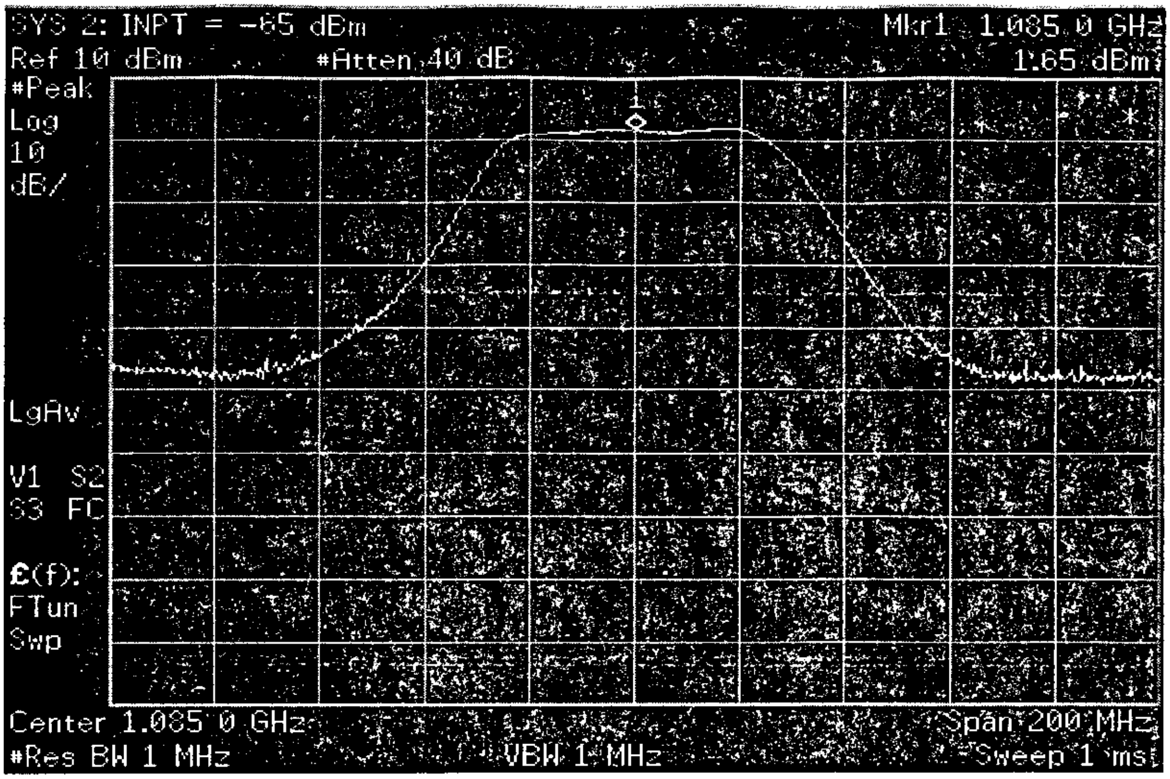

Figure A-13. Measurement System B Calibration Over 1060-1110 MHz Frequency Band.

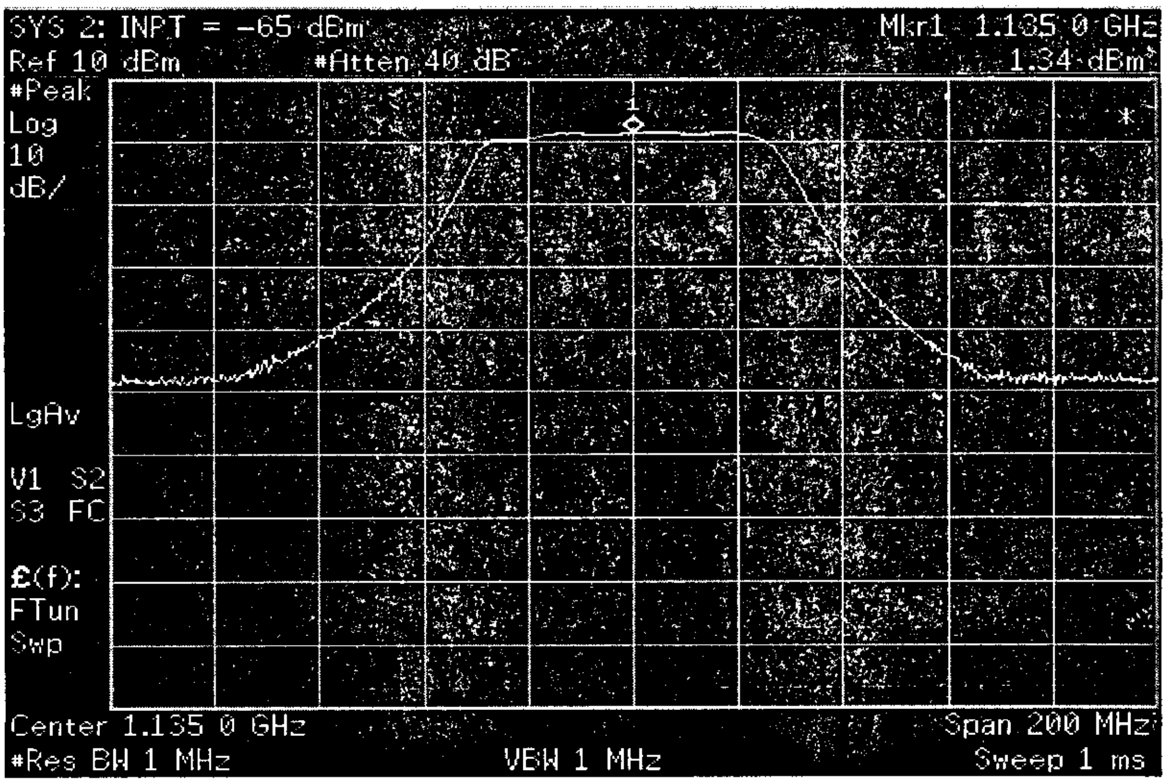

Figure A-14. Measurement System B Calibration Over 1110-1160 MHz Frequency Band.

APPENDIX B
MEASUREMENT PROCEDURES

This appendix presents the procedures used for collection of the data utilized in this report.

AMBIENT EMISSIONS MEASUREMENT PROCEDURES

The following procedures were applied in performing the measurements at each ambient emissions measurement location:

1. Set-up the measurement system as shown in Figure 2-1.

2. Set measurement antenna to a nominal height of four feet above ground level (roughly equivalent to typical height of a hand-held GPS receiver or E-911 enabled cell phone)

3. Orient the measurement antenna in vertical polarization and rotate through 360° observing peak signals and probable direction.

4. Repeat with antenna oriented in horizontal polarization.

5. Review the collected data *to* determine antenna polarization and the bearing that maximizes the received emission levels.

6. Using the data obtained from the previous steps, set up the spectrum analyzer display (e.g., reference level, amplitude scale, attenuation levels, etc.) to accommodate all subsequent measurements. *Set* the analyzer display line to –117.5 dBm.

7. Sequentially measure over each of the frequency bands under consideration (i.e., GPS L1, L2, and L5, and ARNS band segment) collecting peak emission traces and RMS average emission traces, by utilizing two of the three available analyzer traces.

8. When relatively high emission levels are observed, perform a system saturation test by inputting an additional 10-dB attenuator at the spectrum analyzer input and verifying that the received signal is attenuated by 10 dB.

9. Store the composite analyzer displays and associated trace data onto computer disk.

10. Record the relevant measurement site information, i.e., GPS coordinates, street address, site description, date, time, and antenna bearing.

RADIATED EMISSIONS MEASUREMENT PROCEDURES

The following procedures were implemented in the measurement of radiated emissions from common consumer electronic and electrical devices into the GPS frequency bands:

1. Assemble measurement system as shown in Figure 2-1.
2. Place the device under test (DUT) in the center of a non-conductive turntable and turn power on.
3. Place the measurement antenna at a distance of two meters from the DUT.
4. Use turntable to rotate the DUT through 360" with the measurement antenna oriented in vertical polarization.
5. Re-orient the measurement antenna to horizontal polarization and again rotate the DUT through 360".
6. Review the data and observe the antenna polarization and the azimuth with respect to the DUT that produces the maximum emission levels. Use this polarization and DUT orientation for the remainder of the test.
7. With DUT radiating, move the measurement antenna up and down (between approximately 1 and 3 meters) to determine the antenna height at which the emissions are maximized. Set the antenna to the height determined from this procedure.
8. Using the data acquired in the previous steps, set up the spectrum analyzer display (e.g., reference level, amplitude scale, attenuation levels, etc.) to accommodate all subsequent measurements. Set the analyzer display line to –117.5 dBm.
9. Turn the DUT off and use the spectrum analyzers' trace 1 feature to record the ambient RF background.
10. Turn the DUT on and tune the spectrum analyzer to one of the frequency bands under consideration. Use analyzer trace 2 to record the RMS average emission from the DUT and use trace 3 to record the Log average measured emissions.
11. Store the composite analyzer trace and associated trace data to computer disk.
12. Repeat steps 9-11 for each of the frequency bands under consideration.

APPENDIX C
OUTDOOR AMBIENT EMISSIONS MEASUREMENT DATA

The data plots recorded from the measurement of existing ambient emissions at outdoor sites such as airports, shipyards, train yards, and urban/industrial locations are presented in this appendix. The following paragraphs provide guidance on reading and interpreting these plots.

In each of the figures presented in this appendix, the upper (yellow) trace depicts the ambient emissions measured in the subject frequency band using a peak detector and the maximum hold function (i.e., no averaging employed) over a fifteen-minute period. This trace was generated mainly as a tool for orienting the measurement antenna and for determining the maximum likely emission amplitudes to facilitate decisions pertaining to the necessity of adding additional attenuation in the measurement system so as to prevent overdriving of components. This data was not used for any analytical purposes. The lower (blue) trace represents the measured RMS average emission level over one hundred one-millisecond analyzer sweeps across the measurement band. This is the data used to compare to the assumed interference threshold for enhanced GPS receivers. The constant display line (green) at -117.5 dBm is used as the basis for comparing the measured data to the theoretical enhanced GPS interference threshold.

All external measurement system parameters (e.g., amplifier gains, cable loss, and antenna gain) are accounted for in the spectrum analyzer display and are provided on each plot under the tag Ext PG located at the top of the display. At some measurement locations, it was necessary to add additional attenuation in the measurement system due to the presence of relatively high-amplitude signals. In those cases where additional external attenuation was required, the Ext PG value was adjusted accordingly. Thus, the levels shown on the amplitude axis of the spectrum analyzer plots represent the actual RMS average power as measured in a 1 MHz bandwidth at the measurement system antenna.

In each of these plots, the horizontal axis represents frequency and the vertical axis represents amplitude. For measurements in the GPS frequency bands, a span of 25 MHz was used to encompass the 24 MHz registered frequency band. For a 25 MHz span, each vertical graticule line represents a 2.5 MHz deviation in frequency (25 MHz/10 graticule lines). For the measurements performed in the 960-1160 MHz (ARNS) band, a span of 50 MHz was used, the maximum that could be achieved within the pass band of the pre-select filter. In these plots, each vertical graticule line represents a frequency deviation of 5 MHz (50 MHz/10 graticule lines).

On the amplitude axis, each horizontal graticule line represents a 10 dB decrement from the reference level amplitude shown in the upper left-hand comer of the plot.

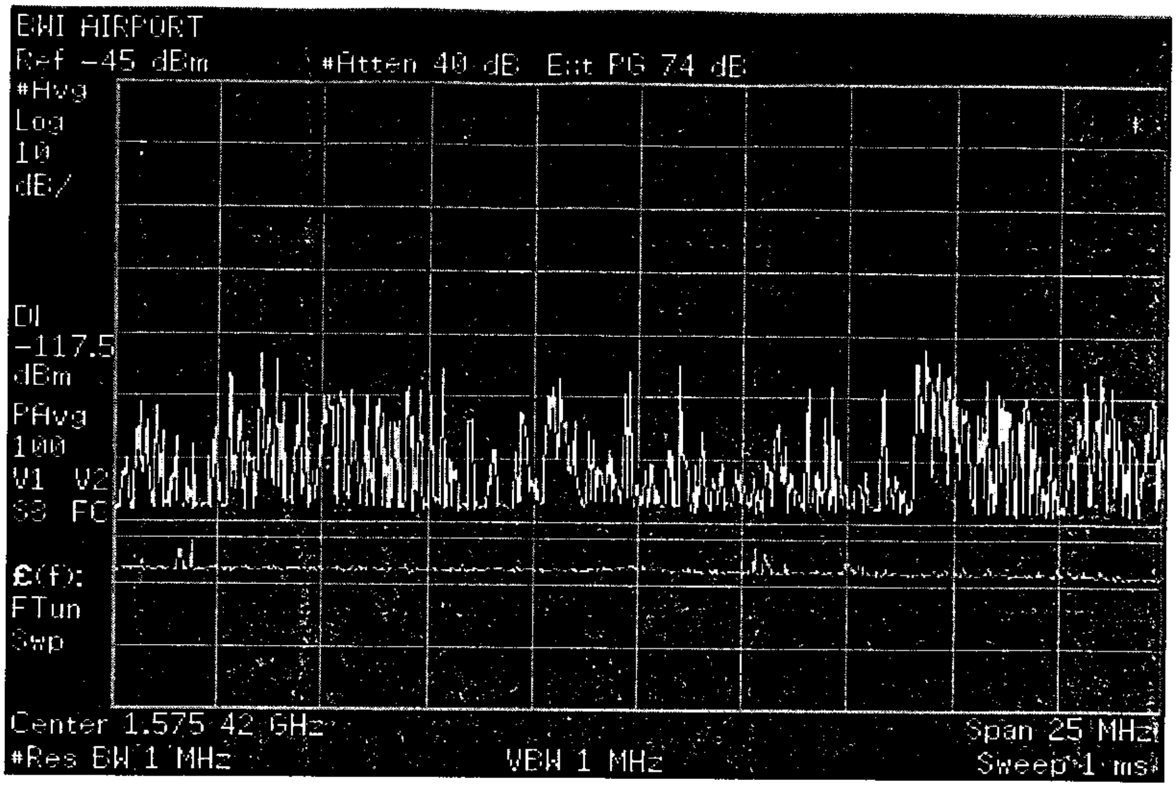

Figure C-15. Ambient Emissions in the GPS L1 Frequency Band at BWI Airport.

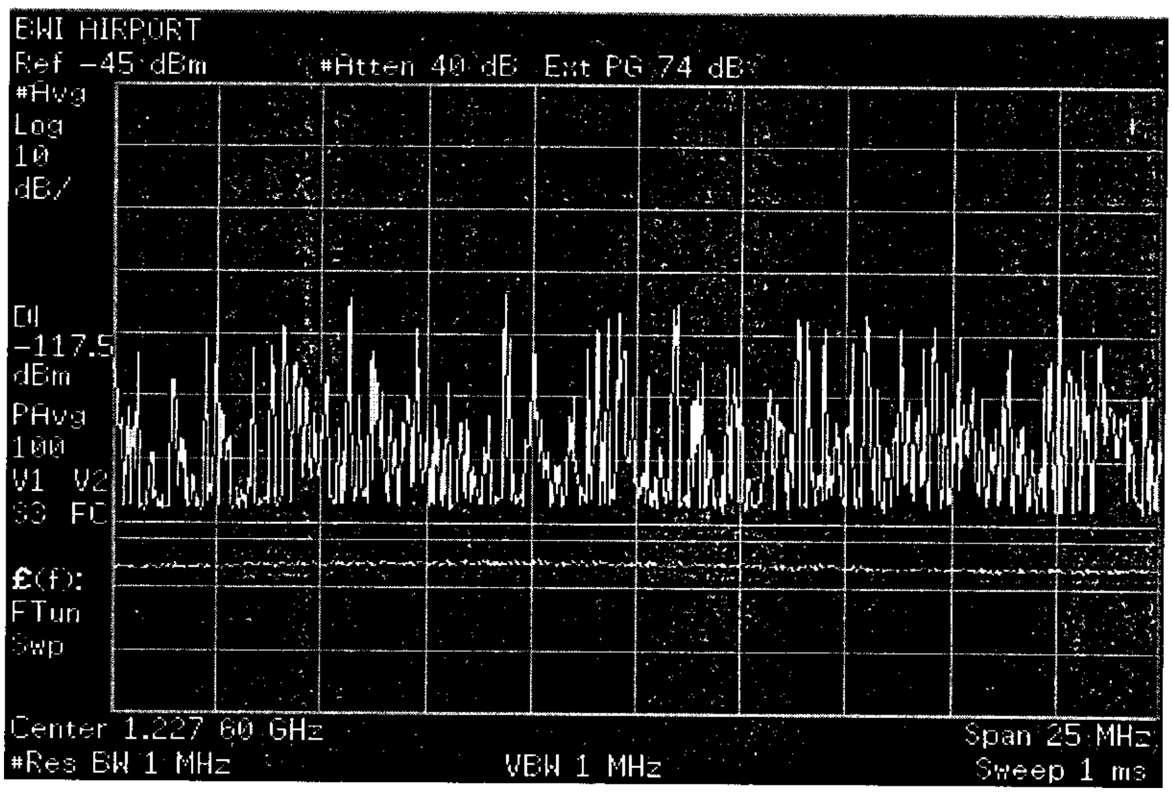

Figure C-16. Ambient Emissions in the GPS L2 Frequency Band at BWI Airport.

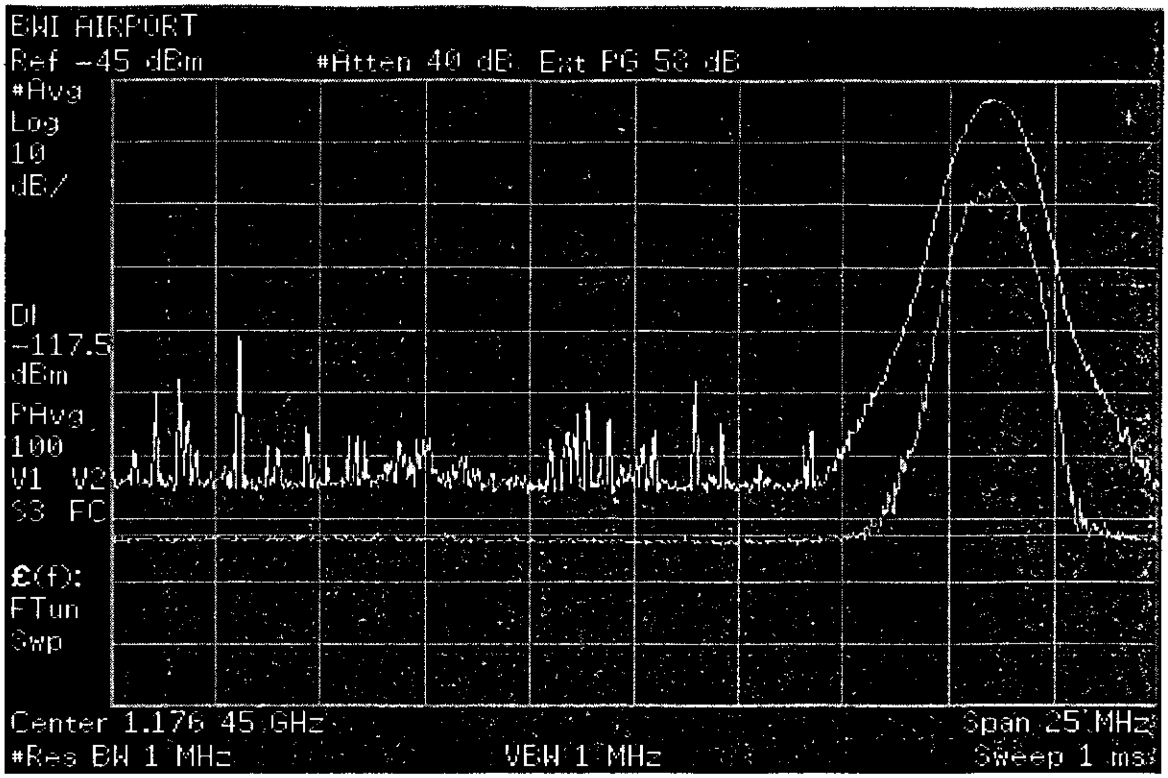

Figure C-17. Ambient Emissions in the GPS L5 Frequency Band at BWI Airport.

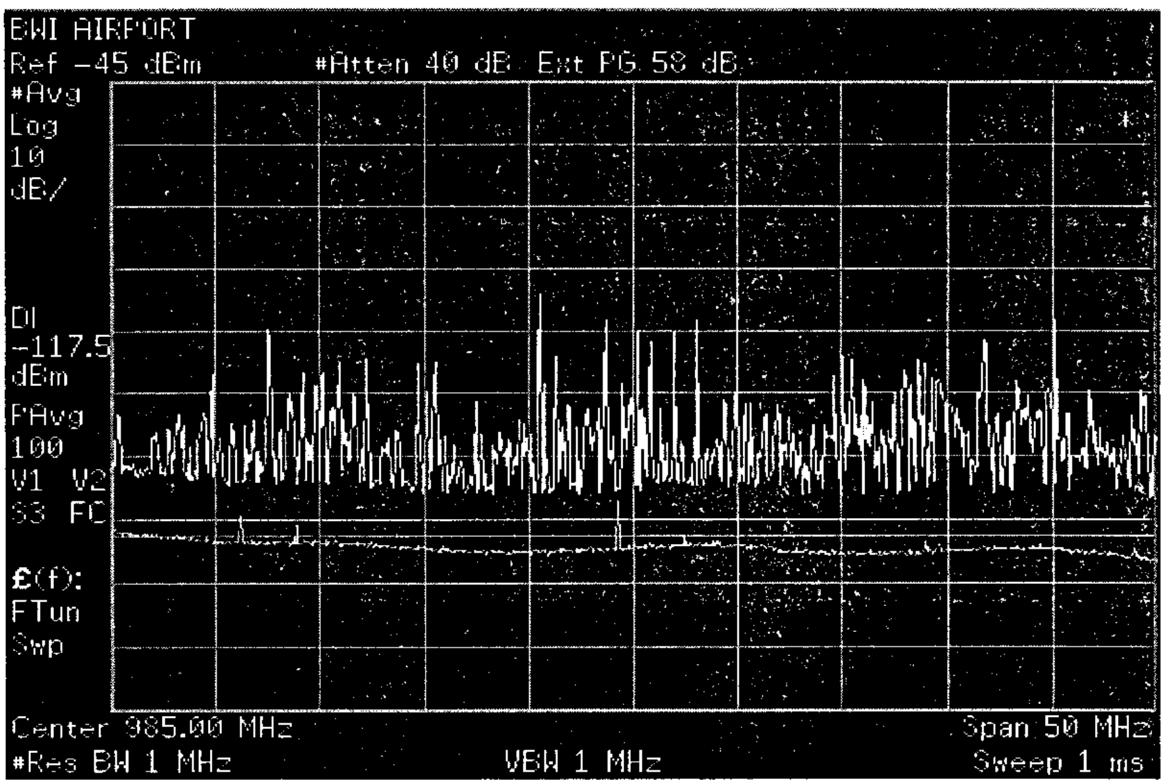

Figure C-18. Ambient Emissions in the 960-1010 MHz Frequency Band at BWI Airport.

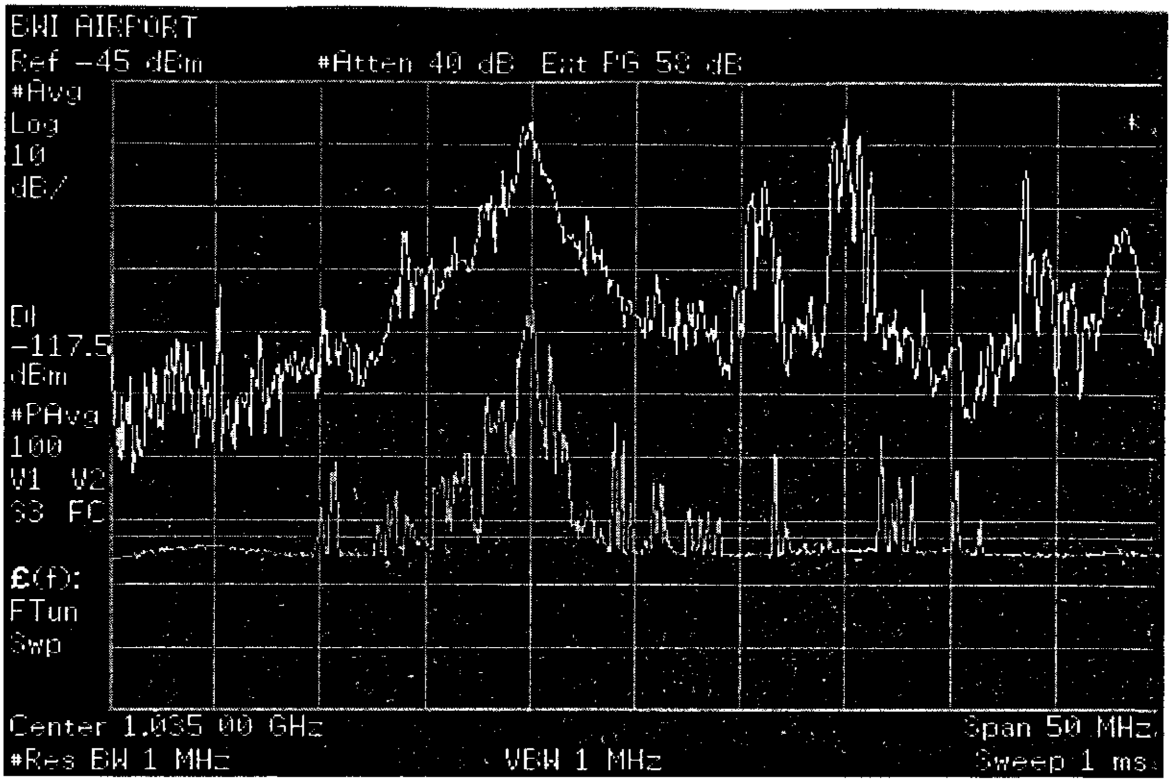

Figure C-19. Ambient Emissions in the 1010-1060 MHz Frequency Baud at BWI Airport.

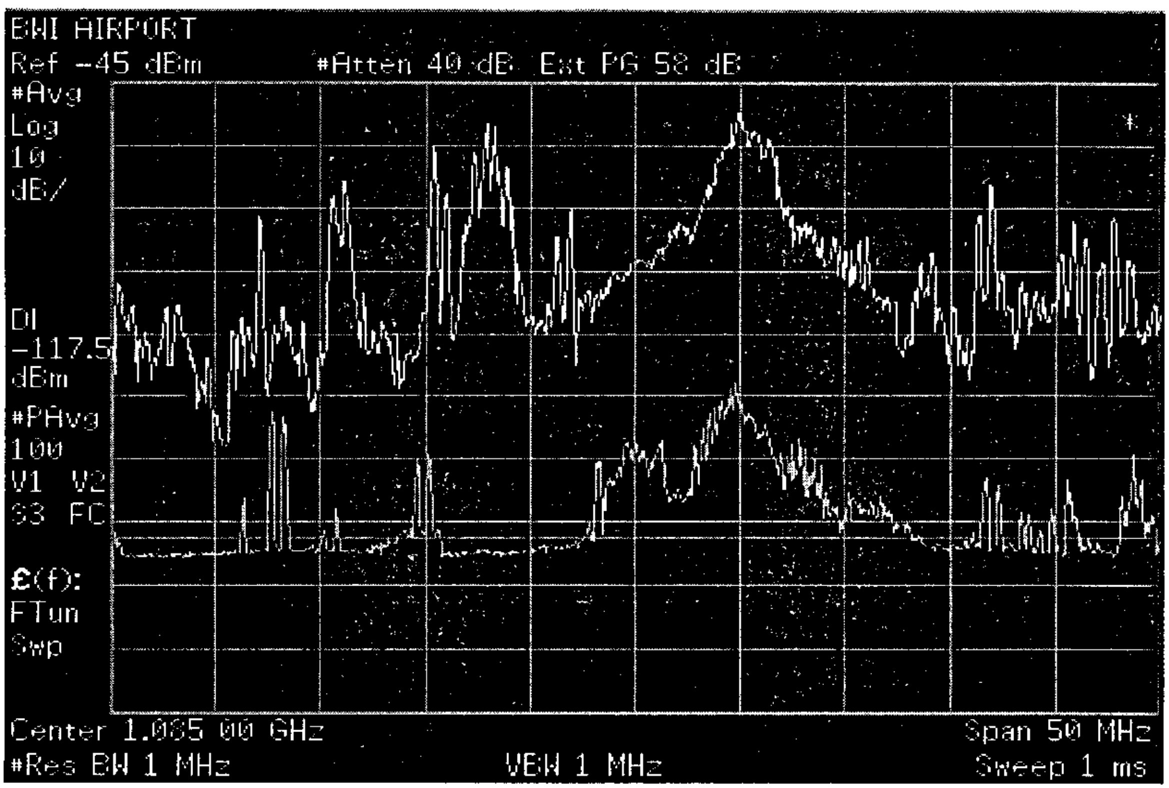

Figure C-20. Ambient Emissions in the 1060-1110 MHz Frequency Baud at BWI Airport.

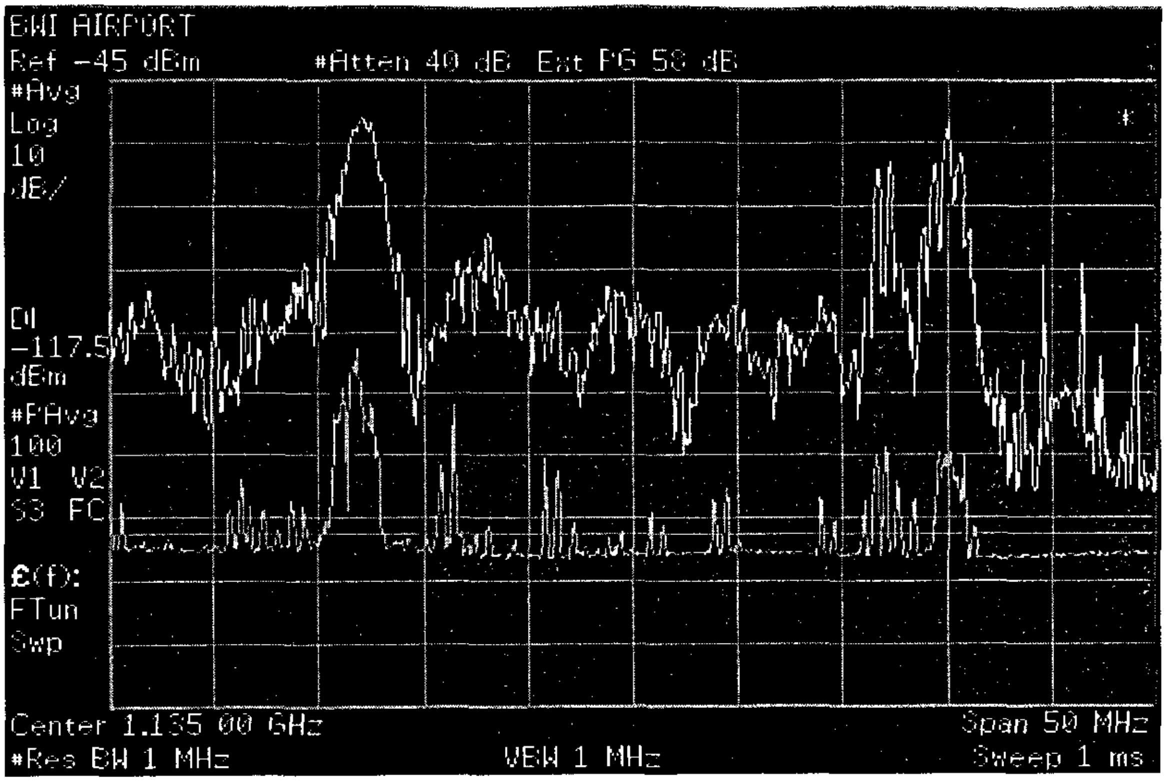

Figure C-21. Ambient Emissions in the 1110-1160 MHz Frequency Band at BWI Airport.

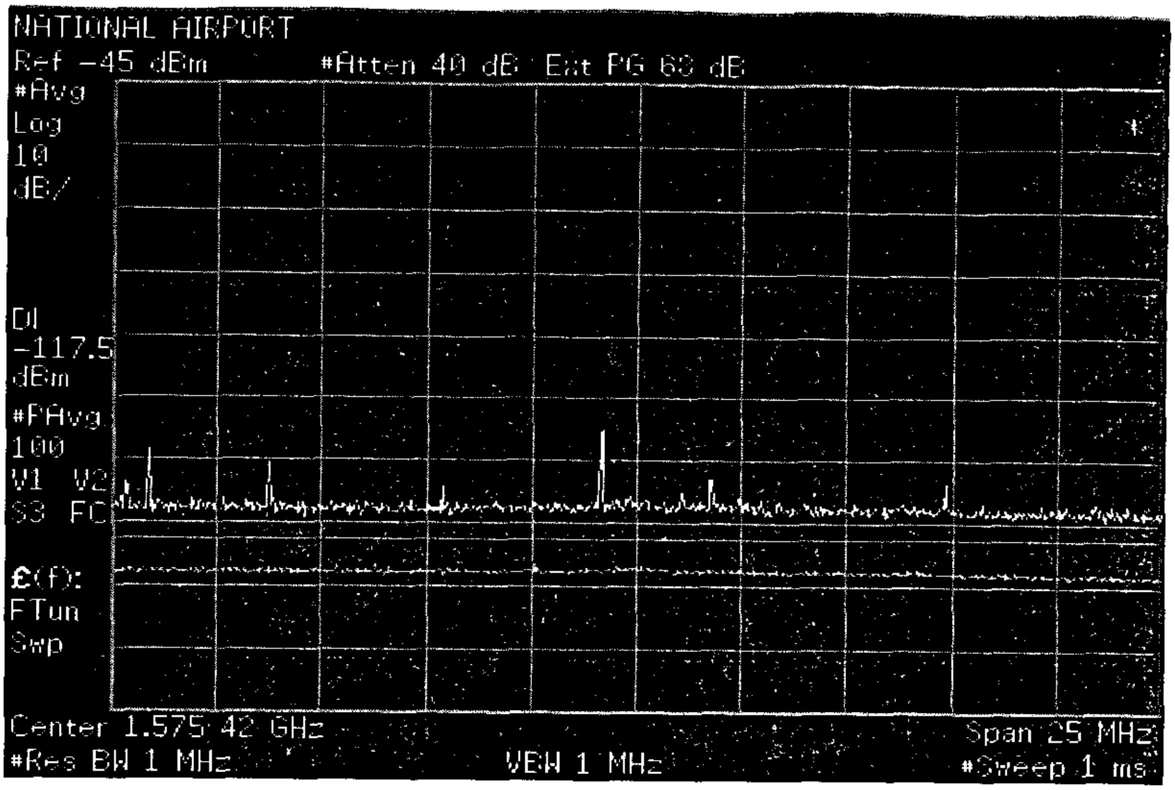

Figure C-22. Ambient Emissions in the GPS L1 Frequency Band at Reagan National Airport.

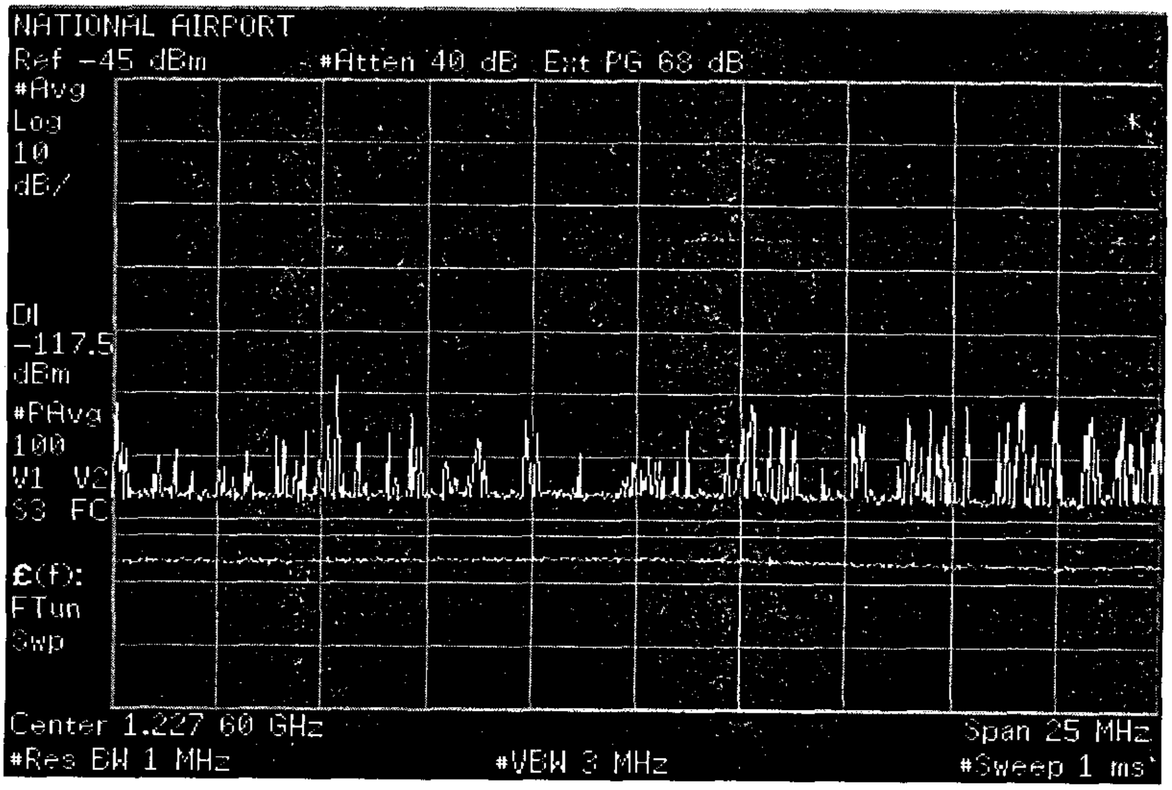

Figure C-23. Ambient Emissions in the GPS L2 Frequency Band at Reagan National Airport.

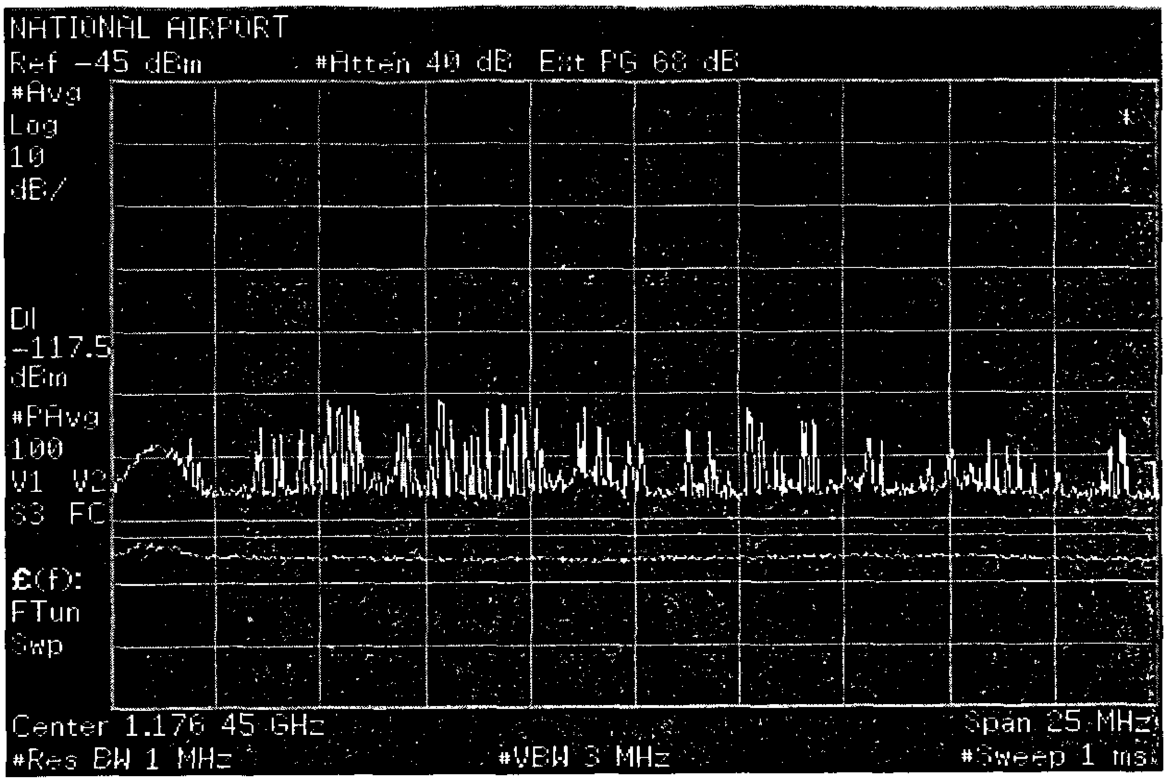

Figure C-24. Ambient Emissions in the GPS L5 Frequency Band at Reagan National Airport.

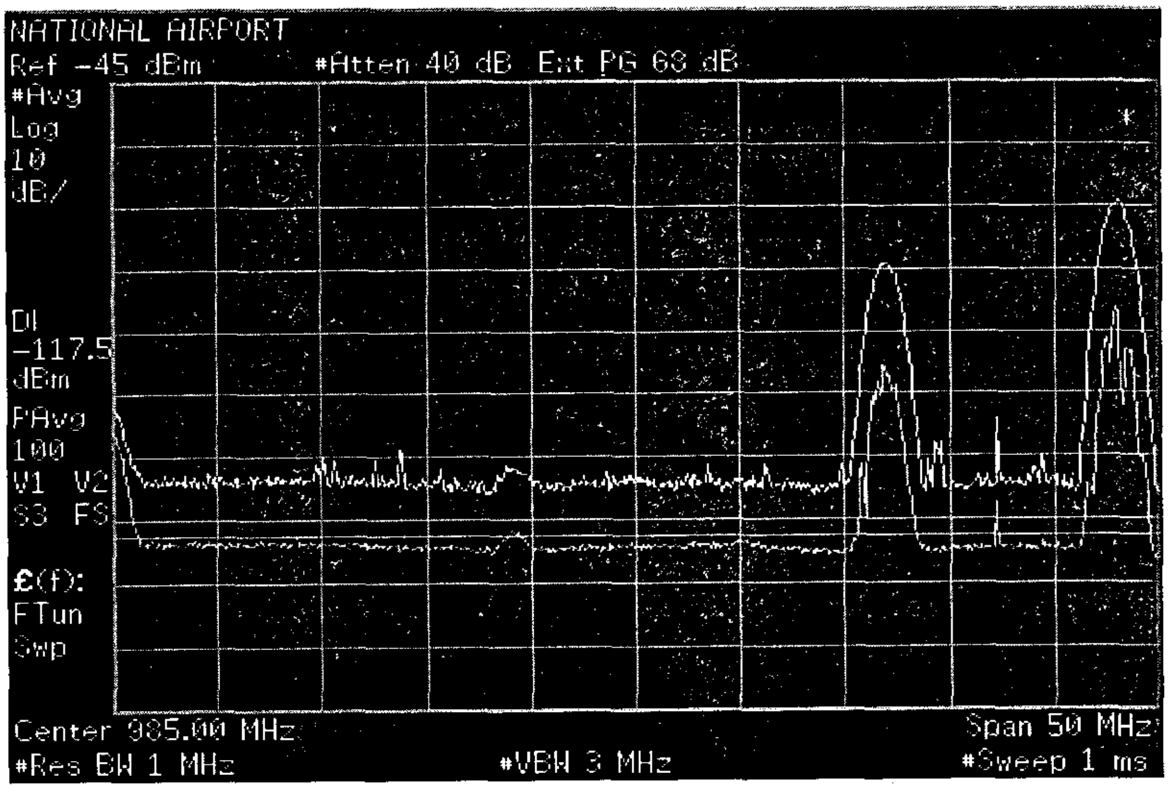

Figure *C-25.* Ambient Emissions in the 960-1010 MHz Frequency Band at Reagan National Airport.

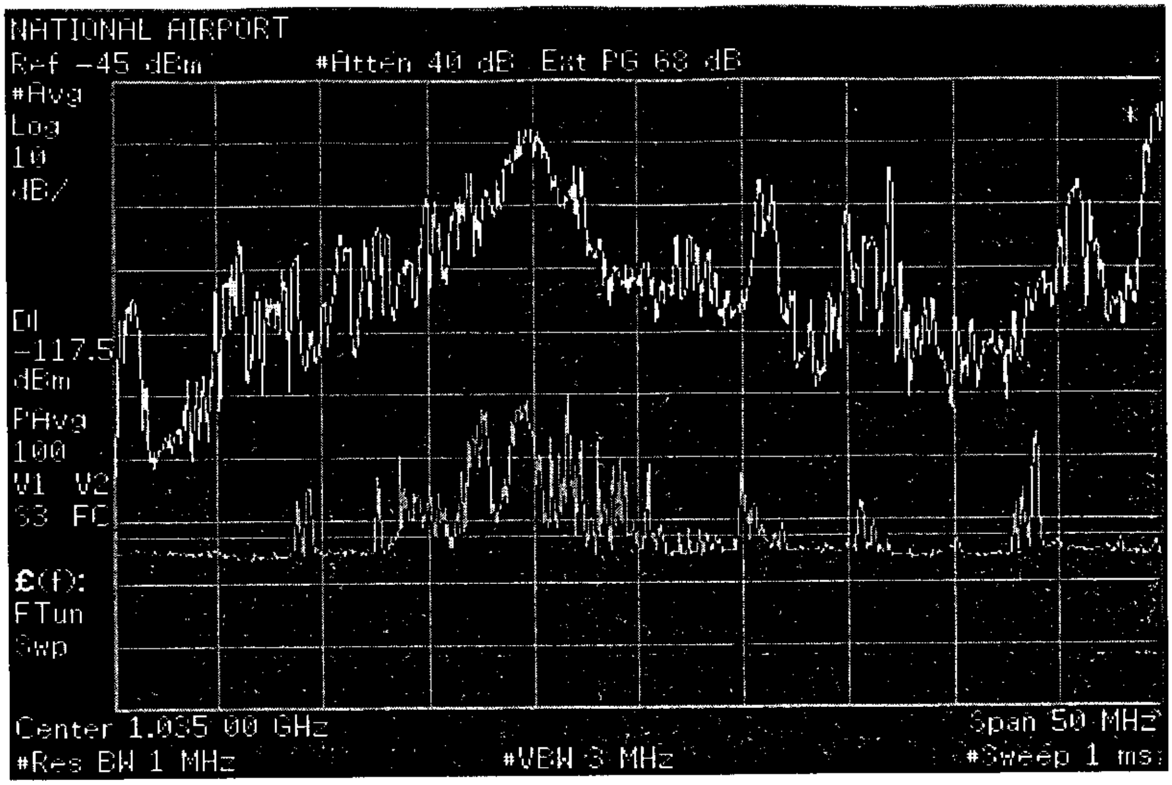

Figure C-26. Ambient Emissions in the 1010-1060 MHz Frequency Band at National Airport.

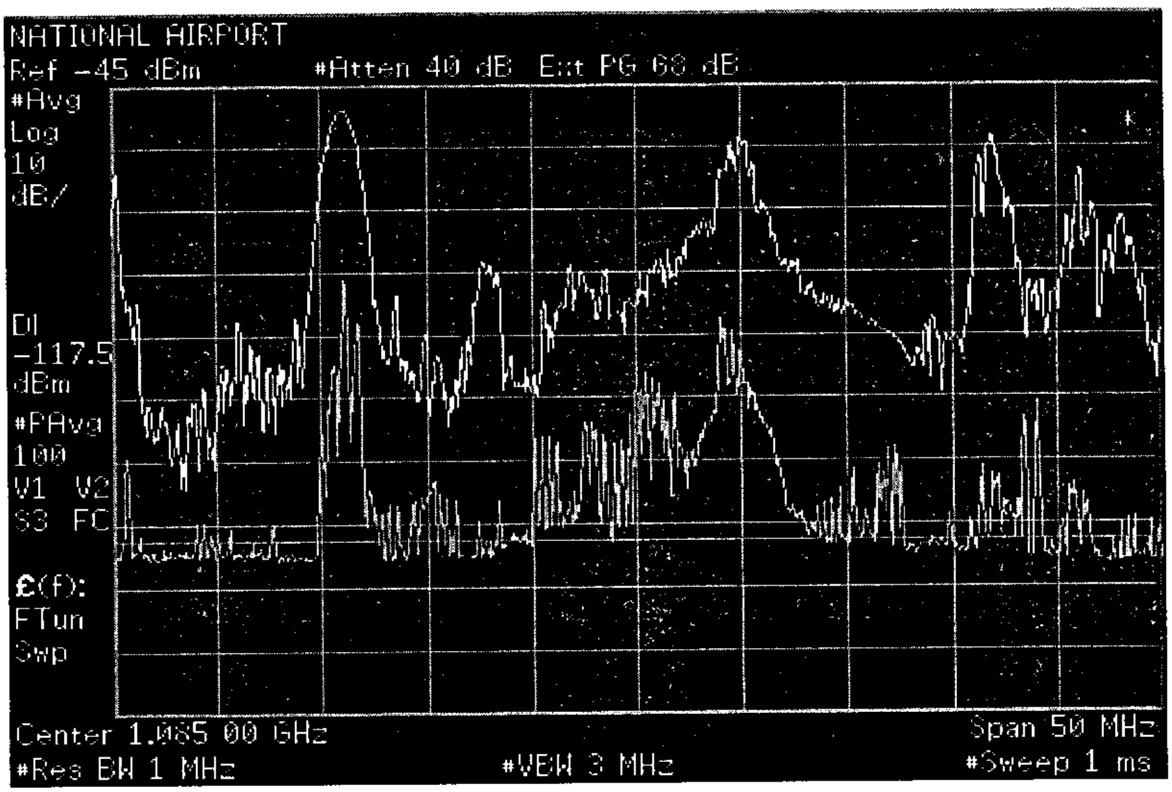

Figure C-27. Ambient Emissions in the 1060-1110 MHz Frequency Band at National Airport.

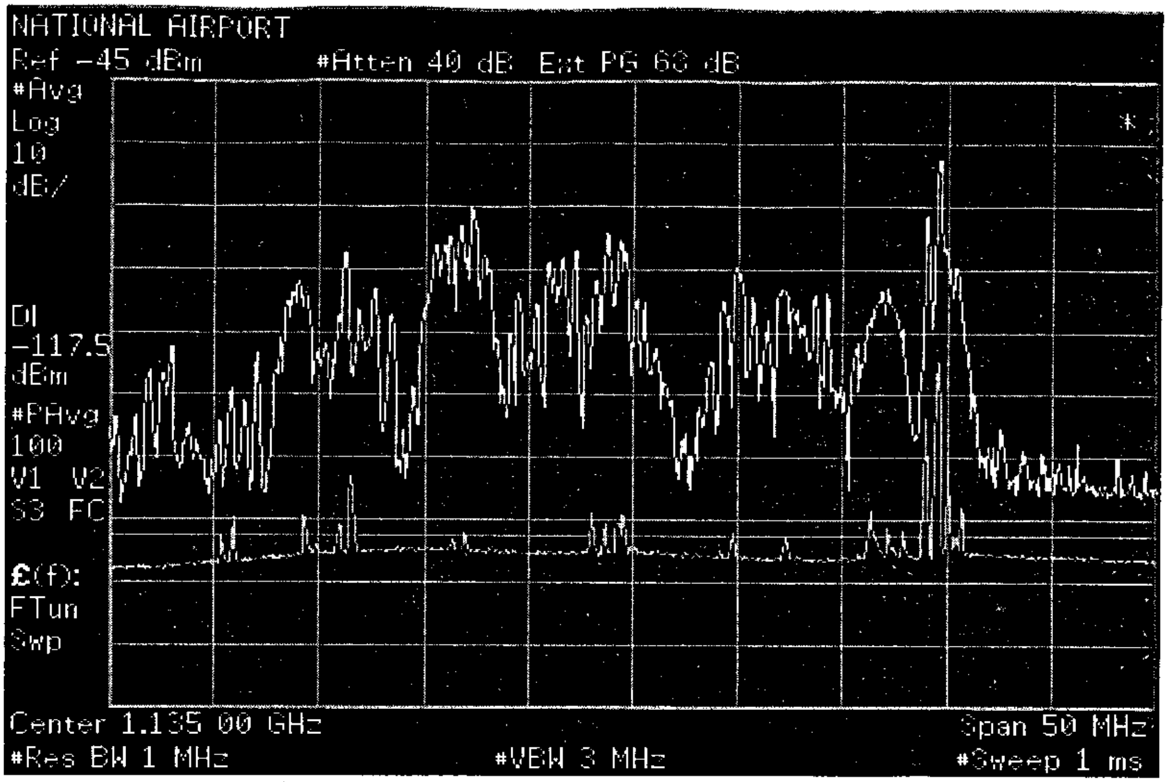

Figure C-28. Ambient Emissions in the 1110-1160MHz Frequency Band at National Airport.

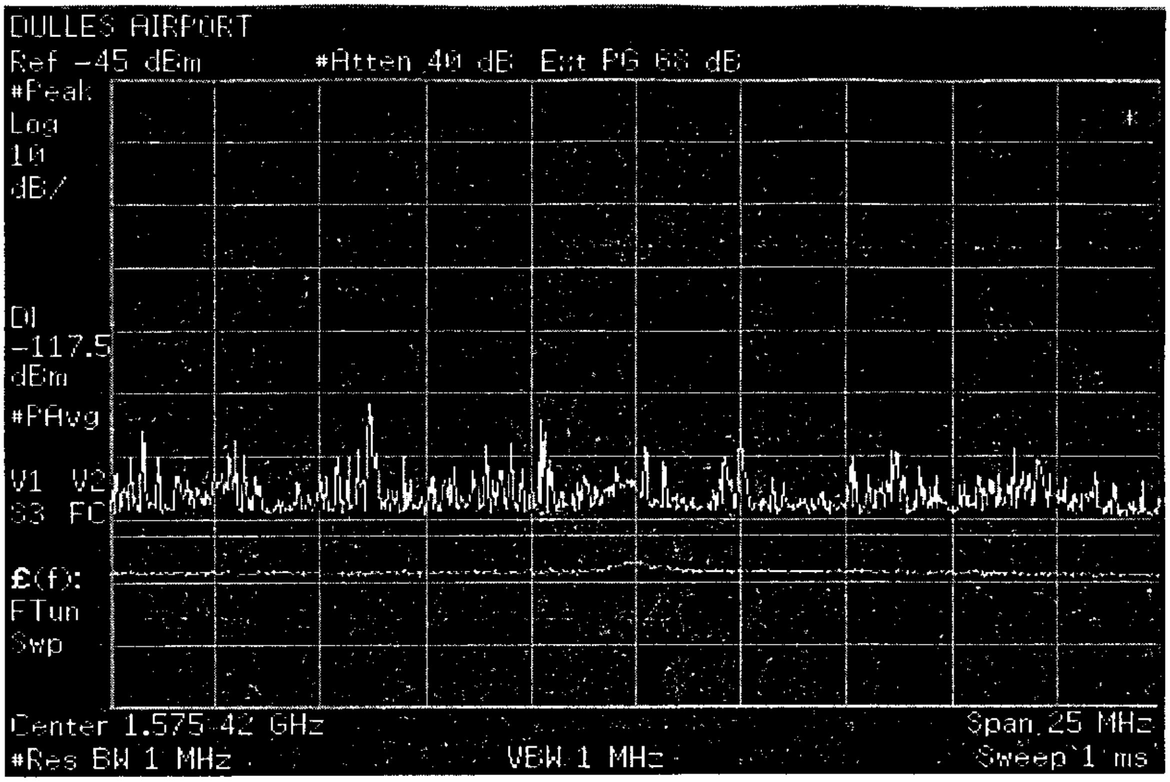

Figure C-29. Ambient Emissions in the CPS L1 Frequency Band at Dulles International Airport.

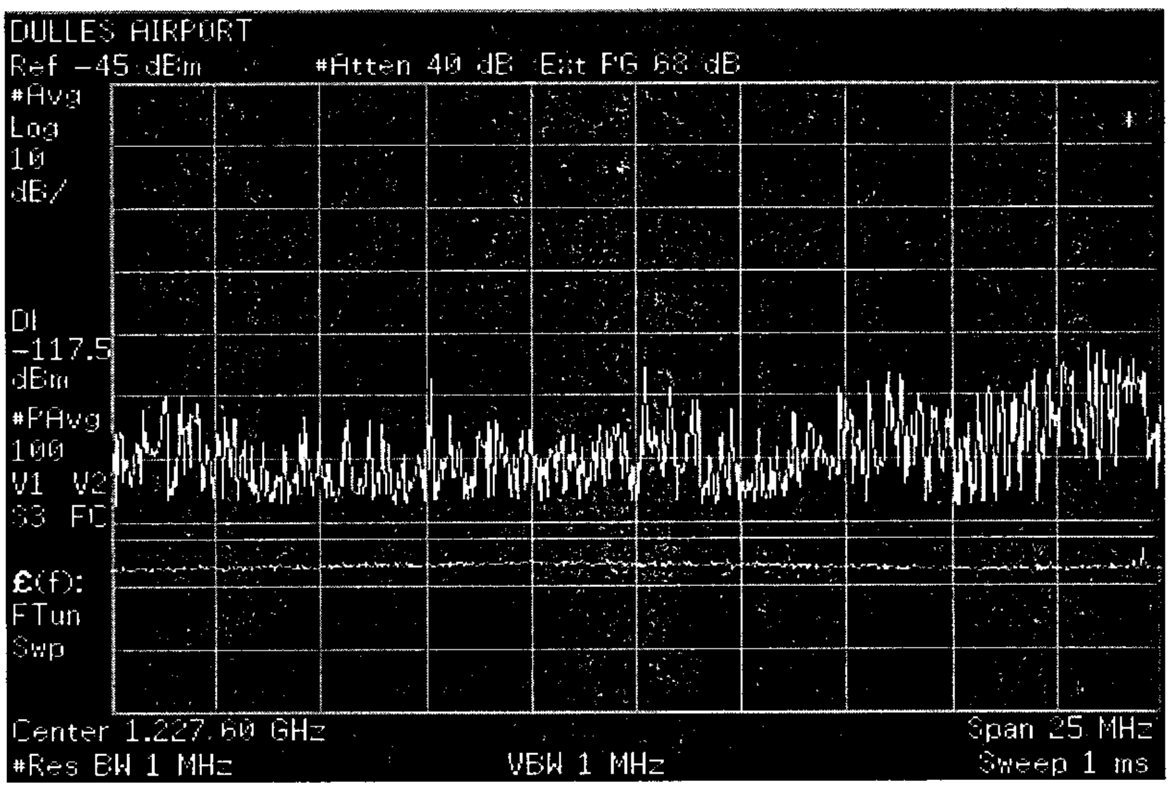

Figure C-30. Ambient Emissions in the CPS L2 Frequency Band at Dulles International Airport.

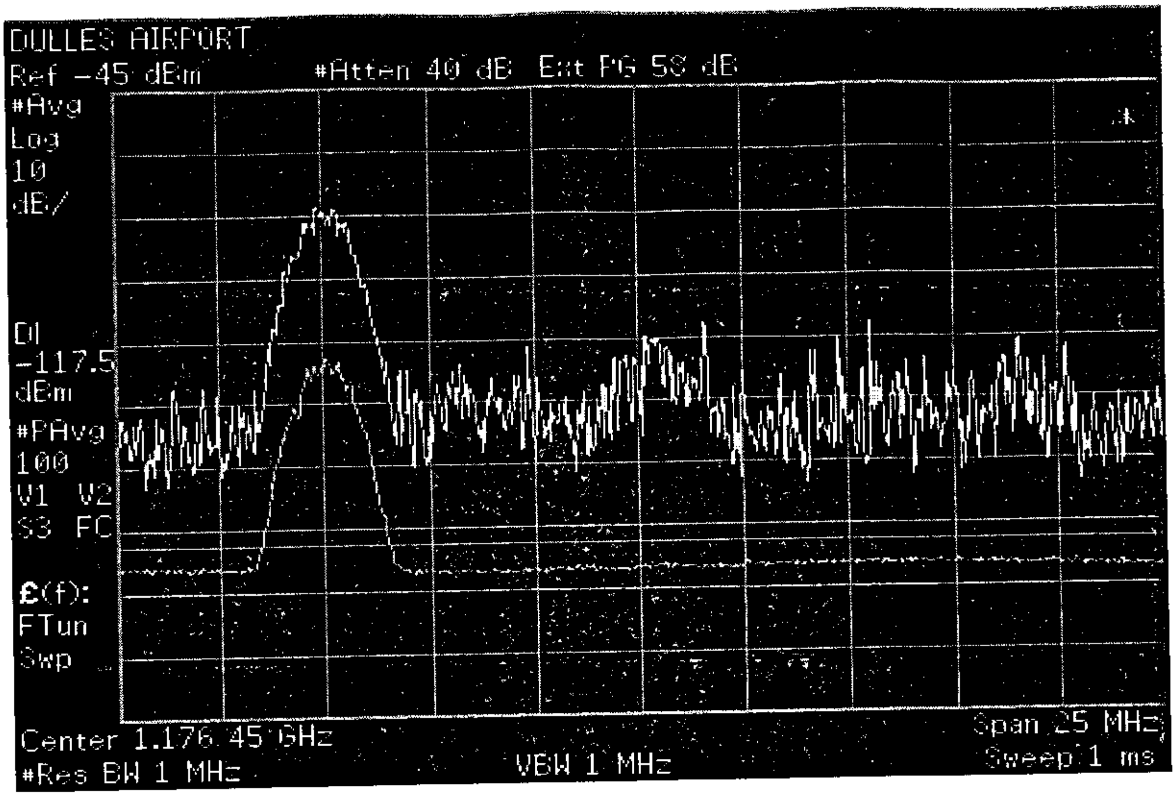

Figure C-31. Ambient Emissions in the GPS L5 Frequency Band at Dulles International Airport.

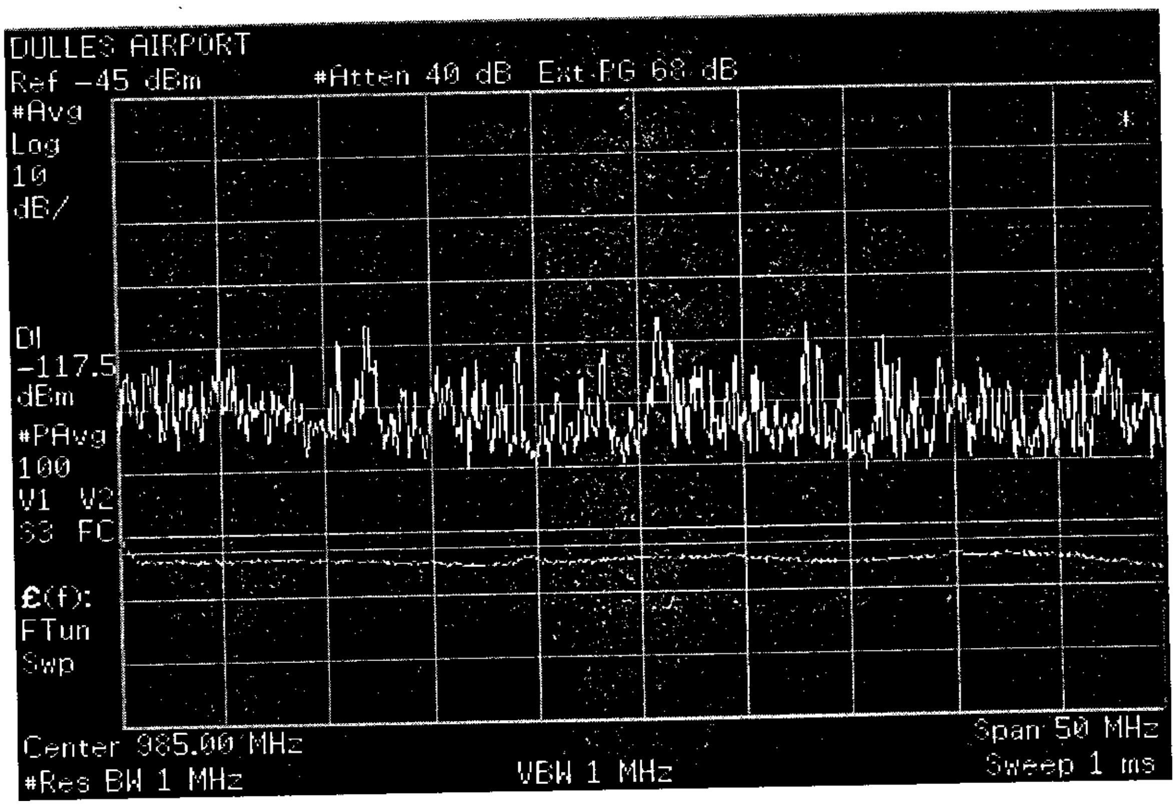

Figure C-32. Ambient Emissions in the 960-1010 MHz Frequency Band at Dulles Airport.

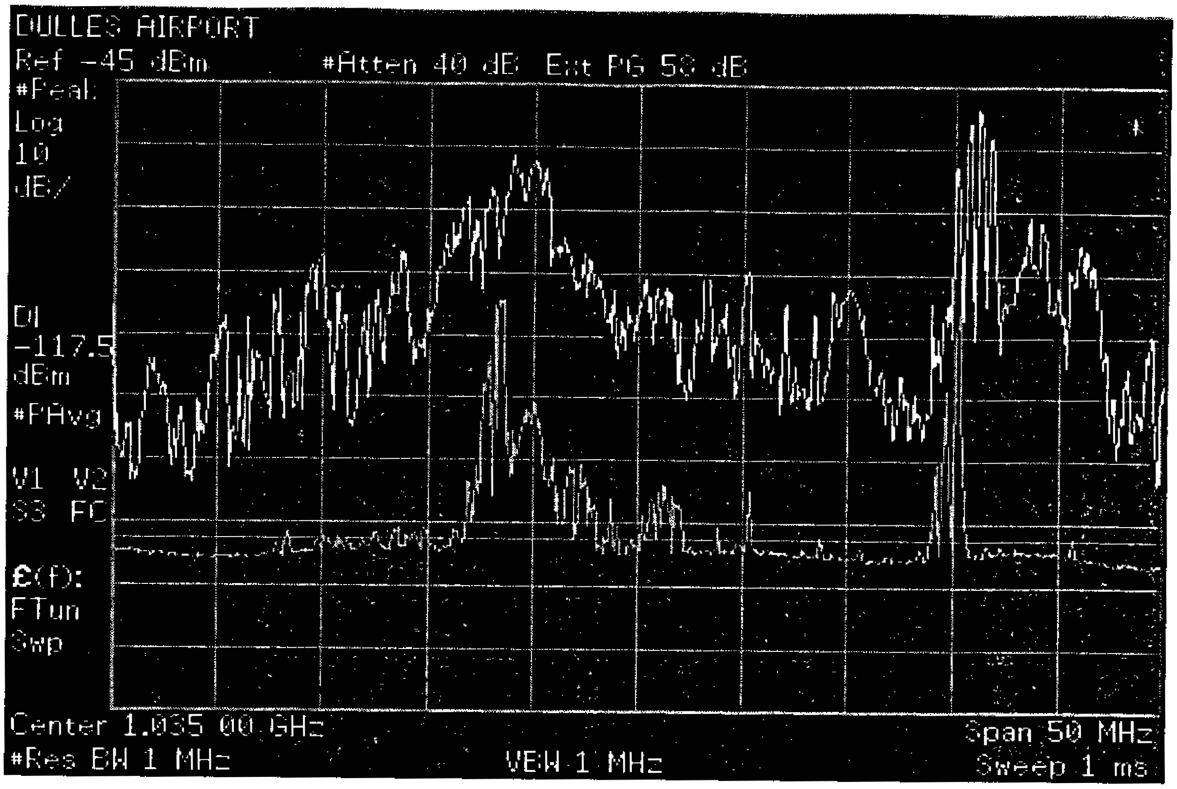

Figure C-33. Ambient Emissions in the 1010-1060 MHz Frequency Band at Dulles Airport.

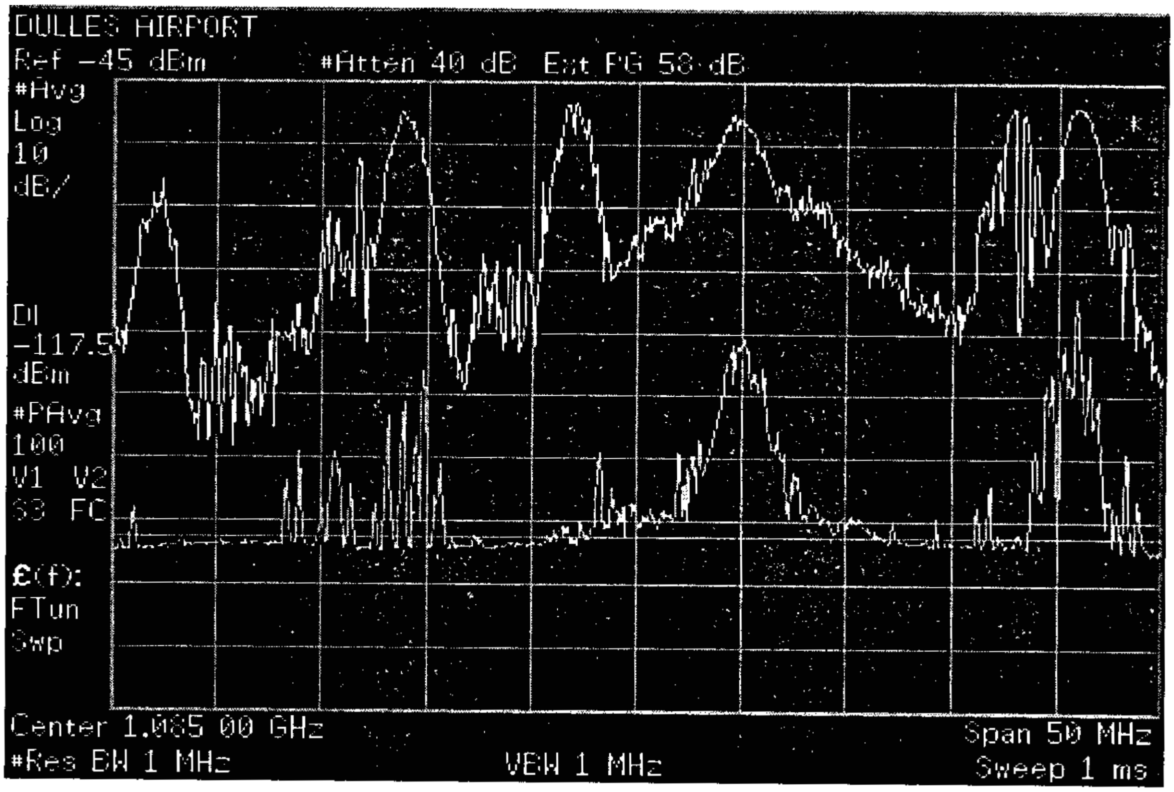

Figure C-34. Ambient Emissions in the 1060-1110 MHz Frequency Band at Dulles Airport.

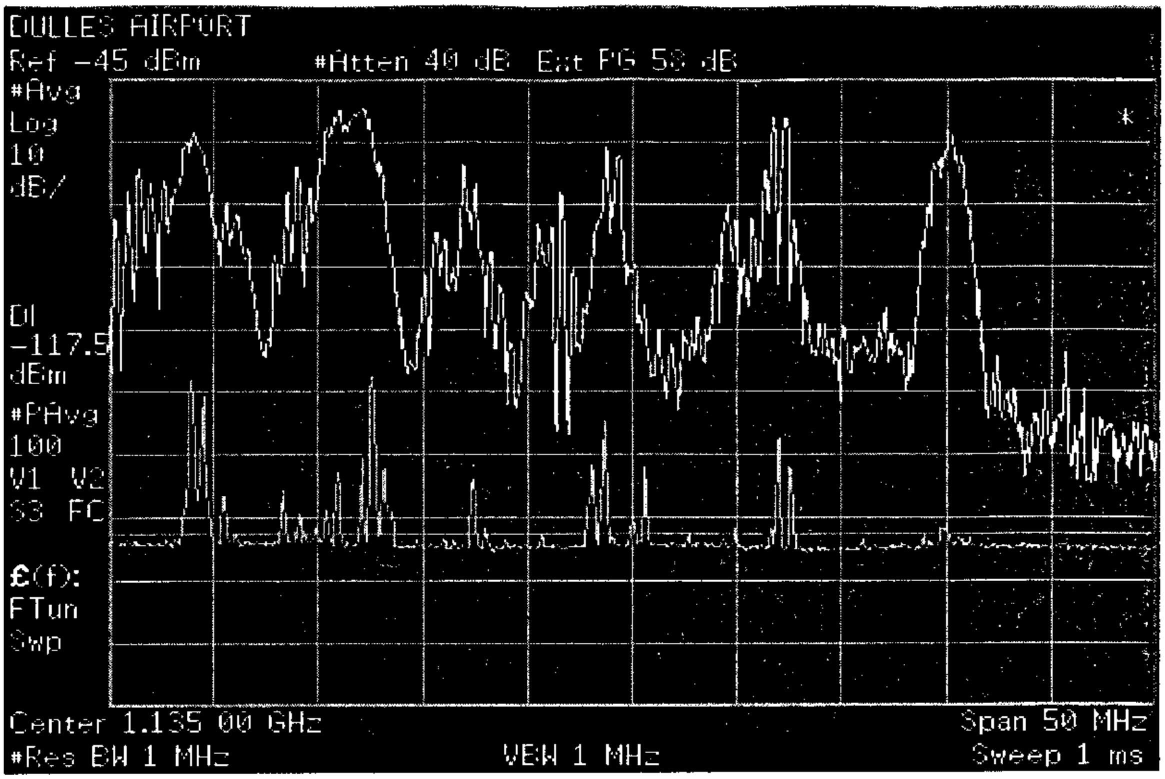

Figure C-35) Ambient Emissions in the 1110-1160 MHz Frequency Band at Dulles Airport.

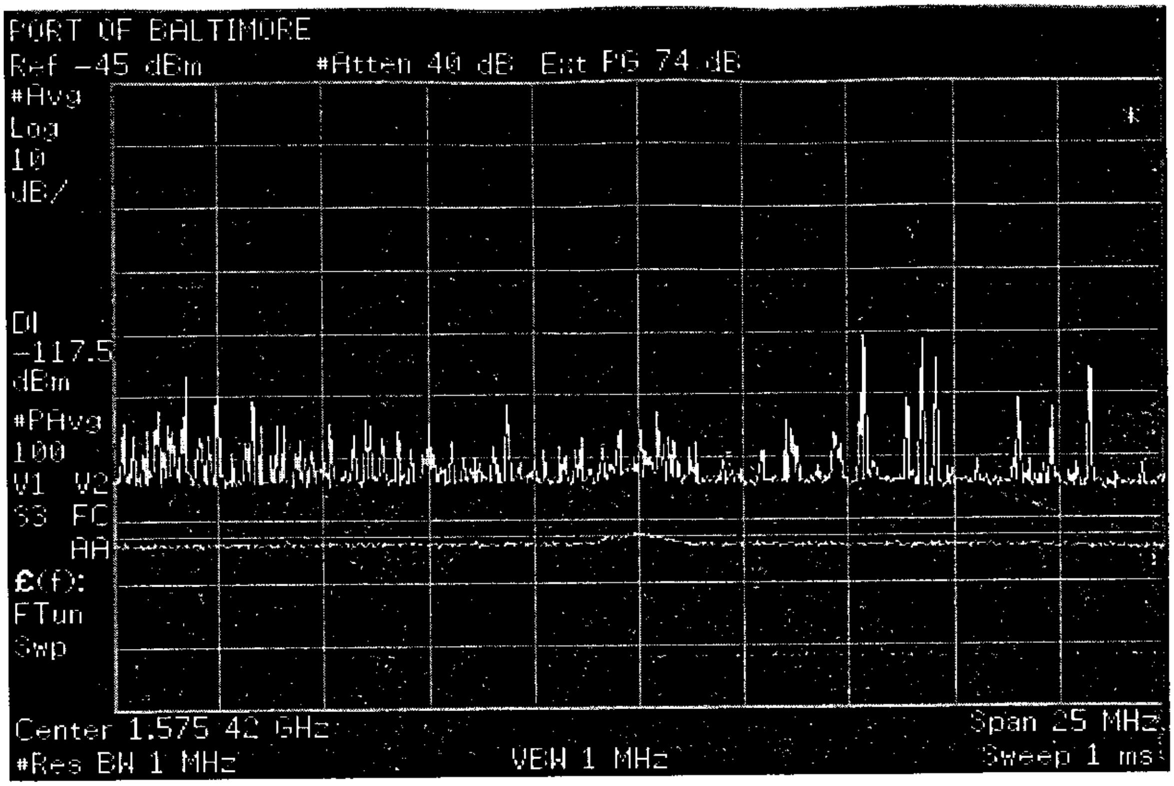

Figure C-36. Ambient Emissions in the GPS L1 Frequency Band at the Port of Baltimore.

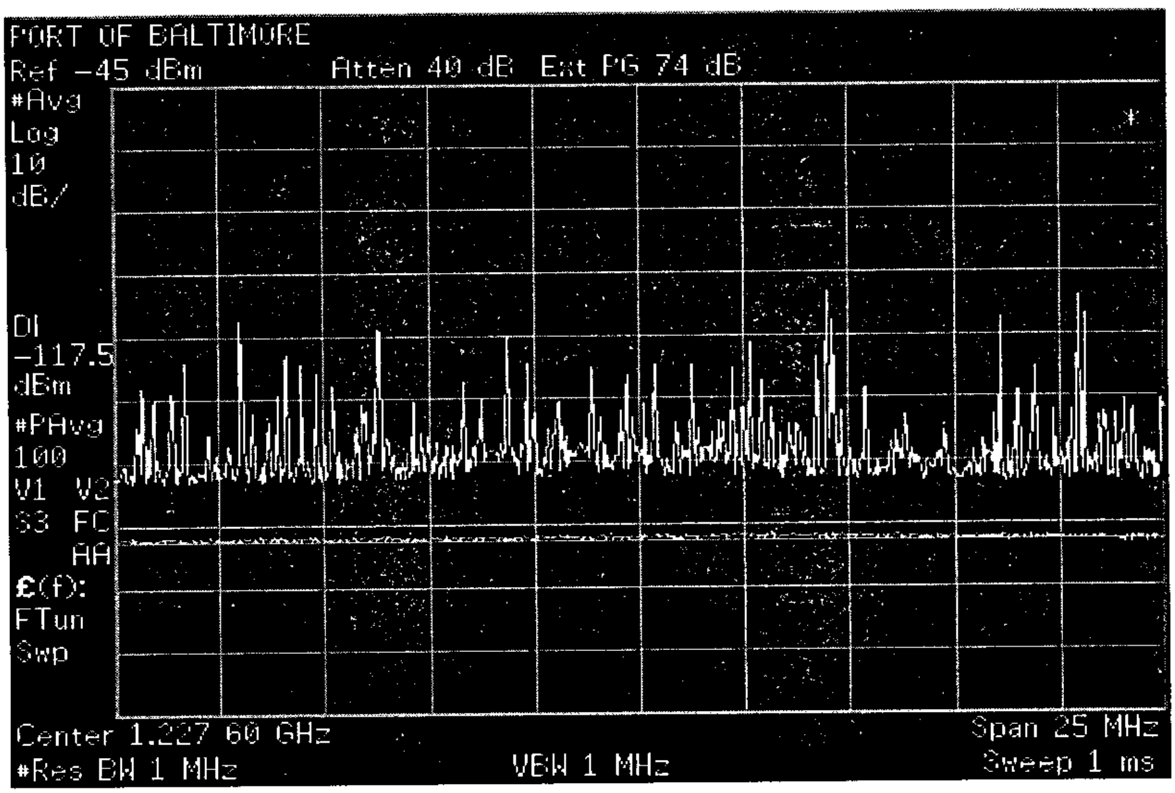

Figure C-37. Ambient Emissions in the GPS L2 Frequency Baud at the Port of Baltimore.

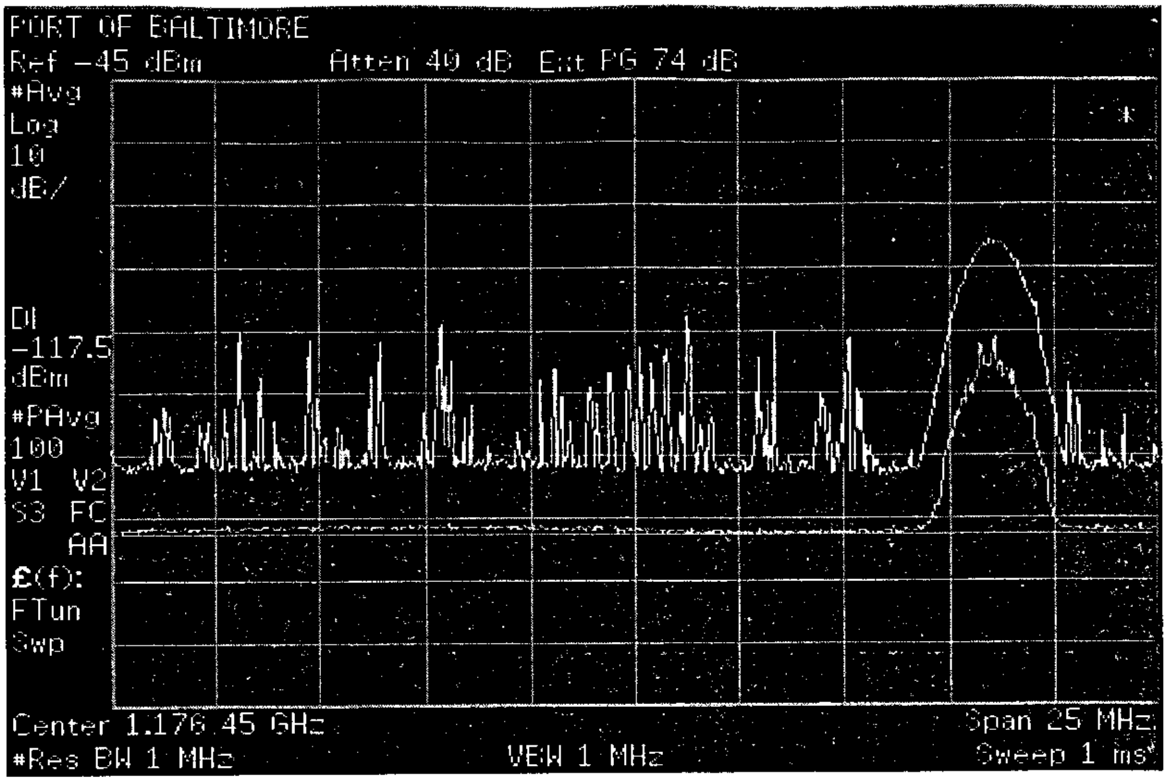

Figure C-38. Ambient Emissions in the GPS L5 Frequency Band at the Port of Baltimore.

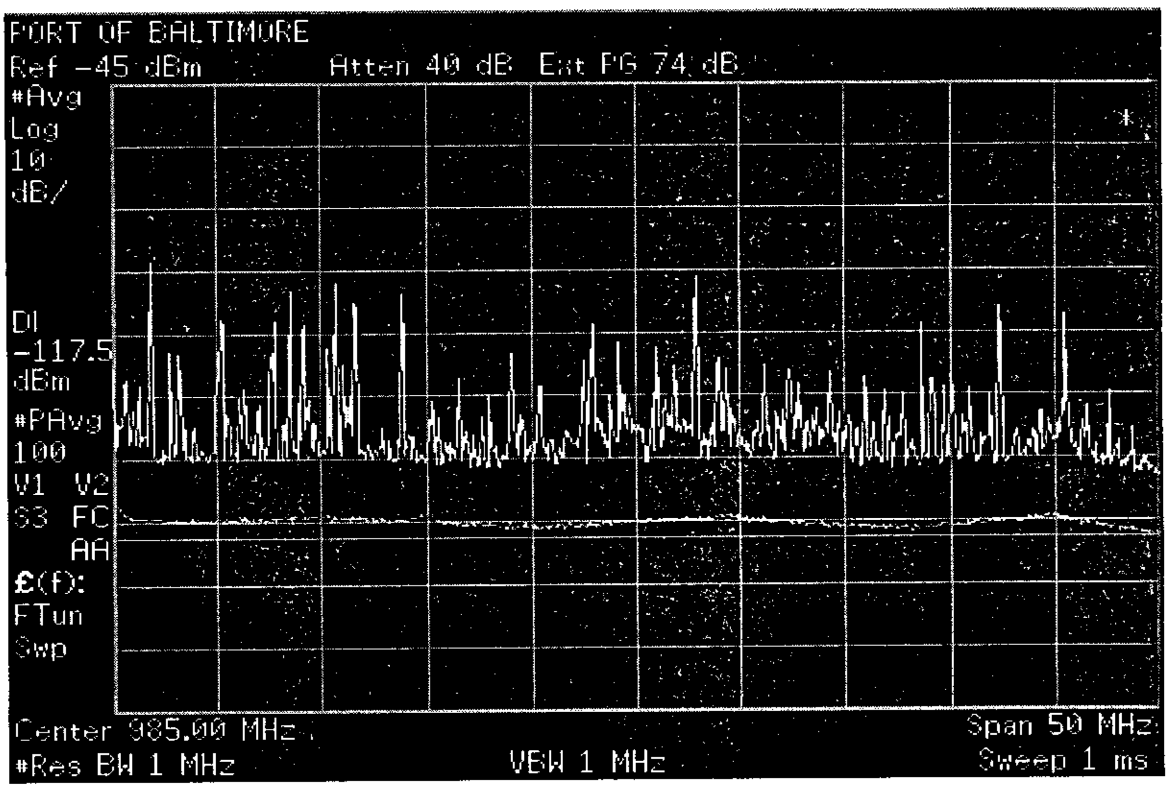

Figure C-39. Ambient Emissions in the 960-1010 MHz Frequency Band at the Port of Baltimore.

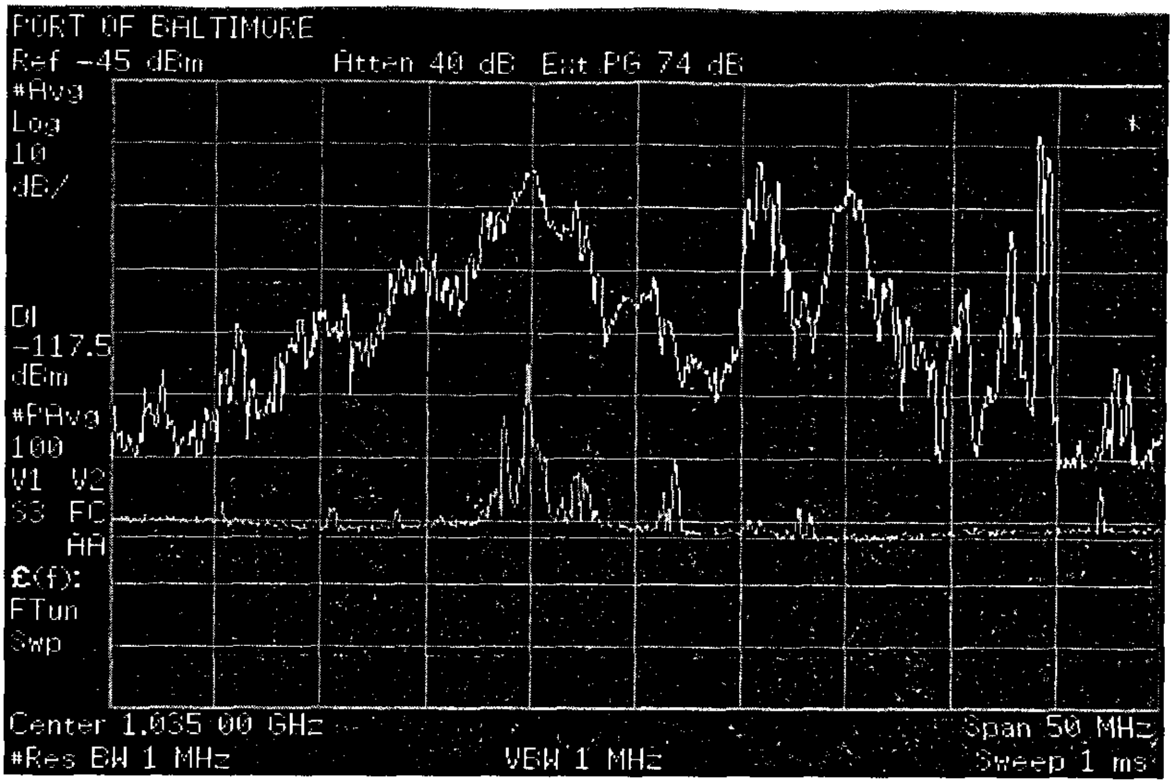

Figure C-40. Ambient Emissions in the 1010-1060 MHz Frequency Band at the Port of Baltimore.

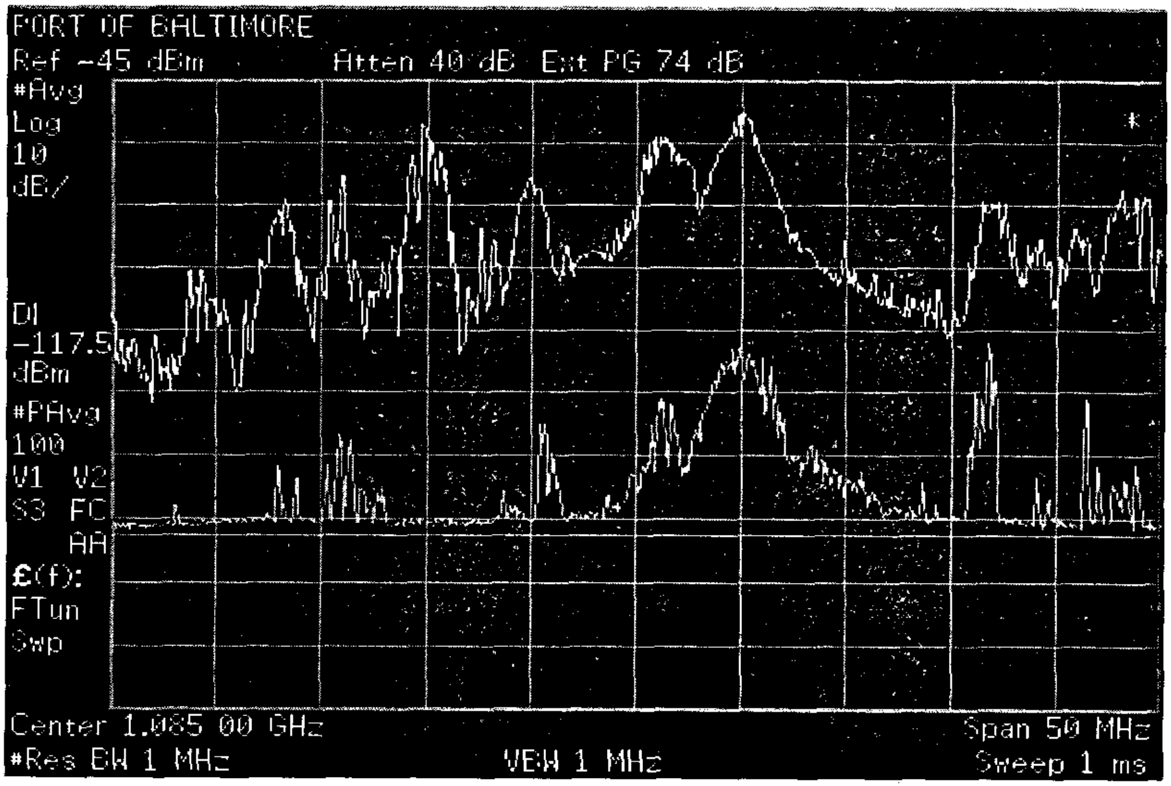

Figure C-41. Ambient Emissions in the 1060-1110 MHz Frequency Band at the Port of Baltimore.

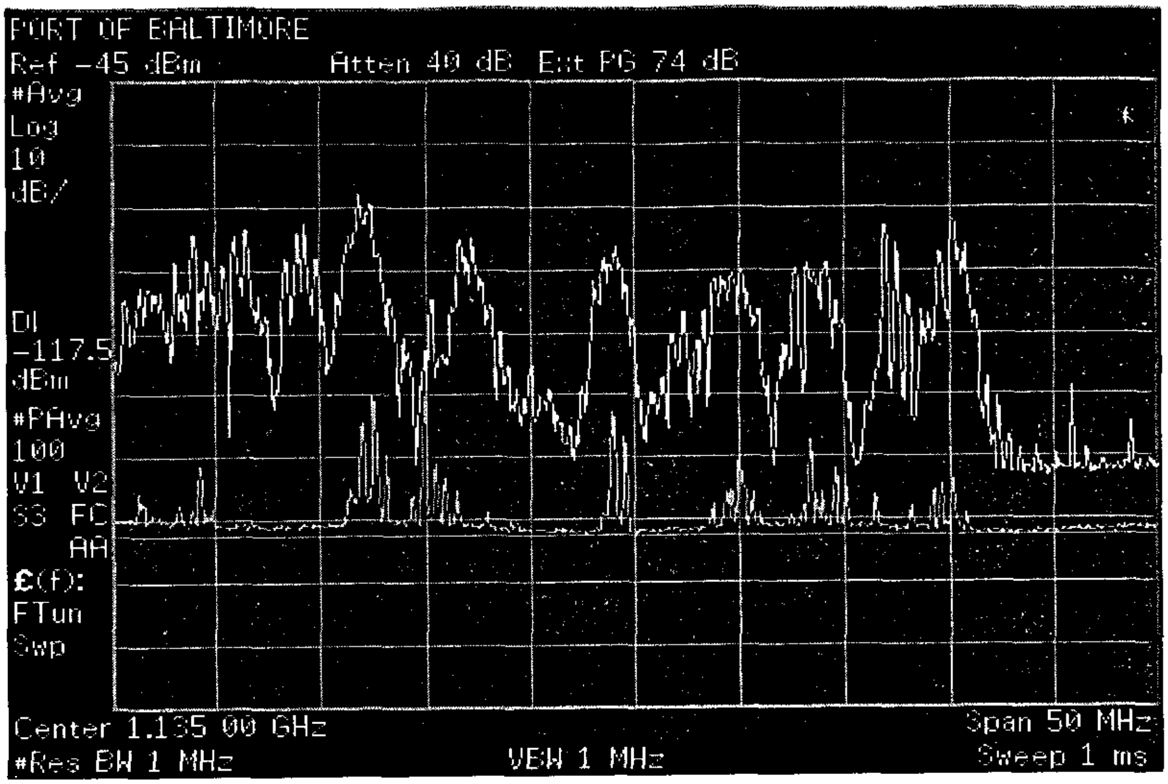

Figure C-42. Ambient Emissions in the 1110-1160 MHzFrequency Baud at the Port of Baltimore.

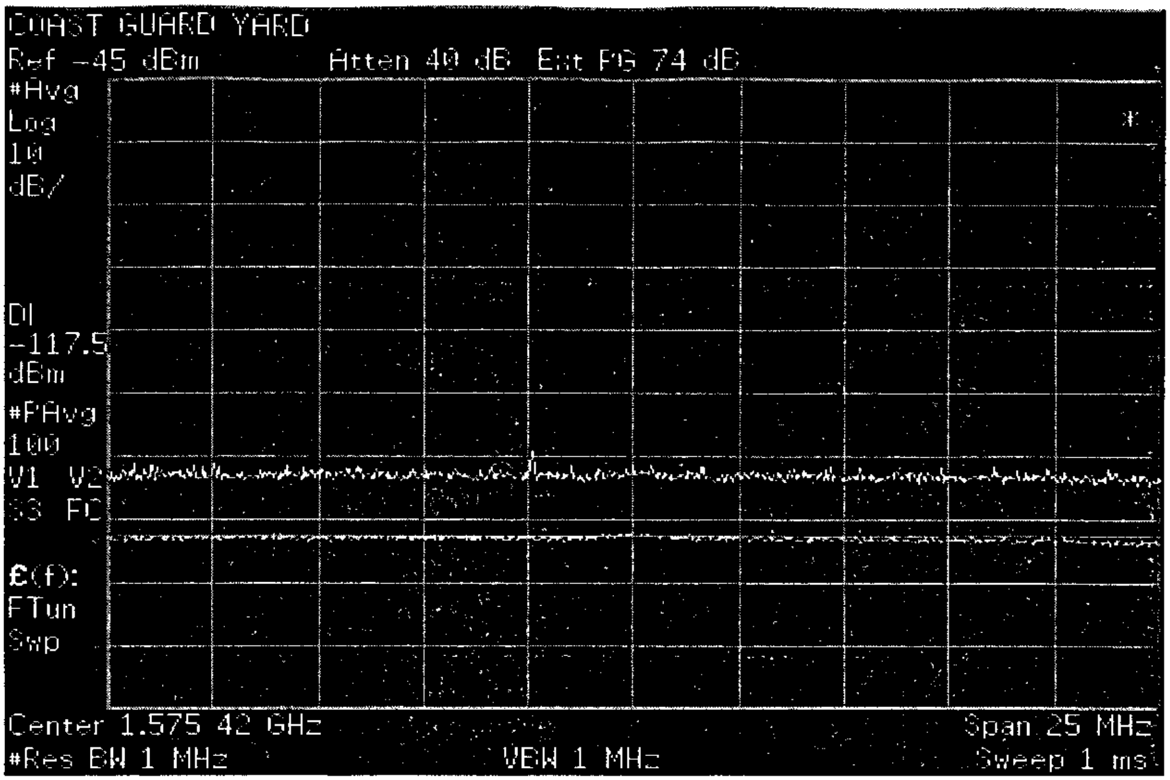

Figure C-43. Ambient Emissions in the GPS L1 Frequency Band at the U.S. Coast Guard Yard.

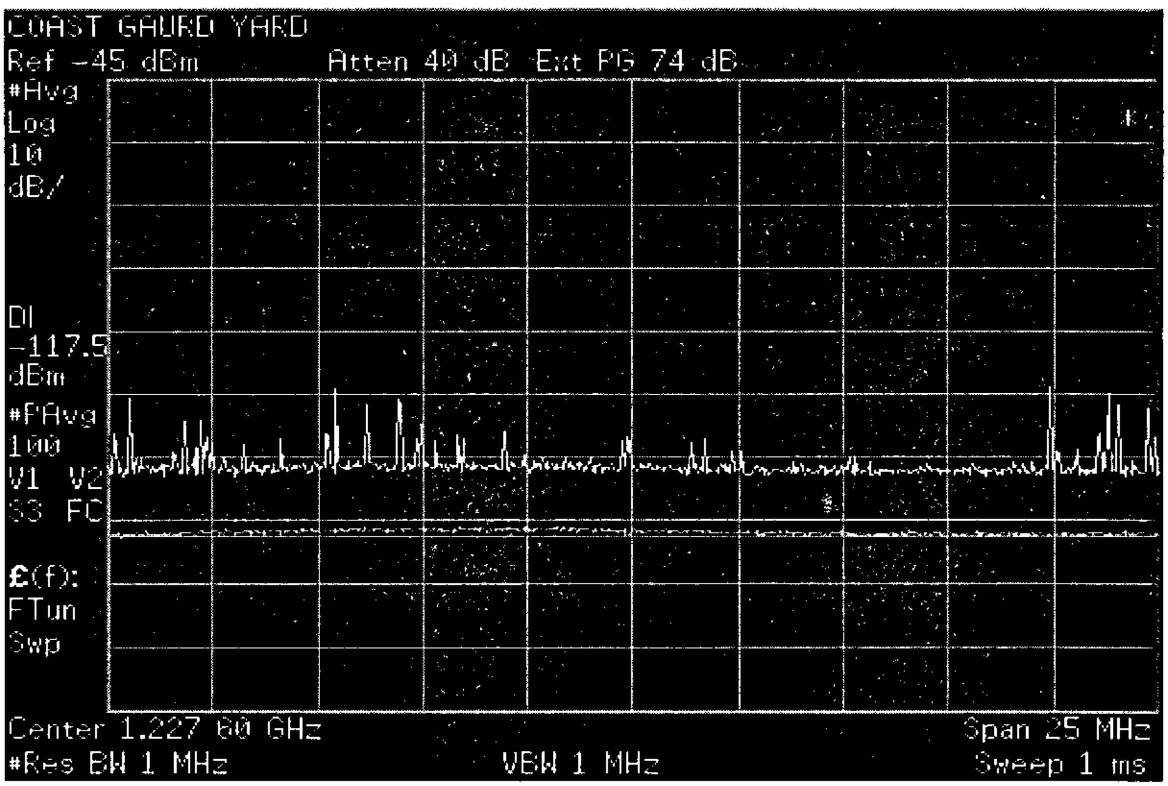

Figure C-44. Ambient Emissions in the GPS L2 Frequency Band at the U.S. Coast Guard Yard.

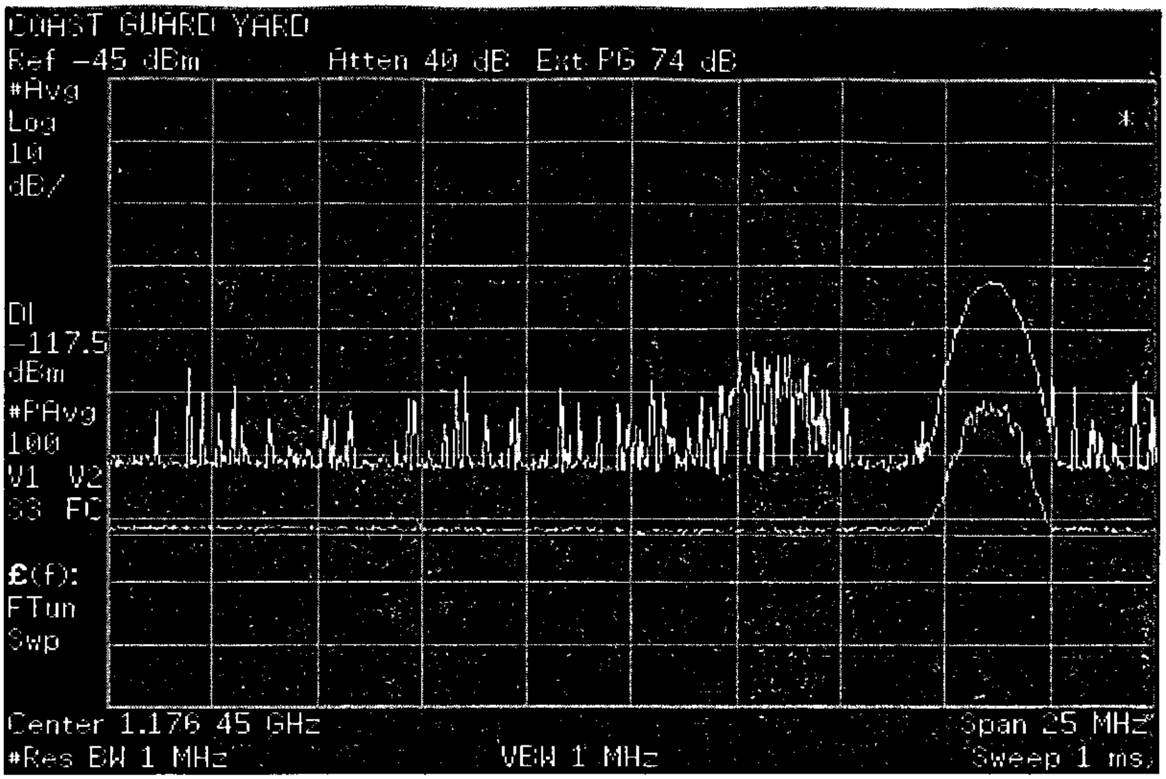

Figure C-45. Ambient Emissions in the GPS L5 Frequency Band at the U.S. Coast Guard Yard.

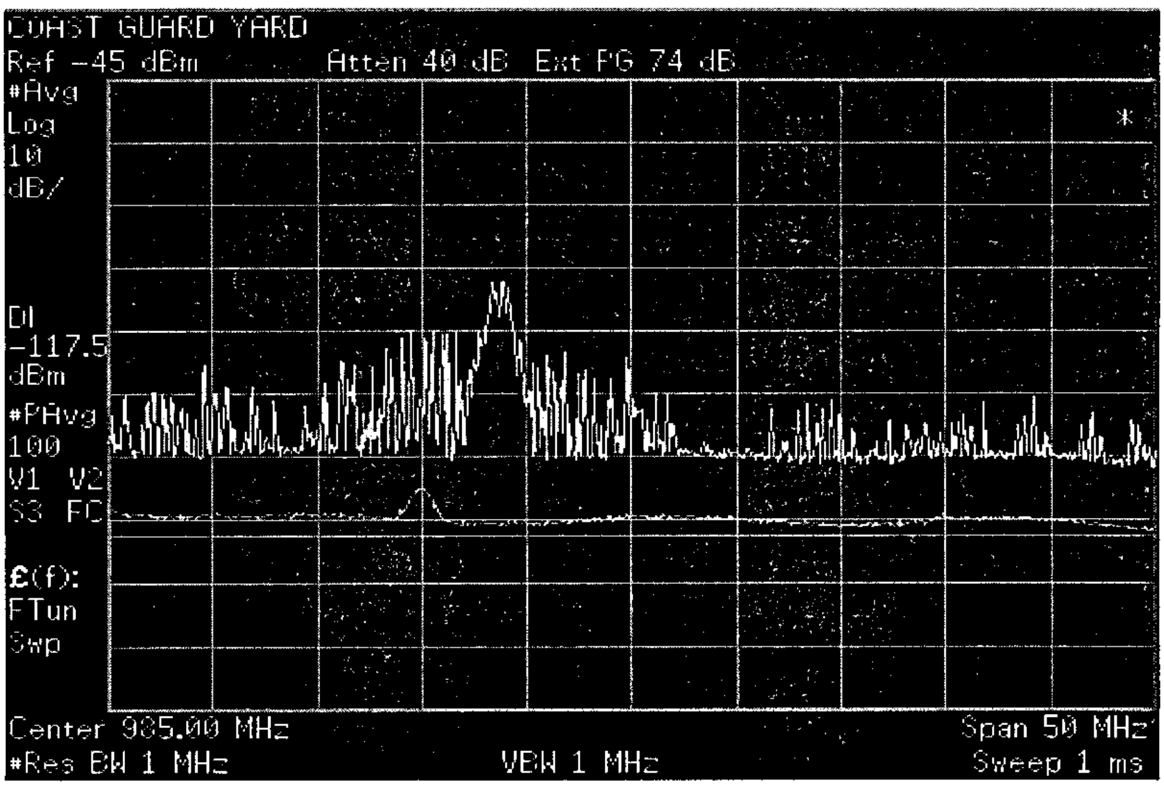

Figure C-46. Ambient Emissions in the 960-1010 MHz Frequency Baud at the Coast Guard Yard.

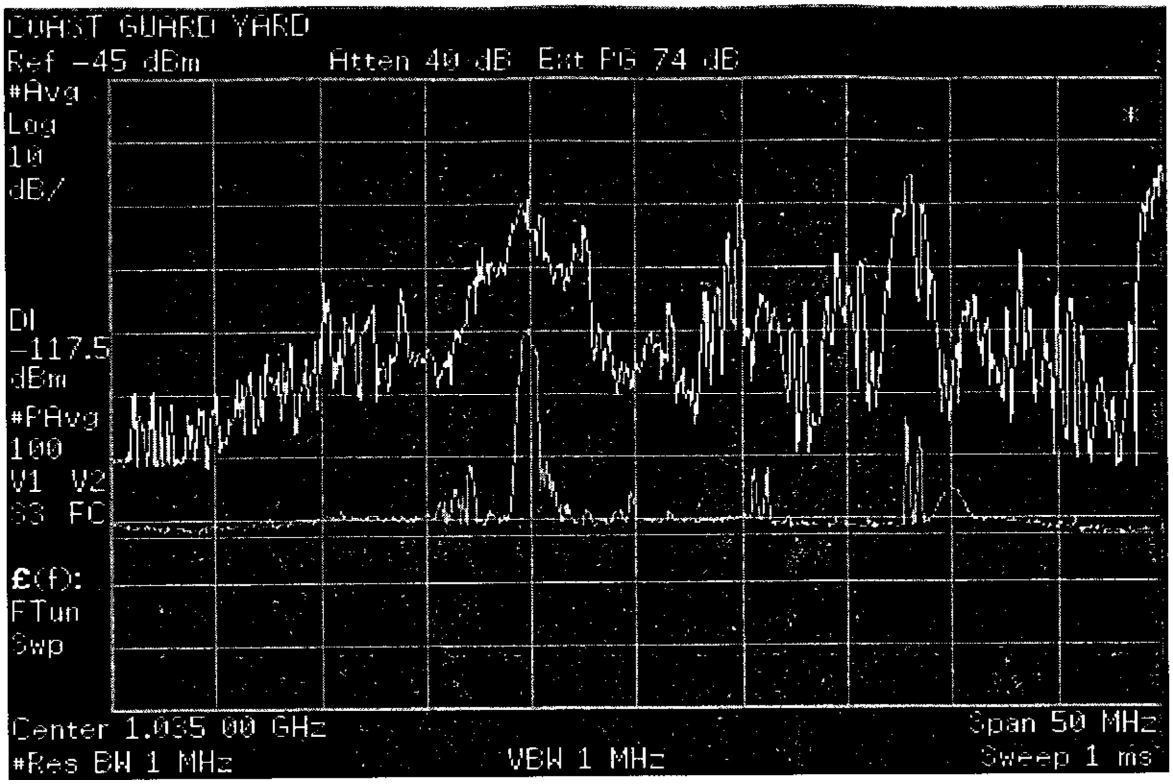

Figure C-47. Ambient Emissions in the 1010-1060 MHz Frequency Band at the Coast Guard Yard.

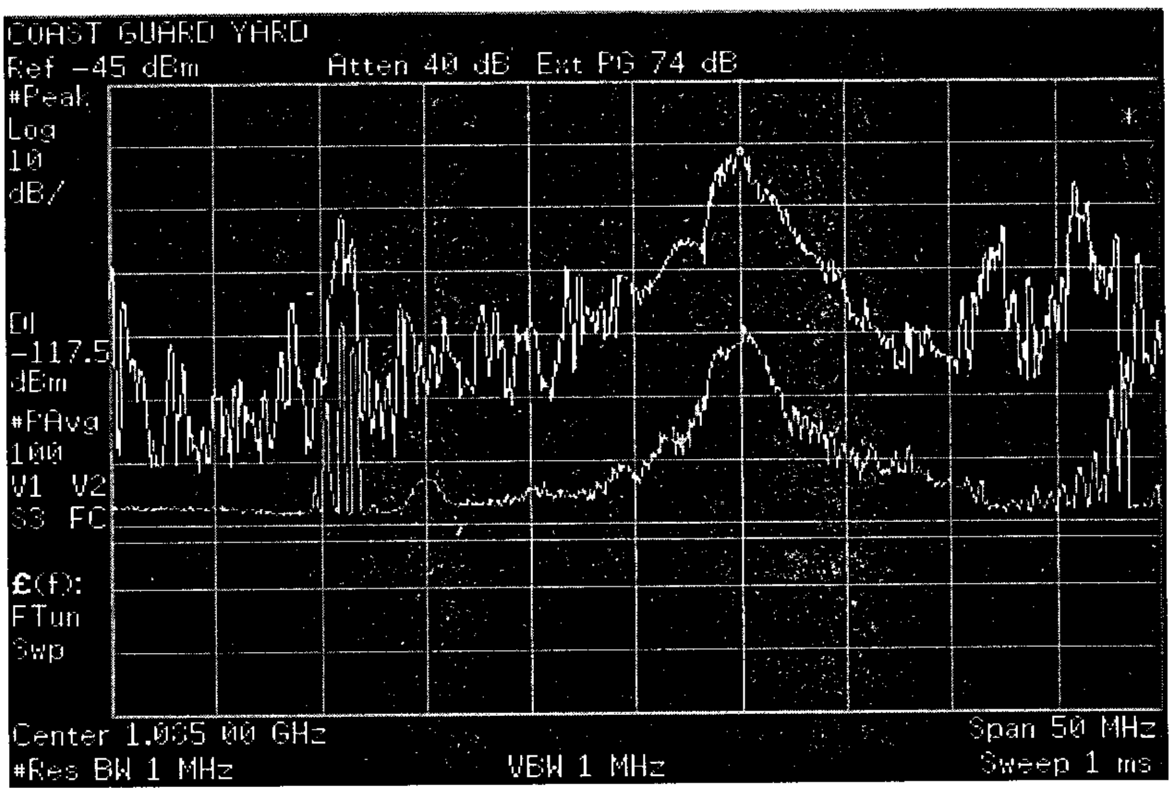

Figure C-48. Ambient Emissions in the 1060-1110 MHz Frequency Band at the Coast Guard Yard.

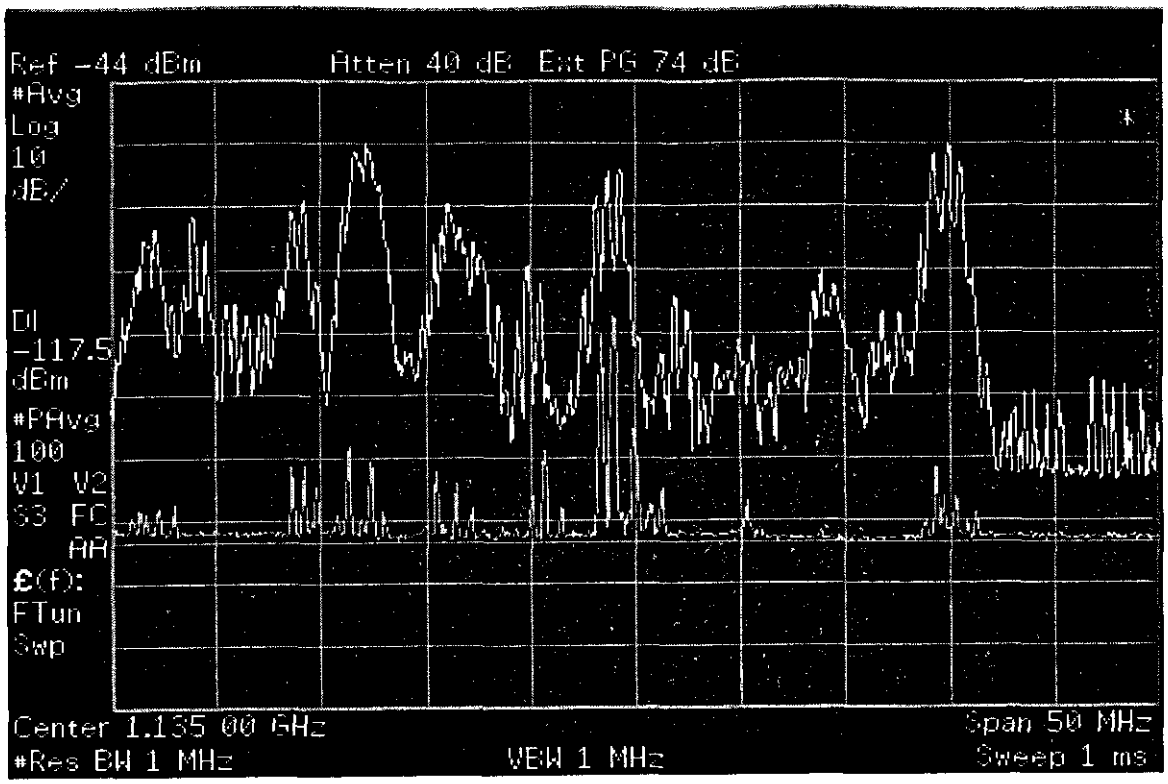

Figure C-49. Ambient Emissions in the 1110-1160 MHz Frequency Band at the Coast Guard Yard.

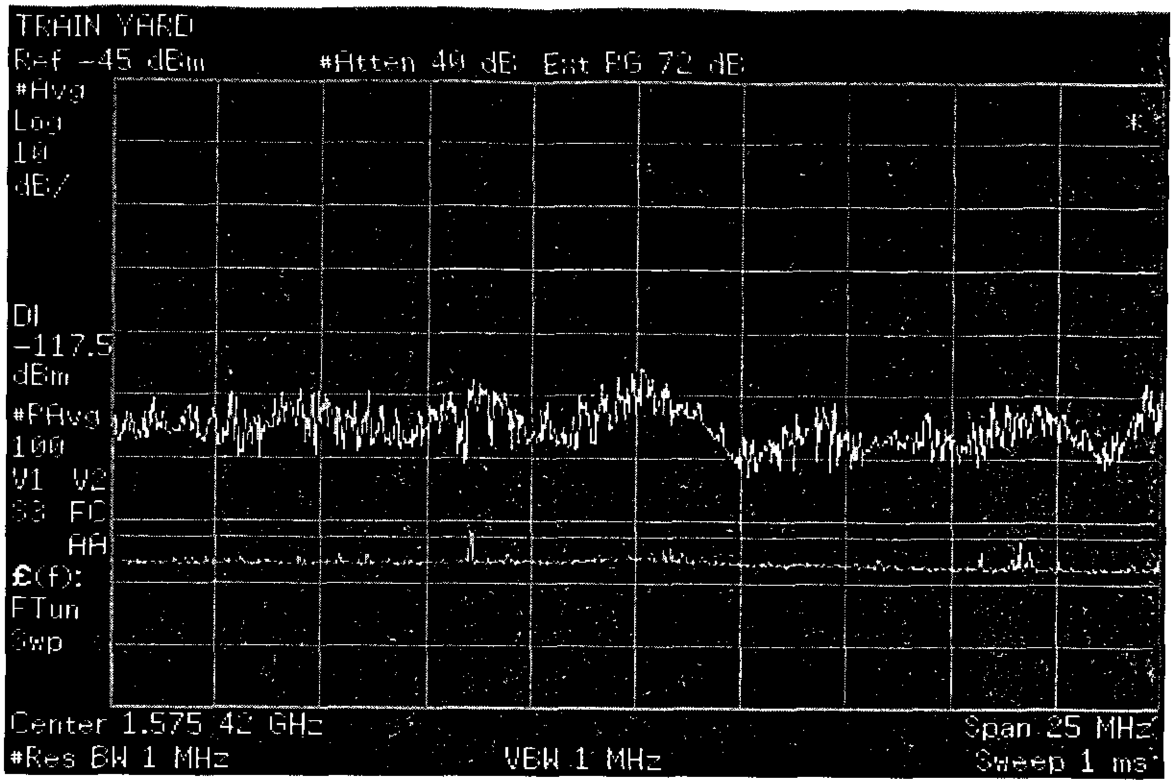

Figure C-50. Ambient Emissions in the GPS L1 Frequency Band at the AMTRAK Train Yard.

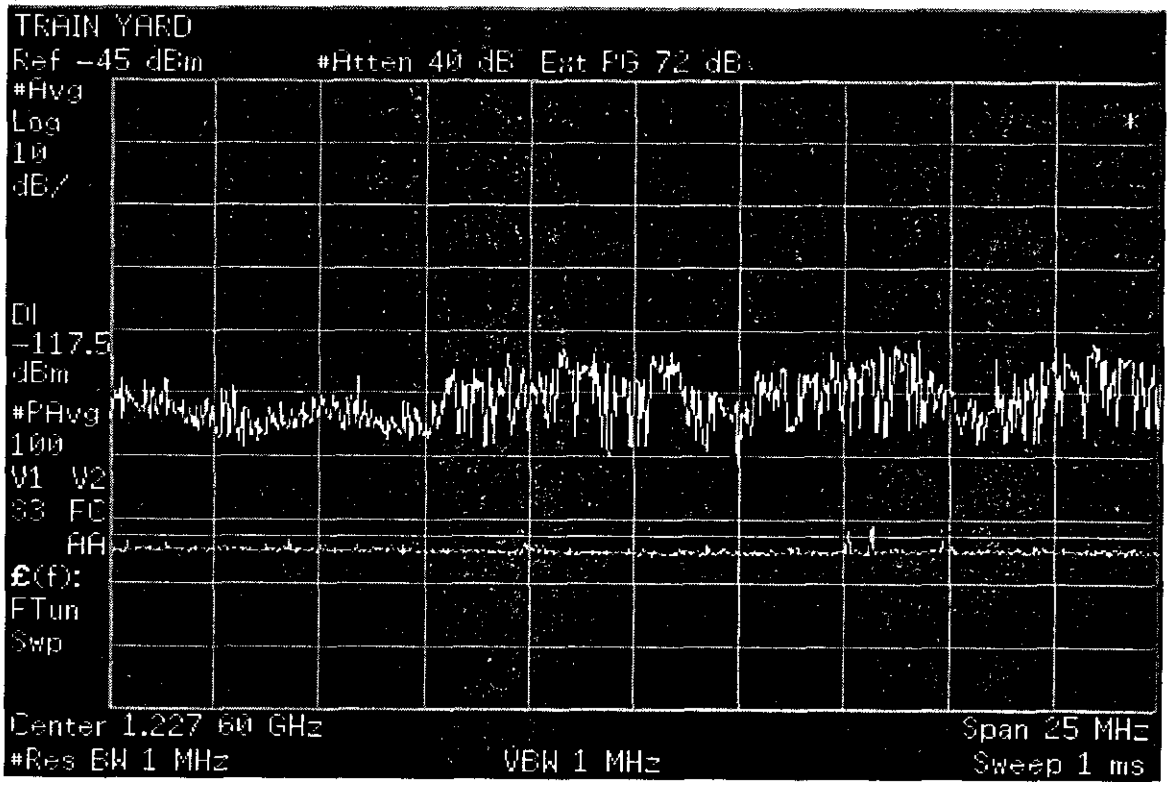

Figure C-51. Ambient Emissions in the GPS L2 Frequency Band at the AMTRAK Train Yard.

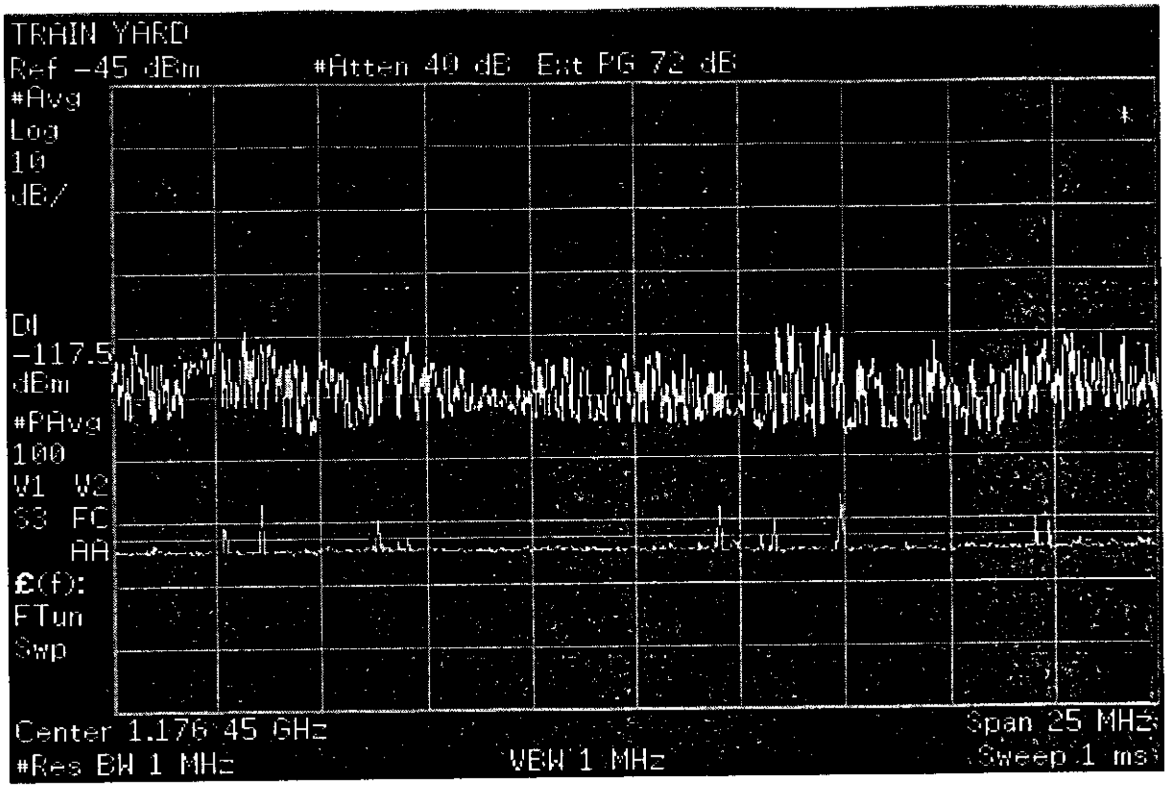

Figure C-52. Ambient Emissions in the GPS L5 Frequency Band at the AMTRAK Train Yard.

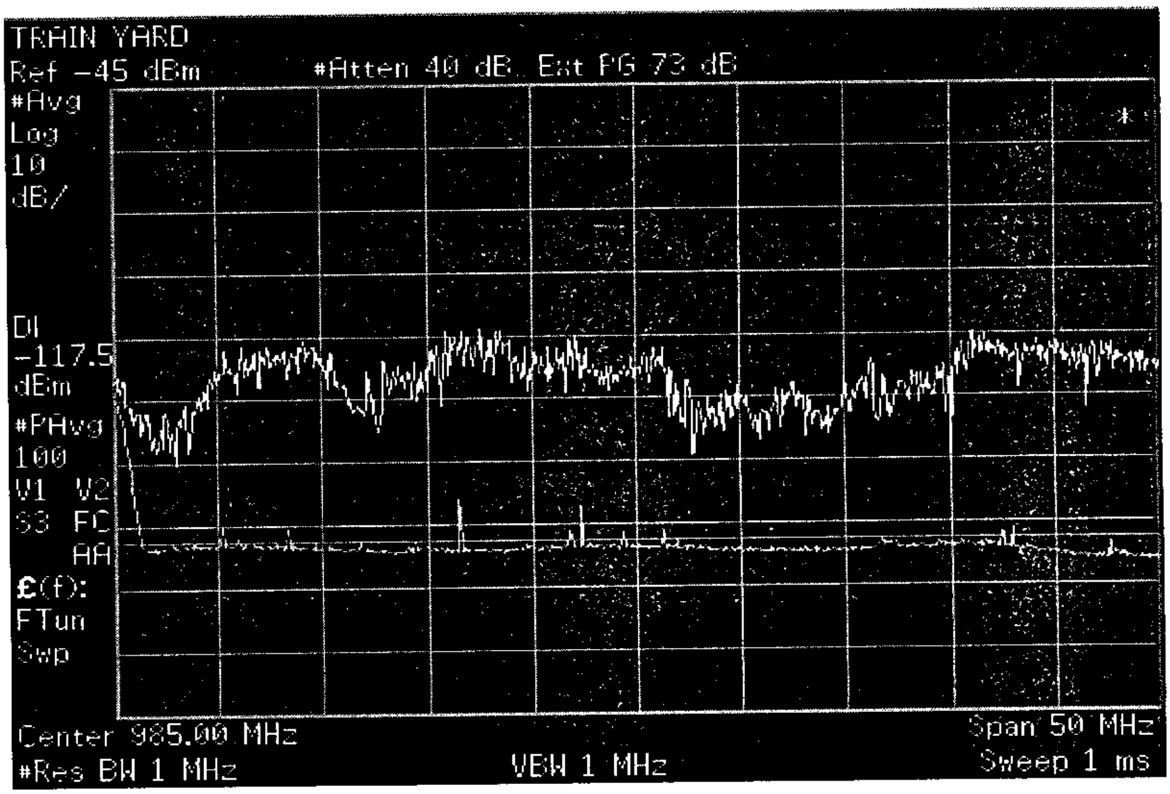

Figure C-53. Ambient Emissions in the 960-1010 MHz Frequency Band at the Train Yard.

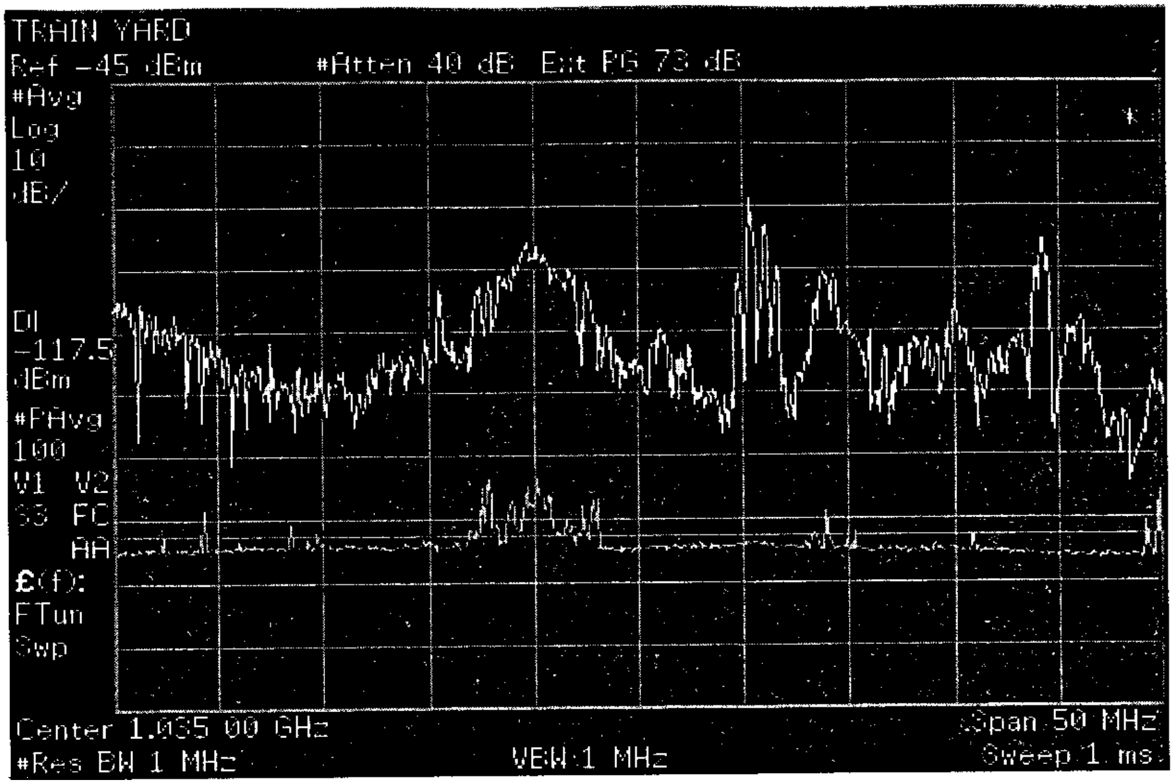

Figure C-54. Ambient Emissions in the 1010-1060 MHz Frequency Band at the Train Yard.

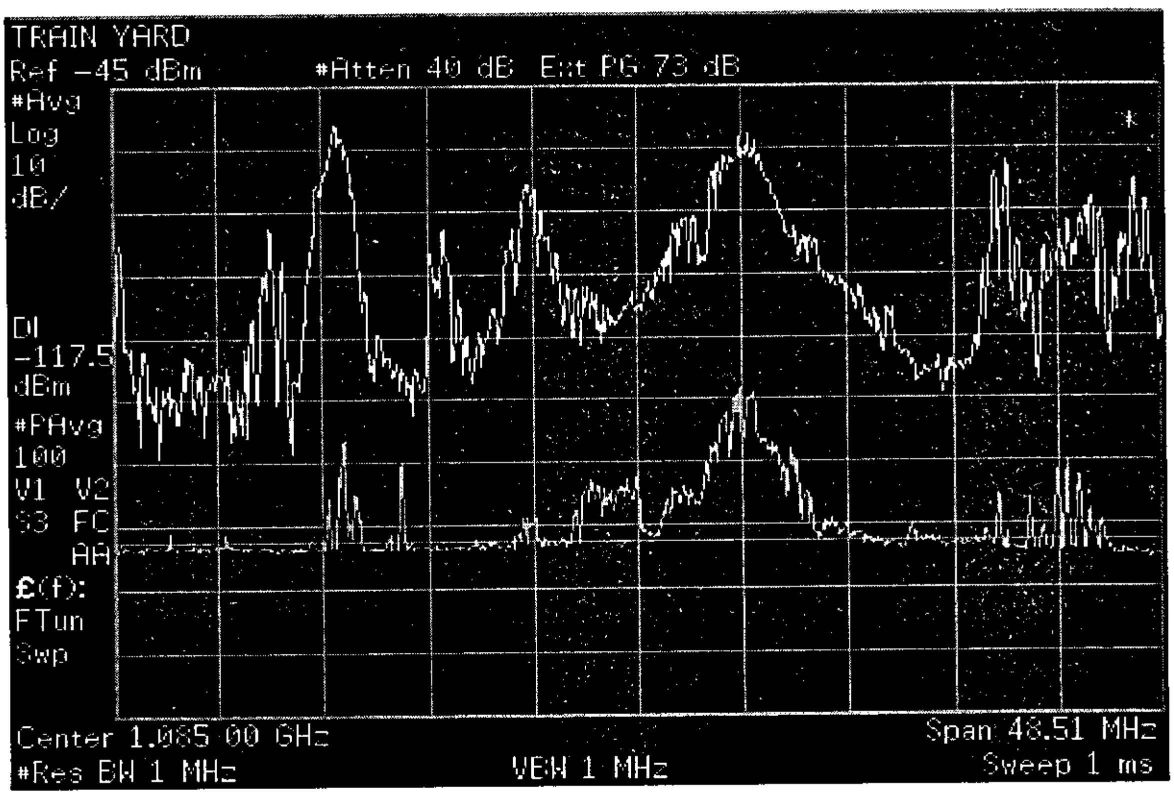

Figure *C-55.* Ambient Emissions in the 1060-1110 MHz Frequency Band at the Train Yard.

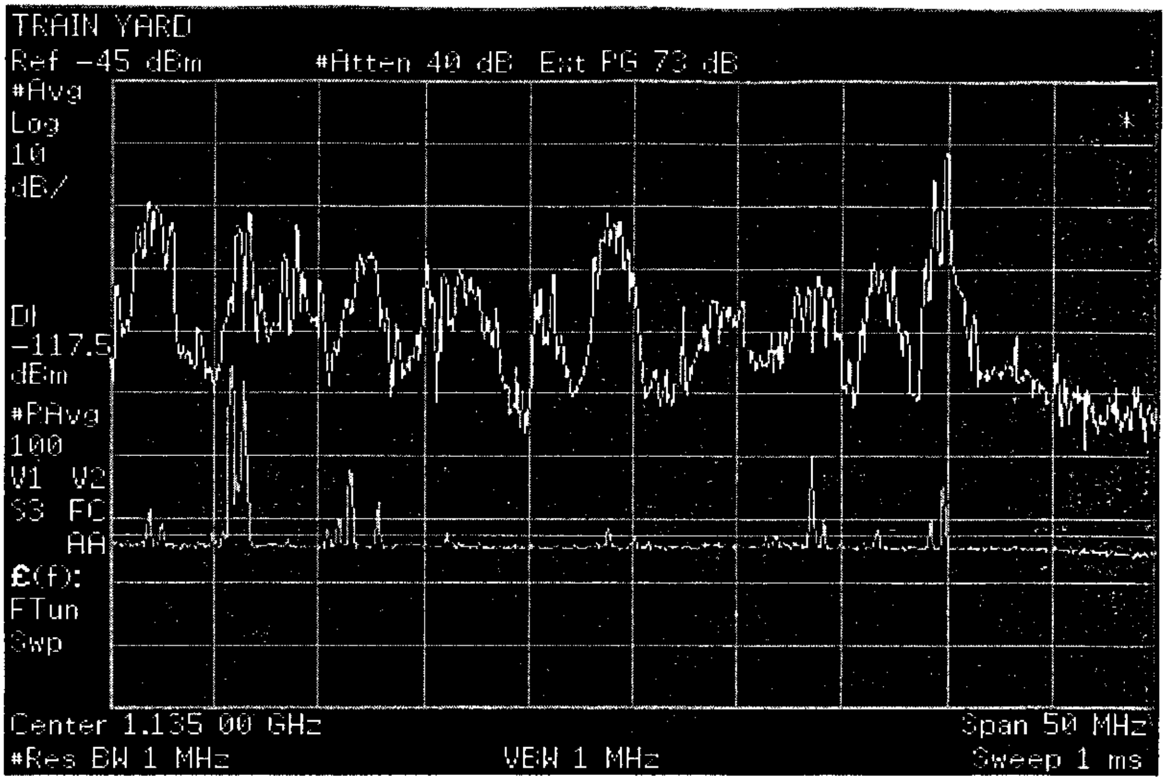

Figure C-56. Ambient Emissions in the 1110-1160 MHz Frequency Band at the Train Yard.

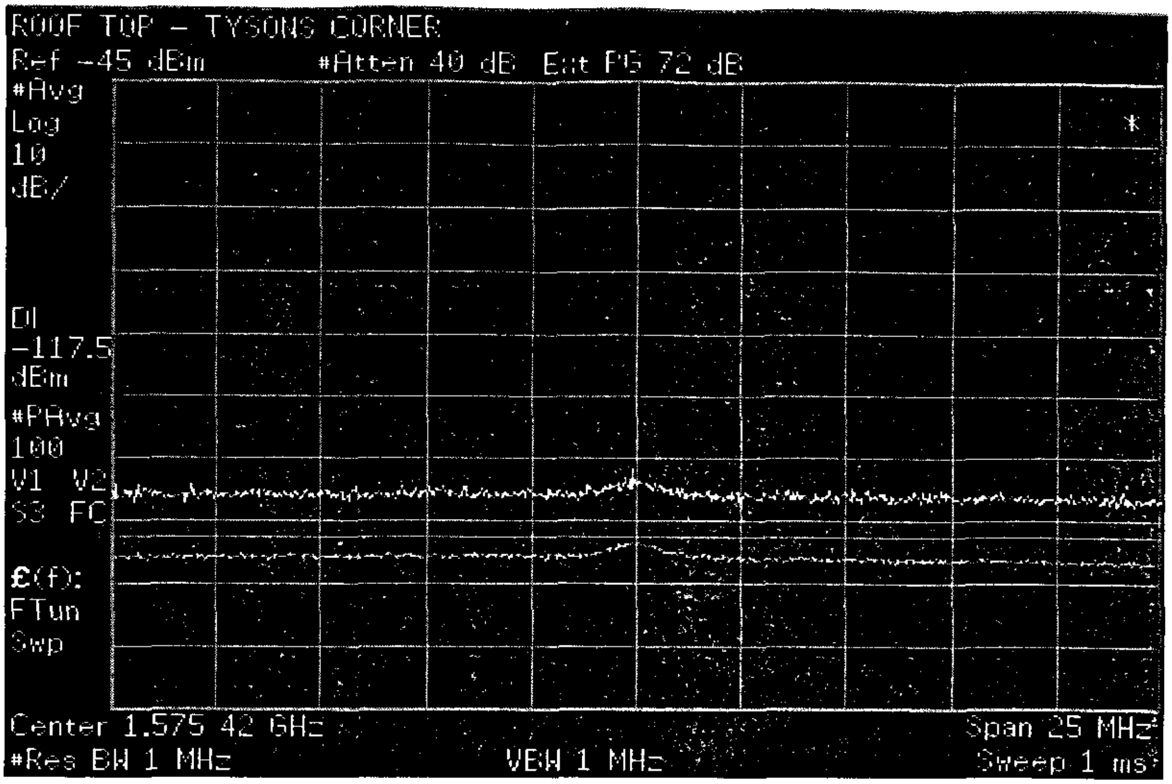

Figure *C-57.* Ambient Emissions in the GPS L1 Frequency Band at Urban/Industrial Site.

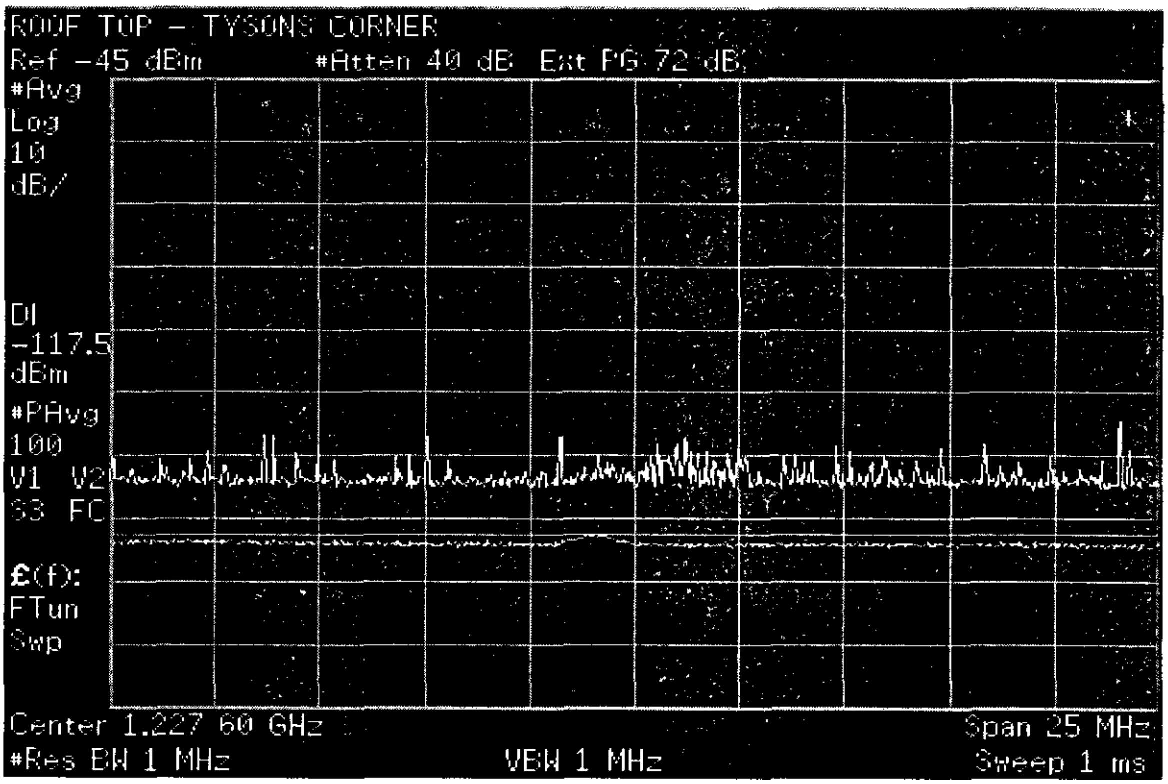

Figure *C-58.* Ambient Emissions in the GPS L2 Frequency Band at Urban/Industrial Site.

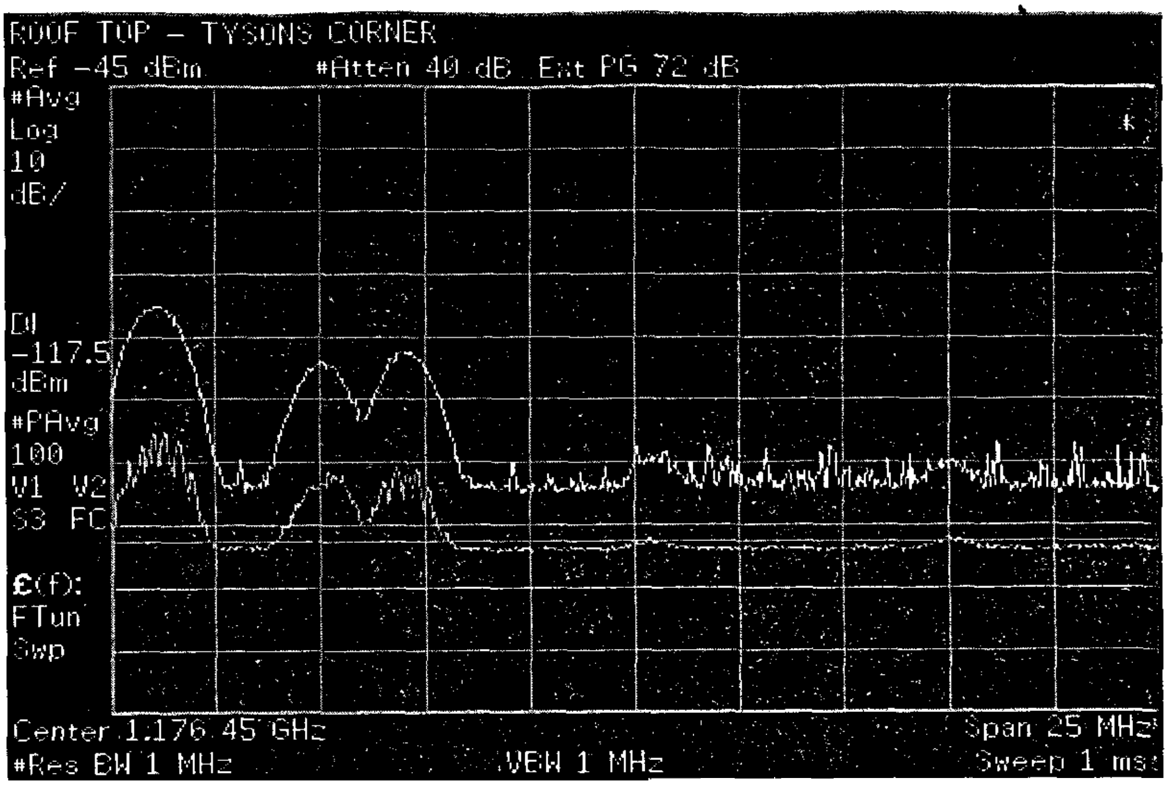

Figure C-59. Ambient Emissions in the GPS L5 Frequency Band at Urbanllndustrial Site.

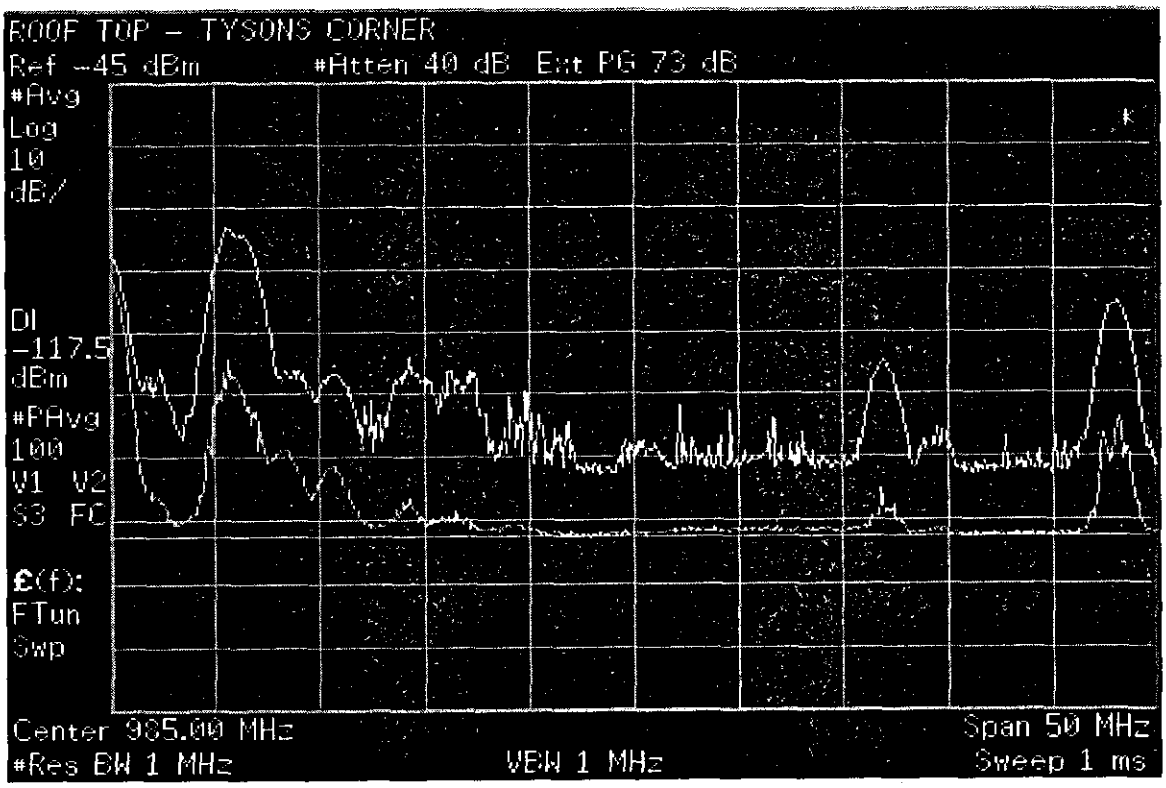

Figure C-60. Ambient Emissions in the 960-1010 MHz Frequency Band at Urban/Industrial Site.

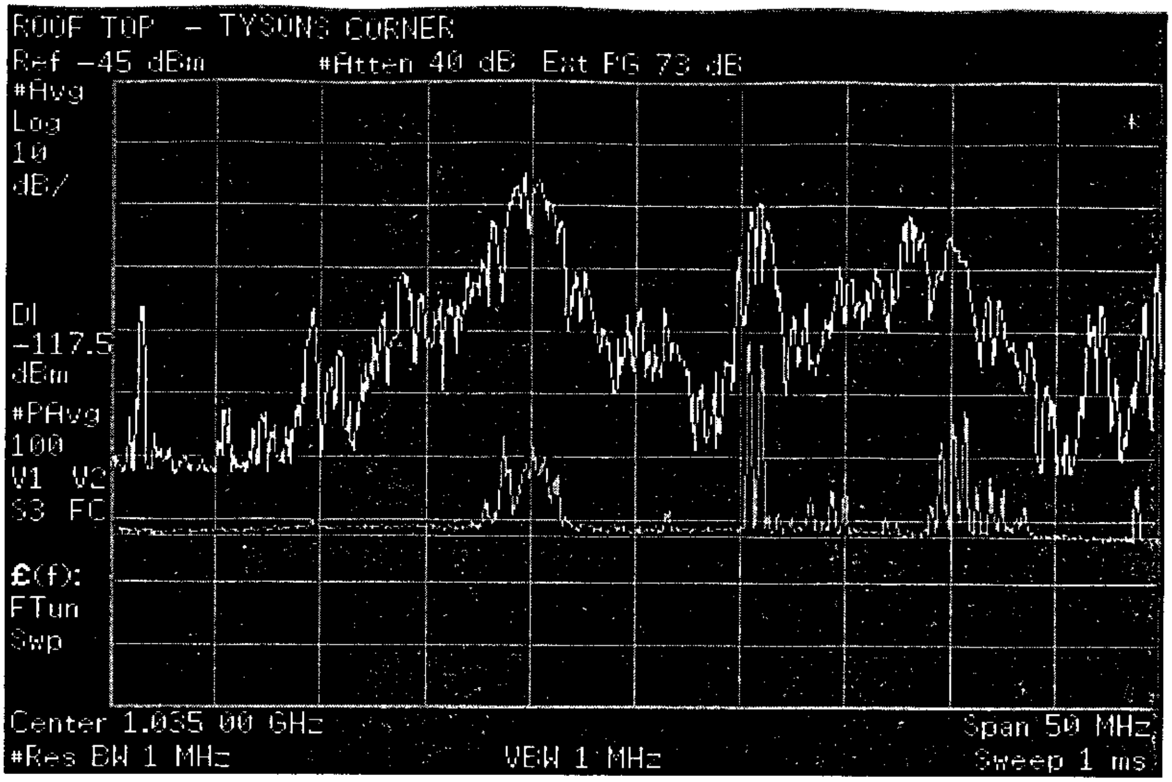

Figure C-61. Ambient Emissions in the 1010-1060 MHz Frequency Band at Urban/Industrial Site.

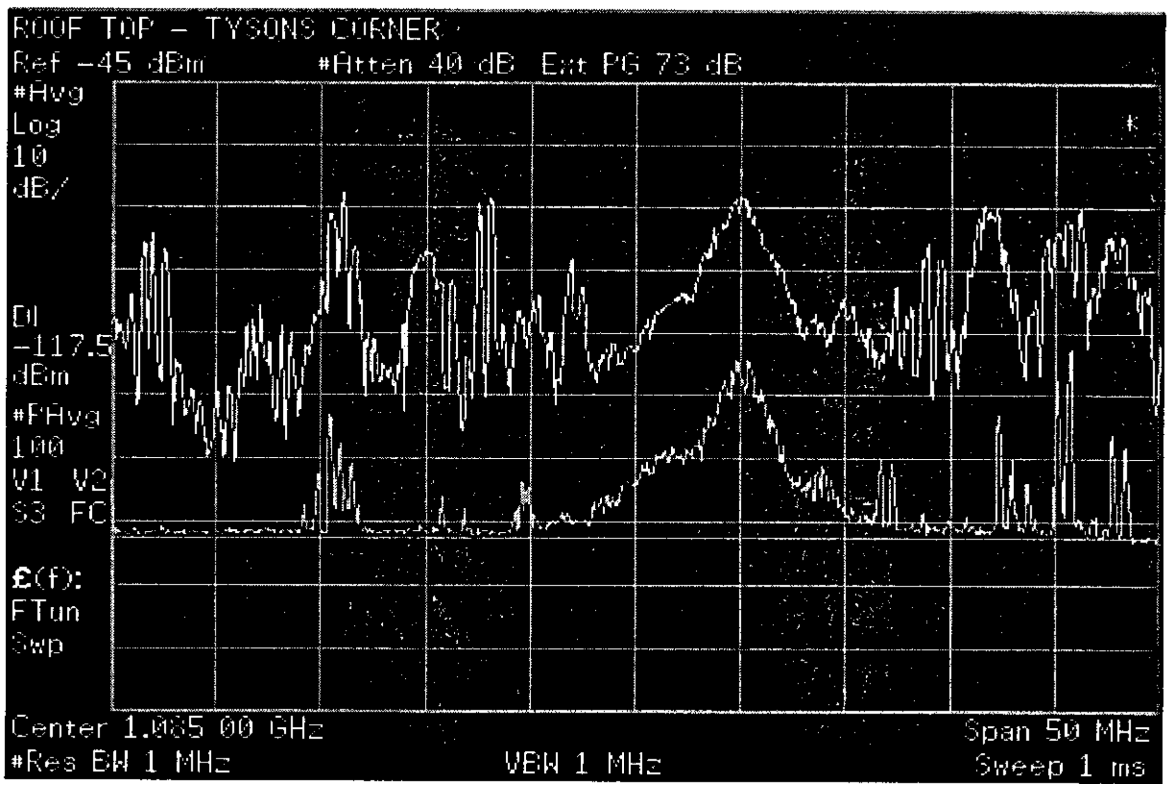

Figure C-62. Ambient Emissions in the 1060-1110 MHz Frequency Band at Urban/Industrial Site.

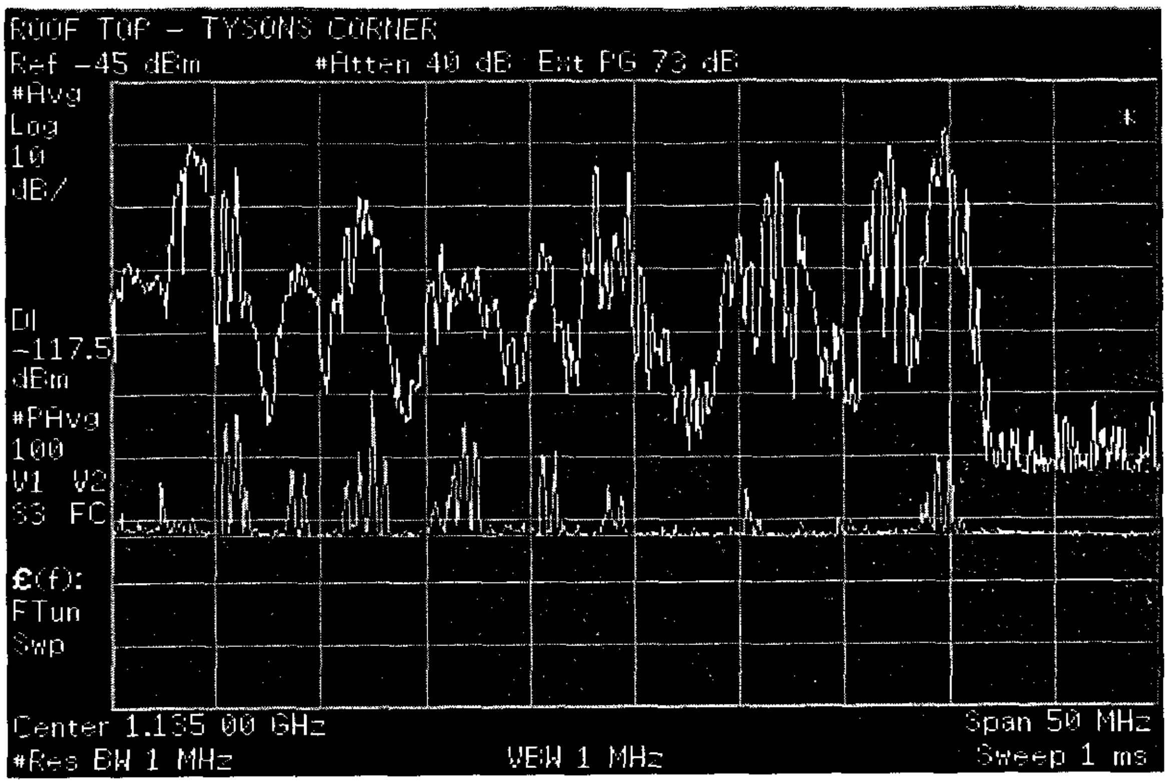

Figure C-63. Ambient Emissions in the 1110-1160 MHz Frequency Band at Urban/Industrial Site.

APPENDIX D
INDOOR AMBIENT EMISSIONS MEASUREMENT DATA

The data plots recorded from the measurement of existing ambient emissions at indoor sites such as office buildings and factory facilities are presented in this appendix. The following paragraphs provide guidance on reading and interpreting these plots.

In each of the figures presented in this appendix, the upper (yellow) trace depicts the ambient emissions measured in the subject frequency band using a peak detector and the maximum hold function (i.e., no averaging employed) over a fifteen-minute period. This trace was generated mainly as a tool for orienting the measurement antenna and for determining the maximum likely emission amplitudes to facilitate decisions pertaining to the necessity of adding additional attenuation in the measurement system so as to prevent overdriving of components. This data was not used for any analytical purposes. The lower (blue) trace represents the measured RMS average emission level over one hundred one-millisecond analyzer sweeps across the measurement band. This is the data used to compare to the assumed interference threshold for enhanced GPS receivers. The constant display line (green) at -117.5 dBm is used as the basis for comparing the measured data **to** the theoretical enhanced GPS interference threshold.

All external measurement system parameters (e.g., amplifier gains, cable loss, and antenna gain) are accounted for in the spectrum analyzer display and are provided on each plot under the tag Ext PG located at the top of the display. At some measurement locations, it was necessary to add additional attenuation in the measurement system due to the presence of relatively high-amplitude signals. In those cases where additional external attenuation was required, the Ext PG value was adjusted accordingly. Thus, the levels shown on the amplitude axis of the spectrum analyzer plots represent the actual RMS average power as measured in a 1 MHz bandwidth at the measurement system antenna.

In each of these plots, the horizontal axis represents frequency and the vertical axis represents amplitude. For measurements in the GPS frequency bands, a span of **25** MHz was used to encompass the **24** MHz registered frequency band. For a *25* MHz span, each vertical graticule line represents a 2.5 MHz deviation in frequency **(25** MHz/10 graticule lines). For the measurements performed in the 960-1160 MHz **(ARNS)** band, a span of 50 MHz was used, the maximum that could be achieved within the pass band of the pre-select filter. In these plots, each vertical graticule line represents a frequency deviation of 5 MHz (50 MHz/10 graticule lines).

On the amplitude axis, each horizontal graticule line represents a 10 dB decrement from the reference level amplitude shown in the upper left-hand comer of the plot.

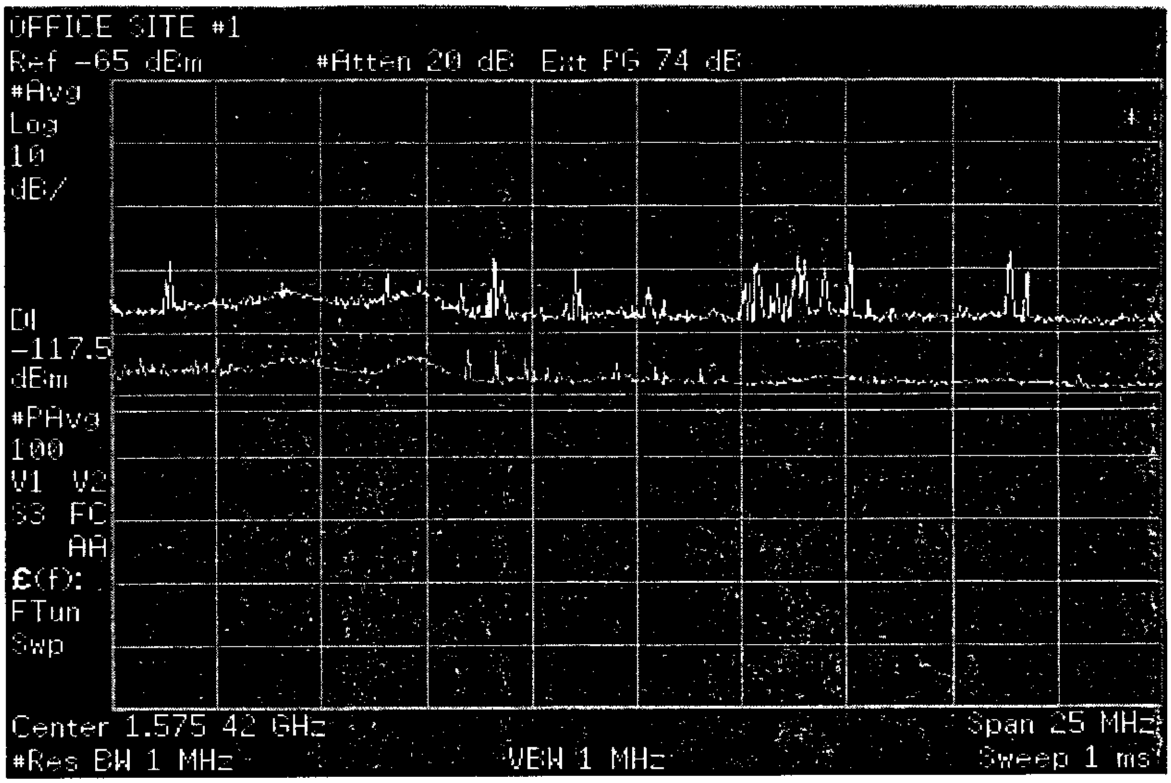

Figure D-64. Ambient Emissions in GPS L1 Frequency Band Office Building #1.

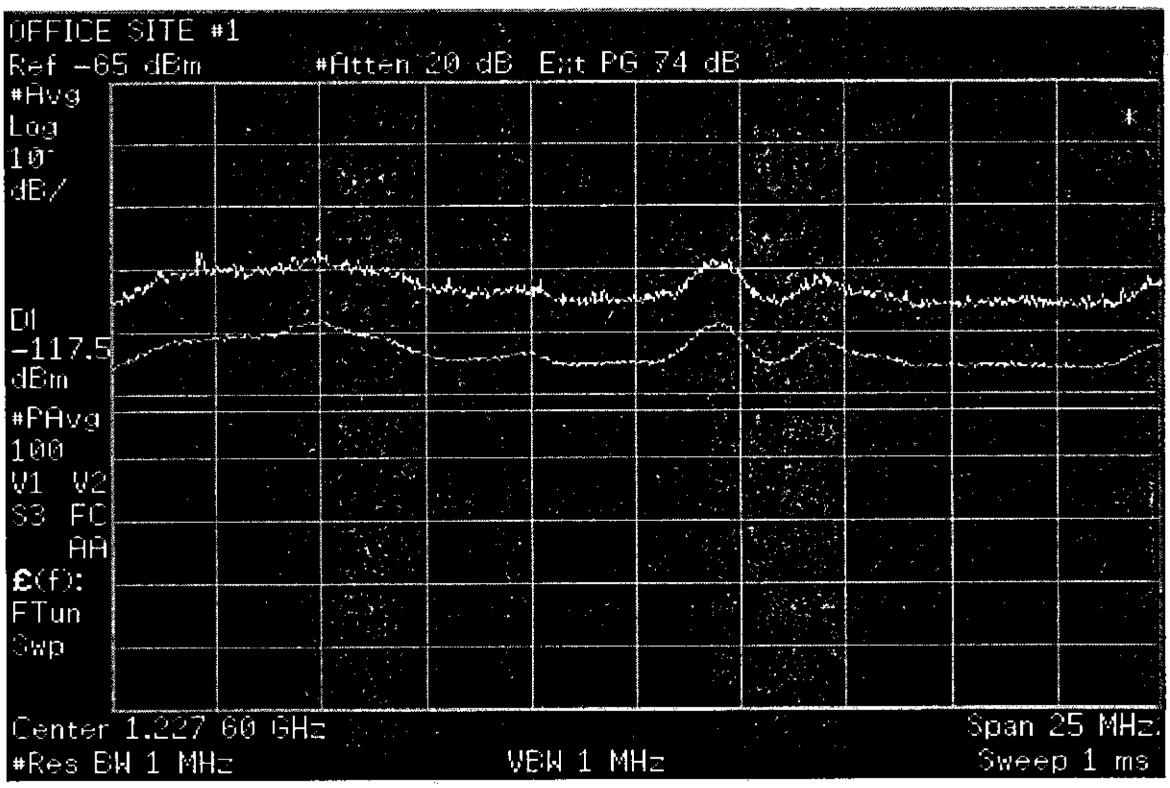

Figure D-65. Ambient Emissions in GPS L2 Frequency Band Office Building #1.

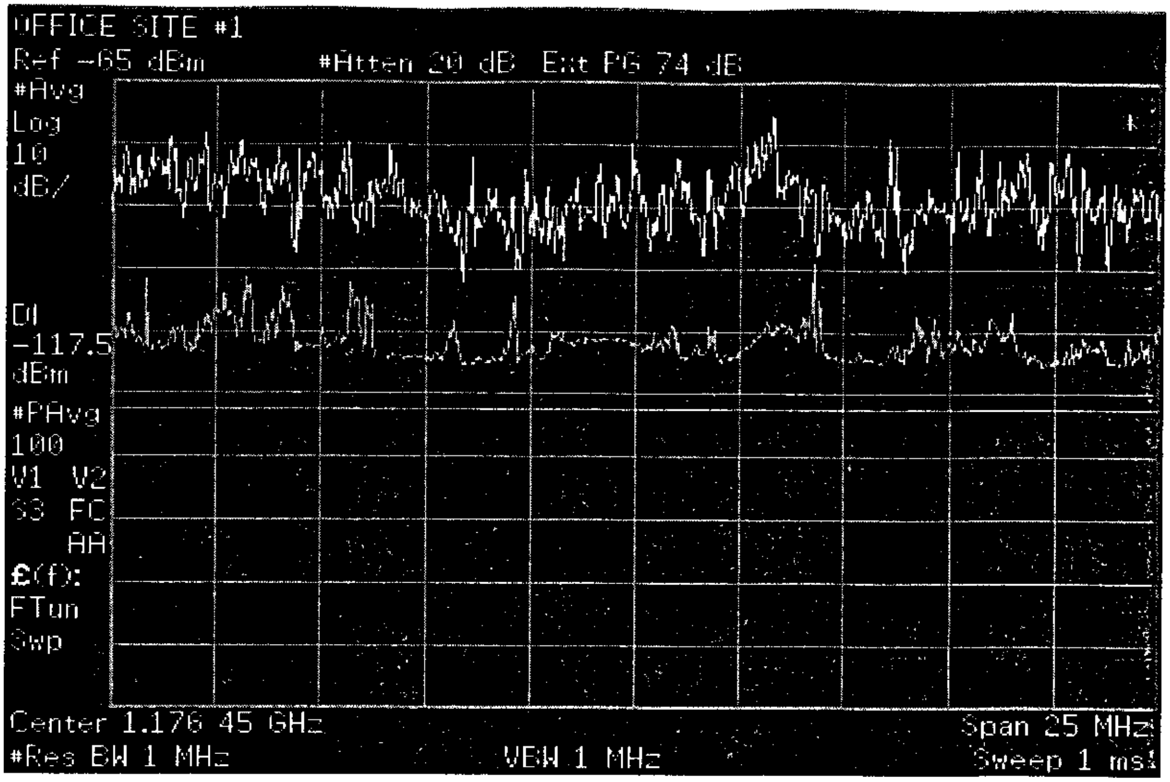

Figure D-66. Ambient Emissions in GPS L5 Frequency Band Office Building #1.

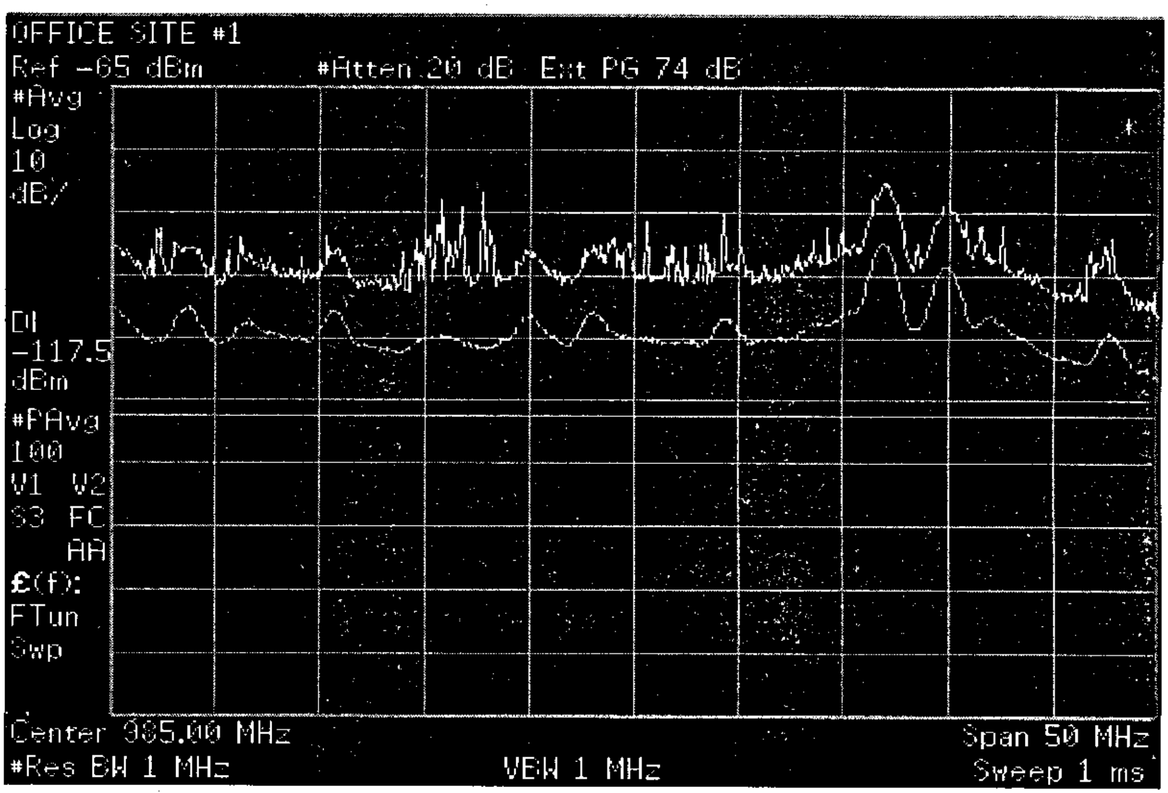

Figure D-67. Ambient Emissions in 960-1010 MHz Frequency Band at Office Building #1.

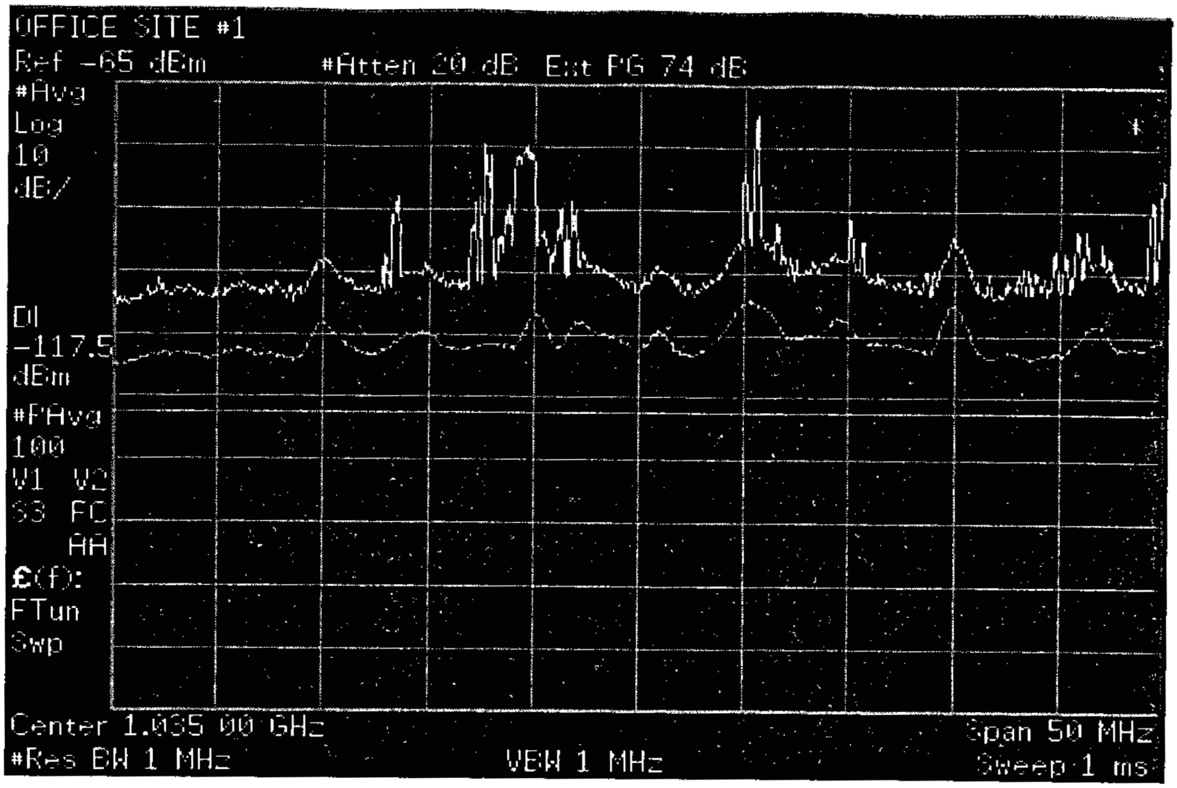

Figure D-68. Ambient Emissions in 1010-1060MHz Frequency Band at Office Site #l.

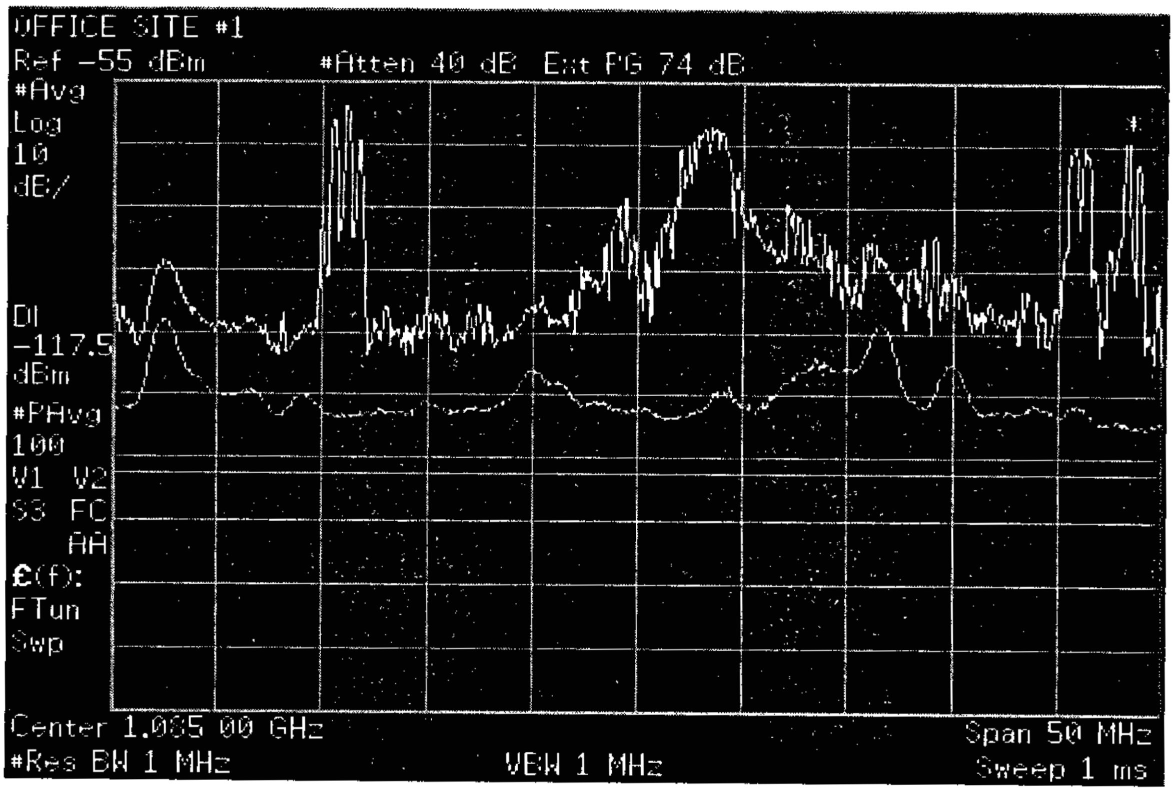

Figure D-69. Ambient Emissions in 1060-1110 MHz Frequency Band at Office Site #1.

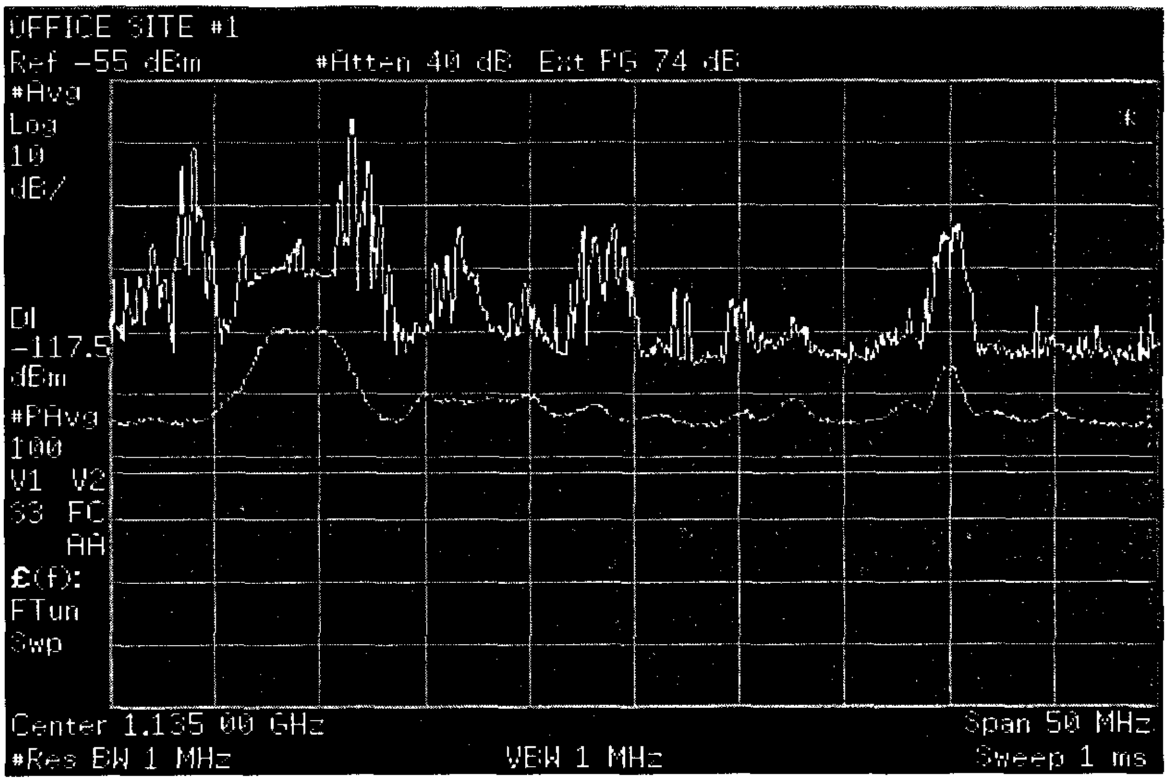

Figure D-70. Ambient Emissions in 1110-1160 MHz Frequency Baud at Office Site #1.

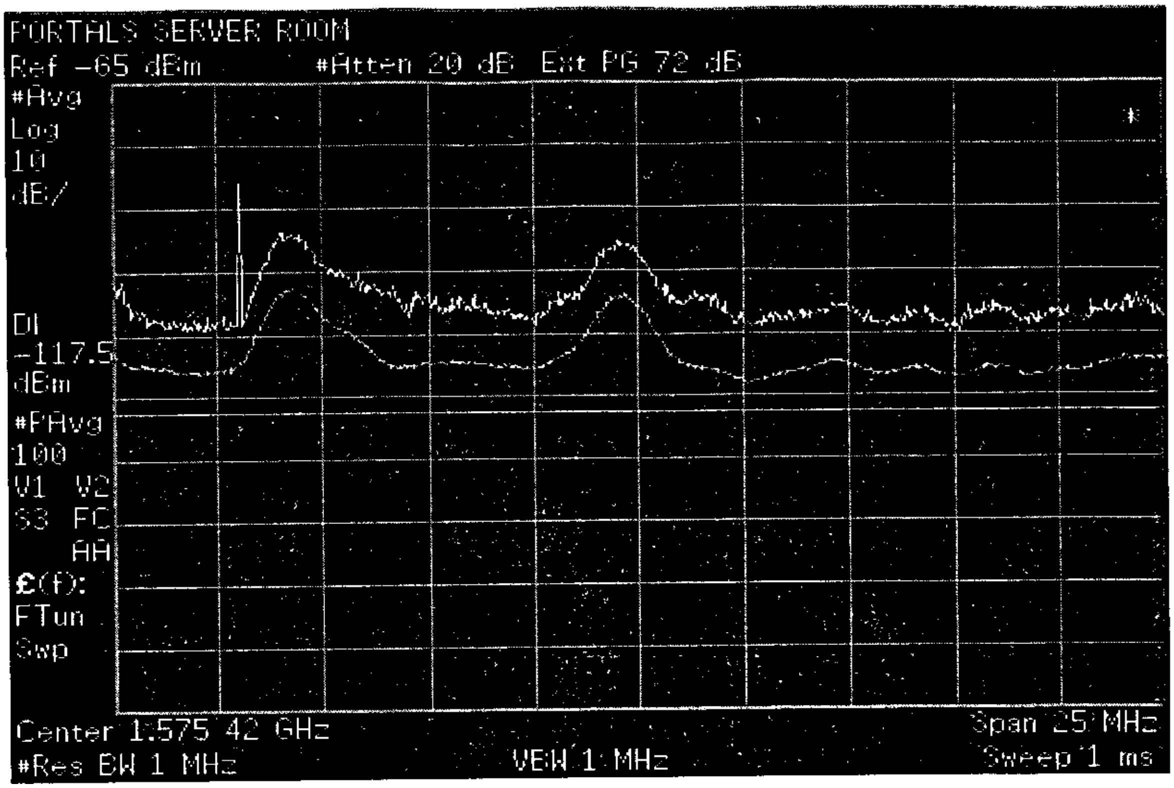

Figure D-71. Ambient Emissions in GPS L1 Frequency Band at Office Site #2.

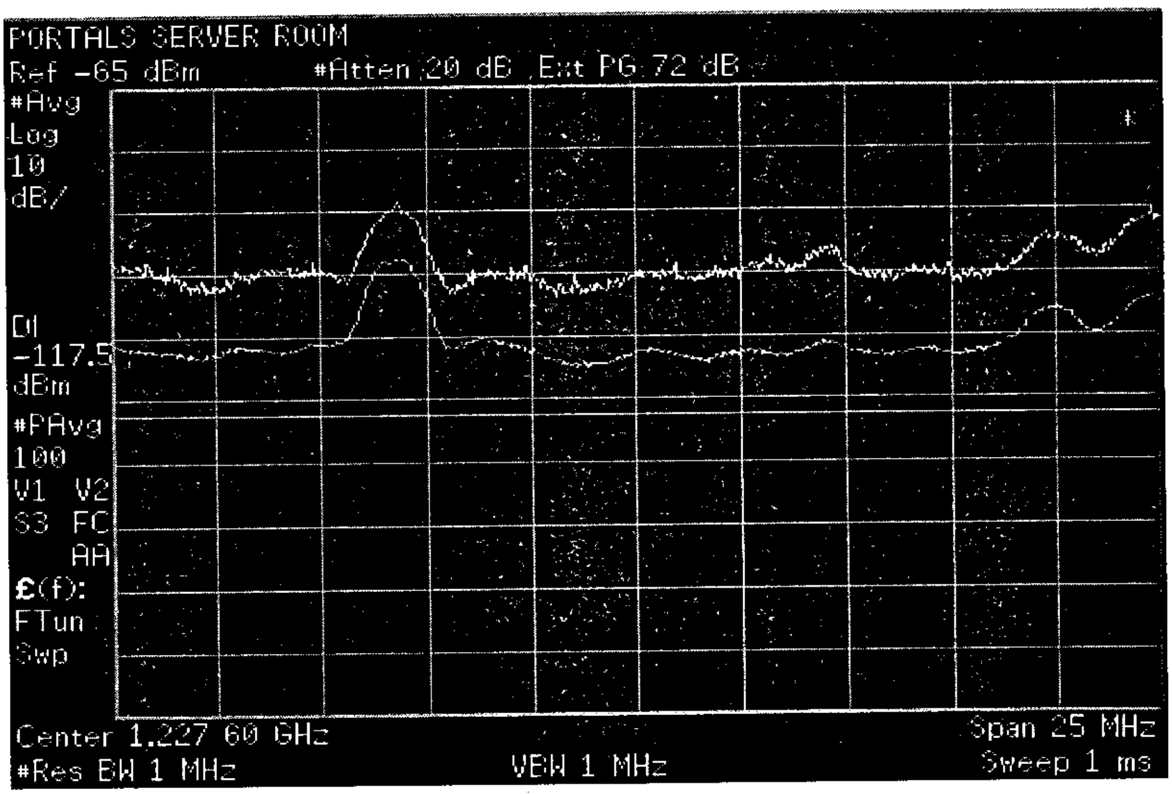

Figure D-72. Ambient Emissions in GPS L2 Frequency Band at Office Site #2.

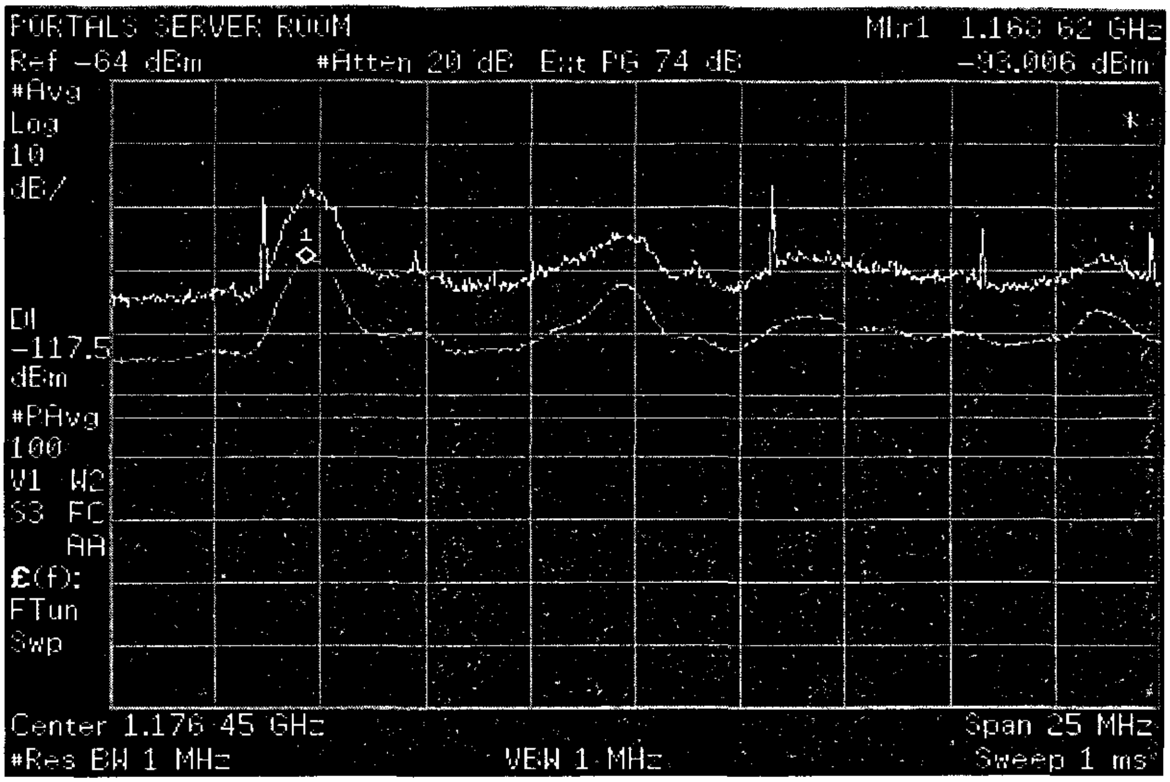

Figure D-73. Ambient Emissions in GPS L5 Frequency Band at Office Site #2.

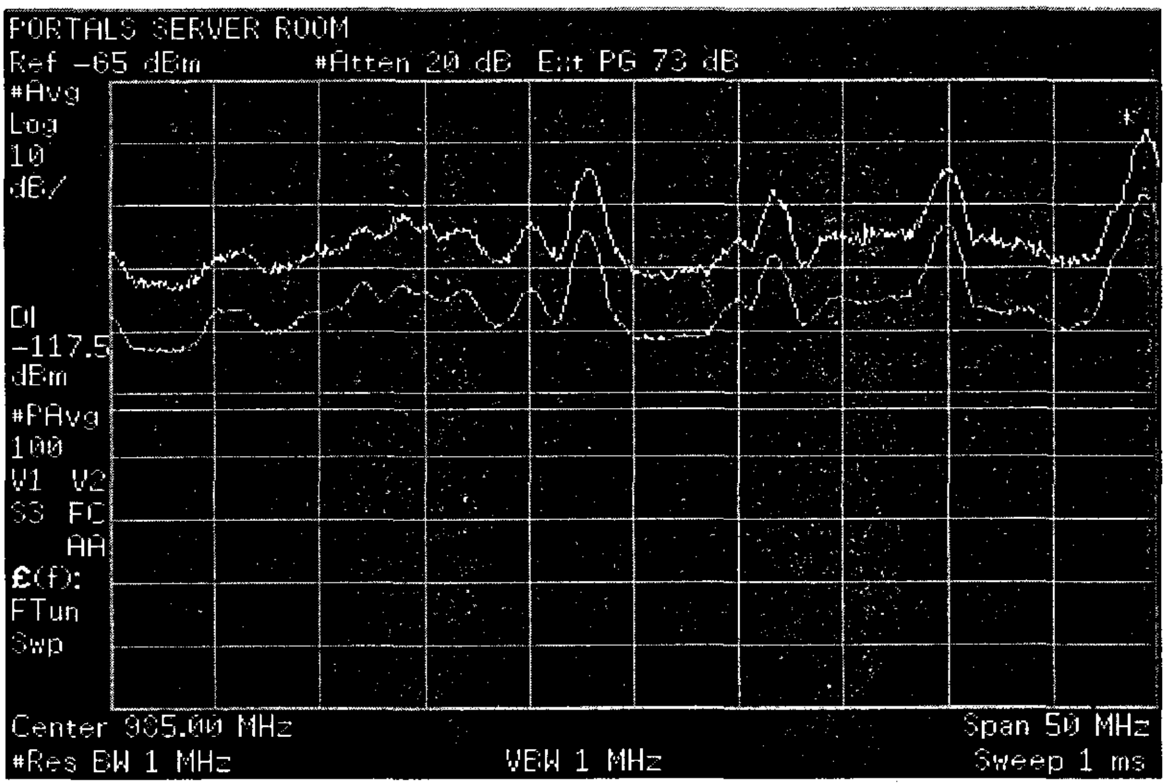

Figure D-74. Ambient Emissions in 960-1010 MHz Frequency Band at Office Site #2.

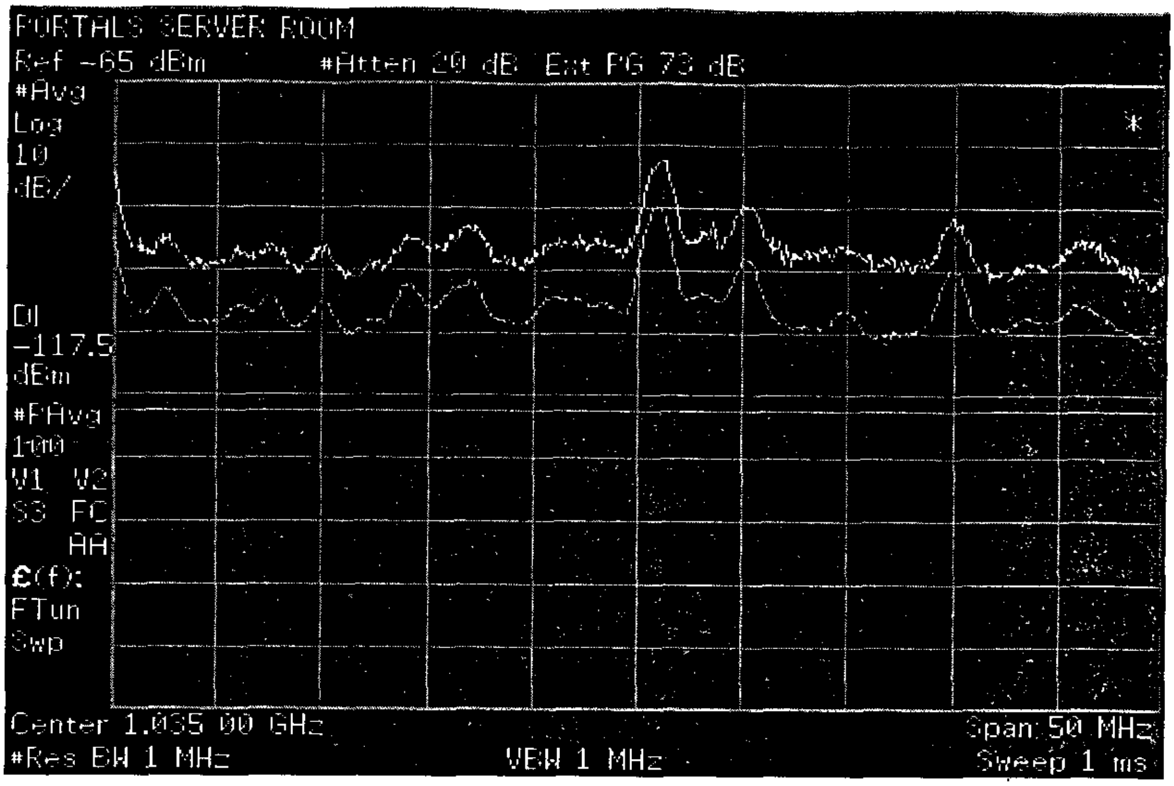

Figure D-75. Ambient Emissions in 1010-1060 MHz Frequency Band at *Office* Site #2.

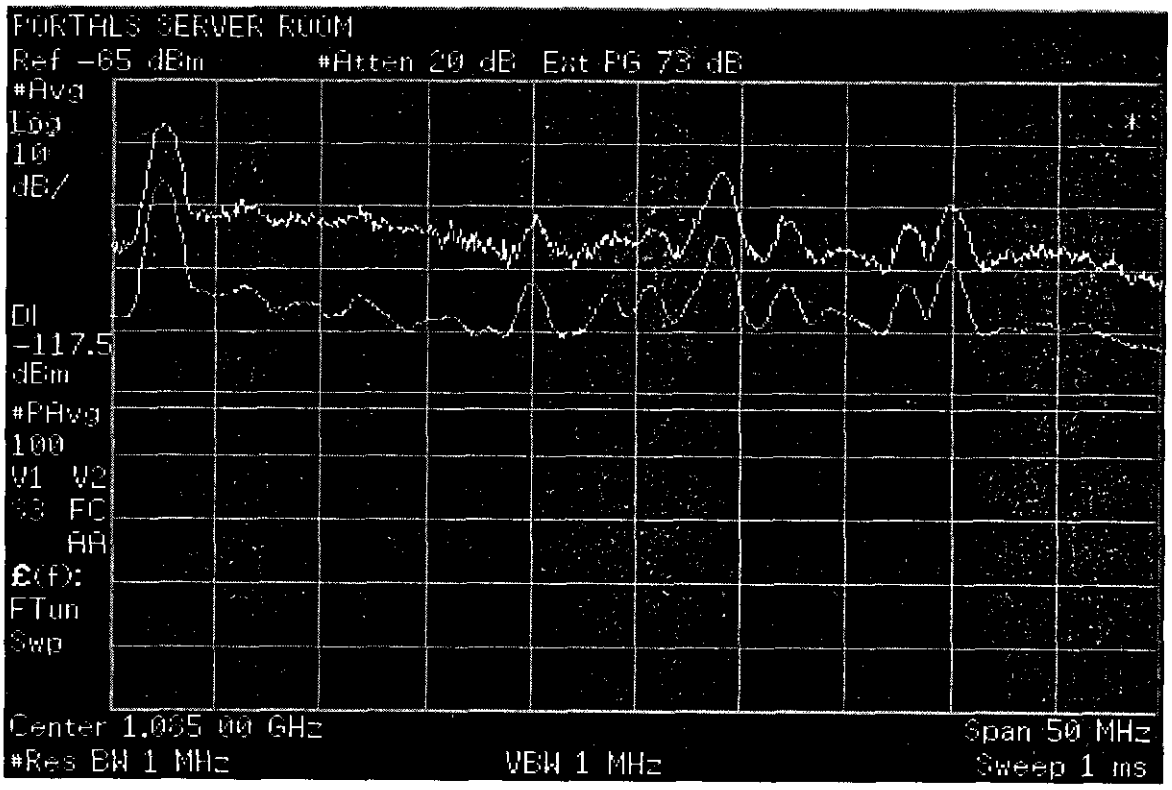

Figure D-76. Ambient Emissions in 1060-1110 MHz Frequency Band at Office Site #2.

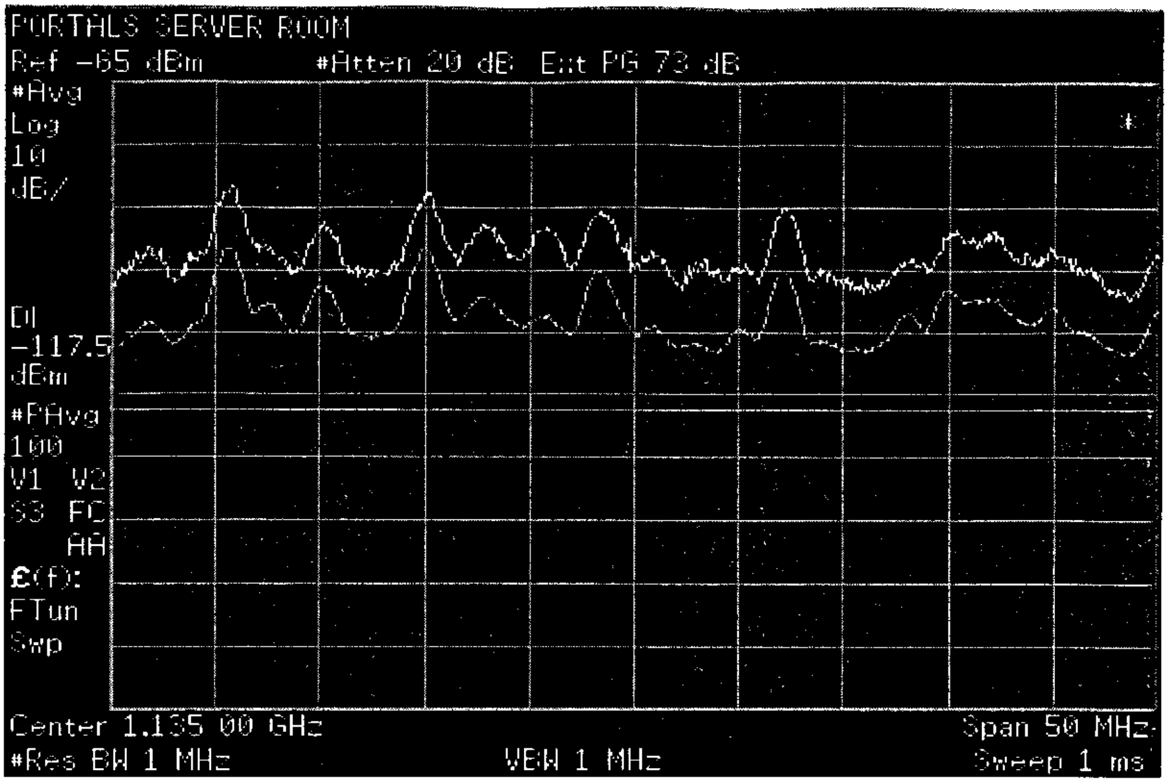

Figure D-77. Ambient Emissions in 1110-1160MHz Frequency Band at Office Site #2.

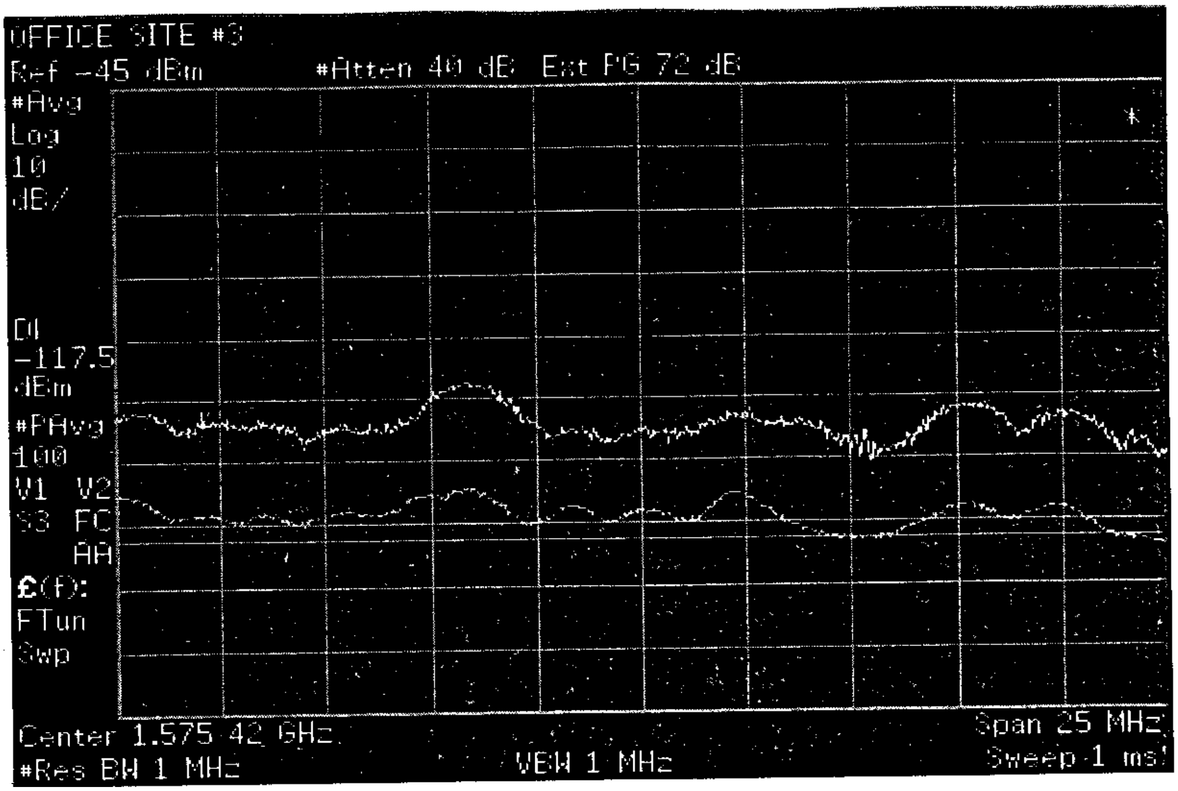

Figure D-78. Ambient Emissions in GPS L1 Frequency Band at Office Site #3.

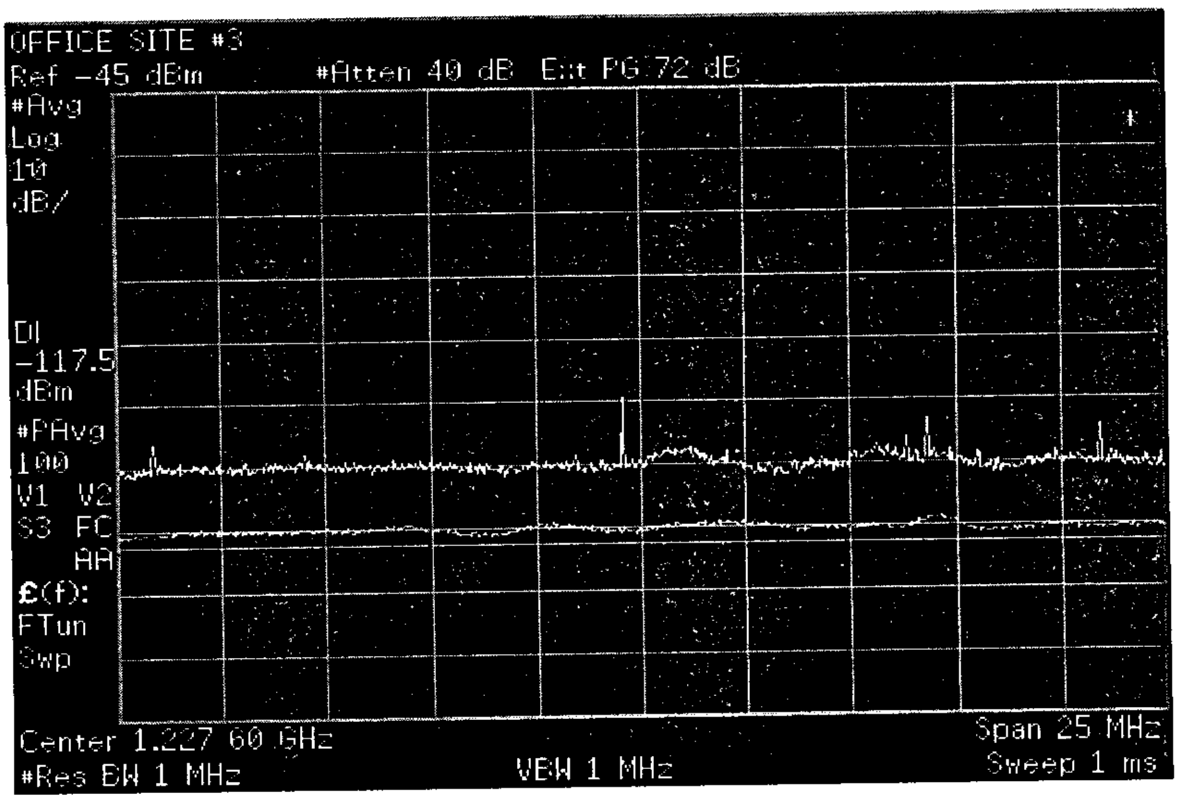

Figure D-79. Ambient Emissions in GPS L2 Frequency Band at Office Site #3.

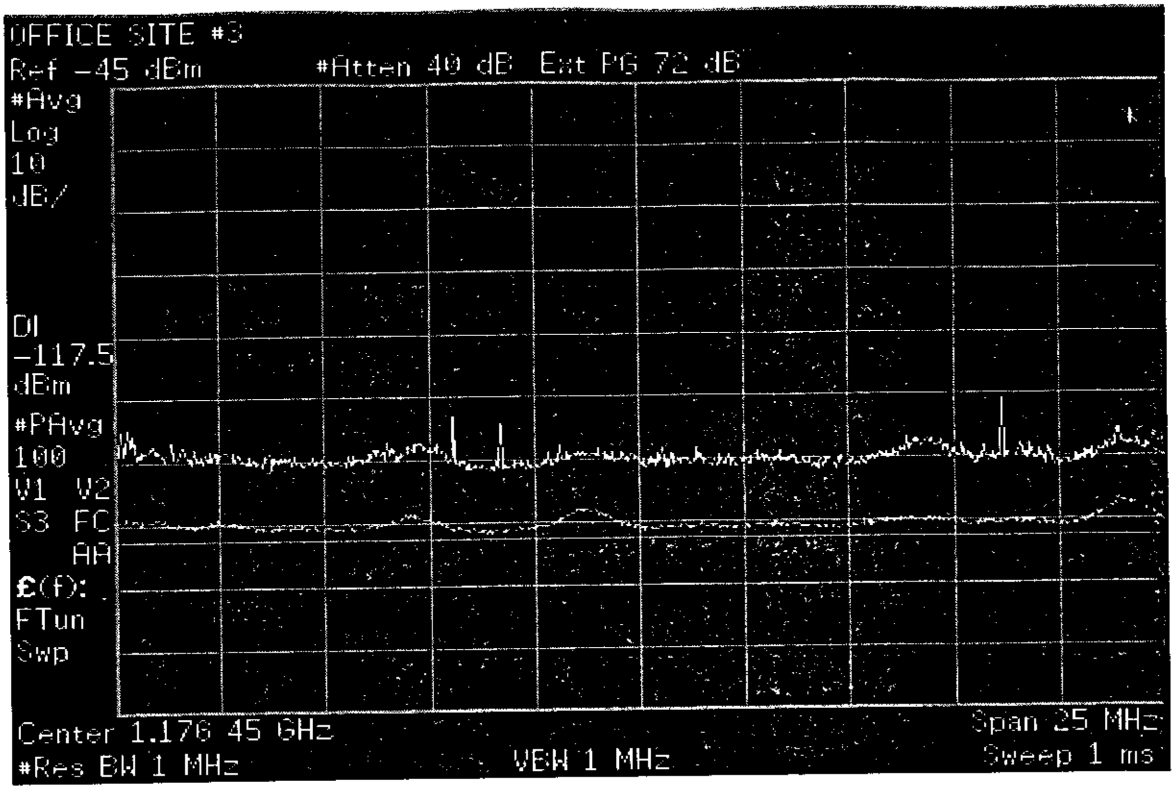

Figure D-80. Ambient Emissions in GPS L5 Frequency Band at Office Site #3.

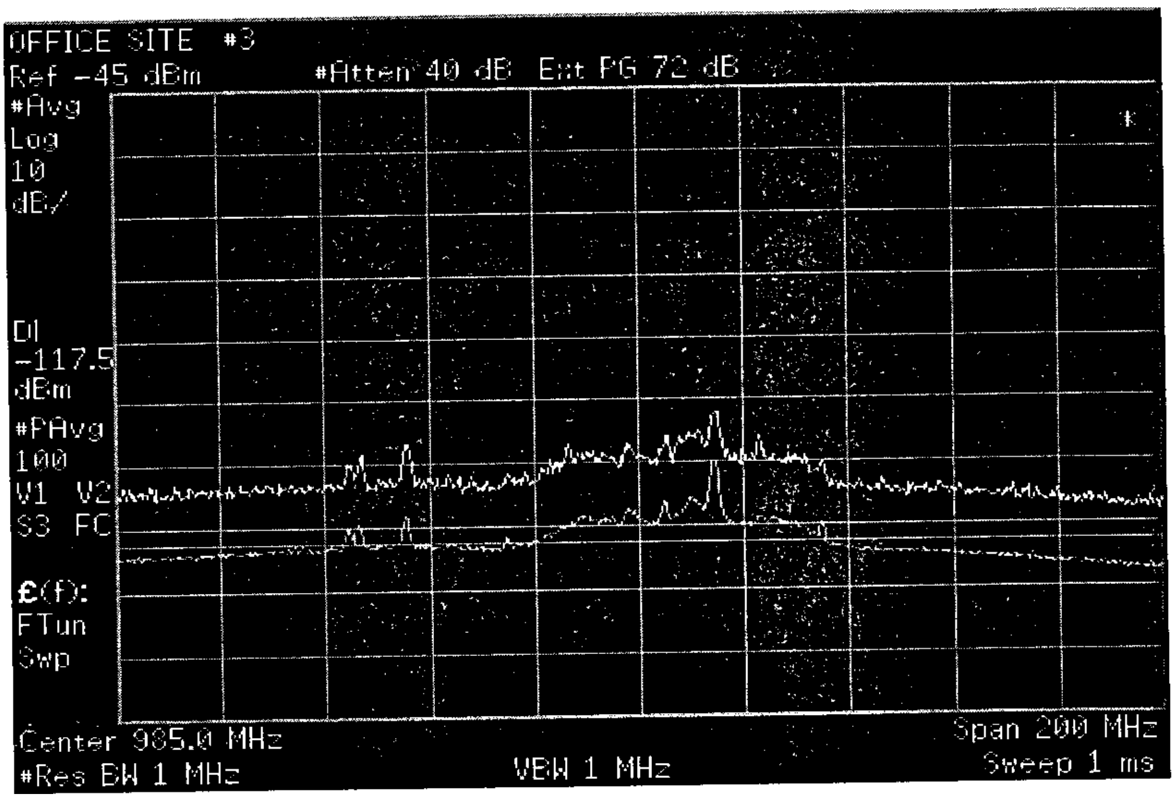

Figure D-81. Ambient Emissions in 960-1010 MHz Frequency Band at Office Site #3.

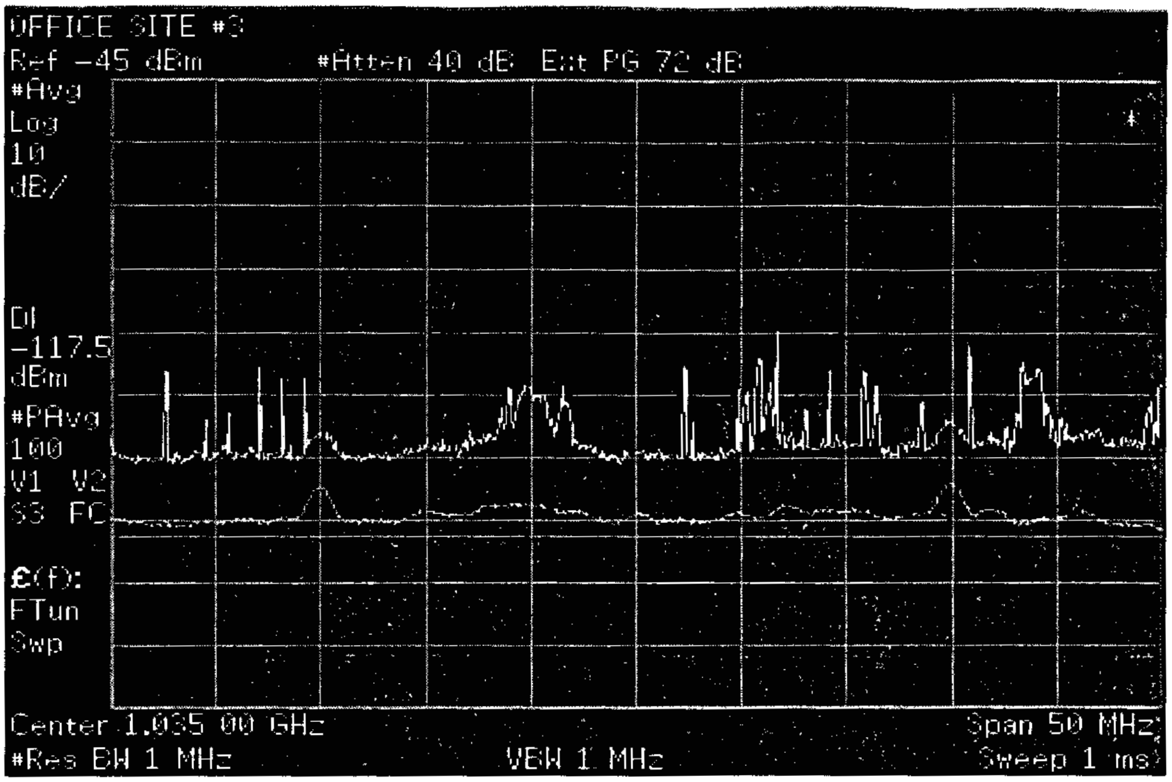

Figure D-82. Ambient Emissions in 1010-1060 MHz Frequency Band at Office Site #3.

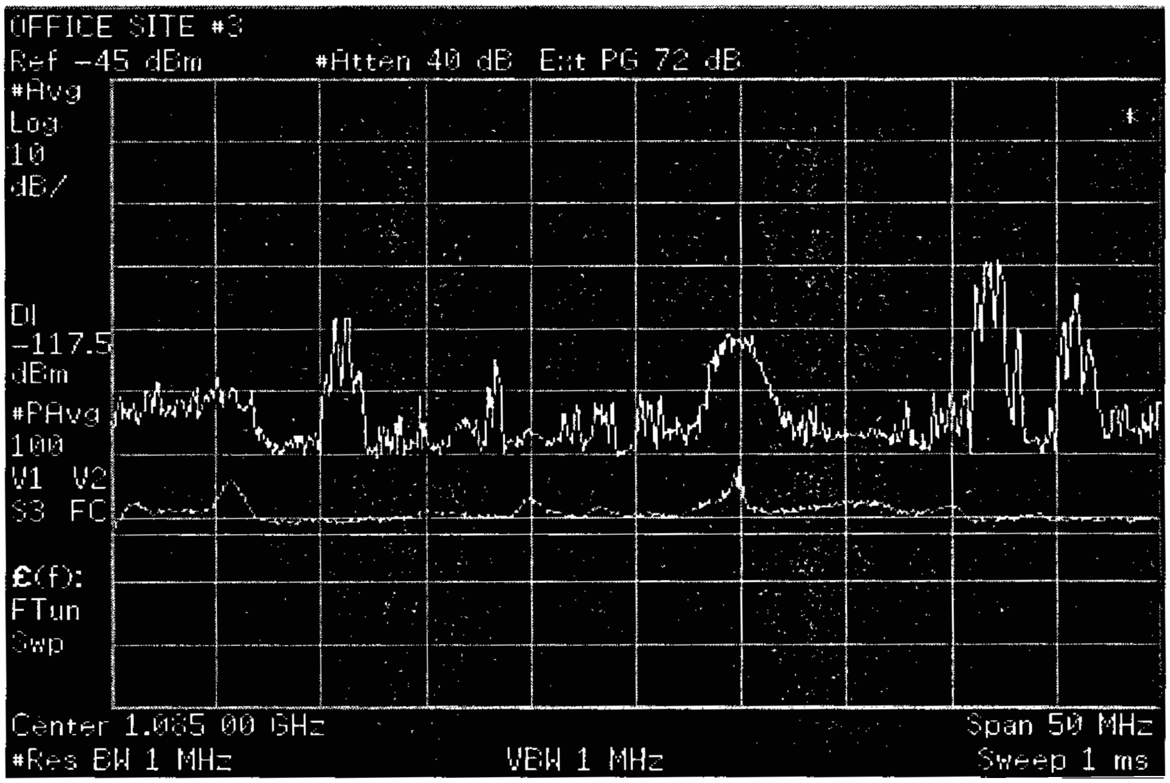

Figure D-83. Ambient Emissions in 1060-1110 MHz Frequency Band at Office Site #3.

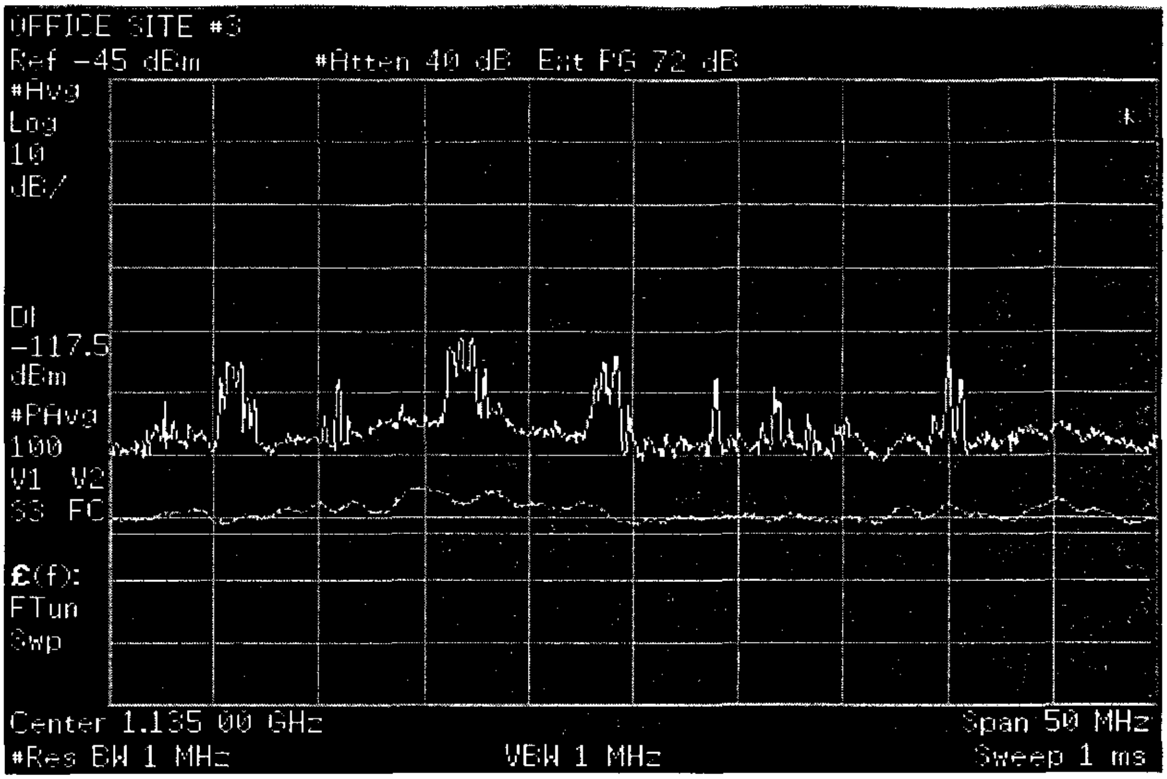

Figure D-84. Ambient Emissions in 1110-1160 MHz Frequency Band at Office Site #3.

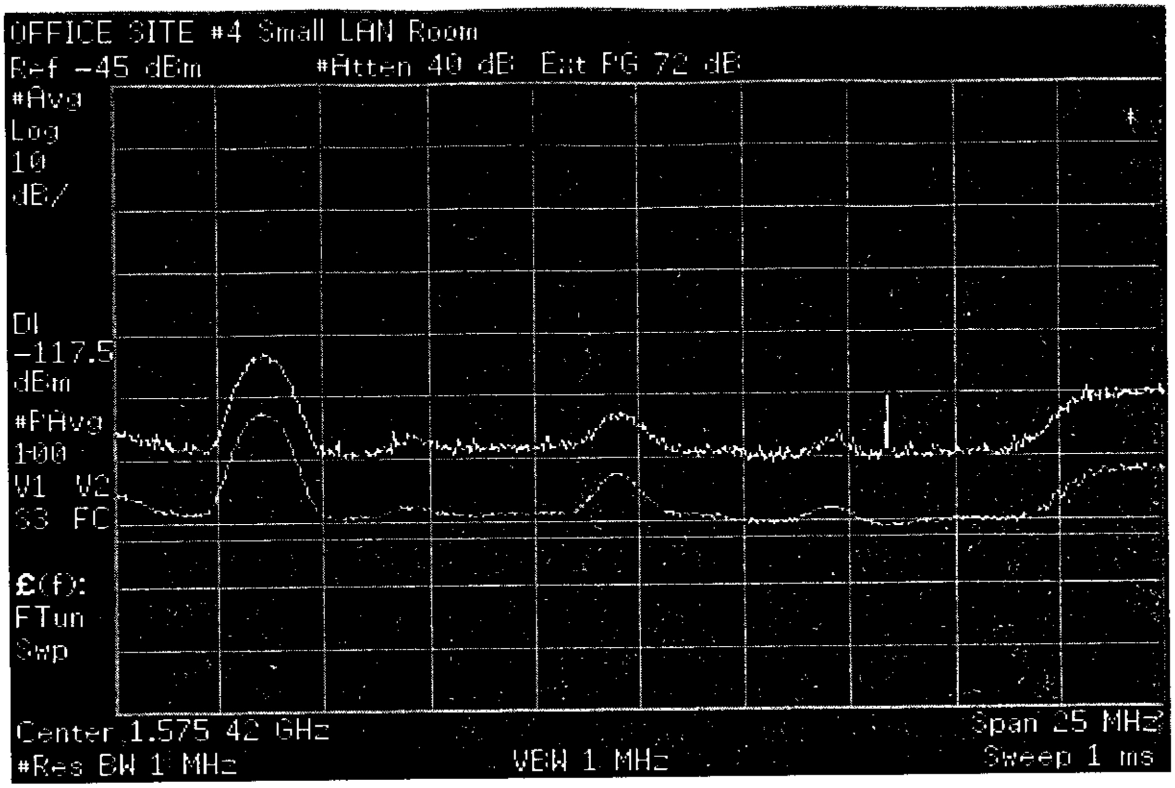

Figure D-85. Ambient Emissions in GPS L1 Frequency Band at Office Site #4.

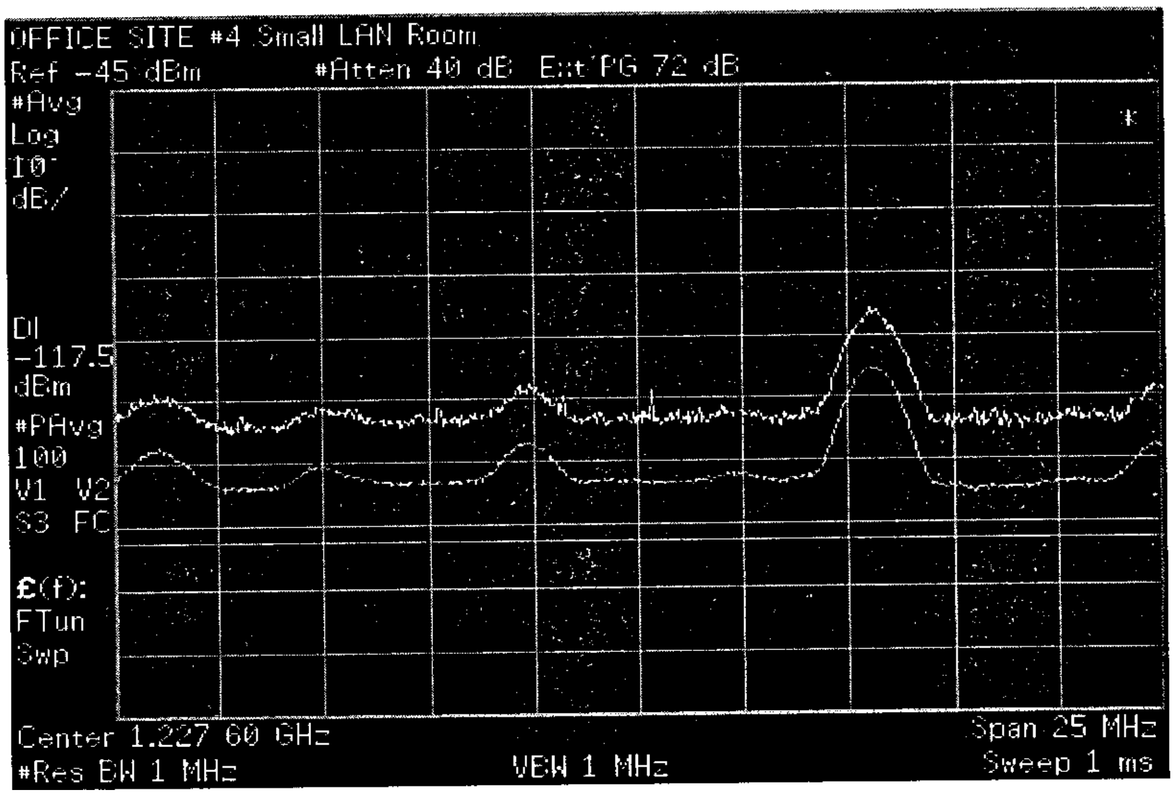

Figure D-86. Ambient Emissions in GPS L2 Frequency Band at Office Site #4.

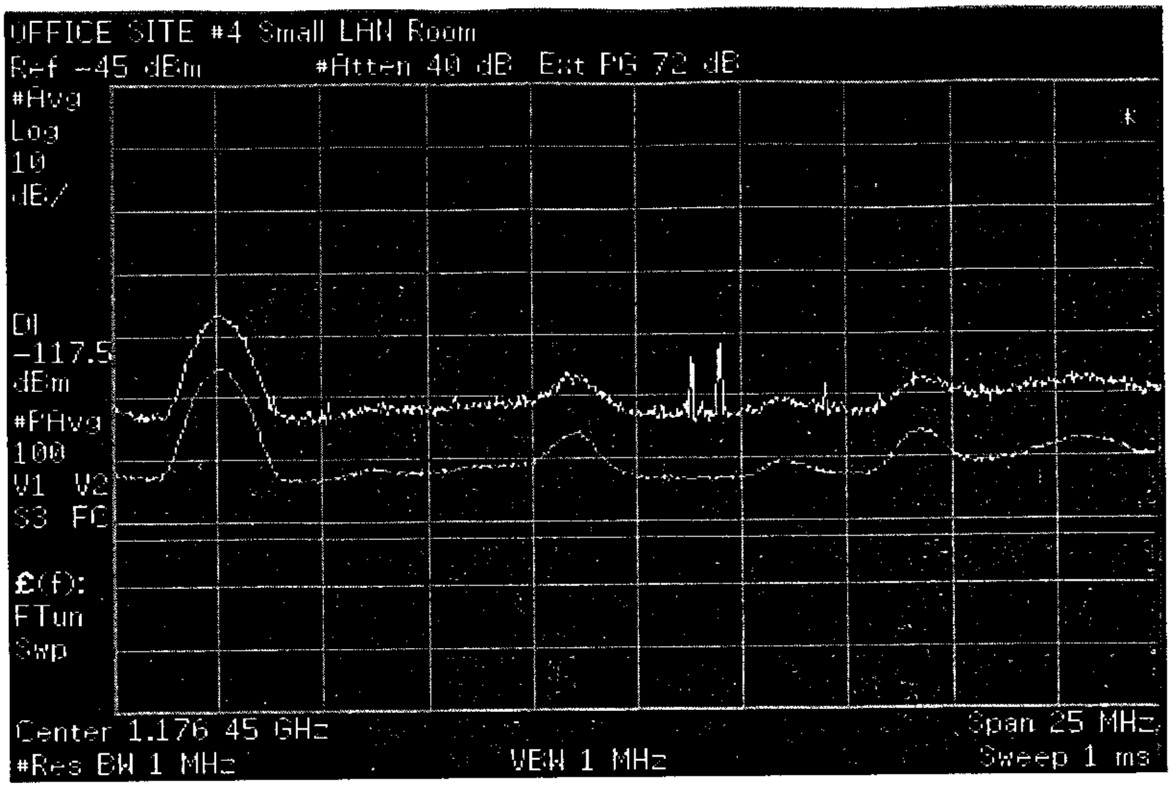

Figure D-87. Ambient Emissions in GPS L5 Frequency Band at Office Site #4.

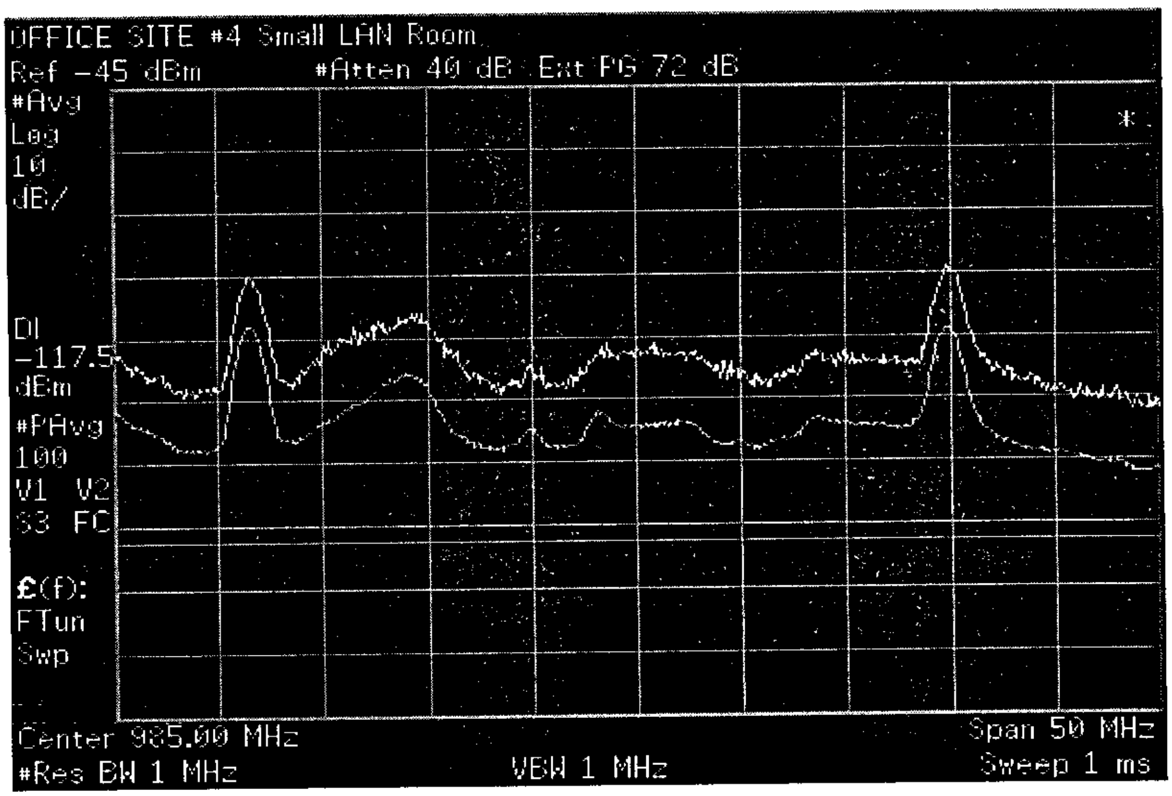

Figure D-88. Ambient Emissions in 960-1010 MHz Frequency Band at Office Site #4.

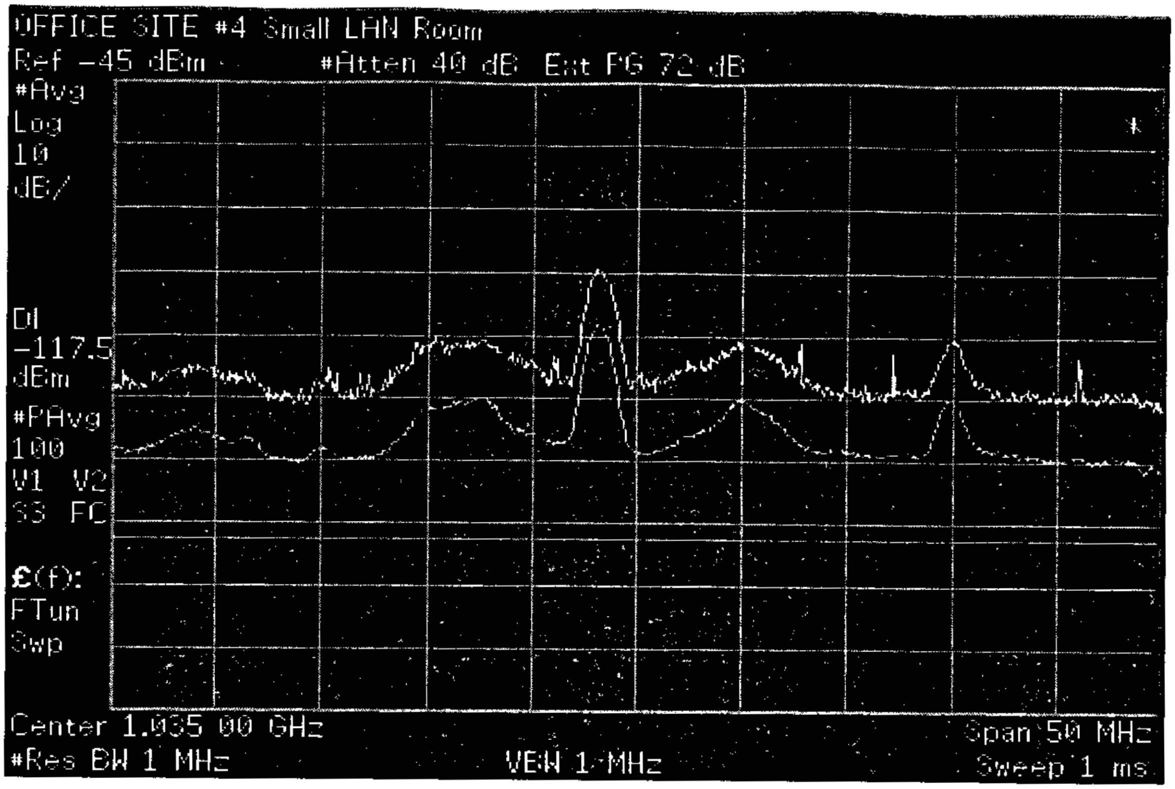

Figure D-89. Ambient Emissions in 1010-1060 MHz Frequency Band at Office Site #4.

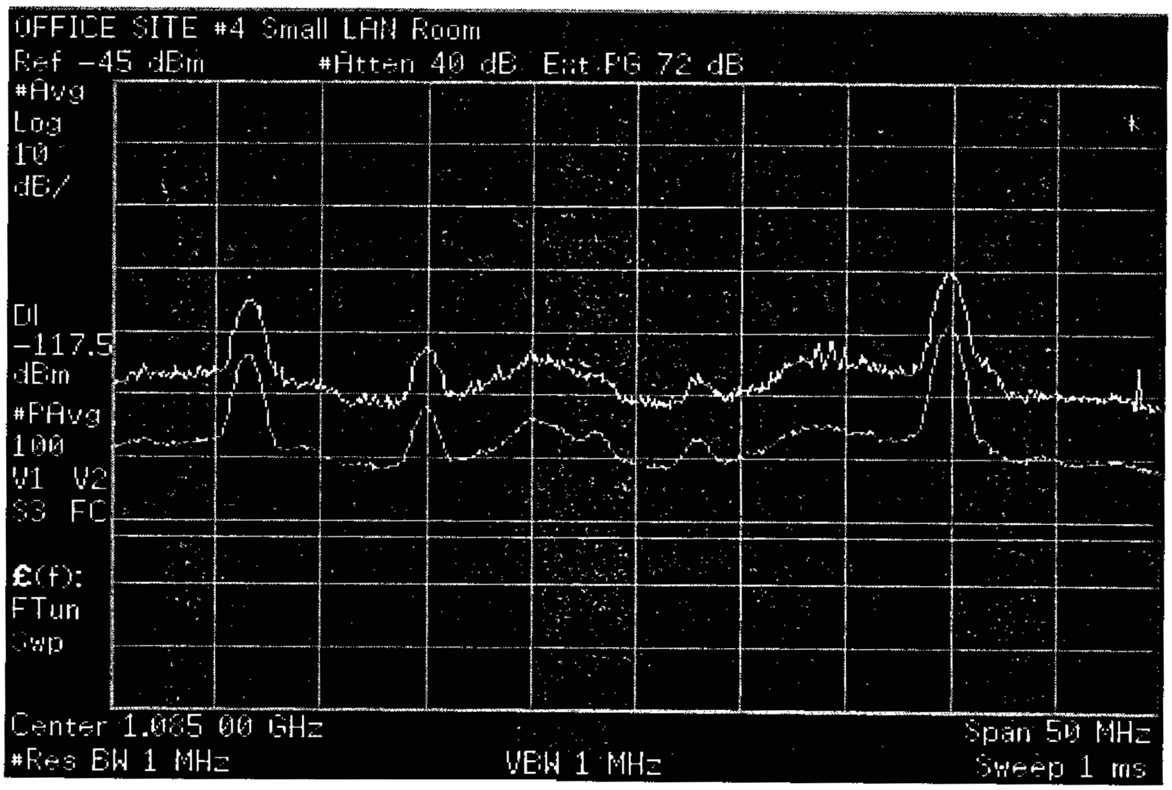

Figure D-90. Ambient Emissions in 1060-1110 MHz Frequency Band at Office Site #4.