*FCC Certification Test Report*

# FCC Certification Test Report
# for
# Eka Systems, Inc.
# FCC ID: P9X-EMS-H200

**May 31, 2002**

Prepared for:

**Eka Systems, Inc.**
**444 N. Frederick Avenue, Suite 315**
**Gaithersburg, MD 20877**

Prepared By:

**Washington Laboratories, Ltd.**
**7560 Lindbergh Drive**
**Gaithersburg, Maryland 20879**

# FCC Certification Test Program

## FCC Certification Test Report
## for the
## Eka Systems, Inc.
## BlueMeter Hub
## FCC ID: P9X-EMS-H200

**May 31, 2002**

WLL JOB# 6959

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Documentation Specialist

Reviewed by: Gregory M. Snyder
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# Abstract

This report has been prepared on behalf of Eka Systems, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Frequency Hopping Spread Spectrum Transmitter under Part 15.247 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for the Eka Systems, Inc. BlueMeter Hub.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Eka Systems, Inc. BlueMeter Hub complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under Part 15.247 of the FCC Rules and Regulations.

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# 1 Introduction

## 1.1 Compliance Statement

The Eka Systems, Inc. BlueMeter Hub complies with the limits for a Frequency Hopping Spread Spectrum Transmitter device under Part 15.247 of the FCC Rules and Regulations.

## 1.2 Test Scope

Tests for radiated and conducted spurious emissions were performed. All measurements were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

## 1.3 Contract Information

| | |
|---|---|
| Customer: | Eka Systems, Inc.<br>444 N. Frederick Avenue, Suite 315<br>Gaithersburg, MD 20877 |
| Purchase Order Number: | 20035 |
| Quotation Number: | 59515 |

## 1.4 Test Dates

Testing was performed from February 19, 2002 to March 21, 2002.

## 1.5 Test and Support Personnel

| | |
|---|---|
| Washington Laboratories, LTD | Steve Koster |
| Customer | Tzeta Tsau |

## 1.6 Abbreviations

| | |
|---|---|
| A | Ampere |
| Ac | alternating current |
| AM | Amplitude Modulation |
| Amps | Amperes |
| b/s | bits per second |
| BW | Bandwidth |
| CE | Conducted Emission |
| cm | centimeter |
| CW | Continuous Wave |
| dB | decibel |
| dc | direct current |
| EMI | Electromagnetic Interference |
| EUT | Equipment Under Test |
| FM | Frequency Modulation |
| G | giga - prefix for $10^9$ multiplier |
| Hz | Hertz |
| IF | Intermediate Frequency |
| k | kilo - prefix for $10^3$ multiplier |
| M | Mega - prefix for $10^6$ multiplier |
| m | Meter |
| μ | micro - prefix for $10^{-6}$ multiplier |
| NB | Narrowband |
| LISN | Line Impedance Stabilization Network |
| RE | Radiated Emissions |
| RF | Radio Frequency |
| rms | root-mean-square |
| SN | Serial Number |
| S/A | Spectrum Analyzer |
| V | Volt |

# 2 Equipment Under Test

## 2.1 EUT Identification & Description

The BlueMeter Hub communicates and collects data from up to 64 electricity meters. The BlueMeter Hub is composed of two major components: an embedded computer and a wireless module. The embedded computer is the hardware of a router which is configured with proprietary software. The wireless module uses a Bluetooth transceiver and interfaces to the embedded computer through an RS-232 interface. The transceiver performs spectrum spreading by frequency hopping in 79 frequencies that are displaced by 1 MHz, between 2.402GHz and 2.480GHz. All 79 channels are equally used. The channel is divided into time slots, with a nominal slot length of 625µs, where each slot corresponds to different RF hop frequencies thus the dwell time on any one channel is 625us.

**Table 1. Device Summary**

| ITEM | DESCRIPTION |
|---|---|
| Manufacturer: | Eka Systems, Inc. |
| FCC ID Number | P9X-EMS-H200 |
| EUT Name: | Hub |
| Model: | BlueMeter |
| FCC Rule Parts: | §15.247 |
| Frequency Range: | 2.402 – 2.480 GHz |
| Maximum Output Power: | 11.17dBm, Conducted Power |
| Modulation: | GFSK |
| Occupied Bandwidth: | 960 kHz |
| Keying: | Automatic |
| Type of Information: | Data |
| Number of Channels: | 79 |
| Power Output Level | Fixed |
| Antenna Type | Permanently attached monopole |
| Interface Cables: | (DB-9) RS-232 Port |
| Power Source & Voltage: | 120VAC |

## 2.2 Test Configuration

The BlueMeter Hub was configured with a support PC that was powered from 120VAC power.

## 2.3 Testing Algorithm

The BlueMeter was operated continuously by being set to transmit on three different channels; 2402, 2441, and 2480 MHz. The functions were controlled by CSR Blue test software v. 1.4 installed on the PC.

Worst case emission levels are provided in the test results data.

## 2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

## 2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

FCC Public Notice DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems; Released March 30, 2000

## 2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

# 3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

**Table 2: Test Equipment List**

| Manufacturer & Model | Description | Serial Number | Property Number | Date Calibrated | Calibration Due Date |
|---|---|---|---|---|---|
| Antenna Research Associates DRG-118/A | Horn Antenna | 1010 | 00004 | 10/20/01 | 10/20/02 |
| Antenna Research Associates LPB-2520 | Biconilog Antenna Site 2 | 1118 | | 5/15/01 | 5/15/02 |
| Hewlett Packard 8449B | Pre-Amplifier | 3008A00729 | 00066 | 1/31/02 | 1/31/03 |
| Hewlett Packard 8564E | Spectrum Analyzer | 3643A00657 | 00067 | 4/11/01 | 4/11/02 |
| Hewlett Packard 85650A | Q.P. Adapter (Site 2) | 2811A01283 | 00068 | 6/29/01 | 6/29/02 |
| Hewlett Packard 85685A | RF Preselector (Site 2) | 3221A01395 | 00071 | 6/28/01 | 6/28/02 |
| Hewlett Packard 8568B | Spectrum Analyzer (Site 2) | 2928A04750 | 00072 | 6/29/01 | 6/29/02 |
| Hewlett Packard 8593A | Spectrum Analyzer | 3009A00739 | 00074 | 5/10/01 | 5/10/02 |
| Solar Electronics 8012-50-R-24-BNC | LISN | 8379493 | 00124 | 8/15/01 | 8/15/02 |

# 4 Test Results

## 4.1 RF Power Output: (FCC Part §15.247(b)(1))

The output from the transmitter was fitted with a coaxial connector and connected to an attenuator and then to the input of the HP8564E RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system. For the power measurement, the resolution bandwidth was set to 2MHz and the video bandwidth was set to 3MHz.

The transmitter was then set to the low, middle and high channels, individually, and the conducted transmitted power was measured. The following table lists the conducted power measurements.

**Table 3: Conducted RF Power Output Results**

| Channel Frequency (MHz) | Measured Power (dBm) | Limit (dBm) | Pass/Fail |
|---|---|---|---|
| 2402 | 10.33 | 30 | Pass |
| 2441 | 11.17 | 30 | Pass |
| 2480 | 10.50 | 30 | Pass |

Figure 1 through Figure 3 show the peak conducted power at Low, Mid, and High channels respectively.

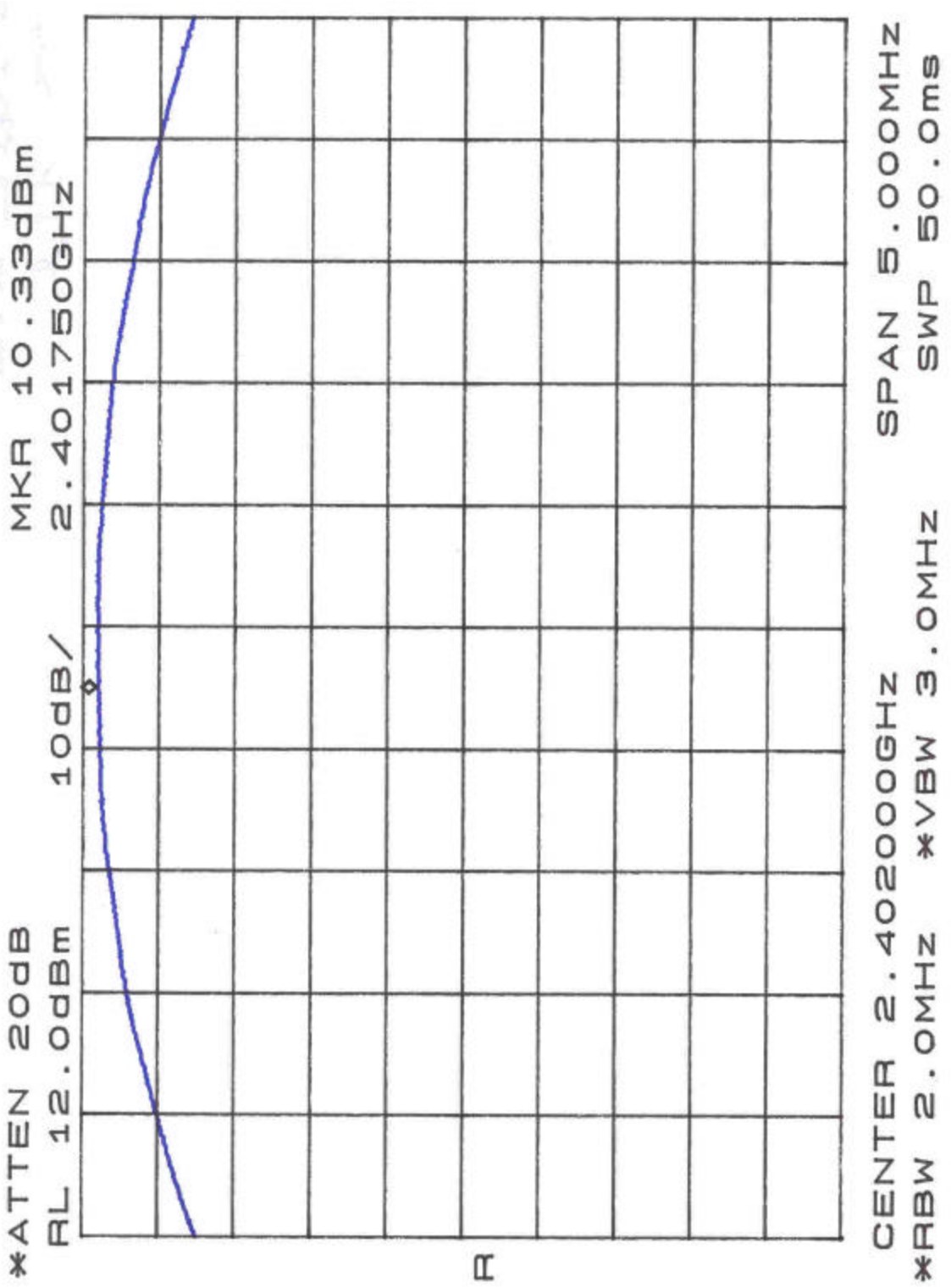


**Figure 1: Peak RF Power Output, Low**

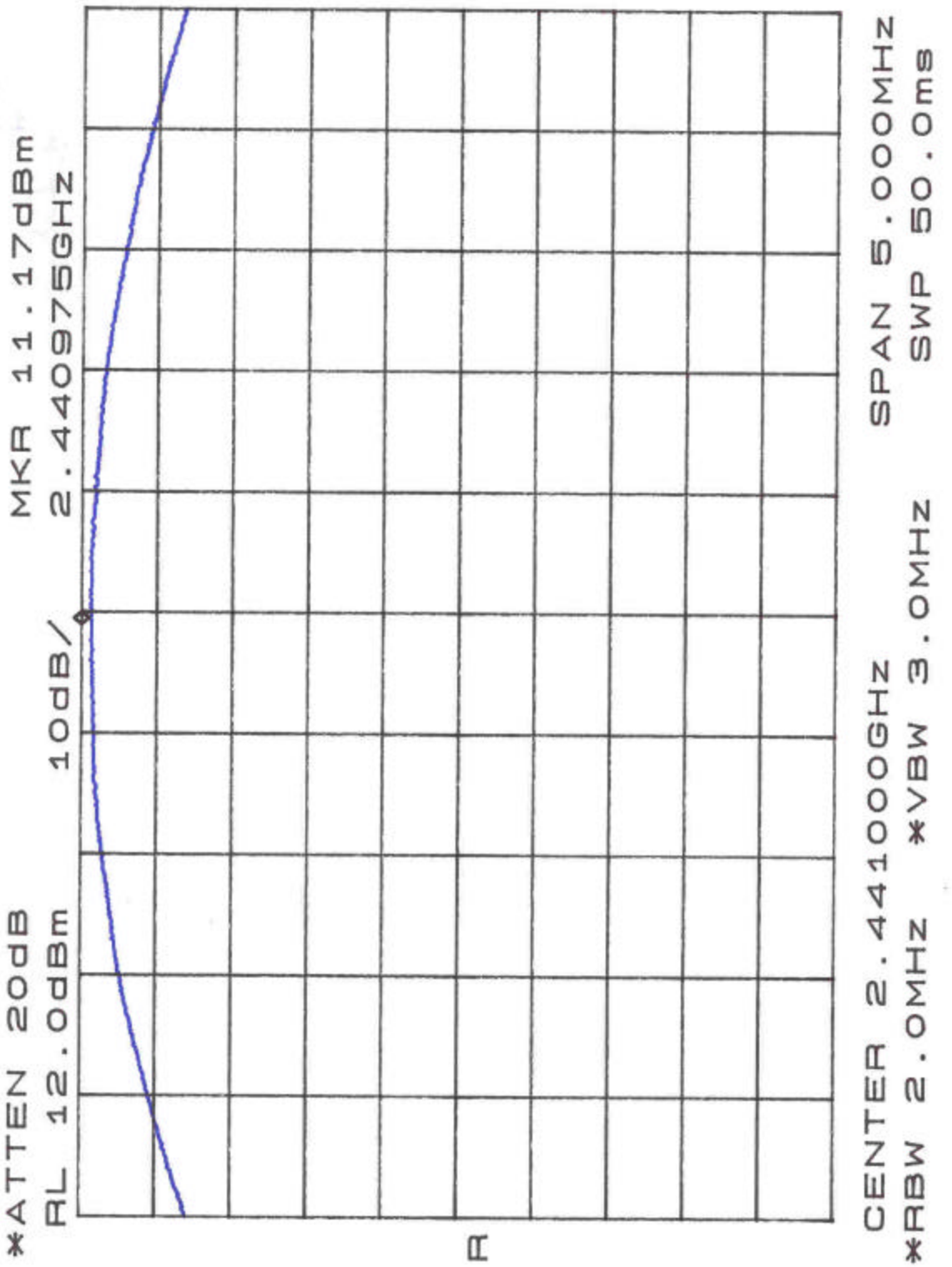


**Figure 2: Peak RF Power Output, Mid**

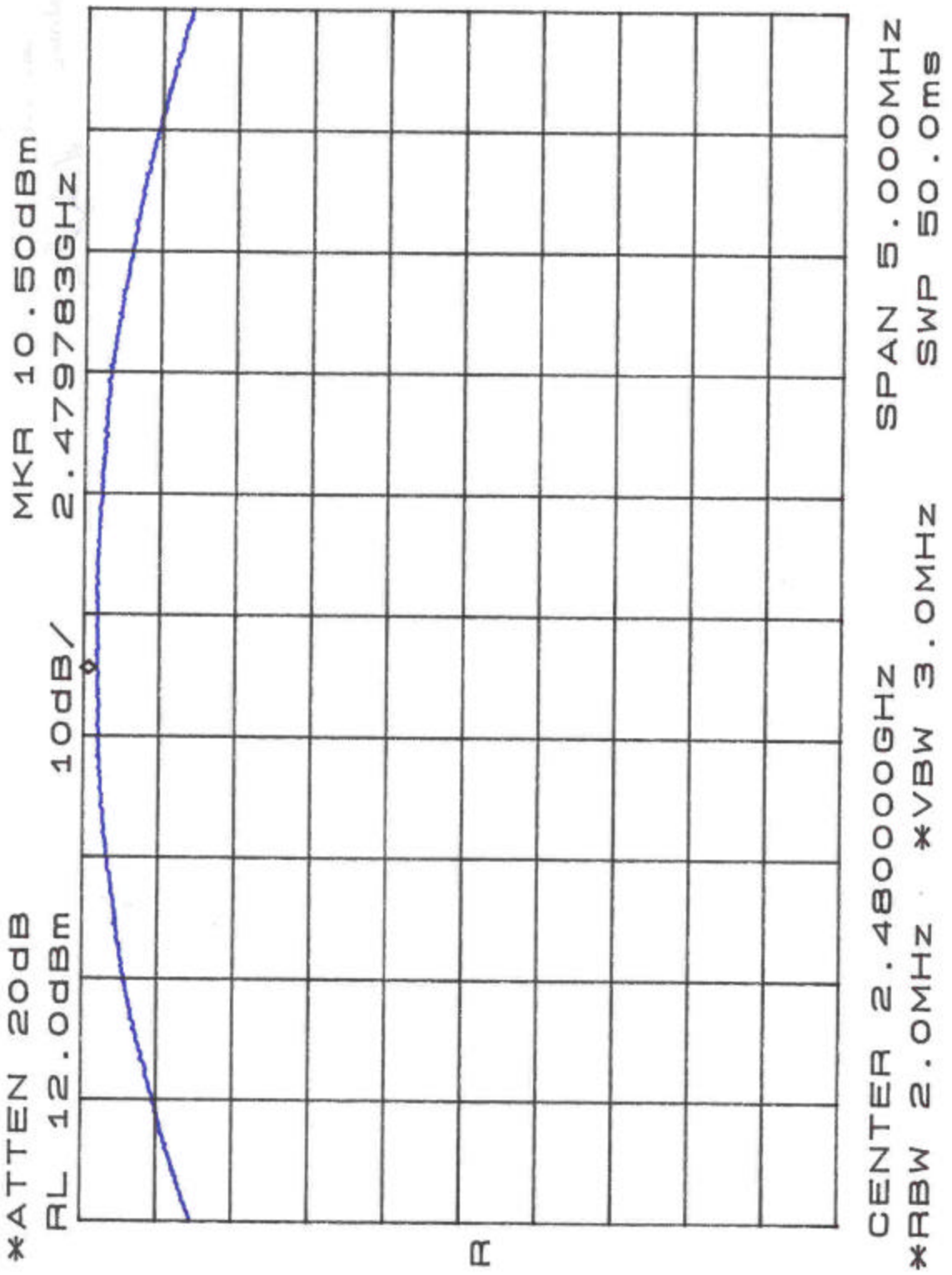


**Figure 3: Peak RF Power Output, High**

## 4.2 Occupied Bandwidth: (FCC Part §15.247(a)(1)(ii))

The antenna was replaced with a coaxial. Occupied bandwidth measurement was performed by direct connection of the output of the EUT to the input of a spectrum analyzer.

For Frequency Hopping Spread Spectrum Systems, FCC Part 15.247 requires the maximum 20 dB bandwidth be no greater than 1 MHz.

At full modulation, the occupied bandwidth was measured for the low, middle and high channels. Figure 4 through Figure 6 are plots of the 20 dB bandwidth measurement results.

Table 4 provides a summary of the Occupied Bandwidth Results.

**Table 4. Occupied Bandwidth Results**

| Frequency | Bandwidth (MHz) | Limit (MHz) | Pass/Fail |
|---|---|---|---|
| Low Channel 2402 MHz | 0.960 | 1 | Pass |
| Mid Channel 2441 MHz | 0.913 | 1 | Pass |
| High Channel 2480 MHz | 0.902 | 1 | Pass |

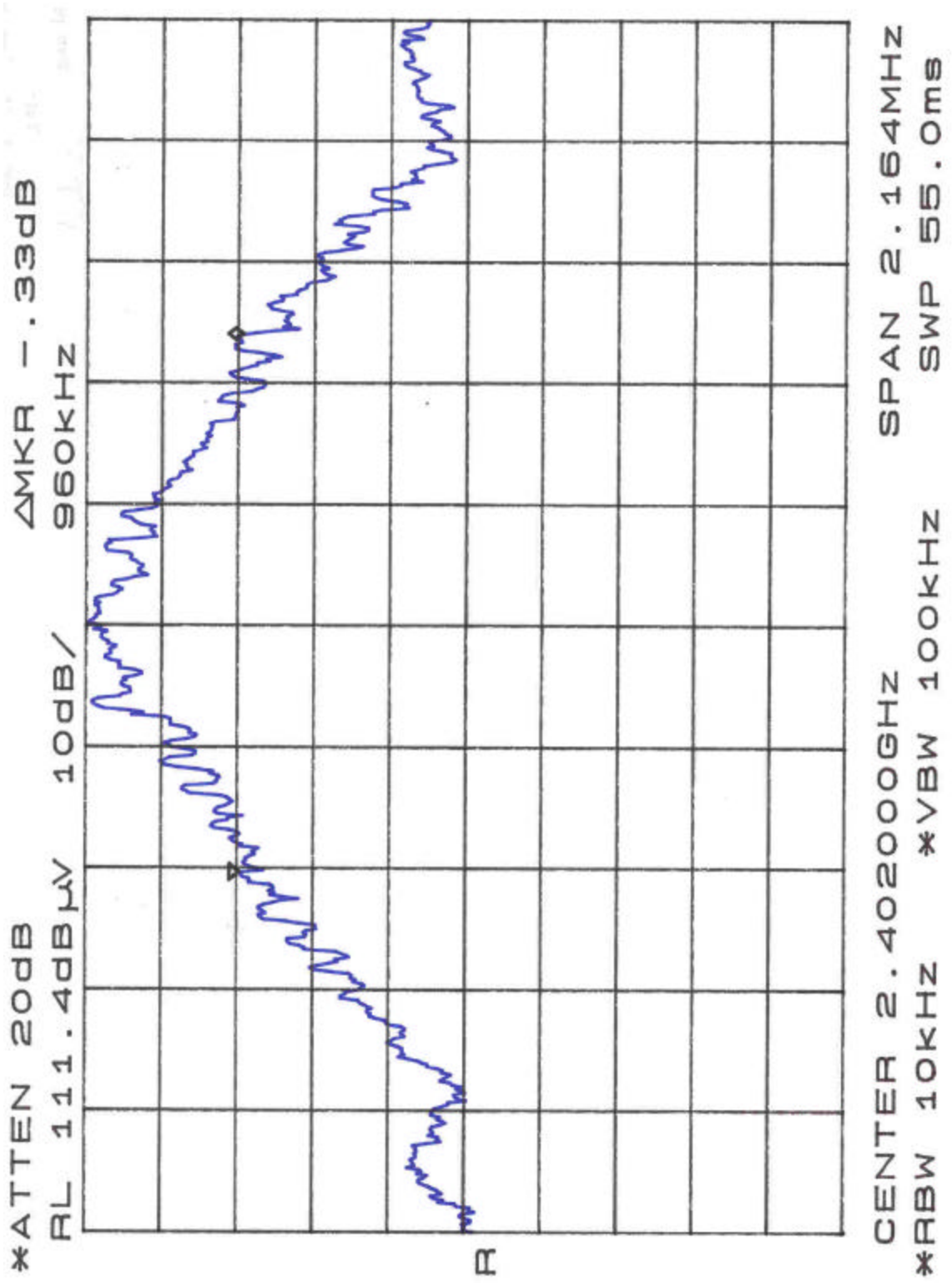


**Figure 4. Occupied Bandwidth, Low**

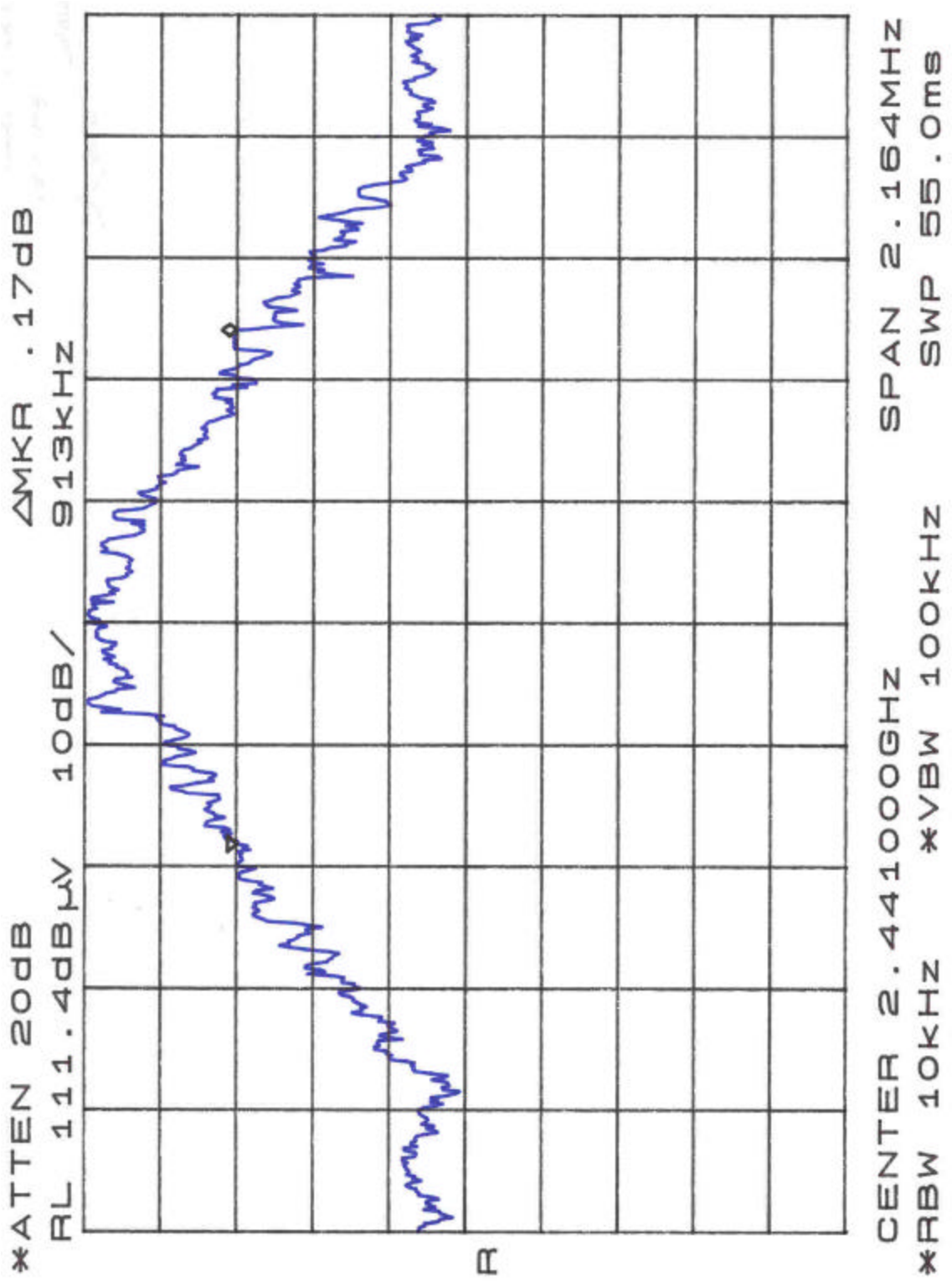


**Figure 5. Occupied Bandwidth, Mid**

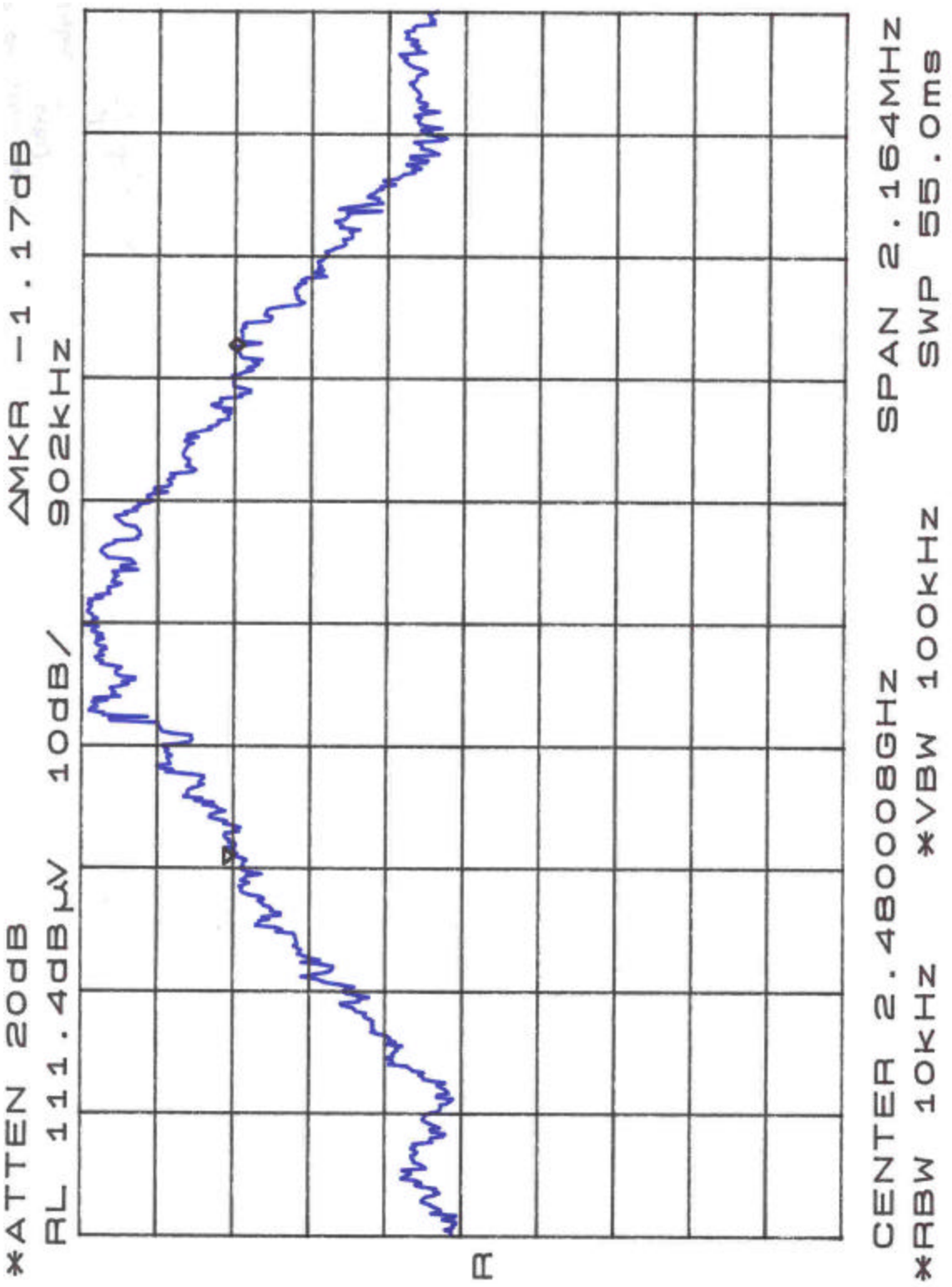


**Figure 6. Occupied Bandwidth, High**

## 4.3 Power Spectral Density (FCC Part §15.247(d))

As the Bluetooth device is a hybrid type spread spectrum transmitter it is required to comply with the Power Spectral Density requirements while in the acquisition mode.

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system. The spectrum analyzer had the follow ing settings:

- Resolution Bandwidth: 3 kHz
- Video Bandwidth: 10 kHz
- Sweep Time: 100 seconds
- Span: 300 kHz

The unit was then placed in the acquisition mode and the power spectral density was measured. Table 5 provides the worst case test results for the measured power spectral density while in the acquisition mode.

**Table 5. Power Spectral Density**

| Frequency | Level | Limit | Pass/Fail |
|---|---|---|---|
| 2402 MHz | -1.5 dBm | 8 dBm | Pass |

## 4.4 Spurious Emissions at Antenna Terminals (FCC Part §15.247(c))

The EUT must comply with requirements for spurious emissions at antenna terminals. In any 100kHz band outside of the spread spectrum operating frequency all spurious emissions must be at least 20 dB below the highest emission level within the band as found with a 100kHz bandwidth.

Testing for spurious emissions was performed as a conducted test. Measurements of the peak levels in a 100kHz bandwidth for the low, middle and high channels and the limits for the conducted spurious emissions are listed in the following table.

For the purpose of this testing the hopping was stopped and the transmitter was set to continuously transmit.

**Table 6. Conducted Spurious Emission Limits**

| Frequency (MHz) | 100kHz Fundamental Level (dBm) | Harmonic Limit (20 dBc) (dBm) |
|---|---|---|
| **Low Channel (2402)** | | |
| Fundamental | 10.50 | |
| Harmonics | | -9.5 |
| **Mid Channel (2441)** | | |
| Fundamental | 10.33 | |
| Harmonics | | -9.7 |
| **High Channel (2480)** | | |
| Fundamental | 9.81 | |
| Harmonics | | -10.2 |

Test results for the conducted spurious emissions for the low, middle and high channels are included in the plots contained in Figure 7 through Figure 39.