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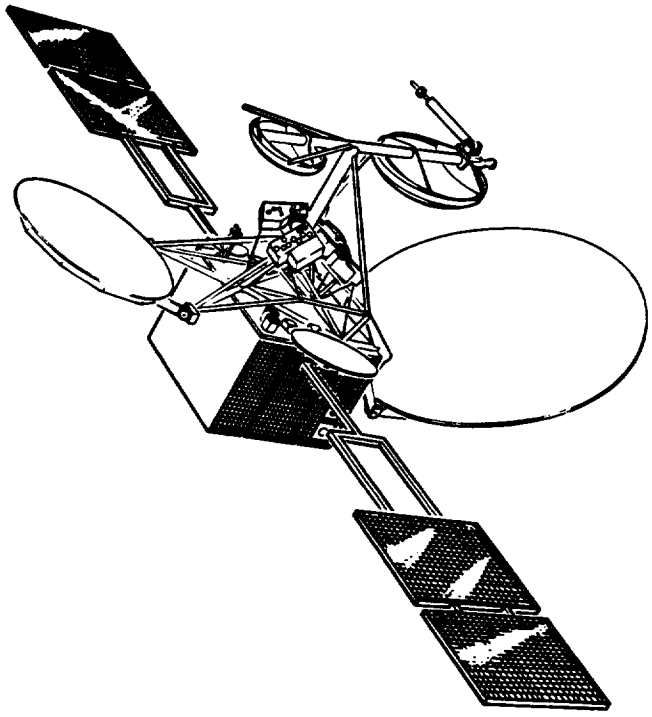
Advanced Communications Technology Satellite High Burst Rate Link Evaluation Terminal Power Control and Rain Fade Software Test Plan

Version 1.0



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High Burst Rate Link Evaluation Terminal
Power Control and Rain Fade Software Test Plan

Version 1.0, January 1993

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1.0 INTRODUCTION

1.1 Identification of Document

This is the Power Control and Rain Fade Software Test Plan document for the NASA Advanced Communications Technology Satellite (ACTS) High Burst Rate Link Evaluation Terminal (HBR-LET). This document complies with the NASA Software Management and Assurance Program (SMAP) guidelines in the Information System Life-Cycle and Documentation Standards, Release 4.3. This manual is one component of the Control and Performance Monitor (C&PM) Subsystem document series.

1.2 Scope of Document

Users must have a working knowledge of the rain fade prediction algorithms and their implementation with the Power Control Software. General knowledge of the Control and Performance Monitoring software is beneficial for interacting with the C&PM menu system.

This document assumes the reader is familiar with the operation of the Power Control Software. Refer to the *Power Control and Rain Fade Software User's Guide* for additional information on the Power Control Software functions and capabilities.

1.3 Purpose and Objectives of Document

The document provides a test procedure to verify the operation of the Power Control Software and rain fade prediction algorithms. A complete step-by-step procedure tests the operation of both the power control and rain fade programs, their interaction, and intertask communication between the programs.

Refer to the *Power Control and Rain Fade Software User's Guide* for detailed information on the Power Control or Rain Fade Software. Information on individual rain fade prediction algorithms is also available in referenced documents.

1.4 Document Status and Schedule

Version 1.0 is the first publication of the Power Control and Rain Fade Software Test Plan. As the development of new rain fade algorithms continues, any modifications to the Power Control and Rain Fade Software Test Plan will be documented in subsequent versions.

Appendix B contains expected test results for past simulations. Additional data will be included as new algorithms are developed and implemented.

1.5 Document Organization

This document contains nine sections. Sections 1 and 2 introduce this document, and describe other documents related to it. Section 3 identifies the tests described in this document. Section 4 contains the test procedures used to verify the operation of the Rain Fade and Power Control software. Expected and actual test results are discussed in Sections 5 and 6. Sections 7 and 8 include a list of abbreviations and acronyms contained in this document and a glossary of special terms. Section 9 contains several appendices that contain the simulation data used in the test procedure and expected test results of existing algorithms.

2.0 Related Documentation

2.1 Parent Document

The following document is parent to this document:

1. *HBR-LET Power Control and Rain Fade Software User's Guide*, NASA Lewis Research Center, Reinhart, R. and Manning, R, to be published.

2.2 Applicable Documents

The following documents are referenced within this test plan and are directly applicable to its content.

1. *HBR-LET Power Control and Rain Fade Software Maintenance Manual*, NASA Lewis Research Center, Reinhart, R. and Manning, R, to be published.

2. *HBR-LET Experiment Control and Monitor Software User's Guide*, NASA Lewis Research Center, Reinhart R., May 1991.

2.3 Information Documents

The following document provides additional information about the rain fade algorithm model discussed in this document. The second document details the specifications of the Power Control Software.

1. *A Statistical Rain Attenuation Prediction Model With Application to the Advanced Communication Technology Satellite Project*, NASA Technical Memorandum 100243, NASA Lewis Research Center, Manning, R., May 1991.

2. *Fade Data Interface Specification ACTS-DOC-89-034*, COMSAT Laboratories, 1989.

3.0 TEST IDENTIFICATION

The Rain Fade Software and rain fade prediction algorithm monitors the observed link attenuation to predict when the rain fade level will surpass the specified threshold attenuation. The rain fade prediction algorithm calculates the optimal link attenuation, independent of the link noise, from fade depth samples received from COMSAT's Beacon Measurement Subsystem (BMS). The Power Control Software adjusts the output power of the LET to compensate for signal degradation based on the rain fade algorithm. The Power Control Software controls the output power of the LET by varying the bias voltage across a PIN diode, thus varying the attenuation at the input of the traveling wave tube amplifier (TWTA). A low input attenuation results in a high input power, and thus a high output power. A high input attenuation results in a low input power, and thus a low output power.

Test 1 and Test 2 use a single rain fade simulation data set. The simulation data set contains low and high values of fade depth levels illustrated by Figure A-1 in Appendix A. Test 1 begins with low fade depth levels of less than 5 dB to demonstrate the ability of the rain fade algorithm to track and predict future up fade depth levels. At low fade depths, depending on the threshold attenuation, the Power Control Software remains inactive while the rain fade algorithm monitors and predicts future fade depth levels. The Rain Fade Software will invoke the Power Control Software when it predicts that the fade depth level will exceed the threshold attenuation value.

At higher fade levels, the Rain Fade Software tracks the current link attenuation while the Power Control Software adjusts the output power of the LET to compensate for signal degradation. Test 2 contains fade levels between 5 and 10 dB. During Test 2, the Power Control Software dynamically sets the PIN diode power supply based on the link attenuation calculated by the rain fade algorithm.

The following tests demonstrate the capability of the Power Control Software to implement the required TWTA input attenuation to compensate for signal loss due to rain fade attenuation. The Rain Fade Software calculates the optimal link attenuation and passes the attenuation value to the Power Control Software. The Power Control Software transforms the link attenuation to the TWTA input attenuation and properly adjusts the Hewlett Packard (HP) DC Power Supply controlling the PIN diode.

The status of the Power Control and Rain Fade Software parameters illustrate the handshaking that occurs between the two programs. The RAIN FADE ALGOR displays ACTIVE when the Rain Fade Software

receives new data from the BMS, otherwise it displays INACTIVE. The Rain Fade Software executes the Power Control Software (ACTIVE) once the rain fade algorithm predicts that the link attenuation will exceed the threshold attenuation. After the fade has passed and the link attenuation falls below the threshold value, the Power Control Software will reset the TWTA input attenuation to a default value and return to an inactive state (INACTIVE). Monitor the handshaking of the two programs by observing the PIN DIODE CONTROL toggle between ACTIVE and INACTIVE.

The Power Control Software is written to support numerous rain fade prediction algorithms. Refer to the *Power Control and Rain Fade Software User's Guide* for the Rain Fade Software requirements. The Rain Fade Software can have any name, provided the name meets the conditions specified in the *Power Control and Rain Fade Software User's Guide*.

4.0 TEST PROCEDURES

4.1 Initial Conditions

The Power Control and Rain Fade Software Test Plan simulates the up link beacon level and down link beacon level data received from COMSAT's BMS. The simulation program simulates the BMS by transmitting data to the Power Control Software.

Two ports on the Concurrent 3205 connected together enables communication between the simulation program and the power control receive program. **CRT6:** is the transmit port of the rain fade simulation software. The rain fade simulation program transmits data to the Power Control Software without alteration. The Power Control Software receives the simulation data at **CRTF:** and decodes the simulation data according to the format specified in the Fade Data Interface Specification.

1) Using a standard communication cable with lines 2 and 3 crossed (to transmit and receive properly), connect ports **CRT6:** and **CRTF:** together.

2) Record the statistical parameters used for the rain fade prediction algorithm. Include the name of the data file containing the parameters in addition to the parameter values.

2) The statistical parameters used in the rain fade algorithm define the rain fade process as described by the ACTS Rain Attenuation Model. Refer to the *Power Control and Rain Fade Software User's Guide* for additional information on the operation of the rain fade algorithm and statistical parameters. Note additional parameters not listed in Table 4-1.

File Name:		
Variable	Parameter	Value
AM	Mean Attenuation @ 30 Ghz link (dB)	
SDA	Standard Deviation of Attn @ 30 Ghz link	
TFF	Temporal Fade Factor (sec)	
ATTN_TH	Threshold Attenuation (dB)	
ATPRED	Sample prediction time (sec)	
SDN	Standard Deviation of Attn Measurement	
DT	Sample Time Interval	

Table 4-1 Rain Fade Algorithm Statistical Parameters

3) A data file named M1:RAININST.FAD/111 contains information about the instruments used by the Power Control Software. Specify the address and IEEE 488 bus extension number of both the HP DC Power Supply and the Wavetek Peak Power Meter. Also indicate the channel(s) and mode of the Wavetek Peak Power Meter for the Power Control Software to monitor. Table 4-2 lists the available modes and channels of the Wavetek Peak Power Meter with the corresponding option number.

Option Number	Channel	Mode
1	A+B	CW
2	A	CW
3	A+B	PEAK
4	B	CW
6	A	PEAK
8	B	PEAK

Table 4-2 Wavetek Peak Power Meter Channel/Mode Definitions

4) In the RAININST.FAD file, specify the default up fade attenuation for clear sky condition. This value is used when there is no fade and power control is not needed. Do not confuse this value with the DC voltage of the power supply.
Up fade default value: _____

Figure 4-1 illustrates the monitor menu of the Power Control Software. Note the location of the various parameters before beginning the simulation. The Power Control Software will receive the simulation data at the rate specified by the algorithm developer in the DT variable. The monitor menu will update different parameters depending on the PIN DIODE CONTROL status. A status of DISABLE indicates that the Power Control Software is temporarily not needed and is therefore INACTIVE. Once the up fade link attenuation surpasses the attenuation threshold, the Rain Fade Software will execute the Power Control Software and ENABLE the PIN DIODE CONTROL parameter.

Rain Fade Prediction Algorithm Monitor

PIN DIODE CONTROL ENABLE

UP FADE DEPTH	-5.55	DOWN FADE DEPTH	-3.68
UP FADE OPT	-5.498	ATTN PREDICTED	-5.2017
POWER CHANNEL A	-16.35	POWER CHANNEL B	-4.17
ATTN PIN	-14.8015	PIN VOLTAGE	1.8409
POWER CONTROL	ACTIVE	RAIN FADE ALGOR	ACTIVE
		CURRENT TIME	12:34:56

Figure 4-1 Power Control Software Monitor Menu

Become familiar with all steps within each test before beginning. The monitor menu parameter values change quickly depending on the variable DT. It is important to note the status of the Power Control and Rain Fade software throughout the simulation.

The Power Control Software will generate data files for both the Power Control and Rain Fade programs. The Rain Fade data file will have the same name as the rain fade algorithm but with the filename extension DAT. This file contains the simulation data received by the Power Control Software, the calculated and predicted attenuation values, the PIN diode flag status, and the time between successive samples. The Power Control data file has the name M1:RAINFADE.DAT/111. RAINFADE.DAT contains the attenuation values calculated by the rain fade algorithm, the Wavetek Peak Power Meter measurements, and the HP Power Supply voltage settings. Use the data in these files to evaluate the simulation.

4.2 Test 1 - Data Reception

_____ Execute the desired rain fade prediction algorithm. Refer to the *Power Control and Rain Fade Software User's Guide* for specific instructions to execute the algorithm.

_____ Verify that the following messages appear at the user's terminal, indicating that the Rain Fade Software correctly loaded and started.

"FILENAME VERIFIED, OPENING REQUIRED FILES"

"PLACING POWER METER AND POWER SUPPLY IN REMOTE"

"LOADING RAIN FADE PREDICTION ALGORITHM"

_____ Visually verify that both the HP DC Power Supply and the Wavetek Peak Power Meter are in remote mode. Remote mode places an instrument under computer control.

_____ Select the Rain Fade Simulation option from the C&PM Main Menu. Verify that the following messages appear at the user's terminal, indicating that the Rain Fade Simulation Software correctly loaded and started.

"Simulation Program Opening Required Files"

"Simulation will begin after two minute delay"

Note: The simulation software will transmit data to the Power Control Software simulating the BMS. A delay built into the software will suspend the execution of the simulation for approximately two minutes, providing the user time to start the rain fade monitor. Appendix A contains a copy of the simulation data and a plot of its up fade depth level versus time.

_____ Select the Rain Fade Monitor option from the C&PM Main Menu to monitor the status of the Power Control and Rain Fade software. Note the CURRENT TIME when the monitor menu appears to estimate when the data transfer will begin and end. TIME _____.

_____ Verify that both the POWER CONTROL and RAIN FADE ALGOR parameters display INACTIVE (dormant), indicating that no data is currently being received. At this time, the simulation data program should be in the two minute delay and not transmitting data. The UP FADE DEPTH parameter should be zero.

_____ After the two minute delay, verify that the UP FADE DEPTH variable randomly changes indicating that the Power Control Software is receiving the simulation data. The DOWN FADE DEPTH variable will remain constant during this test.

_____ Verify that the RAIN FADE ALGOR parameter changes from INACTIVE to ACTIVE. An ACTIVE status indicates that the Rain Fade Software engages once the Power Control Software receives new data. The POWER CONTROL parameter should initially remain INACTIVE.

_____ Note the status of the PIN DIODE CONTROL and current UP FADE DEPTH parameters. If the UP FADE DEPTH is greater than the threshold value, PIN DIODE CONTROL should be ENABLED. If the UP FADE DEPTH is less than the threshold value, PIN DIODE CONTROL should be DISABLED.

Threshold Value _____
UP FADE DEPTH _____
PIN DIODE CONTROL _____

Verify that one of the following occurs, depending on the state of the PIN DIODE CONTROL parameter:

_____ • The ATTN PREDICTED parameter updates with new values when PIN DIODE CONTROL is DISABLED.
_____ • The UP FADE OPT parameter updates with new values when PIN DIODE CONTROL is ENABLED.

4.3 Test 2 - Power Control and Intertask Communication

After approximately one minute and forty seconds the simulation Up Fade Depth level will increase above 5 dB attenuation. The following test will verify that the Power Control Software can dynamically control the HP DC Power Supply and Wavetek Peak Power Meter.

_____ Verify that once the Up Fade Depth exceeds the threshold attenuation, the PIN DIODE CONTROL is ENABLED, and the POWER CONTROL status is ACTIVE. The RAIN FADE ALGOR parameter will remain ACTIVE.

_____ Verify the following once PIN DIODE CONTROL is ENABLED.

_____ The Rain Fade Software updates the UP FADE OPT parameter as the Power Control Software receives new data.

_____ The rain fade algorithm stops predicting the observed attenuation. Note that the ATTN PREDICTED parameter does not change as the Power Control Software receives new data.

_____ The Power Control Software updates the PIN VOLTAGE, appropriate POWER CHANNEL's, and ATTN PIN parameters. These parameters correspond to the HP DC Power Supply voltage, TWTA output power (appropriate channel), and TWTA input attenuation, respectively.

_____ Visually verify that the PIN Diode HP DC Power Supply voltage parameter is changing values corresponding to the values on the user terminal. The current parameter on the instrument will remain unchanged.

_____ Visually verify that the Power Control Software is taking measurements from the Wavetek Peak Power Meter by noting the blinking front panel display. The channels read will depend on those specified by the user in Section 4.

_____ Note that the DOWN FADE DEPTH level is equal to the UP FADE DEPTH level. The DOWN FADE DEPTH parameter will remain equal to the UP FADE DEPTH level for the remainder of the simulation data set.

_____ The simulation data will end after approximately five and a half minutes. Refer to the TIME recorded in Test 1. The last UP FADE DEPTH parameter (a value of -4.2 dB) will remain constant at the end of the simulation. Verify that both the RAIN FADE ALGOR and POWER CONTROL parameters return to an INACTIVE state indicating there is no new data, and the current Up Fade Depth is below the threshold value. The status of the POWER CONTROL parameter is dependent upon the threshold attenuation value specified in Section 4.

_____ Return to the C&PM Main Menu and terminate the Power Control and Rain Fade Algorithm software. This concludes the interactive portion of the Power Control and Rain Fade Software Test Plan. Analyze the test data in subsequent sections.

_____ Manually place the HP DC Power Supply and Wavetek Peak Power Meter in local mode. Local mode returns control of the instrument to its front panel keys.

5.0 EXPECTED TEST RESULTS

Appendix B contains a copy of the Power Control and Rain Fade Software data files of past simulation tests. Compare the expected values of the appropriate simulation with the actual results obtained. Verify the following in Test 3:

- The Rain Fade Software received the simulation data at the rate of DT seconds. Note that the time between successive samples has not changed significantly, relative to DT.

- The Rain Fade Algorithm performance has not changed. This will depend on the respective rain fade algorithm.

- Compare the UP_FADE parameter of the Power Control Software with the predicted (ATTNPRED) and optimal attenuation (ATTN_OPT) calculated by the rain fade algorithm. Note the PIN_FLAG parameter value, and verify that the Power Control Software received the proper variable.

- The Wavetek Power Meter power readings have remained constant. Channels read will depend on those specified in Section 4. Verify that the Power Control Software read the proper channel(s).

6.0 ACTUAL TEST RESULTS

This section is to verify proper operation of the Power Control Software and the intertask communication with the Rain Fade Software. The developer of the rain fade algorithm must interpret the results of the simulation to determine the effectiveness of the rain fade algorithm. The details for evaluating the rain fade algorithm are not discussed in this document.

Note the revision date of the Power Control and Rain Fade programs and record the name and date of the rain fade algorithm used in this test. Sign-on to a private account on the computer system following the procedure outlined in the MTM Primer or the HBR-LET EC&M Software User's Guide. At the system propmt, type the following command to view the file details of the power control software.

D F,M1:DIODESET.TSK/111

Record the latest date that the file was written. Use a similar command to view the file details of the rain fade algorithm program. The user should know the account where the file resides. Contact the system administrator for details on obtaining a private account.

Power Control Software program name	M1:DIODESET.TSK/111
Power Control Software date	_____
Rain Fade Software program name	_____
Rain Fade Software date	_____

6.1 Data abnormalities

The Power Control and Rain Fade software are separate programs concurrently executing on the computer. The performance and execution status of the individual programs depends upon the rain fade samples received and the time between the samples. The Power Control Software receives data from the simulation software every DT seconds. Although the samples are transmitted every DT seconds from the simulation software, the actual program execution time, input/output functions, and the number of programs concurrently executing affects the actual time it takes to transmit and receive a sample. For example, if DT is set to one second, a sample time of two seconds may occur due to program execution time and hardware limitations (seconds is the smallest time resolution available).

Also, as described in the *Power Control and Rain Fade Software User's Guide*, the same memory location is updated with each new sample received. The Rain Fade Software may on occasion be unable to receive a sample due to processing at the time a sample is available. Another sample could be received and overwrite the previous sample. These abnormalities have been identified and are deemed as normal occurrences for the power control and rain fade process.

Two terms defined here are used in the Post Processing and Data Analysis section. The terms *acceptable* and *acceptable range* are defined as 'within a reasonable amount' determined by the algorithm developer. Also, if the Rain Fade Software does not receive a sample, the data may appear shifted compared to the expected data in Appendix B. Take these perversions into account when reviewing the actual simulation results.

6.2 Test 3 - Post Processing and Data Analysis

Print the data files corresponding to the respective programs using the Experiment Control and Monitor (EC&M) Post Processing Software. Refer to the *EC&M Post Processing Software User's Guide* for information on the EC&M Post Processing Software. The name of the Power Control Software data file is M1:RAINFADE.DAT/111. The name of the Rain Fade Software data file is the same as the algorithm name, but with the filename extension DAT.

_____ Note that the Rain Fade Software received the correct data from the simulation file. Compare the UP_FADE and DWN_FADE variables with the data in Table A-1. Verify that the Rain Fade program received an acceptable amount of data.

_____ Verify that the time between samples (SAMPL_DT) is in an acceptable range. The value of SAMPL_DT should be equal to DT, specified by the user in Section 4.

_____ Verify that the PIN_FLAG variable is zero (0.0) when the UP_FADE value is below threshold and one (1.0) when above threshold. This flag determines when the rain fade program activated the Power Control Software.

_____ Compare the ATTN_PIN variable of the Power Control Software data file with the Rain Fade Software data. Using the PIN_FLAG variable, verify that the ATTN_PIN variable corresponds to the ATTNPRED variable when PIN_FLAG is first set to one and then equal to ATTN_OPT for each successive sample until PIN_FLAG is reset to zero.

_____ Plot the PIN diode voltage and TWTA output power versus time as shown in Figure B-3 using the EC&M Post Processing Software.

_____ Compare the PIN diode voltage and corresponding TWTA output power with the appropriate simulation graph with the same variables. Verify that the performance of the TWTA has remained consistent.

_____ Note the time the Power Control implements the proper attenuation as discussed in the previous step. Verify that the power control is implemented in a reasonable amount of time, relative to DT.

_____ Verify that the Power Control Software resets the TWTA input attenuation (ATTN_PIN) when the PIN_FLAG resets to zero. The TWTA input attenuation corresponds to the initial Up Fade Depth value specified in Section 4.

Comments:

7.0 ABBREVIATIONS AND ACRONYMS

Refer to the list of abbreviations and acronyms and their definition for reference when using this manual.

ABBREVIATION	DEFINITION
ACTS	Advanced Communication Technology Satellite
ALGOR	Algorithm
ATPRED/ATTNPRED	Predicted Attenuation
ATTN	Attenuation
ATTN_OPT	Optimal Attenuation
ATTN_PIN	TWTA input attenuation
ATTN_TH	Threshold Attenuation
C&PM	Control and Performance Monitoring Subsystem
COMSAT	Communications Satellite Corporation
DWN_FADE	Down Fade Depth sample
EC&M	Experiment Control and Monitor
ELAP_TIM	Elapse time in seconds since midnight
HBR-LET	High Burst Rate Link Evaluation Terminal
HP	Hewlett Packard
LeRC	Lewis Research Center
NASA	National Aeronautics and Space Administration
PIN_FLAG	PIN diode software flag

PIN_VOLT	PIN diode, HP DC Power Supply voltage setting
SAMPL_DT	Time between successive rain fade samples
TWTA	Traveling Wave Tube Amplifier
UP_FADE	Up Fade Depth sample
WAV_CH_A	Wavetek Peak Power Meter reading channel A
WAV_CH_B	Wavetek Peak Power Meter reading channel B

8.0 GLOSSARY

down fade depth - the beacon fade level of the down link signal from the satellite to the ground station.

optimal link attenuation - link attenuation measured independent of system noise, scintillation, and other imprecisions.

predicted link attenuation - the optimal link attenuation measured some time *t*, into the future. The rain fade algorithm predicts when the link attenuation will surpass the threshold attenuation thus requiring power augmentation.

rain fade prediction algorithm - determines the amount of signal degradation on a communication link. Also capable of predicting future rain fade levels providing time to compensate for the fade.

sample time - time in seconds between two successive fade level measurements. The sample time is user defined for a each application.

threshold value - attenuation value in dB that determines when power control is necessary to compensate for signal degradation. Power control is activated when the fade level exceeds the threshold value.

up fade depth - the beacon fade level of the up link signal from the ground station to the satellite.

9.0 APPENDICES

Appendix A

Up Fade and Down Fade Depth Simulation Samples

Figure A-1 is a plot of the up fade beacon level versus time for the rain fade simulation data corresponding to Table A-1. Table A-1 lists the values for the rain fade simulation data in file M1:SIMDATA1.FAD/111, described in this document. The simulation consists of 316 samples representing a rain fade event. Use the data in Table A-1 to verify that the Power Control Software receives the data and passes it to the Rain Fade Software.

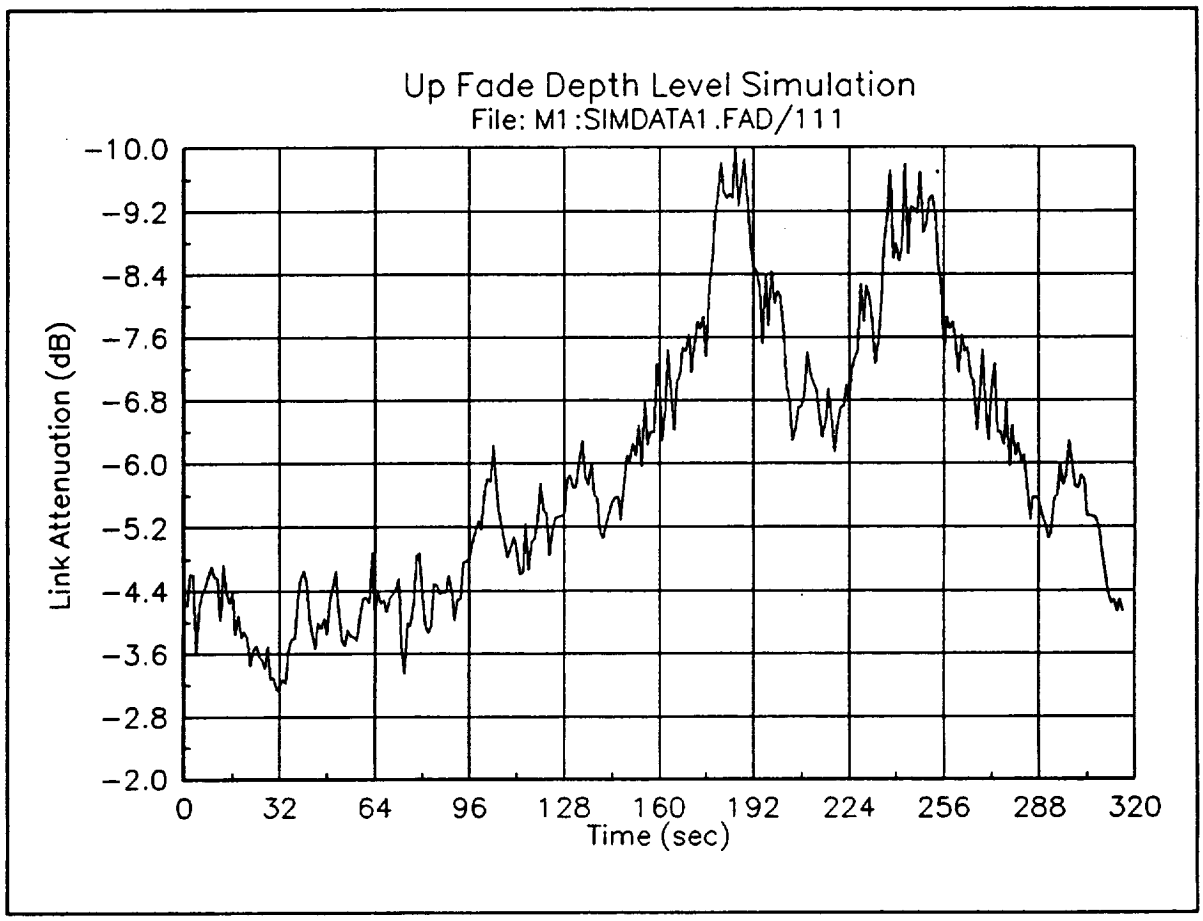

Figure A-1 Up Fade Depth Rain Fade Simulation versus Time

Appendix A - Up Fade and Down Fade Depth Simulation Samples

Sec	UP FADE	DWN FADE	Sec	UP FADE	DWN FADE	Sec	UP FADE	DWN FADE
1	-4.208	+6.000	46	-3.915	+6.000	91	-4.025	+6.000
2	-4.620	+6.000	47	-4.062	+6.000	92	-4.292	+6.000
3	-4.601	+6.000	48	-3.849	+6.000	93	-4.300	+6.000
4	-3.588	+6.000	49	-4.301	+6.000	94	-4.754	+6.000
5	-4.187	+6.000	50	-4.449	+6.000	95	-4.778	+6.000
6	-4.385	+6.000	51	-4.657	+6.000	96	-4.802	+6.000
7	-4.441	+6.000	52	-4.100	+6.000	97	-5.001	+6.000
8	-4.588	+6.000	53	-3.781	+6.000	98	-5.147	+6.000
9	-4.718	+6.000	54	-3.702	+6.000	99	-5.280	+6.000
10	-4.579	+6.000	55	-3.910	+6.000	100	-5.161	+6.000
11	-4.566	+6.000	56	-3.818	+6.000	101	-5.648	+6.000
12	-4.025	+6.000	57	-3.811	+6.000	102	-5.804	+6.000
13	-4.736	+6.000	58	-3.765	+6.000	103	-5.767	+6.000
14	-4.394	+6.000	59	-4.087	+6.000	104	-6.230	+6.000
15	-4.244	+6.000	60	-4.310	+6.000	105	-5.798	+6.000
16	-4.369	+6.000	61	-4.320	+6.000	106	-5.405	+6.000
17	-3.847	+6.000	62	-4.247	+6.000	107	-5.205	+6.000
18	-4.089	+6.000	63	-4.888	+6.000	108	-4.988	+6.000
19	-3.804	+6.000	64	-4.084	+6.000	109	-4.824	+6.000
20	-3.889	+6.000	65	-4.371	+6.000	110	-4.943	+6.000
21	-3.792	+6.000	66	-4.240	+6.000	111	-5.080	+6.000
22	-3.446	+6.000	67	-4.297	+6.000	112	-4.927	+6.000
23	-3.638	+6.000	68	-4.127	+6.000	113	-4.618	+6.000
24	-3.708	+6.000	69	-4.321	+6.000	114	-4.638	+6.000
25	-3.568	+6.000	70	-4.345	+6.000	115	-5.244	+6.000
26	-3.512	+6.000	71	-4.403	+6.000	116	-4.664	+6.000
27	-3.407	+6.000	72	-4.556	+6.000	117	-5.023	+6.000
28	-3.697	+6.000	73	-3.720	+6.000	118	-5.050	+6.000
29	-3.274	+6.000	74	-3.344	+6.000	119	-5.283	+6.000
30	-3.294	+6.000	75	-4.005	+6.000	120	-5.748	+6.000
31	-3.135	+6.000	76	-3.953	+6.000	121	-5.403	+6.000
32	-3.162	+6.000	77	-4.233	+6.000	122	-5.372	+6.000
33	-3.273	+6.000	78	-4.849	+6.000	123	-4.848	+6.000
34	-3.220	+6.000	79	-4.875	+6.000	124	-5.188	+6.000
35	-3.634	+6.000	80	-4.338	+6.000	125	-5.316	+6.000
36	-3.791	+6.000	81	-3.971	+6.000	126	-5.325	+6.000
37	-3.793	+6.000	82	-3.865	+6.000	127	-5.340	+6.000
38	-4.265	+6.000	83	-3.968	+6.000	128	-5.339	+6.000
39	-4.549	+6.000	84	-4.488	+6.000	129	-5.789	-5.789
40	-4.659	+6.000	85	-4.469	+6.000	130	-5.854	-5.854
41	-4.526	+6.000	86	-4.365	+6.000	131	-5.688	-5.688
42	-4.044	+6.000	87	-4.379	+6.000	132	-5.704	-5.704
43	-3.860	+6.000	88	-4.380	+6.000	133	-6.025	-6.025
44	-3.660	+6.000	89	-4.602	+6.000	134	-6.283	-6.283
45	-4.003	+6.000	90	-4.383	+6.000	135	-5.831	-5.831

Appendix A - Up Fade and Down Fade Depth Simulation Samples

Sec	UP FADE	DWN FADE	Sec	UP FADE	DWN FADE	Sec	UP FADE	DWN FADE
136	-5.729	-5.729	181	-9.807	-9.807	226	-7.341	-7.341
137	-6.014	-6.014	182	-9.431	-9.431	227	-7.419	-7.419
138	-5.602	-5.602	183	-9.356	-9.356	228	-8.280	-8.280
139	-5.560	-5.560	184	-9.421	-9.421	229	-7.791	-7.791
140	-5.129	-5.129	185	-9.362	-9.362	230	-8.253	-8.253
141	-5.058	-5.058	186	-10.01	-10.01	231	-8.108	-8.108
142	-5.246	-5.246	187	-9.259	-9.259	232	-7.751	-7.751
143	-5.364	-5.364	188	-9.583	-9.583	233	-7.258	-7.258
144	-5.514	-5.514	189	-9.853	-9.853	234	-7.536	-7.536
145	-5.574	-5.574	190	-9.340	-9.340	235	-8.076	-8.076
146	-5.578	-5.578	191	-8.725	-8.725	236	-8.796	-8.796
147	-5.288	-5.288	192	-8.502	-8.502	237	-9.158	-9.158
148	-5.701	-5.701	193	-8.441	-8.441	238	-9.713	-9.713
149	-6.109	-6.109	194	-8.206	-8.206	239	-8.593	-8.593
150	-6.024	-6.024	195	-7.510	-7.510	240	-8.789	-8.789
151	-6.252	-6.252	196	-8.406	-8.406	241	-8.558	-8.558
152	-6.093	-6.093	197	-7.742	-7.742	242	-8.743	-8.743
153	-6.478	-6.478	198	-8.441	-8.441	243	-9.793	-9.793
154	-5.960	-5.960	199	-8.024	-8.024	244	-8.654	-8.654
155	-6.774	-6.774	200	-8.186	-8.186	245	-9.254	-9.254
156	-6.231	-6.231	201	-8.128	-8.128	246	-9.242	-9.242
157	-6.403	-6.403	202	-7.739	-7.739	247	-9.158	-9.158
158	-6.390	-6.390	203	-6.976	-6.976	248	-9.689	-9.689
159	-7.262	-7.262	204	-6.829	-6.829	249	-8.918	-8.918
160	-6.951	-6.951	205	-6.286	-6.286	250	-9.036	-9.036
161	-6.282	-6.282	206	-6.432	-6.432	251	-9.350	-9.350
162	-6.693	-6.693	207	-6.707	-6.707	252	-9.399	-9.399
163	-7.439	-7.439	208	-6.716	-6.716	253	-9.140	-9.140
164	-6.899	-6.899	209	-6.846	-6.846	254	-8.571	-8.571
165	-6.415	-6.415	210	-7.408	-7.408	255	-8.234	-8.234
166	-7.033	-7.033	211	-7.128	-7.128	256	-7.353	-7.353
167	-7.111	-7.111	212	-7.028	-7.028	257	-7.859	-7.859
168	-7.466	-7.466	213	-6.931	-6.931	258	-7.704	-7.704
169	-7.417	-7.417	214	-6.577	-6.577	259	-7.796	-7.796
170	-7.635	-7.635	215	-6.322	-6.322	260	-7.491	-7.491
171	-7.146	-7.146	216	-6.510	-6.510	261	-7.146	-7.146
172	-7.491	-7.491	217	-6.947	-6.947	262	-7.635	-7.635
173	-7.796	-7.796	218	-6.597	-6.597	263	-7.417	-7.417
174	-7.704	-7.704	219	-6.138	-6.138	264	-7.466	-7.466
175	-7.859	-7.859	220	-6.456	-6.456	265	-7.111	-7.111
176	-7.353	-7.353	221	-6.710	-6.710	266	-7.033	-7.033
177	-8.234	-8.234	222	-6.714	-6.714	267	-6.415	-6.415
178	-8.571	-8.571	223	-6.990	-6.990	268	-6.899	-6.899
179	-9.140	-9.140	224	-6.753	-6.753	269	-7.439	-7.439
180	-9.399	-9.399	225	-7.177	-7.177	270	-6.693	-6.693

Appendix A - Up Fade and Down Fade Depth Simulation Samples

Sec	UP FADE	DWN FADE	Sec	UP FADE	DWN FADE	Sec	UP FADE	DWN FADE
271	-6.282	-6.282	287	-5.574	-5.574	303	-5.789	-5.789
272	-6.951	-6.951	288	-5.514	-5.514	304	-5.339	-5.339
273	-7.262	-7.262	289	-5.364	-5.364	305	-5.340	-5.340
274	-6.390	-6.390	290	-5.246	-5.246	306	-5.325	-5.325
275	-6.403	-6.403	291	-5.058	-5.058	307	-5.316	-5.316
276	-6.231	-6.231	292	-5.129	-5.129	308	-5.188	-5.188
277	-6.774	-6.774	293	-5.560	-5.560	309	-4.848	-4.848
278	-5.960	-5.960	294	-5.602	-5.602	310	-4.638	-4.638
279	-6.478	-6.478	295	-6.014	-6.014	311	-4.371	-4.371
280	-6.093	-6.093	296	-5.729	-5.729	312	-4.240	-4.240
281	-6.252	-6.252	297	-5.831	-5.831	313	-4.297	-4.297
282	-6.024	-6.024	298	-6.283	-6.283	314	-4.127	-4.127
283	-6.109	-6.109	299	-6.025	-6.025	315	-4.297	-4.297
284	-5.701	-5.701	300	-5.704	-5.704	316	-4.127	-4.127
285	-5.288	-5.288	301	-5.688	-5.688			
286	-5.578	-5.578	302	-5.854	-5.854			

Table A-1 Up Fade and Down Fade Simulation data

Appendix B

Rain Fade Simulation Expected Test Results

Use this appendix to compare the actual simulation results with past simulations to evaluate the performance of the Power Control and Rain Fade software. Simulation data is algorithm dependent. The data in this section is that which was available at time of publication. Additional data will be added as new algorithms are developed.

Use the EC&M Post Processing Software to reproduce the tables and graphs of the expected data. Each file contains the file name and date the data was sampled. Update this data as needed. Templates are available to reproduce Figures B-1, B-2 and B-3 using the Post Processing Software. Refer to the *EC&M Post Processing Software User's Guide* for additional information.

Locate the appropriate algorithm from those available to compare results. After evaluating the data files, fill out Section 6 describing the results. Note any significant differences, other than those previously discussed in Section 6. If problems in the Power Control Software are suspected, submit a copy of the actual and expected test results to the C&PM Software Manager. Describe the discrepancy in detail so that the simulation test can be repeated. This information will assist the software developers to improve the Power Control Software and provide more information in the Power Control and Rain Fade Software Test Plan.

Rain Fade Algorithm M1:BMALGR1.FTN/111

Table B-1 lists the statistical parameters used for the rain fade algorithm BMALGR1.FTN. Verify that the parameters listed are concurrent with those used in the actual test. Also, this test simulation read channel B of the Wavetek Peak Power Meter. Note any changes in the actual simulation in Section 6. The channels read will affect the timing of the Power Control Software.

File Name: M1:CLEVE.FAD/111		
Variable	Parameter	Value
AM	Mean Attenuation @ 30 Ghz link (dB)	2.656
SDA	Standard Deviation of Attn @ 30 Ghz link	1.066
TFF	Temporal Fade Factor (sec)	17.487
ATTN_TH	Threshold Attenuation (dB)	5
ATPRED	Sample prediction time (sec)	2
SDN	Standard Deviation of Attn Measurement	.15
DT	Sample Time Interval (sec)	1

Table B-1 Rain Fade Algorithm Actual Statistical Parameters

A copy of both the BMALGR1 algorithm and power control data files and graphs of selected data are provided on the following pages. These tables and graphs were generated using the EC&M Post Processing Software. Compare the actual simulation results with the expected data. Complete Section 6-2, Post Processing and Data Analysis.

Appendix B - Rain Fade Simulation Expected Test Results

File Name: M1:BMALGR1.DAT **Date data sampled:** 8/20/91

Total number of data gathering instruments = 6.

Seq	Actn	Time	Elap_Tim	UP_FADE	DWN_FADE	ATTN_OPT	ATTNPRED	PIN_FLAG	SAMPL_DT
1	RAIN	101856	37136	-4.200	6.000	-4.200	-4.204	0.0000	1.0000
2	RAIN	101857	37137	-4.650	6.000	-4.571	-4.576	0.0000	1.0000
3	RAIN	101858	37138	-3.600	6.000	-3.985	-3.989	0.0000	1.0000
4	RAIN	101900	37140	-4.200	6.000	-4.164	-4.168	0.0000	2.0000
5	RAIN	101901	37141	-4.350	6.000	-4.304	-4.308	0.0000	1.0000
6	RAIN	101902	37142	-4.500	6.000	-4.452	-4.456	0.0000	1.0000
7	RAIN	101903	37143	-4.650	6.000	-4.603	-4.608	0.0000	1.0000
8	RAIN	101904	37144	-4.650	6.000	-4.638	-4.642	0.0000	1.0000
9	RAIN	101905	37145	-4.650	6.000	-4.646	-4.651	0.0000	1.0000
10	RAIN	101906	37146	-4.500	6.000	-4.541	-4.546	0.0000	1.0000
11	RAIN	101907	37147	-4.050	6.000	-4.221	-4.225	0.0000	1.0000
12	RAIN	101908	37148	-4.800	6.000	-4.691	-4.696	0.0000	1.0000
13	RAIN	101909	37149	-4.200	6.000	-4.359	-4.364	0.0000	1.0000
14	RAIN	101910	37150	-4.350	6.000	-4.352	-4.356	0.0000	1.0000
15	RAIN	101912	37152	-3.900	6.000	-4.025	-4.029	0.0000	2.0000
16	RAIN	101913	37153	-4.050	6.000	-4.042	-4.046	0.0000	1.0000
17	RAIN	101914	37154	-3.750	6.000	-3.853	-3.857	0.0000	1.0000
18	RAIN	101915	37155	-3.900	6.000	-3.884	-3.888	0.0000	1.0000
19	RAIN	101916	37156	-3.750	6.000	-3.795	-3.799	0.0000	1.0000
20	RAIN	101917	37157	-3.450	6.000	-3.583	-3.587	0.0000	1.0000
21	RAIN	101918	37158	-3.600	6.000	-3.594	-3.597	0.0000	1.0000
22	RAIN	101919	37159	-3.750	6.000	-3.700	-3.704	0.0000	1.0000
23	RAIN	101920	37160	-3.600	6.000	-3.634	-3.638	0.0000	1.0000
24	RAIN	101921	37161	-3.450	6.000	-3.519	-3.522	0.0000	1.0000
25	RAIN	101923	37163	-3.750	6.000	-3.705	-3.709	0.0000	2.0000
26	RAIN	101924	37164	-3.300	6.000	-3.455	-3.458	0.0000	1.0000
27	RAIN	101925	37165	-3.300	6.000	-3.361	-3.364	0.0000	1.0000
28	RAIN	101926	37166	-3.150	6.000	-3.236	-3.239	0.0000	1.0000
29	RAIN	101927	37167	-3.150	6.000	-3.185	-3.188	0.0000	1.0000
30	RAIN	101928	37168	-3.300	6.000	-3.257	-3.260	0.0000	1.0000
31	RAIN	101929	37169	-3.150	6.000	-3.192	-3.195	0.0000	1.0000
32	RAIN	101930	37170	-3.600	6.000	-3.474	-3.477	0.0000	1.0000
33	RAIN	101931	37171	-3.750	6.000	-3.671	-3.675	0.0000	1.0000
34	RAIN	101932	37172	-3.750	6.000	-3.725	-3.729	0.0000	1.0000
35	RAIN	101933	37173	-4.200	6.000	-4.090	-4.094	0.0000	1.0000
36	RAIN	101935	37175	-4.500	6.000	-4.465	-4.469	0.0000	2.0000
37	RAIN	101936	37176	-4.500	6.000	-4.491	-4.495	0.0000	1.0000
38	RAIN	101937	37177	-4.050	6.000	-4.200	-4.204	0.0000	1.0000
39	RAIN	101938	37178	-3.900	6.000	-4.005	-4.009	0.0000	1.0000
40	RAIN	101939	37179	-3.600	6.000	-3.754	-3.758	0.0000	1.0000
41	RAIN	101940	37180	-4.050	6.000	-3.964	-3.968	0.0000	1.0000
42	RAIN	101941	37181	-3.900	6.000	-3.920	-3.924	0.0000	1.0000
43	RAIN	101942	37182	-4.050	6.000	-4.011	-4.015	0.0000	1.0000
44	RAIN	101943	37183	-3.900	6.000	-3.936	-3.940	0.0000	1.0000
45	RAIN	101944	37184	-4.350	6.000	-4.252	-4.256	0.0000	1.0000
46	RAIN	101945	37185	-4.500	6.000	-4.443	-4.447	0.0000	1.0000
47	RAIN	101947	37187	-4.200	6.000	-4.255	-4.259	0.0000	2.0000
48	RAIN	101948	37188	-4.050	6.000	-4.116	-4.120	0.0000	1.0000
49	RAIN	101949	37189	-3.750	6.000	-3.883	-3.887	0.0000	1.0000
50	RAIN	101950	37190	-3.750	6.000	-3.796	-3.800	0.0000	1.0000
51	RAIN	101951	37191	-3.750	6.000	-3.765	-3.769	0.0000	1.0000
52	RAIN	101952	37192	-3.750	6.000	-3.755	-3.758	0.0000	1.0000
53	RAIN	101953	37193	-3.750	6.000	-3.751	-3.755	0.0000	1.0000
54	RAIN	101954	37194	-4.050	6.000	-3.968	-3.972	0.0000	1.0000
55	RAIN	101955	37195	-4.350	6.000	-4.264	-4.268	0.0000	1.0000

56	RAIN	101956	37196	-4.350	6.000	-4.327	-4.331	0.0000	1.0000
57	RAIN	101957	37197	-4.200	6.000	-4.238	-4.242	0.0000	1.0000
58	RAIN	101959	37199	-4.950	6.000	-4.956	-4.961	0.0000	2.0000
59	RAIN	102000	37200	-4.050	6.000	-4.371	-4.375	0.0000	1.0000
60	RAIN	102001	37201	-4.350	6.000	-4.356	-4.360	0.0000	1.0000
61	RAIN	102002	37202	-4.200	6.000	-4.248	-4.252	0.0000	1.0000
62	RAIN	102003	37203	-4.350	6.000	-4.321	-4.326	0.0000	1.0000
63	RAIN	102004	37204	-4.350	6.000	-4.341	-4.346	0.0000	1.0000
64	RAIN	102005	37205	-4.350	6.000	-4.347	-4.351	0.0000	1.0000
65	RAIN	102006	37206	-4.350	6.000	-4.349	-4.353	0.0000	1.0000
66	RAIN	102007	37207	-4.500	6.000	-4.461	-4.465	0.0000	1.0000
67	RAIN	102008	37208	-3.750	6.000	-4.019	-4.023	0.0000	1.0000
68	RAIN	102009	37209	-3.300	6.000	-3.608	-3.611	0.0000	1.0000
69	RAIN	102011	37211	-4.050	6.000	-3.992	-3.995	0.0000	2.0000
70	RAIN	102012	37212	-3.900	6.000	-3.927	-3.931	0.0000	1.0000
71	RAIN	102013	37213	-4.200	6.000	-4.128	-4.132	0.0000	1.0000
72	RAIN	102014	37214	-4.800	6.000	-4.703	-4.708	0.0000	1.0000
73	RAIN	102015	37215	-4.950	6.000	-4.902	-4.907	0.0000	1.0000
74	RAIN	102016	37216	-4.350	6.000	-4.529	-4.534	0.0000	1.0000
75	RAIN	102017	37217	-3.900	6.000	-4.135	-4.139	0.0000	1.0000
76	RAIN	102018	37218	-3.900	6.000	-3.982	-3.986	0.0000	1.0000
77	RAIN	102019	37219	-4.500	6.000	-4.388	-4.393	0.0000	1.0000
78	RAIN	102020	37220	-4.500	6.000	-4.472	-4.477	0.0000	1.0000
79	RAIN	102021	37221	-4.350	6.000	-4.385	-4.389	0.0000	1.0000
80	RAIN	102023	37223	-4.350	6.000	-4.356	-4.360	0.0000	2.0000
81	RAIN	102024	37224	-4.350	6.000	-4.351	-4.355	0.0000	1.0000
82	RAIN	102025	37225	-4.650	6.000	-4.582	-4.587	0.0000	1.0000
83	RAIN	102026	37226	-4.350	6.000	-4.419	-4.423	0.0000	1.0000
84	RAIN	102027	37227	-4.050	6.000	-4.175	-4.179	0.0000	1.0000
85	RAIN	102028	37228	-4.350	6.000	-4.302	-4.306	0.0000	1.0000
86	RAIN	102029	37229	-4.350	6.000	-4.336	-4.341	0.0000	1.0000
87	RAIN	102030	37230	-4.800	6.000	-4.712	-4.717	0.0000	1.0000
88	RAIN	102031	37231	-4.800	6.000	-4.779	-4.784	0.0000	1.0000
89	RAIN	102032	37232	-4.950	6.000	-4.912	-4.917	0.0000	1.0000
90	RAIN	102033	37233	-5.100	6.000	-5.060	-5.065	1.0000	1.0000
91	RAIN	102035	37235	-5.250	6.000	-5.230	-5.065	1.0000	2.0000
92	RAIN	102036	37236	-5.100	6.000	-5.130	-5.065	1.0000	1.0000
93	RAIN	102037	37237	-5.700	6.000	-5.630	-5.065	1.0000	1.0000
94	RAIN	102038	37238	-5.850	6.000	-5.815	-5.065	1.0000	1.0000
95	RAIN	102039	37239	-5.700	6.000	-5.723	-5.065	1.0000	1.0000
96	RAIN	102040	37240	-5.850	6.000	-5.826	-5.065	1.0000	1.0000
97	RAIN	102042	37242	-5.400	6.000	-5.482	-5.065	1.0000	2.0000
98	RAIN	102043	37243	-5.250	6.000	-5.308	-5.065	1.0000	1.0000
99	RAIN	102044	37244	-4.950	6.000	-5.050	-5.065	1.0000	1.0000
100	RAIN	102045	37245	-4.800	6.000	-4.870	-4.875	0.0000	1.0000
101	RAIN	102046	37246	-4.950	6.000	-4.930	-4.935	0.0000	1.0000
102	RAIN	102047	37247	-5.100	6.000	-5.063	-5.068	1.0000	1.0000
103	RAIN	102048	37248	-4.950	6.000	-4.978	-4.983	0.0000	1.0000
104	RAIN	102049	37249	-4.650	6.000	-4.746	-4.751	0.0000	1.0000
105	RAIN	102051	37251	-5.250	6.000	-5.230	-5.235	1.0000	2.0000
106	RAIN	102052	37252	-4.650	6.000	-4.824	-4.829	0.0000	1.0000
107	RAIN	102053	37253	-4.950	6.000	-4.920	-4.924	0.0000	1.0000
108	RAIN	102054	37254	-5.100	6.000	-5.062	-5.066	1.0000	1.0000
109	RAIN	102055	37255	-5.250	6.000	-5.212	-5.066	1.0000	1.0000
110	RAIN	102056	37256	-5.700	6.000	-5.636	-5.066	1.0000	1.0000
111	RAIN	102058	37258	-5.400	6.000	-5.438	-5.066	1.0000	2.0000
112	RAIN	102059	37259	-4.800	6.000	-4.997	-5.002	1.0000	1.0000
113	RAIN	102100	37260	-5.250	6.000	-5.198	-5.002	1.0000	1.0000
114	RAIN	102101	37261	-5.250	6.000	-5.238	-5.002	1.0000	1.0000
115	RAIN	102102	37262	-5.250	6.000	-5.247	-5.002	1.0000	1.0000

116	RAIN	102103	37263	-5.400	6.000	-5.369	-5.002	1.0000	1.0000
117	RAIN	102104	37264	-5.400	6.000	-5.393	-5.002	1.0000	1.0000
118	RAIN	102106	37266	-5.850	-5.850	-5.837	-5.002	1.0000	2.0000
119	RAIN	102107	37267	-5.700	-5.700	-5.728	-5.002	1.0000	1.0000
120	RAIN	102108	37268	-5.700	-5.700	-5.705	-5.002	1.0000	1.0000
121	RAIN	102109	37269	-6.000	-6.000	-5.955	-5.002	1.0000	1.0000
122	RAIN	102110	37270	-6.300	-6.300	-6.256	-5.002	1.0000	1.0000
123	RAIN	102111	37271	-5.850	-5.850	-5.945	-5.002	1.0000	1.0000
124	RAIN	102112	37272	-5.700	-5.700	-5.756	-5.002	1.0000	1.0000
125	RAIN	102113	37273	-6.000	-6.000	-5.960	-5.002	1.0000	1.0000
126	RAIN	102114	37274	-5.550	-5.550	-5.652	-5.002	1.0000	1.0000
127	RAIN	102116	37276	-5.550	-5.550	-5.564	-5.002	1.0000	2.0000
128	RAIN	102117	37277	-5.100	-5.100	-5.228	-5.002	1.0000	1.0000
129	RAIN	102118	37278	-5.250	-5.250	-5.244	-5.002	1.0000	1.0000
130	RAIN	102119	37279	-5.400	-5.400	-5.368	-5.002	1.0000	1.0000
131	RAIN	102120	37280	-5.550	-5.550	-5.516	-5.002	1.0000	1.0000
132	RAIN	102121	37281	-5.550	-5.550	-5.542	-5.002	1.0000	1.0000
133	RAIN	102122	37282	-5.550	-5.550	-5.548	-5.002	1.0000	1.0000
134	RAIN	102123	37283	-5.250	-5.250	-5.326	-5.002	1.0000	1.0000
135	RAIN	102124	37284	-5.700	-5.700	-5.641	-5.002	1.0000	1.0000
136	RAIN	102125	37285	-6.150	-6.150	-6.097	-5.002	1.0000	1.0000
137	RAIN	102126	37286	-6.000	-6.000	-6.018	-5.002	1.0000	1.0000
138	RAIN	102128	37288	-6.300	-6.300	-6.284	-5.002	1.0000	2.0000
139	RAIN	102129	37289	-6.150	-6.150	-6.175	-5.002	1.0000	1.0000
140	RAIN	102130	37290	-6.000	-6.000	-6.036	-5.002	1.0000	1.0000
141	RAIN	102131	37291	-6.750	-6.750	-6.711	-5.002	1.0000	1.0000
142	RAIN	102132	37292	-6.300	-6.300	-6.387	-5.002	1.0000	1.0000
143	RAIN	102133	37293	-6.450	-6.450	-6.439	-5.002	1.0000	1.0000
144	RAIN	102134	37294	-6.450	-6.450	-6.447	-5.002	1.0000	1.0000
145	RAIN	102136	37296	-7.200	-7.200	-7.251	-5.002	1.0000	2.0000
146	RAIN	102137	37297	-6.900	-6.900	-6.964	-5.002	1.0000	1.0000
147	RAIN	102138	37298	-6.300	-6.300	-6.462	-5.002	1.0000	1.0000
148	RAIN	102139	37299	-7.500	-7.500	-7.529	-5.002	1.0000	1.0000
149	RAIN	102140	37300	-6.900	-6.900	-7.033	-5.002	1.0000	1.0000
150	RAIN	102141	37301	-6.450	-6.450	-6.585	-5.002	1.0000	1.0000
151	RAIN	102142	37302	-7.050	-7.050	-7.008	-5.002	1.0000	1.0000
152	RAIN	102143	37303	-7.050	-7.050	-7.043	-5.002	1.0000	1.0000
153	RAIN	102144	37304	-7.500	-7.500	-7.466	-5.002	1.0000	1.0000
154	RAIN	102146	37306	-7.350	-7.350	-7.360	-5.002	1.0000	2.0000
155	RAIN	102147	37307	-7.650	-7.650	-7.622	-5.002	1.0000	1.0000
156	RAIN	102148	37308	-7.200	-7.200	-7.279	-5.002	1.0000	1.0000
157	RAIN	102149	37309	-7.500	-7.500	-7.475	-5.002	1.0000	1.0000
158	RAIN	102150	37310	-7.650	-7.650	-7.630	-5.002	1.0000	1.0000
159	RAIN	102151	37311	-7.800	-7.800	-7.781	-5.002	1.0000	1.0000
160	RAIN	102152	37312	-7.350	-7.350	-7.429	-5.002	1.0000	1.0000
161	RAIN	102153	37313	-8.250	-8.250	-8.251	-5.002	1.0000	1.0000
162	RAIN	102154	37314	-8.550	-8.550	-8.529	-5.002	1.0000	1.0000
163	RAIN	102155	37315	-9.150	-9.150	-9.141	-5.002	1.0000	1.0000
164	RAIN	102157	37317	-9.450	-9.450	-9.449	-5.002	1.0000	2.0000
165	RAIN	102158	37318	-9.750	-9.750	-9.734	-5.002	1.0000	1.0000
166	RAIN	102159	37319	-9.450	-9.450	-9.484	-5.002	1.0000	1.0000
167	RAIN	102200	37320	-9.450	-9.450	-9.452	-5.002	1.0000	1.0000
168	RAIN	102201	37321	-9.300	-9.300	-9.316	-5.002	1.0000	1.0000
169	RAIN	102202	37322	-10.050	-10.050	-10.058	-5.002	1.0000	1.0000
170	RAIN	102203	37323	-9.300	-9.300	-9.426	-5.002	1.0000	1.0000
171	RAIN	102205	37325	-9.600	-9.600	-9.595	-5.002	1.0000	2.0000
172	RAIN	102206	37326	-9.900	-9.900	-9.884	-5.002	1.0000	1.0000
173	RAIN	102207	37327	-9.300	-9.300	-9.389	-5.002	1.0000	1.0000
174	RAIN	102208	37328	-8.700	-8.700	-8.821	-5.002	1.0000	1.0000
175	RAIN	102209	37329	-8.550	-8.550	-8.587	-5.002	1.0000	1.0000

176	RAIN	102210	37330	-8.400	-8.400	-8.424	-5.002	1.0000	1.0000
177	RAIN	102211	37331	-7.500	-7.500	-7.708	-5.002	1.0000	1.0000
178	RAIN	102212	37332	-8.400	-8.400	-8.386	-5.002	1.0000	1.0000
179	RAIN	102213	37333	-7.800	-7.800	-7.908	-5.002	1.0000	1.0000
180	RAIN	102214	37334	-8.400	-8.400	-8.375	-5.002	1.0000	1.0000
181	RAIN	102216	37336	-7.950	-7.950	-8.001	-5.002	1.0000	2.0000
182	RAIN	102217	37337	-8.250	-8.250	-8.228	-5.002	1.0000	1.0000
183	RAIN	102218	37338	-8.100	-8.100	-8.116	-5.002	1.0000	1.0000
184	RAIN	102219	37339	-7.800	-7.800	-7.850	-5.002	1.0000	1.0000
185	RAIN	102220	37340	-7.050	-7.050	-7.233	-5.002	1.0000	1.0000
186	RAIN	102221	37341	-6.900	-6.900	-6.964	-5.002	1.0000	1.0000
187	RAIN	102222	37342	-6.450	-6.450	-6.565	-5.002	1.0000	1.0000
188	RAIN	102223	37343	-6.750	-6.750	-6.723	-5.002	1.0000	1.0000
189	RAIN	102224	37344	-6.750	-6.750	-6.745	-5.002	1.0000	1.0000
190	RAIN	102226	37346	-6.900	-6.900	-6.889	-5.002	1.0000	2.0000
191	RAIN	102227	37347	-7.350	-7.350	-7.316	-5.002	1.0000	1.0000
192	RAIN	102228	37348	-7.200	-7.200	-7.217	-5.002	1.0000	1.0000
193	RAIN	102229	37349	-7.050	-7.050	-7.077	-5.002	1.0000	1.0000
194	RAIN	102230	37350	-6.900	-6.900	-6.930	-5.002	1.0000	1.0000
195	RAIN	102231	37351	-6.600	-6.600	-6.666	-5.002	1.0000	1.0000
196	RAIN	102232	37352	-6.450	-6.450	-6.492	-5.002	1.0000	1.0000
197	RAIN	102234	37354	-6.900	-6.900	-6.893	-5.002	1.0000	2.0000
198	RAIN	102235	37355	-6.600	-6.600	-6.656	-5.002	1.0000	1.0000
199	RAIN	102236	37356	-6.150	-6.150	-6.269	-5.002	1.0000	1.0000
200	RAIN	102237	37357	-6.450	-6.450	-6.422	-5.002	1.0000	1.0000
201	RAIN	102238	37358	-6.750	-6.750	-6.712	-5.002	1.0000	1.0000
202	RAIN	102239	37359	-6.750	-6.750	-6.743	-5.002	1.0000	1.0000
203	RAIN	102241	37361	-6.750	-6.750	-6.748	-5.002	1.0000	2.0000
204	RAIN	102242	37362	-7.200	-7.200	-7.163	-5.002	1.0000	1.0000
205	RAIN	102243	37363	-7.350	-7.350	-7.328	-5.002	1.0000	1.0000
206	RAIN	102244	37364	-7.350	-7.350	-7.346	-5.002	1.0000	1.0000
207	RAIN	102245	37365	-8.250	-8.250	-8.268	-5.002	1.0000	1.0000
208	RAIN	102246	37366	-7.800	-7.800	-7.880	-5.002	1.0000	1.0000
209	RAIN	102247	37367	-8.250	-8.250	-8.223	-5.002	1.0000	1.0000
210	RAIN	102248	37368	-8.100	-8.100	-8.115	-5.002	1.0000	1.0000
211	RAIN	102249	37369	-7.800	-7.800	-7.850	-5.002	1.0000	1.0000
212	RAIN	102251	37371	-7.500	-7.500	-7.542	-5.002	1.0000	2.0000
213	RAIN	102252	37372	-8.100	-8.100	-8.075	-5.002	1.0000	1.0000
214	RAIN	102253	37373	-8.850	-8.850	-8.857	-5.002	1.0000	1.0000
215	RAIN	102254	37374	-9.150	-9.150	-9.132	-5.002	1.0000	1.0000
216	RAIN	102255	37375	-9.750	-9.750	-9.745	-5.002	1.0000	1.0000
217	RAIN	102256	37376	-8.550	-8.550	-8.810	-5.002	1.0000	1.0000
218	RAIN	102257	37377	-8.850	-8.850	-8.845	-5.002	1.0000	1.0000
219	RAIN	102259	37379	-8.550	-8.550	-8.577	-5.002	1.0000	2.0000
220	RAIN	102300	37380	-9.750	-9.750	-9.852	-5.002	1.0000	1.0000
221	RAIN	102301	37381	-8.700	-8.700	-8.941	-5.002	1.0000	1.0000
222	RAIN	102302	37382	-9.300	-9.300	-9.280	-5.002	1.0000	1.0000
223	RAIN	102303	37383	-9.300	-9.300	-9.297	-5.002	1.0000	1.0000
224	RAIN	102304	37384	-9.150	-9.150	-9.166	-5.002	1.0000	1.0000
225	RAIN	102305	37385	-9.750	-9.750	-9.741	-5.002	1.0000	1.0000
226	RAIN	102306	37386	-8.850	-8.850	-9.017	-5.002	1.0000	1.0000
227	RAIN	102307	37387	-9.000	-9.000	-9.001	-5.002	1.0000	1.0000
228	RAIN	102309	37389	-9.300	-9.300	-9.281	-5.002	1.0000	1.0000
229	RAIN	102310	37390	-9.450	-9.450	-9.445	-5.002	1.0000	2.0000
230	RAIN	102311	37391	-9.150	-9.150	-9.187	-5.002	1.0000	1.0000
231	RAIN	102312	37392	-8.250	-8.250	-8.443	-5.002	1.0000	1.0000
232	RAIN	102313	37393	-7.350	-7.350	-7.617	-5.002	1.0000	1.0000
233	RAIN	102314	37394	-7.800	-7.800	-7.779	-5.002	1.0000	1.0000
234	RAIN	102315	37395	-7.650	-7.650	-7.668	-5.002	1.0000	1.0000
235	RAIN	102316	37396	-7.800	-7.800	-7.784	-5.002	1.0000	1.0000

236	RAIN	102317	37397	-7.500	-7.500	-7.546	-5.002	1.0000	1.0000
237	RAIN	102318	37398	-7.200	-7.200	-7.263	-5.002	1.0000	1.0000
238	RAIN	102319	37399	-7.650	-7.650	-7.617	-5.002	1.0000	1.0000
239	RAIN	102321	37401	-7.350	-7.350	-7.380	-5.002	1.0000	2.0000
240	RAIN	102322	37402	-7.500	-7.500	-7.484	-5.002	1.0000	1.0000
241	RAIN	102323	37403	-7.050	-7.050	-7.134	-5.002	1.0000	1.0000
242	RAIN	102324	37404	-6.450	-6.450	-6.615	-5.002	1.0000	1.0000
243	RAIN	102325	37405	-6.900	-6.900	-6.864	-5.002	1.0000	1.0000
244	RAIN	102326	37406	-7.500	-7.500	-7.473	-5.002	1.0000	1.0000
245	RAIN	102327	37407	-6.750	-6.750	-6.915	-5.002	1.0000	1.0000
246	RAIN	102329	37409	-6.300	-6.300	-6.414	-5.002	1.0000	2.0000
247	RAIN	102330	37410	-6.900	-6.900	-6.856	-5.002	1.0000	1.0000
248	RAIN	102331	37411	-7.200	-7.200	-7.167	-5.002	1.0000	1.0000
249	RAIN	102332	37412	-6.450	-6.450	-6.622	-5.002	1.0000	1.0000
250	RAIN	102333	37413	-6.300	-6.300	-6.368	-5.002	1.0000	1.0000
251	RAIN	102334	37414	-6.750	-6.750	-6.707	-5.002	1.0000	1.0000
252	RAIN	102335	37415	-6.000	-6.000	-6.181	-5.002	1.0000	1.0000
253	RAIN	102337	37417	-6.450	-6.450	-6.435	-5.002	1.0000	2.0000
254	RAIN	102338	37418	-6.150	-6.150	-6.209	-5.002	1.0000	1.0000
255	RAIN	102339	37419	-6.300	-6.300	-6.284	-5.002	1.0000	1.0000
256	RAIN	102340	37420	-6.000	-6.000	-6.061	-5.002	1.0000	1.0000
257	RAIN	102341	37421	-5.700	-5.700	-5.787	-5.002	1.0000	1.0000
258	RAIN	102342	37422	-5.250	-5.250	-5.401	-5.002	1.0000	1.0000
259	RAIN	102343	36423	-5.550	-5.550	-5.520	-5.002	1.0000	1.0000
260	RAIN	102344	37424	-5.550	-5.550	-5.543	-5.002	1.0000	1.0000
261	RAIN	102345	37425	-5.550	-5.550	-5.548	-5.002	1.0000	1.0000
262	RAIN	102346	37426	-5.400	-5.400	-5.434	-5.002	1.0000	1.0000
263	RAIN	102348	37428	-5.250	-5.250	-5.280	-5.002	1.0000	2.0000
264	RAIN	102349	37429	-5.100	-5.100	-5.145	-5.002	1.0000	1.0000
265	RAIN	102350	37430	-5.100	-5.100	-5.110	-5.002	1.0000	1.0000
266	RAIN	102351	37431	-5.550	-5.550	-5.483	-5.002	1.0000	1.0000
267	RAIN	102352	37432	-5.550	-5.550	-5.536	-5.002	1.0000	1.0000
268	RAIN	102353	37433	-6.000	-6.000	-5.943	-5.002	1.0000	1.0000
269	RAIN	102354	37434	-5.850	-5.850	-5.868	-5.002	1.0000	1.0000
270	RAIN	102355	37435	-6.300	-6.300	-6.249	-5.002	1.0000	1.0000
271	RAIN	102357	37437	-6.000	-6.000	-6.036	-5.002	1.0000	2.0000
272	RAIN	102358	37438	-5.700	-5.700	-5.779	-5.002	1.0000	1.0000
273	RAIN	102359	37439	-5.700	-5.700	-5.716	-5.002	1.0000	1.0000
274	RAIN	102400	37440	-5.850	-5.850	-5.825	-5.002	1.0000	1.0000
275	RAIN	102401	37441	-5.850	-5.850	-5.844	-5.002	1.0000	1.0000
276	RAIN	102402	37442	-5.400	6.000	-5.516	-5.002	1.0000	1.0000
277	RAIN	102403	37443	-5.250	6.000	-5.318	-5.002	1.0000	1.0000
278	RAIN	102404	37444	-5.250	6.000	-5.265	-5.002	1.0000	1.0000
279	RAIN	102405	37445	-5.250	6.000	-5.253	-5.002	1.0000	1.0000
280	RAIN	102407	37447	-4.800	6.000	-4.901	-4.906	0.0000	2.0000
281	RAIN	102408	37448	-4.650	6.000	-4.722	-4.727	0.0000	1.0000
282	RAIN	102409	37449	-4.650	6.000	-4.669	-4.674	0.0000	1.0000
283	RAIN	102410	37450	-4.350	6.000	-4.449	-4.454	0.0000	1.0000
284	RAIN	102411	37451	-4.200	6.000	-4.280	-4.284	0.0000	1.0000
285	RAIN	102412	37452	-4.350	6.000	-4.330	-4.334	0.0000	1.0000
286	RAIN	102413	37453	-4.200	6.000	-4.239	-4.243	0.0000	1.0000
287	RAIN	102414	37454	-4.350	6.000	-4.319	-4.323	0.0000	1.0000
288	RAIN	102415	37455	-4.200	6.000	-4.235	-4.240	0.0000	1.0000
289	RAIN	102416	37456	-4.200	6.000	-4.210	-4.214	0.0000	1.0000
290	RAIN	102418	37458	-4.200	6.000	-4.201	-4.205	0.0000	2.0000
291	RAIN	102419	37459	-4.200	6.000	-4.200	-4.204	0.0000	1.0000
292	RAIN	102420	37460	-4.200	6.000	-4.199	-4.204	0.0000	1.0000
293	RAIN	102421	37461	-4.200	6.000	-4.199	-4.203	0.0000	1.0000

Appendix B - Rain Fade Simulation Expected Test Results

Figure B-1 illustrates the Up Fade samples received by the Power Control receive program and passed to the Rain Fade BMALGR1 Software. This figure is similar to Figure A-1. Verify that the actual Up Fade samples received for the current simulation are similar to Figure B-1.

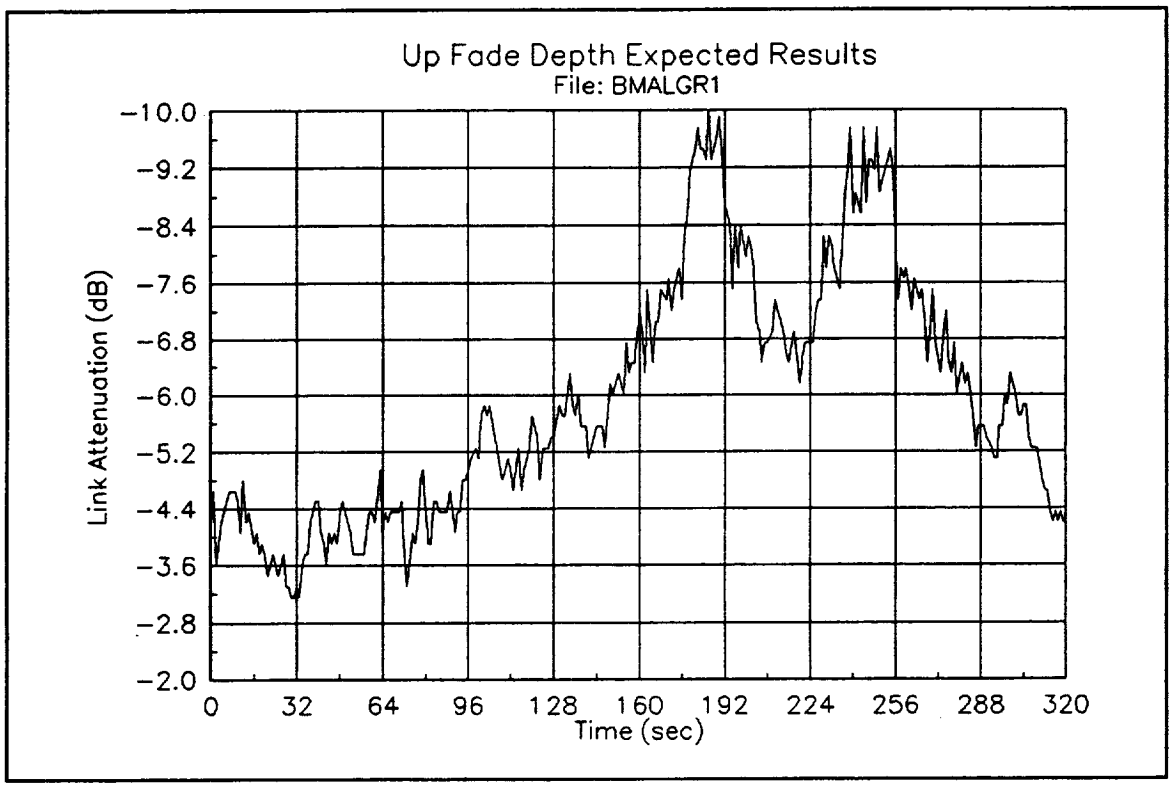

Figure B-1 BMALGR1 Up Fade Depth versus Elapsed Time

Figure B-2 compares the Up Fade samples received to the Optimal Attenuation calculated by the Rain Fade Software. For the given simulation, the Optimal Attenuation tracks the Up Fade samples. In actual rain fade events, the Optimal Attenuation will vary somewhat from the Up Fade samples due to scintillation and other system imperfections. The Optimal Attenuation is a measure of signal fade due to rain only.

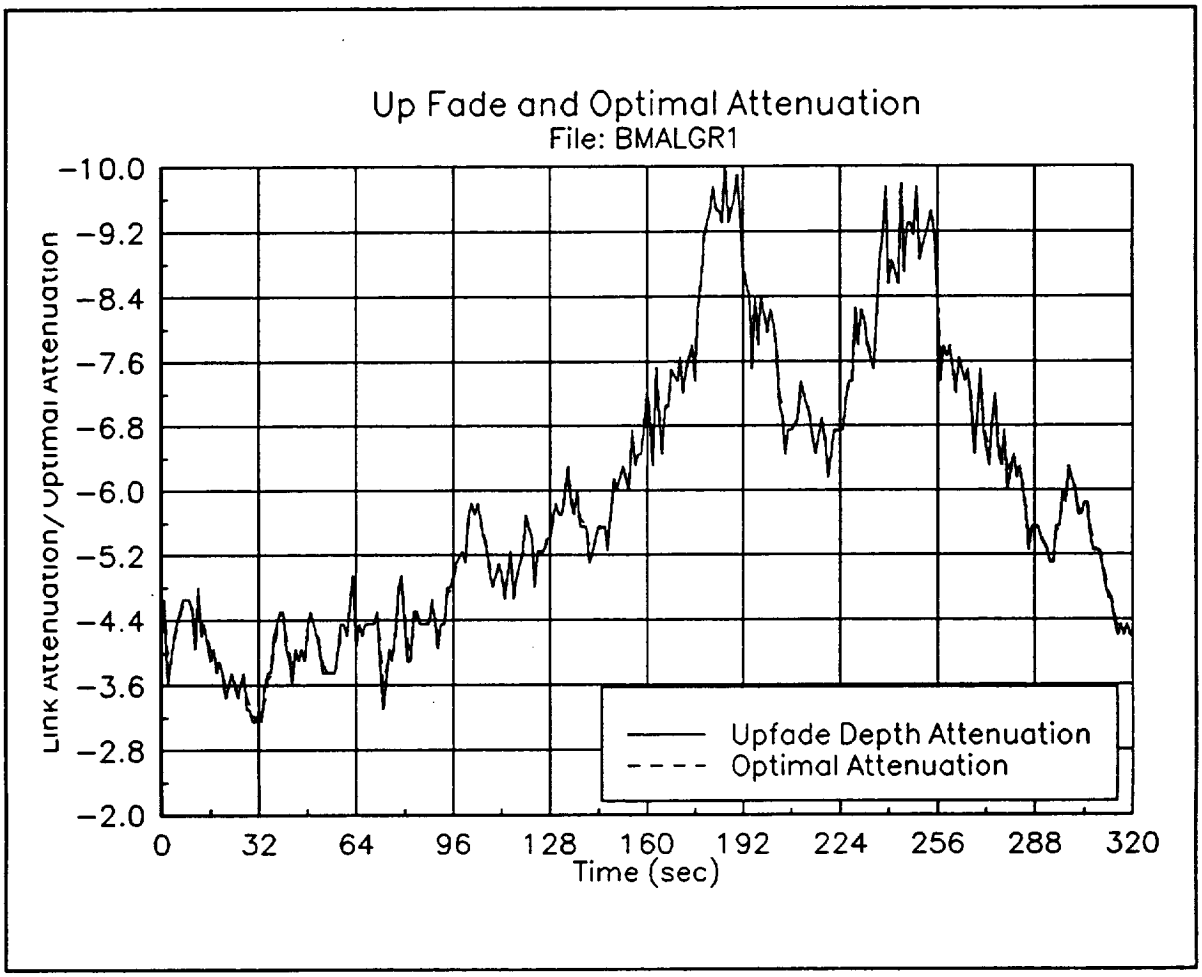

Figure B-2 BMALGR1 Up Fade Depth and Optimal Attenuation versus Elapsed Time

Appendix B - Rain Fade Simulation Expected Test Results

File Name:M1:RAINFADE.DAT **Date data sampled:8/20/91**

Total number of data gathering instruments = 4.

Seq	Actn	Time	Elap_Tim	UP_FADE	ATTN_PIN	WAV_CH_A	WAV_CH_B	PIN_VOLT	CURRENT
1	PWRC	102035	37235	-5.065	-14.877	0.000	-1.980	1.8485	0.00E+00
2	PWRC	102036	37236	-5.230	-14.695	0.000	-1.800	1.8301	0.00E+00
3	PWRC	102037	37237	-5.130	-14.805	0.000	-1.870	1.8412	0.00E+00
4	PWRC	102038	37238	-5.630	-14.206	0.000	-1.370	1.7806	0.00E+00
5	PWRC	102039	37239	-5.815	-13.943	0.000	-1.090	1.7541	0.00E+00
6	PWRC	102040	37240	-5.723	-14.073	0.000	-1.280	1.7672	0.00E+00
7	PWRC	102042	37242	-5.826	-13.927	0.000	-1.090	1.7524	0.00E+00
8	PWRC	102043	37243	-5.482	-14.416	0.000	-1.560	1.8018	0.00E+00
9	PWRC	102044	37244	-5.308	-14.608	0.000	-1.710	1.8213	0.00E+00
10	PWRC	102045	37245	-5.050	-14.895	0.000	-1.980	1.8502	0.00E+00
11	PWRC	102046	37246	0.000	-20.500	0.000	-7.160	2.4167	0.00E+00
12	PWRC	102048	37248	-5.068	-14.874	0.000	-1.980	1.8482	0.00E+00
13	PWRC	102049	37249	-5.068	-14.874	0.000	-1.980	1.8482	0.00E+00
14	PWRC	102050	37250	0.000	-20.500	0.000	-7.160	2.4167	0.00E+00
15	PWRC	102052	37252	-5.235	-14.689	0.000	-1.800	1.8295	0.00E+00
16	PWRC	102053	37253	0.000	-20.500	0.000	-7.150	2.4167	0.00E+00
17	PWRC	102055	37255	-5.066	-14.876	0.000	-1.980	1.8484	0.00E+00
18	PWRC	102056	37256	-5.212	-14.715	0.000	-1.790	1.8321	0.00E+00
19	PWRC	102057	37257	-5.636	-14.197	0.000	-1.370	1.7797	0.00E+00
20	PWRC	102059	37259	-5.438	-14.477	0.000	-1.600	1.8081	0.00E+00
21	PWRC	102100	37260	-5.002	-14.947	0.000	-2.070	1.8556	0.00E+00
22	PWRC	102101	37261	-5.198	-14.730	0.000	-1.800	1.8336	0.00E+00
23	PWRC	102102	37262	-5.238	-14.686	0.000	-1.790	1.8291	0.00E+00
24	PWRC	102104	37264	-5.247	-14.676	0.000	-1.790	1.8282	0.00E+00
25	PWRC	102105	37265	-5.369	-14.541	0.000	-1.610	1.8145	0.00E+00
26	PWRC	102106	37266	-5.393	-14.514	0.000	-1.600	1.8118	0.00E+00
27	PWRC	102107	37267	-5.837	-13.911	0.000	-1.100	1.7509	0.00E+00
28	PWRC	102108	37268	-5.728	-14.067	0.000	-1.280	1.7666	0.00E+00
29	PWRC	102109	37269	-5.705	-14.099	0.000	-1.290	1.7699	0.00E+00
30	PWRC	102110	37270	-5.955	-13.744	0.000	-0.920	1.7340	0.00E+00
31	PWRC	102112	37272	-6.256	-13.317	0.000	-0.560	1.6908	0.00E+00
32	PWRC	102113	37273	-5.945	-13.759	0.000	-1.010	1.7354	0.00E+00
33	PWRC	102114	37274	-5.756	-14.026	0.000	-1.200	1.7625	0.00E+00
34	PWRC	102115	37275	-5.960	-13.737	0.000	-0.930	1.7332	0.00E+00
35	PWRC	102116	37276	-5.652	-14.174	0.000	-1.380	1.7775	0.00E+00
36	PWRC	102117	37277	-5.564	-14.299	0.000	-1.480	1.7901	0.00E+00
37	PWRC	102118	37278	-5.228	-14.697	0.000	-1.800	1.8302	0.00E+00
38	PWRC	102120	37280	-5.244	-14.679	0.000	-1.800	1.8284	0.00E+00
39	PWRC	102121	37281	-5.368	-14.541	0.000	-1.610	1.8145	0.00E+00
40	PWRC	102122	37282	-5.516	-14.368	0.000	-1.570	1.7970	0.00E+00
41	PWRC	102123	37283	-5.542	-14.330	0.000	-1.480	1.7932	0.00E+00
42	PWRC	102124	37284	-5.548	-14.322	0.000	-1.470	1.7924	0.00E+00
43	PWRC	102125	37285	-5.326	-14.589	0.000	-1.710	1.8193	0.00E+00
44	PWRC	102126	37286	-5.641	-14.190	0.000	-1.390	1.7791	0.00E+00
45	PWRC	102127	37287	-6.097	-13.543	0.000	-0.750	1.7136	0.00E+00
46	PWRC	102129	37289	-6.018	-13.655	0.000	-0.830	1.7249	0.00E+00
47	PWRC	102130	37290	-6.175	-13.432	0.000	-0.650	1.7024	0.00E+00
48	PWRC	102131	37291	-6.036	-13.629	0.000	-0.830	1.7224	0.00E+00
49	PWRC	102132	37292	-6.711	-12.670	0.000	-0.090	1.6254	0.00E+00
50	PWRC	102133	37293	-6.387	-13.130	0.000	-0.440	1.6719	0.00E+00
51	PWRC	102135	37295	-6.439	-13.057	0.000	-0.350	1.6645	0.00E+00
52	PWRC	102136	37296	-6.447	-13.045	0.000	-0.340	1.6633	0.00E+00
53	PWRC	102137	37297	-7.251	-11.903	0.000	0.530	1.5479	0.00E+00
54	PWRC	102138	37298	-6.964	-12.311	0.000	0.260	1.5891	0.00E+00
55	PWRC	102139	37299	-6.462	-13.024	0.000	-0.350	1.6612	0.00E+00

56	PWRC	102140	37300	-7.529	-11.509	0.000	0.840	1.5081	0.00E+00
57	PWRC	102142	37302	-7.033	-12.213	0.000	0.330	1.5792	0.00E+00
58	PWRC	102143	37303	-6.585	-12.849	0.000	-0.180	1.6435	0.00E+00
59	PWRC	102144	37304	-7.008	-12.249	0.000	0.330	1.5829	0.00E+00
60	PWRC	102145	37305	-7.043	-12.199	0.000	0.320	1.5778	0.00E+00
61	PWRC	102146	37306	-7.466	-11.598	0.000	0.760	1.5171	0.00E+00
62	PWRC	102147	37307	-7.360	-11.749	0.000	0.690	1.5324	0.00E+00
63	PWRC	102148	37308	-7.622	-11.377	0.000	0.990	1.4947	0.00E+00
64	PWRC	102150	37310	-7.279	-11.864	0.000	0.610	1.5440	0.00E+00
65	PWRC	102151	37311	-7.475	-11.586	0.000	0.770	1.5159	0.00E+00
66	PWRC	102152	37312	-7.630	-11.365	0.000	0.990	1.4936	0.00E+00
67	PWRC	102153	37313	-7.781	-11.151	0.000	1.140	1.4719	0.00E+00
68	PWRC	102154	37314	-7.429	-11.650	0.000	0.770	1.5224	0.00E+00
69	PWRC	102155	37315	-8.529	-9.863	0.000	1.940	1.3418	0.00E+00
70	PWRC	102157	37317	-9.141	-8.444	0.000	2.660	1.1983	0.00E+00
71	PWRC	102158	37318	-9.449	-7.729	0.000	2.950	1.1261	0.00E+00
72	PWRC	102159	37319	-9.734	-6.000	0.000	3.410	0.9514	0.00E+00
73	PWRC	102200	37320	-9.484	-7.648	0.000	2.960	1.1179	0.00E+00
74	PWRC	102201	37321	-9.452	-7.721	0.000	2.940	1.1253	0.00E+00
75	PWRC	102203	37323	-9.316	-8.037	0.000	2.820	1.1572	0.00E+00
76	PWRC	102204	37324	-10.058	-4.000	0.000	3.510	0.7964	0.00E+00
77	PWRC	102205	37325	-9.426	-7.781	0.000	2.930	1.1313	0.00E+00
78	PWRC	102206	37326	-9.595	-6.990	0.000	3.180	1.0514	0.00E+00
79	PWRC	102207	37327	-9.884	-4.926	0.000	3.490	0.8673	0.00E+00
80	PWRC	102208	37328	-9.389	-7.868	0.000	2.890	1.1402	0.00E+00
81	PWRC	102210	37330	-8.821	-9.186	0.000	2.290	1.2733	0.00E+00
82	PWRC	102211	37331	-8.587	-9.728	0.000	1.970	1.3281	0.00E+00
83	PWRC	102212	37332	-8.424	-10.106	0.000	1.750	1.3663	0.00E+00
84	PWRC	102213	37333	-7.708	-11.254	0.000	1.040	1.4824	0.00E+00
85	PWRC	102214	37334	-8.386	-10.196	0.000	1.690	1.3754	0.00E+00
86	PWRC	102215	37335	-7.908	-10.971	0.000	1.220	1.4537	0.00E+00
87	PWRC	102216	37336	-8.375	-10.221	0.000	1.700	1.3779	0.00E+00
88	PWRC	102218	37338	-8.001	-10.839	0.000	1.300	1.4404	0.00E+00
89	PWRC	102219	37339	-8.228	-10.562	0.000	1.500	1.4124	0.00E+00
90	PWRC	102220	37340	-8.116	-10.675	0.000	1.440	1.4238	0.00E+00
91	PWRC	102221	37341	-7.850	-11.052	0.000	1.150	1.4619	0.00E+00
92	PWRC	102222	37342	-7.233	-11.928	0.000	0.510	1.5505	0.00E+00
93	PWRC	102223	37343	-6.964	-12.311	0.000	0.220	1.5892	0.00E+00
94	PWRC	102224	37344	-6.565	-12.877	0.000	-0.280	1.6464	0.00E+00
95	PWRC	102225	37345	-6.723	-12.653	0.000	-0.020	1.6237	0.00E+00
96	PWRC	102227	37347	-6.745	-12.622	0.000	-0.030	1.6206	0.00E+00
97	PWRC	102228	37348	-6.889	-12.417	0.000	0.140	1.5999	0.00E+00
98	PWRC	102229	37349	-7.217	-11.952	0.000	0.510	1.5529	0.00E+00
99	PWRC	102230	37350	-7.077	-12.150	0.000	0.350	1.5729	0.00E+00
100	PWRC	102231	37351	-6.930	-12.359	0.000	0.230	1.5940	0.00E+00
101	PWRC	102232	37352	-6.666	-12.734	0.000	-0.100	1.6319	0.00E+00
102	PWRC	102234	37354	-6.492	-12.982	0.000	-0.370	1.6570	0.00E+00
103	PWRC	102235	37355	-6.893	-12.412	0.000	0.150	1.5993	0.00E+00
104	PWRC	102236	37356	-6.656	-12.749	0.000	-0.100	1.6334	0.00E+00
105	PWRC	102237	37357	-6.269	-13.298	0.000	-0.580	1.6889	0.00E+00
106	PWRC	102238	37358	-6.422	-13.081	0.000	-0.440	1.6670	0.00E+00
107	PWRC	102239	37359	-6.712	-12.669	0.000	-0.110	1.6253	0.00E+00
108	PWRC	102241	37361	-6.743	-12.625	0.000	-0.020	1.6208	0.00E+00
109	PWRC	102242	37362	-6.748	-12.617	0.000	-0.020	1.6201	0.00E+00
110	PWRC	102243	37363	-7.163	-12.028	0.000	0.440	1.5606	0.00E+00
111	PWRC	102245	37365	-7.328	-11.794	0.000	0.590	1.5369	0.00E+00
112	PWRC	102246	37366	-7.346	-11.769	0.000	0.680	1.5343	0.00E+00
113	PWRC	102247	37367	-8.268	-10.468	0.000	1.580	1.4029	0.00E+00
114	PWRC	102248	37368	-7.880	-11.010	0.000	1.160	1.4577	0.00E+00
115	PWRC	102249	37369	-8.223	-10.573	0.000	1.510	1.4135	0.00E+00

116	PWRC	102250	37370	-8.115	-10.676	0.000	1.440	1.4239	0.00E+00
117	PWRC	102252	37372	-7.850	-11.053	0.000	1.160	1.4620	0.00E+00
118	PWRC	102253	37373	-7.542	-11.490	0.000	0.820	1.5062	0.00E+00
119	PWRC	102254	37374	-8.075	-10.734	0.000	1.370	1.4298	0.00E+00
120	PWRC	102255	37375	-9.132	-8.464	0.000	2.640	1.2004	0.00E+00
121	PWRC	102256	37376	-9.745	-5.922	0.000	3.410	0.9436	0.00E+00
122	PWRC	102257	37377	-8.810	-9.212	0.000	2.250	1.2759	0.00E+00
123	PWRC	102259	37379	-8.845	-9.130	0.000	2.310	1.2677	0.00E+00
124	PWRC	102300	37380	-8.577	-9.751	0.000	1.970	1.3304	0.00E+00
125	PWRC	102301	37381	-9.852	-5.159	0.000	3.470	0.8852	0.00E+00
126	PWRC	102302	37382	-8.941	-8.906	0.000	2.400	1.2451	0.00E+00
127	PWRC	102303	37383	-9.280	-8.121	0.000	2.770	1.1657	0.00E+00
128	PWRC	102304	37384	-9.297	-8.081	0.000	2.810	1.1616	0.00E+00
129	PWRC	102306	37386	-9.166	-8.385	0.000	2.670	1.1924	0.00E+00
130	PWRC	102307	37387	-9.741	-5.947	0.000	3.400	0.9456	0.00E+00
131	PWRC	102308	37388	-9.017	-8.731	0.000	2.470	1.2273	0.00E+00
132	PWRC	102309	37389	-9.001	-8.768	0.000	2.470	1.2311	0.00E+00
133	PWRC	102310	37390	-9.281	-8.117	0.000	2.750	1.1653	0.00E+00
134	PWRC	102311	37391	-9.445	-7.737	0.000	2.920	1.1269	0.00E+00
135	PWRC	102312	37392	-9.187	-8.336	0.000	2.660	1.1875	0.00E+00
136	PWRC	102313	37393	-8.443	-10.061	0.000	1.800	1.3618	0.00E+00
137	PWRC	102315	37395	-7.617	-11.384	0.000	0.870	1.4955	0.00E+00
138	PWRC	102316	37396	-7.779	-11.154	0.000	1.090	1.4722	0.00E+00
139	PWRC	102317	37397	-7.668	-11.312	0.000	0.950	1.4882	0.00E+00
140	PWRC	102318	37398	-7.784	-11.146	0.000	1.100	1.4715	0.00E+00
141	PWRC	102319	37399	-7.546	-11.484	0.000	0.800	1.5056	0.00E+00
142	PWRC	102320	37400	-7.263	-11.887	0.000	0.490	1.5463	0.00E+00
143	PWRC	102322	37402	-7.617	-11.383	0.000	0.890	1.4954	0.00E+00
144	PWRC	102323	37403	-7.380	-11.721	0.000	0.660	1.5295	0.00E+00
145	PWRC	102324	37404	-7.484	-11.572	0.000	0.810	1.5145	0.00E+00
146	PWRC	102325	37405	-7.134	-12.070	0.000	0.420	1.5647	0.00E+00
147	PWRC	102326	37406	-6.615	-12.807	0.000	-0.210	1.6393	0.00E+00
148	PWRC	102327	37407	-6.864	-12.453	0.000	0.130	1.6034	0.00E+00
149	PWRC	102328	37408	-7.473	-11.588	0.000	0.740	1.5161	0.00E+00
150	PWRC	102330	37410	-6.915	-12.381	0.000	0.130	1.5962	0.00E+00
151	PWRC	102331	37411	-6.414	-13.092	0.000	-0.470	1.6681	0.00E+00
152	PWRC	102332	37412	-7.167	-12.023	0.000	0.420	1.5601	0.00E+00
153	PWRC	102333	37413	-6.622	-12.797	0.000	-0.200	1.6383	0.00E+00
154	PWRC	102334	37414	-6.368	-13.157	0.000	-0.450	1.6746	0.00E+00
155	PWRC	102336	37416	-6.707	-12.676	0.000	-0.120	1.6260	0.00E+00
156	PWRC	102337	37417	-6.181	-13.423	0.000	-0.680	1.7016	0.00E+00
157	PWRC	102338	37418	-6.435	-13.063	0.000	-0.450	1.6651	0.00E+00
158	PWRC	102339	37419	-6.209	-13.384	0.000	-0.670	1.6975	0.00E+00
159	PWRC	102340	37420	-6.284	-13.277	0.000	-0.580	1.6868	0.00E+00
160	PWRC	102341	37421	-6.061	-13.593	0.000	-0.850	1.7187	0.00E+00
161	PWRC	102343	37423	-5.787	-13.982	0.000	-1.210	1.7581	0.00E+00
162	PWRC	102344	37424	-5.401	-14.531	0.000	-1.630	1.8135	0.00E+00
163	PWRC	102345	37425	-5.520	-14.362	0.000	-1.570	1.7964	0.00E+00
164	PWRC	102346	37426	-5.543	-14.329	0.000	-1.480	1.7931	0.00E+00
165	PWRC	102347	37427	-5.548	-14.322	0.000	-1.490	1.7924	0.00E+00
166	PWRC	102348	37428	-5.434	-14.484	0.000	-1.630	1.8088	0.00E+00
167	PWRC	102350	37430	-5.280	-14.639	0.000	-1.720	1.8244	0.00E+00
168	PWRC	102351	37431	-5.145	-14.789	0.000	-1.890	1.8396	0.00E+00
169	PWRC	102352	37432	-5.110	-14.828	0.000	-1.900	1.8435	0.00E+00
170	PWRC	102353	37433	-5.483	-14.414	0.000	-1.590	1.8017	0.00E+00
171	PWRC	102354	37434	-5.536	-14.338	0.000	-1.480	1.7940	0.00E+00
172	PWRC	102355	37435	-5.943	-13.761	0.000	-1.040	1.7357	0.00E+00
173	PWRC	102356	37436	-5.868	-13.868	0.000	-1.120	1.7465	0.00E+00
174	PWRC	102358	37438	-6.249	-13.327	0.000	-0.580	1.6918	0.00E+00
175	PWRC	102359	37439	-6.036	-13.629	0.000	-0.850	1.7224	0.00E+00

176	PWRC	102400	37440	-5.779	-13.993	0.000	-1.200	1.7592	0.00E+00
177	PWRC	102401	37441	-5.825	-13.928	0.000	-1.120	1.7526	0.00E+00
178	PWRC	102402	37442	-5.844	-13.901	0.000	-1.120	1.7498	0.00E+00
179	PWRC	102403	37443	-5.516	-14.367	0.000	-1.570	1.7970	0.00E+00
180	PWRC	102405	37445	-5.318	-14.597	0.000	-1.720	1.8202	0.00E+00
181	PWRC	102406	37446	-5.265	-14.656	0.000	-1.810	1.8261	0.00E+00
182	PWRC	102407	37447	-5.253	-14.669	0.000	-1.810	1.8275	0.00E+00
183	PWRC	102408	37448	0.000	-20.500	0.000	-7.140	2.4167	0.00E+00

Figure B-3 is a plot of both the PIN Diode voltage and the corresponding TWTA output power as a function of time. As illustrated in the graph and discussed earlier, a low voltage results in a low TWTA input attenuation and thus a high output power. Conversely, a high voltage produces a high TWTA input attenuation and thus a low output power. Plot the appropriate power and voltage data to verify that the actual results obtained are similar to the expected values.

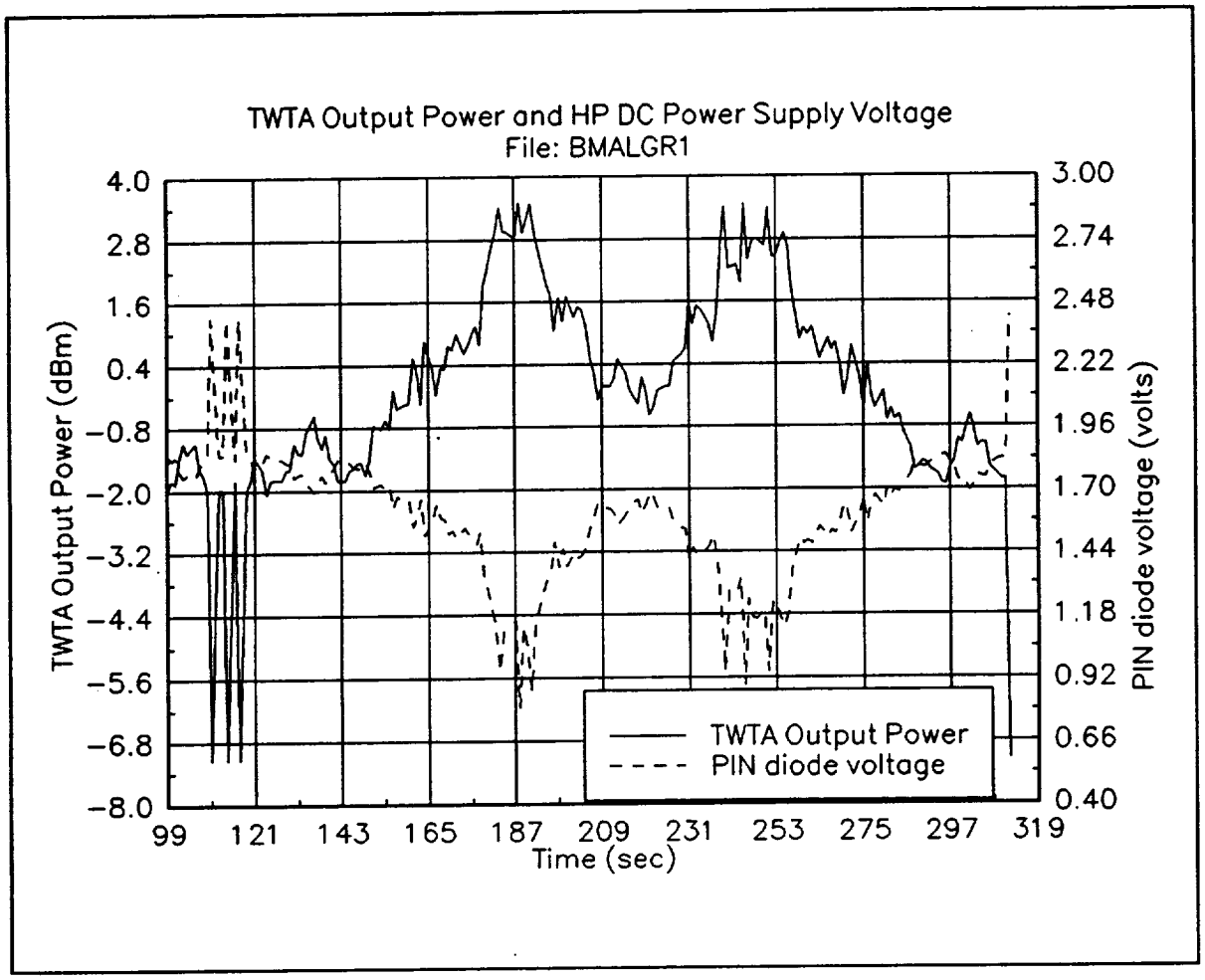

Figure B-3 BMALGR1 TWTA Output Power and PIN Diode Voltage versus Elapsed Time

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12a. DISTRIBUTION/AVAILABILITY STATEMENT
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12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 words)***

The Power Control and Rain Fade Software was developed at the NASA Lewis Research Center to support the Advanced Communications Technology Satellite High Burst Rate Link Evaluation Terminal (ACTS HBR-LET). The HBR-LET is an experimenters terminal to communicate with the ACTS for various experiments by government, university, and industry agencies. The Power Control and Rain Fade Software is one segment of the Control and Performance Monitor (C&PM) Software system of the HBR-LET. The Power Control and Rain Fade Software automatically controls the LET uplink power to compensate for signal fades. Besides power augmentation, the C&PM Software system is also responsible for instrument control during HBR-LET experiments, control of the Intermediate Frequency Switch Matrix on board the ACTS to yield a desired path through the spacecraft payload, and data display. The Power Control and Rain Fade Software User's Guide, Version 1.0 (NASA CR-189165, to be published) outlines the commands and procedures to install and operate the Power Control and Rain Fade Software. The Power Control and Rain Fade Software Maintenance Manual, Version 1.0 (NASA CR-189166, to be published) is a programmer's guide to the Power Control and Rain Fade Software. This manual details the current implementation of the software from a technical perspective. Included is an overview of the Power Control and Rain Fade Software, computer algorithms, format representations, and computer hardware configuration. The Power Control and Rain Fade Test Plan (NASA CR-189167) provides a step-by-step procedure to verify the operation of the software using a predetermined signal fade event. The Test Plan also provides a means to demonstrate the capability of the software.

14. SUBJECT TERMS
ACTS; HBR-LET; Computer software; RS–232 protocol; IEEE 488 protocol; Satellite ground station; Rain fade algorithm; Power augmentation

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