Test Report

Date : 2019-06-11
No. : HM18070005

Applicant: DF Automation & Robotics Sdn Bhd
No. 5, Jalan Impian Emas 18, 81300 Skudai Johor, Malaysia

Supplier / Manufacturer: DF Automation & Robotics Sdn Bhd
No. 5, Jalan Impian Emas 18, 81300 Skudai Johor, Malaysia

Description of Sample(s): Submitted sample(s) said to be

Product:	ZALPHA AGV
Brand Name:	Zalpha
Model No.:	ZALPHA-MG-E-01
FCC ID:	2AP2R-ZALPHA3-MG

Date Samples Received: 2018-07-06

Date Tested: 2018-07-10 to 2018-07-20

Investigation Requested: Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2018 and ANSI C63.10:2013 for FCC Certification.

Conclusions: The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.

Remarks: IEEE 802.11b/g/n (HT20 and HT40)

CHEUNG Chi, Kenneth
Authorized Signatory

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1.0 General Details

1.1 Test Laboratory

The Hong Kong Standards and Testing Centre Ltd.
EMC Laboratory
Head Office: 10 Dai Wang Street, Taipo Industrial Estate, Tai Po, N.T., Hong Kong
Telephone: 852 2666 1888
Fax: 852 2664 4353

1.2 Equipment Under Test [EUT]

Description of Sample(s)

Product:	ZALPHA AGV
Manufacturer:	DF Automation & Robotics Sdn Bhd No. 5, Jalan Impian Emas 18, 81300 Skudai Johor, Malaysia
Brand Name:	Zalpha
Model Number:	ZALPHA-MG-E-01
Rating:	For charger unit: Input: 100-240VAC, 3A, 50/60Hz Output: 28.8VDC, 12.5A For guided vehicle unit: Input: 28.8VDC, 12.5A Digital output: 24VDC, 0.25A Actuator output: 24VDC, 10A Safety output: 24VDC, 0.8A or internal rechargeable LiFePO4 battery: 25.6V, 65Ah

1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is a Zalpha Automated Guided Vehicle. The tests were conducted under RF Test mode to maintain continuous transmission (>98% duty cycle) during test. The transmission signal is digital modulated with channel frequency range 2412-2462MHz. The R.F. signal was modulated by IC; the type of modulation used was DSSS and OFDM.

1.3 Date of Order

2018-07-06

1.4 Submitted Sample(s):

1 Sample

1.5 Test Duration

2018-07-10 to 2018-07-20

1.6 Country of Origin

Malaysia

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1.7 RF Module Details

Module Model Number: EWM-W135H01E
Module FCC ID: N/A
Module Transmission Type: 802.11 b/g/n
Modulation: DSSS, OFDM
Data Rates: 300Mbps (Max)
Frequency Range: 2400-2483.5MHz
Carrier Frequencies: 2412MHz – 2462MHz

Module Specification (specification provided by manufacturer)

1.8 Antenna Details

Antenna Type: 2.4/5 GHz External Dipole
Antenna Gain: 2.7dBi (Max)

1.9 Channel List

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	--	--
6	2437	--	--
7	2442	--	--

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2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 Regulations and ANSI C63.10:2013 for FCC Certification.
According FCC KDB 558074 DTS Measurement Guidance, Duty cycle ≧98%.
The device was realized by test software.

2.2 Test Standards and Results Summary Tables

EMISSION Results Summary						
Test Condition	Test Requirement	Test Method	Class / Severity	Test Result		
				Pass	Failed	N/A
Maximum Peak Output Power	FCC 47CFR 15.247(b)(3)	ANSI C63.10: 2013	N/A	☒	☐	☐
Radiated Spurious Emissions	FCC 47CFR 15.209	ANSI C63.10: 2013	N/A	☒	☐	☐
AC Mains Conducted Emissions	FCC 47CFR 15.207	ANSI C63.10: 2013	N/A	☒	☐	☐
Power Spectral Density	FCC 47CFR 15.247(e)	ANSI C63.10: 2013	N/A	☒	☐	☐
6dB Bandwidth	FCC 47CFR 15.247(a)(2)	ANSI C63.10: 2013	N/A	☒	☐	☐
Band Edge Emissions (Radiated)	FCC 47CFR 15.247(d)	ANSI C63.10: 2013	N/A	☒	☐	☐
Antenna requirement	FCC 47CFR 15.203	N/A	N/A	☒	☐	☐
RF Exposure	FCC 47CFR 15.247(i)	N/A	N/A	☒	☐	☐

Note: N/A - Not Applicable

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3.0 Test Results

3.1 Emission

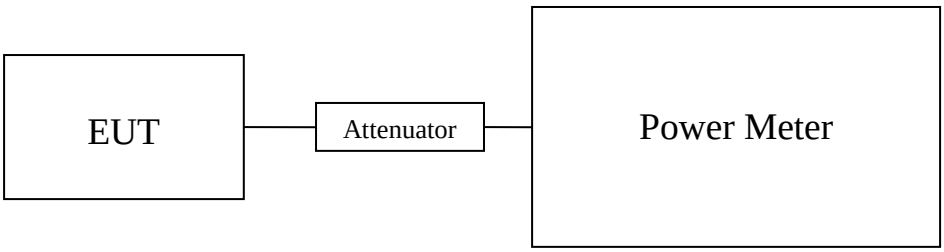
3.1.1 Maximum Peak Output Power

Test Requirement:	FCC 47CFR 15.247(b)(3)
Test Method:	ANSI C63.10: 2013
Test Date:	2018-07-09
Mode of Operation:	Tx mode (802.11b/g/n)
Ambient Temperature:	21°C
Relative Humidity:	51%
Atmospheric pressure	102kPa
Test voltage:	25.6Vd.c

Test Method:

The RF output of the EUT was connected to the Power Meter. All the attenuation or cable loss will be added to the measured maximum output power. The results are recorded in Watt.

Test Setup:



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Limits for Peak Output Power of Fundamental & Harmonics Emissions [FCC 47CFR 15.247]:

For Digital Transmission systems in 2400-2483.5 MHz Band: 1 Watt (30dBm)

Results of Tx Mode: Pass (TX Unit) (802.11b)
Maximum conducted output power

Channel	Frequency(MHz)	Output Power(Watt)
1	2412	0.0064
7	2442	0.0058
11	2462	0.0057

Results of Tx Mode: Pass (TX Unit) (802.11g)
Maximum conducted output power

Channel	Frequency(MHz)	Output Power(Watt)
1	2412	0.0043
7	2442	0.0037
13	2462	0.0039

Results of Tx Mode: Pass (TX Unit) (802.11n(HT20))

Maximum conducted output power

Channel	Frequency(MHz)	Output Power(Watt)
1	2412	0.0048
7	2442	0.0041
13	2462	0.0044

Results of Tx Mode: Pass (TX Unit) (802.11(HT40))
Maximum conducted output power

Channel	Frequency(MHz)	Output Power(Watt)
3	2422	0.0031
7	2442	0.0025
11	2462	0.0029

Calculated measurement uncertainty : 30MHz to 1GHz 1.7dB
1GHz to 26GHz 1.7dB

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3.1.2 Radiated Emissions

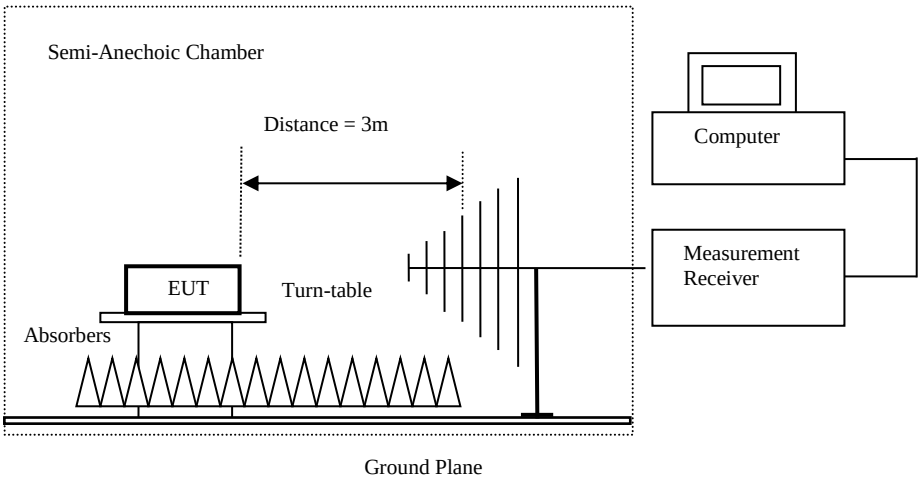
Test Requirement:	FCC 47CFR 15.209
Test Method:	ANSI C63.10:2013
Test Date:	2018-07-11
Mode of Operation:	Tx mode (802.11 b/g/n)
Ambient Temperature:	20°C
Relative Humidity:	52%
Atmospheric pressure	102kPa
Test voltage:	25.6Vd.c

Test Method:

For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages. The measured field strength would be calculated as EIRP.

Semi-anechoic chamber located at STC filed with Industry Canada File Number: 4789A

Test Setup:



- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.
- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used, 9kHz to 30MHz loop antennas are used.
-For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m.

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Limits for Radiated Emissions FCC 47 CFR 15.247 Class B]:

Frequency Range	Quasi-Peak Limits
[MHz]	[μV/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

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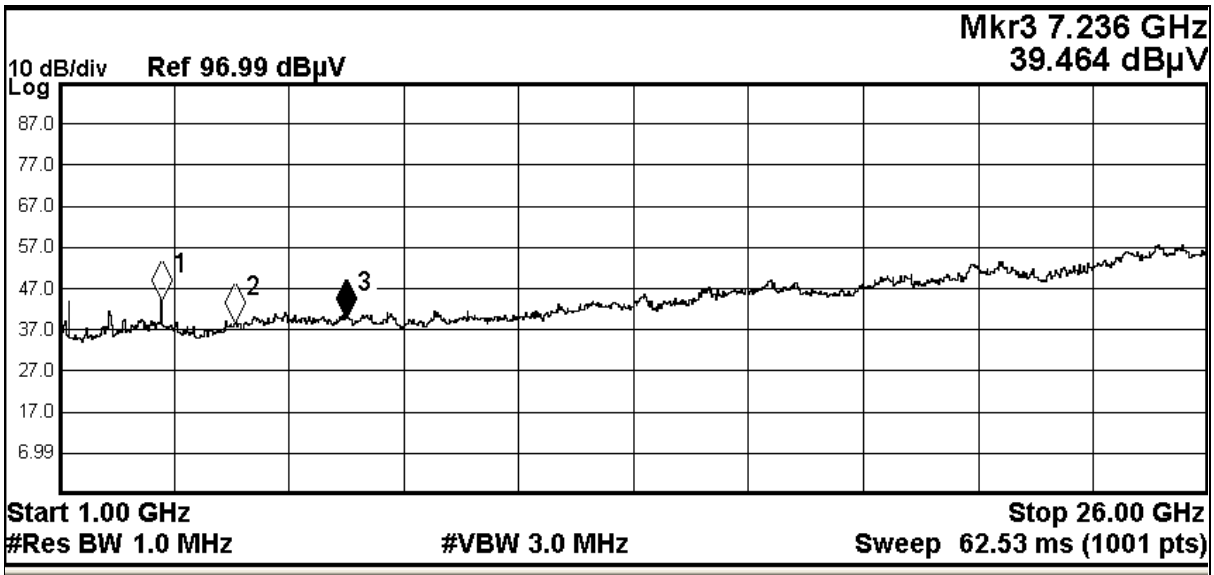
Result of Tx mode (802.11b) (2412.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.225 GHz	44.105 dBµV			
2	N	1	f	4.824 GHz	38.552 dBµV			
3	N	1	f	7.236 GHz	39.464 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11b) (2412.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11b) (2412.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3225.0	15.2	28.9	44.1	74.0	29.9	Vertical
4824.0	6.5	32.1	38.6	74.0	35.4	Vertical
7236.0	0.9	38.6	39.5	74.0	34.5	Vertical
3200.0	6.3	28.9	35.2	74.0	38.8	Horizontal
4824.0	4.3	32.1	36.4	74.0	37.6	Horizontal
7236.0	0.7	38.6	39.3	74.0	34.7	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3225.0	2.8	28.9	31.7	54.0	22.3	Vertical
4824.0	-1.7	32.1	30.4	54.0	23.6	Vertical
7236.0	-2.9	38.6	35.7	54.0	18.3	Vertical
3200.0	-1.7	28.9	27.2	54.0	26.8	Horizontal
4824.0	-2.3	32.1	29.8	54.0	24.2	Horizontal
7236.0	-3.1	38.6	35.5	54.0	18.5	Horizontal

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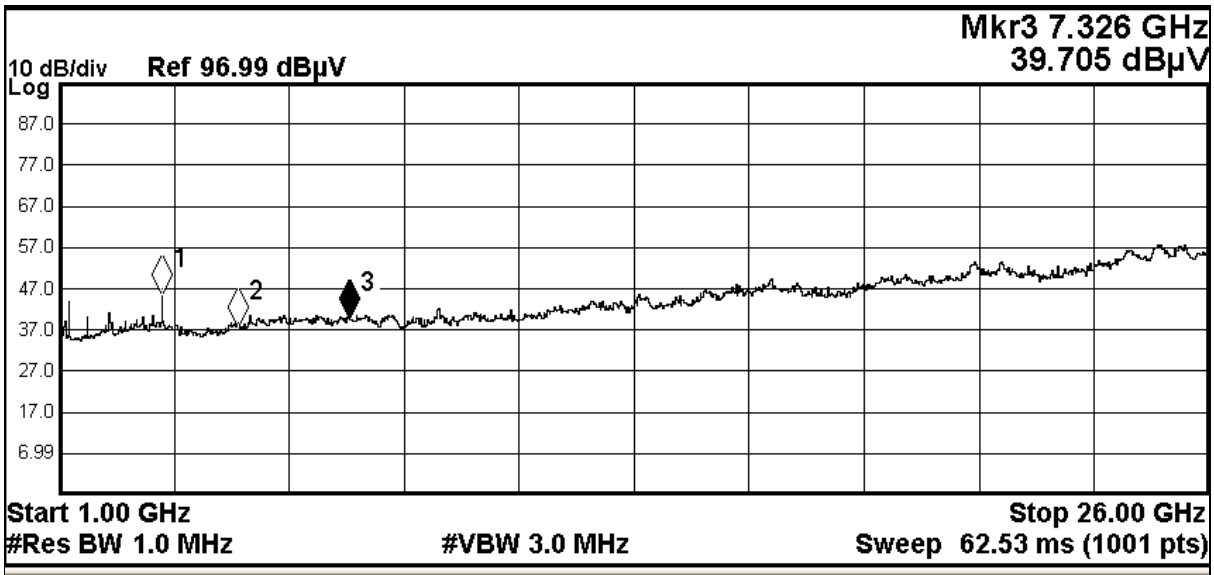
Result of Tx mode (802.11b) (2442.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.250 GHz	45.362 dBµV			
2	N	1	f	4.884 GHz	37.641 dBµV			
3	N	1	f	7.326 GHz	39.705 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11b) (2442.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11b) (2442.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3250.0	16.5	28.9	45.4	74.0	28.6	Vertical
4884.0	5.5	32.1	37.6	74.0	36.4	Vertical
7326.0	1.1	38.6	39.7	74.0	34.3	Vertical
3250.0	8.7	28.9	37.6	74.0	36.4	Horizontal
4884.0	3.8	32.1	35.9	74.0	38.1	Horizontal
7326.0	1.0	38.6	39.6	74.0	34.4	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3250.0	2.1	28.9	31.0	54.0	23.0	Vertical
4884.0	-1.7	32.1	30.4	54.0	23.6	Vertical
7326.0	-2.4	38.6	36.2	54.0	17.8	Vertical
3250.0	-1.9	28.9	27.0	54.0	27.0	Horizontal
4884.0	-3.1	32.1	29.0	54.0	25.0	Horizontal
7326.0	-2.6	38.6	36.0	54.0	18.0	Horizontal

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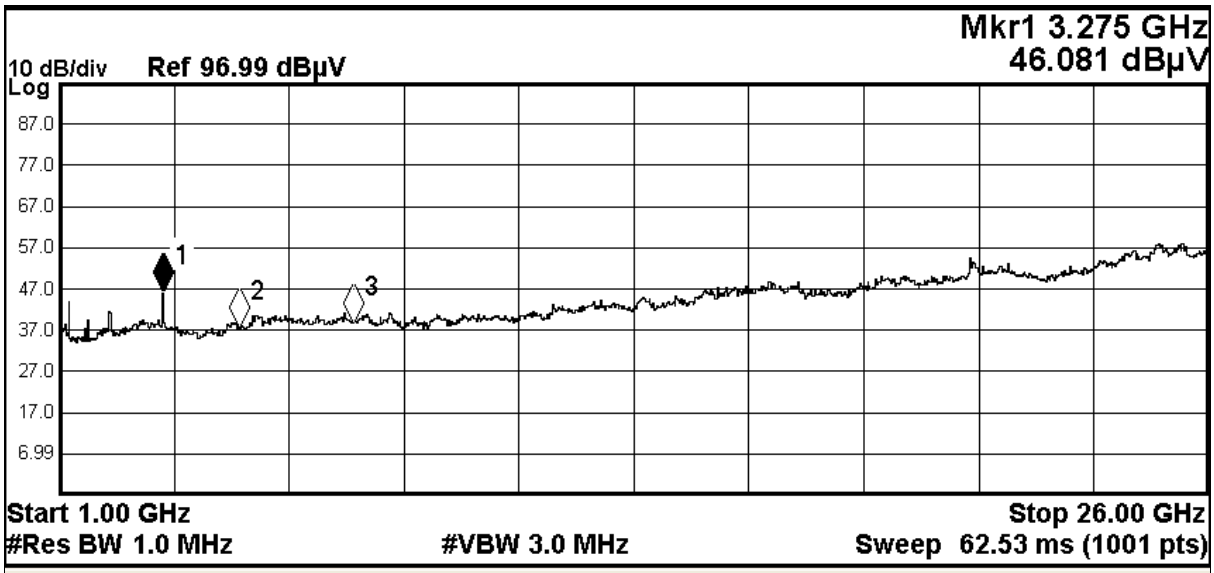
Result of Tx mode (802.11b) (2462.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.275 GHz	46.081 dBµV			
2	N	1	f	4.924 GHz	37.615 dBµV			
3	N	1	f	7.411 GHz	38.765 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11b) (2462.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11b) (2462.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3275.0	17.2	28.9	46.1	74.0	27.9	Vertical
4924.0	5.4	32.2	37.6	74.0	36.4	Vertical
7386.0	0.2	38.6	38.8	74.0	35.2	Vertical
3275.0	6.1	28.9	35.0	74.0	39.0	Horizontal
4924.0	1.9	32.2	34.1	74.0	39.9	Horizontal
7386.0	-1.3	38.6	37.3	74.0	36.7	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3275.0	2.1	28.9	31.0	54.0	23.0	Vertical
4924.0	-1.9	32.2	30.3	54.0	23.7	Vertical
7386.0	-3.2	38.6	35.4	54.0	18.6	Vertical
3275.0	-1.9	28.9	27.0	54.0	27.0	Horizontal
4924.0	-2.9	32.2	29.3	54.0	24.7	Horizontal
7386.0	-3.5	38.6	35.1	54.0	18.9	Horizontal

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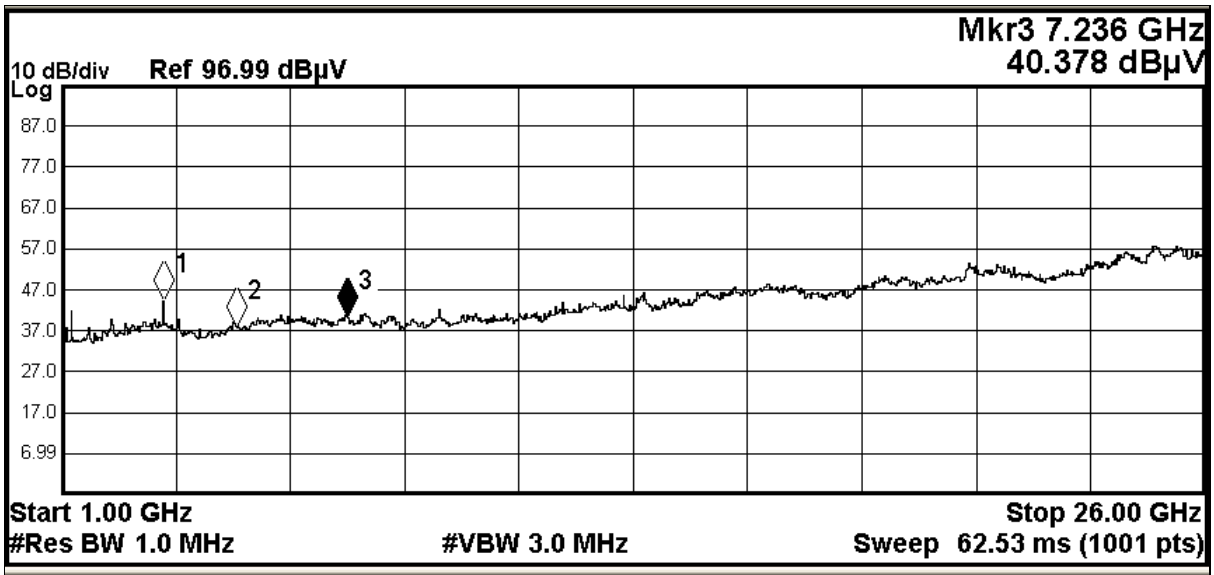
Result of Tx mode (802.11g) (2412.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.225 GHz	44.319 dBµV			
2	N	1	f	4.824 GHz	38.075 dBµV			
3	N	1	f	7.236 GHz	40.378 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11g) (2412.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11g) (2412.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3225.0	15.4	28.9	44.3	74.0	29.7	Vertical
4824.0	6.0	32.1	38.1	74.0	35.9	Vertical
7236.0	1.8	38.6	40.4	74.0	33.6	Vertical
3225.0	2.3	28.9	31.2	74.0	42.8	Horizontal
4824.0	-1.3	32.1	30.8	74.0	43.2	Horizontal
7236.0	-1.9	38.6	36.7	74.0	37.3	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3225.0	2.3	28.9	31.2	54.0	22.8	Vertical
4824.0	-1.9	32.1	30.2	54.0	23.8	Vertical
7236.0	-2.3	38.6	36.3	54.0	17.7	Vertical
3225.0	-2.6	28.9	26.3	54.0	27.7	Horizontal
4824.0	-3.1	32.1	29.0	54.0	25.0	Horizontal
7236.0	-3.9	38.6	34.7	54.0	19.3	Horizontal

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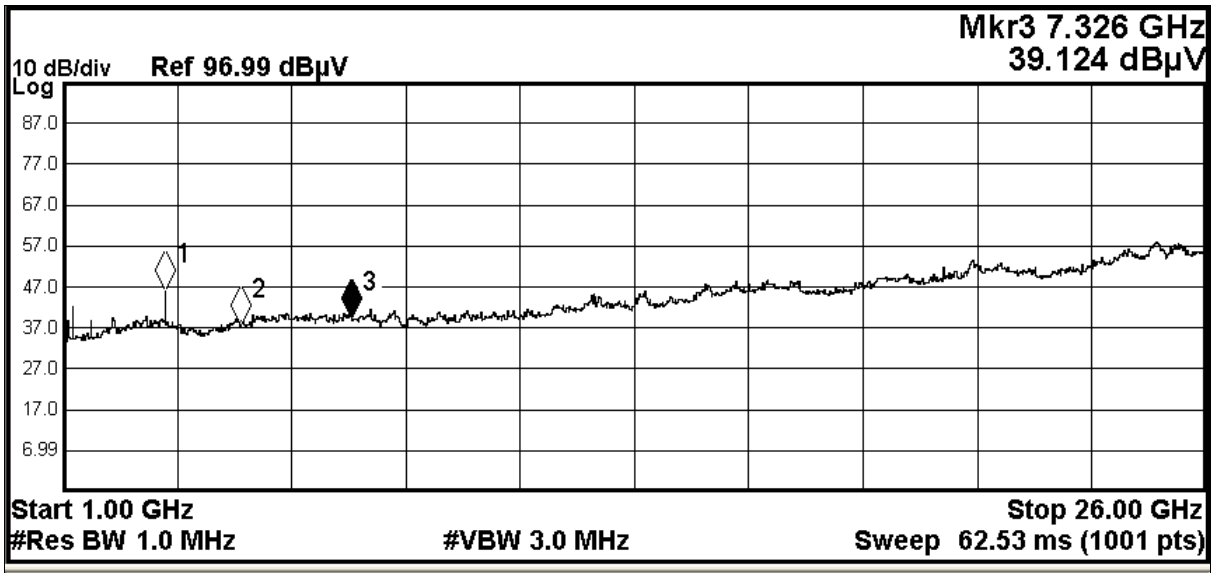
Result of Tx mode (802.11g) (2442.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.250 GHz	46.000 dBµV			
2	N	1	f	4.884 GHz	37.670 dBµV			
3	N	1	f	7.326 GHz	39.124 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11g) (2442.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11g) (2442.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3250.0	17.1	28.9	46.0	74.0	28.0	Vertical
4884.0	5.6	32.1	37.7	74.0	36.3	Vertical
7326.0	0.5	38.6	39.1	74.0	34.9	Vertical
3250.0	3.4	28.9	32.3	74.0	41.7	Horizontal
4884.0	-1.9	32.1	30.2	74.0	43.8	Horizontal
7326.0	-2.7	38.6	35.9	74.0	38.1	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3250.0	3.3	28.9	32.2	54.0	21.8	Vertical
4884.0	-2.3	32.1	29.8	54.0	24.2	Vertical
7326.0	-3.1	38.6	35.5	54.0	18.5	Vertical
3250.0	-1.7	28.9	27.2	54.0	26.8	Horizontal
4884.0	-3.1	32.1	29.0	54.0	25.0	Horizontal
7326.0	-3.8	38.6	34.8	54.0	19.2	Horizontal

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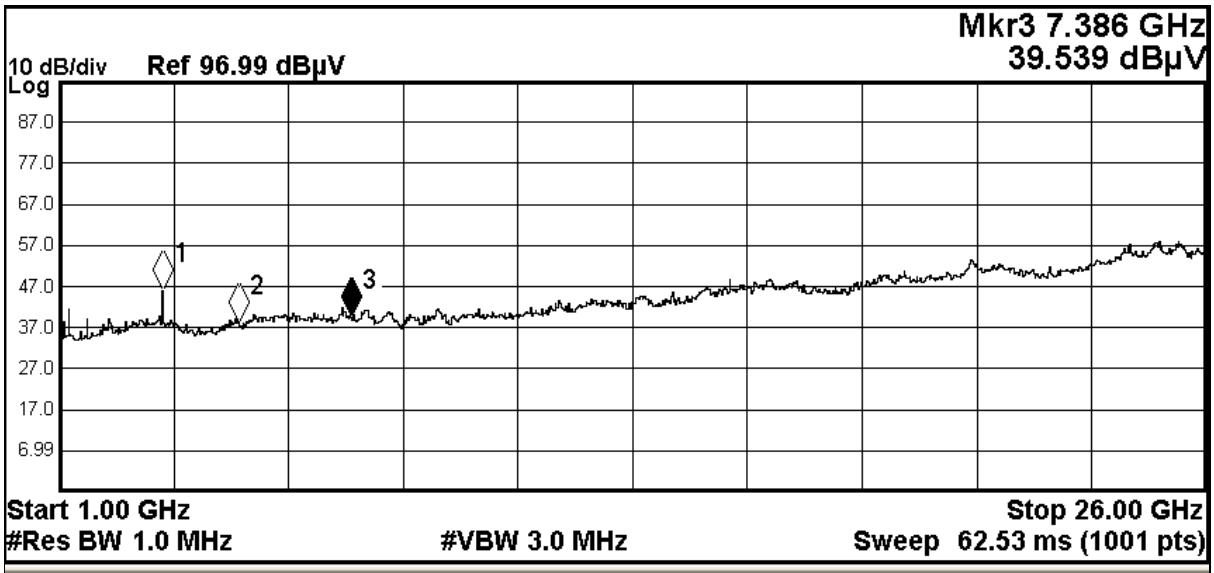
Result of Tx mode (802.11g) (2462.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.275 GHz	46.054 dBµV			
2	N	1	f	4.924 GHz	38.300 dBµV			
3	N	1	f	7.386 GHz	39.539 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11g) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11g) (2462.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3275.0	17.2	28.9	46.1	74.0	27.9	Vertical
4924.0	6.1	32.2	38.3	74.0	35.7	Vertical
7386.0	0.9	38.6	39.5	74.0	34.5	Vertical
3275.0	3.4	28.9	32.3	74.0	41.7	Horizontal
4924.0	-2.9	32.2	29.3	74.0	44.7	Horizontal
7386.0	-3.1	38.6	35.5	74.0	38.5	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3275.0	2.3	28.9	31.2	54.0	22.8	Vertical
4924.0	-2.1	32.2	30.1	54.0	23.9	Vertical
7386.0	-2.9	38.6	35.7	54.0	18.3	Vertical
3275.0	-1.9	28.9	27.0	54.0	27.0	Horizontal
4924.0	-2.7	32.2	29.5	54.0	24.5	Horizontal
7386.0	-3.3	38.6	35.3	54.0	18.7	Horizontal

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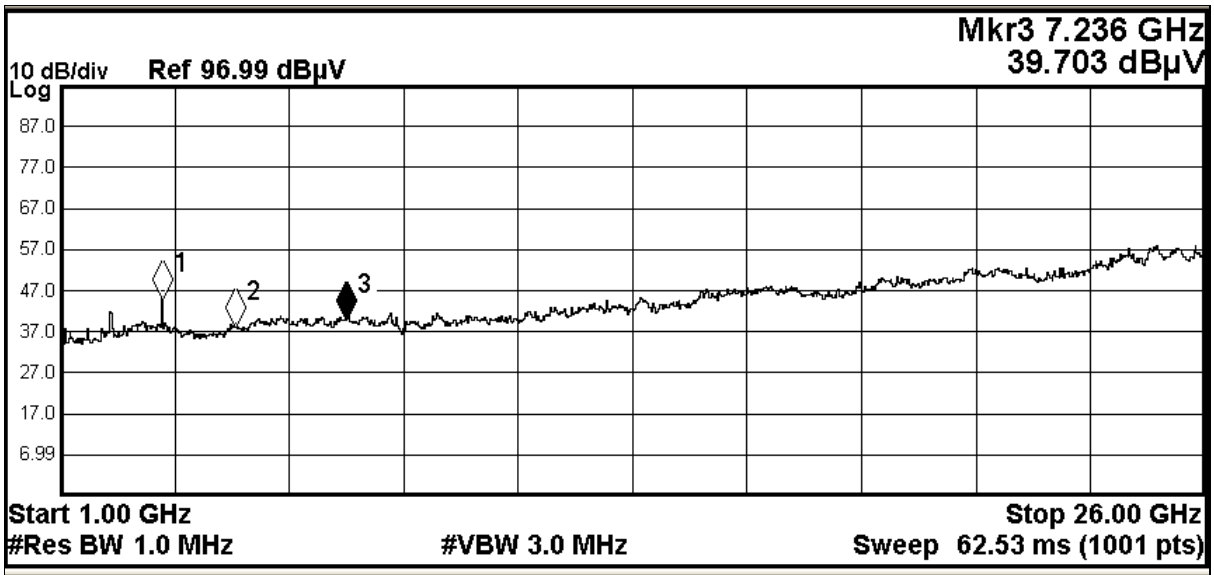
Result of Tx mode (802.11n (HT20)) (2412.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.225 GHz	44.862 dBµV			
2	N	1	f	4.824 GHz	37.962 dBµV			
3	N	1	f	7.236 GHz	39.703 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11n (HT20)) (2412.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11n (HT20)) (2412.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3225.0	16.0	28.9	44.9	74.0	29.1	Vertical
4824.0	5.9	32.1	38.0	74.0	36.0	Vertical
7236.0	1.1	38.6	39.7	74.0	34.3	Vertical
3225.0	3.3	28.9	32.2	74.0	41.8	Horizontal
4824.0	-0.8	32.1	31.3	74.0	42.7	Horizontal
7236.0	-2.9	38.6	35.7	74.0	38.3	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3225.0	3.7	28.9	32.6	54.0	21.4	Vertical
4824.0	-1.8	32.1	30.3	54.0	23.7	Vertical
7236.0	-2.9	38.6	35.7	54.0	18.3	Vertical
3225.0	-2.3	28.9	26.6	54.0	27.4	Horizontal
4824.0	-2.7	32.1	29.4	54.0	24.6	Horizontal
7236.0	-3.0	38.6	35.6	54.0	18.4	Horizontal

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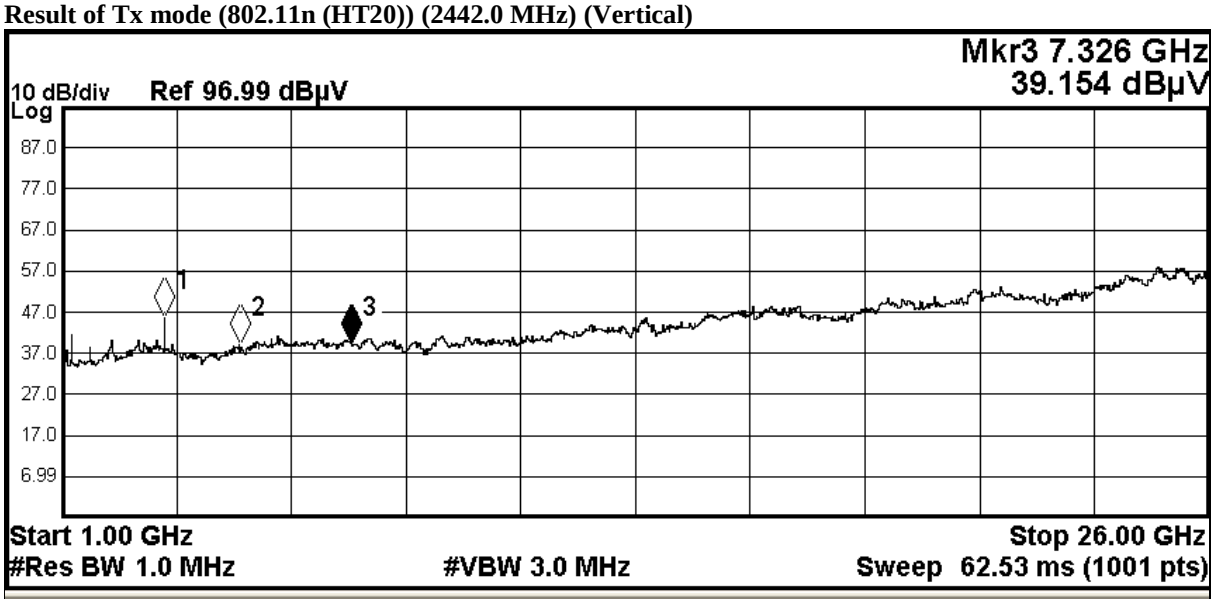
Result of Tx mode (802.11n (HT20)) (2442.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.250 GHz	45.690 dBµV			
2	N	1	f	4.884 GHz	39.182 dBµV			
3	N	1	f	7.326 GHz	39.154 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11n (HT20)) (2442.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11n (HT20)) (2442.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3250.0	16.8	28.9	45.7	74.0	28.3	Vertical
4884.0	7.1	32.1	39.2	74.0	34.8	Vertical
7326.0	0.6	38.6	39.2	74.0	34.8	Vertical
3250.0	3.3	28.9	32.2	74.0	41.8	Horizontal
4884.0	2.3	32.1	34.4	74.0	39.6	Horizontal
7326.0	-2.1	38.6	36.5	74.0	37.5	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3250.0	1.3	28.9	30.2	54.0	23.8	Vertical
4884.0	-2.3	32.1	29.8	54.0	24.2	Vertical
7326.0	-2.9	38.6	35.7	54.0	18.3	Vertical
3250.0	-2.1	28.9	26.8	54.0	27.2	Horizontal
4884.0	-3.1	32.1	29.0	54.0	25.0	Horizontal
7326.0	-3.4	38.6	35.2	54.0	18.8	Horizontal

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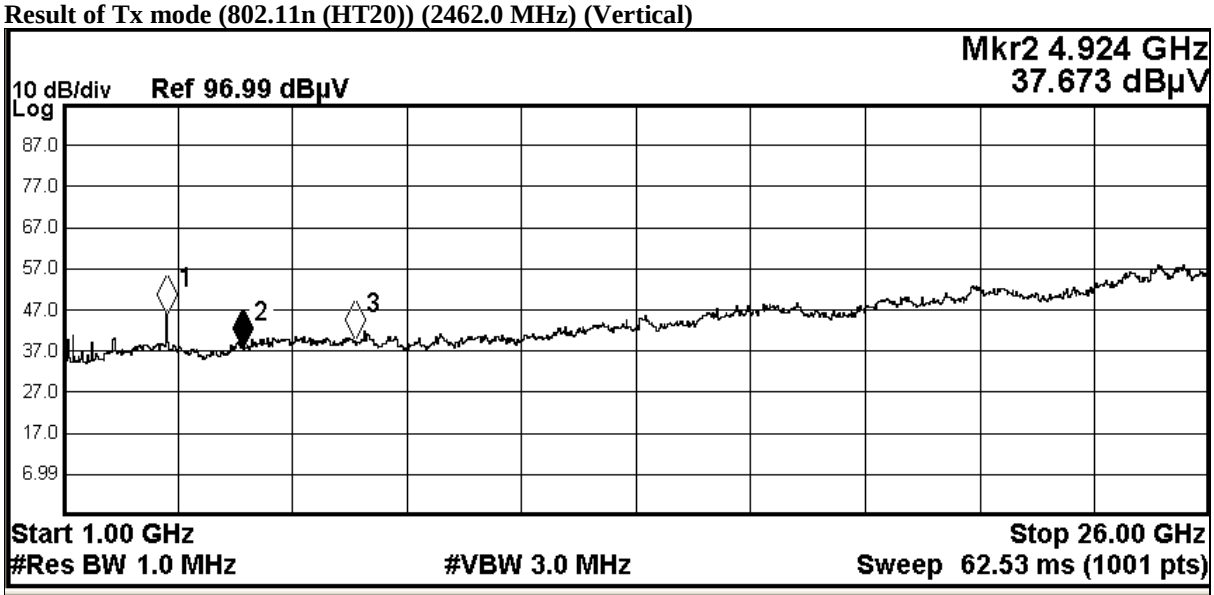
Result of Tx mode (802.11n (HT20)) (2462.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.275 GHz	45.883 dBµV			
2	N	1	f	4.924 GHz	37.673 dBµV			
3	N	1	f	7.386 GHz	39.487 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11n (HT20)) (2462.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11n (HT20)) (2462.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3275.0	17.0	28.9	45.9	74.0	28.1	Vertical
4924.0	5.5	32.2	37.7	74.0	36.3	Vertical
7386.0	0.9	38.6	39.5	74.0	34.5	Vertical
3275.0	3.4	28.9	32.3	74.0	41.7	Horizontal
4924.0	0.9	32.2	33.1	74.0	40.9	Horizontal
7386.0	-2.9	38.6	35.7	74.0	38.3	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3275.0	4.3	28.9	33.2	54.0	20.8	Vertical
4924.0	-1.7	32.2	30.5	54.0	23.5	Vertical
7386.0	-2.9	38.6	35.7	54.0	18.3	Vertical
3275.0	-2.1	28.9	26.8	54.0	27.2	Horizontal
4924.0	-2.9	32.2	29.3	54.0	24.7	Horizontal
7386.0	-3.4	38.6	35.2	54.0	18.8	Horizontal

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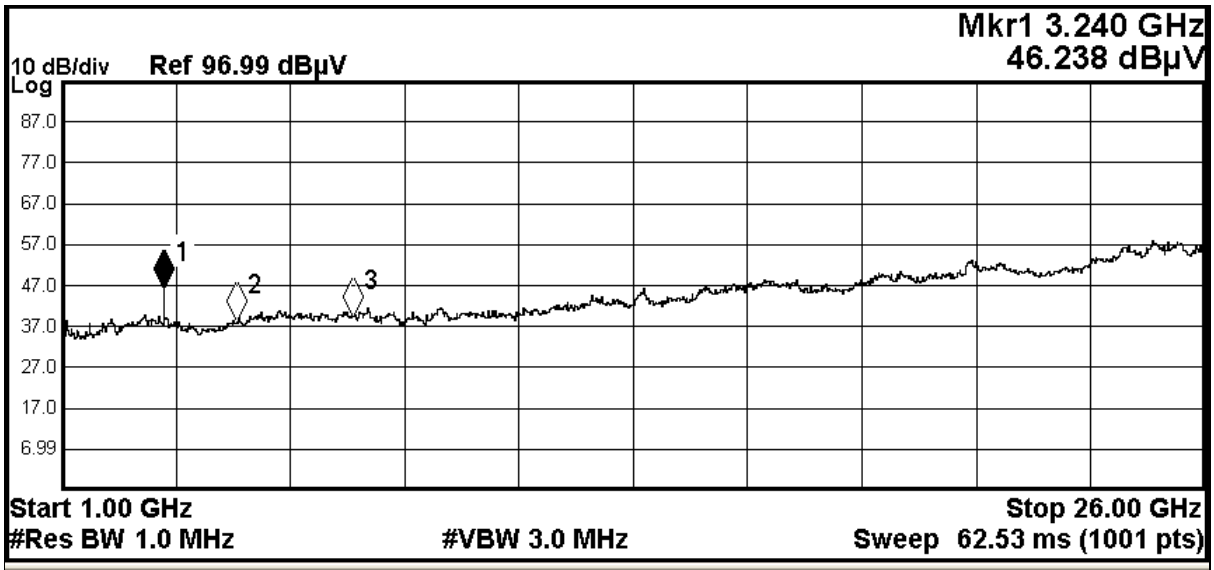
Result of Tx mode (802.11n (HT40)) (2422.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.240 GHz	46.238 dBµV			
2	N	1	f	4.844 GHz	38.194 dBµV			
3	N	1	f	7.366 GHz	39.312 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11n (HT40)) (2422.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11n (HT40)) (2422.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3240.0	17.3	28.9	46.2	74.0	27.8	Vertical
4844.0	6.1	32.1	38.2	74.0	35.8	Vertical
7266.0	0.7	38.6	39.3	74.0	34.7	Vertical
3240.0	4.4	28.9	33.3	74.0	40.7	Horizontal
4844.0	1.4	32.1	33.5	74.0	40.5	Horizontal
7266.0	-2.3	38.6	36.3	74.0	37.7	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3240.0	3.1	28.9	32.0	54.0	22.0	Vertical
4844.0	-1.8	32.1	30.3	54.0	23.7	Vertical
7266.0	-2.3	38.6	36.3	54.0	17.7	Vertical
3240.0	-7.6	28.9	21.3	54.0	32.7	Horizontal
4844.0	-2.3	32.1	29.8	54.0	24.2	Horizontal
7266.0	-3.3	38.6	35.3	54.0	18.7	Horizontal

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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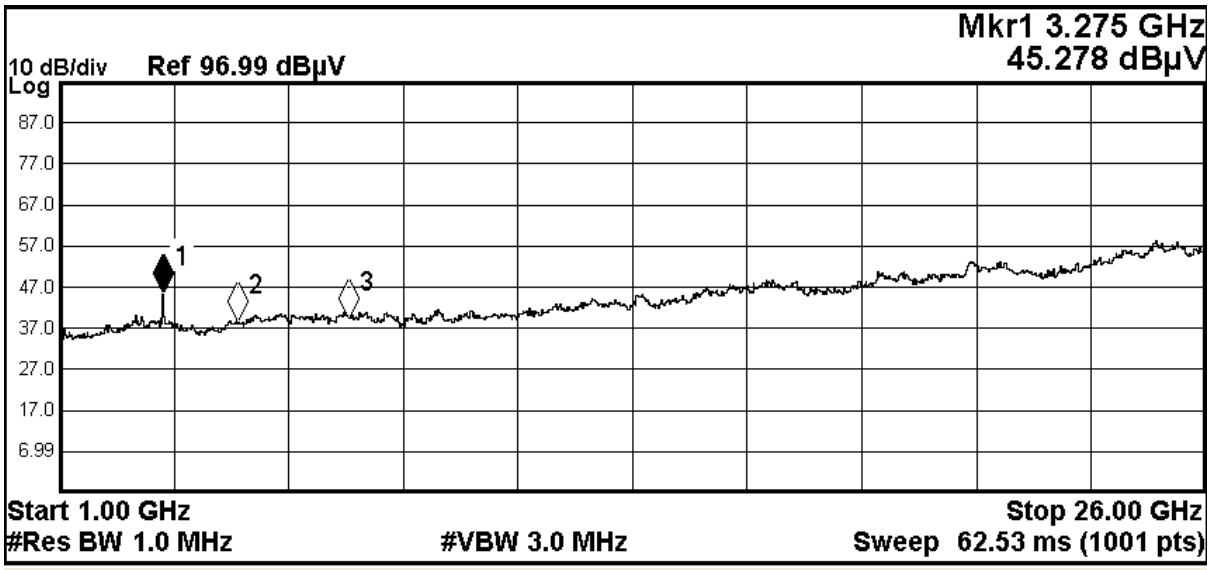
Result of Tx mode (802.11n (HT40)) (2442.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.275 GHz	45.278 dBµV			
2	N	1	f	4.884 GHz	38.759 dBµV			
3	N	1	f	7.326 GHz	39.291 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11n (HT40)) (2442.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11n (HT40)) (2442.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3275.0	16.4	28.9	45.3	74.0	28.7	Vertical
4884.0	6.7	32.1	38.8	74.0	35.2	Vertical
7326.0	0.8	38.6	39.4	74.0	34.6	Vertical
3275.0	3.9	28.9	32.8	74.0	41.2	Horizontal
4884.0	0.8	32.1	32.9	74.0	41.1	Horizontal
7326.0	-2.3	38.6	36.3	74.0	37.7	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3275.0	4.1	28.9	33.0	54.0	21.0	Vertical
4884.0	-0.7	32.1	31.4	54.0	22.6	Vertical
7326.0	-2.0	38.6	36.6	54.0	17.4	Vertical
3275.0	-1.3	28.9	27.6	54.0	26.4	Horizontal
4884.0	-2.4	32.1	29.7	54.0	24.3	Horizontal
7326.0	-3.3	38.6	35.3	54.0	18.7	Horizontal

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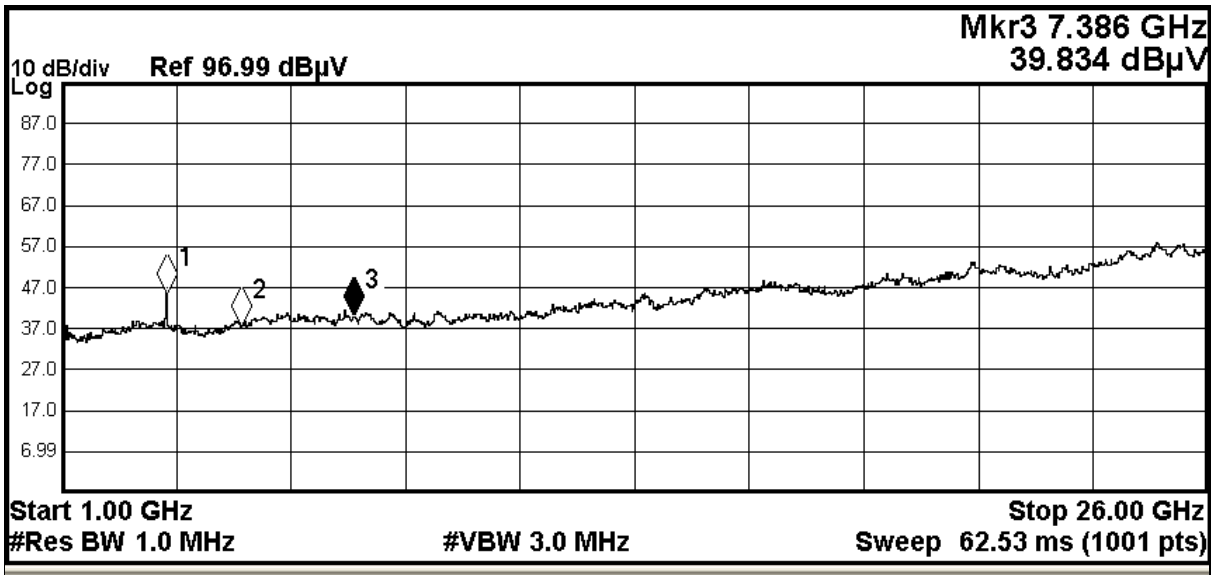
Result of Tx mode (802.11n (HT40)) (2462.0 MHz) (Vertical)



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	3.300 GHz	45.587 dBµV			
2	N	1	f	4.924 GHz	37.402 dBµV			
3	N	1	f	7.386 GHz	39.834 dBµV			
4								

Remarks: The fundamental frequency was not included in the pre-scan plot, a 2.4G notch filter was added prior to the Receiver.

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Result of Tx mode (802.11n (HT40)) (2462.0 MHz) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the Limits						

Result of Tx mode (802.11n (HT40)) (2462.0 MHz) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3300.0	16.7	28.9	45.6	74.0	28.4	Vertical
4924.0	5.2	32.2	37.4	74.0	36.6	Vertical
7386.0	1.2	38.6	39.8	74.0	34.2	Vertical
3300.0	4.3	28.9	33.2	74.0	40.8	Horizontal
4924.0	0.3	32.2	32.5	74.0	41.5	Horizontal
7386.0	-1.9	38.6	36.7	74.0	37.3	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
3300.0	4.6	28.9	33.5	54.0	20.5	Vertical
4924.0	0.3	32.2	32.5	54.0	21.5	Vertical
7386.0	-2.4	38.6	36.2	54.0	17.8	Vertical
3300.0	-1.9	28.9	27.0	54.0	27.0	Horizontal
4924.0	-2.9	32.2	29.3	54.0	24.7	Horizontal
7386.0	-3.4	38.6	35.2	54.0	18.8	Horizontal

Remarks:
No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz
* Denotes restricted band of operation.
Measurements were made using a peak detector. Any emission less than 1000MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty	:	9kHz-30MHz	3.3dB
		30MHz -1GHz	4.6dB
		1GHz -26GHz	4.4dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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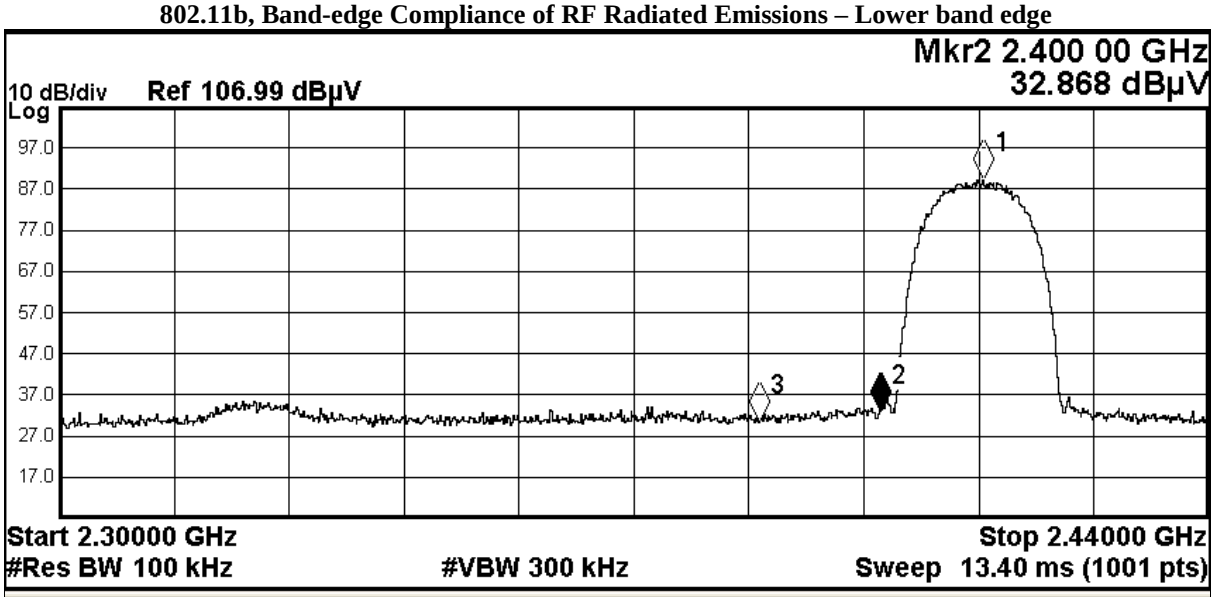
Band Edge Measurement:

Limit：

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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

Frequency Range [MHz]	Conducted Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2412)	56.5

802.11b, Band-edge Compliance of RF Radiated Emissions – Lower band edge



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.412 56 GHz	89.321 dBµV			
2	N	1	f	2.400 00 GHz	32.868 dBµV			
3	N	1	f	2.385 26 GHz	30.358 dBµV			
4								

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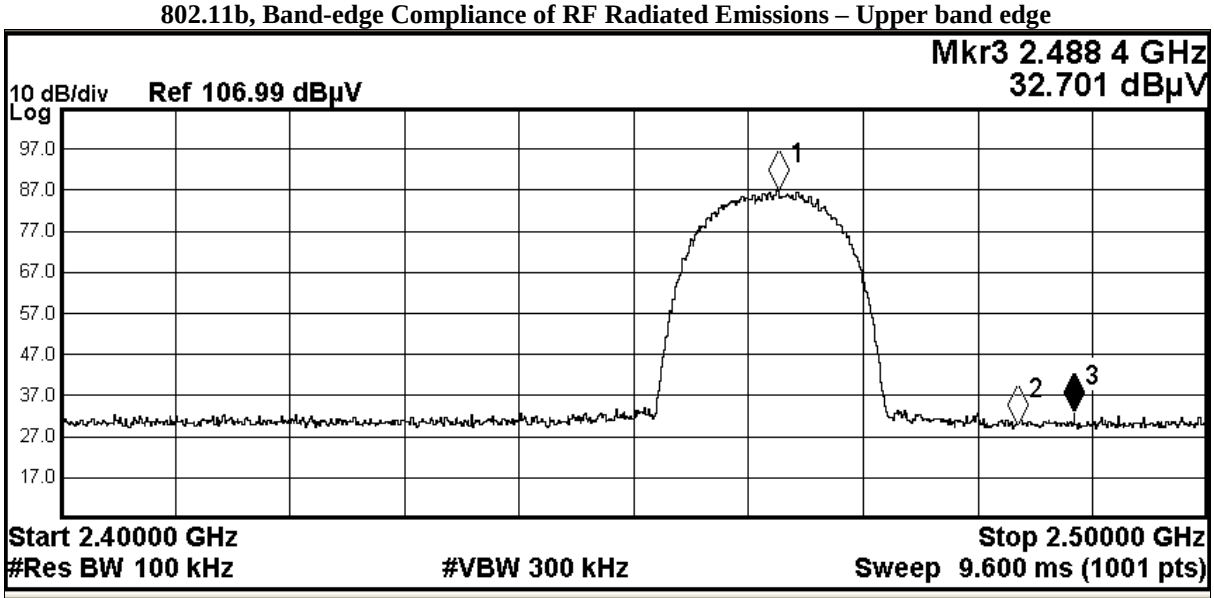
Band-edge Compliance of RF Radiated Emissions Measurement:

Frequency Range [MHz]	Conducted Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2462)	57.1

802.11b, Band-edge Compliance of RF Radiated Emissions – Upper band edge



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.462 6 GHz	87.016 dBµV			
2	N	1	f	2.483 5 GHz	29.913 dBµV			
3	N	1	f	2.488 4 GHz	32.701 dBµV			
4								

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802.11b, Radiated Emissions Band-edge and Restricted Band Result:

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2385.3	2.5	27.9	30.4	74.0	43.6	Vertical
2488.4	4.8	27.9	32.7	74.0	41.3	Vertical

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2385.3	0.3	27.9	28.2	54.0	25.8	Vertical
2488.4	0.4	27.9	28.3	54.0	25.7	Vertical

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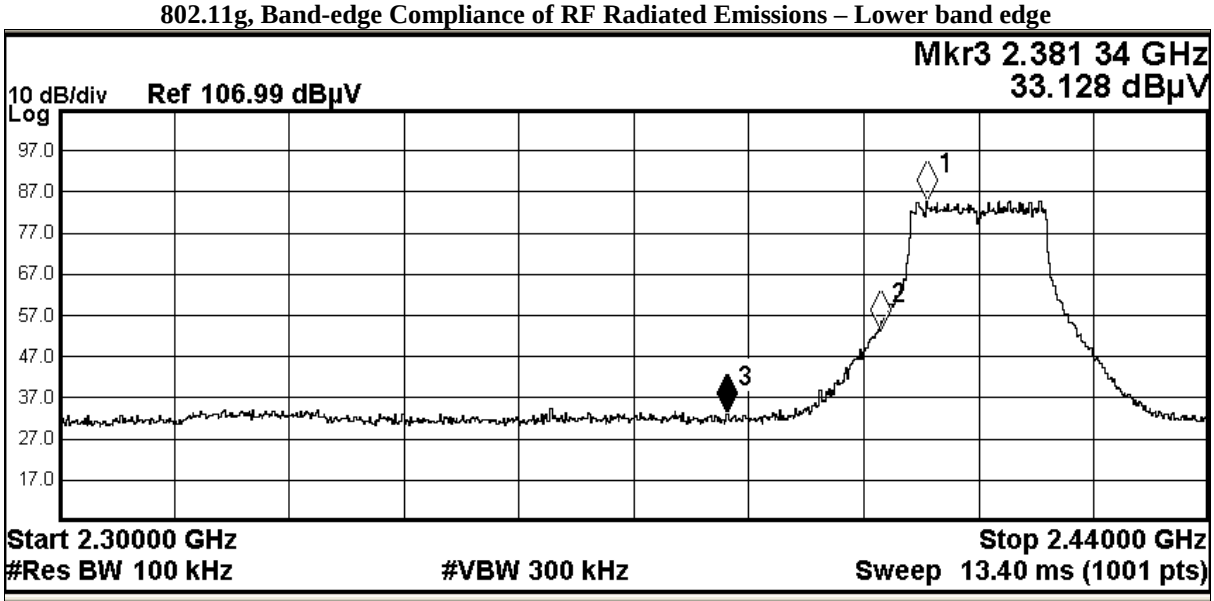
Frequency Range [MHz]	Conducted Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2412)	31.6

802.11g, Band-edge Compliance of RF Radiated Emissions – Lower band edge



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.405 70 GHz	84.867 dBµV			
2	N	1	f	2.400 00 GHz	53.307 dBµV			
3	N	1	f	2.381 34 GHz	33.128 dBµV			
4								

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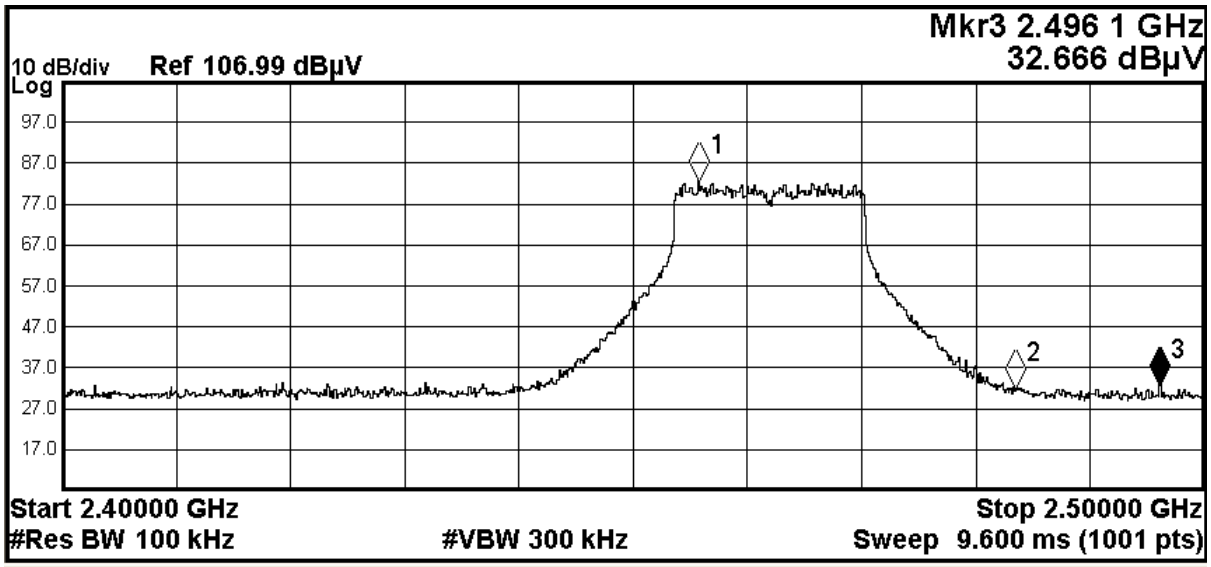
Band-edge Compliance of RF Radiated Emissions Measurement:

Frequency Range [MHz]	Conducted Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2462)	50.6

802.11g, Band-edge Compliance of RF Radiated Emissions – Upper band edge



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.455 7 GHz	82.504 dBµV			
2	N	1	f	2.483 5 GHz	31.884 dBµV			
3	N	1	f	2.496 1 GHz	32.666 dBµV			
4								

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802.11g, Radiated Emissions Band-edge and Restricted Band Result:

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2381.3	5.2	27.9	33.1	74.0	40.9	Vertical
2496.1	4.8	27.9	32.7	74.0	41.3	Vertical

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2384.0	1.3	27.9	29.2	54.0	24.8	Vertical
2488.3	0.7	27.9	28.6	54.0	25.4	Vertical

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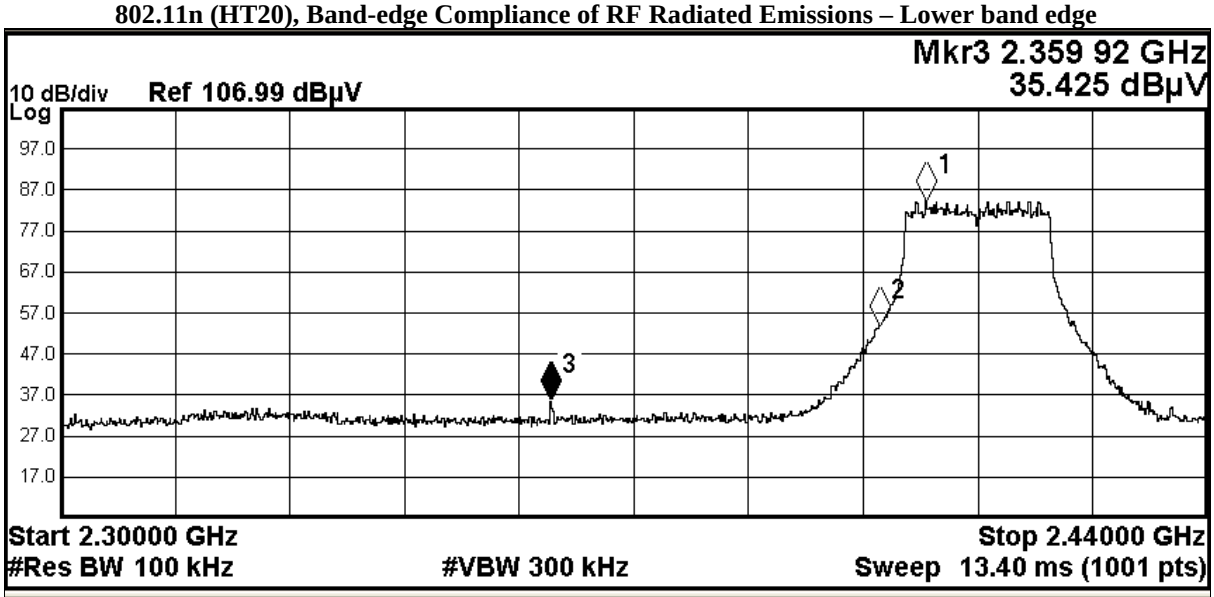
Frequency Range [MHz]	Conducted Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2412)	30.5

802.11n (HT20), Band-edge Compliance of RF Radiated Emissions – Lower band edge



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.405 70 GHz	84.229 dBµV			
2	N	1	f	2.400 00 GHz	53.764 dBµV			
3	N	1	f	2.359 92 GHz	35.425 dBµV			
4								

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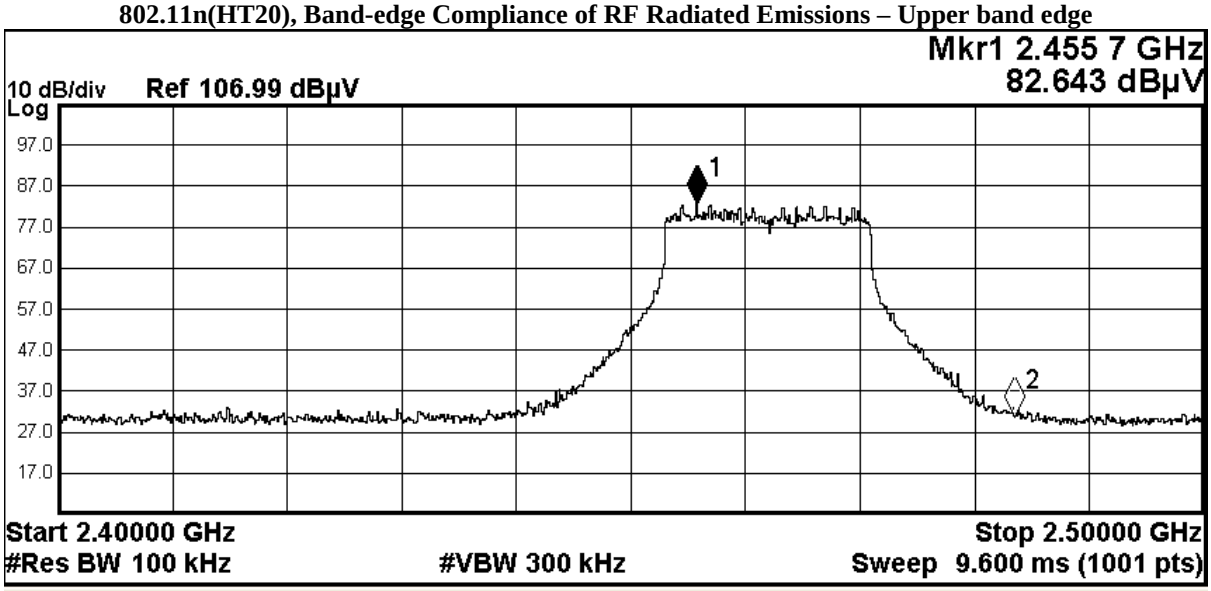
Band-edge Compliance of RF Radiated Emissions Measurement:

Frequency Range [MHz]	Conducted Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2462)	51.9

802.11n(HT20), Band-edge Compliance of RF Radiated Emissions – Upper band edge



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.455 7 GHz	82.643 dBµV			
2	N	1	f	2.483 5 GHz	30.774 dBµV			
3								

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802.11n(HT20), Radiated Emissions Band-edge and Restricted Band Result:

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2359.9	7.5	27.9	35.4	74.0	38.6	Vertical
2484.0	2.9	27.9	30.8	74.0	43.2	Vertical

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2359.9	1.2	27.9	29.1	54.0	24.9	Vertical
2484.0	0.3	27.9	28.2	54.0	25.8	Vertical

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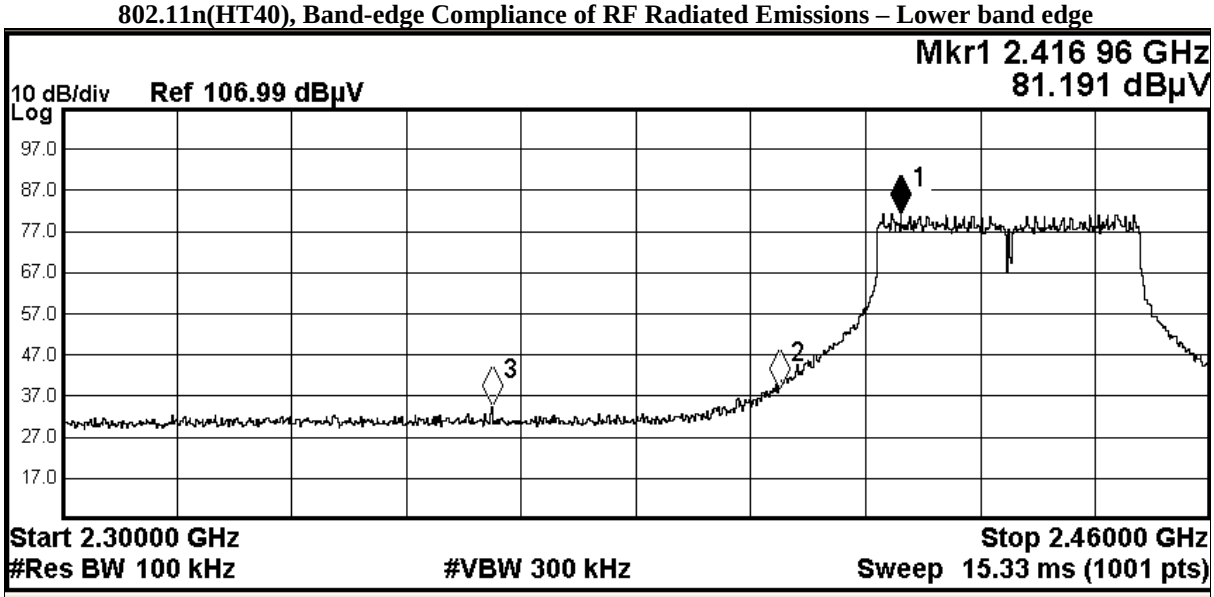
Frequency Range [MHz]	Conducted Emission Attenuated below the Fundamental [dB]
2400 – Lowest Fundamental (2412)	42.4

802.11n(HT40), Band-edge Compliance of RF Radiated Emissions – Lower band edge



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.416 96 GHz	81.191 dBµV			
2	N	1	f	2.400 00 GHz	38.780 dBµV			
3	N	1	f	2.359 92 GHz	34.495 dBµV			
4								

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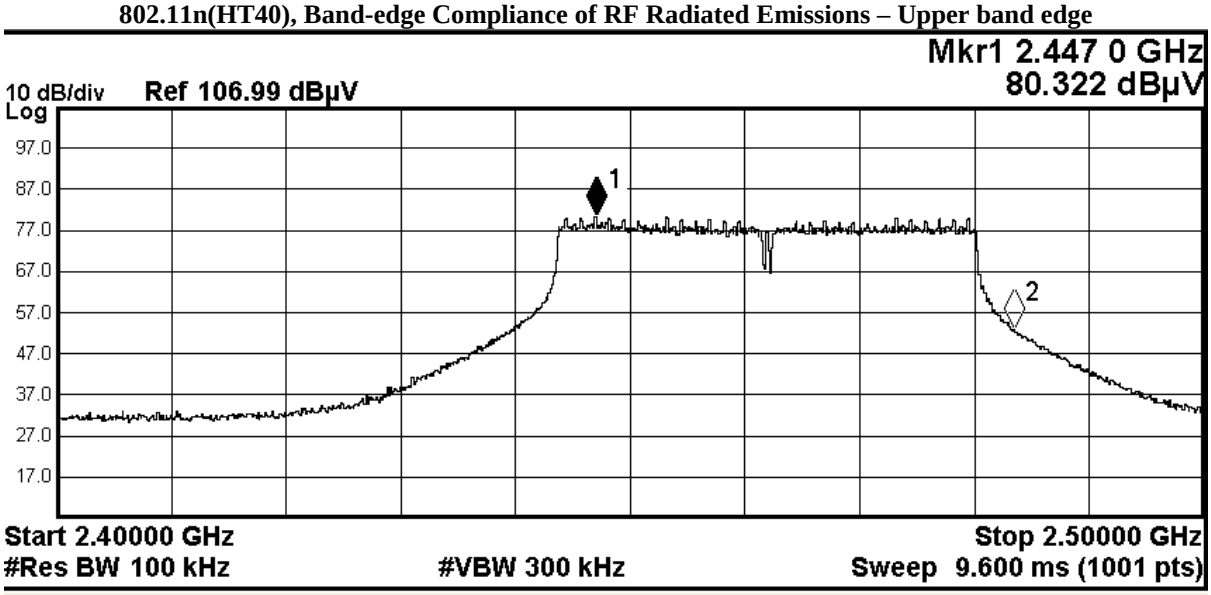
Band-edge Compliance of RF Radiated Emissions Measurement:

Frequency Range [MHz]	Conducted Emission Attenuated below the Fundamental [dB]
2483.5 - Highest Fundamental (2462)	27.4

802.11n(HT40), Band-edge Compliance of RF Radiated Emissions – Upper band edge



MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	2.447 0 GHz	80.322 dBµV			
2	N	1	f	2.483 5 GHz	52.921 dBµV			
3								

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802.11n (HT40), Radiated Emissions Band-edge and Restricted Band Result:

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2389.5	10.9	27.9	38.8	74.0	35.2	Vertical
2483.6	25.0	27.9	52.9	74.0	21.1	Vertical

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBuV	Correction Factor dB/m	Field Strength dBuV/m	Limit @3m dBuV/m	Margin dBuV/m	E-Field Polarity
2389.5	3.7	27.9	31.6	54.0	22.4	Vertical
2483.6	11.9	27.9	39.8	54.0	14.2	Vertical

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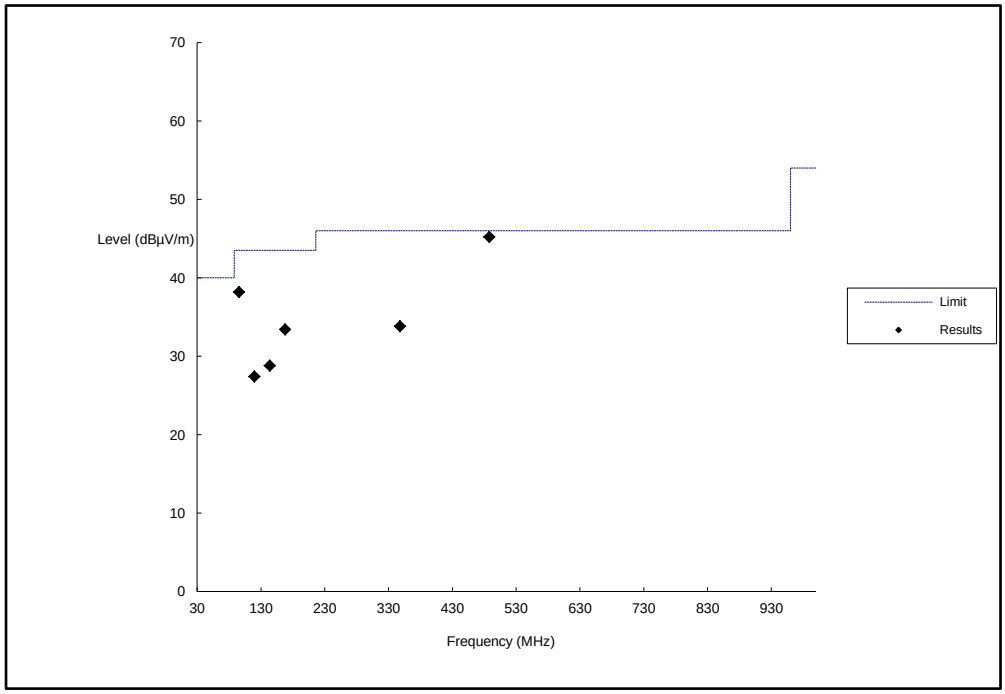
Limits for Radiated Emissions FCC 47 CFR 15.247 Class B]:

Frequency Range	Quasi-Peak Limits
[MHz]	[μV/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Results of Tx mode (802.11n (HT40)) (30MHz – 1GHz): Pass
Please refer to the following table for result details(The data is the worst cases)



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Radiated Emissions Quasi-Peak					
Emission Frequency MHz	E-Field Polarity	Level @3m dBμV/m	Limit @3m dBμV/m	Level @3m μV/m	Limit @3m μV/m
96.0	Vertical	38.2	43.5	81.3	150
120.0	Horizontal	27.4	43.5	23.4	150
144.0	Horizontal	28.8	43.5	27.5	150
168.0	Horizontal	33.4	43.5	46.8	200
348.1	Horizontal	33.8	46.0	49.0	200
488.0	Vertical	45.2	46.0	182.0	200

Remarks:
Calculated measurement uncertainty (30MHz – 1GHz): 4.6dB
Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

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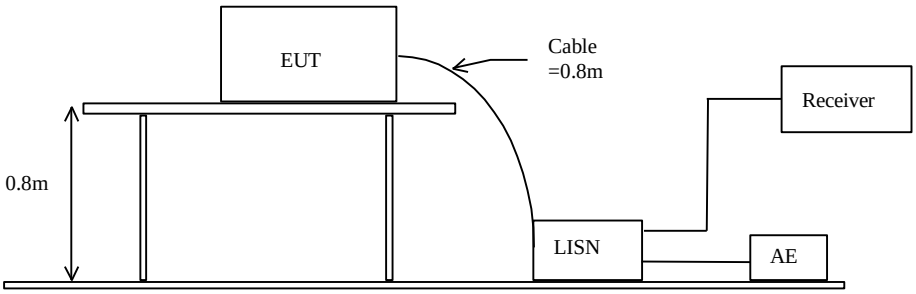
3.1.3 Conducted Emissions (0.15MHz to 30MHz)

Test Requirement:	FCC 47CFR 15.207 Class B
Test Method:	ANSI C63.4: 2014
Test Date:	2018-07-19
Mode of Operation:	Charge mode
Ambient Temperature:	20°C
Relative Humidity:	51%
Atmospheric pressure	102kPa
Test voltage:	25.6Vd.c

Test Method:

The test was performed in accordance with ANSI C63.4: 2014, with the following: initial measurements were performed in peak and average detection modes on the live line, any emissions recorded within 30dB of the relevant limit lines were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

Test Setup:



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Limits for Conducted Emissions (FCC 47 CFR 15.207):

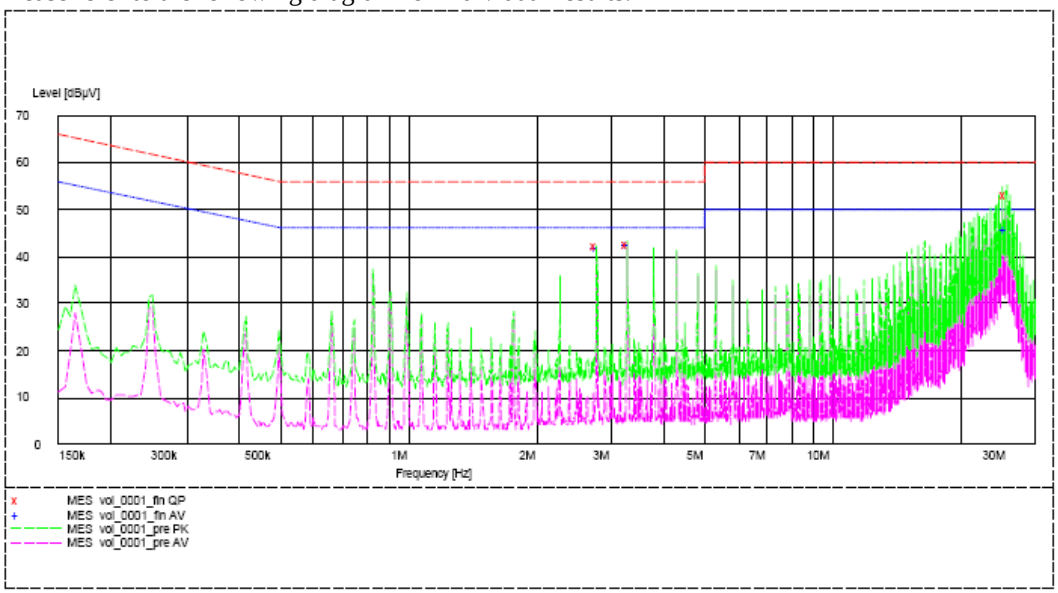
Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

Results of Charge mode (L): PASS

Please refer to the following diagram for individual results.



MEASUREMENT RESULT: "vol_0001_fin QP"

6/26/2018 4:53PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
2.780000	42.2	9.7	56.0	13.8	L1	GND
3.285000	42.7	9.7	56.0	13.3	L1	GND
25.660000	53.0	10.1	60.0	7.0	L1	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

6/26/2018 4:53PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
2.780000	41.8	9.7	46.0	4.2	L1	GND
3.285000	42.4	9.7	46.0	3.6	L1	GND
25.655000	45.6	10.1	50.0	4.4	L1	GND

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Limits for Conducted Emissions (FCC 47 CFR 15.207):

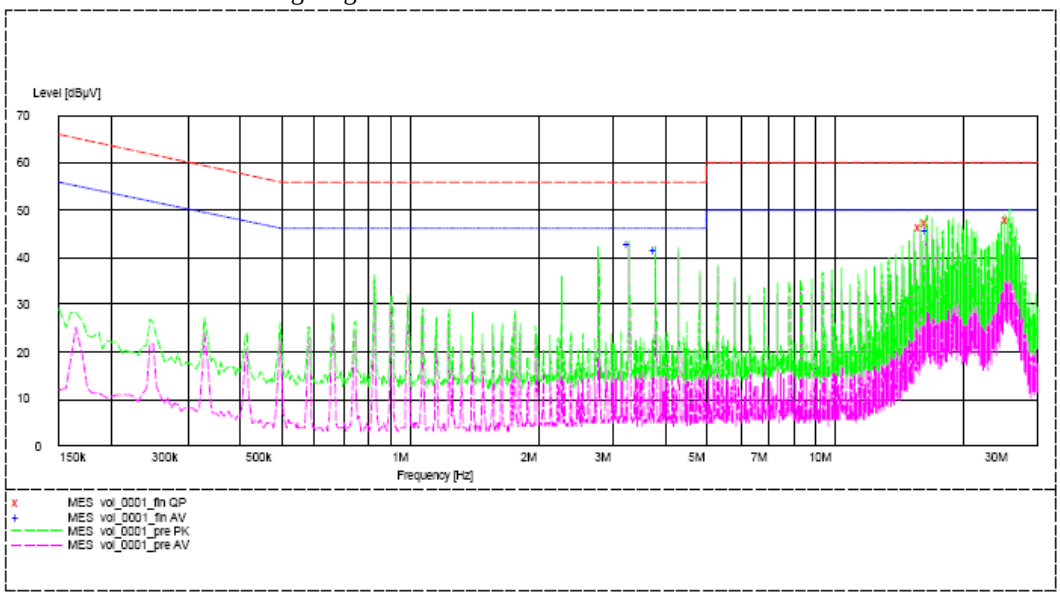
Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.

Limits for Conducted Emissions Test, please refer to limit lines (Quasi-Peak and Average) in the following diagram.

Results of Charge mode (N): PASS

Please refer to the following diagram for individual results.



MEASUREMENT RESULT: "vol_0001_fin QP"

6/26/2018 4:43PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
15.925000	46.3	9.8	60.0	13.7	N	GND
16.430000	47.6	9.8	60.0	12.4	N	GND
25.660000	48.3	10.1	60.0	11.7	N	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

6/26/2018 4:42PM

Frequency MHz	Level dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
3.285000	42.9	9.7	46.0	3.1	N	GND
3.790000	41.5	9.7	46.0	4.5	N	GND
16.430000	45.8	9.8	50.0	4.2	N	GND

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3.1.4 Power Spectral Density

Test Requirement:	FCC 47CFR 15.247(e)
Test Method:	ANSI C63.10:2013
Test Date:	2018-07-12
Mode of Operation:	Tx mode (802.11 b/g/n)
Ambient Temperature:	20°C
Relative Humidity:	52%
Atmospheric pressure	102kPa
Test voltage:	25.6Vd.c

Test Method:

The RF output of the EUT was connected to the spectrum analyzer. Set the fundamental frequency as the center frequency of the spectral analyzer. Use RBW=3kHz , VBW= 10kHz , Set the span to 1.5 times the DTS channel bandwidth. Detector = peak, Sweep time = auto couple , Trace mode = max hold.

Test Setup:

As Test Setup of clause 3.1.1 in this test report.

Test Limit:
The maximum power spectral density (PSD) shall not exceeded 8dBm in any 3kHz band.

Remarks:
The RBW used for PSD measurement was 100 kHz, therefore correction factor applied to calculate final results. The correction factor = 10log(3kHz/100kHz) = -15.2dB.

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Results of Tx Mode (802.11b) : Pass
Maximum power spectral density

Transmitter Frequency (MHz)	Maximum Power spectral density level / 3kHz band (dBm)	Maximum Power spectral density / 3kHz band limit
2412.0	-26.3	**8dBm**
2442.0	-26.9	**8dBm**
2462.0	-27.5	**8dBm**

Results of Tx Mode (802.11g) : Pass
Maximum power spectral density

Transmitter Frequency (MHz)	Maximum Power spectral density level / 3kHz band (dBm)	Maximum Power spectral density / 3kHz band limit
2412.0	-32.4	**8dBm**
2442.0	-33.2	**8dBm**
2462.0	-33.4	**8dBm**

Results of Tx Mode (802.11n(HT20)) : Pass
Maximum power spectral density

Transmitter Frequency (MHz)	Maximum Power spectral density level / 3kHz band (dBm)	Maximum Power spectral density / 3kHz band limit
2412.0	-33.0	**8dBm**
2442.0	-33.5	**8dBm**
2462.0	-34.1	**8dBm**

Results of Tx Mode (802.11n(HT40)) : Pass
Maximum power spectral density

Transmitter Frequency (MHz)	Maximum Power spectral density level / 3kHz band (dBm)	Maximum Power spectral density / 3kHz band limit
2422.0	-35.6	**8dBm**
2442.0	-36.4	**8dBm**
2462.0	-35.8	**8dBm**

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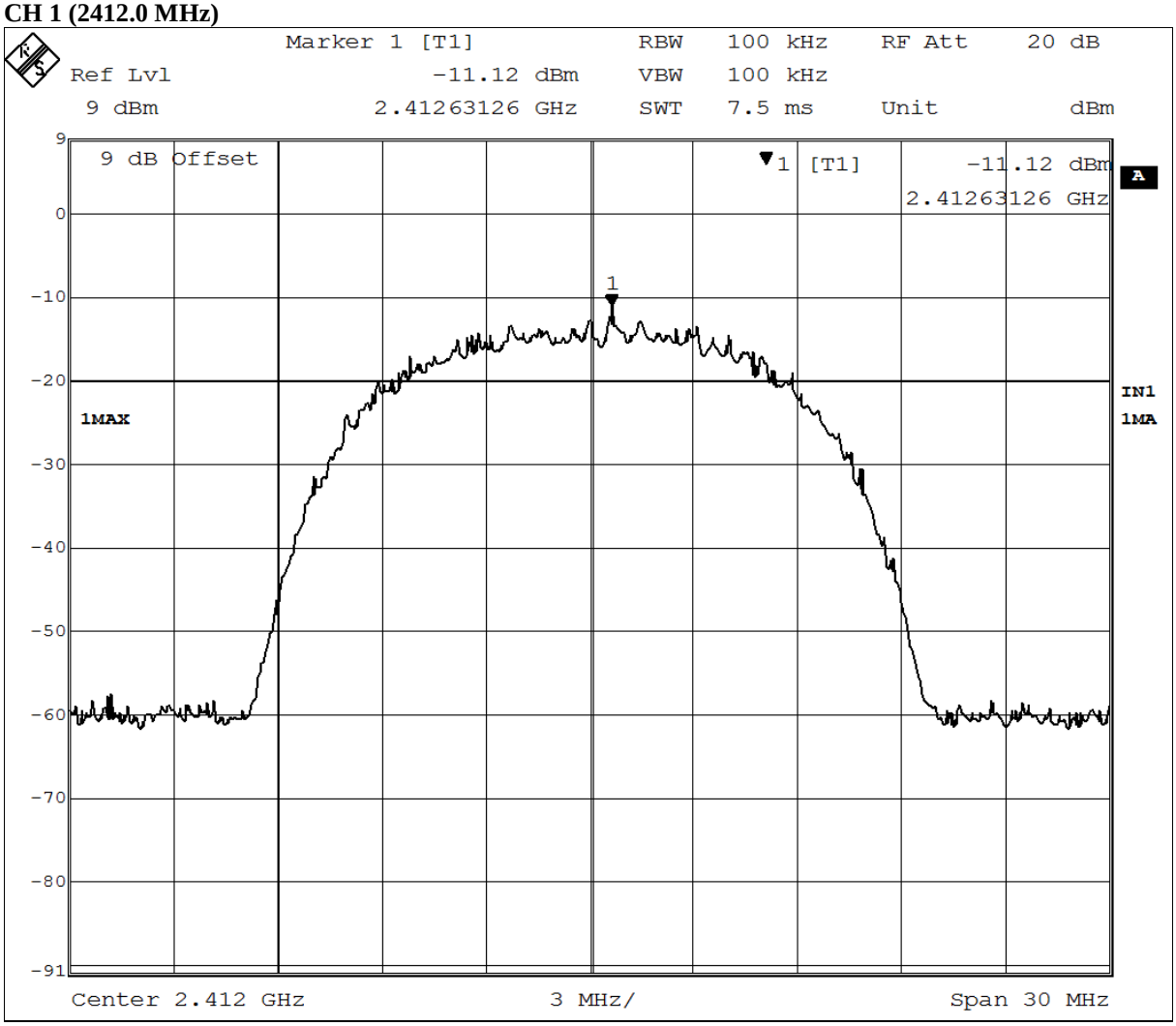
Tx mode (802.11b)
CH 1 (2412.0 MHz)



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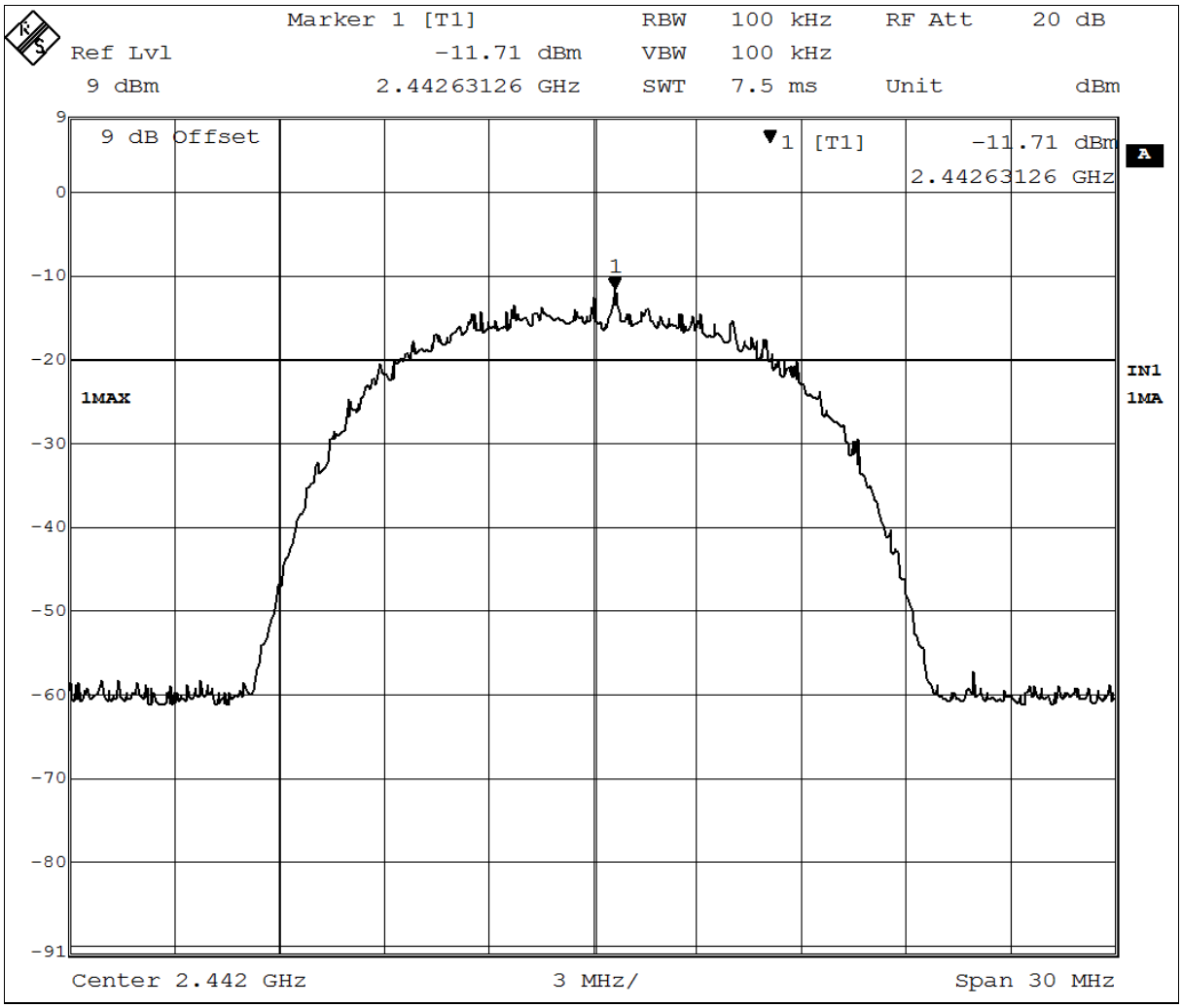
Tx mode (802.11b)
CH 7 (2442.0 MHz)



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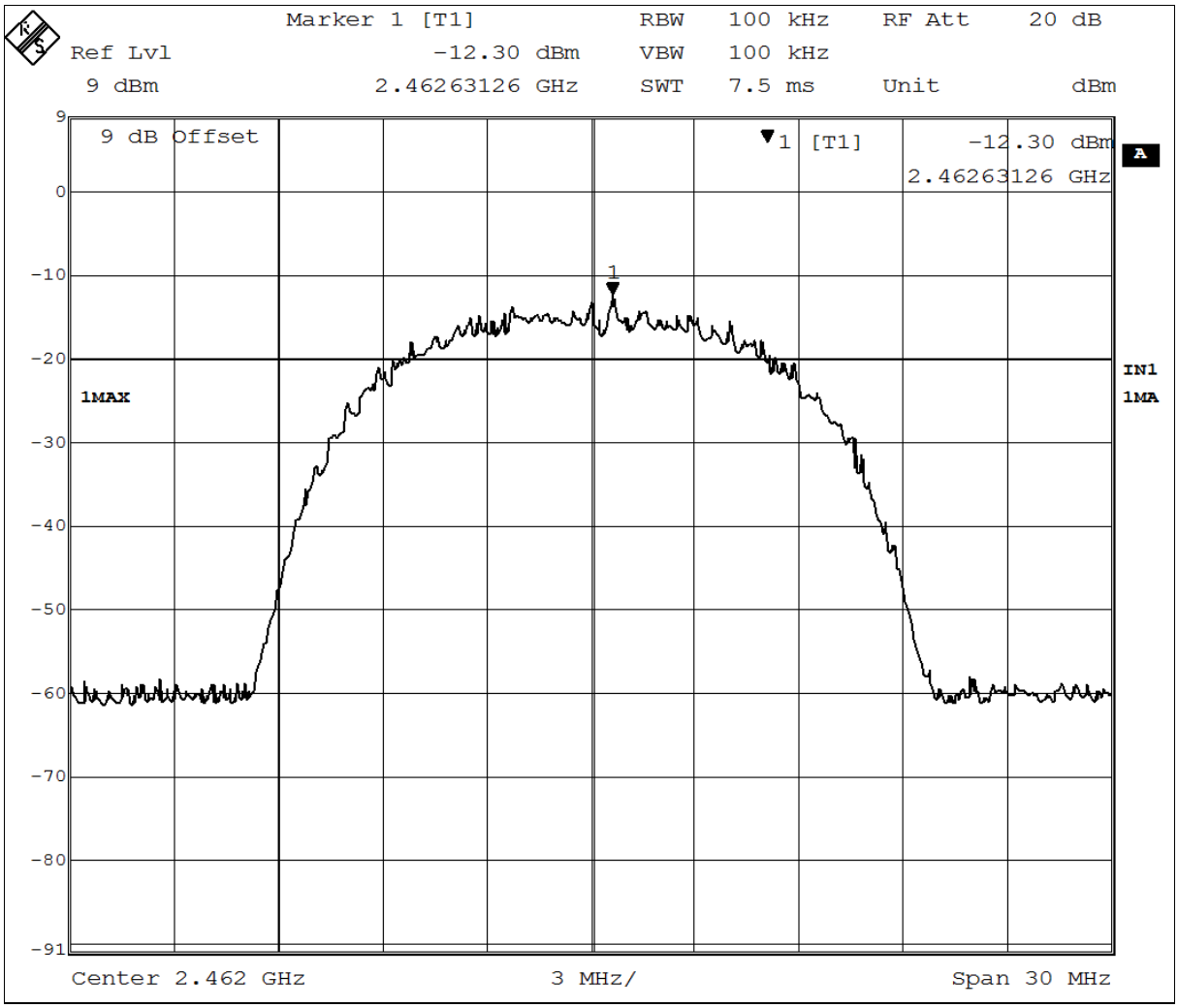
Tx mode (802.11b)
CH 11 (2462.0 MHz)



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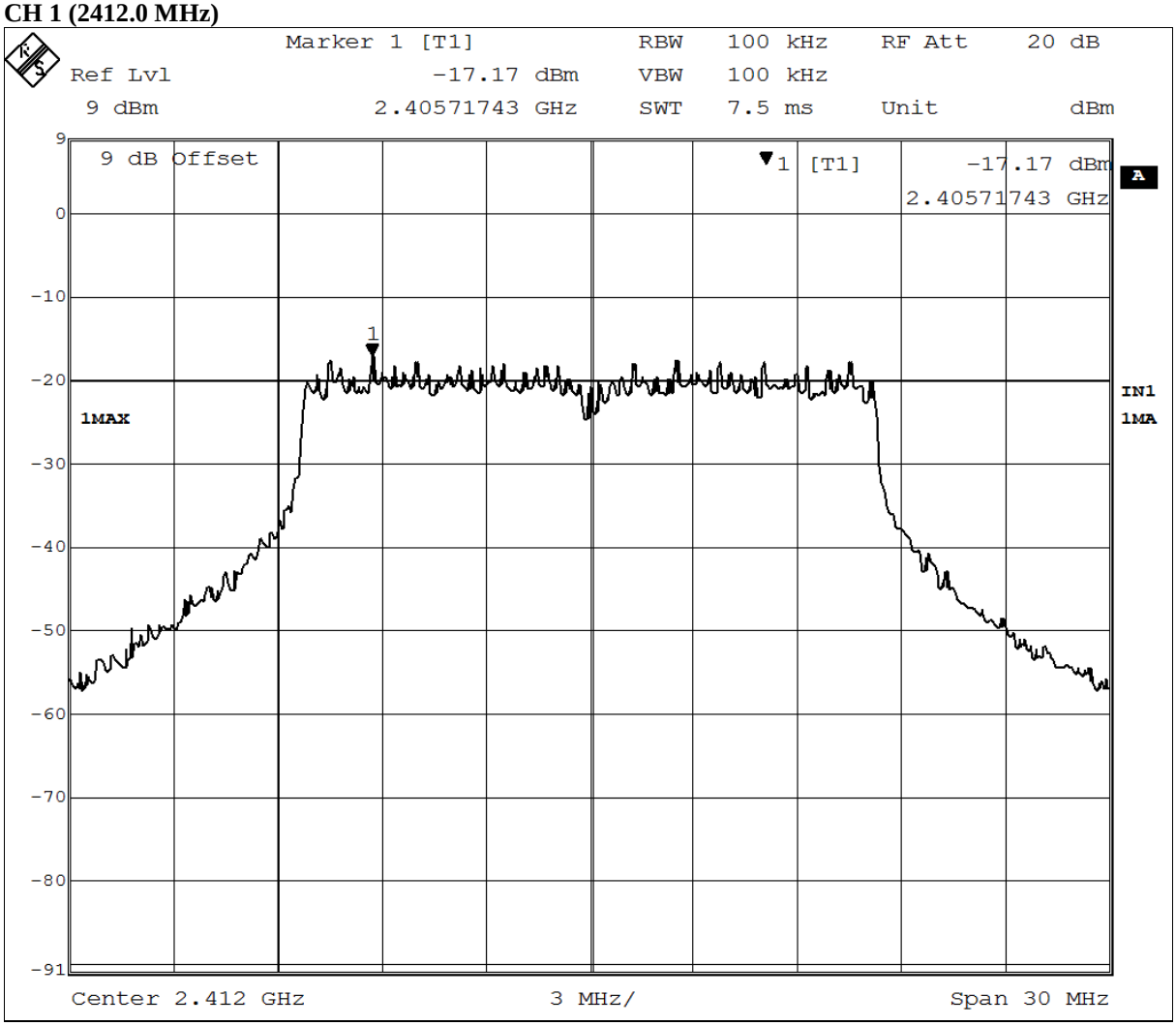
Tx mode (802.11g)
CH 1 (2412.0 MHz)



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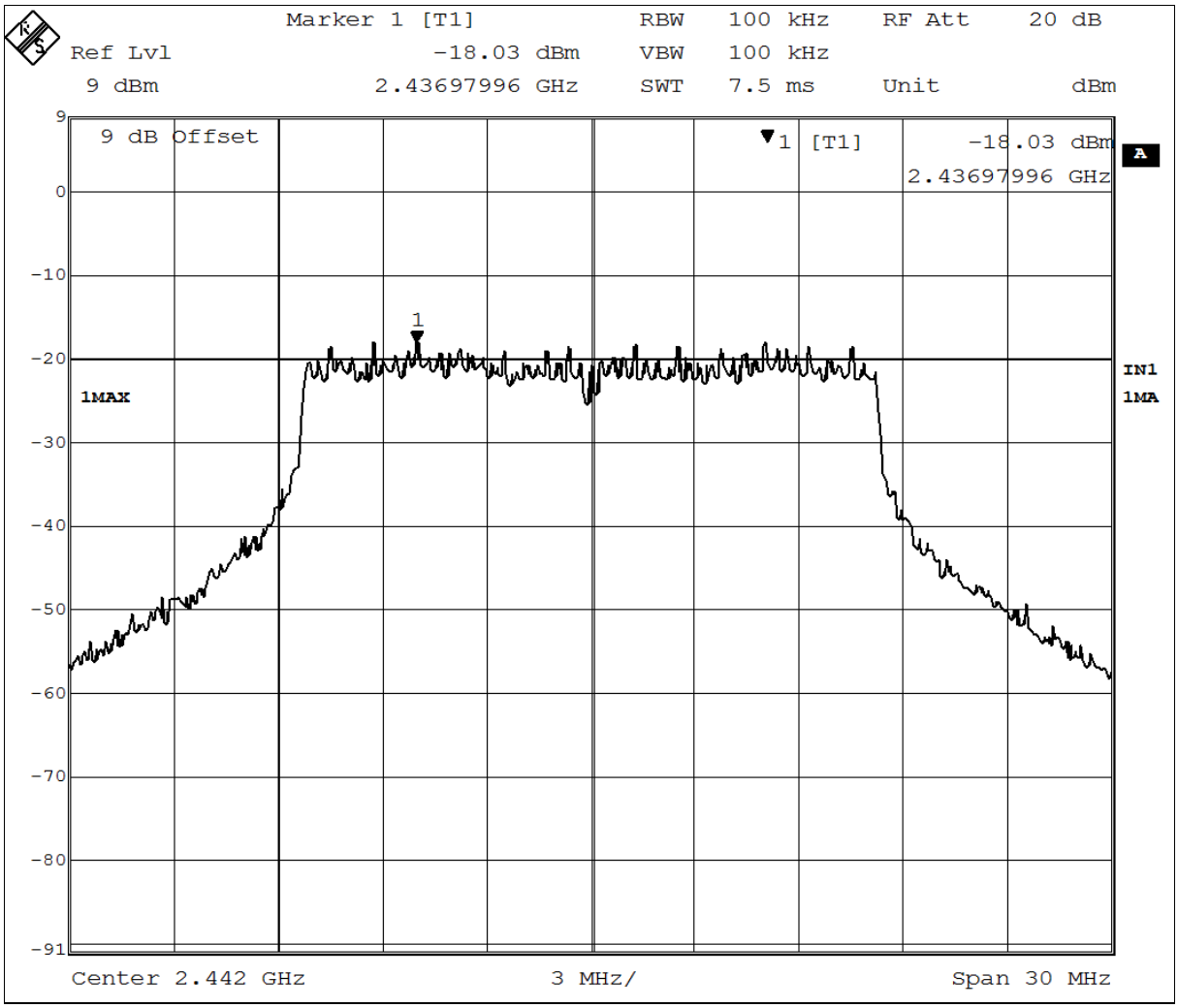
Tx mode (802.11g)
CH 7 (2442.0 MHz)



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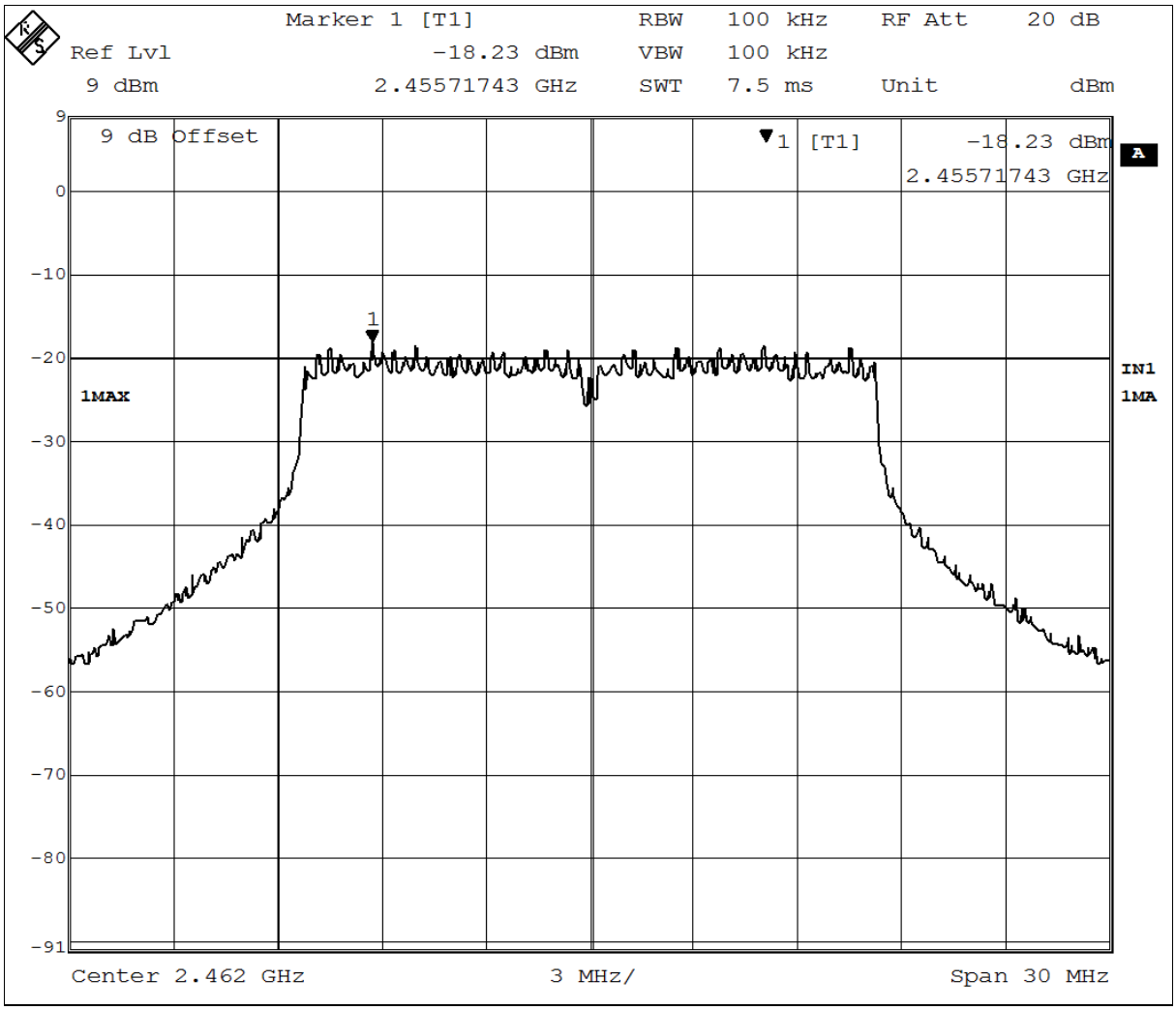
Tx mode (802.11g)
CH 11 (2462.0 MHz)



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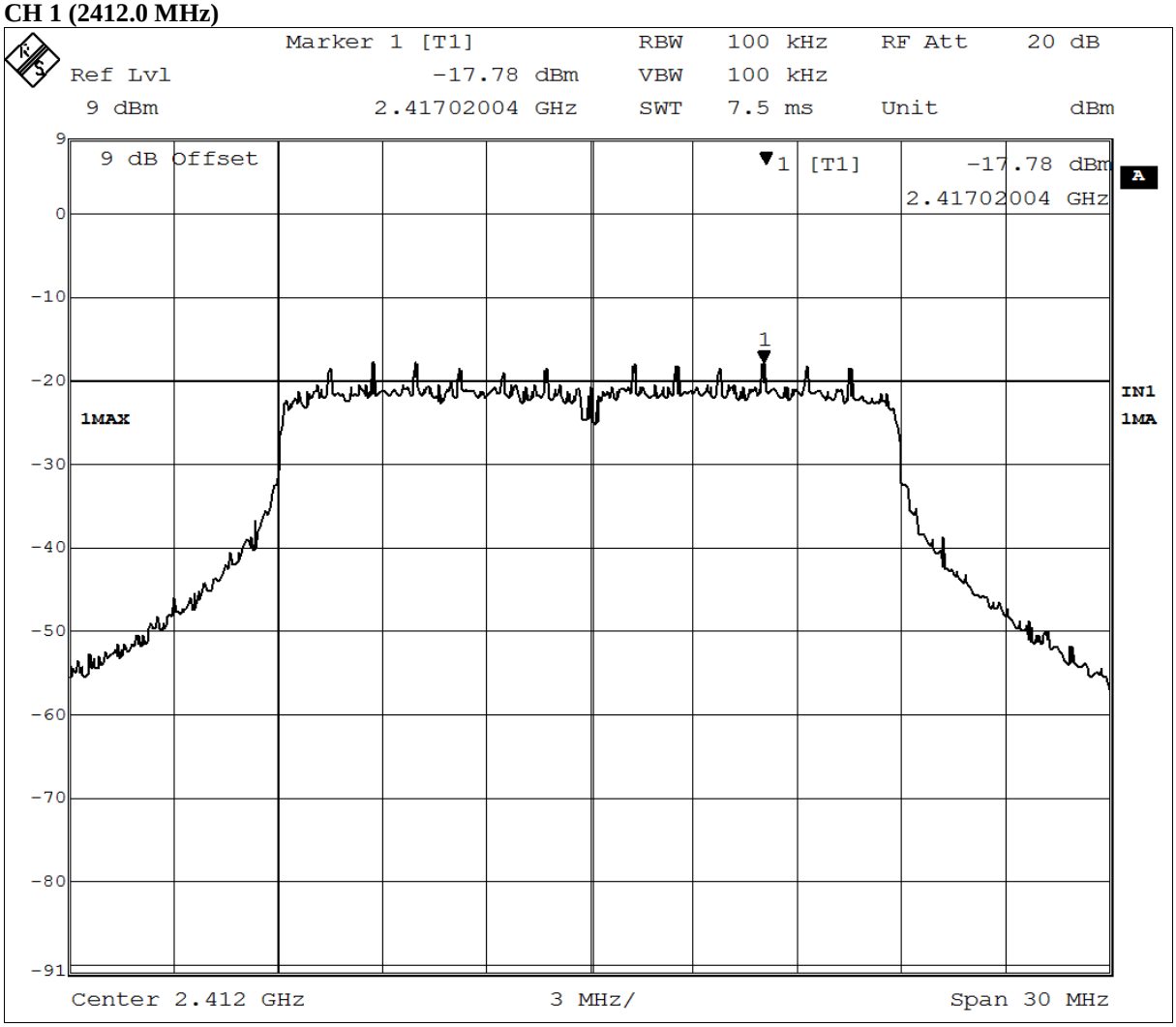
Tx mode (802.11n(HT20))
CH 1 (2412.0 MHz)



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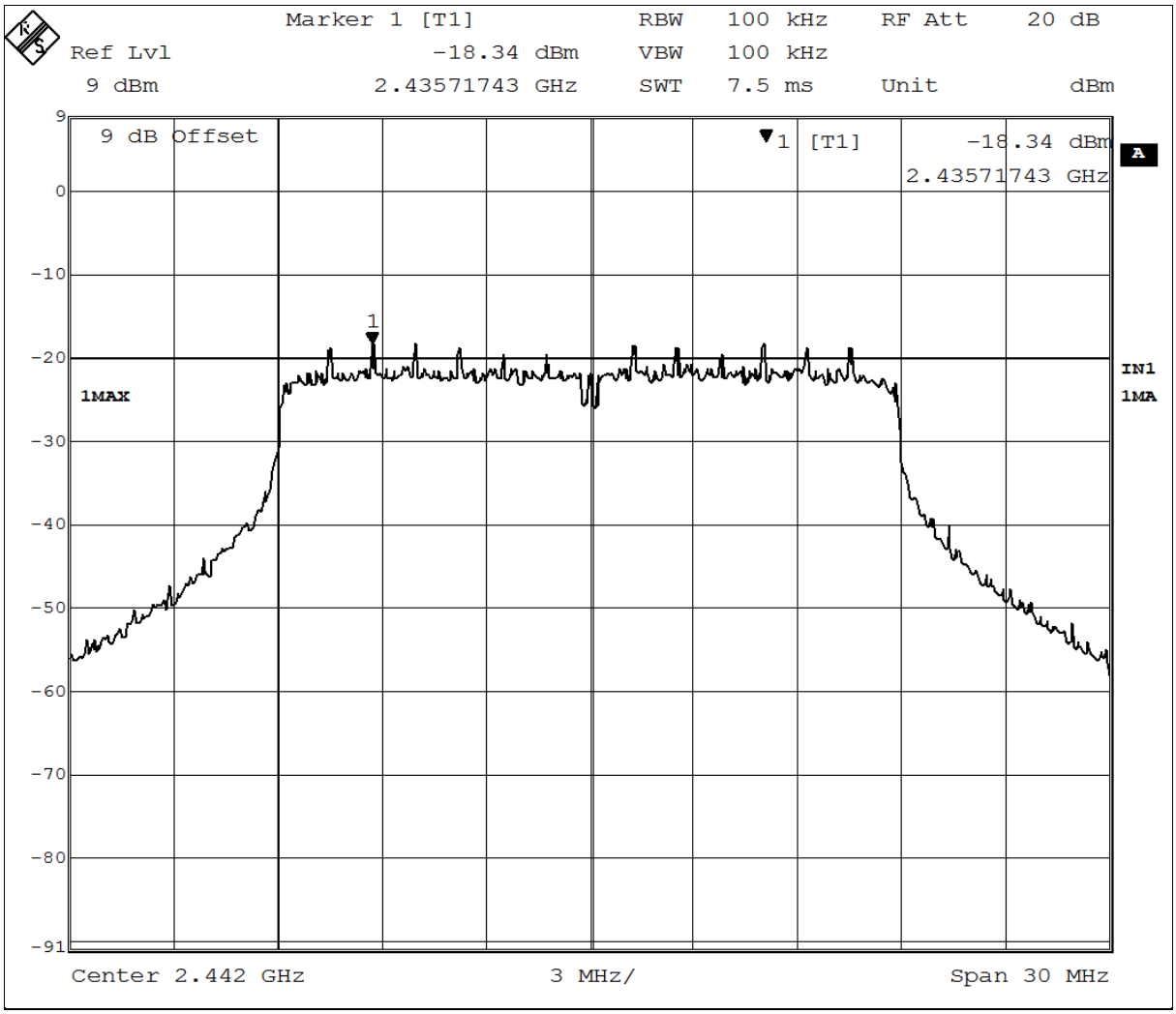
Tx mode (802.11n(HT20))
CH 7 (2442.0 MHz)



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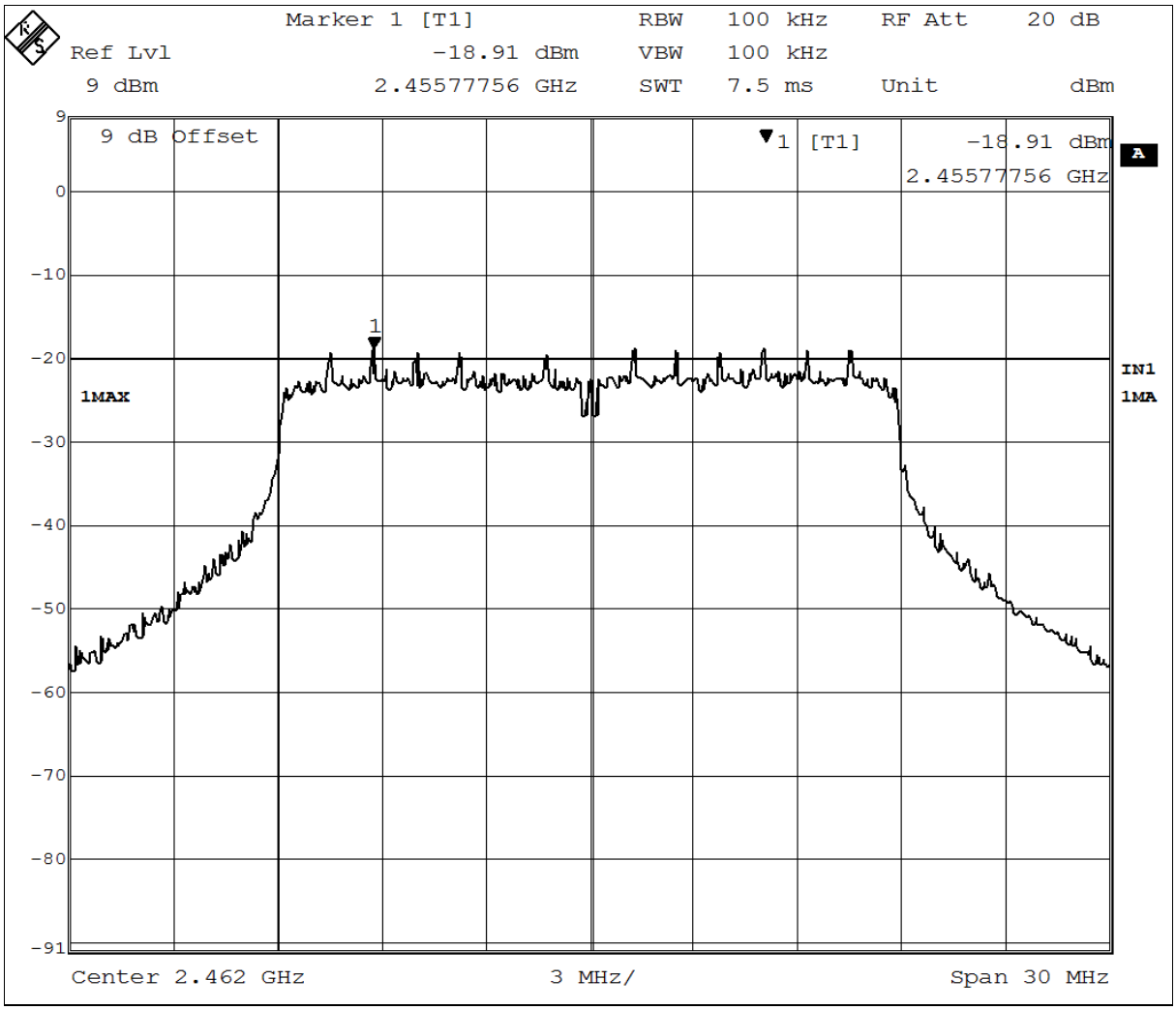
Tx mode (802.11n(HT20))
CH 11 (2462.0 MHz)



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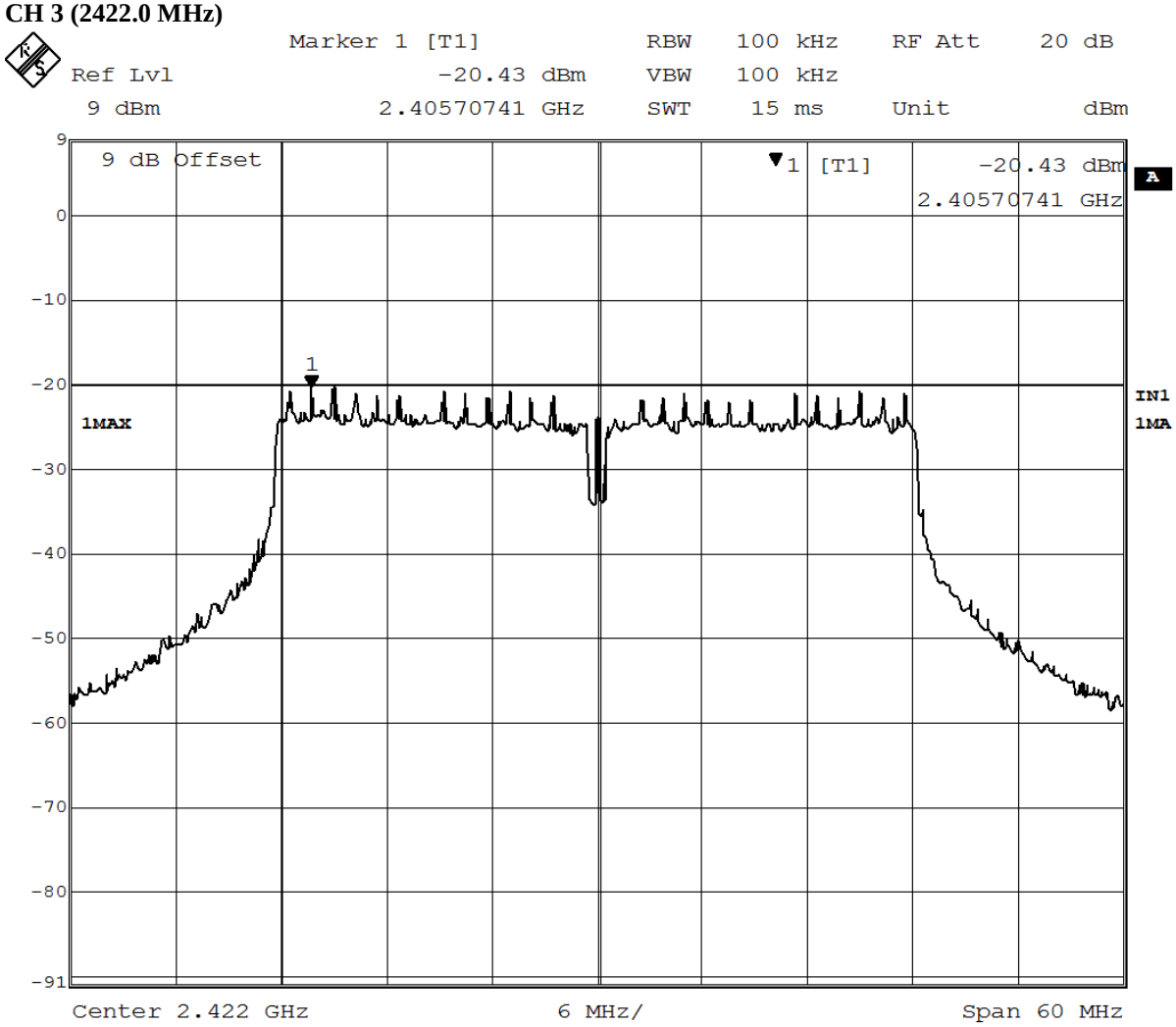
Tx mode (802.11n(HT40))
CH 3 (2422.0 MHz)



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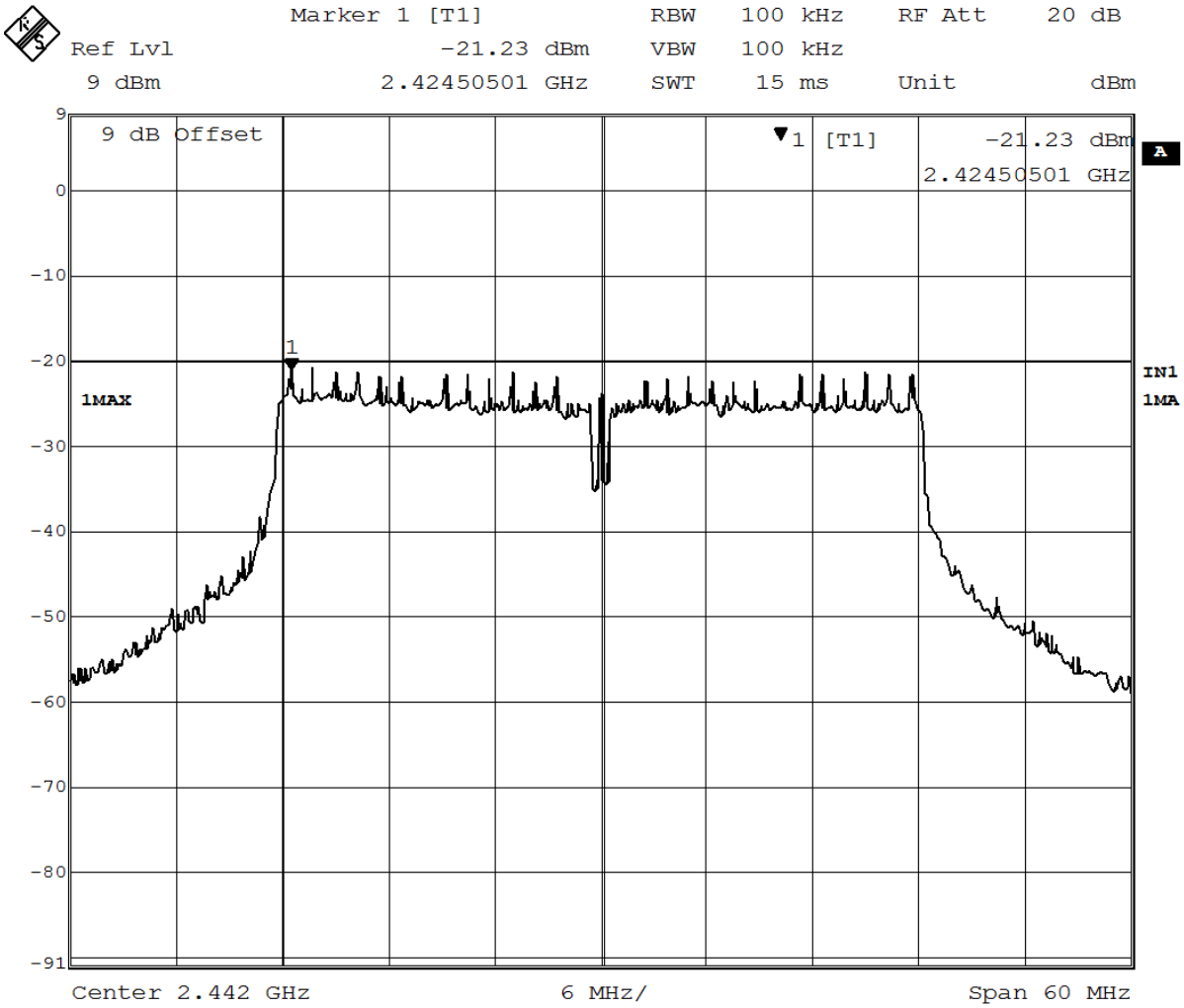
Tx mode (802.11n(HT40))
CH 7 (2442.0 MHz)



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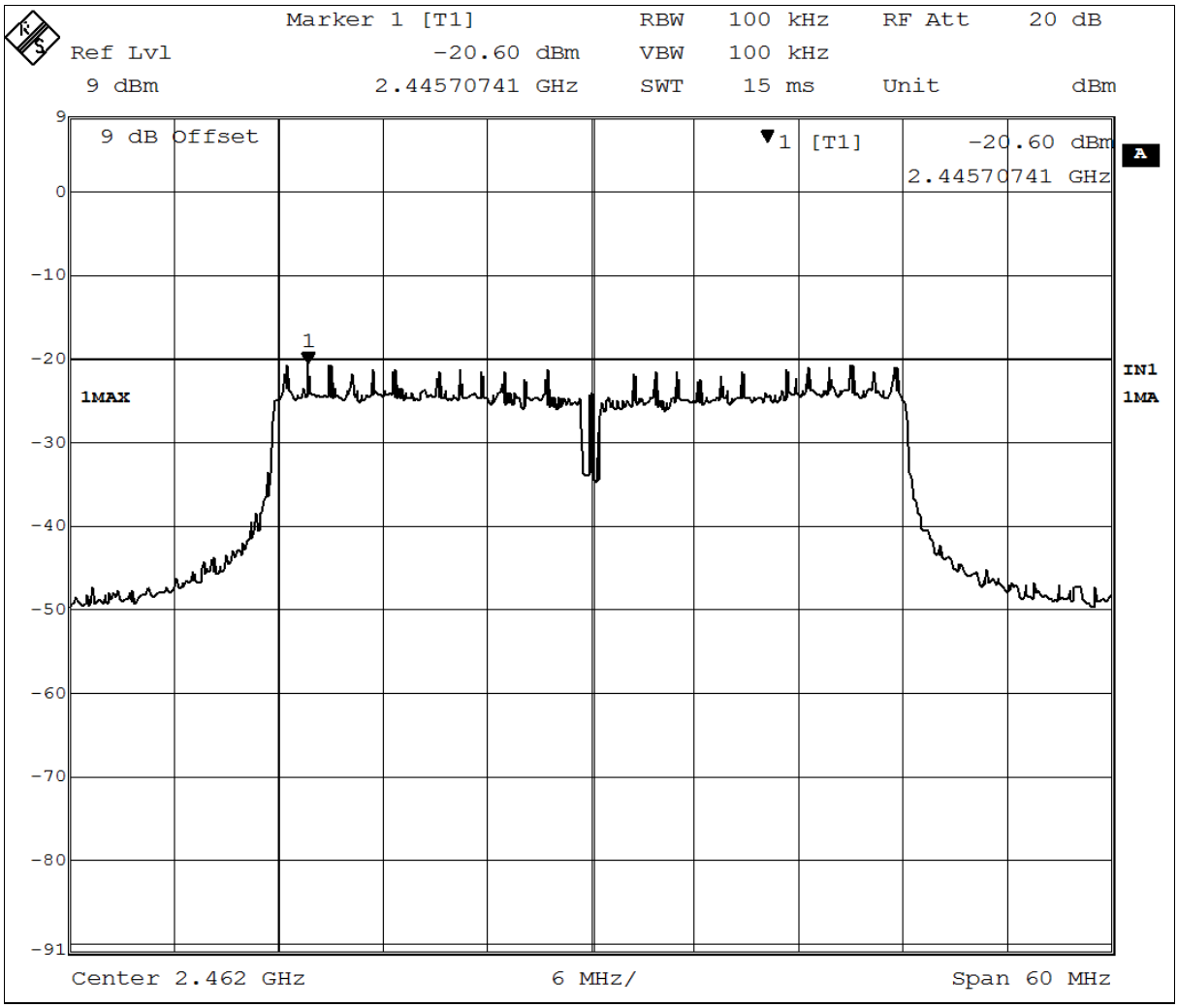
Tx mode (802.11n(HT40))
CH 11 (2462.0 MHz)



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3.1.5 6dB Spectrum Bandwidth Measurement

Test Requirement:	FCC 47CFR 15.247(a)(2)
Test Method:	ANSI C63.10:2013
Test Date:	2018-07-09
Mode of Operation:	Tx mode (802.11 b/g/n)
Ambient Temperature:	20°C
Relative Humidity:	52%
Atmospheric pressure	102kPa
Test voltage:	25.6Vd.c

Test Method:

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

Test Setup:

As Test Setup of clause 3.1.1 in this test report.

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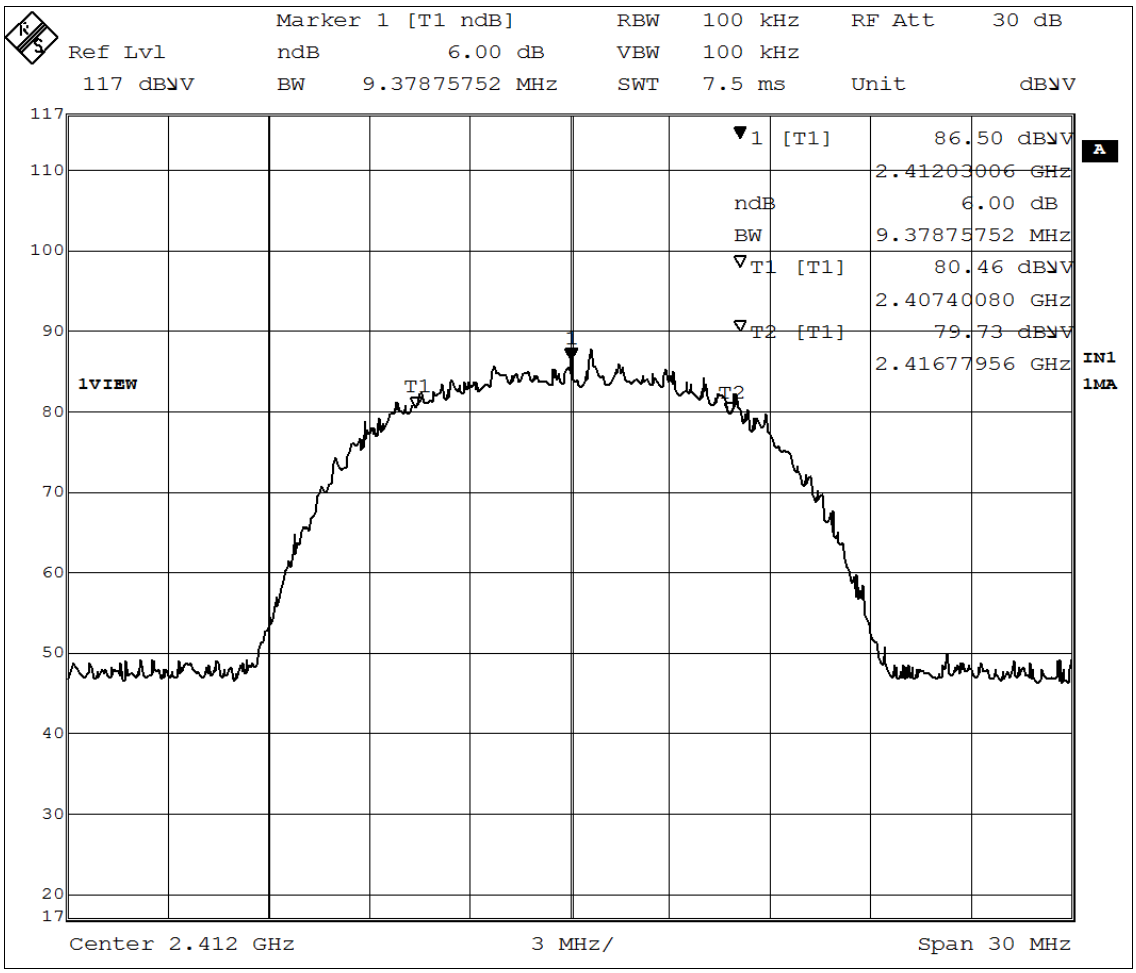
Limits for 6dB Spectrum Bandwidth Measurement:

Center Frequency [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2412.0	9.38	> 500

6dB Bandwidth of Fundamental Emission on 802.11b (2412MHz)



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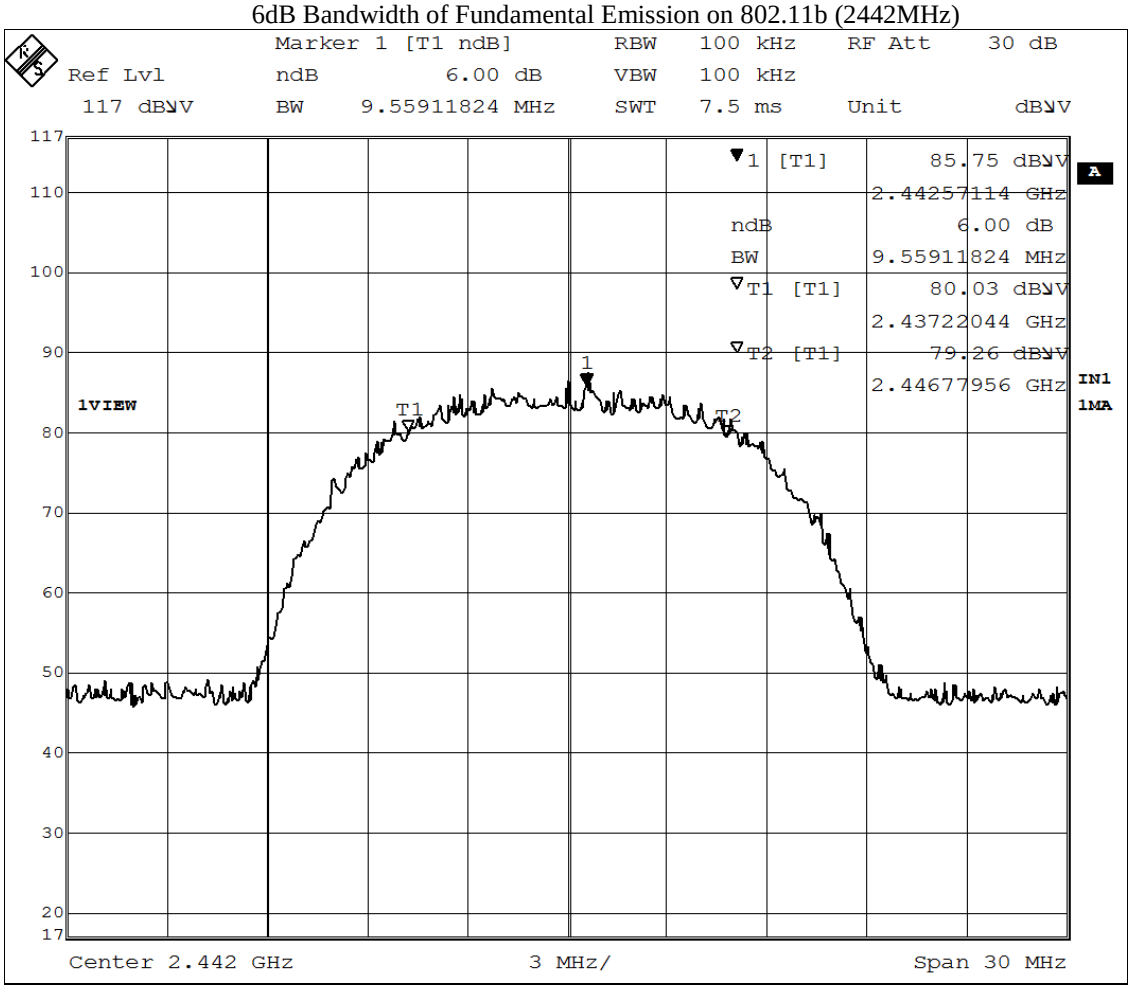
Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2442.0	9.56	> 500

6dB Bandwidth of Fundamental Emission on 802.11b (2442MHz)



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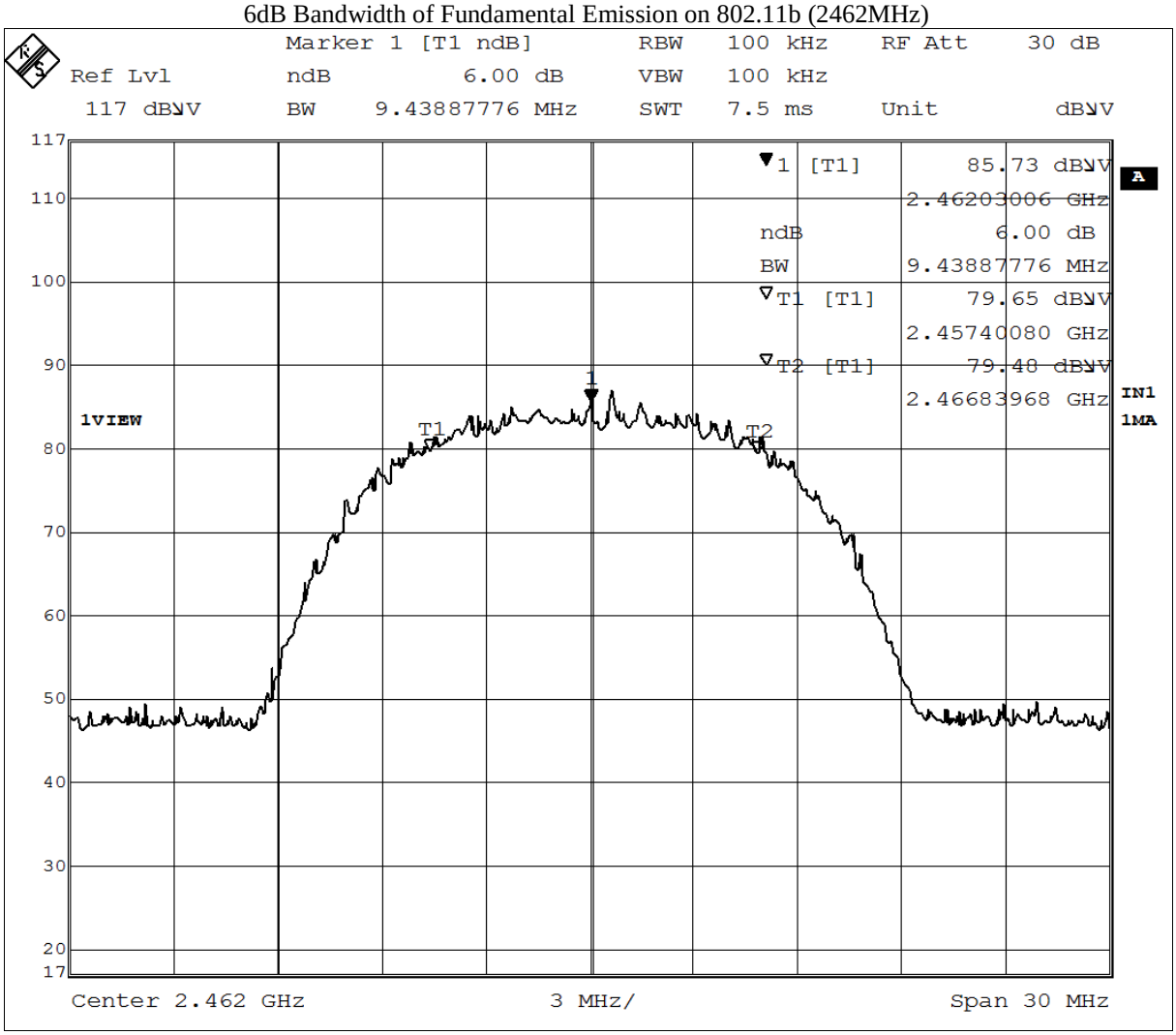
Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2462.0	9.43	> 500

6dB Bandwidth of Fundamental Emission on 802.11b (2462MHz)



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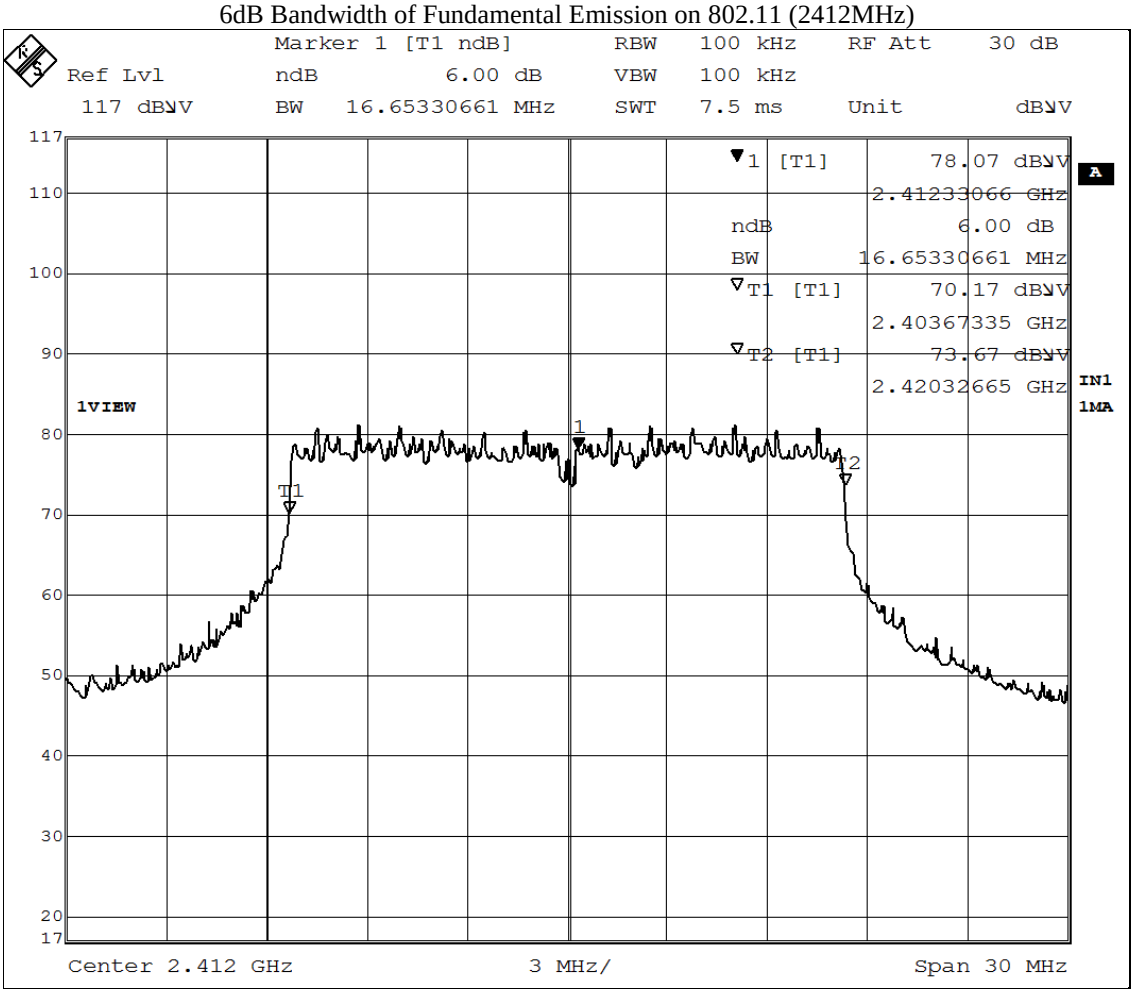
Limits for 6dB Spectrum Bandwidth Measurement:

Center Frequency [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2412.0	16.65	> 500

6dB Bandwidth of Fundamental Emission on 802.11 (2412MHz)



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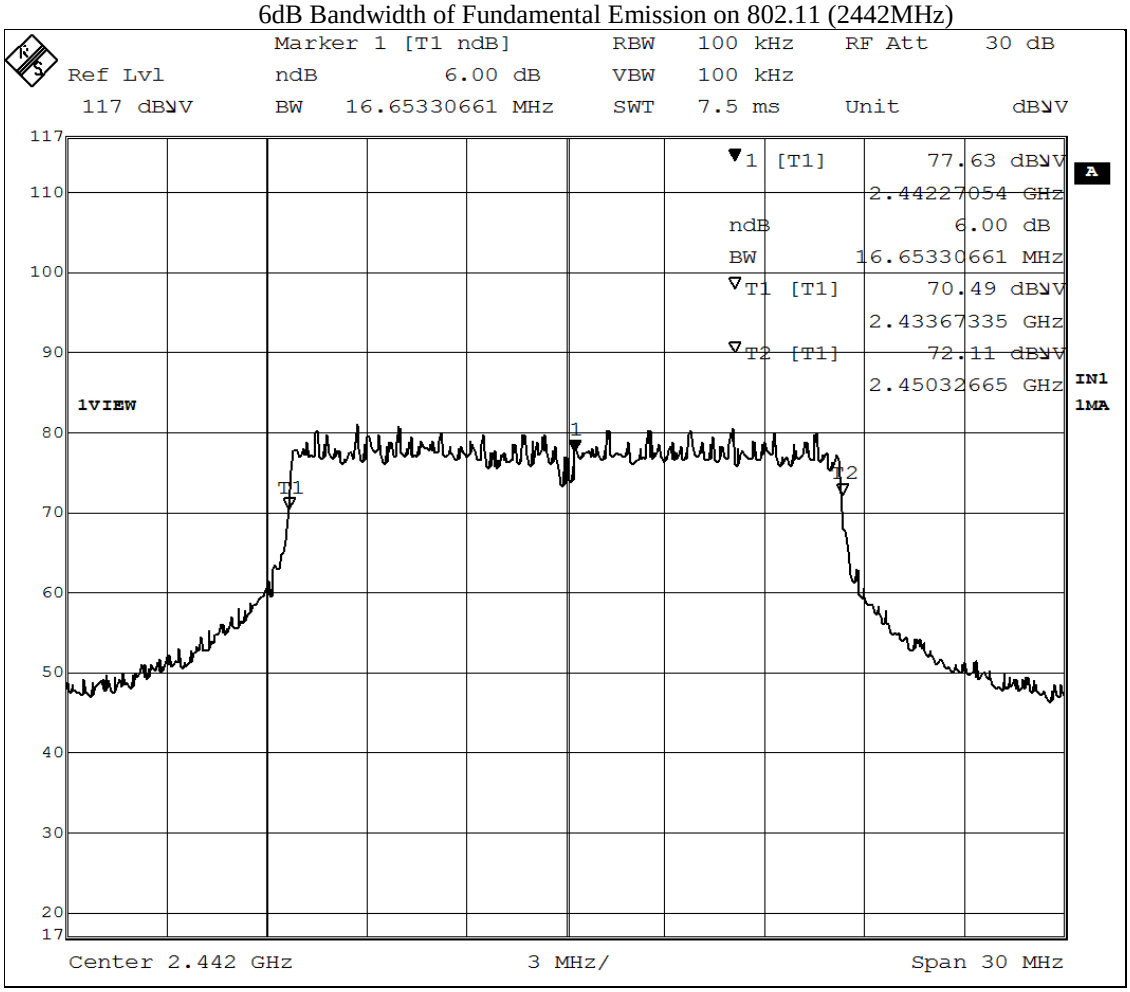
Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2442.0	16.65	> 500

6dB Bandwidth of Fundamental Emission on 802.11 (2442MHz)



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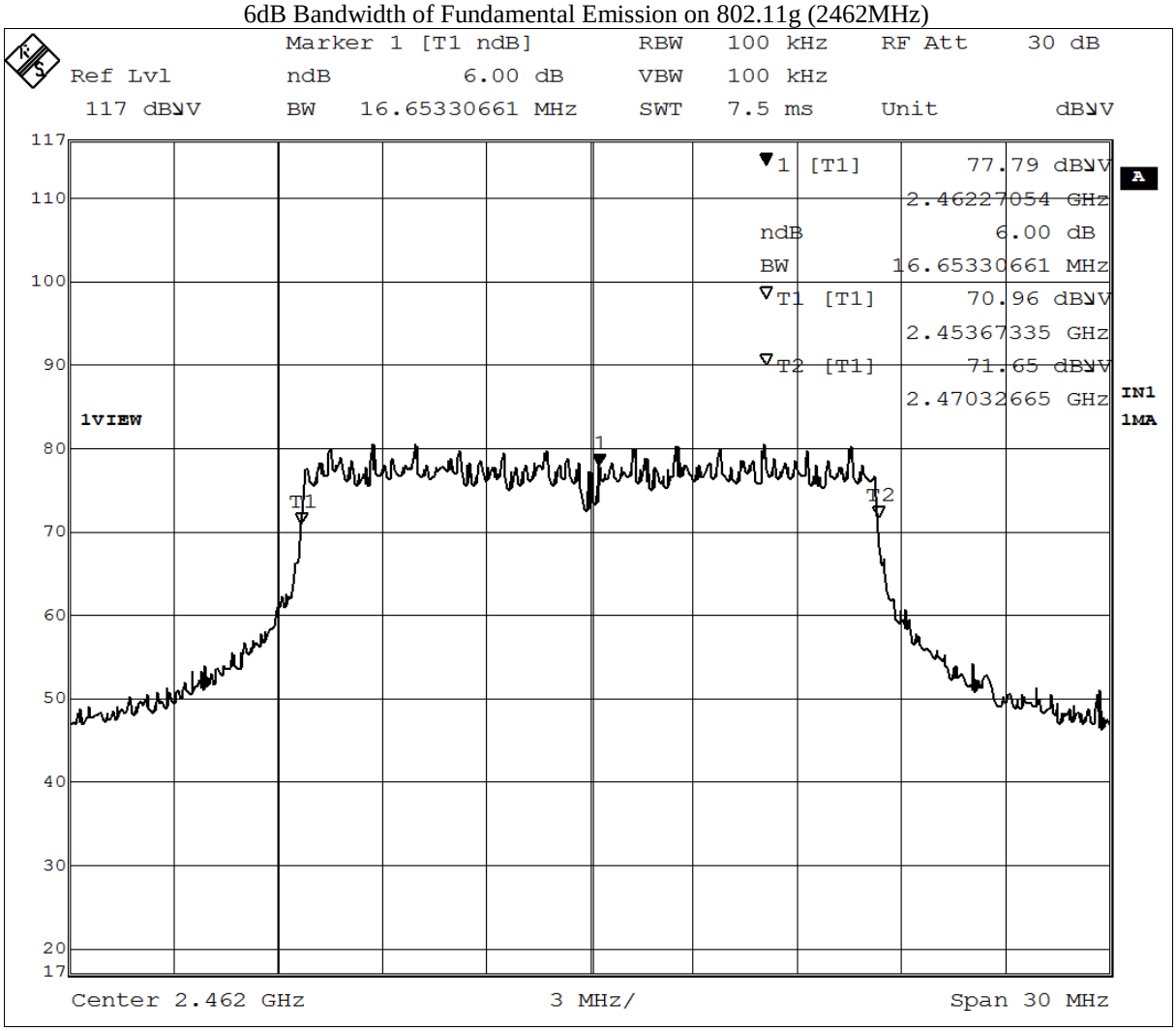
Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2462.0	16.65	> 500

6dB Bandwidth of Fundamental Emission on 802.11g (2462MHz)



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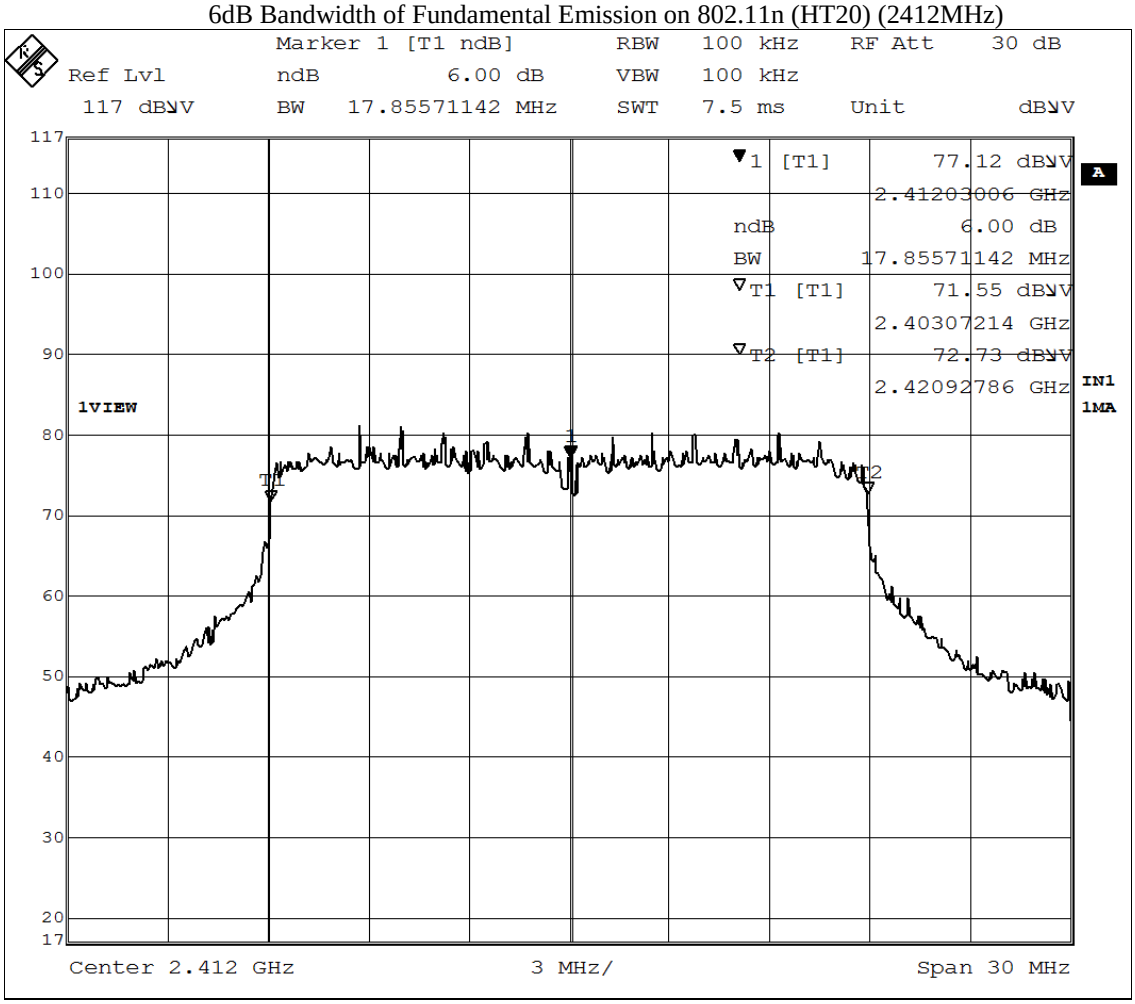
Limits for 6dB Spectrum Bandwidth Measurement:

Center Frequency [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2412.0	17.86	> 500

6dB Bandwidth of Fundamental Emission on 802.11n (HT20) (2412MHz)



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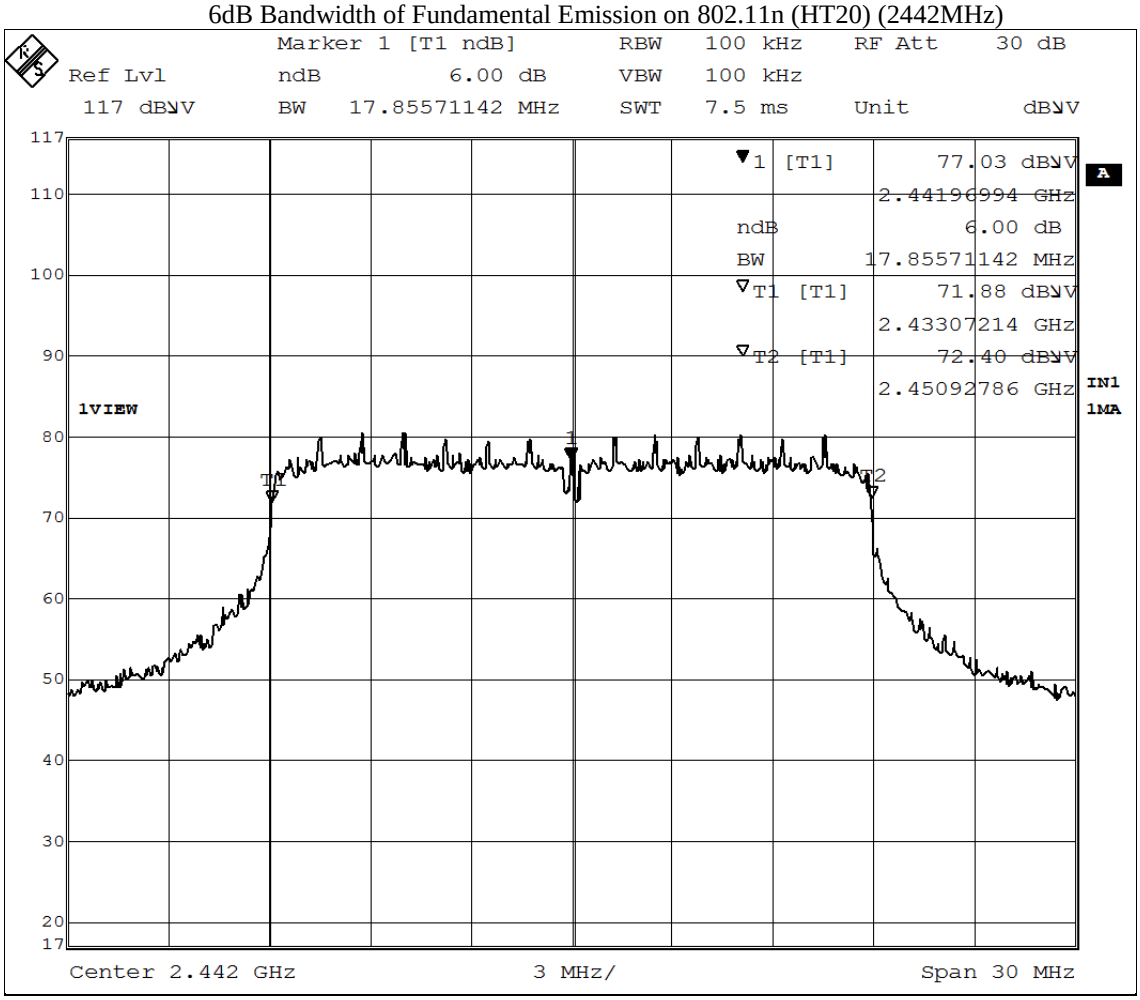
Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2442.0	17.86	> 500

6dB Bandwidth of Fundamental Emission on 802.11n (HT20) (2442MHz)



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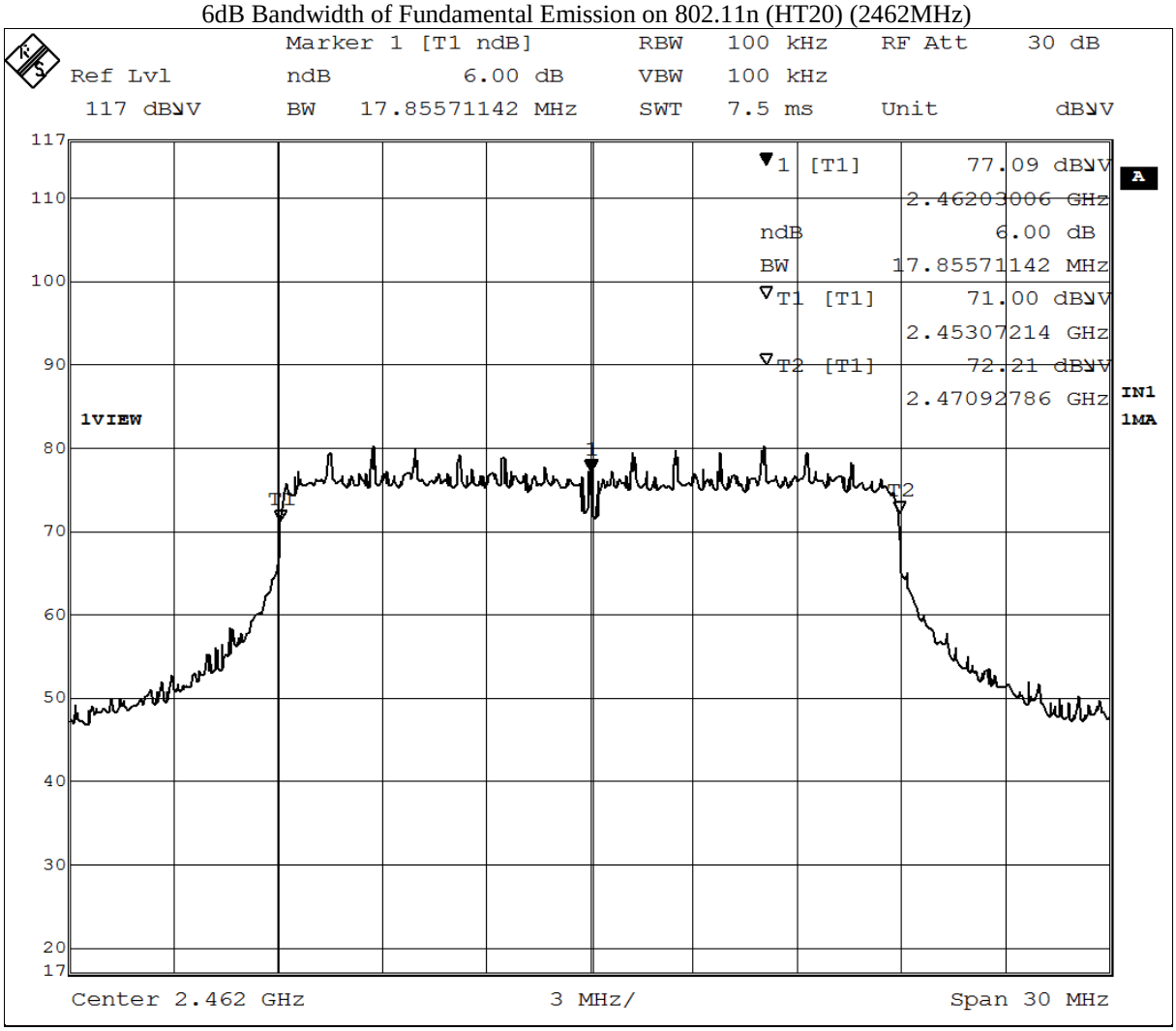
Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2462.0	17.86	> 500

6dB Bandwidth of Fundamental Emission on 802.11n (HT20) (2462MHz)



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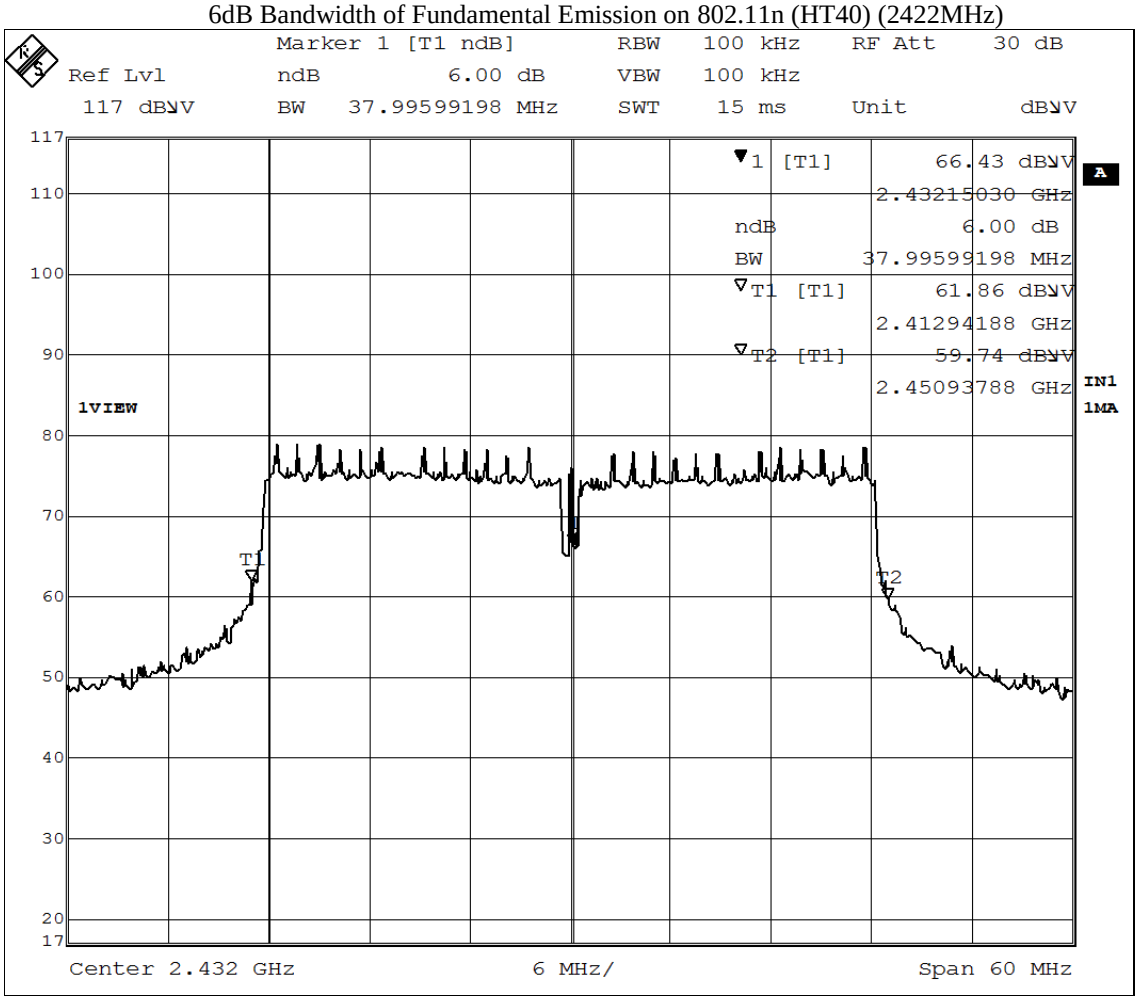
Limits for 6dB Spectrum Bandwidth Measurement:

Center Frequency [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2412.0	38.0	> 500

6dB Bandwidth of Fundamental Emission on 802.11n (HT40) (2422MHz)



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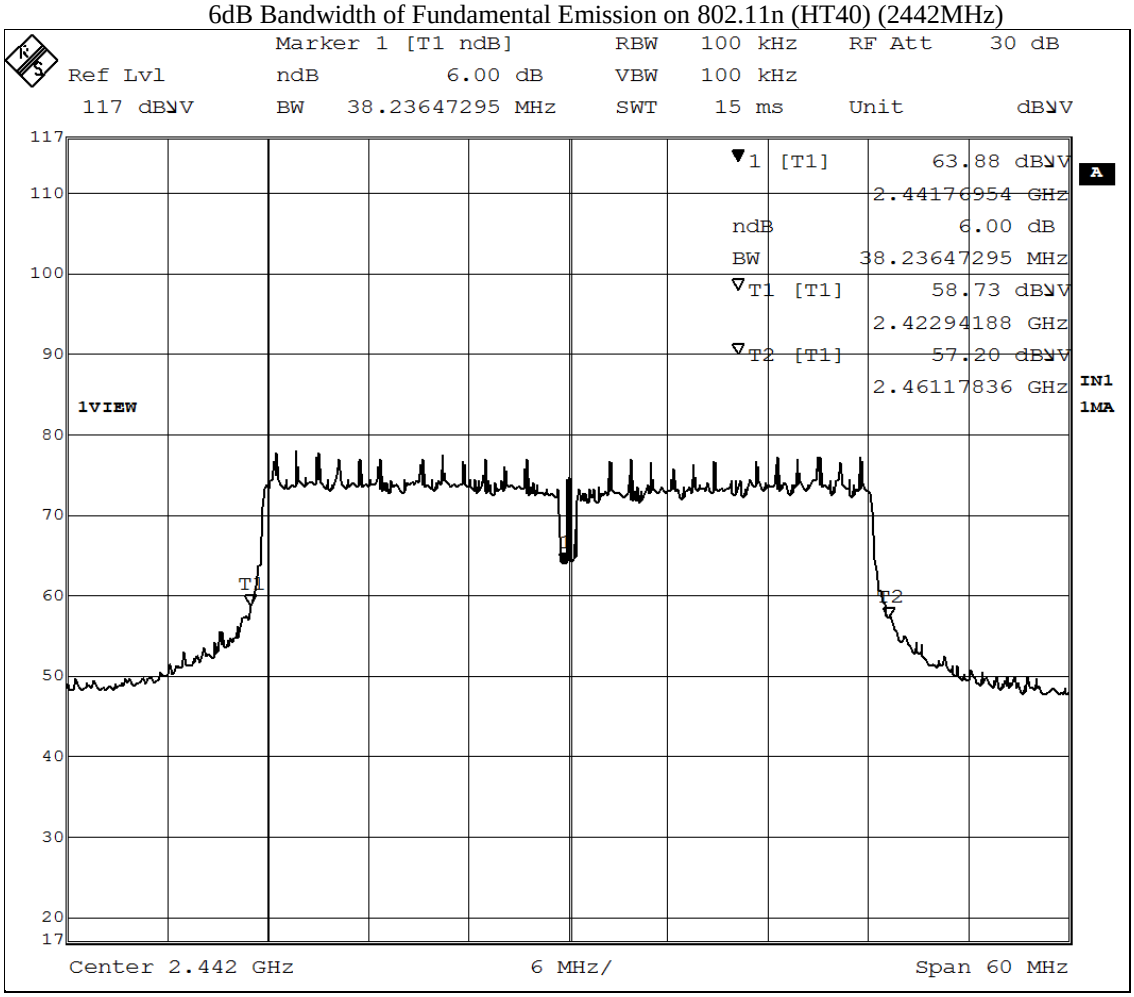
Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2442.0	38.23	> 500

6dB Bandwidth of Fundamental Emission on 802.11n (HT40) (2442MHz)



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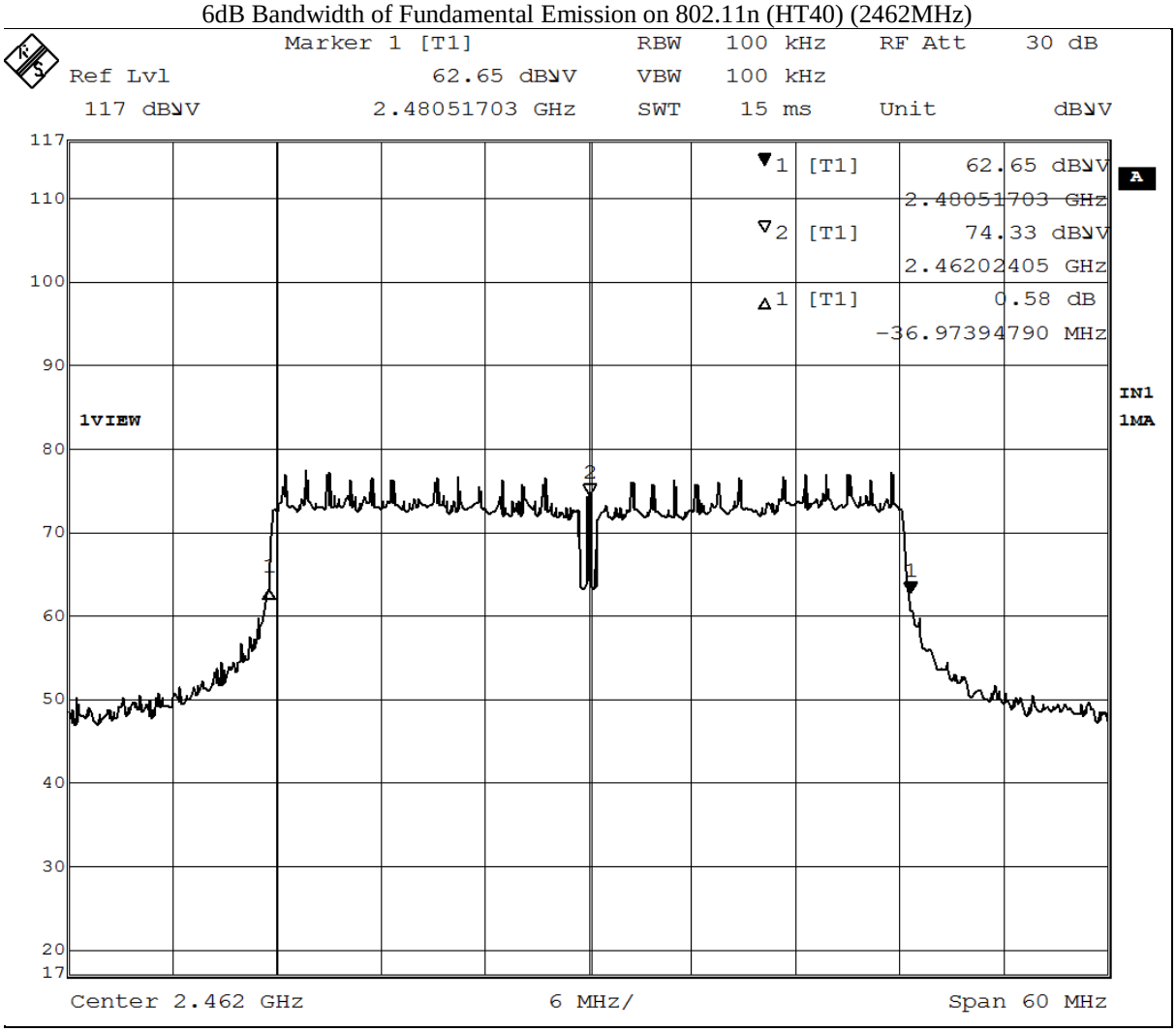
Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [MHz]	FCC Limits [kHz]
2462.0	36.97	> 500

6dB Bandwidth of Fundamental Emission on 802.11n (HT40) (2462MHz)



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3.1.6 RF Exposure

RF Exposure

Test Requirement:	FCC 47CFR 15.247(i)
Test Date:	2018-07-19
Mode of Operation:	Tx mode

Requirements:

In 15.247(i), an equipment shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the limits in §§ 1.1310 and 2.1093 of this chapter.
Applications to the Commission for construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities must contain a statement confirming compliance with the limits unless the facility, operation, or transmitter is categorically excluded, as discussed below. Technical information showing the basis for this statement must be submitted to the Commission upon request.

According to KDB447498 D01 General RF Exposure Guidance v06, unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Exclusion Threshold condition.

Test Results:

RF Exposure Evaluation

The Maximum tune-up power = 9.76dBm (9.46mW)

SAR Test Exclusion Thresholds= 38mW

The test separation distances is ≤20 mm
The power tune up tolerance is 8.06±1.70dBm
Max. duty factor is 100%

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Appendix A

List of Measurement Equipment

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNTABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2018/01/24	2019/01/24
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM354	BICONILOG ANTENNA	ETS-LINDGREN	3143B	00142073	2018/03/29	2020/03/29
EM229	EMI TEST RECEIVER	R&S	ESIB40	100248	2018/06/12	2019/06/12
EM293	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	N9020A	MY50510152	2018/01/21	2019/01/21
EM276	BROADBAND HORN ANTENNA	A-INFOMW	JXTXLB-10180-SF	J2031090903007	2018/04/27	2020/04/27
EM318	USB WIDEBAND POWER SENSOR	AGILENT	U2022XA	MY53470001	2017/03/23	2019/03/23
EM353	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2018/04/16	2020/04/16
EM318	USB WIDEBAND POWER SENSOR	AGILENT	U2022XA	MY53470001	2017/03/23	2019/03/23
EM263	NOTCH FILTER	MICRO-TRONICS	BRM50702	070	2017/11/23	2019/11/23

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM119	LISN	R & S	ESH3-Z5	0831.5518.52	2017/11/06	2018/11/06
EM181	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	100072	2018/06/12	2019/06/12
EM179	IMPULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	357-8810.52/54	2018/01/24	2019/01/24
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740-057-99A	2017/02/06	2022/02/06
N/A	MEASUREMENT AND EVALUATION SOFTWARE	ROHDE & SCHWARZ	ESIB-K1	V1.20	N/A	N/A

Remarks:-

CM Corrective Maintenance
N/A Not Applicable
TBD To Be Determined

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Appendix B

Photographs of EUT

View of the product

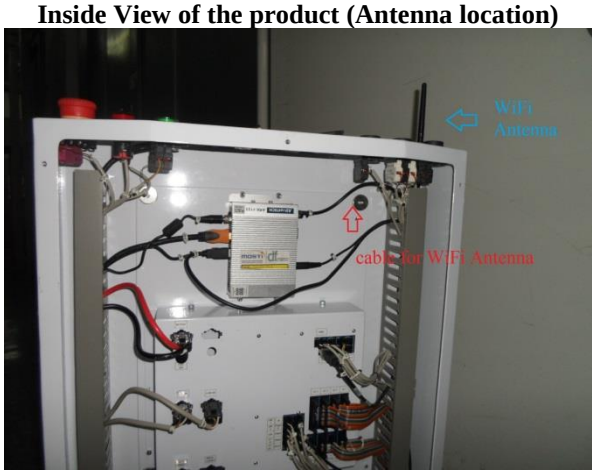
View of the product

View of the product

View of the product

Inside View of the product

Inside View of the product (Antenna location)



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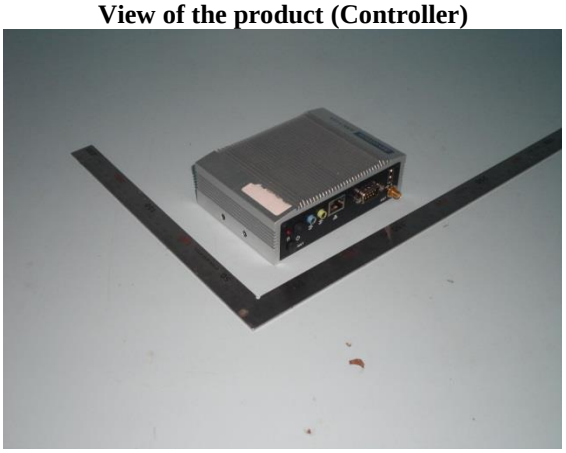
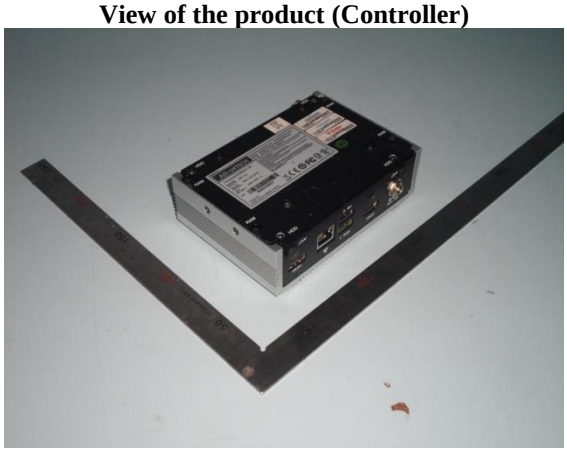
Photographs of EUT

Antenna Port

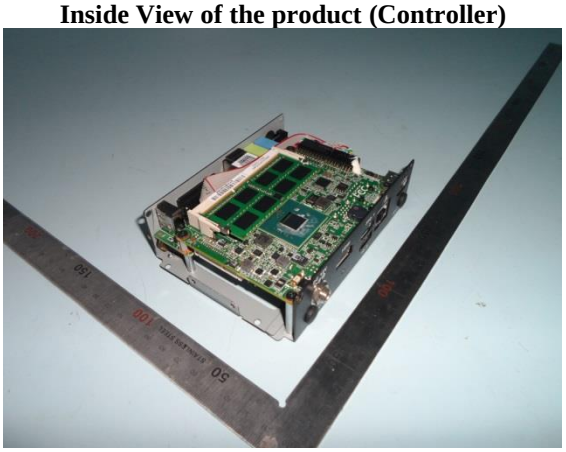
View of the product (Controller)



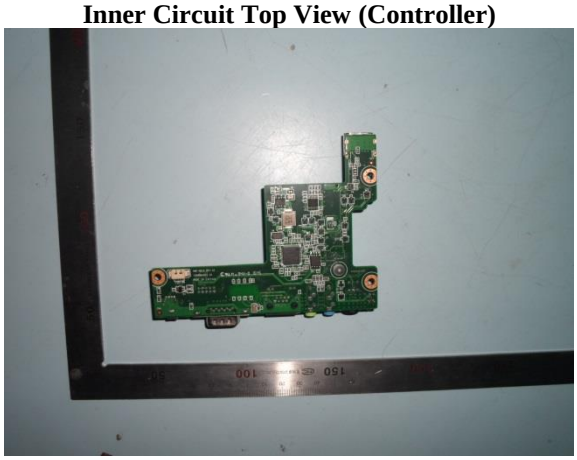
View of the product (Controller)



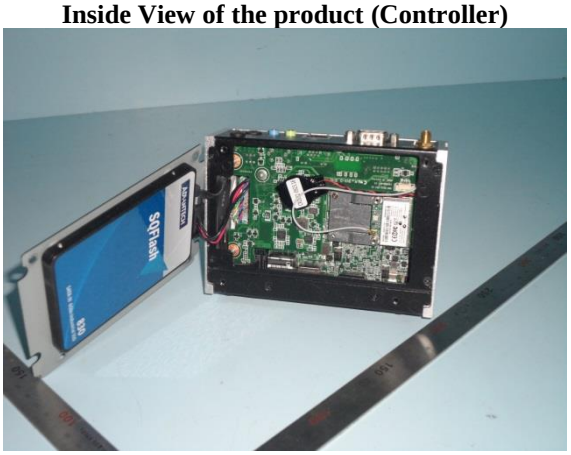
Inside View of the product (Controller)



Inner Circuit Top View (Controller)



Inside View of the product (Controller)



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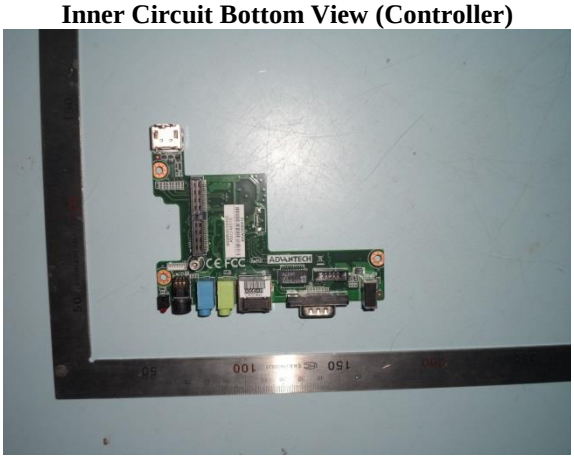
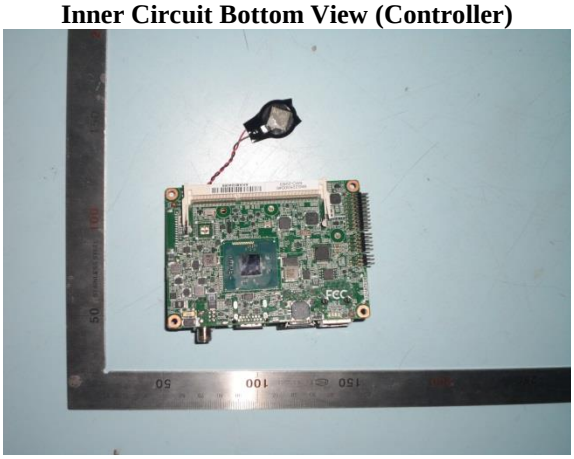
Photographs of EUT

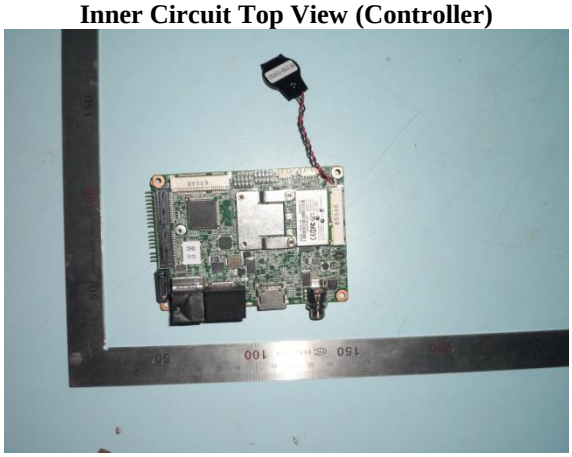
Inner Circuit Bottom View (Controller)



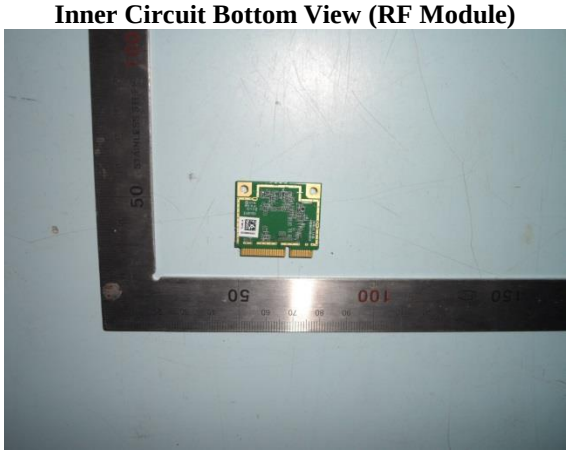
Inner Circuit Bottom View (Controller)



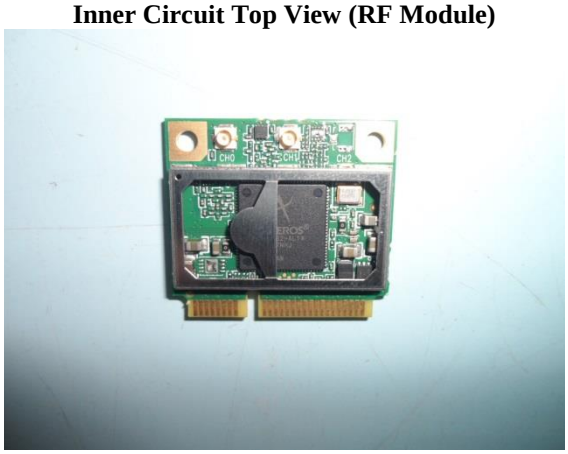
Inner Circuit Top View (Controller)



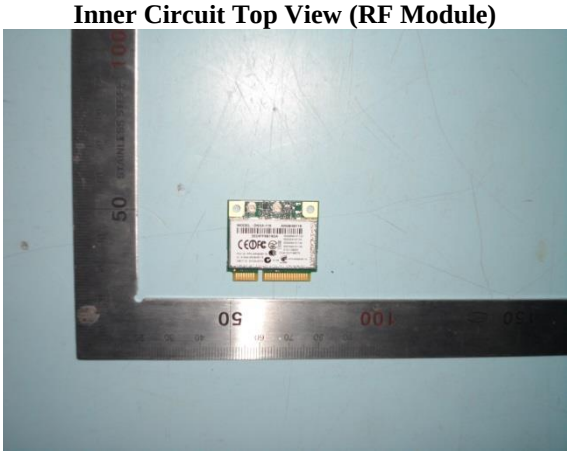
Inner Circuit Bottom View (RF Module)



Inner Circuit Top View (RF Module)



Inner Circuit Top View (RF Module)



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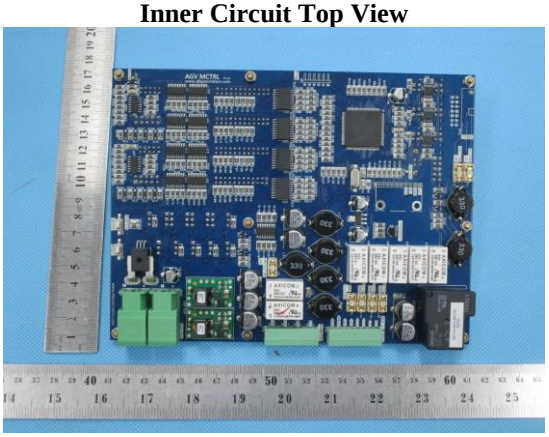
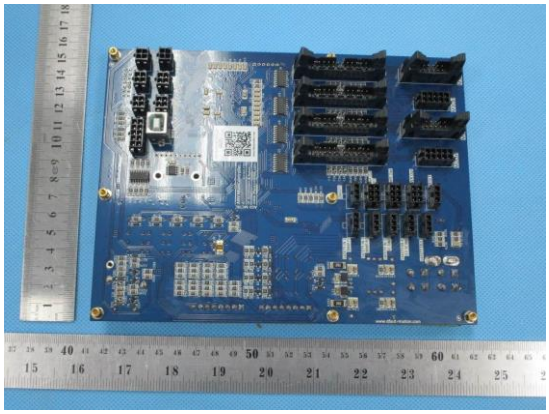
Inside View of the product

Inner Circuit Top View



Inner Circuit Bottom View



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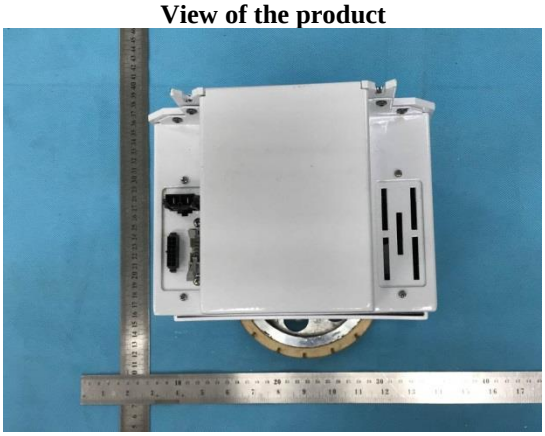
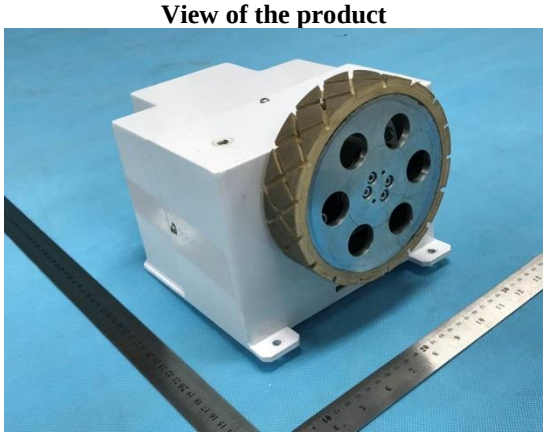
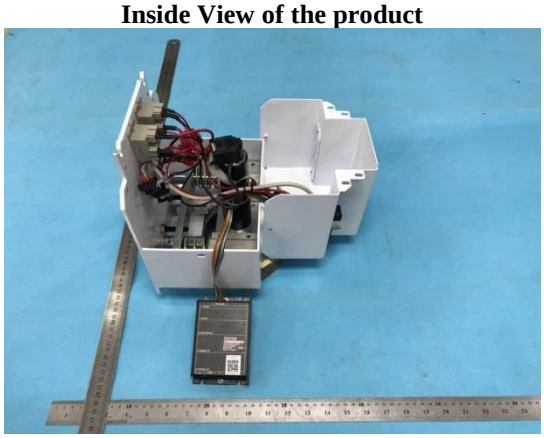
View of the product



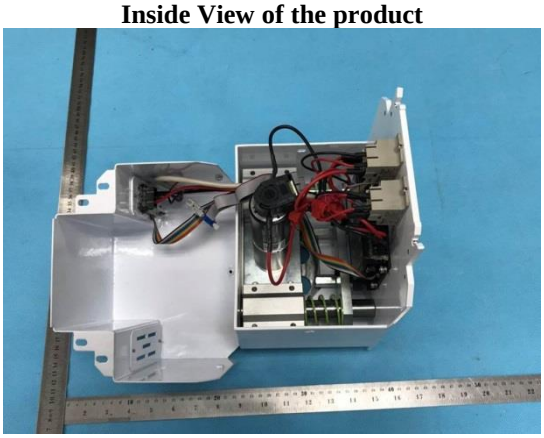
View of the product



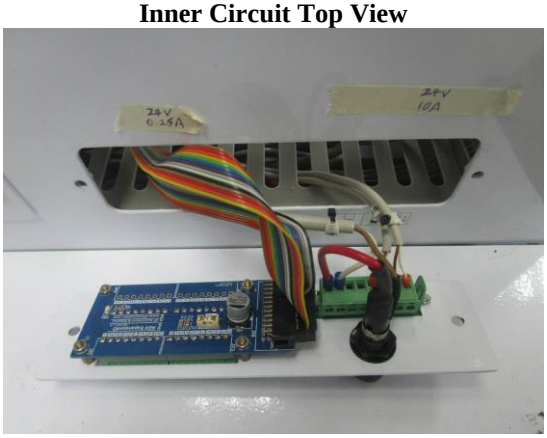
Inside View of the product



Inside View of the product



Inner Circuit Top View



Inner Circuit Bottom View

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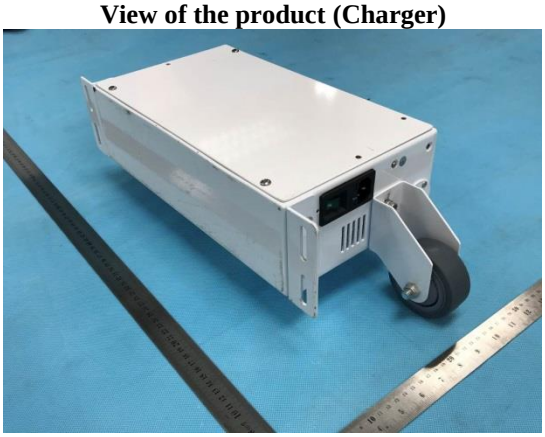
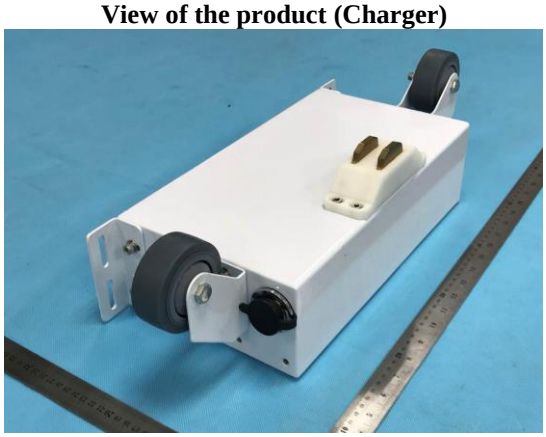
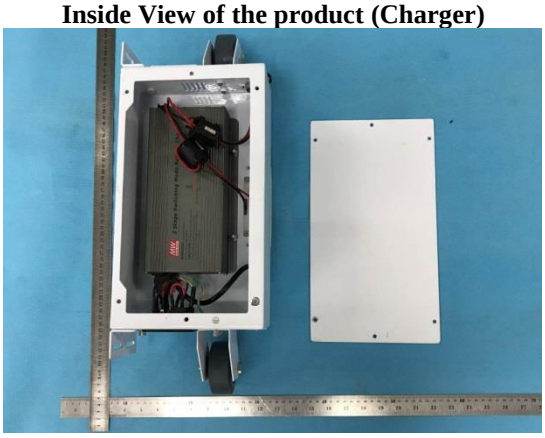
View of the product (Charger)



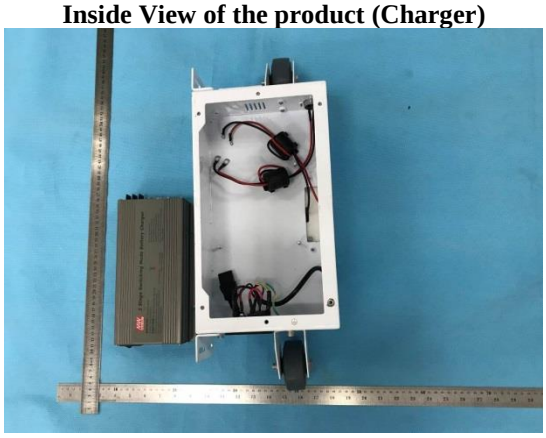
View of the product (Charger)



Inside View of the product (Charger)



Inside View of the product (Charger)



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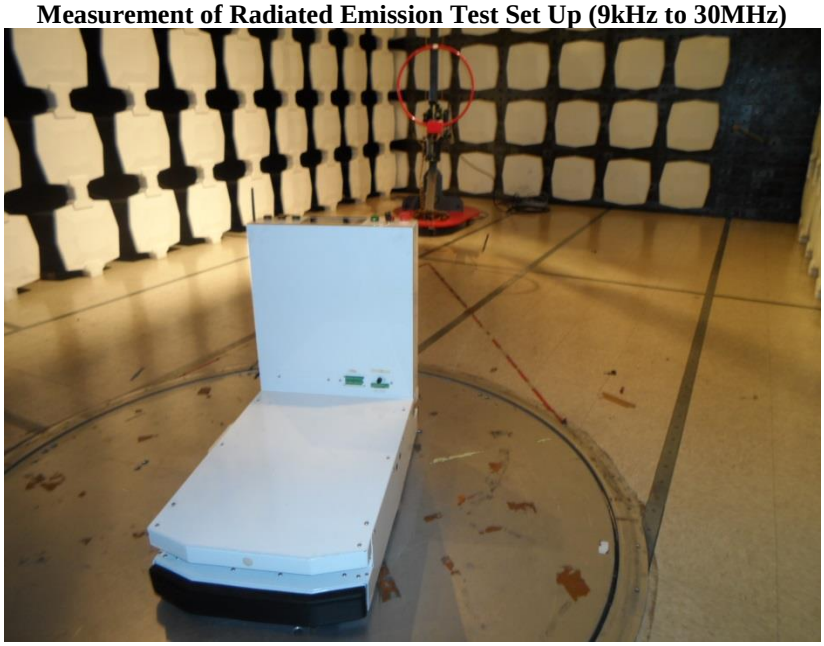
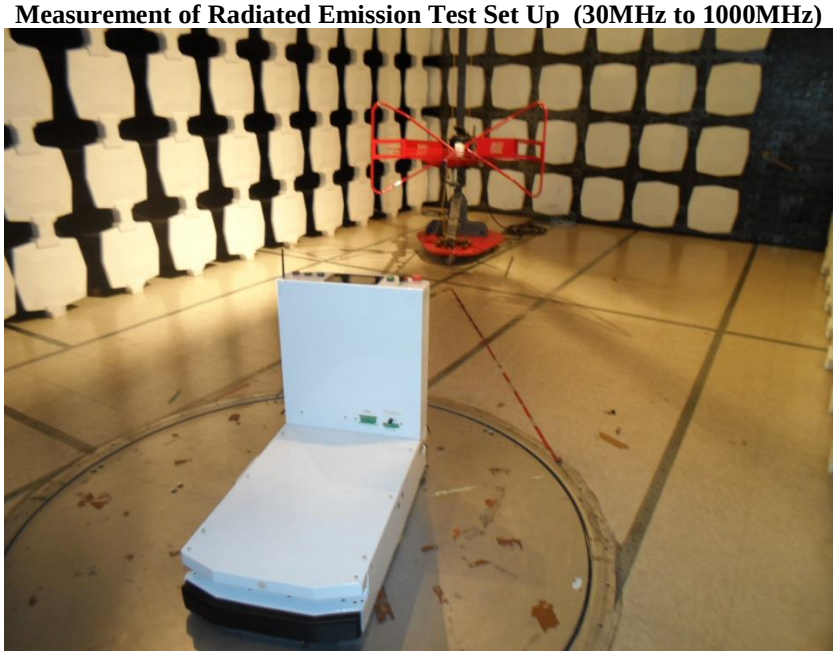
Measurement of Radiated Emission Test Set Up (9kHz to 30MHz)



Measurement of Radiated Emission Test Set Up (30MHz to 1000MHz)



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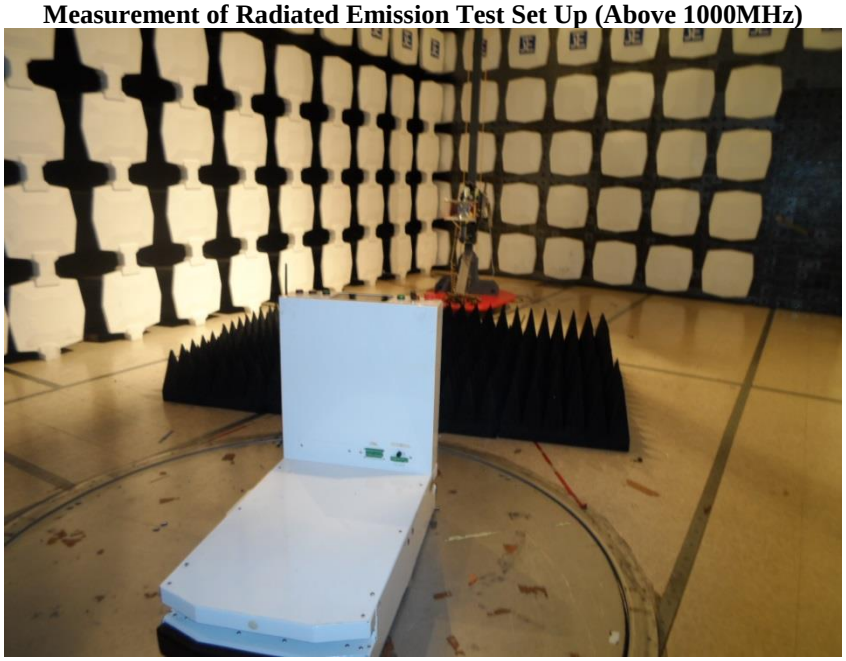
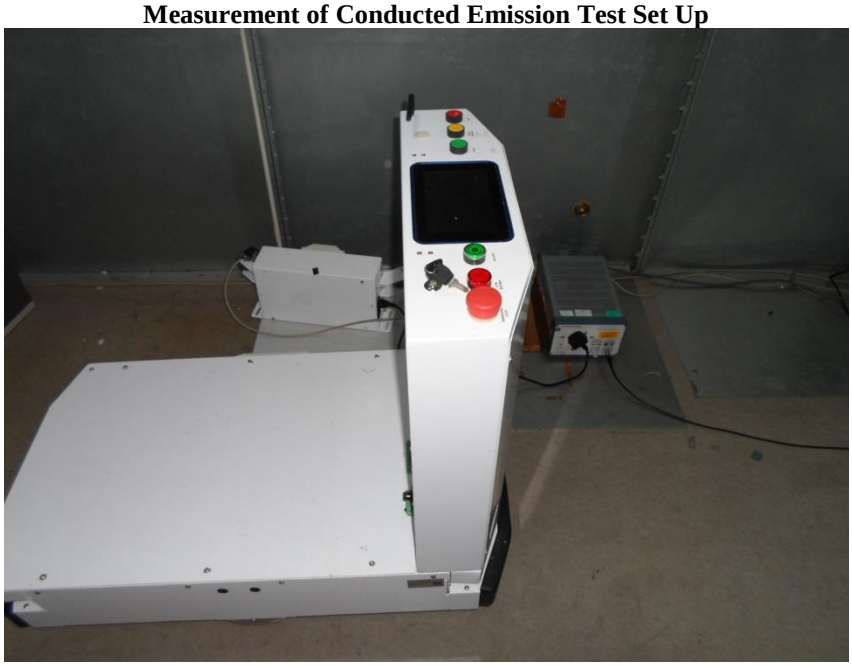
Measurement of Radiated Emission Test Set Up (Above 1000MHz)



Measurement of Conducted Emission Test Set Up



******* End of Test Report *******

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6. When a statement of conformity to a specification or standard is provided, the ILAC-G8 Guidance document (and/or IEC Guide 115 in the electrotechnical sector) will be adopted as a decision rule for the determination of conformity unless it is inherent in the requested specification or standard, or otherwise specified in the Report.

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10. Clients wishing to use the Report in court proceedings or arbitration shall inform the Company to that effect prior to submitting the sample for testing.

11. Subject to the variable length of retention time for test data and report stored hereinto as to otherwise specifically required by individual accreditation authorities, the Company will only keep the supporting test data and information of this test report for a period of three years. The data and information will be disposed of after the aforementioned retention period has elapsed. Under no circumstances shall we provide any data and information which has been disposed of after the retention period. Under no circumstances shall we be liable for damages of any kind, including (but not limited to) compensatory damages, lost profits, lost data, or any form of special, incidental, indirect, consequential or punitive damages of any kind, whether based on breach of contract of warranty, tort (including negligence), product liability or otherwise, even if we are informed in advance of the possibility of such damages.

12. Issuance records of the Report are available on the internet at www.stc.group. Further enquiry of validity or verification of the Reports should be addressed to the Company.