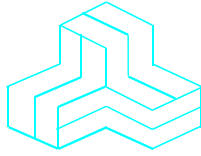


# ENGINEERING TEST REPORT



**LinkNet LNKF100 Service Module**  
**Model No.: LNKF100-A1, LNKF100-A2, LNKF100-B1, LNKF100-B2**  
**FCC ID: E675JS0083**

*Applicant:*

**Powerwave Technologies, Inc.**  
1801 East St. Andrew PL.  
Santa Ana, CA  
USA, 92705

*Tested in Accordance With*

**Federal Communications Commission (FCC)**  
**47 CFR, Parts 2 and 90**

**UltraTech's File No.: KTI-047F90**

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

Date: February 1, 2006



Report Prepared by: Dan Huynh

Tested by: Hung Trinh & Wayne Wu, EMI/RFI  
technicians

Issued Date: February 1, 2006

Test Dates: December 12-19, 2005

- The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.
- This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.

## UltraTech

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SL2-IN-E-1119R



00-034



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**EXHIBIT 1. SUBMITTAL CHECK LIST**

| Annex No. | Exhibit Type            | Description of Contents                                                                                                                                                                                                                                                                                                                                                                              | Quality Check (OK) |
|-----------|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| --        | Test Report             | <ul style="list-style-type: none"> <li>Exhibit 1: Submittal check lists</li> <li>Exhibit 2: Introduction</li> <li>Exhibit 3: Performance Assessment</li> <li>Exhibit 4: EUT Operation and Configuration during Tests</li> <li>Exhibit 5: Summary of test Results</li> <li>Exhibit 6: Measurement Data</li> <li>Exhibit 7: Measurement Uncertainty</li> <li>Exhibit 8: Measurement Methods</li> </ul> | OK                 |
| 1         | Test Setup Photos       | Radiated Emission Setup Photos                                                                                                                                                                                                                                                                                                                                                                       | OK                 |
| 2         | External Photos of EUT  | External Photos                                                                                                                                                                                                                                                                                                                                                                                      | OK                 |
| 3         | Internal Photos of EUT  | Internal Photos                                                                                                                                                                                                                                                                                                                                                                                      | OK                 |
| 4         | Cover Letters           | <ul style="list-style-type: none"> <li>Letter from Ultratech for Certification Request</li> <li>Letter from the Applicant to appoint Ultratech to act as an agent</li> <li>Letter from the Applicant to request for Confidentiality Filing</li> </ul>                                                                                                                                                | OK                 |
| 5         | Attestation Statements  | N/A                                                                                                                                                                                                                                                                                                                                                                                                  | N/A                |
| 6         | ID Label/Location Info  | ID Label and Location of ID Label                                                                                                                                                                                                                                                                                                                                                                    | OK                 |
| 7         | Block Diagrams          | Block Diagram                                                                                                                                                                                                                                                                                                                                                                                        | OK                 |
| 8         | Schematic Diagrams      | Schematics                                                                                                                                                                                                                                                                                                                                                                                           | OK                 |
| 9         | Parts List/Tune Up Info | Parts List/ Tuning Procedures                                                                                                                                                                                                                                                                                                                                                                        | OK                 |
| 10        | Operational Description | Operational Description                                                                                                                                                                                                                                                                                                                                                                              | OK                 |
| 11        | RF Exposure Info        | See Section 6.6 of this test report for MPE evaluation                                                                                                                                                                                                                                                                                                                                               | OK                 |
| 12        | Users Manual            | User, Installation, Operation and Maintenance Manual                                                                                                                                                                                                                                                                                                                                                 | OK                 |

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February 1, 2006

*All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

## EXHIBIT 2. INTRODUCTION

### 2.1. SCOPE

|                                      |                                                                                                                                                                                                                                                                                                              |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Reference:</b>                    | FCC Parts 2 and 90                                                                                                                                                                                                                                                                                           |
| <b>Title:</b>                        | Code of Federal Regulations (CFR) Title 47 Telecommunication, Parts 2 & 90                                                                                                                                                                                                                                   |
| <b>Purpose of Test:</b>              | To obtain FCC equipment authorization for radio operating in the frequency band 136-174 MHz.                                                                                                                                                                                                                 |
| <b>Test Procedures:</b>              | 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. |
| <b>Environmental Classification:</b> | Commercial, industrial or business                                                                                                                                                                                                                                                                           |

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

None.

### 2.3. NORMATIVE REFERENCES

| Publication                | Year        | Title                                                                                                                                                               |
|----------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FCC CFR Parts 0-19, 80-End | 2005        | Code of Federal Regulations – Telecommunication                                                                                                                     |
| ANSI C63.4                 | 2003        | 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 |
| TIA/EIA 603, Edition B     | 01-Nov-2002 | Land Mobile FM or PM Communications Equipment Measurement and Performance Standards                                                                                 |

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## EXHIBIT 3. PERFORMANCE ASSESSMENT

### 3.1. CLIENT INFORMATION

| APPLICANT              |                                                                                                         |
|------------------------|---------------------------------------------------------------------------------------------------------|
| <b>Name:</b>           | Powerwave Technologies, Inc.                                                                            |
| <b>Address:</b>        | 1801 East St. Andrew PL.<br>Santa Ana, CA<br>USA, 92705                                                 |
| <b>Contact Person:</b> | Mr. Rober Biedka<br>Phone #: (714) 466-1433<br>Fax #: (714) 466-5807<br>Email Address: rbiedka@pwav.com |

| MANUFACTURER           |                                                                                                            |
|------------------------|------------------------------------------------------------------------------------------------------------|
| <b>Name:</b>           | Powerwave Technologies, Canada Ltd.                                                                        |
| <b>Address:</b>        | 15 Allstate Parkway, Suite 300<br>Markham, Ontario<br>Canada, L3R 5B4                                      |
| <b>Contact Person:</b> | Mr. Stan Habinski<br>Phone #: (905) 946-3360<br>Fax #: (905) 946-3392<br>Email Address: shabinski@pwav.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.

|                                             |                                                |
|---------------------------------------------|------------------------------------------------|
| <b>Brand Name:</b>                          | Powerwave Technologies, Inc.                   |
| <b>Product Name:</b>                        | LinkNet LNKF100 Service Module                 |
| <b>Model Name or Number:</b>                | LNKF100-A1, LNKF100-A2, LNKF100-B1, LNKF100-B2 |
| <b>Type of Equipment:</b>                   | Licensed Non-Broadcast Station Transmitter     |
| <b>Primary User functions of EUT:</b>       | Single channel narrow band repeater.           |
| <b>Transmitting/Receiving Antenna Type:</b> | Non-Integral                                   |

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### 3.3. EUT'S TECHNICAL SPECIFICATIONS

| TRANSMITTER                     |                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment Type:                 | Base station (fixed use)                                                                                                                                                            |
| Intended Operating Environment: | Commercial, industrial or business environment                                                                                                                                      |
| Power Supply Requirement:       | 28 Vdc (RF module) and 12 Vdc (Controller)                                                                                                                                          |
| RF Input Power Rating:          | -110 to -30 dBm                                                                                                                                                                     |
| RF Output Power Rating:         | +20 to +37 dBm (single carrier)                                                                                                                                                     |
| Operating Frequency Range:      | 136-174 MHz                                                                                                                                                                         |
| RF Output Impedance:            | 50 Ohms                                                                                                                                                                             |
| Occupied Bandwidth (99%):       | Repeater                                                                                                                                                                            |
| Emission Designation:           | <ul style="list-style-type: none"> <li>• F1D</li> <li>• F3E</li> </ul>                                                                                                              |
| Antenna Connector Type:         | SMA                                                                                                                                                                                 |
| Antenna Description:            | In-building antenna: $\frac{1}{4}$ wavelength antenna (0 dB gain)<br><br>Root top antenna or Antennae for linking to the Donor Site(s):<br>directional antennae (20 dBi gain, max.) |

| RECEIVER                        |                                                                             |
|---------------------------------|-----------------------------------------------------------------------------|
| Equipment Type:                 | Base station (fixed use)                                                    |
| Intended Operating Environment: | Commercial, industrial or business environment                              |
| Power Supply Requirement:       | 28 Vdc (RF module) and 12 Vdc (Controller)                                  |
| RF Input Power Rating:          | -110 to -30 dBm                                                             |
| Operating Frequency Range:      | 136-174 MHz                                                                 |
| RF Output Impedance:            | 50 Ohms                                                                     |
| Intermediate Frequency(ies):    | 240 MHz 1 <sup>st</sup> IF; 45 MHz 2 <sup>nd</sup> IF                       |
| Oscillator Frequency(ies):      | 1 <sup>st</sup> LO: 376-397 MHz or 395-414 MHz; 2 <sup>nd</sup> LO: 195 MHz |

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### 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 Input                    | 1                         | SMA Female       | Shielded                           |
| 2           | RF Output                   | 1                         | SMA Female       | Shielded                           |
| 3           | Power supply and monitoring | 1                         | 50-pin Edge Con. | N/A                                |

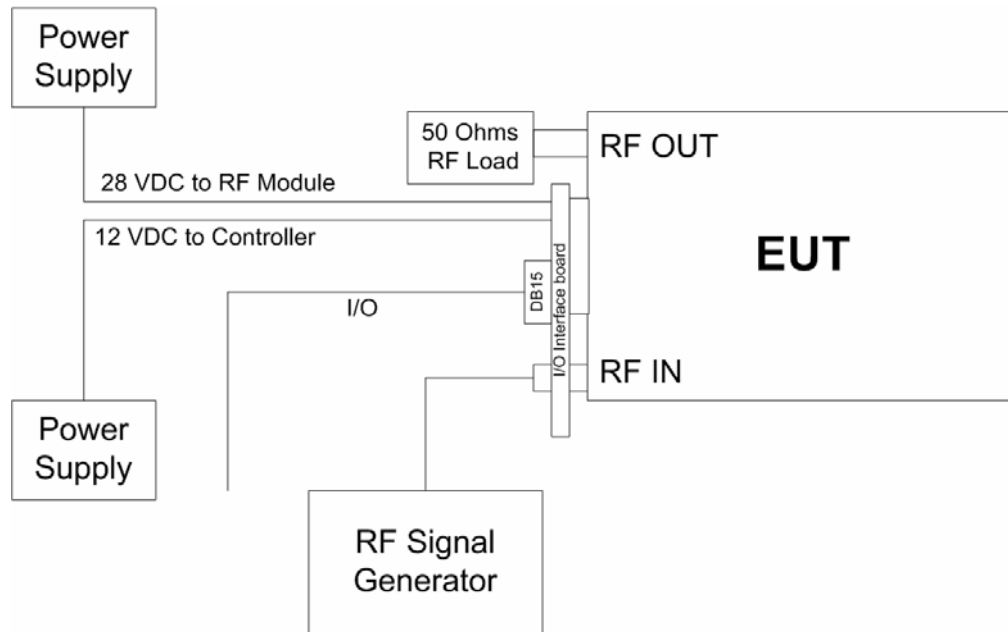
### 3.5. ANCILLARY EQUIPMENT

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:             | Power Supply         |
| Brand name:              | Tenma                |
| Part Number:             | 72-7295              |
| Serial Number:           | 49800270             |
| Connected to EUT's Port: | RF Module power line |

| Ancillary Equipment # 2  |                       |
|--------------------------|-----------------------|
| Description:             | Power Supply          |
| Brand name:              | Tenma                 |
| Part Number:             | 72-6153               |
| Serial Number:           | N/A                   |
| Connected to EUT's Port: | Controller power line |

### 3.6. GENERAL TEST SETUP

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## 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: | 28 Vdc (RF module) and 12 Vdc (Controller) |

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

|                                  |                                                                                                                          |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Operating Modes:</b>          | The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data. |
| <b>Special Test Software:</b>    | N/A                                                                                                                      |
| <b>Special Hardware Used:</b>    | N/A                                                                                                                      |
| <b>Transmitter Test Antenna:</b> | The EUT is tested with the transmitter antenna port terminated to a 50 Ohms RF Load.                                     |

| Transmitter Test Signals                                                                                                      |                        |
|-------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>Frequency Band(s):</b>                                                                                                     | 136-174 MHz            |
| <b>Frequency(ies) Tested:</b><br>(Near lowest, near middle and near highest frequencies in the frequency range of operation.) | 136, 155 and 174 MHz   |
| <b>RF Power Output (measured maximum output power):</b>                                                                       | 37 dBm                 |
| <b>Normal Test Modulation:</b>                                                                                                | Unmodulated, F1D & F3E |
| <b>Modulating signal source:</b>                                                                                              | 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 Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. This test site has 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: Jan.10, 2005.

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

| FCC Section(s)                                                                                                                                                                                                                                                                                                                   | Test Requirements                                            | Applicability (Yes/No) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------|
| 90.205(d) & 2.1046                                                                                                                                                                                                                                                                                                               | RF Power Output & Intermodulation                            | Yes (See note 1)       |
| 1.1307, 1.1310 & 2.1091                                                                                                                                                                                                                                                                                                          | RF Exposure Limit                                            | Yes                    |
| 90.213 & 2.1055                                                                                                                                                                                                                                                                                                                  | Frequency Stability                                          | Yes                    |
| 2.1047(a)                                                                                                                                                                                                                                                                                                                        | Audio Frequency Response                                     | See note 2             |
| 2.1047(b)                                                                                                                                                                                                                                                                                                                        | Modulation Limiting                                          | See note 2             |
| 2.1049                                                                                                                                                                                                                                                                                                                           | Occupied Bandwidth                                           | Yes                    |
| 90.210 & 2.1051 & 2.1057                                                                                                                                                                                                                                                                                                         | Emission Limitation - Spurious Emissions at Antenna Terminal | Yes                    |
| 90.210, 2.1053 & 2.1057                                                                                                                                                                                                                                                                                                          | Emission Limitation - Field Strength of Spurious Emissions   | Yes                    |
| LinkNet LNKF100 Service Module, Model No.: LNKF100-A1, LNKF100-A2, LNKF100-B1, LNKF100-B2, by Powerwave Technologies, Inc. has also been tested and found to comply with FCC Part 15, Subpart B - Radio Receivers and Class A Digital Devices. The engineering test report has been documented and it is available upon request. |                                                              |                        |

Note 1: Intermodulation is not applicable for single channel systems.

Note 2: EUT is a single channel input/output repeater, it has limiting amplifier in the IF module and cannot be swept easily. The limiting amplifier makes the response look like a flat line.

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

None.

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## **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 Ultratech Test Procedures, File # ULTR P001-2004, TIA-603-B and ANSI C63.4.

### **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 and CISPR 16-1.

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

To receive and transmit narrow-band FM signals without demodulation.

## 6.5. RF POWER OUTPUT [§§ 2.1046 & 90.205]

### 6.5.1. Limit

See § 90.205(d)

### 6.5.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004

### 6.5.3. Test Equipment List

| Test Instruments | Manufacturer    | Model No. | Serial No. | Frequency Range                   |
|------------------|-----------------|-----------|------------|-----------------------------------|
| Signal Generator | Gigatronics     | 6061A     | 5130586    | 10 kHz - 1050 MHz                 |
| Attenuator       | Weinschel Corp  | 48-30-34  | BM5354     | DC - 18 GHz                       |
| Power Meter      | Hewlett-Packard | 436A      | 2709A27515 | 100 kHz -50 GHz, Sensor Dependent |
| Power sensor     | Hewlett-Packard | 8481A     | 1550A07043 | 10 MHz – 18 GHz                   |

### 6.5.4. Test Arrangement



### 6.5.5. Test Data

| Test Frequency (MHz)    | Modulation | Output Power at Antenna Port (dBm) | RF Output Power Rating at Antenna Port (dBm) |
|-------------------------|------------|------------------------------------|----------------------------------------------|
| <b>High Power Level</b> |            |                                    |                                              |
| 136                     | F1D/F3E    | 36.79                              | 37                                           |
| 155                     | F1D/F3E    | 37.00                              | 37                                           |
| 174                     | F1D/F3E    | 37.05                              | 37                                           |
| <b>Low Power Level</b>  |            |                                    |                                              |
| 136                     | F1D/F3E    | 20.99                              | 20                                           |
| 155                     | F1D/F3E    | 18.83                              | 20                                           |
| 174                     | F1D/F3E    | 18.81                              | 20                                           |

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## 6.6. RF EXPOSURE REQUIREMENTS [§§ 1.1310 & 2.1091]

### 6.6.1. Limits

**FCC 1.1310:-** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| Frequency range<br>(MHz)                                       | Electric field<br>strength<br>(V/m) | Magnetic field<br>strength<br>(A/m) | Power density<br>(mW/cm <sup>2</sup> ) | Averaging time<br>(minutes) |
|----------------------------------------------------------------|-------------------------------------|-------------------------------------|----------------------------------------|-----------------------------|
| <b>(A) Limits for Occupational/Controlled Exposures</b>        |                                     |                                     |                                        |                             |
| 0.3–3.0 .....                                                  | 614                                 | 1.63                                | *(100)                                 | 6                           |
| 3.0–30 .....                                                   | 1842/f                              | 4.89/f                              | *(900/f <sup>2</sup> )                 | 6                           |
| 30–300 .....                                                   | 61.4                                | 0.163                               | 1.0                                    | 6                           |
| 300–1500 .....                                                 | .....                               | .....                               | f/300                                  | 6                           |
| 1500–100,000 .....                                             | .....                               | .....                               | 5                                      | 6                           |
| <b>(B) Limits for General Population/Uncontrolled Exposure</b> |                                     |                                     |                                        |                             |
| 0.3–1.34 .....                                                 | 614                                 | 1.63                                | *(100)                                 | 30                          |
| 1.34–30 .....                                                  | 824/f                               | 2.19/f                              | *(180/f <sup>2</sup> )                 | 30                          |
| 30–300 .....                                                   | 27.5                                | 0.073                               | 0.2                                    | 30                          |
| 300–1500 .....                                                 | .....                               | .....                               | f/1500                                 | 30                          |
| 1500–100,000 .....                                             | .....                               | .....                               | 1.0                                    | 30                          |

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

### 6.6.2. Method of Measurements

Refer to FCC @ 1.1310 and 2.1091

- In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:
  - (1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
  - (2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement.
  - (3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits.
  - (4) Any other RF exposure related issues that may affect MPE compliance.

**Calculation Method of RF Safety Distance:**

$$S = PG/4\pi r^2 = EIRP/4\pi r^2$$

Where:

- P: power input to the antenna in mW
- EIRP: Equivalent (effective) isotropic radiated power.
- S: power density mW/cm<sup>2</sup>
- G: numeric gain of antenna relative to isotropic radiator
- r: distance to centre of radiation in cm

$$r = \sqrt{PG/4\pi S}$$

- For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones, SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that an SAR evaluation be performed, as provided for in Section 1.1307(d).

### 6.6.3. Test Data

#### Antenna Gain Limit specified by Manufacturer: 0 dB (In-building Antenna)

| (1) Lowest Frequency (MHz) | (1) Measured RF Conducted Power (dBm) | (2) Calculated EIRP (dBm) | (3) Calculated Minimum RF Safety Distance r (cm)* | Manufacturer' Specified Separation Distance (cm) |
|----------------------------|---------------------------------------|---------------------------|---------------------------------------------------|--------------------------------------------------|
| 136                        | 37.05                                 | 27.20                     | 14.5                                              | 20                                               |

- (1) The calculation is based on the lowest frequency (136 MHz) and the highest conducted power (37.05 dBm) for the worst case.
- (2) The In-Building Antenna connection is via a coaxial cable distribution system with signal taps at various points connected to the fixed-mounted indoor antennae. The indoor antennae are simple  $\frac{1}{4}$  wavelength (0 dB Gain) type. They are used with Powerwave Technologies' 12, 16, or 20 dB cable taps. As such the maximum EIRP will be at the first tapped antenna, which will be 12 dB below the maximum signal level of the EUT.
- (3) The minimum separation distance between the antenna and bodies of users are calculated using the following formula:

$$\text{RF EXPOSURE DISTANCE LIMITS: } r = (PG/4\pi S)^{1/2} = (\text{EIRP}/4\pi S)^{1/2}$$

$$S = 0.2 \text{ mW/cm}^2 \text{ (for General Population/ Uncontrolled Exposure)}$$

$$\text{EIRP} = 27.20 \text{ dBm} = 10^{(27.20/10)} \text{ mW} = 524.81 \text{ mW}$$

$$r = (\text{EIRP}/4\pi S)^{1/2} = (524.81 / 4\pi(0.2))^{1/2} = 14.5 \text{ cm}$$

| Evaluation of RF Exposure Compliance Requirements                                                                                                                                          |                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| RF Exposure Requirements                                                                                                                                                                   | Compliance with FCC Rules                                                                                            |
| Minimum calculated separation distance between antenna and persons required:<br><br>Indoor Antenna: 14.5 cm                                                                                | Manufacturer' instruction for separation distance between antenna and persons required:<br><br>Indoor Antenna: 20 cm |
| Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement | See user's manual for details.                                                                                       |
| Caution statements and/or warning labels that are necessary in order to comply with the exposure limits                                                                                    | See user's manual for RF exposure information.                                                                       |
| Any other RF exposure related issues that may affect MPE compliance                                                                                                                        | None.                                                                                                                |

## 6.7. OCCUPIED BANDWIDTH [§ 2.1049]

### 6.7.1. Limits

The spectral shape of the output should look similar to input for all modulations.

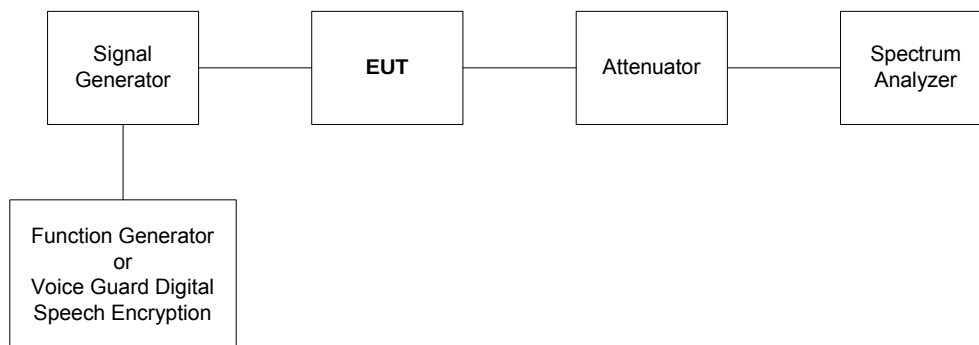
### 6.7.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004

### 6.7.3. Test Equipment List

| Test Instruments                      | Manufacturer              | Model No. | Serial No. | Frequency Range   |
|---------------------------------------|---------------------------|-----------|------------|-------------------|
| Spectrum Analyzer                     | Advantest                 | R3271     | 15050203   | 100Hz-26.5GHz     |
| Function Generator                    | Stanford Research Systems | DS345     | 34591      | 1Hz -30.2 MHz     |
| Voice Guard Digital Speech Encryption | General Electric          | 9600-SW   | 9614517    | --                |
| Attenuator                            | Weinschel Corp            | 48-30-34  | BM5354     | DC - 18 GHz       |
| Signal Generator                      | Gigatronix                | 6061A     | 5130586    | 10 kHz - 1050 MHz |

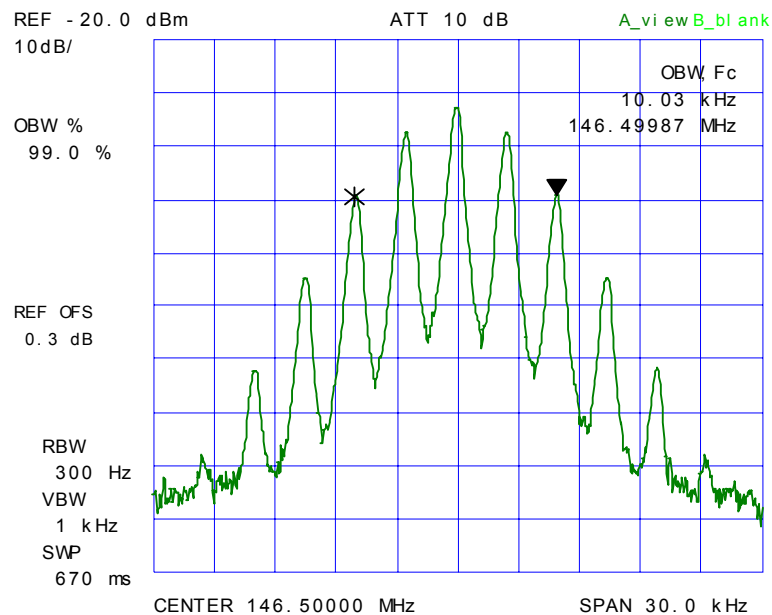
### 6.7.4. Test Arrangement



### 6.7.5. Test Data

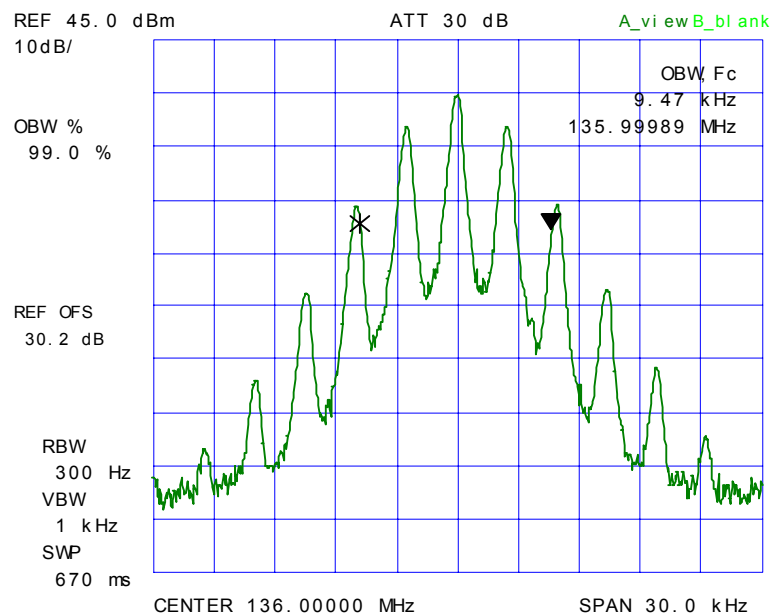
Plot 6.7.5.1: 99% Occupied Bandwidth (Input Signal)

Frequency: 146.5 MHz, 12.5 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal

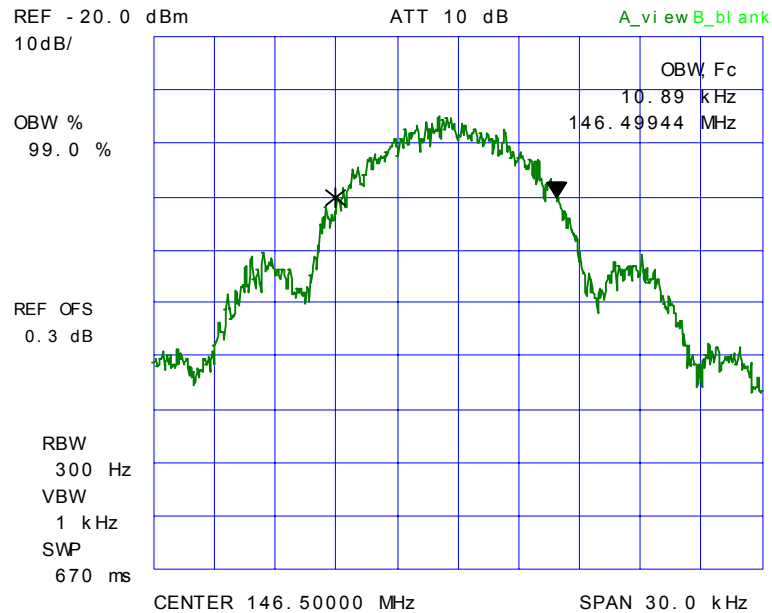


Plot 6.7.5.2: 99% Occupied Bandwidth (Output Signal)

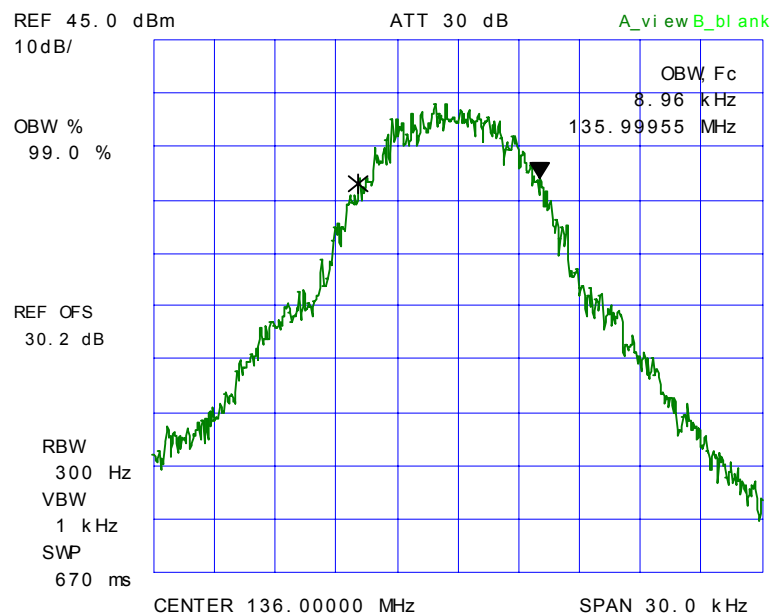
Frequency: 136 MHz, 12.5 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal



Plot 6.7.5.3: 99% Occupied Bandwidth (Input Signal)  
Frequency: 146.5MHz, 12.5 kHz Channel Spacing; Modulation: FM with external 9600 bps random data



Plot 6.7.5.4: 99% Occupied Bandwidth (Output Signal)  
Frequency: 136 MHz, 12.5 kHz Channel Spacing; Modulation: FM with external 9600 bps random data



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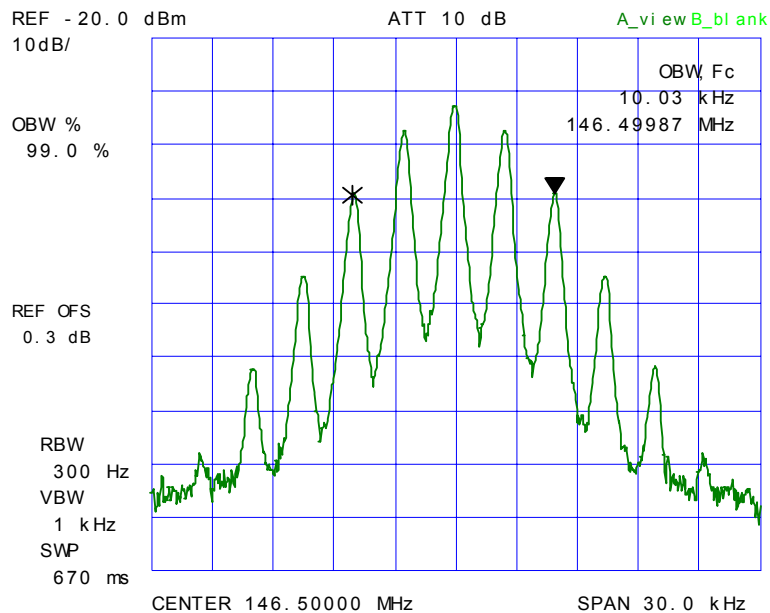
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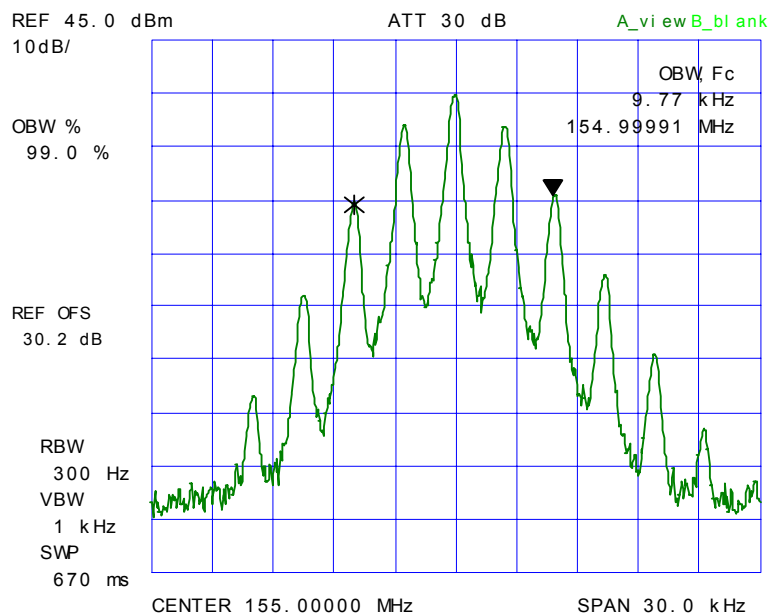
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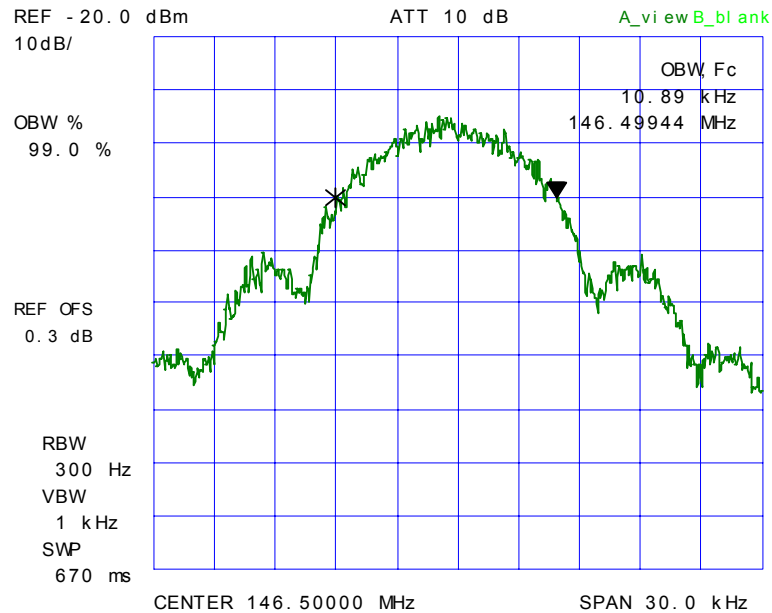
Plot 6.7.5.5: 99% Occupied Bandwidth (Input Signal)  
Frequency: 146.5MHz, 12.5 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal



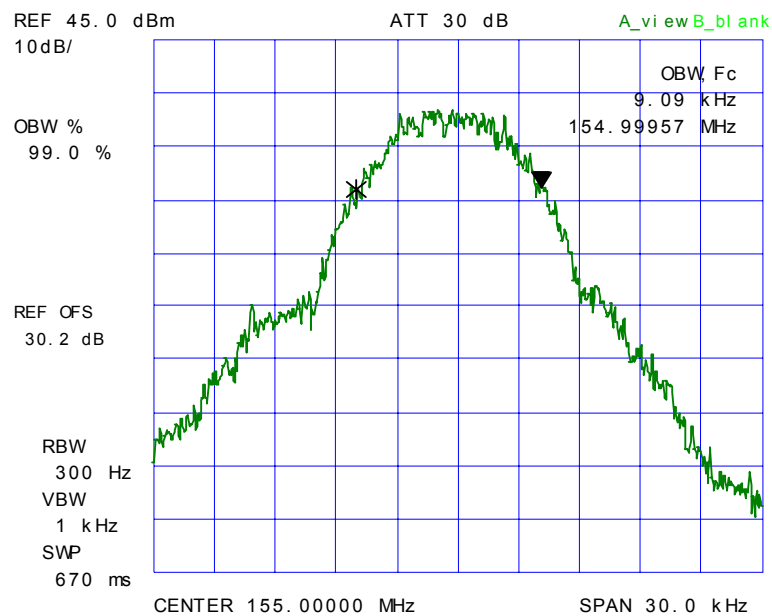
Plot 6.7.5.6: 99% Occupied Bandwidth (Output Signal)  
Frequency: 155MHz, 12.5 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal



Plot 6.7.5.7: 99% Occupied Bandwidth (Input Signal)  
Frequency: 146.5MHz, 12.5 kHz Channel Spacing; Modulation: FM with external 9600 bps random data



Plot 6.7.5.8: 99% Occupied Bandwidth (Output Signal)  
Frequency: 155 MHz, 12.5 kHz Channel Spacing; Modulation: FM with external 9600 bps random data



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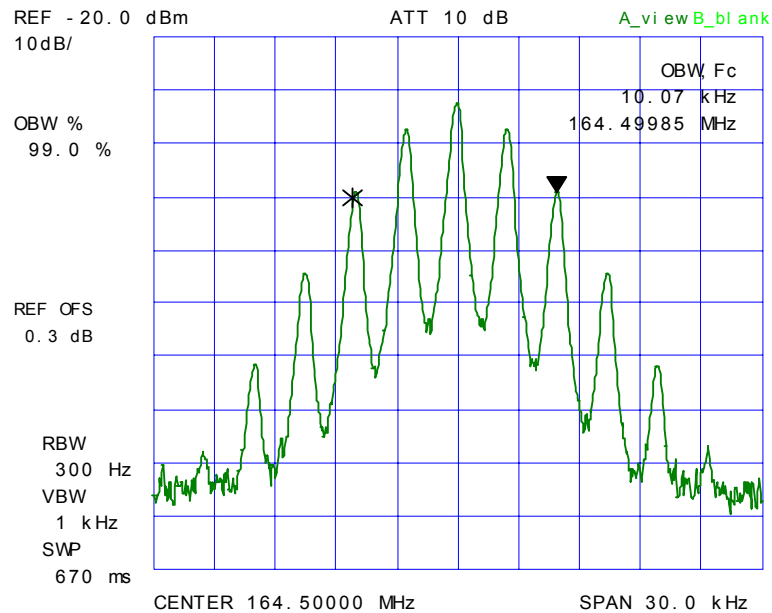
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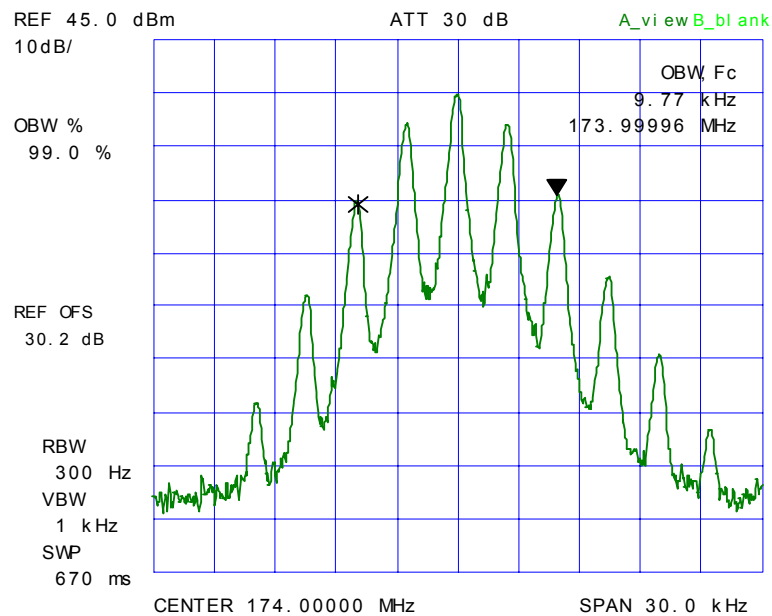
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Plot 6.7.5.9: 99% Occupied Bandwidth (Input Signal)  
Frequency: 164.5 MHz, 12.5 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal

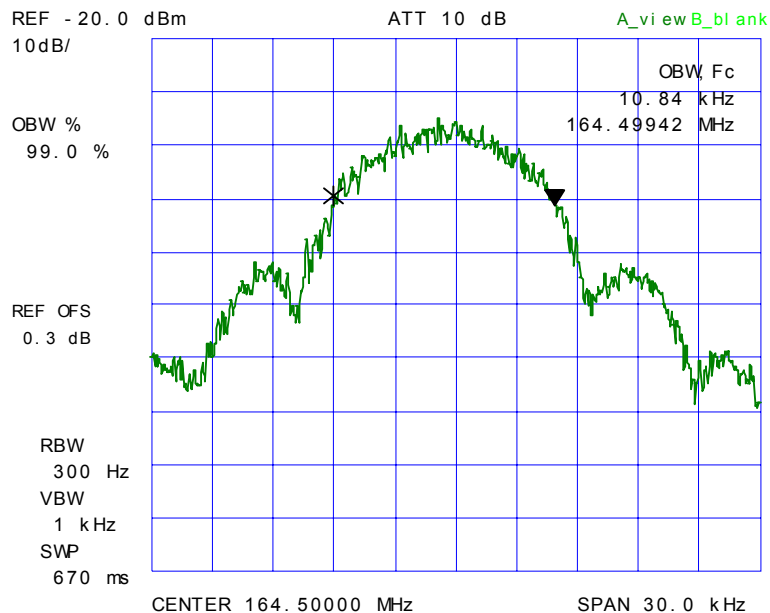


Plot 6.7.5.10: 99% Occupied Bandwidth (Output Signal)  
Frequency: 174MHz, 12.5 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal



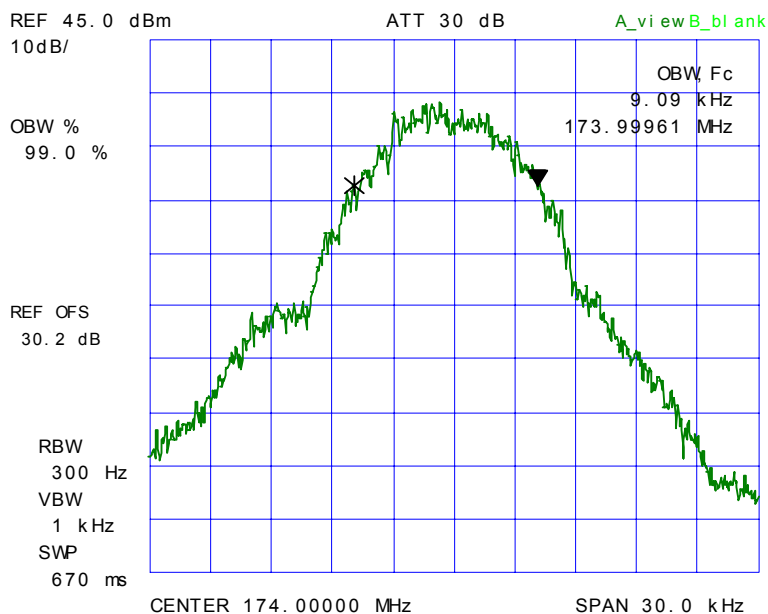
Plot 6.7.5.11: 99% Occupied Bandwidth (Input Signal)

Frequency: 164.5 MHz, 12.5 kHz Channel Spacing; Modulation: FM with external 9600 bps random data

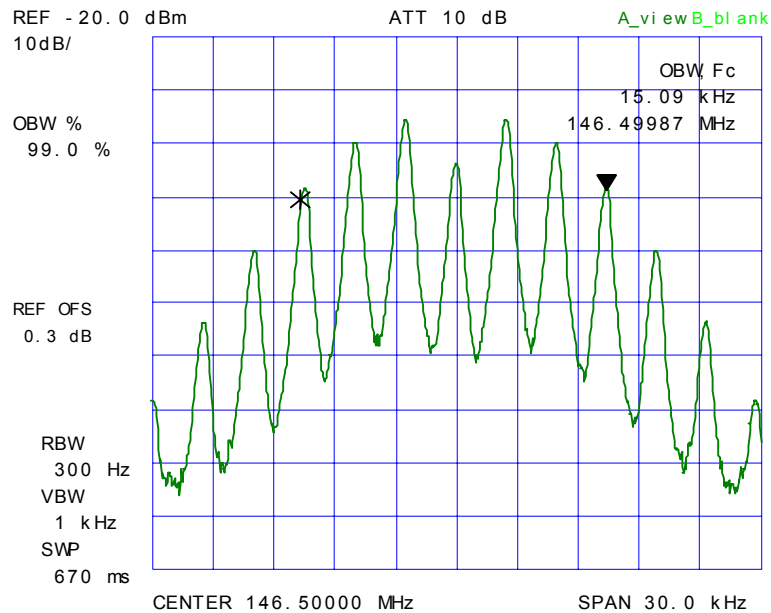


Plot 6.7.5.12: 99% Occupied Bandwidth (Output Signal)

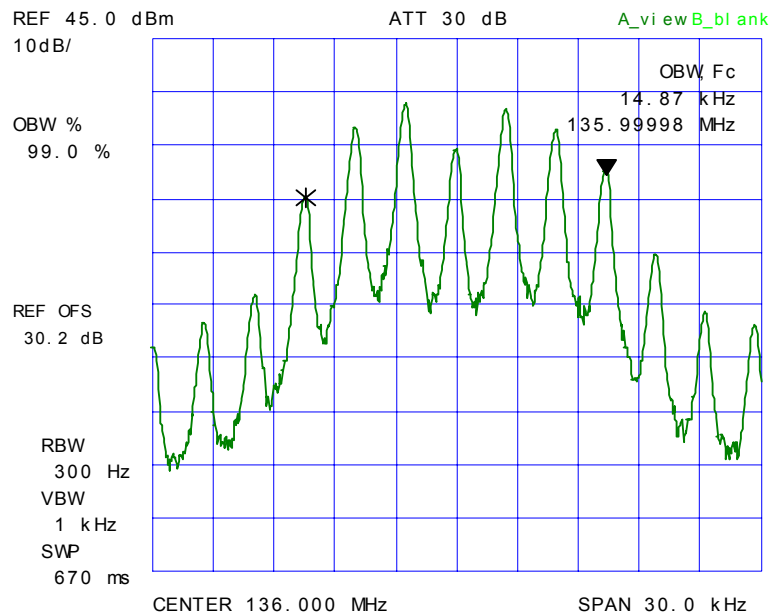
Frequency: 174 MHz, 12.5 kHz Channel Spacing; Modulation: FM with external 9600 bps random data



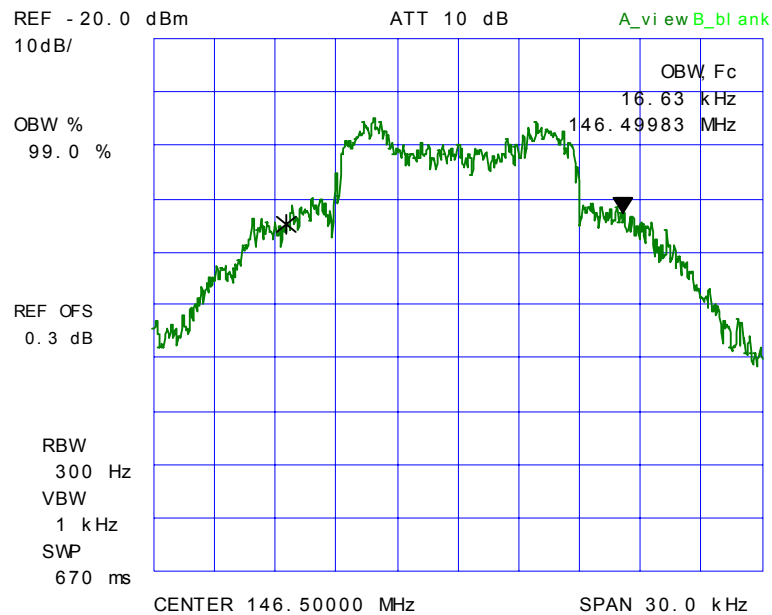
Plot 6.7.5.13: 99% Occupied Bandwidth (Input Signal)  
Frequency: 146.5 MHz, 25 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal



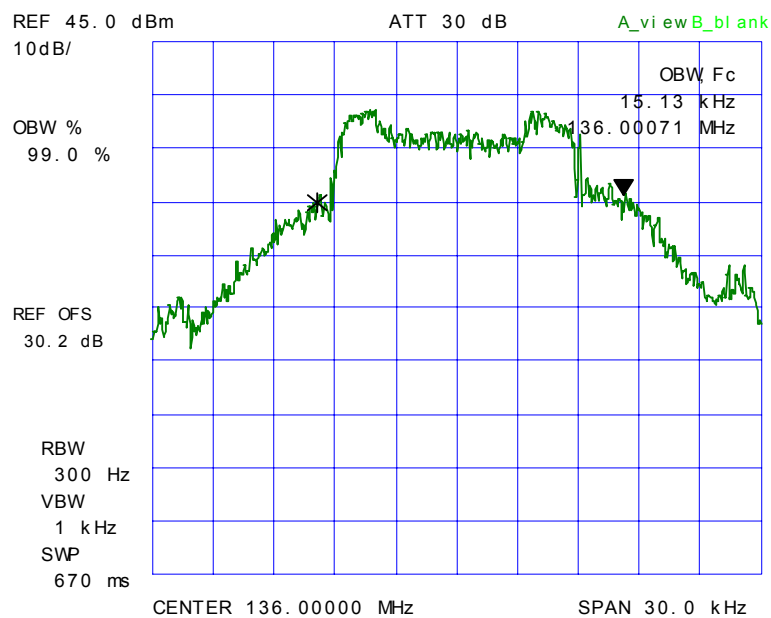
Plot 6.7.5.14: 99% Occupied Bandwidth (Output Signal)  
Frequency: 136 MHz, 25 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal



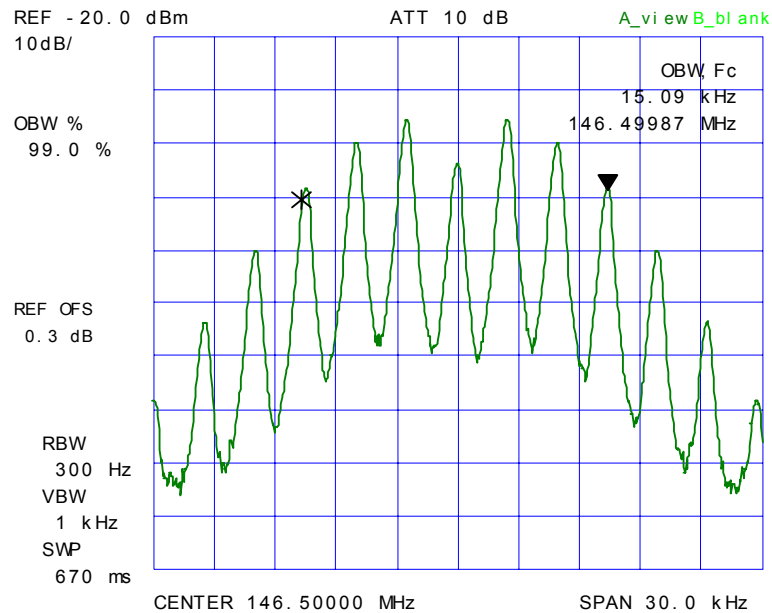
Plot 6.7.5.15: 99% Occupied Bandwidth (Input Signal)  
Frequency: 146.5 MHz, 25 kHz Channel Spacing; Modulation: FM with external 9600bps random data



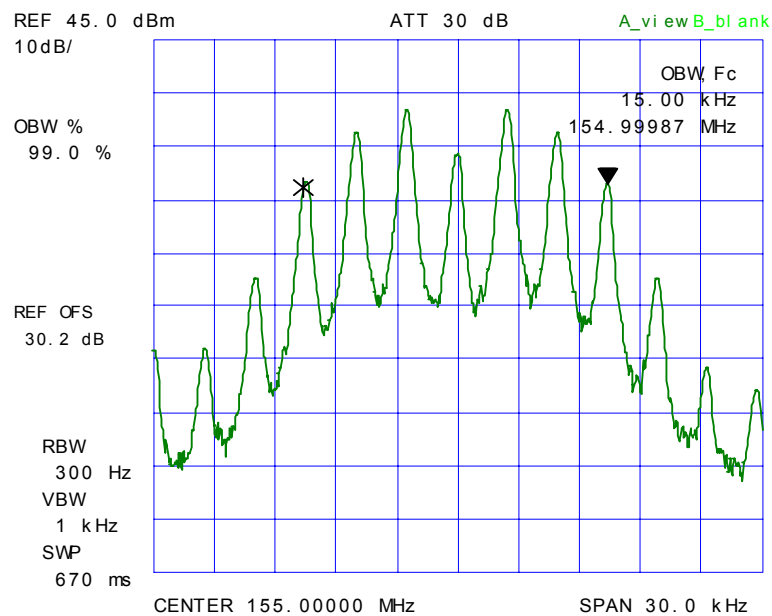
Plot 6.7.5.16: 99% Occupied Bandwidth (Output Signal)  
Frequency: 136 MHz, 25 kHz Channel Spacing; Modulation: FM with external 9600bps random data



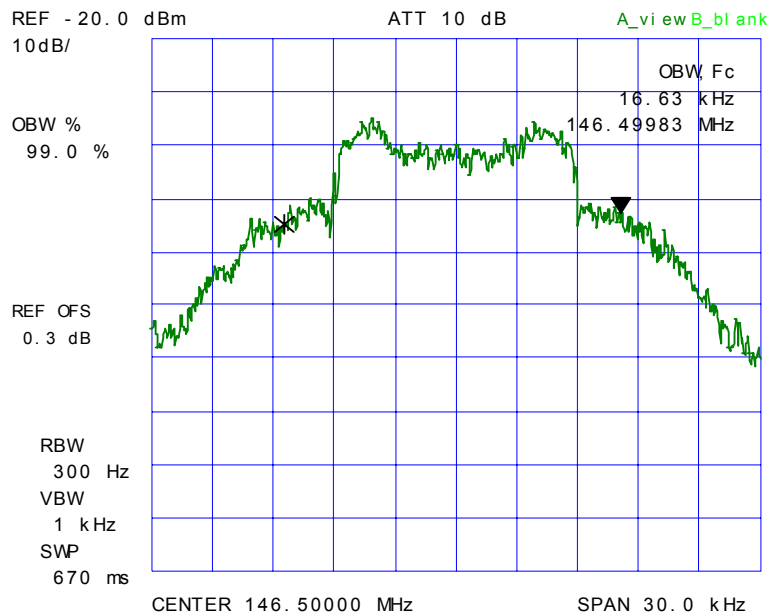
Plot 6.7.5.17: 99% Occupied Bandwidth (Input Signal)  
Frequency: 146.5 MHz, 25 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal



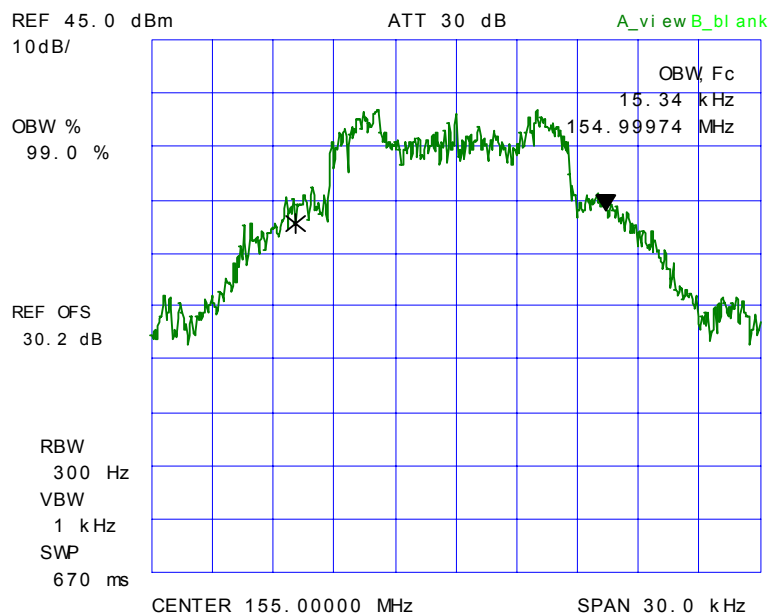
Plot 6.7.5.18: 99% Occupied Bandwidth (Output Signal)  
Frequency: 155 MHz, 25 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal



Plot 6.7.5.19: 99% Occupied Bandwidth (Input Signal)  
Frequency: 146.5 MHz, 25 kHz Channel Spacing; Modulation: FM with external 9600bps random data



Plot 6.7.5.20: 99% Occupied Bandwidth (Output Signal)  
Frequency: 155 MHz, 25 kHz Channel Spacing; Modulation: FM with external 9600bps random data



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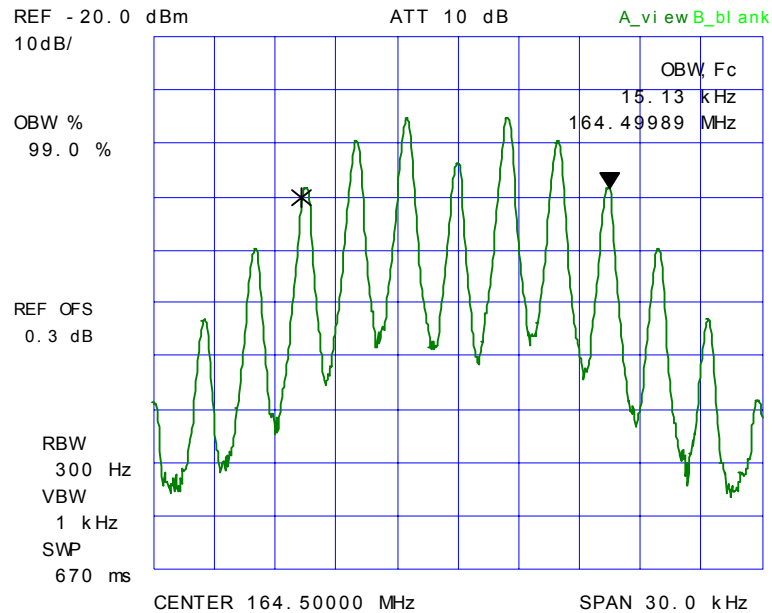
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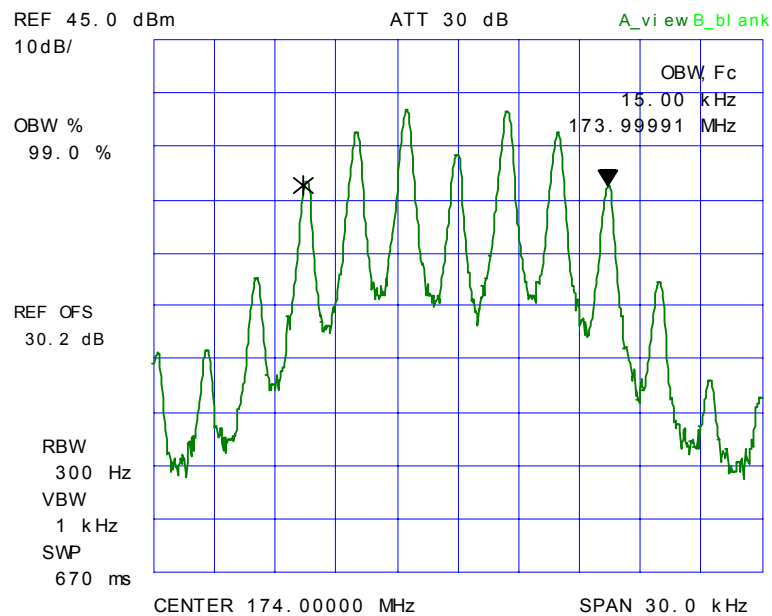
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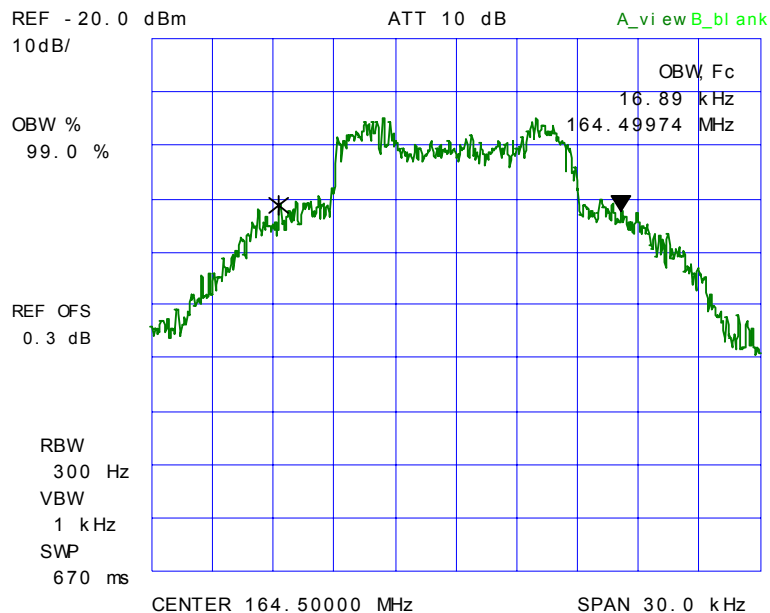
Plot 6.7.5.21: 99% Occupied Bandwidth (Input Signal)  
Frequency: 164.5 MHz, 25 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal



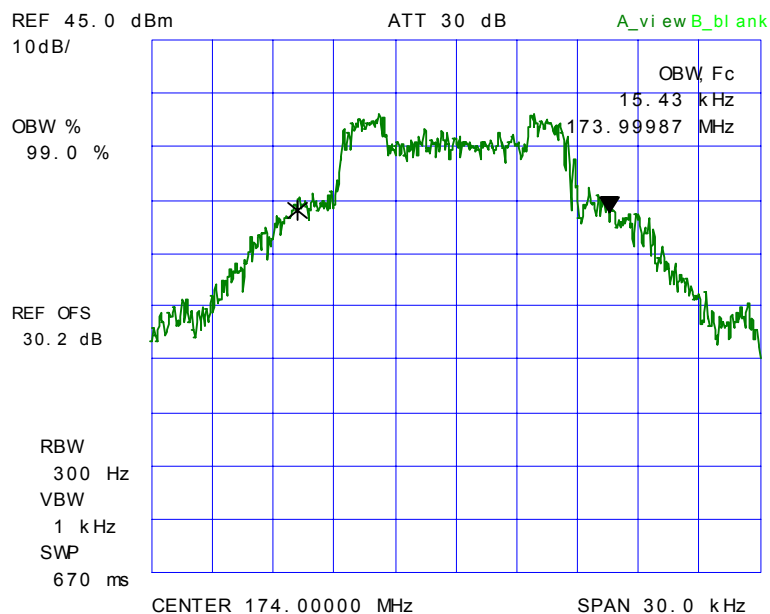
Plot 6.7.5.22: 99% Occupied Bandwidth (Output Signal)  
Frequency: 174 MHz, 25 kHz Channel Spacing; Modulation: FM with 2.5 kHz Sine Wave Signal



Plot 6.7.5.23: 99% Occupied Bandwidth (Input Signal)  
Frequency: 164.5 MHz, 25 kHz Channel Spacing; Modulation: FM with external 9600bps random data



Plot 6.7.5.24: 99% Occupied Bandwidth (Output Signal)  
Frequency: 174 MHz, 25 kHz Channel Spacing; Modulation: FM with external 9600bps random data



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## 6.8. SPURIOUS EMISSIONS AT ANTENNA TERMINAL [§§ 2.1051 & 90.210]

### 6.8.1. Limits

The power of any emission must be reduced below the unmodulated carrier power (P) by at least  $50 + 10 \log (P)$  dB

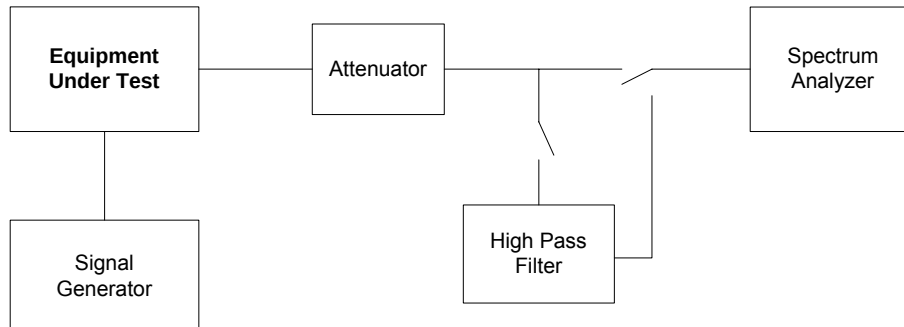
### 6.8.2. Method of Measurements

Refer to ULTRATECH Test Procedures, File # ULTR P001-2004

### 6.8.3. Test Equipment List

| Test Instruments  | Manufacturer   | Model No. | Serial No. | Frequency Range          |
|-------------------|----------------|-----------|------------|--------------------------|
| Spectrum Analyzer | Advantest      | R3271     | 15050203   | 100Hz-26.5GHz            |
| Attenuator        | Weinschel Corp | 48-30-34  | BM5354     | DC - 18 GHz              |
| High Pass Filter  | Mini-Circuit   | SHP-230   | 9027 12    | Cut of Frequency 230 MHz |
| Signal Generator  | Gigatronics    | 6061A     | 5130586    | 10 kHz - 1050 MHz        |

### 6.8.4. Test Arrangement

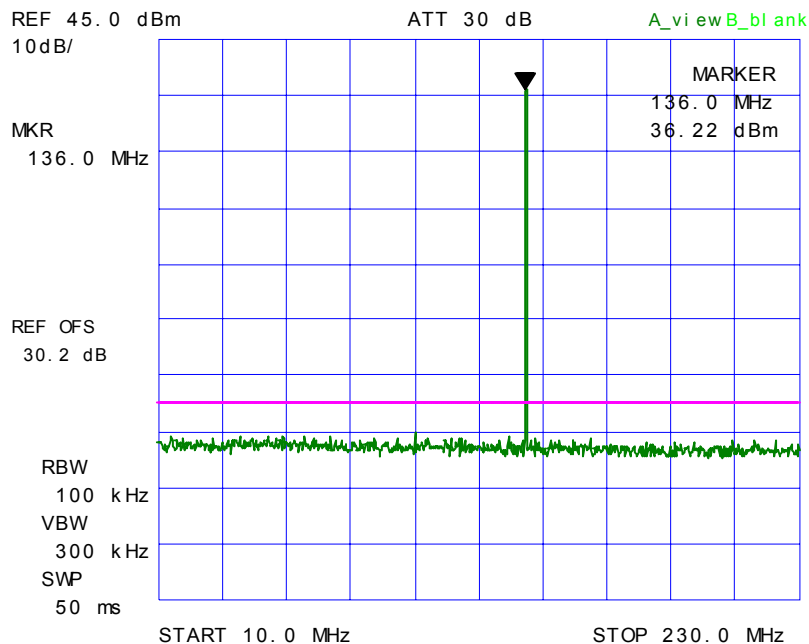


### 6.8.5. Test Data

#### Remarks:

- (1) There was no difference in spurious/harmonic emissions on pre-scans for all different modulations and channel spacing. Therefore, the rf spurious/harmonic emissions in this section would be performed at 12.5 kHz channel spacing using 2500 Hz with 2.5 kHz deviation at high and low power levels.
- (2) The emissions were scanned from 10 MHz to 2 GHz.

Plot 6.8.5.1: Spurious Emissions at Antenna Terminal  
Test Frequency: 136 MHz at High Power Level (37 dBm)



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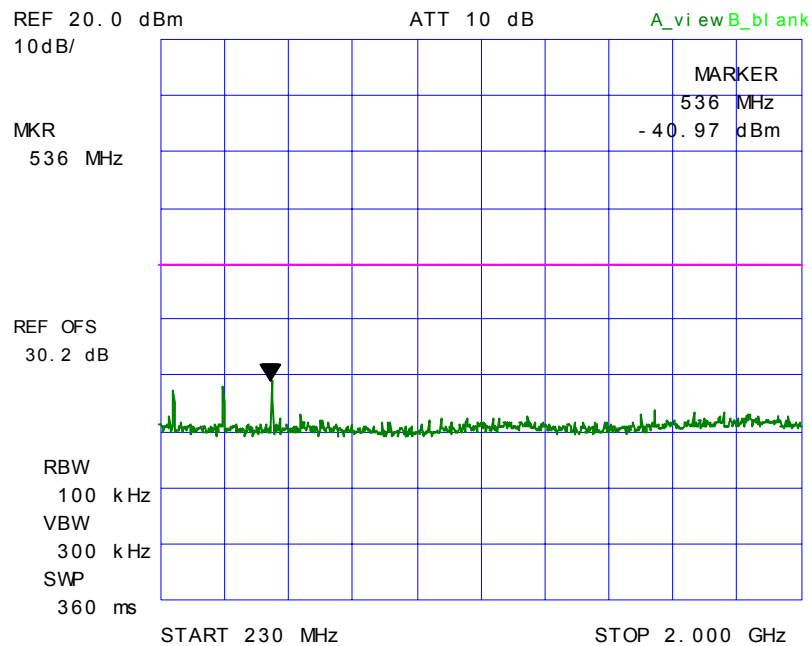
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>

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Plot 6.8.5.2: Spurious Emissions at Antenna Terminal  
Test Frequency: 136 MHz at High Power Level (37 dBm)

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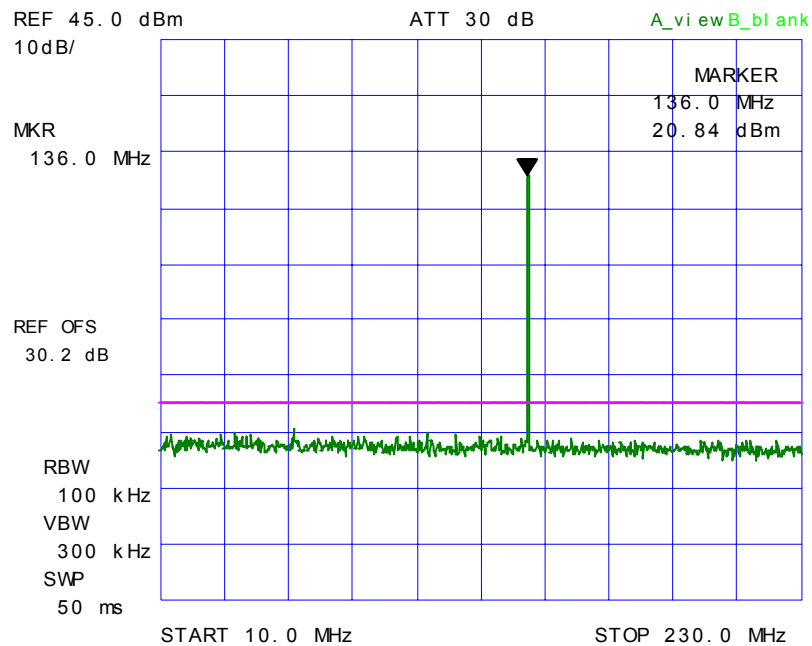
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Plot 6.8.5.3: Spurious Emissions at Antenna Terminal  
Test Frequency: 136 MHz at Low Power Level (20 dBm)

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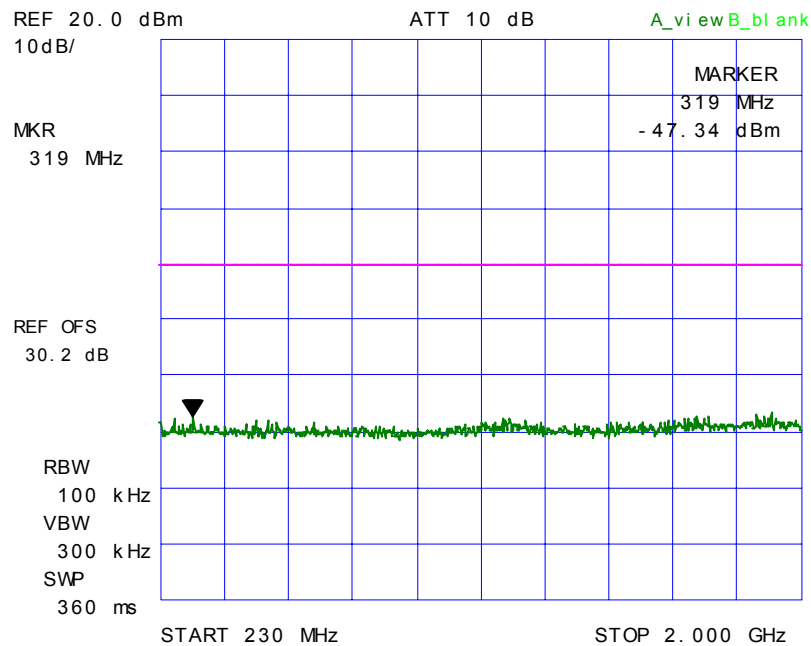
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>**File #: KTI-047F90**

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Plot 6.8.5.4: Spurious Emissions at Antenna Terminal  
Test Frequency: 136 MHz at Low Power Level (20 dBm)

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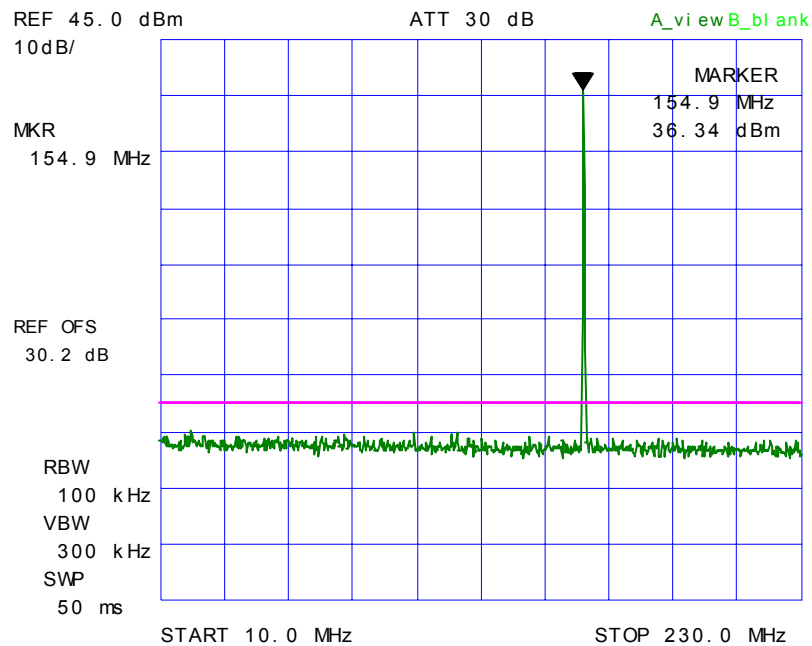
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>**File #: KTI-047F90**

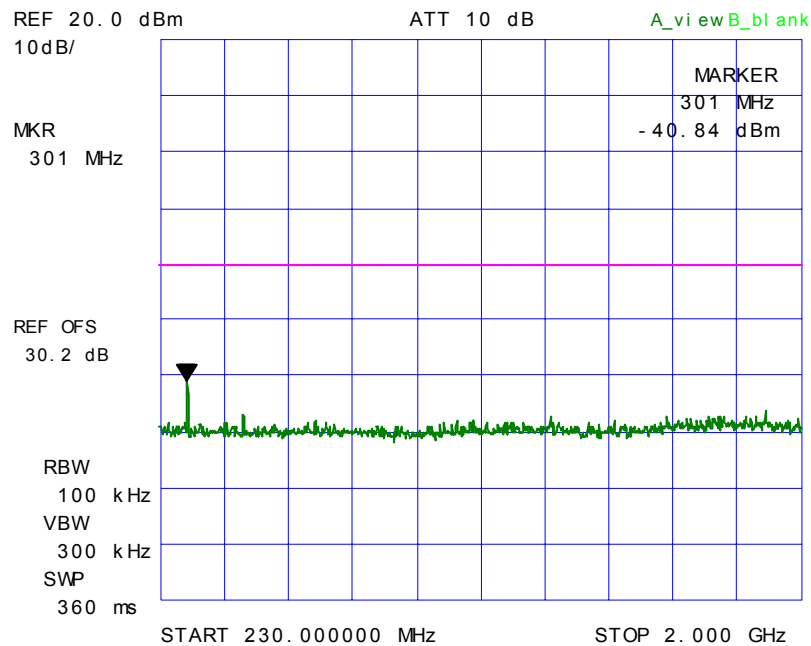
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Plot 6.8.5.5: Spurious Emissions at Antenna Terminal  
Test Frequency: 155 MHz at High Power Level (37 dBm)



Plot 6.8.5.6: Spurious Emissions at Antenna Terminal  
Test Frequency: 155 MHz at High Power Level (37 dBm)

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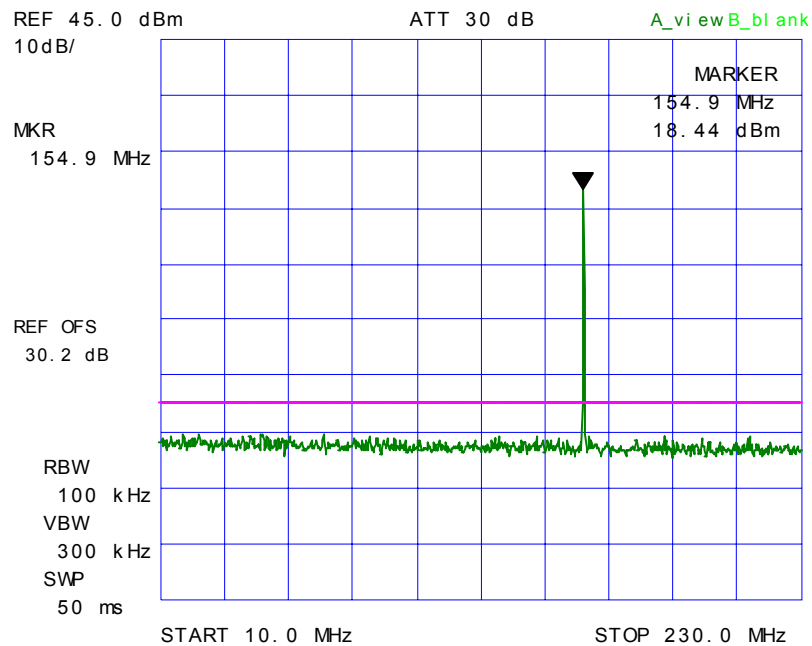
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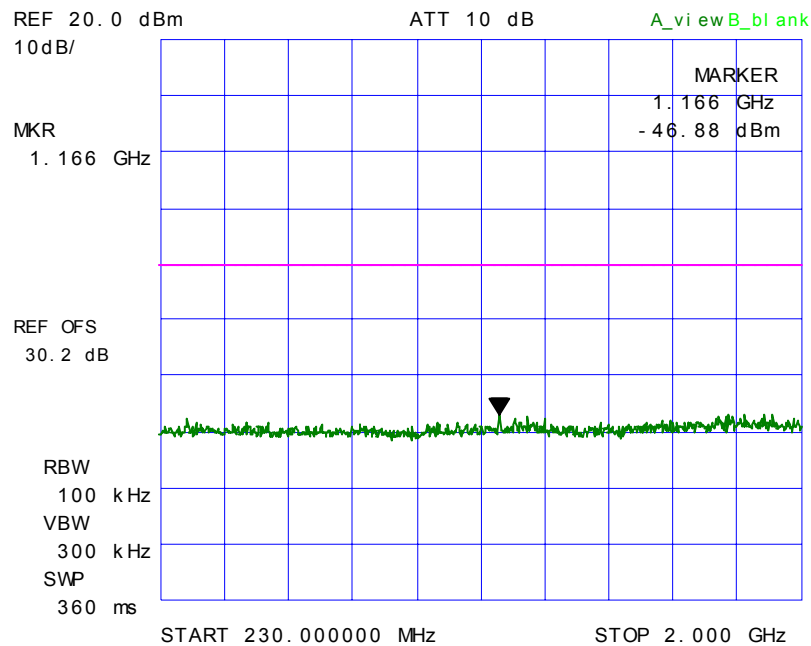
February 1, 2006

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 6.8.5.7: Spurious Emissions at Antenna Terminal  
Test Frequency: 155 MHz at Low Power Level (20 dBm)



Plot 6.8.5.8: Spurious Emissions at Antenna Terminal  
Test Frequency: 155 MHz at Low Power Level (20 dBm)

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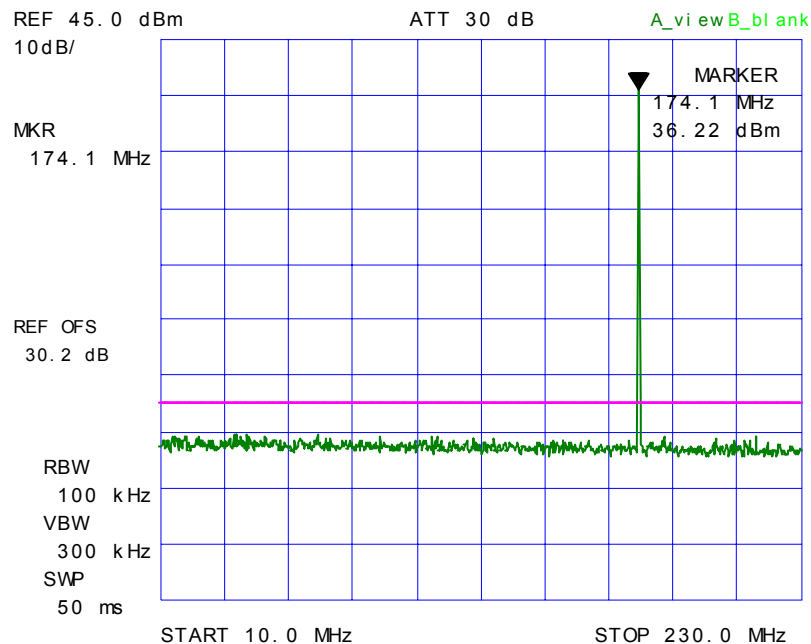
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: [vic@ultratech-labs.com](mailto:vic@ultratech-labs.com), Website: <http://www.ultratech-labs.com>**File #: KTI-047F90**

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Plot 6.8.5.9: Spurious Emissions at Antenna Terminal  
Test Frequency: 174 MHz at High Power Level (37 dBm)

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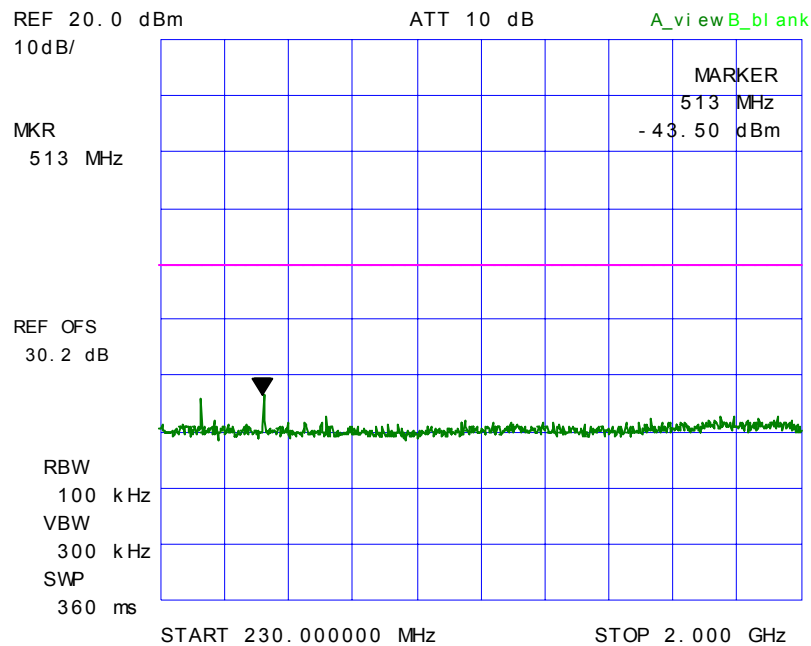
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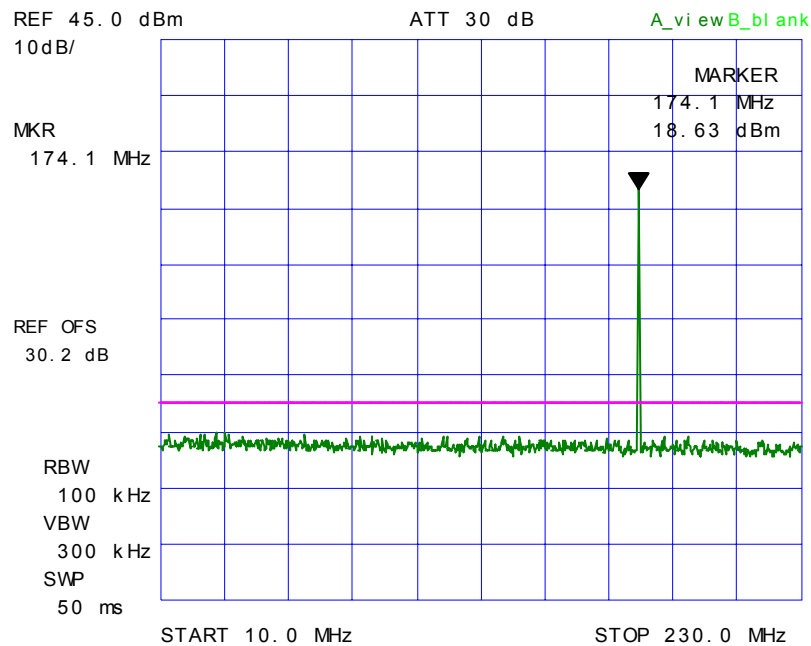
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Plot 6.8.5.10: Spurious Emissions at Antenna Terminal  
Test Frequency: 174 MHz at High Power Level (37 dBm)



Plot 6.8.5.11: Spurious Emissions at Antenna Terminal  
Test Frequency: 174 MHz at Low Power Level (20 dBm)

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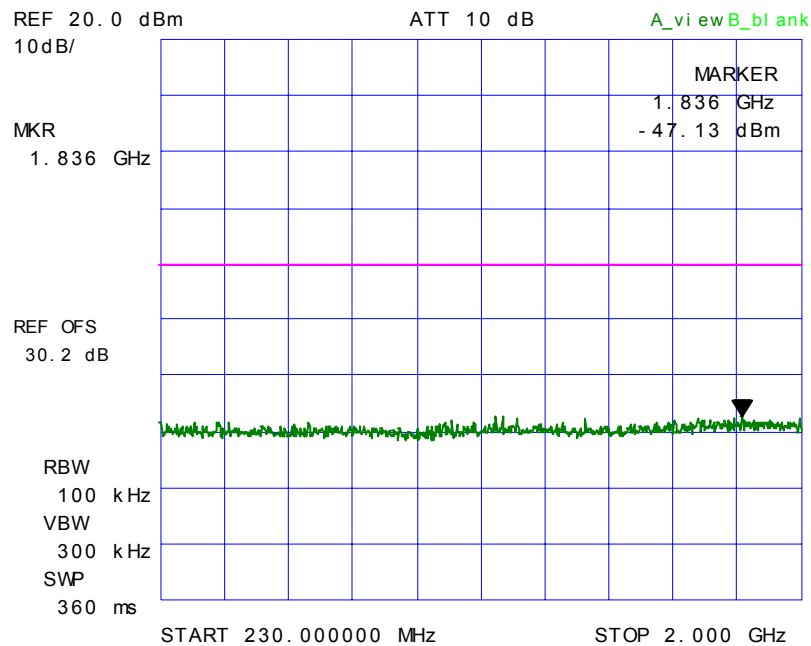
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Plot 6.8.5.12: Spurious Emissions at Antenna Terminal  
Test Frequency: 174 MHz at Low Power Level (20 dBm)

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## 6.9. FIELD STRENGTH OF SPURIOUS EMISSIONS [§§ 2.1053 & 90.210]

### 6.9.1. Limits

The power of any emission must be reduced below the unmodulated carrier power (P) by at least  $50 + 10 \log (P)$  dB.

### 6.9.2. Method of Measurements

The spurious/harmonic ERP measurements are using substitution method specified in Exhibit 8, Section 8.2 of this report and its value in dBc is calculated as follows:

- (1) If the transmitter's antenna is an integral part of the EUT, the ERP is measured using substitution method.
- (2) If the transmitter's antenna is non-integral and diverse, the lowest ERP of the carrier with 0 dBi antenna gain is used for calculation of the spurious/harmonic emissions in dBc:  
Lowest ERP of the carrier = EIRP – 2.15 dB =  $P_c + G - 2.15 \text{ dB} = P_c \text{ dBm (conducted)} + 0 \text{ dBi} - 2.15 \text{ dB}$
- (3) Spurious /harmonic emissions levels expressed in dBc (dB below carrier) are as follows:

**ERP of spurious/harmonic (dBc) = ERP of carrier (dBm) – ERP of spurious/harmonic emission (dBm)**

### 6.9.3. Test Equipment List

| Test Instruments    | Manufacturer    | Model No.     | Serial No. | Frequency Range                    |
|---------------------|-----------------|---------------|------------|------------------------------------|
| Spectrum Analyzer   | Rohde & Schwarz | FSEK20/B4/B21 | 834157/005 | 9 kHz – 40 GHz                     |
| RF Amplifier        | Com-Power       | PA-102        |            | 1 MHz to 1 GHz, 30 dB gain nominal |
| 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                      |

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#### 6.9.4. Test Data

##### Remarks:

- The radiated emissions were performed at 3 meters distance. At its maximum power for worst case.
- The emissions were scanned from 30 MHz to 2 GHz; all emissions that are within 20 dB below the limit are recorded.

##### 6.9.4.1. Lowest Frequency (136 MHz)

|                          |                        |
|--------------------------|------------------------|
| Carrier Frequency (MHz): | 136                    |
| Power (dBm):             | 37                     |
| Limit (dBc):             | $50 + 10 \log(5) = 57$ |

---

All emissions are more than 20 dB below the limit.

##### 6.9.4.2. Middle Frequency (155 MHz)

|                          |                        |
|--------------------------|------------------------|
| Carrier Frequency (MHz): | 155                    |
| Power (dBm):             | 37                     |
| Limit (dBc):             | $50 + 10 \log(5) = 57$ |

---

All emissions are more than 20 dB below the limit.

##### 6.9.4.3. Highest Frequency (174 MHz)

|                          |                        |
|--------------------------|------------------------|
| Carrier Frequency (MHz): | 174                    |
| Power (dBm):             | 37                     |
| Limit (dBc):             | $50 + 10 \log(5) = 57$ |

---

All emissions are more than 20 dB below the limit.

## 6.10. FREQUENCY STABILITY [§§ 2.1055 & 90.213]

### 6.10.1. Limits

See 47 CFR 90.213 for requirements.

| Frequency Range<br>(MHz) | Channel Bandwidth<br>(kHz) | Frequency Tolerance (ppm)               |                 |                              |
|--------------------------|----------------------------|-----------------------------------------|-----------------|------------------------------|
|                          |                            | <sup>1</sup> Fixed and Base<br>Stations | Mobile Stations |                              |
|                          |                            |                                         | Over 2 watts    | <sup>2</sup> 2 watts or less |
| 150–174 MHz              | 6.25                       | 1.0                                     | 2.0             | 2.0                          |
|                          | 12.5                       | 2.5                                     | 5.0             | 5.0                          |
|                          | 25                         | 5.0                                     | 5.0             | 50                           |

- 1 Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150–174 MHz band and 2.5 ppm in the 421–512 MHz band.
- 2 Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.

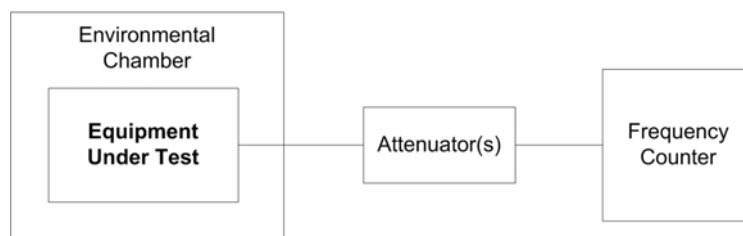
### 6.10.2. Method of Measurements

FCC 47 CFR 2.1055

### 6.10.3. Test Equipment List

| Test Instruments               | Manufacturer   | Model No. | Serial No. | Frequency Range      |
|--------------------------------|----------------|-----------|------------|----------------------|
| Frequency Counter              | EIP            | 545A      | 02683      | 10 Hz-18 GHz         |
| Attenuator                     | Weinschel Corp | 48-30-34  | BM5354     | DC - 18 GHz          |
| Temperature & Humidity Chamber | Tenney         | T5        | 9723B      | -40° to +60° C range |

### 6.10.4. Test Arrangement



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**6.10.5. Test Data**

|                                           |                               |
|-------------------------------------------|-------------------------------|
| <b>Center Frequency:</b>                  | 136 MHz                       |
| <b>Full Power Level:</b>                  | 5 Watts                       |
| <b>Frequency Tolerance Limit:</b>         | $\pm 2.5$ ppm or $\pm 340$ Hz |
| <b>Max. Frequency Tolerance Measured:</b> | +29 Hz or 0.2 ppm             |
| <b>Input Voltage Rating:</b>              | 28/12 VDC                     |

| Ambient Temperature (°C) | CENTER FREQUENCY & RF POWER OUTPUT VARIATION |                                                    |                                                        |
|--------------------------|----------------------------------------------|----------------------------------------------------|--------------------------------------------------------|
|                          | Supply Voltage (Nominal)<br>28/12 Vdc        | Supply Voltage (Battery End Point)<br>23.8/10.2Vdc | Supply Voltage (Battery Fully Charged)<br>32.2/13.8Vdc |
|                          | Hz                                           | Hz                                                 | Hz                                                     |
| -30                      | +29                                          | N/A                                                | N/A                                                    |
| -20                      | +4                                           | N/A                                                | N/A                                                    |
| -10                      | -3                                           | N/A                                                | N/A                                                    |
| 0                        | +1                                           | N/A                                                | N/A                                                    |
| +10                      | +1                                           | N/A                                                | N/A                                                    |
| +20                      | -1                                           | +1                                                 | -1                                                     |
| +30                      | -1                                           | N/A                                                | N/A                                                    |
| +40                      | -3                                           | N/A                                                | N/A                                                    |
| +50                      | -3                                           | N/A                                                | N/A                                                    |

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## 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<br>(Radiated Emissions)                                                                                                                              | PROBABILITY<br>DISTRIBUTION | UNCERTAINTY (+ dB) |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|--------------------|---------------|
|                                                                                                                                                                   |                             | 3 m                | 10 m          |
| Antenna Factor Calibration                                                                                                                                        | Normal (k=2)                | $\pm 1.0$          | $\pm 1.0$     |
| Cable Loss Calibration                                                                                                                                            | Normal (k=2)                | $\pm 0.3$          | $\pm 0.5$     |
| EMI Receiver specification                                                                                                                                        | Rectangular                 | $\pm 1.5$          | $\pm 1.5$     |
| Antenna Directivity                                                                                                                                               | Rectangular                 | $\pm 0.5$          | $\pm 0.5$     |
| Antenna factor variation with height                                                                                                                              | Rectangular                 | $\pm 2.0$          | $\pm 0.5$     |
| Antenna phase center variation                                                                                                                                    | Rectangular                 | 0.0                | $\pm 0.2$     |
| Antenna factor frequency interpolation                                                                                                                            | Rectangular                 | $\pm 0.25$         | $\pm 0.25$    |
| Measurement distance variation                                                                                                                                    | Rectangular                 | $\pm 0.6$          | $\pm 0.4$     |
| Site imperfections                                                                                                                                                | Rectangular                 | $\pm 2.0$          | $\pm 2.0$     |
| Mismatch: Receiver VRC $\Gamma_1 = 0.2$<br>Antenna VRC $\Gamma_R = 0.67(\text{Bi}) 0.3 (\text{Lp})$<br>Uncertainty limits $20\text{Log}(1 \pm \Gamma_1 \Gamma_R)$ | U-Shaped                    | +1.1<br>-1.25      | $\pm 0.5$     |
| System repeatability                                                                                                                                              | Std. Deviation              | $\pm 0.5$          | $\pm 0.5$     |
| 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:

$$U = 2u_c(y) = 2x(+2.19) = +4.38 \text{ dB} \quad \text{And} \quad U = 2u_c(y) = 2x(-2.21) = -4.42 \text{ dB}$$

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## 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).
- If 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,  $x = T_x \text{ on} / (T_x \text{ on} + T_x \text{ off})$  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.

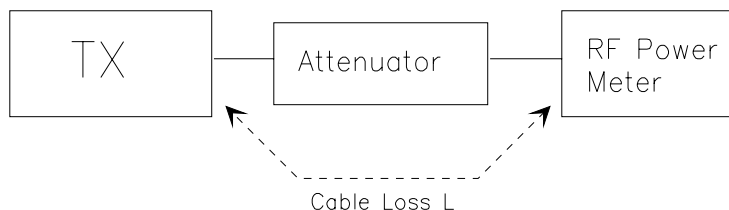
**Step 2:** Calculation of Average EIRP. See Figure 1

- 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:

$$\text{EIRP} = A + G + 10\log(1/x)$$

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

**Figure 1.**



## 8.2. RADIATED POWER MEASUREMENTS (ERP & EIRP) USING SUBSTITUTION METHOD

### 8.2.1. Maximizing RF Emission Level (E-Field)

- (a) The measurements was performed with full rf output power and modulation.
- (b) Test was performed at listed 3m open area test site (listed with FCC, IC, ITI, NVLAP, ACA & VCCI).
- (c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
- (d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
- (e) 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  
 $E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$

- (f) Set the EMI Receiver and #2 as follows:

Center Frequency: test frequency  
Resolution BW: 100 kHz  
Video BW: same  
Detector Mode: positive  
Average: off  
Span: 3 x the signal bandwidth

- (g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
- (h) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
- (i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
- (j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
- (k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
- (l) Repeat for all different test signal frequencies

### 8.2.2. 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  
 $E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$

- (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:

$$P = P1 - L1 = (P2 + L2) - L1 = P3 + A + L2 - L1$$

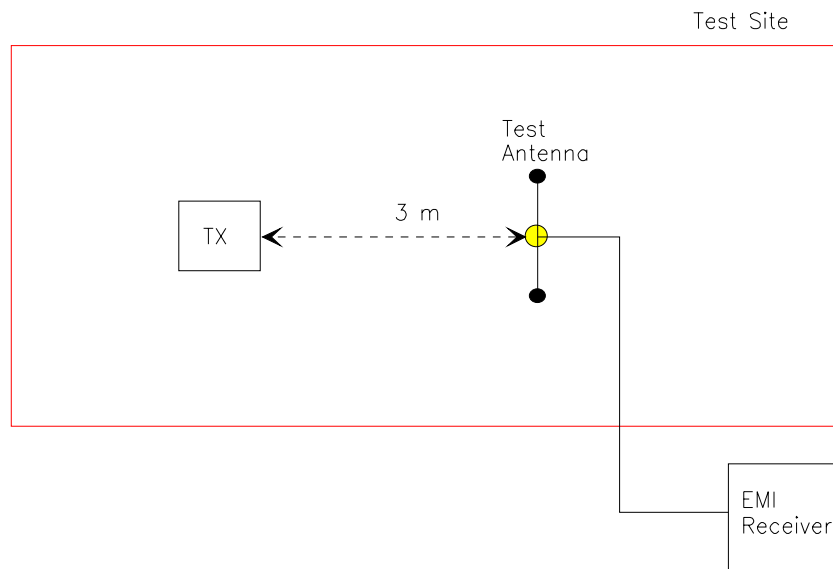
$$EIRP = P + G1 = P3 + L2 - L1 + A + G1$$

$$ERP = EIRP - 2.15 \text{ dB}$$

$$\text{Total Correction factor in EMI Receiver \# 2} = L2 - L1 + G1$$

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)  
 (p) Repeat step (d) to (o) for different test frequency  
 (q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.  
 (r) 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**