UltraTech
Group of Labs

July 18, 2001

**FEDERAL COMMUNICATIONS COMMISSION**
7435 Oakland Mills Road
Columbia, MD 21046
USA

**Subject:** **Type Acceptance Application under FCC CFR 47, Parts 2 and 90 (Subpart I) - Non-Broadcast Radio Transmitters Operating in the frequency bands 2450-2483.52 MHz.**

**Applicant:** **K&A Wireless, LLC**
**Product:** **VideoBlaster**
**Model:** **VBLAST2400**
**FCC ID:** **OPH-VBLAST2400**

Dear Sir/Madam,

As appointed agent for **K&A Wireless, LLC**, we would like to submit the application to Federal Communications Commission for certification of the above product. Please review all necessary files uploaded to FCC OET site.

If you have any queries, please do not hesitate to contact us by our TOLL FREE number:

OUR TELEPHONE NO.: 1-877-765-4173

Yours truly,

Tri Minh Luu, P. Eng.,
V.P., Engineering

TML/DH

Encl.

3000 Bristol Circle,
Oakville, Ontario, Canada
L6H 6G4

Telephone (905) 829-1570
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UltraTech
Group of Labs

July 18, 2001

**K&A Wireless, LLC**
2617 Juan Tabo, NE, Suite A
Albuquerque, NM
USA, 87112

**Attn.:** **Mr. Kamil Agi**

**Subject:** **Certification Testing in accordance with FCC CFR 47, Parts 2 and 90 (Subpart I) - Non-Broadcast Radio Transmitters Operating in the frequency bands 2450-2483.52 MHz.**

**Product:** **VideoBlaster**
**Model:** **VBLAST2400**
**FCC ID:** **OPH-VBLAST2400**

Dear Mr.Agi,

The product sample has been tested in accordance with **FCC CFR 47, Parts 2 and 90 (Subpart I) - Non-Broadcast Radio Transmitters Operating in the frequency bands 2450-2483.52 MHz,** and the results and observation were recorded in the engineering report, Our File No.: K&A-001F90

Enclosed you will find copy of the engineering report. If you have any queries, please do not hesitate to contact us.

Yours truly,

Tri Minh Luu, P.Eng
Vice President - Engineering

Encl.

3000 Bristol Circle,
Oakville, Ontario, Canada
L6H 6G4

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# ENGINEERING TEST REPORT

## VideoBlaster
## Model No.: VBLAST2400
## FCC ID: OPH-VBLAST2400

*Applicant:* **K&A Wireless, LLC**
*2617 Juan Tabo, NE, Suite A*
*Albuquerque, NM*
*USA, 87112*

***Tested in Accordance With***

**Federal Communications Commission (FCC)**
**CFR 47, PARTS 2 and 90 (Subpart I)**
**Operating Frequency Band: 2450 – 2483.52 MHz**

**UltraTech's File No.: K&A-001F90**

This Test report is Issued under the Authority of
Tri M. Luu, Professional Engineer,
Vice President of Engineering
UltraTech Group of Labs

Date: July 20, 2001

| | |
|---|---|
| Report Prepared by: Tri M. Luu, P.Eng. | Tested by: Mr. Wayne Wu, EMI/EMC Engineer |
| Issued Date: July 18, 2001 | Test Dates: July 06 -09, 2001 |

*The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*


**UltraTech**

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**Website: www.ultratech-labs.com Email: vhk.ultratech@sympatico.ca**

# TABLE OF CONTENTS

# EXHIBIT 1. SUBMITTAL CHECK LIST

| Annex No. | Exhibit Type | Description of Contents | Quality Check |
|---|---|---|---|
| -- | Test Report | • Exhibit 1: Submittal check lists<br>• Exhibit 2: Introduction<br>• Exhibit 3: Performance Assessment<br>• Exhibit 4: EUT Operation and Configuration during Tests<br>• Exhibit 5: Summary of test Results<br>• Exhibit 6: Measurement Data<br>• Exhibit 7: Measurement Uncertainty<br>• Exhibit 8: Measurement Methods | |
| 1 | Test Report - Plots of Measurement Data | Plots # 1to 18 | |
| 2 | Test Setup Photos | Photos # 1 to 3 | |
| 3 | External Photos of EUT | Photos # 1 to 3 | |
| 4 | Internal Photos of EUT | Photos of 1 to 10 | |
| 5 | Cover Letters | • Letter from Ultratech for Certification Request<br>• Letter from the Applicant to appoint Ultratech to act as an agent<br>• Letter from the Applicant to request for Confidentiality Filing | OK<br>OK<br>OK |
| 6 | Attestation Statements | • Manufacturer's Declaration for Equipment Specifications, Installation (if it is professionally installed) and Production Quality Production Assurance. | N/A |
| 7 | ID Label/Location Info | ID Label<br>Location of ID Label | |
| 8 | Block Diagrams | Block diagram # 1 of 1 | |
| 9 | Schematic Diagrams | Schematic diagram # 1 of 1 | OK |
| 10 | Parts List/Tune Up Info | | |
| 11 | Operational Description | | |
| 12 | RF Exposure Info | | |
| 13 | Users Manual | Users Manual | OK |

# EXHIBIT 2. INTRODUCTION

## 2.1. SCOPE

| | |
|---|---|
| **Reference:** | FCC Parts 2 and 90 |
| **Title:** | Telecommunication - Code of Federal Regulations, CFR 47, Parts 2 & 90 |
| **Purpose of Test:** | To gain FCC Certification Authorization for Radio operating in the frequency bands 2450-2483.52 MHz . |
| **Test Procedures:** | Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute 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. |

## 2.2. RELATED SUBMITAL(S)/GRANT(S)

None

## 2.3. NORMATIVE REFERENCES

| Publication | Year | Title |
|---|---|---|
| FCC CFR Parts 0-19, 80-End | 1999 | Code of Federal Regulations – Telecommunication |
| ANSI C63.4 | 1992 | 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 |
| CISPR 22 & EN 55022 | 1997 1998 | Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment |
| CISPR 16-1 | | Specification for Radio Disturbance and Immunity measuring apparatus and methods |

# EXHIBIT 3. PERFORMANCE ASSESSMENT

## 3.1. CLIENT INFORMATION

| APPLICANT | |
|---|---|
| **Name:** | K&A Wireless, LLC |
| **Address:** | 2617 Juan Tabo, NE, Suite A<br>Albuquerque, NM<br>USA, 87112 |
| **Contact Person:** | Mr. Kamil Agi<br>Phone #: 505-338-2380<br>Fax #: 505-338-2380<br>Email Address: kagi@ka-wireless.com |

| MANUFACTURER | |
|---|---|
| **Name:** | K&A Wireless, LLC |
| **Address:** | 2617 Juan Tabo, NE, Suite A<br>Albuquerque, NM<br>USA, 87112 |
| **Contact Person:** | Mr. Kamil Agi<br>Phone #: 505-338-2380<br>Fax #: 505-338-2380<br>Email Address: kagi@ka-wireless.com |

## 3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

| | |
|---|---|
| **Brand Name:** | K&A Wireless, LLC |
| **Product Name:** | VideoBlaster |
| **Model Name or Number:** | VBLAST2400 |
| **Serial Number:** | Pre-production |
| **Type of Equipment:** | Non-broadcast Radio Communication Equipment |
| **External Power Supply:** | 6 Vdc battery |
| **Transmitting/Receiving Antenna Type:** | Non-integral Omni-directional, board-mounted disk antenna, Gain = 4 dBi nominal |
| **Primary User Functions of EUT:** | This modular radio transmitter is an FM video transmitter. It is integrated into the OEM Camera for Professional uses.<br><br>The installation for this radio transmitter and its antenna into the FM Video camera is instructed by K&A Wireless in the way that its distance from the radio and antenna to the user's body and head no less than 4 cm for compliance with SAR limits for general uses. |

## 3.3. EUT'S TECHNICAL SPECIFICATIONS

| TRANSMITTER | |
|---|---|
| **Equipment Type:** | [X] Portable<br>[ X] Mobile |
| **Intended Operating Environment:** | [X] Commercial |
| **Power Supply Requirement:** | 6Vdc Alkaline battery |
| **RF Output Power Rating:** | 28.5 dBm average (conducted)<br>35.4 dBm peak EIRP |
| **Operating Frequency Range:** | 2450-2483.52 MHz |
| **Number of Channel** | 2 channels (2459 MHz and 2475 MHz) |
| **RF Output Impedance:** | 50 Ohms |
| **Channel Spacing:** | 16 MHz |
| **Occupied Bandwidth (99%):** | 4 MHz |
| **Emission Designation*:** | 4M4F3F |
| **Antenna Connector Type:** | Non-integral Omni-directional, board-mounted disk antenna, Gain = 4 dBi nominal |

## 3.4. LIST OF EUT'S PORTS

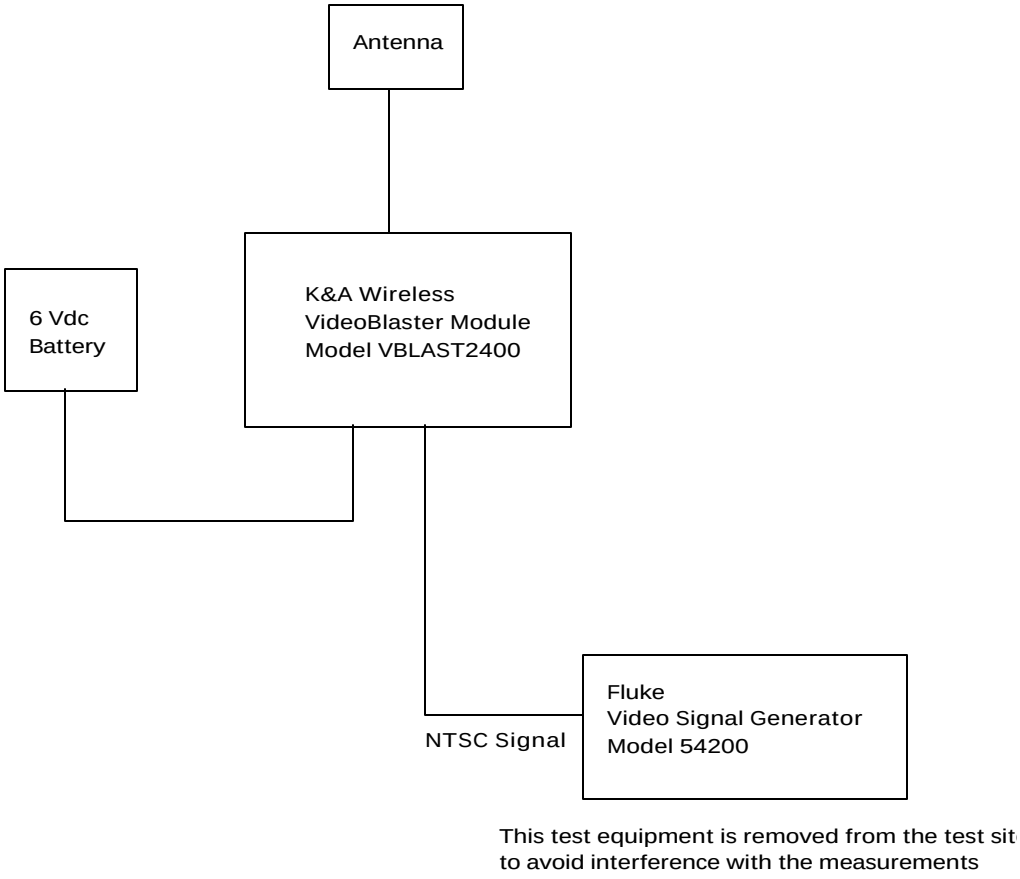
| Port Number | EUT's Port Description | Number of Identical Ports | Connector Type | Cable Type (Shielded/Non-shielded) |
|---|---|---|---|---|
| 1 | RF Output port | 1 | SMA | Shielded 50 Ohm coaxial |
| 2 | Video input port | 1 | BNC | 75 Ohm coaxial |
| 3 | DC input port | 1 | Permanently soldered wireleads | Non-shielded |

## 3.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

| **Ancillary Equipment # 1** | |
|---|---|
| Description: | Video Signal Generator |
| Brand name: | Fluke |
| Model Name or Number: | 54200 |
| Serial Number: | 75 Ohm Coaxial |
| Connected to EUT's Port: | Video (NTSC) input |

## 3.6. BLOCK DIAGRAM OF TEST SETUP



# EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

## 4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

| | |
|---|---|
| Temperature: | 21°C |
| Humidity: | 51% |
| Pressure: | 102 kPa |
| Power input source: | 6Vdc Alkaline battery |

## 4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

| | |
|---|---|
| **Operating Modes:** | The transmitter was operated in a continuous transmission mode with the carrier FM modulated with an external NTSC video signal |
| **Special Test Software:** | None |
| **Special Hardware Used:** | None |
| **Transmitter Test Antenna:** | The EUT is tested with the transmitter antenna port connected to its antenna |

| **Transmitter Test Signals** | |
|---|---|
| **Frequency Band(s):**<br><br>2450 – 2483.52 MHz band: | Near lowest, near middle & near highest frequencies in each frequency bands that the transmitter covers:<br><br>2459 & 2475 MHz |
| **Transmitter Wanted Output Test Signals:**<br><br>RF Power Output<br>(measured maximum output power):<br><br>Normal Test Modulation<br><br>Modulating signal source: | <br><br><br>28.5 dBm (conducted)<br><br>Video NTSC<br><br>external |

# EXHIBIT 5. SUMMARY OF TEST RESULTS

## 5.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 16'(L) by 12'(W) by 12'(H).

- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

  The above sites have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: May 02, 2001.

## 5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

| FCC PARAGRAPH. | TEST REQUIREMENTS | APPLICABILITY (YES/NO) |
|---|---|---|
| **90.205 & 2.1046** | RF Power Output | Yes |
| **1.1307, 1.1310, 2.1091 & 2.1093** | RF Exposure Limit | Yes |
| **90.213 & 2.1055** | Frequency Stability | Yes |
| **90.242(b)(8) & 2.1047(a)** | Audio Frequency Response | Not applicable |
| **90.210 & 2.1047(b)** | Modulation Limiting | Not applicable |
| **90.209 90.210 & 2.1049** | Emission Limitation & Emission Mask | Yes |
| **90.210, 2.1057 & 2.1051** | Emission Limits - Spurious Emissions at Antenna Terminal | Yes |
| **90.210, 2.1057 & 2.1053** | Emission Limits - Field Strength of Spurious Emissions | Yes |
| **VideoBlaster**, **Model No.: VBLAST2400**, by **K&A Wireless, LLC** has also been tested and found to comply with **FCC Part 15, Subpart B - Radio Receivers and Class B Digital Devices**. The engineering test report has been documented and kept in file and it is available anytime upon FCC request. | | |

## 5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

## 5.4. DEVIATION OF STANDARD TEST PROCEDURES

None

# EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

## 6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report

## 6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

## 6.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4:1992 and CISPR 16-1.

## 6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER:

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

# 6.5. RF POWER OUTPUT @ FCC 2.1046 & 90.205

## 6.5.1. Limits @ FCC 90.205(l)

The maximum transmitter power is 5 Watts.

## 6.5.2. Method of Measurements

Refer to Exhibit 8, § 8.1 (Conducted) & 8.2 (Radiated) of this report for measurement details

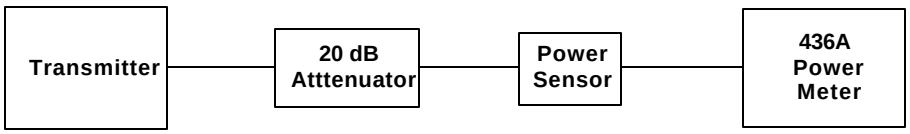
- *The transmitter terminal was coupled to the power meter through a 20 dB attenuator*
- *Power of the transmitter channel near the lowest, middle and highest of each frequency block/band were measured using the power meter, and the reading was corrected by added the calibrated attenuator's attenuation value and cable loss.*
- *The RF Output was turned on with standard modulation applied.*

## 6.5.3. Test Equipment List

| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range |
|---|---|---|---|---|
| Spectrum Analyzer/ EMI Receiver | Hewlett Packard | HP 8546A | … | 9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors. |
| RF Amplifier | Com-Power | PA-102 | | 1 MHz to 1 GHz, 30 dB gain nomimal |
| Horn Antenna | EMCO | 3155 | 9701-5061 | 1 GHz – 18 GHz |
| Horn Antenna | EMCO | 3155 | 9911-5955 | 1 GHz – 18 GHz |
| RF Signal Generator | Hewlett Packard | HP 83752B | 3610A00457 | 0.01 – 20 GHz |

## 6.5.4. Test Arrangement

Power at RF Power Output Terminals




For ERP test arrangement, refer to section 8.1 of this test report for details

## 6.5.5. Test Data

### Conducted Power

| Transmitter Channel Output | Fundamental Frequency (MHz) | Measured (Average) Power (dBm) | Power Rating (dBm) |
|---|---|---|---|
| Channel #1 | 2459 | 27.6 | 37.0 |
| Channel #2 | 2475 | 28.5 | 37.0 |

### ERP Using Substitution Method

| Frequency (MHz) | Peak E-Field @ 3m (dBµV/m) | Antenna Polarization (V/H) | Peak Power From Signal GEN. Ps (dBm) | Substitution Antenna Gain G (dBi) | Measured Peak ERP = Ps+G-2.15 (dBm) | Measured Peak EIRP = Ps+G (dBm) |
|---|---|---|---|---|---|---|
| 2459 | 128.2 | V | 26.2 | 9.2 | 33.3 | 35.4 |
| 2459 | 128.1 | H | 24.9 | 9.2 | 32.0 | 34.1 |
| 2475 | 127.9 | V | 25.8 | 9.2 | 32.9 | 35.0 |
| 2475 | 128.1 | H | 25.2 | 9.2 | 32.3 | 34.4 |

## 6.6. RF EXPOSURE REQUIRMENTS @ 1.1310 & 2.1091

| Evaluation of RF Exposure Compliance Requirements | |
|---|---|
| **RF Exposure Requirements** | **Compliance with FCC Rules** |
| SAR Tests for Portable Transmitters<br>• Body Tissue | • Comply with SAR limits with body tissue with the distance of 4 cm from the EUT and its antenna to the phantom [ Page # 3 of Installation Manual specifies the minimum RF Exposure Distance], please refer to SAR test report. |
| • Brain Tissue | • Page 10 of the Installation Manual specifies that the typical distance from the transmitter's antenna to head is about 13 inches. With this distance, the SAR value is not measurable, please refer to SAR test report |
| Installation instruction of the EUT and its antenna to OEM manufacturer for compliance with FCC SAR limits (1.6 W/Kg) for General Un-controlled Uses. | Please refer to page # 3 and 10 of the Installation Manual for installation instruction of the radio and its antenna for compliance with SAR requirements for general uses. |

# 6.7. FREQUENCY STABILITY @ FCC 2.1055 & 90.213

## 6.7.1. Limits @ FCC 90.213

The frequency stability will be specified in the station authorization.

## 6.7.2. Method of Measurements

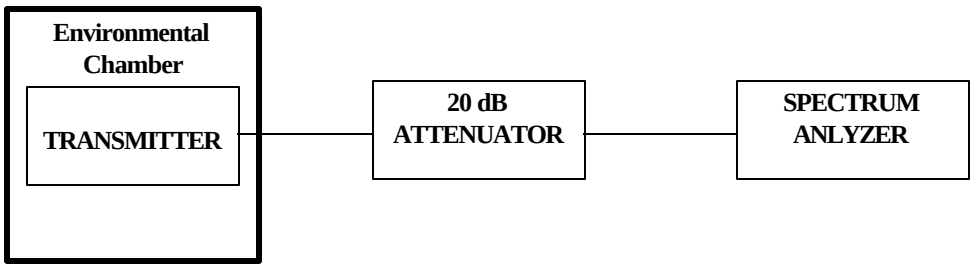
Refer to Exhibit 8, § 8.3 of this report for measurement details.

The frequency stability will be specified in the station authorization. For the purpose of compliance, the carrier frequency stability will be checked for out-of-band emissions at room temperature (20°C) and extreme temperatures (-30°C and +50°C).

## 6.7.3. Test Equipment List

| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range |
|---|---|---|---|---|
| Spectrum Analyzer/ EMI Receiver | Hewlett Packard | HP 8593EM | 3412A00103 | 9 kHz – 26.5 GHz |
| Attenuator(s) | Bird | .. | … | DC – 22 GHz |
| Temperature & Humidity Chamber | Tenney | T5 | 9723B | -40° to +60 ° C range |

## 6.7.4. Test Arrangement




## 6.7.5. Test Data

Conforms. At room temperature (20°C) and extreme temperature (-30°C and +50°C) conditions, the carrier frequencies were found to remain within the FCC permitted band 2450-2483.52 MHz. Please refer to Plots # 3 to 8 in Annex 1 for detailed measurements.

# 6.8. EMISSION MASK @ FCC 2.1049, 90.208 & 90.210

## 6.8.1. Limits @ FCC 90.209 & 90.210

Emissions shall be attenuated below the mean output power of the transmitter as follows:

| Frequency Range (MHz) | FCC Applicable Mask |
|---|---|
| 2450-2483.52 | No emission is specified. The attenuaton of 43 + 10*log(P) in watts) outside the permitted band 2450-2483.52 MHz will be used for compliance evaluation. |

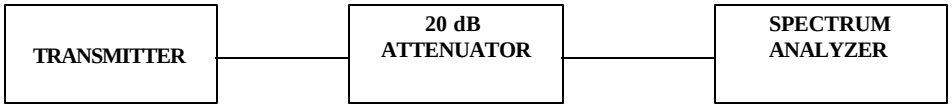
## 6.8.2. Method of Measurements

Refer to Exhibit 8, § 8.4 of this report for measurement details

## 6.8.3. Test Equipment List

| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range |
|---|---|---|---|---|
| Spectrum Analyzer/ EMI Receiver | Hewlett Packard | HP 8593EM | 3412A00103 | 9 kHz – 26.5 GHz |
| Attenuator(s) | Bird | .. | … | DC – 22 GHz |
| Audio Oscillator | Hewlett Packard | HP 204C | 0989A08798 | DC to 1.2 MHz |

## 6.8.4. Test Arrangement




## 6.8.5. Test Data

Conform. Tests were repeated at room temperature (20$^{o}$C) and extreme temperatures (-30 $^{o}$C and +50 $^{o}$C)

Please refer to Plots # 3 through # 8 in Annex 1 for Details of measurements

# 6.9. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS @ FCC 90.210

## 6.9.1. Limits @ 90.210

Emissions shall be attenuated below the mean output power of the transmitter as follows:

| FCC Rules | Frequency Range | Attenuation Limit (dBc) |
|---|---|---|
| 90.210 | 10 MHz to Lowest frequency of the radio to 10th harmonic of the highest frequency of the radio | 43+10*log(P in Watts) |

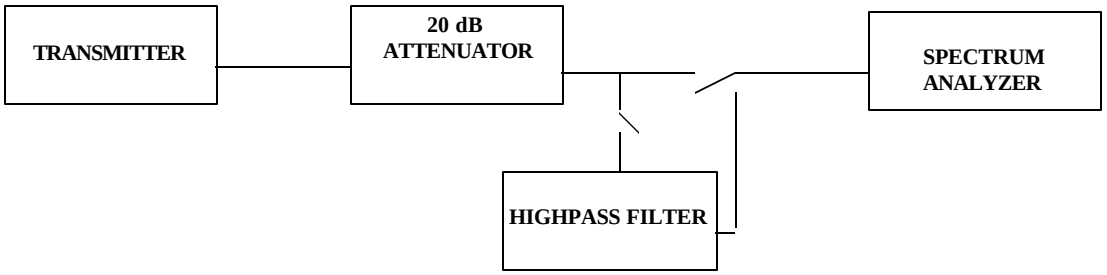
## 6.9.2. Method of Measurements

Refer to Exhibit 8 § 8.5 of this report for measurement details

## 6.9.3. Test Equipment List

| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range |
|---|---|---|---|---|
| Spectrum Analyzer/ EMI Receiver | Hewlett Packard | HP 8593EM | 3412A00103 | 9 kHz – 26.5 GHz |
| Attenuator(s) | Bird | .. | … | DC – 22 GHz |
| Audio Oscillator | Hewlett Packard | HP 204C | 0989A08798 | DC to 1.2 MHz |
| Highpass Filter, Microphase | Microphase | CR220HID | IITI11000AC | Cut-off Frequency at 600 MHz, 1.3 GHz or 4 GHz |

## 6.9.4. Test Arrangement



## 6.9.5. Plots

Please refer to plots # 9 through # 14 in Annex 1 for details of measurements

## 6.9.6. Test Data

### *6.9.6.1. Channel #1 (2459 MHz)*

Fundamental Frequency: 2459 MHz
RF Output Power: 27.6 dBm (conducted)
Modulation: FM modulation with NTSC Video signal

| FREQUENCY | TRANSMITTER CONDUCTED ANTENNA EMISSIONS | | LIMIT | MARGIN | PASS/ |
|---|---|---|---|---|---|
| (MHz) | (dBm) | (dBc) | (dBc) | (dB) | FAIL |
| 516.00 | -23.6 | -51.2 | -40.6 | -10.6 | PASS |
| 1961.00 | -17.2 | -44.8 | -40.6 | -4.2 | PASS |
| 2971.00 | -18.6 | -46.2 | -40.6 | -5.6 | PASS |
| 4918.00 | -22.1 | -49.7 | -40.6 | -9.1 | PASS |

The emissions were scanned from 10 MHz to 25 GHz and all emissions within 20 dB below the limits were recorded.

### *6.9.6.2. Channel # 2 (2475 MHz)*

Fundamental Frequency: 2475 MHz
RF Output Power: 28.5 dBm (conducted)
Modulation: FM modulation with NTSC Video signal

| FREQUENCY | TRANSMITTER CONDUCTED ANTENNA EMISSIONS | | LIMIT | MARGIN | PASS/ |
|---|---|---|---|---|---|
| (MHz) | (dBm) | (dBc) | (dBc) | (dB) | FAIL |
| 509.00 | -26.4 | -54.9 | -41.5 | -13.4 | PASS |
| 1975.00 | -21.9 | -50.4 | -41.5 | -8.9 | PASS |
| 2971.00 | -22.3 | -50.8 | -41.5 | -9.3 | PASS |
| 4950.00 | -22.3 | -50.8 | -41.5 | -9.3 | PASS |

The emissions were scanned from 10 MHz to 25 GHz and all emissions within 20 dB below the limits were recorded.

# 6.10. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS @ FCC 90.210

## 6.10.1. Limits @ FCC 90.210

Emissions shall be attenuated below the mean output power of the transmitter as follows:

| FCC Rules | Frequency Range | Attenuation Limit (dBc) |
|---|---|---|
| 90.210 | 10 MHz to Lowest frequency of the radio to 10th harmonic of the highest frequency of the radio | 43+10*log(P in Watts) |

## 6.10.2. Method of Measurements

Refer to Exhibit 8, § 8.2 of this report for measurement details

## 6.10.3. Test Equipment List

| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range |
|---|---|---|---|---|
| Spectrum Analyzer/ EMI Receiver | Hewlett Packard | HP 8546A | … | 9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors. |
| RF Amplifier | Com-Power | PA-102 | | 1 MHz to 1 GHz, 30 dB gain nomimal |
| Microwave Amplifier | Hewlett Packard | HP 83017A | | 1 GHz to 26.5 GHz, 30 dB nominal |
| Biconilog Antenna | EMCO | 3142 | 10005 | 30 MHz to 2 GHz |
| Dipole Antenna | EMCO | 3121C | 8907-434 | 30 GHz – 1 GHz |
| Dipole Antenna | EMCO | 3121C | 8907-440 | 30 GHz – 1 GHz |
| Horn Antenna | EMCO | 3155 | 9701-5061 | 1 GHz – 18 GHz |
| Horn Antenna | EMCO | 3155 | 9911-5955 | 1 GHz – 18 GHz |
| RF Signal Generator | Hewlett Packard | HP 83752B | 3610A00457 | 0.01 – 20 GHz |

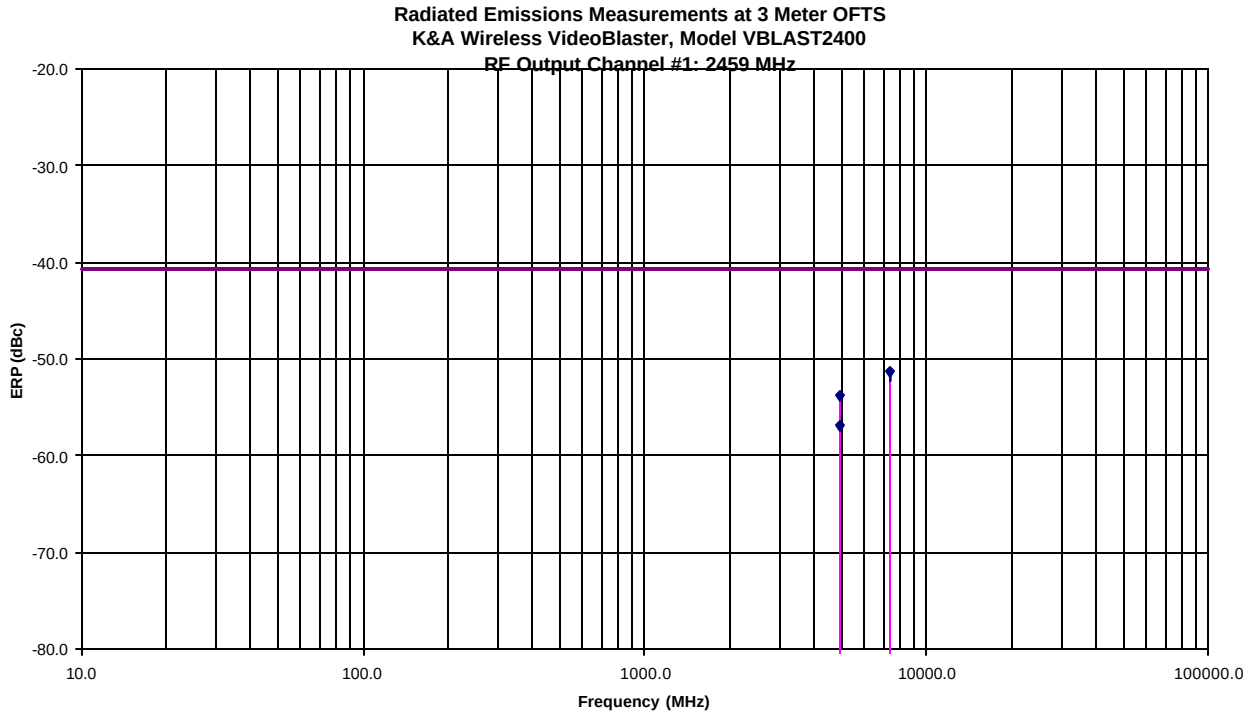
## 6.10.4. Test Data

### *6.10.4.1. Near Lowest Frequency (2459 MHz)*

| | |
|---|---|
| Fundamental Frequency: | 2459 MHz |
| RF Output Power: | 27.6dBm (conducted) |
| Modulation: | FM modulation with 2.5 kHz sine wave signal |

| FREQUENCY | ERP measured by Substitution Method | | EMI DETECTOR | ANTENNA POLARIZATION | LIMIT | MARGIN | PASS/ |
|---|---|---|---|---|---|---|---|
| (MHz) | (dBm) | (dBc) | (Peak/QP) | (H/V) | (dBc) | (dB) | FAIL |
| 2459.00 | 33.3 | -- | PEAK | V | -- | -- | PASS |
| 2459.00 | 32.0 | -- | PEAK | H | -- | -- | PASS |
| 4918.00 | -20.4 | -53.8 | PEAK | V | -40.6 | -13.2 | PASS |
| 4918.00 | -23.5 | -56.9 | PEAK | H | -40.6 | -16.3 | PASS |
| 7377.00 | -18.5 | -51.9 | PEAK | V | -40.6 | -11.3 | PASS |
| 7377.00 | -17.9 | -51.3 | PEAK | H | -40.6 | -10.7 | PASS |

The emissions were scanned from 10 MHz to 25 GHz and all emissions within 20 dB below the limits were recorded.

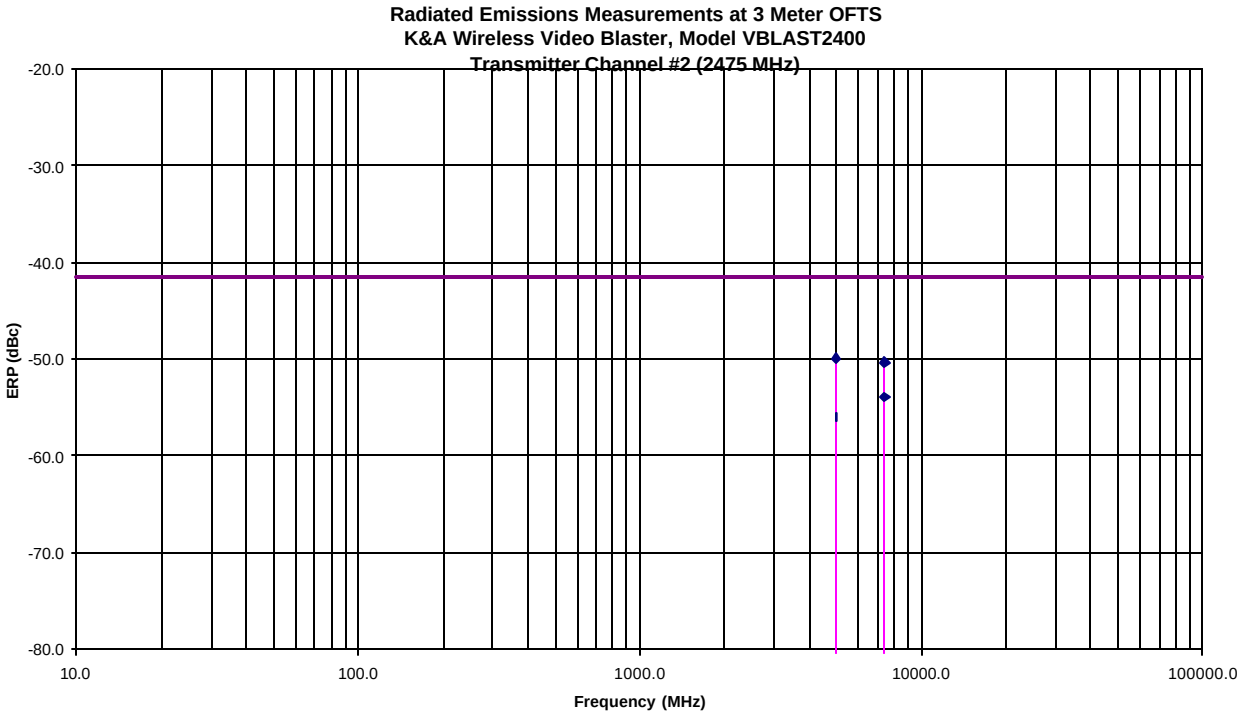


### 6.10.4.2. Near Highest Frequency (2475 MHz)

| | |
|---|---|
| Fundamental Frequency: | 2459 MHz |
| RF Output Power: | 28.5dBm (conducted) |
| Modulation: | FM modulation with 2.5 kHz sine wave signal |

| FREQUENCY | ERP measured by Substitution Method | | EMI DETECTOR | ANTENNA POLARIZATION | LIMIT | MARGIN | PASS/ |
|---|---|---|---|---|---|---|---|
| (MHz) | (dBm) | (dBc) | (Peak/QP) | (H/V) | (dBc) | (dB) | FAIL |
| 2475.00 | 32.9 | -- | PEAK | V | -- | -- | PASS |
| 2475.00 | 32.3 | -- | PEAK | H | -- | -- | PASS |
| 4950.00 | -17.0 | -49.9 | PEAK | V | -41.5 | -8.4 | PASS |
| 4950.00 | -23.0 | -55.9 | PEAK | H | -41.5 | -14.4 | PASS |
| 7425.00 | -17.4 | -50.3 | PEAK | V | -41.5 | -8.8 | PASS |
| 7425.00 | -21.0 | -53.9 | PEAK | H | -41.5 | -12.4 | PASS |

The emissions were scanned from 10 MHz to 25 GHz and all emissions within 20 dB below the limits were recorded.



# EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

## 7.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

| CONTRIBUTION (Radiated Emissions) | PROBABILITY DISTRIBUTION | UNCERTAINTY (± dB) | |
|---|---|---|---|
| | | 3 m | 10 m |
| Antenna Factor Calibration | Normal (k=2) | ±1.0 | ±1.0 |
| Cable Loss Calibration | Normal (k=2) | ±0.3 | ±0.5 |
| EMI Receiver specification | Rectangular | ±1.5 | ±1.5 |
| Antenna Directivit | Rectangular | +0.5 | +0.5 |
| Antenna factor variation with height | Rectangular | ±2.0 | ±0.5 |
| Antenna phase center variation | Rectangular | 0.0 | ±0.2 |
| Antenna factor frequency interpolation | Rectangular | ±0.25 | ±0.25 |
| Measurement distance variation | Rectangular | ±0.6 | ±0.4 |
| Site imperfections | Rectangular | ±2.0 | ±2.0 |
| Mismatch: Receiver VRC $\Gamma_1 = 0.2$<br>Antenna VRC $\Gamma_R = 0.67$(Bi) 0.3 (Lp)<br>Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$) | U-Shaped | +1.1<br><br>-1.25 | ±0.5 |
| System repeatability | Std. Deviation | ±0.5 | ±0.5 |
| Repeatability of EUT | | - | - |
| Combined standard uncertainty | Normal | +2.19 / -2.21 | +1.74 / -1.72 |
| Expanded uncertainty U | Normal (k=2) | +4.38 / -4.42 | +3.48 / -3.44 |

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k=2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

# EXHIBIT 8. MEASUREMENT METHODS

## 8.1. CONDUCTED POWER MEASUREMENTS

The following shall be applied to the combination(s) of the radio device and its intended antenna(e).

- I f the RF level is user adjustable, all measurements shall be made with the highest power level available to the user for that combination.
- The following method of measurement shall apply to both conducted and radiated measurements.

The radiated measurements are performed at the Ultratech Calibrated Open Field Test Site.
The measurement shall be performed using normal operation of the equipment with modulation.

Test procedure shall be as follows:

**Step 1**: Duty Cycle measurements if the transmitter's transmission is transient

Using a EMI Receiver with the frequency span set to 0 Hz and the sweep time set at a suitable value to capture the envelope peaks and the duty cycle of the transmitter output signal;

The duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with $0<x<1$, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.

**Step 2**: Calculation of Average EIRP. See Figure 1

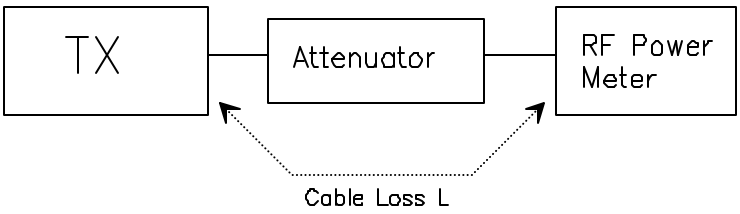
The average output power of the transmitter shall be determined using a wideband, calibrated RF average power meter with the power sensor with an integration period that exceeds the repetition period of the transmitter by a factor 5 or more. The observed value shall be recorded as "A" (in dBm);

The e.i.r.p. shall be calculated from the above measured power output "A", the observed duty cycle x, and the applicable antenna assembly gain "G" in dBi, according to the formula:

**EIRP = A + G + 10log(1/x)**

{ X = 1 for continuous transmission => 10log(1/x) = 0 dB }

**Figure 1.**



## 8.2. MEASURING THE EIRP OF SPURIOUS/HARMONIC EMISSIONS USING SUBSTITUTION METHOD

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

| | |
|---|---|
| Center Frequency: | equal to the signal source |
| Resolution BW: | 10 kHz |
| Video BW: | same |
| Detector Mode: | positive |
| Average: | off |
| Span: | 3 x the signal bandwidth |

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
E (dBuV/m) = Reading (dBuV) + Total Correction Factor (dB/m)

(c) Select the frequency and E-field levels obtained in the Section 8.2.1 for ERP/EIRP measurements.
(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):

- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
(f) Use one of the following antenna as a receiving antenna:
- DIPOLE antenna for frequency from 30-1000 MHz or
- HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
(i) Tune the EMI Receivers to the test frequency.
(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(k) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

**P = P1 - L1 = (P2 + L2) – L1 = P3 + A + L2 - L1**
**EIRP = P + G1 = P3 + L2 - L1 + A + G1**
**ERP = EIRP – 2.15 dB**
Total Correction factor in EMI Receiver # 2 = L2 – L1 + G1

Where: P: Actual RF Power fed into the substitution antenna port after corrected.
P1: Power output from the signal generator
P2: Power measured at attenuator A input
P3: Power reading on the Average Power Meter
EIRP: EIRP after correction
ERP: ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)
Repeat step (d) to (o) for different test frequency
(p) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.

(q) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port. Correct the antenna gain if necessary.:

**Figure 2**

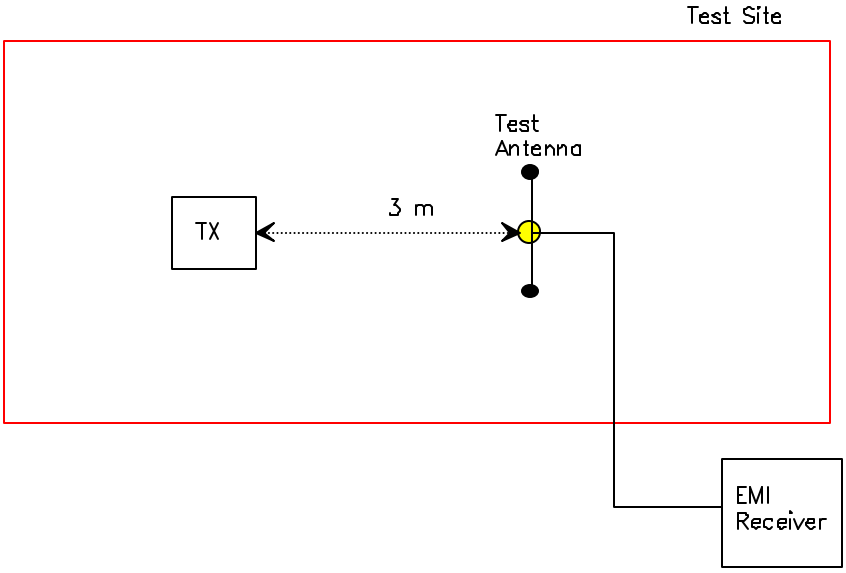
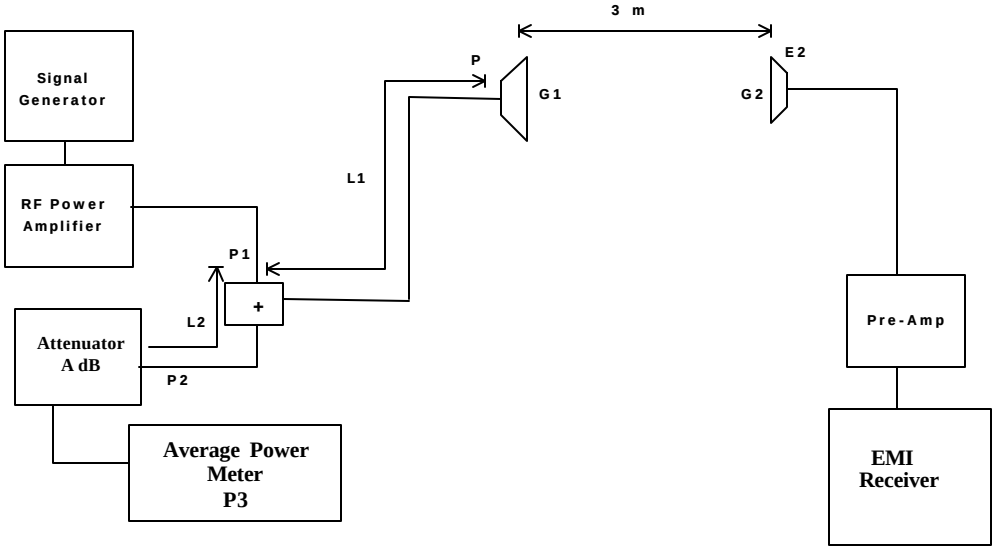



**Figure 3**



## 8.3. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade 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 stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply 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 provide 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.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).

## 8.4. EMISSION MASK

**Voice or Digital Modulation Through a Voice Input Port @ 2.1049(c)(i)**:- The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: ±2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

**Digital Modulation Through a Data Input Port @ 2.1049(h)**:- Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the Emission Masks shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

The following EMI Receiver bandwidth shall be used for measurement of Emission Mask/Out-of-Band Emission Measurements:

For 25 kHz Channel Spacing: RBW = 300 Hz
For 12.5 kHz or 6.25 kHz Channel Spacings: RBW = 100 Hz

The all cases the Video Bandwidth shall be equal or greater than the measuring bandwidth.

## 8.5. SPURIOUS EMISSIONS (CONDUCTED)

With transmitter modulation characteristics described in Out-of-Band Emissions measurements @ 2.1049, the transmitter spurious and harmonic emissions were scanned. The spurious and harmonic emissions were measured with the EMI Receiver controls set as RBW = 30 kHz minimum , VBW ≥ RBW and SWEEP TIME = AUTO). The transmitter was operated at a full rated power output, and modulated as follows:

**FCC CFR 47, Para. 2.1057 - Frequency spectrum to be investigated:-** The spectrum was investigated from the lowest radio generated in the equipment up to at least the $10^{th}$ harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

**FCC CFR 47, Para. 2.1051 - Spurious Emissions at Antenna Terminal:-** The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of the harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.