RF TEST REPORT

Test item	:	Car Audio
Model No.	:	LCF810BR
Order No.	:	1109-01322
Date of receipt	:	2011-09-29
Test duration	:	2011-10-27 ~ 2011-11-15
Date of issue	:	2011-11-18
Use of report	:	FCC Original Grant

Applicant : LG Electronics USA.
1000 Sylvan Avenue Englewood Cliffs, New Jersey, United States

Test laboratory : Digital EMC Co., Ltd.
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Kyunggi-Do, 449-080, Korea

Test specification	:	FCC Part 15.247 Subpart C
Test environment	:	See appended test report
Test result	:	☒ Pass ☐ Fail

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of Digital EMC Co., Ltd.

Tested by:	Witnessed by:	Reviewed by:
Engineer S.K.Ryu	N/A	Technical Director Harvey Sung

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1. Equipment information

1.1 Equipment description

FCC Equipment Class	Part 15 Spread Spectrum Transmitter(DSS)
FCC ID	BEJ9QK-LCF810
Equipment type	Car Audio
Equipment model name	LCF810BR
Equipment add model name	LCS710BR, LCS710DAB, LCS810DAB
Equipment serial no.	Identical prototype
Frequency band	2402 ~ 2480 MHz
Spread Spectrum	Frequency Hopping
Modulation type	GFSK, π/4-DQPSK, 8DPSK
Transmission rate	1Mbps, 2Mbps, 3Mbps
Channel Spacing	1.0 MHz
Power	DC 12 V
Antenna type	Internal Type: Chip Antenna (Max. Peak Gain:2.11 dBi)

1.2 Ancillary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
-	-	-	-	-
-	-	-	-	-

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2. Information about test items

2.1 Test mode & EUT Position

This device was tested in maximum duty mode at maximum power of hopping enable / disable mode.

Test Case 1	GFSK(1Mbps)
Test Case 2	π/4-DQPSK(2Mbps)
Test Case 3	8DPSK (3Mbps)

EUT position: refer to Test photo file.

2.2 Auxiliary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
-	-	-	-	-
-	-	-	-	-

2.3 Tested frequency

- Hopping Function: Enable

	TX Frequency (MHz)	RX Frequency (MHz)
Hopping Band	2402 ~ 2480	2402 ~ 2480

- Hopping Function: Disable

	TX Frequency (MHz)	RX Frequency (MHz)
Lowest Channel	2402	2402
Middle Channel	2441	2441
Highest Channel	2480	2480

2.4 Tested environment

Temperature	:	23 ~ 24 °C
Relative humidity content	:	33 ~ 37 % R.H.
Details of power supply	:	DC 12 V

2.5 EMI Suppression Device(s)/Modifications

EMI suppression device(s) added and/or modifications made during testing
→ None

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3. Test Report

3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit (Using in 2400 ~ 2483.5MHz)	Test Condition	Status Note 1
I. Transmit mode (TX)				
15.247(a)	Carrier Frequency Separation	>= 20dB BW or >= Two-Thirds of the 20dB BW	Conducted	C
	Number of Hopping Frequencies	>= 15 hops		C
	20 dB Bandwidth	None		C
	Dwell Time	=< 0.4 seconds		C
15.247(b)	Transmitter Output Power	=< 1Watt , if CHs >= 75 Others =<0.125W		C
15.247(d)	Band-edge /Conducted	The radiated emission to any 100 kHz of out-band shall be at least 20dB below the highest in-band spectral density.		C
	Conducted Spurious Emissions			C
15.205, 15.209	Radiated Spurious Emissions	FCC 15.209 Limits	Radiated	C Note.2
15.207	AC Conducted Emissions	EN 55022	AC Line Conducted	NA Note. 3
15.203	Antenna Requirements	FCC 15.203	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: This test item was performed in each axis. And the worst case data were reported.

Note 3: The product does not use the ac adaptor and TA. Is a vehicle mounting the product.

The sample was tested according to the following specification:
ANSI C-63.4-2003, DA00-705

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3.2 Transmitter requirements

3.2.1 Carrier Frequency Separation

- Procedure:

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to:

Span = wide enough to capture the peaks of two adjacent channels

RBW = 1% of the span Sweep = auto

VBW = ≥ RBW Detector function = peak

Trace = max hold

- Measurement Data: Comply

Hopping Mode	Test Mode	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (MHz)
Enable	Test Case 1	2439.998	2441.000	1.002
	Test Case 2	2439.986	2440.991	1.005
	Test Case 3	2440.988	2441.990	1.002

Note 1: See next pages for actual measured spectrum plots.

- **Minimum Standard:**

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW

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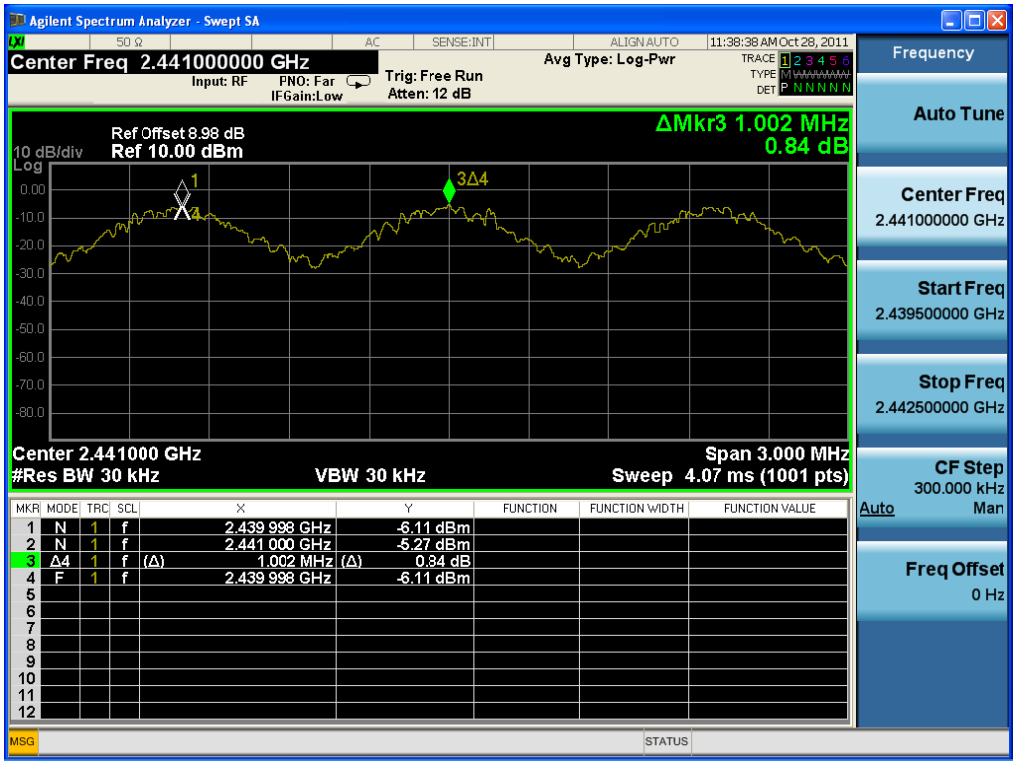
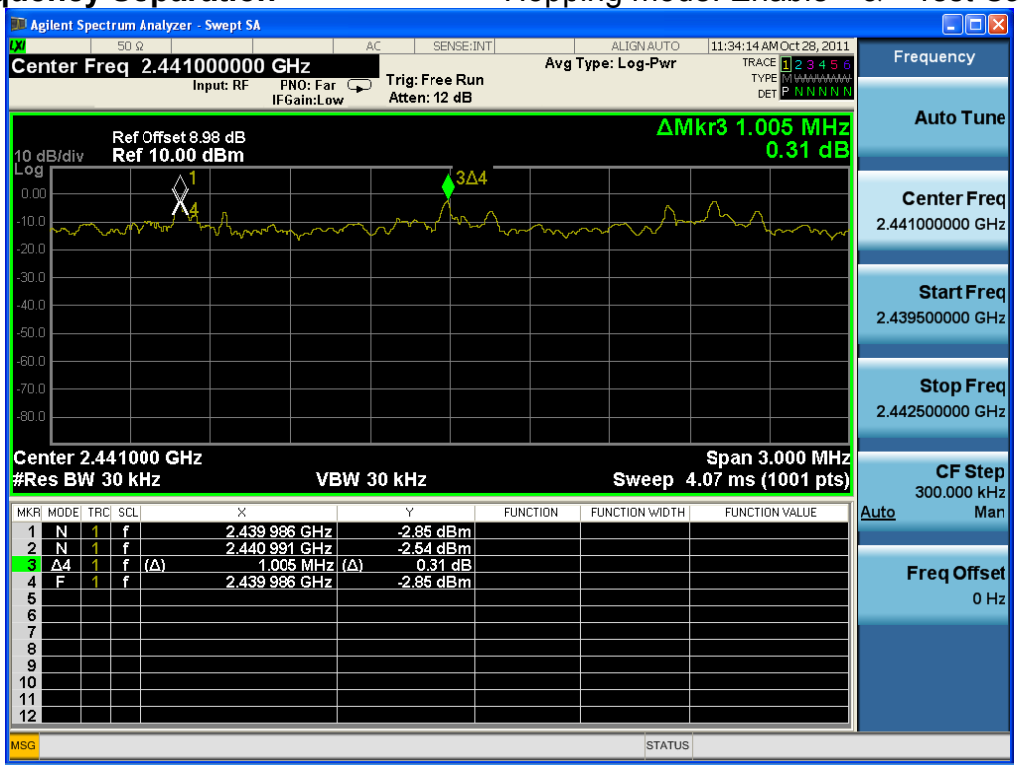
Carrier Frequency Separation Hopping mode: Enable & Test Case 1



Carrier Frequency Separation Hopping mode: Enable & Test Case 2



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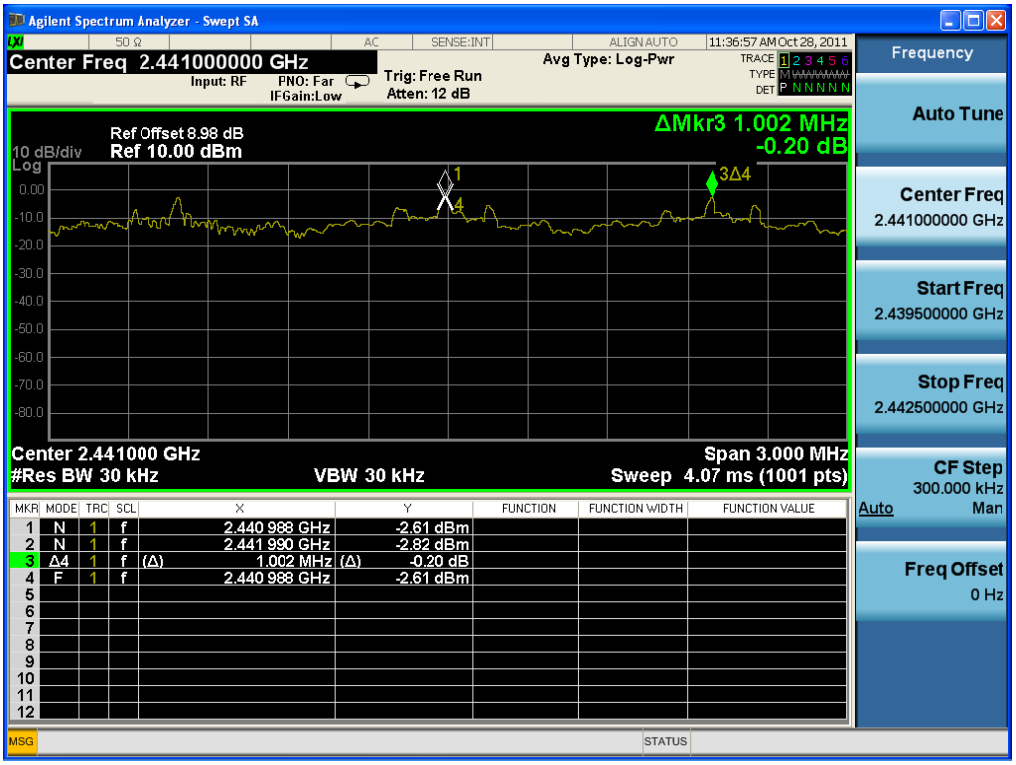
Carrier Frequency Separation Hopping mode: Enable & Test Case 3



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3.2.2 Number of Hopping Frequencies

- Procedure:

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.
To get higher resolution, four frequency ranges within the 2400 ~ 2483.5 MHz FH band were examined.

The spectrum analyzer is set to:

Span = 25MHz
Plot 1: Start Frequency = 2389.5MHz, Stop Frequency = 2414.5 MHz
Plot 2: Start Frequency = 2414.5MHz, Stop Frequency = 2439.5 MHz
Plot 3: Start Frequency = 2439.5MHz, Stop Frequency = 2464.5 MHz
Plot 4: Start Frequency = 2464.5MHz, Stop Frequency = 2489.5 MHz
RBW = 1% of the span or more
Sweep = auto
VBW = ≥ RBW
Detector function = peak
Trace = max hold

- **Measurement Data: Comply**

Hopping mode	Test mode	Test Result (Total Hops)
Enable	Test Case 1	79
	Test Case 2	79
	Test Case 3	79

Note 1: See next pages for actual measured spectrum plots.

- Minimum Standard:

At least 15 hopes

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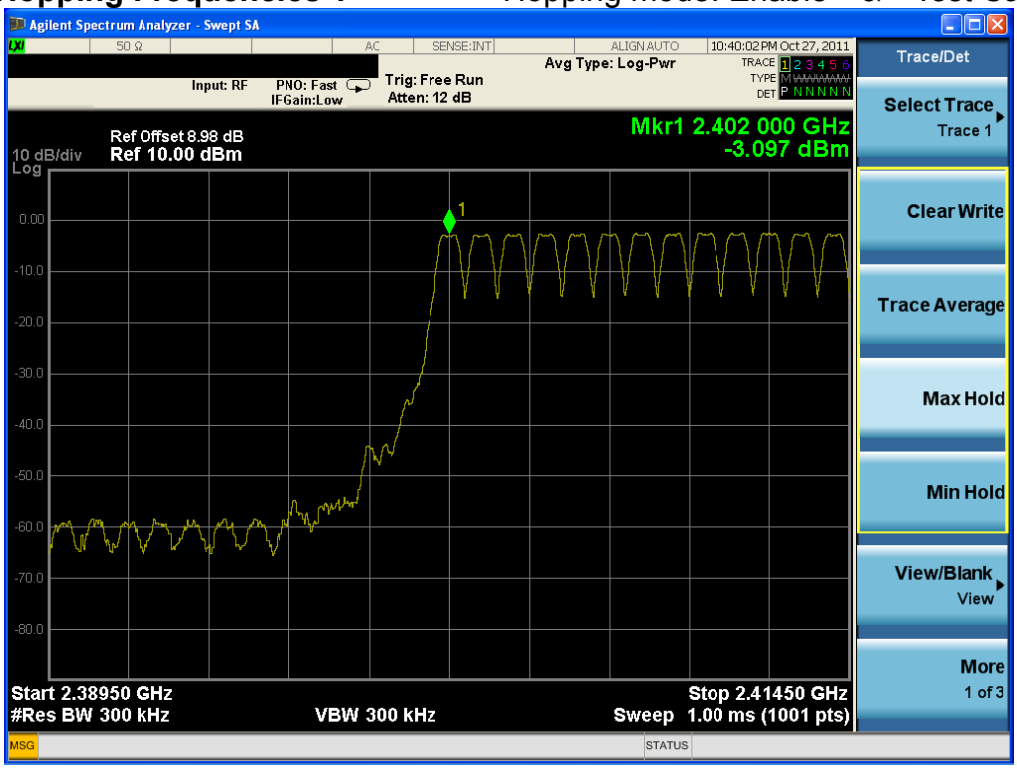
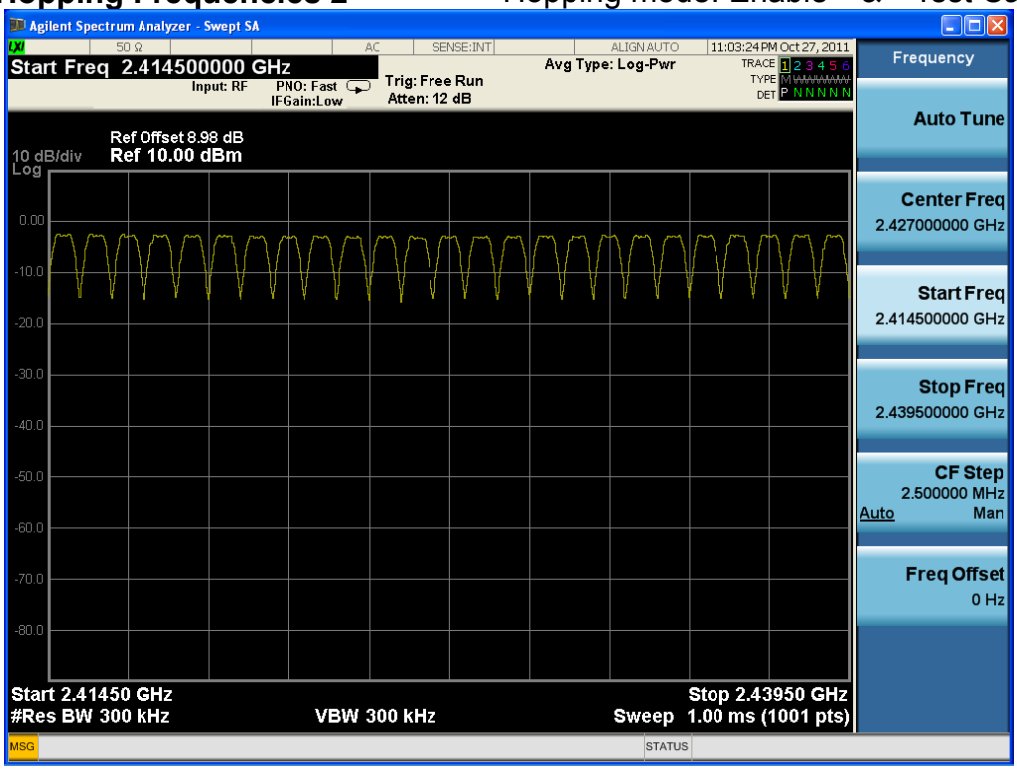
Number of Hopping Frequencies 1 Hopping mode: Enable & Test Case 1



Number of Hopping Frequencies 2 Hopping mode: Enable & Test Case 1



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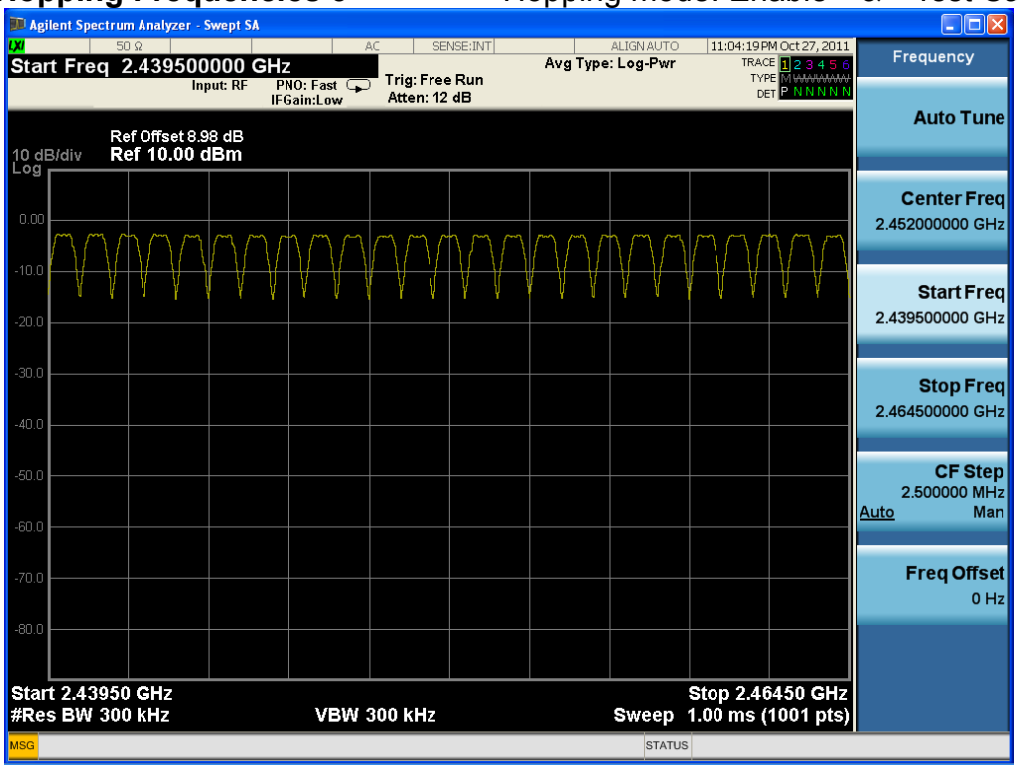
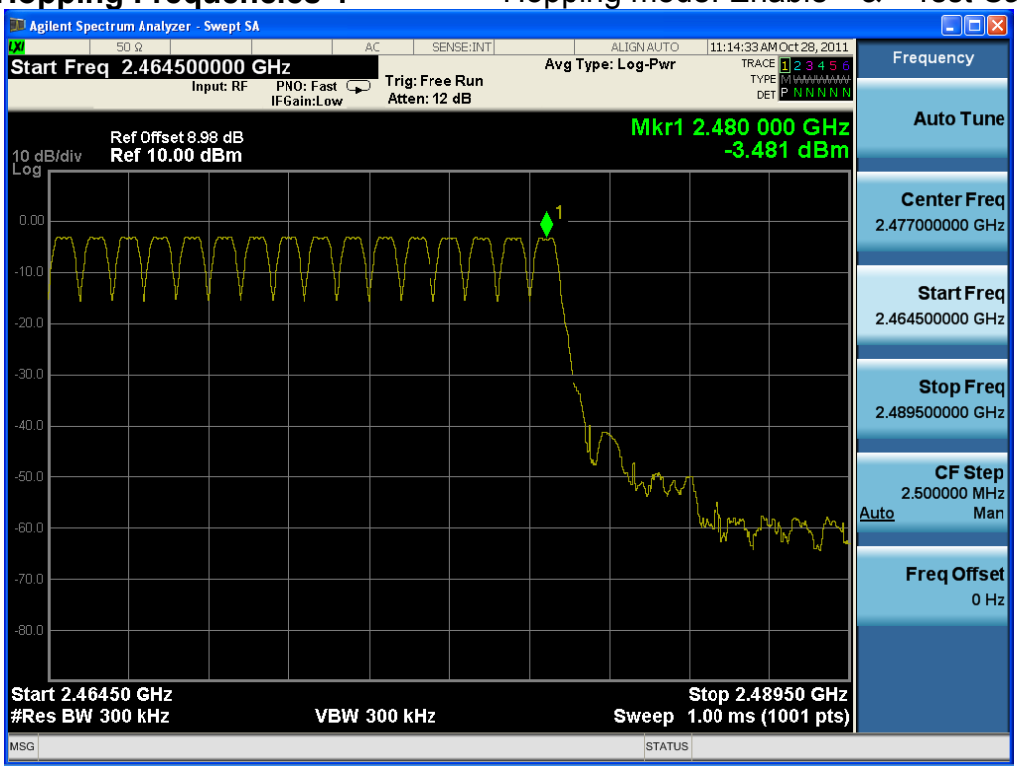
Number of Hopping Frequencies 3 Hopping mode: Enable & Test Case 1



Number of Hopping Frequencies 4 Hopping mode: Enable & Test Case 1



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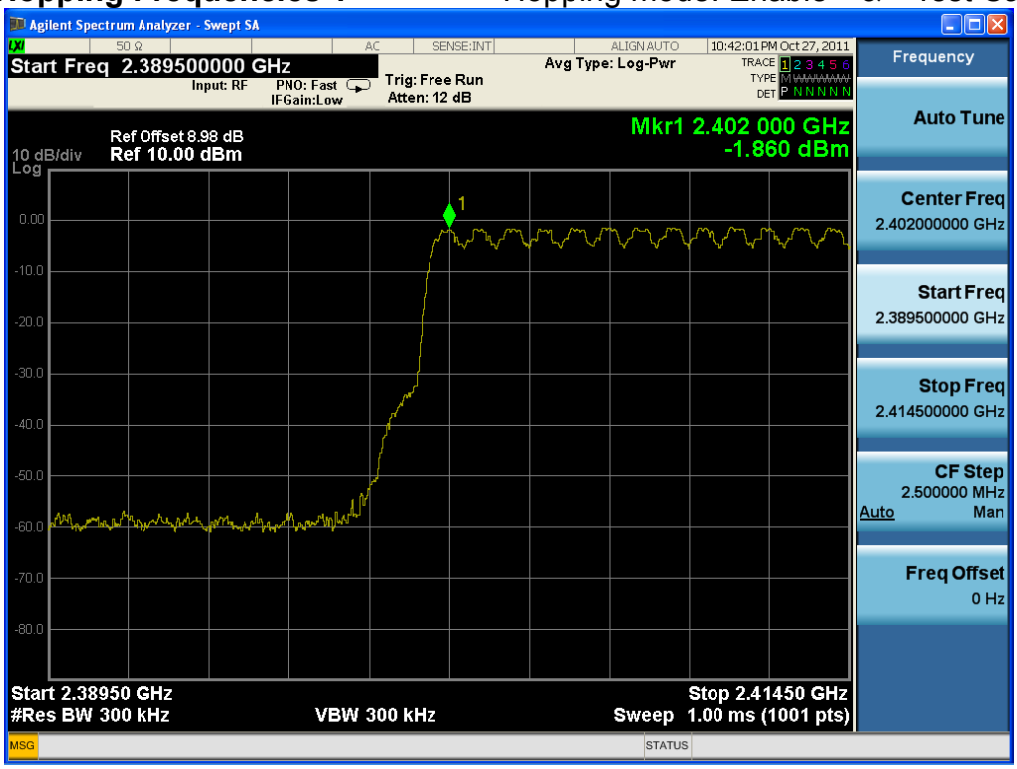
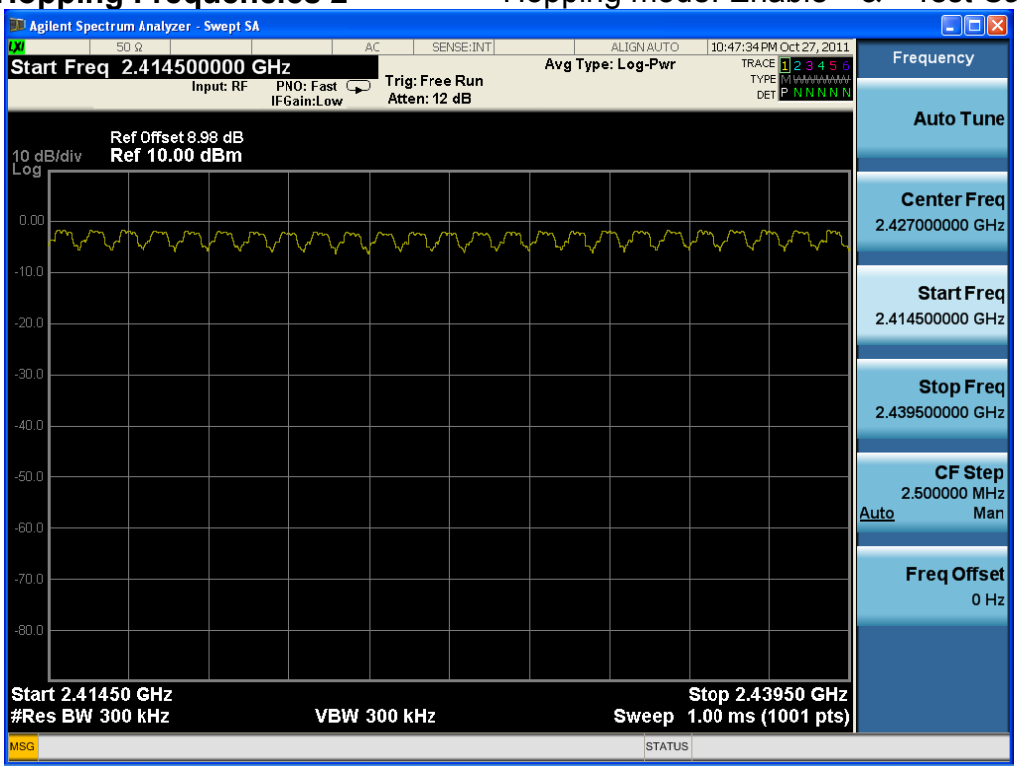
Number of Hopping Frequencies 1 Hopping mode: Enable & Test Case 2



Number of Hopping Frequencies 2 Hopping mode: Enable & Test Case 2



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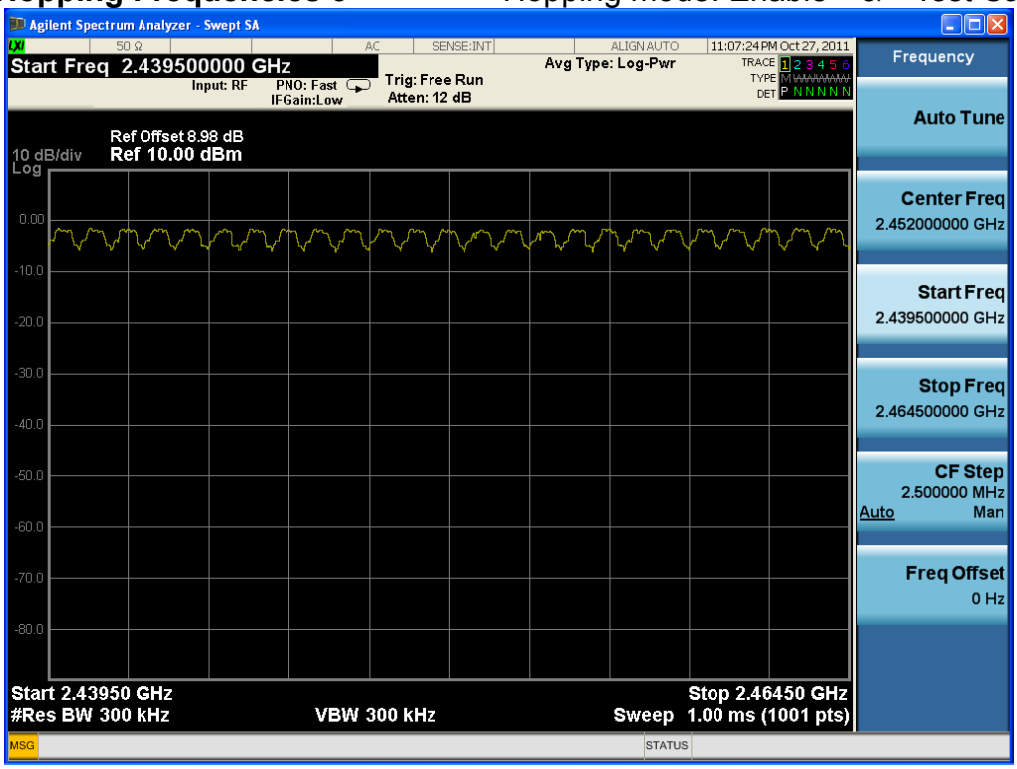
Number of Hopping Frequencies 3 Hopping mode: Enable & Test Case 2



Number of Hopping Frequencies 4 Hopping mode: Enable & Test Case 2

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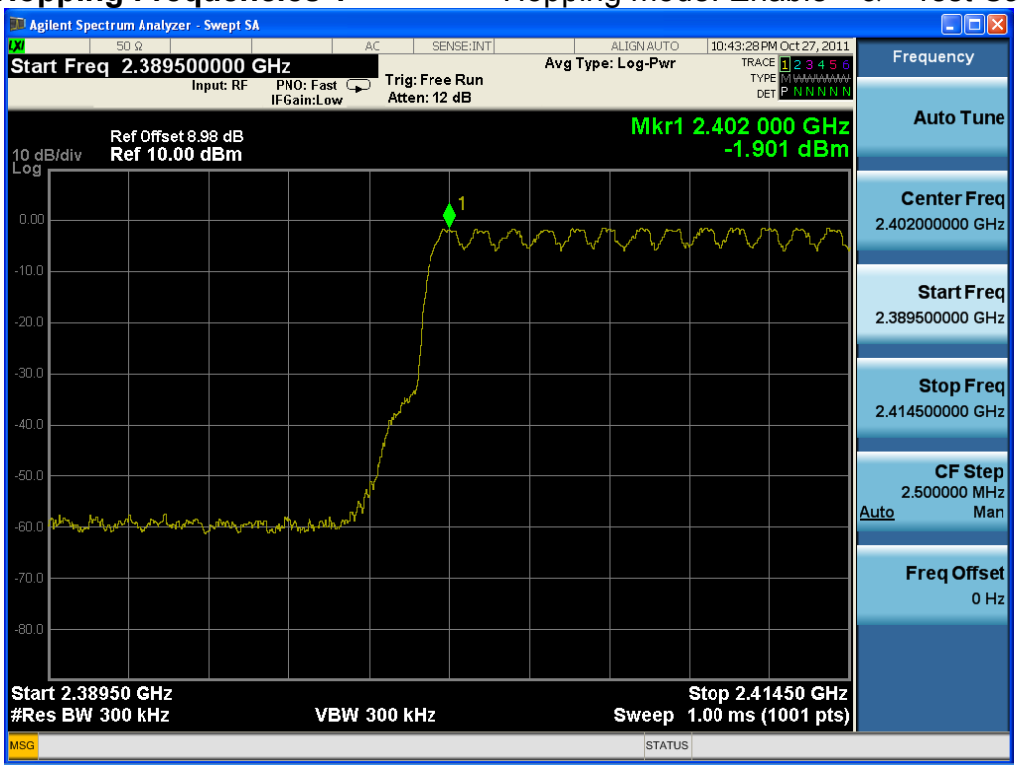
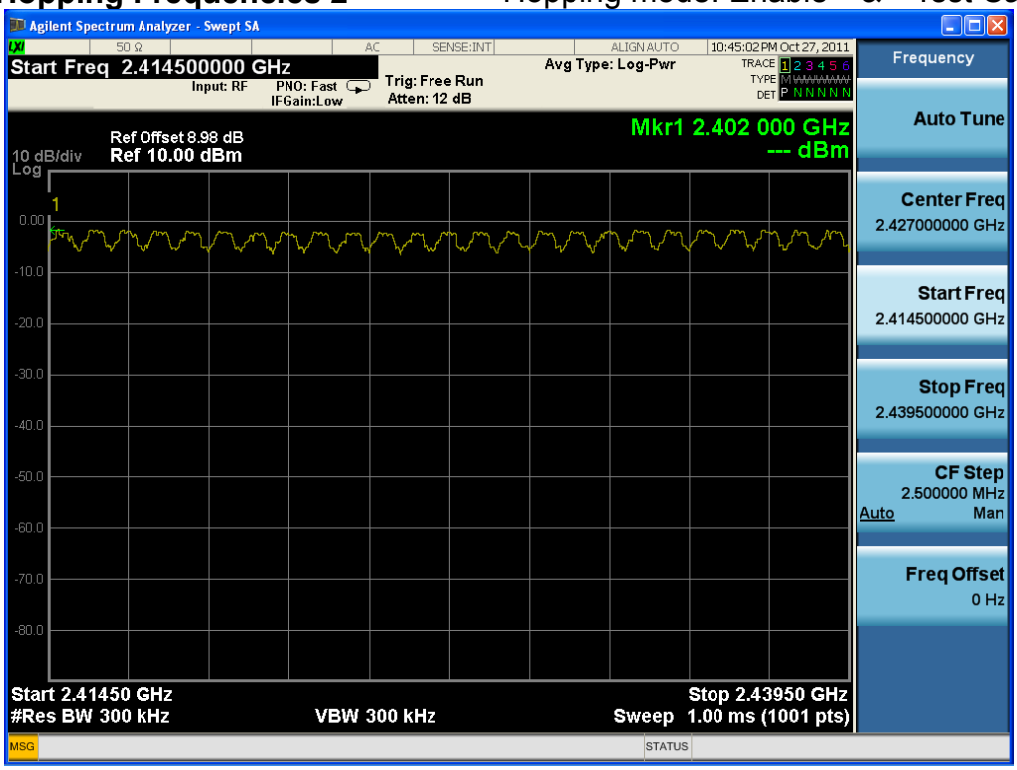
Number of Hopping Frequencies 1 Hopping mode: Enable & Test Case 3



Number of Hopping Frequencies 2 Hopping mode: Enable & Test Case 3



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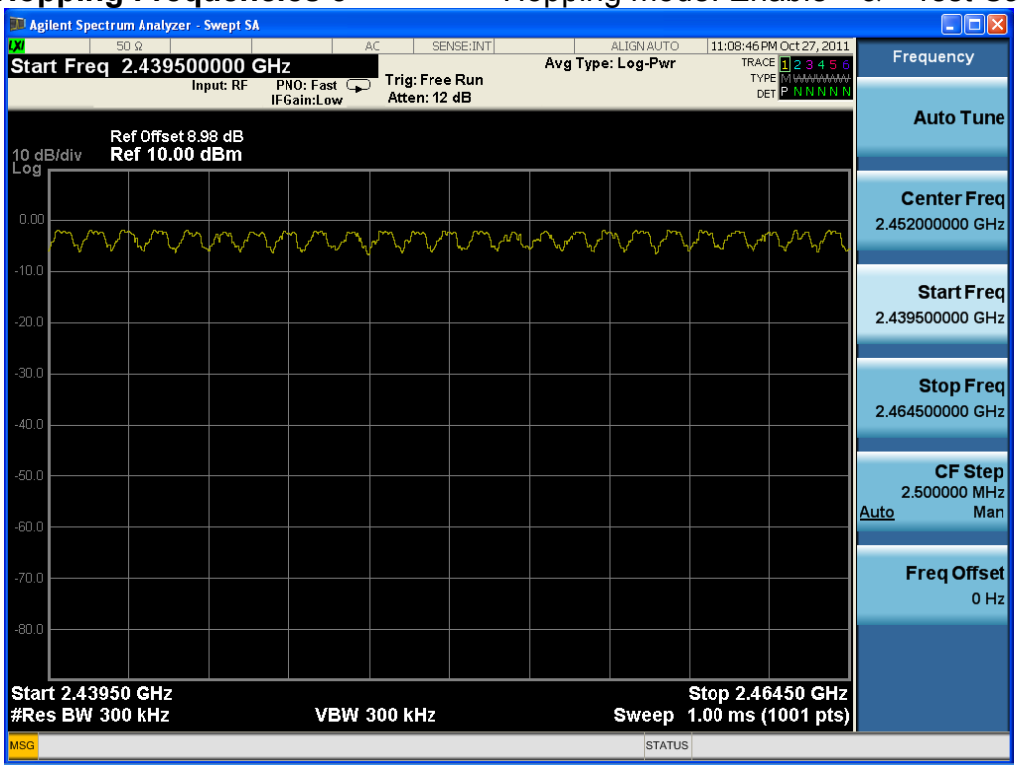
Number of Hopping Frequencies 3 Hopping mode: Enable & Test Case 3



Number of Hopping Frequencies 4 Hopping mode: Enable & Test Case 3

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3.2.3 20 dB Bandwidth

- Procedure:

The bandwidth at 20 dB below the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.

After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20dB down one 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. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest Frequencies

Span = approximately 2 or 3 times of the 20 dB bandwidth

RBW = 1% of the 20dB bandwidth or more

VBW = ≥ RBW

Trace = max hold

Sweep = auto

Detector function = peak

- Measurement Data: Comply

Hopping mode	Test mode	Tested Channel	Test Results(MHz)	
			20dB Bandwidth	Occupied Bandwidth(99%)
Disable	Test Case 1	Lowest	0.932	0.890
		Middle	0.932	0.886
		Highest	0.930	0.884
	Test Case 2	Lowest	1.308	1.184
		Middle	1.277	1.180
		Highest	1.311	1.185
	Test Case 3	Lowest	1.258	1.198
		Middle	1.250	1.203
		Highest	1.253	1.199

Note 1: See next pages for actual measured spectrum plots.

- Minimum Standard:

None

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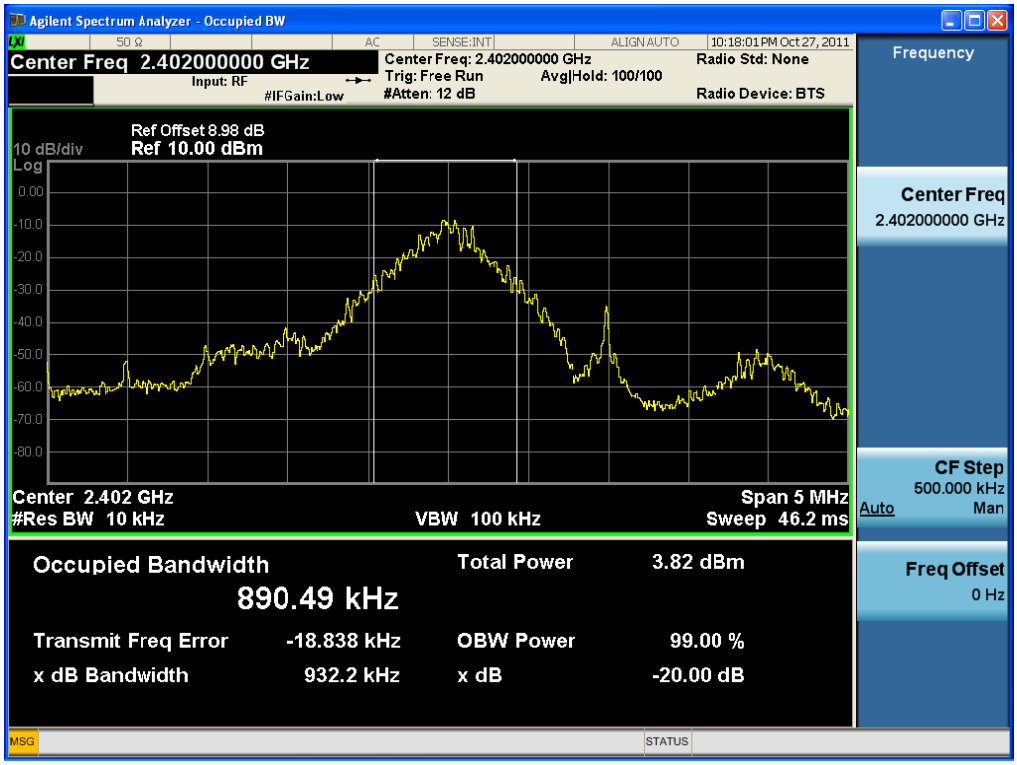
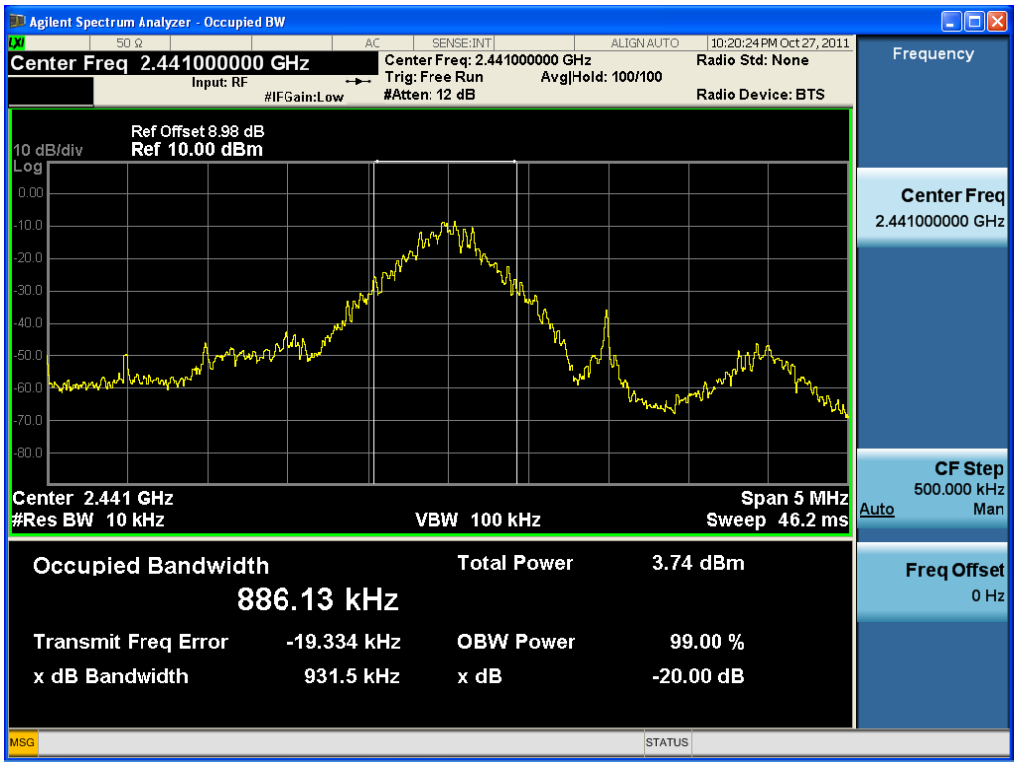
20dB Bandwidth Lowest Channel & Test Case 1



20dB Bandwidth Middle Channel & Test Case 1



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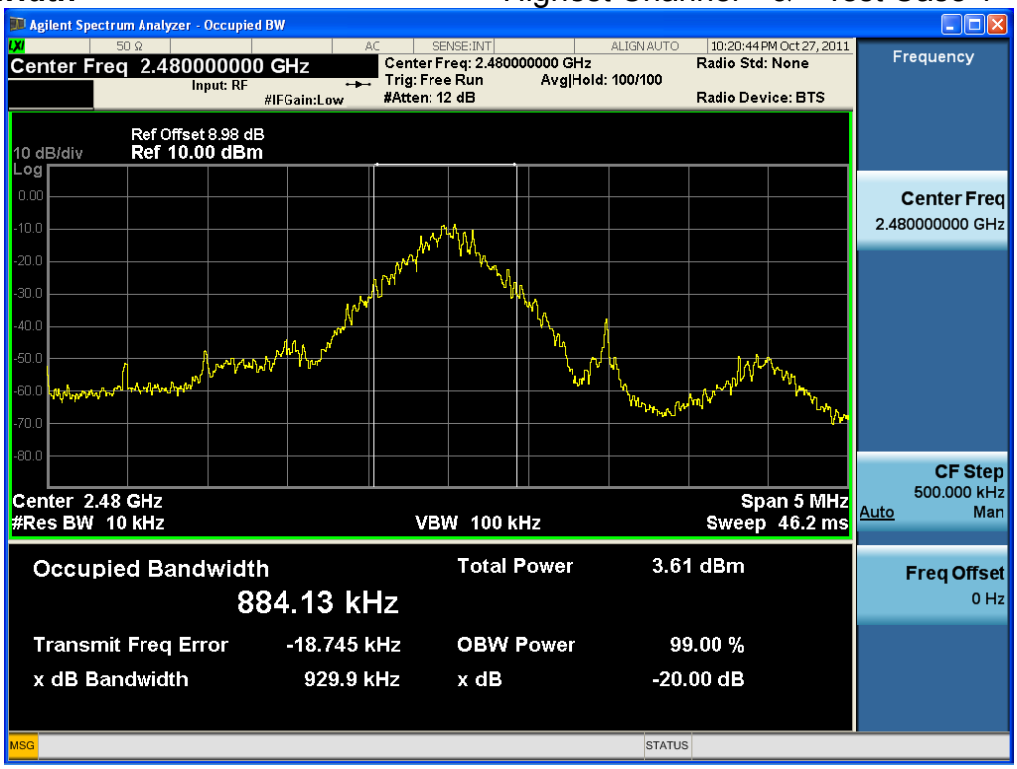
20dB Bandwidth Highest Channel & Test Case 1



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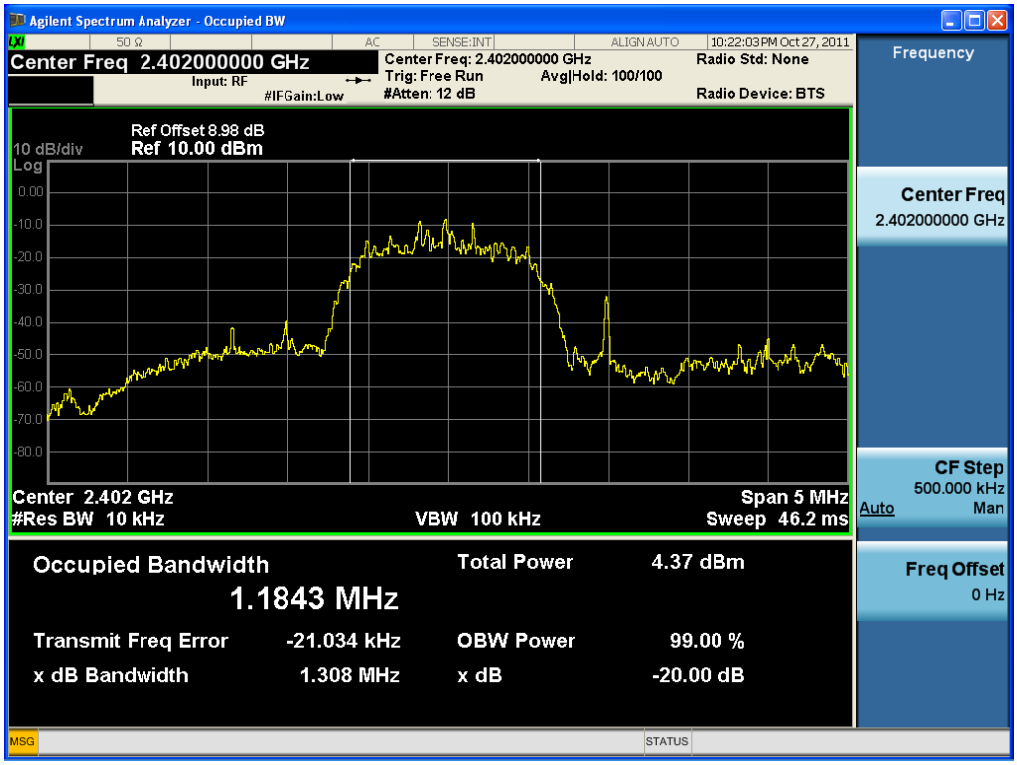
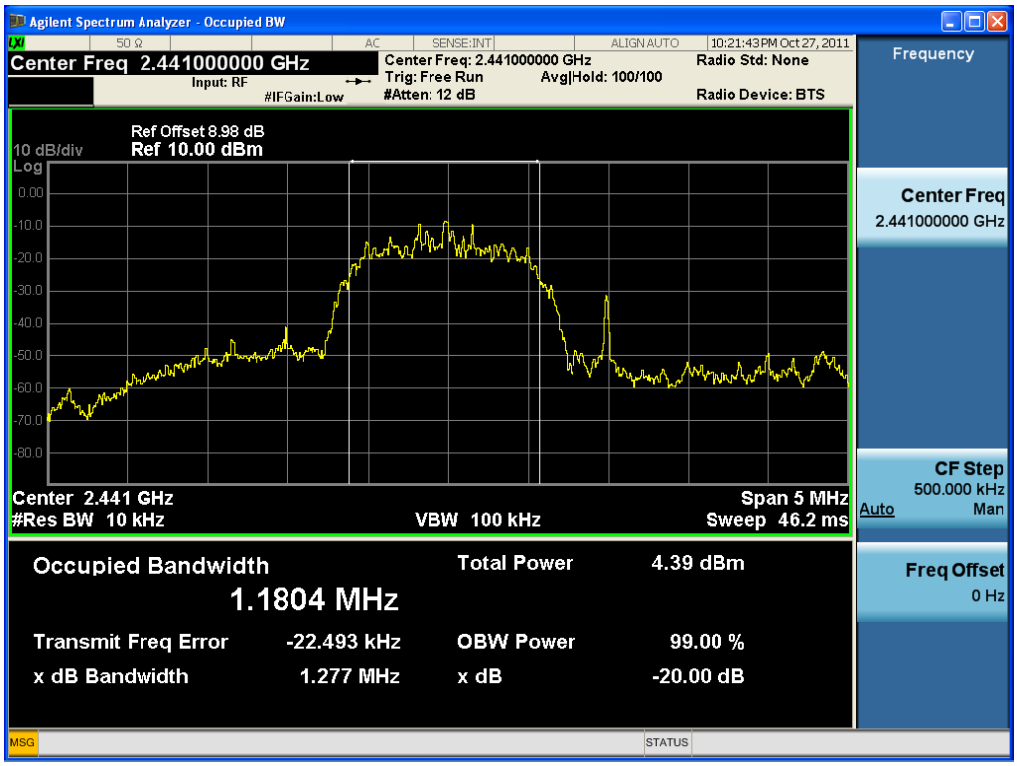
20dB Bandwidth Lowest Channel & Test Case 2



20dB Bandwidth Middle Channel & Test Case 2



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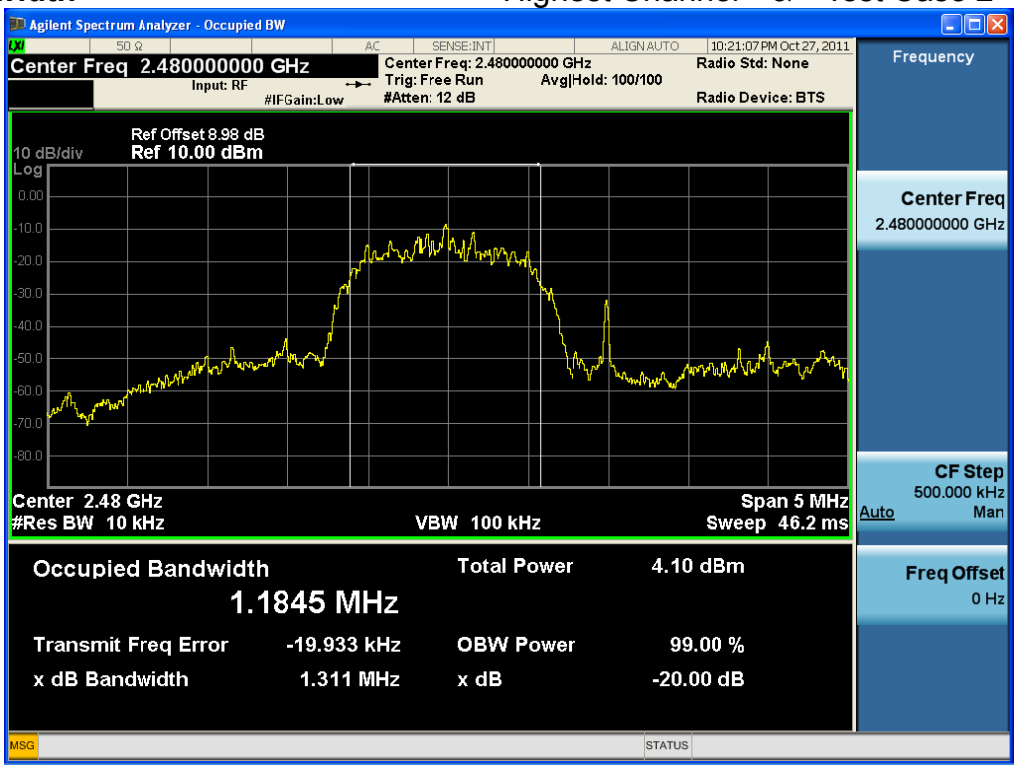
20dB Bandwidth Highest Channel & Test Case 2



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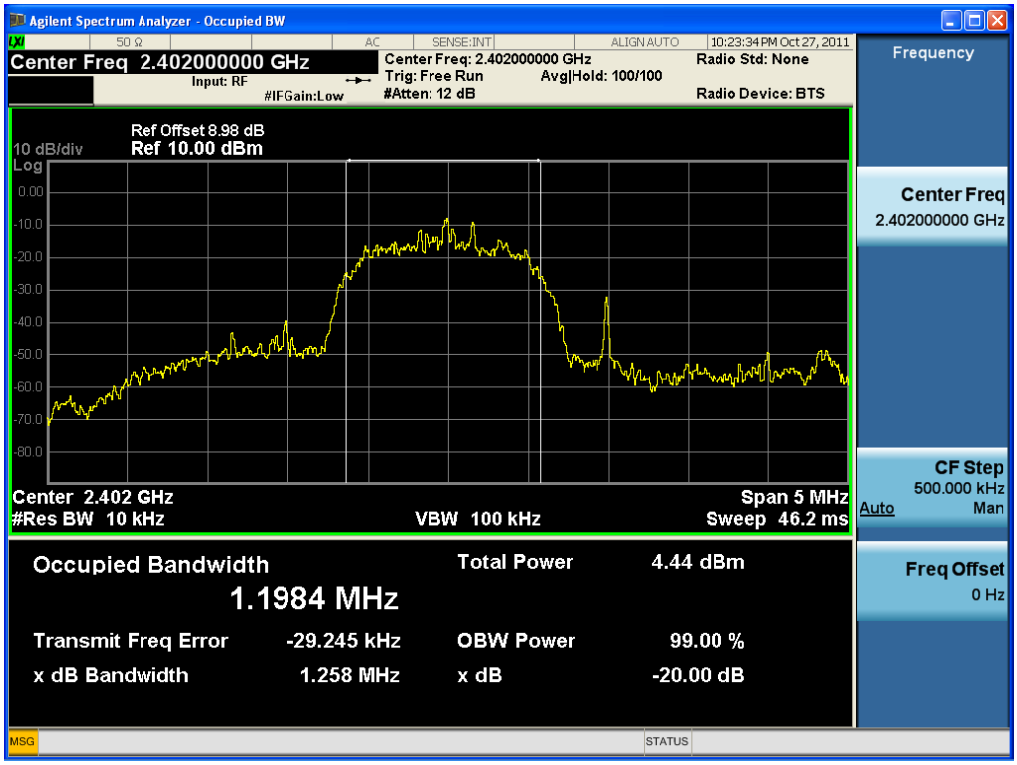
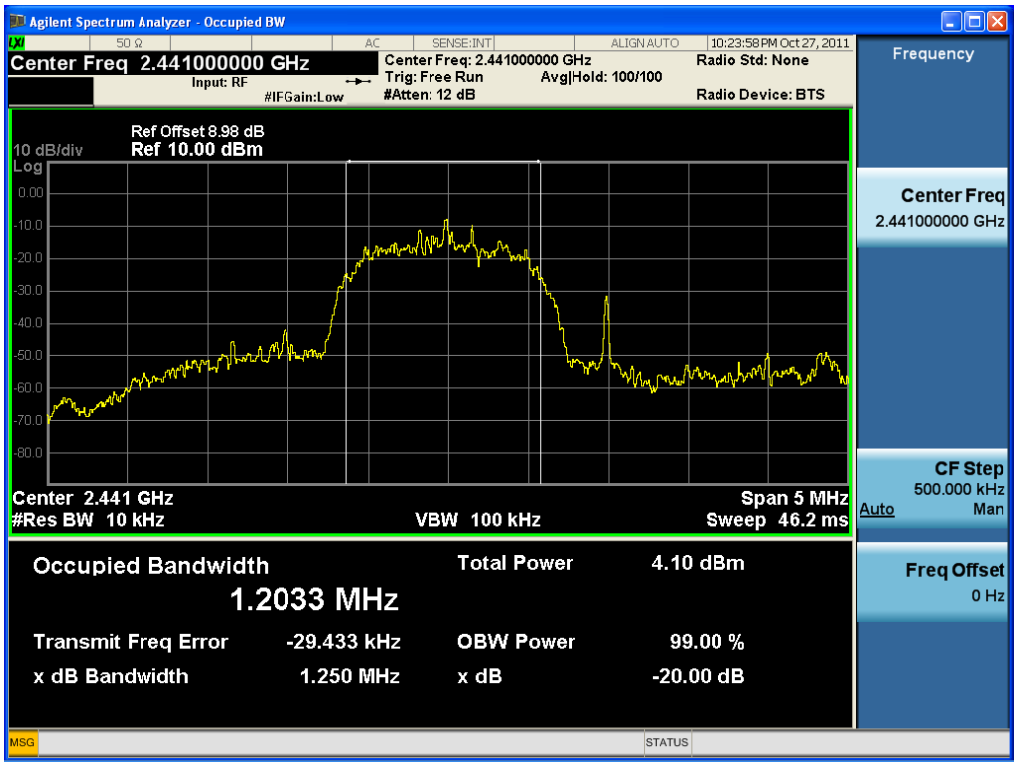
20dB Bandwidth Lowest Channel & Test Case 3



20dB Bandwidth Middle Channel & Test Case 3



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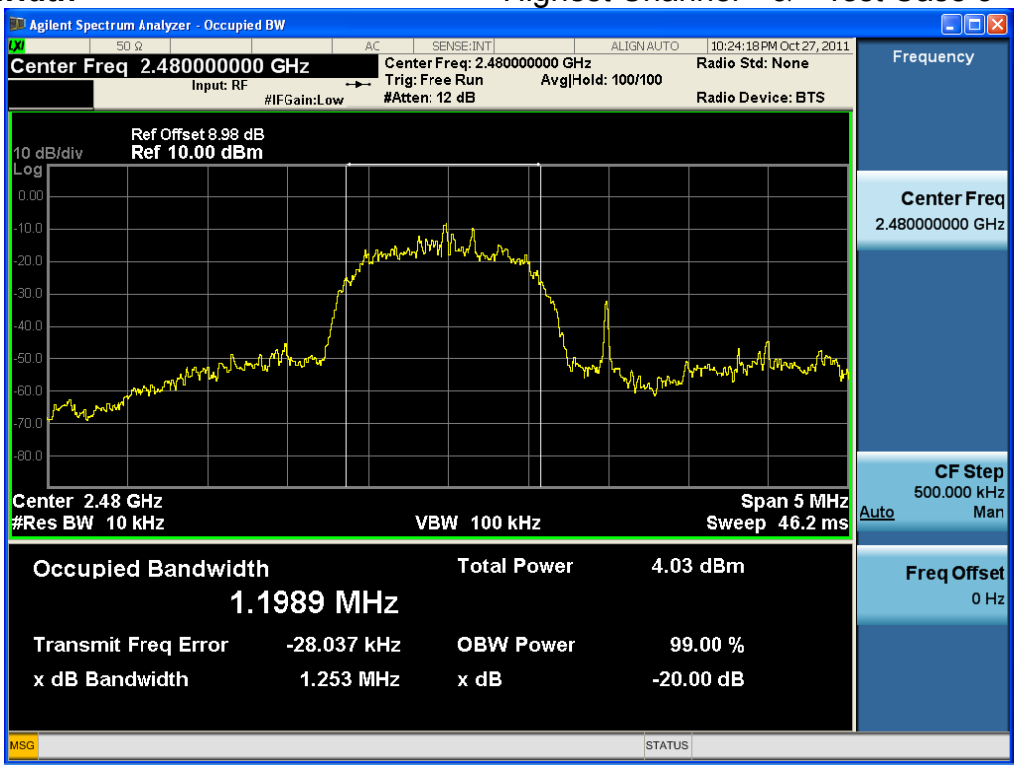
20dB Bandwidth Highest Channel & Test Case 3



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3.2.4 Time of Occupancy (Dwell Time)

- Procedure:

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

Center frequency = 2441 MHz	Span = zero
RBW = 1 MHz	VBW = ≥ RBW
Trace = max hold	Detector function = peak

- Measurement Data: Comply

Hopping mode	Test mode	Packet Type	Burst On Time (ms)	Period (ms)	Number of hopping Channels	Test Result (s)
Enable	Test Case 1	DH 1	0.450	1.255	79	0.143
		DH 3	1.700	2.500		0.272
		DH 5	2.955	3.750		0.315
	Test Case 2	2 DH 1	0.450	1.250	79	0.144
		2 DH 3	1.710	2.500		0.274
		2 DH 5	2.970	3.750		0.317
	Test Case 3	3 DH 1	0.450	1.245	79	0.145
		3 DH 3	1.720	2.500		0.275
		3 DH 5	2.970	3.750		0.317

Note 1: Each new transmission event begins on the next channel in the hopping sequence after the final channel used in the previous transmission event.

DWELL TIME=(0.4 x Number of hopping Channels) x Burst On time / (period x Number of hopping Channels)

Note 2: See next pages for actual measured spectrum plots.

- Minimum Standard:

No greater than 0.4 seconds

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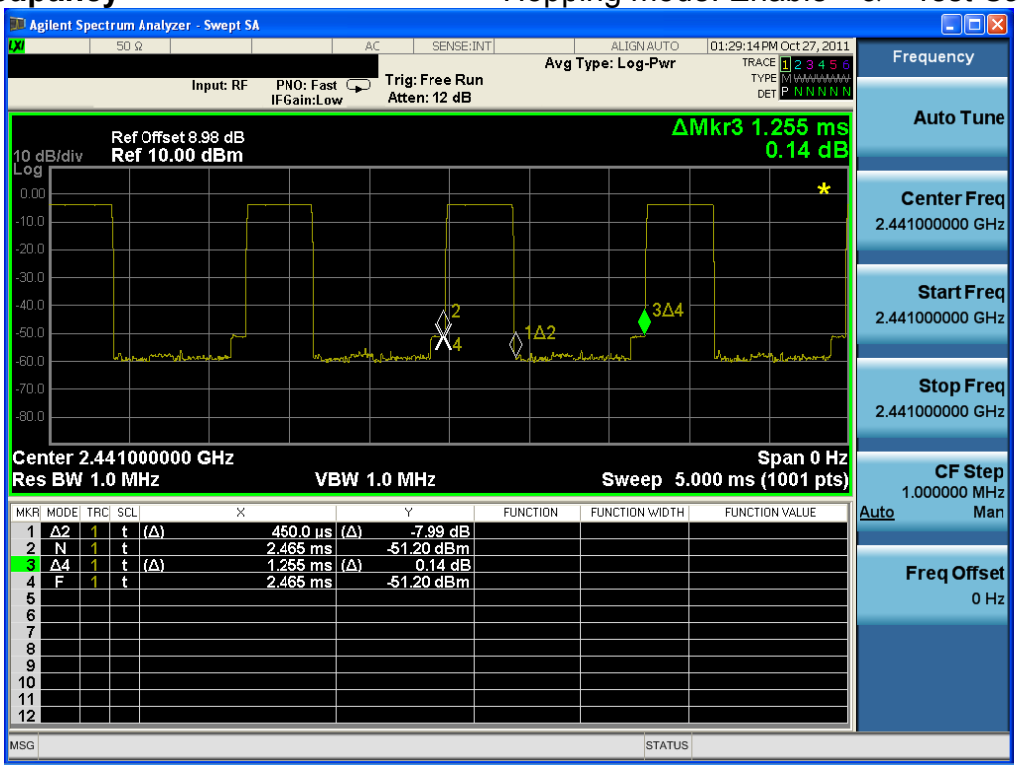
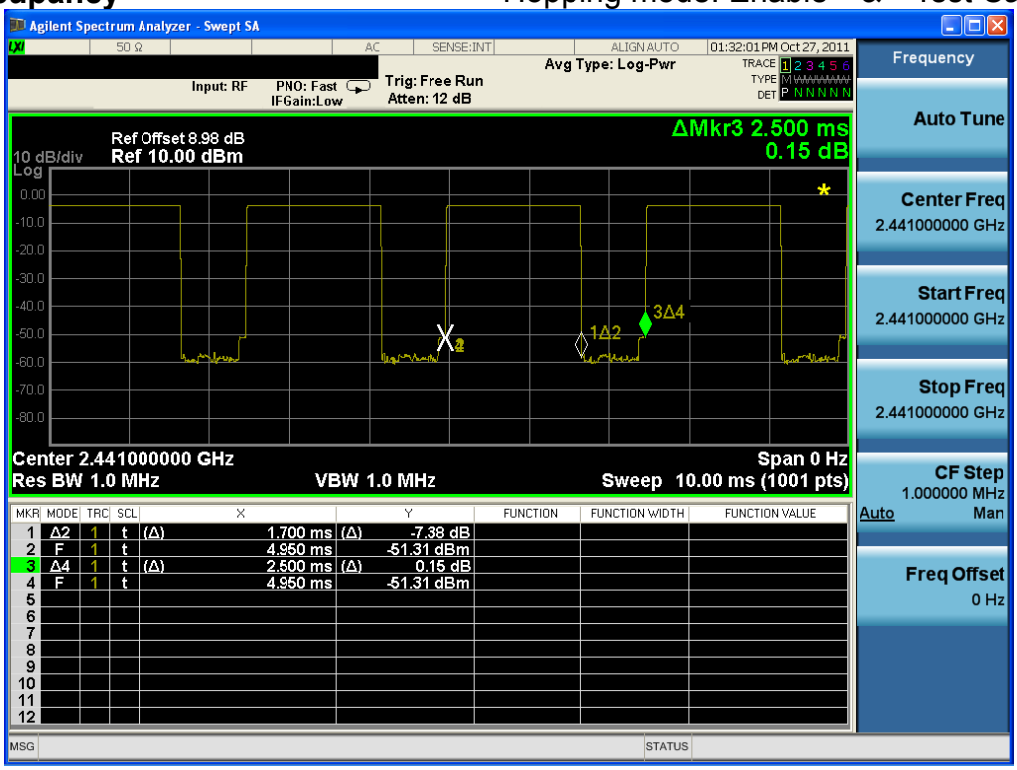
Time of Occupancy Hopping mode: Enable & Test Case 1(DH1)



Time of Occupancy Hopping mode: Enable & Test Case 1(DH3)



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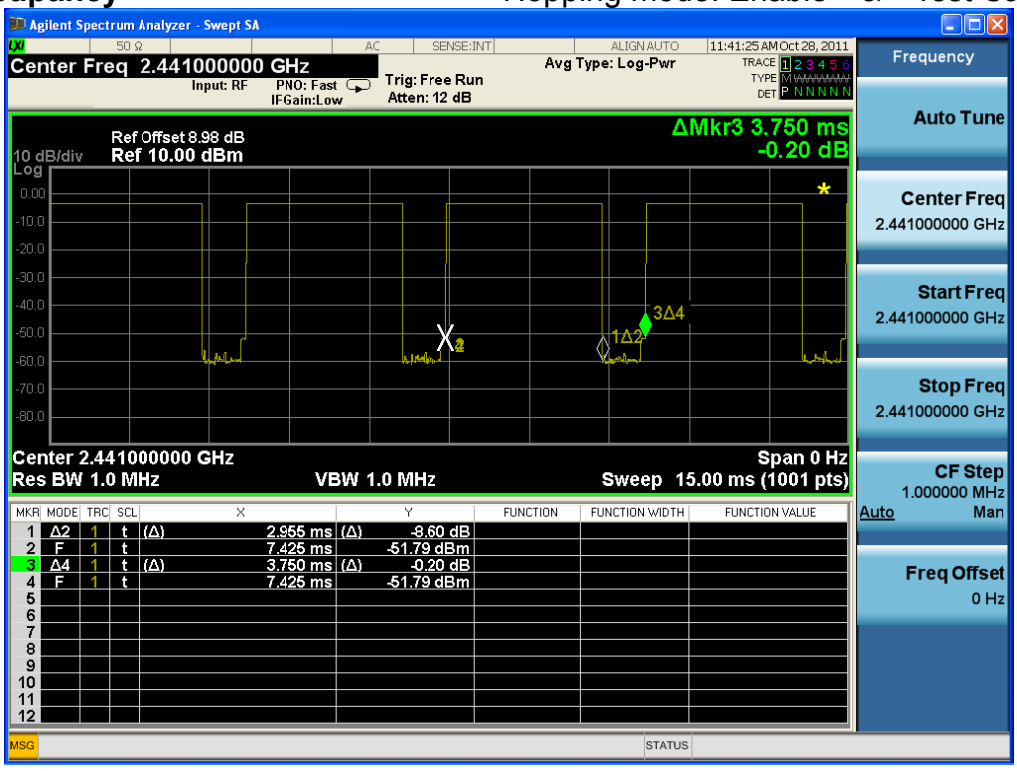
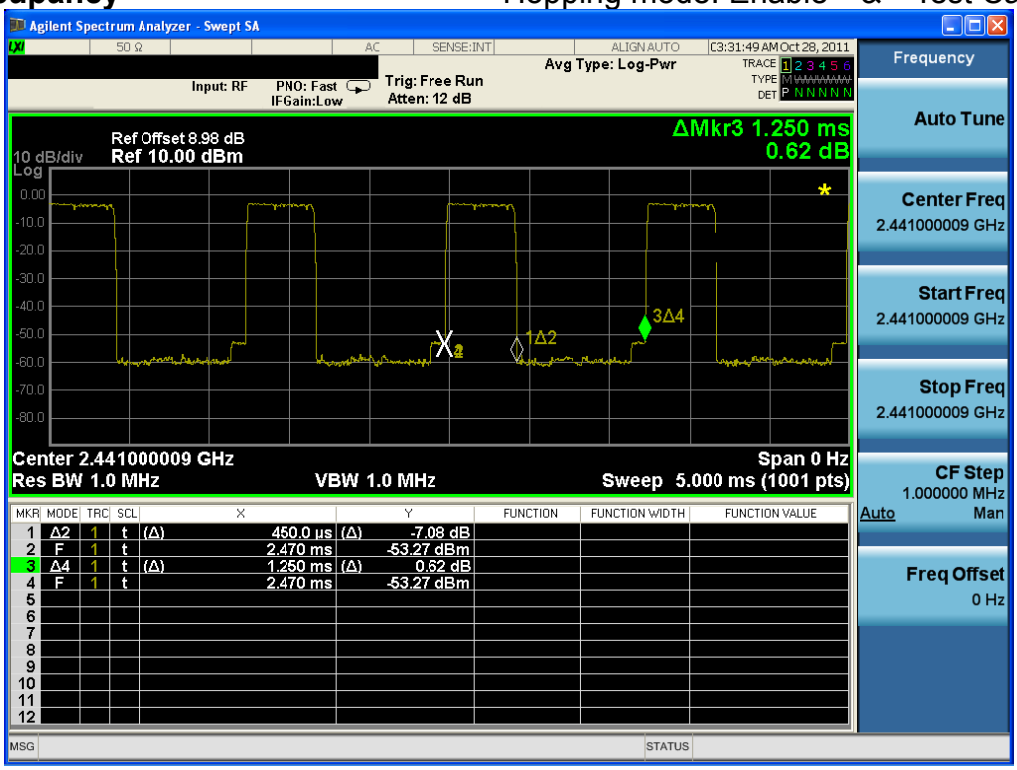
Time of Occupancy Hopping mode: Enable & Test Case 1(DH5)



Time of Occupancy Hopping mode: Enable & Test Case 2(DH1)



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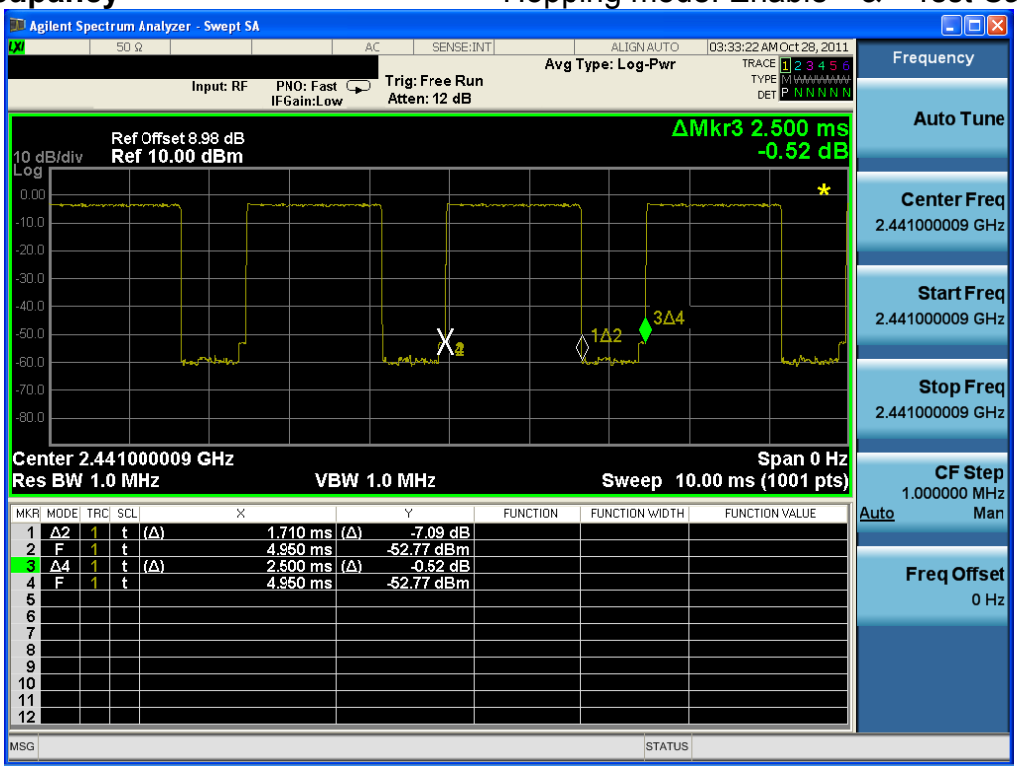
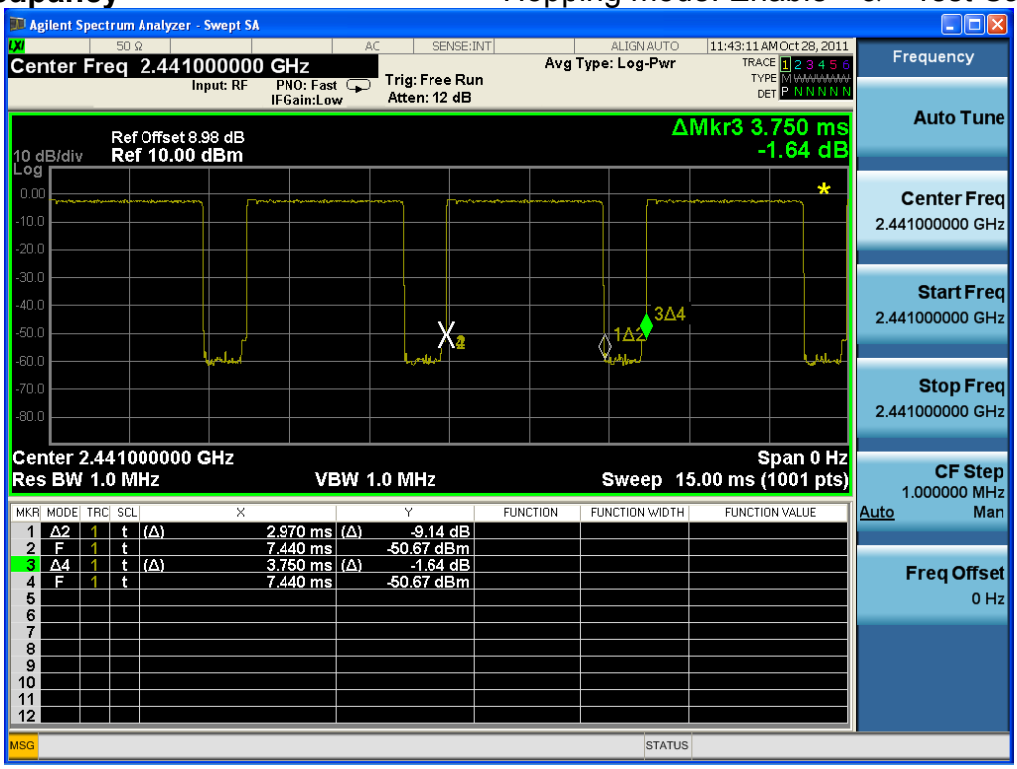
Time of Occupancy Hopping mode: Enable & Test Case 2(DH3)



Time of Occupancy Hopping mode: Enable & Test Case 2(DH5)



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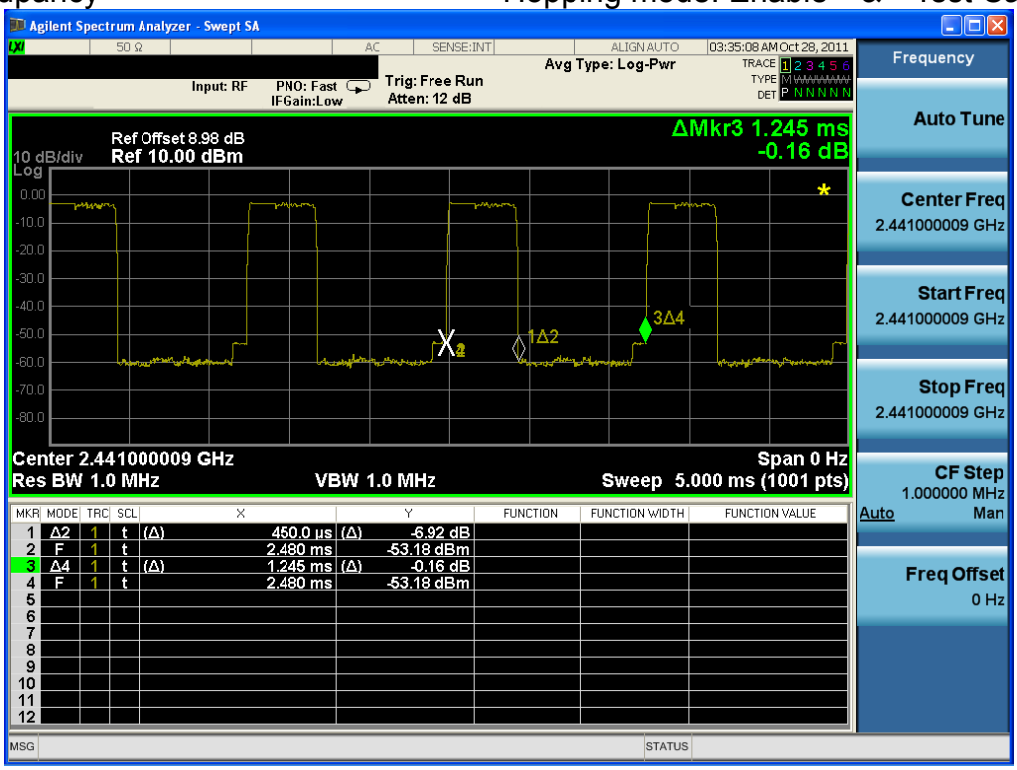
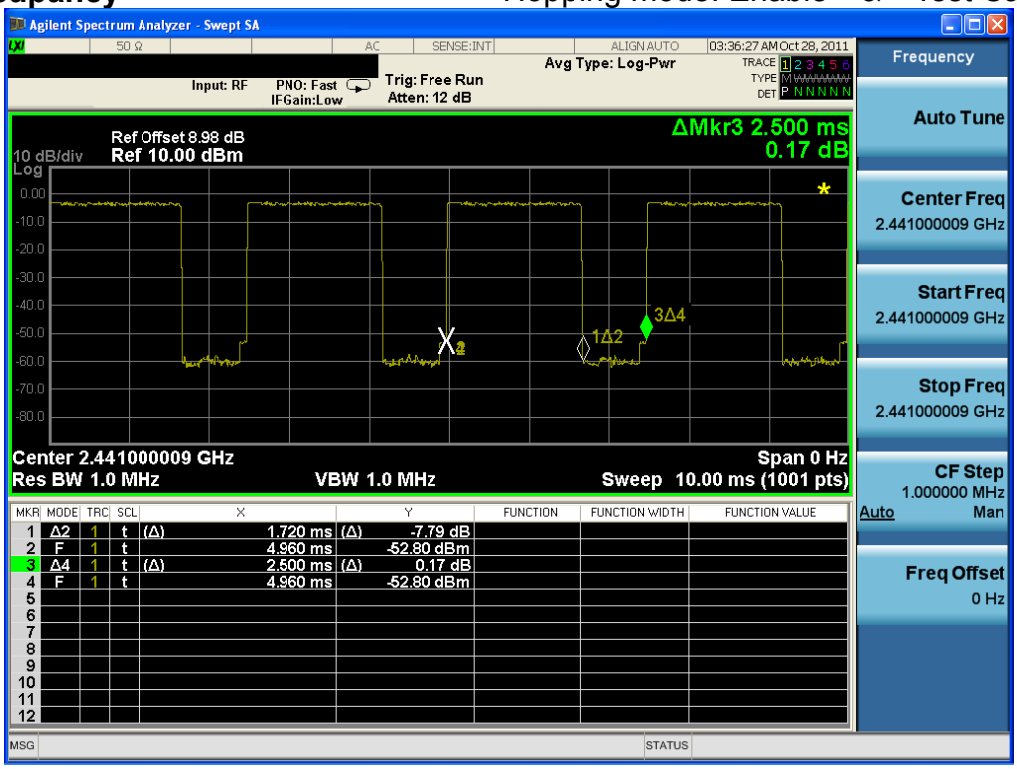
Time of Occupancy Hopping mode: Enable & Test Case 3(DH1)



Time of Occupancy Hopping mode: Enable & Test Case 3(DH3)



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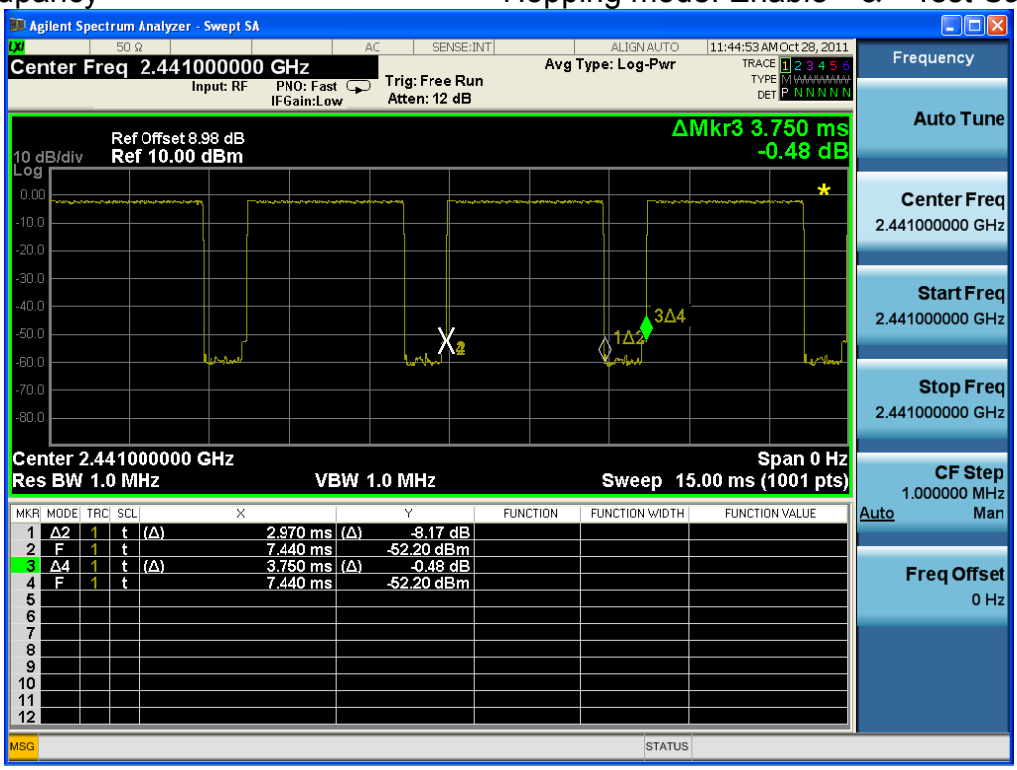
Time of Occupancy Hopping mode: Enable & Test Case 3(DH5)



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3.2.5 Peak Output Power

- Procedure:

The peak output power was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.
After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest Frequencies
Span = approximately 10 times of the 20 dB bandwidth
RBW = greater than the 20dB bandwidth of the emission being measured
VBW = ≥ RBW Detector function = peak
Trace = max hold Sweep = auto

- **Measurement Data: Comply**

Hopping mode	Test mode	Tested Channel	Test Results	
			dBm	mW
Disable	Test Case 1	**Lowest**	**-2.85**	**0.519**
		Middle	-3.02	0.499
		Highest	-3.26	0.472
	Test Case 2	**Lowest**	**-1.41**	**0.723**
		Middle	-1.43	0.719
		Highest	-1.58	0.695
	Test Case 3	**Lowest**	**-1.07**	**0.782**
		Middle	-1.14	0.770
		Highest	-1.36	0.732

Note 1: See next pages for actual measured spectrum plots.

- Minimum Standard:

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: **1 Watt**. For all other frequency hopping systems in the 2400-2483.5 MHz band: **0.125 Watts**

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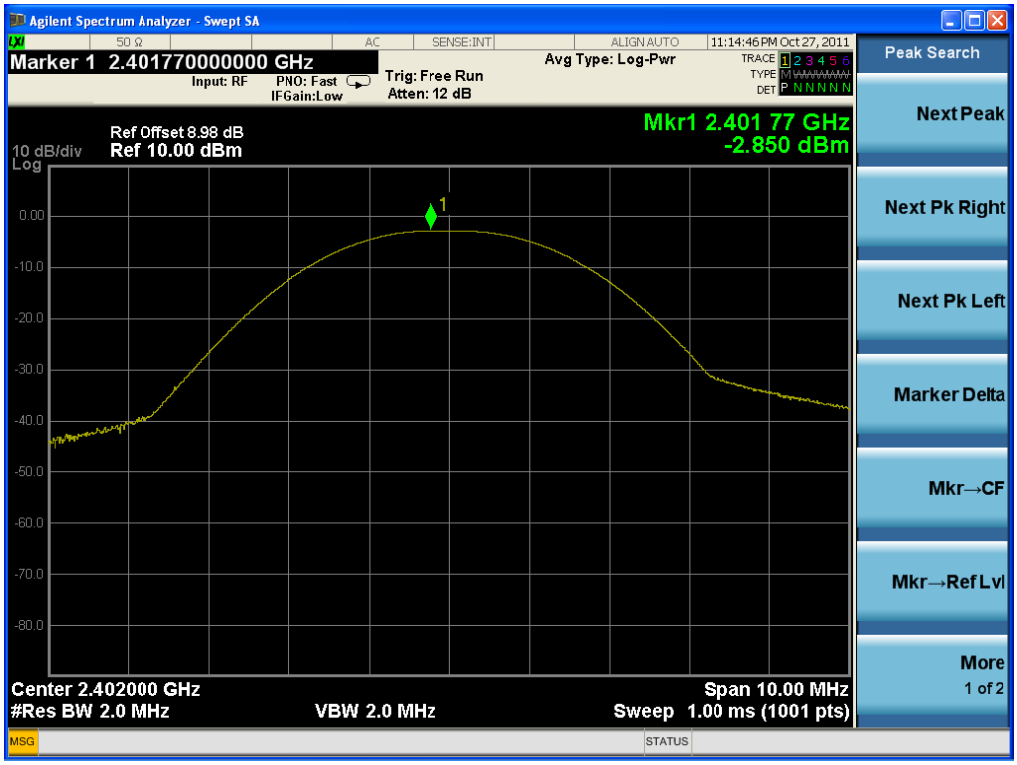
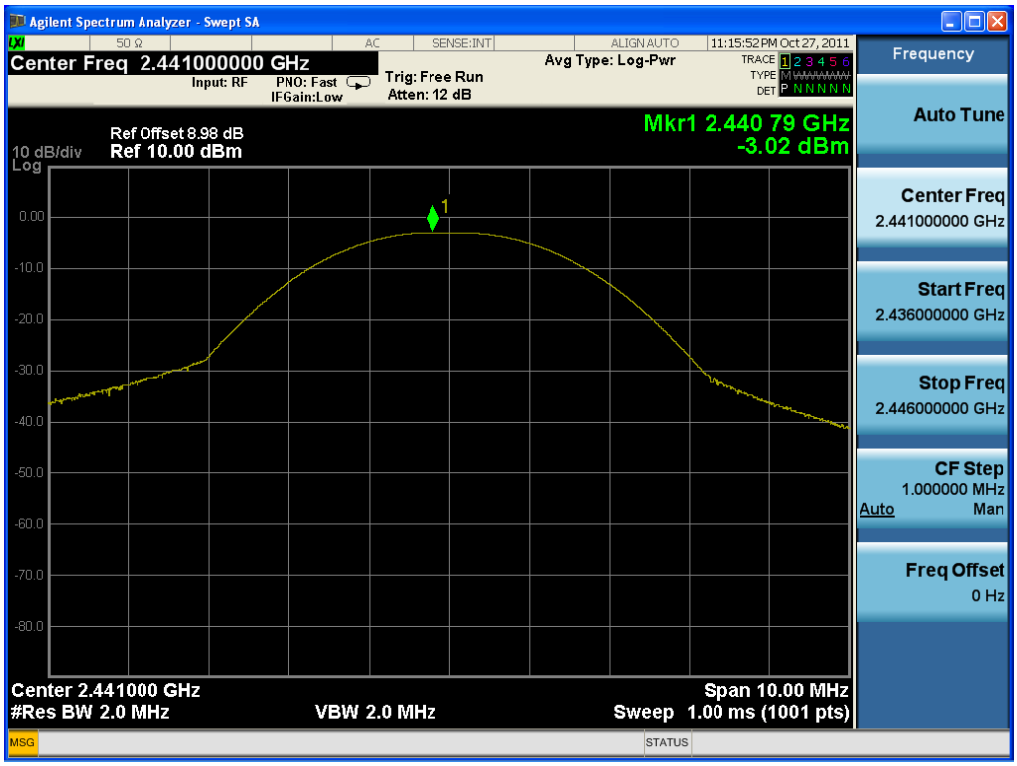
Peak Output Power Lowest Channel & Test Case 1



Peak Output Power Middle Channel & Test Case 1



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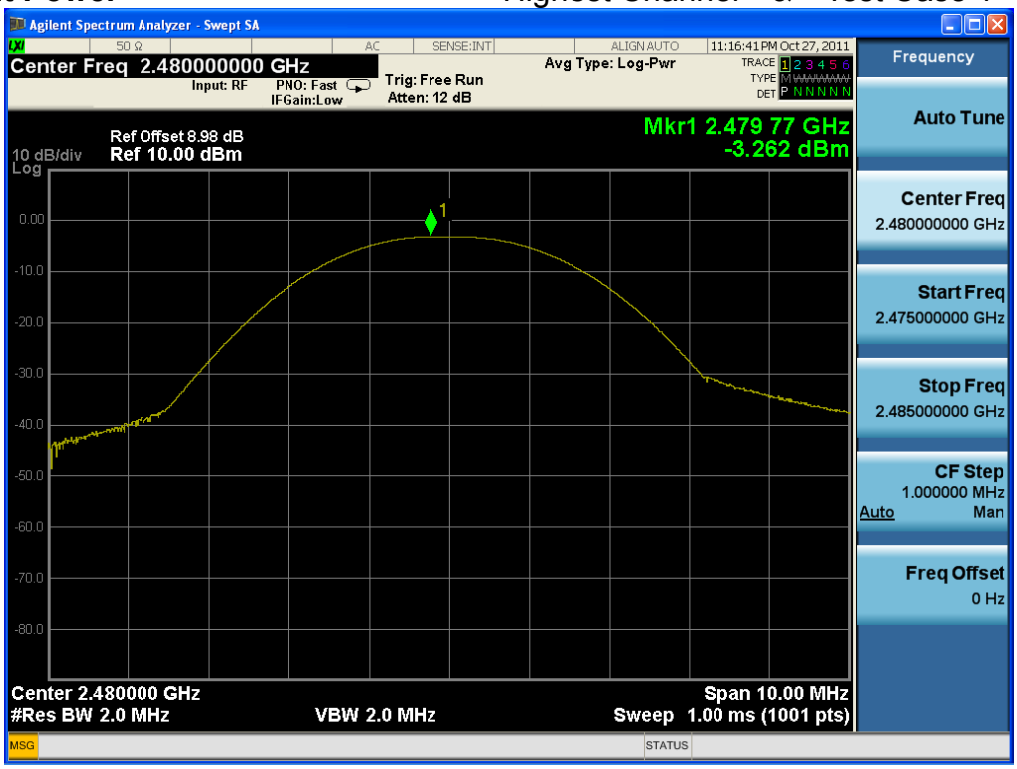
Peak Output Power Highest Channel & Test Case 1



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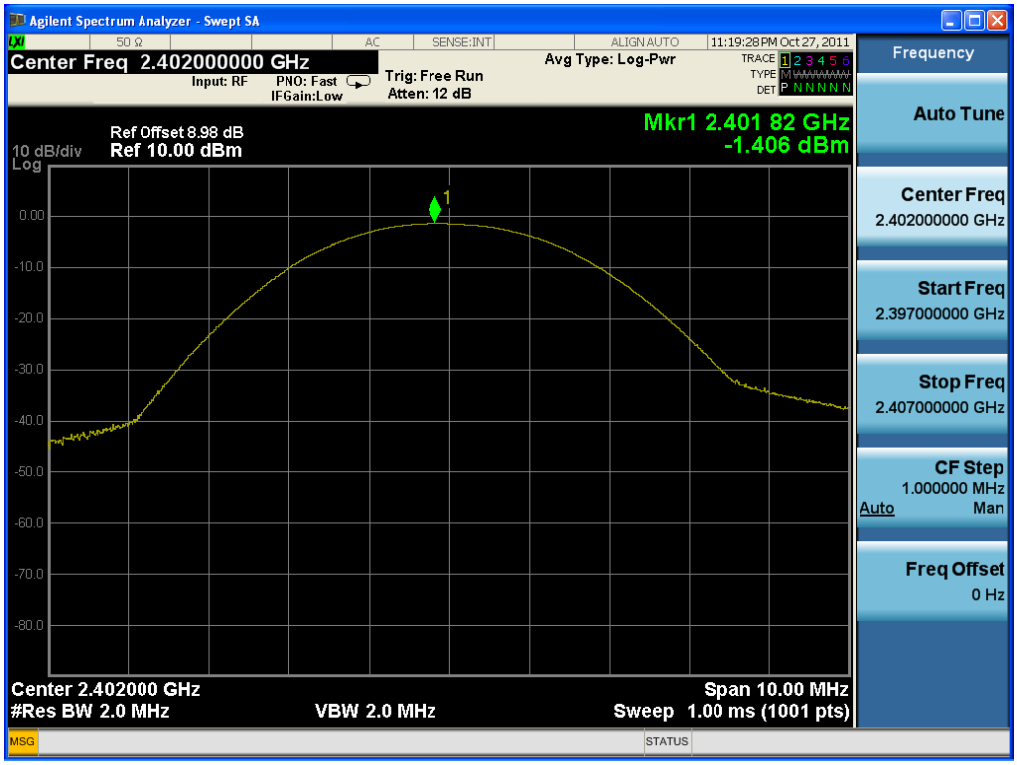
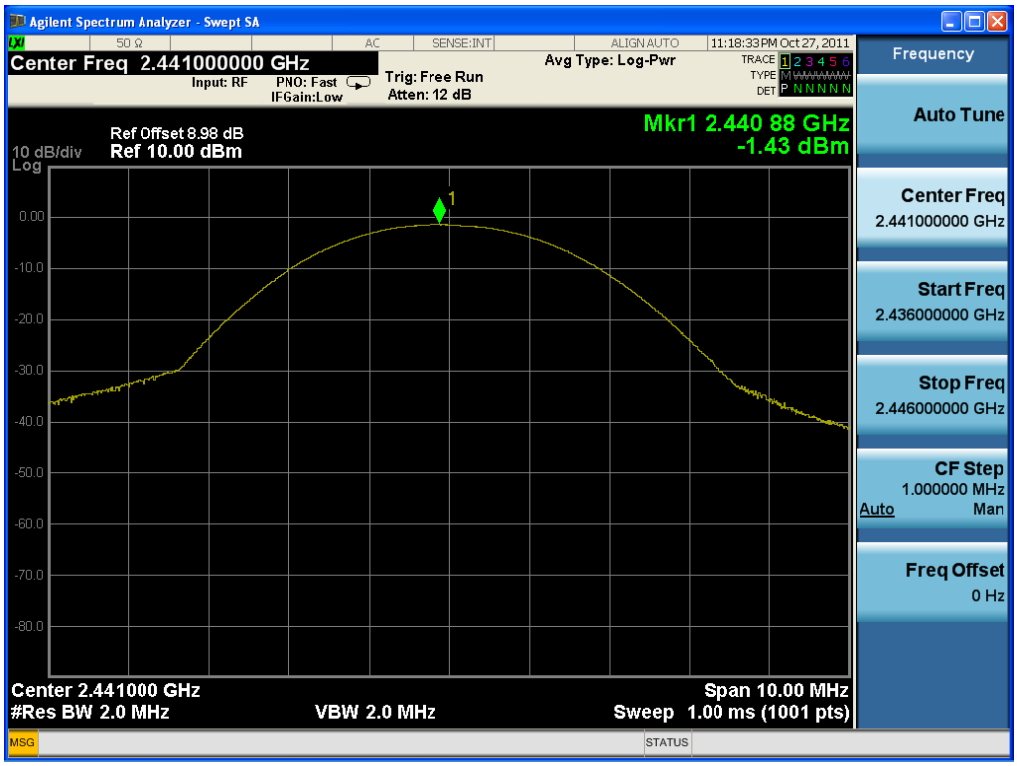
Peak Output Power Lowest Channel & Test Case 2



Peak Output Power Middle Channel & Test Case 2



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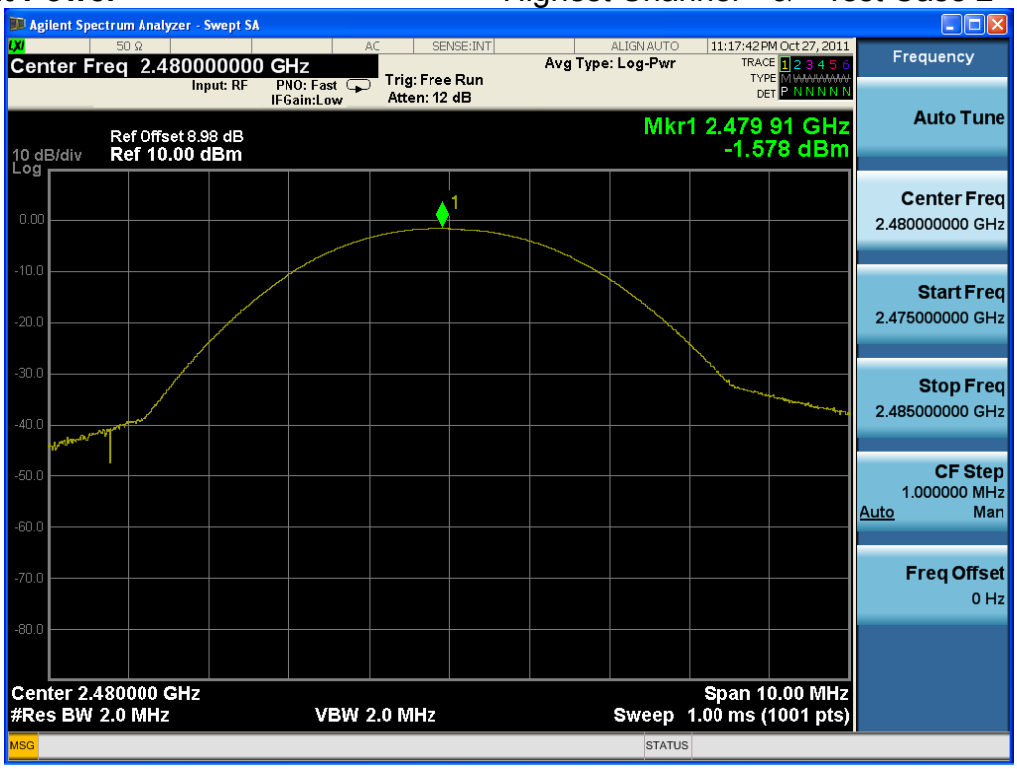
Peak Output Power Highest Channel & Test Case 2



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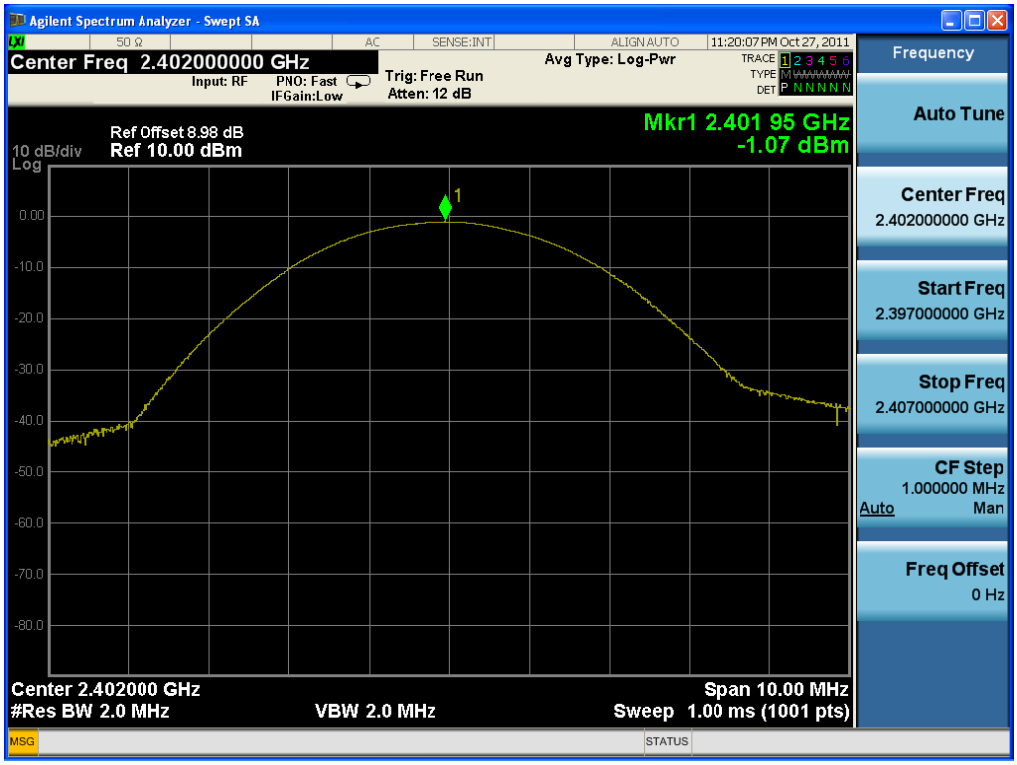
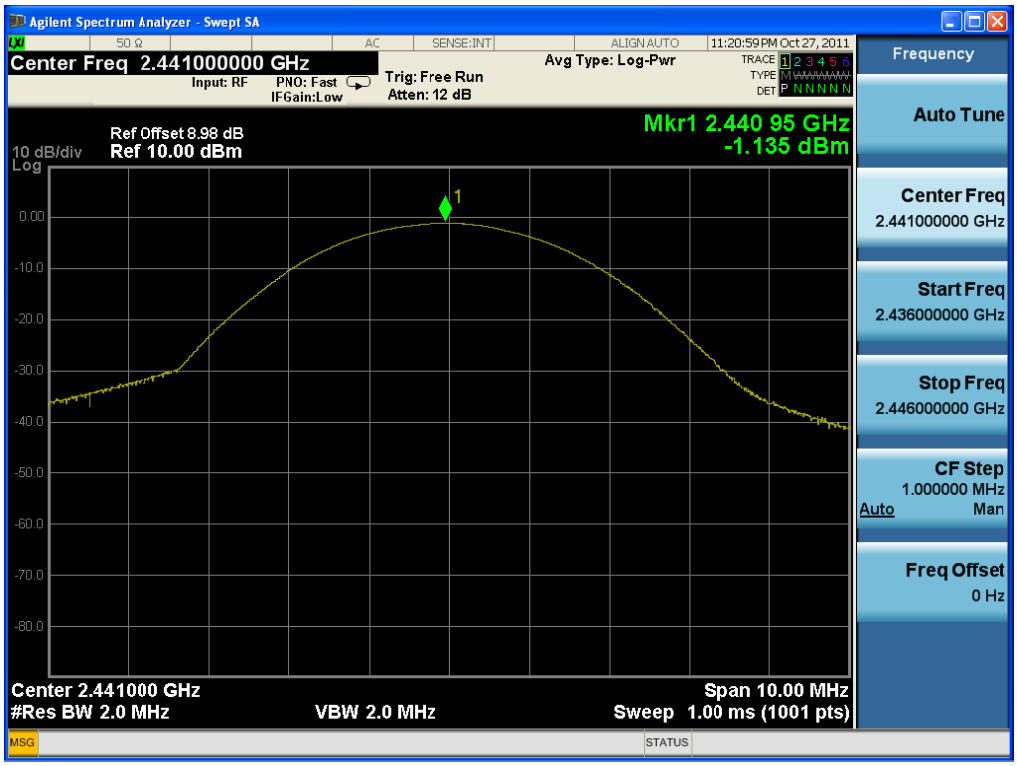
Peak Output Power Lowest Channel & Test Case 3



Peak Output Power Middle Channel & Test Case 3



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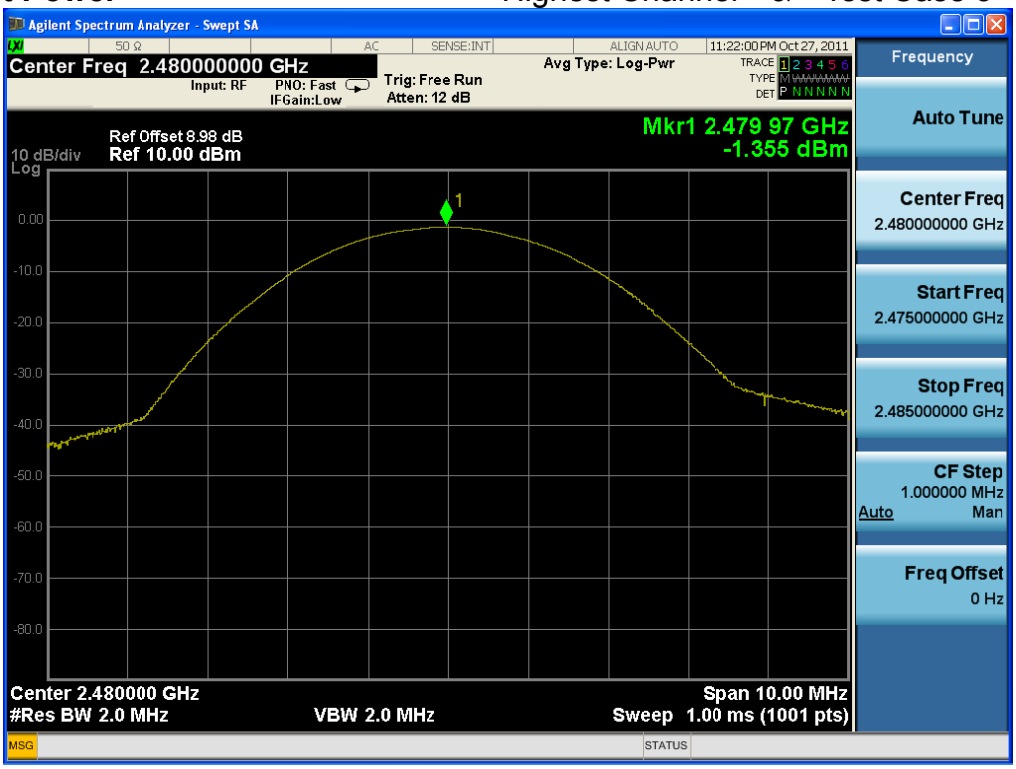
Peak Output Power Highest Channel & Test Case 3



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3.2.6 Conducted Spurious Emissions

- Procedure:

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

For Band-edge testing the spectrum analyzer is set to:

Tested frequency = the highest and the lowest Frequencies

Center frequency = 2400MHz, 2483.5MHz

Span = 10MHz Detector function = peak

RBW = 1% of the span VBW = ≥ RBW

Trace = max hold Sweep = auto

For spurious testing the spectrum analyzer is set to:

Tested frequency = the highest, middle and the lowest Frequencies

RBW = 100 kHz VBW = ≥ RBW

Detector function = peak Sweep = auto

Trace = max hold

- Measurement Data: Comply

Note 1: See next pages for actual measured spectrum plots.

- **Minimum Standard:**

Minimum Standard:	> 20 dBc

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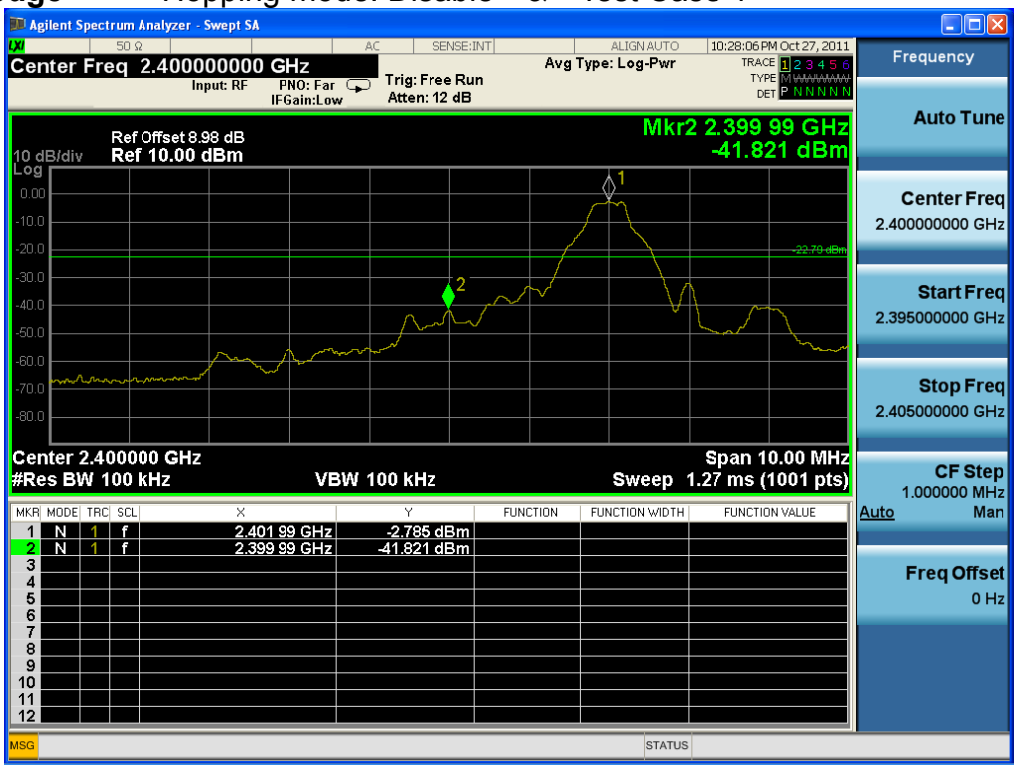
Low Band-edge Hopping mode: Disable & Test Case 1



Low Band-edge Hopping mode: Enable & Test Case 1

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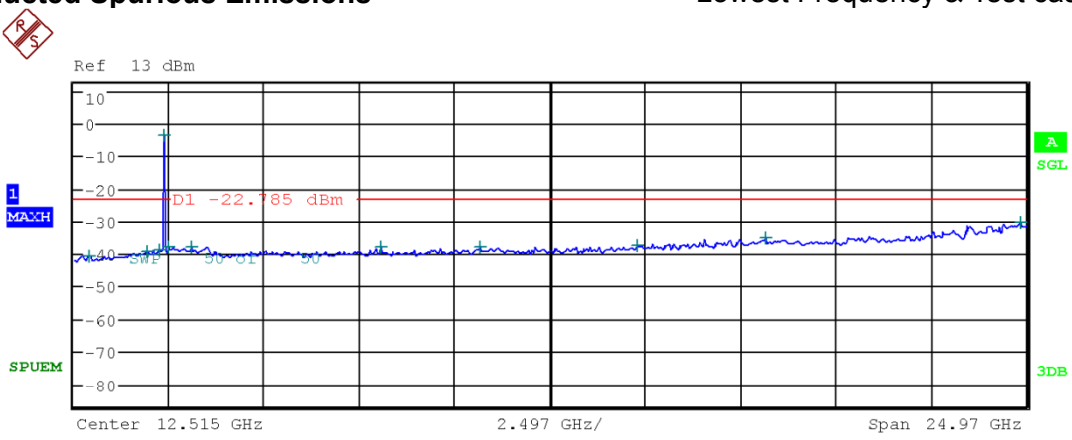
Conducted Spurious Emissions Lowest Frequency & Test case 1



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	415.090000 M	-40.70	-200.00
1.000 G	2.000 G	100.00 k	1.953000 G	-39.46	-200.00
2.000 G	2.400 G	100.00 k	2.256960 G	-38.66	-200.00
2.400 G	2.483 G	100.00 k	2.401979 G	-3.51	-200.00
2.483 G	3.000 G	100.00 k	2.503385 G	-37.94	-200.00
3.000 G	6.000 G	100.00 k	3.127333 G	-37.93	-200.00
6.000 G	9.000 G	100.00 k	8.075000 G	-38.15	-200.00
9.000 G	12.000 G	100.00 k	10.654667 G	-37.93	-200.00
12.000 G	15.000 G	100.00 k	14.815000 G	-37.58	-200.00
15.000 G	20.000 G	100.00 k	18.142778 G	-35.33	-200.00
20.000 G	25.000 G	100.00 k	24.822222 G	-30.51	-200.00

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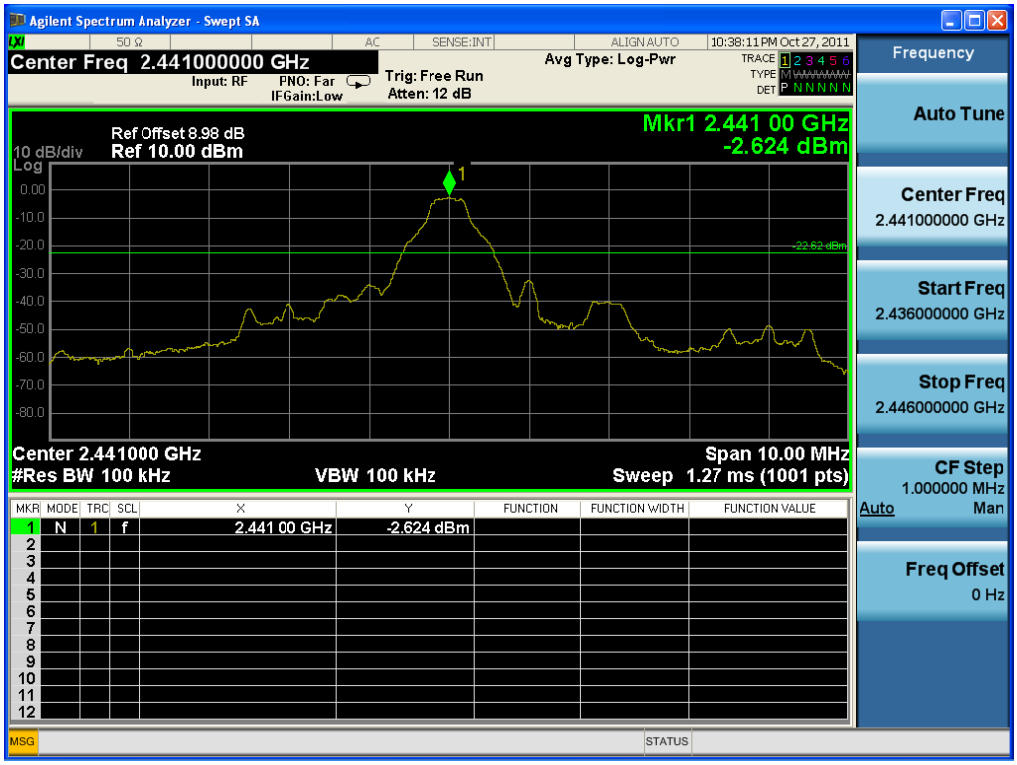
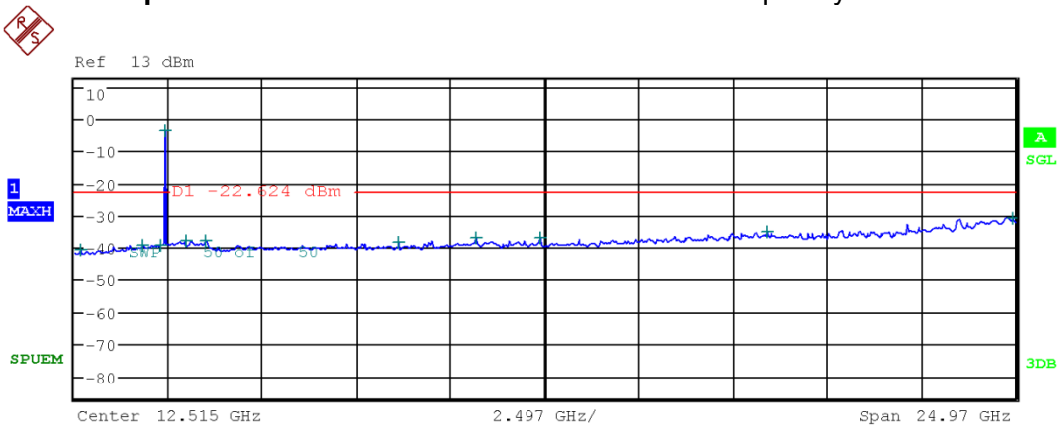
Reference for limit Middle Frequency & Test case 1



Conducted Spurious Emissions Middle Frequency & Test case 1



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	177.440000 M	-40.69	-200.00
1.000 G	2.000 G	100.00 k	1.842000 G	-39.20	-200.00
2.000 G	2.400 G	100.00 k	2.299800 G	-39.23	-200.00
2.400 G	2.483 G	100.00 k	2.440999 G	-3.64	-200.00
2.483 G	3.000 G	100.00 k	2.996901 G	-37.91	-200.00
3.000 G	6.000 G	100.00 k	3.530667 G	-38.03	-200.00
6.000 G	9.000 G	100.00 k	8.619333 G	-38.54	-200.00
9.000 G	12.000 G	100.00 k	10.677000 G	-37.10	-200.00
12.000 G	15.000 G	100.00 k	12.381667 G	-36.80	-200.00
15.000 G	20.000 G	100.00 k	18.399444 G	-35.36	-200.00
20.000 G	25.000 G	100.00 k	24.928889 G	-30.86	-200.00

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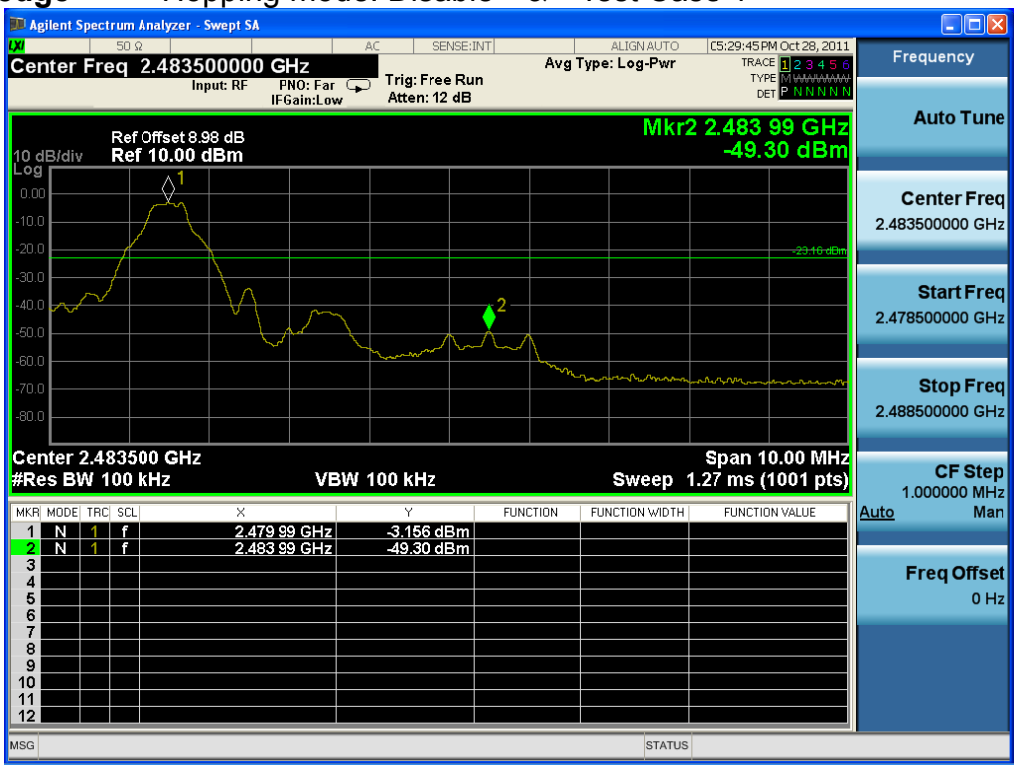
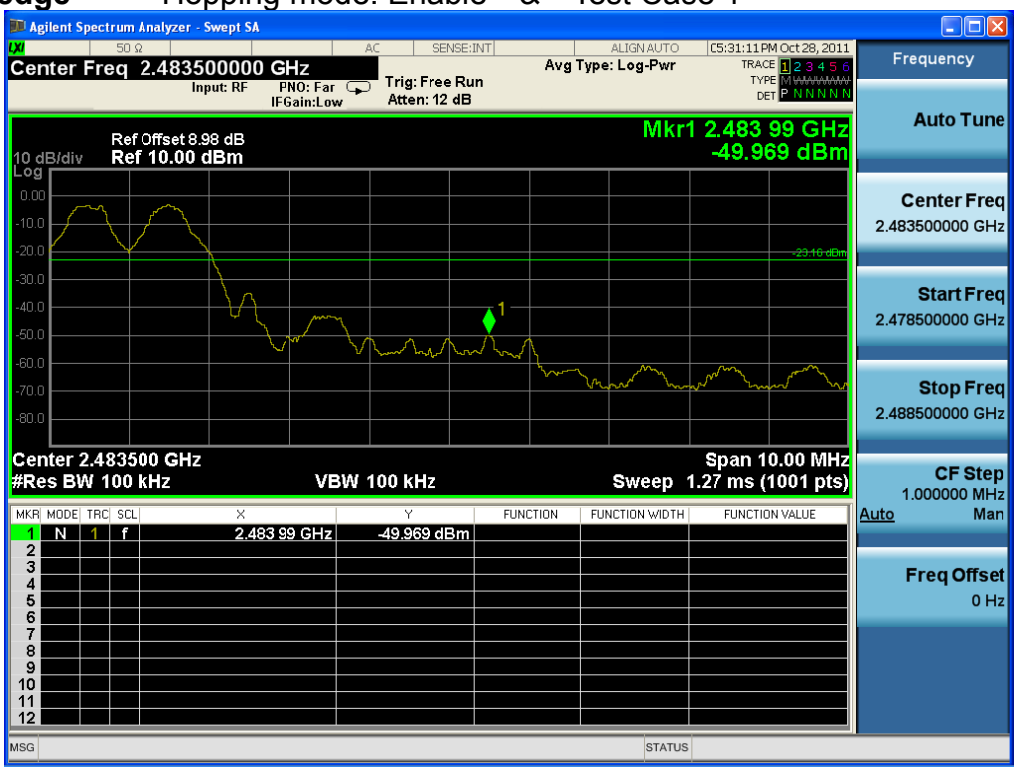
High Band-edge Hopping mode: Disable & Test Case 1



High Band-edge Hopping mode: Enable & Test Case 1



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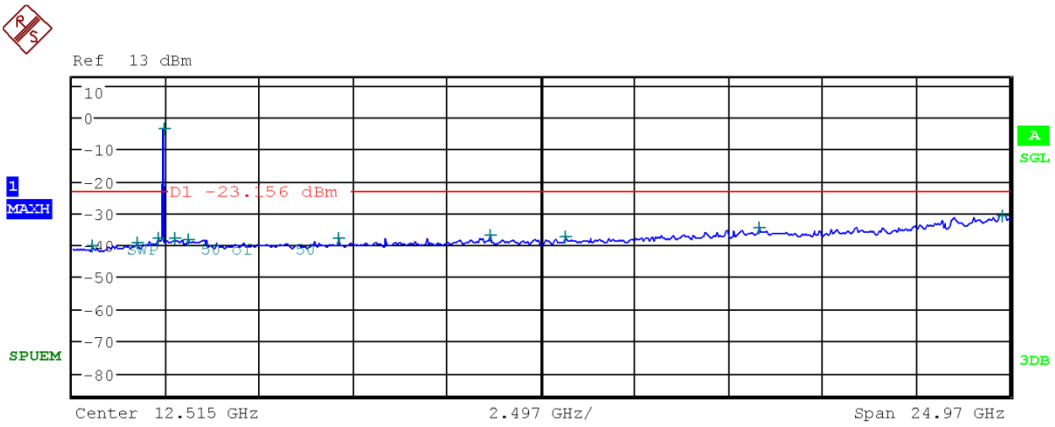
Conducted Spurious Emissions Highest Frequency & Test case 1



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	557.680000 M	-40.47	-200.00
1.000 G	2.000 G	100.00 k	1.740000 G	-39.30	-200.00
2.000 G	2.400 G	100.00 k	2.293560 G	-38.02	-200.00
2.400 G	2.483 G	100.00 k	2.480156 G	-3.54	-200.00
2.483 G	3.000 G	100.00 k	2.755541 G	-38.09	-200.00
3.000 G	6.000 G	100.00 k	3.125667 G	-38.29	-200.00
6.000 G	9.000 G	100.00 k	7.113667 G	-38.13	-200.00
9.000 G	12.000 G	100.00 k	11.166333 G	-37.12	-200.00
12.000 G	15.000 G	100.00 k	13.153333 G	-37.53	-200.00
15.000 G	20.000 G	100.00 k	18.307222 G	-34.69	-200.00
20.000 G	25.000 G	100.00 k	24.817222 G	-30.80	-200.00

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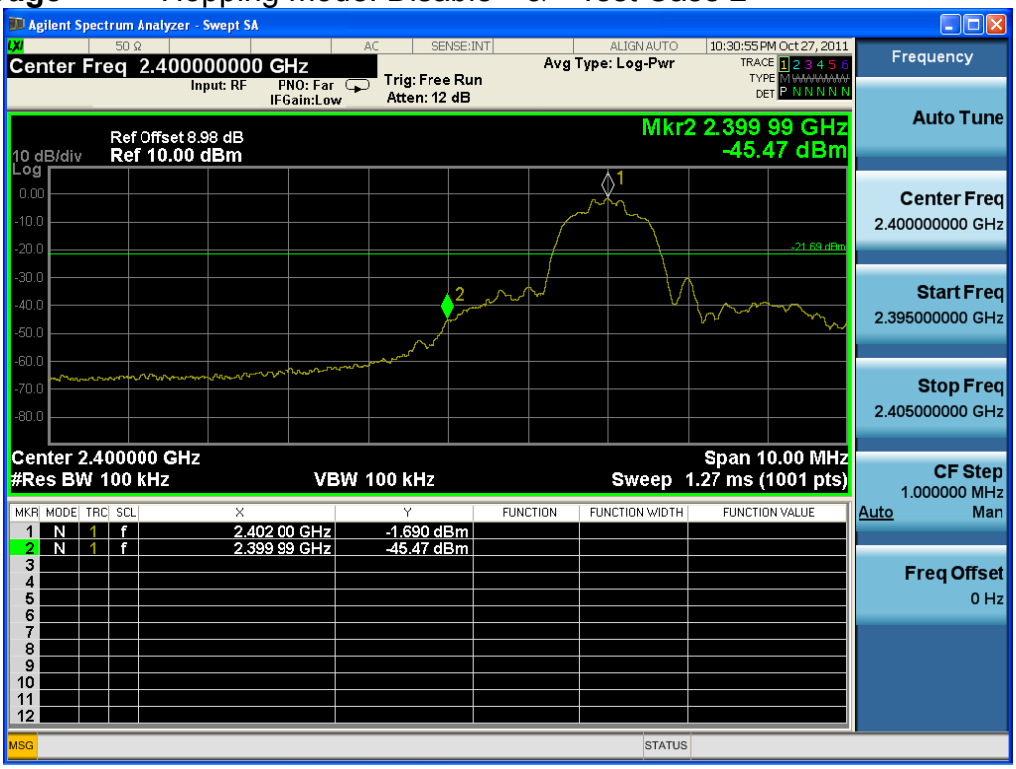
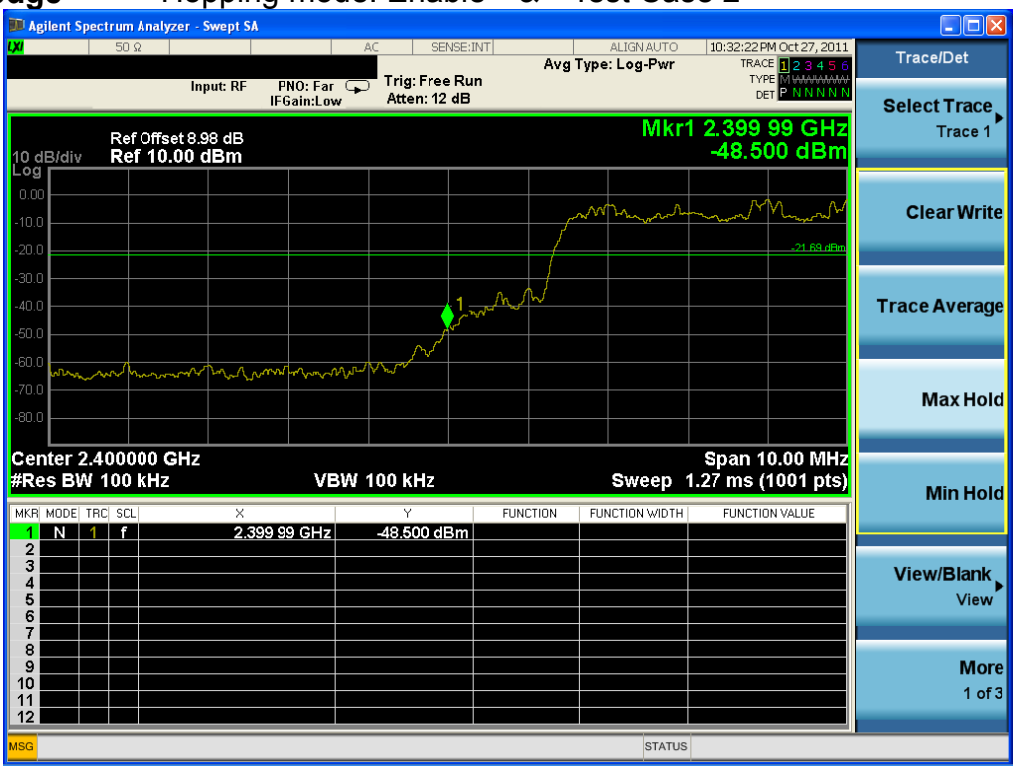
Low Band-edge Hopping mode: Disable & Test Case 2



Low Band-edge Hopping mode: Enable & Test Case 2



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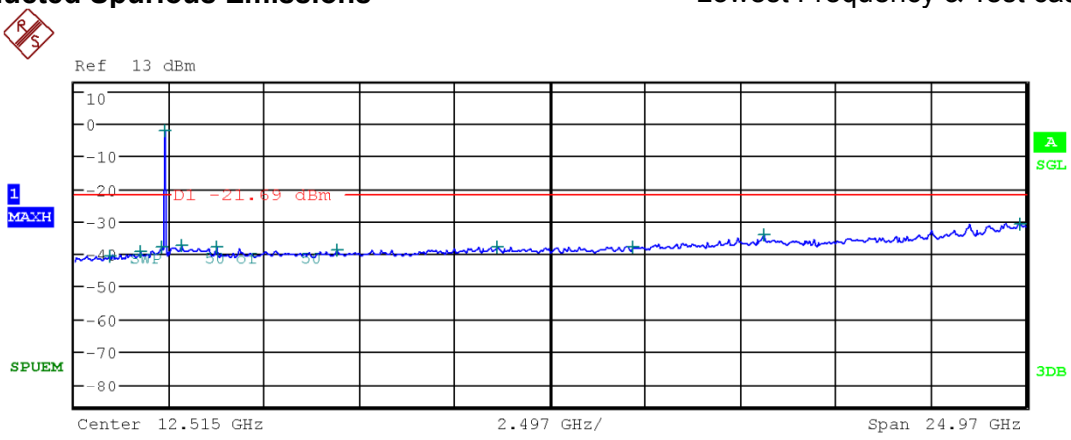
Conducted Spurious Emissions Lowest Frequency & Test case 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	1.000 G	100.00 k	934.040000 M	-40.69	-200.00
1.000 G	2.000 G	100.00 k	1.756000 G	-39.51	-200.00
2.000 G	2.400 G	100.00 k	2.310080 G	-37.87	-200.00
2.400 G	2.483 G	100.00 k	2.401991 G	-2.24	-200.00
2.483 G	3.000 G	100.00 k	2.811581 G	-37.68	-200.00
3.000 G	6.000 G	100.00 k	3.764333 G	-37.93	-200.00
6.000 G	9.000 G	100.00 k	6.926000 G	-38.87	-200.00
9.000 G	12.000 G	100.00 k	11.118333 G	-37.72	-200.00
12.000 G	15.000 G	100.00 k	14.657000 G	-37.92	-200.00
15.000 G	20.000 G	100.00 k	18.126111 G	-34.30	-200.00
20.000 G	25.000 G	100.00 k	24.829444 G	-30.82	-200.00

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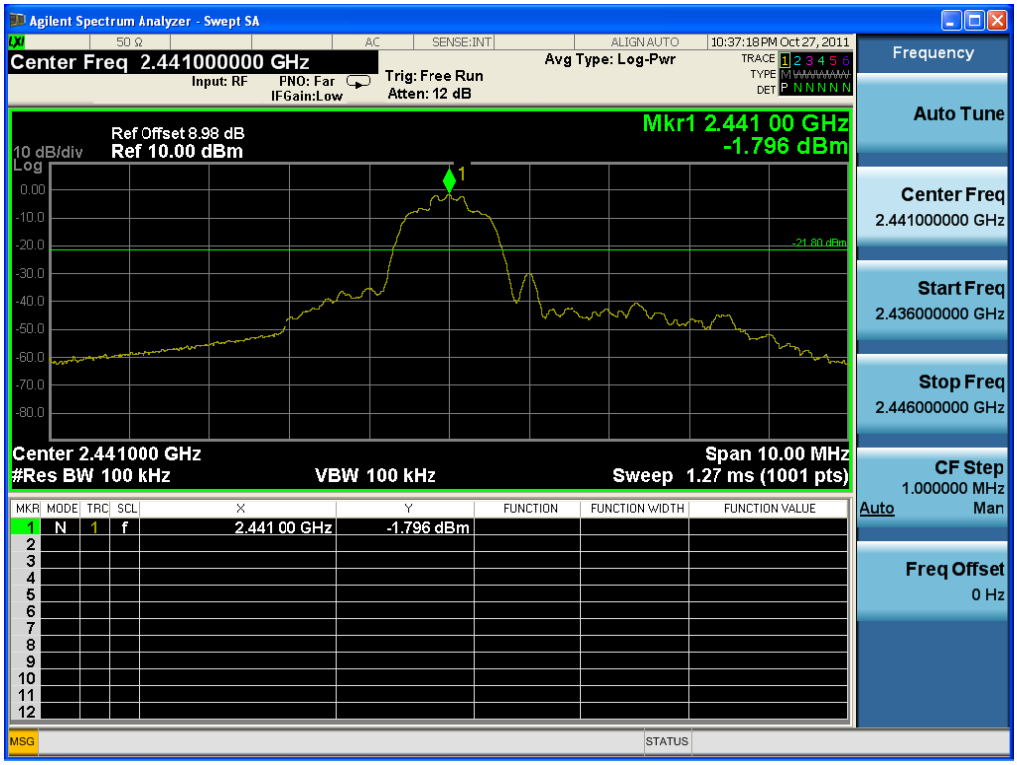
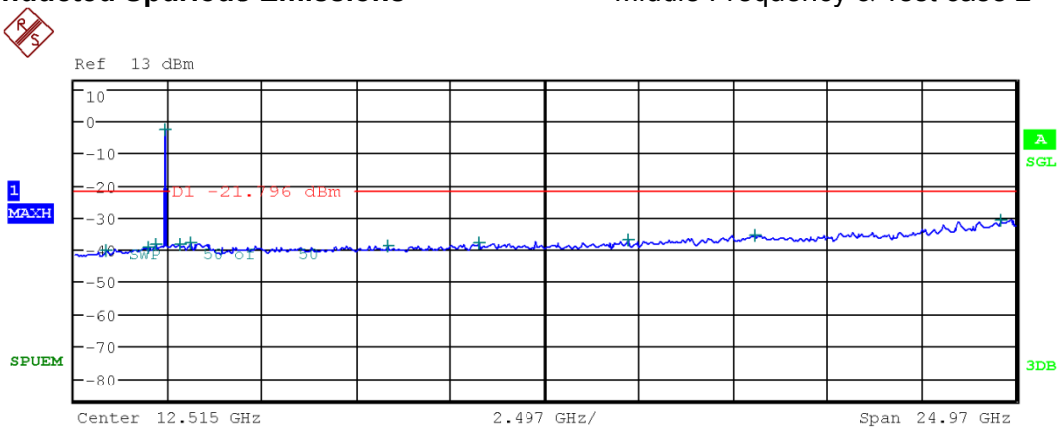
Reference for limit Middle Frequency & Test case 2



Conducted Spurious Emissions Middle Frequency & Test case 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	876.810000 M	-40.39	-200.00
1.000 G	2.000 G	100.00 k	1.976000 G	-39.45	-200.00
2.000 G	2.400 G	100.00 k	2.202480 G	-38.63	-200.00
2.400 G	2.483 G	100.00 k	2.440806 G	-2.74	-200.00
2.483 G	3.000 G	100.00 k	2.831466 G	-38.19	-200.00
3.000 G	6.000 G	100.00 k	3.109333 G	-38.08	-200.00
6.000 G	9.000 G	100.00 k	8.337333 G	-38.84	-200.00
9.000 G	12.000 G	100.00 k	10.738333 G	-37.72	-200.00
12.000 G	15.000 G	100.00 k	14.702667 G	-36.96	-200.00
15.000 G	20.000 G	100.00 k	18.088333 G	-35.50	-200.00
20.000 G	25.000 G	100.00 k	24.585556 G	-30.69	-200.00

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High Band-edge Hopping mode: Disable & Test Case 2

High Band-edge Hopping mode: Enable & Test Case 2

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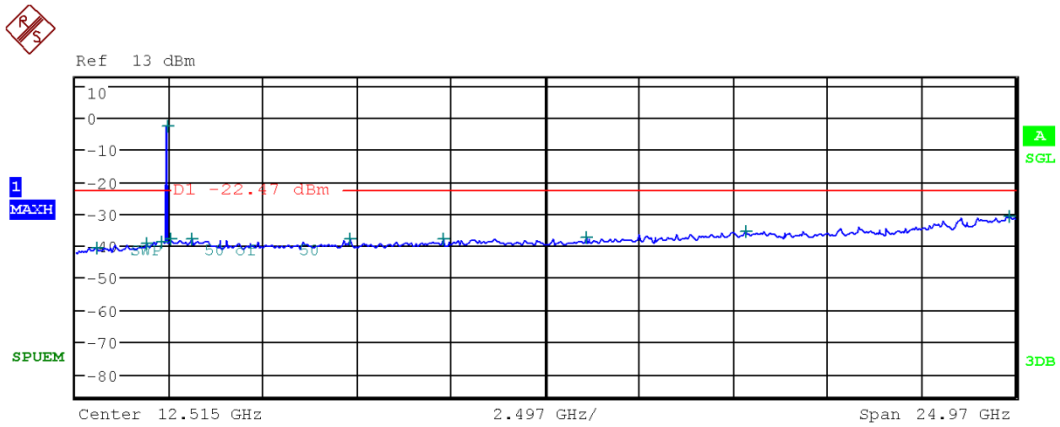
Conducted Spurious Emissions Highest Frequency & Test case 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	607.150000 M	-40.54	-200.00
1.000 G	2.000 G	100.00 k	1.895000 G	-39.30	-200.00
2.000 G	2.400 G	100.00 k	2.306680 G	-38.85	-200.00
2.400 G	2.483 G	100.00 k	2.480006 G	-2.91	-200.00
2.483 G	3.000 G	100.00 k	2.536958 G	-37.79	-200.00
3.000 G	6.000 G	100.00 k	3.100667 G	-38.05	-200.00
6.000 G	9.000 G	100.00 k	7.303000 G	-37.86	-200.00
9.000 G	12.000 G	100.00 k	9.781333 G	-38.01	-200.00
12.000 G	15.000 G	100.00 k	13.599667 G	-37.59	-200.00
15.000 G	20.000 G	100.00 k	17.851111 G	-35.57	-200.00
20.000 G	25.000 G	100.00 k	24.840556 G	-30.78	-200.00

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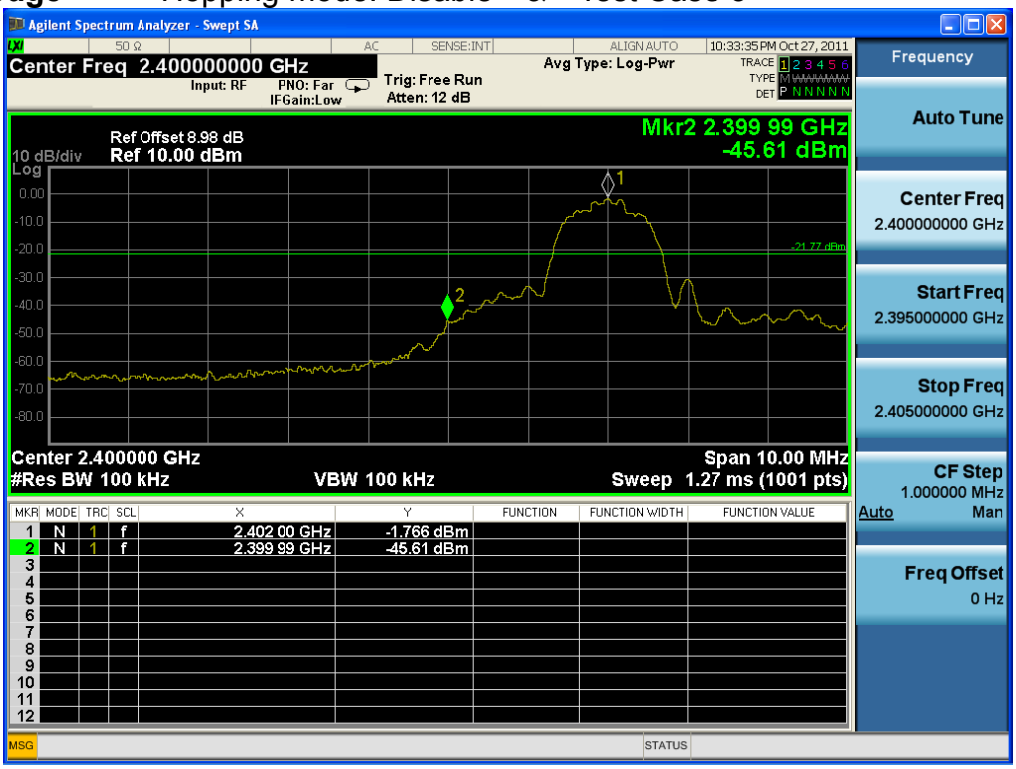
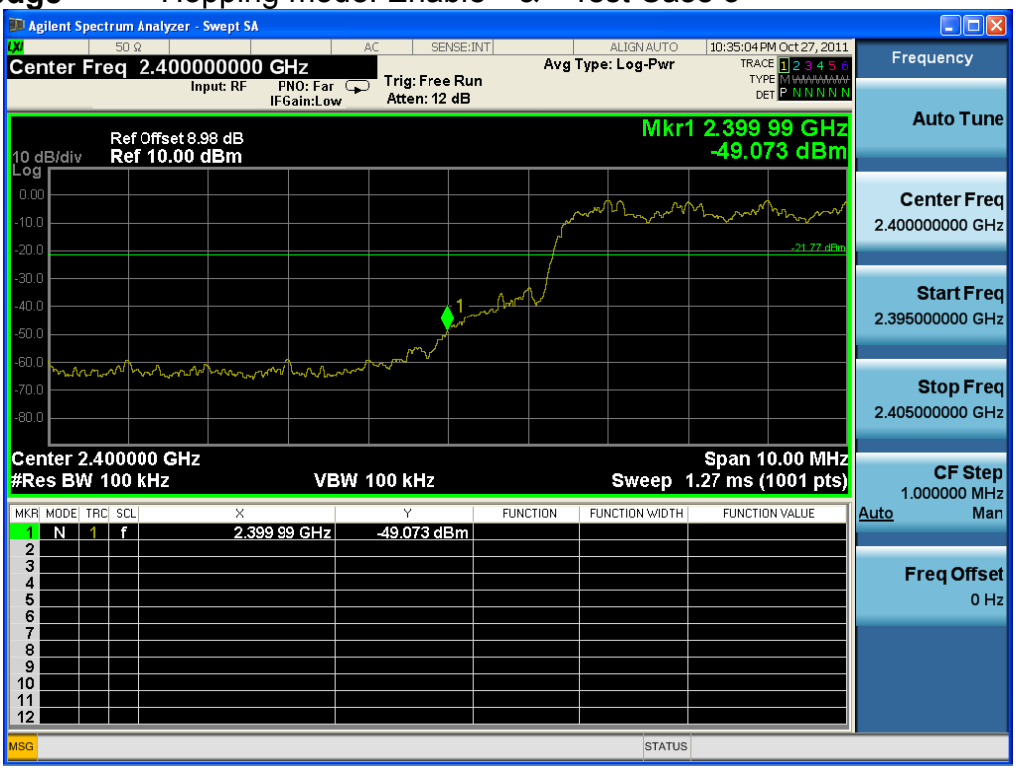
Low Band-edge Hopping mode: Disable & Test Case 3



Low Band-edge Hopping mode: Enable & Test Case 3



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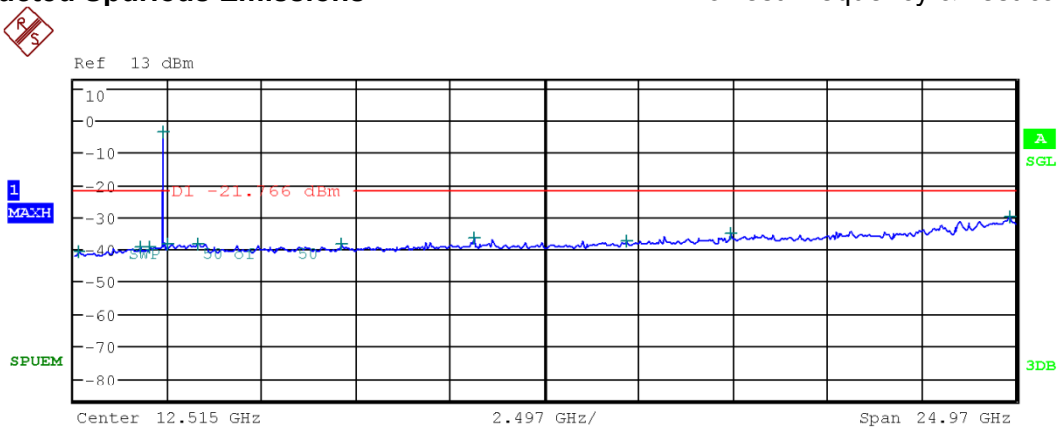
Conducted Spurious Emissions Lowest Frequency & Test case 3



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	147.370000 M	-40.88	-200.00
1.000 G	2.000 G	100.00 k	1.808000 G	-39.53	-200.00
2.000 G	2.400 G	100.00 k	2.021720 G	-39.20	-200.00
2.400 G	2.483 G	100.00 k	2.401904 G	-3.65	-200.00
2.483 G	3.000 G	100.00 k	2.492590 G	-38.47	-200.00
3.000 G	6.000 G	100.00 k	3.308667 G	-38.23	-200.00
6.000 G	9.000 G	100.00 k	7.131000 G	-38.54	-200.00
9.000 G	12.000 G	100.00 k	10.616667 G	-36.30	-200.00
12.000 G	15.000 G	100.00 k	14.668333 G	-37.37	-200.00
15.000 G	20.000 G	100.00 k	17.446111 G	-35.29	-200.00
20.000 G	25.000 G	100.00 k	24.823889 G	-30.01	-200.00

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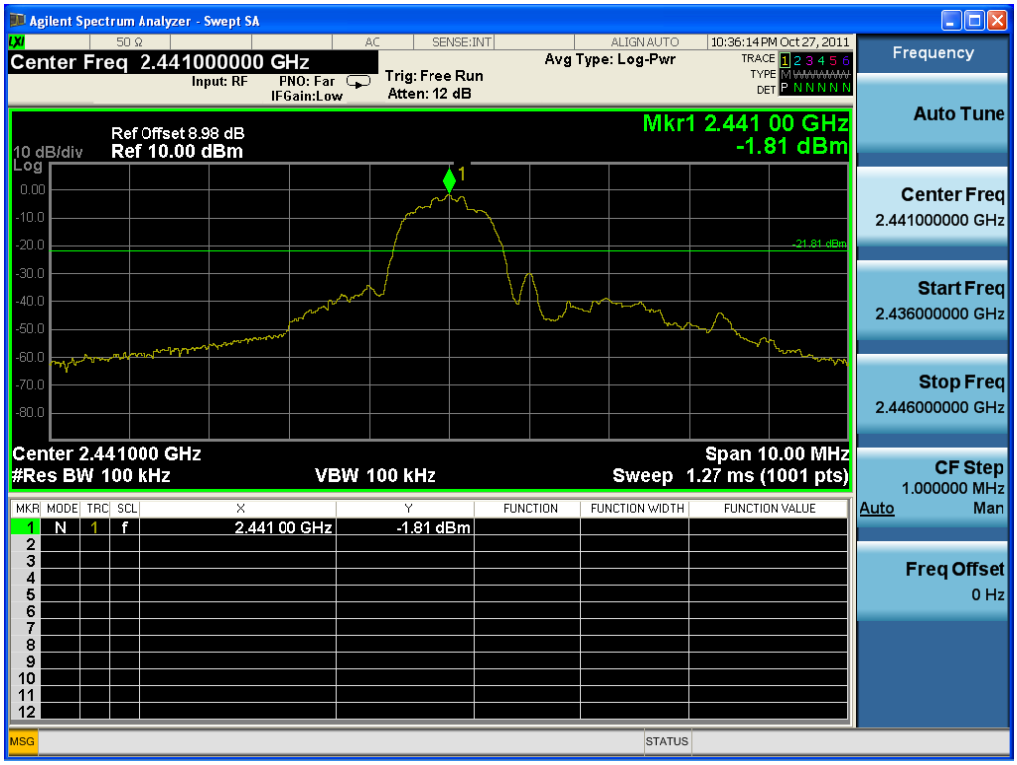
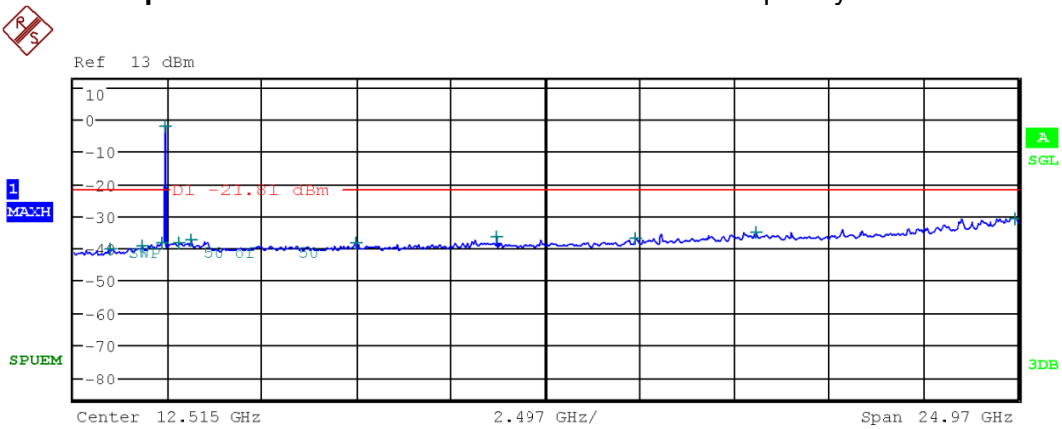
Reference for limit Middle Frequency & Test case 3



Conducted Spurious Emissions Middle Frequency & Test case 3



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	991.270000 M	-40.50	-200.00
1.000 G	2.000 G	100.00 k	1.820000 G	-39.15	-200.00
2.000 G	2.400 G	100.00 k	2.359680 G	-38.47	-200.00
2.400 G	2.483 G	100.00 k	2.440990 G	-2.32	-200.00
2.483 G	3.000 G	100.00 k	2.805538 G	-38.25	-200.00
3.000 G	6.000 G	100.00 k	3.114000 G	-37.62	-200.00
6.000 G	9.000 G	100.00 k	7.472333 G	-38.43	-200.00
9.000 G	12.000 G	100.00 k	11.184667 G	-36.57	-200.00
12.000 G	15.000 G	100.00 k	14.864000 G	-37.18	-200.00
15.000 G	20.000 G	100.00 k	18.067222 G	-34.96	-200.00
20.000 G	25.000 G	100.00 k	24.921667 G	-30.77	-200.00

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High Band-edge Hopping mode: Disable & Test Case 3

High Band-edge Hopping mode: Enable & Test Case 3

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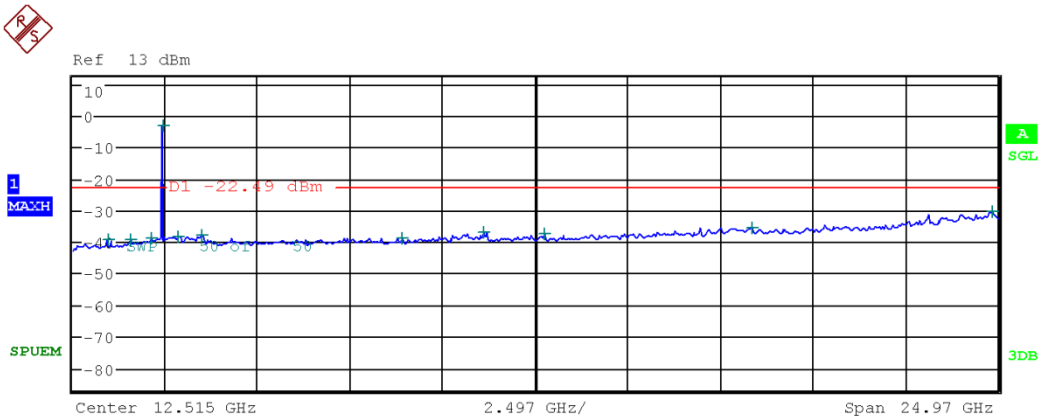
Conducted Spurious Emissions Highest Frequency & Test case 3



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	1.000 G	100.00 k	997.090000 M	-39.54	-200.00
1.000 G	2.000 G	100.00 k	1.604000 G	-39.29	-200.00
2.000 G	2.400 G	100.00 k	2.132720 G	-38.73	-200.00
2.400 G	2.483 G	100.00 k	2.480014 G	-3.28	-200.00
2.483 G	3.000 G	100.00 k	2.890657 G	-38.25	-200.00
3.000 G	6.000 G	100.00 k	3.508000 G	-38.03	-200.00
6.000 G	9.000 G	100.00 k	8.926667 G	-38.68	-200.00
9.000 G	12.000 G	100.00 k	11.099000 G	-36.92	-200.00
12.000 G	15.000 G	100.00 k	12.773333 G	-37.43	-200.00
15.000 G	20.000 G	100.00 k	18.348889 G	-35.55	-200.00
20.000 G	25.000 G	100.00 k	24.828889 G	-30.25	-200.00

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3.2.7 Radiated Spurious Emissions

- Procedure:

The EUT was placed on a 0.8m high wooden table inside a shielded enclosure. An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements. For final radiated testing, measurements were performed in OATS. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

The spectrum analyzer is set to:

Tested frequency = Low, Middle, High Frequencies

Frequency Range = 30 MHz ~ 10th harmonic.

RBW and VBW = 1. Frequency range: 30MHz ~ 1GHz
RBW = 120KHz / VBW = ≥ RBW
2. Frequency range: 1GHz ~ 10th harmonics
Peak mode: RBW = 1MHz / VBW = ≥ RBW
Average mode: RBW = 1MHz / VBW = 10Hz

Detector function = Peak Sweep = auto

Trace = max hold

- Measurement Data: Comply

Note 1: See next pages for actual measured spectrum plots and data.

- Minimum Standard:

▪ FCC Part 15.209(a) and (b)

Frequency (MHz)	Limit (uV/m) @ 3m
30 ~ 88	100 **
88 ~ 216	150 **
216 ~ 960	200 **
Above 960	500

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

▪ FCC Part 15.205 (a): Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	3600 ~ 4400	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	4.5 ~ 5.15	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~ 12.52025	149.9 ~ 150.05	1645.5 ~ 1646.5	5.35 ~ 5.46	17.7 ~ 21.4
4.125 ~ 4.128	12.57675 ~ 12.57725	156.52475 ~ 156.52525	1660 ~ 1710	7.25 ~ 7.75	22.01 ~ 23.12
4.17725 ~ 4.17775	13.36 ~ 13.41	156.7 ~ 156.9	1718.8 ~ 1722.2	8.025 ~ 8.5	23.6 ~ 24.0
4.20725 ~ 4.20775	16.42 ~ 16.423	162.0125 ~ 167.17	2200 ~ 2300	9.0 ~ 9.2	31.2 ~ 31.8
6.215 ~ 6.218	16.69475 ~ 16.69525	167.72 ~ 173.2	2310 ~ 2390	9.3 ~ 9.5	36.43 ~ 36.5
6.26775 ~ 6.26825	16.80425 ~ 16.80475	240 ~ 285	2483.5 ~ 2500	10.6 ~ 12.7	Above 38.6
6.31175 ~ 6.31225	25.5 ~ 25.67	322 ~ 335.4	2655 ~ 2900	13.25 ~ 13.4	
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3260 ~ 3267		
8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3332 ~ 3339		
8.37625 ~ 8.38675	74.8 ~ 75.2	960 ~ 1240	3345.8 ~ 3358		

▪ FCC Part 15.205(b): The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

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30MHz ~ 25GHz Radiated Spurious Emissions & Test Case 1

▪ Lowest Channel

Freq. (MHz)	ANT Pol	The worst case EUT Position	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
320.625	H	X axis	QP	44.80	-7.00	37.80	46.00	8.20
2344.880	V	X axis	PK	52.09	-4.03	48.06	74.00	25.94
2342.240	V	X axis	AV	37.84	-4.03	33.81	54.00	20.19
4804.040	H	Z axis	PK	50.19	6.75	56.94	74.00	17.06
4803.950	H	Z axis	AV	40.54	6.75	47.29	54.00	6.71

▪ Middle Channel

Freq. (MHz)	ANT Pol	The worst case EUT Position	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
320.630	H	X axis	QP	45.02	-7.00	38.02	46.00	7.98
4882.130	H	Z axis	PK	50.47	6.83	57.30	74.00	16.70
4881.950	H	Z axis	AV	41.27	6.83	48.10	54.00	5.90

▪ Highest Channel

Freq. (MHz)	ANT Pol	The worst case EUT Position	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
320.628	H	X axis	QP	44.23	-7.00	37.23	46.00	8.77
2483.740	H	X axis	PK	54.04	-3.65	50.39	74.00	23.61
2483.960	H	X axis	AV	43.15	-3.65	39.50	54.00	14.50
4959.640	H	Z axis	PK	50.32	7.19	57.51	74.00	16.49
4959.940	H	Z axis	AV	41.44	7.19	48.63	54.00	5.37

Note.

1. No other spurious and harmonic emissions were reported greater than listed emissions on above table.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

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30MHz ~ 25GHz Radiated Spurious Emissions & Test Case 2

▪ Lowest Channel

Freq. (MHz)	ANT Pol	The worst case EUT Position	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
320.540	H	X axis	QP	45.31	-7.00	38.31	46.00	7.69
2341.920	V	X axis	PK	51.61	-4.03	47.58	74.00	26.42
2342.000	V	X axis	AV	37.46	-4.03	33.43	54.00	20.57
4805.340	H	Z axis	PK	45.75	6.75	52.50	74.00	21.50
4804.100	H	Z axis	AV	33.61	6.75	40.36	54.00	13.64

▪ Middle Channel

Freq. (MHz)	ANT Pol	The worst case EUT Position	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
320.630	H	X axis	QP	45.02	-7.00	38.02	46.00	7.98
4881.870	H	Z axis	PK	46.63	6.83	53.46	74.00	20.54
4884.860	H	Z axis	AV	33.61	6.83	40.44	54.00	13.56

▪ Highest Channel

Freq. (MHz)	ANT Pol	The worst case EUT Position	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
320.628	H	X axis	QP	44.23	-7.00	37.23	46.00	8.77
2483.500	H	X axis	PK	59.22	-3.65	55.57	74.00	18.43
2483.500	H	X axis	AV	45.75	-3.65	42.10	54.00	11.90
4959.760	H	Z axis	PK	45.54	7.19	52.73	74.00	21.27
4959.810	H	Z axis	AV	32.83	7.19	40.02	54.00	13.98

Note.

1. No other spurious and harmonic emissions were reported greater than listed emissions on above table.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

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30MHz ~ 25GHz Radiated Spurious Emissions & Test Case 3

▪ Lowest Channel

Freq. (MHz)	ANT Pol	The worst case EUT Position	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
320.639	H	X axis	QP	44.92	-7.00	37.92	46.00	8.08
2342.000	V	X axis	PK	51.93	-4.03	47.90	74.00	26.10
2342.000	V	X axis	AV	37.89	-4.03	33.86	54.00	20.14
4805.280	H	Z axis	PK	45.90	6.75	52.65	74.00	21.35
4804.040	H	Z axis	AV	33.82	6.75	40.57	54.00	13.43

▪ Middle Channel

Freq. (MHz)	ANT Pol	The worst case EUT Position	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
320.720	H	X axis	QP	44.66	-7.00	37.66	46.00	8.34
4881.780	H	Z axis	PK	46.23	6.83	53.06	74.00	20.94
4881.930	H	Z axis	AV	32.74	6.83	39.57	54.00	14.43

▪ Highest Channel

Freq. (MHz)	ANT Pol	The worst case EUT Position	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
320.740	H	X axis	QP	44.48	-7.00	37.48	46.00	8.52
2483.500	H	X axis	PK	59.53	-3.65	55.88	74.00	18.12
2483.500	H	X axis	AV	45.48	-3.65	41.83	54.00	12.17
4959.640	H	Z axis	PK	45.89	7.19	53.08	74.00	20.92
4959.890	H	Z axis	AV	32.76	7.19	39.95	54.00	14.05

Note.

1. No other spurious and harmonic emissions were reported greater than listed emissions on above table.
2. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

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3.2.8 AC Line Conducted Emissions

- Procedure:

The conducted emissions are measured in the shielded room with a spectrum analyzer in peak hold. While the measurement, EUT had its hopping function disabled at the middle channels in line with Section 15.31(m). Emissions closest to the limit are measured in the quasi-peak and average detector mode with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation and Exerciser operation. The highest emissions relative to the limit are listed.

- Measurement Data: N/A

- Minimum Standard: FCC Part 15.207(a)/EN 55022

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

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3.2.9 Antenna Requirements

- Procedure:
Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT.

- Conclusion: Comply
→ The antenna type is a Chip antenna. The antenna is attached permanently using soldering.
(Refer to Internal photo file.)

- Minimum Standard:

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions.

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APPENDIX I

TEST EQUIPMENT FOR TESTS

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To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment.

	Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
☐	Spectrum Analyzer	Agilent	E4440A	11/09/30	12/09/30	MY45304199
☒	Spectrum Analyzer	Rohde Schwarz	FSQ26	11/01/11	12/01/11	200445
☐	Spectrum analyzer	Agilent	E4404B	11/03/08	12/03/08	US41061134
☐	Spectrum Analyzer(RE)	H.P	8563E	11/10/04	12/10/04	3551A04634
☒	MXA Signal Analyzer	Agilent Technologies, Inc	N9020A	11/01/07	12/01/07	MY49100833
☐	Power Meter	H.P	EPM-442A	11/07/01	12/07/01	GB37170413
☐	Power Sensor	H.P	8481A	11/07/01	12/07/01	3318A96332
☐	Wideband Power Sensor	Rohde Schwarz	NRP-Z81	11/06/04/	12/06/04	1137.9009.02-101001
☐	Power Divider	Agilent	11636B	11/09/30	12/09/30	56471
☐	4-Way Power Divider	ET Industries	D-0526-4	10/12/24	11/12/24	210195001
☒	Power Splitter	Anritsu	K241B	11/09/30	12/09/30	020611
☐	Power Splitter	Anritsu	K241B	11/07/01	12/07/01	017060
☐	Power Splitters & Dividers	Aeroflex/Weinschel	1594	11/02/21	12/02/21	1177
☐	Frequency Counter	H.P	5342A	11/07/01	12/07/01	2119A04450
☐	TEMP & HUMIDITY Chamber	JISCO	KR-100/J-RHC2	11/09/30	12/09/30	30604493/021031
☒	Digital Multimeter	H.P	34401A	11/03/07	12/03/07	3146A13475, US36122178
☐	Multifunction Synthesizer	HP	8904A	11/10/06	12/10/06	3633A08404
☒	Signal Generator	Rohde Schwarz	SMR20	11/03/08	12/03/08	101251
☐	Signal Generator	H.P	ESG-3000A	11/07/01	12/07/01	US37230529
☒	Vector Signal Generator	Rohde Schwarz	SMJ100A	11/01/11	12/01/11	100148
☐	Vector Signal Generator	Rohde Schwarz	SMBV100A	11/01/11	12/01/11	255571
☐	Audio Analyzer	H.P	8903B	11/07/02	12/07/02	3011A09448
☐	Modulation Analyzer	H.P	8901B	11/07/01	12/07/01	3028A03029
☐	8960 Series 10 Wireless Comms. Test Set	Agilent	E5515C	11/03/07	12/03/07	GB43461134
☐	Universal Radio communication Tester	Rohde Schwarz	CMU200	11/03/07	12/03/07	106760
☒	Bluetooth Tester	TESCOM	TC-3000B	11/07/01	12/07/01	3000B000268
☐	Thermo hygrometer	BODYCOM	BJ5478	11/01/13	12/01/13	090205-3
☒	Thermo hygrometer	BODYCOM	BJ5478	11/01/13	12/01/13	090205-2
☐	Thermo hygrometer	BODYCOM	BJ5478	11/01/13	12/01/13	090205-4
☐	AC Power supply	DAEKWANG	5KVA	11/03/08	12/03/08	20060321-1
☒	DC Power Supply	HP	6622A	11/03/07	12/03/07	3448A03760
☐	DC Power Supply	HP	6633A	11/03/07	12/03/07	3524A06634
☐	DC Power Supply	Protek	PWS-3010D	11/09/30	12/09/30	4072702
☒	DC Power Supply	SM techno	SDP30-5D	11/05/20	12/05/20	305DKA013
☐	BAND Reject Filter	Microwave Circuits	N0308372	11/09/30	12/09/30	3125-01DC0352
☐	BAND Reject Filter	Wainwright	WRCG1750	11/09/30	12/09/30	2
☐	High-Pass Filter	ANRITSU	MP526D	11/09/30	12/09/30	M27756

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	Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
☐	High-pass filter	Wainwright	WHNX2.1	11/09/30	12/09/30	1
☒	High-pass filter	Wainwright	WHNX3.0	11/09/30	12/09/30	9
☐	High-pass filter	Wainwright	WHNX5.0	11/09/19	12/09/19	8
☐	High-Pass Filter	Wainwright	WHKX8.5	11/09/19	12/09/19	1
☐	High-Pass Filter	Wainwright	WHKX1.0	11/09/30	12/09/30	9
☐	Tunable Notch Filter	Wainwright	WRCT800.0 /960.0-0.2/40-8SSK	N/A	N/A	32
☐	Tunable Notch Filter	Wainwright	WRCD1700.0 /2000.0-0.2/40-10SSK	N/A	N/A	53
☐	Tunable Notch Filter	Wainwright	WRCT1900.0/ 2200.0-5/40-10SSK	N/A	N/A	30
☐	HORN ANT	ETS	3115	11/09/06	12/09/06	21097
☒	HORN ANT	ETS	3115	11/03/22	12/03/22	6419
☒	HORN ANT	A.H.Systems	SAS-574	11/03/25	13/03/25	154
☐	HORN ANT	A.H.Systems	SAS-574	11/03/25	13/03/25	155
☐	HORN ANT	SCHWARZBECK	BBHA9120A	10/04/13	12/04/13	322
☐	Dipole Antenna	Schwarzbeck	VHA9103	11/11/22	12/11/22	2116
☐	Dipole Antenna	Schwarzbeck	VHA9103	11/11/22	12/11/22	2117
☐	Dipole Antenna	Schwarzbeck	UHA9105	11/11/22	12/11/22	2261
☐	Dipole Antenna	Schwarzbeck	UHA9105	11/11/22	12/11/22	2262
☐	LOOP Antenna	ETS	6502	11/09/06	12/09/06	3471
☐	Coaxial Fixed Attenuators	Agilent	8491B	11/07/02	12/07/02	MY39260700
☐	Attenuator (3dB)	WEINSCHEL	56-3	11/09/30	12/09/30	Y2342
☐	Attenuator (3dB)	WEINSCHEL	56-3	11/09/30	12/09/30	Y2370
☐	Attenuator (10dB)	WEINSCHEL	23-10-34	11/09/30	12/09/30	BP4386
☐	Attenuator (10dB)	WEINSCHEL	23-10-34	11/01/11	12/01/11	BP4387
☐	Attenuator (10dB)	WEINSCHEL	86-10-11	11/09/30	12/09/30	446
☐	Attenuator (10dB)	WEINSCHEL	86-10-11	11/09/30	12/09/30	408
☐	Attenuator (20dB)	WEINSCHEL	86-20-11	11/09/30	12/09/30	432
☐	Attenuator (30dB)	JFW	50FH-030-300	11/03/07	12/03/07	060320-1
☐	Attenuator (40dB)	WEINSCHEL	57-40-33	11/09/30	12/09/30	NN837
☐	Termination	H.P	HP-909D	11/07/02	12/07/02	02750
☐	Termination	H.P	HP-909D	11/07/02	12/07/02	02702
☐	Type N Coaxial CIRCULATOR	NOVA MICROWAVE	0088CAN	11/07/01	12/07/01	788
☐	Type N Coaxial CIRCULATOR	NOVA MICROWAVE	0185CAN	11/07/01	12/07/01	790
☐	Amplifier (30dB)	Agilent	8449B	11/03/07	12/03/07	3008A01590
☒	Amplifier (30dB)	H.P	8449B	11/03/07	12/03/07	3008A00370
☐	Amplifier	EMPOWER	BBS3Q7ELU	11/09/30	12/09/30	1020
☐	RF Power Amplifier	OPHIRRF	5069F	11/07/01	12/07/01	1006
☒	EMI TEST RECEIVER	R&S	ESU	11/01/20	12/01/20	100014

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	Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
☒	BILOG ANTENNA	SCHAFFNER	CBL6112B	10/07/14	12/07/14	2737
☒	Amplifier (22dB)	H.P	8447E	11/01/11	12/01/11	2945A02865
☐	EMI TEST RECEIVER	R&S	ESCI	11/03/08	12/03/08	100364
☐	BICONICAL ANT.	Schwarzbeck	VHA 9103	10/11/29	12/11/29	91032789
☐	LOG-PERIODIC ANT.	Schwarzbeck	UHALP9108A1	10/11/29	12/11/29	1098
☐	BICONICAL ANT.	Schwarzbeck	VHA 9103	10/12/21	12/12/21	91031946
☐	LOG-PERIODIC ANT.	Schwarzbeck	UHALP9108A1	10/07/07	12/07/07	0590
☐	Low Noise Pre Amplifier	TSJ	MLA-100K01-B01-2	11/03/07	12/03/07	1252741
☐	Low Noise Pre Amplifier	TSJ	MLA-00108-B02-36	11/01/11	12/01/11	1518831
☐	Amplifier (25dB)	Agilent	8447D	11/03/07	12/03/07	2944A10144
☐	Amplifier (25dB)	Agilent	8447D	11/07/01	12/07/01	2648A04922
☐	Spectrum Analyzer(CE)	H.P	8591E	11/03/07	12/03/07	3649A05889
☐	LISN	Kyoritsu	KNW-407	11/01/11	12/01/11	8-317-8
☐	LISN	Kyoritsu	KNW-242	11/07/02	12/07/02	8-654-15
☐	CVCF	NF Electronic	4420	11/03/08	12/03/08	304935/337980
☐	50 ohm Terminator	HME	CT-01	11/01/11	12/01/11	N/A
☐	RFI/FIELD Intensity Meter	Kyoritsu	KNM-2402	11/07/02	12/07/02	4N-170-3
☐	Wideband Radio Communication Tester	R&S	CMW500	11/09/30	12/09/30	100989

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