



# **FCC RADIO TEST REPORT-WIFI**

## **FCC ID:2AHDY-T2**

**Product :** Tessel

**Trade Name :** Bocoup Foundation

**Model Name :** Tessel 2

**Serial Model :** N/A

**Report No. :** NTEK-2015NT0703269F

### **Prepared for**

Bocoup Foundation, Inc  
201-207 South Street, 1st Floor, Boston Massachusetts 02111 ,  
United States

### **Prepared by**

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## TEST RESULT CERTIFICATION

**Applicant's name** ..... Bocoup Foundation, Inc  
**Address**..... 201-207 South Street, 1st Floor, Boston Massachusetts 02111 ,  
 United States

**Manufacture's Name**... Seeed Technology Limited  
**Address**..... 5th Floor,8th Building, shiling industrial Park ,XiLi Town,  
 NanShan dist. Shenzhen,Guangdong,China

### Product description

**Product name** ..... Tessel  
**Model and/or type** ..... Tessel 2  
**reference** .....  
**Serial Model** ..... N/A

**Standards** ..... FCC Part15.247 01 Oct. 2015

**Test procedure** ..... ANSI C63.10-2013 and KDB 558074: June 5, 2014

This device described above has been tested by NTEK, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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### Date of Test .....

**Date (s) of performance of tests**..... 07 Oct. 2015 ~02 Nov. 2015

**Date of Issue** ..... 02 Nov. 2015

**Test Result**..... **Pass**

Testing Engineer :

*Eileen Liu*

(Eileen Liu)

Technical Manager :

*Brown Lu*

(Brown Lu)

Authorized Signatory :

*Sam. Chen*

(Sam Chen)

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## 1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part15 (15.247) , Subpart C			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	PASS	
15.247 (a)(2)	6dB Bandwidth	PASS	
15.247 (b)	Peak Output Power	PASS	
15.247 (c)	Radiated Spurious Emission	PASS	
15.247 (d)	Power Spectral Density	PASS	
15.205	Band Edge Emission	PASS	
15.203	Antenna Requirement	PASS	

### NOTE:

(1) "N/A" denotes test is not applicable in this Test Report

## 1.1 TEST FACILITY

NTEK Testing Technology Co., Ltd

Add.:1/F, Building E, Fenda Science Park, Sanwei Community, Xixiang Street, Bao'an District, Shenzhen P.R. China.

FCC Registration No.:238937; IC Registration No.:9270A-1

CNAS Registration No.:L5516

## 1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement  $y \pm U$ , where expanded uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95 %.

No.	Item	Uncertainty
1	Conducted Emission Test	$\pm 1.38\text{dB}$
2	RF power,conducted	$\pm 0.16\text{dB}$
3	Spurious emissions,conducted	$\pm 0.21\text{dB}$
4	All emissions,radiated(<1G)	$\pm 4.68\text{dB}$
5	All emissions,radiated(>1G)	$\pm 4.89\text{dB}$
6	Temperature	$\pm 0.5^{\circ}\text{C}$
7	Humidity	$\pm 2\%$

## 2. GENERAL INFORMATION

### 2.1 GENERAL DESCRIPTION OF EUT

Equipment	Tessel	
Trade Name	Bocoup Foundation	
Model Name	Tessel 2	
Serial Model	N/A	
Model Difference	N/A	
Product Description	Operation Frequency:	802.11b/g/n(20MHz): 2412~2462MHz 802.11n(40MHz):2422~2452MHz
	Modulation Type:	IEEE 802.11b : DSSS (CCK, QPSK, DBPSK) IEEE 802.11g/n (HT20/HT40) : OFDM (64QAM, 16QAM, QPSK, BPSK)
	Bit Rate of Transmitter	802.11b:11/5.5/2/1 Mbps 802.11g:54/48/36/24/18/12/9/6Mbps 802.11n(20MHz/40MHz):150/144.44/130/117/115.56/104/86.67/78/52/6.5Mbps
	Number Of Channel	802.11b/g/n20MHz:11CH 802.11n40MHz:7CH
	Antenna Designation:	Please see Note 3.
	Antenna Gain (dBi)	1.0 dbi
Channel List	Please refer to the Note 2.	
Ratings	DC 5.0 V	
Adapter	N/A	
Battery	N/A	
Connecting I/O Port(s)	Please refer to the User's Manual	

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

2.

Channel List for 802.11b/g/n(20 MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2412	04	2427	07	2442	10	2457
02	2417	05	2432	08	2447	11	2462
03	2422	06	2437	09	2452		

Channel List for 802.11n(40MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
03	2422	06	2437	09	2452		
04	2427	07	2442				
05	2432	08	2447				

3.

Table for Filed Antenna

Ant	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
A	N/A	N/A	PCB Antenna	N/A	1.0	Wifi Antenna



## 2.2 DESCRIPTION OF TEST MODES

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Pretest Mode	Description
Mode 1	802.11b CH1/ CH6/ CH11
Mode 2	802.11g CH1/ CH6/ CH11
Mode 3	802.11n20 CH1/ CH6/ CH11
Mode 4	802.11n40 CH3/ CH6/ CH9
Mode 5	Link Mode

For Conducted Emission	
Final Test Mode	Description
Mode 5	Link Mode

For Radiated Emission	
Pretest Mode	Description
Mode 1	802.11b CH1/ CH6/ CH11
Mode 2	802.11g CH1/ CH6/ CH11
Mode 3	802.11n20 CH1/ CH6/ CH11
Mode 4	802.11n40 CH3/ CH6/ CH9
Mode 5	Link Mode

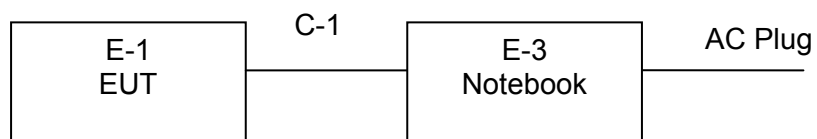
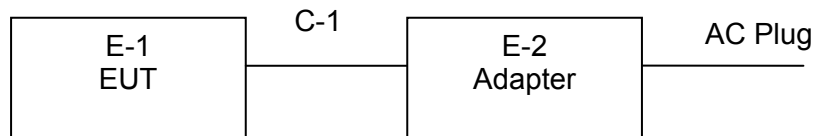
Note:

(1) The measurements are performed at the highest, middle, lowest available channels.

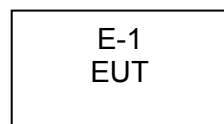
Operated Mode for Worst Duty Cycle	
Test Signal Duty Cycle (x)	Average correction factor (dB)
100% - IEEE 802.11b	0
100% - IEEE 802.11g	0
100% - IEEE 802.11n (HT20)	0
100% - IEEE 802.11n (HT40)	0

## 2.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

### Conducted Emission Test



### Radiated Spurious Emission Test



## 2.4 DESCRIPTION OF SUPPORT UNITS(CONDUCTED MODE)

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Brand	Model/Type No.	Series No.	Note
E-1	Tessel	Bocoup Foundation	Tessel 2	N/A	EUT
E-2	Adapter	N/A	AD1	N/A	
E-3	Notebook	Lenove	Thinkpad Edge E430	N/A	

Item	Shielded Type	Ferrite Core	Length	Note
C-1	Metal wire	NO	0.5m	USB Cable
	Unshielded	NO	0.8m	Power Cable

Note:

- (1) The support equipment was authorized by Declaration of Confirmation.
- (2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.

## 2.5 EQUIPMENTS LIST FOR ALL TEST ITEMS

### Radiation Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Spectrum Analyzer	Agilent	E4407B	MY45108040	2015.07.06	2016.07.05	1 year
2	Test Receiver	R&S	ESPI	101318	2015.06.06	2016.06.05	1 year
3	Bilog Antenna	TESEQ	CBL6111D	31216	2015.07.06	2016.07.05	1 year
4	50Ω Coaxial Switch	Anritsu	MP59B	6200264416	2015.06.06	2016.06.05	1 year
5	Spectrum Analyzer	ADVANTEST	R3132	150900201	2015.06.06	2016.06.05	1 year
6	Horn Antenna	EM	EM-AH-10180	2011071402	2015.07.06	2016.07.05	1 year
7	Horn Ant	Schwarzbeck	BBHA 9170	9170-181	2015.07.06	2016.07.05	1 year
8	Amplifier	EM	EM-30180	060538	2015.07.06	2016.07.05	1 year
9	Loop Antenna	ARA	PLA-1030/B	1029	2015.06.06	2016.06.05	1 year

### Conduction Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Test Receiver	R&S	ESCI	101160	2015.06.06	2016.06.05	1 year
2	LISN	R&S	ENV216	101313	2015.08.24	2016.08.23	1 year
3	LISN	EMCO	3816/2	00042990	2015.08.24	2016.08.23	1 year
4	50Ω Coaxial Switch	Anritsu	MP59B	6200264417	2015.06.06	2016.06.05	1 year
5	Passive Voltage Probe	R&S	ESH2-Z3	100196	2015.06.06	2016.06.05	1 year
6	Absorbing clamp	R&S	MOS-21	100423	2015.06.06	2016.06.05	1 year
2	LISN	R&S	ENV216	101313	2015.07.06	2016.07.05	1 year
3	LISN	EMCO	3816/2	00042990	2015.07.06	2016.07.05	1 year
1	Attenuation	MCE	24-10-34	BN9258	2015.07.06	2016.07.05	1 year

### 3. EMC EMISSION TEST

#### 3.1 CONDUCTED EMISSION MEASUREMENT

##### 3.1.1 POWER LINE CONDUCTED EMISSION Limits (Frequency Range 150KHz-30MHz)

FREQUENCY (MHz)	Class A (dBuV)		Class B (dBuV)		Standard
	Quasi-peak	Average	Quasi-peak	Average	
0.15 -0.5	79.00	66.00	66 - 56 *	56 - 46 *	CISPR
0.50 -5.0	73.00	60.00	56.00	46.00	CISPR
5.0 -30.0	73.00	60.00	60.00	50.00	CISPR

0.15 -0.5	79.00	66.00	66 - 56 *	56 - 46 *	FCC
0.50 -5.0	73.00	60.00	56.00	46.00	FCC
5.0 -30.0	73.00	60.00	60.00	50.00	FCC

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " \* " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

### 3.1.2 TEST PROCEDURE

- The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- LISN at least 80 cm from nearest part of EUT chassis.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

### 3.1.3 DEVIATION FROM TEST STANDARD

No deviation

### 3.1.4 TEST SETUP



**Note: 1.**Support units were connected to second LISN .

**2.**Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

### 3.1.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

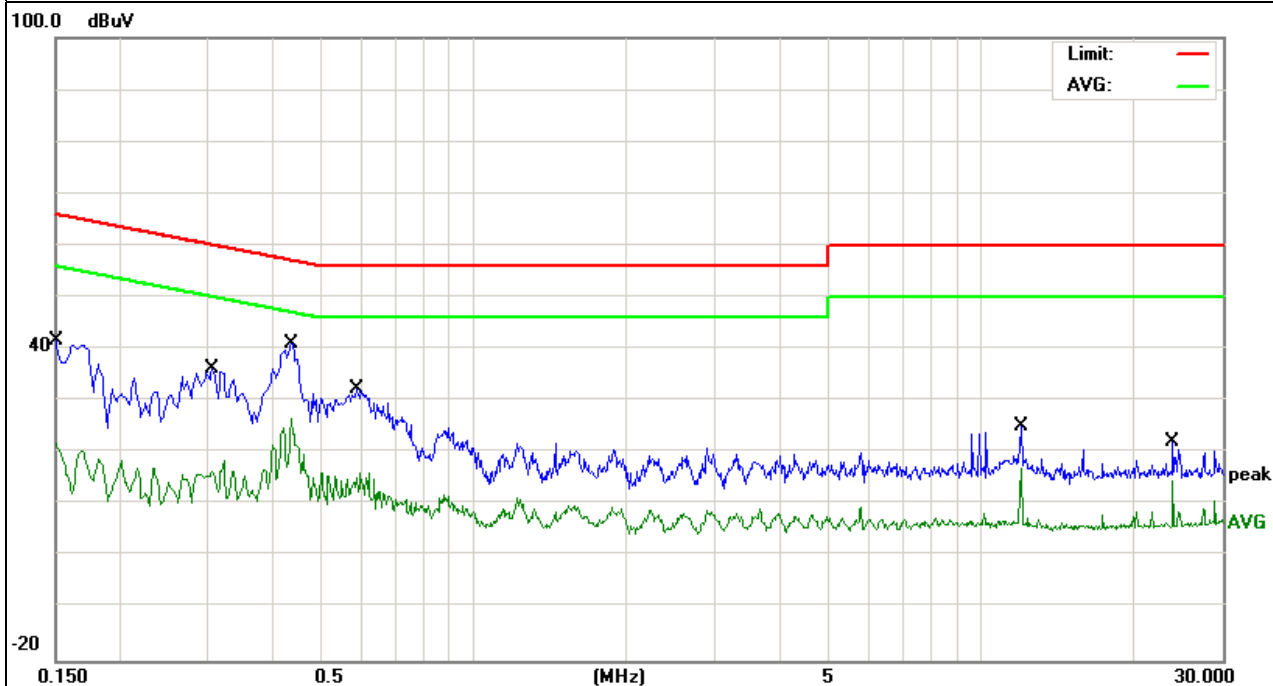
### 3.1.6 TEST RESULTS

EUT :	Tessel	Model Name :	Tessel 2
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz	Test Mode :	Mode 5

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.1500	32.01	9.63	41.64	65.99	-24.35	QP
0.1500	12.17	9.63	21.80	55.99	-34.19	AVG
0.3060	26.38	9.72	36.10	60.08	-23.98	QP
0.3060	8.86	9.72	18.58	50.08	-31.50	AVG
0.4380	31.42	9.52	40.94	57.10	-16.16	QP
0.4380	17.12	9.52	26.64	47.10	-20.46	AVG
0.5899	22.47	9.77	32.24	56.00	-23.76	QP
0.5899	6.35	9.77	16.12	46.00	-29.88	AVG
11.9979	15.41	9.75	25.16	60.00	-34.84	QP
11.9979	7.29	9.75	17.04	50.00	-32.96	AVG
23.9980	12.12	9.93	22.05	60.00	-37.95	QP
23.9980	4.61	9.93	14.54	50.00	-35.46	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

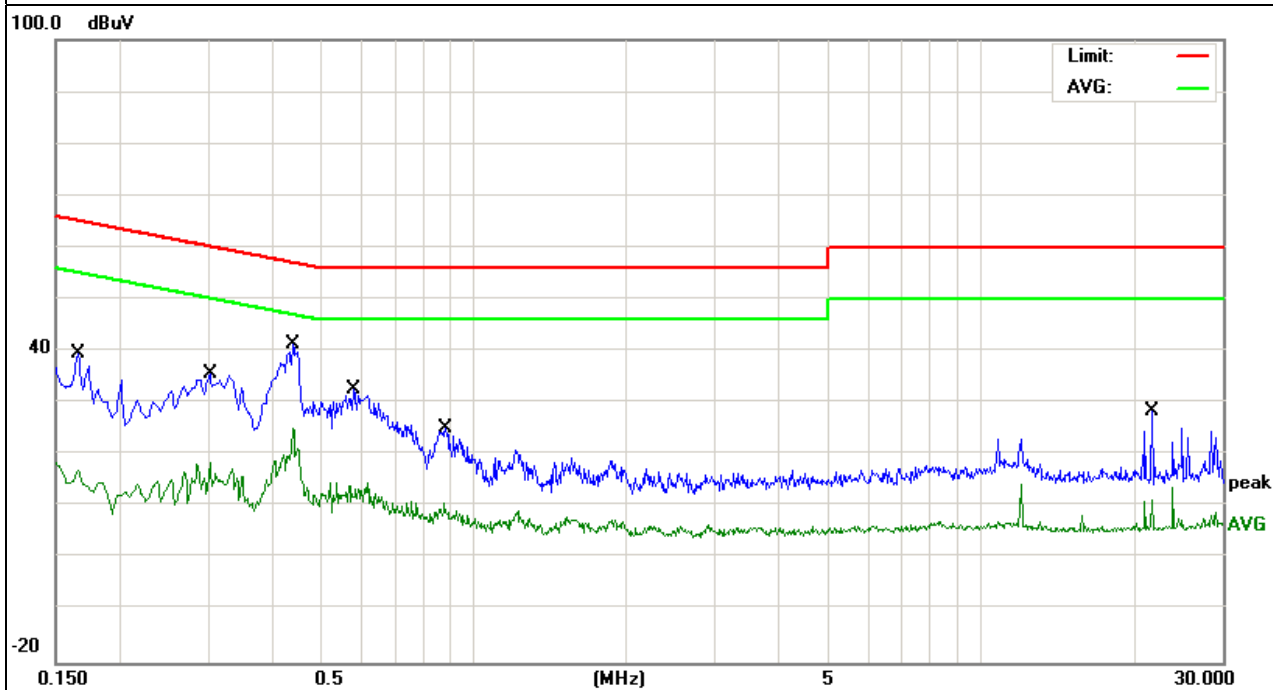


EUT :	Tessel	Model Name :	Tessel 2
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz	Test Mode :	Mode 5

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.1660	30.08	9.60	39.68	65.15	-25.47	QP
0.1660	7.57	9.60	17.17	55.15	-37.98	AVG
0.3020	26.00	9.62	35.62	60.19	-24.57	QP
0.3020	9.06	9.62	18.68	50.19	-31.51	AVG
0.4420	31.63	9.66	41.29	57.02	-15.73	QP
0.4420	15.36	9.66	25.02	47.02	-22.00	AVG
0.5820	23.09	9.66	32.75	56.00	-23.25	QP
0.5820	4.98	9.66	14.64	46.00	-31.36	AVG
0.8820	15.56	9.63	25.19	56.00	-30.81	QP
0.8820	1.22	9.63	10.85	46.00	-35.15	AVG
21.8140	18.44	9.87	28.31	60.00	-31.69	QP
21.8140	1.59	9.87	11.46	50.00	-38.54	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.



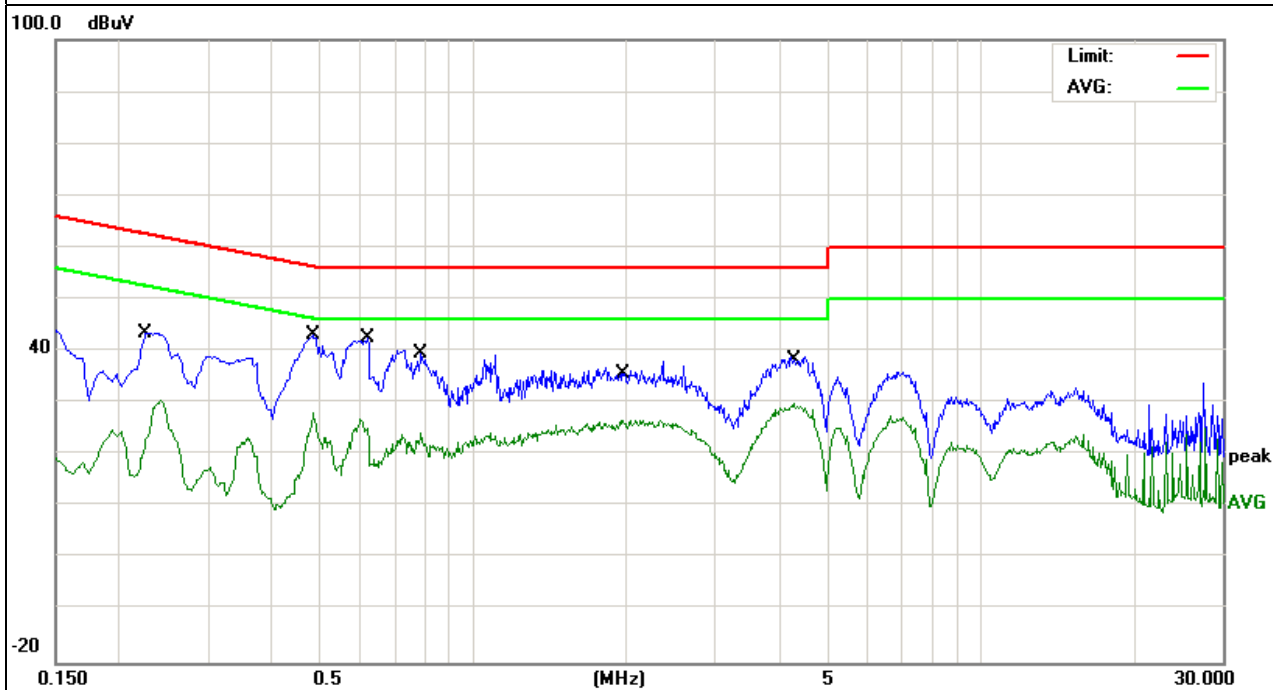


EUT :	Tessel	Model Name :	Tessel 2
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 5.0V form Adapter AC 240V/60Hz	Test Mode :	Mode 5

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.2260	33.89	9.64	43.53	62.59	-19.06	QP
0.2260	20.92	9.64	30.56	52.59	-22.03	AVG
0.4820	33.31	9.70	43.01	56.30	-13.29	QP
0.4820	18.49	9.70	28.19	46.30	-18.11	AVG
0.6180	32.72	9.77	42.49	56.00	-13.51	QP
0.6180	17.22	9.77	26.99	46.00	-19.01	AVG
0.7900	29.71	9.77	39.48	56.00	-16.52	QP
0.7900	14.61	9.77	24.38	46.00	-21.62	AVG
1.9780	27.11	9.65	36.76	56.00	-19.24	QP
1.9780	16.92	9.65	26.57	46.00	-19.43	AVG
4.2780	29.20	9.70	38.90	56.00	-17.10	QP
4.2780	20.25	9.70	29.95	46.00	-16.05	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

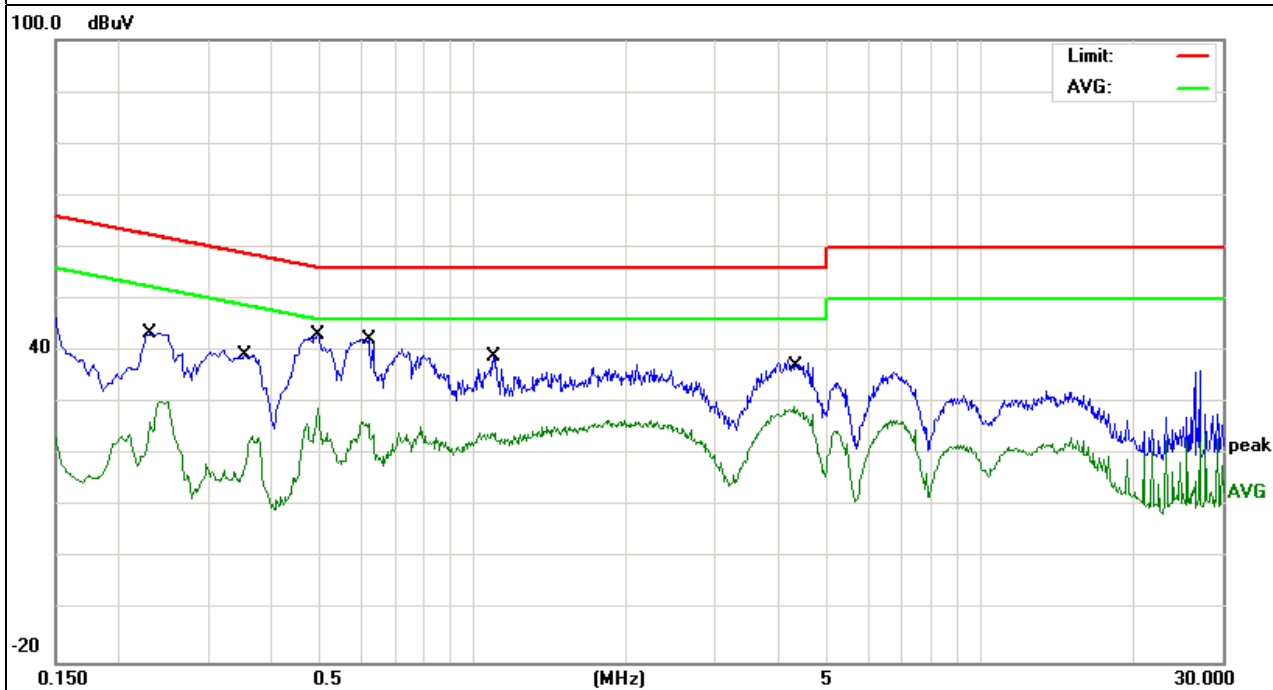


EUT :	Tessel	Model Name :	Tessel 2
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 5.0V form Adapter AC 240V/60Hz	Test Mode :	Mode 5

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.2300	33.81	9.61	43.42	62.45	-19.03	QP
0.2300	20.75	9.61	30.36	52.45	-22.09	AVG
0.3540	29.55	9.63	39.18	58.87	-19.69	QP
0.3540	14.04	9.63	23.67	48.87	-25.20	AVG
0.4940	33.45	9.68	43.13	56.10	-12.97	QP
0.4940	19.35	9.68	29.03	46.10	-17.07	AVG
0.6220	32.70	9.65	42.35	56.00	-13.65	QP
0.6220	16.72	9.65	26.37	46.00	-19.63	AVG
1.0940	29.49	9.60	39.09	56.00	-16.91	QP
1.0940	14.63	9.60	24.23	46.00	-21.77	AVG
4.2738	28.75	9.51	38.26	56.00	-17.74	QP
4.2738	19.97	9.51	29.48	46.00	-16.52	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

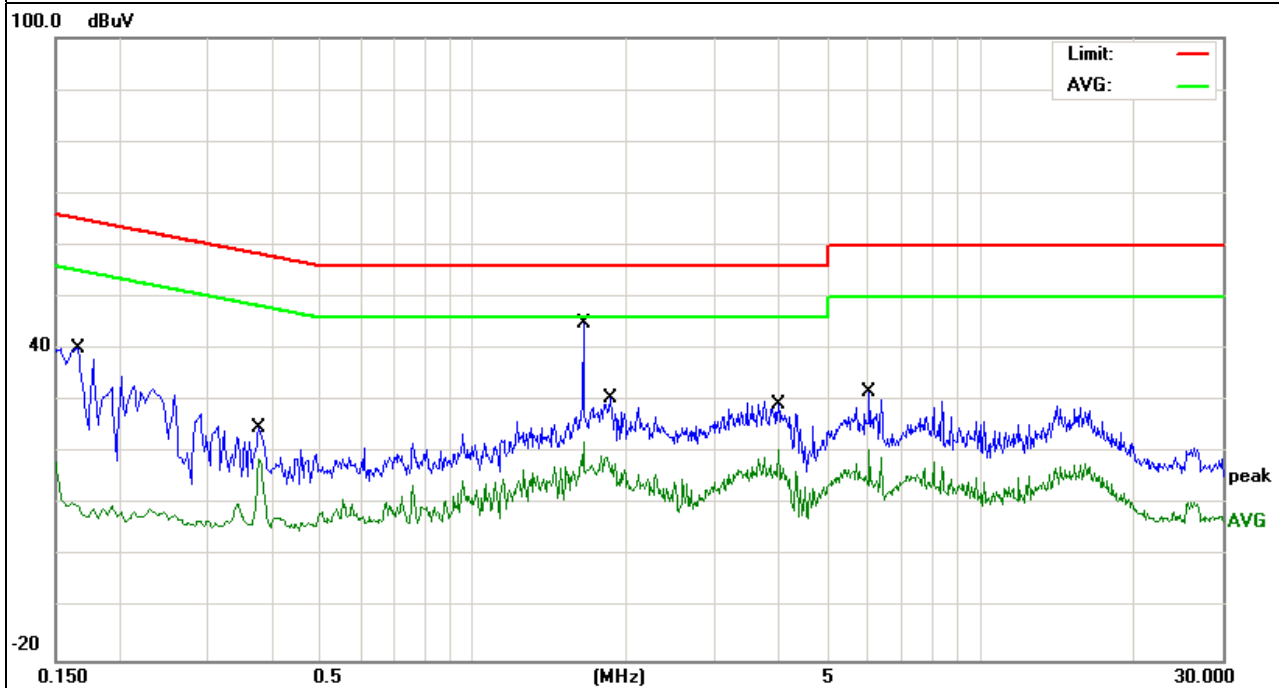


EUT :	Tessel	Model Name :	Tessel 2
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 5.0V form PC AC 120V/60Hz	Test Mode :	Mode 5

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.1660	30.81	9.48	40.29	65.15	-24.86	QP
0.1660	8.78	9.48	18.26	55.15	-36.89	AVG
0.3780	15.59	9.25	24.84	58.32	-33.48	QP
0.3780	9.70	9.25	18.95	48.32	-29.37	AVG
1.6499	35.35	9.56	44.91	56.00	-11.09	QP
1.6499	12.46	9.56	22.02	46.00	-23.98	AVG
1.8660	21.12	9.57	30.69	56.00	-25.31	QP
1.8660	9.60	9.57	19.17	46.00	-26.83	AVG
3.9940	20.39	9.66	30.05	56.00	-25.95	QP
3.9940	10.95	9.66	20.61	46.00	-25.39	AVG
6.0378	22.00	9.69	31.69	60.00	-28.31	QP
6.0378	10.97	9.69	20.66	50.00	-29.34	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

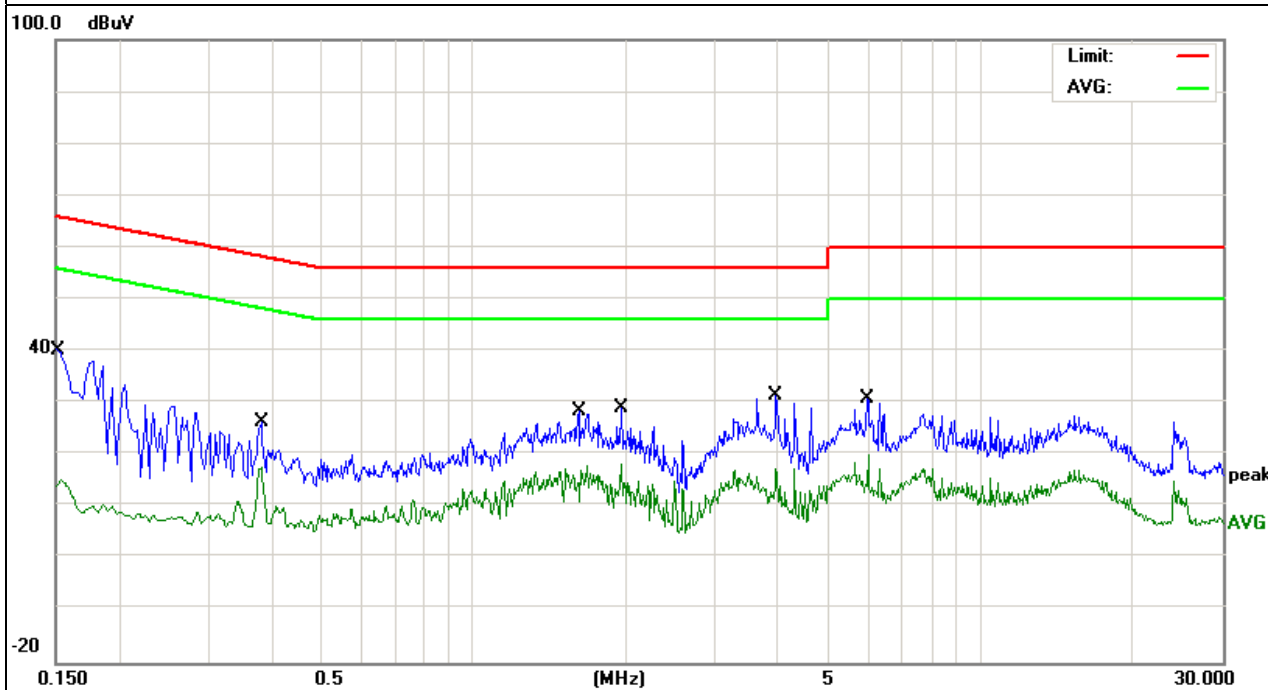


EUT :	Tessel	Model Name :	Tessel 2
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 5.0V form PC AC 120V/60Hz	Test Mode :	Mode 5

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.1539	31.09	9.46	40.55	65.78	-25.23	QP
0.1539	5.72	9.46	15.18	55.78	-40.60	AVG
0.3820	16.81	9.44	26.25	58.23	-31.98	QP
0.3820	8.20	9.44	17.64	48.23	-30.59	AVG
1.6140	18.93	9.45	28.38	56.00	-27.62	QP
1.6140	8.43	9.45	17.88	46.00	-28.12	AVG
1.9659	19.72	9.46	29.18	56.00	-26.82	QP
1.9659	8.73	9.46	18.19	46.00	-27.81	AVG
3.9620	21.86	9.47	31.33	56.00	-24.67	QP
3.9620	8.03	9.47	17.50	46.00	-28.50	AVG
5.9898	21.36	9.50	30.86	60.00	-29.14	QP
5.9898	10.42	9.50	19.92	50.00	-30.08	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

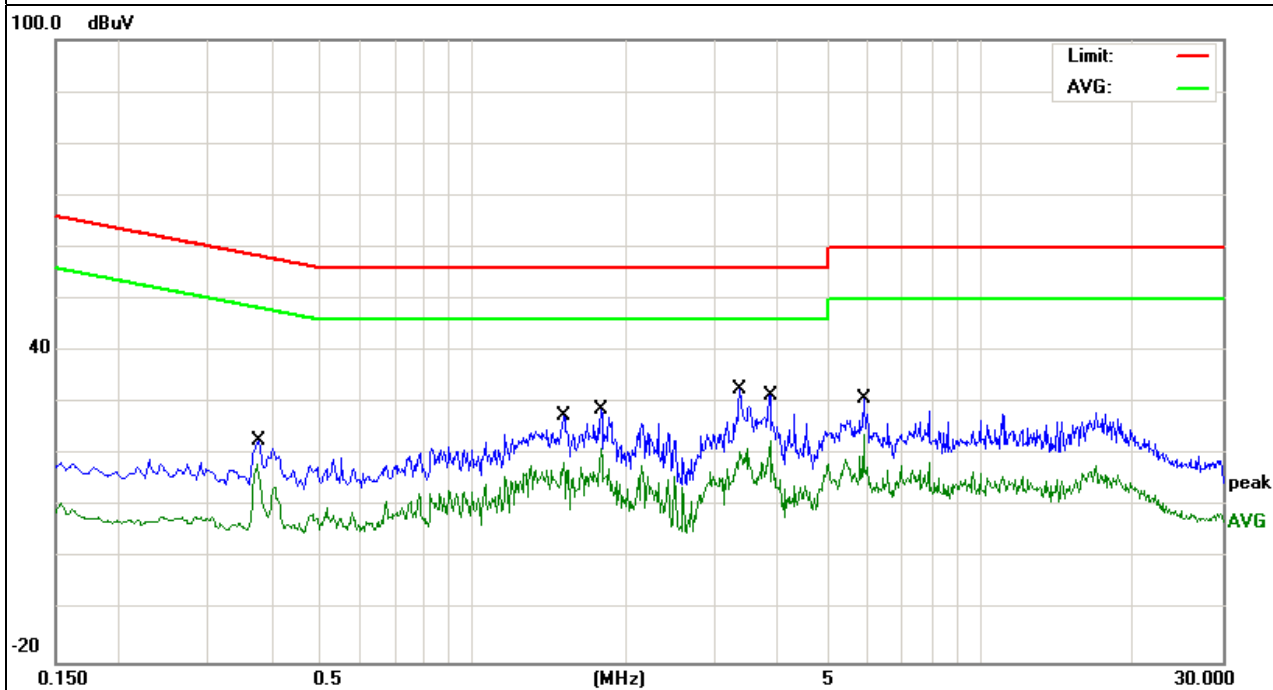


EUT :	Tessel	Model Name :	Tessel 2
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	L
Test Voltage :	DC 5.0V form PC AC 240V/60Hz	Test Mode :	Mode 5

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.3738	13.57	9.27	22.84	58.41	-35.57	QP
0.3738	9.05	9.27	18.32	48.41	-30.09	AVG
1.5060	18.10	9.56	27.66	56.00	-28.34	QP
1.5060	8.86	9.56	18.42	46.00	-27.58	AVG
1.7900	19.11	9.57	28.68	56.00	-27.32	QP
1.7900	11.67	9.57	21.24	46.00	-24.76	AVG
3.3460	23.09	9.64	32.73	56.00	-23.27	QP
3.3460	11.61	9.64	21.25	46.00	-24.75	AVG
3.8420	21.77	9.66	31.43	56.00	-24.57	QP
3.8420	13.00	9.66	22.66	46.00	-23.34	AVG
5.8978	21.17	9.69	30.86	60.00	-29.14	QP
5.8978	14.31	9.69	24.00	50.00	-26.00	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.

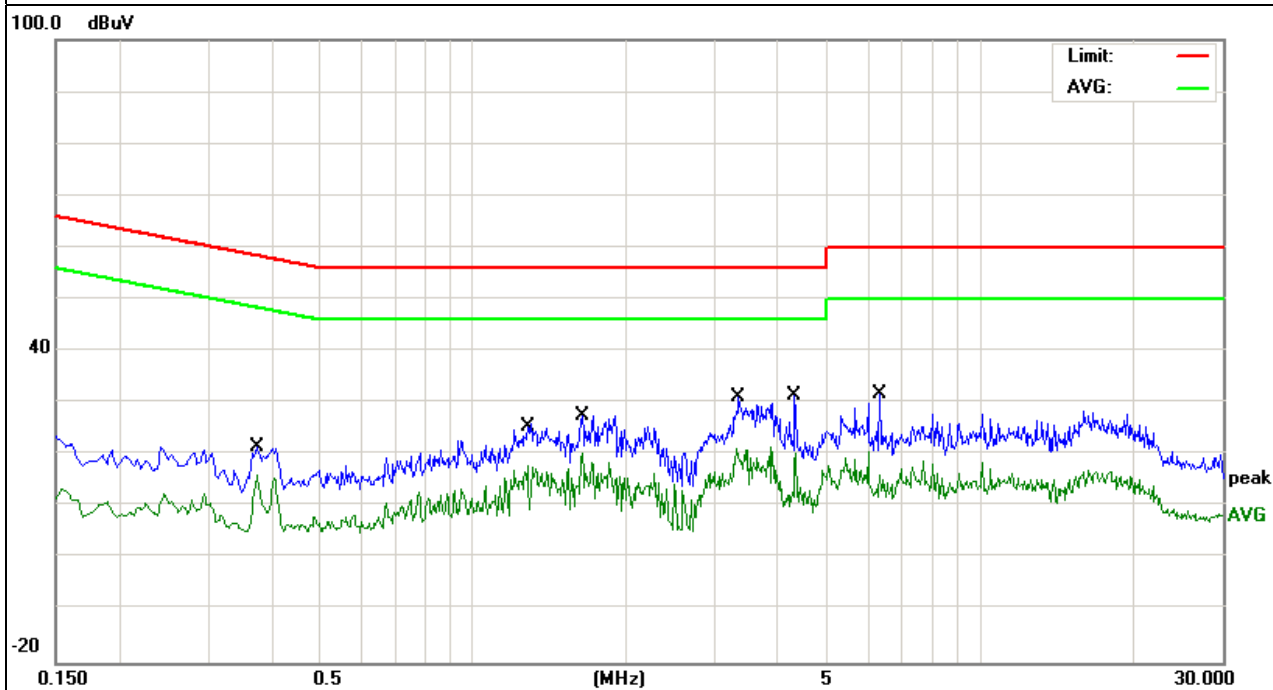


EUT :	Tessel	Model Name :	Tessel 2
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1010hPa	Phase :	N
Test Voltage :	DC 5.0V form PC AC 240V/60Hz	Test Mode :	Mode 5

Frequency	Reading Level	Correct Factor	Measure-ment	Limits	Margin	Remark
(MHz)	(dBμV)	(dB)	(dBμV)	(dBμV)	(dB)	
0.3738	12.04	9.44	21.48	58.41	-36.93	QP
0.3738	6.78	9.44	16.22	48.41	-32.19	AVG
1.2820	16.74	9.45	26.19	56.00	-29.81	QP
1.2820	8.63	9.45	18.08	46.00	-27.92	AVG
1.6379	18.24	9.45	27.69	56.00	-28.31	QP
1.6379	10.94	9.45	20.39	46.00	-25.61	AVG
3.3100	21.57	9.47	31.04	56.00	-24.96	QP
3.3100	11.82	9.47	21.29	46.00	-24.71	AVG
4.3139	21.96	9.48	31.44	56.00	-24.56	QP
4.3139	10.87	9.48	20.35	46.00	-25.65	AVG
6.3418	22.14	9.50	31.64	60.00	-28.36	QP
6.3418	11.15	9.50	20.65	50.00	-29.35	AVG

Remark:

1. All readings are Quasi-Peak and Average values.
2. Factor = Insertion Loss + Cable Loss.



### 3.2 RADIATED EMISSION MEASUREMENT

#### 3.2.1 RADIATED EMISSION LIMITS (Frequency Range 9kHz-1000MHz)

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

#### LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	dBuV/m@at 3M	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

- (1) The limit for radiated test was performed according to FCC PART 15C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

### 3.2.2 TEST PROCEDURE

- a. The measuring distance of at 3 m shall be used for measurements at frequency up to 1GHz. For frequencies above 1GHz, any suitable measuring distance may be used.
- b. The EUT was placed on the top of a rotating table 0.8 m for below 1GHz and 1.5m for above 1GHz the ground at a 3 meter test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The height of the equipment or of the substitution antenna shall be 0.8 m for below 1GHz and 1.5m for above 1GHz; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
- f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported

During the radiated emission test, the Spectrum Analyzer was set with the following configurations:

Frequency Band (MHz)	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	Peak	100 kHz	100 kHz
Above 1000	Peak	1 MHz	1 MHz
	Average	1 MHz	10 Hz

### 3.2.3 DEVIATION FROM TEST STANDARD

No deviation

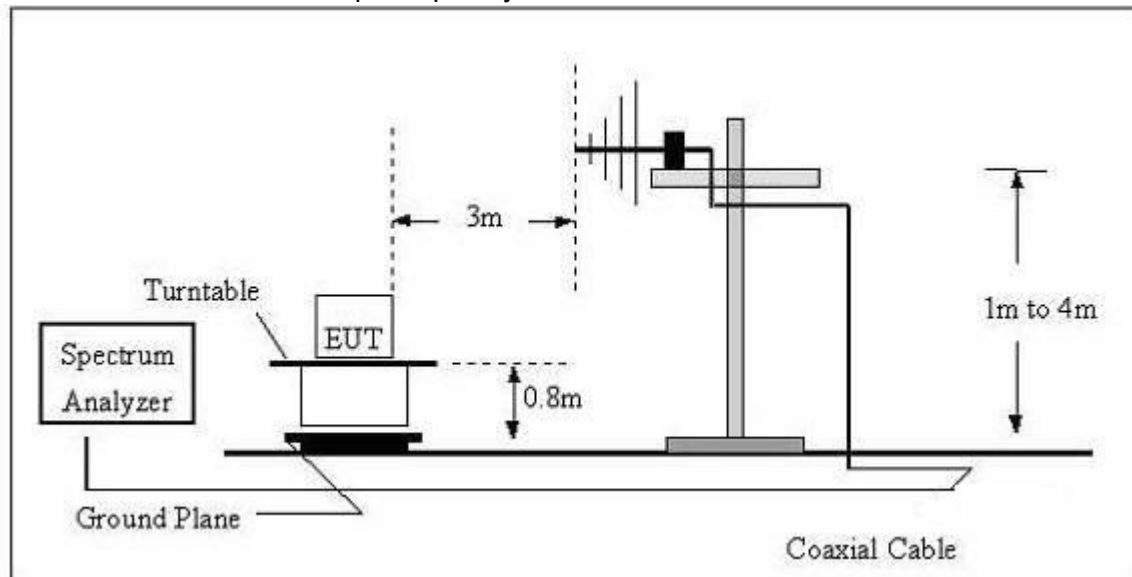


### 3.2.4 TEST SETUP

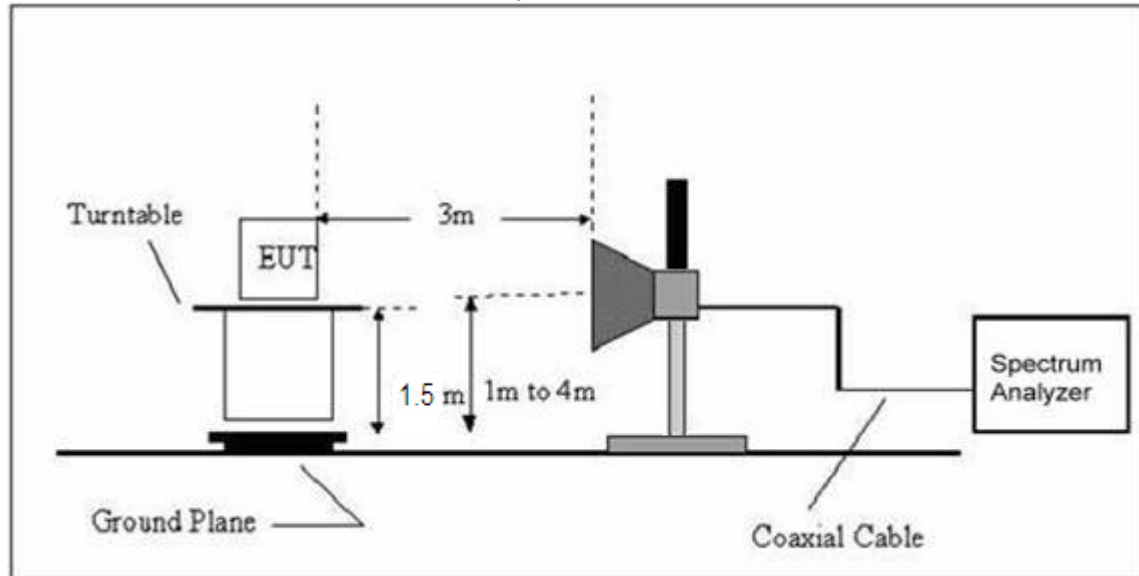
#### (A) Radiated Emission Test-Up Frequency Below 30MHz



#### (B) Radiated Emission Test-Up Frequency 30MHz~1GHz



## (C) Radiated Emission Test-Up Frequency Above 1GHz

**3.2.5 EUT OPERATING CONDITIONS**

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

### 3.2.6 TEST RESULTS (BETWEEN 9KHZ – 30 MHZ)

EUT:	Tessel	Model Name. :	Tessel 2
Temperature:	20 °C	Relative Humidity:	48%
Pressure:	1010 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX	Polarization :	--

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	N/A
--	--	--	--	N/A

#### NOTE:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =  $40 \log (\text{specific distance/test distance})(\text{dB})$ ;

Limit line = specific limits(dBuv) + distance extrapolation factor.

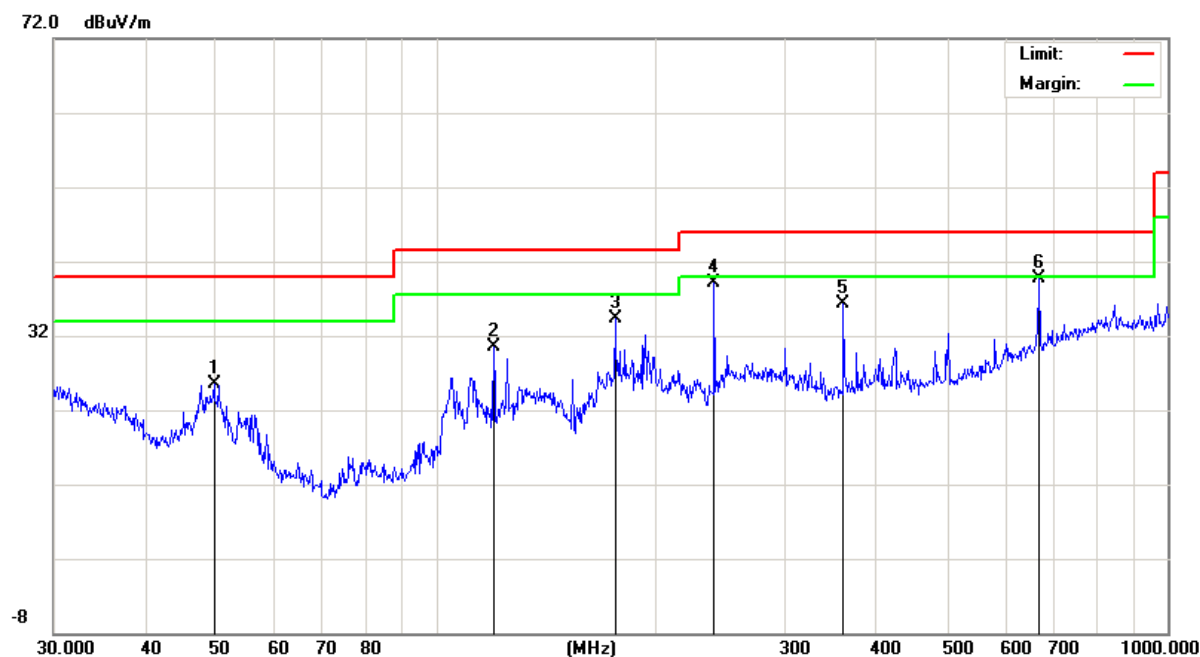
### 3.2.7 TEST RESULTS (BETWEEN 30MHZ – 1GHZ)

EUT :	Tessel	Model Name :	Tessel 2
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX		

Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Remark
	(MHz)	(dBuV)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
V	49.7068	14.73	10.77	25.50	40.00	-14.50	QP
V	119.8555	18.40	12.07	30.47	43.50	-13.03	QP
V	175.6516	23.71	10.60	34.31	43.50	-9.19	QP
V	239.9874	25.64	13.49	39.13	46.00	-6.87	QP
V	360.4476	19.58	16.67	36.25	46.00	-9.75	QP
V	668.1422	15.71	23.91	39.62	46.00	-6.38	QP

#### Remark:

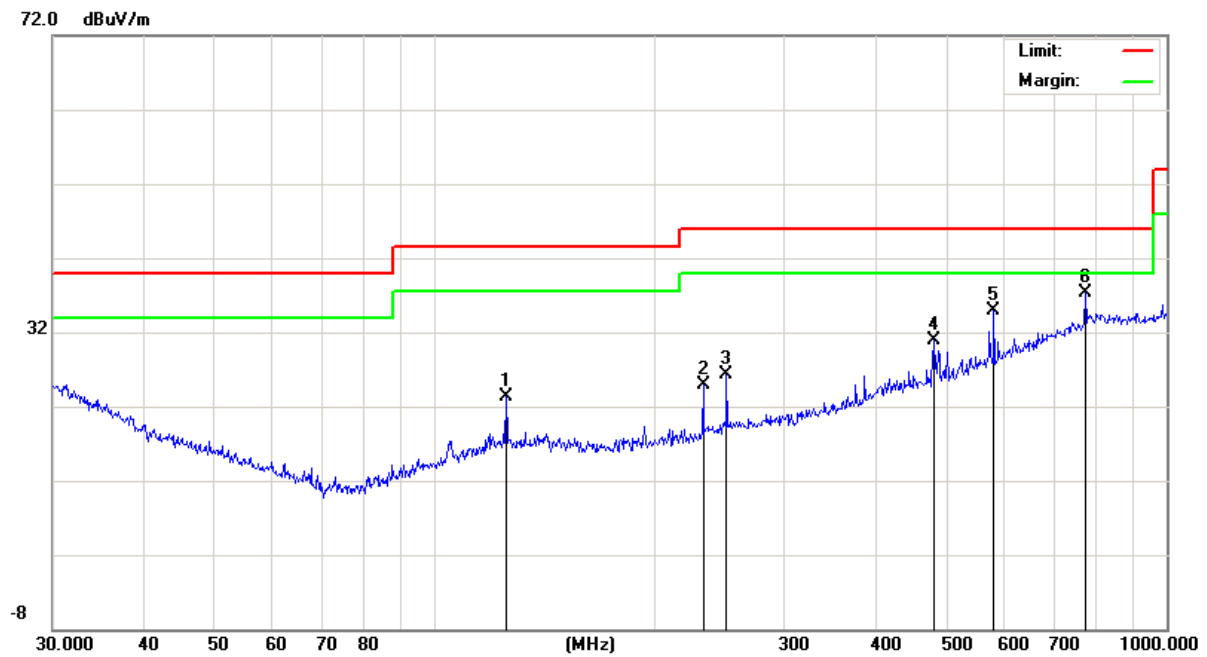
Absolute Level= ReadingLevel+ Factor, Margin= Absolute Level - Limit



Polar (H/V)	Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Remark
	(MHz)	(dBuV)	(dB)	(dBuV/m)	(dBuV/m)	(dB)	
H	125.0066	11.29	11.99	23.28	43.50	-20.22	QP
H	232.5318	11.95	12.98	24.93	46.00	-21.07	QP
H	250.3012	12.80	13.59	26.39	46.00	-19.61	QP
H	480.5276	10.92	19.91	30.83	46.00	-15.17	QP
H	580.7026	13.00	21.99	34.99	46.00	-11.01	QP
H	774.1584	10.58	26.73	37.31	46.00	-8.69	QP

**Remark:**

Absolute Level= ReadingLevel+ Factor, Margin= Absolute Level - Limit



### 3.2.8 TEST RESULTS (ABOVE 1000 MHZ)

EUT :	Tessel	Model Name :	Tessel 2
Temperature :	20 °C	Relative Humidity :	48%
Pressure :	1010 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX		

The Testing have been conformed to 10\*2462MHz=24620MHz, and the worst result was report as below:

Polar (H/V)	Frequency (MHz)	Meter Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Detector Type
<b>Low Channel (2412 MHz)-Above 1G</b>							
Vertical	4824.203	51.24	10.44	61.68	74.00	-12.32	Pk
Vertical	4824.203	33.26	10.44	43.70	54.00	-10.30	Av
Vertical	7236.157	49.87	12.39	62.26	74.00	-11.74	Pk
Vertical	7236.157	29.65	12.39	42.04	54.00	-11.96	Av
Horizontal	4824.341	49.74	10.44	60.18	74.00	-13.82	Pk
Horizontal	4824.341	31.15	10.44	41.59	54.00	-12.41	Av
Horizontal	7236.289	45.58	12.39	57.97	74.00	-16.03	Pk
Horizontal	7236.289	30.03	12.39	42.42	54.00	-11.58	Av
<b>Mid Channel (2437 MHz)-Above 1G</b>							
Vertical	4874.275	50.09	10.40	60.49	74.00	-13.51	Pk
Vertical	4874.275	30.64	10.40	41.04	54.00	-12.96	Av
Vertical	7311.199	46.52	12.75	59.27	74.00	-14.73	Pk
Vertical	7311.199	28.67	12.75	41.42	54.00	-12.58	Av
Horizontal	4874.144	49.93	10.40	60.33	74.00	-13.67	Pk
Horizontal	4874.144	30.01	10.40	40.41	54.00	-13.59	Av
Horizontal	7311.238	46.75	12.75	59.50	74.00	-14.50	Pk
Horizontal	7311.238	30.96	12.75	43.71	54.00	-10.29	Av
<b>High Channel (2462 MHz)- Above 1G</b>							
Vertical	4924.199	49.74	10.39	60.13	74.00	-13.87	Pk
Vertical	4924.199	30.13	10.39	40.52	54.00	-13.48	Av
Vertical	7386.234	44.52	12.68	57.20	74.00	-16.80	Pk
Vertical	7386.234	28.86	12.68	41.54	54.00	-12.46	Av
Horizontal	4924.216	50.01	10.39	60.40	74.00	-13.60	Pk
Horizontal	4924.216	29.97	10.39	40.36	54.00	-13.64	Av
Horizontal	7386.345	48.62	12.68	61.30	74.00	-12.70	Pk
Horizontal	7386.345	28.99	12.68	41.67	54.00	-12.33	Av

Note:"802.11b" mode is the worst mode.

## 4. POWER SPECTRAL DENSITY TEST

### 4.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247	Power Spectral Density	8 dBm (in any 3KHz)	2400-2483.5	PASS

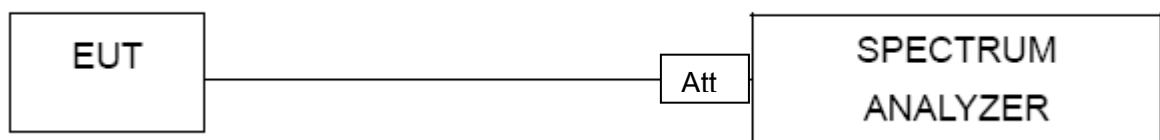
#### 4.1.1 TEST PROCEDURE

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. 3 kHz  $\leq$  Set the RBW  $\leq$  100 kHz.
4. Set the VBW  $\geq$  3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

#### 4.1.2 DEVIATION FROM STANDARD

No deviation.

#### 4.1.3 TEST SETUP



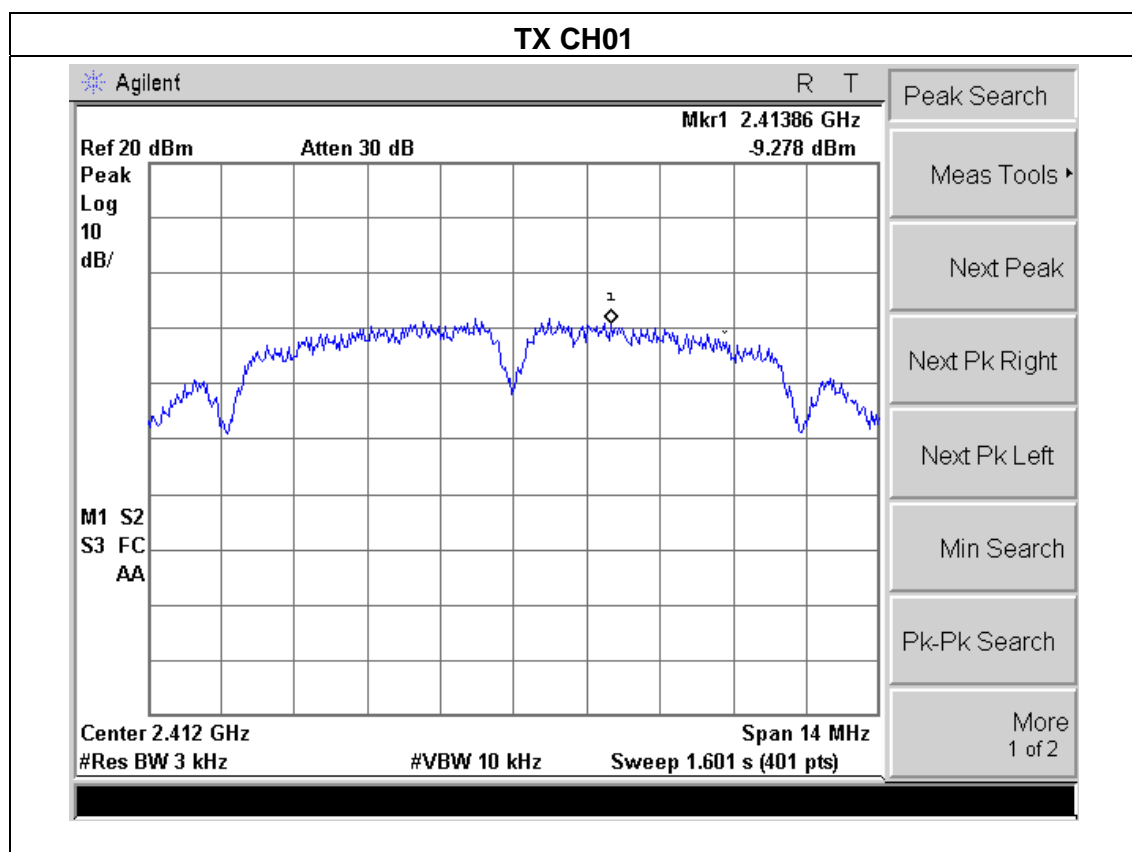
#### 4.1.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.1 Unless otherwise a special operating condition is specified in the follows during the testing.

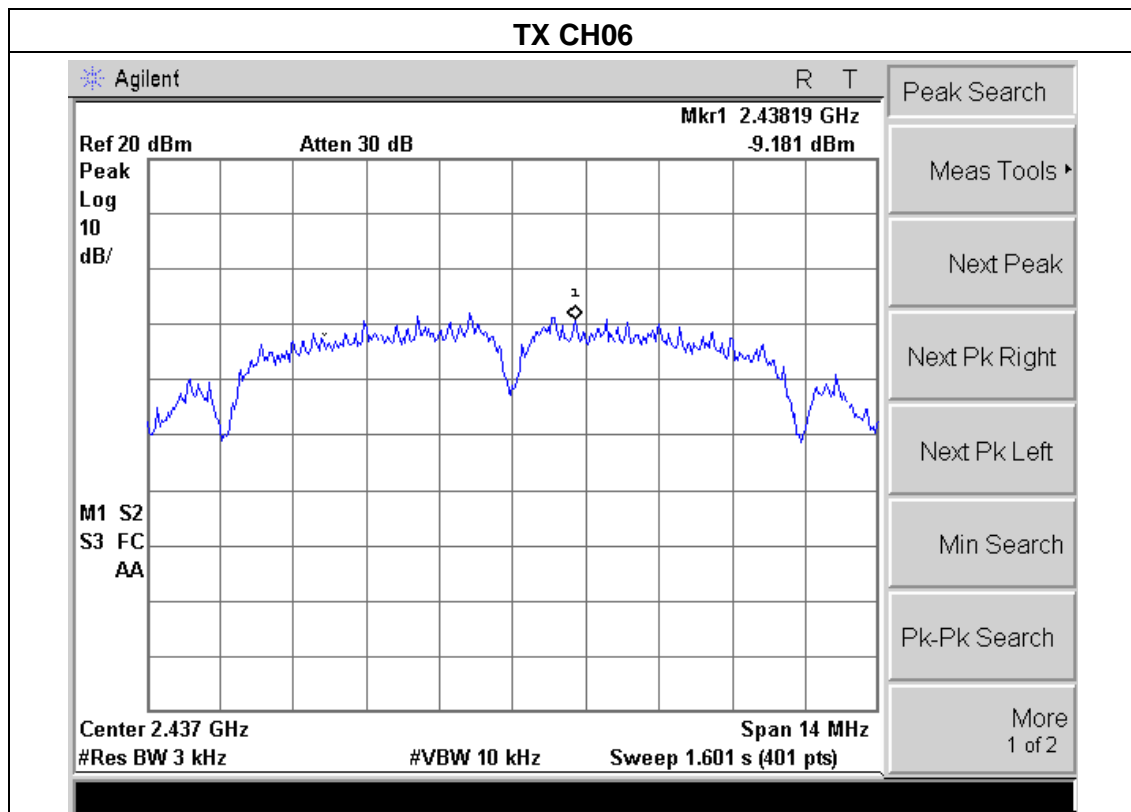
#### 4.1.5 TEST RESULTS

EUT :	Tessel	Model Name :	Tessel 2
Temperature :	25 °C	Relative Humidity :	56%
Pressure :	1015 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX b Mode /CH01, CH06, CH11		

Frequency	Power Density (dBm)	Limit (dBm)	Result
2412 MHz	-9.278	8	PASS
2437 MHz	-9.181	8	PASS
2462 MHz	-10.05	8	PASS

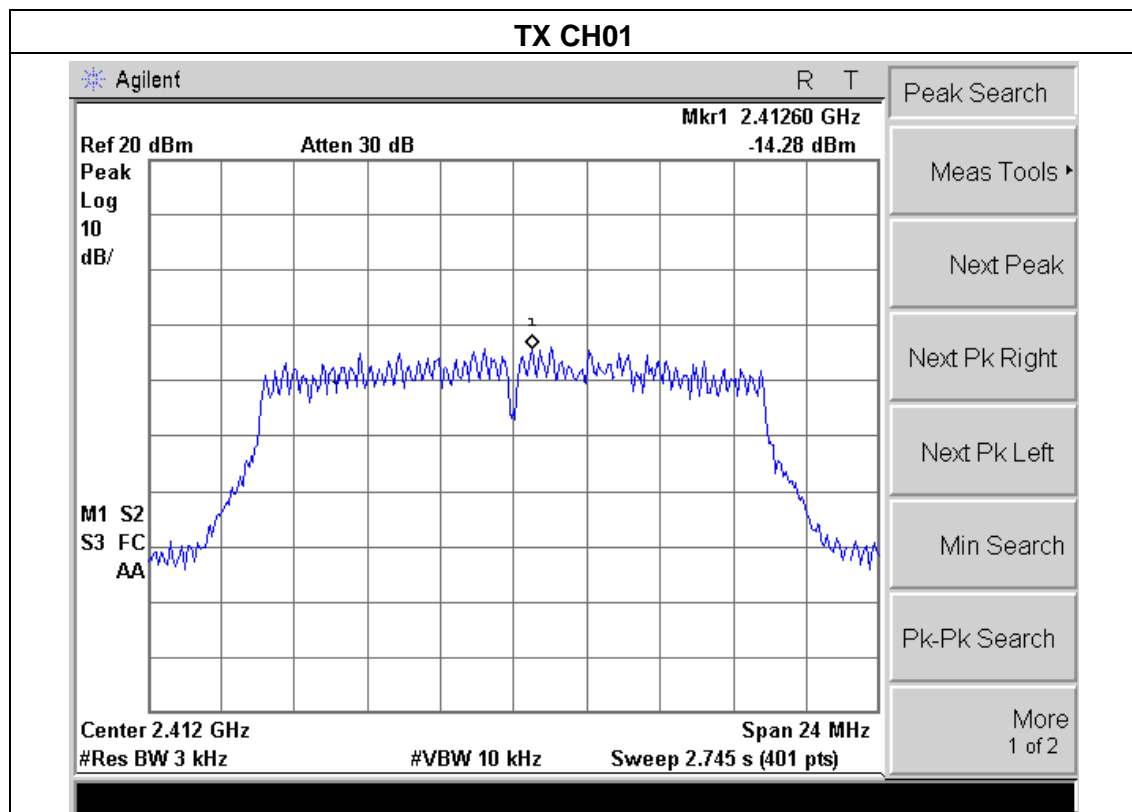


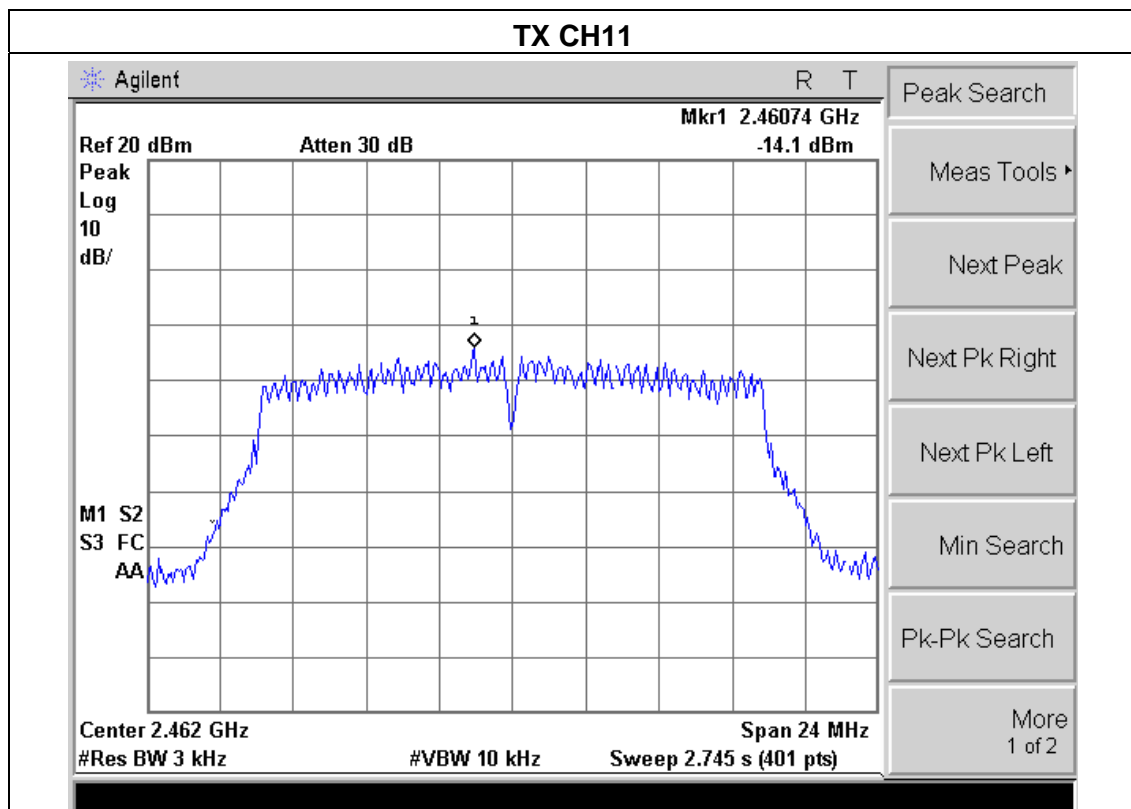
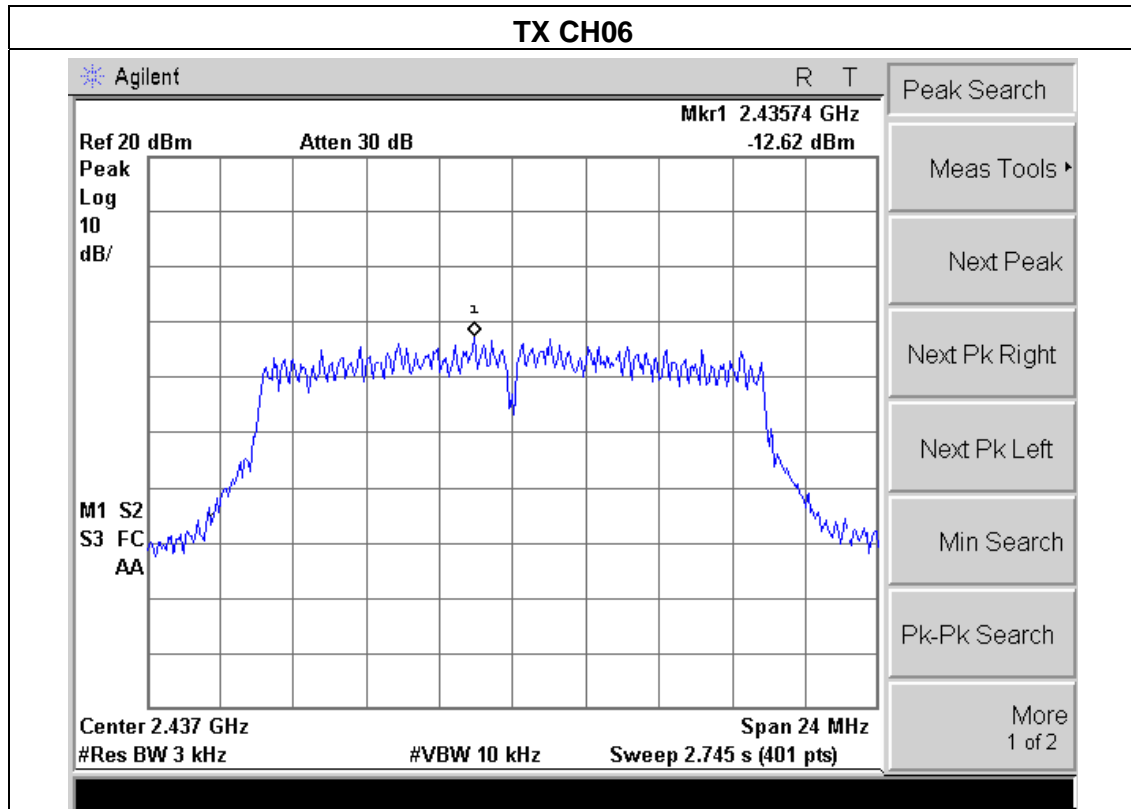




EUT :	Tessel	Model Name :	Tessel 2
Temperature :	25 °C	Relative Humidity :	56%
Pressure :	1015 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX g Mode /CH01, CH06, CH11		

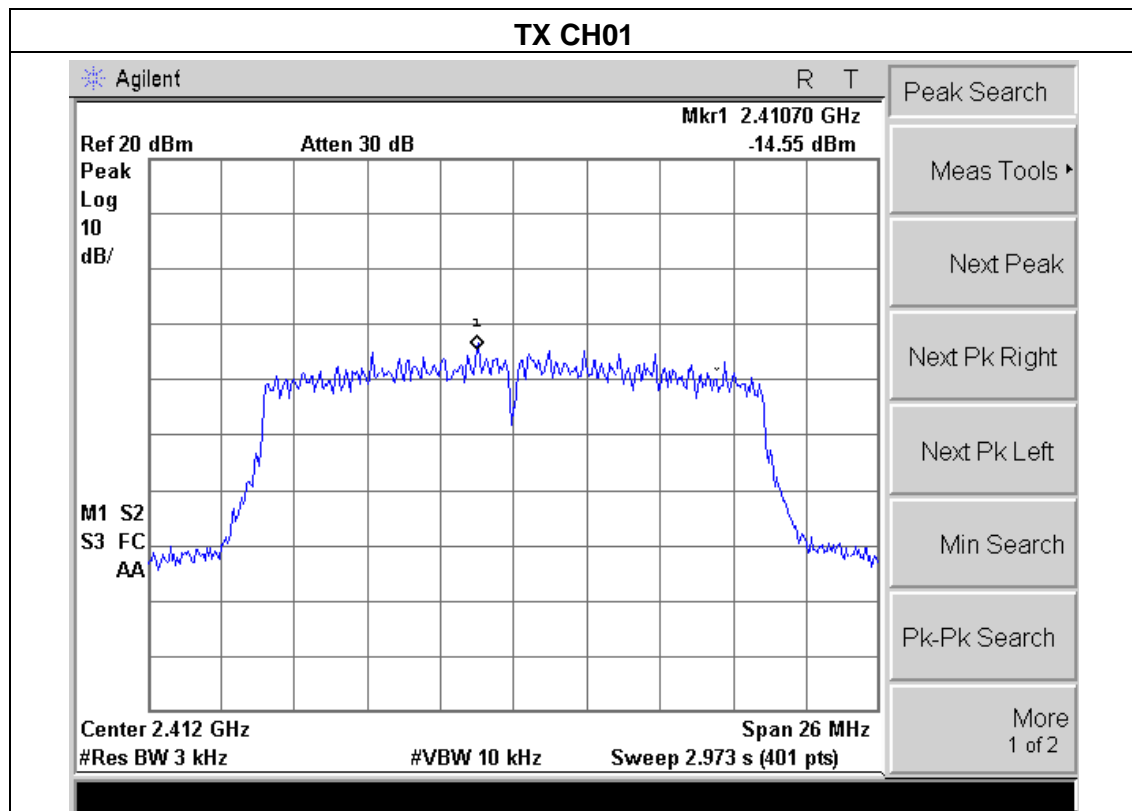
Frequency	Power Density (dBm)	Limit (dBm)	Result
2412 MHz	-14.28	8	PASS
2437 MHz	-12.62	8	PASS
2462 MHz	-14.10	8	PASS

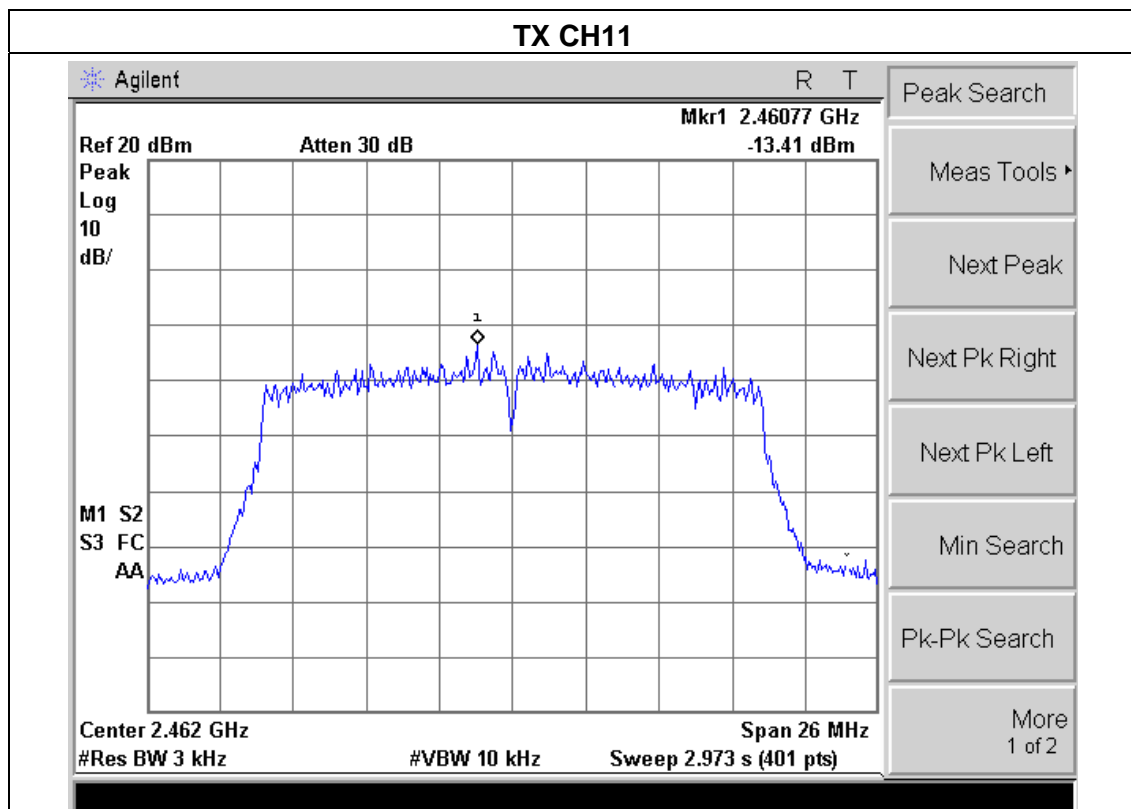
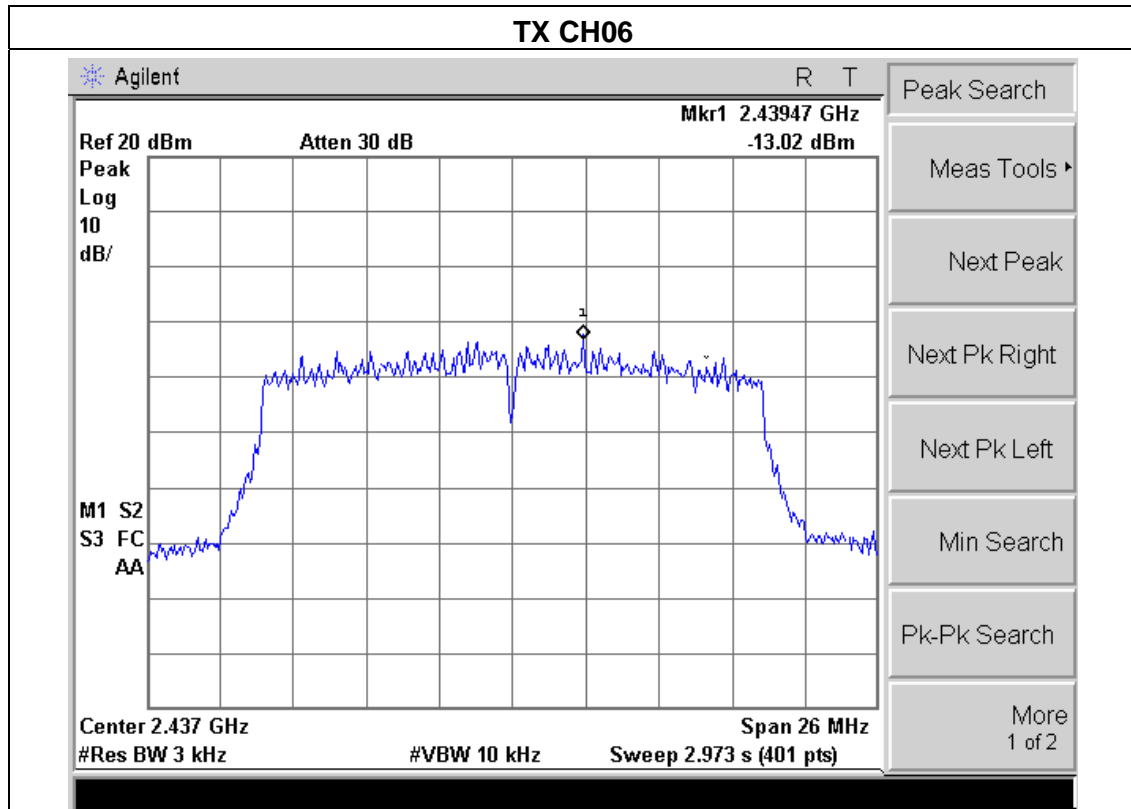




EUT :	Tessel	Model Name :	Tessel 2
Temperature :	25 °C	Relative Humidity :	56%
Pressure :	1015 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX n Mode (20MHz)/CH01, CH06, CH11		

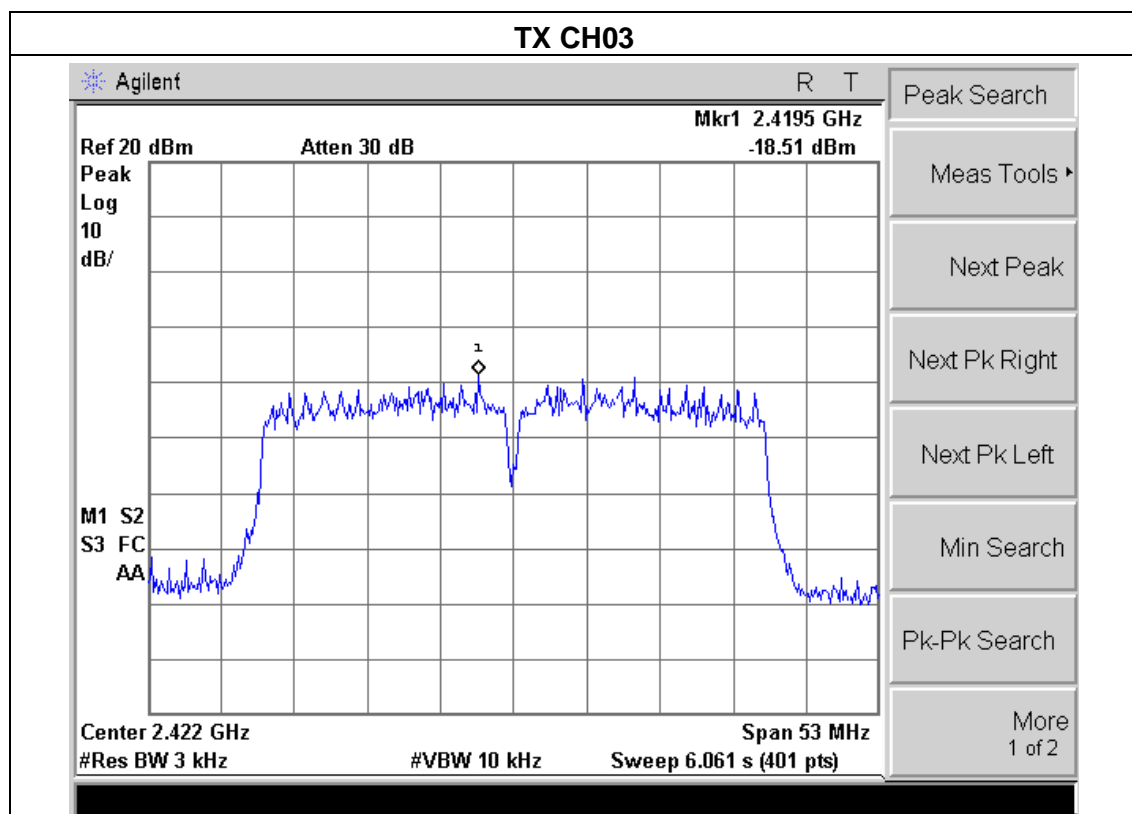
Frequency	Power Density (dBm)	Limit (dBm)	Result
2412 MHz	-14.55	8	PASS
2437 MHz	-13.02	8	PASS
2462 MHz	-13.41	8	PASS

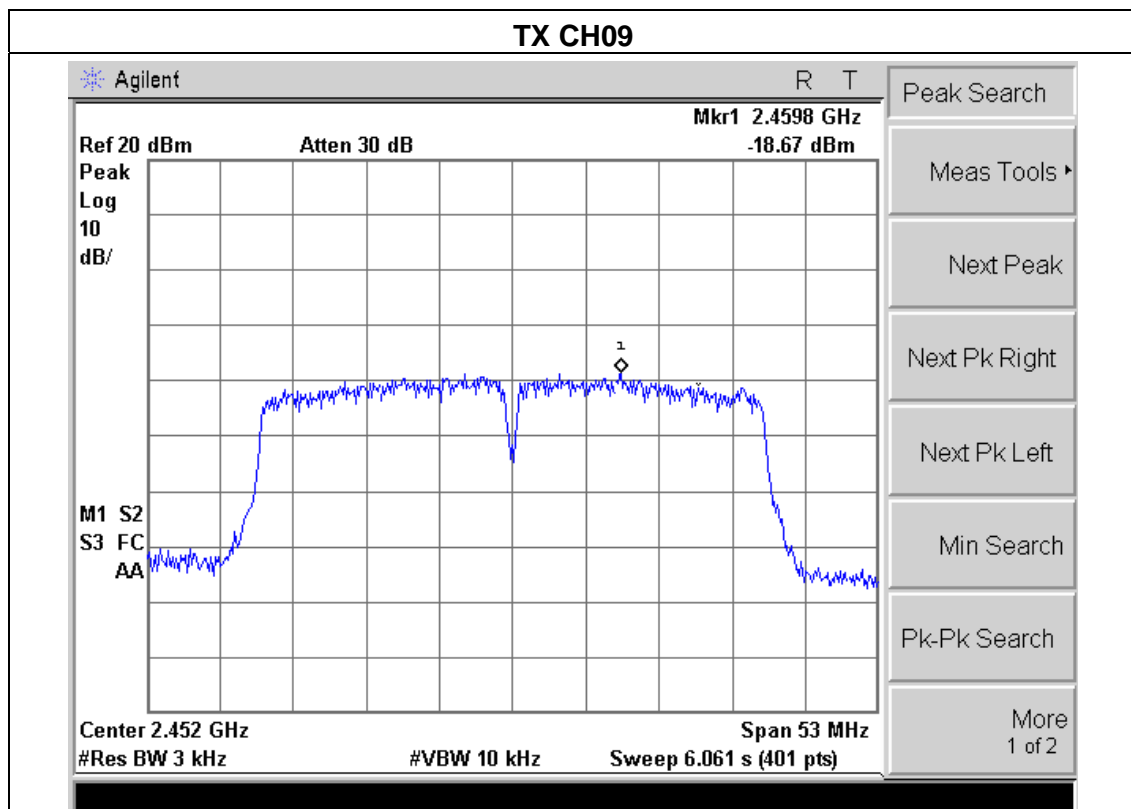
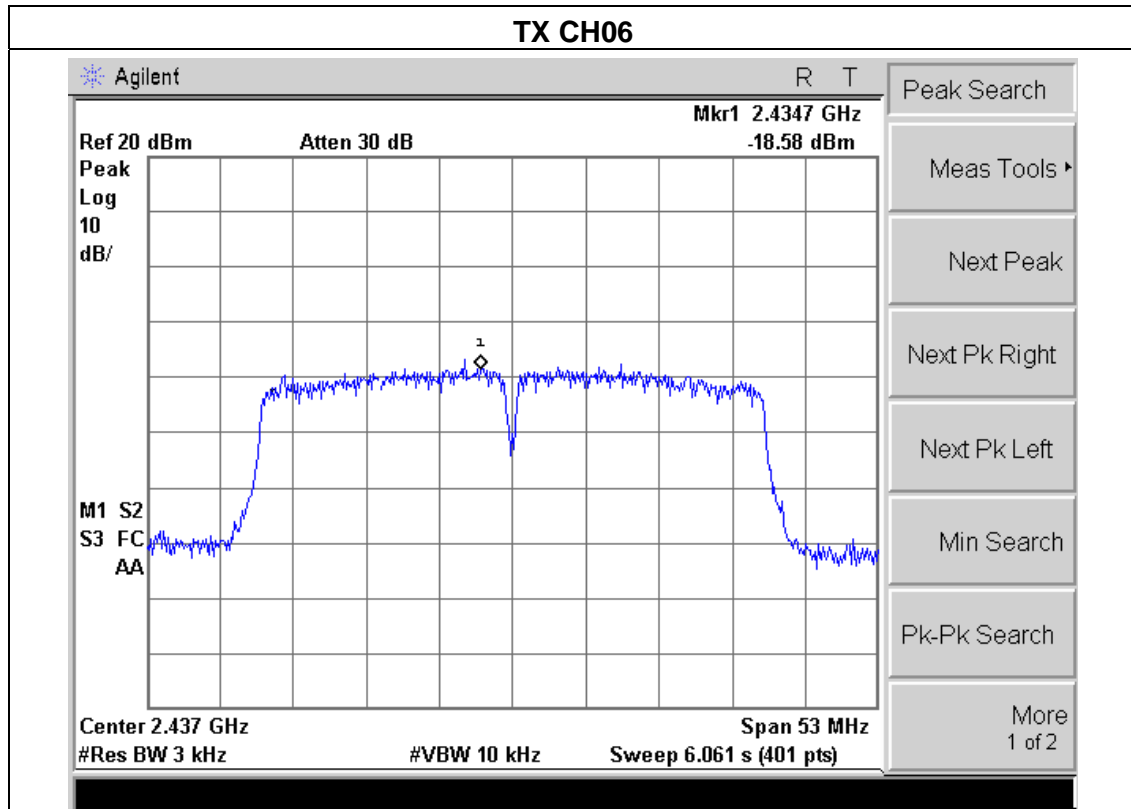




EUT :	Tessel	Model Name :	Tessel 2
Temperature :	25 °C	Relative Humidity :	56%
Pressure :	1015 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX n Mode (40MHz)/CH03, CH06, CH09		

Frequency	Power Density (dBm)	Limit (dBm)	Result
2422 MHz	-18.51	8	PASS
2437 MHz	-18.58	8	PASS
2452 MHz	-18.67	8	PASS





## 5. BANDWIDTH TEST

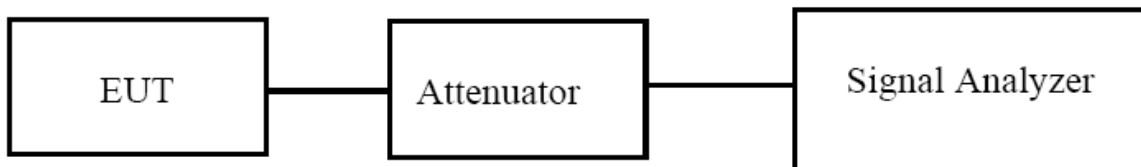
### 5.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	$\geq 500\text{KHz}$ (6dB bandwidth)	2400-2483.5	PASS

#### 5.1.1 TEST PROCEDURE

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW)  $\geq 3 \times \text{RBW}$ .
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

#### TEST SETUP



#### 5.1.2 EUT OPERATION CONDITIONS

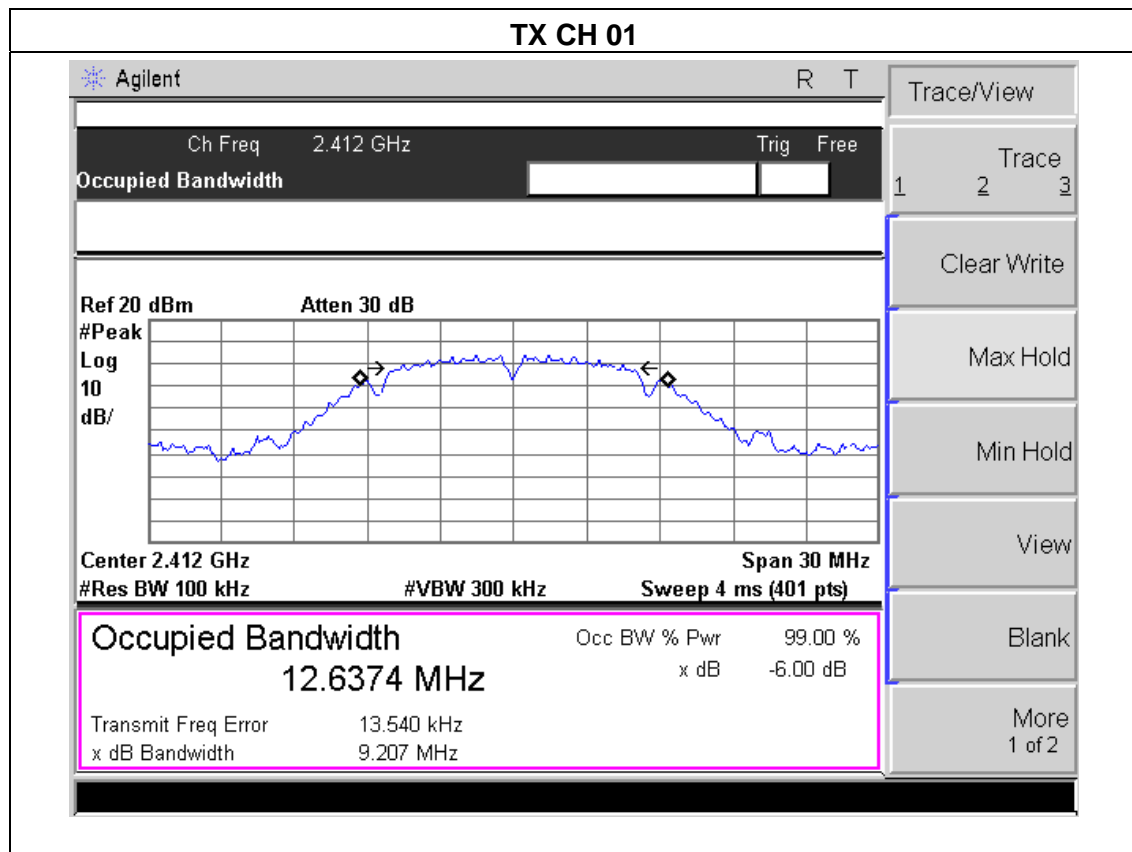
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.



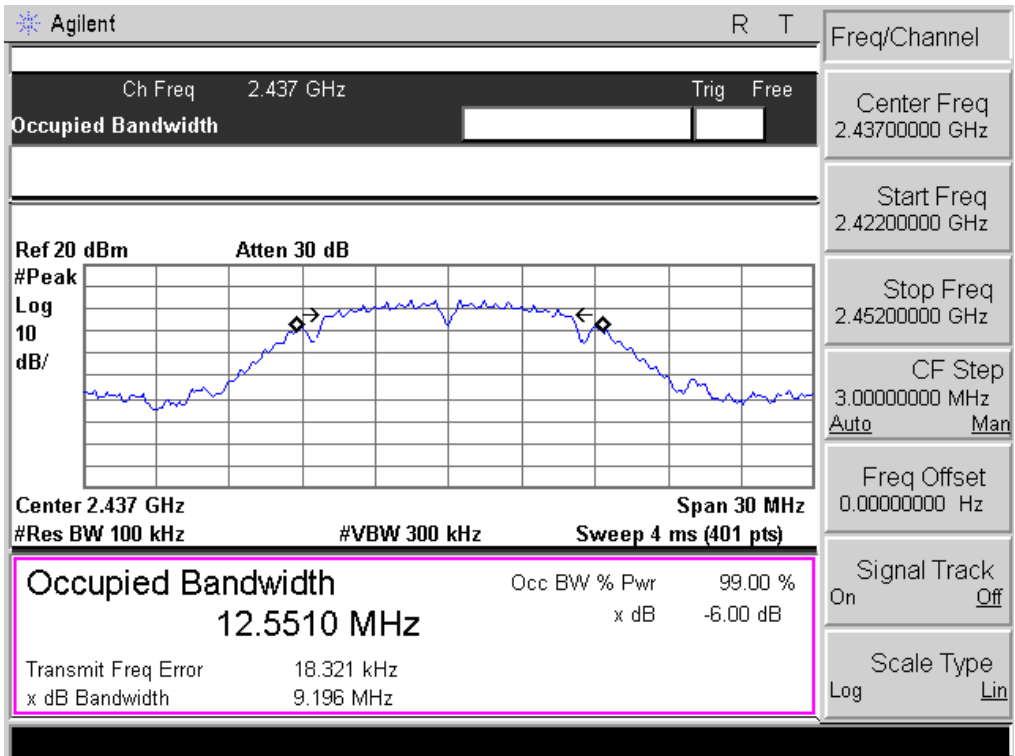
### 5.1.3 TEST RESULTS

EUT :	Tessel	Model Name :	Tessel 2
Temperature :	25 °C	Relative Humidity :	56%
Pressure :	1012 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX b Mode /CH01, CH06, CH11		

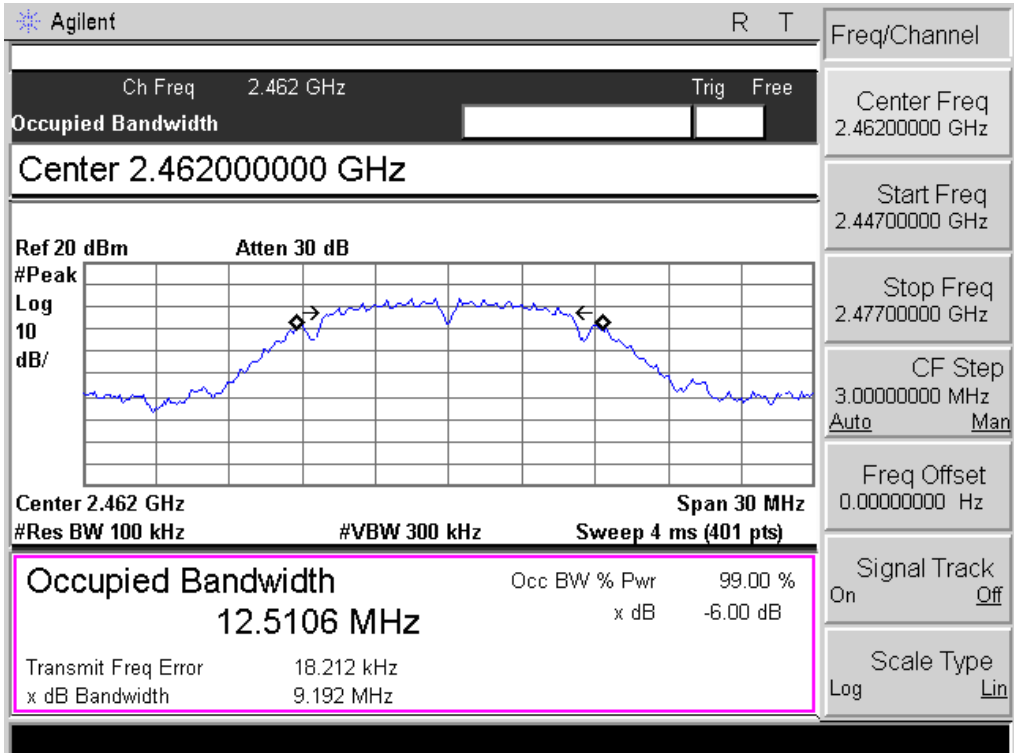
Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
Low	2412	9.207	500	Pass
Middle	2437	9.196	500	Pass
High	2462	9.192	500	Pass



### TX CH 06

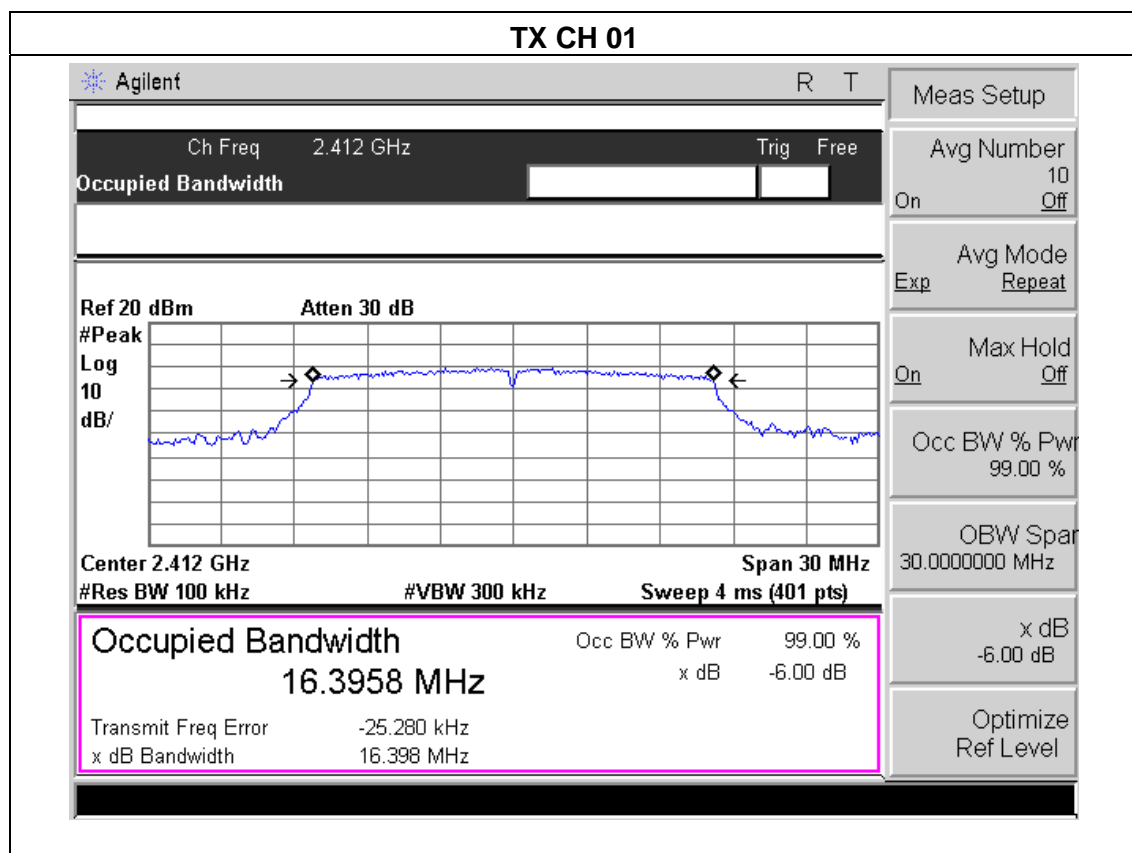


### TX CH 11

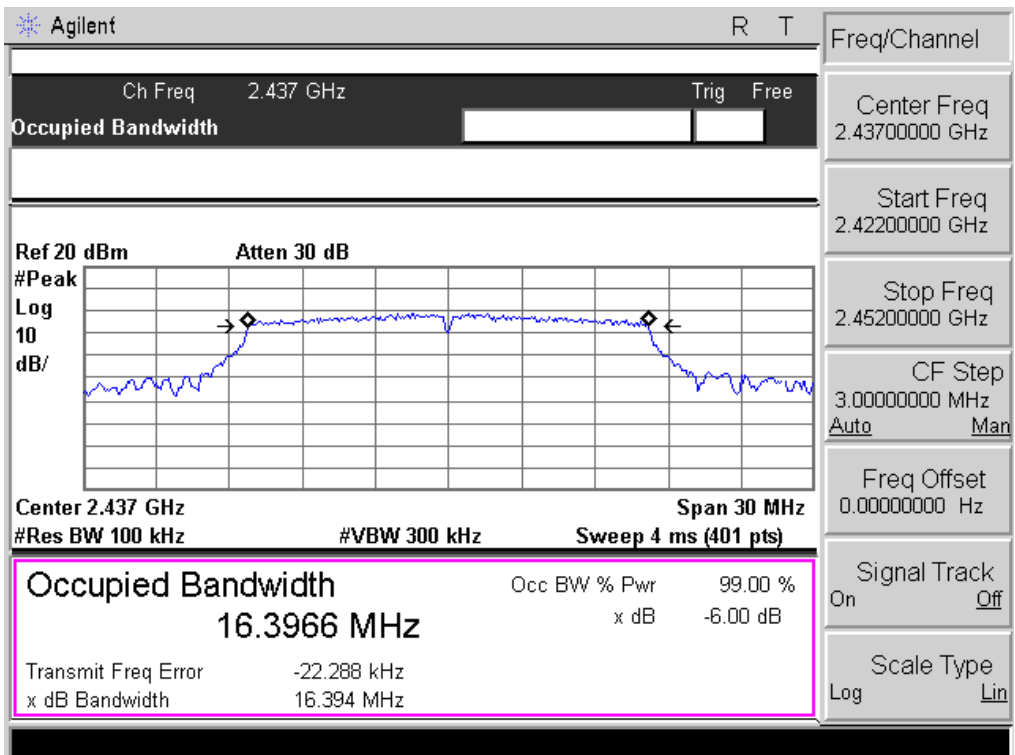


EUT :	Tessel	Model Name :	Tessel 2
Temperature :	25 °C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX g Mode /CH01, CH06, CH11		

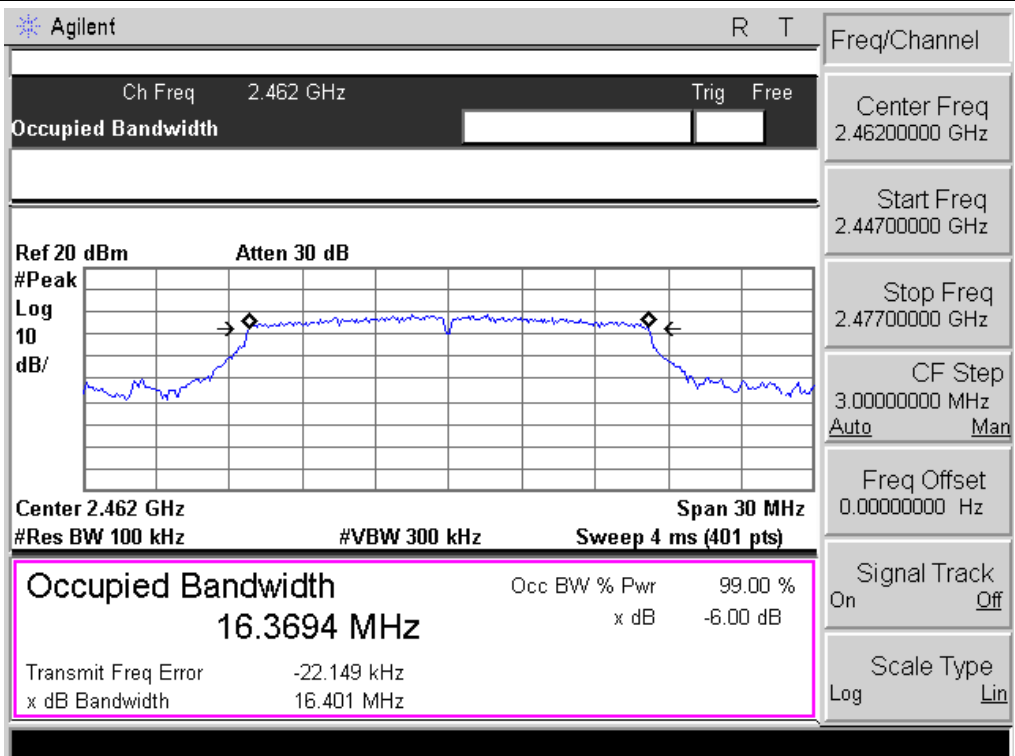
Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
Low	2412	16.398	500	Pass
Middle	2437	16.394	500	Pass
High	2462	16.401	500	Pass



## TX CH 06

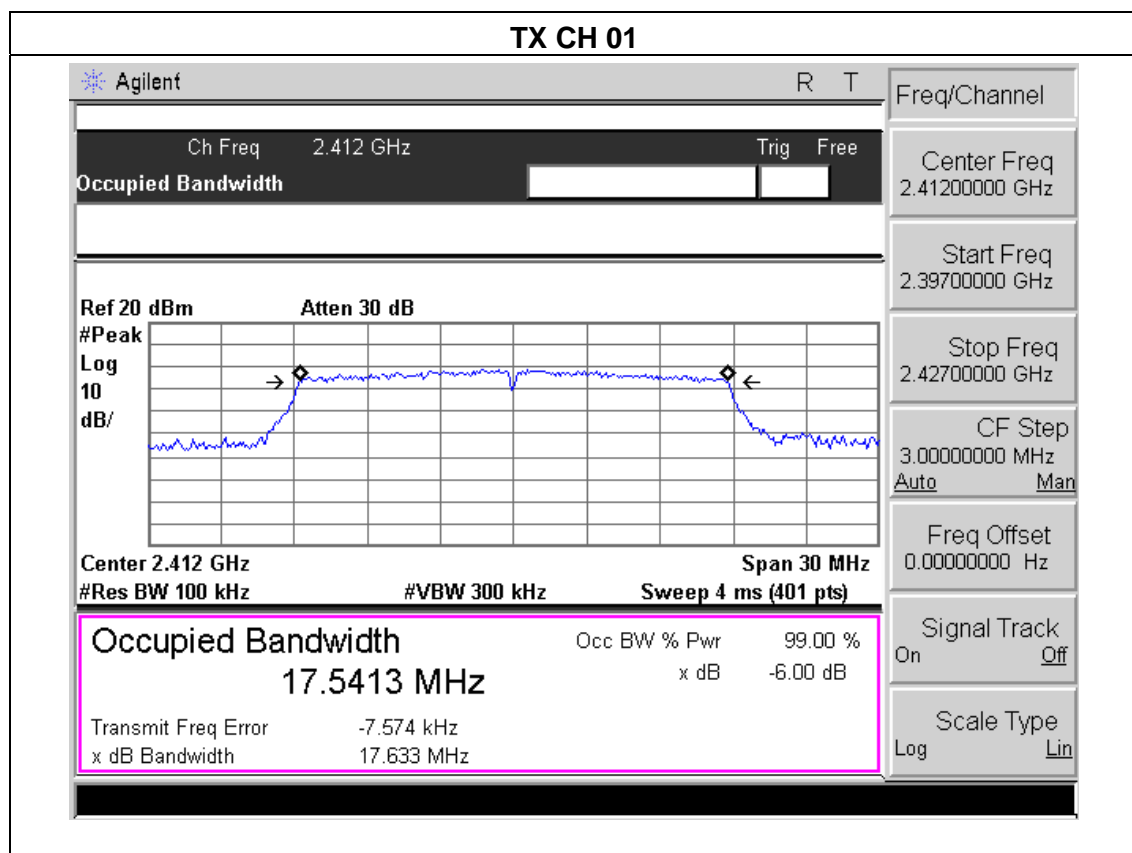


## TX CH 11

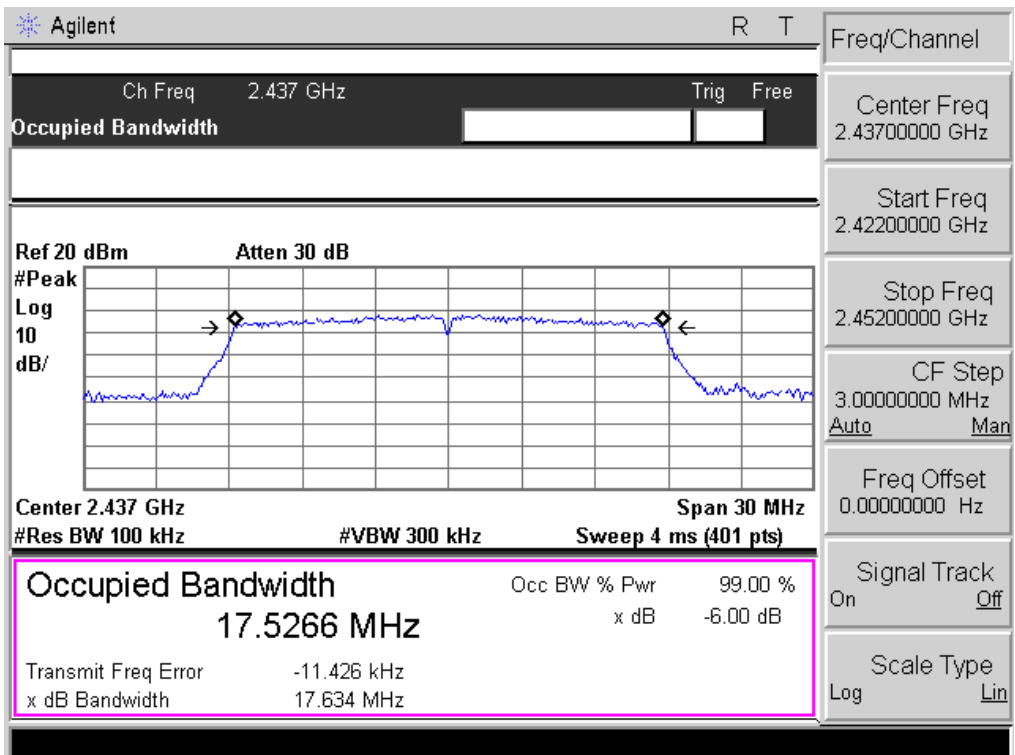


EUT :	Tessel	Model Name :	Tessel 2
Temperature :	25 °C	Relative Humidity :	56%
Pressure :	1012 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX n Mode(20M) /CH01, CH06, CH11		

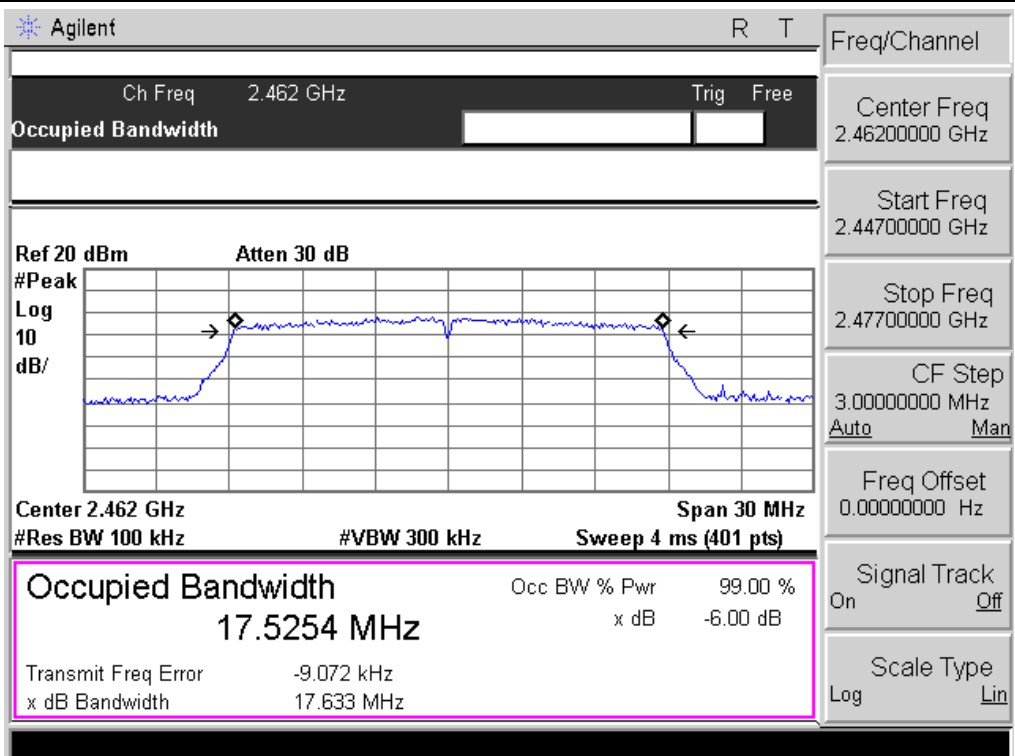
Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
Low	2412	17.633	500	Pass
Middle	2437	17.634	500	Pass
High	2462	17.633	500	Pass



### TX CH 06

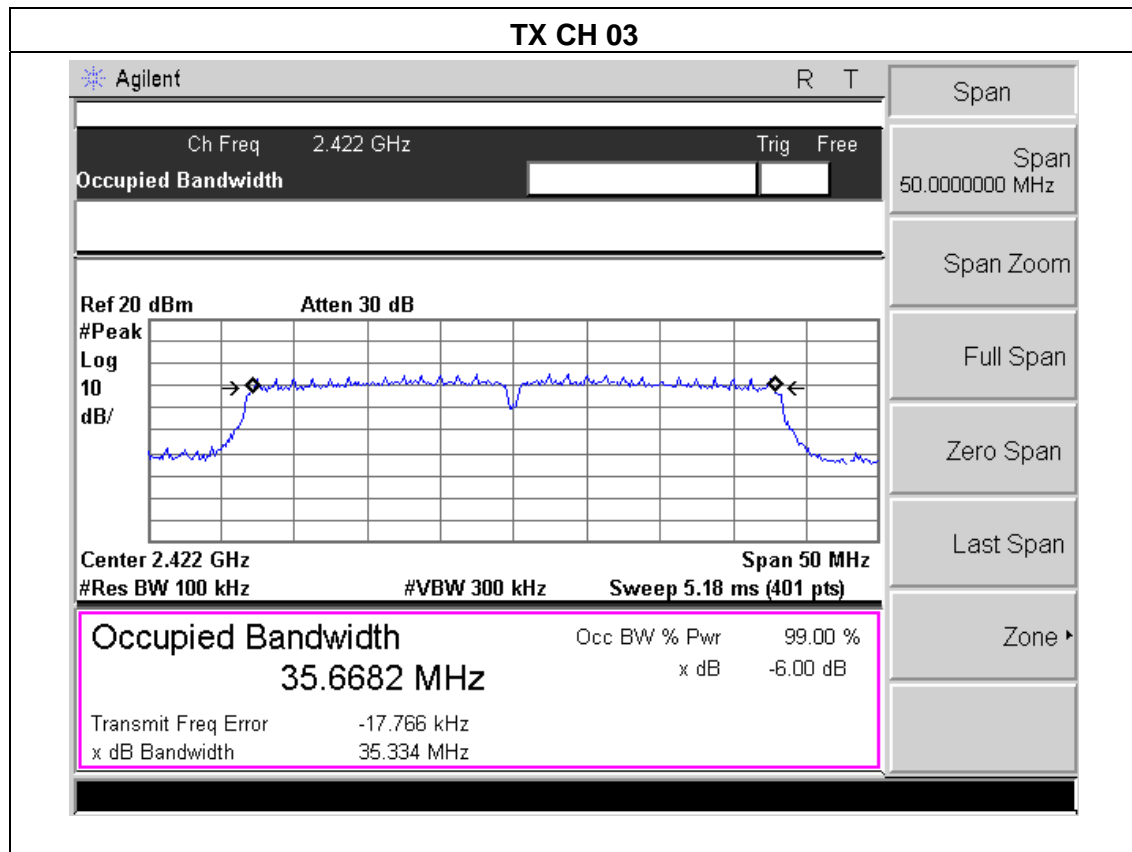


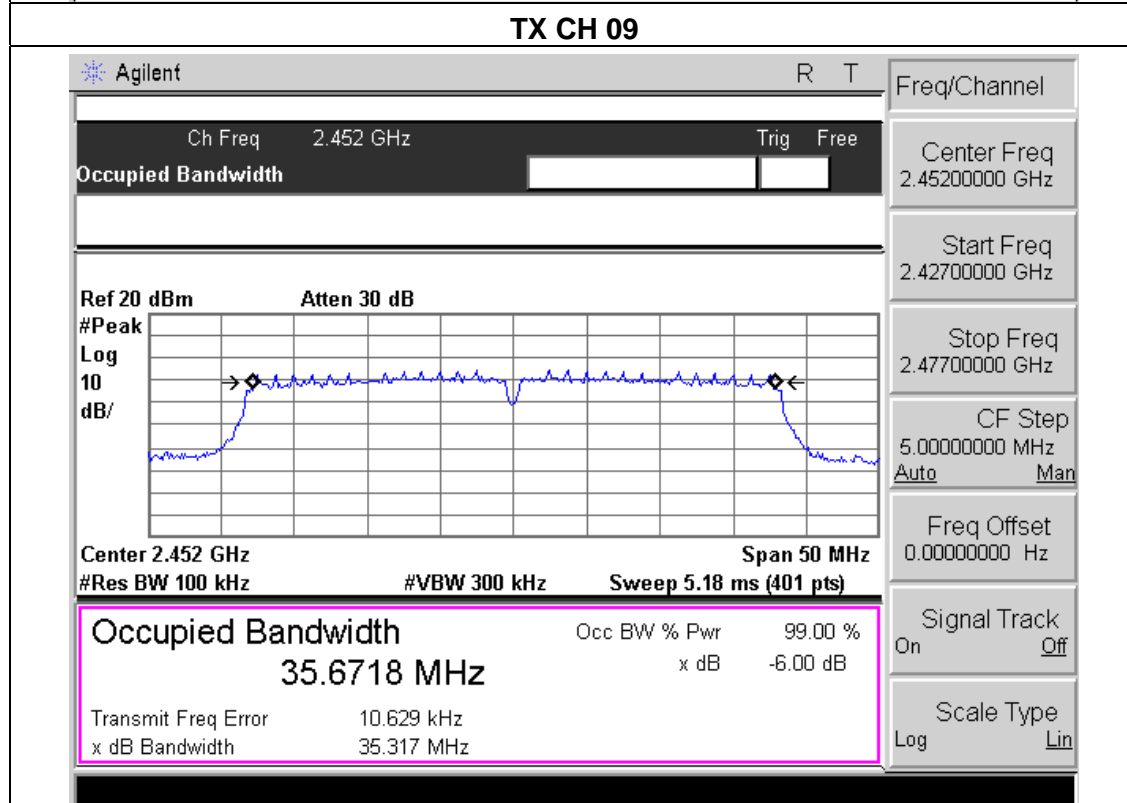
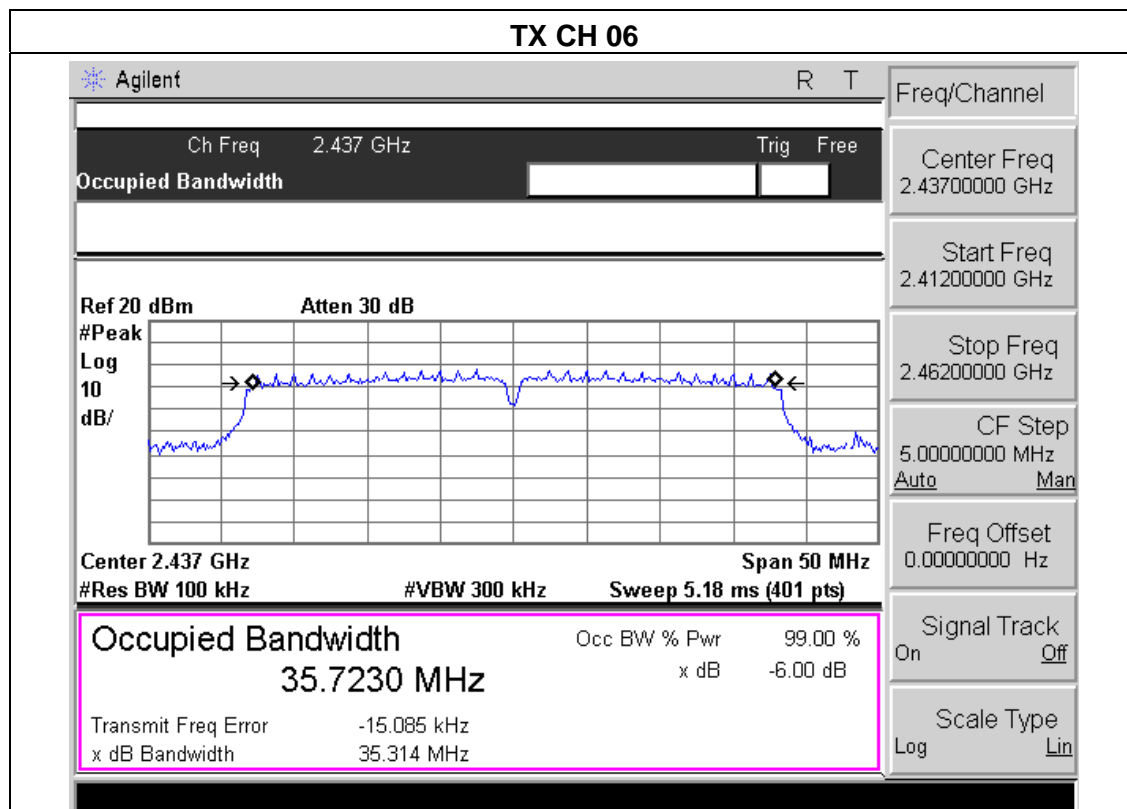
### TX CH 11



EUT :	Tessel	Model Name :	Tessel 2
Temperature :	25 °C	Relative Humidity :	56%
Pressure :	1012 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX n Mode(40M) /CH03, CH06, CH09		

Channel	Frequency (MHz)	6dB bandwidth (MHz)	Limit (kHz)	Result
Low	2422	35.334	500	Pass
Middle	2437	35.314	500	Pass
High	2452	35.317	500	Pass







## 6. OUTPUT POWER TEST

### 6.1 APPLIED PROCEDURES / LIMIT

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Output Power	1 watt or 30dBm	2400-2483.5	PASS

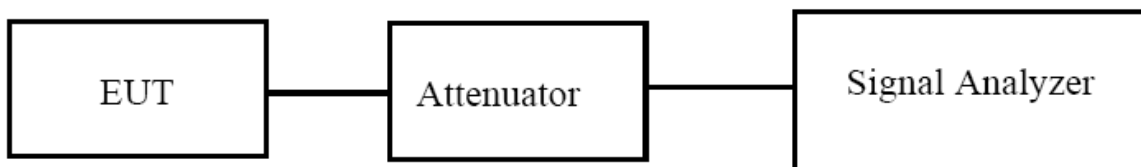
#### 6.1.1 TEST PROCEDURE

- The EUT was connected to the Signal Analyzer by RF cable and Attenuator.
- Set span to at least 1.5 times the OBW.
- Set RBW = 1-5% of the OBW.
- Set VBW  $\geq 3 \times$  RBW
- Sweep time = auto.
- Detector = RMS
- Set to the maximum power setting and enable the EUT transmit continuously.

#### 6.1.2 DEVIATION FROM STANDARD

No deviation.

#### 6.1.3 TEST SETUP



#### 6.1.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

### 6.1.5 TEST RESULTS

EUT :	Tessel	Model Name :	Tessel 2
Temperature :	25 °C	Relative Humidity :	60%
Pressure :	1012 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz
Test Mode :	TX b/g/n(20M/40M) Mode		

#### TX 802.11b Mode

Test Channe	Frequency	Duty Cycle	Maximum Conducted Output Power(AV)	LIMIT
	(MHz)	(%)	(dBm)	dBm
CH01	2412	98.71	9.44	30
CH06	2437	98.75	9.73	30
CH11	2462	98.69	9.39	30

#### TX 802.11g Mode

CH01	2412	91.33	7.09	30
CH06	2437	91.32	7.21	30
CH11	2462	91.30	6.48	30

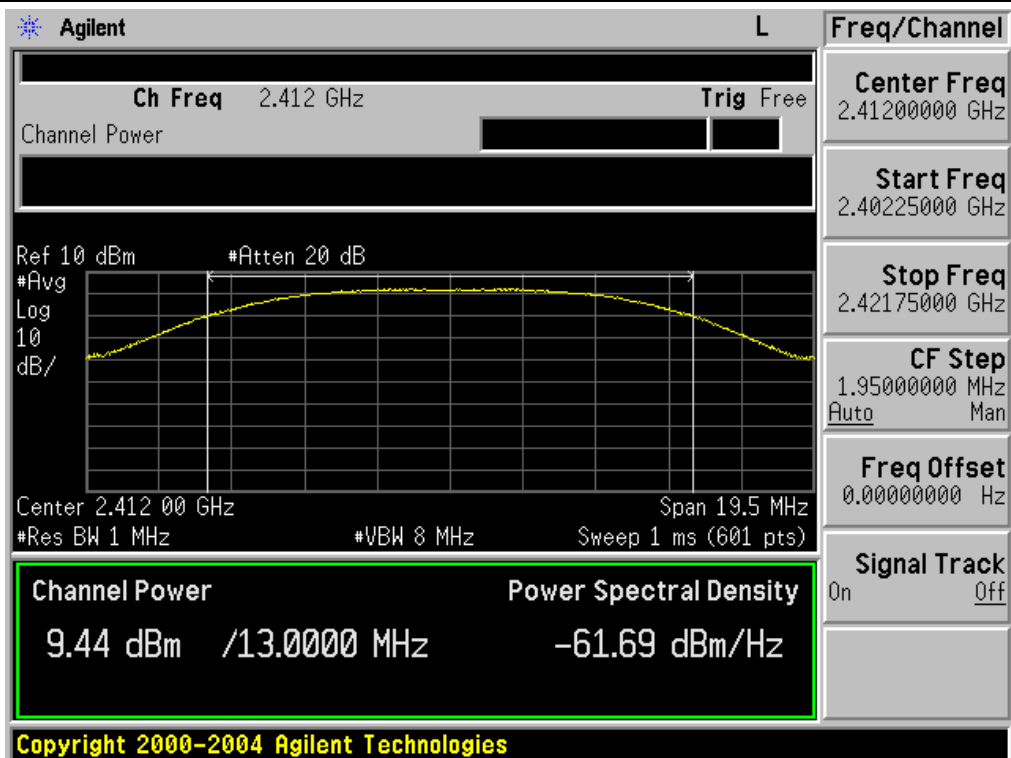
#### TX 802.11n(20) Mode

CH01	2412	90.77	5.43	30
CH06	2437	90.75	5.66	30
CH11	2462	90.72	5.65	30

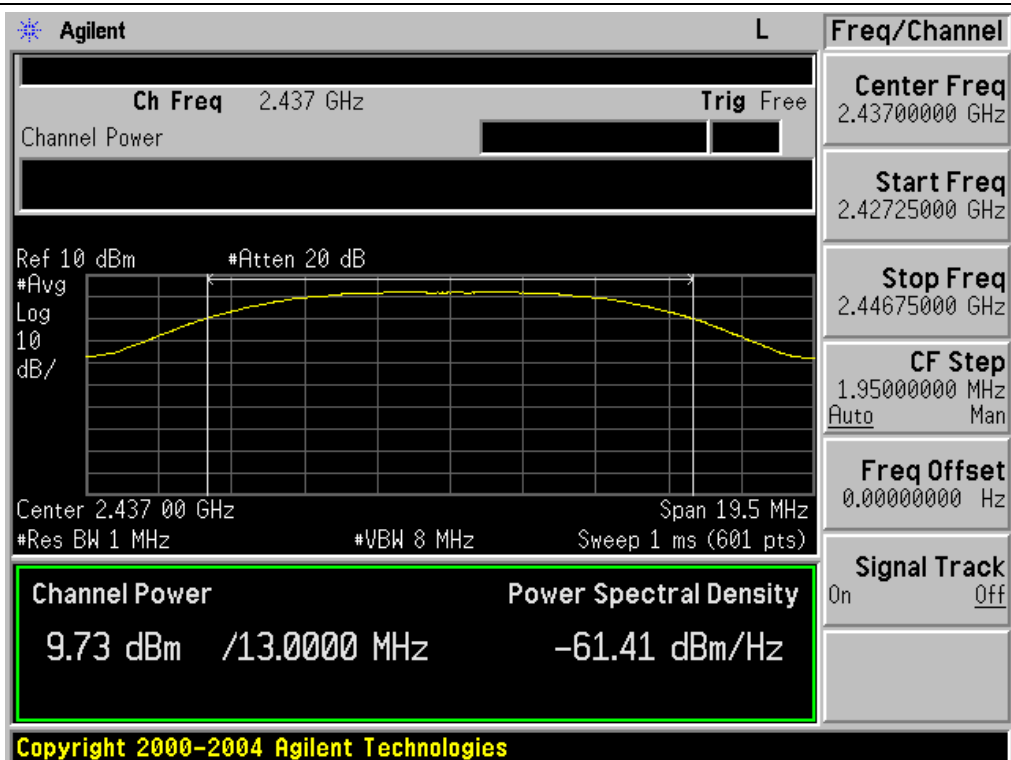
#### TX 802.11n(40) Mode

CH03	2422	85.16	4.20	30
CH06	2437	85.15	4.70	30
CH09	2452	85.15	4.18	30

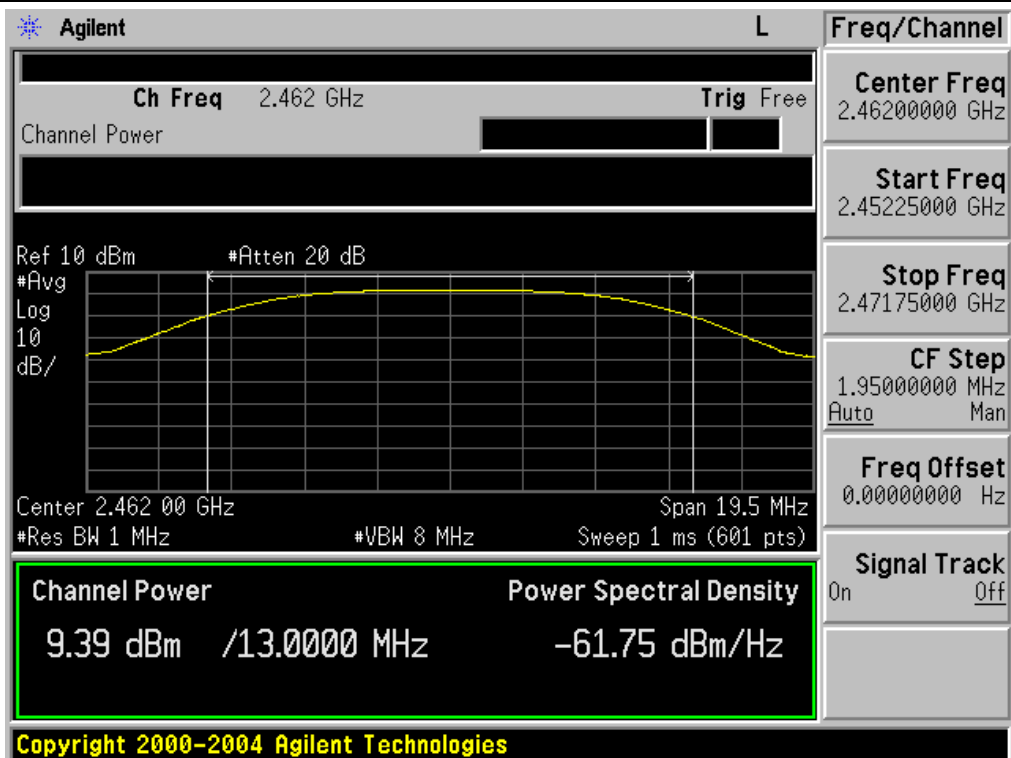
### 802.11b TX CH 01



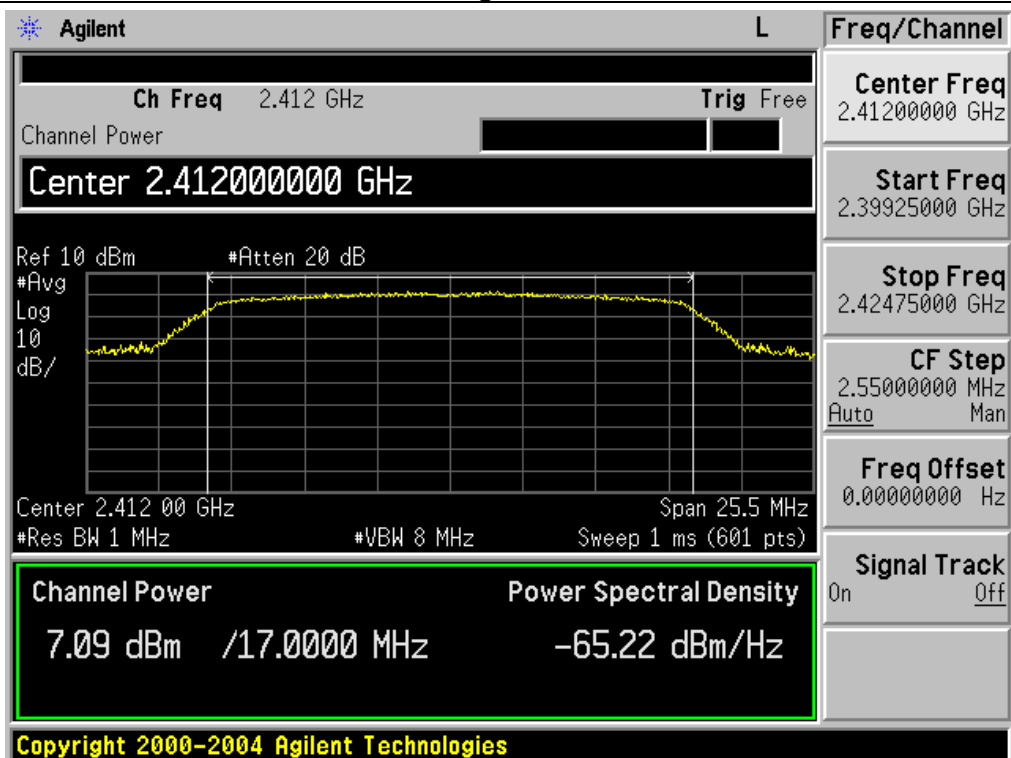
### 802.11b TX CH 06



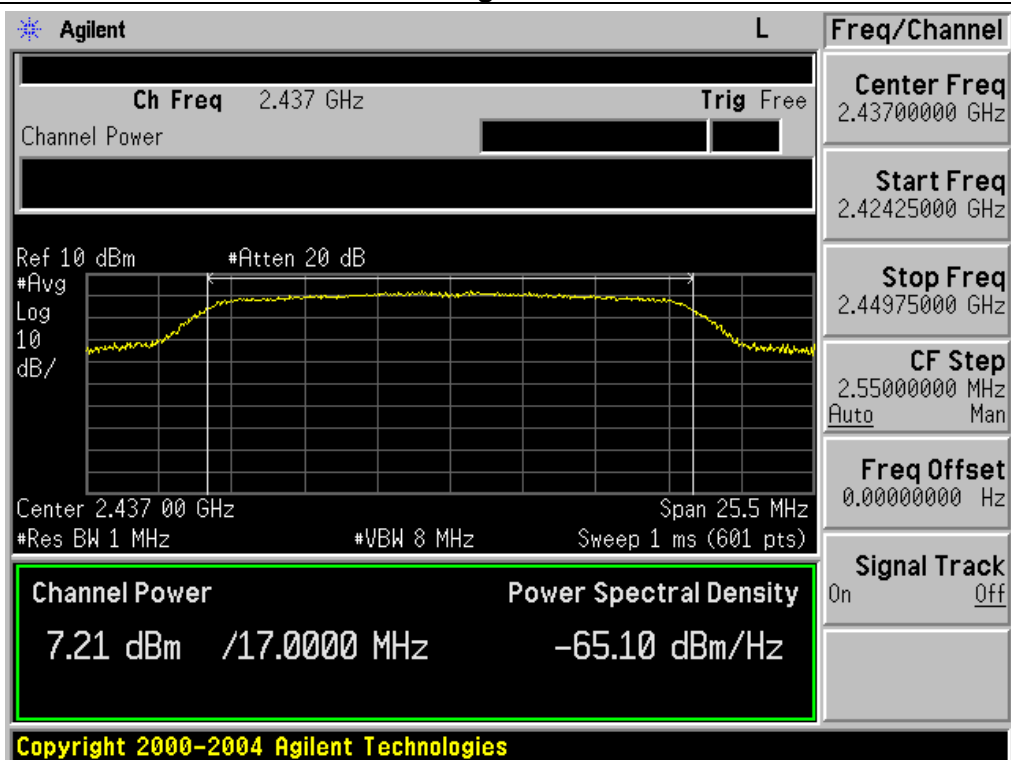
## 802.11b TX CH11



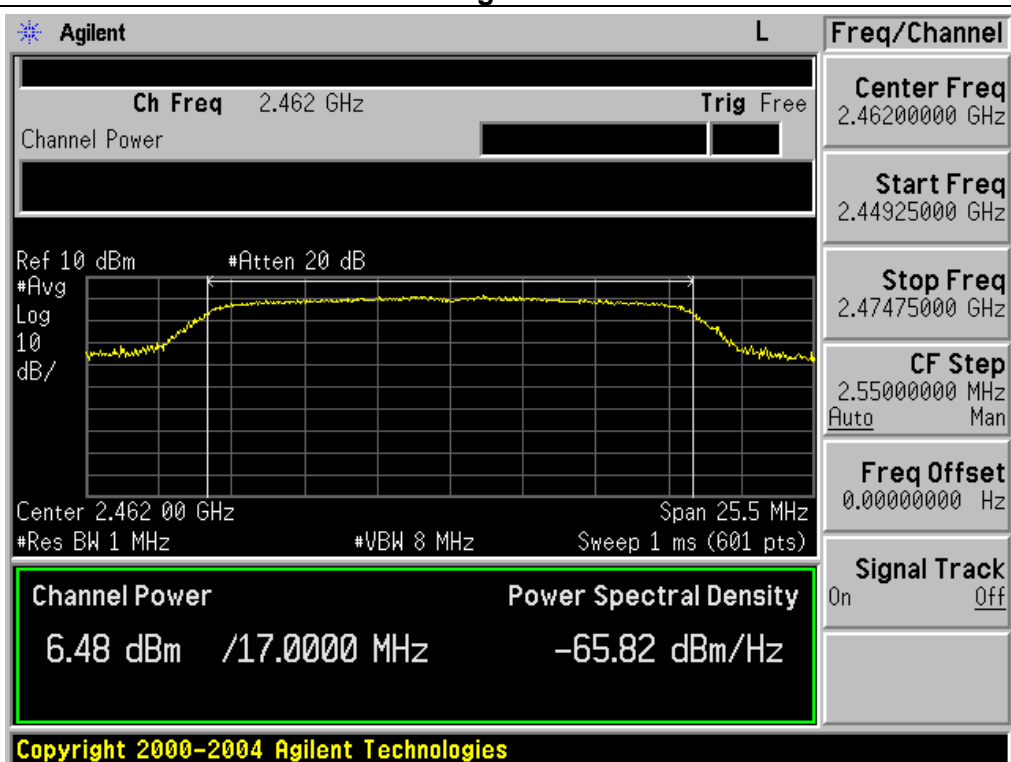
## 802.11g TX CH 01



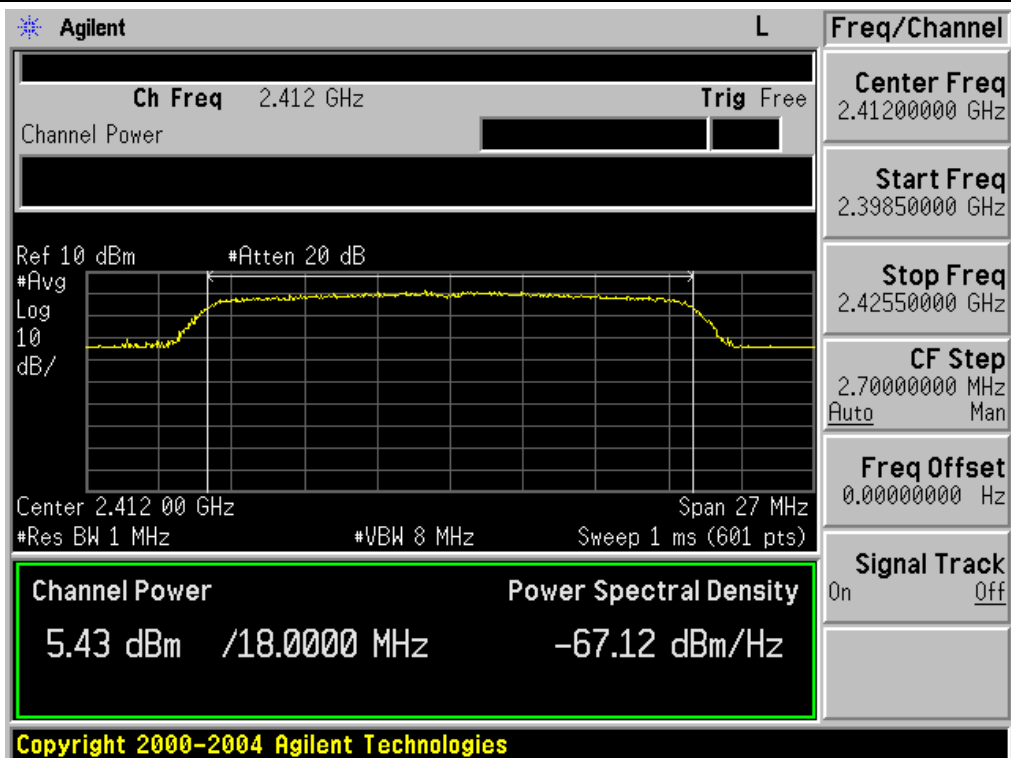
**802.11g TX CH 06**



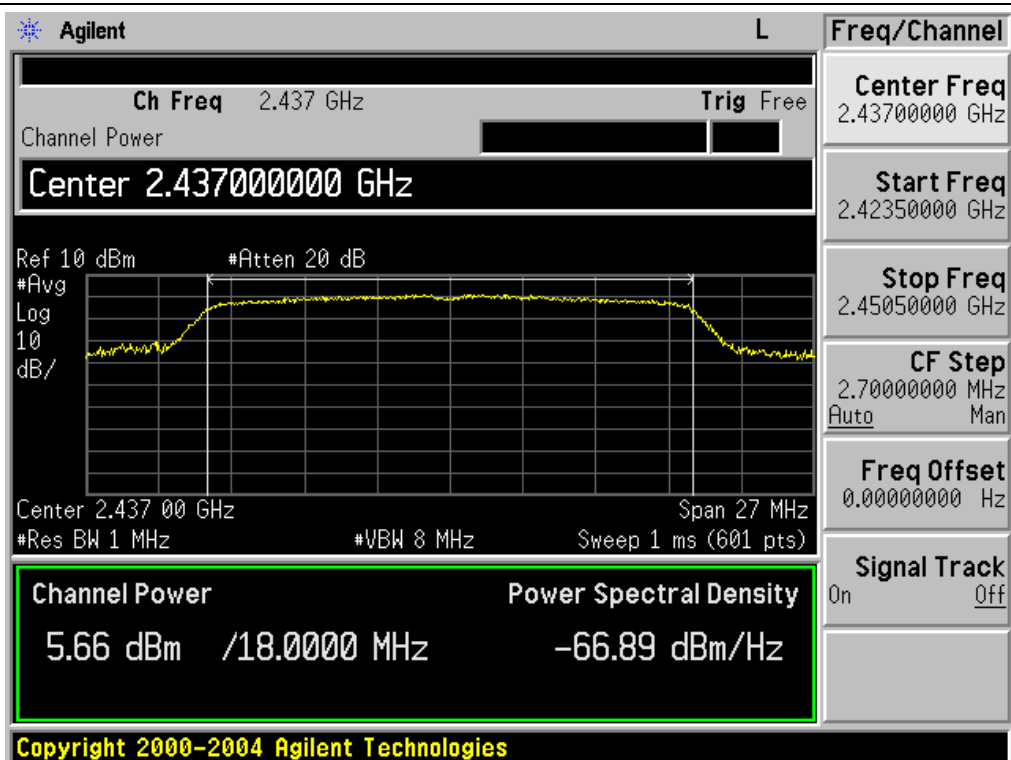
**802.11g TX CH 11**



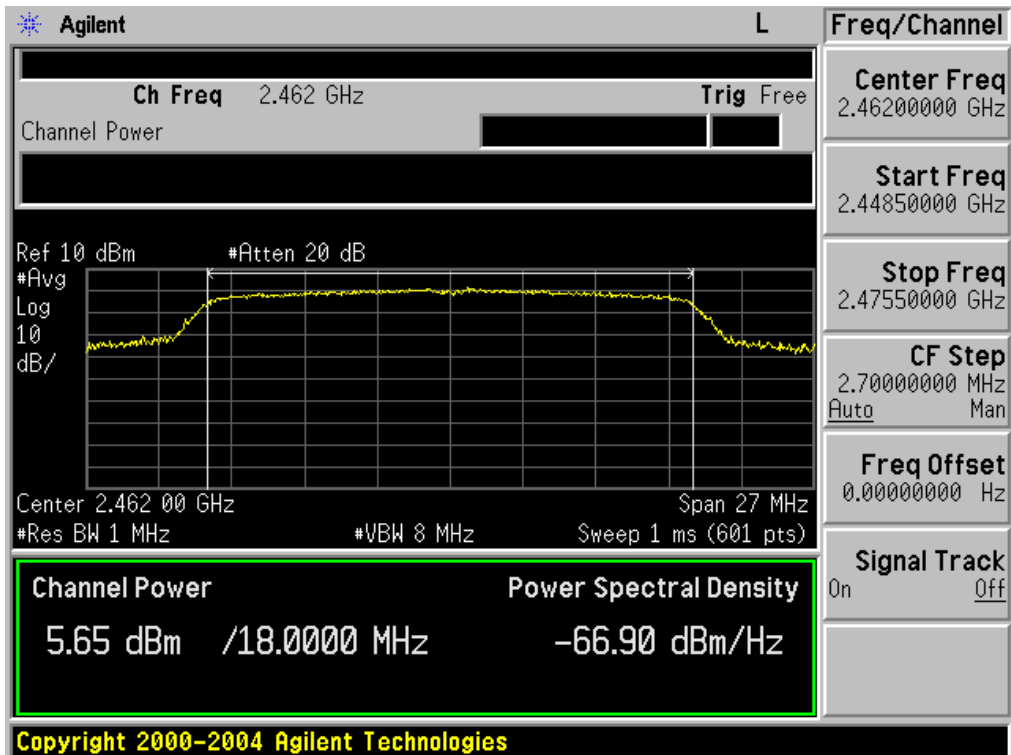
## 802.11n HT20 TX CH 01



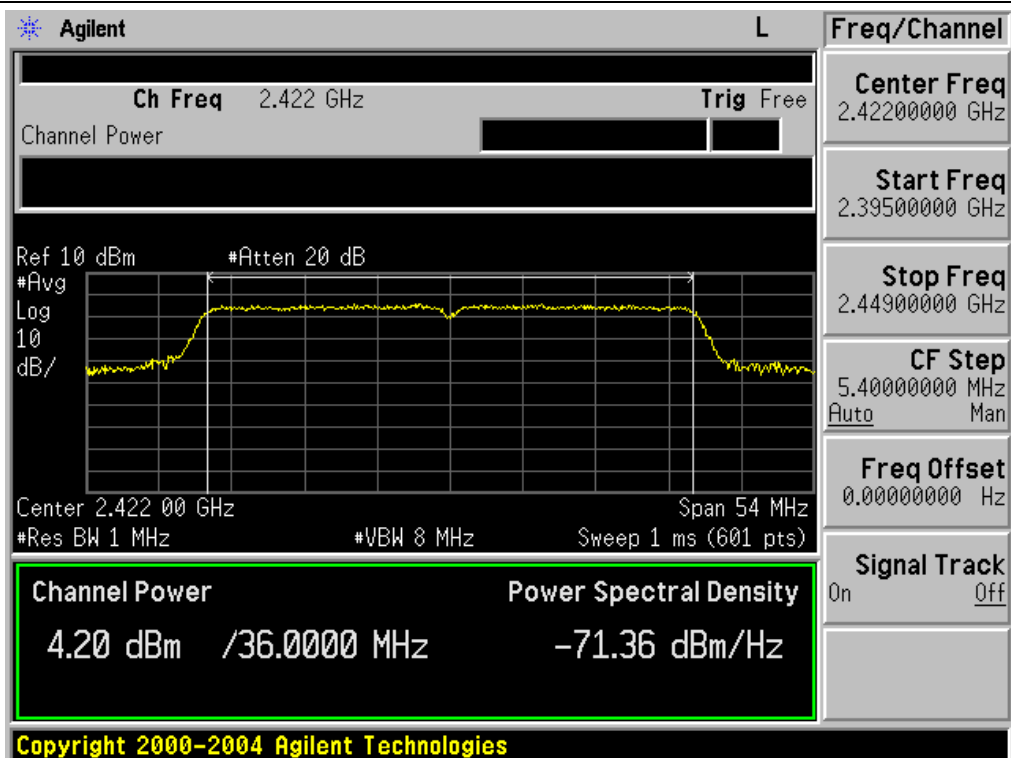
## 802.11n HT20 TX CH 06



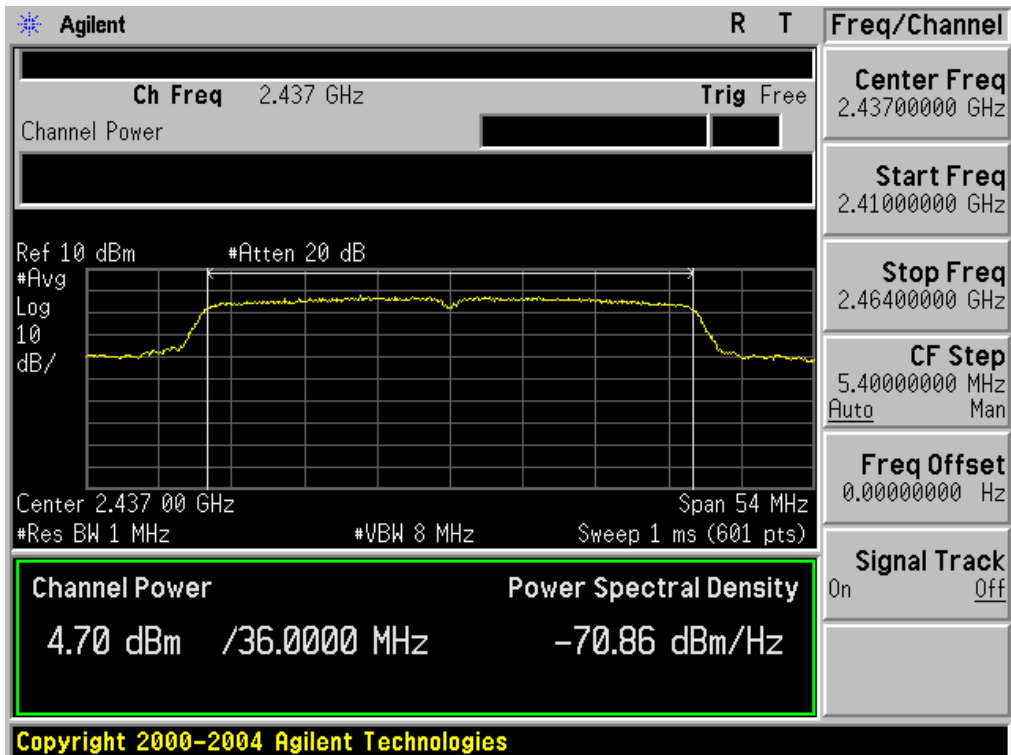
### 802.11n HT20 TX CH 11



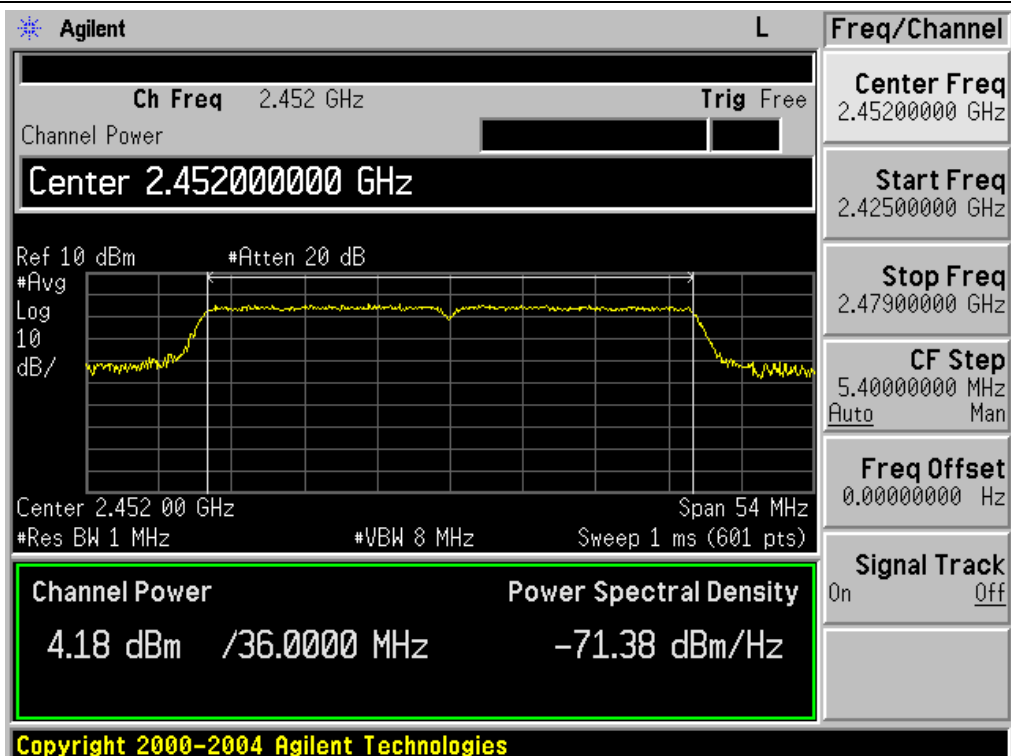
### 802.11n HT40 TX CH 03



### 802.11n HT40 TX CH 06



### 802.11n HT40 TX CH 09





## 7. 100 KHZ BANDWIDTH OF FREQUENCY BAND EDGE

### APPLICABLE STANDARD

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

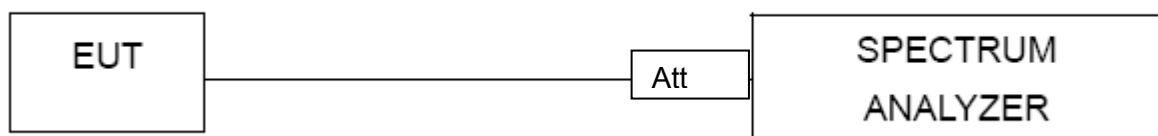
### TEST PROCEDURE

- a) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b) Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- c) Set RBW to 100 kHz and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- d) Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- e) Repeat above procedures until all measured frequencies were complete.

### 7.1 DEVIATION FROM STANDARD

No deviation.

### 7.2 TEST SETUP



### 7.3 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

## 7.4 TEST RESULTS

EUT :	Tessel	Model Name :	Tessel 2
Temperature :	25 °C	Relative Humidity :	56%
Pressure :	1012 hPa	Test Voltage :	DC 5.0V form Adapter AC 120V/60Hz

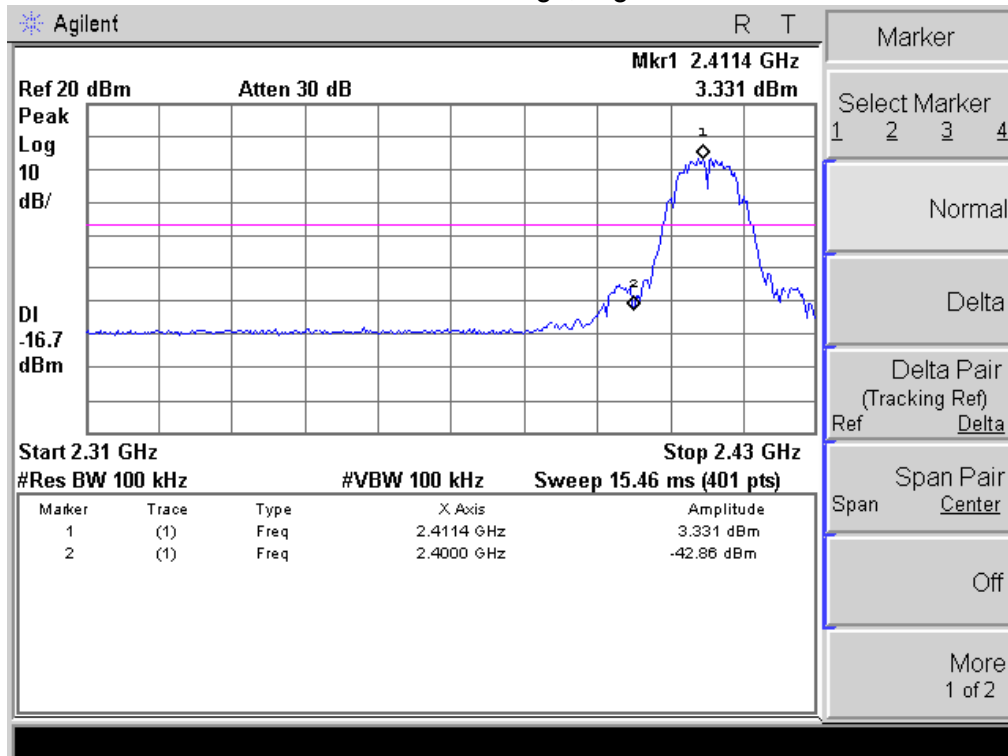
Frequency Band MHz	Delta Peak to band emission (dBc)	> Limit (dBc)	Result
802.11b mode			
2400	46.19	20	Pass
2483.5	50.93	20	Pass
802.11g mode			
2400	30.24	20	Pass
2483.5	37.86	20	Pass
802.11n-HT20 mode			
2400	32.40	20	Pass
2483.5	35.85	20	Pass
802.11n-HT40 mode			
2400	30.39	20	Pass
2483.5	33.23	20	Pass

## Radiated band edge:

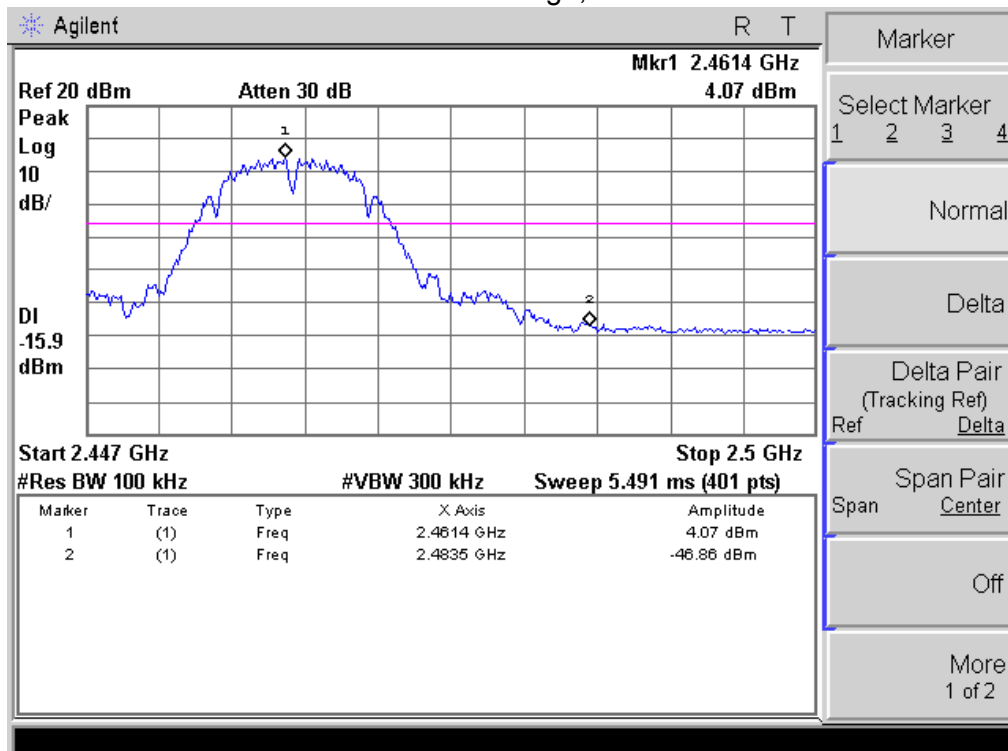
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
802.11b							
2390	60.23	-13.06	47.17	74	-26.83	peak	Vertical
2390	59.68	-13.06	46.62	74	-27.38	peak	Horizontal
2483.5	61.24	-12.78	48.46	74	-25.54	peak	Vertical
2483.5	58.76	-12.78	45.98	74	-28.02	peak	Horizontal
802.11g							
2390	60.23	-13.06	47.17	74	-26.83	peak	Vertical
2390	29.85	-13.06	16.79	74	-57.21	peak	Horizontal
2483.5	61.01	-12.78	48.23	74	-25.77	peak	Vertical
2483.5	59.74	-12.78	46.96	74	-27.04	peak	Horizontal
802.11n (20)							
2390	59.11	-13.06	46.05	74	-27.95	peak	Vertical
2390	59.86	-13.06	46.8	74	-27.20	peak	Horizontal
2483.5	58.98	-12.78	46.2	74	-27.80	peak	Vertical
2483.5	59.67	-12.78	46.89	74	-27.11	peak	Horizontal
802.11n (40)							
2390	59.63	-13.06	46.57	74	-27.43	peak	Vertical
2390	60.47	-13.06	47.41	74	-26.59	peak	Horizontal
2483.5	59.73	-12.78	46.95	74	-27.05	peak	Vertical
2483.5	60.01	-12.78	47.23	74	-26.77	peak	Horizontal

Note: Test method to see chapter 3.2 . When PK value is lower than the Average value limit, average not record.

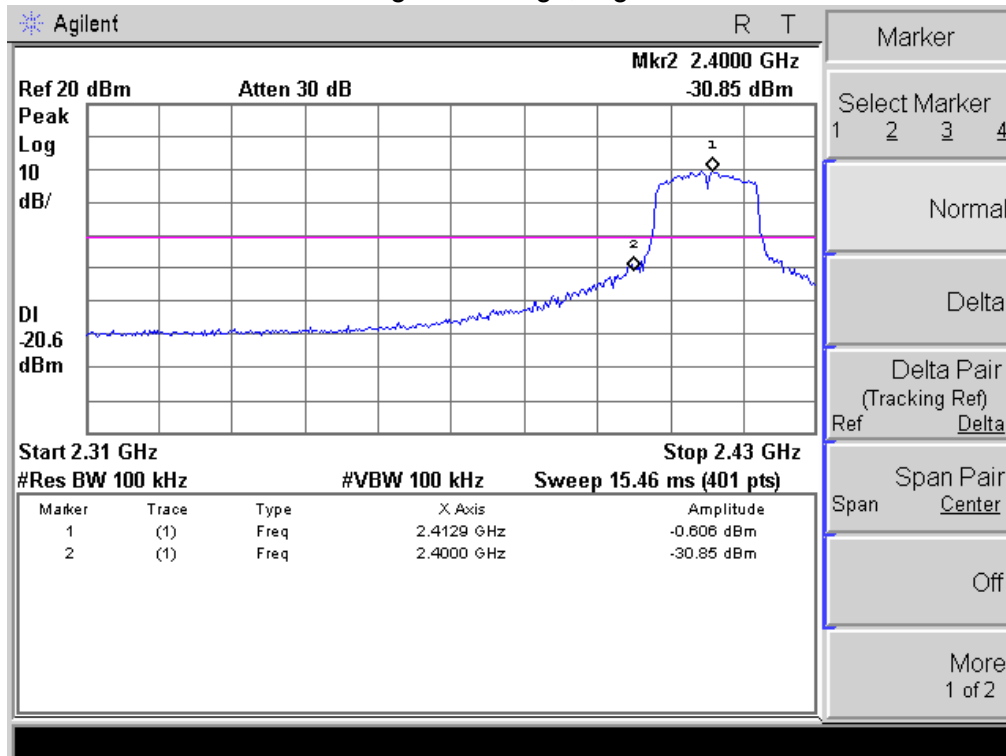
## 802.11b: Band Edge, Right Side



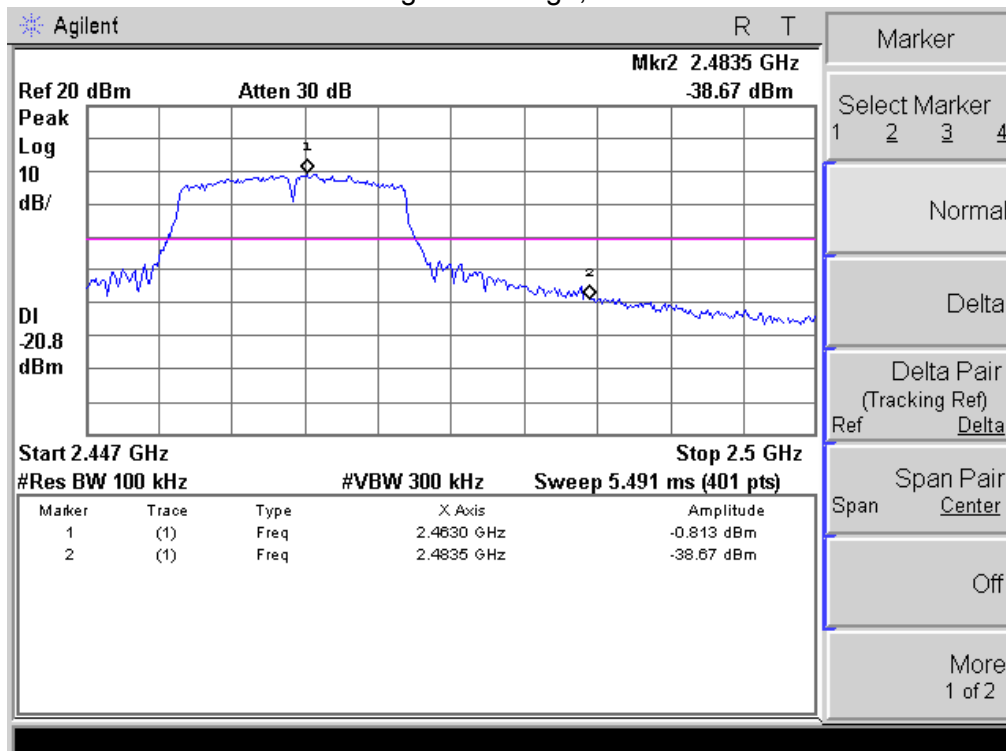
## 802.11b: Band Edge, Left Side



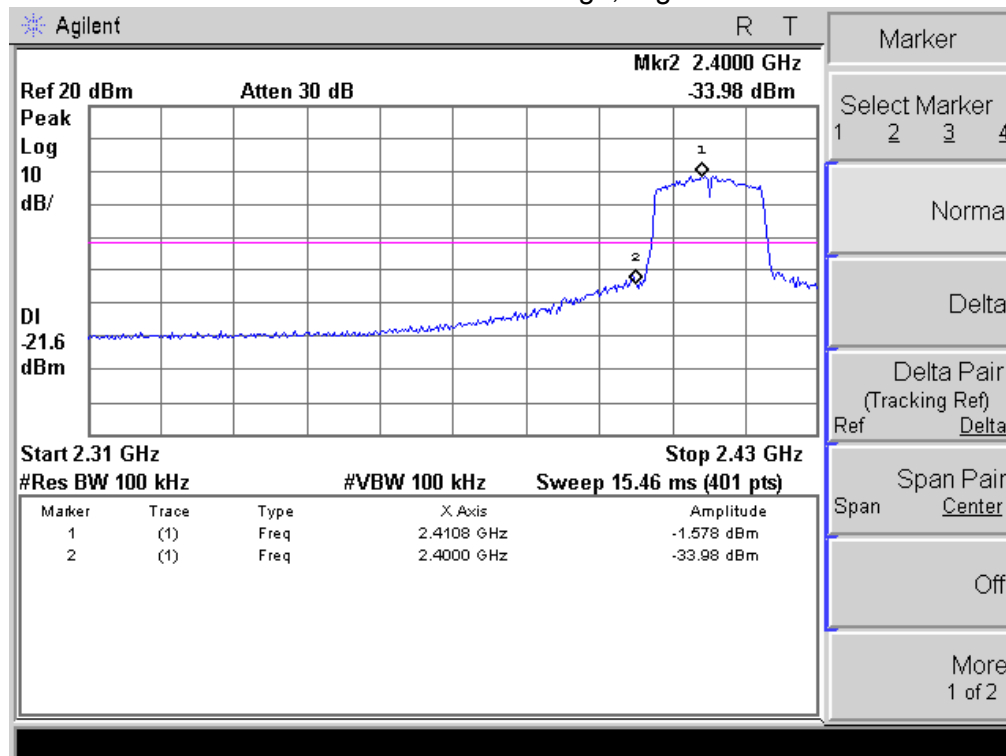
## 802.11g: Band Edge, Right Side



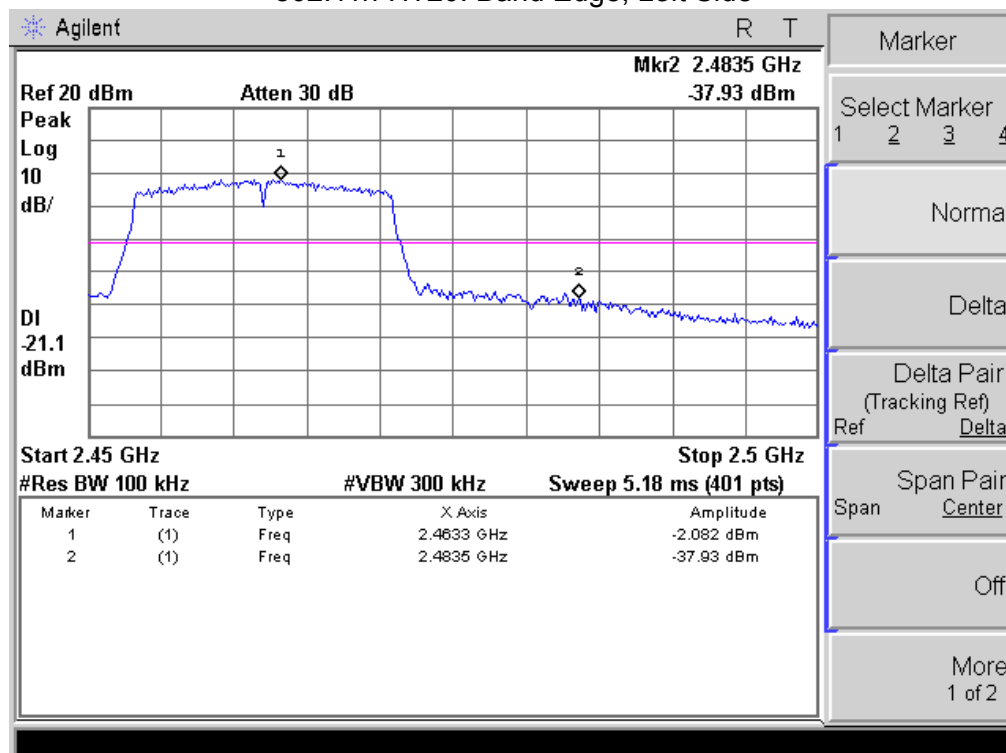
## 802.11g: Band Edge, Left Side



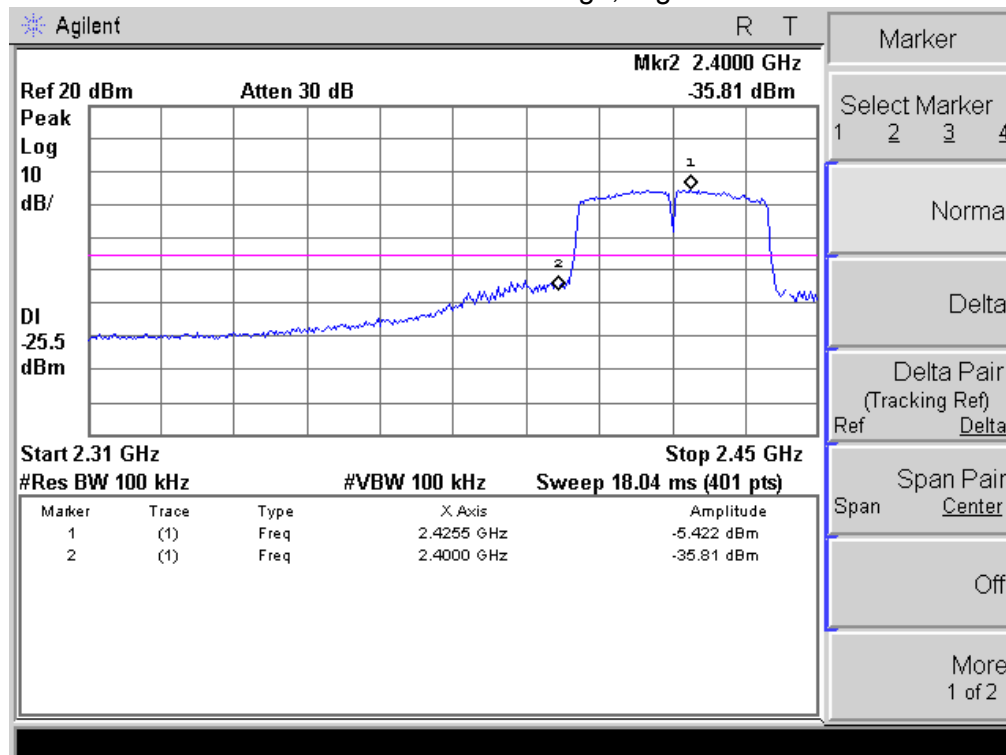
### 802.11n-HT20: Band Edge, Right Side



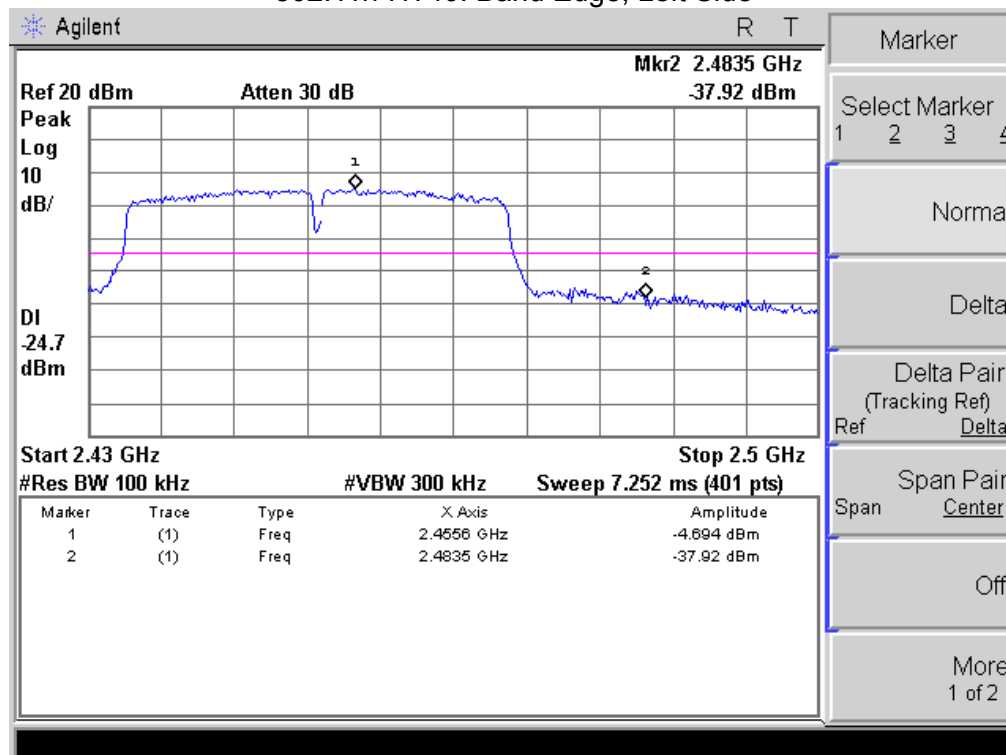
### 802.11n-HT20: Band Edge, Left Side



## 802.11n-HT40: Band Edge, Right Side



## 802.11n-HT40: Band Edge, Left Side



## **8. ANTENNA REQUIREMENT**

### **8.1 STANDARD REQUIREMENT**

15.203 requirement: For intentional device, according 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.

### **8.2 EUT ANTENNA**

The EUT antenna is permanent attached antenna. It comply with the standard requirement.