RF Test Report

Applicant	:	Google LLC
Product Name	:	wireless device
Trade Name	:	Google
Model Number	:	GJQ8U
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART C ANSI C63.10:2013
Received Date	:	Sep. 12, 2023
Test Period	:	Oct. 06 ~ Mar. 05, 2024
Issued Date	:	Apr. 02, 2024

Issued by

Eurofins E&E Wireless Taiwan Co., Ltd.
No. 140-1, Changan Street, Bade District,
Taoyuan City 334025, Taiwan (R.O.C.)
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Testing Laboratory
1330

Taiwan Accreditation Foundation accreditation number: 1330
Frequency Range: 9 kHz to 325 GHz
Test Firm Registration Number: 226252 (Bade test site)
Test Firm Designation Number: TW0010 (Bade test site)
Test Firm Registration Number: 191812 (Wugu test site)
Test Firm Designation Number: TW0034 (Wugu test site)

Note:

1.The test results are valid only for samples provided by customers and under the test conditions described in this report.
2.This report shall not be reproduced except in full, without the written approval of Eurofins E&E Wireless Taiwan Co., Ltd.
3.The relevant information is provided by customers in this test report. According to the correctness, appropriateness or completeness of the information provided by the customer, if there is any doubt or error in the information which affects the validity of the test results, the laboratory does not take the responsibility.

Revision History

Rev.	Issued Date	Description	Revised by
00	Nov. 16, 2023	Initial Issue	Snow Wang
01	Apr. 02, 2024	Update chapter 2 (P.7) Update chapter 3.1 (P.8) Update chapter 3.3 (P.9~ P.10) Update chapter 3.4 (P.11) Update chapter 5.1 (P.27~P.28) Update Test Setup Photographs	Snow Wang

Verification of Compliance

Applicant	:	Google LLC
Product Name	:	wireless device
Trade Name	:	Google
Model Number	:	GJQ8U
FCC ID	:	A4R-GJQ8U
Applicable Standard	:	FCC 47 CFR PART 15 SUBPART C ANSI C63.10:2013
Test Result	:	Complied
Performing Lab.	:	Eurofins E&E Wireless Taiwan Co., Ltd. No. 140-1, Changan Street, Bade District, Taoyuan City 334025, Taiwan (R.O.C.) Tel：+886-3-2710188 / Fax：+886-3-2710190 Taiwan Accreditation Foundation accreditation number: 1330

Eurofins E&E Wireless Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Eurofins E&E Wireless Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Approved By : Kai Yu Yang

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1 General Information

1.1. Summary of Test Result

FCC Standard	Item	Result	Remark
15.207	AC Power Conducted Emission	PASS	-----
15.205, 15.209	Transmitter Radiated Emissions (Below 40 GHz)	PASS	-----
15.255(d)	Transmitter Radiated Emissions (Above 40 GHz)	PASS	-----
15.255(c)(2)(v)	EIRP (Peak & Avg)	PASS	-----
15.255(e)	Peak Conducted Output Power	PASS	-----
15.255(e)(2)	6 dB Emission Bandwidth	Reference only	-----
2.1049	99% Occupied Bandwidth	Reference only	-----
15.255(f)	Frequency Stability	PASS	-----
15.203	Antenna Requirement	PASS	-----

Standard	Description
CFR47, Part 15, Subpart C	Intentional Radiators
ANSI C63. 10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
TCB Workshop	2023-10-25-3.1 Part 15.255 Rules Amendment General Measurement Guidance

Decision Rule

■ Uncertainty is not included.

□ Uncertainty is included.

1.2. Testing Location

Lab Name: Eurofins E&E Wireless Taiwan Co., Ltd.

Site Address: ☐ No. 140-1, Changan Street, Bade District, Taoyuan City 334025, Taiwan (R.O.C.)

Site Address: ■ No. 2, Wuquan 5th Rd. Wugu Dist., New Taipei City, Taiwan (R.O.C.)

1.3. Measurement Uncertainty

Test Item	Frequency	Uncertainty	
		BD	WG
Conducted Emission	150 kHz ~ 30 MHz	2.7 dB	2.6 dB

Test Item	Frequency	Uncertainty			
		96601-BD	96603-BD	96602-WG	96603-WG
Radiated Emission	9 kHz ~ 30 MHz	1.9 dB	1.9 dB	1.6 dB	1.6 dB
	30 MHz ~ 1000 MHz	4.9 dB	4.9 dB	4.8 dB	4.8 dB
	1000 MHz ~ 18000 MHz	4.9 dB	5.0 dB	5.0 dB	5.2 dB
	18000 MHz ~ 26500 MHz	4.3 dB	4.4 dB	4.4 dB	4.5 dB
	26500 MHz ~ 40000 MHz	4.5 dB	4.5 dB	4.6 dB	4.5 dB
	40 GHz ~ 325 GHz	5.2 dB	5.2 dB	5.2 dB	5.2 dB

1.4. Test Site Environment

Items	Required (IEC 60068-1)	Interval(*)
Temperature (°C)	15-35	20-30
Humidity (%RH)	25-75	45-75

(*)The measurement ambient temperature is within this range.

2 EUT Description

The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity(except Max. RF Output Power, Max. EIRP).

Applicant	Google LLC 1600 Amphitheatre Parkway, Mountain View, California, United States
Product Name	wireless device
Trade Name	Google
Model Number	GJQ8U
FCC ID	A4R-GJQ8U
Frequency Range	61.25 GHz
Modulation Type	FMCW
Number of Channel	1 CH
Antenna Type	Chip Antenna
Antenna Gain	3 dBi
Max. EIRP	8.03 dBm (Peak)
Max. RF Output Power	5.03 dBm (Peak Conducted)

Chennal List:

CH	Freq. (GHz)
0	61.25

3 Test Methodology

3.1. Mode of Operation

Decision of Test Eurofins has verified the construction and function in typical operation. All the test modes were carried out with the EUT in normal operation, which was shown in this test report and defined as:

Mode	Transmit Pre-Test Mode	Final-Test Mode
1	EUT + setup Box (AC powered)	
2	EUT+ USB Cable + NB+Adapter	V

Pre-Test Mode	Final-Test Mode
Transmit Mode	V
60GHz Radar mode	V

By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “X axis” position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

Note: After verifying all tests of Conducted Emission, the worst-case test mode will be presented.

Power settings configuration:

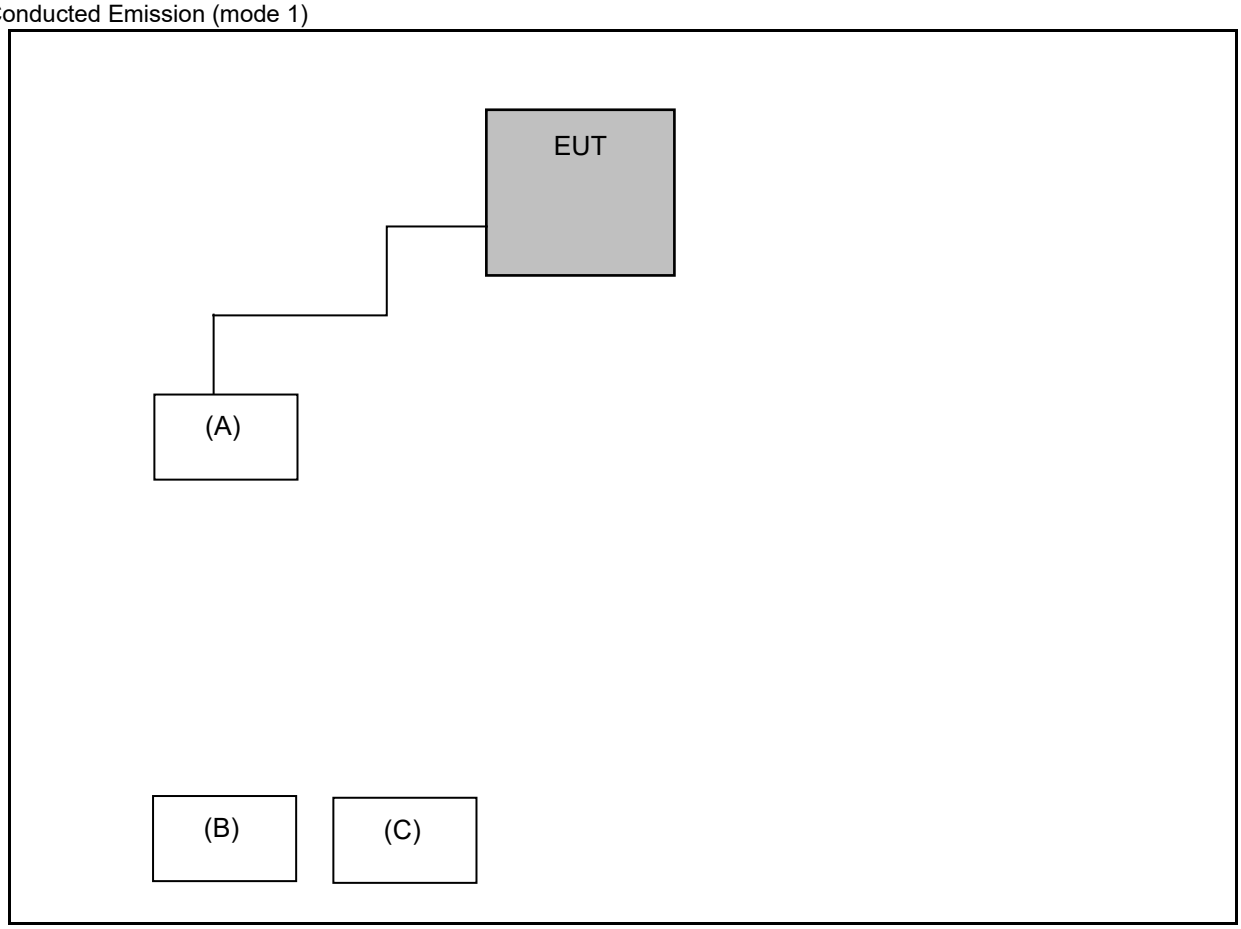
Test Mode	Frequency (GHz)	RF Power setting in Test Software	Test Software Version
60 GHz Radar	61.25	31	Engineering Mode

3.2. EUT Test Step

1	Setup the EUT shown on “Configuration of Test System Details”.
2	Turn on the power of EUT.

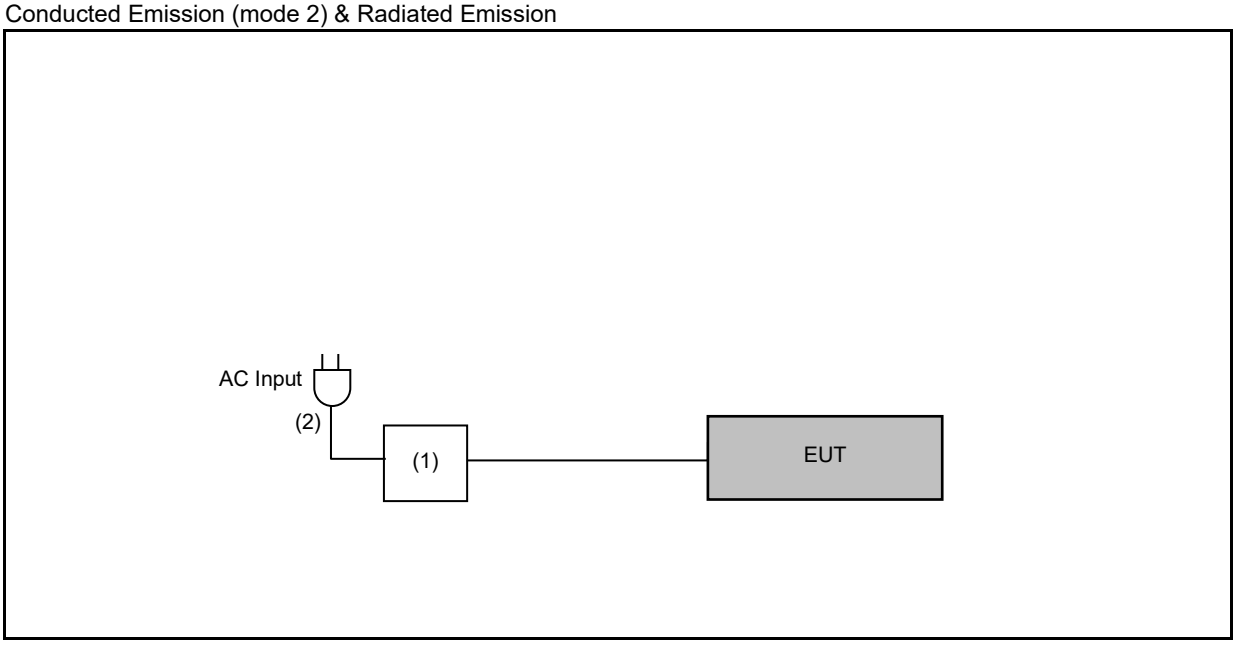
3.3. Configuration of Test System Details

Conducted Emission (mode 1)



Support Unit used in test configuration and system					
Product		Manufacturer	Model Number	Serial Number	Power Cord
(A)	setup BOX	N/A	N/A	N/A	N/A
(B)	AP	TP-Link	Archer AX50	221B330002592	Non-Shielded, 1.0 m
(C)	Smart mobile phone	Samsung	SM-F7110	R3CR5077X3R	N/A

Conducted Emission (mode 2) & Radiated Emission



Product		Manufacturer	Model Number	Serial Number	Power Cord
(1)	Notebook	Dell	Latitude 5420	---	---
(2)	Adapter	Dell	HA65NM190	---	---

3.4. Test Instruments

For Conduction Emissions
Test Period: Oct. 18, 2023 ~ Mar.5.2024
Testing Engineer: Stanley Yang ;Marin Lee

Conducted Emission test site					
Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
Test Receiver	R&S	ESR3	102919	Nov. 30, 2022	1 year
Test Receiver	R&S	ESR3	102919	Nov. 30, 2023	1 year
LISN	R&S	ENV216	101139	Dec. 15, 2022	1 year
Current Probe	R&S	EZ-17	220402	Jun. 15, 2023	1 year
Cable	EMCI	EMCCFD300-BM-NM-4000	220402	Jun. 08, 2023	1 year
Software	ELEKTRA	4.61.0	-----	-----	-----
Test Site	Eurofins	Conduction01-WG	Conduction01-WG	N.C.R.	-----

Note: N.C.R. = No Calibration Request

For Conducted
Test Period: Nov. 7, 2023
Testing Engineer: An Wu

Test Site		RF01				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
☒	Temperature & Humidity Chamber	TAICHY	MHU-225LA	980729	Mar. 29, 2023	1 year
☒	Spectrum Analyzer (2 Hz~50 GHz)	KEYSIGHT	N9030B	MY57153537	Apr. 18, 2023	1 year
☒	Millimeter-Wave Signal (50 GHz~75 GHz)	VDI	SAX 410	US54250165	Sep. 17,2021	3 years

Note: N.C.R. = No Calibration Request.

For Radiated Emissions
Test Period: Oct. 11 ~ Oct. 31, 2023
Testing Engineer: Marin Lee

Radiation test sites		Semi Anechoic Room 96603				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
☒	LOOP Antenna (9 kHz~30 MHz)	Schwarzbeck Mess-Elektronik	FMZB 1513-60	00031	Feb. 21, 2023	1 year
☒	Trilog Broadband Antenna (30 MHz~1 GHz)	Schwarzbeck Mess-Elektronik	VULB9168	01275	Mar. 09, 2023	1 year
☒	Broadband Horn Antenna (1 GHz~18 GHz)	RF SPIN	DRH18-E	210305A18ES	Feb. 21, 2023	1 year
☒	Broadband Horn Antenna (15 GHz~40 GHz)	Schwarzbeck Mess-Elektronik	BBHA9170	01133	Feb. 13, 2023	1 year
☒	Spectrum Analyzer (2 Hz~50 GHz)	KEYSIGHT	N9030B	MY57143537	Apr. 18, 2023	1 year
☒	Pre-Amplifier	Agilent	8447D	2944A10961	Jul. 10, 2023	1 year
☒	Pre-Amplifier	EMCI	EMC118A45SE	980822	Nov. 22, 2022	1 year
☒	Pre-Amplifier	EMCI	EMC184045SE	980861	Dec. 27, 2022	1 year
☒	Coaxial Cable (10 kHz~3000 MHz)	EMCI	EMCCFD400-NM-NM-2000	211006	Nov. 14, 2022	1 year
☒	Coaxial Cable (10 kHz~3000 MHz)	EMCI	EMCCFD400-NM-NM-2000	211007	Nov. 14, 2022	1 year
☒	Coaxial Cable (10 kHz~3000 MHz)	EMCI	EMCCFD400-NM-NM-6000	211015	Nov. 14, 2022	1 year
☒	Coaxial Cable (1 GHz~18 GHz)	EMCI	EMC104-SM-SM-1000	211026	Nov. 14, 2022	1 year
☒	Coaxial Cable (1 GHz~18 GHz)	EMCI	EMC104-SM-SM-2000	211035	Nov. 14, 2022	1 year
☒	Coaxial Cable (1 GHz~18 GHz)	EMCI	EMC104-SM-SM-8000	211036	Nov. 14, 2022	1 year
☒	Coaxial Cable (18 GHz~40 GHz)	EMCI	EMC101G-KM-KM-600	211211	Jan. 19, 2023	1 year
☒	Coaxial Cable (18 GHz~40 GHz)	EMCI	EMC101G-KM-KM-2000	211210	Jan. 19, 2023	1 year
☒	Coaxial Cable (18 GHz~40 GHz)	EMCI	EMC101G-KM-KM-6000	211209	Jan. 19, 2023	1 year
☒	Broadband Horn Antenna (15 GHz~40 GHz)	QuinStar	QWH-QPRR00	1231900027	Oct. 21, 2022	2 years

Note: N.C.R. = No Calibration Request

For Radiated Emissions
Test Period: Oct. 11 ~ Oct. 31, 2023
Testing Engineer: Marin Lee

Radiation test sites		Semi Anechoic Room 96603				
Use	Equipment	Manufacturer	Model Number	Serial Number	Cal. Date	Cal. Period
☒	Millimeter-Wave Signal (50 GHz~75 GHz)	VDI	SAX 410	US54250165	Oct. 23, 2022	2 years
☒	Std Gain Horn Antenna (50 GHz~75 GHz)	VDI	WR15	N9029AH15	Oct. 22, 2022	2 years
☒	Millimeter-Wave Signal (60 GHz~90 GHz)	VDI	SAX 409	US54250171	Oct. 23, 2022	2 years
☒	Std Gain Horn Antenna (60 GHz~90 GHz)	VDI	WR12	N9029AH12	Oct. 22, 2022	2 years
☒	Millimeter-Wave Signal (90 GHz~140 GHz)	VDI	SAX 406	US53250013	Oct. 24, 2022	2 years
☒	Std Gain Horn Antenna (90 GHz~140 GHz)	VDI	WR8.0	N9029AH08	Oct. 22, 2022	2 years
☒	Millimeter-Wave Signal (140 GHz~220 GHz)	VDI	SAX 407	US53250020	Oct. 28, 2022	2 years
☒	Std Gain Horn Antenna (140 GHz~220 GHz)	VDI	WR5.0	N9029AH05	Oct. 28, 2022	2 years
☒	Software	R_RAM	V1.3	N/A	N.C.R.	---
☒	Millimeter-Wave Signal (50 GHz~75 GHz)	VDI	SAX 410	US54250165	Oct. 23, 2022	2 years

Note: N.C.R. = No Calibration Request

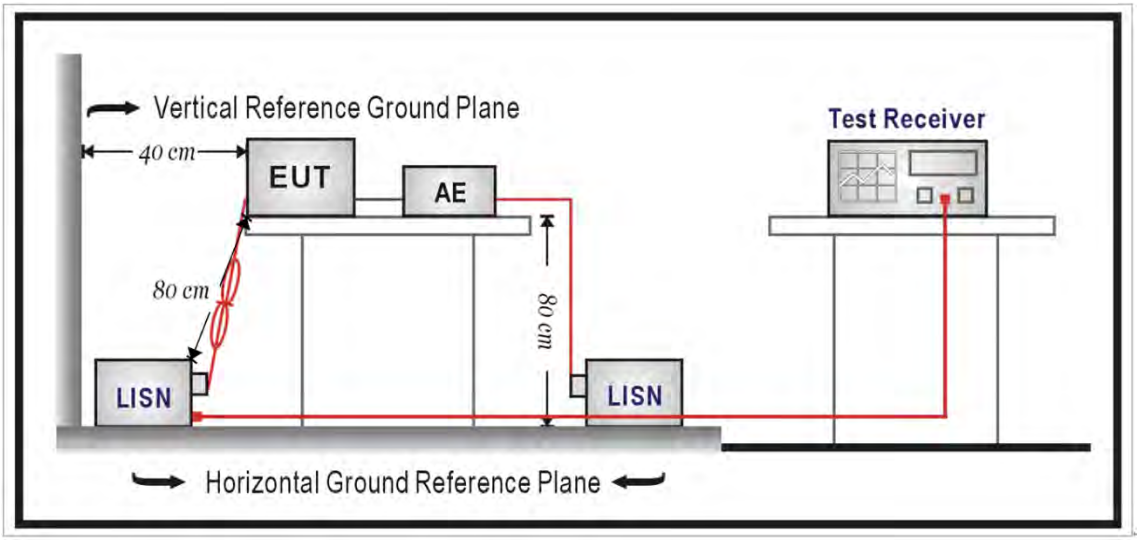
4 Measurement Procedure

4.1. AC Power Line Conducted Emission Measurement

■ **Limit**

Frequency (MHz)	Quasi-peak	Average
0.15 - 0.5	66 to 56	56 to 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

■ **Test Setup**



■ **Test Procedure**

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 Ω// 50 uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50 Ω// 50 uH coupling impedance with 50 ohm termination.

Tabletop device shall be placed on a non-conducting platform, of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The wall of screened room shall be located 40 cm to the rear of the EUT. Other surfaces of tabletop or floor standing EUT shall be at least 80 cm from any other ground conducting surface including one or more LISNs. For floor-standing device shall be placed under the EUT with a 12 mm insulating material.

Conducted emissions were investigated over the frequency range from 0.15 MHz to 30 MHz using a resolution bandwidth of 9 kHz. The equipment under test (EUT) shall be meet the limits in section 4.1, as applicable, including the average limit and the quasi-peak limit when using respectively, an average detector and quasi-peak detector measured in accordance with the methods described of related standard. When all of peak value were complied with quasi-peak and average limit from 150 kHz to 30 MHz then quasi-peak and average measurement was unnecessary.

The AMN shall be placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for AMNs mounted on top of the ground reference plane. This distance is between the closest points of the AMN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8 m from the AMN. If the mains power cable is longer than 1 m then the cable shall be folded back and forth at the centre of the lead to form a bundle no longer than 0.4 m. All of 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. All of EUT and AE shall be separate place more than 0.1 m. All 50 Ω ports of the LISN shall be resistively terminated into 50 Ω loads when not connected to the measuring instrument.

If the reading of the measuring receiver shows fluctuations close to the limit, the reading shall be observed for at least 15 s at each measurement frequency; the higher reading shall be recorded with the exception of any brief isolated high reading which shall be ignored.

4.2. Radiated Emission Measurement

■ **Limit**

(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.

Limits of Radiated Emission Measurement (FCC 15.209):

Frequency (MHz)	Field Strength (μV/m at meter)	Measurement Distance (meter)
0.009 – 0.490	2400 / F (kHz)	300
0.490 – 1.705	24000 / 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

Note: (1) The tighter limit applies at the band edges.

(2) Emission level (dBuV/m)=20 log Emission level (uV/m).

Radiated emissions above 40 GHz:

Frequency Range (GHz)	Limit (pW/cm^2) @ 3 m	Equivalent to EIRP limit (dBm)
40-200	90	-9.92

Note: (1) PD = $EIRP_{Linear}$ / (4 * π * d^2)

Where:

PD is the power density at the distance specified by the limit, in W/m2

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

d is the distance at which the power density limit is specified, in m

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

Standard		Limit
■	Part 15.255(c)(2)(v)	For field disturbance sensors/radars that occupy 500 MHz bandwidth or less that are contained wholly within the frequency band 61.0–61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0–61.5 GHz band, measured during the transmit interval, but still within the 57–71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

Peak transmitter conducted output power:

Except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (b) of this section.

Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. 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 kHz 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).

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

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

Where:

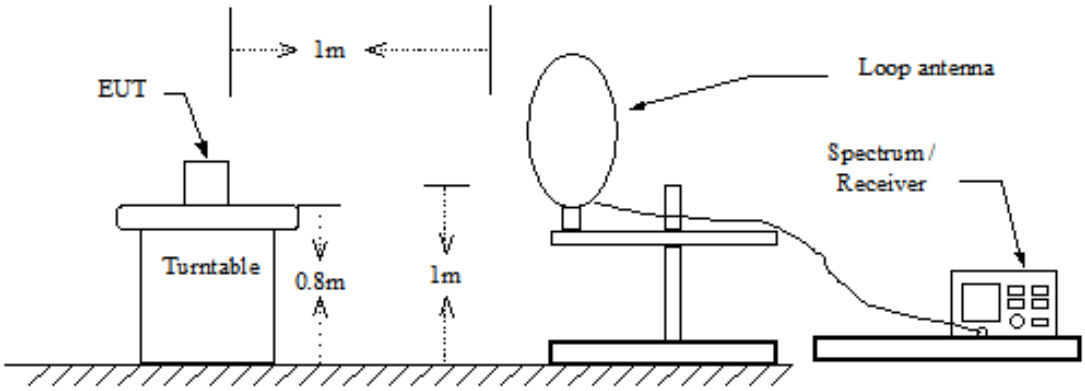
P_{cond} is the conducted output power, in W

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

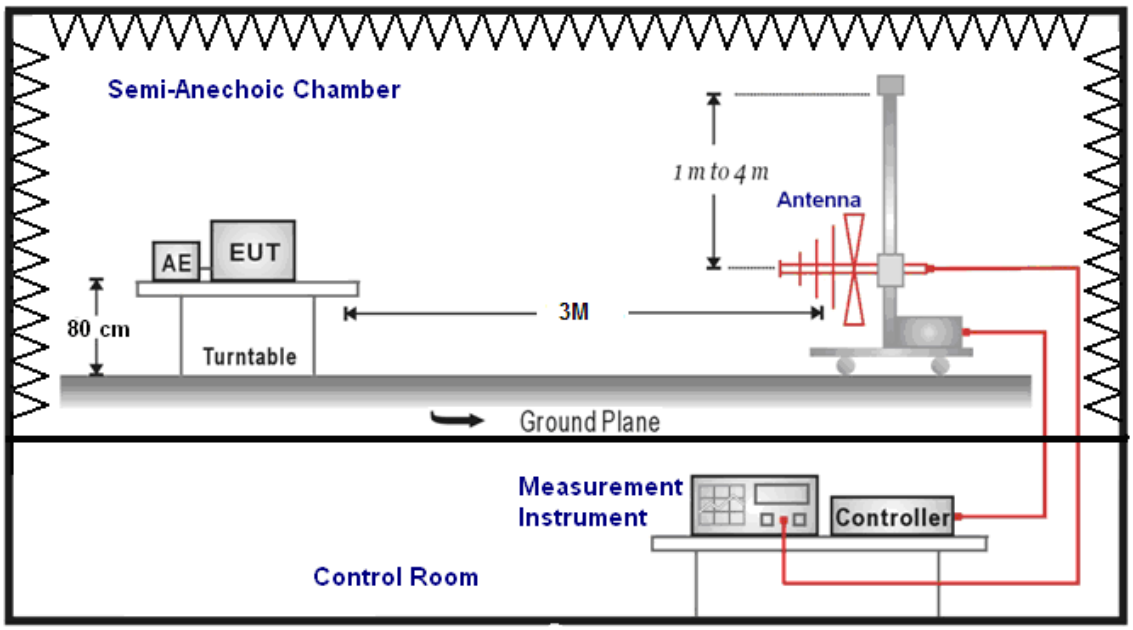
G_{EUT} is numeric gain of the EUT radiating element (antenna)

■ **Setup**

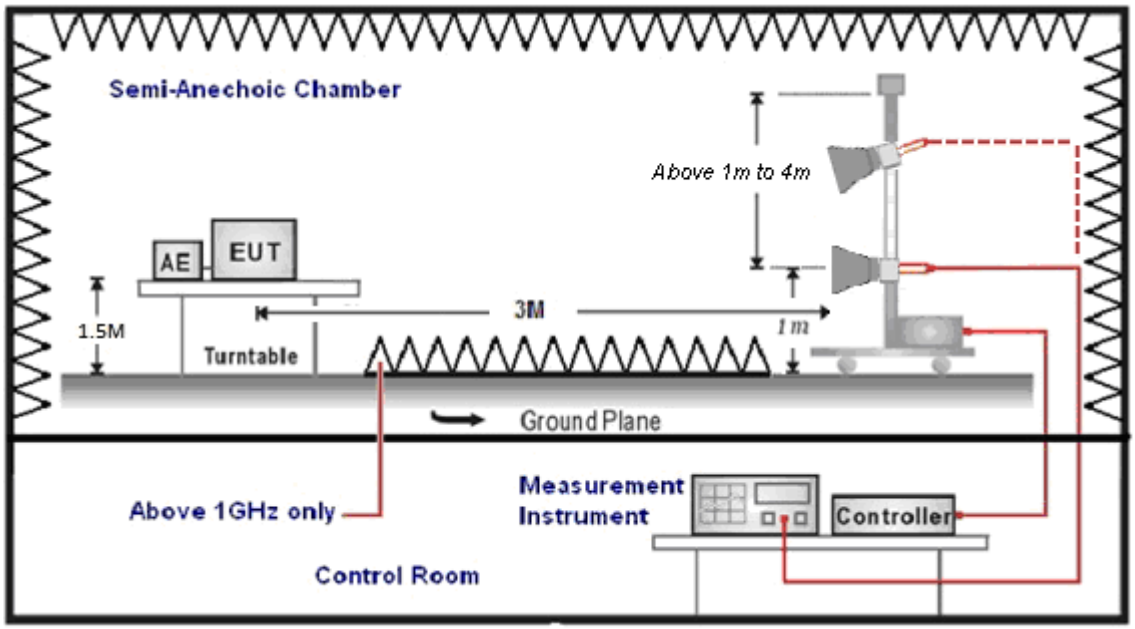
Below 30 MHz



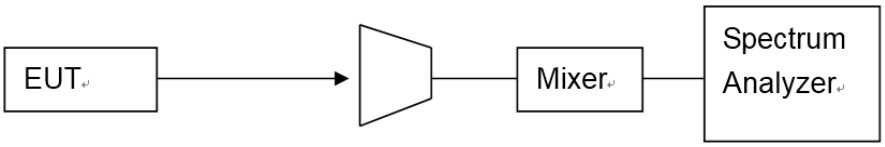
30 MHz ~ 1 GHz



Above 1 GHz



Above 50 GHz



■ **Test Procedure**

Final radiation measurements were made on a three-meter, Semi Anechoic Chamber. The EUT system was placed on a nonconductive turntable which is 0.8 meters height, top surface 1.0 x 1.5 meter. The EUT was set to transmit continuously & Measurements range from 9 kHz to 10th harmonic is investigated.

For measurements below 30 MHz the resolution bandwidth is set to 10 kHz for peak detection measurements or 9 kHz for quasi-peak detection measurements. The video bandwidth is 3 times of the resolution bandwidth.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 3 MHz for peak (detector for peak) measurements and average (detector for peak) measurements.

A nonconductive material surrounded the EUT to supporting the EUT for standing on tree orthogonal planes. At each condition, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters to find the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarization.

Biconilog Antenna at 3 Meter and the Horn Antenna was used in frequencies 18 – 40 GHz at a distance of 1 meter. All test results were extrapolated to equivalent signal at 3 meters utilizing an inverse linear distance extrapolation Factor (20 dB/decade).

For testing above 1 GHz, the emission level of the EUT in peak mode was 20 dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

Appropriate preamplifiers were used for improving sensitivity and precautions were taken to avoid overloading or desensitizing the spectrum analyzer. No post – detector video filters were used in the test.

The spectrum analyzer's 6 dB bandwidth was set to 1 MHz, and the analyzer was operated in the peak detection mode, for frequencies both below and up 1 GHz. The average levels were obtained by subtracting the duty cycle correction factor from the peak readings.

The following procedures were used to convert the emission levels measured in decibels referenced to 1 microvolt (dBuV) into field intensity in micro volts pre meter (uV/m).

The actual field intensity in decibels referenced to 1 microvolt in to field intensity in micro colts per meter (dBuV/m).

The actual field is intensity in referenced to 1 microvolt per meter (dBuV/m) is determined by algebraically adding the measured reading in dBuV, the antenna factor (dB), and cable loss (dB) and Subtracting the gain of preamplifier (dB) is auto calculate in spectrum analyzer.

(1) Amplitude (dBuV/m) = FI (dBuV) +AF (dBuV) +CL (dBuV)-Gain (dB)
FI= Reading of the field intensity.
AF= Antenna factor.
CL= Cable loss.
P.S Amplitude is auto calculate in spectrum analyzer.

(2) Actual Amplitude (dBuV/m) = Amplitude (dBuV)-Dis(dB)
The FCC specified emission limits were calculated according the EUT operating frequency and by following linear interpolation equations:
(a) For fundamental frequency : Transmitter Output < +30 dBm
(b) For spurious frequency : Spurious emission limits = fundamental emission limit /10

Above 40GHz: $E = 126.8 - 20\log(\lambda) + P - G$

E is the field strength of the emission at the measurement distance, in dBuV/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

Note: The measured power P includes all applicable instrument correction factors up to the connection to the test antenna.

Measurement distance conversion calculation formula:

$E_{Space\ Limit} = E_{Meas} + 20\log(D_{Meas} / D_{Space\ Limit})$

E_{Space} Limit is the field strength of the emission at the distance specified by the limit, in dBuV/m

E_{Meas} is the field strength of the emission at the distance specified by the limit, in dBuV/m

D_{Meas} is the measurement distance, in m

D_{Space} Limit is the distance specified by the limit, in m

Field strength to EIRP calculation formula:

$EIRP = E + 20\log(d) – 104.7$

EIRP is the equivalent isotropically radiated power, in dBm

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

d is the measurement distance, in m

Far Field Distance Evaluation:

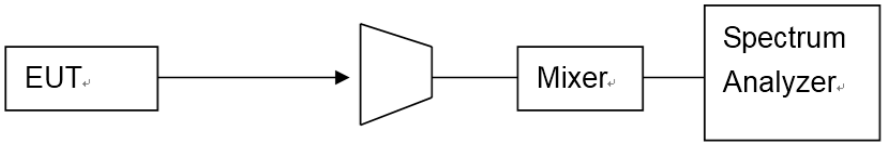
Rx Antenna	Frequency (GHz)	Wavelength λ (m)	Measurement Antenna D (m)	Far field Rm (m) ≧ $2*D^2/\lambda$	Measurement Distance d_1 (m)	Distance specified by the limit d_2 (m)	Distance Factor = 20* log (d_1/d_2) (dB)
9170	18	0.0167	0.06	0.43	1	3	-9.54
	40	0.0075	0.06	0.96	1	3	-9.54
QWH-QPRR00	40	0.0075	0.0389	0.40	1	3	-9.54
	50	0.0060	0.0389	0.50	1	3	-9.54
N9029AH15	50	0.0060	0.0241	0.19	1	3	-9.54
	75	0.0040	0.0241	0.29	1	3	-9.54
N9029AH12	60	0.0050	0.0199	0.16	1	3	-9.54
	90	0.0033	0.0199	0.24	1	3	-9.54
N9029AH08	90	0.0033	0.0136	0.11	1	3	-9.54
	140	0.0021	0.0136	0.17	1	3	-9.54
N9029AH05	140	0.0021	0.0084	0.07	1	3	-9.54
	220	0.0014	0.0084	0.10	1	3	-9.54
N9029AH03	220	0.0014	0.0056	0.05	1	3	-9.54
	325	0.0009	0.0056	0.07	1	3	-9.54

4.3. 6 dB Emission Bandwidth and 99% Occupied Bandwidth Measurement

■ **Limit**

NA.

■ **Test Setup**



■ **Test Procedure**

6 dB Emission Bandwidth:

The testing follows ANSI C63.10-2013 Section 9.3.

99% Occupied Bandwidth:

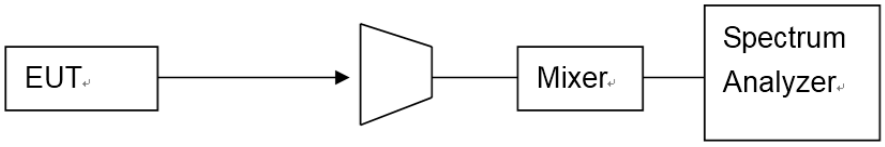
The testing follows ANSI C63.10-2013 Section 6.9.3 and RSS-Gen Section 6.7.

4.4. 20 dB Emission Bandwidth Measurement

■ **Limit**

61 to 61.5GHz.

■ **Test Setup**



■ **Test Procedure**

20 dB Emission Bandwidth:

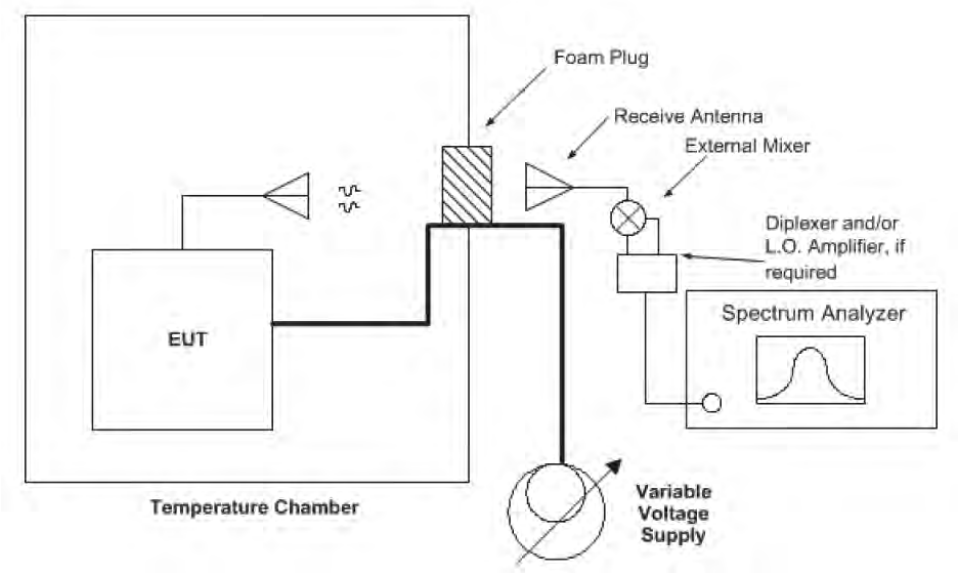
The testing follows ANSI C63.10-2013 Section 9.3.

4.5. Frequency Stability Measurement

■ **Limit**

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 Setup**



■ **Test Procedure**

The testing follows ANSI C63.10-2013 Section 9.14.

4.6. Antenna Measurement

■ **Limit**

FCC Part 15.203:

For intentional device, according to 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

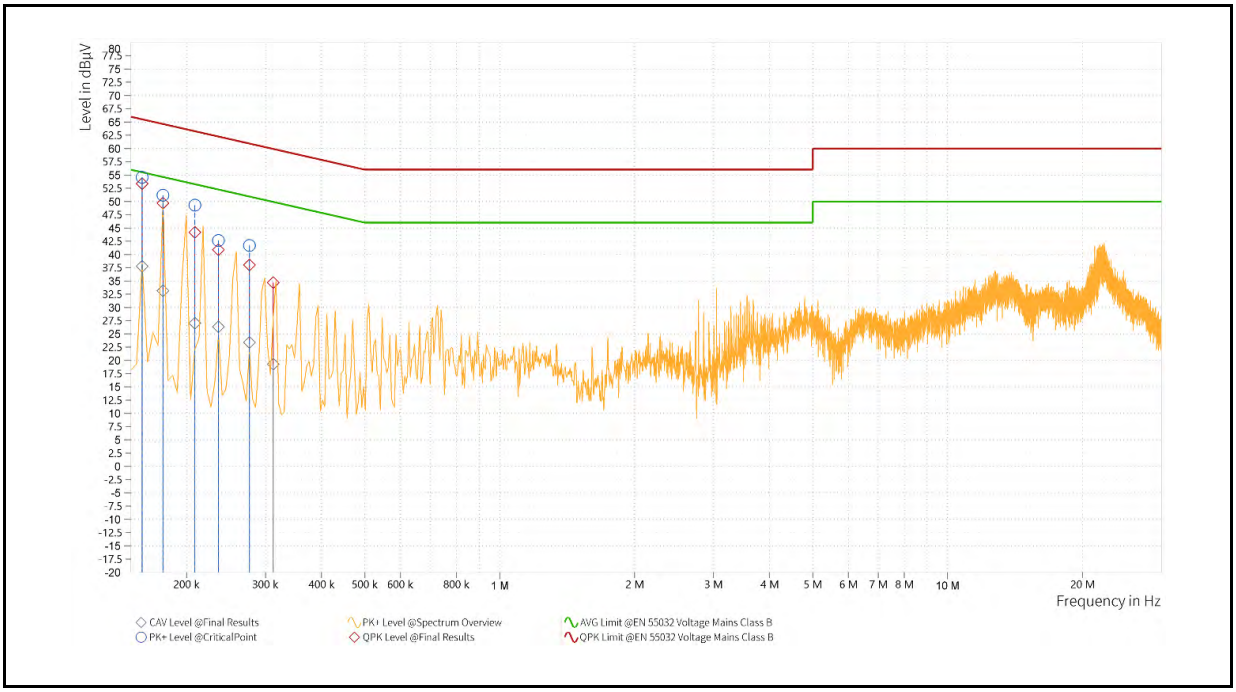
■ **Antenna Connector Construction**

See section 2 – antenna information.

5 Test Results

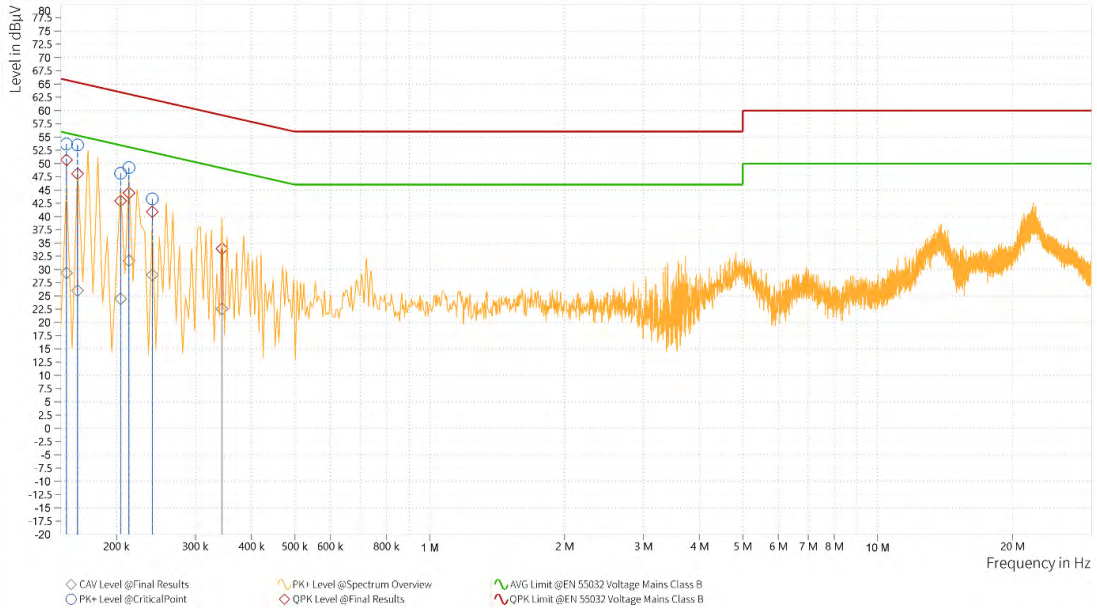
5.1. Conducted Emission

Standard:	FCC Part 15.255	Line:	L1
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Mode:	Mode 2		
Description:			



Rg	Frequency [MHz]	QP Result [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Result [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Correction factor [dB]	Line
1	0.159	53.38	65.52	12.13	37.74	55.52	17.77	9.64	L1
1	0.177	49.67	64.63	14.96	33.15	54.63	21.47	9.64	L1
1	0.209	44.16	63.26	19.11	27.04	53.26	26.22	9.64	L1
1	0.236	40.86	62.25	21.39	26.35	52.25	25.91	9.64	L1
1	0.276	38.00	60.94	22.94	23.38	50.94	27.56	9.64	L1
1	0.312	34.67	59.92	25.24	19.30	49.92	30.62	9.64	L1

Standard:	FCC Part 15.255	Line:	N
Test item:	Conducted Emission	Power:	AC 120 V/60 Hz
Mode:	Mode 2		
Description:			

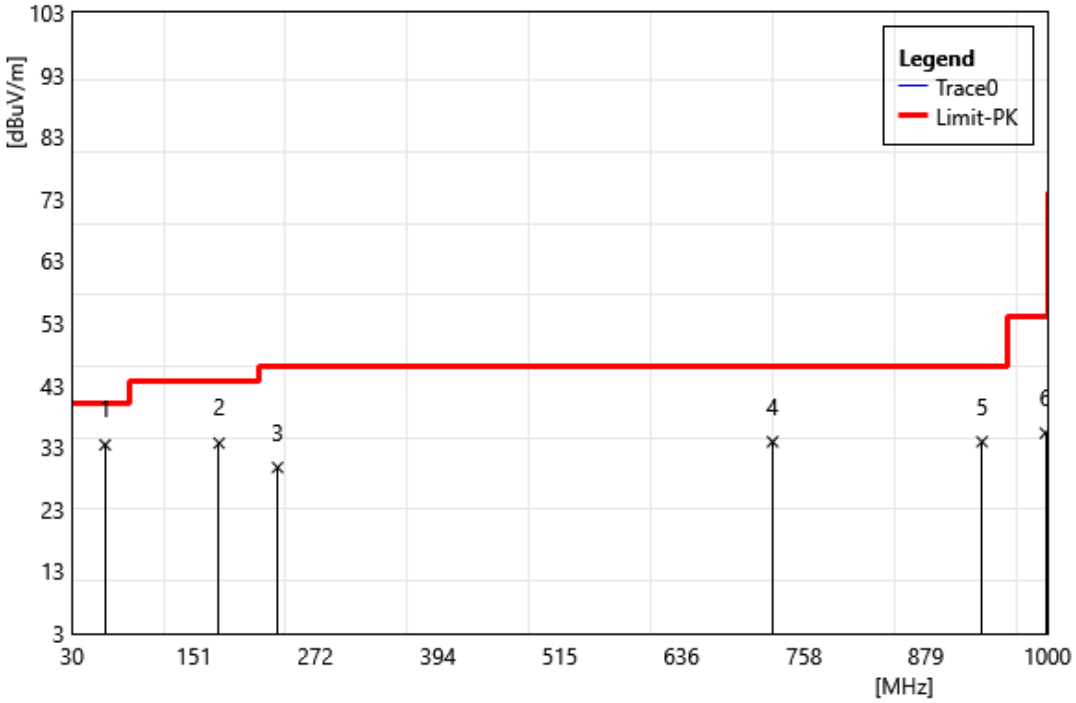


Rg	Frequency [MHz]	QP Result [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Result [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Correction factor [dB]	Line
1	0.155	50.66	65.75	15.10	29.34	55.75	26.41	9.64	N
1	0.164	48.04	65.28	17.24	26.01	55.28	29.28	9.64	N
1	0.204	42.94	63.45	20.51	24.46	53.45	28.99	9.64	N
1	0.213	44.44	63.09	18.65	31.65	53.09	21.44	9.64	N
1	0.240	40.88	62.10	21.22	28.94	52.10	23.16	9.64	N
1	0.344	33.91	59.12	25.21	22.55	49.12	26.57	9.65	N

5.2. Radiated Emission Test Results

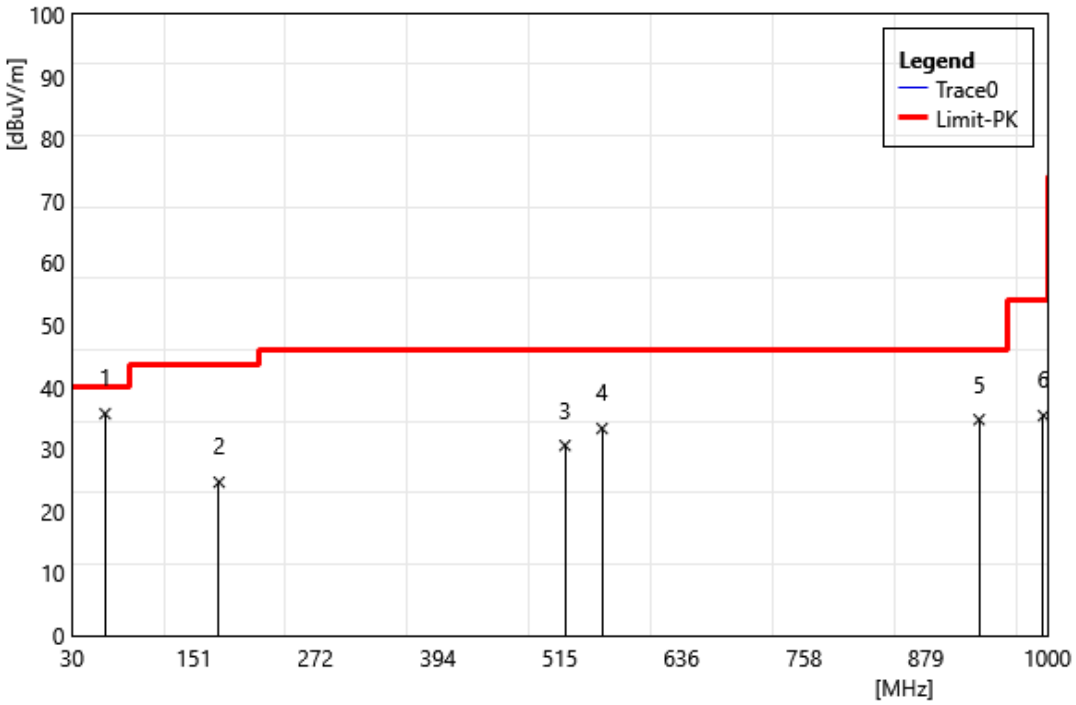
Radiated Emissions (below 1 GHz)

Test Site:	96602 - WG	Standard:	Part 15.255
Mode:	Transmit Mode		
Polarization:	Horizontal		
ReMark:			



ID	Frequency MHz	Reading dBuV	Correct Factor dB/m	Result dBuV/m	Limit dBuV/m	Margin dB	ReMark
1	62.95	41.41	-8.02	33.39	40.00	-6.61	QP
2	176.32	41.69	-8.03	33.66	43.50	-9.84	QP
3	234.47	38.50	-8.77	29.73	46.00	-16.27	QP
4	726.73	32.75	1.12	33.87	46.00	-12.13	QP
5	935.07	29.18	4.71	33.89	46.00	-12.11	QP
6	998.06	29.41	5.86	35.27	54.00	-18.73	QP

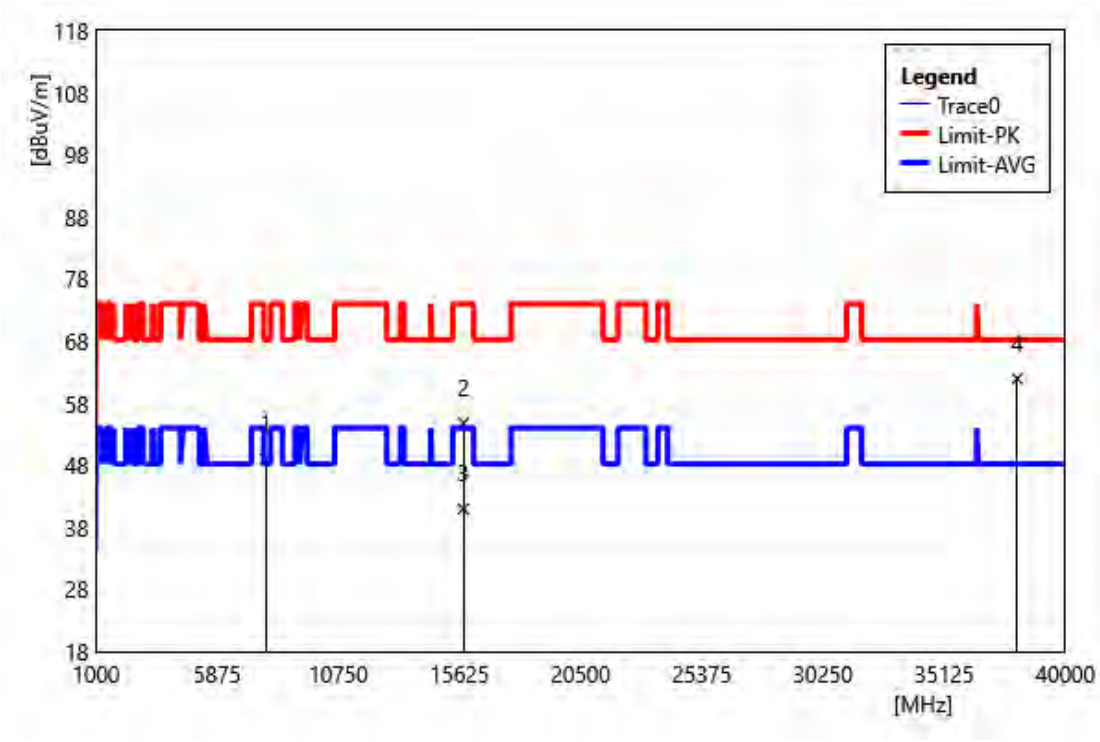
Test Site:	96602 - WG	Standard:	Part 15.255
Mode:	Transmit Mode		
Polarization:	Vertical		
ReMark:			



ID	Frequency MHz	Reading dBuV	Correct Factor dB/m	Result dBuV/m	Limit dBuV/m	Margin dB	ReMark
1	62.95	43.75	-8.02	35.73	40.00	-4.27	QP
2	176.32	32.73	-8.03	24.70	43.50	-18.80	QP
3	520.33	33.49	-2.88	30.61	46.00	-15.39	QP
4	557.15	35.50	-2.16	33.34	46.00	-12.66	QP
5	932.17	30.14	4.63	34.77	46.00	-11.23	QP
6	996.12	29.47	5.95	35.42	54.00	-18.58	QP

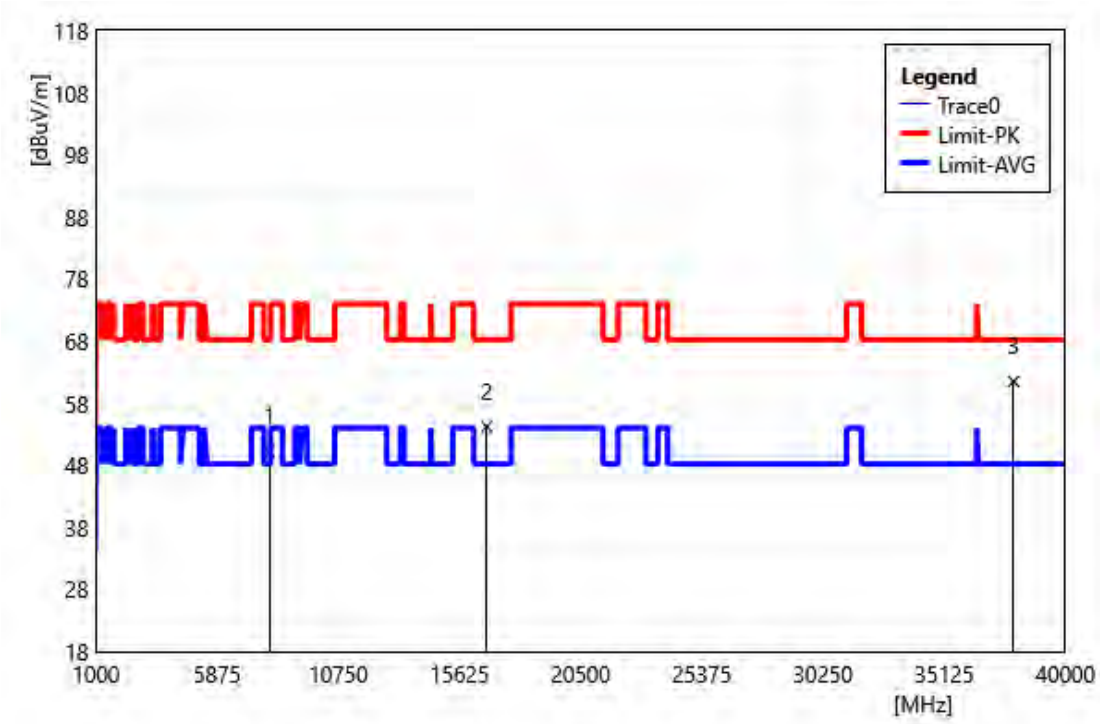
Radiated Emissions (Above 1 GHz)

Test Site:	96602 - WG	Standard:	Part 15.255
Test Mode:	60GHz Radar		
Polarization:	Horizontal		
ReMark:			



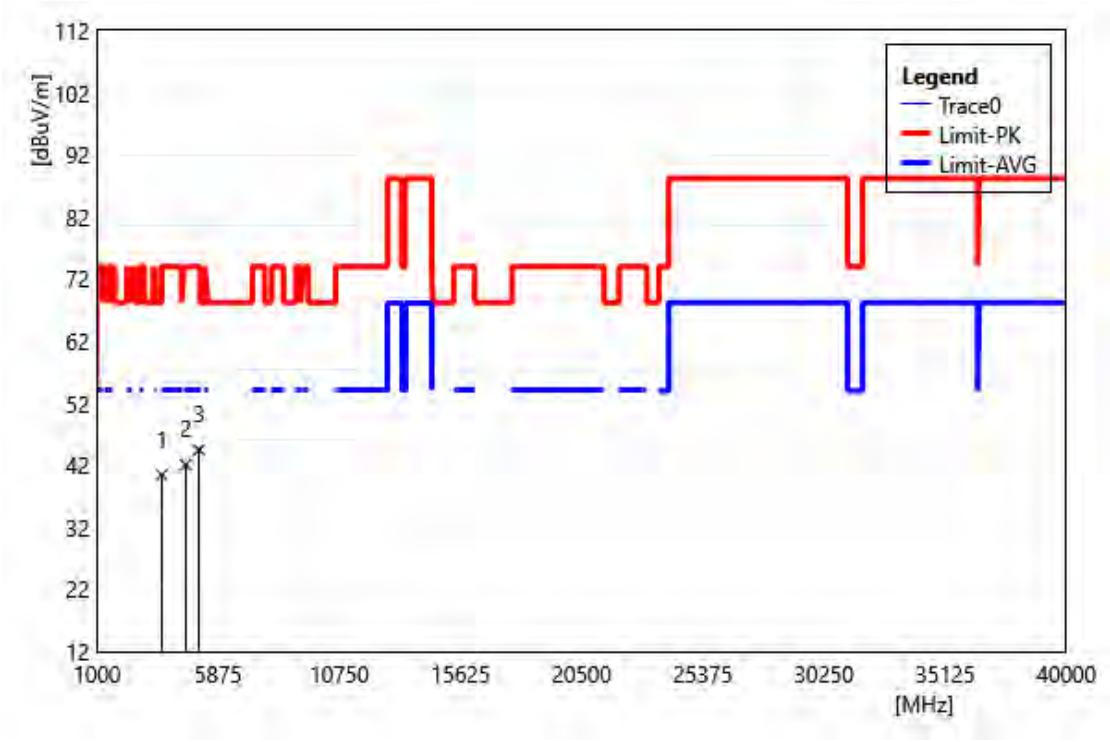
ID	Frequency MHz	Reading dBuV	Correct Factor dB/m	Result dBuV/m	Limit dBuV/m	Margin dB	ReMark
1	7818.18	42.37	6.59	48.96	68.20	-19.24	PEAK
2	15782.22	45.67	9.13	54.80	74.00	-19.20	PEAK
3	15782.22	31.83	9.13	40.96	54.00	-13.04	AVG
4	38065.93	48.49	13.45	61.94	68.20	-6.26	PEAK

Test Site:	96602 - WG	Standard:	Part 15.255
Test Mode:	60GHz Radar		
Polarization:	Vertical		
ReMark:			



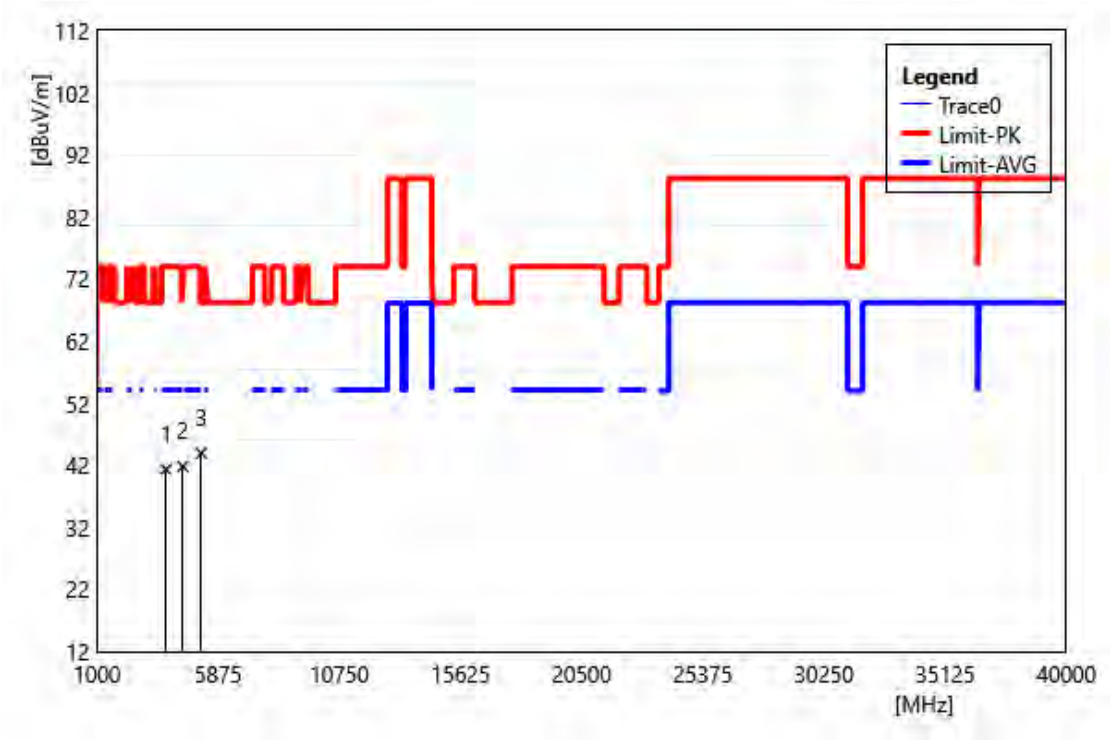
ID	Frequency MHz	Reading dBuV	Correct Factor dB/m	Result dBuV/m	Limit dBuV/m	Margin dB	ReMark
1	7965.04	43.50	6.75	50.25	68.20	-17.95	PEAK
2	16721.28	45.61	8.62	54.23	68.20	-13.97	PEAK
3	37912.09	48.22	13.26	61.48	68.20	-6.72	PEAK

Test Site:	96602 - WG	Standard:	Part15.255
Test Mode:	60GHz Radar + BLE		
Polarization:	Horizontal		
ReMark:	Colocation		



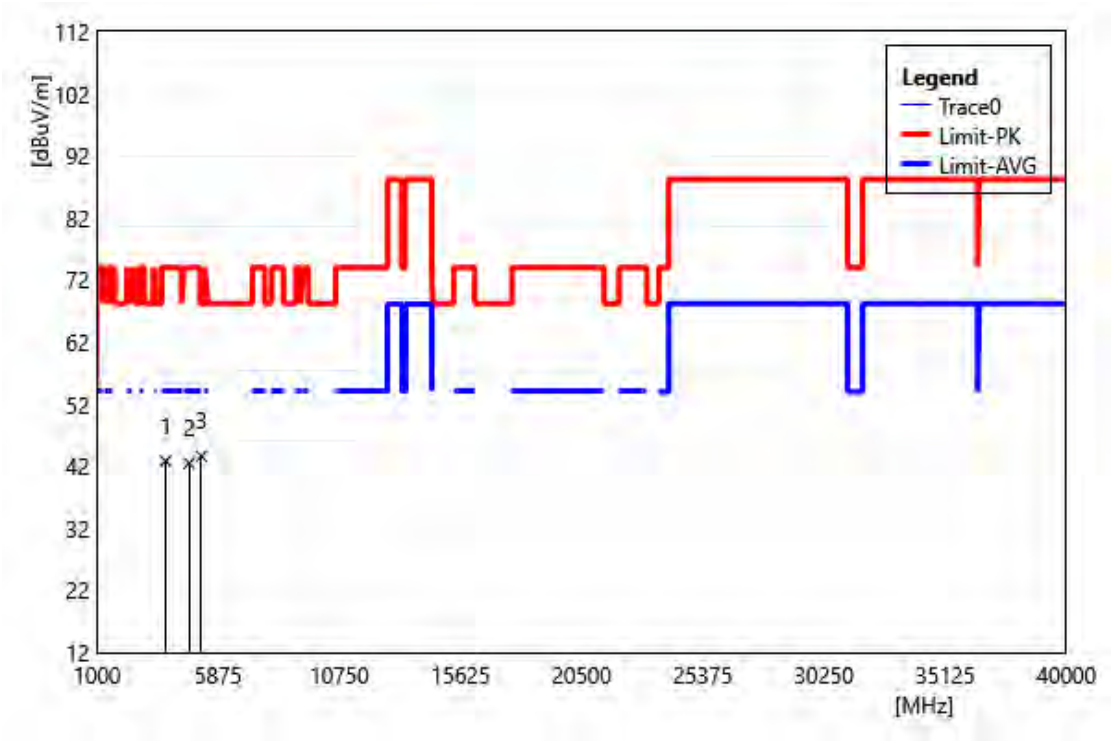
ID	Frequency MHz	Reading dBuV	Correct Factor dB/m	Result dBuV/m	Limit dBuV/m	Margin dB	ReMark
1	3605.39	41.82	-1.34	40.48	74.00	-33.52	PEAK
2	4572.43	41.31	0.78	42.09	74.00	-31.91	PEAK
3	5104.90	42.99	1.50	44.49	74.00	-29.51	PEAK

Test Site:	96602 - WG	Standard:	Part15.255
Test Mode:	60GHz Radar + BLE		
Polarization:	Vertical		
ReMark:	Colocation		



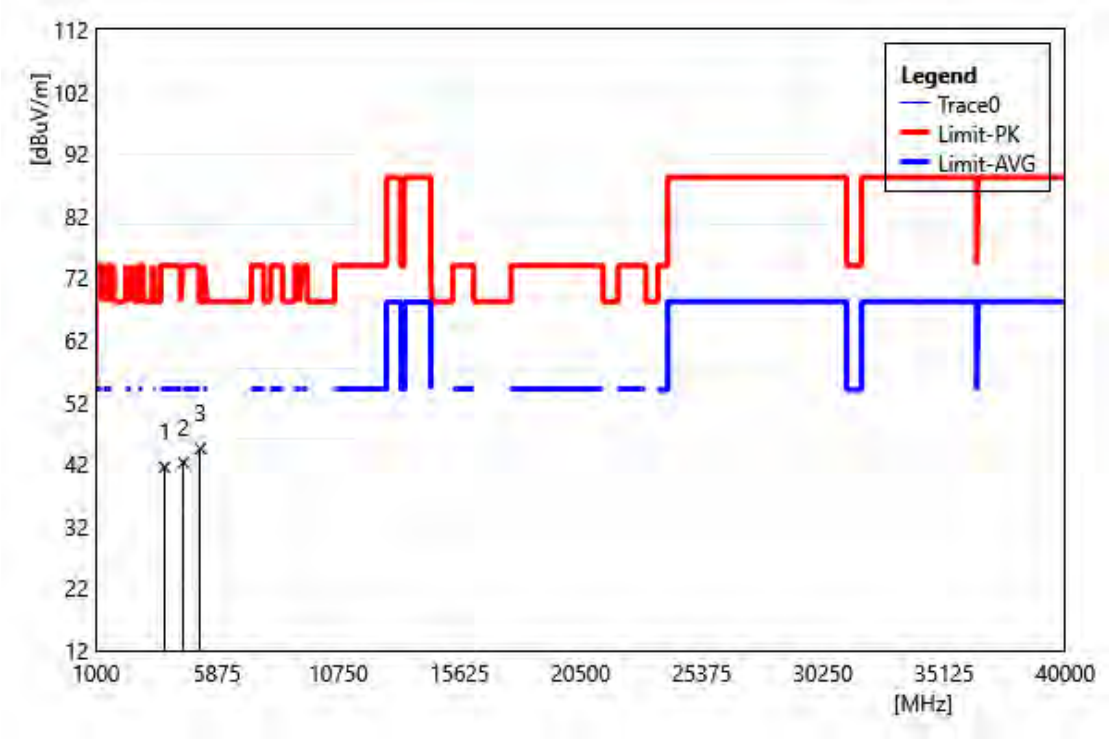
ID	Frequency MHz	Reading dBuV	Correct Factor dB/m	Result dBuV/m	Limit dBuV/m	Margin dB	ReMark
1	3773.23	42.09	-0.78	41.31	74.00	-32.69	PEAK
2	4448.55	41.60	0.19	41.79	68.20	-26.41	PEAK
3	5197.80	42.47	1.48	43.95	68.20	-24.25	PEAK

Test Site:	96602 - WG	Standard:	Part15.255
Test Mode:	60GHz Radar + WLAN 2.4G		
Polarization:	Horizontal		
ReMark:	Colocation		



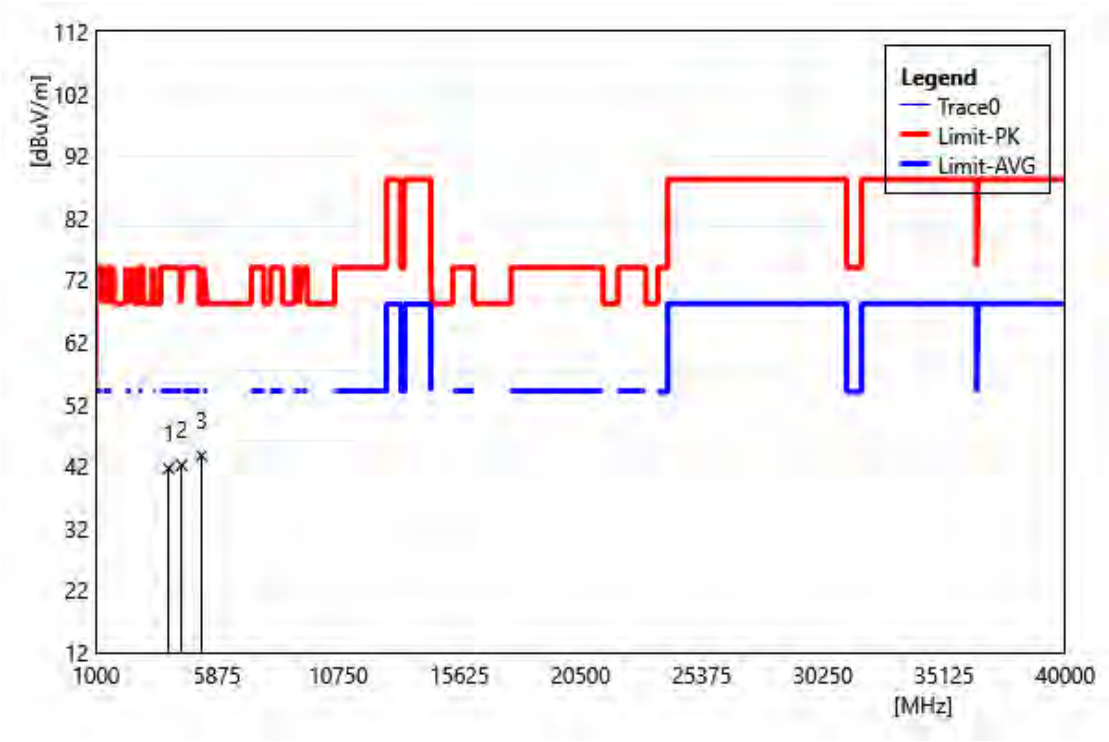
ID	Frequency MHz	Reading dBuV	Correct Factor dB/m	Result dBuV/m	Limit dBuV/m	Margin dB	ReMark
1	3765.23	43.64	-0.75	42.89	74.00	-31.11	PEAK
2	4712.29	41.53	0.94	42.47	74.00	-31.53	PEAK
3	5203.80	42.18	1.47	43.65	68.20	-24.55	PEAK

Test Site:	96602 - WG	Standard:	Part15.255
Test Mode:	60GHz Radar + WLAN 2.4G		
Polarization:	Vertical		
ReMark:	Colocation		



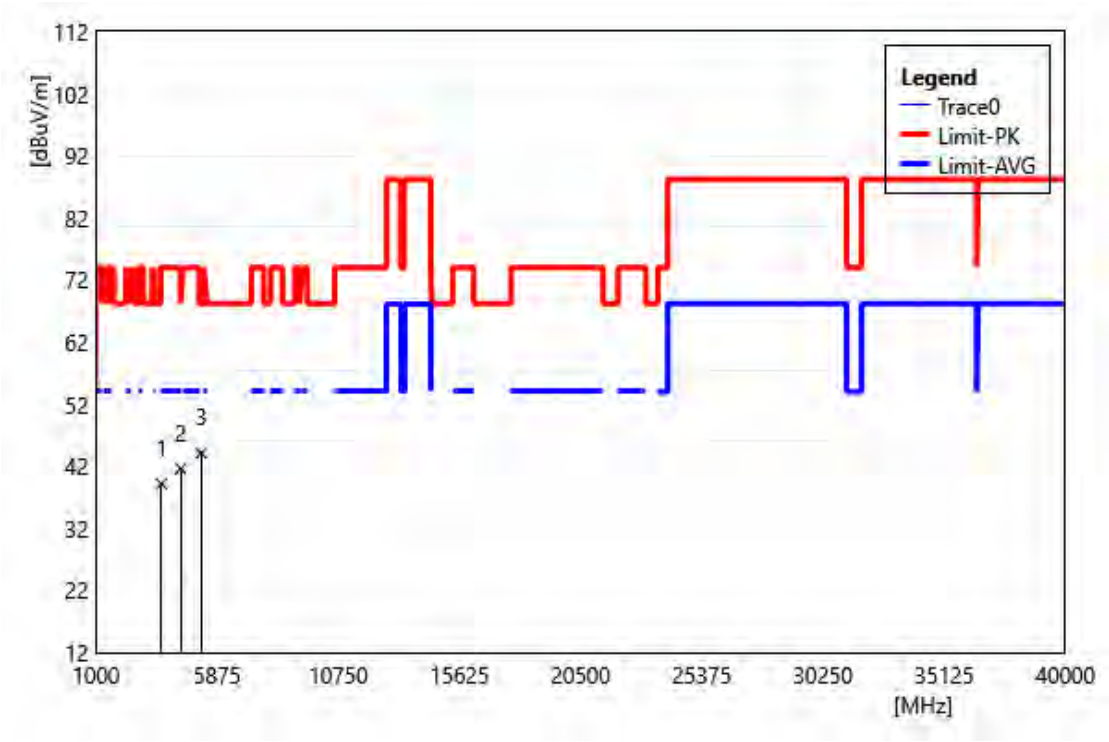
ID	Frequency MHz	Reading dBuV	Correct Factor dB/m	Result dBuV/m	Limit dBuV/m	Margin dB	ReMark
1	3765.23	42.29	-0.75	41.54	74.00	-32.46	PEAK
2	4520.48	41.49	0.79	42.28	74.00	-31.72	PEAK
3	5197.80	43.04	1.48	44.53	68.20	-23.68	PEAK

Test Site:	96602 - WG	Standard:	Part15.255
Test Mode:	60GHz Radar + WLAN 5G		
Polarization:	Horizontal		
ReMark:	Colocation		



ID	Frequency MHz	Reading dBuV	Correct Factor dB/m	Result dBuV/m	Limit dBuV/m	Margin dB	ReMark
1	3925.07	42.75	-1.10	41.65	74.00	-32.35	PEAK
2	4448.55	42.35	-0.18	42.17	68.20	-26.03	PEAK
3	5248.75	42.29	1.42	43.71	68.20	-24.49	PEAK

Test Site:	96602 - WG	Standard:	Part15.255
Test Mode:	60GHz Radar + WLAN 5G		
Polarization:	Vertical		
ReMark:			



ID	Frequency MHz	Reading dBuV	Correct Factor dB/m	Result dBuV/m	Limit dBuV/m	Margin dB	ReMark
1	3633.37	40.86	-1.73	39.13	74.00	-34.87	PEAK
2	4404.60	42.24	-0.60	41.64	68.20	-26.56	PEAK
3	5233.77	42.70	1.43	44.13	68.20	-24.07	PEAK

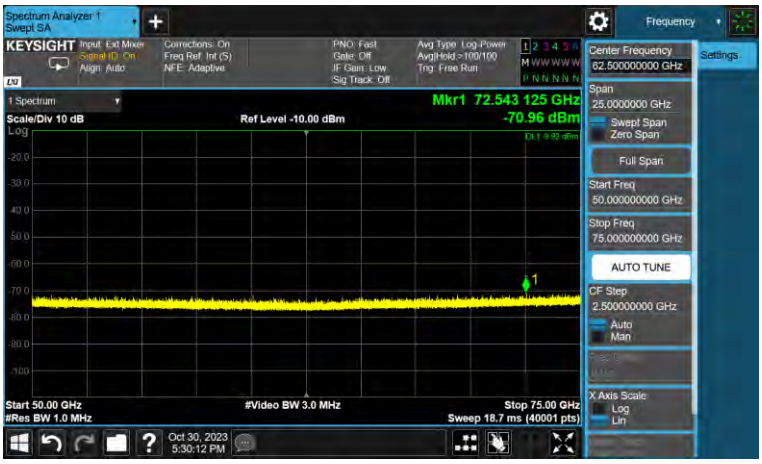
5.3. Power density Test Results

60GHz Radar								
Frepuency (GHz)	Reading (dBm)	Distance Factor = 20* log (1m/3m) (dB)	Ant. Pol.	AF (dBm/m)	CL+ML (dB)	Result (dBm)	Power Density (pW/cm^2)	Limit ((pW/cm^2))
49.94175	-64.50	-9.54	H	23.70	5.30	-45.04	0.0277	90
49.95550	-64.44	-9.54	V	23.70	5.30	-44.98	0.0281	
72.543125	-70.96	-9.54	H	22.80	1.40	-56.30	0.0021	
74.417500	-70.45	-9.54	V	22.80	1.40	-55.79	0.0023	
76.776000	-70.84	-9.54	H	22.50	1.58	-56.30	0.0021	
89.264625	-70.20	-9.54	V	22.50	1.58	-55.66	0.0024	
Above 90	Not detected	---	---	---	---	---	---	

Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	60GHz Radar		
Remark:	40-50 G		

Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	60GHz Radar		
Remark:	40-50 G		

Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	60GHz Radar		
Remark:	50-75 G		



Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	60GHz Radar		
Remark:	50-75 G		

Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	60GHz Radar		
Remark:	75-90 G		

Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	60GHz Radar		
Remark:	75-90 G		

Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	60GHz Radar		
Remark:	90-140 G		

Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	60GHz Radar		
Remark:	90-140 G		

Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Horizontal		
Test Mode:	60GHz Radar		
Remark:	140-200 G		

Standard:	Part 15.255	Test Site:	966 Chamber
Polarization:	Vertical		
Test Mode:	60GHz Radar		
Remark:	140-200 G		

5.4. Output Power Test Results

For Peak Power (E.I.R.P)

Mode	Measurement Distance (m)	Frequency (GHz)	Readin (dBm)	Antenna Gain (dBi)	E (dBuV/m)	E.I.R.P (dBm)	Limit (dBm)	Result
60GHz Radar	1	61.25	-40.11	21.5	111.39	8.03	43	PASS

Note:The EIRP was evaluated on vertical and horizontal polarization, the worst case is Vertical polarization.

For Peak Output Power

Mode	Frequency (GHz)	Peak E.I.R.P (dBm)	Antenna Gain (dBi)	Peak Conduced output Power (dBm)	Limit (dBm)	Result
60GHz Radar	61.25	8.03	3	5.03	27	PASS

Note: Peak power = Peak EIRP power – Antenna Gain.

For Average Power (E.I.R.P)

Mode	Frequency (GHz)	Peak E.I.R.P (dBm)	Duty Factor (dB)	E.I.R.P Average power (dBm)	Limit (dBm)	Result
60GHz Radar	61.25	8.03	19.10	-11.07	40	PASS

Note: Average power = Peak power – 10*log(1/duty cycle in the transmit interval).

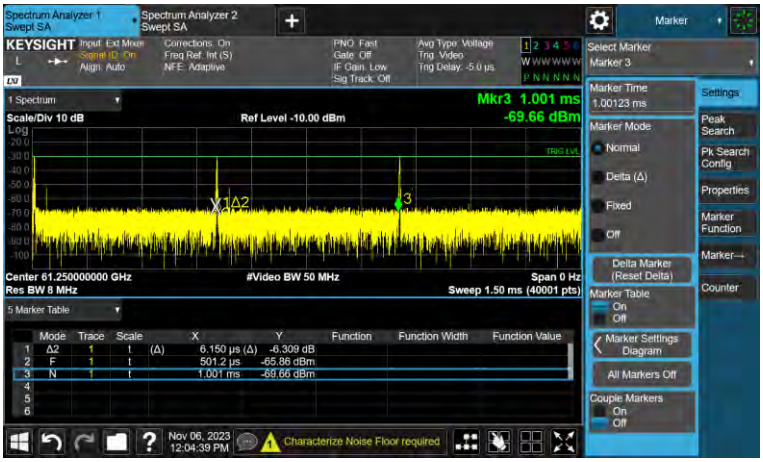
For Duty cycle

Mode	Frequency (GHz)	On time (us)	On+off time (us)	Duty cycle (%)	Duty Factor (dB)
60GHz Radar	61.25	6.15	499.8	1.23	19.10

5.5. 6dB & 99 Occupied Bandwidth Test Results

Mode	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
60GHz Radar	389.0	407.82

6 dB Bandwidth & 99 Occupied Bandwidth	
Ch0	
	

Duty cycle	
Ch0	

5.6. 20dB Bandwidth Test Results

Mode	20 dB Bandwidth (MHz)	Low Frequency (GHz)	High Frequency (GHz)	Result
60GHz Radar	429.4	61.035	61.465	PASS

20 dB Bandwidth	
Ch0	

5.7. Frequency Stability Test Results

Test Mode	:	60GHz Radar
Frequency	:	61.25 GHz
V_{Nom}	:	3.7 Vdc

Environment Temperature (°C)	Power Supplied (Vdc)	Measured Frequency (GHz)				Result
		0 min	2 min	5 min	10 min	
50	V_{Nom}	61.2467	61.2471	61.2477	61.2483	PASS
40	V_{Nom}	61.2468	61.2471	61.2478	61.2482	PASS
30	V_{Nom}	61.2468	61.2472	61.2477	61.2483	PASS
25	V_{Nom}	61.2469	61.2472	61.2479	61.2483	PASS
20	V_{Nom}	61.2490	61.2506	61.2490	61.2507	PASS
10	V_{Nom}	61.2505	61.2506	61.2505	61.2505	PASS
0	V_{Nom}	61.2505	61.2505	61.2490	61.2505	PASS
-10	V_{Nom}	61.2506	61.2506	61.2506	61.2506	PASS
-20	V_{Nom}	61.2467	61.2471	61.2477	61.2483	PASS

Environment Temperature (°C)	Power Supplied (Vdc)	Measured Frequency (GHz)				Result
		0 min	2 min	5 min	10 min	
20	V_{Low}	61.2468	61.2473	61.2479	61.2482	PASS
	V_{High}	61.2468	61.2473	61.2478	61.2482	PASS

Note 1: V_{Low}= 3.6 V ; V_{High}= 4.2 V

---END---