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TEST REPORT

Report Number: 21100480HKG-001

Application for Original Grant of 47 CFR Part 15 Certification

FCC ID: 2AQ7I00012

WiFi Robot

Prepared and Checked by:	**Approved by:**
Signed On File Lee For Yiu, Florey Assistant Engineer	Digitally signed by Kenneth Wong Location: Intertek Testing Services Hong Kong Limited Wong Kwok Yeung, Kenneth Assistant Supervisor Date: November 10, 2021

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TEST REPORT

GENERAL INFORMATION

Applicant Name:	Hanson Robotics Limited
Applicant Address:	Flat A, 25/F., Superluck Industrial Centre Phase 2, 57 Sha Tsui Road, Tsuen Wan, N.T., Hong Kong.
FCC Specification Standard:	FCC Part 15, October 1, 2020 Edition
FCC ID:	2AQ7I00012
FCC Model(s):	0012
Type of EUT:	Spread Spectrum Transmitter
Description of EUT:	Professor Einstein 2.0
Serial Number:	N/A
Sample Receipt Date:	October 15, 2021
Date of Test:	October 15, 2021 to October 26, 2021
Report Date:	November 10, 2021
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%
Conclusion:	Test was conducted by client submitted sample. The submitted sample as received complied with the 47 CFR Part 15 Certification.

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1.0 TEST RESULTS SUMMARY & STATEMENT OF COMPLIANCE

1.1 Summary of Test Results

Test Items	FCC Part 15 Section	Results	Details See Section
Antenna Requirement	15.203	Pass	2.1
Max. Conducted Output Power (Peak)	15.247(b)(3)&(4)	Pass	4.1
Min. 6dB RF Bandwidth	15.247(a)(2)	Pass	4.2
Max. Power Density (average)	15.247(e)	Pass	4.3
Out of Band Antenna Conducted Emission	15.247(d)	Pass	4.4
Radiated Emission in Restricted Bands and Spurious Emissions	15.247(d), 15.209 & 15.109	Pass	4.6
AC Power Line Conducted Emission	15.207 & 15.107	Pass	4.7

Note: Pursuant to FCC Part 15 Section 15.215(c), the 20dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over expected variations in temperature and supply voltage were considered.

1.2 Statement of Compliance

The equipment under test is found to be complying with the following standard:

FCC Part 15, October 1, 2020 Edition

TEST REPORT

2.0 GENERAL DESCRIPTION

2.1 Product Description

The 0012 is a Professor Einstein Robot. It has a microcontroller with integrated wifi which controls speaking and body movement of the device and communicate with the smartphone application. The EUT is powered by an AC/DC adaptor (120VAC 60Hz 0.5A input; 5VDC 2000mA output) and 3.7VDC (2 x 3.7V Rechargeable Batteries in parallel).

For 802.11b mode, it operates at frequency range of 2412MHz to 2462MHz with 11 channels. It transmits via direct-sequence spread spectrum (DSSS) modulation. Maximum bit rate can be up to 11Mbps. For 802.11g mode, it operates at frequency range of 2412MHz to 2462MHz with 11 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation. Maximum bit rate can be up to 54Mbps. For 802.11n (HT20 with 20MHz bandwidth) mode, it operates at frequency range of 2412MHz to 2462MHz with 11 channels. It transmits via Orthogonal Frequency Division Multiplexing (OFDM) modulation (mcs0 to mcs7). Maximum bit rate can support up to 65Mbps.

The circuit description is saved with filename: descri.pdf.

2.2 Test Methodology

Both AC power line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Preliminary radiated scans and all radiated measurements were performed in radiated emission test sites. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application. Antenna port conducted measurements were performed according to ANSI C63.10 (2013) and KDB Publication No.558074 D01 v05r01 (11-February-2019). All other measurements were made in accordance with the procedures in 47 CFR Part 2.

2.3 Test Facility

The radiated emission test site and antenna port conducted measurement facility used to collect the radiated data and conductive data are at Workshop No. 3, G/F., World-Wide Industrial Centre, 43-47 Shan Mei Street, Fo Tan, Sha Tin, N.T., Hong Kong SAR, China. This test facility and site measurement data have been fully placed on file with the FCC.

2.4 Related Submittal(s) Grants

This is a single application for certification of a transceiver (WiFi portion)

TEST REPORT

3.0 SYSTEM TEST CONFIGURATION

3.1 Justification

For radiated emissions testing, the equipment under test (EUT) was setup to transmit / receive continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, all cables (if any) were manipulated to produce worst case emissions.

The EUT was powered by a 120VAC adaptor and 3.7VDC (2 x 3.7V Rechargeable Batteries in parallel).

For the measurements, the EUT was attached to a plastic stand if necessary and placed on the wooden turntable. If the base unit attached to peripherals, they were connected and operational (as typical as possible).

The signal was maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization were varied during the search for maximum signal level. The antenna height was varied from 1 to 4 meters. Radiated emissions were taken at three meters unless the signal level was too low for measurement at that distance. If necessary, a pre-amplifier was used and/or the test was conducted at a closer distance.

For any intentional radiator powered by AC power line, measurements of the radiated signal level of the fundamental frequency component of the emission was performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

Radiated emission measurement for transmitter were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Emission that are directly caused by digital circuits in the transmit path and transmitter portion were measured, and the limit are according to FCC Part 15 Section 15.209. Digital circuitries used to control additional functions other than the operation of the transmitter are subject to FCC Part 15 Section 15.109.

TEST REPORT

3.1 Justification – Cont'd

Detector function for radiated emissions was in peak mode. Average readings, when required, were taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in section 4.8.3.

Determination of pulse desensitization was made according to *Hewlett Packard Application Note 150-2, Spectrum Analysis... Pulsed RF.* The effective period (Teff) was referred to Exhibit 4.8.3. With the resolution bandwidth 1MHz and spectrum analyzer IF bandwidth 3dB, the pulse desensitization factor was 0dB.

For AC line conducted emission test, the EUT along with its peripherals were placed on a 1.0m(W)x1.5m(L) and 0.8m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane. The EUT was connected to power mains through a line impedance stabilization network (LISN), which provided 50ohm coupling impedance for measuring instrument. The LISN housing, measuring instrument case, reference ground plane, and vertical ground plane were bounded together. The excess power cable between the EUT and the LISN was bundled.

All connecting cables of EUT and peripherals were manipulated to find the maximum emission.

All setting of data rate for 802.11b/g/n(HT20) of WiFi mode had been considered, and worst-case test data are shown on this test report.

All data rates were tested under normal mode of WiFi. Only the worst-case data is shown in the report for DSSS and OFDM

3.2 EUT Exercising Software

The EUT exercise program (if any) used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

TEST REPORT

3.3 Details of EUT and Description of Accessories

Details of EUT:

(1) The EUT is powered by 120VAC adaptor and 3.7VDC (2 x 3.7V Rechargeable batteries in parallel).

Description of Accessories:

An AC adaptor (provided with the unit) was used to power the device. Their description are listed below.

(1) An AC adaptor (AC Input: 120V 60Hz, Output: 5.0VDC 2000mA, Model: SED0502000G), Provided by Client

(2) Asus X550Z Notebook (Provided by Client)
(3) USB Cable with 1.22m length (Provided by Client)
(4) Test Mode Software UI_mptool.exe (Provided by Client)

3.4 Measurement Uncertainty

Decision Rule for compliance: For FCC/IC standard, the measured value must be within the limits of applicable standard without accounting for the measurement uncertainty. For EN/IEC/HKTA/HKTC standard, conformity rules will be used as per standard directly excepted EN/IEC 61000-3-2, EN/IEC 61000-3-3, HKTA1004, HKCA1008, HKTA1019, HKTA1020, HKTA1041 and HKTA1044. For these excepted or not mentioned standards, Cl 4.2.2 of ILAC-G8:09/2019 decision rules will be reference and guard band will be equal to our measurement uncertainty with 95% confidence level (k=2). In case, the measured value is within guard band region, undetermined decision will be used. The values of the Measurement uncertainty for radiated emission test and RF conducted measurement test are ± 5.3dB and ±0.99dB respectively. The value of the Measurement uncertainty for conducted emission test is ±4.2dB.

Uncertainty and Compliance - Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

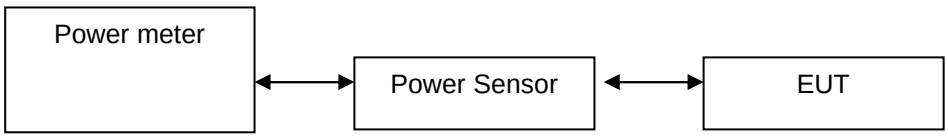
TEST REPORT

4.0 TEST RESULTS

4.1 Maximum Conducted (peak) Output Power at Antenna Terminals

RF Conduct Measurement Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



The antenna port of the EUT was connected to the input of a spectrum analyzer.

☒ The antenna power of the EUT was connected to the input of a power meter. Power was read directly and cable loss correction was added to the reading to the obtain power at the EUT antenna terminals. The measurement procedure 9.1.2 was used.

☐ The EUT should be configured to transmit continuously (at a minimum duty cycle of 98%) at full power over the measurement duration. The measurement procedure AVG1 was used.

IEEE 802.11b (DSSS, 1 Mbps) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm	Output in mWatt
Low Channel:	2412	17.63	57.94
Middle Channel:	2437	16.43	43.95
High Channel:	2462	15.23	33.34

IEEE 802.11g (OFDM, 6 Mbps) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm	Output in mWatt
Low Channel:	2412	19.95	98.86
Middle Channel:	2437	17.69	58.75
High Channel:	2462	16.67	46.45

TEST REPORT

4.1 Maximum Conducted Output Power at Antenna Terminals – Cont'd

IEEE 802.11n (20MHz) (OFDM, MCS0) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm	Output in mWatt
Low Channel:	2412	17.31	53.83
Middle Channel:	2437	17.76	59.70
High Channel:	2462	20.08	101.86

Cable loss : 0.5 dB External Attenuation : 2 dB

Cable loss, external attenuation: ☒ included in OFFSET function
☐ added to SA raw reading

IEEE 802.11b (DSSS, 1 Mbps)
max. conducted (peak) output level = 17.63 dBm

IEEE 802.11g (OFDM, 9 Mbps)
max. conducted (peak) output level = 19.95 dBm

IEEE 802.11n (20MHz) (OFDM, MCS0)
max. conducted (peak) output level = 20.08 dBm

Limits:
☒ 1W (30dBm) for antennas with gains of 6dBi or less

☐ ___W (___dBm) for antennas with gains more than 6dBi

The plots of conducted output power are saved as below.

TEST REPORT

4.2 Minimum 6dB RF Bandwidth

The antenna port of the EUT was connected to the input of a spectrum analyzer. The EBW measurement procedure was used. A PEAK output reading was taken, a DISPLAY line was drawn 6dB lower than PEAK level. The 6dB bandwidth was determined from where the channel output spectrum intersected the display line.

IEEE 802.11b (DSSS, 1 Mbps)

Frequency (MHz)	6dB Bandwidth (MHz)
Low Channel: 2412	9.04
Middle Channel: 2437	9.04
High Channel: 2462	9.04

IEEE 802.11g (OFDM, 6 Mbps)

Frequency (MHz)	6dB Bandwidth (MHz)
Low Channel: 2412	18.0
Middle Channel: 2437	18.0
High Channel: 2462	18.0

IEEE 802.11n (20MHz) (OFDM, MCS0)

Frequency (MHz)	6dB Bandwidth (MHz)
Low Channel: 2412	18.0
Middle Channel: 2437	18.0
High Channel: 2462	18.0

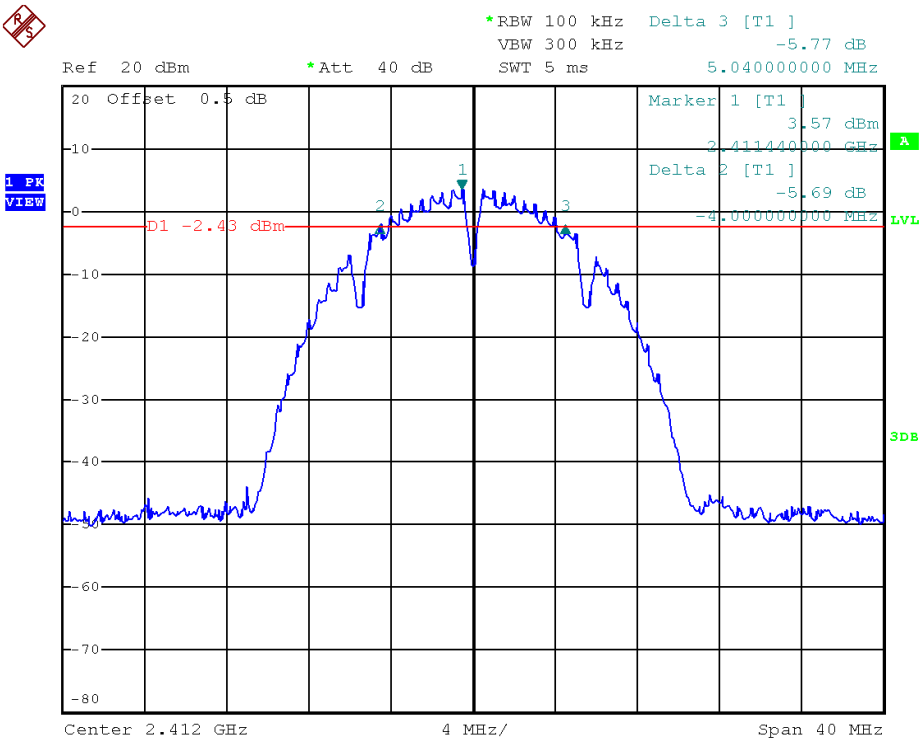
Limits
6 dB bandwidth shall be at least 500kHz

The plots of 6dB RF bandwidth are saved as below.

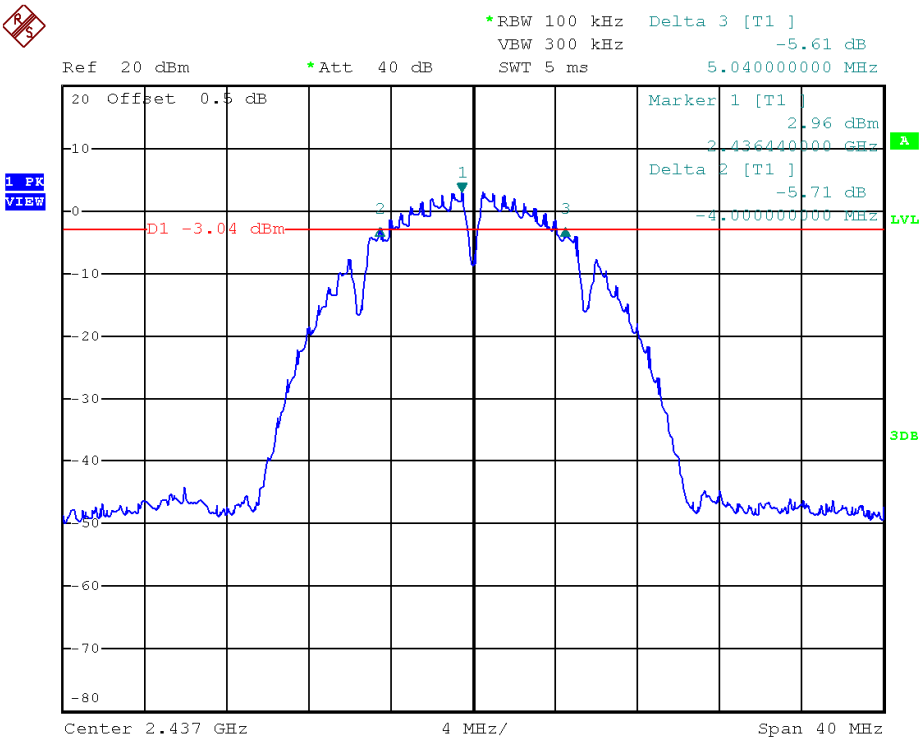
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

802.11b, Lowest Channel



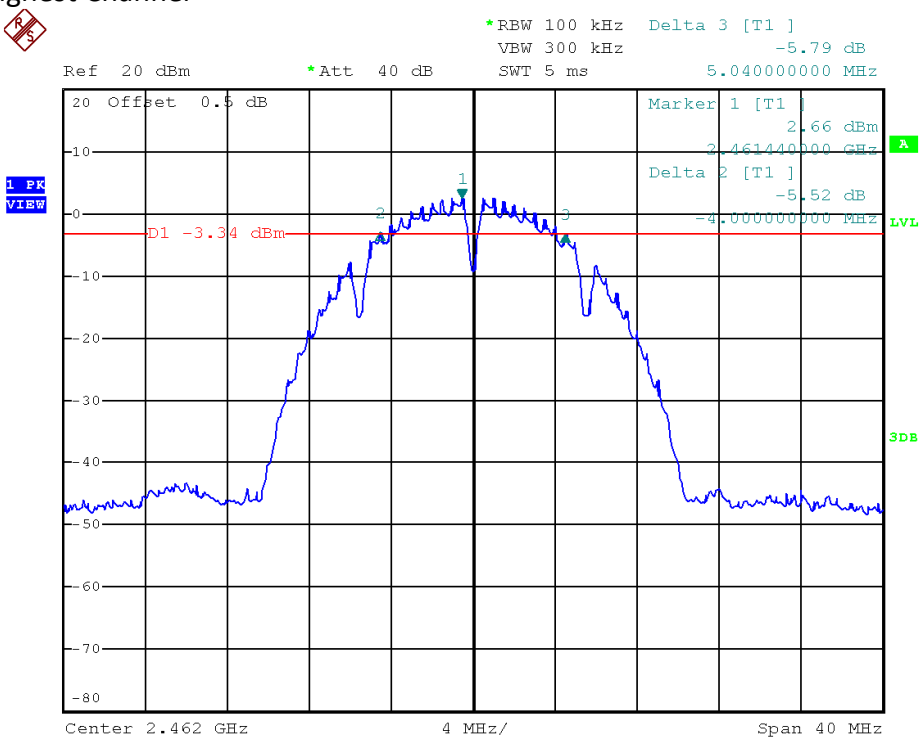
802.11b, Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

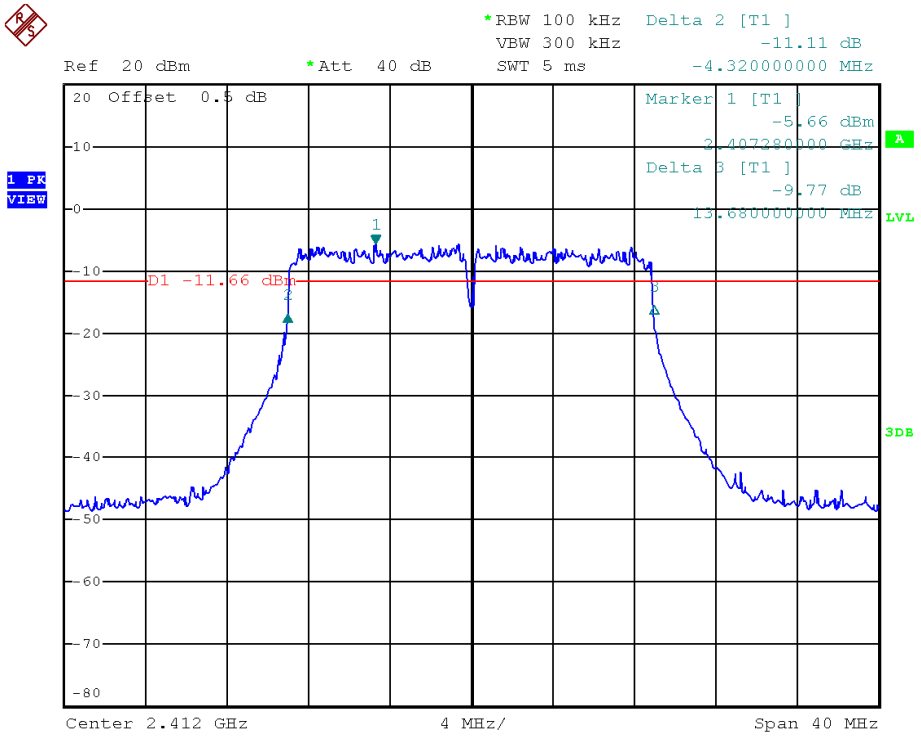
802.11b, Highest Channel



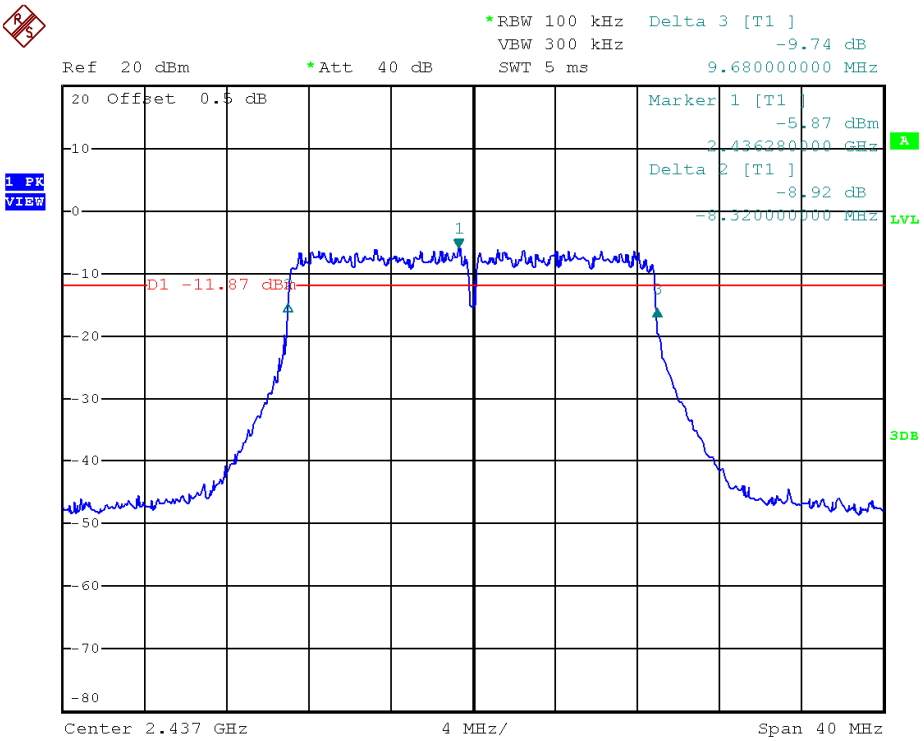
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

802.11g, Lowest Channel



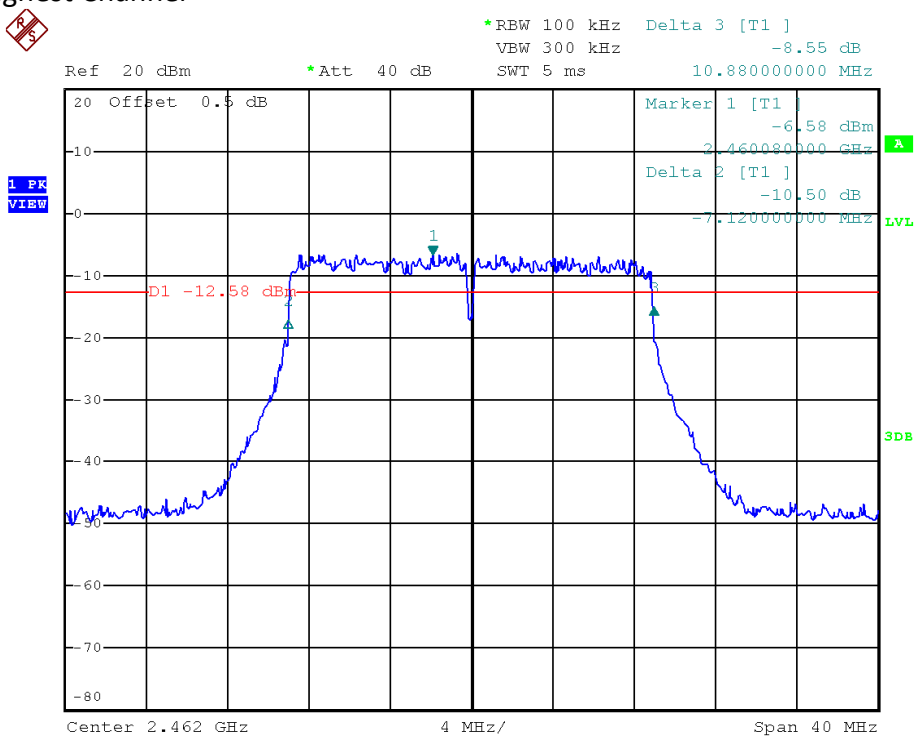
802.11g, Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

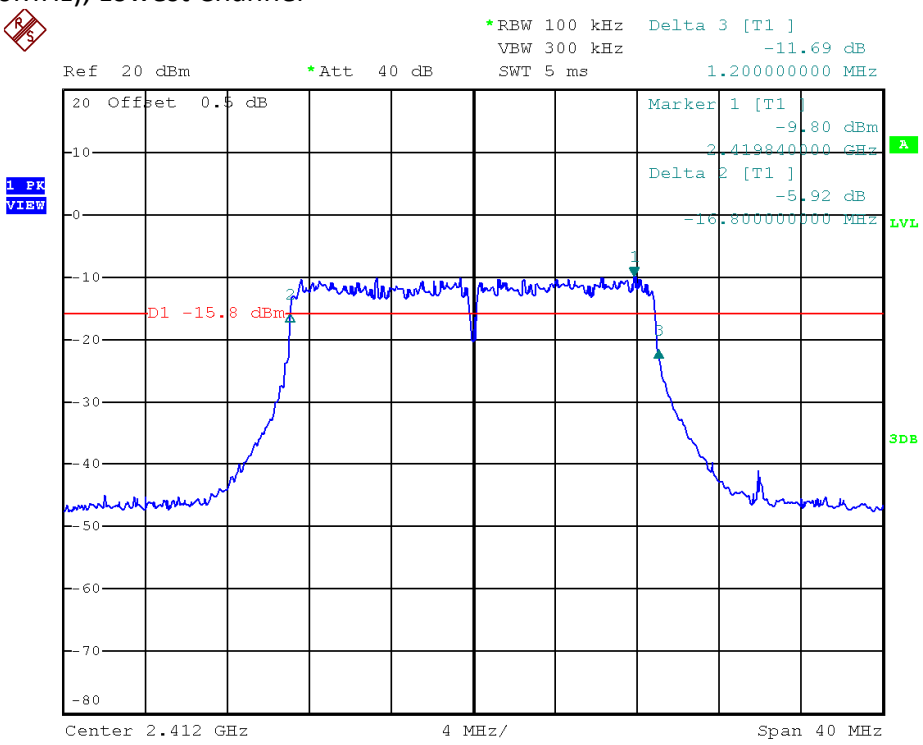
802.11g, Highest Channel



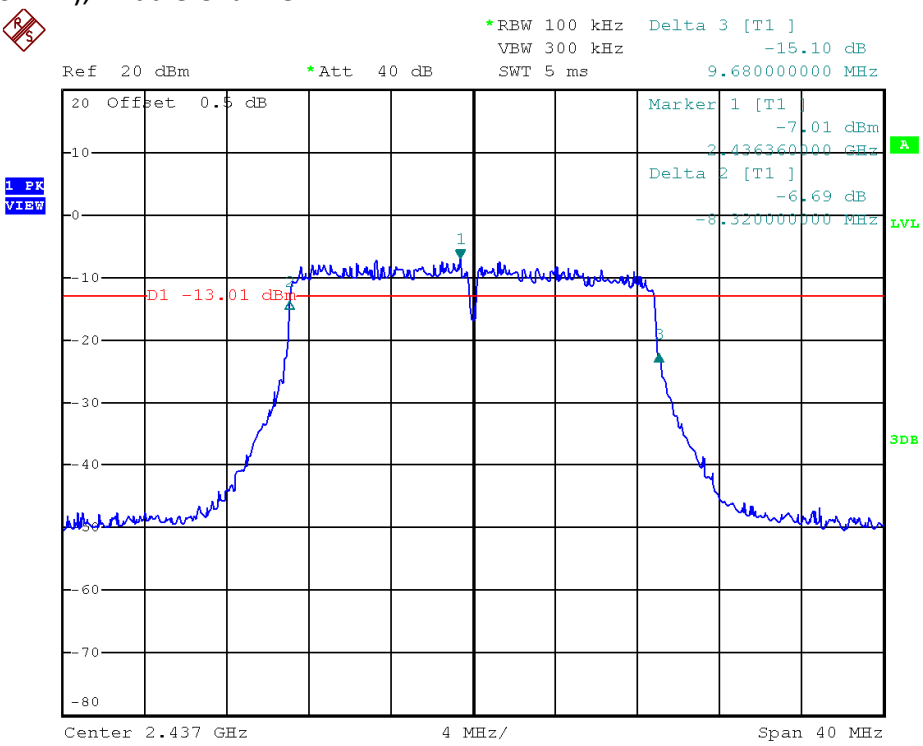
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

802.11n (20MHz), Lowest Channel



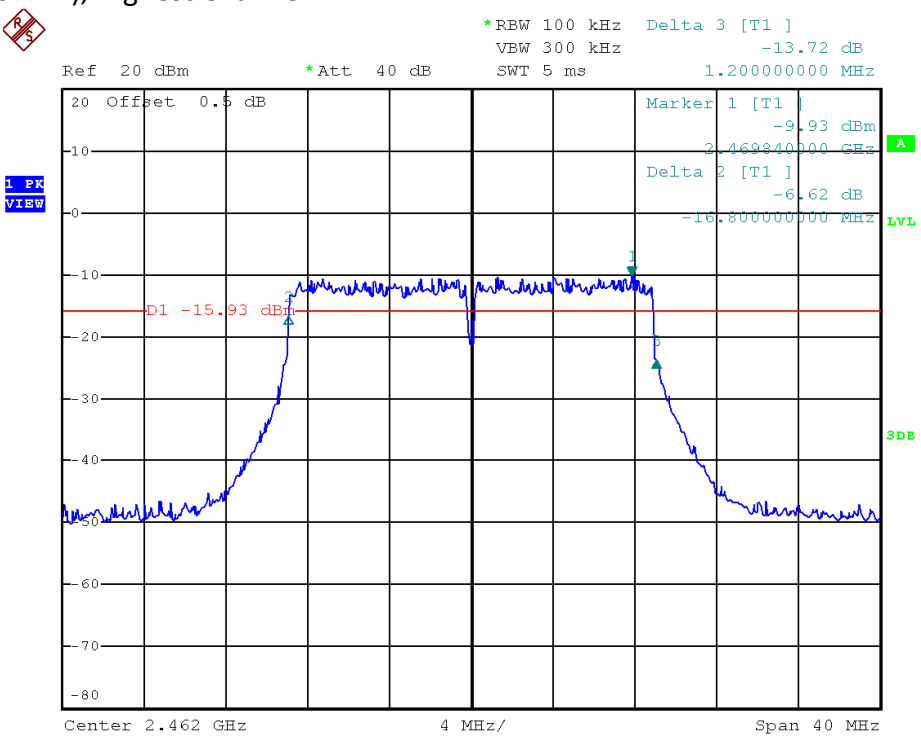
802.11n (20MHz), Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

802.11n (20MHz), Highest Channel



TEST REPORT

4.3 Maximum Power Spectral Density

Antenna output of the EUT was coupled directly to spectrum analyzer. The measurement procedure 10.2 PKPSD was used. If an external attenuator and/or cable was used, these losses are compensated for using the OFFSET function of the analyser.

IEEE 802.11b (DSSS, 1 Mbps)

Frequency (MHz)	PSD in 100kHz (dBm)
Low Channel: 2412	4.02
Middle Channel: 2437	2.99
High Channel: 2462	2.62

IEEE 802.11g (OFDM, 6 Mbps)

Frequency (MHz)	PSD in 100kHz (dBm)
Low Channel: 2412	-5.56
Middle Channel: 2437	-3.51
High Channel: 2462	-4.47

IEEE 802.11n (20MHz) (OFDM, MCS0)

Frequency (MHz)	PSD in 100kHz (dBm)
Low Channel: 2412	-9.66
Middle Channel: 2437	-7.02
High Channel: 2462	-9.82

Cable Loss: 0.5 dB

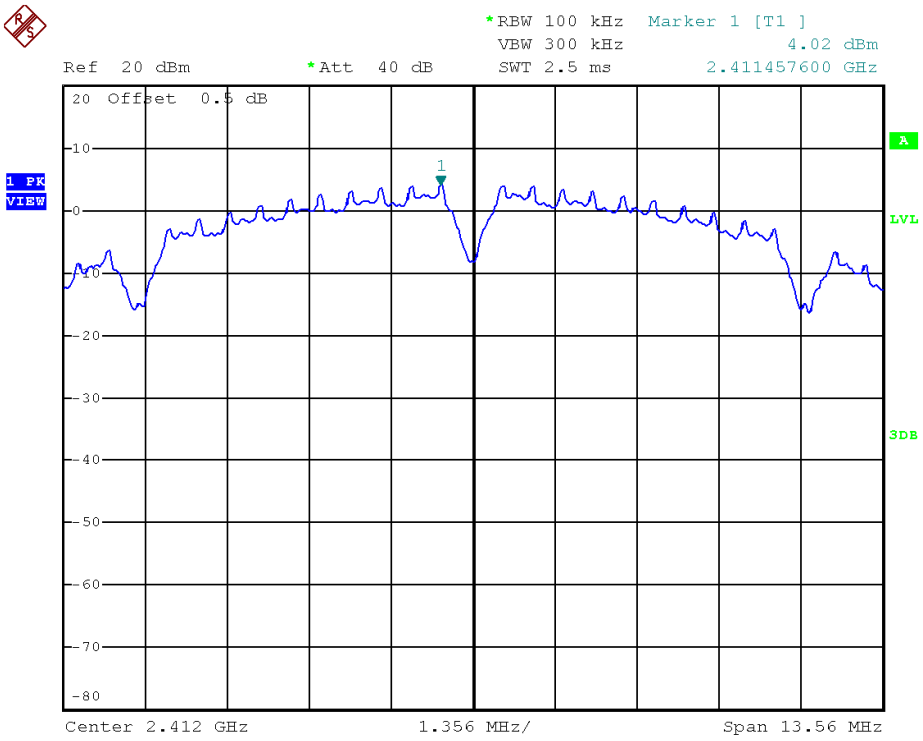
Limit:
8dBm

The plots of power spectral density are as below.

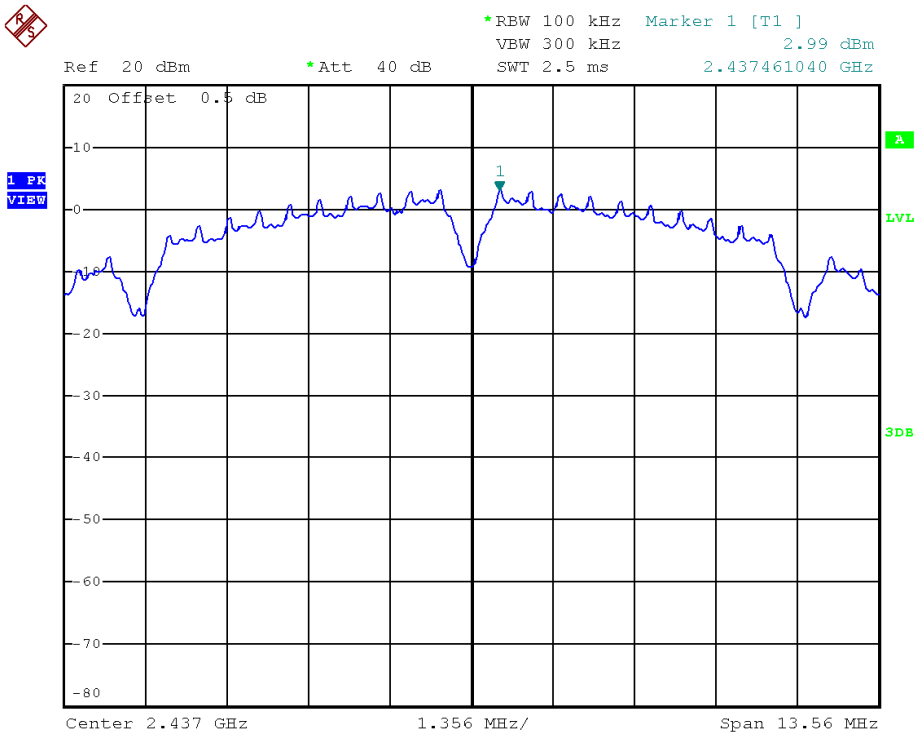
TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

802.11b, Lowest channel



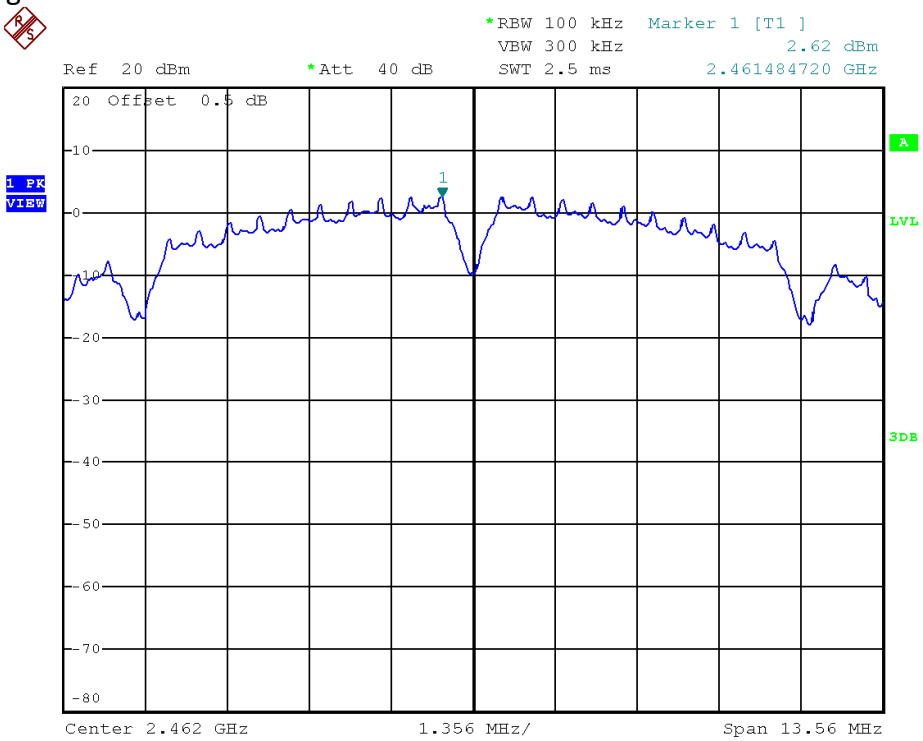
802.11b, Middle channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

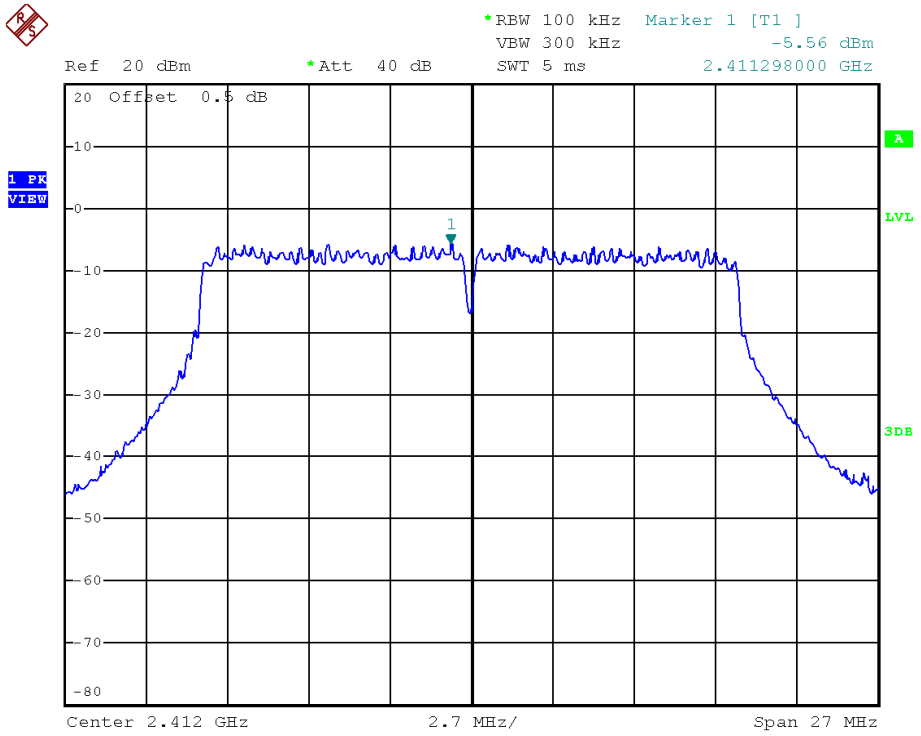
802.11b, Highest channel



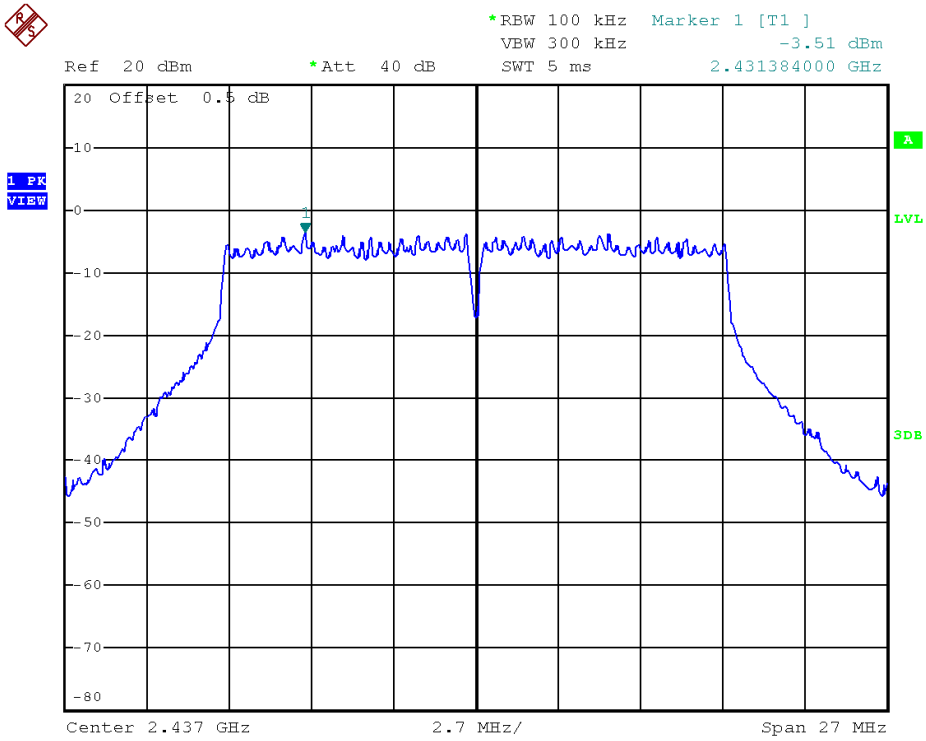
TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

802.11g, Lowest channel



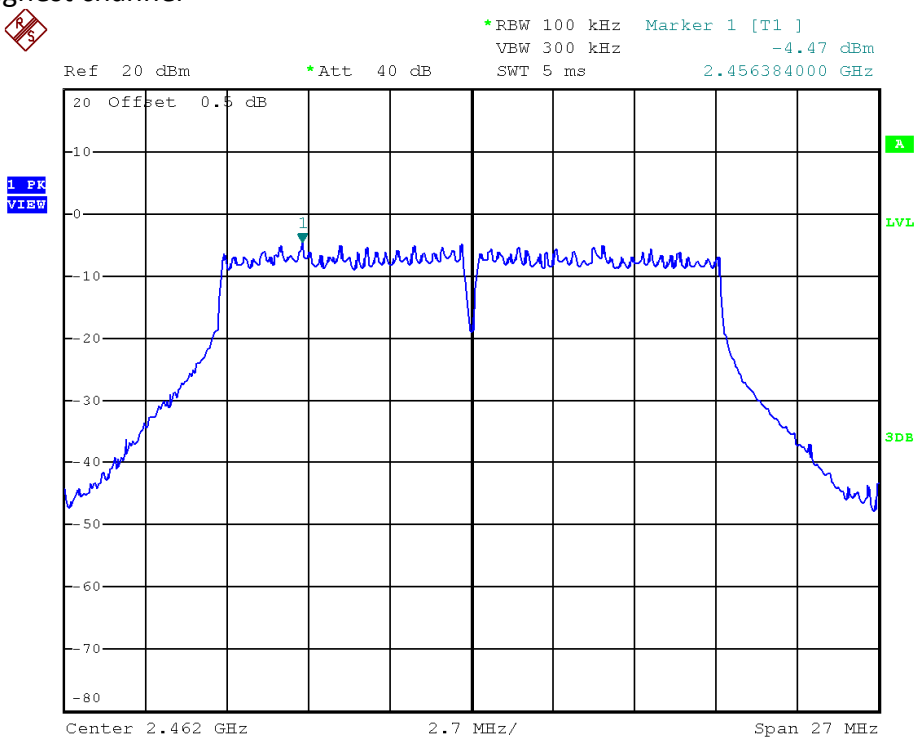
802.11g, Middle channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

802.11g, Highest channel



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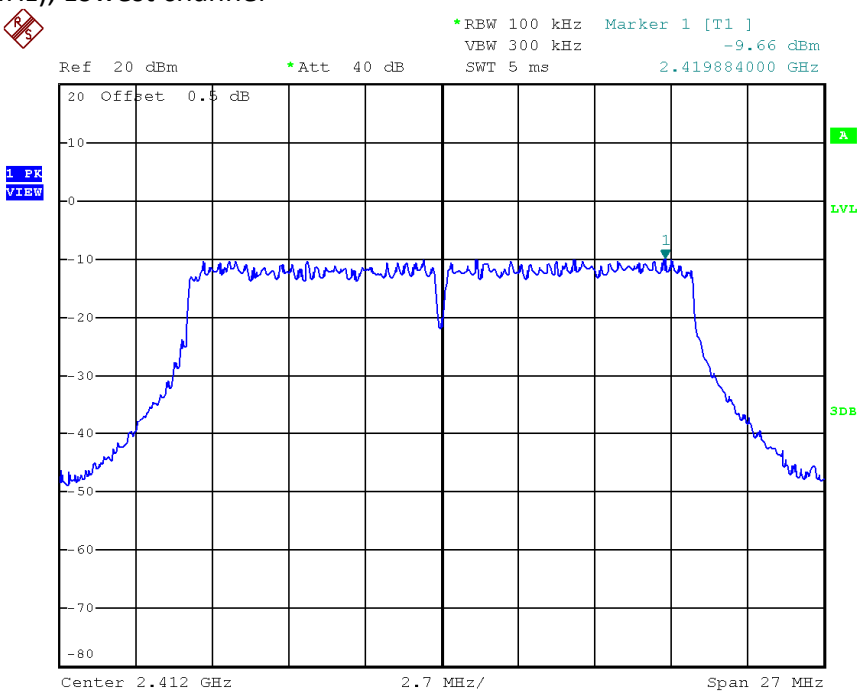
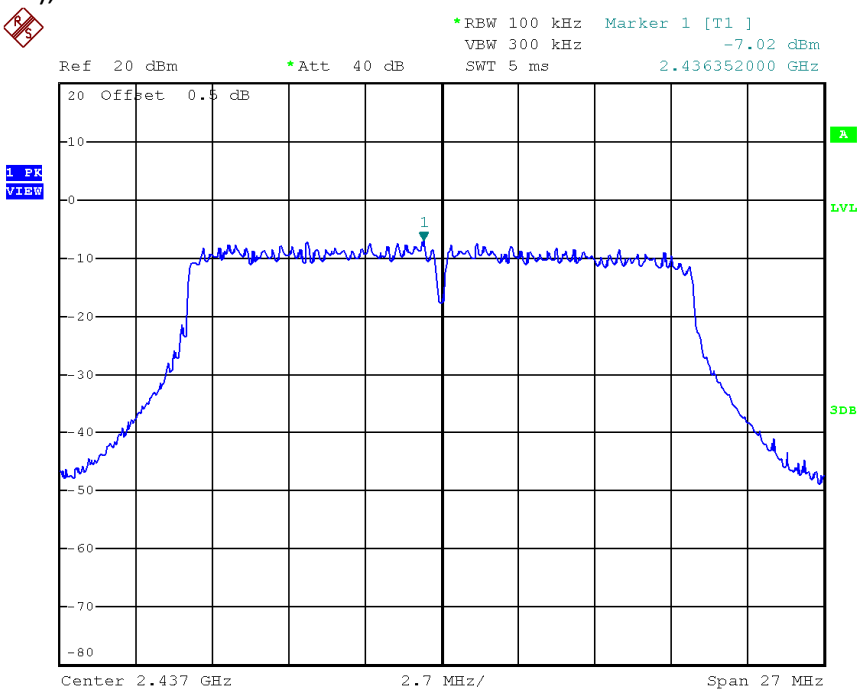
PLOTS OF POWER SPECTRAL DENSITY

802.11n (20MHz), Lowest channel



Date: 11.OCT.2021 09:59:06

802.11n (20MHz), Middle channel

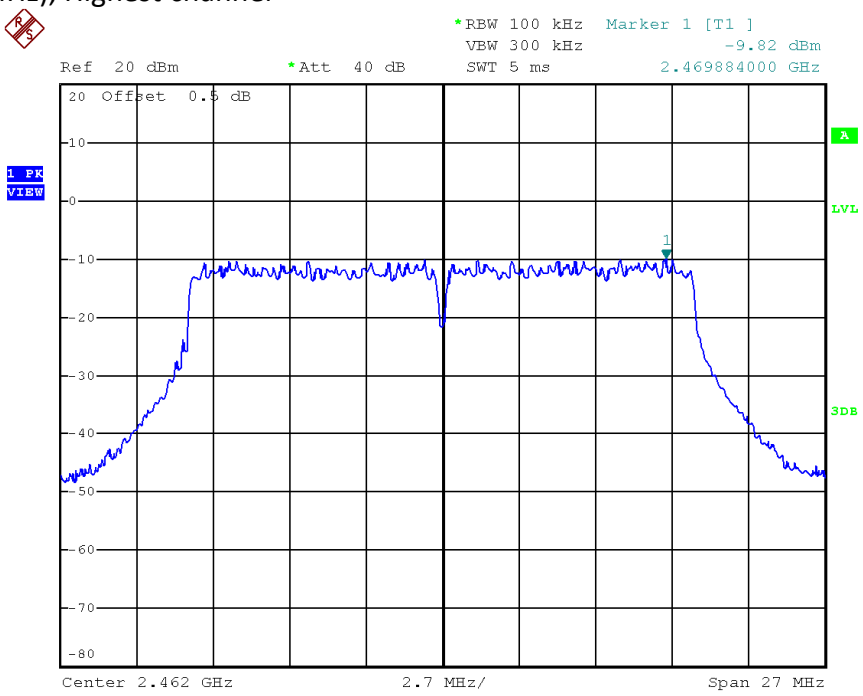


Date: 11.OCT.2021 10:07:31

TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

802.11n (20MHz), Highest channel



Date: 11.OCT.2021 10:19:06

TEST REPORT

4.4 Out of Band Conducted Emissions

For 802.11b/g/n20, the maximum conducted (peak) output power was used to demonstrate compliance as described in 9.1. Then the display line (in red) shown in the following plots denotes the limit at 20dB below maximum measured in-band peak PSD level in 100 KHz bandwidth for 802.11b/g/n20.

The measurement procedures under sections 11 of KDB558074 D01 v05r01 (11-February-2019). were used.

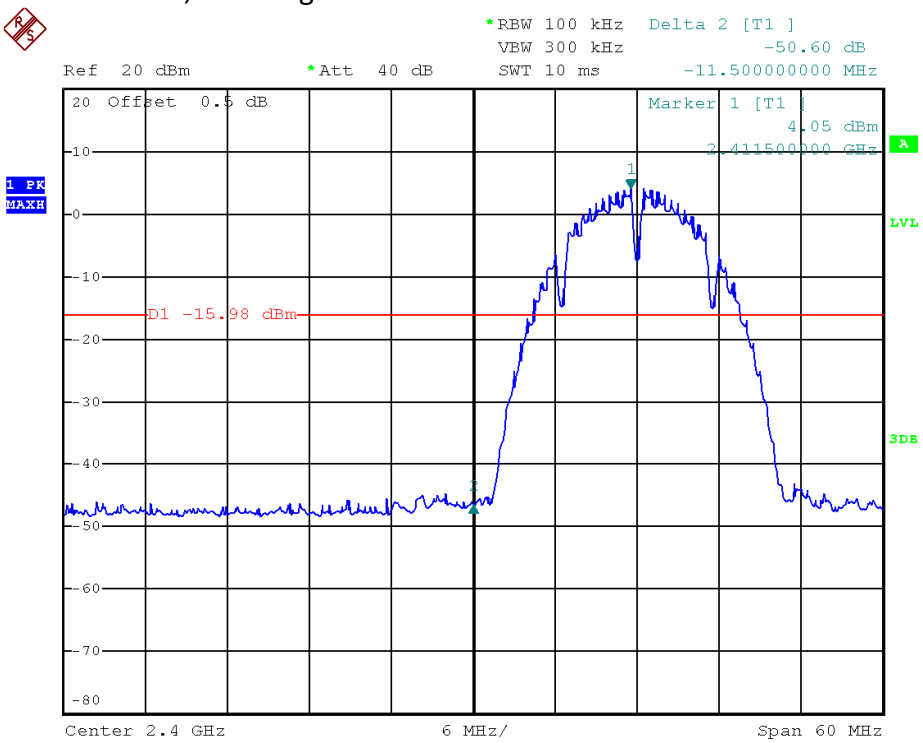
Furthermore, delta measurement technique for measuring bandedge emissions was incorporated in the test of the edge at 2483.5MHz.

Limits:
All spurious emission and up to the tenth harmonic was measured and they were found to be at least for 802.11b,g,n20MHz below the maximum measured in-band peak PSD level.

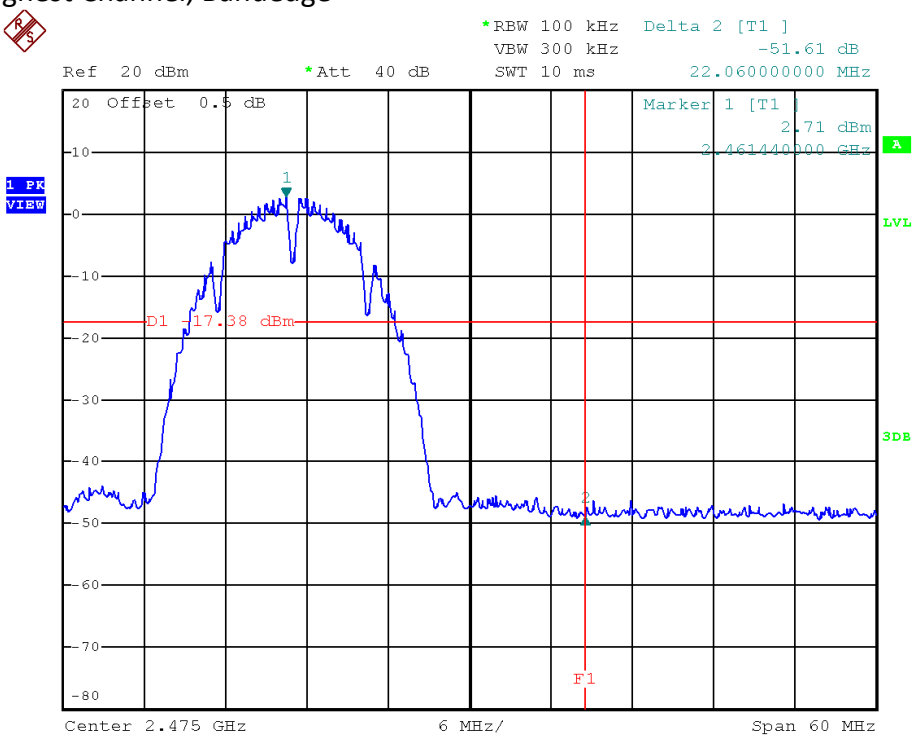
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11b, Lowest Channel, Bandedge



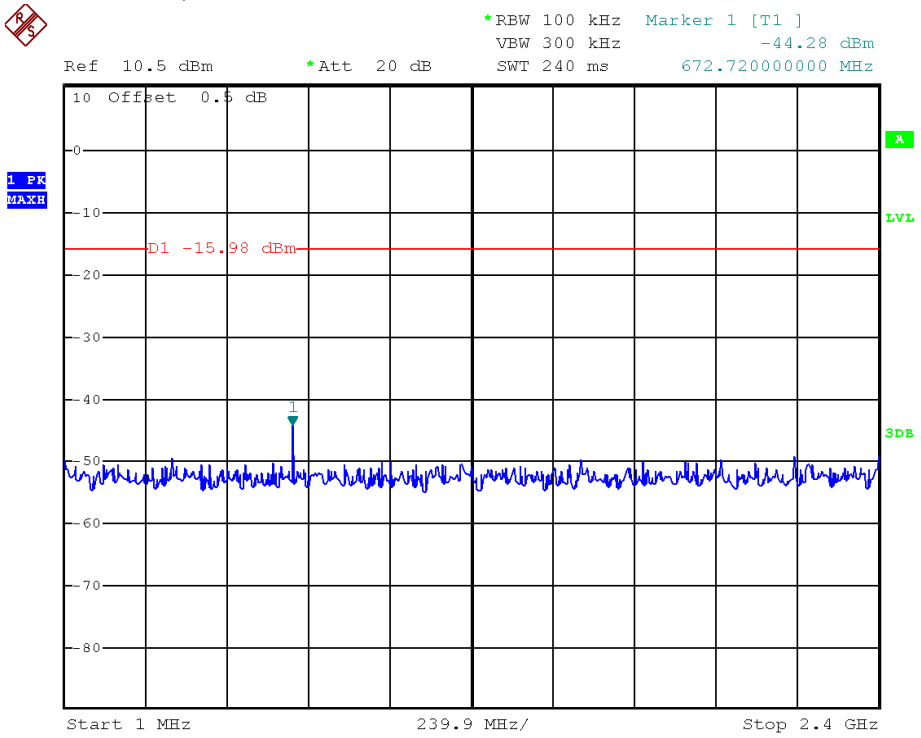
802.11b, Highest Channel, Bandedge



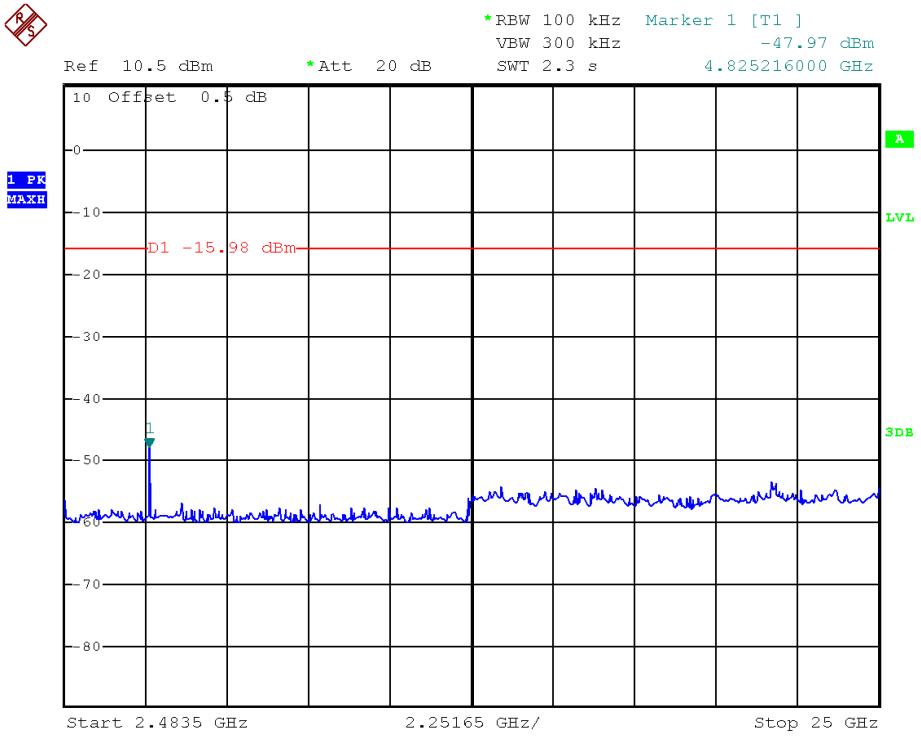
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11b, Lowest Channel, Plot A



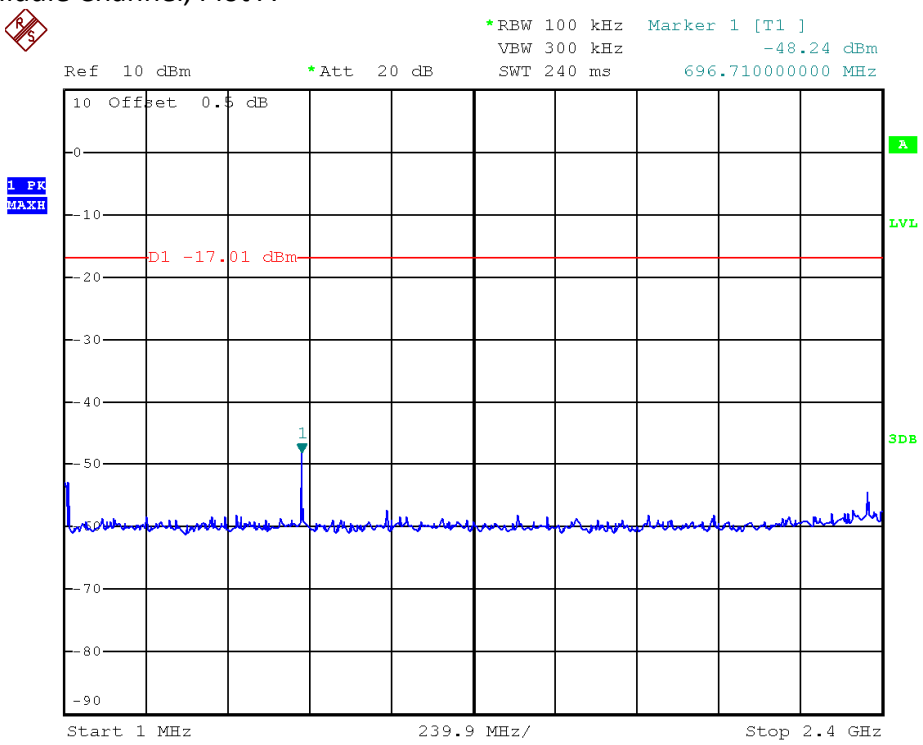
802.11b, Lowest Channel, Plot B



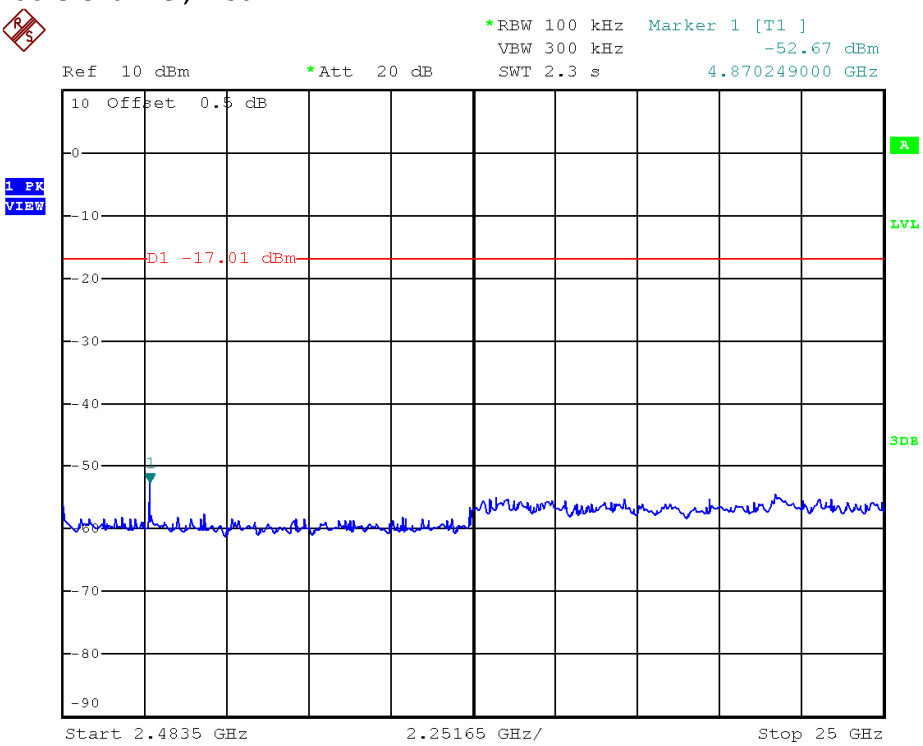
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11b, Middle Channel, Plot A



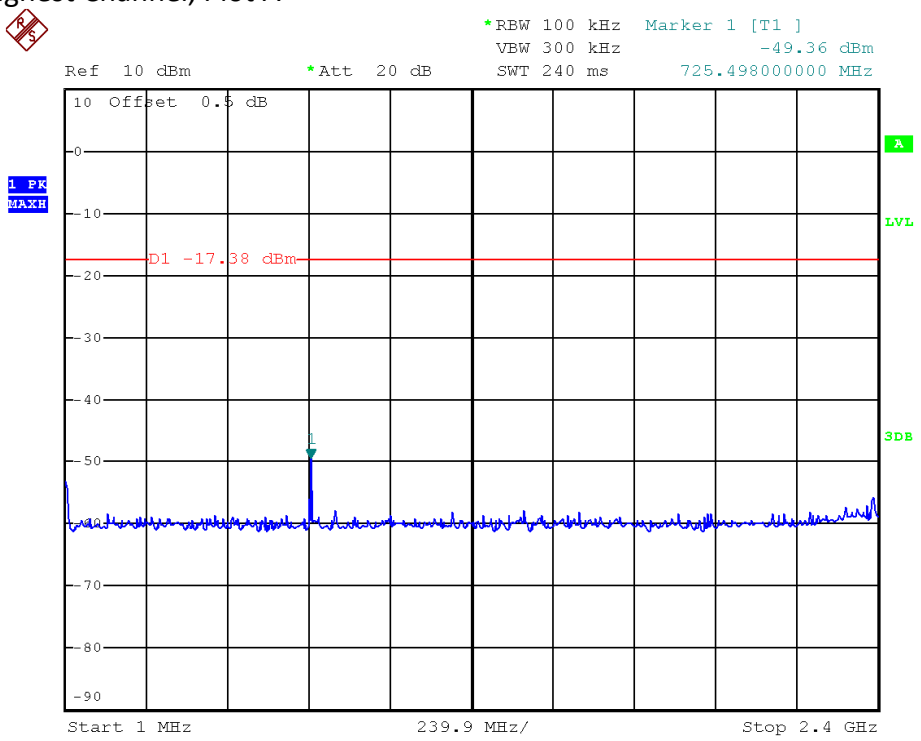
802.11b, Middle Channel, Plot B



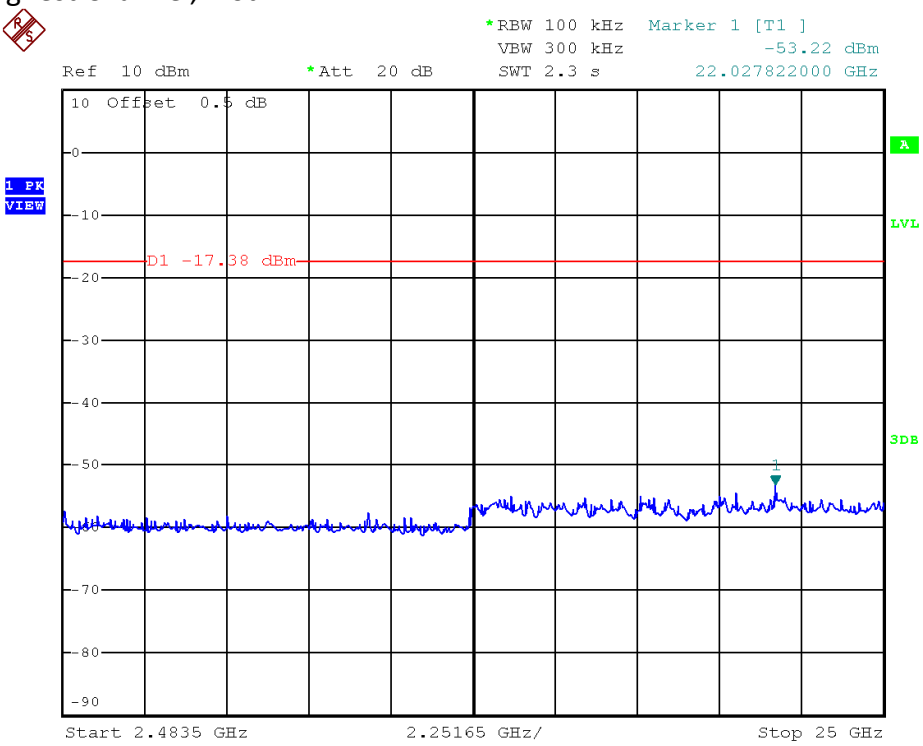
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11b, Highest Channel, Plot A



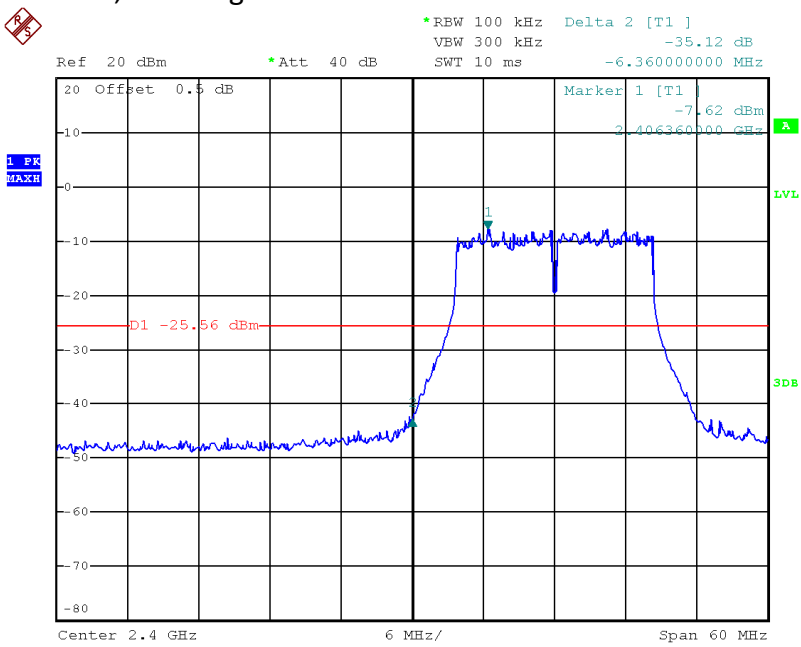
802.11b, Highest Channel, Plot B



TEST REPORT

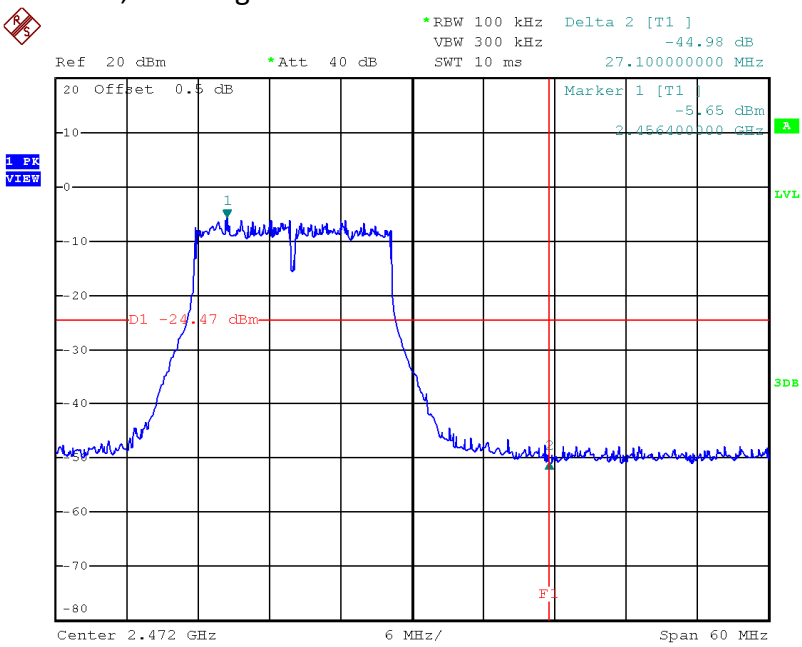
PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11g, Lowest Channel, Bandedge



Date: 11.OCT.2021 09:34:39

802.11g, Highest Channel, Bandedge

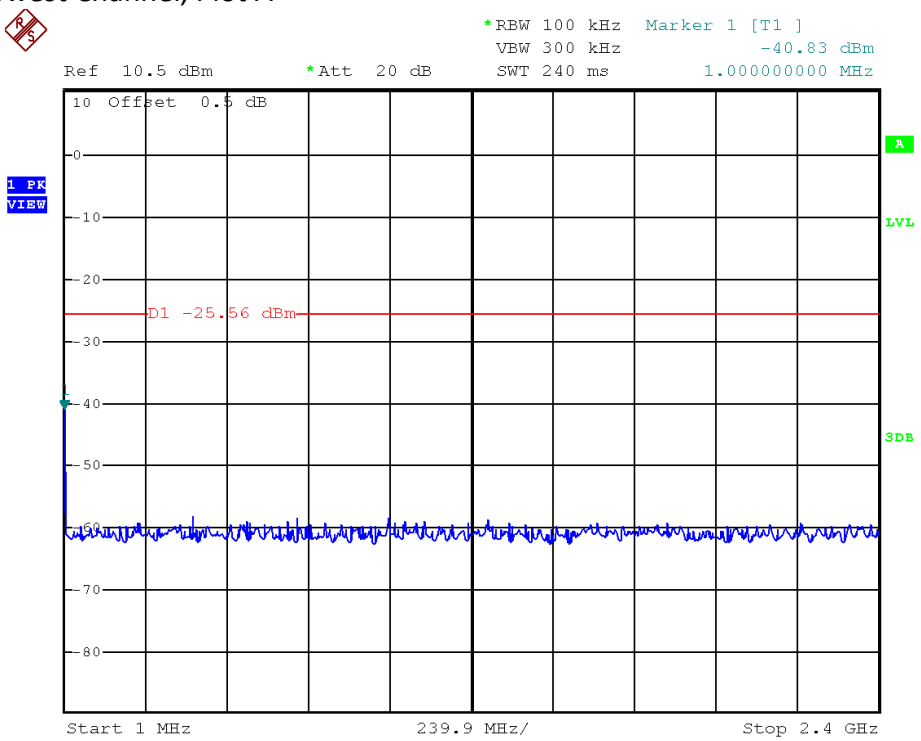


Date: 12.OCT.2021 03:07:30

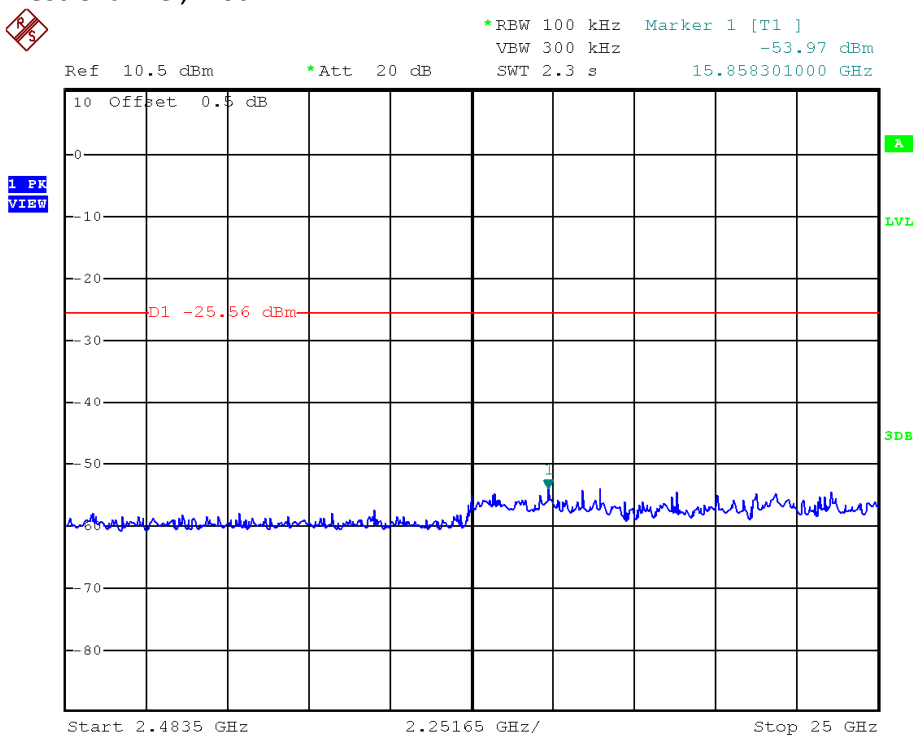
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11g, Lowest Channel, Plot A



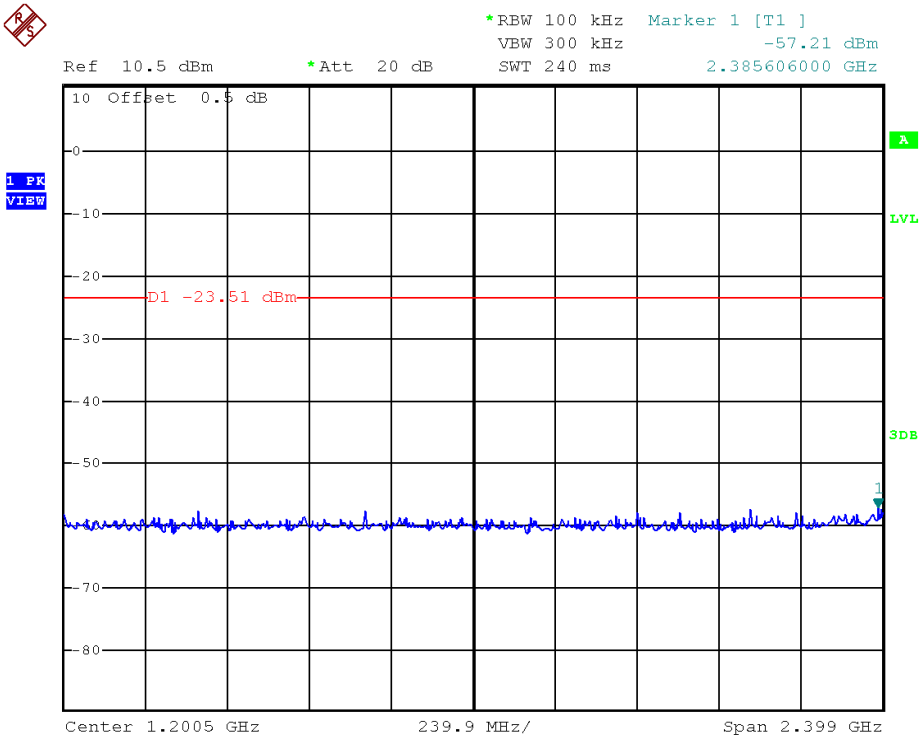
802.11g, Lowest Channel, Plot B



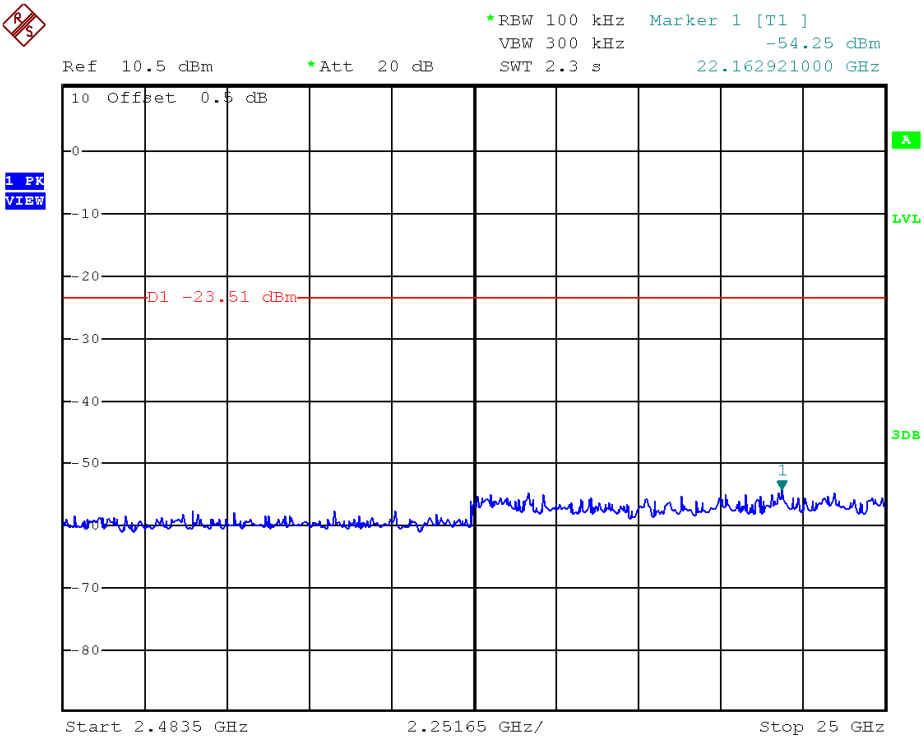
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11g, Middle Channel, Plot A



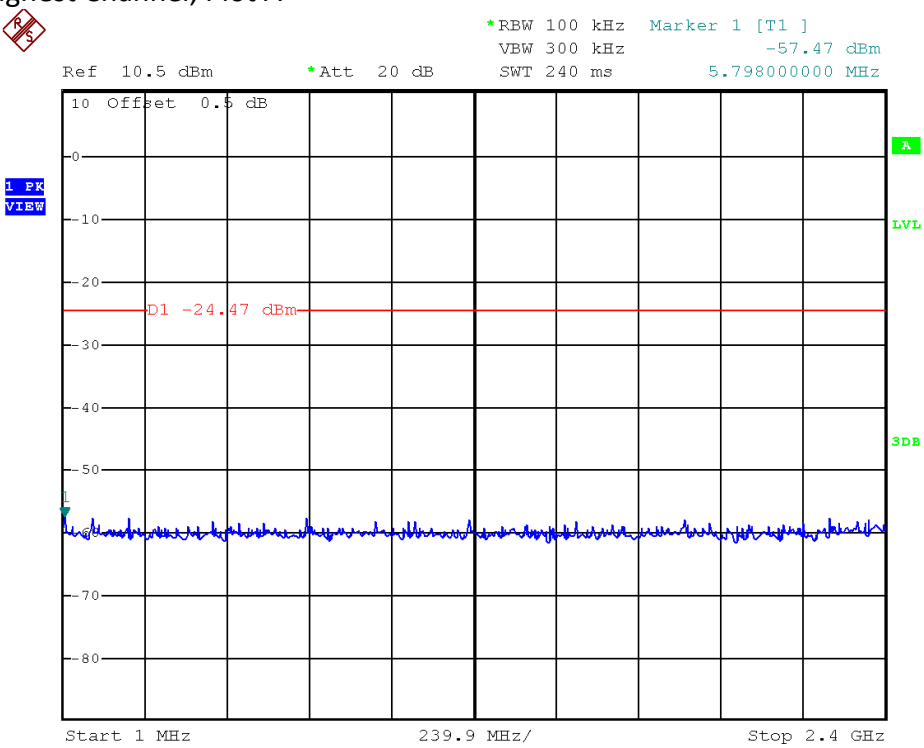
802.11g, Middle Channel, Plot B



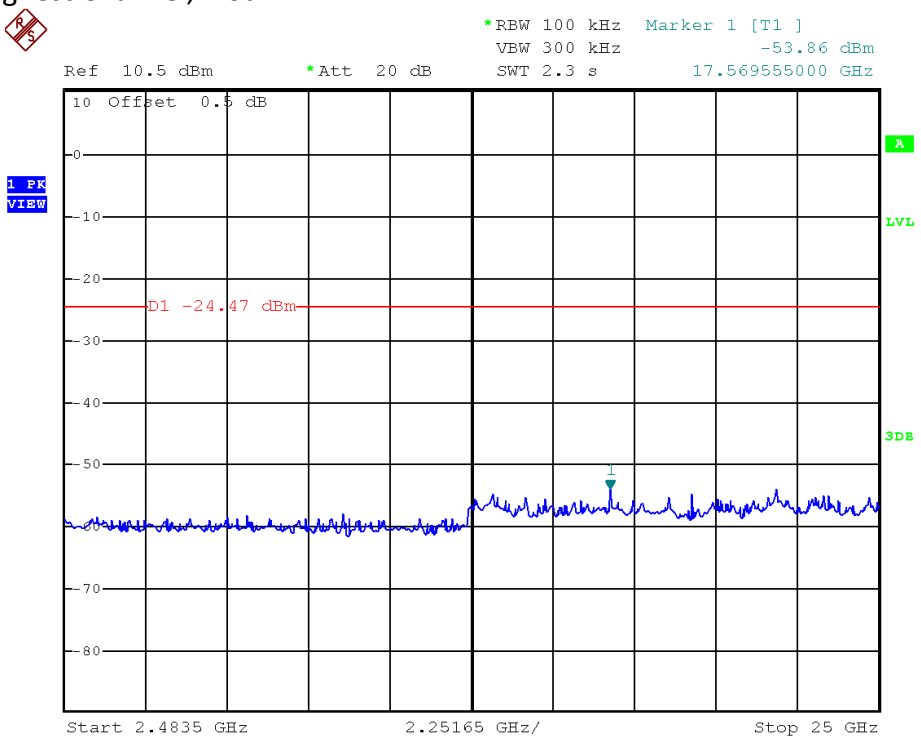
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11g, Highest Channel, Plot A



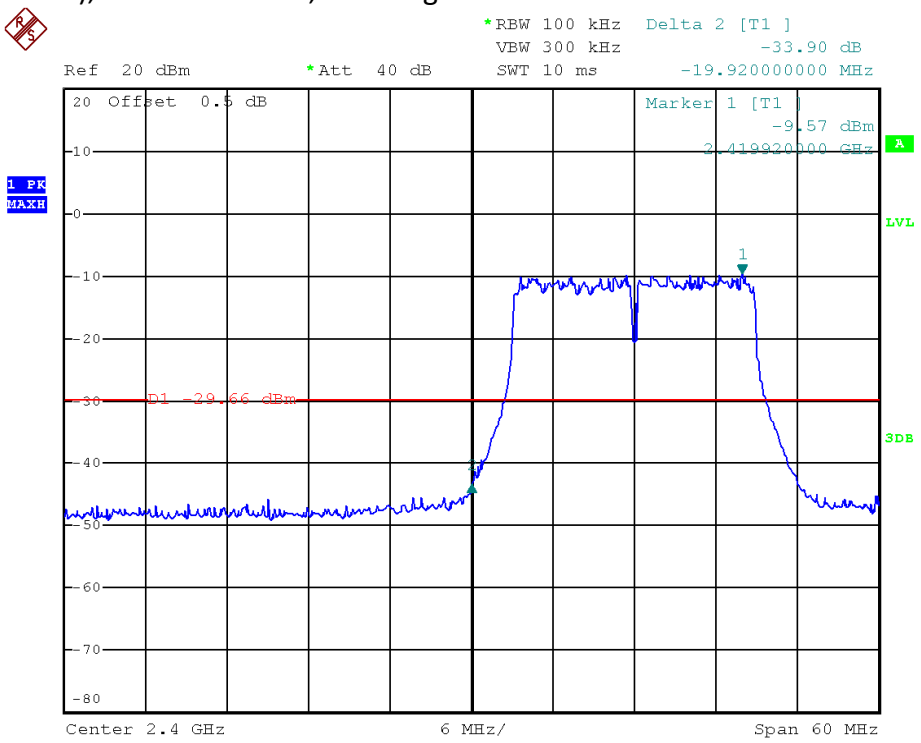
802.11g, Highest Channel, Plot B



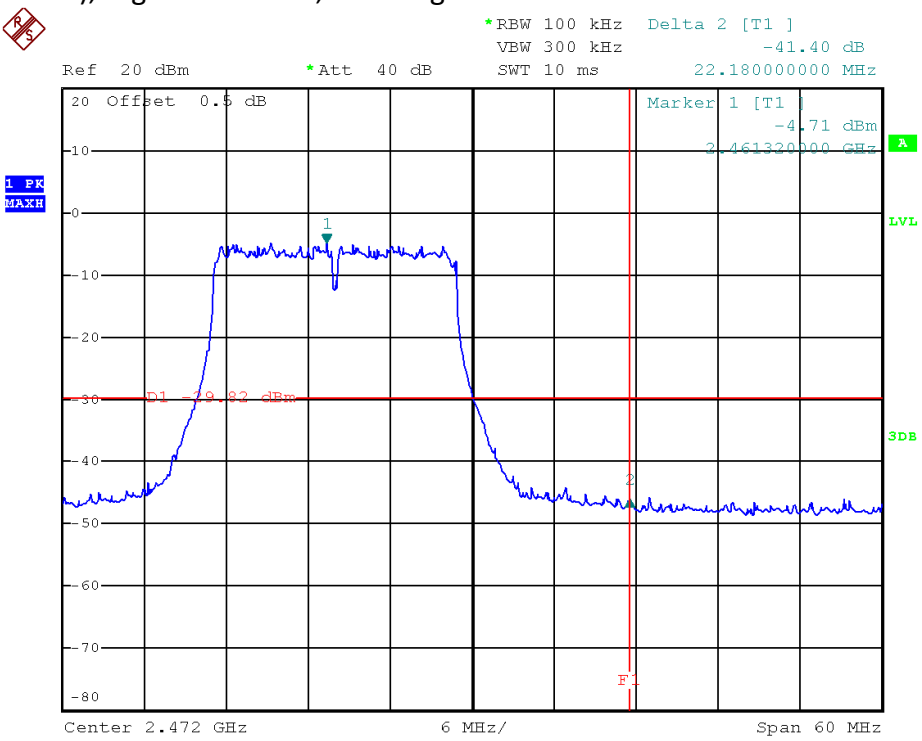
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802. 11n (20MHz), Lowest Channel, Bandedge



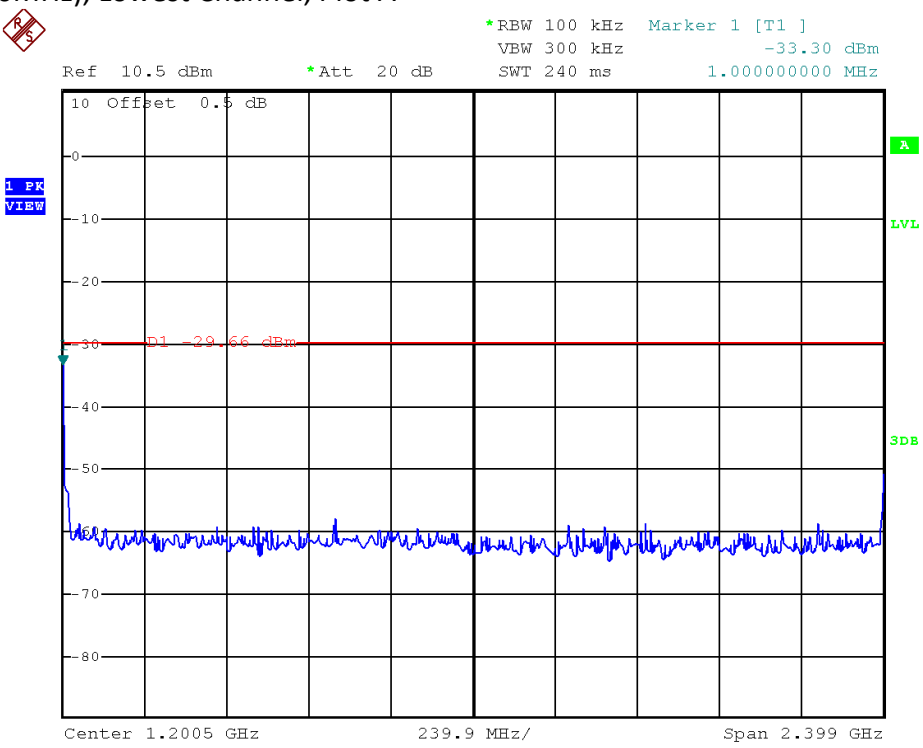
802. 11n (20MHz), Highest Channel, Bandedge



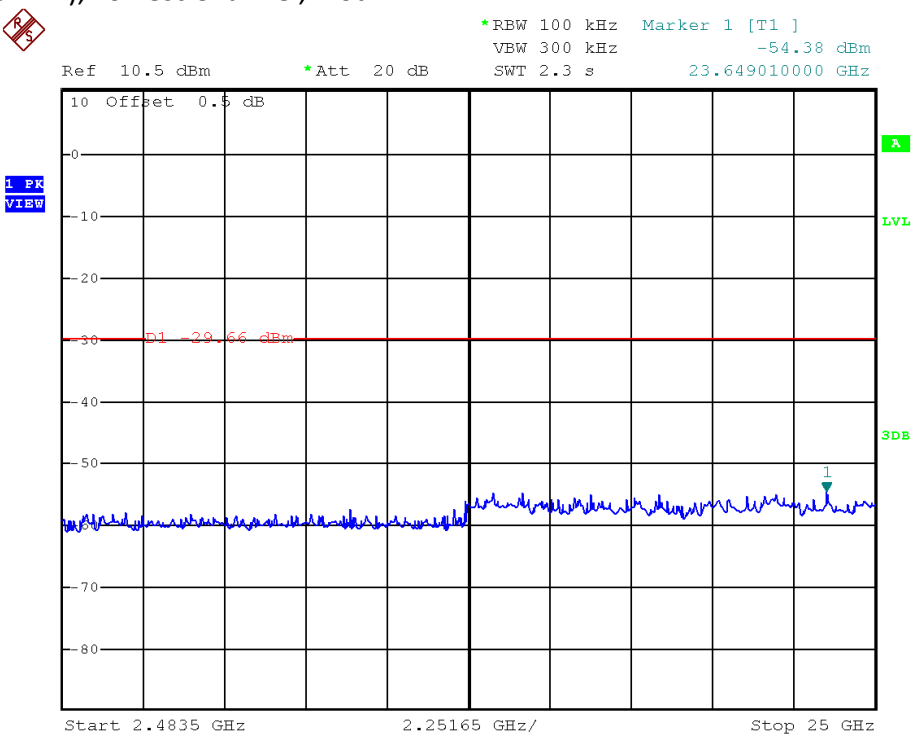
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11n (20MHz), Lowest Channel, Plot A



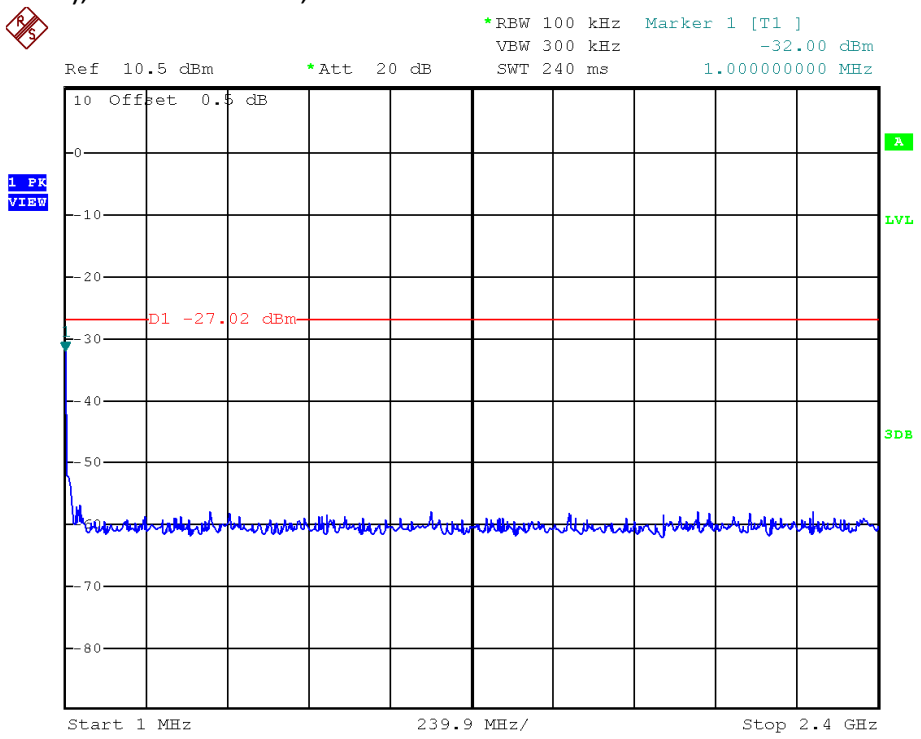
802.11n (20MHz), Lowest Channel, Plot B



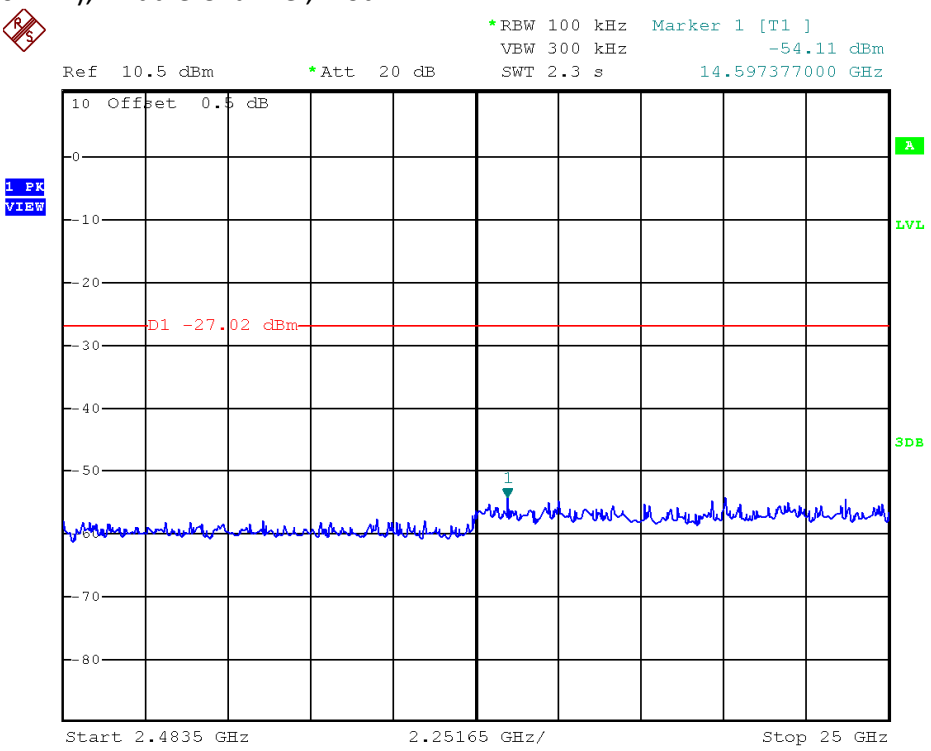
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11n (20MHz), Middle Channel, Plot A



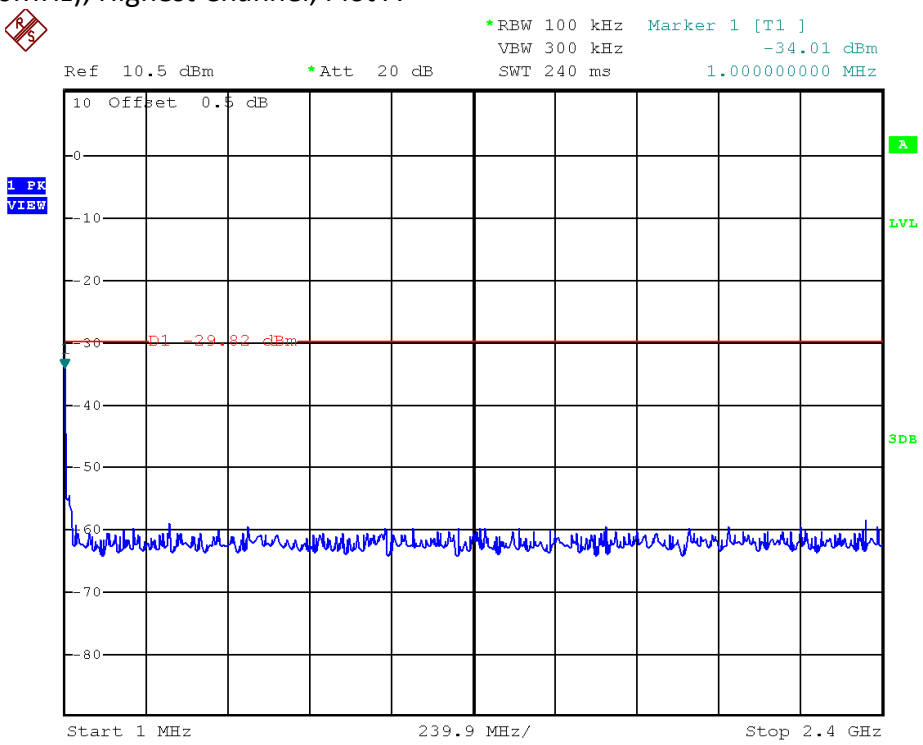
802.11n (20MHz), Middle Channel, Plot B



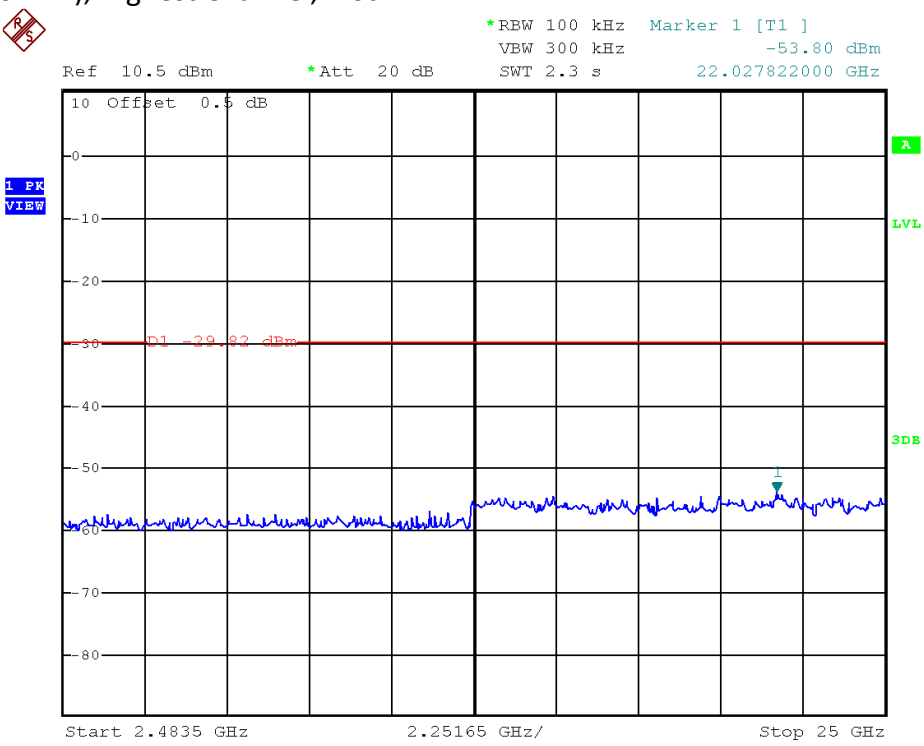
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

802.11n (20MHz), Highest Channel, Plot A



802.11n (20MHz), Highest Channel, Plot B



TEST REPORT

4.5 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD + AV

Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB
AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD + AV

<u>Example</u>
Assume a receiver reading of 62.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29.0 dB is subtracted. The pulse desensitization factor of the spectrum analyzer is 0.0 dB, and the resultant average factor is -10.0 dB. The net field strength for comparison to the appropriate emission limit is 32.0 dBμV/m. This value in dBμV/m is converted to its corresponding level in μV/m.

RA = 62.0 dBμV
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0.0 dB
AV = -10 dB

FS = 62.0 + 7.4 + 1.6 – 29.0 + 0.0 + (-10.0) = 32.0 dBμV/m

Level in μV/m = Common Antilogarithm [(32.0 dBμV/m)/20] = 39.8 μV/m

TEST REPORT

4.6 Transmitter Radiated Emissions in Restricted Bands and Spurious Emissions

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

4.6.1 Radiated Emission Configuration Photograph

Worst Case Restricted Band Radiated Emission
at

2483.5 MHz

The worst case radiated emission configuration photographs are saved with filename: config photos.pdf

4.6.2 Radiated Emission Data

The data in tables 1-9 list the significant emission frequencies, the limit and the margin of compliance.

Judgement -

Passed by 6.3 dB margin

TEST REPORT

RADIATED EMISSION DATA

Mode: TX-Channel 01

Table 1
IEEE 802.11b (DSSS, 1 Mbps)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	***2390.000***	***44.5***	***33***	***29.4***	***40.9***	***54.0***	***-13.1***
V	***4824.000***	***42.6***	***33***	***34.9***	***44.5***	***54.0***	***-9.5***
V	7236.000	31.1	33	37.9	36.0	54.0	-18.0
H	9648.000	30.0	33	40.4	37.4	54.0	-16.6
V	***12060.000***	***30.6***	***33***	***40.5***	***38.1***	***54.0***	***-15.9***
V	***14472.000***	***33.4***	***33***	***40.0***	***40.4***	***54.0***	***-13.6***

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	***2390.000***	***61.1***	***33***	***29.4***	***57.5***	***74.0***	***-16.5***
V	***4824.000***	***47.0***	***33***	***34.9***	***48.9***	***74.0***	***-25.1***
V	7236.000	42.0	33	37.9	46.9	74.0	-27.1
H	9648.000	36.5	33	40.4	43.9	74.0	-30.1
V	***12060.000***	***36.4***	***33***	***40.5***	***43.9***	***74.0***	***-30.1***
V	***14472.000***	***40.0***	***33***	***40.0***	***47.0***	***74.0***	***-27.0***

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement.
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

TEST REPORT

Mode: TX-Channel 06

Table 2
IEEE 802.11b (DSSS, 1 Mbps)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	***4874.000***	***42.1***	***33***	***34.9***	***44.0***	***54.0***	***-10.0***
V	***7311.000***	***35.4***	***33***	***37.9***	***40.3***	***54.0***	***-13.7***
V	9748.000	29.4	33	40.4	36.8	54.0	-17.2
V	***12185.000***	***29.0***	***33***	***40.5***	***36.5***	***54.0***	***-17.5***
H	14622.000	34.7	33	38.4	40.1	54.0	-13.9

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	***4874.000***	***46.6***	***33***	***34.9***	***48.5***	***74.0***	***-25.5***
V	***7311.000***	***43.6***	***33***	***37.9***	***48.5***	***74.0***	***-25.5***
V	9748.000	35.2	33	40.4	42.6	74.0	-31.4
V	***12185.000***	***35.4***	***33***	***40.5***	***42.9***	***74.0***	***-31.1***
H	14622.000	40.4	33	38.4	45.8	74.0	-28.2

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

TEST REPORT

Mode: TX-Channel 11

Table 3
IEEE 802.11b (DSSS, 1 Mbps)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	***2483.500***	***43.8***	***33***	***29.4***	***40.2***	***54.0***	***-13.8***
H	***4914.000***	***41.6***	***33***	***34.9***	***43.5***	***54.0***	***-10.5***
H	***7371.000***	***35.1***	***33***	***37.9***	***40.0***	***54.0***	***-14.0***
V	9828.000	30.2	33	40.4	37.6	54.0	-16.4
H	***12285.000***	***29.1***	***33***	***40.5***	***36.6***	***54.0***	***-17.4***
V	14742.000	33.5	33	38.4	38.9	54.0	-15.1

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	***2483.500***	***58.2***	***33***	***29.4***	***54.6***	***74.0***	***-19.4***
H	***4914.000***	***46.3***	***33***	***34.9***	***48.2***	***74.0***	***-25.8***
H	***7371.000***	***43.1***	***33***	***37.9***	***48.0***	***74.0***	***-26.0***
V	9828.000	36.0	33	40.4	43.4	74.0	-30.6
H	***12285.000***	***35.1***	***33***	***40.5***	***42.6***	***74.0***	***-31.4***
V	14742.000	39.0	33	38.4	44.4	74.0	-29.6

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

TEST REPORT

Mode: TX-Channel 01

Table 4
IEEE 802.11g (OFDM, 6 Mbps)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	***2390.000***	***44.9***	***33***	***29.4***	***41.3***	***54.0***	***-12.7***
V	***4824.000***	***28.6***	***33***	***34.9***	***30.5***	***54.0***	***-23.5***
V	7236.000	33.5	33	37.9	38.4	54.0	-15.6
V	9648.000	29.9	33	40.4	37.3	54.0	-16.7
H	***12060.000***	***29.5***	***33***	***40.5***	***37.0***	***54.0***	***-17.0***
V	***14472.000***	***34.8***	***33***	***40.0***	***41.8***	***54.0***	***-12.2***

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	***2390.000***	***59.5***	***33***	***29.4***	***55.9***	***74.0***	***-18.1***
V	***4824.000***	***42.5***	***33***	***34.9***	***44.4***	***74.0***	***-29.6***
V	7236.000	37.1	33	37.9	42.0	74.0	-32.0
V	9648.000	35.5	33	40.4	42.9	74.0	-31.1
H	***12060.000***	***35.3***	***33***	***40.5***	***42.8***	***74.0***	***-31.2***
V	***14472.000***	***40.4***	***33***	***40.0***	***47.4***	***74.0***	***-26.6***

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

TEST REPORT

Mode: TX-Channel 06

Table 5
IEEE 802.11g (OFDM, 6 Mbps)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	***4874.000***	***30.4***	***33***	***34.9***	***32.3***	***54.0***	***-21.7***
V	***7311.000***	***30.5***	***33***	***37.9***	***35.4***	***54.0***	***-18.6***
V	9748.000	28.6	33	40.4	36.0	54.0	-18.0
V	***12185.000***	***30.0***	***33***	***40.5***	***37.5***	***54.0***	***-16.5***
V	14622.000	34.1	33	38.4	39.5	54.0	-14.5

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
H	***4874.000***	***36.1***	***33***	***34.9***	***38.0***	***74.0***	***-36.0***
V	***7311.000***	***36.4***	***33***	***37.9***	***41.3***	***74.0***	***-32.7***
V	9748.000	35.2	33	40.4	42.6	74.0	-31.4
V	***12185.000***	***36.3***	***33***	***40.5***	***43.8***	***74.0***	***-30.2***
V	14622.000	40.3	33	38.4	45.7	74.0	-28.3

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

TEST REPORT

Mode: TX-Channel 11

Table 6
IEEE 802.11g (OFDM, 6 Mbps)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	***2483.500***	***43.8***	***33***	***29.4***	***40.2***	***54.0***	***-13.8***
H	***4914.000***	***27.7***	***33***	***34.9***	***29.6***	***54.0***	***-24.4***
H	***7371.000***	***30.0***	***33***	***37.9***	***34.9***	***54.0***	***-19.1***
V	9828.000	28.7	33	40.4	36.1	54.0	-17.9
V	***12285.000***	***27.4***	***33***	***40.5***	***34.9***	***54.0***	***-19.1***
V	14742.000	35.6	33	38.4	41.0	54.0	-13.0

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	***2483.500***	***57.7***	***33***	***29.4***	***54.1***	***74.0***	***-19.9***
H	***4914.000***	***41.2***	***33***	***34.9***	***43.1***	***74.0***	***-30.9***
H	***7371.000***	***35.7***	***33***	***37.9***	***40.6***	***74.0***	***-33.4***
V	9828.000	34.8	33	40.4	42.2	74.0	-31.8
V	***12285.000***	***33.8***	***33***	***40.5***	***41.3***	***74.0***	***-32.7***
V	14742.000	41.3	33	38.4	46.7	74.0	-27.3

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

TEST REPORT

Mode: TX-Channel 01

Table 7
IEEE 802.11n (20MHz) (OFDM, MCS0)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	***2390.000***	***44.1***	***33***	***29.4***	***40.5***	***54.0***	***-13.5***
V	***4824.000***	***28.8***	***33***	***34.9***	***30.7***	***54.0***	***-23.3***
V	7236.000	25.8	33	37.9	30.7	54.0	-23.3
V	9648.000	23.1	33	40.4	30.5	54.0	-23.5
H	***12060.000***	***22.7***	***33***	***40.5***	***30.2***	***54.0***	***-23.8***
V	***14472.000***	***23.6***	***33***	***40.0***	***30.6***	***54.0***	***-23.4***

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	***2390.000***	***57.7***	***33***	***29.4***	***54.1***	***74.0***	***-19.9***
V	***4824.000***	***41.8***	***33***	***34.9***	***43.7***	***74.0***	***-30.3***
V	7236.000	33.3	33	37.9	38.2	74.0	-35.8
V	9648.000	31.2	33	40.4	38.6	74.0	-35.4
H	***12060.000***	***31.2***	***33***	***40.5***	***38.7***	***74.0***	***-35.3***
V	***14472.000***	***31.4***	***33***	***40.0***	***38.4***	***74.0***	***-35.6***

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

TEST REPORT

Mode: TX-Channel 06

Table 8
IEEE 802.11n (20MHz) (OFDM, MCS0)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	***4874.000***	***25.7***	***33***	***34.9***	***27.6***	***54.0***	***-26.4***
V	***7311.000***	***24.7***	***33***	***37.9***	***29.6***	***54.0***	***-24.4***
V	9748.000	23.0	33	40.4	30.4	54.0	-23.6
V	***12185.000***	***23.1***	***33***	***40.5***	***30.6***	***54.0***	***-23.4***
H	14622.000	25.0	33	38.4	30.4	54.0	-23.6

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	***4874.000***	***38.7***	***33***	***34.9***	***40.6***	***74.0***	***-33.4***
V	***7311.000***	***37.7***	***33***	***37.9***	***42.6***	***74.0***	***-31.4***
V	9748.000	31.5	33	40.4	38.9	74.0	-35.1
V	***12185.000***	***31.2***	***33***	***40.5***	***38.7***	***74.0***	***-35.3***
H	14622.000	33.4	33	38.4	38.8	74.0	-35.2

NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

TEST REPORT

Mode: TX-Channel 11

Table 9
IEEE 802.11n (20MHz) (OFDM, MCS0)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	***2483.500***	***43.9***	***33***	***29.4***	***40.3***	***54.0***	***-13.7***
V	***4924.000***	***24.1***	***33***	***34.9***	***26.0***	***54.0***	***-28.0***
V	***7386.000***	***24.3***	***33***	***37.9***	***29.2***	***54.0***	***-24.8***
H	9848.000	23.2	33	40.4	30.6	54.0	-23.4
V	***12310.000***	***23.0***	***33***	***40.5***	***30.5***	***54.0***	***-23.5***
H	14772.000	24.8	33	38.4	30.2	54.0	-23.8

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	***2483.500***	***71.3***	***33***	***29.4***	***67.7***	***74.0***	***-6.3***
V	***4924.000***	***37.1***	***33***	***34.9***	***39.0***	***74.0***	***-35.0***
V	***7386.000***	***37.3***	***33***	***37.9***	***42.2***	***74.0***	***-31.8***
H	9848.000	31.1	33	40.4	38.5	74.0	-35.5
V	***12310.000***	***30.9***	***33***	***40.5***	***38.4***	***74.0***	***-35.6***
H	14772.000	33.3	33	38.4	38.7	74.0	-35.3

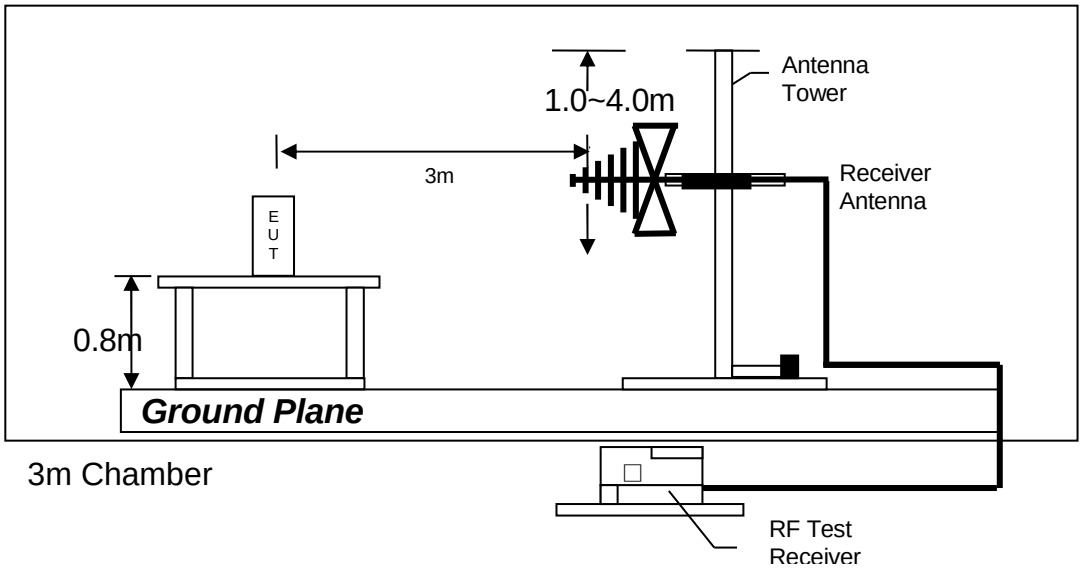
NOTES:

1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205.

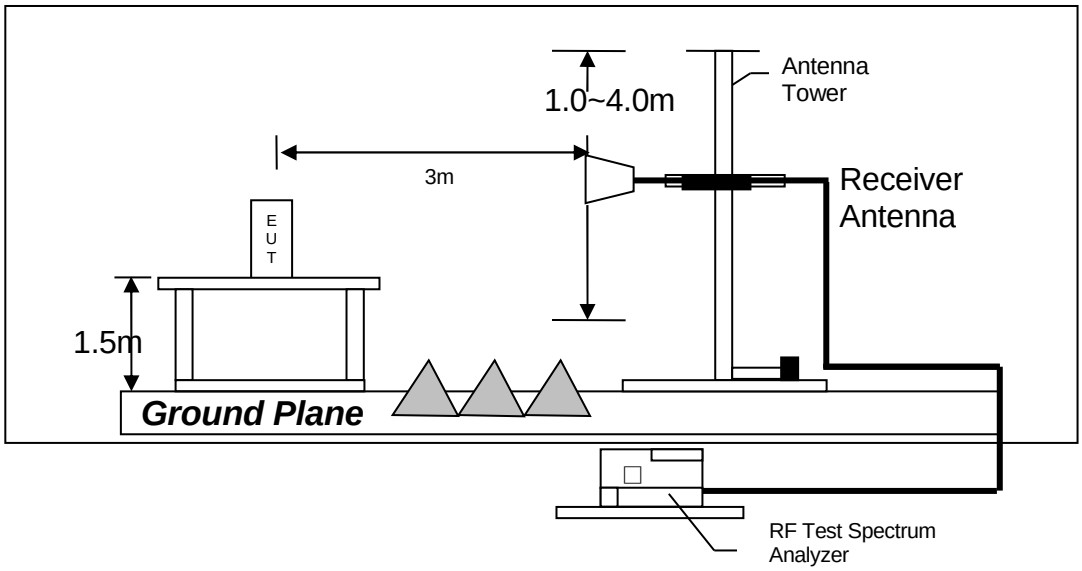
TEST REPORT

4.6.3 Radiated Emission Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



Test setup of radiated emissions up to 1GHz



Test setup of radiated emissions above 1GHz

TEST REPORT

4.6.4 Transmitter Duty Cycle Calculation

Not applicable – No average factor is required.

TEST REPORT

4.7 AC Power Line Conducted Emission

☐ Not applicable – EUT is only powered by battery for operation.

☒ EUT connects to AC power line. Emission Data is listed in following pages.

☐ Base Unit connects to AC power line and has transmission. Handset connects to AC power line but has no transmission. Emission Data of Base Unit is listed in following pages.

4.7.1 AC Power Line Conducted Emission Configuration Photograph

Worst Case Line-Conducted Configuration
at

350 kHz

The worst case line conducted configuration photographs are attached in the Appendix and saved with filename: config photos.pdf

4.7.2 AC Power Line Conducted Emission Data

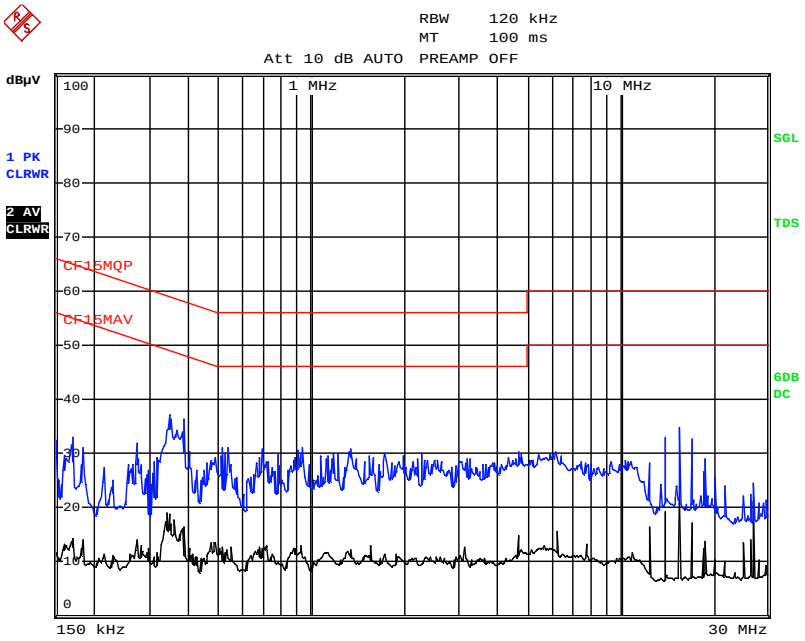
The plot(s) and data in the following pages list the significant emission frequencies, the limit and the margin of compliance.

Passed by >20 dB margin compared with Quasi-peak limit

TEST REPORT

AC POWER LINE CONDUCTED EMISSION

Worst Case: Play



Date: 26.OCT.2021 14:41:05

EDIT PEAK LIST

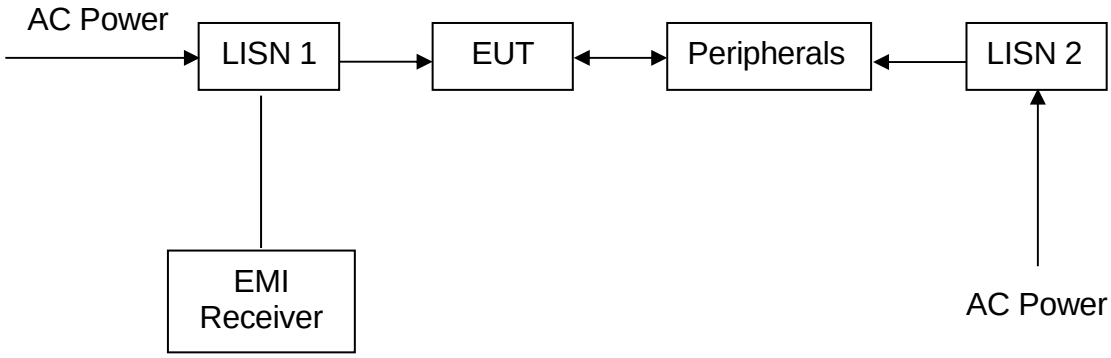
Trace1:	CF15MQP
Trace2:	CF15MAV
Trace3:	---

TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT dB

Date: 26.OCT.2021 14:40:32

TEST REPORT

4.7.3 Conducted Emission Test Setup



TEST REPORT

EQUIPMENT LIST

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Spectrum Analyzer	Biconical Antenna
Registration No.	EW-2500	EW-2466	EW-2512
Manufacturer	ROHDESCHWARZ	ROHDESCHWARZ	EMCO
Model No.	ESCI	FSP30	3104C
Calibration Date	March 29, 2021	November 18, 2019	June 03, 2020
Calibration Due Date	March 29, 2022	August 18, 2022	December 03, 2021

Equipment	Log Periodic Antenna	Double Ridged Guide Antenna	RF Cable 14m (1GHz to 26.5GHz)
Registration No.	EW-3243	EW-1133	EW-2781
Manufacturer	EMCO	EMCO	GREATBILLION
Model No.	3148B	3115	SMA m/SHF5MPU /SMA m ra14m,26G
Calibration Date	June 30, 2021	June 03, 2021	November 24, 2020
Calibration Due Date	December 30, 2022	June 03, 2022	November 24, 202

Equipment	RF Preamplifier (9kHz to 6000MHz)	2.4GHz Notch Filter	14m Double Shield RF Cable (20MHz to 6GHz)
Registration No.	EW-3006b	EW-3435	EW-2074
Manufacturer	SCHWARZBECK	MICROWAVE	RADIALL
Model No.	BBV9718	N0324413	N(m)-RG142-BNC(m) L=14M
Calibration Date	November 25, 2019	November 16, 2019	November 14, 2019
Calibration Due Date	June 25, 2022	June 16, 2022	August 14, 2022

Equipment	Pyramidal Horn Antenna
Registration No.	EW-0905
Manufacturer	EMCO
Model No.	3160-09
Calibration Date	July 23, 2019
Calibration Due Date	June 23, 2022

2) Conducted Emissions Test

Equipment	RF Cable 80cm (RG142) (9kHz to 30MHz)	Artificial Mains Network	EMI Test Receiver (9kHz to 3GHz)
Registration No.	EW-2451	EW-2501	EW-2500
Manufacturer	RADIALL	ROHDESCHWARZ	ROHDESCHWARZ
Model No.	RF Cable 80cm (RG142) (9kHz to 30MHz)	ENV-216	ESCI
Calibration Date	December 08, 2019	September 15, 2020	March 29, 2021
Calibration Due Date	December 08, 2022	September 11, 2022	March 29, 2022

TEST REPORT

3) Conductive Measurement Test

Equipment	Spectrum Analyzer	RF Power Meter with Power Sensor
Registration No.	EW-2253	EW-3309
Manufacturer	ROHDESCHWARZ	ROHDESCHWARZ
Model No.	FSP40	NRP-Z81
Calibration Date	November 18, 2019	May 18, 2020
Calibration Due Date	November 18, 2022	May 18, 2022

END OF TEST REPORT