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TEST REPORT

Report No.: 23010074HKG-001

TWELVE SOUTH, LLC

Application For Original Grant of 47 CFR Part 15 Certification

Single New of RSS-247 Issue 2 Certification

Bluetooth Transmitter

FCC ID: 2AREB-AIRFLYDUO2

IC: 24385-AIRFLYDUO2

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: March 22, 2023

TEST REPORT

GENERAL INFORMATION

Grantee:	TWELVE SOUTH, LLC
Grantee Address:	1503 KING ST STE201, Charleston, South Carolina, 29405, United States.
Manufacturer Name:	TWELVE SOUTH, LLC
Manufacturer Address:	1503 KING ST STE201, Charleston, South Carolina, 29405, United States.
FCC Specification Standard:	FCC Part 15, October 1, 2021 Edition
FCC ID:	2AREB-AIRFLYDUO2
FCC Model(s):	AirFly Duo
IC Specification Standard:	RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 Amendment 2, February 2021
IC:	24385-AIRFLYDUO2
HVIN:	AirFly-Duo
PMN:	AirFly Duo
Type of EUT:	Spread Spectrum Transmitter
Description of EUT:	Bluetooth Transmitter
Brand Name:	twelve south
Serial Number:	N/A
Sample Receipt Date:	January 04, 2023
Date of Test:	January 04, 2023 to March 01, 2023
Report Date:	March 22, 2023
Environmental Conditions:	Temperature: +10 to 40°C Relative 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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SUMMARY OF TEST RESULT

Test Items	FCC Part 15 Section	RSS-247/ RSS-Gen# Section	Results
Antenna Requirement	15.203	8.3#	Complied
Max. Conducted Output Power	15.247(b)(1) & (4)	5.4(2)	Complied
Max. 20dB RF Bandwidth	N/A	5.1(1)	Complied
Min. No. of Hopping Frequencies	15.247(a)(1)(iii)	5.1(4)	Complied
Min. Hopping Channel Carrier Frequency Separation	15.247(a)(1)	5.1(2)	Complied
Average Time of Occupancy Time	15.247(a)(1)(iii)	5.1(4)	Complied
Out of Band Antenna Conducted Emission	15.247(d)	5.5	Complied
Radiated Emission in Restricted Bands and Spurious Emissions	15.247(d)	8.10#	Complied
AC Power Line Conducted Emission	15.207 & 15.107	8.8#	Complied

For Canada, all technical data can be referred to Annex B – Report cover sheet.
For electronic filing, the Annex B – Report cover sheet is saved with filename: Annex B.pdf.

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

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

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.

TEST REPORT

EXHIBIT 1 GENERAL DESCRIPTION

1.1 Product Description

The AirFly Duo (AirFly-Duo) is a Bluetooth Transmitter.

The EUT is powered by DC 3.7V rechargeable lithium battery and/or TYPE-C USB port (DC 5V).

The antenna(s) used in the EUT: internal, integral, ceramic antenna.
Peak antenna gain = 3.32 dBi

The circuit description and frequency hopping algorithm are attached in the Appendix and saved with filename: descri.pdf.

1.2 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 (April 02, 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.

1.3 Test Facility

The radiated emission test site, AC power line conducted measurement facility and antenna port conducted measurement facility used to collect the radiated data, AC Power Line conducted data, and conductive data are located 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 placed on file with the FCC and IC No. 2042H, CABID is “HKAP01”.

TEST REPORT

EXHIBIT 2 SYSTEM TEST CONFIGURATION

2.1 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 USB Port of notebook computer during test.

For the measurements, the EUT was attached to a plastic stand if necessary and placed on the wooden turntable at 0.8m height from the ground plane for emission testing at or below 1GHz and 1.5m for emission measurements above 1GHz.

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.

For transmitter radiated measurement, the spectrum analyzer resolution bandwidth was 100 kHz for frequencies below 1000 MHz. The resolution bandwidth was 1 MHz for frequencies above 1000 MHz.

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. Receiver was performed from 30MHz to the fifth harmonic of the highest frequency or 40GHz, 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

2.1 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 4.3.4.

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 4.3.4. With the resolution bandwidth 1MHz and spectrum analyzer IF bandwidth 3dB, the pulse desensitization factor was 0dB.

For AC power 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 have been tested, and the worst-case data is included in this report.

2.2 EUT Exercising Software

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

TEST REPORT

2.3 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:

(1) HP Notebook Computer (Adaptor Model: HSTNN-CA15) (Provided by Intertek)
(2) 1 X LAN cable with length of 2.0 meter long with termination (Provided by Intertek)
(3) 1 x USB cable with length of 0.4 meter long (Provided by Applicant)

There are no accessories for compliance of this product.

2.4 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, AC line conducted emission test and RF conducted test, frequency stability and timing jitter are ± 5.3dB, ± 4.2dB, ±1dB, ±23Hz, 0.1µs respectively.

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.

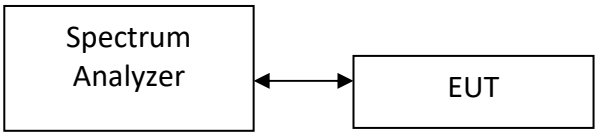
TEST REPORT

EXHIBIT 3 TEST RESULTS

3.1 Maximum Conducted Output Power at Antenna Terminals

RF Conducted measurement Test Setup by a Spectrum Analyzer.

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



☐ 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 antenna port of the EUT was connected to the input of a spectrum analyzer. The analyzer was set for RBW>20dB bandwidth and power was read directly in dBm. External attenuation and cable loss were compensated for using the OFFSET function of the analyzer.

Peak Antenna Gain = 3.32 dBi

Frequency (MHz)		Output in dBm	Output in mW
Low Channel:	2402	10.85	12.2
Middle Channel:	2440	11.06	12.8
High Channel:	2480	11.24	13.3

Cable loss: 0.5 dB External Attenuation: 0 dB

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

EUT dBm Maximum Output Level = 11.24 dBm

Limits:

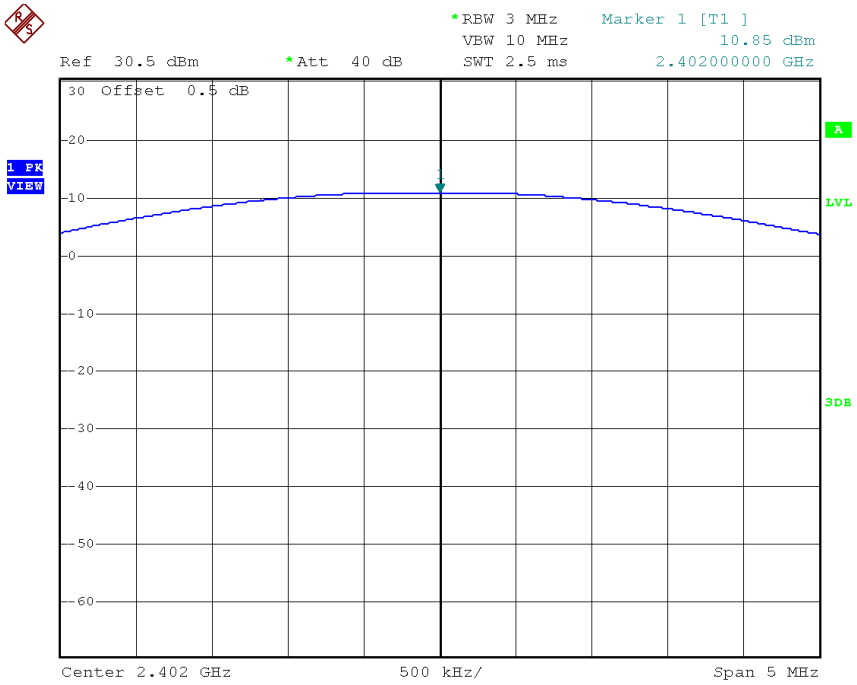
0.125W (21dBm) for antennas with gains of 6dBi or less.

The plots of conducted output power are saved as below.

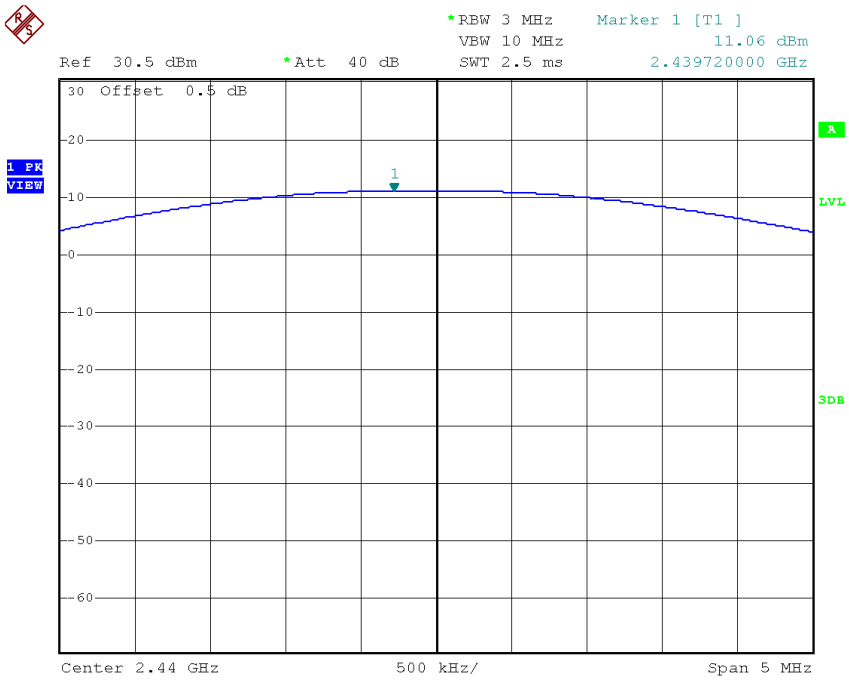
TEST REPORT

PLOTS OF CONDUCTED OUTPUT POWER

Lowest Channel



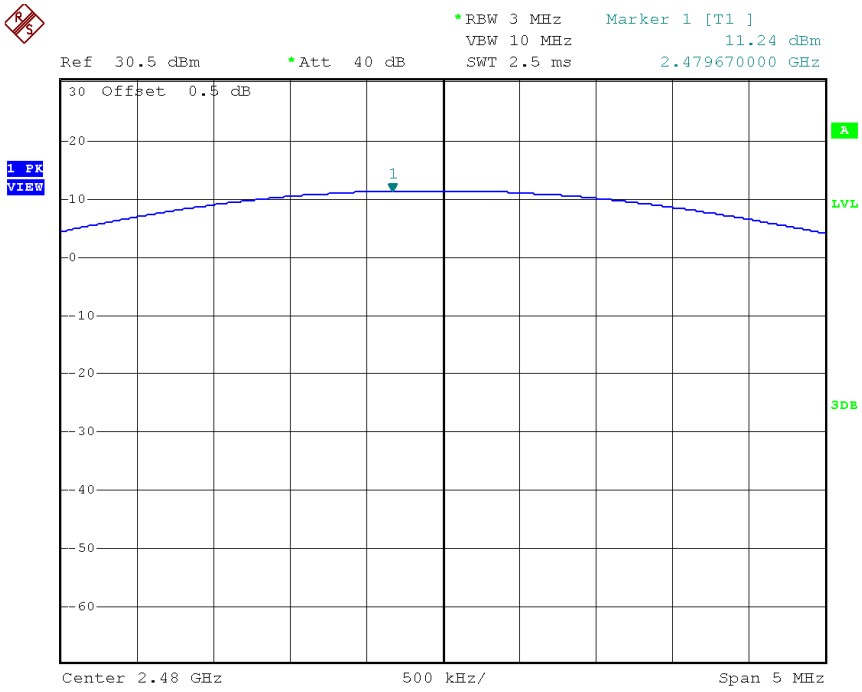
Middle Channel



TEST REPORT

PLOTS OF CONDUCTED OUTPUT POWER

Highest Channel



TEST REPORT

3.2 Maximum 20dB RF Bandwidth

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RES BW was chosen so that the display was a result of the hopping channel modulation. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 20dB lower than PEAK level. The 20dB bandwidth was determined from where the channel output spectrum intersected the display line.

Frequency (MHz)		20dB Bandwidth (MHz)
Low Channel:	2402	972
Middle Channel:	2440	972
High Channel:	2480	978

Limits:

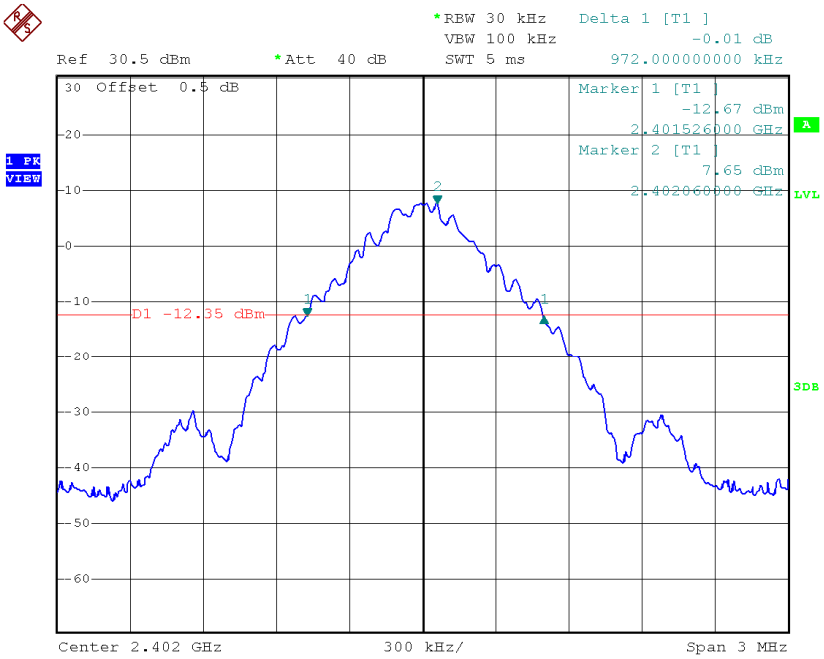
N/A for 2400 MHz to 2483.5 MHz

The plots of 20dB RF bandwidth are saved as below.

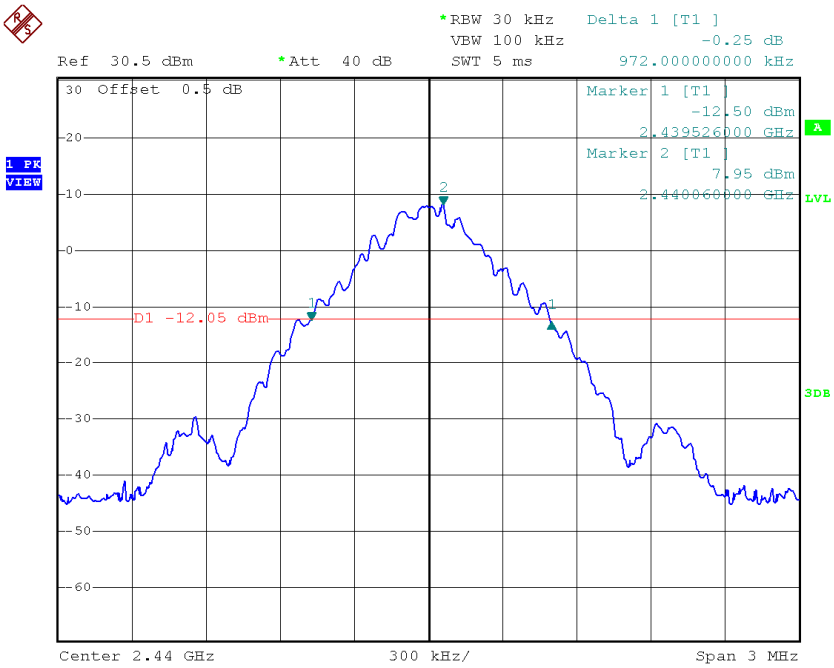
TEST REPORT

PLOTS OF 20dB RF BANDWIDTH

Lowest Channel



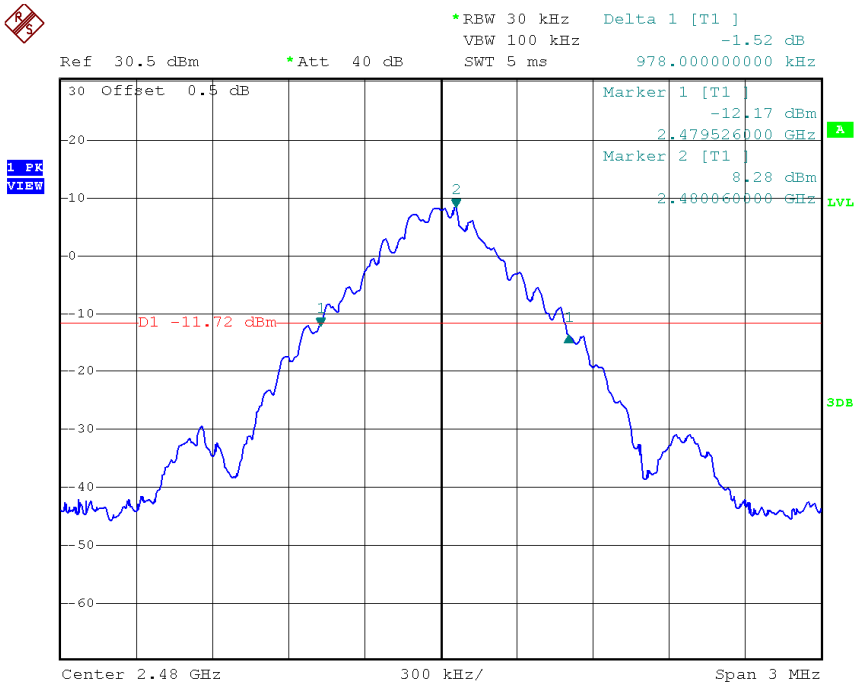
Middle Channel



TEST REPORT

PLOTS OF 20dB RF BANDWIDTH

Highest Channel



TEST REPORT

3.3 Minimum Number of Hopping Frequencies

With the analyzer set to MAX HOLD readings were taken for 2-3 minutes in each band. The channel peaks so recorded were added together, and the total number compared to the minimum number of channels required in the regulation.

No. of Hopping Channels: 79

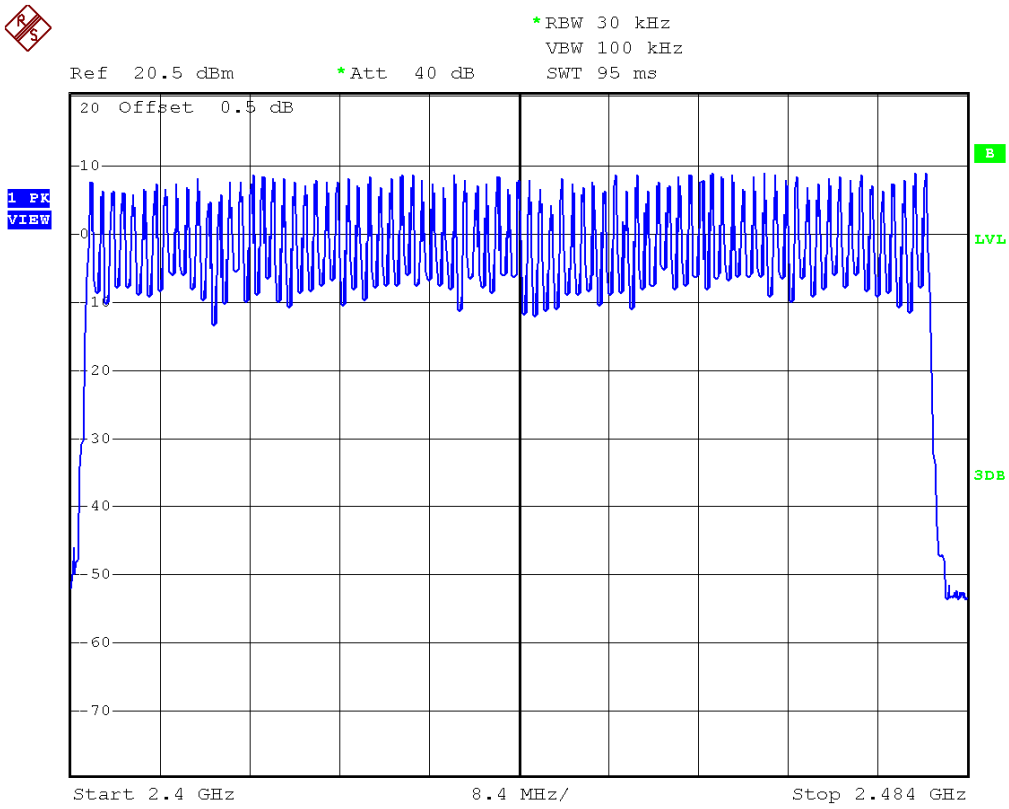
Limits:

At least 15 hopping channels for 2400 MHz to 2483.5 MHz

The plots of number of hopping frequencies are saved as below.

TEST REPORT

PLOTS OF NUMBER OF HOPPING FREQUENCIES



TEST REPORT

3.4 Minimum Hopping Channel Carrier Frequency Separation

Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and met the requirement.

Channel Separation (Channel 39 and Channel 40)	1000 kHz

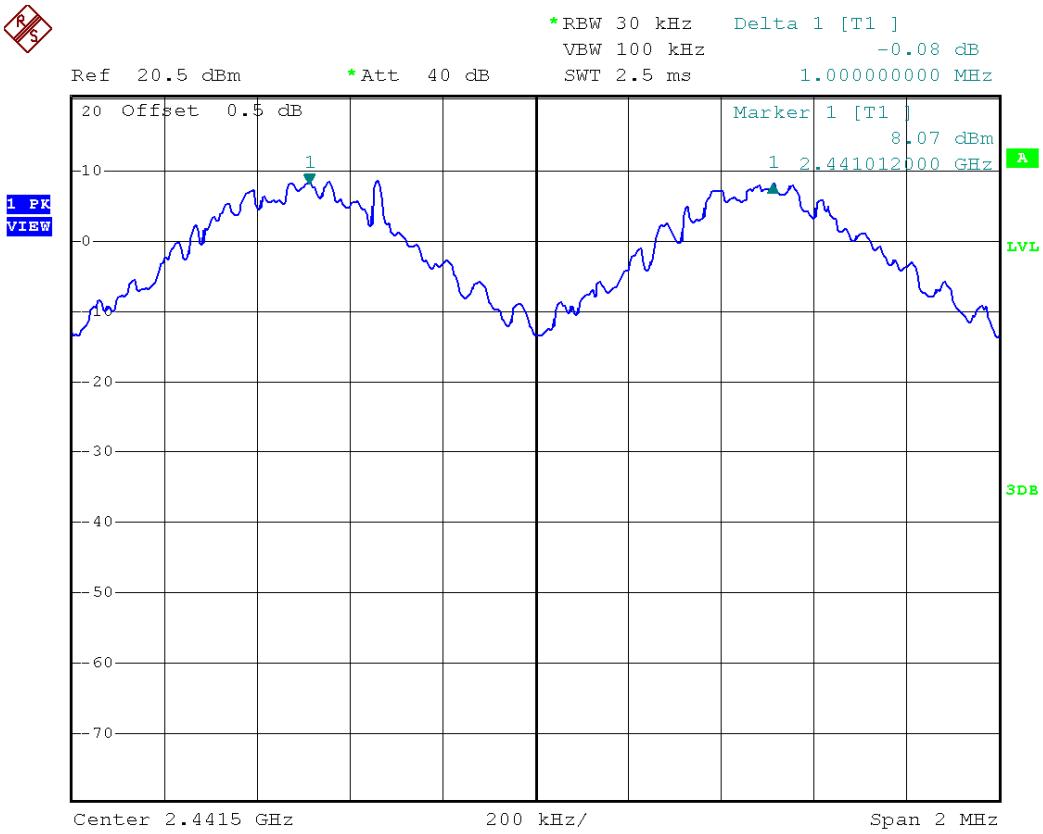
Limits:

The channel separation must be larger than:
2/3 of 20dB bandwidth of hopping channel: 652 kHz

The plots of hopping channel carrier frequency separation is saved as below.

TEST REPORT

PLOTS OF HOPPING CHANNEL CARRIER FREQUENCY SEPARATION



TEST REPORT

3.5 Average Channel Occupancy Time

The spectrum analyzer center frequency was set to one of the known hopping channels. The SWEEP was set to 1ms, the SPAN was set to ZERO SPAN, and the TRIGGER was set to VIDEO. The time duration of the transmission so captured was measured with the MARKER DELTA function.

The SWEEP was then set to the time required by the regulation (20 seconds for 902-928 MHz devices, if the 20dB bandwidth is less than 250kHz, 10 seconds for 902-928 MHz if the 20dB bandwidth is or greater than 250kHz, “0.4 seconds x Number of hopping channels employed” seconds for 2400-2483.5 MHz, 30 seconds for 5725-5850 MHz). The analyzer was set to SINGLE SWEEP, the total ON time was added and compared against the limit (0.4 seconds).

Average Occupancy Time (Traffic – in a clear RF environment) = 2.9ms x 86 = 249.4ms

Limits:

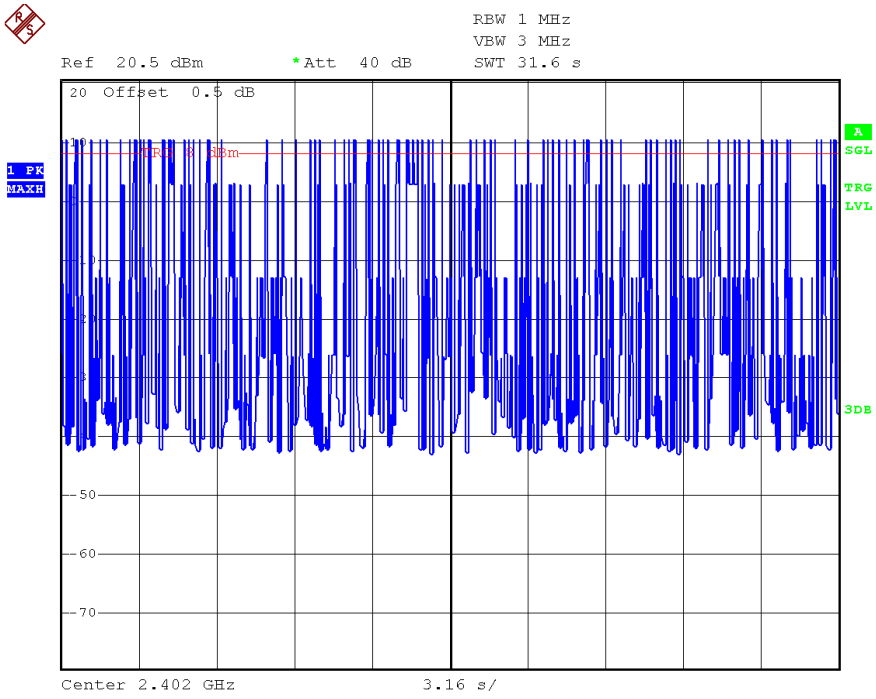
Average 0.4 seconds maximum occupancy in:
31.6 seconds (0.4 sec. x 79) for 2400 MHz to 2483.5 MHz
(Traffic – in a clear RF environment)

The plots of average channel occupancy time are saved as below.

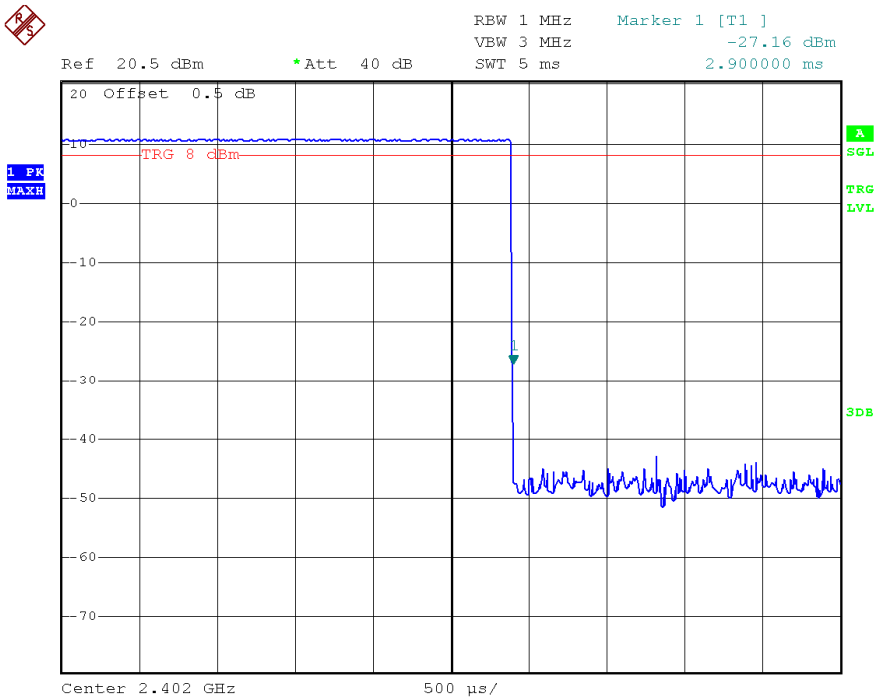
TEST REPORT

PLOTS AVERAGE CHANNEL OCCUPANCY TIME

Plot A



Plot B



TEST REPORT

3.6 Out of Band Conducted Emissions

In any 100 kHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20dB below that of the maximum in-band 100 kHz emission.

The plot(s) of bandedge compliance is shown the worst-case which has been already considered between enable and disable the hopping function of the EUT.

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

Limits:

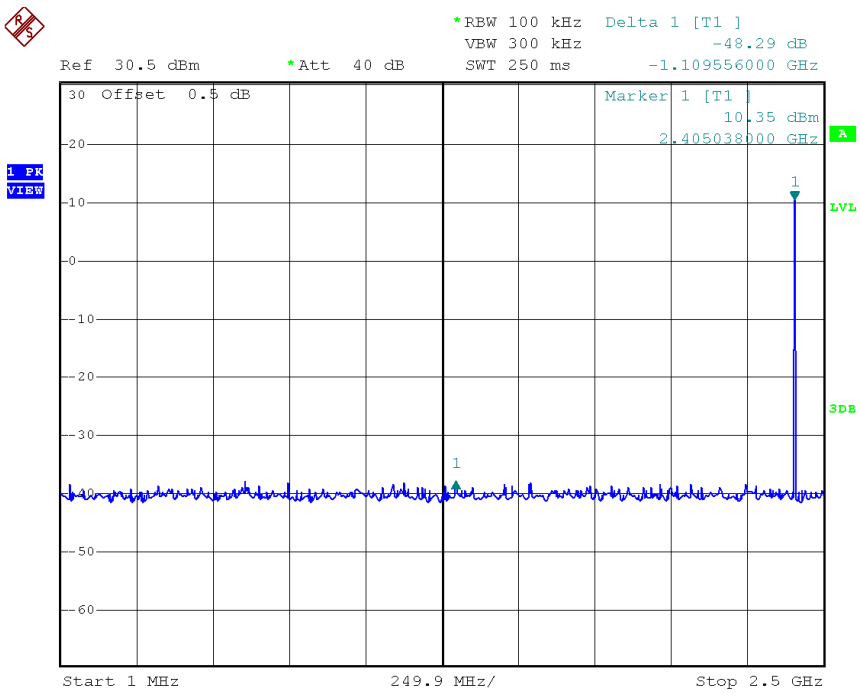
All spurious emission and up to the tenth harmonic was measured and they were found to be at least 20 dB below the highest level of the desired power in the passband.

The plots of out of band conducted emissions are saved as below.

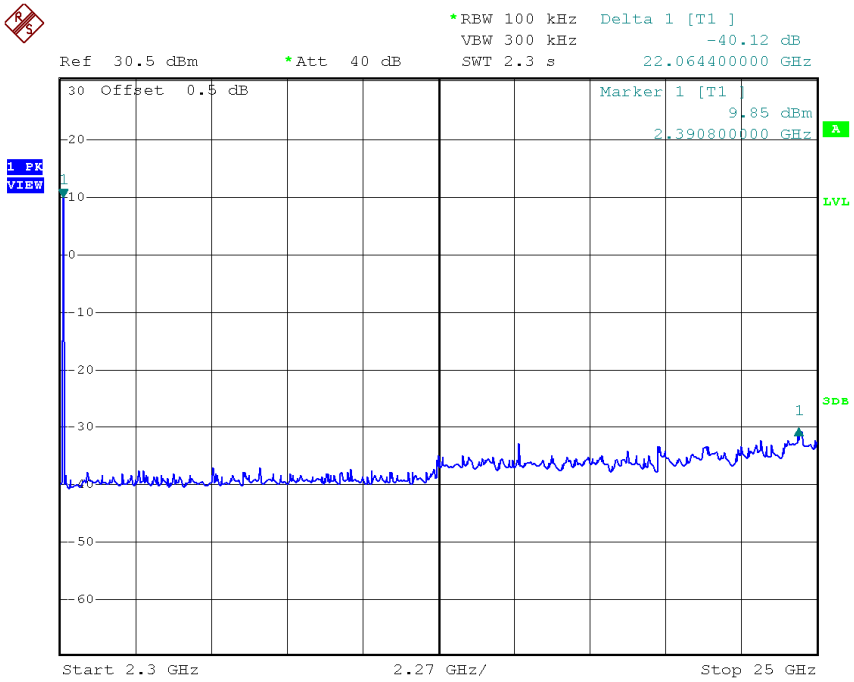
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Lowest Channel, Plot 1



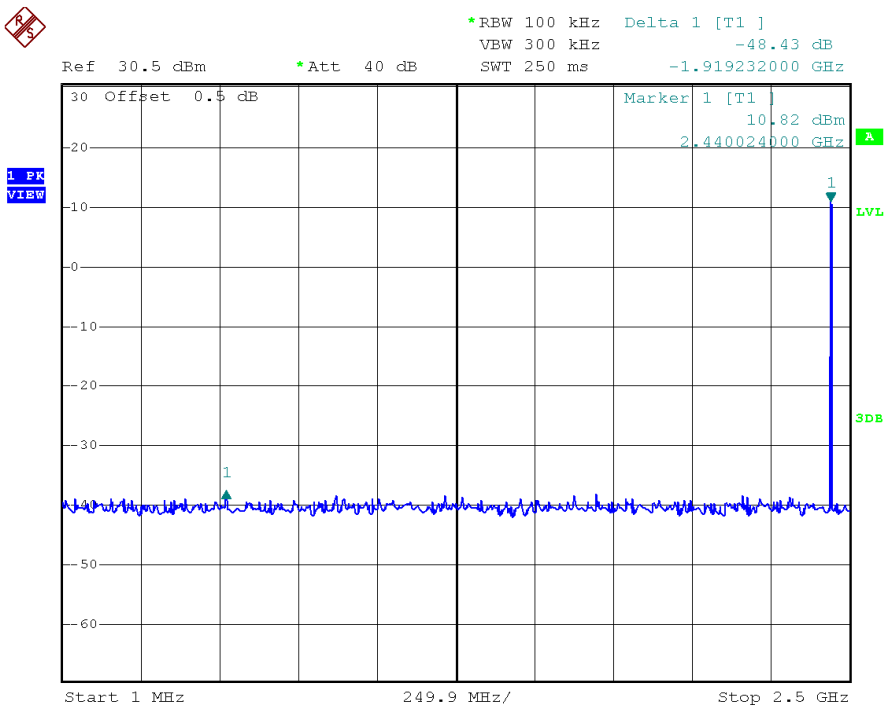
Lowest Channel, Plot 2



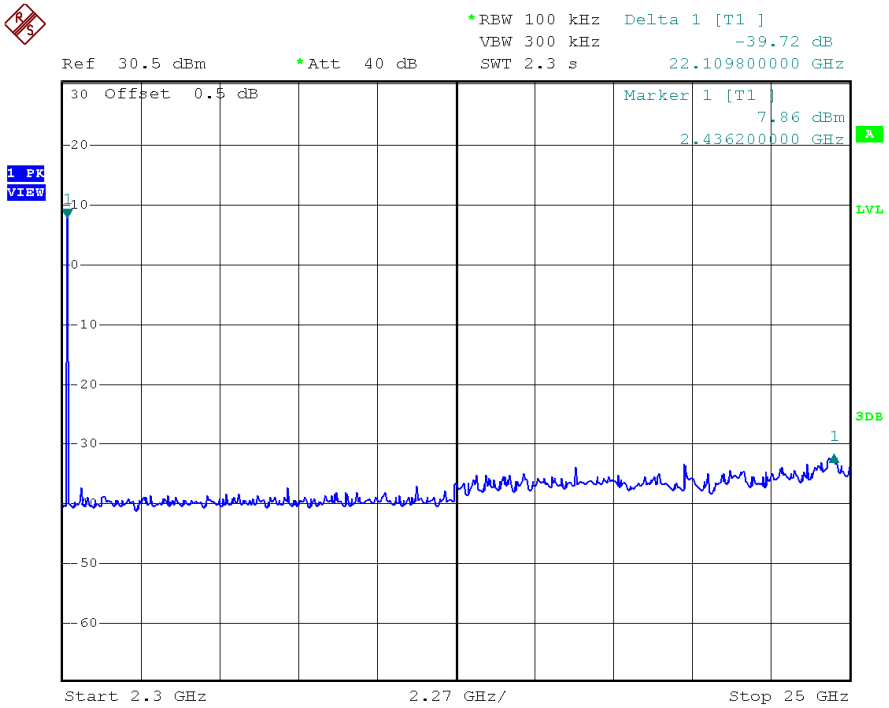
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Middle Channel, Plot 1



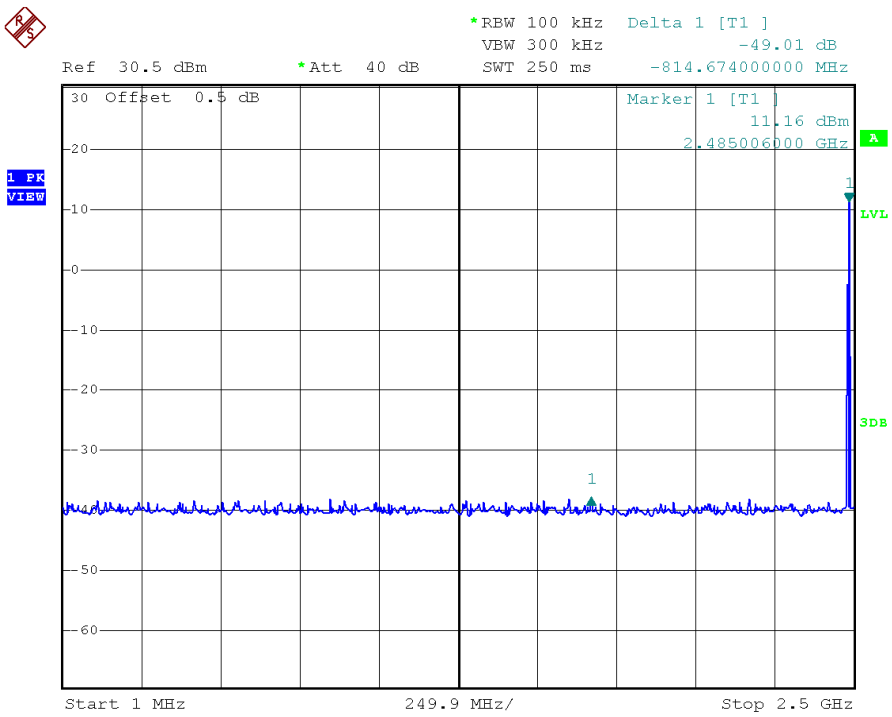
Middle Channel, Plot 2



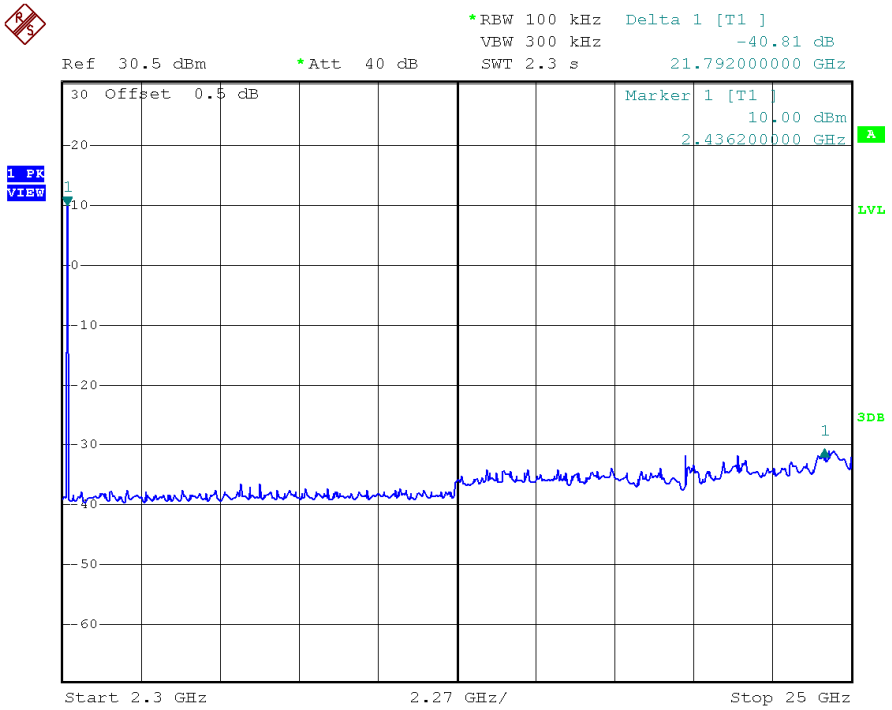
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS

Highest Channel, Plot 1



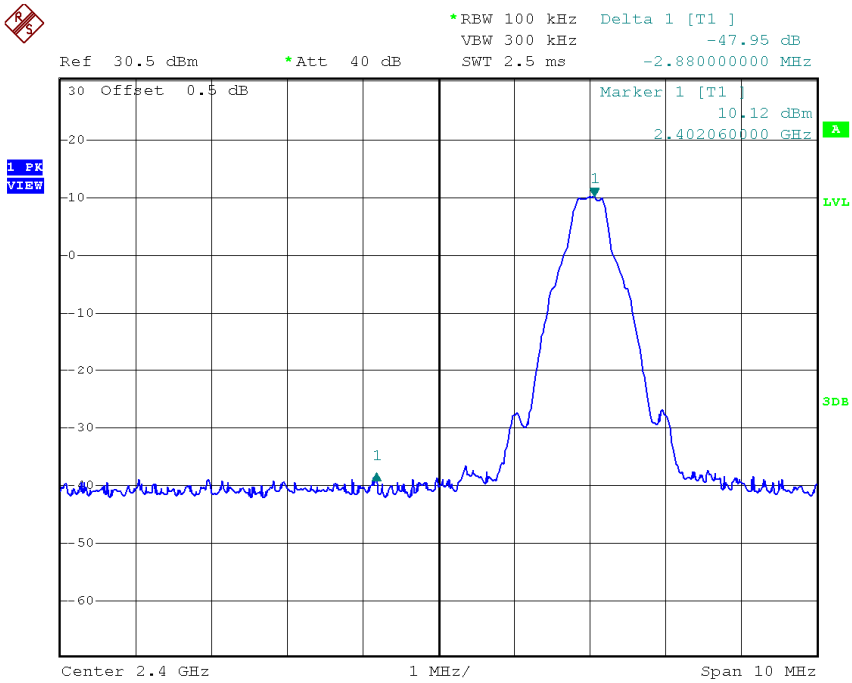
Highest Channel, Plot 2



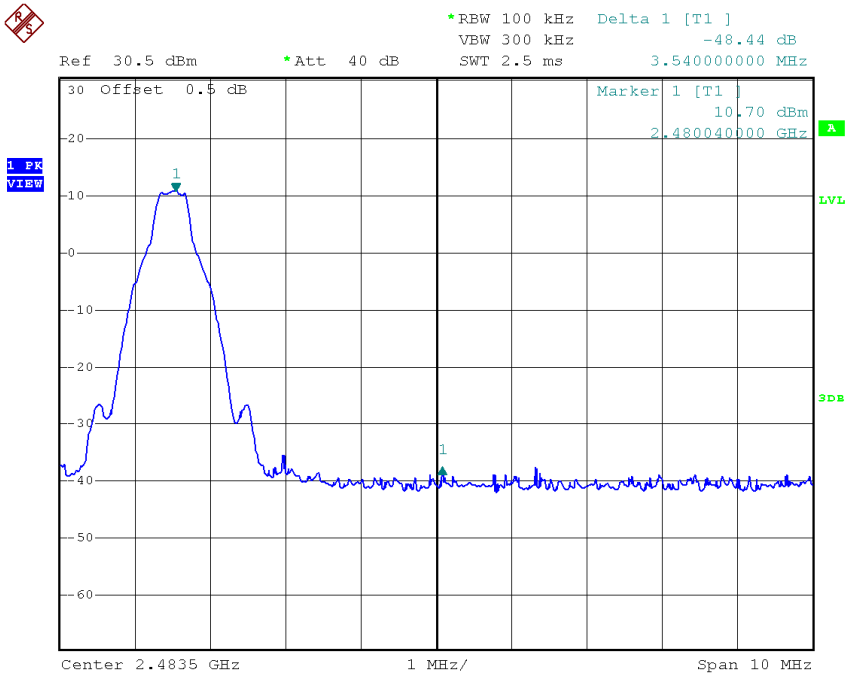
TEST REPORT

PLOTS OF BANDEDGE

Lowest Bandedge



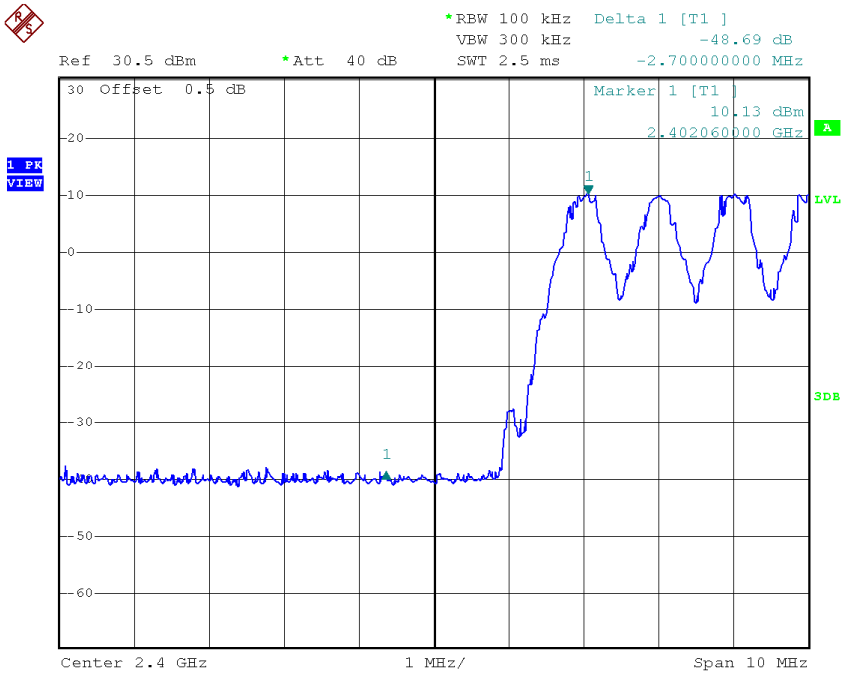
Highest Bandedge



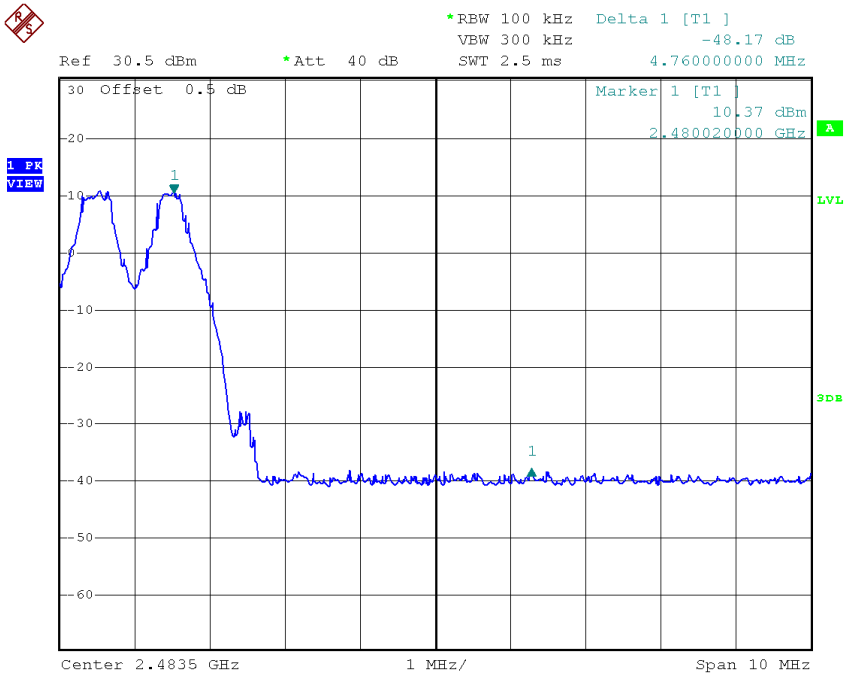
TEST REPORT

PLOTS OF BANDEDGE (HOPPING)

Lowest Bandedge



Highest Bandedge



3.7 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 reflects 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	=	-10.0 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

3.8 Transmitter Radiated Emission in Restricted Bands and Spurious Emission

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.

3.8.1 Radiated Emission Configuration Photograph

Worst Case Restricted Band Radiated Emission at 127.972 MHz.

The worst case radiated emission configuration photographs are attached in the Appendix and saved with filename: config photos.pdf

3.8.2 Radiated Emission Data

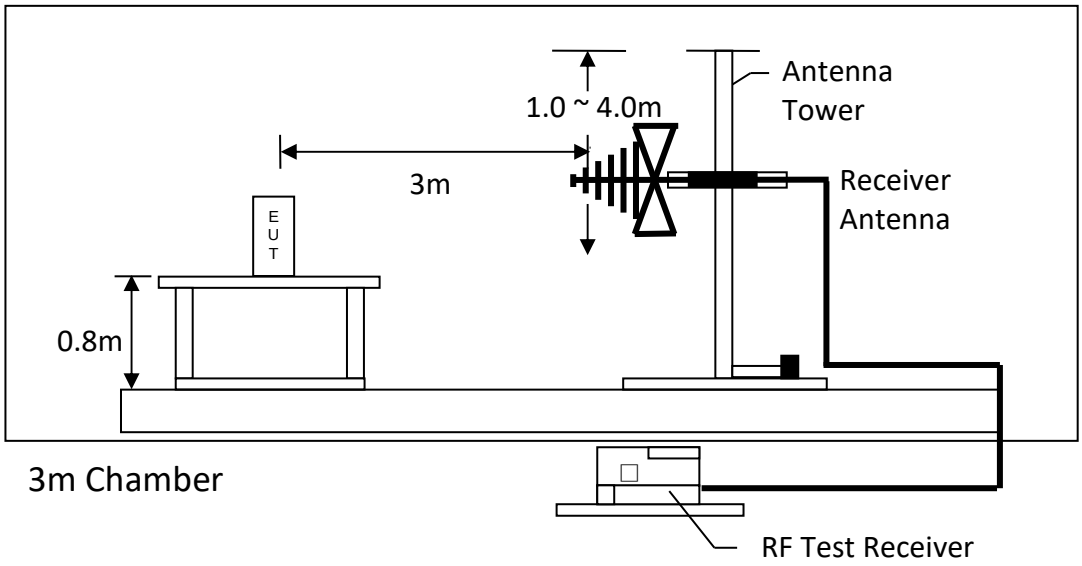
The data in tables 1-4 list the significant emission frequencies, the limit and the margin of compliance.

Judgement – Passed by 3.0 dB margin

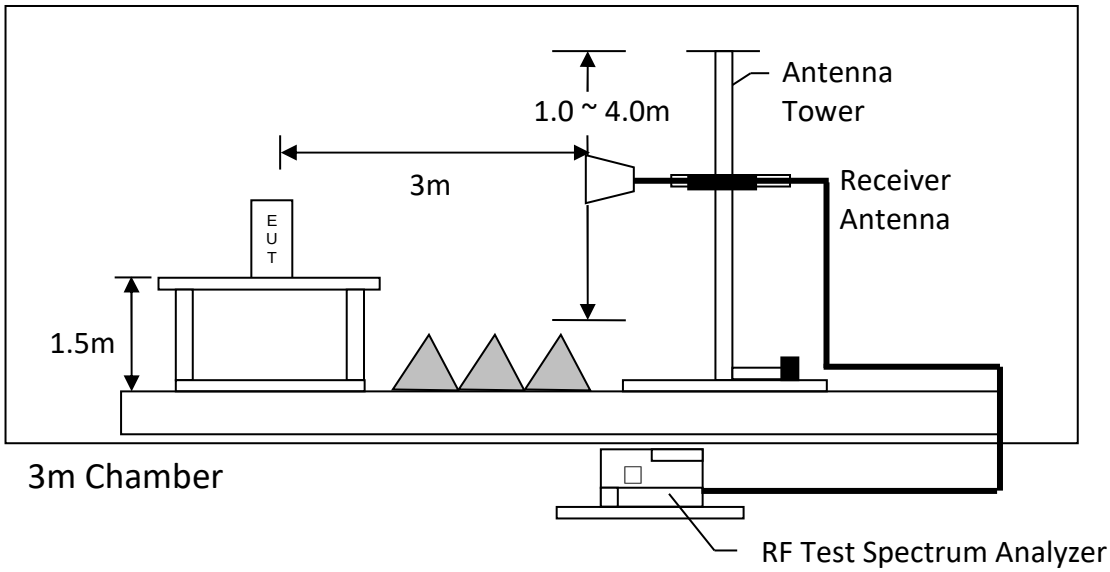
TEST REPORT

3.8.3 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

RADIATED EMISSION DATA

Model/HVIN: AirFly Duo / AirFly-Duo
Date of Test: March 01, 2023
Worst-Case Operating Mode: Bluetooth TX-Channel 2402 MHz

Table 1

Pursuant to FCC Part 15 Section 15.205 / RSS-Gen Section 8.10 Requirement

Lowest Channel

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)
H	2390.000	54.0	33	29.4	50.4	54.0	-3.6
V	4804.000	45.9	33	34.9	47.8	54.0	-6.2
H	12010.000	31.9	33	40.5	39.4	54.0	-14.6

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)
H	2390.000	67.0	33	29.4	63.4	74.0	-10.6
V	4804.000	57.5	33	34.9	59.4	74.0	-14.6
H	12010.000	45.9	33	40.5	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.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz.
6. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.
7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Model/HVIN: AirFly Duo / AirFly-Duo
Date of Test: March 01, 2023
Worst-Case Operating Mode: Bluetooth TX-Channel 2440 MHz

Table 2

Pursuant to FCC Part 15 Section 15.205 / RSS-Gen Section 8.10 Requirement

Middle Channel

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	45.6	33	34.9	47.5	54.0	-6.5
V	7320.000	32.2	33	37.9	37.1	54.0	-16.9
H	12200.000	32.1	33	40.5	39.6	54.0	-14.4

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	57.2	33	34.9	59.1	74.0	-14.9
V	7320.000	44.1	33	37.9	49.0	74.0	-25.0
H	12200.000	46.3	33	40.5	53.8	74.0	-20.2

Notes:
1. Peak detector is used unless otherwise stated.
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. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.
7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Model/HVIN: AirFly Duo / AirFly-Duo
Date of Test: March 01, 2023
Worst-Case Operating Mode: Bluetooth TX-Channel 2480 MHz

Table 3

Pursuant to FCC Part 15 Section 15.205 / RSS-Gen Section 8.10 Requirement

Highest Channel

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)
H	2483.500	54.4	33	29.4	50.8	54.0	-3.2
V	4960.000	45.4	33	34.9	47.3	54.0	-6.7
V	7440.000	33.0	33	37.9	37.9	54.0	-16.1
H	12400.000	31.5	33	40.5	39.0	54.0	-15.0

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)
H	2483.500	68.4	33	29.4	64.8	74.0	-9.2
V	4960.000	57.8	33	34.9	59.7	74.0	-14.3
V	7440.000	44.4	33	37.9	49.3	74.0	-24.7
H	12400.000	45.5	33	40.5	53.0	74.0	-21.0

Notes:
1. Peak detector is used unless otherwise stated.
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. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.
7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Model/HVIN: AirFly Duo / AirFly-Duo
Date of Test: March 01, 2023
Worst-Case Operating Mode: TX and Charge

Table 4

Pursuant to FCC Part 15 Section 15.205 / RSS-Gen Section 8.10 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	32.912	34.4	16	10.0	28.4	40.0	-11.6
H	61.646	42.2	16	10.0	36.2	40.0	-3.8
H	97.536	40.3	16	12.0	36.3	43.5	-7.2
H	114.148	38.4	16	14.0	36.4	43.5	-7.1
H	127.972	42.5	16	14.0	40.5	43.5	-3.0
H	286.565	34.4	16	22.0	40.4	46.0	-5.6
V	371.925	30.5	16	24.0	38.5	46.0	-7.5
V	382.838	26.8	16	24.0	34.8	46.0	-11.2
H	443.222	30.2	16	26.0	40.2	46.0	-5.8
H	492.812	24.4	16	26.0	34.4	46.0	-11.6

Notes:
1. Quasi-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. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10.
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

3.9 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.

3.9.1 AC Power Line Conducted Emission Configuration Photograph

Worst Case Line-Conducted Configuration at 0.150 MHz.

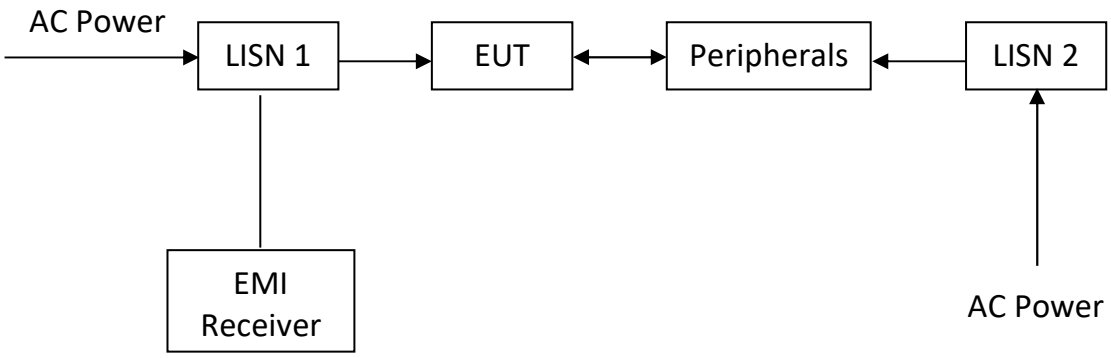
The worst-case line conducted configuration photographs are attached in the Appendix and saved with filename: config photos.pdf.

3.9.2 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 19.7 dB margin

3.9.3 Conducted Emission Test Setup



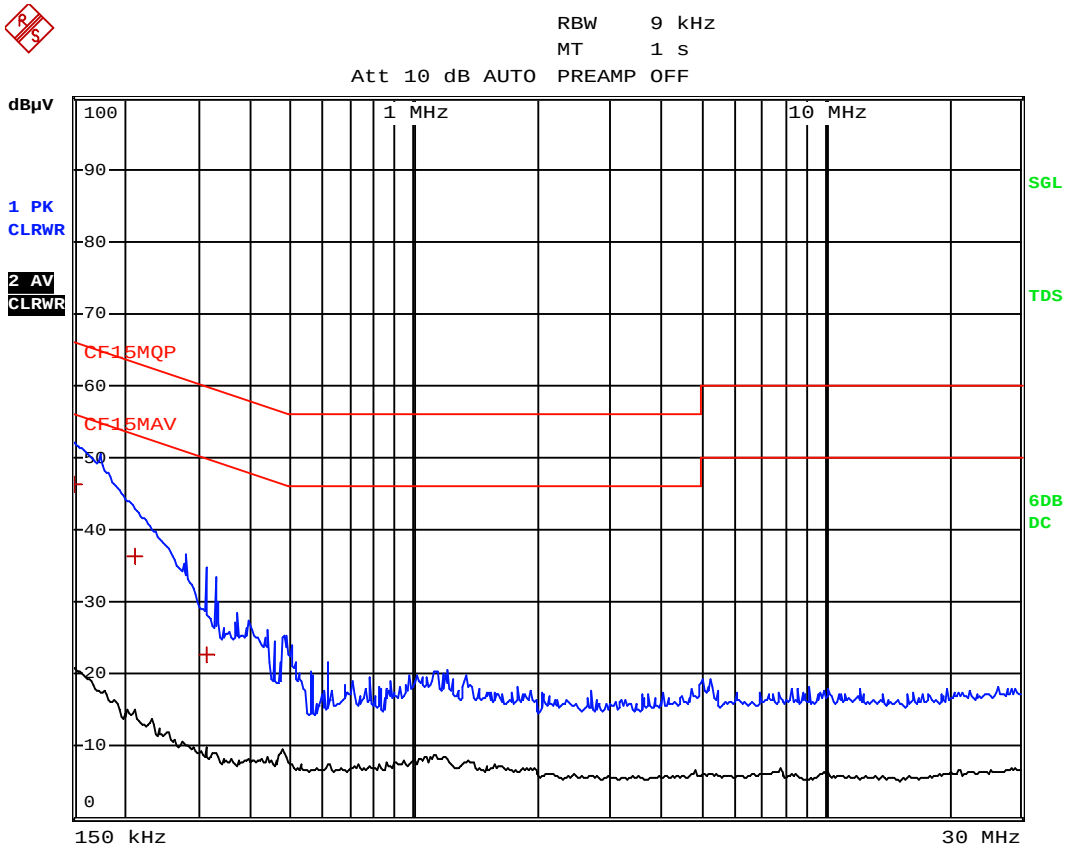
The EUT along with its peripherals were placed on a 1.0m(W)×1.5m(L) and 0.8m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane. The EUT was connected to power mains through a line impedance stabilization network (LISN), which provided 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled.

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

TEST REPORT

AC POWER LINE CONDUCTED EMISSION

Model/HVIN: AirFly Duo / AirFly-Duo
Date of Test: March 01, 2023
Worst-Case Operating Mode: TX and Charge



Date: 1.MAR.2023 11:40:10

Note: Measurement Uncertainty is ±4.2dB at a level of confidence of 95%.

TEST REPORT

AC POWER LINE CONDUCTED EMISSION

Model/HVIN: AirFly Duo / AirFly-Duo
Date of Test: March 01, 2023
Worst-Case Operating Mode: TX and Charge

EDIT PEAK LIST (Final Measurement Results)

Trace1: CF15MQP
Trace2: CF15MAV
Trace3: ---

	TRACE	FREQUENCY	LEVEL dBµV		DELTA LIMIT dB
1	Quasi Peak	150 kHz	46.30	N	-19.69
1	Quasi Peak	213 kHz	36.41	L1	-26.67
1	Quasi Peak	312 kHz	22.61	L1	-37.29

Date: 1.MAR.2023 11:39:54

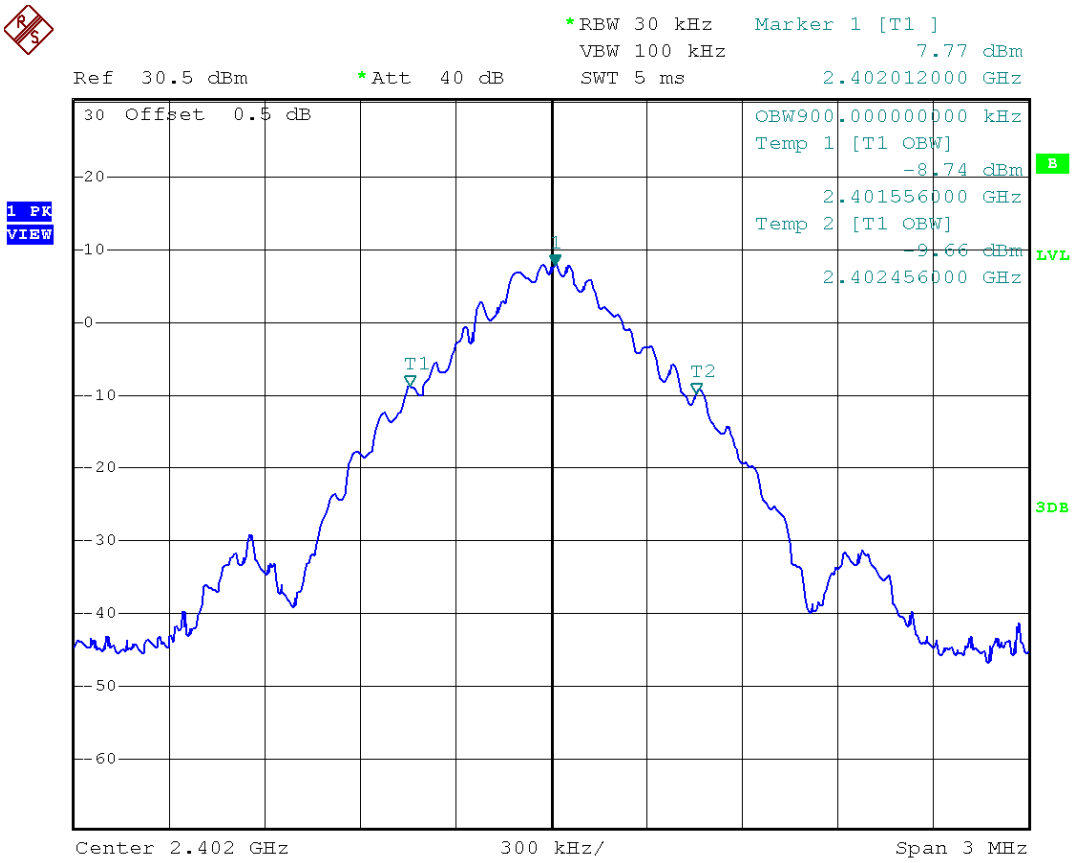
Note: Measurement Uncertainty is ±4.2dB at a level of confidence of 95%.

TEST REPORT

3.10 Occupied Bandwidth:

Frequency (MHz)		Occupied Bandwidth (kHz)
Lowest Channel:	2402	900
Middle Channel:	2440	900
Highest Channel:	2480	894

The worst case is shown as below:



TEST REPORT

EXHIBIT 4 EQUIPMENT LIST

1) Radiated Emissions Test

Equipment	Signal and Spectrum Analyzer (10Hz to 40GHz)	Biconical Antenna (30MHz to 300MHz)	EMI Test Receiver 7GHz
Registration No.	EW-3016	EW-3242	EW-3481
Manufacturer	ROHDESCHWARZ	EMCO	ROHDESCHWARZ
Model No.	FSV40	3110C	ESR7
Calibration Date	January 29, 2022	May 26, 2021	December 21, 2021
Calibration Due Date	April 29, 2023	May 26, 2023	March 21, 2023

Equipment	Log Periodic Antenna	Double Ridged Guide Antenna	Active Loop H-field (9kHz to 30MHz)
Registration No.	EW-3243	EW-1133	EW-3302
Manufacturer	EMCO	EMCO	EMCO
Model No.	3148B	3115	6502
Calibration Date	June 03, 2021	May 26, 2021	September 08, 2022
Calibration Due Date	March 30, 2023	May 26, 2023	September 08, 2023

Equipment	RF Preamplifier (9kHz to 6000MHz)	2.4GHz Notch Filter	14m Double Shield RF Cable (9kHz - 6GHz)
Registration No.	EW-3006b	EW-3435	EW-2376
Manufacturer	SCHWARZBECK	MICROWAVE	RADIALL
Model No.	BBV9718	N0324413	n m/br56/bnc m 14m
Calibration Date	February 15, 2022	June 16, 2022	January 26, 2022
Calibration Due Date	May 15, 2023	June 16, 2023	April 26, 2023

Equipment	RF Cable 14m (1GHz to 26.5GHz)	14m Double Shield RF Cable (20MHz to 6GHz)	Pyramidal Horn Antenna
Registration No.	EW-2781	EW-2074	EW-0905
Manufacturer	GREATBILLION	RADIALL	EMCO
Model No.	SMA m/SHF5MPU /SMA m ra14m,26G	N(m)-RG142-BNC(m) L=14M	3160-09
Calibration Date	November 24, 2021	December 10, 2021	July 20, 2021
Calibration Due Date	April 24, 2023	March 10, 2023	May 20, 2023

TEST REPORT

EXHIBIT 4 EQUIPMENT LIST (CONT'D)

2) Conducted Emissions Test

Equipment	RF Cable 80cm (RG142) (9kHz to 30MHz)	EMI Test Receiver 7GHz	Artificial Mains Network
Registration No.	EW-2451	EW-3481	EW-2501
Manufacturer	RADIALL	ROHDESCHWARZ	ROHDESCHWARZ
Model No.	bnc m st / 142 / bnc m st 80cm	ESR7	ENV-216
Calibration Date	May 06, 2022	December 21, 2021	November 09, 2021
Calibration Due Date	May 06, 2023	March 21, 2023	May 09, 2023

3) Bandedge Measurement Test

Equipment	EMI Test Receiver 7GHz	5m RF Cable (40GHz)
Registration No.	EW-3481	EW-2701
Manufacturer	ROHDESCHWARZ	RADIALL
Model No.	ESR7	Sma m-m 5m 40G
Calibration Date	December 21, 2021	November 24, 2021
Calibration Due Date	March 21, 2023	May 24, 2023

4) OBW Measurement Test

Equipment	EMI Test Receiver 7GHz	5m RF Cable (40GHz)
Registration No.	EW-3481	EW-2701
Manufacturer	ROHDESCHWARZ	RADIALL
Model No.	ESR7	Sma m-m 5m 40G
Calibration Date	December 21, 2021	November 24, 2021
Calibration Due Date	March 21, 2023	May 24, 2023

TEST REPORT

EXHIBIT 4 EQUIPMENT LIST (CONT'D)

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