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Test Report for FCC

FCC ID :TKWFS2-AWB2

Report Number		ESTRFC2111-003		
Applicant	Company name	Suprema Inc.		
	Address	17F-5, Parkview officetower, , 248, Jeongjail-ro Bundang-gu, Seongnam-si, Gyeonggi-do South Korea		
	Telephone	+82-31-710-4908		
	Contack person	Dongmok Shin		
Product	Product name	Face Station2		
	Factory address	17F-5, Parkview officetower, , 248, Jeongjail-ro Bundang-gu, Seongnam-si, Gyeonggi-do South Korea		
	Model No.	FS2-AWB	Manufacturer	Suprema Inc.
	Serial No.	NONE	Country of origin	KOREA
Test date	14-Oct-21 ~ 19-Nov-21		Date of issue	22-Nov-21
Testing location	140-16, Eongmalli-ro, Majang-myeon, Icheon-si, Gyeonggi-do, Rep, of Korea			
Standard	FCC PART 15 Subpart C (15.247) , ANSI C 63.10(2013) , KDB 558074 D01(2018)			
Measurement facility registration number	659627			
Tested by	Senior Engineer H.G. Lee	(Signature)		
Reviewed by	Engineering Manager I.K. Hong	(Signature)		
Abbreviation	OK, Pass = Passed, Fail = Failed, N/A = not applicable			

* Note

- This test report is not permitted to copy partly without our permission
- This test result based on a single evaluation of one sample of the above mentioned
- This test report is not related to KOLAS accreditation

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Contents

1. Laboratory Information

1.1 General

This EUT (Equipment Under Test) has been shown to be capable of compliance with the applicable technical standards and is tested in accordance with the measurement procedures as indicated in this report.
ESTECH Lab attests to accuracy of test data. All measurement reported herein were performed by ESTECH Co., Ltd.
ESTECH Lab assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

1.2 Test Lab.

Corporation Name : ESTECH Co., Ltd.

Head Office : Suite 1015 World Meridian II, 123 Gasan Digital 2-ro, Geumcheon-gu, Seoul 153-759, R. O. Korea

EMC/Telecom/Safety Test Lab : 140-16, Eongmalli-ro, Majang-myeon, Icheon-si,
Gyeonggi-do, Rep, of Korea

1.3 Official Qualification(s)

and Telecommunication
KOLAS : Accredited Lab By Korea Laboratory Accreditation Schema base on CENELEC requirements
FCC : Conformity Assessment Body(CAB) with registration number 659627 under APEC TEL MRA between the RRA and the FCC
VCCI : Granted Accreditation from Voluntary Control Council for Interference from ITE

2. Description of EUT

2.1 Summary of Equipment Under Test

Modulation Type	:	CCK, OFDM
Transfer Rate	:	11 Mbps , 54 Mbps, 135 Mbps
Number of Channel	:	11 ch
PEAK Output Power	:	5.48 dBm (Peak), -0.86 dBm (Average)
Rating	:	INPUT : (100 - 240) Va.c., (50 - 60) Hz, 1.7 A OUTPUT : 24 Vd.c., 3.5 A
Receipt Date	:	20-Aug-21
X-tal list(s) or Frequencies generated	:	The highest operating frequency is 2 462 MHz

2.2 General descriptions of EUT

CPU 1.4 GHz Quad Core
Memory 8GB Flash + 1GB RAM
LCD 4” color TFT LCD (Resolution: 480 x 800)
Sound 24 bit/Voice DSP (echo cancel)
Operating temperature -20°C ~ 50°C
Storage temperature -40°C ~ 70°C
Operating humidity 0% ~ 80%, non-condensing
Storage humidity 0% ~ 90%, non-condensing
Camera CMOS VGA (720 x 480) pixels
Camera angle Visual : Diagonal 92.7° , IR : Diagonal 58°
Dimension (W x H x D) 141 mm x 125 mm x 164 mm (h)
Weight Device: 610g (With Wall-Bracket)
RF Option RFID : 13.56 MHz / 117 KHz

3. Test Standards

Test Standard : FCC PART 15 Subpart C (15.247)

This Standard sets out the regulations under which an intentional, unintentional, or incidental radiator may be operated without an individual license. It also contains the technical specifications, administrative requirements and other conditions relating to the marketing of Part 15 devices.

Test Method : ANSI C 63.10 (2013) & KDB558074 D01(2018)

This standard sets forth uniform methods of measurement of radio-frequency (RF) signals and noise emitted from both unintentional and intentional emitters of RF energy in the frequency range 9 kHz to 40 GHz. Methods for the measurement of radiated and AC power-line conducted radio noise are covered and may be applied to any such equipment unless otherwise specified by individual equipment requirements. These methods cover measurement of certain decides that deliberately radiate energy, such as intentional emitters, but does not cover licensed transmitters. This standard is not intended for certification/approval of avionic equipment or for industrial, scientific, and medical (ISM) equipment These method apply to the measurement of individual units or systems comprised of multiple units

Summary of Test Results

Applied Satandard : 47 CFR Part 15 Subpart C				remark
Standard	Test Type	Result	Remark	Limit
15.207	AC Power Conducted Emission	Pass	Meet the requirement	
15.205 & 15.209	Restricted band / Intentional Radiated Emission	Pass	Meet the requirement	
15.247(a)(2)	6 dB Bandwidth	Pass	Meet the requirement	Min. 500 kHz
	99 % Bandwidth			
15.247(b)(3)	Maximum Peak /Average ouput power	Pass	Meet the requirement	Max. 30 dBm
15.209	Transmitter Radiated Emission	Pass	Meet the requirement	Table 15.209
15.247(e)	Power Spectral Density	Pass	Meet the requirement	Max. 8 dBm
15.247(d)	Band Edge Measurement	Pass	Meet the requirement	20 dB less

4. Measurement Condition

4.1 EUT Operation

a. Channel

Ch.	Frequency	Ch.	Frequency
1	2 412 MHz	7	2 442 MHz
2	2 417 MHz	8	2 447 MHz
3	2 422 MHz	9	2 452 MHz
4	2 427 MHz	10	2 457 MHz
5	2 432 MHz	11	2 462 MHz
6	2 437 MHz		

b. Measurement Channel : WLAN : Low(2 412 MHz), Middle(2 442 MHz), High(2 462 MHz)

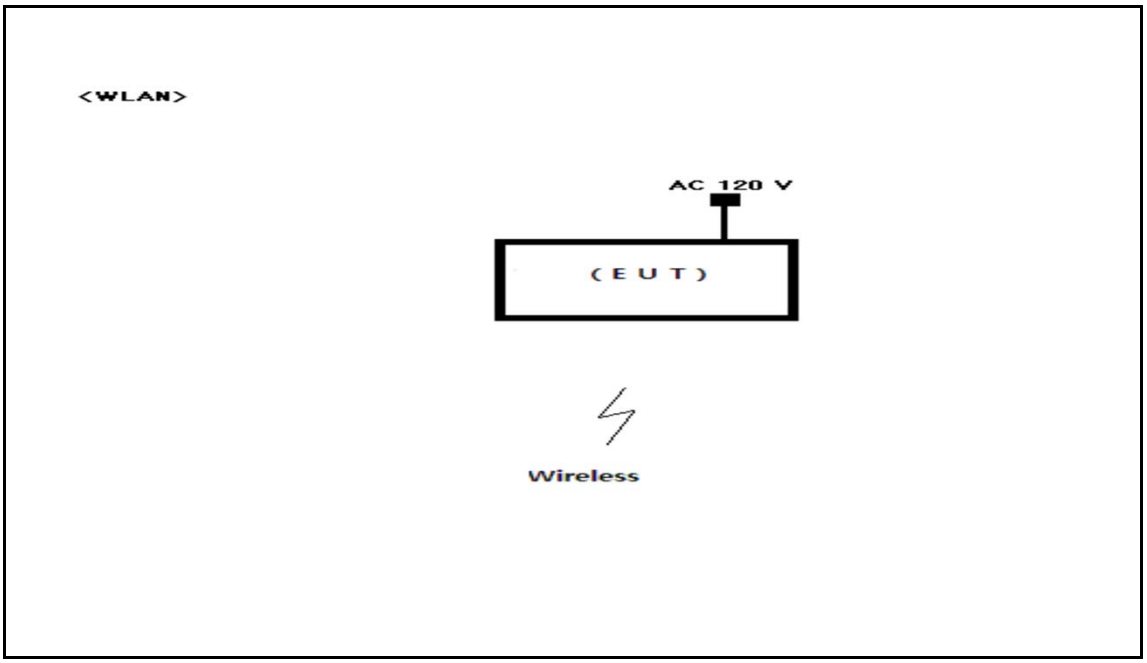
c. Test Mode : Continuous Output, CCK, OFDM

4.2 EUT Operation

- The EUT was in the following operation mode during all testing

* Wireless LAN 2.4 GHz operation check
* Transmit mode were measured each channels(802.11b, 802.11g, 802.11n20, 802.11n40)

4.3 Configuration and Peripherals



4.4 EUT and Support equipment

Equipment Name	Model Name	S/N	Manufacturer	Remark (FCC ID)
Face Station2	FS2-AWB	NONE	Suprema Inc.	EUT
Adapter	KPL-060	NONE	Channel Well Technology	

4.5 Cable Connecting

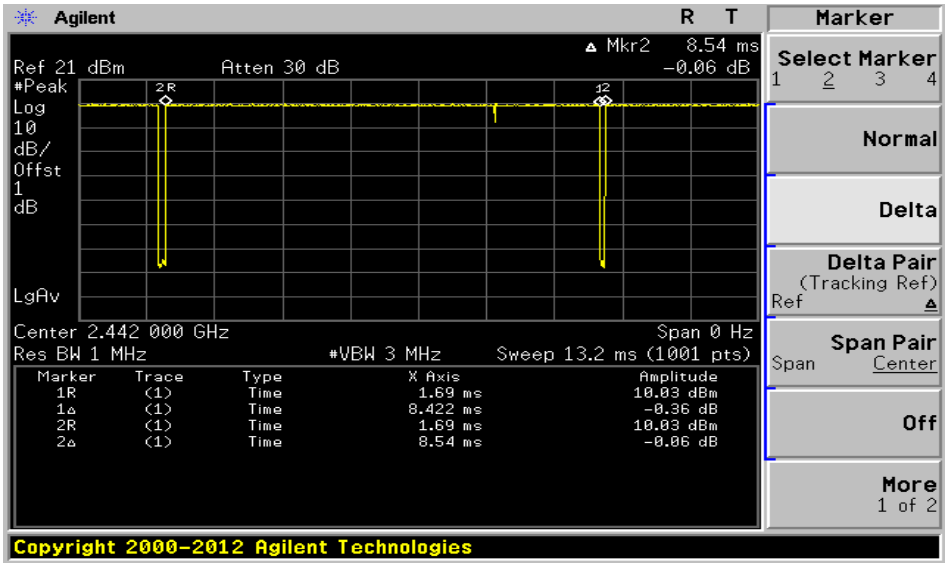
Start Equipment		End Equipment		Cable Standard		Remark
Name	I/O port	Name	I/O port	Length	Shielded	
Face Station2	Power	Adapter	-	2.0	Unshielded	

4.6 DUTY CYCLE OF TEST SIGNAL

Duty cycle is > 98 %, duty factor shall be considered.

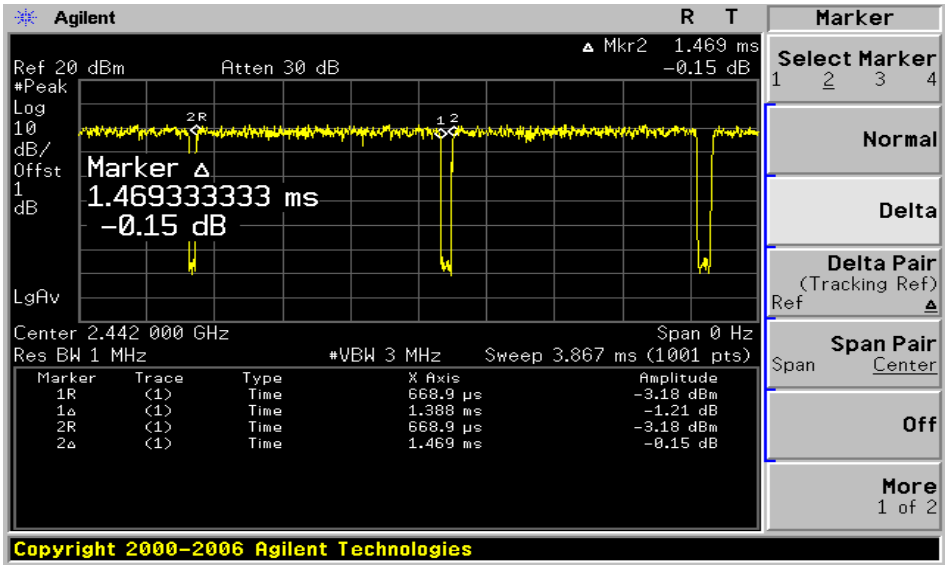
802.11b

duty cycle = 98.6 % , duty factor = 10*log(1/0.986) =0.060



802.11g

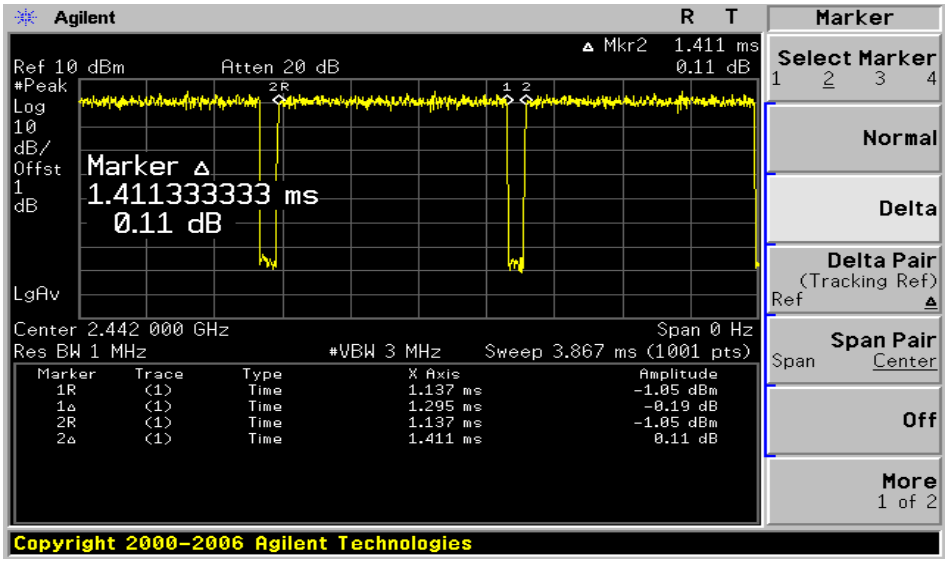
duty cycle =95.3 % , duty factor = 10*log(1/0.953) =0.208



Duty cycle is > 98 %, duty factor shall be considered.

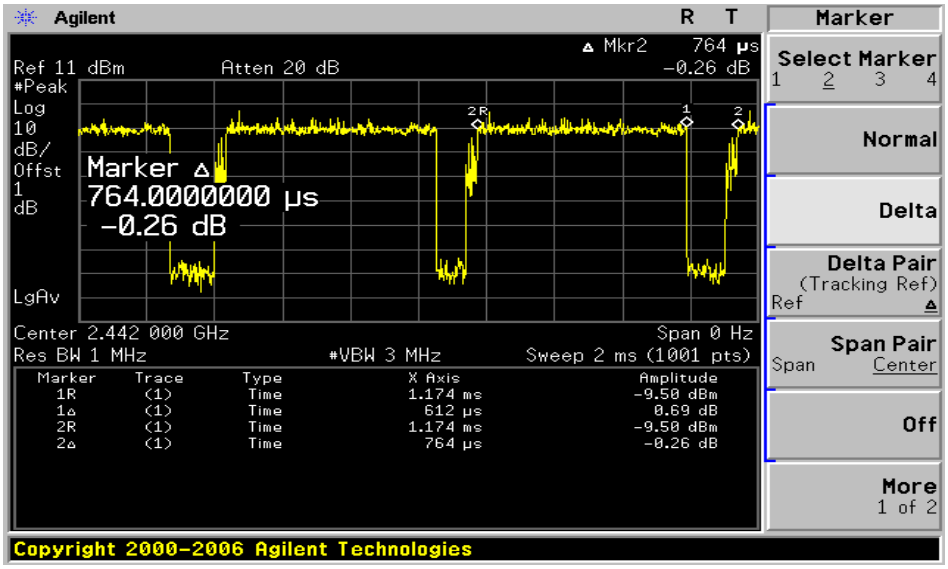
802.11n20

duty cycle = 91.8 % , duty factor = 10*log(1/0.918) =0.373



802.11n40

duty cycle = 80.1 % , duty factor = 10*log(1/0.801) =0.963



5. DTS bandwidth

5.1 Test procedure

558074 D01 DTS Meas Guidance v05 8.2 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 x 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.

5.2 might be > 6 dB Test instruments and measurement setup

The spectrum analyzer is set to as following.

. RBW= 100 KHz . VBW≥ 3 x RBW

. Span= 50 MHz . Sweep= suitable duration based on the EUT specification.

Limits : FCC § 15.247(a)(2)

6dB Bandwidth Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4440A	US42041291	1-Dec-21
RF Cable	Length: 30 cm	-	
-Spectrum Analyzer <=> EUT	Loss: 1.0 dB	-	

5.3 Measurement results

MODE	802.11b, g, n20, n40	ENVIRONMENTAL CONDITION	23.0 ℃, 47.0 % R.H.
INPUT POWER	DC 24.0 V		

MODE - 802.11b

Channel Frequency (MHz)	Emission bandwidth (MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2 412	14.86	8.92	0.5	PASS
2 442	14.98	8.88	0.5	PASS
2 462	14.98	9.21	0.5	PASS

MODE - 802.11g

Channel Frequency (MHz)	Emission bandwidth (MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2 412	16.49	16.50	0.5	PASS
2 442	16.46	16.40	0.5	PASS
2 462	16.44	16.40	0.5	PASS

MODE - 802.11n20

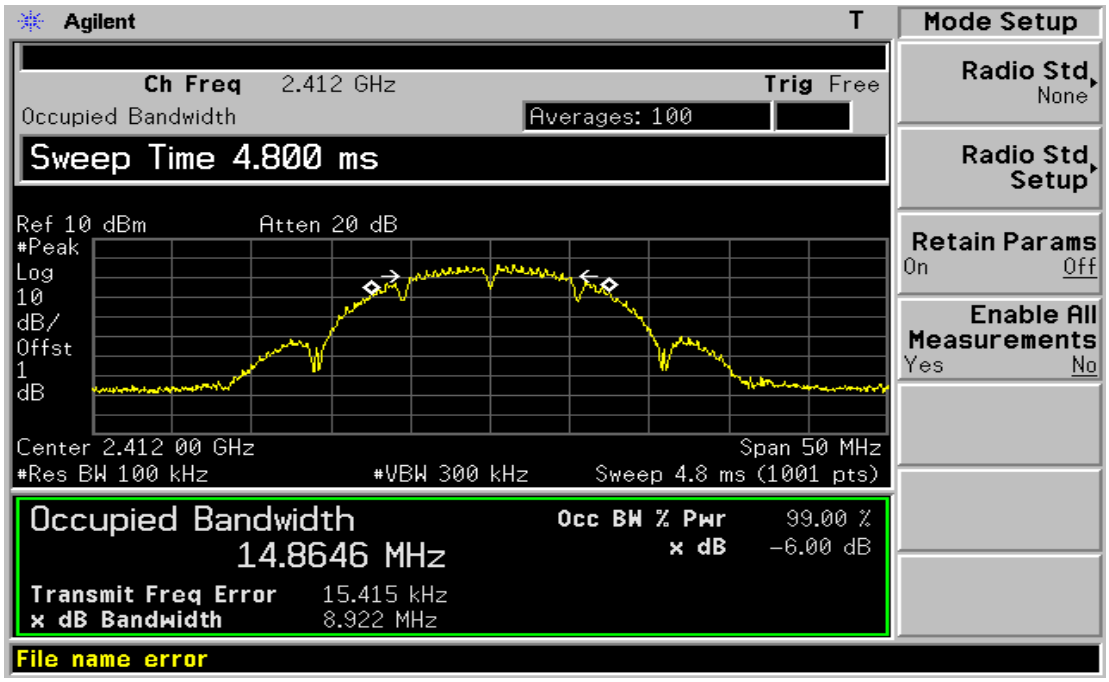
Channel Frequency (MHz)	Emission bandwidth (MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2 412	17.73	17.63	0.5	PASS
2 442	17.73	17.67	0.5	PASS
2 462	17.72	17.67	0.5	PASS

MODE - 802.11n40

Channel Frequency (MHz)	Emission bandwidth (MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2 422	36.01	35.70	0.5	PASS
2 442	35.99	35.60	0.5	PASS
2 452	35.97	35.64	0.5	PASS

5.4 Trace data - 802.11b

(ch_1)



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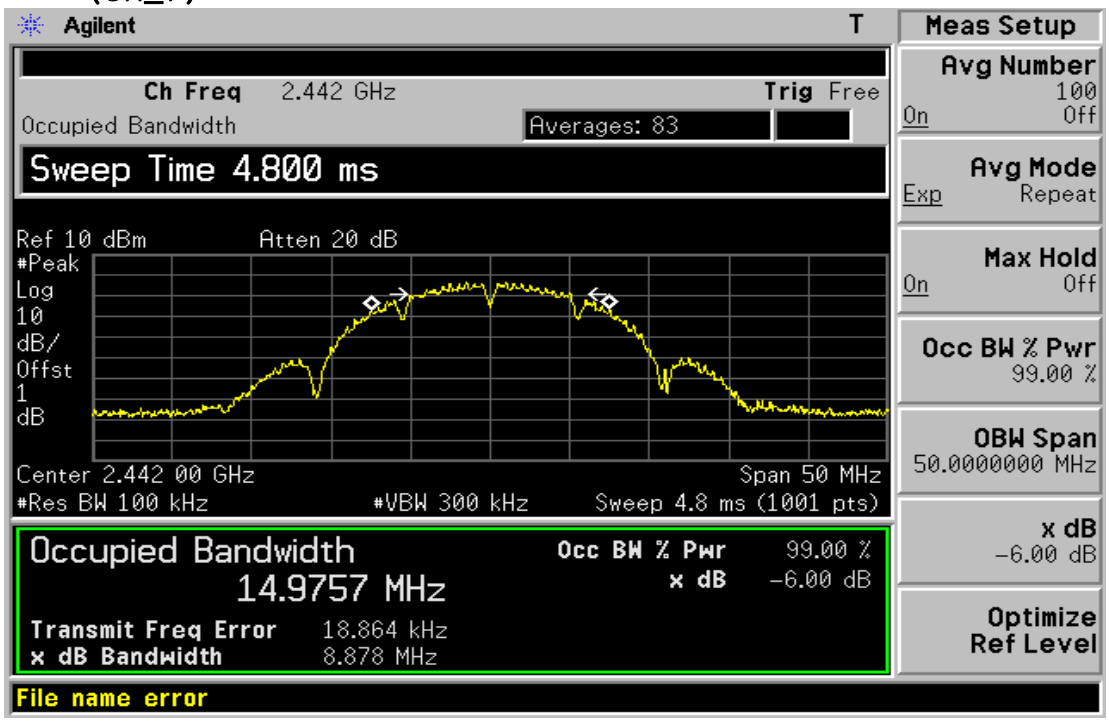

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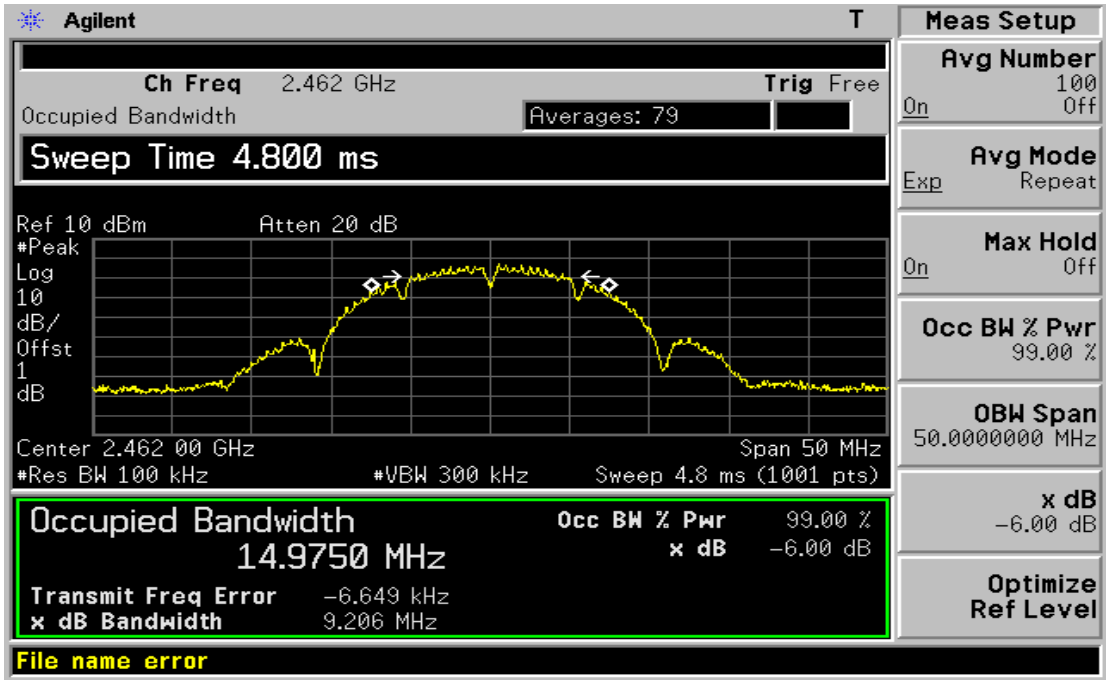
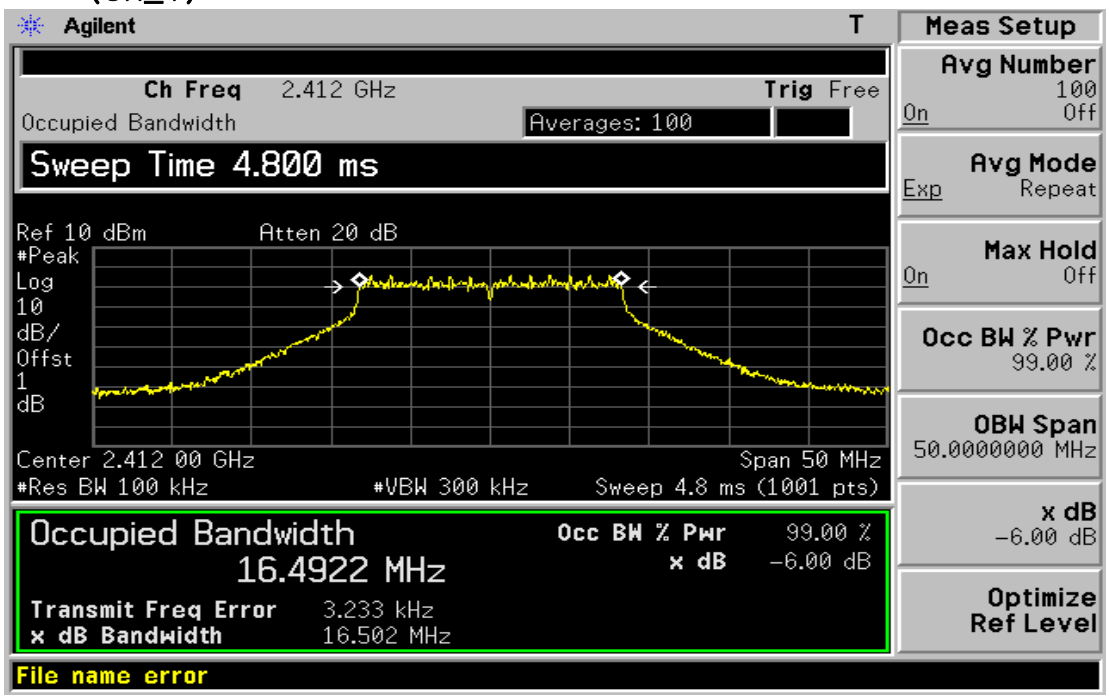

Agilent
T
Meas Setup
Ch Freq 2.462 GHz
Trig Free
Occupied Bandwidth
Averages: 79
Sweep Time 4.800 ms
Avg Number
100
On Off
Avg Mode
Exp Repeat
Ref 10 dBm
Atten 20 dB
#Peak
Log
10
dB/
Offst
1
dB
Max Hold
On Off
Occ BW % Pwr
99.00 %
OBW Span
50.0000000 MHz
Center 2.462 00 GHz
Span 50 MHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 4.8 ms (1001 pts)
Occupied Bandwidth
14.9750 MHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
x dB
-6.00 dB
Transmit Freq Error -6.649 kHz
x dB Bandwidth 9.206 MHz
Optimize
Ref Level
File name error

Trace data - 802.11g

(ch_1)



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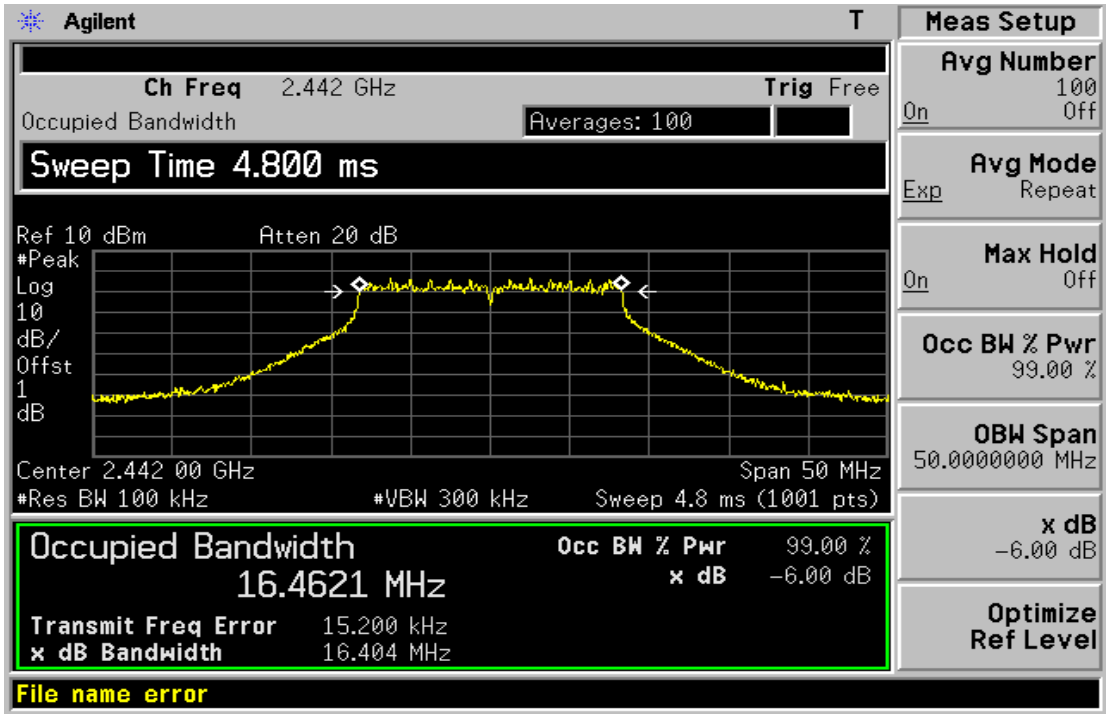
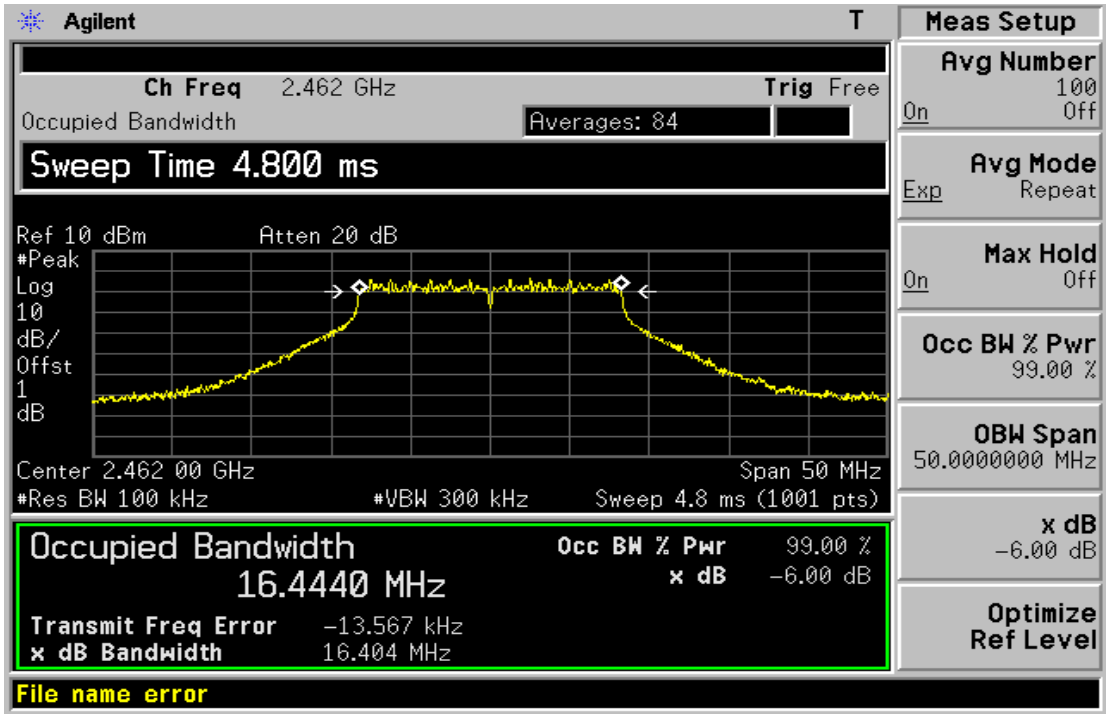
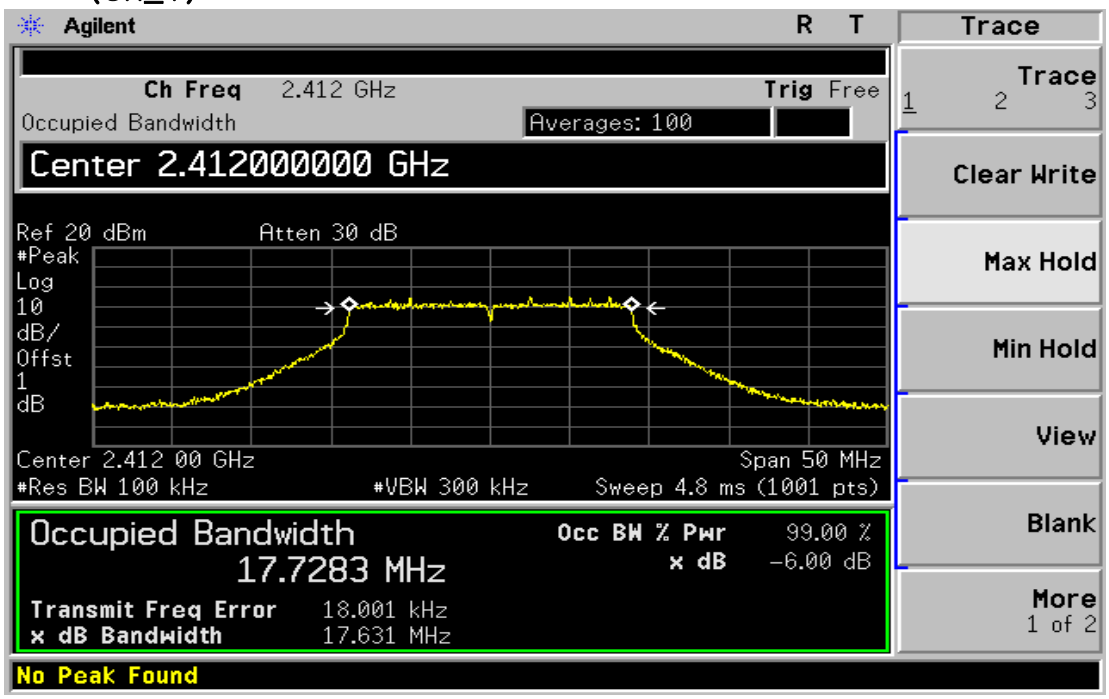


(ch_11)

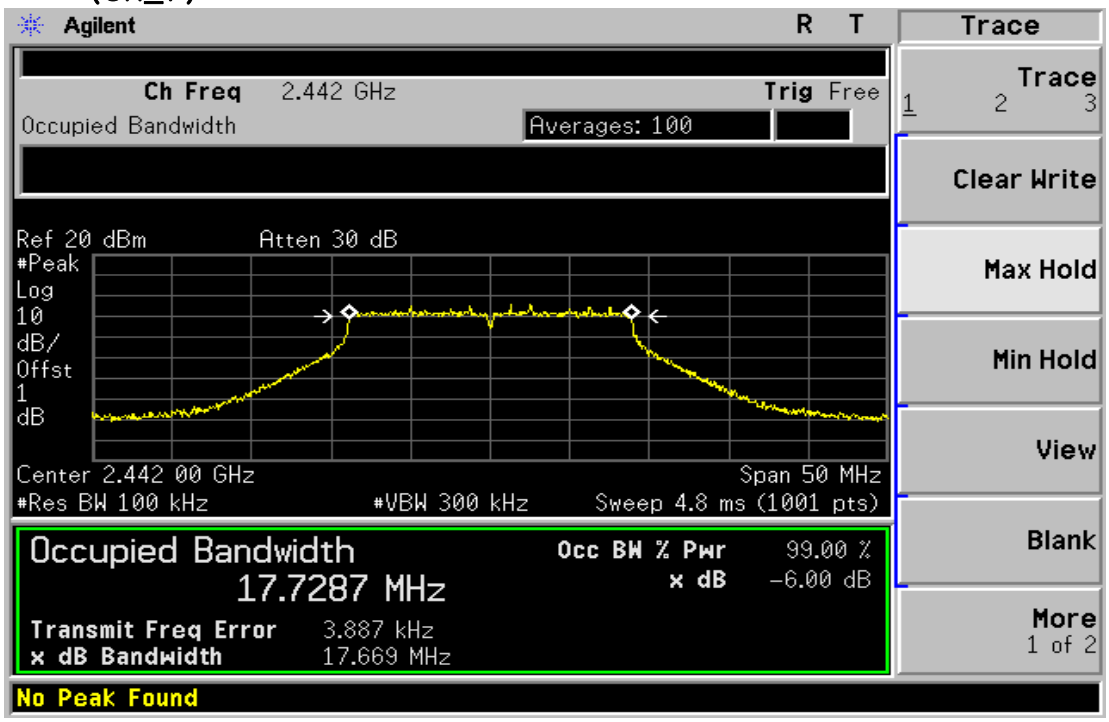

Agilent
T
Meas Setup
Ch Freq 2.462 GHz
Trig Free
Occupied Bandwidth
Averages: 84
Sweep Time 4.800 ms
Ref 10 dBm
Atten 20 dB
#Peak
Log
10
dB/
Offst
1
dB
Center 2.462 00 GHz
Span 50 MHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 4.8 ms (1001 pts)
Occupied Bandwidth
16.4440 MHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
Transmit Freq Error -13.567 kHz
x dB Bandwidth 16.404 MHz
Avg Number
100
On Off
Avg Mode
Exp Repeat
Max Hold
On Off
Occ BW % Pwr
99.00 %
OBW Span
50.0000000 MHz
x dB
-6.00 dB
Optimize
Ref Level
File name error

Trace data - 802.11n20

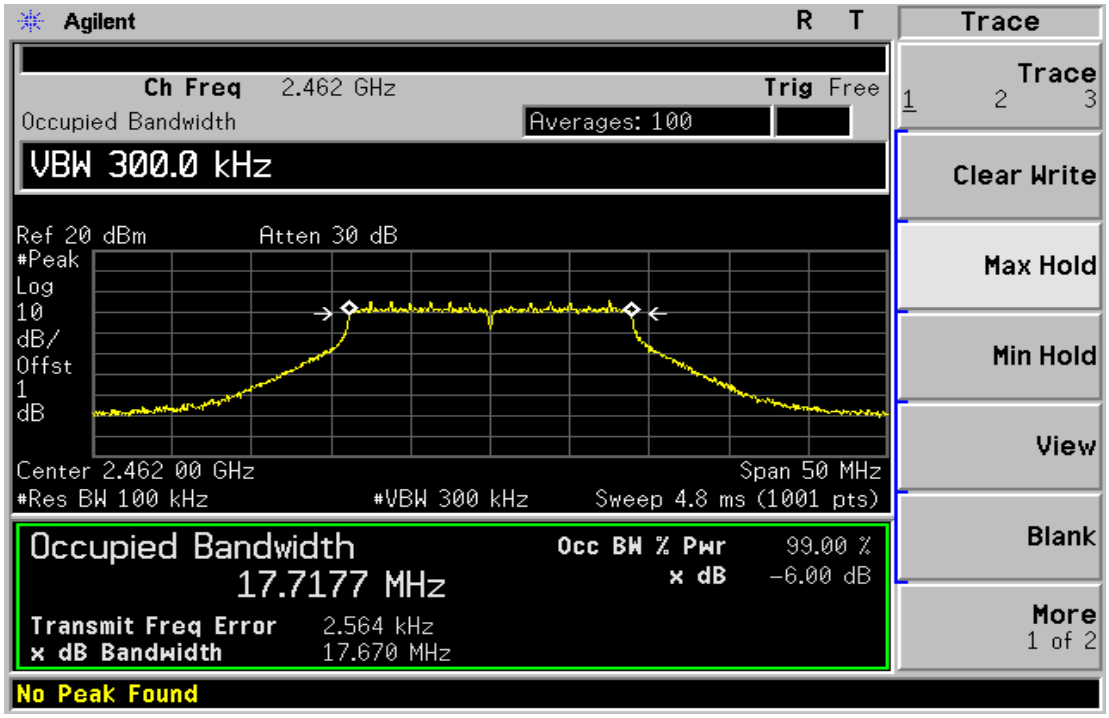
(ch_1)



(ch_7)

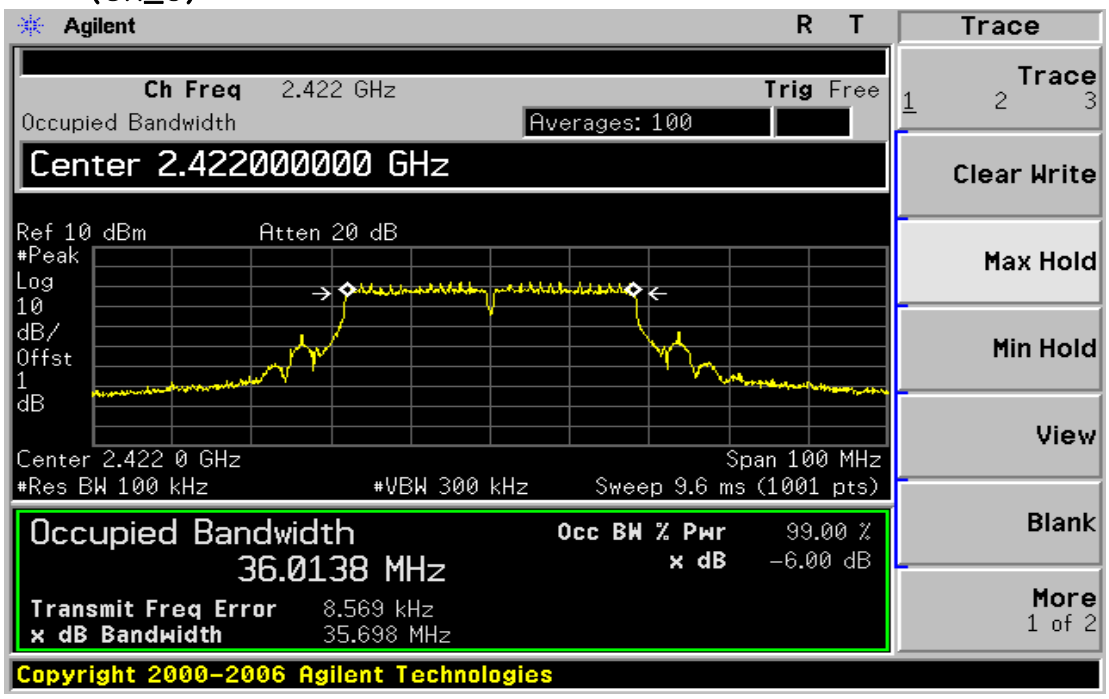


(ch_11)


Agilent
R T
Trace
Ch Freq 2.462 GHz
Trig Free
Occupied Bandwidth
Averages: 100
VBW 300.0 kHz
Ref 20 dBm
Atten 30 dB
#Peak
Log
10
dB/
Offst
1
dB
Center 2.462 00 GHz
Span 50 MHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 4.8 ms (1001 pts)
Occupied Bandwidth
17.7177 MHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
Transmit Freq Error 2.564 kHz
x dB Bandwidth 17.670 MHz
No Peak Found
Trace
1 2 3
Clear Write
Max Hold
Min Hold
View
Blank
More
1 of 2

5.4 Trace data - 802.11n40

(ch_3)



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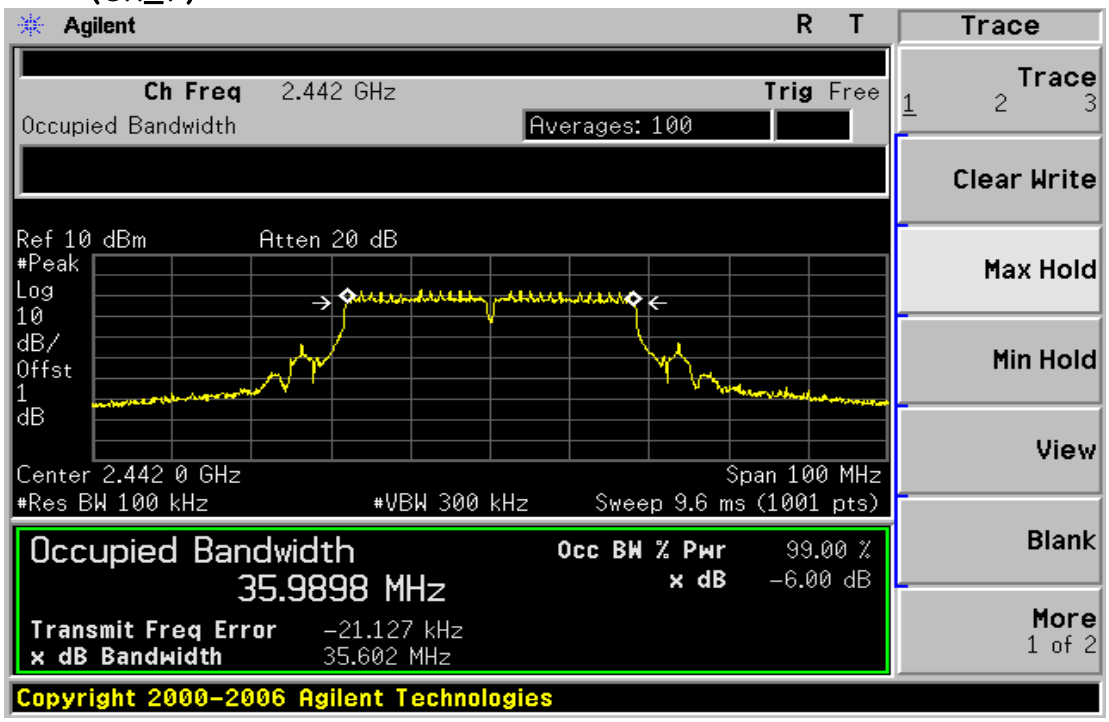

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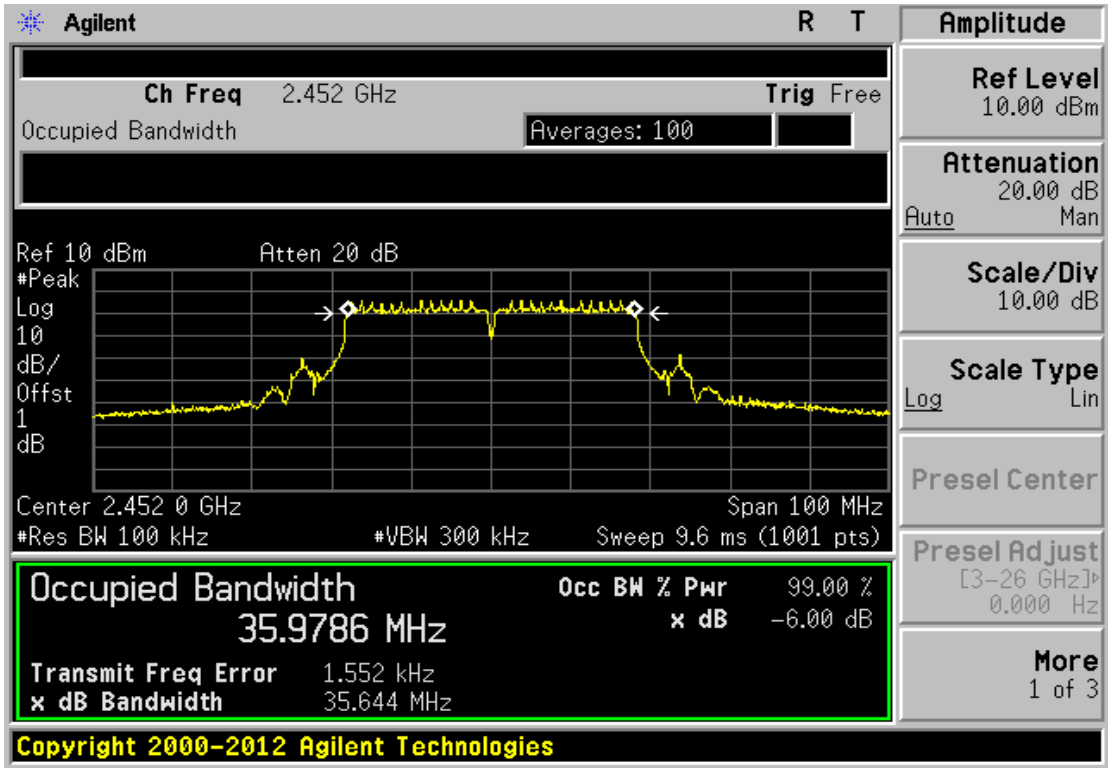

Agilent
R T
Amplitude
Ch Freq 2.452 GHz
Trig Free
Occupied Bandwidth
Averages: 100
Ref Level
10.00 dBm
Attenuation
20.00 dB
Auto Man
Ref 10 dBm
Atten 20 dB
#Peak
Log
10
dB/
Offst
1
dB
Scale/Div
10.00 dB
Scale Type
Log Lin
Center 2.452 0 GHz
Span 100 MHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 9.6 ms (1001 pts)
Presel Center
Presel Adjust
[3-26 GHz]
0.000 Hz
Occupied Bandwidth
35.9786 MHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
More
1 of 3
Transmit Freq Error 1.552 kHz
x dB Bandwidth 35.644 MHz
Copyright 2000-2012 Agilent Technologies

6. Maximum peak conducted output power

6.1 Test procedure

The transmitter antenna terminal is connected to the input of a Power Sensor. Measurement is made while EUT is operating in transmission mode at the appropriate center frequency. The maximum peak output power measurement is 30 dBm.

Maximum Peak Output Power Test Instruments

Description	Model	Serial Number	Cal. Due Date
Power Meter	N1921A	MY45100570	1-Dec-21
Power Sensor	N1921A	MY45240427	1-Dec-21
Power Meter <=> EUT	Loss: 1 dB	-	

6.2 Measurement results

EUT	Face Station2	MODEL	FS2-AWB
MODE	802.11b, g, n20, n40	ENVIRONMENTAL CONDITION	23.0 ℃, 47.0 % R.H.
INPUT POWER	DC 24.0 V		

MODE - 802.11b

CHANNEL	Channel requency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(W)		
1	2 412	PEAK	5.15	0.0033	30.0	PASS
7	2 442	PEAK	5.48	0.0035	30.0	PASS
11	2 462	PEAK	4.69	0.0029	30.0	PASS

MODE - 802.11g

CHANNEL	Channel requency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(W)		
1	2 412	PEAK	3.53	0.0023	30.0	PASS
7	2 442	PEAK	3.72	0.0024	30.0	PASS
11	2 462	PEAK	3.44	0.0022	30.0	PASS

MODE - 802.11n20

CHANNEL	Channel requency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(W)		
1	2 412	PEAK	3.44	0.0022	30.0	PASS
7	2 442	PEAK	3.46	0.0022	30.0	PASS
11	2 462	PEAK	3.35	0.0022	30.0	PASS

MODE - 802.11n40

CHANNEL	Channel requency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(W)		
3	2 422	PEAK	1.33	0.0014	30.0	PASS
7	2 442	PEAK	0.35	0.0011	30.0	PASS
9	2 452	PEAK	0.24	0.0011	30.0	PASS

7. Maximum conducted (average) output power

7.1 Test procedure

The transmitter antenna terminal is connected to the input of a Power Sensor. Measurement is made while EUT is operating in transmission mode at the appropriate center frequency. The maximum Average output power measurement is 30 dBm.

Maximum conducted (average) output power Test Instruments

Description	Model	Serial Number	Cal. Due Date
Power Meter	N1921A	MY45100570	1-Dec-21
Power Sensor	N1921A	MY45240427	1-Dec-21
Power Meter <=> EUT	Loss: 1 dB	-	

7.2 Measurement results

EUT	Face Station2	MODEL	FS2-AWB
MODE	802.11b, g, n20, n40	ENVIRONMENTAL CONDITION	23.0 ℃, 47.0 % R.H.
INPUT POWER	DC 24.0 V		

MODE - 802.11b

CHANNEL	Channel requency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(W)
		Detector	(dBm)	Duty Cycle		
1	2 412	AVG	-1.01	0.06	-0.95	0.0008
7	2 442	AVG	-0.86	0.06	-0.80	0.0008
11	2 462	AVG	-1.07	0.06	-1.01	0.0008

MODE - 802.11g

CHANNEL	Channel requency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(W)
		Detector	(dBm)	Duty Cycle		
1	2 412	AVG	-4.50	0.21	-4.29	0.0004
7	2 442	AVG	-4.97	0.21	-4.76	0.0003
11	2 462	AVG	-4.53	0.21	-4.32	0.0004

MODE - 802.11n20

CHANNEL	Channel requency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(W)
		Detector	(dBm)	Duty Cycle		
1	2 412	AVG	-4.92	0.37	-4.55	0.0004
7	2 442	AVG	-4.83	0.37	-4.46	0.0004
11	2 462	AVG	-4.89	0.37	-4.52	0.0004

MODE - 802.11n40

CHANNEL	Channel requency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(W)
		Detector	(dBm)	Duty Cycle		
3	2 422	AVG	-7.85	0.96	-6.89	0.0002
7	2 442	AVG	-7.97	0.96	-7.01	0.0002
9	2 452	AVG	-8.35	0.96	-7.39	0.0002

8. Maximum power spectral density level in the fundamental emission

8.1 Test procedure

KDB 558074 D01 DTS Meas Guidance V05 10.2 Method PKPSD (peak PSD)

8.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

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 x 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.

Limits FCC § 15.247

The peak power density Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	FSV40	100393	1-Dec-21
Spectrum Analyzer	E4440A	US42041291	1-Dec-21
RF Cable	Length: 30 cm	-	

8.3 Measurement results

EUT	Face Station2	MODEL	FS2-AWB
MODE	802.11b, g, n20, n40	ENVIRONMENTAL CONDITION	22.0 ℃, 47.0 % R.H.
INPUT POWER	DC 24.0 V		

MODE - 802.11b

CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
1	2 412	-16.00	8.00	24.00
7	2 442	-17.26	8.00	25.26
11	2 462	-16.29	8.00	24.29

MODE - 802.11g

CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
1	2 412	-19.01	8.00	27.01
7	2 442	-19.53	8.00	27.53
11	2 462	-19.57	8.00	27.57

MODE - 802.11n20

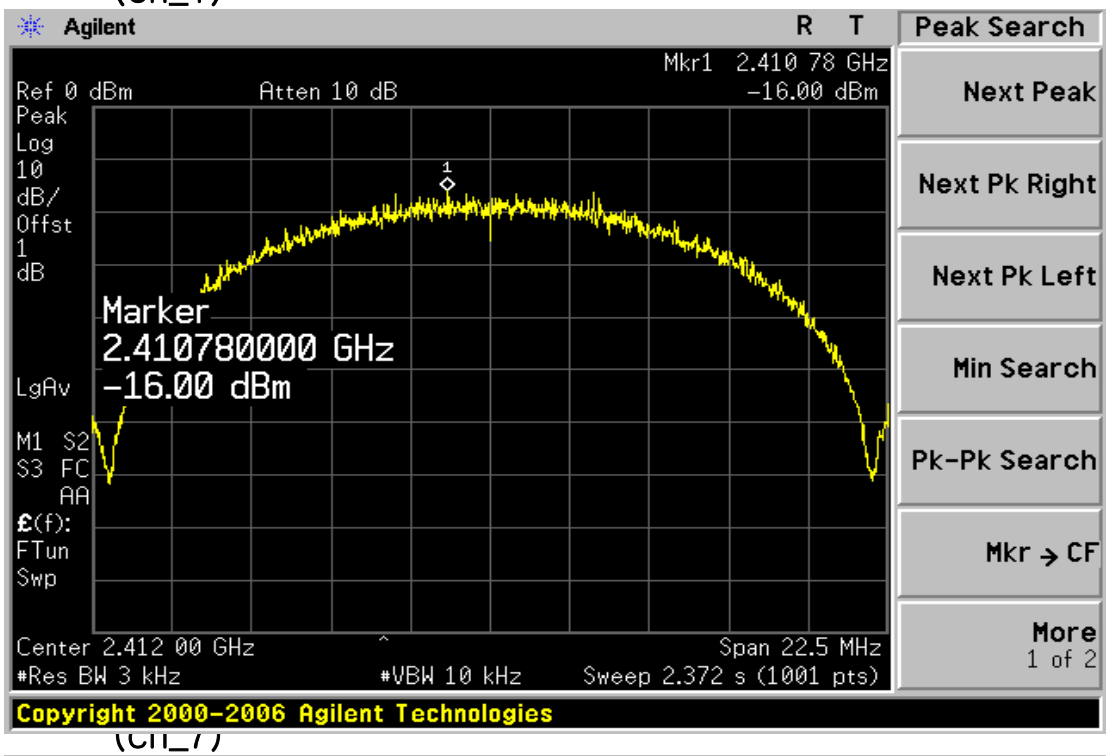
CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
1	2 412	-19.26	8.00	27.26
7	2 442	-19.24	8.00	27.24
11	2 462	-19.03	8.00	27.03

MODE - 802.11n40

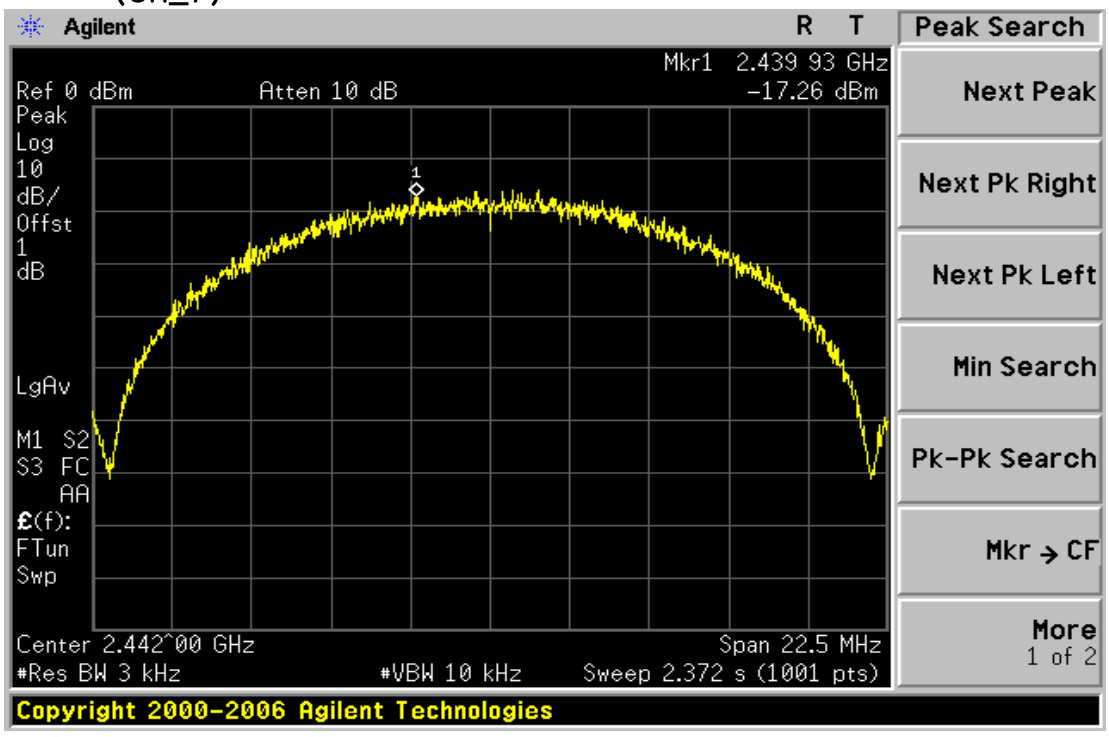
CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
3	2 422	-21.84	8.00	29.84
7	2 442	-20.99	8.00	28.99
9	2 452	-21.57	8.00	29.57

8.4 Trace data - 802.11b mode

(ch_1)

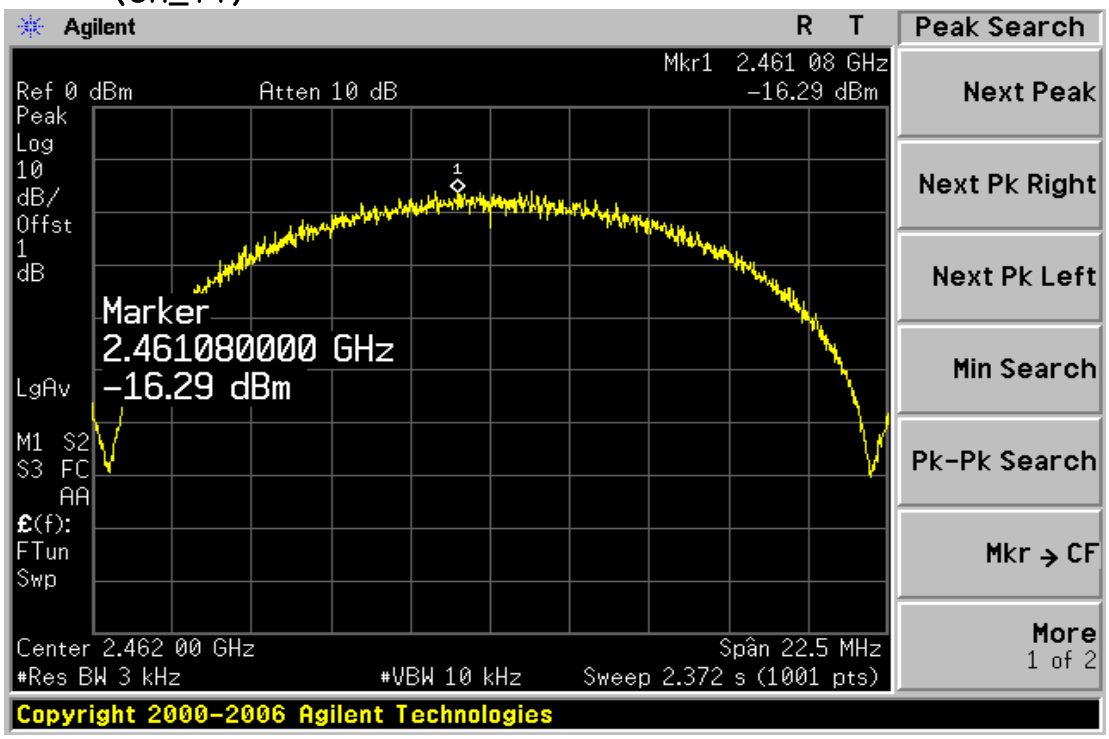


(ch_7)



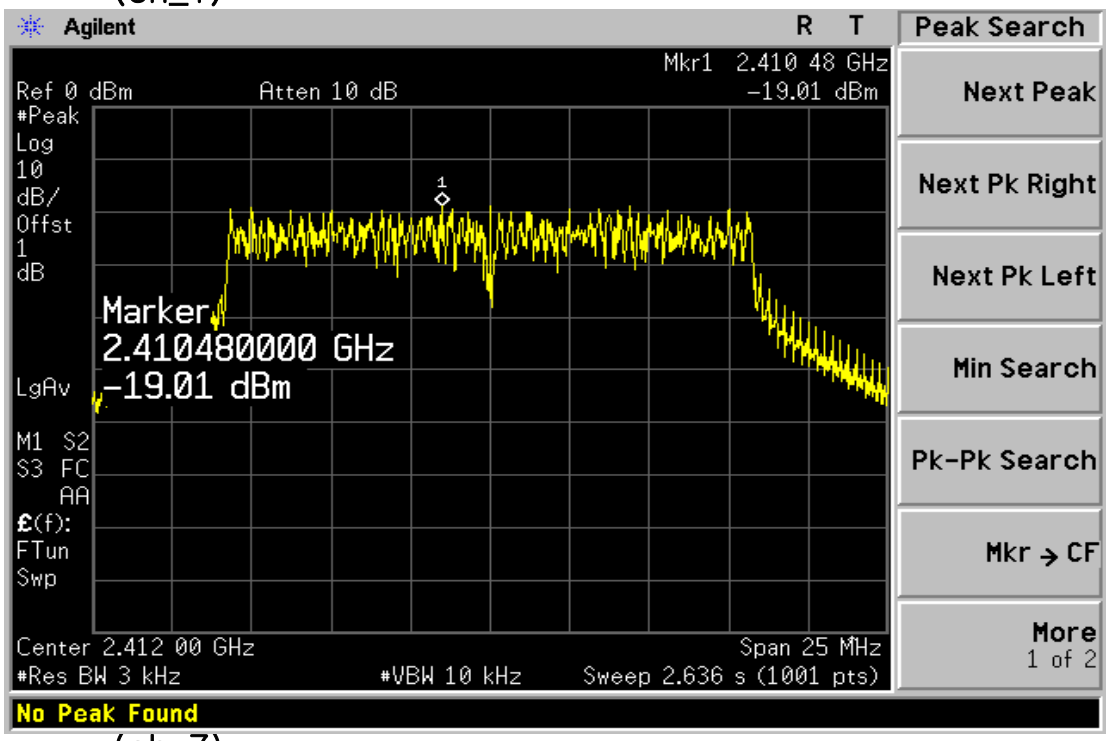
8.4 Trace data - 802.11b

(ch_11)

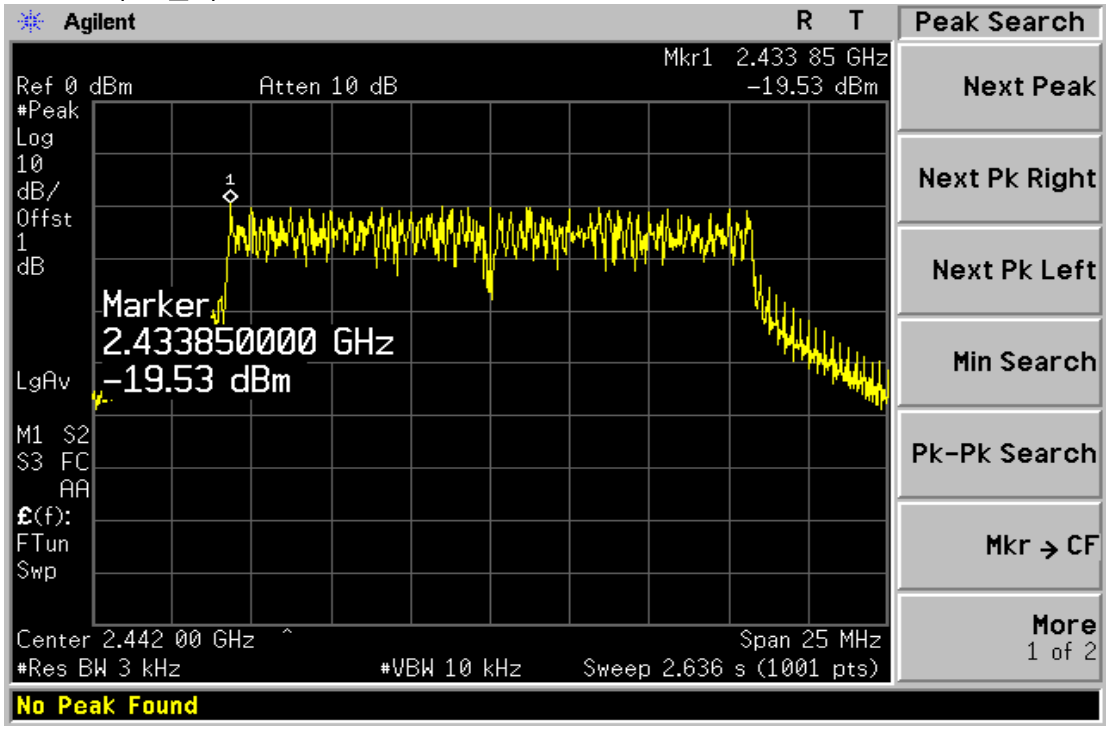


Trace data - 802.11g mode

(ch_1)

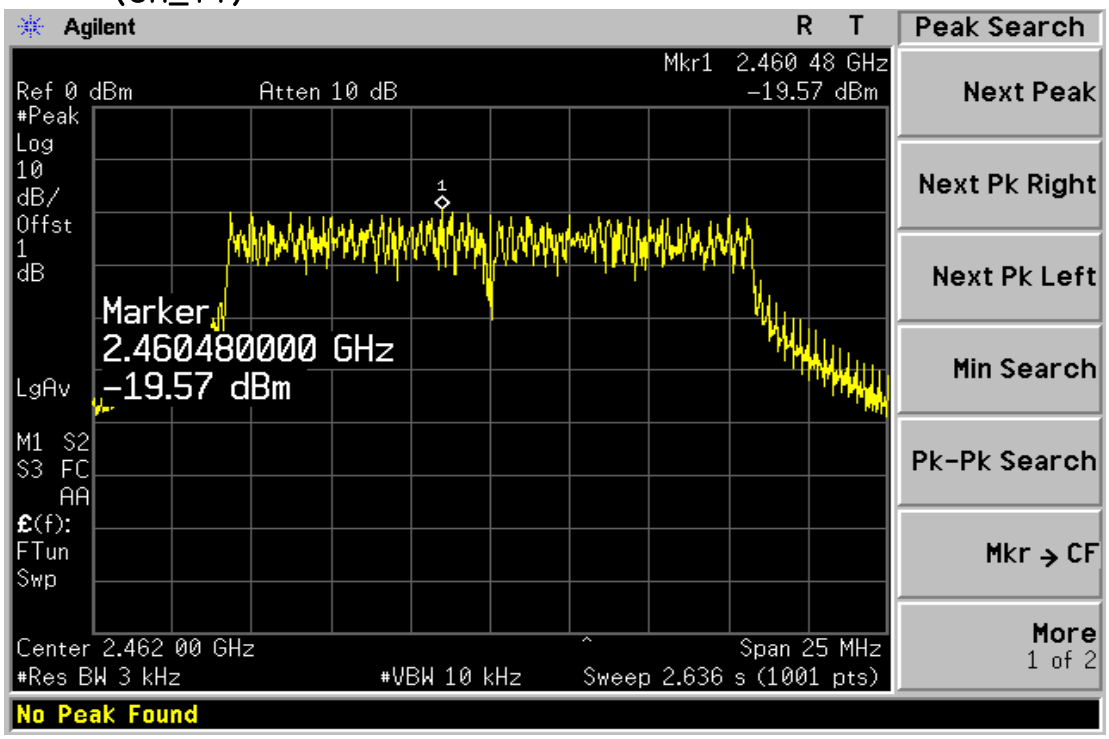


(ch_7)



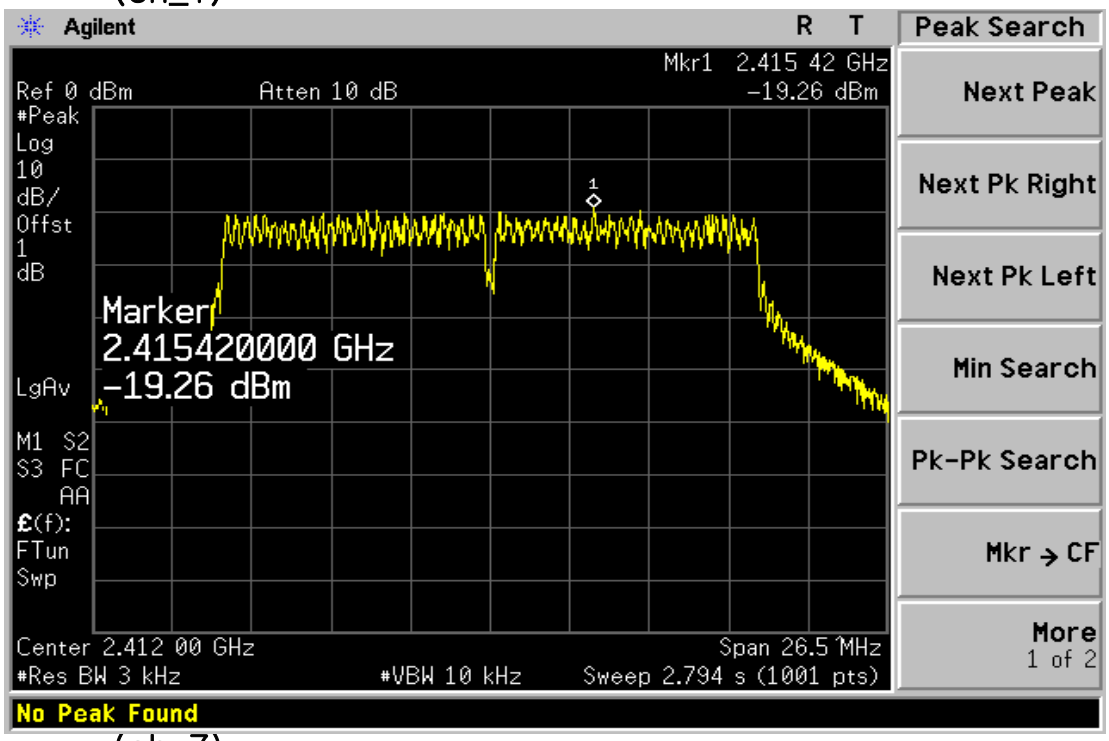
Trace data - 802.11g mode

(ch_11)

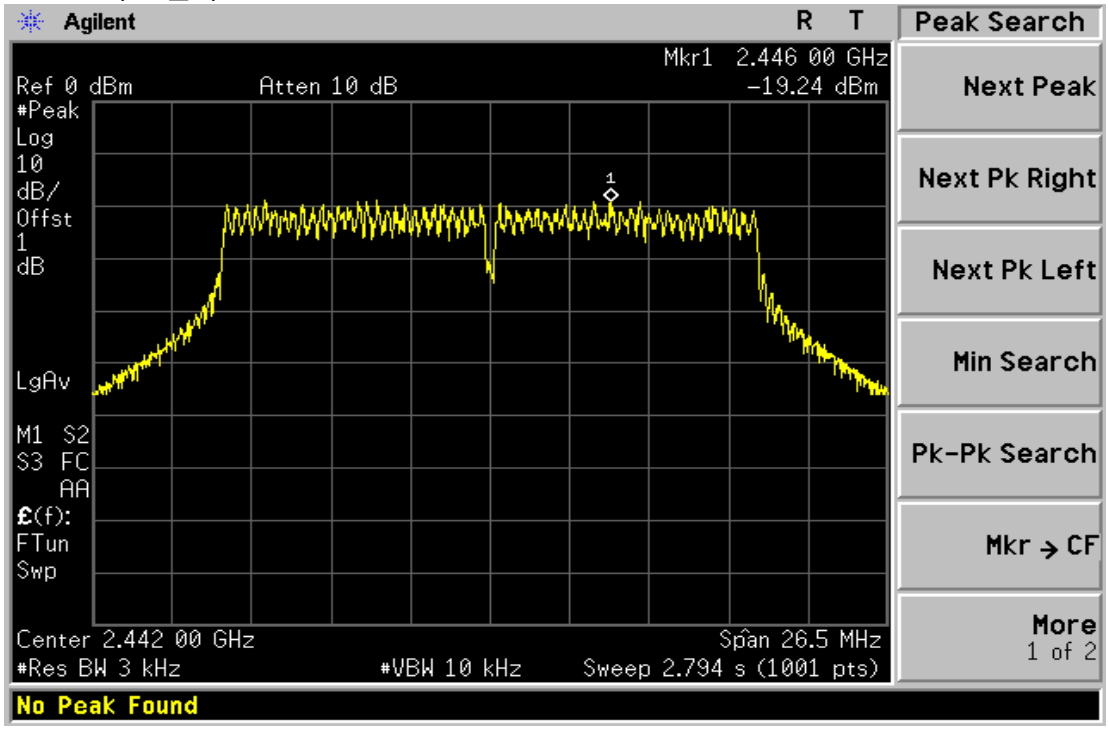


Trace data - 802.11n20 mode

(ch_1)

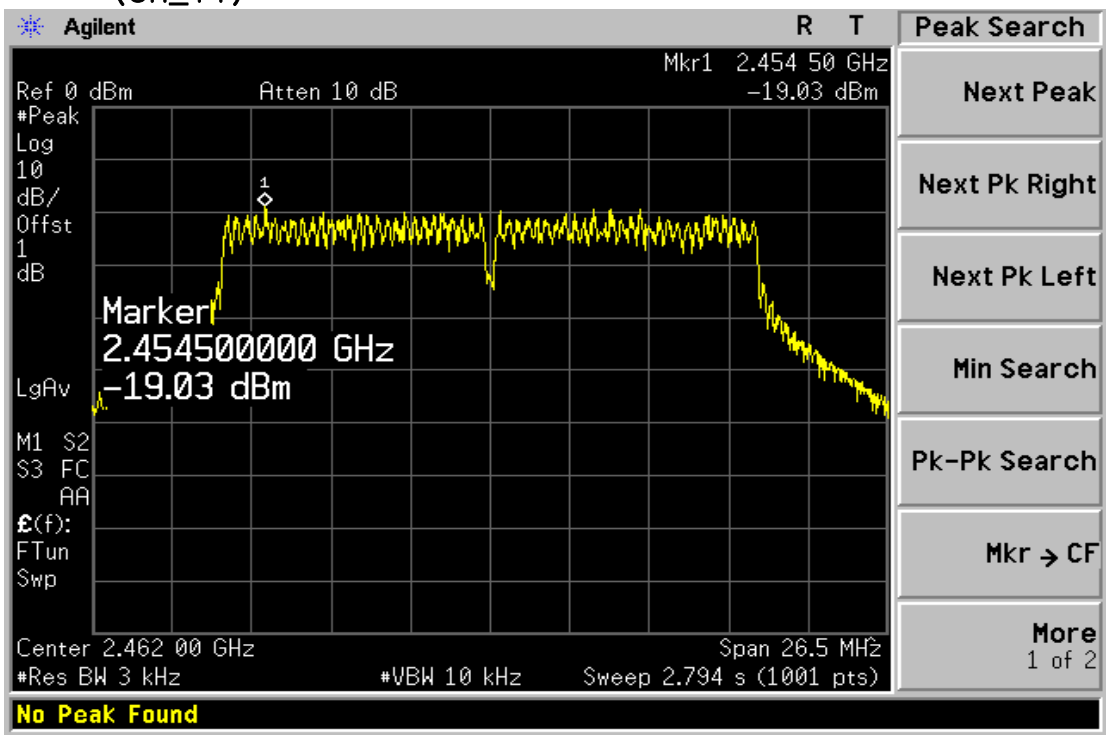


(ch_7)



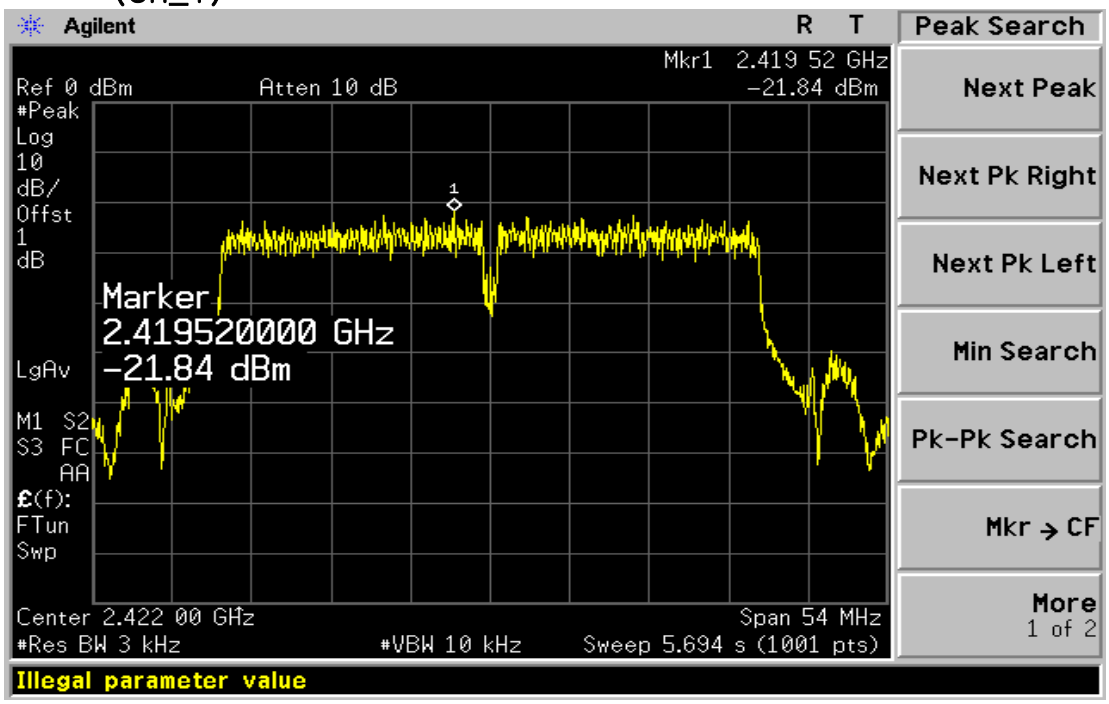
8.4 Trace data - 802.11n20 mode

(ch_11)

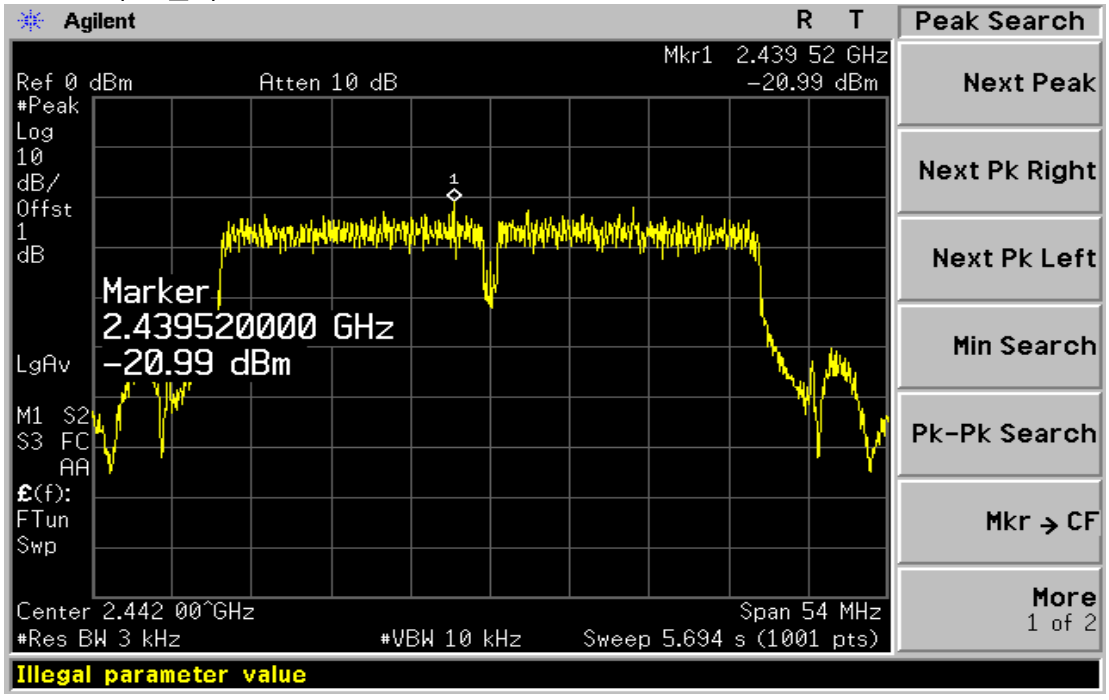


Trace data - 802.11n40 mode

(ch_1)

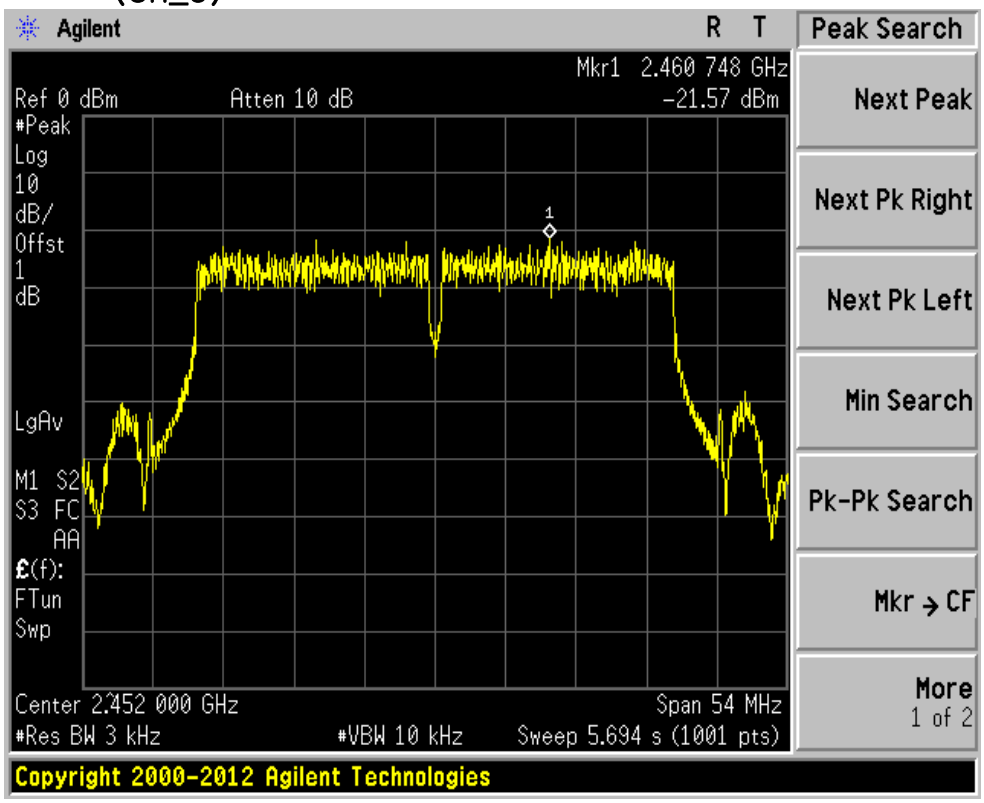


(ch_7)



8.4 Trace data - 802.11g mode

(ch_9)



9. Emissions in non-restricted frequency bands

9.1 Test procedure

KDB 558074 D01 DTS Meas Guidance V05

9.2 Test instruments and measurement setup

The spectrum analyzer is set to as following.

a) Set instrument center frequency to DTS channel center frequency.

b) Set the span to ≥ 1.5 times the DTS bandwidth.

c) Set the RBW = 100 kHz. d) Set the VBW ≥ 3 x 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 PSD level.

Limits FCC § 15.247

Band Edge&Out of Emission Test Instruments

Description	Model	Serial Number	Cal. Due Date
Spectrum Analyzer	E4440A	US42041291	1-Dec-21
Spectrum Analyzer	FSV40	100939	1-Dec-21
RF Cable	Length: 30 cm		-
-Spectrum Analyzer <=> EUT	Loss: 1.0 dB		-

EUT	Face Station2	MODEL	FS2-AWB
MODE	802.11b, g, n20, n40	ENVIRONMENTAL CONDITION	22.0 ℃, 47.0 % R.H.
INPUT POWER	DC 24.0 V		

MODE -802.11b

CHANNEL	Channel Frequency (MHz)	limit	PASS/FAIL
1	2 412	20dBc	PASS
11	2 462	20dBc	PASS

MODE -802.11g

CHANNEL	Channel Frequency (MHz)	limit	PASS/FAIL
1	2 412	20dBc	PASS
11	2 462	20dBc	PASS

MODE -802.11n20

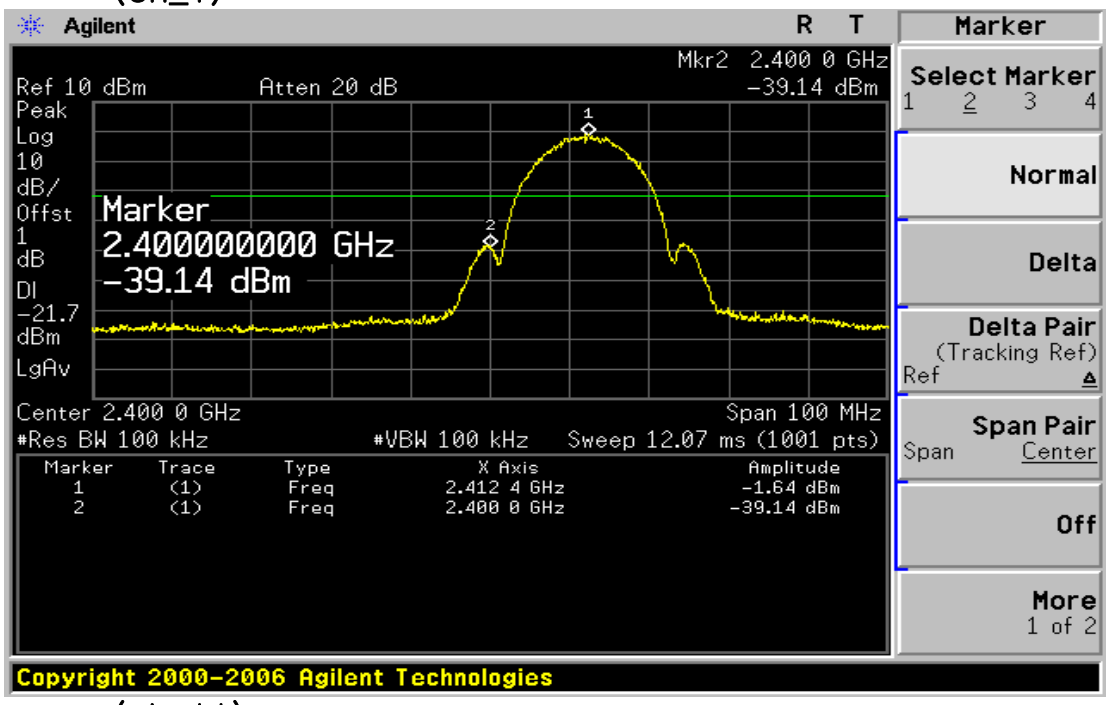
CHANNEL	Channel Frequency (MHz)	limit	PASS/FAIL
1	2 412	20dBc	PASS
11	2 462	20dBc	PASS

MODE -802.11n40

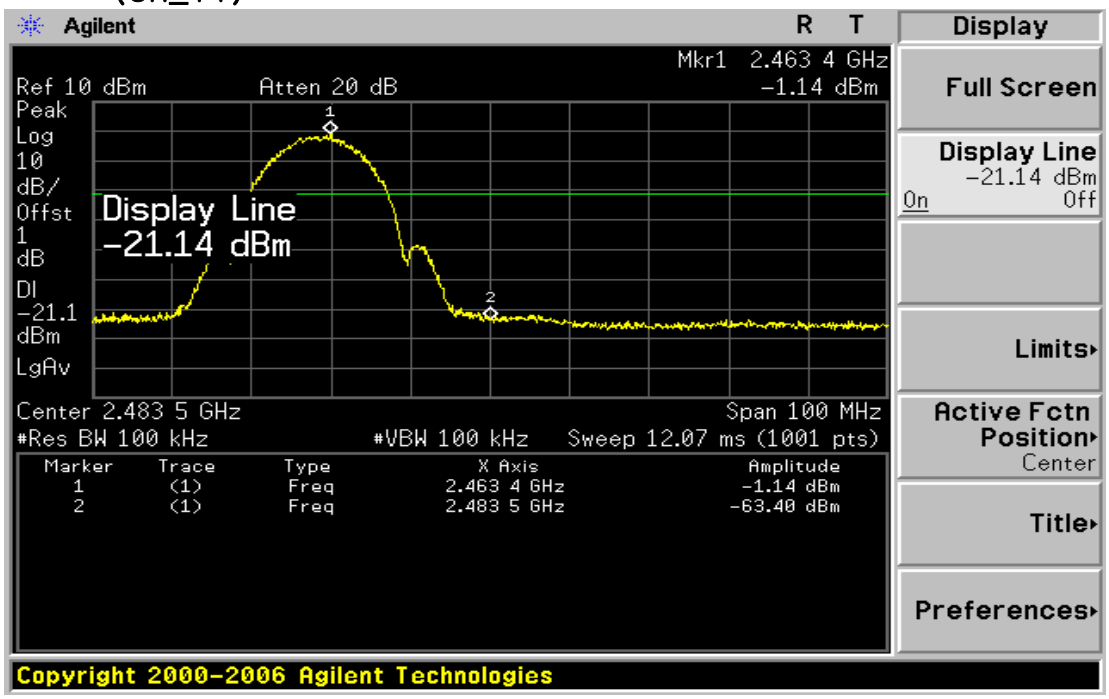
CHANNEL	Channel Frequency (MHz)	limit	PASS/FAIL
3	2 422	20dBc	PASS
9	2 452	20dBc	PASS

Trace data of band-edge & Out of Emission - 802.11b mode

(ch_1)

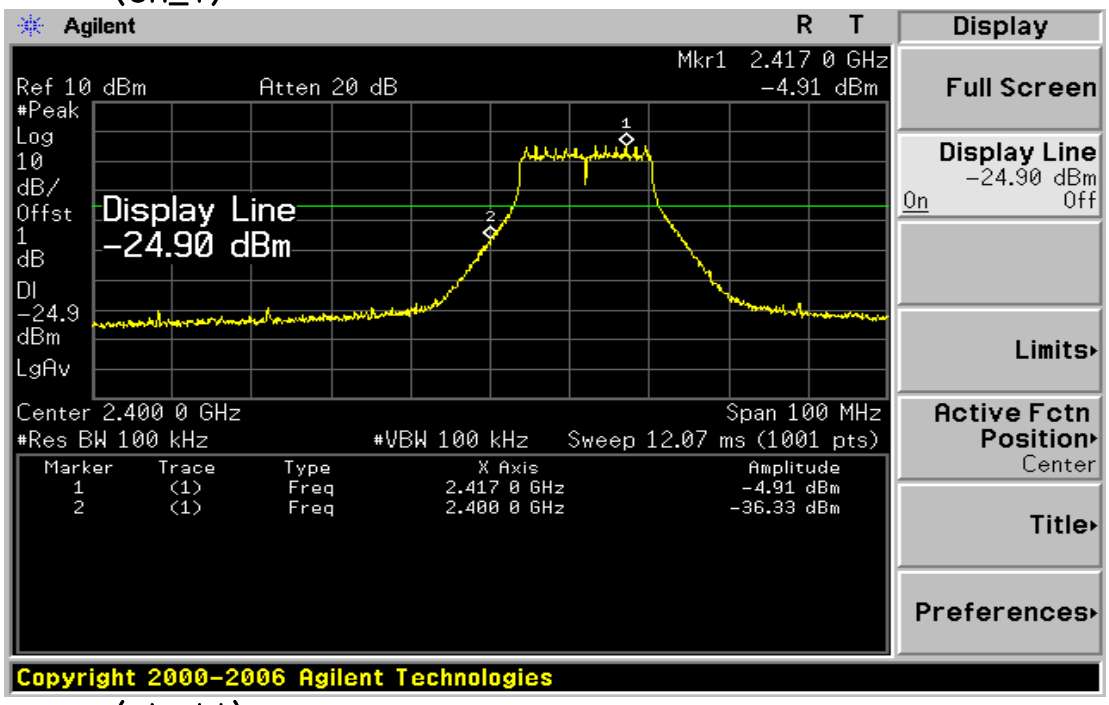


(ch_11)

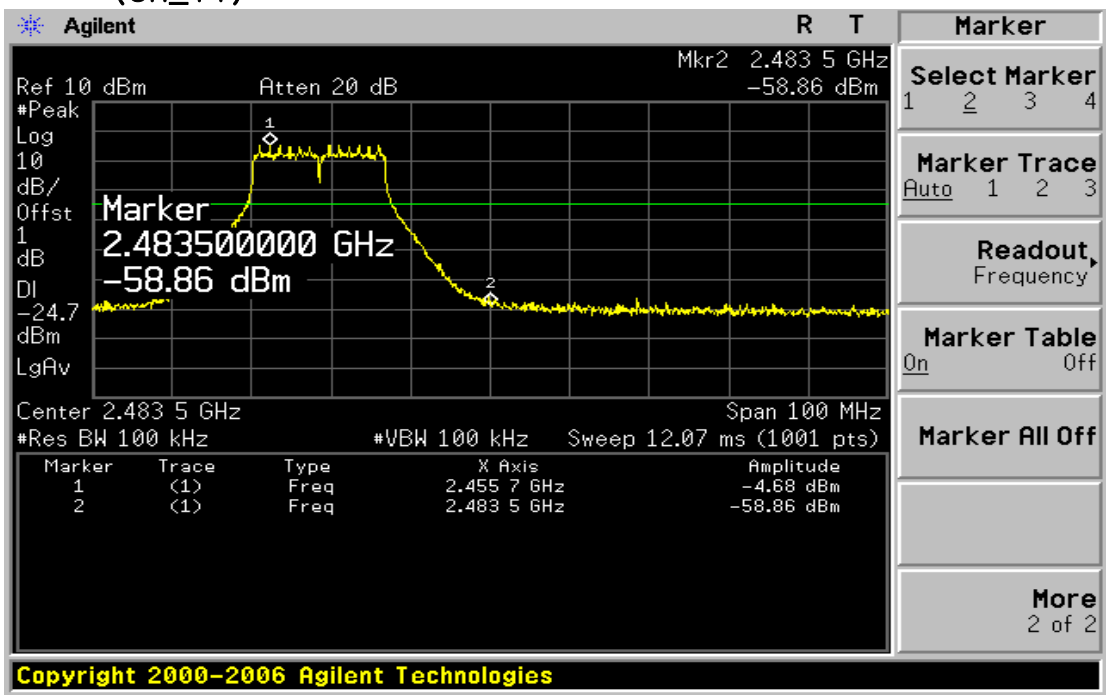


Trace data of band-edge & Out of Emission - 802.11g mode

(ch_1)

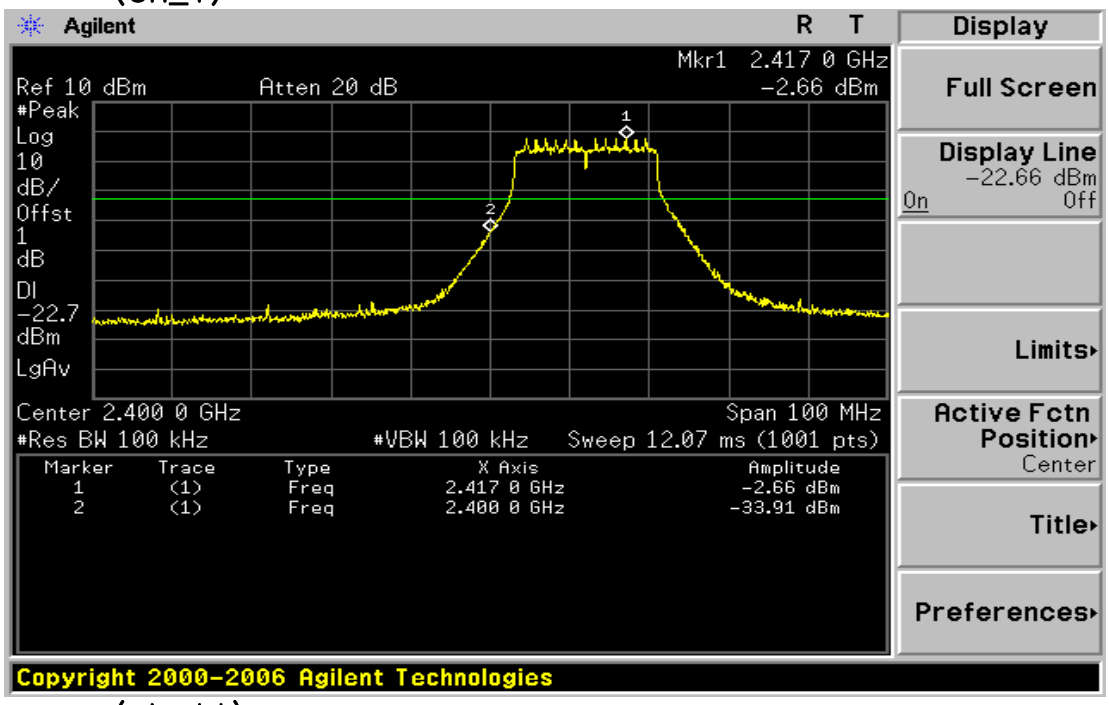


(ch_11)

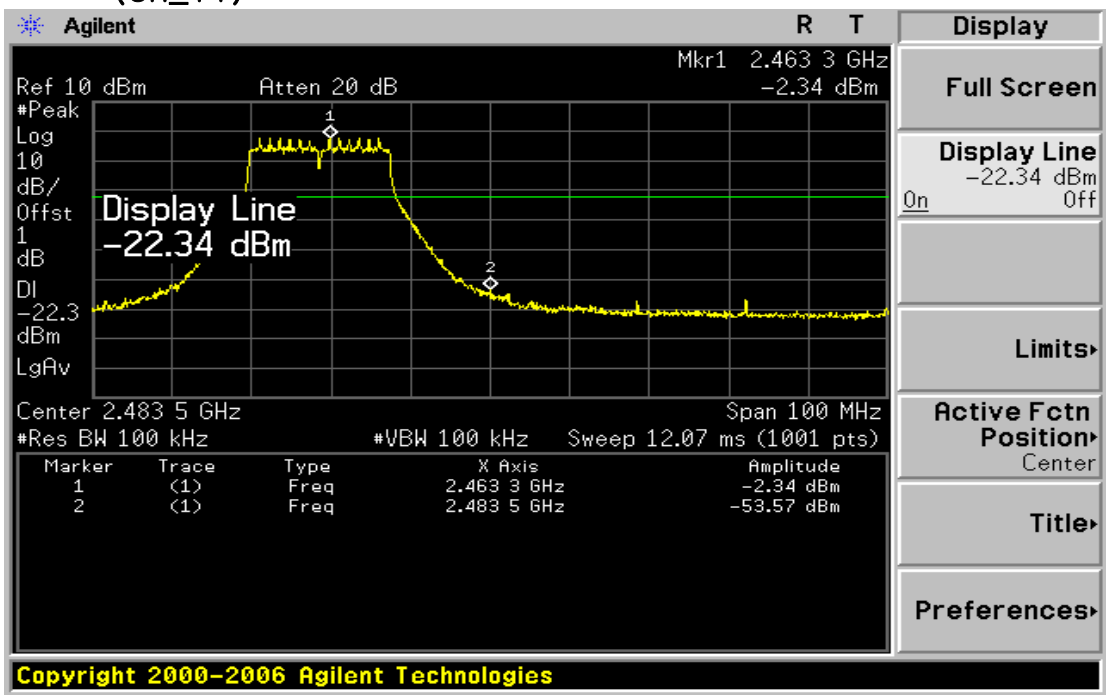


Trace data of band-edge & Out of Emission - 802.11n20 mode

(ch_1)

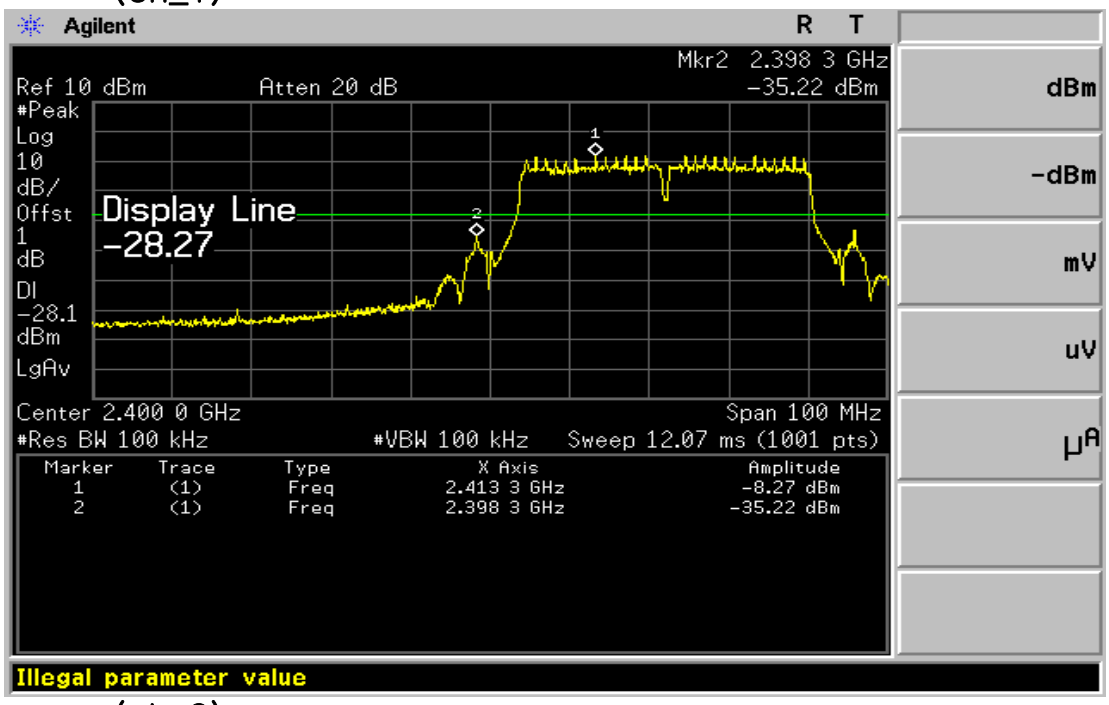


(ch_11)

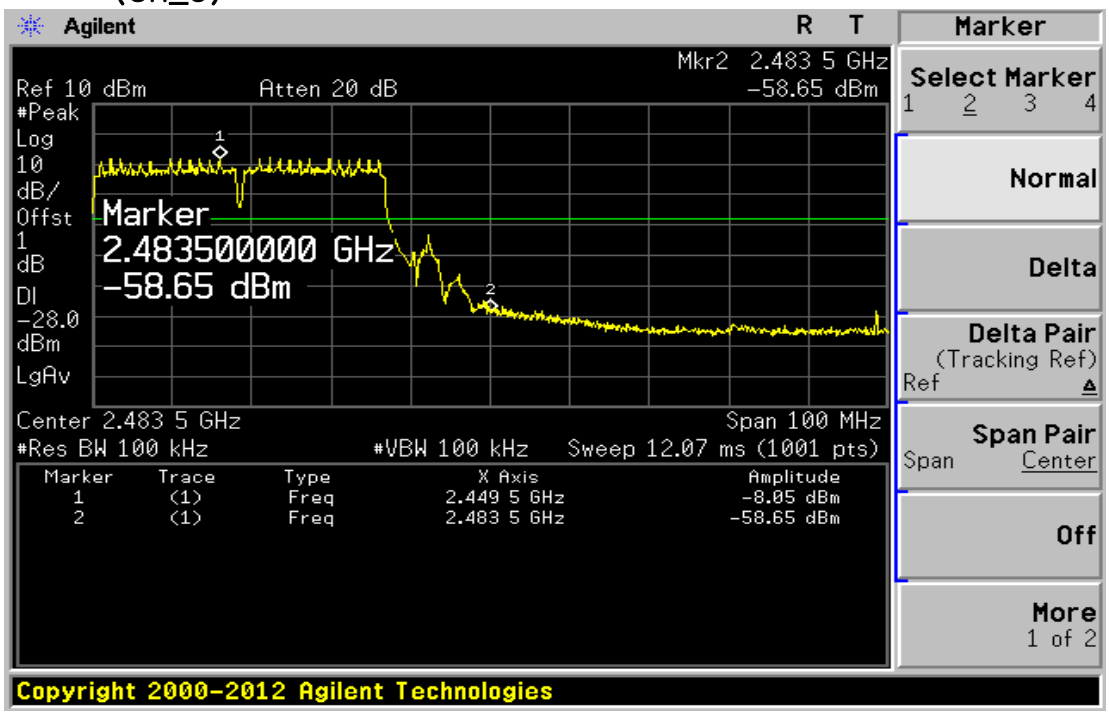


Trace data of band-edge & Out of Emission - 802.11n40 mode

(ch_1)

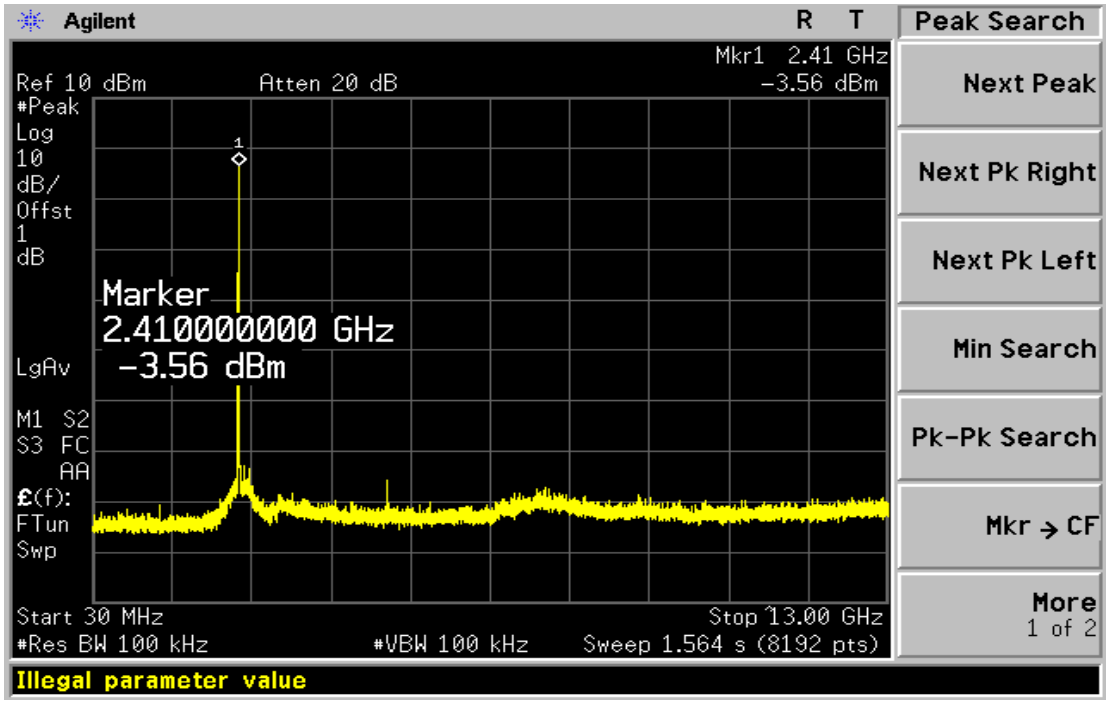


(ch_9)

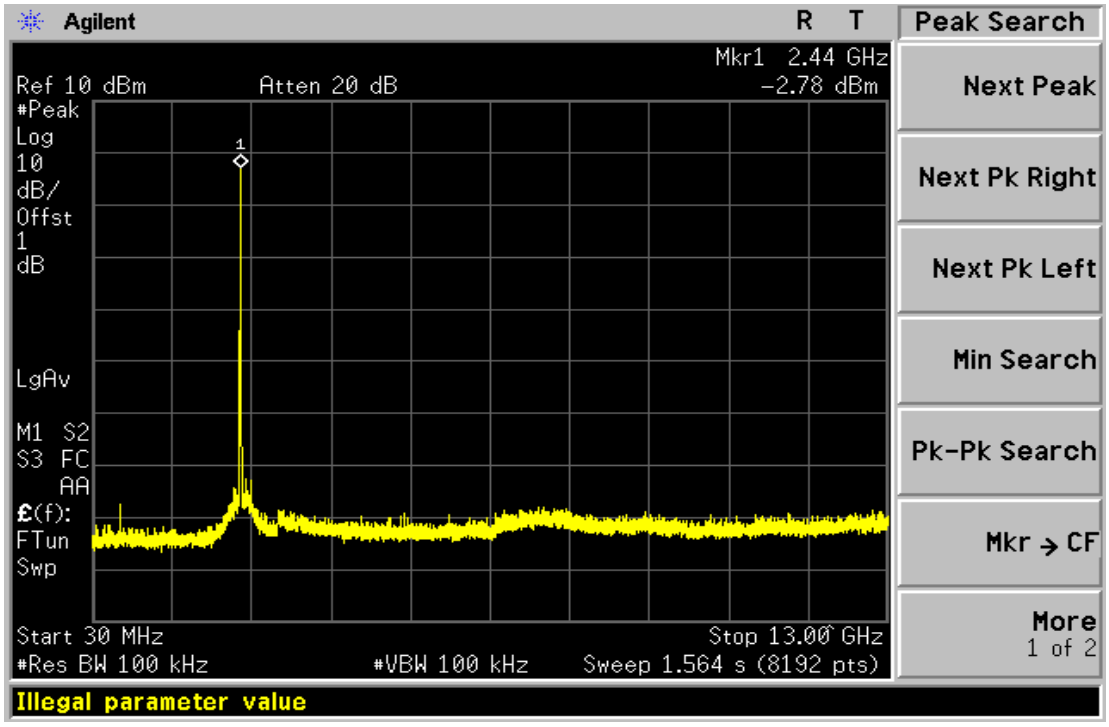


Trace data of Out of Emission - 802.11b mode

(ch_1)

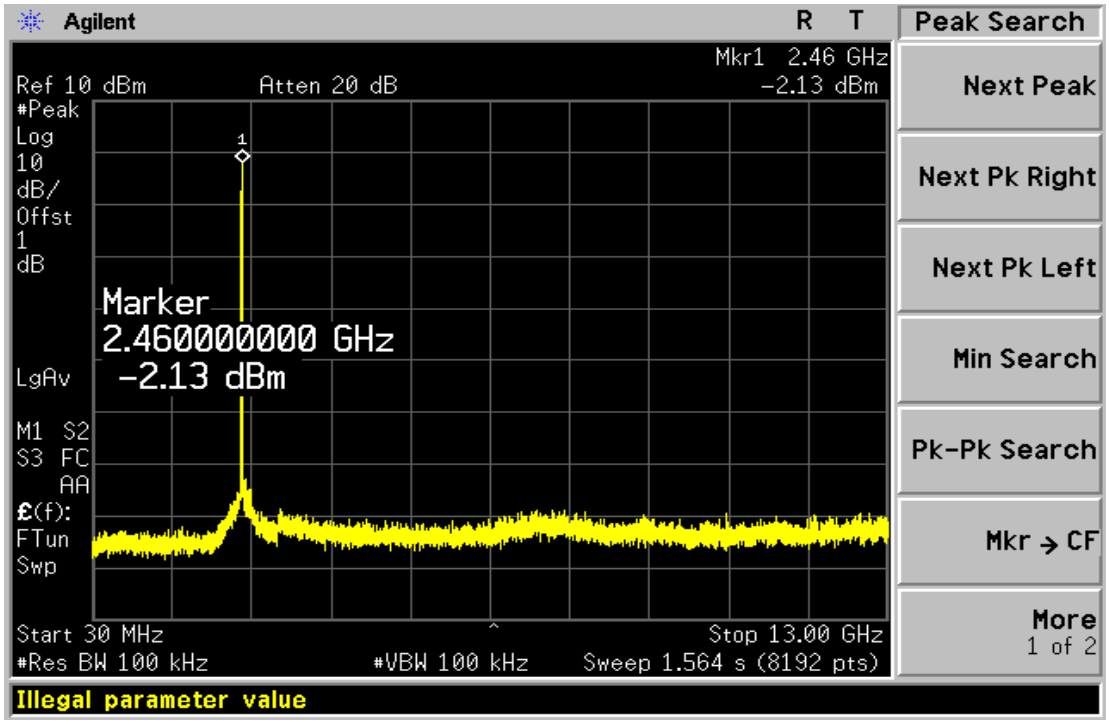


(ch_7)



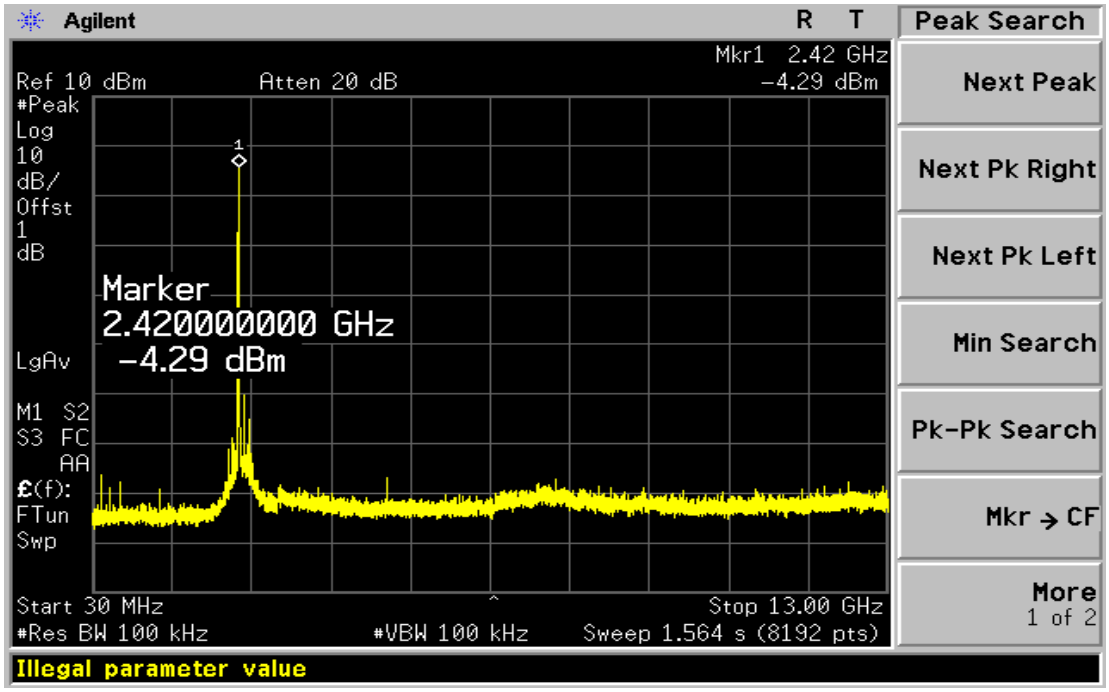
Trace data of Out of Emission - 802.11b mode

(ch_11)

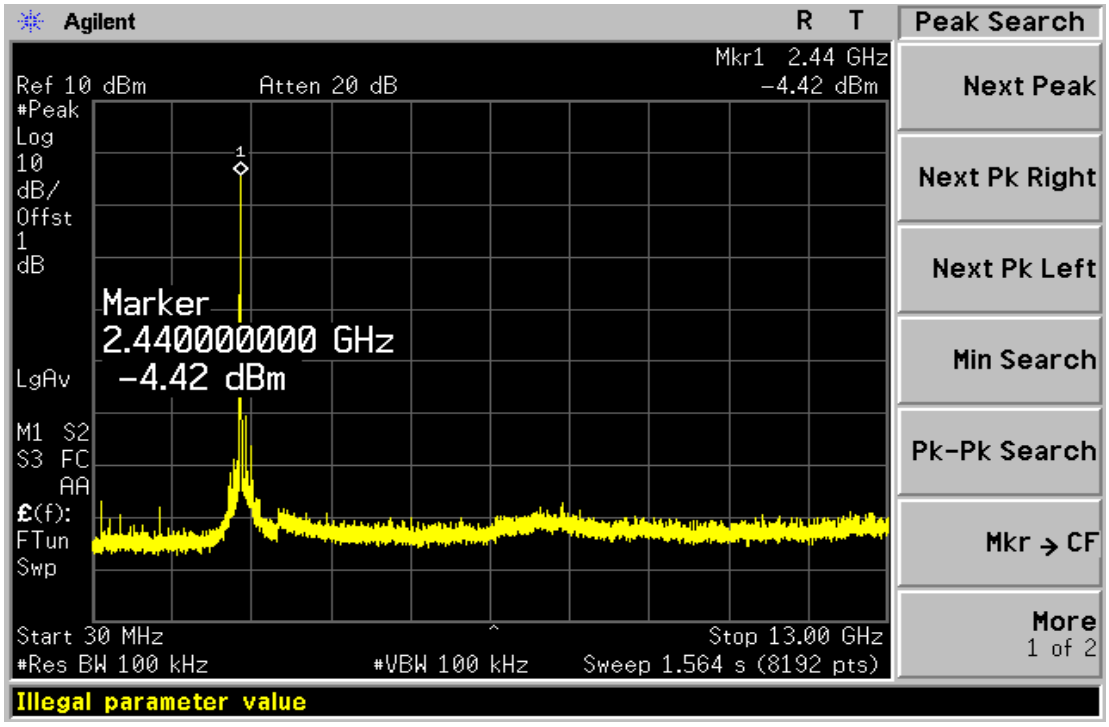


Trace data of Out of Emission - 802.11g mode

(ch_1)

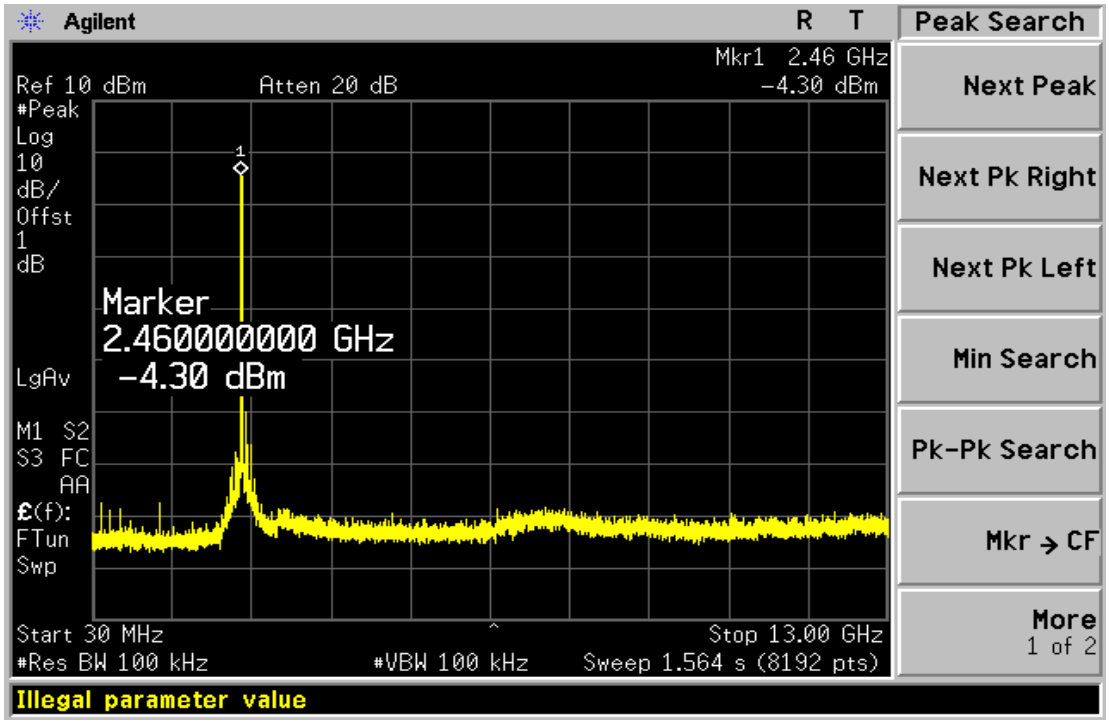


(ch_7)



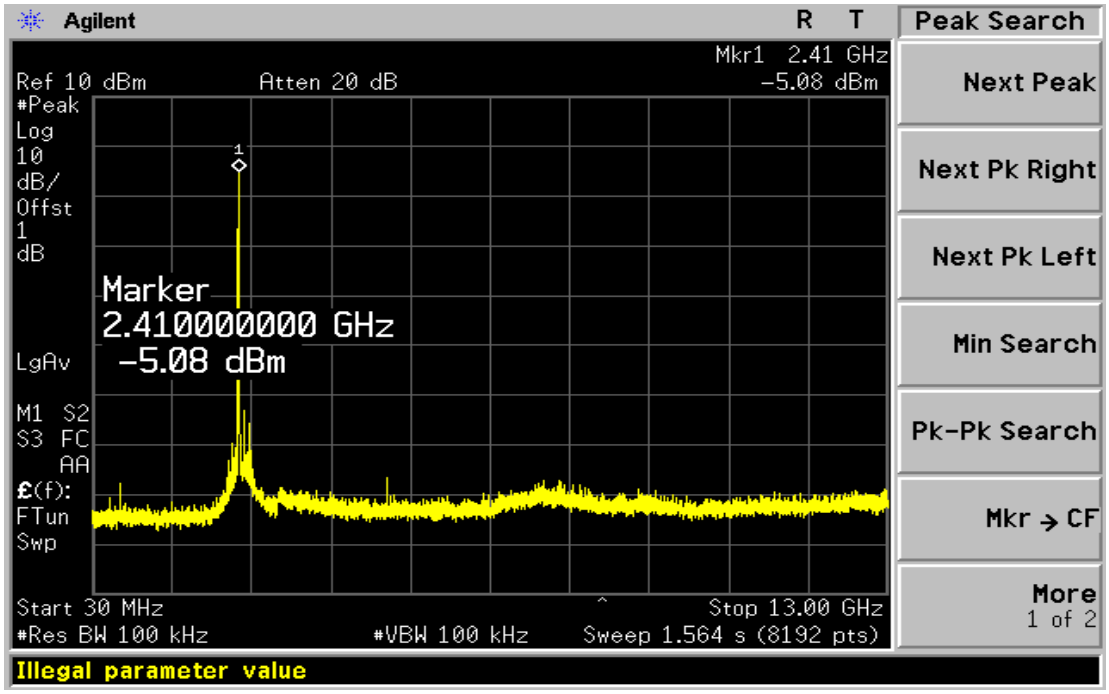
Trace data of Out of Emission - 802.11g mode

(ch_11)

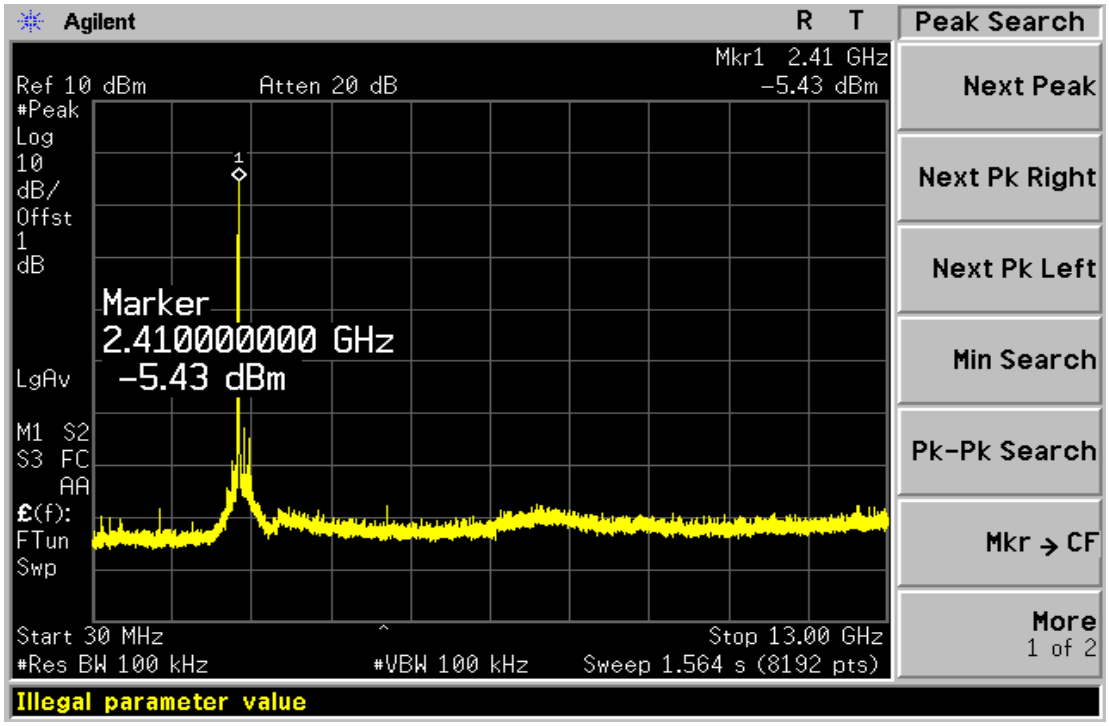


Trace data of Out of Emission - 802.11n20 mode

(ch_1)

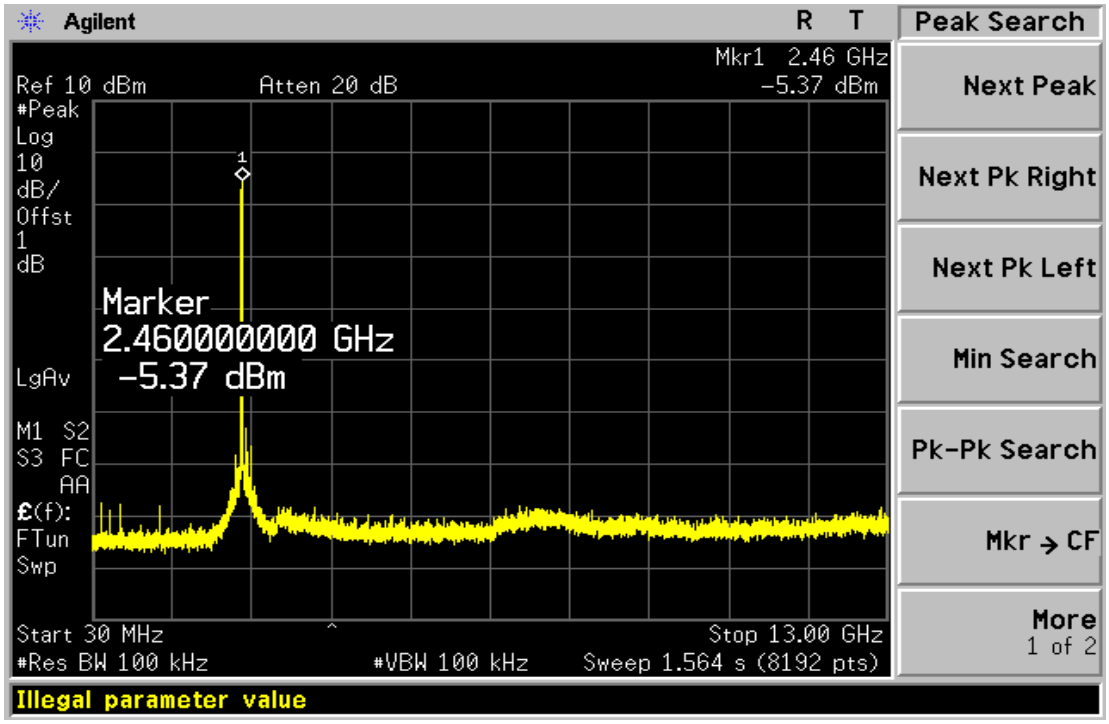


(ch_7)



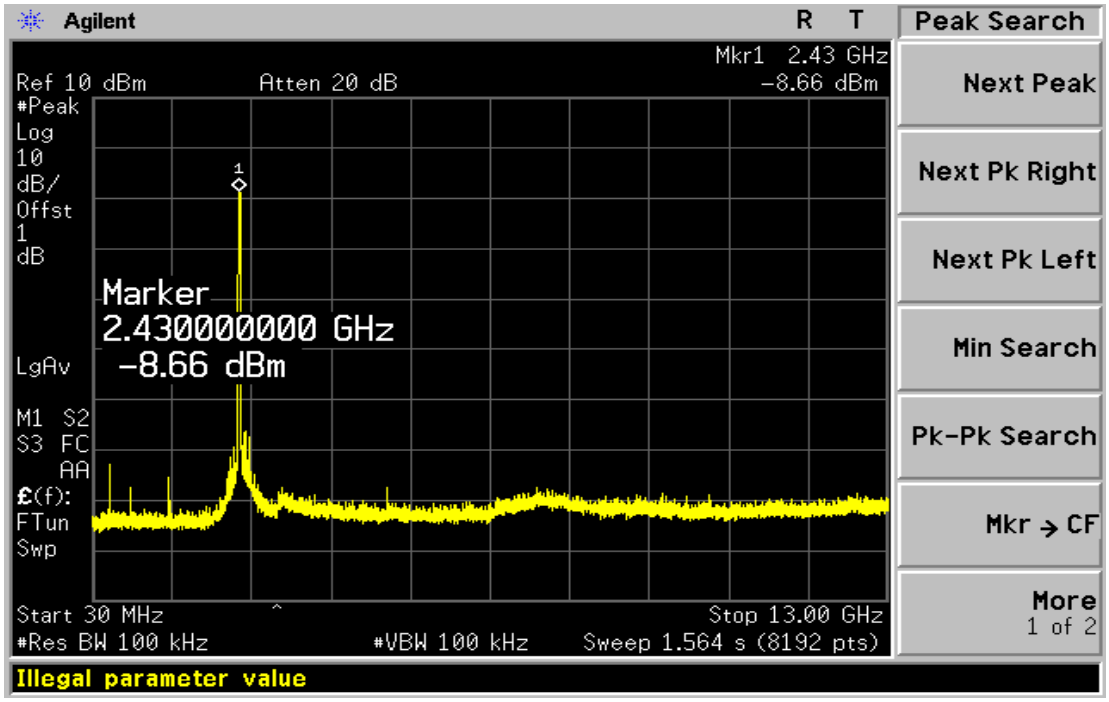
Trace data of Out of Emission - 802.11n20 mode

(ch_11)

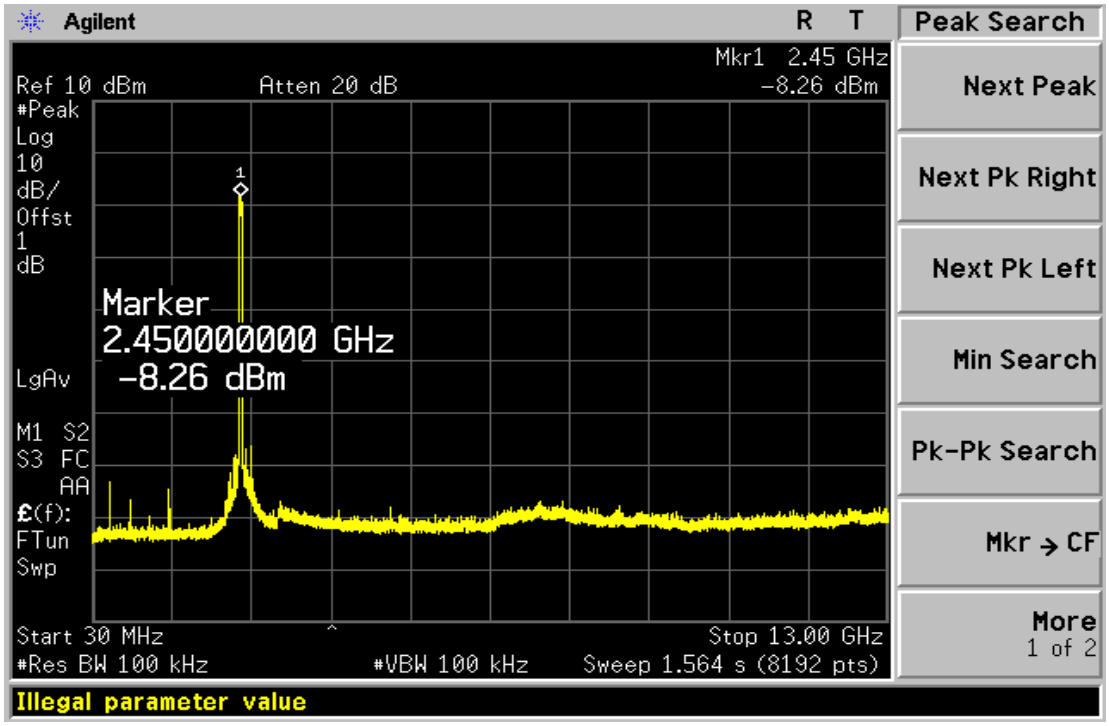


Trace data of Out of Emission - 802.11n40 mode

(ch_3)

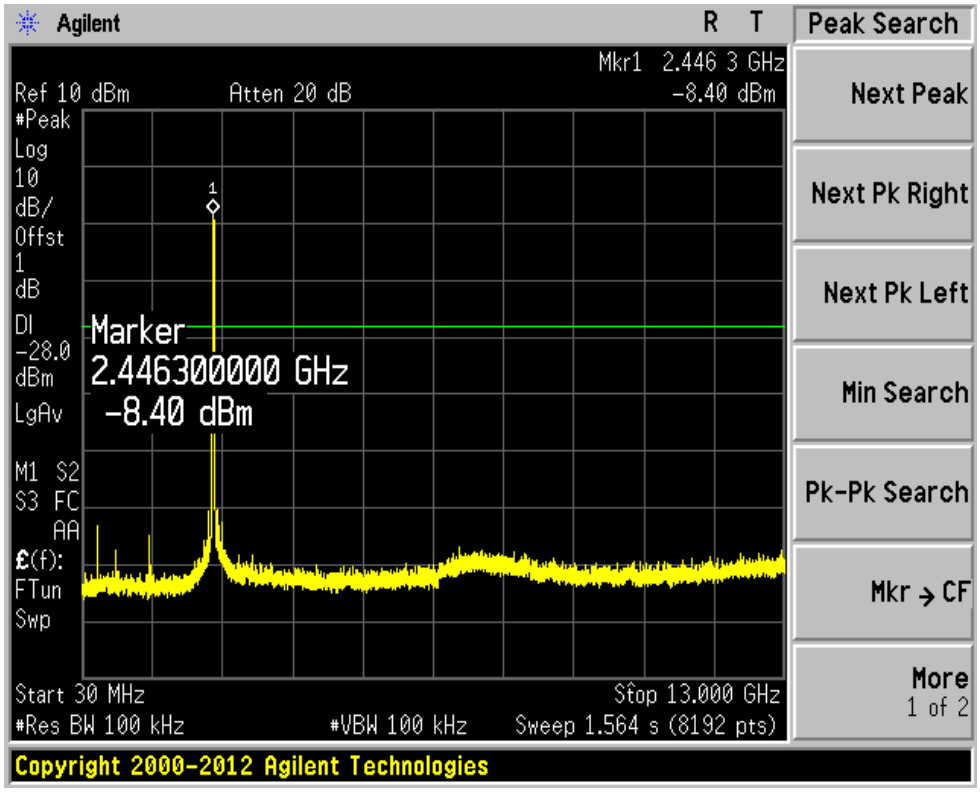


(ch_7)



Trace data of Out of Emission - 802.11n40 mode

(ch_9)



10. Measurement of radiated disturbance

Above 30 MHz Electric Field strength was measured in accordance with FCC PART 15.205, 15.209 . The test setup was made according to ANSI C 63.10 (2013) & KDB 558074 D01 Semi-anechoic chamber, which allows a 3 m distance measurement. The EUT was placed in the center of styrofoam. turntable. The height of this table was 0.8 m. The measurement was conducted with both horizontal and vertical antenna polarization. The turntable has fully rotated. For further description of the configuration refer to the picture of the test setup.

10.1 Measurement equipments

Equipment Name	Type	Manufacturer	Serial No.	Next Calibration date
TEST Receiver	ESCI7	ROHDE & SCHWARZ	100916	19-Jul-22
Logbicon Antenna	VULB 9168	SCHWARZBECK	193	14-Jan-22
Turn Table	DT3000-2t	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
PREAMPLIFIER	8449B	AGILENT	3008A00581	20-Jul-22
Horn Antenna	BBHA9120D	SCHWARZBECK	469	24-Dec-21
Signal Analyzer	FSV40	ROHDE & SCHWARZ	100393	1-Dec-21
Turn Table	DT1500-S	Innco System GmbH	N/A	-
Antenna Mast	MA4000-EP	Innco System GmbH	N/A	-
Horn Antenna	BBHA 9120D	SCHWARZBECK	469	24-Dec-21
Antenna Master & Turn table controller	CO2000-P	Innco System GmbH	CO2000/642 /28051111/L	-

10.2 Environmental Condition

Below 1 GHz -Test Place : 10 m Semi-anechoic chamber

WLAN 802.11 b,g,n20 Mode

Humidity (% R.H.) : 47.7 % R.H.

Above 1 GHz-Test Place : 3 m Semi-anechoic chamber

WLAN 802.11 b,g,n20 Mode

Temperature (°C) : 23.2 ℃

Humidity (% R.H.) : 46.6 % R.H.

10.3 Measurement Instrument setting for Radiated Emission

10.3.1 Frequency range below 1 GHz

Detector : Quasi-Peak

10.3.2 Frequency range above 1 GHz

Peak Power Measurement Procedure (KDB 558074 section 12.2.4)

a. RBW : 1 MHz , VBW : 3 MHz
b. Trace mode = max hold
c. Detector : Peak
d. Sweep time = auto

Average Power Measurement Procedures (KDB 558074 section 12.2.5.2)

a. Set analyzer center frequency to the frequency associated with the emission
b. RBW : 1 MHz , VBW : 3 MHz
c. Detector : RMS
d. Sweep time = auto

* Note

Band	Duty cycle(%)	Ton (ms)	Ton + Toff (ms)	DCF=10*log(1/Duty) (dB)
802.11b	98.6	8.42	8.54	0.06
802.11g	95.3	1.39	1.46	0.21
802.11n20	91.8	1.30	1.41	0.37
802.11n40	96.3	0.61	0.76	0.96

* This was not applied of duty cycle factor for average value because of measured with the EUT transmitting continuously more than 98 % duty cycle at its maximum power control level.

10.4-1 Test Data (802.11 b)

Test Date 1-Nov-21 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
41.60	12.27	V	1.0	13.42	0.91	40.00	26.59	13.41
146.50	24.69	V	1.0	11.84	1.10	43.50	37.63	5.87
249.70	23.77	H	1.4	9.48	1.35	46.00	34.59	11.41
400.00	30.28	H	1.4	12.12	1.57	46.00	43.97	2.03
456.00	22.95	V	1.5	14.00	2.48	46.00	39.43	6.57
996.80	6.78	H	1.0	24.30	4.70	54.00	35.78	18.22

Remark

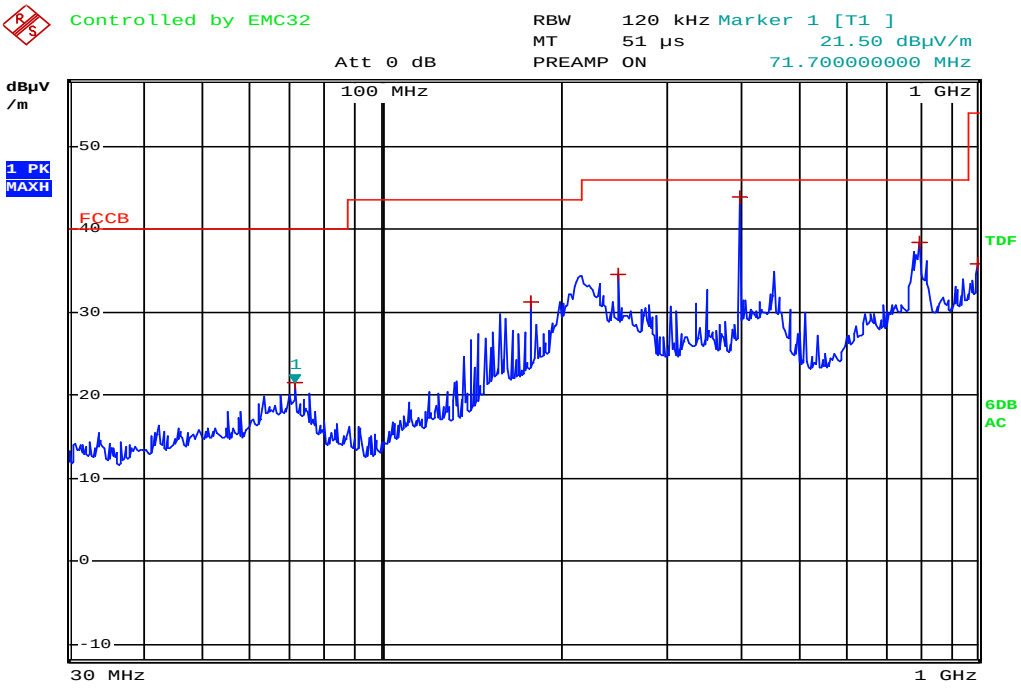
H : Horizontal, V : Vertical

*Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position)
*CL = Cable Loss(In case of below 1 000 MHz)
*Result Value = Reading + Ant Factor + Cable loss
*The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz.

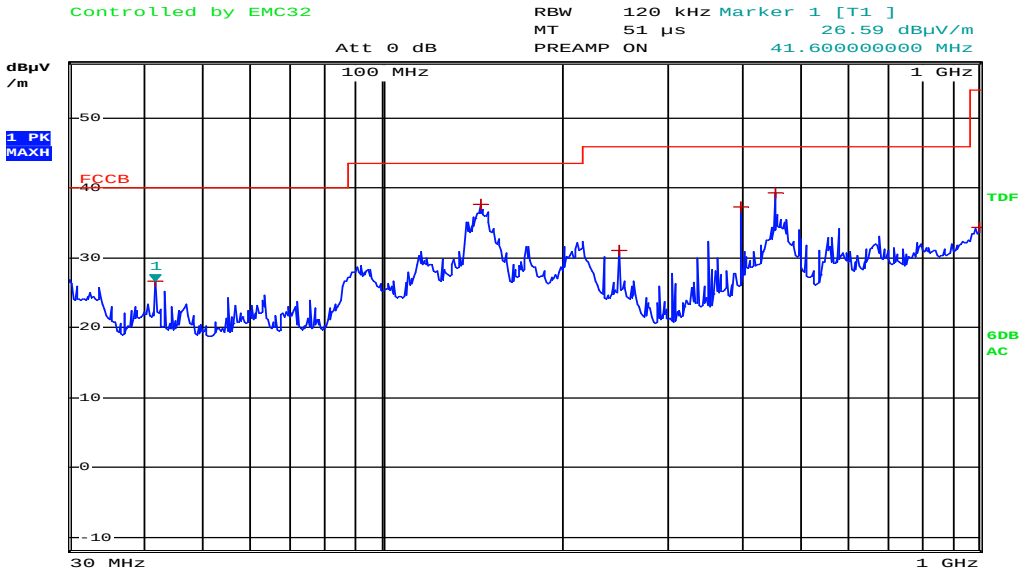
10.4-2 radiated Graph(30 MHz ~ 1 GHz)

*802.11b Mode

Polarity:Horizontal



Polarity:Vertical



10.4-3 Test Data

Test Date : 15-Nov-21 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
2390.00	47.11	H	1.5	27.89	-29.82		74.00	45.18	28.82
2390.00	46.34	V	1.6	27.89	-29.82		74.00	44.41	29.59
4824.00	45.11	H	1.5	31.52	-27.27		74.00	49.36	24.64
4824.00	46.10	V	1.6	31.52	-27.27		74.00	50.35	23.65
AV(RBW: 1 MHz VBW: 3 MHz)									
2390.00	35.30	H	1.5	27.89	-29.82	0.06	54.00	33.43	20.57
2390.00	34.50	V	1.6	27.89	-29.82	0.06	54.00	32.63	21.37
4824.00	33.59	H	1.5	31.52	-27.27	0.06	54.00	37.90	16.10
4824.00	34.10	V	1.6	31.52	-27.27	0.06	54.00	38.41	15.59

Remark	H : Horizontal, V : Vertical TEST MODE : 802.11 b - CH 1(2 412 MHz) *The TX signal wasn't detected from 3th harmonics. *Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position) *Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction *This test was radiated up to 26.5 GHz but no noise was measured.

10.4-4 Test Data

Test Date : 15-Nov-21 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
4884.00	44.97	H	1.6	31.58	-27.23		74.00	49.32	24.68
4884.00	44.87	V	1.5	31.58	-27.23		74.00	49.22	24.78
AV(RBW: 1 MHz VBW: 3 MHz)									
4884.00	34.11	H	1.6	31.58	-27.23	0.06	54.00	38.52	15.48
4884.00	33.97	V	1.5	31.58	-27.23	0.06	54.00	38.38	15.62

Remark	H : Horizontal, V : Vertical TEST MODE : 802.11b - CH 7(2 442 MHz) *The TX signal wasn't detected from 3th harmonics. *Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position) *Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction *This test was radiated up to 26.5 GHz but no noise was measured.

10.4-5 Test Data

Test Date : 15-Nov-21 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
2483.50	46.73	H	1.6	27.48	-29.75		74.00	44.46	29.54
2483.50	46.32	V	1.5	27.48	-29.75		74.00	44.05	29.95
4924.00	46.12	H	1.6	31.62	-27.21		74.00	50.53	23.47
4924.00	45.97	V	1.5	31.62	-27.21		74.00	50.38	23.62
AV(RBW: 1 MHz VBW: 3 MHz)									
2483.50	34.35	H	1.6	27.50	-29.75	0.06	54.00	32.16	21.84
2483.50	34.63	V	1.5	27.50	-29.75	0.06	54.00	32.44	21.56
4924.00	33.67	H	1.6	31.62	-27.21	0.06	54.00	38.14	15.86
4924.00	33.80	V	1.5	31.62	-27.21	0.06	54.00	38.27	15.73

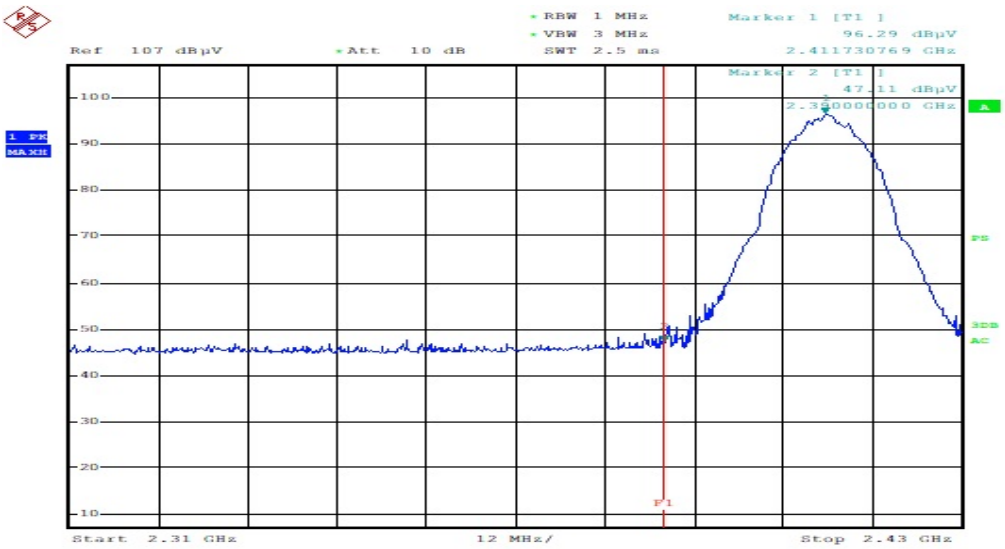
Remark	H : Horizontal, V : Vertical TEST MODE : 802.11 b - CH 11(2 462 MHz) *The TX signal wasn't detected from 3th harmonics. *Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position) *Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction *This test was radiated up to 26.5 GHz but no noise was measured.

10.4-6 Restricted Band Edges

*802.11b Mode

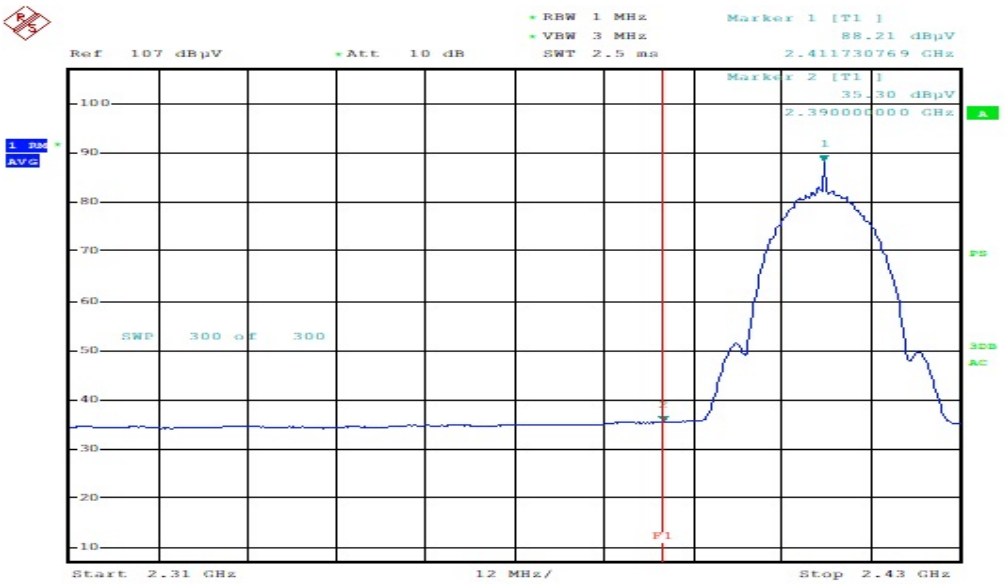
Band Edges(CH Low)

Detector mode:Peak Polarity:Horizontal



ESTR-21-00272

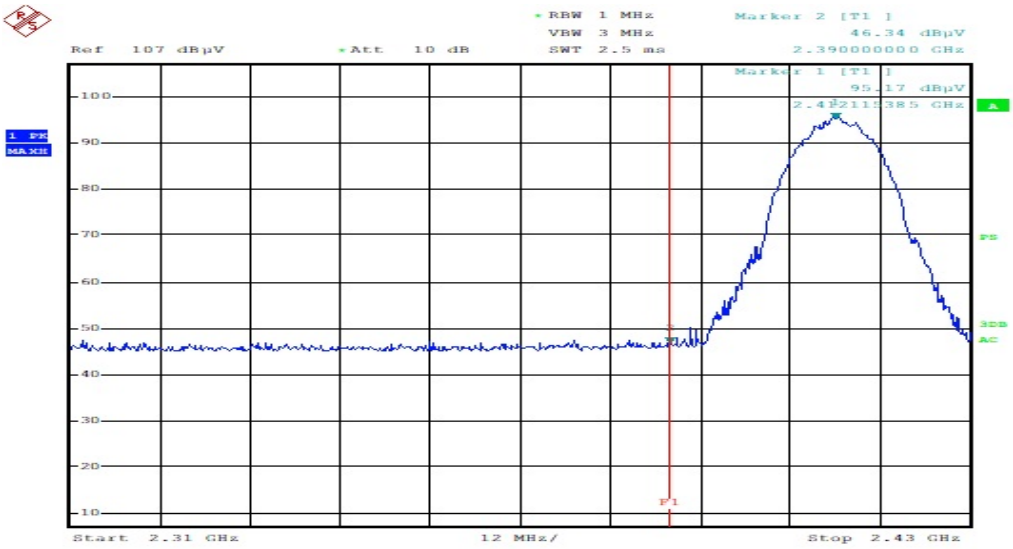
Detector mode:Average Polarity:Horizontal



ESTR-21-00272

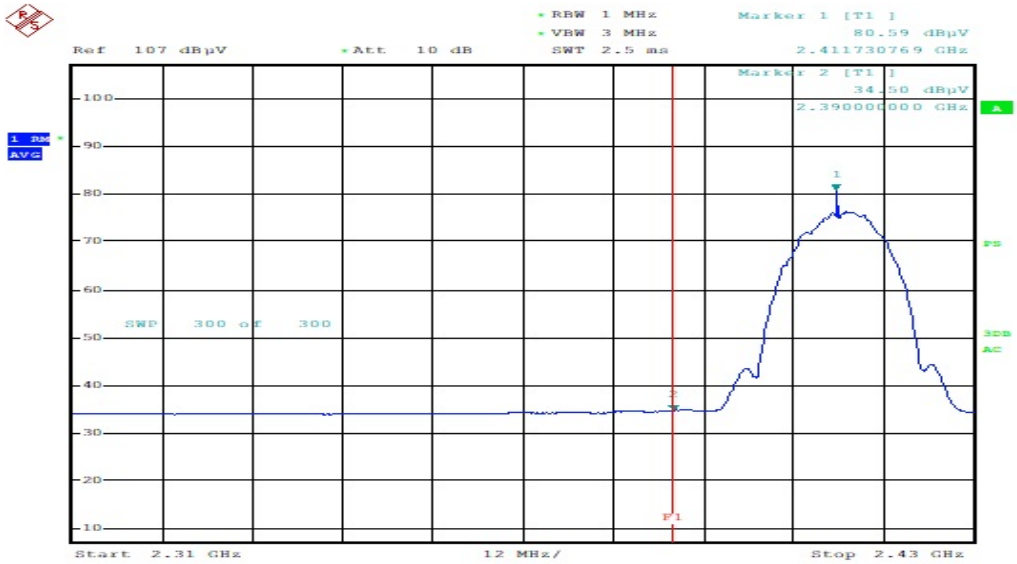
Band Edges(CH Low)

Detector mode:Peak Polarity:Vertical



ESTR-21-00272

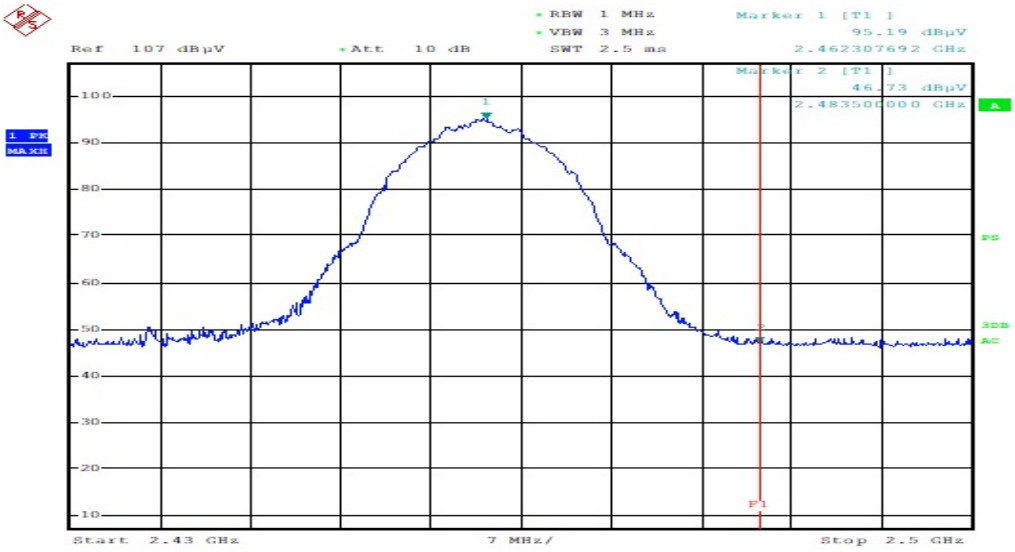
Detector mode:Average Polarity:Vertical



ESTR-21-00272

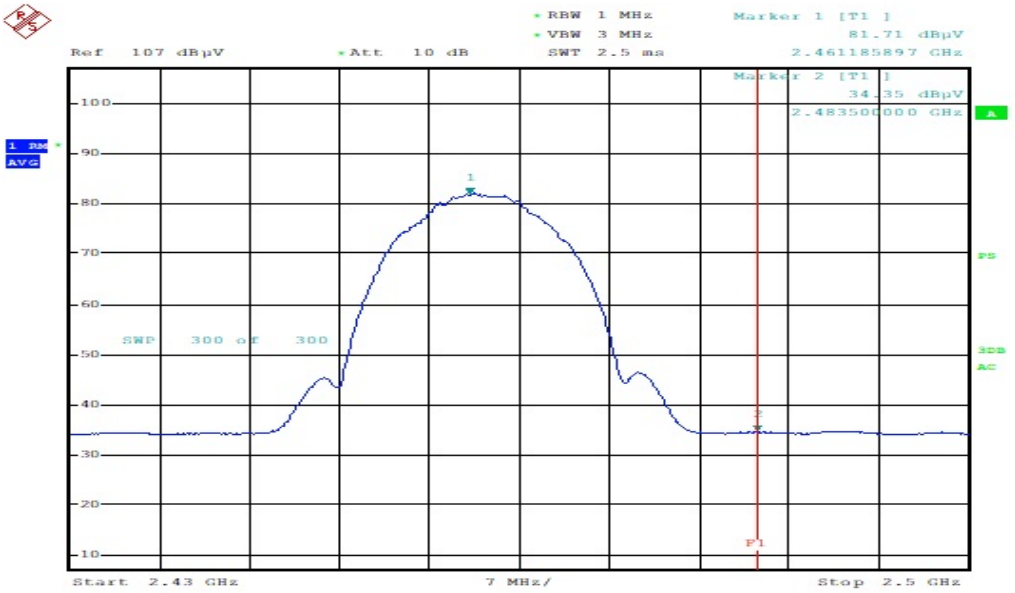
Band Edges(CH High)

Detector mode:Peak Polarity:Horizontal



ESTR-21-00272

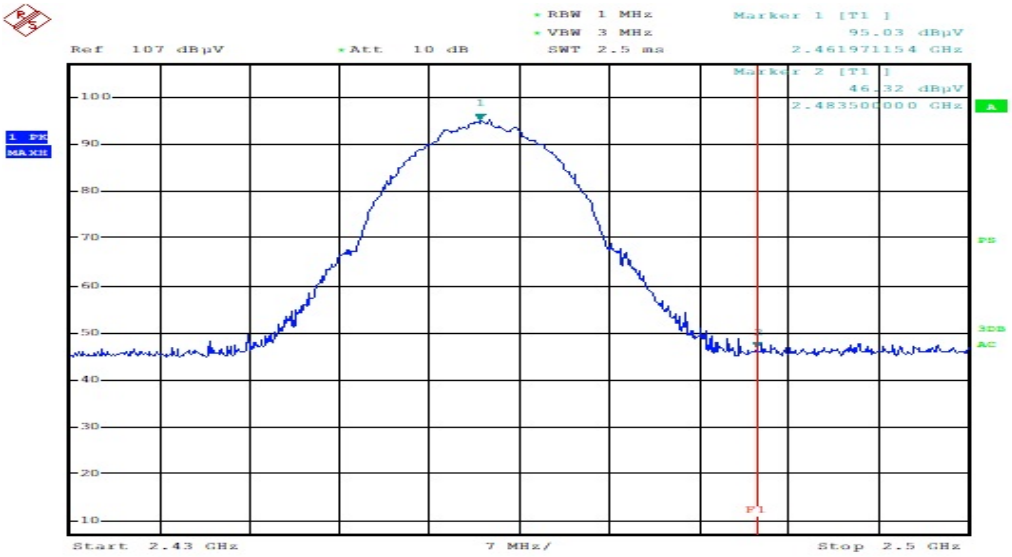
Detector mode:Average Polarity:Horizontal



ESTR-21-00272

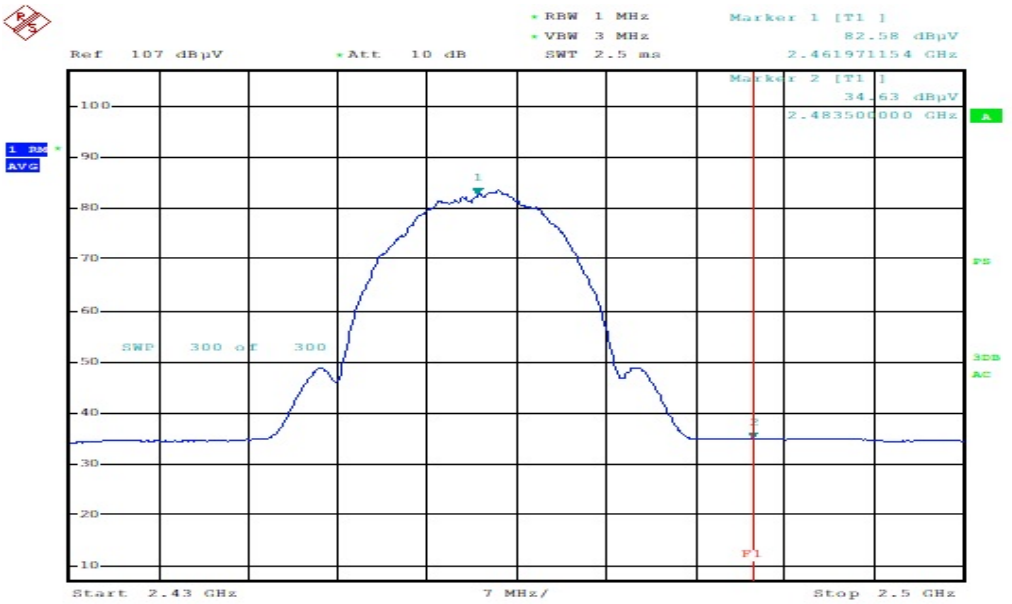
Band Edges(CH High)

Detector mode:Peak Polarity:Vertical



ESTR-21-00272

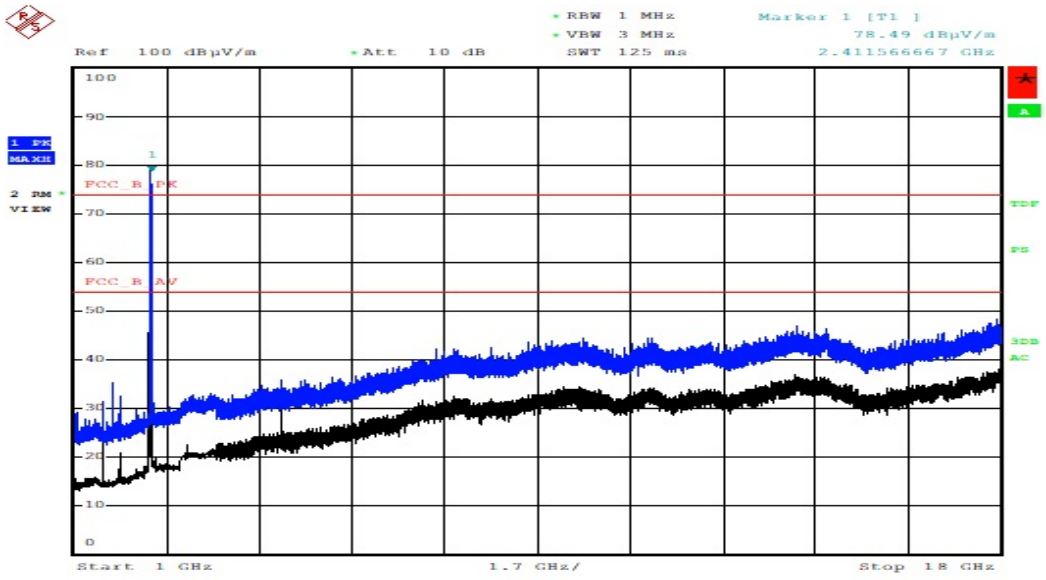
Detector mode:Average Polarity:Vertical



ESTR-21-00272

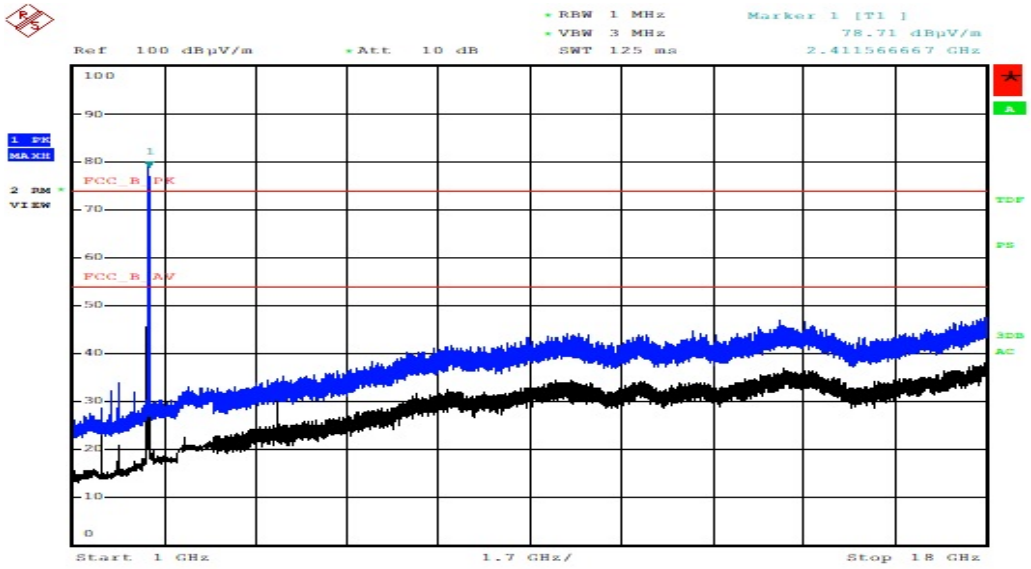
10.4-7 Restricted Band Edges

*802.11b Mode CH1 Polarity:Horizontal



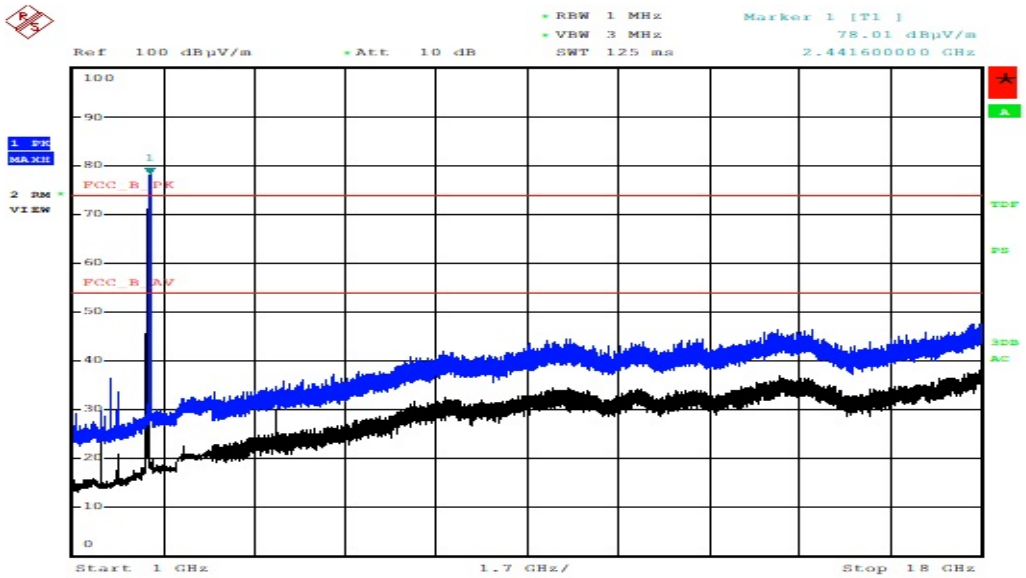
ESTR-21-00272

Polarity:Vertical



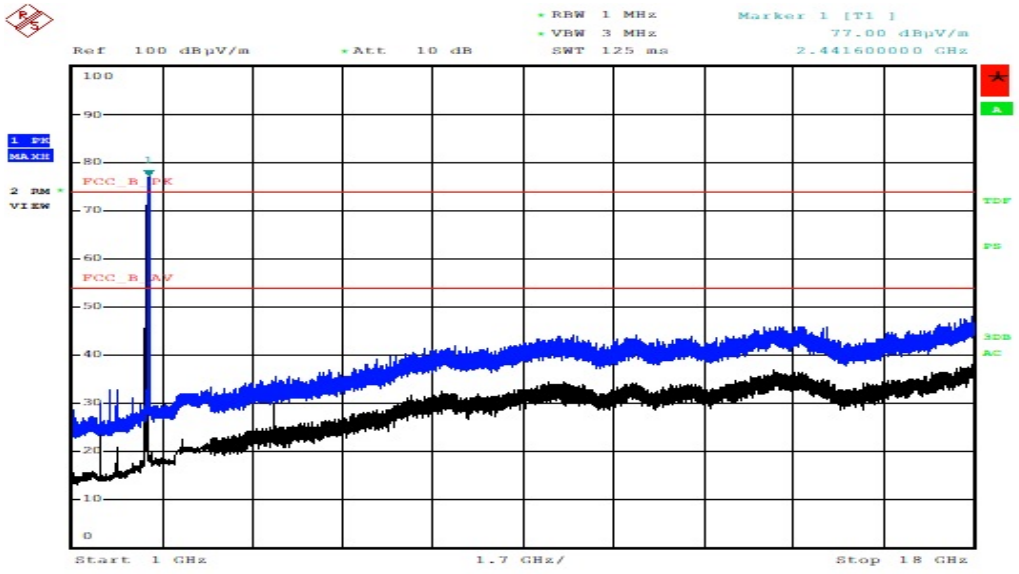
ESTR-21-00272

*802.11b Mode CH7 Polarity:Horizontal



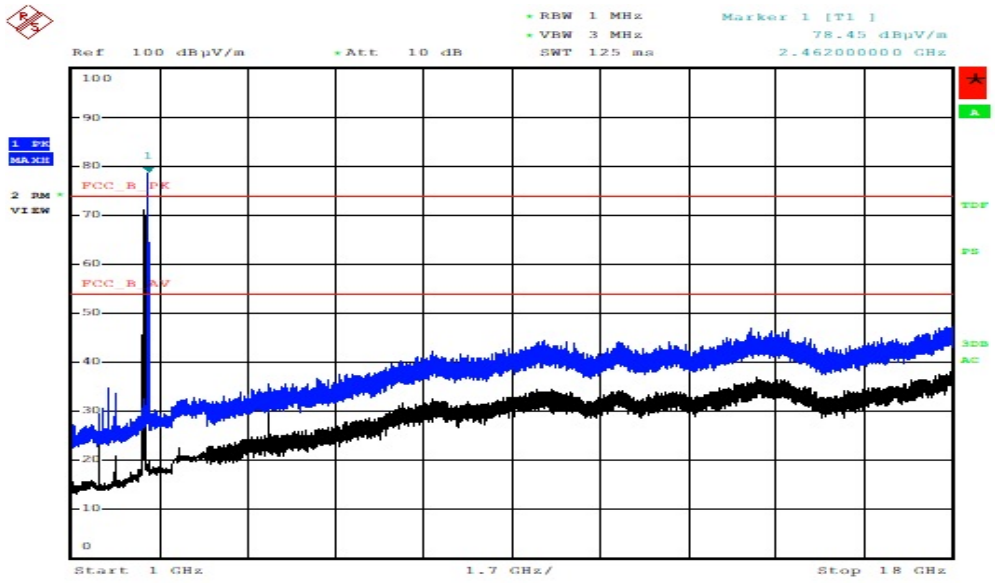
ESTR-21-00272

Polarity:Vertical



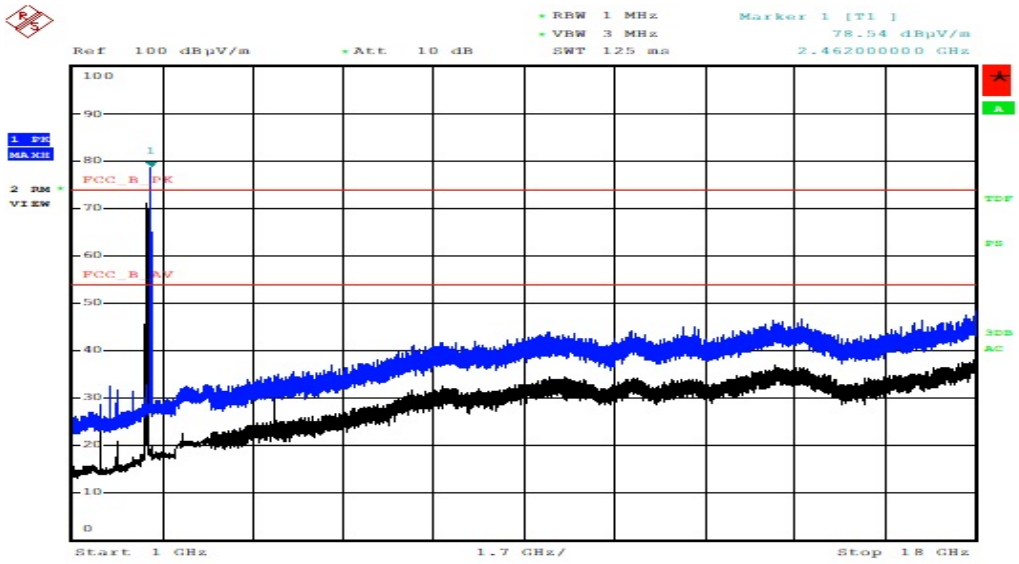
ESTR-21-00272

*802.11b Mode CH11 Polarity:Horizontal



ESTR-21-00272

Polarity:Vertical



ESTR-21-00272

10.4-8 Test Data (802.11 g)

Test Date : 1-Nov-21 Measurement Distance : 3 m

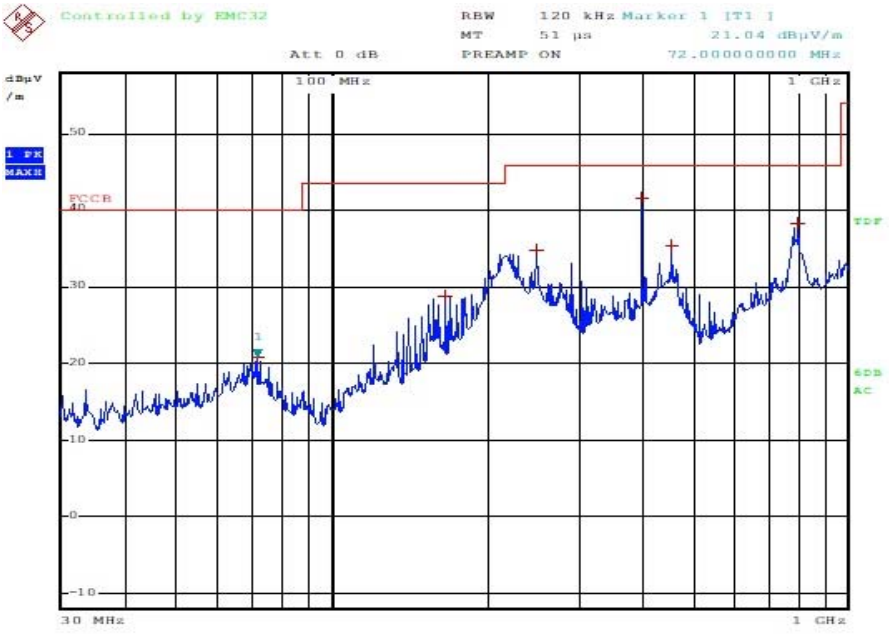
Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
213.20	15.93	V	1.8	13.41	0.91	43.50	30.25	13.25
249.70	21.92	H	1.6	11.85	1.11	46.00	34.88	11.12
400.00	31.43	H	1.4	9.10	1.21	46.00	41.74	4.26
456.00	23.55	V	1.6	12.14	1.57	46.00	37.26	8.74
797.10	21.90	H	1.0	14.00	2.48	46.00	38.38	7.62
972.00	8.00	V	1.7	24.30	4.72	54.00	37.01	16.99

Remark	H : Horizontal, V : Vertical *Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position) *CL = Cable Loss(In case of below 1 000 MHz) *Result Value = Reading + Ant Factor + Cable loss *The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection at frequency below 1 GHz.

10.4-9 radiated Graph(30 MHz ~ 1 GHz)

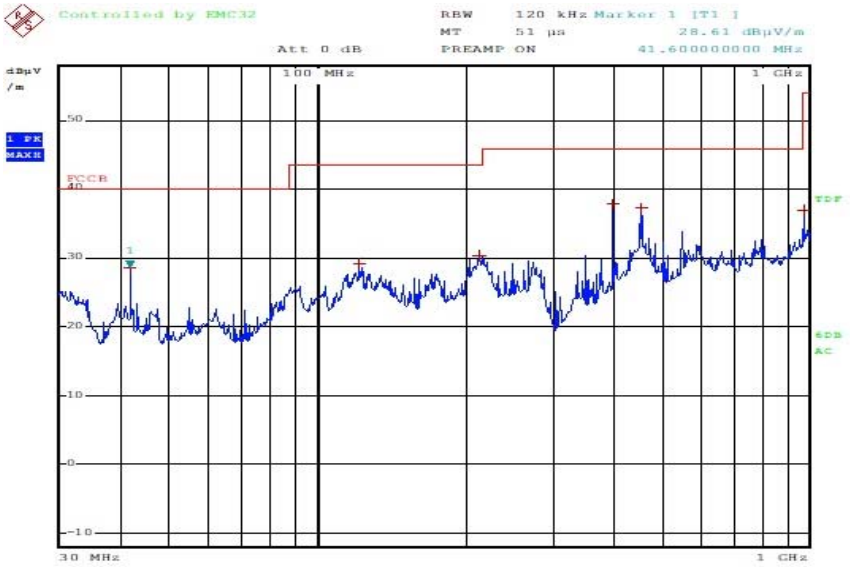
*802.11g Mode

Polarity:Horizontal



FS2-AWB

Polarity:Vertical



FS2-AWB

10.4-10 Test Data

Test Date : 16-Nov-21 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
2390.00	47.69	H	1.5	27.89	-29.82		74.00	45.76	28.24
2390.00	45.96	V	1.6	27.89	-29.82		74.00	44.03	29.97
4824.00	46.13	H	1.5	31.52	-27.27		74.00	50.38	23.62
4824.00	45.95	V	1.6	31.52	-27.27		74.00	50.20	23.80
AV(RBW: 1 MHz VBW: 3 MHz)									
2390.00	34.78	H	1.5	27.89	-29.82	0.21	54.00	33.06	20.94
2390.00	34.78	V	1.6	27.89	-29.82	0.21	54.00	33.06	20.94
4824.00	33.75	H	1.5	31.52	-27.27	0.21	54.00	38.21	15.79
4824.00	33.80	V	1.6	31.52	-27.27	0.21	54.00	38.26	15.74

Remark	H : Horizontal, V : Vertical TEST MODE : 802.11g - CH 1(2 412 MHz) *The TX signal wasn't detected from 3th harmonics. *Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position) *Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction *This test was radiated up to 26.5 GHz but no noise was measured.

10.4-11 Test Data

Test Date : 16-Nov-21 Measurement Distance : 3 m

Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
4884.00	46.32	H	1.5	31.58	-27.23		74.00	50.67	23.33
4884.00	46.21	V	1.5	31.58	-27.23		74.00	50.56	23.44
AV(RBW: 1 MHz VBW: 3 MHz)									
4884.00	35.19	H	1.5	31.58	-27.23	0.21	54.00	39.75	14.25
4884.00	35.34	V	1.6	31.58	-27.23	0.21	54.00	39.90	14.10

Remark	H : Horizontal, V : Vertical TEST MODE : 802.11g - CH 7(2 442 MHz) *The TX signal wasn't detected from 3th harmonics. *Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position) *Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction *This test was radiated up to 26.5 GHz but no noise was measured.

10.4-12 Test Data

Test Date : 16-Nov-21 Measurement Distance : 3 m

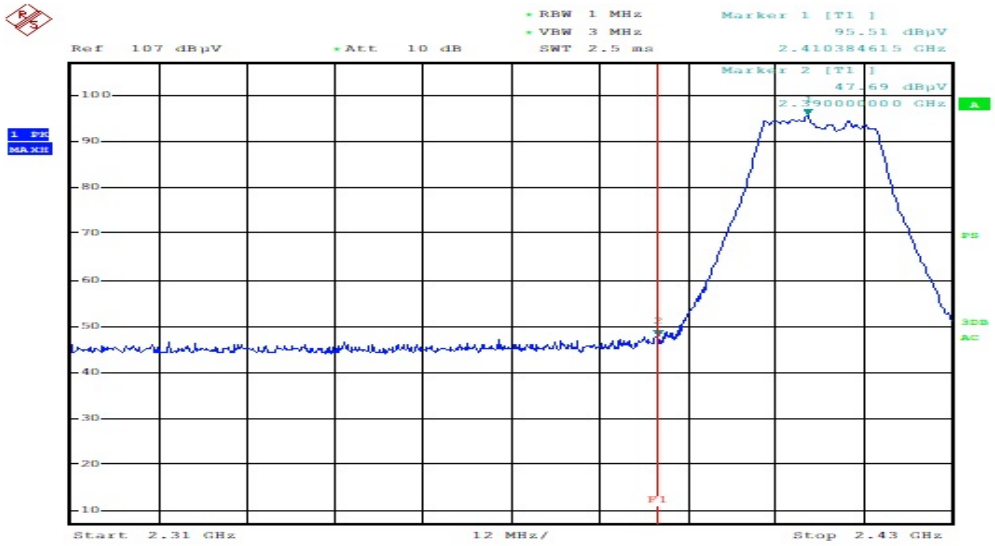
Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
2483.50	46.03	H	1.6	27.48	-29.75		74.00	43.76	30.24
2483.50	46.36	V	1.5	27.48	-29.75		74.00	44.09	29.91
4924.00	45.67	H	1.6	31.62	-27.21		74.00	50.08	23.92
4924.00	45.80	V	1.5	31.62	-27.21		74.00	50.21	23.79
AV(RBW: 1 MHz VBW: 3 MHz)									
2483.50	34.61	H	1.6	27.50	-29.75	0.21	54.00	32.57	21.43
2483.50	34.67	V	1.5	27.50	-29.75	0.21	54.00	32.63	21.37
4924.00	33.59	H	1.6	31.62	-27.21	0.21	54.00	38.21	15.79
4924.00	33.87	V	1.5	31.62	-27.21	0.21	54.00	38.49	15.51

Remark	H : Horizontal, V : Vertical TEST MODE : 802.11g - CH 11(2 462 MHz) *The TX signal wasn't detected from 3th harmonics. *Checked in all 3 axis and the maximum measured data were reported.(Worst data is Z axis of position) *Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction *This test was radiated up to 26.5 GHz but no noise was measured.

10.4-13 Restricted Band Edges
*802.11g Mode

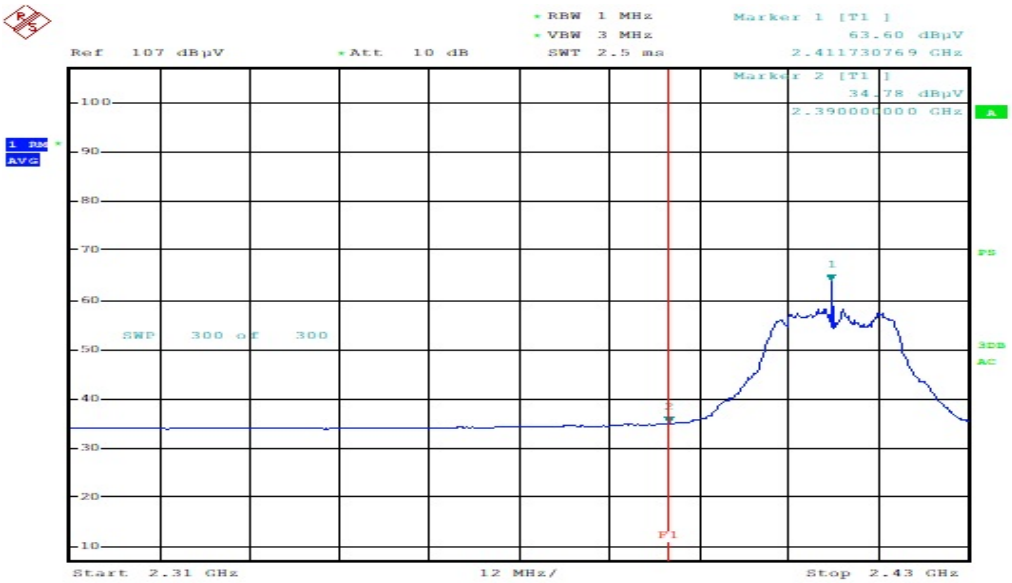
Band Edges(CH Low)

Detector mode:Peak Polarity:Horizontal



ESTR-21-00272

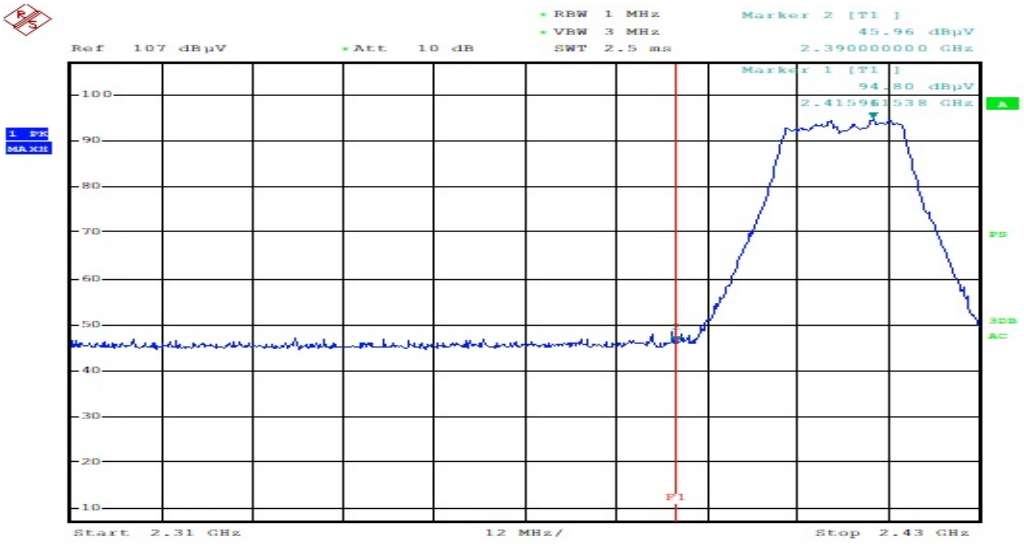
Detector mode:Average Polarity:Horizontal



ESTR-21-00272

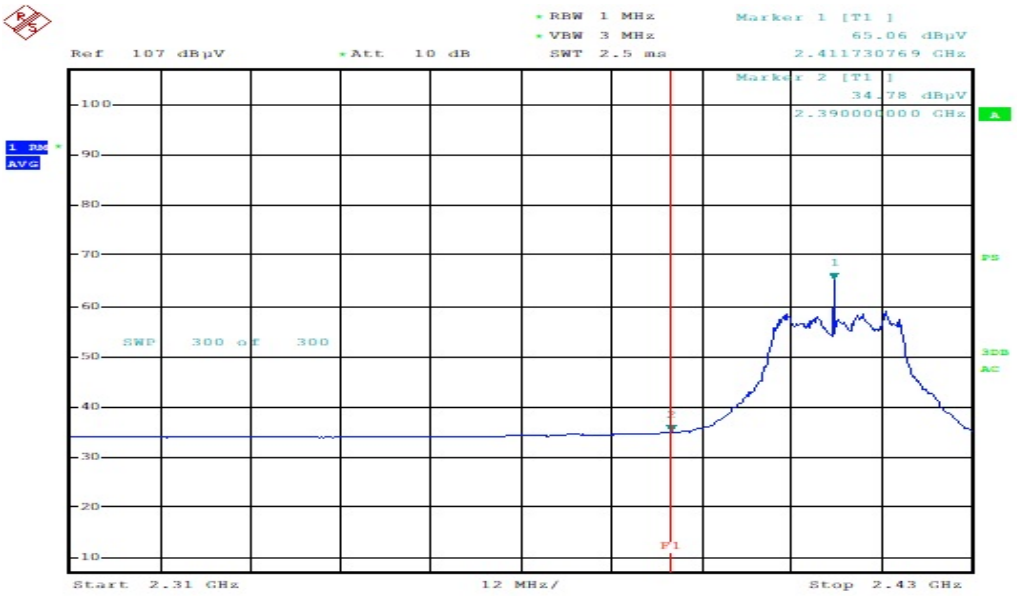
Band Edges(CH Low)

Detector mode:Peak Polarity:Vertical



ESTR-21-00272

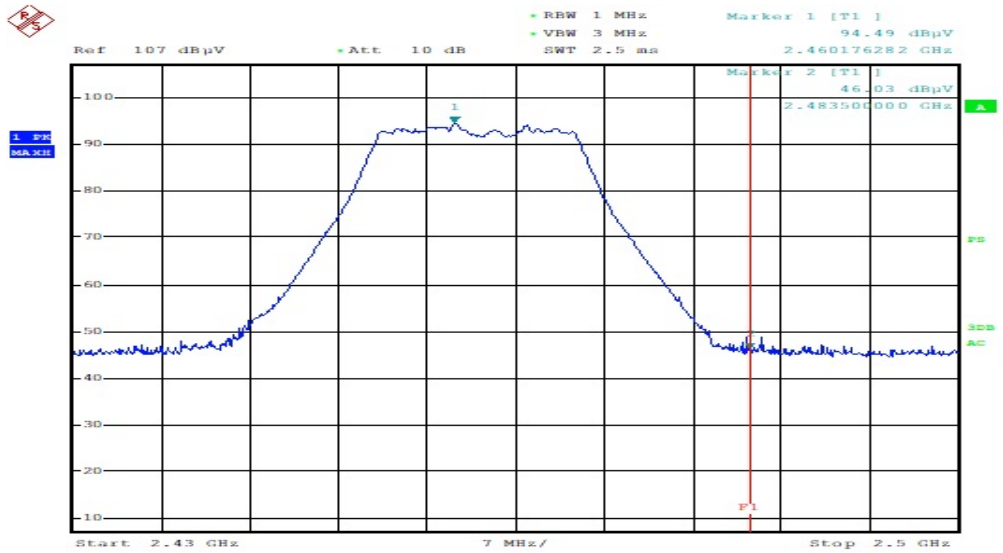
Detector mode:Average Polarity:Vertical



ESTR-21-00272

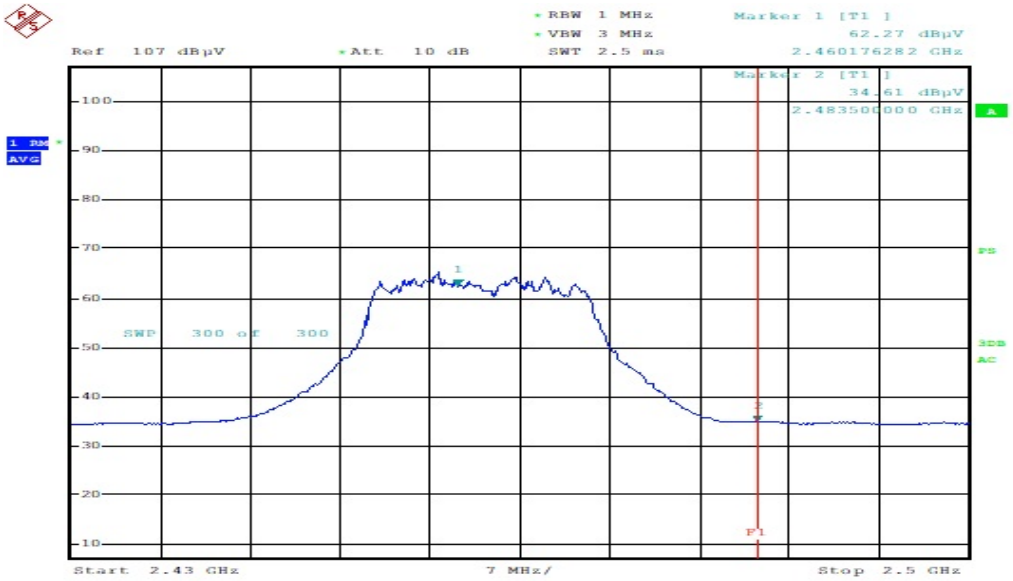
Band Edges(CH High)

Detector mode:Peak Polarity:Horizontal



ESTR-21-00272

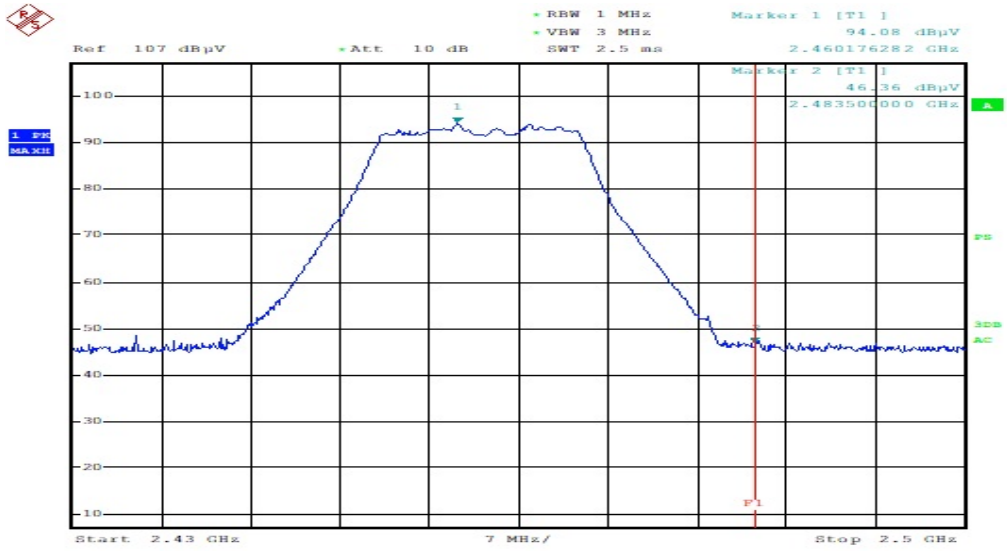
Detector mode:Average Polarity:Horizontal



ESTR-21-00272

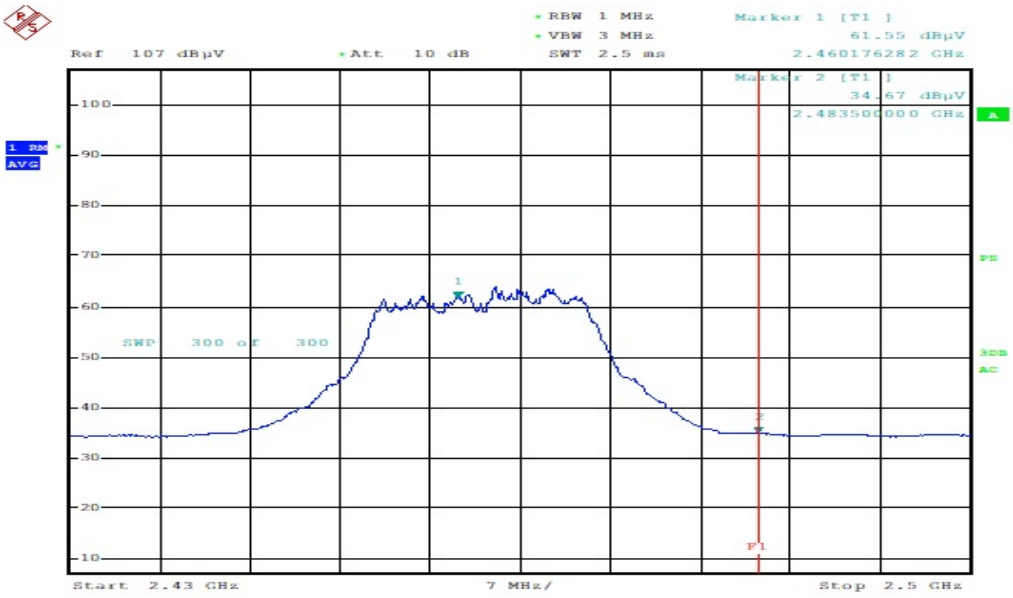
Band Edges(CH High)

Detector mode:Peak Polarity:Vertical



ESTR-21-00272

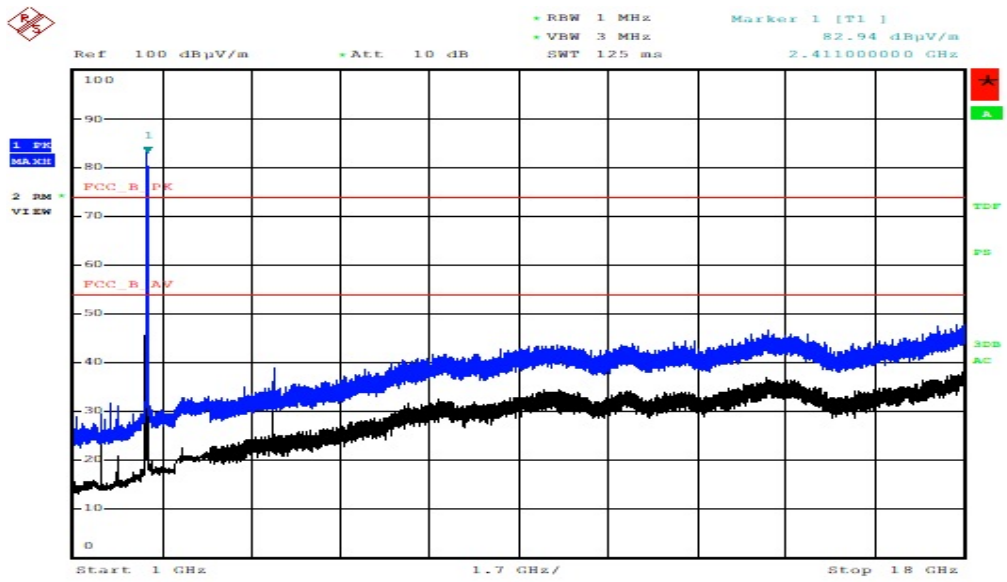
Detector mode:Average Polarity:Vertical



ESTR-21-00272

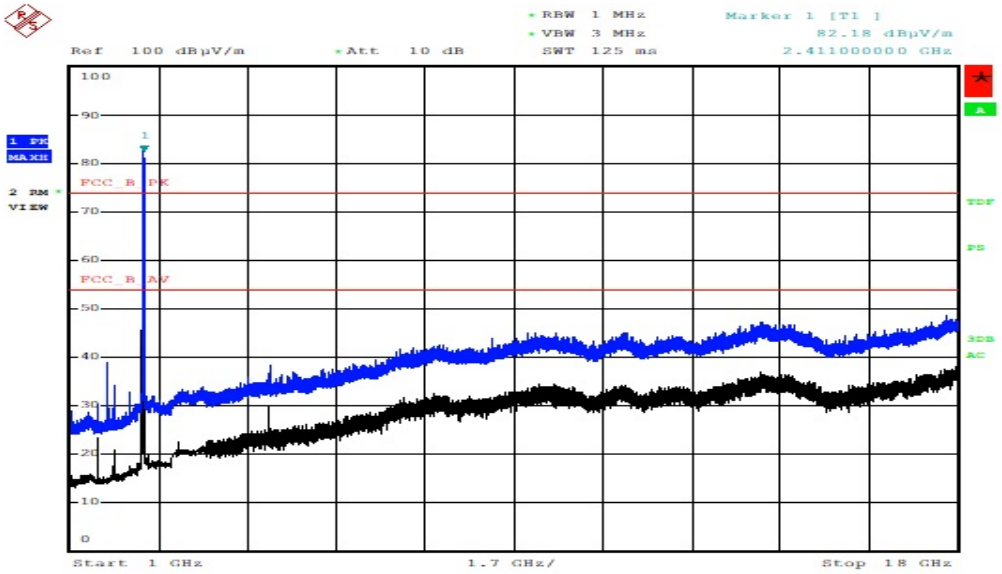
10.4-14 Restricted Band Edges

*802.11g Mode CH1 Polarity:Horizontal



ESTR-21-00272

Polarity:Vertical



ESTR-21-00272