# FCC PART 15C
# TEST REPORT
# No. I18N00281-SRD

**For**

**AEOTEC LIMITED**

**TriSensor**

**Model Name: ZWA005-A**

**With**

**Hardware Version: v1.0**

**Software Version: v1.0**

**FCC ID: 2AOGIZWA005**

**Issued Date: 2018-05-07**

**Designation Number: CN1210**

**Note:**

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of SAICT.

**Test Laboratory:**

Shenzhen Academy of Information and Communications Technology

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# REPORT HISTORY

| Report Number | Revision | Description | Issue Date |
|---|---|---|---|
| I18N00281-SRD | Rev.0 | 1st edition | 2018-05-07 |

# CONTENTS

# 1. Test Laboratory

## 1.1. Testing Location

| | |
|---|---|
| Location: | Shenzhen Academy of Information and Communications Technology |
| Address: | Building G, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian District, Shenzhen, Guangdong Province |
| Postal Code: | 518026 |
| Telephone: | +86(0)755-33322000 |
| Fax: | +86(0)755-33322001 |

## 1.2. Testing Environment

| | |
|---|---|
| Normal Temperature: | 15-30℃ |
| Extreme Temperature: | -10/+55℃ |
| Relative Humidity: | 35-60% |

## 1.3. Project Data

| | |
|---|---|
| Testing Start Date: | 2018-03-05 |
| Testing End Date: | 2018-04-25 |

## 1.4. Signature

**Lin Kanfeng**
**(Prepared this test report)**

**Tang Weisheng**
**(Reviewed this test report)**

**Zhang Bojun**
**(Approved this test report)**

# 2. Client Information

## 2.1. Applicant Information

| | |
|---|---|
| Company Name: | AEOTEC LIMITED |
| Address: | Address: FLAT/RM 704, 7/F, BRIGHT WAY TOWER, 33 MONG KOK ROAD, MONG KOK, KL |
| City: | MONG KOK |
| Postal Code: | / |
| Country: | KL |
| Telephone: | 13590229631 |
| Fax: | / |

## 2.2. Manufacturer Information

| | |
|---|---|
| Company Name: | SHENZHEN TOP-ACCESS ELECTRONICS Co, LTD. |
| Address: | A17 BUILDING, Silicon valley power Pioneer Park,#334 Guiyue Rd., Guanlan, Longhua District, Shenzhen City, Guangdong, China |
| City: | Shenzhen |
| Postal Code: | / |
| Country: | China |
| Telephone: | 13510688045 |
| Fax: | 86-755-29503653 |

# 3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

## 3.1. About EUT

| | |
|---|---|
| Description | TriSensor |
| Model Name | ZWA005-A |
| Market Name | / |
| Operating Frequency | 908.40MHz/908.42MHz/916 MHz |
| FCC ID | 2AOGIZWA005 |

## 3.2. Internal Identification of EUT Used during the Test

| EUT ID* | IMEI | HW Version | SW Version | Receive Date |
|---|---|---|---|---|
| EUT1 | / | v1.0 | v1.0 | 2018-03-05 |

*EUT ID: is used to identify the test sample in the lab internally.

## 3.3. Internal Identification of AE Used during the Test

| AE ID* | Description | SN | Reversion |
|---|---|---|---|
| AE1 | / | / | / |

*AE ID: is used to identify the test sample in the lab internally.

## 3.4. General Description

This is a product supporting Z-Wave with 908.40/908.42/916 MHz technologies.
Manuals and specifications of the EUT were provided to fulfil the test.
Samples undergoing test were selected by the client.
Manufacturer's declaration: The Z-Wave antenna is a trace antenna on the PCB. The trace antenna has a gain of 2.5dBi.

# 4. Reference Documents

## 4.1. Documents Supplied by the Applicant

EUT feature information is supplied by the applicant or manufacturer, which is the basis of testing.

## 4.2. Regulations and Standards

The following documents listed in this section are referred for testing.

| Reference | Title | Version |
|---|---|---|
| CFR 47 Part 15 | Part 15 -- Radio Frequency Devices.<br>Subpart C -- Intentional Radiators.<br>§ 15.35 Measurement detector functions and bandwidths.<br>§ 15.207 Conducted limits.<br>§ 15.209 Radiated emission limits, general requirements.<br>§ 15.215 Additional provisions to the general radiated emission limitations.<br>§ 15.249 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz. | 2016 |
| ANSI C63.10 | American National Standard for Testing Unlicensed Wireless Devices | 2013 |

# 5. Test Results

## 5.1. Summary of Test Results

| No | Test cases | Standard Sub-clause | Verdict |
|---|---|---|---|
| 0 | Antenna Requirement | 15.203 | **P** |
| 1 | Occupied 20dB Bandwidth | 15.215, 15.249 | **P** |
| 2 | Occupied Bandwidth | 15.215, 15.249 | **P** |
| 3 | Radiated Emissions | 15.207, 15.209, 15.249 | **P** |

See **ANNEX A and ANNEX B** for details.

## 5.2. Statements

SAICT has evaluated the test cases requested by the applicant/manufacturer as listed in section 5.1 of this report, for the EUT specified in section 3, according to the standards or reference documents listed in section 4.2.

## 5.3. Terms used in the result table

Terms used in Verdict column

| | |
|---|---|
| P | Pass |
| NA | Not Available |
| F | Fail |

Abbreviations

| | |
|---|---|
| AC | Alternating Current |
| AFH | Adaptive Frequency Hopping |
| BW | Band Width |
| E.I.R.P. | equivalent isotropical radiated power |
| ISM | Industrial, Scientific and Medical |
| R&TTE | Radio and Telecommunications Terminal Equipment |
| RF | Radio Frequency |
| Tx | Transmitter |

## 5.4. Laboratory Environment

**Semi-anechoic chamber** did not exceed following limits along the EMC testing

| | |
|---|---|
| Temperature | Min. = 15 ℃, Max. = 30 ℃ |
| Relative humidity | Min. = 35 %, Max. = 60 % |
| Shielding effectiveness | 0.014MHz - 1MHz, >60dB;<br>1MHz - 1000MHz, >90dB. |
| Electrical insulation | > 2 MΩ |
| Ground system resistance | < 4Ω |
| Normalised site attenuation (NSA) | < ±4dB, 3m/10m distance, from 30 to 1000 MHz |
| Uniformity of field strength | Between 0 and 6 dB, from 80 to 3000 MHz |

**Shielded room** did not exceed following limits along the EMC testing

| | |
|---|---|
| Temperature | Min. = 15 ℃, Max. = 30 ℃ |
| Relative humidity | Min. = 35 %, Max. = 60 % |
| Shielding effectiveness | 0.014MHz - 1MHz, >60dB;<br>1MHz - 1000MHz, >90dB. |
| Electrical insulation | > 2 MΩ |
| Ground system resistance | < 4 Ω |

**Fully-anechoic chamber** did not exceed following limits along the EMC testing

| | |
|---|---|
| Temperature | Min. = 15 ℃, Max. = 30 ℃ |
| Relative humidity | Min. = 35 %, Max. = 60 % |
| Shielding effectiveness | 0.014MHz - 1MHz, >60dB;<br>1MHz - 1000MHz, >90dB. |
| Electrical insulation | > 2 MΩ |
| Ground system resistance | < 4Ω |
| Voltage Standing Wave Ratio (VSWR) | ≤6dB, from 1 to 18 GHz,3m distance |

## 6. Test Facilities Utilized

### Conducted test system

| No. | Equipment | Model | Serial Number | Manufacturer | Calibration Due date | Calibration Period |
|---|---|---|---|---|---|---|
| 1 | Vector Signal Analyzer | FSV40 | 100903 | Rohde & Schwarz | 2019-01-17 | 1 year |

### Radiated emission test system

| No. | Equipment | Model | Serial Number | Manufacturer | Calibration Due date | Calibration Period |
|---|---|---|---|---|---|---|
| 1 | Chamber | FACT3-2.0 | 1285 | ETS-Lindgren | 2019-11-27 | 3 years |
| 2 | Test Receiver | ESR7 | 101676 | Rohde & Schwarz | 2018-11-29 | 1 year |
| 3 | BiLog Antenna | VULB9163 | 9163 329 | Schwarzbeck | 2020-02-27 | 3 years |
| 4 | Horn Antenna | 3117 | 00066585 | ETS-Lindgren | 2019-04-05 | 3 years |
| 5 | Spectrum Analyser | FSV40 | 102192 | Rohde & Schwarz | 2018-05-22 | 1 year |
| 6 | Pre-Amplifier | SCU-03 | 100356 | R&S | / | / |

## 7. Measurement Uncertainty

| Test Name | Uncertainty |
|---|---|
| Occupied 20dB Bandwidth | ±66Hz |
| Occupied Bandwidth | ±66Hz |
| Radiated Emissions | ±1.41dB |

# ANNEX A: MEASUREMENT RESULTS

## A.0 Antenna requirement

**Measurement Limit:**

| Standard | Requirement |
|---|---|
| FCC CRF Part 15.203 | An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, § 15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded. |

**Conclusion: The Directional gains of antenna used for transmitting is 2.5 dBi.**
**The RF transmitter uses an integrate antenna without connector.**

## A.1 Occupied 20dB Bandwidth

**Measurement Procedure**

Use the following spectrum analyzer settings:

Span = approximately 2 to 5 times the OBW, centered on a hopping channel

RBW = 1% to 5% the OBW

VBW = 3*RBW

Sweep = auto

Detector function = peak

Trace = max hold

**Measurement Limit:**

| Standard | Limit (kHz) |
|---|---|
| FCC 47 CFR Part 15.215, 15.249 | / |

**Measurement Result:**

| Channel | Frequency(MHz) | 20dB Bandwidth(kHz) | | conclusion |
|---|---|---|---|---|
| 908.42(9.6kbps) | 908.42 | Fig.1 | 60.78 | P |
| 908.4(40kbps) | 908.4 | Fig.2 | 54.41 | P |
| 916(100kbps) | 916 | Fig.3 | 73.52 | P |

**See ANNEX B for test graphs.**
**Conclusion: PASS**

## A.2 Occupied Bandwidth

**Measurement Procedure**

Use the following spectrum analyzer settings:

Span = approximately 1.5 to 5 times the OBW, centered on a hopping channel

RBW = 1% to 5% the OBW

VBW = 3*RBW

Sweep = auto

Detector function = peak

Trace = max hold

**Measurement Limit:**

| Standard | Limit (kHz) |
|---|---|
| FCC 47 CFR Part 15.215, 15.249 | / |

**Measurement Result:**

| Channel | Frequency(MHz) | Occupied Bandwidth(kHz) | | conclusion |
|---|---|---|---|---|
| 908.42(9.6kbps) | 908.42 | Fig.4 | 57.89 | P |
| 908.4(40kbps) | 908.4 | Fig.5 | 53.84 | P |
| 916(100kbps) | 916 | Fig.6 | 75.54 | P |

**See ANNEX B for test graphs.**
**Conclusion: PASS**

## A.3 Radiated Emissions

**Transmitter Spurious Emission - Radiated**

**Measurement Limit:**

| Standard | Limit |
|---|---|
| FCC 47 CFR Part 15.207, 15.209, 15.249 | / |

Operation within Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHZ, and 24.0–24.25 GHz.

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

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

(d) 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, whichever is the lesser attenuation.

| Frequency of emission (MHz) | Field strength(μV/m) | Measurement distance(meters) |
|---|---|---|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

**Test Condition**

The EUT was placed on a non-conductive table. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

| Frequency of emission (MHz) | RBW/VBW | Sweep Time(s) |
|---|---|---|
| 30-1000 | 120kHz/300kHz | 5 |
| 1000-4000 | 1MHz/3MHz | 15 |
| 4000-18000 | 1MHz/3MHz | 40 |
| 18000-26500 | 1MHz/3MHz | 20 |

For emissions testing at or below 1 GHz, the table height shall be 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m.

**Note**:

According to the performance evaluation, the radiated emission margin of EUT is over 20dB in the band below 30MHz. Therefore, the measurement starts from 30MHz to tenth harmonic.
The measurement results include the horizontal polarization and vertical polarization measurements.

**Measurement Results:**

| Mode | Frequency (MHz) | Result | conclusion |
|---|---|---|---|
| 908.42(9.6kbps) | 908.42 | Fig.7 | P |
| 908.4(40kbps) | 908.4 | Fig.8 | P |
| 916(100kbps) | 916 | Fig.9 | P |

| Mode | Frequency (MHz) | Frequency Range | Test Results | Conclusion |
|---|---|---|---|---|
| 908.42(9.6kbps) | 908.42 | 30 MHz ~1 GHz | Fig.10 | P |
| | | 1 GHz ~10GHz | Fig.11 | P |
| 908.4(40kbps) | 908.4 | 30 MHz ~1 GHz | Fig.12 | P |
| | | 1 GHz ~10 GHz | Fig.13 | P |
| 916(100kbps) | 916 | 30 MHz ~1 GHz | Fig.14 | P |
| | | 1 GHz ~10GHz | Fig.15 | P |

NOTE: The measurement results include the all axis measurements. The test cases are selected as the worst cases for all axis.

**908.42(9.6kbps) (1-10GHz)**

| Frequency (MHz) | MaxPeak-ClearWrite (dBμV/m) | Polarization | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|---|---|---|---|---|---|
| 2437.000000 | 54.87 | V | 15.3 | 19.13 | 74.00 |
| 2603.500000 | 55.35 | V | 16.2 | 18.65 | 74.00 |
| 2692.500000 | 56.90 | V | 16.9 | 17.10 | 74.00 |
| 2761.000000 | 57.38 | V | 17.2 | 16.62 | 74.00 |
| 2899.000000 | 57.07 | H | 17.0 | 16.93 | 74.00 |
| 2936.500000 | 57.27 | H | 17.4 | 16.73 | 74.00 |

| Frequency (MHz) | Average-ClearWrite (dBμV/m) | Polarization | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|---|---|---|---|---|---|
| 2330.000000 | 42.95 | V | 15.5 | 11.05 | 54.00 |
| 2439.000000 | 43.07 | H | 15.3 | 10.93 | 54.00 |
| 2579.000000 | 43.86 | V | 16.1 | 10.14 | 54.00 |
| 2692.500000 | 44.86 | V | 16.9 | 9.14 | 54.00 |
| 2781.500000 | 45.59 | V | 17.5 | 8.41 | 54.00 |
| 2931.500000 | 45.34 | H | 17.5 | 8.66 | 54.00 |

**908.4(40kbps) (1-10GHz)**

| Frequency (MHz) | MaxPeak-ClearWrite (dBμV/m) | Polarization | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|---|---|---|---|---|---|
| 2465.500000 | 54.85 | V | 15.3 | 19.15 | 74.0 |
| 2581.500000 | 56.19 | V | 16.2 | 17.81 | 74.0 |
| 2676.500000 | 57.24 | H | 16.5 | 16.76 | 74.0 |
| 2791.000000 | 57.70 | V | 17.6 | 16.30 | 74.0 |
| 2917.000000 | 57.31 | V | 17.3 | 16.69 | 74.0 |
| 2934.500000 | 56.89 | V | 17.5 | 17.11 | 74.0 |

| Frequency (MHz) | Average-ClearWrite (dBμV/m) | Polarization | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|---|---|---|---|---|---|
| 2449.000000 | 43.06 | H | 15.3 | 10.94 | 54.00 |
| 2582.500000 | 43.97 | V | 16.2 | 10.03 | 54.00 |
| 2691.000000 | 44.88 | V | 16.9 | 9.12 | 54.00 |
| 2789.500000 | 45.70 | V | 17.6 | 8.30 | 54.00 |
| 2928.500000 | 45.20 | H | 17.5 | 8.80 | 54.00 |
| 2938.500000 | 45.37 | V | 17.4 | 8.63 | 54.00 |

**916(100kbps) (1-10GHz)**

| Frequency (MHz) | MaxPeak-ClearWrite (dBμV/m) | Polarization | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|---|---|---|---|---|---|
| 2445.000000 | 55.50 | H | 15.1 | 18.50 | 74.0 |
| 2543.000000 | 55.38 | V | 15.3 | 18.62 | 74.0 |
| 2663.000000 | 56.44 | V | 16.3 | 17.56 | 74.0 |
| 2794.000000 | 57.00 | V | 17.5 | 17.00 | 74.0 |
| 2897.500000 | 57.56 | V | 17.0 | 16.44 | 74.0 |
| 2930.000000 | 57.05 | H | 17.6 | 16.95 | 74.0 |

| Frequency (MHz) | Average-ClearWrite (dBμV/m) | Polarization | Corr. (dB) | Margin (dB) | Limit (dBμV/m) |
|---|---|---|---|---|---|
| 2461.000000 | 42.94 | V | 15.5 | 11.06 | 54.00 |
| 2581.500000 | 43.97 | H | 16.2 | 10.03 | 54.00 |
| 2690.500000 | 44.88 | V | 16.9 | 9.12 | 54.00 |
| 2791.500000 | 45.64 | V | 17.6 | 8.36 | 54.00 |
| 2928.000000 | 45.20 | H | 17.5 | 8.80 | 54.00 |
| 2931.000000 | 45.38 | V | 17.5 | 8.62 | 54.00 |

**See ANNEX B for test graphs.**

**Conclusion: PASS**

**Note:**

A "reference path loss" is established and the $A_{Rpl}$ is the attenuation of “reference path loss”, and including the gain of receive antenna, the gain of the preamplifier, the cable loss.

$P_{Mea}$ is the field strength recorded from the instrument.

The measurement results are obtained as described below:

Result = $P_{Mea}$ + $A_{Rpl}$ = $P_{Mea}$ + Cable Loss + Antenna Factor

# ANNEX B: TEST GRAPHS

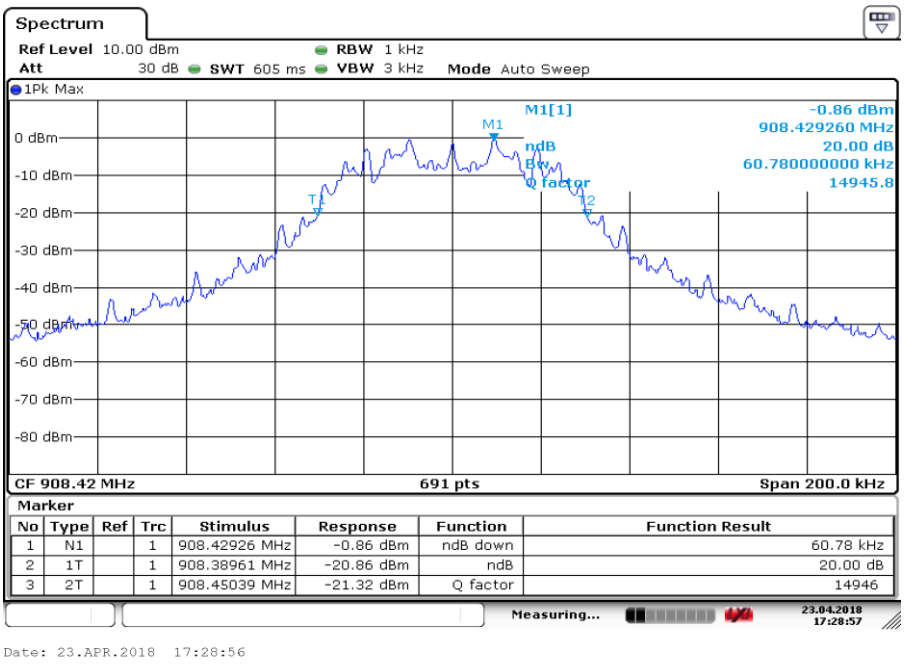


**Fig.1 Occupied 20dB Bandwidth (908.42MHz, 9.6kbps)**

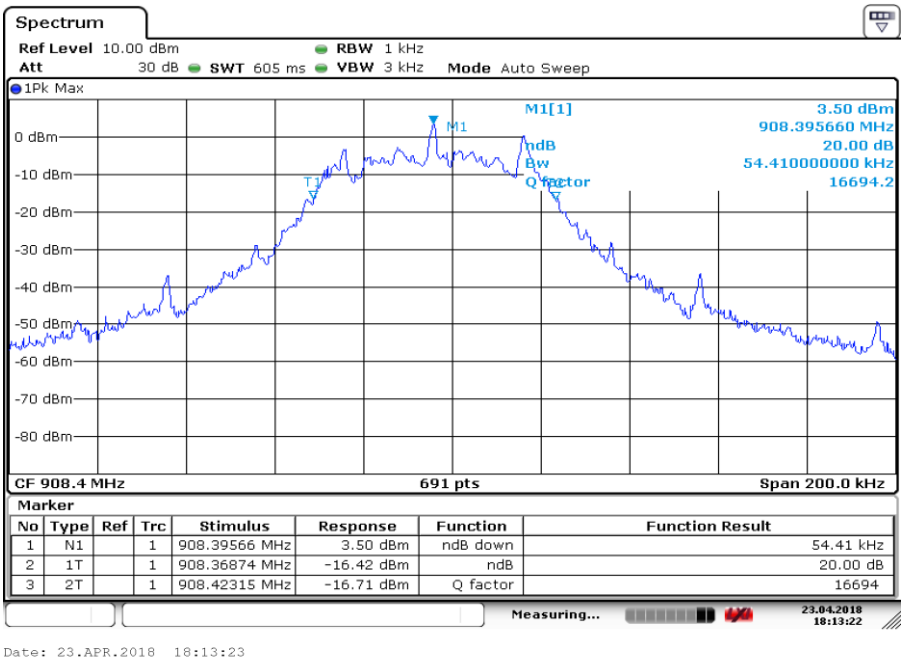


**Fig.2 Occupied 20dB Bandwidth (908.4MHz, 40kbps)**

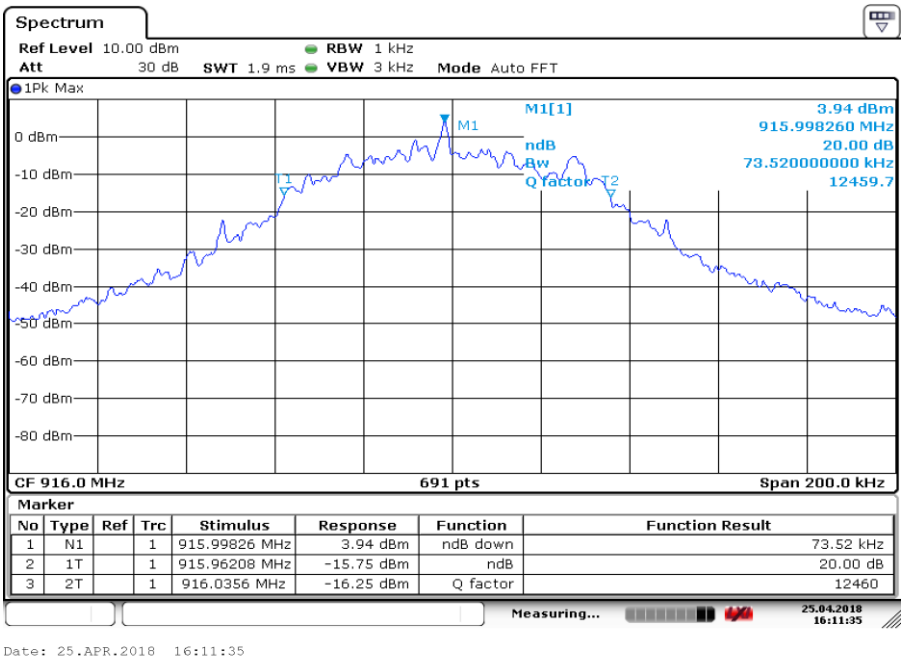


**Fig.3 Occupied 20dB Bandwidth (916MHz, 100kbps)**

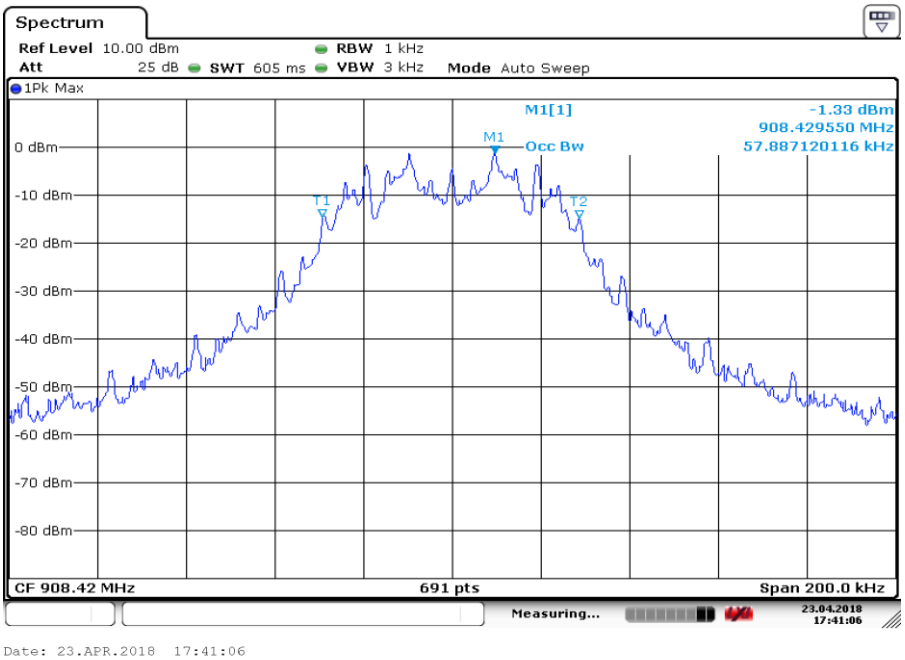


**Fig.4 Occupied Bandwidth (908.42MHz, 9.6kbps)**

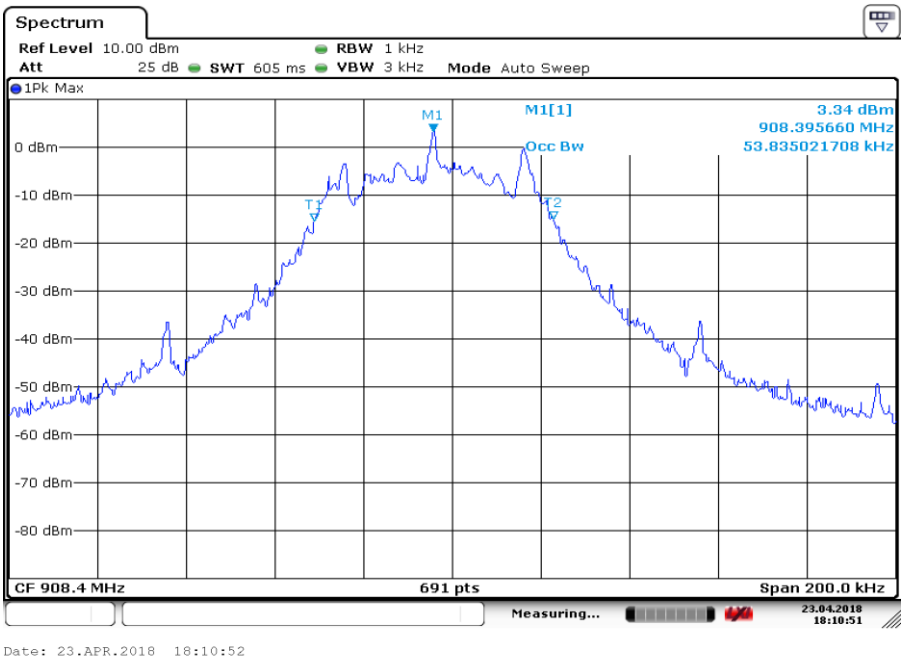


**Fig.5 Occupied Bandwidth (908.4MHz, 40kbps)**

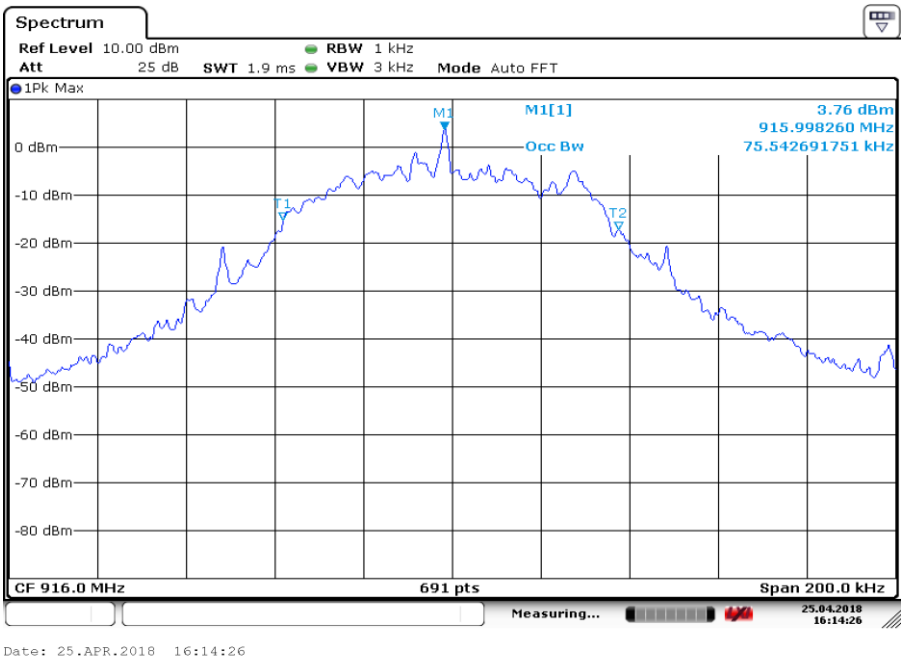


**Fig.6 Occupied Bandwidth (916MHz, 100kbps)**

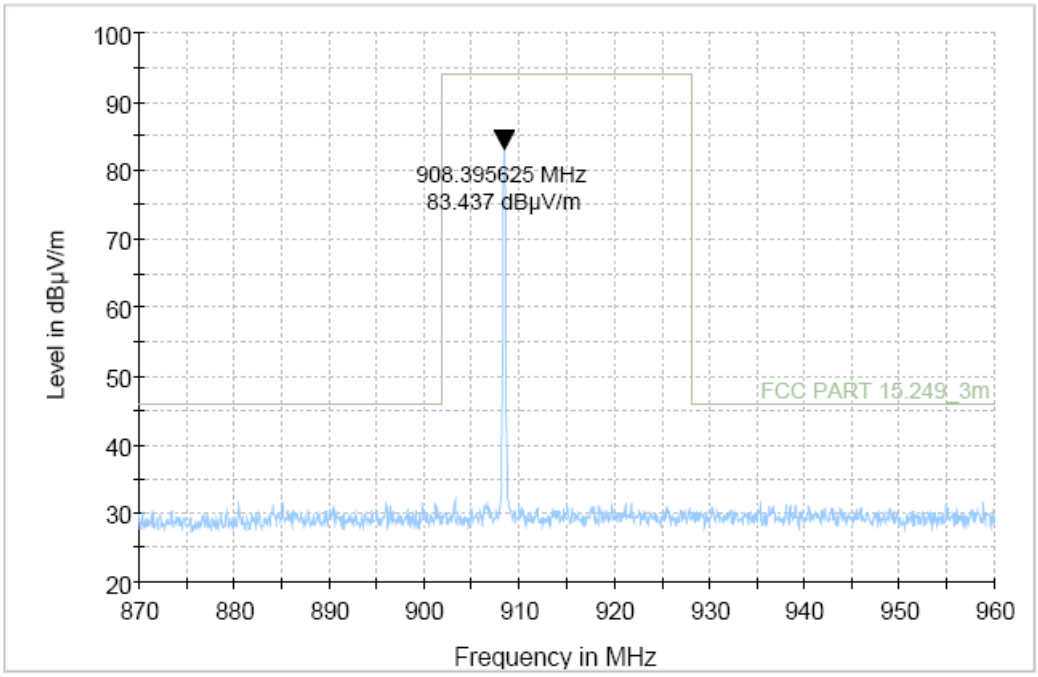


**Fig.7 Radiated Emission (908.42MHz, 9.6kbps)**

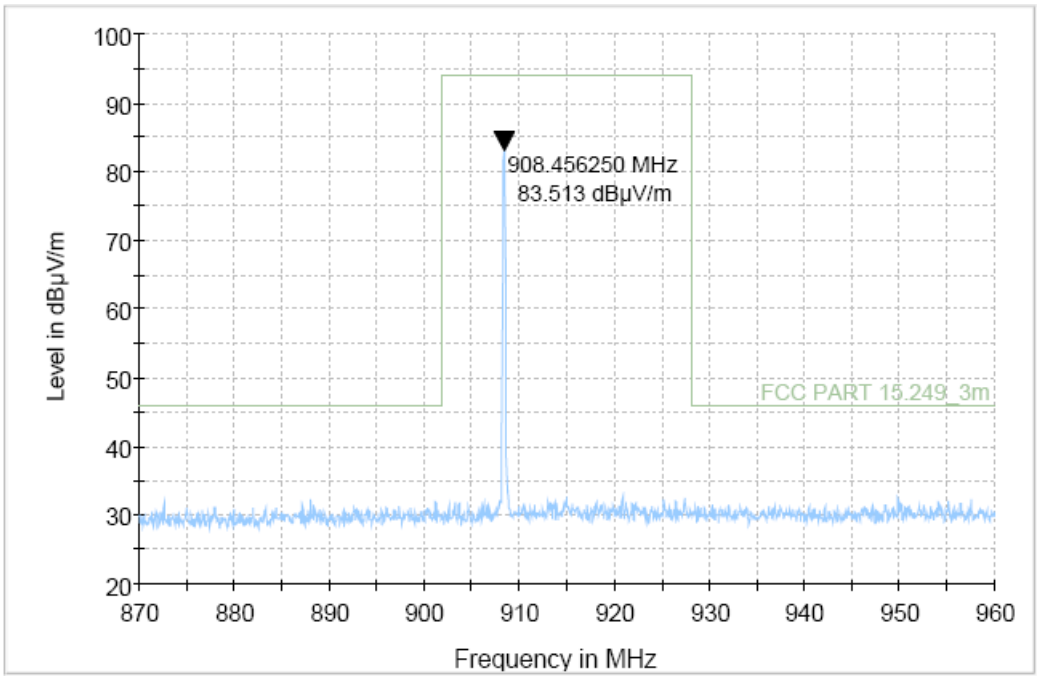


**Fig.8 Radiated Emission (908.4MHz, 40kbps)**

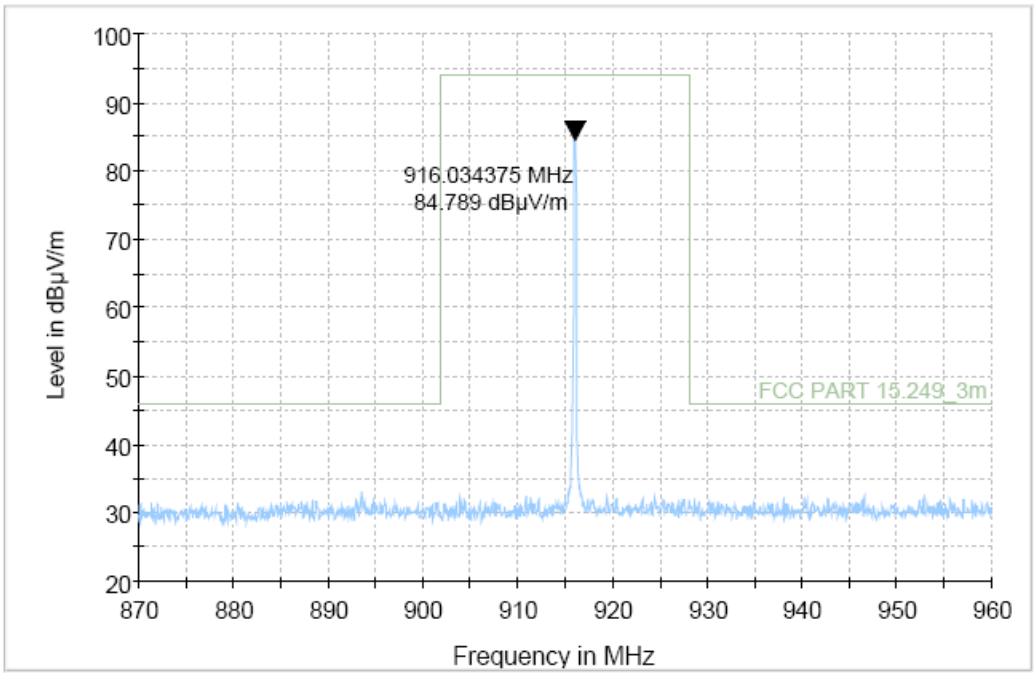


**Fig.9 Radiated Emission (916MHz, 100kbps)**

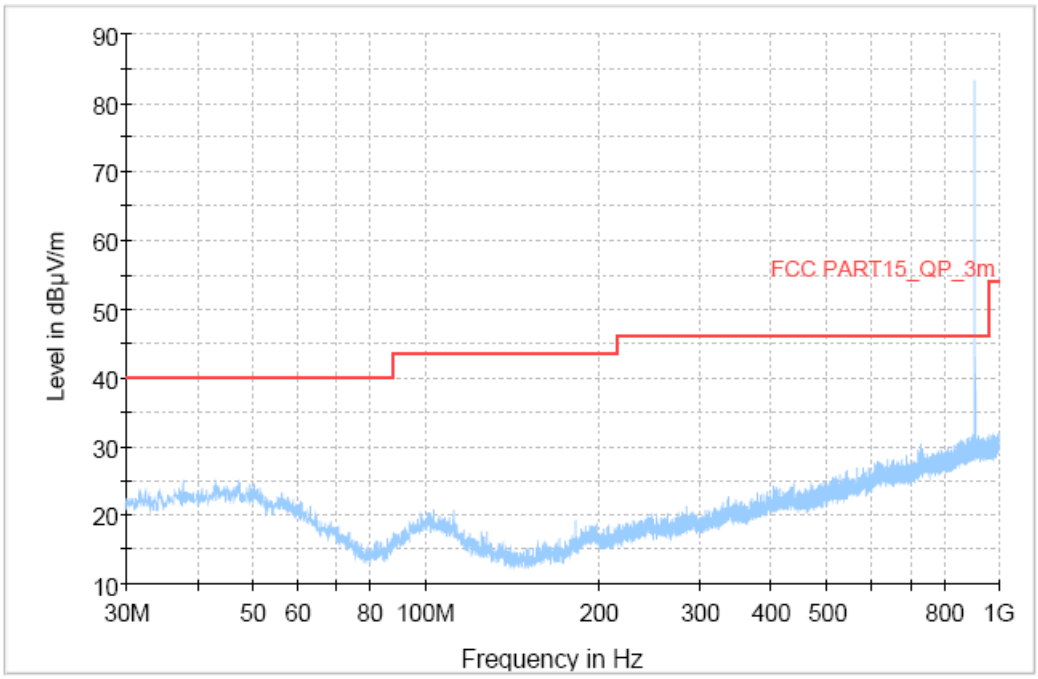


**Fig.10 Radiated Spurious Emission (908.42MHz, 9.6kbps, 30MHz-1GHz)**

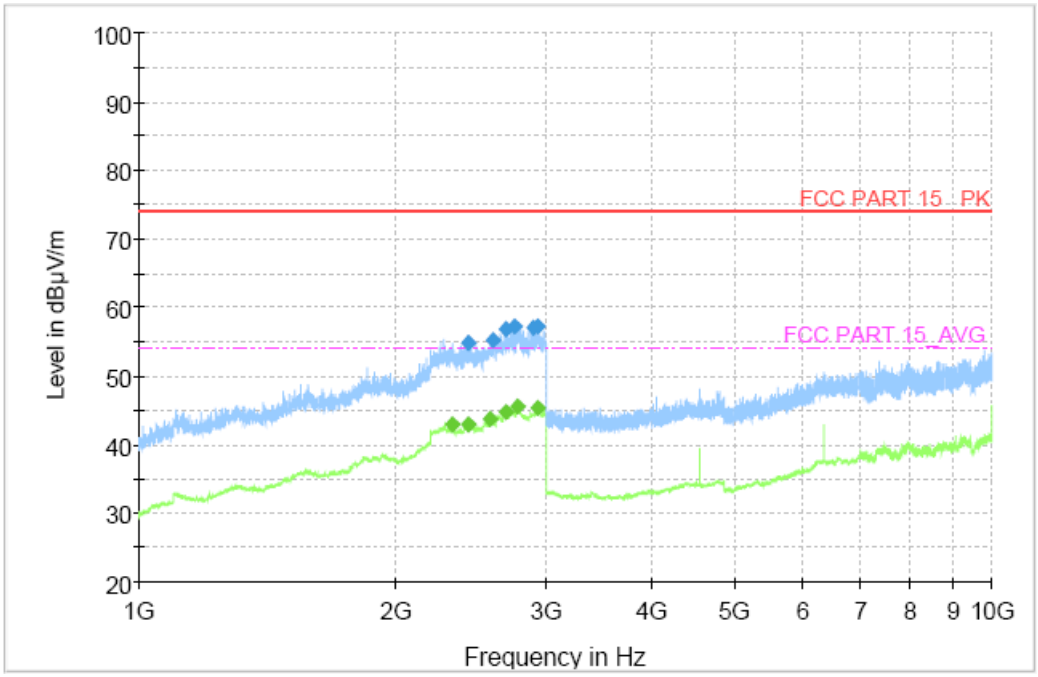


**Fig.11 Radiated Spurious Emission (908.42MHz, 9.6kbps, 1GHz-10GHz)**

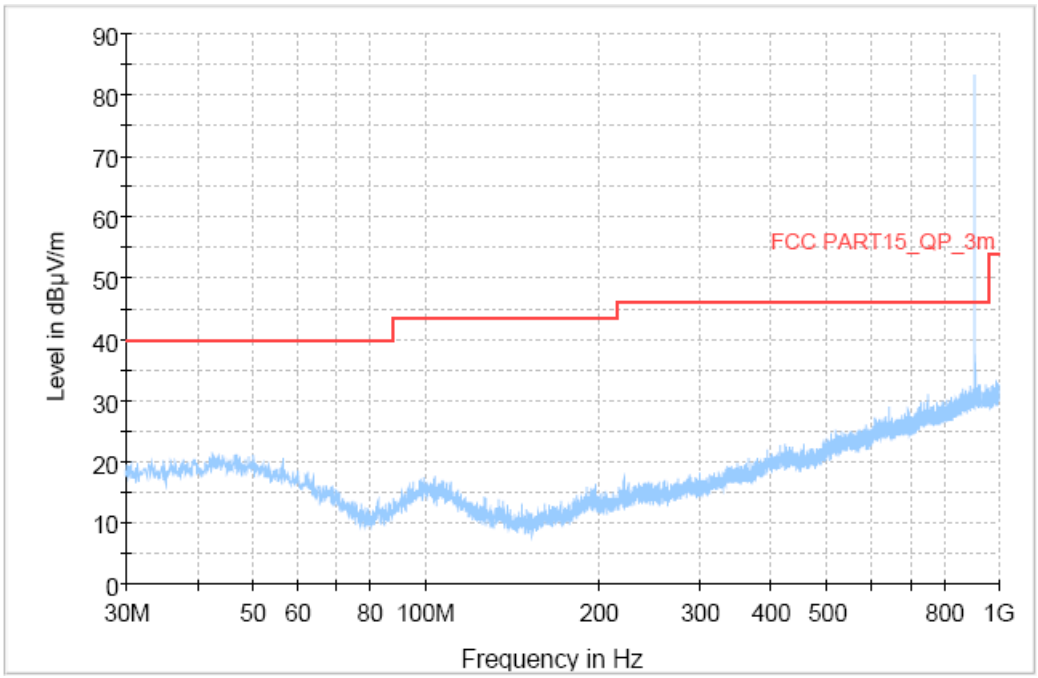


**Fig.12 Radiated Spurious Emission (908.4MHz, 40kbps, 30MHz-1GHz)**

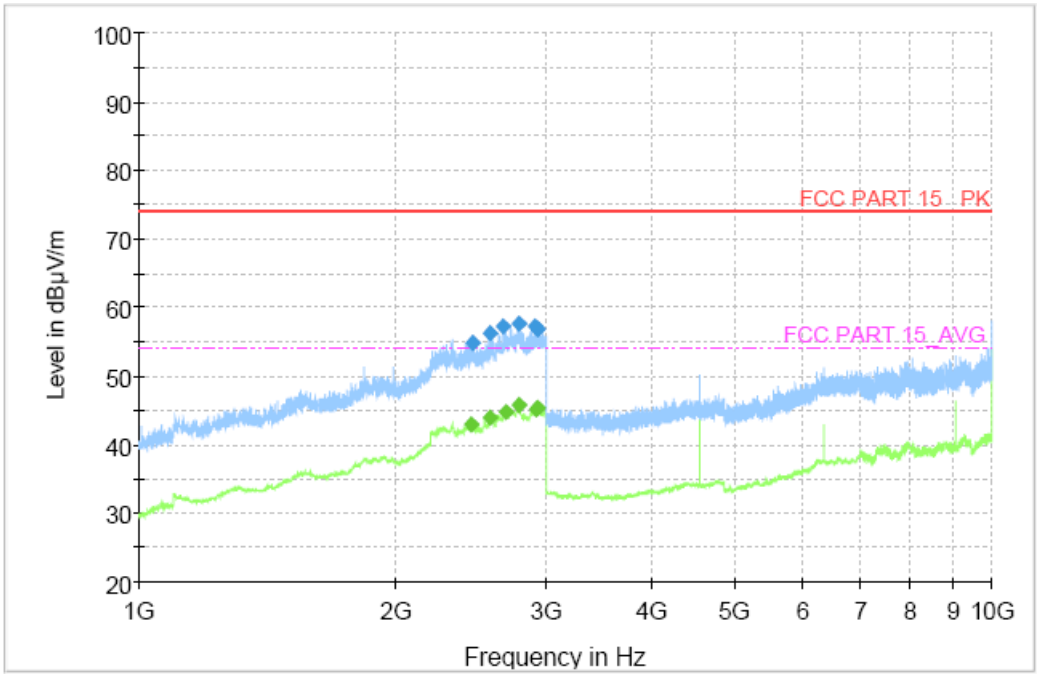


**Fig.13 Radiated Spurious Emission (908.4MHz, 40kbps, 1GHz-10GHz)**

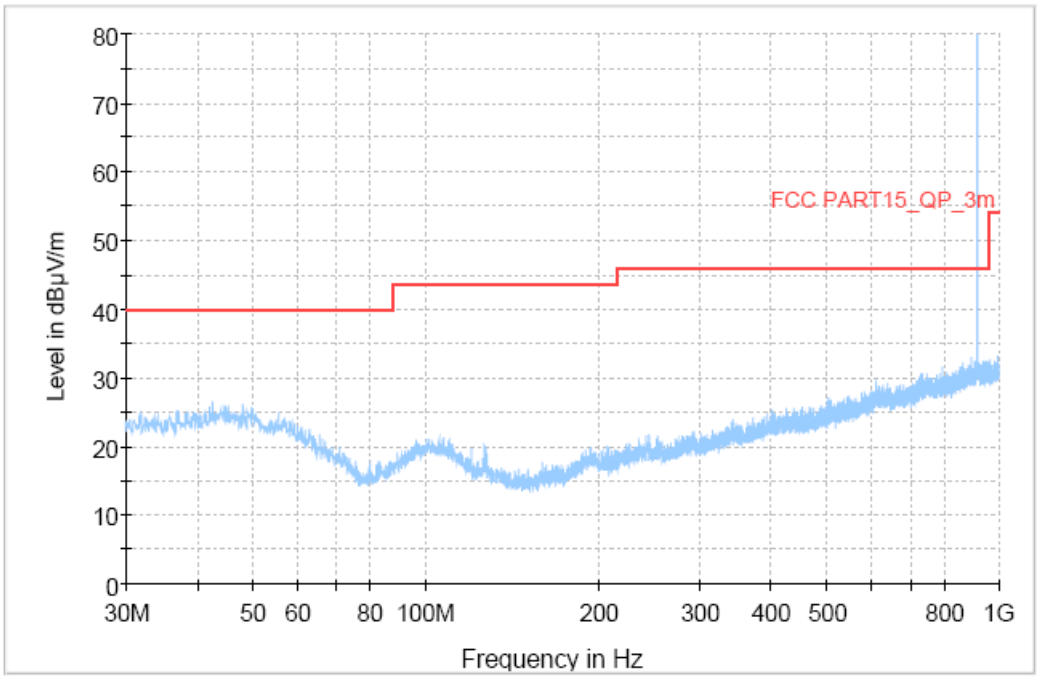


**Fig.14 Radiated Spurious Emission (916MHz, 100kbps, 30MHz-1GHz)**

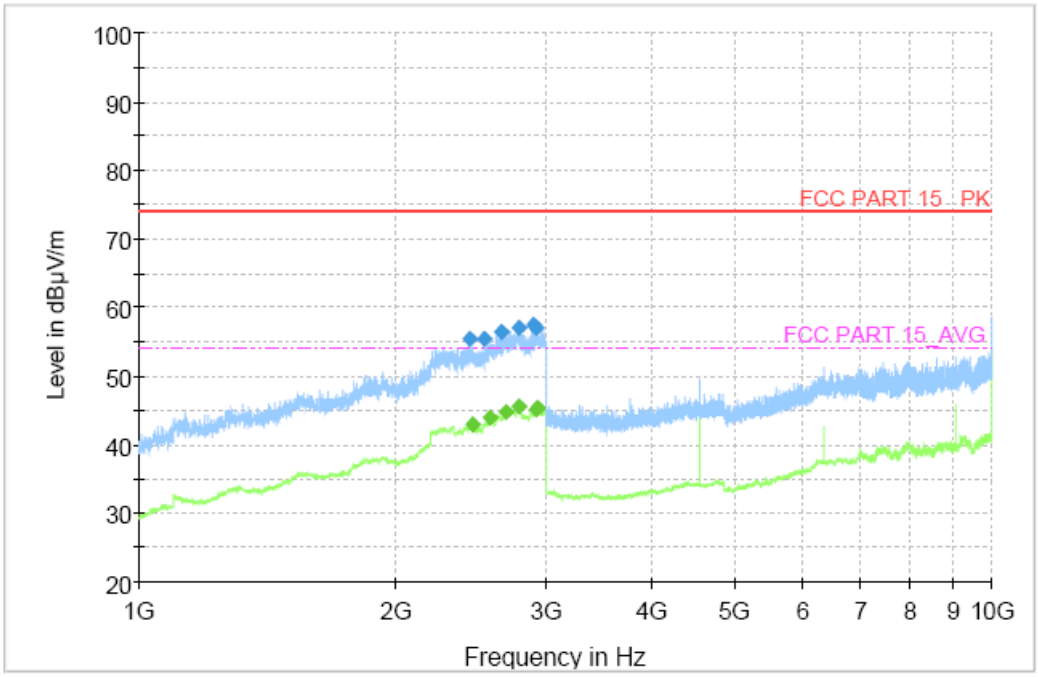


**Fig.15 Radiated Spurious Emission (916MHz, 100kbps, 1GHz-10GHz)**

## ANNEX C: Persons involved in this testing

| Test Name | Tester |
|---|---|
| Occupied 20dB Bandwidth | Lin Kanfeng, Tang Weisheng |
| Occupied Bandwidth | Lin Kanfeng, Tang Weisheng |
| Radiated Emissions | Lin Kanfeng, Tang Weisheng |

*****END OF REPORT*****