

FCC PART 15C TEST REPORT FOR CERTIFICATION

On Behalf of

TLV CO., LTD.

RF Module

Model No.: iT-ZB-S

FCC ID: H3RTZSS1001

Prepared for : TLV CO., LTD.

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Japan

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Report Number : ACS-F17125
Date of Test : Jun.20~Jul.11, 2017
Date of Report : Jul.19, 2017

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TEST REPORT CERTIFICATION

Applicant : TLV CO., LTD.
 Manufacture : TLV CO., LTD.
 Product : RF Module
 FCC ID : H3RTZSS1001
 (A) Model No. : iT-ZB-S
 (B) Power Supply : DC 3.6V
 (C) Test Voltage : DC 3.6V

Tested for comply with:

FCC CFR 47 Part 15 Subpart C
 Test procedure used: ANSI C63.10: 2013;
 KDB558074 D01 v04

The device described above is tested by AUDIX TECHNOLOGY (SHENZHEN) CO., LTD. to confirm comply with all the FCC Part 15 Subpart C requirements. The test results are contained in this test report and AUDIX TECHNOLOGY (SHENZHEN) CO., LTD. is assumed full responsibility for the accuracy and completeness of these tests. Also, this report shows that the Equipment Under Test (EUT) is to be technically compliant with the FCC requirements. This report contains data that are not covered by the NVLAP accreditation.

This Report is made under FCC Part 2.1075. No modifications were required during testing to bring this product into compliance.

This report applies to above tested sample only. This report shall not be reproduced in part without written approval of AUDIX TECHNOLOGY (SHENZHEN) CO., LTD.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

Date of Test : Jun.20~Jul.11, 2017 Report of date: Jul.19, 2017

Prepared by : Monica Liu Reviewed by : Sunny Lu
 Monica Liu / Assistant Sunny Lu / Deputy Manager



Approved & Authorized Signer : David Lin
 David Lin / Manager

1. SUMMARY OF STANDARDS AND RESULTS

1.1. Description of Standards and Results

The EUT have been tested according to the applicable standards as referenced below.

| EMISSION | | |
|------------------------------------|---|---------|
| Description of Test Item | Standard | Results |
| Power Line Conducted Emission Test | FCC Part 15: 15.207 ANSI C63.10 :2013 | N/A |
| Radiated Emission Test | FCC Part 15: 15.209 FCC Part 15: 15.247(d) ANSI C63.10 : 2013 | PASS |
| Conducted Spurious Emissions | FCC Part 15: 15.247(a)(1) ANSI C63.10 : 2013 | PASS |
| 6dB Bandwidth Test | FCC Part 15: 15.215 ANSI C63.10 : 2013 | PASS |
| Maximum Peak Output Power Test | FCC Part 15: 15.247(b)(1) ANSI C63.10 : 2013 | PASS |
| Band Edge Compliance Test | FCC Part 15: 15.247(d) ANSI C63.10 : 2013 | PASS |
| Power Spectral Density Test | FCC Part 15: 15.247(d) ANSI C63.10 : 2013 | PASS |
| MPE Estimation | FCC Part 15: 15.247 | PASS |
| Antenna requirement | FCC Part 15: 15.203 | PASS |

N/A is an abbreviation for Not Applicable

2. GENERAL INFORMATION

2.1. Description of Device (EUT)

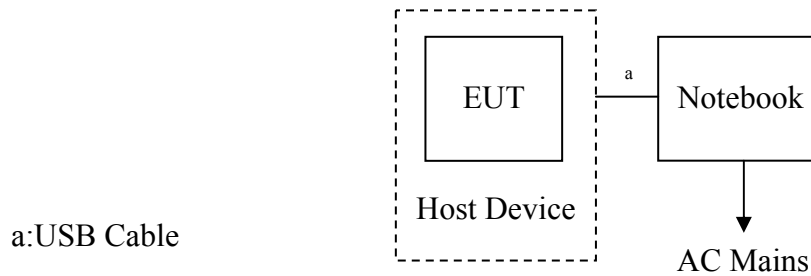
| | |
|---------------------|--|
| Product | : RF Module |
| Model No. | : iT-ZB-S |
| Hardware version | : iT-ZB-S |
| Firmware version | : 1.00 |
| FCC ID | : H3RTZSS1001 |
| Radio | : 2.4GHz Wireless |
| Operation frequency | : 2405MHz-2480MHz |
| Antenna | : Chip Antenna, 2.4dBi PK gain |
| Modulation | : O-QPSK |
| Applicant | : TLV CO., LTD. 881 Nagasuna, Noguchi, Kakogawa, Hyogo 675-8511 Japan |
| Manufacturer | : TLV CO., LTD. 881 Nagasuna, Noguchi, Kakogawa, Hyogo 675-8511 Japan |
| Factory | : TLV CO., LTD. 881 Nagasuna, Noguchi, Kakogawa, Hyogo 675-8511 Japan |
| Date of Test | : Jun.20~Jul.11, 2017 |
| Date of Receipt | : Jun.18, 2016 |
| Sample Type | : Prototype production |

2.2. Block diagram of connection between the EUT and simulators

2.2.1. Tested Supporting System Details

| No. | Description | ACS No. | Manufacturer | Model | Serial Number |
|-----|--|--|--------------|------------|---------------|
| 1 | Notebook | N/A | HP | TPN-C116 | N/A |
| | | Power Cord: Unshielded, Detachable, 1.5m | | | |
| 2. | USB Cable | Shielded, Detachable, 1.5m | | | |
| 3 | iTrapSensor Monitoring System, Sensor Unit | N/A | LTV | iT5-ZB-SUN | N/A |

2.2.2. Radiated Spurious Emissions Test



a:USB Cable

(EUT: RF Module)

2.3. Test Facility
Site Description

Name of Firm : Audix Technology (Shenzhen) Co., Ltd.
No. 6, Kefeng Road, Science & Technology Park, Nanshan District, Shenzhen, Guangdong, China

EMC Lab. : Certificated by Industry Canada
Registration Number: IC 5183A-1
Valid Date: May.07, 2020

: Certificated by DAkkS, Germany
Registration No: D-PL-12151-01-00
Valid Date: Dec.07, 2021

: Accredited by NVLAP, USA
NVLAP Code: 200372-0
Valid Date: Mar.31, 2018

2.4. Measurement Uncertainty (95% confidence levels, k=2)

| Test Item | Uncertainty |
|--|------------------------------------|
| Uncertainty for Radiation Emission test in 3m chamber | 2.8 dB(30~200MHz, Polarization: H) |
| | 2.8 dB(30~200MHz, Polarization: V) |
| | 3.0 dB(200M~1GHz, Polarization: H) |
| | 3.0 dB(200M~1GHz, Polarization: V) |
| Uncertainty for Radiation Emission test in 3m chamber (1GHz-18GHz) | 5.8 dB (1~6GHz, Distance: 3m) |
| | 5.8 dB (6~18GHz, Distance: 3m) |
| Uncertainty for Radiated Spurious Emission test in RF chamber | 3.6 dB |
| Uncertainty for Conduction Spurious emission test | 2.0 dB |
| Uncertainty for Output power test | 0.8 dB |
| Uncertainty for Bandwidth test | 83 kHz |
| Uncertainty for DC power test | 0.1 % |
| Uncertainty for test site temperature and humidity | 0.6°C |
| | 3% |

3. POWER LINE CONDUCTED EMISSION TEST

According to Paragraph (c) of FCC Part 15 section 15.207, Tests to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

4. RADIATED EMISSION MEASUREMENT

4.1. Test Equipment

Frequency range: 30~1000MHz

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|------|-------------------|-----------------|-------------|-----------------|-----------|---------------|
| 1. | 3#Chamber | AUDIX | N/A | N/A | Mar.28,17 | 1 Year |
| 2. | Spectrum Analyzer | Agilent | N9010A | MY52220804 | Oct.15,16 | 1 Year |
| 3. | EMI Test Receiver | Rohde & Schwarz | ESR7 | 101547 | Apr.22,17 | 1 Year |
| 4. | Amplifier | HP | 8447D | 2648A04738 | Apr.22,17 | 1 Year |
| 5. | Bi-log Antenna | TESEQ | CBL6112D | 25237 | Aug.03,16 | 1 Year |
| 6. | Loop Antenna | Chase | HLA6120 | 1062 | Sep.25,16 | 1 Year |
| 7. | RF Cable | MIYAZAKI | CFD400NL-LW | No.3 | Sep.26.16 | 1 Year |
| 8. | Coaxial Switch | Anritsu | MP59B | 6201397222 | Apr.22,17 | 1 Year |
| 9. | Attenuator | EMCI | EMCI-N-6-06 | AT-N0639 | Sep.26.16 | 1 Year |
| 10. | Test Software | AUDIX | e3 | 6.2009-5-21a(n) | N/A | N/A |

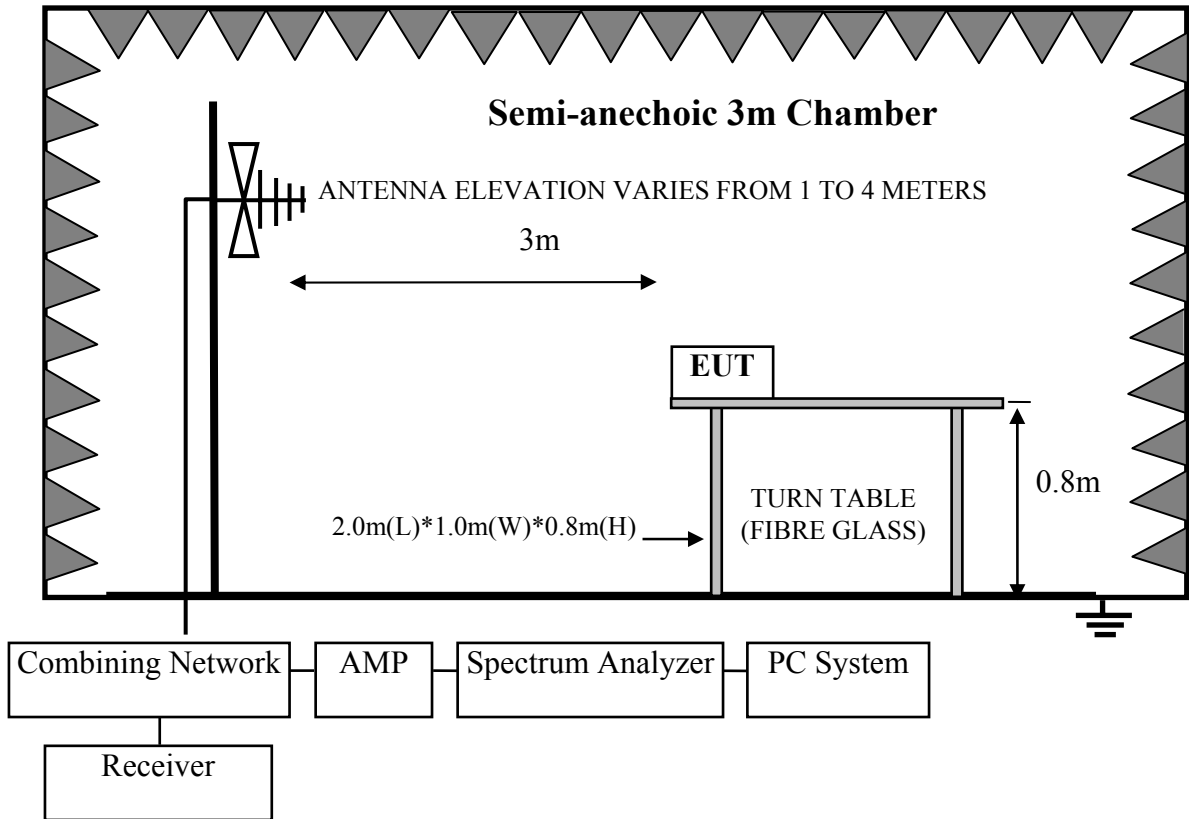
Note: N/A means Not applicable.

Frequency range: above 1000MHz

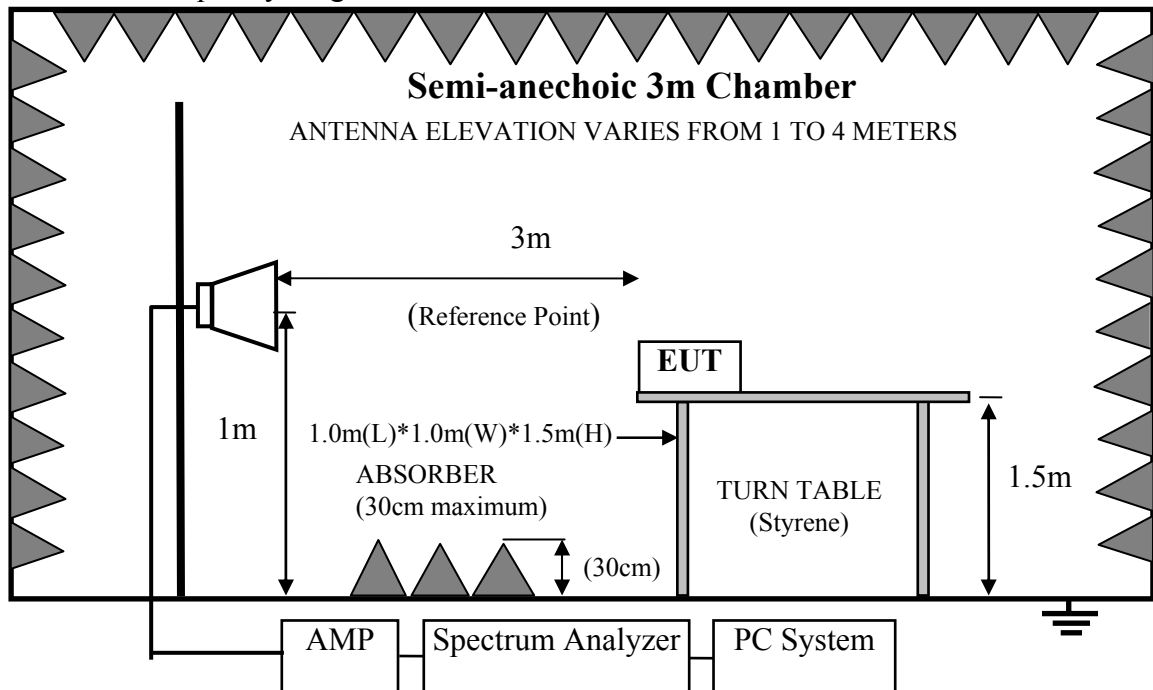
| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|------|-------------------|--------------|-------------|-----------------|-----------|---------------|
| 1. | Spectrum Analyzer | Agilent | E4446A | US44300459 | Apr.22,17 | 1 Year |
| 2. | Horn Antenna | ETC | MCTD 1209 | DRH15F03007 | May.15,17 | 1 Year |
| 3. | Amplifier | Agilent | 8449B | 3008A02495 | Apr.22,17 | 1 Year |
| 4. | RF Cable | Hubersuhner | SUCOFLEX104 | 274094/4 | Apr.22,17 | 1 Year |
| 5. | Horn Antenna | ETS | 3116 | 00060089 | Nov.16,16 | 1 Year |
| 6. | Test Software | AUDIX | e3 | 6.2009-5-21a(n) | N/A | N/A |

Note: N/A means Not applicable.

4.2. Block Diagram of Test Setup
For frequency range 30MHz-1000MHz



For frequency range 1GHz-25GHz



4.3. Radiated Emission Limit Standard:

| FREQUENCY MHz | DISTANCE Meters | FIELD STRENGTHS LIMIT | |
|------------------|--------------------|---|----------|
| | | μV/m | dB(μV)/m |
| 30 ~ 88 | 3 | 100 | 40.0 |
| 88 ~ 216 | 3 | 150 | 43.5 |
| 216 ~ 960 | 3 | 200 | 46.0 |
| 960 ~ 1000 | 3 | 500 | 54.0 |
| Above 1000MHz | 3 | 74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average) | |

- Remark :
- (1) Emission level dBμV = 20 log Emission level μV/m
 - (2) The smaller limit shall apply at the cross point between two frequency bands.
 - (3) Distance is the distance in meters between the measuring instrument, antenna and the closest point of any part of the device or system.
 - (4) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

4.4. EUT Configuration on Test

The following equipment are installed on Radiated Emission Test to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

4.4.1. RF Module (EUT)

Model No. : iT-ZB-S
Serial No. : N/A

4.5. Operating Condition of EUT

- 4.5.1. Setup the EUT and simulator as shown as Section 4.2.
- 4.5.2. Turn on the power of all equipments.
- 4.5.3. Let EUT work in Tx mode.

4.6. Test Procedure

Frequency below 30MHz:

The EUT setup on the turn table which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

EUT and its simulators are placed on a turn table, which is 0.8 meter high above ground for frequency 30MHz~1000MHz, 1.5 meter high above ground for frequency above 1GHz and put the absorbing with 2.4m(L)*2.4m(W)*0.3m(H) on the ground . The turn table can rotate 360 degrees to determine the position of the maximum emission level. Power on the EUT and let it working in test mode, then test it.EUT is set 3 meters away from the receiving antenna, which is mounted on a antenna tower. The antenna can be moved up and down between 1 meter and 4 meters to find out the maximum emission level. Broadband antenna (calibrated bilog antenna) is used as receiving antenna for frequency 30MHz~1000MHz, and the Horn antenna is used as receiving antenna for frequency above 1GHz. Both horizontal and vertical polarization of the antenna is set on Test. In order to find the maximum emission levels, all of the interface cables must be manipulated according to ANSI C63.10-2013 on radiated emission Test.

This test was performed with EUT in X, Y, Z position, and the worse case was found when EUT in X position as the test photo indicated.

The bandwidth of the EMI test receiver (R&S ESVS10) is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's RBW is set at 1MHz and VBW is set at 3MHz for peak emissions measurement and RBW is set at 1MHz, VBW is set at 10Hz for average measurement

The frequency range from 30MHz to 10th harmonic (25GHz) are checked. and no any emissions were found from 18GHz to 25 GHz, So the radiated emissions from 18GHz to 25GHz were not record.

4.7. Radiated Emission Test Results

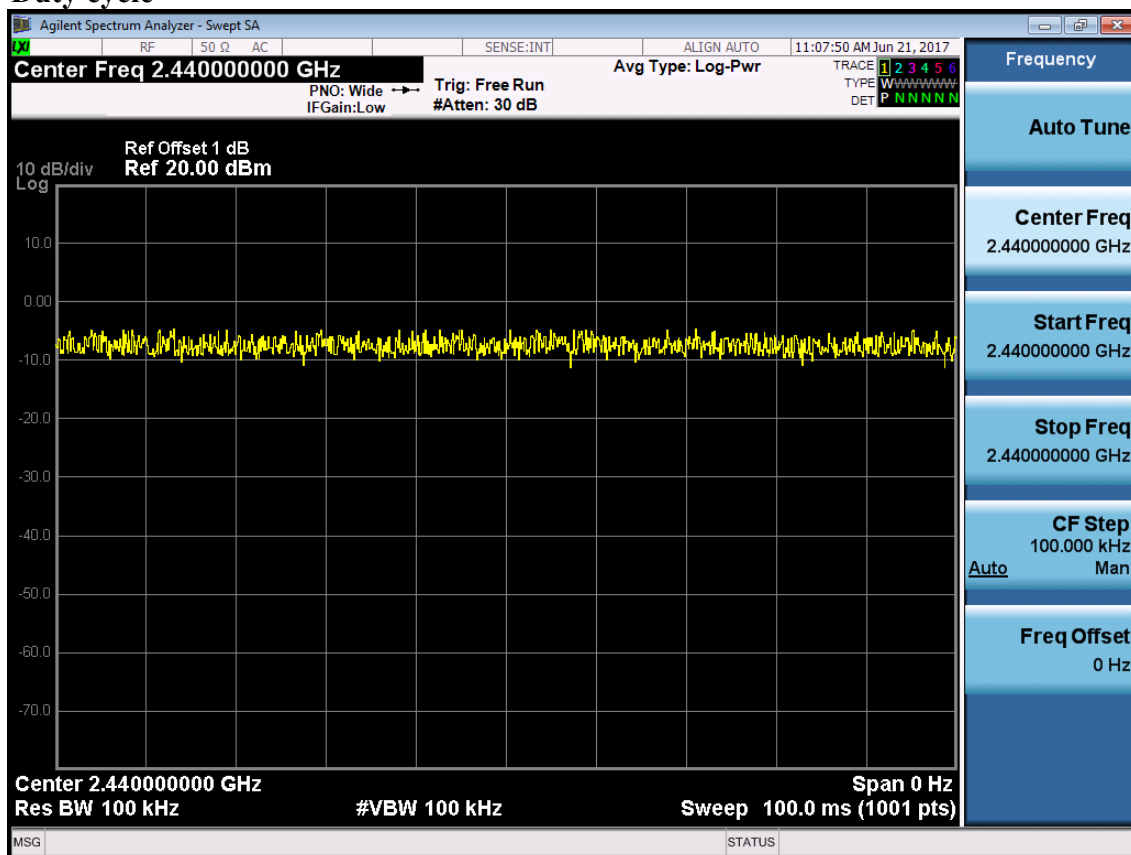
PASS.

All the emissions from 30MHz to 25GHz were comply with the 15.209 Limit.

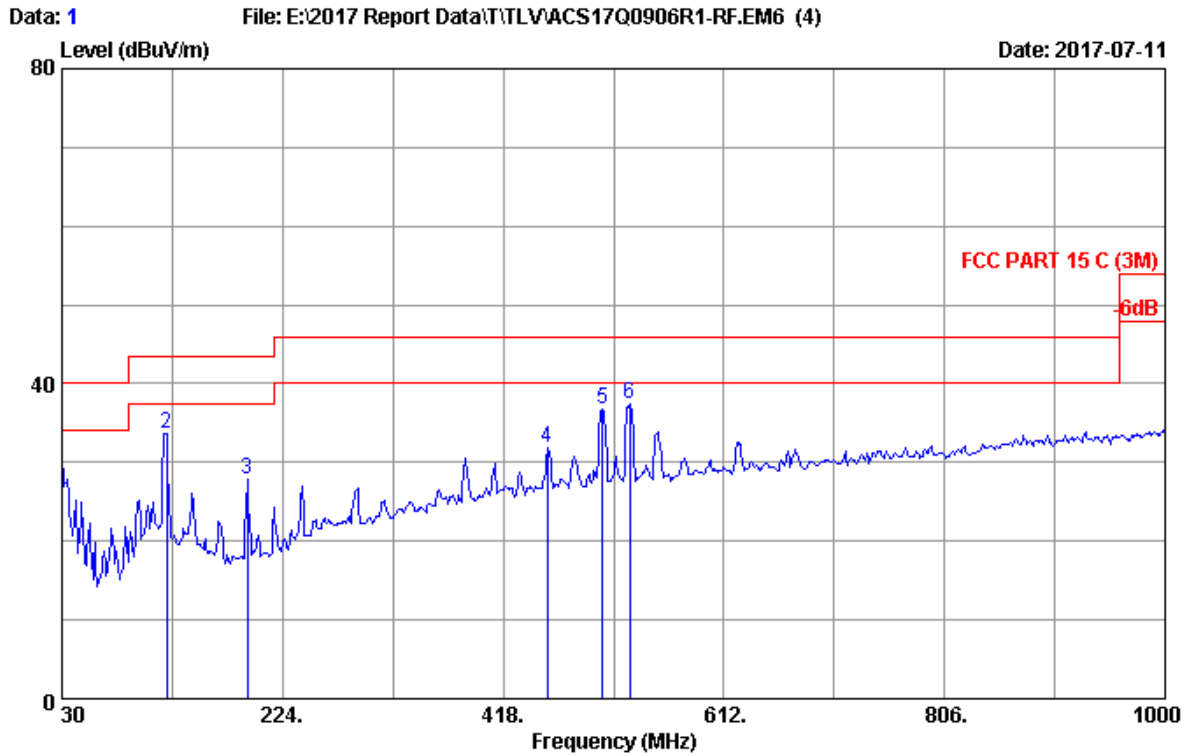
Note1: For emissions above 1GHz, if peak level comply with average limit, then the average level is deemed to comply with average limit.

Note 2: The emissions (9kHz~30MHz) not reported for there is no emission be found.

Duty cycle



Note: The Duty Cycle is close to 100%.

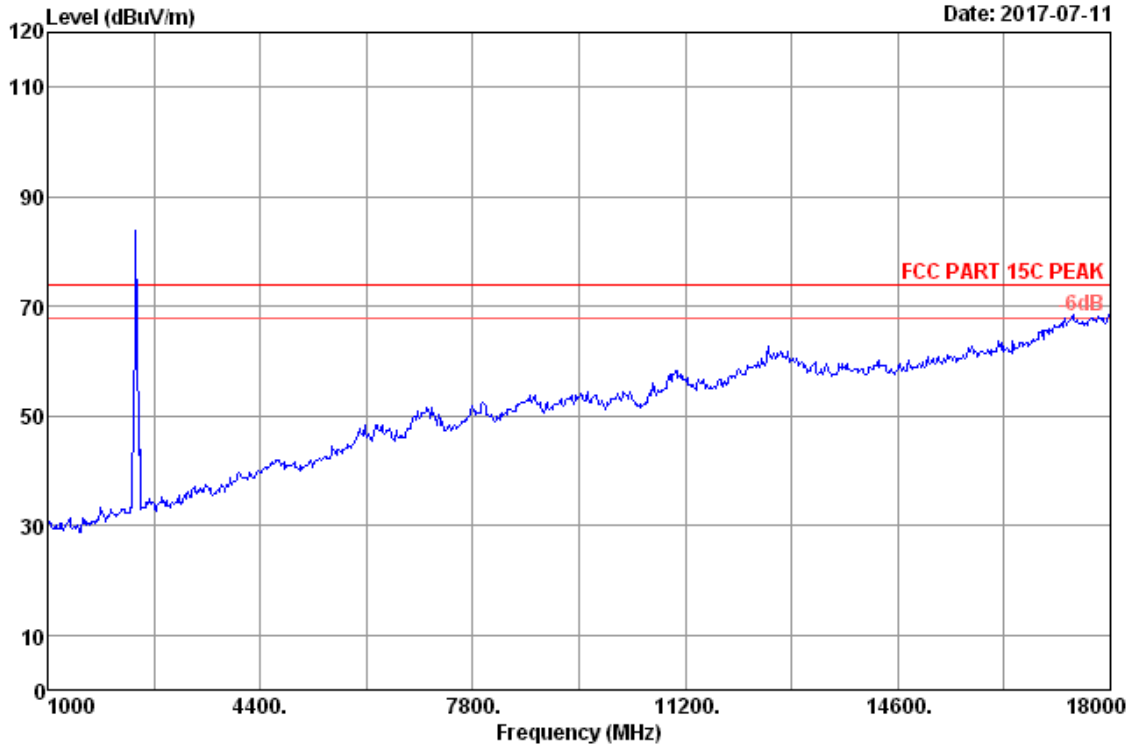


Site no. : 3m Chamber Data no. : 1
 Dis. / Ant. : 3m 2016 CBL6112D 25237 Ant. pol. : VERTICAL
 Limit : FCC PART 15 C (3M)
 Env. / Ins. : 22.5°C/49.2% Engineer : Frank
 EUT : iT-ZB-S
 Power rating : DC 3.6V
 Test Mode : TX Mode

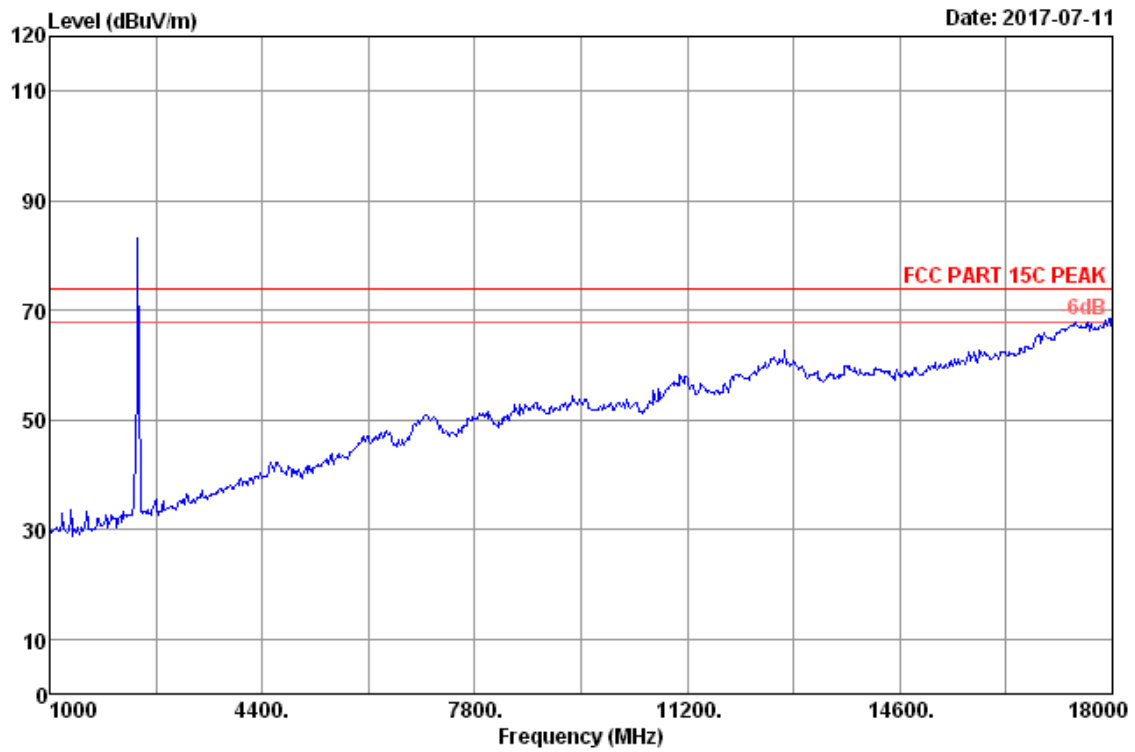
| No. | Freq. (MHz) | Ant. Factor (dB/m) | Cable Loss (dB) | Reading (dBUV) | Emission Level (dBUV/m) | Limits (dBUV/m) | Margin (dB) | Remark |
|-----|-------------|--------------------|-----------------|----------------|-------------------------|-----------------|-------------|--------|
| 1 | 30.000 | 22.20 | 6.42 | 1.53 | 30.15 | 40.00 | 9.85 | QP |
| 2 | 122.150 | 13.00 | 7.01 | 13.56 | 33.57 | 43.50 | 9.93 | QP |
| 3 | 192.960 | 10.25 | 6.93 | 10.63 | 27.81 | 43.50 | 15.69 | QP |
| 4 | 456.800 | 17.45 | 8.51 | 6.01 | 31.97 | 46.00 | 14.03 | QP |
| 5 | 505.300 | 18.16 | 8.66 | 9.95 | 36.77 | 46.00 | 9.23 | QP |
| 6 | 529.550 | 18.45 | 8.75 | 10.19 | 37.39 | 46.00 | 8.61 | QP |

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

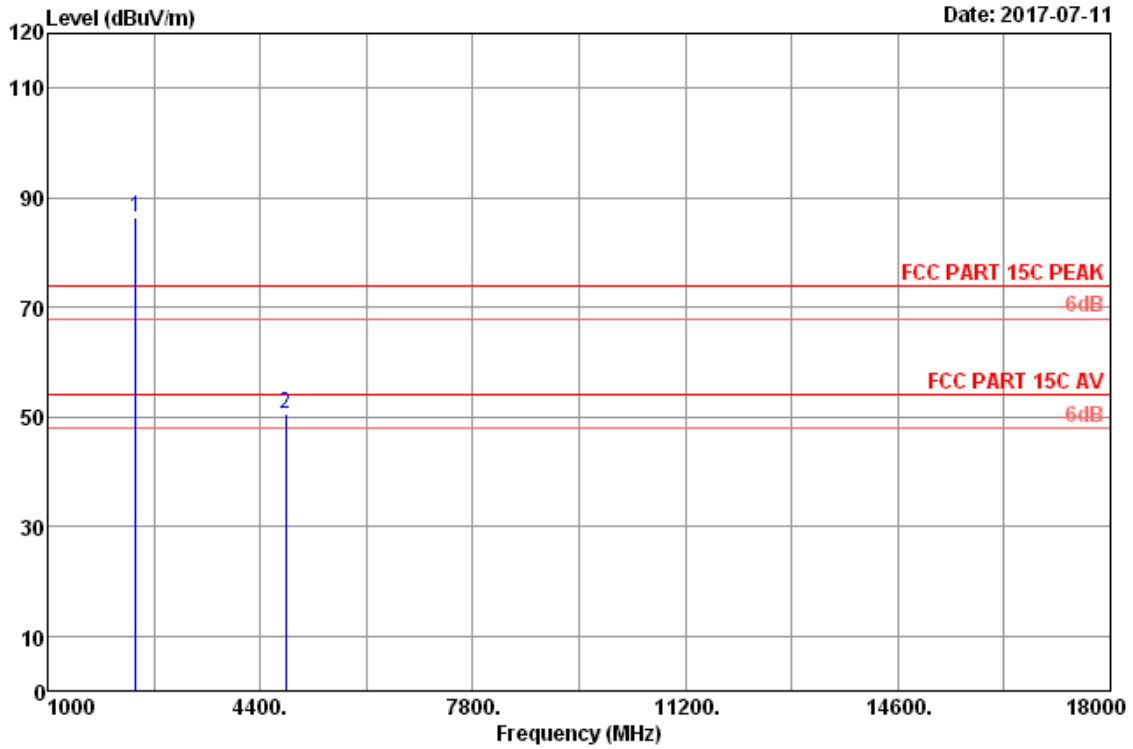
Frequency: 1GHz~18GHz



Site no. : 3m Chamber Data no. : 1
Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : VERTICAL
Limit : FCC PART 15C PEAK Pre : 101.2kPa
Env. / Ins. : 23.1°C/53.2% Engineer : zack_zhu
EUT : iT-ZB-S
Power : DC 3.6V
Test Mode : 2405MHz TX Mode



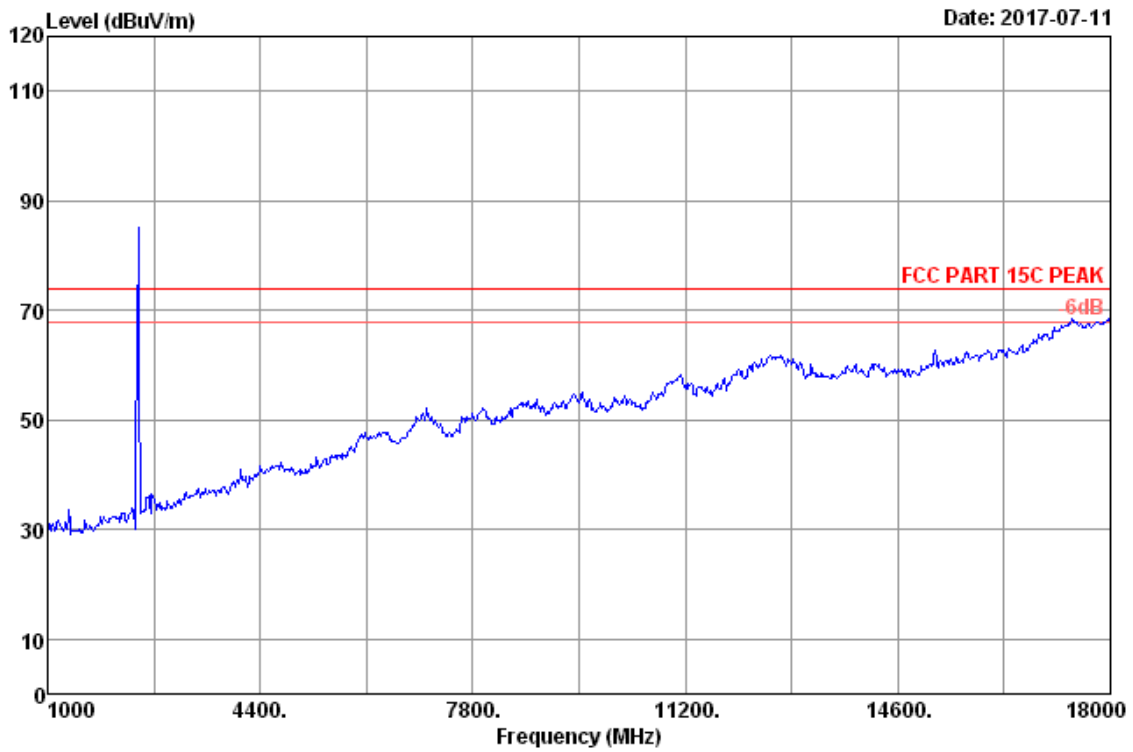
Site no. : 3m Chamber Data no. : 3
Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : HORIZONTAL
Limit : FCC PART 15C PEAK Pre : 101.2kPa
Env. / Ins. : 23.1°C/53.2% Engineer : zack_zhu
EUT : iT-ZB-S
Power : DC 3.6V
Test Mode : 2405MHz TX Mode



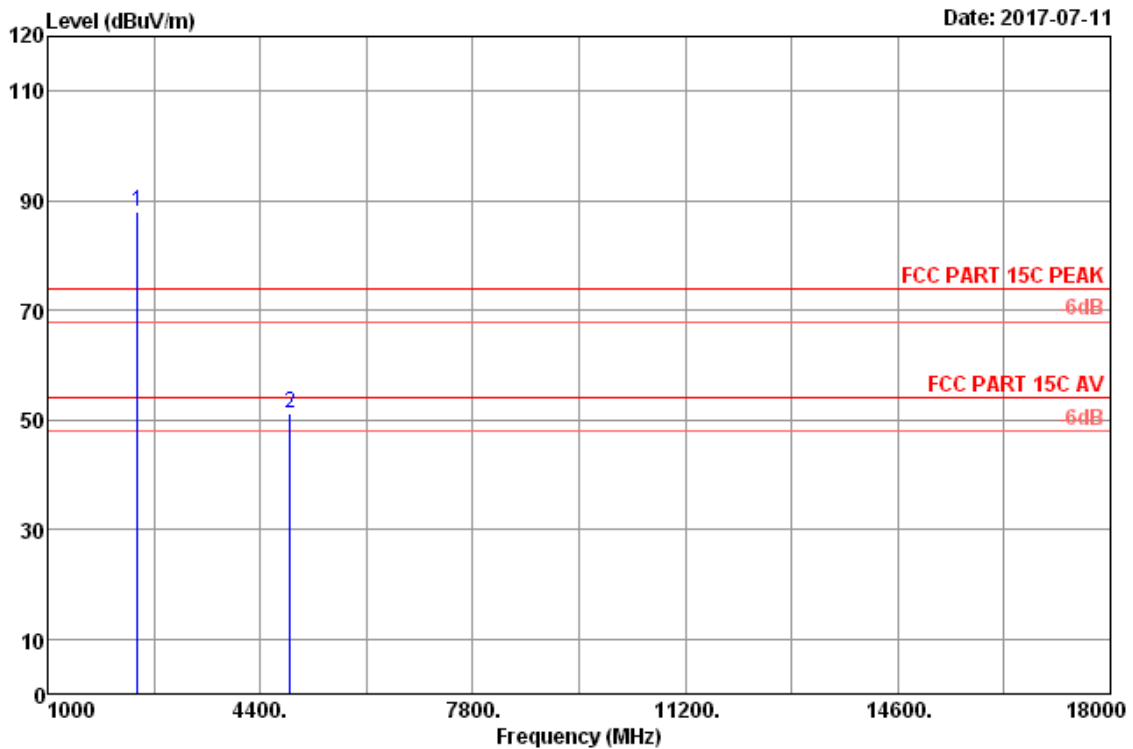
Site no. : 3m Chamber Data no. : 4
 Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK Pre : 101.2kPa
 Env. / Ins. : 23.1*C/53.2% Engineer : zack_zhu
 EUT : iT-ZB-S
 Power : DC 3.6V
 Test Mode : 2405MHz TX Mode

| No. | Freq. (MHz) | Ant. Factor (dB/m) | Cable Loss (dB) | Reading (dBuV) | AMP factor (dB) | Emission Level (dBuV/m) | Limits (dBuV/m) | Margin (dB) | Remark |
|-----|-------------|--------------------|-----------------|----------------|-----------------|-------------------------|-----------------|-------------|--------|
| 1 | 2405.00 | 27.73 | 7.88 | 87.06 | 36.39 | 86.28 | 74.00 | -12.28 | Peak |
| 2 | 4810.00 | 32.25 | 12.07 | 42.04 | 35.67 | 50.69 | 74.00 | 23.31 | Peak |

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading -Amp Factor
 2. The emission levels that are 20dB below the official limit are not reported.



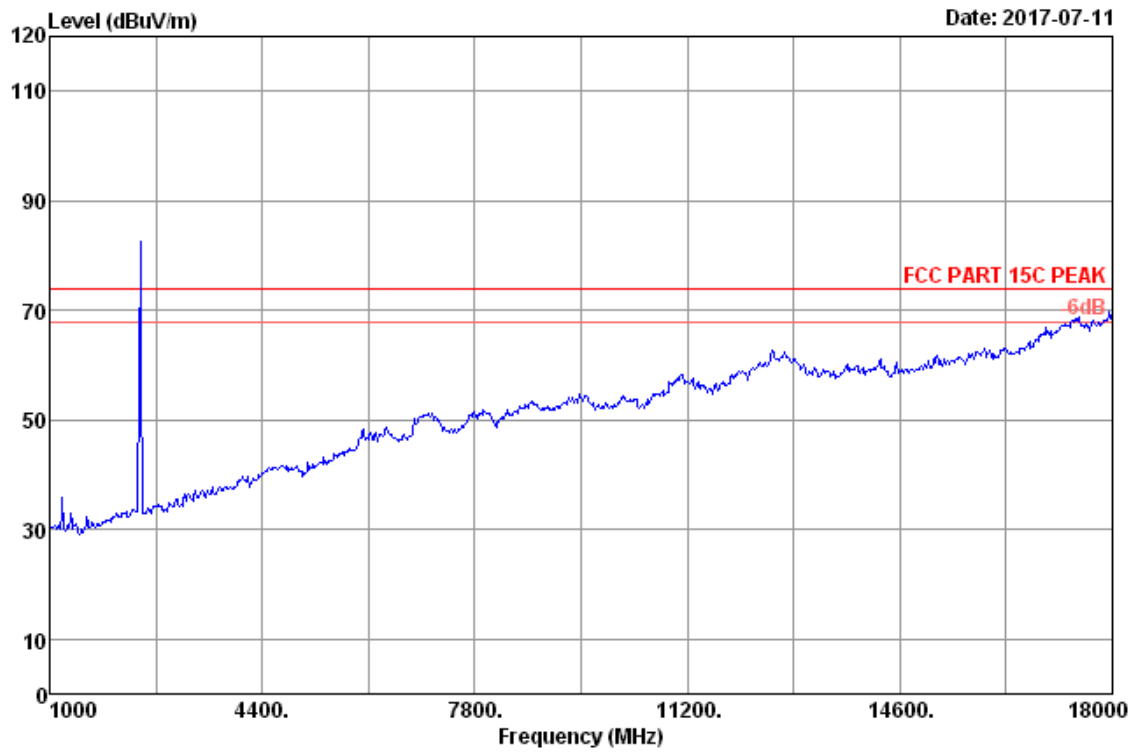
Site no. : 3m Chamber Data no. : 7
Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : VERTICAL
Limit : FCC PART 15C PEAK Pre : 101.2kPa
Env. / Ins. : 23.1*C/53.2% Engineer : zack_zhu
EUT : iT-ZB-S
Power : DC 3.6V
Test Mode : 2440MHz TX Mode



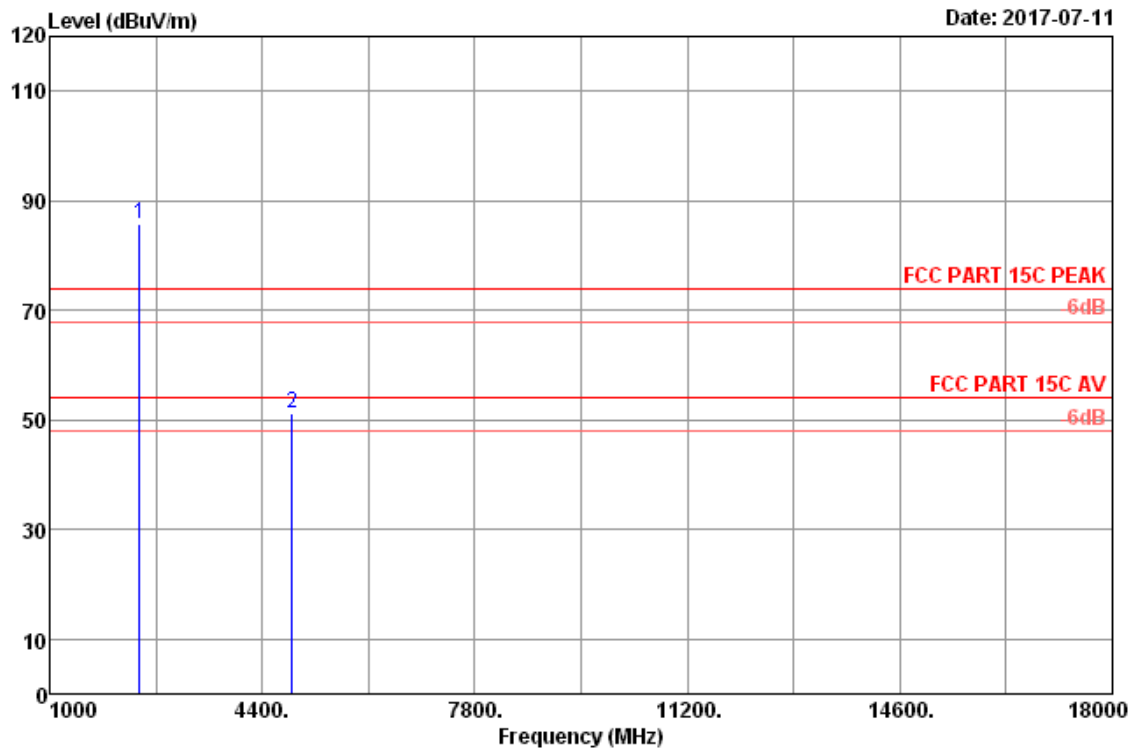
Site no. : 3m Chamber Data no. : 8
 Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK Pre : 101.2kPa
 Env. / Ins. : 23.1*C/53.2% Engineer : zack_zhu
 EUT : iT-ZB-S
 Power : DC 3.6V
 Test Mode : 2440MHz TX Mode

| No. | Freq. (MHz) | Ant. Factor (dB/m) | Cable Loss (dB) | Reading (dBuV) | AMP factor (dB) | Emission Level (dBuV/m) | Limits (dBuV/m) | Margin (dB) | Remark |
|-----|-------------|--------------------|-----------------|----------------|-----------------|-------------------------|-----------------|-------------|--------|
| 1 | 2440.00 | 27.80 | 7.95 | 88.61 | 36.38 | 87.98 | 74.00 | -13.98 | Peak |
| 2 | 4880.00 | 32.20 | 12.22 | 42.56 | 35.69 | 51.29 | 74.00 | 22.71 | Peak |

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading -Amp Factor
 2. The emission levels that are 20dB below the official limit are not reported.



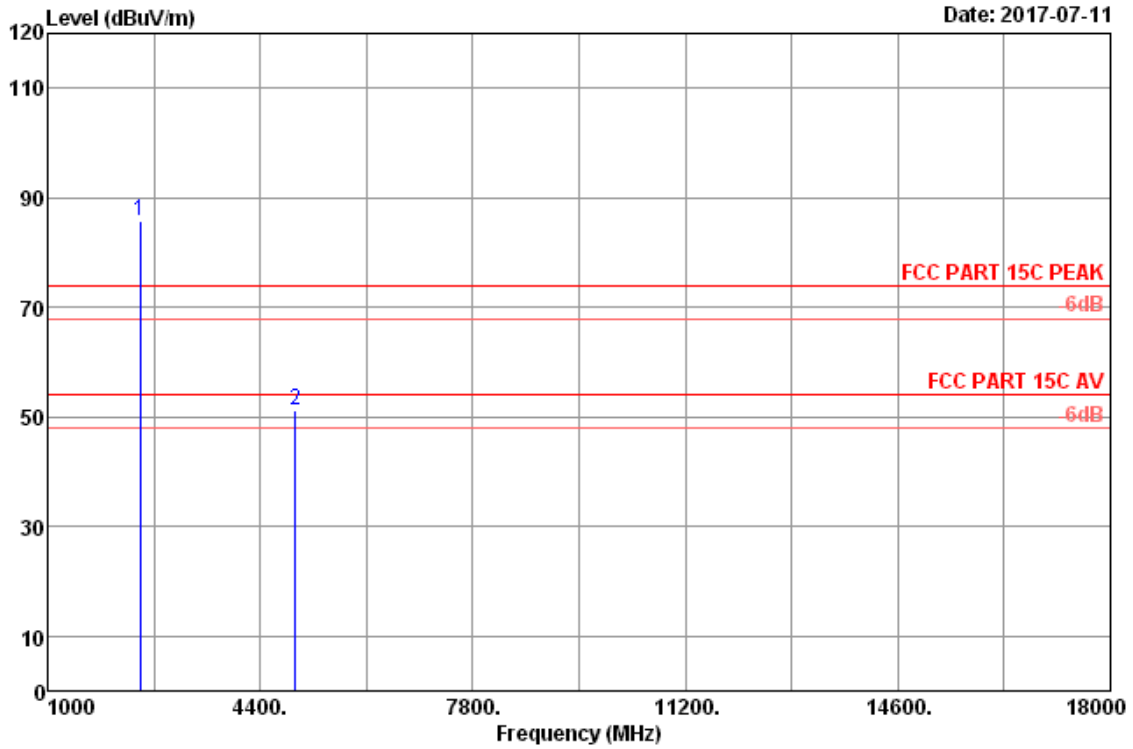
Site no. : 3m Chamber Data no. : 9
Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : HORIZONTAL
Limit : FCC PART 15C PEAK Pre : 101.2kPa
Env. / Ins. : 23.1*C/53.2% Engineer : zack_zhu
EUT : iT-ZB-S
Power : DC 3.6V
Test Mode : 2440MHz TX Mode



Site no. : 3m Chamber Data no. : 10
 Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK Pre : 101.2kPa
 Env. / Ins. : 23.1*C/53.2% Engineer : zack_zhu
 EUT : iT-ZB-S
 Power : DC 3.6V
 Test Mode : 2440MHz TX Mode

| No. | Freq. (MHz) | Ant. Factor (dB/m) | Cable Loss (dB) | Reading (dBuV) | AMP factor (dB) | Emission Level (dBuV/m) | Limits (dBuV/m) | Margin (dB) | Remark |
|-----|-------------|--------------------|-----------------|----------------|-----------------|-------------------------|-----------------|-------------|--------|
| 1 | 2440.00 | 27.80 | 7.95 | 86.34 | 36.38 | 85.71 | 74.00 | -11.71 | Peak |
| 2 | 4880.00 | 32.20 | 12.22 | 42.61 | 35.69 | 51.34 | 74.00 | 22.66 | Peak |

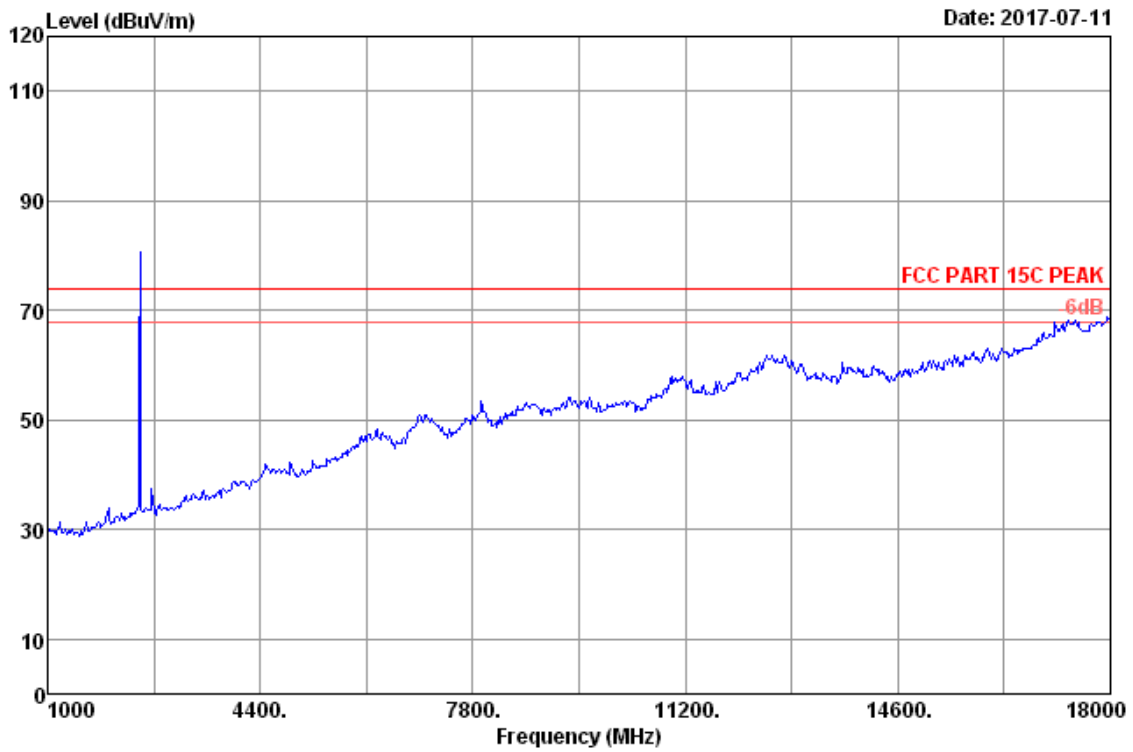
Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading -Amp Factor
 2. The emission levels that are 20dB below the official limit are not reported.



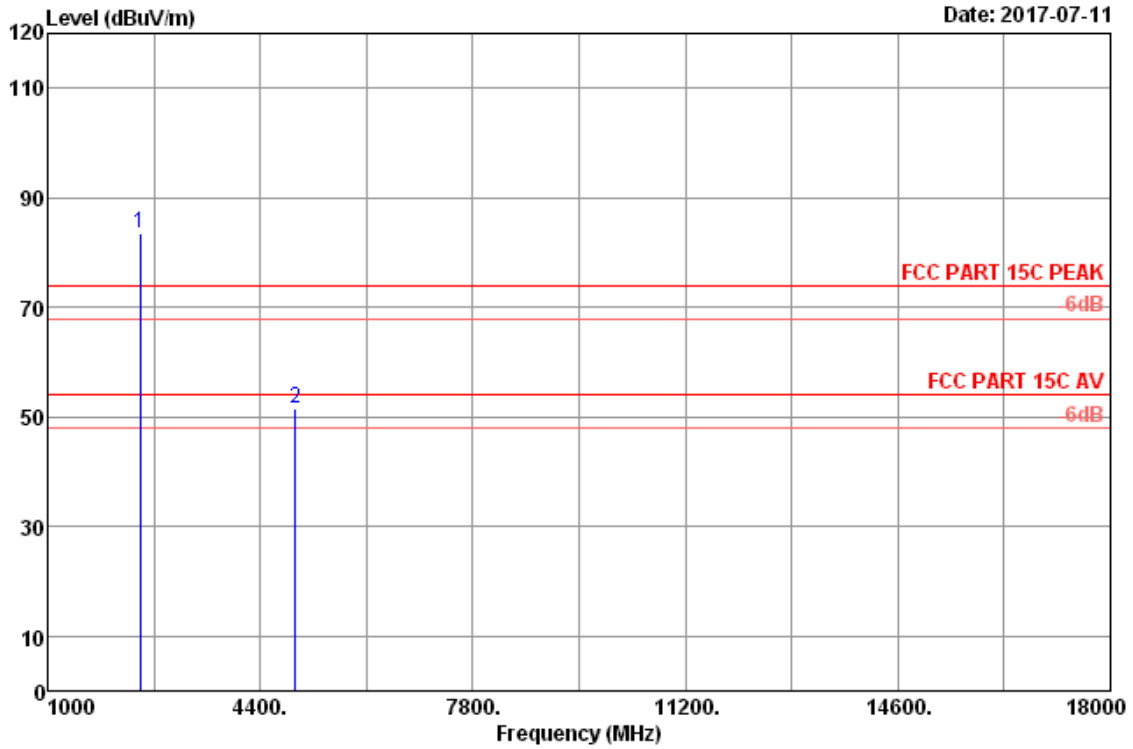
Site no. : 3m Chamber Data no. : 12
 Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK Pre : 101.2kPa
 Env. / Ins. : 23.1°C/53.2% Engineer : zack_zhu
 EUT : iT-ZB-S
 Power : DC 3.6V
 Test Mode : 2480MHz TX Mode

| No. | Freq. (MHz) | Ant. Factor (dB/m) | Cable Loss (dB) | Reading (dBuV) | AMP factor (dB) | Emission Level (dBuV/m) | Limits (dBuV/m) | Margin (dB) | Remark |
|-----|-------------|--------------------|-----------------|----------------|-----------------|-------------------------|-----------------|-------------|--------|
| 1 | 2480.00 | 27.87 | 8.02 | 86.22 | 36.38 | 85.73 | 74.00 | -11.73 | Peak |
| 2 | 4960.00 | 32.13 | 12.38 | 42.56 | 35.71 | 51.36 | 74.00 | 22.64 | Peak |

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading -Amp Factor
 2. The emission levels that are 20dB below the official limit are not reported.



Site no. : 3m Chamber Data no. : 13
Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : VERTICAL
Limit : FCC PART 15C PEAK Pre : 101.2kPa
Env. / Ins. : 23.1*C/53.2% Engineer : zack_zhu
EUT : iT-ZB-S
Power : DC 3.6V
Test Mode : 2480MHz TX Mode



Site no. : 3m Chamber Data no. : 14
 Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK Pre : 101.2kPa
 Env. / Ins. : 23.1*C/53.2% Engineer : zack_zhu
 EUT : iT-ZB-S
 Power : DC 3.6V
 Test Mode : 2480MHz TX Mode

| No. | Freq. (MHz) | Ant. Factor (dB/m) | Cable Loss (dB) | Reading (dBuV) | AMP factor (dB) | Emission Level (dBuV/m) | Limits (dBuV/m) | Margin (dB) | Remark |
|-----|-------------|--------------------|-----------------|----------------|-----------------|-------------------------|-----------------|-------------|--------|
| 1 | 2480.00 | 27.87 | 8.02 | 84.11 | 36.38 | 83.62 | 74.00 | -9.62 | Peak |
| 2 | 4960.00 | 32.13 | 12.38 | 42.71 | 35.71 | 51.51 | 74.00 | 22.49 | Peak |

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading -Amp Factor
 2. The emission levels that are 20dB below the official limit are not reported.

5. CONDUCTED SPURIOUS EMISSIONS

5.1. Test Equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|------|------------|-------------------------|---------------|------------|-----------|---------------|
| 1. | Spectrum | Agilent | N9030A | MY51380221 | Oct.15,16 | 1Year |
| 2. | Attenuator | Agilent | 8491B | MY39262165 | Apr.22,17 | 1 Year |
| 3. | RF Cable | Marvelous Microwave Inc | SFL402105FLEX | NO.1 | Oct.15,16 | 1 Year |

5.2. Limit

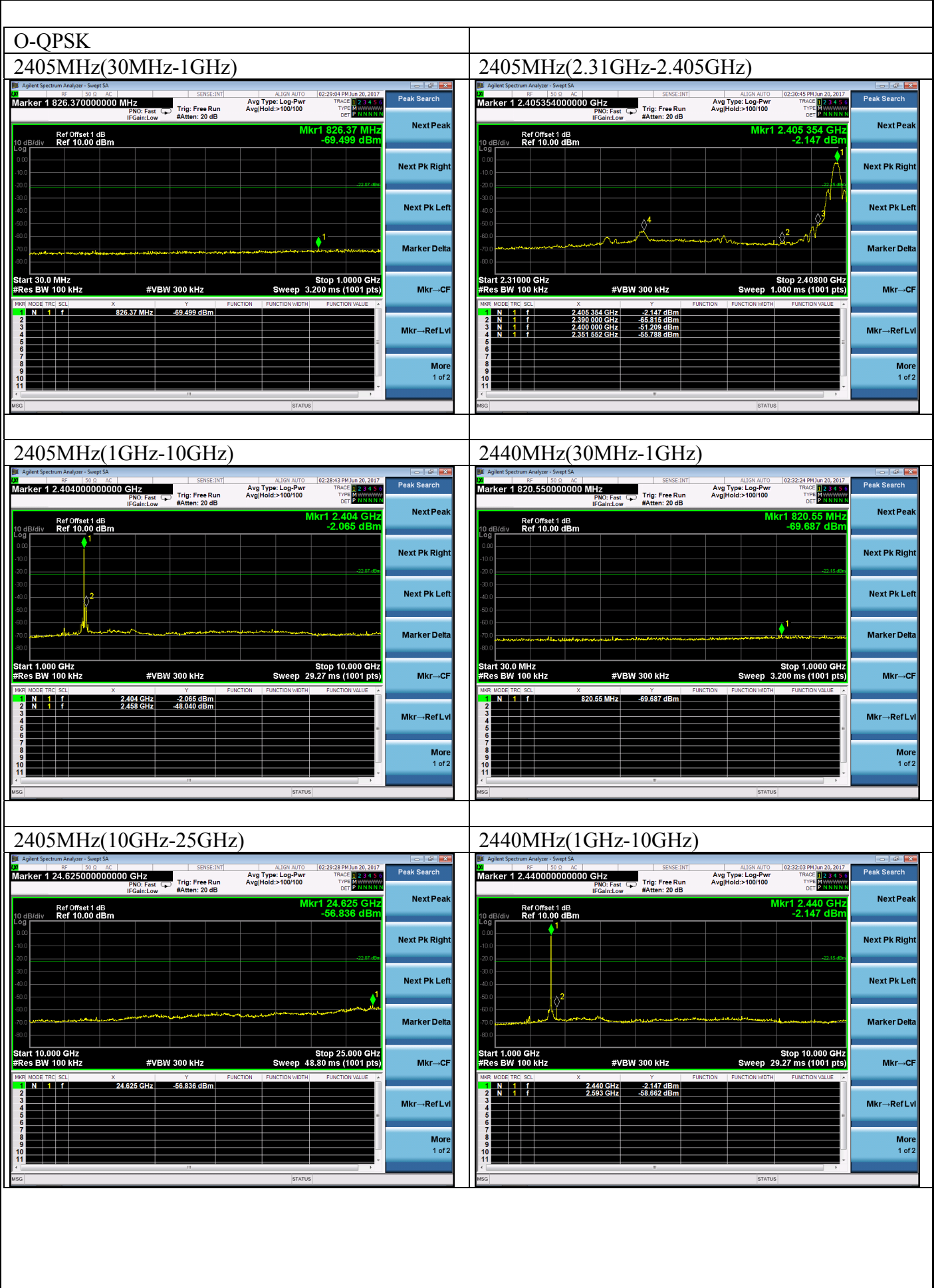
In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

5.3. Test Procedure

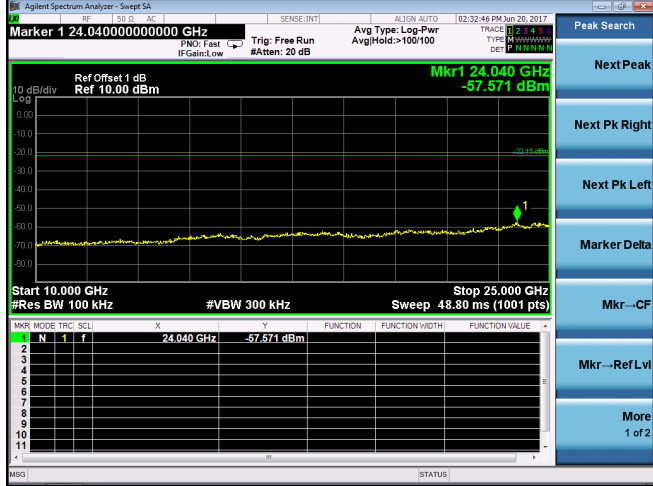
The transmitter output was connected to a spectrum analyzer, The resolution bandwidth is set to 100 kHz, The video bandwidth is set to 300 kHz and measure all the emissions With peak detector.

5.4. Test result

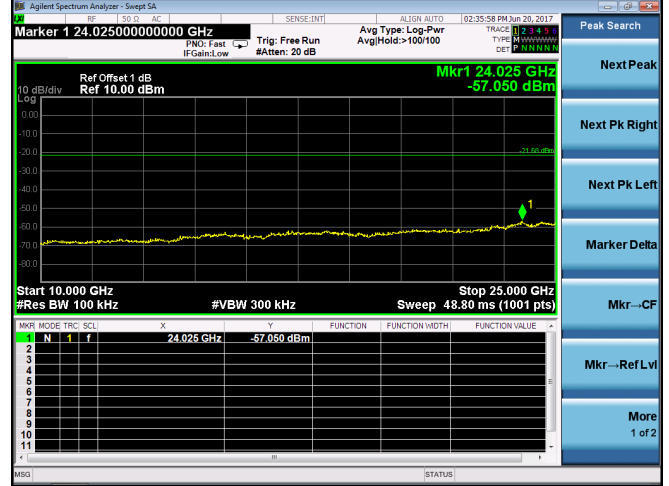
PASS (The testing data was attached in the next pages.)



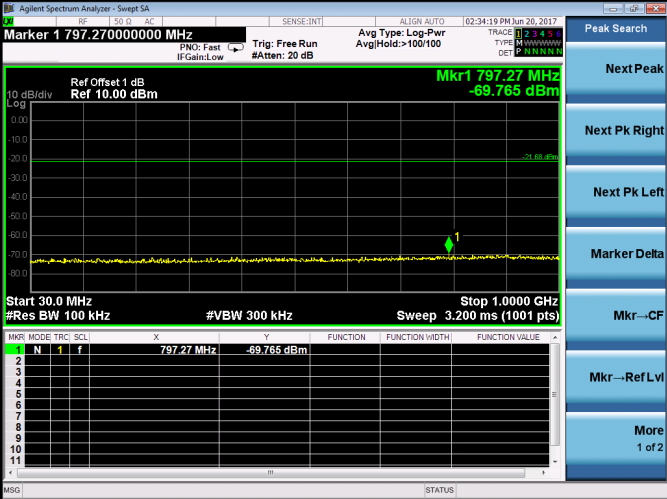
2440MHz(10GHz-25GHz)



2480MHz(10GHz-25GHz)



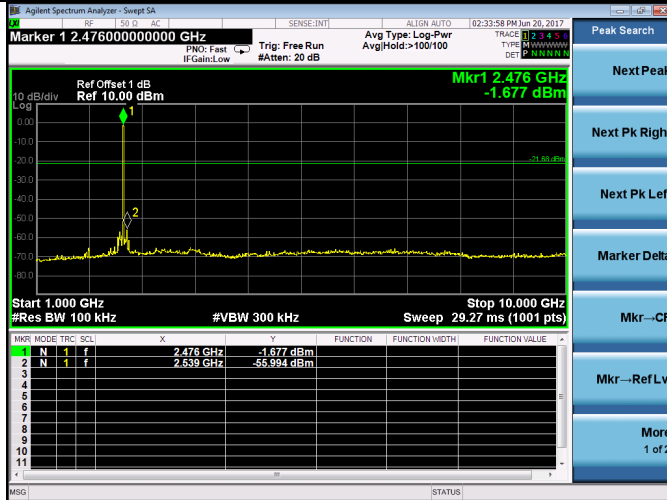
2480MHz(30MHz-1GHz)



2480MHz(2.477GHz-2.51GHz)



2480MHz(1GHz-10GHz)



6. 6dB BANDWIDTH TEST

6.1. Test Equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|------|-------------------|-------------------------|---------------|------------|-----------|---------------|
| 1. | Spectrum Analyzer | Agilent | N9010A | MY52220804 | Oct.15,16 | 1 Year |
| 2. | RF Cable | Marvelous Microwave Inc | SFL402105FLEX | NO.1 | Oct.15,16 | 1 Year |

6.2. Limit

For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz.

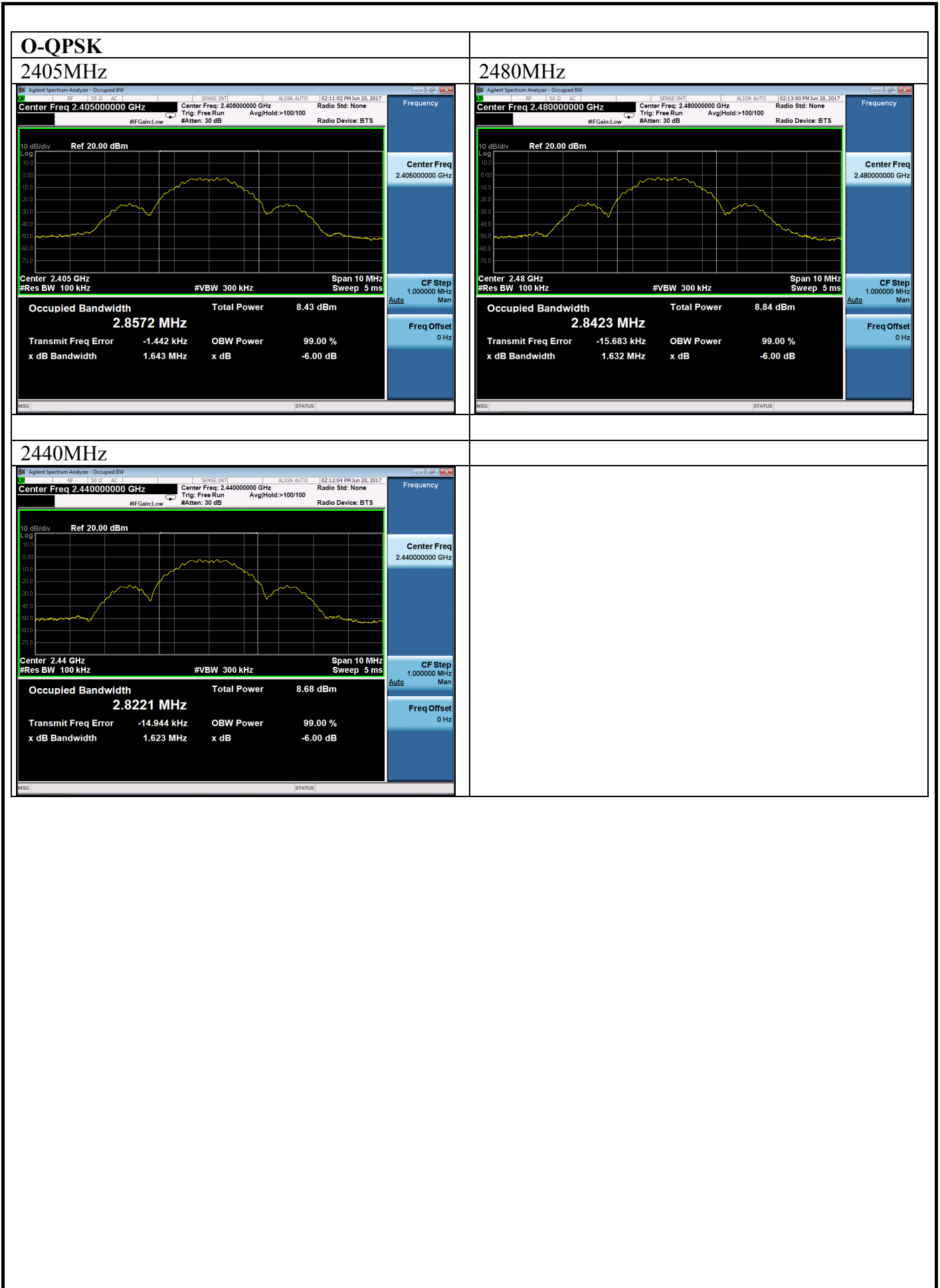
6.3. Test Procedure

The transmitter output was connected to a spectrum analyzer, The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100kHz RBW and 300KHz VBW. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.

6.4. Test Results

| | | |
|-----------------------|-------------------------|--------------------------|
| EUT: RF Module | | |
| M/N: iT-ZB-S | | |
| Test date: 2017-06-20 | Pressure: 102.5±1.0 kpa | Humidity: 52.6±3.0% |
| Tested by: zack_zhu | Test site: RF site | Temperature: 23.4±0.6 °C |

| Test Mode | CH | 6 dB bandwidth (kHz) | Limit (KHz) |
|-------------------|------|----------------------|-------------|
| O-QPSK | 2405 | 1643 | ≥ 500 |
| | 2440 | 1623 | ≥ 500 |
| | 2480 | 1632 | ≥ 500 |
| Conclusion : PASS | | | |



7. MAXIMUM PEAK OUTPUT POWER TEST

7.1. Test Equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|------|--------------|-------------------------|---------------|------------|-----------|---------------|
| 1. | Spectrum | Agilent | N9030A | MY51380221 | Oct.15,16 | 1 Year |
| 2. | Power meter | Anritsu | ML2487A | 6K00002472 | Apr.22,17 | 1 Year |
| 3. | Power sensor | Anritsu | MA2491A | 0033005 | Apr.22,17 | 1 Year |
| 4. | Attenuator | Agilent | 8491B | MY39262165 | Apr.22,17 | 1 Year |
| 5. | RF Cable | Marvelous Microwave Inc | SFL402105FLEX | NO.1 | Oct.15,16 | 1 Year |

7.2. Limit

For systems using digital modulation in the 2400—2483.5MHz, The Peak output Power shall not exceed 1W(30dBm).

7.3. Test Procedure

Connected the EUT's antenna port to Power Sensor, and use power meter to test peak output power.

7.4. Test Results

| | | |
|-----------------------|-------------------------|-------------------------|
| EUT: RF Module | | |
| M/N: iT-ZB-S | | |
| Test date: 2017-06-20 | Pressure: 102.6±1.0 kpa | Humidity: 52.8±3.0% |
| Tested by: zack_zhu | Test site: RF site | Temperature:23.2±0.6 °C |

| Test Mode | Frequency (MHz) | Peak output Power (dBm) | Limit (dBm) |
|------------------|-----------------|-------------------------|-------------|
| O-QPSK | 2405 | 1.368 | 30 |
| | 2440 | 1.746 | 30 |
| | 2480 | 1.784 | 30 |
| Conclusion: PASS | | | |

8. BAND EDGE COMPLIANCE TEST

8.1. Test Equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|------|--------------|--------------|-------------|-------------|-----------|---------------|
| 1. | Spectrum | Agilent | E4446A | US44300459 | Apr.22,17 | 1 Year |
| 2. | Amp | HP | 8449B | 3008A02495 | Apr.22.17 | 1 Year |
| 3. | Horn Antenna | ETC | MCTD 1209 | DRH15F03007 | May.15,17 | 1 Year |
| 4. | HF Cable | Hubersuhner | Sucoflex104 | 274094/4 | Apr.22,17 | 1 Year |

8.2. Limit

All the lower and upper band-edges emissions appearing within 2310MHz to 2390MHz and 2483.5MHz to 2500MHz restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions outside operation frequency band 2400MHz to 2483.5MHz shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

8.3. Test Produce

For upper band emissions that are up to two bandwidths(2MHz) away (2483.5MHz to 2485.5MHz) from the band-edge use below produce:

1. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 100KHz and with a video bandwidth 300KHz. Record the peak levels of the fundamental emission and the relevant band-edge emission, Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement, it is only a relative measurement to determine the amount by which the emission drops at the band edge relative to the highest fundamental emission level.
2. Subtract the delta measured in step (1) from the maximum field strengths measured in clause 4 .The resultant field strengths are then used to determine band-edge compliance as required by Section 15.205

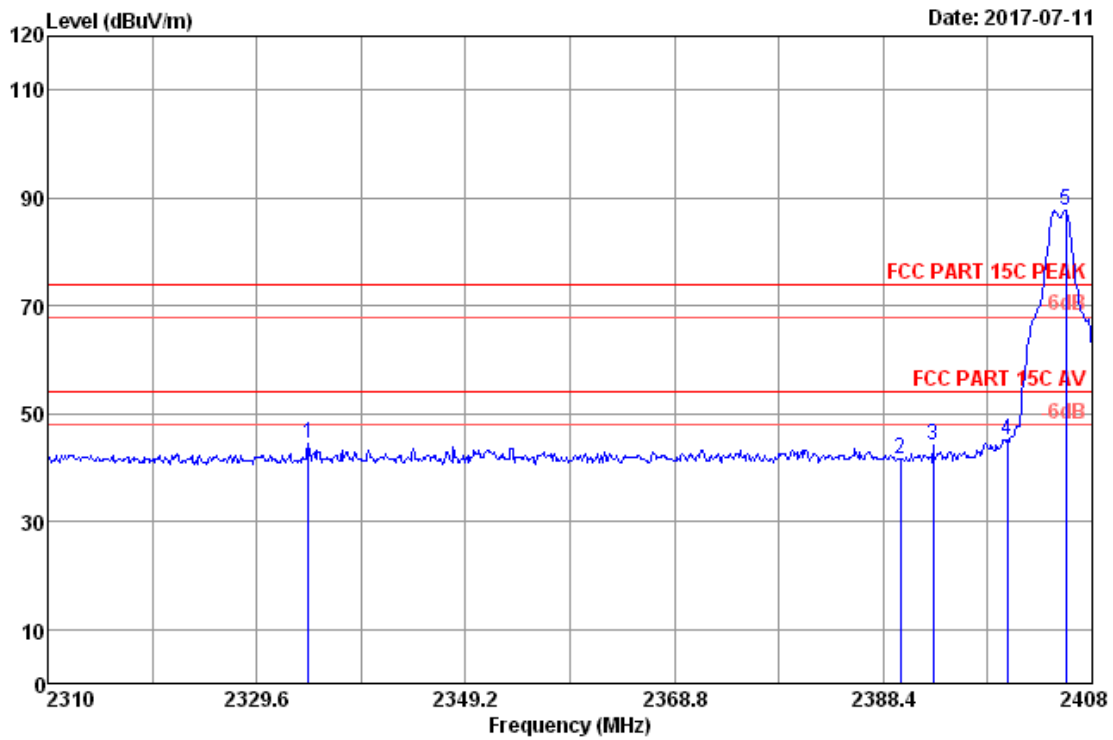
For emissions above two bandwidths away from the band-edge use below produce:

1. The EUT is placed on a turntable, which is 0.8m above the ground plane and worked at highest radiated power.
2. The turntable was rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upperband-edges of the emission:
 - (a) PEAK: RBW=1MHz; VBW=3MHz, PK detector, Sweep=AUTO
 - (b) Average: RBW=1MHz; VBW=10Hz, Sweep=AUTO

8.4. Test Results

Pass (The testing data was attached in the next pages.)

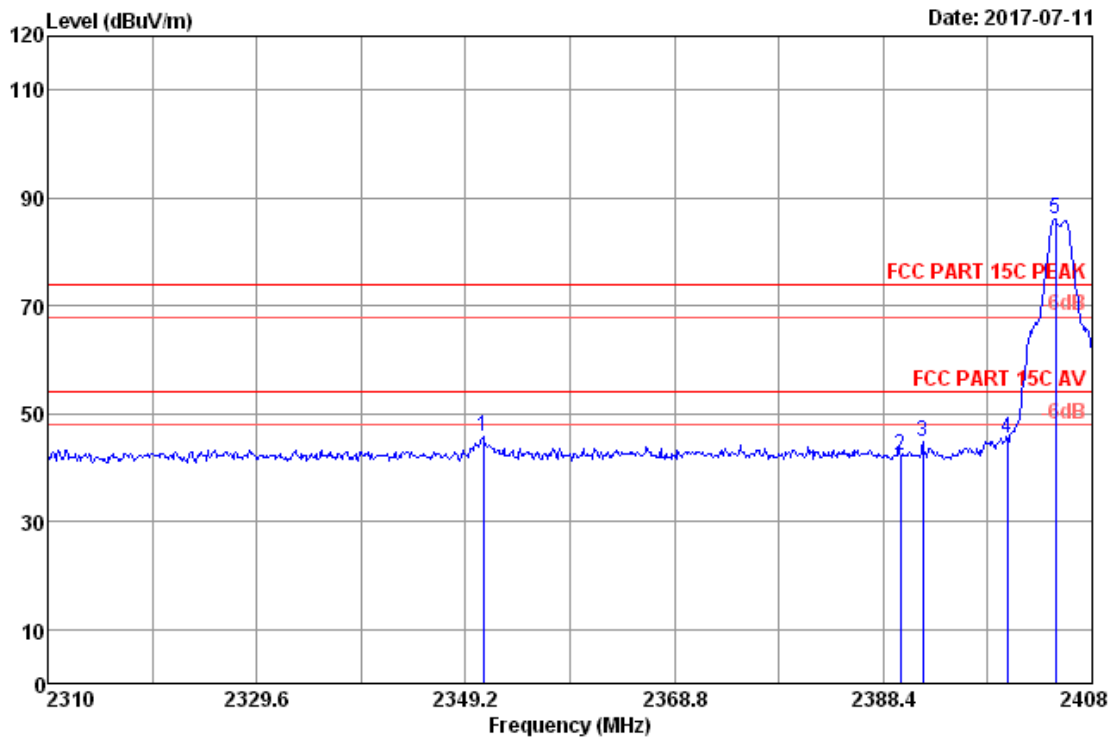
Note: If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.



Site no. : 3m Chamber Data no. : 5
 Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK Pre : 101.2kPa
 Env. / Ins. : 23.1°C/53.2% Engineer : zack_zhu
 EUT : iT-ZB-S
 Power : DC 3.6V
 Test Mode : 2405MHz TX Mode

| No. | Freq. (MHz) | Ant. Factor (dB/m) | Cable Loss (dB) | Reading (dBuV) | AMP factor (dB) | Emission Level (dBuV/m) | Limits (dBuV/m) | Margin (dB) | Remark |
|-----|-------------|--------------------|-----------------|----------------|-----------------|-------------------------|-----------------|-------------|--------|
| 1 | 2334.50 | 27.56 | 7.77 | 45.53 | 36.39 | 44.47 | 74.00 | 29.53 | Peak |
| 2 | 2390.00 | 27.69 | 7.84 | 42.36 | 36.39 | 41.50 | 74.00 | 32.50 | Peak |
| 3 | 2393.10 | 27.69 | 7.88 | 44.96 | 36.39 | 44.14 | 74.00 | 29.86 | Peak |
| 4 | 2400.00 | 27.69 | 7.88 | 46.07 | 36.39 | 45.25 | 74.00 | 28.75 | Peak |
| 5 | 2405.55 | 27.73 | 7.88 | 88.32 | 36.39 | 87.54 | 74.00 | -13.54 | Peak |

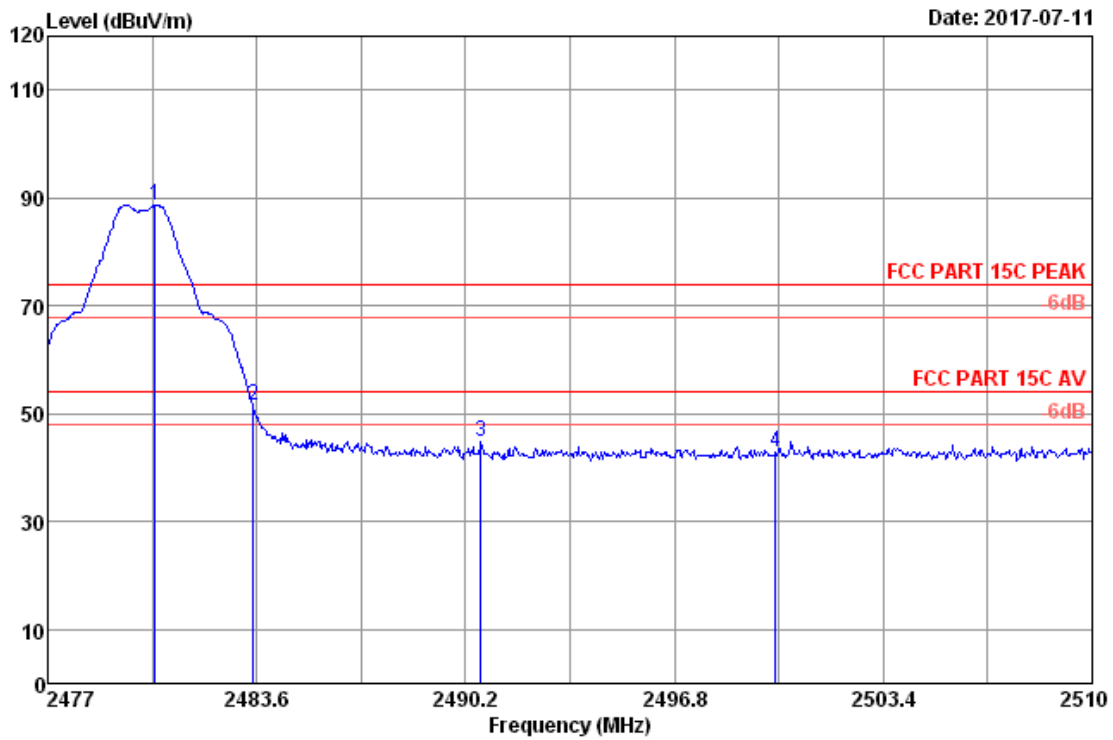
Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading - Amp Factor
 2. The emission levels that are 20dB below the official limit are not reported.



Site no. : 3m Chamber Data no. : 6
 Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK Pre : 101.2kPa
 Env. / Ins. : 23.1°C/53.2% Engineer : zack_zhu
 EUT : iT-ZB-S
 Power : DC 3.6V
 Test Mode : 2405MHz TX Mode

| No. | Freq. (MHz) | Ant. Factor (dB/m) | Cable Loss (dB) | Reading (dBuV) | AMP factor (dB) | Emission Level (dBuV/m) | Limits (dBuV/m) | Margin (dB) | Remark |
|-----|-------------|--------------------|-----------------|----------------|-----------------|-------------------------|-----------------|-------------|--------|
| 1 | 2350.87 | 27.59 | 7.81 | 46.64 | 36.39 | 45.65 | 74.00 | 28.35 | Peak |
| 2 | 2390.00 | 27.69 | 7.84 | 43.07 | 36.39 | 42.21 | 74.00 | 31.79 | Peak |
| 3 | 2392.12 | 27.69 | 7.88 | 45.71 | 36.39 | 44.89 | 74.00 | 29.11 | Peak |
| 4 | 2400.00 | 27.69 | 7.88 | 46.17 | 36.39 | 45.35 | 74.00 | 28.65 | Peak |
| 5 | 2404.57 | 27.73 | 7.88 | 86.79 | 36.39 | 86.01 | 74.00 | -12.01 | Peak |

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading - Amp Factor
 2. The emission levels that are 20dB below the official limit are not reported.



Site no. : 3m Chamber Data no. : 15
 Dis. / Ant. : 3m 2017 ANT 3007 HF Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK Pre : 101.2kPa
 Env. / Ins. : 23.1°C/53.2% Engineer : zack_zhu
 EUT : iT-ZB-S
 Power : DC 3.6V
 Test Mode : 2480MHz TX Mode

| No. | Freq. (MHz) | Ant. Factor (dB/m) | Cable Loss (dB) | Reading (dBuV) | AMP factor (dB) | Emission Level (dBuV/m) | Limits (dBuV/m) | Margin (dB) | Remark |
|-----|-------------|--------------------|-----------------|----------------|-----------------|-------------------------|-----------------|-------------|--------|
| 1 | 2480.40 | 27.87 | 8.02 | 89.26 | 36.38 | 88.77 | 74.00 | -14.77 | Peak |
| 2 | 2483.50 | 27.87 | 8.02 | 51.99 | 36.38 | 51.50 | 74.00 | 22.50 | Peak |
| 3 | 2490.70 | 27.90 | 8.05 | 45.28 | 36.38 | 44.85 | 74.00 | 29.15 | Peak |
| 4 | 2500.00 | 27.90 | 8.05 | 43.30 | 36.38 | 42.87 | 74.00 | 31.13 | Peak |

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading - Amp Factor
 2. The emission levels that are 20dB below the official limit are not reported.

9. POWER SPECTRAL DENSITY TEST

9.1. Test Equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. | Last Cal. | Cal. Interval |
|------|-------------------|-------------------------|---------------|------------|-----------|---------------|
| 1. | Spectrum Analyzer | Agilent | N9010A | MY52220804 | Oct.15,16 | 1 Year |
| 2. | RF Cable | Marvelous Microwave Inc | SFL402105FLEX | NO.1 | Oct.15,16 | 1 Year |

9.2. Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

9.3. Test Procedure

1. Connected the EUT's antenna port to spectrum analyzer device by 20dB attenuator.
2. Set the test frequency as center frequency, Set RBW=3KHz,VBW=10KHz,Span large enough capture the entire frequency, Read out maximum peak level frequency
3. Set the span to 1.5 times of the DTS Bandwidth Detector= Peak; Sweep time= Auto Couple; Trace Mode= Max hold.
4. Allow trace to fully stabilize use the peak marker function to determine the maximum amplitude level within the RBW.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude

9.4. Test Results

| | | |
|-----------------------|-------------------------|-------------------------|
| EUT: RF Module | | |
| M/N: iT-ZB-S | | |
| Test date: 2017-06-20 | Pressure: 102.5±1.0 kpa | Humidity: 52.7±3.0% |
| Tested by: zack_zhu | Test site: RF site | Temperature:23.3±0.6 °C |

| Test Mode | CH | Power density (dBm/3KHz) | Limit (dBm/3KHz) |
|-------------------|------|----------------------------|------------------|
| O-QPSK | 2405 | -13.617 | 8 |
| | 2440 | -12.749 | 8 |
| | 2480 | -12.851 | 8 |
| Conclusion : PASS | | | |

O-QPSK

2405MHz



2480MHz



2440MHz



10.MPE ESTIMATION

10.1.Limit for General Population/ Uncontrolled Exposures

| Frequency | Power density (mW/cm2) | Averaging time(minutes) |
|------------------|------------------------|-------------------------|
| 300MHz----1.5GHz | F/1500 | 30 |
| 1.5GHz---100GHz | 1.0 | 30 |

| Frequency | Power density (mW/cm2) | Averaging time(minutes) |
|-----------|------------------------|-------------------------|
| 2405 | 1 | 30 |
| 2440 | 1 | 30 |
| 2480 | 1 | 30 |

Note: F= Frequency in MHz

10.2.Estimation Result

| | | |
|----------------------|------------------------|-------------------------|
| EUT: RF Module | | |
| M/N: iT-ZB-S | | |
| Test date: 2017-6-20 | Pressure: 102.6±1.0kpa | Humidity: 53.5±3.0% |
| Tested by: Zack Zhu | Test site: RF site | Temperature: 22.4±0.6°C |

| Test Mode | Frequency (MHz) | Peak output power (dBm) | Output power (mW) | Antenna Gain(dBi) | Antenna Gain(Linear) | MPE PSD(mW/cm ²) |
|-----------|-----------------|-------------------------|-------------------|-------------------|----------------------|------------------------------|
| TX | 2405 | 1.368 | 1.37 | 2.14 | 1.64 | 0.0004 |
| | 2440 | 1.746 | 1.49 | 2.14 | 1.64 | 0.0005 |
| | 2480 | 1.784 | 1.51 | 2.14 | 1.64 | 0.0005 |

$$MPE = \frac{PG}{4\pi R^2} \quad (R=20 \text{ cm})$$

11. ANTENNA REQUIREMENT

11.1. STANDARD APPLICABLE

For intentional device, according to FCC 47 CFR Section 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. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

11.2. ANTENNA CONNECTED CONSTRUCTION

The antennas used for this product are Chip Antenna that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is 2.14dBi.

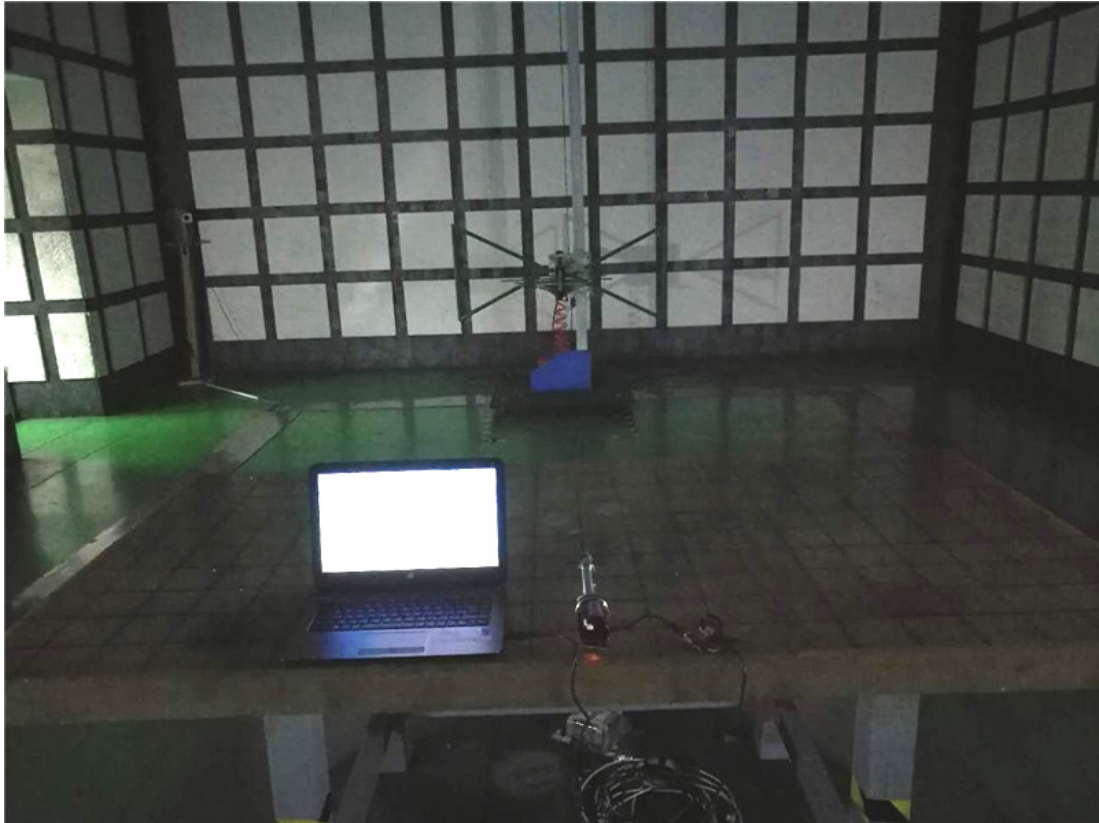
12. DEVIATION TO TEST SPECIFICATIONS

[NONE]

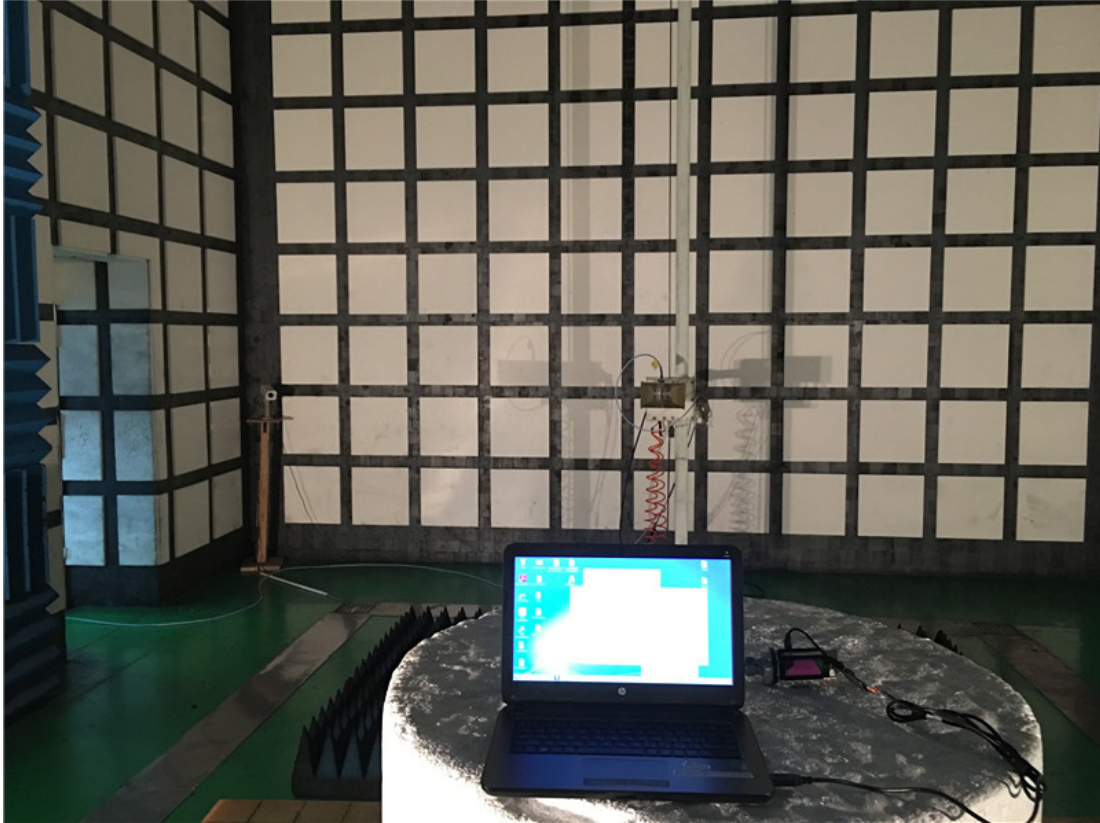
13. HOTOGRAPH OF TEST

13.1.Photos of Radiated Emission Test

30-1000MHz



Above 1000MHz



14. PHOTOS OF THE EUT

Figure 1
General Appearance of the EUT

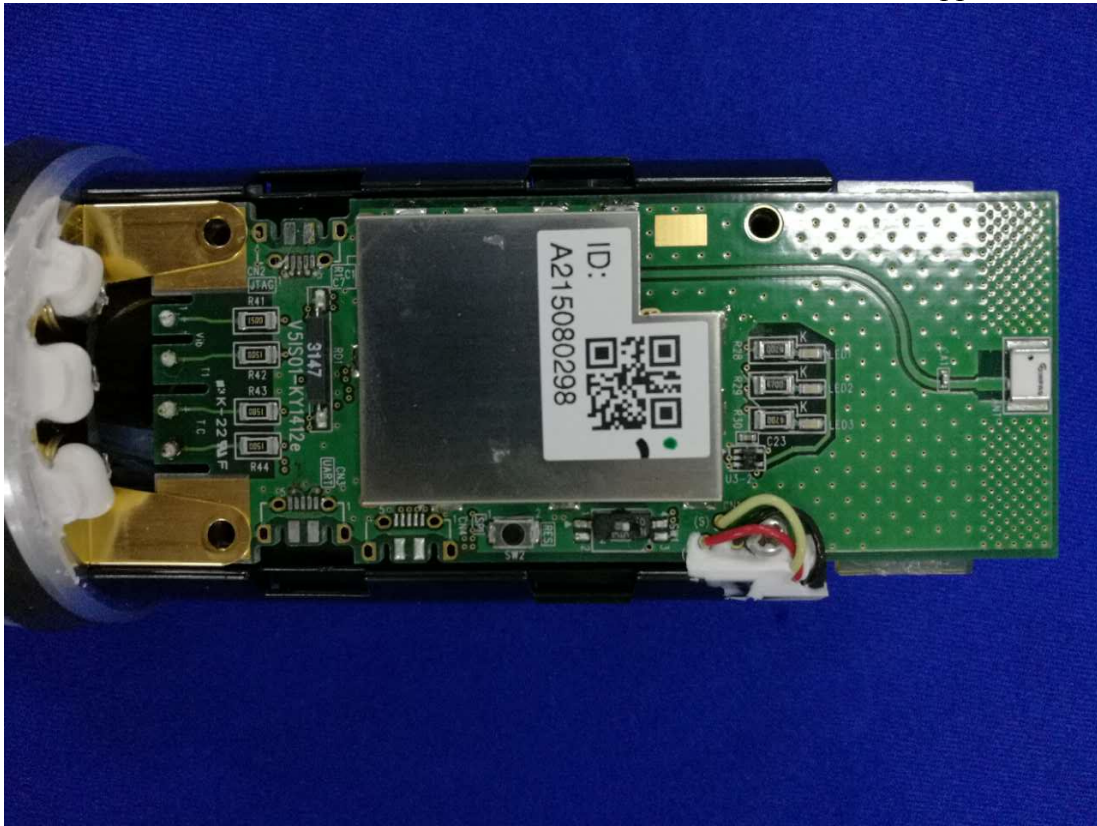


Figure 2
General Appearance of the EUT



Figure 3
General Appearance of the EUT

