

TEST REPORT

Report Number: 18120746HKG-002

Application for Original Grant of 47 CFR Part 15 Certification

Single New of RSS-247 Issue 2 Equipment

FCC ID: AL8-E60XXX

IC: 457A-E60XXX

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TEST REPORT

GENERAL INFORMATION

Applicant Name:	Plantronics, Inc.
Applicant Address:	345 Encinal Street, Santa Cruz, CA 95060, United States of America.
FCC Specification Standard:	FCC Part 15, October 1, 2016 Edition
FCC ID:	AL8-E60XXX
FCC Model(s):	Elara 60 WS
IC Specification Standard:	RSS-247 Issue 2, February 2017 RSS-Gen Issue 4, November 2014
IC:	457A-E60XXX
PMN:	Elara 60 WS
HVIN:	Elara 60 WS
Firmware Version:	0.8.10
Type of EUT:	Unlicensed National Information Infrastructure Transmitter
Description of EUT:	Mobile Phone Station with Bluetooth
Serial Number:	N/A
Sample Receipt Date:	December 17, 2018
Date of Test:	December 17, 2018 to February 26, 2019
Report Date:	March 05, 2019
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%
Conclusion:	Test was conducted by client submitted sample. The submitted sample as received complied with the 47 CFR Part 15 / RSS-247 Issue 2 Certification.

TEST REPORT

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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#	N/A	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, 2016 Edition
RSS-247 Issue 2, February 2017
RSS-Gen Issue 5, April 2018

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2.0 GENERAL DESCRIPTION

2.1 Product Description

The Elara 60 WS is a Mobile Phone Station with Bluetooth. A wireless mobile phone dock consisting of a base unit and either wireless headset/wireless USB dongle or corded headset.

The Equipment Under Test (EUT) operates at frequency range of 2402MHz to 2480 MHz. There are totally 39 with 1MHz channel separation.

The EUT is powered by a 100-240VAC 50/60Hz AC adaptor.

The antenna used in the EUT is integral, and the test sample is a prototype.

The 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 v05r02 (02-April-2019) All other measurements were made in accordance with the procedures in 47 CFR Part 2 and RSS-Gen Issue 5 (2018).

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. This test facility and site measurement data have been fully placed on file with the FCC and Industry Canada No.: 2042V-1.

2.4 Related Submittal(s) Grants

This is a single application for certification of a transceiver (WiFi portion)

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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 100-240VAC 50/60Hz adaptor.

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.

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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.

Different data rates have been tested. Worst case is reported only.

All relevant operation modes 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.

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3.3 Details of EUT and Description of Accessories

Details of EUT:

An AC adaptor (provided with the unit) was used to power the device. Their description are listed below.

- (1) An AC adaptor (100-240VAC 50/60Hz 0.6A to 12VDC 1.5A, Model: SSC-120150) (Provided by Client)

Description of Accessories:

- (1) Pika Cradle model: 5200 #003 and docking. (Provided by Client)
- (2) Pika Cradle model: Focus #01 and docking. (Provided by Client)
- (3) Pika Cradle model: USB-A #01 (Provided by Client)
- (4) Bluetooth USB Model:BT600 (Provided by Client)
- (5) USB loading 5V 1A (Provided by Intertek)
- (6) Samsung S8 (provided by Intertek)

3.4 Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty of test at a level of confidence of 95% has been considered. The values of the Measurement uncertainty for radiated emission test and RF conducted measurement test are $\pm 5.3\text{dB}$ and $\pm 0.99\text{dB}$ respectively. The value of the Measurement uncertainty for conducted emission test is $\pm 4.2\text{dB}$.

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.

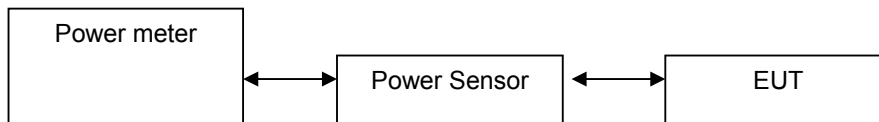
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4.0 TEST RESULTS

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 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.

BLE Antenna Gain = -2.0 dBi

Frequency (MHz)	Output in dBm	Output in mWatt
Low Channel: 2402	0.21	1.05
Middle Channel: 2440	0.19	1.04
High Channel: 2480	-0.40	0.91

Cable loss : 0.5 dB External Attenuation : 0 dB

Cable loss, external attenuation: ☒ included in OFFSET function
☐ added to SA raw reading

BLE

max. conducted (peak) output level = 0.0 dBm

Limits:

- ☒ 1W (30dBm) for antennas with gains of 6dBi or less
- ☐ ___ W (___ dBm) for antennas with gains more than 6dBi

The plots of conducted output power are saved as below.

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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.

BLE	
Frequency (MHz)	6dB Bandwidth (MHz)
Low Channel: 2402	0.792
Middle Channel: 2440	0.792
High Channel: 2480	0.792

Limits

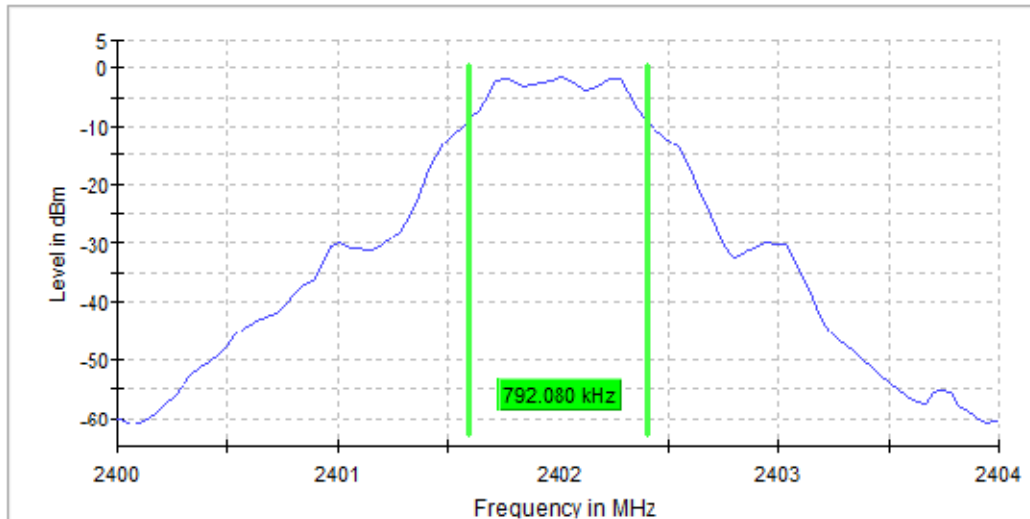
6 dB bandwidth shall be at least 500kHz

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

TEST REPORT

PLOTS OF 6dB RF BANDWIDTH

BLE, Lowest Channel

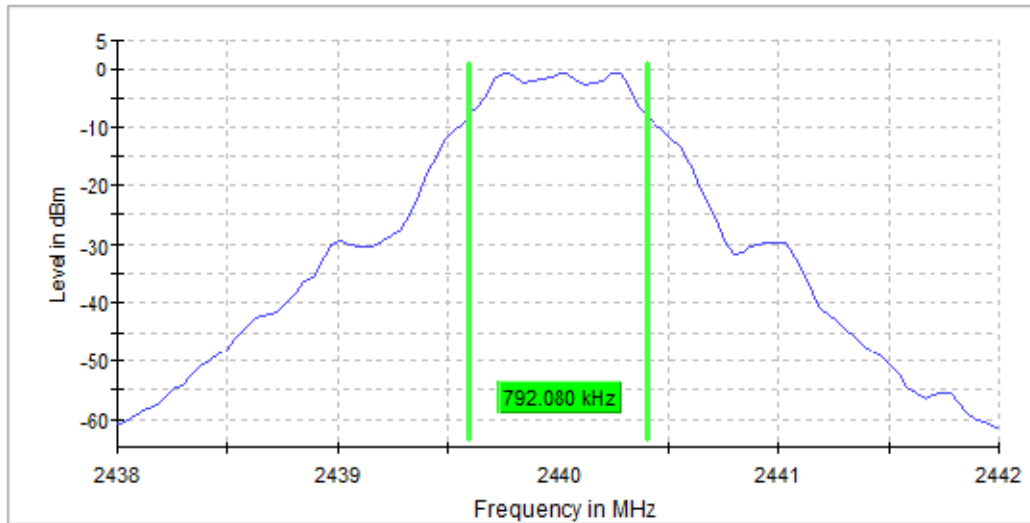


DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2402.000000	0.792080	0.500000	---	2401.603960	2402.396040

Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.40400 GHz	2.40400 GHz
Span	4.000 MHz	4.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
SweepTime	18.938 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	5 / max. 10	max. 10
Stable	2 / 2	2
Max Stable Difference	0.27 dB	0.50 dB

TEST REPORT

BLE, Middle Channel



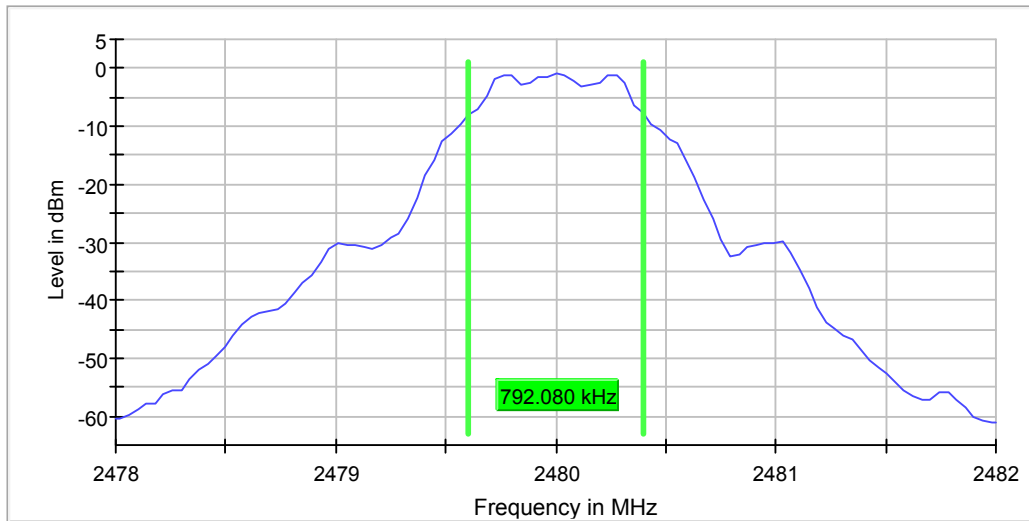
DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2440.000000	0.792080	0.500000	---	2439.603960	2440.396040

Setting	Instrument Value	Target Value
Start Frequency	2.43800 GHz	2.43800 GHz
Stop Frequency	2.44200 GHz	2.44200 GHz
Span	4.000 MHz	4.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
SweepTime	18.938 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	8 / max. 10	max. 10
Stable	2 / 2	2
Max Stable Difference	0.00 dB	0.50 dB

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PLOTS OF 6dB RF BANDWIDTH

BLE, Highest Channel



DUT Frequency (MHz)	Bandwidth (MHz)	Limit Min (MHz)	Limit Max (MHz)	Band Edge Left (MHz)	Band Edge Right (MHz)
2480.000000	0.792080	0.500000	---	2479.603960	2480.396040

Setting	Instrument Value	Target Value
Start Frequency	2.47800 GHz	2.47800 GHz
Stop Frequency	2.48200 GHz	2.48200 GHz
Span	4.000 MHz	4.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
SweepTime	18.938 μ s	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	5 / max. 10	max. 10
Stable	2 / 2	2
Max Stable Difference	0.10 dB	0.50 dB

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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.

BLE

Frequency (MHz)	PSD in 100kHz (dBm)
Low Channel:	-1.478
Middle Channel:	-0.744
High Channel:	-0.941

Cable Loss: 0.5 dB

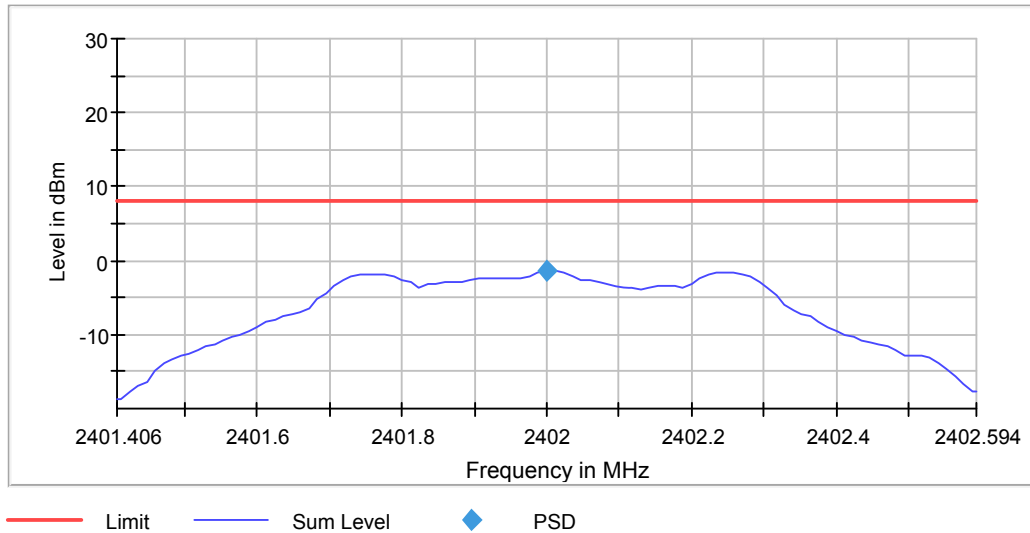
Limit:
8dBm

The plots of power spectral density are as below.

TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY

BLE, Lowest channel

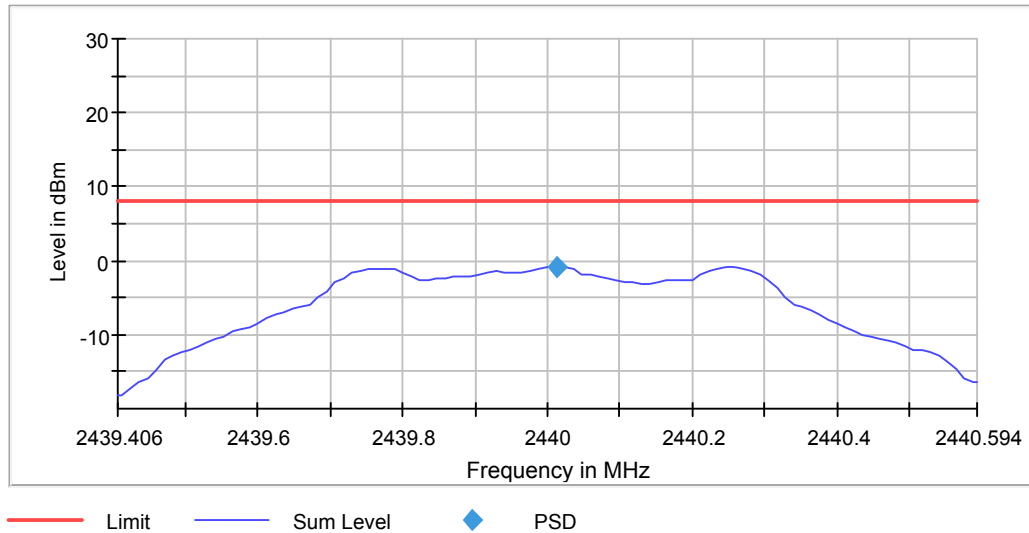


DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	2402.000000	-1.478	8.0	PASS

Setting	Instrument Value	Target Value
Start Frequency	2.40141 GHz	2.40141 GHz
Stop Frequency	2.40259 GHz	2.40259 GHz
Span	1.188 MHz	1.188 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	101	~ 24
SweepTime	505.000 ms	505.000 ms
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	1	1
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	3 / max. 10	max. 10
Stable	2 / 2	2
Max Stable Difference	0.06 dB	0.50 dB

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BLE, Middle channel



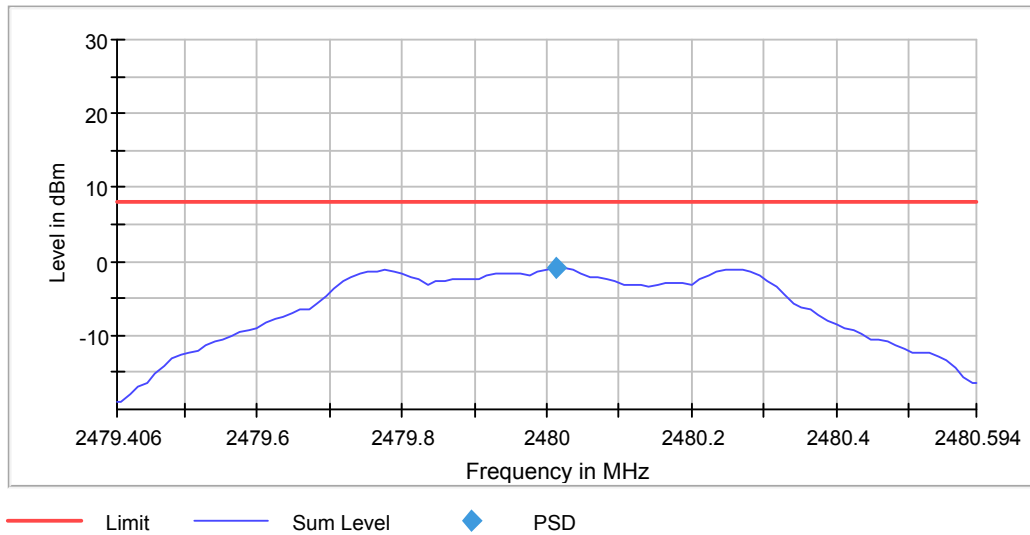
DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2440.000000	2440.011764	-0.744	8.0	PASS

Setting	Instrument Value	Target Value
Start Frequency	2.43941 GHz	2.43941 GHz
Stop Frequency	2.44059 GHz	2.44059 GHz
Span	1.188 MHz	1.188 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	101	~ 24
Sweptime	505.000 ms	505.000 ms
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	Peak	Peak
SweepCount	1	1
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	Sweep
Preamplifier	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	3 / max. 10	max. 10
Stable	2 / 2	2
Max Stable Difference	0.21 dB	0.50 dB

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PLOTS OF POWER SPECTRAL DENSITY

BLE, Highest channel



DUT Frequency (MHz)	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2480.000000	2480.011764	-0.941	8.0	PASS

Setting	Instrument Value	Target Value
Start Frequency	2.47941 GHz	2.47941 GHz
Stop Frequency	2.48059 GHz	2.48059 GHz
Span	1.188 MHz	1.188 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	101	~ 24
SweepTime	505.000 ms	505.000 ms
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	Peak	Peak
SweepCount	1	1
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	3 / max. 10	max. 10
Stable	2 / 2	2
Max Stable Difference	0.17 dB	0.50 dB

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4.4 Out of Band Conducted Emissions

For BLE, 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 BLE/g/n20/n40MHz.

The measurement procedures under sections 11 of No.558074 D01 v05r02 (02-April-2019) were used.

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

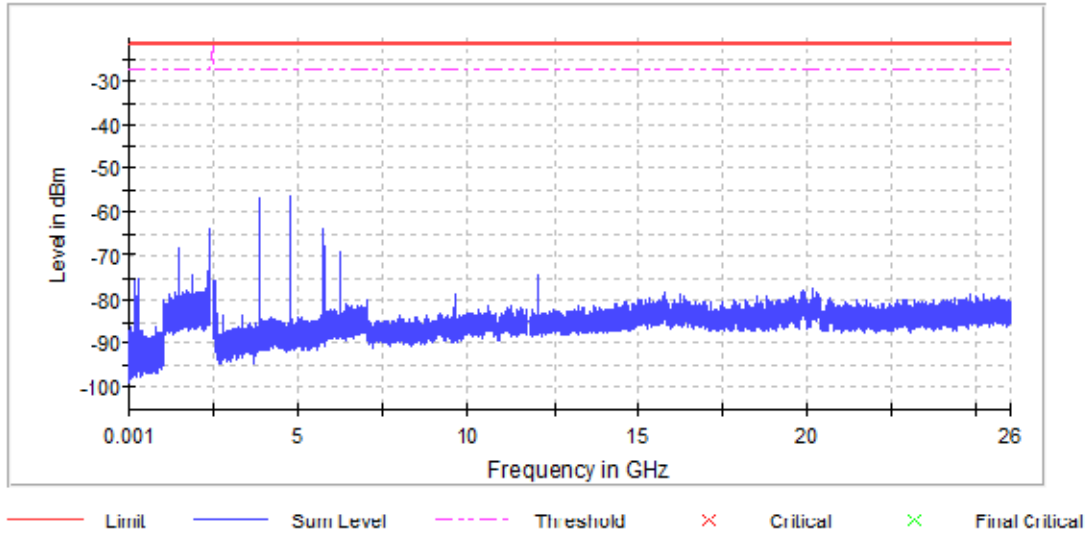
Limits:

All spurious emission and up to the tenth harmonic was measured and they were found to be at least for BLE below the maximum measured in-band peak PSD level.

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PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

BLE, Lowest Channel, Plot A



DUT Frequency (MHz)	Result
2402.000000	PASS

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
4803.567662	-56.6	35.1	-21.5
3843.276859	-56.7	35.2	-21.5
4804.555615	-58.0	36.6	-21.5
4803.849934	-58.3	36.8	-21.5
3843.700267	-58.4	36.9	-21.5
3843.135722	-58.9	37.4	-21.5
3843.559131	-59.6	38.1	-21.5
4804.414479	-61.3	39.8	-21.5
4803.426526	-62.1	40.6	-21.5
4803.991071	-62.9	41.4	-21.5
4804.132207	-63.0	41.5	-21.5
4804.273343	-63.1	41.6	-21.5
4803.708798	-63.4	42.0	-21.5
5743.534850	-63.8	42.3	-21.5
2399.925000	-63.8	42.3	-21.5

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
1.000000	1000.000000	1	1
1000.000000	2400.000000	2	2
2483.500000	7000.000000	2	2
7000.000000	18000.000000	2	2
18000.000000	26000.000000	2	2

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Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	19980	~ 19980
SweepTime	20.000 ms	AUTO
Reference Level	-30.000 dBm	-30.000 dBm
Attenuation	0.000 dB	AUTO
Detector	Peak	Peak
SweepCount	30	30
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	1 / max. 1	max. 1
Stable	0 / 1	1
Max Stable Difference	0.00 dB	0.50 dB

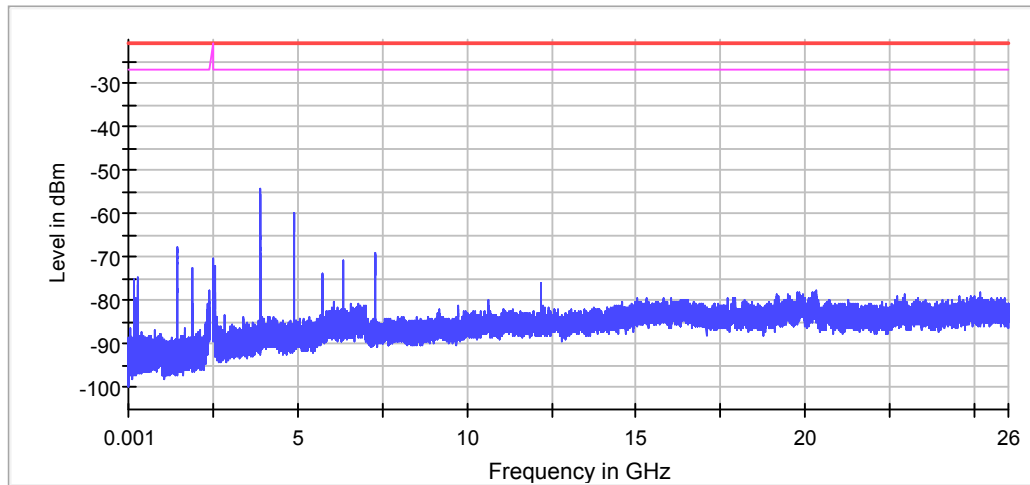
Pre Measurement 2

Setting	Instrument Value	Target Value
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	28000	~ 28000
SweepTime	28.000 ms	AUTO
Reference Level	-20.000 dBm	-30.000 dBm
Attenuation	10.000 dB	AUTO
Detector	Peak	Peak
SweepCount	30	30
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	1 / max. 1	max. 1
Stable	0 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

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PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

BLE, Middle Channel, Plot A



— Limit — Sum Level — Threshold × Critical × Final Critical

DUT Frequency (MHz)	Result
2440.000000	PASS

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
3904.106567	-54.2	33.5	-20.7
3904.529976	-55.5	34.8	-20.7
3903.965431	-55.5	34.8	-20.7
3904.671112	-56.1	35.4	-20.7
3904.247703	-59.0	38.2	-20.7
4879.922354	-59.9	39.1	-20.7
4880.486899	-60.1	39.3	-20.7
4879.781218	-60.2	39.4	-20.7
4880.628035	-61.2	40.5	-20.7
4880.063490	-61.2	40.5	-20.7
4879.640082	-61.6	40.9	-20.7
4879.498945	-62.0	41.2	-20.7
3903.824295	-62.3	41.5	-20.7
3903.683158	-63.6	42.8	-20.7
4880.204626	-63.8	43.1	-20.7

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
1.000000	1000.000000	1	1
1000.000000	2400.000000	2	2
2483.500000	7000.000000	2	2
7000.000000	18000.000000	2	2
18000.000000	26000.000000	2	2

TEST REPORT

Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	19980	~ 19980
SweepTime	20.000 ms	AUTO
Reference Level	-30.000 dBm	-30.000 dBm
Attenuation	0.000 dB	AUTO
Detector	Peak	Peak
SweepCount	30	30
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	1 / max. 1	max. 1
Stable	0 / 1	1
Max Stable Difference	0.00 dB	0.50 dB

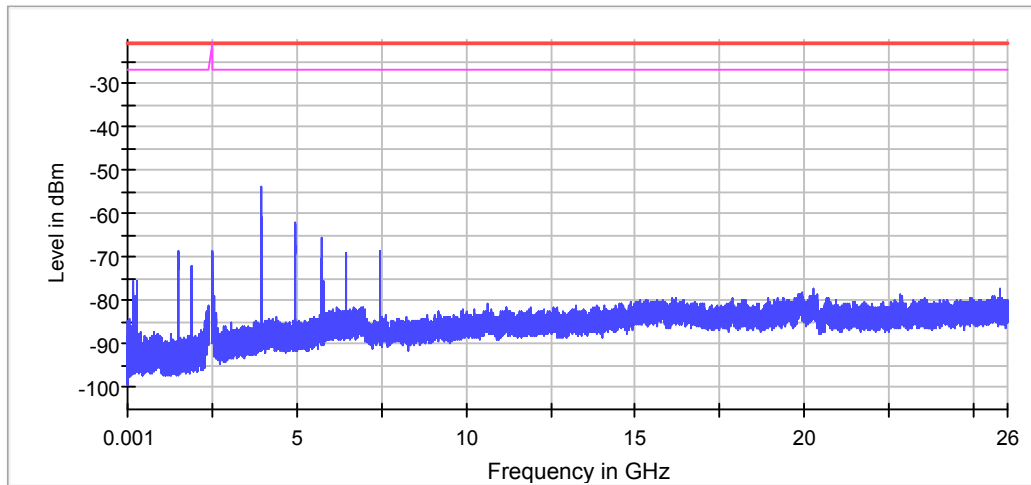
Pre Measurement 2

Setting	Instrument Value	Target Value
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	28000	~ 28000
SweepTime	28.000 ms	AUTO
Reference Level	-30.000 dBm	-30.000 dBm
Attenuation	0.000 dB	AUTO
Detector	Peak	Peak
SweepCount	30	30
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	1 / max. 1	max. 1
Stable	0 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

BLE, Highest Channel, Plot A



— Limit — Sum Level — Threshold × Critical × Final Critical

DUT Frequency (MHz)	Result
2480.000000	PASS

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)
3968.041272	-53.8	32.8	-20.9
3968.182408	-58.7	37.7	-20.9
3956.891511	-60.7	39.7	-20.9
3955.056740	-60.9	40.0	-20.9
3955.197877	-61.0	40.1	-20.9
3956.750375	-61.3	40.4	-20.9
4959.523179	-62.0	41.1	-20.9
4960.511132	-62.3	41.4	-20.9
3957.032647	-63.7	42.7	-20.9
3967.900136	-64.0	43.1	-20.9
3955.339013	-64.7	43.7	-20.9
3967.335591	-65.1	44.1	-20.9
4960.652269	-65.1	44.2	-20.9
3967.476727	-65.5	44.6	-20.9
5747.486664	-65.6	44.7	-20.9

Measurement Settings

Start Frequency (MHz)	Stop Frequency (MHz)	Pre Measurement	Final Measurement
1.000000	1000.000000	1	1
1000.000000	2400.000000	2	2
2483.500000	7000.000000	2	2
7000.000000	18000.000000	2	2
18000.000000	26000.000000	2	2

TEST REPORT

Pre Measurement 1

Setting	Instrument Value	Target Value
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	19980	~ 19980
SweepTime	20.000 ms	AUTO
Reference Level	-30.000 dBm	-30.000 dBm
Attenuation	0.000 dB	AUTO
Detector	Peak	Peak
SweepCount	30	30
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	1 / max. 1	max. 1
Stable	0 / 1	1
Max Stable Difference	0.00 dB	0.50 dB

Pre Measurement 2

Setting	Instrument Value	Target Value
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	28000	~ 28000
SweepTime	28.000 ms	AUTO
Reference Level	-30.000 dBm	-30.000 dBm
Attenuation	0.000 dB	AUTO
Detector	Peak	Peak
SweepCount	30	30
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
SweepType	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	1 / max. 1	max. 1
Stable	0 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

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 dB μ V/m

RA = Receiver Amplitude (including preamplifier) in dB μ V

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 dB μ V 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 dB μ V/m. This value in dB μ V/m is converted to its corresponding level in μ V/m.

$$RA = 62.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$PD = 0.0 \text{ dB}$$

$$AV = -10 \text{ dB}$$

$$FS = 62.0 + 7.4 + 1.6 - 29.0 + 0.0 + (-10.0) = 32.0 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(32.0 \text{ dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m}$$

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

0.361 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 1-4 list the significant emission frequencies, the limit and the margin of compliance.

Judgement -

Passed by 3.2 dB margin

TEST REPORT

RADIATED EMISSION DATA

Mode: TX-2402MHz

Table 1
BLE

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
H	2400.000	53.3	33	29.4	49.7	0	49.7	54.0	-4.3
V	4804.000	29.5	33	34.9	31.4	0	31.4	54.0	-22.6
H	7206.000	29.1	33	37.9	34.0	0	34.0	54.0	-20.0
V	9608.000	29.7	33	40.4	37.1	0	37.1	54.0	-16.9
H	12010.000	32.9	33	40.5	40.4	0	40.4	54.0	-13.6
V	14412.000	36.5	33	40.0	43.5	0	43.5	54.0	-10.5

Polarization	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)
H	2400.000	71.3	33	29.4	67.7	74.0	-6.3
V	4804.000	40.8	33	34.9	42.7	74.0	-31.3
H	7206.000	41.9	33	37.9	46.8	74.0	-27.2
V	9608.000	43.1	33	40.4	50.5	74.0	-23.5
H	12010.000	44.9	33	40.5	52.4	74.0	-21.6
V	14412.000	46.8	33	40.0	53.8	74.0	-20.2

- 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. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
 4. Negative value in the margin column shows emission below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by **bold italic**) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.

TEST REPORT

Mode: TX-2440MHz

Table 2
BLE

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
V	4880.000	29.0	33	34.9	30.9	0	30.9	54.0	-23.1
V	7320.000	28.8	33	37.9	33.7	0	33.7	54.0	-20.3
V	9760.000	29.5	33	40.4	36.9	0	36.9	54.0	-17.1
H	12200.000	33.0	33	40.5	40.5	0	40.5	54.0	-13.5
V	14640.000	37.6	33	38.4	43.0	0	43.0	54.0	-11.0

Polarization	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	40.2	33	34.9	42.1	74.0	-31.9
V	7320.000	40.9	33	37.9	45.8	74.0	-28.2
V	9760.000	42.4	33	40.4	49.8	74.0	-24.2
H	12200.000	45.0	33	40.5	52.5	74.0	-21.5
V	14640.000	48.0	33	38.4	53.4	74.0	-20.6

- 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. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
 4. Negative value in the margin column shows emission below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.

TEST REPORT

Mode: TX-2480MHz

Table 3
BLE

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Average Factor (dB)	Calculated at 3m (dBμV/m)	Average Limit at 3m (dBμV/m)	Margin (dB)
V	2483.500	51.8	33	29.4	48.2	0	48.2	54.0	-5.8
V	4960.000	29.2	33	34.9	31.1	0	31.1	54.0	-22.9
V	7440.000	28.9	33	37.9	33.8	0	33.8	54.0	-20.2
H	9920.000	29.9	33	40.4	37.3	0	37.3	54.0	-16.7
V	12400.000	33.1	33	40.5	40.6	0	40.6	54.0	-13.4
V	14880.000	37.3	33	38.4	42.7	0	42.7	54.0	-11.3

Polarization	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	64.9	33	29.4	61.3	74.0	-12.7
V	4960.000	40.4	33	34.9	42.3	74.0	-31.7
V	7440.000	41.5	33	37.9	46.4	74.0	-27.6
H	9920.000	43.3	33	40.4	50.7	74.0	-23.3
V	12400.000	45.3	33	40.5	52.8	74.0	-21.2
V	14880.000	47.7	33	38.4	53.1	74.0	-20.9

- 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. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.
 4. Negative value in the margin column shows emission below limit.
 5. Horn antenna is used for the emission over 1000MHz.
 6. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.

TEST REPORT

Worst-Case Operating Mode: On Mode

Table 4
Pursuant to FCC Part 15 Section 15.109 / RSS-210 4.4 Requirement

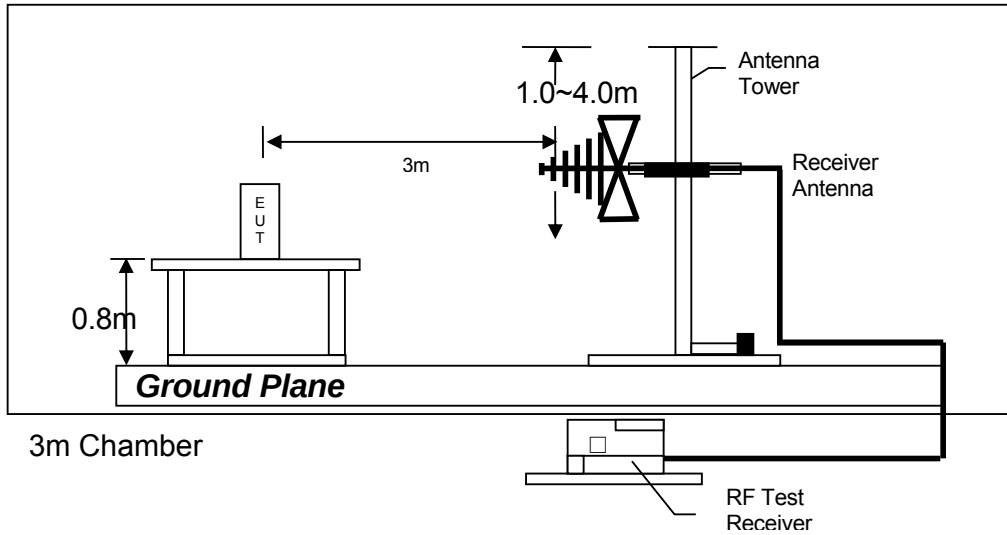
Polarization	Frequency (MHz)	Reading (dBμV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
V	47.328	26.1	16	11.0	21.1	40.0	-18.9
V	112.759	26.6	16	14.0	24.6	43.5	-18.9
V	120.254	38.3	16	14.0	36.3	43.5	-7.2
H	180.306	30.5	16	20.0	34.5	43.5	-9.0
H	240.534	35.5	16	19.0	38.5	46.0	-7.6
H	360.726	34.8	16	24.0	42.8	46.0	-3.2
H	371.220	31.3	16	24.0	39.3	46.0	-6.7
H	438.723	27.5	16	26.0	37.5	46.0	-8.5
V	941.447	22.3	16	33.0	39.3	46.0	-6.7

- NOTES:
1. Peak Detector Data unless otherwise stated.
 2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other harmonic emissions than those reported were detected at a test distance of 0.3-meter.
 3. Negative sign in the column shows value below limit.
 4. Horn antenna is used for the emission over 1000MHz.
 5. Emission (the row indicated by ***bold italic***) within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-210 4.1.
 6. Measurement Uncertainty is ± 5.3 dB at a level of confidence of 95%.

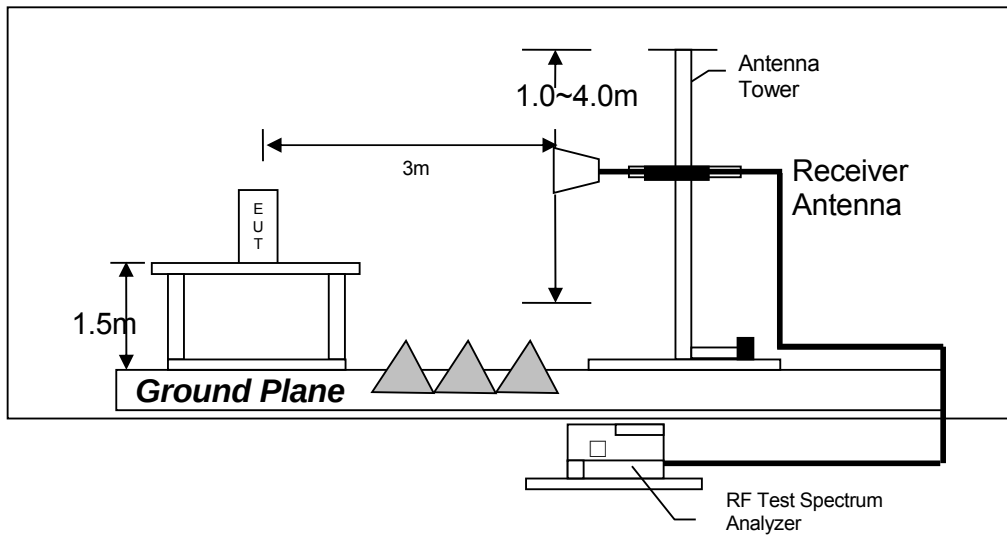
TEST REPORT

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
199.5 kHz

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

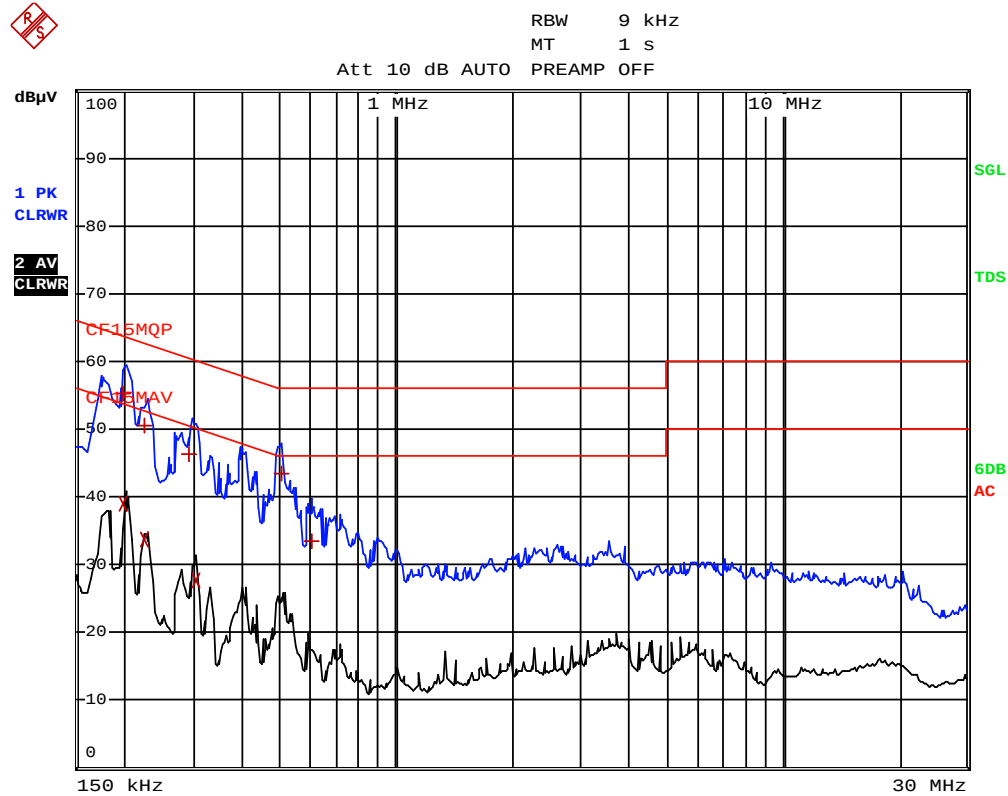
The plot(s) and data in the following pages list the significant emission frequencies, the limit and the margin of compliance.

Passed by 8.31 dB margin compare with Quasi-peak limit

TEST REPORT

AC POWER LINE CONDUCTED EMISSION

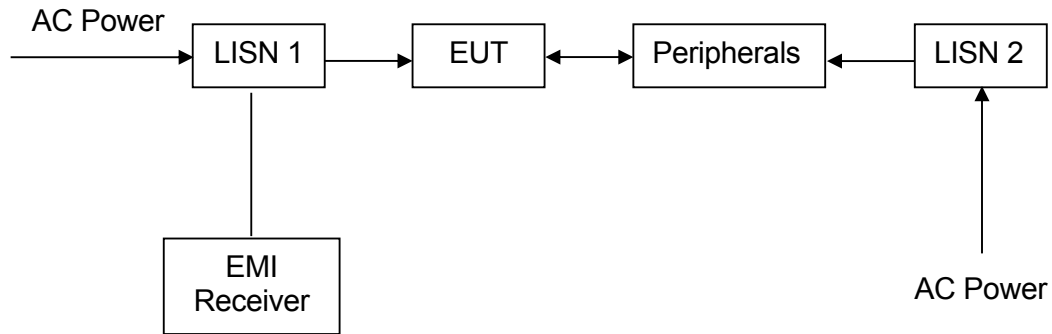
Worst Case: Bluetooth on mode with full load



EDIT PEAK LIST (Final Measurement Results)				
Trace1:	CF15MQP			
Trace2:	CF15MAV			
Trace3:	---			
TRACE	FREQUENCY	LEVEL	dBμV	DELTA LIMIT dB
1 Quasi Peak	199.5 kHz	55.31	N	-8.31
2 CISPR Average	199.5 kHz	38.93	N	-14.69
1 Quasi Peak	226.5 kHz	50.42	N	-12.15
2 CISPR Average	226.5 kHz	33.73	N	-18.84
1 Quasi Peak	294 kHz	46.43	N	-13.97
2 CISPR Average	303 kHz	27.77	N	-22.38
1 Quasi Peak	505.5 kHz	43.42	N	-12.57
1 Quasi Peak	600 kHz	33.37	N	-22.62

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
Registration No.	EW-2500	EW-2253	EW-0571
Manufacturer	R&S	R&S	EMCO
Model No.	ESCI	FSP40	3104C
Calibration Date	November 28, 2018	November 27, 2018	February 27, 2018
Calibration Due Date	November 28, 2019	November 27, 2019	August 27, 2019

Equipment	Log Periodic Antenna	Double Ridged Guide Antenna
Registration No.	EW-0447	EW-1133
Manufacturer	EMCO	EMCO
Model No.	3146	3115
Calibration Date	January 17, 2018	November 29, 2018
Calibration Due Date	July 17, 2019	May 29, 2020

2) Conducted Emissions Test

Equipment	EMI Test Receiver	Artificial Mains Network
Registration No.	EW-2500	EW-2874
Manufacturer	R&S	R&S
Model No.	ESCI	ENV-216
Calibration Date	November 28, 2018	March 29, 2018
Calibration Due Date	November 28, 2019	March 29, 2019

3) Conductive Measurement Test

Equipment	Spectrum Analyzer
Registration No.	EW-2253
Manufacturer	R&S
Model No.	FSP40
Calibration Date	November 27, 2018
Calibration Due Date	November 27, 2019

END OF TEST REPORT