

Test Report for FCC

FCC ID :2A2Q8-HH-930

Report Number		ESTRFC2109-006		
Applicant	Company name	HicareNet Inc.		
	Address	28, Wiryeseong-daero 22-gil, Songpa-gu, Seoul, South Korea		
	Telephone	+82-02-3400-7127		
	Contact person	Chang Yoon Lee		
Product	Product name	Hicare Hub		
	Factory address	28, Wiryeseong-daero 22-gil, Songpa-gu, Seoul, South Korea		
	Model No.	HH-930	Manufacturer	HicareNet Inc.
	Serial No.	NONE	Country of origin	KOREA
Test date	06-Sep-21 ~ 14-Sep-21		Date of issue	15-Sep-21
Testing location	140-16, Eongmalli-ro, Majang-myeon, Icheon-si, Gyeonggi-do, 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 is dependent on only equipment to be used - 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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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 : 347-69, Jungbu-daero 147beon-gil, Majang-myeon, Icheon-si,
Gyeonggi-do 467-811, R. O. Korea

1.3 Official Qualification(s)

MSIP : Granted Accreditation from Ministry of Information & Communication for EMC, Safety
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, MCS7
Number of Channel	:	11 ch
PEAK Output Power	:	4.8 dBm
Rating	:	Input:AC 100 V ~ 240 V 50/60 Hz 0.8 A Output:DC 5 V 3 A
Receipt Date	:	19-Jul-21
X-tal list(s) or Frequencies generated	:	The highest operating frequency is 2 462 MHz

2.2 General descriptions of EUT

Category	Specification
Main MCU	ESP32 (WiFi, BT 내장)
– MCU	Single core 32 bit Microprocessor
	448 KB ROM
	520 KB SRAM
	4MB FLASH Memory
– Peripheral Interface	34 x Programmable GPIOs
	4 x SPI
	2 x I2C
	3 x UART
– WiFi	802. 11 b/g/n
	802.11 n(2.4GHz) up to 150Mbps
– BT	Compliant with Bluetooth v4.2 BDR/EDR and
	BLE Specification
	+12 dBm Transmitting power
	NZIF receiver with –94 dBm BLE sensitivity
USB Controller	USB2412
– Client	2 Ports

Category	Specification
- Function	Table fast charging mode (1.5 A)
	(USB Host Mode)
USB Host	STM32 USB Host
-USB Host	Modem
-LAN	WiFi AP
-WAN	PPP-PSTN Modem
F/W Download	(OTA) Download
Power	AC Adapter (5V/3A)
Dimension (WDH)	280x130x25(88) mm

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

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 devices 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 methods apply to the measurement of individual units or systems comprised

Summary of Test Results

Applied Standard : 47 CFR Part 15 Subpart C				remark
Standard	Test Type	Result	Remark	Limit
15.207	AC Power Conducted Emission	Pass		
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 output 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(2 437 MHz), High(2 462 MHz)

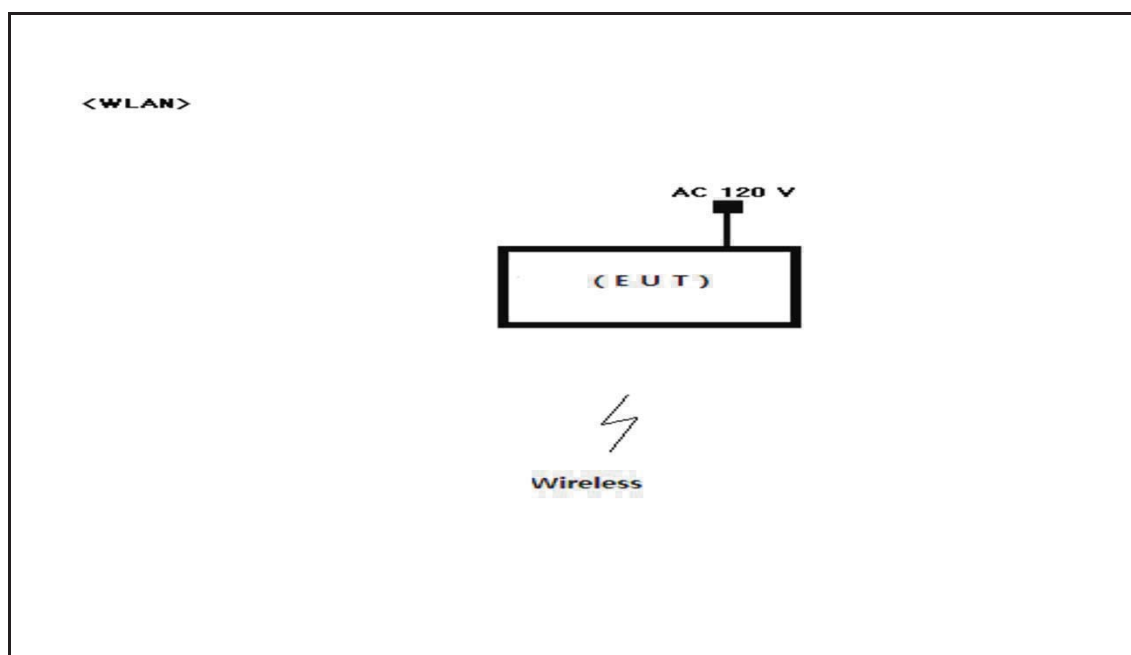
c. Test Mode : Continuous Output, CCK, OFDM

d. Test rate : 11 Mbps, 54 Mbps, Mcs7

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)
Hicare Hub	HH-930	NONE	HicareNet Inc.	EUT
Adapter	SAW30-050-3000U	NONE	VLL POWER	

4.5 Cable Connecting

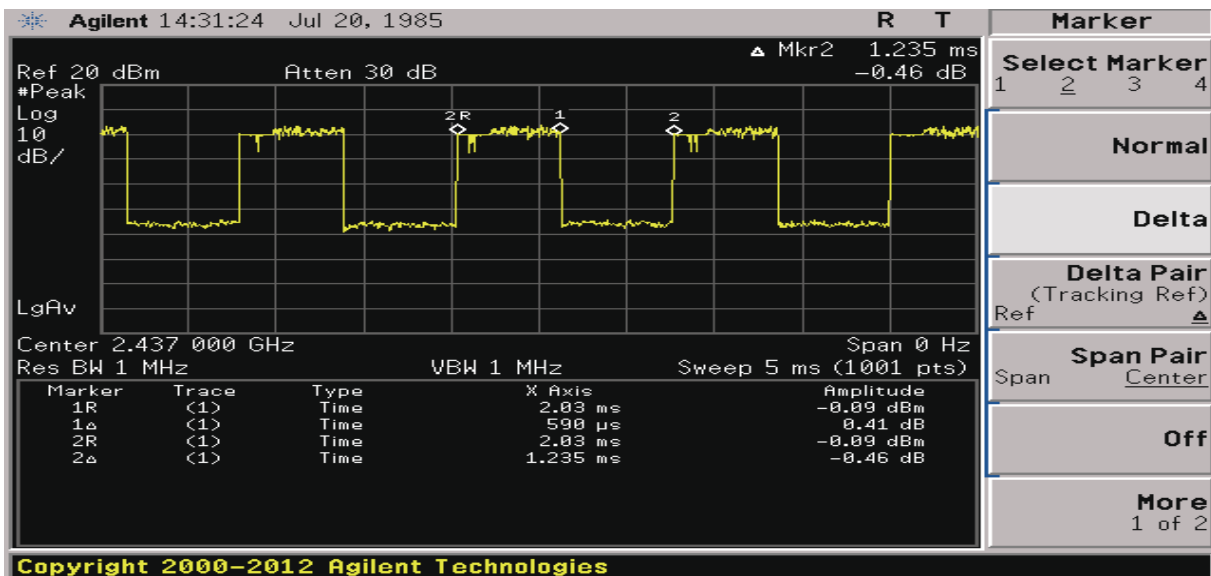
Start Equipment		End Equipment		Cable Standard		Remark
Name	I/O port	Name	I/O port	Length	Shielded	
Hicare Hub	Power	Adapter	–	2.0	Unshielded	

4.6 DUTY CYCLE OF TEST SIGNAL

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

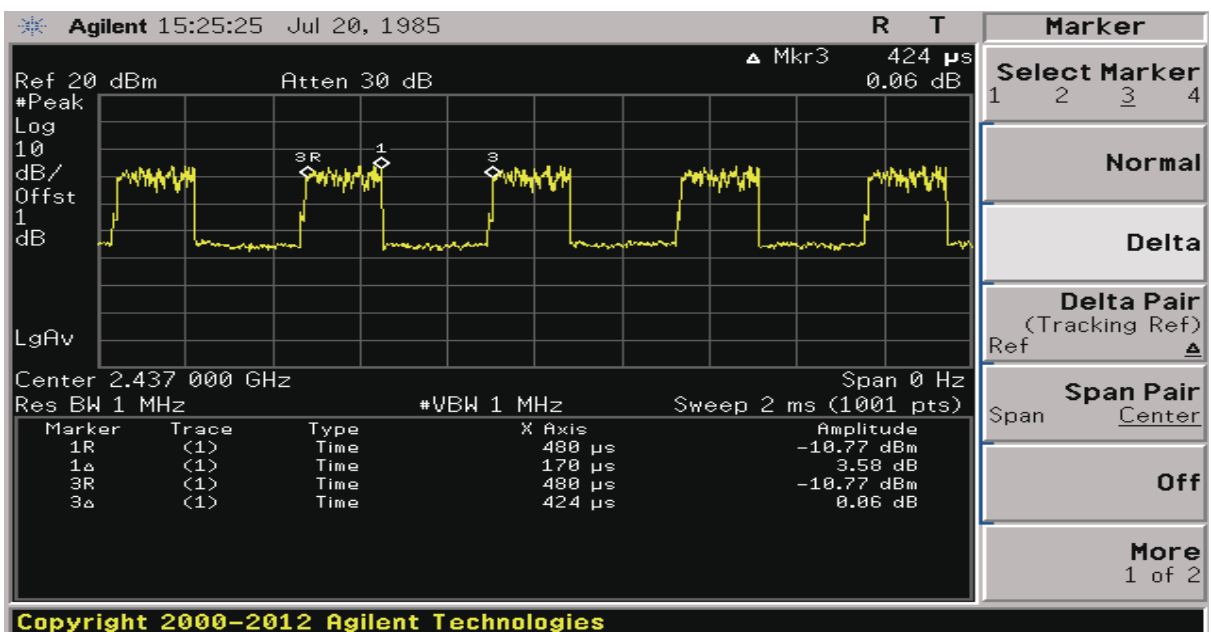
802.11b

duty cycle = 47.7 % , duty factor = $10 \cdot \log(1/0.477) = 3.214$



802.11g

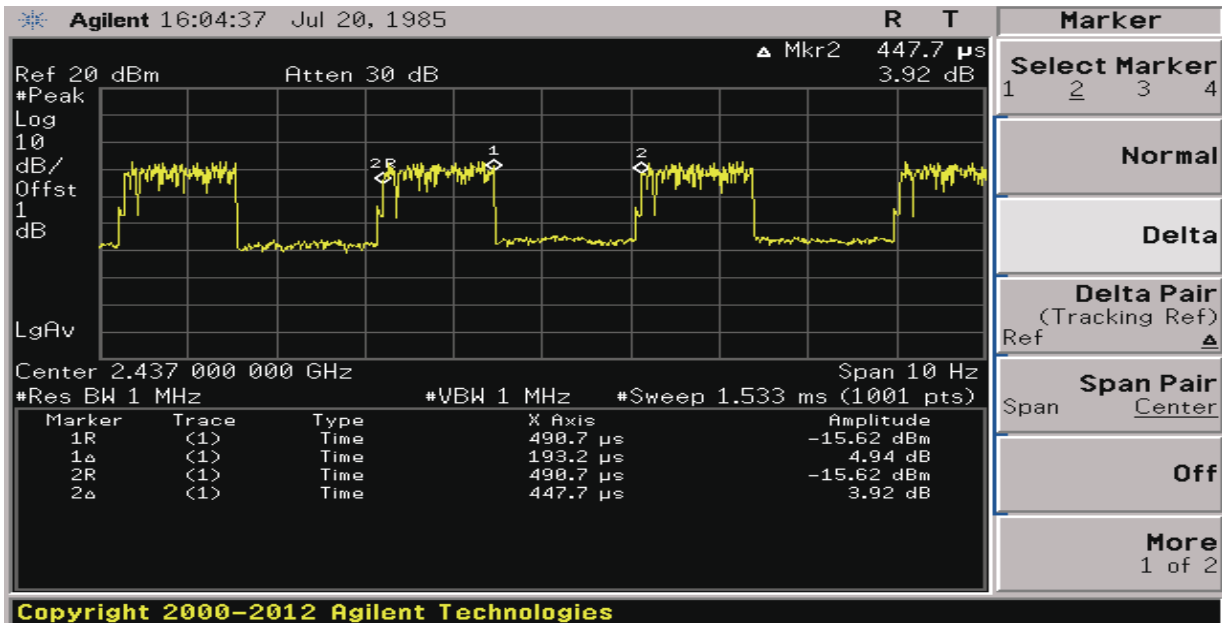
duty cycle = 40.1 % , duty factor = $10 \cdot \log(1/0.401) = 3.968$



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

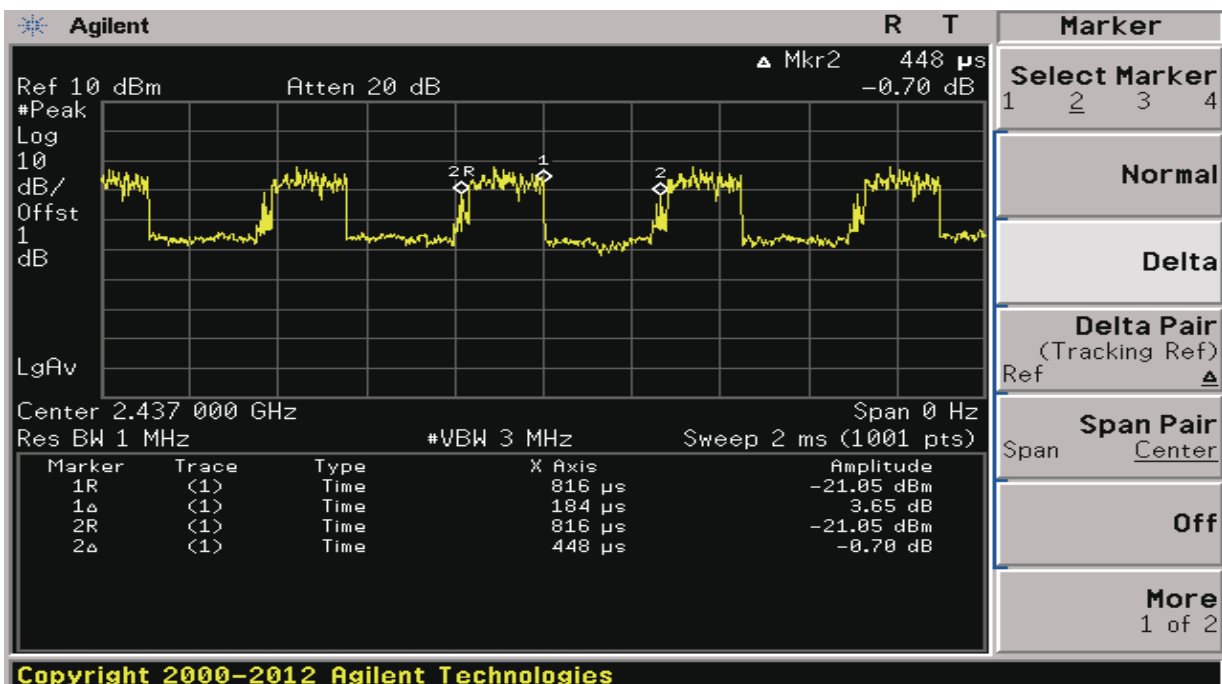
802.11n20

duty cycle = 43.1 % , duty factor = $10 \cdot \log(1/0.431) = 3.655$



802.11n40

duty cycle = 41.0 % , duty factor = $10 \cdot \log(1/0.41) = 3.872$



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 $\geq 3 \times$ 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 $\geq 3 \times$ 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 $\Leftrightarrow$ EUT	Loss: 1.0 dB	–	

5.3 Measurement results

EUT	Hicare Hub	MODEL	HH-930
MODE	802.11b, g, n20, n40	ENVIRONMENTAL CONDITION	23.0 °C, 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	13.05	9.22	0.5	PASS
2 437	13.03	10.07	0.5	PASS
2 462	12.90	9.50	0.5	PASS

MODE – 802.11g

Channel Frequency (MHz)	Emission bandwidth (MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2 412	16.71	16.53	0.5	PASS
2 437	16.64	16.51	0.5	PASS
2 462	16.61	16.51	0.5	PASS

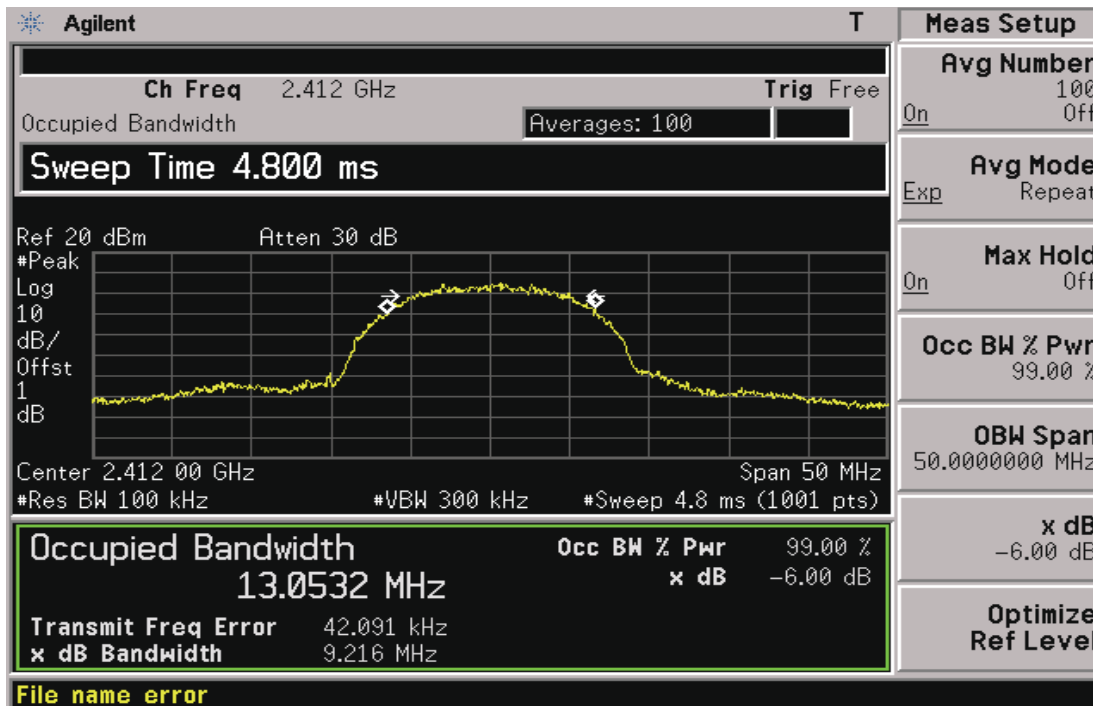
MODE – 802.11n20

Channel Frequency (MHz)	Emission bandwidth (MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2 412	17.69	17.77	0.5	PASS
2 437	17.62	17.67	0.5	PASS
2 462	17.64	17.76	0.5	PASS

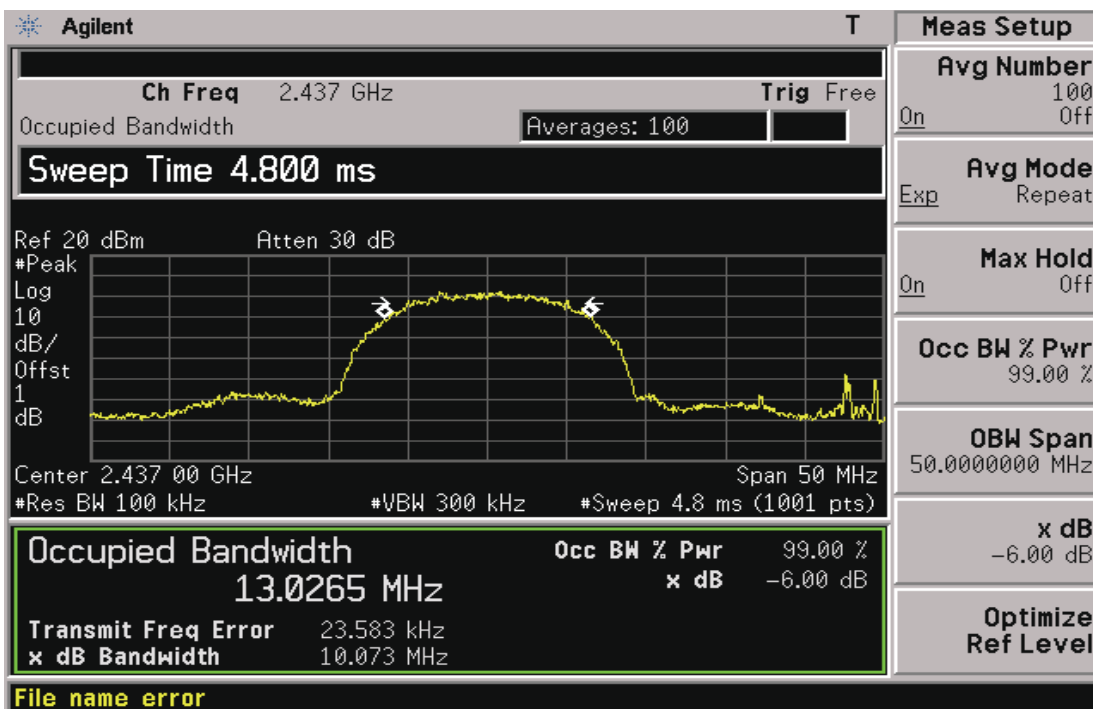
MODE – 802.11n40

Channel Frequency (MHz)	Emission bandwidth (MHz)	Bandwidth at 6dB below(MHz)	Minimum Limit (MHz)	PASS/FAIL
2 422	36.31	36.50	0.5	PASS
2 437	36.28	36.48	0.5	PASS
2 462	36.29	36.46	0.5	PASS

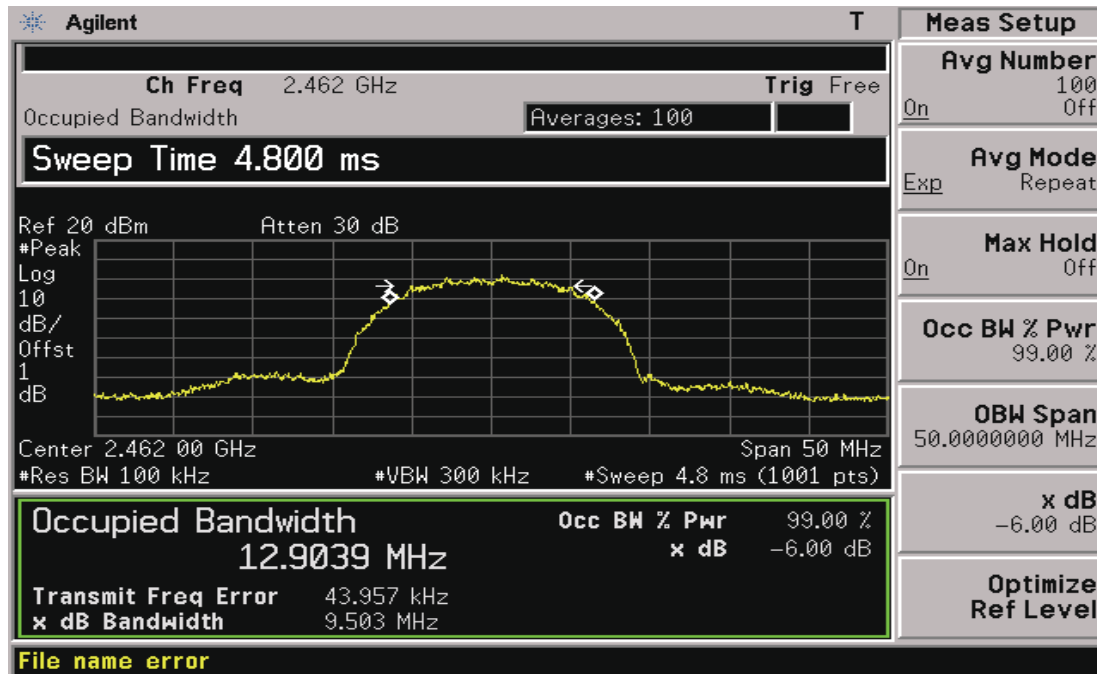
5.4 Trace data – 802.11b (ch_1)



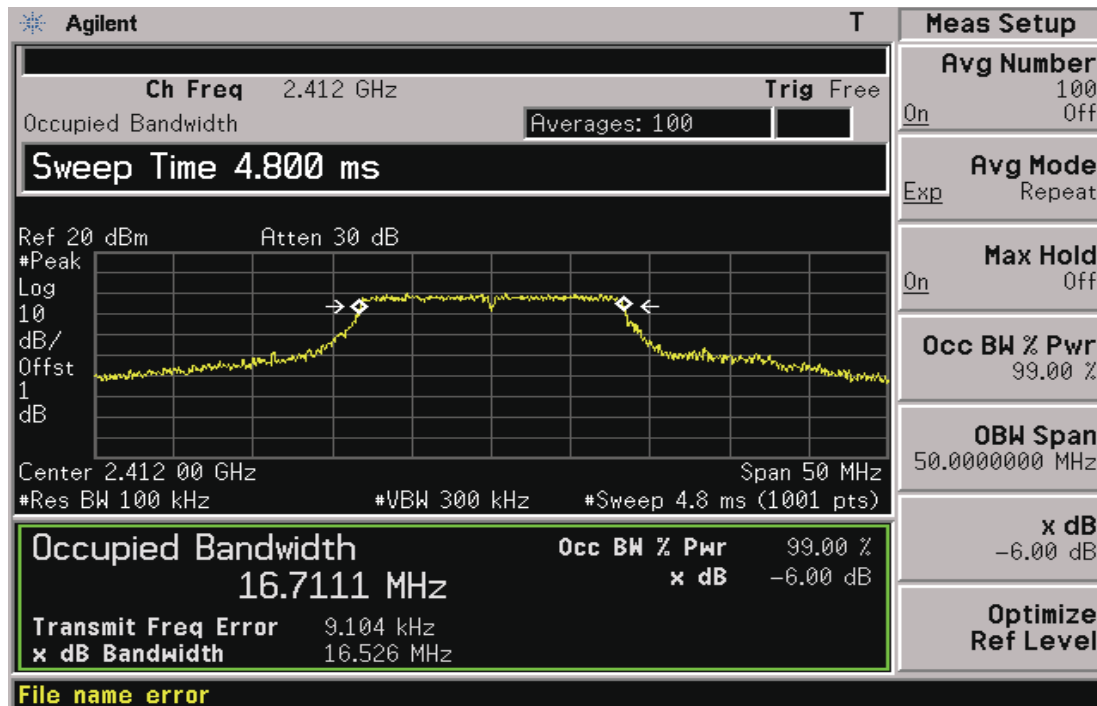
(ch_6)



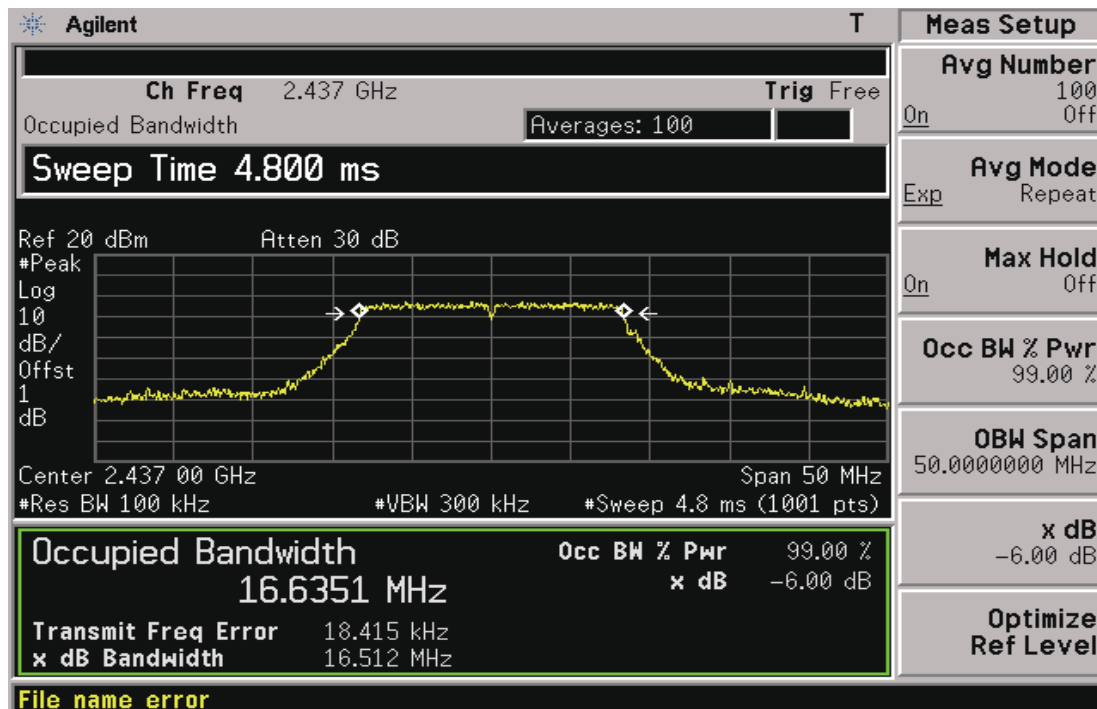
(ch_11)



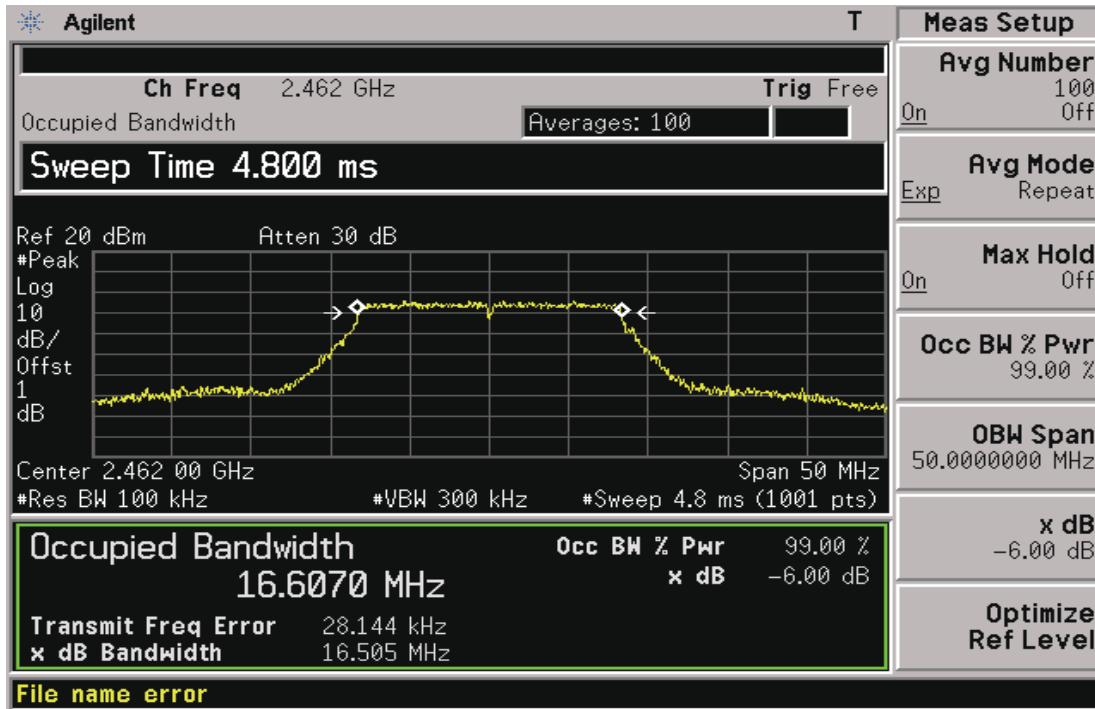
5.4 Trace data – 802.11g (ch_1)



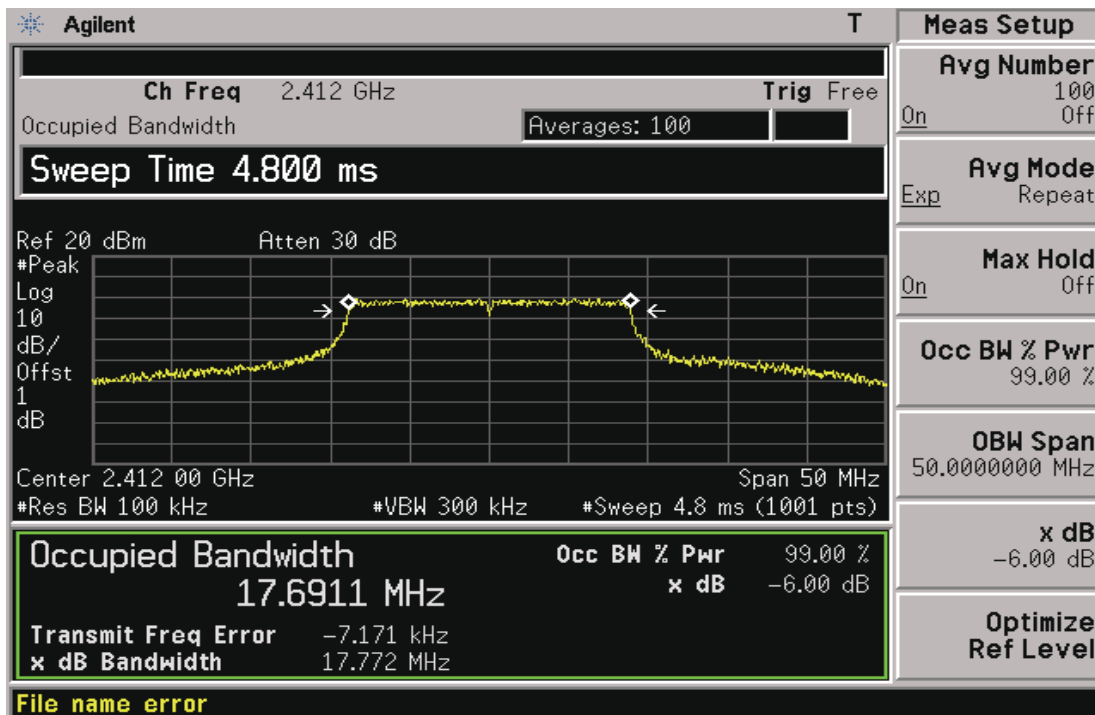
(ch_6)



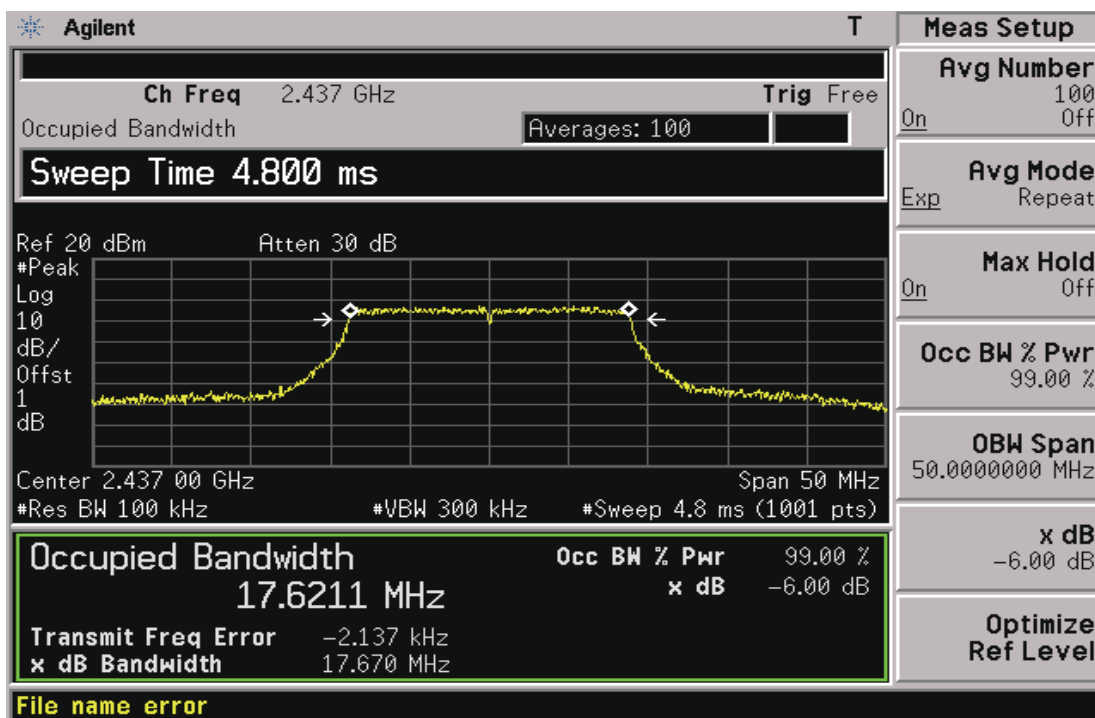
(ch_11)



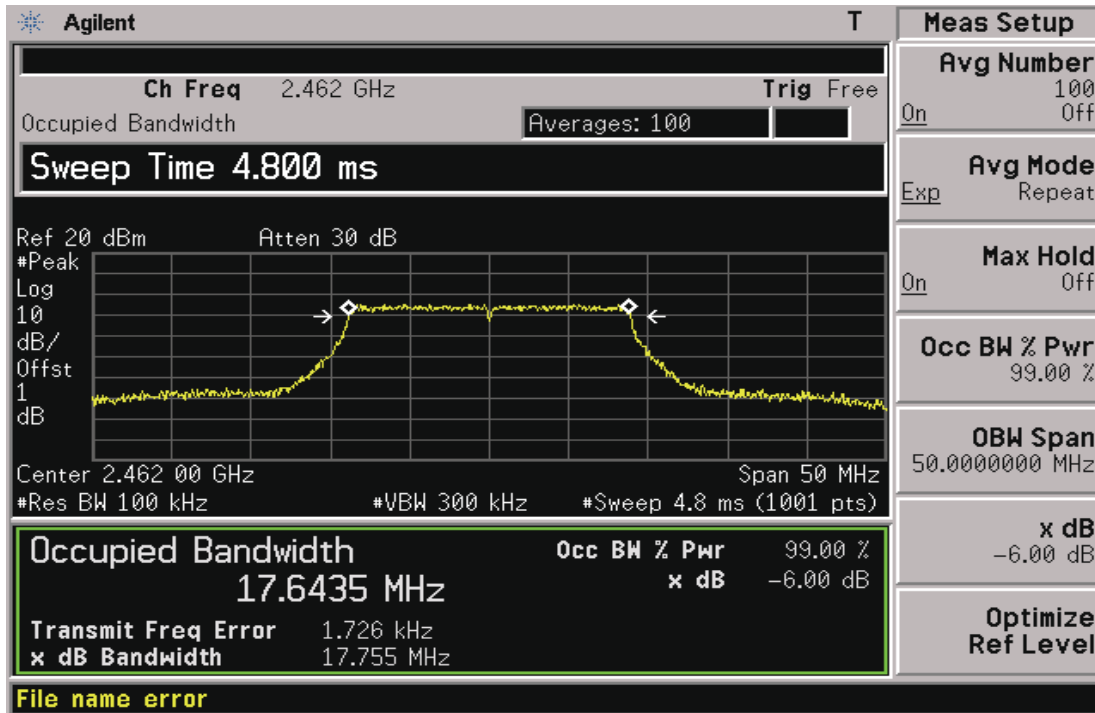
5.4 Trace data – 802.11n20 (ch_1)



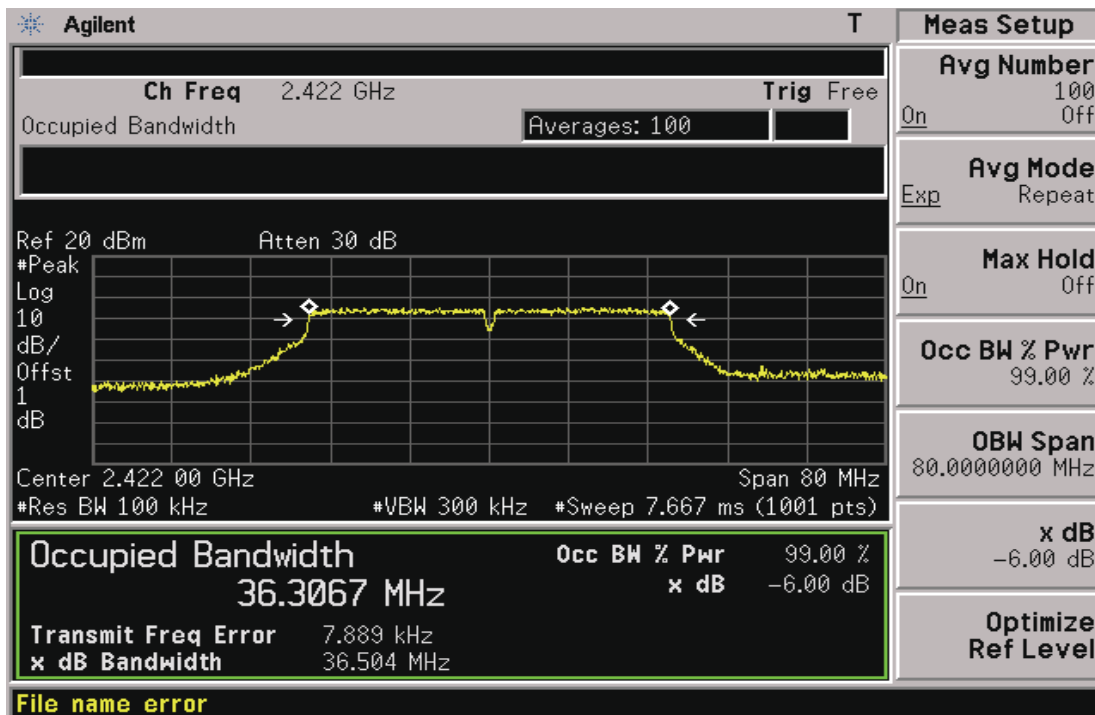
(ch_6)



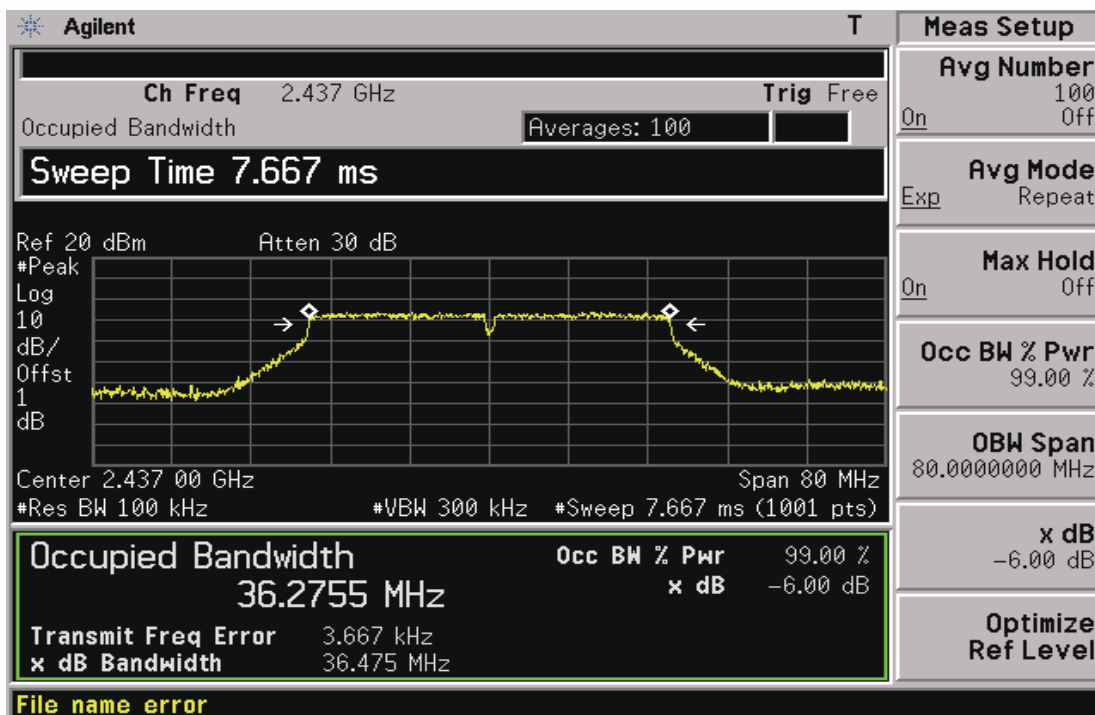
(ch_11)



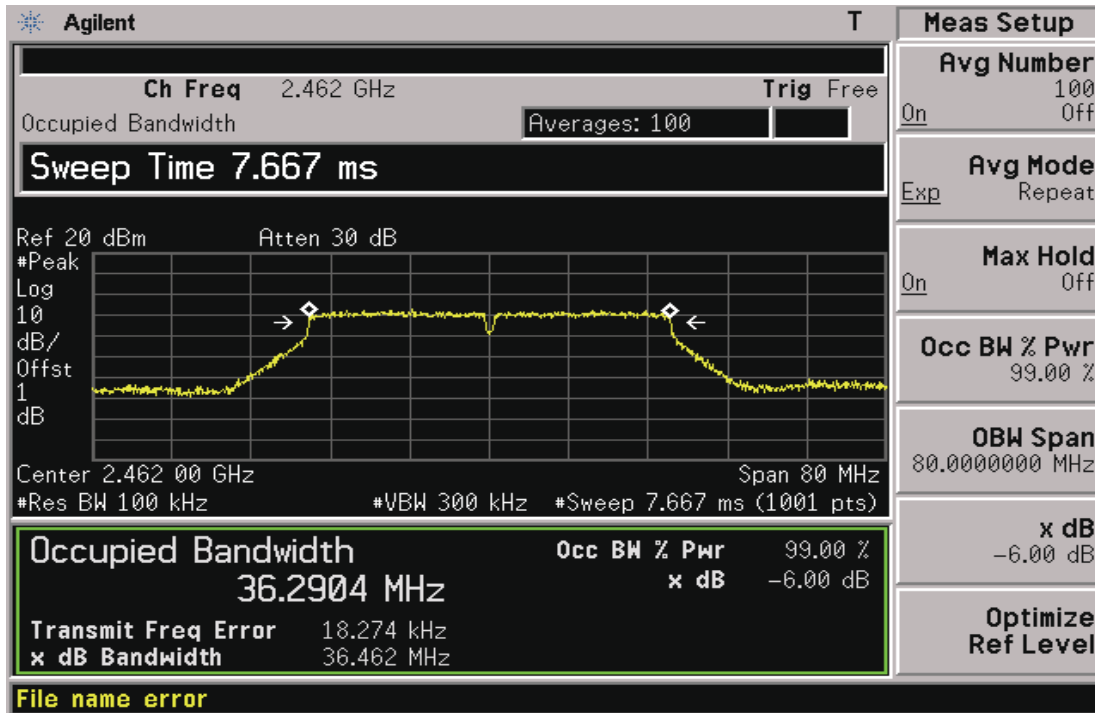
5.4 Trace data – 802.11n40 (ch_3)



(ch_6)



(ch_11)



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	Hicare Hub	MODEL	HH-930
MODE	802.11b, g, n20, n40	ENVIRONMENTAL CONDITION	23.0 °C, 47.0 % R.H.
INPUT POWER	DC 24.0 V		

MODE – 802.11b

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(W)		
1	2 412	PEAK	13.57	0.0228	30.0	PASS
6	2 437	PEAK	11.87	0.0154	30.0	PASS
11	2 462	PEAK	10.52	0.0113	30.0	PASS

MODE – 802.11g

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(W)		
1	2 412	PEAK	15.33	0.0341	30.0	PASS
6	2 437	PEAK	14.41	0.0276	30.0	PASS
11	2 462	PEAK	12.58	0.0181	30.0	PASS

MODE – 802.11n20

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(W)		
1	2 412	PEAK	15.90	0.0389	30.0	PASS
6	2 437	PEAK	15.00	0.0316	30.0	PASS
11	2 462	PEAK	13.19	0.0208	30.0	PASS

MODE – 802.11n40

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Limit[1W] (dBm)	PASS/FAIL
		Detector	(dBm)	(W)		
3	2 422	PEAK	15.25	0.0335	30.0	PASS
6	2 437	PEAK	14.57	0.0286	30.0	PASS
11	2 462	PEAK	12.85	0.0193	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	Hicare Hub	MODEL	HH-930
MODE	802.11b, g, n20, n40	ENVIRONMENTAL CONDITION	23.0 °C, 47.0 % R.H.
INPUT POWER	DC 24.0 V		

MODE – 802.11b

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(W)
		Detector	(dBm)	Duty Cycle		
1	2 412	AVG	6.99	3.21	10.20	0.0105
6	2 437	AVG	5.64	3.21	8.85	0.0077
11	2 462	AVG	3.93	3.21	7.14	0.0052

MODE – 802.11g

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(W)
		Detector	(dBm)	Duty Cycle		
1	2 412	AVG	5.55	3.97	9.52	0.0090
6	2 437	AVG	3.97	3.97	7.94	0.0062
11	2 462	AVG	2.24	3.97	6.21	0.0042

MODE – 802.11n20

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(W)
		Detector	(dBm)	Duty Cycle		
1	2 412	AVG	5.69	3.66	9.34	0.0086
6	2 437	AVG	4.66	3.66	8.31	0.0068
11	2 462	AVG	2.87	3.66	6.52	0.0045

MODE – 802.11n40

CHANNEL	Channel frequency (MHz)	Conducted Power Output(dBm)			Measured + Duty Cycle(dBm)	Measured + Duty Cycle(W)
		Detector	(dBm)	Duty Cycle		
3	2 422	AVG	5.28	3.87	9.15	0.0082
6	2 437	AVG	4.55	3.87	8.42	0.0070
11	2 462	AVG	6.99	3.87	10.86	0.0122

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: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$.
- 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	–	
Spectrum Analyzer <=> EUT	Loss: 1.0 dB	–	

8.3 Measurement results

EUT	Hicare Hub	MODEL	HH-930
MODE	802.11b, g, n20, n40	ENVIRONMENTAL CONDITION	22.0 °C, 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	–10.06	8.00	18.06
6	2 437	–12.40	8.00	20.40
11	2 462	–14.09	8.00	22.09

MODE – 802.11g

CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
1	2 412	–13.08	8.00	21.08
6	2 437	–16.01	8.00	24.01
11	2 462	–17.29	8.00	25.29

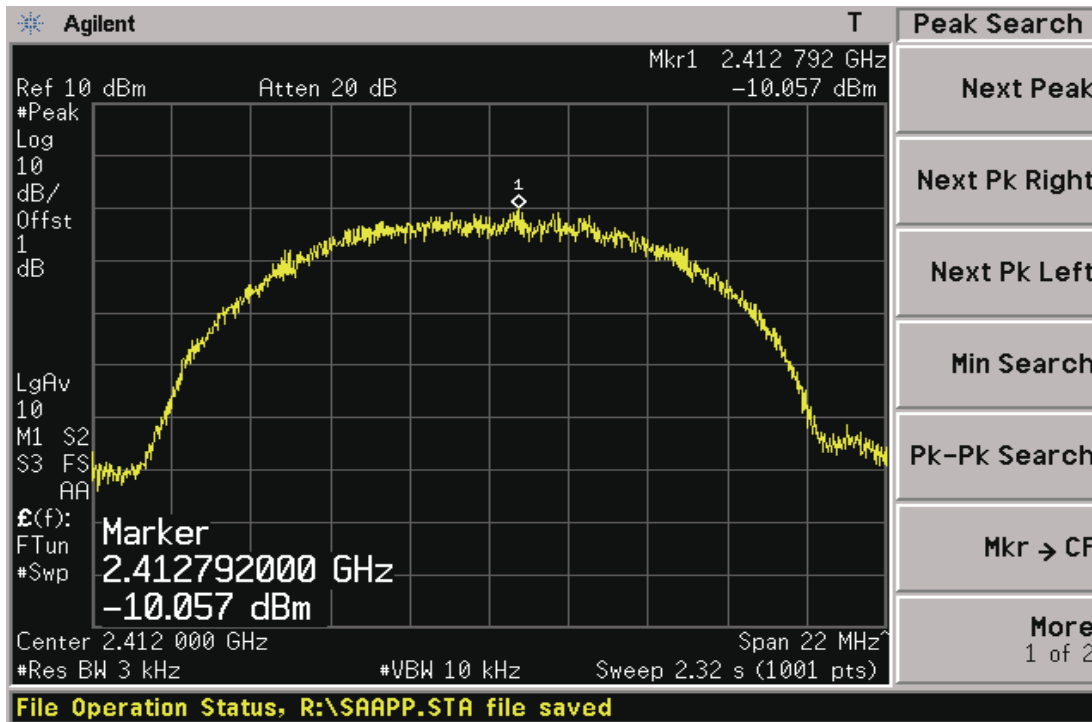
MODE – 802.11n20

CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
1	2 412	-14.97	8.00	22.97
6	2 437	-17.37	8.00	25.37
11	2 462	-17.77	8.00	25.77

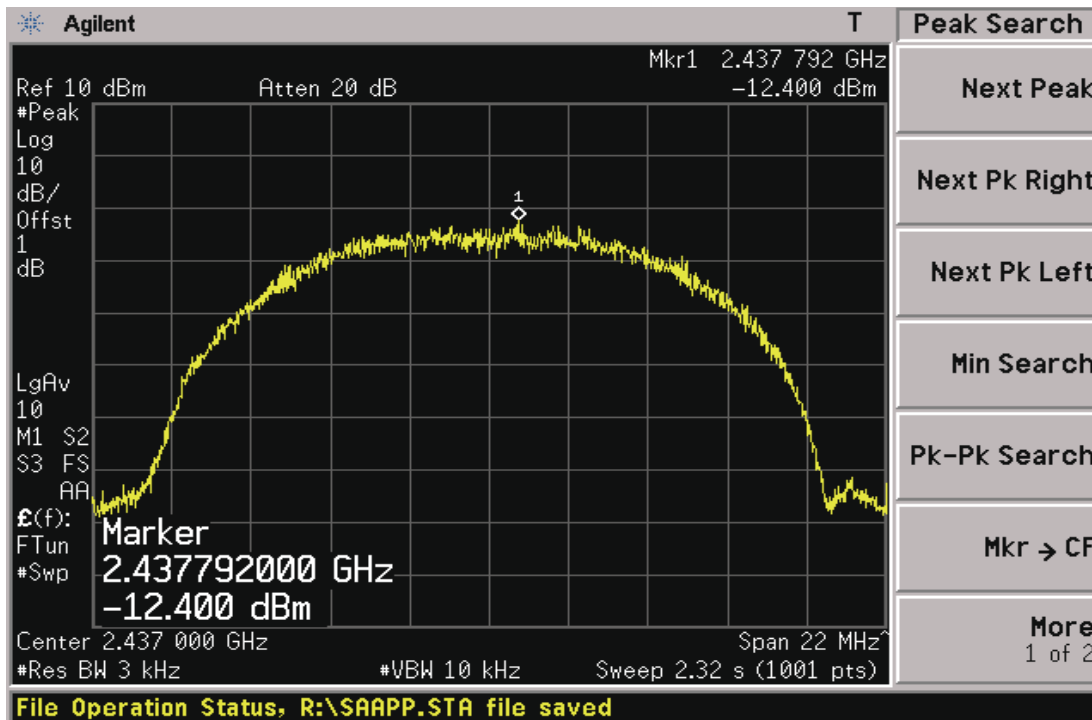
MODE – 802.11n40

CHANNEL	Channel Frequency (MHz)	Measured Power Spectral Density (dBm)	Maximum Permissible Power Density (dBm/3kHz)	Margin
3	2 422	-17.41	8.00	25.41
6	2 437	-19.20	8.00	27.20
11	2 462	-21.13	8.00	29.13

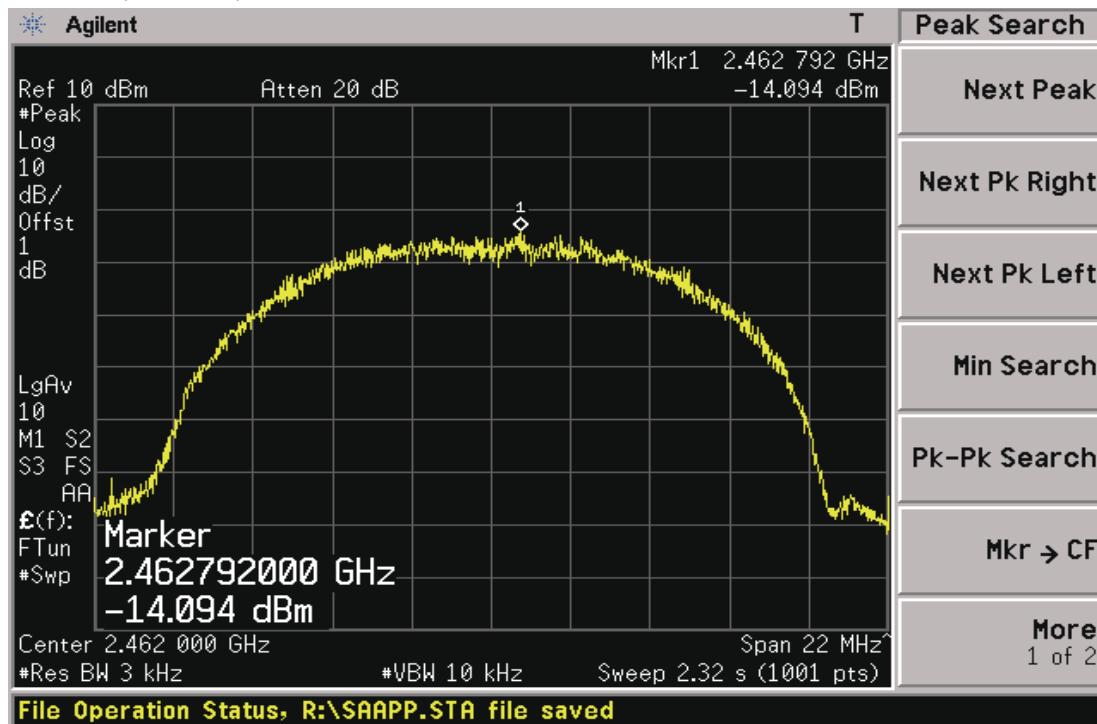
8.4 Trace data – 802.11b mode (ch_1)



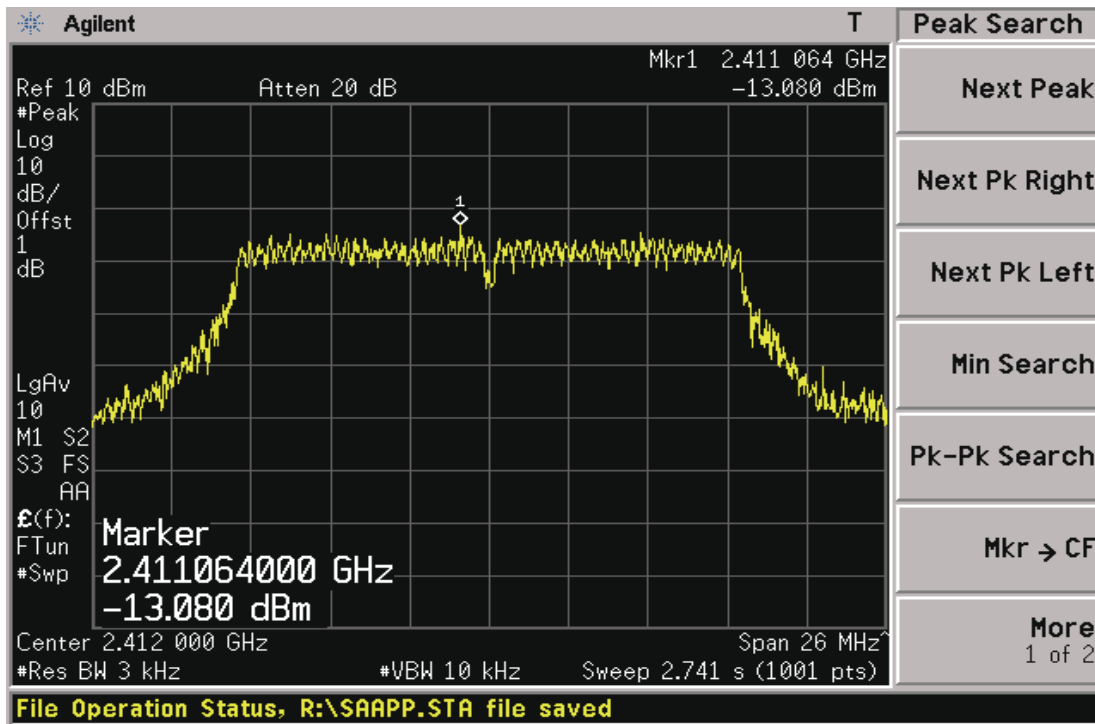
(ch_6)



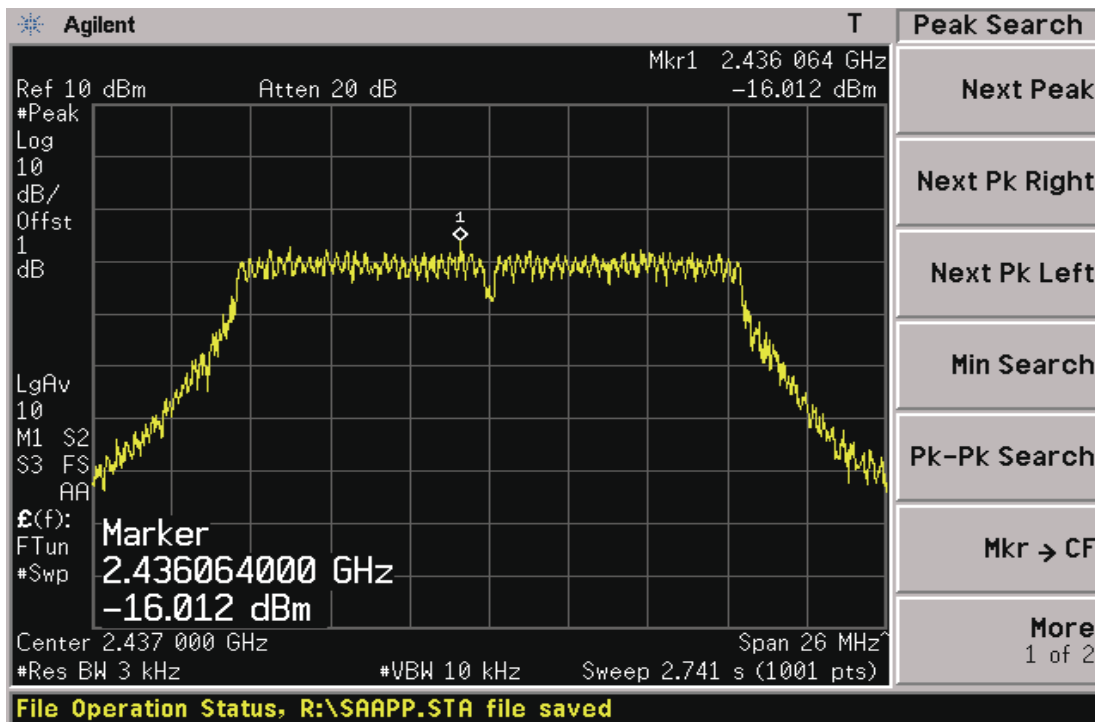
8.4 Trace data – 802.11b (ch_11)



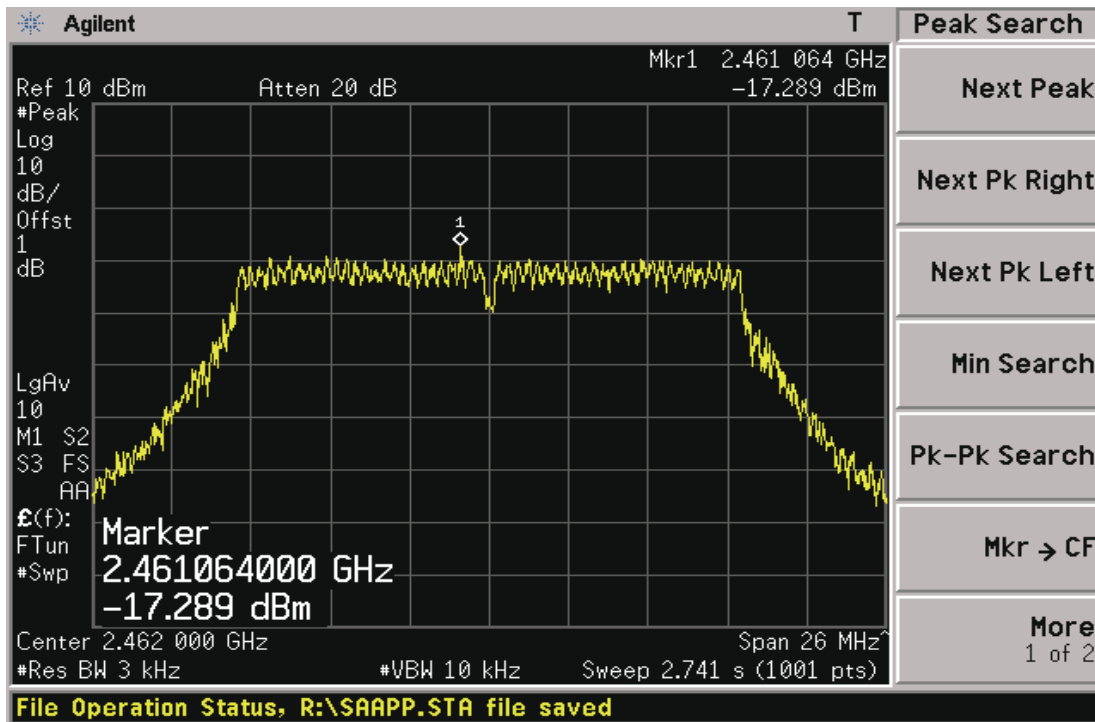
8.4 Trace data – 802.11g mode (ch_1)



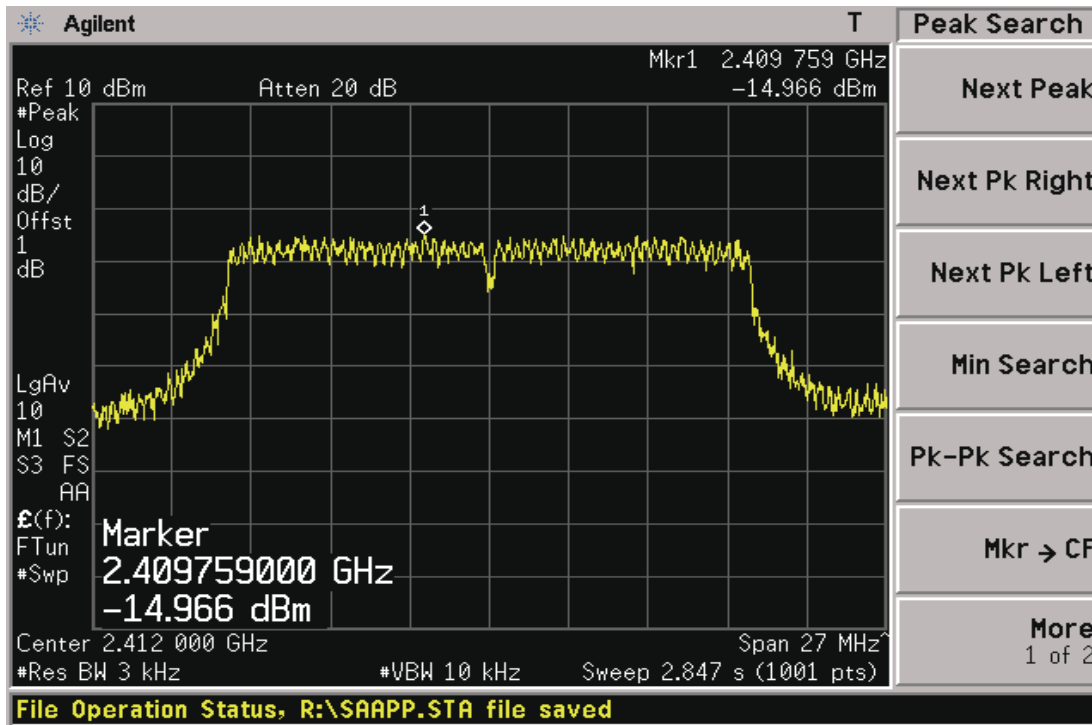
(ch_6)



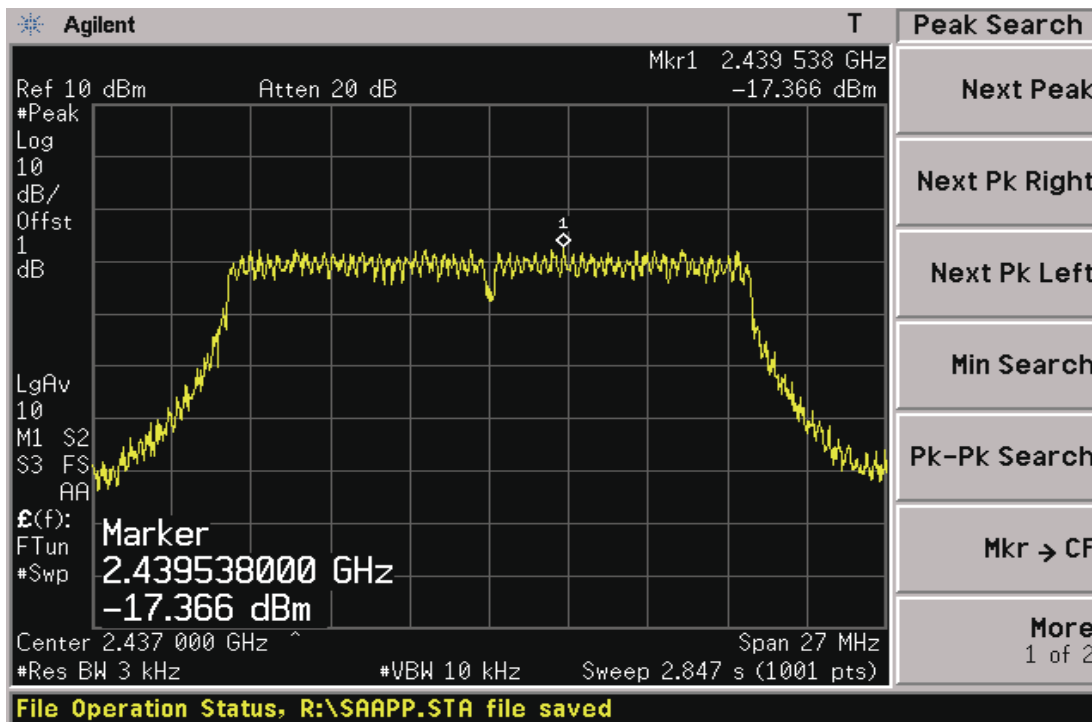
8.4 Trace data – 802.11g mode (ch_11)



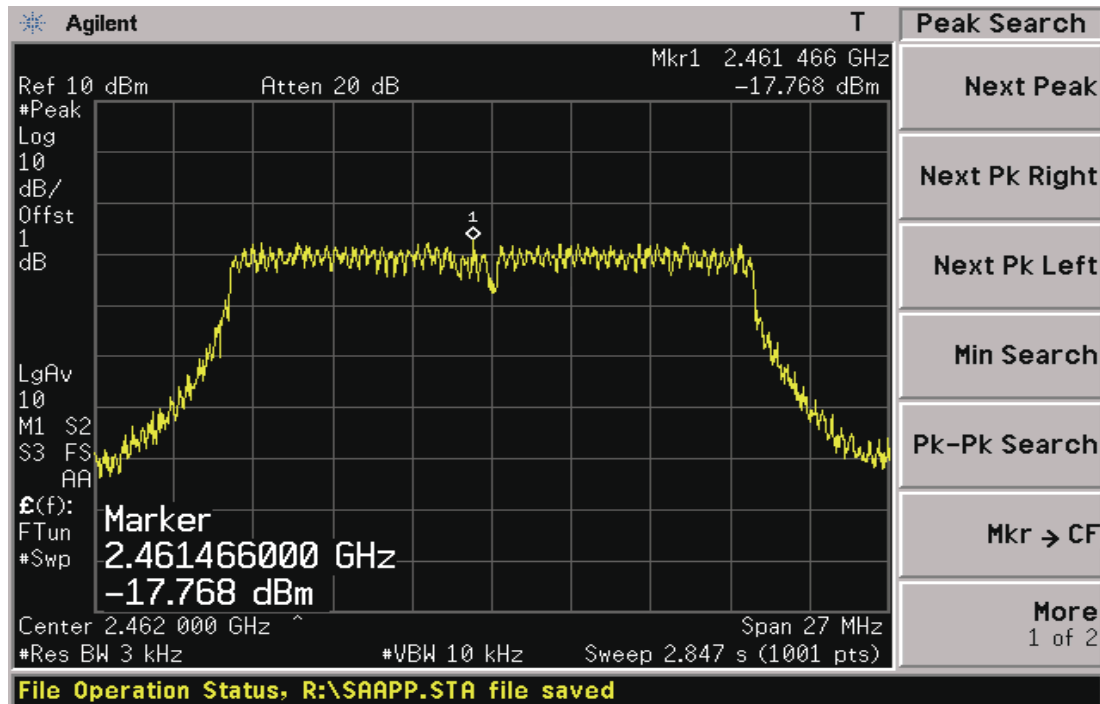
8.4 Trace data – 802.11n20 mode (ch_1)



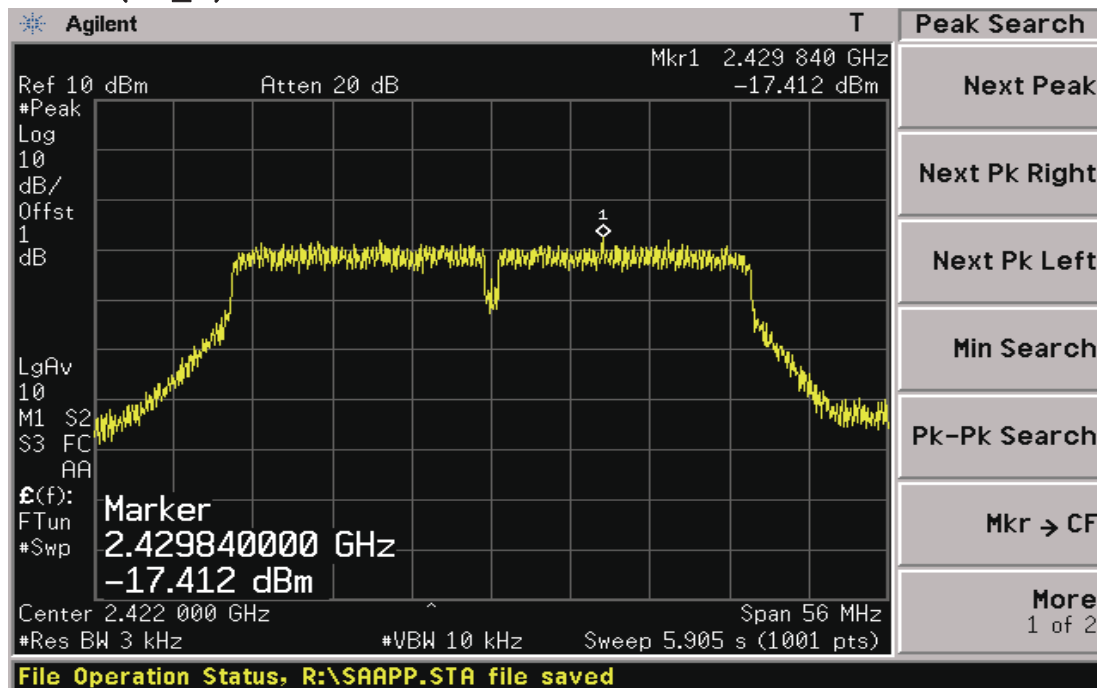
(ch_6)



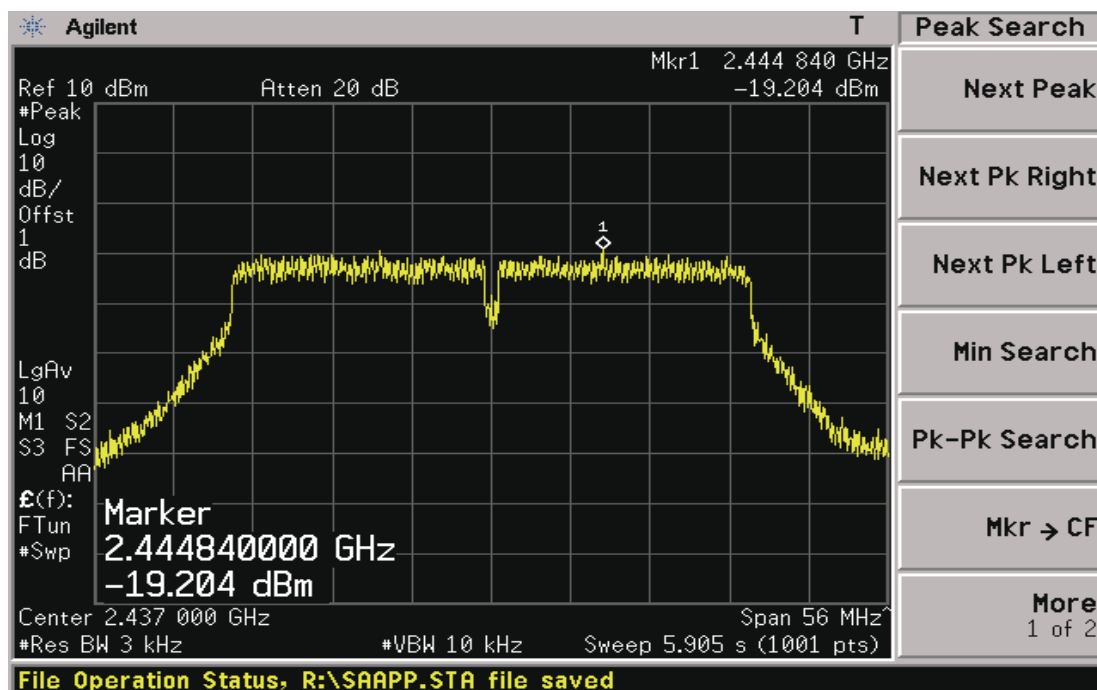
8.4 Trace data – 802.11g mode (ch_11)



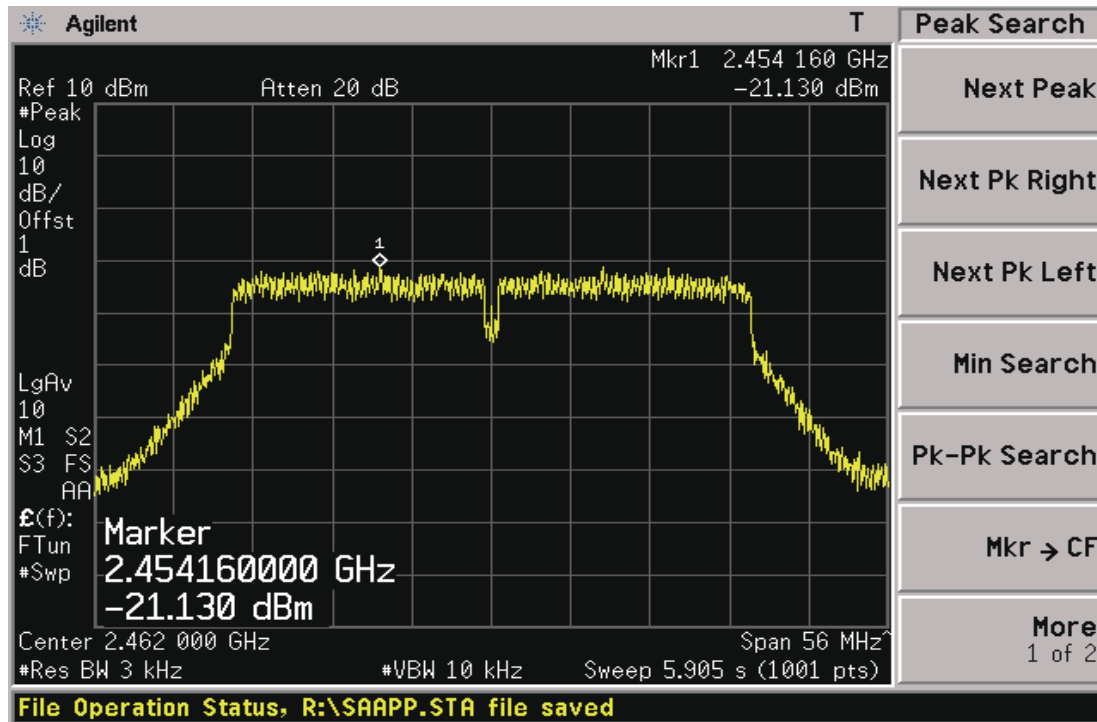
8.4 Trace data – 802.11n40 mode (ch_1)



(ch_6)



8.4 Trace data – 802.11g mode (ch_11)



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 $\geq 3 \times$ 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 $\Leftrightarrow$ EUT	Loss: 1.0 dB		–

9.3 Measurement results of band-edge & out of emission – Adapter

EUT	Hicare Hub	MODEL	HH-930
MODE	802.11b, g, n20, n40	ENVIRONMENTAL CONDITION	22.0 °C, 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

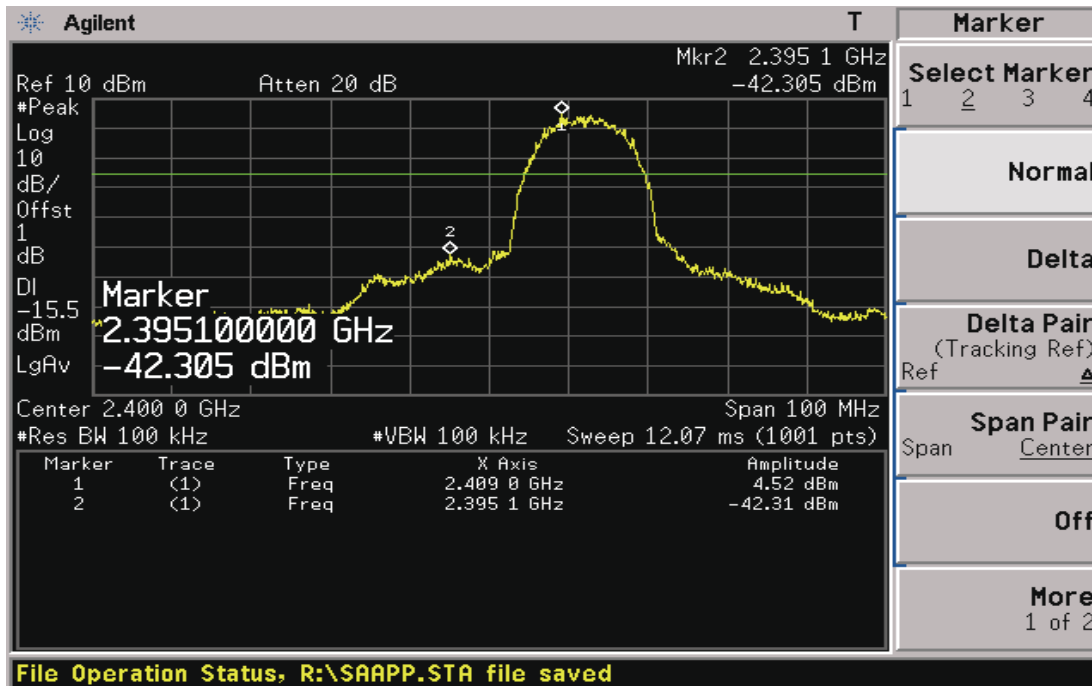
MODE –802.11n20

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

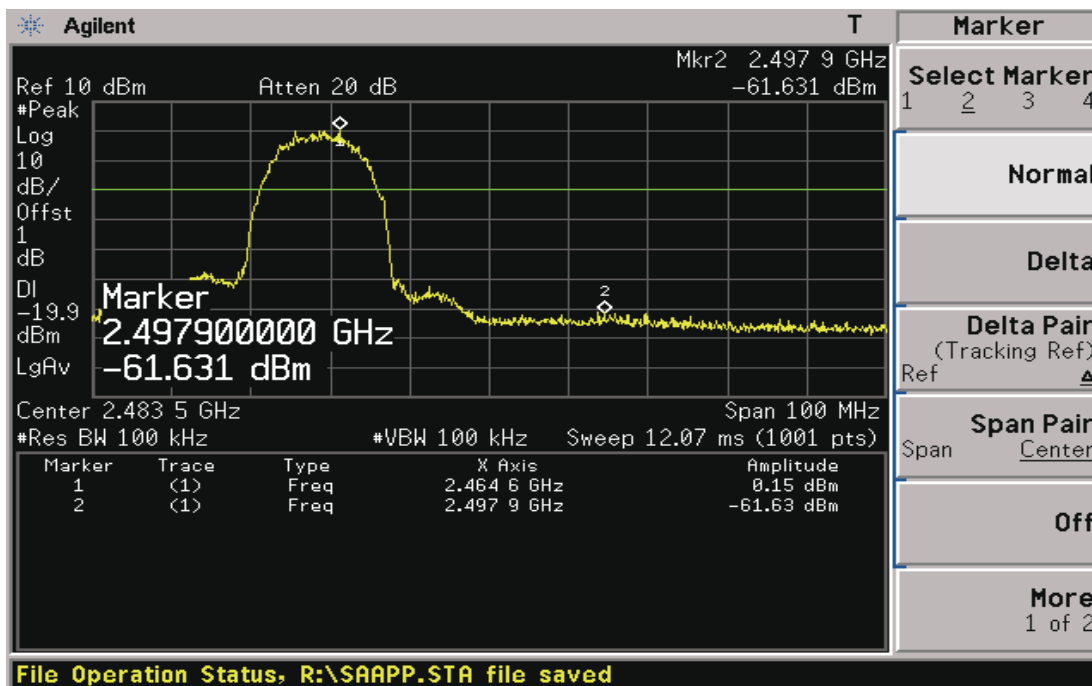
MODE –802.11n40

CHANNEL	Channel Frequency (MHz)	limit	PASS/FAIL
3	2 422	20dBc	PASS
11	2 462	20dBc	PASS

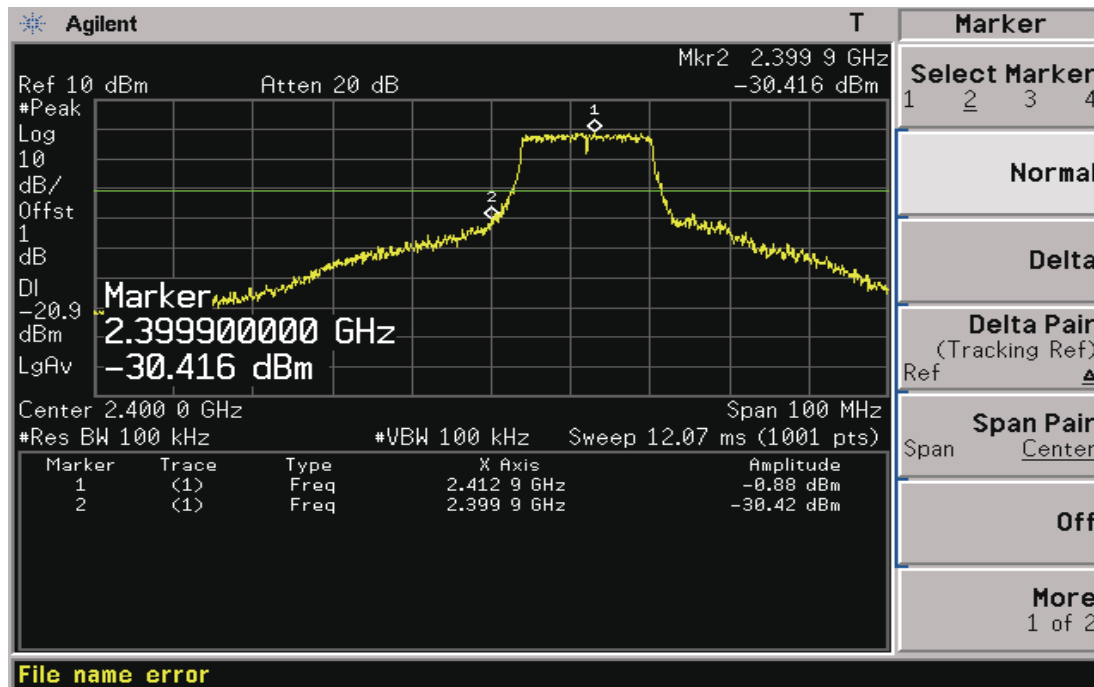
9.4 Trace data of band-edge & Out of Emission – 802.11b mode (ch₁)



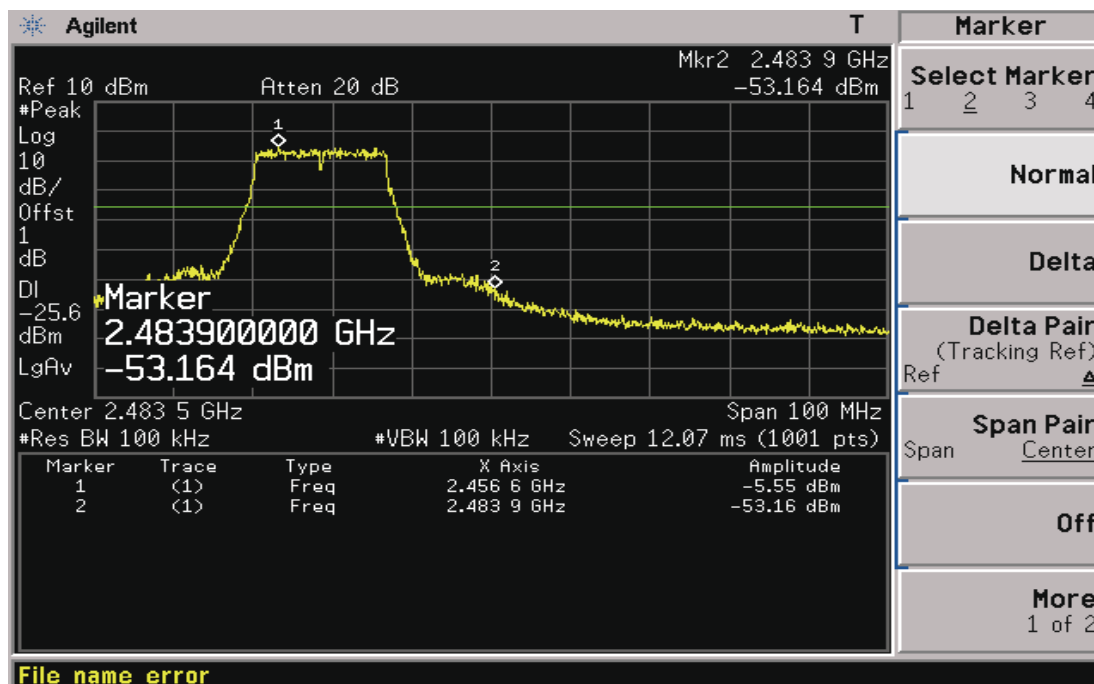
(ch₁₁)



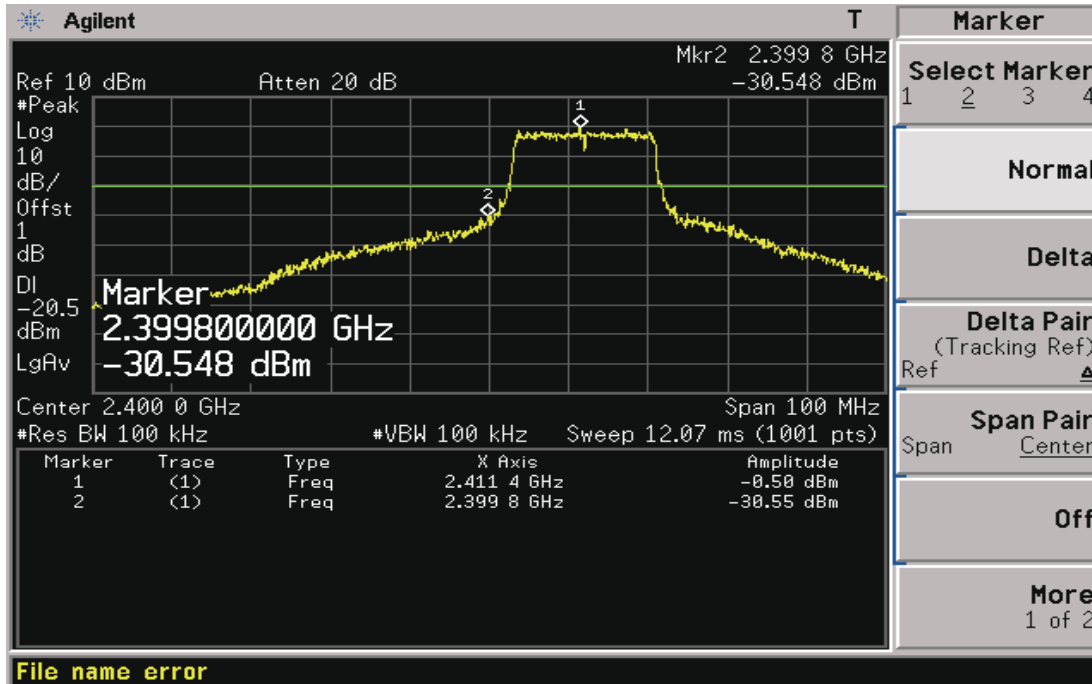
9.4 Trace data of band-edge & Out of Emission – 802.11g mode (ch_1)



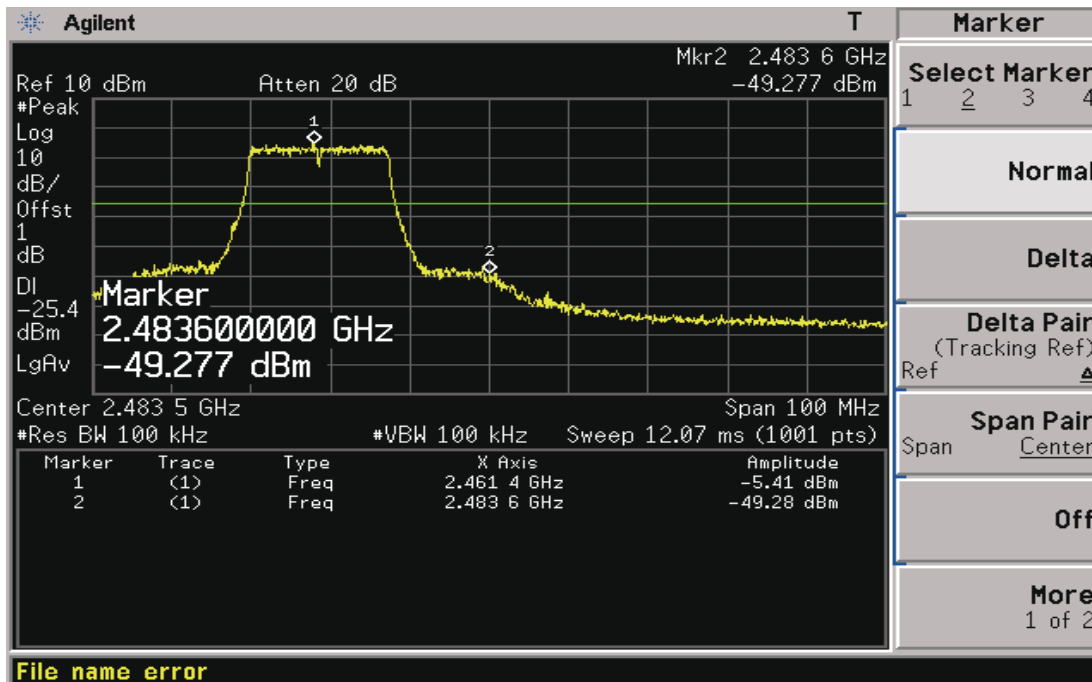
(ch_11)



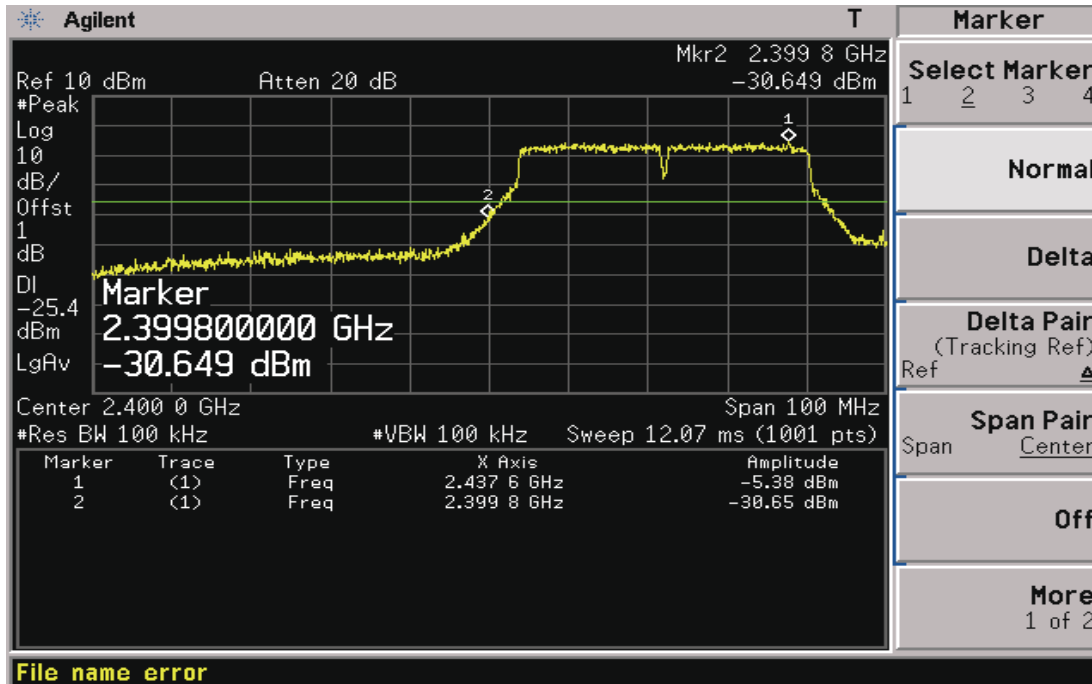
9.4 Trace data of band-edge & Out of Emission – 802.11n20 mode (ch_1)



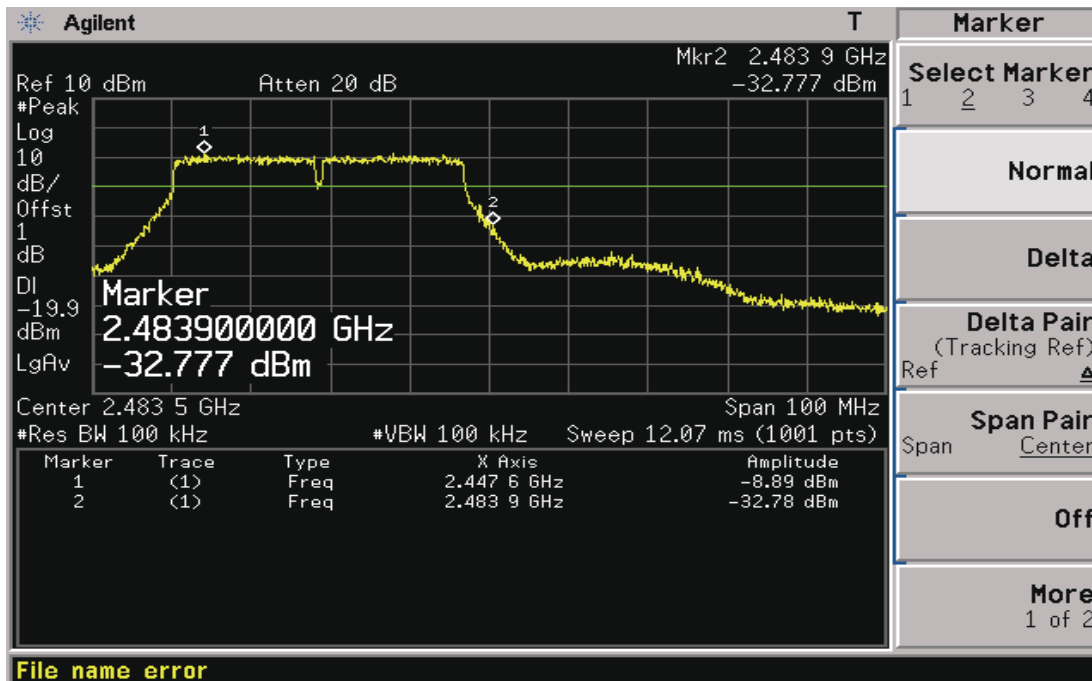
(ch_11)



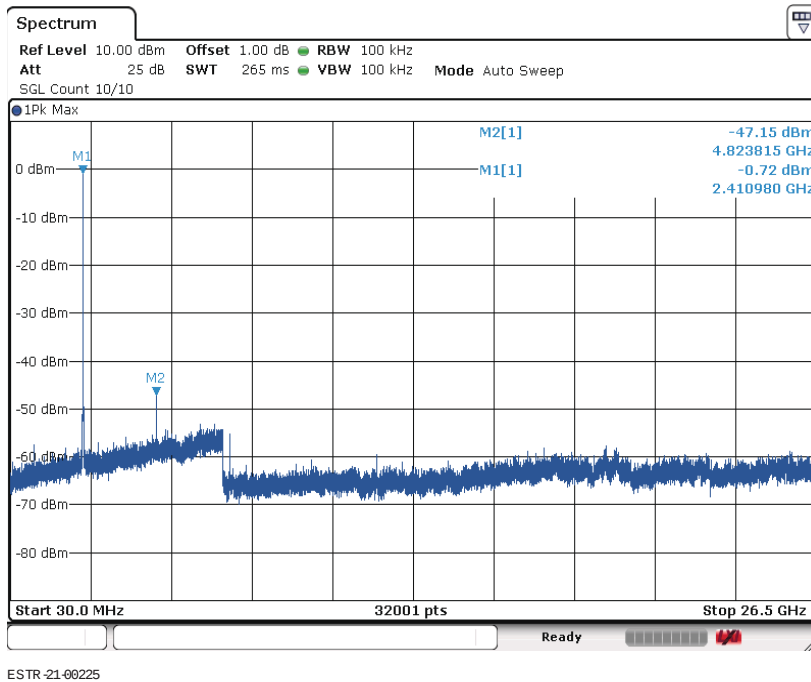
9.4 Trace data of band-edge & Out of Emission – 802.11n40 mode (ch_1)



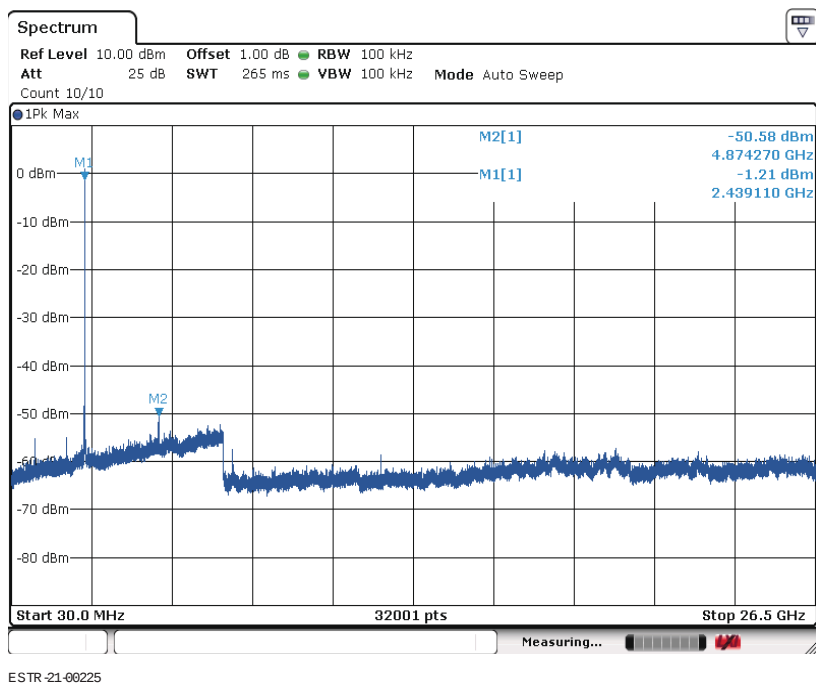
(ch_11)



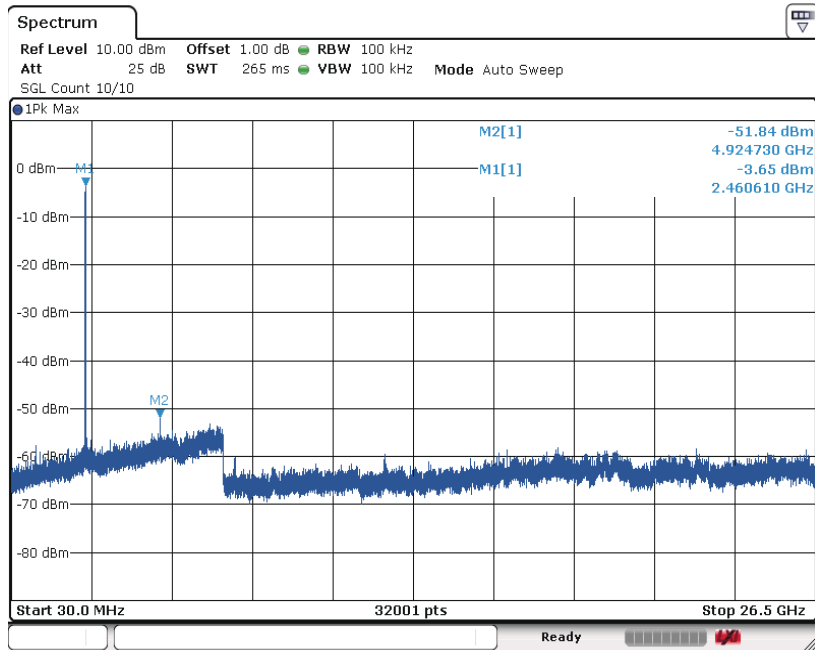
9.4 Trace data of Out of Emission – 802.11b mode (ch_1)



(ch_6)

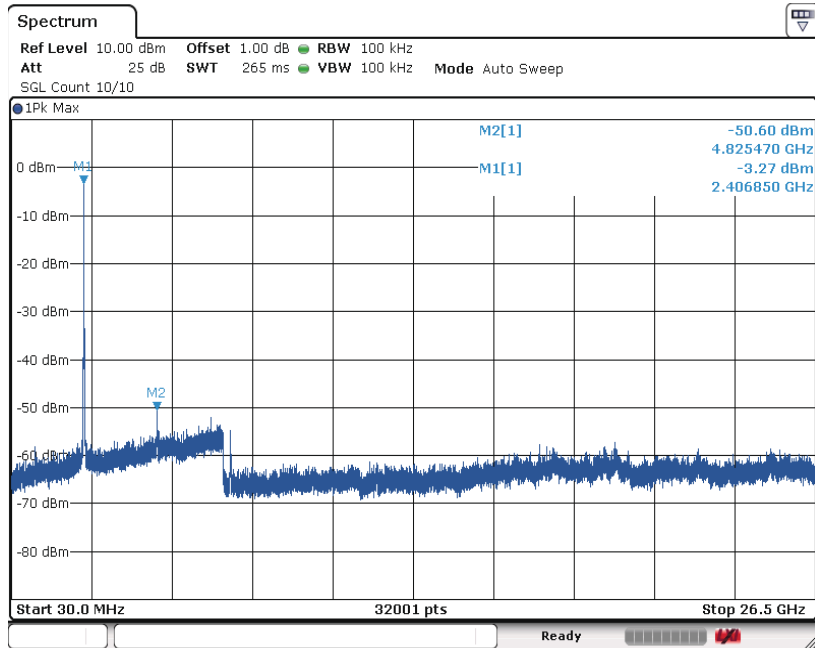


9.4 Trace data of Out of Emission – 802.11b mode (ch_11)



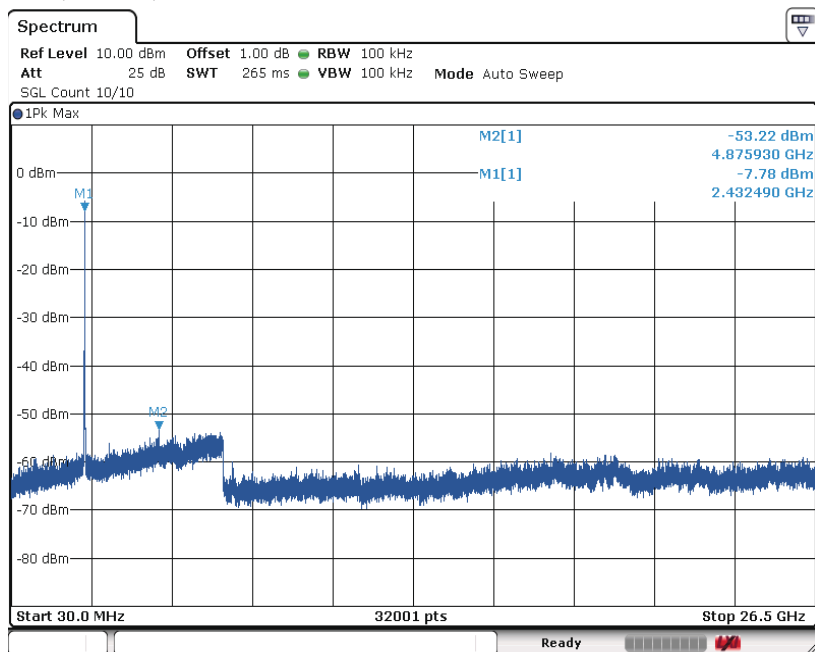
ESTR-21-00225

9.4 Trace data of Out of Emission – 802.11g mode (ch_1)



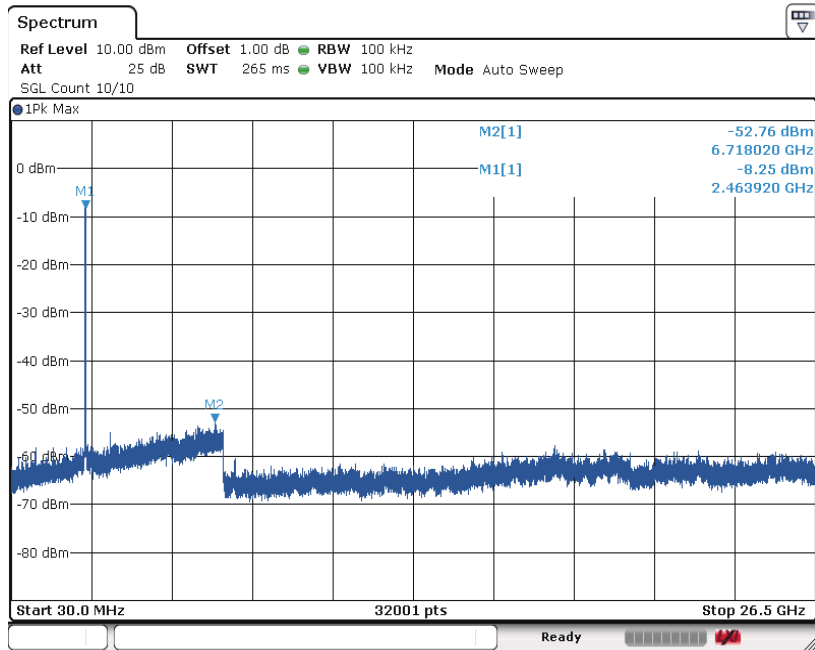
ESTR-21-00225

(ch_6)



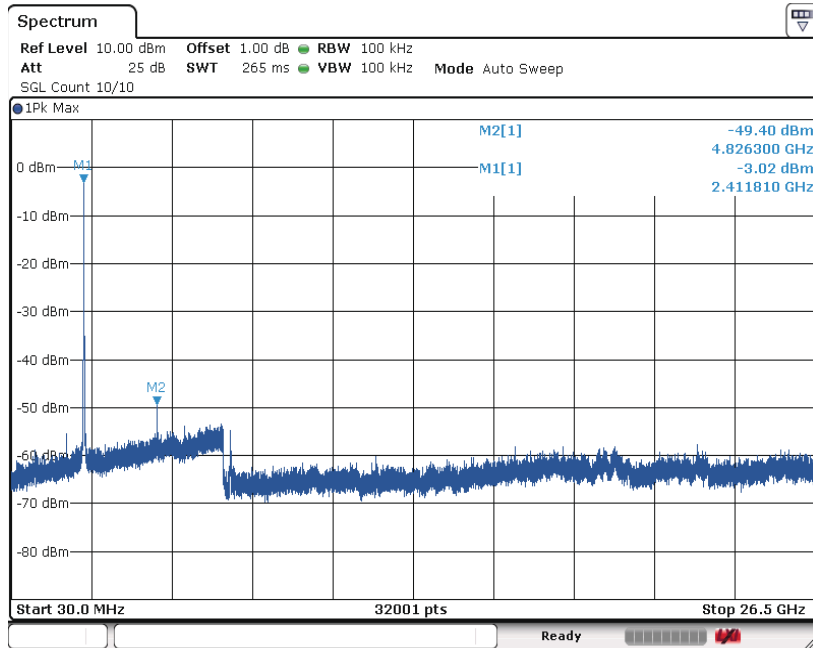
ESTR-21-00225

9.4 Trace data of Out of Emission – 802.11g mode (ch_11)



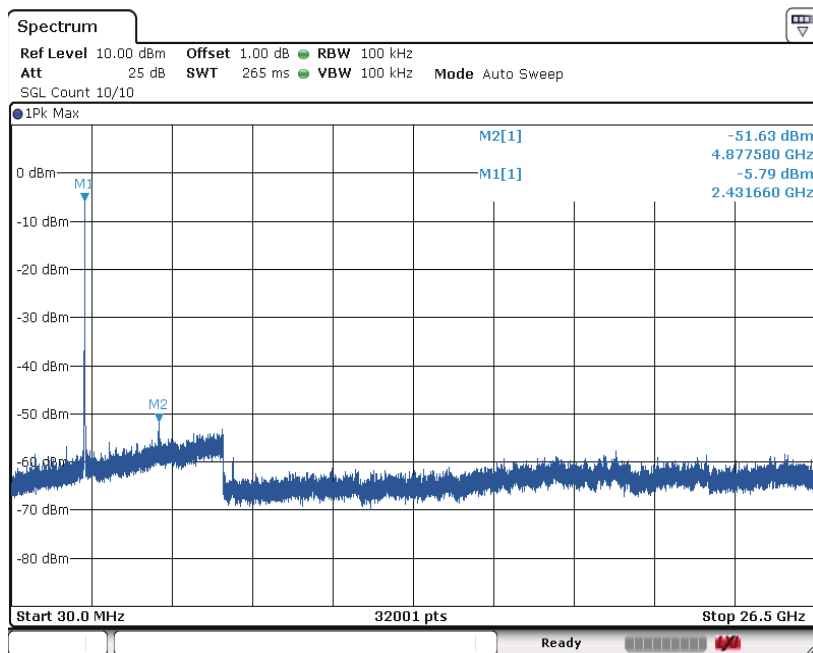
ESTR-21-00225

9.4 Trace data of Out of Emission – 802.11n20 mode (ch_1)



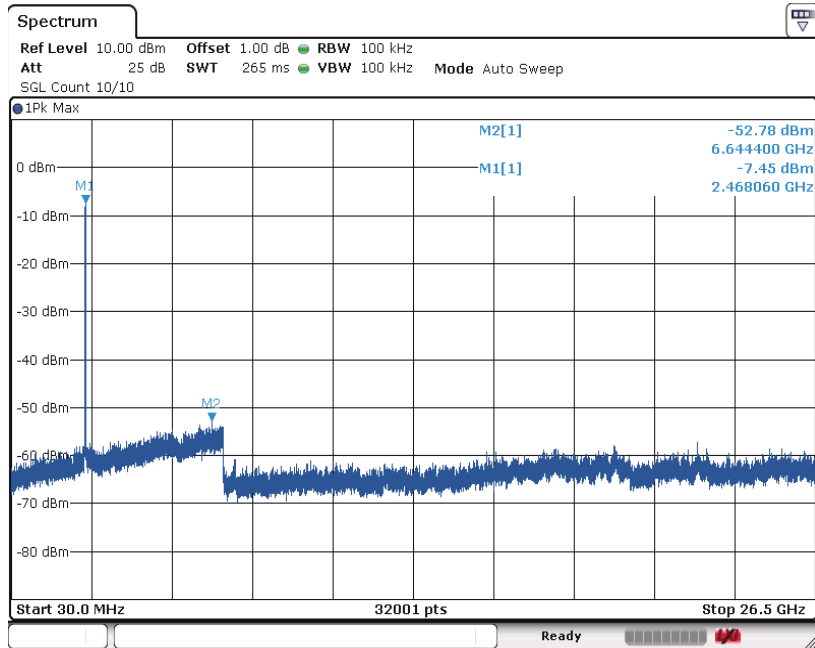
ESTR-21-00225

(ch_6)



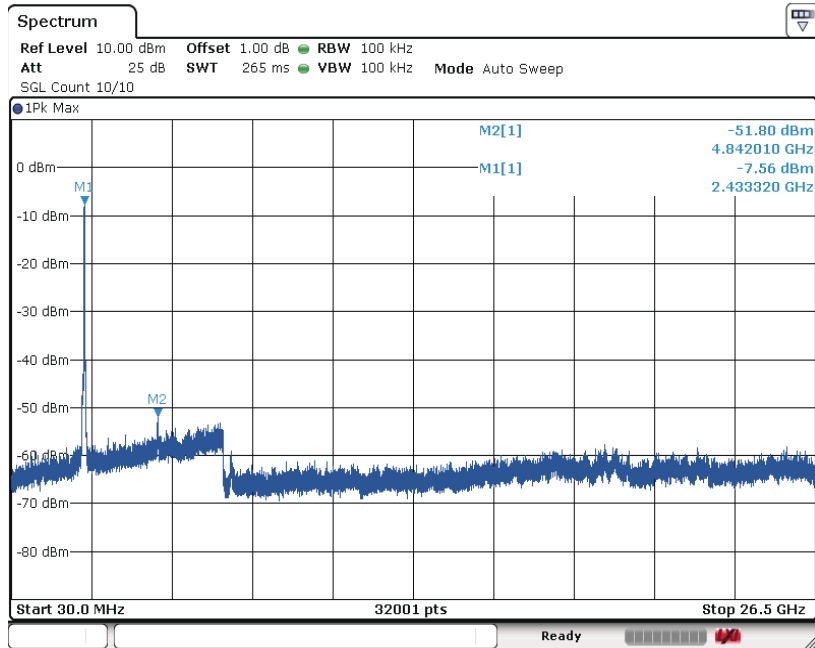
ESTR-21-00225

9.4 Trace data of Out of Emission – 802.11n20 mode (ch_11)



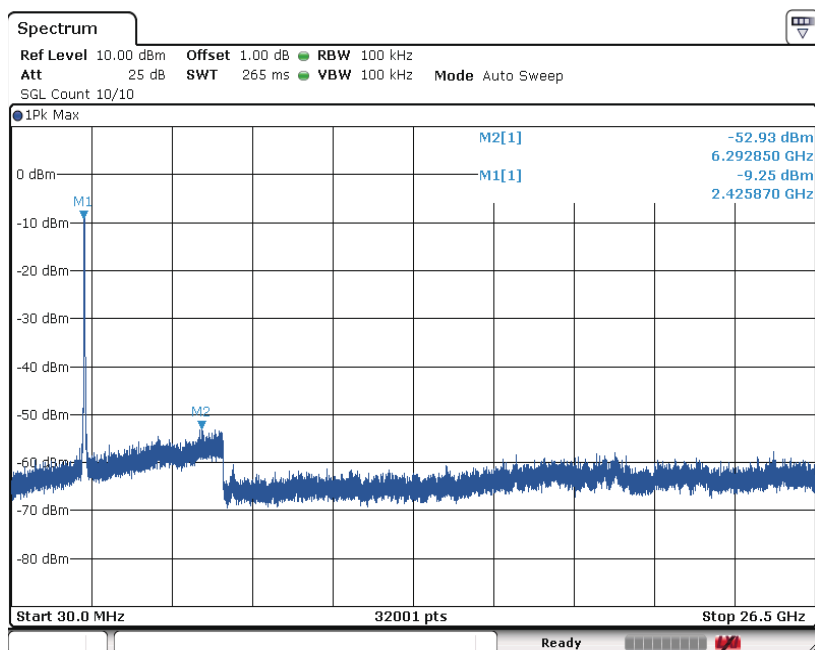
ESTR-21-00225

9.4 Trace data of Out of Emission – 802.11n40 mode (ch_3)



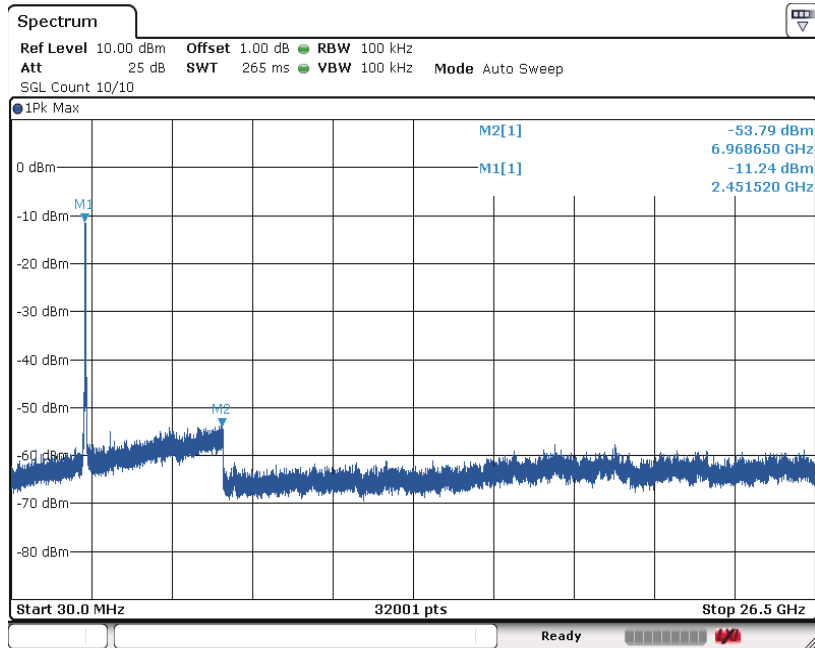
ESTR-21-00225

(ch_6)



ESTR-21-00225

9.4 Trace data of Out of Emission – 802.11n40 mode (ch_11)



ESTR-21-00225

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 9170	SCHWARZBECK	752	15-Oct-21
Antenna Master & Turn table controller	C02000-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

Temperature (°C) : 22.5 °C

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 °C

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)

- RBW : 1 MHz , VBW : 3 MHz
- Trace mode = max hold
- Detector : Peak
- Sweep time = auto

Average Power Measurement Procedures (KDB 558074 section 12.2.5.2)

- Set analyzer center frequency to the frequency associated with the emission
- RBW : 1 MHz , VBW : 3 MHz
- Detector : RMS
- Sweep time = auto

* Note

Band	Duty cycle(%)	Ton (ms)	Ton + Toff (ms)	DCF=10*log(1/Duty) (dB)
802.11b	47.7	0.590	1.235	3.214
802.11g	40.1	0.170	0.424	3.968
802.11n20	43.1	0.193	0.447	3.655
802.11n40	41.0	0.184	0.448	3.872

* 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 6-Sep-21

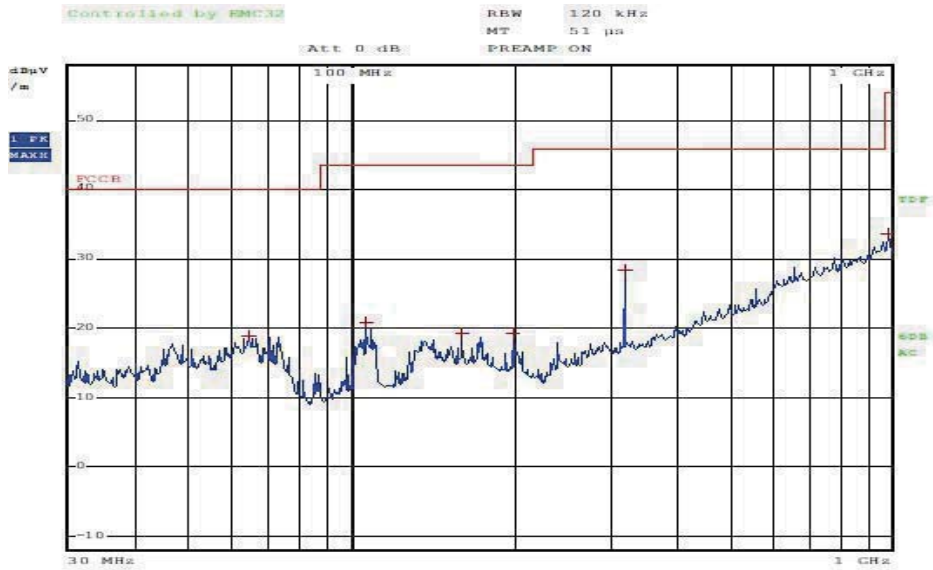
Measurement Distance : 3 m

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)
46.70	17.18	V	1.0	13.42	0.91	40.00	31.50	8.50
73.00	19.19	V	1.0	11.84	1.10	40.00	32.13	7.87
108.80	15.86	V	1.4	9.48	1.35	43.50	26.68	16.82
136.40	17.32	V	1.4	12.12	1.57	43.50	31.01	12.49
320.00	12.00	H	1.5	14.00	2.48	46.00	28.48	17.52
975.70	4.59	H	1.0	24.30	4.70	54.00	33.59	20.41
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)

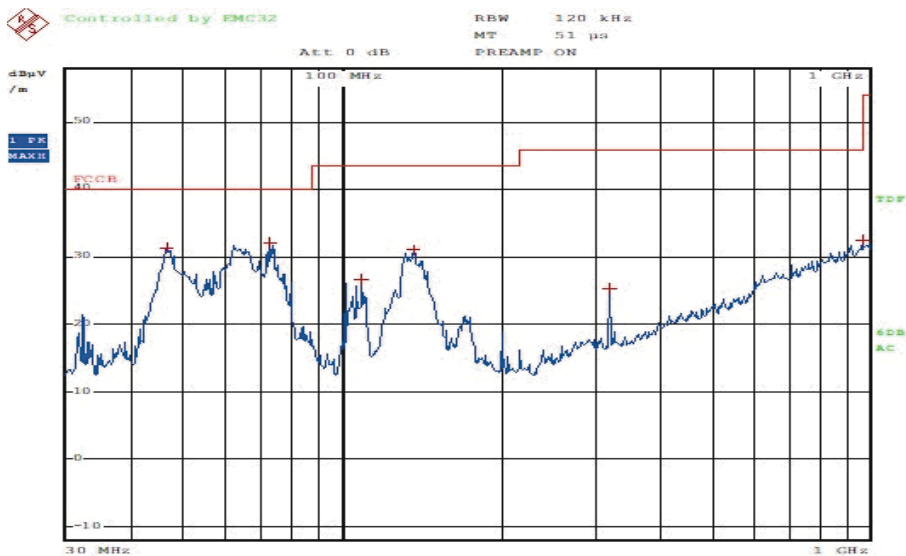
*802.11b Mode

Polarity:Horizontal



ESTR-21-00238

Polarity:Vertical



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10.4-3 Test Data

Test Date : 11-Sep-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	55.49	H	1.5	27.89	-29.82		74.00	53.56	20.44
2390.00	44.54	V	1.6	27.89	-29.82		74.00	42.61	31.39
3220.00	54.00	H	1.5	28.68	-29.19		74.00	53.49	20.51
3220.00	51.00	V	1.6	28.68	-29.19		74.00	50.49	23.51
4824.00	65.00	H	1.5	31.52	-27.27		74.00	69.25	4.75
4824.00	53.00	V	1.6	31.52	-27.27		74.00	57.25	16.75
AV(RBW: 1 MHz VBW: 3 MHz)									
2390.00	33.13	H	1.5	27.89	-29.82	3.21	54.00	34.41	19.59
2390.00	33.05	V	1.6	27.89	-29.82	3.21	54.00	34.33	19.67
3220.00	45.12	H	1.5	28.68	-29.19	3.21	54.00	47.82	6.18
3220.00	40.25	V	1.6	28.68	-29.19	3.21	54.00	42.95	11.05
4824.00	36.30	H	1.5	31.52	-27.27	3.21	54.00	43.76	10.24
4824.00	35.10	V	1.6	31.52	-27.27	3.21	54.00	42.56	11.44
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 measure d.								

10.4-4 Test Data

Test Date : 11-Sep-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)									
3220.00	53.12	H	1.6	28.68	-29.19		74.00	52.61	21.39
3220.00	50.26	V	1.5	28.68	-29.19		74.00	49.75	24.25
4874.00	62.78	H	1.6	31.57	-27.24		74.00	67.11	6.89
4874.00	53.33	V	1.5	31.57	-27.24		74.00	57.66	16.34
AV(RBW: 1 MHz VBW: 3 MHz)									
3220.00	45.31	H	1.6	28.68	-29.19	3.21	54.00	48.01	5.99
3220.00	42.40	V	1.5	28.68	-29.19	3.21	54.00	45.10	8.90
4874.00	35.31	H	1.6	31.57	-27.24	3.21	54.00	42.85	11.15
4874.00	34.40	V	1.5	31.57	-27.24	3.21	54.00	41.94	12.06
Remark	H : Horizontal, V : Vertical TEST MODE : 802.11 b – CH 6(2 437 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 : 11-Sep-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	58.16	H	1.6	27.48	-29.75		74.00	55.89	18.11
2483.50	52.64	V	1.5	27.48	-29.75		74.00	50.37	23.63
3220.00	56.74	H	1.6	28.68	-29.19		74.00	56.23	17.77
3220.00	52.12	V	1.5	28.68	-29.19		74.00	51.61	22.39
4924.00	60.08	H	1.6	31.62	-27.21		74.00	64.49	9.51
4924.00	53.81	V	1.5	31.62	-27.21		74.00	58.22	15.78
AV(RBW: 1 MHz VBW: 3 MHz)									
2483.50	35.95	H	1.6	27.50	-29.75	3.21	54.00	36.91	17.09
2483.50	35.47	V	1.5	27.50	-29.75	3.21	54.00	36.43	17.57
3220.00	46.12	H	1.6	28.68	-29.19	3.21	54.00	48.82	5.18
3220.00	43.12	V	1.5	28.68	-29.19	3.21	54.00	45.82	8.18
4924.00	34.77	H	1.6	31.62	-27.21	3.21	54.00	42.39	11.61
4924.00	35.93	V	1.5	31.62	-27.21	3.21	54.00	43.55	10.45
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 measure d.								

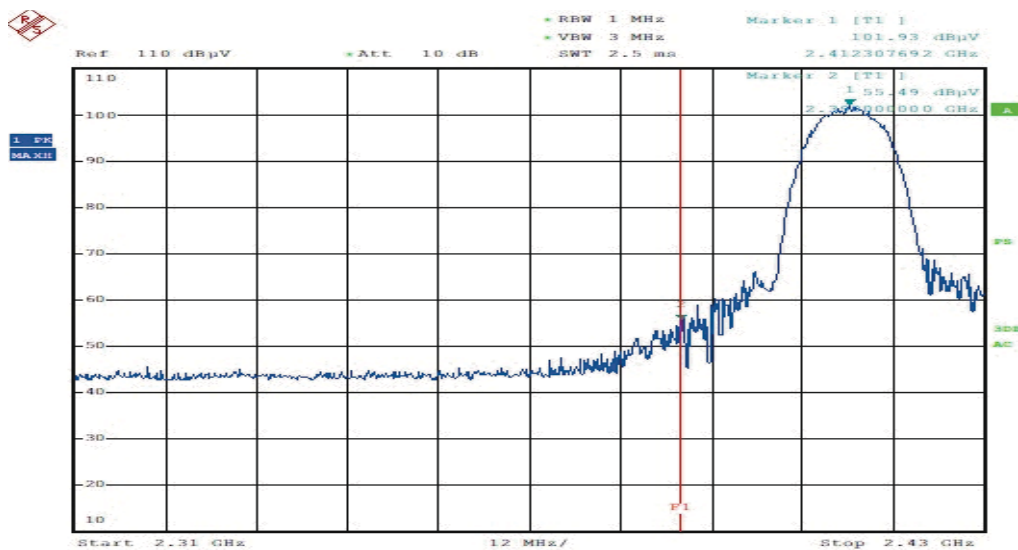
10.4-6 Restricted Band Edges

*802.11b Mode

Band Edges(CH Low)

Detector mode:Peak

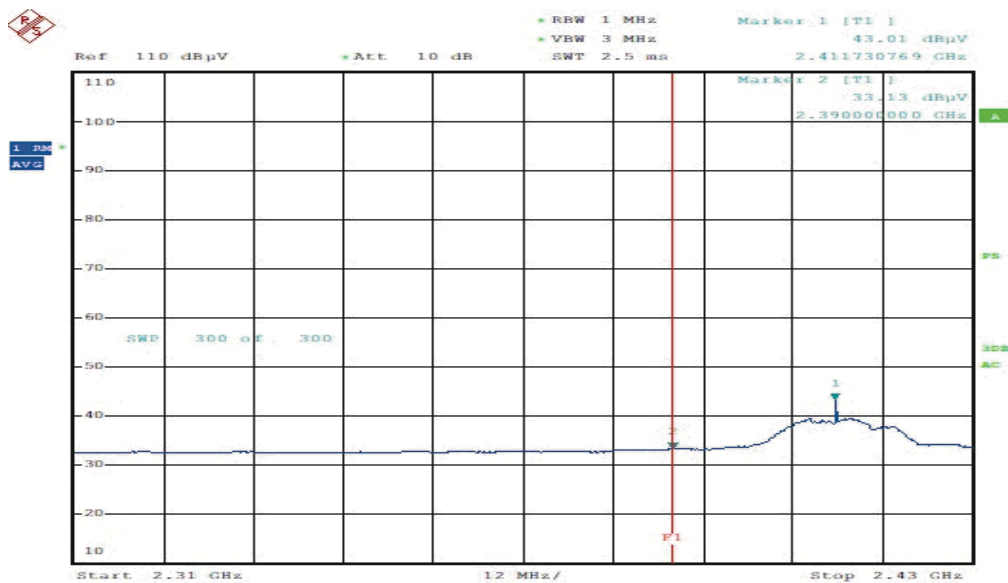
Polarity:Horizontal



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Detector mode:Average

Polarity:Horizontal

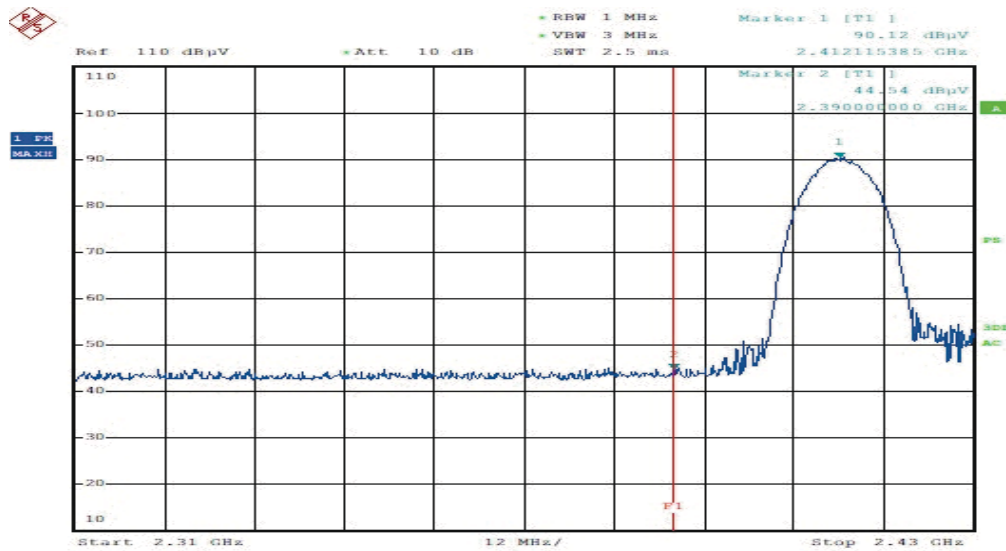


ESTR-21-00238

Band Edges(CH Low)

Detector mode:Peak

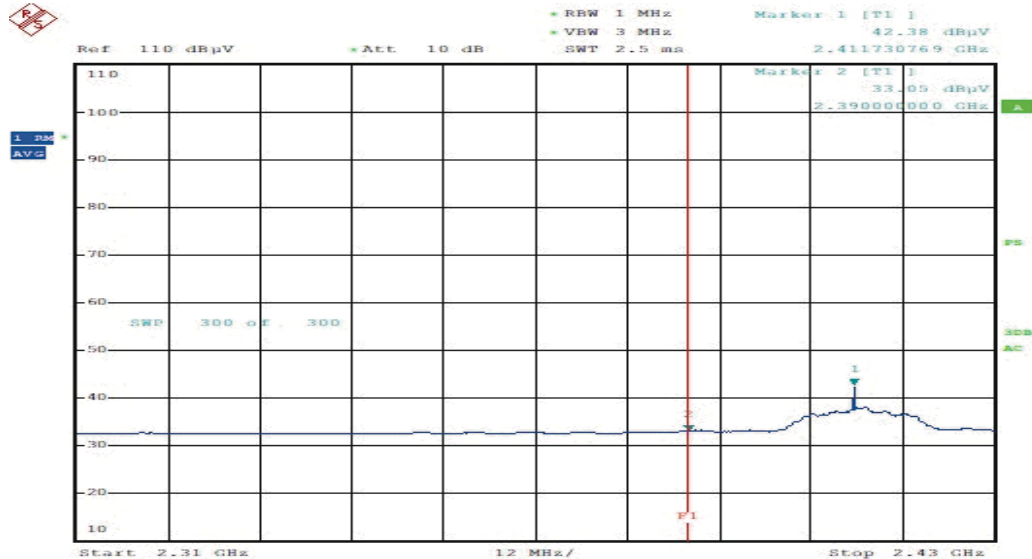
Polarity:Vertical



ESTR-21-00238

Detector mode:Average

Polarity:Vertical

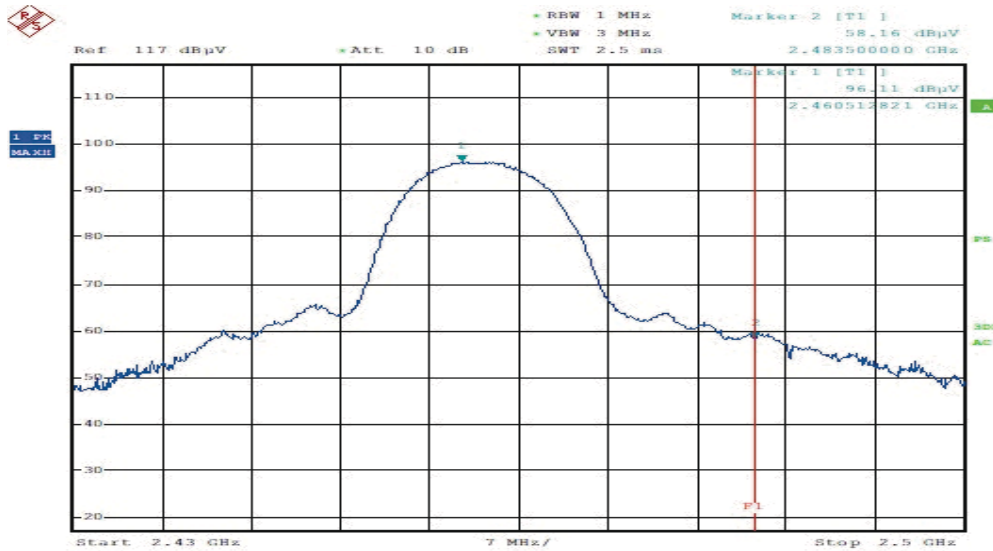


ESTR-21-00238

Band Edges(CH High)

Detector mode:Peak

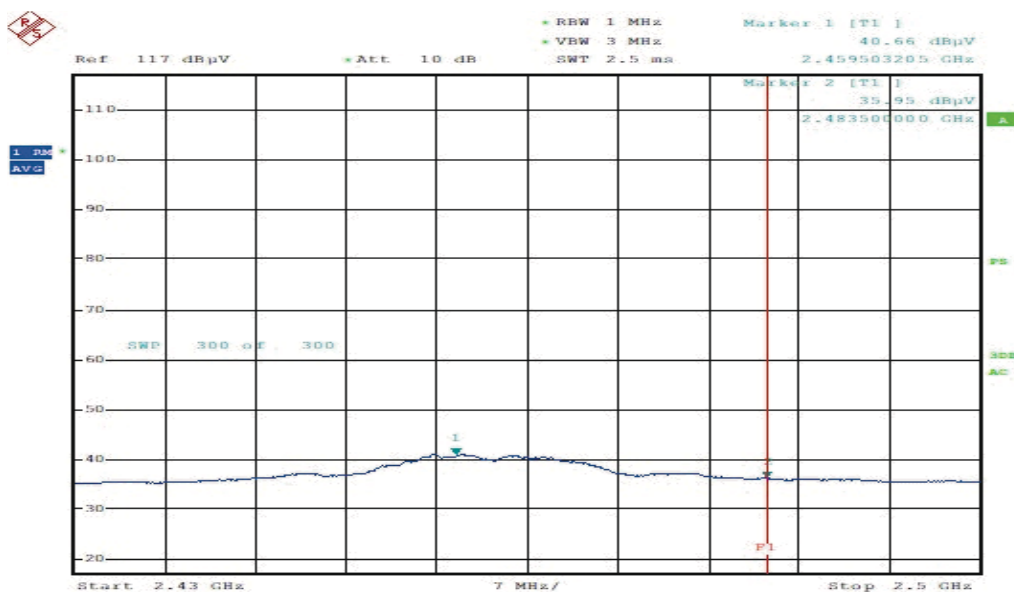
Polarity:Horizontal



ESTR-21-00238

Detector mode:Average

Polarity:Horizontal

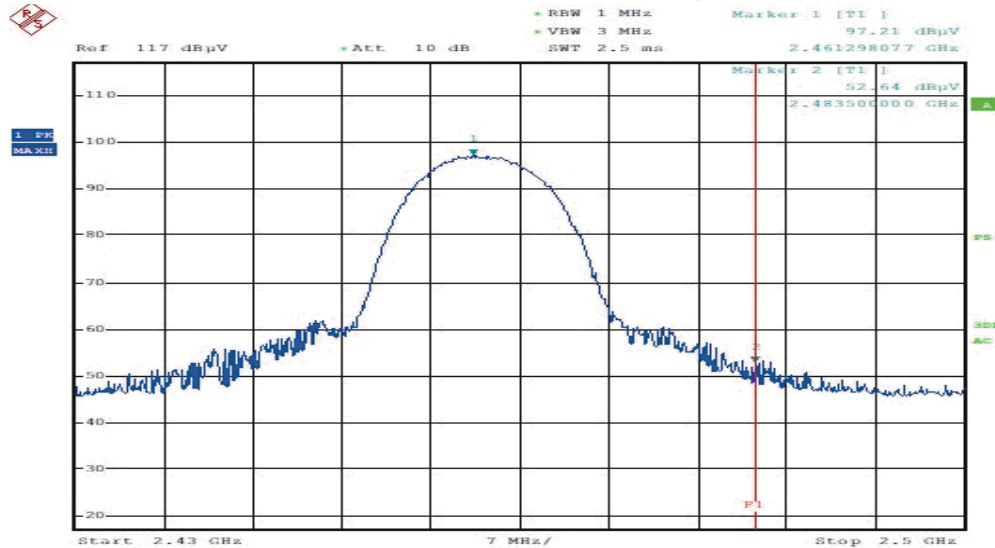


ESTR-21-00238

Band Edges(CH High)

Detector mode:Peak

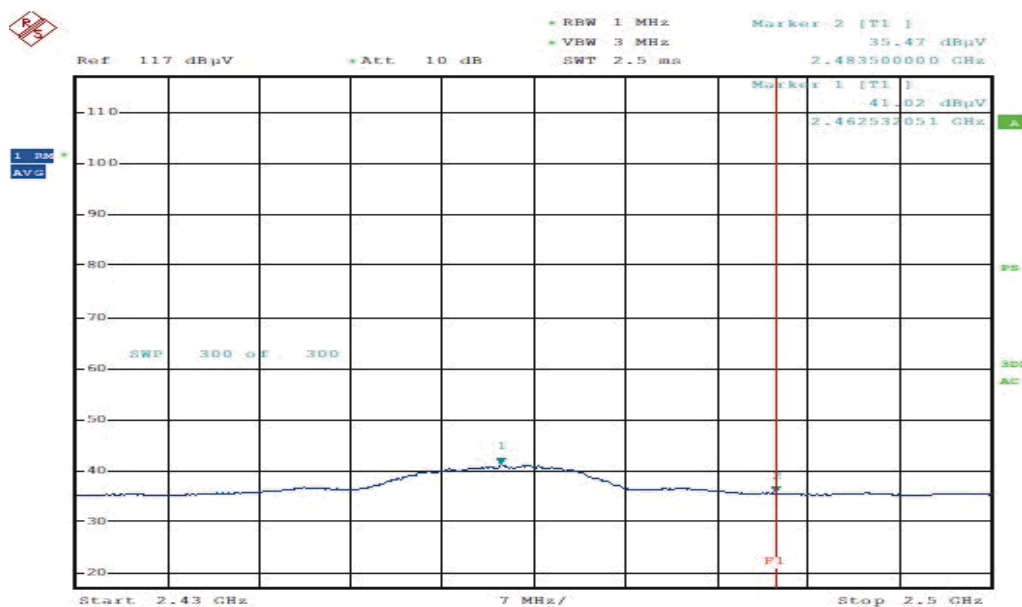
Polarity:Vertical



ESTR-21-00238

Detector mode:Average

Polarity:Vertical

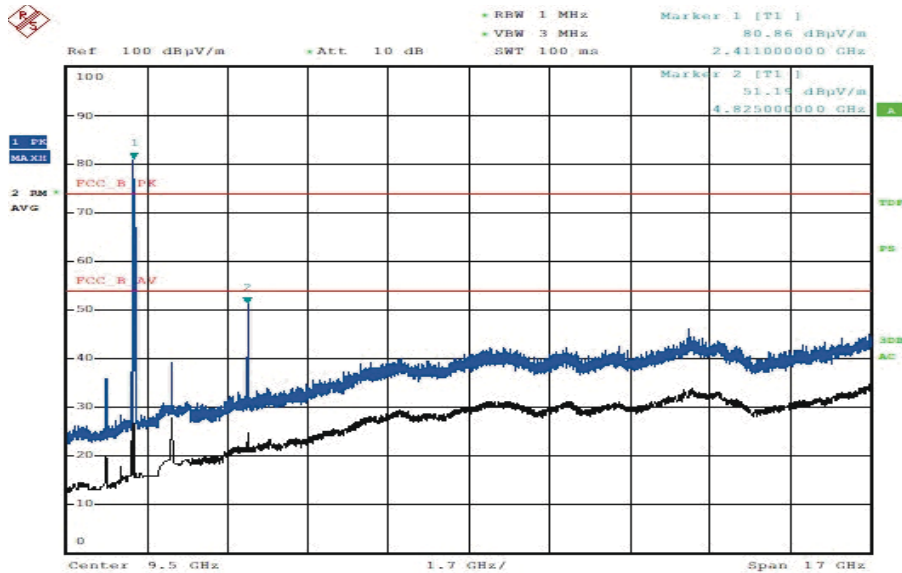


ESTR-21-00238

10.4-7 Restricted Band Edges

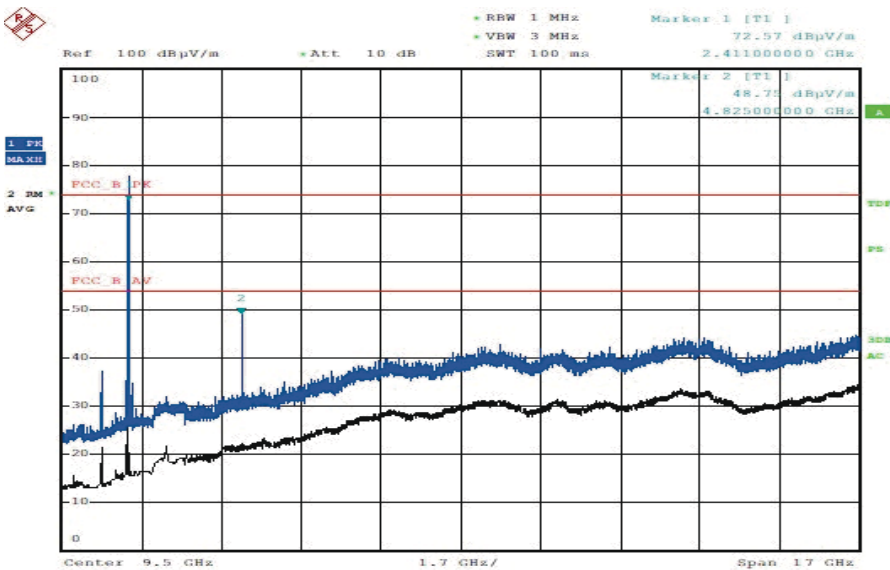
*802.11b Mode CH1

Polarity:Horizontal



ESTR-21-00238

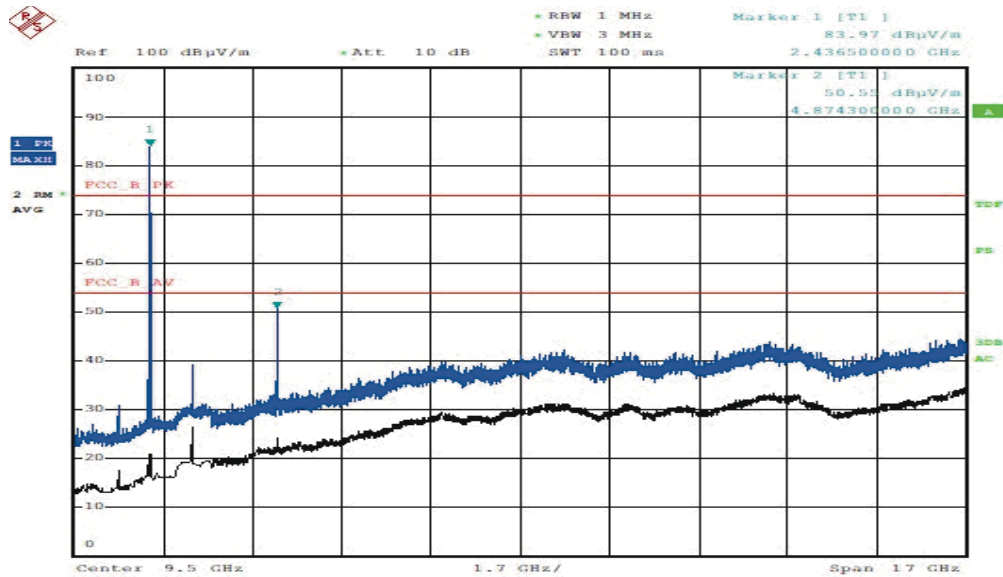
Polarity:Vertical



ESTR-21-00238

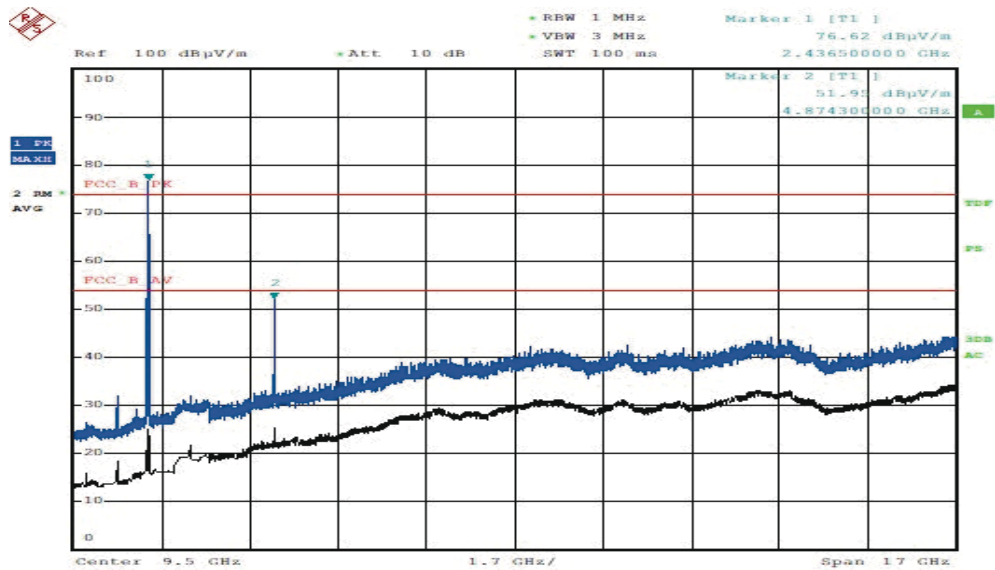
*802.11b Mode CH6

Polarity:Horizontal



ESTR-21-00238

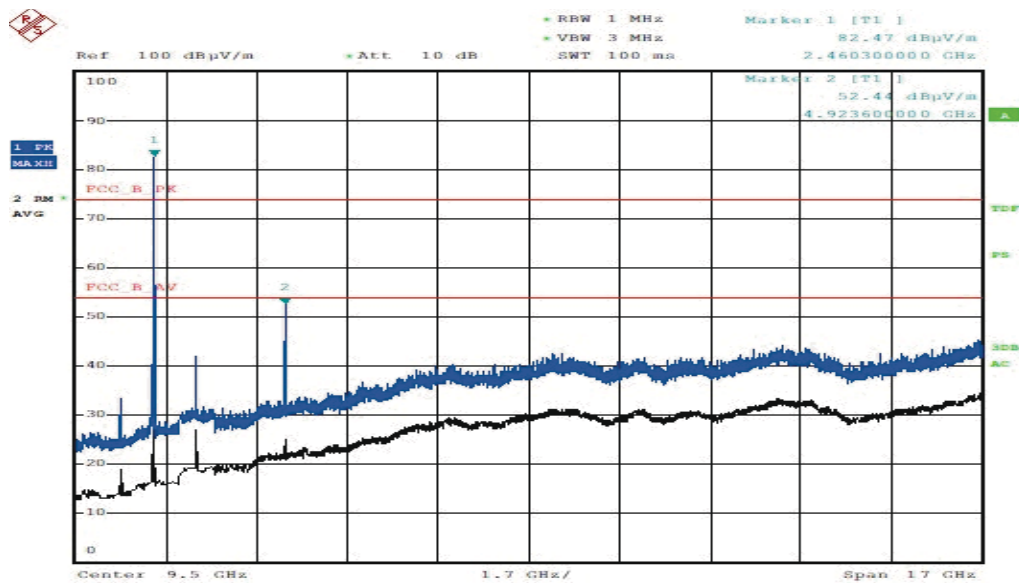
Polarity:Vertical



ESTR-21-00238

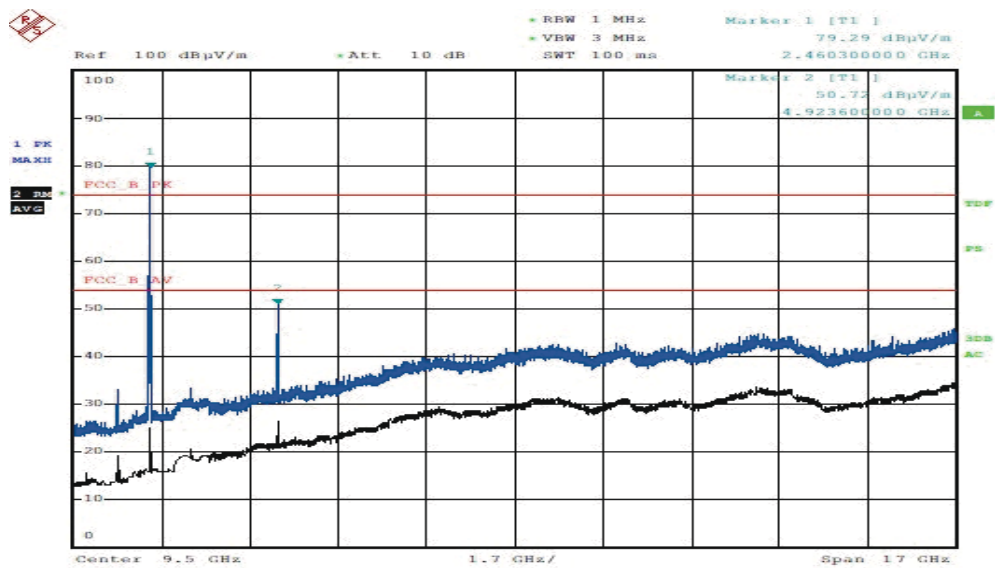
*802.11b Mode CH11

Polarity:Horizontal



ESTR-21-00238

Polarity:Vertical



ESTR-21-00238

10.4-8 Test Data (802.11 g)

Test Date : 6-Sep-21

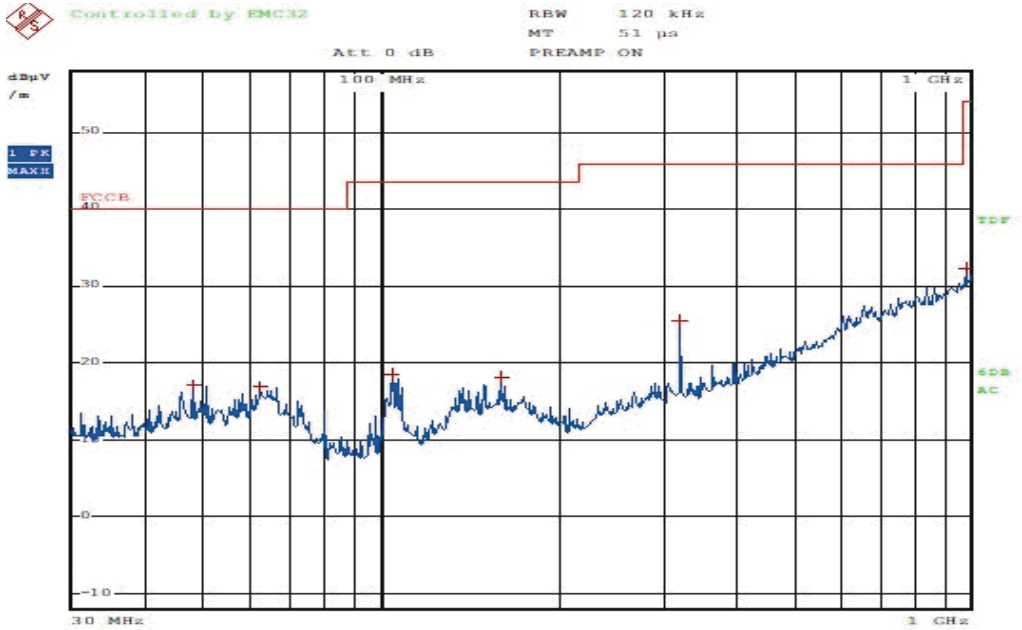
Measurement Distance : 3 m

Frequency (MHz)	Reading (dB μ V)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dB μ V/m)	Result (dB μ V/m)	Margin (dB)
46.30	17.63	V	1.0	13.41	0.91	40.00	31.95	8.05
73.90	19.12	V	1.0	11.85	1.11	40.00	32.08	7.92
80.00	19.39	V	1.4	9.10	1.21	40.00	29.70	10.30
137.70	19.00	V	1.6	12.14	1.57	43.50	32.71	10.79
320.00	11.42	H	1.6	14.00	2.48	46.00	27.90	18.10
980.40	3.30	H	1.7	24.30	4.72	54.00	32.31	21.69
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)

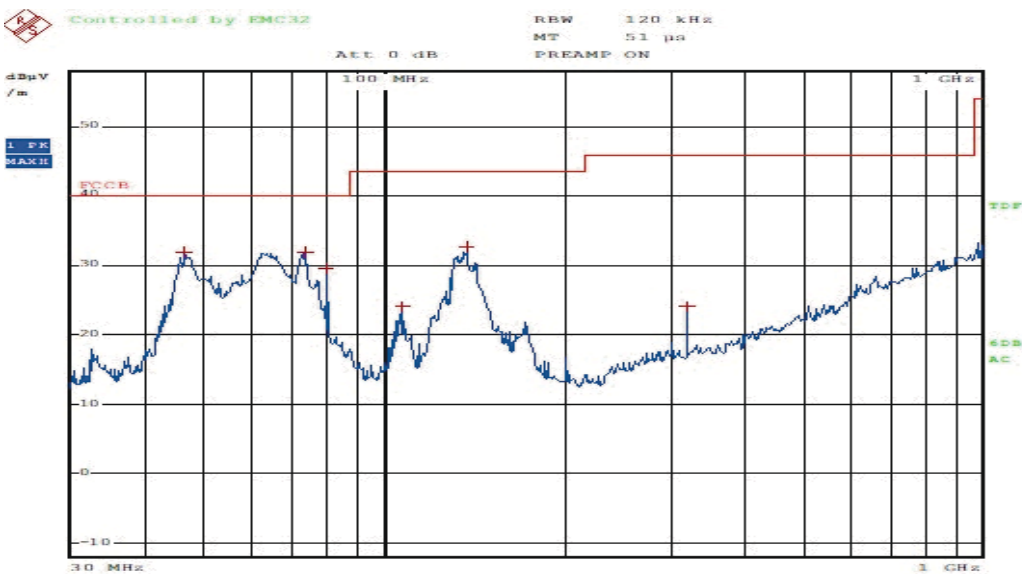
*802.11g Mode

Polarity:Horizontal



ESTR-21-00238

Polarity:Vertical



ESTR-21-00238

10.4-10 Test Data

Test Date : 12-Sep-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	53.13	H	1.6	27.89	-29.82		74.00	51.20	22.80
2390.00	43.40	V	1.6	27.89	-29.82		74.00	41.47	32.53
3220.00	52.10	H	1.5	28.68	-29.19		74.00	51.59	22.41
3220.00	50.40	V	1.6	28.68	-29.19		74.00	49.89	24.11
4824.00	51.52	H	1.6	31.52	-27.27		74.00	55.77	18.23
4824.00	47.76	V	1.6	31.52	-27.27		74.00	52.01	21.99
AV(RBW: 1 MHz VBW: 3 MHz)									
2390.00	33.28	H	1.6	27.89	-29.82	3.97	54.00	35.32	18.68
2390.00	33.11	V	1.6	27.89	-29.82	3.97	54.00	35.15	18.85
3220.00	45.32	H	1.5	28.68	-29.19	3.97	54.00	48.78	5.22
3220.00	41.12	V	1.6	28.68	-29.19	3.97	54.00	44.58	9.42
4824.00	34.91	H	1.6	31.52	-27.27	3.97	54.00	43.13	10.87
4824.00	34.77	V	1.6	31.52	-27.27	3.97	54.00	42.99	11.01
Remark	H : Horizontal, V : Vertical TEST MODE : 802.11 g – 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 measure d.								

10.4-11 Test Data

Test Date : 12-Sep-21

Measurement Distance : 3 m

Frequency (MHz)	Reading (dB μ V)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μ V/m)	Result (dB μ V/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
3220.00	53.20	H	1.5	28.68	-29.19		74.00	52.69	21.31
3220.00	51.00	V	1.6	28.68	-29.19		74.00	50.49	23.51
4874.00	47.52	H	1.5	31.57	-27.24		74.00	51.85	22.15
4874.00	46.98	V	1.5	31.57	-27.24		74.00	51.31	22.69
AV(RBW: 1 MHz VBW: 3 MHz)									
3220.00	44.69	H	1.5	28.68	-29.19	3.97	54.00	48.15	5.85
3220.00	40.59	V	1.6	28.68	-29.19	3.97	54.00	44.05	9.95
4874.00	35.12	H	1.5	31.57	-27.24	3.97	54.00	43.42	10.58
4874.00	34.67	V	1.5	31.57	-27.24	3.97	54.00	42.97	11.03
Remark	H : Horizontal, V : Vertical TEST MODE : 802.11 g – CH 6(2 437 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 measure d.								

10.4-12 Test Data

Test Date : 12-Sep-21

Measurement Distance : 3 m

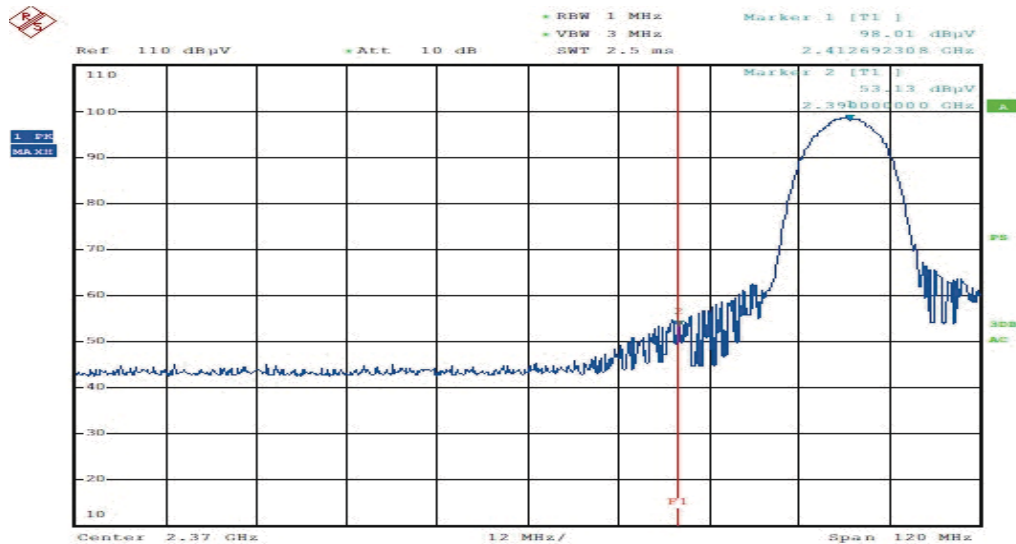
Frequency (MHz)	Reading (dBμV)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dBμV/m)	Result (dBμV/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
2483.50	53.98	H	1.6	27.48	-29.75		74.00	51.71	22.29
2483.50	50.16	V	1.5	27.48	-29.75		74.00	47.89	26.11
3220.00	51.56	H	1.5	28.68	-29.19		74.00	51.05	22.95
3220.00	49.64	V	1.6	28.68	-29.19		74.00	49.13	24.87
4924.00	51.60	H	1.6	31.62	-27.21		74.00	56.01	17.99
4924.00	47.60	V	1.5	31.62	-27.21		74.00	52.01	21.99
AV(RBW: 1 MHz VBW: 3 MHz)									
2483.50	35.74	H	1.6	27.48	-29.75	3.97	54.00	37.44	16.56
2483.50	35.43	V	1.5	27.48	-29.75	3.97	54.00	37.13	16.87
3220.00	43.20	H	1.5	28.68	-29.19	3.97	54.00	46.66	7.34
3220.00	39.59	V	1.6	28.68	-29.19	3.97	54.00	43.05	10.95
4924.00	34.59	H	1.6	31.62	-27.21	3.97	54.00	42.97	11.03
4924.00	34.60	V	1.5	31.62	-27.21	3.97	54.00	42.98	11.02
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 measure d.								

10.4-13 Restricted Band Edges *802.11g Mode

Band Edges(CH Low)

Detector mode:Peak

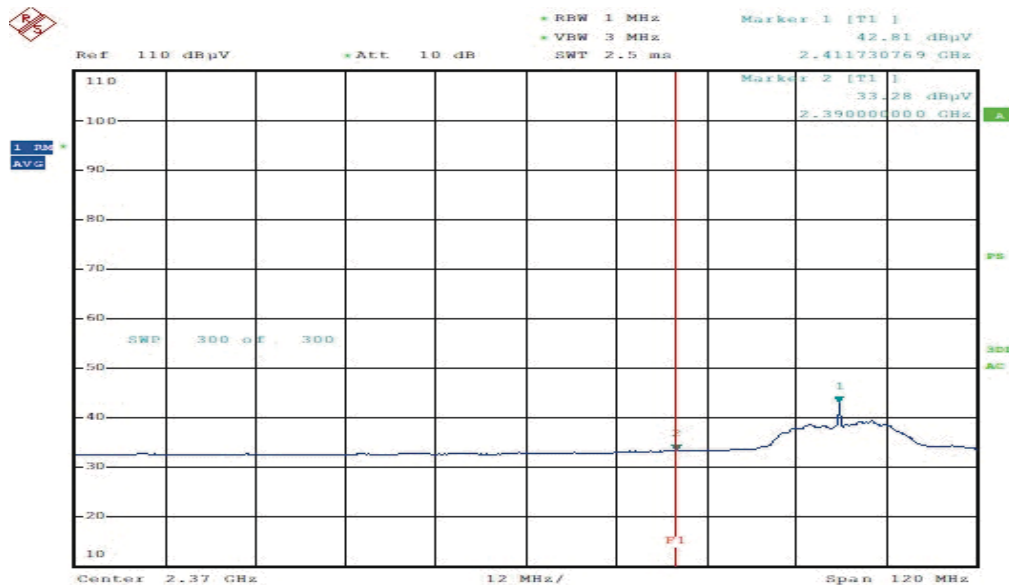
Polarity:Horizontal



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Detector mode:Average

Polarity:Horizontal

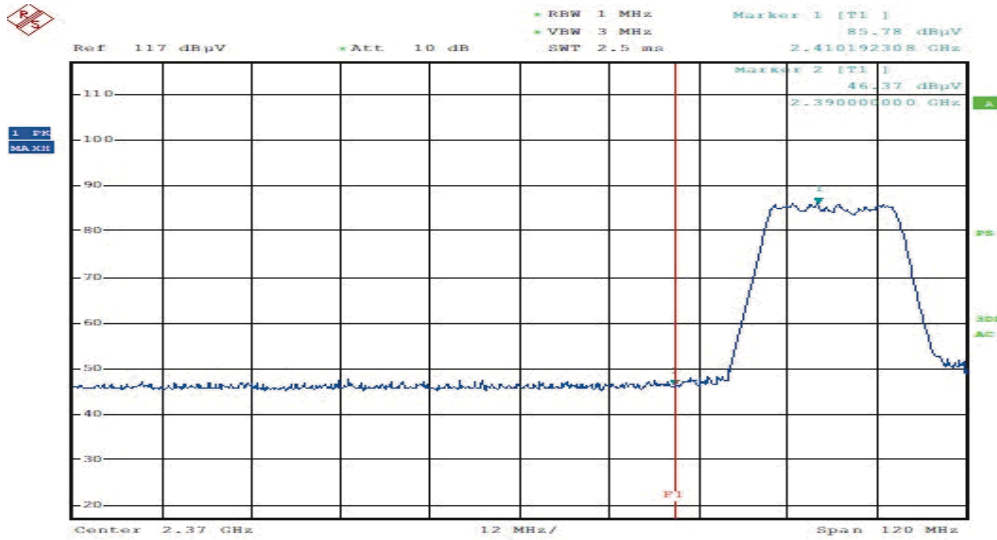


ESTR-21-00238

Band Edges(CH Low)

Detector mode:Peak

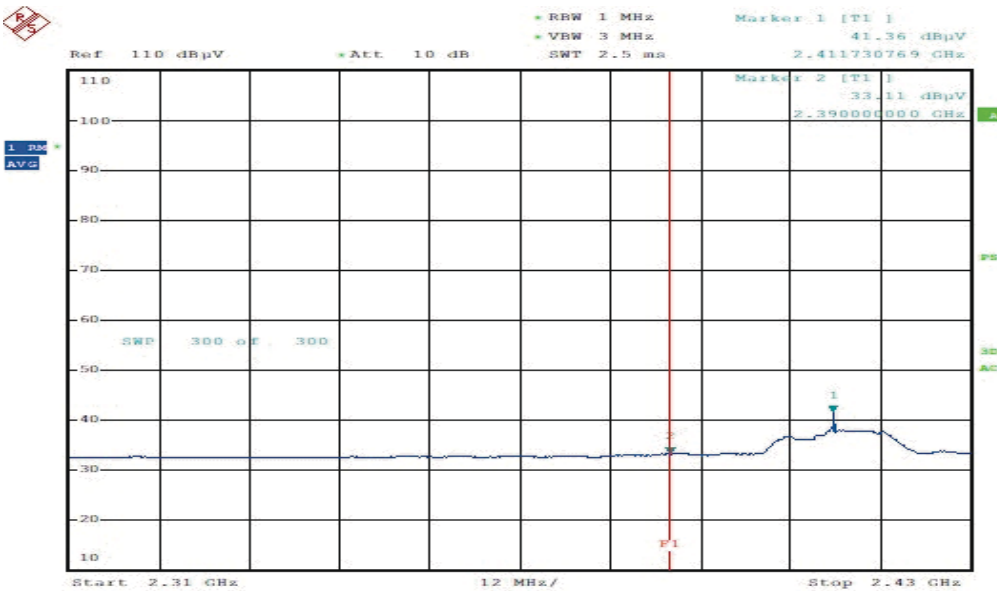
Polarity:Vertical



ESTR-21-00238

Detector mode:Average

Polarity:Vertical

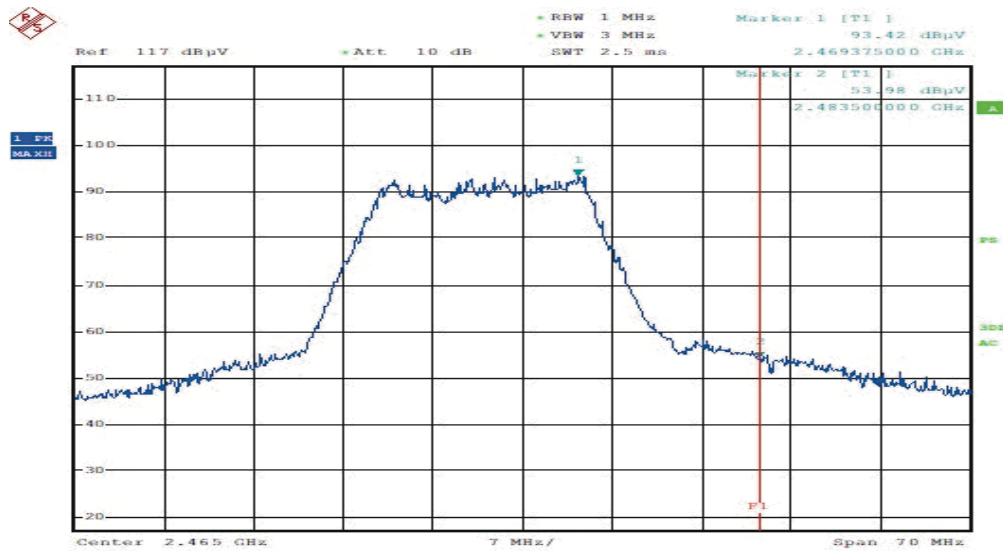


ESTR-21-00238

Band Edges(CH High)

Detector mode:Peak

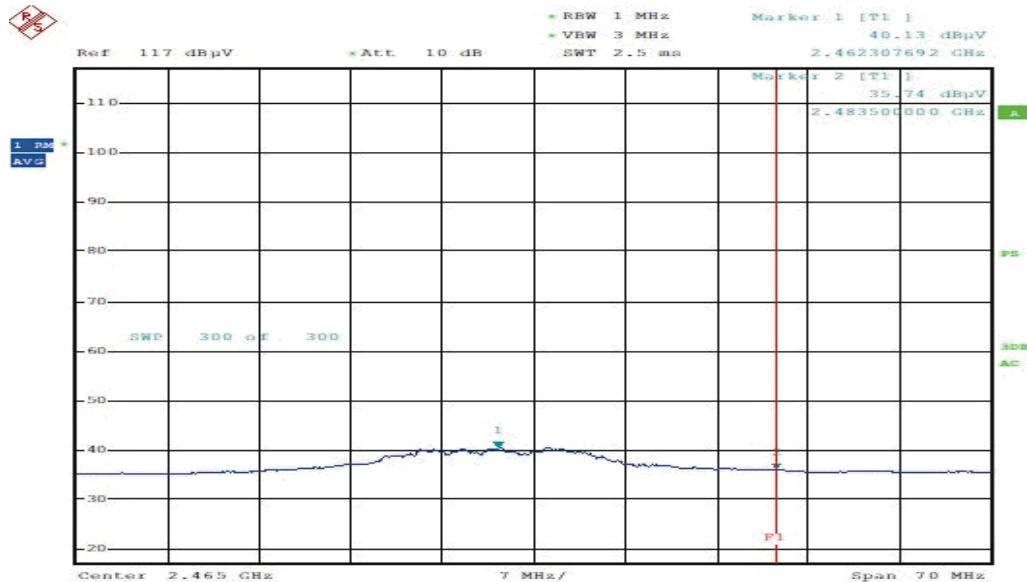
Polarity:Horizontal



ESTR-21-00238

Detector mode:Average

Polarity:Horizontal

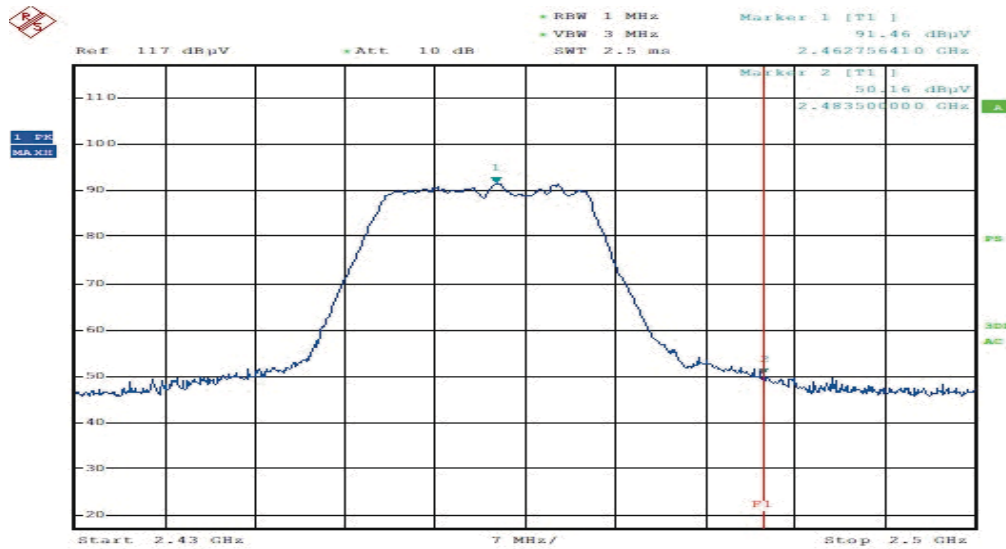


ESTR-21-00238

Band Edges(CH High)

Detector mode:Peak

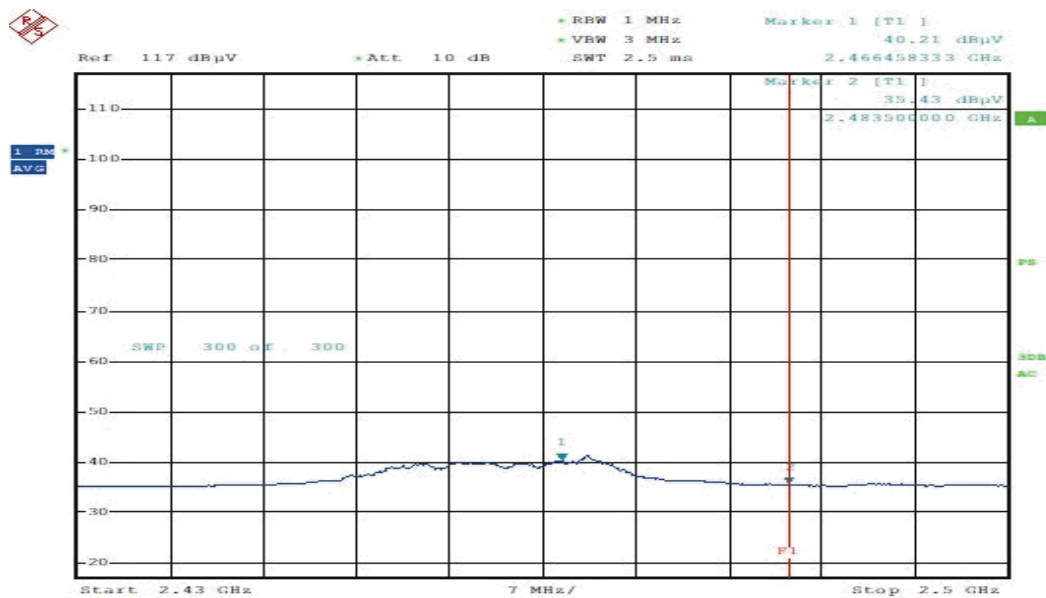
Polarity:Vertical



ESTR-21-00238

Detector mode:Average

Polarity:Vertical

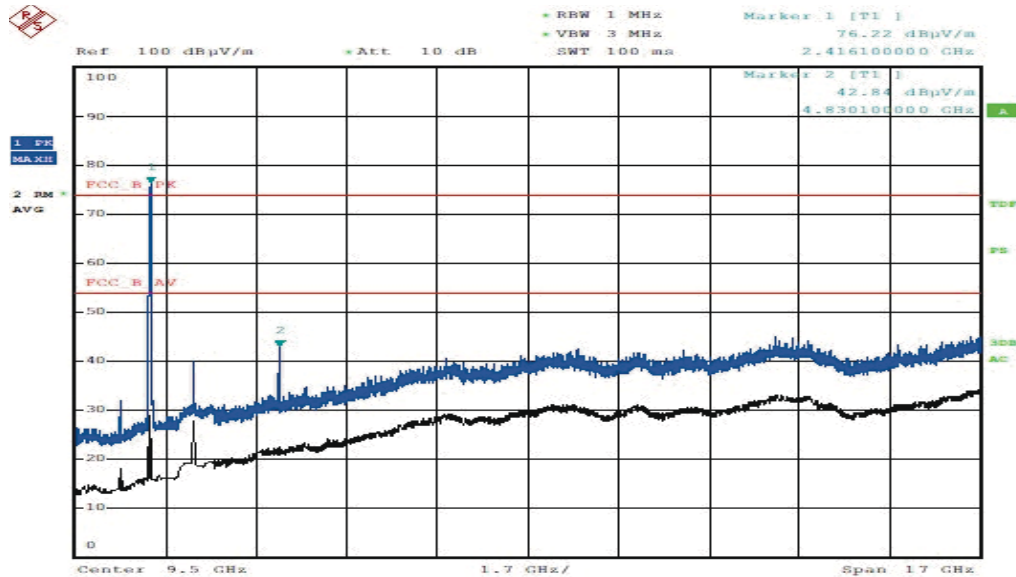


ESTR-21-00238

10.4–14 Restricted Band Edges

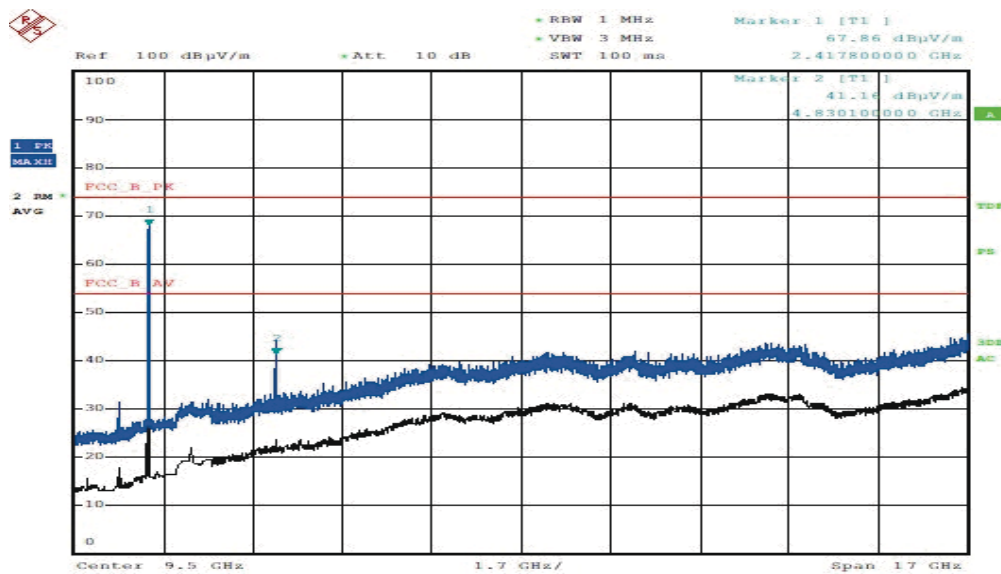
*802.11g Mode CH1

Polarity:Horizontal



ESTR-21-00238

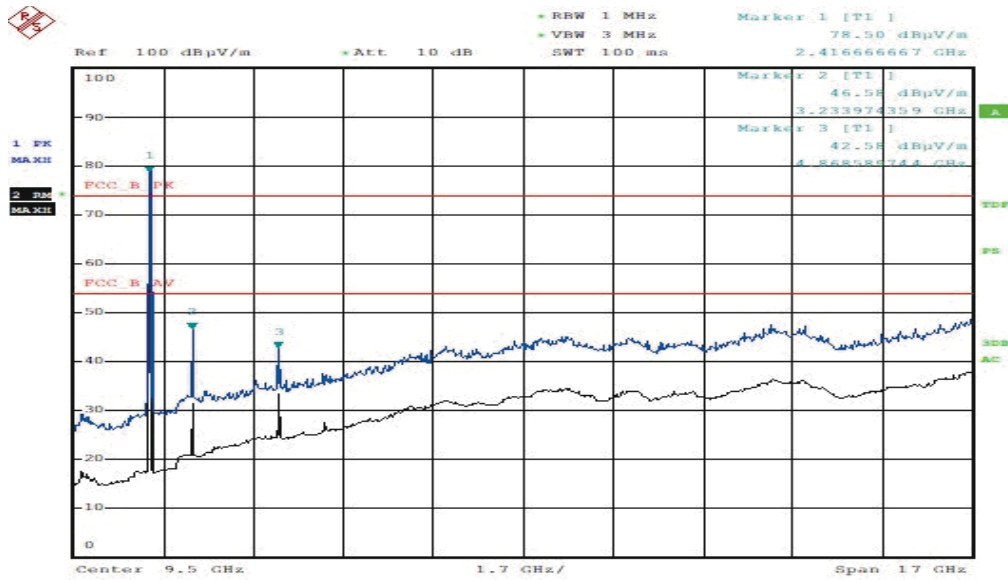
Polarity:Vertical



ESTR-21-00238

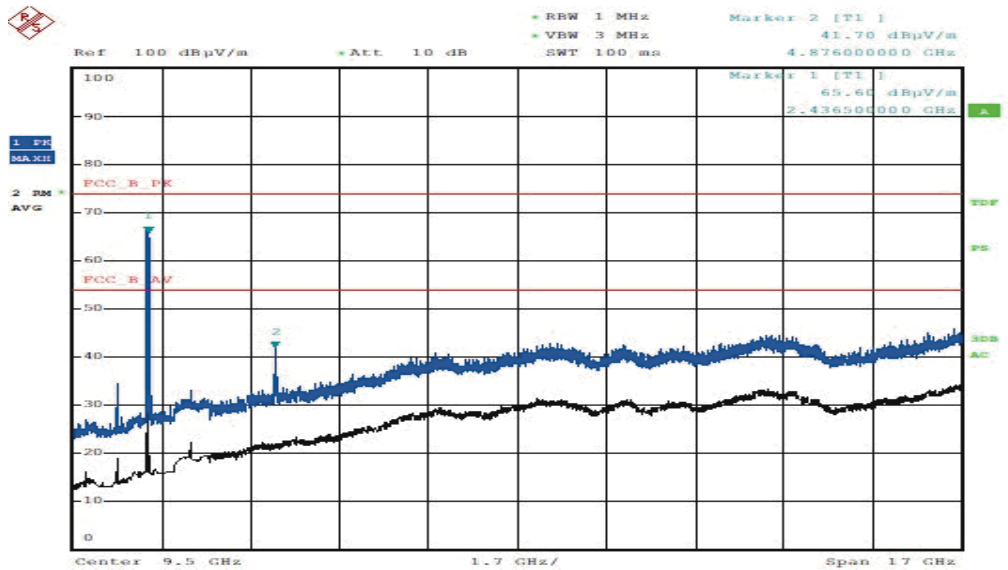
*802.11g Mode CH6

Polarity:Horizontal



ESTR-21-00238

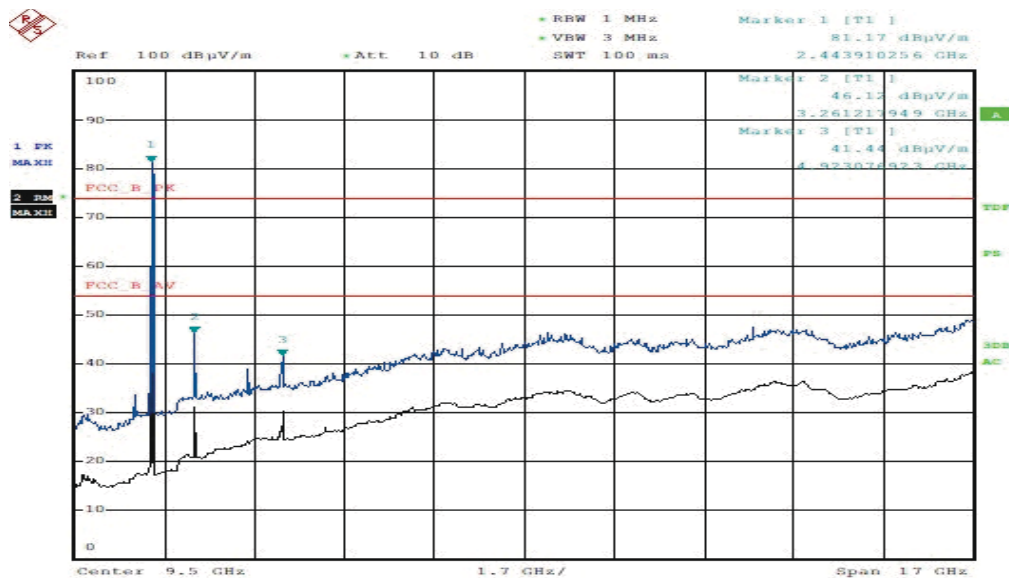
Polarity:Vertical



ESTR-21-00238

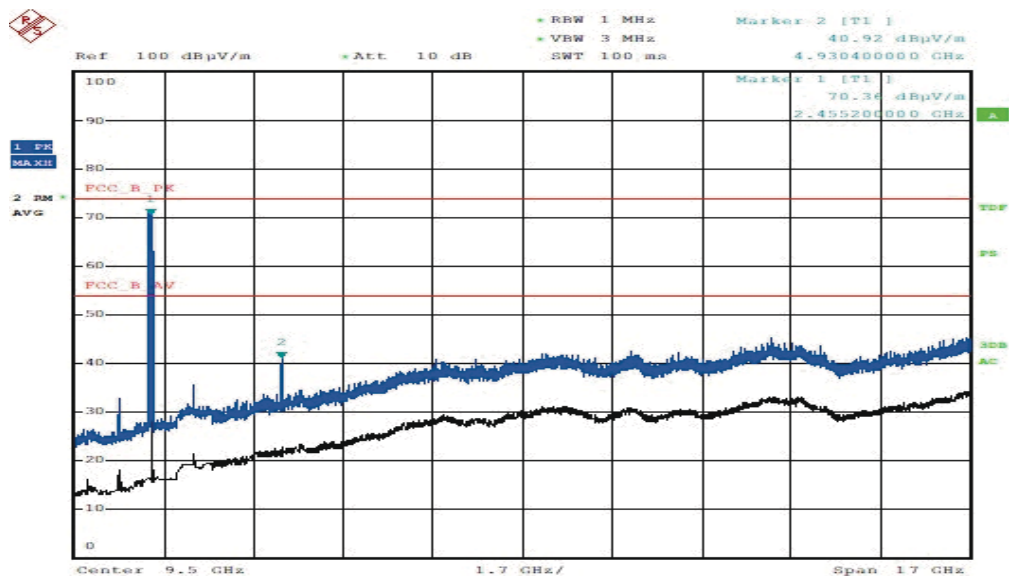
*802.11g Mode CH11

Polarity:Horizontal



ESTR-21-00238

Polarity:Vertical



ESTR-21-00238

10.4–15 Test Data (802.11 n20)

Test Date : 6-Sep-21

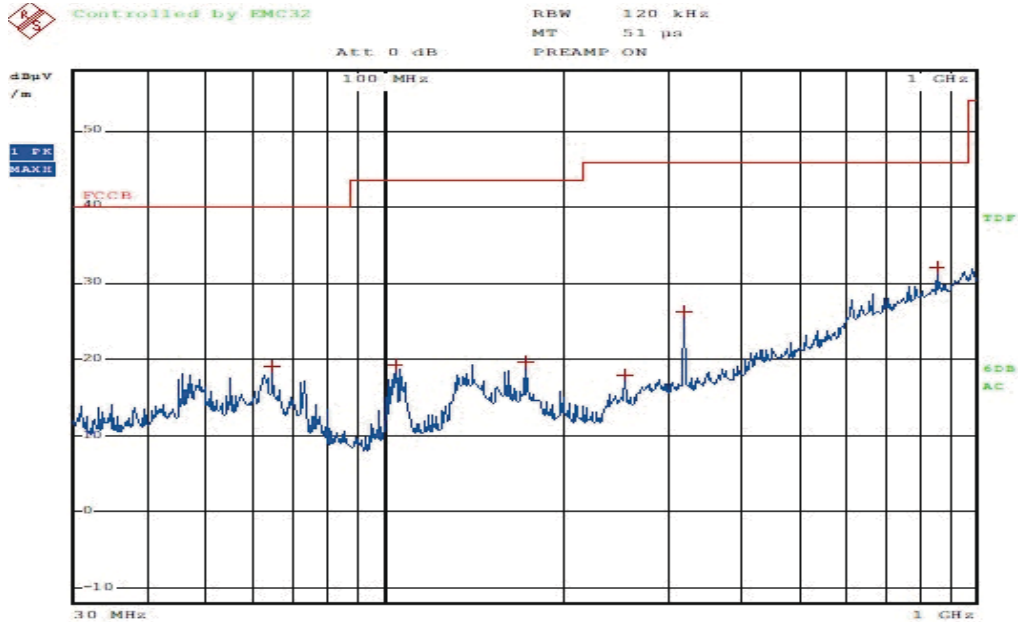
Measurement Distance : 3 m

Frequency (MHz)	Reading (dB μ V)	Position (V/H)	Height (m)	Correction Factor		Result Value		
				Ant Factor (dB)	Cable (dB)	Limit (dB μ V/m)	Result (dB μ V/m)	Margin (dB)
46.90	17.51	V	1.0	13.42	0.91	40.00	31.84	8.16
72.70	18.16	V	1.0	11.84	1.10	40.00	31.10	8.90
106.70	13.40	V	1.0	9.43	1.34	43.50	24.17	19.33
137.60	19.17	V	1.4	12.14	1.57	43.50	32.88	10.62
320.00	11.62	H	1.2	14.00	2.48	46.00	28.10	17.90
854.30	5.18	H	1.0	22.69	4.33	46.00	32.20	13.80
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.							

10.4-16 radiated Graph(30 MHz ~ 1 GHz)

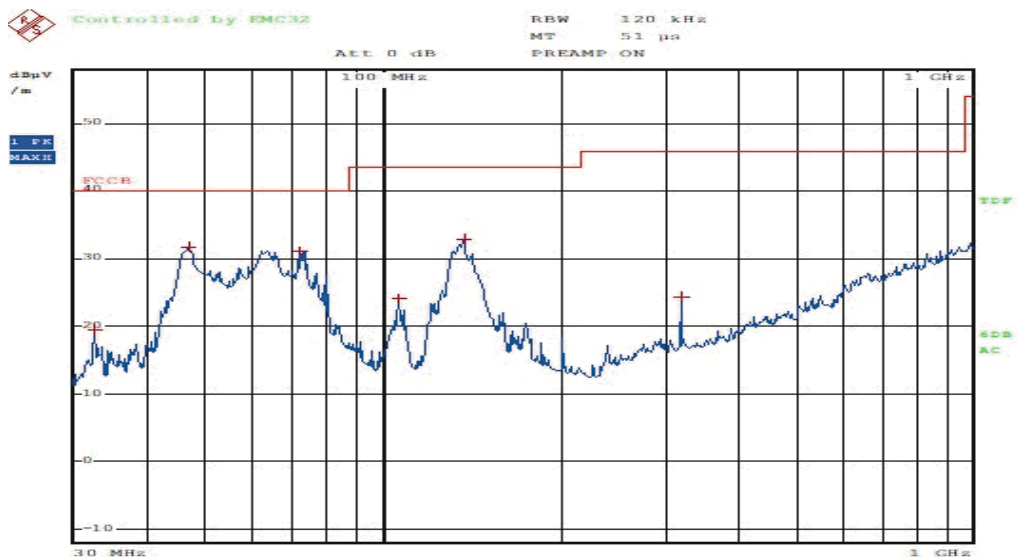
*802.11n20 Mode

Polarity:Horizontal



ESTR-21-00238

Polarity:Vertical



ESTR-21-00238

10.4-17 Test Data

Test Date : 13-Sep-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	48.38	H	1.5	27.89	-29.82		74.00	46.45	27.55
2390.00	44.47	V	1.5	27.89	-29.82		74.00	42.54	31.46
3220.00	51.00	H	1.5	28.68	-29.19		74.00	50.49	23.51
3220.00	49.40	V	1.6	28.68	-29.19		74.00	48.89	25.11
4824.00	50.59	H	1.6	31.52	-27.27		74.00	54.84	19.16
4824.00	46.59	V	1.6	31.52	-27.27		74.00	50.84	23.16
AV(RBW: 1 MHz VBW: 3 MHz)									
2390.00	33.28	H	1.5	27.89	-29.82	3.66	54.00	35.01	19.00
2390.00	33.11	V	1.5	27.89	-29.82	3.66	54.00	34.84	19.17
3220.00	45.21	H	1.5	28.68	-29.19	3.66	54.00	48.36	5.65
3220.00	40.98	V	1.6	28.68	-29.19	3.66	54.00	44.13	9.88
4824.00	35.12	H	1.6	31.52	-27.27	3.66	54.00	43.03	10.98
4824.00	34.89	V	1.6	31.52	-27.27	3.66	54.00	42.80	11.21
Remark	H : Horizontal, V : Vertical TEST MODE : 802.11 n20 – 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 measure d.								

10.4-18 Test Data

Test Date : 18-Mar-21

Measurement Distance : 3 m

Frequency (MHz)	Reading (dB μ V)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μ V/m)	Result (dB μ V/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
3220.00	51.36	H	1.5	28.68	-29.19		74.00	50.85	23.15
3220.00	49.66	V	1.6	28.68	-29.19		74.00	49.15	24.85
4874.00	48.00	H	1.5	31.57	-27.24		74.00	52.33	21.67
4874.00	43.52	V	1.5	31.57	-27.24		74.00	47.85	26.15
AV(RBW: 1 MHz VBW: 3 MHz)									
3220.00	43.20	H	1.5	28.68	-29.19	3.66	54.00	46.35	7.66
3220.00	39.97	V	1.6	28.68	-29.19	3.66	54.00	43.12	10.89
4874.00	34.69	H	1.5	31.57	-27.24	3.66	54.00	42.68	11.33
4874.00	35.00	V	1.5	31.57	-27.24	3.66	54.00	42.99	11.02
Remark	H : Horizontal, V : Vertical TEST MODE : 802.11 n20 – CH 6(2 437 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.								

10.4-19 Test Data

Test Date : 18-Mar-21

Measurement Distance : 3 m

Frequency (MHz)	Reading (dB μ V)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μ V/m)	Result (dB μ V/m)	Margin (dB)
PEAK(RBW: 1 MHz VBW: 3 MHz)									
2483.50	55.30	H	1.6	27.48	-29.75		74.00	53.03	20.97
2483.50	49.74	V	1.5	27.48	-29.75		74.00	47.47	26.53
3220.00	51.34	H	1.5	28.68	-29.19		74.00	50.83	23.17
3220.00	50.10	V	1.6	28.68	-29.19		74.00	49.59	24.41
4924.00	51.34	H	1.6	31.62	-27.21		74.00	55.75	18.25
4924.00	47.82	V	1.5	31.62	-27.21		74.00	52.23	21.77
AV(RBW: 1 MHz VBW: 3 MHz)									
2483.50	35.57	H	1.6	27.48	-29.75	3.66	54.00	36.96	17.05
2483.50	35.46	V	1.5	27.48	-29.75	3.66	54.00	36.85	17.16
3220.00	44.10	H	1.5	28.68	-29.19	3.66	54.00	47.25	6.76
3220.00	40.90	V	1.6	28.68	-29.19	3.66	54.00	44.05	9.96
4924.00	36.00	H	1.6	31.62	-27.21	3.66	54.00	44.07	9.94
4924.00	35.60	V	1.5	31.62	-27.21	3.66	54.00	43.67	10.34
Remark	H : Horizontal, V : Vertical TEST MODE : 802.11n20 – 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.								

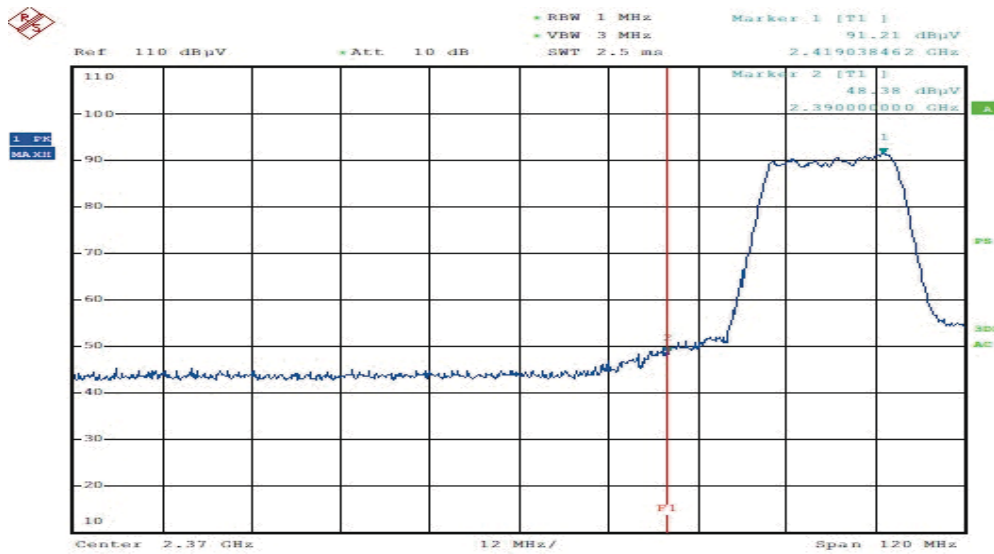
10.4–20 Restricted Band Edges

*802.11n20 Mode

Band Edges(CH Low)

Detector mode:Peak

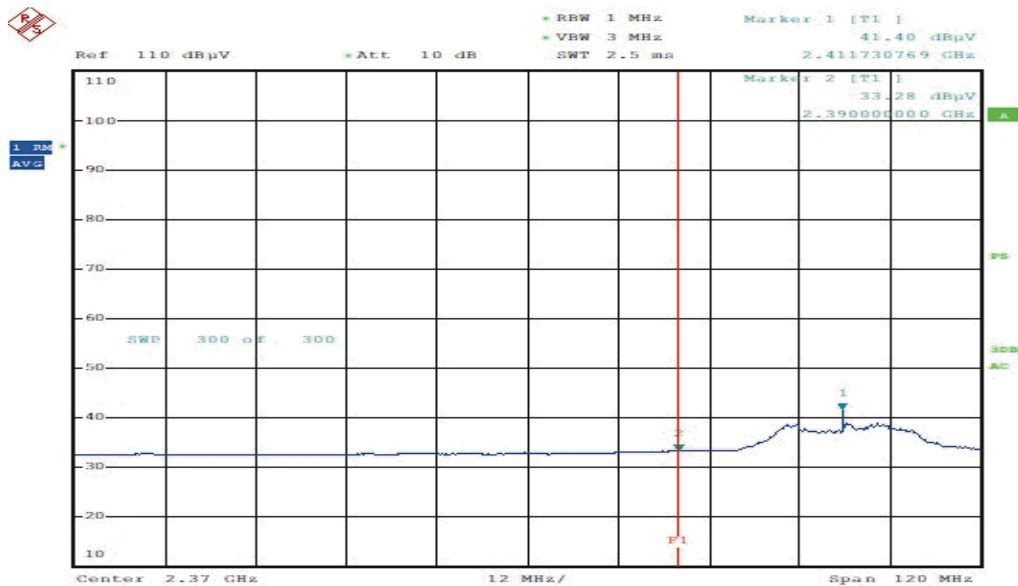
Polarity:Horizontal



ESTR-21-00238

Detector mode:Average

Polarity:Horizontal

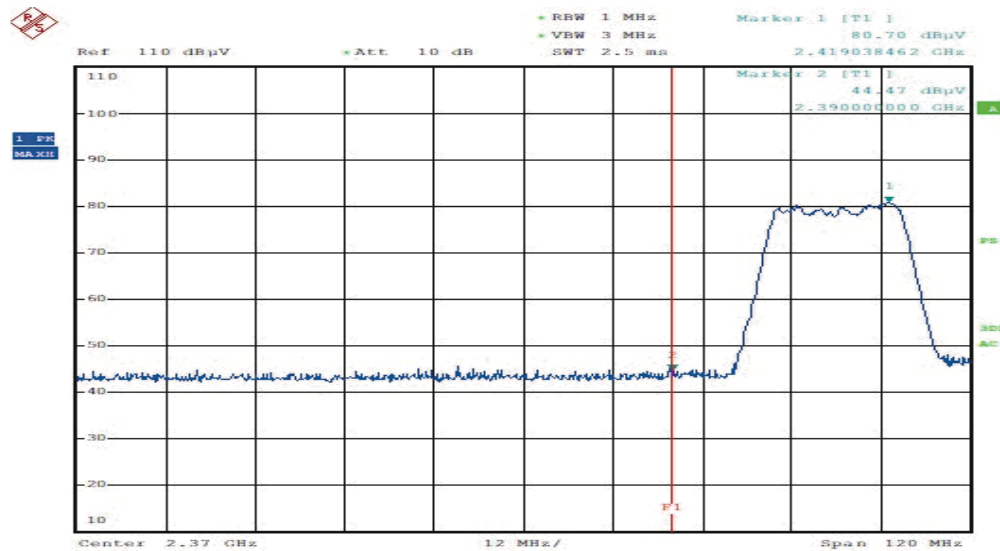


ESTR-21-00238

Band Edges(CH Low)

Detector mode:Peak

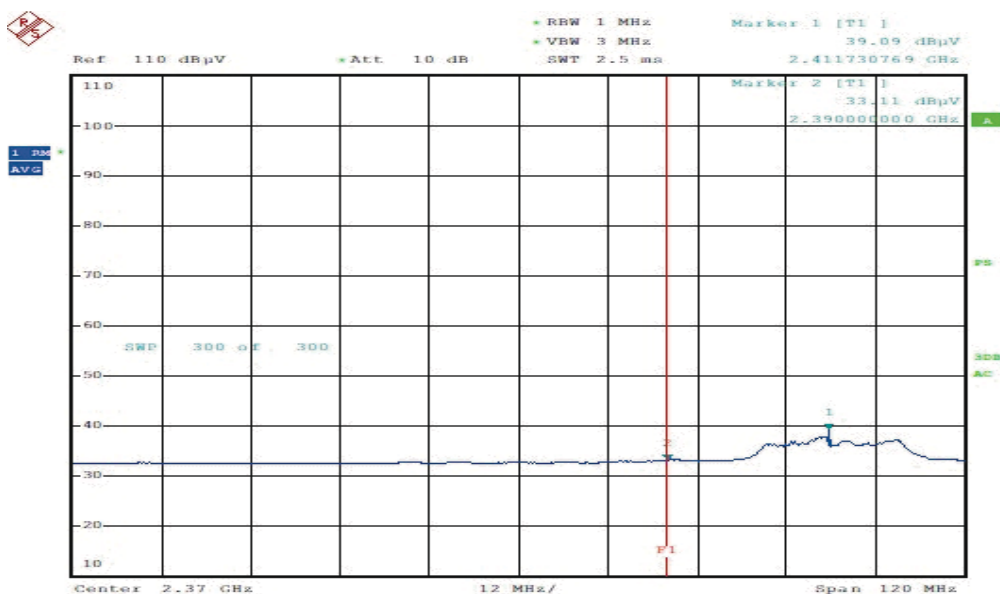
Polarity:Vertical



ESTR-21-00238

Detector mode:Average

Polarity:Vertical

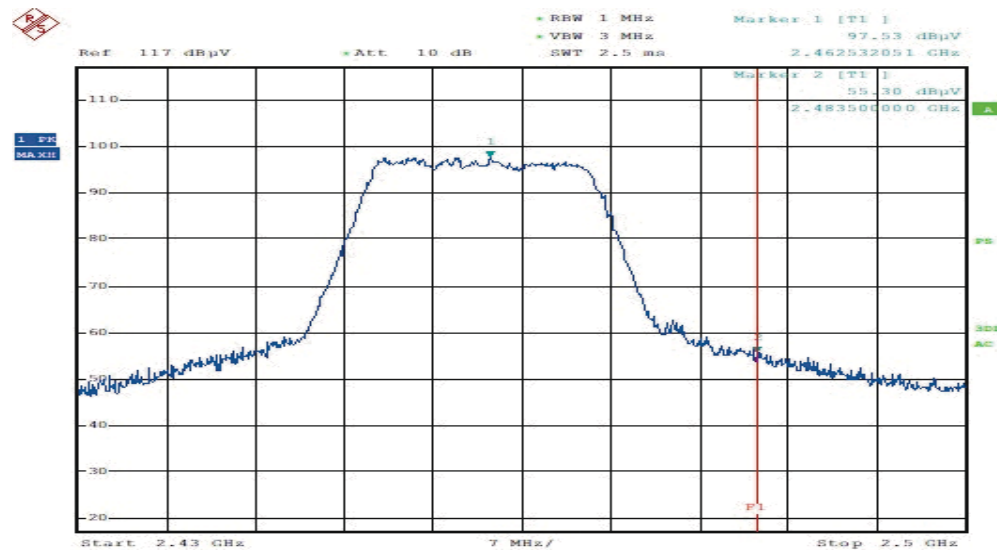


ESTR-21-00238

Band Edges(CH High)

Detector mode:Peak

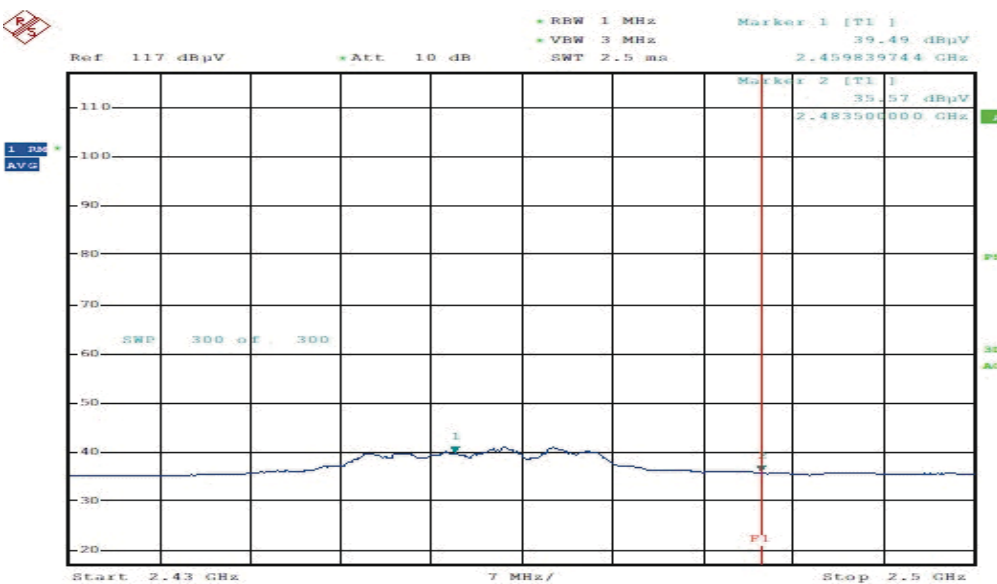
Polarity:Horizontal



ESTR-21-00238

Detector mode:Average

Polarity:Horizontal

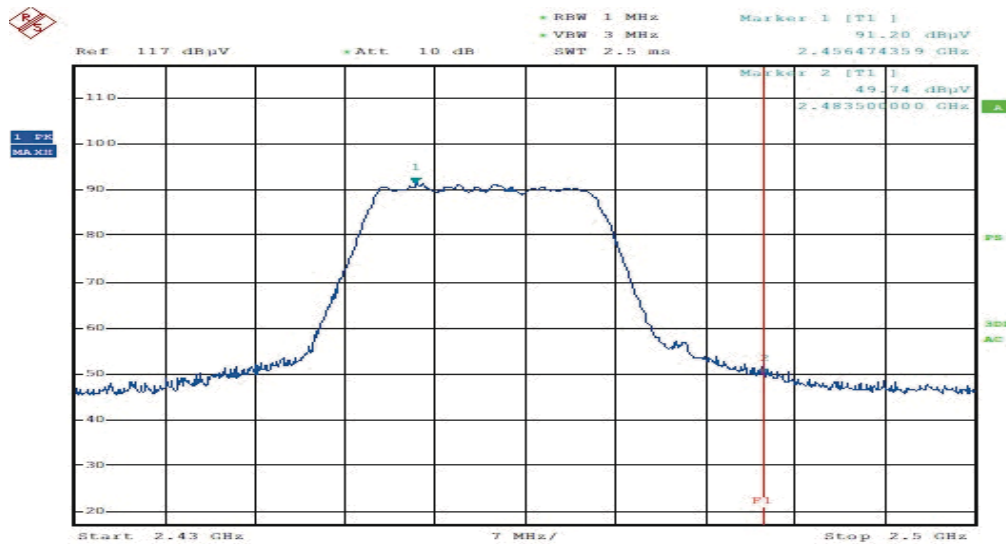


ESTR-21-00238

Band Edges(CH High)

Detector mode:Peak

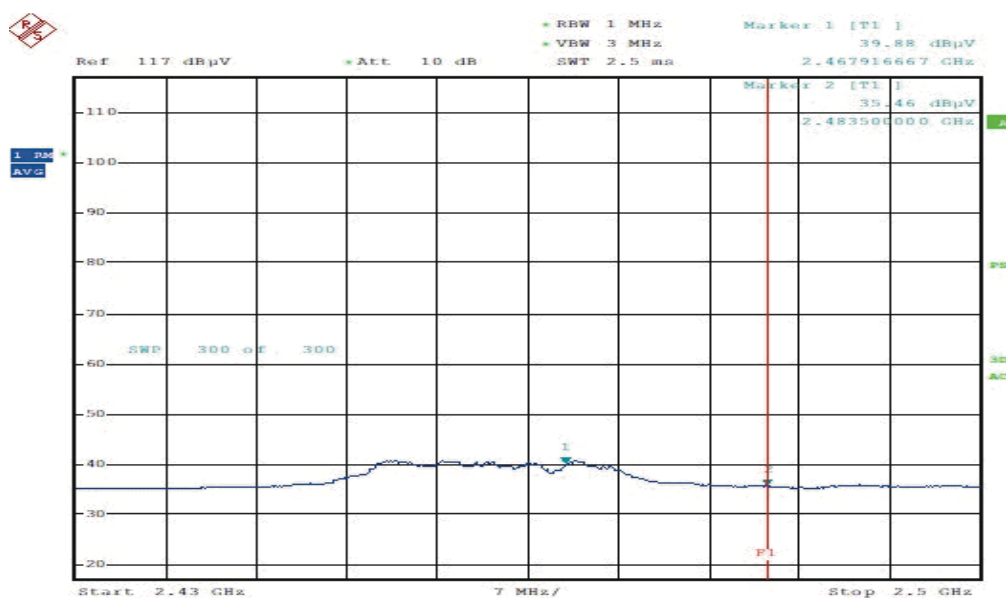
Polarity:Vertical



ESTR-21-00238

Detector mode:Average

Polarity:Vertical

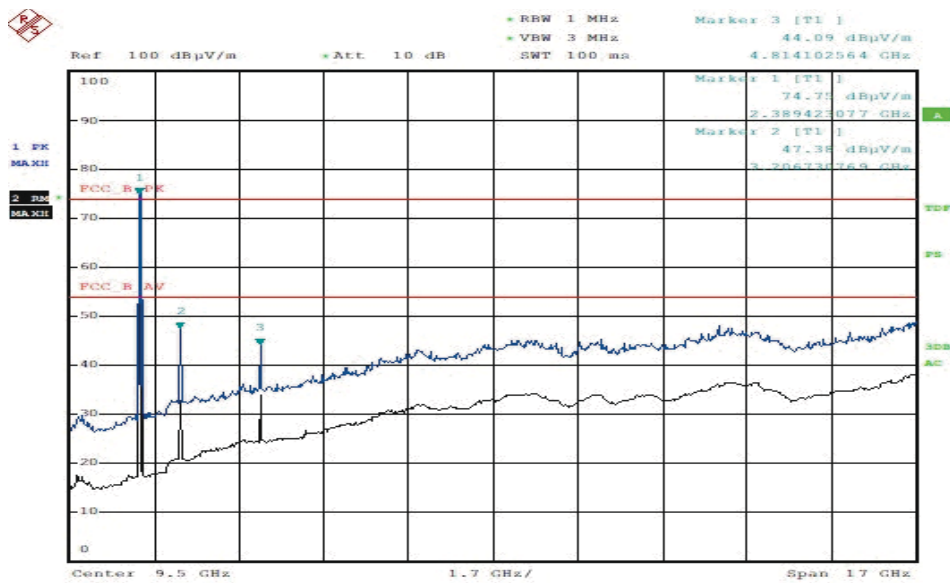


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10.4–21 Restricted Band Edges

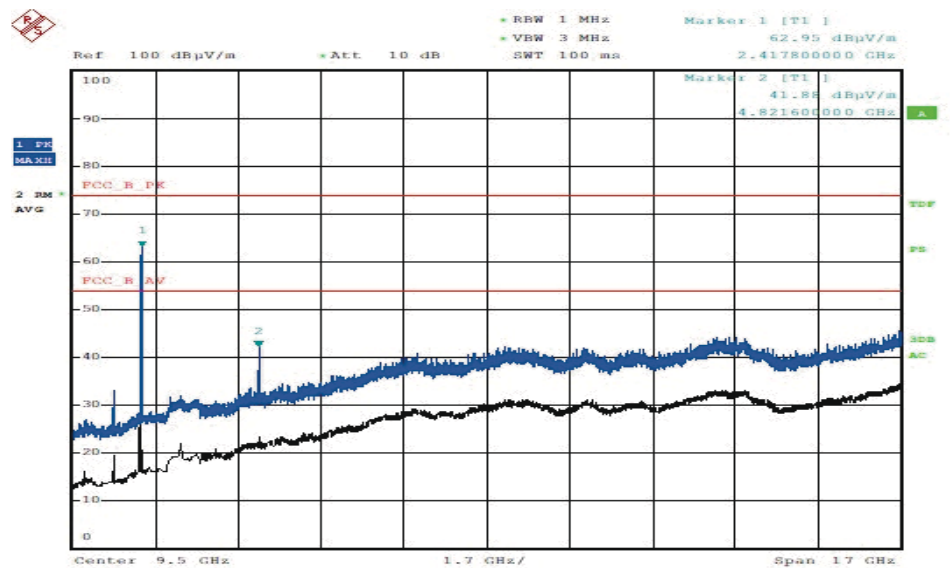
*802.11n20 Mode CH1

Polarity:Horizontal



ESTR-21-00238

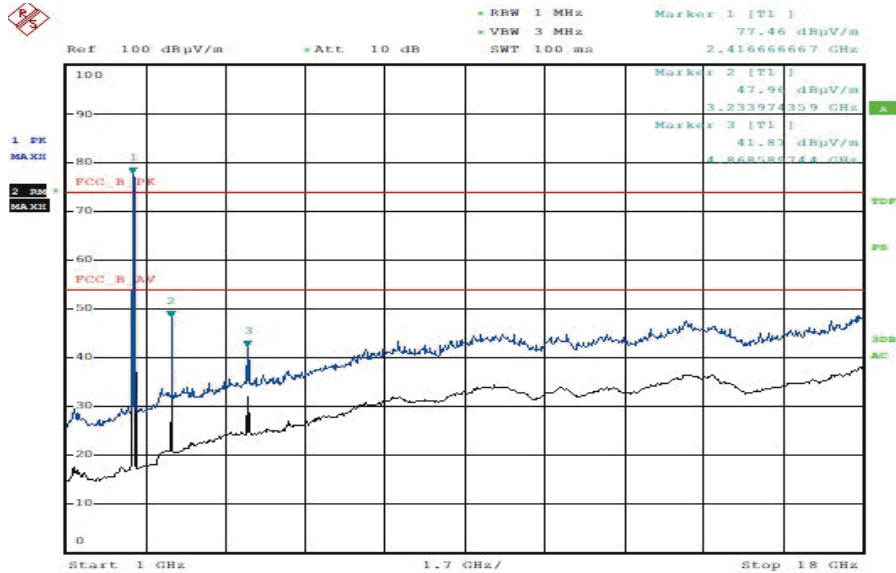
Polarity:Vertical



ESTR-21-00238

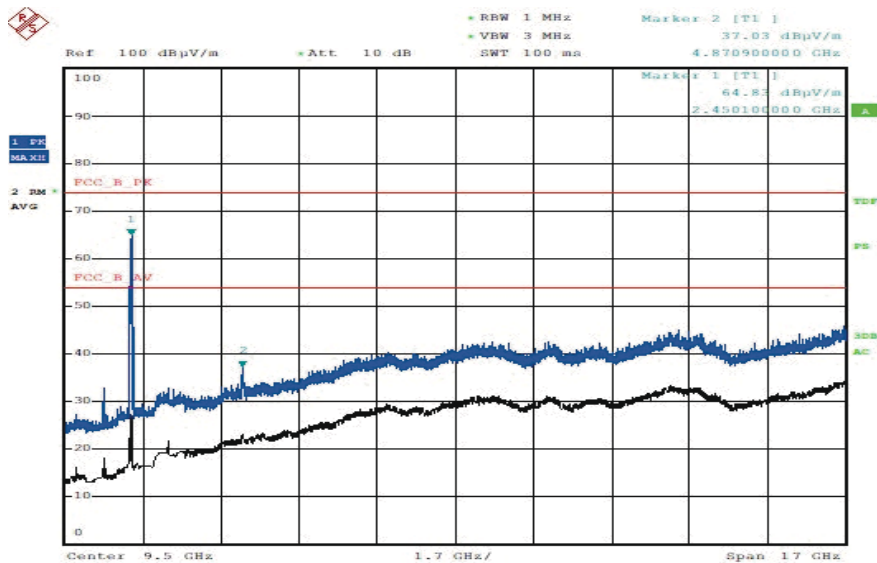
*802.11n20 Mode CH6

Polarity:Horizontal



ESTR-21-00238

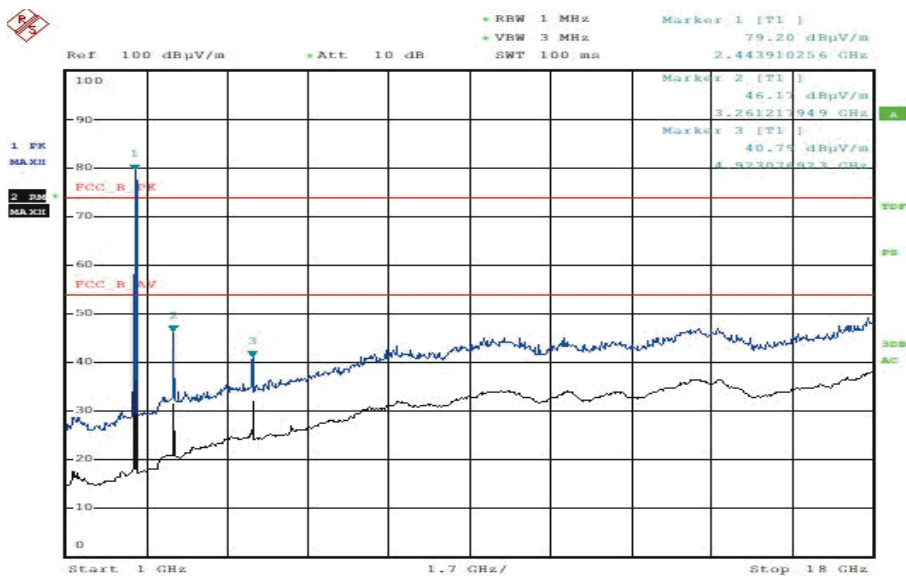
Polarity:Vertical



ESTR-21-00238

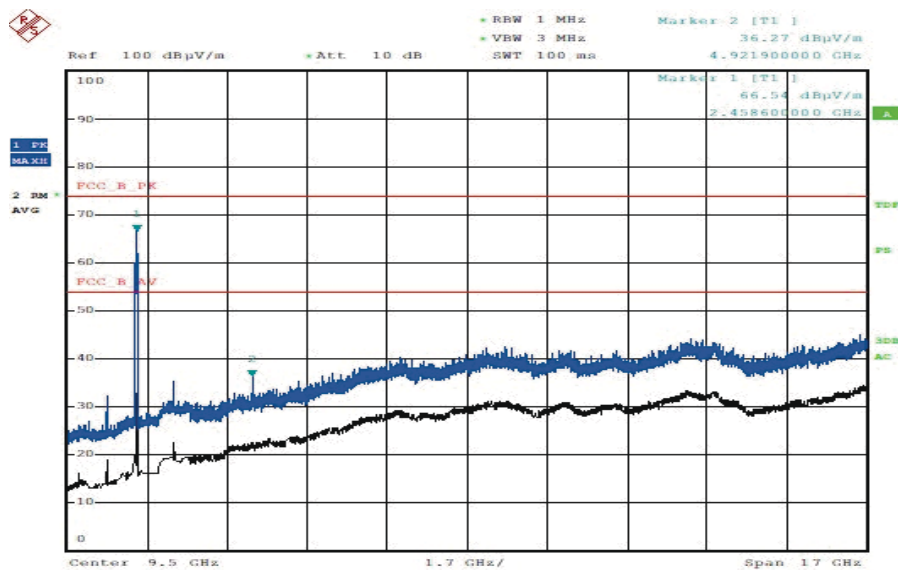
*802.11n20 Mode CH11

Polarity:Horizontal



ESTR-21-00238

Polarity:Vertical



ESTR-21-00238

10.4-22 Test Data (802.11 n40)

Test Date : 6-Sep-21

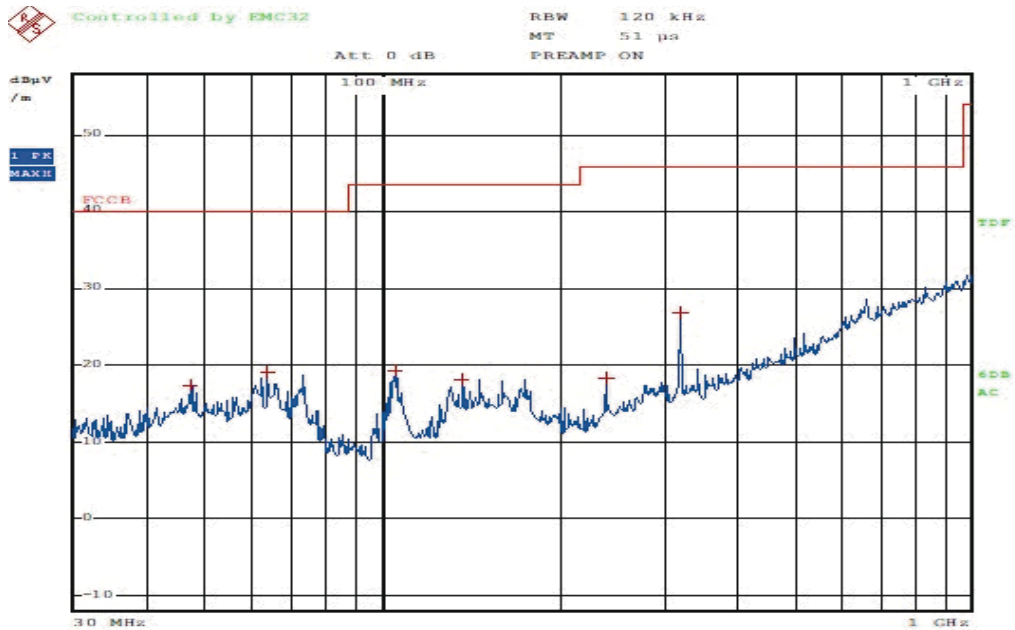
Measurement Distance : 3 m

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)
46.30	17.81	V	1.0	13.41	0.91	40.00	32.13	7.87
61.80	17.24	V	1.0	13.22	1.03	40.00	31.49	8.51
104.80	13.55	V	1.0	8.80	1.30	43.50	23.66	19.84
137.30	19.24	V	1.1	12.13	1.57	43.50	32.95	10.55
174.80	13.65	V	1.2	12.57	1.78	43.50	28.00	15.50
320.00	13.22	V	1.6	14.00	2.48	46.00	29.70	16.30
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.							

10.4-23 radiated Graph(30 MHz ~ 1 GHz)

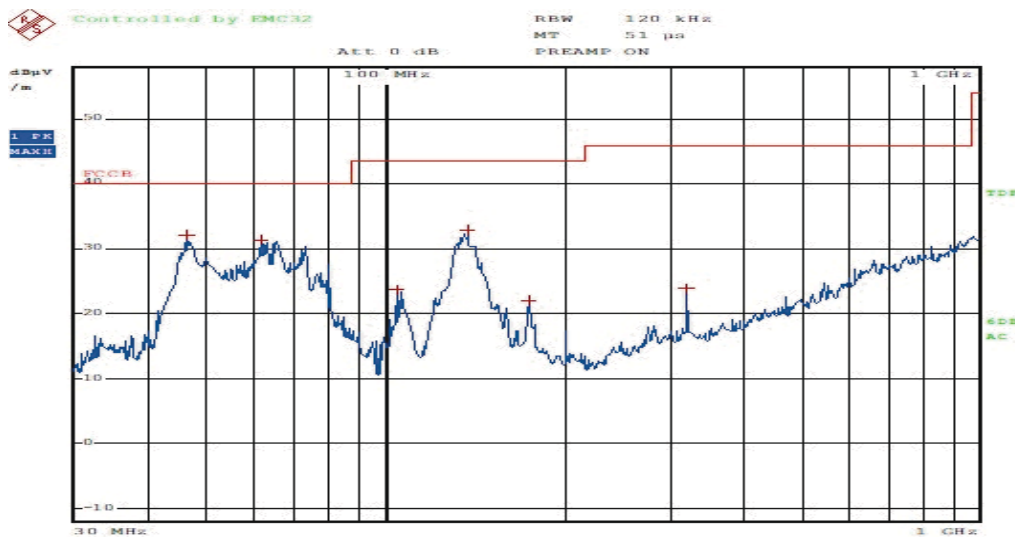
*802.11n Mode

Polarity:Horizontal



ESTR-21-00238

Polarity:Vertical



ESTR-21-00238

10.4-24 Test Data

Test Date : 14-Sep-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	47.16	H	1.5	27.89	-29.82		74.00	45.23	28.77
2390.00	42.98	V	1.6	27.89	-29.82		74.00	41.05	32.95
3220.00	50.48	H	1.5	28.68	-29.19		74.00	49.97	24.03
3220.00	46.52	V	1.6	28.68	-29.19		74.00	46.01	27.99
4844.00	47.65	H	1.5	31.54	-27.26		74.00	51.93	22.07
4844.00	44.52	V	1.6	31.54	-27.26		74.00	48.80	25.20
AV(RBW: 1 MHz VBW: 3 MHz)									
2390.00	33.23	H	1.5	27.89	-29.82	3.87	54.00	35.17	18.83
2390.00	33.07	V	1.6	27.89	-29.82	3.87	54.00	35.01	18.99
3220.00	42.60	H	1.5	28.68	-29.19	3.87	54.00	45.96	8.04
3220.00	38.98	V	1.6	28.68	-29.19	3.87	54.00	42.34	11.66
4844.00	33.25	H	1.5	31.54	-27.26	3.87	54.00	41.40	12.60
4844.00	33.65	V	1.6	31.54	-27.26	3.87	54.00	41.80	12.20
Remark	H : Horizontal, V : Vertical TEST MODE : 802.11n40 - CH 3(2 422 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 measure d.								

10.4-25 Test Data

Test Date : 14-Sep-21

Measurement Distance : 3 m

Frequency (MHz)	Reading (dB μ V)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μ V/m)	Result (dB μ V/m)	Margin (dB)
PEAK(RBW: 100 kHz VBW: 300 kHz)									
3220.00	46.52	H	1.5	28.68	-29.19		74.00	46.01	27.99
3220.00	43.22	V	1.6	28.68	-29.19		74.00	42.71	31.29
4874.00	44.52	H	1.5	31.57	-27.24		74.00	48.85	25.15
4874.00	43.20	V	1.5	31.57	-27.24		74.00	47.53	26.47
AV(RBW: 1 MHz VBW: 3 MHz)									
3220.00	44.32	H	1.5	28.68	-29.19	3.87	54.00	47.68	6.32
3220.00	40.85	V	1.6	28.68	-29.19	3.87	54.00	44.21	9.79
4874.00	33.62	H	1.5	31.57	-27.24	3.87	54.00	41.82	12.18
4874.00	34.12	V	1.5	31.57	-27.24	3.87	54.00	42.32	11.68
Remark	H : Horizontal, V : Vertical TEST MODE : 802.11 n40 – CH 6(2 437 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.								

10.4-26 Test Data

Test Date : 14-Sep-21

Measurement Distance : 3 m

Frequency (MHz)	Reading (dB μ V)	Position (V/H)	Height (m)	Correction Factor		Duty Cycle Correction (dB)	Result Value		
				Ant Factor (dB)	Cable (dB)		Limit (dB μ V/m)	Result (dB μ V/m)	Margin (dB)
PEAK(RBW: 100 kHz VBW: 300 kHz)									
2483.50	72.90	H	1.6	27.48	-29.75		74.00	70.63	3.37
2483.50	69.42	V	1.5	27.48	-29.75		74.00	67.15	6.85
3220.00	50.40	H	1.5	28.68	-29.19		74.00	49.89	24.11
3220.00	48.60	V	1.6	28.68	-29.19		74.00	48.09	25.91
4924.00	47.52	H	1.6	31.67	-27.21		74.00	51.98	22.02
4924.00	46.80	V	1.5	31.67	-27.21		74.00	51.26	22.74
AV(RBW: 1 MHz VBW: 3 MHz)									
2483.50	36.73	H	1.6	27.48	-29.75	3.87	54.00	38.33	15.67
2483.50	37.08	V	1.5	27.48	-29.75	3.87	54.00	38.68	15.32
3220.00	43.25	H	1.5	28.68	-29.19	3.87	54.00	46.61	7.39
3220.00	39.52	V	1.6	28.68	-29.19	3.87	54.00	42.88	11.12
4924.00	33.67	H	1.6	31.67	-27.21	3.87	54.00	42.00	12.00
4924.00	33.59	V	1.5	31.67	-27.21	3.87	54.00	41.92	12.08
Remark	H : Horizontal, V : Vertical TEST MODE : 802.11n40 – 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.								

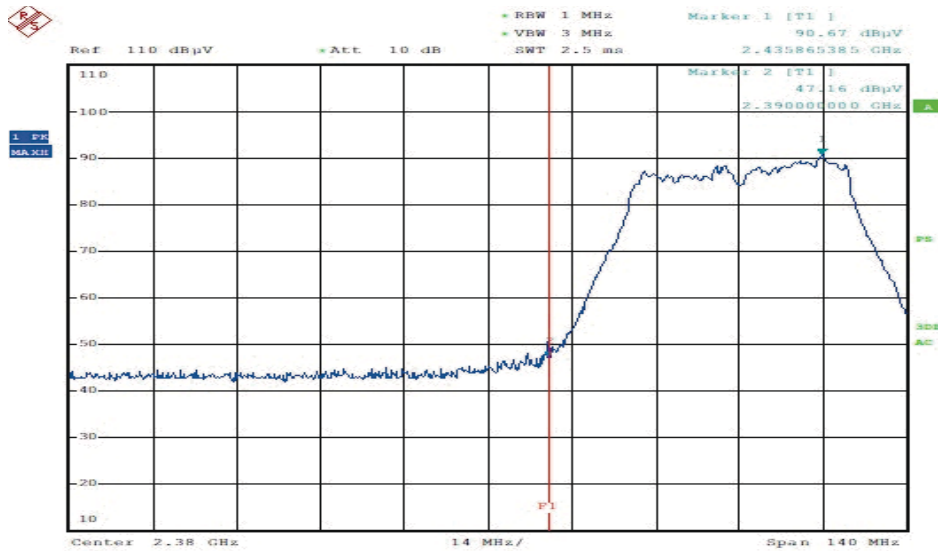
10.4-27 Restricted Band Edges

*802.11n40 Mode

Band Edges(CH Low)

Detector mode:Peak

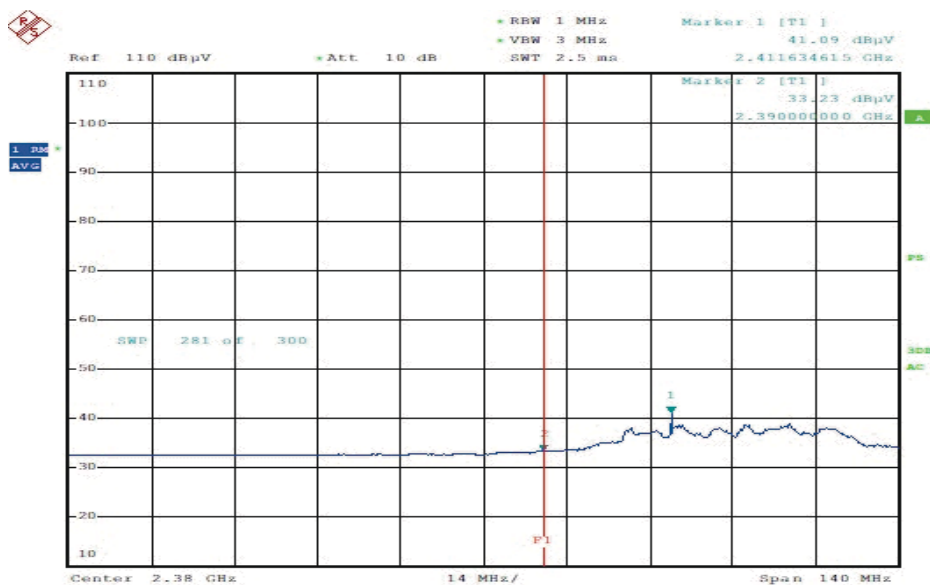
Polarity:Horizontal



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Detector mode:Average

Polarity:Horizontal

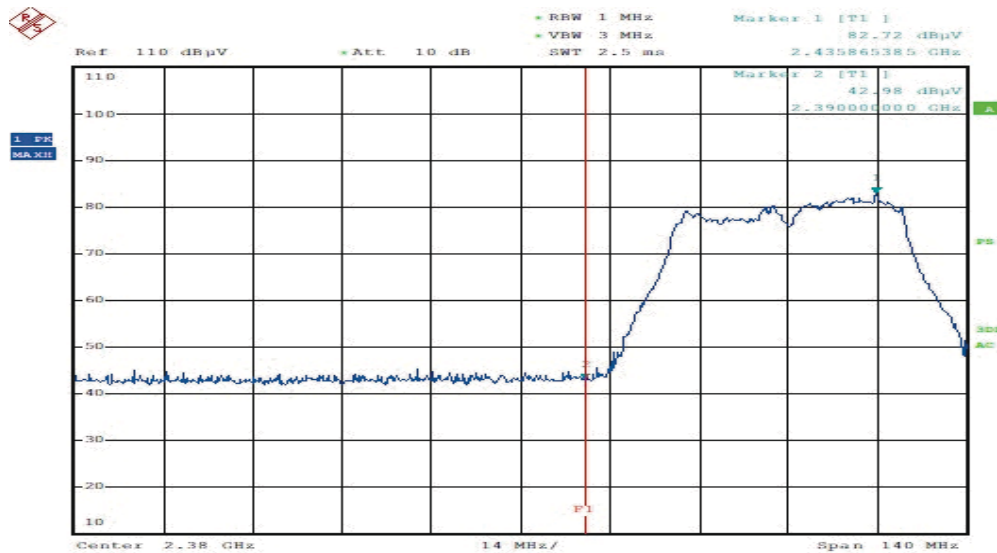


ESTR-21-00238

Band Edges(CH Low)

Detector mode:Peak

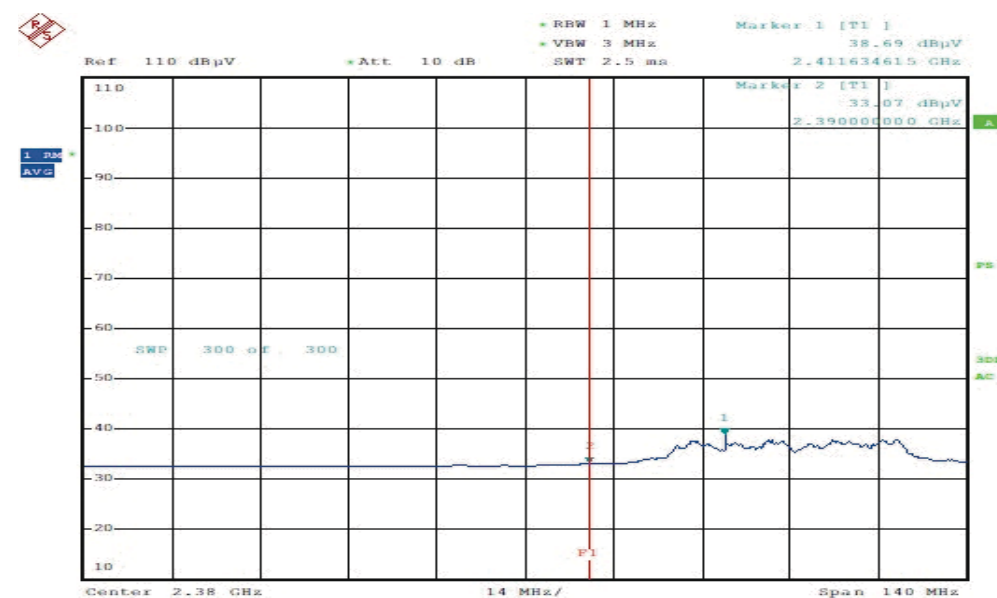
Polarity:Vertical



ESTR-21-00238

Detector mode:Average

Polarity:Vertical

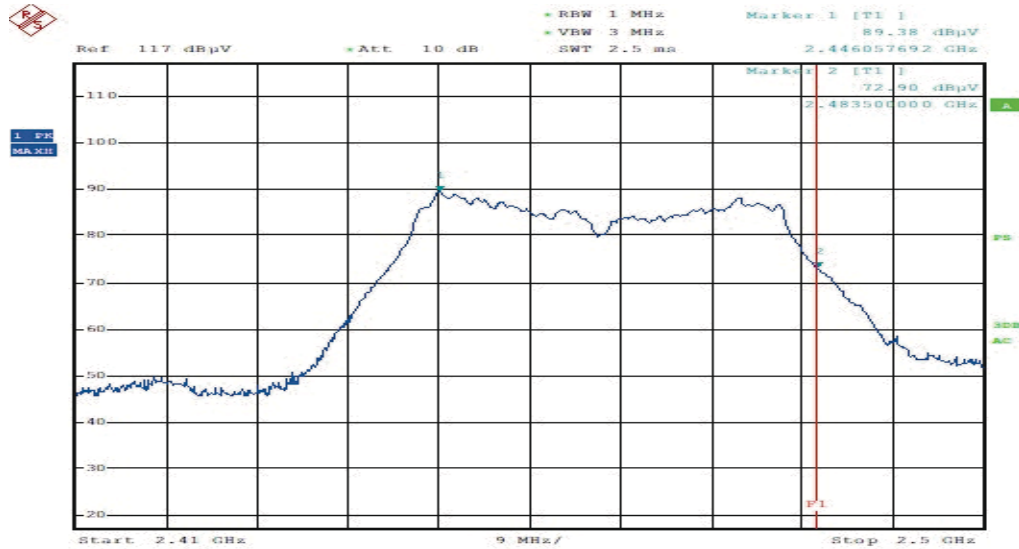


ESTR-21-00238

Band Edges(CH High)

Detector mode:Peak

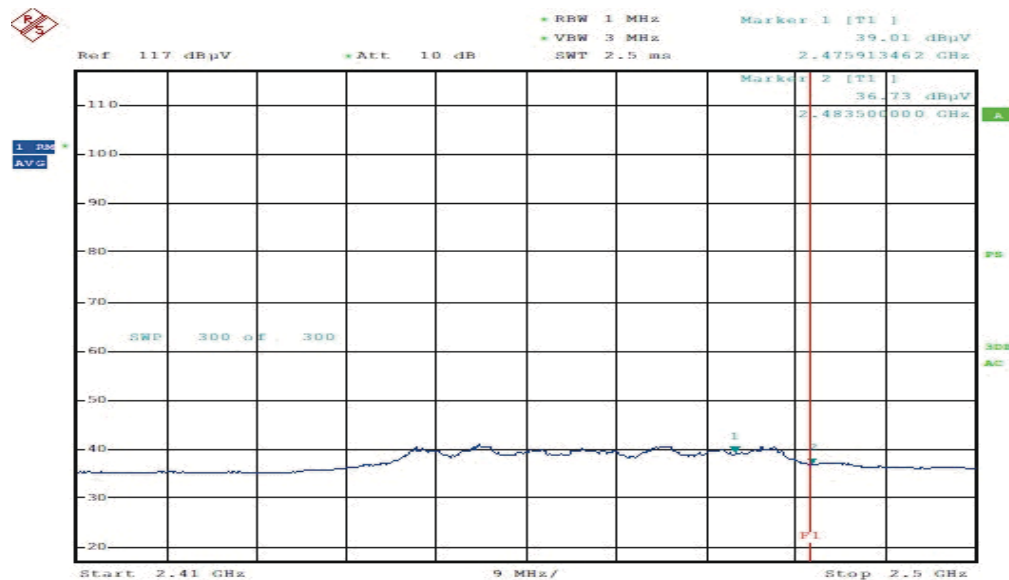
Polarity:Horizontal



ESTR-21-00238

Detector mode:Average

Polarity:Horizontal

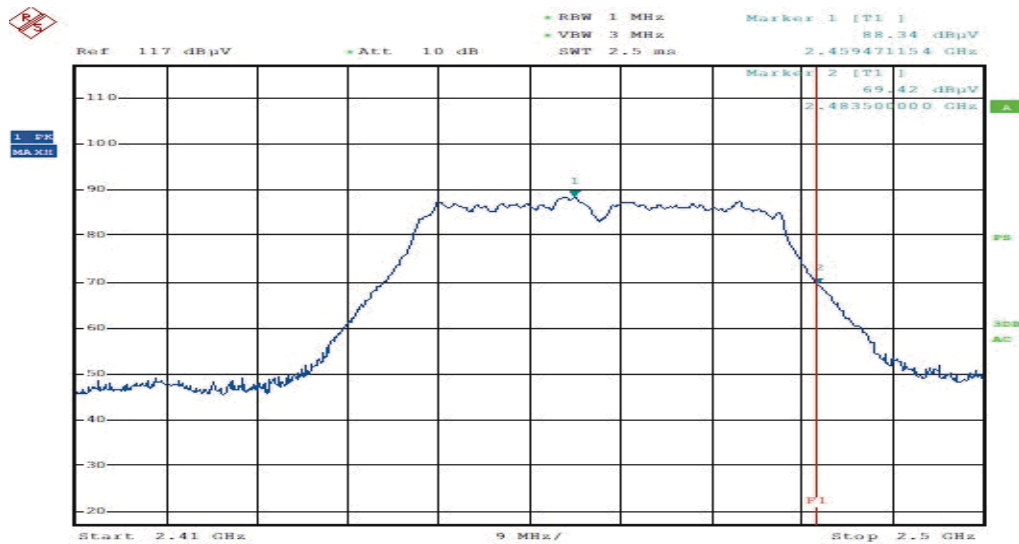


ESTR-21-00238

Band Edges(CH High)

Detector mode:Peak

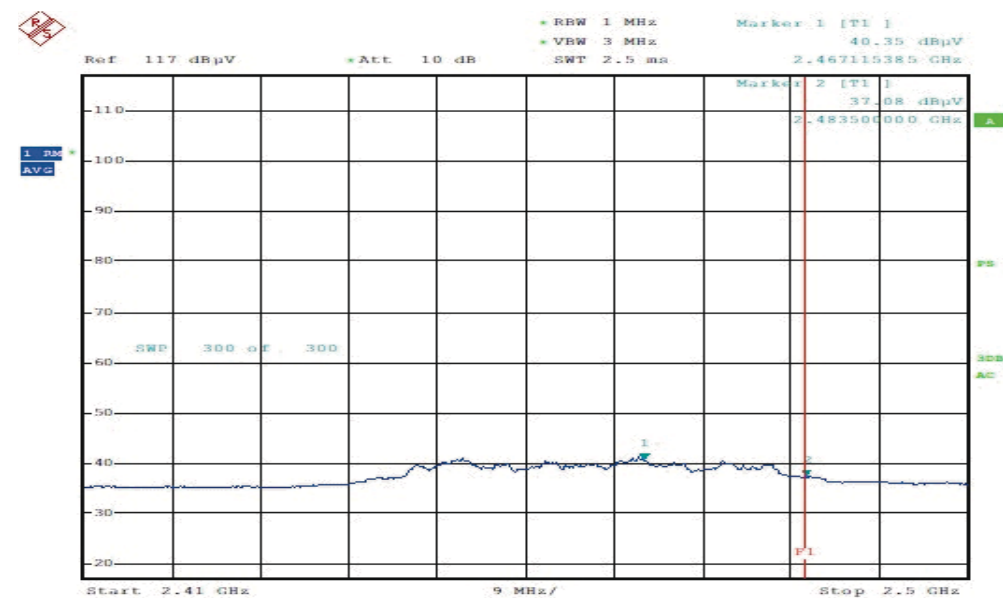
Polarity:Vertical



ESTR-21-00238

Detector mode:Average

Polarity:Vertical

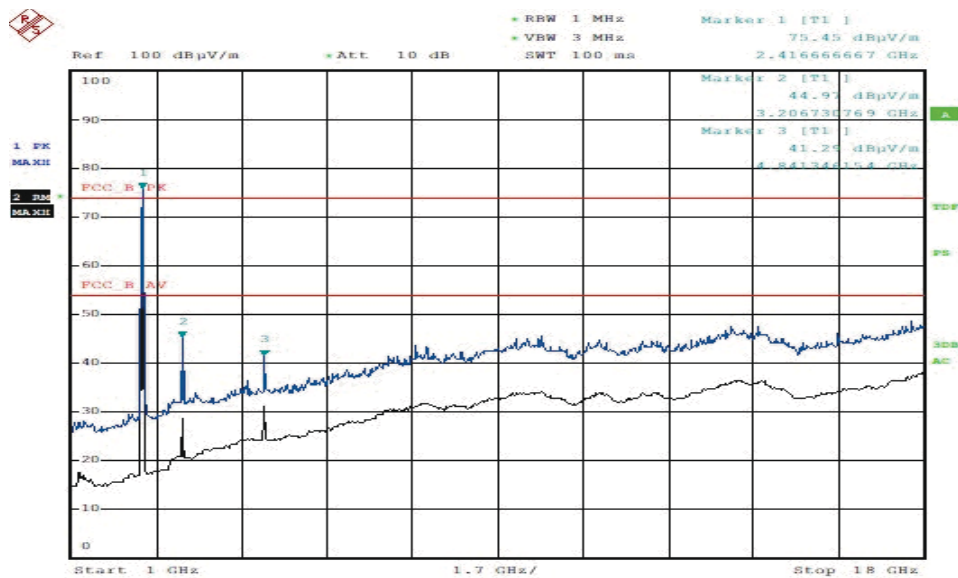


ESTR-21-00238

10.4–28 Restricted Band Edges

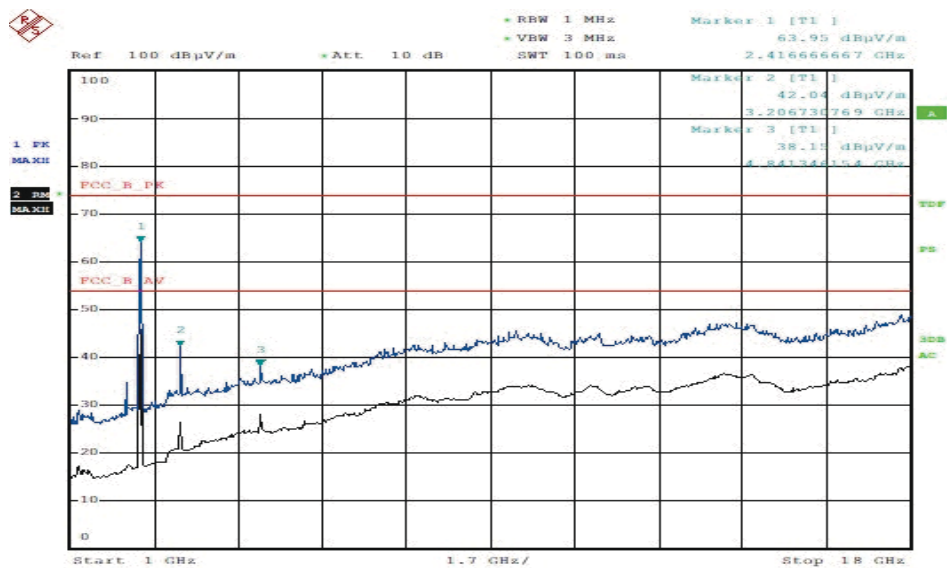
*802.11n40 Mode CH3

Polarity:Horizontal



ESTR-21-00238

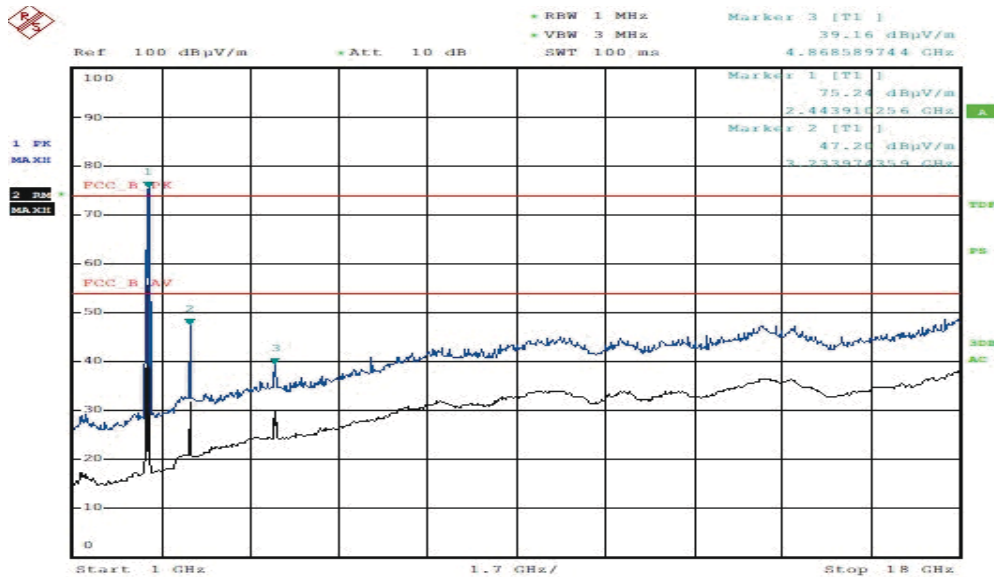
Polarity:Vertical



ESTR-21-00238

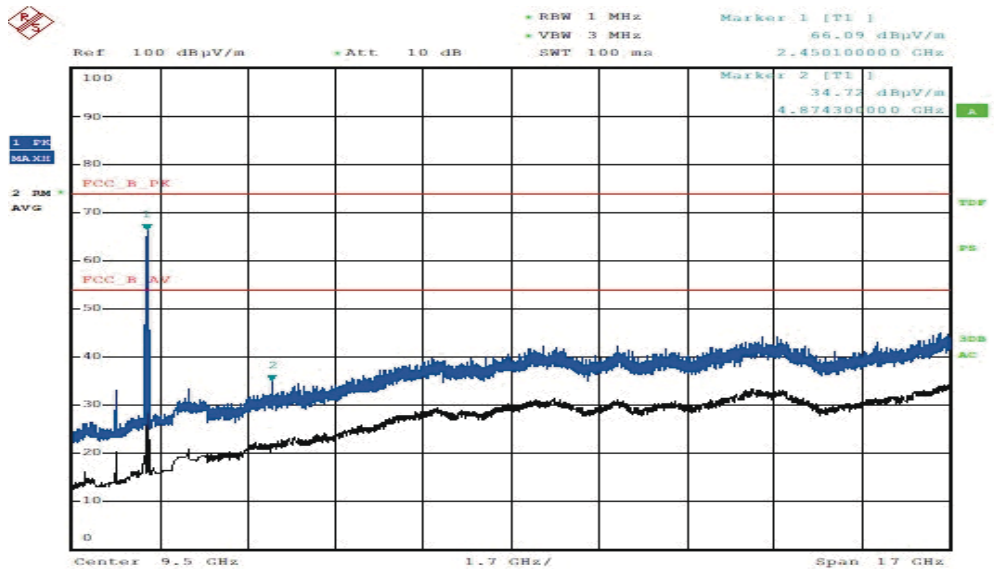
*802.11n40 Mode CH6

Polarity:Horizontal



ESTR-21-00238

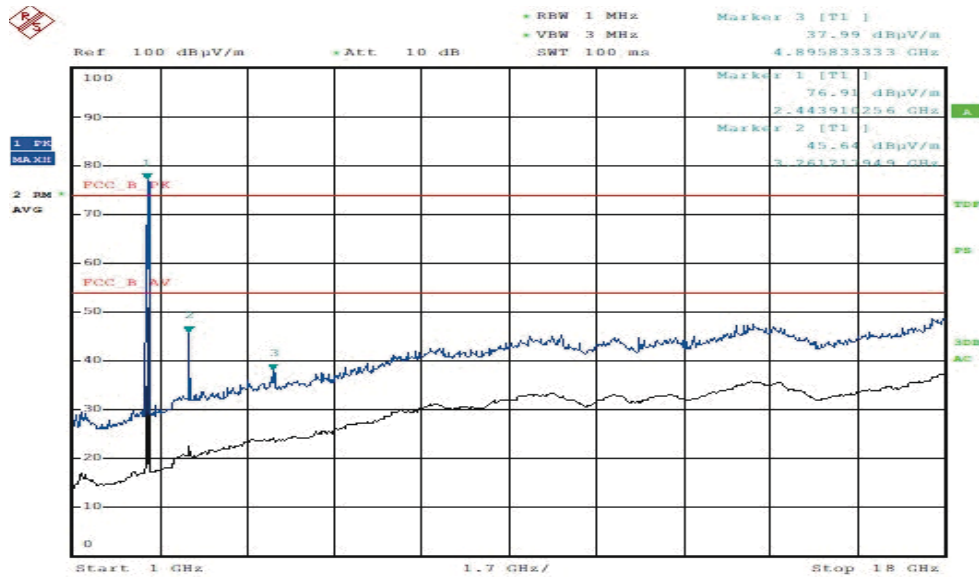
Polarity:Vertical



ESTR-21-00238

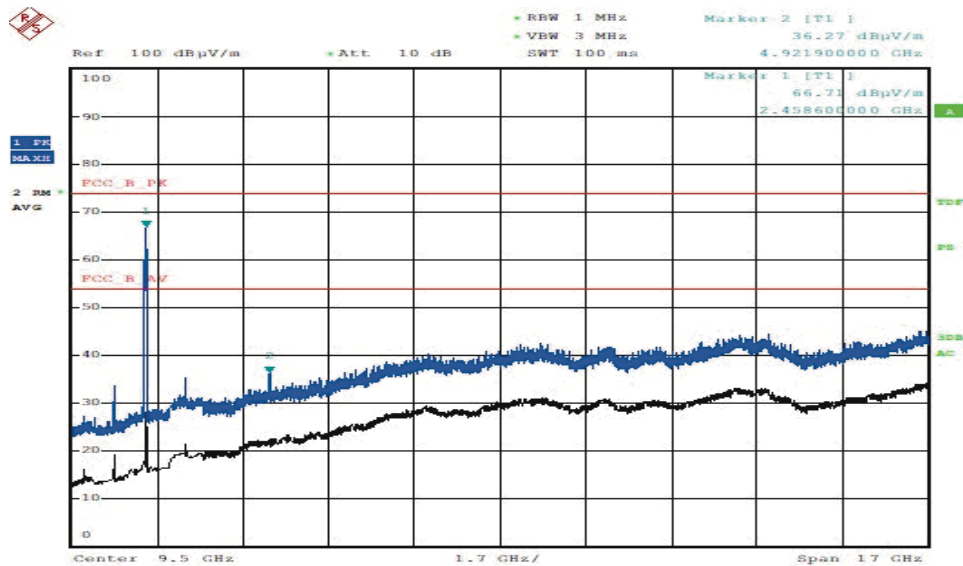
*802.11n40 Mode CH11

Polarity:Horizontal



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Polarity:Vertical



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11. Measurement of conducted disturbance

The continuous disturbance voltage of AC Mains in the frequency from 0.15 MHz to 30 MHz was measured in accordance to FCC PART 15.207. The test setup was made according to ANSI C 63.10 (2009) in a shielded room. The EUT was placed on a non-conductive table at least 0.8 m above the ground plan. A grounded vertical reference plane was positioned in a distance of 0.4 m from the EUT. The distance from the EUT to other metal surfaces was at least 0.8 m. The EUT was only earthen by its power cord through the line impedance stabilizing network. The power cord has been bundled to a length of 1.0 m. The test receiver with Quasi Peak detector complies with CISPR 16.

11.1 Measurement equipments

Equipment Name	Type	Manufacturer	Serial No.	Next Calibration date
TEST RECEIVER	ESPI	Rohde & Schwarz	100005	15-Aug-21
LISN	ESH3-Z5	Rohde & Schwarz	836679/025	15-Aug-21
Pulse Limiter	ESH3Z2	Rohde & Schwarz	NONE	15-Aug-21

11.2 Environmental Condition

Test Place : Shielded Room

Temperature (°C) : 23.5 °C

Humidity (% R.H.) : 44.6 % R.H.

11.3-1 Test Data (802.11 b)

Test Date : 7-Sep-21

Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dB μ W)	Reading (dB μ W)	Result (dB μ W)	Limit (dB μ W)	Reading (dB μ W)	Result (dB)
0.15	0.06	0.17	H	66.00	30.25	30.48	56.00	25.83	26.06
0.16	0.06	0.17	H	65.67	30.63	30.86	55.67	25.55	25.78
0.17	0.06	0.17	N	65.06	31.09	31.32	55.06	26.72	26.95
0.49	0.04	0.32	H	56.24	35.48	35.84	46.24	30.85	31.21
0.49	0.04	0.32	N	56.18	33.78	34.14	46.18	28.05	28.41
0.96	0.04	0.46	H	56.00	30.00	30.50	46.00	25.51	26.01
Remark	H : Hot Line, N : Neutral Line *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

11.3-2 Test Data (802.11 g)

Test Date : 7-Sep-21

Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dB μ V)	Reading (dB μ V)	Result (dB μ V)	Limit (dB μ V)	Reading (dB μ V)	Result (dB)
0.16	0.06	0.17	H	65.67	30.61	30.84	55.67	25.54	25.77
0.17	0.06	0.17	N	65.06	31.17	31.40	55.06	26.80	27.03
0.43	0.04	0.29	N	57.27	31.00	31.34	47.27	25.98	26.32
0.49	0.04	0.32	H	56.24	35.50	35.86	46.24	30.93	31.29
0.96	0.04	0.46	H	56.00	29.98	30.48	46.00	25.52	26.02
1.34	0.05	0.49	N	56.00	29.76	30.30	46.00	25.19	25.73
Remark	H : Hot Line, N : Neutral Line *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

11.3-3 Test Data (802.11 n20)

Test Date : 7-Sep-21

Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dB μ W)	Reading (dB μ W)	Result (dB μ W)	Limit (dB μ W)	Reading (dB μ W)	Result (dB)
0.17	0.06	0.17	H	65.06	31.14	31.37	55.06	26.75	26.98
0.18	0.05	0.18	N	64.35	30.12	30.35	54.35	25.35	25.58
0.26	0.05	0.21	N	61.50	30.28	30.54	51.50	25.73	25.99
0.43	0.04	0.29	N	57.27	30.92	31.26	47.27	25.97	26.31
0.49	0.04	0.32	H	56.18	35.89	36.25	46.18	30.71	31.07
0.79	0.04	0.41	H	56.00	31.04	31.49	46.00	25.90	26.35
Remark	H : Hot Line, N : Neutral Line *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

11.3-4 Test Data (802.11 n40)

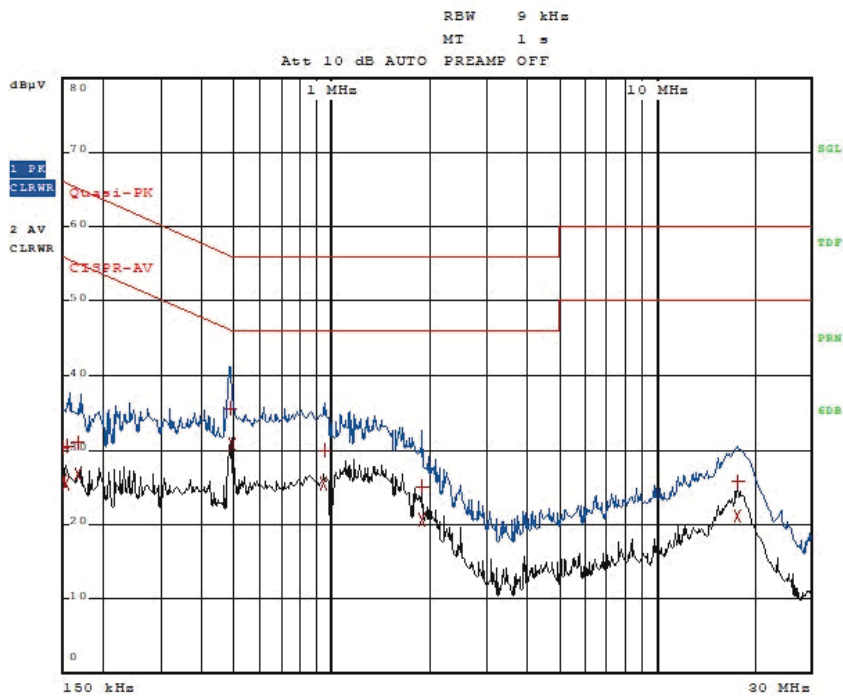
Test Date : 7-Sep-21

Frequency (MHz)	Correction Factor		Line (H/N)	Quasi-peak Value			Average Value		
	Lisn (dB)	Cable (dB)		Limit (dB μ V)	Reading (dB μ V)	Result (dB μ V)	Limit (dB μ V)	Reading (dB μ V)	Result (dB)
0.17	0.06	0.17	H	65.06	31.13	31.36	55.06	26.71	26.94
0.18	0.05	0.18	N	64.35	30.03	30.26	54.35	25.33	25.56
0.26	0.05	0.21	N	61.50	30.22	30.48	51.50	25.73	25.99
0.43	0.04	0.29	H	57.27	30.92	31.26	47.27	26.01	26.35
0.49	0.04	0.32	H	56.18	35.88	36.24	46.18	30.76	31.12
0.79	0.04	0.41	N	56.00	30.91	31.36	46.00	25.92	26.37
Remark	H : Hot Line, N : Neutral Line *Correction Factor = Lisn + Cable *Result = Correction Factor + Reading								

Appendix 1. Special diagram (802.11 b)

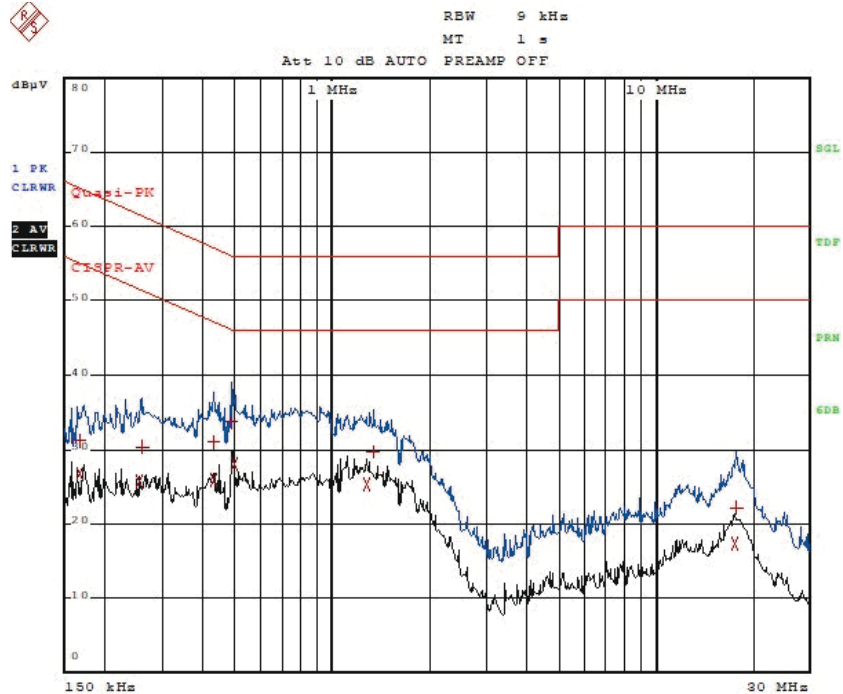
* CONDUCTED EMISSION-N/A

* HOT LINE



Comment: ESTR-21-00238

* NEUTRAL LINE

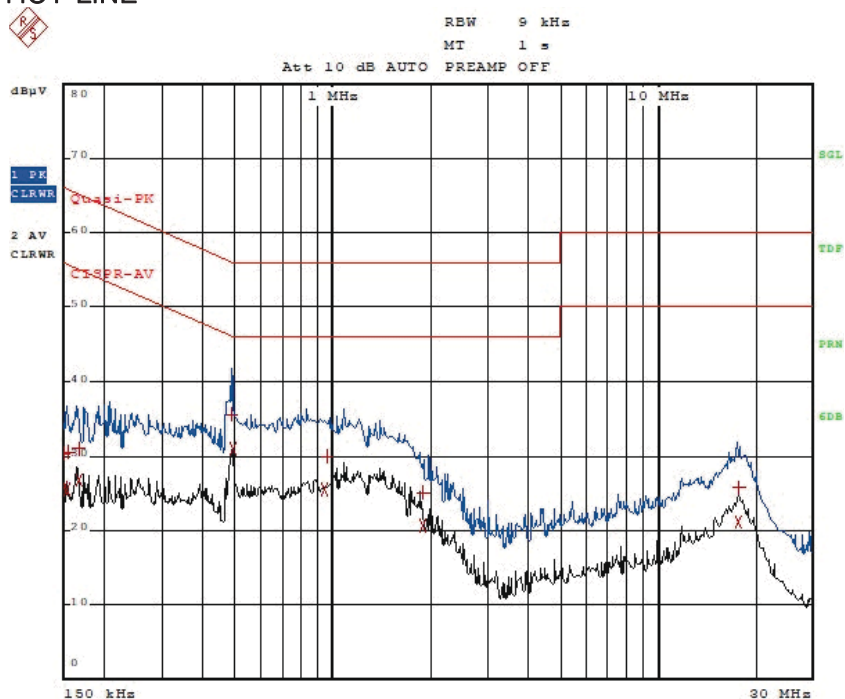


Comment: ESTR-21-00238

Appendix 1. Special diagram (802.11 g)

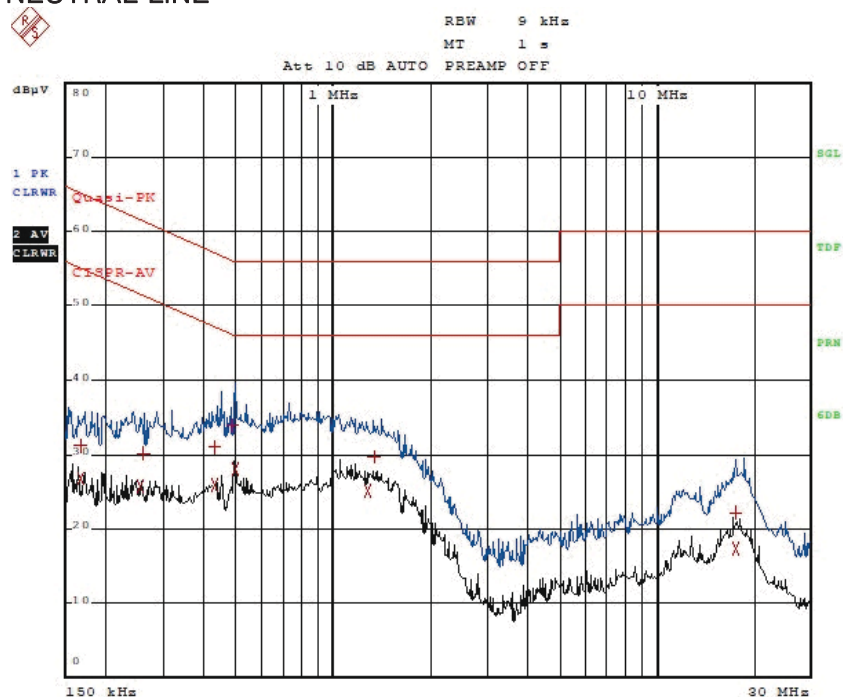
* CONDUCTED EMISSION-N/A

* HOT LINE



Comment: ESTR-21-00238

* NEUTRAL LINE

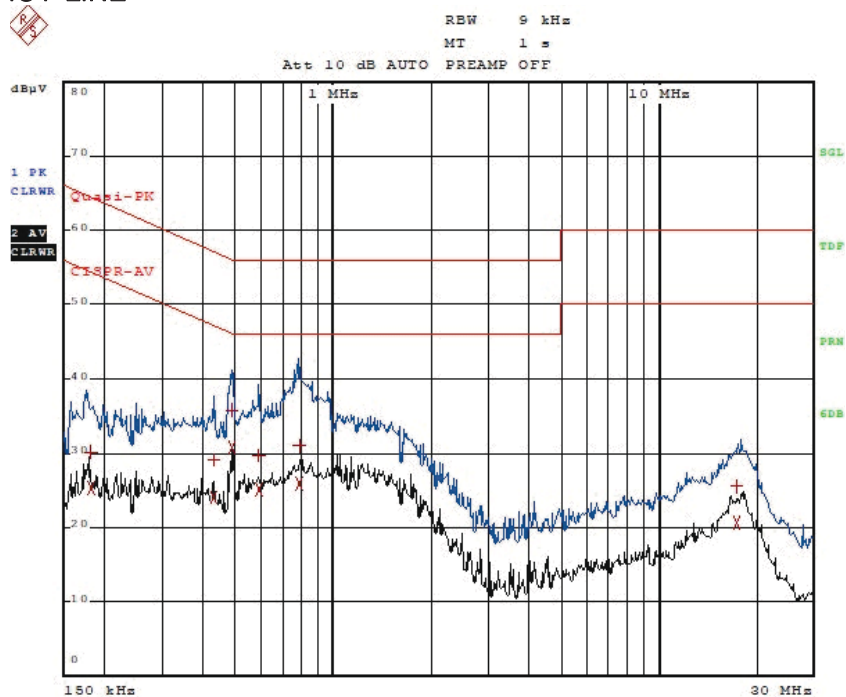


Comment: ESTR-21-00238

Appendix 1. Special diagram (802.11 n20)

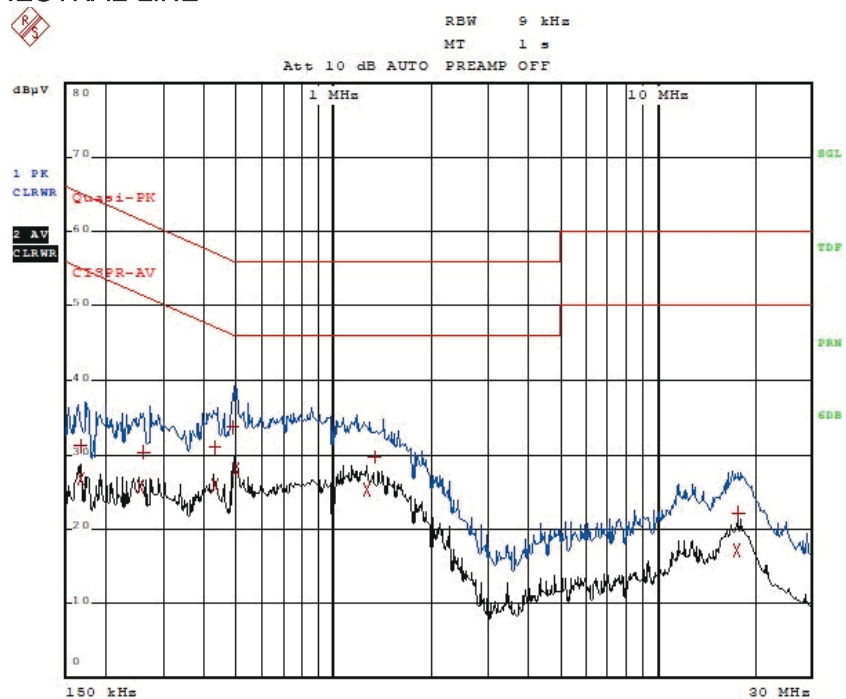
*CONDUCTED EMISSION-N/A

* HOT LINE



Comment: ESTR-21-00238

* NEUTRAL LINE

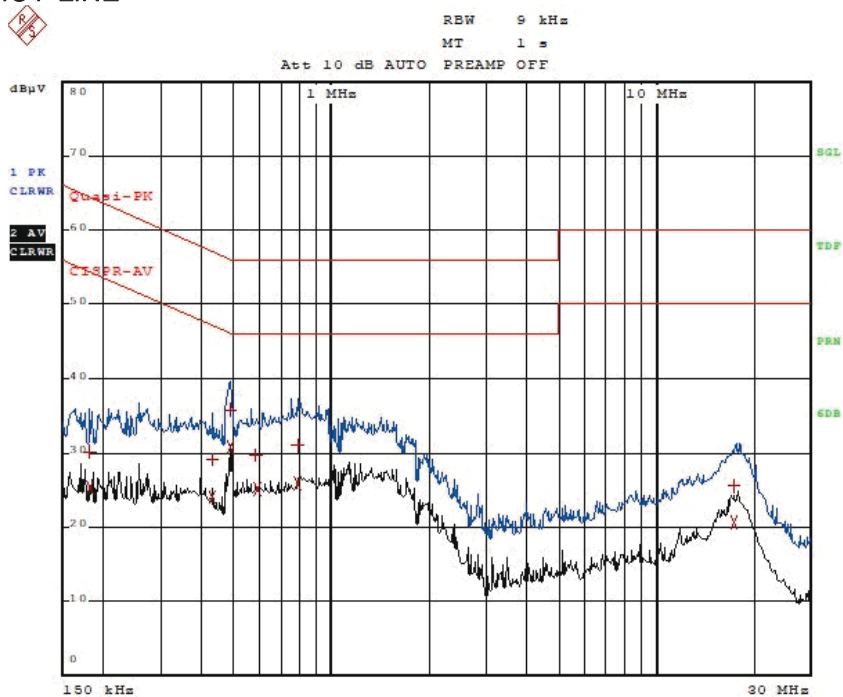


Comment: ESTR-21-00238

Appendix 1. Special diagram (802.11 n40)

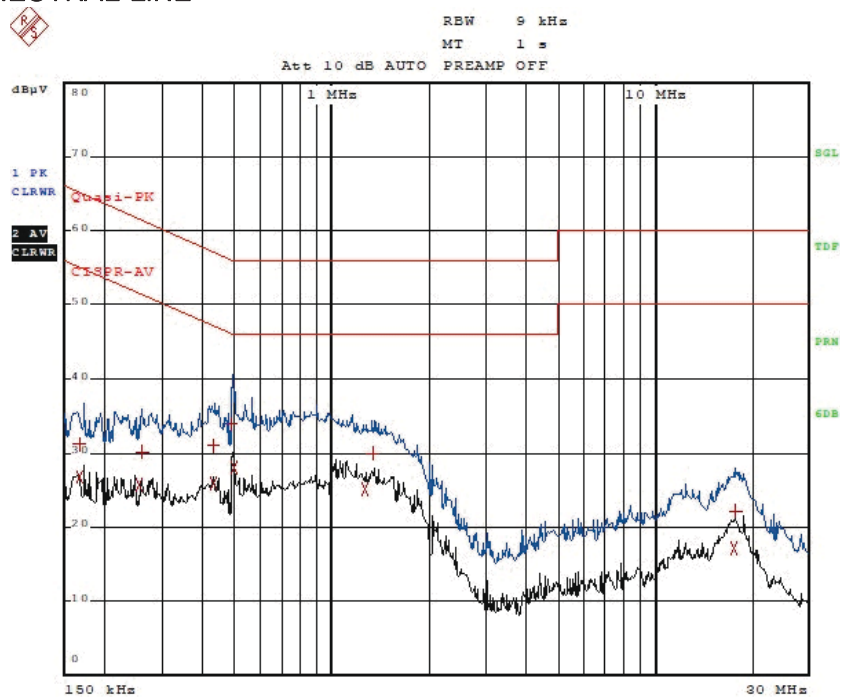
* CONDUCTED EMISSION-N/A

* HOT LINE



Comment: ESTR-21-00238

* NEUTRAL LINE



Comment: ESTR-21-00238

Appendix 2. Antenna information

1. Antenna information

antenna type : Dielectric Chip Antenna.

antenna location : Integral

antenna gain : 0.5 dBi

No temporary RF connector provided