TEST REPORT

Dt&C Co., Ltd.
42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2507-0047

2. Customer

   • Name (FCC) : Miliwave Co., Ltd.

   • Address (FCC) : 504, 106-40 Gwahakdanji-ro, Gangneung-si, Gangwon-do, South Korea 25440

3. Use of Report : FCC Original Certification

4. Product Name / Model Name : airPATH 60 TWIX / MWC-441

   FCC ID : 2AVCWMWC-441

5. FCC regulation(s): Part 15.255

   Test Method Used: ANSI C63.10-2020

6. Date of Test : 2025.07.08 ~ 2025.07.24

7. Testing Environment : Refer to appended test report.

8. Test Result : Refer to the attached test result.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test report is not related to KOLAS accreditation.

Affirmation	Tested by Name : SeokHo Han (Signature)	Technical Manager Name : JaeJin Lee (Signature)

2025 . 07 . 24 .

Dt&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description	Revised By	Reviewed By
DRTFCC2507-0047	Jul. 24, 2025	Initial issue	Seokho Han	JaeJin Lee

Table of Contents

1. General Information

1.1. Description of EUT

FCC Equipment Class	DXX - Part 15 Low Power Communication Device Transmitter
Product	airPATH 60 TWIX
Model Name	MWC-441
Add Model Name	-
Serial Number	No Specified
Power Supply	DC 5 V
Frequency Range	802.11ad: 58.32 ~ 64.80 GHz
Max. RF Output Power (EIRP)	802.11ad : 24.01 dBm
Modulation Type	Single carrier modulation
Data Rate	MCS 0 ~ 12 (Max data rate: 4 620 Mbps)
Antenna Specification	**Antenna type**: PCB array antenna **Antenna gain(Max)**: 10 dBi

1.2. Declaration by the applicant / manufacturer

N/A

1.3. Testing Laboratory

Dt&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of Part 2.948 according to ANSI C63.4-2014. **- FCC & ISED MRA Designation No. : KR0034** **- ISED#: 5740A**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

1.4. Testing Environment

Ambient Condition	
▪ Temperature	+20 ℃ ~ +23 ℃
▪ Relative Humidity	+41 % ~ +44 %

1.5. Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.10-2020. All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

Parameter	Measurement uncertainty
AC power-line conducted emission	3.4 dB (The confidence level is about 95 %, k = 2)
Radiated emission (1 GHz Below)	5.0 dB (The confidence level is about 95 %, k = 2)
Radiated emission (1 GHz ~ 18 GHz)	4.8 dB (The confidence level is about 95 %, k = 2)
Radiated emission (18 GHz Above)	5.8 dB (The confidence level is about 95 %, k = 2)

1.6. Test Equipment List

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal. Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent	N9020A	24/11/27	25/11/27	MY50110097
Spectrum Analyzer	Rohde Schwarz	FSW85	25/05/29	26/05/29	101778
Thermohygrometer	XIAOMI	MHO-C201	24/11/27	25/11/27	00089675
Thermohygrometer	BODYCOM	BJ5478	24/12/05	25/12/05	120612-2
Multimeter	FLUKE	17B+	24/11/27	25/11/27	36390701WS
Signal Generator	Rohde Schwarz	SMBV100A	24/12/10	25/12/10	255571
Signal Generator	ANRITSU	MG3695C	24/11/29	25/11/29	173501
DC Power Supply	SM techno	SDP30-5D	25/05/29	26/05/29	305DMG288
DC Power Supply	SM techno	SDP30-5D	25/05/29	26/05/29	305DMG291
Loop Antenna	ETS-Lindgren	6502	24/11/08	25/11/08	00060496
Hybrid Antenna	Schwarzbeck	VULB 9160	24/12/13	25/12/13	3362
PreAmplifier	H.P	8447D	24/12/11	25/12/11	2944A07774
HORN ANT	ETS	3117	25/05/27	26/05/27	00143278
PreAmplifier	tsj	MLA-0118-B01-40	24/11/26	25/11/26	1852267
HORN ANT	A.H.Systems	SAS-574	25/06/12	26/06/12	155
PreAmplifier	tsj	MLA-1840-J02-45	25/05/29	26/05/29	16966-10728
Horn Antenna	MI Wave	RX ANT-5 261U+410U	25/06/12	26/06/12	108
PreAmplifier	Norden Millimeter Inc.	NA4060G50N8P12	24/12/13	26/12/13	1003
Horn Antenna	MI Wave	RX ANT-6 261V+410V	25/06/12	26/06/12	110
PreAmplifier	ERAVABT	SBL-5037533550-151-E1-ET	24/12/13	25/12/13	10394-01
Horn Antenna	MI Wave	RX ANT-7 261E	25/06/12	26/06/12	112
PreAmplifier	Norden Millimeter Inc.	NN6090G40N5P-2	24/12/13	26/12/13	1001
Harmonic mixer	Rohde Schwarz	FS-Z90	25/06/12	26/06/12	101714
Horn Antenna	MI Wave	RX ANT-8 261F	25/06/12	26/06/12	114
Harmonic mixer	Rohde Schwarz	FS-Z140	25/06/12	26/06/12	101009
Horn Antenna	MI Wave	RX ANT-9 261G	25/06/12	26/06/12	116
Harmonic mixer	Rohde Schwarz	FS-Z220	25/06/12	26/06/12	101012
RF Detector	SAGE Millimeter	SFD-503753-15SF-P1	24/12/09	25/12/09	17841-01
Digital Phosphor	Tektronix	DPO2024B	24/12/13	25/12/13	C012114
Level setting Attenuator	SAGE Millimeter	STA-30-15-M1	24/12/09	25/12/09	10390-01
Level setting Attenuator	SAGE Millimeter	STA-30-12-M3-2	24/12/09	25/12/09	10391-01
Temp & Humi Test Chamber	SJ Science	SJ-TH-S50	24/12/06	25/12/06	U5542113
Multiplier	OML, Inc.	S12MS	25/06/12	26/06/12	170821-1
Multiplier	OML, Inc.	S15MS	25/06/12	26/06/12	170821-1
EMI Test Receiver	ROHDE&SCHWARZ	ESCI7	25/01/20	26/01/20	100910
PULSE LIMITER	ROHDE&SCHWARZ	ESH3-Z2	25/07/10	26/07/10	101333
LISN	SCHWARZBECK	NSLK 8128 RC	24/10/21	25/10/21	8128 RC-387
Thermo HygroMeter	CAS	TE-303N	25/02/13	26/02/13	220502531
High Pass Filter	Wainwright Instruments	WHKX12-935-1000-15000-40SS	25/06/12	26/06/12	8
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300-18000-60SS	25/06/12	26/06/12	1
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5-6SS	25/06/12	26/06/12	3
Cable	DT&C	Cable	25/01/02	26/01/02	G-2
Cable	HUBER+SUHNER	SUCOFLEX 100	25/01/02	26/01/02	G-3
Cable	DT&C	Cable	25/01/02	26/01/02	G-4
Cable	OMT	YSS21S	25/01/02	26/01/02	G-5
Cable	Junkosha	MWX241	25/01/02	26/01/02	mmW-1

Cable	Junkosha	MWX241	25/01/02	26/01/02	mmW-4
Cable	HUBER+SUHNER	SUCOFLEX100	25/01/02	26/01/02	M-1
Cable	HUBER+SUHNER	SUCOFLEX100	25/01/02	26/01/02	M-2
Cable	JUNKOSHA	MWX241/B	25/01/02	26/01/02	M-3
Cable	JUNKOSHA	J12J101757-00	25/01/02	26/01/02	M-7
Cable	HUBER+SUHNER	SUCOFLEX106	25/01/02	26/01/02	M-9
Cable	DTNC	Cable	25/01/02	26/01/02	RFC-69
Cable	Junkosha	MWX261	25/01/02	26/01/02	mmW-7
Cable	Junkosha	MWX261	25/01/02	26/01/02	mmW-15
Cable	SAGE MILLIMETER Inc	SCW-1M1M024-F1	25/01/02	26/01/02	mmW-10
Cable	HUBER+SUHNER	SUCOFLEX 104	25/01/02	26/01/02	mmW-8
Cable	HUBER+SUHNER	SUCOFLEX 104	25/01/02	26/01/02	mmW-9
Test Software	tsj	Radiated Emission Measurement	NA	NA	Version 2.00.0185
Test Software	tsj	Noise Terminal Measurement	NA	NA	Version 2.00.0190
3m Semi Anechoic Chamber	SYC	3m-SAC	25/06/13(NSA) 25/06/19(VSWR)	26/06/13(NSA) 26/06/19(VSWR)	3m-SAC-1
3m Semi Anechoic Chamber	SYC	3m-SAC	25/01/14(NSA) 25/01/17(VSWR)	26/01/14(NSA) 26/01/17(VSWR)	3m-SAC-2

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.
Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

2. Test Methodology

The measurement procedures described in the ANSI C63.10-2020 was used in measurement of the EUT.

2.1. EUT configuration

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

2.2. EUT exercise

The EUT was operated in the test mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.255 under the FCC Rules Part 15 Subpart C.

2.3. General test procedures

Conducted Emissions

The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector

Radiated Emissions

The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axes.

2.4. Instrument Calibration

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

2.5. Description of test modes

The EUT has been tested with all modes of operating conditions to determine the worst case emission characteristics. A test program is used to control the EUT for staying in continuous transmitting mode.

Test Mode	Worst case data rate	Test Frequency(GHz)
802.11ad	MCS 9 (ANT Beamforming Index b)	58.32 GHz (Ch.1)
		60.48 GHz (Ch.2)
		64.80 GHz (Ch.4)

Note: The worst case data rate is determined according to the power measurements

Operation Test setup for EUT

-Tera term / Power setting value: EUT default value

3. Antenna Requirements

▣ **According to Part 15.203**

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

The antenna is permanently attached on the main PCB.
Therefore this E.U.T complies with the requirement of Part 15.203

4. Summary of Test Results

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Status Note 1
15.215(c)	20dB Bandwidth	NA	Radiated	C
15.255(e)(2)	6 dB Bandwidth	NA		C
15.255(c)(1)	Equivalent Isotropic Radiated Power	Peak < 43 dBm Average < 40 dBm		C Note2
15.255(e)(1)	Peak Conducted Output Power	< 500 mW		C
15.255(d) 15.209	Unwanted emissions	Refer to the section 5.3		C Note2
15.255(f)	Frequency Stability	Within the frequency band		C
15.207	AC Line Conducted Emissions	< Part 15.207 limits (Refer to the section 5.5)	AC Line Conducted	C
15.203	Antenna Requirements	Part 15.203 (Refer to the section 3)	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable
Note 2: This test item was performed in three orthogonal EUT positions and the worst case data was reported.

5. Test Results

5.1. Emission Bandwidth

▣ Test Requirements and limit

Part 15.215(c)

The 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Part 15.255(e)(2)

Devices other than field disturbance sensors/radars with an emission bandwidth of less than 100 megahertz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 megahertz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, **as measured with a 100 kilohertz resolution bandwidth spectrum analyzer.** The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (*e.g.,* for frequency hopping devices).

▣ Test Configuration:

Refer to the APPENDIX I.

▣ Test Procedure:

ANSI C63.10-2020 – Section 9.3

The following procedure shall be used for measurement of the bandwidth for millimeter-wave devices.

- Spectrum analyzer settings:
  1) Span equal to approximately 1.5 times the EBW, centered on the carrier frequency
  2) RBW, prefer 1% to 5% of EBW, or a minimum of 1 MHz if this is not possible due to a large EBW, unless otherwise specified by the applicable rule
  3) VBW approximately 3 × RBW
  4) Set the reference level of the instrument as required to reduce the chance of the signal amplitude exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.1.6.
  5) Sweep = No faster than coupled (auto) time.
  6) Detector function = peak.
  7) Trace = max-hold..

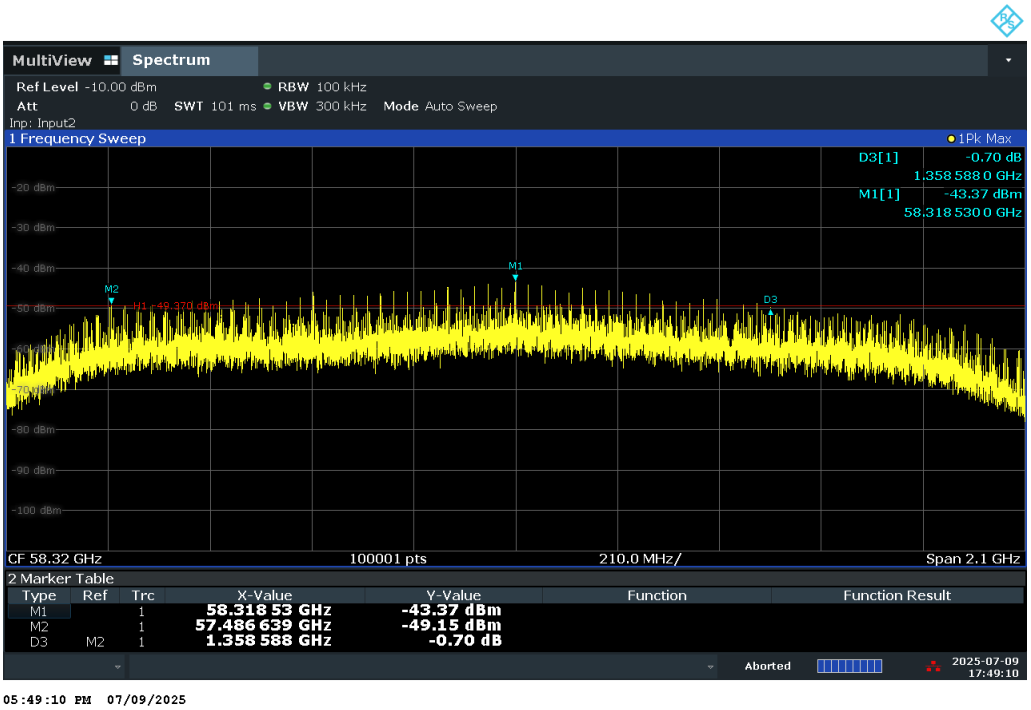
▣ Test Results: Comply

Test Mode	Data Rate	Frequency (GHz)	6 dB Bandwidth (MHz)	20 dB Bandwidth (MHz)
802.11ad	MCS 9	58.32	1358.588	2183.66
		60.48	1136.842	2094.60
		64.80	1334.354	2115.89

▣ Result plots

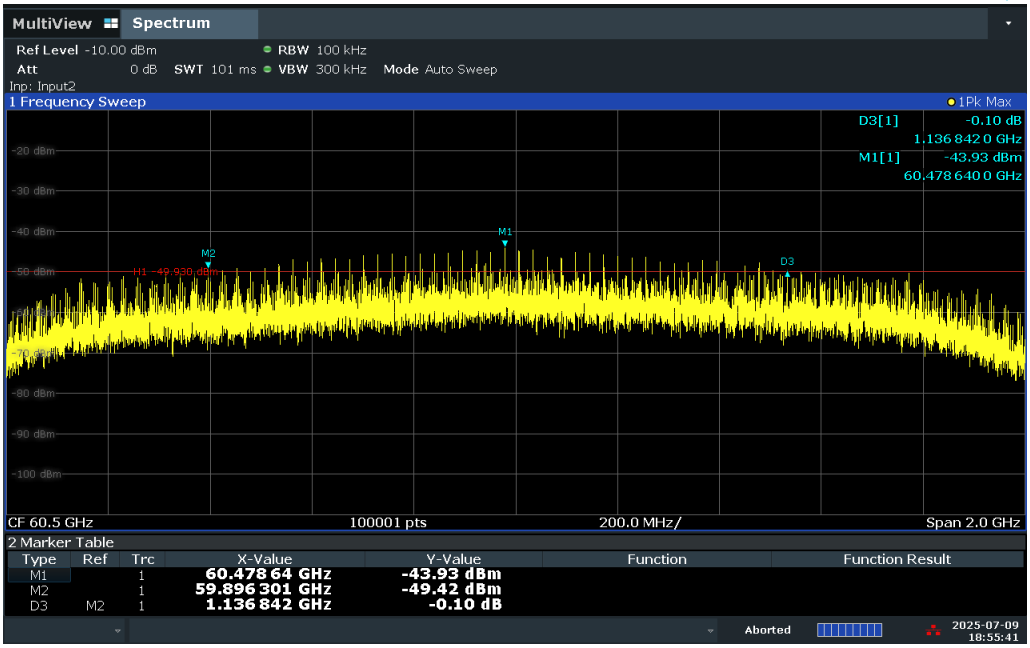
6 dB Bandwidth

Tested Frequency: 58.32 GHz



6 dB Bandwidth

Tested Frequency: 60.48 GHz



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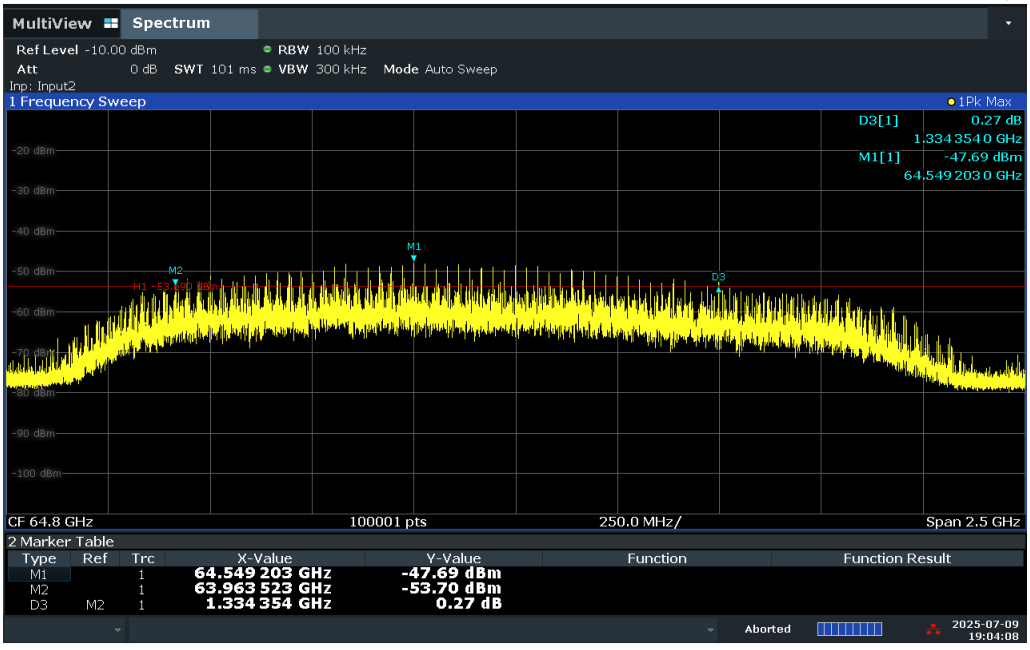
6 dB Bandwidth

Tested Frequency: 64.80 GHz



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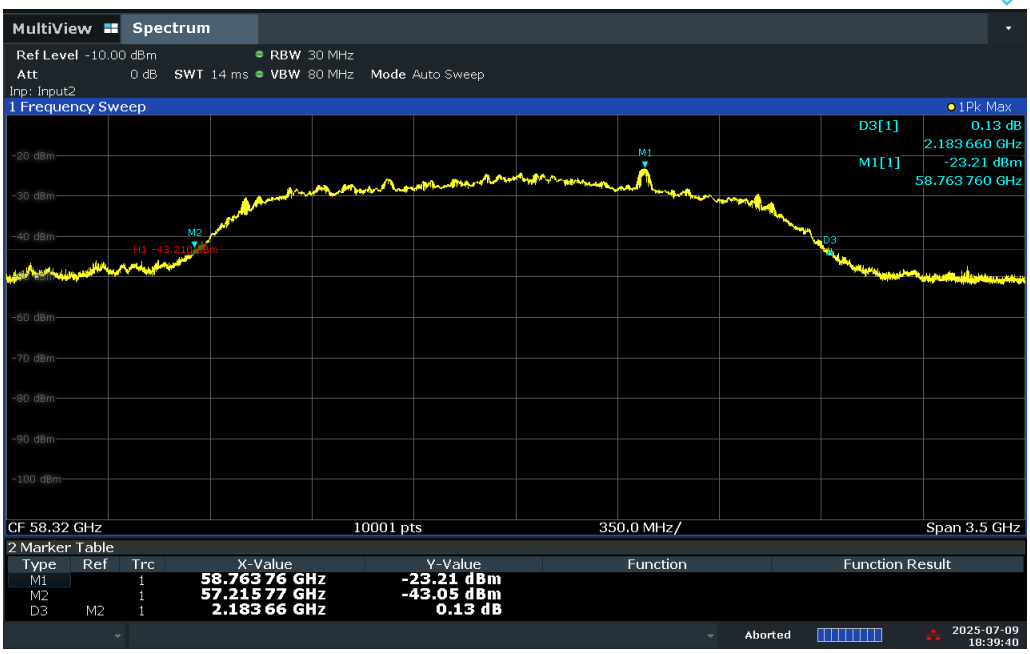
20 dB Bandwidth

Tested Frequency: 58.32 GHz



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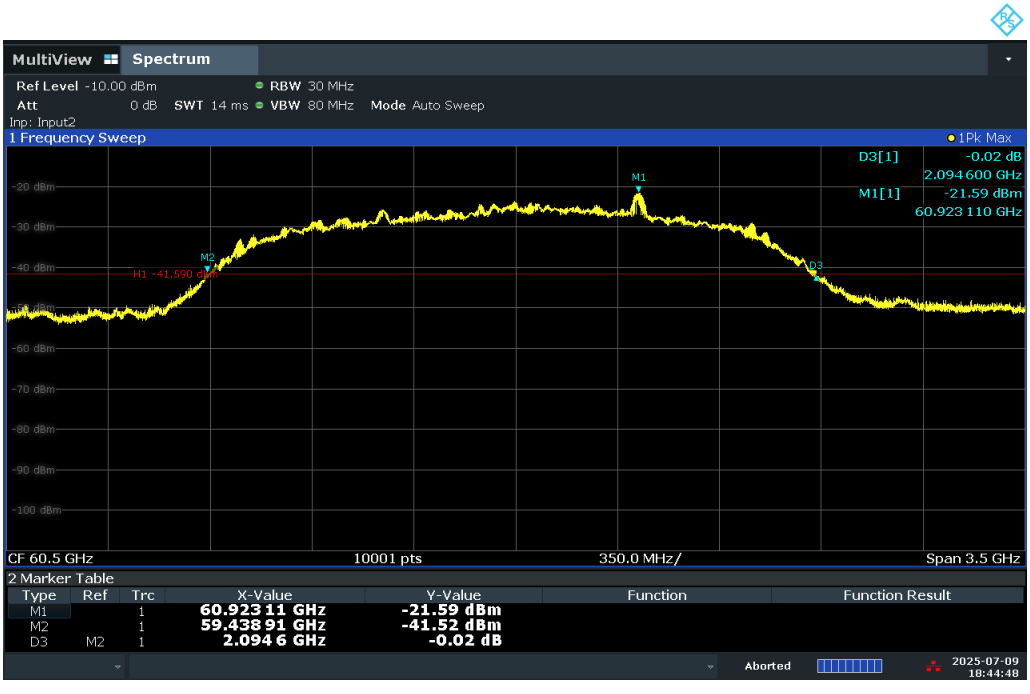
20 dB Bandwidth

Tested Frequency: 60.48 GHz



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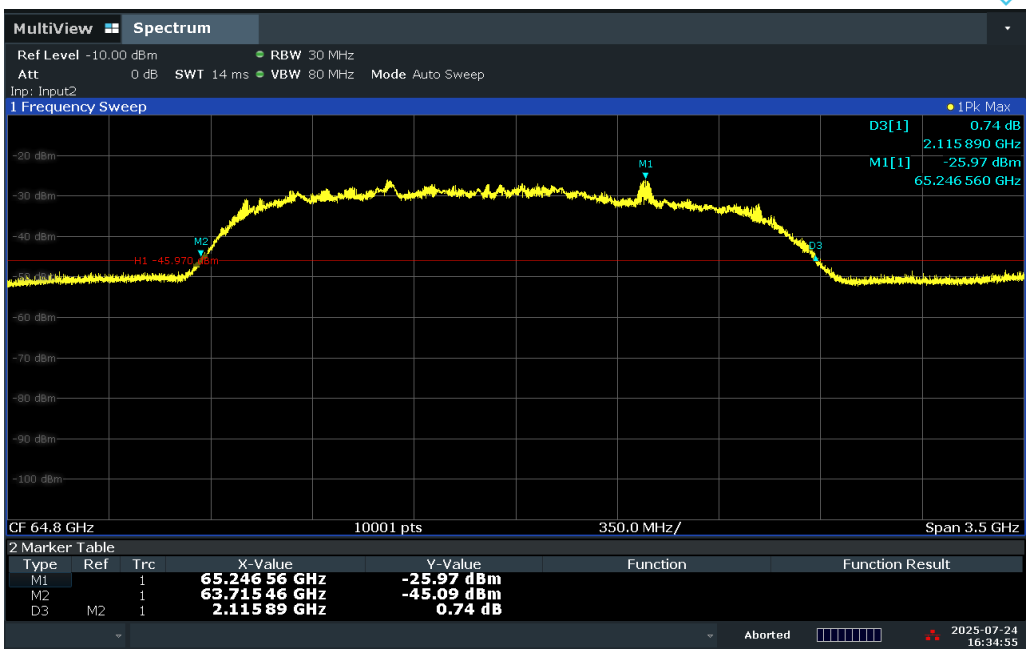
20 dB Bandwidth

Tested Frequency: 64.80 GHz



5.2. Equivalent Isotropic Radiated Power & Peak Conducted Output Power

▣ Test Requirements and limit

Part 15.255(c): Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

(1) Devices other than field disturbance sensors shall comply with one of the following power limits, as measured during the transmit interval:

(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or

(ii) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

▣ Test Configuration:

Refer to the APPENDIX I.

▣ Test Procedure:

The following procedure was used for measurement of the Peak output power for millimeter-wave devices;

ANSI C63.10-2020 – Section 9.9

1) The measurements were performed at 3m test site.
2) The EUT is placed on a non-conductive table is 1.5 meter above test site ground plane.
3) The measurement procedure described in ANSI C63.10-2020 Section 9.9 was followed, to find maximum signal.
4) Record the peak voltage from the DSO and record the average voltage during the ON time of the EUT from the DSO.
5) Replace the EUT with mm-wave source to the RF input port of the instrumentation system.
6) The mm-wave source is unmodulated.
7) Adjust the amplitude of the mm-wave source such that the DSO indicates a voltage equal to the peak voltage recorded in step 4).
8) Without changing any settings, replace the DSO with the mm-wave power meter.
9) Measure and note the power.

Note: Spectrum analyzer was used instead of power meter when measuring power in step 8~9.

The following procedure was used for measurement of the Average output power for millimeter-wave devices;

ANSI C63.10-2020 – Section 9.9

1) Place the measurement antenna at a measurement distance that is in the far-field of the measurement antenna, in the far-field of the EUT antenna, and meets the measurement distance requirements for final radiated measurements as specified in 9.1.4 of ANSI C63.10-2020.

Place the measurement antenna in the main beam of the EUT then maximize the fundamental emission using the procedures of 9.7 of ANSI C63.10-2020 , noting that multiple peaks can be found at different beam orientations and/or polarizations.

2) Place the measurement antenna in the main beam of the EUT then maximize the fundamental emission using the procedures of 9.7 of ANSI C63.10-2020, noting that multiple peaks can be found at different beam orientations and/or polarizations.

3) Correct the power reading from the spectrum analyzer for any external gain and/or attenuation between the measurement antenna and the spectrum analyzer. This is the power at the output of the measurement antenna

4) Calculate the EIRP from the power at the output of the measurement antenna using Equation

(22), and then convert to linear form using Equation (24).

5) Where applicable, calculate conducted output power from the EIRP using Equation (27).

Note:

1) For pulsed emissions, the procedures in 4.1.5.2.4 and Annex C of ANSI C63.10-2020 shall be used.

2) For FMCW emissions, the procedures in 4.1.5.2.8 and Annex L of ANSI C63.10-2020 shall be used.

3) For any other emission, set spectrum analyzer RBW, VBW, detector, span, and so on, to the proper values.

Average measurements were measured by setting the analyzer as follow:

1. RBW = 1 MHz
2. VBW ≥ 3 x RBW.
3. Sweep time: Auto-couple
5. Detector = power averaging (rms).
6. Set sweep trigger to “free run”
8. Compute power by integrating the spectrum across the OBW of the signal using the instrument’s channel power measurement function with band/channel limits set equal to the OBW band edges.
10. Add 10 log (1/duty cycle) to the measured power level to compute the average power during continuous transmission.

Far field distance (R_m)

$R_m = 2D^2 / \lambda$,

Where, D=the largest dimension of the antenna / λ=the wavelength of the emissions

Frequency Range(GHz)	λ (cm)	D (cm)	Rm (m)	Measurement Distance(m)
57.24 ~ 65.88	0.46	5.68	1.42	1.7

Note: The dimension of the antenna of the EUT antenna or measurement antenna, whichever is largest, was used.

▣ Test Results: Comply

Peak Power(e.i.r.p)

Measurement distance(D)	Frequency (GHz)	ANT Pol	DSO Reading [mV]	Spectrum Analyzer Level[dBm]	Antenna Gain [dBi]	E (dBuV/m)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1.7 m	58.32	H	7.08	-25.07	24.40	123.10	23.01	43.00	19.99
1.7 m	60.48	H	10.20	-24.24	24.55	124.10	24.01	43.00	18.99
1.7 m	64.80	H	8.60	-25.21	24.70	123.58	23.49	43.00	19.51

Note.

1. The EIRP was investigated under all data rate and the worst case data was reported.
2. Sample calculation.

$E = 126.8 – 20\log(\lambda) + P – G.$

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

$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$

where

EIRP is the equivalent isotropically 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

Peak Conducted Output Power:

Frequency (GHz)	EIRP(dBm)	EUT Antenna Gain(dBi)	Conducted Output Power(dBm)	Limit (dBm)	Margin (dB)
58.32	23.01	10.00	13.01	26.99	13.98
60.48	24.01	10.00	14.01	26.99	12.98
64.80	23.49	10.00	13.49	26.99	13.50

Note. Calculate the conducted output power (in watts) from the EIRP using Equation:

$P_{cond} = EIRP_{Linear} / G_{EUT}$

Where

P_{cond} is the conducted output power, in W

$EIRP_{Linear}$ is the equivalent isotropically radiated power, in W

G_{EUT} is numeric gain of the EUT radiating element (antenna)

Average Power(e.i.r.p)

Measurement distance(D)	Frequency (GHz)	ANT Pol	λ (m)	Measured level (dBm)	CF (dB)	P (dBm)	G (dBi)	DCCF (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1.7 m	58.32	H	0.0051	-23.14	-8.09	-31.23	24.40	4.29	21.10	43.00	21.90
1.7 m	60.48	H	0.0050	-23.18	-7.86	-31.04	24.55	4.29	21.31	43.00	21.69
1.7 m	64.80	H	0.0046	-27.22	-6.48	-33.70	24.70	4.29	19.22	43.00	23.78

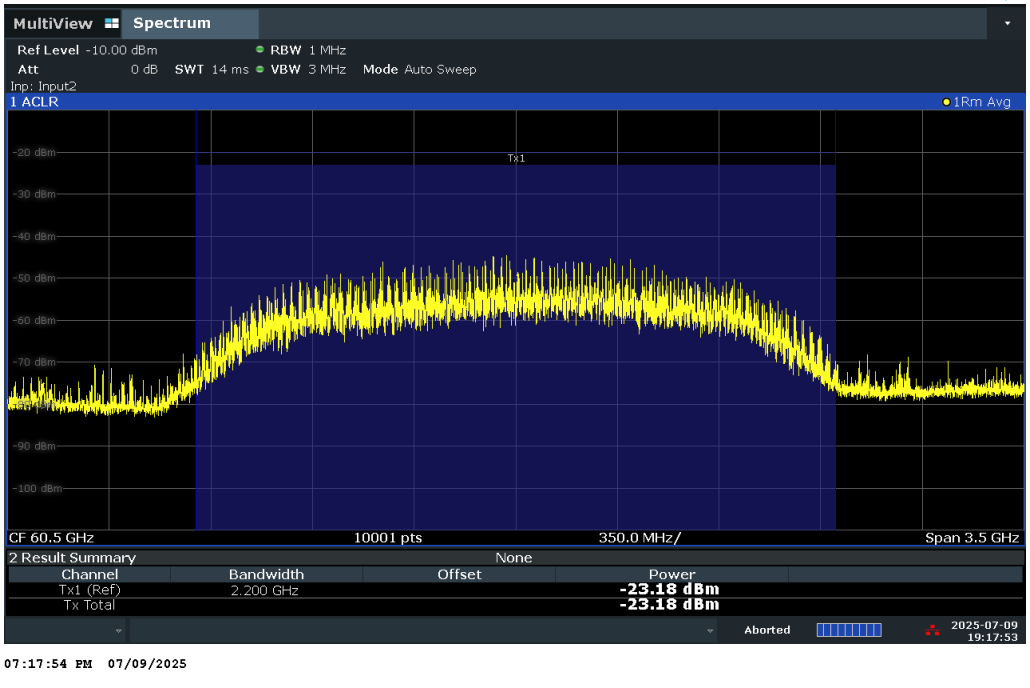
Note.

1. Sample calculation.

EIRP = 21.98 - 20log(λ) + 20 log(d_{Mea}) + P – G + DCF
P(dBm) = Measured level(dBm) + CF(dB)
Where,
λ is the wavelength of the emission under investigation [300/*f*(MHz)], in m
d_{Meas} is the measurement distance, in m
P is the power measured at the output of the measurement antenna, in dBm
G is the gain of the measurement antenna, in dBi
CF = Correction factor up to the connection to the measurement antenna / CF(dB) = Cable Loss(dB) + Attenuator Loss(dB) – Amplifier Gain(dB)
DCCF = Duty Cycle Correction Factor
Duty Cycle Correction Factor Calculation

Data Rate	T_{on}(us)	T_{on+off} (us)	Duty cycle = T_{on} / (T_{on+off})	10 log (1/duty cycle)
MCS9	6.00	16.10	0.373	4.29 dB

Worst data plot (Measured Level) 60.48 GHz & Y axis & Hor



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5.3. Unwanted emissions

▣ Test Requirements and limit

FCC Part 15.255(d): Limits on spurious emissions

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

FCC Part 15.209(a): the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 – 0.490	2 400/F (kHz)	300
0.490 – 1.705	2 4000/F (kHz)	30
1.705 – 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

** Except as provided in 15.209(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.

▣ Test Configuration:

Refer to the APPENDIX I.

▣ Test Procedure:

ANSI C63.10-2020 – Section 9.10 & 9.11

The following procedure was used for measurement of the radiated spurious emissions.

1) The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements at above 1 GHz, the table height is 1.5 m

2) The table was rotated 360 degrees to determine the position of the highest radiation.

3) 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 0.5 ~ 3 meter away from the interference-receiving antenna.

4) For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.

5) The antenna is a broadband 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.

6) 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.

7) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

Spectrum analyzer settings:

1. Frequency Range: Below 1GHz
RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak

2. Frequency Range: 1 ~ 40GHz
Peak Measurement
RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes
Average Measurement
RBW = 1 MHz, VBW ≥ Reduce the video bandwidth until no significant variations in the displayed signal are observed in subsequent traces, provided the video bandwidth is no less than 1 Hz. For regulatory requirements that specify averaging only over the transmit duration (e.g., digital transmission system [DTS] and Unlicensed National Information Infrastructure [U-NII]), the video bandwidth shall be greater than [1 / (minimum transmitter on time)] and no less than 1 Hz.
Detector = Peak, Sweep Time = Auto, Trace Mode = Max Hold until the trace stabilizes

3. Frequency Range: Above 40GHz
RBW = 1 MHz, VBW = 3 MHz, Detector = RMS, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes

Far field distance (R_m)

$R_m = 2D^2 / \lambda$

Where, D=the largest dimension of the measurement antenna / λ=the wavelength of the emissions

Frequency Range(GHz)	λ (cm)	D(cm)	Rm (m)	Measurement Distance(m)
40 ~ 60	0.500	6.24	1.56	1.70
60 ~ 90	0.333	4.82	1.39	1.70
90 ~ 140	0.214	2.74	0.70	0.70
140 ~ 200	0.150	1.89	0.48	0.50

▣ Test Results: Comply

Frequency Range: 9 kHz ~ 1 GHz

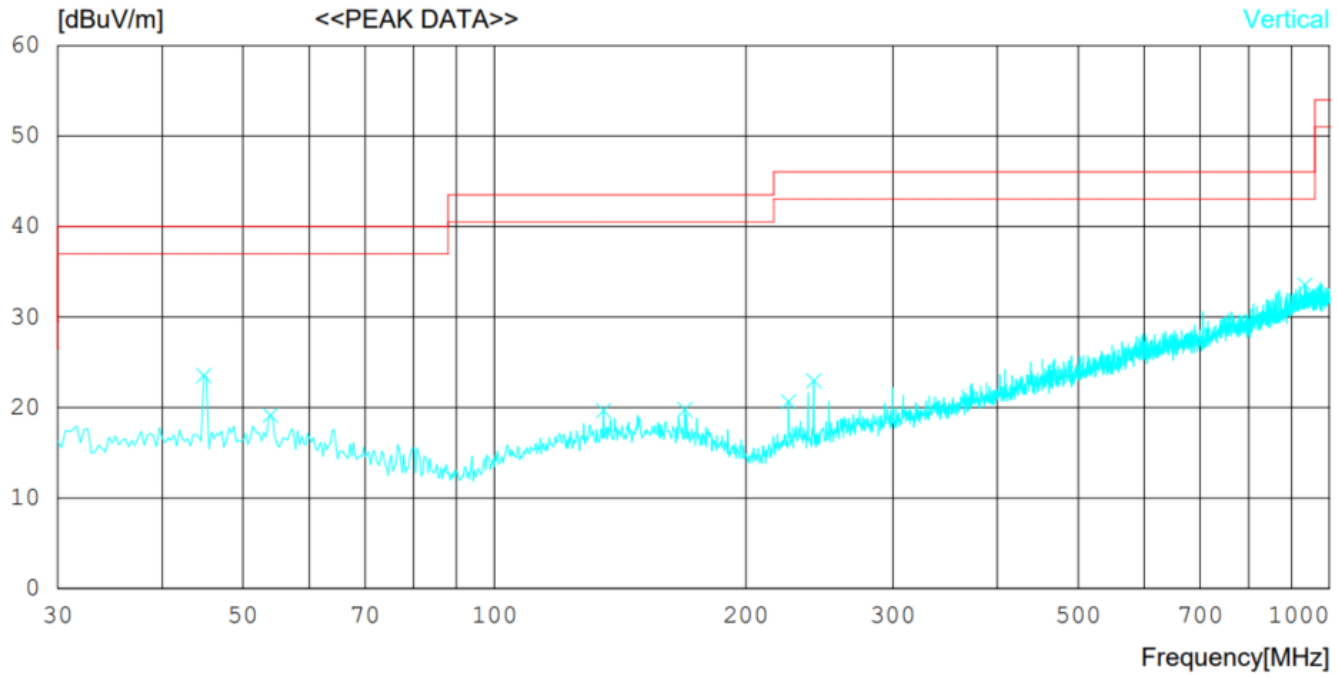
Test Note.

1. Radiated emissions below 30 MHz below 30 MHz were greater than 20 dB below limit.
2. Information of DCF(Distance Correction Factor)
   For finding emissions, measurements may be performed at a distance closer than that specified in the regulations.
   In this case, the distance factor is applied to the result.
   - Calculation of distance correction factor
   At frequencies below 30 MHz = 40 log(tested distance / specified distance)
   At frequencies at or above 30 MHz = 20 log(tested distance / specified distance)
   When distance factor is “NA”, the measurements were performed at the specified distance and distance factor is not applied.
3. Sample Calculation.
   Margin = Limit – Result / Result = Measured Level + TF + Distance factor / TF = AF + CL – AG
   Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain
4. * Noise floor.

Tested Frequency: 64.80 GHz

Frequency (MHz)	ANT Pol	Detector Mode	Measured Level(dBuV)	TF (dB/m)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
44.87	V	PK	32.00	-8.48	NA	23.52	40.00	16.48
53.93	V	PK	27.60	-8.45	NA	19.15	40.00	20.85
135.08	V	PK	26.80	-7.13	NA	19.67	43.50	23.83
169.03	V	PK	26.50	-6.72	NA	19.78	43.50	23.72
224.97	V	PK	27.60	-6.94	NA	20.66	46.00	25.34
241.14	V	PK	29.60	-6.64	NA	22.96	46.00	23.04
933.68	V	PK	24.80	8.75	NA	33.55	46.00	12.45

Worst data plot (Measured Level) 64.80 GHz & X axis & Ver



Frequency Range: 1 ~ 40 GHz

Test Note.

1. No other spurious and harmonic emissions were found above listed frequencies.
2. Information of DCF(Distance Factor)
   For finding emissions, the test distance might be reduced. In this case, the distance factor is applied to the result.
   - Calculation of distance factor = 20 log(applied distance / required distance)
   When distance factor is “N/A”, the distance is 3 m and distance factor is not applied.
3. Sample Calculation.
   Margin = Limit – Result / Result = Measured Level + TF + Distance factor / TF = AF + CL – AG
   Where, TF = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain
4. * Noise floor.
5. # The duty cycle of this spurious emission is 100%.

Tested Frequency: 58.32 GHz

Frequency (MHz)	ANT Pol	Detector Mode	Measured Level(dBuV)	TF (dB/m)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
#7 040.54	V	PK	48.21	6.93	NA	55.14	74.00	18.86
#7 040.39	V	AV	37.65	6.93	NA	44.58	54.00	9.42
#10 560.61	V	PK	46.24	9.45	NA	55.69	74.00	18.31
#10 560.59	V	AV	36.11	9.45	NA	45.56	54.00	8.44
#17 601.23	V	PK	43.38	18.52	NA	61.90	74.00	12.10
#17 601.04	V	AV	33.13	18.52	NA	51.65	54.00	2.35
#21 120.79	H	PK	42.42	9.40	-4.93	46.89	74.00	27.11
#21 120.77	H	AV	33.69	9.40	-4.93	38.16	54.00	15.84
*39 310.60	H	PK	44.60	16.41	-4.93	56.08	74.00	17.92
*39 267.60	H	AV	32.43	16.34	-4.93	43.84	54.00	10.16

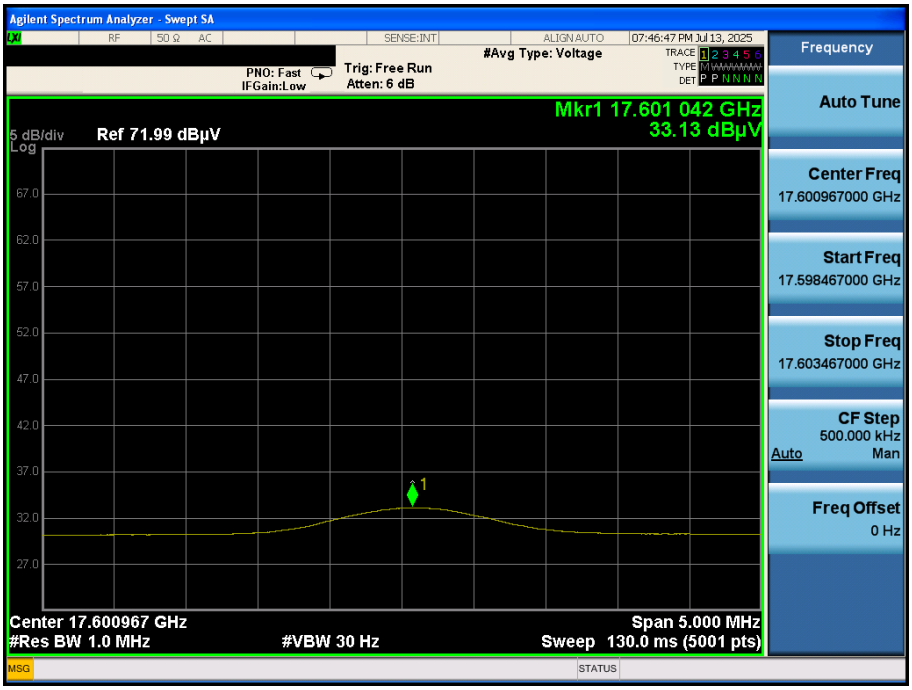
Tested Frequency: 60.48 GHz

Frequency (MHz)	ANT Pol	Detector Mode	Measured Level(dBuV)	TF (dB/m)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
#7 040.22	V	PK	47.95	6.93	NA	54.88	74.00	19.12
#7 040.35	V	AV	37.68	6.93	NA	44.61	54.00	9.39
#10 560.60	V	PK	46.05	9.45	NA	55.50	74.00	18.50
#10 560.62	V	AV	36.12	9.45	NA	45.57	54.00	8.43
#17 600.76	V	PK	43.48	18.52	NA	62.00	74.00	12.00
#17 601.04	V	AV	33.12	18.52	NA	51.64	54.00	2.36
#21 120.63	H	PK	42.67	9.40	-4.93	47.14	74.00	26.86
#21 120.76	H	AV	33.74	9.40	-4.93	38.21	54.00	15.79
*39 253.60	H	PK	45.05	16.33	-4.93	56.45	74.00	17.55
*39 286.60	H	AV	32.35	16.37	-4.93	43.79	54.00	10.21

Tested Frequency: 64.80 GHz

Frequency (MHz)	ANT Pol	Detector Mode	Measured Level(dBuV)	TF (dB/m)	DCF(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
#7 040.50	V	PK	48.62	6.93	NA	55.55	74.00	18.45
#7 040.41	V	AV	37.69	6.93	NA	44.62	54.00	9.38
#10 560.79	V	PK	45.32	9.45	NA	54.77	74.00	19.23
#10 560.54	V	AV	36.14	9.45	NA	45.59	54.00	8.41
#17 600.78	V	PK	42.94	18.52	NA	61.46	74.00	12.54
#17 601.07	V	AV	33.09	18.52	NA	51.61	54.00	2.39
#21 120.68	H	PK	42.71	9.40	-4.93	47.18	74.00	26.82
#21 120.78	H	AV	33.81	9.40	-4.93	38.28	54.00	15.72
*39 089.70	H	PK	44.50	15.95	-4.93	55.52	74.00	18.48
*39 287.60	H	AV	32.51	16.36	-4.93	43.94	54.00	10.06

Worst data plot (Measured Level) 58.32 GHz & X axis & Ver



Frequency Range: 40 ~ 90 GHz

Note.

1. No other spurious and harmonic emissions were found above listed frequencies.
2. Information of DCF(Distance Factor)
   For finding emissions, the test distance might be reduced. In this case, the distance factor is applied to the result.
   - Calculation of distance factor = 20 log(applied distance / required distance)
   When distance factor is “N/A”, the distance is 3 m and distance factor is not applied.
3. Sample Calculation.
   E(dBuV/m) = Measured level (dBm) + 107 + TF(dB/m)
   where, E=field strength / TF(Total Factor) = Antenna Factor(dB/m) + Cable Loss(dB/m) + Attenuator Loss(dB) – Amplifier Gain(dB)
   EIRP(dBm) = E(dBuV/m) + 20log(D) - 104.7; where, D is measurement distance (in the far field region) in m.
   $PD = EIRP_{Linear} / 4\pi d^2$
   Where, PD = the power density at the distance specified by the limit, in W/m^2
   $EIRP_{Linear}$ = EIRP, in watts
   D = is the distance at which the power density limit is specified, in m
   If the mixer is used, mixer loss was applied to the measured level by SA correction factor.
4. * Noise floor.

Tested Frequency: 58.32 GHz

Measurement distance(D)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
1.7 m	56 946.24	H	-36.93	7.53	77.60	-22.49	4.984	90.00
1.7 m	*83 951.67	H	-55.13	32.64	84.51	-15.58	24.465	90.00

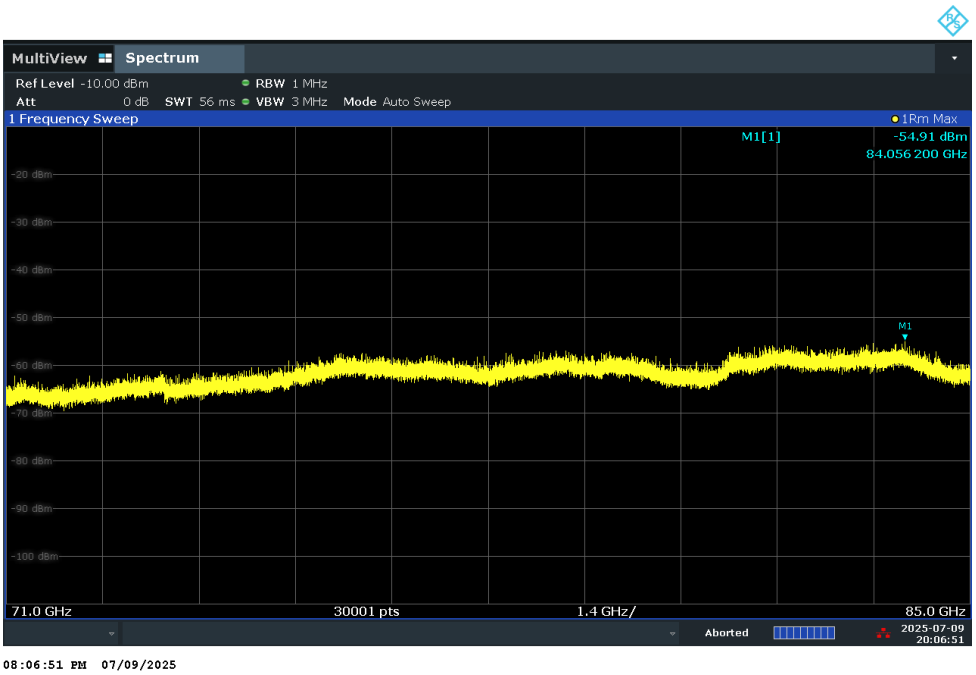
Tested Frequency: 60.48 GHz

Measurement distance(D)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
1.7 m	*55 999.79	H	-42.99	6.89	70.90	-29.19	1.065	90.00
1.7 m	*83 562.01	H	-55.14	31.88	83.74	-16.35	20.490	90.00

Tested Frequency: 64.80 GHz

Measurement distance(D)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
1.7 m	*56 426.05	H	-41.25	7.19	72.94	-27.15	1.704	90.00
1.7 m	*84 056.20	H	-54.91	32.89	84.98	-15.11	27.261	90.00

Worst data plot (Measured Level: Noise floor) 64.80 GHz & Y axis & Hor



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Frequency Range: 90 ~ 200 GHz

Test Note.

1. The radiated emissions were investigated up to 200GHz. And no other spurious and harmonic emissions were found above listed frequencies.
2. Information of DCF(Distance Factor)
   For finding emissions, the test distance might be reduced. In this case, the distance factor is applied to the result.
   - Calculation of distance factor = 20 log(applied distance / required distance)
   When distance factor is “N/A”, the distance is 3 m and distance factor is not applied.
3. Sample Calculation.
   E(dBuV/m) = Measured level (dBm) + 107 + TF(dB/m)
   where, E=field strength / TF(Total Factor) = Antenna Factor(dB/m) + Cable Loss(dB/m) + Attenuator Loss(dB) – Amplifier Gain(dB)
   EIRP(dBm) = E(dBuV/m) + 20log(D) - 104.7; where, D is measurement distance (in the far field region) in m.
   $PD = EIRP_{Linear} / 4\pi d^2$
   Where, PD = the power density at the distance specified by the limit, in W/m^2
   $EIRP_{Linear}$ = EIRP, in watts
   D = is the distance at which the power density limit is specified, in m
   If the mixer is used, mixer loss was applied to the measured level by SA correction factor.
4. * Noise floor.

Tested Frequency: 58.32 GHz

Measurement distance(D)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
0.7 m	*128 820.03	H	-58.93	48.34	96.41	-11.39	64.20	90.00
0.5 m	*191 618.39	H	-62.70	52.22	96.52	-14.20	33.62	90.00

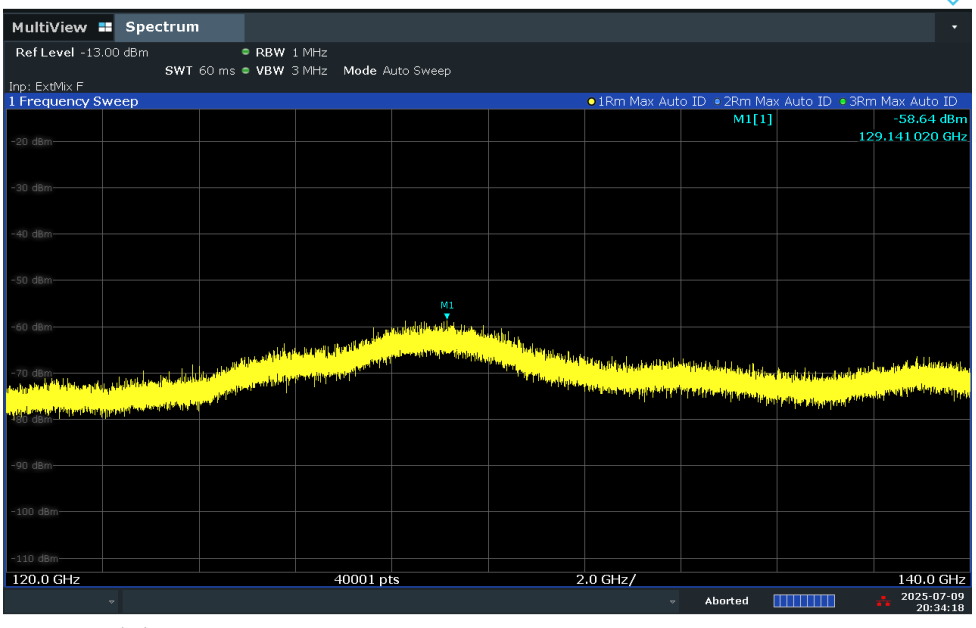
Tested Frequency: 60.48 GHz

Measurement distance(D)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
0.7 m	*129 062.52	H	-59.02	48.34	96.32	-11.48	62.89	90.00
0.5 m	*191 035.40	H	-62.22	52.19	96.97	-13.75	37.29	90.00

Tested Frequency: 64.80 GHz

Measurement distance(D)	Frequency (MHz)	ANT Pol	Measured Level(dBm)	TF (dB/m)	E (dBuV/m)	EIRP (dBm)	Power Density (pW/cm^2)	Limit (pW/cm^2)
0.7 m	*129 141.02	H	-58.64	48.34	96.70	-11.10	68.64	90.00
0.5 m	*190 891.90	H	-62.90	52.18	96.28	-14.44	31.81	90.00

Worst data plot (Measured Level: Noise floor) 64.80 GHz & Y axis & Hor



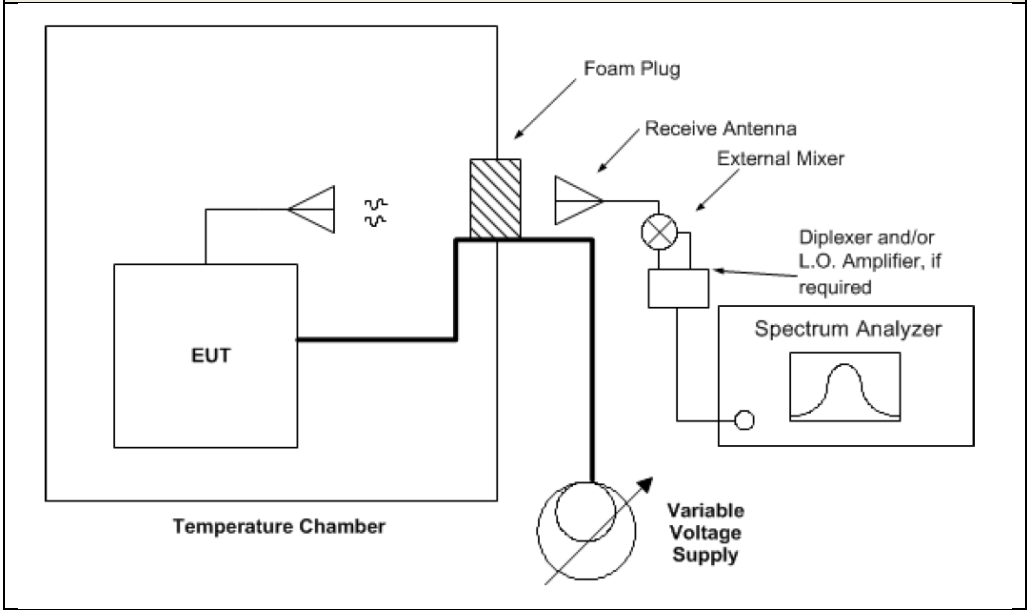
5.4. Frequency stability

▣ Test Requirements and limit

FCC Part 15.255(f): Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85 % to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

▣ Test Configuration:

Frequency stability



▣ Test Procedure:

ANSI C63.10-2020 – Section 9.5

1) With the EUT at ambient temperature (approximately 25 °C) and voltage source set to the EUT nominal operating voltage (100 %), record the spectrum mask of the EUT emission on the spectrum analyzer.

2) Vary EUT power supply between 85% and 115% of nominal, and record the frequency excursion of the EUT emission mask.

3) Set the power supply to 100 % nominal setting, and raise EUT operating temperature to 50 °C. Record the frequency excursion of the EUT emission mask.

4) Repeat step 3) at each 10 °C increment down to −20 °C.

▣ Test Results: Comply

VOLTAGE (%)	POWER (V DC)	TEMP (℃)	Tested Frequency: 58.32 GHz	Tested Frequency: 64.80 GHz
			Measured low frequency(F_L)(MHz), 20dBC	Measured high frequency(F_L)(MHz), 20dBC
100%	5.00	+20'C	57.217960	65.893970
100%		-30	57.218360	65.886570
100%		-20	57.214110	65.885590
100%		-10	57.219460	65.879670
100%		0	57.219810	65.883690
100%		+10	57.220010	65.887470
100%		+20	57.217960	65.893970
100%		+30	57.219360	65.878490
100%		+40	57.219160	65.886570
100%		+50	57.218310	65.887690
115%	5.75	+20'C	57.220060	65.882070
85%	4.25	+20'C	57.219710	65.876470

Note: Fundamental emissions were contained within the frequency band.

5.5. AC line conducted emissions

▣ Test Requirements and limit, Part 15.207

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network(LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

▣ Test Configuration:

See test photographs for the actual connections between EUT and support equipment.

▣ Test Procedure:

Conducted emissions from the EUT were measured according to the ANSI C63.20-2013.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

▣ Test Results: Comply

AC Line Conducted Emissions (Graph) **Tested Frequency: 60.48 GHz**

Results of Conducted Emission

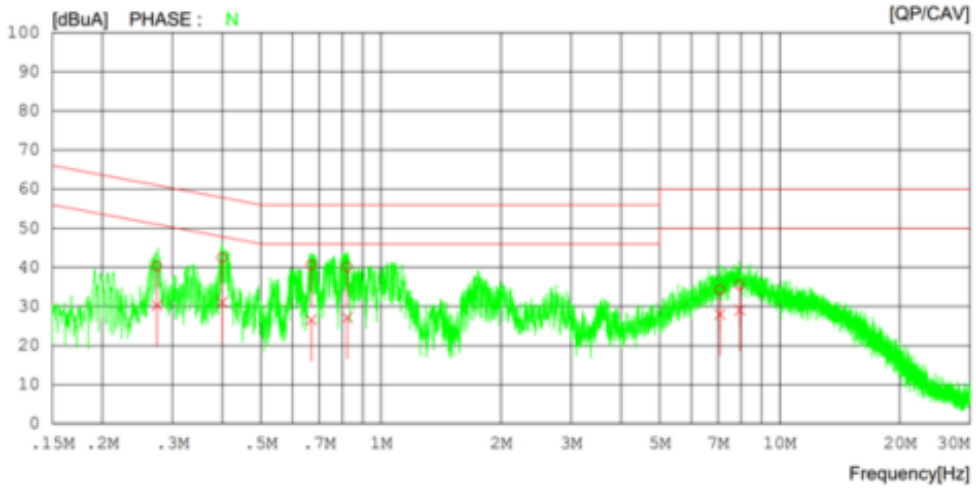
Date 2025-07-18

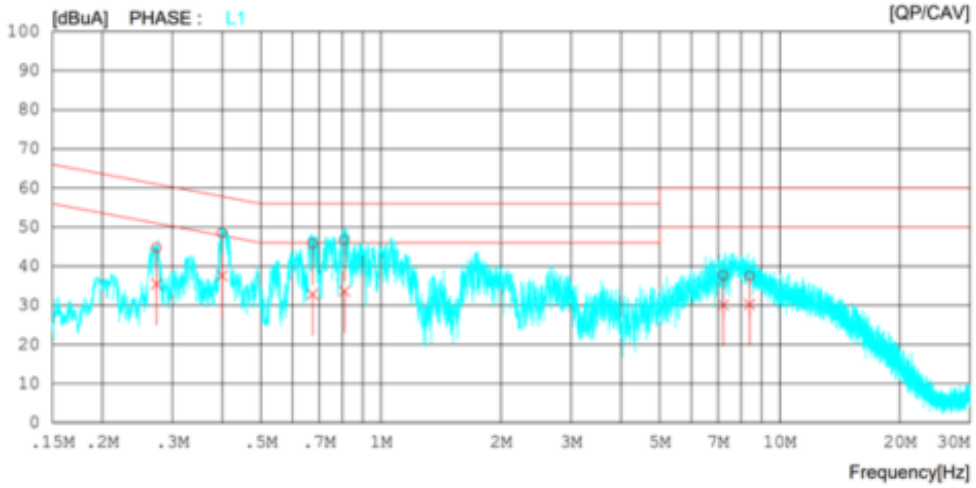
Order No.		Referrence No.	
Model No.	MWC-441	Power Supply	120 V, 60 Hz
Serial No.		Temp/Humi.	23 'C / 41 %
Test Condition	mmW_CH2	Operator	S.H.Han

Memo

LIMIT : FCC P15.207 AV
FCC P15.207 QP

Lisn Factor
1. NSLK 8128 RC-387_N_24.10.21
2. NSLK 8128 RC-387_L1_24.10.21
Cable Loss
1. C1_LISN TO RECEIVER_2024-12-11
Pulse Limitter
1. PULSE LIMITER_ESH3-Z2_101333_2025.07.10





AC Line Conducted Emissions (List) **Tested Frequency: 60.48 GHz**

Results of Conducted Emission

Date 2025-07-18

Order No.		Referrence No.	
Model No.	MWC-441	Power Supply	120 V, 60 Hz
Serial No.		Temp/Humi.	23 °C / 41 %
Test Condition	mmW_CH2	Operator	S.H.Han

Memo

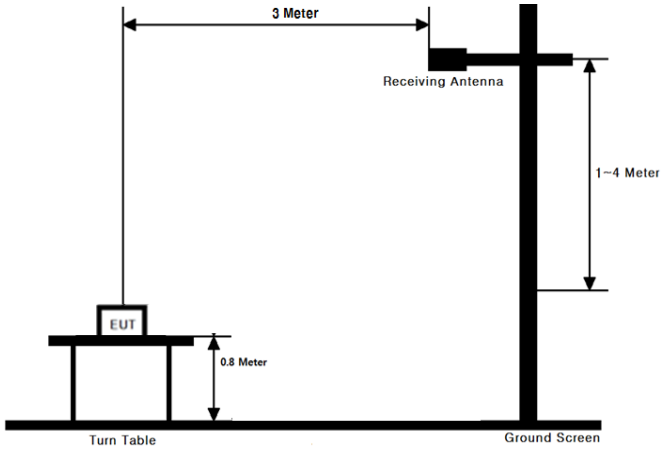
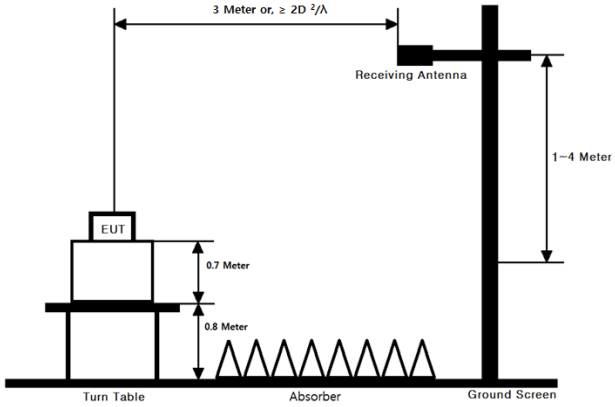
LIMIT : FCC P15.207 AV
FCC P15.207 QP

Lisn Factor
1. NSLK 8128 RC-387_N_24.10.21
2. NSLK 8128 RC-387_LT_24.10.21
Cable Loss
1. C1_LISN TO RECEIVER_2024-12-11
Pulse Limitter
1. PULSE LIMITER_ESH3-Z2_101333_2025.07.10

NO	FREQ	READING QP	READING CAV	C.FACTOR	RESULT QP	RESULT CAV	LIMIT QP	LIMIT CAV	MARGIN QP	MARGIN CAV	PHASE
	[MHz]	[dBuA]	[dBuA]	[dB]	[dBuA]	[dBuA]	[dBuA]	[dBuA]	[dBuA]	[dBuA]	
1	0.27449	30.28	20.21	10.02	40.30	30.23	60.98	50.98	20.68	20.75	N
2	0.39964	32.45	20.99	10.04	42.49	31.03	57.86	47.86	15.37	16.83	N
3	0.66865	30.57	16.52	10.06	40.63	26.58	56.00	46.00	15.37	19.42	N
4	0.82335	30.05	17.07	10.06	40.11	27.13	56.00	46.00	15.89	18.87	N
5	7.07900	23.98	17.73	10.28	34.26	28.01	60.00	50.00	25.74	21.99	N
6	7.94480	25.12	18.77	10.30	35.42	29.07	60.00	50.00	24.58	20.93	N
7	0.27362	34.72	25.44	10.02	44.74	35.46	61.01	51.01	16.27	15.55	L1
8	0.39925	38.46	27.54	10.04	48.50	37.58	57.87	47.87	9.37	10.29	L1
9	0.67315	35.77	22.82	10.06	45.83	32.88	56.00	46.00	10.17	13.12	L1
10	0.81027	36.66	23.55	10.06	46.72	33.61	56.00	46.00	9.28	12.39	L1
11	7.21940	27.37	19.75	10.29	37.66	30.04	60.00	50.00	22.34	19.96	L1
12	8.40280	27.13	19.87	10.36	37.49	30.23	60.00	50.00	22.51	19.77	L1

APPENDIX I

Test set up diagrams

Below 1GHz	Above 1GHz
	

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