# MEASUREMENT/TECHNICAL REPORT

# Company: Airvana
# FRN: 0007-3801-73
# Model: 800002
# FCC ID: QHY800002

Description: This is a report to support a request for an original grant of equipment authorization.

Equipment Type: Licensed Base Station for Part 24 (PCB)


Report prepared for:

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Report prepared by:

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## Introduction

This report is an application for Certification of a Transmitter operating pursuant to 47 CFR Part 24 Subpart E. The model number covered by this report is 800002. This report is designed to demonstrate the compliance of this device with the requirements outlined in 47 CFR Part 24 using the methods outlined in 47 CFR Part 2.

**Statement of Conformity**

The  have been found to conform with the following parts of the 47 CFR as detailed below:

| Part 2 | Part 15 | Comments |
|---|---|---|
| 2.925 | | The label is shown in the label exhibit.  It is attached to the side of the Radio Module and is visible during installation. |
| 2.1049 | | Measurements were taken of the Occupied (99%) Bandwidth. |
| 2.1046 | 24.232 | The EUT meets the peak output power limit specified in 24.232. |
| 2.1055 | 24.235 | Frequency stability with regard to temperature and voltage variations is sufficient to ensure that the fundamental emission will stay within the authorized frequency block. |
| 2.1051 | 24.238 | All spurious emissions outside the authorized frequency block meet the limit specified in 24.238. |

**Test Methodology**

Emissions testing was performed according to the procedures in ANSI C63.4 (1992). The testing was performed at an antenna to EUT distance of 10 meter(s) below 1GHz and a distance of 3 or 1 meter(s) above 1GHz. The device's performance was investigated to 20GHz. The EUT was powered by a 24V DC power supply. The output power of the EUT was set to 42W which will be the maximum allowable output setting for the device. This device consists of three identical transmitter outputs of which one was selected for testing. An antenna is not included with this device. Since the device is installed in one orientation, the emissions were maximized around the vertical axis and the maximum reading was recorded.

All other performance tests were made in accordance with the procedures outlined in Part 2 of CFR 47.

**Test Facility**

*Curtis-Straus LLC*
All testing for the range 30MHz–20GHz was performed at Curtis-Straus (A2LA Certificate Number 1627-01). The open area test site used to collect the radiated data is located at 527 Great Road, Littleton, MA 01460. Site “M” was used.

**Test Equipment Used**

## *SPECTRUM ANALYZERS*

| x | Analyzer | Model No. | Company | Serial No. | Calibration Due |
|---|---|---|---|---|---|
| X | **WHITE** 9kHz-22GHz | 8593E | HP | 3547U01252 | 25-JAN-2003 |
| X | **YELLOW** 9kHz-2.9GHz | 8594E | HP | 3523A01958 | 03-JUL-2003 |

## *OPEN AREA TEST SITES (OATS)*

| x | Site | FCC Code | IC Code | VCCI Code | Calibration Due |
|---|---|---|---|---|---|
| X | **"M"** Maine | 93448 | IC 2762-M | R-904/ C-480 | 04-FEB-2004 |

## *ANTENNAS*

| x | Antenna | Model No. | Company | Serial No. | Calibration Due |
|---|---|---|---|---|---|
| X | **GREEN-BLACK** Bilog: 30MHz-2GHz | CBL6112B | Chase | 2412 | 11-JUL-2004 |
| X | **ORANGE** Horn: 1-18GHz | 3115 | EMCO | 0004-6123 | 27-MAY-2003 |
| X | **WHITE** Std Gain Horn: 18-26.5GHz | 3160-09 | EMCO | 9610-1068 | 26-JUN-2003 |

## *PREAMPLIFIERS / ATTENUATORS*

| x | Preamplifier | Model No. | Company | Serial No. | Calibration Due |
|---|---|---|---|---|---|
| X | **BLACK** 0.01-2000MHz | ZFL-1000-LN | MiniCircuits/ C-S | n/a | 22-MAR-2003 |
| X | **ORANGE-BLACK** 1-20GHz | SMC-12A | MITEQ | 690639 | 06-AUG-2002 |
| X | **YELLOW** 18-26.5GHz | AFS4-18002650-60-8P-4 | MITEQ | 467559 | 29-AUG-2002 |
| X | **20DB ATTENUATOR** 0.03-20 GHz | PE 7019-20 | Pasternack Enterprises | 01 | 13-JUN-2003 |

Unless otherwise noted the calibration interval is one year. All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

# Measurement Results

## Emission Limit Calculation

47 CFR 24.238(a) states that "*On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB.*" Therefore, the limit is:

{10 log (Power[in mW]) – (43 + (10 log (Power[in W])))}dBm
{10 log (P *1000) – (43 + (10 log (P)))}dBm
{10 log (1000) – 43}dBm
**-13dBm**

## Operating Frequency

This device operates in the range 1931.25MHz-1988.75MHz

***Emissions at Antenna Port (Conducted)***

**Date:** 2-Jul-02 **Company:** Airvana **Work Order:** C0514
**Engineer:** Evan Gould **EUT Desc:** BTS **Test Site:** "M"
**Frequency Range:** 30MHz-20GHz **Analyzer:** White
**Channel:** 25 **Center Frequency:** 1931.25MHz **Measured -26dB Bandwidth:** 1.43MHz
**Occupied Bandwidth:** 1.25MHz

| Frequency (GHz) | Reading (dBm) | 50W/20dB Attenuator Factor (dBm) | 20dB Attenuator Factor (dBm) | Cable Factor (dBm) | Adjusted Reading (dBm) | 47 CFR Part 24 Subpart E Limit (dBm) | Margin (dB) | Result (Pass/Fail) |
|---|---|---|---|---|---|---|---|---|
| **Fundamental; Average Reading** | | | | | | | | |
| 1.9312 | -3.2 | 18.4 | 19.2 | 1.9 | 36.3 | 50 (100W) | -13.7 | Pass |
| **Lower Band Edge; Average Reading** | | | | | | | | |
| 1.93 | -54.5 | 18.4 | 19.2 | 1.9 | -15 | -13 | -2 | Pass |

***Table Result:*** Pass by -2 dB ***Worst Freq:*** 1.93 GHz

**30MHz-1GHz >>** **Cable:** blue microflex **Attenuators:** Pasternack PE7019-20
**1GHz-20GHz >>** **Cable:** blue microflex **Attenuators:** Pasternack PE7019-20 & PE7004-20

***Emissions at Antenna Port (Conducted)***

**Date:** 2-Jul-02 **Company:** Airvana **Work Order:** C0514
**Engineer:** Evan Gould **EUT Desc:** BTS **Test Site:** "M"
**Frequency Range:** 30MHz-20GHz **Analyzer:** White
**Channel:** 600 **Center Frequency:** 1960MHz **Measured -26dB Bandwidth:** 1.44MHz
**Occupied Bandwidth:** 1.255MHz

| Frequency (GHz) | Reading (dBm) | 50W/20dB Attenuator Factor (dBm) | 20dB Attenuator Factor (dBm) | Cable Factor (dBm) | Adjusted Reading (dBm) | 47 CFR Part 24 Subpart E Limit (dBm) | Margin (dB) | Result (Pass/Fail) |
|---|---|---|---|---|---|---|---|---|
| **Fundamental; Average Reading** | | | | | | | | |
| 1.96 | -3.8 | 18.4 | 19.2 | 1.9 | 35.7 | 50 (100W) | -14.3 | Pass |

***Table Result:*** Pass by -14.3 dB ***Worst Freq:*** 1.96 GHz

**30MHz-1GHz >>** **Cable:** blue microflex **Attenuators:** Pasternack PE7019-20
**1GHz-20GHz >>** **Cable:** blue microflex **Attenuators:** Pasternack PE7019-20 & PE7004-20

## *Emissions at Antenna Port (Conducted)*

**Date:** 2-Jul-02 **Company:** Airvana **Work Order:** C0514
**Engineer:** Evan Gould **EUT Desc:** BTS **Test Site:** "M"
**Frequency Range:** 30MHz-20GHz **Analyzer:** White

**Channel:** 1175 **Center Frequency:** 1988.75MHz **Measured -26dB Bandwidth:** 1.41MHz
**Occupied Bandwidth:** 1.255MHz

| Frequency | Reading | 50W/20dB Attenuator Factor | 20dB Attenuator Factor | Cable Factor | Adjusted Reading | 47 CFR Part 24 Subpart E | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Limit | Margin | Result |
| (GHz) | (dBm) | (dBm) | (dBm) | (dBm) | (dBm) | (dBm) | (dB) | (Pass/Fail) |
| **Fundamental; Average Reading** | | | | | | | | |
| 1.989 | -5.3 | 18.4 | 19.2 | 1.9 | 34.2 | 50 (100W) | -15.8 | Pass |
| **Upper Band Edge; Average Reading** | | | | | | | | |
| 1.99 | -63.9 | 18.4 | 19.2 | 1.9 | -24.4 | -13 | -11.4 | Pass |

***Table Result:*** Pass by -11.4 dB ***Worst Freq:*** 1.99 GHz

**30MHz-1GHz >>** **Cable:** blue microflex **Attenuators:** Pasternack PE7019-20
**1GHz-20GHz >>** **Cable:** blue microflex **Attenuators:** Pasternack PE7019-20 & PE7004-20

## *Frequency Stability vs. Temperature & Voltage Variations*

**Date:** 1-Jul-02 **Company:** Airvana **Analyzer:** Yellow
**Engineer:** Evan Gould **EUT Desc:** BTS **Work Order:** C0514

**Channel:** 25 **Center Frequency:** 1931.25MHz

| Temp | Reading 1 | Reading 2 | Reading 3 | Reading 4 | Reading 5 |
|---|---|---|---|---|---|
| **-30°C** | 1930.5625**(MHz)** | 1930.5650 | 1930.5663 | 1930.5650 | 1930.5650 |
| | 0 **(delta in MHz)** | +0.0025 | +0.0038 | +0.0025 | +0.0025 |
| **-20°C** | 1930.5613 | 1930.5663 | 1930.5625 | 1930.5613 | 1930.5600 |
| | -0.0012 | +0.0038 | 0 | -0.0012 | -0.0025 |
| **-10°C** | 1930.5613 | 1930.5651 | 1930.5613 | 1930.5651 | 1930.5663 |
| | -0.0012 | +0.0026 | -0.0012 | +0.0026 | +0.0038 |
| **0°C** | 1930.5626 | 1930.5638 | 1930.5651 | 1930.5613 | 1930.5600 |
| | +0.0001 | +0.0013 | +0.0026 | -0.0012 | -0.0025 |
| **10°C** | 1930.5625 | 1930.5613 | 1930.5625 | 1930.5613 | 1930.5613 |
| | 0 | -0.0012 | 0 | -0.0012 | -0.0012 |
| **20°C** | 1930.5650 | 1930.5625 | 1930.5625 | 1930.5650 | 1930.5600 |
| 22.95V | +0.0025 | 0 | 0 | +0.0025 | -0.0025 |
| **20°C** | 1930.5625 | 1930.5600 | 1930.5625 | 1930.5625 | 1930.5625 |
| 27V | 0 | -0.0025 | 0 | 0 | **nominal** |
| **20°C** | 1930.5650 | 1930.5625 | 1930.5613 | 1930.5613 | 1930.5625 |
| 30V | +0.0025 | 0 | -0.0012 | -0.0012 | 0 |
| **30°C** | 1930.5600 | 1930.5625 | 1930.5600 | 1930.5625 | 1930.5638 |
| | -0.0025 | 0 | -0.0025 | 0 | +0.0013 |
| **40°C** | 1930.5600 | 1930.5600 | 1930.5600 | 1930.5600 | 1930.5575 |
| | -0.0025 | -0.0025 | -0.0025 | -0.0025 | -0.005 |
| **50°C** | 1930.5600 | 1930.5600 | 1930.5600 | 1930.5625 | 1930.5625 |
| | -0.0025 | -0.0025 | -0.0025 | 0 | 0 |

**Result:** Passes 47 CFR 24.235 requirement
**Note:** EUT's protection circuitry does not allow operation above 30V.

| ***Frequency Stability vs. Temperature & Voltage Variations*** | | | | | |
|---|---|---|---|---|---|
| **Date:** 1-Jul-02 | | **Company:** Airvana | | **Analyzer:** Yellow | |
| **Engineer:** Evan Gould | | **EUT Desc:** BTS | | **Work Order:** C0514 | |
| **Channel:** 1175 | | | | **Center Frequency:** 1988.75MHz | |
| **Temp** | **Reading 1** | **Reading 2** | **Reading 3** | **Reading 4** | **Reading 5** |
| **-30°C** | 1989.4363**(MHz)** | 1989.4350 | 1989.4363 | 1989.4363 | 1989.4363 |
| | 0 **(delta in MHz)** | -0.0013 | 0 | 0 | 0 |
| **-20°C** | 1989.4351 | 1989.4351 | 1989.4351 | 1989.4351 | 1989.4363 |
| | -0.0012 | -0.0012 | -0.0012 | -0.0012 | 0 |
| **-10°C** | 1989.4351 | 1989.4351 | 1989.4363 | 1989.4351 | 1989.4326 |
| | -0.0012 | -0.0012 | 0 | -0.0012 | -0.0037 |
| **0°C** | 1989.4350 | 1989.4325 | 1989.4350 | 1989.4363 | 1989.4350 |
| | -0.0013 | -0.0038 | -0.0013 | 0 | -0.0013 |
| **10°C** | 1989.4350 | 1989.4350 | 1989.4350 | 1989.4350 | 1989.4350 |
| | -0.0013 | -0.0013 | -0.0013 | -0.0013 | -0.0013 |
| **20°C** 22.95V | 1989.4350 | 1989.4325 | 1989.4350 | 1989.4350 | 1989.4350 |
| | -0.0013 | -0.0038 | -0.0013 | -0.0013 | -0.0013 |
| **20°C** 27V | 1989.4350 | 1989.4325 | 1989.4350 | 1989.4350 | 1989.4363 |
| | -0.0013 | -0.0038 | -0.0013 | -0.0013 | **nominal** |
| **20°C** 30V | 1989.4350 | 1989.4363 | 1989.4350 | 1989.4350 | 1989.4325 |
| | -0.0013 | 0 | -0.0013 | -0.0013 | -0.0038 |
| **30°C** | 1989.4350 | 1989.4350 | 1989.4350 | 1989.4350 | 1989.4363 |
| | -0.0013 | -0.0013 | -0.0013 | -0.0013 | 0 |
| **40°C** | 1989.4350 | 1989.4350 | 1989.4350 | 1989.4350 | 1989.4350 |
| | -0.0013 | -0.0013 | -0.0013 | -0.0013 | -0.0013 |
| **50°C** | 1989.4350 | 1989.4375 | 1989.4350 | 1989.4350 | 1989.4350 |
| | -0.0013 | +0.005 | -0.0013 | -0.0013 | -0.0013 |
| **Result:** Passes 47 CFR 24.235 requirement | | | | | |
| **Note:** EUT's protection circuitry does not allow operation above 30V. | | | | | |

**NOTE:** The fundamental frequency did not stray from its authorized frequency block throughout the entire stability test.

## Radiated Emissions Table

*Curtis-Straus LLC*

**Date:** 03-Jul-02 **Company:** Airvana **Test Site:** "M"
**Engineer:** Evan Gould **EUT Desc:** BTS **Work Order:** C0541

**Frequency Range:** 30MHz-20GHz **Measurement Distance:** 3 m

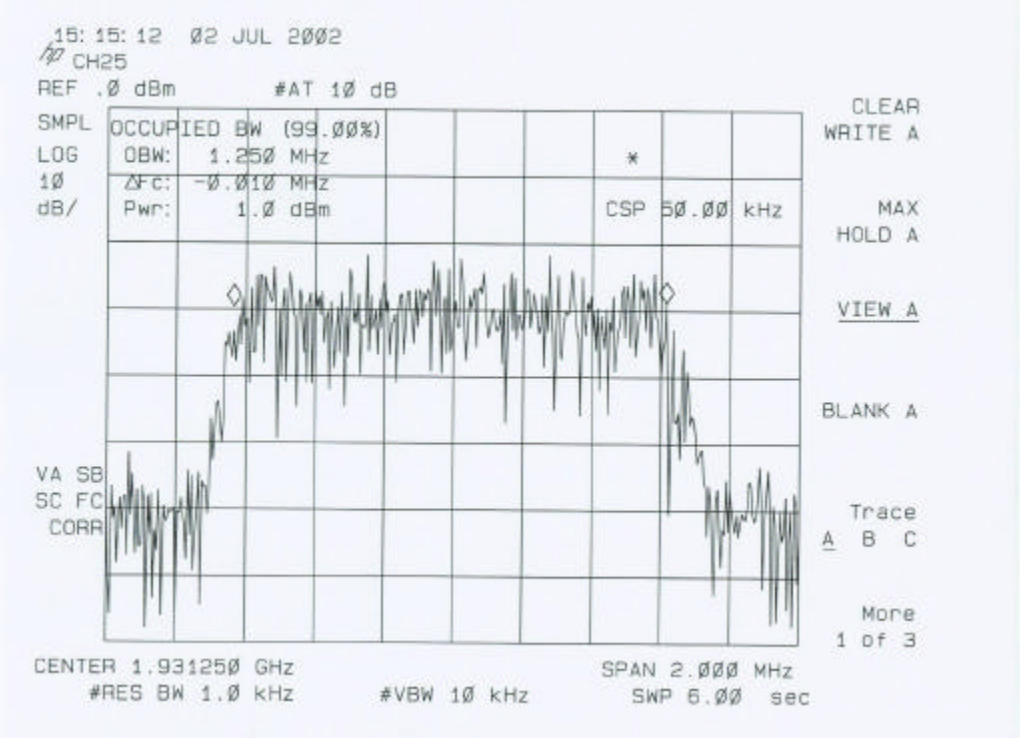
**Notes:** No spurious measurements were within 20dB of the limit, therefore substitution method was not implemented to further investigate these emissions. **Analyzer:** White

| Antenna Polarization (H / V) | Frequency (MHz) | Reading (dBµV) | Preamp Factor (dB) | Antenna Factor (dB/m) | Cable Factor (dB) | Adjusted Reading (dBµV/m) | Adjusted Reading (dBm) | 47 CFR Part 24 Subpart E Limit (dBm) | Margin (dB) | Result (Pass/Fail) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Radiated Spurious Emissions** | | | | | | | | | | |
| H | 1032.0 | 42.1 | 24.0 | 25.1 | 0.9 | 44.1 | -62.9 | -13.0 | -49.9 | Pass |
| H | 1200.0 | 40.1 | 24.1 | 25.6 | 1.0 | 42.6 | -64.4 | -13.0 | -51.4 | Pass |
| noise floor | 3862.5 | 28.5 | 24.1 | 34.0 | 2.1 | 40.5 | -66.5 | -13.0 | -53.5 | Pass |
| noise floor | 5793.75 | 30.1 | 23.7 | 36.3 | 2.4 | 45.1 | -61.9 | -13.0 | -48.9 | Pass |
| noise floor | 7725.0 | 34.0 | 21.7 | 37.8 | 3.0 | 53.1 | -53.9 | -13.0 | -40.9 | Pass |
| noise floor | 9656.25 | 33.0 | 21.2 | 38.7 | 3.4 | 53.9 | -53.1 | -13.0 | -40.1 | Pass |
| noise floor | 11587.5 | 36.7 | 20.1 | 41.3 | 4.6 | 62.5 | -44.5 | -13.0 | -31.5 | Pass |
| noise floor | 13518.75 | 36.5 | 20.7 | 40.1 | 5.1 | 61.0 | -46.0 | -13.0 | -33.0 | Pass |
| noise floor | 15450.0 | 38.0 | 21.9 | 41.6 | 5.1 | 62.8 | -44.2 | -13.0 | -31.2 | Pass |
| noise floor | 17381.25 | 38.4 | 21.4 | 43.9 | 6.1 | 67.0 | -40.0 | -13.0 | -27.0 | Pass |
| noise floor (1m) | 19312.5 | 40.9 | 21.4 | 40.3 | 6.9 | 66.7 | -40.3 | -13.0 | -27.3 | Pass |

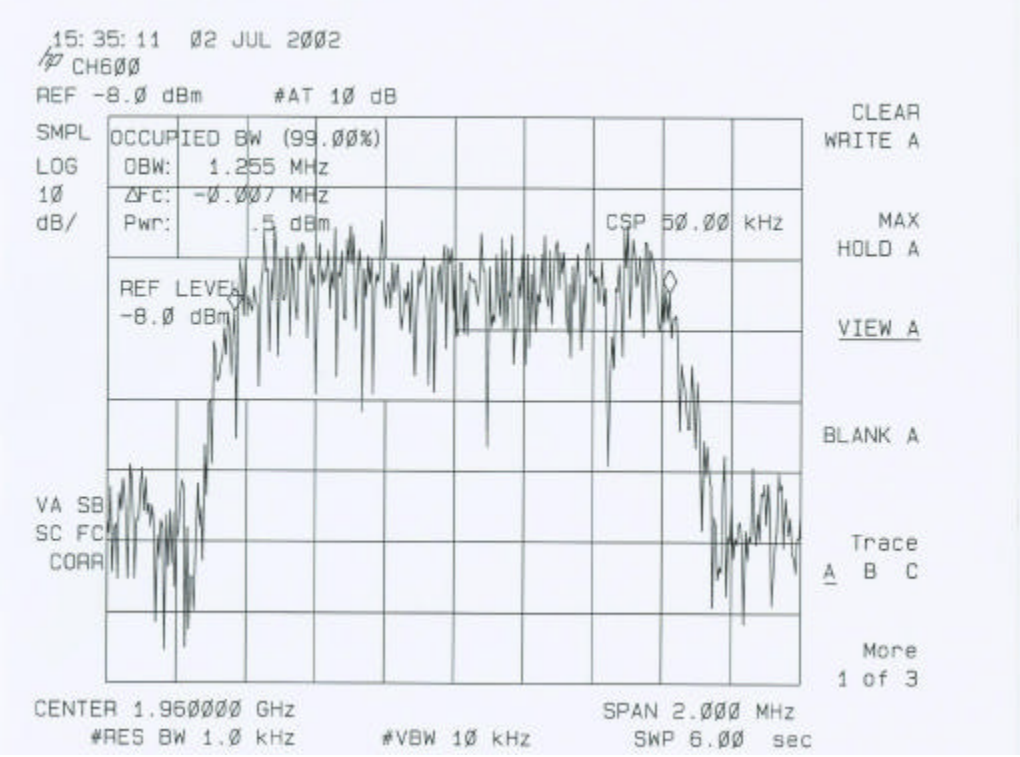
**30-1000MHz >>** **Pre-Amp:** Black **Cable:** 65 ft RG8A/U **Antenna:** Green-Blk
**1-18GHz >>** **Pre-Amp:** Or-Blk **Cable:** 3m Microflex **Antenna:** Orange Horn
**18-20GHz >>** **Pre-Amp:** Yellow **Cable:** 3m Microflex **Antenna:** White Horn

**Emissions Plots**

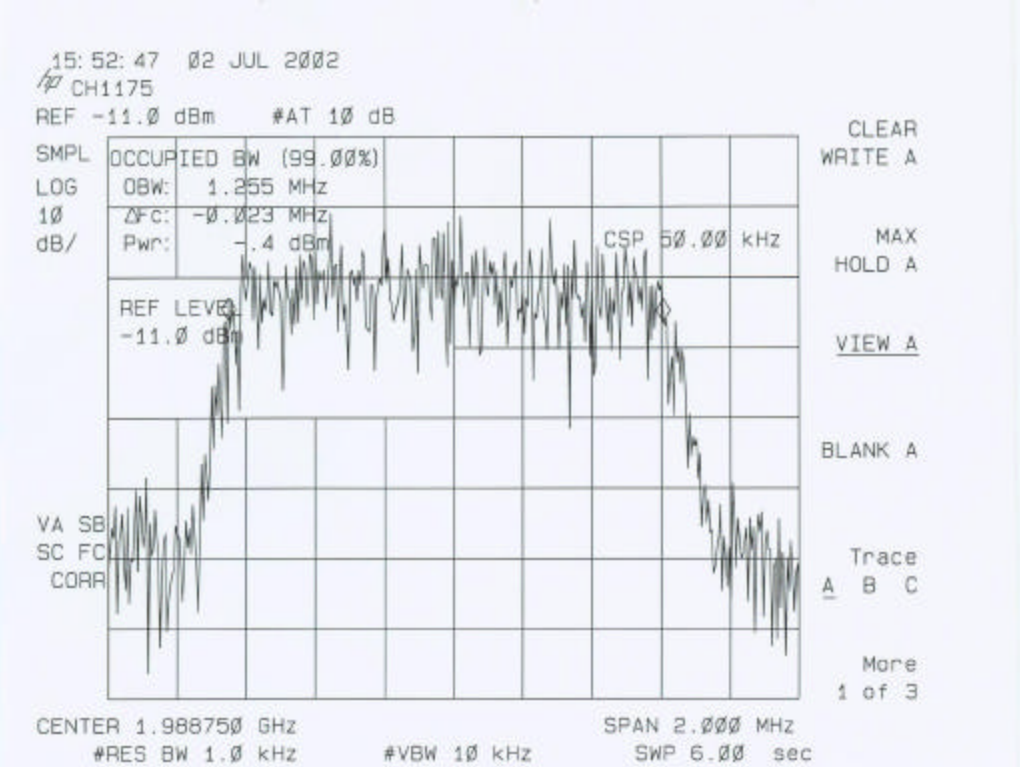
Channel 25 Occupied Bandwidth



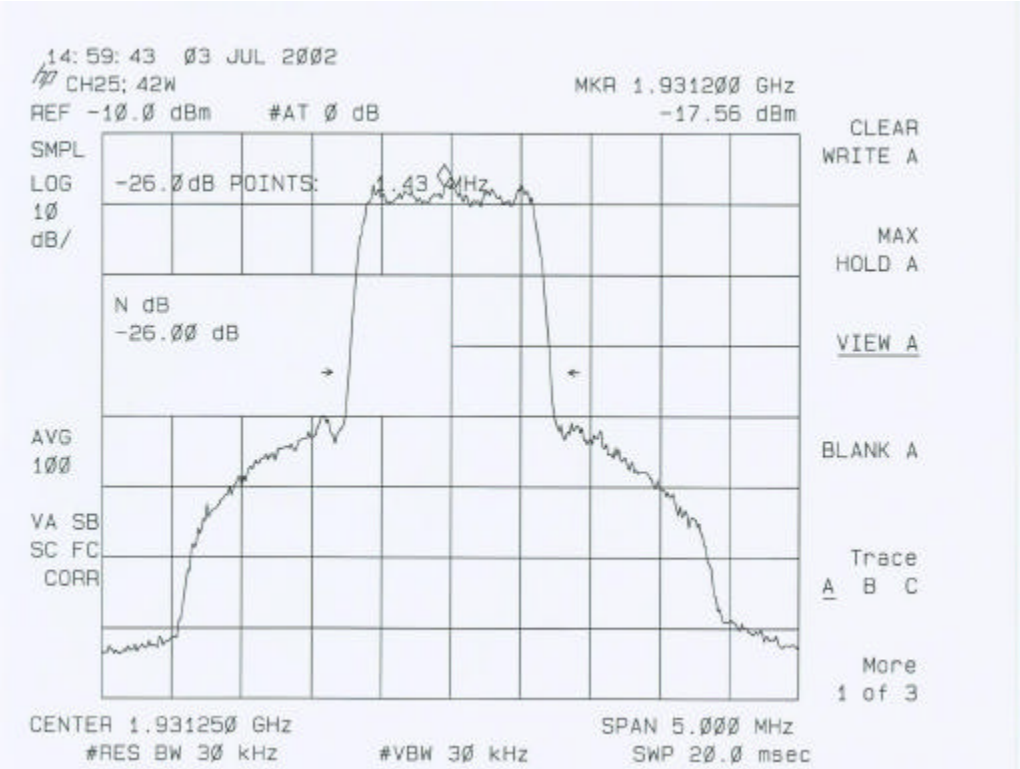

Channel 600 Occupied Bandwidth



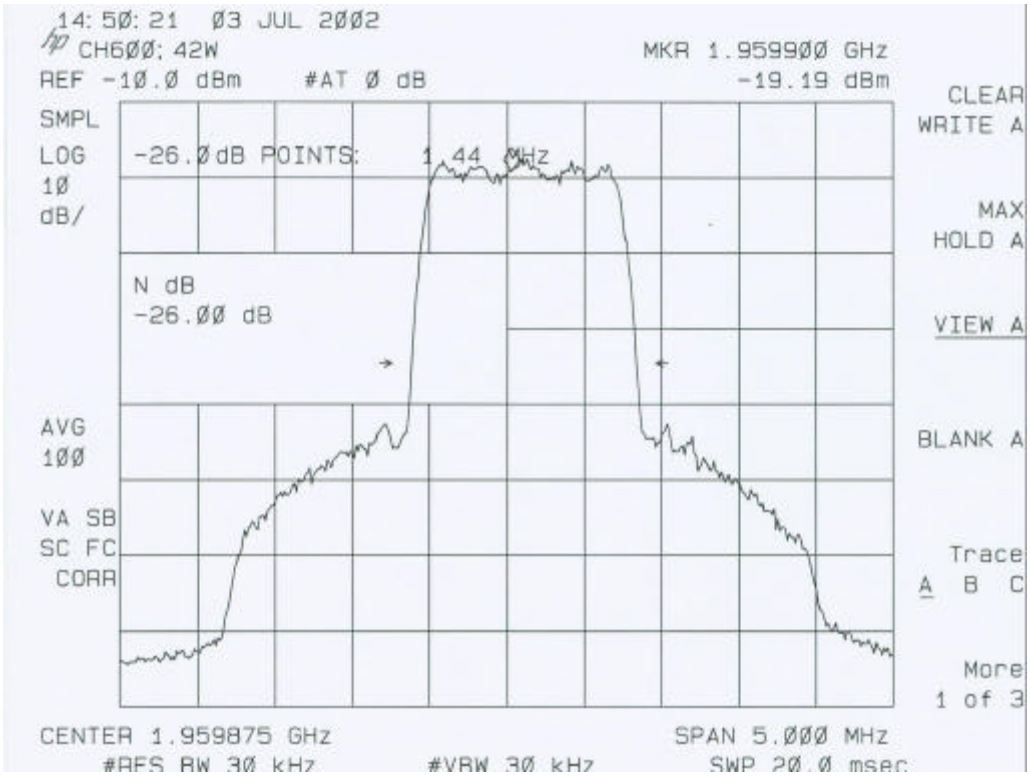
Channel 1175 Occupied Bandwidth



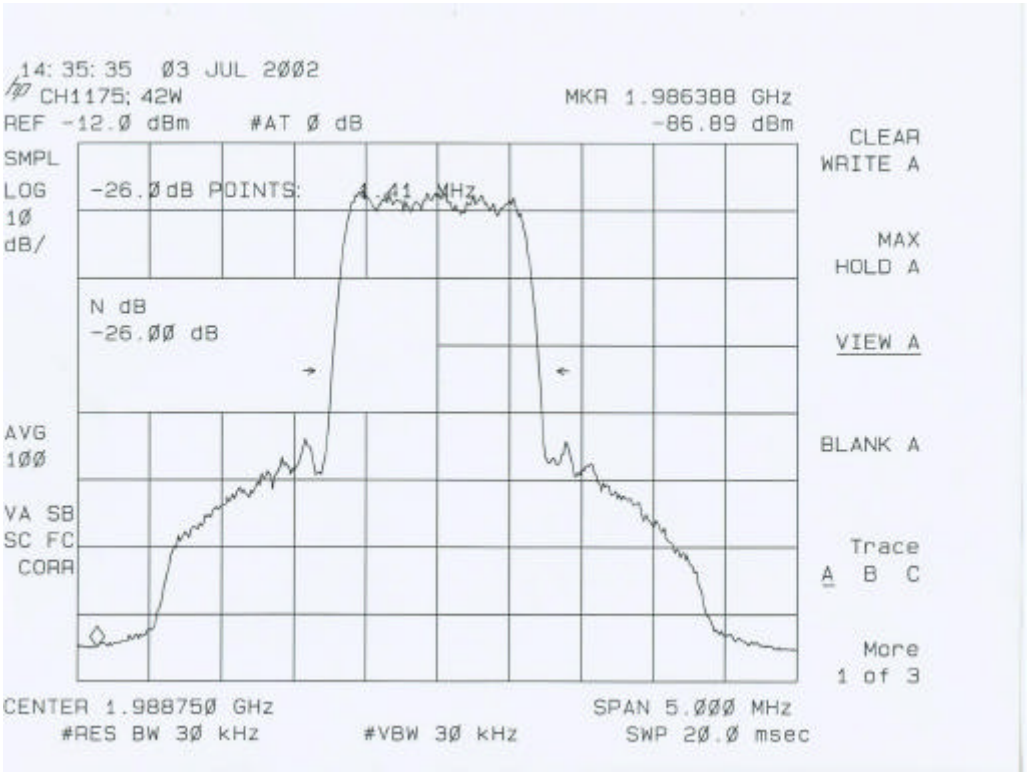

Channel 25 –26dB Bandwidth



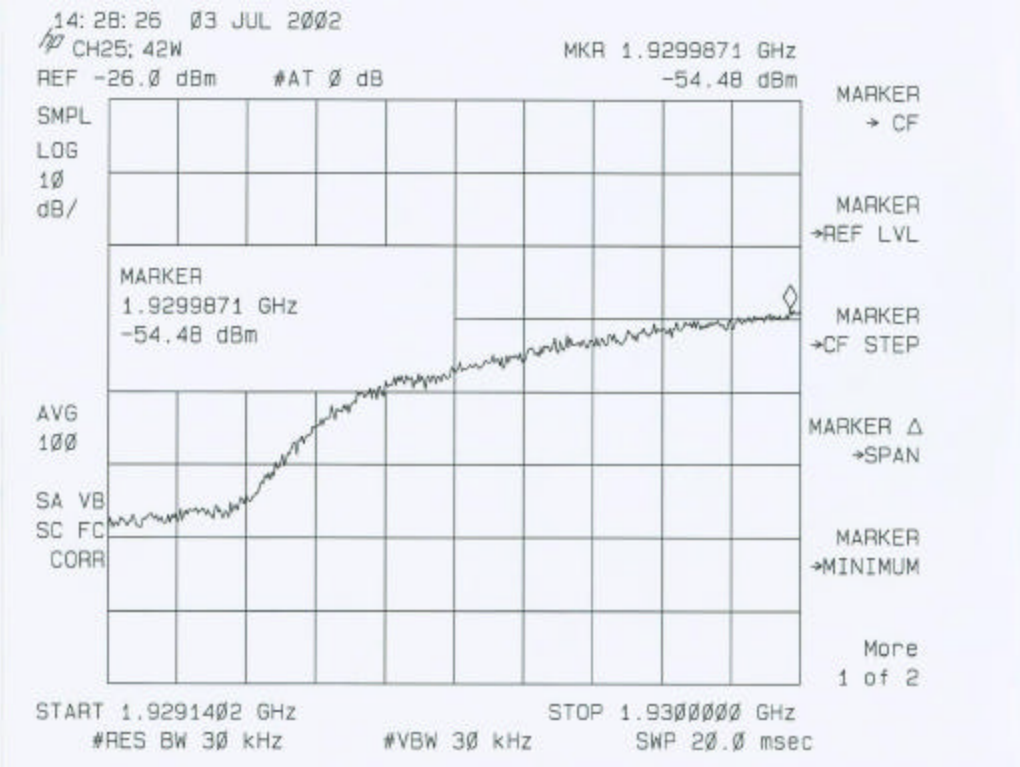
Channel 600 –26dB Bandwidth




Channel 1175 –26dB Bandwidth



Channel 25 Lower Band Edge




Channel 1175 Upper Band Edge