Chapter 11 Test Report

Overview

This section includes the test report and data showing compliance with all applicable technical standards.

Contents

11.1 Test Methodology

This section describes the test methodology used to validate the performance of the AT&T Wireless Services R3 Remote Unit (R3), which consists of the R3 Indoor Unit and the R3 Outdoor Unit, against the applicable requirements of FCC Part 2, 15, and Part 24.

11.1.1 Introduction

The purpose of this chapter is to present the test methodology used to verify FCC regulatory compliance of the R3.

Throughout this document, all depictions of test configurations utilize a common set of interfaces. These interfaces are described in detail in Chapter 7, “Operational Description” of this document. The name and purpose of each interface is summarized in Table 11.1 below:

Table 11.1 PWAN Interface Definitions

Interface ID	Description
T Interface	Terminal interface to R3
A Interface	Air interface between R3 and Base Station radio equipment
P Interface	Interface between Base Station radio equipment and Base Station control
Csw Interface	Interface that provides public switched telephone network (PSTN) connectivity for call processing

11.1.2 Equipment Classification

The AT&T R3 Outdoor Unit is designed to be mounted to a building, therefore it is classified as a “fixed station” as defined in Subpart 24.5 of the FCC Rules and Regulations. Consequently, the output power limitations associated with Base Stations described under FCC Subpart 24.232(a) were applied to this unit. However, it should be noted that the Effective Isotropic Radiated Power (EIRP) of the R3 will not exceed 4 watts EIRP average power.

11.1.3 Remote Unit RF Frequency Stability vs. Temperature Test Methodology

11.1.3.1 Applicable FCC Rules Parts

FCC Subpart 2.995 - Measured over the temperature range of -30 to +50 C. Frequency measurements shall be made at the extremes and at intervals of not greater than 10 degrees C throughout the range. Only the frequency determining portions of the transmitter need be subjected to this test.

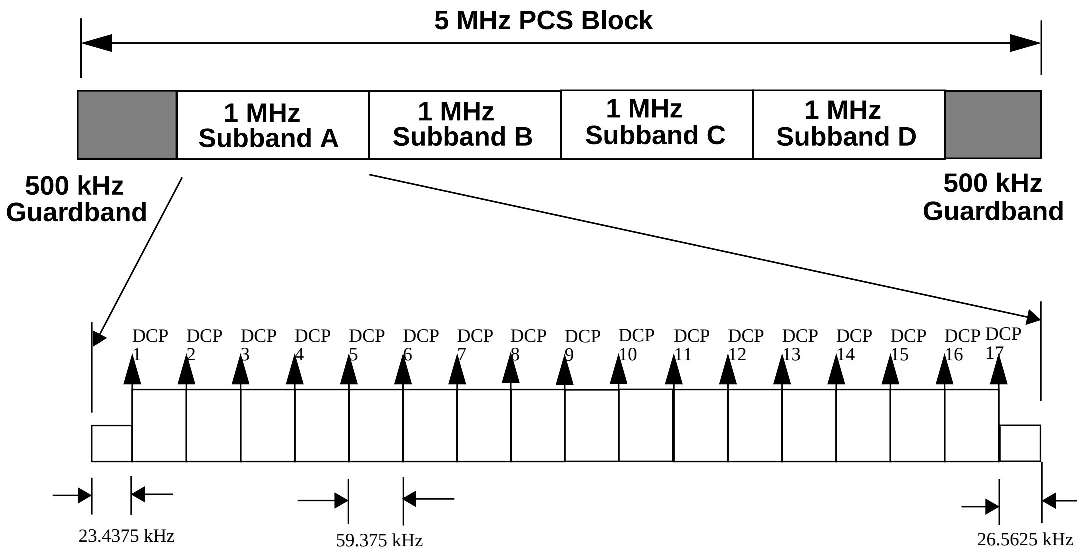
FCC Subpart 24.236 - The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

11.1.3.2 Overview

The R3 obtains its frequency stability from the serving Base Station by synchronizing its internal TCXO to the serving Base Station frequency reference pilots. If a R3 is unable to locate the reference pilots from the serving Base Station, it will not transmit. Consequently, the frequency accuracy of the R3 can be verified only while it is receiving a transmission from a Base Station.

Once a R3 has synchronized to the serving Base, it is capable of transmitting Delay Compensation Pilots (DCPs) upon request. DCPs consist of 17 tones with static modulation (fixed amplitude and phase) spaced at 59.375-kHz intervals beginning 23.4375 kHz from the lower edge of the 1-MHz transmit subband (refer to Figure 11.1). Any frequency error present in the R3 reference oscillator and synchronization circuits will create a corresponding frequency error in each transmitted DCP tone.

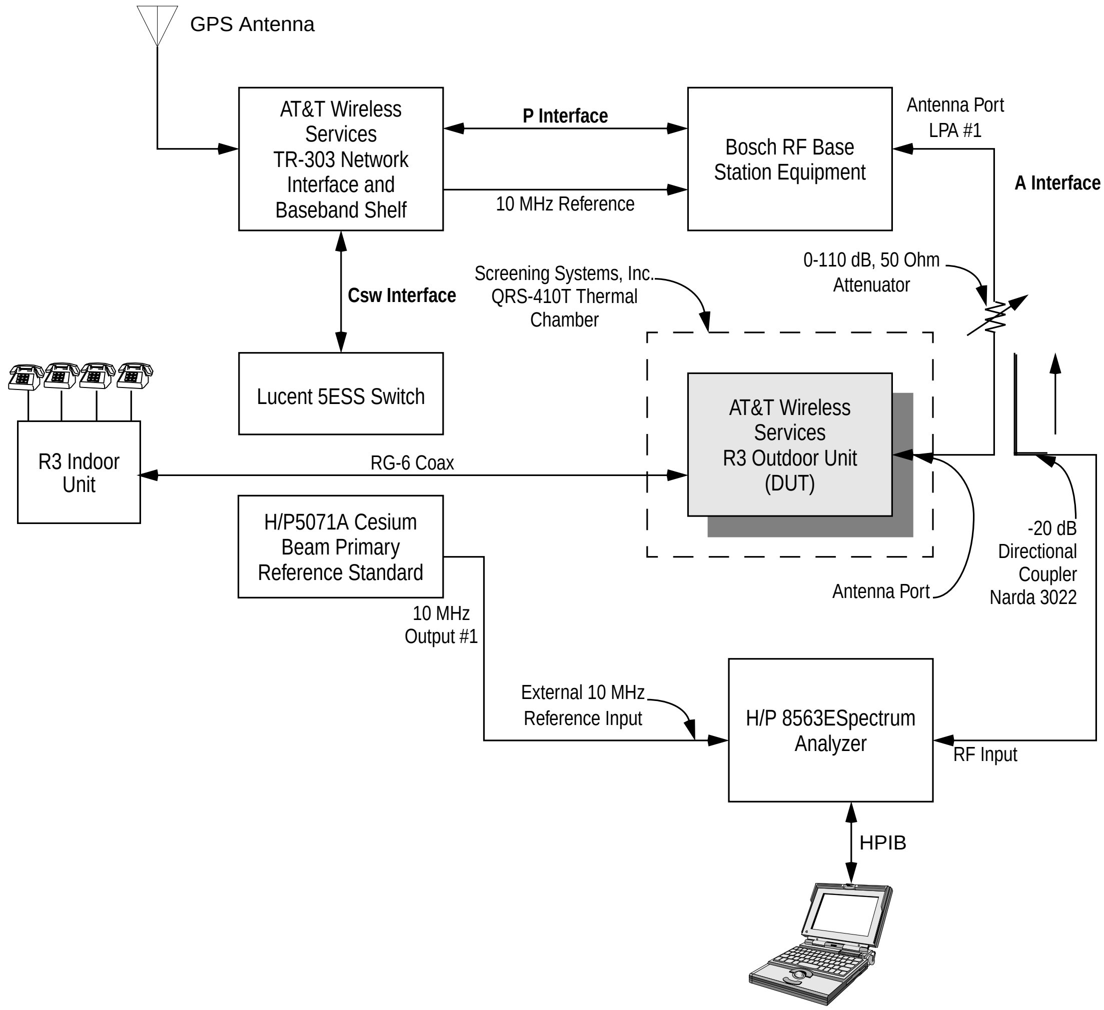
Figure 11.1 Remote Unit Delay Compensation Pilot Frequency Relationships



11.1.3.3 Test Methodology

The R3 under test was placed into a Screening Systems, Inc. model QRS-410T thermal chamber. The standard R3 Outdoor Unit antenna was replaced with a special pin-thru connector built for direct connection to the antenna port, capable of supporting a direct RF connection. This change allowed a direct cabled connection between the Base Station and the R3 while maintaining the integrity and thermal characteristics of the housing (refer to Figure 11.2).

Figure 11.2 Remote Unit Frequency Stability vs. Temperature Test Configuration



A Base Station, in an adjacent room, supplied the downlink signal necessary to permit synchronization of the R3. The Base Station reference oscillator was phase locked to the GPS for the duration of the R3 frequency stability tests. The frequency counter in a Hewlett-Packard 8563A Spectrum Analyzer was used to monitor the frequency of DCP tone #7 from the R3 under test. A Hewlett-Packard 5071A cesium beam primary standard was utilized as a precision frequency reference for the spectrum analyzer’s frequency counter. The spectrum analyzer’s frequency counter resolution was set to 1 Hz.

The frequency accuracy of DCP tone #7 was tracked over the temperature range of -30 to +50 Celsius. During this test the thermal chamber “stair-stepped” from -40 to +60 degrees Celsius in temperature increments of 10 degrees Celsius. A sensing thermocouple placed on the PCB of the R3 Outdoor Unit assured that the DUT was kept to within ±5 degrees Celsius of each pre-determined thermal step. The chamber held each thermal step for 15 minutes. The total run time was three hours per test.

The frequency error was calculated for each temperature step using the formula in Equation 11.1:

(Eq 11.1)

$$\mathrm{FrequencyError(PPM)} = \left(\left(\frac{\Delta f}{f}\right) \cdot 1 \times 10^{6}\right) = \left(\left(\frac{f(\mathrm{measured}) - f(\mathrm{ideal})}{f(\mathrm{ideal})}\right) \cdot 1 \times 10^{6}\right)$$

11.1.4 R3 Frequency Stability vs. Input Voltage Test Methodology

11.1.4.1 Applicable FCC Rule Parts

FCC Subpart 2.995 - Measured over the temperature range of -30 to +50 C. Frequency measurements shall be made at the extremes and at intervals of not greater than 10 degrees C throughout the range. Only the frequency determining portions of the transmitter need be subjected to this test.

FCC Subpart 24.236 - The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

11.1.4.2 Overview

The PWAN R3 obtains its frequency stability from the serving Base Station by synchronizing its internal TCXO to the serving Base Station frequency reference pilots. If a R3 is unable to locate the reference pilots from the serving Base Station, it will not transmit. Consequently, the frequency accuracy of the R3 can be verified only while it is receiving a transmission from a Base Station.

Once the R3 has synchronized to the serving Base Station, it is capable of transmitting Delay Compensation Pilots (DCPs) upon request. DCPs consist of 17 tones with static modulation (fixed amplitude and phase) spaced at 59.375 kHz intervals beginning 23.4375 kHz from the lower edge of the 1 MHz transmit subband (refer to Figure 11.1). Any frequency error present in the R3 reference oscillator and synchronization circuits will create a corresponding frequency error in each transmitted DCP tone.

Under normal operation, the R3 Outdoor Unit is powered by the R3 Indoor Unit via the RG-6 coaxial cabling, that produces an output voltage of -48 VDC, regulated to within ± 5%, regardless of the primary supply voltage or the internal battery voltage. Although the power cable used for this test is not representative of an actual R3 cable in terms of its length, the voltage range over which the R3 was tested simulates a worst-case supply voltage over multiple lengths of cable, including the maximum length allowable in an actual equipment installation.

11.1.4.3 Test Methodology

The R3 under test received a direct RF feed for frequency synchronization from the Base Station as shown in Figure 11.3. The Base Station reference oscillator was phase locked to GPS for the duration of the R3 frequency stability tests. The frequency counter in a Hewlett-Packard 8563A Spectrum Analyzer was used to monitor the frequency of DCP tone #7 from the R3 under test. A Hewlett-Packard 5071A cesium beam primary standard was utilized as a precision frequency reference for the spectrum analyzer's frequency counter. The spectrum analyzer's frequency counter resolution was set to 1 Hz.

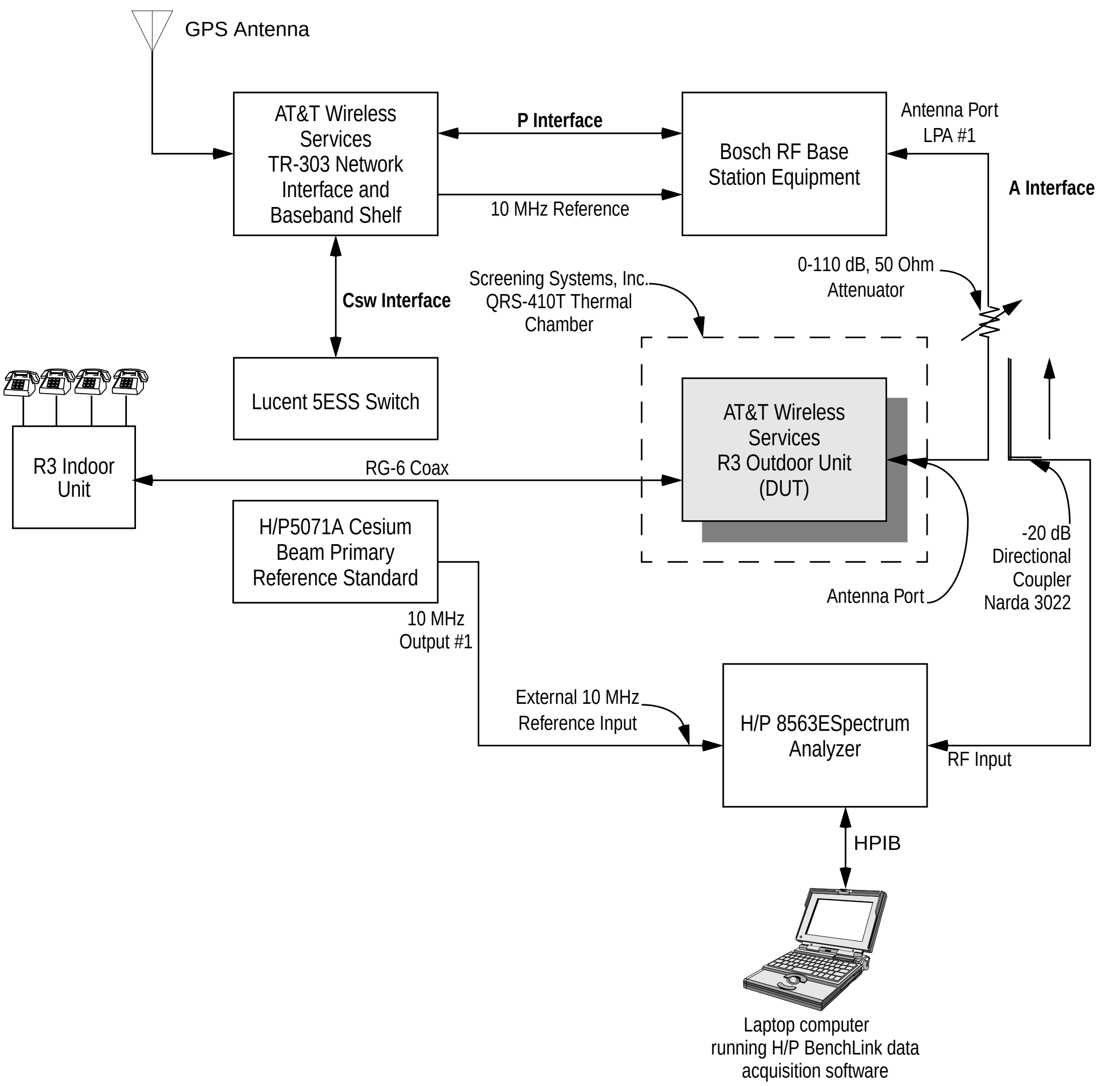
The frequency accuracy of DCP tone #7 was tracked while varying the R3 Outdoor Unit supply voltage in 0.5 volt steps from a minimum of -43.2 volts to a maximum of -52.8 volts (±10% of the nominal -48-volt input voltage).

The frequency error was calculated for each temperature step using the formula in Equation 11.2.

(Eq 11.2)

$$\text{FrequencyError(PPM)} = \left(\left(\frac{\Delta f}{f}\right) \cdot 1 \times 10^6\right) = \left(\left(\frac{f(\text{measured}) - f(\text{ideal})}{f(\text{ideal})}\right) \cdot 1 \times 10^6\right)$$

Figure 11.3 R3 Frequency Stability vs. Input Voltage Test Configuration



11.1.5 R3 Occupied Bandwidth Test Methodology

11.1.5.1 Applicable FCC Rule Parts

FCC Subpart 2.989 - Occupied bandwidth is defined as 99% of the total mean power, measured according to Subpart 2.989 (i), which requires full loading of the baseband, modulated such that the occupied bandwidth is consistent with that expected during normal operation.

11.1.5.2 Overview

PWAN R3 transmitter occupied bandwidth measurements do not differ substantially from any other system. The occupied bandwidth of a PWAN R3 is maximized when all 17 of its Delay Compensation Pilots (DCPs) are active. However, this is an infrequent occurrence, taking place for only 1.5 ms during Solicited Common Access Channel (SCAC) bursts. SCAC bursts occur only when the R3 is responding to an access command from the Base Station (such as during a Base Station-R3 call setup), and as a result the transmission of DCP tones comprise a very small percentage of the transmit activity from a R3. Under normal operating conditions, the R3's occupied bandwidth is maximized during a high-speed data (HSD) session when two FDMA slots are simultaneously active in a single TDMA slot. However, the worst-case occupied bandwidth will not exceed that of the R3 operating with DCPs only, so they were used as the stimulus during the execution of this test.

11.1.5.3 Test Methodology

A software switch in the R3 was set to generate constant Delay Compensation Pilots. The resulting transmitter output was sampled through a -20 dB directional coupler and viewed with a Hewlett-Packard 89441A Vector Signal Analyzer using the Hewlett-Packard 89451A Digital Radio Personality option, set up to measure 99% Occupied Bandwidth (refer to Figure 11.4). The configuration parameters of the 89451A are listed in Table 11.2.

Figure 11.4 R3 Occupied Bandwidth and Modulation Characterization Test Configuration

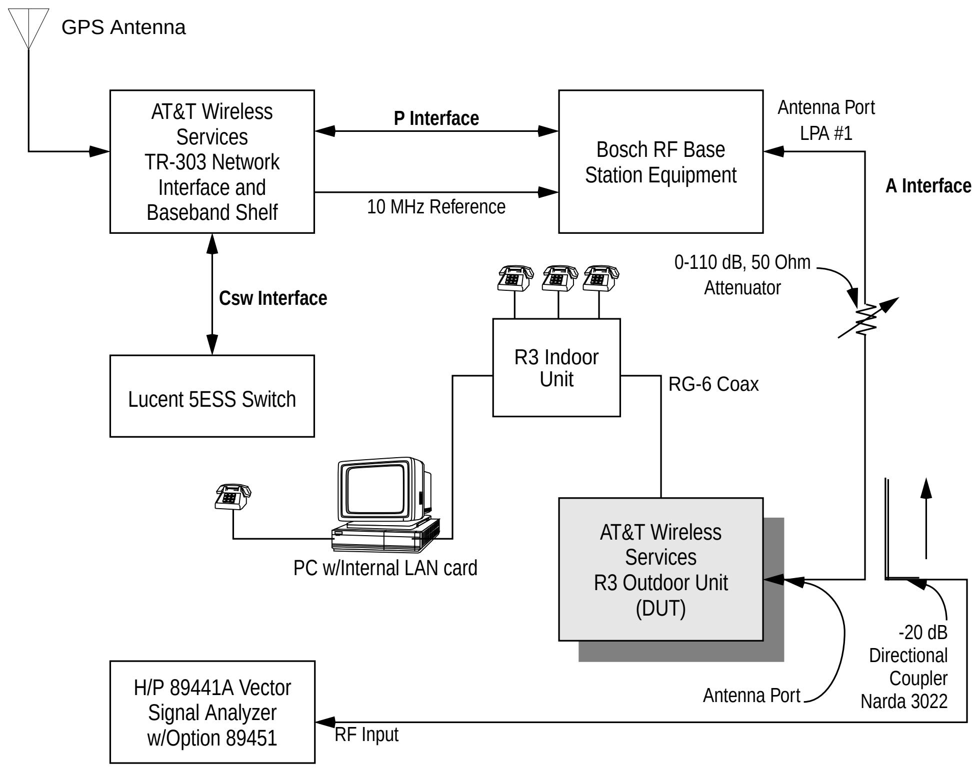


Table 11.2 Hewlett-Packard 89441A Occupied Bandwidth Test Parameters

Parameter	Value
Center Frequency	1866.0 MHz
Span	1 MHz
Main Time Length	400 µs
Gate Time Length	320 µs
Gate Delay	50 µs
Trigger Type	IF Channel 1
Input Level	+10 dBm
External Attenuation	25.8 dB
Trigger Delay	Selected to center 320 µs transmission bursts in time gate (typically -43 µs)
Trigger Holdoff	2300 µs
Frequency-Domain Averaging	20 Samples, RMS Exponential

11.1.6 Modulation Characterization Test Methodology

11.1.6.1 Applicable FCC Rules

FCC Subpart 2.987 - Requires a curve or equivalent data which shows that the equipment will meet the requirements of the rules under which the equipment is to be licensed. Provide data showing that the modulation being employed does not cause the spectral purity to exceed the requirements of 2.985 and 24.238.

11.1.6.2 Overview

The modulation characteristics of the PWAN R3 transmitter differ substantially from any other system. The OFDM time-domain waveform transmitted by the R3 is a composite of several discrete logical “channels”. In this test, each logical “channel” was characterized individually in both the time and frequency domain. The channels characterized by this measurement include:

- Single Voice traffic channel
- High-speed Data traffic channel
- Network Access channel
- Delay Compensation channel

A Hewlett-Packard 89441A Vector Signal Analyzer was used to characterize each of the discrete channels listed above. For each channel, the 89441A was used to obtain the following information:

- 99% occupied bandwidth in kHz
- Integrated power across the measured occupied bandwidth in dBm
- Power vs. frequency (in dBm) at a 12-kHz resolution bandwidth
- Time-domain average RF burst power
- Complimentary Cumulative Distribution Function (CCDF) of the peak to average ratio made up of *x* samples of the time-domain RF bursts

The specific operating parameters of the Hewlett-Packard 89441A Vector Signal Analyzer are summarized in Table 11.3

Table 11.3 Hewlett-Packard 89441A Modulation Characterization Test Parameters

Parameter	Value
Center Frequency	1866.0 MHz
Span	1 MHz
Main Time Length	400 us
Gate Time Length	320 us
Gate Delay	50 µs
Trigger Type	IF Channel 1
Input Level	+10 dBm
External Attenuation	25.8 dB
Peak/Average Metric	99.0%
Trigger Delay	Selected to center 320 µs transmission bursts in time gate (typically -43 µs)
Trigger Holdoff	2300 µs
Frequency-Domain Averaging	20 Samples, RMS Exponential
FFT Window Type	Flat Top
FFT Freq. Points	1601
Resolution BW	12 kHz

11.1.6.3 Test Methodology

Single Voice Channel

A single telephone call was established between the R3 under test and the Base Station using the test configuration shown in Figure 11.4. The Hewlett-Packard 89441A Vector signal analyzer was configured according to the parameters shown in Table 11.3. The random nature of the data produced by the LD-CELP compression algorithm is sufficient to assure results representative of a normally operating system.

High-speed Data Channel

An HSD session was established between the R3 under test and the Base Station using the test configuration shown in Figure 11.4. The Hewlett-Packard 89441A Vector Signal Analyzer was configured according the parameters shown in Table 11.3. During this test, a text file was transferred from the R3 to an FTP server on the AWS network. The random nature of the data contained in this file is sufficient to assure results representative of a normally operating system.

Network Access Channel

Characterization of the network access channel took place utilizing the test configuration shown in Figure 11.4. The Hewlett-Packard Vector Signal Analyzer was configured according to the parameters shown in Table 11.3.

In normal operation, transmission of unsolicited network access bursts is kept to a minimum to reduce contention on the shared common access channel. In this test, in order to obtain statistically meaningful measurement of the peak power and the peak/average ratio, greater transmission persistence from the DUT was required. This was accomplished by disabling the uplink receiver in the Base Station. Without any network access acknowledgments from the Base Station, the DUT was capable of transmitting multiple Network Access bursts, which were measured and analyzed.

Delay Compensation Channel

The R3 Delay Compensation Pilots (DCPs) were characterized using the test configuration shown in Figure 11.4. The Hewlett-Packard Vector Signal Analyzer was configured according to the parameters shown in Table 11.3.

In normal operation, an R3 will only transmit DCPs for 1.5 ms during a solicited network access attempt. However, the R3 is capable of supporting a test function by which it will transmit DCPs in four of the eight TDMA slots continuously. This test mode was utilized for the characterization of the Delay Compensation channel.

11.1.7 RF Output Power Test Methodology

11.1.7.1 Applicable FCC Rules

FCC Subpart 24.232 - Base Stations are limited to 1640 watts EIRP peak power, and in no case shall the output power of a Base Station exceed 100 watts. Peak transmitter power may be measured over any interval of continuous transmission using instrumentation calibrated in terms of RMS equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

11.1.7.2 Overview

Peak RF Output Power from the R3 is maximized during HSD operation. Consequently, maximum RF output power was characterized while the R3 was operating in this mode.

A Hewlett-Packard 89441A Vector Signal Analyzer was used to characterize the R3's composite RF output signal according to the following criteria:

- Time-domain average burst power
- Time-domain peak envelope burst power at the 99.0% level
- Time-domain peak/average ratio at the 99.0% level

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Table 11.4 Hewlett-Packard 89441A RF Power Test Parameters

Parameter	Value
Center Frequency	1866.0 MHz
Span	1 MHz
Main Time Length	400 µs
Gate Time Length	320 µs
Gate Delay	50 µs
Input Level	+10 dBm
External Attenuation	25.8 dB
Peak/Average Metric	99.0%

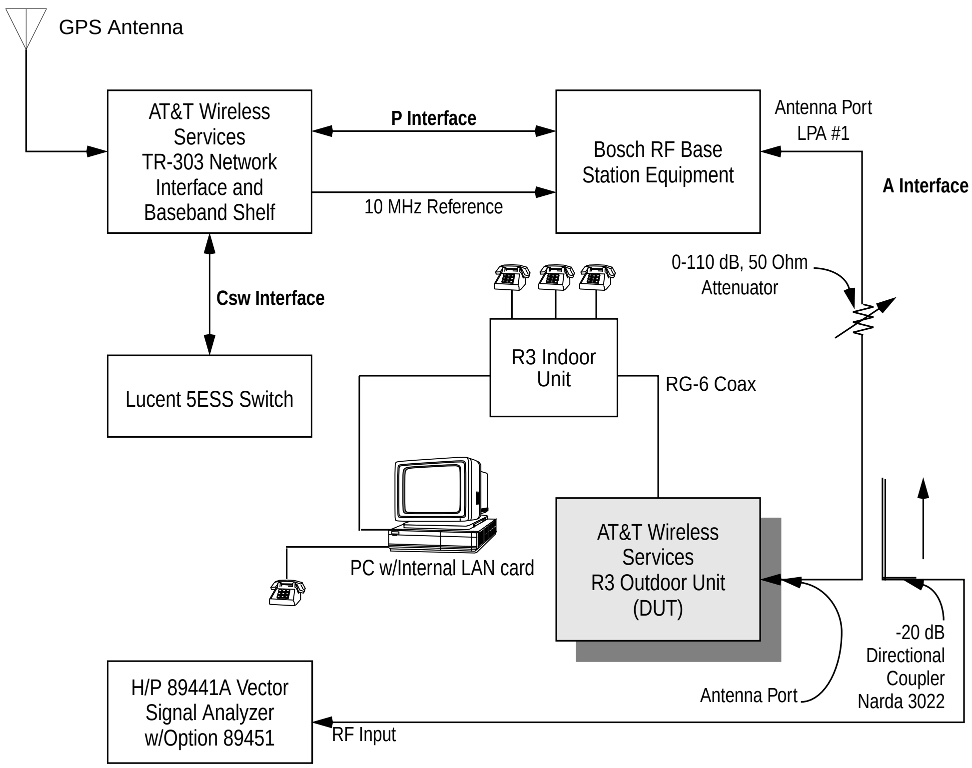
Table 11.4 Hewlett-Packard 89441A RF Power Test Parameters

Parameter	Value
Trigger Type	IF Channel 1
Trigger Delay	Selected to center 320 µs transmission bursts in time gate (typically -43 µs)
Trigger Holdoff	2300 µs
Frequency-Domain Averaging	20 Samples, RMS Exponential
FFT Window Type	Flat Top
FFT Freq. Points	1601
FFT Resolution BW	12 kHz

11.1.7.3 Test Methodology

For this test, an HSD session was established between the R3 under test and the Base Station using the test configuration shown in Figure 11.5. The Hewlett-Packard 89441A Vector Signal Analyzer was configured according the parameters shown in Table 11.4. During this test, a text file was transferred from the R3 to an FTP server on the AWS network. The random nature of the data contained in this file is sufficient to assure results representative of a normally operating system. A -20 dB directional coupler provided the required RF sample for measurement

Figure 11.5 R3 Output Power Test Configuration



11.1.8 Spurious Emissions at the Antenna Terminal Test Methodology

11.1.8.1 Applicable FCC Rules

FCC Subpart 2.985 - Requires that the RF Output be measured at the antenna power terminals into a dummy load after the transmitter has been adjusted in accordance with the manufacturers tune up procedure. Requires documentation of measurement configuration. Transmitter spectral output shall not have any components that exceed the spectral mask applicable to the rule part under which the equipment shall be operated.

FCC Subpart 24.238 - On any frequency outside a licensee’s block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43+10Log(P) dB. Compliance is based on measurement within a 1 MHz resolution bandwidth. However, in the 1-MHz bands immediately adjacent to the frequency block a resolution bandwidth of at least 1 percent of the emission bandwidth may be employed. The emission bandwidth is defined as the width of the signal between two points, one above and one below the carrier frequency, outside of which all emissions are attenuated by at least 25 dB below the transmitter power.

11.1.8.2 Overview

The RF spectral purity of the R3 transmitter does not differ substantially from a conventional TDMA transmitter, other than the characteristics of any intermodulation products that are produced. Intermodulation products are only generated during the TDMA slots occupied by the R3, consequently, accurate emissions measurements must be synchronized to the transmitted bursts. This implies the use of a receiver capable of performing an FFT triggered on the presence of RF burst energy. This requirement is met by the Hewlett-Packard 89441A Vector Signal Analyzer, which was used to characterize the emissions from the R3 transmitter while operating at peak output power. The specific operating parameters of the Hewlett-Packard 89441A Vector Signal Analyzer are summarized in Table 11.5. The emission mask utilized through the course of this test is shown in Figure 11.6.

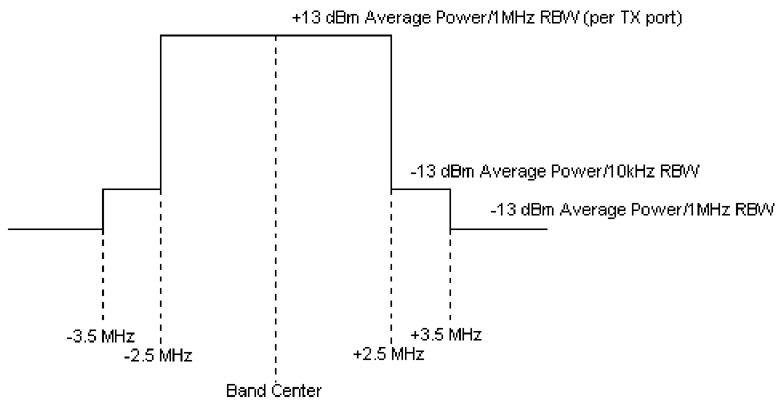
Table 11.5 Hewlett-Packard 89441A Spectral Purity Test Configuration Parameters

Parameter	Value
Center Frequency	Varies with measurement (1866.0 MHz and 1869.0 MHz)
Span	4 MHz and 7 MHz
Main Time Length	400 µs @ 4MHz Span, 229 µs @ 7 MHz Span
Gate Time Length	320 µs @ 4 MHz Span, 229 µs @ 7 MHz Span
Gate Delay	50 µs @ 4 MHz Span, 0 µs @ 7 MHz Span
Input Level	+20 dBm
External Attenuation	25.8 dB

Table 11.5 Hewlett-Packard 89441A Spectral Purity Test Configuration Parameters (continued)

Trigger Type	IF Channel 1; Free Run for measurements with fundamental outside of span
Trigger Delay	-43 µs @ 4 MHz span, +50 µs @ 7 MHz span
Trigger Holdoff	2300 µs
Frequency-Domain Averaging	20 Samples, RMS Exponential
FFT Window Type	Flat Top
FFT Freq. Points	1601
Resolution BW	12 kHz @ 4 MHz Span, 17 kHz @ 7 MHz Span

Figure 11.6 R3 Conducted Power Spectral Mask



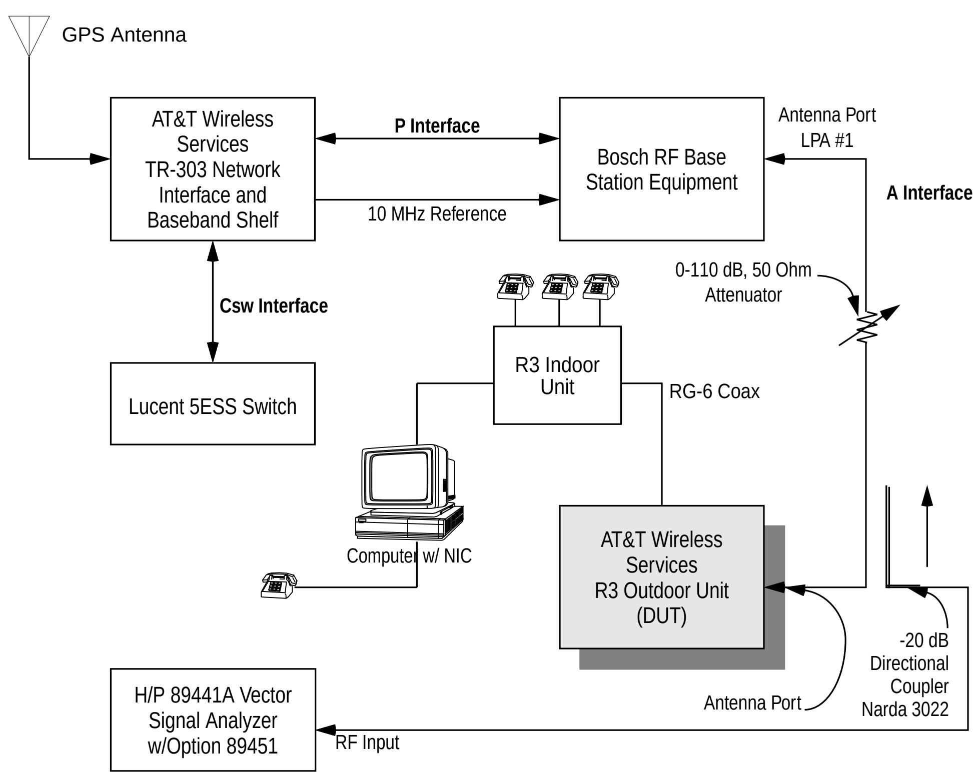
11.1.8.3 Test Methodology

RF Output Power and Out-Of-Band (OOB) emissions from the R3 are maximized when transmitting Delay Compensation Pilots at an “elevated” power level. For this test, the DCP average power level was increased to the point where the DCP peak power was equal to the peak power of an HSD session. Under normal operation, Delay Compensation Pilots are transmitted for 1.5 ms during Solicited Common Access Channel (SCAC) attempts, such as during airlink setup when the Base Station is terminating a call to a R3. As a result, DCP transmissions are typically infrequent, however, the nature of the tones that make up the DCP suite lend themselves to the evaluation of spurious output from the R3, as any intermodulation products produced by the R3 are maximized. For this test, a software switch in the R3 was set to transmit continuous DCP tones during four of the eight TDMA slots, and the transmitter attenuators were set to obtain a peak power with DCP stimulus equivalent to an HSD session. This power level simulates a worst-case condition for the generation of IM products.

Spectral purity measurements were made with the R3 operating in the lowest and highest subbands allocated in the “D” PCS block. Any OOB intermodulation and spurious signals will be contributed by R3s operating in the exterior subbands. OOB spectral contributions from R3s operating within the two interior subbands will be negligible.

A Hewlett-Packard 89441A Vector Signal Analyzer was used to evaluate the spectral purity of the R3. The test configuration is shown in Figure 11.7. The Hewlett-Packard 89441A Vector Signal Analyzer was configured according the parameters shown in Table 11.3.

Figure 11.7 Spectral Purity Test Configuration



The Vector Signal Analyzer was configured to trigger on the presence of RF burst energy during all measurements over spans that included the R3 fundamental. Measurements over spans that did not include the

R3 fundamental were made with the Vector Signal Analyzer trigger disabled (free-running).

The 89441A VSA is optimized to provide highly accurate measurements in the frequency-domain with narrow resolution bandwidths. Conversely, the instrument does not perform well with the wide (1 MHz) resolution bandwidths required by §2.985 and §24.238. However, the 89441A is capable of making integrated power measurements across any desired bandwidth, the results of which are identical to using a 1 MHz resolution bandwidth in a conventional spectrum analyzer. All spectral purity measurements made with the 89441A utilized a 12-kHz resolution bandwidth for 4-MHz spans and a 17 kHz resolution bandwidth for 7-MHz spans. Band power markers (set to 1 MHz BW) were used to measure the total integrated power in 1 MHz segments at frequencies of concern across the range of 1853 to 1882 MHz. Emissions at all applicable frequencies above and below this range have been documented in Section 11.3.4.3, “Radiated to Conducted Spurious Emissions.”

11.1.9 RF Human Exposure

11.1.9.1 Applicable FCC Rules

FCC Subpart 24.51 - Applications for Type Approval of transmitters operating within the PCS region must determine that the equipment complies with IEEE C95.1-1991, *IEEE Standards for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz* as measured using methods specified in IEEE C95.3 - 1991, *Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave*.

11.1.9.2 Overview

For the original RU, Bioelectromagnetics Consulting (BEMC), Schmid & Partner Engineering AG (SPEAG), and SARTest Ltd. were each provided with a physical model of the Outdoor Unit, which consisted of a 4 patch antenna array fed from a stripline network connected to two coaxial cable input power connectors. The patch antenna array and stripline network was backed by a ground plane designed to be bolted to a mounting framework and covered by a HB plastic radome. The gain of the antenna as provided by the manufacturer was measured to be 15.03 dBi when each coaxial input connector is fed with in phase equal power. For this analysis the total input power at a frequency of 1.92 GHz was split equally between coaxial feed connectors.

The modelling and SAR testing for the original RU correlated very well during the testing of the original version. Due to the minimal RF changes of the R3 and the good correlation of the SAR and modelling data of the original RU, only modelling of the R3 Unit was completed.

11.1.9.2.1 Test Methodology

The R3 RF Human Exposure verification was accomplished by completing an FDTD model analysis. The FDTD analysis technique was used to calculate the near and far fields and induced SAR patterns in exposed tissues from the antenna. The FDTD technique is currently the most popular theoretical method of choice for analyzing the safety and compliance of wireless technology devices with human RF exposure MPLs. Both homogeneous and non-homogeneous modelling was completed on two different head models.

11.1.10 Radiated Emissions

11.1.10.1Applicable FCC Rules

FCC Subpart 15.209 - The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the field strength levels specified in table 15.209 (a). Emission limits shown in the table below 1000 MHz are based on measurements employing a CISPR quasi-peak detector. Emission limits above 1000 MHz are based on measurements employing an average detector.

11.1.10.2Overview

The radiated emissions from the R3 must not exceed the levels as stated within the FCC Part 15, Class B requirements. The testing provides the necessary assurance that the R3 when installed in a typical field environment will not interfere with other electronic devices. To make the appropriate measurements, the R3 must be setup in a typical installation configuration and made operational. Utilizing an EMI receiver and quasi-peak detector radiated measurements shall meet the FCC limits as specified in subpart 15.207.

11.1.10.3Test Methodology

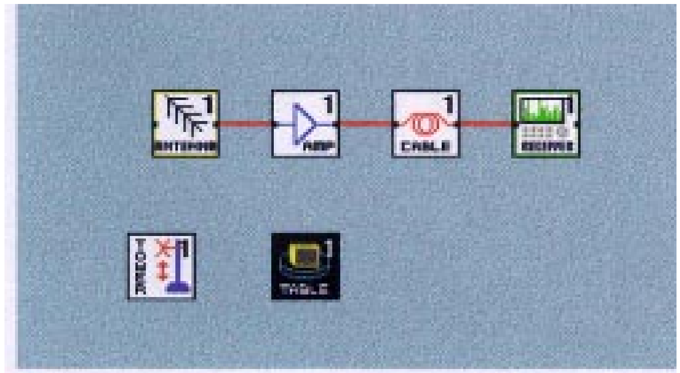
Radiated emissions measurements shall be made over the frequency range specified by the regulatory agency. In this case, per FCC Part 15, subpart 15.207. Measurements shall be made at the EUT azimuth and antenna height such that the maximum radiated emissions level will be detected. This was accomplished using both an automated 360 degree turntable and 1 to 4 meter height antenna positioners. Sixteen azimuth cuts at 22.5 degrees and 1 to 4 meter antenna scans in both polarizations were utilized. The R3 was setup in a typical field configuration, as shown in Figure 12.1, consisting of the Outdoor Unit being attached to the mounting bracket and the bracket being mounted to a vertical piece of typical house siding which was placed on the center of a wooden table located in the center of the turntable. Proper interconnecting cable was utilized from the R3 Outdoor Unit to the R3 Indoor Unit. Various cable lengths were utilized to determine worse case configuration and a Base Station antenna was placed in the chamber for R3 wireless communication. All radiated emissions testing was completed in four configurations; 1) Lucent power supply with two voice channels and the high speed data (HSD) uplink continuously utilized, 2) Lucent power supply with four voice and HSD uplink channels continuously utilized, 3) Panasonic power supply with two voice channels and HSD uplink continuously utilized, and 4) Panasonic power supply with four voice channels and HSD continuously utilized. Testing was completed from 30 MHz to 26 GHz. When testing close to or over the fundamental frequency range, a notch filter tuned to the R3 and Base Station fundamental frequencies was utilized to prevent receiver overload and/or damage.

The R3 test configuration and test setup photos can be found in Chapter 12, “Test Setup Photos”.

11.1.10.4Radiated Emissions Equipment Configuration 30-1000 MHz

Completing FCC Part 15 radiated emissions for the R3 required the test equipment as shown in Table 11.18. The test equipment was setup, monitored, and operated as shown in Figure 12.1 and Figure 11.8, consisting of an HP 8546A EMI Receiver, measured cable, pre-amplifier, and EMI antenna. The measurement equipment includes a turntable, antenna mast, and dual position controller to properly scan and step the antenna and EUT, respectively. Testing was completed with the measurement equipment located within a shielded control room chamber.

Figure 11.8 Equipment Set Graph



11.1.10.4.1Equipment Settings

The following is list detailing the individual pieces of equipment and their settings used to complete the 30 -1000 MHz radiated emissions measurement, including antenna scan heights and turntable azimuth settings.

Setting Details

Config. band: 30MHz - 1000 MHz

Antenna 1: Horizontal and Vertical Polarizations

Cable 1: 53-foot Gortex Cable

Tower 1: 1 to 4 meter scan

Turntable 1: 22.5 degree steps during scans

Amplifier 1: PREAMP OFF

Receiver I (Standard)

EMI BW (RBW): Default FCC

Average BW (VBW): Default FCC

Attenuation: Auto

Reference level: Auto

Sweep time: Auto

Input: Input #2 (20 MHz - 2.9 GHz)

Receiver I (Maximization)

EMI BW (RBW): Default FCC

Average BW (VBW): Default FCC
Attenuation: Auto
Reference level: Auto
Sweep time: Auto
Span: Auto
Single signal per segment: No
Amplitude resolution: 10 dB/div
Detector: Sample
Input: Input #2 (20 MHz - 2.9 GHz)
Maximization traces
  Max. step-mode dwell: 1 sec / 1 sweeps
  Video average: None
  Remove impulses: No
Demodulation: Off

11.1.10.5 Measure Parameters

Measurements for radiated emissions were completed during the first pass with a peak detector, with the following settings:

Peak

- Auto settings: Yes
- Span 240 kHz, RBW 120 khz, VBW 1000 kHz
- Max dwell time: *5* seconds
- Max number of sweeps: *5* seconds

Measurements for radiated emissions were completed on all peak detected signals that exceeded the limit line margin with a quasi-peak detector at the following settings:

QP

- Auto settings: Yes
- Span 90 kHz, RBW 120 kHz, VBW 1000 kHz
- Max dwell time: *5* seconds
- Max number of sweeps: *5* seconds

The tune and listening settings were set to the following span, resolution, and video bandwiths:

Tune/Listen setting

- Narrow span 100 kHz, RBW 30 kHz, VBW 10 kHz

11.1.10.6 Antenna Factors

The Chase, model CBL6111A, EMI measurement antenna was used for radiated emissions measurements from 20 - 1000 MHz. The antenna correction factors are shown in Table 11.6.

Table 11.6 Antenna 1 (Bilog 1632) 3-m Correction Factors

Frequency (MHz)	Amplitude (db/m)
30	19.3
40	13.7
50	7.9
60	5.4
70	6.6
80	8.4
90	9.6
100	10.5
110	11.4
120	12.7
130	12.7
140	12.2
150	11.8
160	10.7
170	9.8
180	9.1
190	9.1
200	9.4
225	10.2

Table 11.6 Antenna 1 (Bilog 1632) 3-m Correction Factors (continued)

Frequency (MHz)	Amplitude (db/m)
250	12.2
275	12.6
300	13.0
325	14.2
350	15.0
375	15.3
400	15.9
425	16.4
450	16.5
475	17.1
500	17.4
525	17.8
550	18.9
575	18.9
600	18.9
625	19.3
650	20.0
675	20.1
700	20.5
725	21.4
750	21.4
775	21.2
800	21.5
825	22.0
850	22.2
875	22.3
900	22.6
925	23.0
950	23.5
975	23.8
1000	24.0

11.1.10.7Cable Factors

The measurement system setup, as shown in Figure 11.8 is interconnected with 53 feet of Gortex coaxial cable. The cable insertion loss was measured and documented for receiver data correction. Table 11.7 outlines the measurement system's cable correction factors.

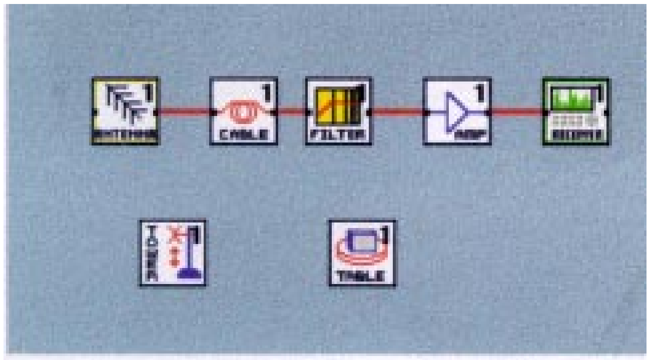
Table 11.7 Cable 1 (Gore Cable) 53-ft. Correction Factors

Frequency (MHz)	Amplitude (dB)
.01	-0.152
300	-1.285
600	-1.896
1000	-2.498
3500	-4.786
5000	-5.782
6000	-6.019

11.1.10.8Radiated Emissions Equipment Configuration 1000-3500 MHz

Completing FCC Part 15 radiated emissions for the R3 required the test equipment as shown in Table 11.18. The test equipment was setup, monitored, and operated as shown in Figure 12.1 and Figure 11.9, consisting of an HP 8546A EMI Receiver, measured cable, pre-amplifier, and EMI antenna. The measurement equipment includes a turntable, antenna mast, and dual position controller to properly scan and step the antenna and EUT, respectively. Testing was completed with the measurement equipment located within a shielded control room chamber.

Figure 11.9 Equipment Set



Equipment Settings

The following is list detailing the individual pieces of equipment and their settings used to complete the 1000 -3500 MHz radiated emissions measurement, including antenna scan heights and turntable azimuth settings

Config. band: 1000 MHz - 3500 MHz Antenna 1:
Cable 1: 53-foot Gortex Cable

Tower 1: 1 to 4 meter scan

Turntable 1: 22.5 degree steps during scans

Amplifier 1: Preamp ON;

Receiver 1 (Standard)

EMI BW (RBW): 1000 kHz

Average BW (VBW): 1000 kHz

Attenuation: Auto

Reference level: Auto

Sweep time: Auto

Input: Input #2 (1 GHz - 3.5 GHz)

Receiver 1 (Maximization)

EMI BW (RBW): 1000 kHz

Average BW (VBW): 1000 kHz

Attenuation: Auto

Reference level: Auto

Sweep time: Auto

Span: Auto
Single signal per segment: No
Amplitude resolution: 10 dB/div
Detector: Sample
Input: Input #2 (1 GHz - 6.5 GHz*)*
Maximization traces
  Max. step-mode dwell: 1 sec / 1 sweeps
  Video average: None
  Remove impulses: No
Demodulation: Off

11.1.10.8.1Measure Parameters

Measurements for radiated emissions were completed during the first pass with a peak detector, with the following settings:

Peak

- Auto settings: Yes
- Span 240 Hz, RBW 1000 kHz, VBW 1000 kHz
- Max dwell time: *5* seconds
- Max number of sweeps: *5* seconds

Measurements for radiated emissions were completed on all peak detected signals that exceeded the limit line margin with an average detector at the following settings:

Average

- Auto settings: Yes
- Span 90 kHz, RBW 1000 kHz, VBW 1000 kHz
- Max dwell time: *5* seconds
- Max number of sweeps: *5* seconds
- Auto selection of avg. VBW: Yes

The tune and listening settings were set to the following span, resolution, and video bandwiths:

Tune/Listen setting

- Narrow span 100 kHz, RBW 30 kHz, VBW 10 kHz

11.1.10.8.2Antenna Factors

The EMCO, model 3115 EMI measurement horn antenna was used for radiated emissions measurements from 1000 - 3500 MHz (Is this the correct range). The antenna correction factors are shown in Table 11.8.

Table 11.8 Antenna 1 (Emco 3115 Serial # 5515) Correction Factors

Frequency (MHz)	Amplitude (dB/m)
1000	25.5
1500	26.9
2000	28.9
2500	30.6
3000	31.8
3500	32.8
4000	34.5
4500	33.9
5000	35.1
5500	36.1
6000	36.8

11.1.10.9Cable Factors

The measurement system setup, as shown in Figure 12.1 and Figure 11.9 is interconnected with 53 feet of Gortex coaxial cable. The cable insertion loss was measured and documented for receiver data correction. Table 11.9 outlines the measurement system's cable correction factors.

Table 11.9 Cable 1 (Gore Cable) 53-ft. Correction Factors

Frequency (MHz)	Amplitude (dB)
0.01	-0.152
300	-1.285
600	-1.896
1000	-2.498
3500	-4.786
5000	-5.782
6000	-6.019

11.2 RF Characterization Test Results

This section describes the test results obtained during the validation of the AT&T Wireless Services R3 against the applicable requirements of FCC Part 2 and Part 24.

11.2.1 Test Equipment List

Test cases within this section were completed utilizing the equipment in the following table. Calibration of equipment, where required, was completed by Techmaster Electronics, Inc. and tracks to NIST.

Table 11.10 Test Equipment

Instrument Name	Manufacturer	Model Number	Serial Number	Calibration Last Date	Calibration Due Date
Thermal Chamber	Screening Systems Inc.	QRS-410T	9511-110	N/A	N/A
Directional Coupler	Narda	3022	76836	N/A	N/A
Directional Coupler	Narda	4012C-10	11626	N/A	N/A
Signal Generator	Hewlett-Packard	8657B	2935U00456	5/10/00	5/10/01
Power Meter	Hewlett-Packard	EPM-442A	GB37170555	2/4/00	2/4/01
Power Sensor	Hewlett-Packard	8482A	3318A26922	6/7/00	6/7/01
Cesium Beam Clock	Hewlett-Packard	5071A	3249A00701	N/A	N/A
Vector Signal Analyzer	Hewlett-Packard	89441A	3416A02243	9/17/99	9/17/00
Frequency Counter	Hewlett-Packard	53132A	3736A06180	2/7/00	2/7/01
Spectrum Analyzer	Hewlett-Packard	8563E	5317A03669	12/5/00	12/5/01
Network Analyzer	Hewlett-Packard	8753D	3410A05861	5/19/00	5/19/01

11.2.2 Equipment Under Test List

Test cases within this section were executed using the equipment under test listed in Table 11.11.

Table 11.11 EUT Equipment Under Test List

Board Type	Serial No.	Revision Level
Main Board (PCB1788907)	991112	6
Antenna Board (PCB1811601)	991020	4
2-Line Expansion Board (PCB1788800)	990930	2
Power Supply (CS930A Series)		1:2

11.2.3 R3 RF Frequency Stability vs. Temperature Test Results

11.2.3.1 Applicable FCC Rules Parts

FCC Subpart 2.995 - Measured over the temperature range of -30 to +50 C. Frequency measurements shall be made at the extremes and at intervals of not greater than 10 degrees C throughout the range. Only the frequency determining portions of the transmitter need be subjected to this test.

FCC Subpart 24.236 - The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

11.2.3.2 Test Configuration

The R3 under test was placed into a Screening Systems, Inc., model QRS-410T thermal chamber (refer to Figure 11.2).

The frequency accuracy of DCP tone #7 was tracked over the temperature range of -30 to +50 Celsius. During this test the thermal chamber “stair-stepped” from -40 to +60 degrees Celsius in temperature increments of 10 degrees Celsius. A sensing thermocouple placed on the PCB of the R3 assured that the device under test was kept to within ±5 degrees Celsius of each pre-determined thermal step. The chamber held each thermal step for 15 minutes.

The R3 transmit frequency error was calculated for each temperature step using the formula in Equation 11.3:

(Eq 11.3)

$$\mathrm{FrequencyError(PPM)} = \left(\left(\frac{\Delta f}{f}\right) \cdot 1 \times 10^{6}\right) = \left(\left(\frac{f(\mathrm{measured}) - f(\mathrm{ideal})}{f(\mathrm{ideal})}\right) \cdot 1 \times 10^{6}\right)$$

The ideal frequency for DCP tone #7 is exactly 23.4375 kHz above the bottom edge of the selected 1 MHz subband. For example, if the R3 is operating in the first 1 MHz subband within the “D” PCS block, the bottom edge of the subband is 1865.5 MHz. However, the duty cycle and cyclical prefix of the transmitted RF burst will cause this DCP tone to appear to have a constant frequency offset of about -0.630 PPM when measured with a swept-frequency spectrum analyzer. During this test, the change in this measurement offset (expressed in PPM) is representative of the R3’s frequency stability over the -40 to +60 Deg. Celsius temperature range.

11.2.4 Results Summary

The measured frequency stability vs. temperature is depicted in Figure 11.10. The results of these tests are summarized in Table 11.12 below:

Figure 11.10 R3 Frequency Stability vs. Temperature, DCP Tone #7

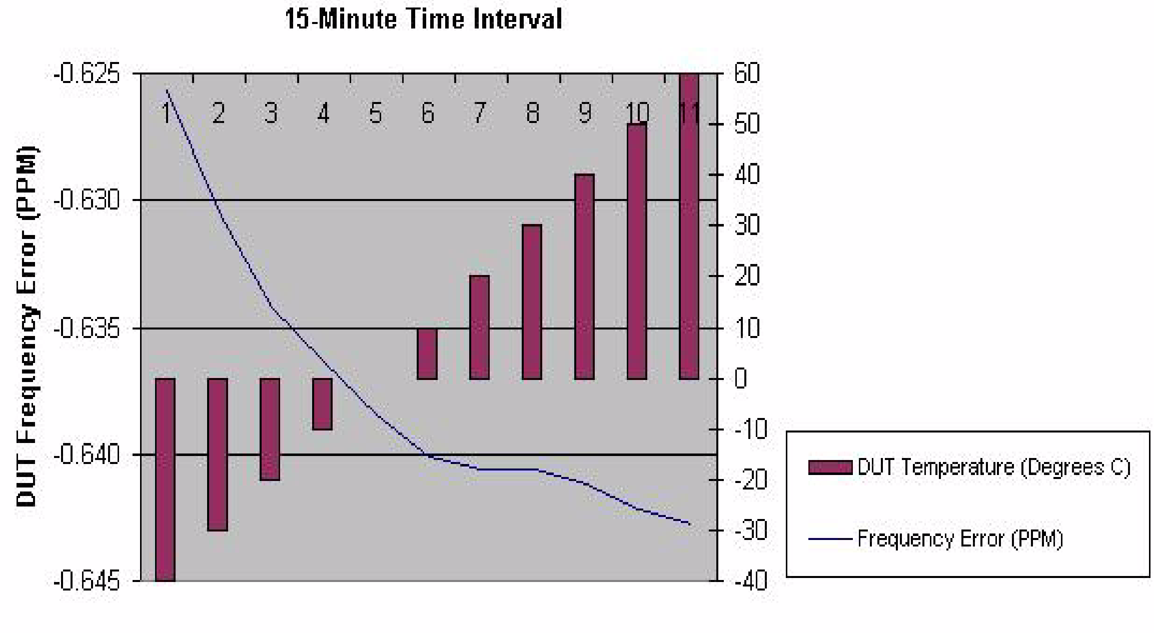


Table 11.12 R3 Transmit Frequency Stability vs. Temperature

Parameter	Measured Value
Transmit frequency stability at 1867 MHz between -40 Deg. Celsius and +60 Deg. Celsius	Frequency change of ≤ 0.003 PPM

11.2.5 R3 Frequency Stability vs. Input Voltage Test Results

11.2.5.1 Applicable FCC Rule Parts

FCC Subpart 2.995 - Measured over the temperature range of -30 to +50 C. Frequency measurements shall be made at the extremes and at intervals of not greater than 10 degrees C throughout the range. Only the frequency determining portions of the transmitter need be subjected to this test.

FCC Subpart 24.236 - The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

11.2.5.2 Test Configuration

The R3 under test was connected to a variable DC power supply (refer to Figure 11.3). The frequency accuracy of DCP tone #7 was tracked while varying the R3 supply voltage in 0.5 volt steps from a minimum of -43.2 volts to a maximum of -52.8 volts (±10% of the nominal -48 volt input voltage).

The frequency error was calculated for each temperature step using the formula in Equation 11.4:

(Eq 11.4)

$$\text{FrequencyError(PPM)} = \left(\left(\frac{\Delta f}{f}\right) \cdot 1 \times 10^{6}\right) = \left(\left(\frac{f(\text{measured}) - f(\text{ideal})}{f(\text{ideal})}\right) \cdot 1 \times 10^{6}\right)$$

The ideal frequency for DCP tone #7 is exactly 23.4375 kHz above the bottom edge of the selected 1 MHz subband. For example, if the R3 is operating in the first 1 MHz subband within the “D” PCS block, the bottom edge of the subband is 1865.5 MHz. Consequently, the ideal tone frequency for DCP tone #1 is 1865.5234375 MHz. However, the duty cycle and cyclical prefix of the transmitted RF burst will cause this DCP tone to appear to have a constant frequency offset of about -0.630 PPM when measured with a swept-frequency spectrum analyzer. During this test, the change in this measurement offset (expressed in PPM) is representative of the R3’s frequency stability over the -43.2 to -52.8, VDC input voltage range.

11.2.5.3 Results Summary

The measured frequency stability vs. input voltage for the R3 under test is depicted in Figure 11.11. The results of these tests are summarized in Table 11.13 below:

Figure 11.11 R3 Frequency Stability vs. Input Voltage

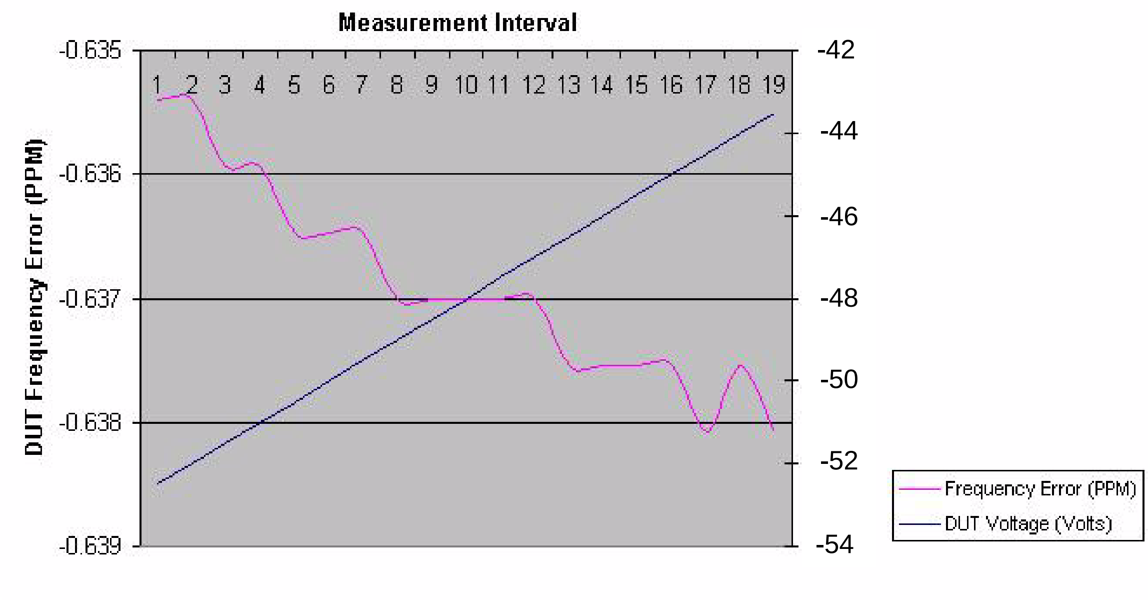


Table 11.13 Transmit Frequency Stability vs. Input Voltage

Parameter	Measured Value
Transmit frequency stability at 1866 MHz between -43.2 VDC and -52.8 VDC input voltage	Total frequency change of ≤ 0.003 PPM

11.2.6 R3 Occupied Bandwidth Test Results

11.2.6.1 Applicable FCC Rule Parts

FCC Subpart 2.989 - Occupied bandwidth is defined as 99% of the total mean power, measured according to Subpart 2.989 (i), which requires full loading of the baseband, modulated such that the occupied bandwidth is consistent with that expected during normal operation.

11.2.6.2 Test Configuration

A software switch in the R3 was set to generate constant Delay Compensation Pilots. The resulting transmitter output was sampled through a -20 dB directional coupler and viewed with a Hewlett-Packard 89441A Vector Signal Analyzer using the Hewlett-Packard 89451A Digital Radio Personality option, set up to measure 99% Occupied Bandwidth. The test configuration is depicted in Figure 11.4. The configuration parameters of the 89451A are listed in Table 11.2.

11.2.6.3 Results Summary

The 99% Occupied Bandwidth for the R3 is depicted in Figure 11.12. The test results are summarized in Table 11.14.

Figure 11.12 R3 99% Occupied Bandwidth During Delay Compensation Pilot Operation

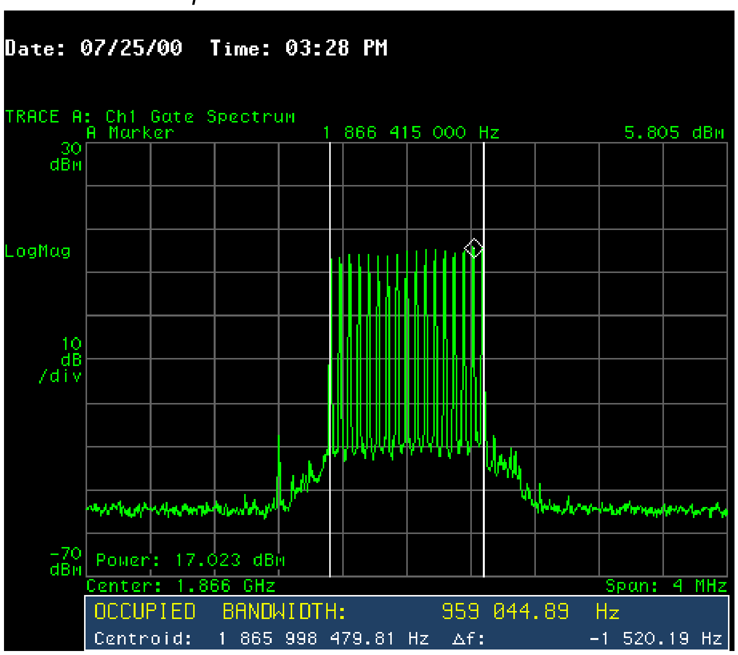


Table 11.14 Occupied Bandwidth Test Result Summary

Parameter	Measured Value
99% Occupied Bandwidth During Delay Compensation Pilot Operation	≤ 960 kHz

11.2.7 Modulation Characterization Test Results

11.2.7.1 Applicable FCC Rules

FCC Subpart 2.987 - Requires a curve or equivalent data which shows that the equipment will meet the requirements of the rules under which the equipment is to be licensed. Provide data showing that the modulation being employed does not cause the spectral purity to exceed the requirements of 2.985 and 24.238.

11.2.7.2 Test Configuration

A Hewlett-Packard 89441A Vector Signal Analyzer was used to characterize each of the following discrete logical channels:

- Single Voice traffic channel
- High-speed Data traffic channel
- Network Access channel
- Delay Compensation pilot channel

For each logical channel, the 89441A Vector Signal Analyzer was used to obtain the following information:

- 99% occupied bandwidth in kHz
- Integrated power across the measured occupied bandwidth in dBm
- Power vs. frequency (in dBm) in a 12-kHz resolution bandwidth
- Time-domain average RF burst power
- Complimentary Cumulative Distribution Function (CCDF) of the peak to average ratio made up of *x* samples of the time-domain RF bursts

11.2.7.3 Results Summary

Single Voice Channel

A single telephone call was established between the R3 under test and the Base using the test configuration shown in Figure 11.4. The Hewlett-Packard 89441A Vector signal analyzer was configured according to the parameters shown in Table 11.3. The measured characteristics of a single voice channel are depicted in Figure 11.13

and Figure 11.14. The results of these tests are summarized in Table 11.15 below:

Figure 11.13 Voice Channel Power vs. Frequency, 99.0% Occupied BW, and Time-Domain Average Burst Power

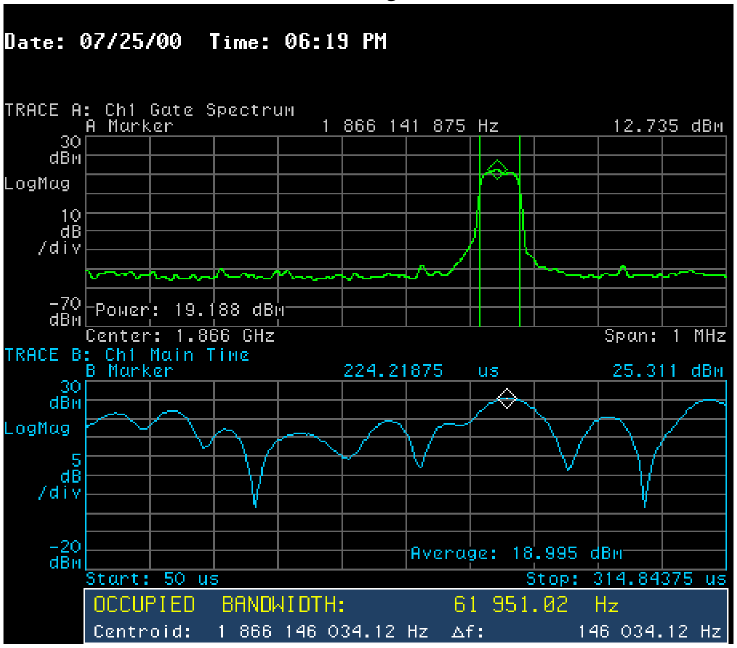
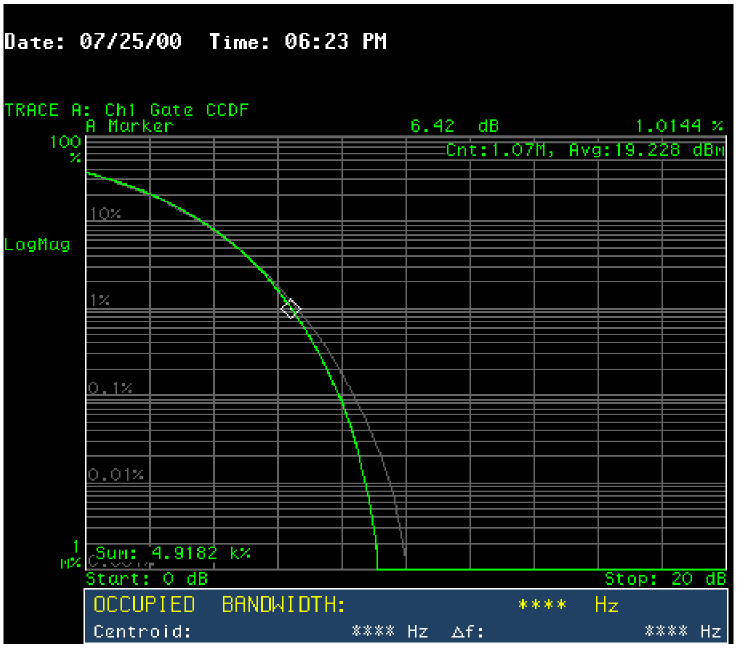


Figure 11.14 Voice Channel CCDF



High-speed Data Channel

An HSD session was established between the R3 under test and the Base using the test configuration shown in Figure 11.4. The Hewlett-Packard 89441A Vector Signal Analyzer was configured according the parameters shown in Table 11.3. During this test, a text file was transferred from the R3 to an FTP server on the AWS network. The random nature of the data contained in this file is sufficient to assure results representative of a normally operating system.

Results Summary

The measured characteristics of the HSD channel are depicted in Figure 11.15 and Figure 11.16. The results of these tests are summarized in Table 11.15.

Figure 11.15 HSD Channel Power vs. Frequency, 99% Occupied BW, and Time-Domain Average Burst Power

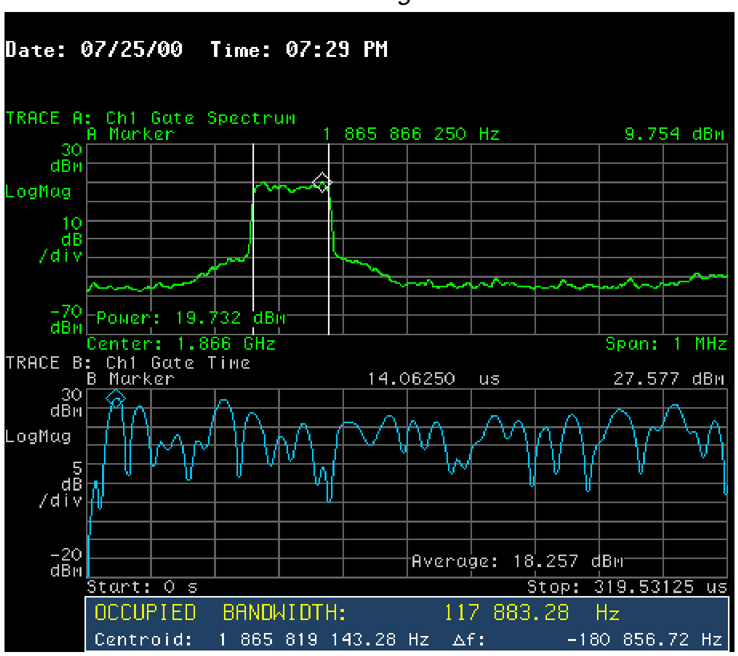
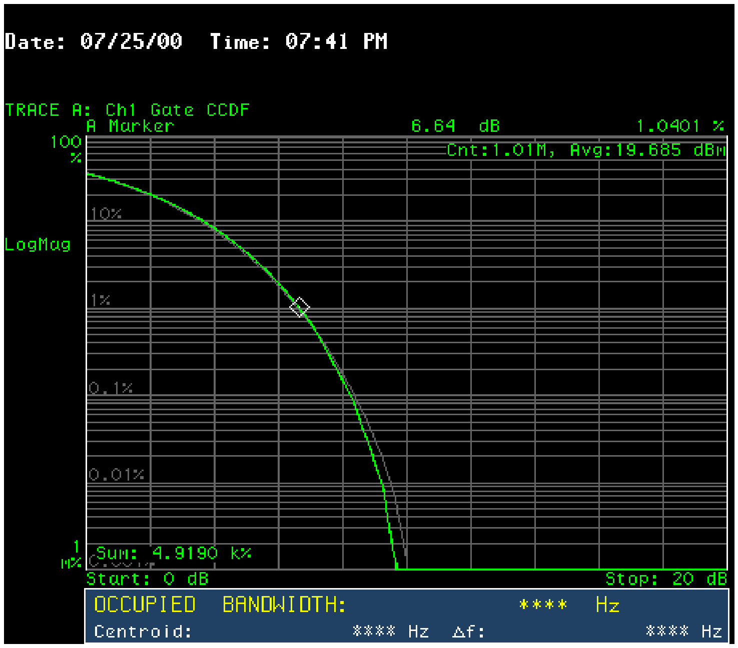


Figure 11.16 HSD Channel CCDF



Network Access Channel

Characterization of the network access channel took place utilizing the test configuration shown in Figure 11.4. The Hewlett-Packard Vector Signal Analyzer was configured according to the parameters shown in Table 11.3.

Results Summary

The measured characteristics of the Network Access channel are depicted in Figure 11.17 and Figure 11.18. The results of these tests are summarized in Table 11.15 below:

Figure 11.17 Network Access Channel Power vs. Frequency, 99% Occupied Bandwidth, and Time-Domain Average Power

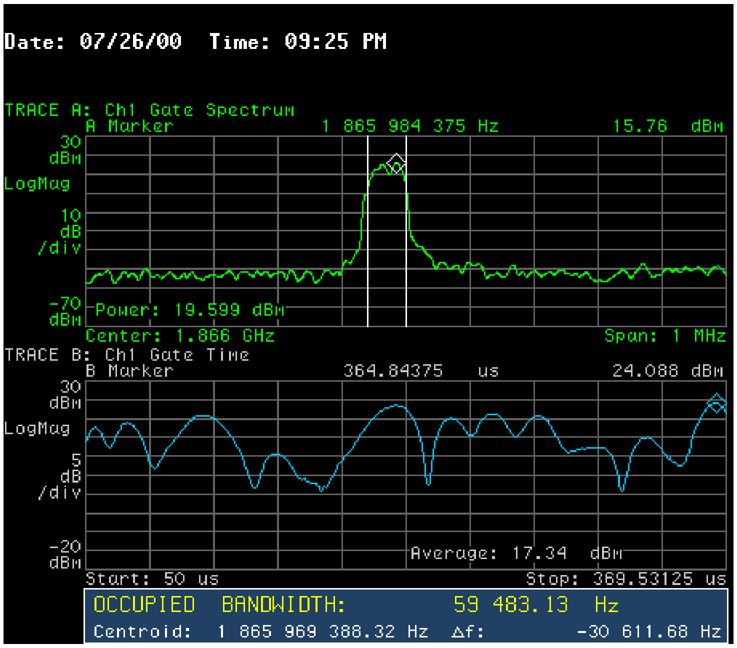
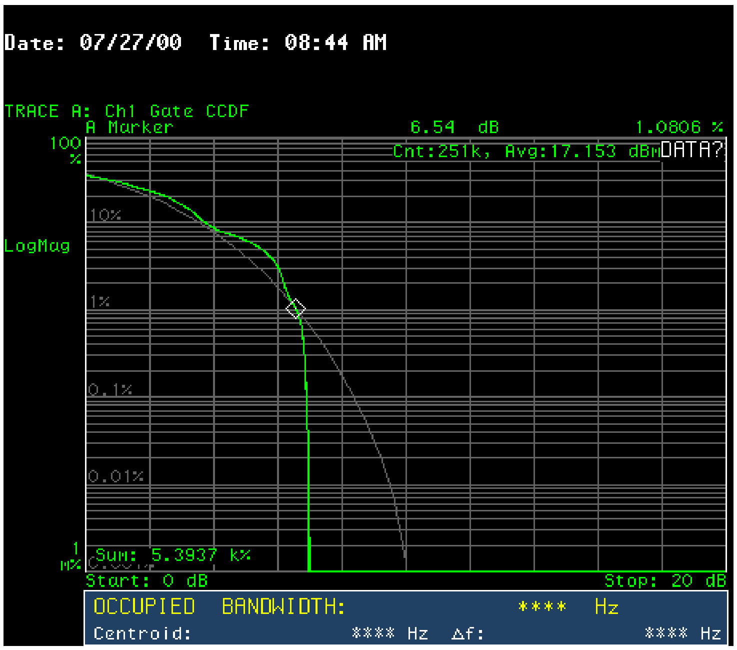


Figure 11.18 Network Access Channel CCDF



Delay Compensation Channel

The R3 Delay Compensation Pilots (DCPs) were characterized using the test configuration shown in Figure 11.4. The Hewlett-Packard Vector Signal Analyzer was configured according to the parameters shown in Table 11.3.

Results Summary

The measured characteristics of the Delay Compensation channel are depicted in Figure 11.19 and Figure 11.20. The results of these tests are summarized in Table 11.15 below:

Figure 11.19 Delay Compensation Channel Power vs. Frequency, 99% Occupied BW, and Time-Domain Average Power

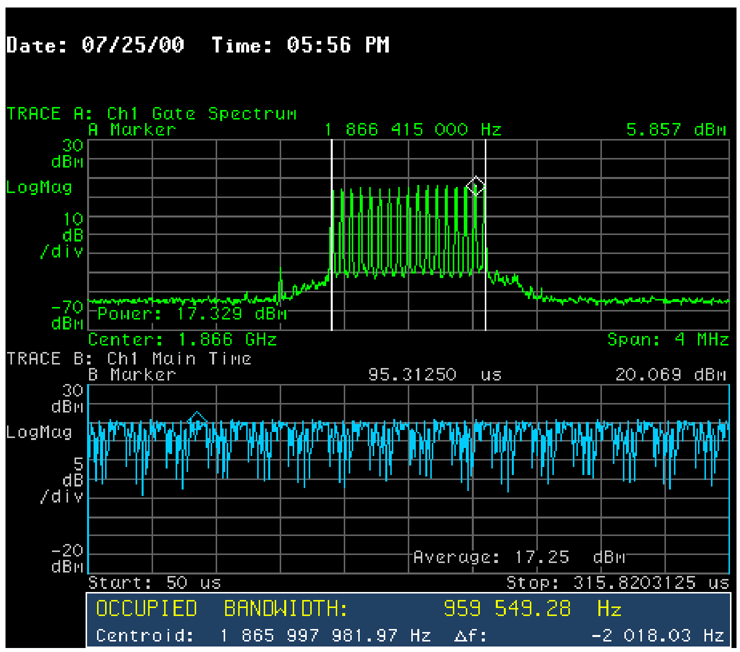


Figure 11.20 Delay Compensation Channel CCDF

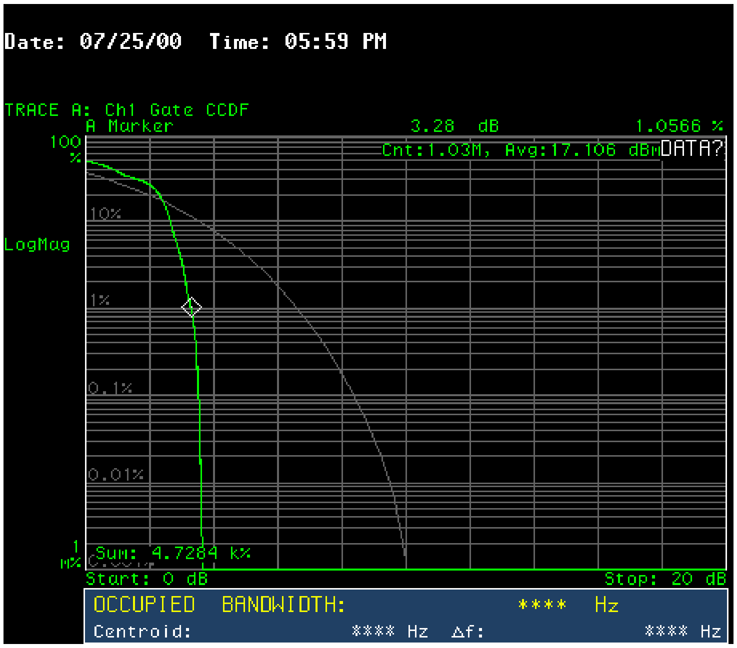


Table 11.15 Channel Characterization Test Results

Parameter	Measured Value
Voice Channel 99% Occupied Bandwidth	≤ 62 kHz
Voice Channel Average Power	+17 dBm
Voice Channel Peak/Average Ratio at ≤ 99.0% occurrence after $1x10^6$ samples	6.4 dB
High-speed Data Channel 99% Occupied Bandwidth	≤ 118 kHz
High-speed Data Channel Average Power	+18.3 dBm
High-speed Data Peak/Average Ratio at ≤ 99.0% occurrence after $1x10^6$ samples	6.7 dB
Network Access Channel 99% Occupied Bandwidth	≤ 60 kHz
Network Access Channel Average Power	+17.4 dBm
Network Access Channel Peak/Average Ratio at ≤ 99.0% after $2.5x10^5$ samples	6.5 dB
Delay Compensation Channel 99% Occupied Bandwidth	≤ 960 kHz
Delay Compensation Channel Average Power	+17.3 dBm
Delay Compensation Channel Peak/Average Ratio at ≤ 99.0% occurrence after $1x10^6$ samples	3.3 dB

11.2.8 RF Output Power Test Results

11.2.8.1 Applicable FCC Rules

FCC Subpart 24.232 - Base stations are limited to 1640 watts EIRP peak power, and in no case shall the output power of a Base Station exceed 100 watts. Peak transmitter power may be measured over any interval of continuous transmission using instrumentation calibrated in terms of RMS equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

11.2.8.2 Test Configuration

Average and peak RF Output Power from the R3 is maximized during HSD operation. Consequently, maximum RF output power was characterized while the R3 was operating in this mode.

A Hewlett-Packard 89441A Vector Signal Analyzer was used to characterize the R3's composite RF output signal according to the following criteria:

- Time-domain average burst power
- Time-domain peak envelope burst power at the 99.0% level
- Time-domain peak/average ratio at the 99.0% level

For this test, an HSD session was established between the R3 under test and the Base using the test configuration shown in Figure 11.5. The Hewlett-Packard 89441A Vector Signal Analyzer was configured according the parameters shown in Table 11.4. During this test, a text file was transferred from the R3 to an FTP server on the AWS network. The random nature of the data contained in this file is sufficient to assure results representative of a normally operating system. A -20-dB directional coupler provided the required RF sample for measurement.

Results Summary

The RF output power of the R3 while supporting an HSD session is depicted in Figure 11.21, Figure 11.22 and Figure 11.23. The results of these tests are summarized in Table 11.16:

Figure 11.21 Time-Domain Power Envelope, Average Power

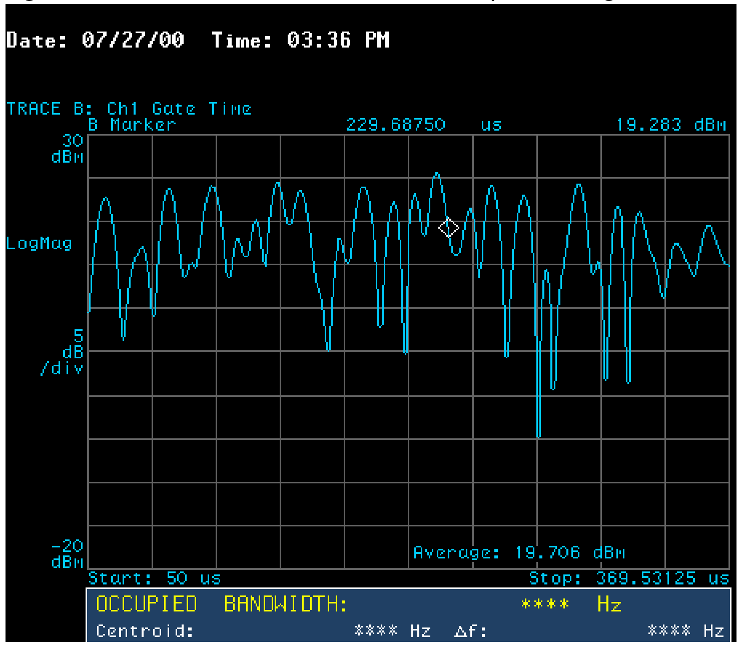


Figure 11.22 Time-Domain Power Envelope, Peak Power at ≤ 99.0% Occurrence

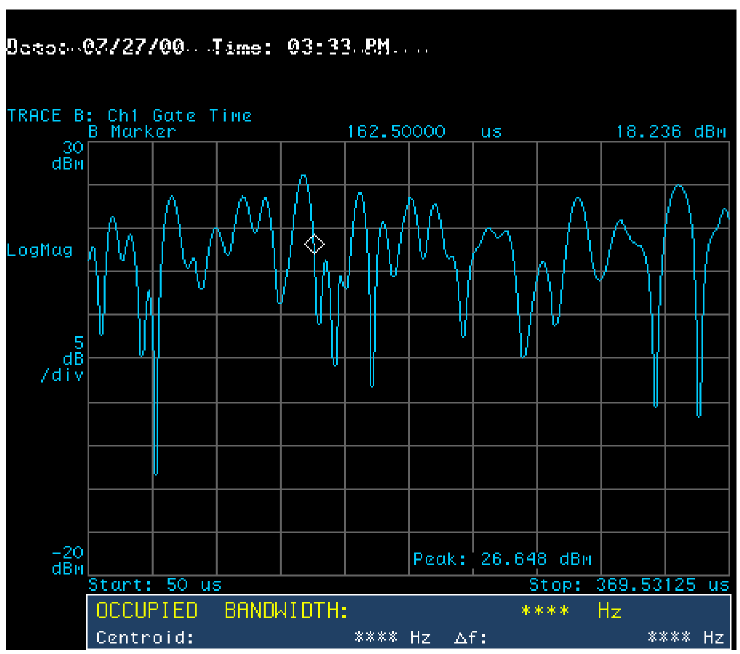


Figure 11.23 Time-Domain Power Envelope, Peak/Average Ratio at ≤ 99.0% Occurrence

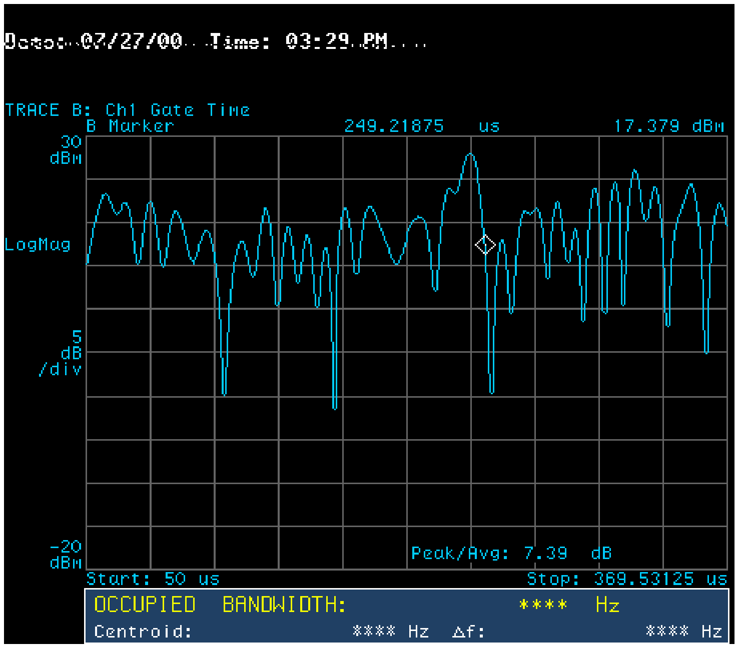


Table 11.16 RF Output Power Characteristics

Parameter	Measured Value	FCC Part 24 Limit
Time-Domain Average Power	+19.7 dBm	N/A
Time-Domain Peak Power at ≤ 99.0% Occurrence	+26.7 dBm	+45.1 dBm/TX port
Time-Domain Peak/Average Ratio at ≤ 99.0% Occurrence	+7.4 dB	N/A

Note: Table 11.16 was modified to reflect the power limitations imposed by 24.232(a). The power was set to +45.1 dBm/port in order to compensate for the fact that two in-phase transmitter ports are available on this version of the RU, and the affective antenna gain is +15 dBi, thus keeping e.i.r.p. within 24.232(a).

11.2.9 Spurious Emissions at the Antenna Terminal

11.2.9.1 Applicable FCC Rules

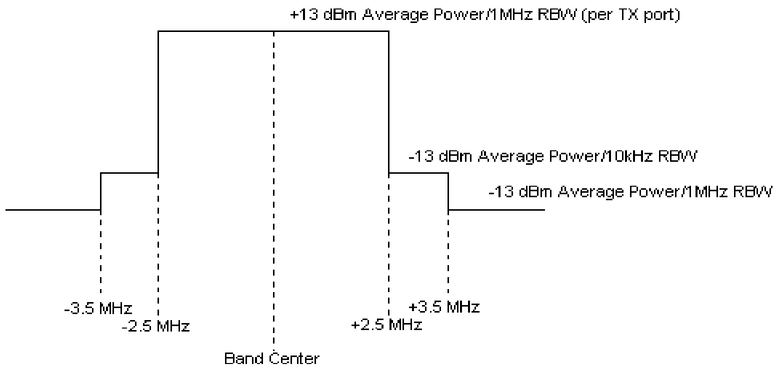
FCC Subpart 2.985 - Requires that the RF Output be measured at the antenna power terminals into a dummy load after the transmitter has been adjusted in accordance with the manufacturers tune up procedure. Requires documentation of measurement configuration. Transmitter spectral output shall not have any components that exceed the spectral mask applicable to the rule part under which the equipment shall be operated.

FCC Subpart 24.238 - On any frequency outside a licensee's block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43+10Log(P) dB. Compliance is based on measurement within a 1-MHz resolution bandwidth. However, in the 1 MHz bands immediately adjacent to the frequency block a resolution bandwidth of at least 1 percent of the emission bandwidth may be employed. The emission bandwidth is defined as the width of the signal between two points, one above and one below the carrier frequency, outside of which all emissions are attenuated by at least 25 dB below the transmitter power.

11.2.9.2 Test Configuration

The R3 under test was configured to transmit continuous Delay Compensation Pilots, with the transmit chain variable attenuators adjusted to provide a peak output power equal to that of an HSD session. This test was executed with the R3 operating in the lowest-frequency subband and again in the highest subband within the PCS "D" block. A Hewlett-Packard 89441A Vector Signal Analyzer was used to characterize the R3's spectral purity with DCP stimulus in each subband. A -20 dB directional coupler provided the required RF sample for measurement. The specific operating parameters of the Hewlett-Packard 89441A Vector Signal Analyzer are summarized in Table 11.5. The test configuration is depicted in Figure 11.7. The emission mask utilized through the course of this test is shown in Figure 11.24.

Figure 11.24 R3 Conducted Power Spectral Mask



11.2.9.3 Results Summary

The measured spectral purity of the R3 across the 1853 to 1882 MHz range while transmitting Delay Compensation Pilots at a peak output power equivalent to that of an HSD session is depicted in Figure 11.25 through Figure 11.34. The results of these tests are summarized in Table 11.17 below. Emissions at all applicable frequencies above and below the 1853-1882 MHz range have been documented in Section 11.3.4.3, "Radiated to Conducted Spurious Emissions."

Figure 11.25 1-MHz Band-Power Between 1865.5 and 1866.5 MHz

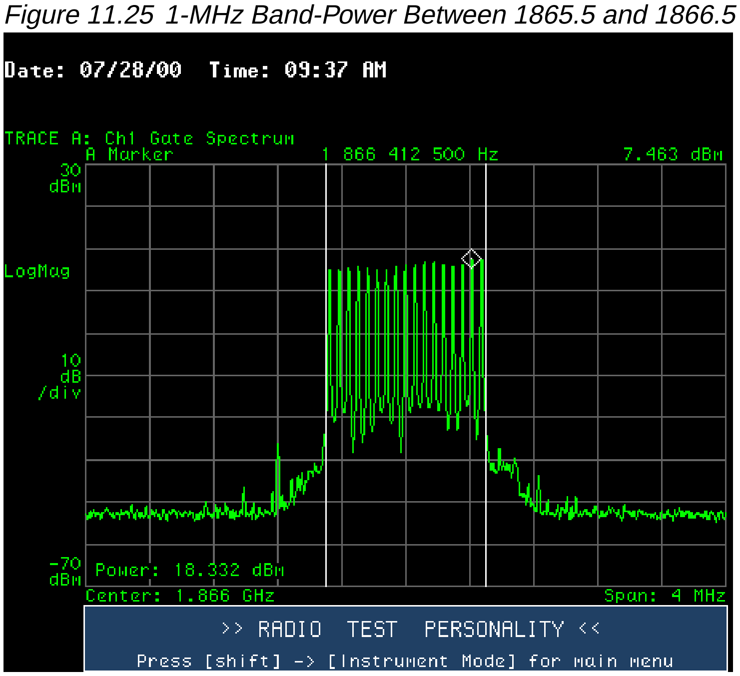


Figure 11.26 1-MHz Band Power Between 1866.5 and 1867.5 MHz

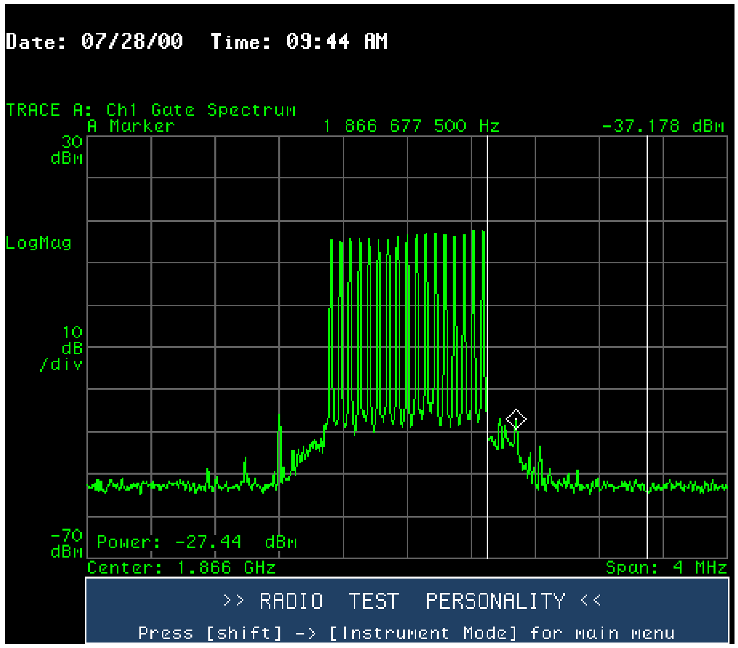


Figure 11.27 1 MHz Channel Power Between 1867.5 and 1868.5 MHz

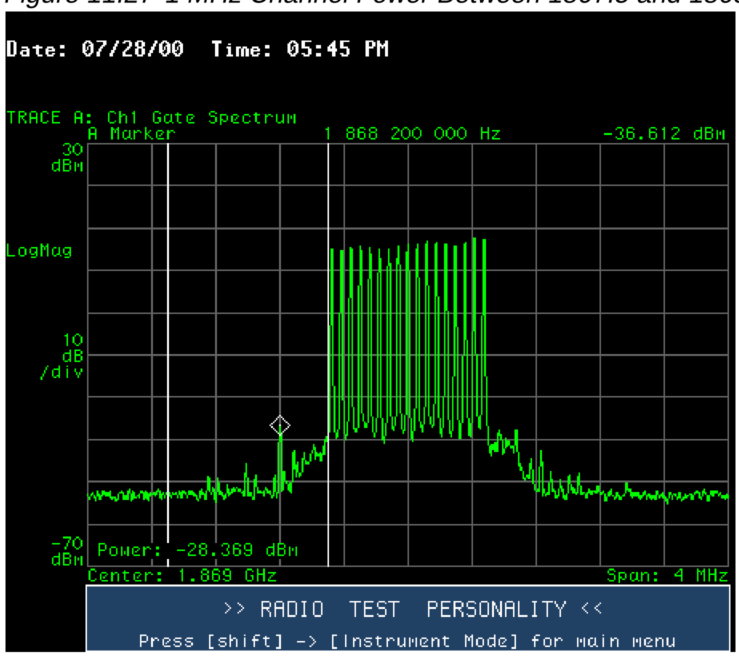


Figure 11.28 1 MHz Channel Power Between 1868.5 and 1869.5 MHz

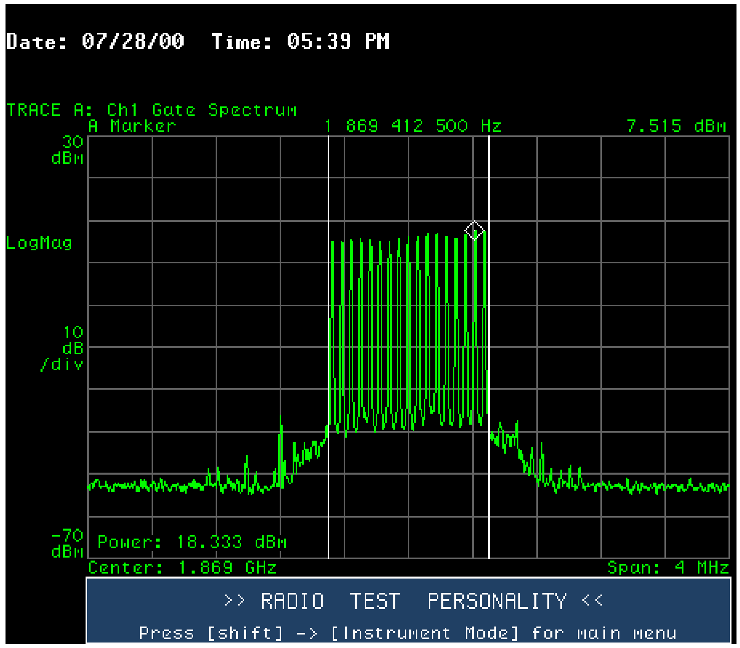


Figure 11.29 Maximum Lower Guard Band Spurious Power, Measured in a 12 kHz Resolution BW

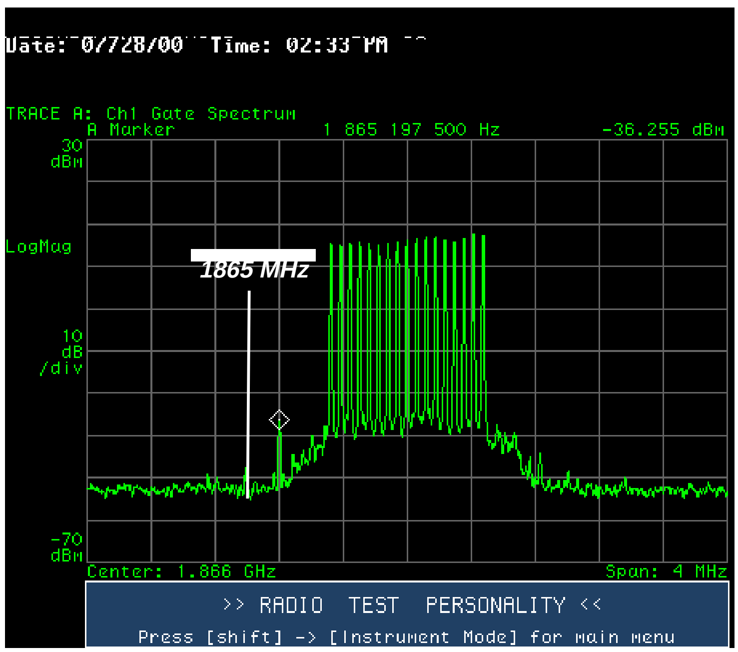


Figure 11.30 Maximum Upper Guard Band Spurious Power Measured in a 12 kHz Resolution BW

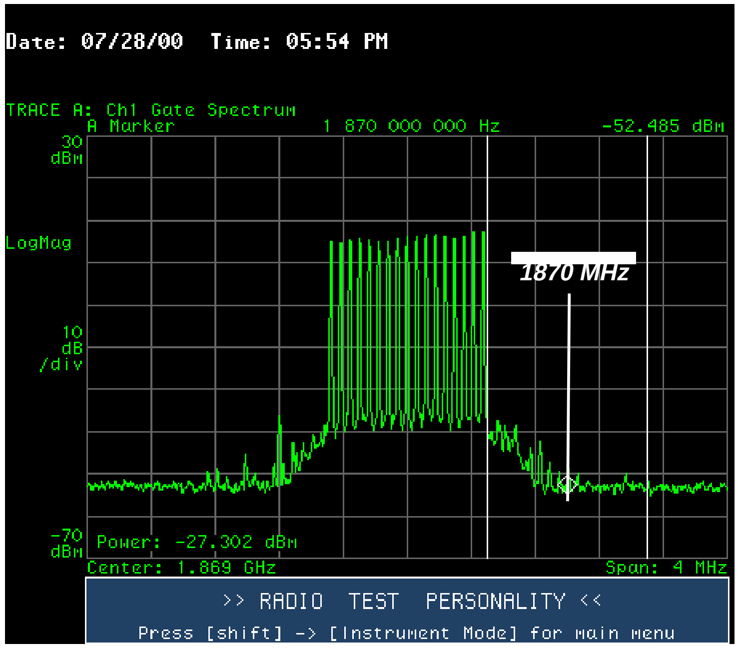


Figure 11.31 Spectral Purity from 1859.5 MHz to 1866.5 MHz, with Spurious Power Between 1864.5 and 1865.5 MHz Measured in a 1 MHz Bandwidth

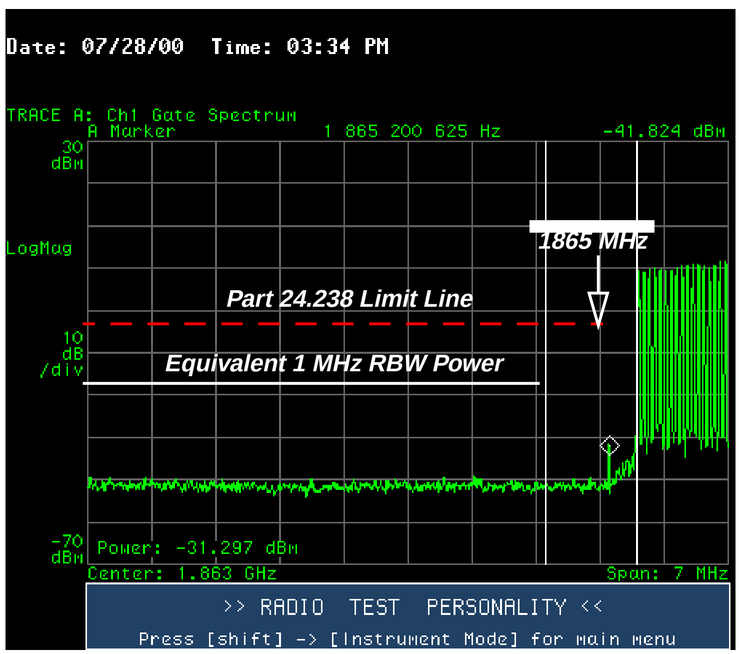


Figure 11.32 Spectral Purity from 1853 to 1860 MHz, with Spurious Power Measured in a 1 MHz Band-Power Marker Centered on 1859 MHz

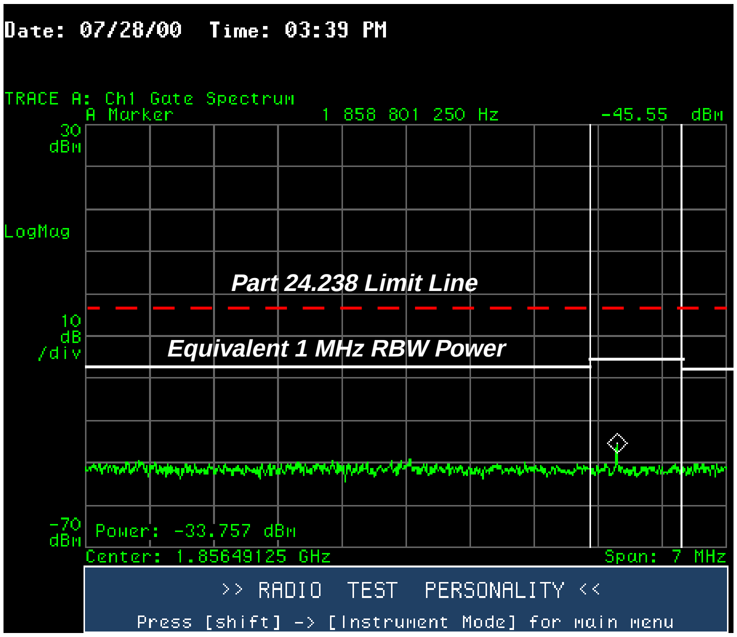


Figure 11.33 Spectral Purity from 1868.5 MHz to 1875.5 MHz with 1 MHz Band-Power Reference Between 1871 and 1872 MHz

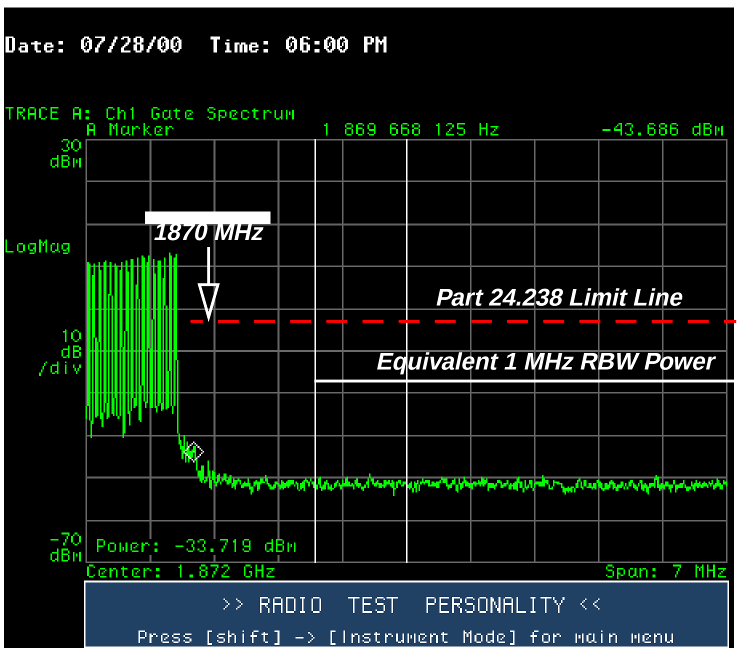


Figure 11.34 Spectral Purity from 1875 MHz to 1882 MHz with 1 MHz Band-Power Reference Centered at 1878 MHz

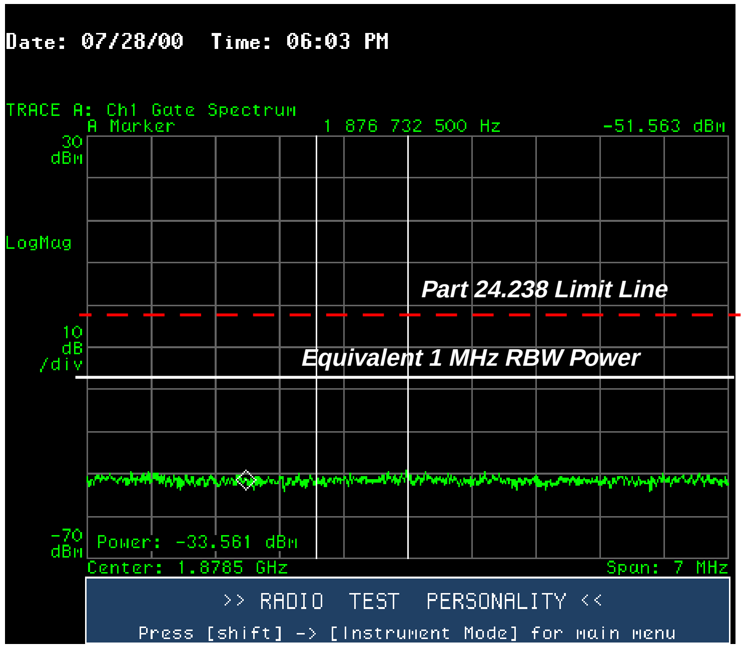


Table 11.17 R3 In-Band and Out-Of-Band Power Summary

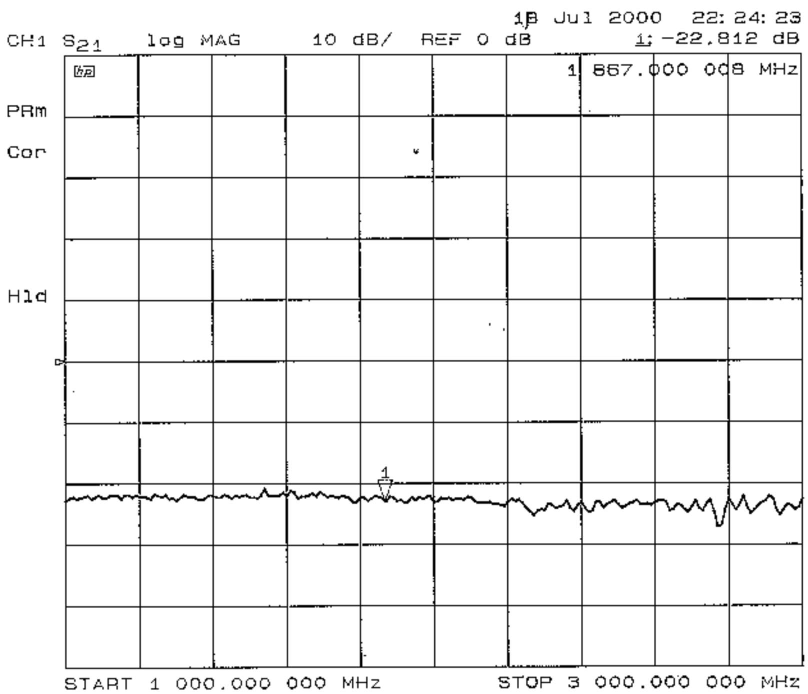
Parameter	Measured Value	FCC Part 24 Limit
Total power centered @ 1866 MHz	+18.3 dBm in a 1 MHz BW	+45.1 dBm/1 MHz RBW
Total power centered @ 1867 MHz	-27.4 dBm in a 1 MHz BW	+45.1 dBm/1 MHz RBW
Total power centered @ 1868 MHz	-28.4 dBm in a 1 MHz BW	+45.1 dBm/1 MHz RBW
Total power centered @ 1869 MHz	+18.3 dBm in a 1 MHz BW	+45.1 dBm/1 MHz RBW
Max. guard band spurious power between 1865 and 1865.5 MHz	-36.3 dBm in a 12 kHz RBW	+45.1 dBm/1 MHz RBW

Table 11.17 R3 In-Band and Out-Of-Band Power Summary (continued)

Parameter	Measured Value	FCC Part 24 Limit
Max. guard band spurious power between 1869.5 and 1870 MHz	-35.8 dBm in a 12 kHz RBW	+45.1 dBm/1 MHz RBW
Maximum spurious power between 1864 and 1865 MHz	-31.3 dBm in a 12 kHz RBW	-13 dBm/10 kHz RBW
Maximum spurious power between 1870 and 1871 MHz	-33.7 dBm in a 12 kHz RBW	-13 dBm/10 kHz RBW
Maximum spurious power between 1853 and 1860 MHz	-33.8 dBm in a 1 MHz BW	-13 dBm/1 MHz RBW
Maximum spurious power between 1859.5 and 1864 MHz	-33.4 dBm in a 1 MHz BW (analyzer noise floor)	-13 dBm/1 MHz RBW
Maximum spurious power between 1871 and 1875.5 MHz	-33.6 dBm in a 1 MHz BW (analyzer noise floor)	-13 dBm/1 MHz RBW
Maximum spurious power between 1875 and 1882 MHz	-33.6dBm in a 1 MHz BW (analyzer noise floor)	-13 dBm/1 MHz RBW

Figure 11.35 identifies the correction factor used for the external attenuation within the vector signal analyzer settings. In addition to the directional coupler and cable corrections, a 3-dB pad was utilized.

Figure 11.35 Directional Coupler and Cable Sweep



11.3 Electromagnetic Compatibility Test Results

This section describes the test results obtained during the validation of the AT&T Wireless Services R3 against the applicable requirements of FCC Parts 15 and 24 (Spurious Emissions 5 MHz outside fundamental).

11.3.1 Introduction

The purpose of this chapter is to present the test results used to verify FCC regulatory compliance of the PWAN R3. The data presented in this chapter are the test results obtained from completing FCC Part 15, radiated and conducted emissions. Additional data representing FCC

Part 24 spurious emissions 5 MHz outside the fundamental frequency is also presented. Testing was completed within the FCC regulatory guidelines, including the utilization of ANSI C63.4-1992 standard entitled “American National Standard for Methods of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. Per these standards, all Part 15 emission testing was performed within the FCC accredited 3-meter Anechoic Chamber shown to meet FCC requirements as outlined within subpart 2.948 as referenced in FCC memo 31040/SIT 1300F2.

During testing, the R3 was setup and configured as close to actual field installation as possible. The antenna was mounted to a tripod and cabled, powered, and operated in a field installation configuration. The system was then tested in a wireless configuration, communicating with a Base Station, in the following configurations:

- Four voice calls with HSD uplink and Lucent power supply
- Four voice calls with HSD uplink and Panasonic power supply
- Two voice calls with HSD uplink and Lucent power supply
- Two voice calls with HSD uplink and Panasonic power supply

The following test measurements were conducted on the EUT in the AC power mode configuration. R3 test measurements were also completed on the DC power mode configuration, however, testing in various configurations identified AC power mode as the worst case scenario for both radiated and conducted emissions. Therefore, all test data have been submitted in the AC power mode configuration.

After testing the various configurations, it was found that worst case emissions were generated while the R3 was being operated in the HSD uplink and four voice call configuration.

11.3.2 Equipment Lists

Test cases within this section were completed utilizing the test equipment outlined in Table 11.18. Equipment calibration is completed on a bi-yearly schedule by the Techmaster Electronics, Inc. and is monitored by both Techmaster and AT&T Wireless. All calibration material is stored in both hard copy and electronic form, tracking to NIST standards.

Table 11.18 Emissions Test Equipment

Instrument Name	Manufacturer	Model Number	Serial Number	Calibration Last Date	Calibration Due Date
Semi-anechoic Chamber	Rantec Test Systems	3-meter semi anechoic	11576	Shield Test NSA 9/25/99	12/20/01
Antenna 1	EMCO	3115	5515	2/26/00	2/26/01 (this should change)
Cable 1	Gore	Gore 53-ft.	1-6-1, 1-14-1, 1-33-1	5/5/00	5/5/01
Analyzer	Hewlett Packard	8546A	3520A00260	6/6/00	6/6/01
Preselector	Hewlett Packard	8546A internal	3330A0010	6/6/00	6/6/01
QPeak Adapter	Hewlett Packard	internal to RF section	internal	6/6/00	6/6/01
Pre-Amplifier	Hewlett Packard	8546A internal	internal	6/6/00	6/6/01
Tower 1	EMCO	1050	1123	11/19/99	11/19/00
Turntable 1	EMCO	1060	1049	11/19/99	11/19/00
Amplifier 1	HP	8546A	Internal	6/6/00	6/6/01
Turnable Notch Filter	K & L	3TNF-1000/2000-0/0	0007	5/13/00	5/13/01
Cable 2	Gore	Gore 53-ft.	2-2-2	5/5/00	5/5/01
Antenna	Chase	CBL6111A	1632	7/17/00	7/17/01
Positioner Controller	EMCO	2090	9601-1101	N/A	N/A
EMI Measurement System	Hewlett Packard	84125C	4536439012	11/12/00	11/12/00

11.3.3 Equipment Under Test List

Test cases within this section were executed using the equipment under test listed in Table 11.19.

Table 11.19 EUT Equipment Under Test List

Board Type	Serial No.	Revision Level	Model #
Lucent AC/DC Power Supply	420	S1:0	1921404
Panasonic AC/DC Power Supply	NPX285A-3	1	ETXLC285G2H
R3 Indoor Unit PCB	505	1	1953007
2-line Expansion PCB	425	2	1924307
Surge Suppressor	N/A	0	TVSSP
R3 Outdoor Unit PCB	503	1	1952810
Lucent DC/DC Power Module	108716416	02	CS937A
Antenna	418	0	1664502

11.3.4 Test Results

11.3.4.1 Radiated Emissions

Radiated emissions measurements shall be made over the frequency range specified by the regulatory agency, in this case the FCC Part 15, subpart 15.207. Measurements shall be made at the EUT azimuth and antenna height such that the maximum radiated emissions level will be detected. This was accomplished using both an automated 360 degree turntable and 1 to 4 meter height antenna positioners. Sixteen azimuth cuts at 22.5 degrees and 1 to 4 meter antenna scans in both polarizations were utilized. The R3 was setup in a typical field configuration, as shown in Figure 12.1, consisting of the antenna being attached to a tripod placed next to the turntable. A proper interconnecting cable was utilized from the antenna to the R3 Indoor Unit sitting on the table on the turntable via the surge arrestor. Various cable lengths were utilized to determine worse case configuration and a Base antenna was placed in the chamber for R3 wireless communication. All radiated emissions testing was completed in four configurations;1) Lucent power supply with two voice channels and the high speed data (HSD) uplink continuously utilized, 2) Lucent power supply with four voice and HSD uplink channels continuously utilized, 3) Panasonic power supply with two voice channels and HSD uplink continuously utilized, and 4) Panasonic power supply with four voice channels and HSD continuously utilized. Testing was completed from 30 MHz to 26 GHz, accomplishing the FCC requirement of testing to the 10th harmonic of the fundamental frequency being used by the transmitter. Testing from 3.5 GHz-26.5 GHz was completed with an Intentional Radiator System, with the antenna placed 1 meter high and 1 meter back. The Spectrum Analyzer was placed on maximum hold and the turntable scanned to find the highest amplitude peaks. When testing close to or over the fundamental frequency range, a notch filter tuned to the R3 and Base fundamental frequencies was utilized to prevent receiver overload and/or damage.

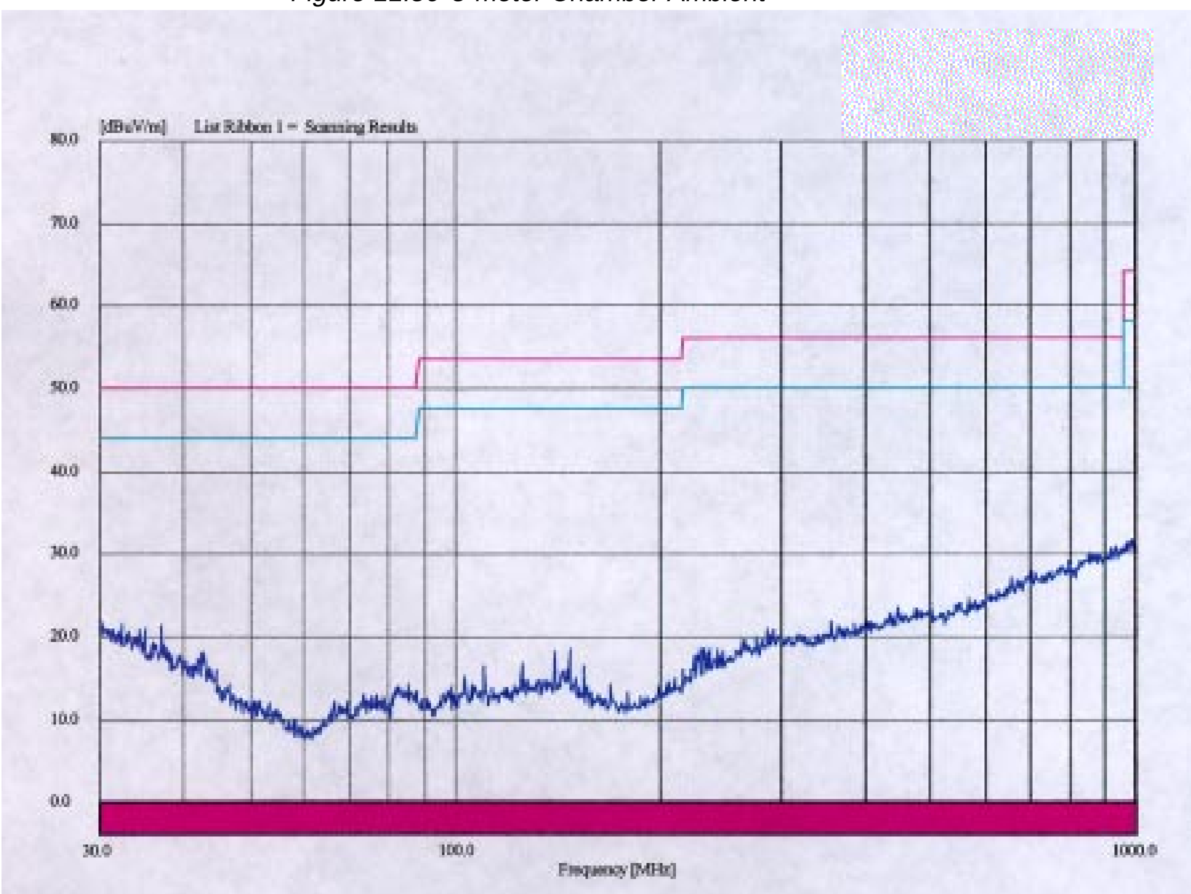
Testing was completed and the radiated emissions detected from the R3 was found to be within the FCC radiated emissions requirements as set forth in Table 11.20.

Table 11.20 FCC Radiated Emissions Limits

Frequency (MHz)	Field Strength (MicroVolts/meter)	Measurement Distance (Meters)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

A measurement of the 3-meter shielded chamber was conducted previous to FCC measurements to establish the chamber ambients. A plot of the chamber's ambient measurement is shown in Figure 11.36.

Figure 11.36 3-meter Chamber Ambient



11.3.4.1.1 Applicable FCC Rules

FCC Subpart 15.209 - The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the field strength levels specified in table 15.209 (a). Emission limits shown in the table below 1000 MHz are based on measurements employing a CISPR quasi-peak detector. Emission limits above 1000 MHz are based on measurements employing an average detector.

11.3.4.1.2 Test Configuration

Radiated emissions scans were performed in the AT&T 3-m semi-anechoic chamber. The R3 system was placed on a non-conductive table 80 cm above the ground plane with the measurement antenna placed a distance of 3 m from the device under test. The R3 Indoor Unit cabling consisted of four standard RJ-11 connectored cables plugged into telephones, AC power cable for power, and RG-6 coaxial cable connected to the R3 Outdoor Unit via the grounded surge protector. The R3 was tested with two different power supplies (Lucent & Panasonic), in two different configurations: 1) four voice channels and an HSD uplink continually utilized and 2) two voice channels and a HSD uplink continually utilized.

The R3 Indoor Unit comprised the following components: R3 digital board version 0.7, Lucent and Panasonic AC power supply, and R3 2-line expansion card version 0.61. The R3 Outdoor Unit comprised the following components: RF board version 0.61 and Lucent DC/DC power module. The R3 Indoor Unit is connected to the R3 Outdoor Unit via RG-6 coaxial cable and a grounded surge protector. All cables were kept at one meter length. Both units were tested together as a system to reduce test time.

11.3.4.1.3 Test Results

The R3 system has passed the necessary FCC Part 15 requirements. The following test results detail the Part 15 findings.

Four Voice Calls with HSD Uplink and Lucent Power Supply: Worst Case Configuration

Figure 11.37 represents the radiated emissions scan from 30 MHz-1.0 GHz utilizing an HP 8546A EMI receiver system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and the R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls as well as high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The receive antenna was positioned 3-meters away and scanned from one to four meters in height. The unit passed the required limit after the QP detector was utilized. See Table 11.21 for the peak and QP measurement data.

Figure 11.37 30 - 1000 MHz: Four Voice Calls with HSD

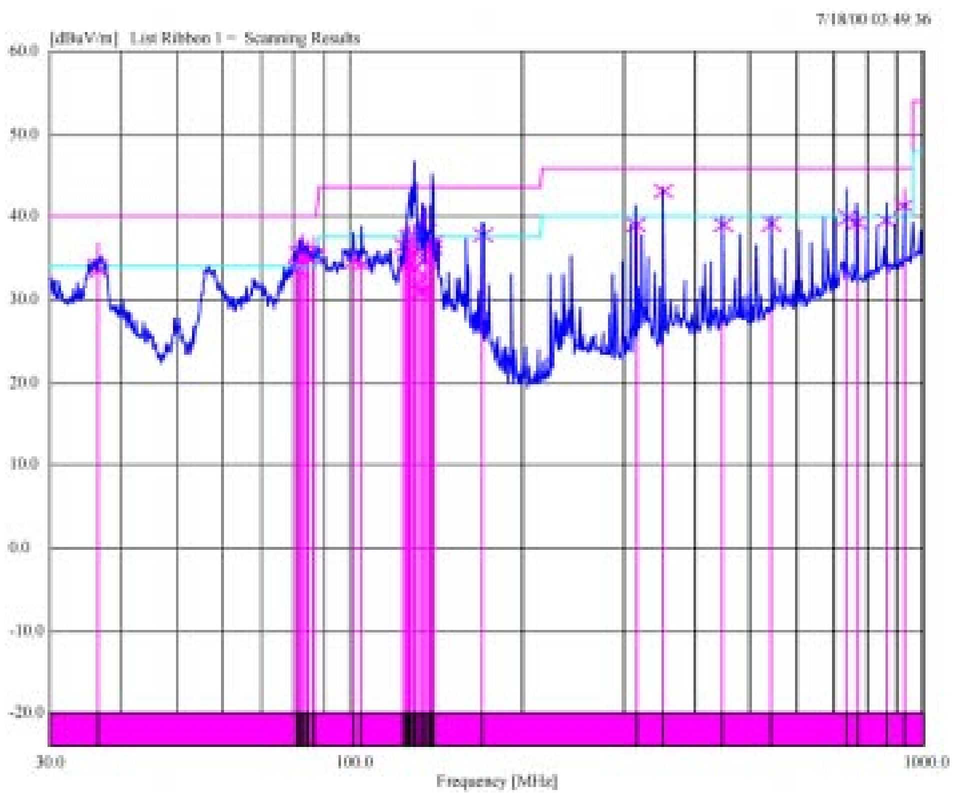


Table 11.21 Data for 30 MHz-1GHz; Lucent Four Voice/HSD

Frequency (MHz)	Peak (dBuV/m)	Peak Lmt (dBuV/m)	DelLim-Pk (dB)	QP (dBuV/m)	QP Lmt (dBuV/m)	DelLmt-QP (dB	Height (cm)	Angle Pol (deg)
123.972987	38.33	37.50	0.83	36.63	43.50	-6.87	275	2 Horz
125.818680	37.01	37.50	-0.49	34.07	43.50	-9.43	245	0 Horz
125.925442	36.44	37.50	-1.06	34.47	43.50	-9.03	314	3 Horz
126.978601	38.78	37.50	1.28	37.63	43.50	-5.87	273	219 Horz
127.578775	36.89	37.50	-0.61	35.27	43.50	-8.23	273	184 Horz
128.206156	37.85	37.50	0.35	36.53	43.50	-6.97	260	219 Horz
129.365034	39.06	37.50	1.56	37.73	43.50	-5.77	255	223 Horz
130.006772	36.69	37.50	-0.81	33.96	43.50	-9.54	257	184 Horz
130.557254	33.52	37.50	-3.98	31.96	43.50	-11.54	194	180 Horz
132.323799	33.53	37.50	-3.97	30.94	43.50	-12.56	141	178 Horz
134.117636	33.02	37.50	-4.48	31.03	43.50	-12.47	235	5 Horz
135.281483	37.07	37.50	-0.43	34.70	43.50	-8.80	293	1 Horz
135.957882	41.11	37.50	3.61	38.22	43.50	-5.28	267	1 Horz
135.967948	40.31	37.50	2.81	36.52	43.50	-6.98	168	1 Horz
137.674178	37.94	37.50	0.44	36.21	43.50	-7.29	211	1 Horz
138.214341	39.79	37.50	2.29	36.64	43.50	-6.86	206	1 Horz
139.514451	43.23	37.50	5.73	37.02	43.50	-6.48	293	1 Horz
139.988243	41.00	37.50	3.50	36.28	43.50	-7.22	195	178 Horz
351.969273	43.56	37.50	3.56	43.05	43.50	-2.95	126	90 Horz

[Figure 11.38](#) represents the radiated emissions scan from 1.0GHz-3.5GHz utilizing a HP 8546A EMI receiver system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls as well as high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The receive antenna was positioned 3-meters away and scanned from one to four meters in height. Also shown are two transmit fundamentals - one for the RU (1867MHz) as well as one for the Base fundamental (1947MHz). The unit passed the required limit after the average detector was utilized. See Table 11.22 for the peak and average measurement data.

Figure 11.38 1000 - 3500 MHZ: Four Voice Calls

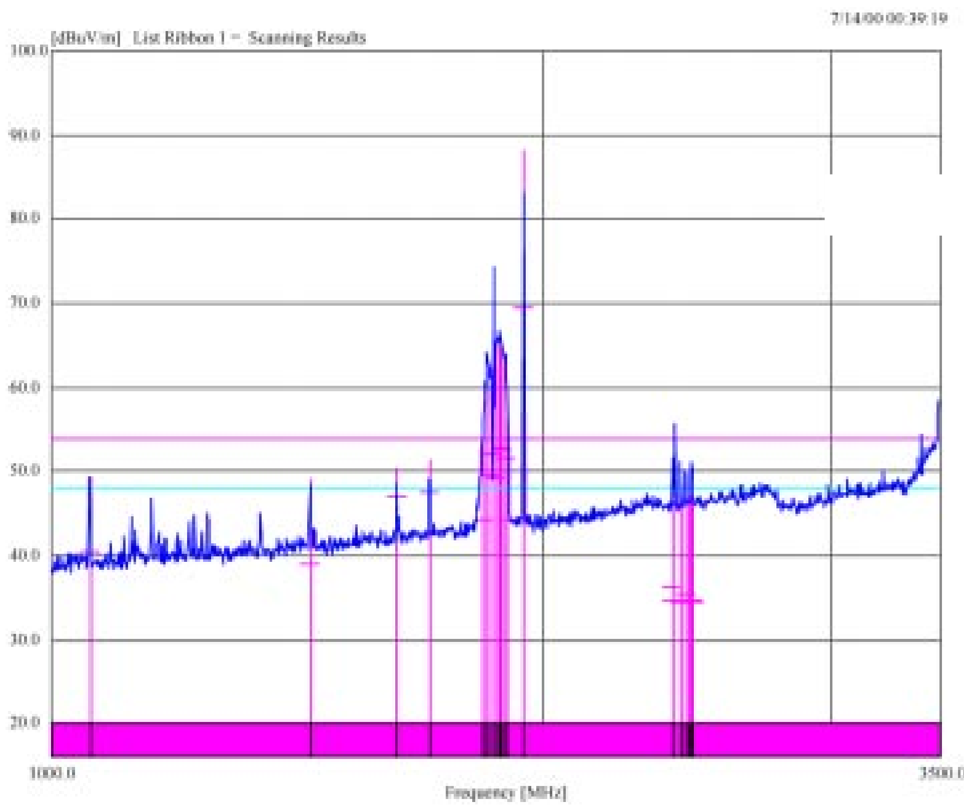
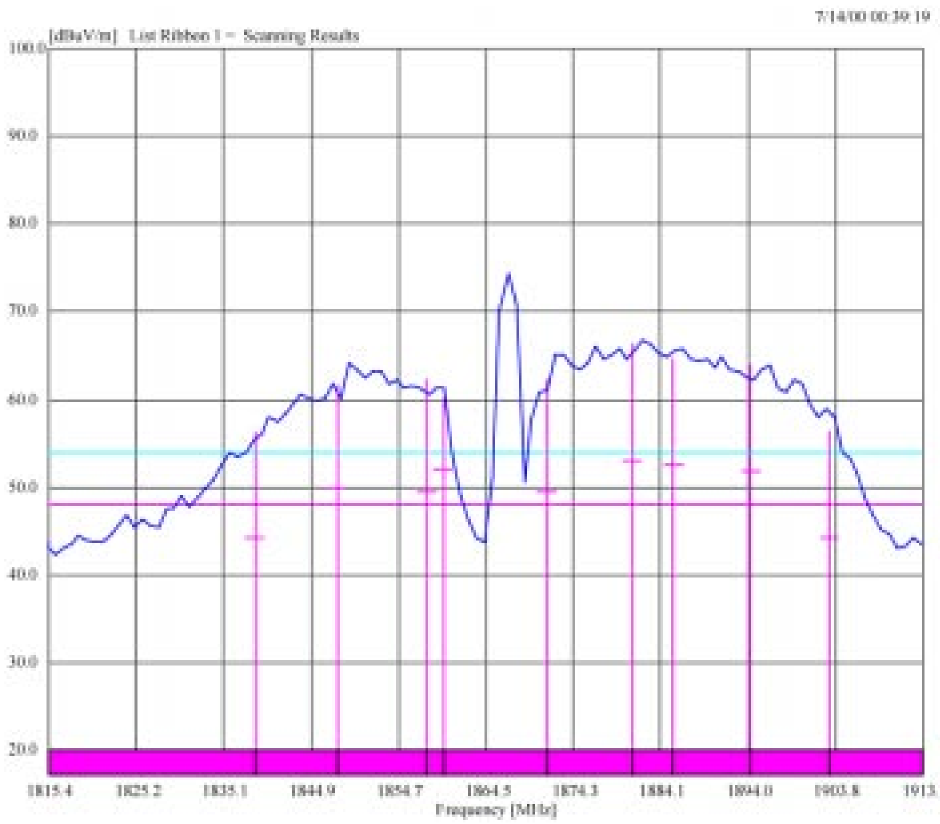


Table 11.22 Data for 1-3.5 GHz; Lucent Four Voice/HSD

Frequency (MHz)	Peak (dBuV/m)	Peak Lmt (dBuV/m)	DelLim-Pk (dB)	Avg (dBuV/m)	Avg Lmt (dBuV/m)	DelLmt-Avg (dB	Height (cm)	Angle Pol (deg)
1055.930855	49.47	48.00	1.47	40.62	54.00	-13.38	135	150 Horz
1439-911748	49.17	48.00	1.17	39.00*	54.00	-15.00	314	170 Vert
1626.996185	50.36	48.00	2.36	47.13	54.00	-6.87	91	104 Horz
1705.009016	51.46	48.00	3.46	47.71	54.00	-6.29	134	123 Horz
2402.373884	46.29	48.00	-1.71	36.34*	54.00	-17.66	134	164 Horz
2402.930821	46.15	48.00	-1.85	34.79*	54.00	-19.21	314	174 Horz
2428.770471	46.47	48.00	-1.53	34.58*	54.00	-19.42	90	119 Vert
2446.725731	46.43	48.00	-1.75	35.43*	54.00	-18.47	133	100 Horz
2461.982637	46.96	48.00	-1.04	34.82*	54.00	-19.18	268	183 Vert
2467.868657	47.06	48.00	-0.94	34.74	54.00	-19.26	2	126 Vert
2472.283412	46.22	48.00	-1.78	34.58*	54.00	-19.42	45	159 Horz

[Figure 11.39](#) identifies the average amplitude within +/- 30 MHz of the notched fundamental. The average measurement amplitude meets the FCC limit line.

Figure 11.39 R3 Fundamental Skirts



[Figure 11.40] represents the full radiated emissions scan from 3.5 GHz - 18.0 GHz utilizing an HP 84125C 1 GHz - 40 GHz Microwave EMI test system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test. Three peak signals exceeded the peak measurement and were re-measured with an average detector and found to pass as shown in Figure 11.41 and Figure 11.46.

Figure 11.40 3.5 - 18 GHz: Four Voice Calls With HSD, Horizontal Polarization, Full Scan

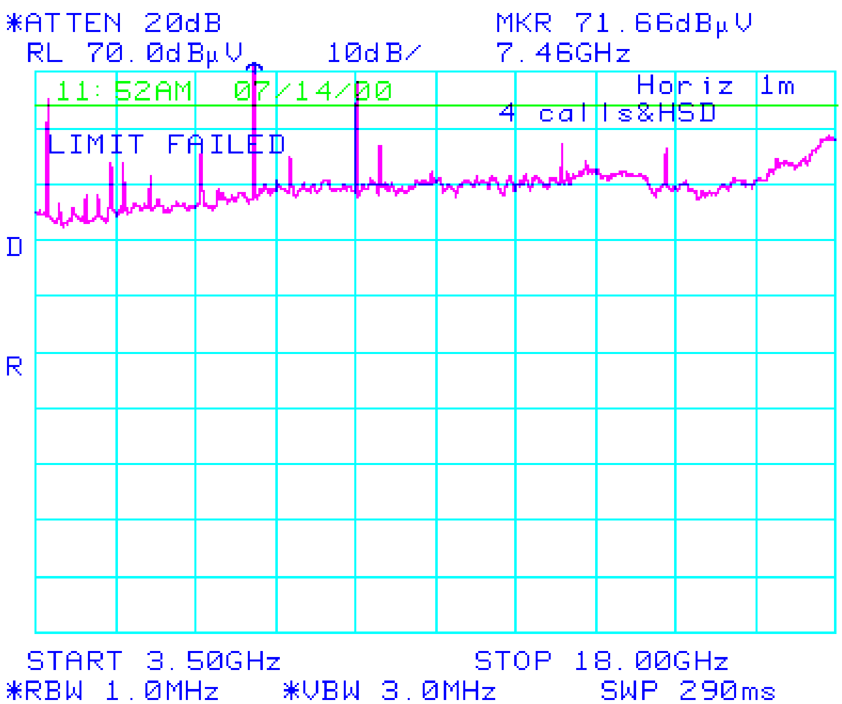


Figure 11.41 represents the max-hold narrow-span peak emissions scan of the highest signal depicted in figure 11.39. This test setup is the same as in Figure 11.40 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter away (horizontal polarization) and at a height of 1-meter away from the equipment under test.

Figure 11.41 3.5 - 18 GHz: Four Voice Calls With HSD, Horizontal Polarization, Highest Signal, 7.46 GHz Peak

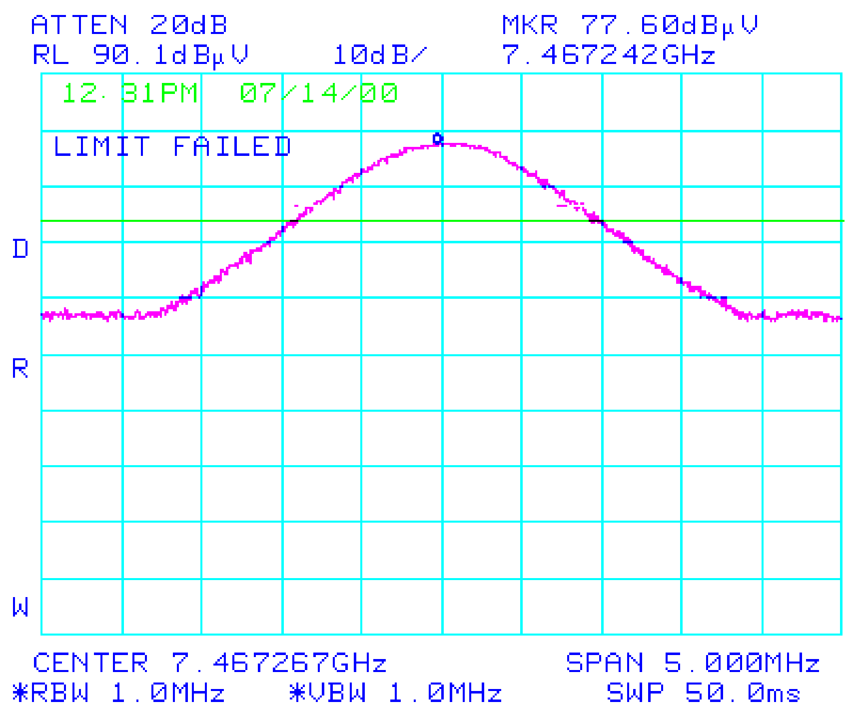


Figure 11.42 represents the average measurement of the peak measurement signal shown in Figure 11.41. This test setup is the same as in figure 11.39 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter away (horizontal polarization) and at a height of 1-meter away from the equipment under test.

Figure 11.42 3.5 - 18 GHz: Four Voice Calls With HSD, Horizontal Polarization, Highest Signal, 7.46 GHz Average

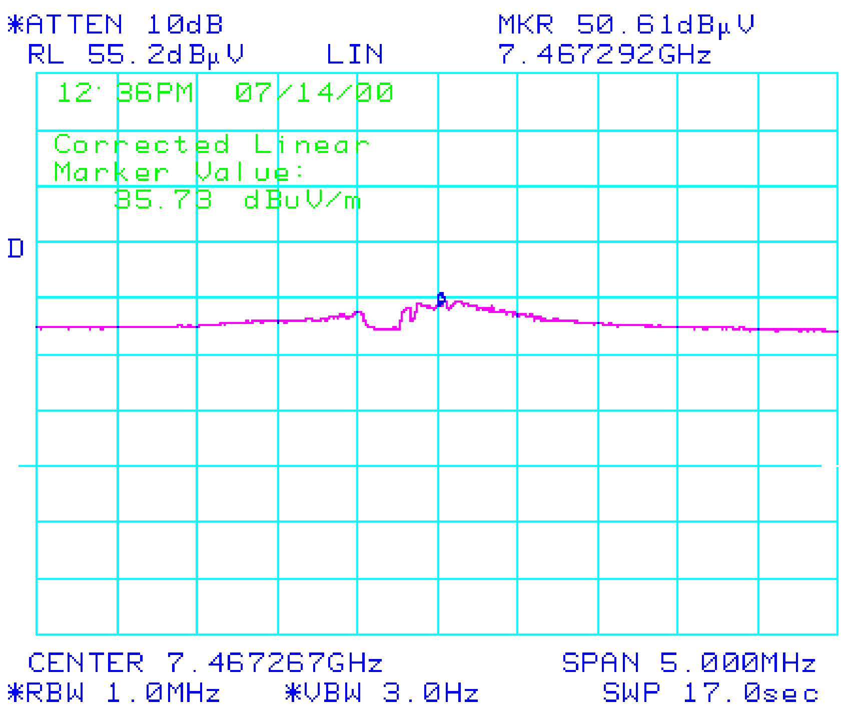


Figure 11.43 represents the peak max-hold narrow-span measurement of the second highest signal as depicted in Figure 11.40. This test setup is the same as in Figure 11.40 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter away (horizontal polarization) and at a height of 1-meter away from the equipment under test.

Figure 11.43 3.5 - 18 GHz: Four Voice Calls With HSD, Horizontal Polarization, Second Highest Signal, 3.73 GHz Peak

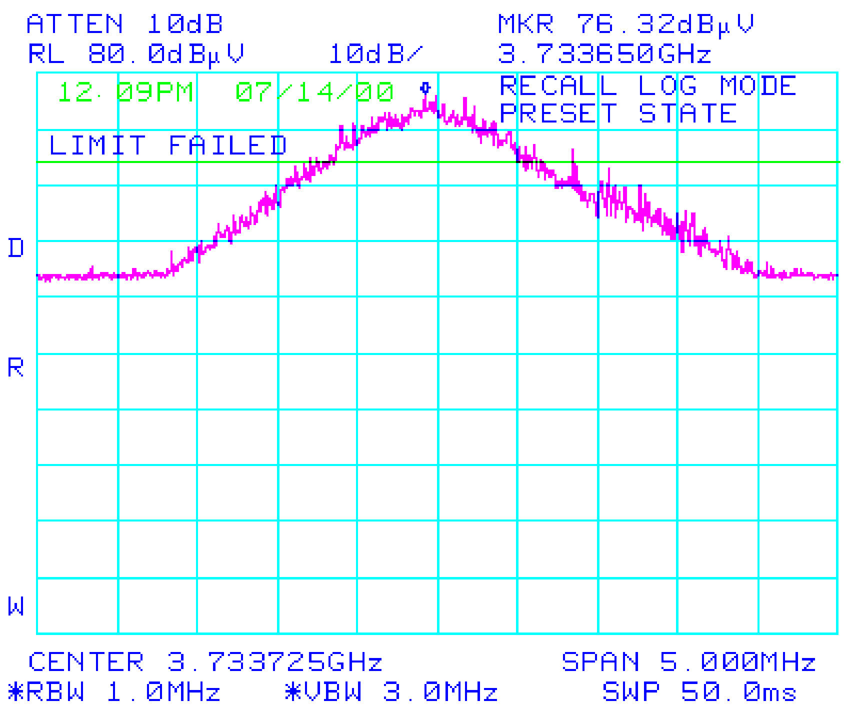


Figure 11.44 represents the average measurement of the second highest signal as depicted in Figure 11.40. This test setup is the same as in Figure 11.40 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter away and at a height of 1-meter away from the equipment under test.

Figure 11.44 3.5 - 18 GHz: Four Voice Calls With HSD, Horizontal Polarization, Second Highest Signal, 3.73 GHz Average

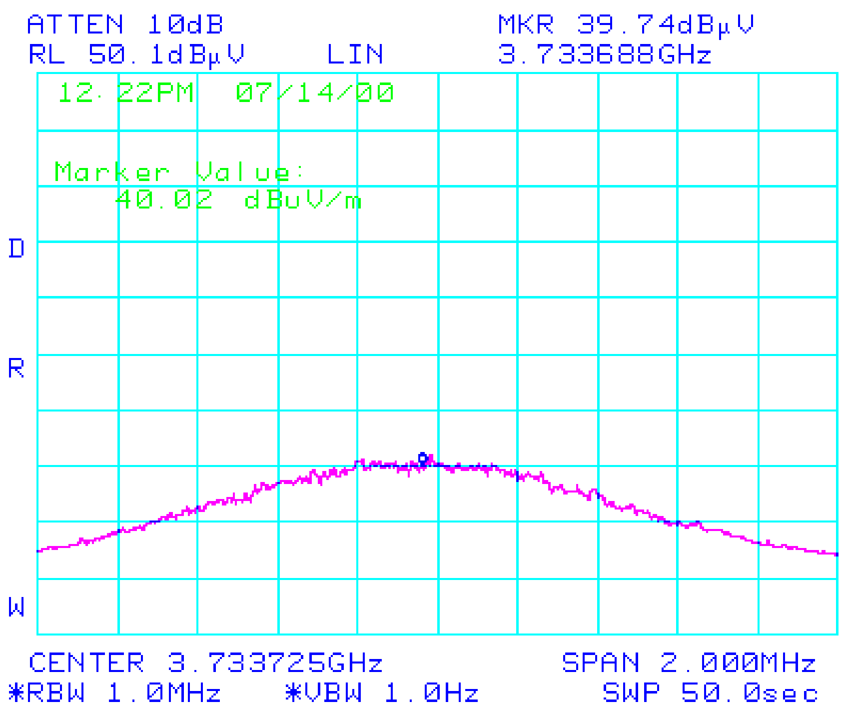


Figure 11.45 represents the peak max-hold narrow-span measurement of the third highest signal as depicted in Figure 11.40. This test setup is the same as in Figure 11.40 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter away and at a height of 1-meter away from the equipment under test.

Figure 11.45 3.5 - 18 GHz: Four Voice Calls With HSD, Horizontal Polarization, Third Highest Signal, 9.33 GHz Peak

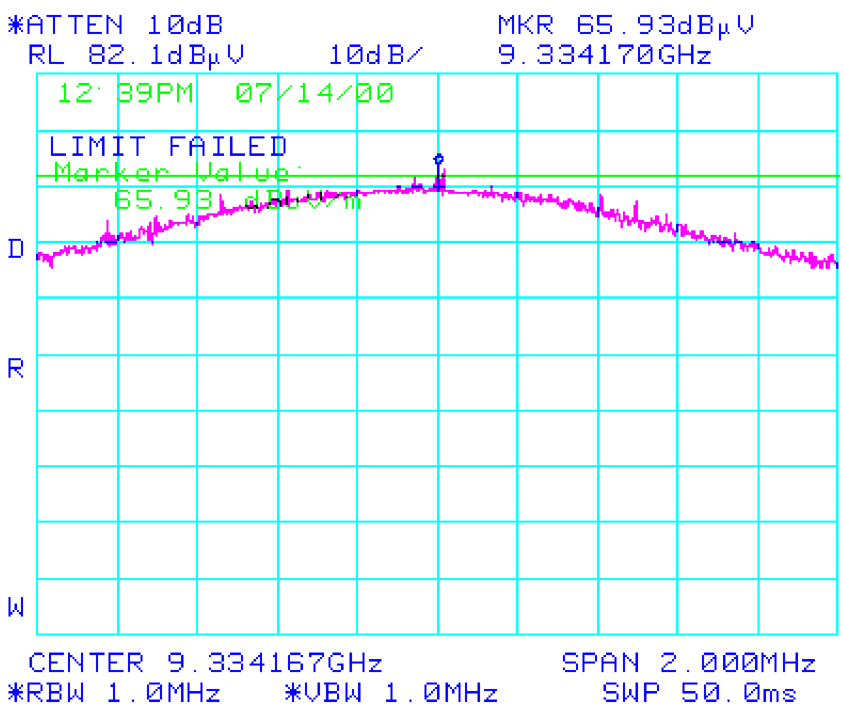


Figure 11.46 represents the average measurement of the third highest signal as depicted in Figure 11.40. This test setup is the same as in Figure 11.40 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter away and at a height of 1-meter away from the equipment under test.

Figure 11.46 3.5 - 18 GHz: Four Voice Calls With HSD, Horizontal Polarization, Third Highest Signal, 9.33 GHz Average

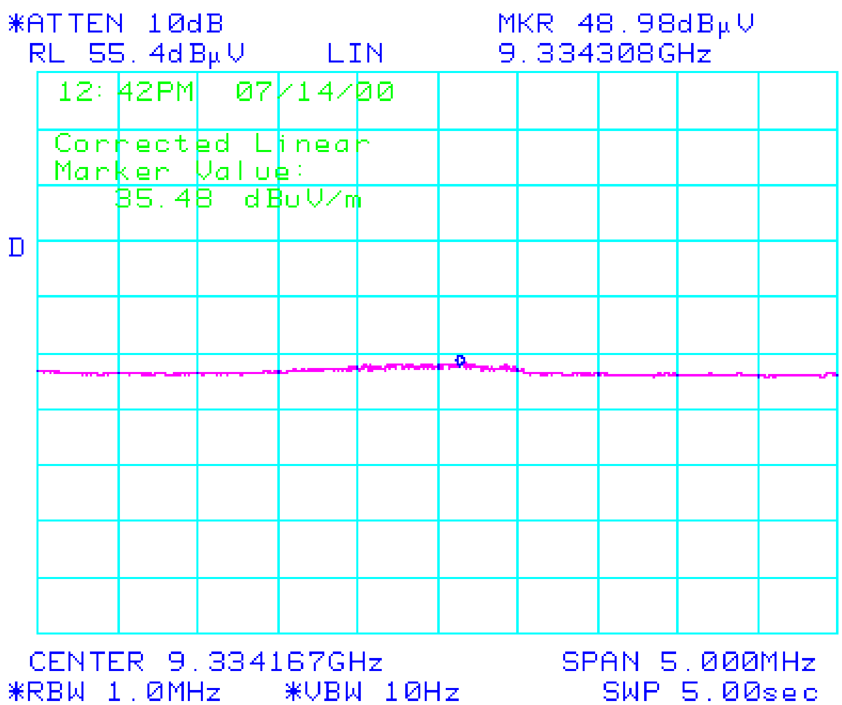


Figure 11.47 represents the full radiated emissions scan from 3.50GHz - 18.0GHz utilizing an HP 84125C 1GHz - 40GHz Microwave EMI test system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test. Two peak signals exceeded the peak measurement and were re-measured with an average detector as shown in Figure 11.48 and Figure 11.51.

Figure 11.47 3.5 - 18 GHz: Four Voice Calls With HSD, Vertical Polarization, Full Scan

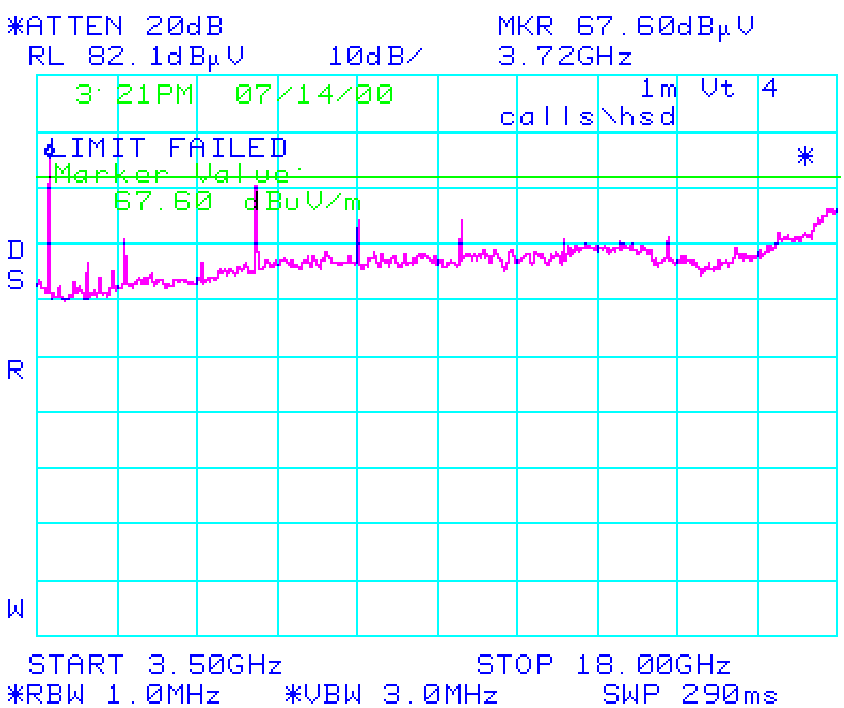


Figure 11.48 represents the max-hold narrow-span peak emissions scan of the highest signal depicted in Figure 11.47. This test setup is the same as inFigure 11.47 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.48 3.5 - 18 GHz: Four Voice Calls With HSD, Vertical Polarization, Highest Signal, 3.73 GHz Peak

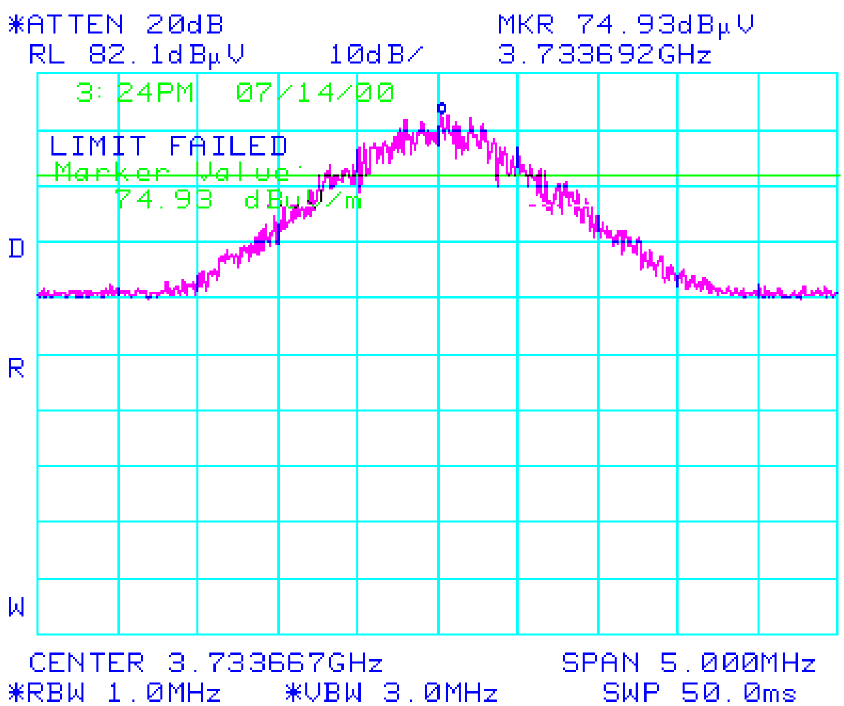


Figure 11.49 represents the average measurement of the peak measurement signal shown in Figure 11.48. This test setup is the same as in Figure 11.48 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.49 3.5 - 18 GHz: Four Voice Calls With HSD, Vertical Polarization, Highest Signal, 3.73 GHz Average

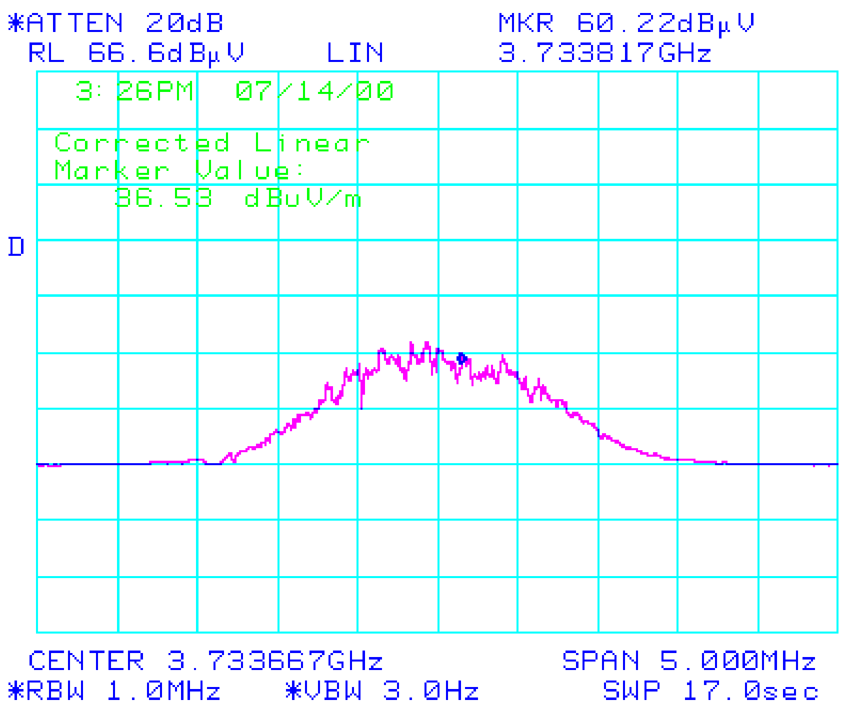


Figure 11.50 represents the peak max-hold narrow-span measurement of the second highest signal as depicted in Figure 11.47. This test setup is the same as in Figure 11.47 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.50 3.5 - 18 GHz: Four Voice Calls With HSD, Vertical Polarization, Second Highest Signal, 7.46 GHz Peak

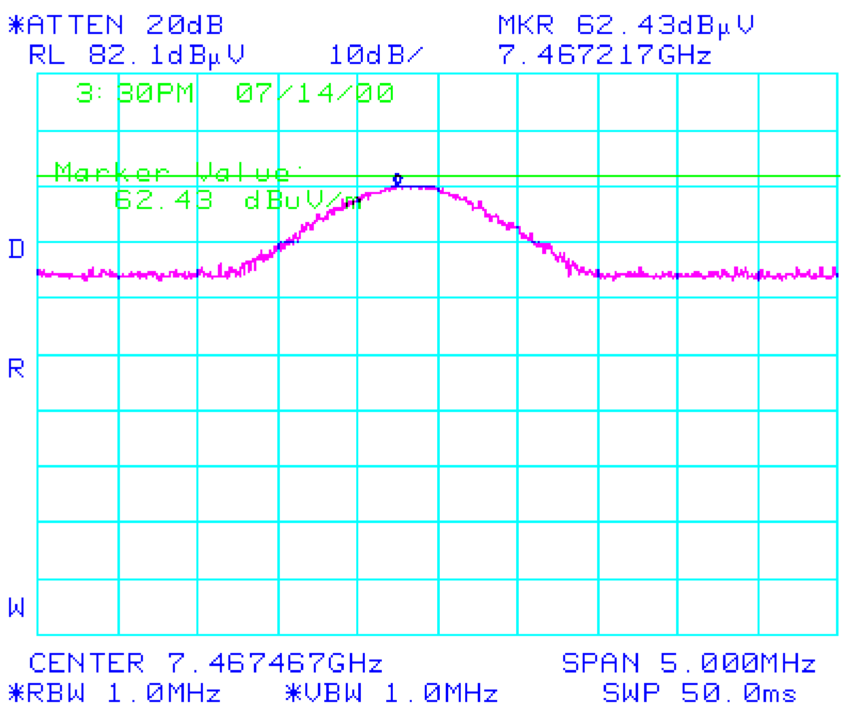


Figure 11.51 represents the average measurement of the second highest signal as depicted in Figure 11.47. This test setup is the same as in Figure 11.40 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter away (vertical polarization) and at a height of 1-meter away from the equipment under test.

Figure 11.51 3.5 - 18 GHz: Four Voice Calls With HSD, Vertical Polarization, Second Highest Signal, 7.46 GHz Average

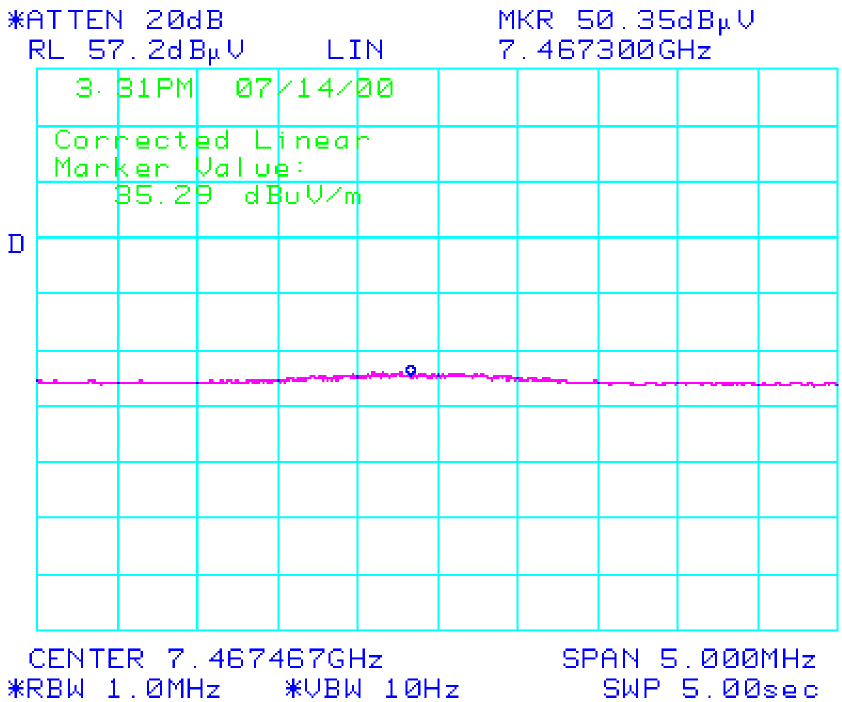


Figure 11.52 represents the full-radiated emissions scan from 18.0GHz-26.5GHz utilizing an HP 84125C 1GHz - 40GHz Microwave EMI test system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test. No peak signals exceeded the FCC limit.

Figure 11.52 18-26.5 GHz: Four Voice Calls With HSD, Horizontal Polarization, Full Scan

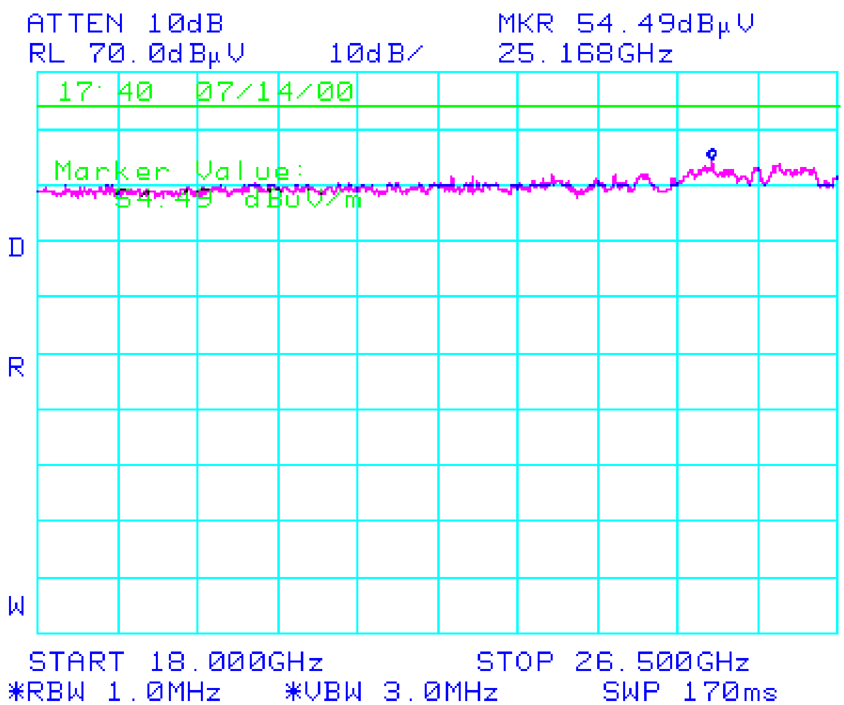
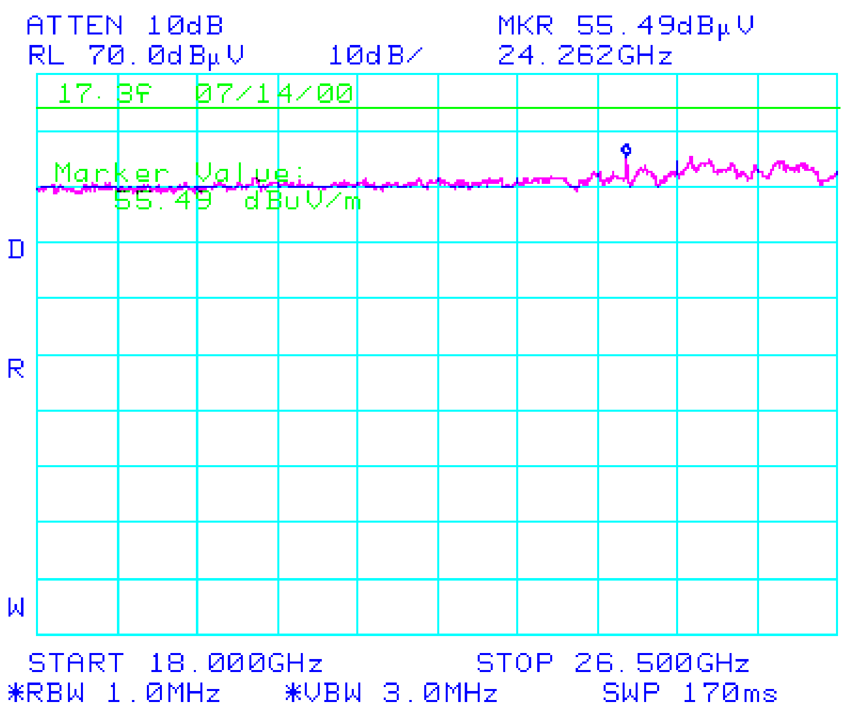


Figure 11.53 represents the full-radiated emissions scan from 18.0GHz-26.5GHz utilizing an HP 84125C 1GHz - 40GHz Microwave EMI test system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test. No peak signals exceeded the FCC limit.

Figure 11.53 18-26.5 GHz: Four Voice Calls With HSD, Vertical Polarization, Full Scan



Two Voice Calls with HSD Uplink and Lucent Power Supply: Typical Configuration

Figure 11.54 represents the radiated emissions scan from 30 MHz - 1.0 GHz utilizing a HP 8546A EMI receiver system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls as well as high-speed data uplink (typical scenario) continuously throughout the duration of the test. The receive antenna was positioned 3-meters away and scanned from one to four meters in height. The unit passed the required limit after the QP detector was utilized. See Table 11.23 for the peak and QP measurement data.

Figure 11.54 30-1000 MHz: Two Voice Calls with HSD

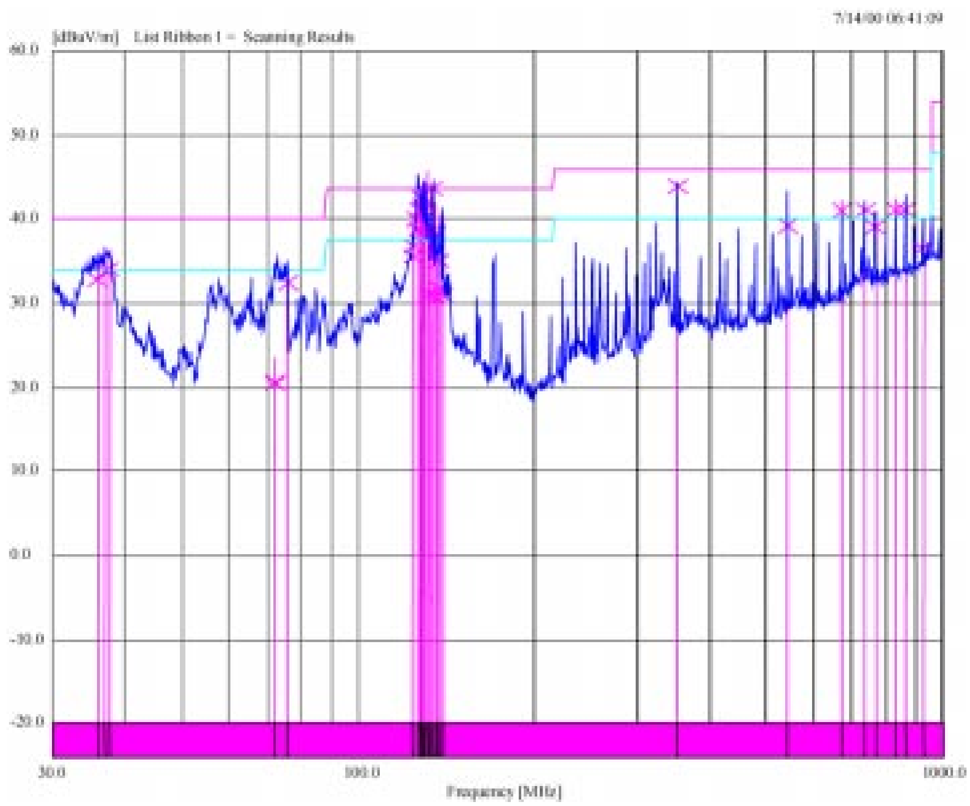


Table 11.23 Data for 30 MHz-1GHz; Lucent Two Voice /HSD

Frequency (MHz)	Peak (dBuV/m)	Peak Lmt (dBuV/m)	DelLim-Pk (dB)	QP (dBuV/m)	QP Lmt (dBuV/m)	DelLmt-QP (dB	Height (cm)	Angle Pol (deg)
74.443478	34.21	34.00	0.21	32.25	40.00	-7.75	209	224 Vert
75.458013	35.09	34.00	1.09	33.37	40.00	-6.63	110	313 Vert
79.809818	38.41	34.00	4.41	35.99	40.00	-4.01	98	314 Vert
79.892052	37.76	34.00	3.76	35.23	40.00	-4.77	176	315 Vert
80.017530	38343	34.00	4.43	36.79	40.00	-3.21	98	314 Vert
80.116454	38.21	34.00	4.21	35.58	40.00	-4.42	177	315 Vert
80.712726	37.30	34.00	3.30	35.17*	40.00	-4.83	176	316 Vert
81.431282	37.43	34.00	3.43	35.18	40.00	-4.82	178	315 Vert
82.022929	37.30	34.00	3.30	35.07	40.00	-4.93	135	315 Vert
82.090018	37.92	34.00	3.92	35.59	40.00	-4.41	136	315 Vert
82.553849	37.07	34.00	3.07	35.39	40.00	-4.61	125	271 Vert
82.580534	38.28	34.00	4.28	35.92	40.00	-4.08	125	271 Vert
83.259375	36.06	34.00	2.06	34.59	40.00	-5.41	140	226 Vert
83.261033	36.47	34.00	2.47	34.17	40.00	-5.83	140	226 Vert
83.950050	34.13	34.00	0.13	32.09	40.00	-7.91	167	314 Vert
83.983971	34.46	34.00	0.46	32.25	40.00	-7.75	167	314 Vert
85.964217	36.32	34.00	2.32	33.96	40.00	-6.04	117	271 Vert
351.983964	42.55	40.00	2.55	42.28	46.00	-3.72	99	90 Horz
543.976853	41.71	40.00	1.71	41.53	46.00	-4.47	95	179 Vert
735.964178	44.24	40.00	4.24	43.00	46.00	-3.00	161	179 Vert
767.962545	43.67	40.00	3.67	42.02	46.00	-3.98	148	181 Vert

Figure 11.55 represents the radiated emissions scan from 1.0GHz-3.5GHz utilizing a HP 8546A EMI receiver system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls as well as high-speed data uplink continuously throughout the duration of the test. The receive antenna was positioned 3-meters away and scanned from one to four meters in height. Also shown are two transmit fundamentals - one for the RU (1867MHz) as well as one for the Base fundamental (1947MHz). The unit passed the required limit after the average detector was utilized. See Table 11.24 for the peak and average measurement data.

Figure 11.55 1-3.5 GHZ: Two Voice Calls with HSD

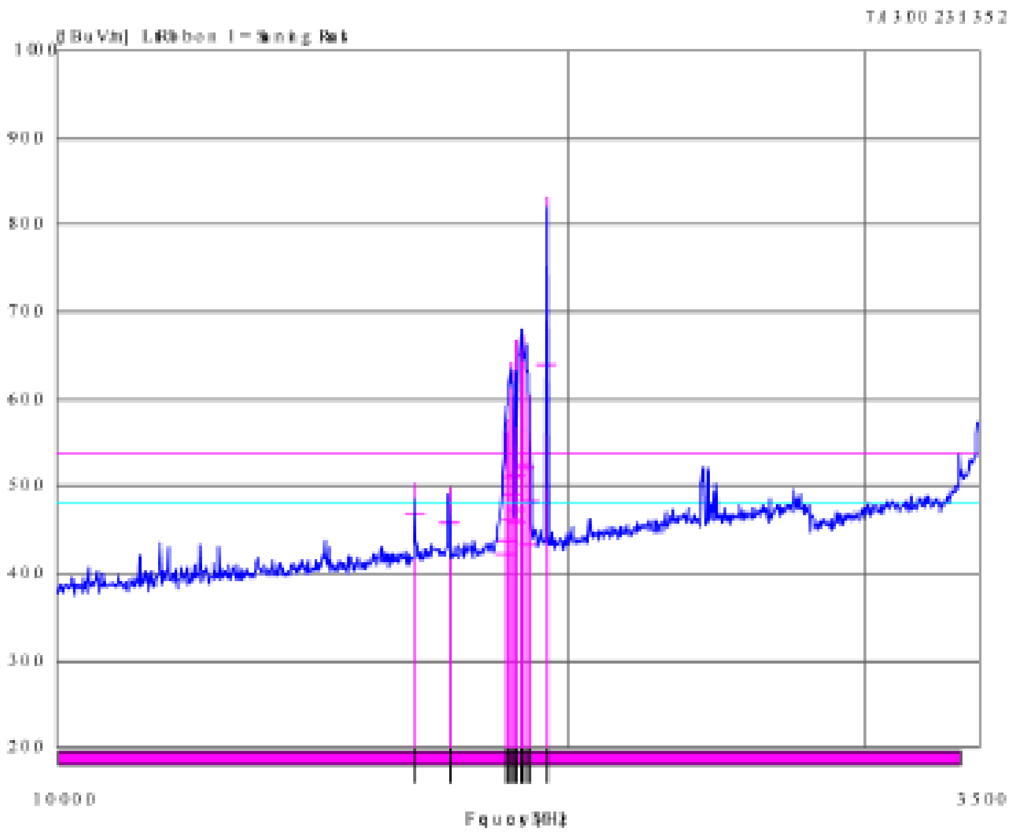


Table 11.24 Data for 1 GHz-3.5 GHz; Lucent Two Voice/HSD

Frequency (MHz)	Peak (dBuV/m)	Peak Lmt (dBuV/m)	DelLim-Pk (dB)	Avg (dBuV/m)	Avg Lmt (dBuV/m)	DelLmt-Avg (dB	Height (cm)	Angle Pol (deg)
1626.927271	50.25	48.00	2.25	46.75	54.00	-7.25	91	98 Horz
1704.987168	49.83	48.00	1.83	45.89	54.00	-8.11	269	98 Horz

Figure 11.56 identifies the average amplitude within +/- 30 MHz of the notched fundamental. The average measurement amplitude meets the FCC limit line.

Figure 11.56 R3 Fundamental Skirts

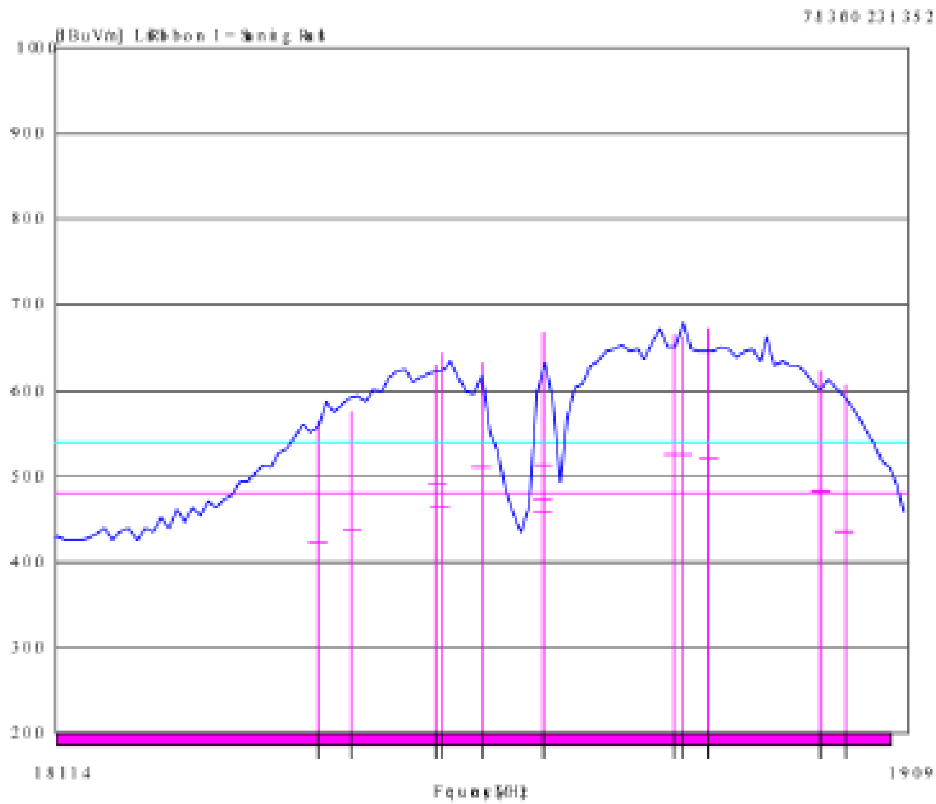


Figure 11.57 represents the full radiated emissions scan from 3.50GHz - 18.0GHz utilizing an HP 84125C 1 GHz - 40 GHz Microwave EMI test system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test. Three peak signals exceeded the peak measurement and were re-measured with an average detector and found to pass as shown in Figure 11.58 and Figure 11.63.

Figure 11.57 3.5 - 18 GHz: Two Voice Calls With HSD, Horizontal Polarization, Full Scan

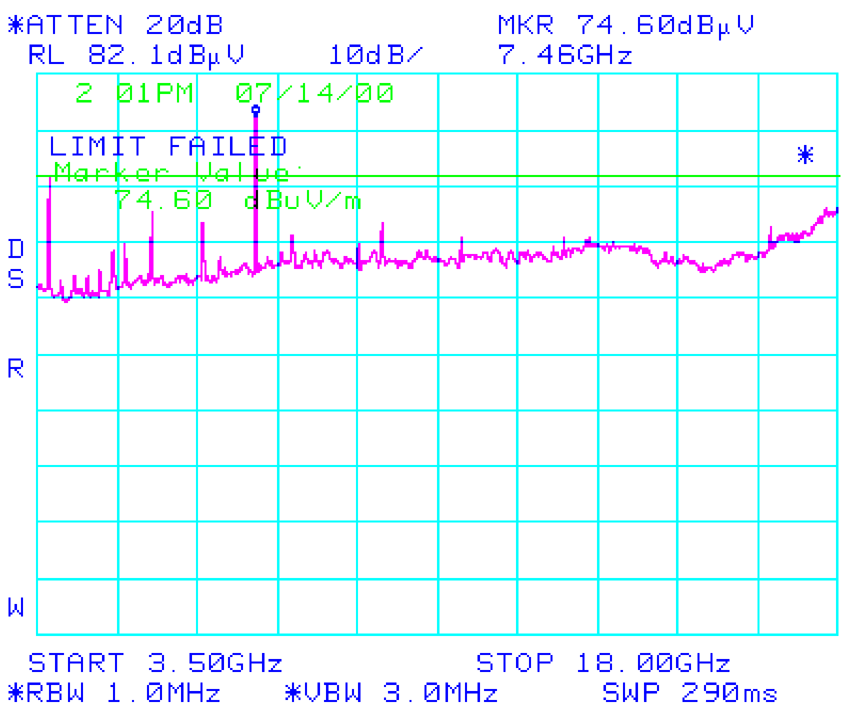


Figure 11.58 represents the max-hold narrow-span peak emissions scan of the highest signal depicted in Figure 11.57. This test setup is the same as in Figure 11.57 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.58 3.5 - 18 GHz: Two Voice Calls With HSD, Horizontal Polarization, Highest Signal, 7.46 GHz Peak

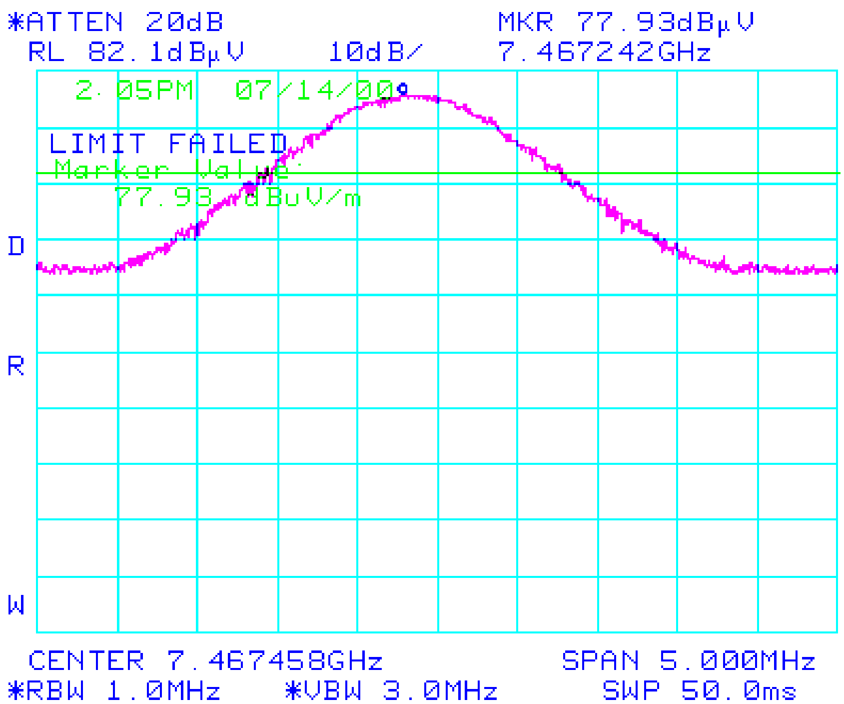


Figure 11.59 represents the average measurement of the highest signal depicted in Figure 11.57. This test setup is the same as in Figure 11.57 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.59 3.5 - 18 GHz: Two Voice Calls With HSD, Horizontal Polarization, Highest Signal, 7.46 GHz Average

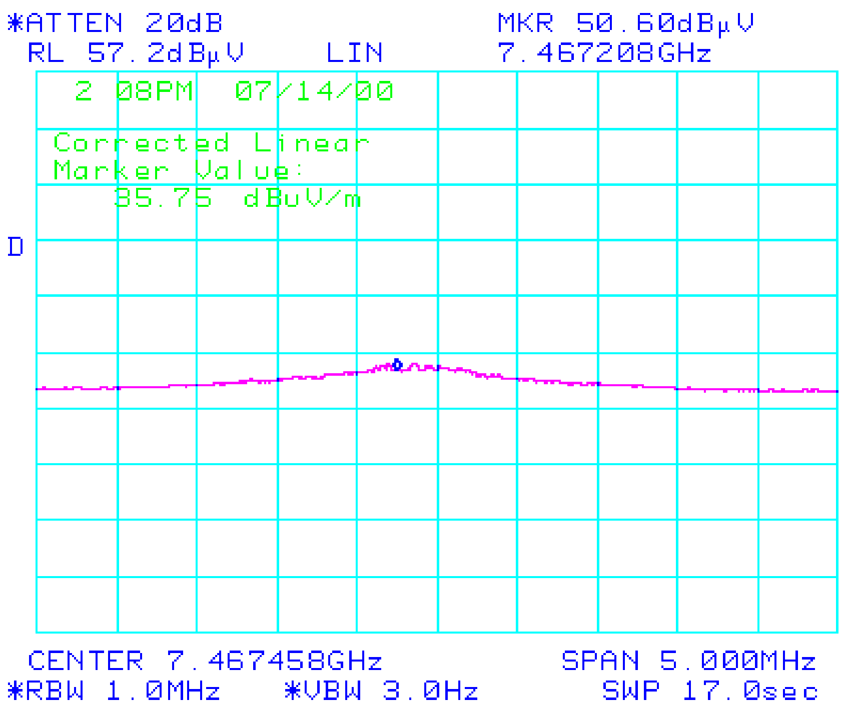


Figure 11.60 represents the max-hold narrow-span peak emissions scan of the second highest signal depicted in Figure 11.57. This test setup is the same as in Figure 11.57 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.60 3.5 - 18 GHz: Two Voice Calls With HSD, Horizontal Polarization, Second Highest Signal, 3.73 GHz Peak

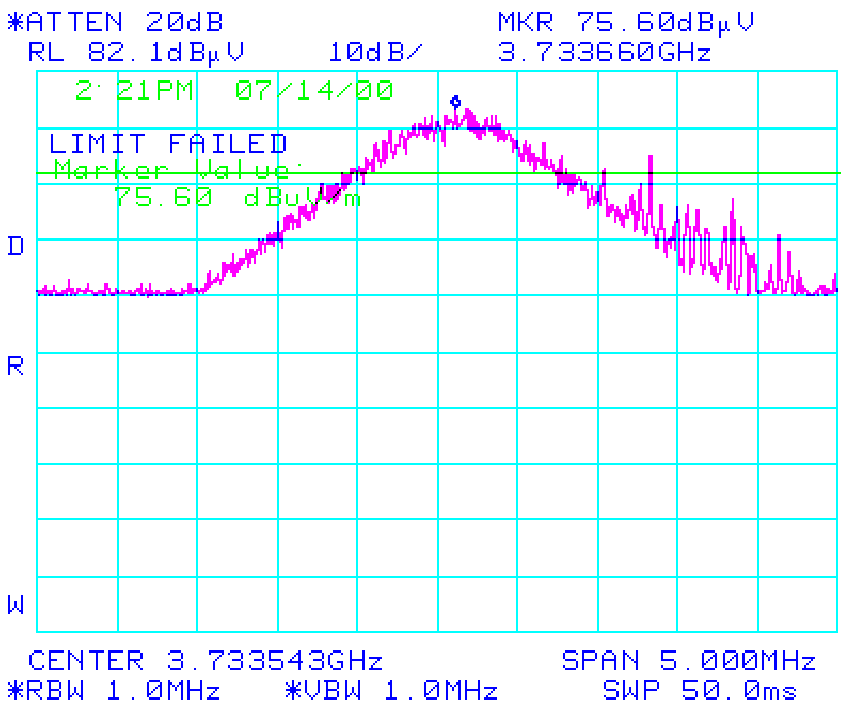


Figure 11.61 represents the average measurement of the second highest signal depicted in Figure 11.57. This test setup is the same as in Figure 11.57 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.61 3.5 - 18 GHz: Two Voice Calls With HSD, Horizontal Polarization, Second Highest Signal, 3.73 GHz Average

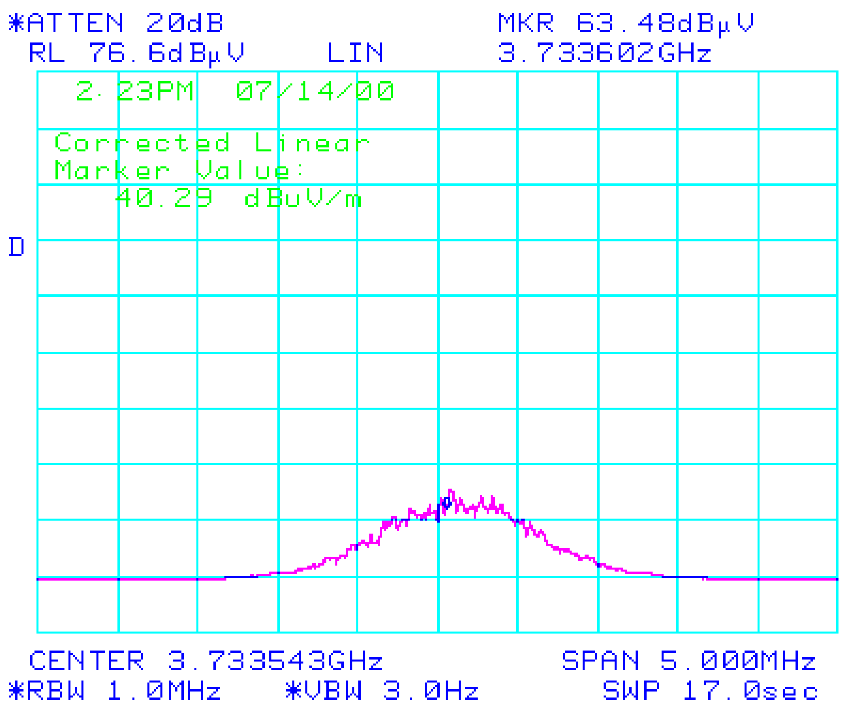


Figure 11.62 represents the max-hold narrow-span peak emissions scan of the third highest signal depicted in Figure 11.57. This test setup is the same as in Figure 11.57 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test

Figure 11.62 3.5 - 18 GHz: Two Voice Calls With HSD, Horizontal Polarization, Third Highest Signal, 5.6 GHz Peak

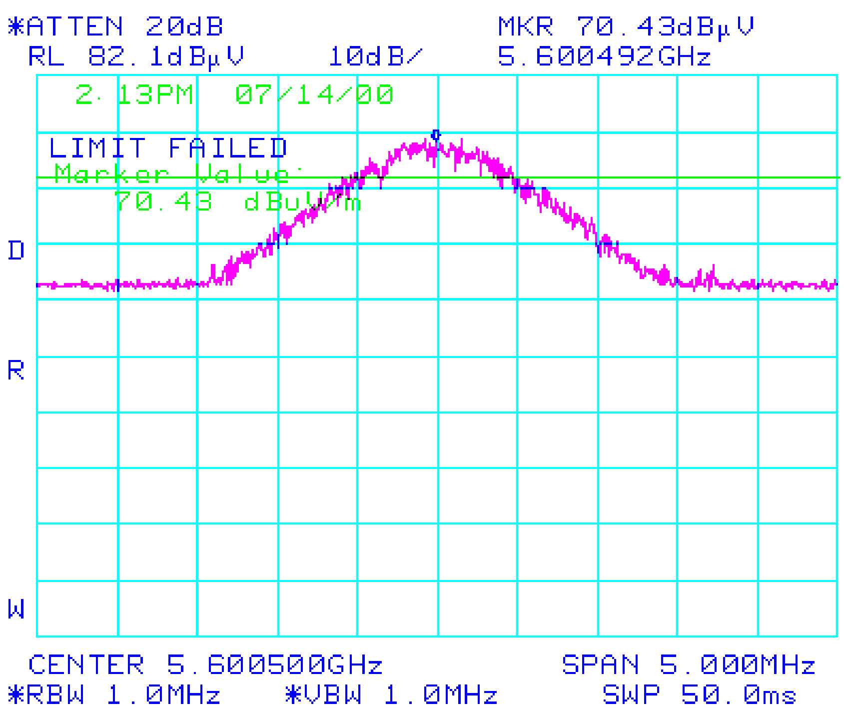
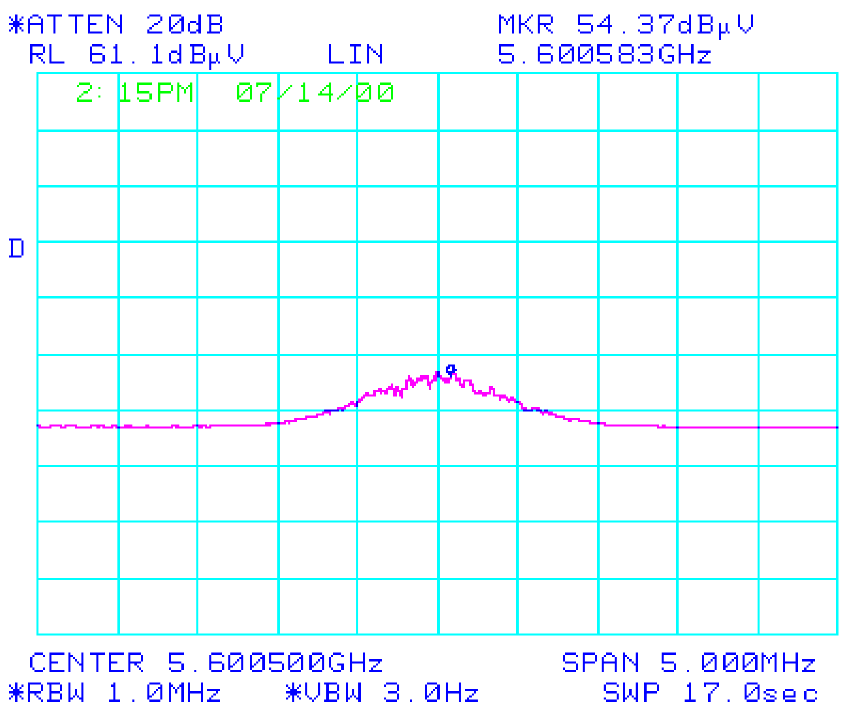


Figure 11.63 represents the average measurement of the third highest signal depicted in Figure 11.57. This test setup is the same as in Figure 11.57 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.63 3.5 - 18 GHz: Two Voice Calls With HSD, Horizontal Polarization, Third Highest Signal, 5.6 GHz Average



[Figure 11.64](#) represents the full radiated emissions scan from 3.50GHz - 18.0GHz utilizing an HP 84125C 1 GHz - 40 GHz Microwave EMI test system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test. Three peak signals exceeded the peak measurement and were re-measured with an average detector and found to pass as shown in Figure 11.65 and Figure 11.70.

Figure 11.64 3.5 - 18 GHz: Two Voice Calls With HSD, Vertical Polarization, Full Scan

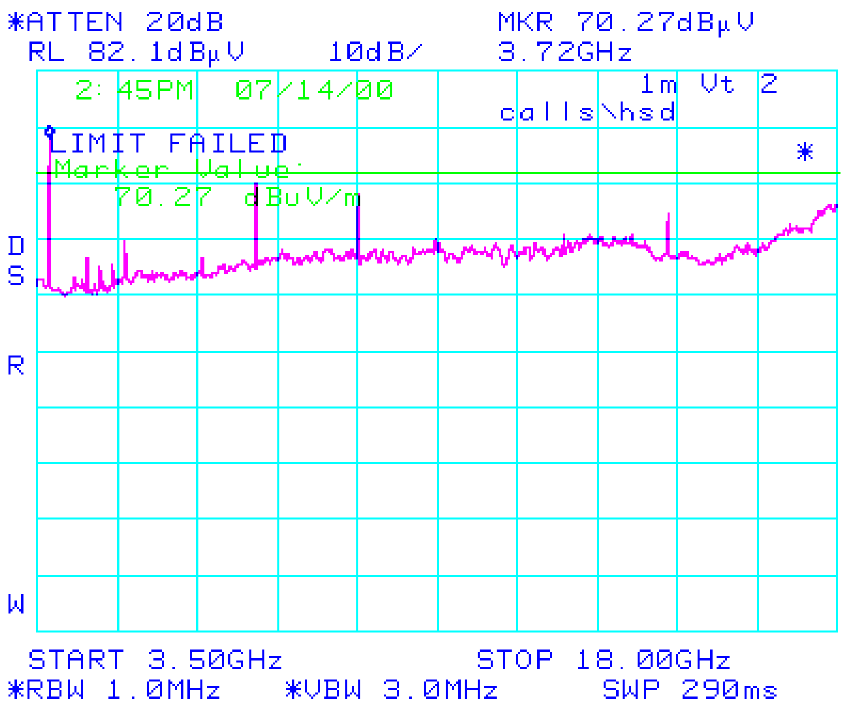


Figure 11.65 represents the max-hold narrow-span peak emissions scan of the highest signal depicted in Figure 11.57. This test setup is the same as in Figure 11.57 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.65 3.5 - 18 GHz: Two Voice Calls With HSD, Vertical Polarization, Highest Signal, 3.73 GHz Peak

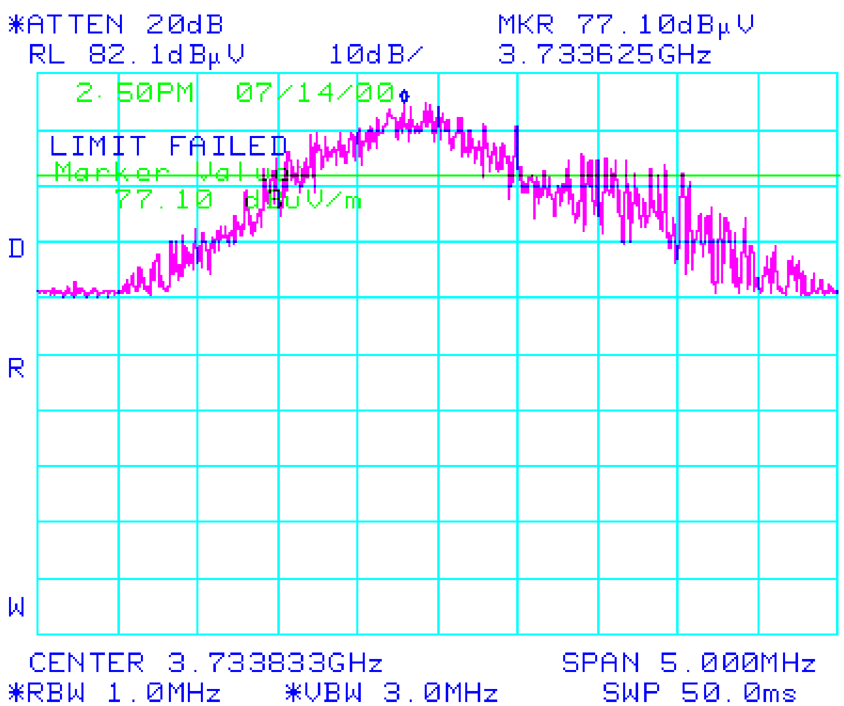


Figure 11.66 represents the average measurement of the signal depicted in Figure 11.65. This test setup is the same as in Figure 11.57 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.66 3.5 - 18 GHz: Two Voice Calls With HSD, Vertical Polarization, Highest Signal, 3.73 GHz Average

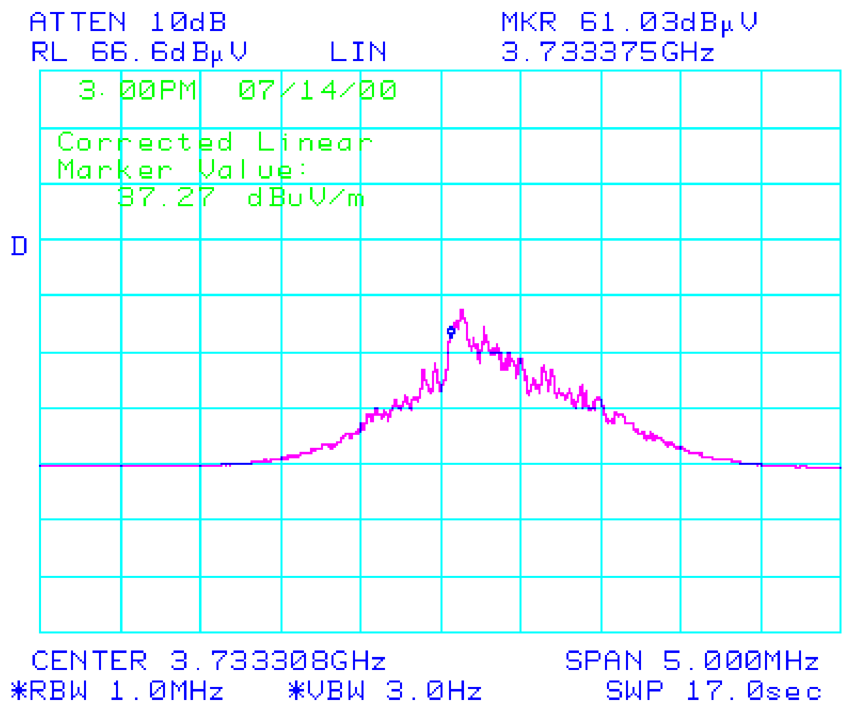


Figure 11.67 represents the max-hold narrow-span peak emissions scan of the second highest signal depicted in Figure 11.64. This test setup is the same as in Figure 11.57 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.67 3.5 - 18 GHz: Two Voice Calls With HSD, Vertical Polarization, Second Highest Signal, 7.46 GHz Peak

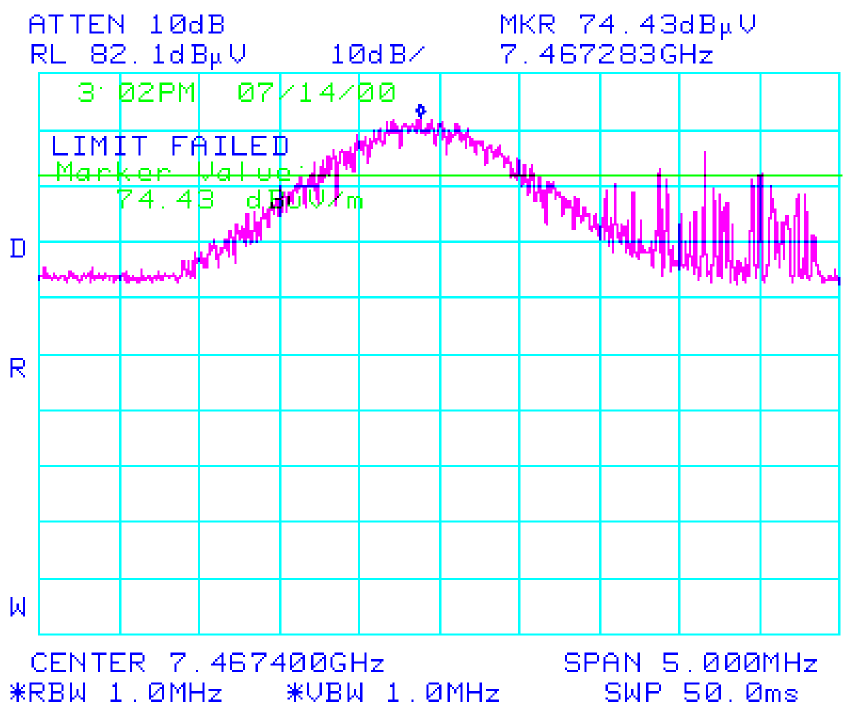


Figure 11.68 represents the average measurement of the signal depicted in Figure 11.67. This test setup is the same as in Figure 11.64 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.68 3.5 - 18 GHz: Two Voice Calls With HSD, Vertical Polarization, Second HIghest Signal, 7.46 GHz Average

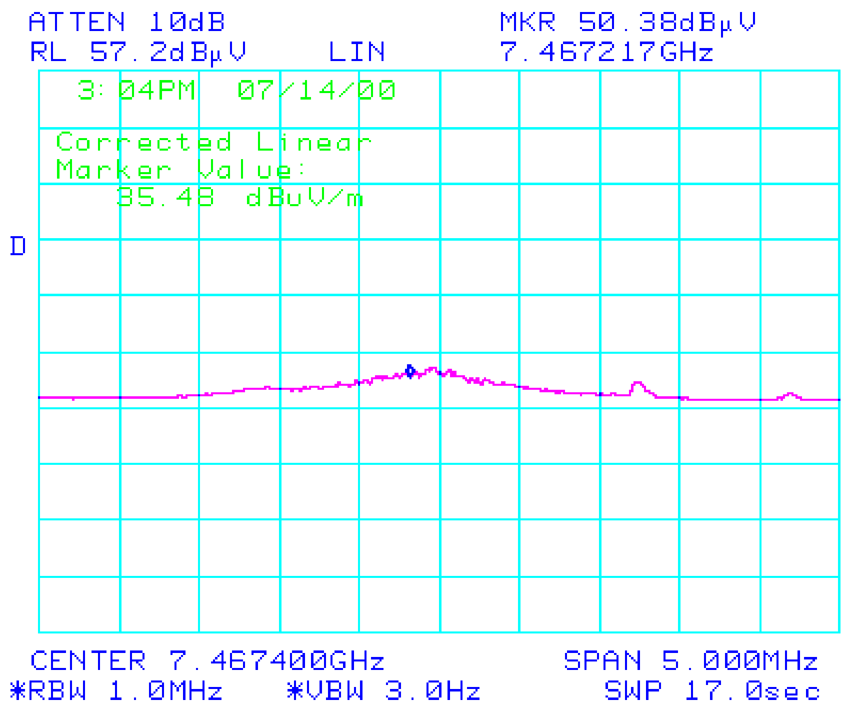


Figure 11.69 represents the max-hold narrow-span peak emissions scan of the third highest signal depicted in Figure 11.64. This test setup is the same as in Figure 11.64 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test

Figure 11.69 3.5 - 18 GHz: Two Voice Calls With HSD, Vertical Polarization, Third Highest Signal, 9.33 GHz Peak

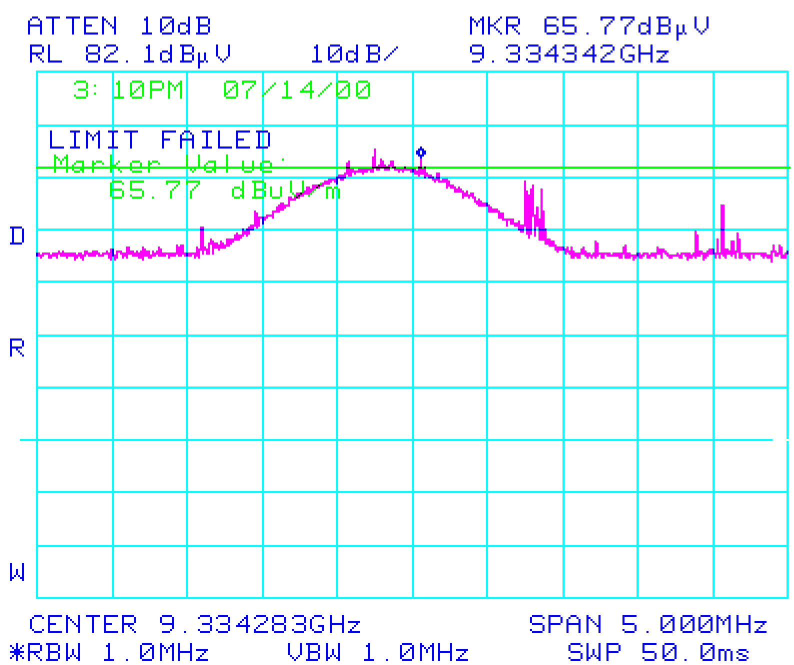
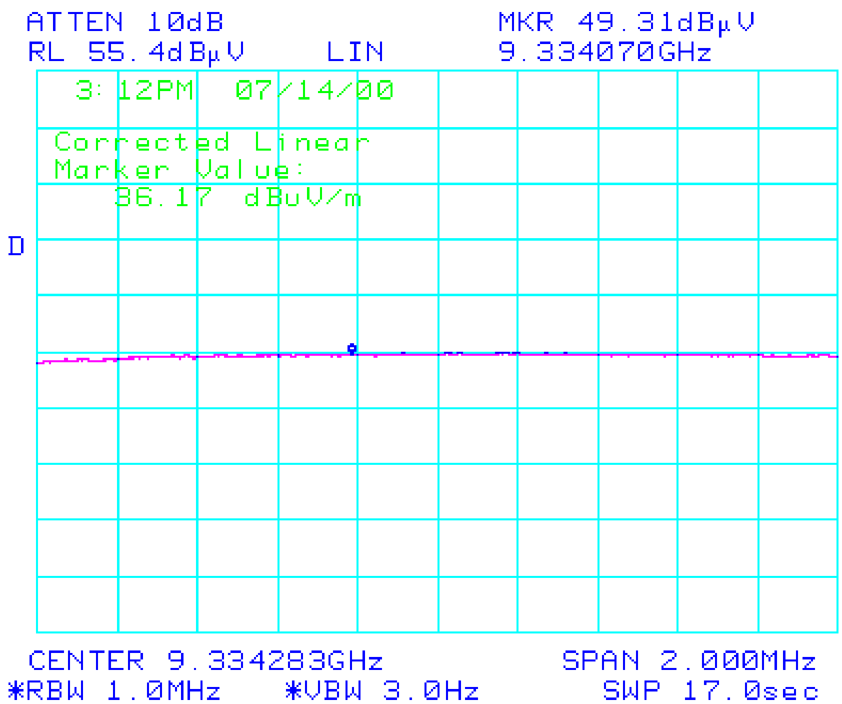


Figure 11.70 represents the average measurement of the signal depicted in Figure 11.69. This test setup is the same as in Figure 11.64 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Lucent Technologies AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls and high-speed data uplink (typical scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.70 3.5 - 18 GHz: Two Voice Calls With HSD, Vertical Polarization, Third Highest Signal, 9.33 GHz Average



Typical configuration test results for 18-26.5 GHz range were identical to the worst case results for the Lucent power supply and four voice calls with HSD for the respective range and were, therefore, not included in this report.

Four Voice Calls with HSD Uplink and Panasonic Power Supply:
Worst Case Configuration

Figure 11.71 represents the radiated emissions scan from 30 MHz - 1.0 GHz utilizing a HP 8546A EMI receiver system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls as well as high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The receive antenna was positioned 3-meters away and scanned from one to four meters in height. The unit passed the required limit after the QP detector was utilized. See Table 11.25 for the QP measurement data.

Figure 11.71 30-1000 MHz: Four Voice Calls with HSD

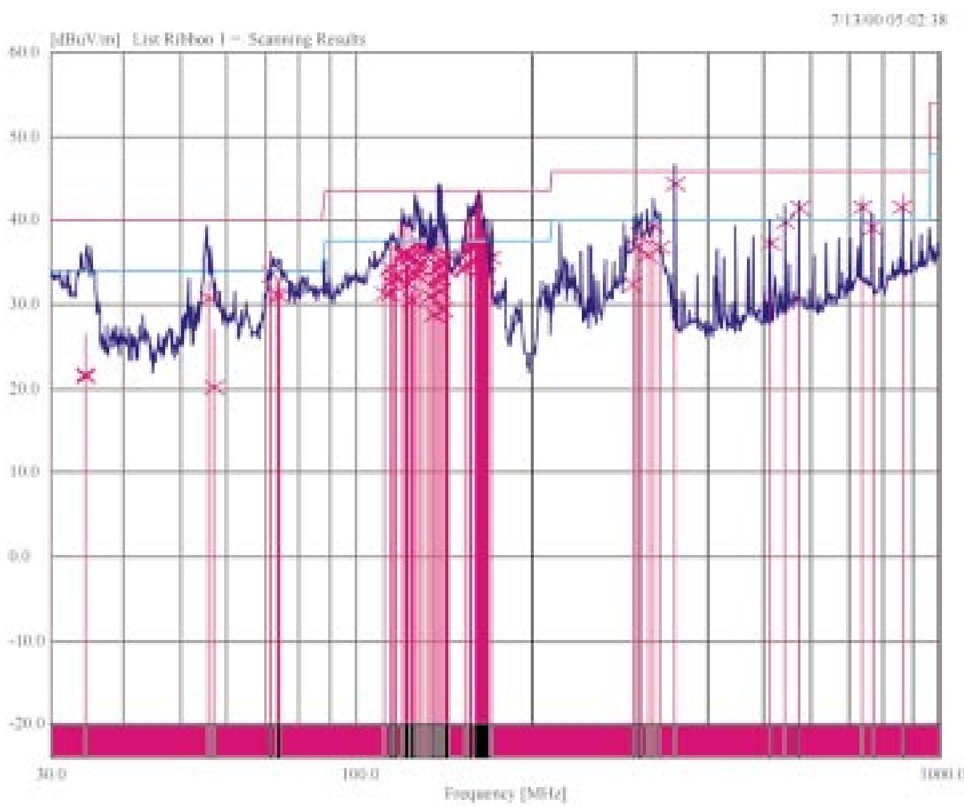


Table 11.25 Data for 30 MHz-1 GHz; Panasonic Four Voice/HSD

Frequency (MHz)	Peak (dBuV/m)	Peak Lmt (dBuV/m)	DelLim-Pk (dB)	QP (dBuV/m)	QP Lmt (dBuV/m)	DelLmt-QP (dB	Height (cm)	Angle Pol (deg)
56.005256	32.77	34.00	-1.23	30.83	--.--	--.--	349	313 Horz
57.137937	26.93	34.00	-7.07	20.16	--.--	--.--	279	90 Vert
71.578644	36.20	34.00	2.20	33.66	--.--	--.--	324	313 Horz
73.335705	33.04	34.00	-0.96	31.30	--.--	--.--	324	315 Horz
73.882154	32.50	34.00	-1.50	31.01	--.--	--.--	348	314 Horz
120.027174	39.26	37.50	1.76	35.95	--.--	--.--	97	90 Vert
120.061003	36.93	37.50	-0.57	35.15	--.--	--.--	112	136 Vert
127.855581	36.80	37.50	-0.70	34.43	--.--	--.--	101	90 Vert
134.141746	33.04	37.50	-4.46	31.09	--.--	--.--	306	270 Horz
139.960376	36.91	37.50	-0.59	31.48*	--.--	--.--	250	313 Horz
153.446153	39.78	37.50	2.28	34.52*	--.--	--.--	165	45 Horz
157.673202	40.85	37.50	3.35	37.03*	--.--	--.--	166	223 Horz
162.984751	42.23	37.50	4.73	36.16	--.--	--.--	320	45 Horz
170.647730	38.37	37.50	0.87	35.63	--.--	--.--	216	224 Horz
351.969538	44.56	40.00	4.56	44.39	--.--	--.--	99	91 Horz
54.966093	40.63	40.00	0.63	39.82	--.--	--.--	201	224 Horz
767.970744	40.61	40.00	0.61	39.21	--.--	--.--	98	181 Vert

Figure 11.72 represents the radiated emissions scan from 1.0 GHz-3.5 GHz utilizing a HP 8546A EMI receiver system. The test setup consisted of an R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls as well as high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The receive antenna was positioned 3-meters away and scanned from one to four meters in height. Also shown are two transmit fundamentals - one for the R3 (1867MHz) as well as one for the Base fundamental (1947MHz). The unit passed the required limit after the average detector was utilized. See Table 11.26 for the peak and average measurement data.

Figure 11.72 1-3.5 GHz: Four Voice Calls with HSD

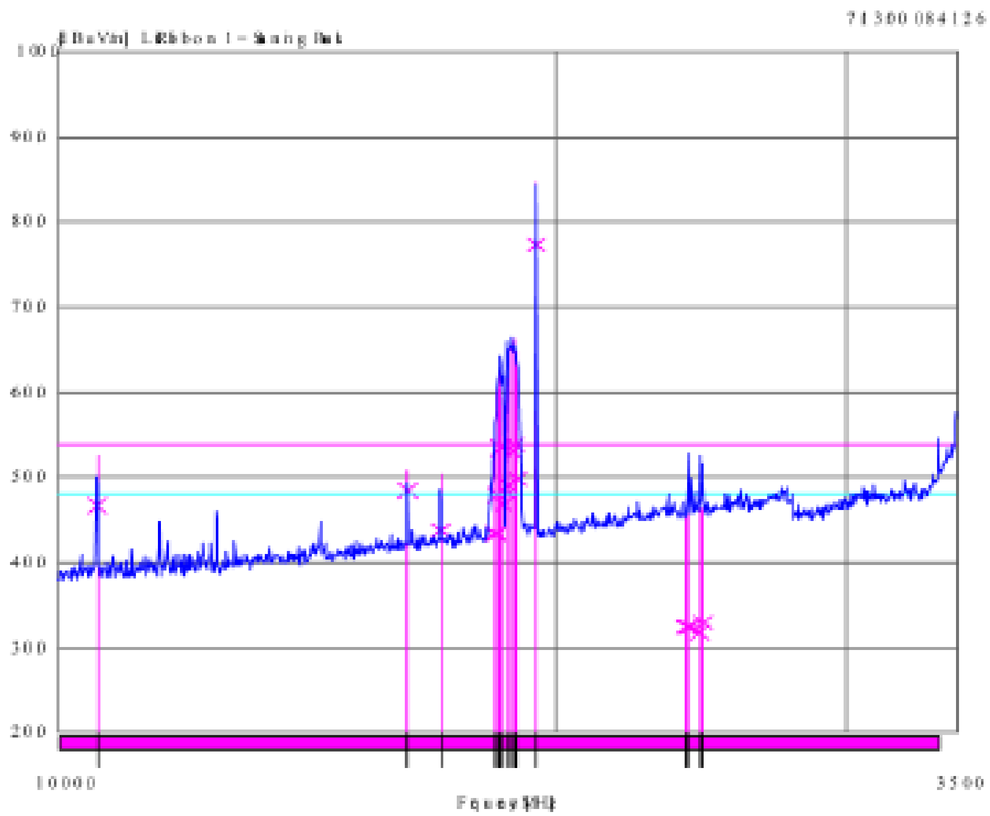


Table 11.26 Data for 1 GHz-3.5 GHz; Panasonic Four Voice/HSD

Frequency (MHz)	Peak (dBuV/m)	Peak Lmt (dBuV/m)	DelLim-Pk (dB)	Avg (dBuV/m)	Avg Lmt (dBuV/m)	DelLmt-Avg (dB	Height (cm)	Angle Pol (deg)
1056.000531	52.65	48.00	4.65	--.--	--.--\	--.--	135	146 Horz
1626.975393	50.74	48.00	2.74	--.--	--.--	--.--	91	104 Horz
1704.940963	50.33	48.00	2.33	--.--	--.--	--.--	134	120 Horz
2400.356538	46.18	48.00	-1.82	--.--		--.--	46	124 Horz
2410.828162	46.04	48.00	-1.96	--.--	--.--	--.--	357	126 Vert
2447.725092	46.37	48.00	-1.63	--.--	--.--	--.--	315	125 Horz
2456.379268	46.21	48.00	-1.79	--.--	--.--	--.--	2	193 Vert

[Figure 11.73](#) identifies the average amplitude within +/- 30 MHz of the notched fundamental. The average measurement amplitude meets the FCC limit line.

Figure 11.73 R3 Fundamental Skirts

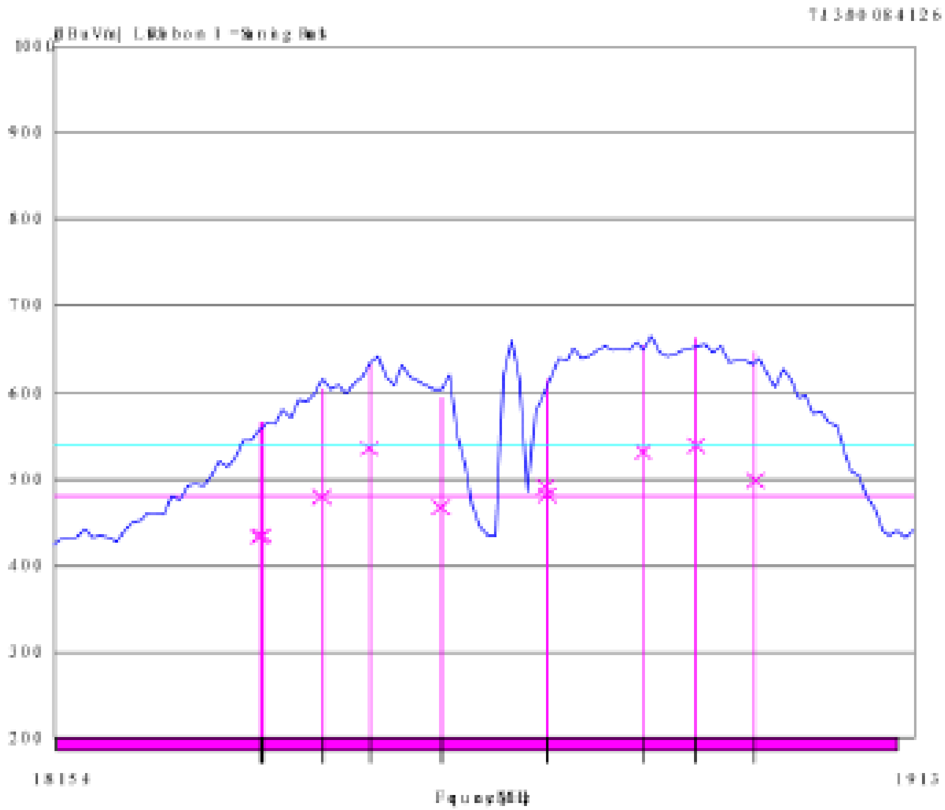


Figure 11.74 represents the full radiated emissions scan from 3.50 GHz - 18.0 GHz utilizing an HP 84125C 1GHz - 40GHz Microwave EMI test system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test. One peak signal exceeded the peak measurement and was re-measured with an average detector and found to pass as shown in Figure 11.75 and Figure 11.76.

Figure 11.74 3.5 - 18 GHz: Four Voice Calls With HSD, Horizontal Polarization, Full Scan

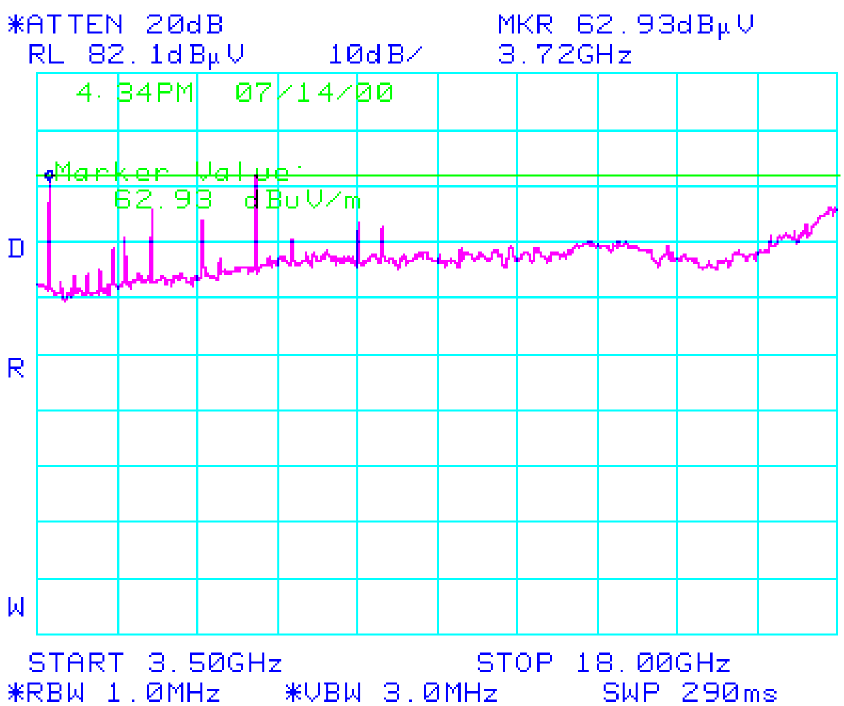


Figure 11.75 represents the max-hold narrow-span peak emissions scan of the highest signal depicted in Figure 11.74. This test setup is the same as in Figure 11.74 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.75 3.5-18 GHz: Four Voice Calls With HSD, Horizontal Polarization, Highest Signal, 3.73 GHz Peak

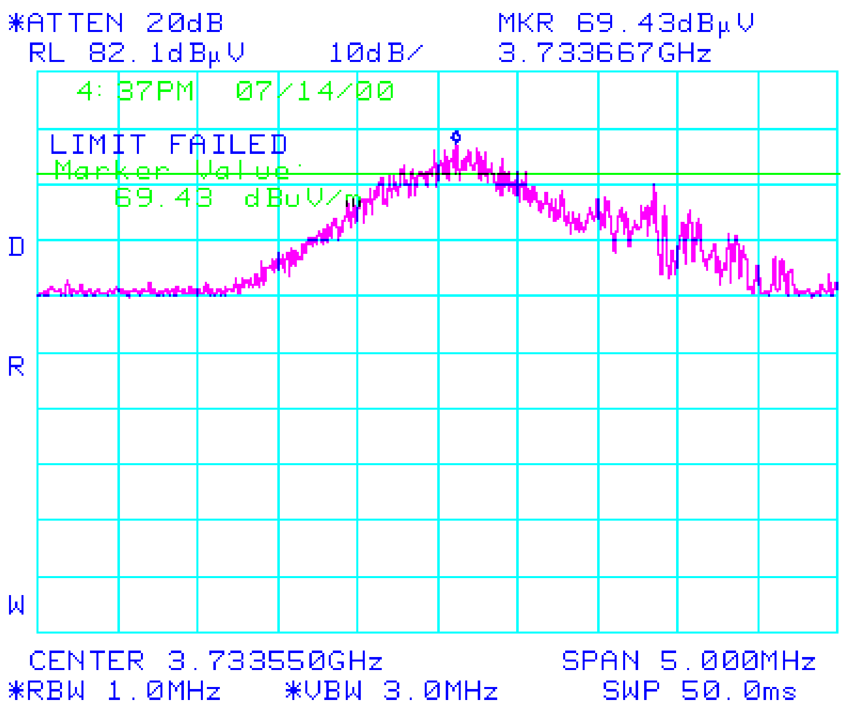


Figure 11.76 represents the average measurement of the signal depicted in Figure 11.75. This test setup is the same as in Figure 11.74 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.76 3.5-18 GHz: Four Voice Calls With HSD, Horizontal Polarization, Highest Signal, 3.73 GHz Average

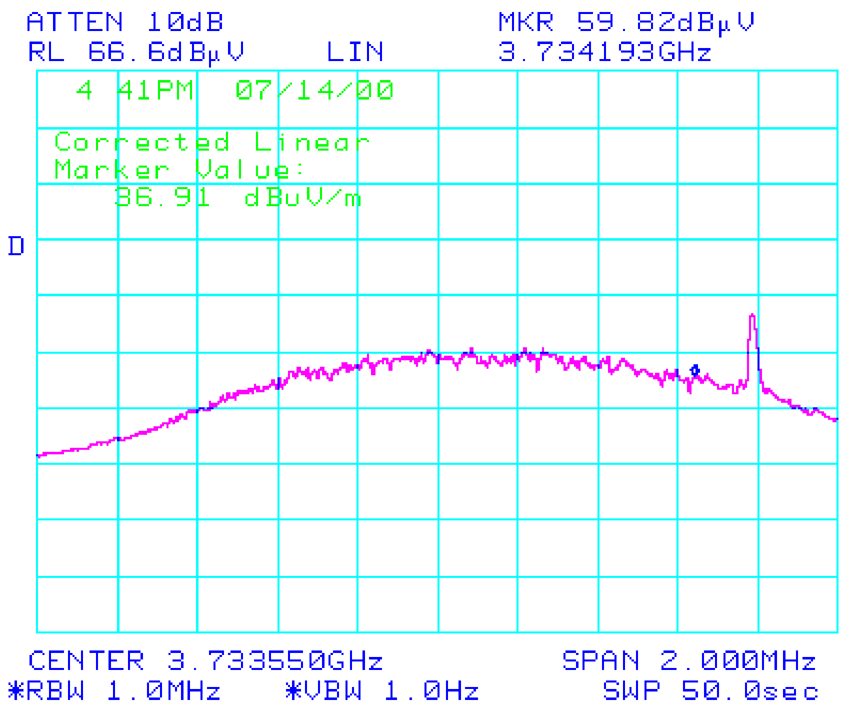


Figure 11.77 represents the full radiated emissions scan from 3.50 GHz - 18.0 GHz utilizing an HP 84125C 1 GHz - 40 GHz Microwave EMI test system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test. Two peak signals exceeded the peak measurement and were re-measured with an average detector and found to pass as shown in Figure 11.78 and Figure 11.81.

Figure 11.77 3.5-18 GHz: Four Voice Calls With HSD, Vertical Polarization, Full Scan

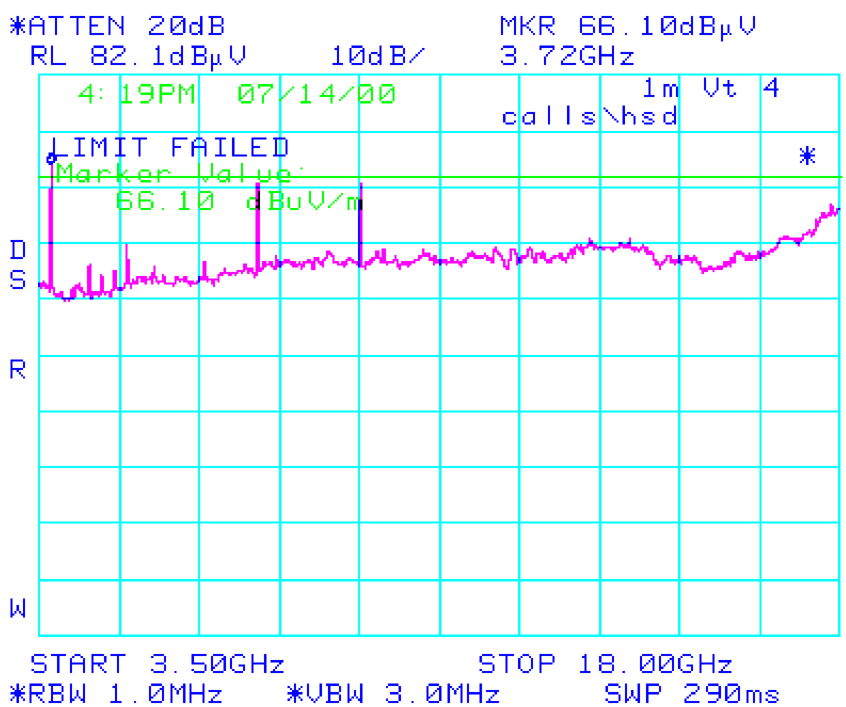


Figure 11.78 represents the max-hold narrow-span peak emissions scan of the highest signal depicted in Figure 11.77. This test setup is the same as in Figure 11.77 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.78 3.5-18 GHz: Four Voice Calls With HSD, Vertical Polarization, Highest Signal, 3.73 GHz Peak

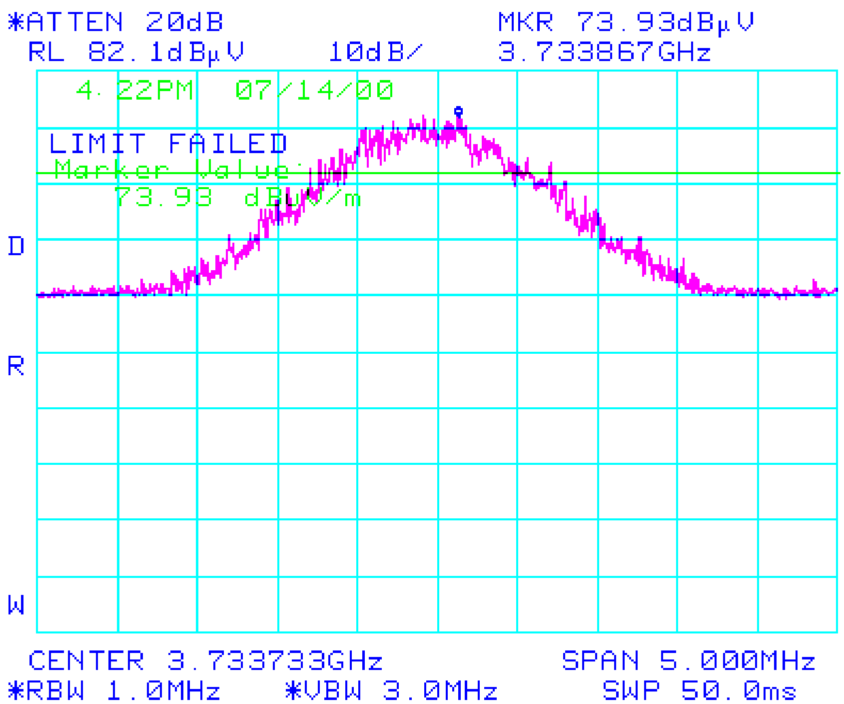


Figure 11.79 represents the average measurement of the signal depicted in Figure 11.78. This test setup is the same as in Figure 11.77 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.79 3.5-18 GHz: Four Voice Calls With HSD, Vertical Polarization, Highest Signal, 3.73 GHz Average

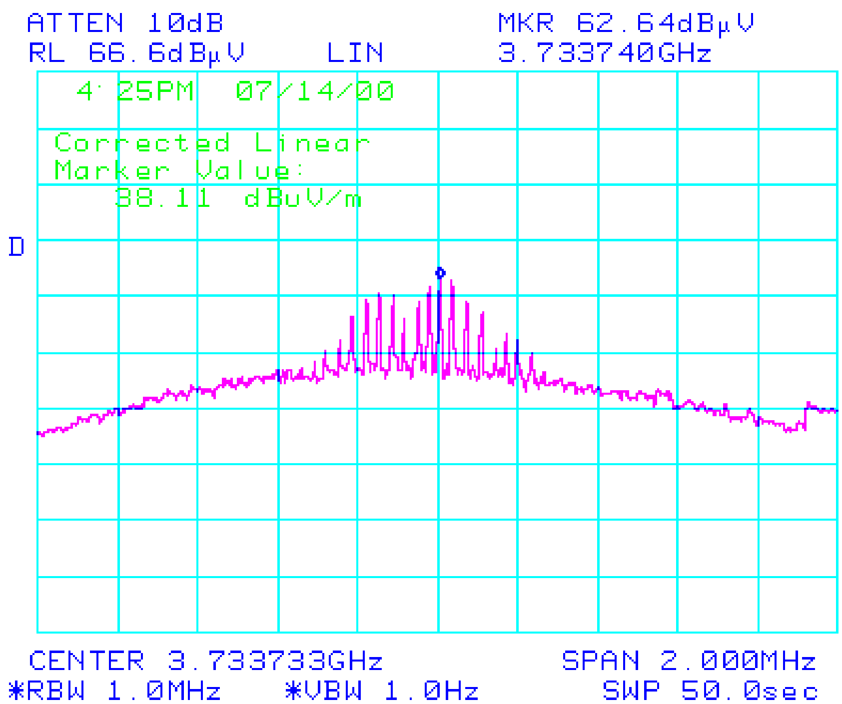


Figure 11.80 represents the max-hold narrow-span peak emissions scan of the second highest signal depicted in Figure 11.77. This test setup is the same as in Figure 11.77 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.80 3.5-18 GHz: Four Voice Calls With HSD, Vertical Polarization, Second Highest Signal, 7.46 GHz Peak

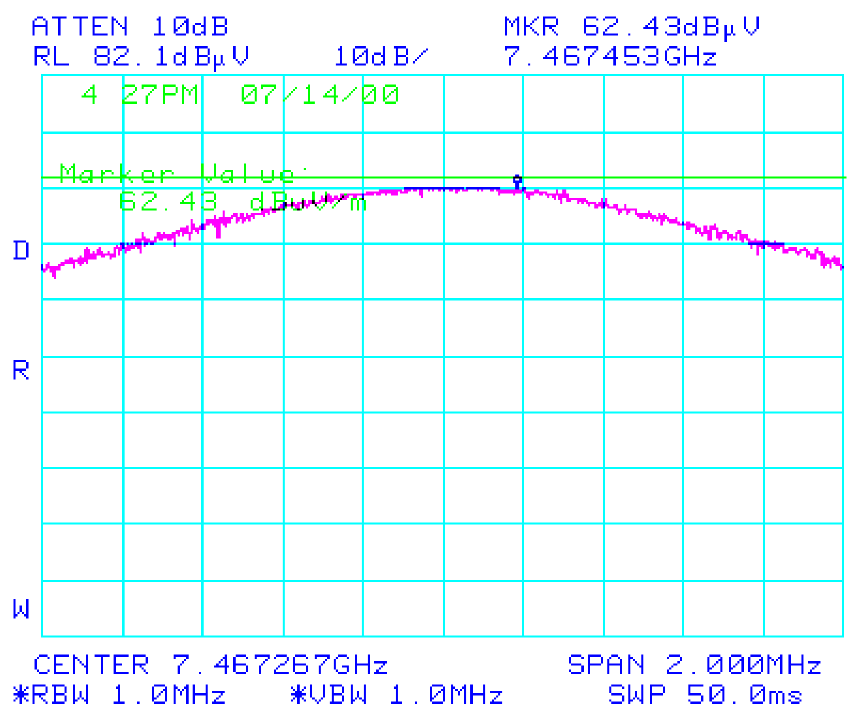


Figure 11.81 represents the average measurement of the signal depicted in Figure 11.80. This test setup is the same as in Figure 11.77 and consisted of the following: R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test.

Figure 11.81 3.5-18 GHz: Four Voice Calls With HSD, Vertical Polarization, Second Highest Signal, 7.46 GHz Average

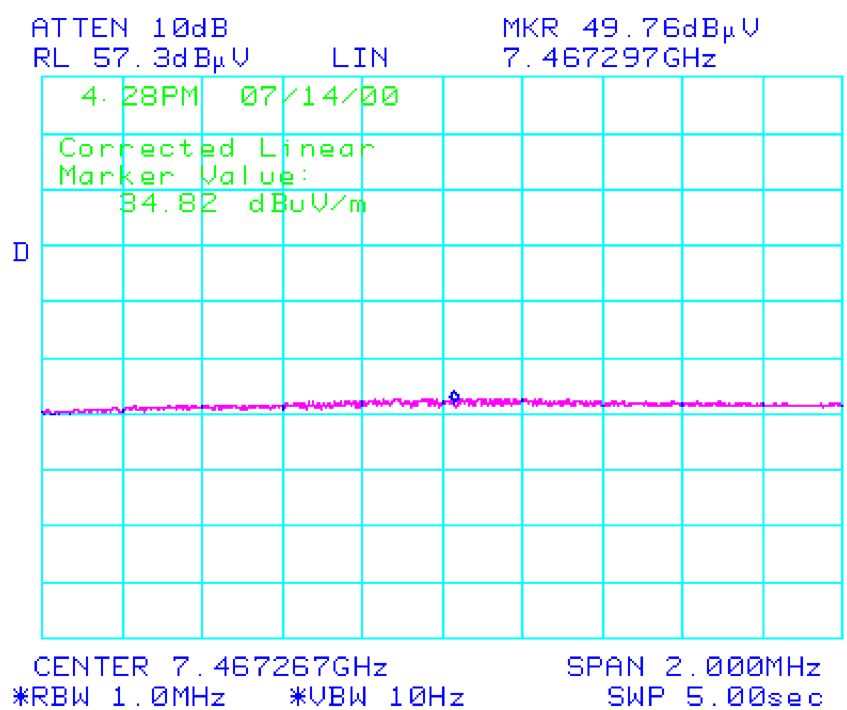


Figure 11.82 represents the full-radiated emissions scan from 18.0 GHz - 26.5 GHz utilizing a HP 84125C 1 GHz - 40 GHz Microwave EMI test system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (horizontal polarization) away and at a height of 1-meter away from the equipment under test. No signals exceeded the FCC limit.

Figure 11.82 18-26.5 GHz: Four Voice Calls With HSD, Horizontal Polarization, Full Scan

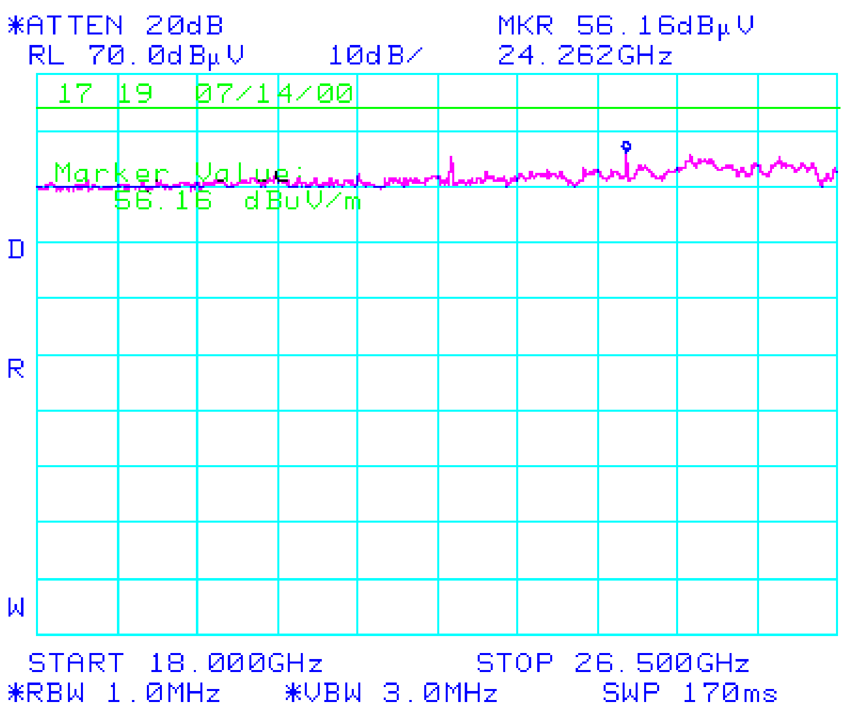
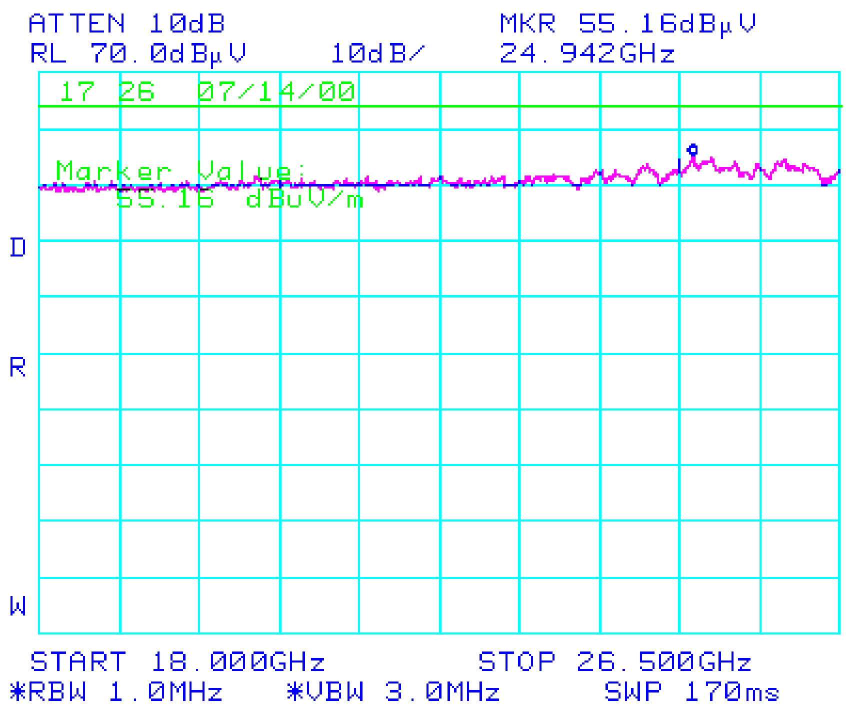


Figure 11.83 represents the full-radiated emissions scan from 18.0 GHz - 26.5 GHz utilizing a HP 84125C 1 GHz - 40 GHz Microwave EMI test system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with four voice calls and high-speed data uplink (worse case scenario) continuously throughout the duration of the test. The HP 84125C EMI test system was positioned 1-meter (vertical polarization) away and at a height of 1-meter away from the equipment under test. No signals exceeded the FCC limit.

Figure 11.83 18-26.5 GHz: Four Voice Calls With HSD, Vertical Polarization, Full Scan



Two Voice Calls with HSD Uplink and Panasonic Power Supply: Typical Configuration

Figure 11.84 represents the radiated emissions scan from 30MHz - 1.0GHz utilizing a HP 8546A EMI receiver system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls as well as high-speed data uplink (typical scenario) continuously throughout the duration of the test. The receive antenna was positioned 3-meters away and scanned from one to four meters in height. The unit passed the required limit after the QP detector was utilized. See Table 11.27 for the peak and QP measurement data.

Figure 11.84 30-1000 MHz: Two Voice Calls and HSD

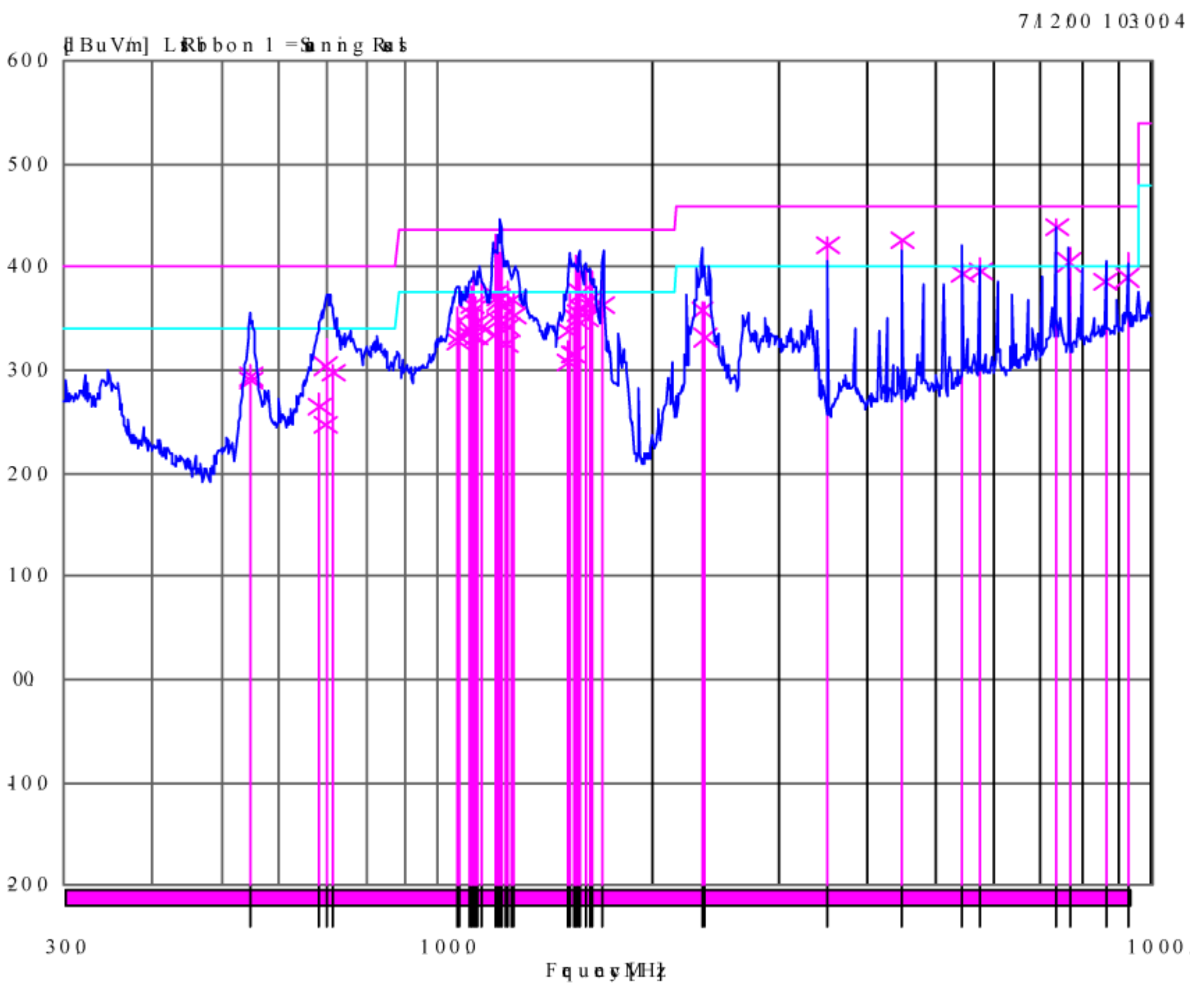


Table 11.27 Data for 30 MHz-1GHz; Panasonic Two Voice /HSD

Frequency (MHz)	Peak (dBuV/m)	Peak Lmt (dBuV/m)	DelLim-Pk (dB)	QP (dBuV/m)	QP Lmt (dBuV/m)	DelLmt-QP (dB	Height (cm)	Angle Pol (deg)
54.889672	30.53	34.00	-3.47	28.97	--.--	--.--	289	314 Horz
69.860848	32.92	34.00	-1.08	30.35	--.--	--.--	391	314 Horz
71.548793	30.63	34.00	-3.37	29.83	--.--	--.--	353	314 Horz
111.515180	37.99	37.50	0.49	35.60	--.--	--.--	235	45 Horz
121.937197	41.43	37.50	3.93	36.65	--.--	--.--	115	45 Vert
127.532575	36.59	37.50	-0.91	36.78	--.--	--.--	101	90 Vert
157.651122	40.52	37.50	3.02	35.57	--.--	--.--	201	89 Horz
170.658987	39.51	37.50	2.01	36.25*	--.--	--.--	154	225 Horz
351.983468	42.90	40.00	2.90	42.06	--.--	--.--	97	88 Horz
447.981294	42.71	40.00	2.71	42.53	--.--	--.--	97	269 Horz
735.973681	44.57	40.00	4.57	43.85	--.--	--.--	113	224 Horz
767.973248	41.96	40.00	1.96	40.85	--.--	--.--	204	136 Horz

Figure 11.85 represents the radiated emissions scan from 1.0 GHz -3.5 GHz utilizing a HP 8546A EMI receiver system. The test setup consisted of a R3 Indoor Unit (V0.7), 2-line expansion card, Panasonic AC power supply, and R3 Outdoor Unit (V0.7). This configuration was exercised with two voice calls as well as high-speed data uplink (typical scenario) continuously throughout the duration of the test. The receive antenna was positioned 3-meters away and scanned from one to four meters in height. Also shown are two transmit fundamentals - one for the R3 (1867MHz) as well as one for the Base fundamental (1947MHz). The unit passed the required limit after the average detector was utilized. See Table 11.28 for the peak and average measurement data.

Figure 11.85 1-3.5 GHz Two Voice Calls and HSD

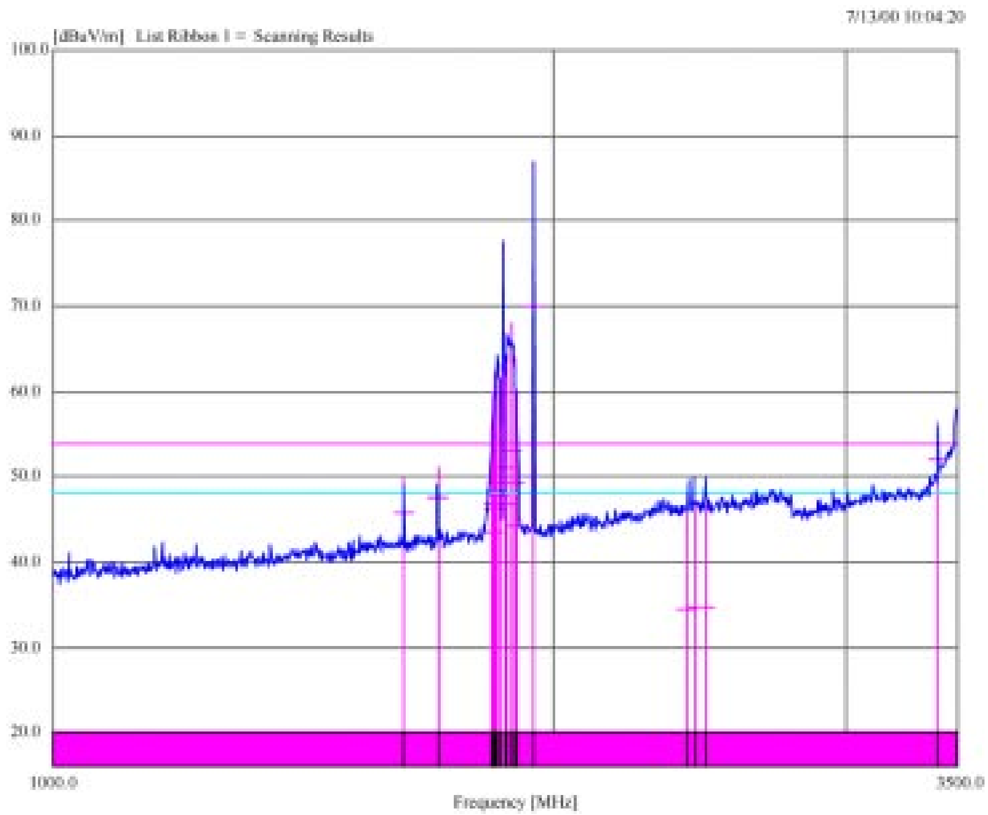
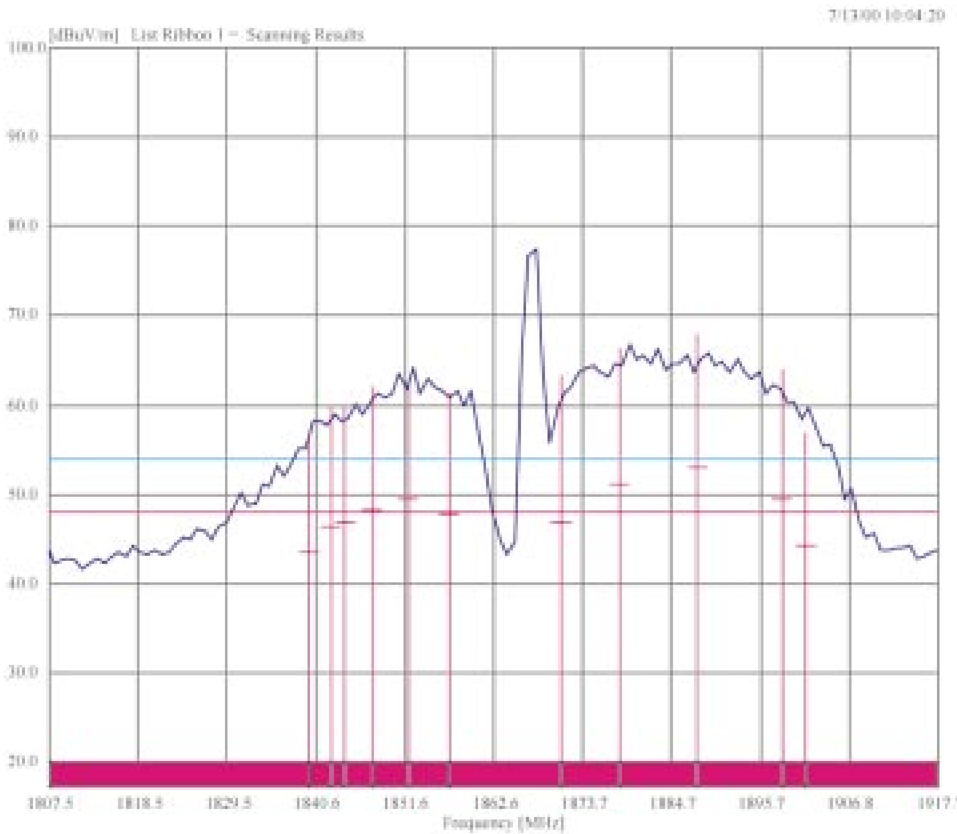


Table 11.28 Data for 1 GHz-3.5 GHz; Panasonic Two Voice/HSD

Frequency (MHz)	Peak (dBuV/m)	Peak Lmt (dBuV/m)	DelLim-Pk (dB)	Avg (dBuV/m)	Avg Lmt (dBuV/m)	DelLmt-Avg (dB	Height (cm)	Angle Pol (deg)
1626.962035	49.81	48.00	1.81	45.92	--.--	--.--	136	104 Horz
1704.960886	51.00	48.00	3.00	47.50	--.--	--.--	134	130 Horz
2408.356863	46.15	48.00	-1.85	34.39*	--.--	--.--	46	100 Horz
2437.961422	46.77	48.00	-1.23	34.83*	--.--	--.--	88	162 Horz
2469.884366	46.60	48.00	-1.40	34.69*	--.--	--.--	45	115 Vert
3409.961231	56.48	48.00	8.48	52.15	--.--	--.--	223	123 Horz

Figure 11.86 identifies the average amplitude within +/- 30 MHz of the notched fundamental. The average measurement amplitude meets the FCC limit line.

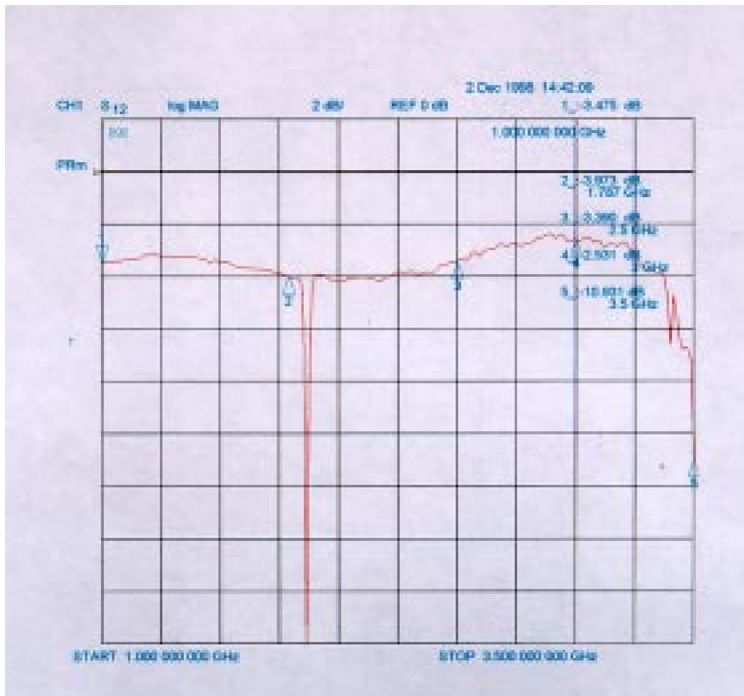
Figure 11.86 R3 Fundamental Skirts



Note: Typical configuration (Panasonic two voice and HSD uplink) test results for 3.5-18 GHz range and 18-26.5 GHz range were identical to the worst case results with the Panasonic power supply and four voice calls with HSD for the respective ranges and were, therefore, not included in this report.

Figure 11.87 shows the K&L notch filter characteristics as used within the 1 to 3.5 GHz radiated emissions testing. Filter was provided for notching the fundamental frequency, thus protecting the EMI 8546A receiver.

Figure 11.87 Notch Filter Characterization From 1 - 2 GHz



11.3.4.2 Conducted Emissions

The purpose of this test is to measure the product emissions on the input power lines to insure that the product will not interfere with other electronic devices. However, the R3 Outdoor Unit has no direct connection to an AC power source. Therefore, conducted testing was completed on the R3 Indoor Unit power supply while properly loaded with an R3 Outdoor Unit.

The R3 Outdoor Unit interconnecting cable consists two RG-6 coaxial cables connected to the R3 Indoor Unit via UL approved surge protector.

The R3 Indoor Unit is connected to the AC power utility, via an eight-foot 18-gauge non-polarized plug. Conducted testing was completed on the power supply while in normal operation. The provided test setups and data was completed at the AT&T Wireless EMC laboratory located in Redmond, Washington.

Radio-frequency line voltage noise being conducted back to the AC utility must not exceed the FCC requirements shown in Table 11.29.

Table 11.29 FCC Conducted Emission Limits

Frequency (MHz)	Maximum Radio - Frequency Live Voltage	
	(μV)	(dBμV)
0.45 - 1.705	250	47.9
1.705 - 30	250	47.9

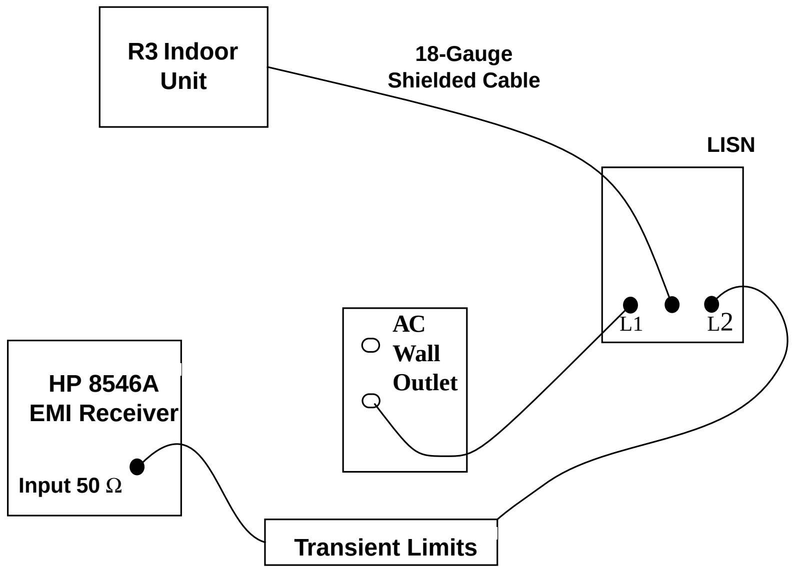
11.3.4.2.1 Applicable FCC Rules

FCC Subpart 15.207 - Device that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

11.3.4.2.2 Test Configuration

The R3 should be setup as shown in Figure 11.88. The R3 Indoor Unit power supply's AC power cord is plugged into the LISN. The extra cord is wrapped in a figure-8 fashion around the 2 posts located on the top of the LISN. The LISN's AC power cord is plugged into the AC outlet at the wall. The HP8546A EMI Receiver is plugged in the AC wall outlet and the conducted emission software is selected and executed. The HP conducted emissions software accounts for the appropriate corrections; i.e., cable, LISN, etc. Each line of the AC power line is tested and compared to the FCC limits.

Figure 11.88 Conducted Emission Setup



The EMI Receiver uses the peak detector, a resolution bandwidth of 9.0 kHz, and a video bandwidth of 30 kHz. The limit line was set to 47.9 dBuV, with a reference level of 80 dBuV, and a sweep time of 10 seconds. Testing was completed with a 120 volt, 60 Hz on both the “Hot Side” and “Neutral Side”.

11.3.4.2.3 Test Results

Figure 11.89 represents FCC Baseline: AC power with 2 voice calls and HSD Uplink. Tx. Atten.=0, power control off. This is with the Lucent power supply, 1 meter ground, 1 meter telcos, 1 meter coax on each side of protector, tested as a system, with expansion card, and conducted measurements on line 1.

Figure 11.89 Two Voice Calls with HSD and Lucent Power Supply: Line 1

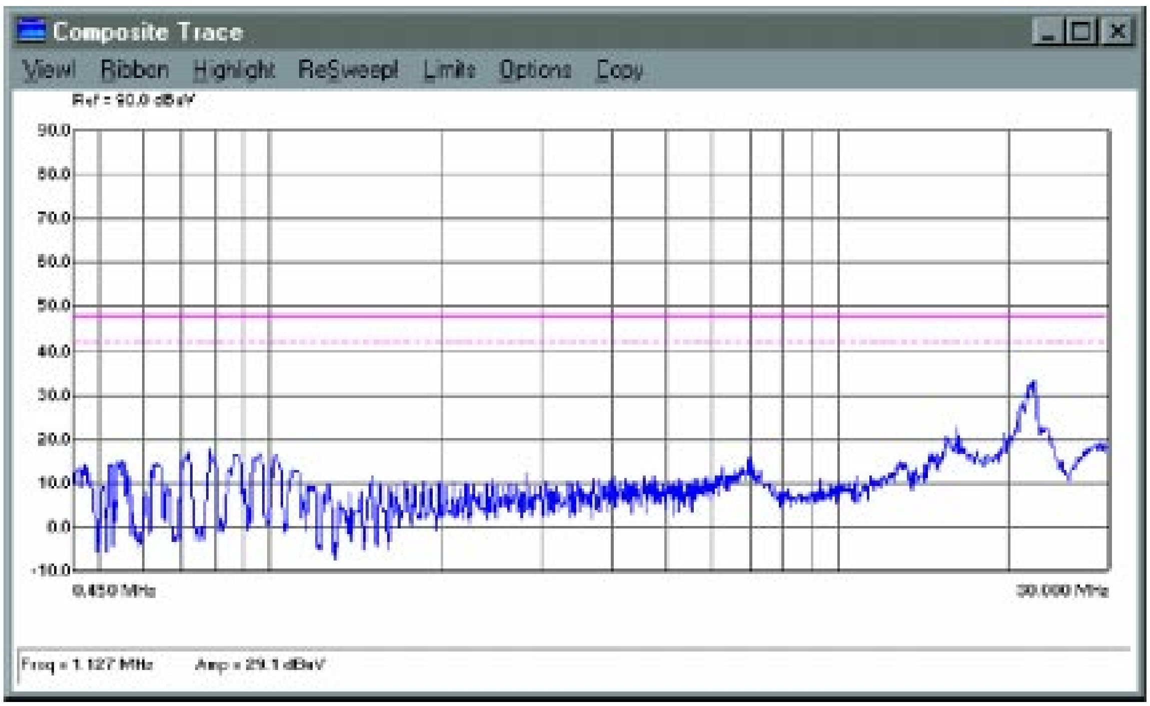


Figure 11.90 represents FCC Baseline: AC power with 2 voice calls and HSD Uplink. Tx. Atten.=0, power control off. This is with the Lucent power supply, 1 meter ground, 1 meter telcos, 1 meter coax on each side of protector, tested as a system, with expansion card, and conducted measurements on line 2.

Figure 11.90 Two Voice Calls with HSD and Lucent Power Supply: Line 2

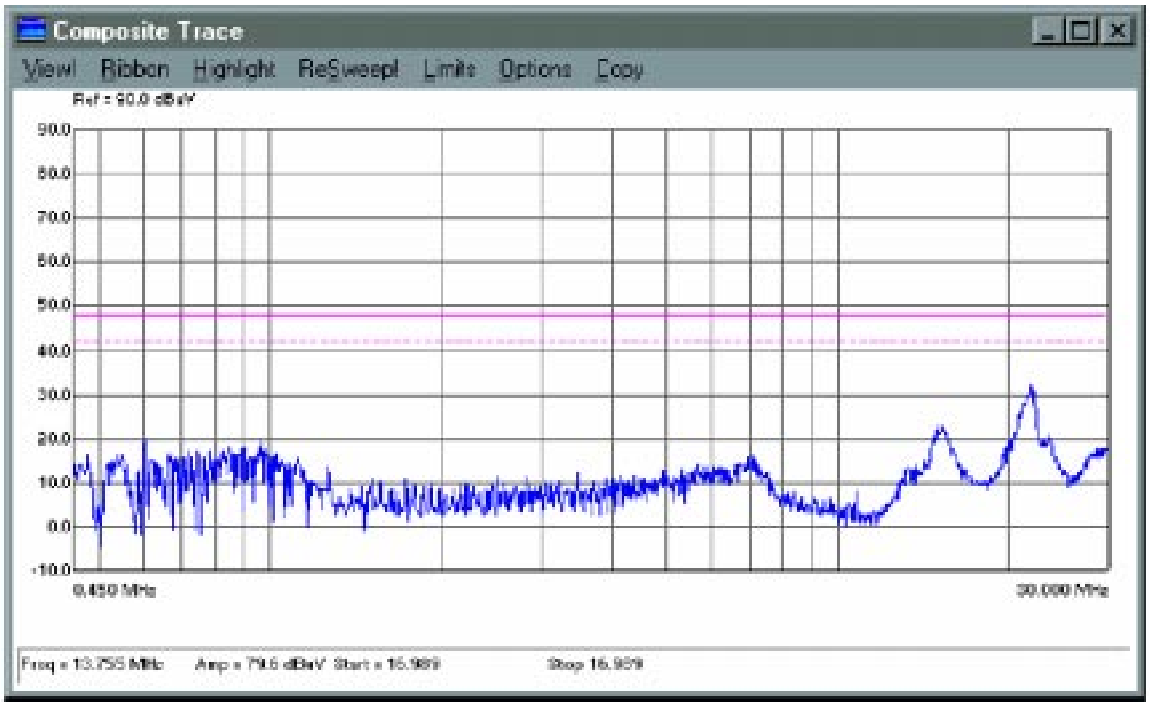


Figure 11.91 represents FCC Baseline: AC power with 4 voice calls and HSD Uplink. Tx. Atten.=0, power control off. This is with the Lucent power supply, 1 meter ground, 1 meter telcos, 1 meter coax on each side of protector, tested as a system, with expansion card, and conducted measurements on line 1.

Figure 11.91 Four Voice Calls with HSD and Lucent Power Supply: Line 1

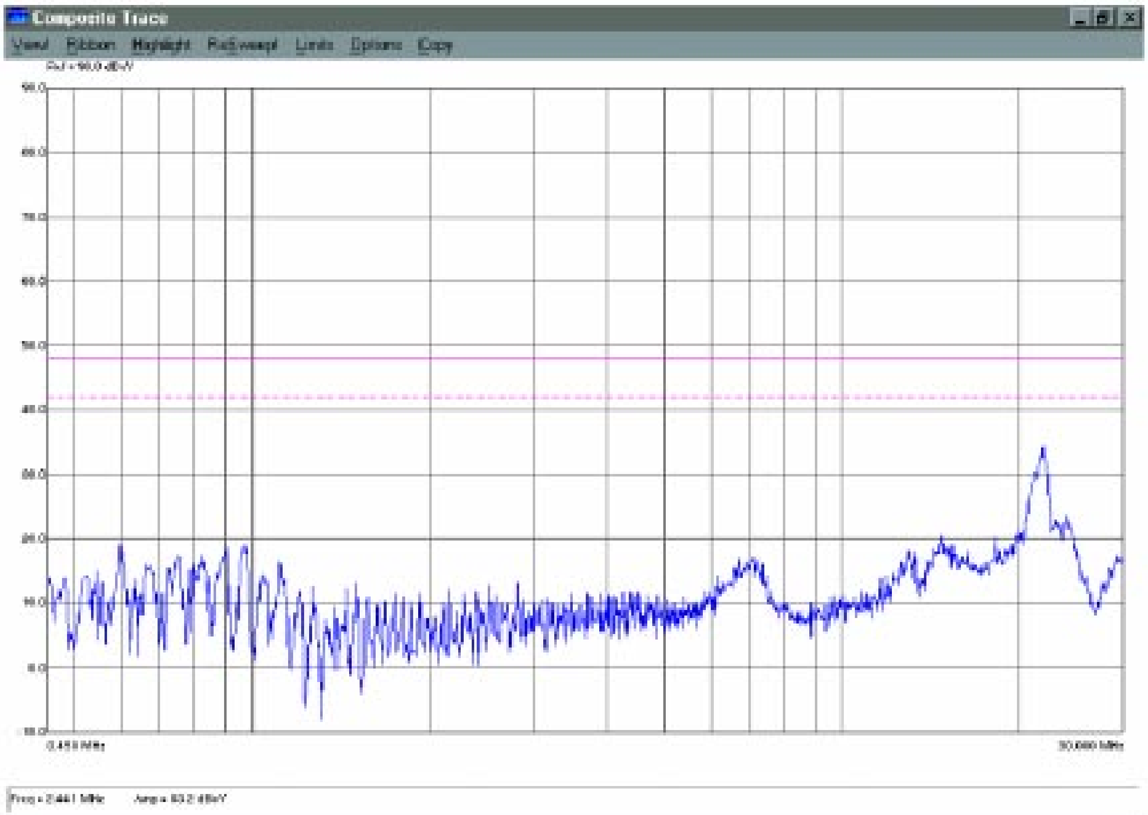


Figure 11.92 represents FCC Baseline: AC power with 4 voice calls and HSD Uplink. Tx. Atten.=0, power control off. This is with the Lucent power supply, 1 meter ground, 1 meter telcos, 1 meter coax on each side of protector, tested as a system, with expansion card, and conducted measurements on line 2.

Figure 11.92 Four Voice Calls with HSD and Lucent Power Supply: Line 2

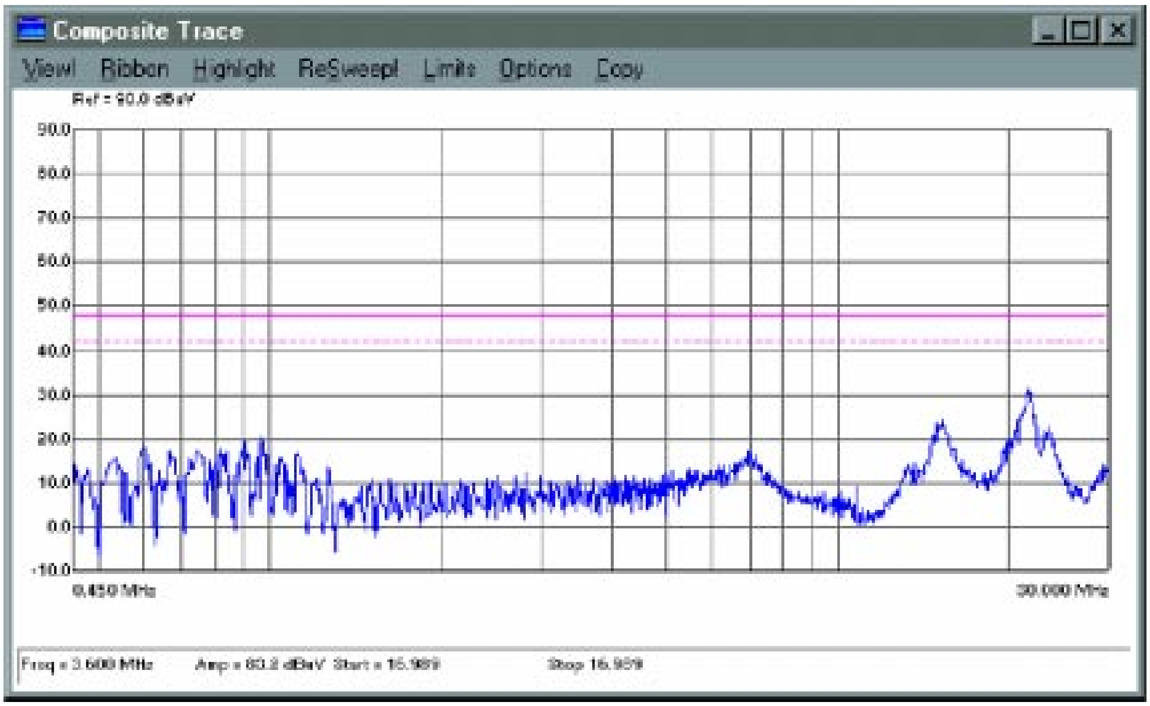


Figure 11.93 represents FCC Baseline: AC power with 2 voice calls and HSD Uplink. Tx. Atten.=0, power control off. This is with the Panasonic power supply, 1 meter ground, 1 meter telcos, 1 meter coax on each side of protector, tested as a system, with expansion card, and conducted measurements on line 1.

Figure 11.93 Two Voice Calls with HSD and Panasonic Power Supply: Line 1

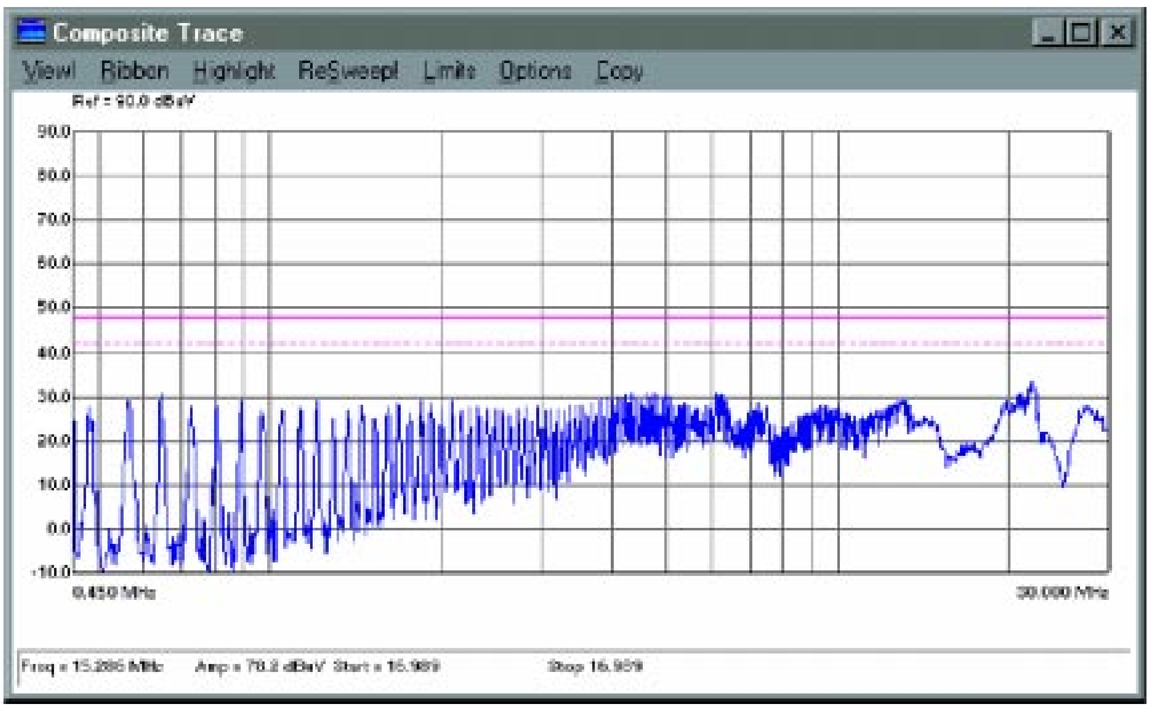


Figure 11.94 represents FCC Baseline: AC power with 2 voice calls and HSD Uplink. Tx. Atten.=0, power control off. This is with the Panasonic power supply, 1 meter ground, 1 meter telcos, 1 meter coax on each side of protector, tested as a system, with expansion card, and conducted measurements on line 2.

Figure 11.94 Two Voice Calls with HSD and Panasonic Power Supply: Line 2

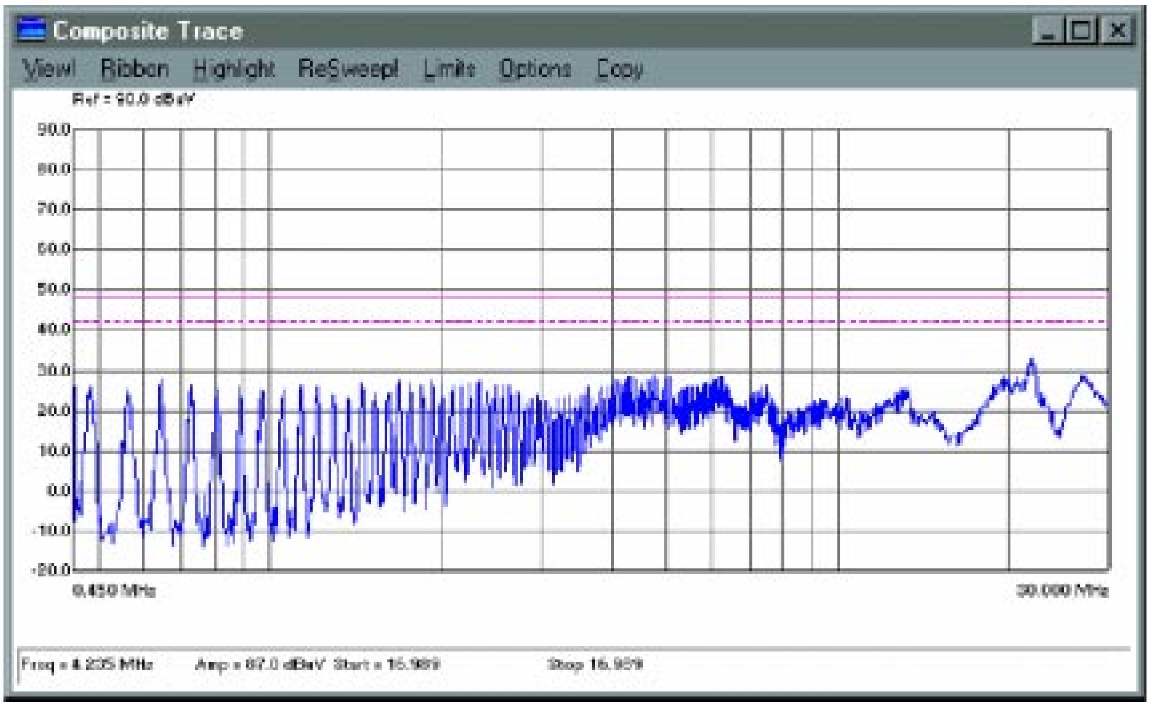


Figure 11.95 represents FCC Baseline: AC power with 4 voice calls and HSD Uplink. Tx. Atten.=0, power control off. This is with the Panasonic power supply, 1 meter ground, 1 meter telcos, 1 meter coax on each side of protector, tested as a system, with expansion card, and conducted measurements on line 1.

Figure 11.95 Four Voice Calls with HSD and Panasonic Power Supply: Line 1

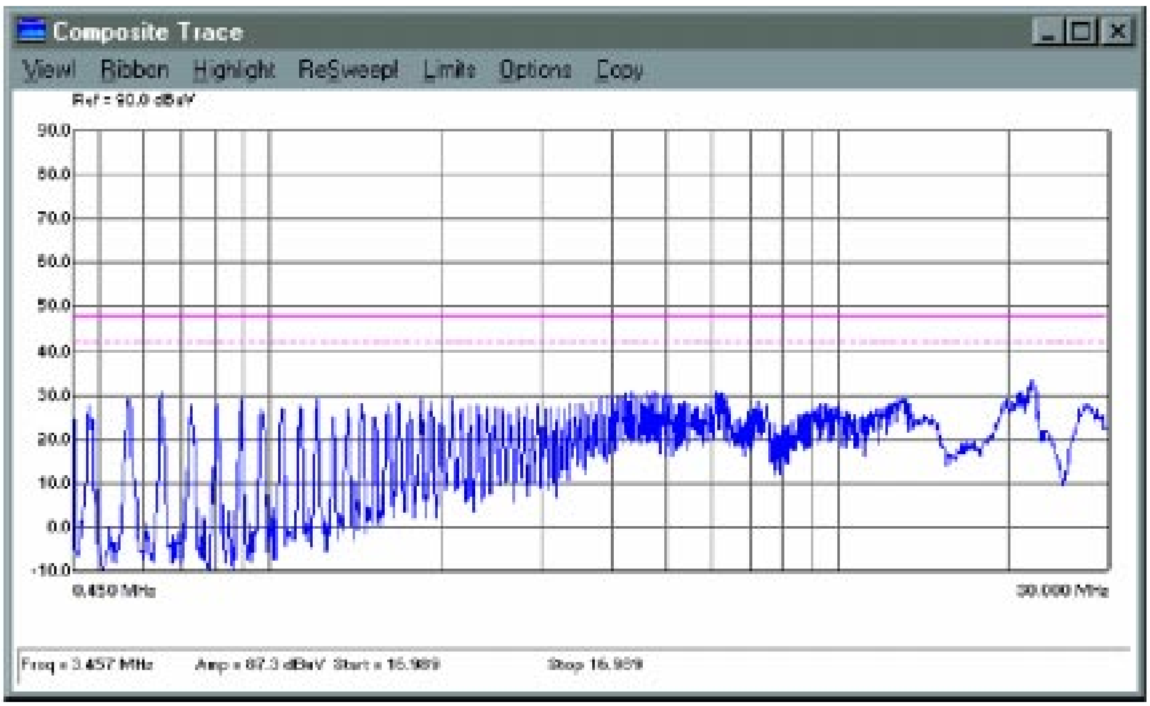
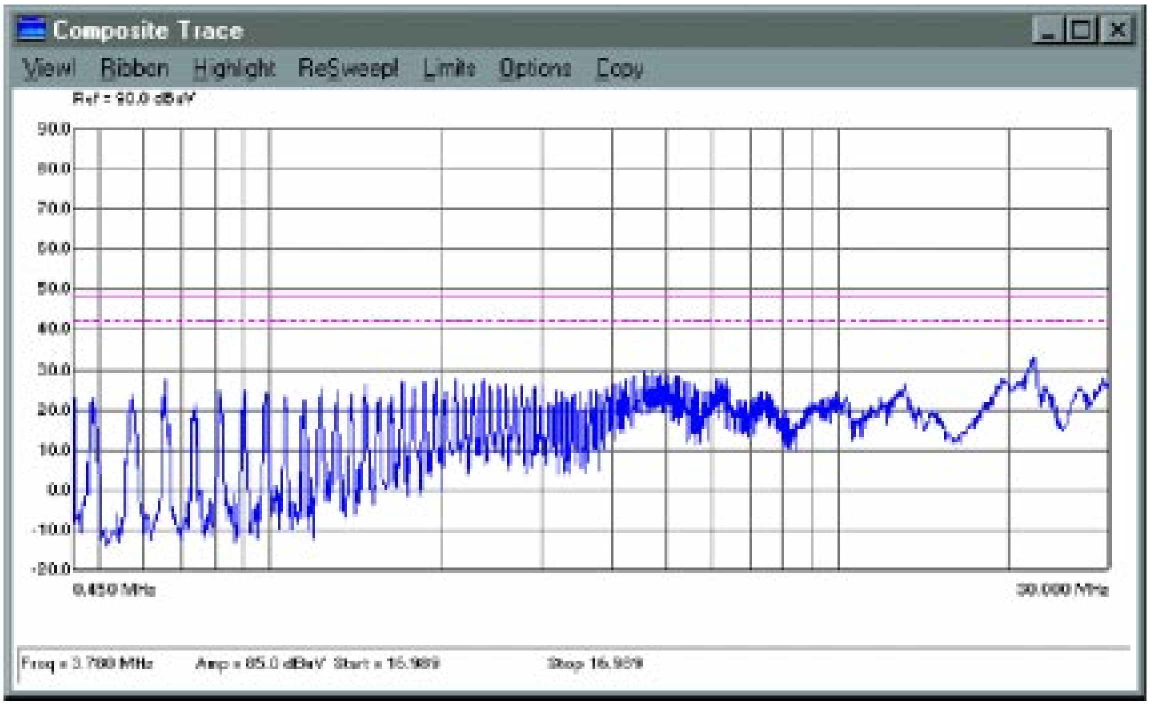


Figure 11.96 represents FCC Baseline: AC power with 4 voice calls and HSD Uplink. Tx. Atten.=0, power control off. This is with the Panasonic power supply, 1 meter ground, 1 meter telcos, 1 meter coax on each side of protector, tested as a system, with expansion card, and conducted measurements on line 2.

Figure 11.96 Four Voice Calls with HSD and Panasonic Power Supply: Line 2



11.3.4.3 Radiated to Conducted Spurious Emissions

The conducted spurious emissions at the R3 Outdoor Unit terminal was tested at +/- 7 MHz from the fundamental frequency within Section 11.2.9 of the report. The testing within Section 11.2.9 was conducted with a HP Signal Vector Analyzer, specifically suited for close in measurements to the fundamental frequency. To further evaluate the R3 for spurious emissions outside the +/- 7MHz fundamental investigation using the test setup outlined in Figure 12.1 was utilized. This allowed the flexibility to scan for R3 harmonics from 1000 to 3500 MHz.

11.3.4.3.1 Applicable FCC rules

FCC Subpart 2.985 -This requires that the RF output be measured at the antenna power terminals into a dummy load after the transmitter has been adjusted in accordance with the manufacturers tune up procedure. Requires documentation of measurement configuration. Transmitter spectral output shall not have any components that exceed the spectral mask applicable to the rule part under which the equipment shall be operated.

FCC Subpart 24.238 - On any frequency outside a licensee's block, the power of any emission shall be attenuated below the transmitter power (P) by at least 43+10Log(P) dB. Compliance is based on measurement within a 1 MHz resolution bandwidth. However, in the 1 MHz bands immediately adjacent to the frequency block a resolution bandwidth of at least 1 percent of the emission bandwidth may be employed. The emission bandwidth is defined as the width of the signal between two points, one above and one below the carrier frequency, outside of which all emissions are attenuated by at least 25 dB below the transmitter power.

11.3.4.3.2 Test Configuration

Radiated emissions scans were performed in the AT&T 3-m semi-anechoic chamber. The R3 was placed on a non-conductive table 80 cm above the ground plane with a receive antenna placed a distance of 3 m from the device under test. The test setup consisted of an R3 Indoor Unit with two coax cables to the R3 Outdoor Unit and four Telco lines attached to phones. Four simultaneous voice calls together with HSD uplink operating over an RF Link via the R3 Outdoor Unit exercised the unit in a worst case scenario. The R3 Indoor and Outdoor Units under test were comprised of the following components:

- R3 2 line expansion board version 0.6.
- R3 Outdoor Unit version 0.7 (transmitter attenuation was manually set to 10 dB as a worst case condition), and
- R3 Indoor Unit version 0.6.
- Power Supply (both Lucent and Panasonic)

11.3.4.3.3 Test Results

The data presented here is in addition to the results presented in both the conducted spurious and radiated emission sections. After completion of the radiated emission scans, from 1.0 GHz to 3.5 GHz, the highest four signals closest to the fundamental frequency were evaluated to the spurious emission spectrum as shown in Figure 11.24. These frequencies were converted from dBμV to dBm and compares to the FCC Part 24 spurious emissions limit. Testing was completed with a resolution and video bandwidth of 1000 MHz. Table 11.30 provides the data and comparison to both the dBuV and dBm FCC limits. It should be noted that the frequencies contained within the following table have been evaluated and found to be non-spurious occurrences.

Table 11.30 Part 24 Spurious Emission Limits

Frequency (GHz)	Part 15 Avg Level (dBμV)	Avg dBm	dB Below -13 dBm Limit Line
1.626	47.13	-59.86	46.86
1.704	47.71	-59.28	46.28
2.408	34.79	-72.2	59.2
2.417	34.58	-72.41	59.41

11.4 R3 Outdoor Unit Specifications

11.4.1 Overview

The R3 Outdoor Unit is composed of a planar array of dual slant polarized radiating elements fed with integral feed networks. This antenna will form a single fixed broadside beam with sufficient gain, sidelobe level, beamwidth and cross-polarization isolation to provide adequate coverage to its serving Base Station in Band D of the personal communication system (PCS) spectrum. The antenna assembly will provide two outputs (slant+45° and slant-45°) to the two radio frequency (RF) receivers that reside in the same housing.

11.4.2 Antenna Specification

The R3 Outdoor Unit consists of an array of dual slant polarized (slant+45° and slant-45°) radiating elements and their integrated corporate feed networks.

The size of this antenna is planned to be no greater than 13" x 13". The depth of the enclosure housing the antenna assembly and associated RF, digital, and power supply electronics is 3.75". The antenna assembly can occupy up to 1 inch of this depth. Refer to the mechanical drawing for proposed final dimensions.

The interface between the RF board and antenna will be made through two RF connectors located on the antenna. In transmit, these two antenna ports will be driven via an in-phase splitter located on the RF board. The amplitude and phase of the antenna's feed networks will be properly balanced so that vertical polarization is achieved in transmit. The antenna input impedance at the connectors is nominally 50 ohms.

The R3 Outdoor Unit will be installed with appropriate mounting hardware such that it points directly to its Base Station antenna within +/- 10 degrees.

Table 11.31 gives performance specifications for the R3 Outdoor Unit.

Table 11.31 R3 Outdoor Unit Performance Specifications

Specification	Required Value
Frequency Range	1850 - 1990 MHz
Gain	15 dBi (min.)
Azimuth Half-Power Beamwidth	30^{o}
Azimuth Sidelobe Level	-13 dB (max)
Azimuth Beam-Squint	+/-3^{o}
Front-to-Back Ratio	>25 dB
Polarization	Transmit: Vertical/Horizontal Receive: Slant+45^{o} & Slant-45^{o}
IM Distortion (with two 10 W tones applied at input connector)	-150 dBc
RF Connectors	Thru hole coaxial
Typical Connecting Cable Loss	0.3 dB
Ambient temperature range	-40^{o} C to +50^{o} C outside air temperature
Operating temperature range	-40^{o} C to +70^{o} C inside R3 Outdoor Unit with solar loading

11.4.3 Operational Temperature Ranges

Operational temperature range:	
Outdoor air temperature:	-40°C to +70°C (-40°F to +158°F)
Relative humidity:	5% to 95%

11.4.4 R3 Outdoor Unit Pattern

The manufacturer completed an antenna pattern measurement as shown in Figure 11.97, showing an antenna gain of 15 dBi. This antenna and pattern was verified to meet the minimum AT&T antenna specifications and was measured to have a 14 dBi gain as shown in Figure 11.98 at the AT&T Redmond, Washington EMC/Antenna Laboratory.

Figure 11.97 Manufacturer's Antenna Pattern

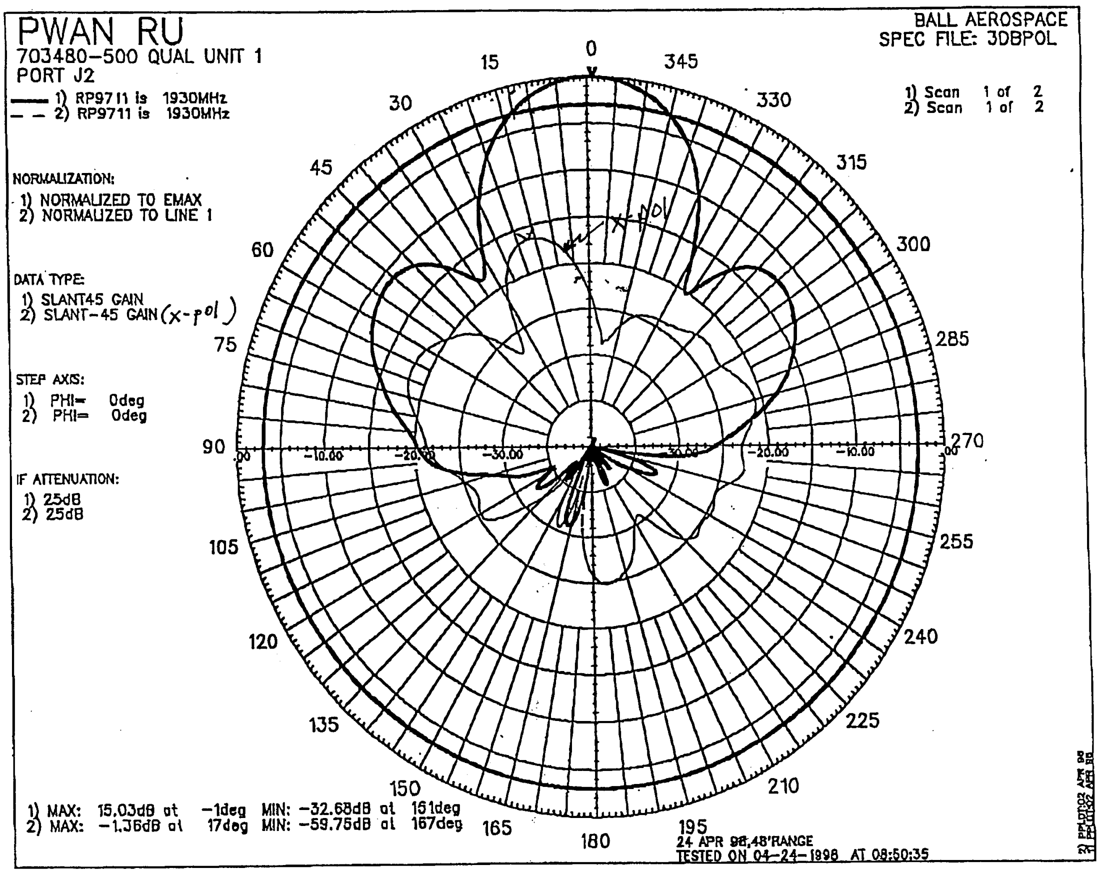


Figure 11.98 AT&T R3 Outdoor Unit Pattern