RF TEST REPORT

Test Equipment	:	Black box
Model Name	:	IVSS001
FCC ID	:	2ARMQIVSS001
Date of receipt	:	2018-10-02
Test duration	:	2018-10-17 ~ 2018-10-24
Date of issue	:	2018-10-29

Applicant : HANHWA HIGHTECH

5th Floor, Samsung mediplus Bldg, 14, Cheyukgwan-ro Bupyeong-gu, Incheon, Korea

Test Laboratory : Lab-T, Inc.

2182-42 Baegok-daero, Mohyeon-myeon, Cheoin-gu, Yongin-si Gyeonggi-do, 17036, Korea

Test specification	:	FCC Part 15 Subpart C 15.247
RF Output Power	:	21.15 dBm
Test result	:	Pass

The above equipment was tested by Lab-T Testing Laboratory for compliance with the requirements of FCC Rules and Regulations.
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 Lab-T, Inc

Tested by:

Engineer
SungSin Kim

Reviewed by:

Technical Manager
SangHoon Yu

CONTENTS

1. Applicant Information

Applicant	:	HANHWA HIGHTECH
Address	:	5th Floor, Samsung mediplus Bldg, 14, Cheyukgwan-ro, Bupyeong-gu, Incheon, Korea
Telephone No.	:	+82-70-4922-1076
Person in charge	:	Sang-Heuk Moon / shmoon@leemen.net

Manufacturer	:	HANHWA HIGHTECH
Address	:	5th Floor, Samsung mediplus Bldg, 14, Cheyukgwan-ro, Bupyeong-gu, Incheon, Korea

2. Laboratory Information

Test Laboratory	:	Lab-T, Inc.
Address	:	2182-42 Baegok-daero, Mohyeon-myeon, Cheoin-gu, Yongin-si, Gyeonggi-do 17036, Korea
Telephone No.	:	+82 31-322-6767
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Certificate

FCC Designation No.	:	KR0159
FCC Registration No.	:	133186
IC Site Registration No.	:	22000-1

3. Information About Test Equipment

3.1 Equipment Information

Equipment type	Black box
Equipment model name	IVSS001
Equipment add model name	-
Frequency range	802.11b/g/n_HT20 : 2 412 ~ 2 462 MHz 802.11n_HT40 : 2 422 ~ 2 452 MHz
Modulation type	CCK, OFDM
Modulation technology	DSSS(802.11b), OFDM(802.11g/n_HT20/ n_HT40)
Power supply	DC 12 V
H/W version	MP0.1
S/W version	v0.64

Note1: The above EUT information was declared by the manufacturer.

3.2 Antenna Information

Antenna	Type	Chip Antenna
	Gain	3.1 dBi

3.3 Test Frequency

Test mode	Test frequency (MHz)		
	Lowest frequency	Middle frequency	Highest frequency
802.11b	2 412	2 437	2 462
802.11g	2 412	2 437	2 462
802.11n_HT20	2 412	2 437	2 462
802.11n_HT40	2 422	2 437	2 452

3.4 Worst-Case

802.11b	802.11g	802.11n_HT20	802.11n_HT40
1 Mbps	6 Mbps	MCS0	MCS0

Note:The power measurement has been conducted to determine the worst-case mode from all possible combi nations between available modulations, data rates.

3.5 Tested Companion Device Information

Type	Manufacturer	Model	Note
-	-	-	-
-	-	-	-

4. Test Report

4.1 Summary

FCC Part 15			
Reference	Parameter	Clause	Status
Transmitter Requirements			
15.203 15.247(b)(4)	Antenna Requirement	5.3.2	C
15.247(b)(3)	Maximum Peak Output Power	5.3.3	C
15.247(e)	Peak Power Spectral Density	5.3.2	C
15.247(a)(2)	6 dB Channel Bandwidth	5.3.2	C
-	Occupied Bandwidth	5.3.7	C
15.247(d) 15.205(a) 15.209(a)	Spurious Emission, Band Edge and Restricted bands	5.3.8	C
15.207(a)	Conducted Emissions	5.3.9	N/A[NOTE2]

NOTE 1 : C = Comply N/C = Not Comply N/T = Not Tested N/A = Not Applicable
NOTE 2 : Not Applicable (This device gets power supply from vehicle battery. (DC 12 V) Therefore this test item was not performed)

* The general test methods used to test this device is ANSI C63.10:2013

4.2 Measurement Uncertainty

Mesurement items	Expanded Uncertainty	
RF Output Power	0.75 dB	(The confidence level is about 95 %, *k*=2)
Power Spectral Density	0.94 dB	(The confidence level is about 95 %, *k*=2)
Occupied Channel Bandwidth	10.22 kHz	(The confidence level is about 95 %, *k*=2)
Conducted Spurious Emissions	0.44 dB	(The confidence level is about 95 %, *k*=2)
Radiated Spurious Emissions (1 GHz under)	4.56 dB	(The confidence level is about 95 %, *k*=2)
Radiated Spurious Emissions (Above 1 GHz)	4.46 dB	(The confidence level is about 95 %, *k*=2)
Conducted emission	4.08 dB	(The confidence level is about 95 %, *k*=2)

4.3 Test Report Version

Test Report No.	Date	Description
TRRFCC18-0015	18-10-29	Initial issue

4.4 Transmitter Requirements

4.4.1 Antenna Requirement

4.4.1.1 Regulation

Accoding to §15.203 An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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 of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Accoding to §15.247(b)(4) e 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 transmitting 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.

4.4.1.2 Result

Comply
(The transmitter has a Internal chip Antenna. The directional peak gain of the antenna is 3.10 dBi.)

4.4.2 Maximum Peak Output Power

4.4.2.1 Regulation

According to §15.247(b)(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 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 output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all 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 transmitting 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.

4.4.2.2 Measurement Procedure

These test measurement settings are specified in section 9.0 of 558074 D01 DTS Meas Guidance.

4.4.2.2.1 PKPM1 Peak power meter method

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

4.4.2.3 Result

Comply (measurement data : refer to the next page)

4.4.2.4 Measurement data

Test mode : 802.11b

Maximum Peak Output Power				Average Power
Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)	Result (dBm)
2 412	14.51	30.00	15.49	11.93
2 437	14.78	30.00	15.22	12.17
2 462	14.82	30.00	15.18	12.23

Note1 : Since the directional gain of the PCB Antenna declared by the manufacturer (GANT = 3.10 dBi), does not exceed 6.0 dBi ,there was no need to reduce the output power.
Note2 : We took the insertion loss of the cable loss into consideration within the measuring instrument.

Test mode : 802.11g

Maximum Peak Output Power				Average Power
Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)	Result (dBm)
2 412	20.69	30.00	9.31	11.76
2 437	21.12	30.00	8.88	12.16
2 462	21.15	30.00	8.85	12.18

Note1 : Since the directional gain of the PCB Antenna declared by the manufacturer (GANT = 3.10 dBi), does not exceed 6.0 dBi ,there was no need to reduce the output power.
Note2 : We took the insertion loss of the cable loss into consideration within the measuring instrument.

Test mode : 802.11n_HT20

Maximum Peak Output Power				Average Power
Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)	Result (dBm)
2 412	20.51	30.00	9.49	11.74
2 437	20.95	30.00	9.05	12.12
2 462	21.00	30.00	9.00	12.18

Note1 : Since the directional gain of the PCB Antenna declared by the manufacturer (GANT = 3.10 dBi), does not exceed 6.0 dBi ,there was no need to reduce the output power.
Note2 : We took the insertion loss of the cable loss into consideration within the measuring instrument.

Test mode : 802.11n_HT40

Maximum Peak Output Power				Average Power
Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)	Result (dBm)
2 442	20.63	30.00	9.37	11.99
2 437	20.79	30.00	9.21	12.14
2 452	20.89	30.00	9.11	12.17

Note1 : Since the directional gain of the PCB Antenna declared by the manufacturer (GANT = 3.10 dBi), does not exceed 6.0 dBi ,there was no need to reduce the output power.
Note2 : We took the insertion loss of the cable loss into consideration within the measuring instrument.

4.4.3 Peak Power Spectral Density

4.4.3.1 Regulation

According to §15.247(e) 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.

4.4.3.2 Measurement Procedure

These test measurement settings are specified in section 10.0 of 558074 D01 DTS Meas Guidance.

4.4.3.2.1 Method PKPSD (peak PSD)

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

4.4.3.3 Result

Comply (measurement data : refer to the next page)

4.4.3.4 Measurement data

Test mode : 802.11b

Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	-17.93	8.00	25.93
2 437	-17.56	8.00	25.56
2 462	-17.56	8.00	25.56

Note1 : Since the directional gain of the PCB Antenna declared by the manufacturer (GANT = 3.10 dBi), does not exceed 6.0 dBi ,there was no need to reduce the output power.
Note2 : We took the insertion loss of the cable loss into consideration within the measuring instrument.

Test mode : 802.11g

Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	-16.35	8.00	24.35
2 437	-15.84	8.00	23.84
2 462	-15.97	8.00	23.97

Note1 : Since the directional gain of the PCB Antenna declared by the manufacturer (GANT = 3.10 dBi), does not exceed 6.0 dBi ,there was no need to reduce the output power.
Note2 : We took the insertion loss of the cable loss into consideration within the measuring instrument.

Test mode : 802.11n_HT20

Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
2 412	-15.96	8.00	23.96
2 437	-15.52	8.00	23.52
2 462	-15.44	8.00	23.44

Note1 : Since the directional gain of the PCB Antenna declared by the manufacturer (GANT = 3.10 dBi), does not exceed 6.0 dBi ,there was no need to reduce the output power.
Note2 : We took the insertion loss of the cable loss into consideration within the measuring instrument.

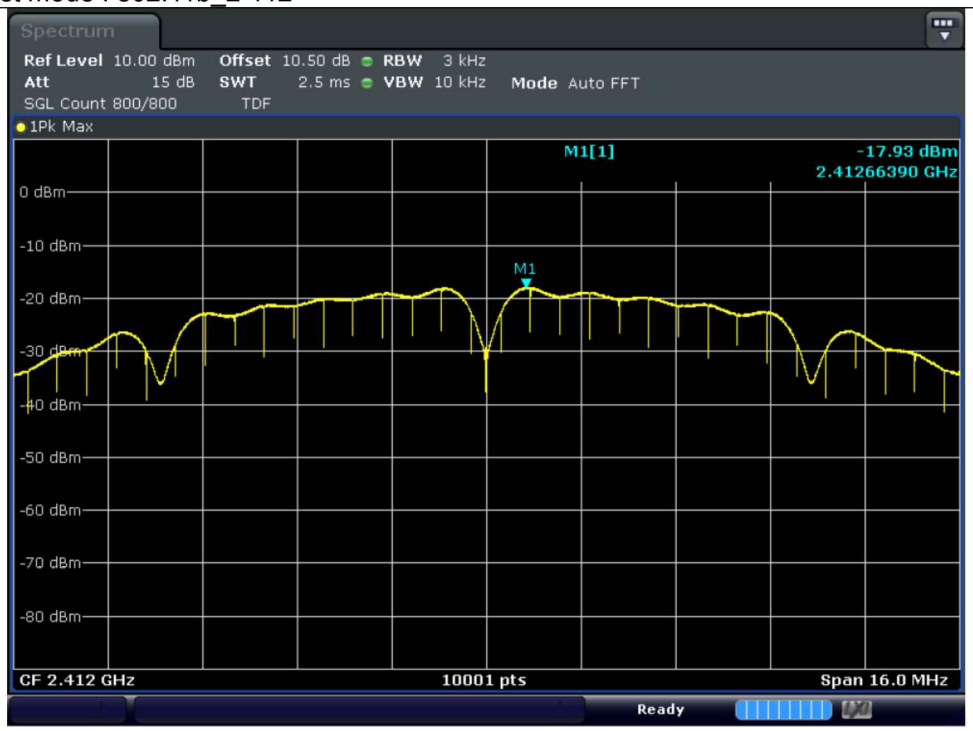
Test mode : 802.11n_HT40

Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
2 422	-15.67	8.00	23.67
2 437	-15.37	8.00	23.37
2 452	-15.23	8.00	23.23

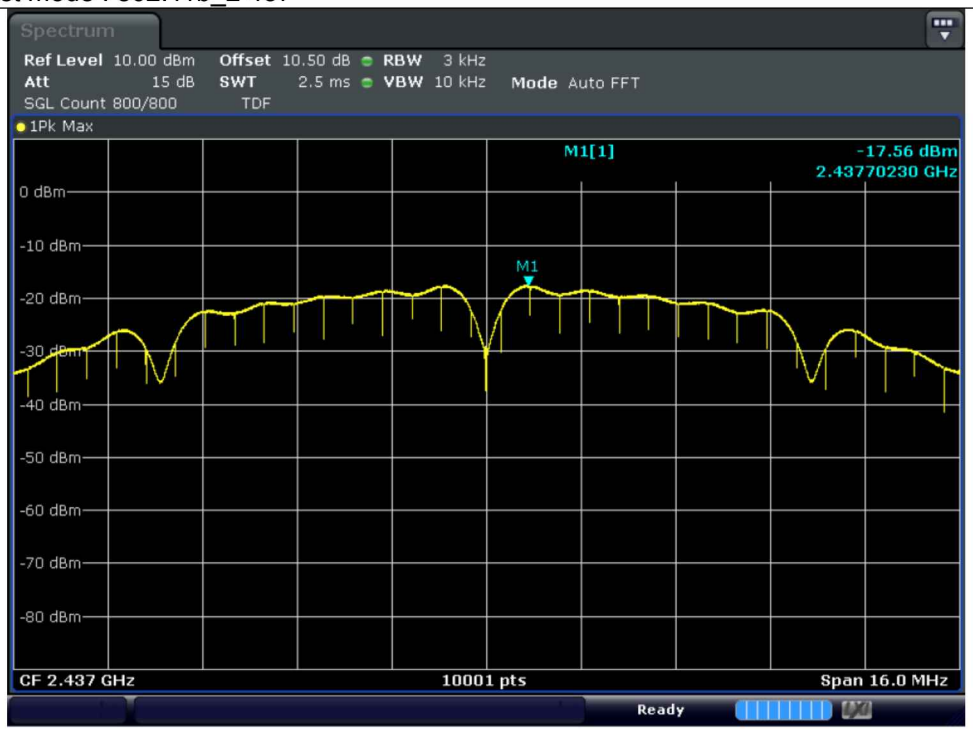
Note1 : Since the directional gain of the PCB Antenna declared by the manufacturer (GANT = 3.10 dBi), does not exceed 6.0 dBi ,there was no need to reduce the output power.
Note2 : We took the insertion loss of the cable loss into consideration within the measuring instrument.

4.4.3.5 Test Plot

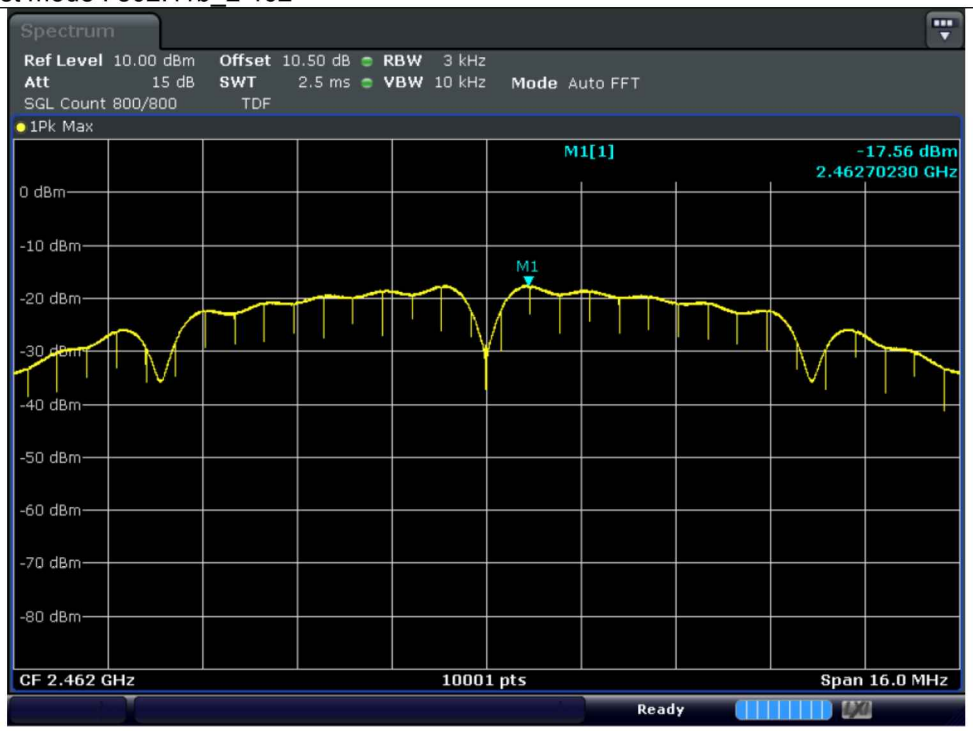
Test mode : 802.11b_2 412



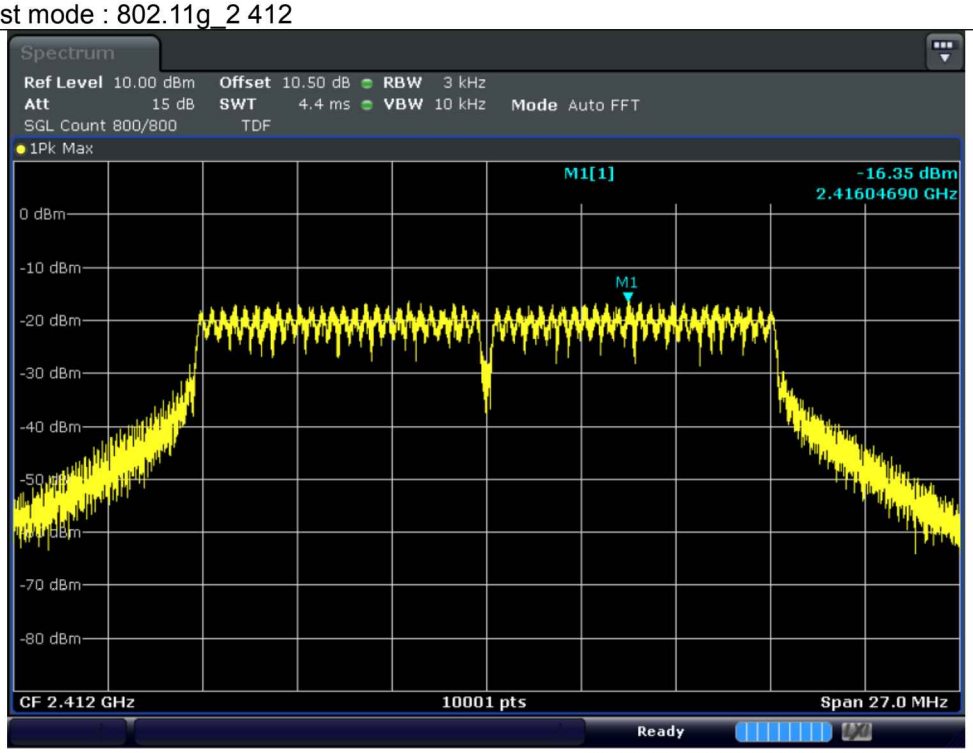
Test mode : 802.11b_2 437



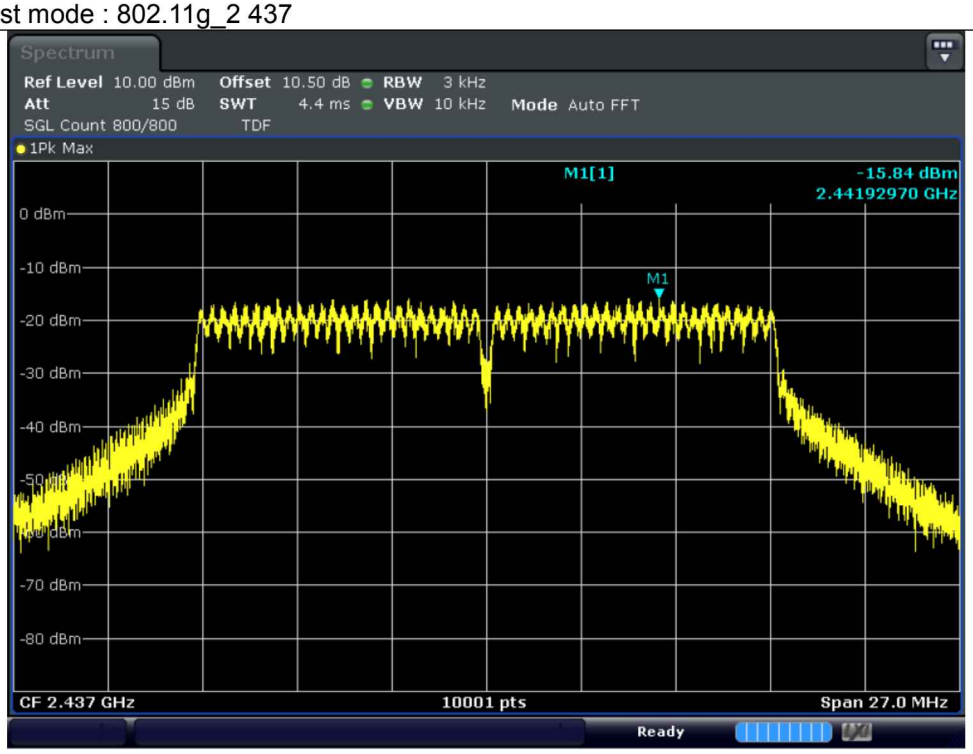
Test mode : 802.11b_2 462



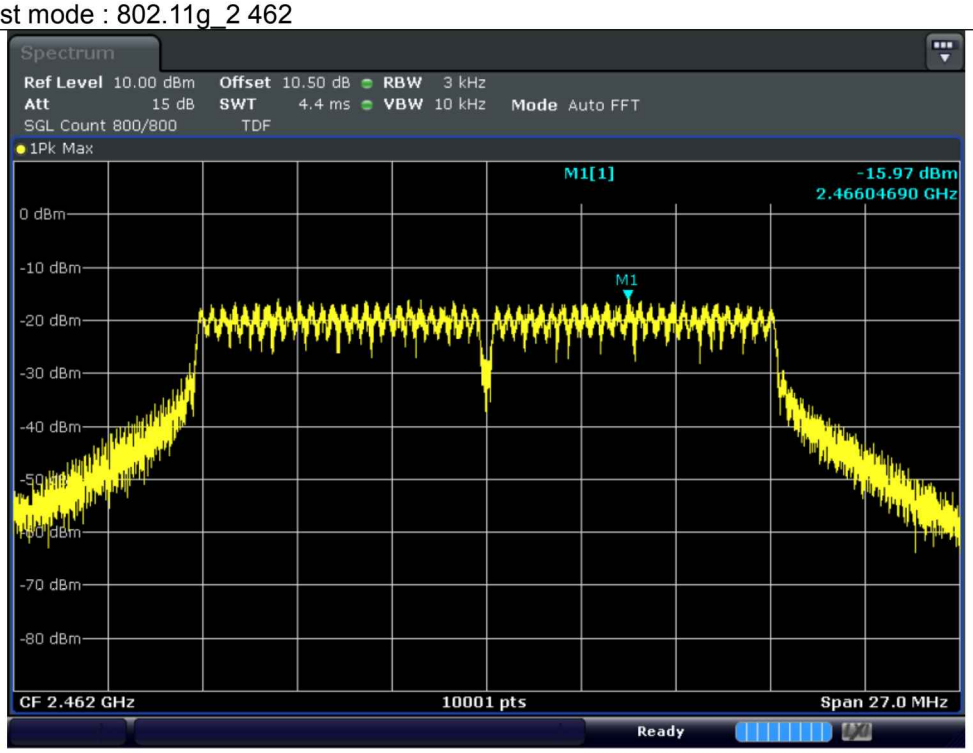
Test mode : 802.11g_2 412



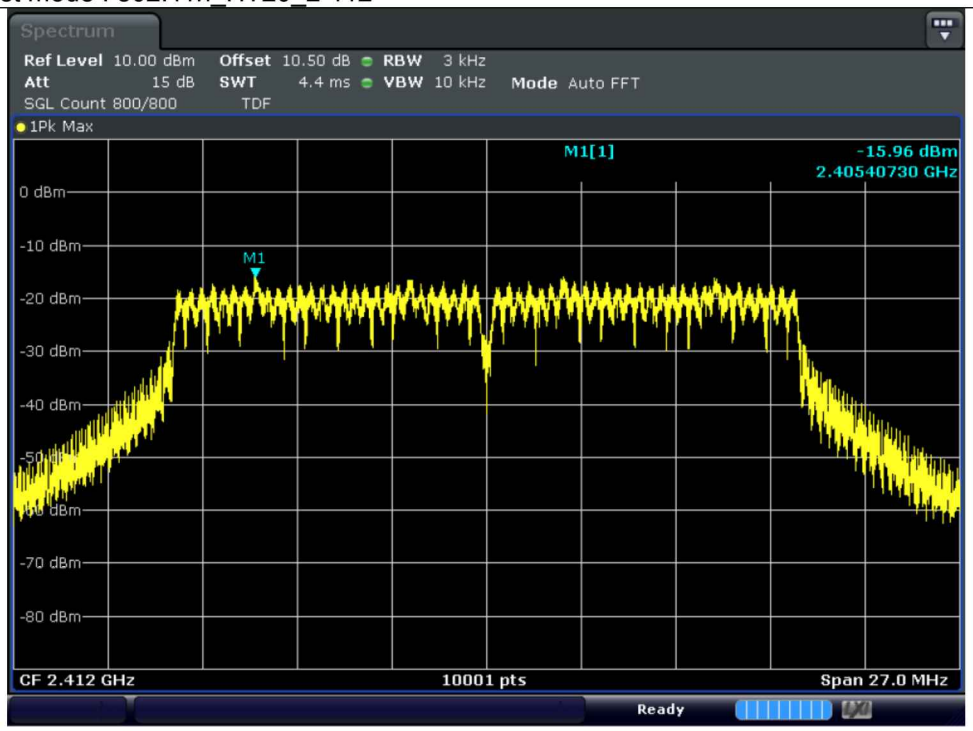
Test mode : 802.11g_2 437



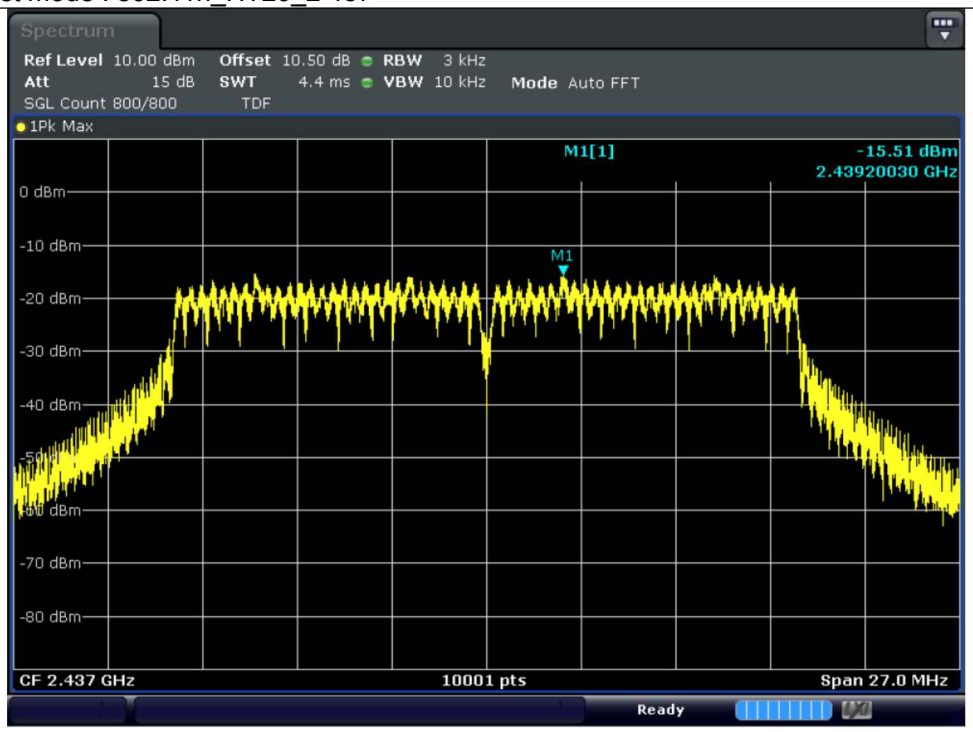
Test mode : 802.11g_2 462



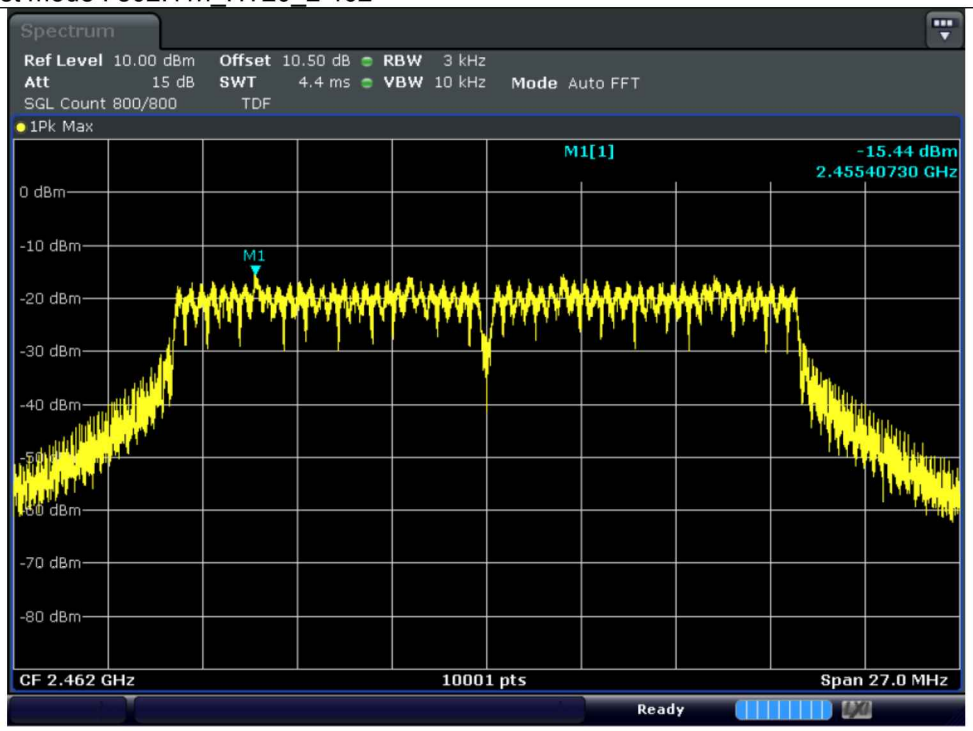
Test mode : 802.11n_HT20_2 412



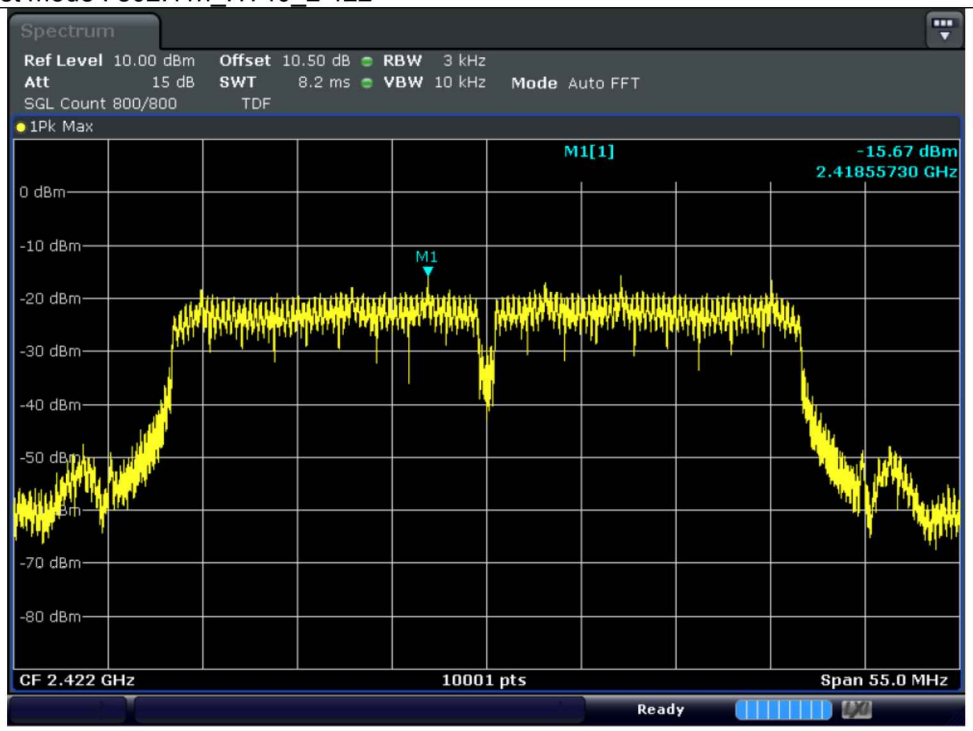
Test mode : 802.11n_HT20_2 437



Test mode : 802.11n_HT20_2 462



Test mode : 802.11n_HT40_2 422



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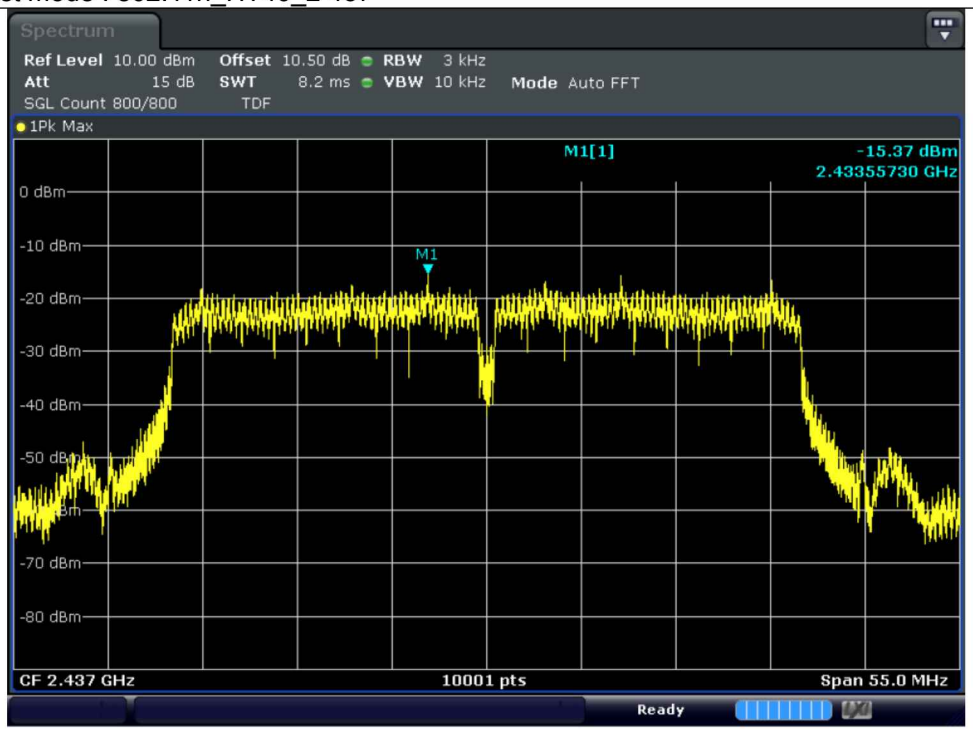
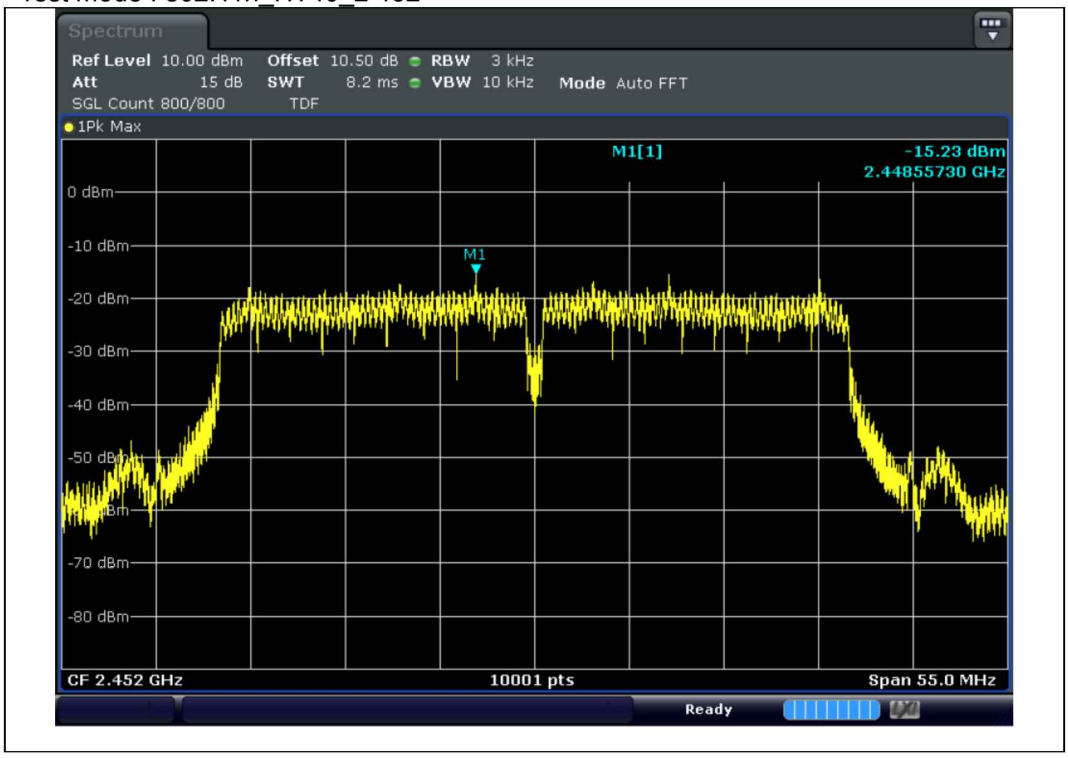


Test mode : 802.11n_HT40_2 452



4.4.4 6 dB Bandwidth(DTS Bandwidth)

4.4.4.1 Regulation

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

4.4.4.2 Measurement Procedure

These test measurement settings are specified in section 8.0 of 558074 D01 DTS Meas Guidance.

4.4.4.2.1 DTS Channel Bandwidth-Option 1

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 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.

4.4.4.2.2 DTS Channel Bandwidth Measurement Procedure-Option 2

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥3 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 ≥ 6 dB.

4.4.4.3 Result

Comply (measurement data : refer to the next page)

4.4.4.4 Measurement data

Test mode : 802.11b

Frequency (MHz)	6 dB Bandwidth (MHz)	Min. Limit (MHz)	Occupied Bandwidth (99 % Bandwith)(MHz)
2 412	10.07	0.50	14.95
2 437	10.07	0.50	14.95
2 462	10.07	0.50	14.97

Test mode : 802.11g

Frequency (MHz)	6 dB Bandwidth (MHz)	Min. Limit (MHz)	Occupied Bandwidth (99 % Bandwith)(MHz)
2 412	16.57	0.50	16.50
2 437	16.57	0.50	16.49
2 462	16.57	0.50	16.49

Test mode : 802.11n_HT20

Frequency (MHz)	6 dB Bandwidth (MHz)	Min. Limit (MHz)	Occupied Bandwidth (99 % Bandwith)(MHz)
2 412	17.80	0.50	17.70
2 437	17.80	0.50	17.70
2 462	17.80	0.50	17.71

Test mode : 802.11n_HT40

Frequency (MHz)	6 dB Bandwidth (MHz)	Min. Limit (MHz)	Occupied Bandwidth (99 % Bandwith)(MHz)
2 422	36.36	0.50	35.89
2 437	36.35	0.50	35.88
2 452	36.20	0.50	35.88