

Exhibit 5 Spurious Emissions,- 2.991, 2.993 (a), 2.997

Exhibit 5 provides measurements of spurious emissions both in the laboratory and in the field. Each set of data includes a block diagram of the test set up, list of test equipment, description of the test sequence, and test data. Specific items included in Exhibit 5 are listed following.

Included Items

1. Spurious Emissions at the Antenna terminals
2. Spurious Emissions Radiated Directly from the Cabinet
3. Spurious Emissions - Field Measurements

5-1 Spurious Emissions at the Antenna Terminals

Test Configurations

The Active Antenna has two transmit paths, each of which contains five amplifiers. Each amplifier is connected to a subarray of four antenna elements. To measure the purity of the output spectrum of the power amplifiers, it is necessary to disconnect the antenna and observe the spectrum of each of the five channels at the filter output coaxial connection where the normal attachment to the radiating elements is made.

The amplifiers were driven to their maximum rated output power (2 Watts each) with a GMSK modulated signal source and the output spectrum was measured from 10 KHz to 20 Ghz. Data was collected at each of the five output ports for both transmit paths.

Figure 5-1 shows the test configuration. Lists of test equipment and calibration data are included at the end of this section.

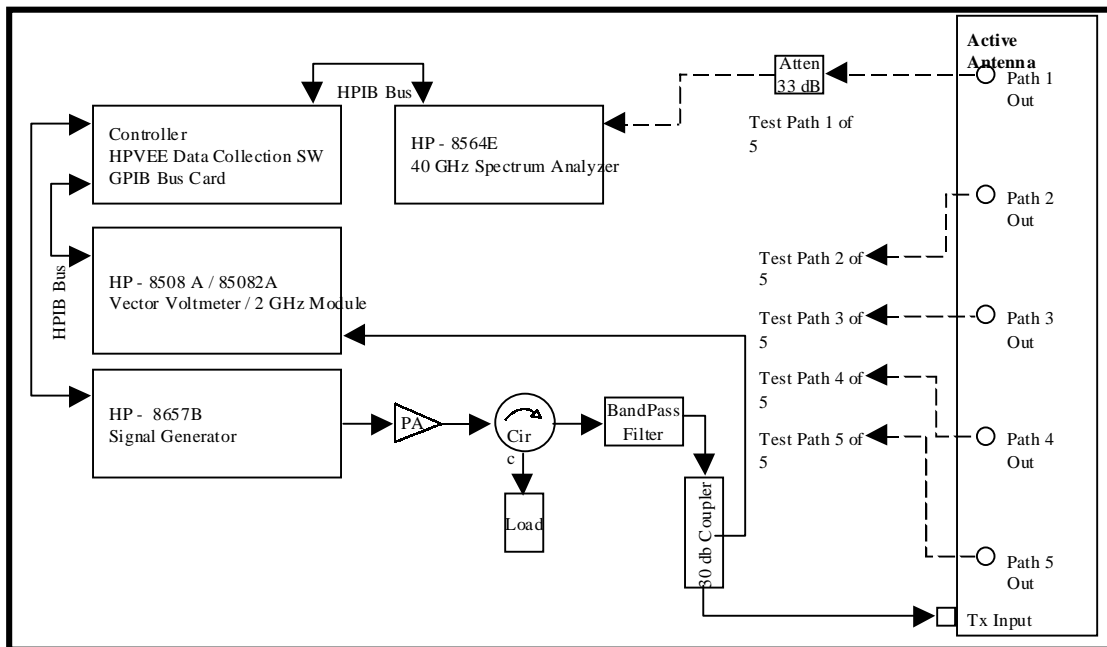


Figure 5-1 Test Configuration for Spurious Emissions at the Antenna Terminals

Test Results

The limit on spurious emissions was computed from 47 CFR 24.238 to be $43 + 10 \log P$, where P is the combined output power of the five amplifiers (10 W), or $43 + 10 \log (10) = -53 \text{ dBc}$.

The spectrum was observed to a level of -73 dBc , approximately 20 dB below the -53 dBc limit. Test results showed no observable spurious energy at the antenna terminals for any of the five channels on either transmit path. Based on this the Active Antenna's amplifiers were determined to be compliant with the limitations on spurious energy.

An example plot showing the results for one amplifier is shown in Figure 5-2. The vertical scale shows the signal level with respect to the carrier (dBc) from +5 to -80 dBc in 10 dB divisions. The horizontal scale shows frequency in GHz from 0 to 20 GHz, with the carrier visible just below 2 GHz. Resolution bandwidth and video bandwidth are noted at the bottom of the chart, with both set at 1 MHz. The only energy visible is the noise floor of the spectrum analyzer at approximately -73 dBc, showing the amplifier to be well within the specified limitations.

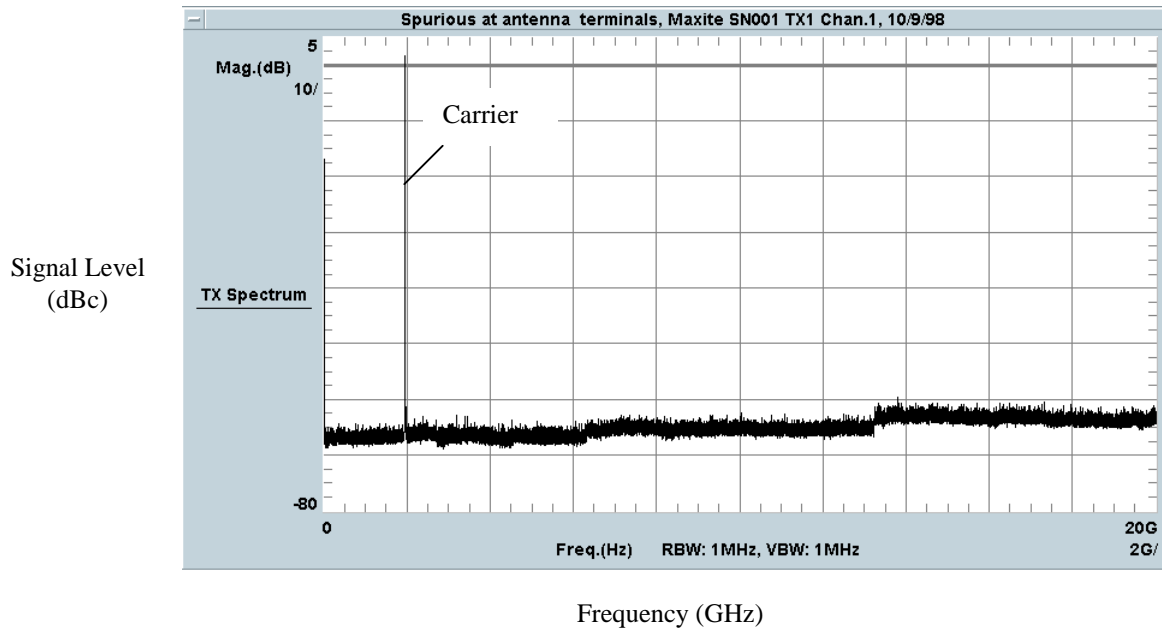


Figure 5-2 Band 1 Power Amplifier Output Spectra 10 KHz - 20 GHz with Modulated Signal Input

Plots showing all of the amplifier output ports to be compliant with 24.238 under these operating conditions are on file at RTIS.

Test Equipment List for Emissions Testing

Mfg. / Model #	Qty	Description	Calibration Date	Asset Number
Gateway P5-133	1	133 MHz PC w/ HPVEE & HPIB	No Cal Req	None
HP-8508 A	1	Vector Voltmeter	22 Dec 98	1209612
HP-85082A	1	2 GHz Vector Voltmeter Input Module	22 Dec 98	1292439
HP-E4432A	1	Modulated Signal Generator	10 Jan 99	1284429
R&S FSEM30	1	Spectrum Analyzer, 20 Hz - 26.5 GHz	3 Jan 99	1292321
HP-EPM-41A	1	Power Meter	11 May 99	1289194
Mini Circuits 15542	1	Power Amplifier	No Cal Req	N/A
Trak 20B1601	1	Circulator	No Cal Req	N/A
Narda 4012C-30	2	Coupler, 30 dB	No Cal Req	N/A

5-2 Spurious Emissions Radiated Directly From the Cabinet (2.993)

This test was contracted with KTL in Lewisville, Texas. Results of the test are that the unit passed the requirement with a minimum of 15 dB margin. The full report is provided in Exhibit 6.

5-3 Spurious Emissions - Open Field Measurements

Test Configuration

After final assembly, the completed active antenna was retested for spurious emissions. The test configuration is shown in Figure 5-3. Due to availability of test assets, the field measurements for this section were made with a Band 2 unit. Results for Band 1 and Band 3 units will be identical since the out of band performance is set by the bandpass filters. (Reference data for bandpass filters supplied in Exhibit 2)

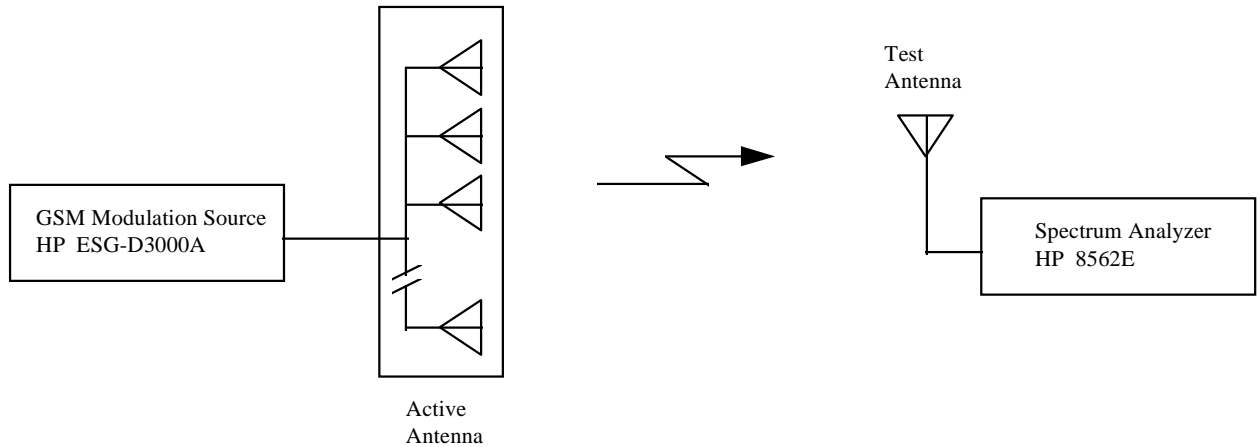


Figure 5-3 - Test Configuration for Radiated Spurious Emissions

Figure 5-4 shows the GSM modulated signal transmitted by the active antenna unit. The spectral mask superimposed is from J-STD-007A, PCS Air Interface Specification, the JTC standard for 1900 MHz GSM equipment providers. The transmitted signal is compliant with this mask.

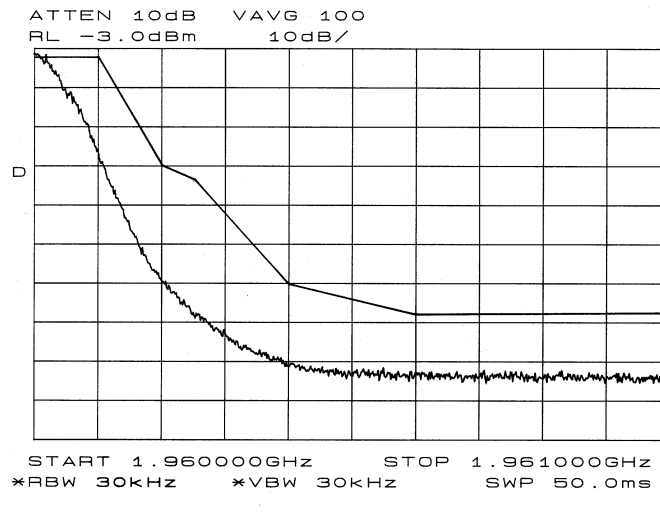


Figure 5-4 – Transmitted signal spectrum.

Figures 5-5 and 5-6 show the entire PCS band, from 1850 to 1990 MHz. Figure 5-5 shows no spurious emissions in a 65 dBc range. (The small amount of energy visible at approximately 1940 MHz is a nearby CDMA base station.)

The carrier frequency was chosen to avoid interference with existing PCS providers, but the results shown are typical for any transmit frequency. This complies with the -53 dBc limit computed from 24.238.

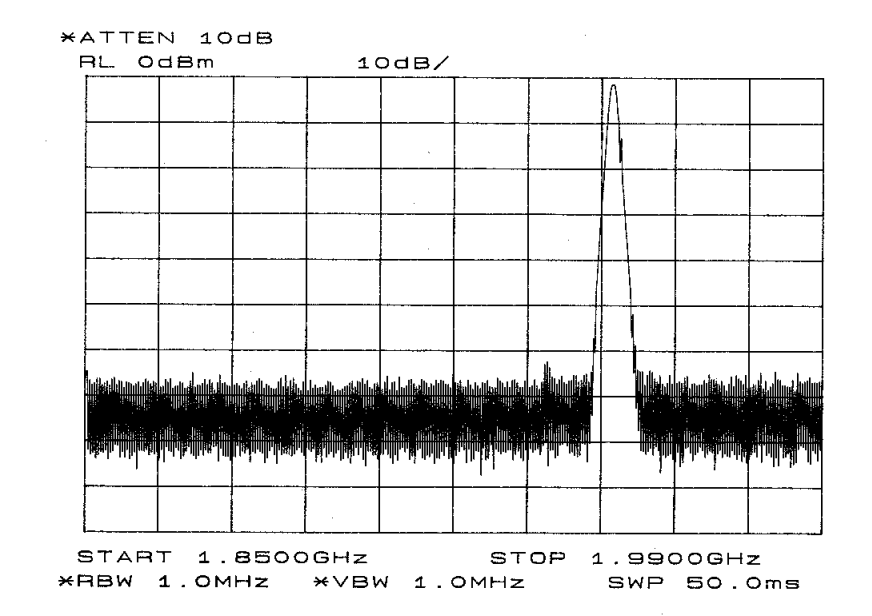


Figure 5-5 - Transmitted signal spectrum over the PCS band (1850 -1990 MHz).

While the noise floor in Figure 5-5 is adequate to establish compliance with the -53 dBc limit, when configured with the 1 MHz resolution bandwidth specified, it does not rule out reportable spurs between -65 dBc and -73 dBc. The resolution bandwidth was decreased to 30 kHz to scan for energy down to -73 dBc, as shown in Figure 5-6. No reportable spurs were detected.

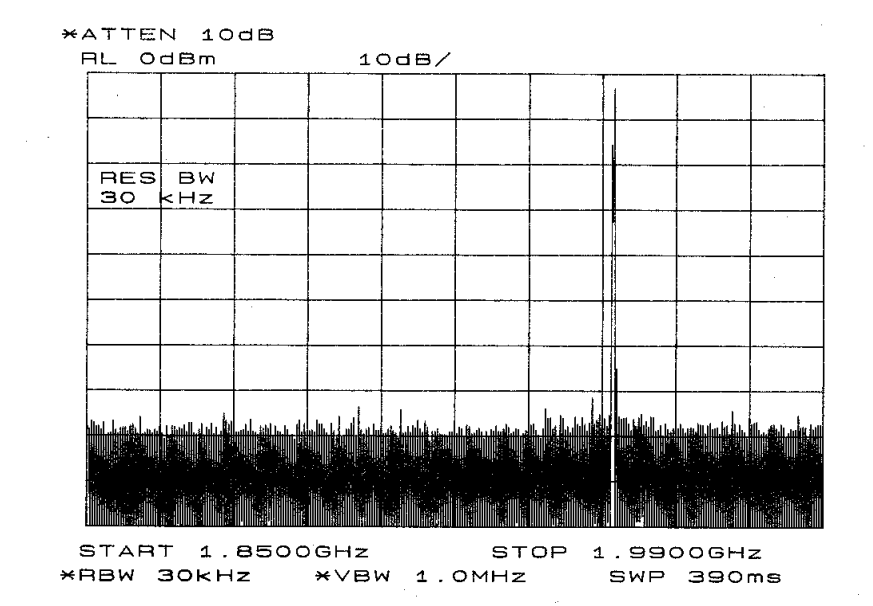


Figure 5-6 - Transmitted signal spectrum over the PCS band (1850 -1990 MHz) (Resolution BW decreased to improve dynamic range).

Figure 5-7 focuses on the expected location of the second harmonic. The resolution bandwidth has been decreased to 3 KHz to provide the best possible noise floor. No harmonics are visible above -73 dBc. A

detailed examination was also made at the expected location of the third and fourth harmonics. No measurable energy was detected at either location.

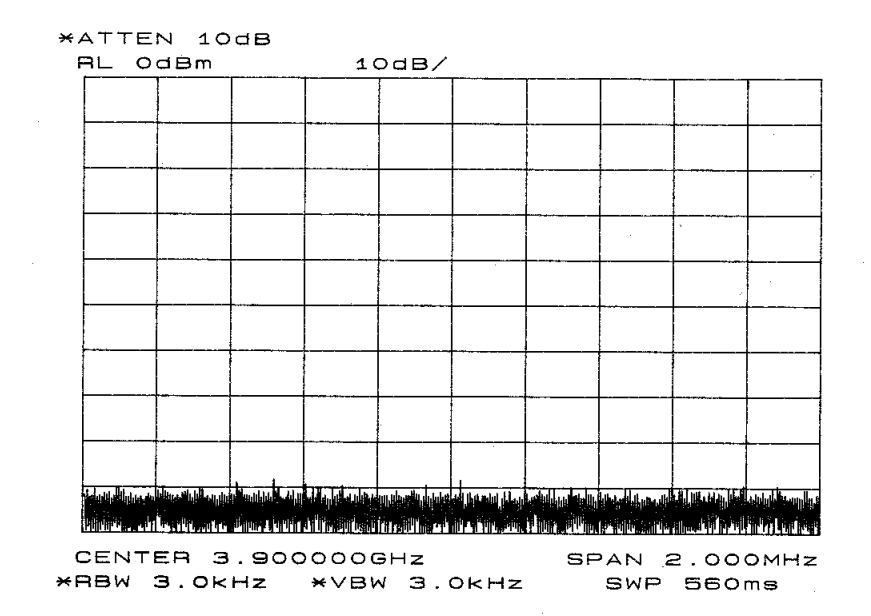


Figure 5-7 - Expected location of the second harmonic.

Figure 5-8 again shows the full PCS band. For these measurements, the driving signal has been reduced by 30 dB. The emission limit, $43 + 10 \log P$, decreases linearly with the log of the output power, from -53 dBc at 10 W output, to -23 dBc at 10 mW output. No harmonics are visible above this level, therefore the system was determined to be compliant over its dynamic output power operating range.

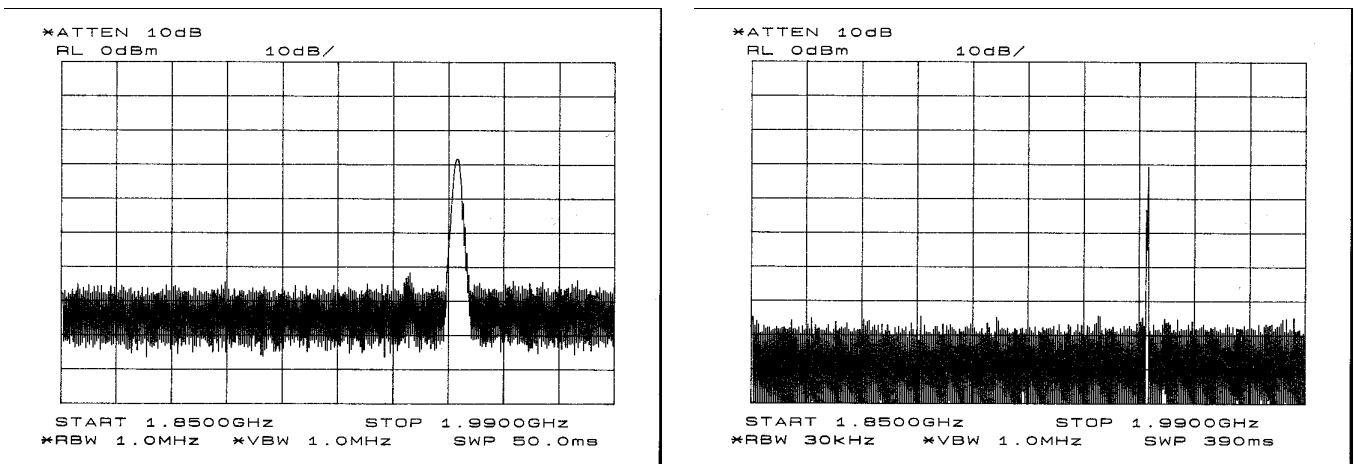


Figure 5-8 – Active Antenna unit operating at reduced (-30 dB) drive level ,
Transmitted signal spectrum over the PCS band (1850 -1990 MHz).

Figures 5-9, 10, 11, and 12 focus on the first 1 MHz of spectrum lying above and below each of the PCS operating bands. In Figure 5-9, the transmitted signal has been centered at the first channel in the B band, and the spectral energy has been measured from a point 1 MHz below B band, up to the start of B band. (The first 200 KHz of B band has also been included in the plot, making the transmitted signal visible as a power level reference.) No out of

band radiation is visible in a -53 dBc range, except that associated with the envelope of a standard GSM signal. To avoid this problem, the User's Manual for the radio base station advises operators that this channel cannot be used except at reduced power levels. This restriction is also noted in the Active Antenna's Operation Instructions included in Exhibit 7.

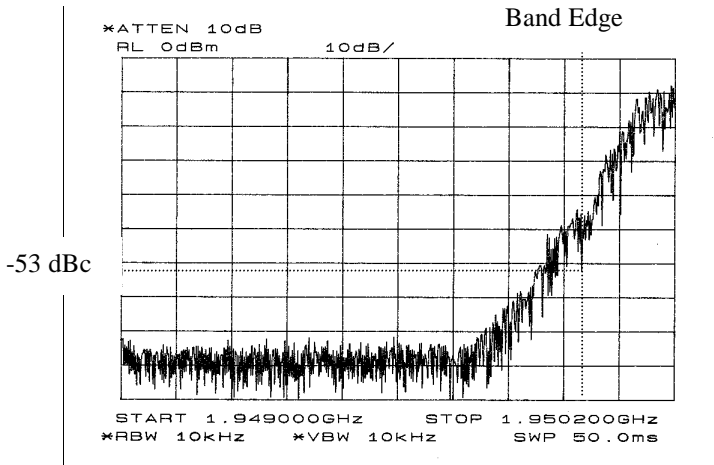


Figure 5-9 - First 1 MHz of spectrum below B band

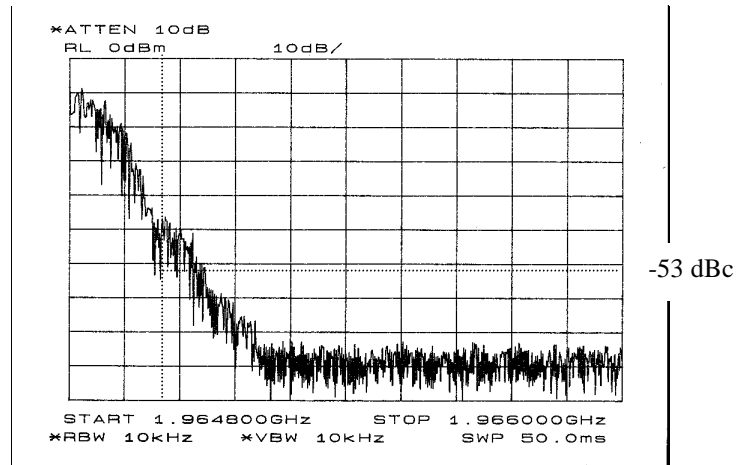


Figure 5-10 - First 1 MHz of spectrum above B band.

In Figure 5-10 a similar measurement has been made just above the end of B band, with the transmitted signal moved to the last channel in B band. Figures 5-11 and 5-12 repeat these measurements for the E band. In no case were any spurious emissions generated by the Active Antenna, indicating that it is in compliance with emission limits.

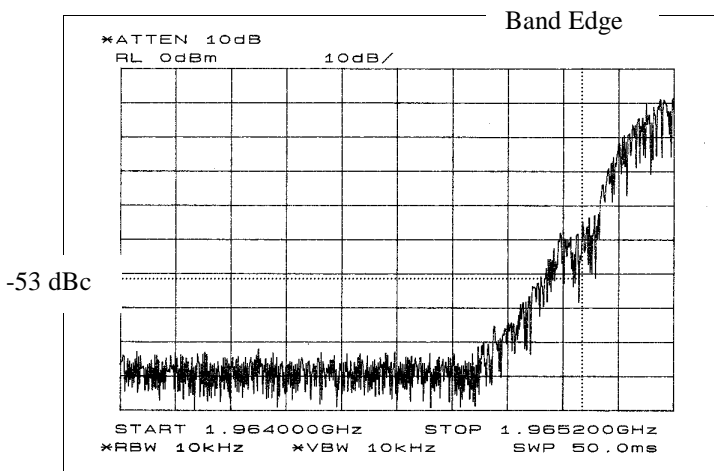


Figure 5-11 - First 1 MHz of spectrum below E band

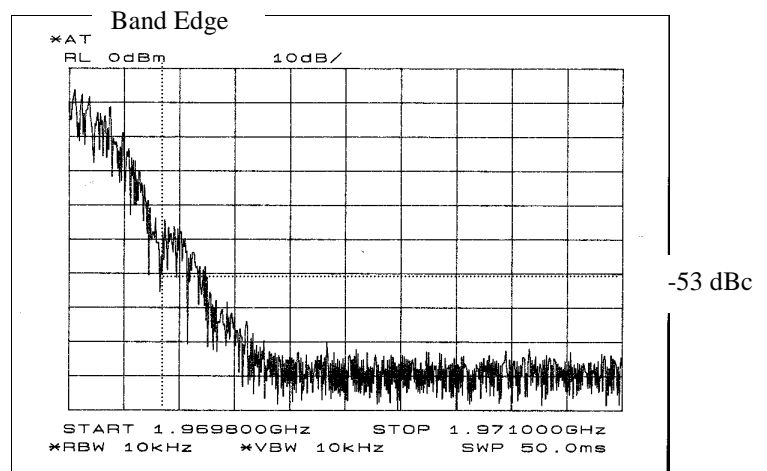


Figure 5-12 - First 1 MHz of spectrum above E band.

Test Equipment List

Mfg. / Model #	Qty	Description	Calibration Date	Serial Number
HP-E4432A	1	Modulated Signal Generator	14 Apr 99	1293181
HP-8564E	1	Spectrum Analyzer, 30 Hz - 40 GHz	18 Sep 99	1289277