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NVLAP LAB CODE: 200413-0

**August 11, 2003**

# Test Record

## Product Verification
## According to FCC Part 95 Subparts E,G

**for**

# LISTEN TECHNOLOGIES CORPORATION

# MODEL: MSF0001

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# Revision History

| Revision | Date | Description of Changes | Author |
|---|---|---|---|
| 0.1 | 11 Aug 2003 | Initial document | V.Shapiro/L.Kogan |
| 0.2 | 26 Sept.2003 | Revised pages 14-16,18,20,22,31,43: | L.Kogan |
| 0.3 | 06 Nov.2003 | Revised pages:16,19-22,42-54 | L.Kogan |

## Introduction – Test Plan

This report describes the results of all measurements made on an Low Power Radio Service (LPRS) portable transmitter which falls under the class of intentional radiator by the FCC Part 95 Rules and Regulations.

This EUT is designated: **Wireless Audio FM Transmitter/Receiver for personal use.**

Model : **MSF0001**

The **EUT** is designed and manufactured by **Listen Technologies Corporation**.

The EUT was tested in full compliance with the FCC Regulations using the methods of FCC Part 95 and Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations". The results of the testing indicate that the MSF0001 met the Part 95 limits and requirements.

## 1.0 CERTIFICATION OF TEST DATA

### Verification statement.

The data, data evaluation and equipment configuration represented herein are a true and accurate representation of the test sample (EUT), and characteristics and measurements obtained as of the dates and the times of the test under the conditions specified and to the methods of FCC Part 95 "Personal radio Services" and Part 2 "Frequency Allocations and radio Treaty Matters; General Rules and regulations"

The test results provided with this report, indicate that the equipment tested:
**WIRELESS AUDIO FM TRANSMITTER/RECEIVER FOR PERSONAL USE. MODEL : MSF0001** is compliant with the following Rules and Regulations with modifications of the design:

A. 47 Code of Federal Regulations, Part 95, Subpart E and G
B. 47 Code of Federal Regulations, Part 2
C. 47 Code of Federal Regulations, Part 15.109

Tests performed by:

_____
Vlad Shapiro
EMC Test Engineer

Report prepared by:

_____
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EMC Test Engineer

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_____
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JMR Compliance Engineering, 20400 Plummer Street, Chatsworth CA 91311.
**E-mail:emc@jmr.com**

# 2.0 GENERAL INFORMATION

## 2.1 Client Information

| | |
|---|---|
| Company Name: | Listen Technologies Corporation |
| Contact: | Russell Gentner |
| Company Address: | 8535 South 700 West, Suite A<br>Sandy, UT 84070 |
| Phone: | (801) 233-8992 |

## 2.2 Administrative Data

| | |
|---|---|
| Device tested: | Wireless Audio FM Transmitter/Receiver for personal use |
| Model: | MSF0001 |
| Equipment category: | LPRS |
| Accessories: | N/A |
| Expository Statement: | This device is intended for personal use and in public facilities |
| Purpose of test: | Compliance to FCC Rules and Regulations, Part 95, Subparts E and G and Part 15.109 |
| Date of test: | 07/31/2003 – 11/06/2003 |
| Place of the test: | JMR Electronics, Inc.<br>Compliance Engineering Laboratory<br>20400 Plummer Street<br>Chatsworth, CA 91311<br>Phone: (818) 993-4801 |

## 3.0 Description of Equipment Under Test (EUT)

### 3.1 Brief Description of the EUT

The EUT, Microfield MSF0001, is the Low Power radio Service (LPRS) FM Transmitter/Receiver with RF transmitting frequency range of 216.0125 MHz – 216.9875 MHz . The EUT receives audio on three frequency bands :

1) 72.0250 MHz – 75.9750 MHz for FM Receiver, 57 channels;
2) 216.0125 MHz – 216.9875 MHz for FM Receiver, 62 channels;
3) Multiple Infrared (IR) Channels

The EUT was design to aid children and adults with hearing impairments by receiving audio transmissions (for personal use and in public settings as required by the ADA) and re-transmitting them directly to the individual's hearing aid. Several hearing aid manufacturer's provide such receivers as an accessory to their products."
The EUT was configured as an independent module, standalone device and was tested with standard Microphone and Speaker connected. The modulation frequency was provided by external Test Oscillator HP 651B.

**Operating frequencies :** 216.0125 – 216.9875 MHz .
**Clock frequencies :** 4MHz, 48MHz.
**Power Supply** : External Power AC Adapter : Sino-American, Model A41208D, Input : 120 VAC 60Hz, Output : 12 VDC, 300 mA

### 3.2 Test Run

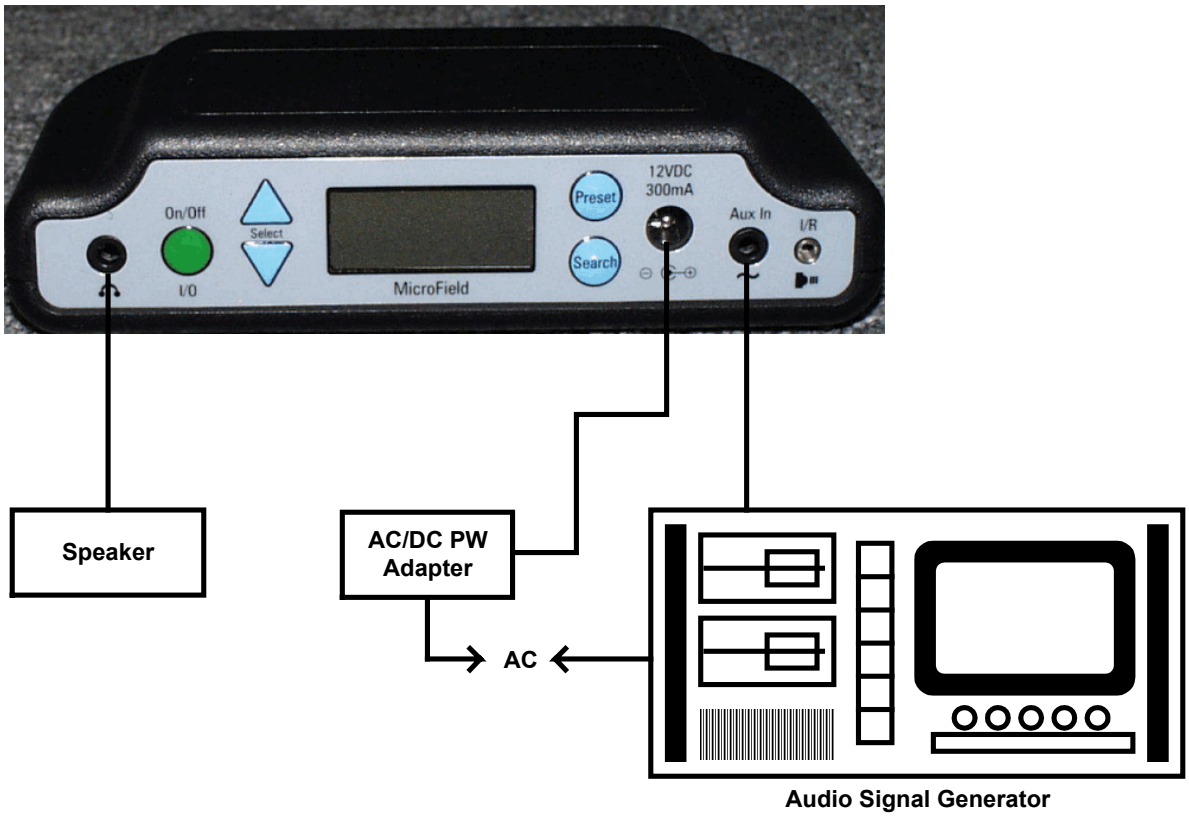
1) The EUT was connected through AC Power adapter to AC 110 VAC lines;
2) Standard Microphone and Speaker devices were connected to the appropriate input/output of the EUT;
3) Test Oscillator HP 651B had been connected to the Aux In input when it was necessary.

For test purposes the following channels were selected for measurements :

1) three channels – Channel 1 / 216.0125 MHz, Channel 61 / 216.5125 MHz and Channel 80 / 216.9875 for FM LPRS Transmitter;
2) one channel – 9E / 72.9250 MHz for FM Receiver in frequency range of 72-76 MHz;
3) one channel – 61 / 216.5125 MHz for FM Receiver in frequency range of 216-217 MHz;
4) one channel – 94 / 2.3 MHz for IR Receiver.

Each channel had generated/received its frequency continuously for the duration of the testing. The above mentioned set-up allowed the article to perform sufficiently for the test purposes and required time.

## 3.3 Block Diagram of the Test Setup




## 3.4 Support Equipment List:

## 3.5

| No | Equipment | Model | S/N (last 6) | Notes |
|---|---|---|---|---|
| 1 | **HP Test Oscillator** | 651B | **1230A08435** | |
| 2 | **IFR Communication Analyser** | 1500A | | |
| 3 | **Standard Microphone** | N/A | N/A | |
| 4 | **Standard Speaker** | N/A | N/A | |

## 3.5 Cabling Configuration

### Power Cords:

| | |
|---|---|
| Unit | The EUT, nondetachable AC Adapter Power cable |
| MFG | Sino-American |
| Shielded | No |
| Length | 2.0 m |

| | |
|---|---|
| Unit | HP 651B Test Oscillator |
| MFG | Standard |
| Shielded | No |
| Length | 2 m |

| | |
|---|---|
| Unit | Communication Analyzer 1500A |
| MFG | Standard |
| Shielded | No |
| Length | 2 m |

### I / O Cables External:

| | |
|---|---|
| Connection | Mic input of the EUT |
| Cable | Generic microphone cable |
| Shielded? | No |
| Connector | Mic jack |
| Length | 1 m |

| | |
|---|---|
| Connection | AUX In of the EUT |
| Cable | Generic Speaker cable |
| Shielded? | No |
| Connector | Speaker jack |
| Length | 0.3 m |

| | |
|---|---|
| Connection | AUX In of the EUT to Out, 50 Ohm of the HP 651B |
| Cable | Generic 50 Ohm RF cable |
| Shielded? | Yes |
| Connector | BNC, Jack |
| Length | 0.3 m |

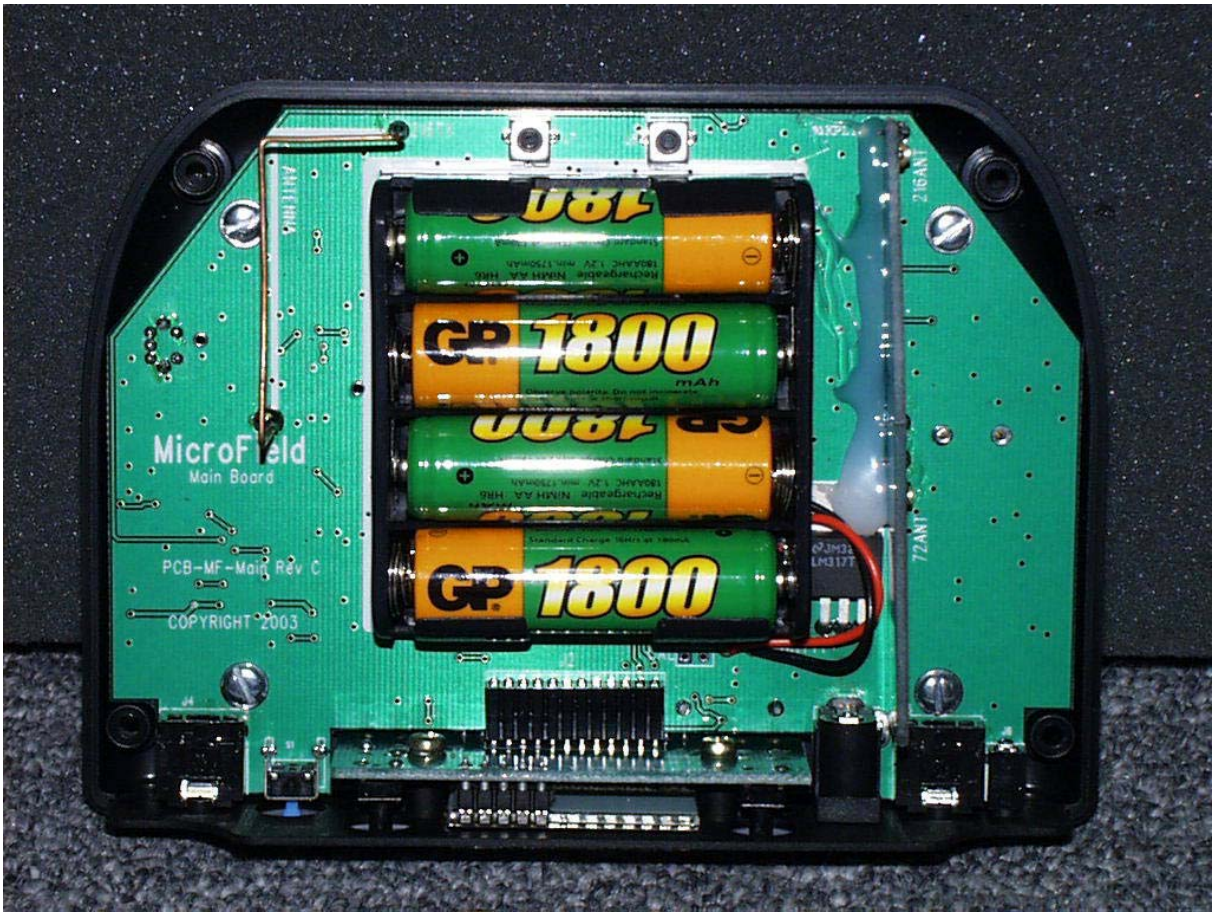
## Photos of the EUT


**EUT: MSF0001 with AC-DC A41208D Power Adapter**
**Front View**

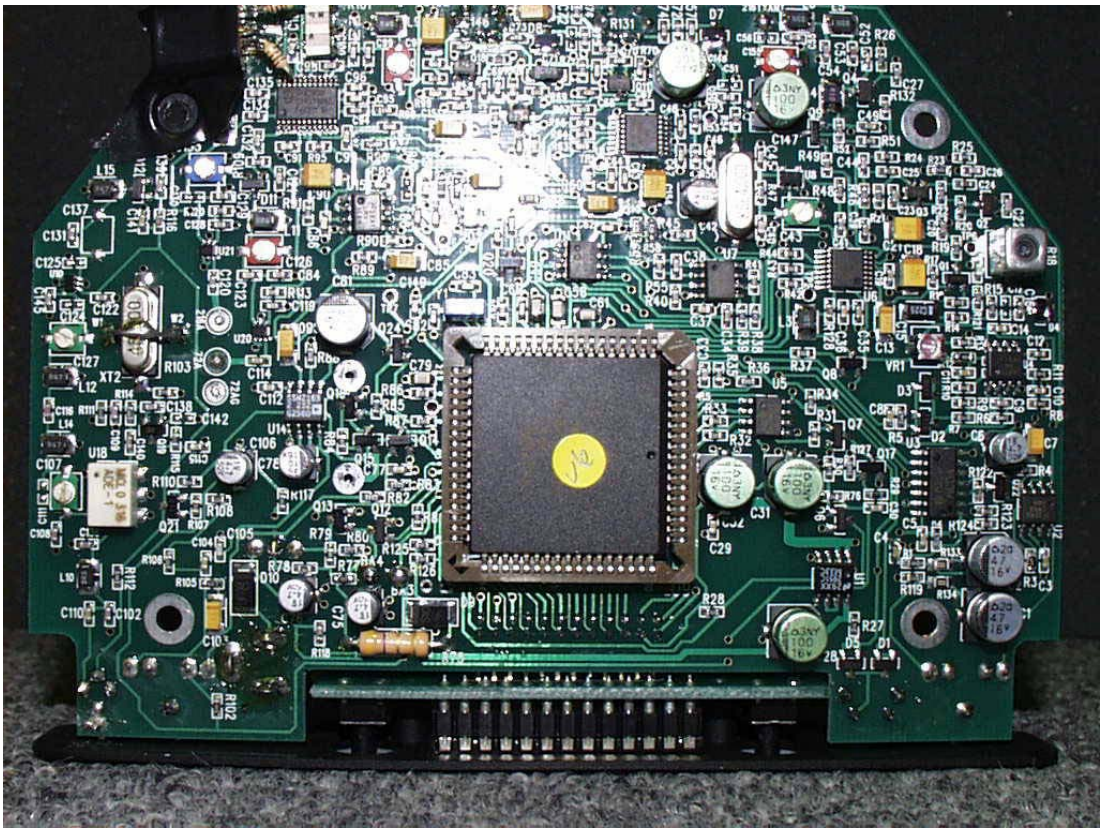

**EUT: MSF0001 FM Transmitter/Receiver**
**Front View**


**EUT: MSF0001 FM Transmitter/Receiver**
**Bottom View**


**EUT: MSF0001 FM , Power Adapter**
**Front View**




**EUT: MSF0001 FM Transmitter/Receiver**
**Solder side view without cover**



**EUT: MSF0001 FM Transmitter/Receiver**
**PCB Component side view**

## 3.7 EUT Modifications

**N/A**

## 3.8 Photographs of EUT Modifications

**N/A**

## 4.0 Test equipment used

| Device | Model No. | Serial No. | Last Cal. | Next Cal |
|---|---|---|---|---|
| Cable 1 | 8214 | CBL-006 | 06/21/03 | 06/21/04 |
| Analyzer | HP85462A | 3325A00120 | 04/11/03 | 04/11/04 |
| Cable 2 | 8268 | CBL-002 | 06/21/03 | 06/21/04 |
| Preselector | HP85460A | 3330A00117 | 04/11/03 | 04/11/04 |
| Qpeak Adapter | HP85462 Internal | Internal | 04/11/03 | 04/11/04 |
| Pre-Amplifier | None | | | |
| Tower 1 | EMCO 1050 | 9310-1786 | N/A | N/A |
| Turntable 1 | EMCO 1060 | 9409-1753 | N/A | N/A |
| Bilog Antenna | CBL6112B | 2604 | 08/08/02 | 08/08/03 |
| DRG Horn Antenna | SAS-200/571 | 175 | 10/18/02 | 10/18/03 |
| Log-Periodic Antenna | CBL6111 | 11167 | 11/01/02 | 11/01/03 |
| Cable1 | RG-214/U | CBL-001 | 06/21/03 | 06/21/04 |
| Shielded Semi-Anechoic Chamber | RANTEC | N/A | 02/11/03 | 02/11/04 |
| Communica-Tion's Analyzer | IFR 1500A | | 07/01/03 | 07/01/04 |
| 16 Channel Termocouple Monitor | SR630 | 34202 | 12/16/02 | 12/16/03 |
| Temperature's Oven | Ingoco Ovens | 5966B | N/A | N/a |
| Sorensen DC Power Supply | DCS80-13E | 9916B1012 | 07/07/03 | 07/07/04 |
| Temperature and Humidity Recorder | Dickson TH8-24C | 5097755 | 09/16/03 | 09/16/05 |

## 5.0 RF Power Output

**Type of Test : RF Power Output**
**FCC Part 95 : Subclause 95.639 (e)**
**FCC Part 2 : Subclause 2.1046**

**Limit : The maximum transmitter output power authorized for LPRS is 100 mW that equals 20 dBm**

The test facility consists of a shielded semi-anechoic chamber with attached shielded control room. The semi-anechoic chamber is approximately 18 feet wide by 28 feet long by 19 feet high. A hybrid absorber combines high performance anechoic polyurethane foam with a ferrite tile base to achieve high levels of absorption and power dissipation capability.

The EUT had been placed at the 0.8 m height on the non-conducting table. Transmitter had been turned ON without modulation and worked at the frequencies of the selected 1, 61 and 80 channels.
All data was obtained via a HP 85876A EMI measurement software package using an HP 85462A Receiver which is compliant to CISPR 16. RF Power Level of the EUT was installed to maximum value equal "25". The EUT was configured in various geometric patterns to find the geometric configuration and EUT attitude that produced the largest RF power.
After determination of the maximum emissions configuration the distance of the EUT to the scanning antenna was set to 3 meters.
**At each Channel 1, 61, and 80 RF Power Output had been measured. Then Effective Radiated power of each channel's frequency had been determined by a substitution measurement. For substitution method of ERP measurement the CBL6111 antenna with RG-214/U, 26' length cable and HP 8648A Signal generator were used.**

The equation for ERP determination is

**ERP = P + Gain – L –2.14** **where**

**P** is a reading of the power delivered from calibrated HP8648A signal generator to the substitution antenna ;
**Gain** is the antenna gain (dBi) of the substitution antenna at the measured frequency ;
**2.14 dBi** - ideal dipole gain
**L** is the losses of the RG-214/U cable at the measured frequency.

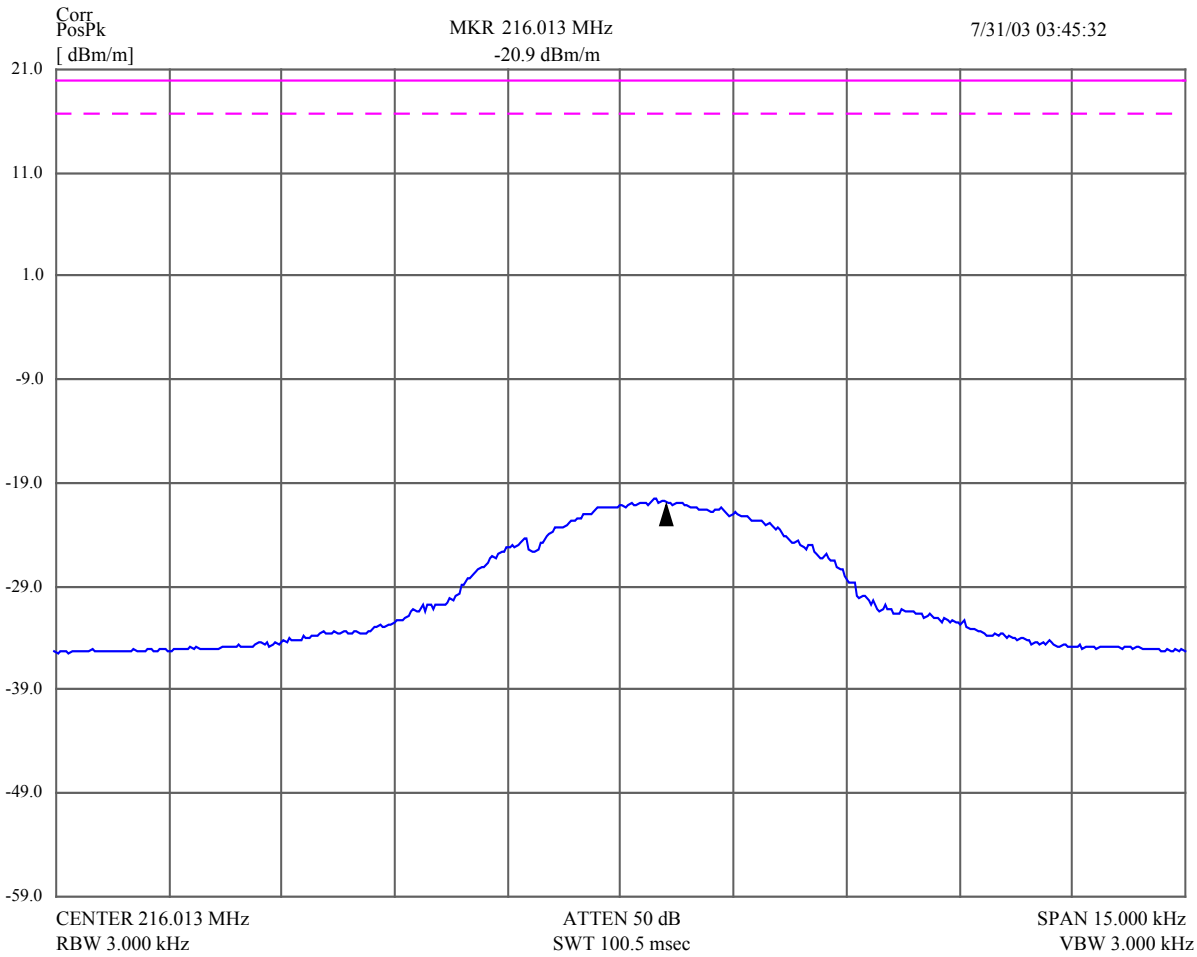
Below are the Peak and ERP measurements/calculation of the highest value RF Power output at the frequencies of the selected channels.

## 5.1. Channel 1

### Peak value data

| Frequency MHz | Peak dBm | Peak Limit dBm | DelLim – Peak dB | Status |
|---|---|---|---|---|
| 216.013104 | -20.9 | 20.0 | - 40.9 | PASS |

### Receiver graph of RF Power output at 3 m



The following are the result of the calculated ERP based on the actual HP8648A Signal generator readings at the transmitter channel's 1 frequency to produce the same peak field strength readings as above graph

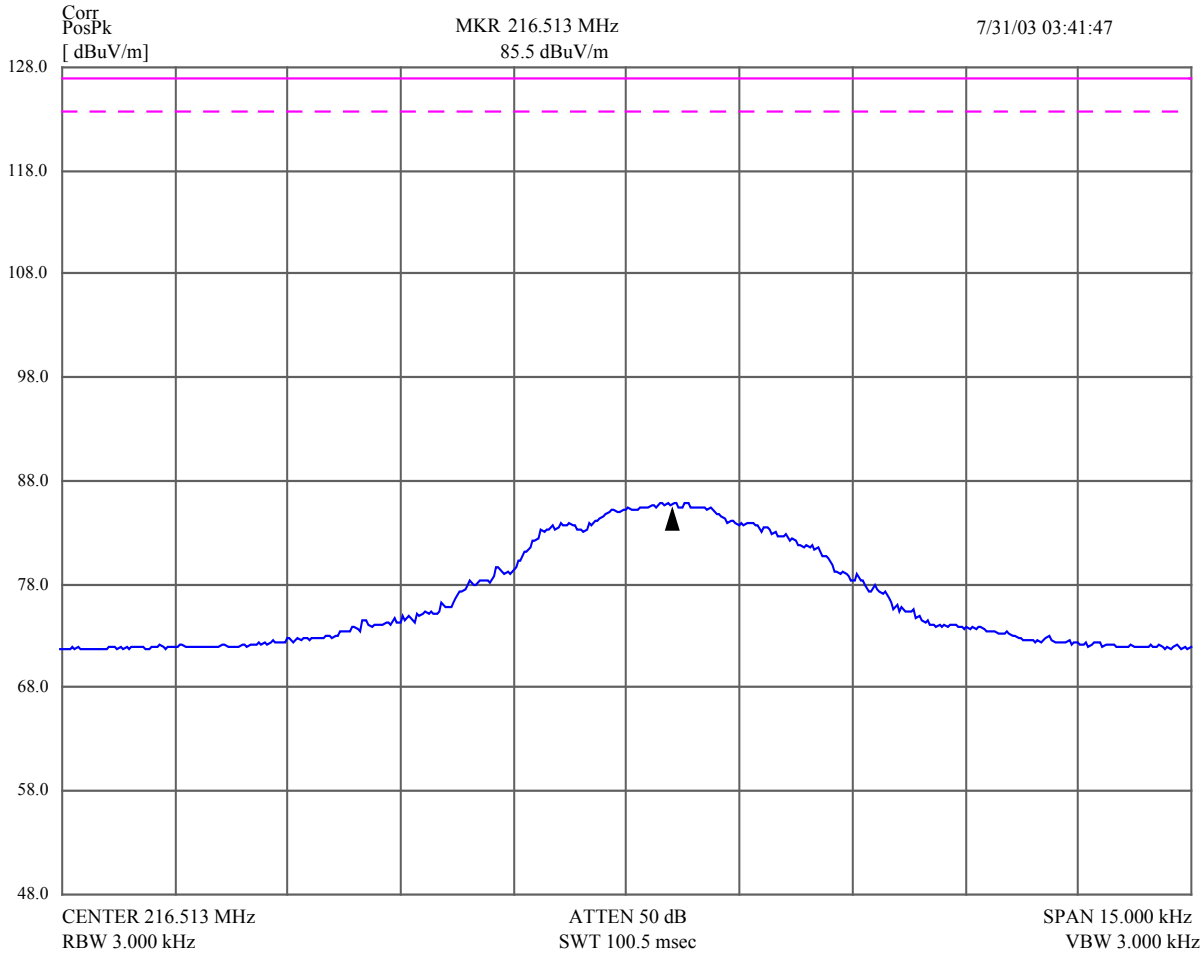
| **Frequency**<br><br>**MHz** | **Peak**<br><br>**dBm** | **P – HP8648A Reading**<br>**dBm** | **Antenna gain**<br>**dBi** | **Cable Losses**<br><br>**dB** | **ERP Value**<br><br>**dBm** |
|---|---|---|---|---|---|
| 216.012496 | -20.8 | -17.2 | 6.1 | 1.41 | -14.65 |

## 5.2. Channel 61

### Peak value data

| Frequency MHz | Peak dBm | Peak Limit dBm | DelLim – Peak dB | Status |
|---|---|---|---|---|
| 216.513104 | -21.35 | 20.0 | -41.35 | PASS |

### Receiver graph of RF Power output at 3 m



The following are the result of the calculated ERP based on the actual HP8648A Signal generator readings at the transmitter channel's 61 frequency to produce the same peak field strength readings as above graph

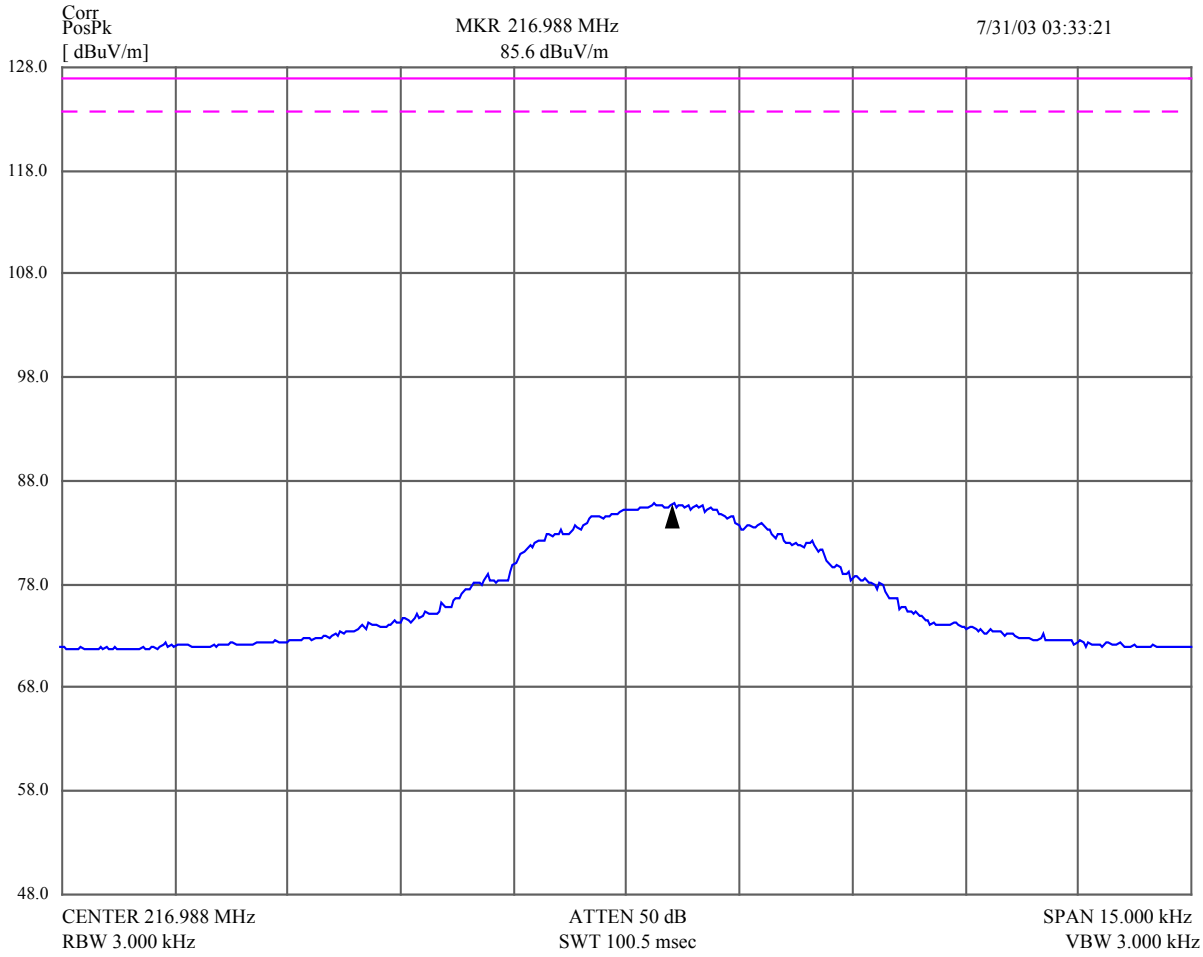
| **Frequency**<br><br>**MHz** | **Peak**<br><br>**dBm** | **P – HP8648A Reading**<br>**dBm** | **Antenna gain**<br>**dBi** | **Cable Losses**<br><br>**dB** | **ERP Value**<br><br>**dBm** |
|---|---|---|---|---|---|
| 216.513104 | -21.3 | -17.6 | 6.1 | 1.407 | -15.05 |

## 5.3. Channel 80

### Peak value data

| Frequency MHz | Peak dBm | Peak Limit dBm | DelLim – Peak dB | Status |
|---|---|---|---|---|
| 216.988144 | -21.9 | 20.0 | -41.9 | PASS |

### Receiver graph of RF Power output at 3 m



The following are the result of the calculated ERP based on the actual HP8648A Signal generator readings at the transmitter channel's 80 frequency to produce the same peak field strength readings as above graph

| **Frequency**<br><br>**MHz** | **Peak**<br><br>**dBm** | **P – HP8648A Reading**<br>**dBm** | **Antenna gain**<br>**dBi** | **Cable Losses**<br><br>**dB** | **ERP Value**<br><br>**dBm** |
|---|---|---|---|---|---|
| 216.988000 | -21.8 | -17.6 | 6.1 | 1.41 | -15.05 |

## 6.0 Unwanted radiation

**Type of Test : Unwanted radiation**
**FCC Part 95 : Subclause 95.635 (c) (1)**
**FCC Part 2 : Subclause 2.1046**

**Limit : Emissions for LPRS transmitters operating on standard band channels (25kHz) shall be attenuated below the unmodulated carrier in according the following :**

1) **emissions 12.5 kHz to 22.5 kHz away from the channel center frequency : at least 30 dB;**
2) **emissions more than 22.5 kHz away from the channel center frequency : at least 33 dB.**

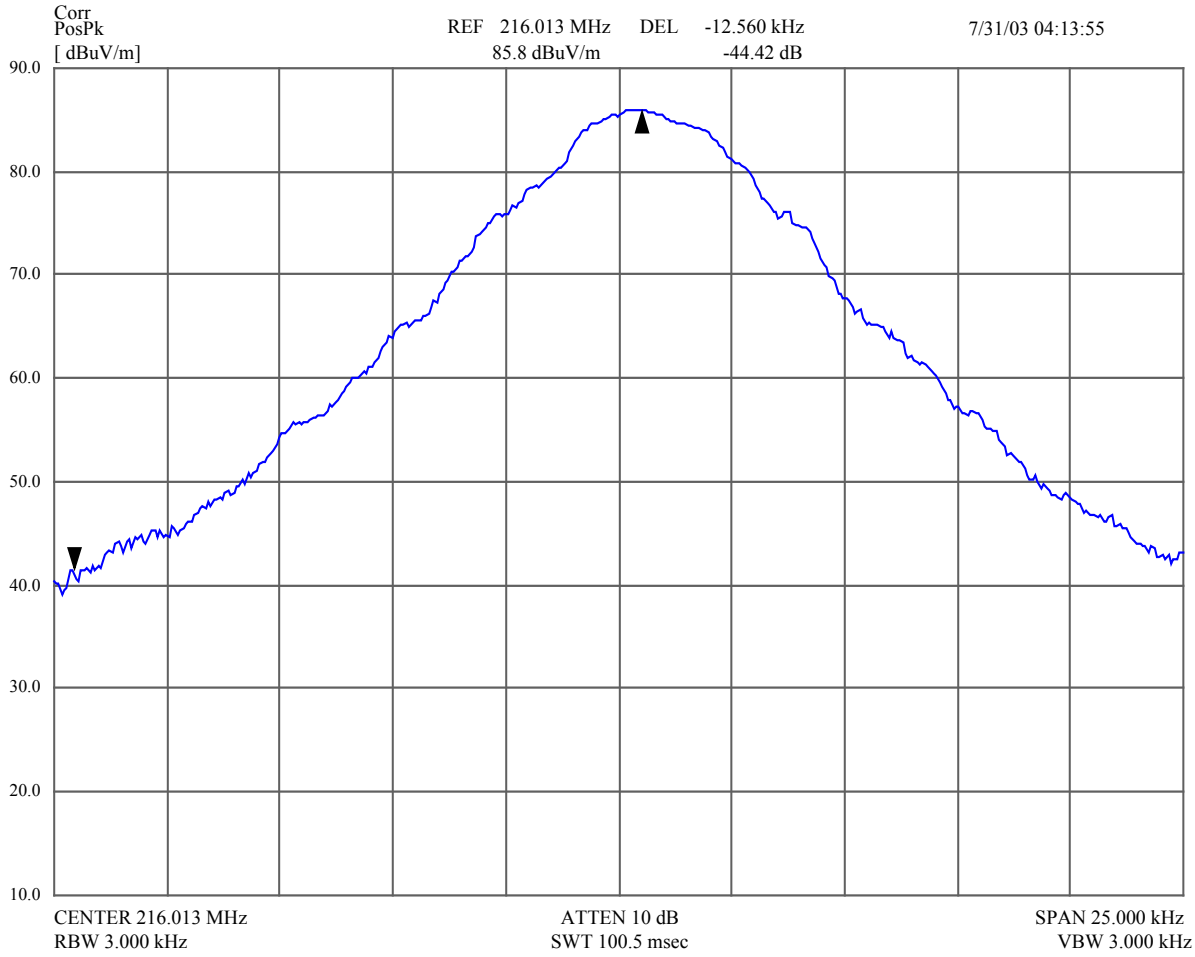
Below is the Peak measurements of the emission value UNWANTED RADIATION signals observed at the frequency carrier of the selected channels.

### 6.1 Channel 1

**Emission values of the unwanted frequencies**

| Frequency MHz | Peak dBuV/m | Peak Carier dBuV/m | Limit attenuation dB | Pk carrier-Pk dB | Status | Comment |
|---|---|---|---|---|---|---|
| 216.000432 | 41.43 | 85.85 | 30 | 44.42 | PASS | -(12.5…22.5) kHz |
| 215.999980 | 41.42 | 85.85 | 33 | 44.43 | PASS | > -22.5 kHz |

## Receiver graph of unwanted radiation

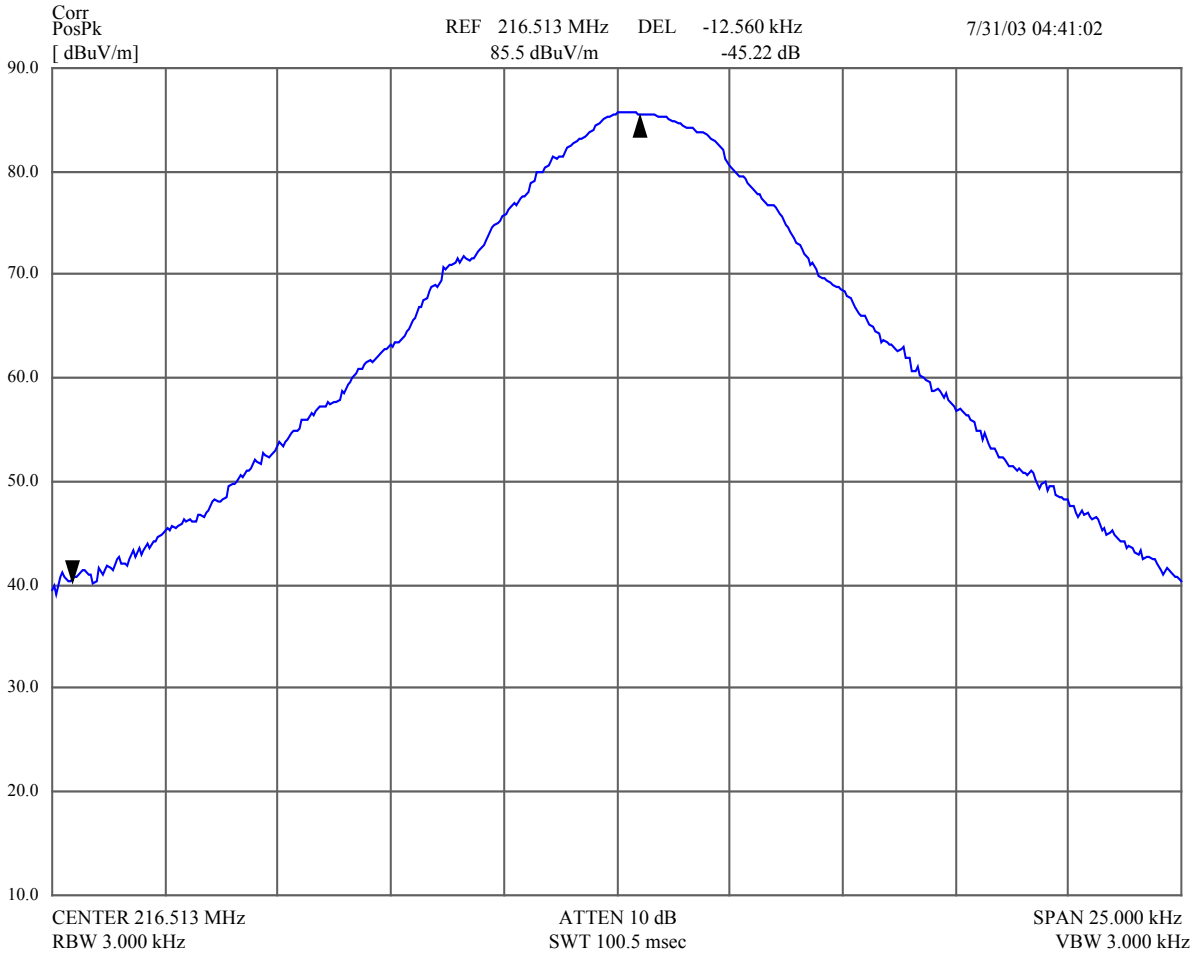


## 6.2 Channel 61

### Emission values of the unwanted frequencies

| Frequency<br>MHz | Peak<br>dBuV/m | Peak Carier<br>dBuV/m | Limit attenuation<br>dB | Pk carrier-Pk<br>dB | Status | Comment |
|---|---|---|---|---|---|---|
| 216.500432 | 40.25 | 85.47 | 30 | 45.22 | PASS | -(12.5…22.5) kHz |
| 215.499980 | 41.24 | 85.47 | 33 | 45.23 | PASS | > -22.5 kHz |

### Receiver graph of unwanted radiation

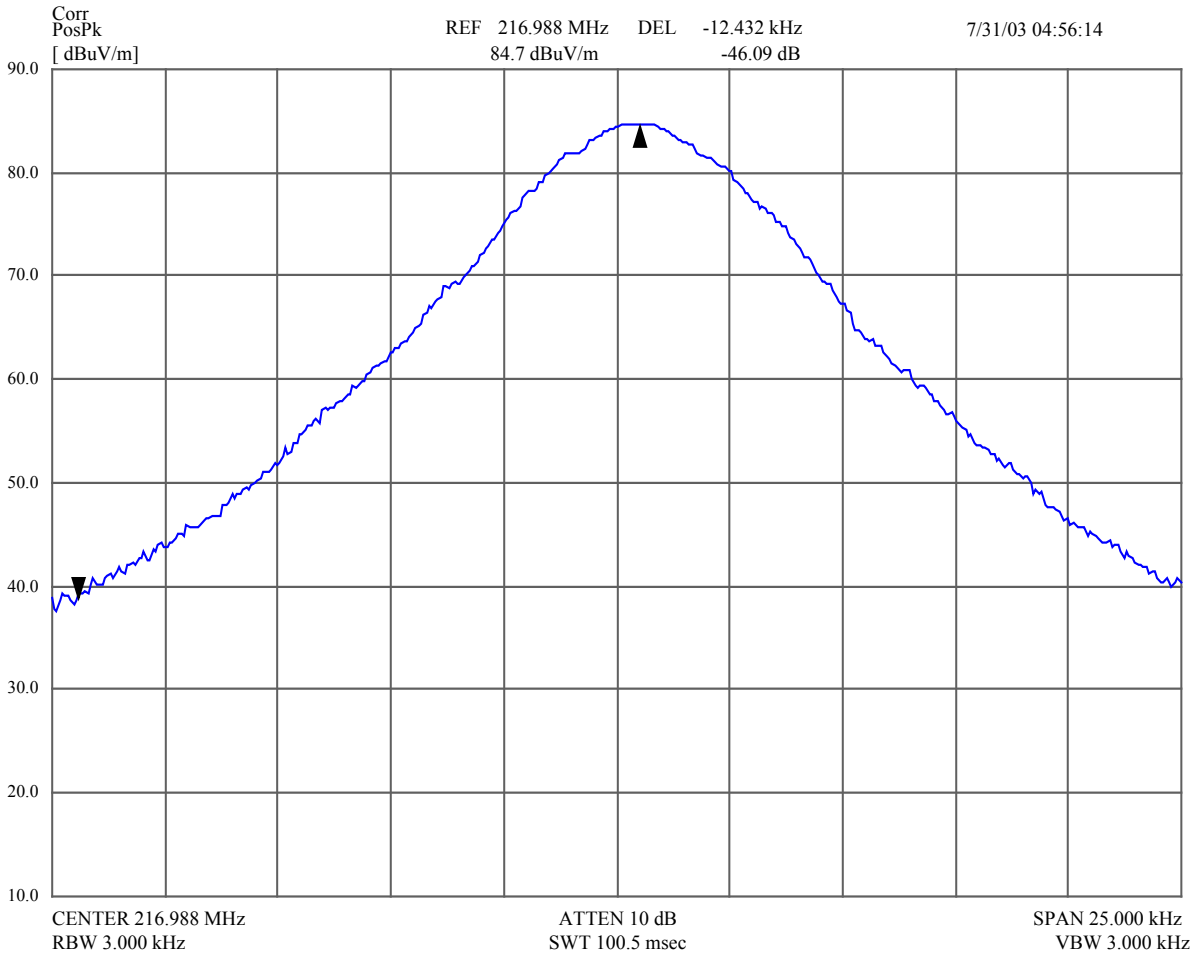


## 6.3 Channel 80

### Emission values of the unwanted frequencies

| Frequency<br>MHz | Peak<br>dBuV/m | Peak Carier<br>dBuV/m | Limit attenuation<br>dB | Pk carrier-Pk<br>dB | Status | Comment |
|---|---|---|---|---|---|---|
| 216.975568 | 38.56 | 84.63 | 30 | 46.07 | PASS | -(12.5…22.5) kHz |
| 215.974999 | 38.55 | 84.63 | 33 | 46.07 | PASS | > -22.5 kHz |

### Receiver graph of unwanted radiation



## 7.0 Occupied channel bandwidth

Type of Test : Occupied Channel bandwidth
**FCC Part 95 : Subclause 95.633 (d) (2)**
**FCC Part 2 : Subclause 2.1049 © (1)**

The channel Bandwidth (BW) is defined as the minimum declared bandwidth +/- 12.5 kHz, within which the transmitter's necessary bandwidth can be contained.

The BW value was defined using The First Carrier Null procedure :

1. The Transmitter was adjusted to work at the selected channels -1, 61 and 80. All measurements were conducted by the HP 85462A Spectrum Analyzer;
2. The test Signal generator HP651B was connected to the Aux audio input of the EUT with amplitude equals 150 mV rms. This value had been defined by **Limiting Threshold measured (see below, an audio input level versus a modulation frequency) ;**
3. Then the modulation frequency at test Signal Generator had been adjusted to the certain value **Fmod** at which the First carrier Null was achieved ;
4. The Channel BW was calculated by the following equation :

**BW = +/- [ (Fmod x M ) ( kHz)**

Where :
**Fmod** = the certain frequency of the Signal Generator at which the First Carrier Null was achieved ;
**M** = Modulation index equal 2.4 for the First Carrier null ;

### 7.1 Test Results

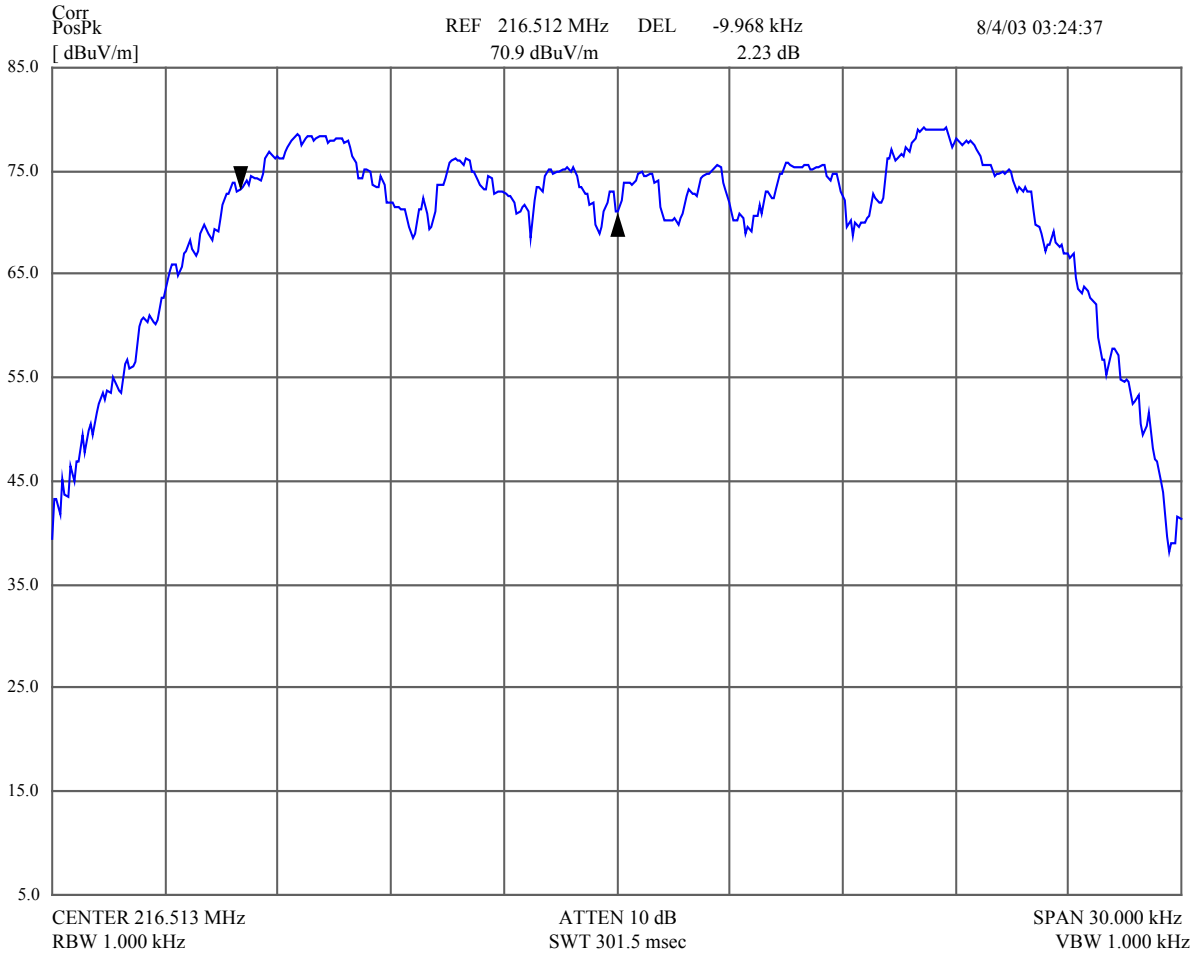
#### 7.1.1 Limiting Threshold

The Limiting Threshold was tested and defined with Channel 61. The Limiting Threshold is defined as the minimum audio input level at which the slope of the audio input/output transfer curve is greater or equal to 4:1. **The EUT don't support the audio output so the limiting threshold was defined by the curve "of the modulation limiting data which is the deviation as a function of audio input level".** The modulation frequency of the Signal generator had been installed at 1kHz, 2 kHz, 3 kHz, 4kHz and 5kHz..
Measurements were conducted by HP 85462A Spectrum Analyzer with RBW=1 and 3 kHz and Span=30 kHz installed.

## 1) Fmod = 1 kHz

| The modulation Amplitude mV, rms | Frequency at level 99% of F peak carrier MHz | Frequency of carier mHz | Transmitter Deviation kHz |
|---|---|---|---|
| 10 | 216.511376 | 216.512496 | 1.120 |
| 20 | 216.508000 | 216.512496 | 4.496 |
| **30** | **216.503424** | **216.512496** | **9.072** |
| 40 | 216.503424 | 216.512496 | 9.072 |
| 50 | 216.503424 | 216.512496 | 9.072 |
| 60 | 216.503424 | 216.512496 | 9.072 |
| 70 | 216.503424 | 216.512496 | 9.072 |
| 80 | 216.503424 | 216.512496 | 9.072 |
| 90 | 216.503424 | 216.512496 | 9.072 |
| 100 | 216.503424 | 216.512496 | 9.072 |
| 110 | 216.503424 | 216.512496 | 9.072 |
| 120 | 216.503424 | 216.512496 | 9.072 |
| 130 | 216.503424 | 216.512496 | 9.072 |
| 140 | 216.503424 | 216.512496 | 9.072 |
| 150 | 216.503424 | 216.512496 | 9.072 |

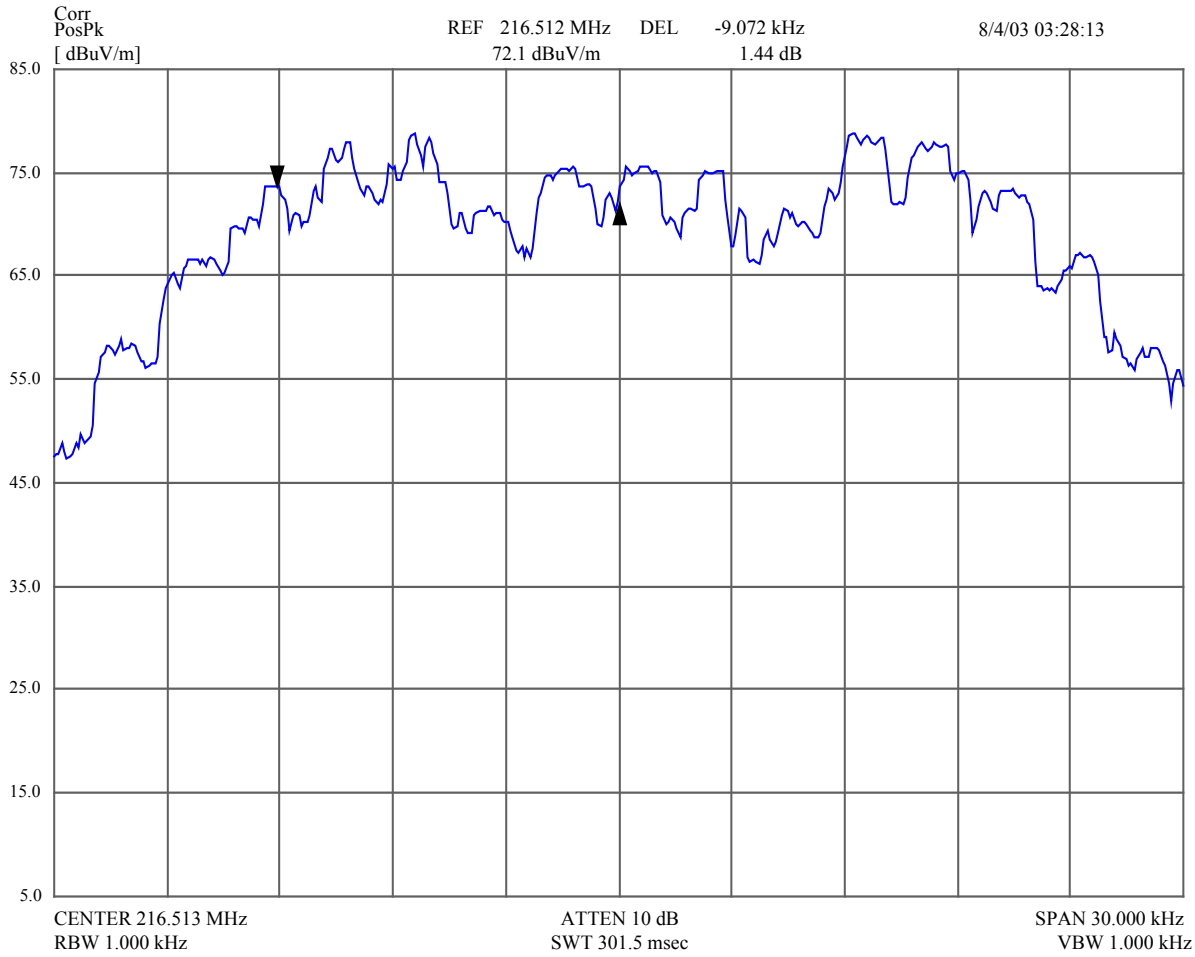
## Receiver graph at Fmod = 1 kHz and 100 mV audio input level



## 2) Fmod = 2 kHz

| The modulation Amplitude mV, rms | Frequency at level 99% of F peak carrier MHz | Frequency of carier MHz | Transmitter Deviation kHz |
|---|---|---|---|
| 10 | 216.511520 | 216.512496 | 0.976 |
| 20 | 216.508752 | 216.512496 | 3.744 |
| **30** | **216.504400** | **216.512496** | **8.096** |
| 40 | 216.504400 | 216.512496 | 8.096 |
| 50 | 216.504400 | 216.512496 | 8.096 |
| 60 | 216.504400 | 216.512496 | 8.096 |
| 70 | 216.504400 | 216.512496 | 8.096 |
| 80 | 216.504400 | 216.512496 | 8.096 |
| 90 | 216.504400 | 216.512496 | 8.096 |
| 100 | 216.504400 | 216.512496 | 8.096 |
| 110 | 216.504400 | 216.512496 | 8.096 |
| 120 | 216.504400 | 216.512496 | 8.096 |
| 130 | 216.504400 | 216.512496 | 8.096 |
| 140 | 216.504400 | 216.512496 | 8.096 |
| 150 | 216.504400 | 216.512496 | 8.096 |

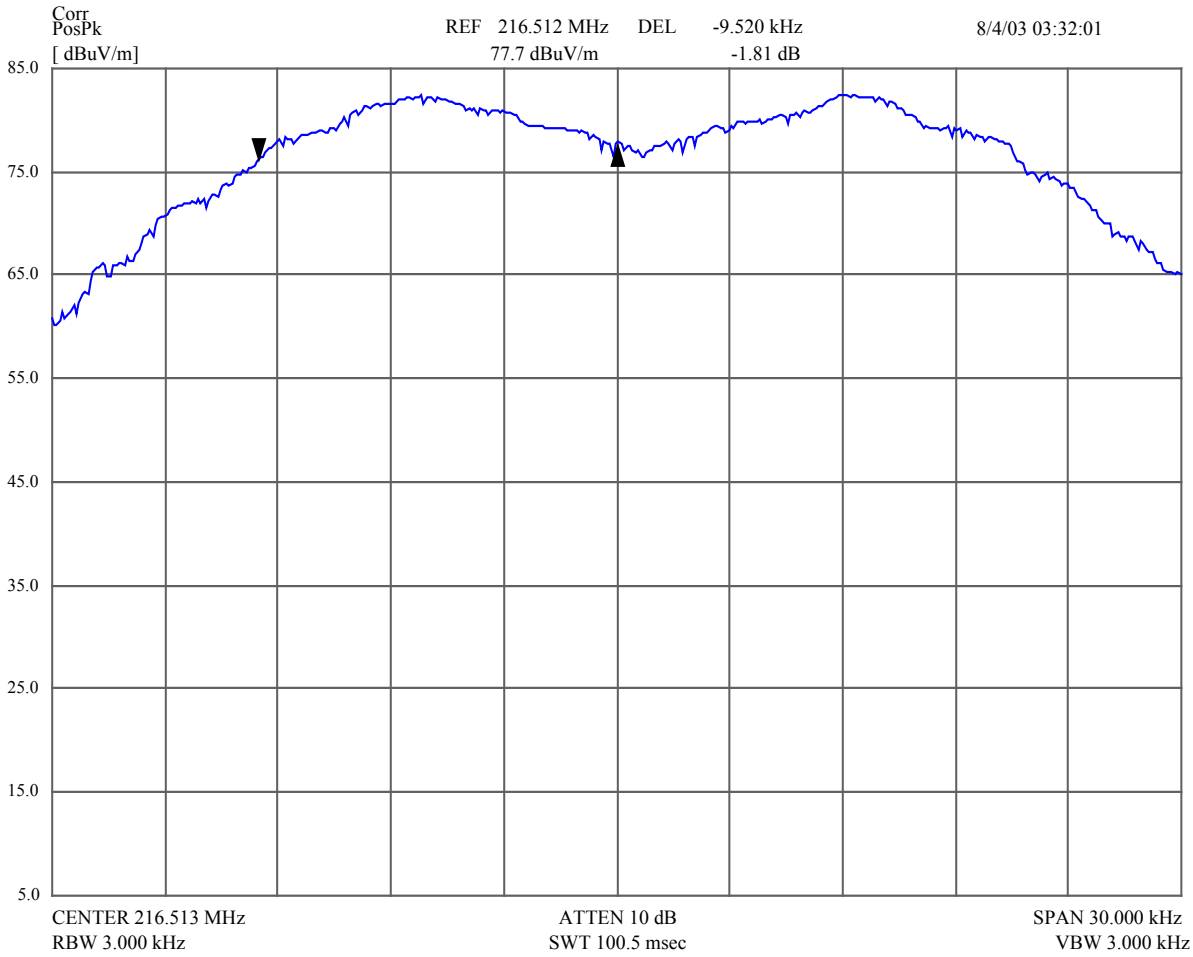
## Receiver graph at Fmod = 2 kHz and 100 mV audio input level



### 3) Fmod = 3 kHz

| The modulation Amplitude mV, rms | Frequency at level 99% of F peak carrier MHz | Frequency of carier MHz | Transmitter ½ of Deviation kHz |
|---|---|---|---|
| 10 | 216.511456 | 216.512496 | 1.040 |
| 20 | 216.508832 | 216.512496 | 3.664 |
| **30** | **216.504096** | **216.512496** | **8.400** |
| 40 | 216.504096 | 216.512496 | 8.400 |
| 50 | 216.504096 | 216.512496 | 8.400 |
| 60 | 216.504096 | 216.512496 | 8.400 |
| 70 | 216.504096 | 216.512496 | 8.400 |
| 80 | 216.504096 | 216.512496 | 8.400 |
| 90 | 216.504096 | 216.512496 | 8.400 |
| 100 | 216.504096 | 216.512496 | 8.400 |
| 110 | 216.504096 | 216.512496 | 8.400 |
| 120 | 216.504096 | 216.512496 | 8.400 |
| 130 | 216.504096 | 216.512496 | 8.400 |
| 140 | 216.504096 | 216.512496 | 8.400 |
| 150 | 216.504096 | 216.512496 | 8.400 |

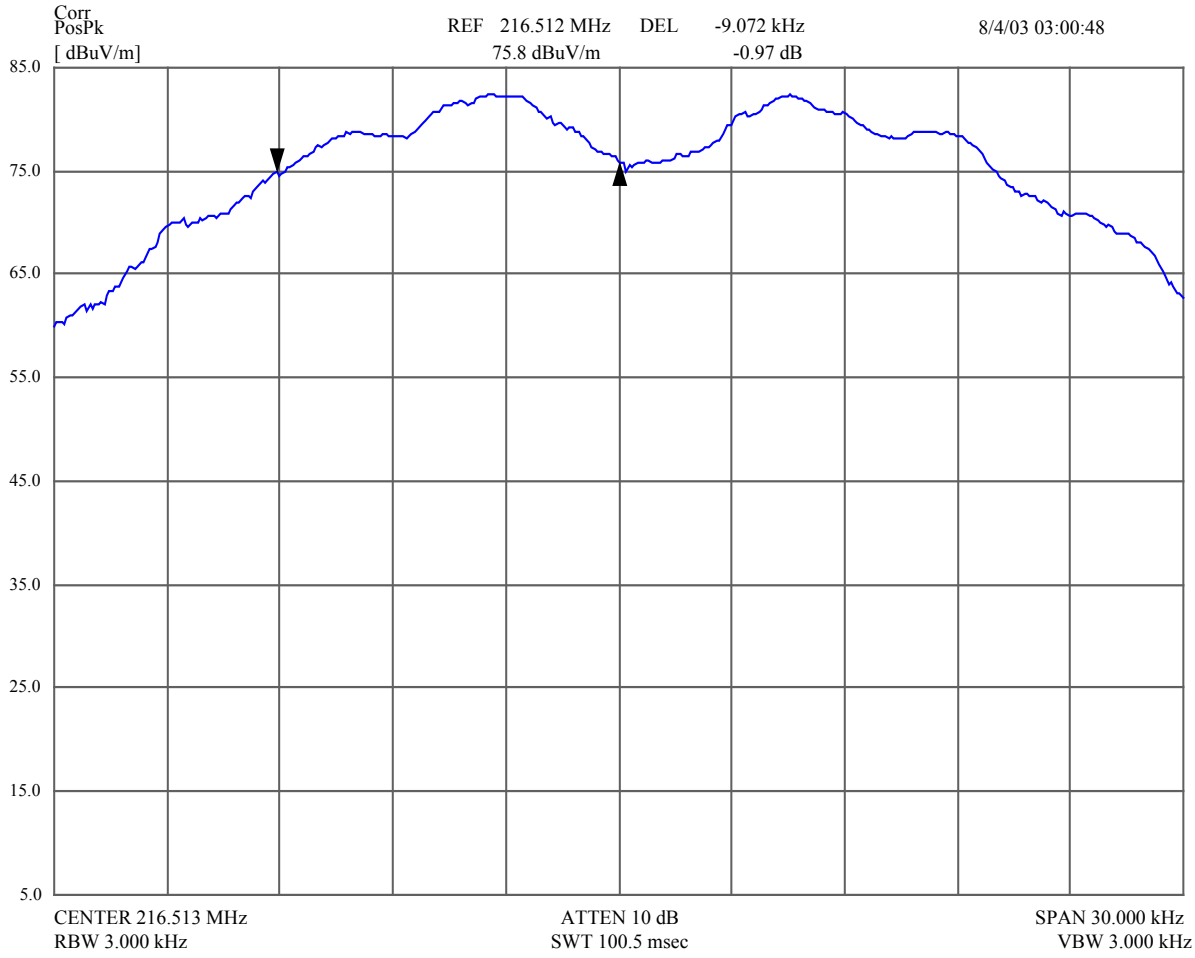
## Receiver graph at Fmod = 3 kHz and 100 mV audio input level



### 4) Fmod = 4 kHz

| The modulation Amplitude mV, rms | Frequency at level 99% of F peak carrier MHz | Frequency of carier mHz | Transmitter ½ of Deviation kHz |
|---|---|---|---|
| 10 | 216.511968 | 216.512496 | 0.528 |
| 20 | 216.508448 | 216.512496 | 4.048 |
| **30** | **216.504480** | **216.512496** | **8.016** |
| 40 | 216.504480 | 216.512496 | 8.016 |
| 50 | 216.504480 | 216.512496 | 8.016 |
| 60 | 216.504480 | 216.512496 | 8.016 |
| 70 | 216.504480 | 216.512496 | 8.016 |
| 80 | 216.504480 | 216.512496 | 8.016 |
| 90 | 216.504480 | 216.512496 | 8.016 |
| 100 | 216.504480 | 216.512496 | 8.016 |
| 110 | 216.504480 | 216.512496 | 8.016 |
| 120 | 216.504480 | 216.512496 | 8.016 |
| 130 | 216.504480 | 216.512496 | 8.016 |
| 140 | 216.504480 | 216.512496 | 8.016 |
| 150 | 216.504480 | 216.512496 | 8.016 |

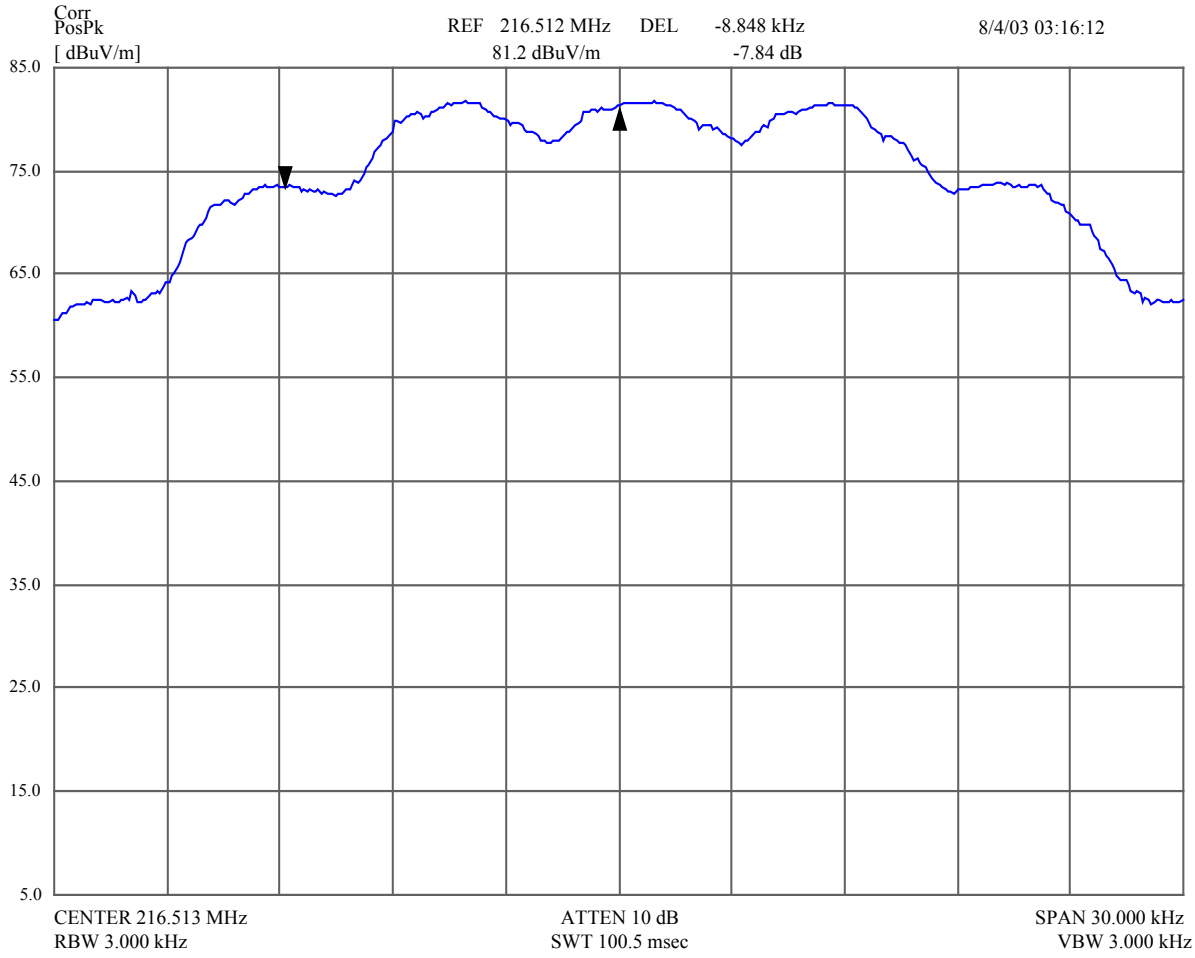
## Receiver graph at Fmod = 4 kHz and 100 mV audio input level



## 5) Fmod = 5 kHz

| The modulation Amplitude mV, rms | Frequency at level 99% of F peak carrier MHz | Frequency of carier mHz | Transmitter ½ of Deviation kHz |
|---|---|---|---|
| 10 | 216.511008 | 216.512496 | 1.448 |
| 20 | 216.507168 | 216.512496 | 5.328 |
| **30** | **216.505560** | **216.512496** | **6.936** |
| 40 | 216.503808 | 216.512496 | 8.688 |
| 50 | 216.503808 | 216.512496 | 8.688 |
| 60 | 216.503808 | 216.512496 | 8.688 |
| 70 | 216.503808 | 216.512496 | 8.688 |
| 80 | 216.503808 | 216.512496 | 8.688 |
| 90 | 216.503808 | 216.512496 | 8.688 |
| 100 | 216.503808 | 216.512496 | 8.688 |
| 110 | 216.503808 | 216.512496 | 8.688 |
| 120 | 216.503808 | 216.512496 | 8.688 |
| 130 | 216.503808 | 216.512496 | 8.688 |
| 140 | 216.503808 | 216.512496 | 8.688 |
| 150 | 216.503808 | 216.512496 | 8.688 |

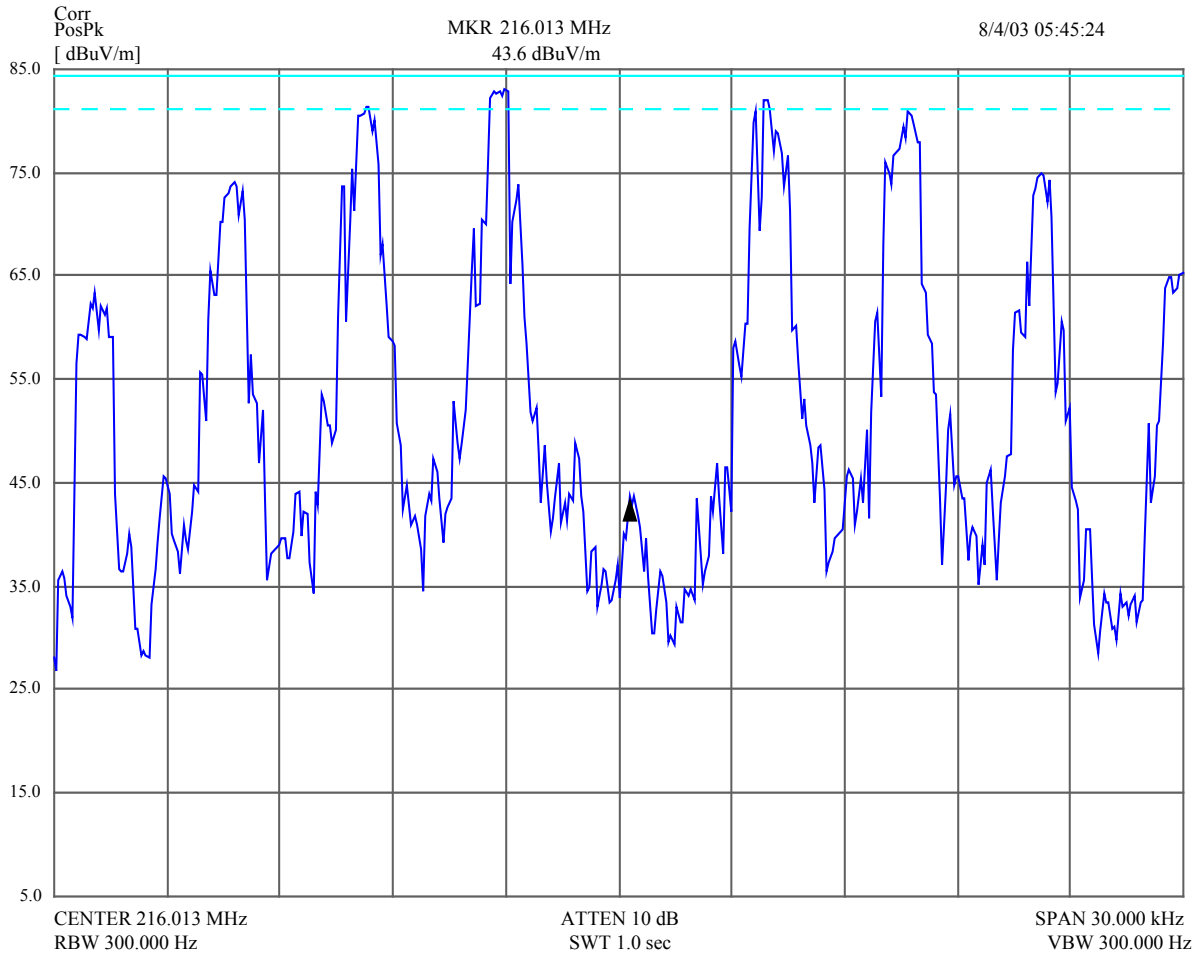
**Receiver graph at Fmod = 5 kHz and 100 mV audio input level**




5) Data depicted above (7.1.1) show that we can take 25 mV as the Limiting Threshold amplitude of audio input and according to Subclause 2.1049 we should use this input level increased by 16 dB as the modulation input level at **Fmod = 2500 Hz** to define all characteristics of the EUT – it comes to **150 mV** value.

### 7.1.2 BW, Channel 1

**Below are the Receiver Spectrum at the First Carrier Null , at 150 mV audio input amplitude :**

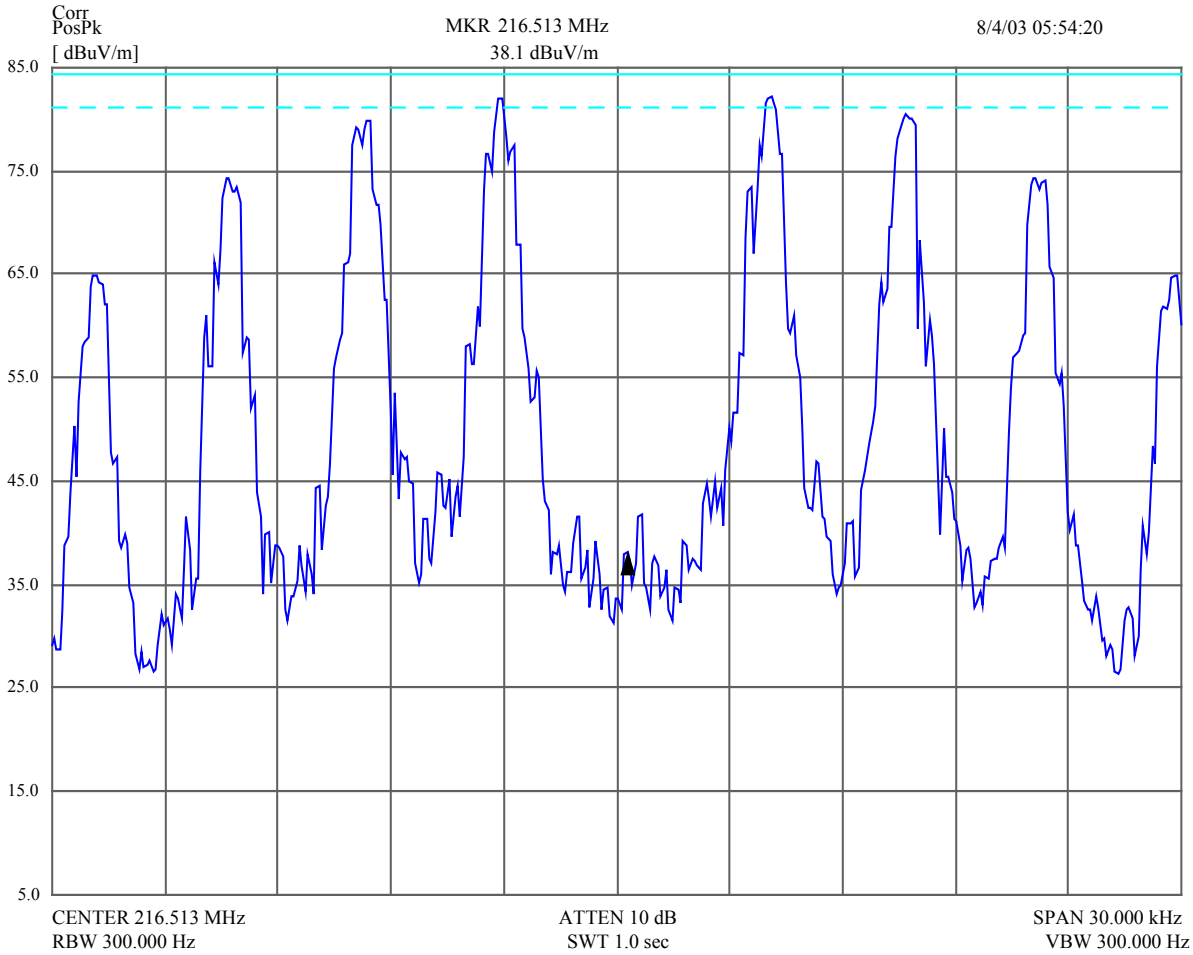



**The First Carrier Null was achieved at Fmod = 3.61 kHz.**
**Channel Bandwidth calculated with the First Carrier Null procedure is**

**BW = +/- [ (Fmod x M ) = 3.61 x 2 = =+/- 7.22 kHz**

### 7.1.3 BW, Channel 61

**Below are the Receiver Spectrum at the First Carrier Null, at 150 mV audio input amplitude :**

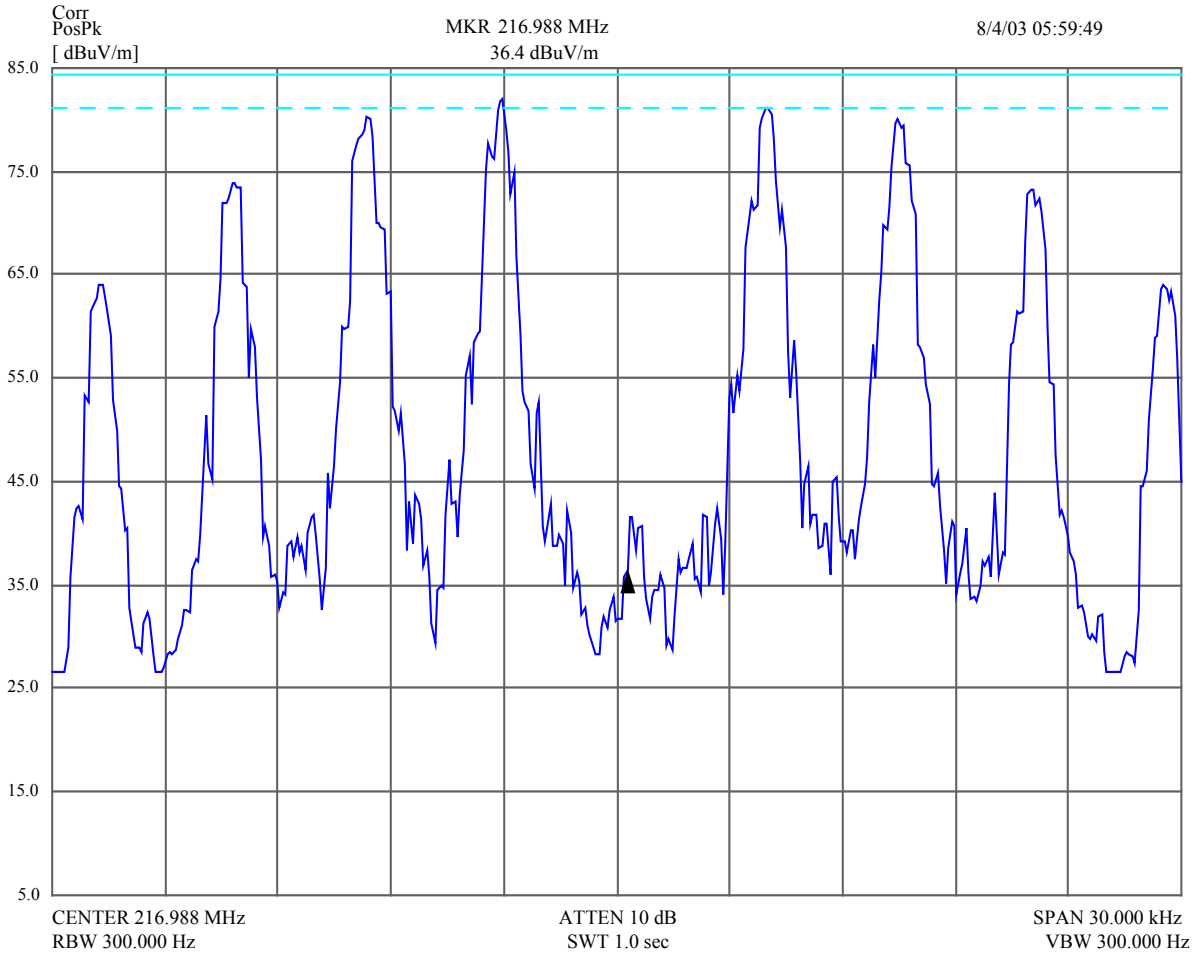



**The First Carrier Null was achieved at Fmod = 3.63 kHz.**
**Channel Bandwidth calculated with the First Carrier Null procedure is**

**BW = +/- [ (Fmod x M ) = 3.61 x 2 = =+/- 7.26 kHz**

### 7.1.4 BW, Channel 80

**Below are the Receiver Spectrum at the First Carrier Null , at 150 mV audio input amplitude :**




**The First Carrier Null was achieved at Fmod = 3.59 kHz.**
**Channel Bandwidth calculated with the First Carrier Null procedure is**

**BW = +/- [ (Fmod x M ) = 3.59 x 2 = =+/- 7.18 kHz**

## 8.0 Field strength of spurious radiation

Type of Test : Field strength of spurious radiation
**FCC Part 2 : Subclause 2.1053 (a) (b)**
**FCC Part 2 : Subclause 2.1057 (a) (1))**

**Limit value :**
**ERP of transmitter spurious emission should not exceed the value of -13 dBm.**

### 8.1 Spurious emissions (radiation) had been measured with the following procedure :

The EMC radiated test facility consists of a shielded semi-anechoic chamber with attached shielded control room. The semi-anechoic chamber is approximately 18 feet wide by 28 feet long by 19 feet high. A hybrid absorber combines high performance anechoic polyurethane foam with a ferrite tile base to achieve high levels of absorption and power dissipation capability.
The test site is designed according to the ANSI 63.4 -2000 requirements and the anechoic treatment of the chamber is sufficient to achieve the requirements of CISPR 22 and ANSI C63.4. The test site description along with the site attenuation data has been filed with the FCC and a letter of compliance with the requirements of Section 2.948 of the FCC Rules was issued on August 20,1998 by the FCC.

The EUT had been placed at the 0.8 m height on the non-conducting table. Transmitter had been turned ON with modulation at Fmod = 2500 Hz, 150 mV amplitude and worked at the frequencies of the selected 1, 61 and 80 channels.
All data was obtained via an HP 85876A EMI measurement software package using an HP 85462A Receiver which is compliant to CISPR 16. RF Power Level of the EUT was installed to maximum value equal “25”. The EUT was configured in various geometric patterns to find the geometric configuration and EUT attitude that produced the largest RF power of a field strength spurious radiation.
After determination of the maximum emissions configuration the distance of the EUT to the scanning antenna was set to 3 meters. Radiated emissions were then monitored from the EUT over a frequency range of 30 MHz to 2000 MHz in horizontal polarization with the scanning antenna repeatedly moving from 1 to 4 meters in elevation while the turntable rotated through a 360 degree arc. This procedure was then repeated in vertical polarization to confirm the strongest signals and polarization orientation.
Radiation of spurious frequencies had been measured by the test equipment over the frequency range 30 MHz to 2000 MHz excluding a 216 MHz band of frequencies centered on the channel on which the transmitter is intended to operate.

**At each Channel 1, then 61, then 80 RF Field strength of all spurious emissions had been measured. Then Effective Radiated power of each spurious frequency defined had been determined by a substitution measurement. For substitution method of ERP measurement the CBL6111 or SAS 200/571 Horn antennas, RG-214/U, 26' length cable and HP 8648A Signal generator were used.**

The equation for ERP determination is

**ERP = P + Gain– L –2.14** **where**

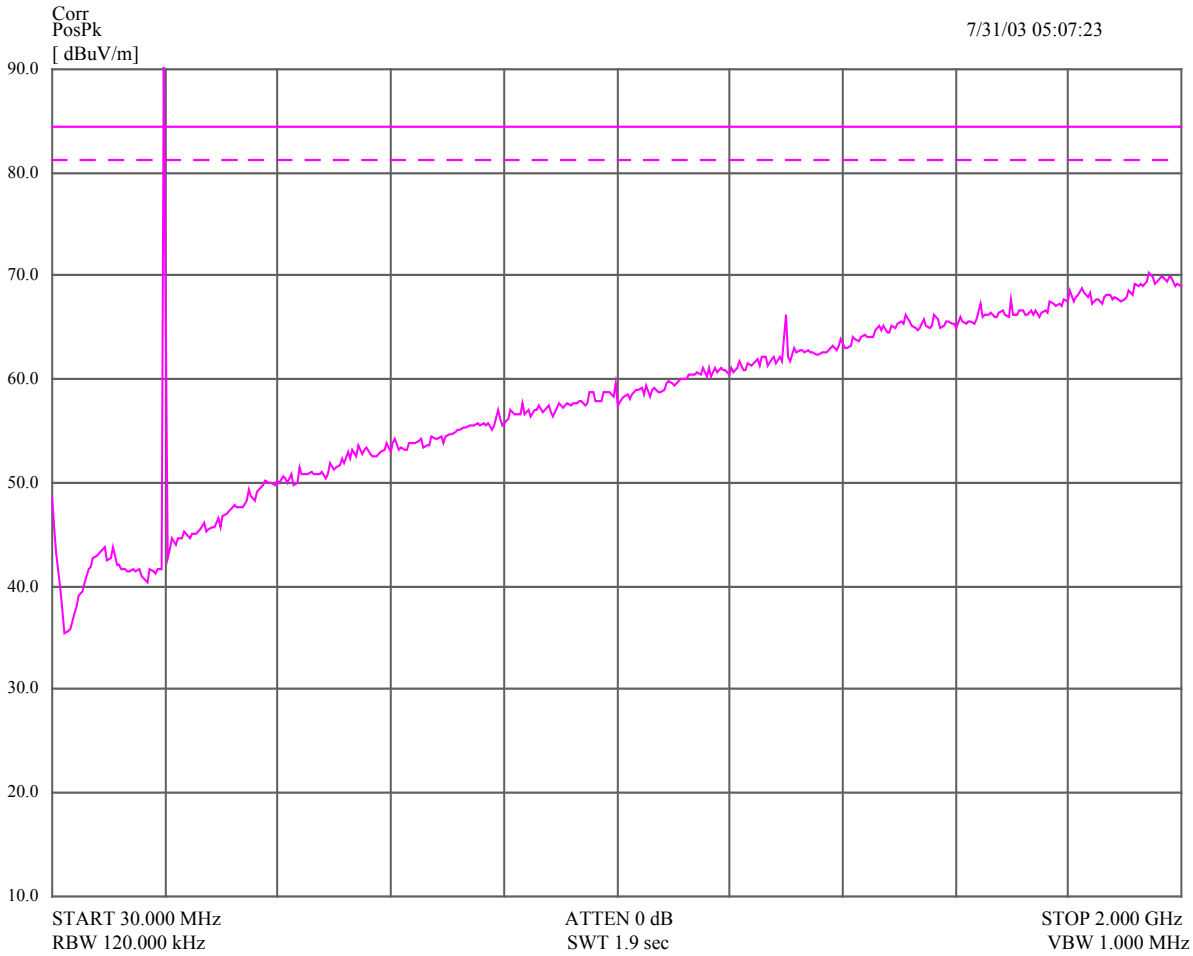
**P** is a reading of the power delivered from calibrated HP8648A signal generator to the substitution antenna ;
**Gain** is the antenna factor of the substitution antenna at the measured frequency ;
**L** is the losses of the RG-214/U cable at the measured frequency.
**2.14 dBi** is ideal dipole gain

Below is a results with a spectrum traces of the magnitude of all the signals throughout the band and ERP measurements/calculation of all spurious frequencies may be seen below.

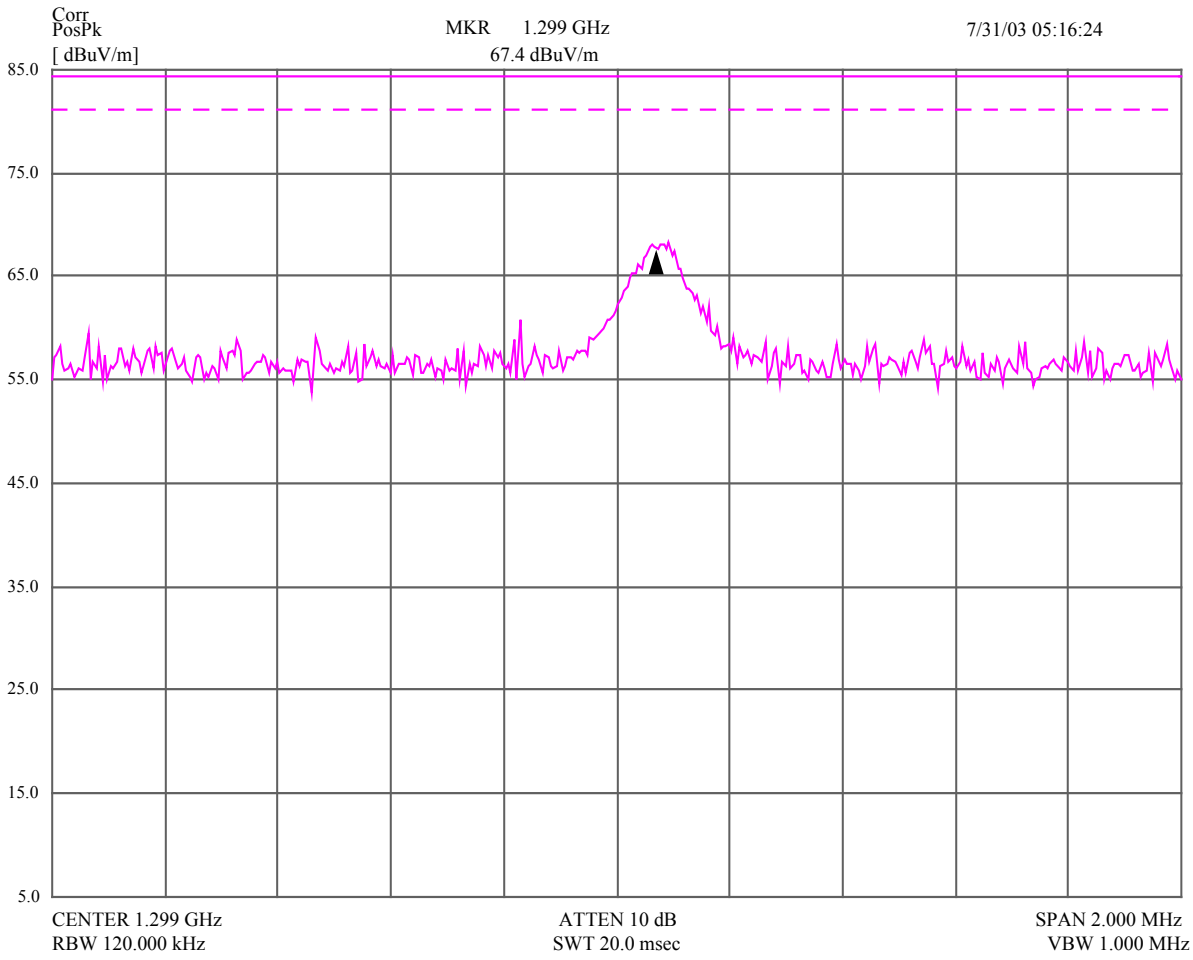
## 8.2 Test results
**Transmitter 216 MHz – 217 MHz**
**Channel 61 is turned ON**

In this graph the magnitude of the largest signal is plotted for the configuration that produced the largest signal at 3m distance between the EUT and receiving antenna. **The largest signal (above the limit ) that you can see in this graph is the operating frequency on which transmitter works.**

**Spectrum graph from 30 MHz to 2000 MHz**



## Spectrum graph and data of the spurious emission at frequency F = 1299 MHz




| Frequency MHz | Peak dBuV/m | Peak Lmt dBuV/m | DelLim-Pk dB | Angle deg | Hgt cm | Status |
|---|---|---|---|---|---|---|
| 1299.079936 | 67.48 | 84.46 | -16.98 | 276 | 100 | PASS |

The following is the result of the calculated ERP based on the actual HP8648A Signal generator readings at the spurious frequency 1299 MHz to produce the same peak field strength readings as above graph

| Frequency<br>MHz | Peak<br>dBm | P – HP8648A Reading<br>dBm | Gain Antenna<br>dBi | Cable Losses<br>dB | Limit Value<br>dBm | ERP Value<br>dBm | Status |
|---|---|---|---|---|---|---|---|
| 1299.079936 | -39.52 | -52.9 | 11.9 | 3.36 | -13.0 | -46.5 | PASS |

## 8.3 Test results

**Receiver 216 MHz – 217 MHz, Channel 22,**
**Transmitter 216 MHz – 217 MHz is turned Off**

**Test Specifications**

| | |
|---|---|
| Specification: | ANSI C63.4: 2000 |
| Title: | 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. |
| Specification: | FCC 47 CFR, Part 15.109, class B: 2003 |
| Title: | Code of Federal Regulations, Telecommunication |
| Specification: | JMR Work Procedure W090-5206 |
| Title: | Radiated Emission Test |

**Radiated Emissions Test Results**

Measurements expanded uncertainty equals 3.26 dB with 95% confidence level.
Room Ambient Temperature: 20°C±1°C
Relative Humidity: 57%±5%

Below are the Quasi-Peak and Avg. readings of the highest value signals observed throughout the 30 MHz to 2300 MHz frequency range.

| Frequency MHz | QP dBuV/m | QP Lmt dBuV/m | DelLim-QP dB | Pol | Hgt cm | Angle deg | Status |
|---|---|---|---|---|---|---|---|
| 226.840000 | 43.42 | 46.00 | -2.58 | Horz | 168 | 352 | PASS |
| 226.848992 | 40.15 | 46.00 | -5.85 | Vert | 95 | 252 | PASS |

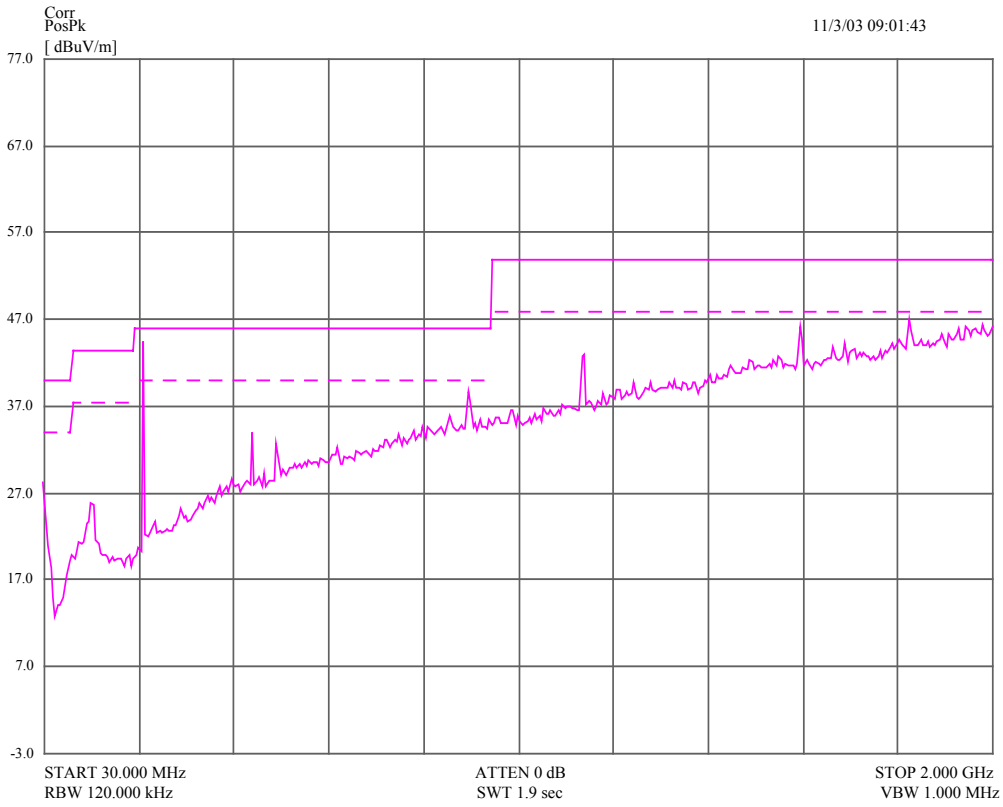
| Frequency MHz | Avg dBuV/m | Avg Lmt dBuV/m | DelLim-Avg dB | Pol | Hgt cm | Angle deg | Status |
|---|---|---|---|---|---|---|---|
| 1134.192000 | 39.23 | 54.00 | -14.77 | Horz | 144 | 283 | PASS |
| 1361.026944 | 43.84 | 54.00 | -10.16 | Vert | 96 | 261 | PASS |
| 1587.864960 | 47.84 | 54.00 | -6.16 | Horz | 95 | 40 | PASS |
| 1814.700032 | 44.75 | 54.00 | -9.25 | Horz | 112 | 51 | PASS |
| 2268.189952 | 36.45 | 54.00 | -17.55 | Horz | 165 | 194 | PASS |

A horizontal and vertical polarization spectrum traces of the magnitude of all the signals

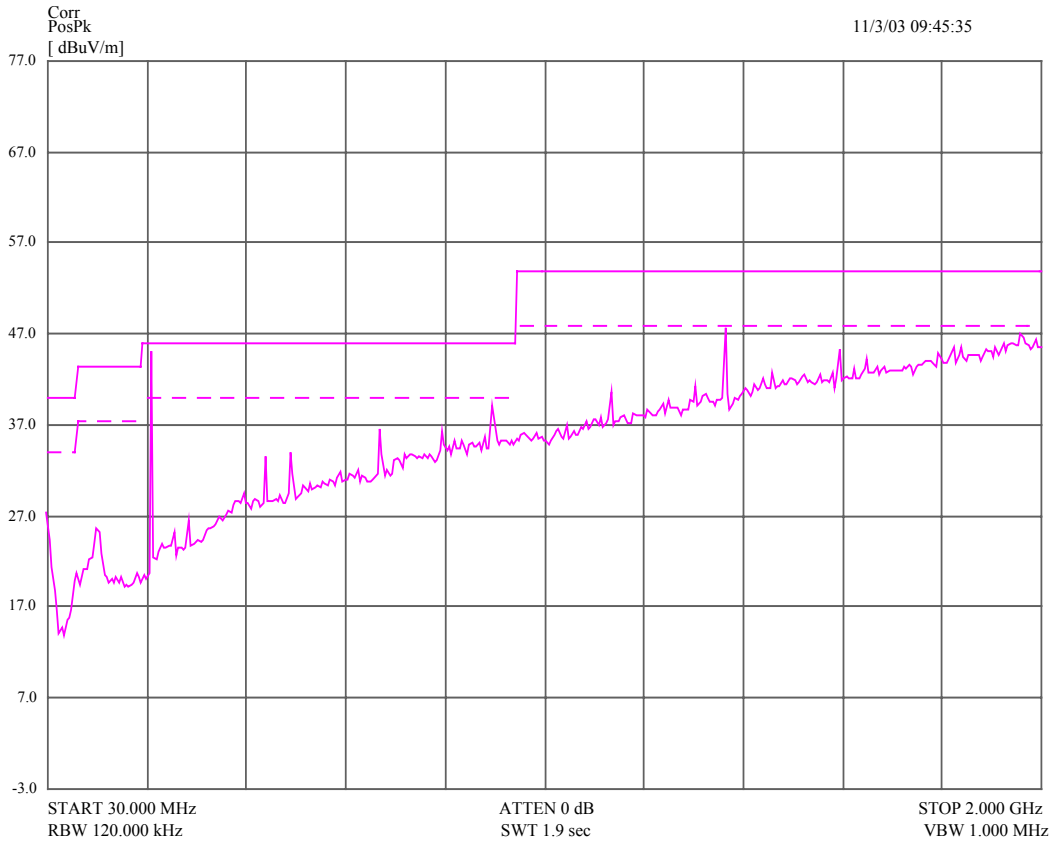
throughout the band may be seen below. In this graph the magnitude of the largest signal is plotted for the configuration that produced the largest signal.

**Spectrum graph from 30 MHz to 2300 MHz**

**horizontal polarization**




**vertical polarization**




## 8.4 Test results

**Receiver 72 MHz – 76 MHz, Channel 9E,**
**Transmitter 216 MHz – 217 MHz is turned Off**

**Test Specifications**

| | |
|---|---|
| Specification: | ANSI C63.4: 2000 |
| Title: | 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. |
| Specification: | FCC 47 CFR, Part 15.109, class B: 2003 |
| Title: | Code of Federal Regulations, Telecommunication |
| Specification: | JMR Work Procedure W090-5206 |
| Title: | Radiated Emission Test |

**Radiated Emissions Test Results**

Measurements expanded uncertainty equals 3.26 dB with 95% confidence level.
Room Ambient Temperature: 20°C±1°C
Relative Humidity: 57%±5%

Below are the Quasi-Peak and Avg. readings of the highest value signals observed throughout the 30 MHz to 1000 MHz frequency range.

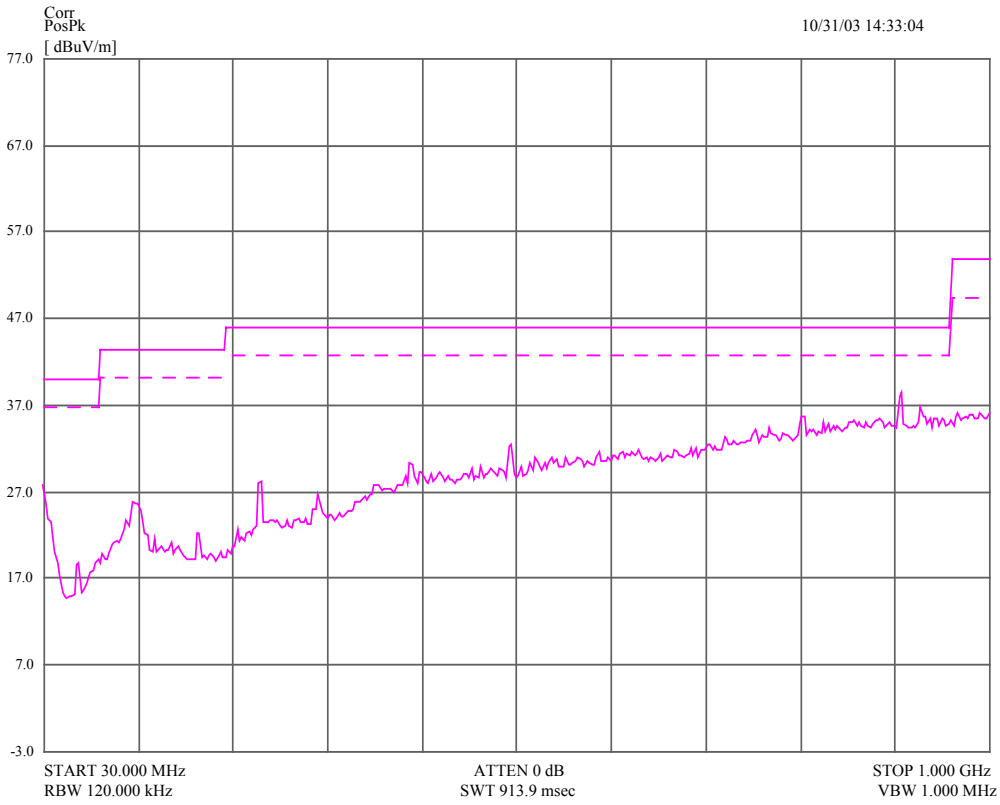
| Frequency MHz | QP dBuV/m | QP Lmt dBuV/m | DelLim-QP dB | Pol | Hgt cm | Angle deg | Status |
|---|---|---|---|---|---|---|---|
| 61.376000 | 19.25 | 40.00 | -20.75 | Vert | 95 | 18 | PASS |
| 119.918000 | 22.85 | 43.50 | -20.65 | Vert | 168 | 42 | PASS |
| 123.498000 | 21.69 | 43.50 | -21.81 | Horz | 132 | 183 | PASS |
| 245.500000 | 24.33 | 46.00 | -21.67 | Horz | 148 | 17 | PASS |
| 501.179008 | 27.11 | 46.00 | -18.89 | Horz | 137 | 131 | PASS |

A horizontal and vertical polarization spectrum traces of the magnitude of all the signals

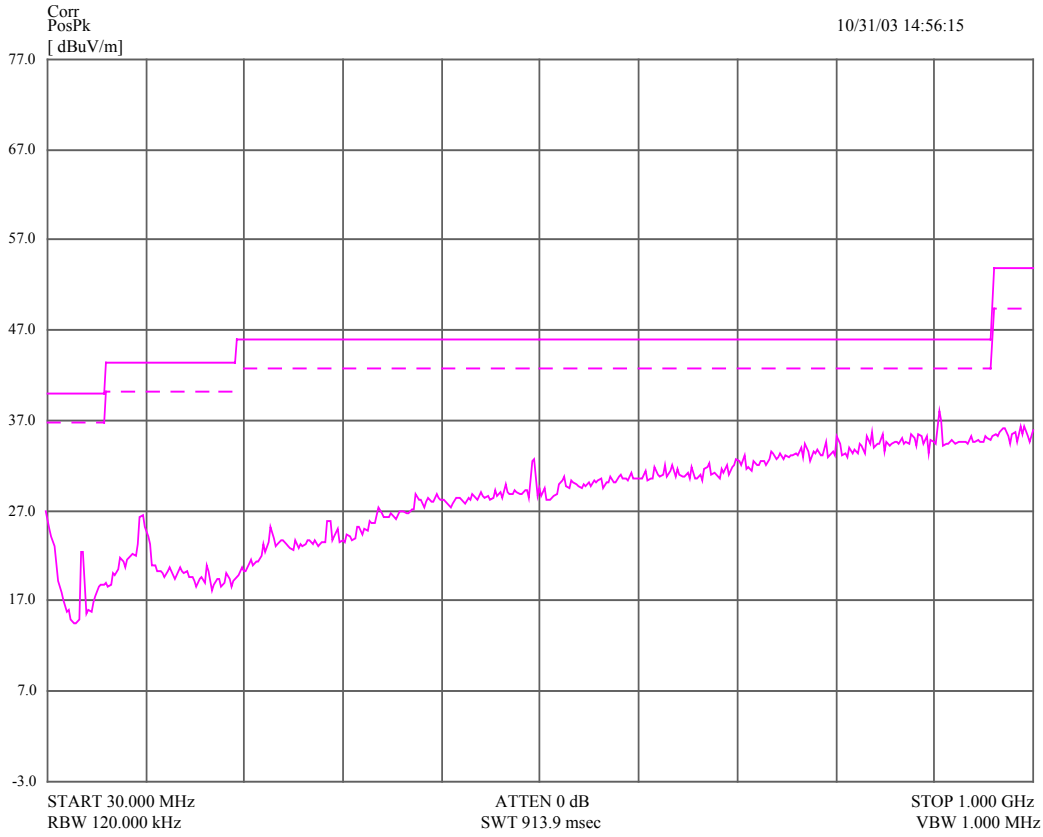
throughout the band may be seen below. In this graph the magnitude of the largest signal is plotted for the configuration that produced the largest signal.

**Spectrum graph from 30 MHz to 1000 MHz**

**horizontal polarization**



## vertical polarization

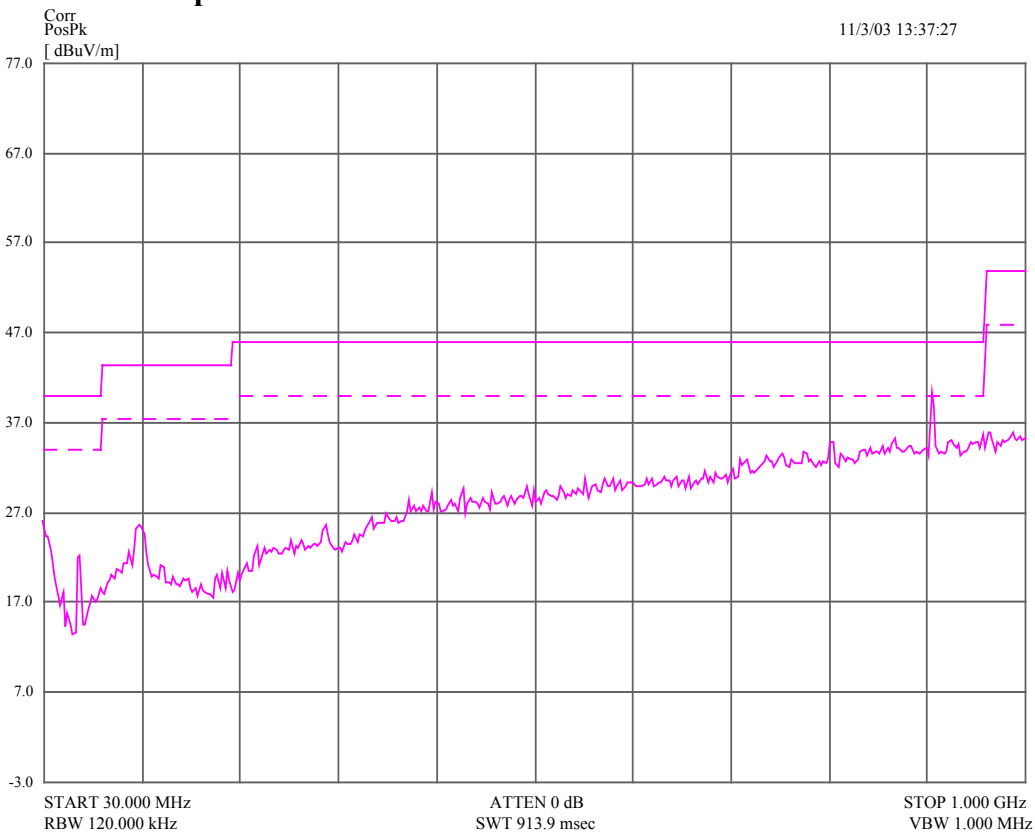


## 8.5 Test results
**IR Multiple channels Receiver , Channel 94,**
**Transmitter 216 MHz – 217 MHz is turned Off**

In this graph the magnitude of the largest signal is plotted for the configuration that produced the largest signal at 3m distance between the EUT and receiving antenna.

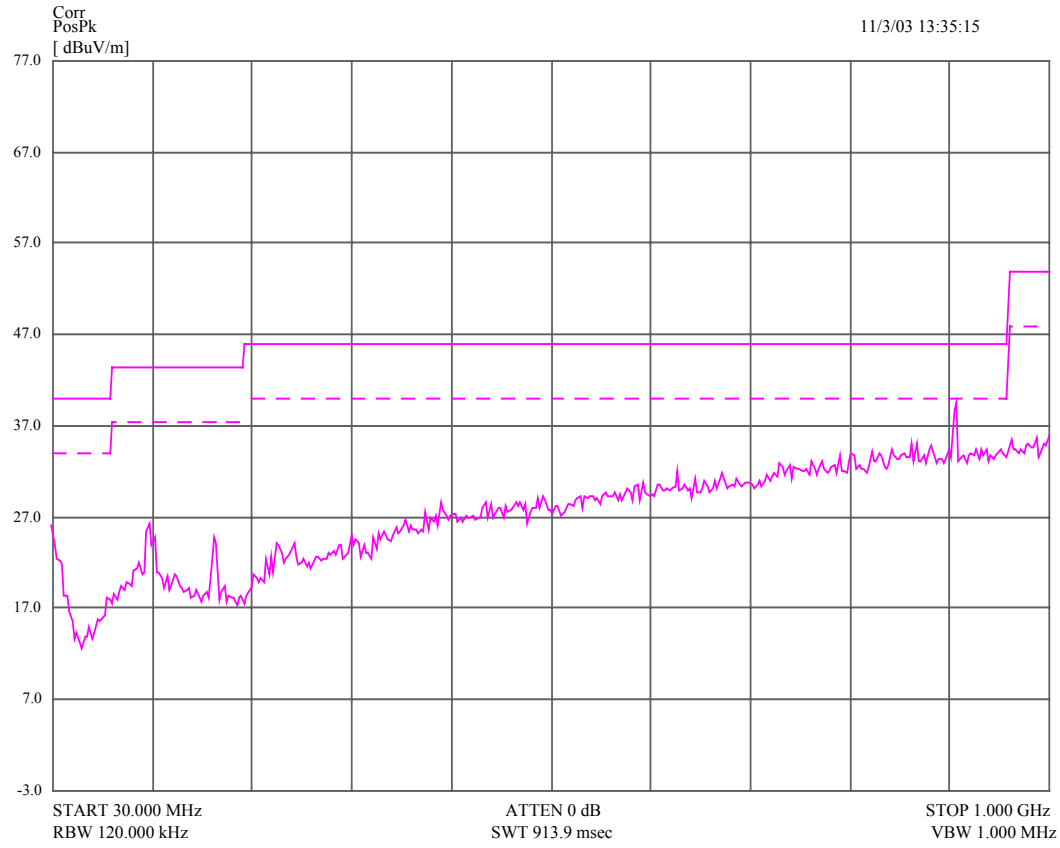
**Spectrum graph from 30 MHz to 1000 MHz**

**horizontal polarization**




The test results are depicted by the spectrum graph above show that there is no data of spurious emission to measure

**Vertical polarization**



## 9.0 Frequency stability

Type of Test : Frequency stability
FCC Part 95 : Subclause 95.629 (c ) (2)
**FCC Part 2 : Subclause 2.1055 (a) (1)**
**FCC Part 2 : Subclause 2.1055 (d) (1))**

**Limit requirement : LPRS transmitters operating on standard band channels must be maintained within a frequency stability of 50 parts per million.**

The **FREQUENCY STABILITY TEST** was done :

1) with variation of ambient temperature from -30° to +50° centigrade ;
2) with variation primary supply voltage from 85 to 115 percent of the nominal AC and DC value

for the selected standard channel 61.

Room Ambient Temperature: 21°C±1°C.
Relative Humidity: 47%±5%.
The thermocouple was installed on the enclosure of the EUT. Variation of ambient temperature was performed by Temperature's Ingogo Oven. The Carrier frequency was measured by HP85462A Spectrum Analyzer.
Variation of primary power supply was performed by BEHLMAN's Power Test Station. Variation of DC power supply was performed by SORENSEN's power supply.

### 9.1. Variation of ambient temperature
**Channel 61 , Fcarrier (Fc) = 216.5125 MHz**

| Temperature Measured ° C | Frequency measured Fm MHz | Frequency tolerance ΔF=Fm-Fc kHz | Frequency Stability Limit,Flim KHz | Status |
|---|---|---|---|---|
| -30 | 216.514592 | 2.09 | 10.83 | PASS |
| -20 | 216.514400 | 2.15 | 10.83 | PASS |
| -10 | 216.514352 | 2.10 | 10.83 | PASS |
| 0 | 216.514208 | 1.96 | 10.83 | PASS |
| 10 | 216.513696 | 1.45 | 10.83 | PASS |
| 20 | 216.512928 | 0.68 | 10.83 | PASS |
| 30 | 216.512576 | 0.33 | 10.83 | PASS |
| 40 | 216.511872 | -0.38 | 10.83 | PASS |
| 50 | 216.511328 | -0.92 | 10.83 | PASS |

## 9.3. Variation of primary supply voltage
## Channel 61 , Fcarrier (Fc) = 216.5125 MHz

| Primary AC supply Voltage V | Frequency measured Fm MHz | Frequency tolerance ΔF=Fm-Fc kHz | Frequency stability Limit,Flim +/-kHz | Status |
|---|---|---|---|---|
| 93.5 | 216.513104 | 0.854 | 10.83 | PASS |
| 110 | 216.513104 | 0.854 | 10.83 | PASS |
| 126.5 | 216.513104 | 0.854 | 10.83 | PASS |

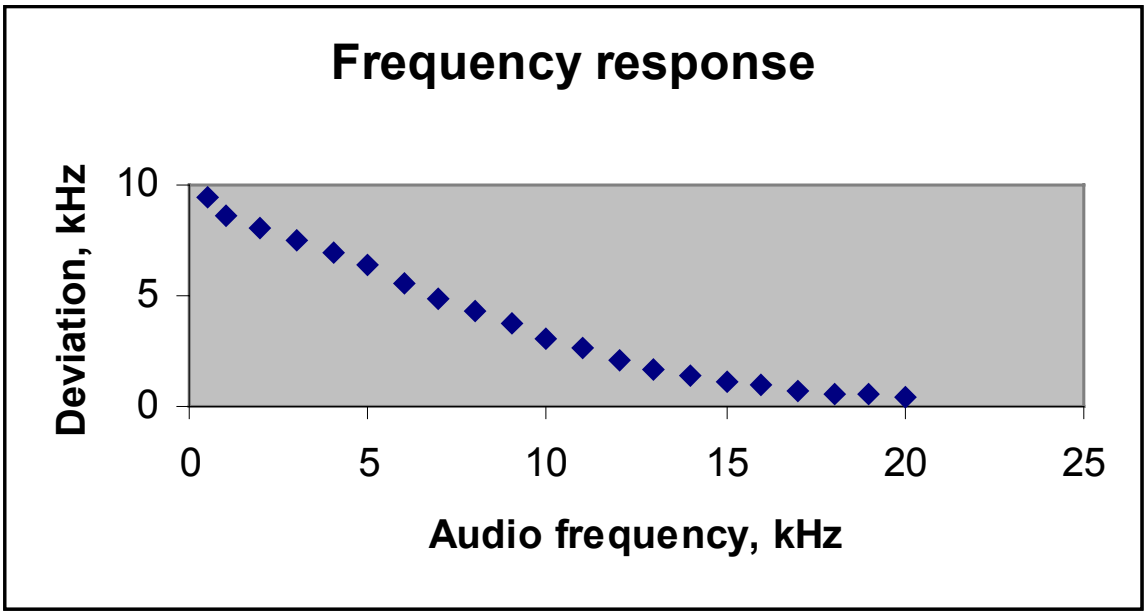
| Primary DC supply Voltage V | Frequency measured Fm MHz | Frequency tolerance ΔF=Fm-Fc kHz | Frequency stability Limit,Flim +/-kHz | Status |
|---|---|---|---|---|
| 10.2 | 216.513104 | 0.854 | 10.83 | PASS |
| 12 | 216.513104 | 0.854 | 10.83 | PASS |
| 13.8 | 216.513104 | 0.854 | 10.83 | PASS |

## 10.0 Frequency response

**Type of Test :** **Audio frequency response**
**FCC Part 95 :** **Subclause 95.633 (d ) (2)**
**FCC Part 2 :** **Subclause 2.1047 (a)**

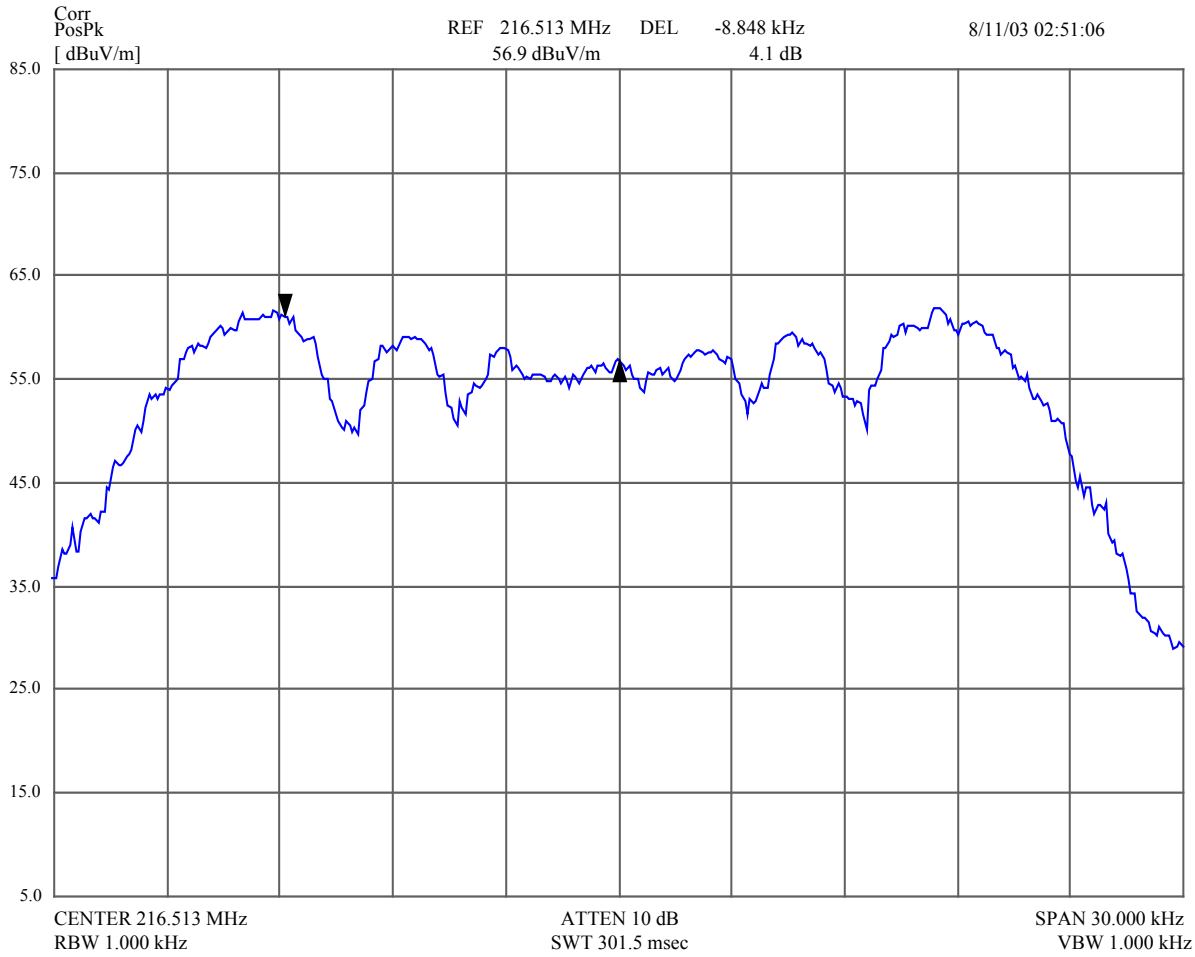
**Below is a data and spectrum graph showing the frequency response of the audio modulating circuit of the EUT over a range of 0.5 kHz to 20 kHz measured with the IFR 1500A Communication Analyzer.**

| Audio frequency kHz | Deviation +/- kHz |
|---|---|
| 0.5 | 9.42 |
| 1.0 | 8.65 |
| 2.0 | 8.04 |
| 3.0 | 7.52 |
| **4.0** | **6.95** |
| 5.0 | 6.34 |
| 6.0 | 5.49 |
| 7.0 | 4.91 |
| 8.0 | 4.30 |
| 9.0 | 3.72 |
| 10.0 | 3.12 |
| 11.0 | 2.60 |
| 12.0 | 2.13 |
| 13.0 | 1.73 |
| 14.0 | 1.40 |
| 15.0 | 1.12 |
| 16.0 | 0.91 |
| 17.0 | 0.73 |
| 18.0 | 0.61 |
| 19.0 | 0.51 |
| 20.0 | 0.42 |

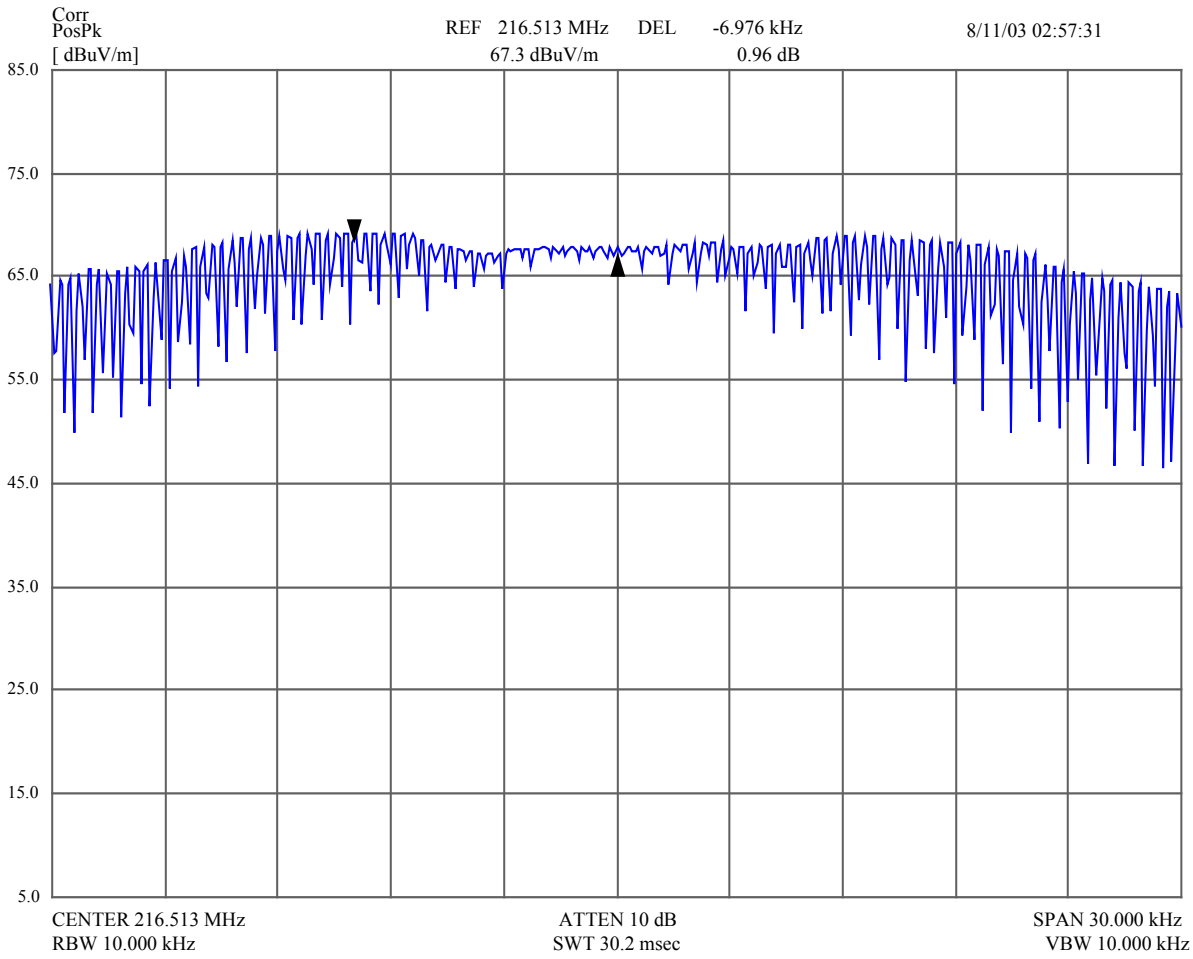



**Audio modulation frequency 4.0 kHz should be accepted as the Maximum modulation frequency.**

**Below is the spectrum graph, Fmod = 1 kHz**



**Below is the spectrum graph,**
**Fmod = 4.0 kHz that is the maximum modulation frequency**



## 11.0 FCC Designation of emission for the EUT

**Type of Test :** **Necessary bandwidth**
**FCC Part 2 :** **Subclause 2.202 (a)**

**Bn = 2M + 2DK , where**

Bn - Necessary bandwidth in hertz;
M - Maximum modulation frequency in hertz;
D - Peak frequency deviation;
K - An overall numerical factor that equal 1 for FM Sound Broadcasting

**For the EUT** :
M = 4000 Hz
D = 9420 Hz

**Necessary bandwidth calculated Bn is**

Bn = 2x4000 + 2x9420x1 = 26840 Hz

**Designation of emission is 26K8F3E**

## 12.0 FCC Labeling requirements

**Type of Test :** **Labeling requirements**
**FCC Part 95 :** **Subclause 95.1017**
**FCC Part 95 :** **Subclause 95.1015**

**1. Each LPRS transmitting device shall bear the following statement in a conspicuous location on the device :**

| |
|---|
| "This device may not interfere with TV reception or federal government radar, and must accept any interference received, including interference that may cause undesired operation." |

**2. Manufacturers of LPRS transmitters used for auditory assistance, health care assistance and law enforcement tracking purposes must include with each transmitting device the following statement :**

"This transmitter is authorized by rule under the Low Power Radio Service (47 C.F.R. Part 95) and must not cause harmful interference to TV reception or United States Navy SPASUR installations. You don't need a FCC license to operate this transmitter. This transmitter may only be used to provide : auditory assistance to persons who require language translation, or person in educational settings; health care services to ill. Two-way voice communications and all other types of uses not mentioned above are expressly prohibited"