RF Test Report
2.4 GHz WLAN 802.11b/g/n

Report No.	:	FCCCBNW-WAY-P22120046
Customer	:	Pittasoft Co.,Ltd.
Address	:	A4th floor, ABN Tower, 331, Pangyo-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea
Use of Report	:	Certification
Model Name	:	DR770X
FCC ID	:	YCK-DR770X
Date of Test	:	2022.12.10 to 2023.01.11
Test Method Used	:	FCC 47 CFR PART 15 Subpart C (Section §15.247) KDB55804 D01v05r02, ANSI C63.10-2013
Testing Environment	:	Refer to the Test Condition

Test Result : ☒ **Pass** ☐ **Fail**

ISSUED BY: BV CPS ADT Korea Ltd., EMC/RF Laboratory

ADDRESS: Innoplex No.2 106, Sinwon-ro 306, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea 16675

TEST LOCATION: HeungAn-daero 49, DongAn-gu, Anyang-si, Gyeonggi-do, Korea, 14119

Tested by
Name : Donghoon Kang (Signature)

Technical Manager
Name : Jungwoo Kim (Signature)

2023. 01. 25

BV CPS ADT Korea Ltd.

RELEASE CONTROL RECORD

REPORT NO.	REASON FOR CHANGE	DATE ISSUED
FCCCBNW-WAY-P22120046	Original release	2023.01.25

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1 Summary of Test Results

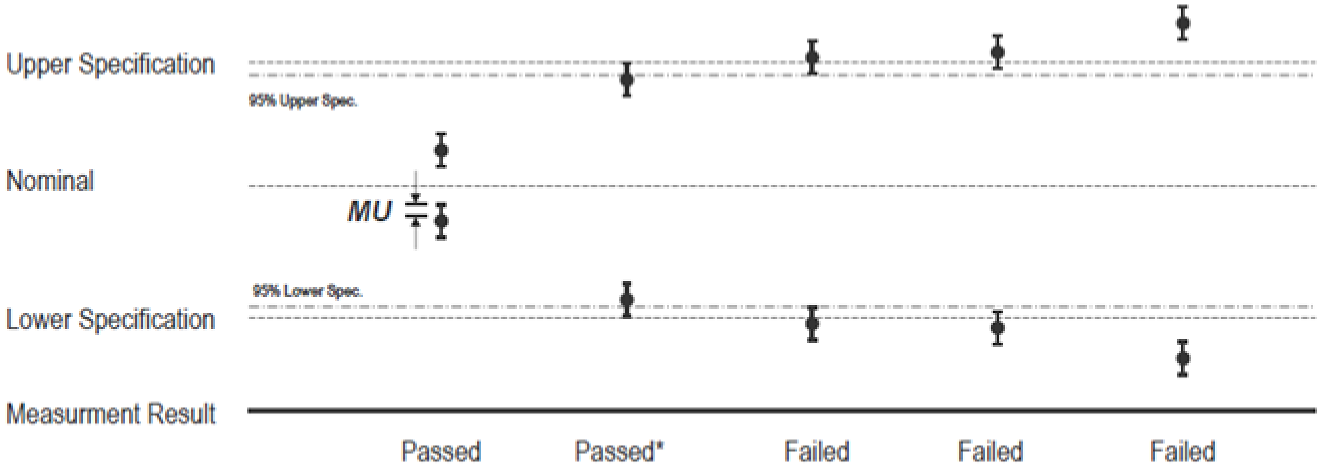
The EUT has been tested according to the following specifications

Applied Standard : FCC Part 15, Subpart C 15.247					
FCC Part Section(s)	**Test Description**	**Limit**	**Test Condition**	**Test Result**	**Reference**
15.247(a)(2)	6 dB Bandwidth	> 500 kHz	Conduted	PASS	Section 3.2
15.247(b)(3)	Maximum Peak Output Power	< 1 Watt		PASS	Section 3.3
15.247(e)	Power Spectral Density	< 8 dBm / 3 kHz Band		PASS	Section 3.4
15.247(d)	Conducted spurious emissions	≥ 20 dBc In any 100 kHz bandwidth		PASS	Section 3.5
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in Restricted bands must meet the radiated limits detailed in 15.209	Radiated	PASS	Section 3.5
15.207	AC Conducted Emissions (150 kHz – 30 MHz)	< FCC 15.207 limits	AC Line Conduted	NA[Note3)]	Section 3.6
15.203	Antenna Requirement	FCC 15.203	-	PASS	Section 3.1

NOTES

1) The general test methods used to test on this devices are ANSI C63.10.
2) Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
3) This Devices which only employ battery power for operation.

1.1 Decision Rules for Statement of Conformity



QUA-52 Decision Rule(QA Document) was applied.

Step 1) : Reference Check, Daily Check, Peripheral device Check

Step 2) : Re-test Procedure (Repeat the test maximum 3 times, Different Test Engineer)

1) If the original test results are subject to retesting and the judgement is unclear, the retest is carried out.

2) If the result of the first retest is the same as the initial test, the judgement is made based on the value.

3) If the result of the first retest differ from the results of the initial test, the second re-test is carried out.

4) After completion of the second retest, the average of the three test results is determined as the final result. However, if the deviation of the three test values is more than 5 % of the reference value, the technical manager should review the reproducibility of the test from the beginning.

1.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2

Measurement Items	Frequency Range	Expanded Uncertainty U = *k*Uc (*k* = 2)
Radiated Spurious Emissions	9 kHz – 30 MHz	2.06
	30 MHz – 1 GHz	4.48
	1 GHz – 18 GHz	5.24
	18 GHz – 26.5 GHz	5.08

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k = 2.

2 General Information

2.1 General Description of EUT

Equipment Class	Digital Transmission System (DTS)
Product name	CAR DASHCAM
FCC ID	YCK-DR770X
Model	DR770X
Additional model name	DR770X-2CH, DR770X-1CH, DR770X-2CH IR, DR770X-2CH Truck, DR770X-2CH DMS, DR800 GOLD
Identification No. of EUT	-
Power Supply	DC 12 V , DC 24V
Modulation Type	802.11b: CCK, DSSS 802.11g/n: OFDM
Transfer Rate	1, 2, 5.5, 11 Mbps (802.11b) 6, 9, 12, 18, 24, 36, 48, 54 Mbps (802.11g) MCS0 to MCS7 (802.11n)
Operating Frequency	802.11b/g/n(HT20): 2 412 MHz to 2 462 MHz 802.11n(HT40): 2 422 MHz to 2 452 MHz
Output Power	23.39 dBm
Antenna Type	Chip Antenna
Antenna Gain	1.06
H/W Version	1.0
S/W Version	1.0

NOTES

1) The above equipment has been tested by **Bureau Veritas Consumer Products Services ADT Korea**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

2) **List of Accessories**

Accessories	Brand	Model	Manufacturer	Specification
-	-	-	-	-

2.2 Description of Test Mode

The EUT has been tested with all modes of operating conditions to determine the worst case emission characteristics.

Test Mode		Worst case data rate	Tested Frequency (MHz)		
TM 1	802.11b	1 Mbps	2 412	2 437	2 462
TM 2	802.11g	6 Mbps	2 412	2 437	2 462
TM 3	802.11n(HT20)	MCS 0	2 412	2 437	2 462
TM 4	802.11n(HT40)	MCS 0	2 422	2 437	2 452

Note: A test was performed for each voltage.

2.3 INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

2.4 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.6 General Description of Applied Standards

Generally the tests were performed according to the specifications of the standard, it must comply with the requirements of the following standards.

FCC CFR 47 Part 15, Subpart C (§15.247)
KDB 558074 D01 15.247 Meas Guidance v05r02
KDB 662911 D01 Multiple Transmitter Output v02r01
ANSI C63.10-2013

All test items in this test report have been performed and recorded as per the above standards.

2.7 Test Equipment

Test Equipment is traceable to the National Institute of Standards and Technology (NIST). Measurement antenna used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Serial Number	Cal Date (yyyy.mm.dd)	Cal Due (yyyy.mm.dd)
EMI Test Receiver	R&S	ESR7	102121	2022.11.21	2023.11.21
Spectrum Analyzer	R&S	FSW50	101403	2022.11.22	2023.11.22
Signal Analyzer	Keysight Technologies	N9030B	MY57142476	2022.11.22	2023.11.22
Active Loop Antenna	R&S	HFH2-Z2E	100881	2022.02.18	2023.02.18
Trilog Antenna (with 6 dB ATT.)	Schwarzbeck	VULB 9163	01099	2022.09.03	2023.09.03
Horn Antenna	R&S	HF907	102772	2022-12-03	2023-12-03
Horn Antenna	Steatite Antenna	QSH-SL-18-26-S-20	19926	2022.11.23	2023.11.23
Signal Conditioning Unit	R&S	SCU08F2	08400017	2022.11.21	2023.11.21
Signal Conditioning Unit	R&S	SCU-18F	180112	2022.11.21	2023.11.21
Signal Conditioning Unit	R&S	SCU-26F	260005	2022.11.23	2023.11.23
High Pass Filter	Micro-Tronics	HPM17543	028	2022.06.03	2023.06.03
High Pass Filter	Wt Microwave	WT-A1698-HS	WT190313-6-4	2022.11.22	2023.11.22
Attenuator	API inmet	40AH2W-10	3	2022.06.03	2023.06.03
EXG Analog Signal Generator	Keysight Technologies	N5171B	MY56200336	2022.11.22	2023.11.22
Signal Generator	R&S	SMB100A	MY41006053	2022.06.03	2023.06.03
MIMO Power Set Master	Keysight Technologies	MP400B	NONE	2022.12.02	2023.12.02
DC Power Supply	Keysight Technologies	E3632A	MY62216181	2022.07.12	2023.07.12

3 Test Results

3.1 Antenna Requirement

Except from §15.203 of the FCC Rules/Regulations:

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of the section.

- The antenna(s) of the EUT are Permanently attached.
- There are no provisions for connection to an external antenna.

Result

The EUT complies with the requirement of §15.203

3.2 6 dB Bandwidth

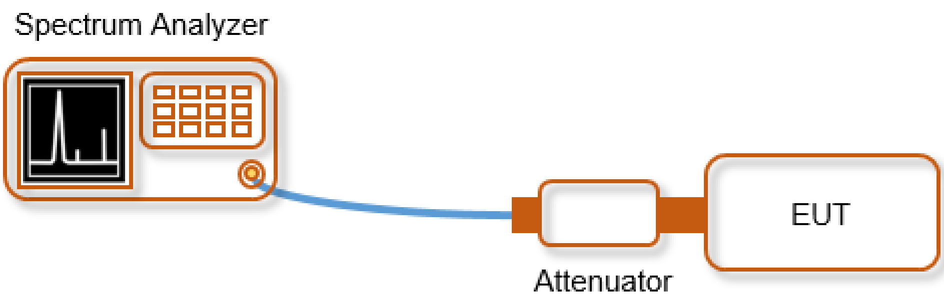
3.2.1 Regulation

§15.247(a)(2) : Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. **The minimum 6 dB bandwidth shall be at least 500 kHz.**

3.2.2 Test Procedure

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 in 11.8.1 (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, and 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.

3.2.3 Test Setup



3.2.4 Test Result

[Test Data of 6 dB Bandwidth]

Limit: The minimum 6 dB bandwidth shall be at least 500 kHz.

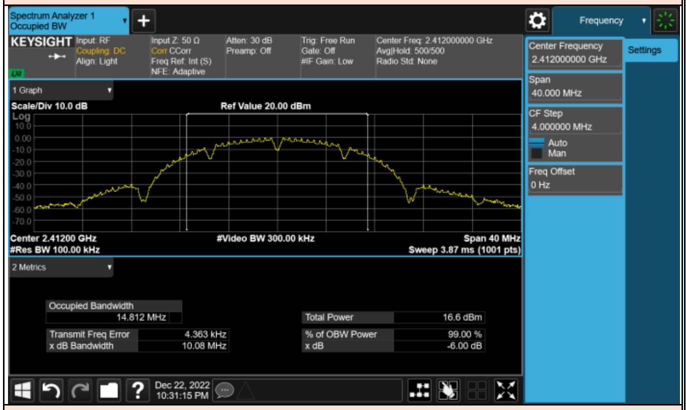
Test Mode	Tested Frequency	6dB Bandwidth [MHz]	
		12 V	24 V
TM1	2 412	10. 08	10. 08
SISO	2 437	10. 08	10. 06
802.11b	2 462	10. 08	10. 07
TM2	2 412	16. 56	16. 54
SISO	2 437	16. 56	16. 56
802.11g	2 462	16. 55	16. 52
TM3	2 412	17. 78	17. 72
SISO	2 437	17. 72	17. 73
802.11n(HT20)	2 462	17. 67	17. 77
TM4	2 422	36. 42	36. 42
SISO	2 437	36. 40	36. 40
802.11n(HT40)	2 452	36. 40	36. 41

[Test Plot of 6 dB Bandwidth]

802.11b

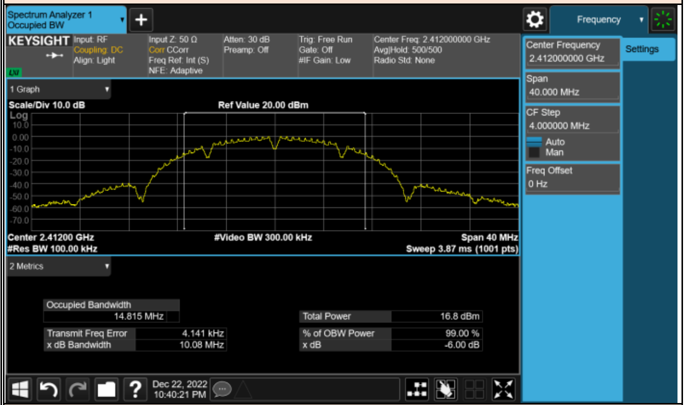
12 V

2 412 MHz



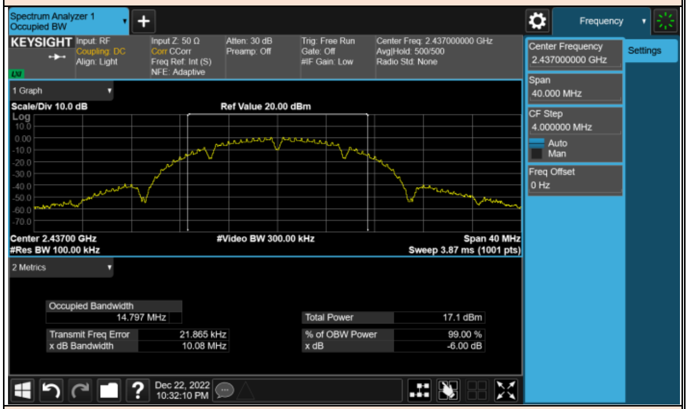
24 V

2 412 MHz



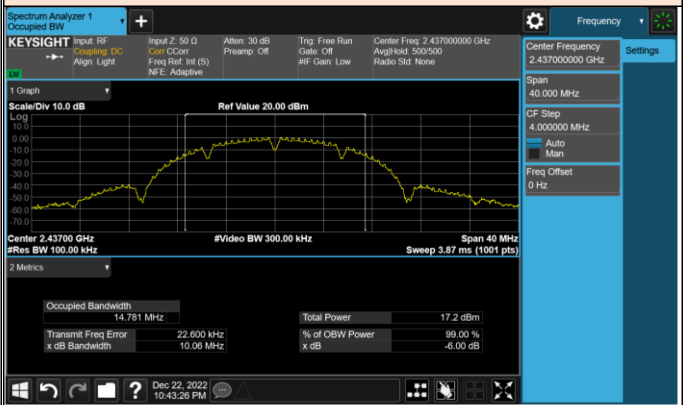
12 V

2 437 MHz



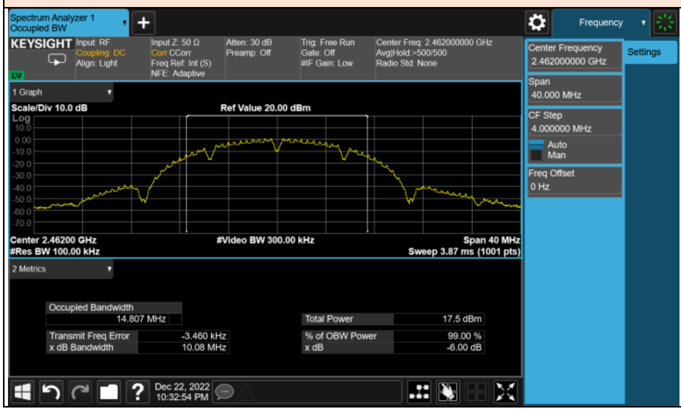
24 V

2 437 MHz



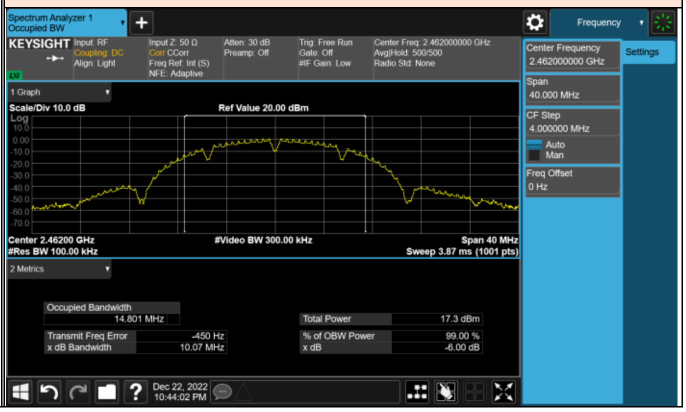
12 V

2 462 MHz



24 V

2 462 MHz



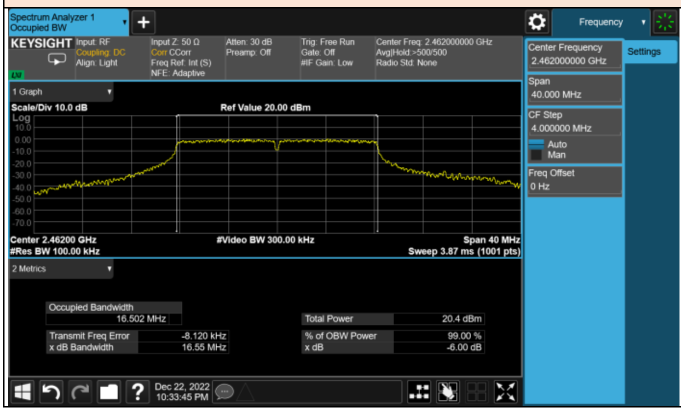
802.11g

12 V

2 412 MHz

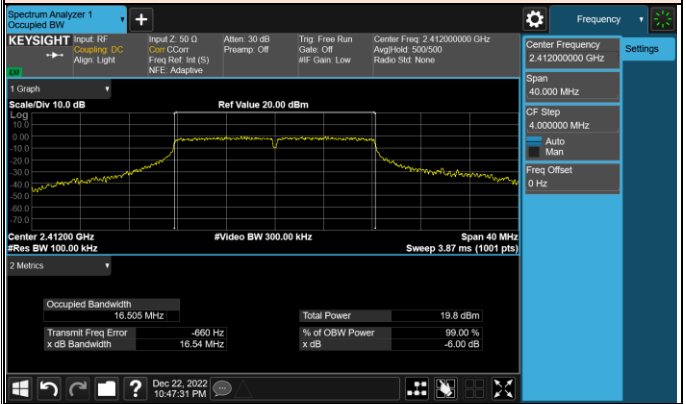
2 437 MHz

2 462 MHz

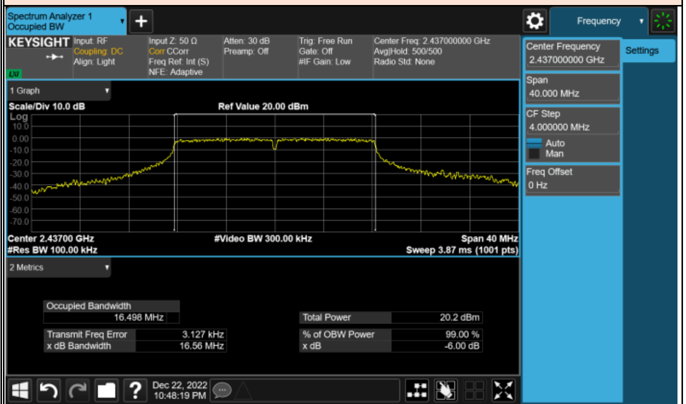


24 V

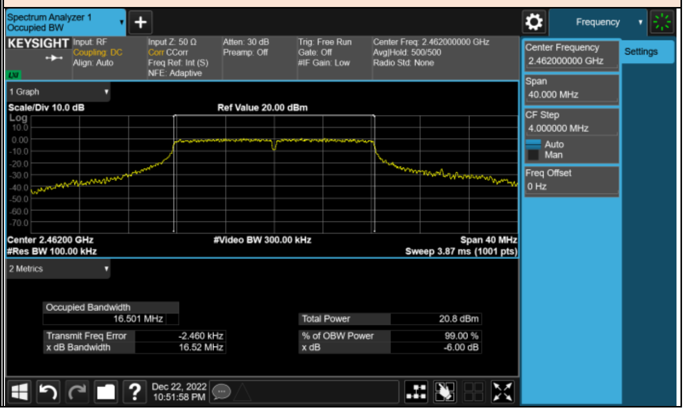
2 412 MHz



2 437 MHz

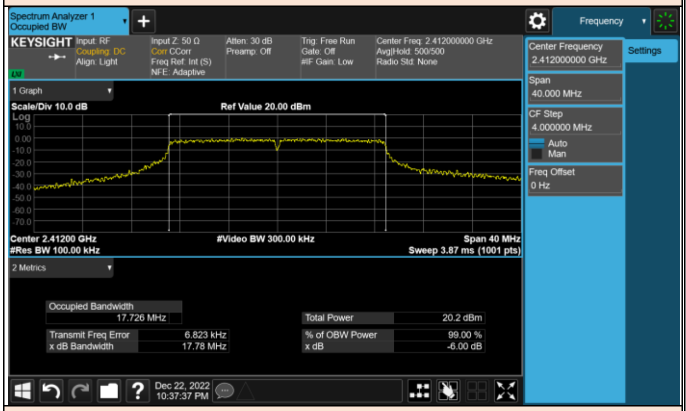


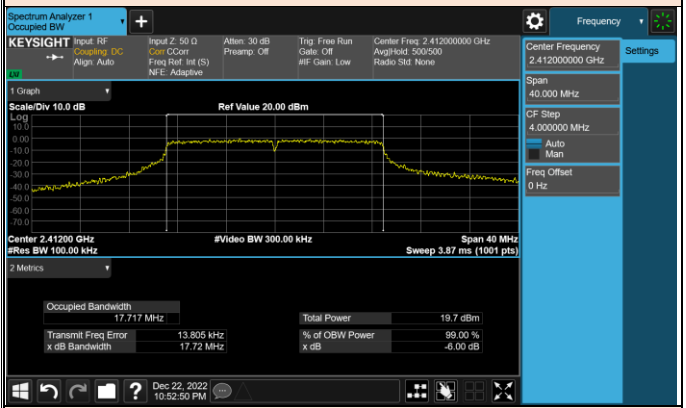
2 462 MHz



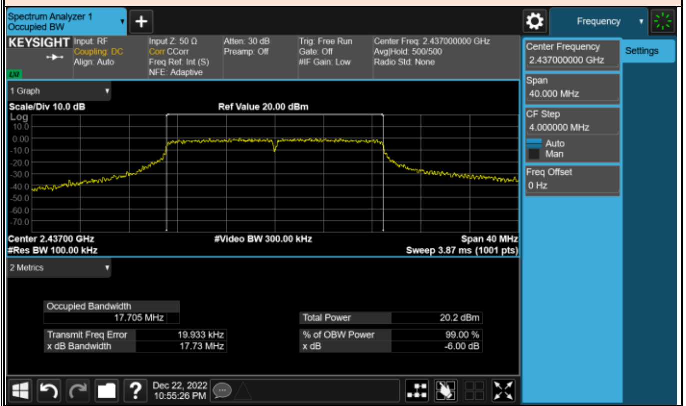
802.11n(HT20)

12 V	24 V
2 412 MHz	2 412 MHz

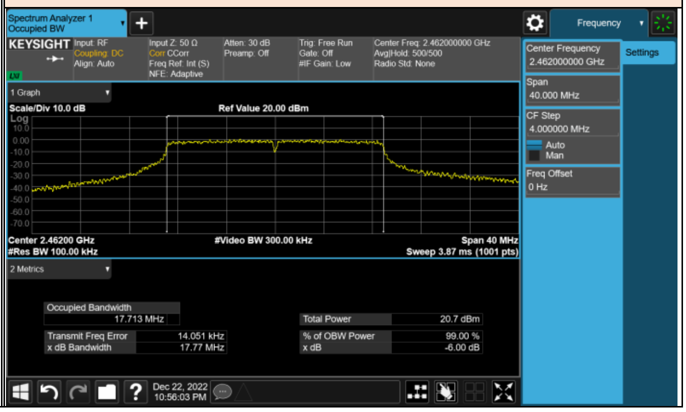


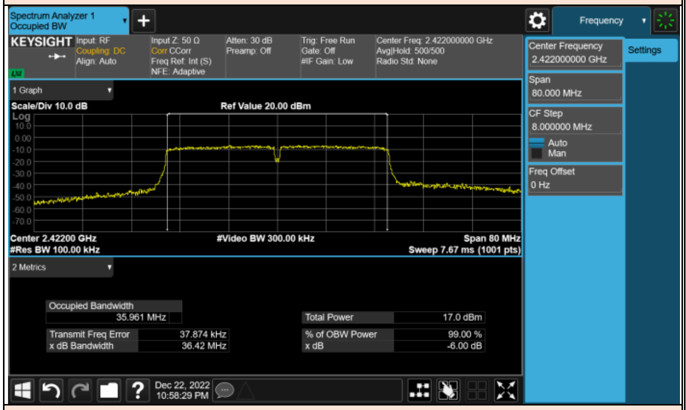


12 V	24 V
2 437 MHz	2 437 MHz



12 V	24 V
2 462 MHz	2 462 MHz



<table>
<tr><th colspan="2">802.11n(HT40)</th></tr>
<tr><th>12 V</th><th>24 V</th></tr>
<tr><th>2 422 MHz</th><th>2 422 MHz</th></tr>
<tr><td>
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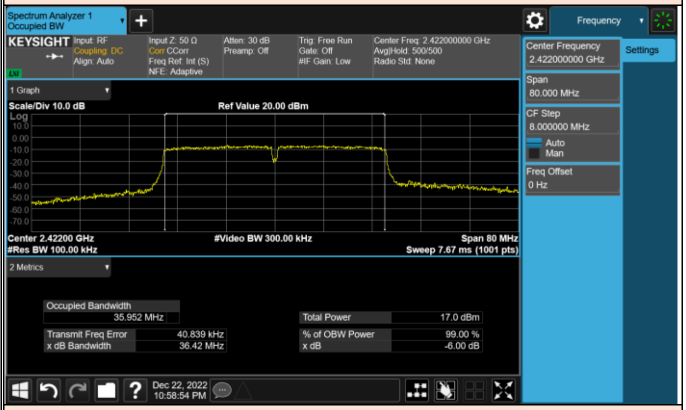
<td>
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<tr><th>2 437 MHz</th><th>2 437 MHz</th></tr>
<tr><td>
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<tr><th>2 452 MHz</th><th>2 452 MHz</th></tr>
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3.3 Maximum Peak Output Power

3.3.1 Regulation

§15.247(b)(3) : For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

§15.247(b)(4) : The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3.2 Test Procedure

General

Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth (see ANSI C63.10 for measurement guidance).

When using a spectrum analyzer or EMI receiver to perform these measurements, it shall be capable of utilizing a number of measurement points in each sweep that is greater than or equal to twice the span/RBW to set a bin-to-bin spacing of ≤ RBW/2 so that narrowband signals are not lost between frequency bins.

If possible, configure or modify the operation of the EUT so that it transmits continuously at its maximum power control level. The intent is to test at 100 % duty cycle; however a small reduction in duty cycle (to no lower than 98 %) is permitted, if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.

If continuous transmission (or at least 98 % duty cycle) cannot be achieved due to hardware limitations (e.g., overheating), the EUT shall be operated at its maximum power control level, with the transmit duration as long as possible, and the duty cycle as high as possible during which sweep triggering/signal gating techniques may be used to perform the measurement over the transmission duration.

3.3.2.1 Maximum peak conducted output power

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

RBW ≥ DTS bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.

b) Set VBW ≥ [3 × RBW].

c) Set span ≥ [3 × RBW].

d) Sweep time = auto couple.

e) Detector = peak.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use peak marker function to determine the peak amplitude level.

PKPM1 Peak power meter method
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

Measurement using a power meter (PM)
Method AVGPM is a measurement using an RF average power meter, as follows:

a) As an alternative to spectrum analyzer or EMI receiver measurements, measurements maybe performed using a wideband RF power meter with a thermocouple detector or equivalent
if all of the conditions listed below are satisfied:
1) The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

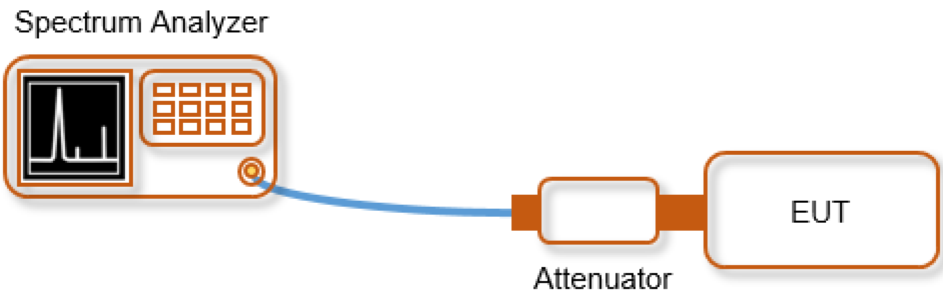
b) If the transmitter does not transmit continuously, measure the duty cycle, D, of the transmitter output signal as described in 11.6.

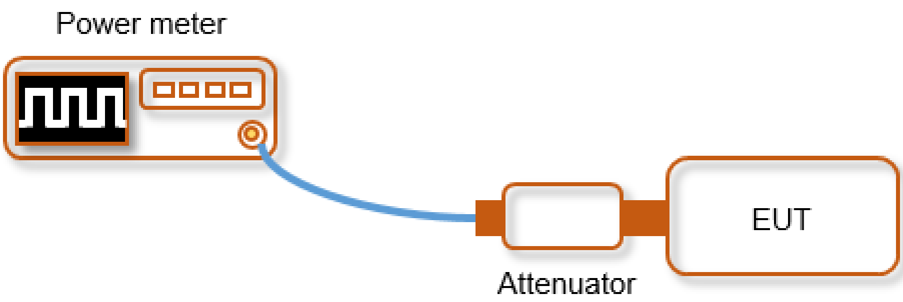
c) Measure the average power of the transmitter. This measurement is an average over both the ON and OFF periods of the transmitter.

d) Adjust the measurement in dBm by adding [10 log(1/D)], where D is the duty cycle

Notes:
A peak responding power sensor is used, where the power sensor system video bandwidth is greater than the occupied bandwidth of the EUT.

3.3.3 Test Setup





3.3.4 Test Result

[Test Result of Peak Power & Average Power]

Limit: 1 Watt

Test Mode	Tested Frequency	Measured Power [dBm]			
		12V		24V	
		PK	Average	PK	Average
TM1 SISO 802.11b	2 412	15. 24	12. 88	15. 11	12. 74
	2 437	**15. 36**	12. 33	15. 24	12. 13
	2 462	14. 96	11. 93	14. 88	11. 81
TM2 SISO 802.11g	2 412	22. 74	16. 45	22. 65	16. 44
	2 437	**22. 83**	16. 38	22. 71	16. 18
	2 462	22. 55	15. 92	22. 44	15. 77
TM3 SISO 802.11n(HT20)	2 412	22. 61	15. 48	22. 45	15. 33
	2 437	**22. 74**	15. 18	22. 61	15. 14
	2 462	**22. 74**	15. 58	22. 57	15. 41
TM4 SISO 802.11n(HT40)	2 422	21. 49	12. 47	21. 41	12. 38
	2 437	**23. 39**	15. 89	23. 09	15. 77
	2 452	22. 21	13. 68	22. 05	13. 59

Note: The intent is to test at 100 % duty cycle.

3.4 Power Spectral Density

3.4.1 Regulation

§15.247(e) : For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

3.4.2 Test Procedure

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

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

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

c) Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.

d) Set the VBW ≥ [3 × RBW].

e) Detector = peak.

f) Sweep time = auto couple.

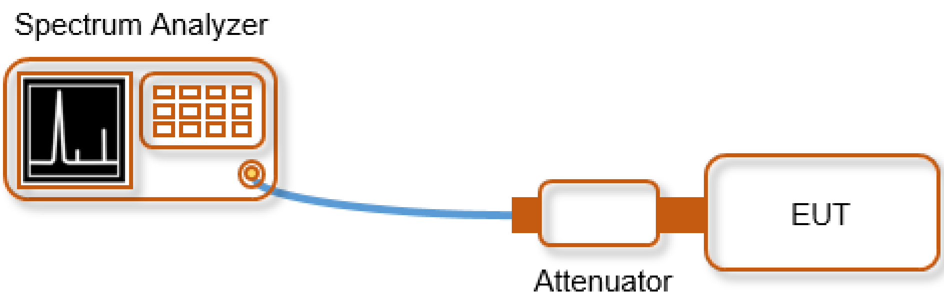
g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the RBW.

j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

3.4.3 Test Setup



3.4.4 Test Result

[Test Data of Power Spectral Density]

Limit: not be greater than 8 dBm in any 3 kHz

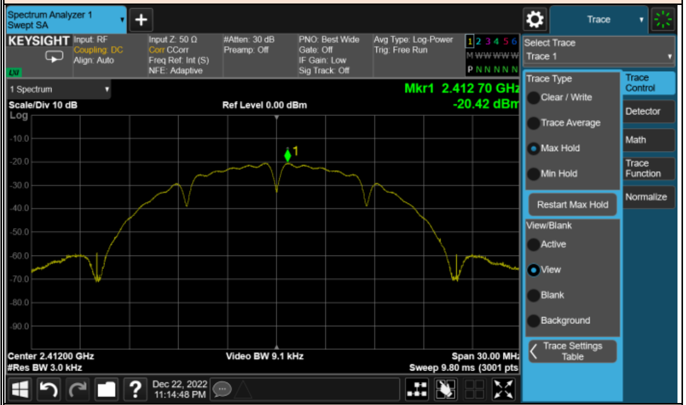
Test Mode	Tested Frequency	Measured Power [dBm / 3 kHz]	
		12 V	24 V
TM1 SISO 802.11b	2 412	-20.29	-20.42
	2 437	-19.76	-19.92
	2 462	-19.63	-19.69
TM2 SISO 802.11g	2 412	-14.97	-15.37
	2 437	-14.75	-14.98
	2 462	-14.26	-14.63
TM3 SISO 802.11n(HT20)	2 412	-14.19	-14.44
	2 437	-13.67	-13.88
	2 462	-13.52	-13.65
TM4 SISO 802.11n(HT40)	2 422	-17.64	-17.72
	2 437	-13.98	-14.12
	2 452	-14.88	-14.96

[Test Plot of Power Spectral Density]

802.11b

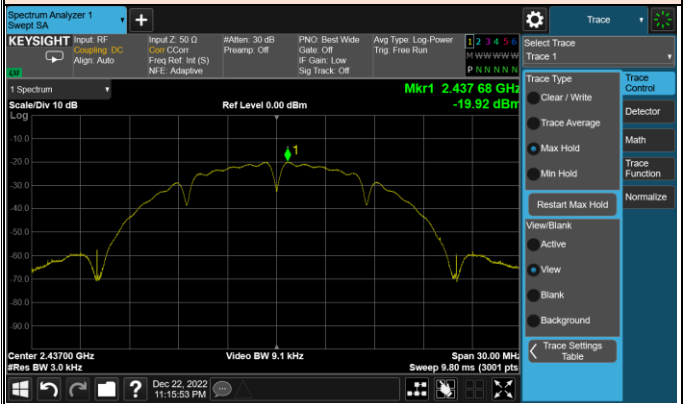
12 V — 2 412 MHz

24 V — 2 412 MHz



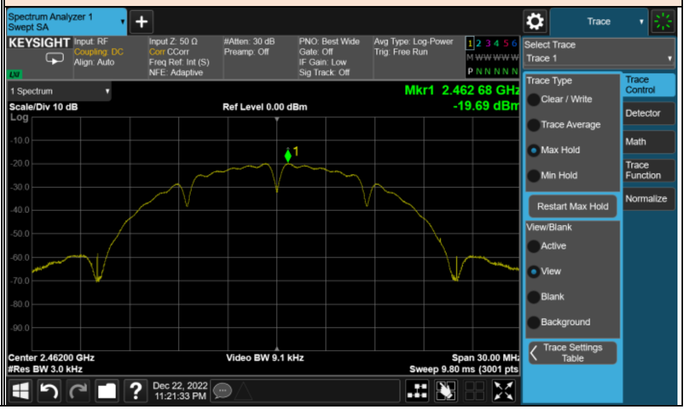
12 V — 2 437 MHz

24 V — 2 437 MHz



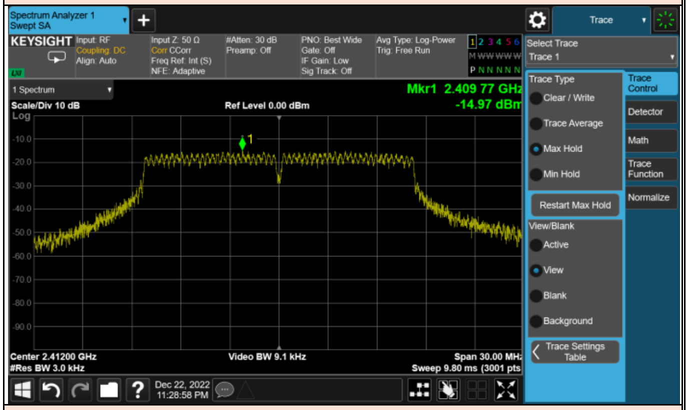
12 V — 2 462 MHz

24 V — 2 462 MHz

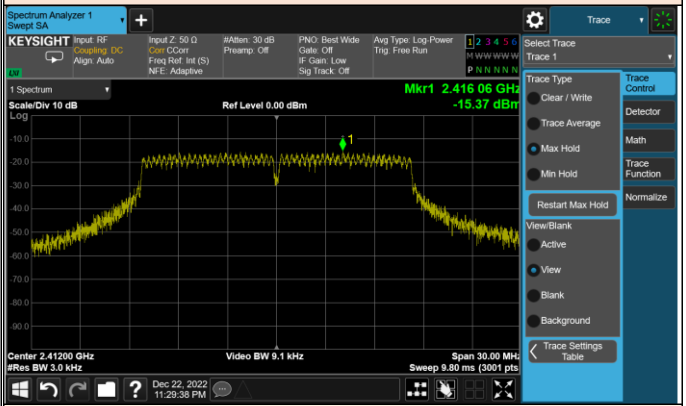


802.11g

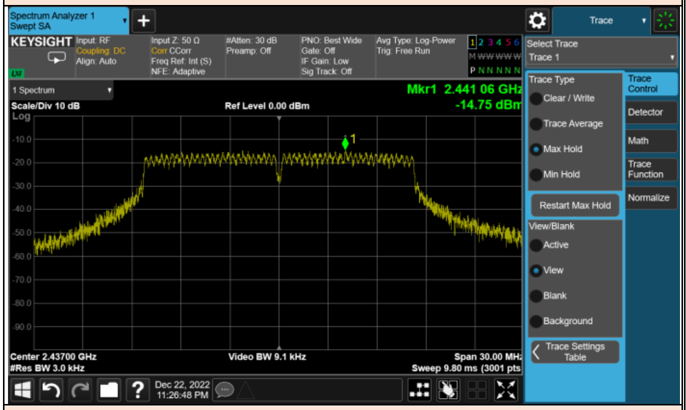
12 V — 2 412 MHz



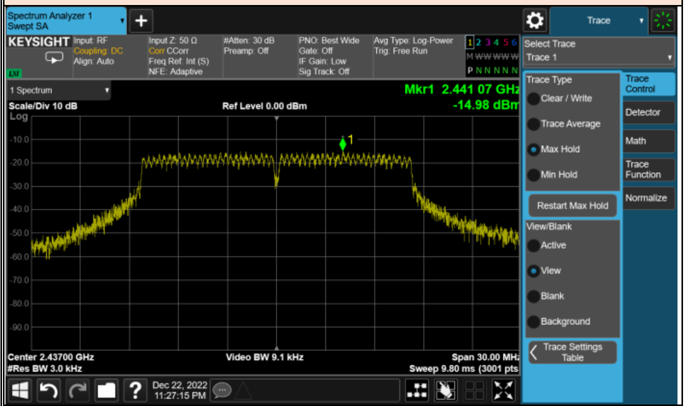
24 V — 2 412 MHz



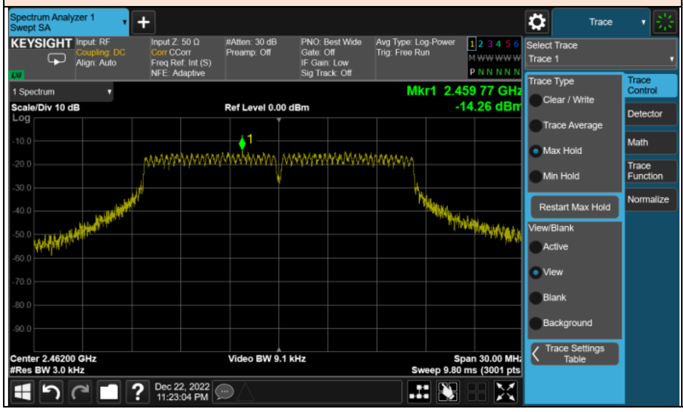
12 V — 2 437 MHz



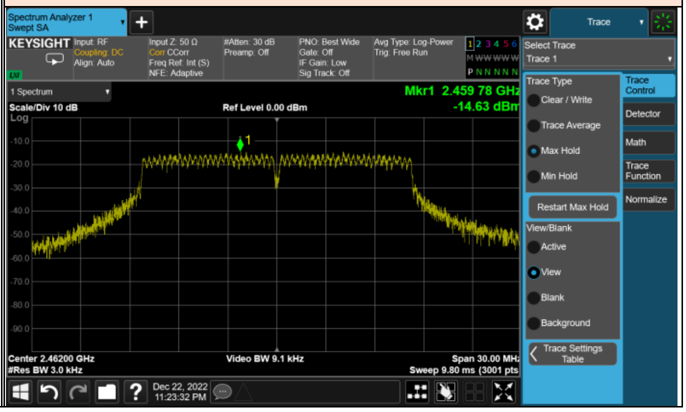
24 V — 2 437 MHz



12 V — 2 462 MHz



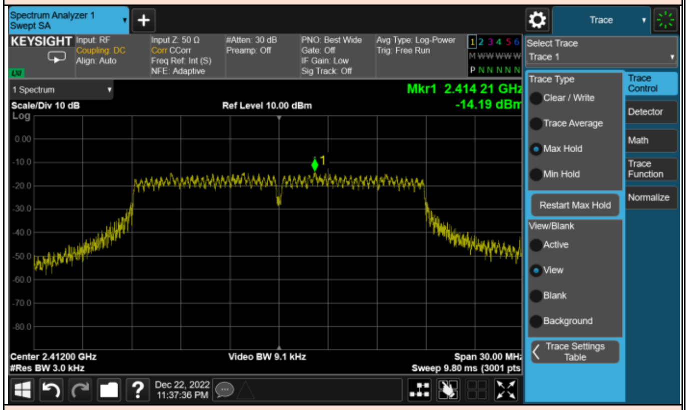
24 V — 2 462 MHz



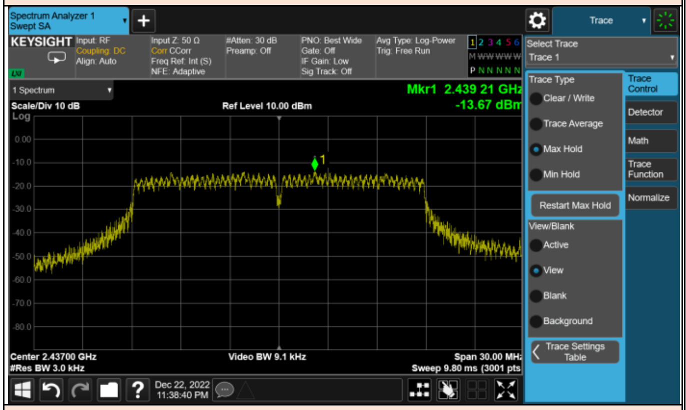
802.11n(HT20)

12 V

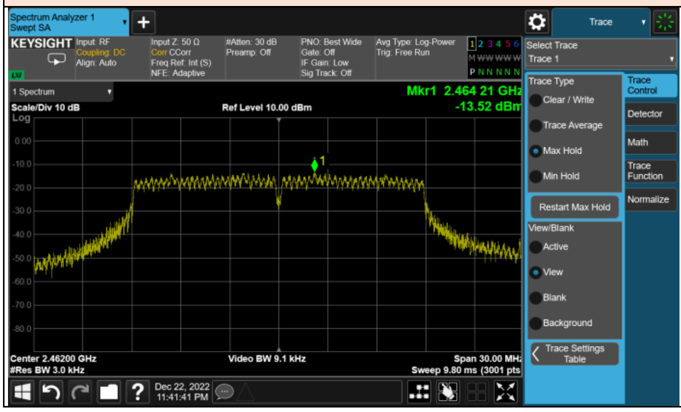
2 412 MHz



2 437 MHz

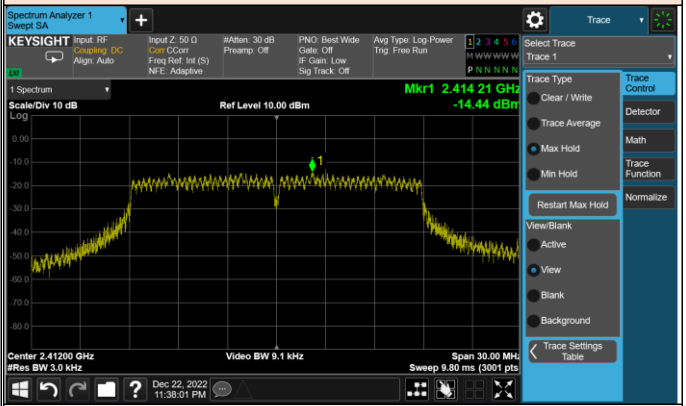


2 462 MHz

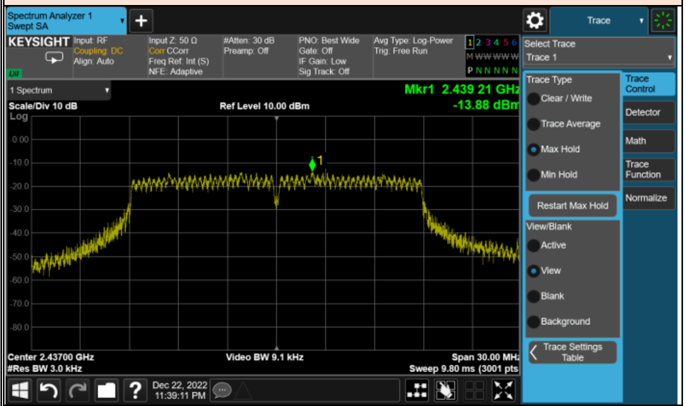


24 V

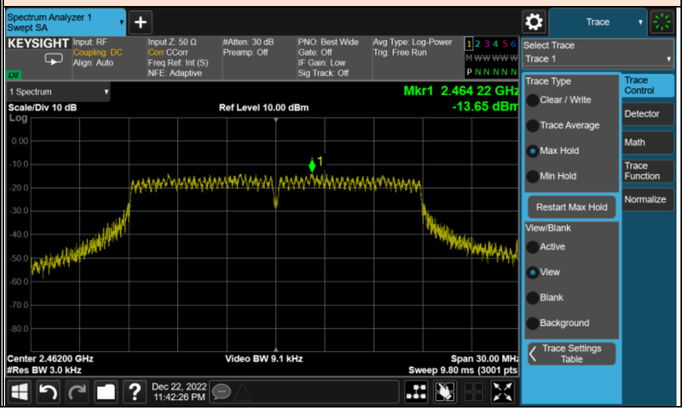
2 412 MHz

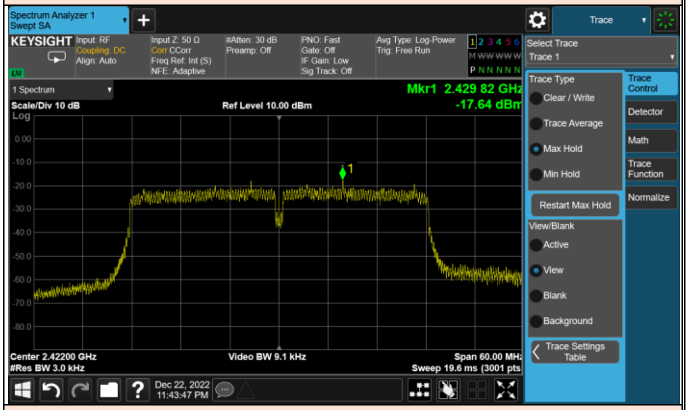
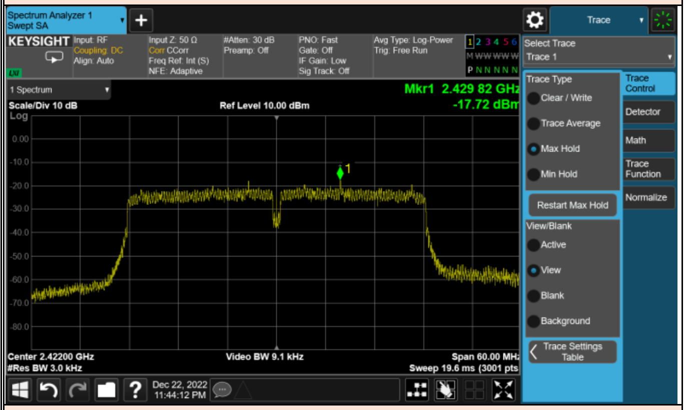
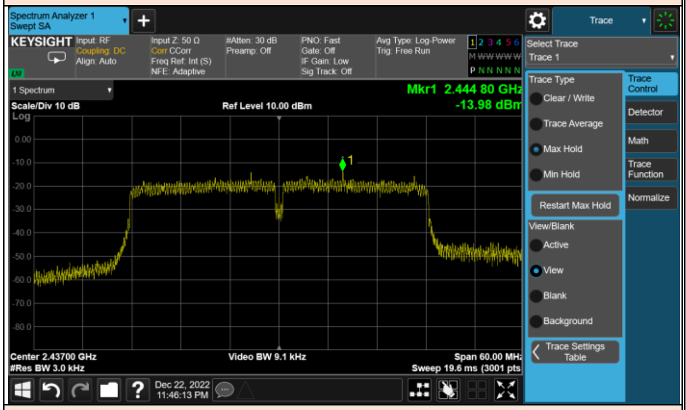
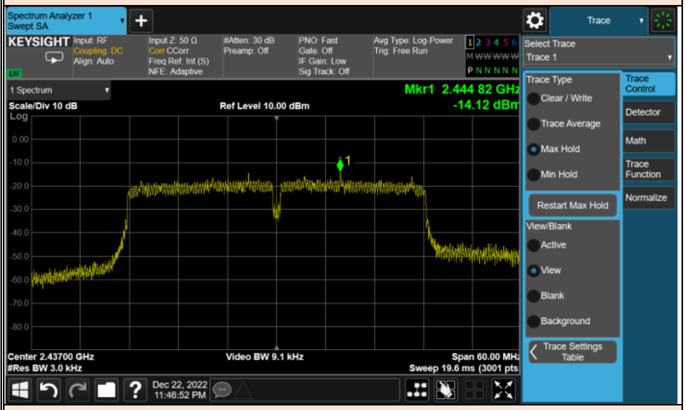
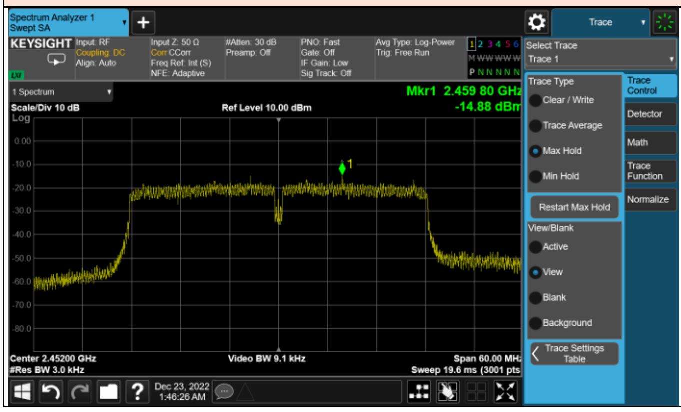
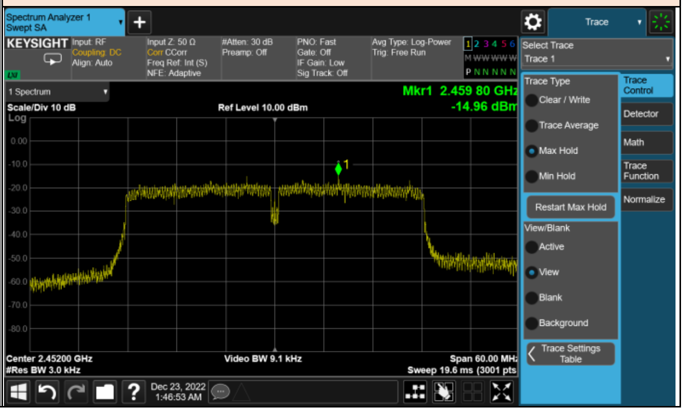


2 437 MHz



2 462 MHz



802.11n(HT40)	
12 V	24 V
2 422 MHz	2 422 MHz
	
2 437 MHz	2 437 MHz
	
2 452 MHz	2 452 MHz
	

3.5 Spurious Emission, Band edge and Restricted Bands

3.5.1 Regulation

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

§15.209(a) : Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	**Field strength (microvolts/meter)**	**Measurement distance (meters)**
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

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

§15.205(a) : Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41			

[1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2]Above 38.6

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

3.5.2 Test Procedure

Band-edge Compliance for RF Conducted Emissions

These procedures are applicable for determining compliance at authorized-band band-edges where the requirements are expressed as a value relative to the in-band signal level. Procedures for determining compliance with field strength limits at or close to the band-edges are given in 6.10.6 (see also Table A.2).

Band-edge tests are typically performed as a conducted test but may be performed as radiated measurements on a test site meeting the specifications in 5.2, at the measurement distances specified in 5.3. The instrumentation shall meet the requirements in 4.1.1 using the bandwidths and detectors specified in 4.1.4.2.

When performing radiated measurements, the measurement antenna(s) shall meet the specifications in 4.3. The EUT shall be connected to an antenna and operated at the highest power settings following procedures in 6.3.

For other than frequency-hopping devices, this test sequence shall be performed once. For devices that support frequency hopping, this test sequence shall be performed twice: once with the hopping function turned OFF and then repeated with the hopping function turned ON. The purpose of the test with the hopping function turned on is to confirm that the RF power remains OFF while the device is changing frequencies, and that the oscillator stabilizes at the new frequency before RF power is turned back ON. Overshoot of any oscillator, including phase-lock-loop stabilized oscillators, can cause the device to be temporarily tuned to frequencies outside the authorized band, and it is important that no transmissions occur during such temporary periods. Particular attention to the hopping sequence requirements specified below is needed in the case of adaptive frequency-hopping devices:

a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).

b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).

c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normalmode of operation” as specified in 6.10.3.

d) If using the radiated method, then use the applicable procedure(s) of 6.4, 6.5, or 6.6, and orient the EUT and measurement antenna positions to produce the highest emission level.

e) Perform the test as follows:

    1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

    2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

    3) Attenuation: Auto (at least 10 dB preferred).

    4) Sweep time: Coupled.

    5) Resolution bandwidth: 100 kHz.

    6) Video bandwidth: 300 kHz.

    7) Detector: Peak.

    8) Trace: Max hold.

f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can takeseveral minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot.

g) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

h) Repeat step c) through step e) for every applicable modulation.

i) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).

j) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

Spurious RF Conducted Emissions

Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers.

Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results,account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

Spurious Radiated Emissions

1. The preliminary radiated measurement were performed to determine the frequency producing the maximum emissions in an semi-anechoic chamber at a distance of 3 meters.

2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360^{o}.

3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, and from 30 to 1000 MHz using the Bi-Log antenna, and from 1000 MHz to 26500 MHz using the horn antenna.

4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 x 4 meter in an semi-anechoic chamber. The EUT was tested at a distance 3 meters.

5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector fuction with specified bandwidth.

6. The 0.8 m height is for below 1 GHz testing, and 1.5 m is for above 1GHz testing.

- Procedure for unwanted emissions measurements below 1 000 MHz

The procedure for unwanted emissions measurements below 1 000 MHz is as follows:

a) Follow the requirements in 12.7.4.

b) Compliance shall be determined using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

- Procedure for peak unwanted emissions measurements above 1 000 MHz

The procedure for peak unwanted emissions measurements above 1 000 MHz is as follows:

a) Follow the requirements in 12.7.4.

b) Peak emission levels are measured by setting the instrument as follows:

1) RBW = 1 MHz.

2) VBW ≥ [3 × RBW].

3) Detector = peak.

4) Sweep time = auto.

5) Trace mode = max hold.

6) Allow sweeps to continue until the trace stabilizes. Note that if the transmission is not ontinuous, then the time required for the trace to stabilize will increase by a factor of pproximately 1 / D, where D is the duty cycle. For example, at 50 % duty cycle, the easurement time will increase by a factor of two, relative to measurement time for ontinuous transmission.

- Procedure for average unwanted emissions measurements above 1 000 MHz

Trace averaging with continuous EUT transmission at full power

If the EUT can be configured or modified to transmit continuously (D ≥ 98%), then the average emission levels shall be measured using the following method (with EUT transmitting continuously):

a) RBW = 1 ㎒ (unless otherwise specified).

b) VBW ≥ (3×RBW).

c) Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

d) Averaging type = power (i.e., rms):

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode to use linear voltage averaging. Log or ㏈ averaging shall not be used.

e) Sweep time = auto.

f) Perform a trace average of at least 100 traces.

Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction

If continuous transmission of the EUT (D ≥ 98%) cannot be achieved and the duty cycle is constant (duty cycle variations are less than ±2%), then the following procedure shall be used:

a) The EUT shall be configured to operate at the maximum achievable duty cycle.

b) Measure the duty cycle D of the transmitter output signal as described in 2.4

c) RBW = 1 ㎒ (unless otherwise specified).

d) VBW ≥ [3 × RBW].

e) Detector = RMS (power averaging), if [span / (# of points in sweep)] ≤ (RBW / 2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

f) Averaging type = power (i.e., rms):

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode to use linear voltage averaging. Log or ㏈ averaging shall not be used.

g) Sweep time = auto.

h) Perform a trace average of at least 100 traces.

i) A correction factor shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:

3) If power averaging (rms) mode was used in step f), then the applicable correction factor is [10 log (1 / D)], where D is the duty cycle.

4) If linear voltage averaging mode was used in step f), then the applicable correction factor is [20 log (1 / D)], where D is the duty cycle.

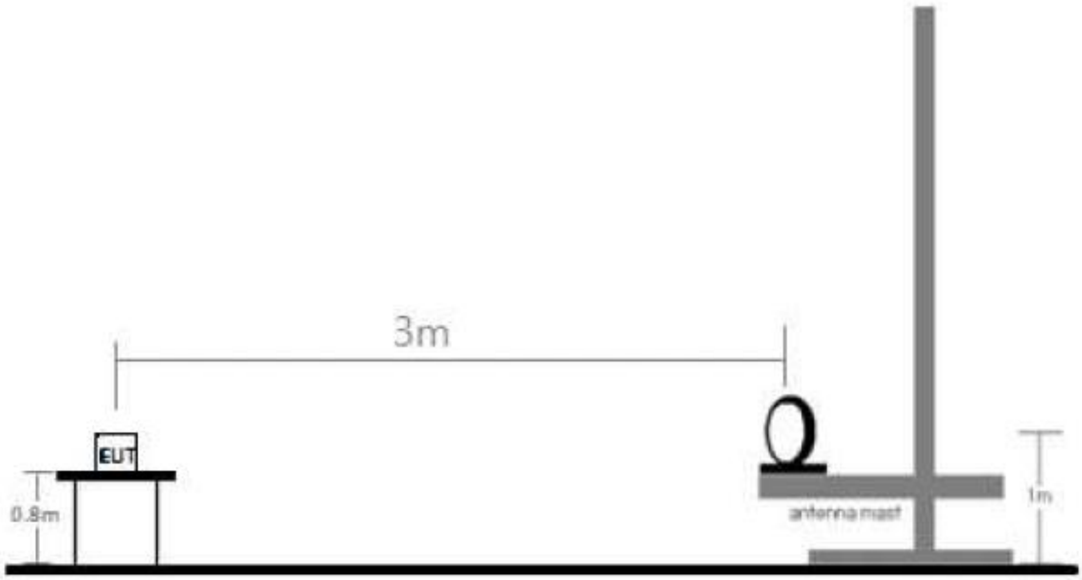
5) If a specific emission is demonstrated to be continuous (D ≥ 98%) rather than turning ON and OFF with with the transmit cycle, then no duty cycle correction is required for that emission.

- Sample Calculation

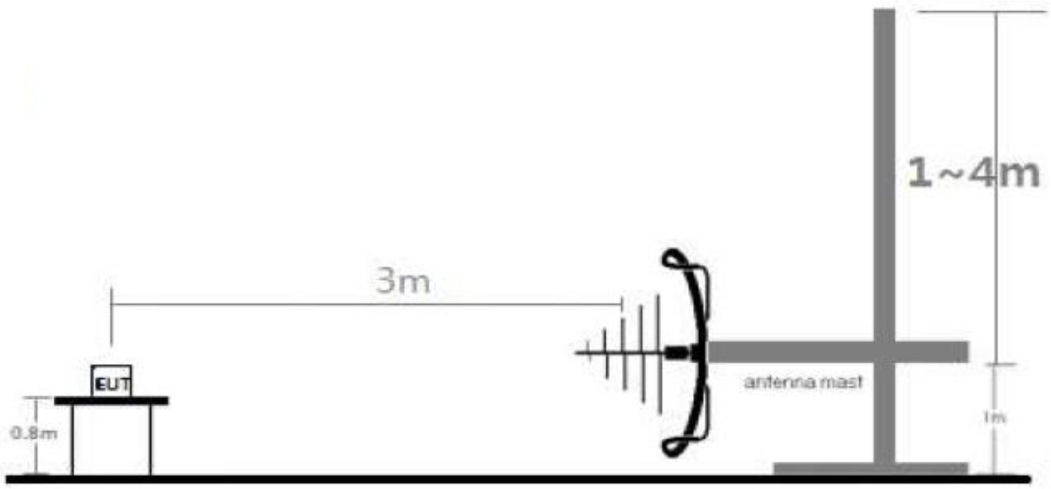
- Field Strength Level [dBμV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m] + Duty Cycle Correction [dB]

- AFCL [dB/m] = Antenna Factor [dB/m] + Cable loss [dB]
- Margin [dB] = Field Strength Level [dBμV/m] – Limit [dBμV/m]

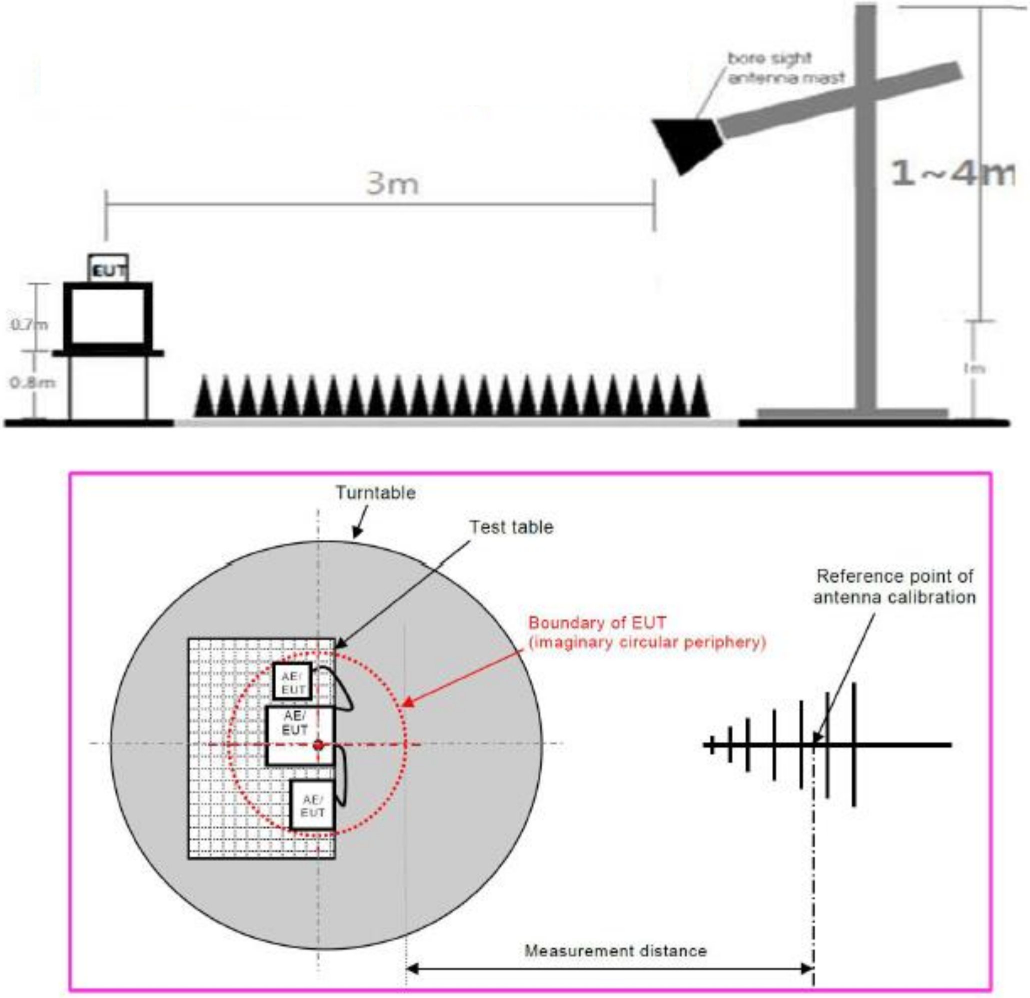
3.5.3 Test Setup



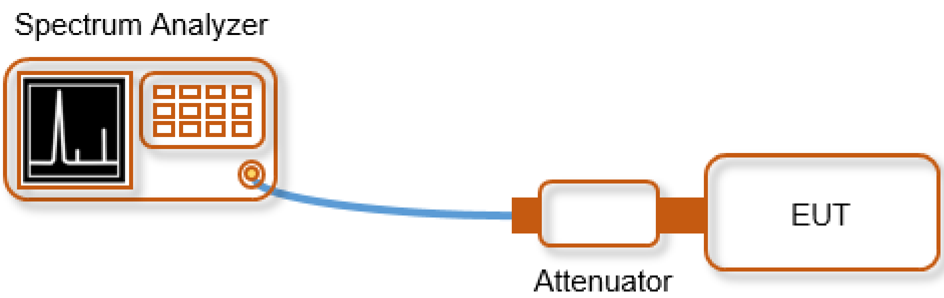
[Radiated Emission Test Setup Below 30 MHz]



[Radiated Emission Test Setup Below 1 GHz]



[Radiated Emission Test Setup Above 1 GHz]



[Conducted Spurious Emission]