	8.34	51.32	74.00	22.68
4512.50	45.35	PK	V	8.34	53.69	74.00	20.31
5415.00	38.95	PK	H	12.61	51.56	74.00	22.44
5415.00	45.56	PK	V	12.61	58.17	74.00	15.83
5415.00	30.25	AV	V	12.61	42.86	54.00	11.14

Channel: 26

Operating frequency: 915.00 ㎒

Distance of measurement: 3 meter

Frequency (㎒)	Level (dB㎶)	Detector	Ant. Pol.	Correction factors (dB/m)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1830.00	61.69	PK	H	-2.53	59.16	74.00	14.84
1830.00	45.51	AV	H	-2.53	42.98	54.00	11.02
1830.00	57.92	PK	V	-2.53	55.39	74.00	18.61
1830.00	44.96	AV	V	-2.53	42.43	54.00	11.57
2745.00	54.88	PK	H	0.86	55.74	74.00	18.26
2745.00	39.80	AV	H	0.86	40.66	54.00	13.34
2745.00	55.39	PK	V	0.86	56.25	74.00	17.75
2745.00	34.37	AV	V	0.86	35.23	54.00	18.77
3660.00	44.30	PK	H	3.08	47.38	74.00	26.62
3660.00	46.22	PK	V	3.08	49.30	74.00	24.70
4575.00	44.14	PK	H	8.34	52.48	74.00	21.52
4575.00	45.23	PK	V	8.34	53.57	74.00	20.43
5490.00	36.37	PK	H	12.61	48.98	74.00	25.02
5490.00	44.94	PK	V	12.61	57.55	74.00	16.45
5490.00	33.84	AV	V	12.61	46.45	54.00	7.55

Channel: 50

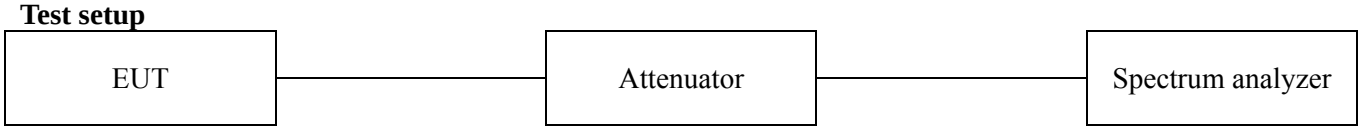
Operating frequency: 927.0 ㎒

Distance of measurement: 3 meter

Frequency (㎒)	Level (dB㎶)	Detector	Ant. Pol.	Correction factors (dB/m)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1854.00	61.00	PK	H	-2.23	58.77	74.00	15.23
1854.00	44.02	AV	H	-2.23	41.79	54.00	12.21
1854.00	56.72	PK	V	-2.23	54.49	74.00	19.51
1854.00	42.26	AV	V	-2.23	40.03	54.00	13.97
2781.00	56.02	PK	H	1.03	57.05	74.00	16.95
2781.00	42.04	AV	H	1.03	43.07	54.00	10.93
2781.00	51.81	PK	V	1.03	52.84	74.00	21.16
2781.00	36.98	AV	V	1.03	38.01	54.00	15.99
3708.00	44.78	PK	H	3.56	48.34	74.00	25.66
3708.00	44.88	PK	V	3.56	48.44	74.00	25.56
4635.00	43.02	PK	H	9.00	52.02	74.00	21.98
4635.00	45.86	PK	V	9.00	54.86	74.00	19.14
4635.00	33.31	AV	V	9.00	42.31	54.00	11.69
5562.00	37.25	PK	H	13.11	50.36	74.00	23.64
5562.00	43.42	PK	V	13.11	56.53	74.00	17.47
5562.00	30.38	AV	V	13.11	43.49	54.00	10.51

3.2. Conducted band edge and out of band emissions

Test setup



Test procedure

DA 00-705

Test setting

1. Span = wide enough to capture the peak level of the in-band emission and all spurious emissions(e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
2. RBW = 100 ㎑
3. VBW ≥ 300 ㎑
4. Detector = Peak
5. Number of sweep points ≥ 2 × Span/RBW
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

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))

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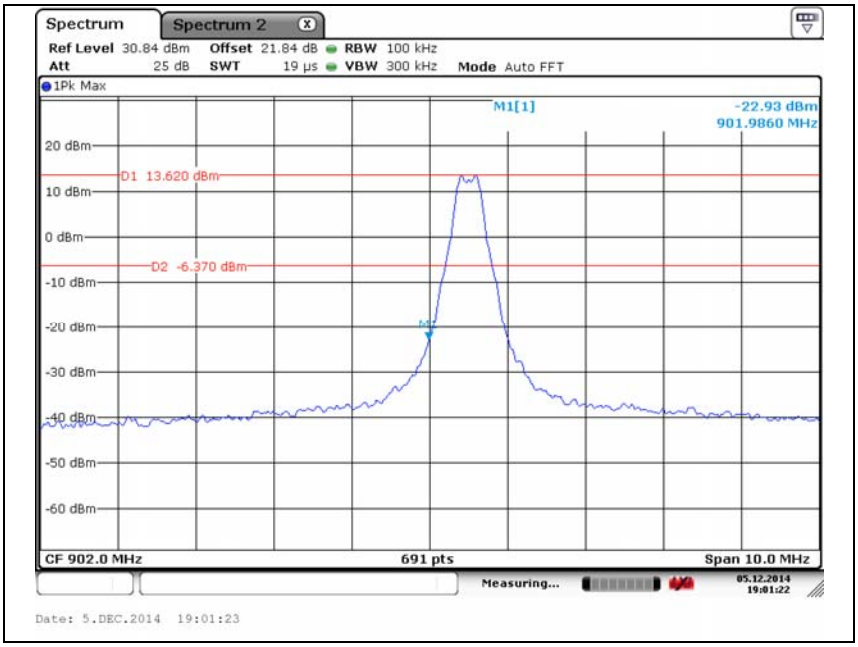

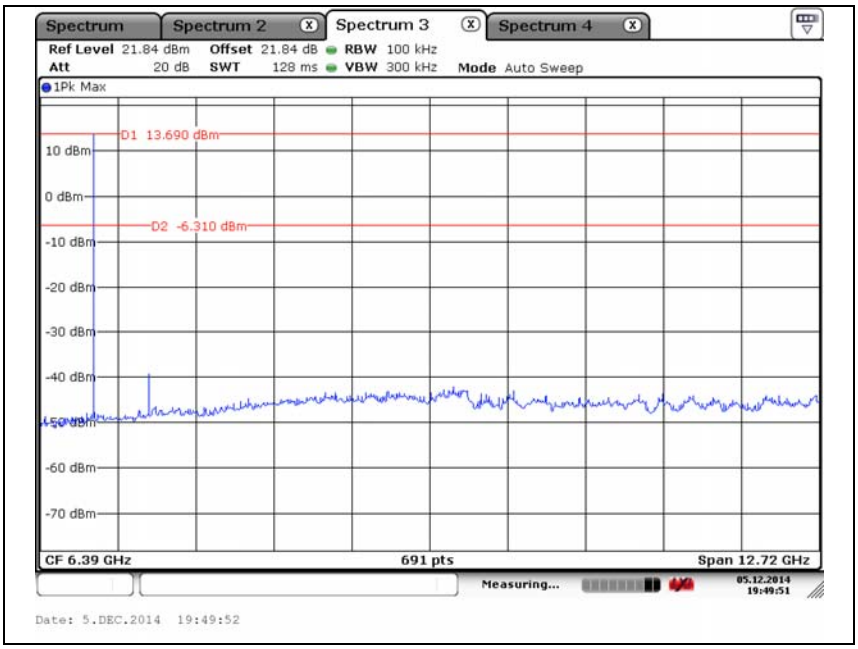

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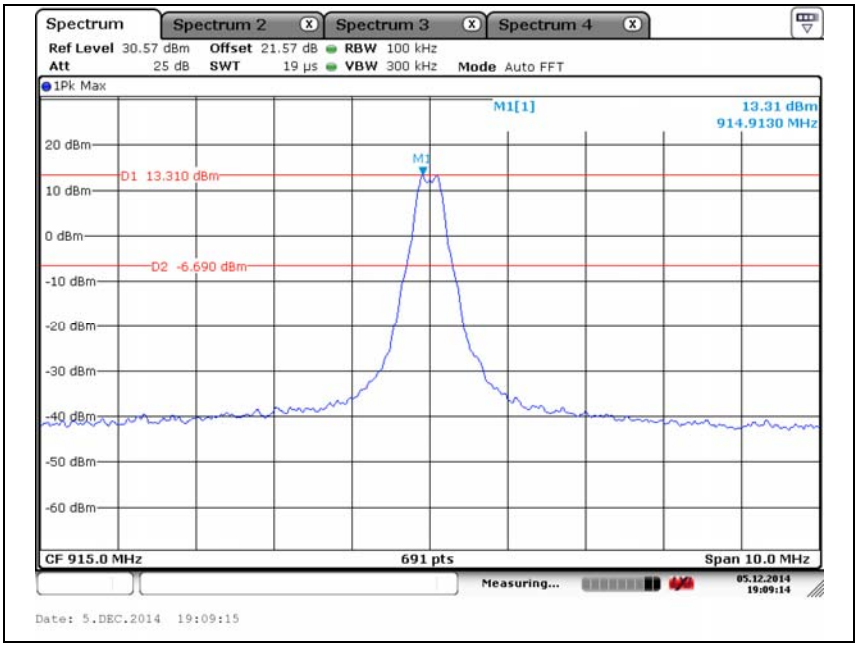

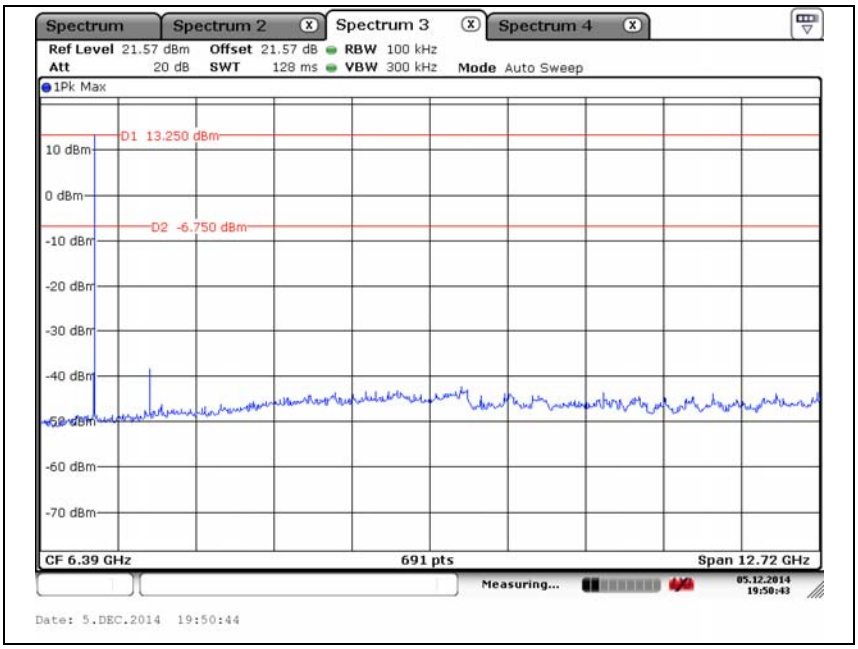

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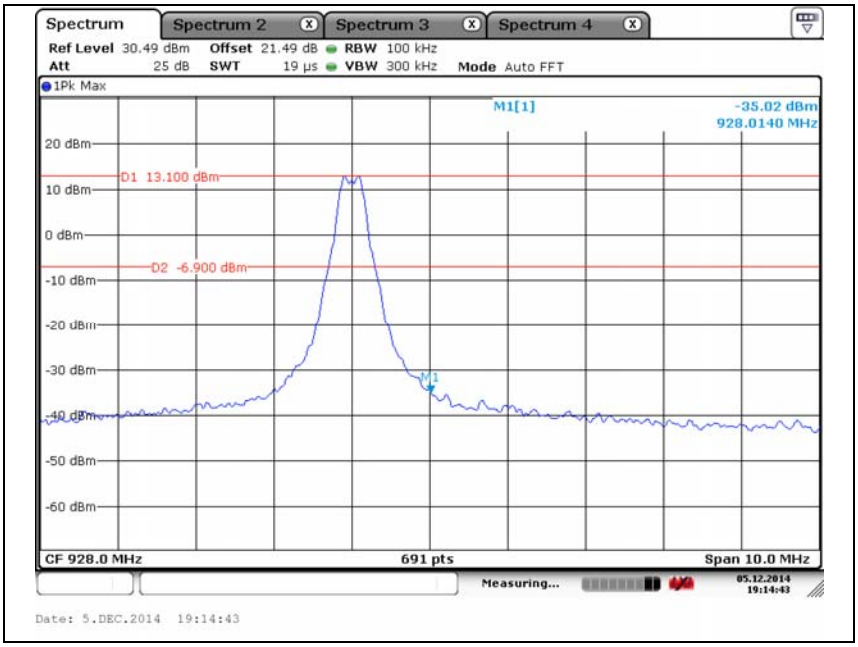
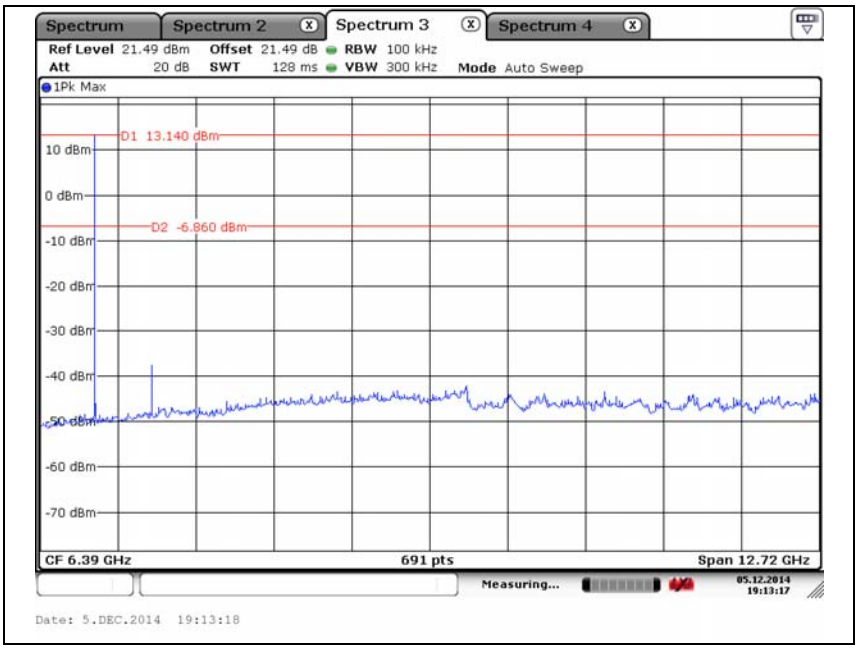
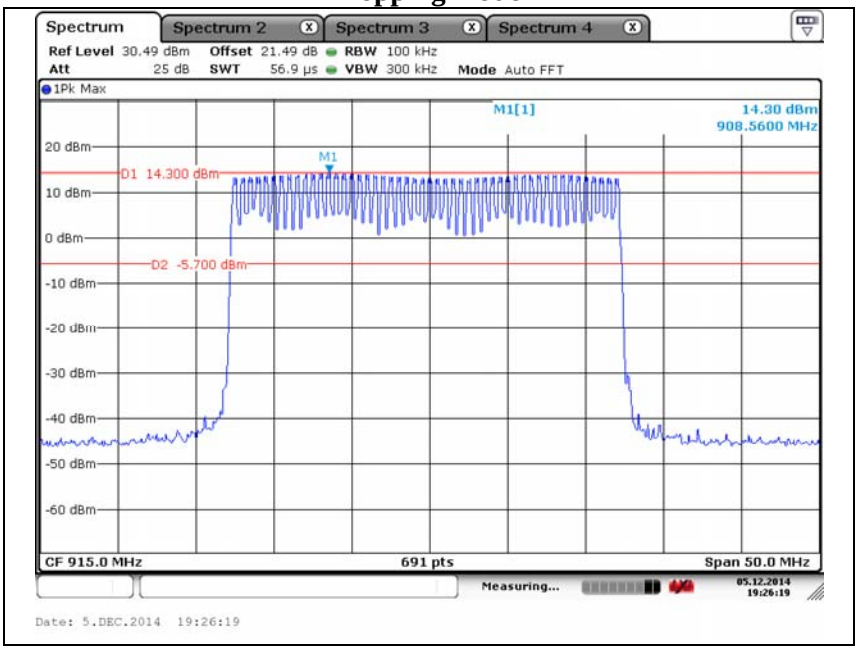
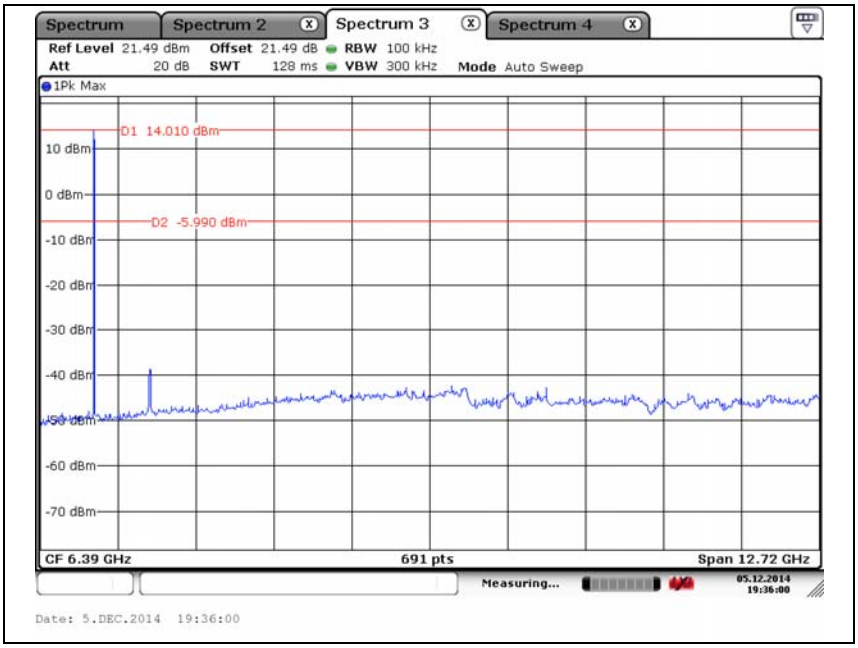


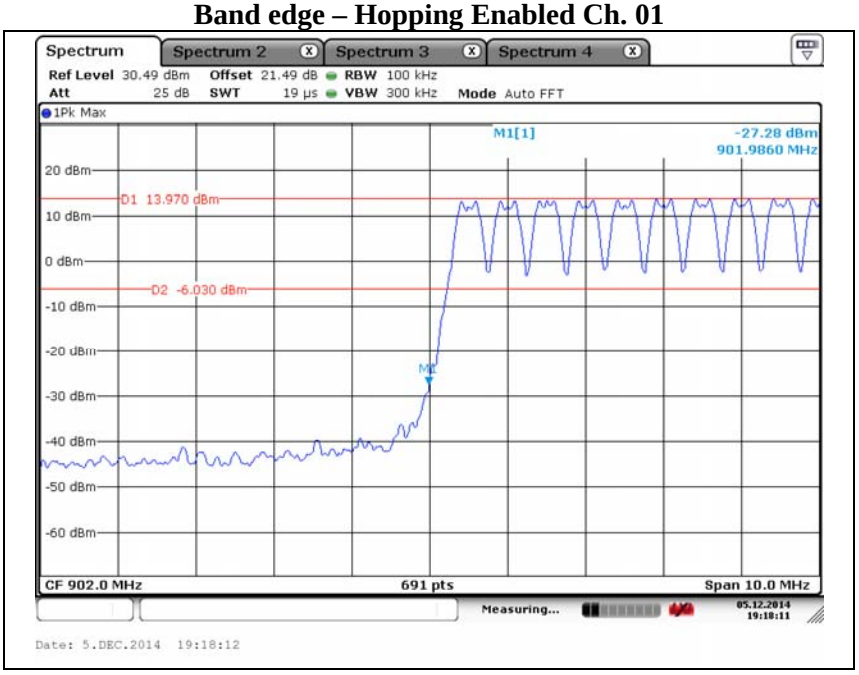


Hopping mode

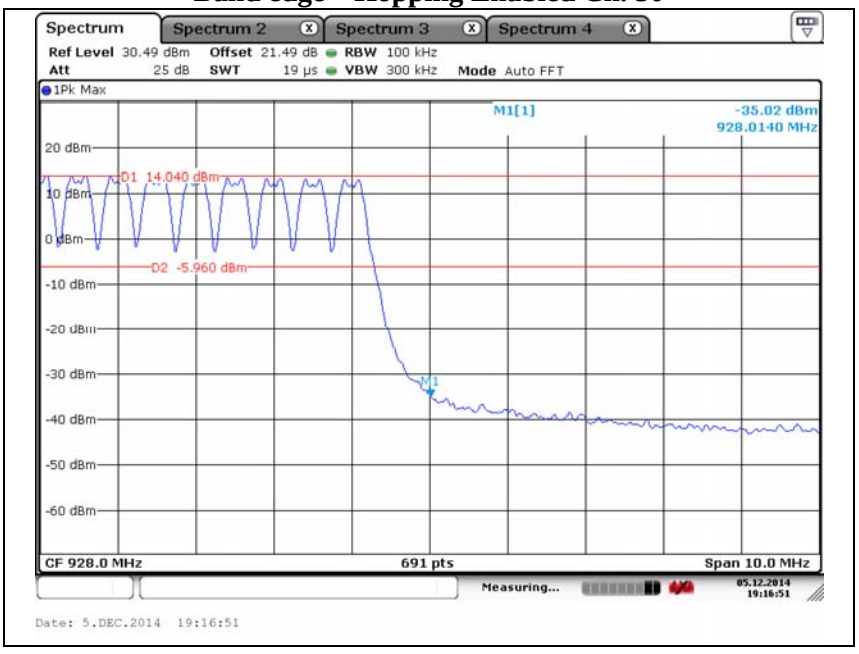




Band edge – Hopping Enabled Ch. 01

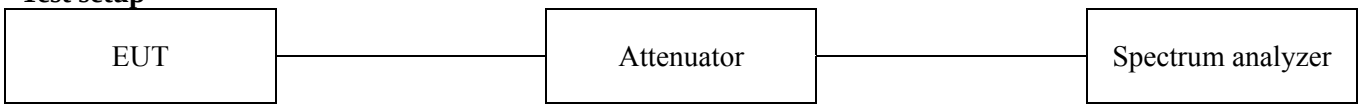


Band edge – Hopping Enabled Ch. 50



3.3. 20 dB bandwidth

Test setup



Test procedure
DA 00-075

Test setting
1. Span = 1 ㎒ (Approximately 2 to 3 times the 20 ㏈ bandwidth, centered on a hopping channel)
2. RBW ≥ 10 ㎑ (≥ 1% of the span)
3. VBW ≥ 10 ㎑ (≥ RBW)
4. Sweep = auto
5. Detector function = peak
6. Sweep = auto couple
7. Trace mode = max hold
8. The EUT should be transmitting at its maximum data rate. Allow the trance to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 ㏈ down on side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level.

Limit
Not applicable

Frequency(㎒)	Channel no.	20 ㏈ bandwidth(㎑)
902.5	01	379.2
915.0	26	379.2
927.0	50	379.2

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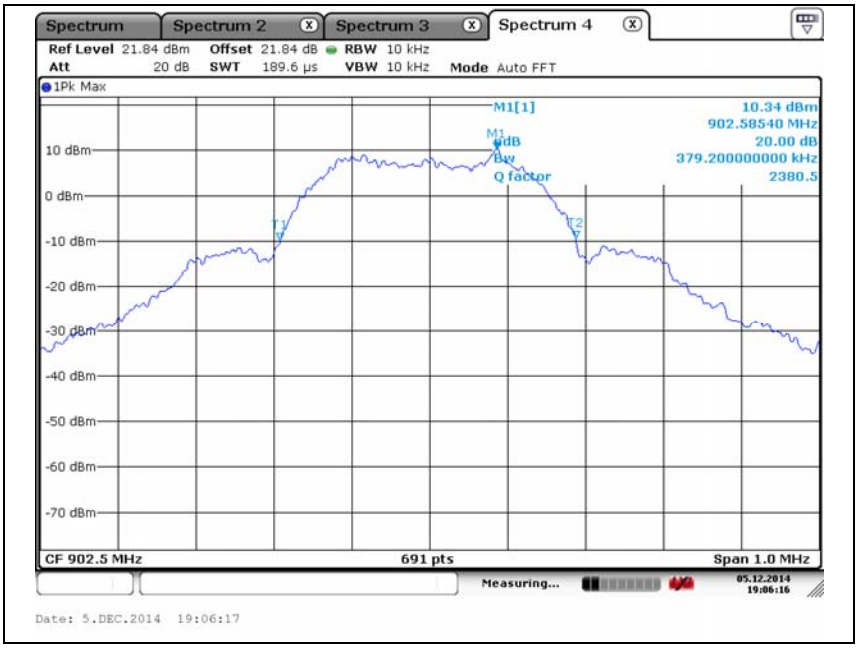

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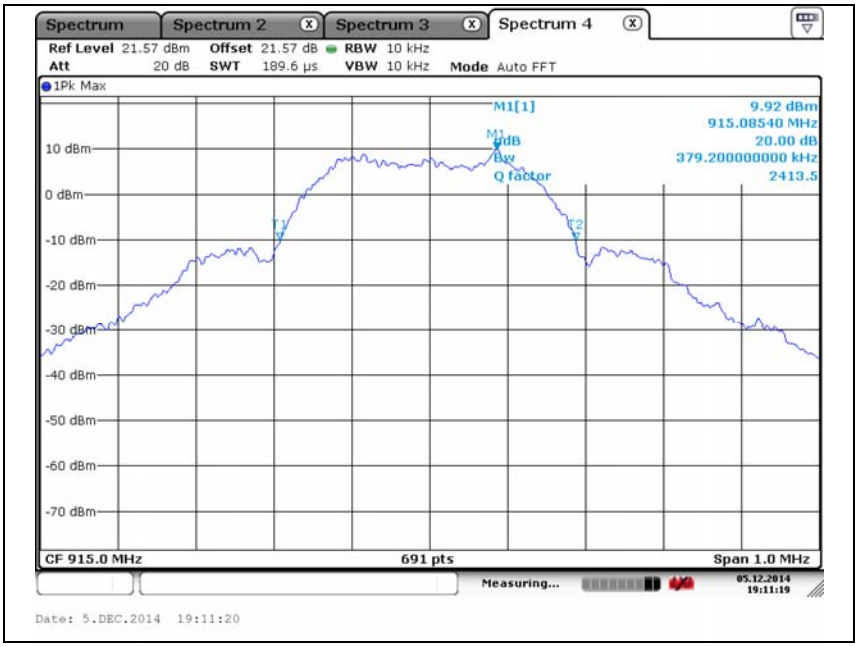

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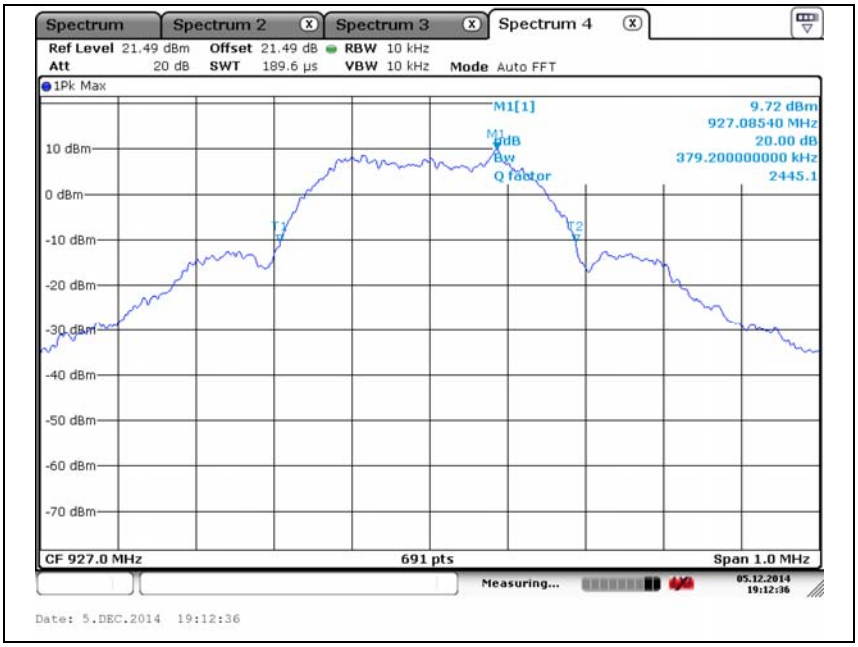
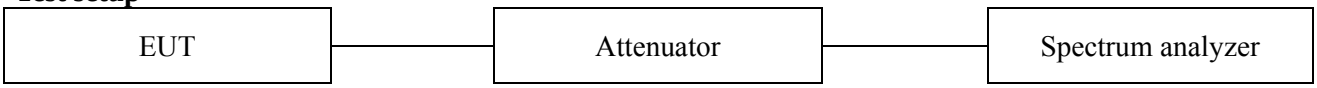


3.4. Output power

Test setup



Test procedure

DA 00-075

Test setting

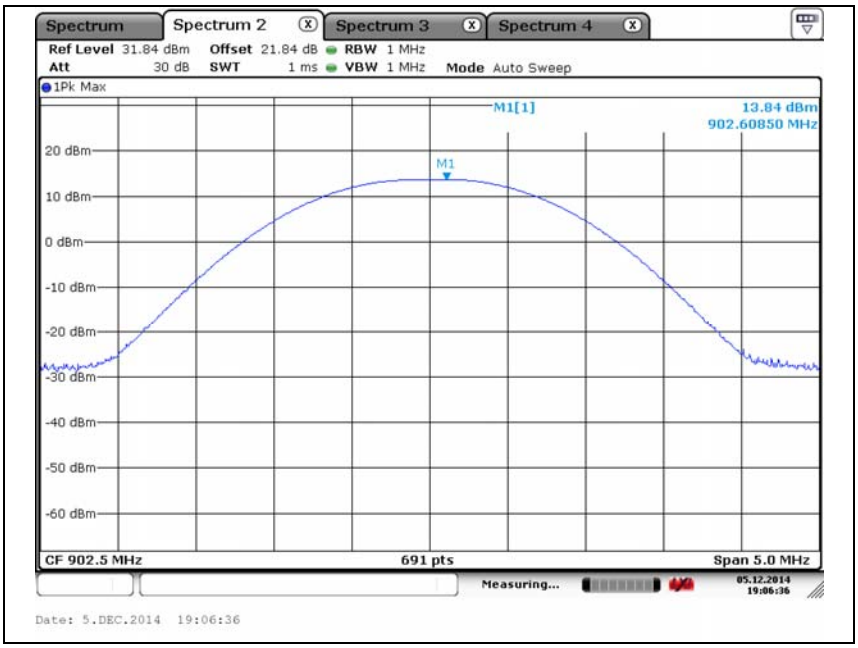
1. Span = 5 ㎒ (Approximately 5 times the 20 ㏈ bandwidth, centered on a hopping channel)
2. RBW = 1 ㎒ (the 20 ㏈ bandwidth of the emission being measured)
3. VBW = 1 ㎒ (≥ RBW)
4. Sweep = Auto
5. Detector function = Peak
6. Trace = Max hold

Limit

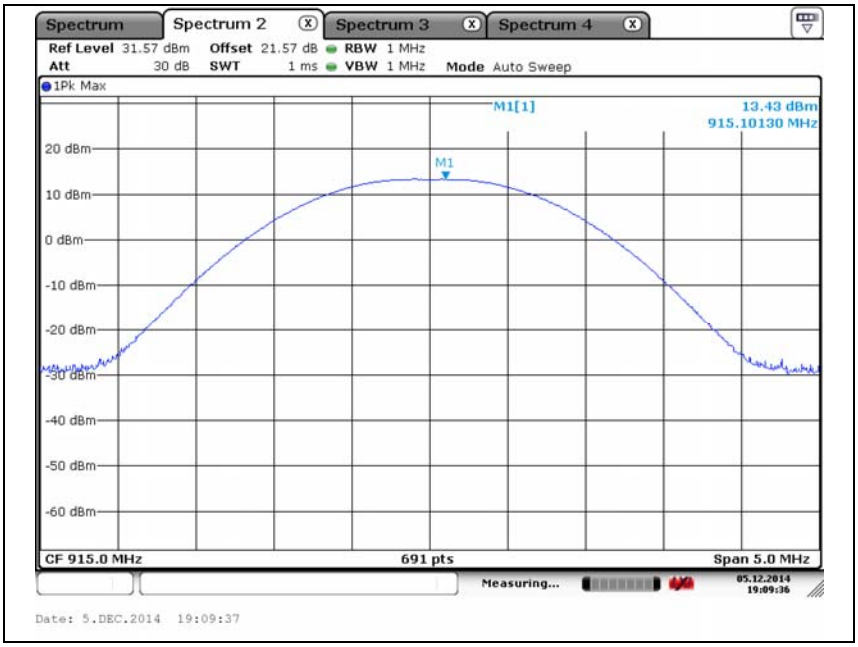
For frequency hopping systems operating in the 902 ~ 928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

Frequency(㎒)	Channel no.	Measured power(dBm)
902.5	01	13.84
915.0	26	13.43
927.0	50	13.29

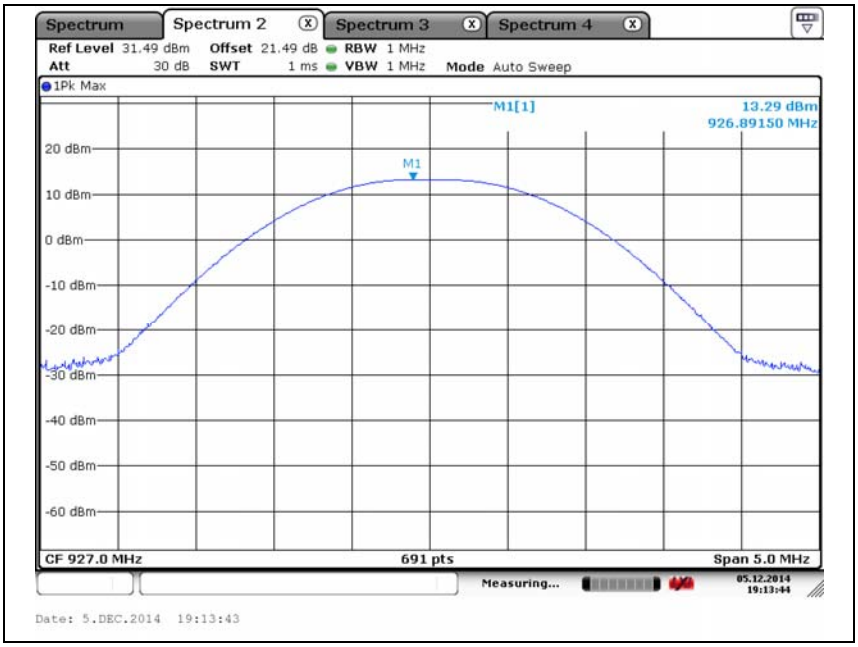
Ch. 01



Ch. 26

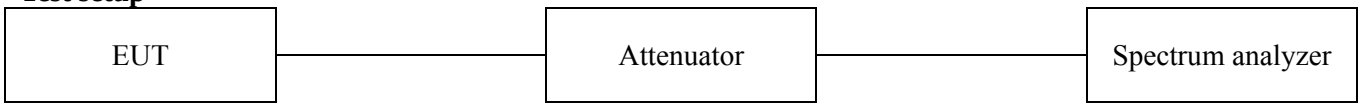


Ch. 50



3.5. Carrier frequency separation

Test setup



Test procedure

DA 00-075

Test Setting

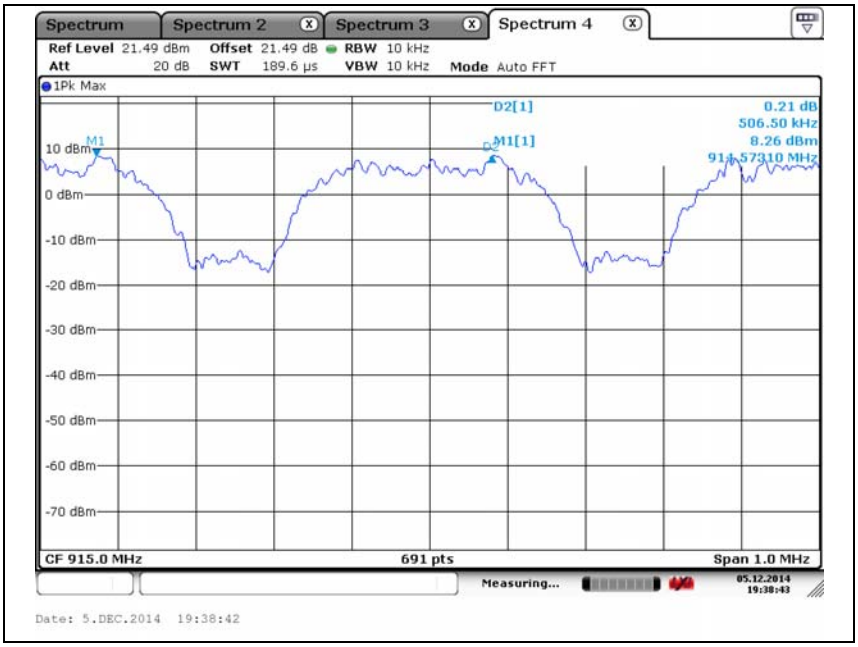
1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
2. Span = 1 ㎒ (wide enough to capture the peaks of two adjacent channels)
3. RBW = 10 ㎑ (≥ 1% of the span)
4. VBW = 10 ㎑ (≥ RBW)
5. Sweep = auto
6. Detector function = peak
7. Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Limit

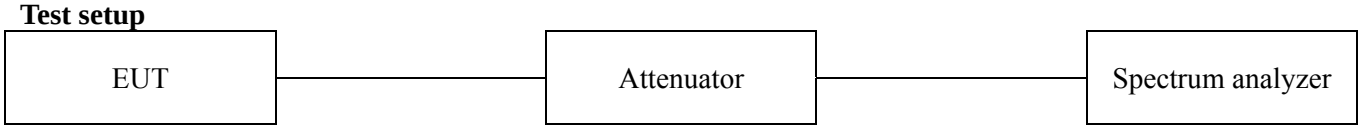
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater.

Operation mode	Channel separation(㎑)	Minimum bandwidth (㎑)
Hopping mode	506.5	379.2



3.6. Number of hopping frequency

Test setup

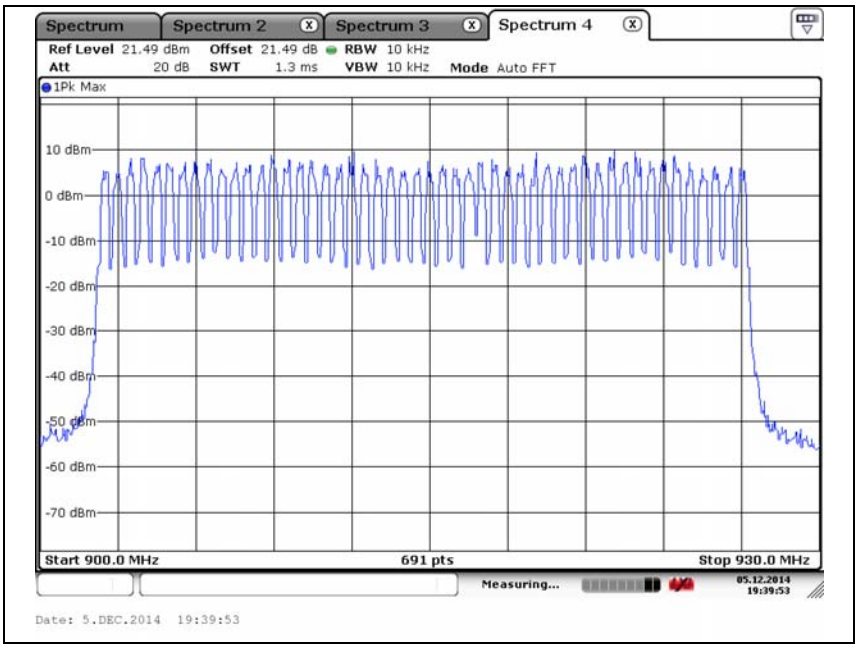


Test procedure
DA 00-075

Test setting
1. The EUT must have its hopping function enabled.
2. Frequency range: 902.5 ㎒ ~ 927 ㎒
3. Span = the frequency band of operation
4. RBW = 10 ㎑ (≥ 1% of the span)
5. VBW = 10 ㎑ (≥ RBW)
6. Sweep = auto
7. Detector function = peak
8. Trace = max hold

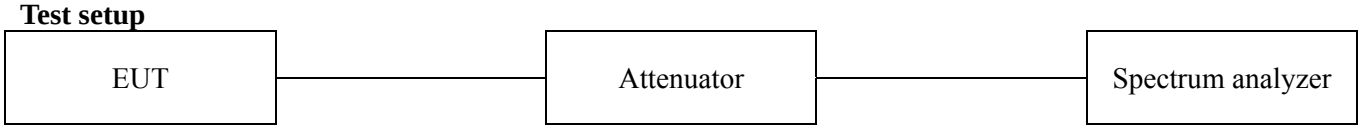
All the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Limit
For frequency hopping systems operating in the 902 ~ 928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.



3.7. Time of occupancy

Test setup



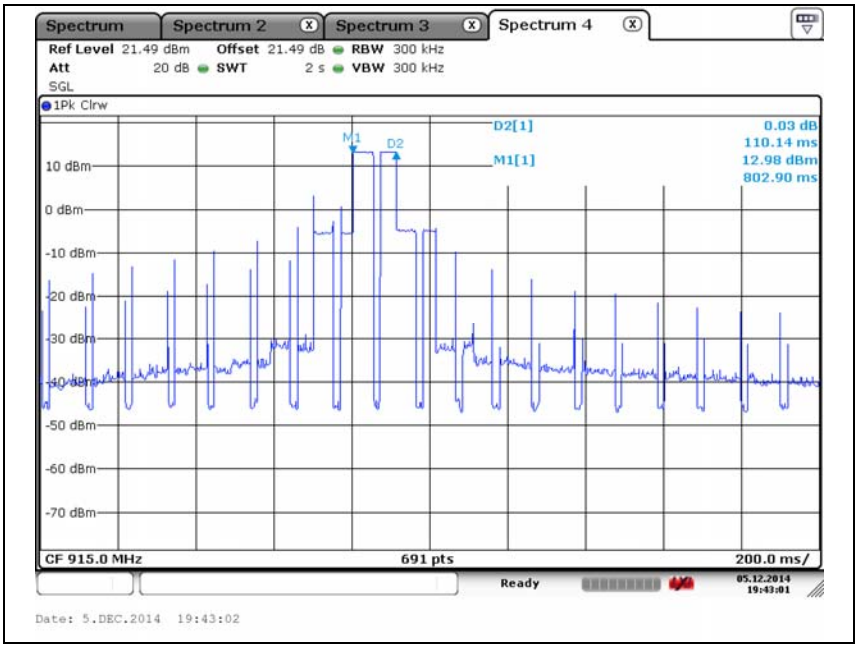
Test procedure
DA 00-075

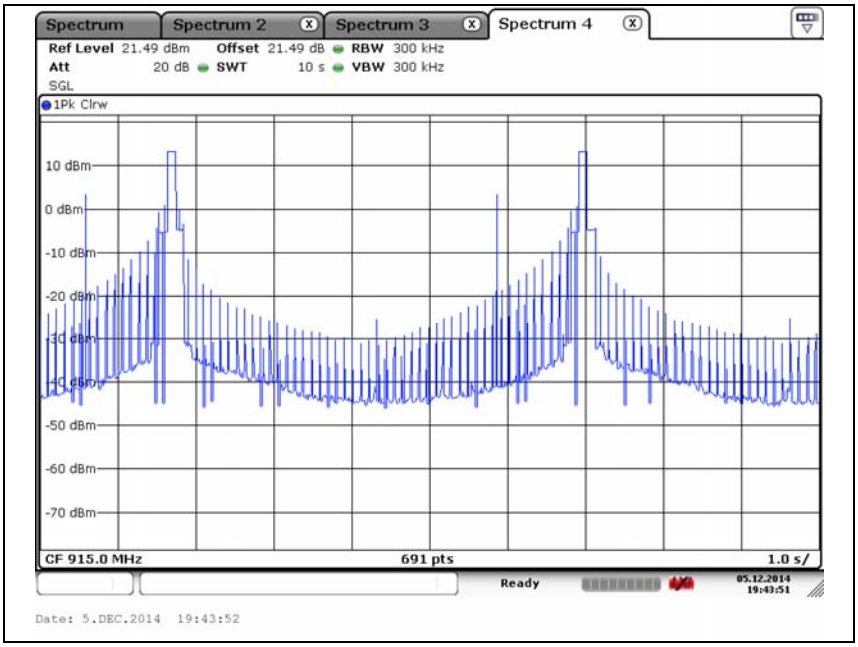
Test setting
1. The EUT must have its hopping function enabled.
2. Span = zero span, centered on a hopping channel
4. RBW = 300 ㎑
5. VBW = 300 ㎑ (≥ RBW)
6. Sweep = as necessary to capture the entire dwell time per hopping channel
7. Detector function = peak
8. Trace = max hold

Limit
For frequency hopping systems operating in the 902 ~ 928 ㎒ band: if the 20 ㏈ bandwidth of the hopping channel is less than 250 ㎑, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 ㏈ bandwidth of the hopping channel is 250 ㎑ or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 ㏈ bandwidth of the hopping channel is 500 ㎑.

Frequency (㎒)	Dwell time (ms)	Transmission occurred	Result (㎳)	Limit (㎳)
915	110.14	2	220.28	400

Dwell time





Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV30	101389	1 year	2015.05.06
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2015.04.30
Brodband coaxial preamplifier	Schwarzbeck Mess-Elektronik	BBV 9718	9718-245	1 year	2015.08.13
Trilog-broadband antenna	Schwarzbeck	VULB 9168	9168-385	2 years	2015.05.09
Horn antenna	A.H.	SAS-571	414	2 years	2015.02.28
Attenuator	HP	8494B	2630A12857	1 year	2015.04.30
DC Power Supply	HP	6632B	US36351824	1 year	2015.07.23
Preamplifier	HP	8447F	2805A02570	1 year	2015.04.30
High pass filter	Weinschel	WHKX1.2/15G-6TT	1	1 year	2015.07.23

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook	Samsung	NT-R519	ZLT393BSBOOZO4H

Appendix B. Test setup photo

Radiated spurious