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TEST REPORT

Report Number: 22030405HKG-001

Application for Original Grant of 47 CFR Part 15 Certification

Single New of RSS-247 Issue 2 Equipment

FCC ID: Q2O-QCC5151

IC: 152B-QCC5151

Prepared and Checked by:	Approved by:
Signed On File Wong Cheuk Ho, Herbert Lead Engineer	Digitally signed by Kenneth Wong Location: Intertek Testing Services Hong Kong Limited Wong Kwok Yeung, Kenneth Assistant Supervisor Date: June 30, 2022

TEST REPORT

GENERAL INFORMATION

Applicant Name:	Lenbrook Industries Limited
Applicant Address:	633 Granite Court, Pickering, ON, L1W 3K1, Canada.
FCC Specification Standard:	FCC Part 15, October 1, 2020 Edition
FCC ID:	Q2O-QCC5151
FCC Model(s):	QCC5151
IC Specification Standard:	RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 Amendment 2, February 2021
IC:	152B-QCC5151
PMN:	Bluetooth Module
HVIN:	QCC5151
Type of EUT:	Spread Spectrum Transmitter
Description of EUT:	Bluetooth Module
Sample Receipt Date:	March 08, 2022
Date of Test:	March 08, 2022 to June 20, 2022
Report Date:	June 30, 2022
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%
Conclusion:	Test was conducted by client submitted sample. The submitted sample as after modification complied with the 47 CFR Part 15 / RSS-247 Issue 2 Certification.

TEST REPORT

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TEST REPORT

1.0 TEST RESULTS SUMMARY & STATEMENT OF COMPLIANCE

1.1 Summary of Test Results

Test Items	FCC Part 15 Section	RSS-247/ RSS-Gen# Section	Results	Details See Section
Antenna Requirement	15.203	7.1.2#	Pass	2.1
Max. Conducted Output Power (Peak)	15.247(b)(3)&(4)	5.4(4)	Pass	4.1
Min. 6dB RF Bandwidth	15.247(a)(2)	5.2(1)	Pass	4.2
Max. Power Density (average)	15.247(e)	5.2(2)	Pass	4.3
Out of Band Antenna Conducted Emission	15.247(d)	5.5	Pass	4.4
Radiated Emission in Restricted Bands and Spurious Emissions	15.247(d), 15.209 & 15.109	5.5	Pass	4.6
AC Power Line Conducted Emission	15.207 & 15.107	7.2.4#	Pass	4.7

Note: Pursuant to FCC Part 15 Section 15.215(c), the 20dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over expected variations in temperature and supply voltage were considered.

1.2 Statement of Compliance

The equipment under test is found to be complying with the following standard:

FCC Part 15, October 1, 2020 Edition
RSS-247 Issue 2, February 2017
RSS-Gen Issue 5 Amendment 2, February 2021

TEST REPORT

2.0 GENERAL DESCRIPTION

2.1 Product Description

The Equipment-Under-Test (EUT) QCC5151 is Bluetooth Module. The EUT is powered by 5VDC.

This report contains the data of Bluetooth BLE only.

Antenna Type: Internal, Integral with Unique Antenna Connector.

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

2.2 Test Methodology

Both AC power line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Preliminary radiated scans and all radiated measurements were performed in radiated emission test sites. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application. Antenna port conducted measurements were performed according to ANSI C63.10 (2013) and KDB Publication No.558074 D01 v05r01 (11-February-2019). All other measurements were made in accordance with the procedures in 47 CFR Part 2 and RSS-Gen Issue 5 Amendment 2, February 2021.

2.3 Test Facility

The radiated emission test site and antenna port conducted measurement facility used to collect the radiated data and conductive data are at Workshop No. 3, G/F., World-Wide Industrial Centre, 43-47 Shan Mei Street, Fo Tan, Sha Tin, N.T., Hong Kong SAR, China. This test facility and site measurement data have been fully placed on file with the FCC and Industry Canada No.: 2042H, CABID is “HKAP01”.

2.4 Related Submittal(s) Grants

This is a single application for certification of a transceiver (Bluetooth BLE portion).

TEST REPORT

3.0 SYSTEM TEST CONFIGURATION

3.1 Justification

For radiated emissions testing, the equipment under test (EUT) was setup to transmit / receive continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, all cables (if any) were manipulated to produce worst case emissions.

The EUT was powered by a 5VDC (USB port of notebook computer powered by 120VAC).

For the measurements, the EUT was attached to a plastic stand if necessary and placed on the wooden turntable. If the base unit attached to peripherals, they were connected and operational (as typical as possible).

The signal was maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization were varied during the search for maximum signal level. The antenna height was varied from 1 to 4 meters. Radiated emissions were taken at three meters unless the signal level was too low for measurement at that distance. If necessary, a pre-amplifier was used and/or the test was conducted at a closer distance.

For any intentional radiator powered by AC power line, measurements of the radiated signal level of the fundamental frequency component of the emission was performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

Radiated emission measurement for transmitter were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Emission that are directly caused by digital circuits in the transmit path and transmitter portion were measured, and the limit are according to FCC Part 15 Section 15.209 / RSS-247 2.5. Digital circuitries used to control additional functions other than the operation of the transmitter are subject to FCC Part 15 Section 15.109 / RSS-247 Section 5.5 Limits.

TEST REPORT

3.1 Justification – Cont'd

Detector function for radiated emissions was in peak mode. Average readings, when required, were taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in section 4.8.3.

Determination of pulse desensitization was made according to *Hewlett Packard Application Note 150-2, Spectrum Analysis... Pulsed RF.* The effective period (Teff) was referred to Exhibit 4.8.3. With the resolution bandwidth 1MHz and spectrum analyzer IF bandwidth 3dB, the pulse desensitization factor was 0dB.

For AC line conducted emission test, the EUT along with its peripherals were placed on a 1.0m(W)x1.5m(L) and 0.8m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane. The EUT was connected to power mains through a line impedance stabilization network (LISN), which provided 50ohm coupling impedance for measuring instrument. The LISN housing, measuring instrument case, reference ground plane, and vertical ground plane were bounded together. The excess power cable between the EUT and the LISN was bundled.

All connecting cables of EUT and peripherals were manipulated to find the maximum emission.

All relevant operation modes and data rates have been tested, and the worst-case data is included in this report.

3.2 EUT Exercising Software

The EUT exercise program (if any) used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

TEST REPORT

3.3 Details of EUT and Description of Accessories

Details of EUT:

The EUT is powered by 5VDC (supplied by notebook computer USB port)

Description of Accessories:

Provided by Intertek:
(1) HP notebook computer (Adaptor Model: HSTNN-CA15)
(2) 1 X LAN cable of 2m long with termination

3.4 Measurement Uncertainty

Decision Rule for compliance: For FCC/IC standard, the measured value must be within the limits of applicable standard without accounting for the measurement uncertainty. For EN/IEC/HKTA/HKTC standard, conformity rules will be used as per standard directly excepted EN/IEC 61000-3-2, EN/IEC 61000-3-3, HKTA1004, HKCA1008, HKTA1019, HKTA1020, HKTA1041 and HKTA1044. For these excepted or not mentioned standards, Cl 4.2.2 of ILAC-G8:09/2019 decision rules will be reference and guard band will be equal to our measurement uncertainty with 95% confidence level (k=2). In case, the measured value is within guard band region, undetermined decision will be used. The values of the Measurement uncertainty for radiated emission test and RF conducted measurement test are ± 5.3dB and ±0.99dB respectively. The value of the Measurement uncertainty for conducted emission test is ±4.2dB.

Uncertainty and Compliance - Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

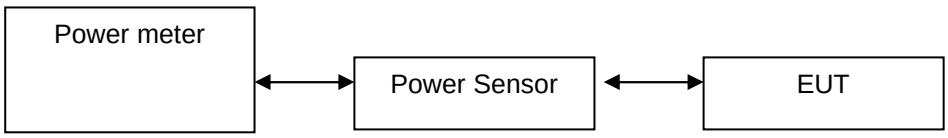
TEST REPORT

4.0 TEST RESULTS

4.1 Maximum Conducted (peak) Output Power at Antenna Terminals

RF Conduct Measurement Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



The antenna port of the EUT was connected to the input of a spectrum analyzer.

☒ The antenna power of the EUT was connected to the input of a power meter. Power was read directly and cable loss correction was added to the reading to the obtain power at the EUT antenna terminals. The measurement procedure 9.1.2 was used.

☐ The EUT should be configured to transmit continuously (at a minimum duty cycle of 98%) at full power over the measurement duration. The measurement procedure AVG1 was used.

Bluetooth 4.0 (BLE 1M) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm	Output in mWatt
Low Channel:	2402	7.4	5.5
Middle Channel:	2440	7.3	5.4
High Channel:	2480	7.8	6.0

Bluetooth 4.0 (BLE 2M) Antenna Gain = 2 dBi

Frequency (MHz)		Output in dBm	Output in mWatt
Low Channel:	2402	8.1	6.5
Middle Channel:	2440	7.4	5.5
High Channel:	2480	7.6	5.8

Cable loss: 0.5 dB External Attenuation: 0 dB
Cable loss, external attenuation: ☒ included in OFFSET function
☐ added to SA raw reading

Bluetooth 4.0 (BLE 1M): max. conducted (peak) output level = 7.8 dBm
Bluetooth 4.0 (BLE 2M): max. conducted (peak) output level = 8.1 dBm

Limits:
☒ 1W (30dBm) for antennas with gains of 6dBi or less
☐ ___W (___dBm) for antennas with gains more than 6dBi

TEST REPORT

4.2 Minimum 6dB RF Bandwidth

The antenna port of the EUT was connected to the input of a spectrum analyzer. The EBW measurement procedure was used. A PEAK output reading was taken, a DISPLAY line was drawn 6dB lower than PEAK level. The 6dB bandwidth was determined from where the channel output spectrum intersected the display line.

Bluetooth 4.0 (BLE 1M)

Frequency (MHz)		6dB Bandwidth (MHz)
Low Channel:	2402	0.732
Middle Channel:	2440	0.732
High Channel:	2480	0.736

Bluetooth 4.0 (BLE 2M)

Frequency (MHz)		6dB Bandwidth (MHz)
Low Channel:	2402	1.3
Middle Channel:	2440	1.3
High Channel:	2480	1.3

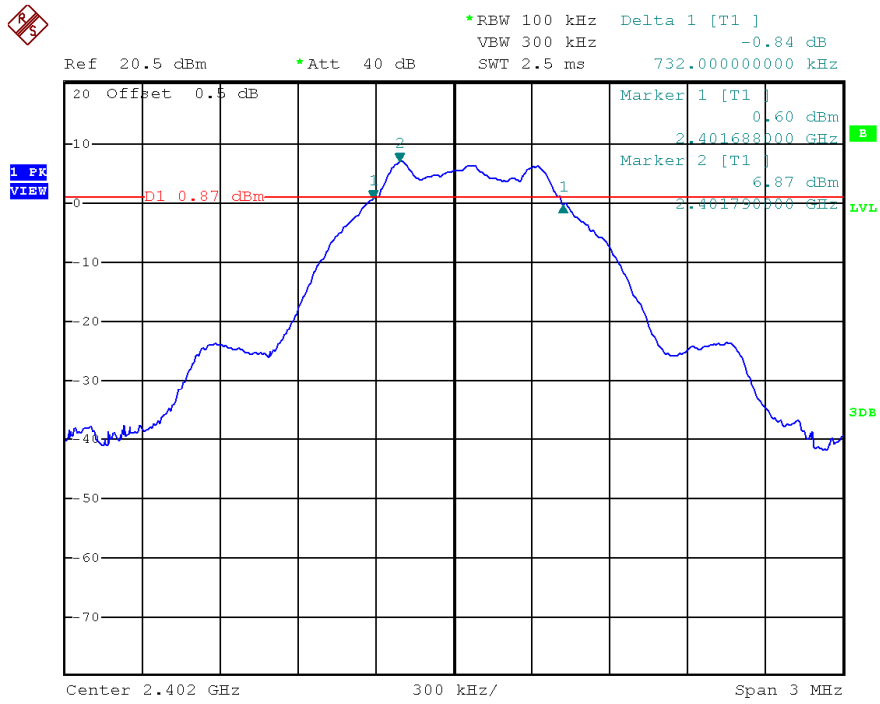
Limits
6 dB bandwidth shall be at least 500kHz

The plots of 6dB RF bandwidth are saved as below.

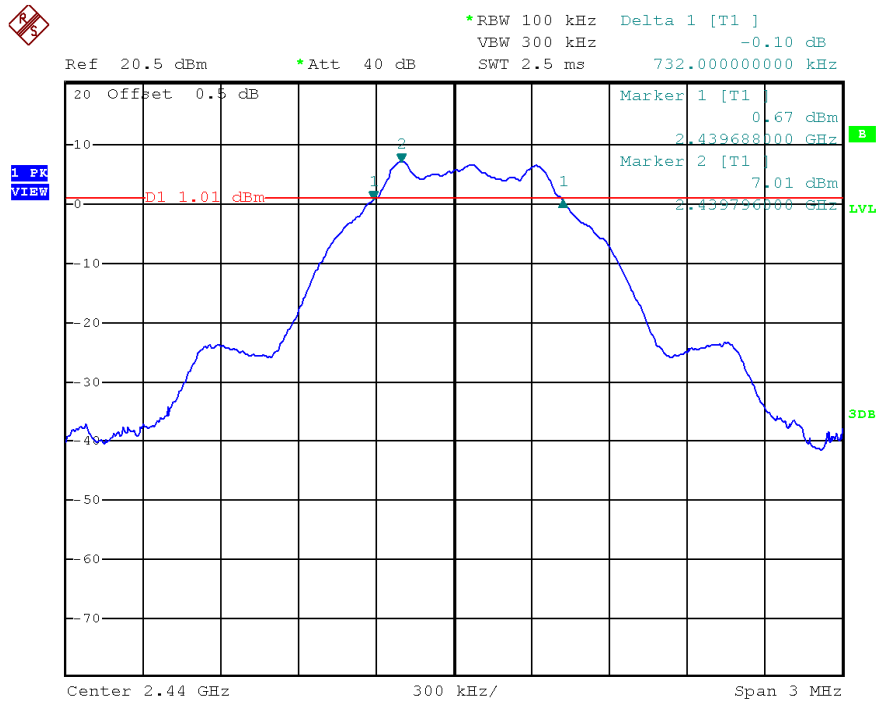
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

Bluetooth 4.0 (BLE 1M), Lowest Channel



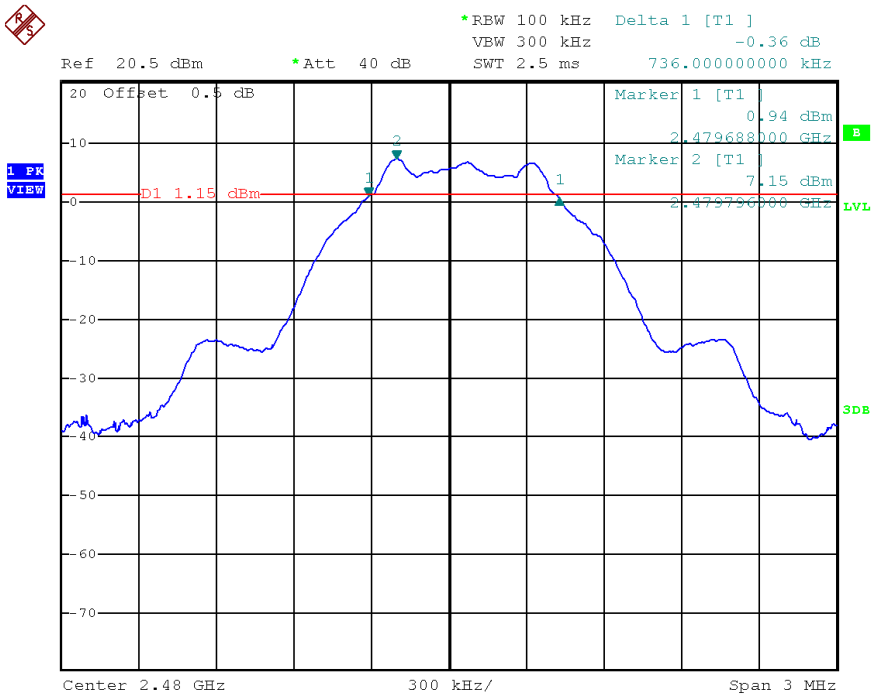
Bluetooth 4.0 (BLE 1M), Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

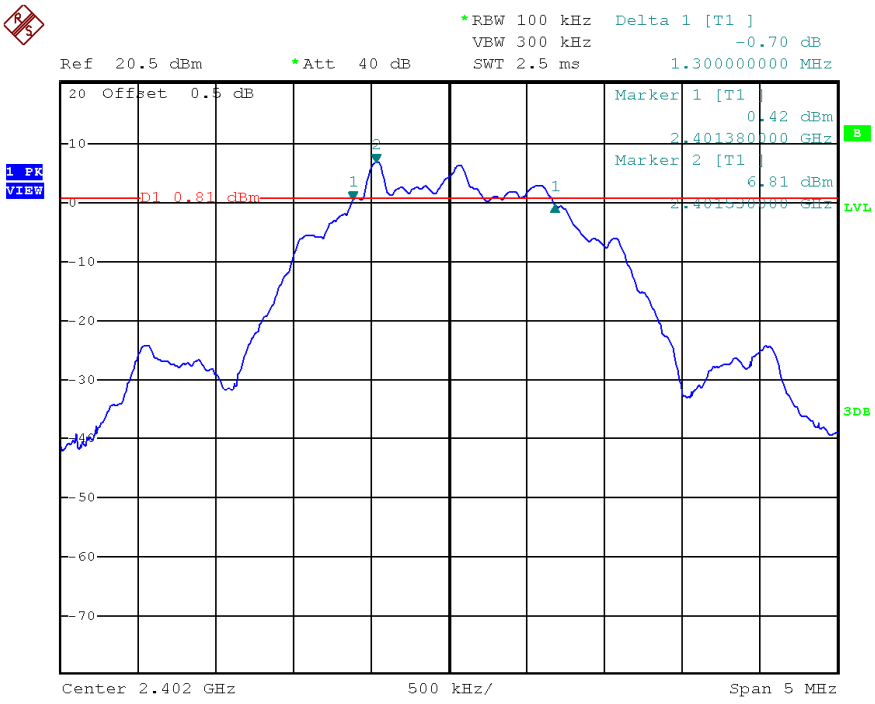
Bluetooth 4.0 (BLE 1M), Highest Channel



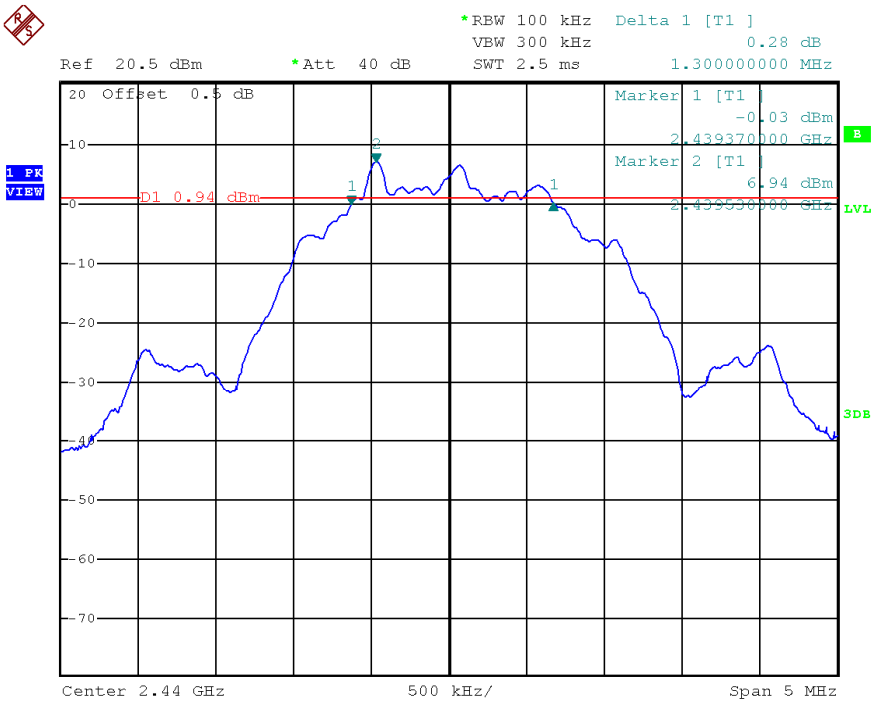
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

Bluetooth 4.0 (BLE 2M), Lowest Channel



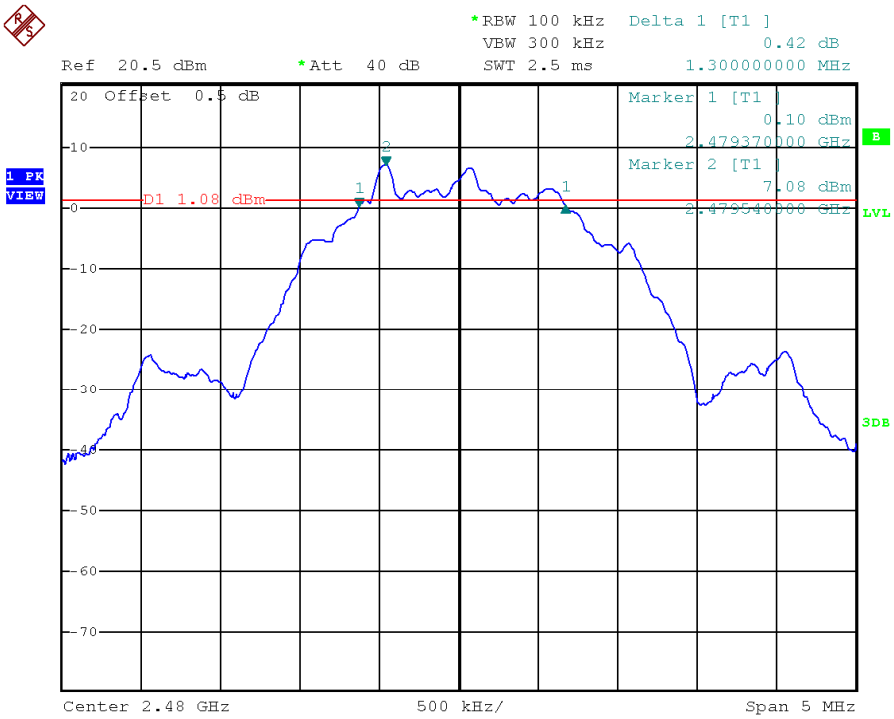
Bluetooth 4.0 (BLE 2M), Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

Bluetooth 4.0 (BLE 2M), Highest Channel



TEST REPORT

4.3 Maximum Power Spectral Density

Antenna output of the EUT was coupled directly to spectrum analyzer. The measurement procedure 10.2 PKPSD was used. If an external attenuator and/or cable was used, these losses are compensated for using the OFFSET function of the analyser.

Bluetooth 4.0 (BLE 1M)

Frequency (MHz)		PSD in 100kHz (dBm)
Low Channel:	2402	6.90
Middle Channel:	2440	7.04
High Channel:	2480	7.18

Bluetooth 4.0 (BLE 2M)

Frequency (MHz)		PSD in 100kHz (dBm)
Low Channel:	2402	6.84
Middle Channel:	2440	6.97
High Channel:	2480	7.10

Cable Loss: 0.5 dB

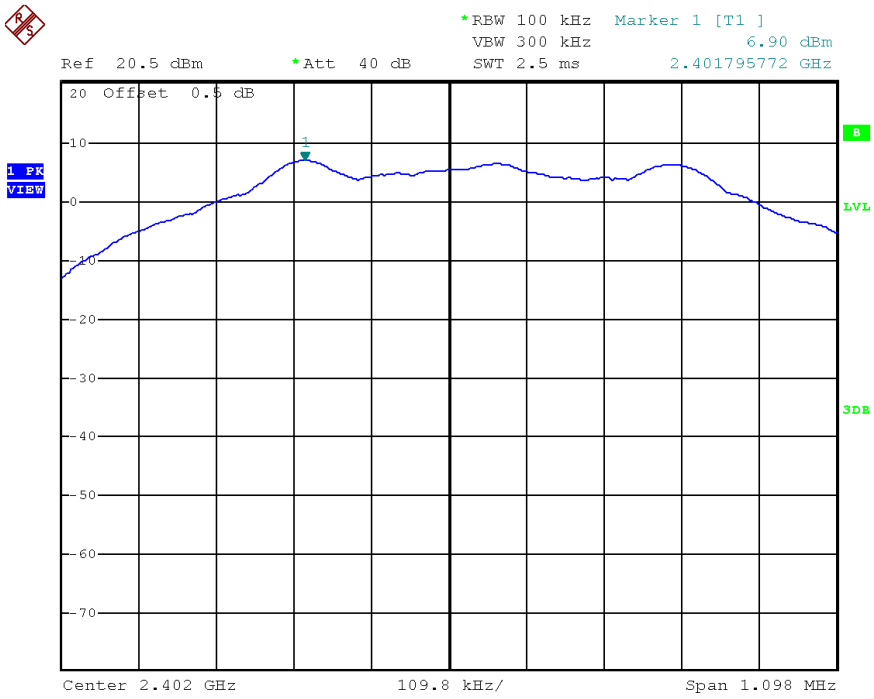
Limit:
8dBm

The plots of power spectral density are as below.

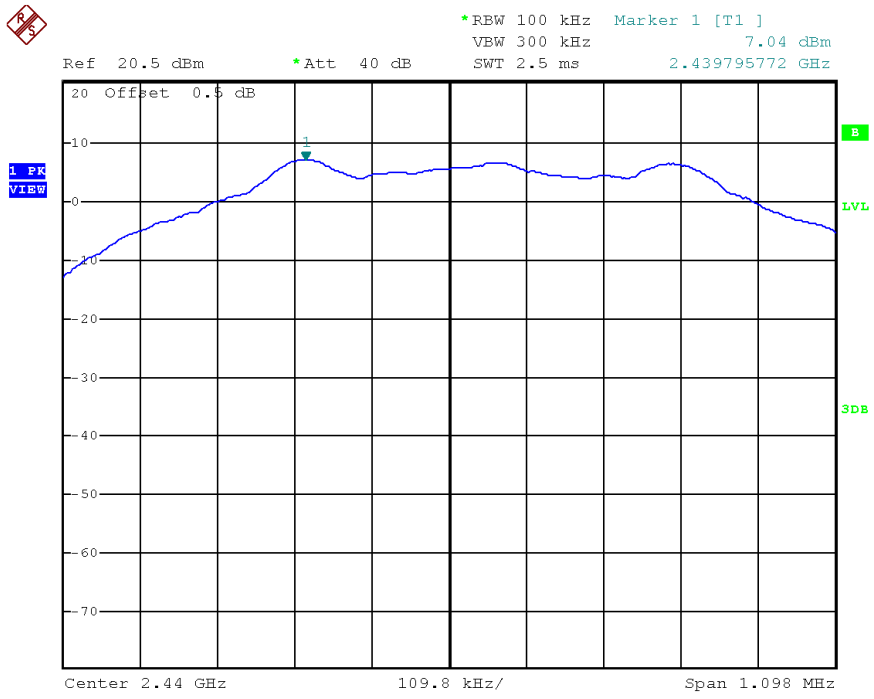
TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

Bluetooth 4.0 (BLE 1M), Lowest channel



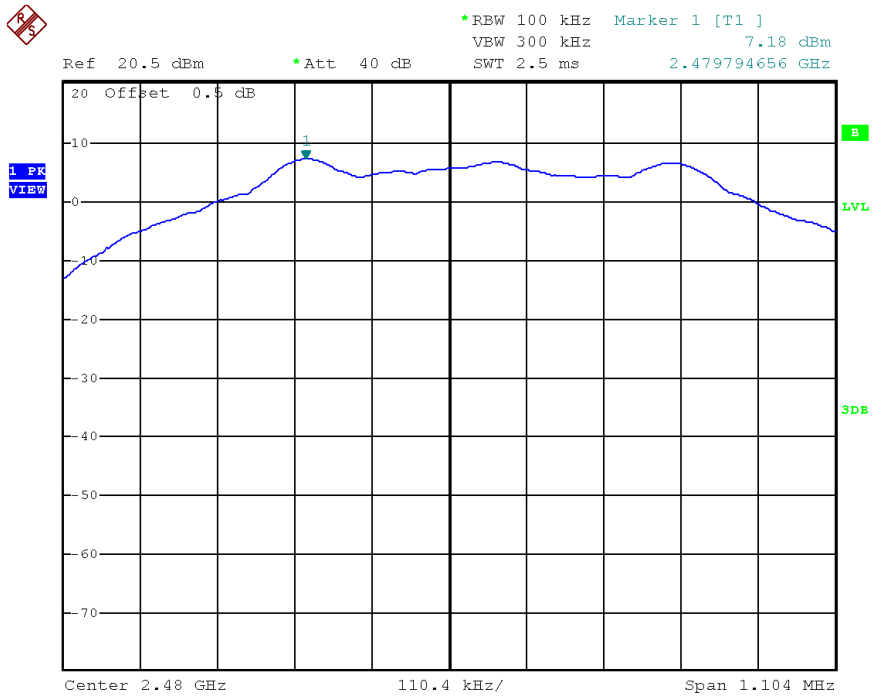
Bluetooth 4.0 (BLE 1M), Middle channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

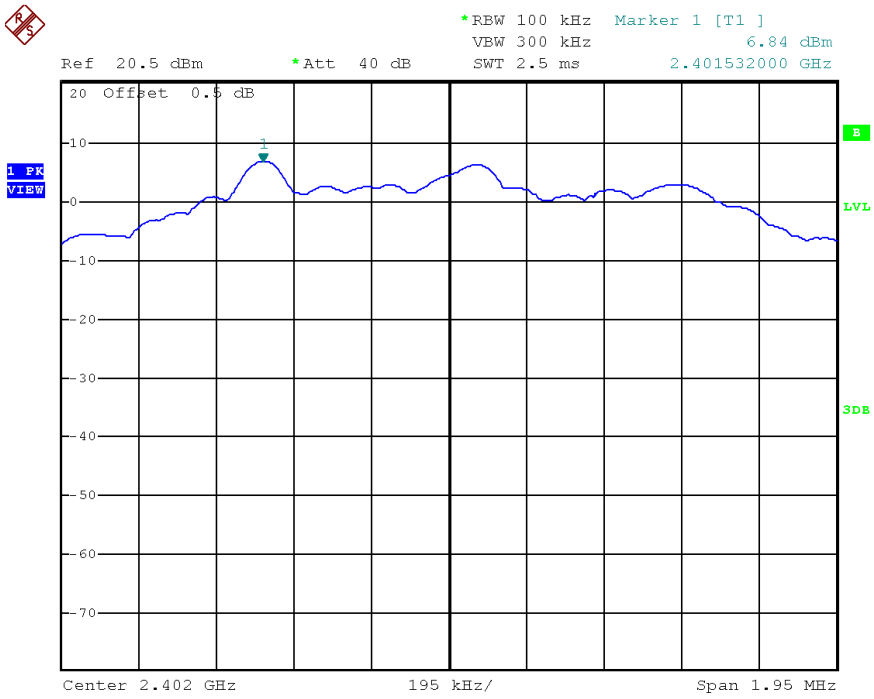
Bluetooth 4.0 (BLE 1M), Highest channel



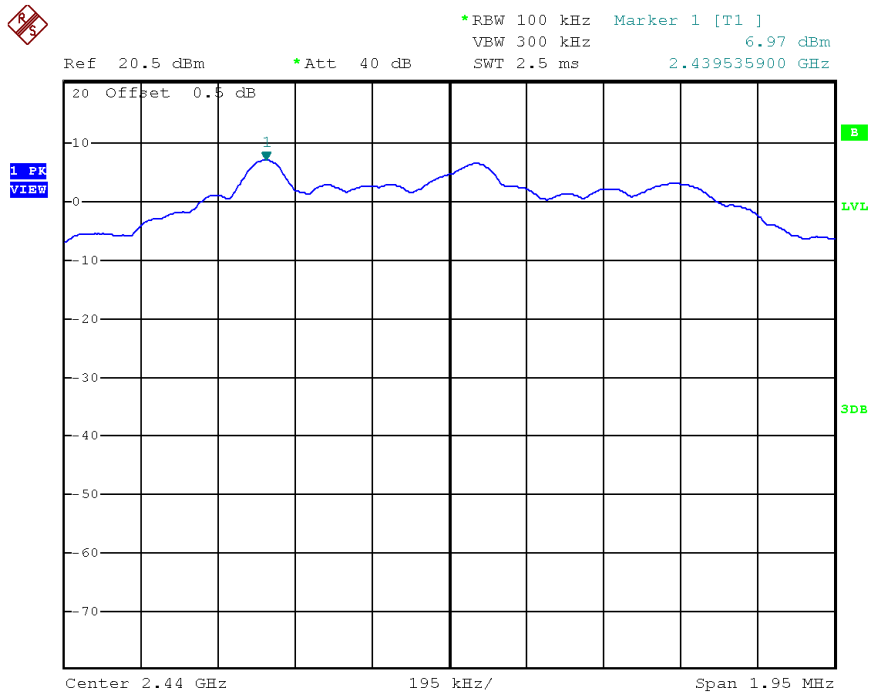
TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

Bluetooth 4.0 (BLE 2M), Lowest channel



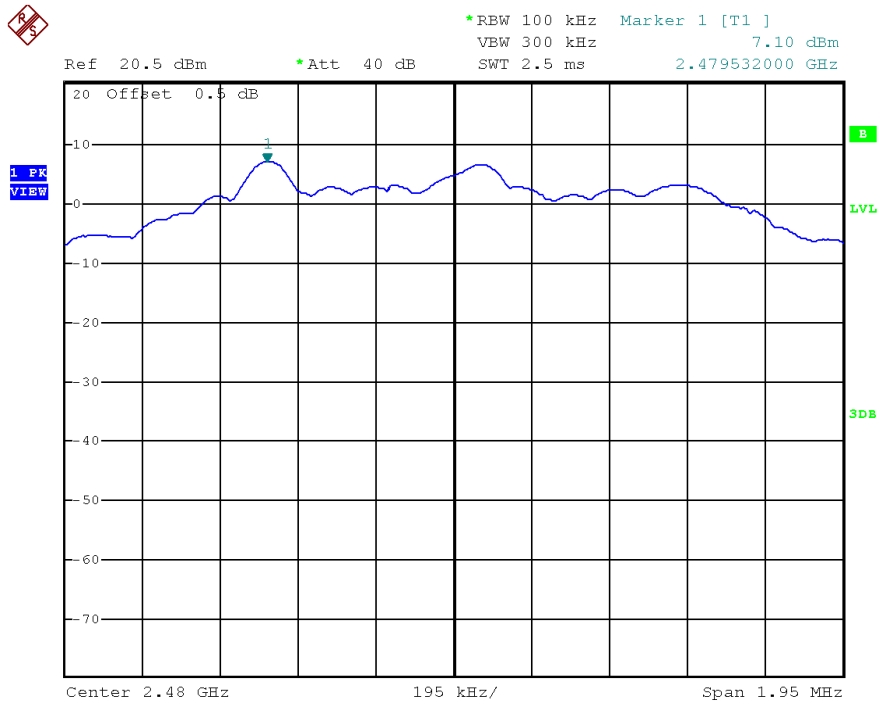
Bluetooth 4.0 (BLE 2M), Middle channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

Bluetooth 4.0 (BLE 2M), Highest channel



TEST REPORT

4.4 Out of Band Conducted Emissions

For Bluetooth 4.0 (BLE 1M/2M), the maximum conducted (peak) output power was used to demonstrate compliance as described in 9.1. Then the display line (in red) shown in the following plots denotes the limit at 20dB below maximum measured in-band peak PSD level in 100 KHz bandwidth for Bluetooth 4.0 (BLE 1M/2M).

The measurement procedures under sections 11 of KDB558074 D01 v05r01 (11-February-2019) were used.

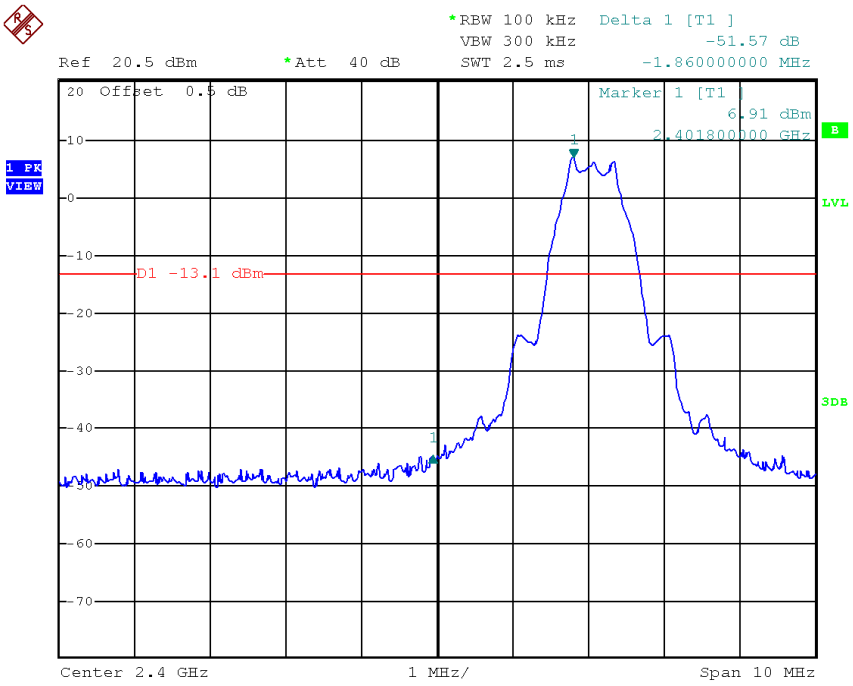
Furthermore, delta measurement technique for measuring bandedge emissions was incorporated in the test of the edge at 2483.5MHz.

Limits:
All spurious emission and up to the tenth harmonic was measured and they were found to be at least 20dB below the maximum measured in-band peak PSD level for Bluetooth 4.0 (BLE 1M/2M).

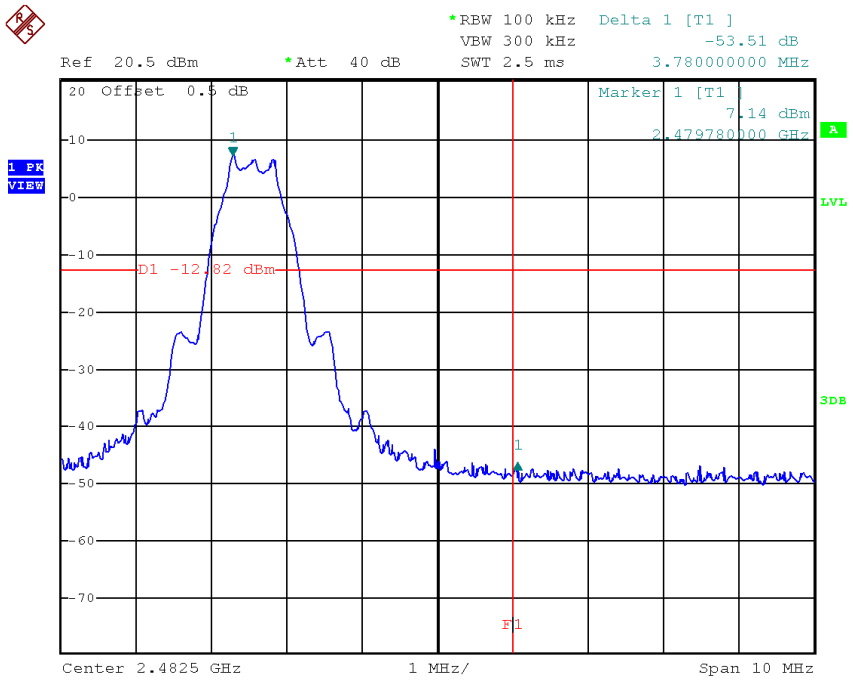
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Bluetooth 4.0 (BLE 1M), Lowest Channel, Bandedge



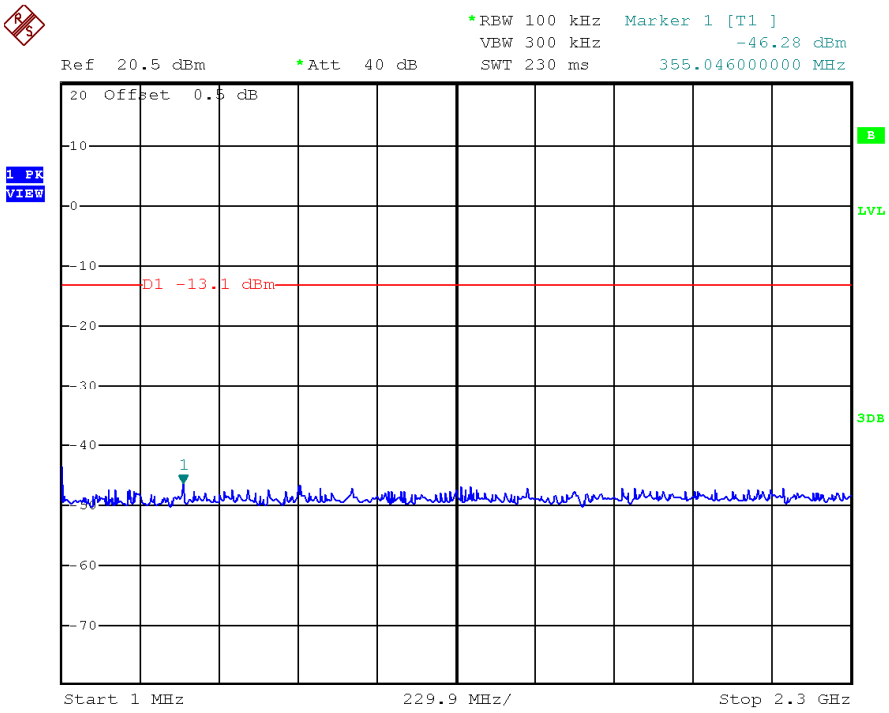
Bluetooth 4.0 (BLE 1M), Highest Channel, Bandedge



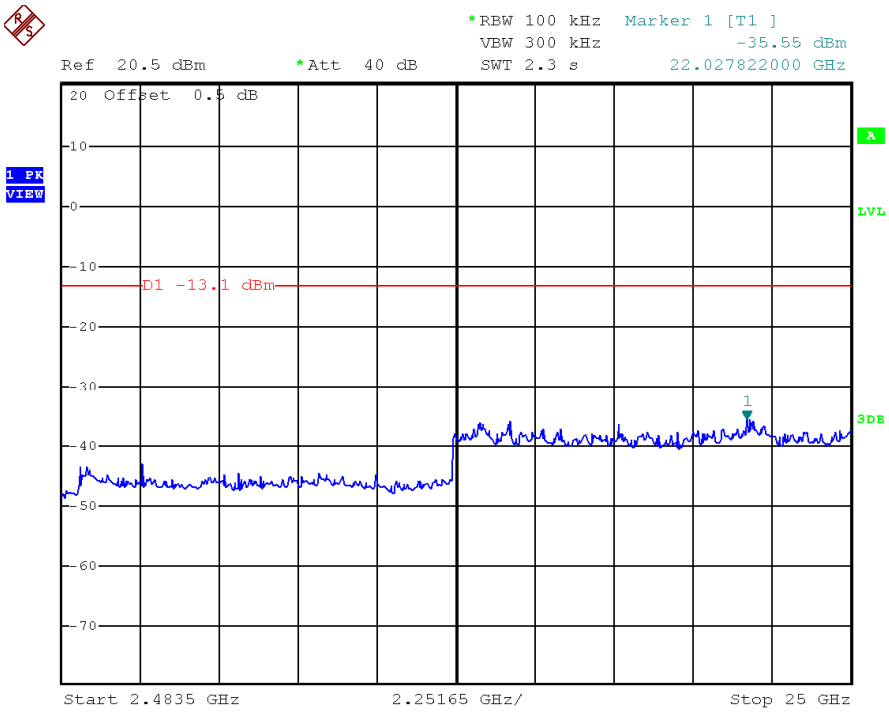
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Bluetooth 4.0 (BLE 1M), Lowest Channel, Plot A



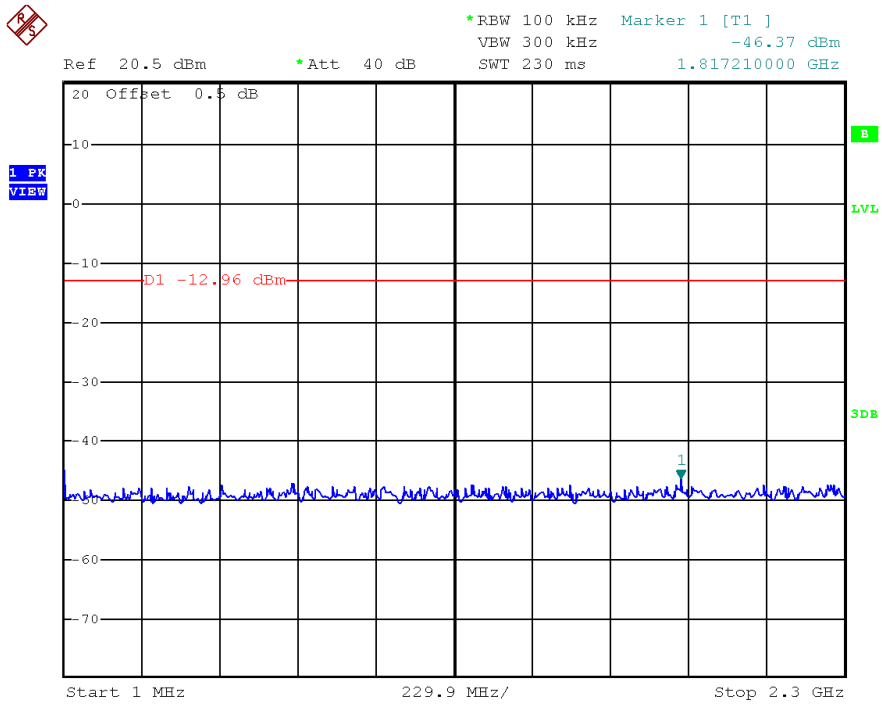
Bluetooth 4.0 (BLE 1M), Lowest Channel, Plot B



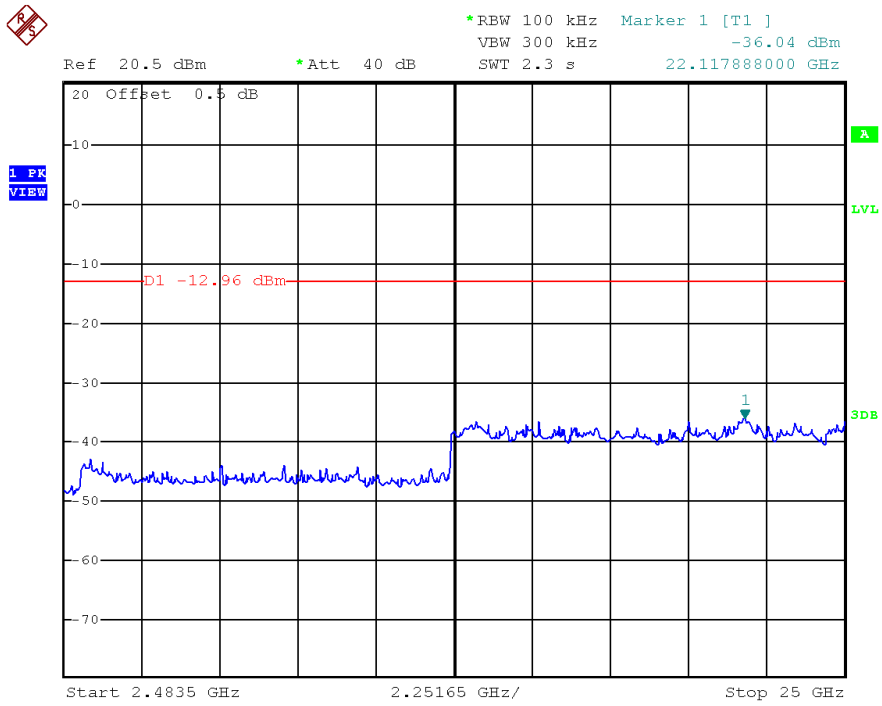
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Bluetooth 4.0 (BLE 1M), Middle Channel, Plot A



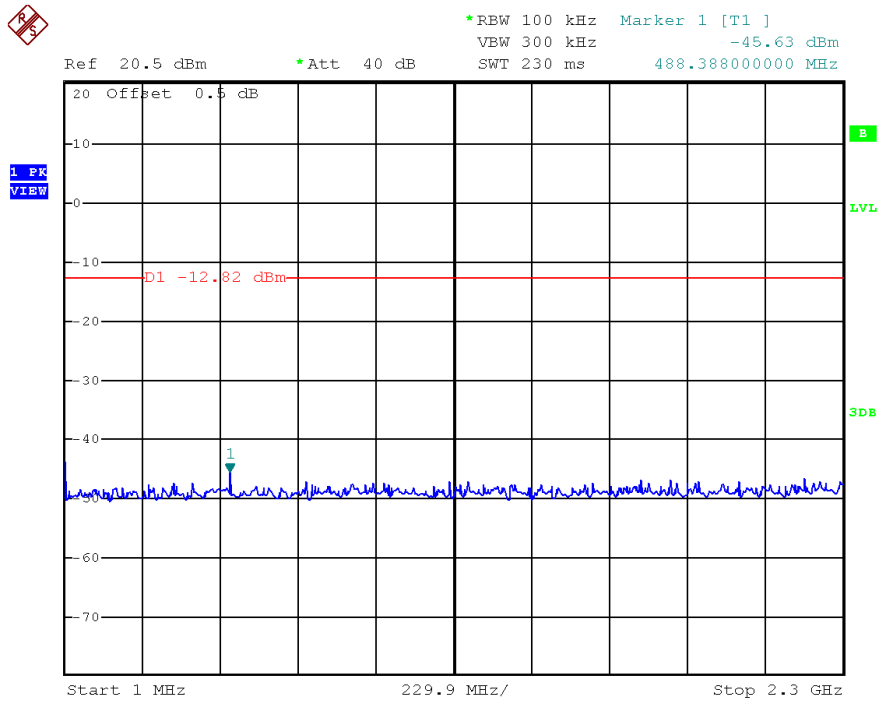
Bluetooth 4.0 (BLE 1M), Middle Channel, Plot B



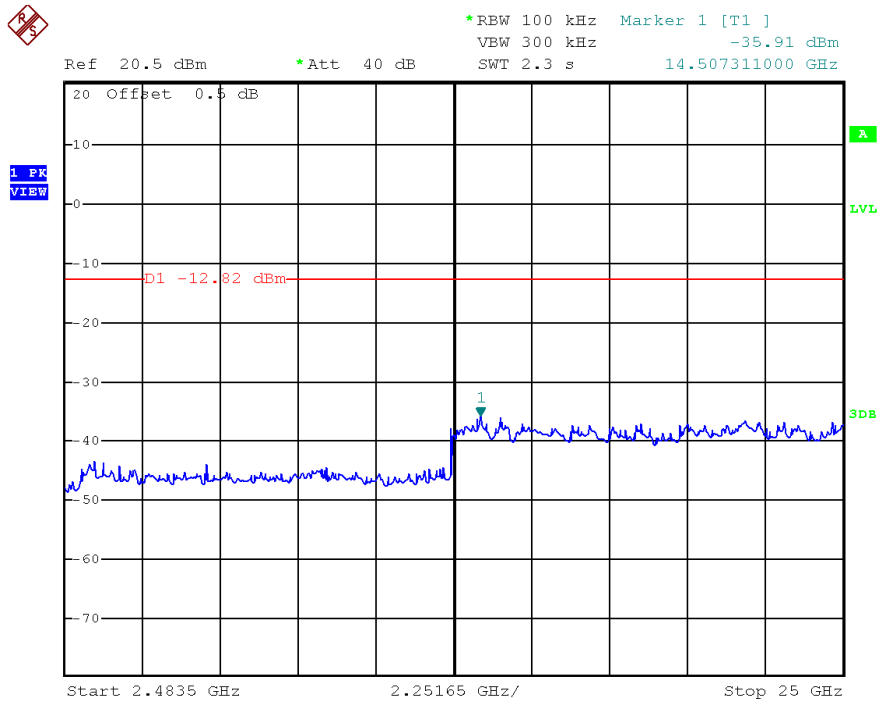
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Bluetooth 4.0 (BLE 1M), Highest Channel, Plot A



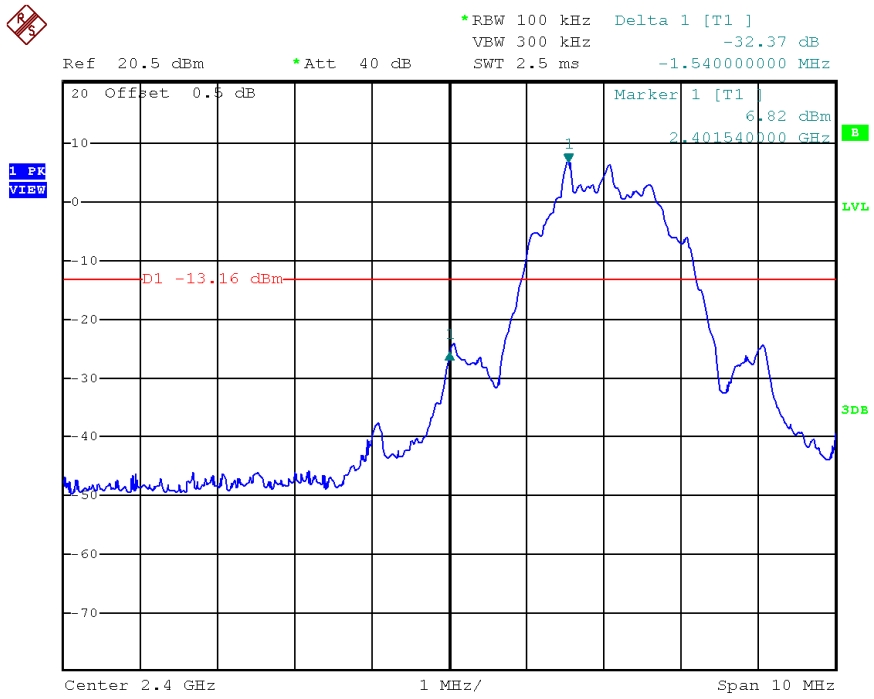
Bluetooth 4.0 (BLE 1M), Highest Channel, Plot B



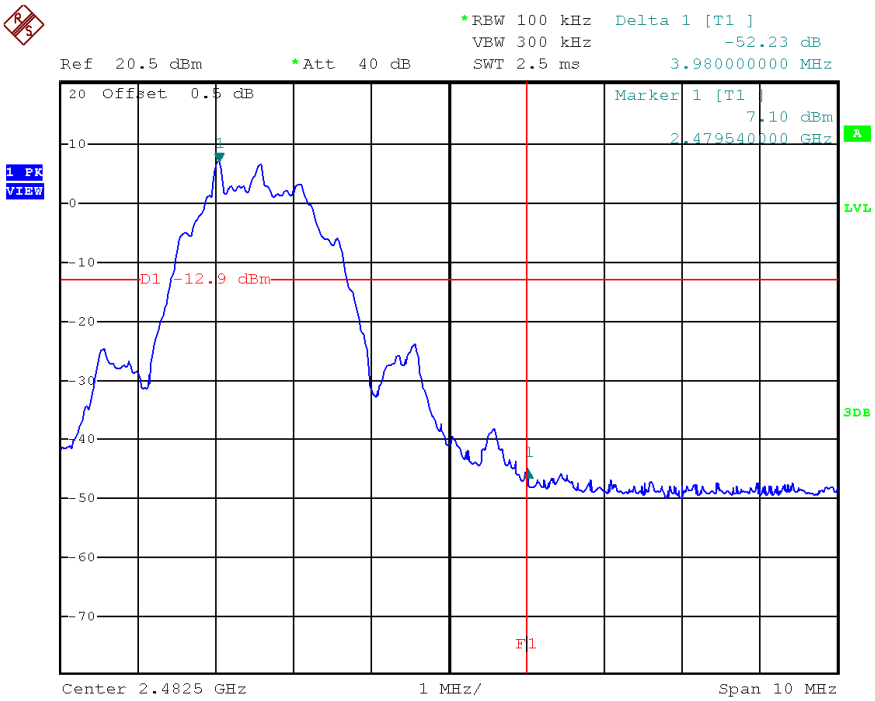
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Bluetooth 4.0 (BLE 2M), Lowest Channel, Bandedge



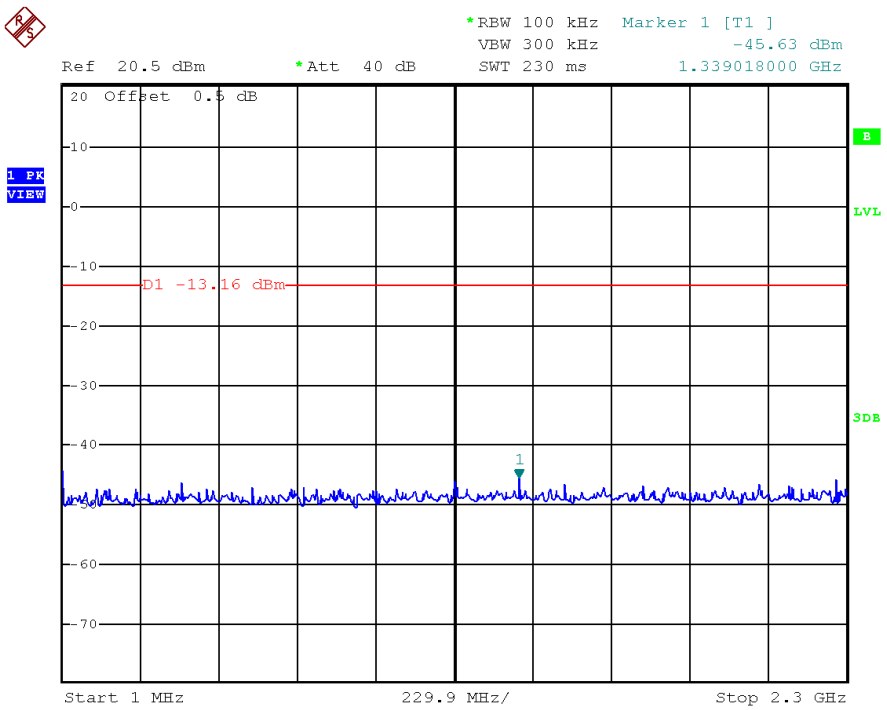
Bluetooth 4.0 (BLE 2M), Highest Channel, Bandedge



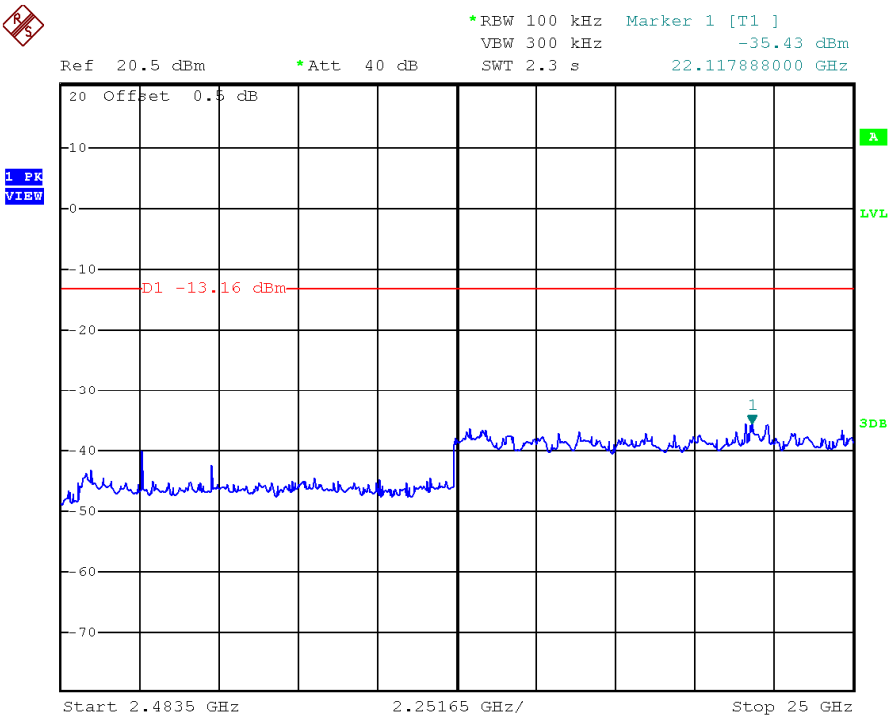
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Bluetooth 4.0 (BLE 2M), Lowest Channel, Plot A



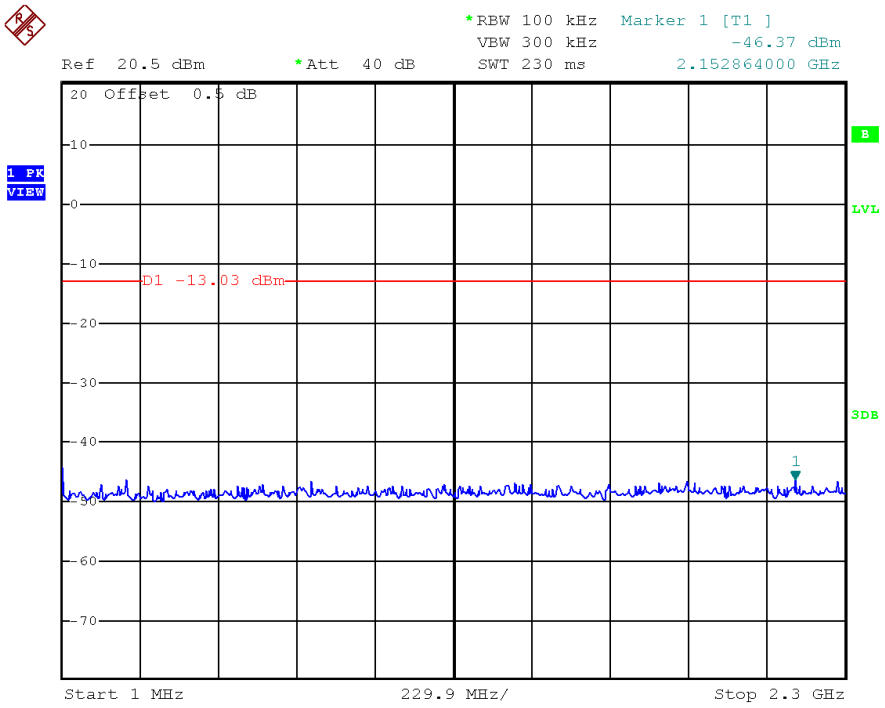
Bluetooth 4.0 (BLE 2M), Lowest Channel, Plot B



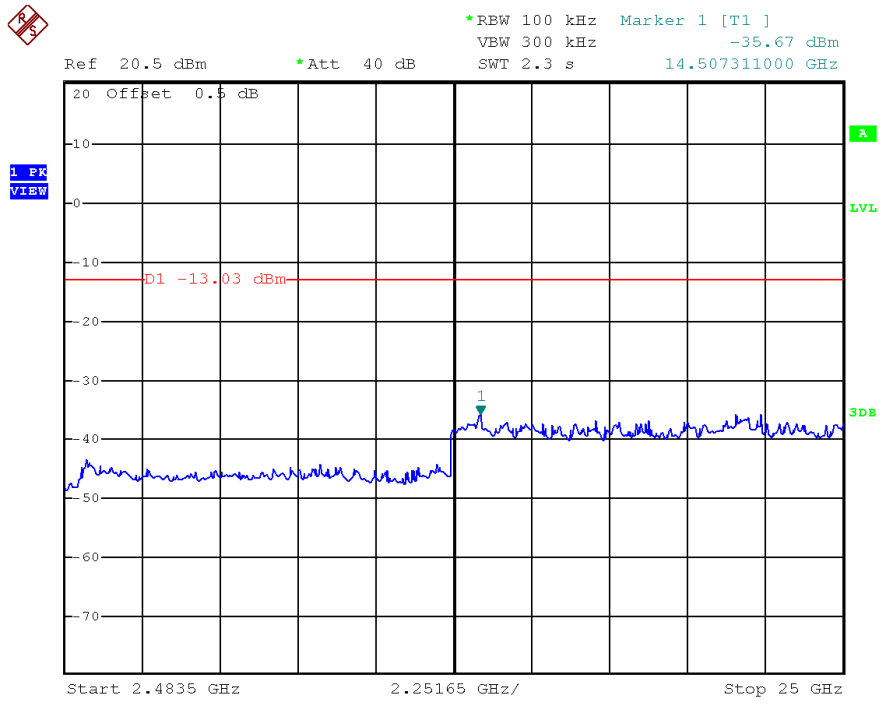
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Bluetooth 4.0 (BLE 2M), Middle Channel, Plot A



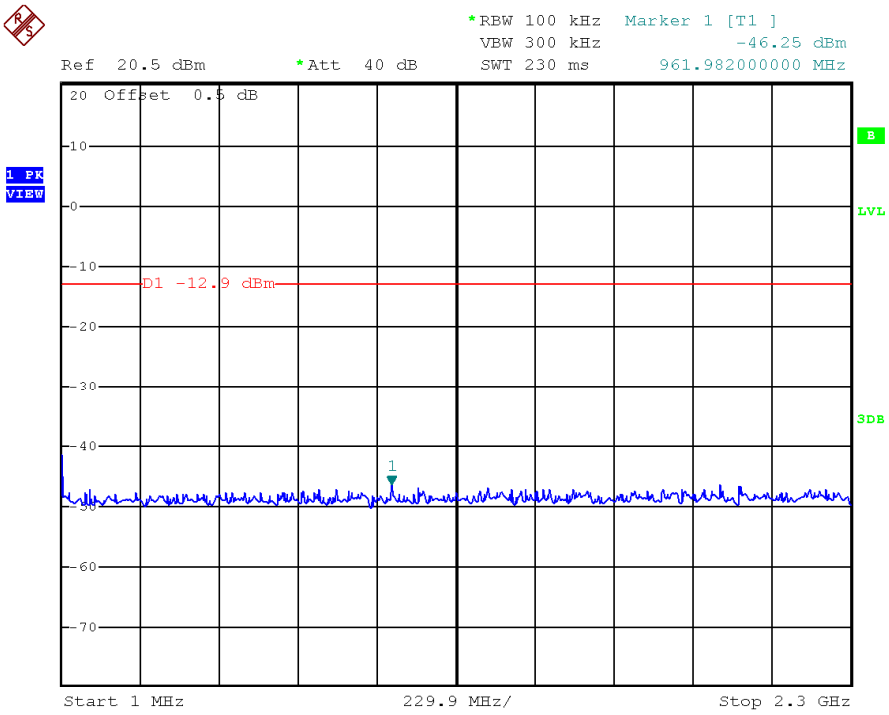
Bluetooth 4.0 (BLE 2M), Middle Channel, Plot B



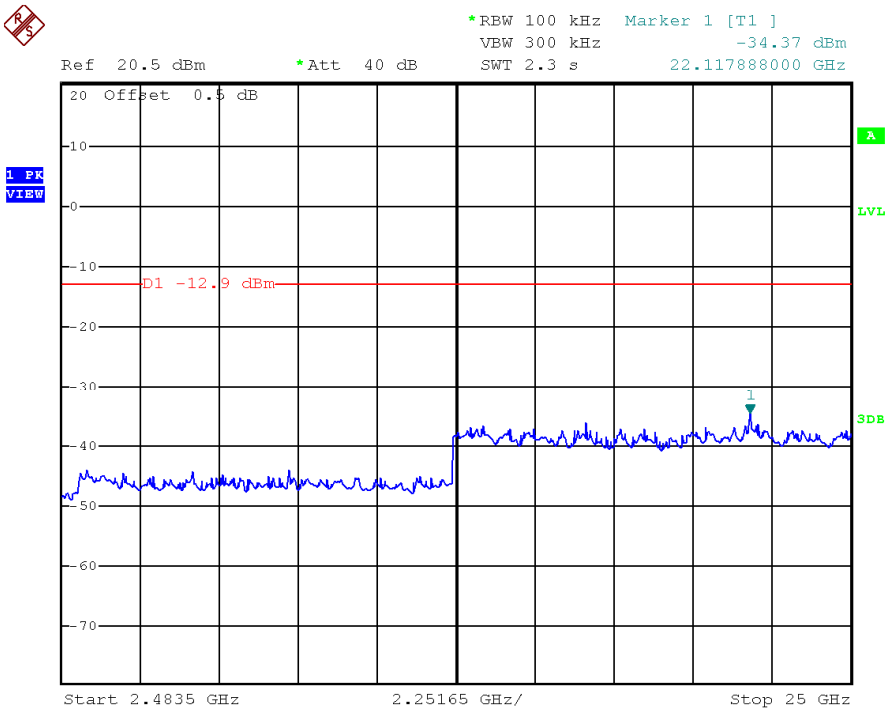
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Bluetooth 4.0 (BLE 2M), Highest Channel, Plot A



Bluetooth 4.0 (BLE 2M), Highest Channel, Plot B



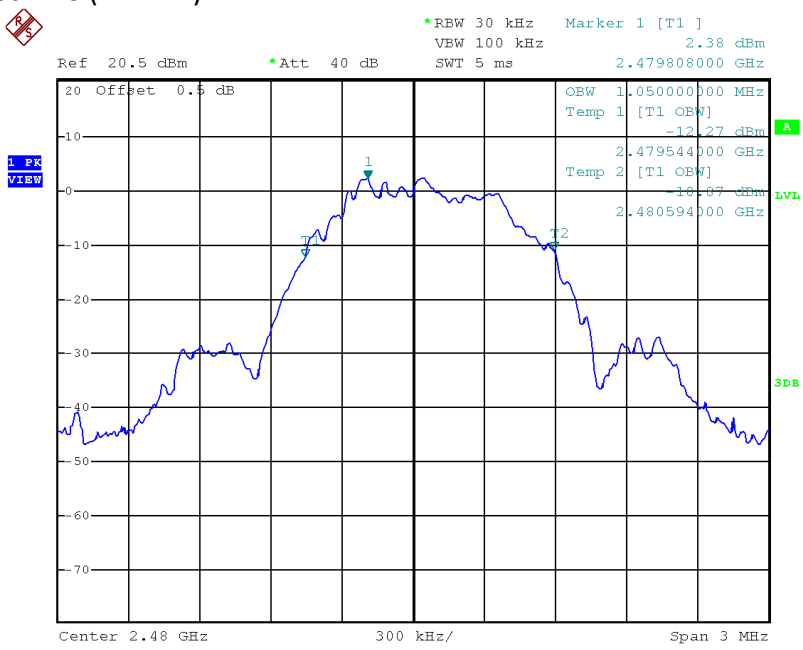
TEST REPORT

Occupied Bandwidth Results:

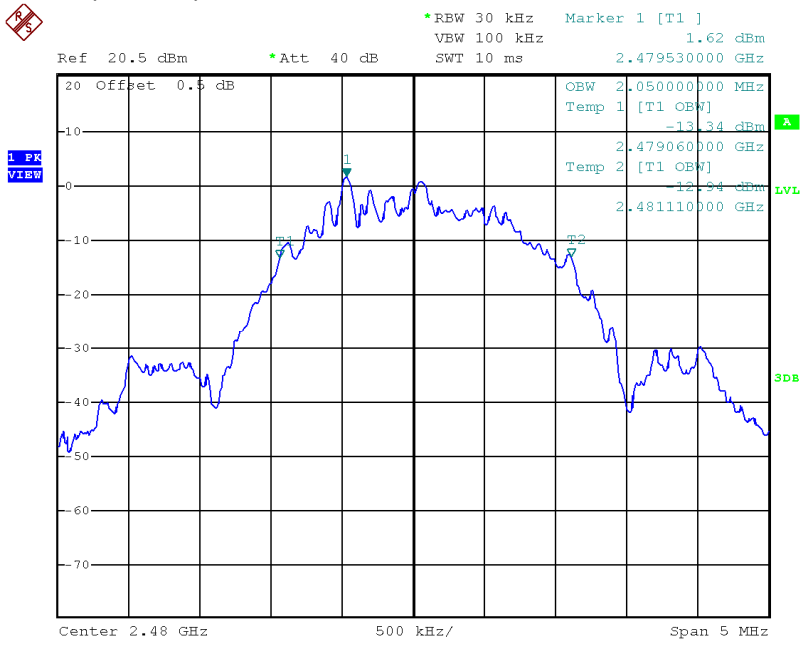
	Bluetooth 4.0 (BLE 1M Occupied Bandwidth (MHz)	Bluetooth 4.0 (BLE 2M Occupied Bandwidth (MHz)
Low Channel: 2402	1044	2050
Middle Channel: 2440	1044	2050
High Channel: 2480	1050	2050

The worst case is shown as below

Bluetooth 4.0 (BLE 1M)



Bluetooth 4.0 (BLE 2M)



TEST REPORT

4.5 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD + AV

Where FS = Field Strength in dBµV/m
RA = Receiver Amplitude (including preamplifier) in dBµV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB
AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD + AV

Example
Assume a receiver reading of 62.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29.0 dB is subtracted. The pulse desensitization factor of the spectrum analyzer is 0.0 dB, and the resultant average factor is -10.0 dB. The net field strength for comparison to the appropriate emission limit is 32.0 dBµV/m. This value in dBµV/m is converted to its corresponding level in µV/m.

RA = 62.0 dBµV
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0.0 dB
AV = -10 dB

FS = 62.0 + 7.4 + 1.6 – 29.0 + 0.0 + (-10.0) = 32.0 dBµV/m

Level in µV/m = Common Antilogarithm [(32.0 dBµV/m)/20] = 39.8 µV/m

TEST REPORT

4.6 Transmitter Radiated Emissions in Restricted Bands and Spurious Emissions

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

4.6.1 Radiated Emission Configuration Photograph

Worst Case Restricted Band Radiated Emission
at

168.002 MHz

The worst case radiated emission configuration photographs are saved with filename: config photos.pdf

4.6.2 Radiated Emission Data

The data in tables 1-7 list the significant emission frequencies, the limit and the margin of compliance.

Judgement -

Passed by 2.0 dB margin

TEST REPORT

RADIATED EMISSION DATA

Mode: TX-Channel 01

Table 1
Bluetooth 4.0 (BLE 1M)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (Average) (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	2390.000	48.2	33	29.4	44.6	54.0	-9.4
V	4804.000	43.9	33	34.9	45.8	54.0	-8.2
H	12010.000	25.0	33	40.5	32.5	54.0	-21.5

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	2390.000	73.8	33	29.4	70.2	74.0	-3.8
V	4804.000	53.9	33	34.9	55.8	74.0	-18.2
H	12010.000	38.9	33	40.5	46.4	74.0	-27.6

NOTES:
1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement.
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.

TEST REPORT

Mode: TX-Channel 06

Table 2
Bluetooth 4.0 (BLE 1M)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (Average) (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	4880.000	43.5	33	34.9	45.4	54.0	-8.6
V	7320.000	32.4	33	37.9	37.3	54.0	-16.7
H	12200.000	25.9	33	40.5	33.4	54.0	-20.6

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	4880.000	52.5	33	34.9	54.4	74.0	-19.6
V	7320.000	45.6	33	37.9	50.5	74.0	-23.5
H	12200.000	39.1	33	40.5	46.6	74.0	-27.4

NOTES:
1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.

TEST REPORT

Mode: TX-Channel 11

Table 3
Bluetooth 4.0 (BLE 1M)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (Average) (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	2483.500	44.9	33	29.4	41.3	54.0	-12.7
V	4960.000	42.5	33	34.9	44.4	54.0	-9.6
V	7440.000	27.9	33	37.9	32.8	54.0	-21.2
H	12400.000	26.7	33	40.5	34.2	54.0	-19.8

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	2483.500	69.2	33	29.4	65.6	74.0	-8.4
V	4960.000	50.9	33	34.9	52.8	74.0	-21.2
V	7440.000	40.6	33	37.9	45.5	74.0	-28.5
H	12400.000	41.0	33	40.5	48.5	74.0	-25.5

NOTES:
1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.

TEST REPORT

Mode: TX-Channel 01

Table 4
Bluetooth 4.0 (BLE 2M)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (Average) (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	2390.000	55.1	33	29.4	51.5	54.0	-2.5
V	4804.000	35.3	33	34.9	37.2	54.0	-16.8
H	12010.000	25.0	33	40.5	32.5	54.0	-21.5

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	2390.000	74.8	33	29.4	71.2	74.0	-2.8
V	4804.000	50.9	33	34.9	52.8	74.0	-21.2
H	12010.000	39.0	33	40.5	46.5	74.0	-27.5

NOTES:
1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.

TEST REPORT

Mode: TX-Channel 06

Table 5
Bluetooth 4.0 (BLE 2M)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (Average) (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	4880.000	35.7	33	34.9	37.6	54.0	-16.4
V	7320.000	27.5	33	37.9	32.4	54.0	-21.6
H	12200.000	25.7	33	40.5	33.2	54.0	-20.8

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	4880.000	52.7	33	34.9	54.6	74.0	-19.4
V	7320.000	42.9	33	37.9	47.8	74.0	-26.2
H	12200.000	39.1	33	40.5	46.6	74.0	-27.4

NOTES:
1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.

TEST REPORT

Mode: TX-Channel 11

Table 6
Bluetooth 4.0 (BLE 2M)

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (Average) (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
V	2483.500	47.7	33	29.4	44.1	54.0	-9.9
V	4960.000	29.7	33	34.9	31.6	54.0	-22.4
V	7440.000	29.8	33	37.9	34.7	54.0	-19.3
H	12400.000	29.6	33	40.5	37.1	54.0	-16.9

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
V	2483.500	72.7	33	29.4	69.1	74.0	-4.9
V	4960.000	43.8	33	34.9	45.7	74.0	-28.3
V	7440.000	42.5	33	37.9	47.4	74.0	-26.6
H	12400.000	43.1	33	40.5	50.6	74.0	-23.4

NOTES:
1. Peak detector is used for the emission measurement.
2. Average detector is used for the average data of emission measurement
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emission within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.

TEST REPORT

Mode: Bluetooth Operating

Table 7

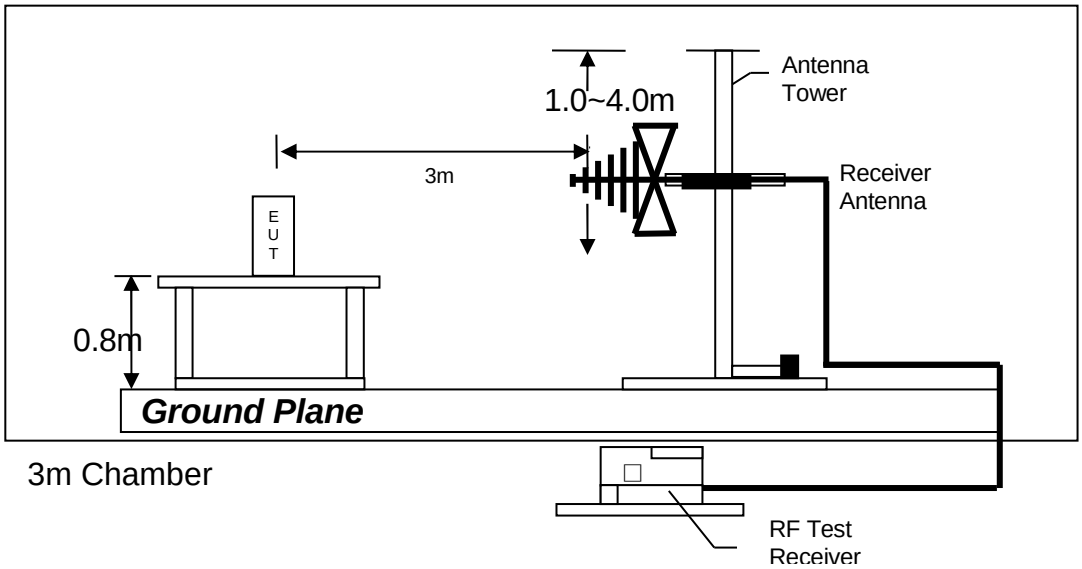
Polarization	Frequency (MHz)	Reading (dBµV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
V	35.846	37.2	16	10.0	31.2	40.0	-8.8
V	86.058	31.2	16	8.0	23.2	40.0	-16.8
H	168.002	39.5	16	18.0	41.5	43.5	-2.0
H	180.025	33.4	16	20.0	37.4	43.5	-6.1
V	390.868	27.4	16	25.0	36.4	46.0	-9.6
V	528.222	25.6	16	27.0	36.6	46.0	-9.4

NOTES:
1. Quasi-Peak detector is used for the emission measurement.
2. All measurements were made at 3 meters.
3. Negative value in the margin column shows emission below limit.
4. Emission within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.

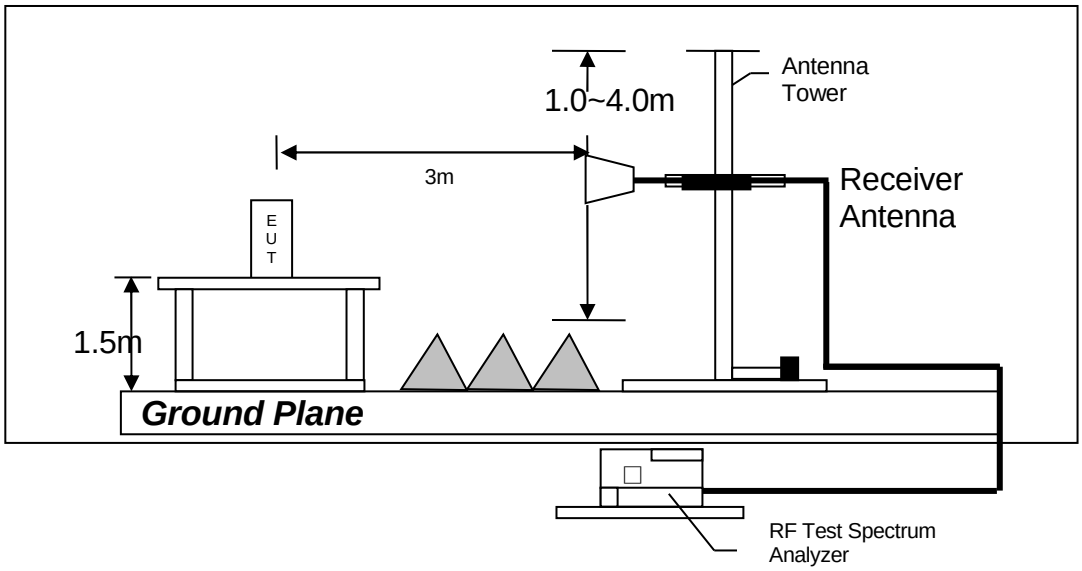
TEST REPORT

4.6.3 Radiated Emission Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



Test setup of radiated emissions up to 1GHz



Test setup of radiated emissions above 1GHz

TEST REPORT

4.6.4 Transmitter Duty Cycle Calculation

Not applicable – No average factor is required.

TEST REPORT

4.7 AC Power Line Conducted Emission

☐ Not applicable – EUT is only powered by battery for operation.

☒ EUT connects to AC power line. Emission Data is listed in following pages.

☐ Base Unit connects to AC power line and has transmission. Handset connects to AC power line but has no transmission. Emission Data of Base Unit is listed in following pages.

4.7.1 AC Power Line Conducted Emission Configuration Photograph

Worst Case Line-Conducted Configuration
at

0.263 MHz

The worst-case line conducted configuration photographs are attached in the Appendix and saved with filename: config photos.pdf

4.7.2 AC Power Line Conducted Emission Data

The plot(s) and data in the following pages list the significant emission frequencies, the limit and the margin of compliance.

Passed by 4.0 dB margin

TEST REPORT

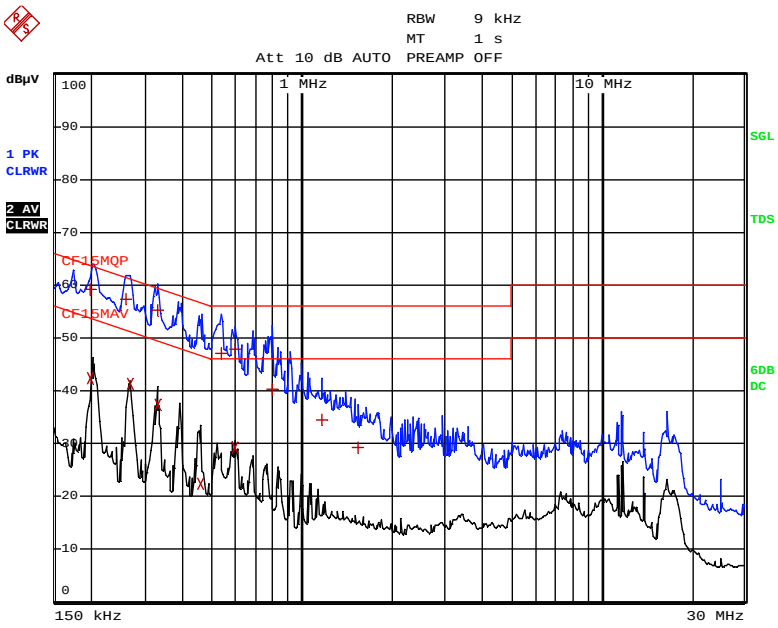
AC POWER LINE CONDUCTED EMISSION

Worst Case: Bluetooth Operating

EDIT PEAK LIST (Final Measurement Results)

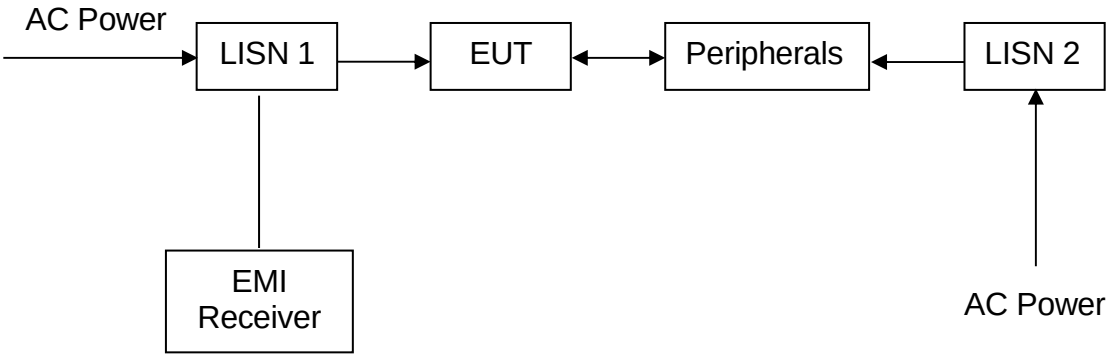
Trace1: CF15MQP
Trace2: CF15MAV
Trace3: ---

	TRACE	FREQUENCY	LEVEL dBµV		DELTA LIMIT dB
1	Quasi Peak	199.5 kHz	59.16	L1	-4.46
2	CISPR Average	199.5 kHz	42.33	L1	-11.30
1	Quasi Peak	262.5 kHz	57.36	N	-3.98
2	CISPR Average	267 kHz	41.37	N	-9.83
1	Quasi Peak	330 kHz	55.24	L1	-4.20
2	CISPR Average	330 kHz	37.34	L1	-12.10
2	CISPR Average	456 kHz	22.39	L1	-24.36
1	Quasi Peak	537 kHz	46.98	N	-9.01
1	Quasi Peak	595.5 kHz	47.90	L1	-8.09
2	CISPR Average	595.5 kHz	29.14	N	-16.85
1	Quasi Peak	793.5 kHz	40.33	L1	-15.66
1	Quasi Peak	1.1715 MHz	34.40	N	-21.59
1	Quasi Peak	1.545 MHz	29.13	N	-26.86



TEST REPORT

4.7.3 Conducted Emission Test Setup



TEST REPORT

5.0 EQUIPMENT LIST

1) Radiated Emissions Test

Equipment	EMI Test Receiver	Spectrum Analyzer	Biconical Antenna (20MHz to 200MHz)
Registration No.	EW-3481	EW-2466	EW-2512
Manufacturer	ROHDESCHWARZ	ROHDESCHWARZ	EMCO
Model No.	ESR7	FSP30	3104C
Calibration Date	December 21, 2021	November 18, 2019	June 03, 2020
Calibration Due Date	December 21, 2022	August 18, 2022	December 03, 2022

Equipment	Log Periodic Antenna	Double Ridged Guide Antenna	RF Cable 14m (1GHz to 26.5GHz)
Registration No.	EW-3243	EW-1133	EW-2781
Manufacturer	EMCO	EMCO	GREATBILLION
Model No.	3148B	3115	SMA m/SHF5MPU /SMA m ra14m,26G
Calibration Date	June 30, 2021	June 03, 2021	November 24, 2020
Calibration Due Date	December 30, 2022	November 26, 2022	November 24, 2022

Equipment	RF Preamplifier (9kHz to 6000MHz)	2.4GHz Notch Filter	14m Double Shield RF Cable (20MHz to 6GHz)
Registration No.	EW-3006b	EW-3435	EW-2074
Manufacturer	SCHWARZBECK	MICROWAVE	RADIALL
Model No.	BBV9718	N0324413	N(m)-RG142-BNC(m) L=14M
Calibration Date	November 25, 2019	November 16, 2019	November 14, 2019
Calibration Due Date	June 25, 2022	September 16, 2022	August 14, 2022

Equipment	Pyramidal Horn Antenna	Active Loop H-field (9kHz to 30MHz)
Registration No.	EW-0905	EW-3302
Manufacturer	EMCO	EMCO
Model No.	3160-09	6502
Calibration Date	July 23, 2019	December 13, 2021
Calibration Due Date	June 23, 2022	June 13, 2023

TEST REPORT

2) Conducted Emissions Test

Equipment	RF Cable 240cm (RG142) (9kHz to 30MHz)	Artificial Mains Network	EMI Test Receiver
Registration No.	EW-2454	EW-2501	EW-3481
Manufacturer	RADIALL	ROHDESCHWARZ	ROHDESCHWARZ
Model No.	Bnc m st / 142 / bnc mra 240cm	ENV-216	ESR7
Calibration Date	November 10, 2020	September 11, 2021	December 21, 2021
Calibration Due Date	August 10, 2022	September 11, 2022	December 21, 2022

3) Conductive Measurement Test

Equipment	5m RF Cable (40GHz)	Wideband power sensor 2 pcs 50MHz to 18GHz	Spectrum Analyzer
Registration No.	EW-2701	EW-3309	EW-2466
Manufacturer	RADIALL	ROHDESCHWARZ	ROHDESCHWARZ
Model No.	Sma m-m 5m 40G	NRP-Z81	FSP30
Calibration Date	November 24, 2020	December 01, 2021	November 18, 2019
Calibration Due Date	November 24, 2022	December 01, 2022	August 18, 2022

4) Bandedge & Bandwidth Measurement

Equipment	Spectrum Analyzer	5m RF Cable (40GHz)
Registration No.	EW-2466	EW-2701
Manufacturer	ROHDESCHWARZ	RADIALL
Model No.	FSP30	Sma m-m 5m 40G
Calibration Date	November 18, 2019	November 24, 2020
Calibration Due Date	August 18, 2022	November 24, 2022

5) Control Software for Radiated Emission

Software Information	
Software Name	EMC32
Manufacturer	ROHDESCHWARZ
Software version	10.50.40 & 10.40.10

END OF TEST REPORT