NRSC REPORT

NATIONAL RADIO SYSTEMS COMMITTEE

NRSC-R57
VHF Multipath Simulation: Mean Average Power Characterization on the HP 11759C RF Channel Simulator
November, 1995

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FOREWORD

NRSC-R57, VHF Multipath Simulation: Mean Average Power Characterization on the HP 11759C RF Channel Simulator, documents the results of a test designed to establish the mean average power of the desired or undesired composite path(s) of the HP 11759C RF channel simulator. This report was prepared for Working Group B and the Combined EIA DAR and NRSC DAB Subcommittees.

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Report on:

VHF Multipath Simulation: Mean Average Power Characterization on the HP 11759C RF Channel Simulator

November 1, 1995

Prepared For:

**Working Group B and
The Combined
EIA DAR and
NRSC DAB
Subcommittees**

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1.0 INTRODUCTION

The Urban, Rural and Obstructed environments programmed for simulation control of the HP 11759C RF Channel Simulator in Rayleigh and Doppler mode have been characterized in the VHF region for mean average power levels using two separate methods.

1.1 SCOPE

This report will present the mean average power of the desired or undesired composite path(s) of the HP 11759C multipath simulator during the respective simulations specified by the VHF Channel Characterization Task Force.

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2.0 Methods

2.1 Average Power Meter

The first method used an average power meter and a tunable band pass filter to measure the mean average power of the simulations and a single path zero phase reference. The running averages were calculated over a 27 second period. The simulations were programmed into the simulator with Doppler speeds in Rayleigh mode which were much faster (225 kmph) than the Doppler speeds in the corresponding test scenarios (2, 60 and 150 kmph).

The ratios, $\frac{Simulation\,Mean\,Average\,Power}{One\,Path\,Zero\,Phase\,Power}$ are given in Table 1.

HP 11759C RF Channel Simulator Characterization

Offsets (dB)

	9 Path				3 Path	
	Urban		Rural	Obsructed	Undesired	
	Slow	Fast				
Rayleigh	-3.1	-3.1	-6.6	-4.8		Spectrum Analyzer
	-2.6	-2.6	-6.6	-4.4		Average Power Meter
	-3.1	-3.1	-8.1	-5.2		CRC 6 Path Approximation / Average Power Meter
		6 Path				
Doppler	6.0	6.2	2.8	4.5	3.6	Spectrum Analyzer

Table 1 :Offsets from the One Path Zero Phase Reference

2.2 Spectrum Analyzer

Figure 1 and Figure 2 show two representative Rayleigh simulations where the Doppler speed is higher in one simulation. Since the average power is virtually the same in each case it will be assumed that the Rayleigh simulations at different Doppler speeds have similar mean average power.

The spectrum analyzer method was used to gather the points necessary to plot Figures 1 - 10. A CW signal at 94.1 MHz was used as the one path zero phase reference. The simulations were run and data was gathered for more than two periods (approximately 54 seconds) of the Rayleigh Simulations. The spectrum analyzer settings were as follow:

Resolution Band Width	30 kHz	Logarithmic Scale (dBm)
Video Band Width	3 kHz	5 dB per division
Span	500 kHz	
Sweep Time	20.0 ms	

Figures 3-10 represent the raw data plots of Instantaneous Average Power (dBm) Vs Time (seconds). The raw data was converted from dBm to Watts before the arithmetic mean was taken over one period worth of data. The mean average power was then converted back to dBm for comparison to the one path zero phase reference (see Figures 3-10). The numbers in parenthesis indicate 1) mean average power in dBm and 2) Offset from the One Path Zero Phase Reference in dB.

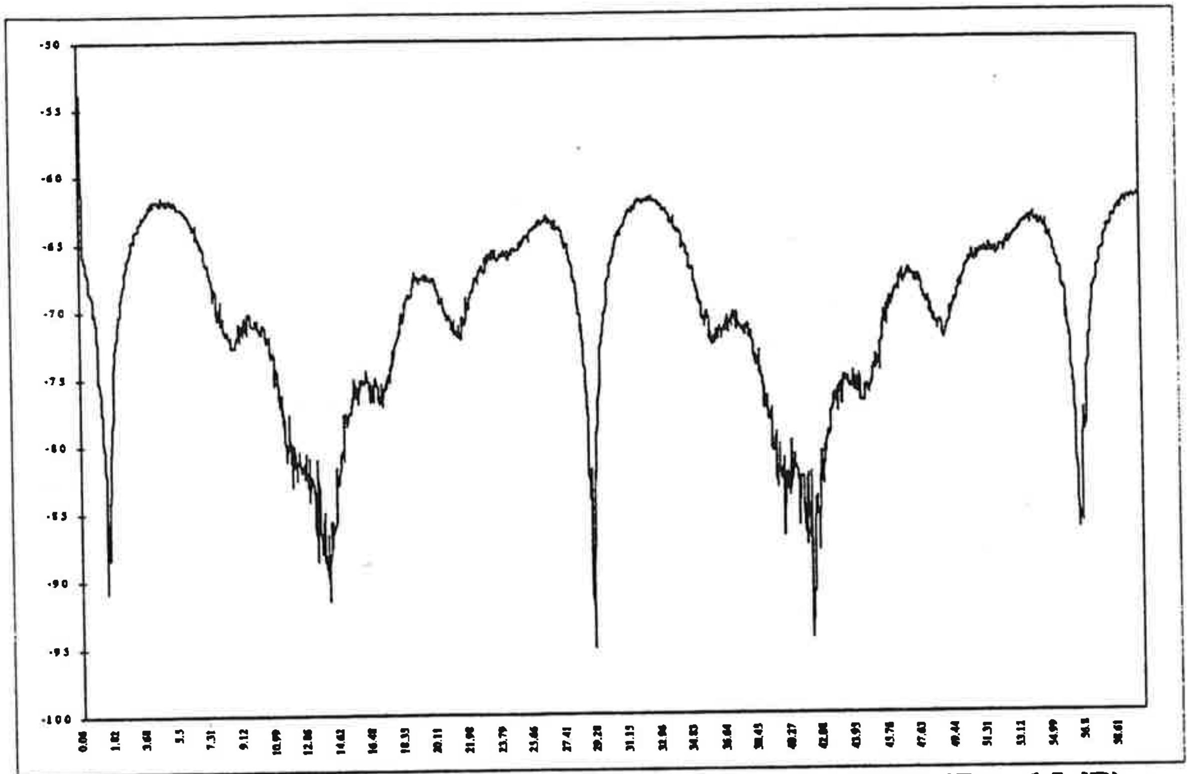

Figure 1 :Rural 2 kmph Rayleigh 6 Path Approximation (-67.3 dBm -6.5 dB)

mean avg. pwr.

Deviat from 1-path 0 pha ref

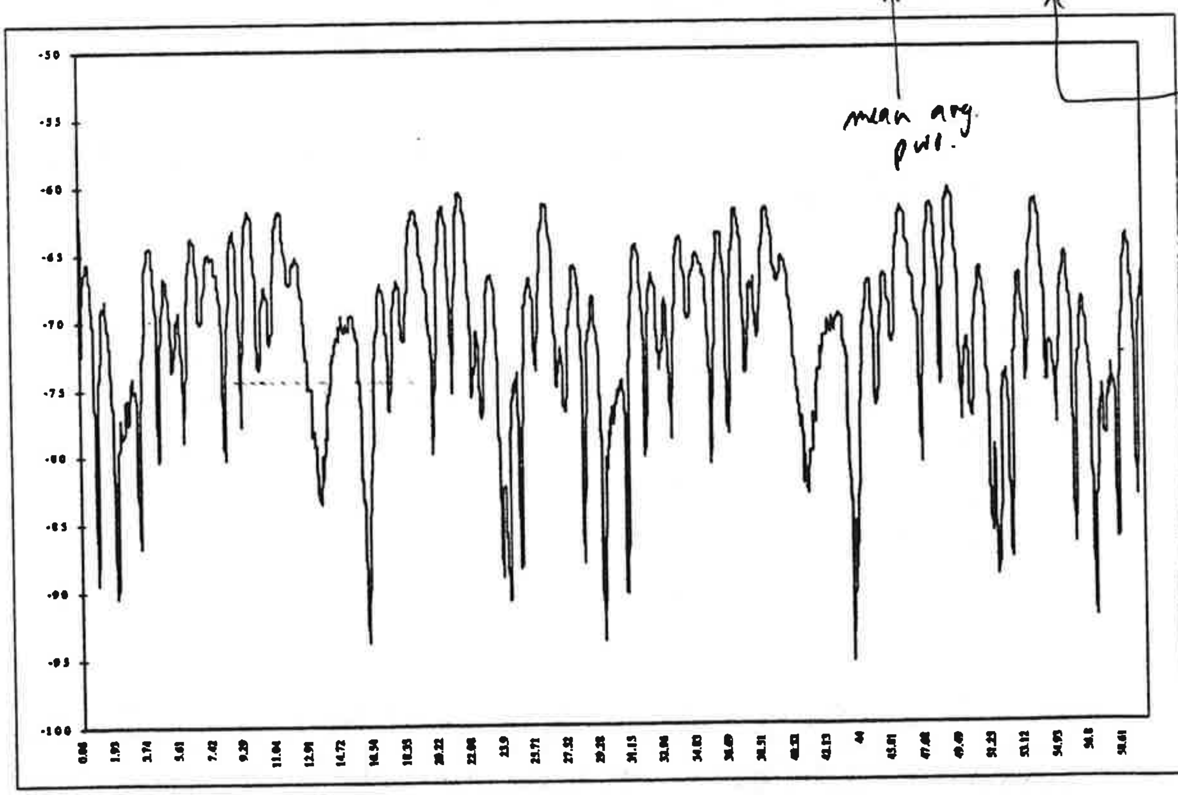

Figure 2 :Rural 8 kmph Rayleigh 6 Path Approximation (-67.7 dBm -6.9 dB)

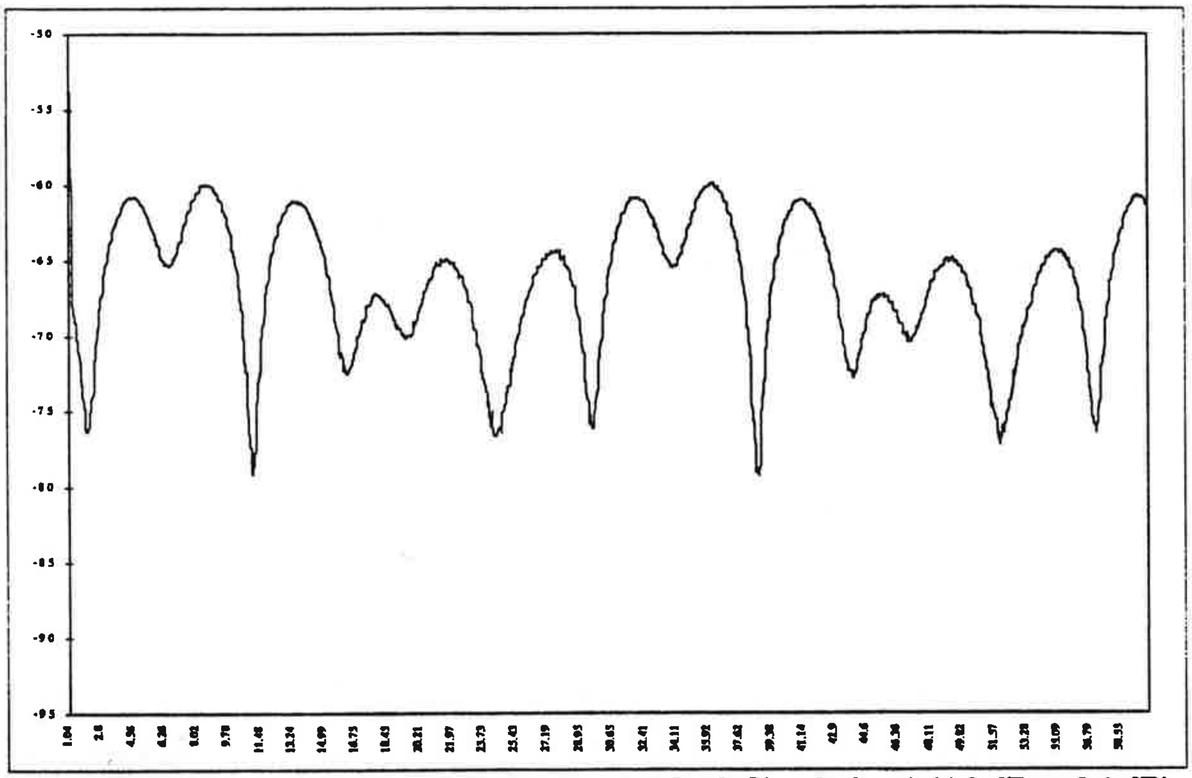

Figure 3 :Urban Slow Rayleigh 2 kmph 9 Path Simulation (-64.8 dBm -3.1 dB)

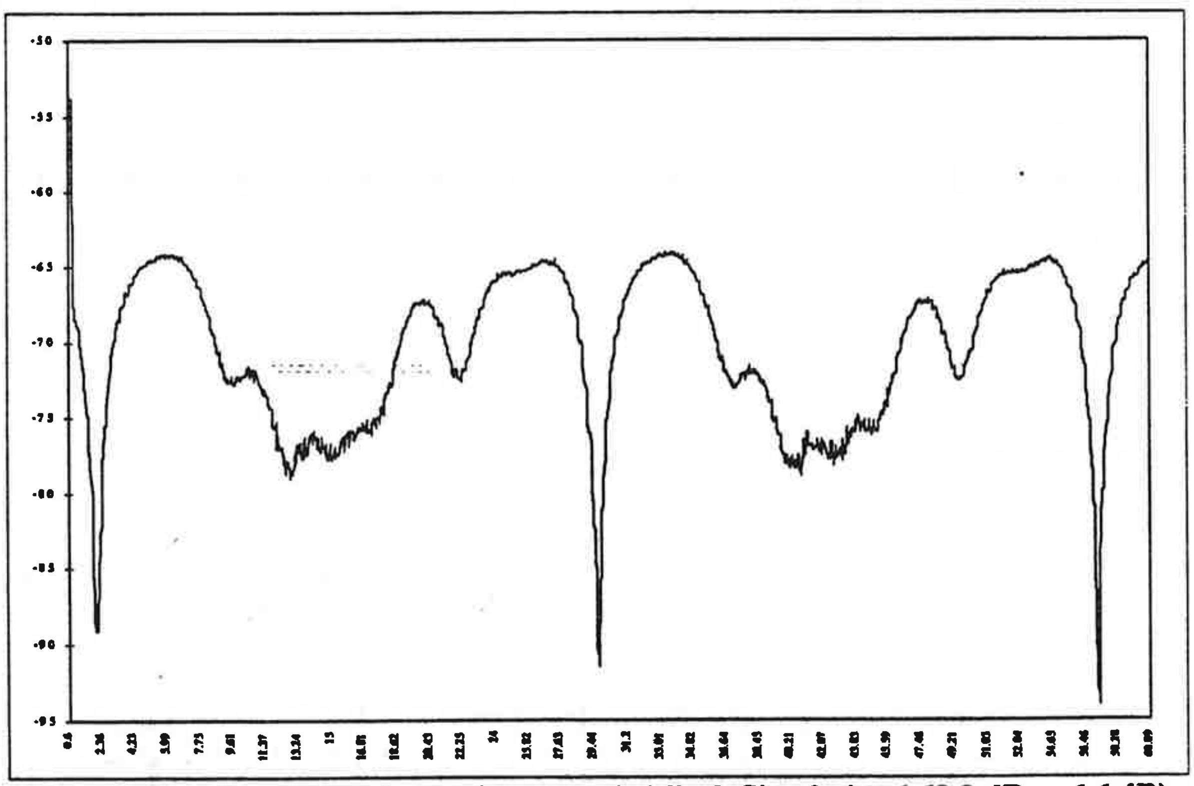

Figure 4 :Rural Slow Rayleigh 2 kmph 9 Path Simulation (-68.3 dBm -6.6 dB)

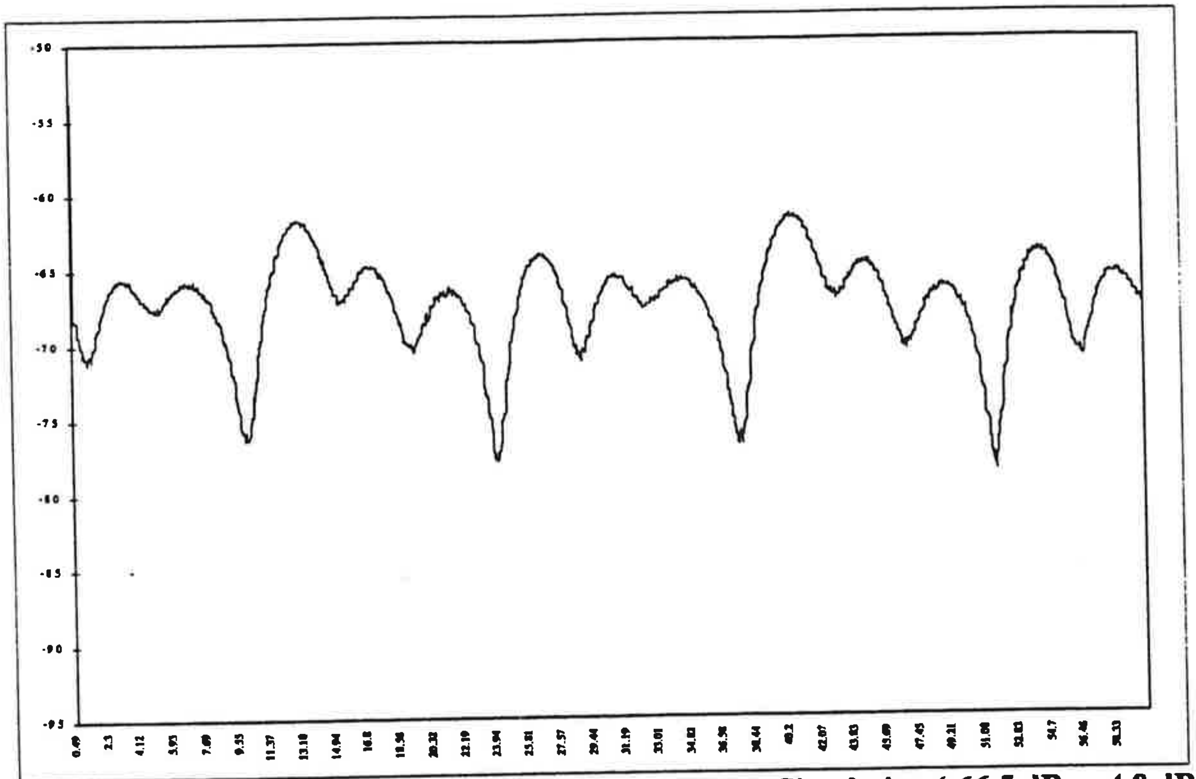

Figure 5 :Obstructed Slow Rayleigh 2 kmph 9 Path Simulation (-66.5 dBm -4.8 dB)

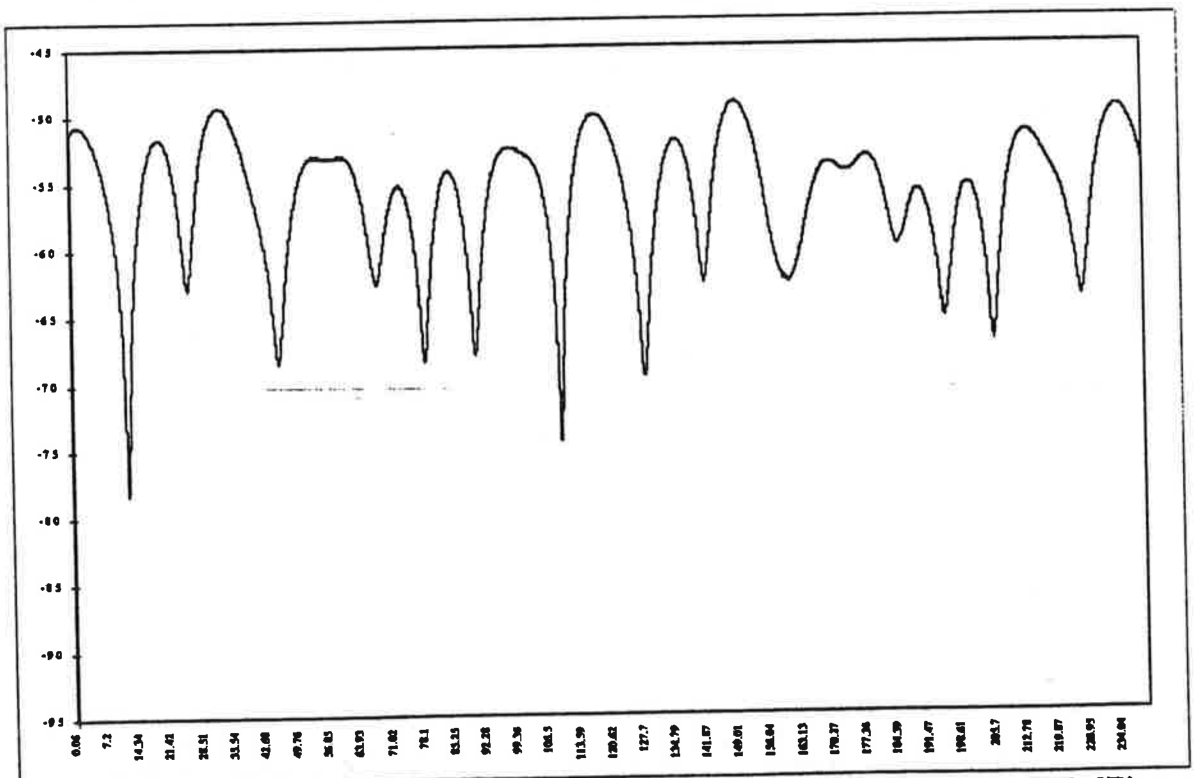

Figure 6 :Urban Slow Doppler 6 Path Approximation (-54.8 dBm 6.0 dB)

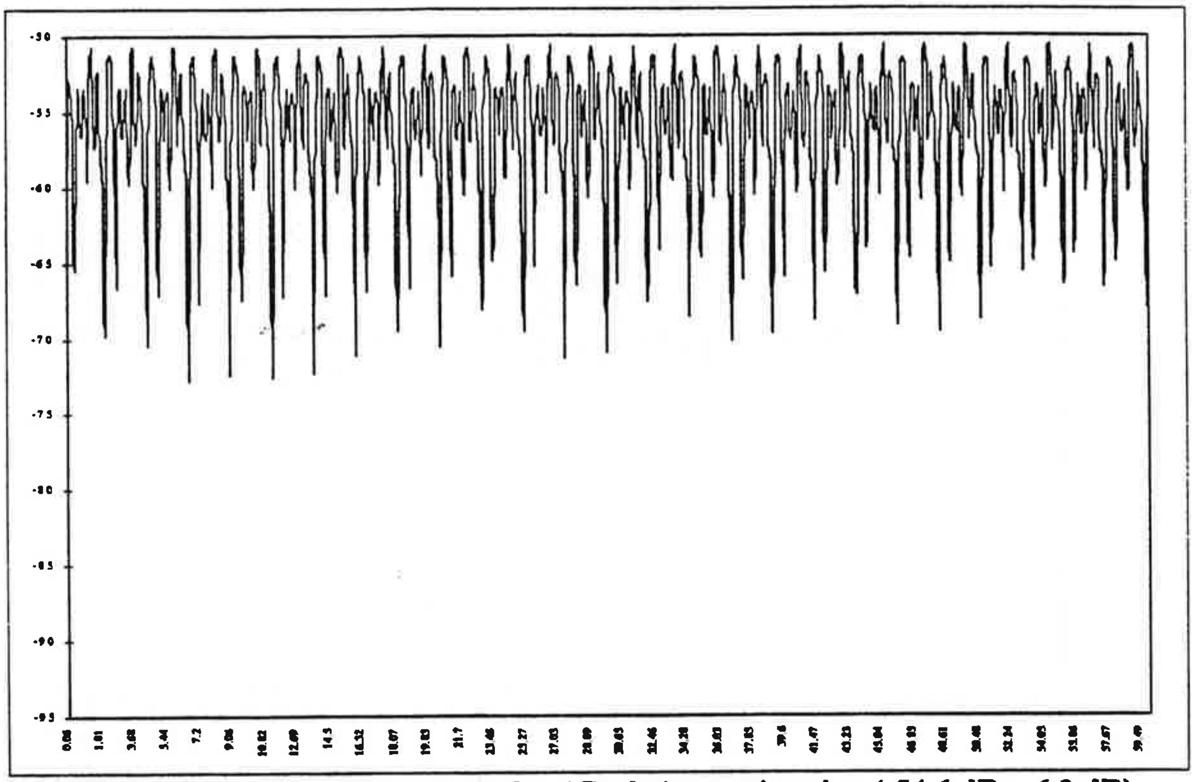

Figure 7 :Urban Fast Doppler 6 Path Approximation (-54.6 dBm 6.2 dB)

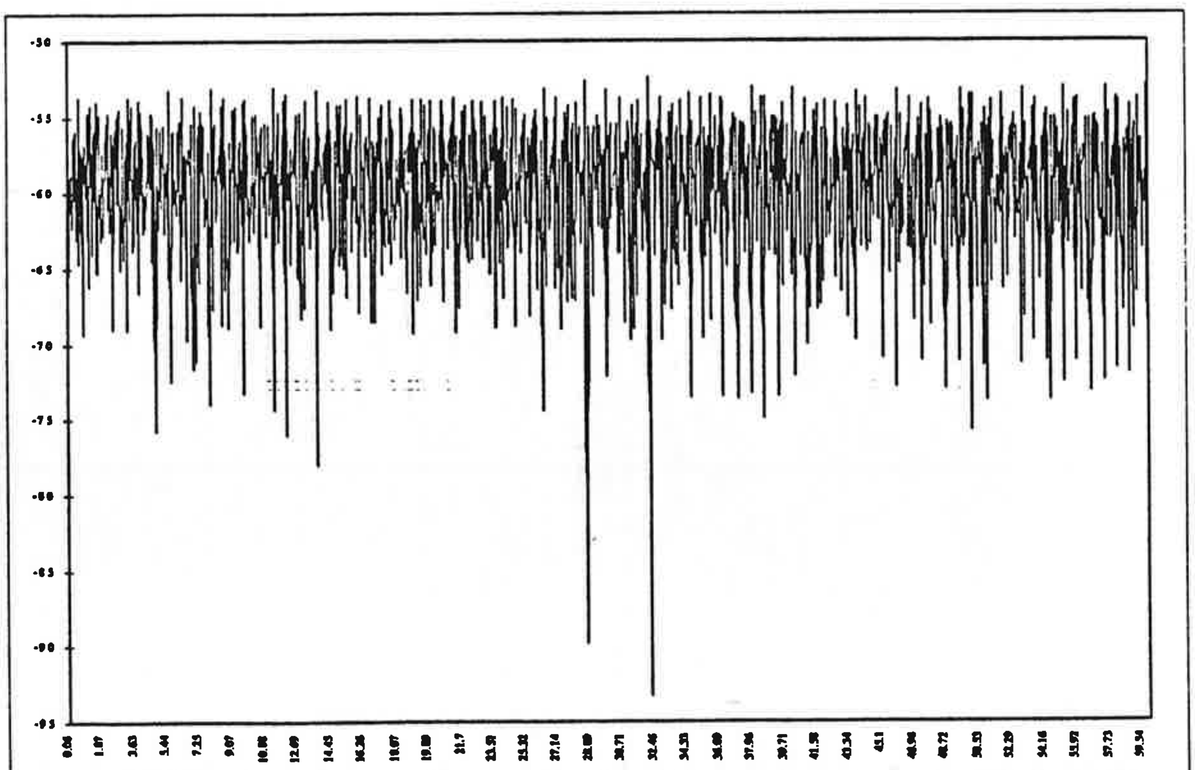

Figure 8 :Rural Fast Doppler 6 Path Approximation (-58.0 dBm 2.8 dB)

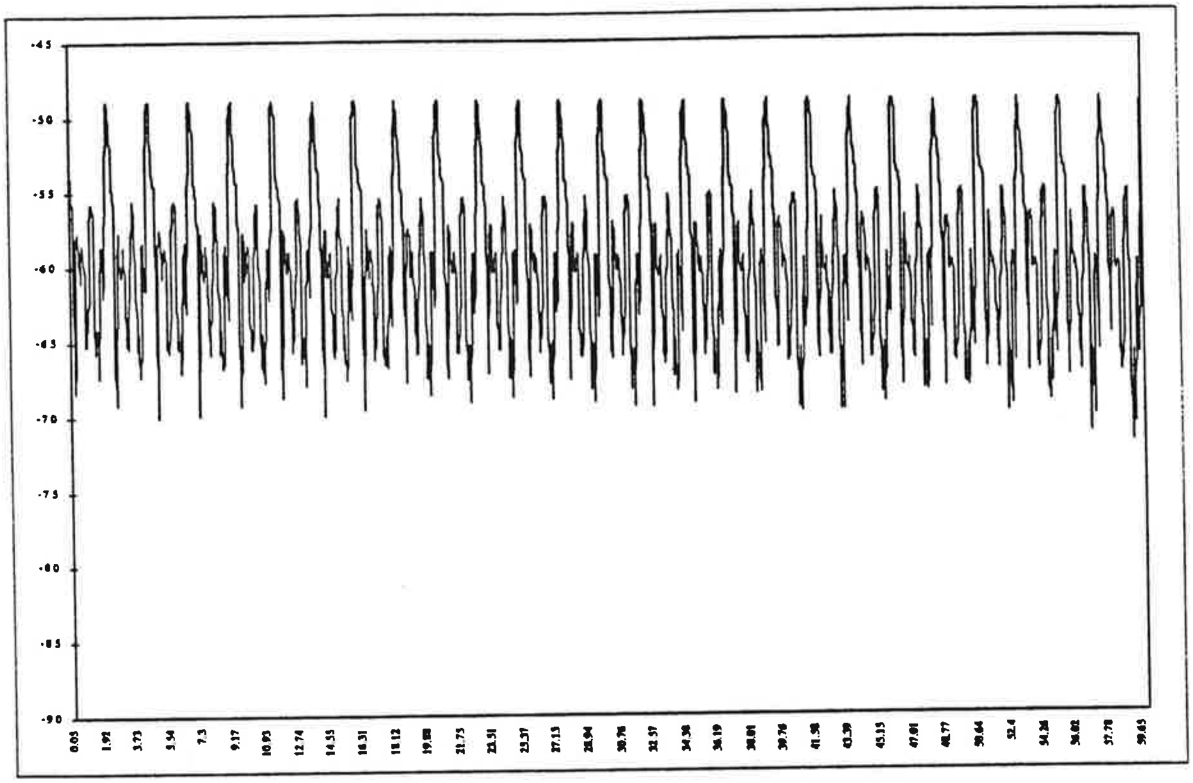

Figure 9 :Obstructed Fast Doppler 6 Path Approximation (-56.3 dBm 4.5 dB)

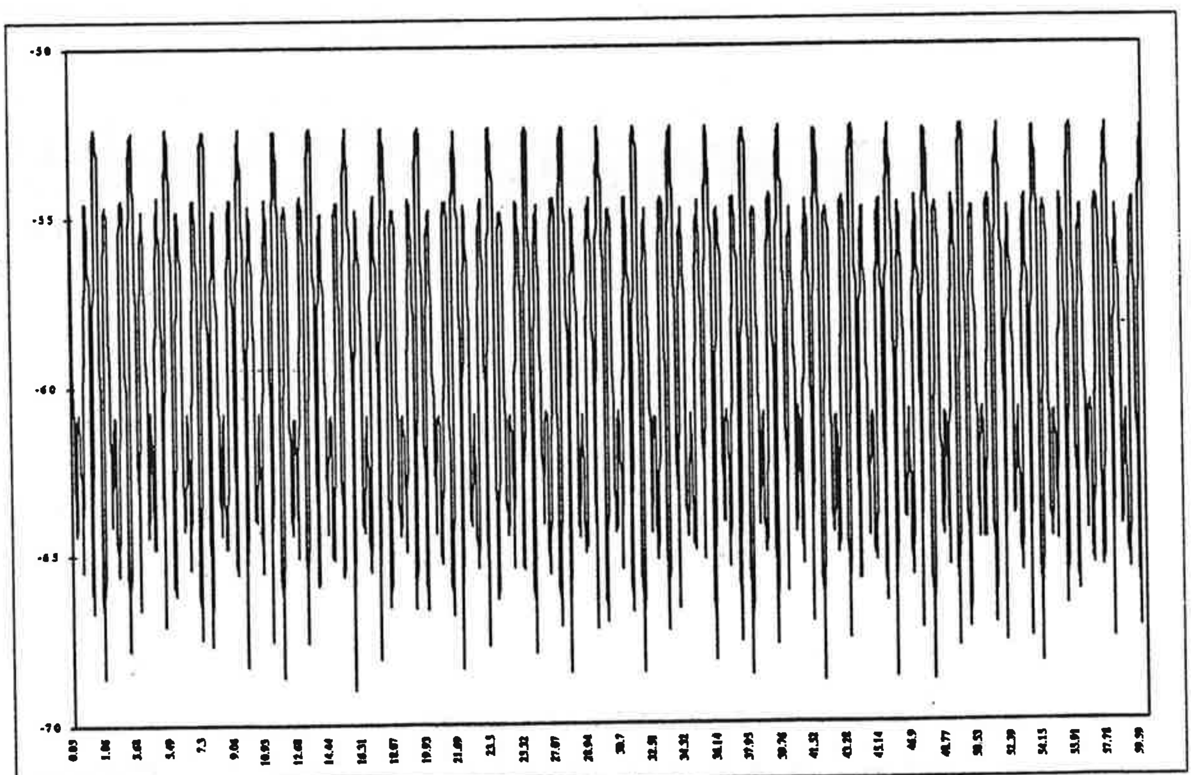

Figure 10 :Doppler Interferer 3 Path Simulation (-57.2 dBm 3.6 dB)

3.0 CONCLUSION

The simulations have been characterized for mean average power. The offsets from the one path zero phase reference are again listed in Table 2.

HP 11759C RF Channel Simulator Characterization

Offsets (dB)

	9 Path			3 Path		
	Urban		Rural	Obsructed	Undesired	
	Slow	Fast				
Rayleigh	-3.1	-3.1	-6.6	-4.8		Spectrum Analyzer
	-2.6	-2.6	-6.6	-4.4		Average Power Meter
	-3.1	-3.1	-8.1	-5.2		CRC 6 Path Approximation / Average Power Meter
		6 Path				
Doppler	6.0	6.2	2.8	4.5	3.6	Spectrum Analyzer

Table 2 :Offsets from the One Path Zero Phase Reference

3.1 Applying Offsets

Due to the dynamic nature of the simulations it is difficult at best to predict the instantaneous D/U or C_0/N_0 of a given simulation however, the offsets when applied to the previously reported data will yield performance criterion consistent with the mean average power of the desired and undesired signals.

3.1.1 Test B-3 C_0/N_0

The C_0/N_0 parameter for the Rayleigh 9 path simulations in test B-3 can be adjusted by the offsets in Table 2 for the respective simulations. Because the desired signal is lower by the offset amount listed in Table 2 the corresponding C_0/N_0 parameter will be smaller by the respective offset value for the Urban, Rural or Obstructed simulations.

3.1.2 Test C-6 C_0/N_0

Test C-6 used the Doppler simulations. The approximated offsets are positive. The positive offsets cause the C_0/N_0 to increase by the offset amount.

3.1.3 Test C-3

Since the level of the reflected path relative to the direct path was logged for this test using the internal simulator attenuator offsets should not be applied to this data.

3.1.4 Test C-5

The data logged in this test is quality of audio at various delay spreads and Doppler speeds. Offsets should not be applied to this data.

3.1.5 Test E-Series Rayleigh

The Rayleigh desired composite signal was lower than the expected one path zero phase reference and the Doppler undesired composite was higher than the reference therefore when these offsets are applied to the actual test data the respective D/U's will decrease in magnitude if the D/U is positive and they will increase in magnitude if the D/U is negative.

3.1.6 Test E-Series Doppler

The Doppler desired composite signal was higher than the expected one path zero phase reference and the Doppler undesired composite was higher than the reference therefore when these offsets are applied to the actual test data the respective D/U's will decrease in magnitude if the offset for the desired signal is smaller than the undesired offset or increase in magnitude if the offset for the desired signal is larger than the undesired offset.

NRSC Document Improvement Proposal

If in the review or use of this document a potential change appears needed for safety, health or technical reasons, please fill in the appropriate information below and email, mail or fax to:

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