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Test and Control Computer User's Guide for a Digital Beam Former Test System

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ABSTRACT

The Digital Beam Former Test System was developed to determine the effects of noise, interferers and distortions, and digital implementations of beam forming as applied to Advanced Tracking and Data Relay System (ATDRS) architectures. This investigation of digital beam forming with application to ATDRS architectures, as described in ATDRS advanced concept design studies, was conducted by the NASA/Lewis Research Center (NASA/Lewis) for the NASA Goddard Space Flight Center (NASA/GSFC).

The Digital Beam Former Test System, Test and Control Computer (TCC), will establish predetermined test conditions, conduct pre and post on-line calibrations, initiate and execute the programmed test, and validate the test results. The TCC also will contain the test program software used to control the test execution, sequence, and timing. In addition, the TCC will contain the test parameters used to establish the test conditions, limits, and criteria used to validate the calibration and test results. The TCC will be the main controlling element of the Digital Beam Former Test System and is interconnected to several subsystems.

The Test and Control Computer User's Guide provides a well organized, easily used description of the Digital Beam Forming Test System commands It is written for users who wish to conduct tests of the Digital Beam Forming Processor using the TCC. The document describes the function, use, and syntax of the TCC commands available to the user while summarizing and demonstrating the use of TCC commands within DOS batch files.

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Digital Beam Former Test System Test and Control Computer

User's Guide

Version 1.0, January 1992

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Digital Beam Former Test System Test and Control Computer

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1.0 INTRODUCTION

1.1 Identification of Document

This is the User's Guide for the Digital Beam Former Test System, Test and Control Computer (TCC).

The purpose of the Digital Beam Former Test System is to determine the effects of noise, interferers and distortions, and digital implementations of beam forming as applied to Advanced Tracking and Data Relay System (ATDRS) architectures. This investigation of digital beam forming with application to ATDRS architectures, as described in ATDRS advanced concept design studies, was conducted by the NASA/Lewis Research Center (NASA/Lewis) for the NASA Goddard Space Flight Center (NASA/GSFC).

1.2 Scope of Document

The User's Guide is written for users who wish to conduct tests of the Digital Beam Forming Processor (DBFP) using the TCC. Users should have some knowledge of the terminology and application of digital beam forming as it relates to ATDRS architectures. Users also should be familiar with the use and construction of Microsoft Disk Operating System (DOS) batch files.

1.3 Purpose and Objectives of Document

The purpose of the document is to provide a well organized, easily used description of the Digital Beam Forming Test System commands. The document describes the function, use, and syntax of the TCC commands available to the user. It also summarizes and demonstrates the use of TCC commands within DOS batch files.

1.4 Document Status and Schedule

Release 1.0 is the first complete release of the TCC User's Guide and no further releases are planned at this time. This document adheres to the NASA Software Management and Assurance Program (SMAP) Documentation Standards (Release 4.3) for a User's Guide.

1.5 Document Organization

Sections 1 and 2 of this document identify it, describe its purpose, and cite other related documents. Section 3 provides an overview of purpose and functions. Section 4 outlines the installation and initialization of the software while Section 5 describes the startup and termination of user tests. Section 6 contains a list of available commands and their operation. Section 7 lists the error and warning messages with Section 8 identifying recovery steps available to the user. Section 9 contains a list of abbreviations and acronyms. Section 10 is available for notes with Section 11 listing the Appendices.

2.0 RELATED DOCUMENTATION

2.1 Parent Documents

The following document is the parent from which this document's scope and content derive:

1. Alexovich, Robert E.: *Digital Beam Former Test Plan*, Analex Corporation report prepared for NASA Lewis Research Center, March 1990.

2.2 Applicable Documents

The following documents are referenced herein and are directly applicable to this document:

1. Kokkonen, Kim, *TSR Utilities Version 2.9*, TurboPower Software, May 1989.
2. *Microsoft MS-DOS Version 3.3 Plus User's Guide and Command Reference*, Microsoft Corporation, 1988.
3. *Microsoft MS-DOS Version 3.3 Plus User's Reference*, Microsoft Corporation, 1988.
4. *The Norton Utilities Advanced Edition Version 4.5* ©, Peter Norton Computing, Inc., 1988.
5. Wolchak, John, *Set Environment Variable Program Version 1.4* ©, June 1990.

2.3 Information Documents

The following documents, although not directly applicable, may amplify or clarify the information presented in this document, and are not binding:

1. *CM401 Digital Multirate Modem Operation and Installation Manual*, ComStream Corporation, October 1988.
2. *Code Operated Switch (8-Port, COS-8P) User's Manual*, Black Box Corporation, 1989.
3. *Hewlett-Packard 437B Power Meter Operating Manual*, Hewlett-Packard Company, 1988.
4. *Micro488A Bus Controller User's Manual*, IOtech Incorporated, 1988.

3.0 OVERVIEW OF PURPOSE AND FUNCTIONS

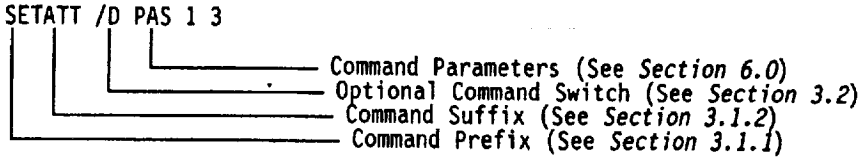
The Digital Beam Former Test System, Test and Control Computer, will establish predetermined test conditions, conduct pre and post on-line calibrations, initiate and execute the programmed test, and validate the test results. The TCC also will contain the test program software used to control the test execution, sequence, and timing. In addition, the TCC will contain the test parameters used to establish the test conditions, limits, and criteria used to validate the calibration and test results. The TCC will be the main controlling element of the Digital Beam Former Test System and is interconnected to several subsystems. Refer to the *Digital Beam Former Test Plan* for additional information on the testing approach, design, and constraints.

The ATDRS Digital Beam Former tests are conducted using experimental hardware under computer control. Software used to control the testing consists of DOS batch files specifying each test. The batch files are fashioned using standard DOS batch file commands and TCC commands written to control specific test hardware elements. Examples of the test software illustrating command usage are contained in *Appendices A* and *B*.

3.1 Command Functions and Structure

Specific commands were written to enhance DOS batch files used to control the execution of the Digital Beam Former tests. Constrained by DOS file naming conventions, the structure of a command name has a prefix of three letters that define an action to be performed, and a suffix of three to five letters defining the hardware component or variable to perform the command on. In addition, the commands also may be used with predefined options or switches.

Example command structure:



Example command switch usage (parameters not shown):

```
SETATT      - Set an attenuator.
SETATT /A   - Set all attenuators.
SETATT /D   - Set an attenuator and suppress console display.
SETATT /AD  - Set all attenuators and suppress console display.
```

3.1.1 Command Prefixes

Except for a few special purpose commands, all valid TCC commands begin with a three letter prefix that indicates the action or function to be performed (e.g., the SET prefix shows that a specific hardware element will be assigned a value). *Table 3-1* defines the command prefixes.

Command Prefix	Action or Command Function
LCK	LOCK. Lock an instrument or device (manually implemented by the user).
MSR	MEASURE. Measure a device or instrument.
REA	READ. Read the value of a device setting as stored within the TCC memory.
SET	SET. Set an instrument and store variable values in TCC memory.
STR	START. Start an instrument or function.
STP	STOP. Stop an instrument or function.
STS	STATISTICS. Read and calculate the mean and/or the root mean square from a device or instrument.

Table 3-1 Command Prefixes

3.1.2 Command Suffixes

Except for a few special purpose commands, all valid TCC commands end with a three to five letter suffix that shows the hardware component or variable to perform the command on (e.g., the ATT suffix refers to an attenuator). *Table 3-2* defines the command suffixes.

Command Suffix	Instrument or Device Acted Upon
A-A	(Amplitude modulation)/(amplitude modulation) coefficient
A-D	Analog/digital converter
A-P	(Amplitude modulation)/(phase modulation) coefficient
ANL	Analog non-linearity
APT	Antenna beam pointing angle
APTNF	Antenna beam pointing used in near field tests
ATT	Attenuator
BER	Bit error rate
C-N	(Carrier power)/(noise power)
CLK	Bit error rate clock slips (loss of sync)
CPW	Carrier power
DIR	Direction angle for arriving signal (normal array)
DNL	Digital non-linearity
FRQ	Frequency

Command Suffix	Instrument or Device Acted Upon
FRQNF	Frequency used in near field tests
IIN	Digital in-phase input signal
IINB	Digital in-phase input signal using the digital beam former processor buffer
ISM	Digital sum in-phase signal
ISMB	Digital sum in-phase signal using the digital beam former processor buffer
IWT	In-phase component of digital beam former processor weight
MAO	Modem start frequency for acquisition
MBE	Modem BER threshold
MBR	Modem remote control baud rate
MCE	Modem error correcting code error rate
MFL	Modem accumulated fault status
MOD	Modem modulation
MRC	Modem receive code rate
MRD	Modem receive data rate
MRO	Modem receive offset frequency
MRR	Modem receive symbol rate
MSR	Modem receive synthesizer frequency
MTC	Modem transmit code
MTD	Modem transmit data rate
MTM	Modem transmit modulation type
MTO	Modem transmit offset
MTP	Modem output power level
MTR	Modem output symbol rate
MTS	Modem transmit synthesizer frequency
MTT	Modem input external clock frequency
NPD	Noise power density
NPW	Noise power
NUM	Number of antenna elements
PHA	Phase shift
QIN	Digital quadrature input signal
QINB	Digital quadrature input signal using the digital beam former processor buffer
QSM	Digital sum quadrature signal

Command Suffix	Instrument or Device Acted Upon
QSMB	Digital sum quadrature signal using the digital beam former processor buffer
QWT	Quadrature component of digital beam forming processor weight
RES	Resolution
SPA	Spacing between antenna receiving elements
SPANF	Radial and angular spacing between near field antenna elements

Table 3-2 Command Suffixes

3.2 Command Options and Switches

Certain commands contain optional switches that allow the user to modify the way a command performs a task. A switch is a forward slash (/) followed by a letter or letters representing command options. Switches **always** precede any other parameter that a command may require on the command line. Some TCC commands do not have any switches, whereas others have several. If a command has more than one switch, type them one after the other following the slash without any spaces in between the letters. Use a space to separate a command from its switches and parameters. *Table 3-3* lists the available command switches.

Optional Command Switches	Effect on Command or Function
/A	All instruments available to the command are impacted by the execution of the command function.
/D	Suppress the display of command output to the console.
/M	Calculate only the mean or average in statistics (STS) commands.
/R	Calculate only the root mean square in statistics (STS) commands.
/W	Return the weight value from the weight file instead of the TCC memory.

Table 3-3 Optional Command Switches

3.3 Command Restrictions and Limitations

The user should note that the software was developed for use with specific hardware elements in mind. While every attempt was made to generalize the commands for use in a variety of testing situations, the platform they operated on was designed to suit a specific purpose. All TCC commands have been custom written for use with the Digital Beam Former Test System and cannot be guaranteed to execute properly without it. The TCC commands also have been designed to operate within the constraints outlined in the *Digital Beam Former Test Plan.*

While a variety of errors which may arise during a test session have been taken into account, it is possible for others to continue to exist unchecked. Should an unexpected error occur, the user should send a description of the command along with a description of the error with a completed *Abnormal Errors Encountered Report Form* to the software developers. Please refer to *Appendix F* for instructions and a copy of the *Abnormal Errors Encountered Report Form.*

4.0 INSTALLATION AND INITIALIZATION

4.1 Equipment Requirements and Set-up

The TCC software operates on an IBM (or fully compatible) personal computer under Microsoft's MS-DOS operating system, Version 3.3 or later.

The program and related data files are distributed on one 5¼ inch floppy diskette labeled **Test and Control Computer System Software.** A user may also request a copy of the files on a 3½ inch floppy diskette.

Connect a 9-pin RS-232 control cable from the Digital Beam Forming Test System to the **COM1:** serial port of the microcomputer. A printer may be optionally connected to the **LPT1:** parallel port of the microcomputer to print reports and/or data files during the digital beam forming testing.

This manual assumes that the microcomputer used for testing is equipped with a hard disk system. The user also should allow for three to five megabytes of free storage on the hard disk system for the data files output by the test system.

4.2 Bootstrap and Loading of Program Files

The following steps will load the program and data files onto the hard disk from the program diskette (user entered commands are in bold):

1. Turn on the computer

   If you are prompted for the date and time, type the date, press ***Enter****, type the time, and press* ***Enter*** *again.*

2. Insert the **TCC System Software** program and data diskette into drive A.

3. Execute the installation program to load the command and data files from floppy diskette by typing the following:

   C:\> A:\INSTALL <CR>

   The installation program will create several directories and locate the command and data files in various subdirectories.

4. Edit your **AUTOEXEC.BAT** file to add the following directory path to your **PATH** command:

   PATH=C:\TCC\BIN

   The user must re-boot the microcomputer in order to initiate the change to the path.

If the files cannot be successfully copied, please complete and return the *Abnormal Errors Encountered Report Form* contained in *Appendix F* of this document.

When the files have been successfully copied onto the hard disk and the path has been modified, store the original floppy diskette in a safe place for backup purposes. The software is now ready for use.

4.3 Obtaining a Copy of the Software

The original copies of the TCC software reside at Lewis. Additional copies of the TCC commands, testing data files, and related documentation may be obtained by contacting:

Paul G. Mallasch
Mail Stop 54-2
NASA Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135-3191
Telephone: (216) 433-6587
FAX: (216) 433-8705

5.0 STARTUP AND TERMINATION

5.1 Startup Procedures

To start the TCC software, perform the following steps from within MS-DOS (user entered commands are in bold type):

1. Turn on the DBFP test rack, TCC computer and printer.

2. Change the default directory to the directory containing the test batch file(s) to be executed (e.g., WORKAREA):

   C:\> **CHDIR WORKAREA <CR>**

3. Establish the initial DBFP test hardware conditions and initialize the TCC by executing the INITCKOU.BAT batch file. Refer to *Appendix A* for a documented listing of the INITCKOU.BAT batch file and its function:

   C:\WORKAREA> **INITCKOU <CR>**

4. Enter the name of the TCC command or test batch file to begin DBFP testing (e.g., 632_2CKO.BAT). Refer to *Appendix B* for a documented listing of the 632_2CKO.BAT batch file and its function:

   C:\WORKAREA> **632_2CKO <CR>**

5.2 Normal Termination Procedures

Commands executed at the command line (i.e., the DOS prompt) will return to the DOS prompt once their function has been completed. Unless a particular function has been commanded to sample large amounts of data, most commands will terminate normally within a second or two.

Commands executed from within batch files also will terminate normally within a short period of time, but the user should recall that a particular batch file may contain several commands in sequence and in loops that could cause a batch file to execute for several minutes or hours. The user may employ the DOS **ECHO ON** command to view the batch file commands as they execute. Batch file execution also may be tracked easily using the printer attached to the TCC. Refer to the *MS-DOS User's Reference* for additional information on batch file control.

5.3 Abnormal Termination Procedures

To exit a TCC batch file during the actual testing or after the occurrence of some unknown error, hold down the **Control** key and press the **Break** key (**Ctrl-Break**). This sequence of keystrokes will abort the batch file and return the user to MS-DOS. However, the DBFP will be in an unknown state following an abnormal abort of any command or batch file and must be subsequently restarted using the instructions in *Section 5.4* below. Refer to the *MS-DOS User's Reference* for additional information on batch file control.

5.4 Abnormal Restart Procedures

If the user cancels the execution of a batch file or function from the console or encounters some unknown system error that halts the software, the DBFP will be in an unknown state and must be re-initialized. It is recommended that the user reboot the computer and DBFP test rack to insure that the instruments are completely reset to a known hardware condition. Typing the sequence of commands found in *Section 5.1* of this document will insure the correct conditions for a system restart.

If the software cannot be successfully restarted, please complete and return the *Abnormal Errors Encountered Report Form* contained in *Appendix F* of this document.

6.0 COMMAND FUNCTIONS AND THEIR OPERATION

The TCC commands were designed to be executed either one at a time on the DOS command line or executed automatically from within DOS batch file programs. The user may mix uppercase and lowercase characters in all of the commands. If the user wishes to see the correct syntax of a command, simply type the command name by itself at the DOS prompt. In the command listing that follows, the developers have employed the following conventions:

- Square brackets ([ ]) mean that the enclosed parameter is optional; the user may include it in the command or omit it. Some options must be used with other values however, refer to the specific command syntax for additional information.
- Angled brackets (< >) mean that the enclosed parameter is to be typed literally; the user may use either capital letters or lowercase letters, but the word(s) must be spelled as they appear in this document. Numerical values must be within the range specified by the command syntax. Refer to the specific command syntax for additional information.
- A vertical bar (|) means that the user must choose one or the other given parameter and it must typed literally; the user may use either capital letters or lowercase letters, but the word(s) must be spelled as they appear in this document. Numerical values must be within the range specified by the command syntax. Refer to the specific command syntax for additional information.

The values of all instruments set using the SET command: are stored in the Test and Control Computer memory. The last or prior value also is saved to permit restoration of prior settings. This allows the user to restore the previous state of the DBFP if so desired.

Signal levels given in dBm refer to the Analog/Digital (A/D) input and are to be calculated such that the peak-to-peak signal at the A/D input is <range> set using the SETA-D command (see below) based on a 50 ohm source.

For A/D range set to 1.0 volt:

1. A sin wave input of 2.5 mw or 4 dBm at A/D input (10 dBm at channel n, attenuator 3 input) will produce a peak-peak voltage of 1.0 volt.
2. A noise input of 0.55 mw or -2.6 dBm (-8.6 dBm at channel n, attenuator 3 input) will have a 3σ peak-peak voltage of 1.0 volt.

Channel n, attenuator 3 attenuation is 6 dB for nominal 1 volt peak-peak input to A/D input. In general, noise + sin wave input is subject to the following constraint:

$$42.43\sqrt{noisepower}+20.00\sqrt{signalpower} = 1\ volt\ peak\text{-}peak$$

The signal power used here and in following commands refer to the sum of the desired signal plus interferer power.

Parameters returned for display by all commands may be stored in a new file, or appended to an existing file, by using the DOS redirection symbol, *> filename*, or *>> filename* respectively. Refer to the *MS-DOS User's Reference* for additional information on redirecting command input or output.

ADD <a> <b>

This command produces the sum of <a> and <b>.

Example 1:
Obtain the sum of 10.2 and -5.1.
ADD 10.2 -5.1
This will produce an output of 5.1.

ANGLE <a> <b>

This command produces the arc tangent of <b> / <a> in degrees.

Example 1:
Determine the angle of 10.2 and -5.1.
ANGLE 10.2 -5.1
This will produce an output of 11.404 degrees.

DIV <a> <b>

This command produces the quotient of <a> and <b>.

Example 1:
Obtain the ratio of 10.2 and -5.1.
DIV 10.2 -5.1
This produces an output of -2.00.

FTOI <a>

This command changes a floating point number <a> to an integer number.

Example 1:
Convert 10.2 to an integer.
FTOI 10.2
This produces an output of 10.

Example 2:
Convert 5.9 to an integer.
FTOI 5.9
This produces an output of 5

INITVARS This command creates and sets the TCC terminate-and-stay-resident (TSR) variable names and the corresponding current and previous values. A text file (VARIABLE.NMS) contains the name of all variable names required by the TCC software.

Example 1:
Load the TCC TSR variable names and initialize the values to zero.
INITVARS

LOADFIR [/D] <filename>

This command loads the FIR filter coefficient registers in the DBFP with coefficient and control data from the <filename> specified. See *Appendix E* for a sample FIR filter coefficient data file.

Optional switch:
[/D] suppresses the display to console.

Example 1:
Load the FIR filter coefficient registers with data from a file.
LOADFIR ..\DATADIR\FILTER.DAT

MAG <a> <b>

This command produces an output which is the square root of ($<a>^2$ + $<b>^2$).

Example 1:
Obtain the magnitude of 10.2 and -5.1.
MAG 10.2 -5.1
This produces an output of 11.403.

MAX $<n_1 \mid n_1\ n_2 \mid n_1 \ldots n_k>$

This command returns the position of the largest number entered (n_k).

Example 1:
Determine the position of the maximum argument in the following set of numbers: 3, .12, 2.13, 24, 13, and 14.6.
MAX 3 .12 2.13 24 13 14.6
The command returns 4, the location of the number 24.

MIN $<n_1 \mid n_1\ n_2 \mid n_1 \ldots n_k>$

This command returns the position of the smallest number entered (n_k).

Example 1:
Determine the position of the minimum argument in the following set of numbers: -3, .12, 2.13, 24, -13, and 14.6
MIN -3 .12 2.13 24 -13 14.6
The command returns 5, the location of the number -13.

MODEM [/AD] <source> <modem_command> [command_parameter]

This command controls the QPSK modem subsystem. Any of the 3 modem <source(s)> may be commanded using any valid <modem_command> and [command_parameter].
NOTE: The modem echo feature must be disabled before using this command.

Optional switch:
[/A] executes command for all operating modems.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<modem_command> Where <modem_command> equals:
<ao> (-30000 ≤ <ao> ≤ 30000)
<be> (19000 ≤ <be> ≤ 93000)
<xy> parameter xy implies x * 10^{-y}.
<rc> (0 ≤ <rc> ≤ 2)
0 = uncoded.
1 = rate 1/2.
2 = rate 3/4.
<rm> (0 ≤ <rm> ≤ 1)
0 = BPSK.
1 = QPSK.
<tc> (0 ≤ <tc> ≤ 2)
0 = uncoded.
1 = rate 1/2.
2 = rate 3/4.
<tm> (0 ≤ <tm> ≤ 1)
0 = BPSK.
1 = QPSK.
<to> (-15000 ≤ <to> ≤ 15000)
<tp> (5 ≤ <tp> ≤ 250)
<tr> (19200 ≤ <tr> ≤ 1544000)
<ts> (52000 ≤ <ts> ≤ 88000)

[command_parameter] Where [command_parameter] equals a valid command parameter.
Refer to the *CM401 Digital Multirate Modem Operation and Installation Manual* for additional information on optional command parameters.

Example 1:
Set desired signal modem transmit modulation to BPSK.
MODEM 1 tm 0

Example 2:
Set modem interferer source 2 transmit power to -20 dBm.
MODEM 2 tp 200

MULT <a> <b>

This command produces an output which is the product of <a> and <b>.

Example 1:
Obtain the product of 10.2 and -5.1.
MULT 10.2 -5.1
This produces an output of -52.02.

MSRBER [/D]

This command measures and displays the current values for bit count, error count, and clock slip count, then display the ratio of error count to bit count for signal source 1, the desired signal.

Optional switch:
[/D] suppresses the display to console.

The bit error rate measurement is made by latching counters and reading a count representing number of bits, number of errors, and number of frame slips, since the last reset of the counters. Bit error rate is calculated by taking the ratio of errors to total number of bits.

Example 1:
Make a measure of bit error rate.
MSRBER

MSRBIT [/D]

This command measures and displays the current bit count value of signal source 1, the desired signal.

Optional switch:
[/D] suppresses the display to console.

The bit count measurement is made by latching a counter and reading a count representing number of bits since last reset of the counters.

Example 1:
Make a measure of bit count.
MSRBIT

MSRCLK [/D]

This command measures and displays the current clock slip value of signal source 1, the desired signal.

Optional switch:
[/D] suppresses the display to console.

The clock slip measurement is made by latching a counter and reading a count representing number of frame slips since last reset of the counters.

Example 1:
What is the current number of clock slips?
MSRCLK

MSRERR [/D]

This command measures and displays the current error count value of signal source 1, the desired signal.

Optional switch:
[/D] suppresses the display to console.

The bit error measurement is made by latching a counter and reading a count representing number of errors since last reset of the counters.

Example 1:
Make a measure of bit error count.
MSRERR

MSRIIN [/AD] <channel>

This command measures and displays the current value in hexadecimal notation, the two's complement decimal equivalent, and the decimal equivalent of the digital in-phase input signal in the DBFP, of the <channel> specified by the user.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
Measure and display the digital in-phase input signal in the DBFP, for channel 5.
MSRIIN 5

Example 2:
Measure and display the digital in-phase input signal in the DBFP, for all channels.
MSRIIN /A

MSRIINB <m>

This command measures and displays the current array of values in hexadecimal notation, the two's complement decimal equivalent, and the decimal equivalent of <m> multiples of the digital in-phase input signal in the DBFP.

<m> Where (1 ≤ <m> ≤ 4095)

Example 1:
Measure and display 100 multiples of 256 successive samples of the digital in-phase input sum signal in the DBFP.
MSRIIN 100

MSRISM

This command measures and displays the current value in hexadecimal notation, the two's complement decimal equivalent, and the decimal equivalent of the digital in-phase output sum signal in the DBFP.

Example 1:
Measure and display the digital in-phase output sum signal in the DBFP.
MSRISM

MSRISMB <m>

This command measures and displays the current array of values, in hexadecimal notation, the two's complement decimal equivalent, the decimal equivalent, of m multiples of the digital in-phase output sum signal in the DBFP.

<m> Where (1 ≤ <m> ≤ 4095)

Example 1:
Measure and display the 512 multiples of 256 successive samples of the digital in-phase output sum signal in the DBFP sum buffer.
MSRISMB 512

MSRMCE

This command measures and displays the modem error rate for the desired signal modem, when error correction encoding is used.

The measure of modem error rate is made using the modem CE command.

Example 1:
Measure and display the desired signal error rate.
MSRMCE

MSRMET <meter>

This command selects power <meter> and displays the power meter output power.

<meter> Where (1 ≤ <meter> ≤ 3).

Example 1:
Measure power meter 3.
MSRMET 3

MSRMFL

This command measures and displays the modem accumulated fault status of the desired signal modem.

The measure of modem accumulated fault status is made using the modem FL command.

Example 1:
Measure and display the desired signal accumulated fault status.
MSRMFL

MSRMOD [/AD] <source>

This command measures and displays the current method of modulation used, by the QPSK Modem subsystem, for signal <source> specified.

Optional switch:
[/A] executes command for all operating modems.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

The method of modulation is measured by:
1. Select <source> modem.
2. Interrogate modem using modem DP command.

The above is repeated for all (option [/A]) sources.

Example 1:
For desired signal source 1, measure and display the modulation used.
MSRMOD 1

Example 2:
Measure and display the mode of modulation for all sources.
MSRMOD /A

MSRNPD [/AD] <channel>

This command measures and displays the current value of noise power density, in dB/Hz, of the phased array simulator <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
Measure and display the noise power density for channel 5.
MSRNPD 5

Example 2:
Measure and display the noise power density for all channels.
MSRNPD /A

MSRNPW [/AD] <channel>

This command measures and displays the current value of noise power (in dBm) of the phased array simulator <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
Measure and display the noise power for channel 5.
MSRNPW 5

Example 2:
Measure and display the noise for all channels.
MSRNPW /A

MSRQIN [/AD] <channel>

This command measures and displays the current value in hexadecimal notation, the two's complement decimal equivalent, and the decimal equivalent of the digital quadrature input signal in the DBFP, of the channel specified by the user.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
Measure and display the digital quadrature input signal in the DBFP, for channel 5.
MSRQIN 5

Example 2:
Measure and display the digital quadrature input signal in the DBFP, for all channels.
MSRQIN /A

MSRQINB [/AD] <m>

This command measures and displays the current array of values in hexadecimal notation, the two's complement decimal equivalent, and the decimal equivalent of the digital quadrature input signal in the DBFP.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<m> Where (1 ≤ <m> ≤ 4095)

Example 1:
Measure and display 512 multiples of 256 successive samples of the digital quadrature input signal in the DBFP.
MSRIINB 512

MSRQSM

This command measures and displays the current value in hexadecimal notation, the two's complement decimal equivalent, and the decimal equivalent of the digital quadrature output sum signal in the DBFP.

Example 1:
Measure and display the digital quadrature output sum signal in the DBFP.
MSRQSM

MSRQSMB <m>

This command measures and displays the current array of values in hexadecimal notation, the two's complement decimal equivalent, and the decimal equivalent of <m> multiples of the digital quadrature output sum signal in the DBFP.

<m> Where (1 ≤ <m> ≤ 4095)

Example 1:
Measure and display the 512 multiples of 256 successive samples of the digital quadrature output sum signal in the DBFP sum buffer.
MSRQSMB 512

REAA-D [/A] <channel>

This command reads and displays the current value of A/D full scale range expressed in peak volts full scale, of the DBFP <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
For array element 2, read and display the analog/digital converter range.
REAA-D 2

REAAPT

This command reads and displays the current stored DBFP array antenna beam angle value in degrees.

Example 1:
Read and display array beam pointing angle and DBFP weights.
REAAPT

REAAPTNF

This command reads and displays the current stored values of azimuth and elevation angles which cause the DBFP to point the array antenna in the azimuth and elevation direction, expressed in degrees.

Example 1:
Read and display array beam pointing azimuth and elevation angles used in near field test.
REAAPTNF

REAATT [/A] <subsystem> <channel> <attenuator>

This command reads and displays the current value of attenuation, expressed in dB, for the <subsystem>, <channel> and <attenuator> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<subsystem> Where <subsystem> = PAS or DC

For <subsystem> = PAS:
<channel> Where (1 ≤ <channel> ≤ 8)
<attenuator> Where (1 ≤ <attenuator> ≤ 3)
For <subsystem> = DC:
<channel> Where (1 ≤ <channel> ≤ 3)
<attenuator> Default value = 1

Example 1:
For Phased Array Simulator subsystem, channel 4, read and display attenuation of attenuator 1 (noise attenuator).
REAATT PAS 4 1

Example 2:
For Down Converter subsystem, channel 2 (interferer), read and display the attenuation of attenuator 1 (default 1).
REAATT dc 2 1

REAC-N [/A] <channel>

This command reads and displays the current value of carrier-to-noise ratio, expressed in dB, of the Phased Array Simulator <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
For Phased Array Simulator channel 7, read and display the carrier-to-noise ratio.
REAC-N 7

REACPW [/A] <channel>

This command reads and displays the current value of carrier power, expressed in dBm, of the Phased Array Simulator <channel> specified.

Optional switch:
[/A] executes command for all available operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
For array element 3, read and display the carrier power.
REACPW 3

READIR [/A] <source>

This command reads and displays the current stored value of the angle of arrival for a specified <source>.

Optional switch:
[/A] executes command for all operating sources or channels.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

Example 1:
For interfering signal 3, read and display the angle of arrival.
READIR 3

READNL [/A] <channel>

This command reads and displays the current value of non-linearity caused by an A/D input signal which exceeds full scale, used in a specified <channel>. The non-linearity is expressed in percent of full scale.

Optional switch:
[/A] executes command for all operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
For array receive channel 6, read and display the digital non-linearity.
READNL

REAE-B [/A] <channel>

This command reads and displays the current value of energy/bit, expressed in dBmw-second, of the Phased Array Simulator <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
For array receive channel 4, read and display the energy per bit.
REAE-B 4

REAE-N [/A] <channel>

This command reads and displays the current value of energy per bit to noise power density, expressed in dB, of the Phased Array Simulator <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
For array receive channel 4, read and display the energy per bit to noise power density level.
REANE-N 4

REAFRQ [/A] <source>

This command reads and displays the current value of the frequency, expressed in MHz, for <source> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<source> Where (1 ≤ <source> ≤ 4)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.
Source 4 is the SMA receive frequency.

Example 1:
For interfering signal source 2, read and display the frequency.
REAFRQ 2

Example 2:
Read and display the SMA S-band frequency, which is used in scaling.
REAFRQ 5

REAFTL

This command reads and displays the current value used for FIR filter tap length.

Example 1:
Read and display the current FIR filter tap length.
REAFTL

REAIWT [/AW] <channel>

This command reads and displays the current value of the in-phase component of the DBFP weight for the selected <channel>.

Optional switch:
[/A] executes command for all operating sources or channels.
[/W] returns a value from the weight file instead of TCC values.

<channel> Where (1 ≤ <channel> ≤ 7)

Example 1:
For array element channel 2, read and display the DBFP in-phase weight component.
REAIWT 2

REAMOD [/A] <source>

This command reads and displays the current method of modulation used by the QPSK Modem subsystem of the specified signal <source>.

Optional switch:
[/A] executes command for all operating sources or channels.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

Example 1:
For desired signal source 1, read and display the modulation used.
REAMOD 1

REAMTP [/A] <source>

This command reads and displays the current value (internal to the TCC) of transmit power expressed in dBm, used by the QPSK modem subsystem for the specified signal <source>.

Optional switch:
[/A] executes command for all operating sources or channels.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

Example 1:
For desired signal source 1, read and display the transmit power used.
REAMTP 1

REANBW

This command reads and displays the current value (internal to the TCC) of the noise bandwidth in MHz.

Example 1:
Read and display noise bandwidth.
REANBW

REANPW [/A] <channel>

This command reads and displays the current value of noise power, expressed in dBm, for the Phased Array Simulator <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
For array receive channel 4, read and display the noise power level.
REANPW 4

REANUM

This command reads and displays the current value stored for the number of antenna elements.

Example 1:
Read and display the number of elements in the array.
REANUM

REAPHA [/A] <source> <channel>

This command reads and displays the current value of phase shift, expressed in degrees, used for signal <source> and <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<Channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
Read and display phase shift used for the desired signal and channel 2.
REAPHA 1 2

REAQWT [/AW] <channel>

This command reads and displays the current value of the quadrature component of the DBFP weight for the selected <channel>. This command will read the current value stored in the test control computer.

Optional switch:
[/A] executes command for all operating sources or channels.
[/W] returns a value from the weight file instead of TCC values.

<channel> Where (1 ≤ <channel> ≤ 7)

Example 1:
For array element channel 3, read and display the DBFP quadrature weight component.
REAQWT 3

REASPA

This command reads and displays the current value of antenna element spacing, expressed in inches.

Example 1:
Read and display the array antenna element spacing.
REASPA

REASPANF

This command reads and displays the current values of antenna element radial distance and angle, measured in a cylindrical coordinate system, for each element of antenna array used in near field tests, expressed in inches and degrees respectively.

Example 1:
Read and display the array antenna element locations used in near field antenna tests.
REASPANF

REATBL [/A] <column> <rangeval> <channel>

This command reads and displays a row of values corresponding with the range <rangeval> value in the lookup table for <channel>.

[/A] executes command for all operating sources or channels.

<column> Where <column> = C-N, CPW, or NPW
C-N, carrier-to-noise, dB.
CPW, carrier power, dBm.
NPW, noise power, dBm.

<rangeval> Where (-57 ≤ <rangeval> ≤ 20)

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
Read and display the noise power for all channels from the lookup table for a carrier-to-noise ratio of -7 dBm.
REATBL /A NPW -7

REAWPI [/A] <channel>

This command reads and displays the current value (internal to the TCC) of the in-phase component of the beam pointing weight for the DBFP <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 7)

Example 1:
For channel 3, read and display in-phase component of the beam pointing weight stored in the test control computer.
REAWPI 3

REAWPQ [/A] <channel>

This command reads and displays the current value (internal to the TCC) of the quadrature component of the beam pointing weight in the DBFP <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 7)

Example 1:
For channel 3, read and display quadrature component of the beam pointing weight stored in the test control computer.
REAWPQ 3

REAWTA [/A] <channel>

This command reads and displays the current value of weight phase angle, expressed in degrees, for the <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 7)

Example 1:
For array element channel 5, read and display the phase angle, of the DBFP, complex beam weight.
REAWTA 5

REAWTM [/A] <channel>

This command reads and displays the current value of weight magnitude for the <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.

<channel> Where (1 ≤ <channel> ≤ 7)

Example 1:
For array element channel 1, read and display the magnitude, of the DBFP, complex beam weight.
REAWTM 1

SETA-D [/AD] <channel> <range | r>

This command changes the current value of A/D full scale range to the level of <range>, or restores <r> the prior value used, expressed in peak volts full scale, of the DBFP <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<channel> Where (1 ≤ <channel> ≤ 8)
<range> Where (0.5 ≤ <range> ≤ 1.25)

An algorithm is used which relates the setting of Phased Array Simulator channel n attenuator 3 (CHnA3), to A/D full scale range of channel n.

$$CHnA3 = 6 + 20\ LOG_{10}\langle range\rangle$$

CHnA3 = 0, 2, 4, 6, and 8 dB, for <range> = 0.5, 0.63, 0.79, 1.0, and 1.25 respectively.

Example 1:
For array element 2, change the analog/digital converter range to 1.13.
SETA-D 2 1.13

Example 2
For array element 3, restore the prior value used for the analog/digital converter range.
SETA-D 3 R

Example 3:
For all array elements (as defined by stored number of elements), change all (as defined by stored number of elements) analog/digital converter ranges to 0.95.
SETA-D /A 0.95

Example 4:
For all (as defined by stored number of elements) array elements, restore the prior value used for all (as defined by stored number of elements) analog/digital converter ranges.
SETA-D /A R

SETAPT [/D] <angle | r>

This command changes the current stored values of angle and the corresponding DBFP weights, or restores <r> the prior value used, to cause the DBFP to point the array antenna in the direction <angle>, expressed in degrees.

Optional switch:
[/D] suppresses the display to console.

<angle> Where (-45 ≤ <angle> ≤ 45)

The array beam pointing is a function of the number of elements in the array, the ATDRS SMA receive frequency, and the array element spacing. The DBFP weights are computed using $W(\theta)$ and W_g (Digital Beam Former Test Plan Appendix B). The DBFP nth channel weight, W_n, is given by the product of the nth pointing weight and the corresponding nth diagonal entry of the inverse gain matrix, G^{-1}.

$$W_n = (e^{i\theta_n}) \times (M_{g_{nn}} e^{i\zeta_{nn}})$$

where the nth, diagonal entry of the inverse gain matrix is given by:

$$M_{nn} e^{i\zeta_{nn}}$$

To point the array beam in the direction <angle>, the DBFP weights, IWTn and QWTn, are changed as follows.

1. Set weights from file WTFILE.621. (See *Appendix D*).
Let:
IFFn = IWTn from file, and;
QFFn = QWTn from file.

2.

$$\theta_n = \frac{(n-1)\,(spacing)}{wavelength} Sin(<arrayangle>) \times 360 degrees$$

Where the channel n, is less than or equal to the number of operating channels set by SETNUM command. The in-phase and quadrature components of the pointing weight are given by:
WPIn = $\cos(\theta_n)$
WPQn = $\sin(\theta_n)$

3. The total beam forming weights are given by:
IWTn = (WPIn)(IFFn) - (WPQn)(QFFn)
QWTn = (WPIn)(QFFn) + (WPQn)(IFFn)

4. IWTn and QWTn are 0 for all n greater than the number of set operating channels.

Example 1:
Set array beam pointing angle to -15 degrees.
SETAPT -15

Example 2:
Restore the prior value used for array beam pointing angle.
SETAPT R

SETAPTNF [/D] <azangle | r> <elangle | r>

This command changes the current stored values of azimuth and elevation angles and the corresponding DBFP weights, or restores <r> the prior value used, to cause the DBFP to point the array antenna in the direction <azangle>, <elangle> expressed in degrees.

Optional switch:
[/D] suppresses the display to console.

<azangle> Where (0 ≤ <angle> ≤ 359)
<elangle> Where (0 ≤ <angle> ≤ 180)

The array beam pointing is a function of the number of elements in the array, ATDRS SMA receive frequency, and the array element spacing. The Digital Beam Former weights are computed using $W(\theta)$ and W_g, (Digital Beam Former Test Plan Appendix B). The DBFP nth channel weight, W_n^g, is given by the product of the nth pointing weight and the corresponding nth, diagonal entry of the inverse gain matrix, G^{-1}.

$$W_n = (e^{i\theta_n}) \times (M_{g_{nn}} e^{i\zeta_{nn}})$$

Where the nth, diagonal entry of the inverse gain matrix is given by:

$$M_{nn} e^{i\zeta_{nn}}$$

To point the array beam in the direction <azangle>, <elangle> the DBFP weights, IWTn and QWTn, are changed as follows.

1. Set weights from file WTFILE.621. (See *Appendix D*)
Let:
IFFn = IWTn from file, and;
QFFn = QWTn from file.

2.

$$\phi_n = \frac{Rn}{wavelength} Cos(<Azangle> - \theta_n) Sin(<elangle>) \times 360 degrees$$

Where the channel n, is less than or equal to the number of operating channels set by the SETNUM command.
R_n = radial distance to nth patch, measured from chosen reference patch.

θ_n = angular distance to nth patch, measured CCW from positive x-axis.

The components of beam pointing weight are given by:
WPIn = Cos(ϕ_n)
WPQn = Sin(ϕ_n)

3. The total beam forming weights are given by:
IWTn = (WPIn)(IFFn) - (WPQn)(QFFn)
QWTn = (WPIn)(QFFn) + (WPQn)(IFFn)

4. IWTn and QWTn are 0 for all n greater than the number of set operating channels.

Example 1:
Set array beam pointing angle to -15 azimuth and 45 degrees elevation for near field test.
SETAPTNF -15 45

Example 2:
Restore the prior value used for array beam pointing angle.
SETAPTNF R

SETATT [/AD] <subsystem> <channel> <attenuator> <dB | r>

This command changes the current value of attenuation to the level of <dB>, or restores <r> the prior value used, expressed in dB, for the <subsystem>, <channel> and <attenuator> specified.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<subsystem> Where <subsystem> = PAS or DC
<dB> Where (-32 ≤ <dB> ≤ 0)

For <subsystem> = PAS:
<channel>
Where (1 ≤ <channel> ≤ 8)
<attenuator>
Where (1 ≤ <attenuator> ≤ 3)

For <subsystem = DC:
<channel>
Where (1 ≤ <channel> ≤ 3)
<attenuator>
Default value = 1

A algorithm is used, which relates the setting of Phased Array Simulator attenuator, CH1A1... CH8A1, CH1A2... CH8A2, CH1A3... CH8A3, or Down Converter DCA1... DCA3 to attenuation, and the selected attenuator is set. The algorithm, base 2, is:

$[\text{attsetting}]_2 = [-\text{<dB>}]_2$.

Example 1:
For Phased Array Simulator subsystem channel 4, set attenuator 1 (noise attenuator) to -15 dB.
SETATT PAS 4 1 -15

Example 2:
For Down Converter subsystem channel 2 (interferer), set attenuator (default 1) to -25 dB.
SETATT DC 2 1 -25

Example 3:
For Down Converter subsystem channel 2 (interferer), restore the prior value used for attenuator (default 1).
SETATT DC 2 1 R

Example 4:
For Phased Array Simulator subsystem, all channels (as defined by stored number of elements), set attenuator 1 (noise attenuator) to -15 dB.
SETATT /A PAS 1 -15

Example 5:
For Down Converter subsystem, desired signal and both interferers, set all attenuators (default 1) to -25 dB.
SETATT /A DC 1 -25

Example 6:
For Down Converter subsystem, desired signal and both interferers, restore the prior value used for all attenuators (default 1).
SETATT /A DC 1 R

SETC-N [/D] <ratio | r>

This command changes the current value of carrier-to-noise ratio used to the level <ratio>, or restores <r> the prior value used, expressed in dB, in all Phased Array Simulator channels, when the QPSK modem is used as a signal source.

Optional switch:
[/D] suppresses the display to console.

<ratio> Where (-55 ≤ <ratio> ≤ 20)

Lookup tables are used that relate the carrier-to-noise ratio to the settings of Phased Array Simulator attenuators, CH1A1... CH8A1, for noise power; and Phased Array Simulator attenuators, CH1A2... CH8A2 and CH1A3... CH8A3 for channel gain; modem output power, and DCAx for carrier power. The lookup tables are predicated on the constraint that:

$$42.43\sqrt{noisepower} + 2.0\ \sqrt{signalpower} = 1\ volt, peak\text{-}peak$$

referred to the A/D input. The lookup tables are:
Table A: A/D INPUT SIGNAL LEVELS
CHANNELS 1 to 8
See *Appendix C.*

The steps used in setting the carrier-to-noise ratio for the channel specified are:

1. Select table for channel specified.

2. Read table values corresponding to carrier-to-noise ratio, MODPWR (modem output power), DCA1 (down-converter attenuator), CHA1 (Phased Array Simulator noise attenuator), CHA2, and CHA3 (Phased Array Simulator gain attenuators).

3. Set Modem output power, down-converter attenuator, and specified Phased Array Simulator channel attenuators 1, 2, and 3 to table values.

Repeat the steps above to set the carrier-to-noise ratio in all channels.

Example 1:
For all Phased Array Simulator channels (as defined by stored number of elements), set the carrier-to-noise ratio to -27 dB.
SETC-N -27

Example 2:
For all Phased Array Simulator channels (as defined by stored number of elements), restore the prior value used for the carrier-to-noise ratio and suppress the display to console.
SETC-N /D r

SETC-NHP [/D] <ratio | r>

This command changes the current value of carrier-to-noise ratio used to the level <ratio>, or restores <r> the prior value used, expressed in dB, in all Phased Array Simulator channels when the HP synthesizer is used as a signal source.

Optional switch:
[/D] suppresses the display to console.

<ratio> Where (-55 ≤ <ratio> ≤ 20)

Lookup tables are used that relate the carrier-to-noise ratio to the settings of Phased Array Simulator attenuators, CH1A1... CH8A1, for noise power. Phased Array Simulator attenuators, CH1A2... CH8A2 and CH1A3... CH8A3 are used for channel gain, and HP synthesizer output power for carrier power. The lookup tables are predicated on the constraint that:

$$42.43\sqrt{noisepower + 2.0}\ \sqrt{signalpower} = 1\ volt, peak\text{-}peak$$

referred to the A/D input.
The lookup tables are:
Table A: A/D INPUT SIGNAL LEVELS
CHANNELS 1 to 8
See Appendix C.

The steps used in setting the carrier-to-noise ratio for the channel specified are:

1. Select table for channel specified.

2. Read table values corresponding to carrier-to-noise ratio for PASIN (HP synthesizer output power), CHA1 (Phased Array Simulator noise attenuator), CHA2, and CHA3 (Phased Array Simulator gain attenuators).

3. Set HP synthesizer output power and specified Phased Array Simulator channel attenuators 1, 2, and 3 to table values.

The above steps are repeated to set the carrier-to-noise ratio in all channels.

Example 1:
For all Phased Array Simulator channels (as defined by stored number of elements), set the carrier-to-noise ratio to -27 dB, using the HP synthesizer.
SETC-NHP -27

Example 2:
For all Phased Array Simulator channels (as defined by stored number of elements), using the HP synthesizer as a signal source, restore the prior value used for the carrier-to-noise ratio and suppress the display to console.
SETC-NHP /D R

SETCPW [/AD] <source> <carrierpower | r>

This command changes the current value of <source> carrier power used to the level of <carrierpower> or restores <r> the prior value used, expressed in dBm, in all (as defined by stored number of elements) Phased Array Simulator channels while the noise power remains constant.

Optional switch:
[/A] executes command for all operating sources.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<carrierpower> Where (-60 ≤ <carrierpower> ≤ 5)

Lookup tables (See *Appendix C*) are used that relate the carrier power to the settings of Phased Array Simulator attenuators, CH1A2...CH8A2 and CH1A3...CH8A3 for channel gain; modem output power, and DCAx for carrier power. The settings of CHnA1 and CHnA2 are adjusted to correct for signal + interferer powers.
The lookup tables are:
Table A: A/D INPUT SIGNAL LEVELS
CHANNEL 1 to 8

The steps used to set CPW in a specified channel are:

1. Select table for channel specified.

2. Read table values corresponding to carrier power, for MODPWR (modem output power), DCA1 (down-converter attenuator), CHA2, and CHA3 (Phased Array Simulator gain attenuators).

3. Set Modem output power, down-converter attenuator, and specified Phased Array Simulator channel attenuators 2 and 3 to table values.

Repeat the steps above to set the carrier power in all channels.

Example 1:
For all (as defined by stored number of elements) array element signals, set the carrier power to -2.7 dBm for interferer 2.
SETCPW 2 -2.7

Example 2:
For all (as defined by stored number of elements) array element signals, restore the prior value used for all sources carrier power.
SETCPW /A R

SETDIR [/AD] <source> <angle | r>

This command changes the current stored value of angle for all (as defined by stored number of elements) phase shifters, for a <source> to simulate the signal arriving at the specified <angle>, or restores <r> the prior value used, expressed in degrees.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<angle> Where (-45 ≤ <angle> ≤ 45)

Other input data used are the number of elements in the array, ATDRS SMA receive frequency, and the array element spacing. Phased Array Simulator phase shift settings,

$$\phi(\gamma)$$

are computed (see Test Plan Appendix A).

Example 1:
For interfering signal 3, set the angle of arrival to 20 degrees.
SETDIR 3 20

Example 2:
For interfering signal 3, restore the prior value used for the angle of arrival.
SETDIR 3 r

SETDNL [/AD] <channel> <non-linearity | r>

This command changes the current value of non-linearity caused by an A/D input signal which exceeds full scale used in a specified <channel> to <non-linearity>, or restores <r> the prior value used. The <non-linearity> is expressed in percent of full scale.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<channel> Where (1 ≤ <channel> ≤ 8)

<non-linearity>
Where (100 ≤ <non-linearity> ≤ 125)

An algorithm is used which relates PAS attenuator settings in each channel to <non-linearity>. Channel n, attenuator 3 (CHnA3) is modified to change the digital non-linearity. The algorithm is: CHnA3 = LOG_{10}<non-linearity> + 6. The algorithm is predicated on the constraint that:

$$42.43\sqrt{noisepower + 20.0}\ \sqrt{signalpower} = A/D\ full\ scale\ range,$$

referred to the A/D input. The full scale range = <non-linearity>. See SETA-D command.

Example 1:
For array receive channel 6, set the digital non-linearity to 110%.
SETDNL 6 110

Example 2:
For all array receive channels, restore the prior value used for the digital non-linearity, and suppress the display to console.
SETDNL /ad R

SETE-B [/AD] <source> <energy/bit | r>

This command changes the current value of <source> energy/bit used in each channel to the level of <energy/bit>, or restores <r> the prior value used, expressed in dBmw-second, in all (as defined by stored number of elements) the Phased Array Simulator channels while the noise in each channel remains unchanged.

Optional switch:
[/A] executes command for all operating sources.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<energy/bit> Where (-110 ≤ <energy/bit> ≤ -56)

E-B is converted to carrier power. Lookup tables are used which relate the settings of Phased Array Simulator gain attenuators, CH1A1... CH8A1, CH1A2... CH8A2; Down Converter attenuator DCA1, and Modem output power, to carrier power for the current value of bit rate. The lookup tables used are:
Table A: A/D INPUT SIGNAL LEVELS
CHANNELS 1 to 8
See Appendix C.
Energy/bit is related to carrier power by the following:

$$E\text{-}B = \frac{(CPW)}{(BitRate)}$$

The steps used to set carrier power are used to set energy/bit. See SETCPW command.

Example 1:
For all channels set the desired signal energy/bit level to -75.7 dBmw-second.
SETNE-B 1 -75.7

Example 2:
For all channels restore the prior value used for the desired signal energy/bit level.
SETNE-B 1 r

SETENV <variable> <value>
<variable> by it's self to erase variable.
<value> can be: '%rep<del><txt1><del><txt2><del>' text replace.
'%prompt %noecho %upper %def<del><text><del> <message>'.
'%noecho' for no echo, '%upper' for upper case only.
'%def<del><text><del>' to supply a default.

<value> can include keys such as:
%dosv / %dosm for DOS major / minor version.
%cwd for current directory.
%drive for default drive.
%+n / %-n for default drive plus / minus 'n'.

Root environment change usage: SETENV %rce <variable> <value>
Note: Use %% to represent a single % in BAT files.

Example 1:
Within a test batch file, store the value of PAS channel 3 attenuator 1, returned by REAATT command, as environment variable PAS3_1.
REAATT PAS 3 1 | SETENV PAS3_1 %%prompt%noecho

Set Environment Variable Program Version 1.4 © June 2, 1990 by John Wolchak.

SETFRQ [/AD] <source> <frequency | r>

This command changes the current value of the frequency used for <source> to <frequency>, or restores <r> the prior value used Or changes the current value of the frequency used for signal source 1, the desired signal, and interferers 2 and 3 to <frequency>. All frequency values are expressed in MHz.

Optional switch:
[/A] executes command for all operating sources except SMA receive frequency.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 4)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.
Source 4 is the SMA receive frequency.

<frequency> Where <source> = 1, 2, or 3, (52 ≤ <frequency> ≤ 88)
Where <source> = 4, (2250 ≤ <frequency> ≤ 2290)

The frequency, for <source> = 1, 2, or 3, is set by using the TS modem command; for <source> = 4, the SMA frequency used in scaling is set.

Example 1:
For interfering signal source 2, set the frequency to 65.4 MHz.
SETFRQ 2 65.4

Example 2:
Change the SMA S-band frequency, which is used in scaling, to 2276.4432 MHz.
SETFRQ 4 2276.4432

Example 3:
Restore the prior value used for the SMA S-band frequency, which is used in scaling and suppress the display to console.
SETFRQ /D 4 r

SETIWT [/AD] <channel> <iweight | r>

This command changes the current value of the in-phase component of the DBFP weight used to the value <iweight>, or restores <r> the prior value used of the selected <channel>.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<channel> Where (1 ≤ <channel> ≤ 7)

<iweight> Where (-1.5 ≤ <iweight> ≤ 1.5)

Other input data used are the DBFP weight magnitude, M_n. The DBFP I and Q weight components, IWT1, QWT1,... IWT7, QWT7, are determined from the following:

IWTn = <iweight>

where: n is the selected <channel>.

Example 1:
For array element channel 2, set the DBFP in-phase weight component to -0.48.
SETIWT 2 -0.48

Example 2:
For array element channel 2, restore the prior value used for the DBFP in-phase weight component.
SETIWT 2 r

Example 3:
For all array element channels (as defined by stored number of elements), set the DBFP in-phase weight component to 0.75.
SETIWT /A 0.75

Example 4:
For all array element channels (as defined by stored number of elements), restore the prior value used for the DBFP in-phase weight component.
SETIWT /A r

SETMAO [/D] <source> <aofreq | r>

This command changes the current value of the modem acquisition start, offset frequency used (in kHz) to the value <aofreq>, or restores <r> the prior value used for the desired signal source.

Optional switch:
[/D] suppresses the display to console.

<aofreq> Where (-30 ≤ <aofreq> ≤ 30)

For further explanation see modem manual, command AO.

Example 1:
Set modem 1 acquisition start frequency to 20 kHz.
SETMOA 1 20

SETMBE [/D] <thrhold | r>

This command changes the current value of the modem bit error rate threshold to the value <thrhold>, or restores <r> the prior value used for the desired signal source.

Optional switch:
[/D] suppresses the display to console.

<thrhold> Where (19 ≤ <thrhold> ≤ 93)
<thrhold> parameter xy implies x * 10^{-y}.

For further explanation see modem manual, command BE.

Example 1:
Set modem bit error rate threshold to $3*10^{-7}$.
SETMBE 37

SETMOD [/AD] <source> <modulation | r>

This command changes the current method of modulation, or restores <r> the prior value used by the QPSK Modem subsystem for signal <source> to <modulation>.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<modulation> Where <modulation> = BPSK or QPSK.

The method of modulation is changed by using the QPSK modem RM or TM command for the signal source selected.

Example 1:
For desired signal source 1, set the modulation to QPSK and suppress the display to console.
SETMOD /d 1 QPSK

Example 2: For desired signal source 1, restore the prior value used for the modulation.
SETMOD 1 r

SETMRC [/D] <rcode-rate | r>

This command changes the current receive code rate used to <rcode-rate>, or restores <r> the prior value used by the QPSK Modem subsystem for the desired signal source.

Optional switch:
[/D] suppresses the display to console.

<rcode-rate> Where (0 ≤ <rcode-rate> ≤ 2)
0 = uncoded.
1 = rate 1/2.
2 = rate 3/4.

The receive code rate is changed by using the QPSK modem RC command for the desired signal source.

Example 1:
For desired signal source 1, set the receive code rate to uncoded and suppress the display to console.
SETMRC /d 0

For command explanation see modem manual, command RC.

SETMRM [/D] <rmod | r>

This command changes the current receive modulation used to <rmod>, or restores <r> the prior value used by the QPSK Modem subsystem for the desired signal source.

Optional switch:
[/D] suppresses the display to console.

<rmod> Where (0 ≤ <rmod> ≤ 1)
0 = BPSK.
1 = QPSK.

The receive modulation is changed by using the QPSK modem RM command for the desired signal source.

Example 1:
For the desired signal source, set the receive modulation to QPSK and suppress the display to console.
SETMRM /d 1

For command explanation see modem manual, command RM.

SETMTC [/AD] <source> <tcode-rate | r>

This command changes the current transmit code rate used to <tcode-rate>, or restores <r> the prior value used by the QPSK Modem subsystem for the selected signal <source>.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<tcode-rate> Where (0 ≤ <tcode-rate> ≤ 2)
0 = uncoded.
1 = rate 1/2.
2 = rate 3/4.

The transmit code rate is changed by using the QPSK modem TC command for the selected signal source.

Example 1:
For signal source 1, set the transmit code rate to uncoded and suppress the display to console.
SETMTC /d 0

For command explanation see modem manual, command TC.

SETMTM [/AD] <source> <tmod | r>

This command changes the current transmit modulation used to <tmod>, or restores <r> the prior value used by the QPSK Modem subsystem for the selected signal <source>.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<tmod> Where (0 ≤ <tmod> ≤ 1)
0 = BPSK.
1 = QPSK.

The transmit modulation is changed by using the QPSK modem TM command for the selected signal source.

Example 1:
For signal source 1, set the transmit modulation to BPSK and suppress the display to console.
SETMTM /d 0

For command explanation see modem manual, command TM.

SETMTO [/AD] <source> <offreq | r>

This command changes the current transmit offset frequency used in kHz to <offreq>, or restores <r> the prior value used by the QPSK Modem subsystem for the selected signal <source>.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<offreq> Where (-15 ≤ <offreq> ≤ 15)

The transmit offset frequency is changed by using the QPSK modem TO command for the selected signal source.

Example 1:
For signal source 1, set the transmit offset frequency to -5 kHz.
SETMTO -5

For command explanation see modem manual, command TO.

SETMTP [/AD] <source> <tpwr | r>

This command changes the current transmit output power used in dBm to <tpwr>, or restores <r> the prior value used by the QPSK Modem subsystem for the selected signal <source>.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<tpwr> Where (-25 ≤ <tpwr> ≤ -5)

The transmit output power is changed by using the QPSK modem TP command for the selected signal source.

Example 1:
For signal source 3, set the transmit output power to -15 dBm.
SETMTP 3 -15

For command explanation see modem manual, command TP.

SETMTR [/AD] <source> <tsymrate | r>

This command changes the current transmit symbol rate used in kHz, to <tsymrate>, or restores <r> the prior value used by the QPSK Modem subsystem for the selected signal <source>.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<tsymrate> Where (19.2 ≤ <tsymrate> ≤ 1544)

The transmit symbol rate is changed by using the QPSK modem TR command for the selected signal source.

Example 1:
For signal source 1, set the transmit symbol rate to 1000 kHz.
SETMTR 1 1000

For command explanation see modem manual, command TR.

SETMTS [/AD] <source> <tsynfreq | r>

This command changes the current transmit synthesizer frequency used in kHz, to <tsynfreq>, or restores <r> the prior value used by the QPSK Modem subsystem for the selected signal <source>.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<tsynfreq> Where (52 ≤ <tsynfreq> ≤ 88)

The transmit synthesizer frequency is changed by using the QPSK modem TS command for the selected signal source.

Example 1:
For signal source 1, set the transmit synthesizer frequency to 60 kHz.
SETMTS 1 60

For command explanation see modem manual, command TS.

SETNUM [/D] <number | r>

This command changes the current value stored for the number of antenna elements to <number>, or restores <r> the prior value used and set the antenna pointing angle to 0.

Optional switch:
[/D] suppresses the display to console.

<Number> Where (1 ≤ <number> ≤ 7).

The I and Q weights, IWTn and QWTn, for n = 1 to 7, are loaded from the WTFILE.621 weight file (see *Appendix D*). The weights stored in WTFILE.621 are based on measured hardware characteristics. The DBFP weights IWTn and QWTn, for all n greater than <number> are set equal to 0.

Example 1:
Change the number of elements in the array to 6.
SETNUM 6

Example 2:
Restore the prior value used for the number of elements in the array.
SETNUM R

SETPHA [/AD] <source> <channel> <phase | r>

This command changes the current value of phase shift, used for signal <source> and <channel> specified to <phase>, or restores <r> the prior value used, expressed in degrees.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<source> Where (1 ≤ <source> ≤ 3)
Source 1 is the desired signal.
Sources 2 and 3 are interferers.

<channel> Where (1 ≤ <channel> ≤ 8)

<phase> Where (-4100 ≤ <phase> ≤ 4100)

An algorithm is used that relates phase shift to phase shifter setting for Phase Array Simulator phase shifters CH1PS1... CH8PS1, CH1PS2... CH8PS2, and CH1PS3... CH8PS3. The selected <source> and <channel> phase shifter is set to the value <phase> (modulo 360 degrees). The algorithm used is: [phase shift setting] = $0.1778 * \text{<phase>}_{\text{modulo } 360°}$

Example 1:
For the desired signal, set phase shifter channel 2 to 3600 degrees.
SETPHA 1 2 3600

Example 2:
For the desired signal, restore the prior value used for phase shifter channel 2.
SETPHA 1 2 r

SETPSWT <register> <channel>

This command will write a 3-bit control word to 1 of 2 control registers determined by the channel number (1 through 8). This function will select <channel> to be measured by 1 of 2 power meters in the PAS subsystem.

<register> Where <register> = IPMSWT or OPMSWT.

<channel> Where (1 ≤ <channel> ≤ 8)

Example 1:
Set output power meter to be read for Phased Array Simulator channel 6.
SETPSWT OPMSWT 6

SETQWT [/AD] <channel> <qweight | r>

This command changes the current value of the quadrature component of the DBFP weight used to the value <qweight>, or restores <r> the prior value used for the selected <channel>.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<channel> Where (1 ≤ <channel> ≤ 7)

<qweight> Where (-1.5 ≤ <qweight> ≤ 1.5)

Other input data used are the DBFP weight magnitude, M_n. The DBFP I and Q weight components, IWT1, QWT1, ... IWT7, QWT7, are determined from the following:

QWTn = <iweight>

where: n is the selected <channel>.

Example 1:
For array element channel 3, set the DBFP quadrature weight component to -0.25.
SETQWT 3 -0.25

Example 2:
For array element channel 3, restore the prior value used for the DBFP quadrature weight component.
SETQWT /A 3 r

Example 3:
For all array element channels (as defined by stored number of elements), restore the prior value used for the DBFP quadrature weight component.
SETQWT /A r

SETRES [/D] <dev> <res | r> <path\filename>

This command changes the current resolution of all (as defined by stored number of elements) A/D converters, weights, or FIR filter coefficients of the DBFP Processor to the resolution <res> given in bits, or restores <r> the prior values used for all channels (as defined by stored number of elements). FIR filter coefficients are stored in files containing coefficients for a given resolution and bandwidth.

Optional switch:
[/D] suppresses the display to console.

<dev> = A-D (A/D converter)
<res> Where (3 ≤ <res> ≤ 8)

<dev> = D-A (D/A converter)
<res> Where (4 ≤ <res> ≤ 12)

<dev> = WT (DBFP weight)
<res> Where (3 ≤ <res> ≤ 8)

<dev> = FIR (FIR is the filter coefficient)
<path\filename> File containing FIR coefficients.

The DBFP Processor A/D converter and weight resolutions are set using write commands to DBFP registers. The DBFP Processor FIR filter coefficient resolution is set using the data values found in <path\filename>.

Example 1:
Set the DBFP Processor A/D converter resolution to 5 bits.
SETRES A-D 5

Example 2:
Set the resolution of all DBFP weights to their prior value.
SETRES wt r

Example 3:
Set the resolution and bandwidth of FIR filter 8 and 2 MHz using a file.
SETRES FIR ..\DATAFILE\MHZ2.FIR

SETSPA [/D] <spacing | r>

This command changes the current value of antenna element spacing (expressed in inches) stored to <spacing>, or restores <r> the prior value used.

Optional switch:
[/D] suppresses the display to console.

<spacing> Where (7 ≤ <spacing> ≤ 30).

Example 1:
Set the array antenna element spacing to 9.4 inches.
SETSPA 9.4

Example 2:
Restore the prior value used for the array antenna element spacing.
SETSPA r

SETSPANF [/D] <spacing> <angles>

This command changes the current set of antenna element locations stored (current set of 6 radial distances and 6 angles, measured from a reference element and the positive x-axis, respectively) to <location>. Expressed in a set of 6 dimensions in inches and 6 dimensions in degrees. This command was designed to be used in near field antenna laboratory testing.

Optional switch:
[/D] suppresses the display to console.

<spacing> Where <spacing> = <R1 R2 ... R6>
Where: ($1 \leq \langle R_n \rangle \leq 24$)

<angles> Where <angles> = <θ1 θ2 ... θ6>
Where: ($0 \leq \theta_n \leq 359$).

Example 1:
Set the near field array antenna element location to the set of radial distances and angles: 1, 2, 3, 4, 5, and 6 inches, and 0, 50, 100, 150, 200, and 250 degrees.
SETSPANF 1 2 3 4 5 0 50 100 150 200 250

SETWFF [/D] <path\filename>

This command will set all I and Q weights according to the values found in <path\filename>, the user weight file specified. If no filename is given the default file WTFILE.621 (see *Appendix D*) is used.

Optional switch:
[/D] suppresses the display to console.

Example 1:
Set weights from weight file SUBDIR\USERWT.621.
SETWFF SUBDIR\USERWT.621

SETWTA [/AD] <channel> <angle | r>

This command changes the current value of the weight phase angle used to the value <angle>, or restores <r> the prior value used, expressed in degrees of the <channel> specified. The antenna pointing angle will be undefined.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<channel> Where ($1 \leq$ <channel> ≤ 7)

<angle> Where ($-180 \leq$ <angle> ≤ 180)

Other input data used are the absolute magnitude of the nth channel weight, M_n. DBFP weights are computed using the product of $W_g x W(\theta)$ (see DBFP Test Plan Appendix B). The DBFP I and Q weight components, IWT1, QWT1, ... IWT7, QWT7, are determined from the following:

$IWTn = M_n \times \sin\langle angle \rangle$
$QWTn = M_n \times \cos\langle angle \rangle$

where n is the selected <channel>.

Example 1:
For array element channel 5, set the phase angle of the DBFP complex beam weight to -35 degrees, and suppress the display to console.
SETWTA /D 5 -35

Example 2:
For array element channel 5, restore the prior value used for the phase angle of the DBFP complex beam weight.
SETWTA 5 r

SETWTM [/AD] <channel> <magnitude | r>

This command changes the current value of the weight magnitude used to the value <magnitude>, or restores <r> the prior value used of the <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.

<channel> Where (1 ≤ <channel> ≤ 7)

<magnitude> Where (0.5 ≤ <magnitude> ≤ 1.5)

Other input data used are the DBFP weight angles. DBFP weights are computed using the product of $W_0 x W(\theta)$ (see DBFP Test Plan Appendix B). The DBFP I and Q weight components, IWT1, QWT1, ... IWT7, QWT7, are determined where n is the selected <channel> from the following:

1. Read current IWTn, QWTn, and WTMn for DBFP.
   1. REAIWT <channel>, R1.
   2. REAQWT <channel>, R2.
   3. REAWTM <channel>, R3.

2. Compute new values for IWTn and QWTn, and store.

   1. $IWTn = \frac{<magnitude>}{R3} R1$

   2. $QWTn = \frac{<magnitude>}{R3} R2$

3. Store new WTM for DBFP.
   WTM = <magnitude>.

Example 1:
For array element channel 1, set the magnitude of the DBFP complex beam weight to 0.95.
SETWTM 1 .95

Example 2:
For array element channel 1, restore the prior value used for the magnitude of the DBFP complex beam weight.
SETWTM 1 r

STRBER

This command measures and displays the current values for bit count, error count, and clock slip count. It also displays the ratio of error-count to bit-count for signal source 1, the desired signal, and resets all counts to zero.

The measurements are made by latching and reading the registers for bit count, error count and slip count respectively, the ratio of error count to bit count is computed and displayed with bit count, error count, and slip count. The counters are then reset.

Example 1:
Restart bit-error-rate measurement.
STRBER

STSIIN [/ADMR] <channel> <n>

This command calculates and displays the average and root [(mean-of-the-squares) - (average-squared)] of the DBFP Processor input in-phase signal using <n> samples of the <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.
[/M] returns only the average, i.e., the mean.
[/R] returns only the RMS, i.e., root [(mean-of-the-squares) - (average-squared)].

<channel> Where (1 ≤ <channel> ≤ 7)

<n> Where (1 ≤ <n> ≤ 1000000)

Note: Samples are taken at approximate rate of 1 sample/second.

This command is implemented by interrogating the DBFP using one read from each of the sample registers. This step is repeated n - 1 times to produce <n> samples. The average and root [(mean-of-the-squares) - (average-squared)] are calculated using the <n> samples. The preceding is repeated for all (option [/A]) channels.

Example 1:
Measure and display the average and root-mean-square of the DBFP Processor input in-phase signal for channel 1, using 3000 samples.
STSIIN 1 3000

Example 2:
Measure and display the average of the DBFP Processor input in-phase signal for channel 4, using 6000 samples.
STSIIN /M 4 6000

Example 3:
Measure and display the average and root-mean-square of the DBFP Processor input in-phase signal for all channels, using 10000 samples.
STSIIN /A 10000

STSIINB [/DMR] <number> <m>

This command will: (1) measure the current array of 256 in-phase samples and successive <number> of multiples of 256 in-phase samples stored in the DBFP buffer in channel 1, (2) repeat the measure, of <number> multiples of 256 samples <m> times, (3) for each of the <m> + 1 groups, compute and display the average and root [(mean-of-the-squares) - (average-squared)], and (4) extend computation and display overall average and overall root [(mean-of-the-squares) - (average-squared)].

Optional switch:
[/D] suppresses the display to console.
[/M] returns only the average, i.e., the mean.
[/R] returns only the RMS, i.e., root [(mean-of-the-squares) - (average-squared)].

<number> Where (1 ≤ <number> ≤ 4095)

<m> Where (1 ≤ <m> ≤ 255)

This command is implemented by interrogating the DBFP buffers and repeating the step <m> times. For each <m> + 1 group, an average and root [(mean-of-the-squares) - (average-squared)] is computed and displayed. The overall average and overall root [(mean-of-the-squares) - (average-squared)] of the total number of samples also is computed and displayed.

Example 1:
Measure and display the root-mean-square of 6 sets of 255 successive multiples of samples stored in the DBFP Processor input in-phase buffer of channel 1.
STSIINB /R 255 6

STSISM [/DMR] <n>

This command calculates and displays the average and root [(mean-of-the-squares) - (average-squared)] of the DBFP Processor in-phase-sum signal using <n> samples.

Optional switch:
[/D] suppresses the display to console.
[/M] returns only the average, i.e., the mean.
[/R] returns only the RMS, i.e., root [(mean-of-the-squares) - (average-squared)].

<n> Where (1 ≤ <n> ≤ 1000000)

This command is implemented by interrogating the DBFP buffers. This step is repeated n - 1 times to produce <n> samples. The average and root [(mean-of-the-squares) - (average-squared)] are calculated using the <n> samples.

Example 1:
Measure and display the average and root-mean-square of the DBFP Processor in-phase-sum signal using 500 samples.
STSISM 1 500

STSISMB [/DMR] <number> <m>

This command will: (1) measure the current array of 256 in-phase-sum samples and successive <number> of multiples of 256 in-phase-sum samples stored in the DBFP buffer, (2) repeat the measure, of <number> multiples of 256 samples, <m> times, (3) for each of the <m> + 1 groups, compute and display the average and root [(mean-of-the-squares) - (average-squared)], and (4) extend computation and display overall average and overall root [(mean-of-the-squares) - (average-squared)].

Optional switch:
[/D] suppresses the display to console.
[/M] returns only the average, i.e., the mean.
[/R] returns only the RMS, i.e., root [(mean-of-the-squares) - (average-squared)].

<number> Where (1 ≤ <number> ≤ 255)

<m> Where (1 ≤ <m> ≤ 4095)

This command is implemented by interrogating the DBFP and repeating the step <m> times. For each <m> + 1 group an average and root [(mean-of-the-squares) - (average-squared)] is computed and displayed. The overall average and overall root [(mean-of-the-squares) - (average-squared)] of the total number of samples is computed and displayed.

Example 1:
Measure and display the average and root-mean-square of 6 sets of 255 successive multiples of 256 samples stored in the DBFP in-phase sum buffer.
STSISMB 255 6

STSQIN [/ADMR] <channel> <n>

This command calculates and displays the average and root [(mean-of-the-squares) - (average-squared)] of the DBFP input quadrature signal using <n> samples of the <channel> specified.

Optional switch:
[/A] executes command for all operating sources or channels.
[/D] suppresses the display to console.
[/M] returns only the average, i.e., the mean.
[/R] returns only the RMS, i.e., root [(mean-of-the-squares) - (average-squared)].

<channel> Where (1 ≤ <channel> ≤ 7)

<n> Where (1 ≤ <n> ≤ 1000000)

Note: samples are taken at approximate rate of 1 sample/second.

This command is implemented by interrogating the DBFP while reading from each of the buffers which correspond to the <channel> specified. The step is repeated n - 1 times to produce <n> samples. The average and root [(mean-of-the-squares) - (average-squared)] are calculated using the <n> samples. The preceding step is repeated for all (option [/A]) channels.

Example 1:
Measure and display the root-mean-square of the DBFP input quadrature signal for channel 1 using 100 samples.
STSQIN /R 1 100

Example 2:
Measure and display the average of the DBFP input quadrature signal for all channels using 10000 samples.
STSQIN /MA 10000

STSQINB [/DMR] <number> <m>

This command will: (1) measure the current array of 256 quadrature samples and successive <number> of multiples of 256 quadrature samples stored in the DBFP buffer in channel 1, (2) repeat the measure, of <number> multiples of 256 samples, <m> times, (3) for each of the <m> + 1 groups, compute and display the average and root [(mean-of-the-squares) - (average-squared)], and (4) extend computation and display overall average and overall root [(mean-of-the-squares) - (average-squared)].

Optional switch:
[/D] suppresses the display to console.
[/M] returns only the average, i.e., the mean.
[/R] returns only the RMS, i.e., root [(mean-of-the-squares) - (average-squared)].

<number> Where (1 ≤ <number> ≤ 255)

<m> Where (1 ≤ <m> ≤ 4095)

This command is implemented by interrogating the DBFP while repeating the step <m> times. For each <m> + 1 group an average and root [(mean-of-the-squares) - (average-squared)] is computed and displayed. The overall average and overall root [(mean-of-the-squares) - (average-squared)] for the total number of samples is computed and displayed.

Example 1:
Measure and display the average of 6 sets of 241 successive multiples of 256 samples stored in the DBFP input quadrature buffer for channel 1.
STSQINB /M 241 6

STSQSM [/DMR] <n>

This command calculates and displays the average and root [(mean-of-the-squares) - (average-squared)] of the DBFP quadrature-sum signal using <n> samples.

Optional switch:
[/D] suppresses the display to console.
[/M] returns only the average, i.e., the mean.
[/R] returns only the RMS, i.e., root [(mean-of-the-squares) - (average-squared)].

<n> Where (1 ≤ <n> ≤ 1000000)

This command is implemented by interrogating the DBFP buffers and repeated n - 1 times to produce <n> samples. The average and root [(mean-of-the-squares) - (average-squared)] are calculated using the <n> samples.

Example 1:
Measure and display the average and root-mean-square of the DBFP quadrature-sum signal using 1500 samples.
STSQSM 1500

STSQSMB [/DMR] <number> <m>

This command will: (1) measure the current array of 256 quadrature-sum samples and successive <number> of multiples of 256 quadrature-sum samples stored in the DBFP buffer, (2) repeat the measure of <number> multiples of 256 samples <m> times, (3) for each of the <m> + 1 groups, compute and display the average and root [(mean-of-the-squares) - (average-squared)], and (4) extend computation and display overall average and overall root [(mean-of-the-squares) - (average-squared)].

Optional switch:
[/D] suppresses the display to console.
[/M] returns only the average, i.e., the mean.
[/R] returns only the RMS, i.e., root [(mean-of-the-squares) - (average-squared)].

<number> Where (1 ≤ <number> ≤ 255)

<m> Where (1 ≤ <m> ≤ 4095)

This command is implemented by interrogating the DBFP and repeating the step <m> times. For each <m> + 1 group an average and root [(mean-of-the-squares) - (average-squared)] is computed and displayed. The overall average and overall root [(mean-of-the-squares) - (average-squared)] for the total number of samples is computed and displayed.

Example 1:
Measure and display the average and root-mean-square of 6 sets of 200 successive multiples of samples stored in the DBFP quadrature sum buffer.
STSQSMB 200 6

STAMP

This command displays the current date and time in MMDDHHMM format, i.e., 08261345 equates to August 26 1:45 pm.

Example 1:
Stamp the current date and time.
STAMP

SYNTAX [/D] <on | off>

This command sets the global syntax flag on or off. Allowing the user to check the syntax of test batch files without actually executing the command functions on the DBFP.

Example 1:
Set syntax flag on.
SYNTAX on

TCCTSR

This command invokes the TCC Terminate and Stay Resident (TSR) routine. Allocating memory for a maximum number of variable names, the current data values, and previous data values. Run this command before any of the TCC functions or commands are executed.

Example 1:
Invoke the TCC Terminate and Stay Resident software.
TCCTSR

TL488 <address> <string> [milliseconds]

This command sends a <string> command to the IEEE 488 bus device specified by the <address> and listens for return data for [milliseconds]. It will not verify the device address.

<address> Where <address> is a valid IEEE 488 bus address.

<string> Where <string> = ASCII string in quotes (").

[milliseconds] Where (1 ≤ [milliseconds] ≤ 60000)

Example 1:
Set HP synthesizer (at address 7) frequency to 20 MHz and listen for response for up to 10 milliseconds.
TL488 7 "FR 20 MZ" 10

TM <string>

This command appends the current date and time to <string>.

<string> Where <string> = ASCII string in quotes (").

Example 1:
Create identifying header for a data file containing the title "AWG_CHANNEL_NOISE" and append it to the file DATAFILE.631.

TM AWG_CHANNEL_NOISE_At: /1 /log > datafile.631

Refer to *The Norton Utilities Advanced Edition Version 4.5* for additional information on this command.

WAIT [/D] <time>

This command delays the execution of a batch file for the period of <time> given in (hh:mm:ss) hours, minutes, and seconds.

Optional switch:
[/D] suppresses the display to console.

<time> Where (00:00:00 ≤ <time> ≤ 99:59:59)

Example 1:
Pause for 1 hour 45 minutes and 52 seconds.
WAIT 01:45:52

WASCII <mnemonic> <string>

This command writes an arbitrary ASCII string to the device specified by the mnemonic.

<mnemonic> Where <mnemonic> BER or DBFP.

<string> Where <string> = ASCII string in quotes (").

Example 1:
Write the string "this is a test" to the DBFP.
WASCII DBFP "this is a test"

WBYTE <mnemonic> <address> <hex-byte>

This command writes an 8-bit ASCII byte of data <hex-byte>, to the <address> of the device specified by the <mnemonic>.

<mnemonic> Where <mnemonic> = BER or DBFP.

<address> Where <address> = hex character address of register.

<hex-byte> Where <hex-byte> = 8-bit ASCII byte.

Example 1:
Write byte 73h to DBFP address 97h.
WBYTE DBFP 97 73

WRASCII <mnemonic> <string>

This command writes an arbitrary ASCII <string> to the device specified by <mnemonic> and reads from the device for any characters that might be returned. The data received will be displayed on the console.

<mnemonic> Where <mnemonic> = BER or DBFP.

<string> Where <string> = ASCII string in quotes (").

Example 1:
Write test string "this is a test" to DBFP and read return data.
WRASCII DBFP "this is a test"

7.0 ERROR AND WARNING MESSAGES

Error and warning messages result from improper command syntax, invalid parameters or optional command switches, transmission errors, and system/equipment failure. All TCC commands display error and/or warning messages on the console at the time they occur. Messages displayed will contain the name of the command function where the error occurred and descriptive text outlining the cause of the error. In most cases, users will be able to read the error message and correct the problem by editing a batch file or adjusting a device or instrument. In rare instances, the user may require assistance from the software or hardware designers.

The user may execute the **SYNTAX** command to test the syntax of a batch file(s). With the TCC syntax flag set, it is possible to execute commands at the DOS prompt or from within batch files without actually issuing commands to the DBFP. Commands with invalid parameters or syntax will display the correct syntax on the console and can be corrected later for the actual test run.

If the user cannot understand an error message or is unable to correct the error, please complete and return the *Abnormal Errors Encountered Report Form* contained in *Appendix F* of this document.

8.0 ERROR RECOVERY

All TCC commands display error and warning messages on the console at the time they occur. If the user is operating the DBFP from the command line (i.e., the DOS prompt), the user can simply re-enter the command in question. If the user is executing a test using one or more batch files, an error message will be displayed, but the batch file will continue to run. Consequently, the command in question will not be executed properly and completely, leaving the DBFP to operate with improper or incomplete instrument or device settings. The user should cancel the execution of the batch file(s) in question and investigate the cause of the error. Batch files may be restarted following the technique listed in *Section 5.4, Abnormal Restart Procedures* of this document.

The user may execute the **SYNTAX** command to test the syntax of a batch file(s). With the TCC syntax flag set, it is possible to execute commands at the DOS prompt or from within batch files without actually issuing commands to the DBFP. Commands with invalid parameters or syntax will display the correct syntax on the console and can be corrected later for the actual test run.

If the software cannot be successfully restarted, please complete and return the *Abnormal Errors Encountered Report Form* contained in *Appendix F* of this document.

9.0 ABBREVIATIONS AND ACRONYMS

All abbreviations are defined when they first appear in the text. An alphabetized list of the definitions for abbreviations and acronyms used in this document is defined here.

ABBREVIATION	MEANING
A/D	analog to digital
ASCII	American Standard Code for Information Interchange
ATDRS	Advanced Tracking and Data Relay Satellite
BER	bit error measurement
D/A	digital to analog
dB	decibel referred to one watt
dBm	decibel referred to one milliwatt
DBFP	Digital Beam Forming Processor
FIR	finite input response
HP	Hewlett-Packard
IBM	International Business Machines
IF	intermediate frequency
MHz	megahertz
NASA	National Aeronautics and Space Administration
PAS	Phase Array Simulator
PC	personal computer
QPSK	Quadriphase-Shift Keying (Four-Phase-Shift Keying)
RF	radio frequency
SMAP	Software Management and Assurance Program
TCC	Test and Control Computer

10.0 NOTES

11.0 APPENDICES

Appendix A

Test Batch File INITCKOU.BAT

The ATDRS DBFP tests are conducted using experiment hardware under computer control. The test file used to establish initial test hardware conditions prior to each test is INITCKOU.BAT. A listing for INITCKOU.BAT is contained in this appendix.

INITCKOU.BAT

```
IF NOT "%ECHO%" == "" GOTO NOECHO
@ECHO OFF
:NOECHO

ECHO make sure TCC TSR is present, otherwise load and initialize it.

disable tcctsr /c
if not ERRORLEVEL 2 goto TSRLOADED
    tcctsr
    initvars
:TSRLOADED

ECHO call init that initializes DBF and BER
modem /a re
CALL init

ECHO CONNECT UP-CONVERTER TO DBFP.
REM PAUSE
ECHO LOCK QPSK MODEM 1 FREQUENCY TO TEST SYSTEM
REM PAUSE
ECHO UP-CONVERTER SHOULD BE FREQUENCY LOCKED TO DBF PROCESSOR
ECHO FOR ALL TESTS.

SETFRQ 4 2276.4432

rem Paul and Nam moved this command up here from down below because you
rem have to set the resolution BEFORE you set the number of elements.

setres wt 8

ECHO SETNUM COMMAND SETS ALL I & Q WEIGHTS FROM FILE, WTFILE.621,
ECHO TO REFLECT ACTUAL HARDWARE CHARACTERISTICS.
ECHO IF FILE DOES NOT EXIST, SETNUM CREATES FILE WITH ALL IWTn=1.0 AND
QWTn=0.0.
SETNUM 7

SETSPA 11.5

MODEM /A RE

MODEM 1 RC 0
MODEM 1 AG 200

MODEM 1 RR 1024000
MODEM 2 RR 1024000
MODEM 3 RR  288000

ECHO SEE MODEM APPLICATION NOTE FOR QPSK MODULATION.
ECHO disable differential coding in demodulator 1
ECHO We don't care about demodulators 2 and 3.
MODEM 1 DD 2

ECHO set modem IF output frequency
MODEM /A RS 70000
ECHO disable all modulator output
MODEM /A EM 0
```


PRECEDING PAGE BLANK NOT FILMED

```
ECHO disable pure carrier output of modulators
MODEM /A PC 0

ECHO set receive modulation type to QPSK
ECHO We don't care about demodulators 2 and 3.
MODEM 1 RM 1

ECHO SEE MODEM APPLICATION NOTE FOR QPSK MODULATION.
MODEM 1 DM 0
MODEM 2 DM 0
MODEM 3 DM 2

MODEM /A TM 1

ECHO BUILT-IN SYMBOL RATE UNKNOWN.
MODEM 1 TR 1024000
MODEM 2 TR 1024000
MODEM 3 TR  288000

ECHO Set transmit synth. frequency
MODEM /A TS 70000

SETA-D /A 1.0
SETAPT  0

ECHO FOLLOWING COMMAND SETS NOISE BANDWIDTH.
ECHO 3.78 COMPUTED USING XFER DATA FOR 2 INTERNAL INLINE PAS FILTERS.
SETNBW 3.78

SETC-N 14
SETATT /A PAS 1 -31

ECHO FOLLOWING SET COMMANDS, SET ALL PHASE SHIFTERS TO 0.
SETDIR /A 0

SETRES  A-D 8
SETRES  FIR ..\DATAFILE\1MHZ.FIR
```

Appendix B

Test Batch File 632_2CK0.BAT

The ATDRS DBFP tests are conducted using experiment hardware under computer control. The test file used to determine the effects of added white gaussian noise on the digital beam forming processor is 632_2CK0.ABT. This file uses a pure carrier as an input signal source. The carrier-to-noise ratio is stepped in 1 dB increments from 15 dB to -42 dB. Measurements are made internal to the DBFP. A listing for 632_2CK0.BAT is contained in this appendix.

632_2CK0.BAT

```
@ECHO OFF

REM TEST 632_2.BAT: AWG CHANNEL NOISE, PURE CARRIER
REM THIS TEST IS USED THE INPUT C/N OF EACH CHANNEL, AND DBFP OUTPUT S/N

REM make sure TCC TSR is present, otherwise load and initialize it.

disable tcctsr /c
if not ERRORLEVEL 2 goto TSRLOADED
     tcctsr
     initvars
:TSRLOADED

REM set data directory and file name in the form MMDDHHMM.322
stamp | setenv FNAME %%prompt%%noecho
set DATAFILE=c:\workarea\datadir\632\%FNAME%.322

REM create file and write time and date to it.

tm #632_2:AWG_CHANNEL_NOISE,_PURE_CARRIER_At: /1 /log > %DATAFILE%

CALL INITCK0U.BAT
SETRES FIR ..\DATAFILE\%7MHZ.FIR

SET NUM=8
SET RETURN01=7
SET RETURN02=20
TL488 7 "FR 20 MZ" 1
TL488 7 "R3" 1

IF "%1" == "" GOTO EXPLAIN
IF "%2" == "" GOTO EXPLAIN
IF "%3" == "" GOTO EXPLAIN
IF "%4" == "" GOTO EXPLAIN
IF "%5" == "" GOTO EXPLAIN
IF "%6" == "" GOTO EXPLAIN
IF "%7" == "" GOTO EXPLAIN

IF "%1" == "1" GOTO MARK01
IF "%1" == "2" GOTO MARK02

ECHO # SIG(1,0,0)RES(%2,%3,%4)NL(%5,%6)FIR(%7) >> %DATAFILE%
SET SIGNAL=SIG(1,0,0)
GOTO CONTINUE01

:MARK01 ECHO # SIG(1,1,0)RES(%2,%3,%4)NL(%5,%6)FIR(%7) >> %DATAFILE%
SET SIGNAL=SIG(1,1,0)
GOTO CONTINUE01

:MARK02 ECHO # SIG(1,1,1)RES(%2,%3,%4)NL(%5,%6)FIR(%7) >> %DATAFILE%
SET SIGNAL=SIG(1,1,1)
:CONTINUE01

SETRES A-D %2 >> %DATAFILE%
SETRES WT %3 >> %DATAFILE%
ECHO # FIR resolution is set to %4 >> %DATAFILE%
```

```
:LOOP02

REM LOOP02 STEPS CARRIER-TO-NOISE, IN 3dB STEPS, FROM 15 TO -42dB.

IF "%RETURN02%" == "0.000000" GOTO ENDLP02
MULT %RETURN02% 3 | SETENV DELC-N %%prompt%%noecho
ADD %DELC-N% -45 | SETENV C-N %%prompt%%noecho
SETC-NHP %C-N%
MULT %NUM% 1.7 | SETENV NUM %%prompt%%noecho
FTOI %RETURN01% | SETENV IRETURN01 %%prompt%%noecho
    :LOOP01
    ECHO MEASURE NOISE WITHOUT CARRIER PRESENT
    TL488 7 "R2" 1
    ECHO IPM %IRETURN01%
    CALL IPM %IRETURN01%
    MSRMET 2 | setenv INPW %%prompt%%noecho
    ECHO OPM %IRETURN01%
    CALL OPM %IRETURN01%
    MSRMET 3 | setenv ONPW %%prompt%%noecho

    TL488 7 "R3" 1
    ECHO THE FOLLOWING COMMANDS MEASURE CPW+NPW AT PAS IN AND OUT PORTS
    ECHO IPM %IRETURN01%
    CALL IPM %IRETURN01%
    MSRMET 2 | setenv ICNPW %%prompt%%noecho
    ECHO OPM %IRETURN01%
    CALL OPM %IRETURN01%
    MSRMET 3 | setenv OCNPW %%prompt%%noecho

    ECHO CHANNEL: %IRETURN01% >> %DATAFILE%
    REATBL C-N %C-N% %IRETURN01% >> %DATAFILE%
    ECHO %INPW% %ICNPW% %ONPW% %OCNPW% >> %DATAFILE%
    FTOI %NUM% | SETENV INUM %%prompt%,%noecho
    ECHO # %INUM% SAMPLES USED IN STS AVERAGE & RMS. >> %DATAFILE%

    ECHO # CHANNEL %IRETURN01% IIN: >> %DATAFILE%
    STSIIN %IRETURN01% %INUM% >> %DATAFILE%
    ECHO # CHANNEL %IRETURN01% QIN: >> %DATAFILE%
    STSQIN %IRETURN01% %INUM% >> %DATAFILE%

    ECHO # %SIGNAL%RES(%2,%3,%4)NL(%5,%6)FIR(%7)

    ADD %IRETURN01% -1 | SETENV RETURN01 %%prompt%%noecho
    FTOI %RETURN01% | SETENV IRETURN01 %%prompt%%noecho
    IF NOT "%IRETURN01%" == "0" GOTO LOOP01
    :ENDLOOP01
SET RETURN01=7

ECHO >> %DATAFILE%
ECHO >> %DATAFILE%
SETNUM 1
ECHO SET C/N: %C-N%, NUMBER OF SUMMED ELEMENTS: 1 >> %DATAFILE%
ECHO ISM >> %DATAFILE%
STSISM %INUM% >> %DATAFILE%
ECHO QSM >> %DATAFILE%
STSQSM %INUM% >> %DATAFILE%

SETNUM 2
ECHO >> %DATAFILE%
ECHO SET C/N: %C-N%, NUMBER OF SUMMED ELEMENTS: 2 >> %DATAFILE%
ECHO ISM >> %DATAFILE%
STSISM %INUM% >> %DATAFILE%
ECHO QSM >> %DATAFILE%
STSQSM %INUM% >> %DATAFILE%

SETNUM 4
ECHO >> %DATAFILE%
ECHO SET C/N: %C-N%, NUMBER OF SUMMED ELEMENTS: 4 >> %DATAFILE%
ECHO ISM >> %DATAFILE%
```

```
        STSISM %INUM% >> %DATAFILE%
        ECHO QSM >> %DATAFILE%
        STSQSM %INUM% >> %DATAFILE%

        SETNUM 7
        ECHO >> %DATAFILE%
        ECHO SET C/N: %C-N%, NUMBER OF SUMMED ELEMENTS: 7 >> %DATAFILE%
        ECHO ISM >> %DATAFILE%
        STSISM %INUM% >> %DATAFILE%
        ECHO QSM >> %DATAFILE%
        STSQSM %INUM% >> %DATAFILE%

        ADD %RETURNO2% -1 | SETENV RETURNO2 %%prompt%%noecho
        GOTO LOOPO2
      :ENDLPO2
SETC-NHP 15

:EXPLAIN
ECHO PARAMETER 1, INTERFERERS PRESENT, ENTER 0/1/2
ECHO PARAMETER 2, A-D RESOLUTION, ENTER INTEGER (3 TO 8)
ECHO PARAMETER 3, WEIGHT RESOLUTION, ENTER INTEGER (4 TO 8)
ECHO PARAMETER 4, FIR FILTER RESOLUTION, ENTER INTEGER (3 TO 8)
ECHO PARAMETER 5, DIGITAL NON-LINEARITY, ENTER INTEGER (-3 TO 6)
ECHO PARAMETER 6, ANALOG NON-LINEARITY, ENTER INTEGER (-3 TO 9)
ECHO PARAMETER 7, FIR FILTER BANDWIDTH, ENTER VALUE (0.5,1,2,4)

tm #632_2:END_OF_TEST_At: /l /log >> %DATAFILE%

:END
```

Appendix C

Test Condition Setup Tables

The ATDRS DBFP tests are conducted using experimental hardware under computer control. The test execution is controlled using batch files. The test conditions established by specific commands during batch file execution are created using tables. The tables are derived from hardware calibrations. This appendix contains the tables used in the DBFP tests and an explanation of their derivation.

There are eight tables, one for each Phased Array Simulator channel. The tables are numbered 0 through 7 corresponding to Phased Array Simulator channels 1 through 8 respectively. The preface to each table contains table the identification, constraints, gain constants used in preparing the tables, and column headings. This supporting information is identified to separate it from the table data by a leading # in each line. The table data are prepared such that the 3σ test conditions for noise + signal are established in the linear operating range of the hardware.

The gain constants used for each PAS channel table are listed in *Table C-1*. The column heading abbreviations are listed in *Table C-2* with the table constraints listed in *Table C-3*.

Gain Constant	Type of Gain
DCG	Down-Converter Gain
PASG	Phase Array Simulator Gain
ADDPASG	Gain Added to Phase Array Simulator Channel
EFFNSRC	Effective Noise Source

Table C-1 Gain Constants

Heading	Meaning
C/N	Carrier-to-Noise Ratio in dB
C	Carrier Power in dB
N	Noise Power in dB
MODPWR	Modem Output Power in dBm
DCA1	Down-Converter Attenuator 1 in dB
CHA1	Phase Array Simulator Noise Attenuator 1 in dB
CHA2	Phase Array Simulator Input Gain Attenuator 2 in dB
CHA3	Phase Array Simulator Output Gain Attenuator 3 in dB
PASIN	Input Signal in dB, Referred to the Phase Array Simulator Input Port

Table C-2 Column Headings

The tables are used in the following manner. Given a value for C/N, C, or N, the test conditions are established by setting signal source output powers, MODPWR or PASIN, and all attenuator values in a corresponding line. This is done for each channel when the SETC-N command is used and for the selected channel when SETCPW or SETNPW commands are used.

Heading	Meaning
PASINn	Phase Array Simulator nth channel input
EFFSRCn	nth Channel effective noise source
ADDPASGn	Gain Added to nth Phase Array Simulator channel
MODPWRm	mth Modem Output Power Table: modem power, <mtp>, for each m. (-5 to -25 dBm)
DCGm	mth Maximum Down-Converter Gain (DCAm = 0), for each m. (45 dB)
DCAm	mth Down-Converter attenuator attenuation. Table: (output/input)/(dcgm), <db>, for each m. (0 to -32 dB)
DIVmn	Divider Loss from mth input to nth output, for each m input port to nth output port. (10 dB)
PSmn	Phase Shifter loss for mth signal to nth channel. Table: phase shifter loss, <phase>, for each mnth phase shifter. (2 dB)
PASGmn	Phase Array Simulator maximum gain from input port 1 to output port (CHnA2 = 0, CHnA3 = 0), for each nth channel. (27 dB)
CHnA2	nth Channel Attenuator 2 attenuation. Table: (output/input port 1)/(PASG1n), <dB>. (CHnA1 = 0, CHnA3 = 0), for each channel. Extend to other input ports using factor (PASG1n)/(PASGmn). (0 to -32 dB)
CHnA1	nth Channel attenuator 1 attenuation. Table: (output/input port 1)/(PASG1n), <dB> (CHnA2 = 0, CHnA3 = 0), for each channel. Extend to other input ports using factor (PASG1n)/(PASGmn). (0 to -32 dB)
CHnA3	nth Channel attenuator 3 attenuation. Table: (output/input port 1)/(PASG1n), <dB> (CHnA1 = 0, CHnA2 = 0), for each channel. Extend to other input ports using factor (PASG1n)/(PASGmn). (0 to -32 dB)

Table C-3 Table Constraints

The table entries are derived using the following relations and assumptions:

- The last column, PASIN is used to set the Phase Array Simulator input when the Hewlett Packard synthesizer is used as a signal source.
- Signals are referred to A/D input port (Phase Array Simulator output port).
- Attenuator values are negative numbers for consistency with command list definitions.
- Attenuator zero-offset has been included in terms DCG_m and $PASG_{mn}$. Attenuation value, <db>, for attenuators CHnA1, CHnA2, CHnA3, and DCA*m*, is: $(-32 \leq$ <db> $\leq 0)$.
- Cn1 = Desired signal in nth channel.
- Cn2 = First interferer in nth channel.
- Cn3 = Second interferer in nth channel.
- Cn1 = MODPWR1 + DCG1 + DCA1 - DIV1n - PSn1 + PASG1n + CHnA2 + CHnA3 + ADDPASGn
- Cn2 = MODPWR2 + DCG2 + DCA2 - DIV2n - PSn2 + PASG2n + CHnA2 + CHnA3 + ADDPASGn
- Cn3 = MODPWR3 + DCG3 + DCA3 - DIV3n - PSn3 + PASG3n + CHnA2 + CHnA3 + ADDPASGn
- PASINn = MODPWR1 + DCG1 + DCA1 - DIV1n - PSn1
- SUMSIG = 10LOG[10Cn1/10 + 10Cn2/10 + 10Cn3/10]
- Nn = EFFNSRCn + PASG4n + CHnA1 + CHnA2 + CHnA3 + ADDPASGn

```
#       Table A: A/D Input Signal Levels
#             Channel 0
#       A/D input subject to constraint:
#            42.43 * SQRT(NPW) + 20.00 * SQRT(CPW) = 1 volt Peak-Peak
#       Powers referred to a/d input port 3 sigma signal will produce 1 volt peak-peak at A/D input
#       A/D <range> = 1.00
#       NPRW AT A-D INPUT = EFFNSRC + ATT1 + ATT2 + ATT3 + ADDPASG
# DCG = 29 dB      PASG = 13.5 dB       ADDPASG = 20.12 dB              EFFNSRC = 28.1 dBm #
    C/N    C        N     MODPWR    DCA1     CHA2   CHA1   CHA3   PASIN
    20   2.38    -17.62   -7.12     -14      -25    -30    -14    7.88
    15   1.26    -13.74  -13.24     -13      -21    -30    -14    2.76
    14   0.98    -13.02  -13.52     -13      -21    -30    -14    2.48
    13   0.66    -12.34  -13.84     -14      -20    -30    -14    1.16
    12   0.33    -11.67  -14.17     -15      -19    -30    -14   -0.17
    11  -0.04    -11.04  -14.54     -15      -19    -30    -14   -0.54
    10  -0.43    -10.43  -14.93     -16      -18    -30    -14   -1.93
     9  -0.84     -9.84  -15.34     -17      -17    -30    -14   -3.34
     8  -1.29     -9.29  -15.79     -17      -17    -30    -14   -3.79
     7  -1.77     -8.77  -16.27     -17      -17    -29    -14   -4.27
     6  -2.27     -8.27  -16.77     -17      -17    -29    -14   -4.77
     5  -2.80     -7.80  -17.30     -17      -17    -28    -14   -5.30
     4  -3.36     -7.36  -17.86     -17      -17    -28    -14   -5.86
     3  -3.95     -6.95  -18.45     -17      -17    -27    -14   -6.45
     2  -4.57     -6.57  -19.07     -13      -21    -23    -14   -3.07
     1  -5.21     -6.21  -19.71     -13      -21    -23    -14   -3.71
     0  -5.88     -5.88  -20.38     -13      -21    -22    -14   -4.38
    -1  -6.57     -5.57  -21.07     -13      -21    -22    -14   -5.07
    -2  -7.29     -5.29  -21.79     -13      -21    -22    -14   -5.79
    -3  -8.03     -5.03  -22.53     -13      -21    -22    -14   -6.53
    -4  -8.79     -4.79  -23.29     -13      -21    -21    -14   -7.29
    -5  -9.58     -4.58  -24.08     -13      -21    -21    -14   -8.08
    -6 -10.38     -4.38  -24.88     -13      -21    -21    -14   -8.88
                           -30
                       ADD  -30 dB
    -7 -11.20     -4.20  -35.70     -12      -12    -30    -14   -18.70
    -8 -12.03     -4.03  -36.53     -12      -12    -30    -14   -19.53
    -9 -12.88     -3.88  -37.38     -13      -11    -30    -14   -21.38
   -10 -13.75     -3.75  -38.25     -13      -11    -30    -14   -22.25
   -11 -14.63     -3.63  -39.13     -13      -11    -30    -14   -23.13
   -12 -15.52     -3.52  -40.02     -13      -11    -30    -14   -24.02
   -13 -16.42     -3.42  -40.92     -13      -11    -30    -14   -24.92
   -14 -17.33     -3.33  -41.83     -13      -11    -30    -14   -25.83
   -15 -18.25     -3.25  -42.75     -13      -11    -30    -14   -26.75
   -16 -19.17     -3.17  -43.67     -13      -11    -30    -14   -27.67
   -17 -20.11     -3.11  -44.61     -13      -11    -30    -14   -28.61
   -18 -21.05     -3.05  -45.55     -13      -11    -30    -14   -29.55
   -19 -22.00     -3.00  -46.50     -13      -11    -29    -14   -30.50
   -20 -22.95     -2.95  -47.45     -13      -11    -29    -14   -31.45
   -21 -23.91     -2.91  -48.41     -13      -11    -29    -14   -32.41
   -22 -24.87     -2.87  -49.37     -13      -11    -29    -14   -33.37
   -23 -25.84     -2.84  -50.34     -13      -11    -29    -14   -34.34
   -24 -26.80     -2.80  -51.30     -13      -11    -29    -14   -35.30
   -25 -27.78     -2.78  -52.28     -13      -11    -29    -14   -36.28
   -26 -28.75     -2.75  -53.25     -13      -11    -29    -14   -37.25
   -27 -29.73     -2.73  -54.23     -13      -11    -29    -14   -38.23
   -28 -30.71     -2.71  -54.21     -12      -13    -27    -14   -37.21
   -29 -31.70     -2.70  -54.20     -11      -15    -25    -14   -36.20
   -30 -32.68     -2.68  -54.18     -10      -17    -23    -14   -35.18
   -31 -33.67     -2.67  -54.17      -9      -19    -21    -14   -34.17
   -32 -34.65     -2.65  -54.15      -8      -21    -19    -14   -33.15
   -33 -35.64     -2.64  -54.14      -7      -23    -17    -14   -32.14
   -34 -36.63     -2.63  -54.13      -6      -25    -15    -14   -31.13
   -35 -37.62     -2.62  -54.13     -21      -11    -29    -14   -46.14
   -36 -38.62     -2.62  -54.13     -20      -13    -27    -14   -45.15
   -37 -39.61     -2.61  -54.13     -19      -15    -25    -14   -44.16
   -38 -40.60     -2.60  -54.13     -18      -17    -23    -14   -43.16
   -39 -41.60     -2.60  -54.13     -17      -19    -21    -14   -42.17
   -40 -42.59     -2.59  -54.13     -16      -21    -19    -14   -41.17
   -41 -43.59     -2.59  -54.13     -15      -23    -17    -14   -40.18
   -42 -44.58     -2.58  -54.13     -14      -25    -15    -14   -39.18
   -43 -45.58     -2.58  -54.13     -33       -7    -33    -14   -58.19
   -44 -46.58     -2.58  -54.13     -32       -9    -31    -14   -57.19
   -45 -47.58     -2.58  -54.13     -31      -11    -29    -14   -56.19
   -46 -48.57     -2.57  -54.13     -30      -13    -27    -14   -55.19
   -47 -49.57     -2.57  -54.13     -29      -15    -25    -14   -54.20
   -48 -50.57     -2.57  -54.13     -28      -17    -23    -14   -53.20
   -49 -51.57     -2.57  -54.13     -27      -19    -21    -14   -52.20
   -50 -52.57     -2.57  -54.13     -26      -21    -19    -14   -51.20
   -51 -53.56     -2.56  -54.13     -25      -23    -17    -14   -50.20
   -52 -54.56     -2.56  -54.13     -24      -25    -15    -14   -49.20
   -53 -55.56     -2.56  -54.13     -31      -19    -21    -14   -50.20
   -54 -56.56     -2.56  -54.13     -30      -21    -19    -14   -55.21
   -55 -57.56     -2.56  -54.13     -29      -23    -17    -14   -54.21
   -56 -58.56     -2.56  -54.13     -29      -24    -16    -14   -54.13
   -57 -59.56     -2.56  -54.13     -29      -25    -15    -14   -54.13
```

```
#       Table A: A/D Input Signal Levels
#             Channel 1
#       A/D input subject to constraint:
#          42.43 * SQRT(NPW) + 20.00 * SQRT(CPW) = 1 volt Peak-Peak
#       Powers referred to a/d input port 3 sigma signal will produce 1 volt peak-peak at A/D input
#       A/D <range> = 1.00
#       NPRW AT A-D INPUT = EFFNSRC + ATT1 + ATT2 + ATT3 + ADDPASG
# DCG = 29 dB      PASG = 17.5 dB        ADDPASG = 18.90 dB          EFFNSRC = 35 dBm #
    C/N     C         N      MODPWR     DCA1     CHA2   CHA1   CHA3   PASIN
     20   2.38    -17.62    -7.12       -14      -28    -30    -14    7.88
     15   1.26    -13.74   -13.24       -13      -24    -30    -14    2.76
     14   0.98    -13.02   -13.52       -13      -24    -29    -14    2.48
     13   0.66    -12.34   -13.84       -14      -23    -29    -14    1.16
     12   0.33    -11.67   -14.17       -15      -22    -30    -14   -0.17
     11  -0.04    -11.04   -14.54       -15      -22    -29    -14   -0.54
     10  -0.43    -10.43   -14.93       -16      -21    -29    -14   -1.93
      9  -0.84     -9.84   -15.34       -17      -20    -30    -14   -3.34
      8  -1.29     -9.29   -15.79       -17      -20    -29    -14   -3.79
      7  -1.77     -8.77   -16.27       -17      -20    -29    -14   -4.27
      6  -2.27     -8.27   -16.77       -17      -20    -28    -14   -4.77
      5  -2.80     -7.80   -17.30       -17      -20    -28    -14   -5.30
      4  -3.36     -7.36   -17.86       -17      -20    -27    -14   -5.86
      3  -3.95     -6.95   -18.45       -17      -20    -27    -14   -6.45
      2  -4.57     -6.57   -19.07       -13      -24    -23    -14   -3.07
      1  -5.21     -6.21   -19.71       -13      -24    -22    -14   -3.71
      0  -5.88     -5.88   -20.38       -13      -24    -22    -14   -4.38
     -1  -6.57     -5.57   -21.07       -13      -24    -22    -14   -5.07
     -2  -7.29     -5.29   -21.79       -13      -24    -21    -14   -5.79
     -3  -8.03     -5.03   -22.53       -13      -24    -21    -14   -6.53
     -4  -8.79     -4.79   -23.29       -13      -24    -21    -14   -7.29
     -5  -9.58     -4.58   -24.08       -13      -24    -21    -14   -8.08
     -6 -10.38     -4.38   -24.88       -13      -24    -20    -14   -8.88
                                        -30
                                        ADD   -30 dB
     -7 -11.20     -4.20   -35.70       -12      -15    -29    -14   -18.70
     -8 -12.03     -4.03   -36.53       -12      -15    -29    -14   -19.53
     -9 -12.88     -3.88   -37.38       -13      -14    -30    -14   -21.38
    -10 -13.75     -3.75   -38.25       -13      -14    -30    -14   -22.25
    -11 -14.63     -3.63   -39.13       -13      -14    -30    -14   -23.13
    -12 -15.52     -3.52   -40.02       -13      -14    -30    -14   -24.02
    -13 -16.42     -3.42   -40.92       -13      -14    -29    -14   -24.92
    -14 -17.33     -3.33   -41.83       -13      -14    -29    -14   -25.83
    -15 -18.25     -3.25   -42.75       -13      -14    -29    -14   -26.75
    -16 -19.17     -3.17   -43.67       -13      -14    -29    -14   -27.67
    -17 -20.11     -3.11   -44.61       -13      -14    -29    -14   -28.61
    -18 -21.05     -3.05   -45.55       -13      -14    -29    -14   -29.55
    -19 -22.00     -3.00   -46.50       -13      -14    -29    -14   -30.50
    -20 -22.95     -2.95   -47.45       -13      -14    -29    -14   -31.45
    -21 -23.91     -2.91   -48.41       -13      -14    -29    -14   -32.41
    -22 -24.87     -2.87   -49.37       -13      -14    -29    -14   -33.37
    -23 -25.84     -2.84   -50.34       -13      -14    -29    -14   -34.34
    -24 -26.80     -2.80   -51.30       -13      -14    -29    -14   -35.30
    -25 -27.78     -2.78   -52.28       -13      -14    -29    -14   -36.28
    -26 -28.75     -2.75   -53.25       -13      -14    -29    -14   -37.25
    -27 -29.73     -2.73   -54.23       -13      -14    -29    -14   -38.23
    -28 -30.71     -2.71   -54.21       -12      -16    -27    -14   -37.21
    -29 -31.70     -2.70   -54.20       -11      -18    -25    -14   -36.20
    -30 -32.68     -2.68   -54.18       -10      -20    -23    -14   -35.18
    -31 -33.67     -2.67   -54.17        -9      -22    -21    -14   -34.17
    -32 -34.65     -2.65   -54.15        -8      -24    -19    -14   -33.15
    -33 -35.64     -2.64   -54.14        -7      -26    -17    -14   -32.14
    -34 -36.63     -2.63   -54.13        -6      -28    -15    -14   -31.13
    -35 -37.62     -2.62   -54.13       -21      -14    -29    -14   -46.14
    -36 -38.62     -2.62   -54.13       -20      -16    -27    -14   -45.15
    -37 -39.61     -2.61   -54.13       -19      -18    -25    -14   -44.16
    -38 -40.60     -2.60   -54.13       -18      -20    -23    -14   -43.16
    -39 -41.60     -2.60   -54.13       -17      -22    -21    -14   -42.17
    -40 -42.59     -2.59   -54.13       -16      -24    -19    -14   -41.17
    -41 -43.59     -2.59   -54.13       -15      -26    -17    -14   -40.18
    -42 -44.58     -2.58   -54.13       -14      -28    -15    -14   -39.18
    -43 -45.58     -2.58   -54.13       -33      -10    -33    -14   -58.19
    -44 -46.58     -2.58   -54.13       -32      -12    -31    -14   -57.19
    -45 -47.58     -2.58   -54.13       -31      -14    -29    -14   -56.19
    -46 -48.57     -2.57   -54.13       -30      -16    -27    -14   -55.19
    -47 -49.57     -2.57   -54.13       -29      -18    -25    -14   -54.20
    -48 -50.57     -2.57   -54.13       -28      -20    -23    -14   -53.20
    -49 -51.57     -2.57   -54.13       -27      -22    -21    -14   -52.20
    -50 -52.57     -2.57   -54.13       -26      -24    -19    -14   -51.20
    -51 -53.56     -2.56   -54.13       -25      -26    -17    -14   -50.20
    -52 -54.56     -2.56   -54.13       -24      -28    -15    -14   -49.20
    -53 -55.56     -2.56   -54.13       -31      -22    -21    -14   -56.20
    -54 -56.56     -2.56   -54.13       -30      -24    -19    -14   -55.21
    -55 -57.56     -2.56   -54.13       -29      -26    -17    -14   -54.21
    -56 -58.56     -2.56   -54.13       -29      -27    -16    -14   -54.13
    -57 -59.56     -2.56   -54.13       -29      -28    -15    -14   -54.13
```

```
#       Table A: A/D Input Signal Levels
#             Channel 2
#       A/D input subject to constraint:
#            42.43 * SQRT(NPW) + 20.00 * SQRT(CPW) = 1 volt Peak-Peak
#       Powers referred to a/d input port 3 sigma signal will produce 1 volt peak-peak at A/D input
#       A/D <range> = 1.00
#       NPRW AT A-D INPUT = EFFNSRC + ATT1 + ATT2 + ATT3 + ADDPASG
# DCG = 29 dB      PASG = 14 dB          ADDPASG = 20.13 dB          EFFNSRC = 33 dBm #
    C/N   C        N      MODPWR    DCA1     CHA2   CHA1   CHA3   PASIN
    20  2.38    -17.62   -7.12     -14      -31    -31    -9     7.88
    15  1.26    -13.74   -13.24    -13      -27    -31    -9     2.76
    14  0.98    -13.02   -13.52    -13      -27    -31    -9     2.48
    13  0.66    -12.34   -13.84    -14      -26    -31    -9     1.16
    12  0.33    -11.67   -14.17    -15      -25    -31    -9     -0.17
    11  -0.04   -11.04   -14.54    -15      -25    -31    -9     -0.54
    10  -0.43   -10.43   -14.93    -16      -24    -31    -9     -1.93
    9   -0.84   -9.84    -15.34    -17      -23    -31    -9     -3.34
    8   -1.29   -9.29    -15.79    -17      -23    -31    -9     -3.79
    7   -1.77   -8.77    -16.27    -17      -23    -30    -9     -4.27
    6   -2.27   -8.27    -16.77    -17      -23    -30    -9     -4.77
    5   -2.80   -7.80    -17.30    -17      -23    -29    -9     -5.30
    4   -3.36   -7.36    -17.86    -17      -23    -29    -9     -5.86
    3   -3.95   -6.95    -18.45    -17      -23    -28    -9     -6.45
    2   -4.57   -6.57    -19.07    -13      -27    -24    -9     -3.07
    1   -5.21   -6.21    -19.71    -13      -27    -24    -9     -3.71
    0   -5.88   -5.88    -20.38    -13      -27    -23    -9     -4.38
    -1  -6.57   -5.57    -21.07    -13      -27    -23    -9     -5.07
    -2  -7.29   -5.29    -21.79    -13      -27    -23    -9     -5.79
    -3  -8.03   -5.03    -22.53    -13      -27    -23    -9     -6.53
    -4  -8.79   -4.79    -23.29    -13      -27    -22    -9     -7.29
    -5  -9.58   -4.58    -24.08    -13      -27    -22    -9     -8.08
    -6  -10.38  -4.38    -24.88    -13      -27    -22    -9     -8.88
                                   -30
#                                  ADD   -30 dB
    -7  -11.20  -4.20    -35.70    -12        -18    -31    -9     -18.70
    -8  -12.03  -4.03    -36.53    -12        -18    -31    -9     -19.53
    -9  -12.88  -3.88    -37.38    -13        -17    -31    -9     -21.38
    -10 -13.75  -3.75    -38.25    -13        -17    -31    -9     -22.25
    -11 -14.63  -3.63    -39.13    -13        -17    -31    -9     -23.13
    -12 -15.52  -3.52    -40.02    -13        -17    -31    -9     -24.02
    -13 -16.42  -3.42    -40.92    -13        -17    -31    -9     -24.92
    -14 -17.33  -3.33    -41.83    -13        -17    -31    -9     -25.83
    -15 -18.25  -3.25    -42.75    -13        -17    -31    -9     -26.75
    -16 -19.17  -3.17    -43.67    -13        -17    -31    -9     -27.67
    -17 -20.11  -3.11    -44.61    -13        -17    -31    -9     -28.61
    -18 -21.05  -3.05    -45.55    -13        -17    -31    -9     -29.55
    -19 -22.00  -3.00    -46.50    -13        -17    -30    -9     -30.50
    -20 -22.95  -2.95    -47.45    -13        -17    -30    -9     -31.45
    -21 -23.91  -2.91    -48.41    -13        -17    -30    -9     -32.41
    -22 -24.87  -2.87    -49.37    -13        -17    -30    -9     -33.37
    -23 -25.84  -2.84    -50.34    -13        -17    -30    -9     -34.34
    -24 -26.80  -2.80    -51.30    -13        -17    -30    -9     -35.30
    -25 -27.78  -2.78    -52.28    -13        -17    -30    -9     -36.28
    -26 -28.75  -2.75    -53.25    -13        -17    -30    -9     -37.25
    -27 -29.73  -2.73    -54.23    -13        -17    -30    -9     -38.23
    -28 -30.71  -2.71    -54.21    -12        -19    -28    -9     -37.21
    -29 -31.70  -2.70    -54.20    -11        -21    -26    -9     -36.20
    -30 -32.68  -2.68    -54.18    -10        -23    -24    -9     -35.18
    -31 -33.67  -2.67    -54.17    -9         -25    -22    -9     -34.17
    -32 -34.65  -2.65    -54.15    -8         -27    -20    -9     -33.15
    -33 -35.64  -2.64    -54.14    -7         -29    -18    -9     -32.14
    -34 -36.63  -2.63    -54.13    -6         -31    -16    -9     -31.13
    -35 -37.62  -2.62    -54.13    -21        -17    -30    -9     -46.14
    -36 -38.62  -2.62    -54.13    -20        -19    -28    -9     -45.15
    -37 -39.61  -2.61    -54.13    -19        -21    -26    -9     -44.16
    -38 -40.60  -2.60    -54.13    -18        -23    -24    -9     -43.16
    -39 -41.60  -2.60    -54.13    -17        -25    -22    -9     -42.17
    -40 -42.59  -2.59    -54.13    -16        -27    -20    -9     -41.17
    -41 -43.59  -2.59    -54.13    -15        -29    -18    -9     -40.18
    -42 -44.58  -2.58    -54.13    -14        -31    -16    -9     -39.18
    -43 -45.58  -2.58    -54.13    -33        -13    -34    -9     -58.19
    -44 -46.58  -2.58    -54.13    -32        -15    -32    -9     -57.19
    -45 -47.58  -2.58    -54.13    -31        -17    -30    -9     -56.19
    -46 -48.57  -2.57    -54.13    -30        -19    -28    -9     -55.19
    -47 -49.57  -2.57    -54.13    -29        -21    -26    -9     -54.20
    -48 -50.57  -2.57    -54.13    -28        -23    -24    -9     -53.20
    -49 -51.57  -2.57    -54.13    -27        -24    -22    -9     -52.20
    -50 -52.57  -2.57    -54.13    -26        -26    -20    -9     -51.20
    -51 -53.56  -2.56    -54.13    -25        -28    -18    -9     -50.20
    -52 -54.56  -2.56    -54.13    -24        -30    -16    -9     -49.20
    -53 -55.56  -2.56    -54.13    -31        -24    -22    -9     -50.20
    -54 -56.56  -2.56    -54.13    -30        -26    -20    -9     -55.21
    -55 -57.56  -2.56    -54.13    -29        -28    -18    -9     -54.21
    -56 -58.56  -2.56    -54.13    -29        -30    -17    -9     -54.13
    -57 -59.56  -2.56    -54.13    -29        -31    -16    -9     -54.13
```

```
#       Table A: A/D Input Signal Levels
#              Channel 3
#       A/D input subject to constraint:
#            42.43 * SQRT(NPW) + 20.00 * SQRT(CPW) = 1 volt Peak-Peak
#       Powers referred to a/d input port 3 sigma signal will produce 1 volt peak-peak at A/D input
#       A/D <range> = 1.00
#       NPRW AT A-D INPUT = EFFNSRC + ATT1 + ATT2 + ATT3 + ADDPASG
# DCG = 29 dB      PASG = 15 dB          ADDPASG = 20.71 dB          EFFNSRC = 31 dBm #
    C/N    C         N      MODPWR     DCA1      CHA2   CHA1   CHA3   PASIN
    20   2.38    -17.62    -7.12      -14       -27    -28    -14    7.88
    15   1.26    -13.74   -13.24      -13       -23    -28    -14    2.76
    14   0.98    -13.02   -13.52      -13       -23    -28    -14    2.48
    13   0.66    -12.34   -13.84      -14       -22    -28    -14    1.16
    12   0.33    -11.67   -14.17      -15       -21    -28    -14   -0.17
    11  -0.04    -11.04   -14.54      -15       -21    -28    -14   -0.54
    10  -0.43    -10.43   -14.93      -16       -20    -28    -14   -1.93
    9   -0.84    -9.84    -15.34      -17       -19    -28    -14   -3.34
    8   -1.29    -9.29    -15.79      -17       -19    -28    -14   -3.79
    7   -1.77    -8.77    -16.27      -17       -19    -27    -14   -4.27
    6   -2.27    -8.27    -16.77      -17       -19    -27    -14   -4.77
    5   -2.80    -7.80    -17.30      -17       -19    -26    -14   -5.30
    4   -3.36    -7.36    -17.86      -17       -19    -26    -14   -5.86
    3   -3.95    -6.95    -18.45      -17       -19    -25    -14   -6.45
    2   -4.57    -6.57    -19.07      -13       -23    -21    -14   -3.07
    1   -5.21    -6.21    -19.71      -13       -23    -21    -14   -3.71
    0   -5.88    -5.88    -20.38      -13       -23    -20    -14   -4.38
   -1   -6.57    -5.57    -21.07      -13       -23    -20    -14   -5.07
   -2   -7.29    -5.29    -21.79      -13       -23    -20    -14   -5.79
   -3   -8.03    -5.03    -22.53      -13       -23    -20    -14   -6.53
   -4   -8.79    -4.79    -23.29      -13       -23    -19    -14   -7.29
   -5   -9.58    -4.58    -24.08      -13       -23    -19    -14   -8.08
   -6  -10.38    -4.38    -24.88      -13       -23    -19    -14   -8.88
!                                     -30
#                                     ADD   -30 dB
   -7  -11.20    -4.20    -35.70      -12       -14    -28    -14   -18.70
   -8  -12.03    -4.03    -36.53      -12       -14    -28    -14   -19.53
   -9  -12.88    -3.88    -37.38      -13       -13    -28    -14   -21.38
  -10  -13.75    -3.75    -38.25      -13       -13    -28    -14   -22.25
  -11  -14.63    -3.63    -39.13      -13       -13    -28    -14   -23.13
  -12  -15.52    -3.52    -40.02      -13       -13    -28    -14   -24.02
  -13  -16.42    -3.42    -40.92      -13       -13    -28    -14   -24.92
  -14  -17.33    -3.33    -41.83      -13       -13    -28    -14   -25.83
  -15  -18.25    -3.25    -42.75      -13       -13    -28    -14   -26.75
  -16  -19.17    -3.17    -43.67      -13       -13    -28    -14   -27.67
  -17  -20.11    -3.11    -44.61      -13       -13    -28    -14   -28.61
  -18  -21.05    -3.05    -45.55      -13       -13    -28    -14   -29.55
  -19  -22.00    -3.00    -46.50      -13       -13    -27    -14   -30.50
  -20  -22.95    -2.95    -47.45      -13       -13    -27    -14   -31.45
  -21  -23.91    -2.91    -48.41      -13       -13    -27    -14   -32.41
  -22  -24.87    -2.87    -49.37      -13       -13    -27    -14   -33.37
  -23  -25.84    -2.84    -50.34      -13       -13    -27    -14   -34.34
  -24  -26.80    -2.80    -51.30      -13       -13    -27    -14   -35.30
  -25  -27.78    -2.78    -52.28      -13       -13    -27    -14   -36.28
  -26  -28.75    -2.75    -53.25      -13       -13    -27    -14   -37.25
  -27  -29.73    -2.73    -54.23      -13       -13    -27    -14   -38.23
  -28  -30.71    -2.71    -54.21      -12       -15    -25    -14   -37.21
  -29  -31.70    -2.70    -54.20      -11       -17    -23    -14   -36.20
  -30  -32.68    -2.68    -54.18      -10       -19    -21    -14   -35.18
  -31  -33.67    -2.67    -54.17      -9        -21    -19    -14   -34.17
  -32  -34.65    -2.65    -54.15      -8        -23    -17    -14   -33.15
  -33  -35.64    -2.64    -54.14      -7        -25    -15    -14   -32.14
  -34  -36.63    -2.63    -54.13      -6        -27    -13    -14   -31.13
  -35  -37.62    -2.62    -54.13      -21       -13    -27    -14   -46.14
  -36  -38.62    -2.62    -54.13      -20       -15    -25    -14   -45.15
  -37  -39.61    -2.61    -54.13      -19       -17    -23    -14   -44.16
  -38  -40.60    -2.60    -54.13      -18       -19    -21    -14   -43.16
  -39  -41.60    -2.60    -54.13      -17       -21    -19    -14   -42.17
  -40  -42.59    -2.59    -54.13      -16       -23    -17    -14   -41.17
  -41  -43.59    -2.59    -54.13      -15       -25    -15    -14   -40.18
  -42  -44.58    -2.58    -54.13      -14       -27    -13    -14   -39.18
  -43  -45.58    -2.58    -54.13      -33       -9     -31    -14   -58.19
  -44  -46.58    -2.58    -54.13      -32       -11    -29    -14   -57.19
  -45  -47.58    -2.58    -54.13      -31       -13    -27    -14   -56.19
  -46  -48.57    -2.57    -54.13      -30       -15    -25    -14   -55.19
  -47  -49.57    -2.57    -54.13      -29       -17    -23    -14   -54.20
  -48  -50.57    -2.57    -54.13      -28       -19    -21    -14   -53.20
  -49  -51.57    -2.57    -54.13      -27       -21    -19    -14   -52.20
  -50  -52.57    -2.57    -54.13      -26       -23    -17    -14   -51.20
  -51  -53.56    -2.56    -54.13      -25       -25    -15    -14   -50.20
  -52  -54.56    -2.56    -54.13      -24       -27    -13    -14   -49.20
  -53  -55.56    -2.56    -54.13      -31       -21    -19    -14   -56.20
  -54  -56.56    -2.56    -54.13      -30       -23    -17    -14   -55.21
  -55  -57.56    -2.56    -54.13      -29       -25    -15    -14   -54.21
  -56  -58.56    -2.56    -54.13      -29       -26    -14    -14   -54.13
  -57  -59.56    -2.56    -54.13      -29       -27    -13    -14   -54.13
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```
#       Table A: A/D Input Signal Levels
#             Channel 4
#       A/D input subject to constraint:
#          42.43 * SQRT(NPW) + 20.00 * SQRT(CPW) = 1 volt Peak-Peak
#       Powers referred to a/d input port 3 sigma signal will produce 1 volt peak-peak at A/D input
#       A/D <range> = 1.00
#       NPRW AT A-D INPUT = EFFNSRC + ATT1 + ATT2 + ATT3 + ADDPASG
# DCG = 29 dB      PASG = 15.5 dB       ADDPASG = 18.87 dB          EFFNSRC = 31.5 dB #
    C/N    C         N     MODPWR     DCA1     CHA2   CHA1   CHA3   PASIN
    20   2.38    -17.62   -7.12      -14      -27    -28    -13    7.88
    15   1.26    -13.74   -13.24     -13      -23    -28    -13    2.76
    14   0.98    -13.02   -13.52     -13      -23    -28    -13    2.48
    13   0.66    -12.34   -13.84     -14      -22    -28    -13    1.16
    12   0.33    -11.67   -14.17     -15      -21    -28    -13   -0.17
    11  -0.04    -11.04   -14.54     -15      -21    -28    -13   -0.54
    10  -0.43    -10.43   -14.93     -16      -20    -28    -13   -1.93
     9  -0.84    -9.84    -15.34     -17      -19    -28    -13   -3.34
     8  -1.29    -9.29    -15.79     -17      -19    -28    -13   -3.79
     7  -1.77    -8.77    -16.27     -17      -19    -27    -13   -4.27
     6  -2.27    -8.27    -16.77     -17      -19    -27    -13   -4.77
     5  -2.80    -7.80    -17.30     -17      -19    -26    -13   -5.30
     4  -3.36    -7.36    -17.86     -17      -19    -26    -13   -5.86
     3  -3.95    -6.95    -18.45     -17      -19    -25    -13   -6.45
     2  -4.57    -6.57    -19.07     -13      -23    -21    -13   -3.07
     1  -5.21    -6.21    -19.71     -13      -23    -21    -13   -3.71
     0  -5.88    -5.88    -20.38     -13      -23    -20    -13   -4.38
    -1  -6.57    -5.57    -21.07     -13      -23    -20    -13   -5.07
    -2  -7.29    -5.29    -21.79     -13      -23    -20    -13   -5.79
    -3  -8.03    -5.03    -22.53     -13      -23    -20    -13   -6.53
    -4  -8.79    -4.79    -23.29     -13      -23    -19    -13   -7.29
    -5  -9.58    -4.58    -24.08     -13      -23    -19    -13   -8.08
    -6  -10.38   -4.38    -24.88     -13      -23    -19    -13   -8.88
                                     -30
                                     ADD   -30 dB
    -7  -11.20   -4.20    -35.70     -12      -14    -28    -13   -18.70
    -8  -12.03   -4.03    -36.53     -12      -14    -28    -13   -19.53
    -9  -12.88   -3.88    -37.38     -13      -13    -28    -13   -21.38
   -10  -13.75   -3.75    -38.25     -13      -13    -28    -13   -22.25
   -11  -14.63   -3.63    -39.13     -13      -13    -28    -13   -23.13
   -12  -15.52   -3.52    -40.02     -13      -13    -28    -13   -24.02
   -13  -16.42   -3.42    -40.92     -13      -13    -28    -13   -24.92
   -14  -17.33   -3.33    -41.83     -13      -13    -28    -13   -25.83
   -15  -18.25   -3.25    -42.75     -13      -13    -28    -13   -26.75
   -16  -19.17   -3.17    -43.67     -13      -13    -28    -13   -27.67
   -17  -20.11   -3.11    -44.61     -13      -13    -28    -13   -28.61
   -18  -21.05   -3.05    -45.55     -13      -13    -28    -13   -29.55
   -19  -22.00   -3.00    -46.50     -13      -13    -27    -13   -30.50
   -20  -22.95   -2.95    -47.45     -13      -13    -27    -13   -31.45
   -21  -23.91   -2.91    -48.41     -13      -13    -27    -13   -32.41
   -22  -24.87   -2.87    -49.37     -13      -13    -27    -13   -33.37
   -23  -25.84   -2.84    -50.34     -13      -13    -27    -13   -34.34
   -24  -26.80   -2.80    -51.30     -13      -13    -27    -13   -35.30
   -25  -27.78   -2.78    -52.28     -13      -13    -27    -13   -36.28
   -26  -28.75   -2.75    -53.25     -13      -13    -27    -13   -37.25
   -27  -29.73   -2.73    -54.23     -13      -13    -27    -13   -38.23
   -28  -30.71   -2.71    -54.21     -12      -15    -25    -13   -37.21
   -29  -31.70   -2.70    -54.20     -11      -17    -23    -13   -36.20
   -30  -32.68   -2.68    -54.18     -10      -19    -21    -13   -35.18
   -31  -33.67   -2.67    -54.17     -9       -21    -19    -13   -34.17
   -32  -34.65   -2.65    -54.15     -8       -23    -17    -13   -33.15
   -33  -35.64   -2.64    -54.14     -7       -25    -15    -13   -32.14
   -34  -36.63   -2.63    -54.13     -6       -27    -13    -13   -31.13
   -35  -37.62   -2.62    -54.13     -21      -13    -27    -13   -46.14
   -36  -38.62   -2.62    -54.13     -20      -15    -25    -13   -45.15
   -37  -39.61   -2.61    -54.13     -19      -17    -23    -13   -44.16
   -38  -40.60   -2.60    -54.13     -18      -19    -21    -13   -43.16
   -39  -41.60   -2.60    -54.13     -17      -21    -19    -13   -42.17
   -40  -42.59   -2.59    -54.13     -16      -23    -17    -13   -41.17
   -41  -43.59   -2.59    -54.13     -15      -25    -15    -13   -40.18
   -42  -44.58   -2.58    -54.13     -14      -27    -13    -13   -39.18
   -43  -45.58   -2.58    -54.13     -33      -9     -31    -13   -58.19
   -44  -46.58   -2.58    -54.13     -32      -11    -29    -13   -57.19
   -45  -47.58   -2.58    -54.13     -31      -13    -27    -13   -56.19
   -46  -48.57   -2.57    -54.13     -30      -15    -25    -13   -55.19
   -47  -49.57   -2.57    -54.13     -29      -17    -23    -13   -54.20
   -48  -50.57   -2.57    -54.13     -28      -19    -21    -13   -53.20
   -49  -51.57   -2.57    -54.13     -27      -21    -19    -13   -52.20
   -50  -52.57   -2.57    -54.13     -26      -23    -17    -13   -51.20
   -51  -53.56   -2.56    -54.13     -25      -25    -15    -13   -50.20
   -52  -54.56   -2.56    -54.13     -24      -27    -13    -13   -49.20
   -53  -55.56   -2.56    -54.13     -31      -21    -19    -13   -56.20
   -54  -56.56   -2.56    -54.13     -30      -23    -17    -13   -55.21
   -55  -57.56   -2.56    -54.13     -29      -25    -15    -13   -54.21
   -56  -58.56   -2.56    -54.13     -29      -26    -14    -13   -54.13
   -57  -59.56   -2.56    -54.13     -29      -27    -13    -13   -54.13
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```
#       Table A: A/D Input Signal Levels
#              Channel 5
#       A/D input subject to constraint:
#            42.43 * SQRT(NPW) + 20.00 * SQRT(CPW) = 1 volt Peak-Peak
#       Powers referred to a/d input port 3 sigma signal will produce 1 volt peak-peak at A/D input
#       A/D <range> = 1.00
#       NPRW AT A-D INPUT = EFFNSRC + ATT1 + ATT2 + ATT3 + ADDPASG
# DCG = 29 dB      PASG = 17 dB          ADDPASG = 19.17 dB          EFFNSRC = 35.5 dBm #
    C/N    C         N     MODPWR    DCA1    CHA2  CHA1  CHA3  PASIN
    20   2.38    -17.62    -7.12     -14     -28   -31   -14    7.88
    15   1.26    -13.74   -13.24     -13     -24   -31   -14    2.76
    14   0.98    -13.02   -13.52     -13     -24   -30   -14    2.48
    13   0.66    -12.34   -13.84     -14     -23   -30   -14    1.16
    12   0.33    -11.67   -14.17     -15     -22   -31   -14   -0.17
    11  -0.04    -11.04   -14.54     -15     -22   -30   -14   -0.54
    10  -0.43    -10.43   -14.93     -16     -21   -30   -14   -1.93
     9  -0.84     -9.84   -15.34     -17     -20   -31   -14   -3.34
     8  -1.29     -9.29   -15.79     -17     -20   -30   -14   -3.79
     7  -1.77     -8.77   -16.27     -17     -20   -30   -14   -4.27
     6  -2.27     -8.27   -16.77     -17     -20   -29   -14   -4.77
     5  -2.80     -7.80   -17.30     -17     -20   -29   -14   -5.30
     4  -3.36     -7.36   -17.86     -17     -20   -28   -14   -5.86
     3  -3.95     -6.95   -18.45     -17     -20   -28   -14   -6.45
     2  -4.57     -6.57   -19.07     -13     -24   -24   -14   -3.07
     1  -5.21     -6.21   -19.71     -13     -24   -23   -14   -3.71
     0  -5.88     -5.88   -20.38     -13     -24   -23   -14   -4.38
    -1  -6.57     -5.57   -21.07     -13     -24   -23   -14   -5.07
    -2  -7.29     -5.29   -21.79     -13     -24   -22   -14   -5.79
    -3  -8.03     -5.03   -22.53     -13     -24   -22   -14   -6.53
    -4  -8.79     -4.79   -23.29     -13     -24   -22   -14   -7.29
    -5  -9.58     -4.58   -24.08     -13     -24   -22   -14   -8.08
    -6 -10.38     -4.38   -24.88     -13     -24   -21   -14   -8.88
                                     -30
                          ADD  -30 dB
    -7 -11.20     -4.20   -35.70     -12     -15   -30   -14   -18.70
    -8 -12.03     -4.03   -36.53     -12     -15   -30   -14   -19.53
    -9 -12.88     -3.88   -37.38     -13     -14   -31   -14   -21.38
   -10 -13.75     -3.75   -38.25     -13     -14   -31   -14   -22.25
   -11 -14.63     -3.63   -39.13     -13     -14   -31   -14   -23.13
   -12 -15.52     -3.52   -40.02     -13     -14   -31   -14   -24.02
   -13 -16.42     -3.42   -40.92     -13     -14   -30   -14   -24.92
   -14 -17.33     -3.33   -41.83     -13     -14   -30   -14   -25.83
   -15 -18.25     -3.25   -42.75     -13     -14   -30   -14   -26.75
   -16 -19.17     -3.17   -43.67     -13     -14   -30   -14   -27.67
   -17 -20.11     -3.11   -44.61     -13     -14   -30   -14   -28.61
   -18 -21.05     -3.05   -45.55     -13     -14   -30   -14   -29.55
   -19 -22.00     -3.00   -46.50     -13     -14   -30   -14   -30.50
   -20 -22.95     -2.95   -47.45     -13     -14   -30   -14   -31.45
   -21 -23.91     -2.91   -48.41     -13     -14   -30   -14   -32.41
   -22 -24.87     -2.87   -49.37     -13     -14   -30   -14   -33.37
   -23 -25.84     -2.84   -50.34     -13     -14   -30   -14   -34.34
   -24 -26.80     -2.80   -51.30     -13     -14   -30   -14   -35.30
   -25 -27.78     -2.78   -52.28     -13     -14   -30   -14   -36.28
   -26 -28.75     -2.75   -53.25     -13     -14   -30   -14   -37.25
   -27 -29.73     -2.73   -54.23     -13     -14   -30   -14   -38.23
   -28 -30.71     -2.71   -54.21     -12     -16   -28   -14   -37.21
   -29 -31.70     -2.70   -54.20     -11     -18   -26   -14   -36.20
   -30 -32.68     -2.68   -54.18     -10     -20   -24   -14   -35.18
   -31 -33.67     -2.67   -54.17      -9     -22   -22   -14   -34.17
   -32 -34.65     -2.65   -54.15      -8     -24   -20   -14   -33.15
   -33 -35.64     -2.64   -54.14      -7     -26   -18   -14   -32.14
   -34 -36.63     -2.63   -54.13      -6     -28   -16   -14   -31.13
   -35 -37.62     -2.62   -54.13     -21     -14   -30   -14   -46.14
   -36 -38.62     -2.62   -54.13     -20     -16   -28   -14   -45.15
   -37 -39.61     -2.61   -54.13     -19     -18   -26   -14   -44.16
   -38 -40.60     -2.60   -54.13     -18     -20   -24   -14   -43.16
   -39 -41.60     -2.60   -54.13     -17     -22   -22   -14   -42.17
   -40 -42.59     -2.59   -54.13     -16     -24   -20   -14   -41.17
   -41 -43.59     -2.59   -54.13     -15     -26   -18   -14   -40.18
   -42 -44.58     -2.58   -54.13     -14     -28   -16   -14   -39.18
   -43 -45.58     -2.58   -54.13     -33     -10   -34   -14   -58.19
   -44 -46.58     -2.58   -54.13     -32     -12   -32   -14   -57.19
   -45 -47.58     -2.58   -54.13     -31     -14   -30   -14   -56.19
   -46 -48.57     -2.57   -54.13     -30     -16   -28   -14   -55.19
   -47 -49.57     -2.57   -54.13     -29     -18   -26   -14   -54.20
   -48 -50.57     -2.57   -54.13     -28     -20   -24   -14   -53.20
   -49 -51.57     -2.57   -54.13     -27     -22   -22   -14   -52.20
   -50 -52.57     -2.57   -54.13     -26     -24   -20   -14   -51.20
   -51 -53.56     -2.56   -54.13     -25     -26   -18   -14   -50.20
   -52 -54.56     -2.56   -54.13     -24     -28   -16   -14   -49.20
   -53 -55.56     -2.56   -54.13     -31     -22   -22   -14   -56.20
   -54 -56.56     -2.56   -54.13     -30     -24   -20   -14   -55.21
   -55 -57.56     -2.56   -54.13     -29     -26   -18   -14   -54.21
   -56 -58.56     -2.56   -54.13     -29     -27   -17   -14   -54.13
   -57 -59.56     -2.56   -54.13     -29     -28   -16   -14   -54.13
```

```
#       Table A: A/D Input Signal Levels
#              Channel 6
#       A/D input subject to constraint:
#            42.43 * SQRT(NPW) + 20.00 * SQRT(CPW) = 1 volt Peak-Peak
#       Powers referred to a/d input port 3 sigma signal will produce 1 volt peak-peak at A/D input
#       A/D <range> = 1.00
#       NPRW AT A-D INPUT = EFFNSRC + ATT1 + ATT2 + ATT3 + ADDPASG
# DCG = 29 dB      PASG = 13 dB          ADDPASG = 20.65 dB          EFFNSRC = 31.5 dBm #
    C/N   C        N     MODPWR    DCA1     CHA2  CHA1  CHA3  PASIN
    20  2.38   -17.62  -7.12     -14      -26   -31   -13   7.88
    15  1.26   -13.74  -13.24    -13      -22   -31   -13   2.76
    14  0.98   -13.02  -13.52    -13      -22   -30   -13   2.48
    13  0.66   -12.34  -13.84    -14      -21   -30   -13   1.16
    12  0.33   -11.67  -14.17    -15      -20   -31   -13   -0.17
    11  -0.04  -11.04  -14.54    -15      -20   -30   -13   -0.54
    10  -0.43  -10.43  -14.93    -16      -19   -30   -13   -1.93
    9   -0.84  -9.84   -15.34    -17      -18   -31   -13   -3.34
    8   -1.29  -9.29   -15.79    -17      -18   -30   -13   -3.79
    7   -1.77  -8.77   -16.27    -17      -18   -30   -13   -4.27
    6   -2.27  -8.27   -16.77    -17      -18   -29   -13   -4.77
    5   -2.80  -7.80   -17.30    -17      -18   -29   -13   -5.30
    4   -3.36  -7.36   -17.86    -17      -18   -28   -13   -5.86
    3   -3.95  -6.95   -18.45    -17      -18   -28   -13   -6.45
    2   -4.57  -6.57   -19.07    -13      -22   -24   -13   -3.07
    1   -5.21  -6.21   -19.71    -13      -22   -23   -13   -3.71
    0   -5.88  -5.88   -20.38    -13      -22   -23   -13   -4.38
    -1  -6.57  -5.57   -21.07    -13      -22   -23   -13   -5.07
    -2  -7.29  -5.29   -21.79    -13      -22   -22   -13   -5.79
    -3  -8.03  -5.03   -22.53    -13      -22   -22   -13   -6.53
    -4  -8.79  -4.79   -23.29    -13      -22   -22   -13   -7.29
    -5  -9.58  -4.58   -24.08    -13      -22   -22   -13   -8.08
    -6  -10.38 -4.38   -24.88    -13      -22   -21   -13   -8.88
!                                 -30
#                     ADD  -30 dB
    -7  -11.20 -4.20   -35.70    -12      -13   -30   -13   -18.70
    -8  -12.03 -4.03   -36.53    -12      -13   -30   -13   -19.53
    -9  -12.88 -3.88   -37.38    -13      -12   -31   -13   -21.38
    -10 -13.75 -3.75   -38.25    -13      -12   -31   -13   -22.25
    -11 -14.63 -3.63   -39.13    -13      -12   -31   -13   -23.13
    -12 -15.52 -3.52   -40.02    -13      -12   -31   -13   -24.02
    -13 -16.42 -3.42   -40.92    -13      -12   -30   -13   -24.92
    -14 -17.33 -3.33   -41.83    -13      -12   -30   -13   -25.83
    -15 -18.25 -3.25   -42.75    -13      -12   -30   -13   -26.75
    -16 -19.17 -3.17   -43.67    -13      -12   -30   -13   -27.67
    -17 -20.11 -3.11   -44.61    -13      -12   -30   -13   -28.61
    -18 -21.05 -3.05   -45.55    -13      -12   -30   -13   -29.55
    -19 -22.00 -3.00   -46.50    -13      -12   -30   -13   -30.50
    -20 -22.95 -2.95   -47.45    -13      -12   -30   -13   -31.45
    -21 -23.91 -2.91   -48.41    -13      -12   -30   -13   -32.41
    -22 -24.87 -2.87   -49.37    -13      -12   -30   -13   -33.37
    -23 -25.84 -2.84   -50.34    -13      -12   -30   -13   -34.34
    -24 -26.80 -2.80   -51.30    -13      -12   -30   -13   -35.30
    -25 -27.78 -2.78   -52.28    -13      -12   -30   -13   -36.28
    -26 -28.75 -2.75   -53.25    -13      -12   -30   -13   -37.25
    -27 -29.73 -2.73   -54.23    -13      -12   -30   -13   -38.23
    -28 -30.71 -2.71   -54.21    -12      -14   -28   -13   -37.21
    -29 -31.70 -2.70   -54.20    -11      -16   -26   -13   -36.20
    -30 -32.68 -2.68   -54.18    -10      -18   -24   -13   -35.18
    -31 -33.67 -2.67   -54.17    -9       -20   -22   -13   -34.17
    -32 -34.65 -2.65   -54.15    -8       -22   -20   -13   -33.15
    -33 -35.64 -2.64   -54.14    -7       -24   -18   -13   -32.14
    -34 -36.63 -2.63   -54.13    -6       -26   -16   -13   -31.13
    -35 -37.62 -2.62   -54.13    -21      -12   -30   -13   -46.14
    -36 -38.62 -2.62   -54.13    -20      -14   -28   -13   -45.15
    -37 -39.61 -2.61   -54.13    -19      -16   -26   -13   -44.16
    -38 -40.60 -2.60   -54.13    -18      -18   -24   -13   -43.16
    -39 -41.60 -2.60   -54.13    -17      -20   -22   -13   -42.17
    -40 -42.59 -2.59   -54.13    -16      -22   -20   -13   -41.17
    -41 -43.59 -2.59   -54.13    -15      -24   -18   -13   -40.18
    -42 -44.58 -2.58   -54.13    -14      -26   -16   -13   -39.18
    -43 -45.58 -2.58   -54.13    -33      -8    -34   -13   -58.19
    -44 -46.58 -2.58   -54.13    -32      -10   -32   -13   -57.19
    -45 -47.58 -2.58   -54.13    -31      -12   -30   -13   -56.19
    -46 -48.57 -2.57   -54.13    -30      -14   -28   -13   -55.19
    -47 -49.57 -2.57   -54.13    -29      -16   -26   -13   -54.20
    -48 -50.57 -2.57   -54.13    -28      -18   -24   -13   -53.20
    -49 -51.57 -2.57   -54.13    -27      -20   -22   -13   -52.20
    -50 -52.57 -2.57   -54.13    -26      -22   -20   -13   -51.20
    -51 -53.56 -2.56   -54.13    -25      -24   -18   -13   -50.20
    -52 -54.56 -2.56   -54.13    -24      -26   -16   -13   -49.20
    -53 -55.56 -2.56   -54.13    -31      -20   -22   -13   -56.20
    -54 -56.56 -2.56   -54.13    -30      -22   -20   -13   -55.21
    -55 -57.56 -2.56   -54.13    -29      -24   -18   -13   -54.21
    -56 -58.56 -2.56   -54.13    -29      -25   -17   -13   -54.13
    -57 -59.56 -2.56   -54.13    -29      -26   -16   -13   -54.13
```

```
#       Table A: A/D Input Signal Levels
#                Channel 7
#       A/D input subject to constraint:
#            42.43 * SQRT(NPW) + 20.00 * SQRT(CPW) = 1 volt Peak-Peak
#       Powers referred to a/d input port 3 sigma signal will produce 1 volt peak-peak at A/D input
#       A/D <range> = 1.00
#       NPRW AT A-D INPUT = EFFNSRC + ATT1 + ATT2 + ATT3 + ADDPASG
# DCG = 29 dB      PASG = 8 dB          ADDPASG = 21.89 dB          EFFNSRC = 30 dBm #
    C/N   C        N     MODPWR    DCA1    CHA2   CHA1   CHA3   PASIN
    20  2.38   -17.62  -7.12     -14     -23    -34    -12    7.88
    15  1.26   -13.74  -13.24    -13     -19    -34    -12    2.76
    14  0.98   -13.02  -13.52    -13     -19    -34    -12    2.48
    13  0.66   -12.34  -13.84    -14     -18    -34    -12    1.16
    12  0.33   -11.67  -14.17    -15     -17    -34    -12    -0.17
    11  -0.04  -11.04  -14.54    -15     -17    -34    -12    -0.54
    10  -0.43  -10.43  -14.93    -16     -16    -34    -12    -1.93
    9   -0.84  -9.84   -15.34    -17     -15    -34    -12    -3.34
    8   -1.29  -9.29   -15.79    -17     -15    -34    -12    -3.79
    7   -1.77  -8.77   -16.27    -17     -15    -33    -12    -4.27
    6   -2.27  -8.27   -16.77    -17     -15    -33    -12    -4.77
    5   -2.80  -7.80   -17.30    -17     -15    -32    -12    -5.30
    4   -3.36  -7.36   -17.86    -17     -15    -32    -12    -5.86
    3   -3.95  -6.95   -18.45    -17     -15    -31    -12    -6.45
    2   -4.57  -6.57   -19.07    -13     -19    -27    -12    -3.07
    1   -5.21  -6.21   -19.71    -13     -19    -27    -12    -3.71
    0   -5.88  -5.88   -20.38    -13     -19    -26    -12    -4.38
    -1  -6.57  -5.57   -21.07    -13     -19    -26    -12    -5.07
    -2  -7.29  -5.29   -21.79    -13     -19    -26    -12    -5.79
    -3  -8.03  -5.03   -22.53    -13     -19    -26    -12    -6.53
    -4  -8.79  -4.79   -23.29    -13     -19    -25    -12    -7.29
    -5  -9.58  -4.58   -24.08    -13     -19    -25    -12    -8.08
    -6  -10.38 -4.38   -24.88    -13     -19    -25    -12    -8.88
!                                 -30
#                      ADD  -30 dB
    -7  -11.20 -4.20   -35.70    -12     -10    -34    -12    -18.70
    -8  -12.03 -4.03   -36.53    -12     -10    -34    -12    -19.53
    -9  -12.88 -3.88   -37.38    -13     -9     -34    -12    -21.38
    -10 -13.75 -3.75   -38.25    -13     -9     -34    -12    -22.25
    -11 -14.63 -3.63   -39.13    -13     -9     -34    -12    -23.13
    -12 -15.52 -3.52   -40.02    -13     -9     -34    -12    -24.02
    -13 -16.42 -3.42   -40.92    -13     -9     -34    -12    -24.92
    -14 -17.33 -3.33   -41.83    -13     -9     -34    -12    -25.83
    -15 -18.25 -3.25   -42.75    -13     -9     -34    -12    -26.75
    -16 -19.17 -3.17   -43.67    -13     -9     -34    -12    -27.67
    -17 -20.11 -3.11   -44.61    -13     -9     -34    -12    -28.61
    -18 -21.05 -3.05   -45.55    -13     -9     -34    -12    -29.55
    -19 -22.00 -3.00   -46.50    -13     -9     -33    -12    -30.50
    -20 -22.95 -2.95   -47.45    -13     -9     -33    -12    -31.45
    -21 -23.91 -2.91   -48.41    -13     -9     -33    -12    -32.41
    -22 -24.87 -2.87   -49.37    -13     -9     -33    -12    -33.37
    -23 -25.84 -2.84   -50.34    -13     -9     -33    -12    -34.34
    -24 -26.80 -2.80   -51.30    -13     -9     -33    -12    -35.30
    -25 -27.78 -2.78   -52.28    -13     -9     -33    -12    -36.28
    -26 -28.75 -2.75   -53.25    -13     -9     -33    -12    -37.25
    -27 -29.73 -2.73   -54.23    -13     -9     -33    -12    -38.23
    -28 -30.71 -2.71   -54.21    -12     -11    -31    -12    -37.21
    -29 -31.70 -2.70   -54.20    -11     -13    -29    -12    -36.20
    -30 -32.68 -2.68   -54.18    -10     -15    -27    -12    -35.18
    -31 -33.67 -2.67   -54.17    -9      -17    -25    -12    -34.17
    -32 -34.65 -2.65   -54.15    -8      -19    -23    -12    -33.15
    -33 -35.64 -2.64   -54.14    -7      -21    -21    -12    -32.14
    -34 -36.63 -2.63   -54.13    -6      -23    -19    -12    -31.13
    -35 -37.62 -2.62   -54.13    -21     -9     -33    -12    -46.14
    -36 -38.62 -2.62   -54.13    -20     -11    -31    -12    -45.15
    -37 -39.61 -2.61   -54.13    -19     -13    -29    -12    -44.16
    -38 -40.60 -2.60   -54.13    -18     -15    -27    -12    -43.16
    -39 -41.60 -2.60   -54.13    -17     -17    -25    -12    -42.17
    -40 -42.59 -2.59   -54.13    -16     -19    -23    -12    -41.17
    -41 -43.59 -2.59   -54.13    -15     -21    -21    -12    -40.18
    -42 -44.58 -2.58   -54.13    -14     -23    -19    -12    -39.18
    -43 -45.58 -2.58   -54.13    -33     -5     -37    -12    -58.19
    -44 -46.58 -2.58   -54.13    -32     -7     -35    -12    -57.19
    -45 -47.58 -2.58   -54.13    -31     -9     -33    -12    -56.19
    -46 -48.57 -2.57   -54.13    -30     -11    -31    -12    -55.19
    -47 -49.57 -2.57   -54.13    -29     -13    -29    -12    -54.20
    -48 -50.57 -2.57   -54.13    -28     -15    -27    -12    -53.20
    -49 -51.57 -2.57   -54.13    -27     -17    -25    -12    -52.20
    -50 -52.57 -2.57   -54.13    -26     -19    -23    -12    -51.20
    -51 -53.56 -2.56   -54.13    -25     -21    -21    -12    -50.20
    -52 -54.56 -2.56   -54.13    -24     -23    -19    -12    -49.20
    -53 -55.56 -2.56   -54.13    -31     -17    -25    -12    -56.20
    -54 -56.56 -2.56   -54.13    -30     -19    -23    -12    -55.21
    -55 -57.56 -2.56   -54.13    -29     -21    -21    -12    -54.21
    -56 -58.56 -2.56   -54.13    -29     -22    -20    -12    -54.13
    -57 -59.56 -2.56   -54.13    -29     -23    -19    -12    -54.13
```

Appendix D

I and Q Weights Default Weight File WTFILE.621

Several TCC commands set the DBFP I and Q weights from values read from a weight file. Unless a weight file is specified by the user, the TCC commands use the weights listed in the default weight file WTFILE.621. Initially set to 1.0 and 0.0 respectively, the I and Q weights may be modified by various TCC functions. A listing of the default weight file is presented here for reference.

```
# WTFILE.621 - Weight file for the 7 complex weights, one for
# each of the 7 channels.  Each complex weight is made up of an
# 'I' or real part and a 'Q' or imaginary part.

# Lines beginning with a '#' or null/whitespace are ignored.
# Separate the values with one or more blank spaces with the
# weight values in incremental order.

# I weight | Q weight

1.000000     0.000000
1.000000     0.000000
1.000000     0.000000
1.000000     0.000000
1.000000     0.000000
1.000000     0.000000
1.000000     0.000000
```

Appendix E

Finite Input Response Files

Some TCC commands set the DBFP Finite Input Response (FIR) filters to values read from a data file. FIR data files must be specified by the user. A listing of an example FIR file is presented here for reference.

```
# This is an example of a file for loading FIR filters in the DBFP with
# coefficient and control data.

# This is a comment line.  All lines starting with a # or blank/null lines
# are ignored.

# There must be at least 1 to a maximum of 16 data values for each and the
# number of coefficient data values must be equal to the number of control
# values.

# The following are 16 "I" FIR coefficient data values.
FF 44 55 66 7 22 33 44 55 66 55 34  3  44 55 44

# The following are 16 "Q" FIR coefficient data values.
FF 44 55 6 77 22 33 44 55 6 55 34 A3 44 55 44

# The following are 16 "I" FIR control data values.
42 34 55 33 23 45 45 00 AF 33 44 55 12 CF AF 23

# The following are 16 "Q" FIR control data values.
42 34 55 33 23 45 45 0 af 3 44 55 12 cf af 23
```

Appendix F

Abnormal Errors Encountered Report Form

An Abnormal Errors Encountered Report Form has been provided in the event that a user encounters an undocumented error or problem during the operation of the Test and Control Computer software system.

While a variety of errors occurring in the software have been taken into consideration by the developers, it is still possible to encounter an error that has not been considered. The TCC commands are able to recover from several types of errors during the digital beam forming testing, but should an unexpected error occur, the user should send the original test batch file(s), any unfinished file(s) containing the output data, and a completed *Abnormal Errors Encountered Report Form* to the software developers.

Documenting all software errors will allow the developers of the TCC software to correct problems and make the necessary modifications to the program code in a timely and useful manner. Refer to *Figure F-1* for a copy of the report form.

Return the completed form to:

Paul G. Mallasch
Mail Stop 54-2
NASA Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135-3191
Telephone: (216) 433-6587
FAX: (216) 433-8705

Abnormal Errors Encountered Report Form

Name: _____ Date: _____

Address/Mail Stop: _____ Organization Code: _____

_____ Telephone: _____

_____

Problem Description:
(Include command name and parameters.)

Error Messages:
(Include a printed listing if available.)

Type of PC used to execute the software: _____

Version of MS-DOS being used: _____

Memory resident software being used (if any): _____

Other Information: _____

Date Corrected: _____

Cause of Problem: _____

Action Taken: _____

Figure F-1 Abnormal Errors Encountered Report Form

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

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13. ABSTRACT (*Maximum 200 words*)

A Digital Beam Former Test System was developed to determine the effects of noise, interferers and distortions, and digital implementations of beam forming as applied to the Tracking and Data Relay Satellite II (TDRS II) architectures. The investigation of digital beam forming with application to TDRS II architectures, as described in TDRS II advanced concept design studies, was conducted by the NASA/Lewis Research Center for NASA/Goddard Space Flight Center. A Test and Control Computer (TCC) was used as the main controlling element of the Digital Beam Former Test System. The Test and Control Computer User's Guide for a Digital Beam Former Test System provides an organized description of the Digital Beam Former Test System commands. It is written for users who wish to conduct tests of the Digital Beam Forming Test Processor using the TCC. The document describes the function, use, and syntax of the TCC commands available to the user while summarizing and demonstrating the use of the commands within DOS batch files.

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