# FCC
# RF Test Report

**Product Name: WiMAX CPE**

**Model Number: BM622i**

**Report No: SYBH(Z-RF)020032011**

**FCC ID:QISBM622I**


**Reliability Laboratory of Huawei Technologies Co., Ltd.**

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# Notice

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# Notice 2

Modification Information:

Modification Information

| | | |
|---|---|---|
| Modification Information | 1 | |
| | 2 | |
| | 3 | Not Applicable! |
| | 4 | |
| | 5 | |
| | 6 | |
| | 7 | |

| | |
|---|---|
| | **FCC CFR47 Part 2: Subpart J;** |
| | **47 CFR FCC Part 27, Subpart C&M** |
| | |
| | |
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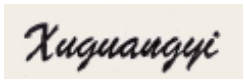
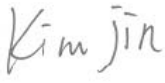
| | |
| | |
| | |
| **START OF TEST** | **Mar.18, 2011** |
| **END OF TEST** | **Apr.26, 2011** |
| | |
| **Final Judgement:** | **Pass** |

**Approved By** **2011-05-03** **Chen Xiaohong**
**Date** **Name** **Signature**



**Reviewed By** **2011-05-03** **Xu Guangyi**
**Date** **Name** **Signature**



**Operator** **2011-04-26** **Jingjinhua**
**Date** **Name**

# Contents

# 1 Summary

## 1.1 Results Summary

The table below summarizes the measurements and results for the equipment of QISBM622I WiMAX CPE-BM622i. Detailed results and descriptions are shown in the following pages.

Table 1. Summary of results for FCC requirements for BRS&EBS Band

| 47 CFR FCC Part(s) Requirements | | Description | Result |
|---|---|---|---|
| Specification | Limits | | |
| 2.1046 | 27.50(h)(2) | Transmitter Output Power | PASS |
| 2.1047 | --- | Modulation Characteristics | PASS |
| 2.1049 | --- | Occupied Bandwidth | PASS |
| 2.1051 | 27.53(m)(4)<br>27.53(m)(6) | Band Edges Compliance | PASS |
| 2.1051 | 27.53(m)(4)<br>27.53(m)(6) | Spurious Emission at Antenna Terminal | PASS |
| 2.1053 | 27.53(m)(4)<br>27.53(m)(6) | Radiated Spurious Emission | PASS |
| 2.1055 | 27.54 | Frequency Stability | PASS |

Note1: If no limits were applied, limits for product standards may be employed in this test report.

Note2: The Radiated Spurious Emissions' test results are shown in the EMC report

## 1.2 Supporting Standards

Table 2. Supporting Standards

| Standard Name | Description |
|---|---|
| ANSI/TIA-603-C | Land Mobile FM or PM Communications Equipment Measurement and Performance Standards |
| WiMAX MRCT | WiMAX Forum™ Mobile Radio Conformance Tests |

# 2 Product Description

## 2.1 Production Information of EUT

### 2.1.1 General Description

HUAWEI BM622i, a WiMAX CPE, is a proprietary product developed by HUAWEI based on IEEE 802.16e-2005, and works in range of 2.496-2.69GHz, The product is composed of three PCB boards, a WiMAX RF board, a home gate board, and an antenna PCB board, providing two ports for the user service.
1×RJ45:10/100M LAN port;
1×RJ11:TEL port for VOIP;

### 2.1.2 Support Modulation and Coding Rate

The EUT supports the modulation and coding rate as follows:

Table 3. Modulation and Coding Rate List

| Modulation | Coding Rate | Test Mode | Remark |
|---|---|---|---|
| QPSK | 1/2 | TM1 | DL and UL |
| | 3/4 | TM2 | DL and UL |
| 16QAM | 1/2 | TM3 | DL and UL |
| | 3/4 | TM4 | DL and UL |
| 64QAM | 1/2 | TM5 | DL Only |
| | 2/3 | TM6 | DL Only |
| | 3/4 | TM7 | DL Only |
| | 5/6 | TM8 | DL Only |

Note: The test conditions and settings are defined in WiMAX MRCT.

# 3 Test Site Description

The test site of:

***Huawei Technologies Co. Ltd.***
***P.O. Box 518129***
***Huawei base, Bantian,***
***Longgang District, Shenzhen, China***

## 3.1 Testing Period

The test has been performed during the period of:

Date of Start (y-m-d): 2011-3-18
Date of End (y-m-d): 2011-4-22

# 4 Product Description

## 4.1 Technical Characteristics

### 4.1.1 Frequency Range

Table 4. Frequency Range for BRS&EBS Band

| | |
|---|---|
| Uplink band: | 2496 to 2690 MHz |
| Downlink band: | 2496 to 2690 MHz |

### 4.1.2 Channel Bandwidth

Table 5. Channel Bandwidth

| | |
|---|---|
| Channel bandwidth: | 5 MHz and 10 MHz |

### 4.1.3 Output Power

Table 6. Output Power

| | |
|---|---|
| Transmitter Output Power | 25dBm±2dB (Per Antenna Group of EUT)<br>22dBm±2dB (Per Antenna Port of 2TX MIMO) |

### 4.1.4 Antenna Profiles

Table 7. Antenna Profiles

| | |
|---|---|
| Antenna Brand: | Huawei |
| Antenna Type: | Omnidirectional Antenna |
| Antenna Frequency Range: | 2.496GHz~2.690GHz |
| Antenna Maximum Peak Gain: | 7 dBi |

### 4.1.5 Power Source

Table 8. DC Power Source

| | |
|---|---|
| Charger voltage range: | ～100-240 V, 50/60Hz |
| Charger current maximal: | 600mA Max |
| DC Voltage Nominal: | ⎓ 12V |
| DC Voltage Range | ⎓ 9.6V~14.4 V |

### 4.1.6 Environmental Requirements

Table 9. Environmental Requirements

| | |
|---|---|
| Temperature Range: | 0°C ~+40 °C |
| Relative Humidity: | 5% to 95% RH |

### 4.1.7 UL Zone Type

Table 10. UL Zone Type

| | |
|---|---|
| UL Zone Type: | PUSC |

### 4.1.8 Tune-up Procedure

Refer to FCC 2.1033(c) (9).

Please reference the document Tune-up Procedure in TCF.

**Note:**

1. The EUT can support different DL/UL ration in the normal operation, the maximum DL/UL (29:18) ration is used for 5MHz and 10MHz in this test, which can be controlled by the software from the host equipment.
2. The EUT have five TRX antenna ports, respectively named ‘TRXA’, ‘TRXB’, ‘TRXC’, ‘TRXD’, and ‘TRXE’. They are partitioned to three groups; ‘TRXE’ is group No.1, which is for an external antenna, ‘TRXA’ and ‘TRXC’ is group No.2, ‘TRXB’ and ‘TRXD’ is group No.3, each of group No.2 and group No.3 gets two inner PCB antenna for MIMO, group No.1 can’t supports MIMO.
3. The EUT can switch between the three antenna groups; only one group is used at a time. Which group will be switch is decided by the receiver signal, the group gets a strongest RX signal will be used first for TX and RX.
4. The above EUT information was declared by manufacture, for more detailed features description please refers to the manufacture’s specifications or User’s Manual.

## 4.2 EUT Identification List

### 4.2.1 Component Parts Information

The EUT involved in the test report consists of sub-assembly and ancillary Equipments as below.

### (1) Sub-assembly identity of EUT

Sub-assembly identity of EUT

| Model Identify | Hardware Version | Qty. | Software Version | Serial Number | Description |
|---|---|---|---|---|---|
| BM622i | BM62VLIE | 1 | V100R001 | NA | Home gate Board |
| | BM65WACA | 1 | V100R001 | NA | WiMAX RF Board |
| | BM62ANSL | 1 | V100R001 | NA | Antenna Board |

### (2) Sub-assembly identity of Ancillary Equipments

Table 11. Sub-assembly identity of Ancillary Equipments

| Model Identify | Qty. | Hardware Version | Software Version | Serial Number | Description |
|---|---|---|---|---|---|
| / | / | / | / | / | / |

### 4.2.2 FCC Identification

Grantee Code: QIS
Product Code: BM622I
FCC Identification: QISBM622I

# 5 Main Test Instruments

Table 12. Main Test Equipments

| Equipment Description | Manufacturer | Model | Serial Number | Calibrated until |
|---|---|---|---|---|
| Power supply | KEITHLEY | 2303 | 1288003 | Sep.27,2011 |
| Wireless Communication Test set | Agilent | N4010A | MY49081592 | Dec.14.2011 |
| Universal Radio Communication Tester | R&S | CMU200 | 105822 | Oct.24.2011 |
| Universal Radio Communication Tester | Agilent | E5515C | MY50260239 | Aug.04,2011 |
| Spectrum Analyzer | Agilent | E4440A | MY49420179 | Apr.24,2012 |
| Signal Analyzer | R&S | FSQ40 | 100025 | Oct.09,2011 |
| Signal Analyzer | R&S | FSQ31 | 200021 | Sep.27,2011 |
| Temperature Chamber | WEISS | WKL64 | 24600294 | Jan.03,2012 |
| Signal Generator | R&S | SMR40 | 100325 | May.12,2012 |
| Vector Signal Generator | R&S | SMU200A | 104162 | Sep.07,2011 |
| Spectrum Analyzer | R&S | FSU26 | EG26725 | Mar.07,2012 |
| Test receiver | R&S | ESIB26 | 100318 | May.04.2012 |
| Tunable Dipole | Schwarzbeck | D69250-UHAP/D69250-VHAP | 919/1009 | Dec.13.2011 |
| Tunable Dipole | Schwarzbeck | D69250-UHAP/D69250-VHAP | 979/917 | Dec.13.2011 |
| Horn Antenna | R & S | HF906 | 359287/005 | May.07, 2012 |
| Horn Antenna | R & S | HF906 | 359287/006 | April.27, 2012 |
| Broadband Antenna | SCHAFFNER | CBL 6112B | 2536 | Sep.21, 2011 |
| Broadband Antenna | SCHAFFNER | CBL 6112B | 2941 | Jun.11, 2011 |
| Horn Antenna | ETS-LINDGREN | 3160 | 60008 | Sep.20.2011 |
| Horn Antenna | ETS-LINDGREN | 3160 | 60006 | Oct.27.2011 |

# 6 Transmitter & Receiver Measurements

## Test Ports:

The information as below is followed in tests and in the present test report:

- The EUT has five TRX antenna ports, respectively named ‘TRXA’, ‘TRXB’, ‘TRXC’, ‘TRXD’, and ‘TRXE’. They are partitioned to three groups; ‘TRXE’ is group No.1, which is for an extern antenna, ‘TRXA’ and ‘TRXC’ is group No.2, ‘TRXB’ and ‘TRXD’ is group No.3, group No.2 and No.3 are used for MIMO with the inner PCB antennas. TRXE can’t support MIMO.
- The Uplink of EUT is relevant to Transmitter (TX), while Downlink to Receiver (RX).
- Unless otherwise stated, all “RF Channels under Test”, “Test Environments”, “Test Modes”, “Channel Bandwidth” and “their combinations” should be considered in tests (see detailed as following clauses).

## Test Frequencies:

Table 13. Frequency points (channels) selected to perform transmitter tests

| Transmitter Operating Band | Multiple Carriers | Channels under Test | | |
|---|---|---|---|---|
| | | Bottom/lowest (B) | Middle (M) | Top/highest (T) |
| BRS&EBS band (5 MHz Channel Bandwidth) | 1 | 2498.5 MHz | 2593 MHz | 2687.5 MHz |
| BRS&EBS band (10 MHz Channel Bandwidth) | 1 | 2501 MHz | 2593 MHz | 2685 MHz |

## 6.1 Maximum Channel Power

### 6.1.1 Test Conditions

Table 14. Test Conditions

| | |
|---|---|
| Measured at: | All Antenna connectors |
| Ambient temperature: | 24 °C to 26 °C |
| Relative humidity: | 55% to 63% |

### 6.1.2 Test Specifications and Limits

Compliance with FCC part 2.1046 and part 27.50(h)(2), Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

Table 15. FCC Limits for BRS&EBS Band

| | |
|---|---|
| Limits for mobile stations | <2W(33dBm),EIRP |
| Limits for user stations | <2W(33dBm),transmitter output power |

### 6.1.3 Test Method and Setup

The EUT was connected to the Wireless Signal Analyzer or equivalent via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Maximum Channel Power of the EUT by the Wireless Signal Analyzer or equivalent.

Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an RMS equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

Note 1: Compliance with FCC part 2.1046 and part 27.50(h)(2), Mobile stations are limited to 2.0 watts EIRP and other user stations are limited to 2.0W transmitter output power (see table 15);

Note 2:QISBM622I is desktop equipment, which doesn’t belong to mobile station, a normal user stations transmitter output power limit 2W (33dBm) is used;

## Test setup

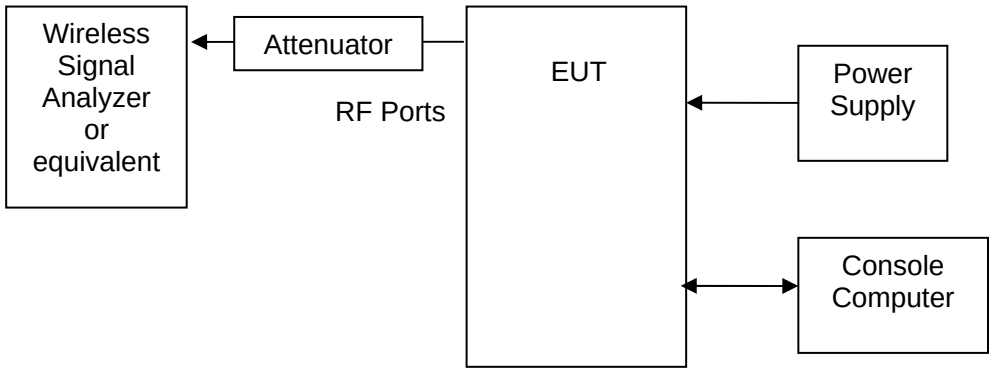



Figure 1. TEST SETUP

### 6.1.4 Measurement Results

#### 6.1.4.1 Maximum Output Power at Antenna Port

**(1) Channel Bandwidth = 5 MHz:**

Table 16. Measurement Results for Maximum Output Power

| Test Mode | | Transmitter output power (dBm) | | | | | | Limit (dBm) |
|---|---|---|---|---|---|---|---|---|
| | | Ch. B | | Ch. M | | Ch. T | | |
| | | Single TX | MIMO | Single TX | MIMO | Single TX | MIMO | |
| TM 1 | Antenna TRXA | 22.36 | 25.36 | 22.11 | 25.11 | 22.16 | 25.16 | < 33 |
| | Antenna TRXB | 22.59 | 25.59 | 22.36 | 25.36 | 22.51 | 25.51 | < 33 |
| | Antenna TRXC | 21.86 | 24.86 | 21.88 | 24.88 | 21.92 | 24.92 | < 33 |
| | Antenna TRXD | 22.40 | 25.40 | 22.61 | 25.61 | 22.67 | 25.67 | < 33 |
| | Antenna TRXE | 24.89 | / | 24.46 | / | 23.80 | / | < 33 |
| TM 2 | Antenna TRXA | 22.36 | 25.36 | 22.10 | 25.1 | 22.15 | 25.15 | < 33 |
| | Antenna TRXB | 22.59 | 25.59 | 22.35 | 25.35 | 22.47 | 25.47 | < 33 |
| | Antenna TRXC | 22.84 | 24.84 | 21.86 | 24.86 | 21.88 | 24.88 | < 33 |
| | Antenna TRXD | 22.37 | 25.37 | 22.57 | 25.57 | 22.64 | 25.64 | < 33 |
| | Antenna TRXE | 24.88 | / | 24.42 | / | 23.74 | / | < 33 |
| TM 3 | Antenna TRXA | 22.35 | 25.35 | 22.00 | 25 | 22.03 | 25.03 | < 33 |
| | Antenna TRXB | 22.58 | 25.58 | 22.27 | 25.27 | 22.37 | 25.37 | < 33 |
| | Antenna TRXC | 21.83 | 24.83 | 21.76 | 24.76 | 21.79 | 24.79 | < 33 |
| | Antenna TRXD | 22.36 | 25.36 | 22.46 | 25.46 | 22.53 | 25.53 | < 33 |
| | Antenna TRXE | 24.88 | / | 24.34 | / | 23.50 | / | < 33 |
| TM 4 | Antenna TRXA | 22.11 | 25.11 | 21.76 | 24.76 | 21.78 | 25.78 | < 33 |
| | Antenna TRXB | 22.36 | 25.36 | 22.03 | 25.03 | 22.13 | 25.13 | < 33 |
| | Antenna TRXC | 21.60 | 24.6 | 21.53 | 24.53 | 21.55 | 24.55 | < 33 |
| | Antenna TRXD | 22.13 | 25.13 | 22.23 | 25.23 | 22.29 | 25.29 | < 33 |
| | Antenna TRXE | 24.66 | / | 24.14 | / | 23.46 | / | < 33 |

**(2) Channel Bandwidth = 10 MHz:**

Table 17. Measurement Results for Maximum Output Power

| Test Mode | | Transmitter output power (dBm) | | | | | | Limit (dBm) |
|---|---|---|---|---|---|---|---|---|
| | | Ch. B | | Ch. M | | Ch. T | | |
| | | Single TX | MIMO | Single TX | MIMO | Single TX | MIMO | |
| TM 1 | Antenna TRXA | 22.34 | 25.34 | 22.66 | 25.66 | 22.87 | **25.87** | < 33 |
| | Antenna TRXB | 22.17 | 25.17 | 22.47 | 25.47 | 22.75 | 25.75 | < 33 |
| | Antenna TRXC | 21.67 | 24.67 | 21.95 | 24.95 | 22.15 | 25.15 | < 33 |
| | Antenna TRXD | 22.09 | 25.09 | 22.40 | 25.4 | 22.70 | 25.7 | < 33 |
| | Antenna TRXE | 24.87 | / | 24.78 | / | 24.43 | / | < 33 |
| TM 2 | Antenna TRXA | 22.27 | 25.27 | 22.54 | 25.54 | 22.70 | 25.7 | < 33 |
| | Antenna TRXB | 22.13 | 25.13 | 22.40 | 25.4 | 22.67 | 25.67 | < 33 |
| | Antenna TRXC | 21.60 | 24.6 | 21.82 | 24.82 | 22.02 | 25.02 | < 33 |
| | Antenna TRXD | 22.03 | 25.03 | 22.39 | 25.39 | 22.62 | 25.62 | < 33 |
| | Antenna TRXE | 24.70 | / | 24.56 | / | 24.16 | / | < 33 |
| TM 3 | Antenna TRXA | 22.22 | 25.22 | 22.40 | 25.4 | 22.52 | 25.52 | < 33 |
| | Antenna TRXB | 22.08 | 25.08 | 22.27 | 25.27 | 22.52 | 25.52 | < 33 |
| | Antenna TRXC | 21.54 | 24.54 | 21.68 | 24.68 | 21.86 | 24.86 | < 33 |
| | Antenna TRXD | 21.94 | 24.94 | 22.20 | 25.2 | 22.42 | 25.42 | < 33 |
| | Antenna TRXE | 24.59 | / | 24.30 | / | 23.83 | / | < 33 |
| TM 4 | Antenna TRXA | 21.99 | 24.99 | 22.15 | 25.15 | 22.26 | 25.26 | < 33 |
| | Antenna TRXB | 21.83 | 24.83 | 22.02 | 25.02 | 22.26 | 25.26 | < 33 |
| | Antenna TRXC | 21.30 | 24.3 | 21.41 | 24.41 | 21.58 | 24.58 | < 33 |
| | Antenna TRXD | 21.68 | 24.68 | 21.89 | 24.89 | 22.09 | 25.09 | < 33 |
| | Antenna TRXE | 24.31 | / | 24.00 | / | 23.53 | / | < 33 |

Note 1: Double transmitter output power for MIMO is amount to the Single TX output power adding with 10lgN, where N is the number of antenna ports used for MIMO at once, 10lg2=3.

Note 2: The maximum output power is **25.87dBm** at Antenna TRXA of MIMO Antenna Group No.2, so the rest tests will be mainly test on Antenna TRXA Port.

### 6.1.5 Conclusion

The equipment **PASSED** the requirement of this clause.

## 6.2 Modulation Characteristics

### 6.2.1 Test Conditions

Table 18. Test Conditions

| | |
|---|---|
| Measured at: | Antenna TRXA |
| Ambient temperature: | 24 °C to 26 °C |
| Relative humidity: | 55% to 63% |

### 6.2.2 Test Specifications and Limits

No specific modulation characteristics requirement limits in FCC part 2.1047 and part 27 subpart C for BRS&EBS Band.

In addition, limits according to the technical requirements of the EUT can be adopted as showed in the following table.

Table 19. Limits According to EUT technical requirements

| | |
|---|---|
| Limits for IEEE802.16 mobile stations: | QPSK 1/2 modulation: RCE < -15 dB<br>QPSK 3/4 modulation: RCE < -18 dB<br>16QAM 1/2 modulation: RCE < -20.5 dB<br>16QAM 3/4 modulation: RCE < -24 dB |

### 6.2.3 Test Method and Setup

The EUT was connected to the Wireless Signal Analyzer or equivalent via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Modulation Characteristics of the EUT by the Wireless Signal Analyzer or equivalent.

## Test setup

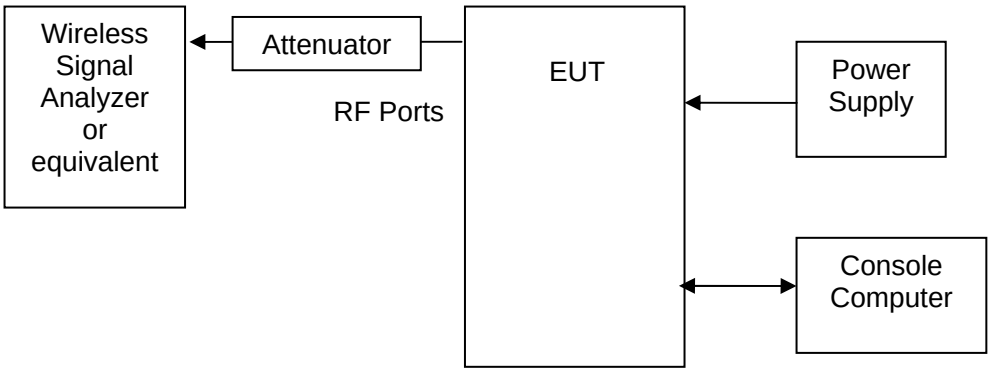



Figure 2. TEST SETUP

### 6.2.4 Measurement Results

**(1) Channel Bandwidth = 5 MHz:**

Table 20. Measurement Results for Modulation Characteristics

| Test Mode | Modulation Characteristics (dB) | | | Limit |
|---|---|---|---|---|
| | B | M | T | |
| TM 1 | -30.19 | -29.26 | -29.99 | < -15 dB |
| TM 2 | -30.58 | -29.46 | -29.99 | < -18 dB |
| TM 3 | -30.64 | -29.43 | -30.45 | < -20.5 dB |
| TM 4 | -30.51 | -30.02 | -30.80 | < -24 dB |

**(2) Channel Bandwidth = 10 MHz:**

Table 21. Measurement Results for Modulation Characteristics

| Test Mode | Modulation Characteristics (dB) | | | Limit |
|---|---|---|---|---|
| | B | M | T | |
| TM 1 | -30.71 | -29.26 | -30.63 | < -15 dB |
| TM 2 | -30.59 | -29.05 | -30.78 | < -18 dB |
| TM 3 | -30.50 | -29.40 | -30.75 | < -20.5 dB |
| TM 4 | -30.81 | -29.55 | -30.54 | < -24 dB |

### 6.2.5 Conclusion

The equipment **PASSED** the requirement of this clause.
For the measurement results refer to Appendix A.

## 6.3 Occupied Bandwidth

### 6.3.1 Test Conditions

Table 22. Test Conditions

| | |
|---|---|
| Measured at: | Antenna TRXA |
| Ambient temperature: | 24 °C to 26 °C |
| Relative humidity: | 55% to 63% |

### 6.3.2 Test Specifications and Limits

No specific occupied bandwidth requirement in FCC part 2.1049 and part 27 subpart C for BRS&EBS Band.

### 6.3.3 Test Method and Setup

The EUT was connected to the Spectrum Analyzer or equivalent via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Occupied Bandwidth of the EUT by the Spectrum Analyzer or equivalent.

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured (as 99% bandwidth).

The measurement bandwidth (RBW) of Spectrum Analyzer or equivalent is set to about or less than 1% of the channel bandwidth.

**Test setup**

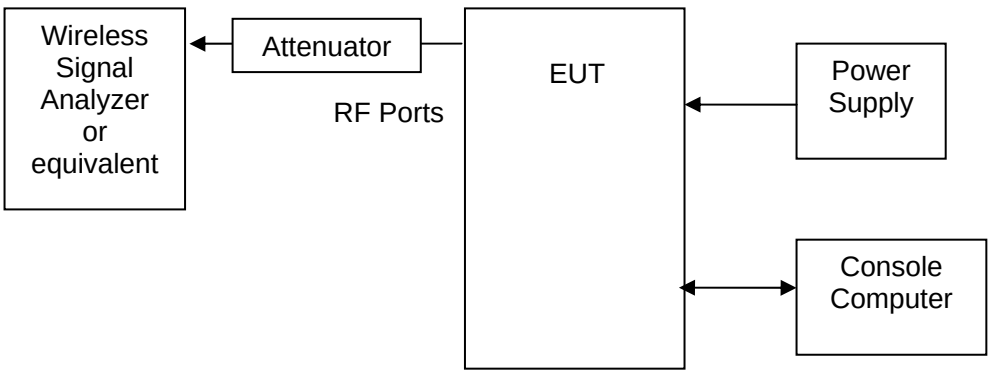



Figure 3. TEST SETUP

### 6.3.4 Measurement Results

**Channel Bandwidth = 5 MHz:**

Table 23. Measurement Results for Occupied Bandwidth

| Test Mode | Occupied Bandwidth (MHz) | | | | | | Limit |
|---|---|---|---|---|---|---|---|
| | B | | M | | T | | |
| | 99% | 26dB | 99% | 26dB | 99% | 26dB | |
| TM 1 | 4.4688 | 5.248 | 4.4617 | 4.965 | 4.4603 | 4.962 | --- |
| TM 2 | 4.4709 | 5.271 | 4.4642 | 4.997 | 4.4584 | 4.921 | |
| TM 3 | 4.4740 | 5.312 | 4.4695 | 5.009 | 4.4645 | 4.947 | |
| TM 4 | 4.4628 | 5.135 | 4.4578 | 4.964 | 4.4538 | 4.912 | |

**Channel Bandwidth = 10 MHz:**

Table 24. Measurement Results for Occupied Bandwidth

| Test Mode | 99% Occupied Bandwidth (MHz) | | | | | | Limit |
|---|---|---|---|---|---|---|---|
| | B | | M | | T | | |
| | 99% | 26dB | 99% | 26dB | 99% | 26dB | |
| TM 1 | 9.1086 | 9.676 | 9.1030 | 9.567 | 9.1004 | 9.518 | --- |
| TM 2 | 9.1102 | 9.716 | 9.1047 | 9.626 | 9.0999 | 9.530 | |
| TM 3 | 9.1164 | 9.545 | 9.1109 | 9.505 | 9.1093 | 9.470 | |
| TM 4 | 9.1178 | 9.698 | 9.1134 | 9.513 | 9.1114 | 9.524 | |

### 6.3.5 Conclusion

The equipment **PASSED** the requirement of this clause.
For the measurement results refer to Appendix B.

## 6.4 Band Edges Compliance

### 6.4.1 Test Conditions

Table 25. Test Conditions

| | |
|---|---|
| Measured at: | Antenna TRXA |
| Ambient temperature: | 24 °C to 26 °C |
| Relative humidity: | 55% to 63% |

### 6.4.2 Test Specifications and Limits

FCC part 2.1051 and part 27.53(m)(4) and part 27.53(m)(6)

Table 26. Supporting Standards

| | |
|---|---|
| ANSI/TIA-603-C | Land Mobile FM or PM Communications Equipment Measurement and Performance Standards |
| WiMAX MRCT | WiMAX Forum™ Mobile Radio Conformance Tests |

Compliance with FCC part 2.1051 and part 27.53(m)(4) and part 27.53(m)(6), for mobile digital stations, is based on the use of measurement instrumentation employing a resolution bandwidth of 1MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, the attenuation factor shall not be less than 43 + 10 log (P) dB at the channel edge and 55 + 10 log (P) dB at 5.5MHz from the channel edges.

Table 27. FCC Limits for BRS&EBS Band

| | |
|---|---|
| Limit: | At the channel edge:<br>$< P - (43 + 10\log_{10}P) = 10\log_{10}(1000 * P) - (43 + 10\log_{10}P) = 30 - 43 = -13$dBm<br>At 5.5MHz from the channel edges:<br>$< P - (55 + 10\log_{10}P) = 10\log_{10}(1000 * P) - (55 + 10\log_{10}P) = 30 - 55 = -25$dBm, at 5.5MHz from the channel edges |

### 6.4.3 Test Method and Setup

The EUT was connected to the Spectrum Analyzer or equivalent via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Band Edge Spurious Emissions of the EUT by the Spectrum Analyzer or equivalent.

Set the Spectrum Analyzer or equivalent in power averaging mode and resolution bandwidth (RBW) as close to 1.0% of the emission bandwidth as possible. Set the sweep span to cover at least ±250% of the emission bandwidth or 2 MHz, which is larger.

The measurement bandwidth (RBW) of Spectrum Analyzer or equivalent is set to at least 1% of the channel bandwidth for the 1MHz bands immediately outside and adjacent to the frequency block, But 1MHz or great RBW should be used for other bands offset out of 1MHz to the frequency block.

## Test setup

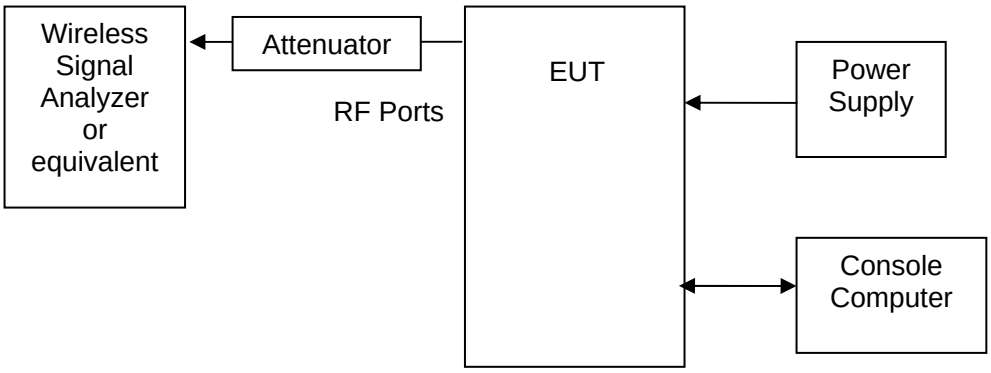



Figure 4. TEST SETUP

### 6.4.4 Measurement Results

#### 6.4.4.1 Band edge emissions

**Channel Bandwidth = 5 MHz:**

Table 28. Measurement Results for Band Edge Characteristics

| Test Mode | Test Frequency offset (MHz) | Band Edge Emissions (dBm) | | | | |
|---|---|---|---|---|---|---|
| | | B | | T | | Limit (dBm) |
| | | Single TX | MIMO | Single TX | MIMO | |
| TM 1 | < 1MHz | -31.62 | -28.62 | -49.08 | -46.08 | < -13 |
| | < 5.5MHz | -17.42 | -14.42 | -17.33 | -14.33 | < -13 |
| | > 5.5MHz | -46.78 | -43.78 | -47.51 | -44.51 | < -25 |
| TM 2 | < 1MHz | -32.39 | -29.39 | -49.95 | -46.95 | < -13 |
| | < 5.5MHz | -17.45 | -14.45 | -17.32 | -14.32 | < -13 |
| | > 5.5MHz | -46.75 | -43.75 | -47.41 | -44.41 | < -25 |
| TM 3 | < 1MHz | -28.95 | -25.95 | -50.43 | -47.43 | < -13 |
| | < 5.5MHz | -19.65 | -16.65 | -19.56 | -16.56 | < -13 |
| | > 5.5MHz | -49.27 | -46.27 | -48.97 | -45.97 | < -25 |
| TM 4 | < 1MHz | -31.71 | -28.71 | -51.06 | -48.06 | < -13 |
| | < 5.5MHz | -20.62 | -17.62 | -19.55 | -16.55 | < -13 |
| | > 5.5MHz | -49.31 | -46.31 | -48.91 | -45.91 | < -25 |

**Channel Bandwidth = 10 MHz:**

Table 29. Measurement Results for Band Edge Characteristics

| Test Mode | Test Frequency offset (MHz) | Band Edge Emissions (dBm) | | | | |
|---|---|---|---|---|---|---|
| | | B | | T | | Limit (dBm) |
| | | Single TX | MIMO | Single TX | MIMO | |
| TM 1 | < 1MHz | -35.10 | -32.1 | -43.57 | -40.57 | < -13 |
| | < 5.5MHz | -16.63 | -13.63 | -16.32 | -13.32 | < -13 |
| | > 5.5MHz | -31.83 | -28.83 | -32.36 | -29.36 | < -25 |
| TM 2 | < 1MHz | -33.59 | -30.59 | -44.07 | -41.07 | < -13 |
| | < 5.5MHz | -16.64 | -13.64 | -16.26 | -13.26 | < -13 |
| | > 5.5MHz | -31.94 | -28.94 | -32.55 | -29.55 | < -25 |
| TM 3 | < 1MHz | -32.74 | -29.74 | -47.44 | -44.44 | < -13 |
| | < 5.5MHz | -16.64 | -13.64 | -16.26 | -13.26 | < -13 |
| | > 5.5MHz | -36.65 | -33.65 | -38.22 | -35.22 | < -25 |
| TM 4 | < 1MHz | -33.51 | -30.51 | -46.86 | -43.86 | < -13 |
| | < 5.5MHz | -16.63 | -13.63 | -16.31 | -13.31 | < -13 |
| | > 5.5MHz | -36.35 | -33.35 | -38.23 | -35.23 | < -25 |

Note 1: Double transmitter output power for MIMO is amount to the Single TX output power adding with 10lgN, where N is the number of antenna ports used for MIMO at once, 10lg2=3.

### 6.4.5 Conclusion

The equipment **PASSED** the requirement of this clause.
For the measurement results refer to Appendix C.

## 6.5 Spurious Emission at Antenna Terminal

### 6.5.1 Test Conditions

Table 30. Test Conditions

| | |
|---|---|
| Measured at: | Antenna TRXA |
| Ambient temperature: | 24 °C to 26 °C |
| Relative humidity: | 55% to 63% |

### 6.5.2 Test Specifications and Limits

FCC part 2.1051 and part 27.53(m) (4) and part 27.53(m)(6)

Table 31. Supporting Standards

| | |
|---|---|
| WiMAX MRCT | WiMAX Forum™ Mobile Radio Conformance Tests |

Compliance with FCC part 2.1051 and part 27.53(m)(4) and part 27.53(m)(6), for mobile digital stations, is based on the use of measurement instrumentation employing a resolution bandwidth of 1MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, the attenuation factor shall not be less than 43 + 10 log (P) dB at the channel edge and 55 + 10 log (P) dB at 5.5MHz from the channel edges.

Table 32. FCC Limits for BRS&EBS Band

| | |
|---|---|
| Limit: | $< P - (55 + 10\log_{10}P) = 10\log_{10}(1000 * P) - (55 + 10\log_{10}P) = 30 - 55 = -25dBm$ |

### 6.5.3 Test Method and Setup

The EUT was connected to the Spectrum Analyzer or equivalent via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Out-band Spurious Emissions of the EUT by the Spectrum Analyzer or equivalent.

According to FCC part 2.1057, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Measurement bandwidth (RBW) of Spectrum Analyzer or equivalent for test frequency range of 9 kHz to 10th harmonic:

| | |
|---|---|
| BRS&EBS Band: | 1 MHz |

Alternatively, according to ITU SM.329, measurement bandwidth (RBW) of Spectrum Analyzer or equivalent can be set as following for test frequency range of 9 kHz to 30 MHz:

| | |
|---|---|
| 9 kHz – 150 KHz: | 1 kHz |
| 150 kHz – 30 MHz: | 10 kHz |

Detector of Spectrum Analyzer or equivalent

| | |
|---|---|
| WiMAX equipment | RMS |

## Test setup

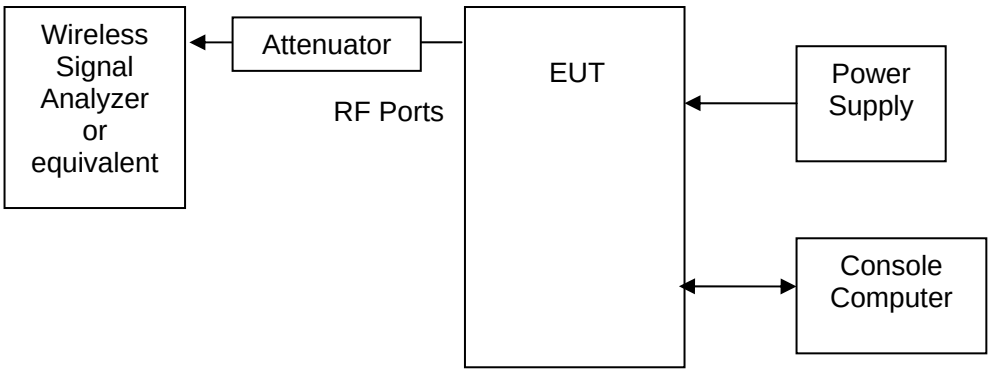



Figure 5. TEST SETUP

### 6.5.4 Measurement Results

**Channel Bandwidth = 5 MHz:**

Table 33. Measurement Results for Spurious Emissions

| Test Mode | Test Frequency Range | Conducted Spurious Emissions (dBm) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | B | | M | | T | | Limit (dBm) |
| | | Single TX | MIMO | Single TX | MIMO | Single TX | MIMO | |
| TM 1 | 9K – 150K | -55.26 | -52.26 | -54.71 | -51.71 | -52.61 | -49.61 | < -25 |
| | 150K – 30M | -52.72 | -49.72 | -52.35 | -49.35 | -53.57 | -50.57 | < -25 |
| | 30M – 1G | -48.53 | -45.53 | -47.58 | -44.58 | -44.87 | -41.87 | < -25 |
| | 1G – 27G | -29.01 | -26.01 | -37.00 | -34 | -29.84 | -26.84 | < -25 |
| TM 2 | 9K – 150K | -53.24 | -50.24 | -52.89 | -49.89 | -52.63 | -49.63 | < -25 |
| | 150K – 30M | -52.75 | -49.75 | -53.37 | -50.37 | -51.21 | -48.21 | < -25 |
| | 30M – 1G | -48.62 | -45.62 | -48.26 | -45.26 | -47.94 | -44.94 | < -25 |
| | 1G – 27G | -34.31 | -31.31 | -32.15 | -29.15 | -33.88 | -30.88 | < -25 |
| TM 3 | 9K – 150K | -53.29 | -50.29 | -53.76 | -50.76 | -53.91 | -50.91 | < -25 |
| | 150K – 30M | -52.32 | -49.32 | -52.52 | -49.52 | -53.69 | -50.69 | < -25 |
| | 30M – 1G | -48.06 | -45.06 | -46.21 | -43.21 | -48.08 | -45.08 | < -25 |
| | 1G – 27G | -36.11 | -33.11 | -28.22 | -25.22 | -37.99 | -34.99 | < -25 |
| TM 4 | 9K – 150K | -54.71 | -51.71 | -53.39 | -50.39 | -54.83 | -51.83 | < -25 |
| | 150K – 30M | -52.74 | -49.74 | -52.45 | -49.45 | -52.48 | -49.48 | < -25 |
| | 30M – 1G | -48.27 | -45.27 | -48.49 | -45.49 | -46.48 | -43.48 | < -25 |
| | 1G – 27G | -29.21 | -26.21 | -34.11 | -31.11 | -30.66 | -27.66 | < -25 |

**Channel Bandwidth = 10 MHz:**

Table 34. Measurement Results for Spurious Emissions

| Test Mode | Test Frequency Range | Conducted Spurious Emissions (dBm) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | B | | M | | T | | Limit (dBm) |
| | | Single TX | MIMO | Single TX | MIMO | Single TX | MIMO | |
| TM 1 | 9K – 150K | -52.75 | -49.75 | -53.60 | -50.6 | -53.44 | -50.44 | < -25 |
| | 150K – 30M | -51.92 | -48.92 | -54.62 | -51.62 | -54.33 | -51.33 | < -25 |
| | 30M – 1G | -48.21 | -45.21 | -47.99 | -44.99 | -48.54 | -45.54 | < -25 |
| | 1G – 27G | -32.73 | -29.73 | -31.49 | -28.49 | -36.15 | -33.15 | < -25 |
| TM 2 | 9K – 150K | -53.91 | -50.91 | -54.48 | -51.48 | -53.23 | -50.23 | < -25 |
| | 150K – 30M | -53.38 | -50.38 | -52.09 | -49.09 | -53.88 | -50.88 | < -25 |
| | 30M – 1G | -48.60 | -45.6 | -48.35 | -45.35 | -47.76 | -44.76 | < -25 |
| | 1G – 27G | -34.25 | -31.25 | -31.36 | -28.36 | -35.62 | -32.62 | < -25 |
| TM 3 | 9K – 150K | -53.60 | -50.6 | -53.91 | -50.91 | -52.70 | -49.7 | < -25 |
| | 150K – 30M | -53.46 | -50.46 | -51.94 | -48.94 | -50.96 | -47.96 | < -25 |
| | 30M – 1G | -48.57 | -45.57 | -48.35 | -45.35 | -48.36 | -45.36 | < -25 |
| | 1G – 27G | -33.08 | -30.08 | -31.79 | -28.79 | -33.81 | -30.81 | < -25 |
| TM 4 | 9K – 150K | -55.33 | -52.33 | -54.13 | -51.13 | -55.20 | -52.2 | < -25 |
| | 150K – 30M | -52.02 | -49.02 | -52.53 | -49.53 | -50.69 | -47.69 | < -25 |
| | 30M – 1G | -48.47 | -45.47 | -48.72 | -45.72 | -48.11 | -45.11 | < -25 |
| | 1G – 27G | -32.48 | -29.48 | -31.44 | -28.44 | -33.76 | -30.76 | < -25 |

Note 1: Double transmitter output power for MIMO is amount to the Single TX output power adding with 10lgN, where N is the number of antenna ports used for MIMO at once, 10lg2=3.

### 6.5.5 Conclusion

The equipment **PASSED** the requirement of this clause.
For the measurement results refer to Appendix D.

## 6.6 Frequency Stability

### 6.6.1 Test Conditions

Table 35. Test Conditions

| | |
|---|---|
| Measured at: | Antenna TRXA |
| Ambient temperature: | See Measurement Results |
| Relative humidity: | 70 % |
| Power supply: | See Measurement Results |

### 6.6.2 Test Specifications and Limits

FCC part 2.1055 and part 27.54

Table 36. Supporting Standards

| | |
|---|---|
| WiMAX MRCT | WiMAX Forum™ Mobile Radio Conformance Tests |

Compliance with FCC part 2.1055 and part 27.54, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Table 37. FCC Limits for BRS&EBS Band

| | |
|---|---|
| Limit: | (not defended) |

Specially, limits according to the technical requirements of the EUT can be adopted as showed in the following table:

Table 38. Limits According to EUT technical requirements for all operating bands

| | |
|---|---|
| Limits for IEEE802.16 equipments: | < ±2 ppm |

### 6.6.3 Test Method and Setup

The frequency stability shall be measured with variation of ambient temperature from -30 °C to 50 °C.

Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10 °C through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

The frequency stability shall be measured with variation of primary supply voltage as follows:
(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery

operating end point, which shall be specified by the manufacturer.
(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

## The test procedure

The EUT was placed inside an environmental temperature chamber. The EUT was connected to the Signal Analyzer or equivalent via one RF connector, and other RF connectors were connected to match loads. The EUT was controlled to transmit maximum power by Console Computer. Measure and record the Frequency Tolerance of the EUT by the Signal Analyzer or equivalent.

According to ANSI C63.4 clause 13.1.6, no modulation needs to be supplied to the intentional radiator during these tests, unless modulation is required to produce an output, e.g., single-sideband suppressed carrier transmitters.

According to IC RSS-Gen clause 4.7, with the transmitter installed in an environment test chamber, the unmodulated carrier frequency shall be measured under the conditions specified below.

| | |
|---|---|
| The operating end points: | 12 VDC (Normal Voltage), 9.6 VDC (Lowest Voltage) and 14.4 VDC (Highest Voltage). |

## Test Set up

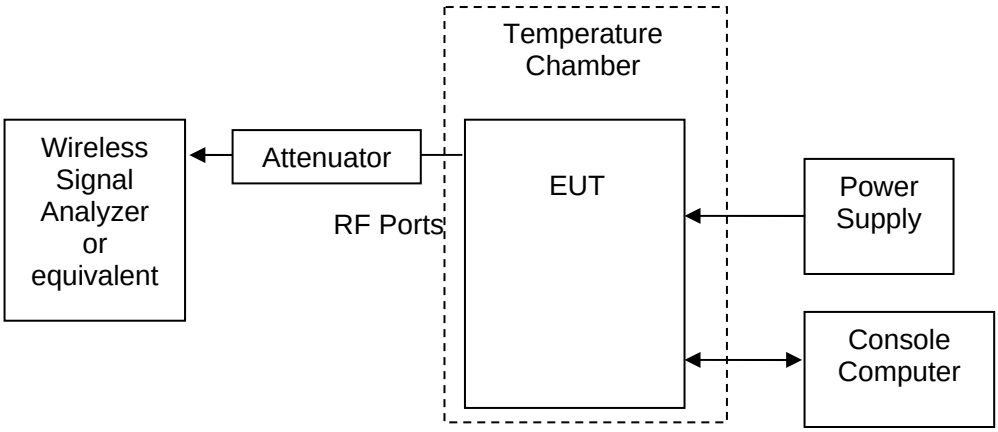



Figure 6. Test Set up

### 6.6.4 Measurement Results

#### 6.6.4.1 Frequency Error vs. Temperature

**Channel Bandwidth = 5 MHz:**

Table 39. Measurement Results for Frequency Error vs. Temperature

| Measured Maximum Frequency Error | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Test Environment | | | B | | M | | T | | |
| Test Mode | Voltage | Temperature | Hz | ppm | Hz | ppm | Hz | ppm | Limit |
| TM1 | 12 VDC (100% rated / normal) | -30 °C | 2040.3 | 0.824 | 2143.5 | 0.826 | 2218.0 | 0.825 | < ±2ppm |
| | | -20 °C | 2053.2 | 0.821 | 2144.3 | 0.826 | 2218.3 | 0.825 | |
| | | -10 °C | 2047.5 | 0.819 | 2130.5 | 0.821 | 2211.6 | 0.822 | |
| | | 0 °C | 2059.1 | 0.824 | 2148.1 | 0.828 | 2226.2 | 0.828 | |
| | | +10 °C | 2026.0 | 0.810 | 2113.3 | 0.815 | 2188.4 | 0.821 | |
| | | +20 °C | 2047.5 | 0.819 | 2130.5 | 0.821 | 2211.6 | 0.822 | |
| | | +30 °C | 2053.2 | 0.821 | 2144.3 | 0.826 | 2218.3 | 0.825 | |
| | | +40 °C | 2026.0 | 0.810 | 2113.3 | 0.815 | 2188.4 | 0.814 | |
| | | +50 °C | 2032.2 | 0.813 | 2109.8 | 0.813 | 2186.3 | 0.813 | |

**Channel Bandwidth = 10 MHz:**

Table 40. Measurement Results for Frequency Error vs. Temperature

| Measured Maximum Frequency Error | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Test Environment | | | B | | M | | T | | |
| Test Mode | Voltage | Temperature | Hz | ppm | Hz | ppm | Hz | ppm | Limit |
| TM1 | 12 VDC (100% rated / normal) | -30 °C | 2130.4 | 0.814 | 2118.2 | 0.815 | 2154.2 | 0.814 | < ±2ppm |
| | | -20 °C | 2124.3 | 0.812 | 2120.1 | 0.812 | 2147.6 | 0.815 | |
| | | -10 °C | 2113.1 | 0.815 | 2104.5 | 0.813 | 2154.6 | 0.816 | |
| | | 0 °C | 2012.8 | 0.816 | 2107.6 | 0.820 | 2156.8 | 0.818 | |
| | | +10 °C | 2030.4 | 0.811 | 2110.2 | 0.813 | 2174.5 | 0.809 | |
| | | +20 °C | 2032.1 | 0.812 | 2116.0 | 0.816 | 2180.2 | 0.812 | |
| | | +30 °C | 2030.3 | 0.811 | 2113.4 | 0.815 | 2180.6 | 0.812 | |
| | | +40 °C | 2032.1 | 0.812 | 2120.1 | 0.811 | 2175.4 | 0.813 | |
| | | +50 °C | 2023.1 | 0.814 | 2119.4 | 0.812 | 2159.3 | 0.815 | |

### 6.6.4.2 Frequency Error vs. Voltage

**Channel Bandwidth = 5 MHz:**

Table 41. Measurement Results for Frequency Error vs. Temperature

| Measured Maximum Frequency Error | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Test Environment | | | B | | M | | T | | |
| Test Mode | Voltage | Temperature | Hz | ppm | Hz | ppm | Hz | ppm | Limit |
| TM1 | 9.6 VDC (85% rated / lowest) | +20 °C | 2043.5 | 0.816 | 2127.6 | 0.820 | 2187.3 | 0.821 | < ±2ppm |
| | 12 VDC (100% rated / normal) | +20 °C | 2047.5 | 0.819 | 2130.5 | 0.821 | 2211.6 | 0.822 | |
| | 14.4 VDC (115% rated / highest) | +20 °C | 2158.4 | 0.821 | 2132.4 | 0.821 | 2198.1 | 0.823 | |

**Channel Bandwidth = 10 MHz:**

Table 42. Measurement Results for Frequency Error vs. Temperature

| Measured Maximum Frequency Error | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Test Environment | | | B | | M | | T | | |
| Test Mode | Voltage | Temperature | Hz | ppm | Hz | ppm | Hz | ppm | Limit |
| TM1 | 9.6 VDC (85% rated / lowest) | +20 °C | 2029.3 | 0.811 | 2112.5 | 0.817 | 2176.4 | 0.814 | < ±2ppm |
| | 12 VDC (100% rated / normal) | +20 °C | 2032.1 | 0.812 | 2116.0 | 0.816 | 2180.2 | 0.812 | |
| | 14.4 VDC (115% rated / highest) | +20 °C | 2034.6 | 0.812 | 2115.4 | 0.816 | 2189.2 | 0.813 | |

### 6.6.5 Conclusion

The equipment **PASSED** the requirement of this clause.

# 7 System Measurement Uncertainty

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

Table 43. System Measurement Uncertainty

| Items | | Extended Uncertainty |
|---|---|---|
| Band Width | Magnitude (%) | U=0.2%; k=2 |
| Band Edge Compliance | Disturbance Power (dBm) | U=2.0dB; k=2 |
| Conducted Spurious Emission at Antenna Terminal | Disturbance Power (dBm) | U=2.0dB; k=2 |
| Frequency Stability | Frequency Accuracy(ppm) | U=0.21ppm; k=2 |
| Field Strength of Spurious Radiation | ERP (dBm)(30MHz~1G) | U=4.6dB; k=2 |
| | ERP (dBm) (>1G) | U=3dB; k=2 |
| Conducted Output Power | Power (dBm) | U=0.39dB; k=2 |

# 8 Appendices

| | | |
|---|---|---|
| Appendix A | Measurement Results Modulation Characteristics | 38Pages |
| Appendix B | Measurement Results Occupied Bandwidth | 25Pages |
| Appendix C | Measurement Results Band Edges | 17Pages |
| Appendix D | Measurement Results Spurious Emission at Antenna Terminal | 97Pages |

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**END**