FCC Radio Test Report

Equipment	: RouterBOARD wAP G-60ad
Brand Name	: RouterBOARD
Model No.	: RBwAPG-60ad
FCC ID	: TV7WAPG60AD
Standard	: 47 CFR FCC Part 15.255
Applicant	: Mikrotikls SIA Pernavas 46, Riga, LV-1009 Latvia
Manufacturer	: Mikrotikls SIA Pernavas 46, Riga, LV-1009 Latvia

The product sample received on Jun. 29, 2017 and completely tested on Aug. 08, 2017. We, SPORTON, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013, 47 CFR FCC Part 15.255 and Millimeter Wave Test Procedures and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Cliff Chang
SPORTON INTERNATIONAL INC.

Testing Laboratory
1190

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Summary of Test Result

Standard Requirements and Conformance Test Specifications				
Report Clause	**Ref. Std. Clause**	**Description**	**Result**	**Remark**
3.1	FCC 15.207	AC Power Conducted Emissions	Complied	-
3.2	FCC 15.255(d)	Occupied Bandwidth	Complied	-
3.3	FCC 15.255(b)(1)	EIRP Power	Complied	-
3.4	FCC 15.255(d)	Peak Conducted Power	Complied	-
3.5	FCC 15.255(c)	Transmitter Spurious Emissions	Complied	-
3.6	FCC 15.255(e)	Frequency Stability	Complied	-
3.7	FCC 15.255(a),(g)	Operation Restriction and Group Installation	Complied	-

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR760927	Rev. 01	Initial issue of report	Aug. 15, 2017

1 General Description

1.1 Information

1.1.1 The Channel Plan(s)

Frequency Range	57-71GHz
The Channel Plan(s)	Channel 1: 58.32 GHz Channel 2: 60.48 GHz Channel 3: 62.64 GHz

1.1.2 Antenna Information

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)		
					58.32 GHz	60.48 GHz	62.64 GHz
1	Mikrotik	60G-phased-array	Integral phased-array	Soldered	12.13	13.48	10.56

1.1.3 Extreme Operating

The Extreme Operating Temperature Range that Apply to the Equipment					
☐ -20 °C to +50 °C					
☐ 0 °C to +40 °C					
☒ Other: 0 °C to +50 °C					
EUT Power Type	From Power Adapter or PoE				
Supply Voltage	☒	AC	State AC voltage	120	V
Supply Voltage	☐	DC	State DC voltage		V

1.1.4 Equipment Use Condition

Equipment Use Condition
☐ Fixed field disturbance sensors at 61-61.5GHz
☐ Except fixed field disturbance sensors at 61-61.5GHz
☒ Except fixed field disturbance sensors

1.1.5 User Condition

Intended Operation
☒ Indoor only
☐ Outdoor only

1.2 Additional Information Provided by the Submitter

1.2.1 Product Details

IEEE 802.11ad Modulation Scheme

MCS Index	Modulation	Code rate	Data rate (Mbit/s)
0	π/-2BPSK	1/2	27.5
1	π/-2BPSK	1/2	385
2	π/-2BPSK	1/2	770
3	π/-2BPSK	5/8	962.5
4	π/-2BPSK	3/4	1155
5	π/-2BPSK	13/16	1251.25
6	π/-2QPSK	1/2	1540
7	π/-2QPSK	5/8	1925
8	π/-2QPSK	3/4	2310
9	π/-2QPSK	13/16	2502.5
10	π/2-16QAM	1/2	3080
11	π/2-16QAM	5/8	3850
12	π/2-16QAM	3/4	4620
The Channel Bandwidth is 2.16GHz			
Can the transmitter operate un-modulated:	☒ Yes	☐ No	

1.2.2 Duty Cycle

Duty Cycle		Duty Cycle Factor
The transmitter is intended for	100 %	0.00

1.3 Accessories

Accessories				
No.	Equipment Name	Brand Name	Model Name	Rating
1	Adapter	MLF	MLF-A00122400380U0141	Input: 100-240V ~ 50/60Hz, 0.4Amax Output: 24V, 0.38A
2	PoE	MikroTik	RBGPOE	Input: 9-48V

1.4 Support Equipment

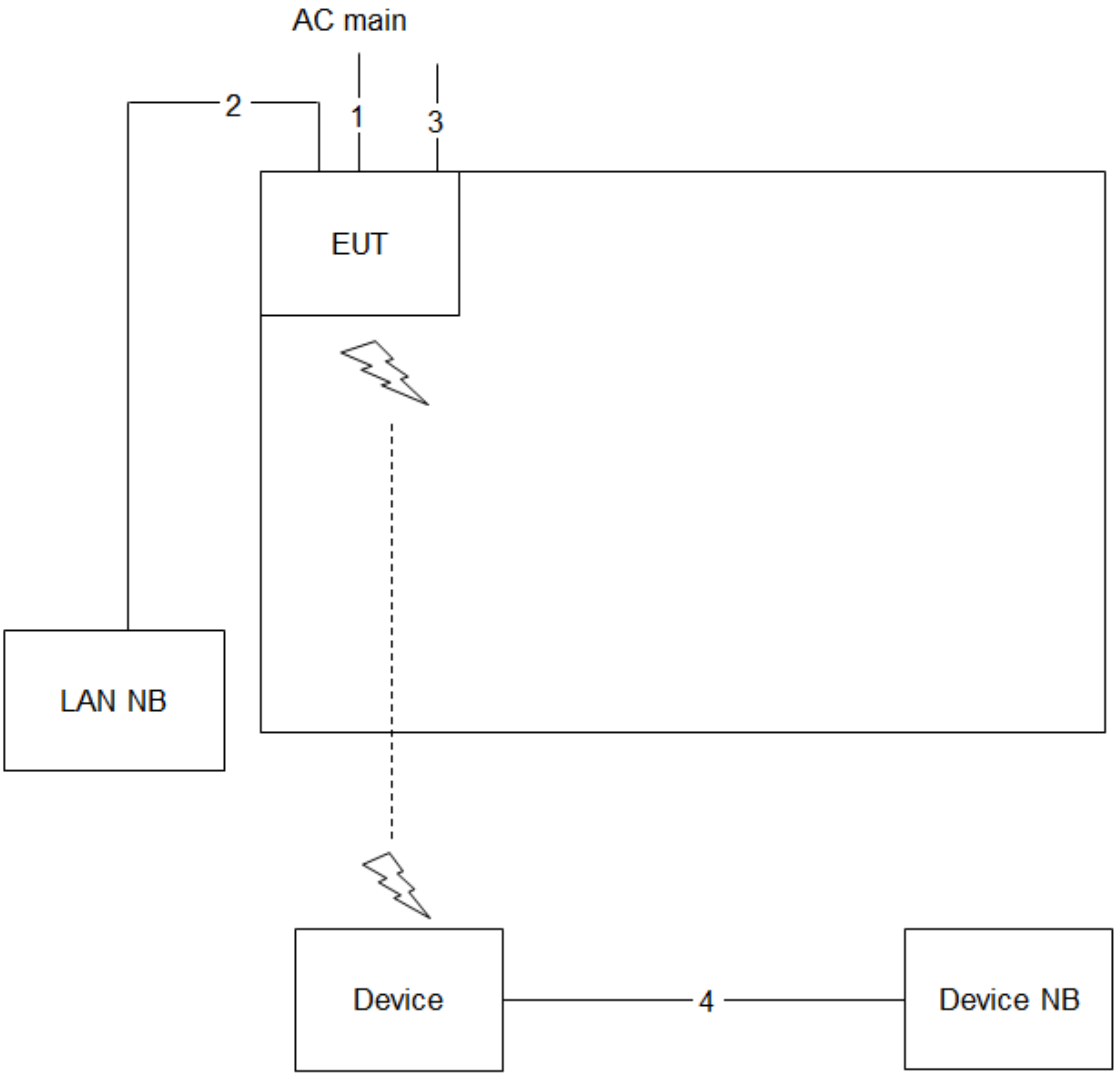
Support Equipment				
No.	Equipment	Brand Name	Model Name	FCC ID
1	Notebook	lenovo	80J2	DoC

1.5 EUT Operation during Test

During the test, executed the test program to control the EUT continuously transmit RF signal.

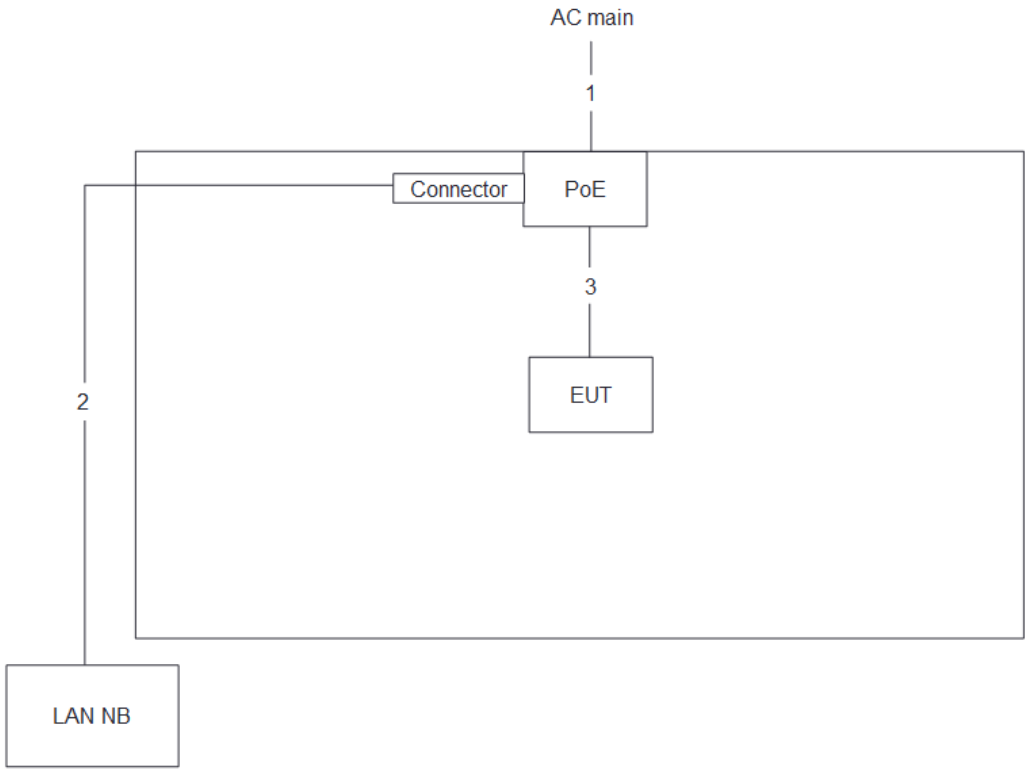
1.6 Test Setup Diagram

Test Setup Diagram - AC Power Conducted Emissions



Item	Connection	Shielded	Length
1	Power cable	No	1.5m
2	RJ-45 cable	No	10m
3	Ground cable	No	1.5m
4	RJ-45 cable	No	1.5m

Test Setup Diagram - Transmitter Spurious Emissions



Item	Connection	Shielded	Length
1	Power cable	No	1.6m
2	RJ-45 cable	No	10m
3	RJ-45 cable	No	1m

1.7 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR FCC Part 15.255
- ANSI C63.10-2013 Section 9. “Procedures for testing millimeter-wave systems”

1.8 Testing Location

Testing Location				
☐	HWA YA	ADD : No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL : 886-3-327-3456 FAX : 886-3-327-0973		
☒	JHUBEI	ADD : No.8, Lane 724, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C. TEL : 886-3-656-9065 FAX : 886-3-656-9085		
Test Site No.				
CO01-CB		03CH01-CB		TH01-CB

2 Test Configuration of Equipment under Test

2.1 Test Channel Frequencies

Test Channel Frequencies Configuration (GHz)	
Low Channel	58.32
Middle Channel	60.48
High Channel	62.64

2.2 Conformance Tests and Related Test Frequencies

Test Item	Test Frequencies (GHz)		
	Low Channel	Middle Channel	High Channel
AC Power Conducted Emissions	CTX		
Occupied Bandwidth	58.32	60.48	62.64
EIRP Power	58.32	60.48	62.64
Peak Conducted Power	58.32	60.48	62.64
Transmitter Spurious Emissions (below 1 GHz)	CTX		
Transmitter Spurious Emissions (1 GHz-40 GHz)	58.32	60.48	62.64
Transmitter Spurious Emissions (above 40 GHz)	58.32	60.48	62.64
Frequency Stability	Un-Modulation		

The following test modes were performed for all tests:

For Conducted Emission test:

Mode 1. EUT with Adapter

Mode 2. EUT with PoE

Mode 1 is the worst case, so it was selected to record in this test report.

For Radiated Emission test below 1GHz:

The EUT was performed at Y axis and Z axis position for Radiated emission test, and the worst case was found at Y axis. So the measurement will follow this same test configuration.

The EUT was performed adapter and PoE for Radiated emission test, and the worst case was found PoE. So the measurement will follow this same test configuration.

Mode 1. EUT in Y axis with PoE

For Radiated Emission test above 1GHz:

The EUT was performed at Y axis and Z axis position for Radiated emission test, and the worst case was found at Y axis. So the measurement will follow this same test configuration.

The power supply does not affect the test result of RF tests, so only PoE was tested and recorded in this report.

Mode 1. EUT in Y axis with PoE

2.3 Far Field Boundary Calculations

The far-field boundary is given as:

far field = (2 * L^2) / λ

where:

L = Largest Antenna Dimension, including the reflector, in meters

λ = wavelength in meters

Far Field (m)				
Frequency (GHz)	**L (m)**	**Lambda (m)**	**d(Far Field) (m)**	**d(Far Field) (cm)**
58.32	0.02	0.0051440	0.156	15.55
60.48	0.02	0.0049603	0.161	16.13
62.64	0.02	0.0047893	0.167	16.70

3 Transmitter Test Result

3.1 AC Power Conducted Emissions

3.1.1 Limit of AC Power Conducted Emissions

AC Power Conducted Emissions Limit		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note: * Decreases with the logarithm of the frequency.		

3.1.2 Measuring Instruments

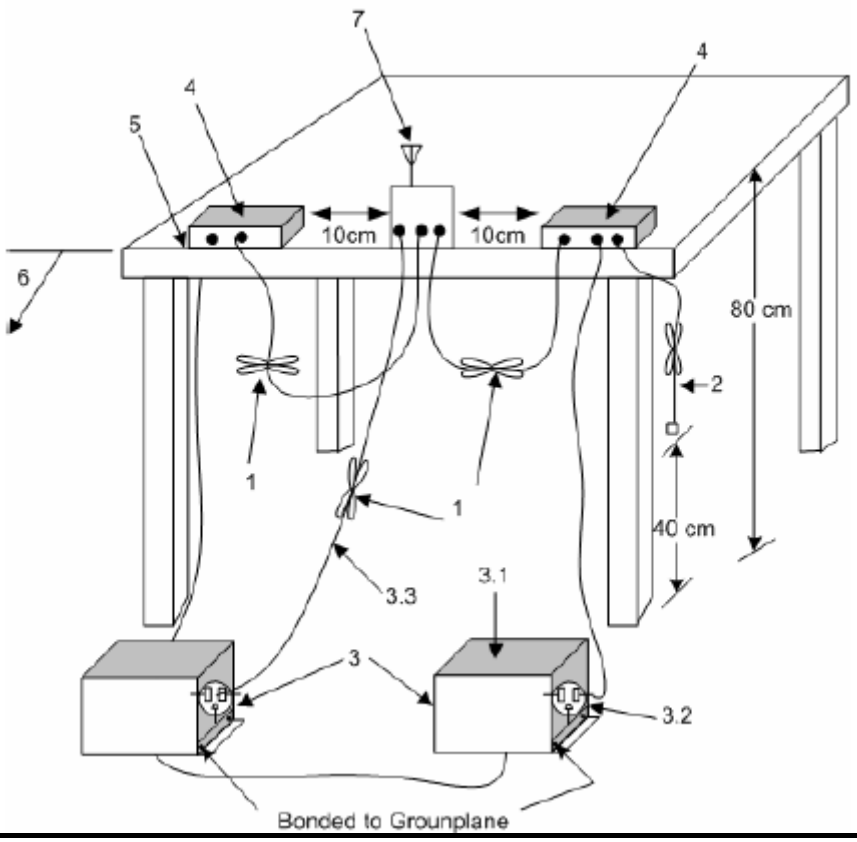
Refer a measuring instruments list in this test report.

3.1.3 Test Procedures

Method of measurement: Refer as ANSI C63.10-2013, clause 6.2.

3.1.4 Test Setup

AC Power Conducted Emissions



AC Power Conducted Emissions
1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long (see ANSI C63.10, clause 6.2.3.2).
2. I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m (see ANSI C63.10, clause 6.2.2).
3. EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 ohm loads. LISN can be placed on top of, or immediately beneath, reference ground plane (see ANSI C63.10, clauses 6.2.2 and 6.2.3).
3.1. All other equipment powered from additional LISN(s).
3.2. A multiple-outlet strip can be used for multiple power cords of non-EUT equipment.
3.3. LISN at least 80 cm from nearest part of EUT chassis.
4. Non-EUT components of EUT system being tested.
5. Rear of EUT, including peripherals, shall all be aligned and flush with edge of tabletop (see ANSI C63.10, clause 6.2.3.2).
6. Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane (see ANSI C63.10, clause 6.2.2 for options).
7. Antenna may be integral or detachable. If detachable, the antenna shall be attached for this test.

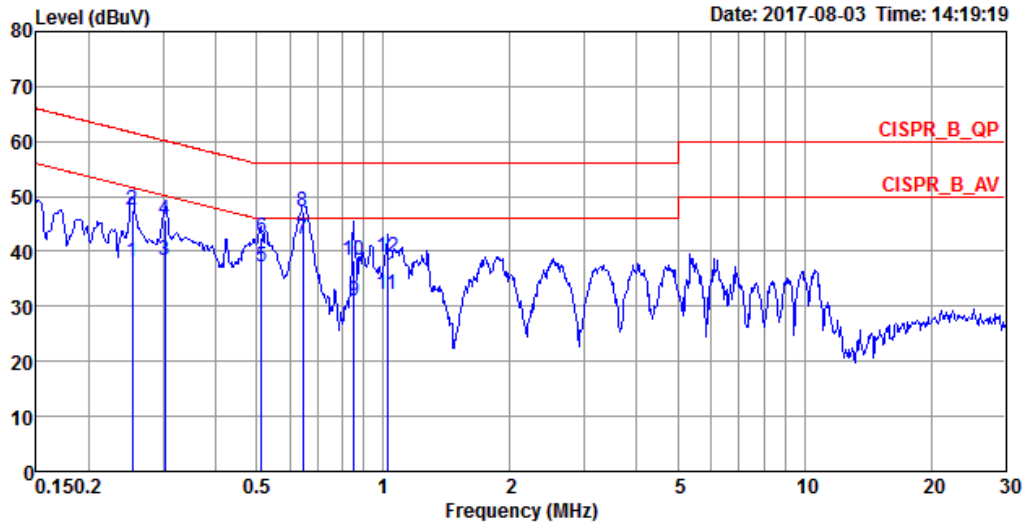
3.1.5 Test Result of AC Power Conducted Emissions

Test Conditions	see ANSI C63.10, clause 5.11
Test Setup	see ANSI C63.10, clause 6.2.3

NOTE 1: If equipment having different channel plan and nominal channel bandwidth modes (see test report clause 1.1.1), the measurements are uninfluenced by different channel plan and nominal channel bandwidth modes, may not need to be repeated for all modes. If equipment having different transmit operating modes (see test report clause 1.1.2), the measurements are uninfluenced by different transmit operating modes, may not need to be repeated for all the operating modes. Similar, if the equipment supports different modulations and/or data rates, the measurements described in ANSI C63.10, clause 5.12 may not need to be repeated for all these modulations and data rates. Simple comparison of engineering test across all operating modes, modulations and data rates may need to be performed to define the worse case combination to be used for the conformance testing.

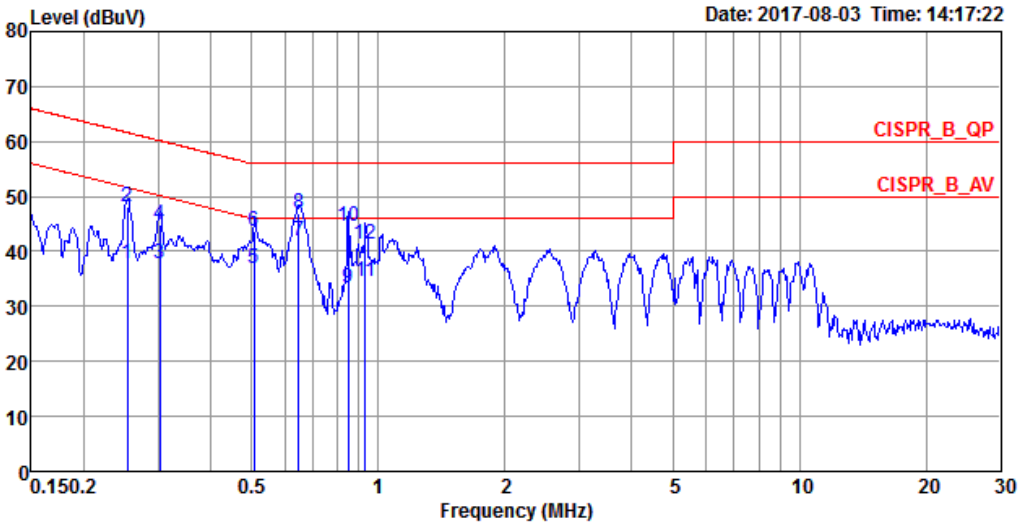
NOTE 2: “>20dB” means the tables in this clause should only list values of spurious emissions that exceed the level of 20 dB below the applicable limit, see ANSI C63.4, clause 10.1.8.1.

Temp	25°C	Humidity	60%
Test Engineer	Rick Yeh	Phase	Line
Configuration	CTX		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.2535	37.98	-13.66	51.64	27.97	9.92	0.09	Average	LINE
2	0.2535	47.64	-14.00	61.64	37.63	9.92	0.09	QP	LINE
3	0.3035	38.52	-11.63	50.15	28.53	9.93	0.06	Average	LINE
4	0.3035	45.75	-14.40	60.15	35.76	9.93	0.06	QP	LINE
5	0.5128	37.06	-8.94	46.00	27.05	9.95	0.06	Average	LINE
6	0.5128	42.47	-13.53	56.00	32.46	9.95	0.06	QP	LINE
7	0.6440	42.33	-3.67	46.00	32.28	9.95	0.10	Average	LINE
8	0.6440	47.09	-8.91	56.00	37.04	9.95	0.10	QP	LINE
9	0.8528	31.09	-14.91	46.00	20.97	9.96	0.16	Average	LINE
10	0.8528	38.46	-17.54	56.00	28.34	9.96	0.16	QP	LINE
11	1.0211	32.29	-13.71	46.00	22.14	9.96	0.19	Average	LINE
12	1.0211	39.05	-16.95	56.00	28.90	9.96	0.19	QP	LINE

Temp	25°C	Humidity	60%
Test Engineer	Rick Yeh	Phase	Neutral
Configuration	CTX		



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.2535	37.92	-13.72	51.64	27.75	10.08	0.09	Average	NEUTRAL
2	0.2535	47.99	-13.65	61.64	37.82	10.08	0.09	QP	NEUTRAL
3	0.3035	37.81	-12.34	50.15	27.60	10.15	0.06	Average	NEUTRAL
4	0.3035	44.92	-15.23	60.15	34.71	10.15	0.06	QP	NEUTRAL
5	0.5074	36.91	-9.09	46.00	26.63	10.22	0.06	Average	NEUTRAL
6	0.5074	43.67	-12.33	56.00	33.39	10.22	0.06	QP	NEUTRAL
7	0.6474	41.84	-4.16	46.00	31.56	10.18	0.10	Average	NEUTRAL
8	0.6474	46.87	-9.13	56.00	36.59	10.18	0.10	QP	NEUTRAL
9	0.8483	33.31	-12.69	46.00	23.05	10.10	0.16	Average	NEUTRAL
10	0.8483	44.43	-11.57	56.00	34.17	10.10	0.16	QP	NEUTRAL
11	0.9331	34.42	-11.58	46.00	24.17	10.07	0.18	Average	NEUTRAL
12	0.9331	41.44	-14.56	56.00	31.19	10.07	0.18	QP	NEUTRAL

3.2 Occupied Bandwidth

3.2.1 Limit of Occupied Bandwidth

6dBc Bandwidth (see Note 1)	None
26dBc Bandwidth	None
99% Occupied Bandwidth (see Note 2)	None

NOTE 1: The 6dBc bandwidth is the frequency bandwidth of the signal power at the -6 dBc points when measured with a 100 kHz resolution bandwidth. These measurements shall also be performed at normal test conditions.

NOTE 2: The 99% occupied bandwidth is the frequency bandwidth of the signal power at the 99% channel power of occupied bandwidth when resolution bandwidth should be approximately 1 % to 5 % of the occupied bandwidth (OBW). These measurements shall also be performed at normal test conditions.

3.2.2 Measuring Instruments

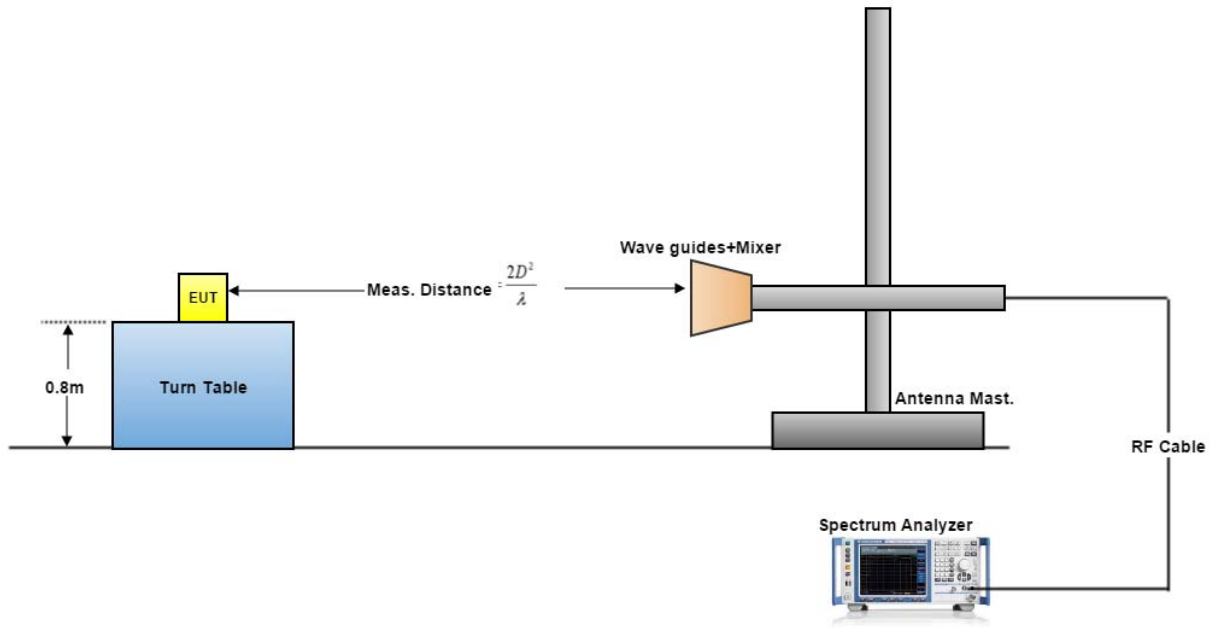
Refer a measuring instruments list in this test report.

3.2.3 Test Procedures

Method of measurement: Refer as ANSI C63.10-2013, clauses 6.9.2.

3.2.4 Test Setup

Occupied Channel Bandwidth



3.2.5 Test Result of Occupied Bandwidth

Test Conditions	see ANSI C63.10, clause 5.11
Test Setup	see ANSI C63.10, clause 6.9.2
NOTE: If equipment having different transmit operating modes (see test report clause 1.1.2), the measurements are uninfluenced by different transmit operating modes, may not need to be repeated for all the operating modes. Similar, if the equipment supports different modulations and/or data rates, the measurements described in ANSI C63.10, clause 5.11 may not need to be repeated for all these modulations and data rates. Simple comparison of engineering test across all operating modes, modulations and data rates may need to be performed to define the worse case combination to be used for the conformance testing. Refer as ANSI C63.10, clause 15, observe and record with plotted graphs or photographs the worst-case (i.e., widest) occupied bandwidth produced by these different modulation sources.	

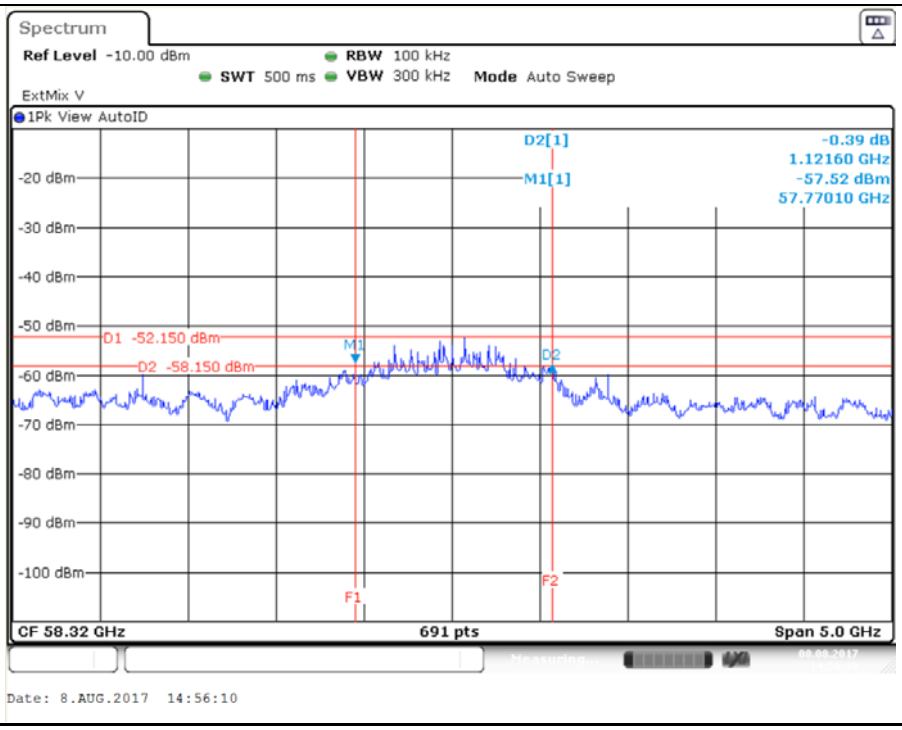
Temp	22℃	**Humidity**	54%
Test Engineer	DK Chang		

Test Results

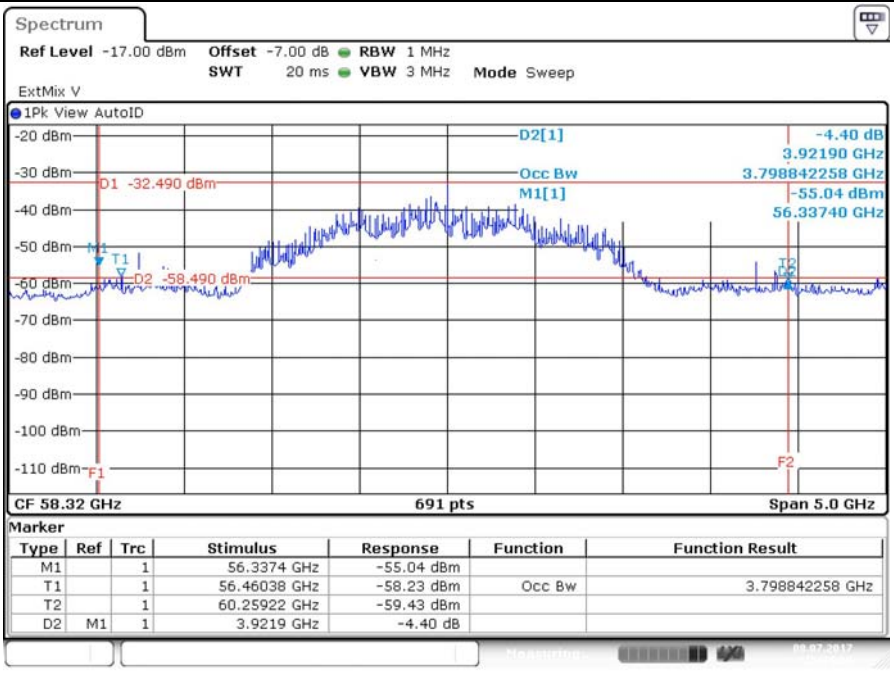
Channel Plan (GHz)	Test Freq. (GHz)	6 dBc Bandwidth (MHz)	Occupied Bandwidth (MHz)	26 dBc Bandwidth (MHz)	Limit (MHz)
Low Channel	58.32	1121.600	3798.84	3921.90	N/A
Middle Channel	60.48	1772.800	3371.92	3687.40	N/A
High Channel	62.64	1259.000	3444.28	3849.50	N/A

3.2.5.1 Bandwidth Plots

Channel Plan: Low Channel GHz
Test Frequency: 58.32 GHz
6 dBc Bandwidth

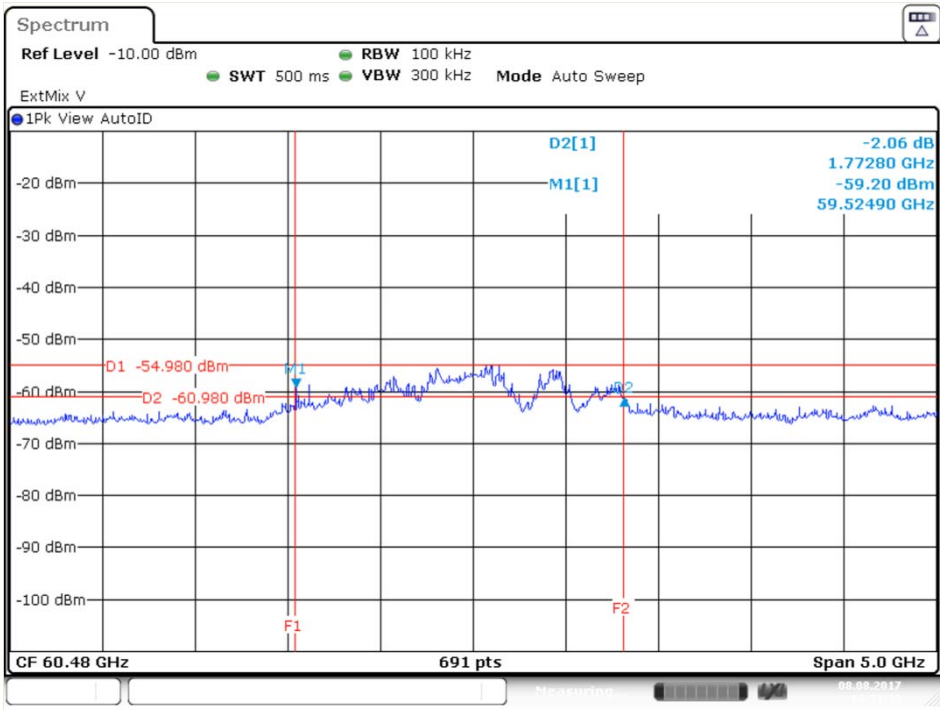


Occupied Bandwidth&26 dBc Bandwidth



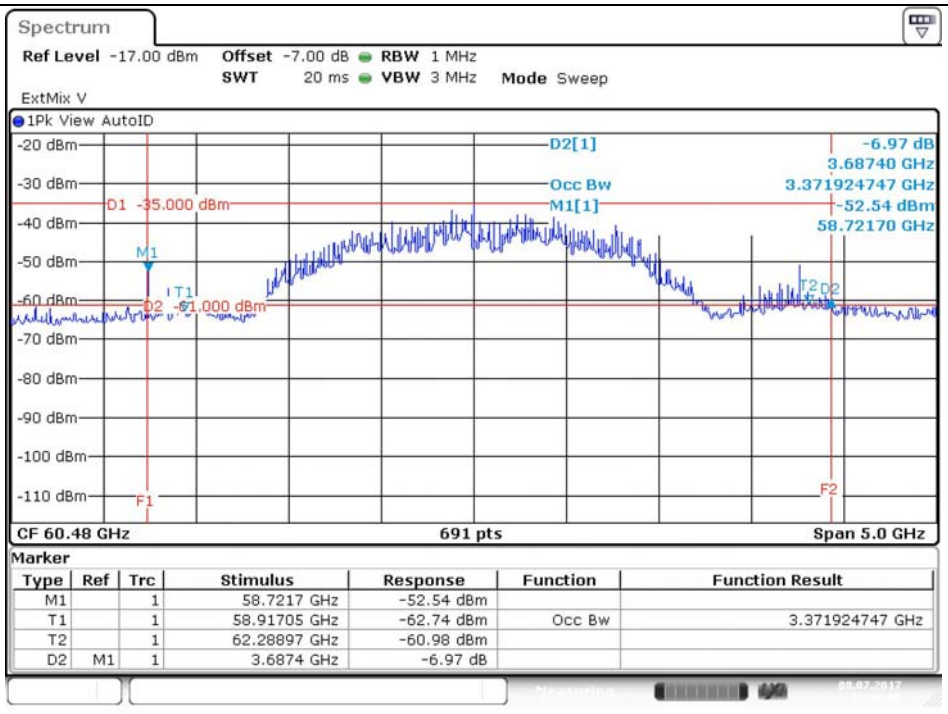
Channel Plan: Middle Channel GHz
Test Frequency: 60.48 GHz

6 dBc Bandwidth



Date: 8.AUG.2017 14:53:39

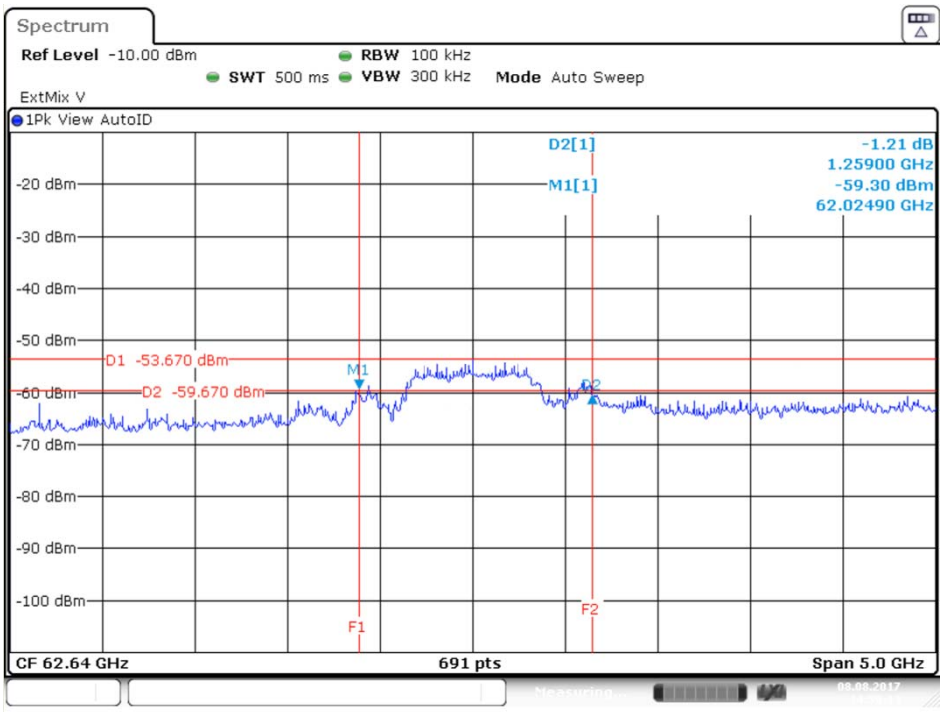
Occupied Bandwidth&26 dBc Bandwidth



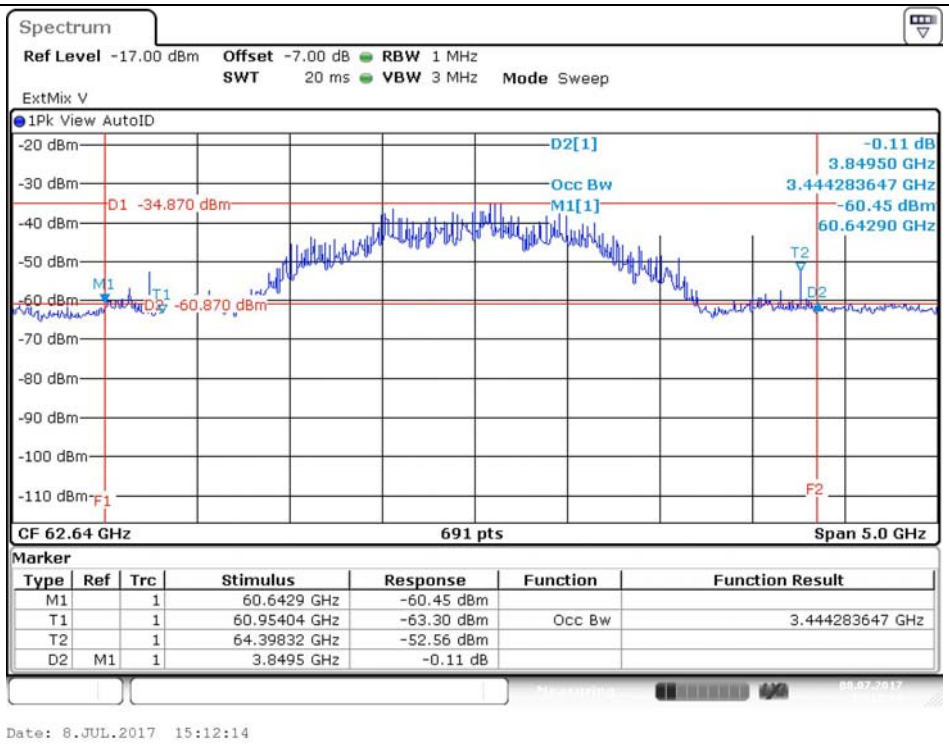
Date: 8.JUL.2017 15:04:02

Channel Plan: High Channel GHz
Test Frequency: 62.64 GHz

6 dBc Bandwidth



Occupied Bandwidth&26 dBc Bandwidth



3.3 EIRP Power

3.3.1 Limit of EIRP Power

EIRP Power Limit		
Use Condition	**EIRP Average Power**	**EIRP Peak Power**
Fixed field disturbance sensors at within the frequency band 61-61.5GHz	40 dBm	43 dBm
Fixed field disturbance sensors at outside of the band 61-61.5GHz	10 dBm	13 dBm
Except fixed field disturbance sensors at 61-61.5GHz	N/A	10 dBm
Except fixed field disturbance sensors(indoor)	40 dBm	43 dBm
Except fixed field disturbance sensors(outdoor)	82 dBm	85 dBm

NOTE: For the applicable limit, see FCC 15.255 (b)

3.3.2 Measuring Instruments

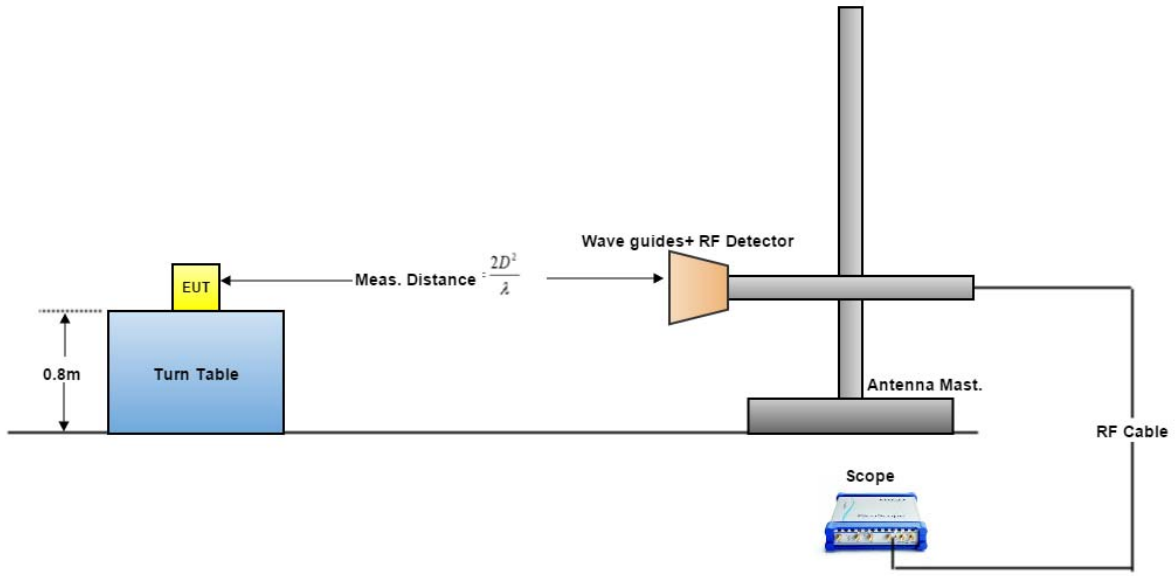
Refer a measuring instruments list in this test report.

3.3.3 Test Procedures

Method of measurement: Refer as ANSI C63.10-2013 clause 9.3 & 9.5.

3.3.4 Test Setup

EIPR Power



3.3.5 Test Result of EIRP Power

Test Conditions	see ANSI C63.10, clause 5.11 & clause 9
Test Setup	see ANSI C63.10, clause 9.11

NOTE: If the equipment supports different modulations and/or data rates, the measurements described in ANSI C63.10, clause 5.11 may not need to be repeated for all these modulations and data rates. Simple comparison of engineering test across all operating modes, modulations and data rates may need to be performed to define the worst case combination to be used for the conformance testing.

3.3.5.1 Test Result of EIRP Power

Temp	22℃				Humidity		54%			
Test Engineer	DK Chang				Test Distance		0.17 m			
Test Results										
Channel Plan (GHz)	Test Freq. (GHz)	DSO (mV)		Power Measured (dBm)		E_{Meas} (dBuV/m)		EIRP (dBm)		EIRP Limit (dBm) (note 1)	
		Peak	AV	Peak	AV	Peak	AV	Peak	AV	Peak	AV
Low Channel	58.32	569.3	397.9	3.25	0.45	152.22	149.42	32.03	29.23	43	40
Middle Channel	60.48	653.1	432.6	6.03	1.48	155.32	150.77	35.13	30.58	43	40
High Channel	62.64	453.9	296.1	2.16	-1.74	151.75	147.85	31.56	27.66	43	40

The measured power level is converted to EIRP using the Friis equation:

For radiated emissions, calculate the field strength (E) in dBμV/meter.

$E = 126.8 – 20\log(\lambda) + P - G$

where:

E : is the field strength of the emission at the measurement distance, in dBμV/m

P : is the power measured at the output of the test antenna, in dBm

λ : is the wavelength of the emission under investigation [300/fMHz], in m

G : is the gain of the test antenna, in dBi For radiated emissions, calculate the EIRP (dBm). If the measurement was performed in the far field, calculate the EIRP.

EIRP = E-meas +20log(d-meas)-104.7

where:

EIRP : is the equivalent isotopically radiated power, in dBm

E-meas. : is the field strength of the emission at the measurement distance, in dBμV/m

d-meas. : is the measurement distance, in m

NOTE 1: For the applicable limit, see FCC 15.255 (b)

3.4 Peak Conducted Power

3.4.1 Limit of Peak Conducted Power

Peak Conducted Power Limit	
6dBc Bandwidth	**Peak Conducted Power (note 1)**
> 100MHz	500mW
≤ 100MHz	500mW x (BW/100) (see note 2)
NOTE 1: For the applicable limit, see FCC 15.255(d)	
NOTE 2: BW= 6dB bandwidth (measured at RBW 100kHz)	

3.4.2 Measuring Instruments

Refer a measuring instruments list in this test report.

3.4.3 Test Procedures

Method of measurement: Refer as ANSI C63.10-2013, clause 9.5

3.4.4 Test Result of Peak Conducted Power

Test Conditions	see ANSI C63.10, clause 5.11 & clause 9
Test Setup	see ANSI C63.10, clause 9.11
NOTE: If the equipment supports different modulations and/or data rates, the measurements described in ANSI C63.10, clause 5.11 may not need to be repeated for all these modulations and data rates. Simple comparison of engineering test across all operating modes, modulations and data rates may need to be performed to define the worst case combination to be used for the conformance testing.	

3.4.4.1 Peak Conducted Power

Temp	22℃	Humidity	54%
Test Engineer	DK Chang		
Test Date	Jul. 08, 2017 ~ Jul. 15, 2017		

Test Results

Channel Plan (GHz)	Test Freq. (GHz)	EIRP (dBm)	Max. Ant. Gain (dBi)	Peak Power (dBm) (note1)	Peak Power (mW)	6dBc BW (MHz) (note2)	Peak Power Limit (mW) (note3)
Low Channel	58.32	32.03	12.13	19.90	97.72372	1121.60	500.00
Middle Channel	60.48	35.13	13.48	21.65	146.21772	1772.80	500.00
High Channel	62.64	31.56	10.56	21.00	125.89254	1259.00	500.00

NOTE 1: Because EUT used for the integral antenna without temporary RF connector provided. Therefore peak conducted power is equal to EIRP power subtract the antenna gain.

NOTE 2: For the 6dBc bandwidth, see test report clause 3.2.5.

NOTE 3: For the applicable limit, see FCC 15.255(d)

NOTE 4: For radiated emission measurements, calculate conducted transmitter output power P(cond)(dBm)

P(cond) = EIRP - G(dBi)

where:

G(dBi) is gain of EUT antenna.

3.5 Transmitter Spurious Emissions

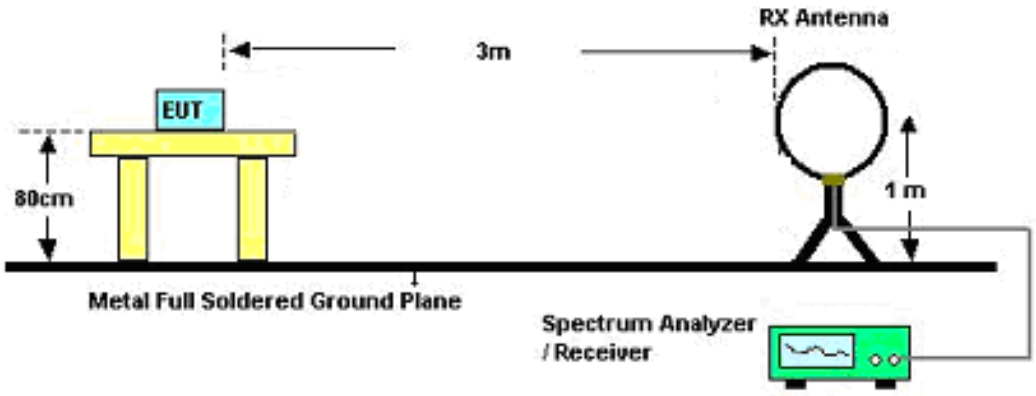
3.5.1 Limit of Transmitter Spurious Emissions

Frequency Range	Limit
Radiated emissions below 40 GHz	FCC 15.209
Radiated emissions above 40 GHz – 200GHz	90 pW/cm^2 @ 3 m (Equivalent EIRP 102 μW, -9.91dBm)
NOTE 1: For the applicable limit, see FCC 15.255(c) NOTE 2: Spurious emissions shall not exceed the level of the fundamental emission.	

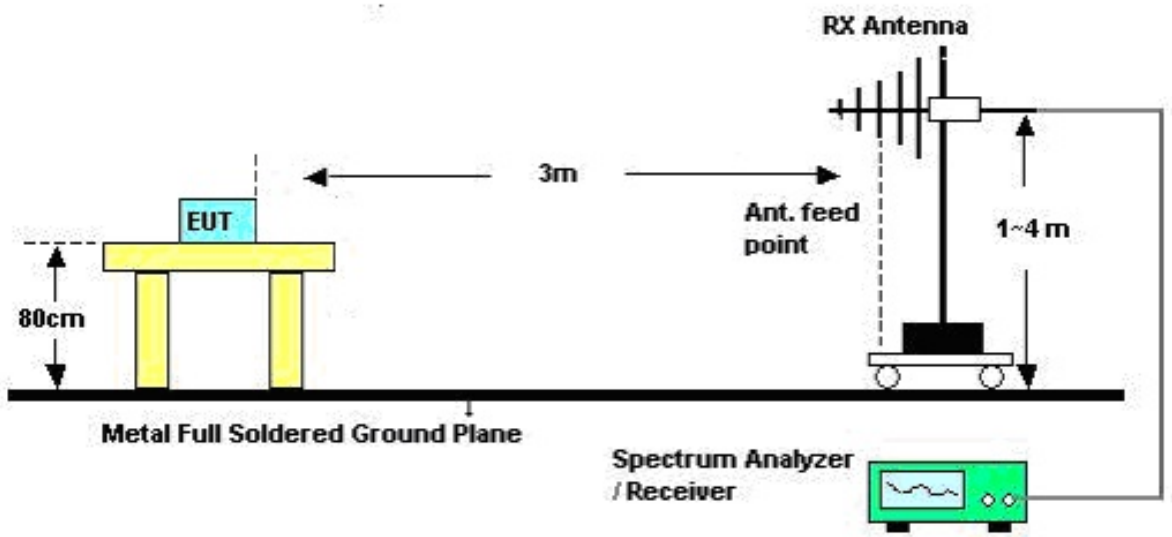
3.5.2 Test Procedures

Method of measurement: Refer as ANSI C63.10-2013, clause 9.12

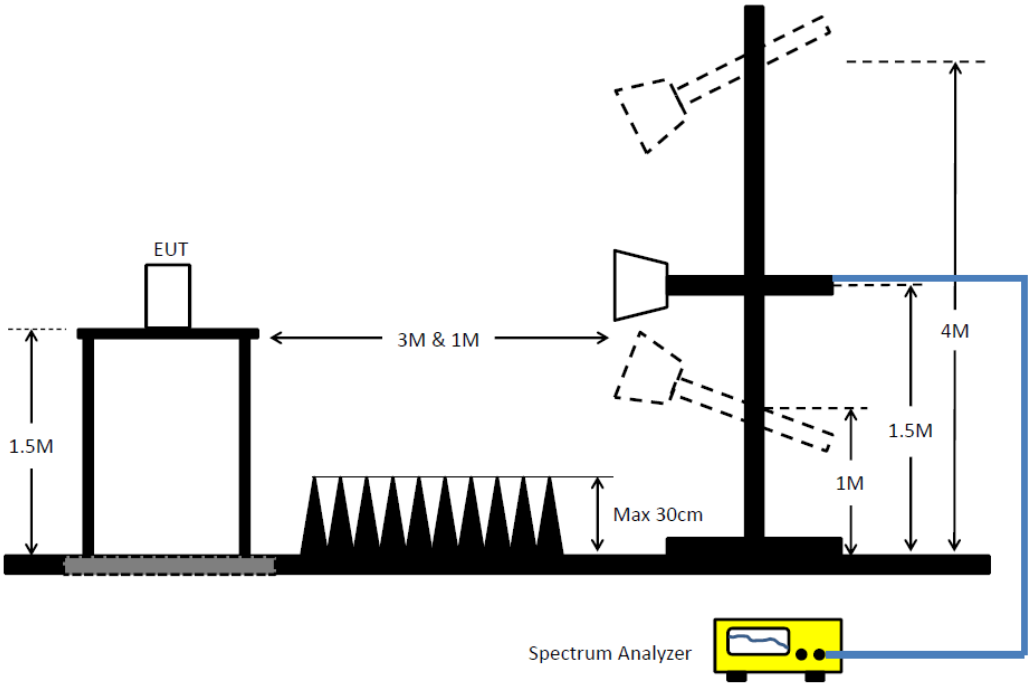
3.5.3 Test Setup

Transmitter Spurious Emissions
9kHz ~30MHz


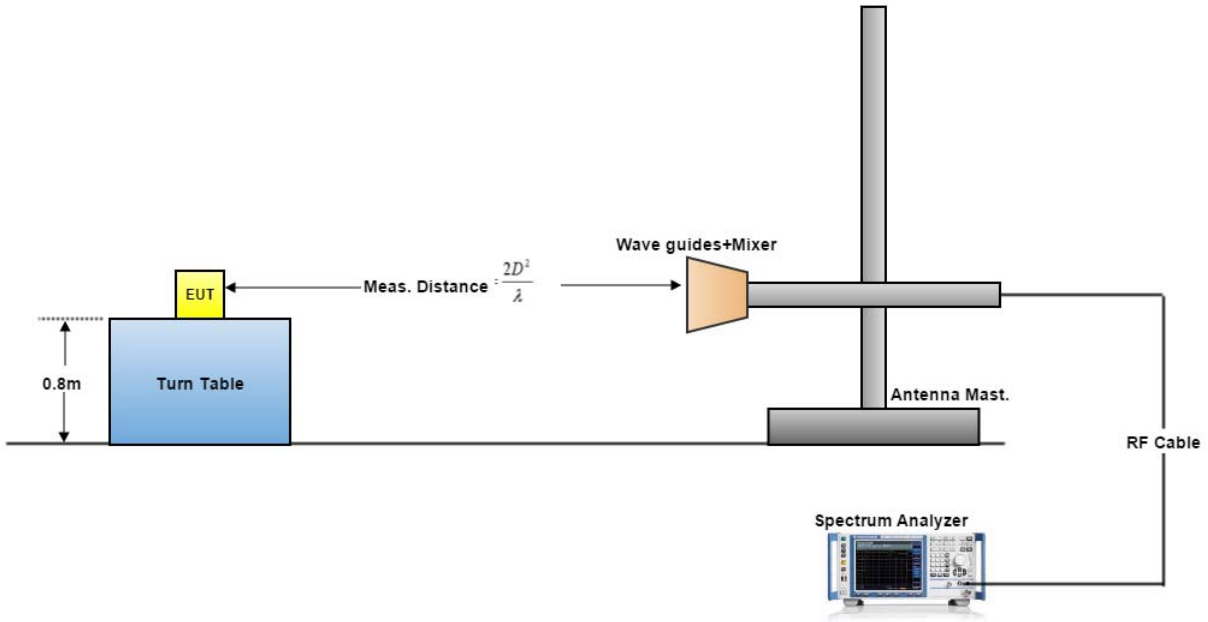
30MHz~1GHz



1GHz ~40GHz



Above 40GHz



A measuring distance of at 3 m shall be used for measurements at frequencies up to 15 GHz. For frequencies above 15 GHz, any suitable measuring distance may be used. The measurement distance is chosen up to far field distance, depending on the test system noise floor for detecting spurious emission signals. Then above 15 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from spec. distance (3 m) to measurement distance. Distance extrapolation factor = 20 log (spec. distance [3 m] / measurement distance [N m]) (dB) .The measurements described in ANSI C63.10, clause 7.8.6. If the emission cannot be detected at 1 m, reduce the RBW to increase system sensitivity. Note the value. If the emission still cannot be detected, move the horn closer to the EUT, noting the distance at which a measurement is made.

3.5.4 Test Result of Transmitter Spurious Emissions

Test Conditions	see ANSI C63.10, clause 5.11 & clause 9
Test Setup	see ANSI C63.10, clause 9.12 、9.13
NOTE: If equipment having different channel plan and nominal channel bandwidth modes (see test report clause 1.1.1), the measurements are uninfluenced by different channel plan and nominal channel bandwidth modes, may not need to be repeated for all modes.	

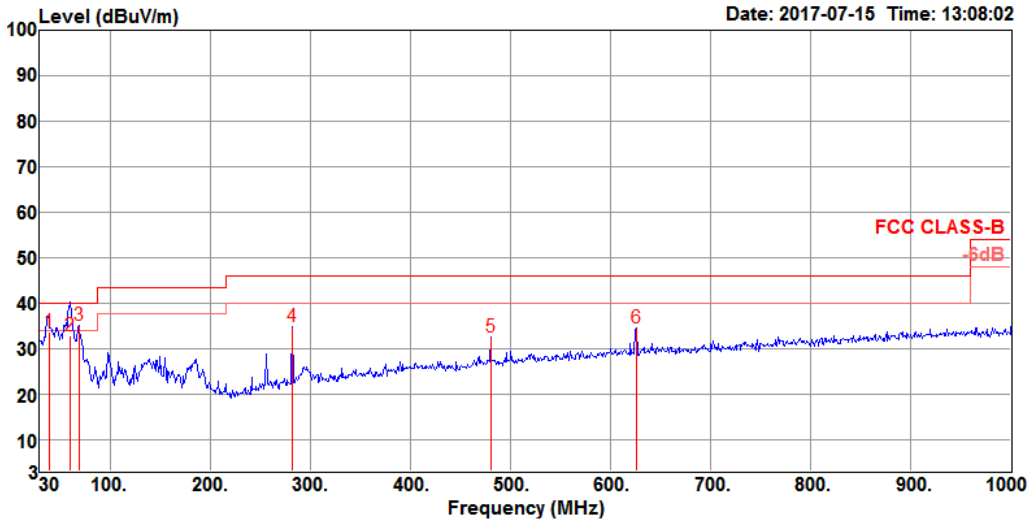
3.5.4.1 Test Result of Transmitter Spurious Emissions (Below 30MHz)

All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

3.5.4.2 Test Result of Transmitter Spurious Emissions

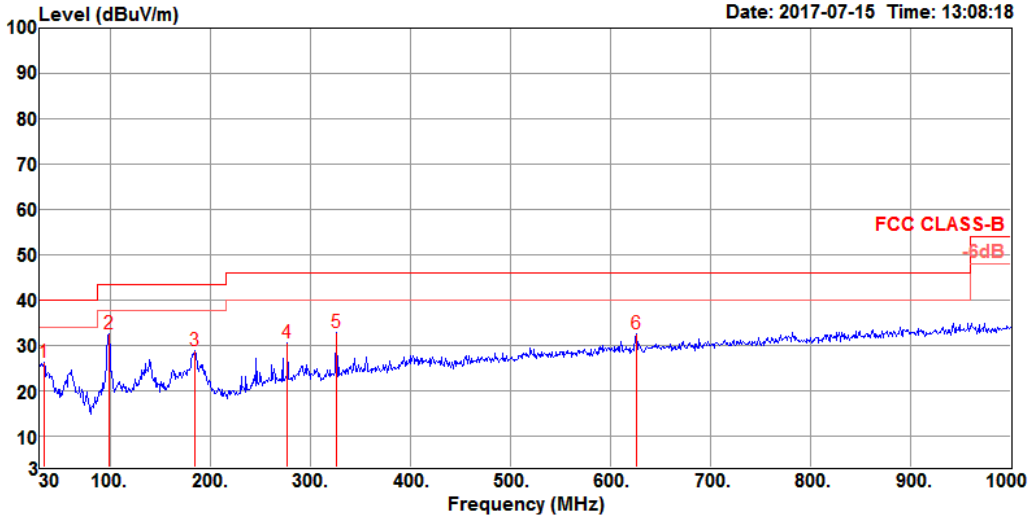
Temp	22°C	**Humidity**	54%
Test Engineer	DK Chang	**Test Distance**	3 m
Test Range	30 MHz – 1000 MHz	**Test Configuration**	CTX

Vertical



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	38.73	33.72	40.00	-6.28	44.70	1.03	20.51	32.52	100	232	QP	VERTICAL
2	60.07	32.67	40.00	-7.33	51.40	1.29	12.50	32.52	150	129	QP	VERTICAL
3	68.80	35.14	40.00	-4.86	53.70	1.38	12.59	32.53	150	341	Peak	VERTICAL
4	282.20	34.67	46.00	-11.33	44.78	2.92	19.42	32.45	150	327	Peak	VERTICAL
5	480.08	32.62	46.00	-13.38	37.72	3.87	23.51	32.48	200	114	Peak	VERTICAL
6	625.58	34.40	46.00	-11.60	37.35	4.44	25.16	32.55	100	146	Peak	VERTICAL

Horizontal



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	33.88	26.26	40.00	-13.74	34.44	0.94	23.41	32.53	150	188	Peak	HORIZONTAL
2	98.87	32.53	43.50	-10.97	46.61	1.67	16.81	32.56	150	351	Peak	HORIZONTAL
3	184.23	28.71	43.50	-14.79	43.32	2.34	15.55	32.50	200	216	Peak	HORIZONTAL
4	277.35	30.38	46.00	-15.62	40.54	2.89	19.40	32.45	150	301	Peak	HORIZONTAL
5	325.85	32.63	46.00	-13.37	41.44	3.15	20.48	32.44	100	338	Peak	HORIZONTAL
6	625.58	32.41	46.00	-13.59	35.36	4.44	25.16	32.55	200	284	Peak	HORIZONTAL

Temp	22°C	Humidity	54%
Test Engineer	DK Chang	Test Distance	3 m
Test Range	1 GHz – 18 GHz	Test Freq. (GHz)	58.32
Test Date	Jul. 08, 2017 ~ Jul. 15, 2017		

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1829.96	49.99	54.00	-4.01	53.40	4.31	25.95	33.67	173	234	Average	VERTICAL
2	1830.26	59.14	74.00	-14.86	62.55	4.31	25.95	33.67	173	234	Peak	VERTICAL

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1830.26	47.18	54.00	-6.82	50.59	4.31	25.95	33.67	169	87	Average	HORIZONTAL
2	1830.26	56.56	74.00	-17.44	59.97	4.31	25.95	33.67	169	87	Peak	HORIZONTAL

Temp	22°C	Humidity	54%
Test Engineer	DK Chang	Test Distance	1 m
Test Range	18 GHz – 40 GHz	Test Freq. (GHz)	58.32
Test Date	Jul. 08, 2017 ~ Jul. 15, 2017		

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	22115.22	35.23	63.54	-28.31	31.16	15.34	38.28	49.55	168	241	Average	VERTICAL
2	22119.36	49.40	83.54	-34.14	45.33	15.34	38.28	49.55	168	241	Peak	VERTICAL

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	22114.00	34.32	63.54	-29.22	30.25	15.34	38.28	49.55	157	138	Average	HORIZONTAL
2	22114.86	49.19	83.54	-34.35	45.12	15.34	38.28	49.55	157	138	Peak	HORIZONTAL

Temp	22°C	Humidity	54%
Test Engineer	DK Chang	Test Distance	3 m
Test Range	1 GHz – 18 GHz	Test Freq. (GHz)	60.48
Test Date	Jul. 08, 2017 ~ Jul. 15, 2017		

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1830.26	49.67	54.00	-4.33	53.08	4.31	25.95	33.67	176	240	Average	VERTICAL
2	1830.26	56.61	74.00	-17.39	60.02	4.31	25.95	33.67	176	240	Peak	VERTICAL

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1830.26	47.67	54.00	-6.33	51.08	4.31	25.95	33.67	176	333	Average	HORIZONTAL
2	1830.26	56.56	74.00	-17.44	59.97	4.31	25.95	33.67	176	333	Peak	HORIZONTAL

Temp	22°C	**Humidity**	54%
Test Engineer	DK Chang	**Test Distance**	1 m
Test Range	18 GHz – 40 GHz	**Test Freq. (GHz)**	60.48
Test Date	Jul. 08, 2017 ~ Jul. 15, 2017		

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	22111.97	49.09	83.54	-34.45	45.02	15.34	38.28	49.55	156	219	Peak	VERTICAL
2	22114.58	33.42	63.54	-30.12	29.35	15.34	38.28	49.55	156	219	Average	VERTICAL

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	22110.70	34.03	63.54	-29.51	29.96	15.34	38.28	49.55	171	238	Average	HORIZONTAL
2	22115.19	49.99	83.54	-33.55	45.92	15.34	38.28	49.55	171	238	Peak	HORIZONTAL

Temp	22°C	**Humidity**	54%
Test Engineer	DK Chang	**Test Distance**	3 m
Test Range	1 GHz – 18 GHz	**Test Freq. (GHz)**	62.64
Test Date	Jul. 08, 2017 ~ Jul. 15, 2017		

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1828.83	57.92	74.00	-16.08	61.33	4.31	25.95	33.67	172	238	Peak	VERTICAL
2	1831.66	50.33	54.00	-3.67	53.74	4.31	25.95	33.67	172	238	Average	VERTICAL

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	1826.98	46.41	54.00	-7.59	49.82	4.31	25.95	33.67	165	238	Average	HORIZONTAL
2	1834.62	56.89	74.00	-17.11	60.28	4.32	25.96	33.67	165	238	Peak	HORIZONTAL

Temp	22°C	**Humidity**	54%
Test Engineer	DK Chang	**Test Distance**	1 m
Test Range	18 GHz – 40 GHz	**Test Freq. (GHz)**	62.64
Test Date	Jul. 08, 2017 ~ Jul. 15, 2017		

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	22116.32	34.18	63.54	-29.36	30.11	15.34	38.28	49.55	162	222	Average	VERTICAL
2	22117.20	49.99	83.54	-33.55	45.92	15.34	38.28	49.55	162	222	Peak	VERTICAL

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	22113.37	49.37	83.54	-34.17	45.30	15.34	38.28	49.55	173	219	Peak	HORIZONTAL
2	22114.03	34.40	63.54	-29.14	30.33	15.34	38.28	49.55	173	219	Average	HORIZONTAL

Temp	22°C	Humidity	54%
Test Engineer	DK Chang	Test Date	Jun. 08, 2017 ~ Jul. 15, 2017
Test Range	40GHz – 200GHz		

Test Frequency (GHz)	Rx Antenna Gain (dBi)	Measurement Distance (m)	Read Worse Frequency (GHz)	Read Level (dBm)
58.32	23	0.5	56.56	-73.65
EIRP (dBm)	**Specification Distance (m)**	**Power Density (pW/m^2)**	**Limit (pW/cm^2)**	**Test Result**
-35.18	3	0.2683	90.00	Complied

Test Frequency (GHz)	Rx Antenna Gain (dBi)	Measurement Distance (m)	Read Worse Frequency (GHz)	Read Level (dBm)
60.48	23	0.5	56.88	-71.78
EIRP (dBm)	**Specification Distance (m)**	**Power Density (pW/m^2)**	**Limit (pW/cm^2)**	**Test Result**
-33.26	3	0.2683	90.00	Complied

Test Frequency (GHz)	Rx Antenna Gain (dBi)	Measurement Distance (m)	Read Worse Frequency (GHz)	Read Level (dBm)
62.64	23	0.5	56.56	-73.02
EIRP (dBm)	**Specification Distance (m)**	**Power Density (pW/m^2)**	**Limit (pW/cm^2)**	**Test Result**
-37.38	3	0.1616	90.00	Complied

3.6 Frequency Stability

3.6.1 Limit of Frequency Stability

Frequency Stability	Limit
Refer as FCC 15.255(e) and ANSI C63.10-2013, clause 9.14	within the frequency bands
Note: These measurements shall also be performed at normal and extreme test conditions.	

3.6.2 Measuring Instruments

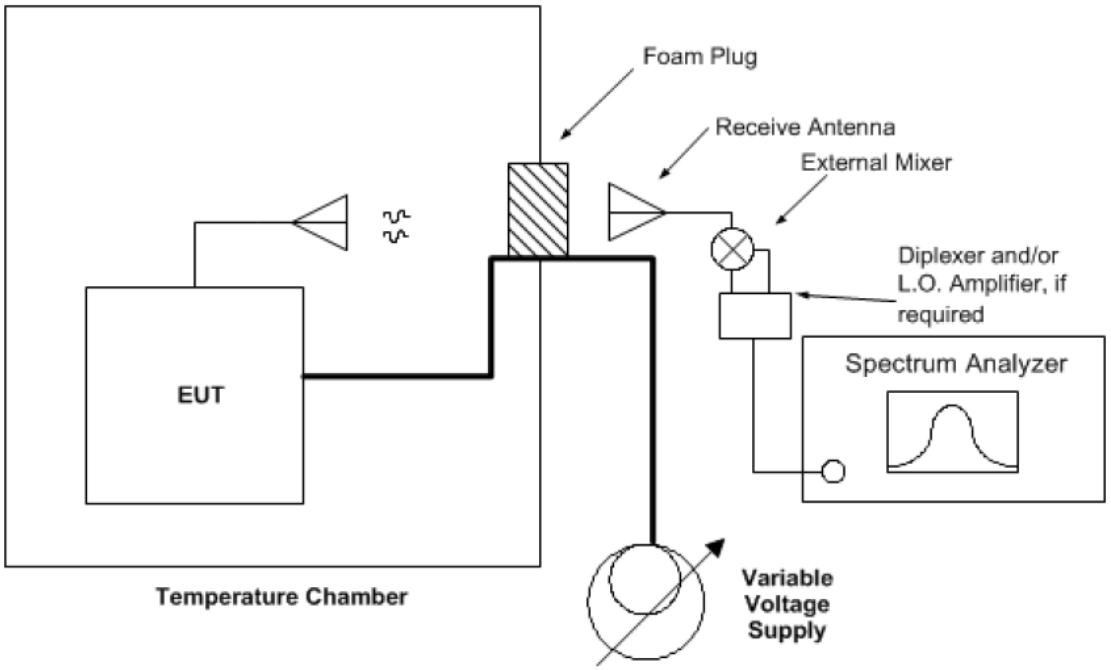
Refer a measuring instruments list in this test report.

3.6.3 Test Procedures

Method of measurement: Refer as ANSI C63.10-2013, clauses 9.14.

3.6.4 Test Setup

Frequency Stability



3.6.5 Test Result of Frequency Stability

Test Conditions	see ANSI C63.10, clause 5.11 & clause 9
Test Setup	see ANSI C63.10, clause 9.14
NOTE: If equipment having different channel plan and nominal channel bandwidth modes (see test report clause 1.1.1), the measurements are uninfluenced by different channel plan and nominal channel bandwidth modes, may not need to be repeated for all modes.	

3.6.5.1 Frequency Stability with Respect to Ambient Temperature

Frequency Stability with Respect to Ambient Temperature			
Temp	22℃	**Humidity**	54%
Test Engineer	DK Chang	**Test Date**	Jul. 08, 2017 ~ Jul. 15, 2017

Test Results

Test Temperature (°C)	Measured Frequency (MHz)	Delta Frequency (kHz)	Limit (±kHz)
0	60548.71	-40	within band
10	60548.74	-10	within band
20	60548.75	Reference	within band
30	60548.71	-40	within band
40	60548.74	-10	within band
50	60548.74	-10	within band

NOTE: The manufacturer's specified temperature range of 0 to 50°C.

3.6.5.2 Frequency Stability When Varying Supply Voltage

Frequency Stability When Varying Supply Voltage			
Temp	22℃	**Humidity**	54%
Test Engineer	DK Chang	**Test Date**	Jul. 08, 2017 ~ Jul. 15, 2017

Test Results

Test Voltage: (Vdc)	Measured Frequency (MHz)	Delta Frequency (kHz)	Limit (±kHz)
93.5	60548.75	0	within band
110	60548.75	Reference	within band
126.5	60548.75	0	within band

3.7 Operation Restriction and Group Installation

3.7.1 Limit of Operation Restriction and Group Installation

Item	Limit
Operation Restriction	Operation is not permitted for the following products: ♦ Equipment used on aircraft or satellites. (Refer as FCC 15.255 (a)) ♦ Field disturbance sensors, including vehicle radar systems, unless the field disturbance sensors are employed for fixed operation. (Refer as FCC 15.255 (a))
Group Installation	Operation is not permitted for the following products: ♦ External phase-locking (Refer as FCC 15.255(g))

3.7.2 Result of Operation Restriction

Manufacturer declares that EUT will not been used on aircraft or satellites. Then user manual will include a statement to caution EUT is not permitted for used on aircraft or satellites. EUT is a wireless video area network (WVAN) for the connection of consumer electronic (CE) audio and video devices.

3.7.3 Result of Group Installation

The frequency, amplitude and phase of the transmit signal are set within the EUT. There are no external phase-locking inputs or any other means of combining two or more units together to realize a beam-forming array.

4 Test Equipment and Calibration Data

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMI Receiver	Agilent	N9038A	My52260123	9kHz ~ 8.45GHz	Jan. 23, 2017	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 14, 2016	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Dec. 21, 2016	Conduction (CO01-CB)
COND Cable	Woken	Cable	01	150kHz ~ 30MHz	May 23, 2017	Conduction (CO01-CB)
Software	Audix	E3	6.120210n	-	N.C.R.	Conduction (CO01-CB)
BILOG ANTENNA with 6dB Attenuator	TESEQ & EMCI	CBL6112D & N-6-06	37880 & AT-N0609	20MHz ~ 2GHz	Aug. 30, 2016	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 16, 2016*	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz ~ 18GHz	Nov. 10, 2016	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 05, 2017	Radiation (03CH01-CB)
Pre-Amplifier	EMCI	EMC330N	980332	20MHz ~ 3GHz	May 02, 2017	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 16, 2017	Radiation (03CH01-CB)
Amplifier	-	-	TF-130N-R1	26GHz ~ 40GHz	Jun. 20, 2017	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Nov. 22, 2016	Radiation (03CH01-CB)
EMI Test	R&S	ESCS	100355	9kHz ~ 2.75GHz	May 06, 2017	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-16+17	N/A	30 MHz ~ 1 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16	N/A	1 GHz ~ 18 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16+17	N/A	1 GHz ~ 18 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#1	N/A	18GHz ~ 40 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G#2	N/A	18GHz ~ 40 GHz	Oct. 24, 2016	Radiation (03CH01-CB)
Test Software	Audix	E3	6.2009-I0-7	N/A	N/A	Radiation (03CH01-CB)
Mixer	OML	M19HW/A	U91113-1	40 ~ 60 GHz	Sep. 09, 2015*	Radiation (03CH01-CB)
Mixer	OML	M15HW/A	V91113-1	50 ~ 75 GHz	Sep. 14, 2015*	Radiation (03CH01-CB)
Mixer	OML	M12HW/A	E91113-1	60 ~ 90 GHz	Sep. 17, 2015*	Radiation (03CH01-CB)

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Mixer	OML	M08HW/A	F91113-1	90 ~ 140 GHz	Sep. 21, 2015*	Radiation (03CH01-CB)
Mixer	OML	M05HW/A	G91113-1	140 ~ 220 GHz	Sep. 24, 2015*	Radiation (03CH01-CB)
Mixer	OML	M03HWD	120320-1	220 ~ 325 GHz	Sep. 29, 2015*	Radiation (03CH01-CB)
Detector	Millitech	DET-15-RPFW0	#A16473(038)	50 ~ 75 GHz	Dec. 29, 2015*	Radiation (03CH01-CB)
Pico Scope	Pico	Pico Scope 6402C	CX372/002	N/A	Jul. 26, 2017	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M19RH	U91113-A	40 ~ 60 GHz	Sep. 09, 2015*	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M15RH	V91113-A	50 ~ 75 GHz	Sep. 14, 2015*	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M12RH	E91113-A	60 ~ 90 GHz	Sep. 17, 2015*	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M08RH	F91113-A	90 ~ 140 GHz	Sep. 21, 2015*	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M05RH	G91113-A	140 ~ 220 GHz	Sep. 24, 2015*	Radiation (03CH01-CB)
Standard Horn Antenna	Custom Microwave	M03RH	120320-A	220 ~ 325 GHz	Sep. 29, 2015*	Radiation (03CH01-CB)
Spectrum analyzer	R&S	FSV40	100979	9kHz~40GHz	Dec. 26, 2016	Conducted (TH01-CB)
Temp. and Humidity Chamber	Ten Billion	TTH-D3SP	TBN-931011	-30~100 degree	Jun. 02, 2017	Conducted (TH01-CB)

Note: Calibration Interval of instruments listed above is one year.

"*" Calibration Interval of instruments listed above is two years.

N.C.R. means Non-Calibration required.

5 Measurement Uncertainty

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	3.2 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	3.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	3.5 dB	Confidence levels of 95%
Radiated Emission (40GHz ~ 220GHz)	4.7 dB	Confidence levels of 95%
Temperature	0.7°C	Confidence levels of 95%