

FCC TEST REPORT

Applicant	Marquardt GmbH
Address	Schloss-str.16,78604 Rietheim-Weilheim,Germany

Manufacturer or Supplier	Marquardt GmbH
Address	Schloss-str.16,78604 Rietheim-Weilheim,Germany
Product	Geely UWB module
Brand Name	Marquardt
Model	GU1
FCC ID:	IYZGU1
Date of tests	May. 10, 2023~ Aug. 18, 2023

The tests have been carried out according to the requirements of the following standard:

☒ **FCC Part 15, Subpart F, Section 15.519**

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Prepared by Chao Wu Engineer / Mobile Department	Approved by Peibo Sun Manager / Mobile Department
 Date: Aug. 18, 2023	 Date: Aug. 18, 2023

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Test Report No.: W7L-P23040005RF01

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
W7L-P23040005RF01	Original release	Aug. 18, 2023

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15, Subpart F(Section 15.519)			
STANDARD SECTION	TEST TYPE AND LIMIT	RESULT	REMARK
15.207	AC Power Conducted Emission	PASS	Powered by DC Source
15.519(a)(1)	Shutoff Timing Requirements	PASS	Meet the requirement of limit.
15.503(d) 15.519(b)	UWB bandwidth	PASS	Meet the requirement of limit.
15.519(c)/ 15.209 15.519(d)	Radiated Emissions	PASS	Meet the requirement of limit.
15.519(e)	Peak Level of the Emission	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	No antenna connector is used
*Test Lab Information Reference Lab : Huarui 7Layers High Technology (Suzhou) Co., Ltd. Lab Address: Tower N, Innovation Center, 88 Zhuyi Road, High-tech District, Suzhou City, Anhui Province Accredited Test Lab Cert 6613.01 The FCC Site Registration No. is 434559; The Designation No. is CN1325.			

2 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	UNCERTAINTY
AC Power Conducted emissions	$\pm 2.70\text{dB}$
Radiated emissions (30MHz~1GHz)	$\pm 4.98\text{dB}$
Radiated emissions (1GHz ~6GHz)	$\pm 4.70\text{dB}$
Radiated emissions (6GHz ~18GHz)	$\pm 4.60\text{dB}$
Radiated emissions (18GHz ~40GHz)	$\pm 4.12\text{dB}$
Conducted emissions	$\pm 4.01\text{dB}$
Occupied Channel Bandwidth	$\pm 43.58\text{KHz}$
Conducted Output power	$\pm 2.06\text{dB}$
Power Spectral Density	$\pm 0.85\text{ dB}$

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT*	Geely UWB module
BRAND NAME*	Marquardt
MODEL NAME*	GU1
FCC ID*	IYZGU1
NOMINAL VOLTAGE*	12Vdc
MODULATION TYPE*	BPSK
FREQUENCY*	CH5 : 6489.6MHz/ CH9: 7987.2MHz
HW VERSION*	UWB:222901
SW VERSION*	221701
ANTENNA TYPE*	PCB Antenna
I/O PORTS*	Refer to user's manual
CABLE SUPPLIED*	N/A
EXTREME TEMPERATURE*	-40 ~ 85°C
EXTREME VOLTAGE*	EUT 9V ~ EUT 16V
EQUIPMENT TYPE	Hand held UWB systems

NOTE:

1. *Since the above data and/or information is provided by the client relevant results or conclusions of this report are only made for these data and/or information , Test Lab is not responsible for the authenticity, integrity and results of the data and information and/or the validity of the conclusion.
2. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
3. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

List of Accessory:

ACCESSORIES	BRAND	MANUFACTURER	MODEL	SPECIFICATION
PCB Antenna	Marquardt GmbH	Schloss-str.16,78604 Rietheim-Weilheim, Germany	UWB : MQUANTK	Size : 25.6mm* 16.3mm

3.2 DESCRIPTION OF TEST MODES

CHANNEL	FREQUENCY
5	6489.6MHz
9	7987.2MHz

3.2.1 CONFIGURATION OF SYSTEM UNDER TEST

Please see section 5 photographs of the test configuration for reference.

3.2.2 TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports. The worst case was found when positioned on X axis for radiated emission. Following test modes were selected for the final test, and the final worst case is marked in boldface and recorded in the report:

EUT CONFIGURE MODE	APPLICABLE TO						DESCRIPTION
	RE ≥ 1G	RE < 1G	PLC	BW	PE&AE	STR	
-	√	√	√	√	√	√	DC 12V by DC source

Where **RE ≥ 1G**: Radiated Emission above 1GHz **RE < 1G**: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission **BW**: 10dB Bandwidth measurement
PE&AE: Peak power and maximum average emissions
STR: Shutoff Timing Requirements

POWER LINE CONDUCTED EMISSION TEST

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	UWB	5, 9	9	BFSK

RADIATED EMISSION TEST (BELOW 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	UWB	5, 9	9	BFSK

RADIATED EMISSION TEST (ABOVE 1GHz):

Huarui 7layers High Technology (Suzhou) Co., Ltd.

Tower N, Innovation Center, 88 Zhuyi Road, High-tech District, Suzhou City, Anhui Province

Tel: +86 (0557) 368 1008

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports (if EUT with antenna diversity architecture).

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	UWB	5, 9	5, 9	BFSK

UWB BANDWIDTH MEASUREMENT:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations.

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	UWB	5, 9	5, 9	BFSK

PEAK POWER AND MAXIMUM AVERAGE EMISSIONS

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations.

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	UWB	5, 9	5, 9	BFSK

SHUTOFF TIMING REQUIREMENTS:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations.

☒ Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE
-	UWB	5, 9	5, 9	BFSK

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE	TESTED BY
RE<1G	23deg. C, 53%RH	DC 12V from DC Source	Chao Wu
RE≥1G	23deg. C, 53%RH	DC 12V from DC Source	Chao Wu
PLC	23deg. C, 53%RH	AC 120V/60HZ(DC Source)	Chao Wu
BW	20deg. C, 55%RH	DC 12V from DC Source	Chao Wu
PE&AE	23deg. C, 53%RH	DC 12V from DC Source	Chao Wu
STR	23deg. C, 53%RH	DC 12V from DC Source	Chao Wu

3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart F, Section 15.519

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

3.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	DC Source	HYELEC	HY3010B	551016	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	N/A

4 TEST TYPES AND RESULTS

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB μ V)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56	56 to 46
0.5 ~ 5	56	46
5 ~ 30	60	50

- NOTE:**
1. The lower limit shall apply at the transition frequencies.
 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.
 3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR3	101900	Feb. 14,23	Feb. 13,24
EMC32 test software	Rohde&Schwarz	EMC32	NA	NA	NA
LISN network	Rohde&Schwarz	ENV216	101922	Mar. 10,23	Mar. 09,24

NOTE:

1. The test was performed in CE shielded room.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.1.3 TEST PROCEDURES

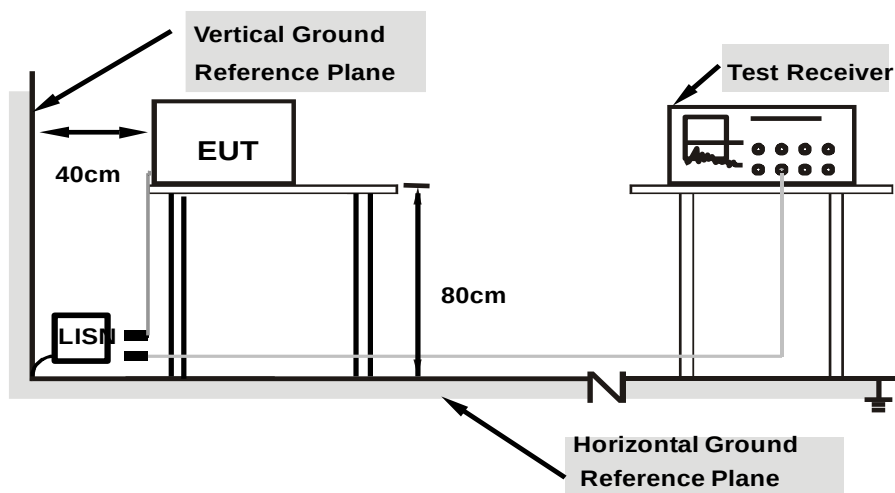
- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150KHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE: All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation.

4.1.5 TEST SETUP



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT OPERATING CONDITIONS

- a. Turned on the power and connected of all equipment.
- b. EUT was operated according to the type used was description in manufacturer's specifications or the User's Manual.

4.1.7 TEST RESULTS

CONDUCTED WORST-CASE DATA:

Frequency Range	150KHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power	120Vac, 60Hz	Environmental Conditions	26deg. C, 51%RH
Tested By	Carl Xie		

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.170000	---	6.36	54.96	48.60	L1	ON	9.7
0.170000	25.21	---	64.96	39.75	L1	ON	9.7
0.948000	---	2.22	46.00	43.78	L1	ON	9.7
0.948000	3.81	---	56.00	52.19	L1	ON	9.7
1.884000	---	7.98	46.00	38.02	L1	ON	9.7
1.884000	10.02	---	56.00	45.98	L1	ON	9.7
3.464000	---	3.36	46.00	42.64	L1	ON	9.7
3.464000	4.89	---	56.00	51.11	L1	ON	9.7
4.832000	---	4.01	46.00	41.99	L1	ON	9.7
4.832000	5.57	---	56.00	50.43	L1	ON	9.7
22.212000	---	6.51	50.00	43.49	L1	ON	9.8
22.212000	10.16	---	60.00	49.84	L1	ON	9.8

REMARKS: 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.

2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.

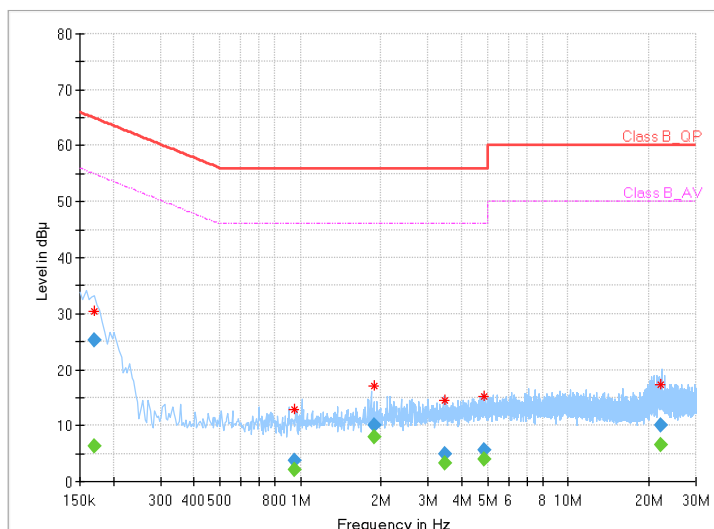
3. The emission levels of other frequencies were very low against the limit.

4. Margin value = Limit value - Emission level

5. Correction factor = Insertion loss + Cable loss

6. Emission Level = Correction Factor + Reading Value.

Full Spectrum

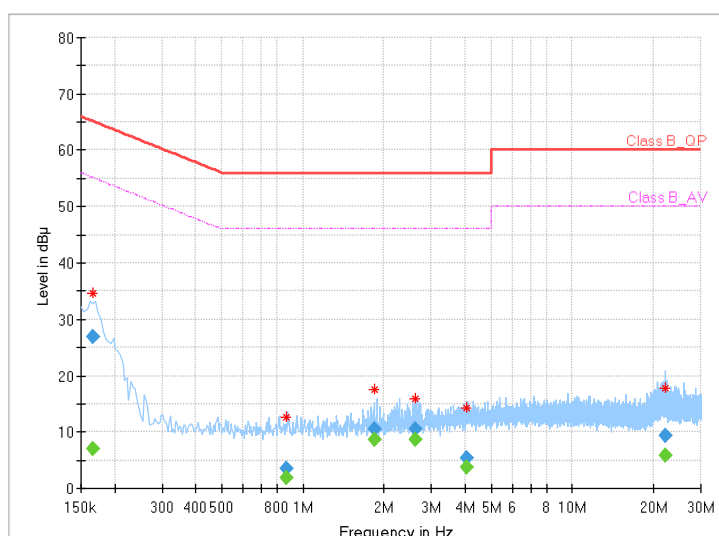


Frequency Range	150KHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power	120Vac, 60Hz	Environmental Conditions	26deg. C, 51%RH
Tested By	Carl Xie		

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Line	Filter	Corr. (dB)
0.166000	---	6.92	55.16	48.24	N	ON	9.7
0.166000	26.85	---	65.16	38.31	N	ON	9.7
0.864000	---	1.96	46.00	44.04	N	ON	9.7
0.864000	3.41	---	56.00	52.59	N	ON	9.7
1.836000	---	8.63	46.00	37.37	N	ON	9.8
1.836000	10.55	---	56.00	45.45	N	ON	9.8
2.600000	---	8.73	46.00	37.27	N	ON	9.8
2.600000	10.59	---	56.00	45.41	N	ON	9.8
4.068000	---	3.83	46.00	42.17	N	ON	9.8
4.068000	5.34	---	56.00	50.66	N	ON	9.8
22.052000	---	5.88	50.00	44.12	N	ON	9.9
22.052000	9.40	---	60.00	50.60	N	ON	9.9

- REMARKS:** 1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. "-": The Quasi-peak reading value also meets average limit and measurement with the average detector is unnecessary.
3. The emission levels of other frequencies were very low against the limit.
4. Margin value = Limit value - Emission level
5. Correction factor = Insertion loss + Cable loss
6. Emission Level = Correction Factor + Reading Value.

Full Spectrum



4.2 RADIATED EMISSION

4.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT

Below 960MHz

The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209:

FREQUENCIES (MHz)	FIELD STRENGTH (microvolts/meter)	MEASUREMENT DISTANCE (meters)
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

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).

Above 960MHz

1. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
960-1610	-75.3
1610-1990	-63.3
1990-3100	-61.3
3100-10600	-41.3
Above 10600	-61.3

2. In addition to the radiated emission limits specified in the table in paragraph (a)(b) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164-1240	-85.3
1559-1610	-85.3

3. The calculation below has been used for the test, in order to translate the Limit to 1m test distance.

According to the ANSI C63.10-2013:

$$E(\text{dB}\mu\text{V/m}) = \text{EIRP}(\text{dBm}) + 95.2,$$

$$3\text{m to } 1\text{m test distance : Distance Correction Factor}(\text{db}) = 20 \cdot \log(1/3) = -9.54\text{db}$$

So Field Strength(@3m) = Field Strength(@1m) + Distance Correction Factor,

For radiated emission measurement:

Margin = Field Strength(@3m) - Limit(@3m) = Field Strength(@1m) + Distance Correction Factor - Limit(@3m) = Field Strength(@1m) - (**Limit(@3m) - Distance Correction Factor**), so (**Limit(@3m) - Distance Correction Factor**) can treat as 1m Field Strength Limit.

For Limit above 960MHz, It's EIRP limit, So we can translate it to Field Strength Limit(@1m), by the equation below:

$$\text{Field Strength Limit}(@1\text{m}) = \text{EIRP Limit}(@3\text{m}) + 95.2 - \text{Distance Correction Factor}(3\text{m to } 1\text{m})$$

So 1m test distance Field Strength Limit is:

FCC @1m Distance	
Frequency in MHz	Field Strength in dBμV/m
960-1610	29.44
1610-1990	41.44
1990-3100	43.44
3100-10600	63.44
Above 10600	43.44

FCC @1m Distance	
Frequency	Field Strength in dBμV/m
1 164-1 240 MHz	19.44
1 559-1 610 MHz	19.44

4.2.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
EMI Test Receiver	R&S	ESW 44	101973	Feb.25,22	Feb.24,24
Open Switch and Control Unit	R&S	OSP-B157W8	100836	N/A	N/A
Vector Signal Generator	R&S	SMBV100B	102176	Feb.16,22	Feb.15,24
Signal Generator	R&S	SMB100A03	182185	Feb.16,22	Feb.15,24
Wideband Radio Communication	R&S	CMW500	169399	Jun.26,22	Jun.25,24
Hygrothermograph	DELI	20210528	SZ015	Sep.06,22	Sep.05,24
PC	LENOVO	E14	HRSW0024	N/A	N/A
CABLE	R&S	J12J103539-00-1	SEP-03-20-069	Apr.28,23	Oct.27,23
CABLE	R&S	J12J103539-00-1	SEP-03-20-070	Apr.28,23	Oct.27,23
Test Software	EMC32	EMC32	N/A	N/A	N/A
Temperature Chamber	votsch	VT4002	58566078100050	May.31,22	May.30,24

- NOTE:**
1. The calibration interval of the above test instruments is 6 months or 24 months and the calibrations are traceable to CEPREI/CHINA, GREGT/CHINA and NIM/CHINA.
 2. The test was performed in 3m Chamber.
 3. The FCC Site Registration No. is 434559; The Designation No. is CN1325.

4.2.3 TEST PROCEDURES

1. The EUT was placed on the top of a rotating table 0.8 meters (below 960MHz) and 1.5 meters (above 960MHz) above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters (below 960MHz) and 1 meters (above 960MHz) away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. 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.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. For below 30MHz, a loop antenna with its vertical plane is placed 3m from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. And the centre of the loop shall be 1m above the ground.
6. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, For battery operated equipment, the equipment tests shall be performed using fresh batteries. The turntable was rotated to maximize the emission level.

NOTE:

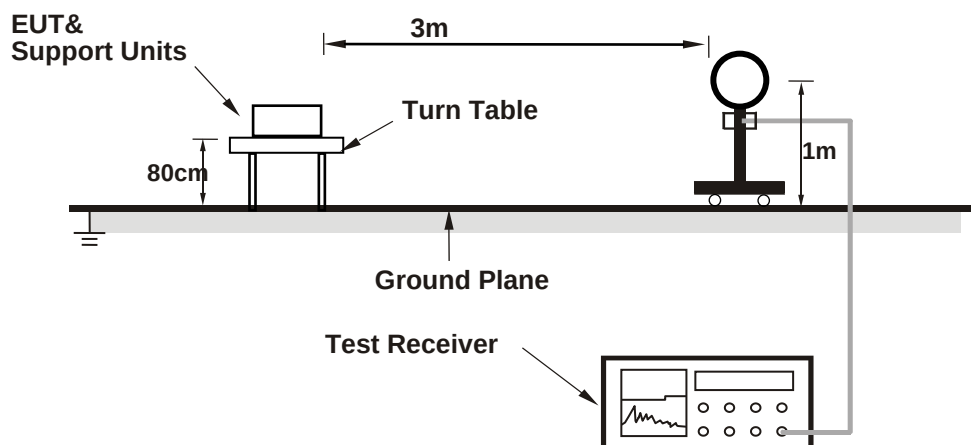
1. The resolution bandwidth of test receiver/spectrum analyzer is 120KHz and video bandwidth is 300kHz for Quasi-peak detection at frequency below 960MHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Average detection at frequency above 960MHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1KHz and the video bandwidth is 3KHz for Average detection at frequency range from 1164-1240MHz & 1559-1610MHz.
4. All modes of operation were investigated and the worst-case emissions are reported.
5. The testing of the EUT was performed on all 3 orthogonal axes, the worst-case test configuration was reported on the file test setup photo.

4.2.4 DEVIATION FROM TEST STANDARD

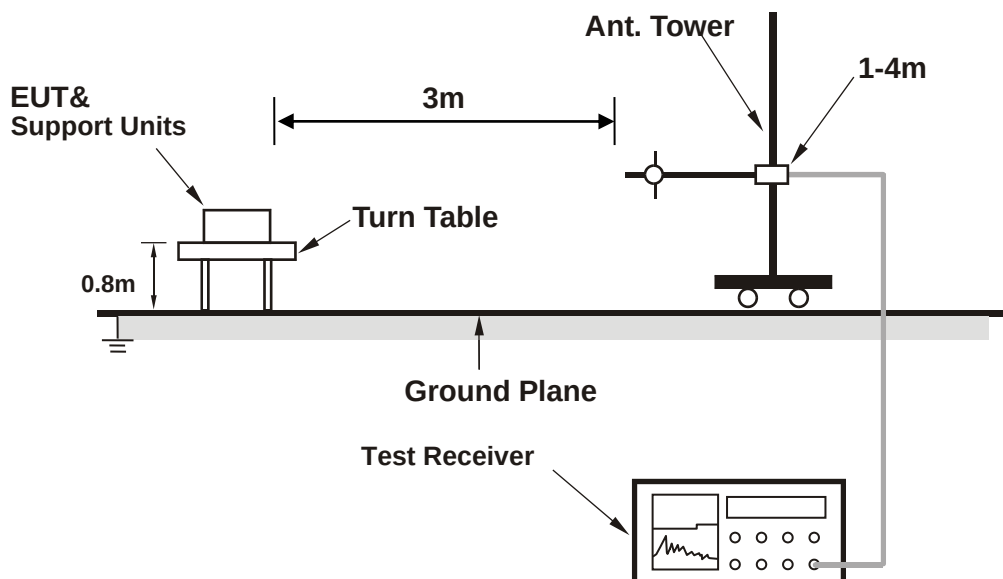
No deviation.

4.2.5 TEST SETUP

Below 30MHz test setup

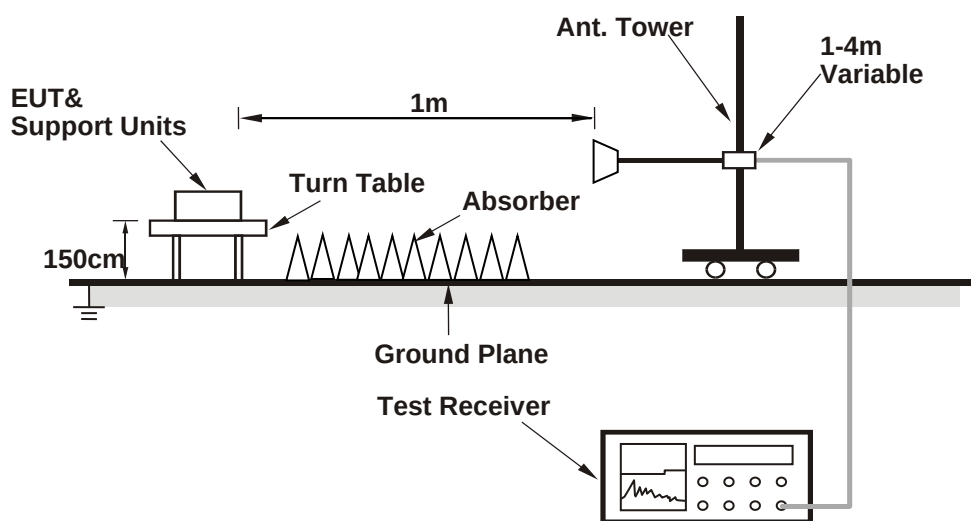


Below 960MHz test setup



Note: For the actual test configuration, please refer to the attached file (Test Setup Photo).

Above 960MHz test setup



Note: For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.2.6 EUT OPERATING CONDITIONS

- Placed the EUT on a testing table.
- Set the transmitter part of EUT under transmission condition continuously at specific channel frequency.
- The necessary accessories enable the EUT in full functions.

4.2.7 TEST RESULTS

Radiated Emissions Test Data Below 960 MHz:

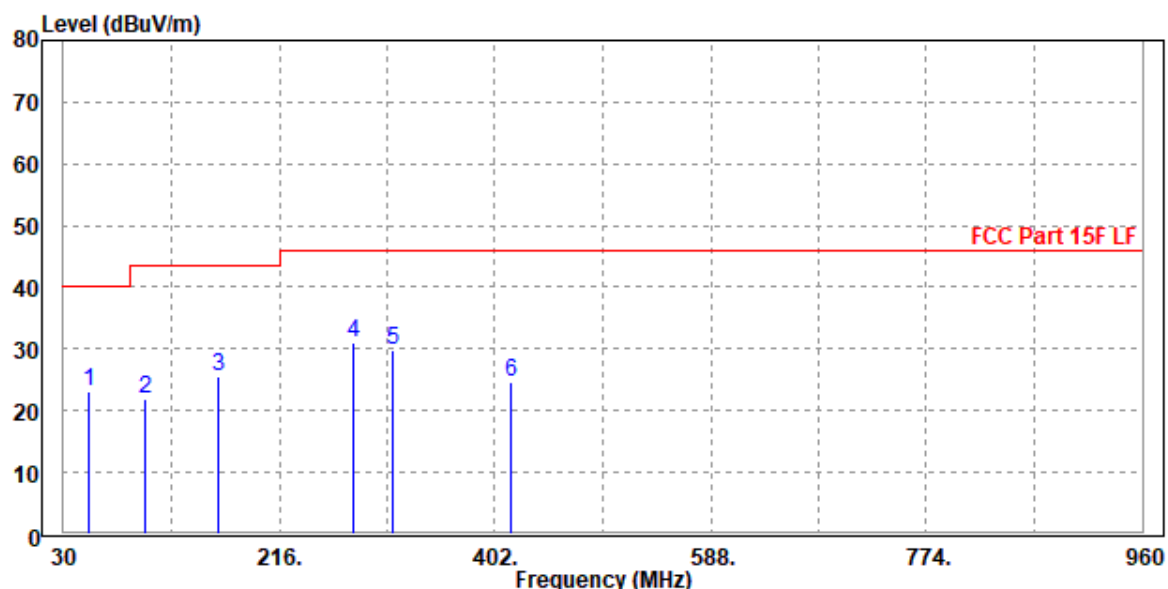
CHANNEL	TX Channel 9	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 960MHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV	dBuV/m	dB	dB/m		
1	52.310	23.11	49.72	40.00	-16.89	-26.61	Peak	Horizontal
2	100.810	21.79	47.63	43.50	-21.71	-25.84	Peak	Horizontal
3	163.860	25.42	50.23	43.50	-18.08	-24.81	Peak	Horizontal
4 PP	279.290	30.89	52.49	46.00	-15.11	-21.60	Peak	Horizontal
5	314.210	29.72	50.76	46.00	-16.28	-21.04	Peak	Horizontal
6	415.090	24.66	43.52	46.00	-21.34	-18.86	Peak	Horizontal

REMARKS:

1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
2. Margin value = Emission level – Limit value.
3. The emission levels of other frequencies were greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.



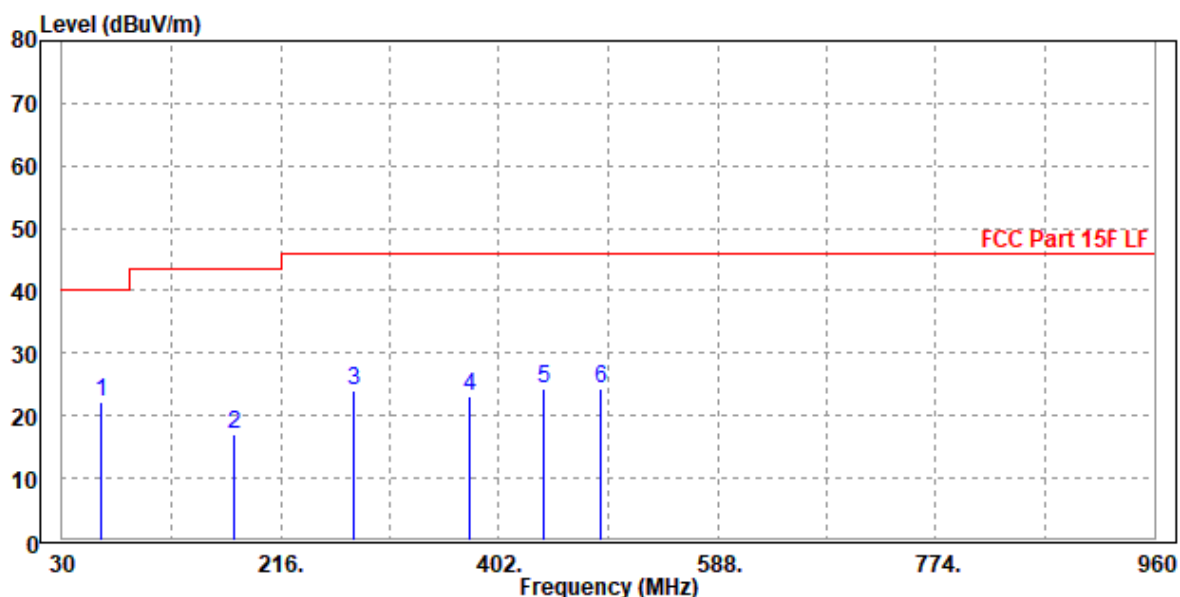
CHANNEL	TX Channel 9	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 960MHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

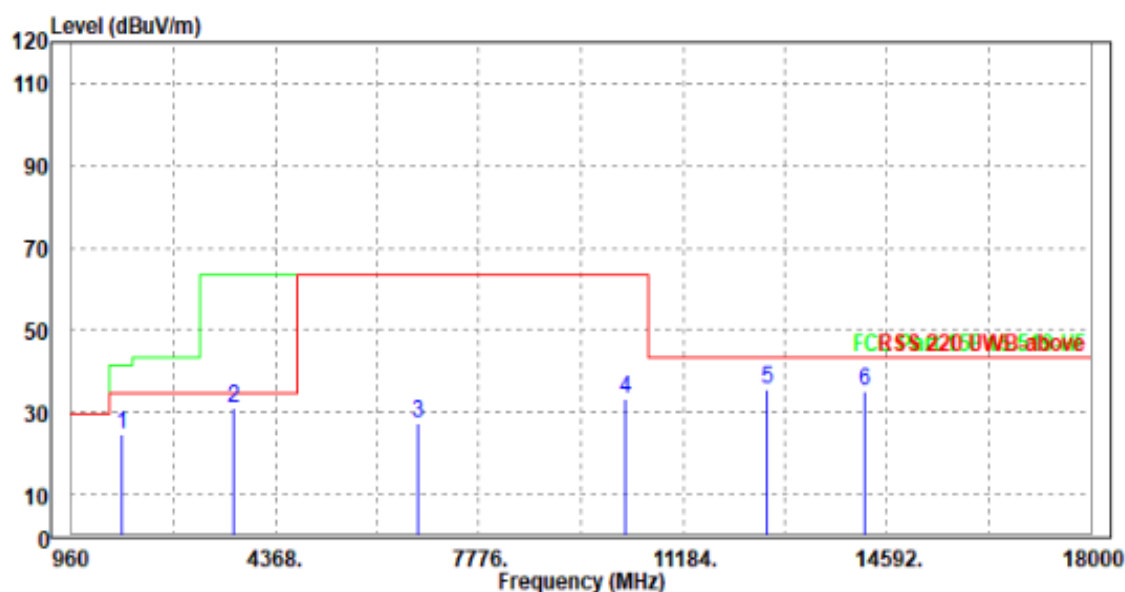
	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark	Pol/Phase
	MHz	dBuV/m	dBuV	dBuV/m	dB	dB/m		
1 PP	62.980	22.06	50.11	40.00	-17.94	-28.05	Peak	Vertical
2	176.470	17.18	41.75	43.50	-26.32	-24.57	Peak	Vertical
3	278.320	23.94	45.94	46.00	-22.06	-22.00	Peak	Vertical
4	377.260	23.05	42.61	46.00	-22.95	-19.56	Peak	Vertical
5	440.310	24.40	42.95	46.00	-21.60	-18.55	Peak	Vertical
6	487.840	24.40	42.36	46.00	-21.60	-17.96	Peak	Vertical

REMARKS:

1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
2. Margin value = Emission level – Limit value.
3. The emission levels of other frequencies were greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.



ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 1 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
1799	24.84	34.46	41.44	-16.6	31.16	5.35	46.13	150	101	Average
3669	31.06	34.36	63.44	-32.38	34.27	7.91	45.48	150	357	Average
6746	27.31	24.84	63.44	-36.13	37.15	10.54	45.22	150	225	Average
10214	33.23	24.57	63.44	-30.21	39.13	13.16	43.63	100	98	Average
12594	35.64	23.4	43.44	-7.8	40.89	14.95	43.6	200	75	Average
14226	35.08	20.66	43.44	-8.36	40.72	17.15	43.45	100	135	Average

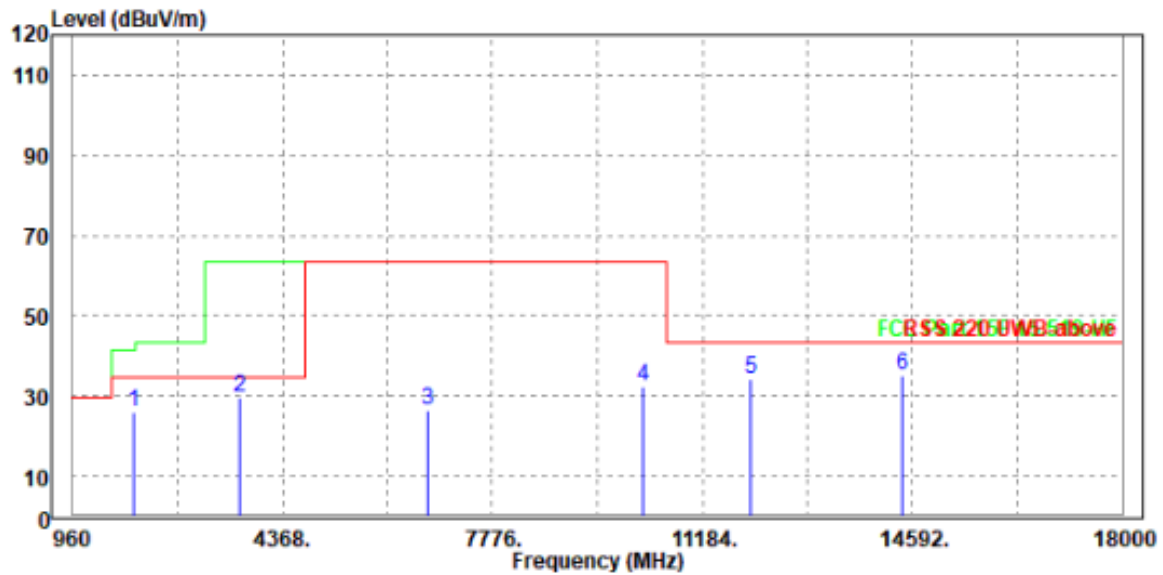


REMARKS:

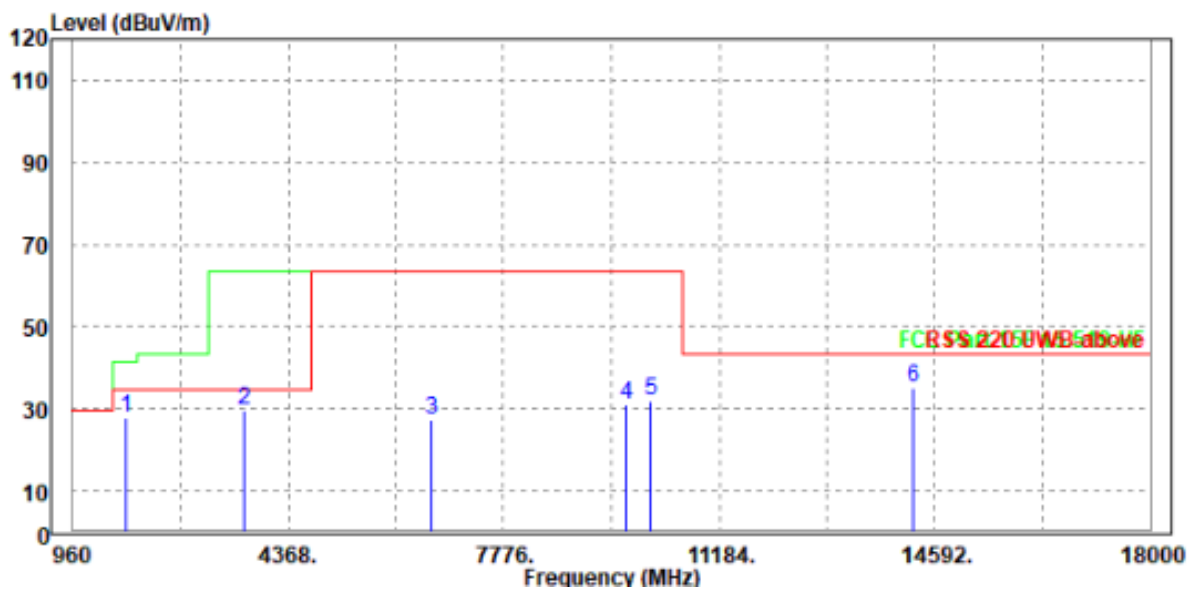
1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
Margin value = Emission level – Limit value.
2. The emission levels of other frequencies were greater than 20dB margin.
3. The band 3100-10600 MHz is equipped with filters
4. For frequency above 18GHz, the emission was tested 20db below the limit so the data not recorded in the sheet.

CHANNEL	TX Channel 9	DETECTOR FUNCTION	Average (AV)
FREQUENCY RANGE	960MHz ~ 40GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 1 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
1952	25.91	33.05	41.44	-15.53	33.42	5.58	46.14	100	0	Average
3669	29.85	31.49	63.44	-33.59	35.93	7.91	45.48	100	0	Average
6712	26.64	23.24	63.44	-36.8	38.13	10.51	45.24	100	0	Average
10231	32.36	22.58	63.44	-31.08	40.24	13.18	43.64	100	0	Average
11982	34.03	20.6	43.44	-9.41	41.68	14.65	42.9	100	0	Average
14430	35.24	17.99	43.44	-8.2	42.32	18.48	43.55	100	0	Average



ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 1 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
1799	27.8	37.42	41.44	-13.64	31.16	5.35	46.13	100	360	Average
3669	29.43	32.73	63.44	-34.01	34.27	7.91	45.48	100	360	Average
6644	27.25	24.88	63.44	-36.19	37.17	10.46	45.26	100	360	Average
9721	30.99	23.01	63.44	-32.45	38.89	12.78	43.69	100	360	Average
10112	31.86	23.35	63.44	-31.58	39.07	13.03	43.59	100	360	Average
14243	34.97	20.46	43.44	-8.47	40.71	17.26	43.46	100	360	Average



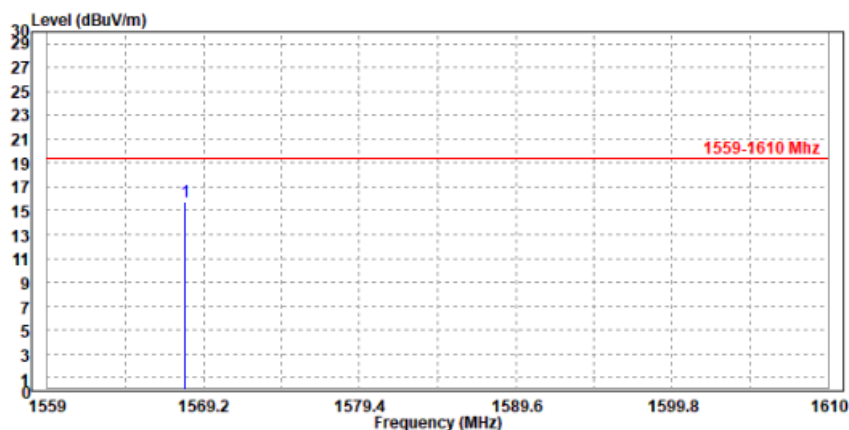
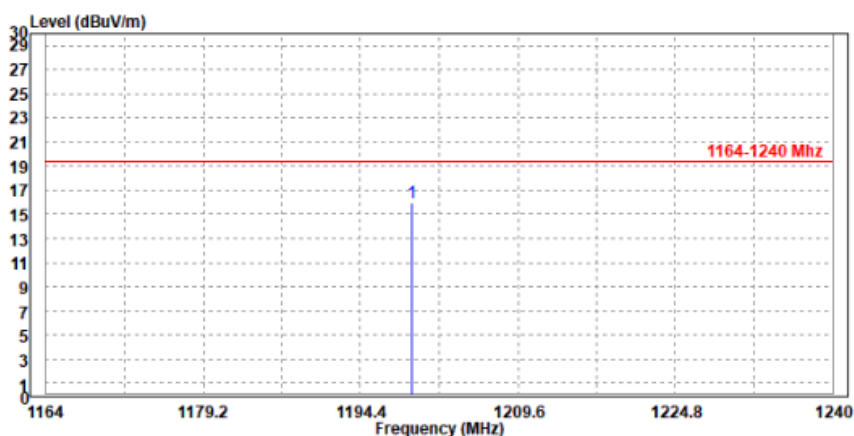
REMARKS:

1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
Margin value = Emission level – Limit value.
2. The emission levels of other frequencies were greater than 20dB margin.
3. The band 3100-10600 MHz is equipped with filters
4. For frequency above 18GHz, the emission was tested 20db below the limit, so the data not recorded in the sheet.

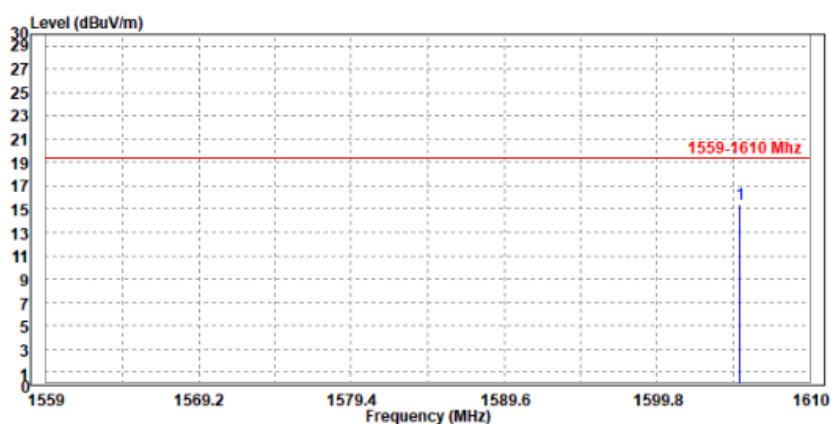
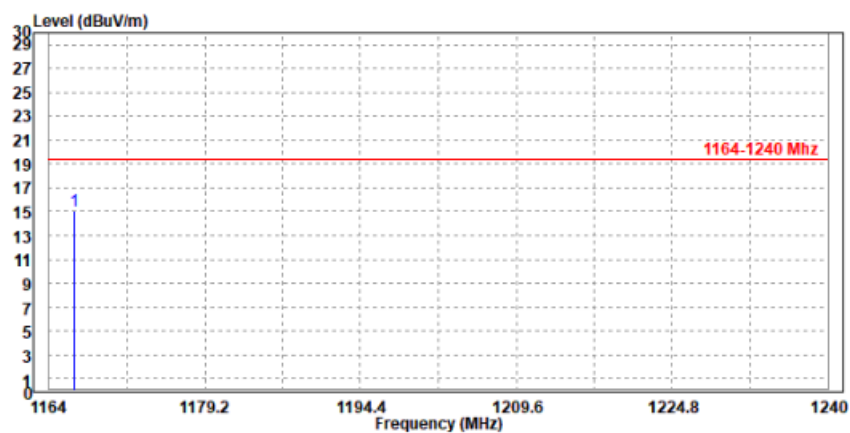
Radiated Emissions Test Data in The GPS Bands:

CHANNEL	TX Channel 5	DETECTOR FUNCTION	Average (AV)
FREQUENCY RANGE	1164 – 1240 MHz and 1559- 1610 MHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 1 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
1199.42	15.92	28.52	19.44	-3.52	29.26	4.26	46.12	100	0	Average
1568.03	15.75	26.57	19.44	-3.69	30.34	4.97	46.13	100	360	Average



ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 1 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
1166.43	15	28.14	19.44	-4.44	28.77	4.2	46.11	100	0	Average
1605.36	15.39	26.15	19.44	-4.05	30.34	5.03	46.13	100	0	Average

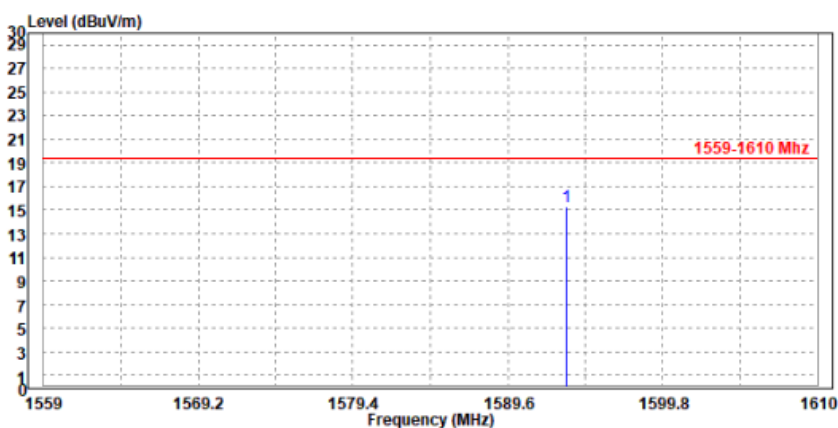
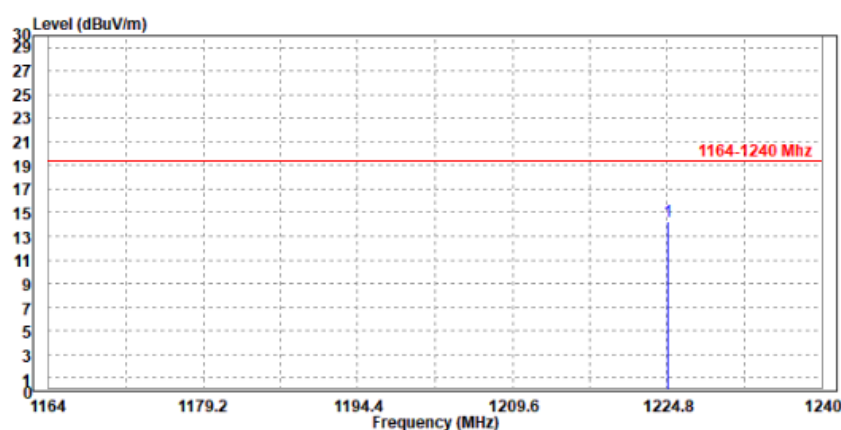


REMARKS:

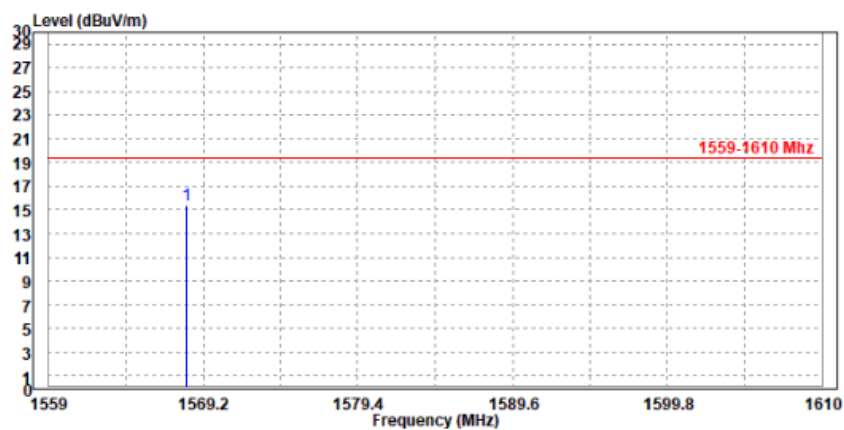
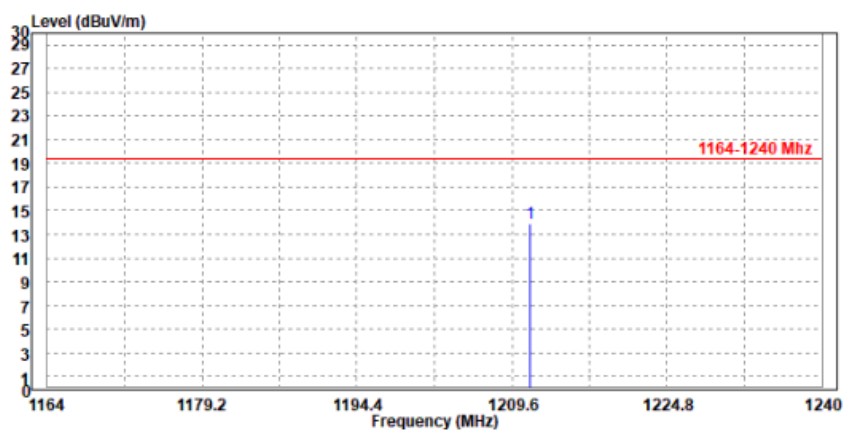
- Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
Margin value = Emission level – Limit value.
- The emission levels of other frequencies were greater than 20dB margin.

CHANNEL	TX Channel 9	DETECTOR FUNCTION	Average (AV)
FREQUENCY RANGE	1164 – 1240 MHz and 1559- 1610 MHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 1 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
1224.88	14.29	26.8	19.44	-5.15	29.3	4.31	46.12	150	260	Average
1593.48	15.25	25.82	19.44	-4.19	30.55	5.01	46.13	150	79	Average



ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 1 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
1211.35	13.86	26.78	19.44	-5.58	28.92	4.28	46.12	150	99	Average
1568.08	15.45	26.42	19.44	-3.99	30.19	4.97	46.13	100	360	Average



REMARKS:

1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
Margin value = Emission level – Limit value.
2. The emission levels of other frequencies were greater than 20dB margin.

4.3 UWB BANDWIDTH

4.3.1 LIMITS OF UWB BANDWIDTH

FCC 15.503(d) Has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

FCC 15.519(3)(b) The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

4.3.2 TEST INSTRUMENTS

Same as 4.2.2

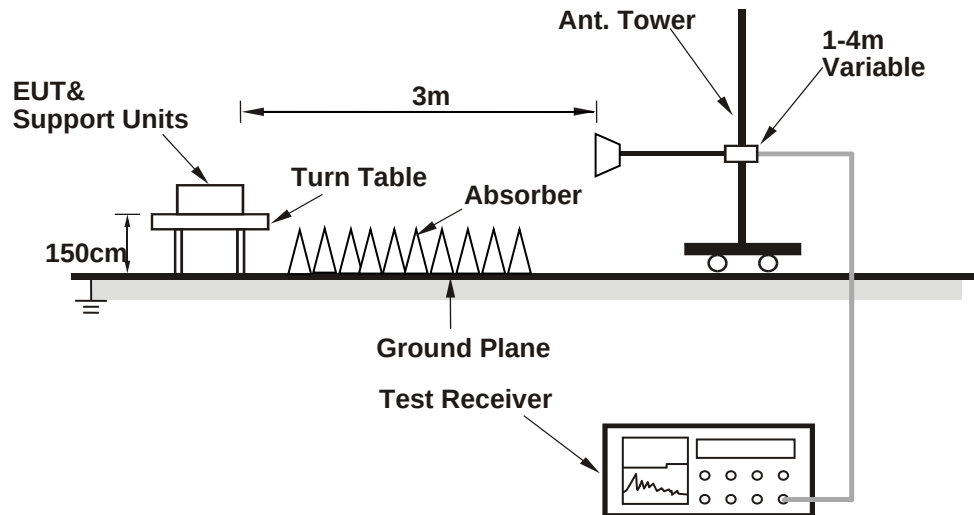
4.3.3 TEST PROCEDURES

1. Set the center frequency of the channel under test
2. Set resolution bandwidth (RBW) = 1MHz
3. Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 10 dB relative to the maximum level measured in the fundamental emission.

4.3.4 DEVIATION FROM TEST STANDARD

No deviation.

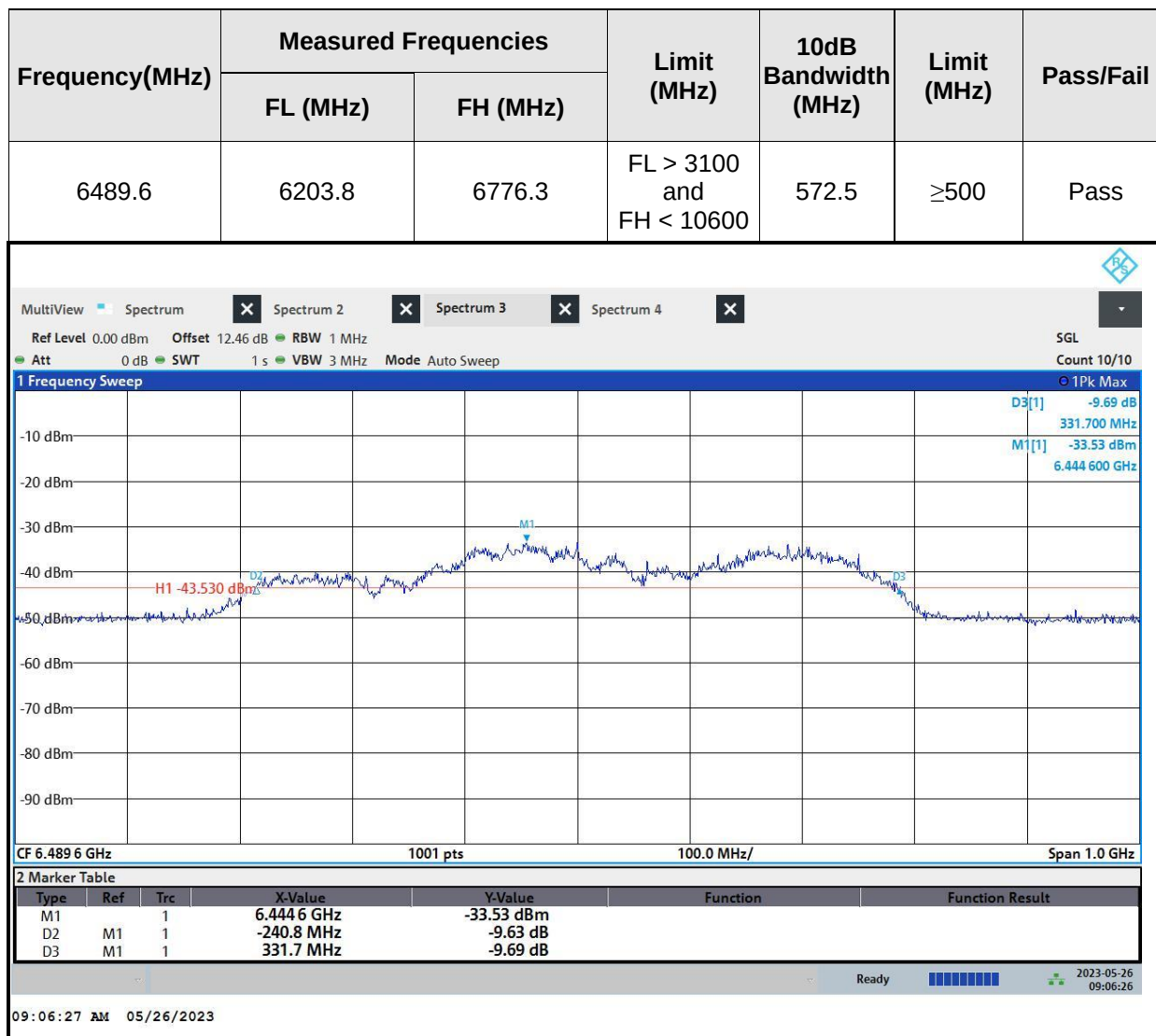
4.3.5 TEST SETUP



4.3.6 EUT OPERATING CONDITIONS

The sample provided by client to enable the EUT under transmission condition continuously.

4.3.7 TEST RESULTS



Note: FL=M1+D2 , FH=M1+D3 , 10DB BANDWIDTH=FH-FL

Frequency(MHz)	Measured Frequencies		Limit (MHz)	10dB Bandwidth (MHz)	Limit (MHz)	Pass/Fail
	FL (MHz)	FH (MHz)				
7987.2	7701.5	8272.9	FL > 3100 and FH < 10600	571.4	≥500	Pass



Note: FL=M1+D2 , FH=M1+D3 , 10DB BANDWIDTH=FH-FL

4.4 PEAK POWER AND MAXIMUM AVERAGE EMISSIONS

4.4.1 LIMITS

There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, fM. That limit is 0 dBm EIRP.

When a peak measurement is required, it is acceptable to use a resolution bandwidth other than the 50 MHz specified in this subpart. This resolution bandwidth shall not be lower than 1 MHz or greater than 50 MHz, and the measurement shall be centered on the frequency at which the highest radiated emission occurs, fM. If a resolution bandwidth other than 50 MHz is employed, the peak EIRP limit shall be $20 \log (RBW/50)$ dBm where RBW is the resolution bandwidth in megahertz that is employed. This may be converted to a peak field strength level at 3 meters using $E(\text{dBuV/m}) = P(\text{dBm EIRP}) + 95.2$.

47 CFR 15.519(c) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency in MHz	EIRP in dBm
3100-10600	-41.3

4.4.2 TEST INSTRUMENTS

Same as 4.2.2

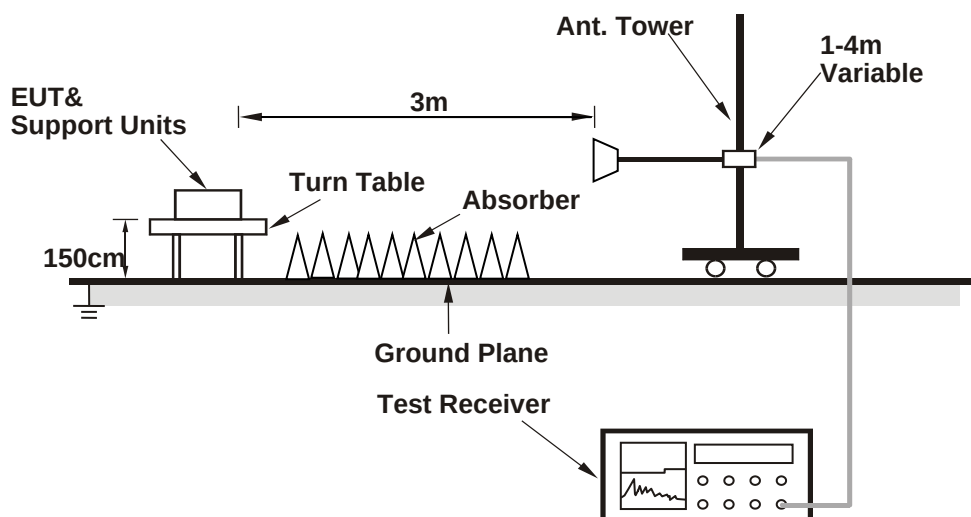
4.4.3 TEST PROCEDURES

1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. 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.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak/RMS Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

4.4.4 DEVIATION FROM TEST STANDARD

No deviation.

4.4.5 TEST SETUP



4.4.6 EUT OPERATING CONDITIONS

The sample provided by client to enable the EUT under transmission condition continuously.

4.4.7 TEST RESULTS

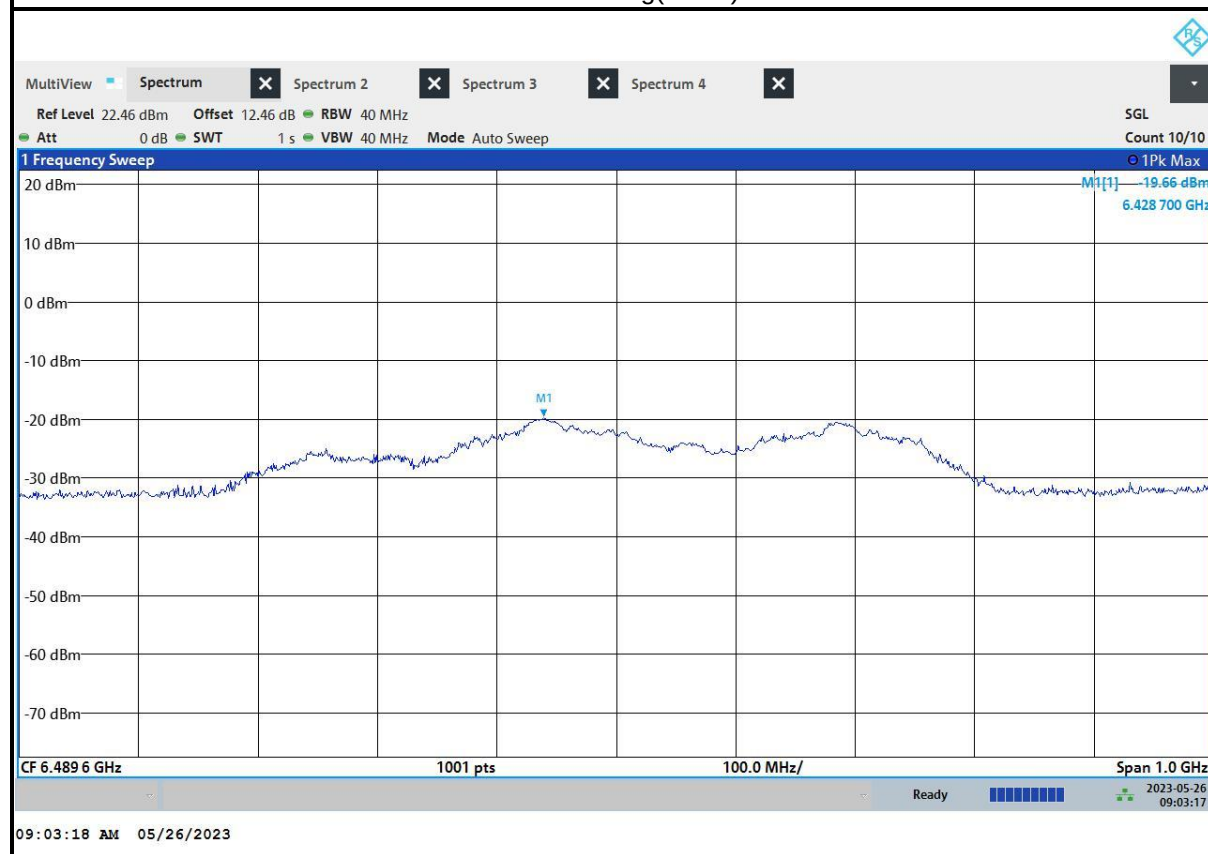
Peak Power Emissions

NOTE: The RBW=40MHz, VBW=40MHz, so the EIRP limit is $0\text{dBm} + 20 \log(40/50) = -1.94\text{dBm}/40\text{MHz}$.

CHANNEL	TX Channel 5	DETECTOR FUNCTION	Peak (PK)
TEST FREQUENCY	6489.6MHz		

Frequency (MHz)	Peak Value (dBm/40MHz)	EIRP Limit (dBm/40MHz)	Pass/Fail
6489.6	-19.66	-1.94	Pass

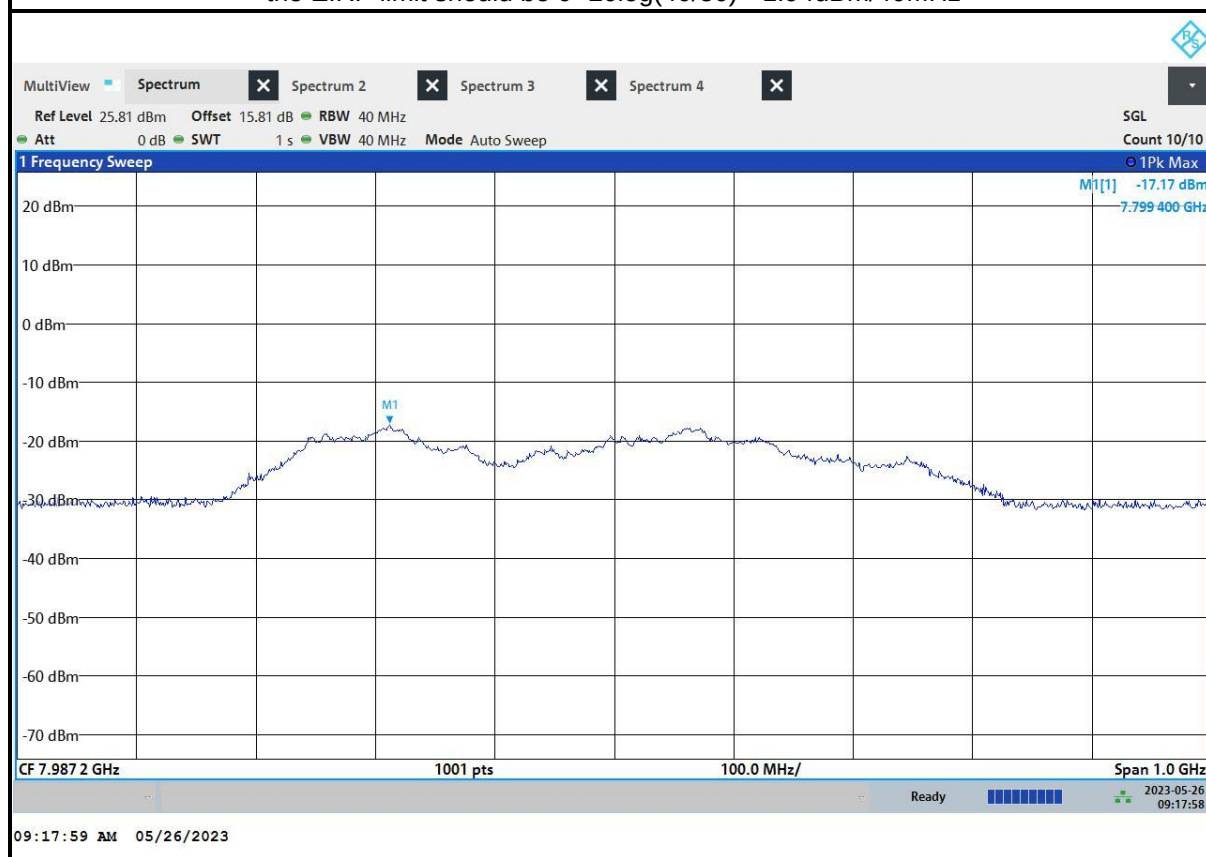
the EIRP limit should be $0 + 20\log(40/50) = -1.94\text{dBm}/40\text{MHz}$



CHANNEL	TX Channel 9	DETECTOR FUNCTION	Peak (PK)
TEST FREQUENCY	7987.2MHz		

Frequency (MHz)	Peak Value (dBm/40MHz)	EIRP Limit (dBm/40MHz)	Pass/Fail
7987.2	-17.17	-1.94	Pass

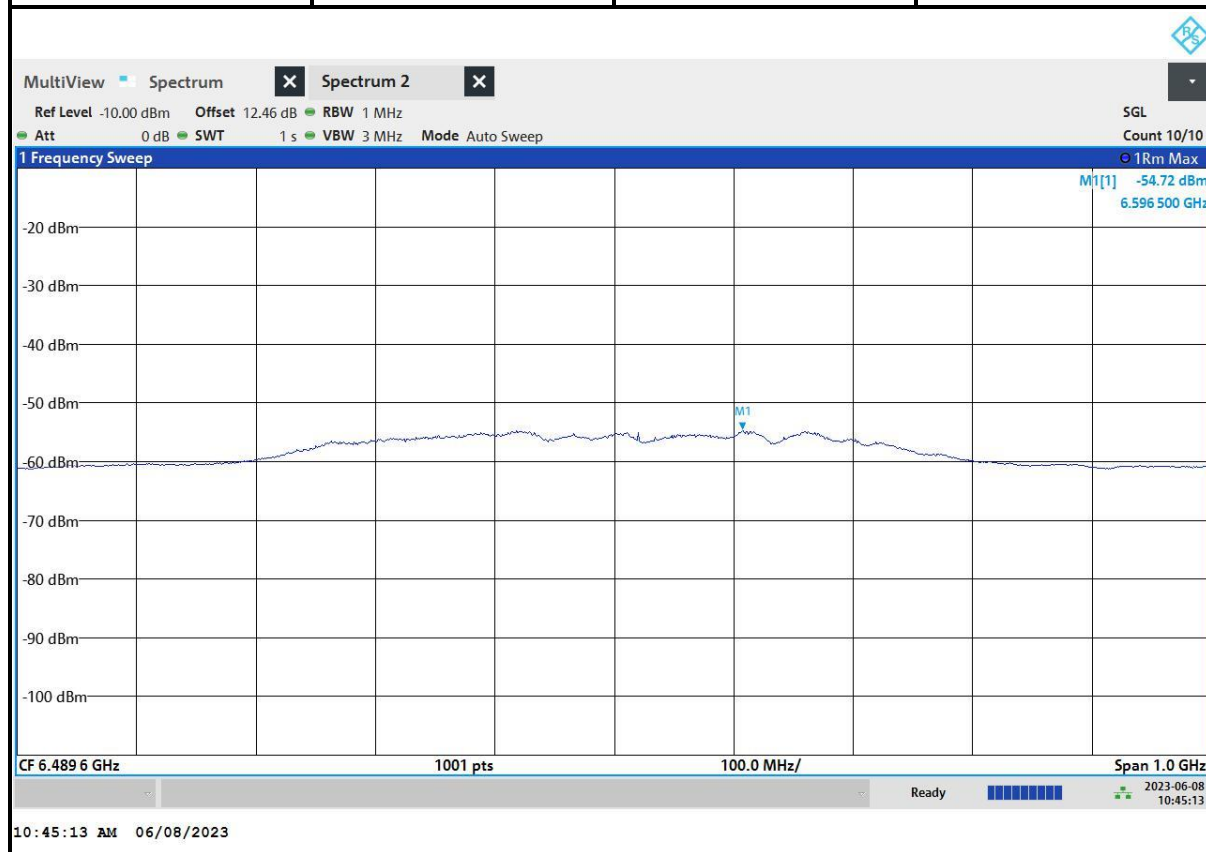
the EIRP limit should be $0+20\log(40/50)=-1.94\text{dBm/40MHz}$



Average Power Emissions

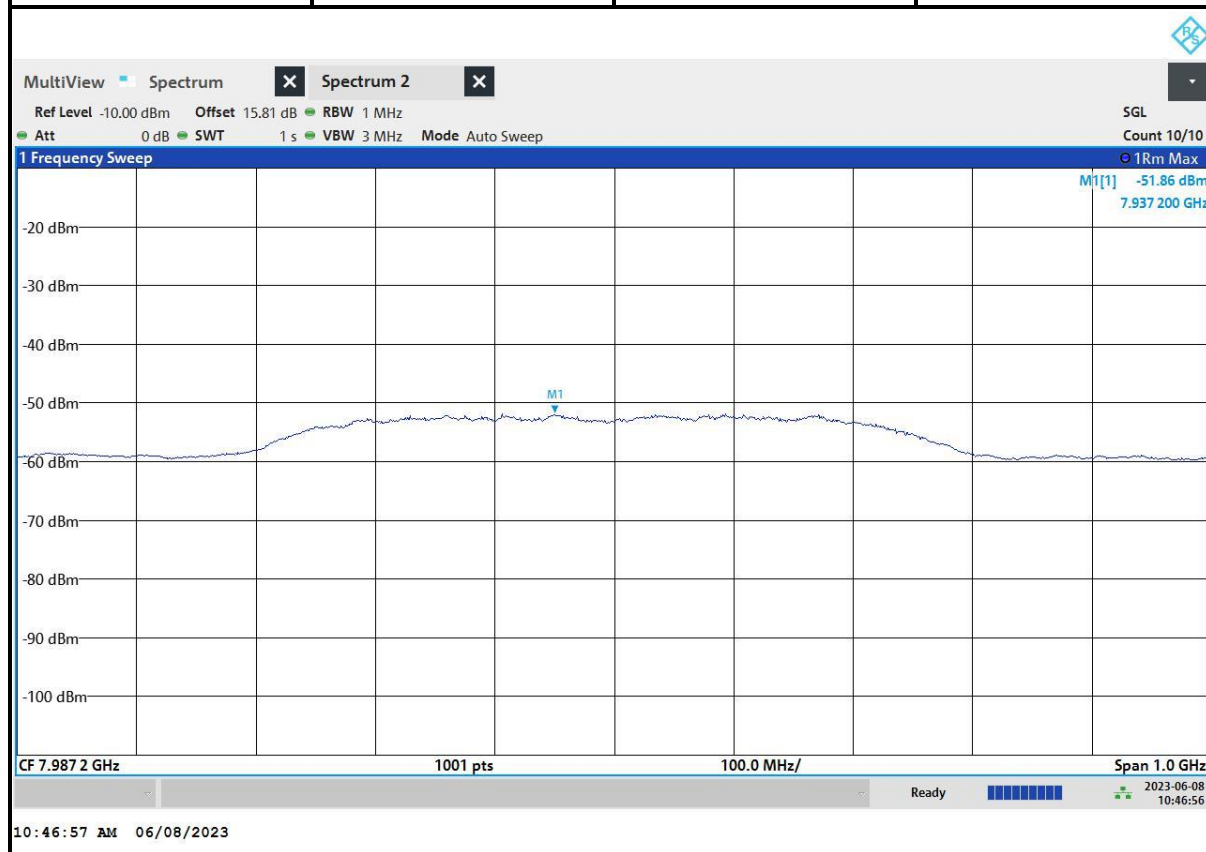
CHANNEL	TX Channel 5	DETECTOR FUNCTION	Average (RMS)
TEST FREQUENCY	6489.6MHz		

Frequency (MHz)	Peak Value (dBm)	EIRP Limit (dBm)	Pass/Fail
6489.6	-54.72	-41.3	Pass



CHANNEL	TX Channel 9	DETECTOR FUNCTION	Average (RMS)
TEST FREQUENCY	7987.2MHz		

Frequency (MHz)	Peak Value (dBm)	EIRP Limit (dBm)	Pass/Fail
7987.2	-51.86	-41.3	Pass



4.5 SHUTOFF TIMING REQUIREMENTS

4.5.1 LIMITS OF SHUTOFF TIMING REQUIREMENTS

The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

4.5.2 TEST INSTRUMENTS

Same as 4.2.2

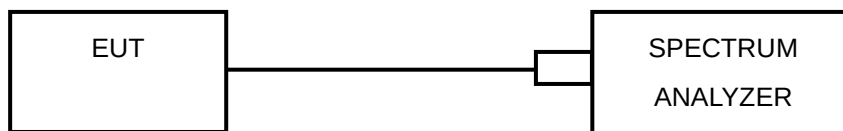
4.5.3 TEST PROCEDURES

With the EUT's antenna attached, the EUT's output signal was received by the test antenna, which was connected to the spectrum analyzer set the center frequency, than set the spectrum analyzer to Zero Span for the release time reading. During the testing, the transmission duration was measured and recorded.

4.5.4 DEVIATION FROM TEST STANDARD

No deviation.

4.5.5 TEST SETUP

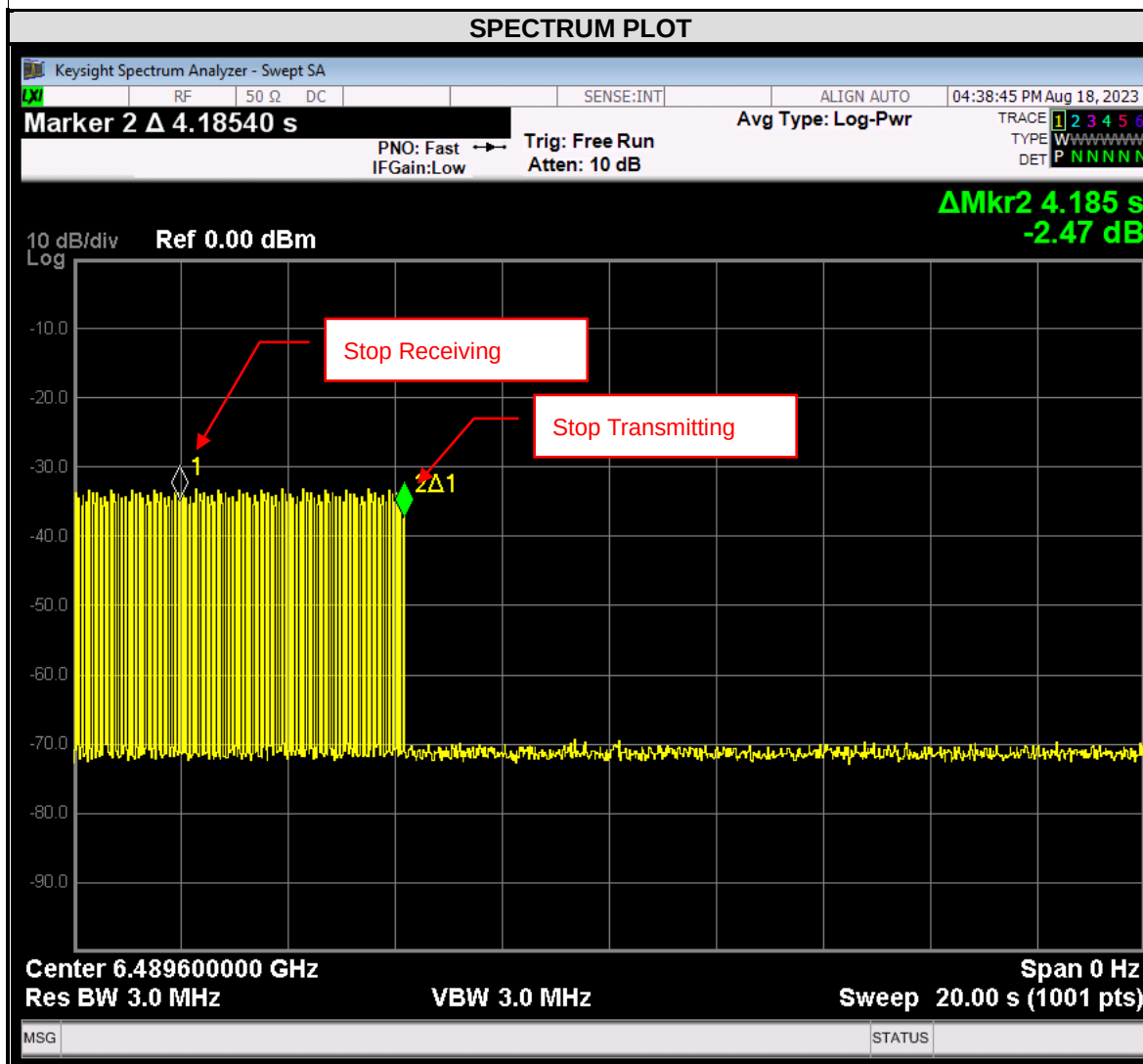


4.5.6 EUT OPERATING CONDITIONS

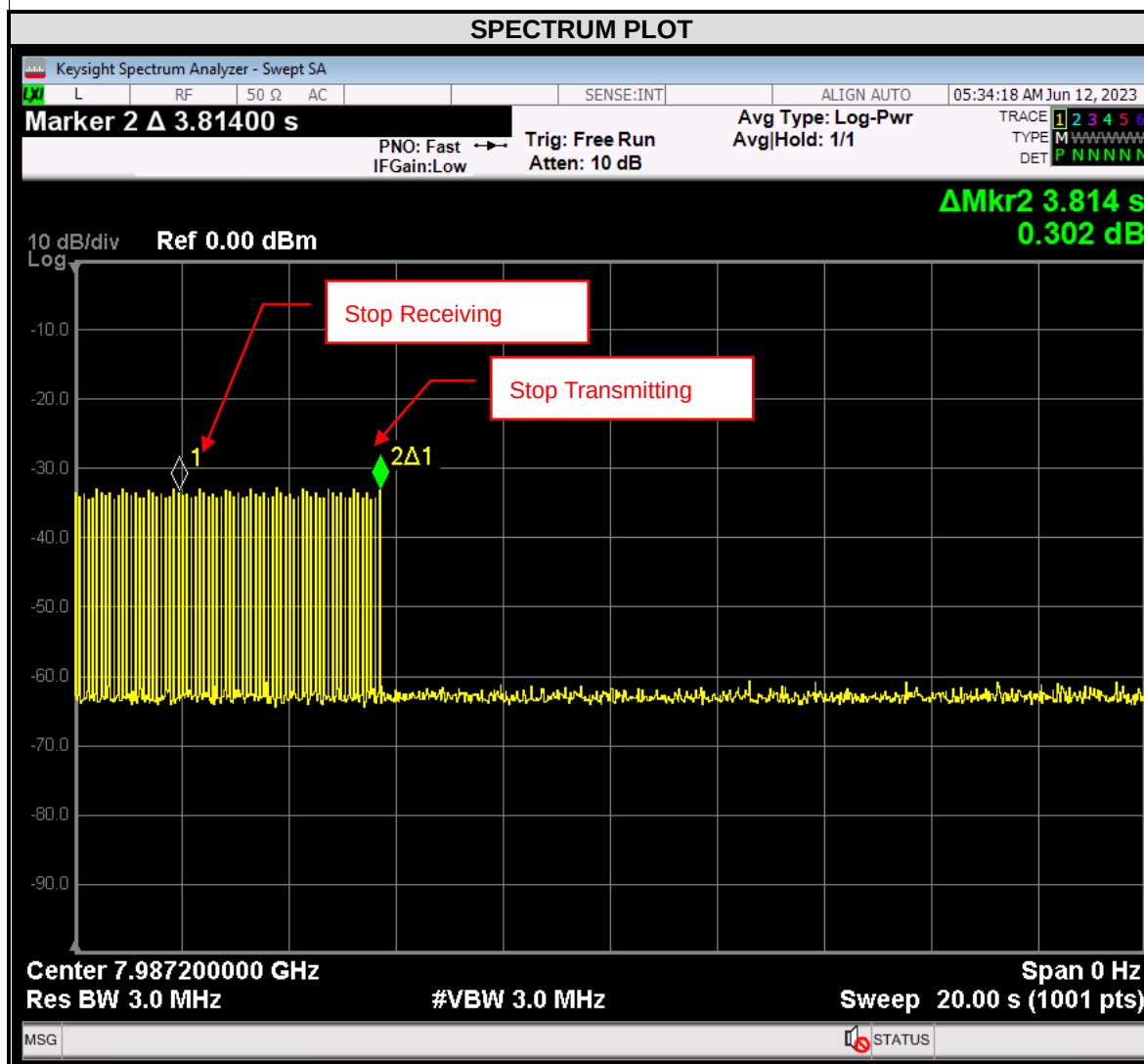
- Turned on the power of all equipment.
- EUT was operated according to the type used was description in manufacturer's specifications or the User's Manual.

4.5.7 TEST RESULTS

FREQUENCY (MHz)	MEASUREMENT RESULT (sec)	MAXIMUM LIMIT (sec)	PASS/FAIL
6489.6	4.815	10	PASS



FREQUENCY (MHz)	MEASUREMENT RESULT (sec)	MAXIMUM LIMIT (sec)	PASS/FAIL
7987.2	3.814	10	PASS



Note : The device is to transmit only when it is sending information to an associated receiver. The device will cease transmission of information within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received.

5 PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the attached file (Test Setup Photo).

6 APPENDIX A - Modifications recorders for engineering changes to the eut BY THE LAB

No any modifications are made to the EUT by the lab during the test.

---END---