Engineering and Testing for EMC and Safety Compliance

# TYPE PERMISSIVE CHANGE CERTIFICATION REPORT

**Vertex Standard Co., LTD.**
**4-8-8, Nakameguro, Meguro-ku, Tokyo 153-8644, Japan**
**81-(0) 3-5725-6122**

## MODEL: VX-900U/600U
## FCC ID: K66VX-900U

***June 12, 2001***

| STANDARDS REFERENCED FOR THIS REPORT | |
|---|---|
| PART 2: 1999 | FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS |
| PART 15: 1999 | §15.109: RADIATED EMISSIONS LIMITS |
| PART 22: 1998 | PUBLIC MOBILES SERVICES |
| PART 74: 1998 | LOW POWER AUXILIARY STATION |
| PART 90: 1998 | PRIVATE LAND MOBILE RADIO SERVICES |
| PART 95 (A): 1998 | GENERAL MOBILE RADIO SERVICES |
| ANSI C63.4-1992 | STANDARD FORMAT MEASUREMENT/TECHNICAL REPORT PERSONAL COMPUTER AND PERIPHERALS |
| ANSI/TIA/EIA603- 1992 | LAND MOBILE FM OR PM COMMUNICATIONS EQUIPMENT MEASUREMENT AND PERFORMANCE STANDARDS |
| ANSI/TIA/EIA 603-1-1998 | ADDENDUM TO ANSI/TIA/EIA 603-1992 |
| RSS-119, Issue 5: 1996 | LAND MOBILE AND FIXED RADIO TRANSMITTERS AND RECEIVERS.27.41 TO 960.0 MHZ |

| FCC Rules Parts | Frequency Range | Output Power (W) | Freq. Tolerance | Emission Designator |
|---|---|---|---|---|
| 90.210 | 450-489.95 MHz | 5 | 2.5 ppm | 11K0F3E |
| 90, 22, 74, 95 | 450-489.95MHz | 5 | 2.5 ppm | 16K0F3E |
| 90.210 | 450-489.95 MHz | 2.5 | 2.5 ppm | 11K0F3E |
| 90, 22, 74, 95 | 450-489.95 MHz | 2.5 | 2.5 ppm | 16K0F3E |
| 90.210 | 450-489.95 MHz | 1.0 | 2.5 ppm | 11K0F3E |
| 90, 22, 74, 95 | 450-489.95MHz | 1.0 | 2.5 ppm | 16K0F3E |
| 90.210 | 450-489.95 MHz | 0.25 | 2.5 ppm | 11K0F3E |
| 90, 22, 74, 95 | 450-489.95 MHz | 0.25 | 2.5 ppm | 16K0F3E |
| **Canadian** | **Frequency Range** | **Output Power (W)** | **Freq. Tolerance** | |
| RSS-119 | 450-489.95 MHz | 5 | 2.5 ppm | 16K0F3E |
| RSS-119 | 450-4859.95MHz | 5 | 2.5 ppm | 11K0F3E |

## REPORT PREPARED BY:

**EMC Engineer: Desmond Fraser**
**Technical Writer: Melissa Carter**

*Document Number: 2000468*



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# 1 GENERAL INFORMATION

The following Report of a class II Type permissive change is prepared on behalf of ***Vertex Standard Co., LTD*** in accordance with the Federal Communications Commissions and Industry Canada Rules and Regulations. The Equipment Under Test (EUT) was the ***VX_900U/600U***. The test results reported in this document relate only to the item that was tested. **The VX-900U and the VX-600U are identical both electrically and mechanically. The only between both units is an LCD display that is removed from the VX-900U to form the VX-600U. The VX-900U/600U supports 5 watt, 2.5 watt, 1 watt, and 0.25 watt. It was determined during testing that the VX-900U 5 watt and 2.5 watt were the worst-case. Hence through out this report the VX-900U was used for testing. The manufacturer intends to remove the LCD display measured at 1 inch by 0.5 inch leaving all other electronic and mechanical supporting components.**

All measurements contained in this application were conducted in accordance with FCC Rules and Regulations CFR 47, Industry Canada RSS-119, and ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 1992. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

## 1.1 TEST FACILITY

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report dated March 3, 1994, submitted to and approved by the Federal Communication Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).

## 1.2 RELATED SUBMITTAL(S)/GRANT(S)

# FCC ID: K66VX-900U

This is a class II permissive change report. The frequency range has been expanded through software program from 484.750 MHz to 489.950 MHz.

## 2 CONFORMANCE STATEMENT

We, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. No modifications were made to the equipment during testing in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the FCC Part 2, FCC Part 90 and Industry Canada RSS-119 Certification methodology.

Signature:  Date: June 12, 2001

Typed/Printed Name: Desmond A. Fraser Position: President
(NVLAP Signatory)

*Accredited by the National Voluntary Accreditation Program for the specific scope of accreditation under Lab Code 200061-0.*

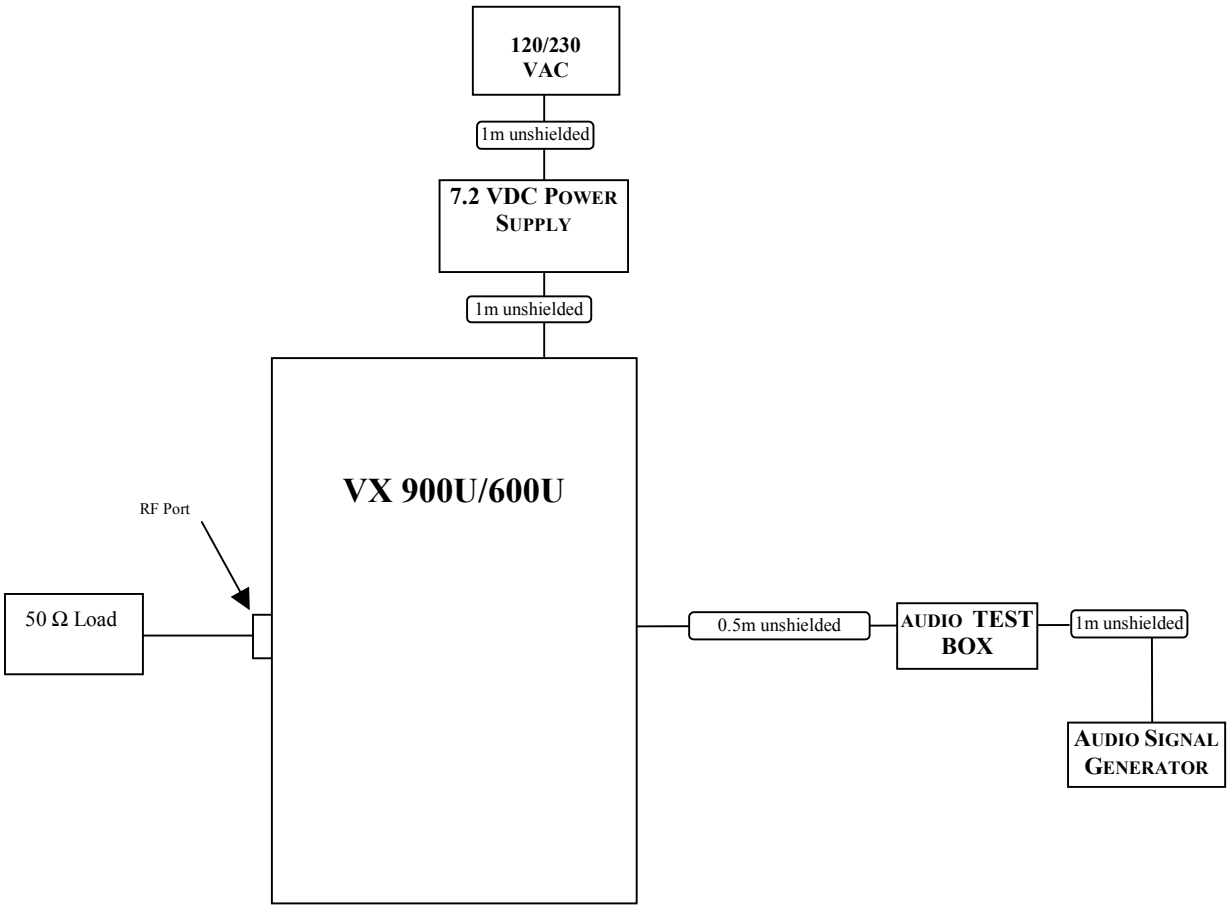
**Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.**

# 3 TESTED SYSTEM DETAILS

Listed below is the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable.

| PART | MANUFACTURER | MODEL | SERIAL NUMBER | FCC ID |
|---|---|---|---|---|
| **RADIO** | **VERTEX** | **VX-900U/600U** | **N/A** | **K66VX-900U** |
| ANTENNA WHIP | VERTEX | N/A | N/A | N/A |
| AUDIO TEST CABLE | VERTEX | N/A | N/A | N/A |
| AUDIO TEST BOX | VERTEX | TUNING I/F | N/A | N/A |
| BATTERY | VERTEX | FNB-V68L1 | N/A | N/A |
| MICROPHONE / SPEAKER | VERTEX | MH-50E7A | N/A | N/A |

## 3.1 CONFIGURATION OF TESTED SYSTEM



# 4 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FI(dBuV/m) = SAR(dBuV) + SCF(dB/m)
FI = Field Intensity
SAR = Spectrum Analyzer Reading
SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

SCF(dB/m) = - PG(dB) + AF(dB/m) + CL(dB)

SCF = Site Correction Factor
PG = Pre-amplifier Gain
AF = Antenna Factor
CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI(uV/m) = 10^{FI(dBuV/m)/20}$$

For example, assume a signal at a frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is -11.5 dB/m. The actual radiated field strength is calculated as follows:

49.3 dBuV - 11.5 dB/m = 37.8 dBuV/m

$$10^{37.8/20} = 10^{1.89} = 77.6 \text{ uV/m}$$

# 5 CONDUCTED MEASUREMENT

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50 ohm / 50 microhenry Line Impedance Stabilization Network (EUT LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 400 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 400 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. No video filter less than 10 times the resolution bandwidth was used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from (150/450) kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in this report.

## 5.1 CONDUCTED MEASUREMENT TEST RESULTS

Mode: 467.525MHz High Wide band
NEUTRAL SIDE (Line 1)

| Temperature: 74°F Humidity: 34% | | | | | | |
|---|---|---|---|---|---|---|
| **Emission Frequency (MHz)** | **Test Detector** | **Analyzer Reading (dBuV)** | **Site Correction Factor (dB)** | **Emission Level (dBuV)** | **FCC B Limit (dBuV)** | **FCC B Margin (dB)** |
| 0.464 | Pk | 23.3 | 0.8 | 24.1 | 48.0 | -23.9 |
| 0.596 | Pk | 23.1 | 0.9 | 24.0 | 48.0 | -24.0 |
| 0.798 | Pk | 21.0 | 0.9 | 21.9 | 48.0 | -26.1 |
| 2.698 | Pk | 19.3 | 1.5 | 20.8 | 48.0 | -27.2 |
| 8.490 | Pk | 16.2 | 2.3 | 18.5 | 48.0 | -29.5 |
| 15.700 | Pk | 18.6 | 3.0 | 21.6 | 48.0 | -26.4 |
| 27.810 | Pk | 16.4 | 3.4 | 19.8 | 48.0 | -28.2 |

Hot Side (L2)

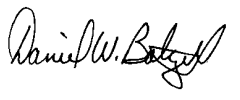
Mode: 467.525 MHz high power wide band

HOT SIDE (Line 2)

| Temperature: 74°F Humidity: 34% | | | | | | |
|---|---|---|---|---|---|---|
| **Emission Frequency (MHz)** | **Test Detector** | **Analyzer Reading (dBuV)** | **Site Correction Factor (dB)** | **Emission Level (dBuV)** | **FCC B Limit (dBuV)** | **FCC B Margin (dB)** |
| 0.613 | Pk | 21.1 | 0.8 | 21.9 | 48.0 | -26.1 |
| 0.795 | Pk | 19.4 | 0.9 | 20.3 | 48.0 | -27.7 |
| 0.984 | Pk | 20.1 | 0.9 | 21.0 | 48.0 | -27.0 |
| 2.130 | Pk | 20.2 | 1.3 | 21.5 | 48.0 | -26.5 |
| 11.440 | Pk | 18.9 | 2.6 | 21.5 | 48.0 | -26.5 |
| 22.050 | Pk | 17.8 | 3.4 | 21.2 | 48.0 | -26.8 |

**Pk = Peak; QP = Quasi-Peak; Av = Average**

**TEST PERSONNEL:**

**Signature:**  **Date:** June 12, 2001

**Typed/Printed Name**: Daniel Baltzell

# 6 RADIATED MEASUREMENT

Before final measurements of radiated emissions were made on the open-field three meter range, the EUT was scanned indoors at a three meter distance in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three-meter, open-field test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations.

*Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech quality manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.*

# 7 FCC RULES AND REGULATIONS PART 2 §2.1046 (A): RF POWER OUTPUT: CONDUCTED

## 7.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.1

The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

## 7.2 TEST DATA

The following channel (in MHz) were tested: 450.025, 469.975, 489.950
The worst-case Output Power (highest) levels are shown.

**CARRIER OUTPUT POWER (UNMODULATED)**

| Power Setting | RF Power measured (Watt)* |
|---|---|
| Low1 | 2.5 |
| High | 5 |

*Measurement accuracy: +/- 3%

Rated Power:

| Power Setting | Rated Power (W) |
|---|---|
| Low1 | 2.5 |
| High | 5 |

## 7.3 TEST EQUIPMENT

| | | |
|---|---|---|
| Power Meter | HP437B | s/n 2949A02966 |
| | HP 8901A | s/n 2545A04102 (power mode) |
| Power Sensor | HP8481B | s/n 2702A05059 |
| Frequency Counter | HP8901A | s/n 2545A04102 (Frequency mode) |

# 8 PART 2.1046 (A) RF POWER OUTPUT: RADIATED - ERP

## 8.1 TEST PROCEDURE

Substitution Method:

The EUT was setup at an antenna to EUT distance of 3 meters on an open area test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane.

The physical arrangement of the EUT and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations.

The worst-case, maximum radiated emission was recorded and used as reference for the ERP measurement.

The EUT was then replaced by an ½ wave dipole antenna and polarized in accordance with the EUT's antenna polarization. The ½ wave dipole antenna was connected to a RF signal generator with a coaxial cable.

The search antenna height, and search antenna polarity was set to levels that produced the maximum reading obtained in step 3. The signal generator was adjusted to a level that produced the radiated emission level obtained in step 3.

The signal generator level was recorded and corrected by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal ½ wave dipole antenna. The signal generator corrected level is the ERP level

Calculation Method:

$$P_{Watt} = \frac{E_{v/m}{}^{2} x d_{m}{}^{2}}{30 x 1.64}$$

## 8.2 TEST DATA

Settings:

- High Power: 5 Watt delivered to antenna
- 5W VX-900U/600U radiated power measurements (3 meter)

| Frequency (MHz) | Level Measured (dBµV) | Site Factor (dB/m) | ERP Calculated (Watt) | ERP Substitution Method (dBm) |
|---|---|---|---|---|
| 450.025 | 106.0 | 30.8 | 5.0 | 37.0 |
| 467.975 | 104.5 | 31.7 | 6.0 | 37.8 |
| 489.950 | 102.6 | 31.8 | 5.0 | 37.0 |

*Antenna as specified by manufacturer (unity gain)
**Measurement accuracy is +/- 1.5 dB

## 8.3 TEST EQUIPMENT

Spectrum Analyzer HP8566B
Antenna Roberts ½ wave dipoles

# 9 FCC RULES AND REGULATIONS PART 2 §2.1051: SPURIOUS EMISSIONS AT ANTENNA TERMINALS

## 9.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, Section 2.2.13

The transmitter is terminated with a 50 Ω load and interfaced with a spectrum analyzer.
The transmitter is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1000 Hz.

## 9.2 TEST DATA

### 9.2.1 CFR PART 90 REQUIREMENTS

Frequency range of measurement per Part 2.1057: 9kHz to 10 x Fc

Limits: Mask B (dBm): P(dBm) – (43+10xLOG P(W))
Mask D (dBm): P(dBm) – (50+10xLOG P(W))

The following channel (in MHz) was investigated: 450.025, 467.525, and 484.975 in 5W, 2.5W, 1W and 0.25W mode for both 25KHz and 12.5 KHz channel spacing.

The worst case (unwanted emissions) channels are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

Channel1 (450.025 MHz) – 5 Watt and 12.5 kHz Channel Bandwidth: Mask D

| Frequency (MHz) | Level Measured (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|
| 830.050 | Noise floor | | |
| 1245.075 | Noise floor | | |
| 1660.100 | Noise floor | | |
| 2075.125 | Noise floor | | |
| 2490.150 | Noise floor | | |
| 2513.000 | -26.3 | -20.0 | -6.3 |
| 2905.175 | Noise floor | | |
| 3320.200 | Noise floor | | |
| 3735.225 | Noise floor | | |
| 4150.250 | Noise floor | | |

Channel 5 (467.525 MHz) – 5 Watt and 12.5 kHz Channel Bandwidth: Mask D

| Frequency (MHz) | Level Measured (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|
| 830.050 | Noise floor | | |
| 1245.075 | Noise floor | | |
| 1660.100 | Noise floor | | |
| 2075.125 | Noise floor | | |
| 2490.150 | Noise floor | | |
| 2905.175 | Noise floor | | |
| 3073.333 | -24.7 | -20.0 | -4.7 |
| 3320.200 | Noise floor | | |
| 3735.225 | Noise floor | | |
| 4150.250 | Noise floor | | |

Channel 7 (489.950MHz) – 5 Watt and 12.5 kHz Channel Bandwidth: Mask D

| Frequency (MHz) | Level Measured (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|
| 979.900 | -42.8 | -20 | -22.8 |
| 1469.850 | -53.6 | -20 | -33.6 |
| 1959.800 | Noise floor | | |
| 2449.750 | Noise floor | | |
| 2939.700 | Noise floor | | |
| 3429.650 | Noise floor | | |
| 3919.600 | Noise floor | | |
| 4409.550 | -45.20 | -20 | -25.2 |
| 4899.500 | Noise floor | | |

4.3 Test Equipment

Audio Generator:
Synthesized Level Generator HP3336B s/n 2127A00559
Selective Level Meter HP3585 s/n B032374

Spectrum Analyzer:
HP8564E s/n 3943A01719
HP8546A s/n 3525A00159

# 10 FCC RULES AND REGULATIONS PART 2 §2.1053 (A): FIELD STRENGTH OF SPURIOUS RADIATION

## 10.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.12

The transmitter is terminated with a 50 Ω load and is modulated with a 2,500 Hz sine wave at an input level 16 dB greater than that required to produce 50% of the rated system deviation at 1000 Hz.

Refer to section "Radiated Measurement" in this report for further information.

## 10.2 TEST DATA

The worst-case emissions test data are shown. The magnitude of emissions attenuated more than 20 dB below the FCC limit need not be recorded.

HIGH POWER

| 5Watt at 12.5 kHz channel spacing | | | | | | |
|---|---|---|---|---|---|---|
| Radiated Emissions (Channel 7 at 489.95 MHz)<br>Substitution Method | | | | | | |
| **Frequency** | **ERP S/G level (dBm)** | **Cable Loss*** | **Difference in gain (ref. to 1/2 wave dipole)** | **Emission level (dBm)** | **Limit (dBm) Mask D** | **Margin (dB)** |
| 979.900 | -58.84 | 2.97 | 32.37 | -23.5 | -20 | -3.5 |
| 1469.850 | -28.67 | 3.56 | 1.01 | -24.1 | -20 | -4.1 |
| 1959.800 | -46.00 | 4.39 | 3.11 | -38.5 | -20 | -18.5 |
| 2449.700 | -39.47 | 4.94 | 9.13 | -25.4 | -20 | -5.40 |
| 2939.700 | -46.00 | 5.78 | 6.22 | -34.0 | -20 | -14.0 |
| 3429.650 | Noise floor | 12.0 | | <-40 | | |
| 3919.600 | Noise floor | 13.5 | | <-40 | | |
| 4409.550 | Noise floor | 15.9 | | <-40 | | |
| 4899.500 | Noise floor | 17.8 | | <-40 | | |

*This insertion loss corresponds to the cable connecting the RF Signal Generator to the ½ wave dipole antenna.

## LOW POWER

| 489.950 | MHz | | | | | |
|---|---|---|---|---|---|---|
| Emission Frequency [MHz] | ERP S/G level [dBm] | Cable Loss [dB] | Correction Factor (ref. to 1/2 dipole) [dB] | Emission level [dBm] | Limit Mask D [dBm] | Margin [dB] |
| 979.90 | -57.84 | 2.97 | 32.37 | -22.50 | -20.00 | 2.50 |
| 1469.85 | -29.97 | 3.56 | 1.01 | -25.40 | -20.00 | 5.40 |
| 1959.80 | -39.30 | 4.39 | 3.11 | -31.80 | -20.00 | 11.80 |
| 2449.75 | -47.27 | 4.94 | 9.13 | -33.20 | -20.00 | 13.20 |
| 2939.70 | Noise floor | | | <-40 | | |
| 3429.65 | -56.36 | 6.66 | 11.80 | -37.90 | -20.00 | 17.90 |
| 3919.60 | Noise floor | | | <-40 | | |
| 4409.55 | Noise floor | | | <-40 | | |
| 4899.50 | Noise floor | | | <-40 | | |

### 10.3 TEST EQUIPMENT

Reference Antennas (Substitute Antenna):

| Frequency Range | Manufacturer | Model | Gain |
|---|---|---|---|
| 30-250MHz | Anritsu | MP534A | 0dB |
| 250-1000MHz | Anritsu | MP651A | 0dB |
| 1000MHz- | EMCO | 3115 | 6-16dBi |

Measurement Antennas:

| Frequency Range | Manufacturer | Model | Gain |
|---|---|---|---|
| 30MHz-3GHz | Schaffner-Chase | CBL6143 | 1-8dB |
| 3GHz- | EMCO | 3115 | 6-16dBi |

Antenna: CHASE CBL6112 s/n 2099
Amplifier: HP8449B s/n 3008A00505
Spectrum analyzer: HP8564E s/n 3943A01719

RF Signal Generator HP8648C s/n 3537A01741
Synthesized Sweeper HP83752A s/n 3610A00846

# 11 FCC RULES AND REGULATIONS PART 2 §2.1049 (C) (1): OCCUPIED BANDWIDTH

OCCUPIED BANDWIDTH - COMPLIANCE WITH THE EMISSION MASKS

## 11.1 TEST PROCEDURE

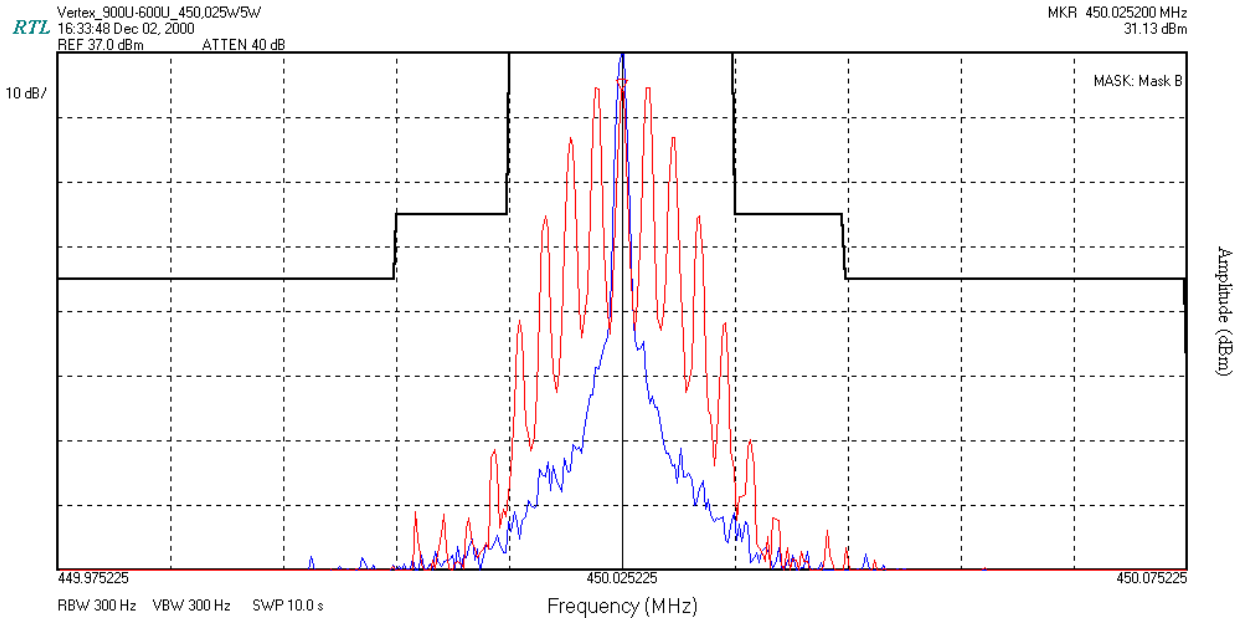
ANSI/TIA/EIA-603-1992, section 2.2.11

Device with audio modulation: Transmitter is modulated with a 2500 Hz sine wave at an input level of 16 dB greater than that required to produce 50% of rated system deviation at 1000 Hz.

Device with digital modulation: N/A

## 11.2 TEST DATA

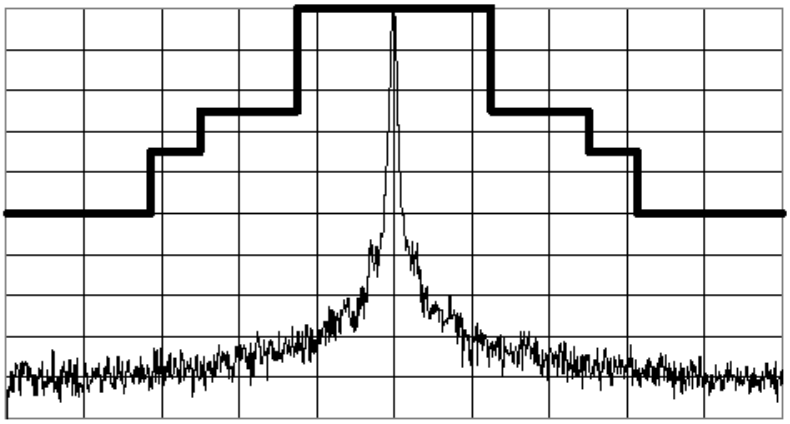
### 11.2.1 CHANNEL 1: 5W FOR 25 KHZ CHANNEL BANDWIDTH: MASK B (AUDIO MODULATION: 2,500 HZ)



### 11.2.2 CHANNEL 7: 5 W FOR 12.5 KHZ CHANNEL BANDWIDTH: MASK D (AUDIO MODULATION: 2,500 HZ)

Occuiped bandwidth

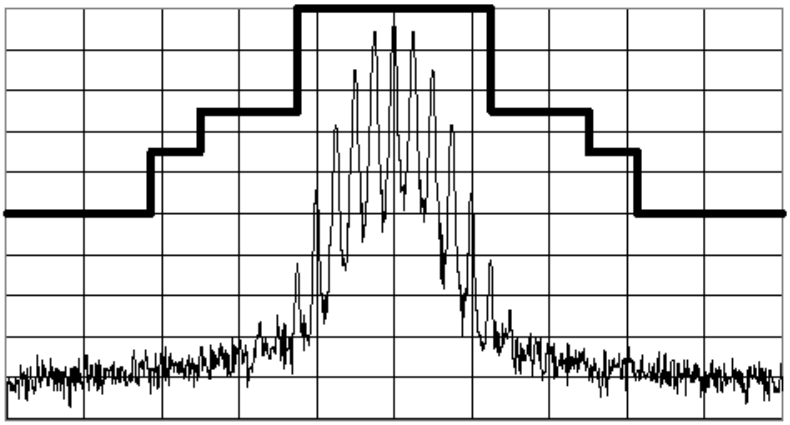
| | |
|---|---|
| CENTER FREQ | 489.95 MHz |
| SPAN | 100 KHz |
| REF LEVEL | 36.6 dBm |
| /DIV | 10 dB/ |
| ATT | 20 dB |
| OFFSET | 36.8 dB |
| RES BW | 300 Hz |
| VIDEO BW | 300 Hz |
| SWEEP TIME | 5 s |
| AVG | |



| | | | |
|---|---|---|---|
| Model Name | VX-900U | Transmit Frequency | 489.95 MHz |
| Serial Number | 1E050385 | Channel Spacing | 25 kHz |
| Power Setting | High | Modulation | None |

Occuiped bandwidth

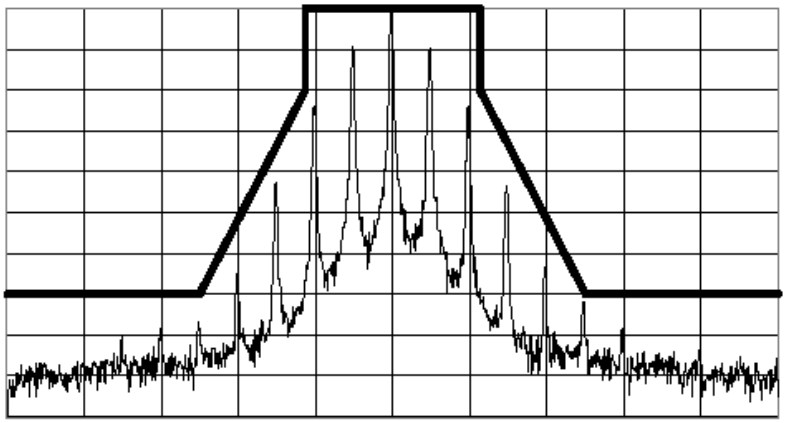
| | |
|---|---|
| CENTER FREQ | 489.95 MHz |
| SPAN | 100 KHz |
| REF LEVEL | 36.6 dBm |
| /DIV | 10 dB/ |
| ATT | 20 dB |
| OFFSET | 36.8 dB |
| RES BW | 300 Hz |
| VIDEO BW | 300 Hz |
| SWEEP TIME | 5 s |
| AVG | 0 |



| | | | |
|---|---|---|---|
| Model Name | VX-900U | Transmit Frequency | 489.95 MHz |
| Serial Number | 1E050385 | Channel Spacing | 25 kHz |
| Power Setting | High | Modulation | Voice |

Occuiped bandwidth

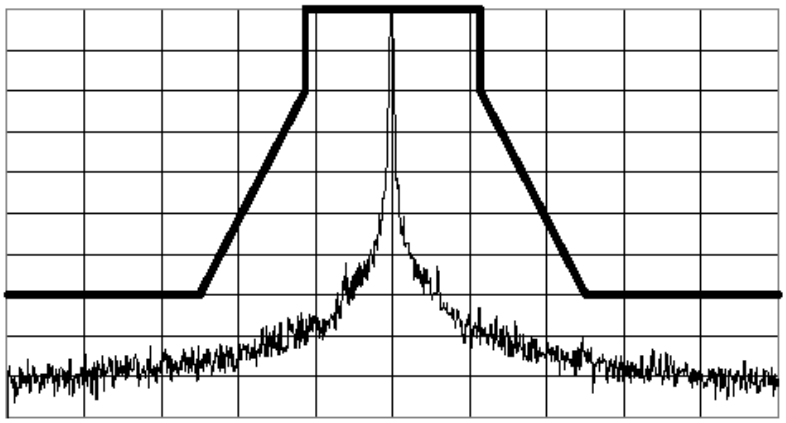
| | |
|---|---|
| CENTER FREQ | 489.9499 MHz |
| SPAN | 50 KHz |
| REF LEVEL | 36.6 dBm |
| /DIV | 10 dB/ |
| ATT | 20 dB |
| OFFSET | 36.8 dB |
| RES BW | 100 Hz |
| VIDEO BW | 100 Hz |
| SWEEP TIME | 30 s |
| AVG | 0 |



| | | | |
|---|---|---|---|
| Model Name | VX-900U | Transmit Frequency | 489.95 MHz |
| Serial Number | 1E050385 | Channel Spacing | 12.5 kHz |
| Power Setting | High | Modulation | Voice |

Occuiped bandwidth

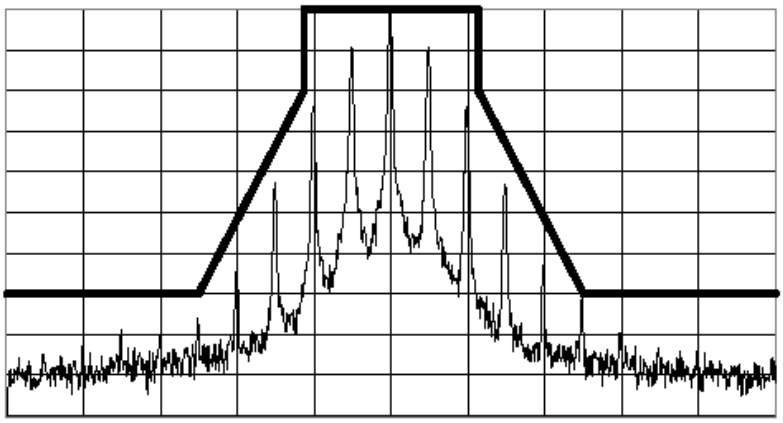
| | |
|---|---|
| CENTER FREQ | 489.9497 MHz |
| SPAN | 50 KHz |
| REF LEVEL | 29.1 dBm |
| /DIV | 10 dB/ |
| ATT | 20 dB |
| OFFSET | 36.8 dB |
| RES BW | 100 Hz |
| VIDEO BW | 100 Hz |
| SWEEP TIME | 30 s |
| AVG | |



| | | | |
|---|---|---|---|
| Model Name | VX-900U | Transmit Frequency | 489.95 MHz |
| Serial Number | 1E050385 | Channel Spacing | 12.5 kHz |
| Power Setting | Low | Modulation | None |

Occuiped bandwidth

| | |
|---|---|
| CENTER FREQ | 489.9497 MHz |
| SPAN | 50 KHz |
| REF LEVEL | 29.1 dBm |
| /DIV | 10 dB/ |
| ATT | 20 dB |
| OFFSET | 36.8 dB |
| RES BW | 100 Hz |
| VIDEO BW | 100 Hz |
| SWEEP TIME | 30 s |
| AVG | 0 |



| | | | |
|---|---|---|---|
| Model Name | VX-900U | Transmit Frequency | 489.95 MHz |
| Serial Number | 1E050385 | Channel Spacing | 12.5 kHz |
| Power Setting | Low | Modulation | Voice |

## 11.3 TEST EQUIPMENT

Spectrum Analyzer HP8564E s/n 3943A01719

# 12 FCC RULES AND REGULATION PART 2 §2.1055: FREQUENCY STABILITY

## 12.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.2

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +50°C.
The temperature was initially set to -30°C and a 2-hour period was observed for stabilization of the EUT.
The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½ an hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter.
Additionally, the power supply voltage of the EUT was varied from 85% to 115% of the nominal voltage.

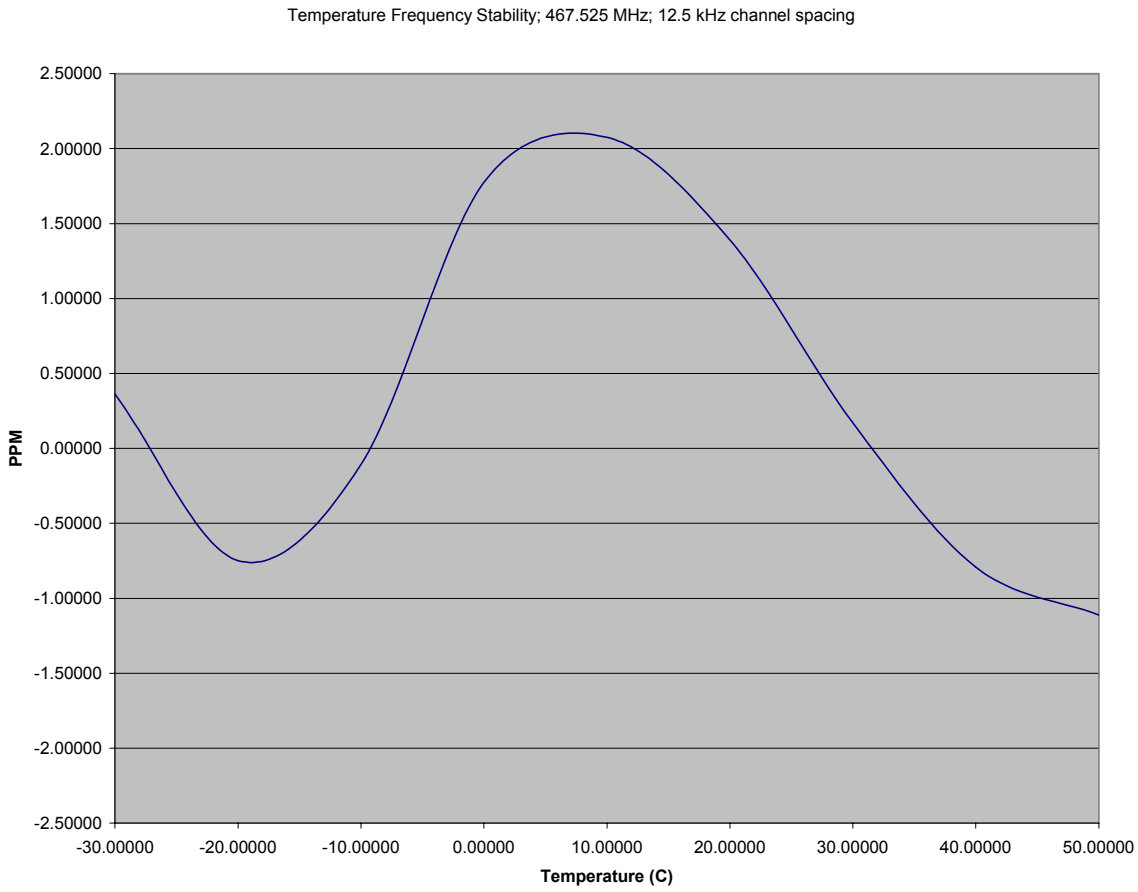
The worst-case test data are shown.

## 12.2 TEST DATA

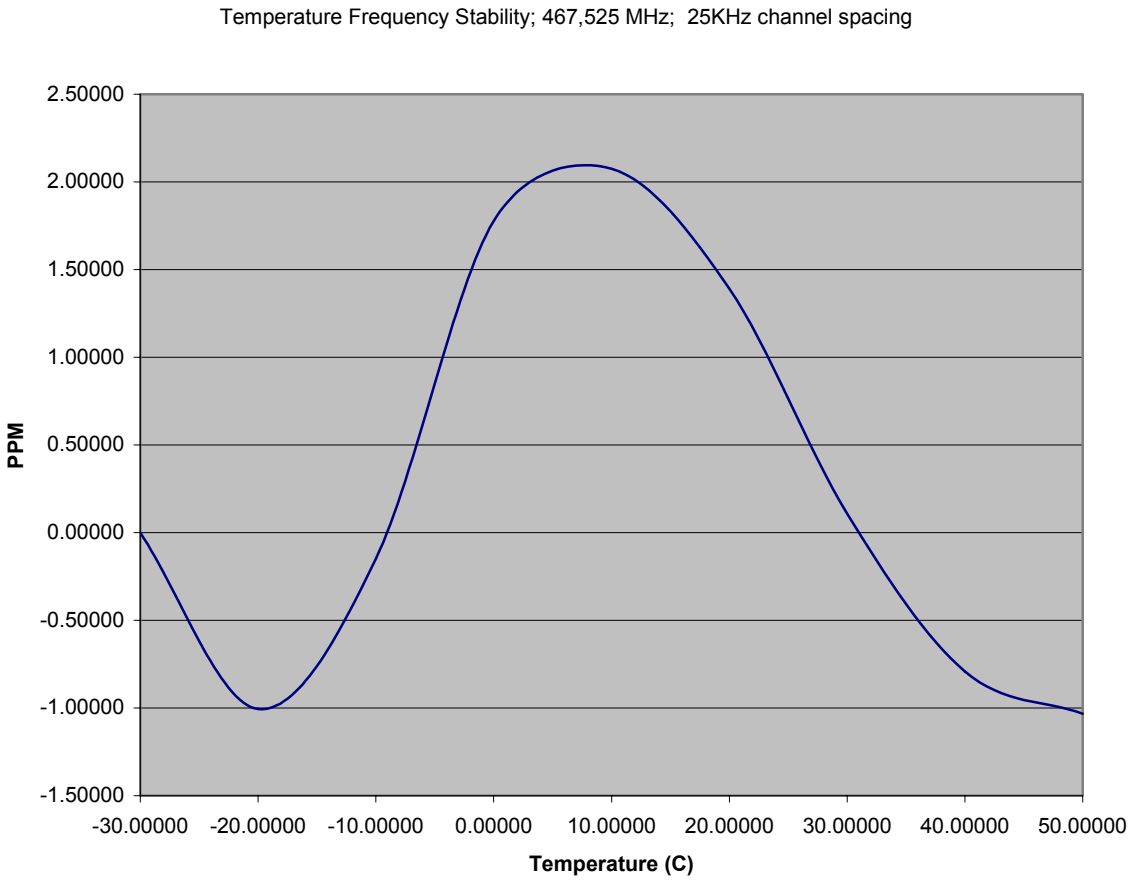
### 12.2.1 FREQUENCY STABILITY/TEMPERATURE VARIATION

Limit is 2.5 ppm for device with a 12.5 kHz channel bandwidth
Limit is 5 ppm for device with a 25 kHz channel bandwidth

The VX-900U/600U 5Watt radios was tested with 12.5 kHz and 25 kHz channel bandwidth. The worst-case temperature deviation on the following plots.



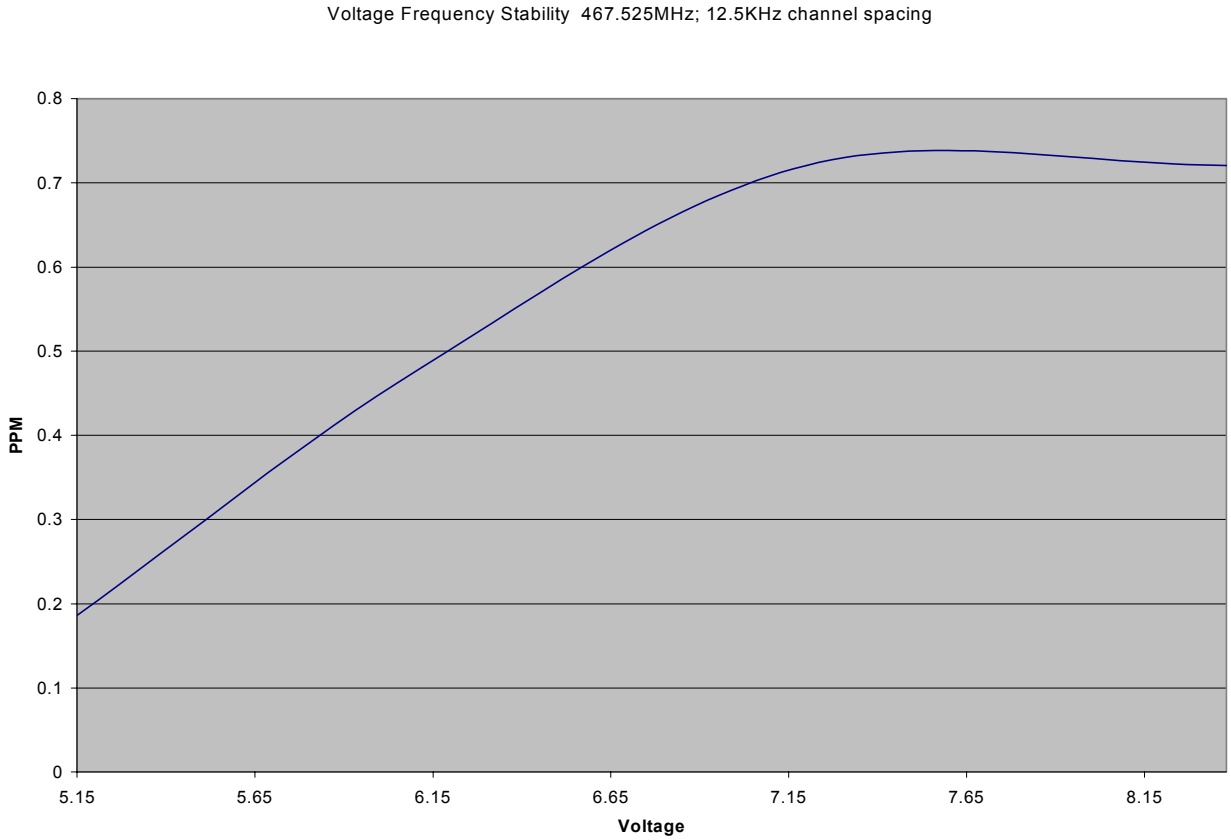

| Temperature (C) | Frequency (MHz) | ppm |
|---|---|---|
| -30.00000 | 467.52517 | 0.36362 |
| -20.00000 | 467.52465 | -0.74862 |
| -10.00000 | 467.52495 | -0.10695 |
| 0.00000 | 467.52583 | 1.77531 |
| 10.00000 | 467.52597 | 2.07476 |
| 20.00000 | 467.52565 | 1.39030 |
| 30.00000 | 467.52508 | 0.17111 |
| 40.00000 | 467.52463 | -0.79140 |
| 50.00000 | 467.52448 | -1.11224 |




| Temperature (C) | Frequency (MHz) | ppm |
|---|---|---|
| -30.00000 | 467.52500 | 0.00000 |
| -20.00000 | 467.52453 | -1.00529 |
| -10.00000 | 467.52493 | -0.14972 |
| 0.00000 | 467.52583 | 1.77531 |
| 10.00000 | 467.52597 | 2.07476 |
| 20.00000 | 467.52565 | 1.39030 |
| 30.00000 | 467.52505 | 0.10695 |
| 40.00000 | 467.52463 | -0.79140 |
| 50.00000 | 467.52452 | -1.03310 |

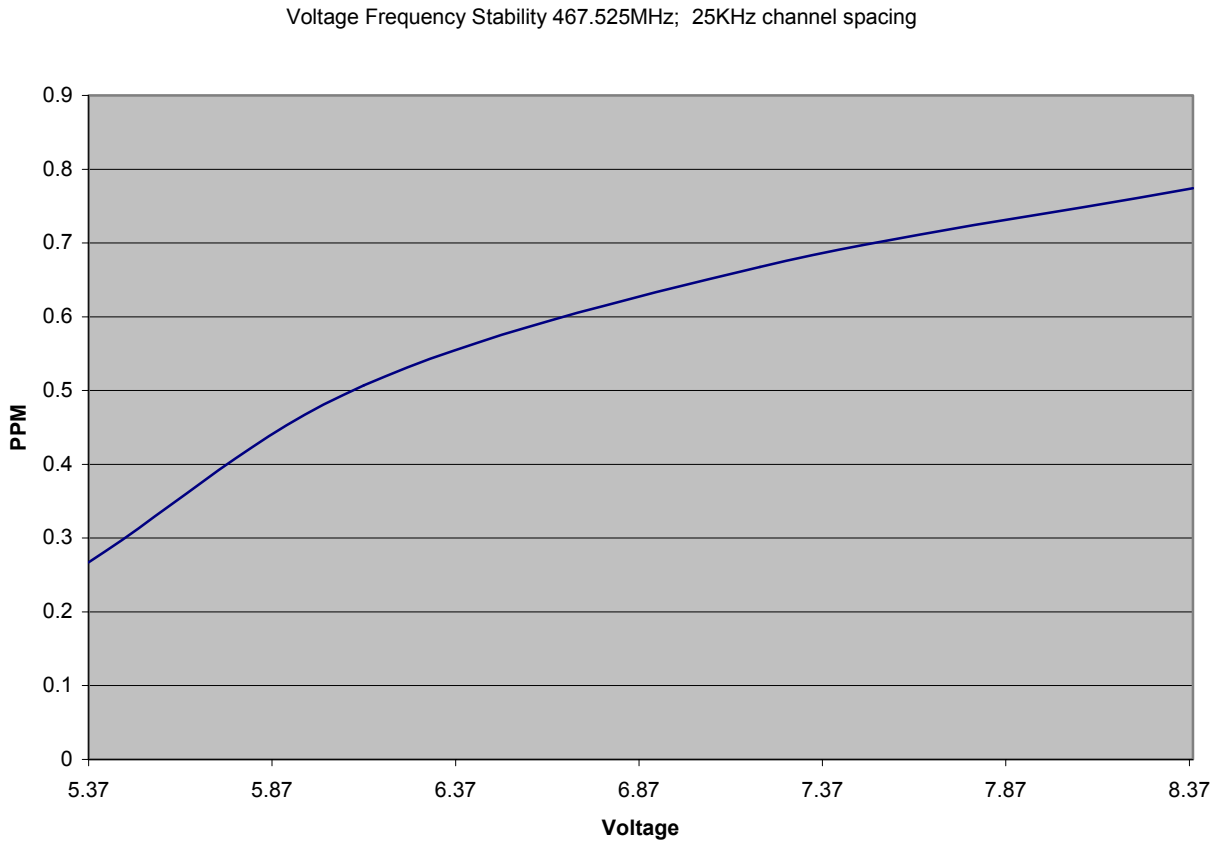
### 12.2.2 FREQUENCY STABILITY/VOLTAGE VARIATION

Assigned Frequency 467.525 MHz




| Voltage (7.2V +/- 85-115%) | Frequency (MHz) | ppm |
|---|---|---|
| 5.15 | 467.525087 | 0.18609 |
| 6.12 | 467.525225 | 0.48126 |
| 7.2 | 467.525337 | 0.72082 |
| 8.38 | 467.525337 | 0.72082 |

Battery end point = 5.15V




| Voltage (7.2V +/- 85-115%) | Frequency (MHz) | ppm |
|---|---|---|
| 5.15 | 467.525087 | 0.18609 |
| 6.12 | 467.525225 | 0.48126 |
| 7.2 | 467.525337 | 0.72082 |
| 8.38 | 467.525337 | 0.72082 |

Battery end point = 5.15

### 12.3 7.3 TEST EQUIPMENT

Temperature Chamber Tenney TH65 s/n 11380

Frequency Counter HP8901A (Frequency Mode) s/n 2545A04102

# 13 FCC RULES AND REGULATIONS PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO FREQUENCY RESPONSE

## 13.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.6

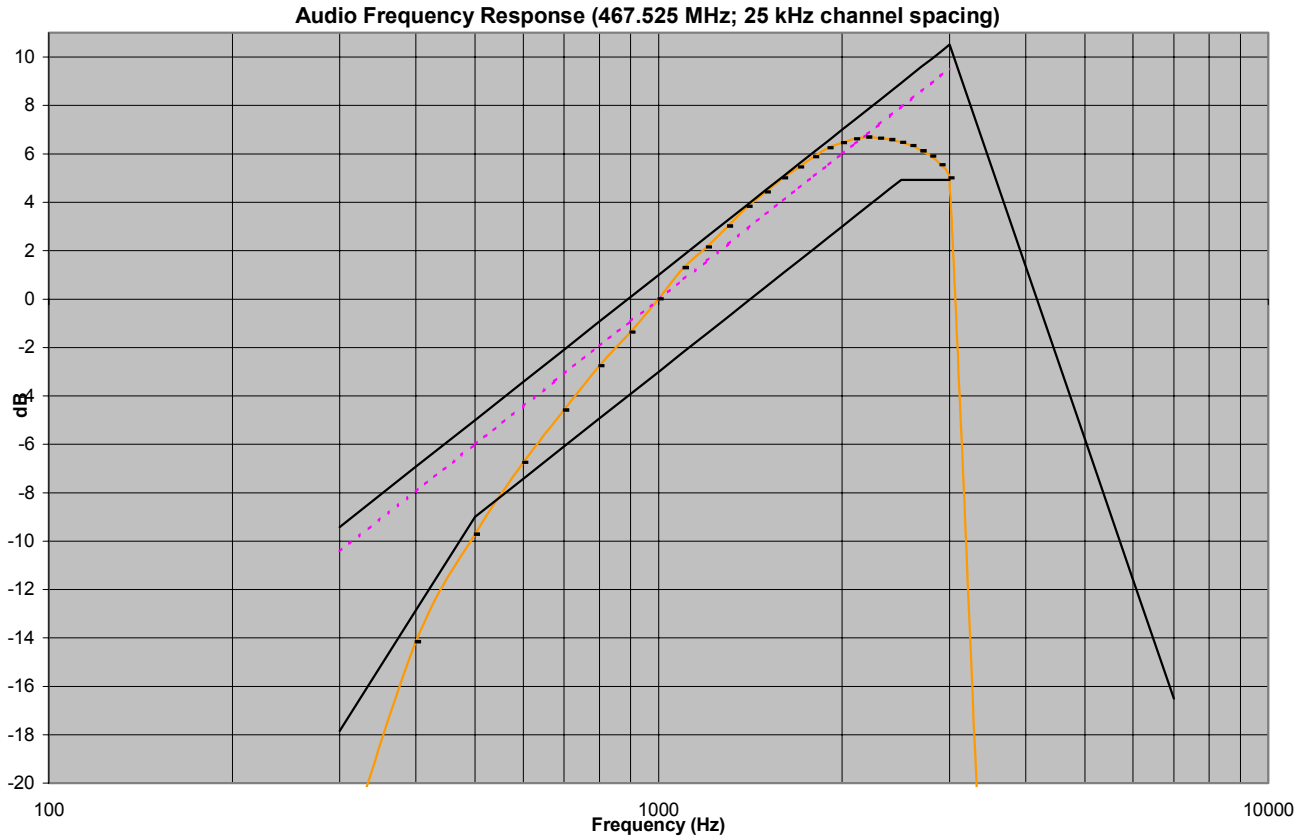
The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.

The input audio level at 1000 Hz is set to produce 20% of the rated system deviation. This point is shown as the 0 dB reference level, noted DEVref.
The audio signal generator was varied from 100Hz to 5kHz with the input level held constant.
The deviation in kHz was recorded using a modulation analyzer as DEVfreq.
The response in dB relative to 1 kHz was calculated as follows:

Audio Frequency Response = 20 LOG (DEVfreq/DEVref)

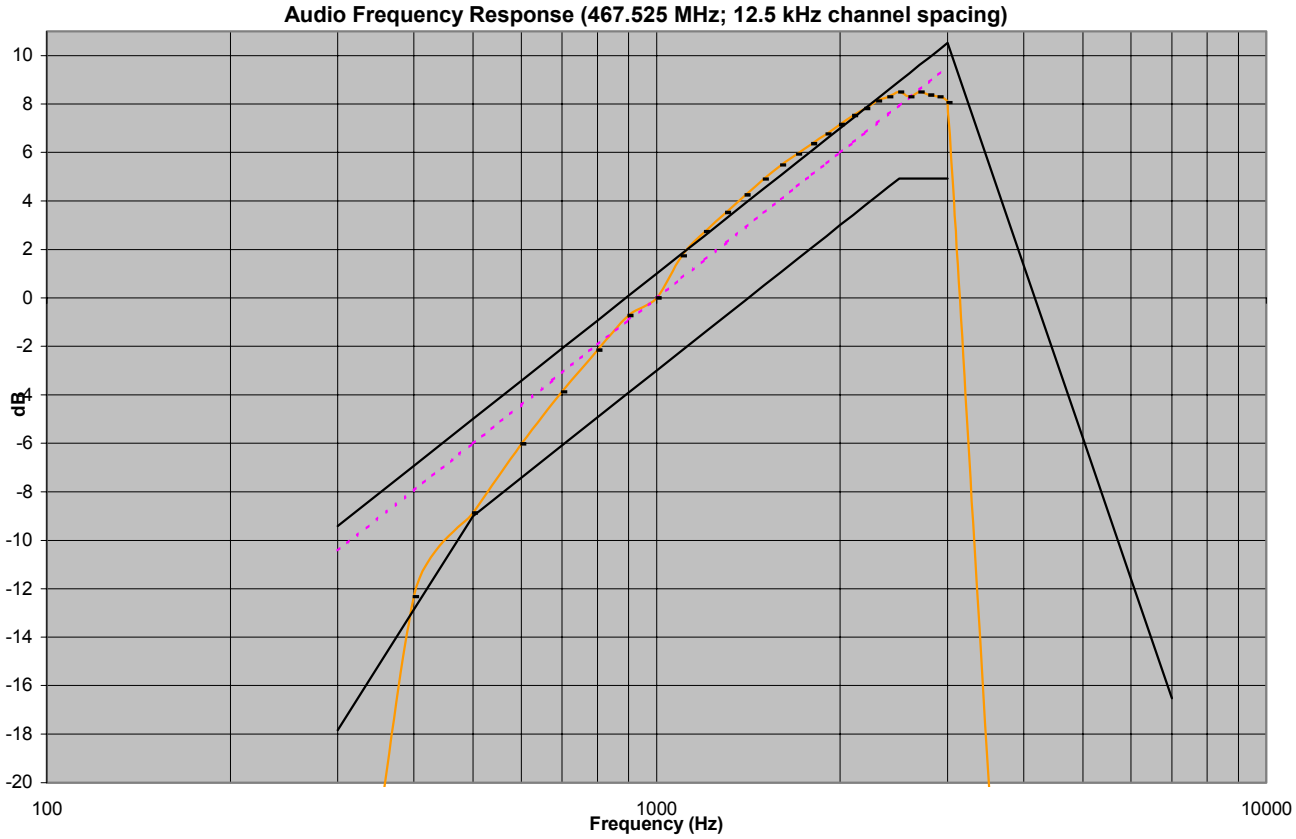
## 13.2 TEST DATA

### 13.2.1 CHANNEL 1 – 25 KHZ AUDIO FREQUENCY RESPONSE




### 13.2.2

### 13.2.3 CHANNEL 4 – 12.5 KHZ AUDIO FREQUENCY RESPONSE




## 13.3 TEST EQUIPMENT

| | | |
|---|---|---|
| Audio generator | HP3336B | s/n 2127A00559 |
| Modulation analyzer | HP8901A | s/n 2545A04102 |

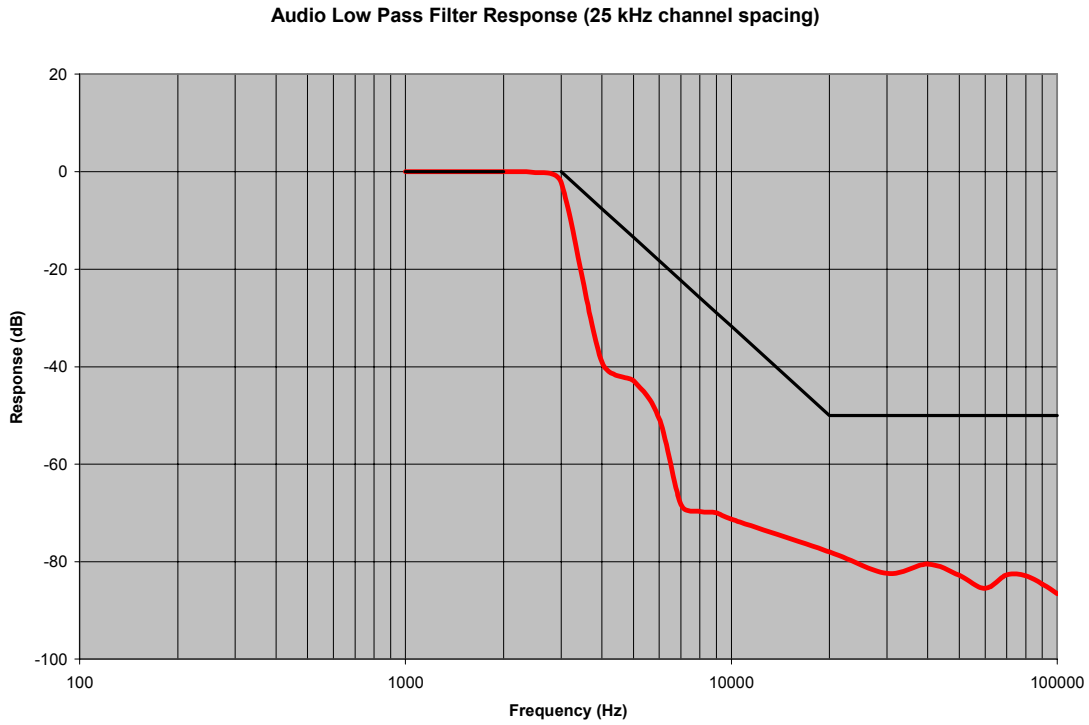
# 14 FCC RULES AND REGULATIONS PART 2 §2.1047 (A): MODULATION CHARACTERISTICS - AUDIO LOW PASS FILTER RESPONSE

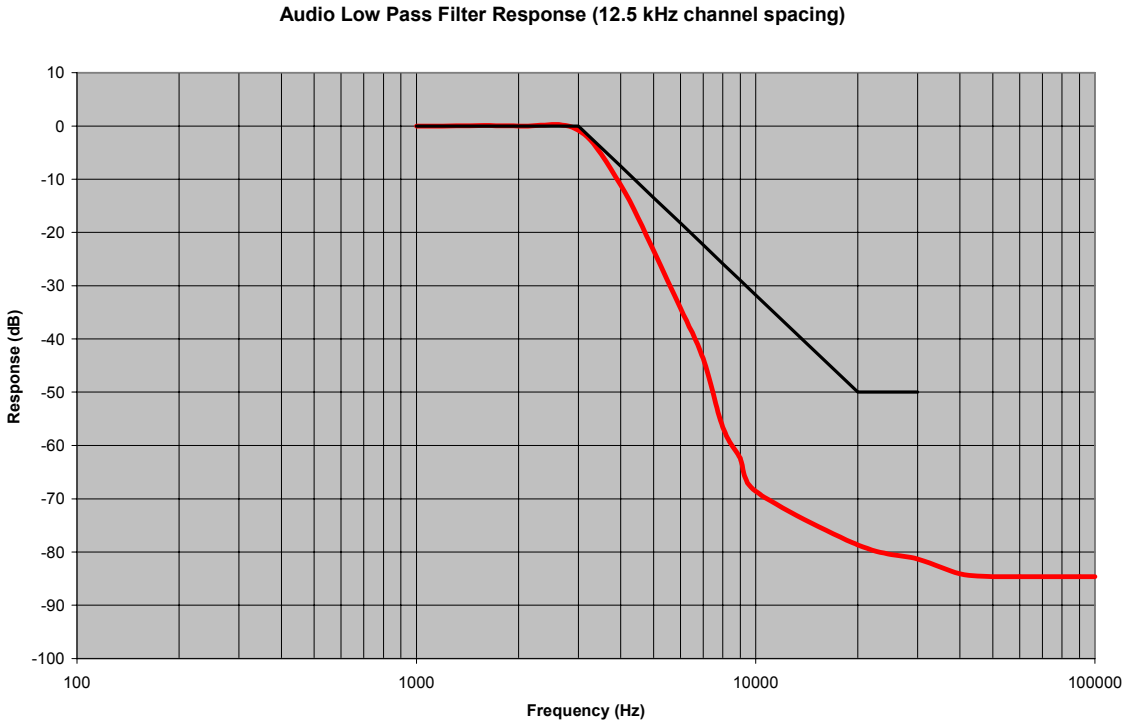
## 14.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, 2.2.15

The Audio Low Pass Filter Response is the frequency response of the post limiter low pass filter circuit above 3000 Hz.

## 14.2 TEST DATA






## 14.3 TEST EQUIPMENT

| | | |
|---|---|---|
| Audio generator | HP3336B | s/n 2127A00559 |
| Modulation analyzer | HP8901A | s/n 2545A04102 |
| Selective level meter | HP3586B | s/n 1928A01892 |
| Synthesizer/Level generator | HP3336B | s/n 2514A02585 |

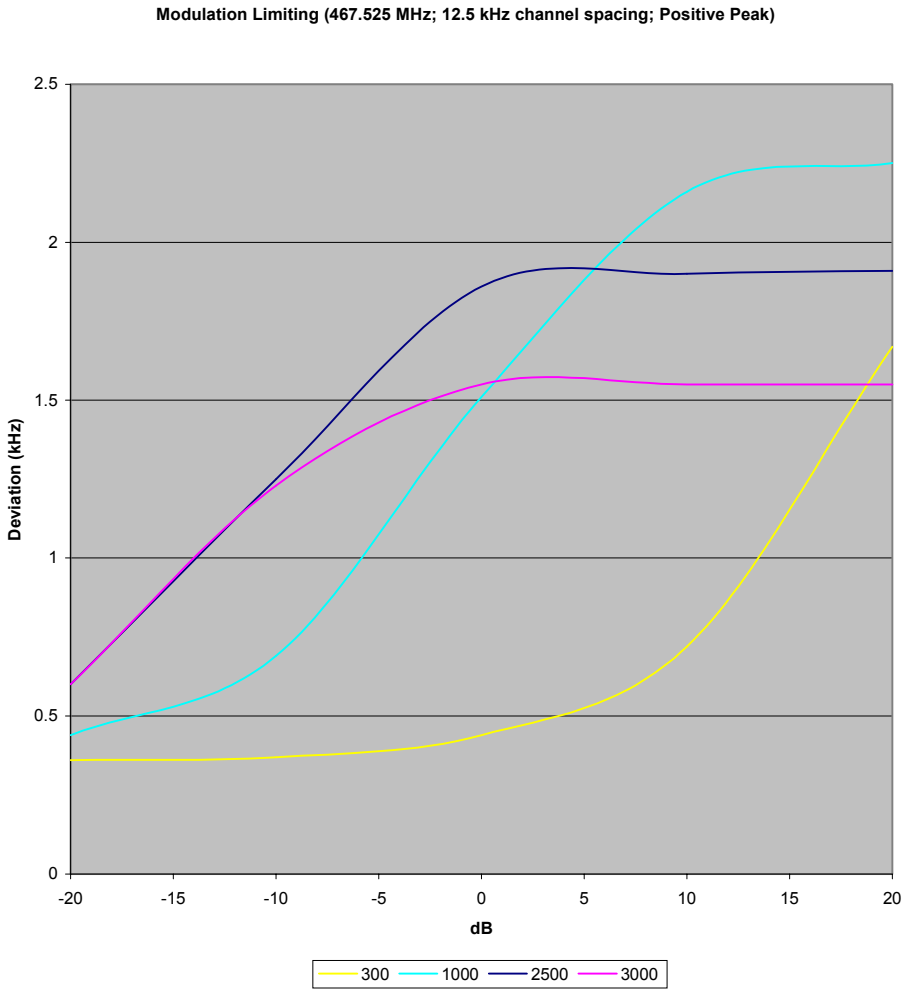
# 15 FCC RULES AND REGULATIONS PART 2 §2.1047 (B): MODULATION CHARACTERISTICS - MODULATION LIMITING

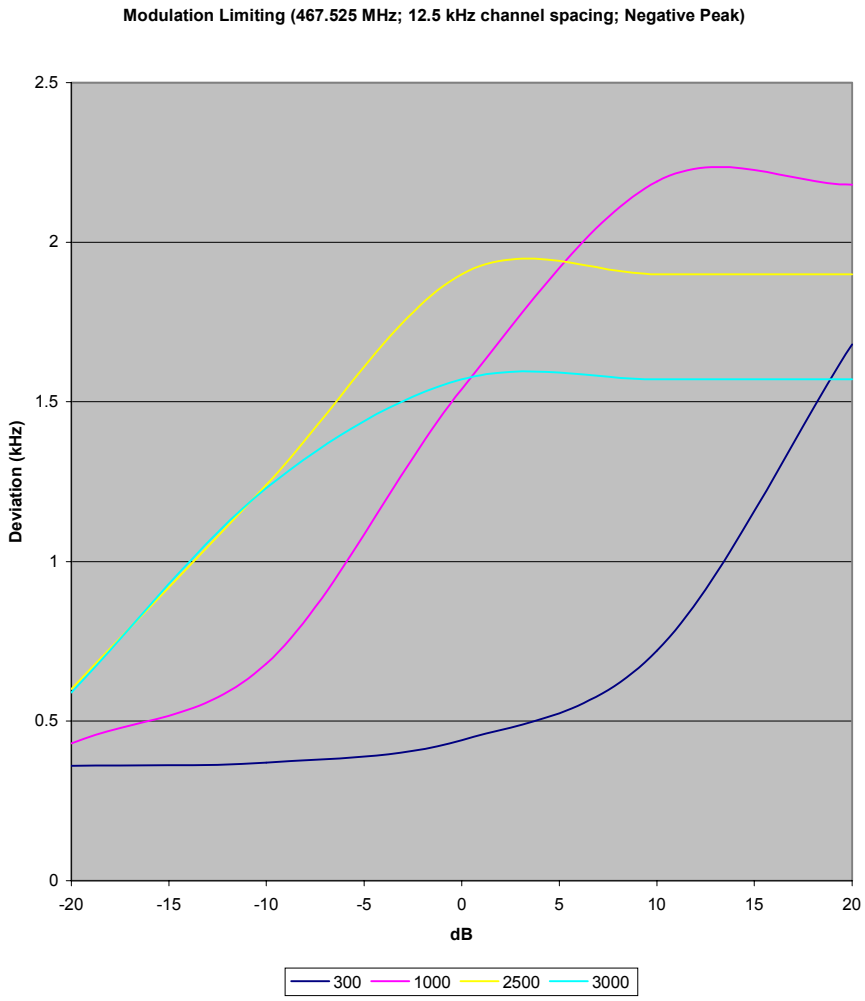
## 15.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.3

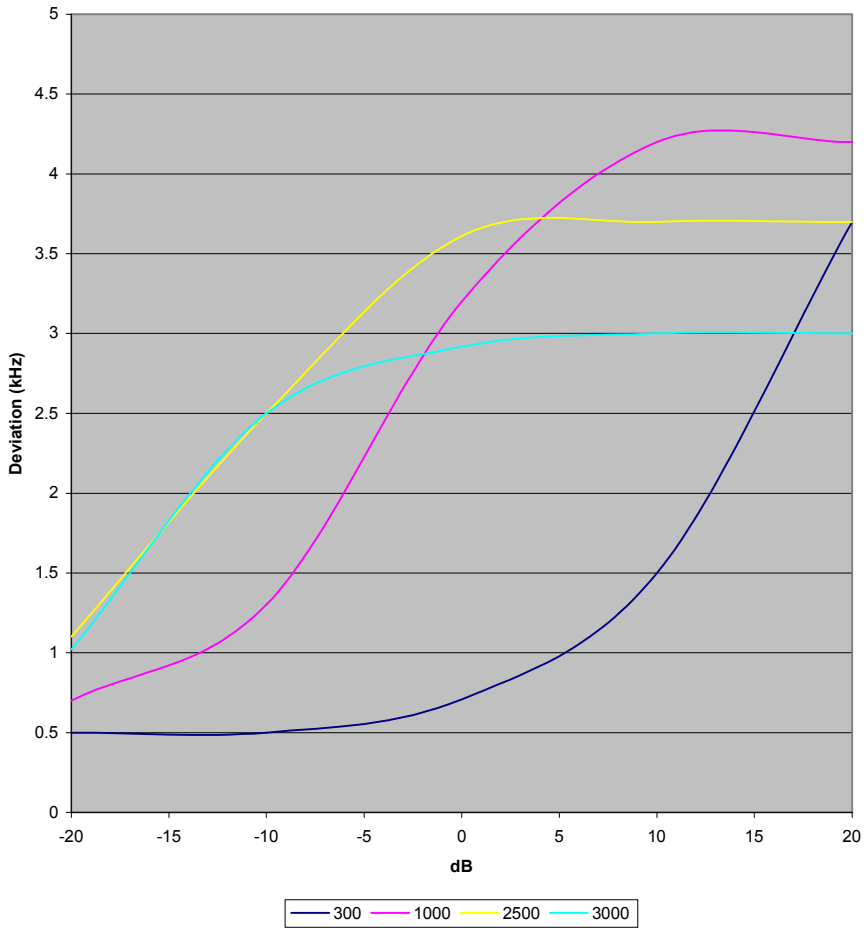
The transmitter is adjusted for full rated system deviation. The audio input level is adjusted for 60% of rated system deviation at 1000Hz. Using this level as a reference (0dB) the audio input level is varied from the reference to a level +20 dB above it and –20 dB under it, for modulation frequencies of 300Hz, 1,000Hz, and 2,500Hz. The system deviation obtained as a function of the input level is recorded. Both Positive and Negative Peak deviations were recorded.

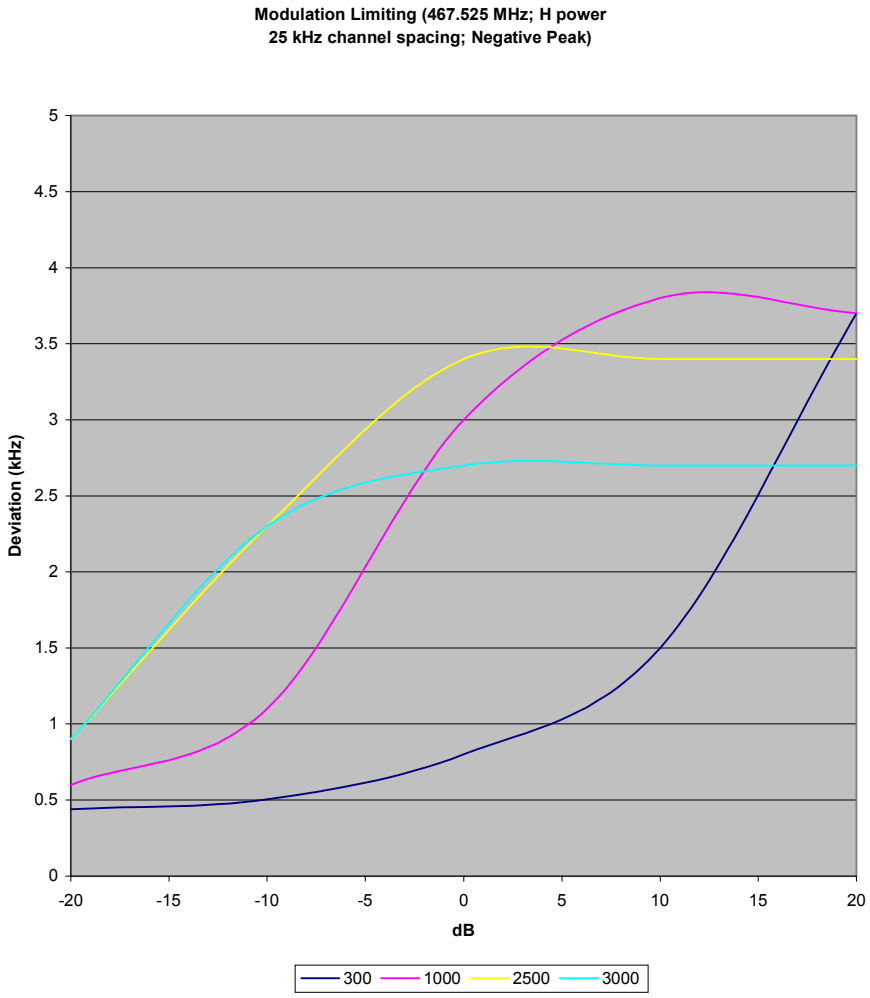
## 15.2 TEST DATA




Modulation Limiting (467.525 MHz; 12.5 kHz channel spacing; Negative Peak)
Deviation (kHz)
2.5
2
1.5
1
0.5
0
-20
-15
-10
-5
0
5
10
15
20
dB
300
1000
2500
3000

**Modulation Limiting (467.525 MHz; H power 25 kHz channel spacing; Positive Peak)**






## 15.3 TEST EQUIPMENT

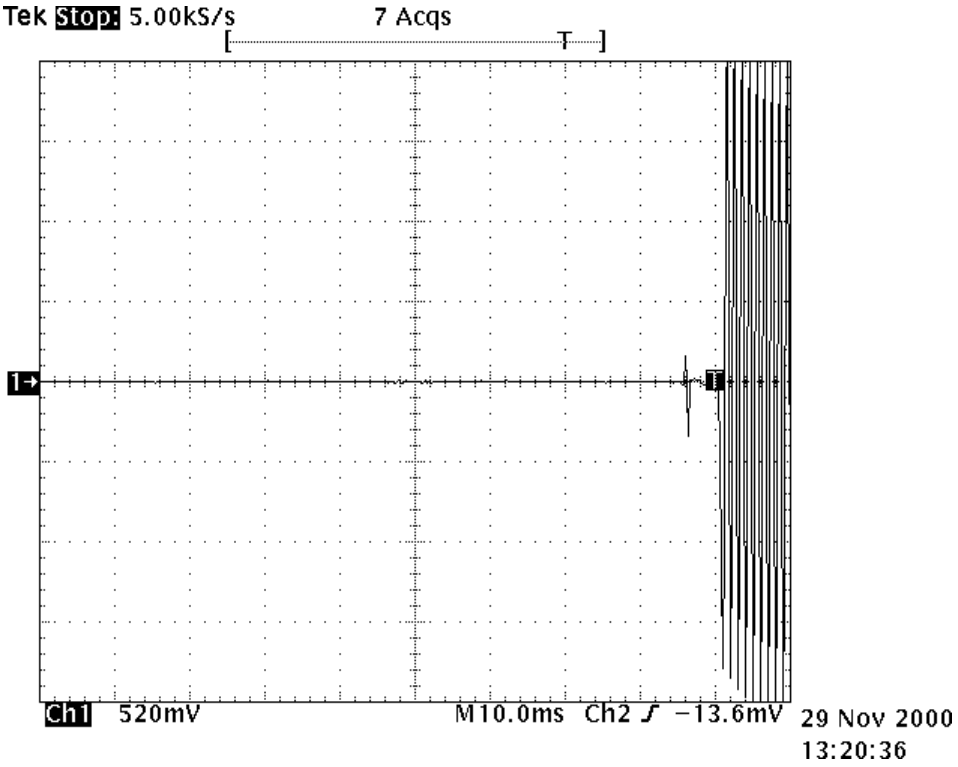
| | | |
|---|---|---|
| Audio generator | HP3336B | s/n 2127A00559 |
| Modulation analyzer | HP8901A | s/n 2545A04102 |
| Selective level meter | HP3586B | s/n 1928A01892 |
| Synthesizer/Level generator | HP3336B | s/n 2514A02585 |

# 16 FCC RULES AND REGULATIONS PART 90 §90.214 : TRANSIENT FREQUENCY BEHAVIOR

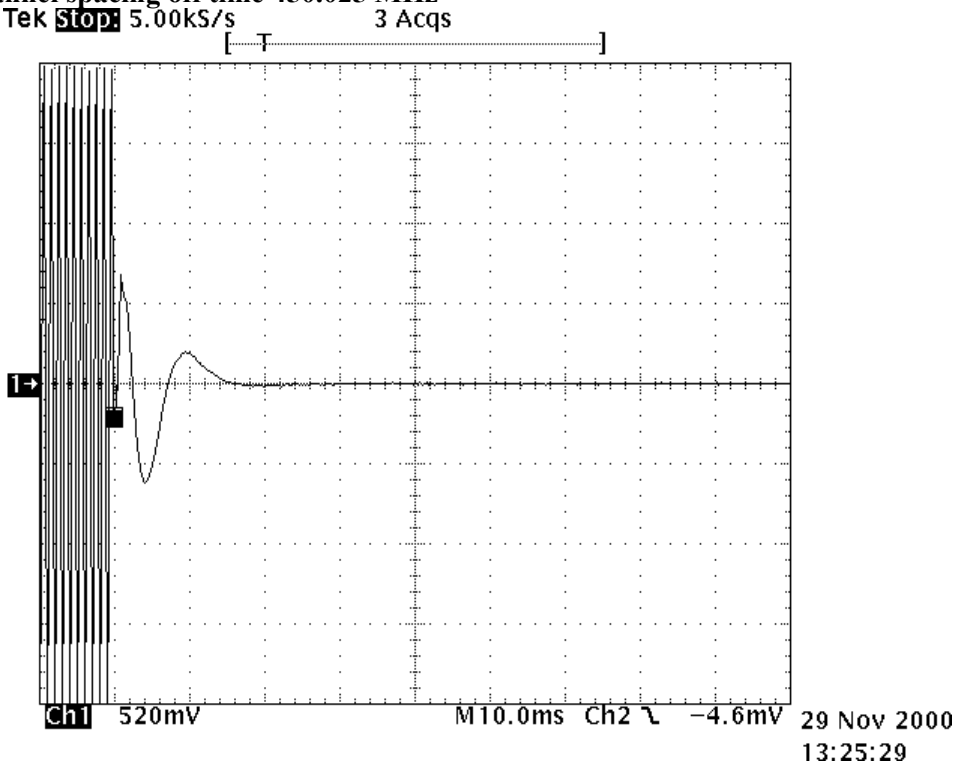
## 16.1 TEST PROCEDURE

ANSI/TIA/EIA-603-1992, section 2.2.19

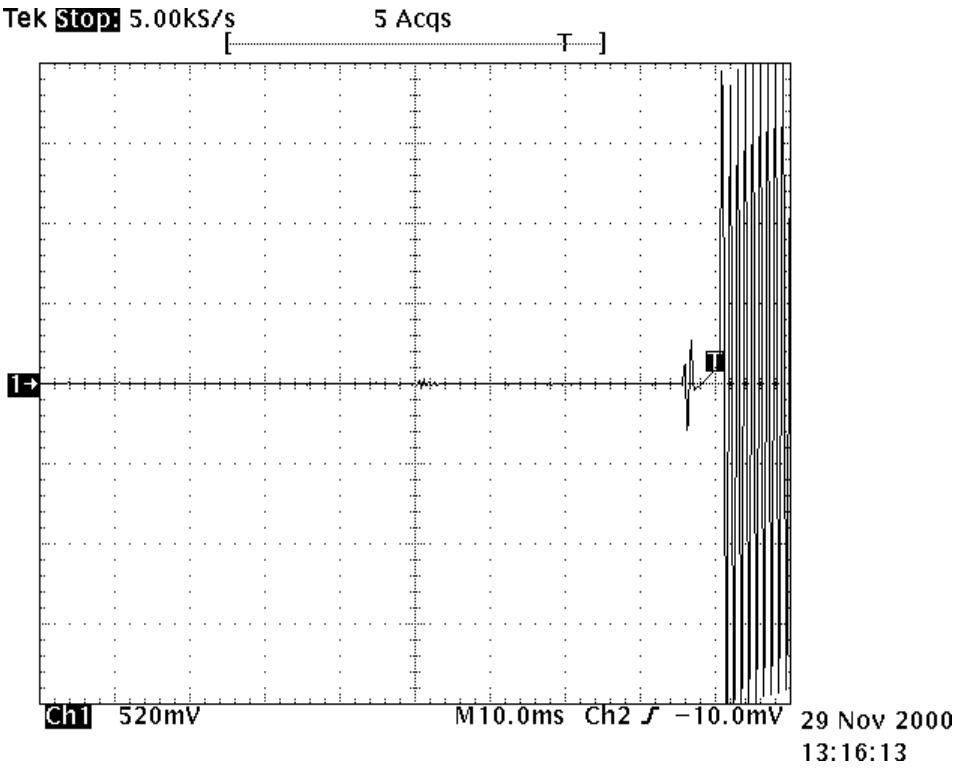
## 16.2 TEST DATA WIDE BAND



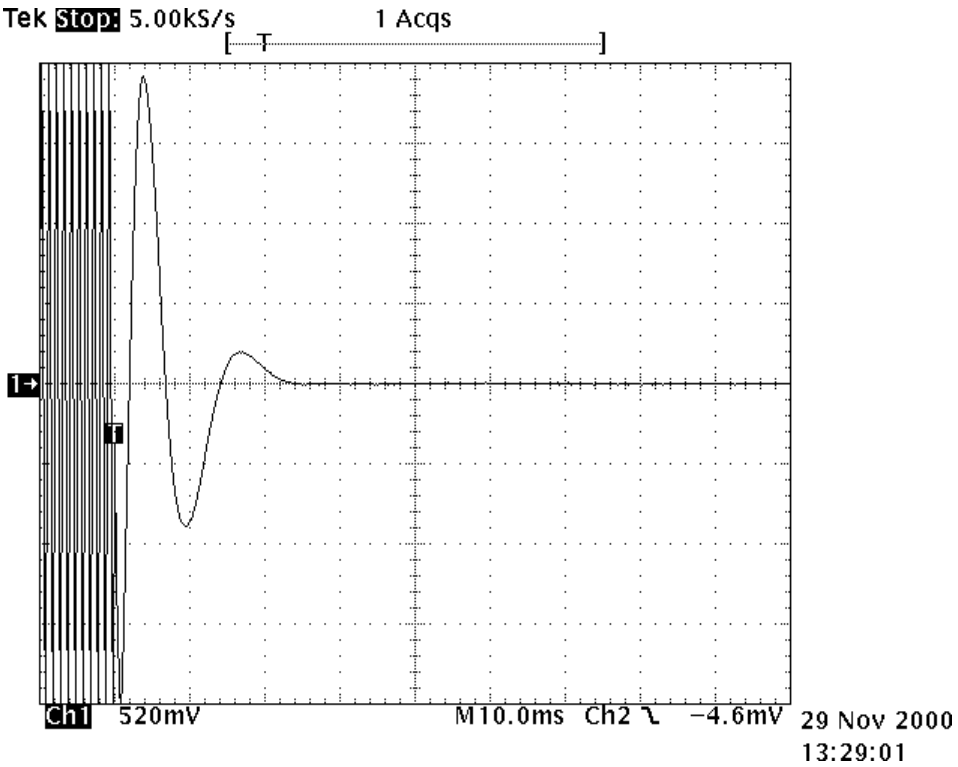
**25KHz channel spacing off time 450.025 MHz**



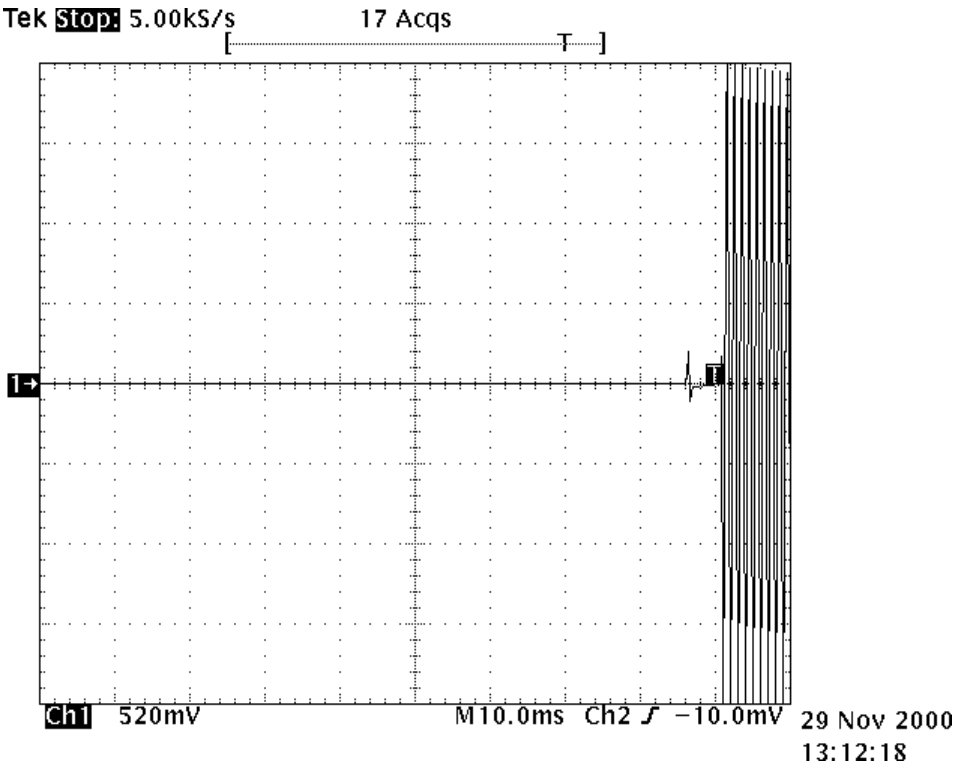

**25KHz channel spacing on time 450.025 MHz**


Tek Stop: 5.00kS/s
5 Acqs
Ch1 520mV
M10.0ms Ch2 ƒ −10.0mV
29 Nov 2000
13:16:13

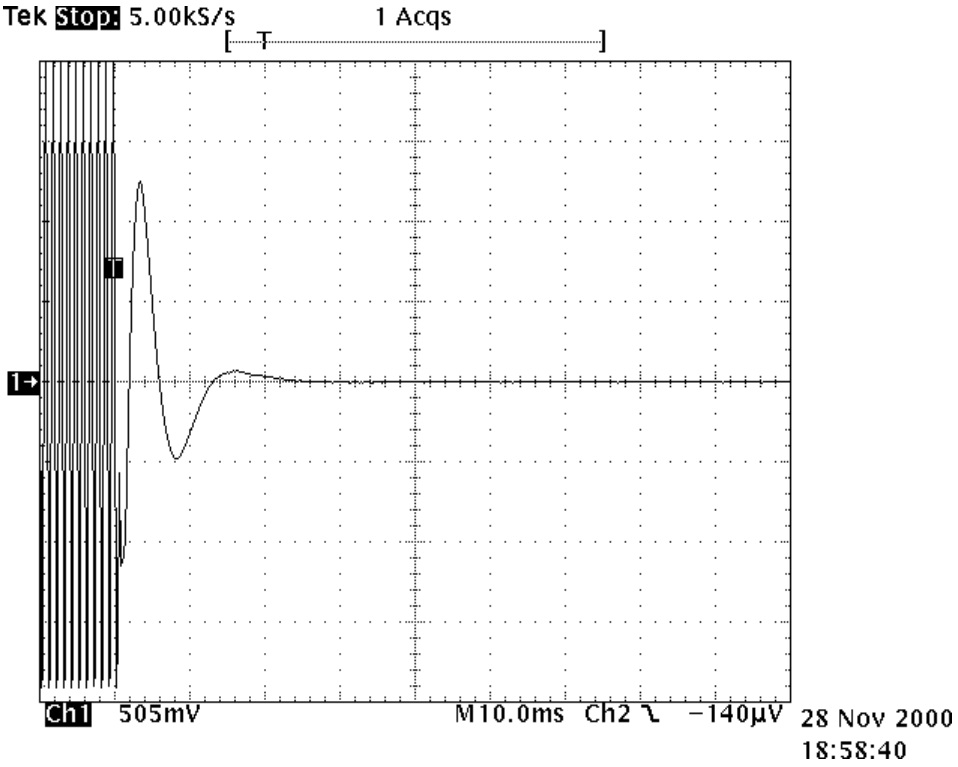
**25KHz channel spacing off time 484.975 MHz**




**25KHz channel spacing on time 484.975 MHz**

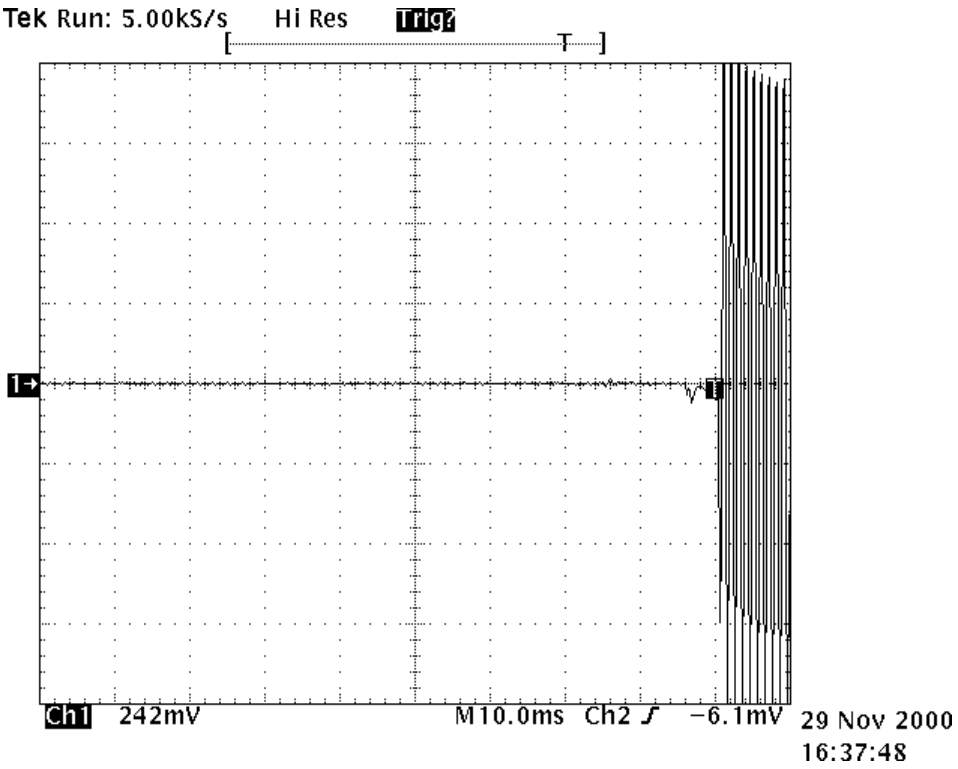

Tek Stop: 5.00kS/s
17 Acqs
Ch1 520mV
M10.0ms Ch2 ∫ −10.0mV
29 Nov 2000
13:12:18

**25KHz channel spacing off time 467.525 MHz**

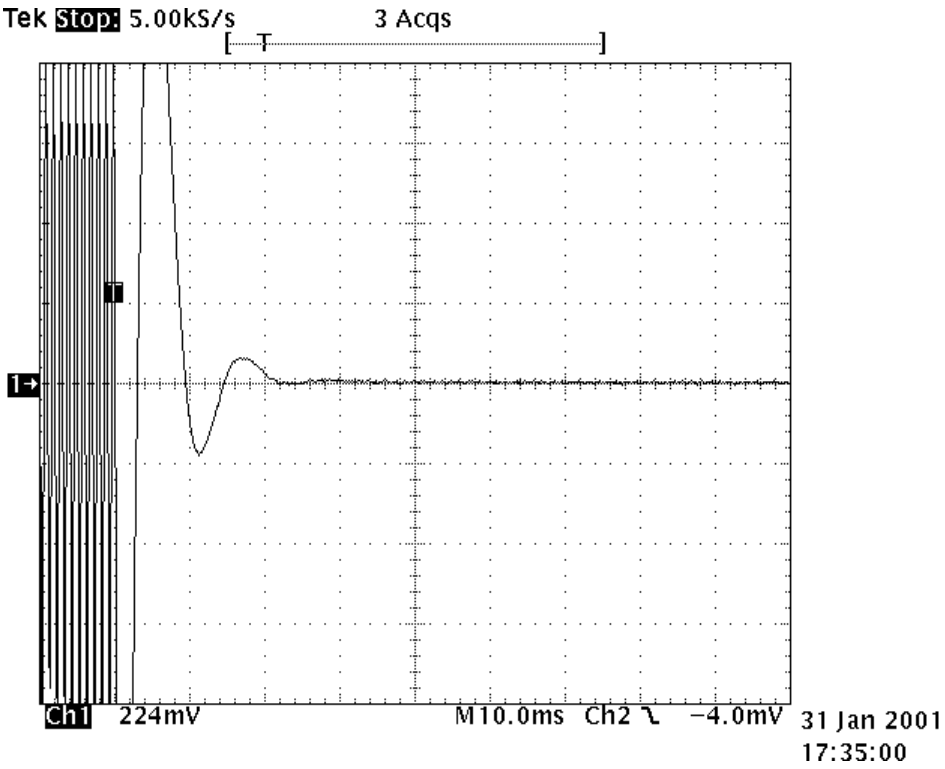



**25KHz channel spacing on time 467.525 MHz**

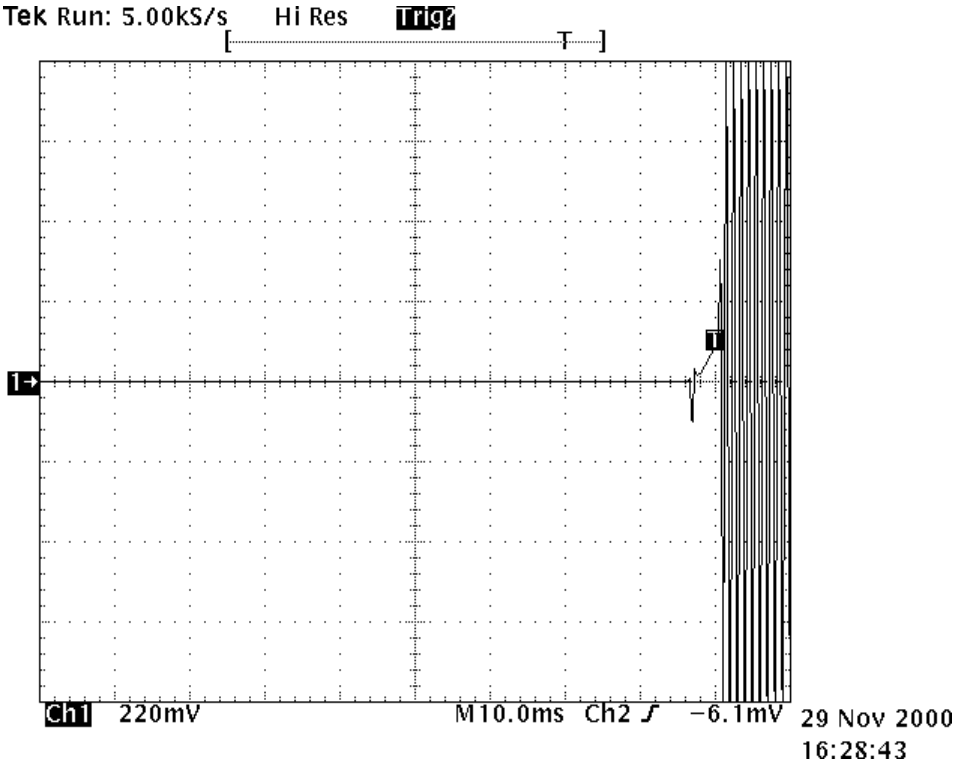
**Test Data Narrow Band**



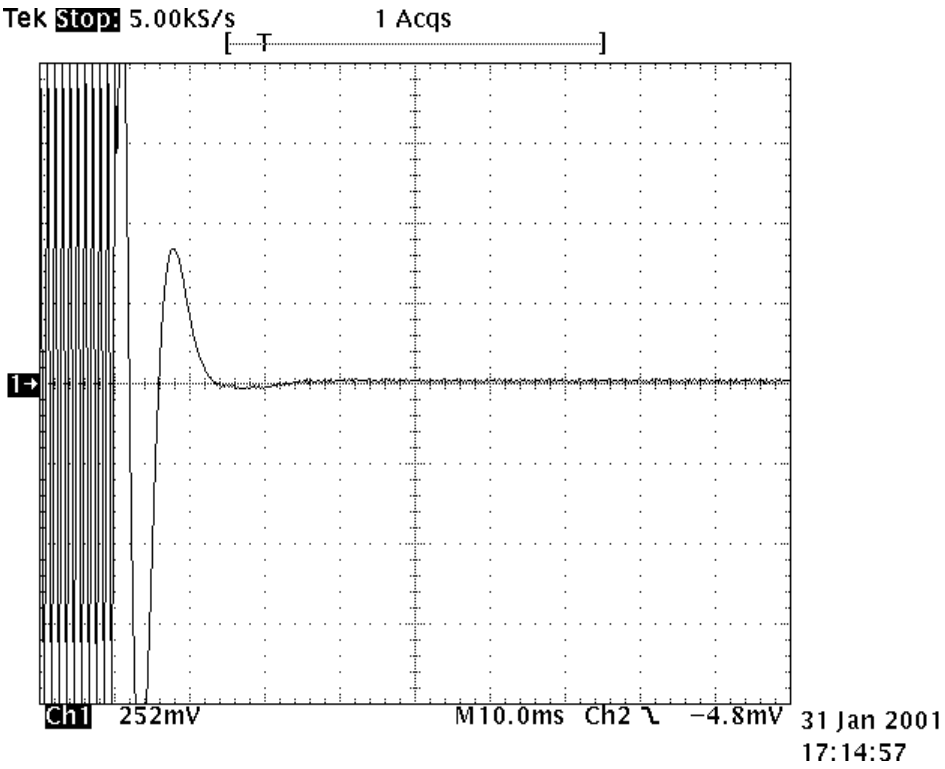
**12.5KHz channel spacing off time 450.025 MHz**



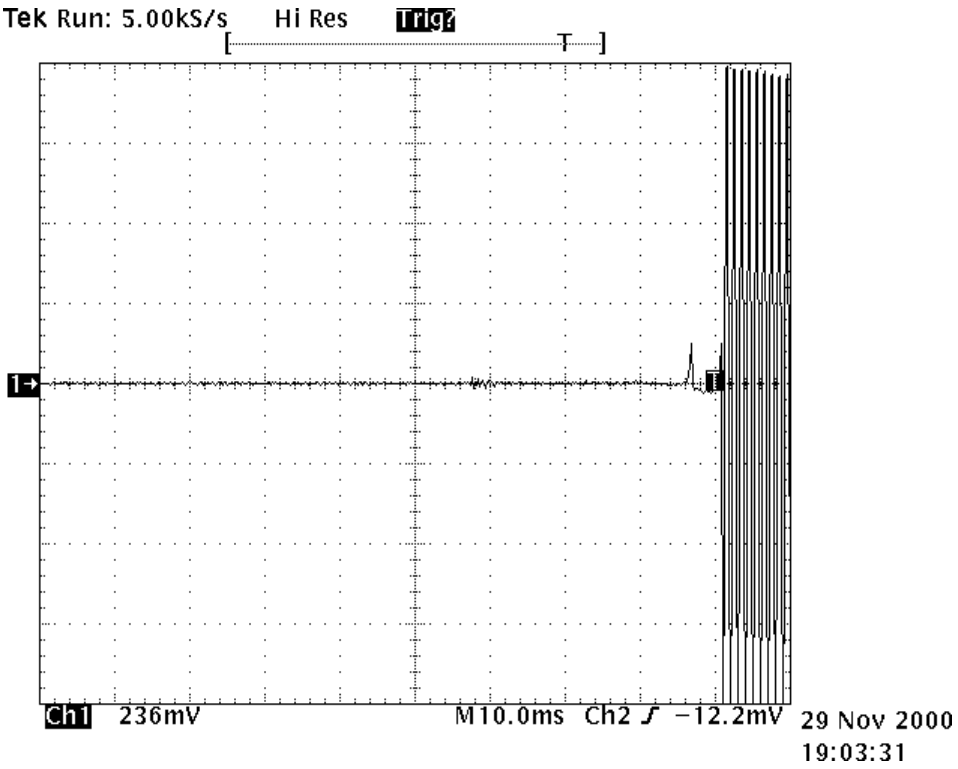
**12.5KHz channel spacing on time 450.025 MHz**



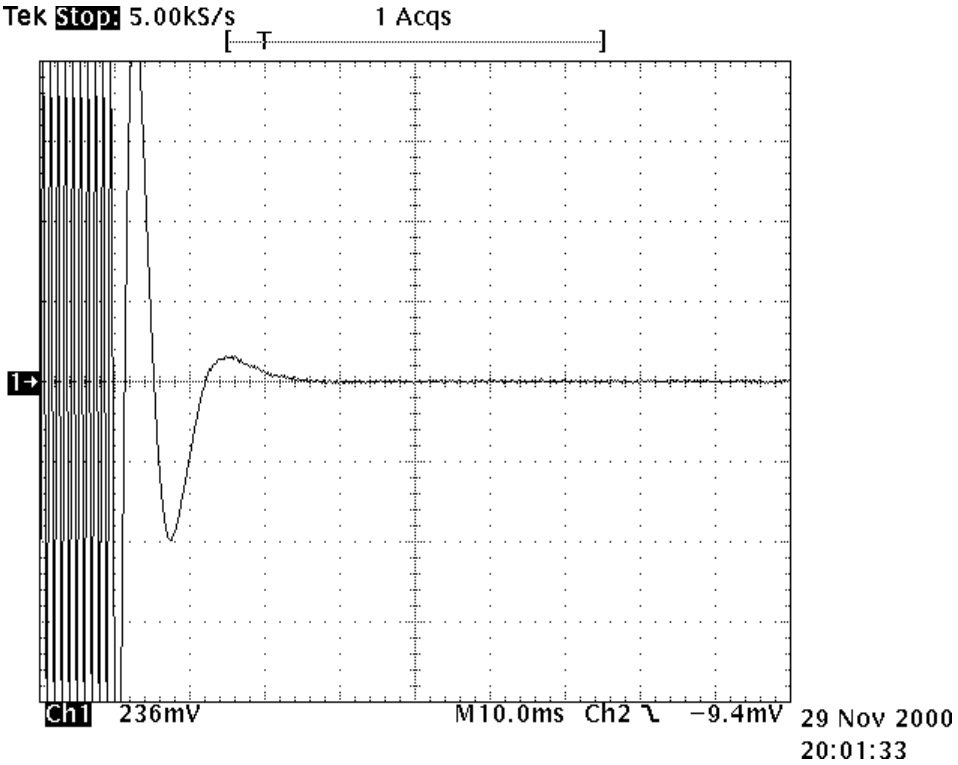
**12.5KHz channel spacing off time 484.975 MHz**



**12.5KHz channel spacing on time 484.975 MHz**



**12.5KHz channel spacing off time 450.025 MHz**




**12.5KHz channel spacing on time 450.025 MHz**

**Limits:**

Requirements for EUT with 25 kHz channel spacing:

| Time Intervals (*)(**) | Maximum Frequency Difference(***) | 150-174 MHz | 421-512 MHz |
|---|---|---|---|
| | | | |
| t1(****) | ± 25 kHz | 5.0 mSec | 10.0 mSec |
| t2 | ± 12.5 kHz | 20.0 mSec | 25.0 mSec |
| t3(****) | ± 25 kHz | 5.0 mSec | 10.0 mSec |

Requirements for EUT with 12.5 kHz channel spacing:

| Time Intervals (*)(**) | Maximum Frequency Difference(***) | 150-174 MHz | 421-512 MHz |
|---|---|---|---|
| | | | |
| t1(****) | ± 12.5 kHz | 5.0 mSec | 10.0 mSec |
| t2 | ± 6.25 kHz | 20.0 mSec | 25.0 mSec |
| t3(****) | ± 12.5 kHz | 5.0 mSec | 10.0 mSec |

(*) t on is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t 1 is the time period immediately following ton.
t2 is the time period immediately following t1.
t3 is the time period from the instant when the transmitter is turned off until $t_{off}$.
$t_{off}$ is the instant when the 1 kHz test signal starts to rise.
(**) During the time from the end of t2 to the beginning of t3, the frequency difference must not exceed the limits specified in § 90.213.
(***) Difference between the actual transmitter frequency and the assigned transmitter frequency.
(****) If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

Maximum frequency difference between time T2 and T3: Calculation for Channel 6:
The frequency stability is required to be 2.5ppm.
Calculation for Channel 6:
4 div. on scope represent 12.5kHz for narrow band channel.
Therefore, 487.975M times 2.5 ppm times +/- 4 Divisions divided by 12.5kHz equals about +/- 0.4 division. 0.4 Div. correspond to 1.219 kHz

### 16.3 TEST EQUIPMENT

Detector: HP8471D s/n 2952A
RF signal generator: HP8648C s/n 3537A01741
Modulation Analyzer: HP8901A s/n 2545A04102
Oscilloscope: Tektronix TDS540B s/n B020129
Receiver: HP 8546A s/n 3525A00159

## 17 FCC RULES AND REGULATIONS PART 2.202: NECESSARY BANDWIDTH AND EMISSION BANDWIDTH

Type of Emission: F3E

Necessary Bandwidth and Emission Bandwidth:
12.5kHz (NB channel) : Bn = 11K0F3E
25kHz (WB channel): Bn = 16K0F3E

Calculation:
Max modulation(M) in kHz : 3
Max deviation (D) in kHz: 2.5 (NB) and 5 (BB)
Constant factor (K) : 1
Bn = 2xM+2xDK