FCC Test Report

Report No.:	RF200710C07-1
FCC ID:	L6AITE100-1
Test Model:	ITE100-1
Received Date:	July 10, 2020
Test Date:	Oct. 01 to 12, 2020
Issued Date:	Nov. 05, 2020
Applicant:	BlackBerry Limited
Address:	2200 University Avenue East, Waterloo, Ontario, Canada N2K 0A7
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan
Test Location:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan
FCC Registration / Designation Number:	723255 / TW2022

Table of Contents

Release Control Record

Issue No.	Description	Date Issued
RF200710C07-1	Original release.	Nov. 05, 2020

1 Certificate of Conformity

Product:	Radar R2
Brand:	BlackBerry
Test Model:	ITE100-1
Sample Status:	Engineering sample B007 SCH-63567-003_revE with waveguide with wings and no screws
Applicant:	BlackBerry Limited
Test Date:	Oct. 01 to 12, 2020
Standards:	47 CFR FCC Part 95, Subpart M ANSI C63.10:2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : _____ , **Date:** Nov. 05, 2020

Claire Kuan / Specialist

Approved by : _____ , **Date:** Nov. 05, 2020

Clark Lin / Technical Manager

2 Summary of Test Results

47 CFR FCC Part 95, Subpart M			
FCC Clause	Test Item	Result	Remarks
95.3367 (a)/(b)	Equivalent Isotropically Radiated Power (EIRP)Test	PASS	Meet the requirement of limit.
95.3379(a)	Unwanted Emission Test	PASS	Meet the requirement of limit.
95.3379(b)	Frequency Stability Test	PASS	Meet the requirement of limit.
2.1049	Occupied Bandwidth Measurement	PASS	Meet the requirement of limit.
2.1047	Modulation characteristics	PASS	Meet the requirement

Note:
Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 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	Frequency	Expanded Uncertainty (k=2) (±)
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	3.1 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	5.4 dB
	6GHz ~ 18GHz	5.0 dB
	18GHz ~ 40GHz	5.3 dB
	40GHz ~ 231GHz	5.4 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Radar R2
Brand	BlackBerry
Test Model	ITE100-1
Status of EUT	Engineering sample B007 SCH-63567-003_revE with waveguide with wings and no screws
Power Supply Rating	3.6Vdc from battery
Modulation Type	FMCW
Operating Frequency	77-81GHz
Emission designator	3G76F1N
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	NA
Data Cable Supplied	NA

Note:

1. 77GHz radar device and other technology can't transmit at the same time.
2. The EUT power needs to be supplied from Lithium Metal Battery, the follow as below table:

Brand	Model No.	Spec.
BlackBerry	TLP-93111/A/BB7B	DC3.6V, 19A

3. The antennas provided to the EUT, please refer to the following table:

Antenna No.	Frequency Range (GHz)	Antenna Net Gain (dBi)	Antenna Type	Connector Type
1	77~81	20.2	antennas on chip with external Horn Waveguide	None

4. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.
5. The above antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.

3.2 Description of Test Modes

Frequency is 79GHz provided for test.

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE≥1G	RE<1G	FS	OB	
-	√	√	√	√	-

Where **RE≥1G:** Radiated Emission above 1GHz– **RE<1G:** Radiated Emission below 1GHz
FS: Frequency Stability **OB:** Occupied Bandwidth measurement

Test Condition:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER	TESTED BY
RE≥1G	25deg. C, 69%RH 23deg. C, 62%RH	DC 3.6V	Tom Yang Weiwei Lo
RE<1G	25deg. C, 69%RH	DC 3.6V	Tom Yang
FS	23deg. C, 62%RH	DC 3.6V	Weiwei Lo
OB	23deg. C, 62%RH	DC 3.6V	Weiwei Lo

3.3 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.

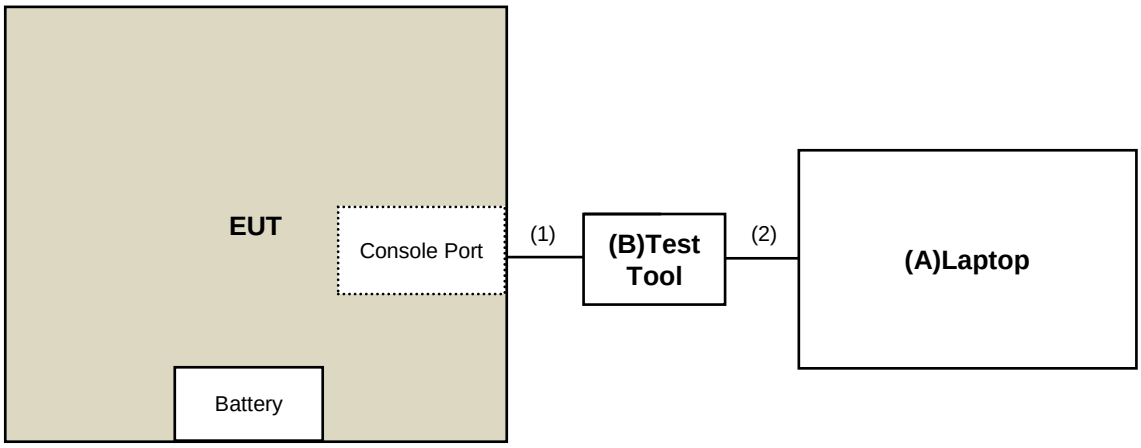
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Laptop	Dell	Latitude 5480	14CSPH2	NA	Proivded by Lab
B.	Test Tool	BlackBerry	NA	NA	NA	Supplied by client

Note:

1. All power cords of the above support units are non-shielded (1.8m).

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Console Cable	1	0.15	No	0	Supplied by client
2.	USB Cable	1	0.3	No	0	Supplied by client

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards and references

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

Test standard:

FCC Part 95, Subpart M

ANSI 63.10-2013

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

References Test Guidance:

KDB 653005 D01 76-81 GHz Radars v01r01

All test items have been performed as a reference to the above KDB test guidance.

4 Test Types and Results

4.1 Radiated Power and Unwanted Emission Measurement

4.1.1 Limits of Radiated Power and Unwanted Emission Measurement

According to 95.3367 the field strength of emissions from intentional radiators operated under these frequencies bands shall not exceed the following:

Fundamental Frequency (GHz)	Equivalent Isotropically Radiated Power (EIRP)	
	Peak	Average
76 ~ 81	55 dBm/MHz	50 dBm

According to 95.3379 the power density of any emissions outside the 76-81 GHz band shall consist solely of spurious emissions and shall not exceed the following:
(1) Radiated emissions below 40 GHz shall not exceed the field strength as shown in the following emissions table.

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
Above 960	500	3

NOTE:

1. The tighter limit applies at the band edges.
2. The limits are based on the frequency of the unwanted emissions and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
3. The emissions limits are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9.0-90.0 kHz, 110.0-490.0 kHz, and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector.

(2) The power density of radiated emissions outside the 76-81 GHz band above 40.0 GHz shall not exceed the following, based on measurements employing an average detector with a 1 MHz RBW:

(i) For radiated emissions outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 600 pW/cm^2 at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm2 at a distance of 3 meters from the exterior surface of the radiating structure.

(3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz.

4.1.2 Test Instruments

Below 40GHz test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Keysight	N9038A	MY54450088	July 06, 2020	July 05, 2021
Pre-Amplifier EMCI	EMC001340	980142	May 25, 2020	May 24, 2021
Loop Antenna Electro-Metrics	EM-6879	264	Feb. 18, 2020	Feb. 17, 2021
RF Cable	NA	LOOPCAB-001	Jan. 08, 2020	Jan. 07, 2021
RF Cable	NA	LOOPCAB-002	Jan. 08, 2020	Jan. 07, 2021
Pre-Amplifier Mini-Circuits	ZFL-1000VH2B	AMP-ZFL-05	Apr. 28, 2020	Apr. 27, 2021
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-361	Nov. 11, 2019	Nov. 10, 2020
RF Cable	8D	966-3-1	Mar. 17, 2020	Mar. 16, 2021
RF Cable	8D	966-3-2	Mar. 17, 2020	Mar. 16, 2021
RF Cable	8D	966-3-3	Mar. 17, 2020	Mar. 16, 2021
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-3-01	Sep. 24, 2020	Sep. 23, 2021
Horn_Antenna SCHWARZBECK	BBHA9120-D	9120D-406	Nov. 24, 2019	Nov. 23, 2020
Pre-Amplifier EMCI	EMC12630SE	980384	Jan. 15, 2020	Jan. 14, 2021
RF Cable	EMC104-SM-SM-1500	180504	Apr. 29, 2020	Apr. 28, 2021
RF Cable	EMC104-SM-SM-2000	180601	June 09, 2020	June 08, 2021
RF Cable	EMC104-SM-SM-6000	180602	June 09, 2020	June 08, 2021
Spectrum Analyzer Keysight	N9030A	MY54490679	July 13, 2020	July 12, 2021
Pre-Amplifier EMCI	EMC184045SE	980387	Jan. 15, 2020	Jan. 14, 2021
Horn_Antenna SCHWARZBECK	BBHA 9170	BBHA9170519	Nov. 24, 2019	Nov. 23, 2020
RF Cable	EMC102-KM-KM-1200	160924	Jan. 15, 2020	Jan. 14, 2021
RF Cable	EMC-KM-KM-4000	200214	Mar. 11, 2020	Mar. 10, 2021
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Antenna Tower & Turn Table Max-Full	MF-7802	MF780208406	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in 966 Chamber No. 3.
3. Tested Date: Oct. 01, 2020

Above 40GHz test:

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Spectrum Analyzer Keysight	N9030A	MY55330160	Feb. 07, 2020	Feb. 06, 2021
**Horn Antenna (33~55GHz) OML	M22RH	110215-1	Oct. 17, 2017	Oct. 16, 2020
**Horn Antenna (50~75GHz) OML	M15HWD	110215-1	Oct. 17, 2017	Oct. 16, 2020
**Horn Antenna (75~110GHz) OML	M10RH	110215-1	Oct. 17, 2017	Oct. 16, 2020
**Horn Antenna(110~170GHz) OML	M06HWD	110215-1	Oct. 17, 2017	Oct. 16, 2020
**Horn Antenna (140~220GHz) OML	M05RH	110215-1	Oct. 17, 2017	Oct. 16, 2020
**Horn Antenna (220~325GHz) OML	M03RH	M03RH_140508-1	Oct. 17, 2017	Oct. 16, 2020
**Zero-Bias Detector (50~75GHz) Vdi	WR15ZBD	WR15R5 1-30	Oct. 17, 2017	Oct. 16, 2020
4CH Infiniivision Oscilloscope Keysight	DSOX6004A	MY55190202	July 03, 2020	July 02, 2021
*OXE89 Horn Antenna (33~55GHz) QuinStar	QWH-UCRR00	924200002	Jan. 20, 2020	Jan. 19, 2022
*Conical Horn Antenna (50~75GHz) Keysight	WR15CH-Conical	WR15CH_001	Jan. 20, 2020	Jan. 19, 2022
*Conical Horn Antenna (75~110GHz) Keysight	WR10CH-Conical	WR10CH_001	Jan. 20, 2020	Jan. 19, 2022
*Conical Horn Antenna (110~170GHz) Keysight	WR6.5CH-Conical	WR6.5CH_001	Jan. 20, 2020	Jan. 19, 2022
*Conical Horn Antenna (140~220GHz) Keysight	WR5.1CH-Conical	WR5.1CH_001	Dec. 09, 2019	Dec. 08, 2021
*Conical Horn Antenna (220~330GHz) Keysight	WR3.4DH-Diagonal	WR3.4DH_001	Dec. 09, 2019	Dec. 08, 2021
N9029AV15-DC9 - 50-75 GHz VDI Standard Downconverter with 9VDC supply Keysight	SA Extension WR15	SAX 381	CoC	CoC
N9029AV10-DC9 - 75-110 GHz VDI Standard Downconverter with 9VDC supply Keysight	SA Extension WR10	SAX 378	CoC	CoC

N9029AV06-DC9 - 110-170 GHz VDI Standard Downconverter with 9VDC supply Keysight	SA Extension WR6.5	SAX 377	CoC	CoC
*N9029AV05-DC9 - 140-220 GHz VDI Standard Downconverter with 9VDC supply Keysight	SA Extension WR5.1	SAX 375	Dec. 09, 2019	Dec. 08, 2021
*N9029AV03-DC9 - 220-330 GHz VDI Standard Downconverter with 9VDC supply Keysight	SA Extension	SAX 376	Dec. 09, 2019	Dec. 08, 2021
Millimeter-Wave Signal Generator Frequency Extension Module (50~75 GHz) Keysight	E8257DV15	SGX 050	CoC	CoC
Millimeter-Wave Signal Generator Frequency Extension Module (75~110 GHz) Keysight	E8257DV10	SGX 069	CoC	CoC
Millimeter-Wave Signal Generator Frequency Extension Module (110~170 GHz) Keysight	E8257DV06-DC9	SGX 223	CoC	CoC
PSG analog signal generator Keysight	E8257D	MY53401987	June 17, 2020	June 16, 2021
*Power Meter VDI	PM5	431V	Dec. 09, 2019	Dec. 08, 2021
Boresight Antenna Tower & Turn Table Max-Full	MF-7802BS	MF780208530	NA	NA

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. *The calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. **The calibration interval of the above test instruments is 36 months and the calibrations are traceable to NML/ROC and NIST/USA.
4. Certificate of Conformance (CoC) which is issued by manufacturer states that the product meets the specification.
5. The test was performed in 966 Chamber No. 6
6. Tested Date: Oct. 06, 2020

4.1.3 Test Procedures

For Radiated emission: Below 30 MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

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

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission: 30 MHz ~ 40GHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna 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.

d. 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.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Peak detection (PK) at frequency from 1GHz to 40GHz.
3. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Average detection (AV) at frequency from 1GHz to 40GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated emission: Above 40GHz

External mixers are utilized.

a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meters chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The distance at which limits are typically specified is 3 meter; however, closer measurement distances may be utilized.

c. Begin handheld measurements with the test antenna (horn) at a distance of 1 meter from the EUT, in a horizontally polarized position. Slowly adjust its position, entirely covering the plane 1 meter from the EUT.

d. Repeat (b) with the horn in a vertically polarized position.

e. If the emission cannot be detected at 1 meter, reduce the RBW in order to increase system sensitivity. Note the value. If the emission still cannot be detected, move the horn closer to the EUT, noting the distance at which a measurement is made.

f. Note the maximum level indicated on the Spectrum Analyzer.

g. Based on the distance at which the measurement was made and the calculated distance to the edge of the far field, determine the appropriate distance attenuation factor. Apply this factor to the calculated field strength in order to determine the equivalent field strength at the distance at which the regulatory limit is specified. Compare to the appropriate limits

h. Repeat (a) - (f) for every emission that must be measured, up through the required frequency range of investigation

NOTE:

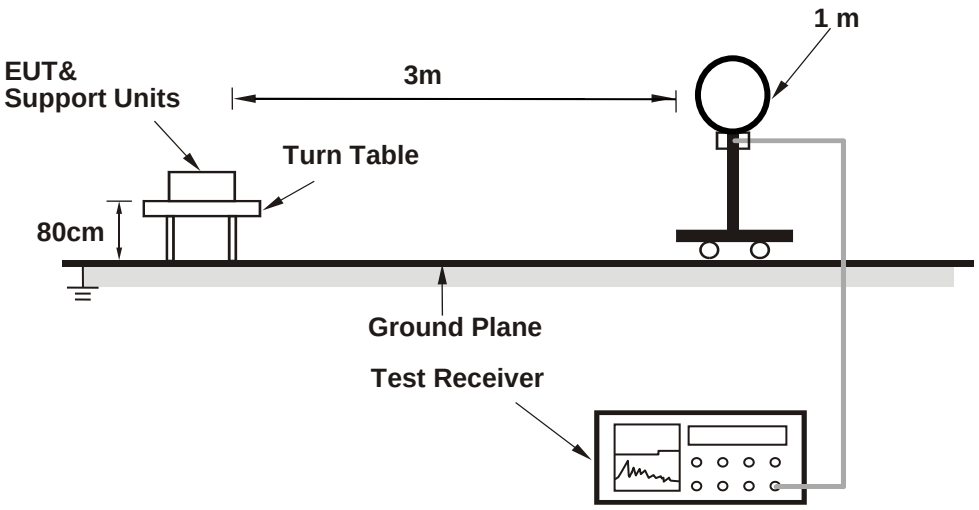
1. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for Peak and RMS detection for fundamental emission.
2. The resolution bandwidth is 1MHz and video bandwidth of test receiver/spectrum analyzer is 3MHz for RMS detection at frequency above 40GHz.

4.1.4 Deviation from Test Standard

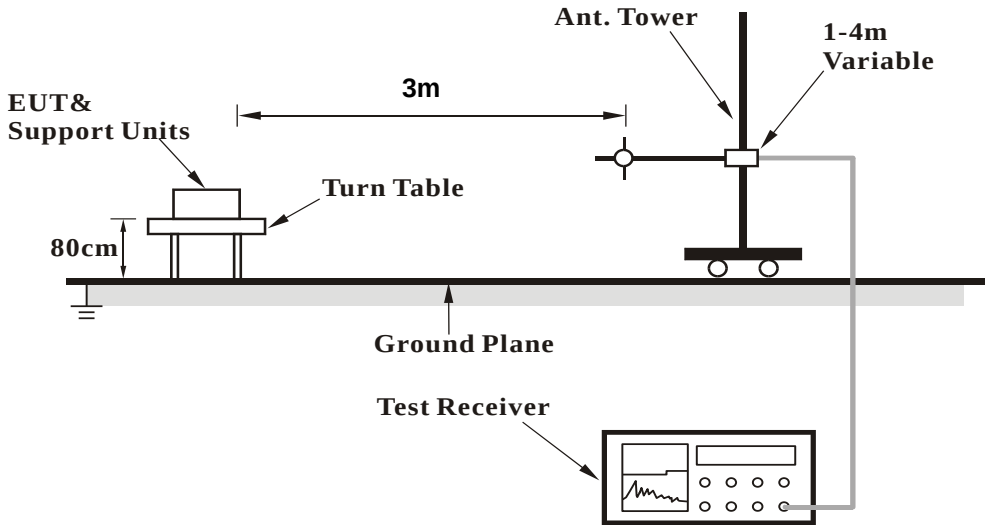
No deviation.

4.1.5 Test Setup

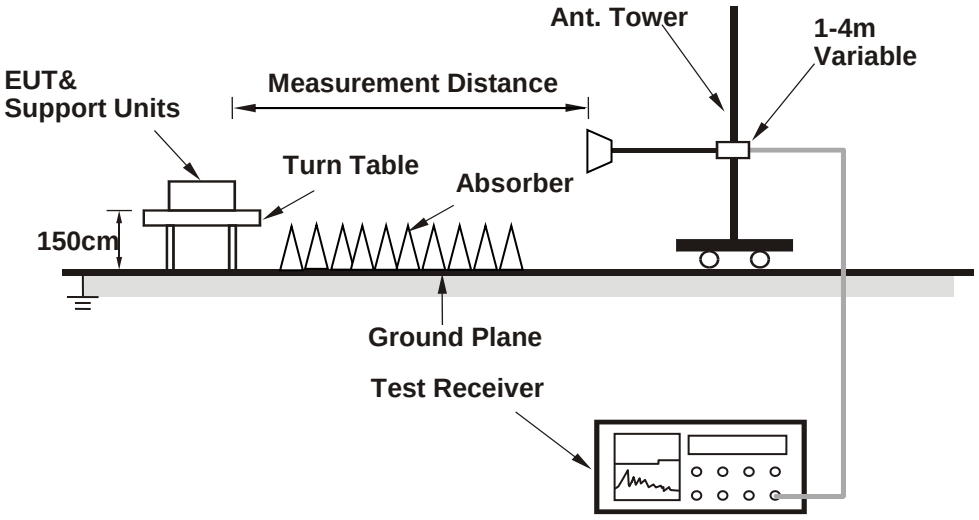
For Radiated emission below 30MHz



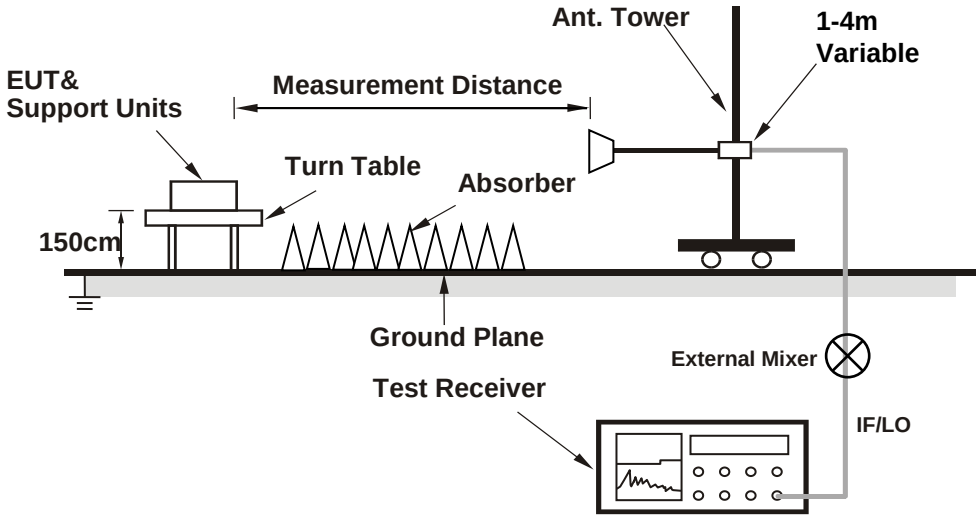
For Radiated emission 30MHz to 1GHz



For Radiated emission 1GHz to 50GHz



For Radiated emission above 50GHz



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

4.1.6 EUT Operating Conditions

Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz Data

FREQUENCY RANGE	1GHz ~ 18GHz	DETECTOR FUNCTION	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (m)**	**Table Angle (Degree)**	**Raw Value (dBuV)**	**Correction Factor (dB/m)**
1	#5160.75	38.7 PK	74.0	-35.3	2.13 H	156	34.5	4.2
2	#5160.75	29.5 AV	54.0	-24.5	2.13 H	156	25.3	4.2
3	#8538.23	43.7 PK	74.0	-30.3	2.43 H	111	33.5	10.2
4	#8538.23	31.1 AV	54.0	-22.9	2.43 H	111	20.9	10.2
5	11676.42	47.9 PK	74.0	-26.1	1.64 H	331	33.9	14.0
6	11676.42	34.1 AV	54.0	-19.9	1.64 H	331	20.1	14.0
Antenna Polarity & Test Distance : Vertical at 3 m								
No	**Frequency (MHz)**	**Emission Level (dBuV/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (m)**	**Table Angle (Degree)**	**Raw Value (dBuV)**	**Correction Factor (dB/m)**
1	#2457.32	37.2 PK	74.0	-36.8	1.72 V	353	38.8	-1.6
2	#2457.32	25.4 AV	54.0	-28.6	1.72 V	353	27.0	-1.6
3	#7159.95	43.6 PK	74.0	-30.4	2.56 V	337	33.8	9.8
4	#7159.95	31.7 AV	54.0	-22.3	2.56 V	337	21.9	9.8
5	12018.12	47.3 PK	74.0	-26.7	1.49 V	83	33.7	13.6
6	12018.12	34.0 AV	54.0	-20.0	1.49 V	83	20.4	13.6

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " # ": The radiated frequency is out of the restricted band.

FREQUENCY RANGE	18GHz ~ 40GHz	DETECTOR FUNCTION	Peak (PK) Average (AV)

Antenna Polarity : Horizontal								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	#23508.00	46.3 PK	74.0	-27.7	1.37 H	304	56.7	-10.4
2	#23508.00	33.8 AV	54.0	-20.2	1.37 H	304	44.2	-10.4
3	31672.00	46.5 PK	74.0	-27.5	2.83 H	10	50.0	-3.5
4	31672.00	35.9 AV	54.0	-18.1	2.83 H	10	39.4	-3.5
5	#35423.00	49.1 PK	74.0	-24.9	1.74 H	144	51.6	-2.5
6	#35423.00	38.9 AV	54.0	-15.1	1.74 H	144	41.4	-2.5
Antenna Polarity : Vertical								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	#24742.00	44.7 PK	74.0	-29.3	1.74 V	103	53.7	-9.0
2	#24742.00	35.5 AV	54.0	-18.5	1.74 V	103	44.5	-9.0
3	#28233.00	44.8 PK	74.0	-29.2	2.03 V	211	53.1	-8.3
4	#28233.00	37.7 AV	54.0	-16.3	2.03 V	211	46.0	-8.3
5	#34994.00	46.6 PK	74.0	-27.4	1.56 V	225	49.7	-3.1
6	#34994.00	38.3 AV	54.0	-15.7	1.56 V	225	41.4	-3.1

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " # ": The radiated frequency is out of the restricted band.
6. Shorter measurement distances was used to improve the measurement system's noise floor. As standard description is based on the measurement in distance of 3 meters, the data obtained at 1-meter distance was extrapolate results to the 3-m distance:

Test value at 3-meter distance (dBuV)
= Test value at 1 meter distance (dBuV) -20log(3/1)(dB)
= Test value at 1 meter distance (dBuV) -9.5(dB).

FREQUENCY RANGE	76GHz ~ 81GHz	DETECTOR FUNCTION	Peak (PK)

Antenna Polarity & Test Distance : Horizontal						
NO.	Frequency (GHz)	E_{Meas} (dBμV/m)	EIRP Level (dBm)	EIRP Limit (dBm)	EIRP margin (dBm)	PASS/FAIL
1	79	123.03	18.33	55	-36.67	PASS
Antenna Polarity & Test Distance : Vertical						
NO.	Frequency (GHz)	E_{Meas} (dBμV/m)	EIRP Level (dBm)	EIRP Limit (dBm)	EIRP margin (dBm)	PASS/FAIL
1	79	111.72	7.02	55	-47.98	PASS

REMARKS:

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

Follow ANSI 63.10 section 9.4 Equations to calculate and extrapolate field strength

E_{Meas} (dBμV/m) = 126.8 − 20log(λ) + P −G

where:

E_{Meas} 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

Follow ANSI 63.10 section 9.5 Equations to calculate EIRP

EIRP Level (dBm/MHz) = E_{Meas} (dBμV/m)+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

Measurements made at 1 meter distance.

2. The far-field boundary is given in ANSI 63.10 as:

R far field = (2 * L^2) / λ

L is the Largest Antenna Dimension of either the EUT antenna or measurement antenna, including the reflector

λ is the wavelength

FREQUENCY (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
79	0.02	0.0038	0.211

FREQUENCY RANGE	76GHz ~ 81GHz	DETECTOR FUNCTION	Average (AV)

Antenna Polarity & Test Distance : Horizontal								
No.	Frequency (GHz)	E_{Meas} (dBμV/m)	EIRP Level (dBm/MHz)	Occupied Bandwidth (MHz)	Total EIRP Power (dBm)	EIRP Limit (dBm)	EIRP margin (dBm)	PASS/FAIL
1	79	96.49	-8.21	3757.20	27.54	50	-22.46	PASS
Antenna Polarity & Test Distance : Vertical								
No.	Frequency (GHz)	E_{Meas} (dBμV/m)	EIRP Level (dBm/MHz)	Occupied Bandwidth (MHz)	Total EIRP Power (dBm)	EIRP Limit (dBm)	EIRP margin (dBm)	PASS/FAIL
1	79	96.49	-8.21	3757.20	27.54	50	-22.46	PASS

REMARKS:

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

Follow ANSI 63.10 section 9.4 Equations to calculate and extrapolate field strength

E_{Meas} (dBμV/m) = 126.8 − 20log(λ) + P −G

where:

E_{Meas} 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

Follow ANSI 63.10 section 9.5 Equations to calculate EIRP

EIRP Level (dBm/MHz) = E_{Meas} (dBμV/m)+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

Measurements made at 1 meter distance.

2. Total EIRP power (dBm) = EIRP Level (dBm/MHz) + 10*log(Occupied Bandeidth)(MHz)

3. The far-field boundary is given in ANSI 63.10 as:

R far field = (2 * L^2) / λ

L is the Largest Antenna Dimension of either the EUT antenna or measurement antenna, including the reflector

λ is the wavelength

FREQUENCY (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
79	0.02	0.0038	0.211

FREQUENCY RANGE	40GHz ~ 231GHz	DETECTOR FUNCTION	RMS (AV)

Antenna Polarity : Horizontal							
NO.	Frequency (GHz)	E_{Meas} (dBμV/m)	EIRP Level (dBm/MHz)	Power Density (pW/cm^2)	Power Density Limit (pW/cm^2)	Margin (pW/cm^2)	PASS/FAIL
1	47.71	80.53	-24.17	3.39	600	-596.61	PASS
2	50.06	85.97	-18.73	11.85	600	-588.15	PASS
3	75.73	72.68	-32.02	0.56	600	-599.44	PASS
4	102.87	75.31	-29.39	1.02	600	-598.98	PASS
5	117.07	88.14	-16.56	19.52	600	-580.48	PASS
6	194.15	79.41	-25.29	2.62	600	-597.38	PASS
7	220.69	79.09	-25.61	2.43	1000	-997.57	PASS
Antenna Polarity : Vertical							
NO.	Frequency (GHz)	E_{Meas} (dBμV/m)	EIRP Level (dBm/MHz)	Power Density (pW/cm^2)	Power Density Limit (pW/cm^2)	Margin (pW/cm^2)	PASS/FAIL
1	47.86	81.87	-22.83	4.61	600	-595.39	PASS
2	50.19	90.96	-13.74	37.37	600	-562.63	PASS
3	75.85	78.46	-26.24	2.10	600	-597.90	PASS
4	102.94	74.55	-30.15	0.85	600	-599.15	PASS
5	117.47	91.09	-13.61	38.51	600	-561.49	PASS
6	192.99	79.22	-25.48	2.50	600	-597.50	PASS
7	221.03	78.89	-25.81	2.32	1000	-997.68	PASS

REMARKS:

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

Follow ANSI 63.10 section 9.4 Equations to calculate and extrapolate field strength

E_{Meas} (dBμV/m) = 126.8 − 20log(λ) + P −G

where:

E_{Meas} 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

Follow ANSI 63.10 section 9.5 Equations to calculate EIRP

EIRP Level (dBm/MHz) = E_{Meas} (dBμV/m)+20*log(d_{Meas})-104.7

E_{Meas} is the field strength of the emission at the measurement distance, in dBμV/m

d_{Meas} is the measurement distance, in m

Measurements made at 1 meter distance.

2. Power density formula as follows

Follow ANSI 63.10 section 9.6 Equations to calculate power density

$PD=EIRP_{Linear}/4\pi d^2$

PD is is the power density at the distance specified by the limit, in W/m^2

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

d is the 3m distance.

3. The far-field boundary is given in ANSI 63.10 as:

R far field = (2 * L^2) / λ

L is the Largest Antenna Dimension of measurement antenna, including the reflector

λ is the wavelength

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
40	0.03	0.0075	0.240
50	0.03	0.0060	0.300

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
50	0.025	0.0060	0.208
75	0.025	0.0040	0.313

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
75	0.018	0.0040	0.162
110	0.018	0.0027	0.238

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
110	0.012	0.0027	0.106
170	0.012	0.0018	0.163

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
170	0.008	0.0018	0.073
260	0.008	0.0012	0.111

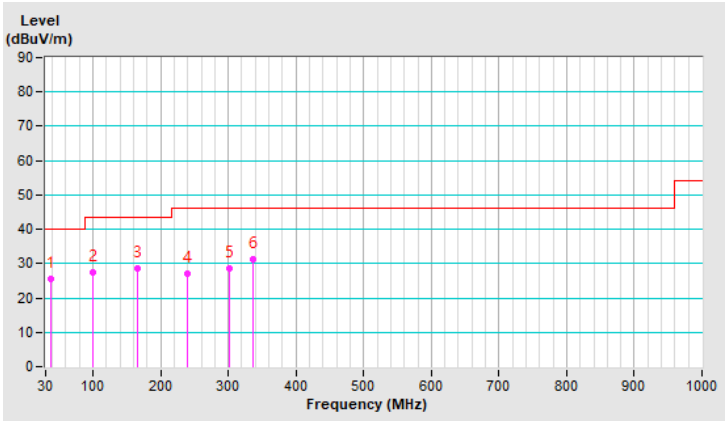
Below 1GHz Data

FREQUENCY RANGE	9kHz ~ 1GHz	DETECTOR FUNCTION	Quasi-Peak (QP)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	38.17	25.5 QP	40.0	-14.5	3.00 H	36	33.8	-8.3
2	99.86	27.6 QP	43.5	-15.9	3.00 H	177	39.3	-11.7
3	165.99	28.5 QP	43.5	-15.0	2.00 H	282	35.6	-7.1
4	240.00	27.1 QP	46.0	-18.9	1.50 H	292	35.3	-8.2
5	301.31	28.7 QP	46.0	-17.3	1.00 H	310	34.5	-5.8
6	336.01	31.3 QP	46.0	-14.7	1.00 H	130	36.0	-4.7

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

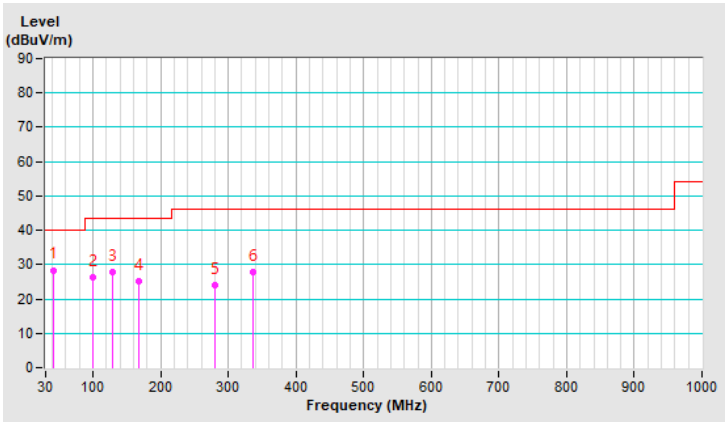


FREQUENCY RANGE	9kHz ~ 1GHz	DETECTOR FUNCTION	Quasi-Peak (QP)

Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	40.99	28.4 QP	40.0	-11.6	1.00 V	255	36.3	-7.9
2	99.82	26.2 QP	43.5	-17.3	2.00 V	147	37.9	-11.7
3	129.35	27.8 QP	43.5	-15.7	1.00 V	267	36.0	-8.2
4	167.76	25.1 QP	43.5	-18.4	1.50 V	344	32.3	-7.2
5	280.87	24.0 QP	46.0	-22.0	3.00 V	264	30.5	-6.5
6	336.01	27.9 QP	46.0	-18.1	1.00 V	232	32.6	-4.7

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
5. The emission levels were very low against the limit of frequency range 9kHz~30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



4.2 Modulation characteristics Measurement

The RF transceiver supports FMCW radar systems covering 77 to 81GHz. The FMCW generator will support a chirp waveform type as described by the below EDM chirp parameters.

Below EDM chirp parameters are used for short range and cargo measurements on B007:

Table 2-1 – EDM Chirp Parameter

Parameters	Default Chirp (us)	EDM Chirp (us)
Ta: Valley period (us)	59.93	9.20
Tb: Up slope period (us)	68.80	132.80
Tc: Peak period (us)	13.76	1.00
Td: Down slope period (us)	13.76	1.00
DFE decimation rate	6	12
Chirps per frame	32	2
FFT points	1024	1024

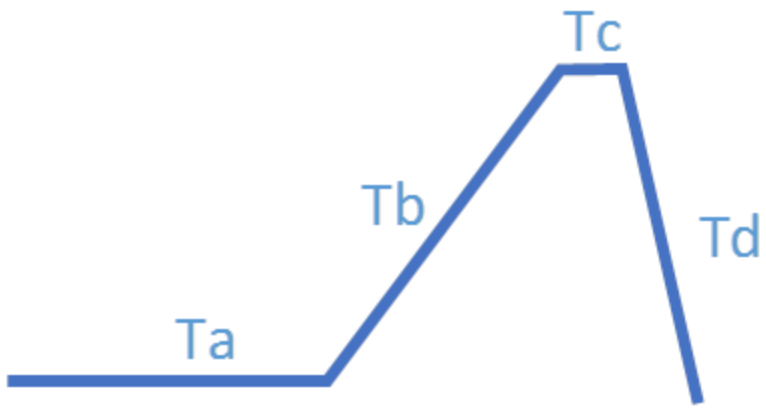
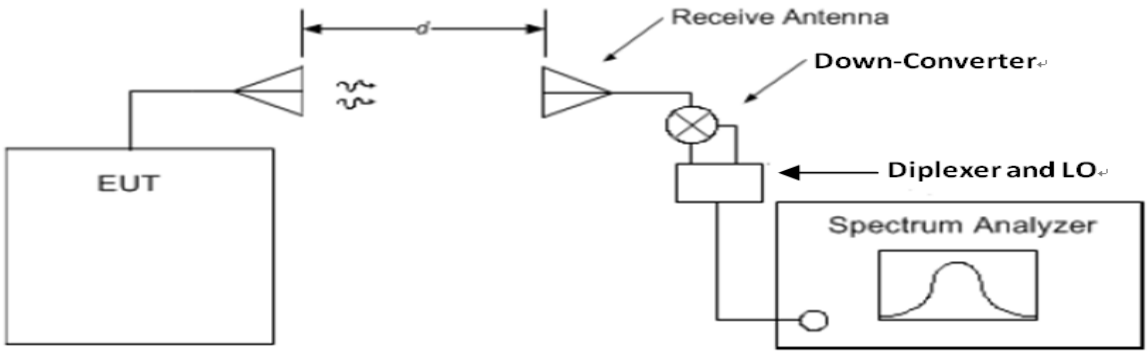


Figure 2-1 – Chirp Profile

4.3 Occupied Bandwidth Measurement

4.3.1 Test Setup



4.3.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.3 Test Procedure

The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to PEAK. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the total mean power of a given emission.

4.3.4 Deviation from Test Standard

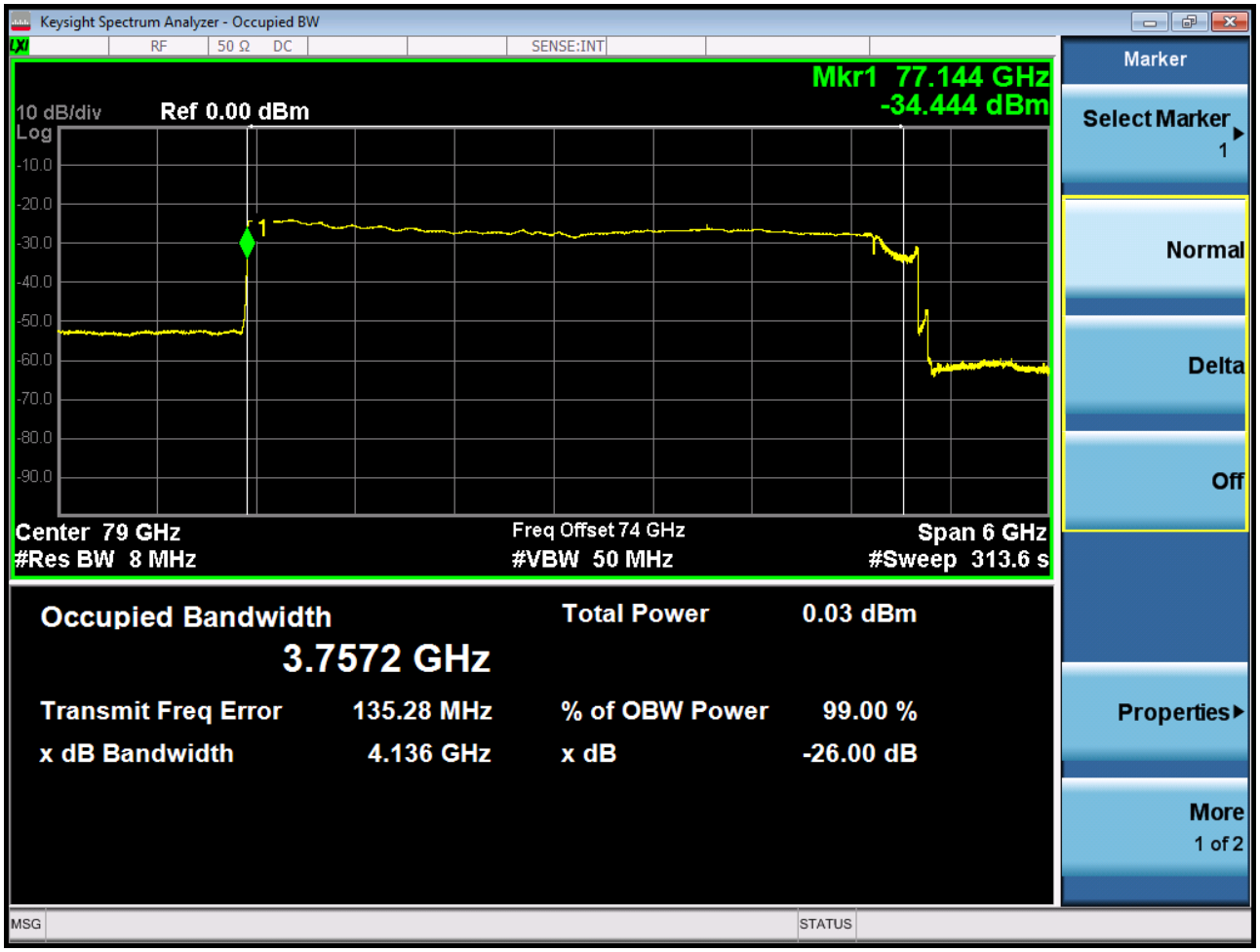
No deviation.

4.3.5 EUT Operating Conditions

Set the EUT under transmission condition continuously at specific channel frequency.

4.3.6 Test Results

Frequency (MHz)	Occupied Bandwidth (MHz)
79000	3757.2



4.4 Frequency Stability Measurement

4.4.1 Limits of Frequency Stability Measurement

Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation.

4.4.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
N9029AV10-DC9 - 75-110 GHz VDI Standard Downconverter with 9VDC supply Keysight	SA Extension WR10	SAX 378	CoC	CoC
*Horn Antenna (75~110GHz) OML	M10RH	110215-1	Oct. 17, 2017	Oct. 16, 2020
Spectrum Analyzer Keysight	N9030A	MY54490679	July 13, 2020	July 12, 2021
DC Power Supply Topward	6603D	795558	NA	NA
Temperature & Humidity Chamber Giant Force	GTH-150-40-SP-AR	MAA0812-008	Jan. 16, 2020	Jan. 15, 2021
True RMS Clamp Meter FLUKE	325	31130711WS	June 06, 2020	June 05, 2021

NOTE:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. *The calibration interval of the above test instruments is 36 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. Certificate of Conformance (CoC) which is issued by manufacturer states that the product meets the specification.
4. The test was performed in Oven room 2.
5. Tested Date: Oct. 12, 2020

4.4.3 Test Procedure

a. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.

b. Turn the EUT on and couple its output to a spectrum analyzer.

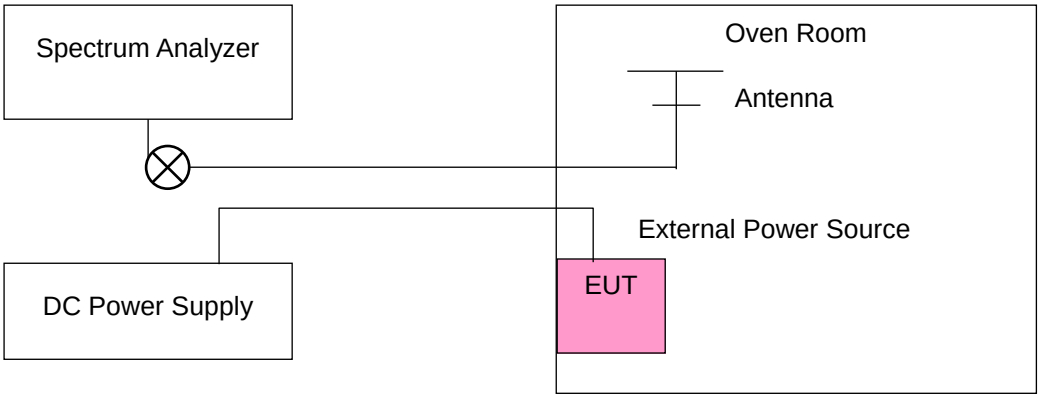
c. Turn the EUT off and set the chamber to the highest temperature specified.

d. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 minutes.

e. Repeat step (d) with the temperature chamber set to the next desired temperature until measurements down to the lowest specified temperature have been completed.

f. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

4.4.4 Test Setup



4.4.5 Test Results

Frequency Stability Versus Temp.													
Operating Frequency: 79000 MHz													
TEMP. (℃)	Power Supply (Vdc)	0 Minute			2 Minutes			5 Minutes			10 Minutes		
		FL (MHz)	FH (MHz)	Pass/ Fail	FL (MHz)	FH (MHz)	Pass/ Fail	FL (MHz)	FH (MHz)	Pass/ Fail	FL (MHz)	FH (MHz)	Pass/ Fail
50	3.6	77143.78	80901.20	PASS	77143.82	80901.14	PASS	77143.84	80901.15	PASS	77143.79	80901.21	PASS
40	3.6	77143.77	80901.43	PASS	77143.79	80901.46	PASS	77143.82	80901.42	PASS	77143.79	80901.42	PASS
30	3.6	77143.97	80900.78	PASS	77143.94	80900.80	PASS	77143.93	80900.82	PASS	77143.93	80900.84	PASS
20	3.6	77144.24	80901.16	PASS	77144.23	80901.17	PASS	77144.27	80901.16	PASS	77144.26	80901.18	PASS
10	3.6	77144.15	80901.28	PASS	77144.19	80901.32	PASS	77144.21	80901.30	PASS	77144.20	80901.27	PASS
0	3.6	77144.33	80901.56	PASS	77144.34	80901.61	PASS	77144.33	80901.54	PASS	77144.34	80901.61	PASS
-10	3.6	77143.92	80901.50	PASS	77143.89	80901.52	PASS	77143.89	80901.47	PASS	77143.91	80901.52	PASS
-20	3.6	77144.12	80900.95	PASS	77144.08	80900.99	PASS	77144.08	80901.00	PASS	77144.13	80900.97	PASS

Frequency Stability Versus Voltage													
Operating Frequency: 79000 MHz													
TEMP. (℃)	Power Supply (Vdc)	0 Minute			2 Minutes			5 Minutes			10 Minutes		
		FL (MHz)	FH (MHz)	Pass/ Fail	FL (MHz)	FH (MHz)	Pass/ Fail	FL (MHz)	FH (MHz)	Pass/ Fail	FL (MHz)	FH (MHz)	Pass/ Fail
20	3.7	77144.24	80901.15	PASS	77144.21	80901.17	PASS	77144.26	80901.17	PASS	77144.25	80901.20	PASS
	3.6	77144.24	80901.16	PASS	77144.23	80901.17	PASS	77144.27	80901.16	PASS	77144.26	80901.18	PASS
	3.5	77144.25	80901.16	PASS	77144.23	80901.18	PASS	77144.28	80901.15	PASS	77144.24	80901.17	PASS

5 Pictures of Test Arrangements

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

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Lin Kou EMC/RF Lab
Tel: 886-2-26052180
Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab
Tel: 886-3-6668565
Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab
Tel: 886-3-3183232
Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com
Web Site: www.bureauveritas-adt.com

The address and road map of all our labs can be found in our web site also.

--- END ---