

TEST REPORT

of

FCC Part 15 Subpart C §15.247
IC RSS-247 Issue 2 and RSS-Gen Issue 5

FCC ID: BEJTA4HEBN2
IC Certification: 2703H-TA4HEBN2

Equipment Under Test : Car Telematics Device
Model Name : TA4HEB-N2
Variant Model Name(s) : -
FCC Applicant : LG Electronics USA
IC Applicant : LG ELECTRONICS INC.
Manufacturer : LG Electronics Inc.
Date of Receipt : 2020.11.16
Date of Test(s) : 2021.01.13 ~ 2021.02.24
Date of Issue : 2021.02.25

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

- 1) The results of this test report are effective only to the items tested.
- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
- 3) This test report cannot be reproduced, except in full, without prior written permission of the Company.

Tested by:



Nancy Park

Technical
Manager:



Jinhyoung Cho

SGS Korea Co., Ltd. Gunpo Laboratory



INDEX

Table of Contents

1. General Information	3
2. Transmitter Radiated Spurious Emissions	10

1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

Phone No. : +82 31 688 0901

Fax No. : +82 31 688 0921

1.2. Details of Applicant

FCC Applicant : LG Electronics USA

FCC Address : 111 Sylvan Avenue, North Building, Englewood Cliffs, New Jersey, United States, 07632

IC Applicant : LG ELECTRONICS INC.

IC Address : 222, LG-ro, Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do, Korea (Republic of), 451-713

Contact Person : Kim, Dae-woong

Phone No. : +1 201 266 2215

1.3. Details of Manufacturer

Company : LG Electronics Inc.

Address : 10, Magokjungang 10-ro, Gangseo-gu, Seoul, Korea, 07796

1.4. Description of EUT

Kind of Product	Car Telematics Device
Model Name	TA4HEB-N2
Serial Number	001VITA000080
Power Supply	DC 12 V
Frequency Range	2 412 MHz ~ 2 462 MHz (11b/g/n_HT20) 2 422 MHz ~ 2 452 MHz (11n_HT40)
Modulation Technique	DSSS, OFDM
Number of Channels	11 channels (11b/g/n_HT20) 7 channels (11n_HT40)
Antenna Type	External antenna
Antenna Gain	2.55 dBi
H/W Version	Rev.D
S/W Version	V9.1.02

1.5. Introduction of Test Data Reuse

This test report referenced from the test report DTS of FCC ID: BEJTM05GTJN2 and IC Certification: 2703H-TM05GTJN2.

The applicant takes full responsibility that the test data as referenced in this report represent compliance for this FCC ID.

1.6. Reference Detail

Reference applicant that contains the reused reference data in the individual test reports:

Mode	Reference FCC ID / IC Certification	Application Type	Reference Test Report Number	Exhibit Type	Variant Test Report Number	Data Reuse
GSM, WCDMA	FCC: BEJTM05GTJN2 IC: 2703H-TM05GTJN2	Original Grant	F690501-RF-RTL001646 (GSM, WCDMA)	Test Report	F690501-RF-RTL001712	All
LTE			F690501-RF-RTL001647 F690501-RF-RTL001648 (LTE)			
DTS			F690501-RF-RTL001644 (WLAN 2.4G)		F690501-RF-RTL001713	
NII			F690501-RF-RTL001645 (WLAN 5G)		F690501-RF-RTL001714	

1.7. Difference

Model name	Description
TM05GTJN2	- Reference model - Single modular
TA4HEB-N2	- Host equipment - Same to reference model except below - With external case

1.8. Spot Check Data

Mode	Test Items	Frequency (MHz)	Limit	Original Model	Spot Check Model	Deviation (dB)
				TM05GTJN2	TA4HEB-N2	
				FCC ID: BEJTM05GTJN2 IC Certification: 2703H-TM05GTJN2	FCC ID: BEJ-TA4HEBN2 IC Certification: 2703H-TA4HEBN2	
11b	Conducted power	2 412	30 dB m	14.64 dB m	14.56 dB m	-0.08
11g	Conducted power	2 437	30 dB m	15.65 dB m	15.69 dB m	0.04
11n_HT20	Conducted power	2 437	30 dB m	14.75 dB m	14.73 dB m	-0.02
	Spurious	2 462	54 dB μ V/m	49.69 dB μ V/m	49.82 dB μ V/m	0.13
11n_HT40	Conducted power	2 437	30 dB m	14.97 dB m	14.92 dB m	-0.05

1.9. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMR40	100272	Jun. 18, 2020	Annual	Jun. 18, 2021
Signal Generator	R&S	SMBV100A	255834	Jun. 03, 2020	Annual	Jun. 03, 2021
Spectrum Analyzer	R&S	FSV30	103101	Jun. 01, 2020	Annual	Jun. 01, 2021
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 04, 2020	Annual	Sep. 04, 2021
Spectrum Analyzer	Agilent	N9030A	US51350132	Nov. 12, 2020	Annual	Nov. 12, 2021
Attenuator	AEROFLEX / INMET	40AH2W-10	40G-3	Jun. 16, 2020	Annual	Jun. 16, 2021
High Pass Filter	Wainwright Instrument GmbH	WHK3.0/18G-10SS	344	May 18, 2020	Annual	May 18, 2021
High Pass Filter	Wainwright Instrument GmbH	WHNX7.5/26.5G-6SS	15	Jun. 05, 2020	Annual	Jun. 05, 2021
Low Pass Filter	Mini-Circuits	NLP-1200+	V 9500401023-2	Jun. 01, 2020	Annual	Jun. 01, 2021
Power Sensor	R&S	NRP-Z81	102779	Dec. 07, 2020	Annual	Dec. 04, 2021
DC Power Supply	Agilent	U8002A	MY53150029	Jun. 04, 2020	Annual	Jun. 04, 2021
Preamplifier	H.P.	8447F	2944A03909	Aug. 06, 2020	Annual	Aug. 06, 2021
Signal Conditioning Unit	R&S	SCU-18	10117	Jun. 10, 2020	Annual	Jun. 10, 2021
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	May 08, 2020	Annual	May 08, 2021
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 22, 2019	Biennial	Aug. 22, 2021
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	396	Mar. 21, 2019	Biennial	Mar. 21, 2021
Horn Antenna	R&S	HF906	100326	Feb. 04, 2021	Annual	Feb. 04, 2022
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA 9170	BBHA9170431	Sep. 16, 2020	Annual	Sep. 16, 2021
Test Receiver	R&S	ESU26	100368	Nov. 05, 2020	Annual	Nov. 05, 2021
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/383 30516/L	N.C.R.	N/A	N.C.R.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/383 30516/L	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	RFONE	MWX221-NMSNNMS (4 m)	J1023142	Dec. 01, 2020	Semi-annual	Jun. 01, 2021
Coaxial Cable	RFONE	SFX086-NMNM-10M (10 m)	20200324001	Dec. 01, 2020	Semi-annual	Jun. 01, 2021
Coaxial Cable	Rosenberger	LA1-C006-1500	131014 11/20	Feb. 19, 2021	Semi-annual	Aug. 19, 2021

1.10. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part15 Subpart C, IC RSS-247 Issue 2 and RSS-Gen Issue 5			
Section in FCC	Section in IC	Test Item(s)	Result
15.205(a) 15.209	RSS-Gen Issue 5 8.9	Transmitter Radiated Spurious Emissions	Complied
15.247(d)	RSS-247 Issue 2 5.5	Conducted Spurious Emission	N/A ¹⁾
15.247(a)(2)	RSS-247 Issue 2 5.2(a) RSS-Gen Issue 5 6.7	6 dB Bandwidth & 99 % Bandwidth	N/A ¹⁾
15.247(b)(3)	RSS-247 Issue 2 5.4(d)	Maximum Peak Conducted Output Power	N/A ¹⁾
15.247(e)	RSS-247 Issue 2 5.2(b)	Power Spectral Density	N/A ¹⁾
15.207	RSS-Gen Issue 5 8.8	AC Power Line Conducted Emission	N/A ²⁾

Note;

- 1) The TA4HEB-N2 uses same module with TM05GTJN2. So only spot check was performed and the rule was satisfied.
- 2) The AC power line test was not performed because the EUT use battery power for operation and which do not operate from the AC power lines.

1.11. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedure for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 15.247 Meas Guidance v05r02 were used in the measurement of the DUT.

1.12. Sample Calculation

Where relevant, the following sample calculation is provided:

1.12.1. Conducted Test

Offset value (dB) = Attenuator (dB) + Cable loss (dB)

1.12.2. Radiation Test

Field strength level (dB μ V/m) = Measured level (dB μ V) + Antenna factor (dB) + Cable loss (dB) - Amplifier gain (dB)
+ Duty factor (dB)

1.13. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL001713	2021.02.25	Initial

1.14. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty	
RF Output Power	± 0.44 dB	
Radiated Emission, 9 kHz to 30 MHz	H	± 3.66 dB
	V	± 3.66 dB
Radiated Emission, below 1 GHz	H	± 4.90 dB
	V	± 4.82 dB
Radiated Emission, above 1 GHz	H	± 3.62 dB
	V	± 3.64 dB

Uncertainty figures are valid to a confidence level of 95 %.

1.15. Duty Cycle of EUT

Regarding to KDB 558074 D01 15.247 Meas Guidance v05r02, 6, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below;

Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

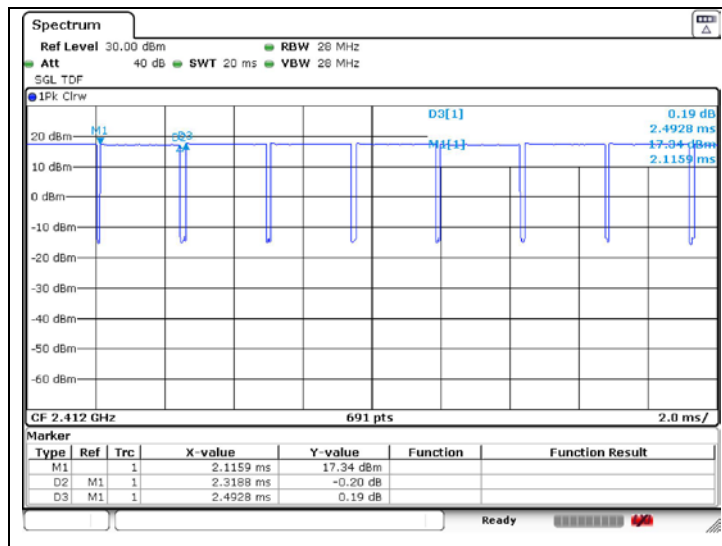
Mode	Data Rate (Mbps)	Duty Cycle (%)	Correction Factor (dB)
11b	5.5	93.02	0.31
11g	24	73.47	1.34
11n_HT20	MCS3	70.84	1.50
11n_HT40	MCS3	59.02	2.29

Remark;

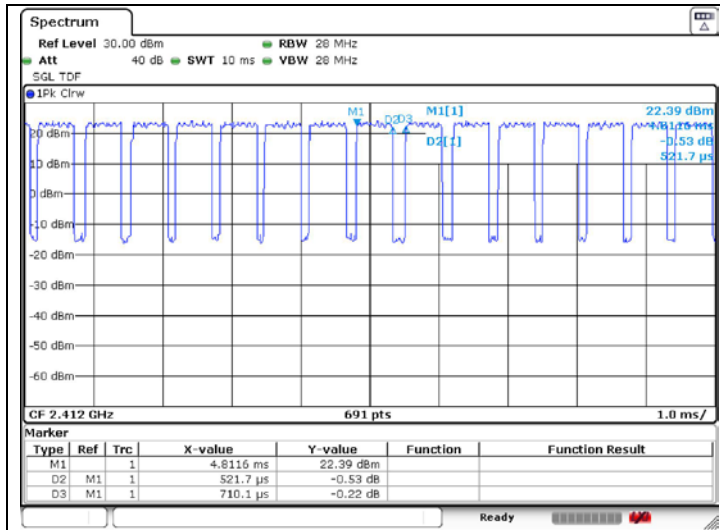
- As measured duty cycles of EUT, all of mode and data rate keeps constant period and are converted to log scale (power averaging) to compensate correction factor to result of average test items.
- Duty Cycle (%) = (Tx on time / Tx on + off time) × 100
- Correction Factor (dB) = 10 log (1 / Duty Cycle)

- Test plots

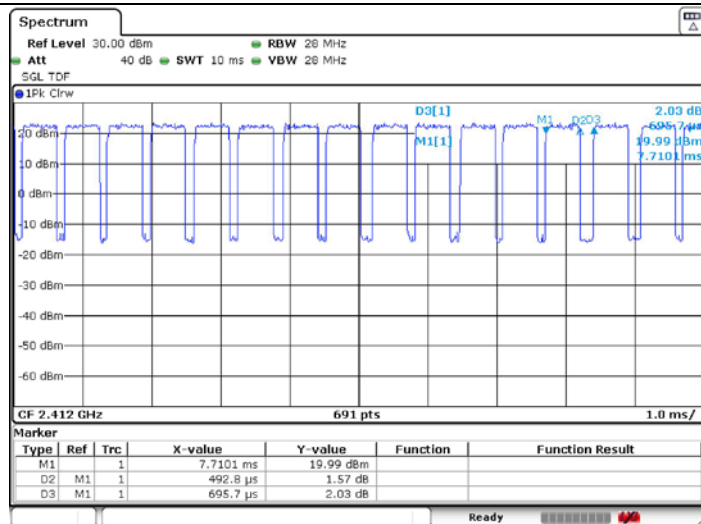
802.11b



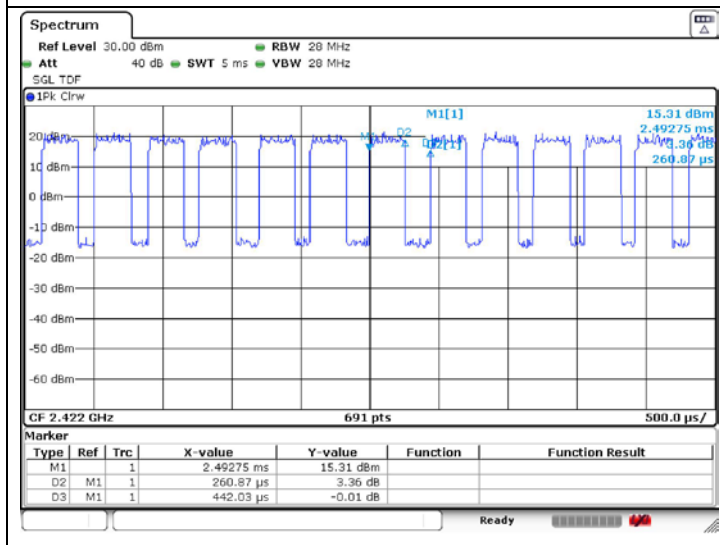
802.11g



802.11n_HT20



802.11n_HT40

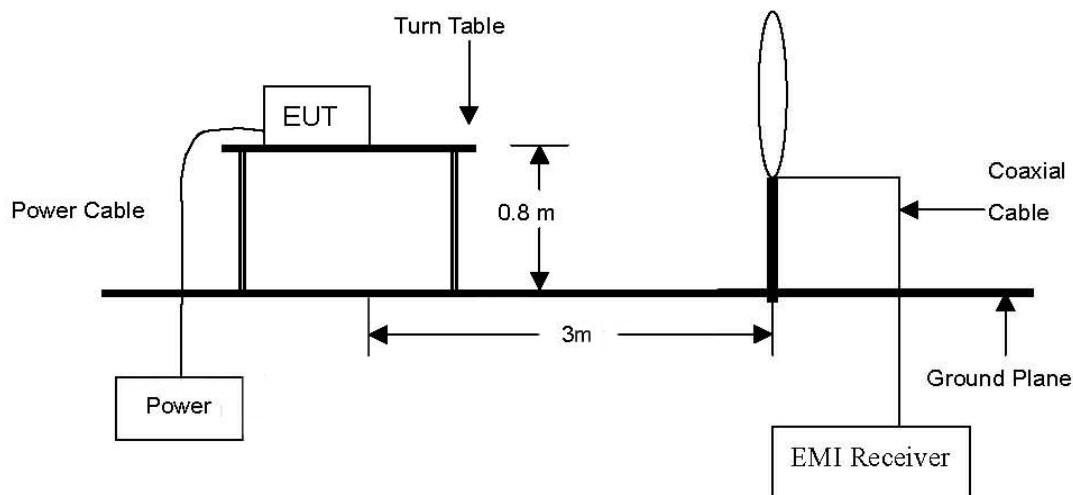


2. Transmitter Radiated Spurious Emissions

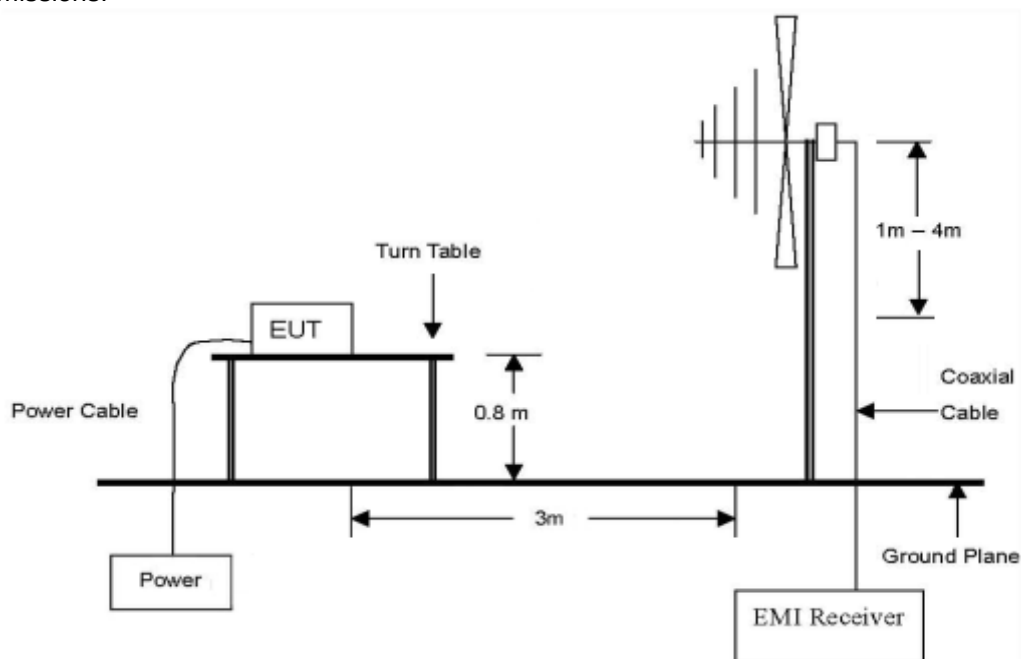
2.1. Test Setup

2.1.1. Transmitter Radiated Spurious Emissions

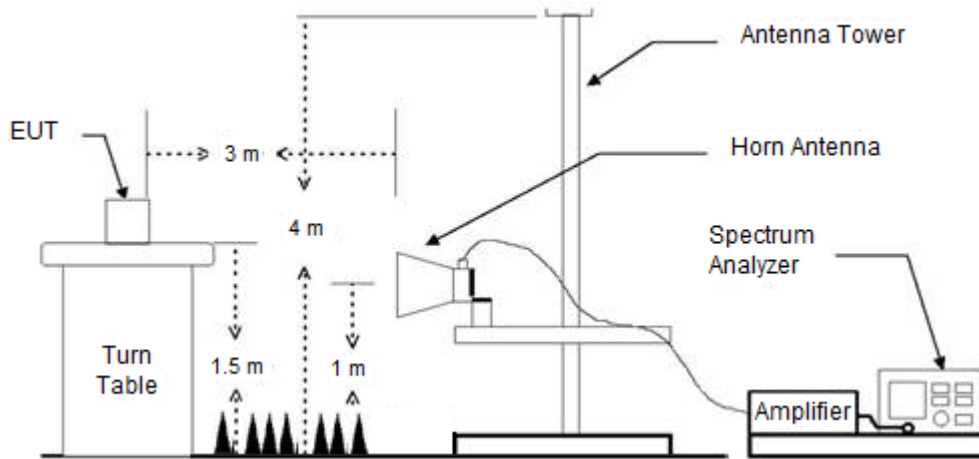
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 GHz to the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.



2.2. Limit

2.2.1. FCC

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

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

Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement Distance (Meters)
0.009-0.490	$2\,400/F(\text{kHz})$	300
0.490-1.705	$24\,000/F(\text{kHz})$	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

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

2.2.2. IC

According to RSS-247 Issue 2, 5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

According to RSS-Gen Issue 5, 8.9, except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Table 5 – General Field Strength Limits at frequencies above 30 MHz

Frequency (MHz)	Field Strength ($\mu V/m$ at 3 m)
30-88	100
88-216	150
216-960	200
Above 960	500

Table 6 – General Field Strength Limits at frequencies below 30 MHz

Frequency	Magnetic Field Strength (H-Field) ($\mu A/m$)	Measurement Distance (meters)
9-490 kHz ¹	6.37/F (F in kHz)	300
490-1 705 kHz	63.7/F (F in kHz)	30
1.705-30 MHz	0.08	30

Note¹: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates in section 11.11 & 11.12 of ANSI C63.10-2013.

2.3.1. Test Procedures for emission below 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from above 30 MHz

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 GHz and 1.5 meters above the ground at a 3 meter anechoic chamber test site above 1 GHz. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

1. Unwanted Emissions into Non-Restricted Frequency Bands

- The Reference Level Measurement refer to section 11.11.2

Set analyzer center frequency to DTS channel center frequency, SPAN ≥ 1.5 times the DTS bandwidth, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold.

- Unwanted Emissions Level Measurement refer to section 11.11.3

Set the center frequency and span to encompass frequency range to be measured, the RBW = 100 kHz and VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = Auto couple, Trace = Max hold.

2. Unwanted Emissions into Restricted Frequency Bands

- Peak Power measurement procedure refer to section 11.12.2.4

Set RBW = as specified in Table 9, VBW $\geq 3 \times$ RBW, Detector = Peak, Sweep time = auto, Trace = Max hold.

Table 9 – RBW as a function of frequency

Frequency	RBW
9 kHz to 150 kHz	200 Hz to 300 Hz
0.15 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1 000 MHz	100 kHz to 120 kHz
> 1 000 MHz	1 MHz

If the peak – detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

- Average Power measurements procedure refer to section 11.12.2.5.2

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

Measure the duty cycle D of the transmitter output signal as described in section 11.6.

Set RBW = 1 MHz, VBW $\geq 3 \times$ RBW, Detector = RMS, if span / (# of points in sweep) $\leq$ (RBW/2).

Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied then the detector mode shall be set to peak.

Averaging type = power (i.e., RMS).

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

Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used. Sweep time = auto, Perform a trace average of at least 100 traces.

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

- 1) If power averaging (rms) mode was used in step f), then the applicable correction factor is $[10 \log (1 / D)]$, where D is the duty cycle.
- 2) If a specific emission is demonstrated to be continuous (D ≥ 98 %) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

3. Definition of DUT Axis.

Definition of the test orthogonal plan for EUT was described in the test setup photo.

The test orthogonal plan of EUT is **X – axis** during radiation test.

2.4. Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

2.4.1. Radiated Spurious Emission below 1 000 MHz

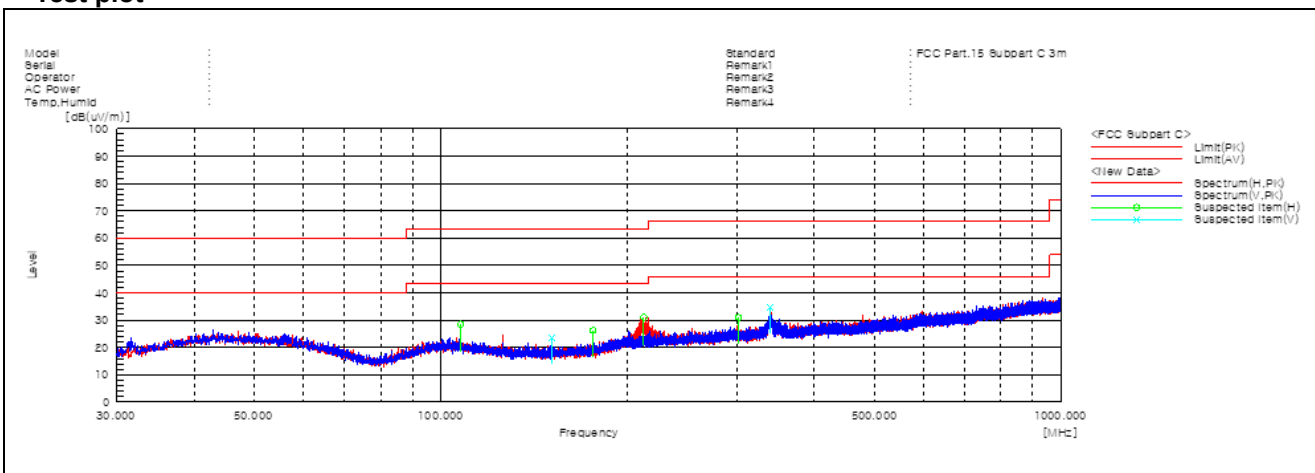
The frequency spectrum from 9 kHz to 1 000 MHz was investigated. All reading values are peak values.

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
107.68	38.40	Peak	H	16.76	-26.64	28.52	43.50	14.98
151.01	36.00	Peak	V	13.90	-26.18	23.72	43.50	19.78
176.07	37.20	Peak	H	14.91	-25.91	26.20	43.50	17.30
212.48	39.70	Peak	H	16.85	-25.59	30.96	43.50	12.54
302.21	36.90	Peak	H	19.20	-25.03	31.07	46.00	14.93
339.83	34.30	Peak	V	25.42	-25.16	34.56	46.00	11.44
Above 400.00	Not detected	-	-	-	-	-	-	-

Remark;

- Spurious emissions for all channels were investigated and almost the same below 1 GHz.
- Reported spurious emissions are in **11n HT20 / MCS3 / High channel** as worst case among other modes.
- Radiated spurious emission measurement as below.
 (Actual = Reading + AF + AMP + CL)
- According to §15.31(o), emission levels are not report much lower than the limits by over 20 dB.

- Test plot



2.4.2. Radiated Spurious Emission above 1 000 MHz

The frequency spectrum above 1 000 MHz was investigated. All reading values are peak and average values.

OFDM: 802.11n_HT20 (MCS3)

High Channel (2 462 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	DF (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*2 483.50	26.56	Peak	V	28.33	6.21	-	61.10	74.00	12.90
*2 483.50	12.86	Average	V	28.33	6.21	1.50	48.90	54.00	5.10
*2 483.88	28.11	Peak	V	28.33	6.21	-	62.65	74.00	11.35
*2 483.72	13.78	Average	V	28.33	6.21	1.50	49.82	54.00	4.18
*2 500.00	18.22	Peak	V	28.30	6.27	-	52.79	74.00	21.21
*2 500.00	8.23	Average	V	28.30	6.27	1.50	44.30	54.00	9.70

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	DF (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

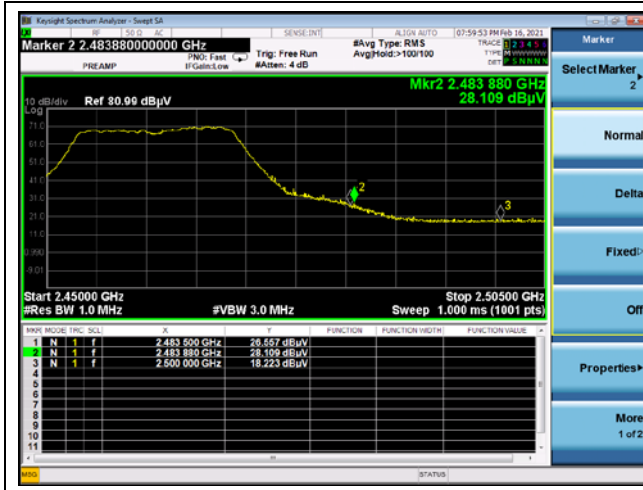
Remarks;

1. "*" means the restricted band.
2. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
3. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
4. Actual = Reading + AF + CL + (DF) or Reading + AF + AMP + CL + (DF).
5. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 dB.
6. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.

- Test plots

OFDM: 802.11n_HT20 (MCS3)

High channel band edge (Peak)



High channel band edge (Average)



- End of the Test Report -