



## Shenzhen Asia Test Technology Co., Ltd.

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# FCC RF Test Report

Product Type : Multiple Function Sensor

Report No : ATT-2015SZ0229146F-1

Applicant : Sensing TeK Co., Ltd.

Address : 4F-1, No. 62, Chen Gung 5 st., ChuBei City, Hsinchu county Taiwan 302

Trade Name : N/A

Model Number : THZ100

List Model : LCZ2T00, DRZ2100, PIZ2100

Test Specification : FCC 47 CFR PART 15 SUBPART C: Oct., 2013  
ANSI C63.10:2009  
KD558074 D01 DTS Meas Guidance v03r02

Receive Date : 15 Feb, 2015

Test Period : 16 Feb, 2015 to 11 Mar, 2015

Issue Date : 12 Mar, 2015

### Issue by

### Shenzhen Asia Test Technology Co., Ltd.

7 / F, Xinwei Building, Gushu Village, Xixiang Town, Baoan District, Shenzhen, China.

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## Certification of Compliance

Issued Date: 12/03/2015

Product Type : Multiple Function Sensor

Applicant : Sensing TeK Co., Ltd.

Address : 4F-1, No. 62, Chen Gung 5 st., ChuBei City, Hsinchu county Taiwan 302

Manufacturer : Sensing TeK Co., Ltd.

Address : 4F-1, No. 62, Chen Gung 5 st., ChuBei City, Hsinchu county Taiwan 302

Trade Name : N/A

Model Number : THZ100

List Mode : LCZ2T00, DRZ2100, PIZ2100

FCC ID : WMXTHZ100

EUT Rated Voltage : DC 3.0V From Battery

FCC 47 CFR PART 15 SUBPART C: Oct., 2013

Applicable Standard : ANSI C63.10:2009  
KD558074 D01 DTS Meas Guidance v03r02

Test Result : Complied

Shenzhen Asia Test Technology Co., Ltd.

Performing Lab. : 7 / F, Xinwei Building, Gushu Village, Xixiang Town, Baoan District,  
Shenzhen, China

The EUT described above is tested by Shenzhen Asia Test Technology Co., Ltd. EMC Laboratory to determine the maximum emissions from the EUT. Shenzhen Asia Test Technology Co., Ltd. EMC Laboratory assumed full responsibility for the accuracy of the test results. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4 (2003) and the energy emitted by the sample EUT tested as described in this report is in compliance with FCC Rules Part 15.207, 15.209 and 15.247.

The test results of this report relate only to the tested sample identified in this report.

Approved By

:

Reviewed By

:

(Testing Engineer)

(Seal Chen)

(Manager)

(Jackie Deng)



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## 1 General Information

### 1.1 Applied Standard

Applied Rules: FCC 47 CFR PART 15 SUBPART C: Oct., 2013

Test Method: KD558074 D01 DTS Meas Guidance v03r02

### 1.2 Test Location

TestLocation1: Asia Institute Technology (DongGuan) Limited

Address: No. 22,JinQianLing Street 3, JiTiGang Village,Huang-Jiang Town, DongGuan,Guangdong, China

FCC Registration No.: 248337

### 1.3 Test Environment Condition

Ambient Temperature: 19.5 to 25°C

Ambient Relative Humidity: 40 to 55 %

Atmospheric Pressure: Not applicabl

## 2 Test Summary

| Test Item                                                      | FCC Part No.        | Requirements                                                                                  | Verdict |
|----------------------------------------------------------------|---------------------|-----------------------------------------------------------------------------------------------|---------|
| DTS (6 dB) Bandwidth                                           | 15.247(a)(2)        | $\geq 500$ kHz.                                                                               | PASS    |
| Maximum Peak Conducted Output Power                            | 15.247(b)(3)        | For directional gain:< 30dBm – (G[dBi] –6 [dB]),peak;<br>Otherwise :< 30dBm, peak.            | PASS    |
| Maximum Power Spectral Density Level                           | 15.247(e)           | For directional gain :< 8dBm/3 kHz – (G[dBi] –6[dB]), peak.<br>Otherwise :< 8dBm/3 kHz, peak. | PASS    |
| Band Edges Compliance                                          | 15.247(d)           | < -20dBm/100 kHz if total<br>Peak power $\leq$ power limit.                                   | PASS    |
| Unwanted Emissions into Non-Restricted Frequency Bands         | 15.247(d)           | < -20dBm/100 kHz if total peak power<br>$\leq$ power limit.                                   | PASS    |
| Unwanted Emissions into Restricted Frequency Bands (Conducted) | 15.247(d)<br>15.209 | < -20dBm/100 kHz if total peak power<br>$\leq$ power limit.                                   | PASS    |
| Unwanted Emissions into Restricted Frequency Bands (Radiated)  | 15.247(d)<br>15.209 | FCC Part 15.209 field strength limit;                                                         | PASS    |
| AC Power Line Conducted Emissions                              | 15.207              | FCC Part 15.207 conducted limit;                                                              | N/A     |



### 3 Description of the Equipment under Test (EUT)

#### 3.1 General Description

|                    |                                                                                                                                                                          |              |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| Product            | Multiple Function Sensor                                                                                                                                                 |              |
| Trade Name         | N/A                                                                                                                                                                      |              |
| Model Number       | THZ100, LCZ2T00, DRZ2100, PIZ2100                                                                                                                                        |              |
| Model Difference   | All models in this application are identically with electric and no impact on products safety and EMC characteristics. They are named differently due to market purpose. |              |
| Hardware Version   | BS- THZ-410-ZB                                                                                                                                                           |              |
| Software Version   | V 01                                                                                                                                                                     |              |
| Serial Number      | 487905101                                                                                                                                                                |              |
| Applicant          | Sensing TeK Co., Ltd.<br>4F-1, No. 62, Chen Gung 5 st., ChuBei City, Hsinchu county Taiwan 302                                                                           |              |
| Manufacturer       | Sensing TeK Co., Ltd.<br>4F-1, No. 62, Chen Gung 5 st., ChuBei City, Hsinchu county Taiwan 302                                                                           |              |
| FCC ID             | WMXTHZ100                                                                                                                                                                |              |
| Mode               | Frequency (MHz)                                                                                                                                                          | Modulation   |
| IEEE 802.15        | 2405 ~ 2480                                                                                                                                                              | OQPSK (DSSS) |
| Antenna Delivery   | 1*Tx + 1*Rx                                                                                                                                                              |              |
| Type of Antenna    | Internal                                                                                                                                                                 |              |
| Antenna Gain (dBi) | 0 dBi                                                                                                                                                                    |              |

NOTE: Only ZigBee test data included in this report.

#### 3.2 EUT Configurations

##### 3.2.1 General Configurations

The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

##### 3.2.2 Customized Configurations

###### ZigBee Frequency List

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 11      | 2405 MHz  | 19      | 2445 MHz  |
| 12      | 2410 MHz  | 20      | 2450 MHz  |
| 13      | 2415 MHz  | 21      | 2455 MHz  |
| 14      | 2420 MHz  | 22      | 2460 MHz  |
| 15      | 2425 MHz  | 23      | 2465 MHz  |
| 16      | 2430 MHz  | 24      | 2470 MHz  |
| 17      | 2435 MHz  | 25      | 2475 MHz  |
| 18      | 2440 MHz  | 26      | 2480 MHz  |

###### Test Frequency

| Test Mode | RF Ch. | TX Channel NO. | TX Freq. [MHz] | RX Freq. [MHz] |
|-----------|--------|----------------|----------------|----------------|
| ZigBee    | L      | CH 11          | 2405MHz        | 2405MHz        |
|           | M      | CH 18          | 2440MHz        | 2440MHz        |
|           | H      | CH 26          | 2480MHz        | 2480MHz        |



### 3.3 Test Environments

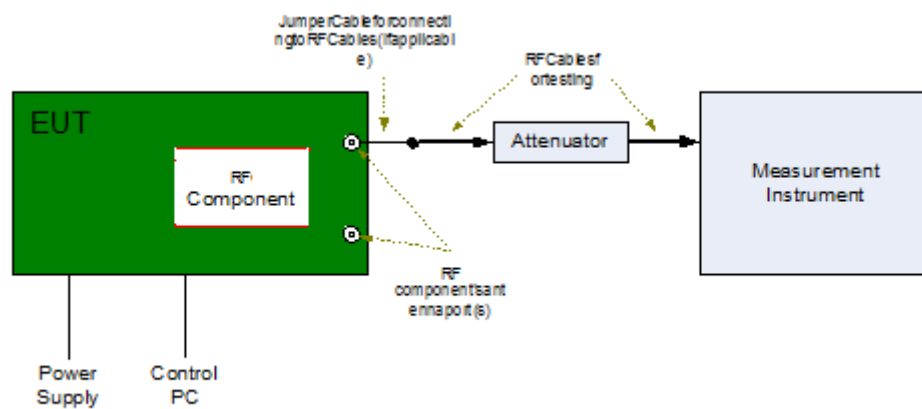
NOTE: The values used in the test report maybe stringent than the declared.

| Environment Parameter | Selected Values During Tests |         |                   |
|-----------------------|------------------------------|---------|-------------------|
| NT/NV                 | Temperature                  | Voltage | Relative Humidity |
|                       | Ambient                      | DC 3.0V | Ambient           |

### 3.4 Test Setups

#### 3.4.1 Test Setup 1

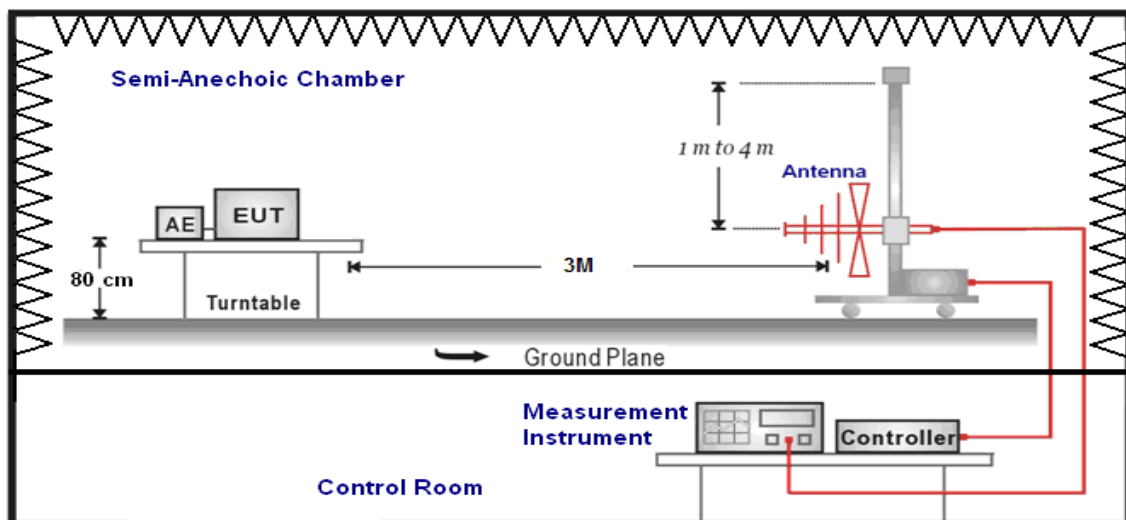
The WLAN component's antenna ports(s) of the EUT are connected to the measurement instrument per an appropriate attenuator. The EUT is controlled by PC/software to emit the specified signals for the purpose of measurements.



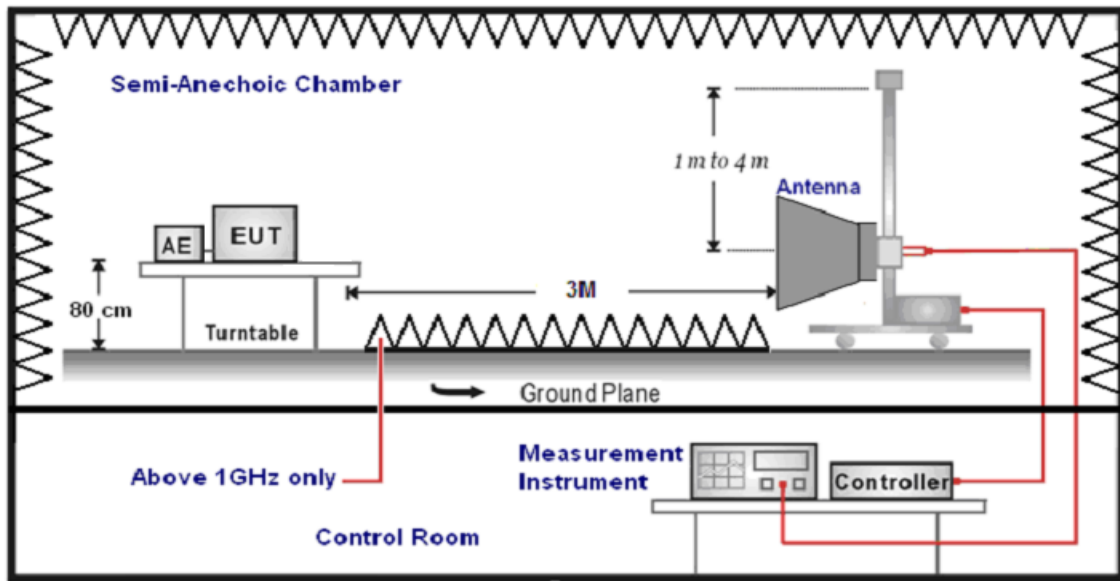
#### 3.4.2 Test Setup 2

The test site's anechoic chamber has met the requirement of NSA tolerance 4dB according to the standards: ANSIC63.4. The test distance is 3m. The setup is according to ANSI C63.4 and CAN/CSA-CEI/IEC CISPR 22.

The maximal emission value is acquired by adjusting the antenna height, polarization and turntable azimuth. Normally, the height range of antenna is 1m to 4m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).



(Below 1 GHz)

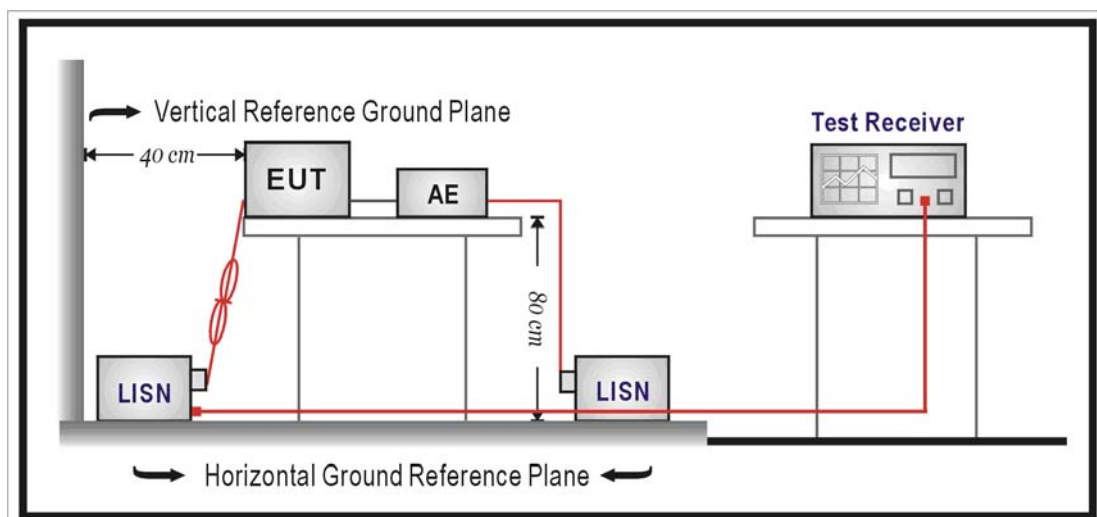


(Above 1GHz)

### 3.4.3 Test Setup 3

The mains cable of the EUT (maybe per AC/DC Adapter) must be connected to LISN. The LISN shall be placed 0.8 m from the boundary of EUT and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance is between the closest points of the LISN and the EUT. All other units of the EUT and associated equipment shall be least 0.8m from the LISN.

Ground connections, where required for safety purposes, shall be connected to the reference ground point of the LISN and, where not otherwise provided or specified by the manufacturer, shall be of same length as the mains cable and run parallel to the mains connection at a separation distance of not more than 0.1 m.





## 3.5 Test Conditions

| Test Case                                                      | Test Conditions    |                                                                                                |
|----------------------------------------------------------------|--------------------|------------------------------------------------------------------------------------------------|
|                                                                | Configuration      | Description                                                                                    |
| DTS (6 dB) Bandwidth                                           | Measurement Method | FCC KDB 558074 §8.1 Option2.                                                                   |
|                                                                | Test Environment   | NTNV                                                                                           |
|                                                                | Test Setup         | Test Setup 1                                                                                   |
|                                                                | EUT Configuration  | CH11, CH18, CH26                                                                               |
| Maximum Peak Conducted Output Power                            | Measurement Method | FCC KDB 558074§9.1.2                                                                           |
|                                                                | Test Environment   | NTNV                                                                                           |
|                                                                | Test Setup         | Test Setup 1                                                                                   |
|                                                                | EUT Configuration  | CH11, CH18, CH26                                                                               |
| Maximum Power Spectral Density Level                           | Measurement Method | FCC KDB 558074 §10.2 (peak PSD).                                                               |
|                                                                | Test Environment   | NTNV                                                                                           |
|                                                                | Test Setup         | Test Setup 1                                                                                   |
|                                                                | EUT Configuration  | CH11, CH18, CH26                                                                               |
| Unwanted Emissions into Non-Restricted Frequency Bands         | Measurement Method | FCC KDB 558074§11.0                                                                            |
|                                                                | Test Environment   | NTNV                                                                                           |
|                                                                | Test Setup         | Test Setup 1                                                                                   |
|                                                                | EUT Configuration  | CH11, CH18, CH26                                                                               |
| Unwanted Emissions into Restricted Frequency Bands (Conducted) | Measurement Method | FCC KDB 558074§12.2, Conducted (antenna-port).                                                 |
|                                                                | Test Environment   | NTNV                                                                                           |
|                                                                | Test Setup         | Test Setup 1                                                                                   |
|                                                                | EUT Configuration  | CH11, CH26                                                                                     |
| Unwanted Emissions into Restricted                             | Measurement Method | FCC KDB 558074§12.1,Radiated(cabinet/case emissions with Impedance matching for antenna-port). |
|                                                                | Test Environment   | NTNV                                                                                           |
|                                                                | Test Setup         | Test Setup 2                                                                                   |
|                                                                | EUT Configuration  | CH11, CH26                                                                                     |

Note: For Radiated Emissions, By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “X axis” position was the worst, then the final test was executed the worst condition and test data were recorded in this report.



## 4 Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements and is documented in the Shenzhen Asia Test Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for General Testing & Inspection laboratory is reported:

| Test Items                              | Measurement Uncertainty | Notes |
|-----------------------------------------|-------------------------|-------|
| Transmitter power conducted             | 0.65 dB                 | (1)   |
| Transmitter power Radiated              | 2.33 dB                 | (1)   |
| Conducted spurious emission 9KHz-40 GHz | 1.62 dB                 | (1)   |
| Radiated spurious emission 9KHz-40 GHz  | 2.20 dB                 | (1)   |
| Conducted Emission 9KHz-30MHz           | 3.50 dB                 | (1)   |
| Radiated Emission 30~1000MHz            | 4.50 dB                 | (1)   |
| Radiated Emission 1~18GHz               | 4.60 dB                 | (1)   |
| Radiated Emission 18-40GHz              | 5.12 dB                 | (1)   |
| Occupied Bandwidth                      | -----                   | (1)   |

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=1.96$ .



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### 5 Main Test Instruments

| Maximum Peak Output Power |                             |              |             |            |            |               |
|---------------------------|-----------------------------|--------------|-------------|------------|------------|---------------|
| Item                      | Equipment                   | Manufacturer | Model No.   | Serial No. | Last Cal.  | Cal. Interval |
| 1                         | Power Meter                 | Anritsu      | ML2487B     | 110553     | 2014-07-10 | 1Y            |
| 2                         | Power Sensor                | Anritsu      | MA2411B     | 100345     | 2014-07-10 | 1Y            |
| 3                         | Temporary antenna connector | MMCX-SMA     | 1547        | Qitianxin  | 2014-07-10 | 1Y            |
| 4                         | Cable                       | MURATA       | MM8430-2610 | 11547      | 2015-01-15 | 6M            |

| Power Spectral Density / 6dB Bandwidth / Band Edge Compliance of RF Emission / Spurious RF Conducted Emission |                             |                 |             |            |            |               |
|---------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------|-------------|------------|------------|---------------|
| Item                                                                                                          | Equipment                   | Manufacturer    | Model No.   | Serial No. | Last Cal.  | Cal. Interval |
| 1                                                                                                             | Spectrum Analyzer           | Rohde & Schwarz | FSP40       | 100108     | 2014-12-20 | 1Y            |
| 2                                                                                                             | Temporary antenna connector | MMCX-SMA        | 1547        | Qitianxin  | 2014-07-10 | 1Y            |
| 3                                                                                                             | Cable                       | MURATA          | MM8430-2610 | 11547      | 2015-01-15 | 6M            |

| Radiated Emission |                                |              |                  |            |            |               |
|-------------------|--------------------------------|--------------|------------------|------------|------------|---------------|
| Item              | Equipment                      | Manufacturer | Model No.        | Serial No. | Last Cal.  | Cal. Interval |
| 1                 | Spectrum Analyzer (9KHz-40GHz) | ADVANTEST    | R3182            | 150900201  | 2014.12.30 | 1Y            |
| 2                 | EMI Receiver (9KHz-7GHz)       | R&S          | ESPI             | 101781     | 2014.06.26 | 1Y            |
| 3                 | Preamplifier                   | Tsj          | MLA-10K01-B01-27 | 1205323    | 2014.06.26 | 1Y            |
| 4                 | Preamplifier                   | Tsj          | MLA-0120-A02-34  | 2648A04738 | 2014.12.03 | 1Y            |
| 5                 | Bilog Antenna (30MHz-1GHz)     | SCHWARZBEC K | VULB9160         | 3207       | 2014.12.01 | 1Y            |
| 6                 | Horn Antenna (1GHz -18GHz)     | SCHWARZBEC K | BBHA 9120D       | 452        | 2014.12.04 | 1Y            |
| 7                 | Loop Antenna (9 kHz-30 MHz)    | HLA6120      | 35779            | TESEQ      | 2014-05-29 | 1Y            |
| 8                 | Horn Ant (15GHz-26.5GHz)       | ShwarzBeck   | BBHA9170         | 9170-181   | 2014-05-29 | 1Y            |
| 9                 | Coaxial Cable                  | Anritsu      | MP59B            | 6200264416 | 2014.06.25 | 1Y            |



## 6 Test Conditions and Results

### 6.1 AC Power Conducted Emission

#### TEST PROCEDURE

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2009.
2. Support equipment, if needed, was placed as per ANSI C63.10-2009
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2009
4. The EUT received DC12V power from the adapter, the adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

#### AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

| Frequency<br>(MHz) | Maximum RF Line Voltage (dBμV) |      |         |        |
|--------------------|--------------------------------|------|---------|--------|
|                    | CLASS A                        |      | CLASS B |        |
|                    | Q.P.                           | Ave. | Q.P.    | Ave.   |
| 0.15 - 0.50        | 79                             | 66   | 66-56*  | 56-46* |
| 0.50 - 5.00        | 73                             | 60   | 56      | 46     |
| 5.00 - 30.0        | 73                             | 60   | 60      | 50     |

\* Decreasing linearly with the logarithm of the frequency

#### TEST RESULTS

Not applicable to this device which powered by battery.



## 6.2 Radiated Emissions

### TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9 KHz to 25GHz.

### Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

|                           |                                            |
|---------------------------|--------------------------------------------|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude    | AG = Amplifier Gain                        |
| AF = Antenna Factor       |                                            |

### RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT 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 desired power.

The frequency spectrum above 1 GHz for Transmitter was investigated. All emission not reported are much lower than the prescribed limits. Set the RBW=1MHz, VBW=3MHz for Peak Detector while the RBW=1MHz, VBW=10Hz for Average Detector, Readings are both peak and average values.

| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m)         | Radiated (μV/m) |
|-----------------|-------------------|---------------------------|-----------------|
| 0.009-0.49      | 300               | $20\log(2400/F(KHz))+80$  | $2400/F(KHz)$   |
| 0.49-1.705      | 30                | $20\log(24000/F(KHz))+40$ | $24000/F(KHz)$  |
| 1.705-30        | 30                | $20\log(30)+40$           | 30              |
| 30-88           | 3                 | 40.0                      | 100             |
| 88-216          | 3                 | 43.5                      | 150             |
| 216-960         | 3                 | 46.0                      | 200             |
| Above 960       | 3                 | 54.0                      | 500             |

### TEST RESULTS

Remark:

1. The radiated measurement is performed at channel (low/mid/high) and recorded worst datum at low channel for below 1GHz measurement.
2. ULTRA-BROADBAND ANTENNA for the radiation emission test below 1G.
3. HORN ANTENNA for the radiation emission test above 1G.
4. We tested X, Y, Z Axis, and recorded the worst case at the X Axis.



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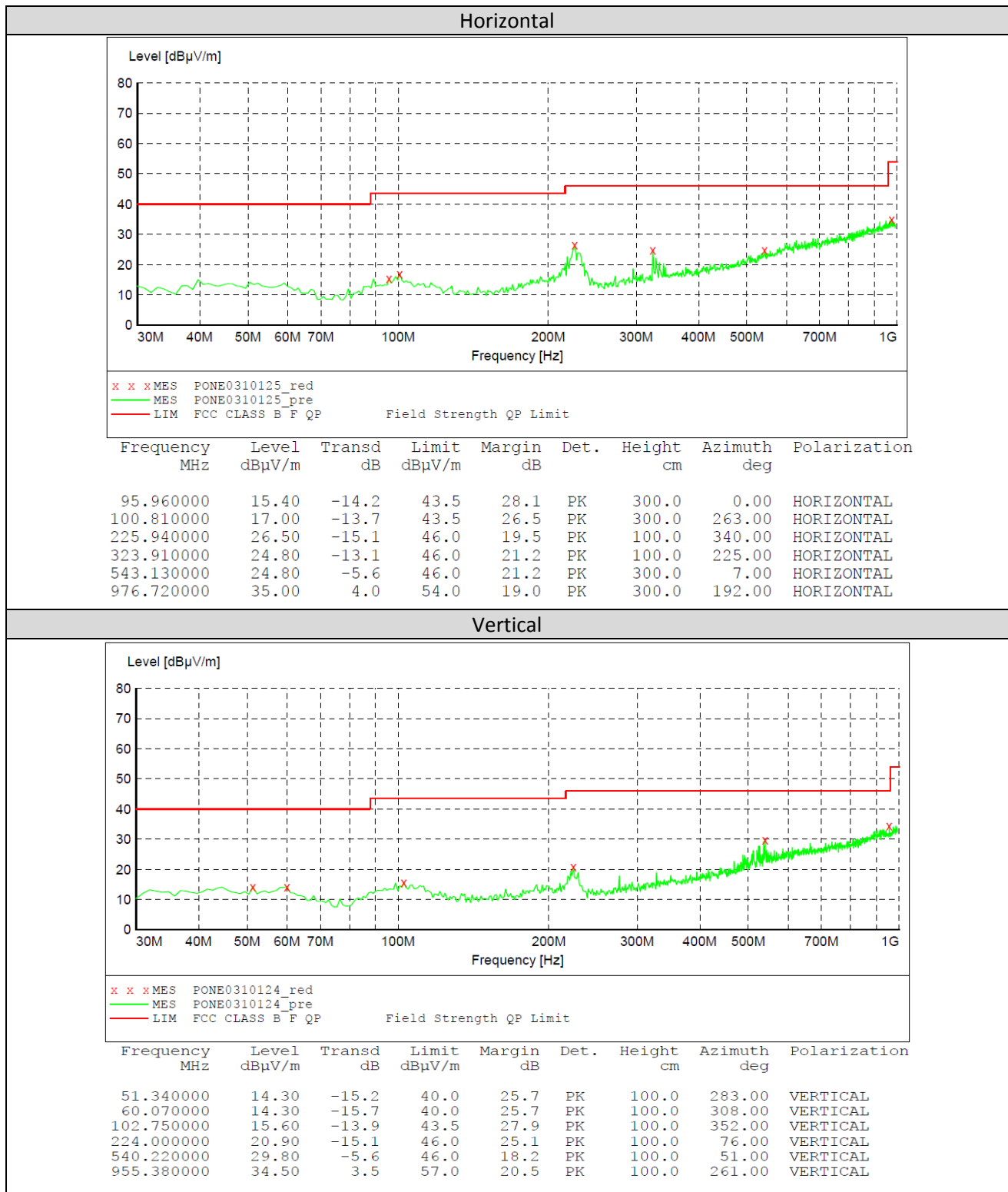
Email: [att@att-lab.com](mailto:att@att-lab.com)

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## For 9 KHz to 30MHz

| Frequency (MHz) | Corrected Reading (dBuV/m)@3m | FCC Limit (dBuV/m) @3m | Margin (dB) | Detector | Result |
|-----------------|-------------------------------|------------------------|-------------|----------|--------|
| 0.14            | 54.36                         | 104.68                 | 50.32       | QP       | PASS   |
| 1.59            | 43.54                         | 63.58                  | 20.04       | QP       | PASS   |
| 22.54           | 55.87                         | 69.54                  | 13.67       | QP       | PASS   |
| 24.69           | 48.36                         | 69.54                  | 21.18       | QP       | PASS   |

## For 30MHz to 1000MHz





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## For 1GHz to 25GHz

| Frequency(MHz): |                 |                         |    | 2405           |             |                    | Polarity:            |                  |                       | HORIZONTAL        |                    |                          |
|-----------------|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
| No.             | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 1               | 4810.00         | 56.69                   | PK | 74             | 17.31       | 1.00               | 55                   | 54.55            | 31.65                 | 6.89              | 36.40              | 2.14                     |
| 1               | 4810.00         | 42.87                   | AV | 54             | 11.13       | 1.00               | 55                   | 40.73            | 31.65                 | 6.89              | 36.40              | 2.14                     |
| 2               | 7215.00         | 48.26                   | PK | 74             | 25.74       | 1.00               | 100                  | 37.93            | 37.10                 | 8.58              | 35.35              | 10.33                    |
| 2               | 7215.00         | --                      | AV | 54             | --          | --                 | --                   | --               | --                    | --                | --                 | --                       |

| Frequency(MHz): |                 |                         |    | 2405           |             |                    | Polarity:            |                  |                       | VERTICAL          |                    |                          |
|-----------------|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
| No.             | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 1               | 4810.00         | 57.47                   | PK | 74             | 16.53       | 1.00               | 185                  | 55.33            | 31.65                 | 6.89              | 36.40              | 2.14                     |
| 1               | 4810.00         | 43.25                   | AV | 54             | 10.75       | 1.00               | 185                  | 41.11            | 31.65                 | 6.89              | 36.40              | 2.14                     |
| 2               | 7215.00         | 49.36                   | PK | 74             | 24.64       | 1.00               | 120                  | 39.03            | 37.10                 | 8.58              | 35.35              | 10.33                    |
| 2               | 7215.00         | --                      | AV | 54             | --          | --                 | --                   | --               | --                    | --                | --                 | --                       |

| Frequency(MHz): |                 |                         |    | 2440           |             |                    | Polarity:            |                  |                       | HORIZONTAL        |                    |                          |
|-----------------|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
| No.             | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 1               | 4880.00         | 56.48                   | PK | 74.00          | 17.52       | 1.00               | 133                  | 55.08            | 30.47                 | 7.49              | 36.56              | 1.40                     |
| 1               | 4880.00         | 42.22                   | AV | 54.00          | 11.78       | 1.00               | 133                  | 40.82            | 30.47                 | 7.49              | 36.56              | 1.40                     |
| 2               | 7320.00         | 47.69                   | PK | 74.00          | 26.31       | 1.00               | 180                  | 36.78            | 37.65                 | 8.56              | 35.30              | 10.91                    |
| 2               | 7320.00         | --                      | AV | 54.00          | --          | --                 | --                   | --               | --                    | --                | --                 | --                       |

| Frequency(MHz): |                 |                         |    | 2440           |             |                    | Polarity:            |                  |                       | VERTICAL          |                    |                          |
|-----------------|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
| No.             | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 1               | 4880.00         | 57.39                   | PK | 74.00          | 16.61       | 1.00               | 126                  | 55.99            | 30.47                 | 7.49              | 36.56              | 1.40                     |
| 1               | 4880.00         | 43.64                   | AV | 54.00          | 10.36       | 1.00               | 126                  | 42.24            | 30.47                 | 7.49              | 36.56              | 1.40                     |
| 2               | 7320.00         | 48.96                   | PK | 74.00          | 25.04       | 1.00               | 78                   | 38.05            | 37.65                 | 8.56              | 35.30              | 10.91                    |
| 2               | 7320.00         | --                      | AV | 54.00          | --          | --                 | --                   | --               | --                    | --                | --                 | --                       |

| Frequency(MHz): |                 |                         |    | 2480           |             |                    | Polarity:            |                  |                       | HORIZONTAL        |                    |                          |
|-----------------|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
| No.             | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 1               | 4960.00         | 56.69                   | PK | 74.00          | 17.31       | 1.00               | 131                  | 53.63            | 31.55                 | 7.79              | 36.28              | 3.06                     |
| 1               | 4960.00         | 42.15                   | AV | 54.00          | 11.85       | 1.00               | 131                  | 39.09            | 31.55                 | 7.79              | 36.28              | 3.06                     |
| 2               | 7440.00         | 47.22                   | PK | 74.00          | 26.78       | 1.00               | 125                  | 35.49            | 38.36                 | 8.70              | 35.33              | 11.73                    |
| 2               | 7440.00         | --                      | AV | 54.00          | --          | --                 | --                   | --               | --                    | --                | --                 | --                       |

| Frequency(MHz): |                 |                         |    | 2480           |             |                    | Polarity:            |                  |                       | VERTICAL          |                    |                          |
|-----------------|-----------------|-------------------------|----|----------------|-------------|--------------------|----------------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
| No.             | Frequency (MHz) | Emission Level (dBuV/m) |    | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |
| 1               | 4960.00         | 57.36                   | PK | 74.00          | 16.64       | 1.00               | 105                  | 54.30            | 31.55                 | 7.79              | 36.28              | 3.06                     |
| 1               | 4960.00         | 42.14                   | AV | 54.00          | 11.86       | 1.00               | 105                  | 39.08            | 31.55                 | 7.79              | 36.28              | 3.06                     |
| 2               | 7440.00         | 48.78                   | PK | 74.00          | 25.22       | 1.00               | 45                   | 37.05            | 38.36                 | 8.70              | 35.33              | 11.73                    |
| 2               | 7440.00         | --                      | AV | 54.00          | --          | --                 | --                   | --               | --                    | --                | --                 | --                       |



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### REMARKS:

1. Emission level (dBUV/m) =Raw Value (dBUV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.



### 6.3 Maximum Peak Output Power

#### TEST PROCEDURE

According to KDB558074 D01 DTS Mea Guidance v03r02 9.1.2 PKPM1 Peak power meter method “The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.”

#### LIMIT

The Maximum Peak Output Power Measurement is 30dBm.

#### TEST RESULTS

| Type   | Channel | Total Output power(dBm) | Limit (dBm) | Result |
|--------|---------|-------------------------|-------------|--------|
| Zigbee | 11      | -1.487                  | 30.00       | Pass   |
|        | 18      | -0.869                  |             |        |
|        | 26      | 0.157                   |             |        |



## 6.4 Power Spectral Density

### TEST PROCEDURE

According to KDB 558074 D01 V03 Method PKPSD (peak PSD) this procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
4. Set the VBW  $\geq 3 \text{ RBW}$ .
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

### LIMIT

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

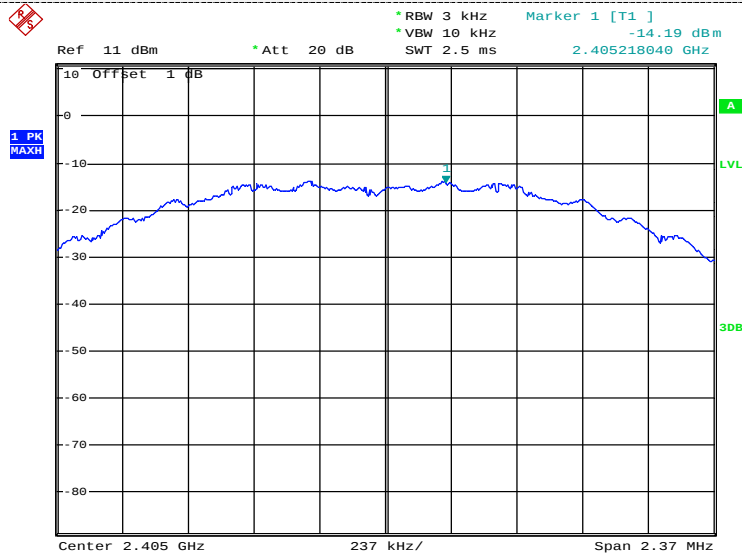
### TEST RESULTS

| Type   | Channel | Total Power Spectral Density (dBm/3KHz) | Limit (dBm/3KHz) | Result |
|--------|---------|-----------------------------------------|------------------|--------|
| Zigbee | 11      | -14.19                                  | 8.00             | Pass   |
|        | 18      | -13.44                                  |                  |        |
|        | 26      | -13.37                                  |                  |        |

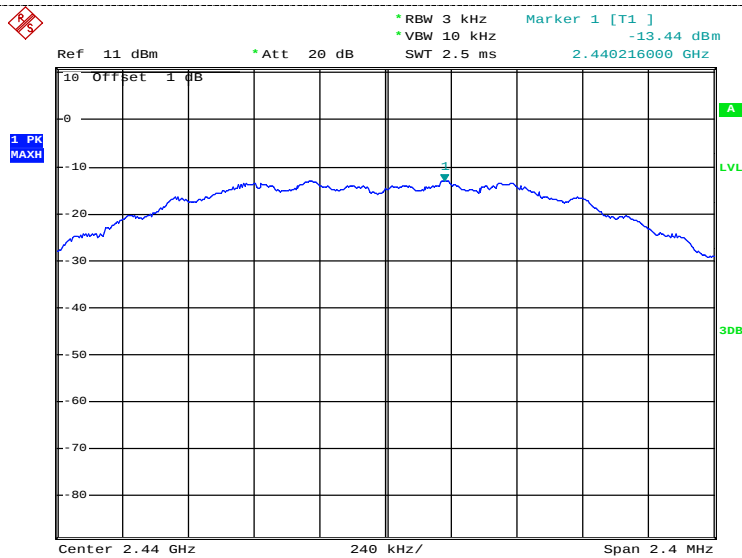
Test plots as follow:



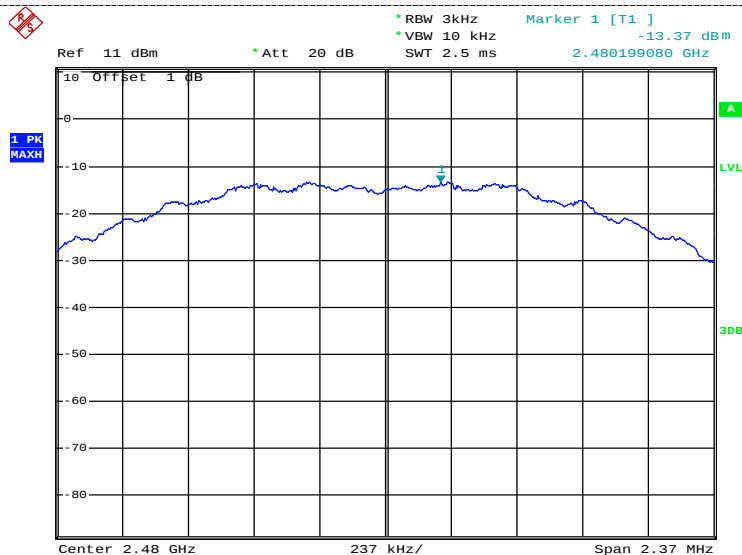
### Zigbee



### CH11



### CH18



### CH26



## **6.5 Band Edge Compliance of RF Emission**

### **TEST REQUIREMENT**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### **Test Procedure**

#### **Test Procedure tor conducted method**

1. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a spectrum analyzer
2. Turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set spectrum analyzer RBW =100 kHz and VBW=300 kHz
4. Use spectrum analyzer Maxhold function to allow trace to fully stabilize
5. Marker the highest point which fall into restricted frequency bands
6. Repeat above procedures until all measured frequencies were complete.

#### **Test Procedure tor radiated method**

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber. 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 antenna height 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. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel
7. Test the EUT in the lowest channel, the highest channel
8. The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report.
9. Repeat above procedures until all frequencies measured was complete.



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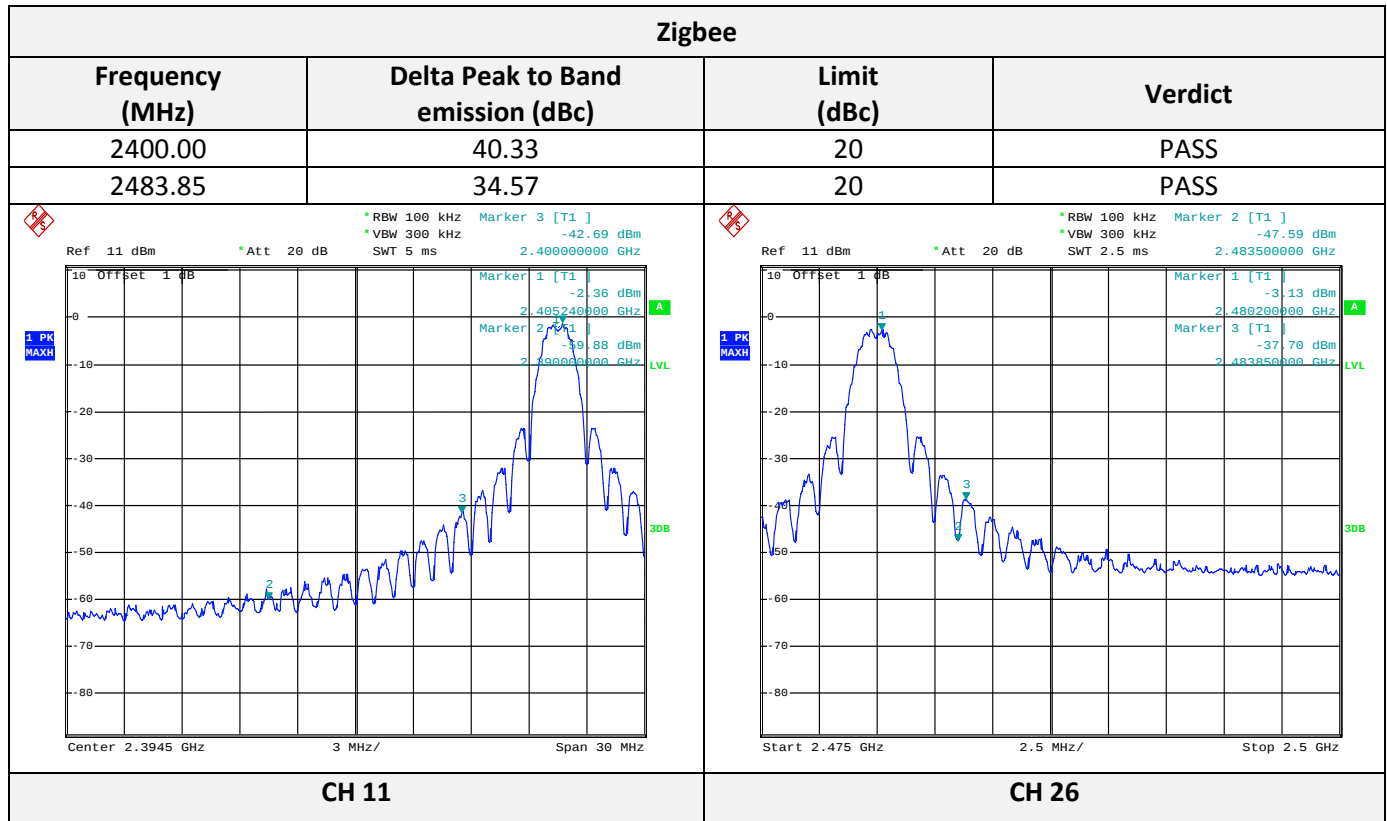
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## Test Results

### A. Conducted measurements



### B. Radiated measurements

| Frequency(MHz): |                         | 2405           |             |                    |                      | Polarity:        |                       |                   | HORIZONTAL         |                          |  |
|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|-----------------------|-------------------|--------------------|--------------------------|--|
| Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |  |
| 2390.00         | 65.26 PK                | 74.00          | 8.74        | 1.00               | 55                   | 70.57            | 27.49                 | 3.32              | 36.12              | -5.31                    |  |
| 2390.00         | 44.36 AV                | 54.00          | 9.64        | 1.00               | 55                   | 49.67            | 27.49                 | 3.32              | 36.12              | -5.31                    |  |
| Frequency(MHz): |                         | 2405           |             |                    |                      | Polarity:        |                       |                   | VERTICAL           |                          |  |
| Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |  |
| 2390.00         | 64.98 PK                | 74.00          | 9.02        | 1.00               | 105                  | 70.29            | 27.49                 | 3.32              | 36.12              | -5.31                    |  |
| 2390.00         | 42.14 AV                | 54.00          | 11.86       | 1.00               | 105                  | 47.45            | 27.49                 | 3.32              | 36.12              | -5.31                    |  |
| Frequency(MHz): |                         | 2480           |             |                    |                      | Polarity:        |                       |                   | HORIZONTAL         |                          |  |
| Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |  |
| 2483.50         | 65.98 PK                | 74.00          | 8.02        | 1.00               | 166                  | 71.70            | 27.45                 | 3.38              | 36.55              | -5.72                    |  |
| 2483.50         | 46.47 AV                | 54.00          | 7.53        | 1.00               | 166                  | 52.19            | 27.45                 | 3.38              | 36.55              | -5.72                    |  |
| Frequency(MHz): |                         | 2480           |             |                    |                      | Polarity:        |                       |                   | VERTICAL           |                          |  |
| Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre-amplifier (dB) | Correction Factor (dB/m) |  |
| 2483.50         | 63.74 PK                | 74.00          | 10.26       | 1.00               | 131                  | 69.46            | 27.45                 | 3.38              | 36.55              | -5.72                    |  |
| 2483.50         | 43.69 AV                | 54.00          | 10.31       | 1.00               | 131                  | 49.41            | 27.45                 | 3.38              | 36.55              | -5.72                    |  |



## **6.6 Spurious RF Conducted Emission**

### **TEST PROCEDURE**

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2009 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=100 kHz and VBW= 300 KHz to measure the peak field strength, and measure frequency range from 9 KHz to 26.5GHz.

### **LIMIT**

1. Below -20dB of the highest emission level in operating band.
2. Fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209.

### **TEST RESULTS**

Remark: The measurement frequency range is from 9 KHz to the 10<sup>th</sup> harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions measurement data.

The spurious emissions of the 9 kHz to 30MHz are look like floor noise and lower than Limit, so we don't recorded it.

We segment the test range to 30MHz-3GHz (sweep point 30000), 3GHz-15GHz (sweep point 120000) and 15 GHz-25 GHz (sweep point 120000) during the test.



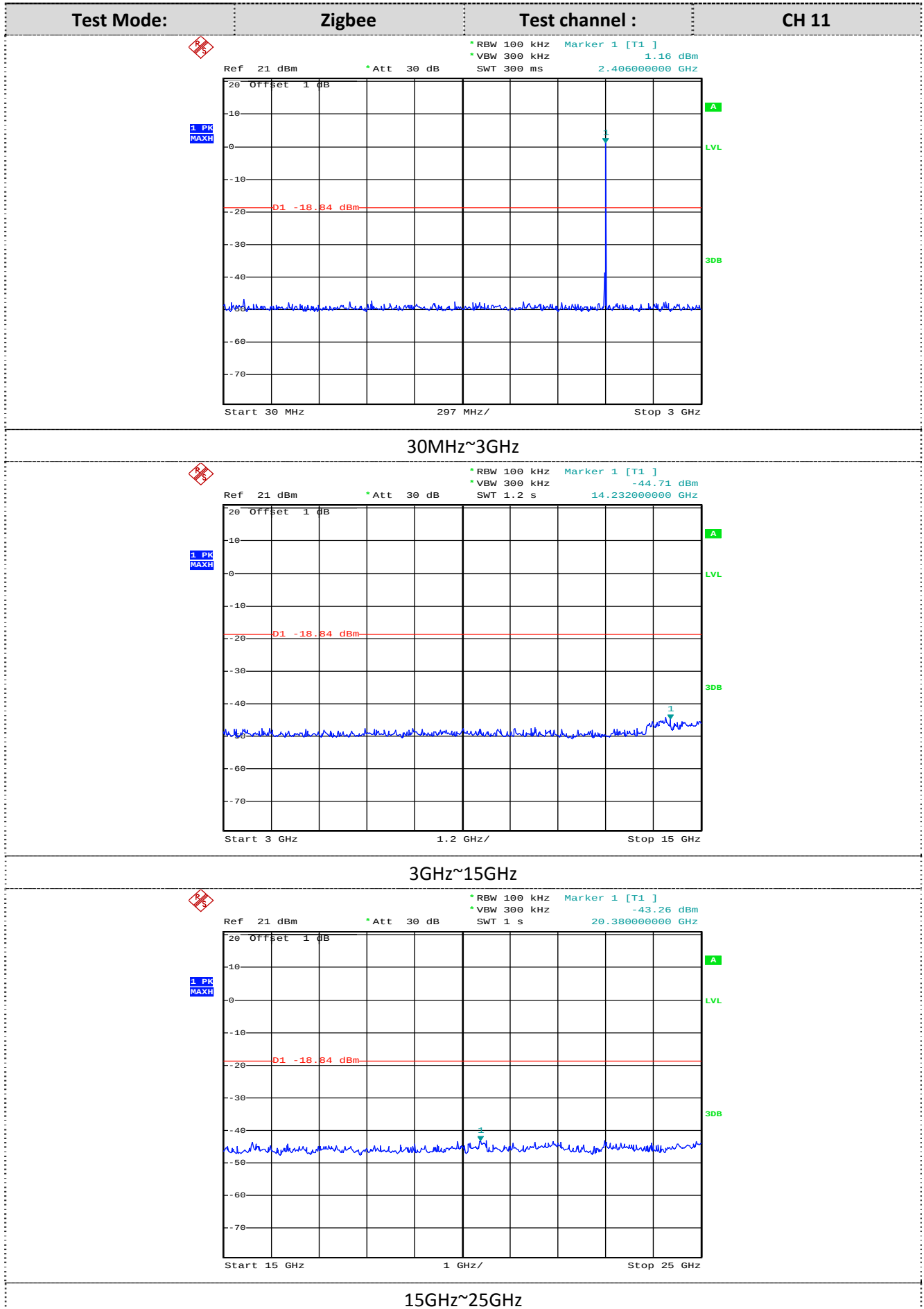
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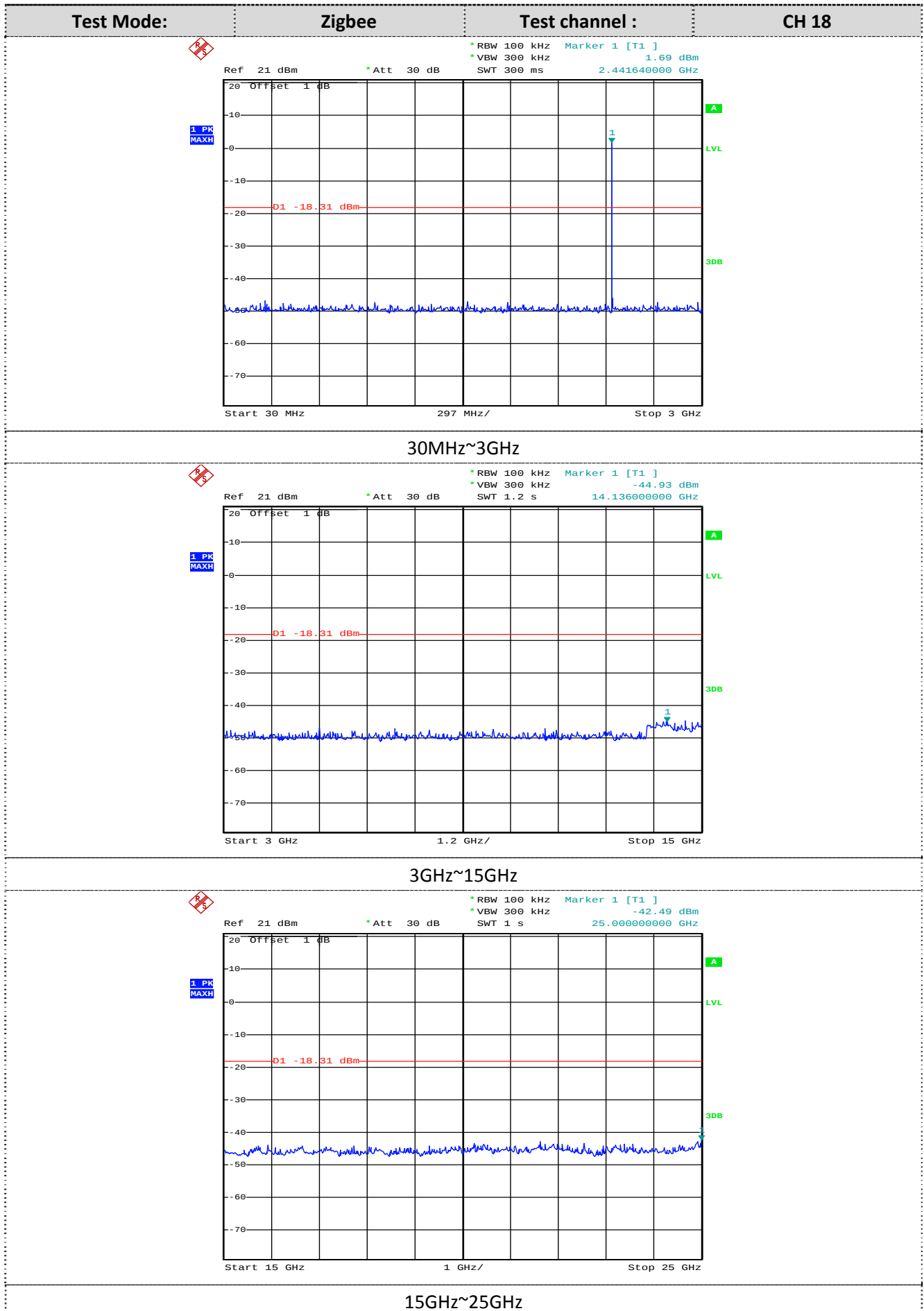
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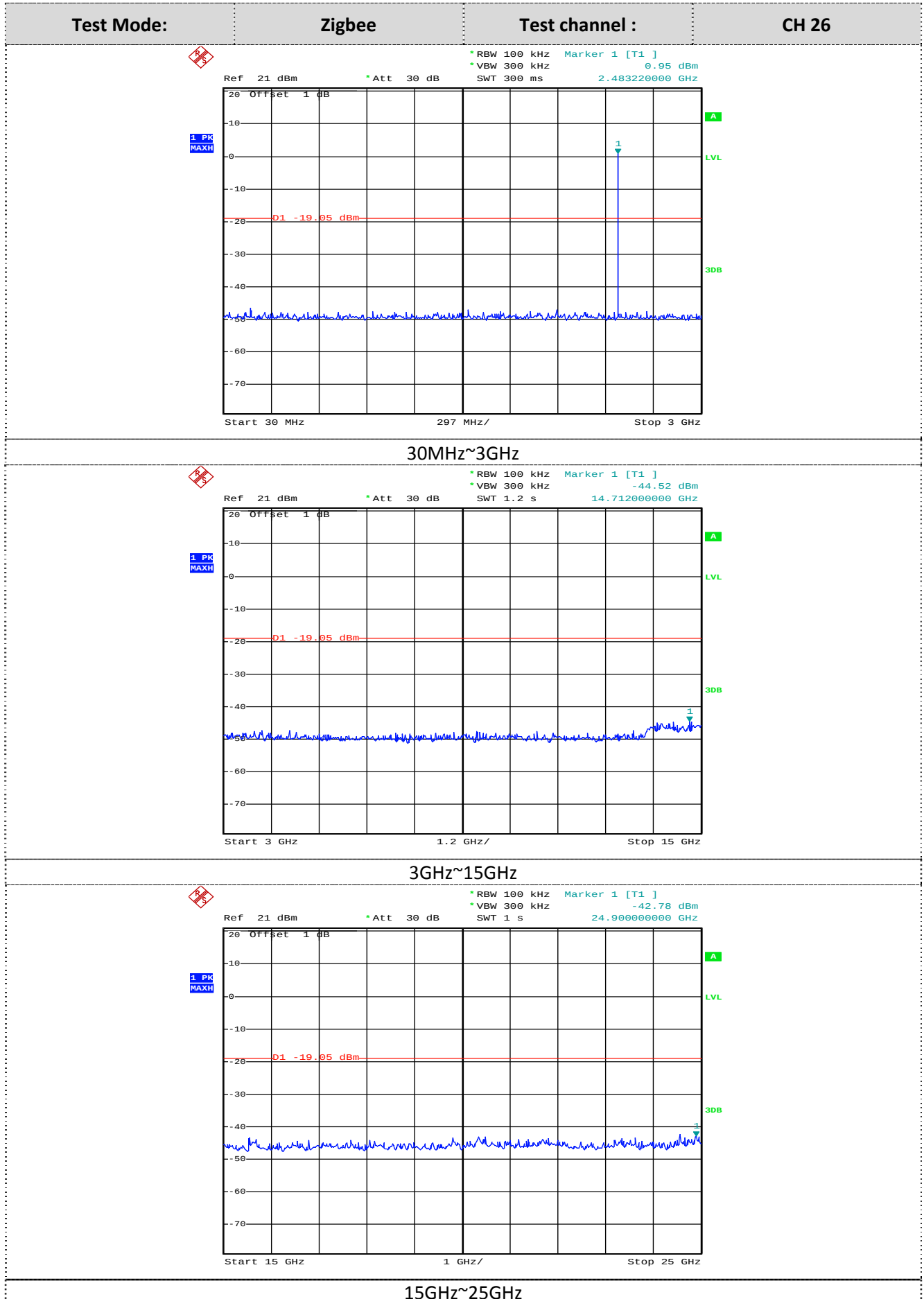
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## 6.7 6dB Bandwidth

### TEST PROCEDURE

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

According to KDB558074 D01 V03 for one of the following procedures may be used to determine the modulated DTS device signal bandwidth.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW)  $\geq 3$  RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

### LIMIT

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

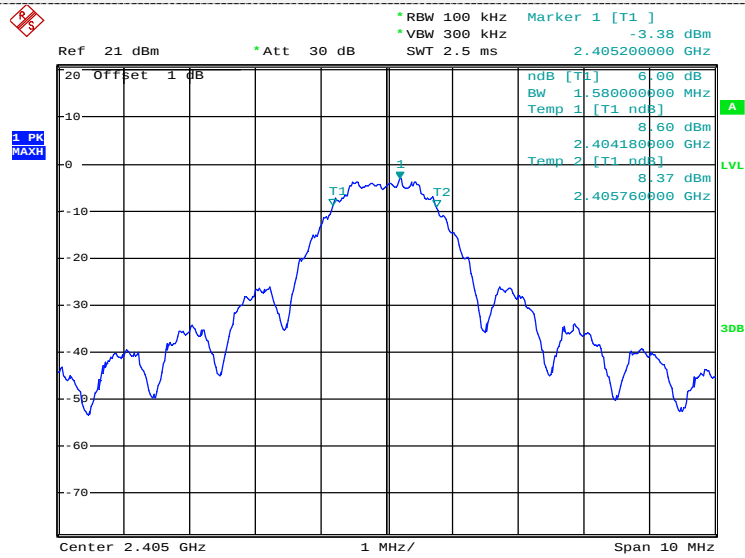
### TEST RESULTS

| Type   | Channel | Bandwidth (MHz) | Limit (KHz) | Result |
|--------|---------|-----------------|-------------|--------|
| ZigBee | 11      | 1.580           | $\geq 500$  | Pass   |
|        | 18      | 1.600           |             |        |
|        | 26      | 1.580           |             |        |

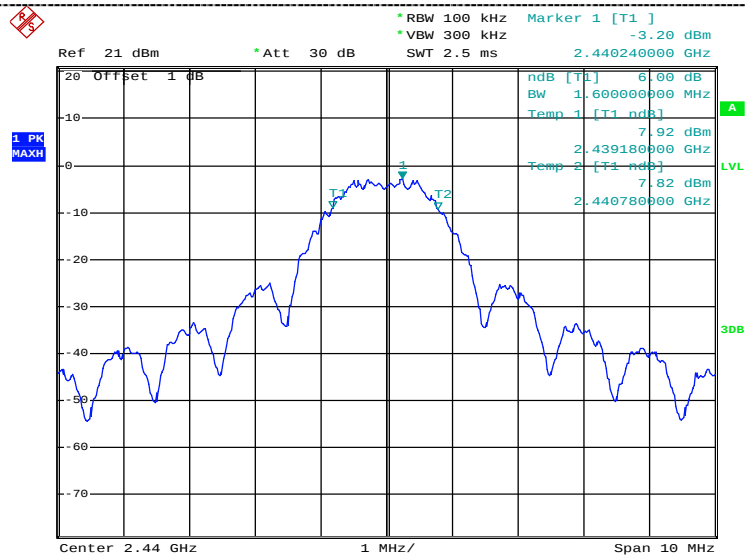
Test plots as follow:



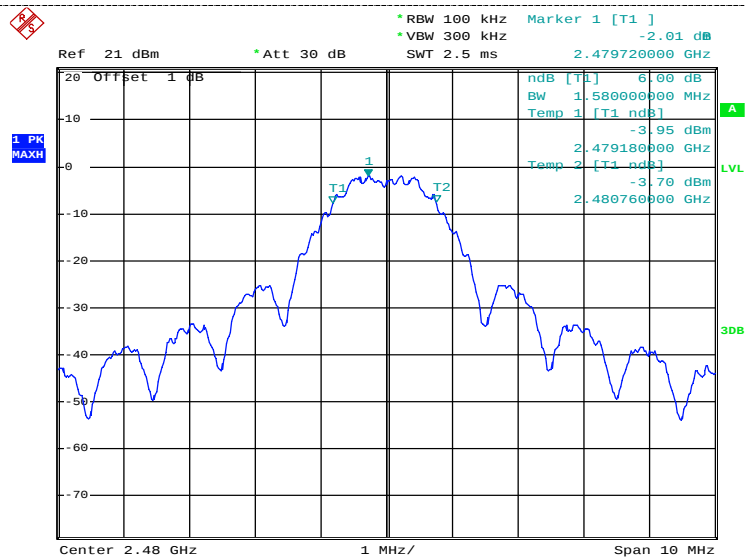
### Zigbee



### CH 11



### CH 18



### CH 26



## **6.8 Antenna Requirement**

### **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 (c), 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.

### **Refer to statement below for compliance**

The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

### **Antenna Connected Construction**

The device use an internal Antenna and the maximum antenna gain was 0 dBi.

---

END