

FCC/IC - TEST REPORT

Report Number : **68.940.19.0027.01** Date of Issue: May 29, 2019

Model : RFOFFROAD

Product Type : OFFROAD RF SWITCH CONTROLLER

Applicant : Winplus Co., Ltd.

Address : Suites 6-11, 7th Floor, Corporation Park, 11 On Lai Street, Shatin,
Hong Kong

Manufacture : Winplus Co., Ltd.

Address : Suites 6-11, 7th Floor, Corporation Park, 11 On Lai Street, Shatin,
Hong Kong

Test Result : **n Positive o Negative**

Total pages including Appendices : 19

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2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12&13, Zhiheng Wisdomland Business Park,
Nantou Checkpoint Road 2, Nanshan District,
Shenzhen City, 518052,
P. R. China

FCC Registration Number: 514049

ISED#: 10320A

CAB identifier: CN0077

Telephone: 86 755 8828 6998
Fax: 86 755 8828 5299

3 Description of the Equipment Under Test

Description of the Equipment Under Test

Product/PMN: OFFROAD RF SWITCH CONTROLLER

Model no./HVIN: RFOFFROAD

FCC ID: WUI-RFOFFROAD

IC: 7297A-RFOFFROAD

Options and accessories: NIL

Ratings: 12VDC

RF Transmission Frequency: 2475MHz

Modulation: GFSK

Antenna Type: PCB

Antenna Gain: 5dBi

Description of the EUT: The product is a OFFROAD RF SWITCH CONTROLLER that operated at 2475MHz

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	RATINGS	MODEL NO.(SHIELD)
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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2017 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-Gen Issue 5, Amendment 1, March 2019	General Requirements and Information for the Certification of Radio Apparatus
RSS-210 Issue 9 August 2016	RSS-210 — Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

All the test methods were according to ANSI C63.10-2013.

5 Summary of Test Results

Technical Requirements					
FCC Part 15 Subpart C 15.249, RSS-Gen, RSS-210					
Test Condition	Pages	Test Site	Test Result		
			Pass	Fail	N/A
15.207 & RSS-Gen A8.8 Conducted emission AC power port	See note 1		☐	☐	☒
§15.205(a), §15.209(a), §15.249(a), §15.249(c) & RSS-210 B.10, RSS-GEN 6.13/8.9/8.10 Field strength of emissions and Restricted bands	12	Site 1	☒	☐	☐
§15.249(d), RSS-210 B.10 Out of band emissions	21	Site 1	☒	☐	☐
FCC §15.215(c) 20dB bandwidth & RSS-Gen 6.7 99% Occupied Bandwidth	26	Site 1	☒	☐	☐
§15.203, RSS-GEN 6.8 Antenna requirement	See note 2		☒	☐	☐

Remark : N/A- Not Applicable;

Note 1: The EUT is not intended to operate from the AC power lines;

Note 2: The EUT used an integral PCB antenna, which gain is 5dBi. According to §15.203, it is considered sufficiently to comply with the provisions of this section.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: WUI-RFOFFROAD and IC: 7297A-RFOFFROAD complies with Section 15.207, 15.205, 15.209, 15.249 of the FCC Part 15, Subpart C Rules; RSS-Gen Issue 5 and RSS-210 issue 9.

SUMMARY:

All tests according to the regulations cited on page 5 were

n - Performed

o - **Not** Performed

The Equipment Under Test

n - **Fulfills** the general approval requirements.

o - **Does not** fulfill the general approval requirements.

Sample Received Date: May 23, 2019

Testing Start Date: May 23, 2019

Testing End Date: May 24, 2019

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch -

Reviewed by:

Prepared by:

Tested by:



Laurent Yuan
EMC Project Manager



Henry Chen
EMC Project Engineer

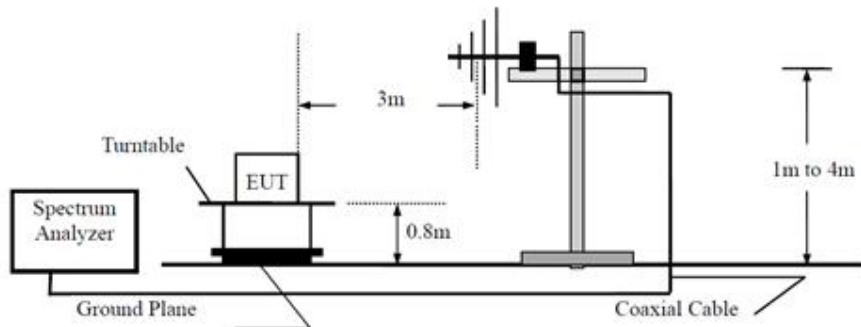


Louise Liu
EMC Test Engineer

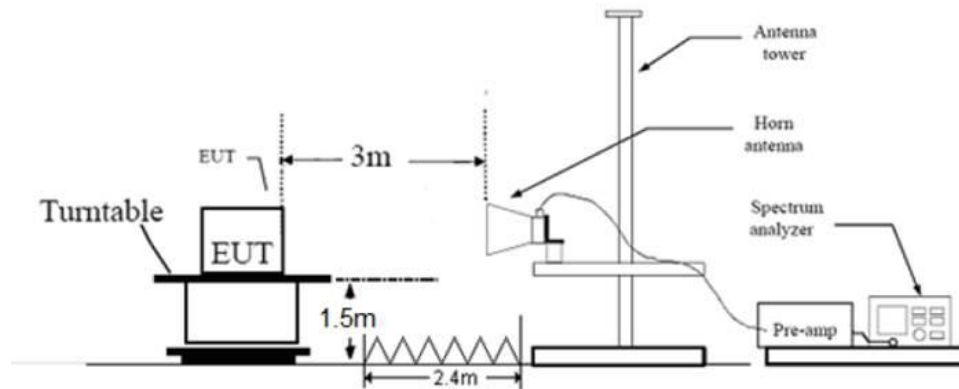
7 Test setups

7.1 Radiated test setups

Below 1GHz



Above 1GHz



8 Technical Requirement

8.1 Field strength of emissions and Restricted bands

Test Method

- 1: The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3-meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
- 3: The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- 4: For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 5: Use the following spectrum analyzer settings According to C63.10:

For Above 1GHz

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW $\geq$ RBW for peak measurement and VBW = 10Hz for average measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 KHz, VBW $\geq$ RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Note:

- 1: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.
- 2: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.
- 3: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results were added to a correction factor (20log (1/duty cycle)).
- 4: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.

Field strength of emissions and Restricted bands

Limits

According to §15.249 (a) & RSS-210 A2.9(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

According to §15.249 (c) & RSS-210 B.10, Field strength limits are specified at a distance of 3 meters.

According to §15.249 (d) & RSS-210 B.10, Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209 & RSS-Gen, whichever is the lesser attenuation.

According to §15.205 and RSS-GEN 8.10 Unwanted emissions falling into restricted bands in §15.205 (a) and RSS-GEN 8.10 Table 7 shall comply with the limits specified in §15.209 and RSS-Gen.

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

Field strength of emissions and Restricted bands

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

EUT: OFFROAD RF SWITCH CONTROLLER

M/N: RFOFFROAD

Operating Condition: Tx; 2475MHz

For Peak Value

Radiated Emission								
Value	Emissions Frequency MHz	E-Field Polarity	Reading Level dBμV/m	Correction Factor dB	PK Emission dBμV/m	Limit dBμV/m	Margin dBm	Emission Type
For Below 1GHz								
PK	936.411111	H	49.60	-15.4	34.20	46.00	11.80	Spurious
PK	904.508889	V	48.44	-15.5	32.94	46.00	13.06	Spurious
For Above 1GHz								
PK	1235.625000*	H	50.00	-12.0	38.00	74.00	36.00	Spurious
PK	1229.250000*	V	50.15	-12.1	38.05	74.00	35.95	Spurious
PK	2475.000000	H	102.53	-5.3	97.23	114.00	16.77	Fundamental
PK	2475.000000	V	99.78	-5.3	94.48	114.00	19.52	Fundamental
PK	7424.062500*	H	38.69	6.0	44.69	74.00	15.38	Harmonics
PK	7425.468750*	V	36.65	6.0	42.65	74.00	31.25	Harmonic

For AV Value

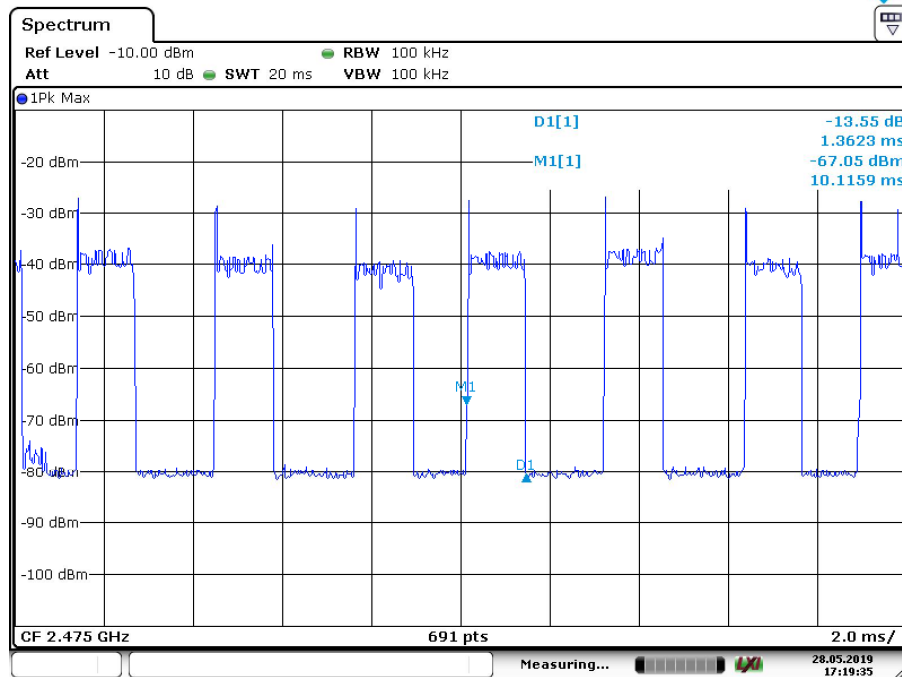
Radiated Emission										
Value	Emissions Frequency MHz	E-Field Polarity	Reading Level dBμV/m	Correction Factor dB	AV Reading Level dBμV/m	Average Factor dB	AV Emission dBμV/m	Limit dBμV/m	Margin dBm	Emission Type
AV	1235.625000*	H	21.11	-12.0	9.11	9.63	18.74	54.00	35.26	Spurious
AV	1229.250000*	V	21.26	-12.1	9.16	9.63	18.79	54.00	35.21	Spurious
AV	2475.000000	H	73.64	-5.3	68.34	9.63	77.97	94.00	16.03	Fundamental
AV	2475.000000	V	70.89	-5.3	65.59	9.63	75.22	94.00	18.78	Fundamental
AV	7424.062500*	H	9.80	6.0	15.80	9.63	25.43	54.00	28.57	Harmonic
AV	7425.468750*	V	7.76	6.0	13.76	9.63	23.39	54.00	30.61	Harmonic

Remark:

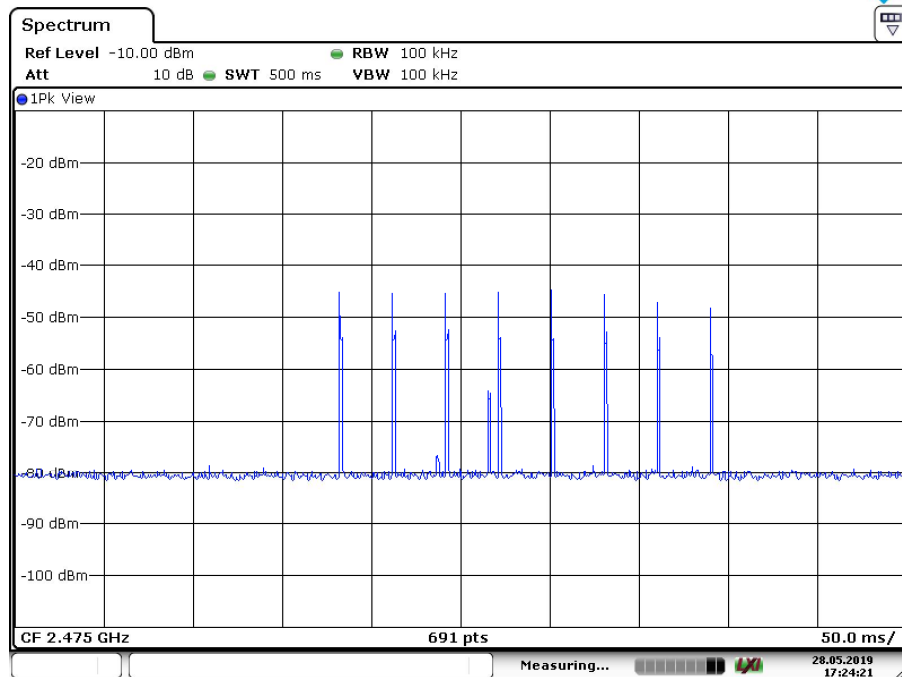
- 1: Data of measurement within this frequency range shown "/" in the table above means the reading of emissions are attenuated more than 20db below the permissible limits or the field strength is too small to be measured.
- 2: "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
- 3: AV Emission Level= AV Reading Level+10log(1/dutycycle)
- 4: PK Emission = Reading Level + Correction Factor
 AV Emission = Reading Level + Correction Factor
 Correction Factor=Antenna Factor + Cable Loss (For Below 1GHz)
 Correction Factor = Antenna Factor + Cable Loss- Amplifier Gain (For Above 1GHz)
 (The Reading Level is recorded by software which is not shown in the sheet)

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Duty Cycle = $1.36 \times 8 / 100(\text{ms}) = 10.88\%$
Duty Cycle Factor = $10 \log (1/\text{Duty Cycle}) = 9.63$



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8.2 Out of Band Emissions

Test Method

- 1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW $\geq$ RBW, Sweep = auto, Detector function = peak, Trace = max hold.
- 2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
- 3 The level displayed must comply with the limit specified in this Section.

Limits

According to §15.249(d) & RSS-210 B.10 Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209 and RSS-Gen, whichever is the lesser attenuation.

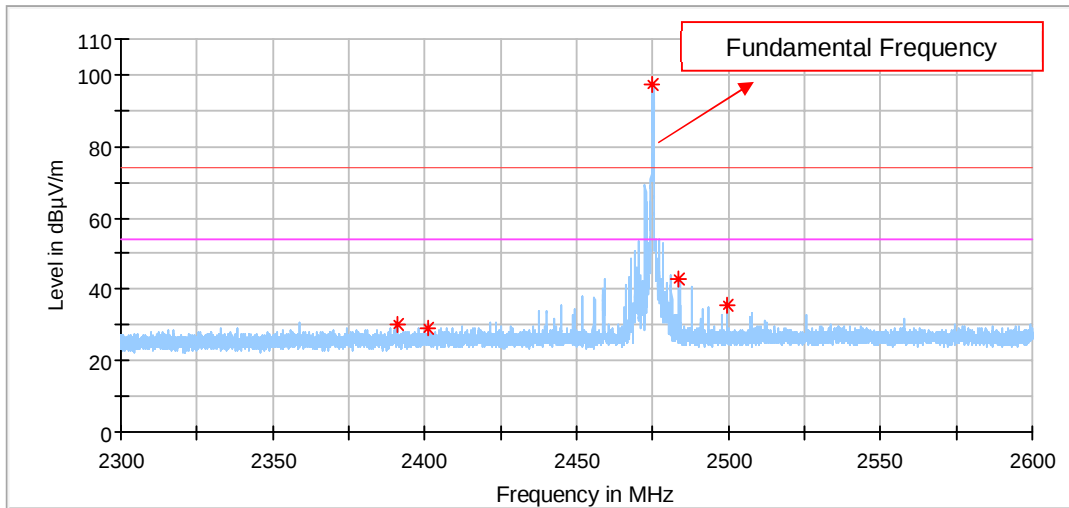
Out of Band Emissions

EUT: OFFROAD RF SWITCH CONTROLLER

M/N: RFOFFROAD

Operating Condition: Tx; 2475MHz

Polarization: Horizontal



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2391.303125	30.39	74.00	43.61	---	---	154.0	H	193.0	-6.0
2401.043750	29.04	74.00	44.96	---	---	154.0	H	45.0	-5.9
2483.778125	42.84	74.00	31.16	---	---	154.0	H	13.0	-5.2
2499.490625	35.34	74.00	38.66	---	---	154.0	H	17.0	-5.1

Remark:

1: Level = Reading Level + Correction Factor

Correction Factor = Antenna Factor + Cable Loss- Amplifier Gain

(The Reading Level is recorded by software which is not shown in the sheet)

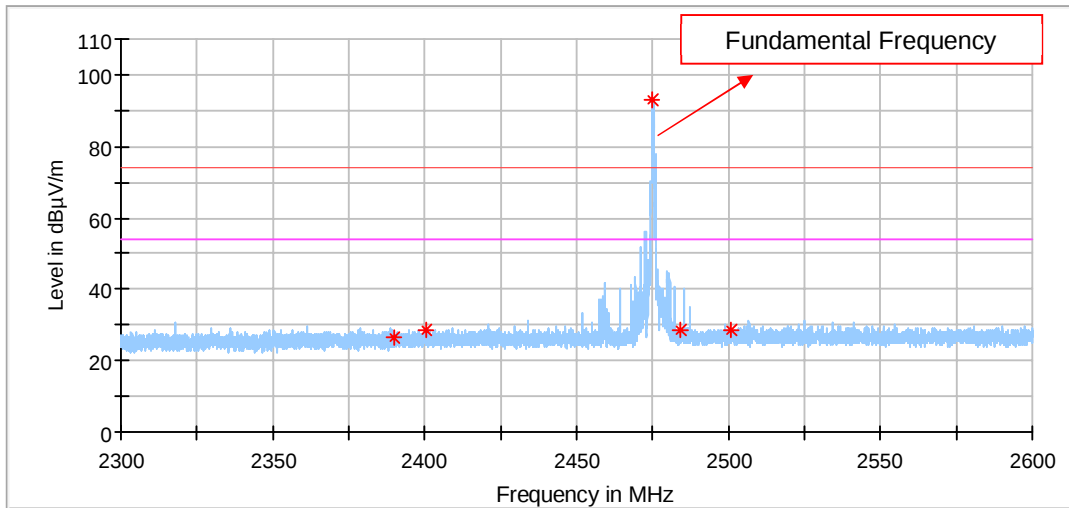
Out of Band Emissions

EUT: OFFROAD RF SWITCH CONTROLLER

M/N: RFOFFROAD

Operating Condition: Tx; 2475MHz

Polarization: Vertical



Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.046875	26.37	74.00	47.63	---	---	154.0	V	354.0	-6.0
2400.115625	28.33	74.00	45.67	---	---	154.0	V	220.0	-6.0
2483.871875	28.33	74.00	45.67	---	---	154.0	V	296.0	-5.2
2500.559375	28.34	74.00	45.66	---	---	154.0	V	358.0	-5.1

Remark:

1: Level = Reading Level + Correction Factor

Correction Factor = Antenna Factor + Cable Loss- Amplifier Gain

(The Reading Level is recorded by software which is not shown in the sheet)

8.4 20dB Bandwidth & 99% Occupied Bandwidth

Test Method

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.

Limits:

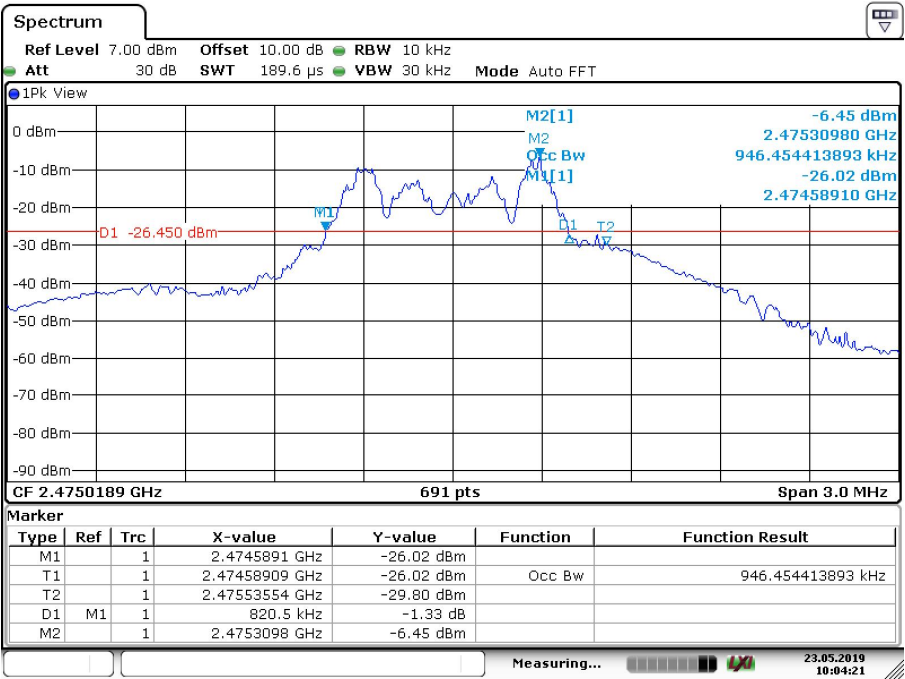
According to 15.215 (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

According to RSS-Gen 6.7 when an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.



20dB Bandwidth & 99% Occupied Bandwidth

Frequency	20dB Bandwidth	99% Bandwidth	Limit
MHz	kHz	kHz	kHz
2475	820.50	946.45	--



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2475MHz

9 Test equipment lists

List of Test Instruments

DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	101031	2019-7-6
Wideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	12827	2019-7-12
Pre-amplifier	Rohde & Schwarz	SCU 40A	100432	2019-7-6
EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2019-7-6
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2019-6-28
Horn Antenna	Rohde & Schwarz	HF907	102294	2019-6-28
Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2019-7-6
Signal Generator	Rohde & Schwarz	SMY01	839369/005	2019-7-6
Attenuator	Agilent	8491A	MY39264334	2019-7-6
3m Semi-anechoic chamber	TDK	9X6X6	----	2020-7-7

10 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Radiated Emission in 3m chamber 30MHz-1000MHz	Horizontal: 4.91dB; Vertical: 4.89dB;
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.80dB; Vertical: 4.87dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.59dB; Vertical: 4.58dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 5.05dB; Vertical: 5.04dB;