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Agilent E5022A/B and E5023A Hard Disk Read/Write Test System

Operation Manual

27th Edition

Software Revision
This manual applies directly to system which has
the software revision B.04.00.

Agilent Technologies

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Safety Summary

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific WARNINGS elsewhere in this manual may impair the protection provided by the equipment. In addition it violates safety standards of design, manufacture, and intended use of the instrument.

The Agilent Technologies, Inc. assumes no liability for the customer's failure to comply with these requirements.

- Ground The Instrument

  To avoid electric shock hazard, the instrument chassis and cabinet must be connected to a safety earth ground by the supplied power cable with earth blade.

- DO NOT Operate In An Explosive Atmosphere

  Do not operate the instrument in the presence of flammable gasses or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

- Keep Away From Live Circuits

  Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

- DO NOT Service Or Adjust Alone

  Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

- DO NOT Substitute Parts Or Modify Instrument

  Because of the danger of introducing additional hazards, do not install substitute parts or perform unauthorized modifications to the instrument. Return the instrument to Agilent Technologies Sales and Service Office for service and repair to ensure that safety features are maintained.

- Dangerous Procedure Warnings

  Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING **Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting this instrument.**

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- **When you notice any of the unusual conditions listed below, immediately terminate operation and disconnect the power cable.**

  Contact your local Agilent Technologies sales representative or authorized service company for repair of the instrument. If you continue to operate without repairing the instrument, there is a potential fire or shock hazard for the operator.

  — **Instrument operates abnormally.**

  — **Instrument emits abnormal noise, smell, smoke or sparklike light during operation.**

  — **Instrument generates high temperature or electrical shock during operation.**

  — **Power cable, plug or receptacle on instrument is damaged.**

  — **Foreign substance or liquid has fallen into the instrument.**

Warning

- Do not stick your fingers near the HLM- Spindle stage while it is moving as it may cause injury to the operating personnel.
- Do not stick your fingers in shroud while the spindle is running.
- The furnished shroud does not provide protection from glass shards which can cause death or serious injury. To prevent injury to the operating personnel use a safety cover when you use glass media. Contact Agilent Technologies when you design a safety cover.

Caution

- Strong magnetic fields exist in the X-Y stage drive motors. Keep magnetic devices away from the motor to avoid damaging it.
- When applications such as VEE and Visual Basic is aborted abnormally or when the reset button on the spinstand turns to red, you should remove the cassette first before restarting. The cassette and spindle could bump into the shroud as the head moves to home position during restarting.

Safety Symbol

General definitions of safety symbols used on the instrument or in manuals are listed below.

Instruction Manual symbol: the product is marked with this symbol when it is necessary for

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the user to refer to the instrument manual.

Alternating current.

Direct current.

On (Supply).

Off (Supply).

In position of push-button switch.

Out position of push-button switch.

Frame (or chassis) terminal. A connection to the frame (chassis) of the equipment which normally include all exposed metal structure.



Do not stick your fingers.

WARNING **This warning sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.**

CAUTION This Caution sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

NOTE Note denotes important information. It calls attention to a procedure, practice, condition or the like, which is essential to highlight.

Certification

Agilent Technologies, Inc. certifies that the module and the spectrum analyzer and the oscilloscope met its published specifications at the time of shipment from the factory. Agilent Technologies further certifies that their calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by the Institution’s calibration facility, or to the calibration facilities of other International Standards Organization members.

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Assistance

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For any assistance, contact your nearest Agilent Technologies Sales and Service Office. Addresses are provided at the back of this manual.

Typeface Conventions

Bold	Boldface type is used when a term is defined. For example: **icons** are symbols.
Italic	Italic type is used for emphasis and for titles of manuals and other publications.

Sample Program

A sample program is installed in the PC. The sample program list is described in the programming manual.

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1 Introduction

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Manual Overview

The Agilent E5022A/B and E5023A have the following seven manuals.

Site Preparation and Installation Manual

This manual provides the information on how to prepare the environment or place of installation before installing the system. Information such as required space, power supply, load capacity, air pressure, vacuum pressure and others are all provided in this manual. User should read this manual before installing the system.

This manual also explains the necessary procedures on how to install the system. Information on how to unpack the equipment, how to set the system, proper cable connections, air pressure and vacuum settings are all explained in this manual.

Operation Manual

This manual provides the information such as product overview, measurement procedures, how to use the VEE Measurement program, measurement definition, specifications and others. All important informations related to the system's operation and measurement are explained in this manual.

Programming Manual

This manual provides the information to allow the user to create his own program. This contains sample programs in Visual Basic and function references.

UDS Programming Manual

This manual provides the information to allow the user to create his own program using User Defined Sequence (UDS). An individual test sequence such as write offset, erase, write etc. has been provided as a call function to allow the user to create his own measurement sequence.

Programming Manual for E5039A/B/C

This manual provides the information to allow the user to create his own program when you operate E5039A/B/C. This manual contains the sample programs and function references.

E5039A/B Option Pxx Manual Supplement (xx means digit)

This manual supplement provides the information peculiar to read channel IC option (Pxx) of E5039A/B.

Service Manual

This manual provides trouble isolation and trouble shooting techniques in case the system fails to operate. It explains how to analyze and fix the system in case trouble occurs.

The Operation Manual, Programming Manual, UDS Programming Manual and Installation Manual are all furnished with the system. The Programming Manual for E5039A/B/C and E5039A/B Option Pxx Manual Supplement are furnished with the E5039A/B/C.

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The Operating Manual, the Programming Manual and the UDS Programming Manual have been installed in PDF format inside the PC. By selecting the desired manual from the start menu of Windows 95/2000 [Program][Agilent Hard Disk ReadWrite Test System], the Acrobat Reader will automatically start up displaying the manual on the screen.

You can also download these documents from our website "**http://dst.tm.agilent.com/**".

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About this Manual

This manual covers the information on product overview, measurement procedures, how to use the measurement program, measurement definition, specifications and others. All important informations related to the system's operation and measurement are explained in this manual. The detailed information is listed in the following chapters.

Chapter 1 Overview

This chapter explains the manual structure, product overview and safety precautions.

Chapter 2 Preparation for Measurement

This chapter provides the information before you perform any measurements.

Chapter 3 Using the VEE Measurement Program

This chapter explains on how to use the pre-installed VEE measurement program. Basic measurements for Agilent Technologies E5022/E5023 can be performed with this program.

Chapter 4 Measurement Definition

This chapter explains the definition of parameters that can be used for measurement. Also, it explains other definition of parameters that are used for other measurements.

Chapter 5 Specifications

This chapter covers the performance characteristics and specifications of the Agilent Technologies E5022/E5023.

Appendix A. Manual Changes

This appendix provides the information required to adapt this manual to earlier versions or configurations of the Agilent Technologies E5022/E5023 to the current printing data of this manual.

Appendix B. Error Messages

This appendix provides the error messages list from a Measurement software and LCD on the spinstand's front panel.

Appendix C. Z height Adjustment

This appendix explains how to adjust the Z height for the HGA cassette assembly.

Appendix E. Module/Head Amplifier/Cassette/Filter Lists

This appendix provides the information of head amplifiers, cassettes and filters.

Appendix F. Cable loss compensation for E5023A

This appendix provides the information about the cable loss compensation for E5023A.

Appendix G. E5029K Connection Board Maintenance

This appendix provides the information about the maintenance of the connection board of the E5029K 001/002/004.

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Product Overview

Agilent Technologies E5022A/B and EE5023A are hard disk read/write test systems. The difference between E5022A, E5022B, and E5023A is a measurement channel bit rate. E5022A has a capability to measure up to 600 Mbps/750 Mbps (option 002). E5022B has one up to 1G bps. E5023A has one up to 1.5 Gbps (option 415) or 2.6 Gbps (option 426). E5022B/E5023A does not have a capability of precompensation.

Agilent offers various head amplifiers and HGA cassettes. Head amplifiers are provided as models of the E5029H (conventional type) and the E5029J/K (amplifier on cassette type). HGA cassettes are provided as models of the E5029C (conventional type) and the E5029D/E (amplifier on cassette type).

Agilent also offers four types of spinstand. The E5010B is a normal type of spinstand. The E5011A is a small profile spinstand. The E5011A is a high TPI of normal type spinstand. The E5013A is a high TPI small profile spinstand.

System Components

The E5022A/B and E5023A include measuring instruments and PC. Figure 1-1 shows the system components. If rack option is not ordered the rack will not be provided.

Measuring Instrument Portion

The heart of the system is a set of C-size VXI modules which are designed for E5022/E5023. Some of them are provided as options.

The measuring instruments that are installed in the VXI mainframe are as follows.

Agilent E8491A	IEEE-1394 PC Link to VXI Module
Agilent E5035A[*1]	Spinstand I/F Module for standard spinstand
Agilent E5035B	Spinstand I/F Module for High TPI spinstand
Agilent E5036A	Filter Matrix Module
Agilent E5037A[*1]	Data Generator Module for E5022A (600 Mbps, 750 Mbps (Opt. 002))
Agilent E5037B[*1]	Data Generator Module for E5022B (1 Gbps, No precompensation)
Agilent E5037C	Data Generator Module for E5023A (1.5 Gbps, No precompensation)
Agilent E5037D	Data Generator Module for E5023A (2.6 Gbps, No precompensation)
Agilent E5038A[*1]	Parametric Measurement Module for E5022A/B
Agilent E5038B	Parametric Measurement Module for E5023A
Agilent E5039A[*1]	Bit Error Test Module for E5022A/B (Optional)
Agilent E5039B[*1]/C	Bit Error Test Module for E5023A (Optional)
Agilent E5040A	Spectrum Measurement Module
Agilent E5041A	Dual Counter Module (Optional)

The oscilloscope and E4402B spectrum analyzer are available as an option.

*1. Obsolete.

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The oscilloscope allows you to observe a wave on time domain, and the E4402B spectrum analyzer expands the frequency coverage in the spectrum measurements up to 3GHz.

Agilent 54845A 8Gsa/s Oscilloscope

Agilent E4402B 3GHz Spectrum Analyzer

Table 1-1 E5022/E5023 Components Matrix (Bit Rate Dependent)

Module	E5022A	E5022B	E5023A
IEEE-1394 PC Link	E8491A	E8491A	E8491A
Data Generator Module	E5037A	E5037B	E5037C*1 or E5037D*2
Filter Matrix Module	E5036A	E5036A	E5036A
Parametric Module	E5038A	E5038A	E5038B
Spectrum Measurement Module	E5040A	E5040A	E5040A
Bit Error Test Module (Optional)	E5039A	E5039A	E5039B or E5039C
Dual Counter Module (Optional)	E5041A	E5041A	E5041A
Oscilloscope (Optional)	54845A	54845A	54845A
Spinstand	E5010B, E5011A, E5010C, or E5013A	E5010B, E5011A, E5010C, or E5013A	E5010C or E5013A

*1. It must be used with the E5043A Head Amplifier Control Unit.
*2. It must be used with the E5043C Head Amplifier Control Unit.

The spinstand interface module, head amplifier control module, head amplifier and cassette depend on the spinstand type. The Table 1-2 shows its matrix.

Table 1-2 E5022/E5023 Components Matrix (Spinstand Dependent)

Module	E5010B	E5011A	E5010C	E5013A
Spinstand I/F module	E5035A	E5035A	E5035B Opt. 001	E5035B Opt. 001
Head Amplifier Control Module	Not Necessary	Not Necessary	E5043A/C (E5023A) E5043B*1 (E5022A/B)	E5043A/C (E5023A) E5043B*1 (E5022A/B)

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Table 1-2 E5022/E5023 Components Matrix (Spinstand Dependent)

Module	E5010B	E5011A	E5010C	E5013A
Head Amplifier	E5029H (Conventional) E5029J (AOC)	E5029H (Conventional) E5029J (AOC)	E5029K (AOC)	E5029K (AOC)
Cassette	E5029C (Conventional) E5029D (AOC)	E5029C (Conventional) E5029D (AOC)	E5029E (AOC)	E5029E (AOC)

*1. Obsolete.

Head Amplifier/Cassette Portion

The various head amplifiers and the cassettes are provided for the test system as shown in the table below.

Spinstand Type		E5010B/E5011A		E5010C/E5013A
HA/Cassette Type		Conventional	AOC	AOC
Buffer Board	UHA	N/A	E5029J Option 001	E5029K Option 001
	Commercial	N/A	E5029J Option 004 (Thermal Drift Prevention)	E5029K Option 004
Head Amp.	UHA	E5029H Option 001	E5029J Option xxx	E5029K Option 5xx
	Commercial	E5029H Option Hxx	E5029J Option xxx	E5029K Option 6xx, 8xx
Cassette		E5029C Option xxx	E5029D Option xxx	E5029E Option xxx

The buffer boards, E5029K option 001/004 consists of the two portions, the On stage buffer unit and the Connection board.

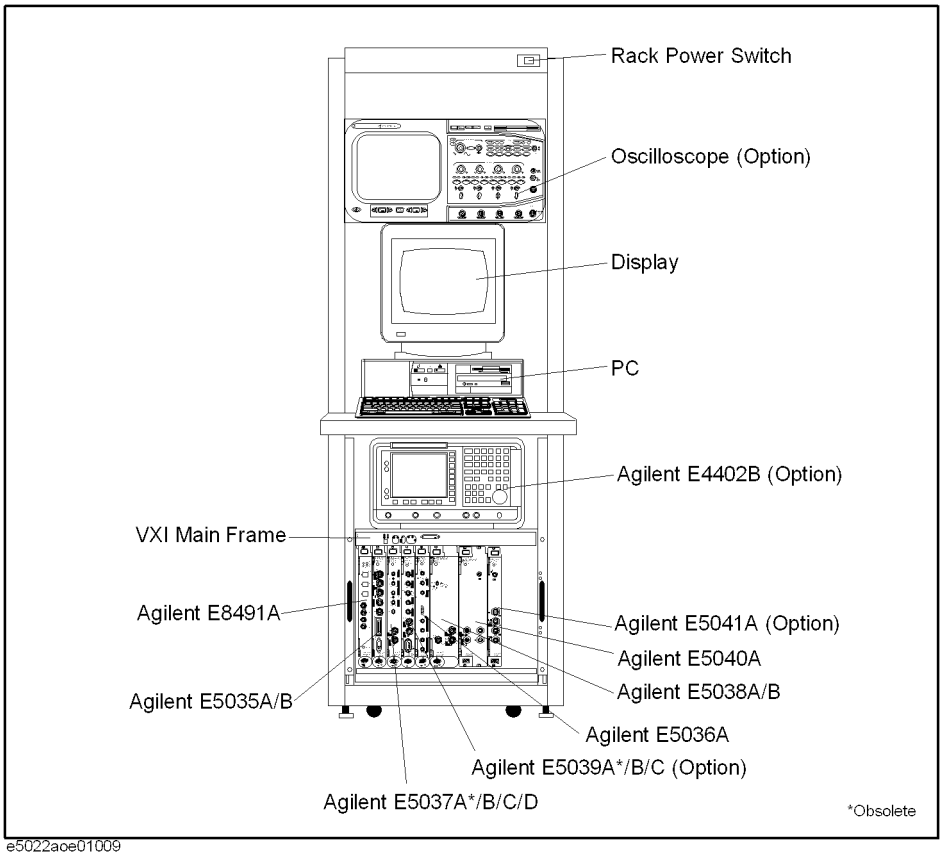
PC Portion

The desk-top type PC is used as a controller of E5022/E5023. The system software for E5022/E5023 measurement and the other required software are installed at factory shipment. The system software is easy to upgrade.

PC	Desk Top Type with CD-ROM, IEEE-1395, Network and GPIB cards.
Display	17 inch CRT type

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Figure 1-1 **Name of each E5022/E5023**

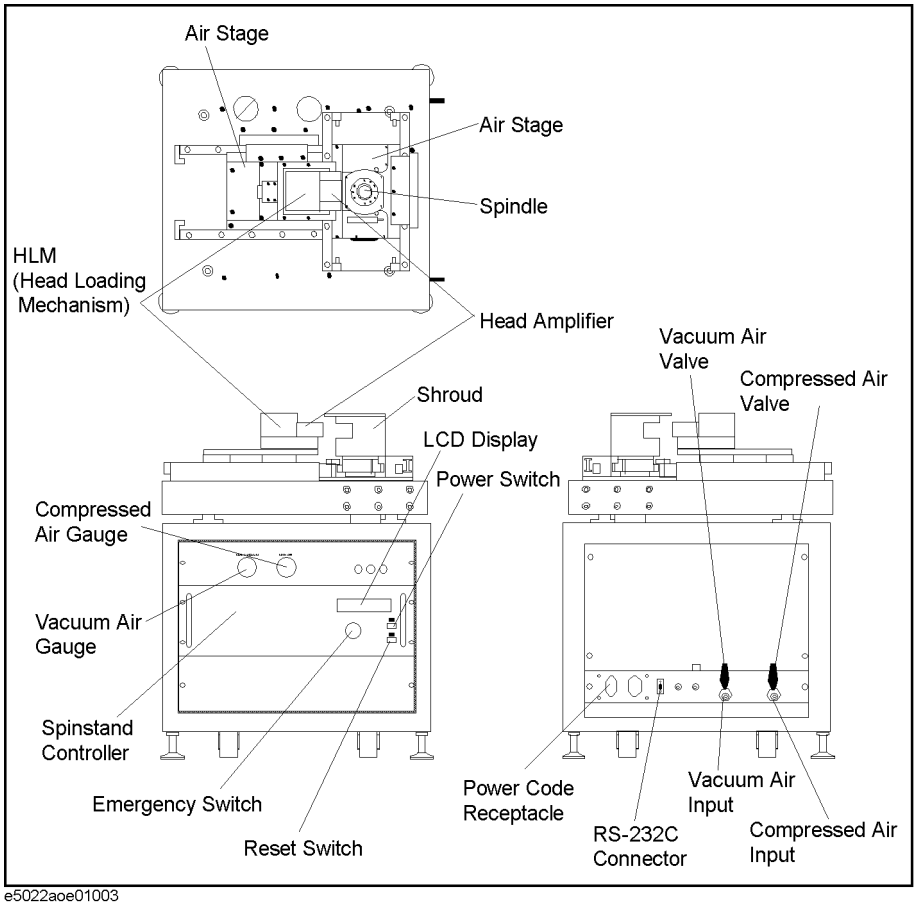


e5022aoe01009

Spinstand Portion Agilent E5010B/ E5011A/E5010C/E5013A, the split-axis style spinstand, is used as a spinstand of E5022/E5023. The 3.5 and 2.5 inch spindle clamps (chuck) are available as a option. Figure 1-2 shows the name of each part of spinstand.

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Figure 1-2 **Name of each part of the E5010B Spinstand**



e5022aoe01003

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Figure 1-3 **Name of each part of the E5010C Spinstand (with Spinstand Cover Option)**

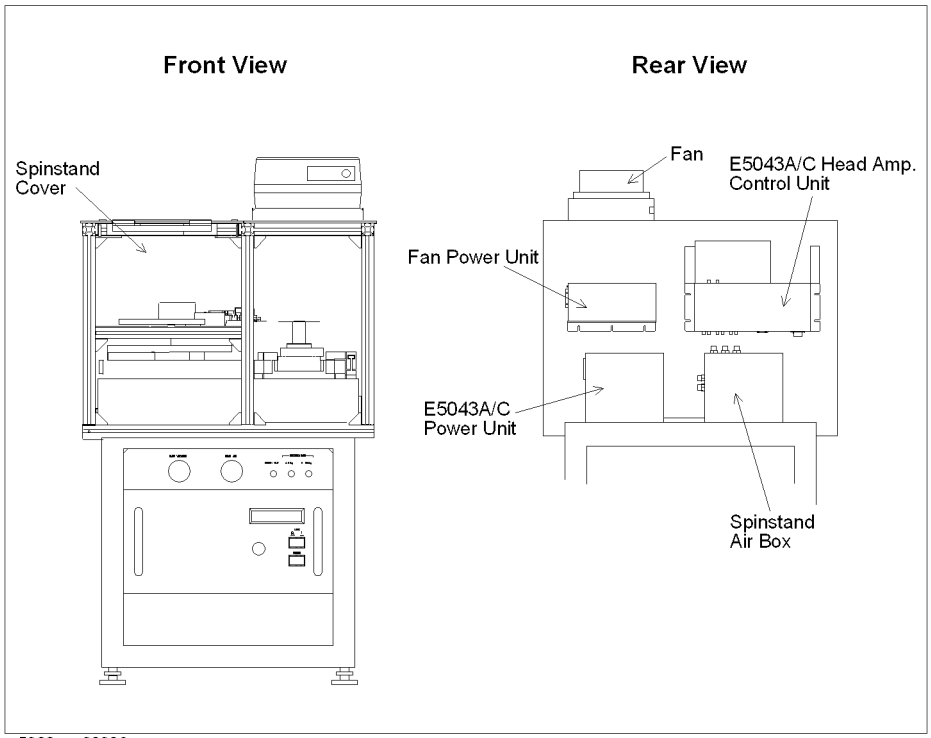
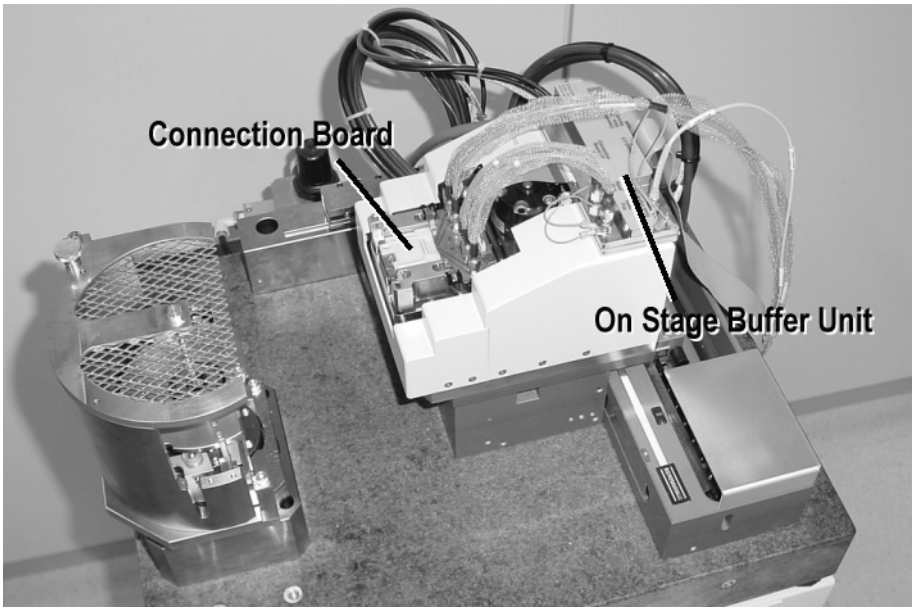


Figure 1-4 **E5029K On Stage Buffer Unit/Connection Board**



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Safety Precautions

WARNING **This section explains the safety precautions when you operate the spinstand.**

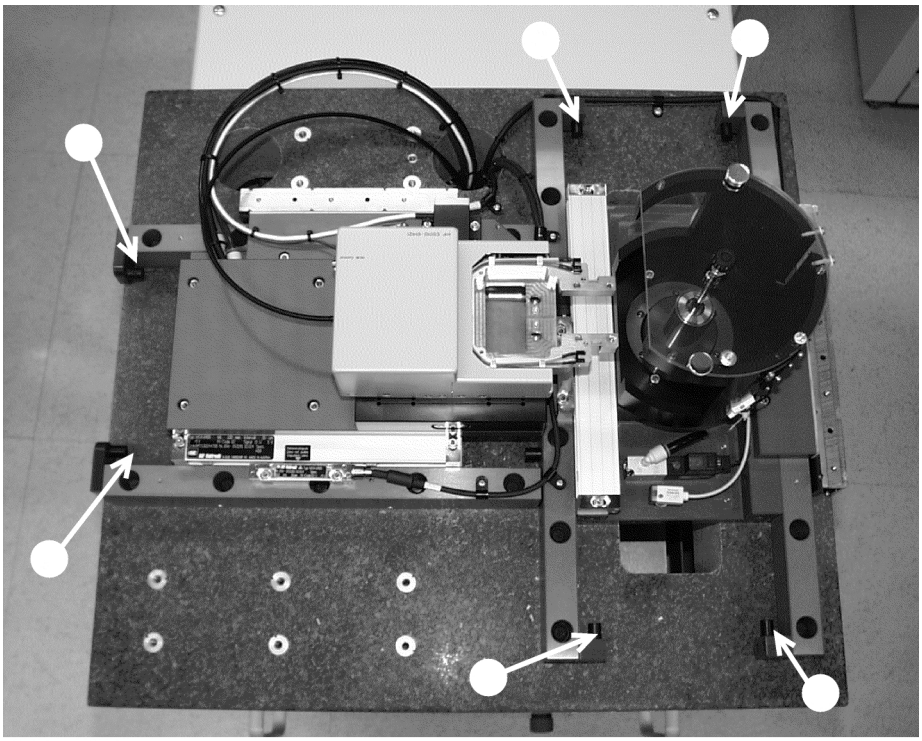
E5010B HLM-Spindle Stage

When you power on the spinstand, Do Not stick your fingers near the HLM-Spindle Stage in the following precautionary points.

- The HLM- Spindle stage is equipped with a terminal guide.

  When the stage is moving, DO NOT put your fingers in between the HLM- Spindle stage and the guide terminal (rubber bushing).

Figure 1-5 **Precautionary points (HLM-Spindle Stage guide terminal)**



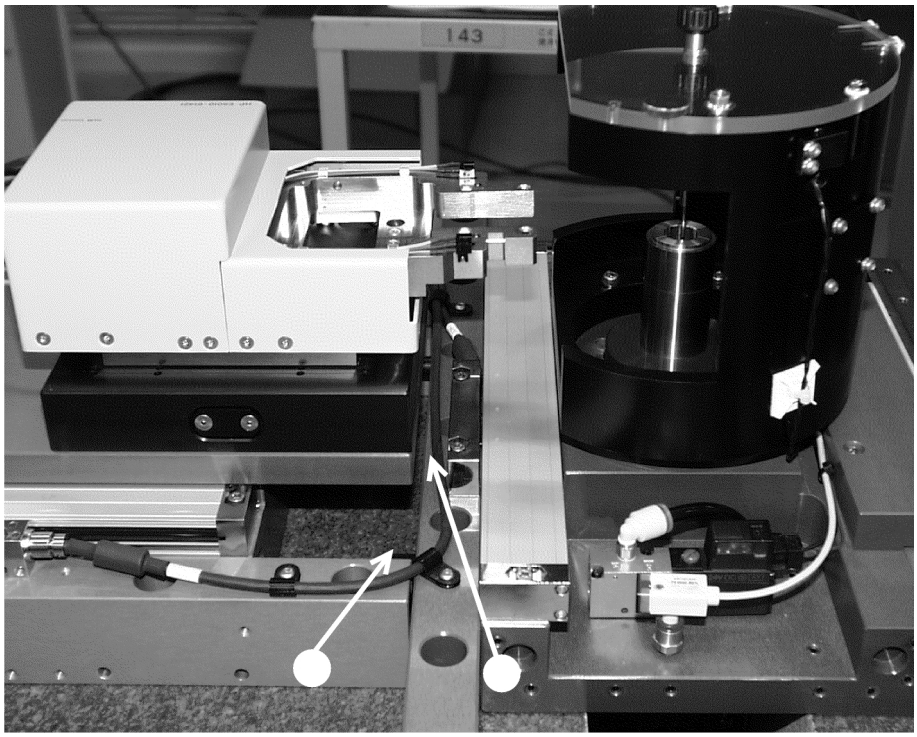
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- The intersection point between the HLM and Spindle stage as shown below.

  When the HLM moves toward the spinstand, DO NOT put your fingers along this line as shown in the figure below.

Figure 1-6 **HLM-Spindle stage**



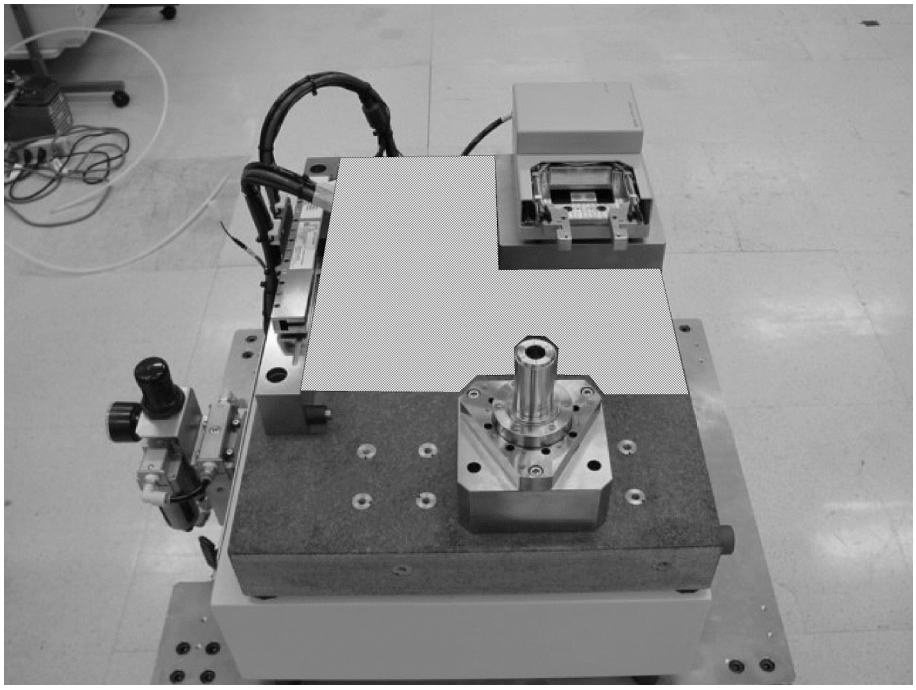
e5022aoe01011

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E5011A HLM Stage

During power on the spinstand, do not stick your fingers near the HLM Stage in the following precautionary area.

Figure 1-7 **Precautionary Area**



NOTE Although there is no shroud in Figure 1-7, do not remove it in use.

Shroud (Spindle Cover)

While the spindle is running, DO NOT stick your fingers in the shroud.

The spindle will not rotate if the shroud is open. This is designed to provide safety during work, therefore DO NOT remove the shroud.

Emergency Switch

In the event of an emergency push the emergency switch button (red button on the front panel of the spinstand), this will immediately stop the spindle rotation and HLM- Spindle stage movement. To reset this switch, slowly turn it clockwise until it pops up.

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System Structure

This section explains the structure of the system.

Measuring Instrument System

The measuring instrument system of Agilent E5022/E5023 have three major parts namely:

- Signal Generation Part
  - Agilent E5037A/B/C/D Data Generator Module
  - Agilent E5043A/B/C Head Amplifier Control Unit
  - Agilent E5039A/B/C Bit Error Test Module (Optional)
- Signal Distribution Part
  - Agilent E5036A Filter Matrix Module
- Measurement Part
  - Agilent E5038A/B Parametric Measurement Module
  - Agilent E5039A/B/C Bit Error Test Module (Optional)
  - Agilent E5040A Spectrum Measurement Module
  - Agilent E5041A Dual Counter Module (Optional)
  - Oscilloscope (Optional)

Flow of Measurement Signal

The signal produced by the E5037A/B Data Generator Module is inputted to the head amplifier. When the spinstand is a high TPI type, the signal from the E5037C/D goes through the E5043A/B/C and inputted to the head amplifier. For the compatibility of E5037A/B/C/D and E5043A/B/C, see Table 1-1 on page 22.

The head amplifier writes the data with a specified amount of write current to the media.

When reading the data, as specified by the amount of read current, the read data is amplified by the head amplifier and inputted into the Filter Matrix Module.

The Filter Matrix Module filters out the signal before distributing it to each measuring instrument. The Filter Matrix Module is equipped with replaceable four filters. The user can set any of the four filters as desired. The signal received by parametric module, oscilloscope and dual counter module will be filtered out from this module. However, for the spectrum measurement module and the bit error test module, the received signal is a non-filtered signal. The signal is simply pre-amplified as it passes through the filter matrix module.

According to what is measured, one of module in measuring part is activated to measure. For example, Narrow Band TAA is measured by the Spectrum Measurement Module.

Under normal measurement operation the data generator module is used to produce the signal needed for measurement. The bit error test module on the other hand, writes and reads its own signal. In other words, it produces its own signal and compare with its read-back data.

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Spinstand System

HLM Stage, Spindle Stage

The HLM and Spindle stages simulate the head movement inside the disk drive. Both stages employ the air stage. The air stage floats over the granite bed by means of compressed air. And vacuum air is used to lock down the stages to the granite bed.

Piezo (HLM) Stage

When you make a track profile measurement it requires an extremely small amount of head movement. To achieve such movement, a piezo element is employed.

The piezo stage is consisted of two main parts, namely; the actuator and flexure stage. The piezo actuator is composed of a piezoelectric material that when voltage is applied to this material it expands. The movement is controlled by applied voltage. E5035A/B controls the voltage.

HLM (Head Loading Mechanism)

The HLM performs the loading and unloading of the HGA cassette. It has four photo couplers, two of them are located inside of HLM in order to detect the HLM “load”, “unload” position. The other two are located beside the HGA cassette to detect the “up”, “down” position of the HGA cassette.

In the event that air or power supply is shut, the HLM will automatically unload to protect the head and media from crashing.

Spindle

The spindle together with the stage employs an air spindle.Through air pressure the central axis is caused to float, rotation is made by the motor. Clamp the head before rotation and un clamp the head when it is stopped. Also, the spindle is equipped with a shroud as a means of protection. If the lid cover of the shroud is open the spindle will not rotate.

Spinstand Controller

The spinstand controller is a component of the spinstand that controls every movement of the spinstand except the HLM stage. The two main functions of the spinstand controller are production of control signal and acquisition of status. It has four main components, namely: controller, servo amplifiers, piggyback board and a power unit.

Control (PC) System

The commands for each measuring instrument and spinstand all come from the PC. The commands being sent by the PC to each module of the VXI mainframe passes through the IEEE-1394 interface. The triggers synchronizing with the index signal are generated from Agilent E5035A/B Spinstand Interface Module to all modules and instrument. The Agilent E5037A/B/C/D Data Generator Module sends its write data as controlled by the Write Gate to the head amp from Agilent E5035A/B Spinstand Interface Module.

The same procedure applies for piezo, HLM and head amp. The command passes through the Agilent E5035A/B Spinstand Interface Module.

The box type measuring instrument such as Oscilloscope and (4395A) are controlled by the PC through GPIB cable. Also, the trigger to start measurement from Agilent E5035A Spinstand Interface Module are received to start measurement.

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The XY stage of the spinstand and spindle as controlled by the spinstand controller, this is controlled by the PC through RS-232C.

NOTE The power management of your PC has been set to OFF at factory shipment. If this is set to ON, it will slow down the measurement proceedings.

CAUTION Agilent Technologies does not warrant any troubles and damages caused by computer virus. Protection, recovery, and the installation of any anti-virus software are to be performed under the responsibility of the Users.

Software

The PC of Agilent E5022/E5023 uses an English version of the Windows 95 or 2000 as its operating system. Windows 98/Me/NT and the other language version of Windows 95 are not supported.

The following items have been installed at the factory before shipment.

- E5022/E5023 System Software
  - — E5022/E5023 Measurement Library
  - — E5022/E5023 VEE Measurement Program
  - — Sample Program (Visual Basic)
- Agilent I / O Library
- Agilent VEE Pro 6.0
- Adobe Acrobat Reader

E5022/E5023 System Software

E5022A system software is a package includes many software to control E5022/E5023. The system software mainly can be divided into three parts, Measurement Library, VEE Measurement Program, and Sample Program. The latest system software can be downloaded from the website “http:\\dst.tm.agilent.com\”.

E5022/E5023 Measurement Library

E5022/E5023 Measurement Library is a dynamic link library designed to facilitate measurement programming. This creates an environment that makes the E5022A/B into an integrated system rather than a rack-and-stack set of instruments, which allows the instruments to perform at a higher level as a system.

The Measurement Library includes the DLLs to control the head amplifier and HGA cassette. The DLLs are stored in the directory named “c:\Program Files\Agilent\e5022\plugins\”. The DLL files of head amplifiers and HGA cassettes named as its part number. When new head amplifiers and HGA cassette are released, new DLLs for them are provided as a service release software. It puts the new DLLs into the directory. The service release software also can be downloaded from the website “http:\\dst.tm.agilent.com\.

There are two kind of software. One is stored in the PC. The other is stored in the modules (E5035, E5037, E5038, E5039, E5040 and E5041). The installer install s both of them. They have their own revisions and they must be the same in one system. When you replace

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one of the modules in the VXI Mainframe, the system software must be installed again if the module's revision does not match with one installed in PC.

E5022/E5023 VEE Measurement Program (Demo Program)

The VEE Measurement Program is a user interface, it is constructed in VEE which allows the user to make quick measurements and display the system settings. It controls the system by calling the measurement library from the VEE. Since the internal structure of the VEE Measurement Program is open to public, one can use it as a reference for your programming.

E5022/E5023 Sample Program in Visual Basic

Agilent E5022/E5023 sample programs in Visual Basic are provided to help the user make his own program. As VEE is not suitable to explain how the program works due to its visual programming structure, the Visual Basic is used for an application of sample program although the Visual Basic is not installed at factory shipment. The sample program shows you the example procedure for measurement to understand the programming. The sample programs are stored in the directory named "c:\Program Files\Agilent\e5022\doc\vb\"

Agilent I/O Library

I/O library is a general I/O library used to control the instrument. This includes Agilent VISA library. It is not necessary to care about this library because the Agilent E5022/E5023 measurement library controls this.

I/O Library is installed in the PC and the VXI modules (E8491). They have their own revisions and they must be the same in one system. When you replace the E8491 in the VXI Mainframe, the I/O library must be installed again if the revision does not match with one installed in PC.

Agilent VEE

VEE is a powerful visual programming language, which allows you to control the instrument, make quick measurements and display the system settings. You can create your own program on VEE by calling the E5022/E5023 measurement functions.

Adobe Acrobat Reader

Acrobat Reader lets you view and print Adobe Portable Document Format (PDF) files on all major computer platforms. This software is used to view the E5022/E5023 operation and programming manuals in PDF format on PC. This is a free software and can be download from Adobe website.

Software for E5039A/B/C Bit Error Test Module

The software for bit error measurement is provided as an add-on software, separately from E5022/E5023 system software. The different software are provided for each E5039A/B channel IC option. For example, the E5039A option P10 requires its own software, E5039A option P10 software. The revision number of E5022/E5023 and E5039A/B/C software must be the same.

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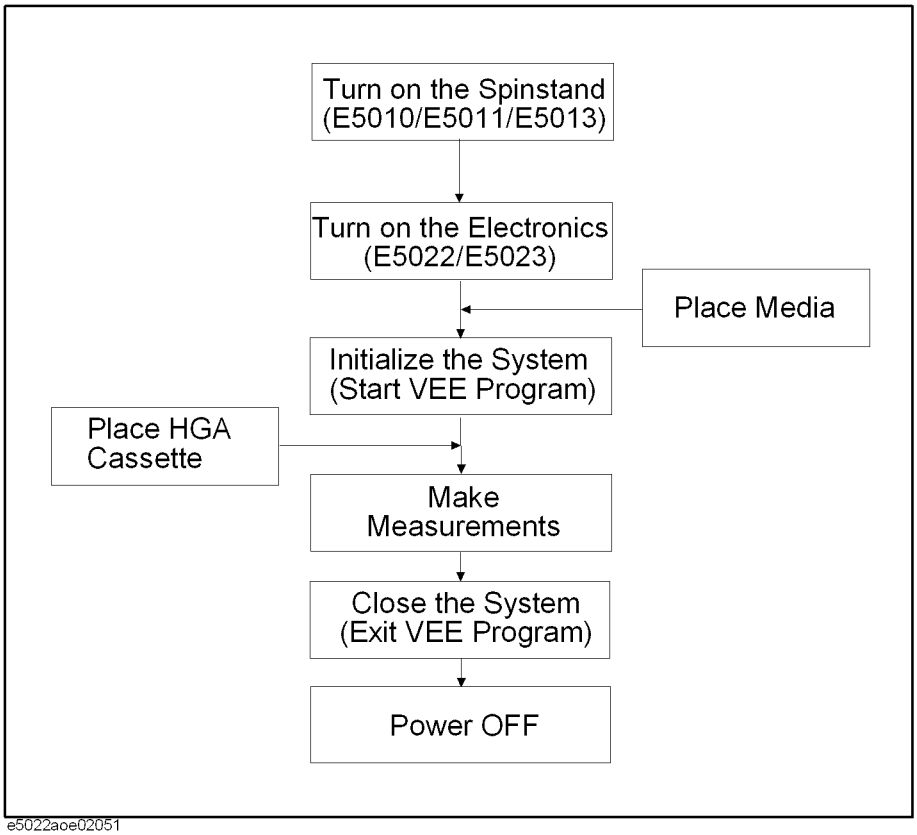
2 Preparation for Measurement

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Overview

The basic procedure by which the measurement of Agilent E5022/E5023 is executed is shown in Figure 2-1.

Figure 2-1 **Basic Procedure**



First turn on the spinstand system, second turn on the electronics system, then attach the head cassette on the HLM. You can also attach the head cassette and media before you turn on the power supply.

Then proceed to measurement. Turn-off the power after measurement.

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Switch on the System

This section provides the procedure when you turn on the system.

NOTE *Do not turn on the electronics system (VXI modules, oscilloscope, PC, monitor, etc.), before you turn on the spinstand system. Doing so may cause some troubles or failures of the spinstand system.*

Step 1. Check the air pressure of the spinstand.

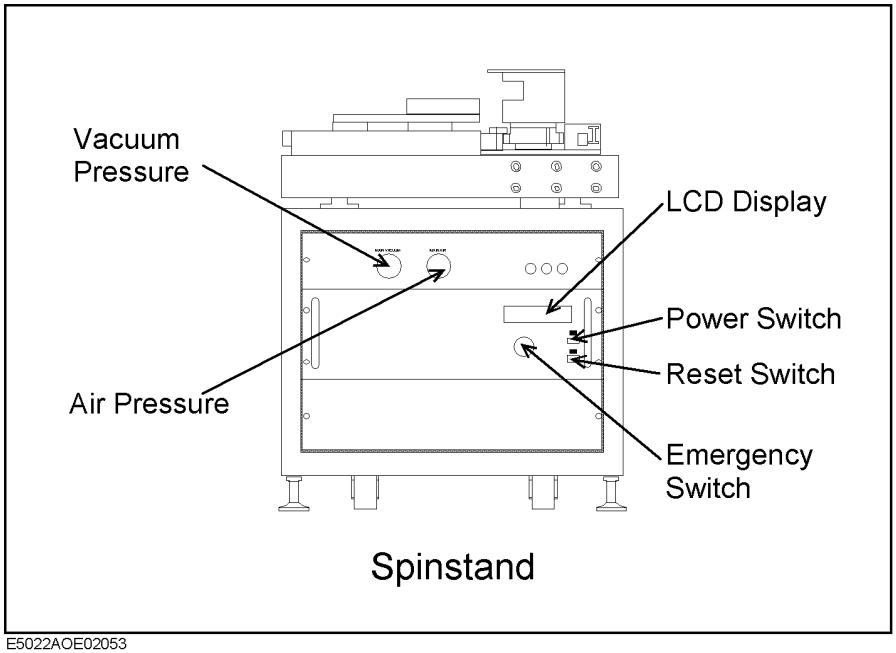
Step 2. Check the vacuum pressure of the spinstand.

Step 3. Switch on the spinstand.

Step 4. Switch on the VXI mainframe and other measuring instruments.

Step 5. Switch on the PC and its monitor.

Figure 2-2 Front Panel of the Spinstand



E5022AOE02053

Check the air pressure and the vacuum pressure of the spinstand.

Make sure that the air pressure gauge and the vacuum pressure gauge readings are both correct.

Table 2-1 Air Pressure and Vacuum Pressure

Air Pressure Range	0.67 MPa to 0.73 Mpa (98 psi to 105 psi)

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Table 2-1 **Air Pressure and Vacuum Pressure**

Minimum Vacuum Pressure	-70 kPa (-20.5 inHg)

Switch on the VXI mainframe and other measuring instruments.

Switch on the VXI mainframe and other measuring instruments (i.e, spectrum analyzer, oscilloscope). If the system is rack mounted, switch on the rack's main switch before you switch on each instrument.

Switch on the E5043A/B/C and Fun Power Unit on the rear panel of the spinstand cover.

When your system has E5043A/B/C and fan, switch on the power unit of the E5043A/B/C and the Fun Power Unit. Confirm if the power LED on E5043A/B/C control unit is lit.

Switch on the spinstand.

Switch on the spinstand and check if the message "Spindle Status Normal" is displayed on the LCD panel.

IMPORTANT The spinstand is equipped with an Emergency Switch button located on the front panel. In the event of an emergency push the emergency switch button (red button on the front panel of the spinstand), this will immediately stop the spindle rotation and HLM- Spindle stage movement. To reset this switch, slowly turn it clockwise until it pops up.

Switch on the PC and its monitor.

Make sure that no floppy disk is inserted inside the disk drive. Switch on the PC and its monitor, then wait for a few seconds until it boots up the english version of Windows 2000.

The user name and password for login are shown below:

- User name: agilent
- Password: agilent

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Setting the Media

Place the media on top of the spindle. The spindle is equipped with a protective cover called shroud. The shroud protects operating personnel from any injury, in case the user accidentally touches the media under test. If the shroud's top lid cover is left open the spindle will not rotate.

Listed below are the procedures to follow when setting the media.

Step 1. Loosen 2 screws mounted on top of shroud's lid cover.

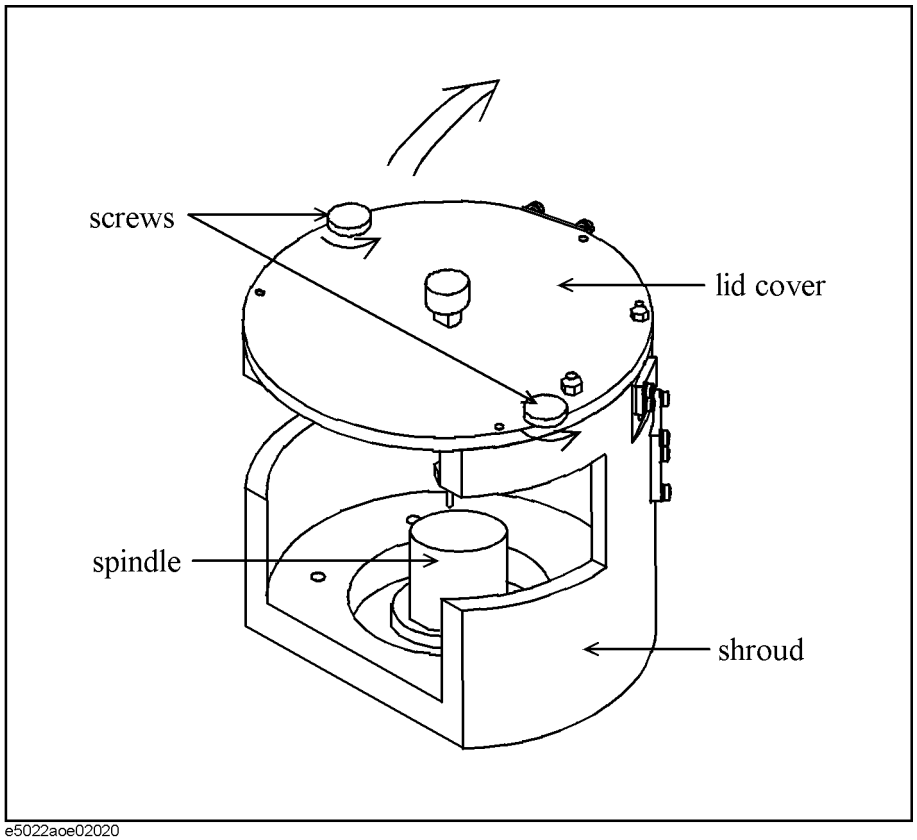
Step 2. Lift the lid cover slightly and slide it outwards.

Step 3. Set the media on the spindle.

Step 4. Replace the lid cover.

Step 5. Screw the two screws of the lid cover.

Figure 2-3 **Opening the shroud's lid cover**



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At the center of the shroud is a pole, it is used to prevent the media from spinning off during rotation.

NOTE If the user opens the shroud cover while the spindle is running, the spindle will stop.

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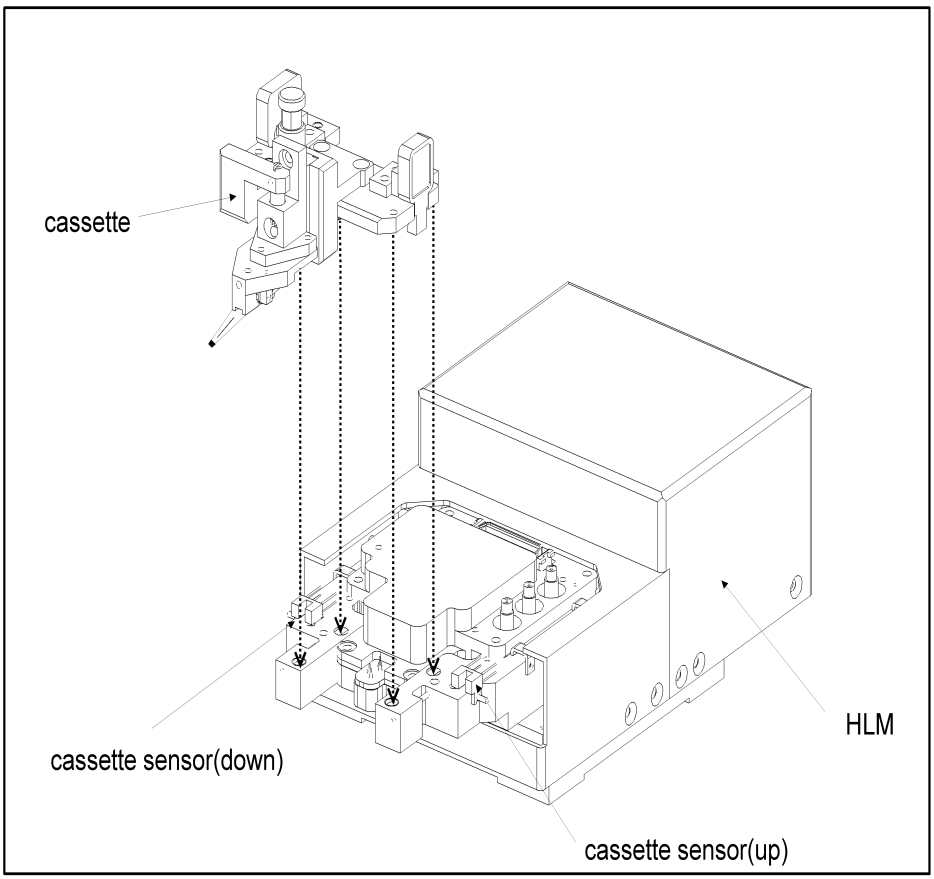
Initialize the System

Before placing the HGA cassette on the HLM of the spinstand, initialize the system. In the case of VEE measurement program, start the program before placing the HGA cassette. This is because the initialization perform the homing of the spinstand. As the homing moves the stage to full travel. This might that the HGA contacts the shroud.

Setting the HGA Cassette

Set the head cassette on the HLM (Head Loading Mechanism). Cassette attachment is basically the same for all types of cassettes. Push the cassette knob inwards to widen its claw, then insert the head cassette on top of the HLM. Release the cassette knob and check if it is locked down on the HLM. The cassette face (i.e, up face, down face) is automatically detected by the cassette sensor mounted on each side of the HLM.

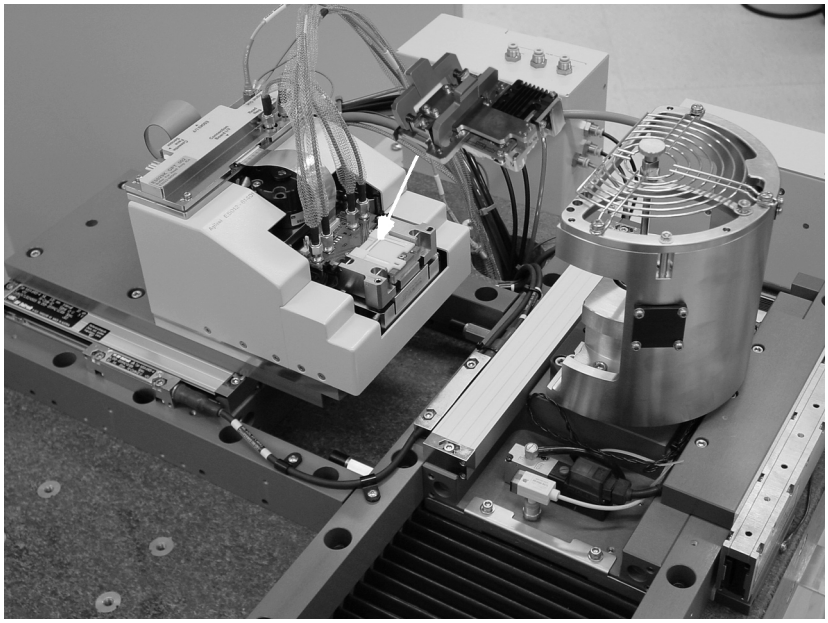
Figure 2-4 **Setting the Cassette on the HLM (E5010B)**



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Figure 2-5 **Setting the Cassette on the HLM (E5010C)**



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Measurement

After doing all the preparations you can now proceed to measurement.

The Agilent E5022/E5023 has a pre-installed VEE measurement program. This measurement program allows the user to do basic measurements. Detailed description on how to use the measurement program is written in Chapter 3. This software controls the system by calling the Agilent E5022/E5023 DLL measurement library from VEE.

The measurement process will not change whether the user executes his own program or the provided measurement program.

Closing the System

Close the system before turning off the system. In the case of the VEE measurement program, exit the program.

Switch off the System

After executing the measurement program, check if the spinstand stopped from rotating. Switch off the power of each instrument in the following order.

1. Switch off the VXI mainframe and other measuring instruments.
2. Switch off the spinstand.
3. Switch off the PC and its monitor.

Turn off the air compressor and vacuum air AFTER switching off all power supply.

Shutting down the PC

To shut down your PC follow the procedures listed below.

1. To shutdown the PC, click on [Start] menu from the left side of the task bar and click [Shutdown].

NOTE If problem occurs during shutdown and the software hangs, then after one minute, push the power switch of the PC for ten seconds. This turns off the power but may result in the lost of data.

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3 VEE Measurement Program Operation

This chapter provides the information on how to make measurements on the Agilent E5022/E5023 using the furnished Measurement program.

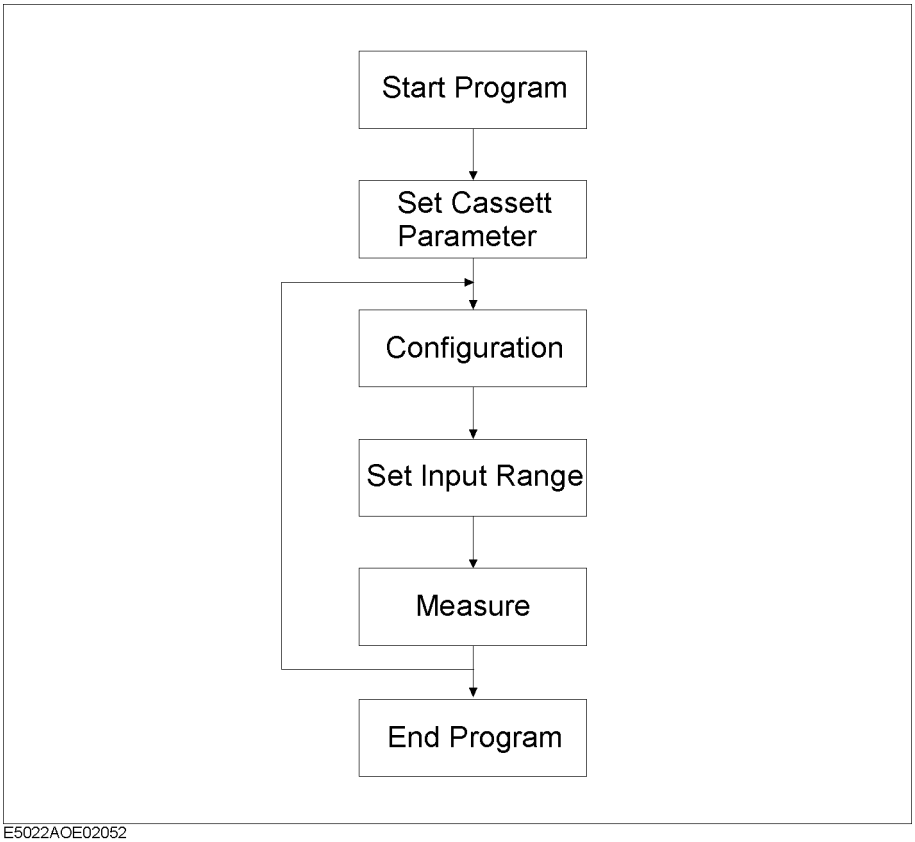
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Introduction

The Agilent E5022/E5023 has a dynamic link library designed to facilitate the control and measurement programming. The Measurement program has been provided to enable the user to set, measure and display the results in graphical display easily. It is not necessary to care about the DLL library because the measurement program controls this.

Agilent E5022/E5023 VEE measurement program is a graphical user interface visual software, which allows the user to make quick measurements and display the system settings.

Figure 3-1 **Flowchart of VEE measurement program**



E5022AOE02052

1. Starting the VEE measurement program. This section explains how to start the VEE measurement program.
2. Setting the cassette parameters. Before proceeding to measurement the user must specify the size and type of cassette being used.
3. Setting configurations. This section explains the necessary parameters to be configured on the following :
   a. Common Parameter Setup
   b. Spinstand Setup
4. Setting the input range (Auto Configuration). The level of signal output from the media

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will vary depending on measurement applications. This section explains how to set the input range automatically.

5. Performing measurement. Typical measurement and functions have been built-in on Agilent E5022/E5023. This section explains the parameter setting for each measurement.
6. Exit the VEE measurement program. This section shows how to end the program.

Measurement settings can also be executed using DLL function of Agilent E5022/E5023. Refer to the programming manual for the DLL's detailed descriptions.

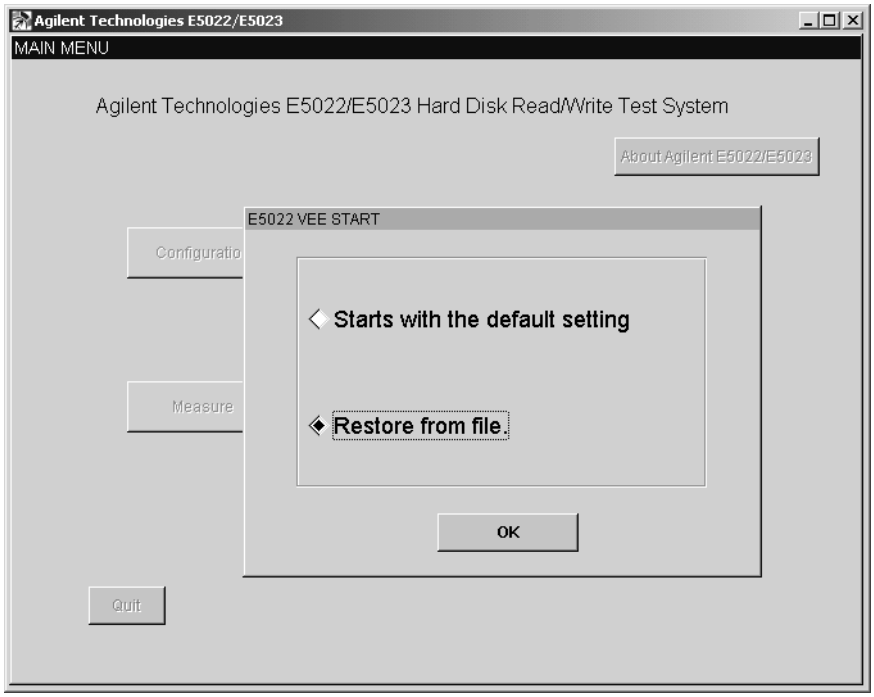
NOTE Proper values for each parameter described in this chapter must be used. Each parameter value depends on individual head characteristics that you use. DO NOT use the parameter values described in this chapter.

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Starting the VEE measurement program

1. Click on [Start] > [Programs] > [Agilent Hard Disk ReadWrite Test System] > [Test Environment (RunTime Version)] from the task bar of Windows 95/2000 to start the program.

Figure 3-2 **Default Setting Selection Menu**



Before the program starts to initialize, a pop up window ‘VEE START’ will appear. When ‘Restore from file’ is selected, a file menu will pop up that will allow you to load the parameters stored in a text file. When ‘Starts with the default setting’ is selected, measurement will start at default setting.

NOTE If you install a new kind of module or box instrument into the system, you must select “Starts with the default setting” at first time execution. Otherwise, VEE measurement program does not recognize the module. Then, load your setting in the configuration menu and re-store the setting.

2. Click [OK] it takes about 60 seconds to initialize the program.

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HGA Cassette Parameter Configuration

After initializing the system, the cassette parameter setup menu will pop up, this will require you to specify the size of the cassette's HGA and cassette part number. This setup menu is necessary to activate the VEE measurement program and remind the user that such parameter setup is required. If the user decides to change the cassette parameter setup during operation, click on [Cassette Parameter] from the Spinstand Menu and reset the parameters.

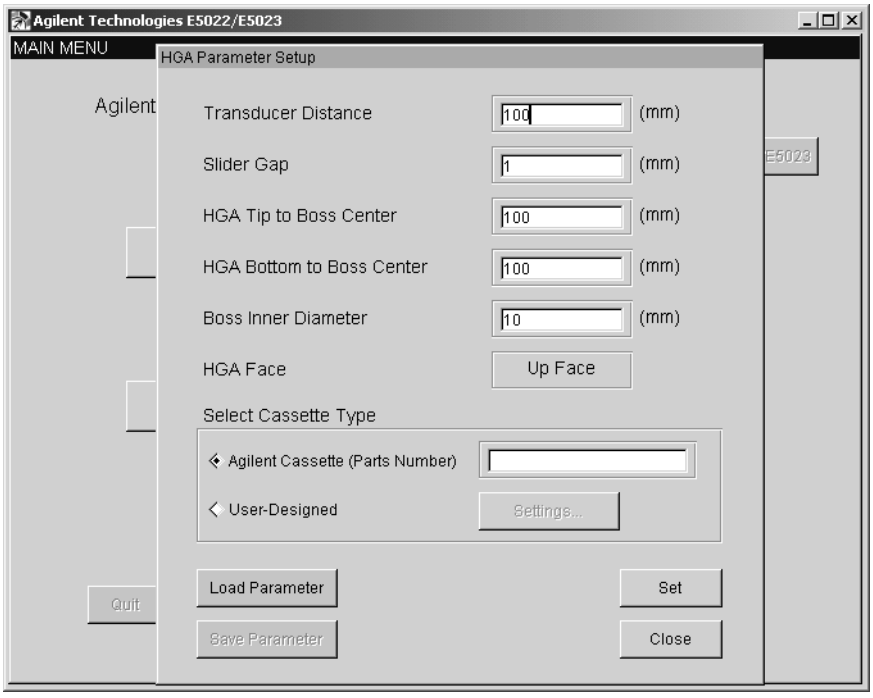
Basically there are two purpose for setting the cassette parameters. First is to know the reference point. The write offset and read offset's reference point must be specified. This becomes the track's center point. The second purpose is to let the system know the HGA and cassette size so as to prevent the head from bumping into the shroud. Size of cassettes varies with each Agilent part number.

NOTE

If the Agilent part number is not registered on the system's software an error "hpe5022_ERROR_NSUP_HGA_ CASSETTE" will appear on the display. The software does not support the cassette. In such case, the system's software must be upgraded.

1. After initialization, the 'Cassette Parameter Setup' menu will pop up as shown below. This allows the user to set the cassette parameters.

Figure 3-3 Cassette Parameter Setup Menu



- Transducer Distance, specify the perpendicular distance from the boss center to the reference point as shown in (Figure 3-4 "**td**").
- Slider Gap, specify the perpendicular distance from the reference point to the boss center as shown in (Figure 3-4 "**sg**").

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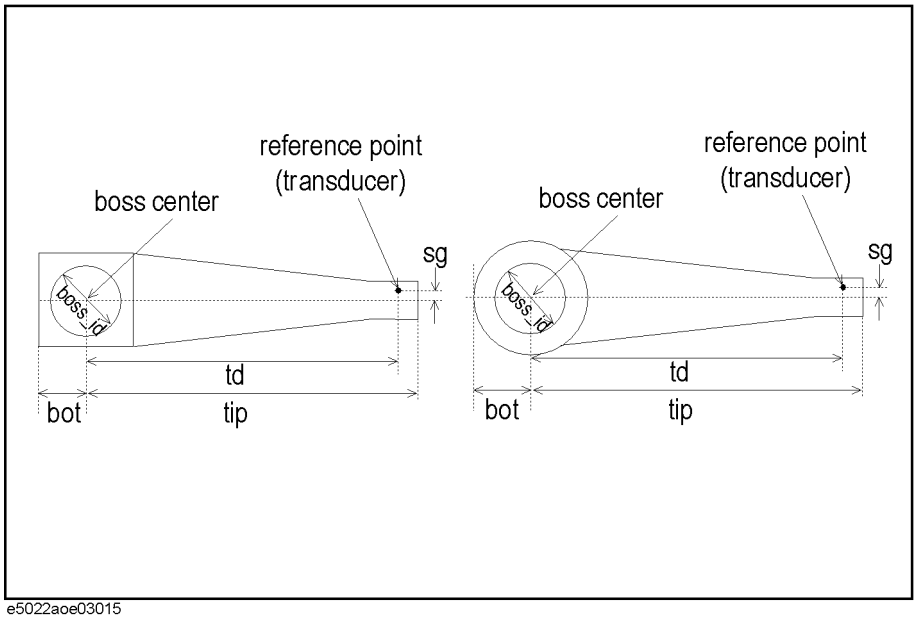
- HGA tip to Boss Center, specify the distance from the boss center to the tip of the HGA as shown in (Figure 3-4 “**tip**”).
- HGA bottom to Boss Center, specify the distance from the boss center to the base of the HGA as shown in (Figure 3-4 “**bot**”).
- Boss Inner Diameter, specify the inner diameter of the boss as shown in (Figure 3-4 “**boss_id**”).
- Select Cassette Type

  When using Agilent designed cassette, check on “Agilent Cassette (Part Number)” and enter the Agilent part number of the HGA cassette. The part number is printed on top of the cassette. A string example is “E5022-61141s”. If the cassette parameters are stored in a text file (e.g., Cassette.txt), you can load the cassette parameters automatically using the [Load Parameter] button.

  When you use a customer-designed cassette, see the next section.

NOTE When the FIC length of cassette is adjustable such as E5029C Option C11, the letters “s” (short length), “m” (medium length) and “l” (long length) is added as subscript to the cassette’s part number (e.g, “E5010-61145s”, “E5010-61145m” or “E5010-61145l”). Refer to Option C11 on page 277 for details.

Figure 3-4 HGA Parameters



e5022aoe03015

2. Click the [Set] button to set the parameters.

NOTE If you want to save the parameters specified in this menu for future use, click on [Save Parameter] button. A file menu will pop up, enter the file name in text format (e.g., FileName.txt). There is no need to assign a sub-file name. To load the saved file, click on [Load Parameter] button.

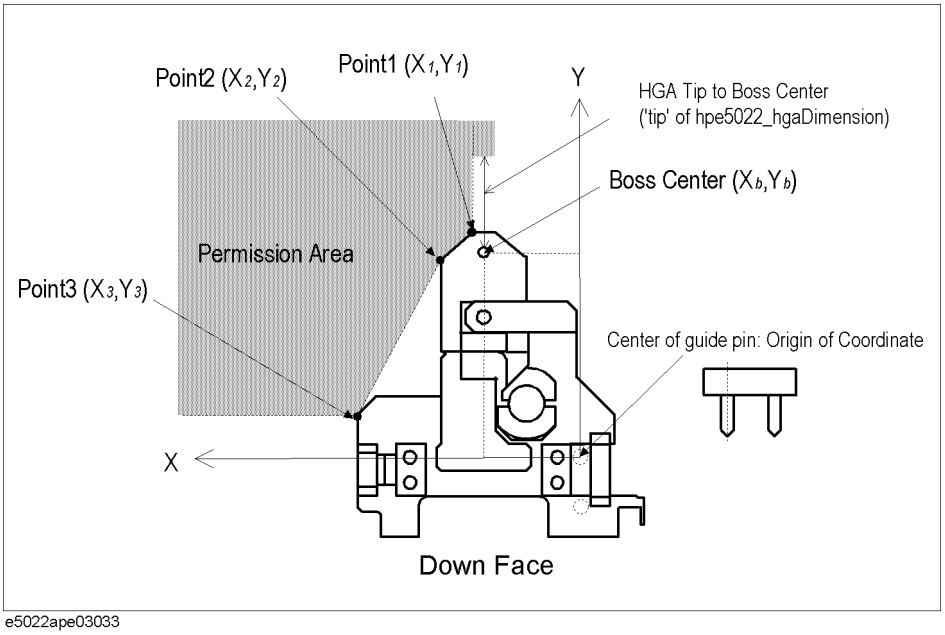
3. Click the [Close] button to return to main menu.

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Customer-designed Cassette Configuration

Agilent E5022/E5023 allows the user to use a customer-designed HGA cassette. When you use your own designed cassette, you have to let the system know the dimensions of the cassette. This is prevent the cassette from bumping into the spindle and shroud. The location of the HGA boss center and several points outside of the cassette must be specified as shown below using a down face cassette. Since the up face is the line asymmetry of the down face it is impossible to define the down face and up face separately.

Figure 3-5 **Customer-Designed Cassette Dimension**



e5022ape03033

The center location of the right side guide pin is defined as the origin of coordinates.When a cassette has two guide pins on one side, the head pin becomes the origin.

The x and y coordinates of the HGA boss center is defined as the ‘position’. From the x and y coordinates, two or three location points must be specified in order to let the system know the shape of the cassette. The user can specify certain points outside the cassette.

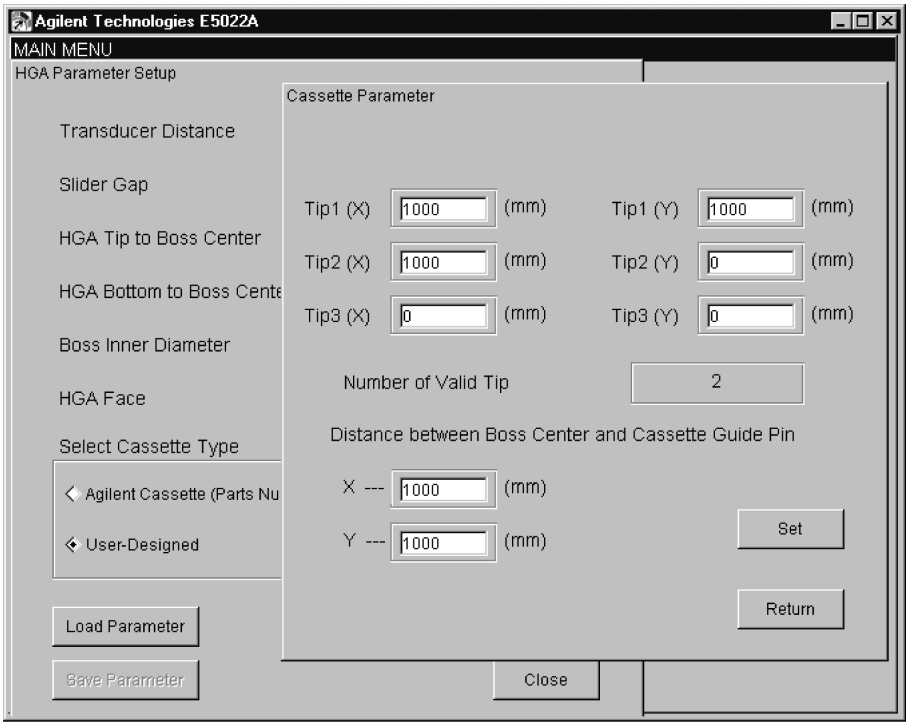
As shown in Figure 3-5 the outer area covered by the lines connecting Points 1,2 and 3 form what is called as the “permission area”. The spindle and shroud is allowed to exist within this area. On the other hand, the inner area is defined as the inhibit area where the spindle is not allowed to exist.

NOTE Although, the DLL functions of E5022/E5023 allows you to specify the locations for more than three points of the outer area, the VEE measurement program supports up to three points only. See the “hpe5022_hgaCassetteDimention” function in the programming manual for details.

1. Click on ‘User Designed’ from the “Select Cassette Type” frame of the [HGA Parameter Setup] menu. This will activate the [Settings] button.
2. Click on [Settings] to open the “Cassette Parameter” menu.

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Figure 3-6 **User-Designed Cassette Parameter Menu**



- Tip1(X), Tip1(Y):

  Specifies the location of the base of HGA.

- Tip2(X), Tip2(Y):

  Specifies the location of an arbitrary point in theouter area.

- Tip3(X), Tip3(Y):

  Specifies the location of an arbitrary point in theouter area. This is optional. If not specified x and y is set to zero (i.e, default).

- Distance between boss center and cassette guide pin:

- Specifies the location of HGA boss center (X_b and Y_b in Figure 3-5). See also the “hpe5022_hgaCassetteDimension” in the programming manual.

3. Click the [Set] button to set the specified parameters.
4. Click the [Close] button to return to main menu.

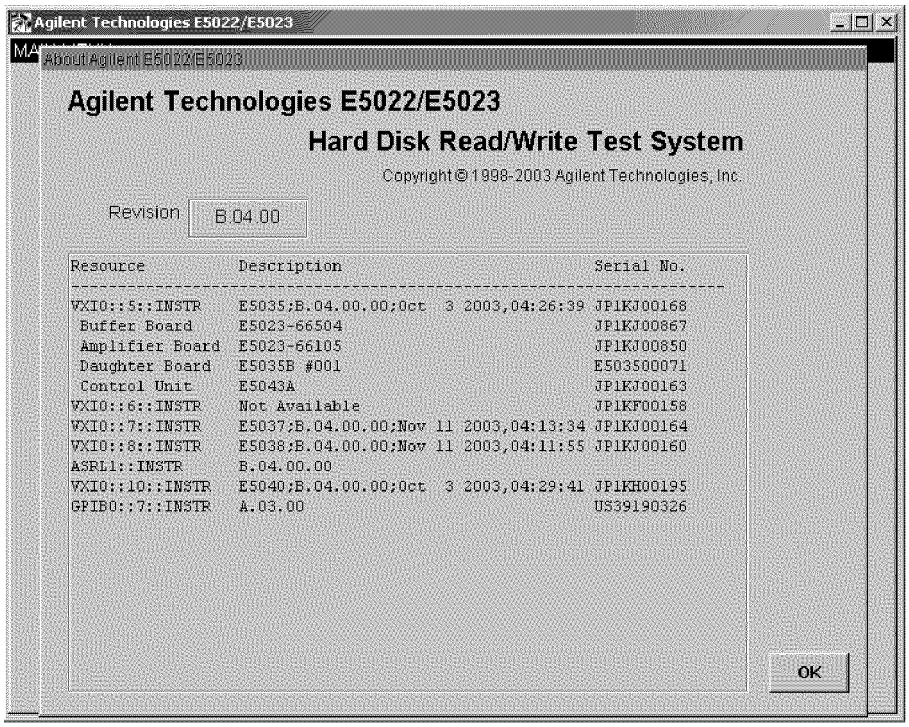
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Software Revision and Hardware Information

The revision number of Agilent E5022/E5023 system software, serial number of modules and instruments, part number and serial number of Buffer/Amplifier Board are reported in [About E5022/E5023] menu.

1. Click on [About E5022/E5023] button to check the current software version and module revision of the system. The E5022/E5023 revision shows the major revision number. The revision number of service releases are not shown at this. When you confirm if a service release software is installed, click [start][Programs][Agilent Hard Disk ReadWrite Test System][Readme] on the windows 95/2000.

Figure 3-7 **About E5022/E5023**



NOTE The E5036A module (VXIO :: 6 :: INSTR) and E5041A module (VXIO :: 11 :: INSTR) will not report any module revision because it does not have any DSP chip (i.e, there is no firmware). The spinstand with module address (ASRL1:: INSTR) will not report the serial number. If BER module is installed in the system it will report the name of read channel IC.

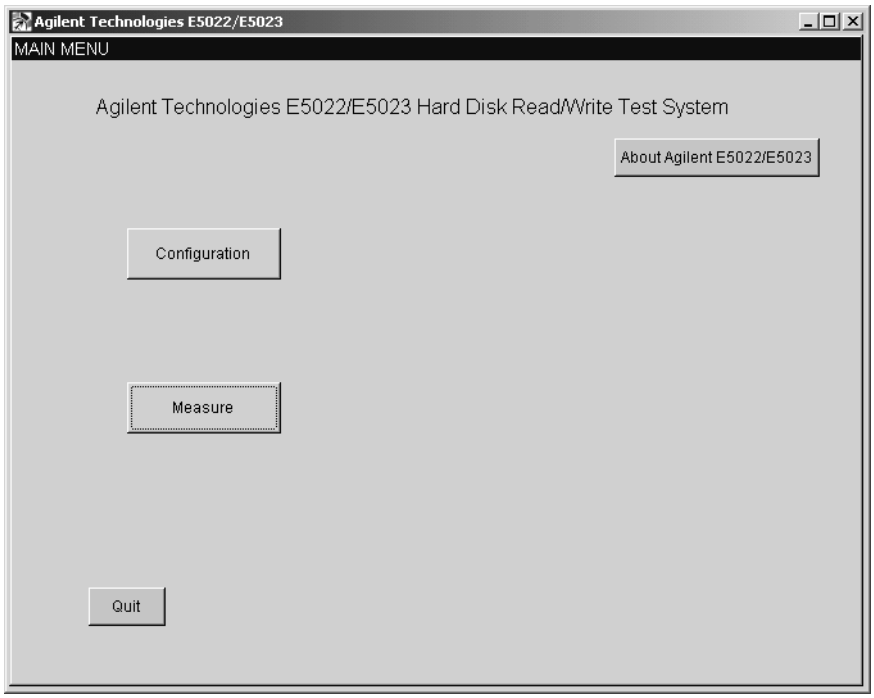
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Setup Menu

The Setup Menu is used to set the configuration for precompensation, head amplifier, input range, filter, data pattern and narrow band TAA frequency for advance measurements.

1. Displays the Main Menu.

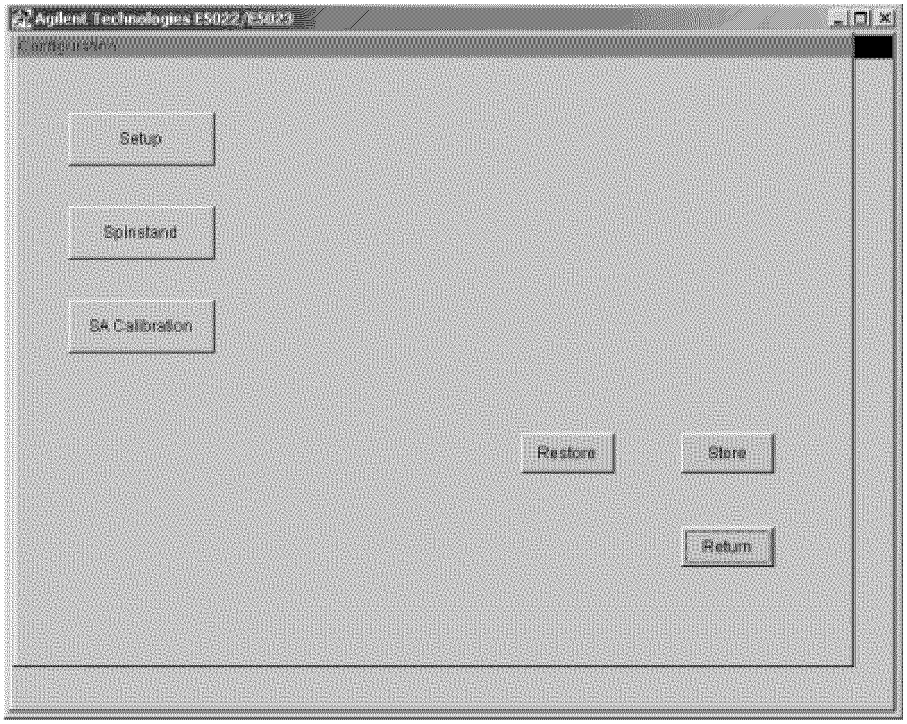
Figure 3-8 **Main Menu**



2. Click on the [Configuration] button to open the configuration menu.

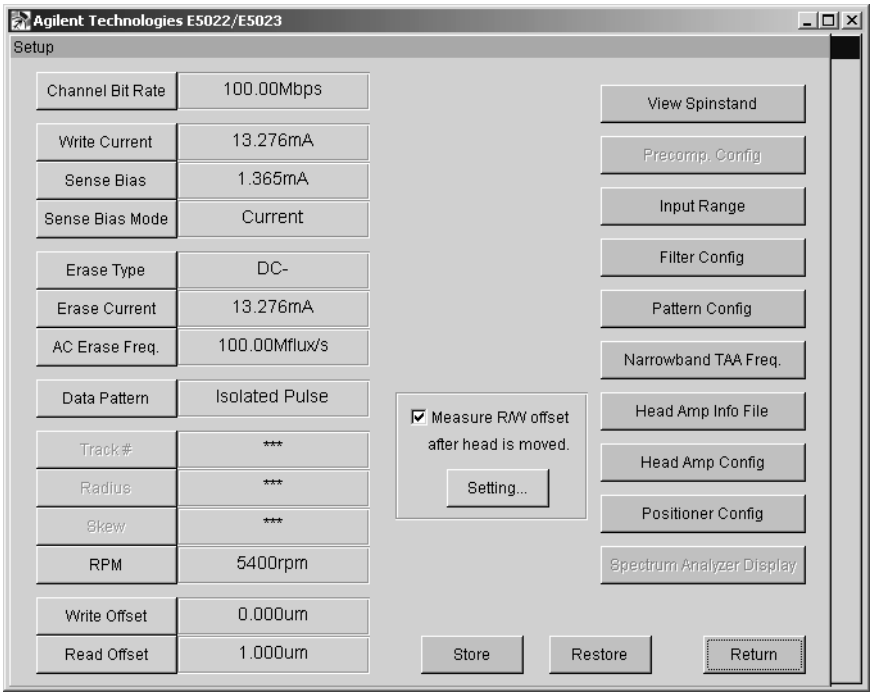
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Figure 3-9 Configuration Menu



3. Click on [Setup] button to open the setup menu.

Figure 3-10 Setup Menu



4. Set the parameters within the limits of measurement.

Channel Bit Rate Specifies the speed at which data bits are

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	written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Bias	Specifies the MR bias applied to the read head.
Sense Bias Mode	Specifies the MR bias type and its polarity during a write sequence. Either current, voltage, or power are selectable as the MR bias type. You can set at voltage and/or power only if the installed head amplifier has the capability to select. When voltage is selected, a DCR of the read head is required to input. See “DCR Measurement” on page 191. As the polarity, when “Normal Mode” is selected, the same polarity MR bias is applied to the read head during a write sequence. When “Reverse Mode” is selected, the MR bias has opposite polarity to the write current polarity during a write sequence. When “off Mode” is selected, the MR bias is turned off during a write sequence. You can set at the “reverse” and/or “off” modes only if the installed head amplifier has the capability to select.
Erase Type	Specifies the erase type either DC erase or AC erase.
Erase Current	Specifies the amount of current to erase.
AC Erase Frequency	Specifies frequency for an AC erase.
Data Pattern	Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
Track #	Specifies the track number to be tested. If the drive is off the symbol [****] will appear.
Radius	Shows the current radius of the head. When the head is unloaded the symbol [****] will appear.
Skew	Shows the current skew angle of the head. When the head is unloaded the symbol [****] will appear.
RPM	Specifies the revolution speed of spindle.
Write Offset	Specifies the position of the write head to write the data track.
Read Offset	Specifies the position of the read head to read the data track.

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Measure R/W offset

Sets the read/write offset automatically even if the head position is changed. When this parameter is checked, track profile measurement is performed on background just after head position is changed, then [Write Offset] and [Read Offset] parameters are updated to the appropriate values. Click the [Setting] button to set the parameters for background track profile. It is better to uncheck this parameter if 'Skew' is set below -30 degrees.

NOTE When parameter [Skew] is set below -30 degrees the E5022/E5023 system can not guarantee a track offset of ± 6µm, this could result to an error "hpe5022_ERROR_INV_PARAMETER". When the skew angle is set below -30 degrees the user may need to uncheck the [Measure R/W offset] parameter or set the range of the background track offset to a value lower than ± 6µm to avoid generating an error. Refer to "hpe5022_headPosition" function of the programming manual for details.

NOTE When you set the Track #, you must properly specify the parameters in the Data Area and Drive frames from the [Spinstand] menu. This will automatically compute and set the radius and skew angle. When you specify a new [Radius] the track number nearest to the specified value will appear as the new Track #.

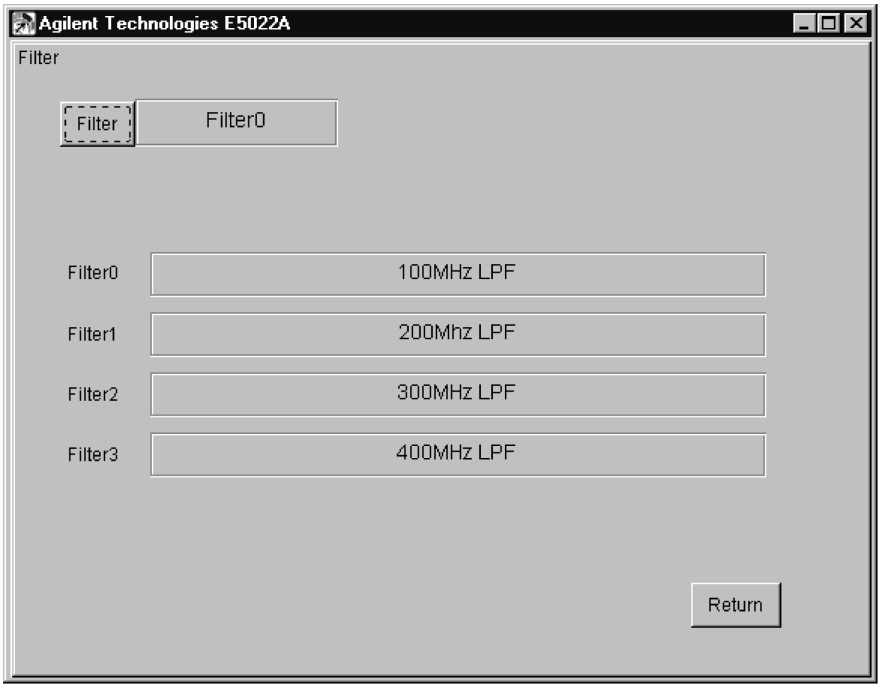
5. Click the [Return] button to return to main menu.

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Filter Configuration Menu

1. Click on [Configuration] > [Setup] > [Filter Config] to open the Filter menu.

Figure 3-11 **Filter Menu**



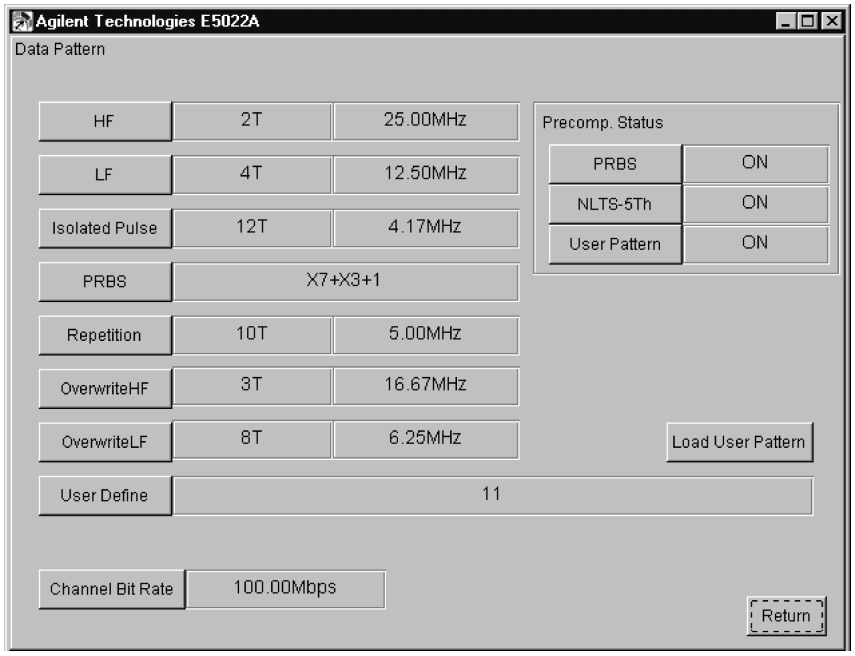
2. Click on [Filter] and select the type of filter to be used by the Filter Matrix Module.
3. Click the [Return] button to return to setup menu.

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Pattern Configuration Menu

1. Click on [Configuration] > [Setup] > [Pattern Config.] to open the Data Pattern menu.

Figure 3-12 Data Pattern Menu



Specify the number of repetitive periods for each data pattern. Consequently, the frequency of each data pattern will be computed in 'MHz' based on the specified repetitive period (i.e. *Channel Bit Rate[Bps] / Repetitive Period [nT] / 2*). Default setting can be used for unwanted patterns. Binary pattern is used for user defined pattern. Use [Load User Pattern] to down load the file that contains user defined data pattern into the [User Define] parameter. The format of this file should be in text form, example, FileName.txt. Also, a maximum of only 256 numerical strings can be set with this parameter. If it goes over 256 numerical strings, you won't be able to change the set parameter into a new value.

If you change the setting of the "Precomp Status" frame, it will automatically change and update similar parameters in "Precompensation Setting" menu.

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Perform the Amplitude Calibration for E4402B Spectrum Analyzer

This chapter describes how to perform the amplitude calibration for E4402B Spectrum Analyzer.

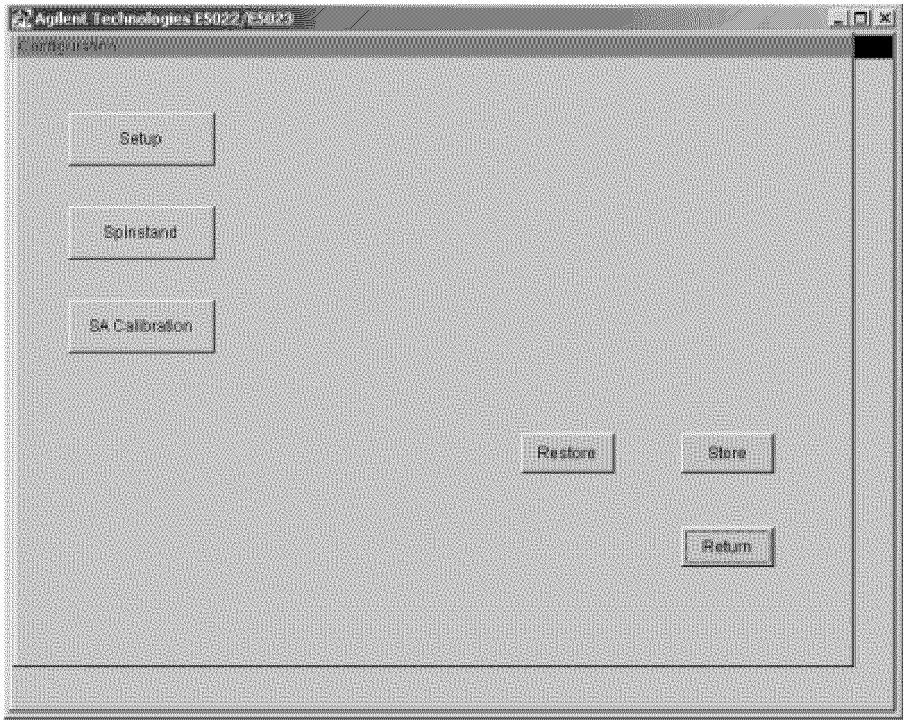
NOTE The amplitude calibration must be performed at least once after the installation. Or the error message will be displayed in the Narrow Band Spectrum measurements, such as Narrow Band TAA, Overwrite, and Narrow Band Track Profile, etc.

NOTE The amplitude calibration must be performed after at least 30 minutes warming-up of the system.

Followings are the procedures for the amplitude calibration of E4402B Spectrum Analyzer:

1. Run the VEE Test Environment Software after the warming up the system. On the Main Menu display, click on [Configuration] to open the Configuration menu.

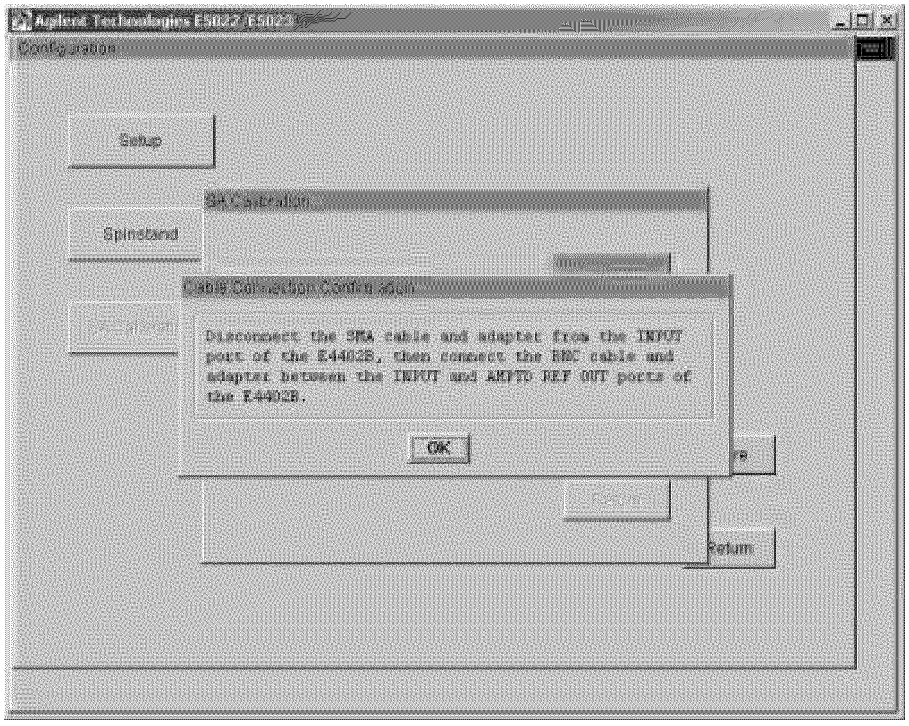
Figure 3-13



2. On the Configuration Menu display, click on [SA Calibration] button to open the SA Calibration menu.

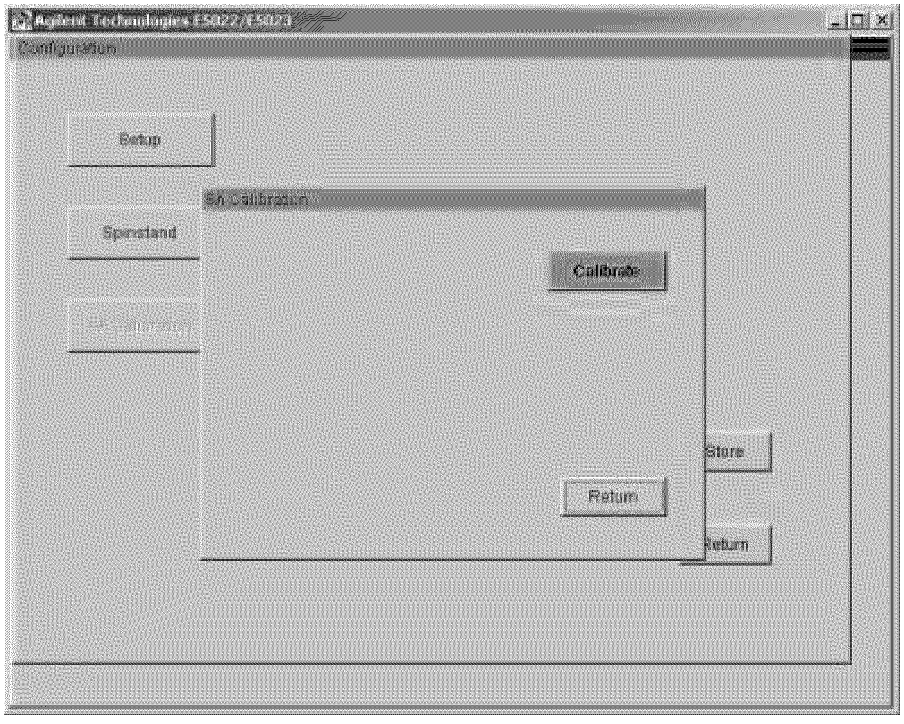
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Figure 3-14



3. Replace the cable and adapter on E4402B as advised on the display, and then Click on [OK].

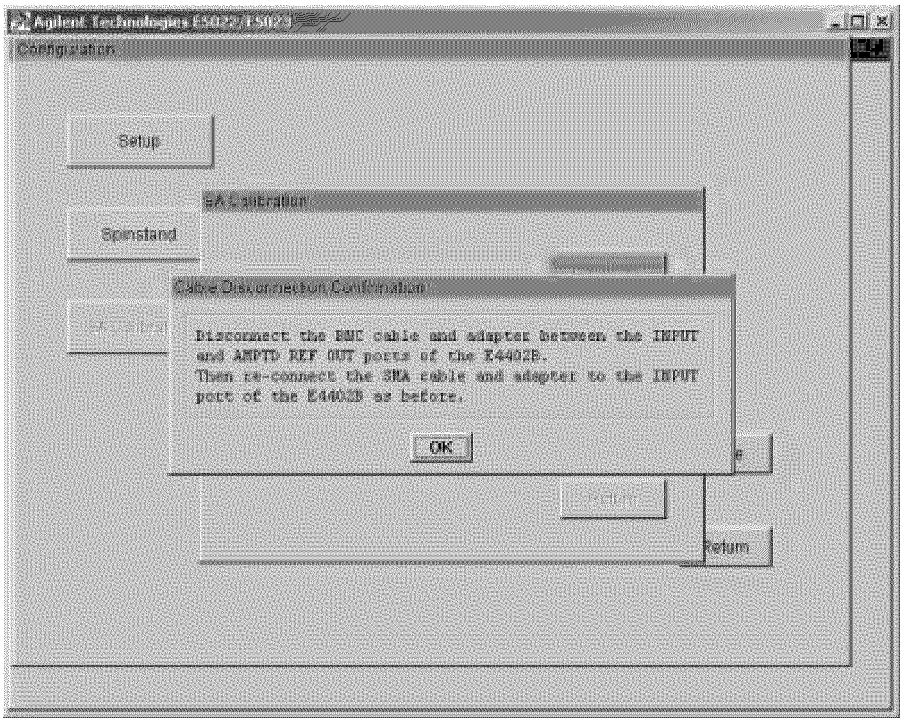
Figure 3-15



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4. Click on [Calibration] to start the amplitude calibration.

Figure 3-16



5. Replace the cable and adapter on E4402B again as advised on the display, and then Click on [OK] to finish the amplitude calibration.

NOTE It is recommended to do the calibration in case of the followings:

a. Temperature has changed more than 5 deg. C after the previous calibration.

b. 24 hours or more has past after the previous calibration.

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Auto Configuration (Input Range Configuration)

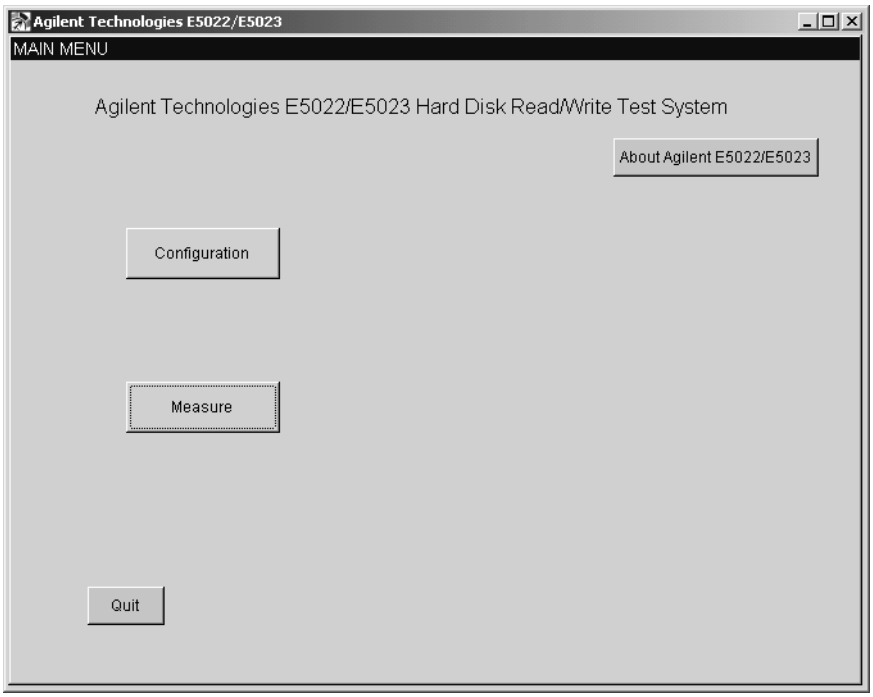
Although it is a must to set the input range relative to the signal level. This setting can be done automatically by a function called “Auto Configuration”. See also the “Input Range Control & Auto Configuration” on page 308.

NOTE

Repeat the Auto Configuration when any of the following events occur: when the output signal has changed significantly, when you set the write and sense currents at relatively high value.

1. Click [Measure] to open the Main menu.

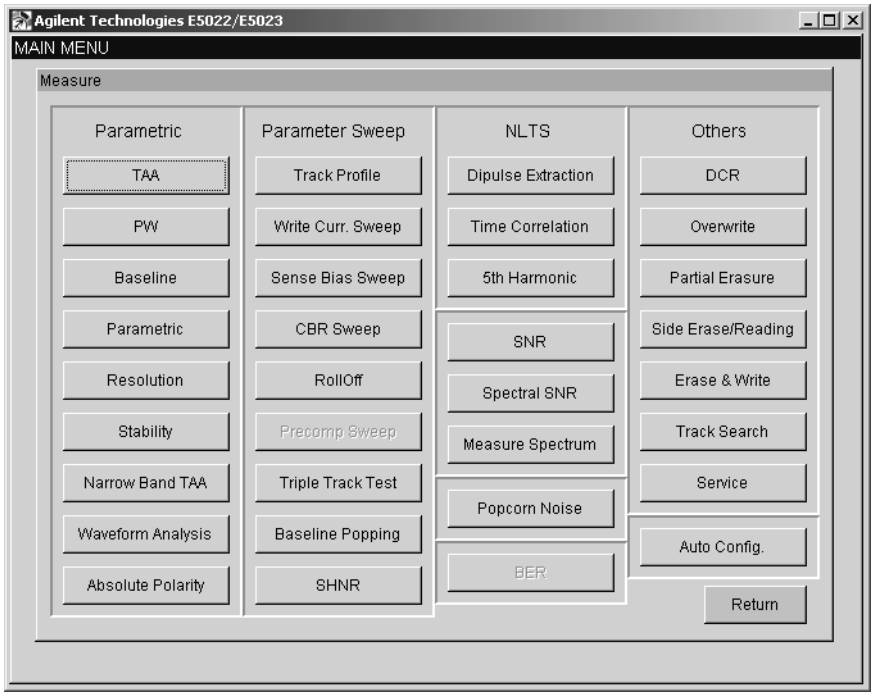
Figure 3-17 VEE measurement program Main Menu



2. Check if the head and media are already installed.
3. Click on the [Measure] button to open the Measure menu.

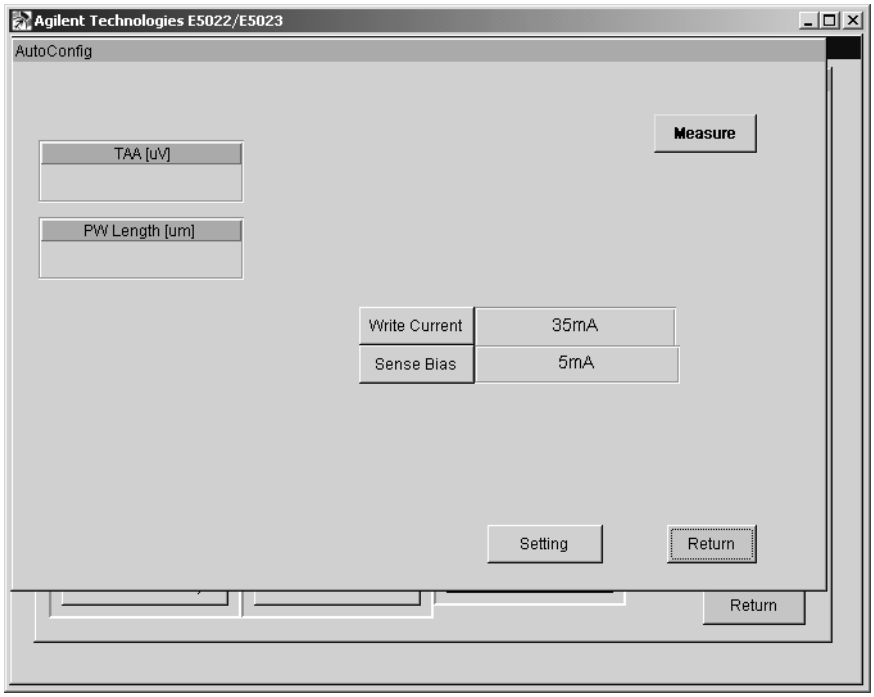
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Figure 3-18 **Measure Menu**



4. Click on [Auto Config.] button to open the Auto Config. menu.

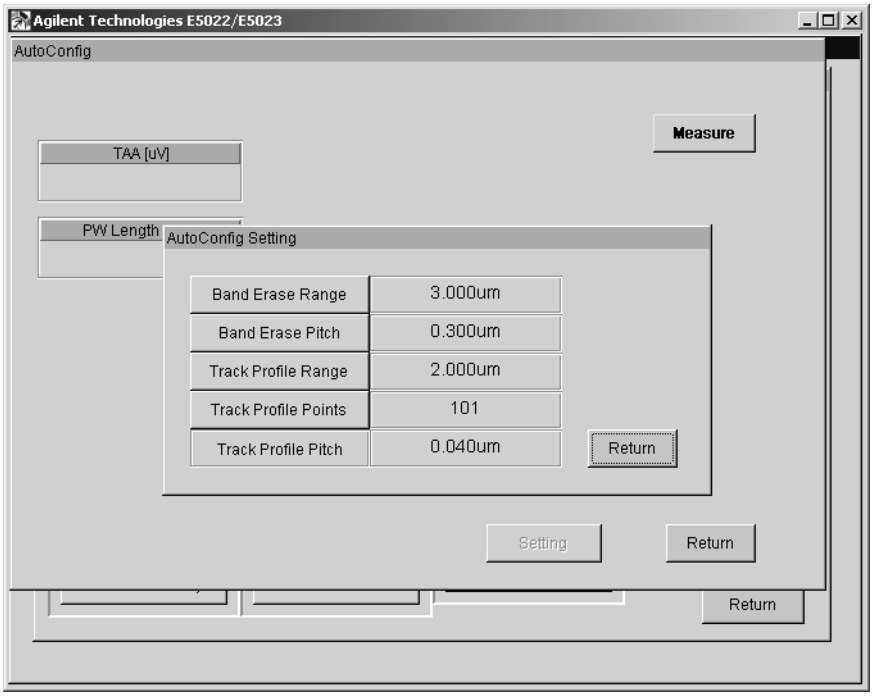
Figure 3-19 **Auto Configuration Menu**



5. Set the write and sense currents according to test requirements. The new setting will automatically update similar parameters in other menus.
6. Click on the [Setting] to open the autoconfig setting menu.

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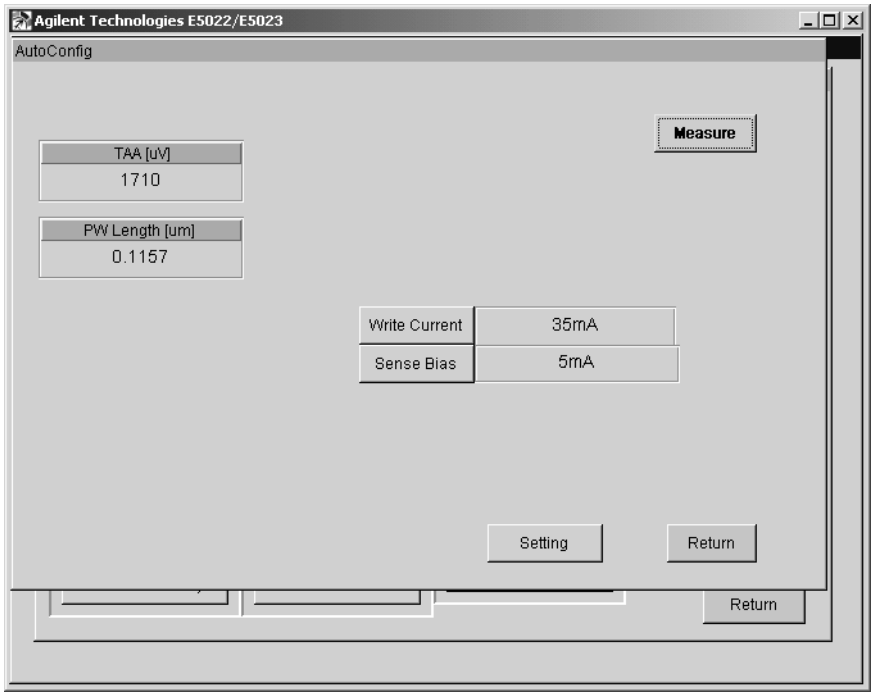
Figure 3-20 Auto Config - Result



7. Set the parameters of the band erase and the track profile measurement since the auto config performs a track profile measurement in the sequence.
8. Click [Measure] to start measurement.
9. The results of TAA and PW length for a Reference Isolated Pulse Pattern will be displayed. The displayed values will automatically be reflected in the Input Range Menu.

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Figure 3-21 **Auto Config - Result**



10. Click on the [Return] button to return to Measure menu.

See also See “Input Range Control & Auto Configuration” on page 308 for the auto configuration.

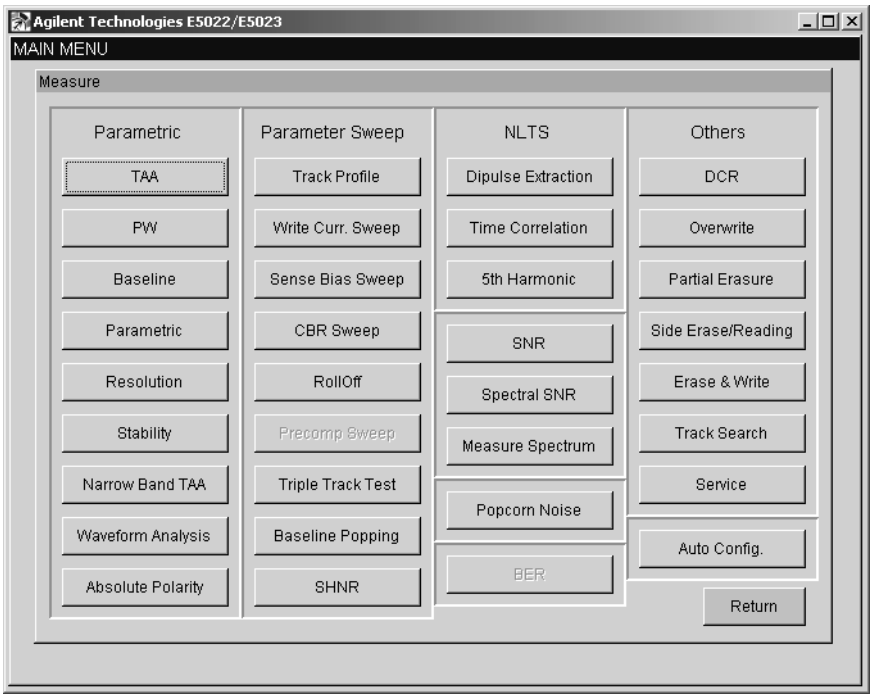
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Measurement

After executing the auto configuration, you can now proceed to perform any measurements. Prior to any measurements you need to specify proper values of the parameters. Measurements are generally performed automatically. The spindle rotation, head loading and unloading are also done automatically.

When replacing the head, the head must be at home position and the spindle should not be rotating. Click the [Return] button of the 'Measure' menu, then click on [Configuration] so that the head is unloaded. If you use a different type of head or cassette, Click [Spinstand] > [Cassette Parameter] button to enter the dimensions of the new cassette.

Figure 3-22 **Measure Menu**



NOTE

When your system equipped with E5037B/C/D, the [Precomp Sweep] button is not activated as E5037B/C/D does not have a capability of precompensation.

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TAA Measurement (Parametric)

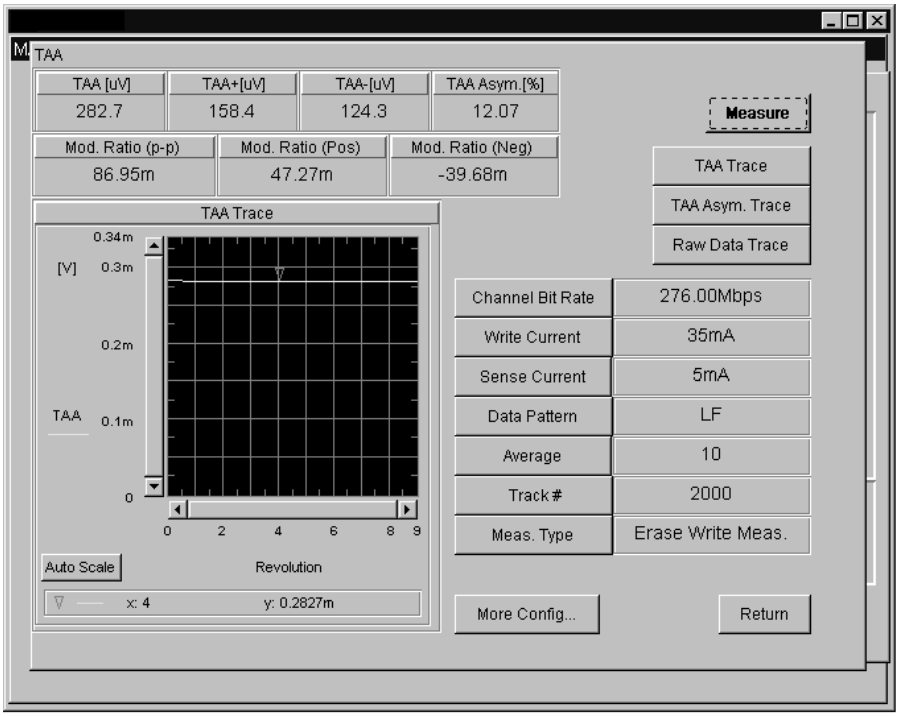
Overview

This section describes the TAA measurement. TAA measurement is used to measure TAA positive, TAA negative and TAA asymmetry. TAA measurement is measured by the parametric module (E5038A).

Measurement Procedure

1. To open the TAA menu, click on the [TAA] button from the Parametric frame of the Measure menu.

Figure 3-23 TAA Menu



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Data Pattern	Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the menu.
Average	Specifies the number of revolutions to get the average results.
Track #	Specifies the track number to be tested.

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Meas. Type — Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to perform DC erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click the [Measure] button to start measurement. When [Auto Scale] is pressed the graph scale will adjust itself automatically to its maximum and minimum values.

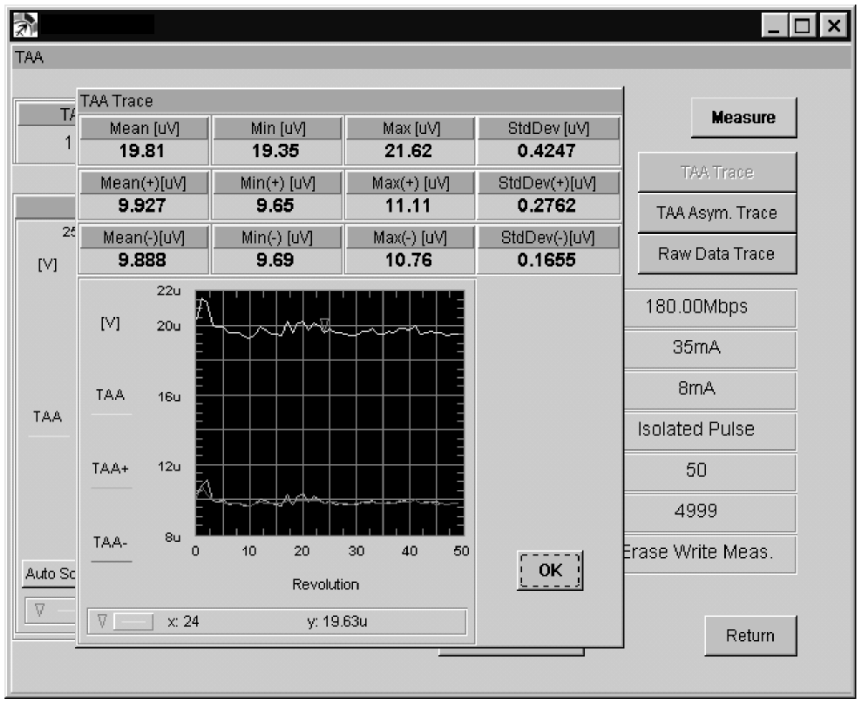
Measurement Display

The TAA, TAA+, TAA- and TAA Asymmetry are averaged from the number of measured revolutions set by the Average. Mod. Ratio, Mod Ratio (Pos) and Mod. Ratio (Neg) are modulation result. The test result only for the last revolution of TAA measurement is used to calculate the modulation. The TAA data at each revolution are displayed on the graph.

When you click the [TAA Trace] and [TAA Asym.Trace] buttons for more detailed information of the TAA+, TAA- and TAA Asymmetry. Refer to the "hpe5022_taaRawData_Q" function in Chapter 3 of the programming manual.

4. Click on the [TAA Trace] button to display the results of TAA Trace.

Figure 3-24 TAA Trace Display



Measurement Display

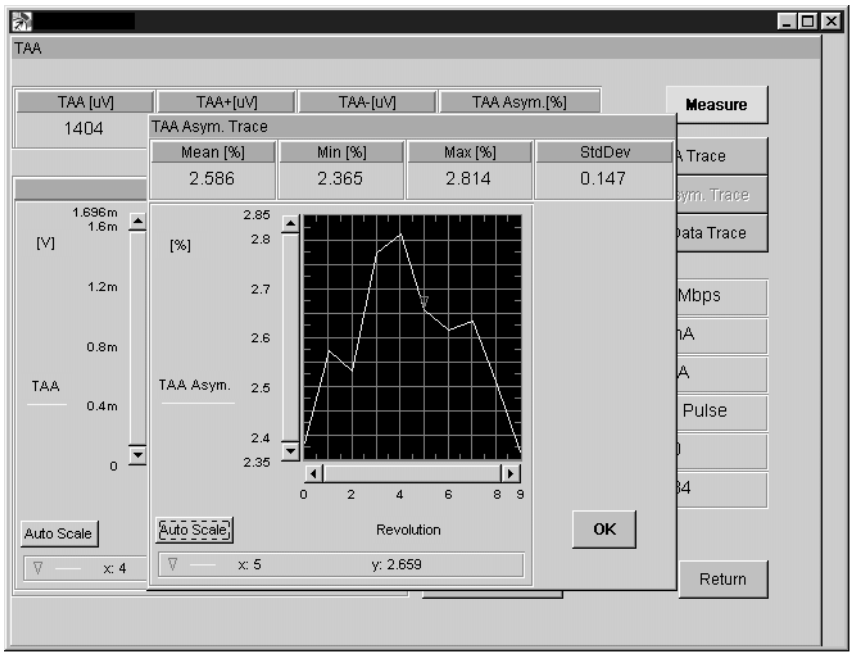
The upper portion of the window shows the mean, maximum, minimum and standard deviation of the measured TAA, TAA+ and TAA- for the number of specified revolution.

5. Click [OK] to display the TAA menu.

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6. Click on the [TAA Asym. Trace] button to display the results of TAA Asym Trace.

Figure 3-25 TAA Asym.Trace Display

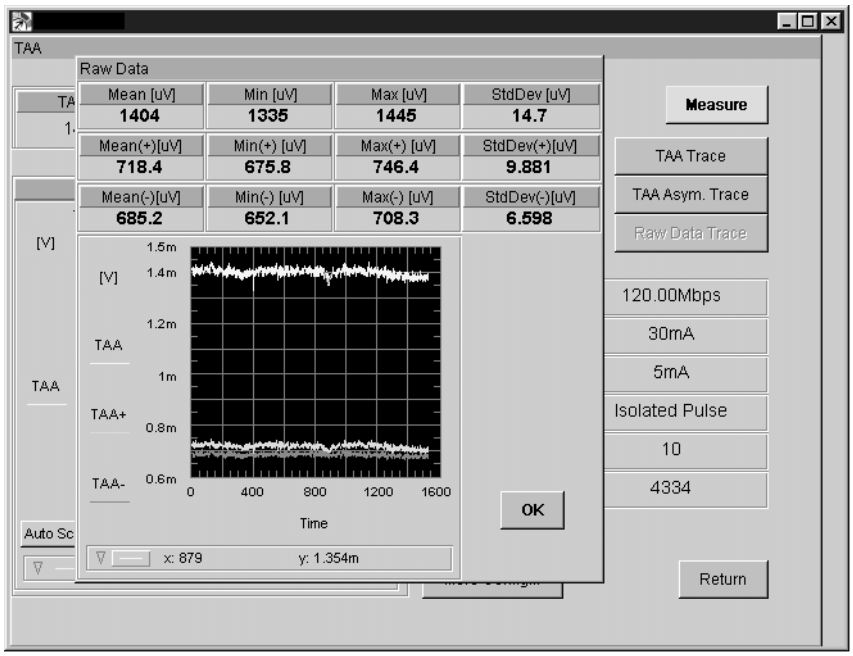


Measurement Display

The upper portion of the window shows the mean, minimum, maximum and standard deviation of TAA Asymmetry from the number of measured revolutions.

7. Click [OK] to return to TAA menu.
8. Click on the [Raw Data Trace] button to display the results of Raw Data.

Figure 3-26 Raw Data Display



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Measurement Display

The Raw Data represents the original data used to calculate the TAA. Although its averaged value is measured for every rotation of the track, the raw data displays the measurement results for every 5 µsec of each track. If Average is set to 2, then only the results of the last rotation will be displayed.

The upper portion of the graph shows the mean, maximum, minimum and std. deviation of the raw data. The graph on the other hand shows the measured TAA, TAA+ and TAA- of the raw data for every 5 µsec.

9. Click [OK] to return to TAA menu.
10. Click on the [Return] button to return to Measure menu.

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PW Measurement (Parametric)

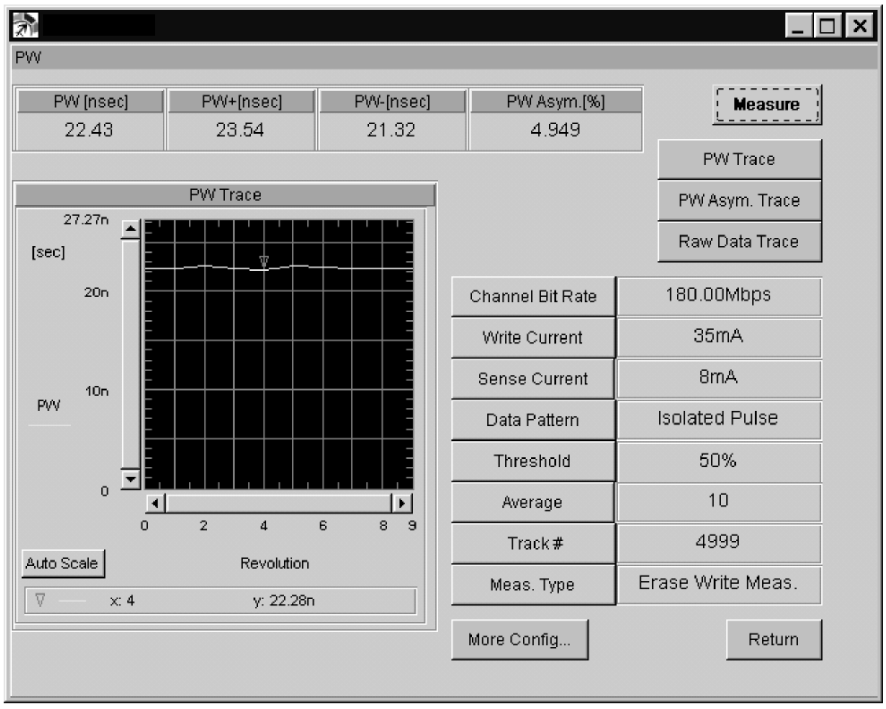
Overview

This section describes the PW measurement. The PW measurement is used to measure the PW+ positive, PW- negative and PW asymmetry. PW is measured by the parametric module (E5038A).

Measurement Procedure

1. To open the PW menu, click on the [PW] button from the Parametric frame of the Measure menu.

Figure 3-27 **PW Menu**



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate — Specifies the speed at which data bits are written on the media per second [bps].

Write Current — Specifies the current applied to the write head.

Sense Current — Specifies the current applied to the read head.

Data Pattern — Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the menu.

Threshold — Specifies the threshold level for PW measurement.

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Average	Specifies the number of revolutions to get the average results.
Track #	Specifies the track number to be tested.
Meas. Type	Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to perform a DC erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click the [Measure] button to start measurement. When [Auto Scale] is pressed the graph scale will adjust itself automatically to its maximum and minimum values.

4. Click the [Return] button to return to Measure menu.

See also See the “PW measurement function” section in the chapter 3 of the programming manual for the parameter range and its detailed description.

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Baseline Measurement (Parametric)

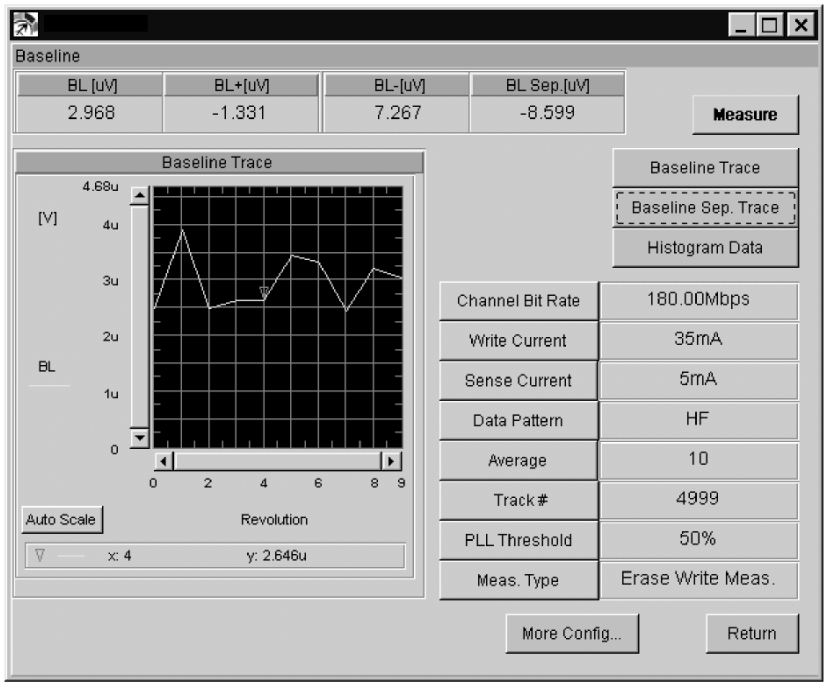
Overview

This section describes the Baseline measurement. The Baseline measurement is used to measure Baseline, Baseline+ positive, Baseline- negative and Baseline Separation. Baseline measurement is measured by the parametric module (E5038A).

Measurement Procedure

1. To open the Baseline menu, click on [Baseline] button from the Parametric frame of the Measure menu.

Figure 3-28 **Baseline Menu**



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Data Pattern	Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the menu.
Average	Specifies the number of revolutions to get the average results.
Track#	Specifies the track number to be tested.

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PLL Threshold — Specifies the PLL threshold when measuring with a parametric module. This is normally set to 50%.

Meas. Type — Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to perform a DC erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3)[Meas.] means to measure only.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

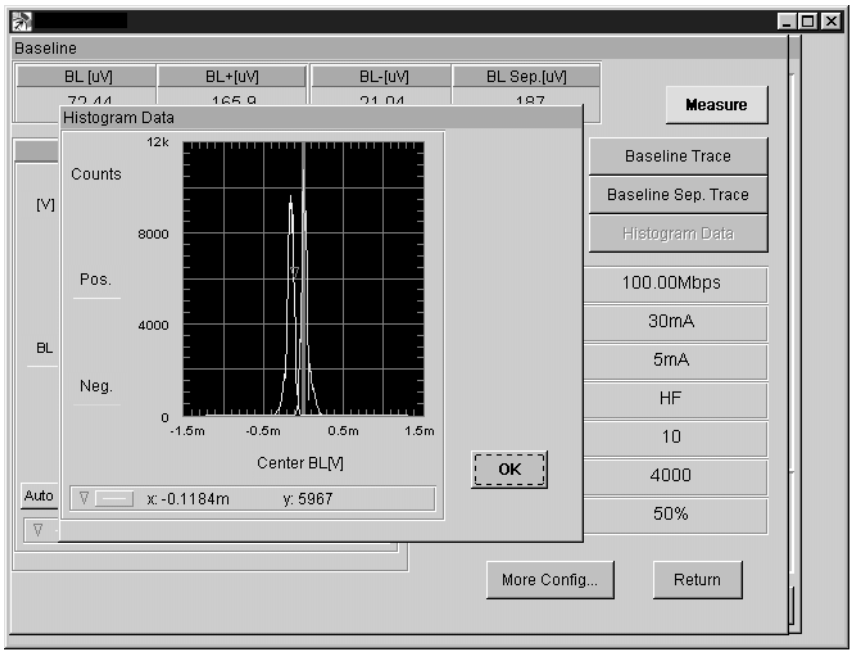
3. Click on the [Measure] button, to start measurement. When [Auto Scale] is pressed the graph scale will adjust itself automatically to its maximum and minimum values.

Measurement Display

The upper portion of the window shows the Baseline, Baseline +, Baseline- and Baseline Separation. The graph on the other hand displays the results for each revolution.

4. Click the [Histogram] button to open the Histogram Data Window.

Figure 3-29 Histogram Data Window



Measurement Display

The results of the measured Baseline (BL), Baseline +, Baseline - and its gap results are displayed in the form of histogram. If Average is set to 2, then only the results of the last revolution will be displayed.

5. Click [OK] to return to Baseline menu.
6. Click the [Return] button to return to Measure menu.

See Also See the “Baseline measurement function” section in Chapter 3 of the programming manual.

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Parametric Measurement (Parametric)

Overview

This section describes the parametric measurement. Parametric measurement is performed with TAA, PW and Baseline measurements.

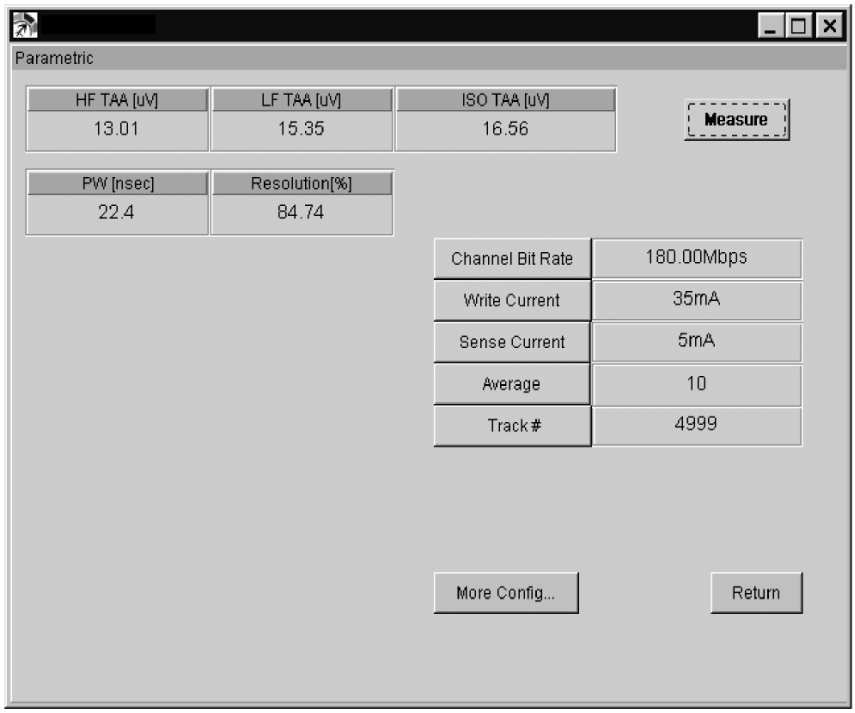
The Parametric measurement measures the following data patterns:

- HF pattern for TAA measurement (HF TAA).
- LF pattern for TAA measurement (LF TAA).
- Isolated Pulse Pattern for TAA measurement (Isolated TAA).
- Isolated Pulse Pattern for PW measurement (PW).
- HF-TAA and LF-TAA for Resolution computation (Resolution).

Measurement Procedure

1. To open the Parametric menu, click on [Parametric] from the Parametric frame of the Measure menu.

Figure 3-30 Parametric Menu



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate — Specifies the speed at which data bits are written on the media per second [bps].

Write Current — Specifies the current applied to the write head.

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Sense Current	Specifies the current applied to the read head.
Average	Specifies the number of revolutions to get the average results.
Track#	Specifies the track number to be tested.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click the [Measure] button to start measurement. Results are displayed according to the overview explanation.

Measurement Display

The upper portion of the window shows the results of the HF TAA, LF TAA, Isolated TAA, PW and Resolution.

4. Click the [Return] button to return to Measure menu.

See Also See the “Parametric measurement function” section in Chapter 3 of the programming manual.

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Resolution Measurement (Parametric)

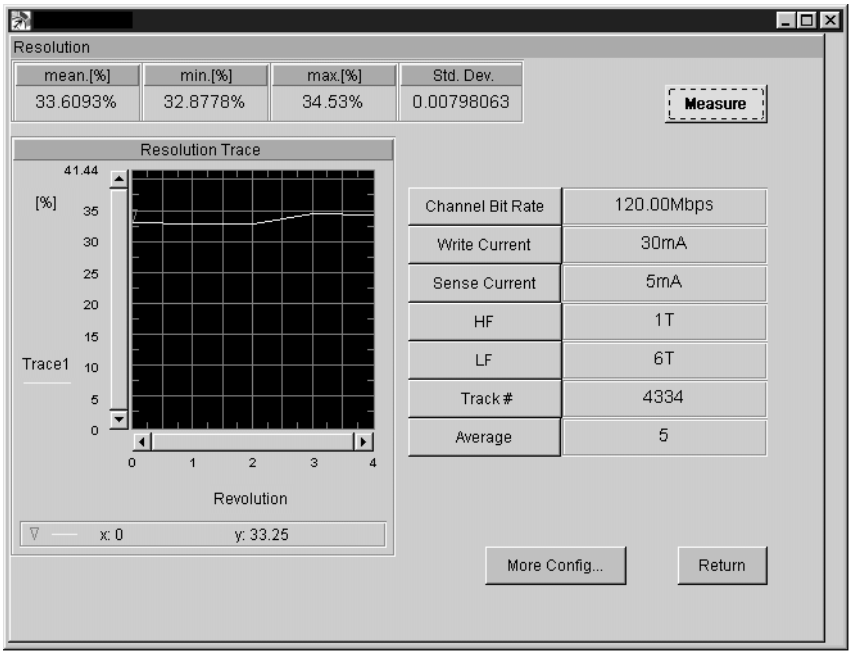
Overview

This section describes the Resolution measurement. Resolution is used to measure the TAA of HF and LF data patterns. Resolution is measured by the parametric module (E5038A).

Measurement Procedure

1. To open the Resolution menu, click on the [Resolution] button from the Parametric frame of the Measure menu.

Figure 3-31 **Resolution Menu**



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written/read on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
HF	Specifies the number of repetitive periods for HF data pattern.
LF	Specifies the number of repetitive periods for LF data pattern.
Track#	Specifies the track number to be tested.
Average	Specifies the number of revolutions to get the average results.

NOTE

The parameter values of Channel Bit Rate, Write Current and Sense Current that have been

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set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on the [Measure] button to start measurement, results are displayed after measurement.

Measurement Display

The upper portion of the window shows the mean, minimum, maximum and standard deviation. While the graph displays the resolution trace for every revolution.

4. Click the [Return] button to return to Measure Menu.

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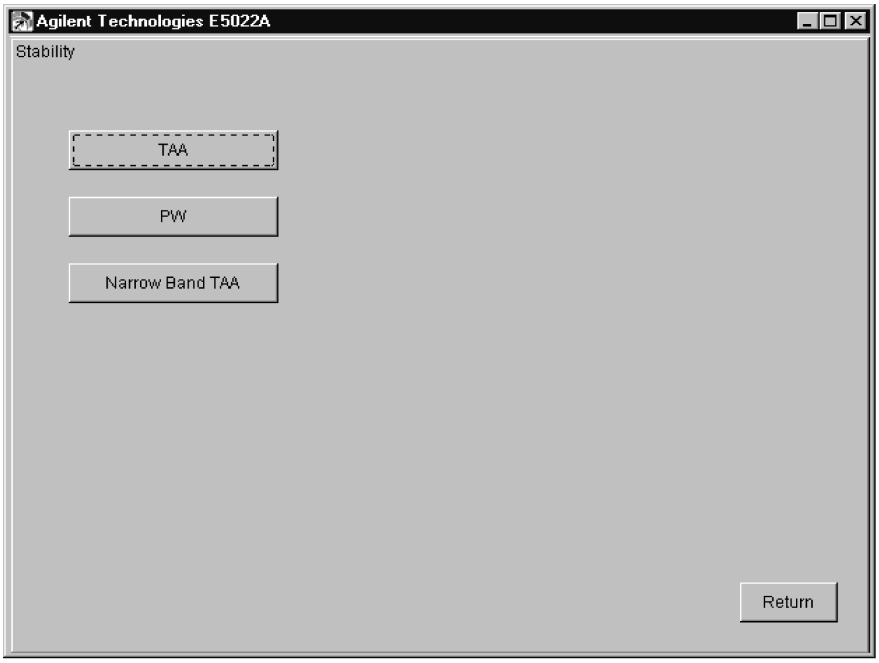
Stability Measurement

Stability Measurement (Ratio Setting)

The Stability measurement is used to measure the TAA stability during many read /write iterations of the head. See “Stability Measurement” on page 248.

1. To open the ‘Stability (Ratio Setting)’ menu, click on the [Stability] > [Stability (Ratio Setting)] button from the measurement menu.

Figure 3-32 **Stability Menu**

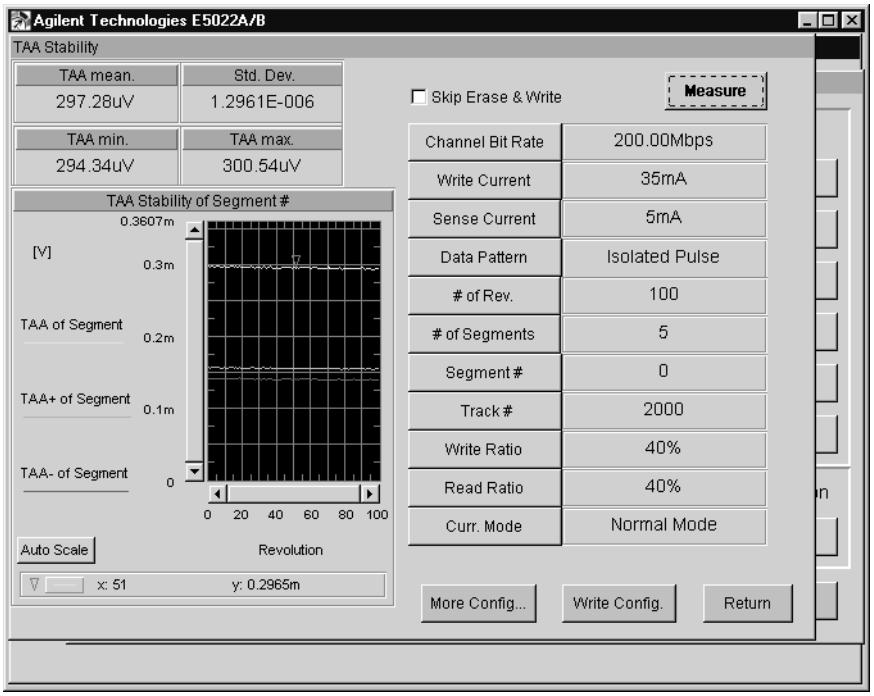


TAA	Measures the stability of TAA.
PW	Measures the stability of PW.
Narrow Band TAA	Measures the stability of the Narrow Band TAA.

2. Click on the [TAA] button to open the TAA Stability menu.

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Figure 3-33 TAA Stability Menu



3. Set the parameters, click on each button to enter a new value.

Skip Erase & Write	Selects the type of measurement sequence. Erase and write sequences are not done when this is checked.
Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Data Pattern	Specifies the data pattern to be selected for measurement. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
# of Rev.	Specifies the number of revolutions of measurement.
# of Segments	Specifies the number segments or track divisions.
Segment #	Specifies the segment number by which to get the results. The results of the specified segment number will be plotted on the window.
Track#	Specifies the track number to be tested.
Write Ratio	Specifies the write aperture ratio relative to its corresponding sector (segment). See “Stability Measurement” on page 248.

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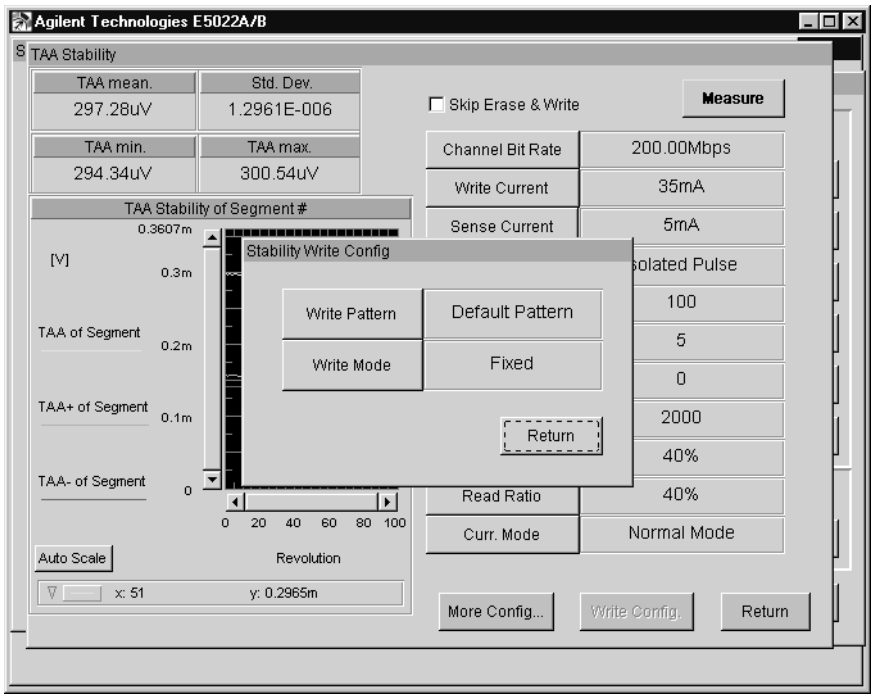
Read Ratio — Specifies the read aperture ratio relative to its corresponding sector (segment). See “Stability Measurement” on page 248.

Curr. Mode — Specifies the current polarity. When “Normal Mode” is selected, write current polarity is the same as read current polarity. If “Reverse Mode” is selected, the read current polarity is opposite to the write current polarity. Some head amplifier does not support the reverse and/or off functions. This setting is used for only the stability measurement. The other measurements use the setting of Sense Curr. Mode under the setup menu for the current polarity. See Figure 3-10 on page 53.

4. Click on the [Write Config] button, to set the stimulus write pattern of the stability measurement.

   In order to effectively use the write mode “continuous” you must set the repetitive period of the selected data pattern to 1T, 2T, 4T and/or 8T in the [Pattern Config] menu. Refer to the “hpe5022_stabilityWriteModeConfig” function of the programming manual for details.

Figure 3-34 **Stability Write Configuration Menu**

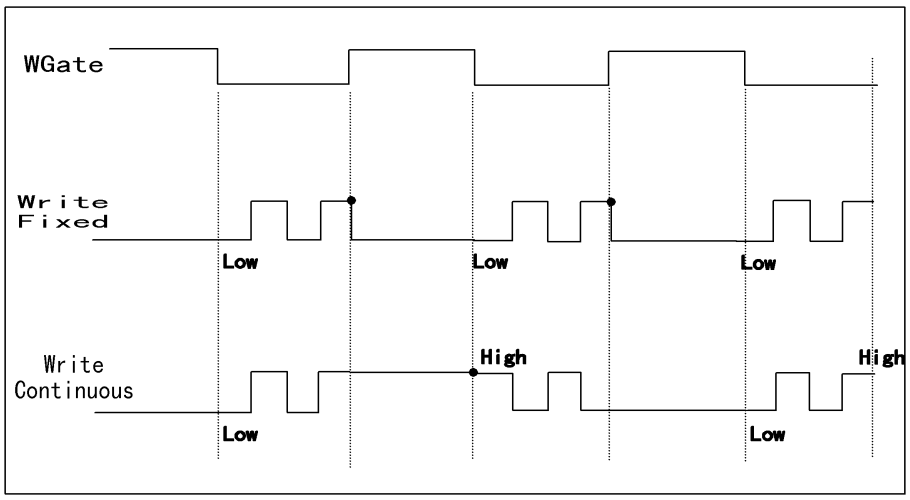


NOTE If the attached head amplifier does not support “continuous” write current function, a

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system error “hpe5022_ERROR_NSUP_CONF” will be displayed, when you set the [Write Mode] to “Continuous”.

Figure 3-35 **Write Mode**



Write Pattern Specifies the write excitation pattern for stability measurement.

Write Mode Specifies the write data polarity when writing the data. When ‘Fixed’ is selected the write current direction of each write operation is the always the same for all segments. When ‘Continuous’ is selected the write current direction at the beginning of write operation is the same as the last current direction of the previous write. Refer to the programming manual for details.

5. Click on the [Measure] button to start measurement. Results are displayed after measurement.

Measurement Display

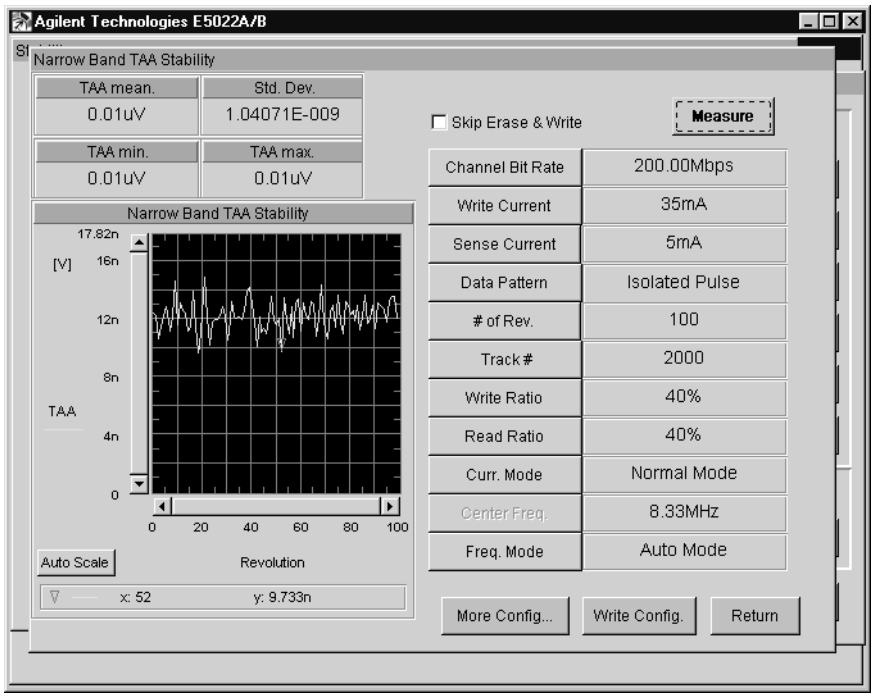
The menu shows the measurement results of TAA, TAA+ and TAA- from the first revolution up to the # of Rev. The mean, minimum, maximum and standard deviation of the TAA are all displayed on the upper portion of the graph.

6. Click the [Return] button to return to the Stability menu.

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1. Click on [Narrow Band TAA] to open the Narrow Band TAA menu

Figure 3-36 **Narrow Band TAA Menu**



NOTE For Stability measurement of Narrow Band TAA, tracks are unsectored.

2. Set the parameters, click on each button to enter a new value.

Skip Erase & Write Selects the type of measurement sequence. Erase and write sequences are not done when this is checked.

Channel Bit Rate Specifies the speed at which data bits are written on the media per second [bps].

Write Current Specifies the current applied to the write head.

Sense Current Specifies the current applied to the read head.

Data Pattern Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.

Track# Specifies the track number to be tested.

Write Ratio Specifies the write aperture ratio of a sector (segment). See “Stability Measurement” on page 248.

Read Ratio Specifies the read aperture ratio of a sector (segment) See “Stability Measurement” on page 248.

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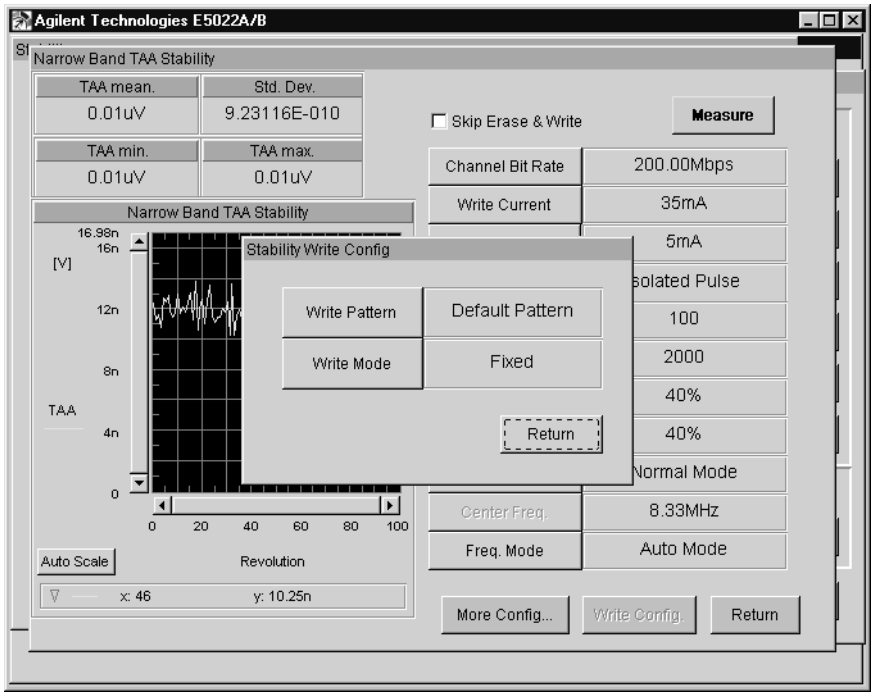
Curr. Mode	Specifies the current polarity. When “Normal Mode” is selected, write current polarity is the same as read current polarity. If “Reverse Mode” is selected, the read current polarity is opposite to the write current polarity. Some head amplifier does not support the reverse and/or off functions. This setting is used for only the stability measurement. The other measurements use the setting of Sense Curr. Mode under the setup menu for the current polarity. See Figure 3-10 on page 53.
Center Freq.	Specifies the measurement frequency of the spectrum analyzer.
Freq. Mode	Specifies the type of frequency mode to measure the Narrow Band TAA. When ‘Auto Mode’ is selected, the measurement frequency is set to the fundamental frequency of the data pattern. When ‘Fixed Mode’ is selected, measurement frequency is set to the frequency specified by the parameter [Center Freq.].

3. Click on the [Write Config] button, to set the stimulus write pattern of the stability measurement.

   In order to effectively use the write mode “continuous” you must set the transition period of the selected data pattern to a value of 1T, 2T, 4T and 8T in the [Pattern Config] menu. Refer to the “hpe5022_stabilityWriteModeConfig” function of the programming manual for details.

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Figure 3-37 **Stability Write Configuration**



Write Pattern Specifies the write excitation pattern for stability measurement.

Write Mode Specifies the write data polarity when writing the data. When ‘Fixed’ is selected the write current direction of each write operation is the always the same. When ‘Continuous’ is selected the write current direction at the beginning of write operation is the same as the last current direction of the previous write. Refer to the programming manual for details.

4. Click the [Measure] button to start measurement. Results are displayed after measurement.

Measurement Display The window shows the measurement results of TAA from a specified number of revolutions [# of Rev]. The mean, minimum, maximum and standard deviation of the measured narrow band TAA are all displayed on the upper portion of the graph.

5. Click the [Return] button to return to the Measure menu.

See also See the “Stability Measurement function” section in Chapter 3 of the programming manual.

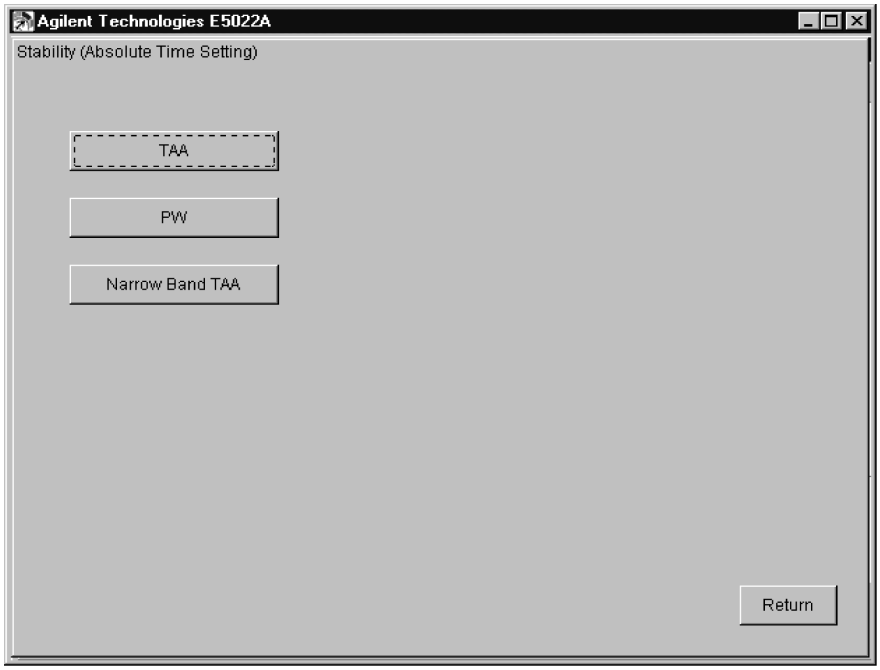
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Stability Measurement (Absolute Time Setting)

This measurement allows the user to set up the write and read operation in each segment (sector) as a function of absolute time so that test results can be closely correlated to popcorn noise test.

1. To open the 'Stability Measurement (Absolute Time Setting)' menu, click on the [Stability] > [Stability (Absolute Time Setting)] button from the Measurement Menu.

Figure 3-38 **Stability Measurement (Absolute Time Setting) Menu**

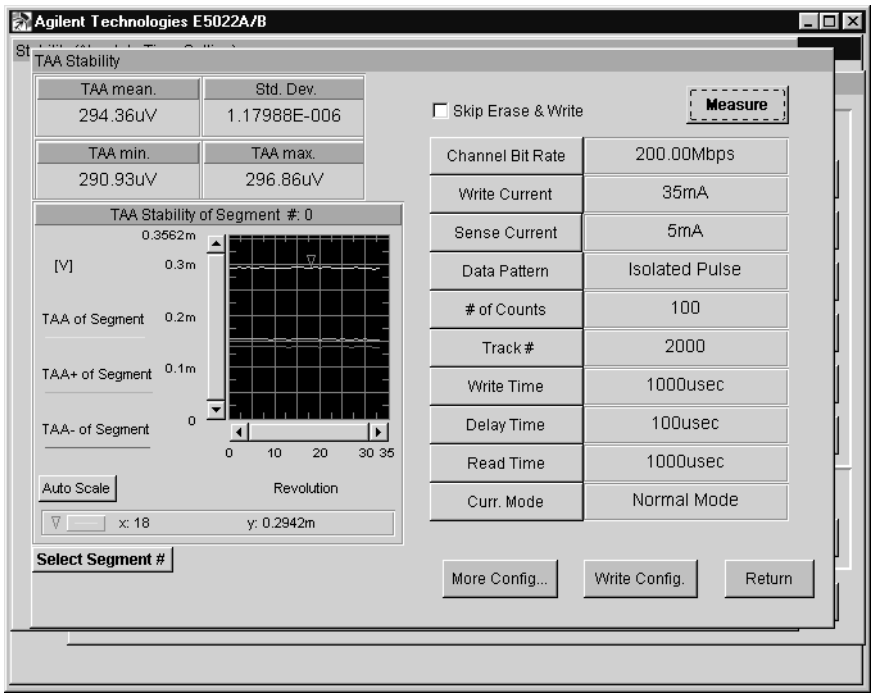


TAA	Measures the stability of TAA.
PW	Measures the stability of PW.
Narrow Band TAA	Measures the stability of the Narrow Band TAA.

2. Click on the [TAA] button to open the TAA Stability menu.

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Figure 3-39 TAA Stability Menu



3. Set the parameters, click on each button to enter a new value.

Skip Erase & Write	Selects the type of measurement sequence. Erase and write sequences are not done when this is checked.
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Data Pattern	Specifies the data pattern to be selected for measurement. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
# of Counts	Specifies the number of measurement counts. (where, *count = revolution x segment)*
Track#	Specifies the track number to be tested.
Write Time	Specifies the time to write the data. Minimum value is 1[µsec] and maximum value is 10[msec]. Refer to “hpe5022_measureAbsStability” function of the programming manual for details.
Delay	Specifies the distance in time between write and read operation. This parameter represents the delay time when to read the data after write. Minimum value is zero and maximum value is 10[msec]. Refer to

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"hpe5022_measureAbsStability" function of the programming manual for details.

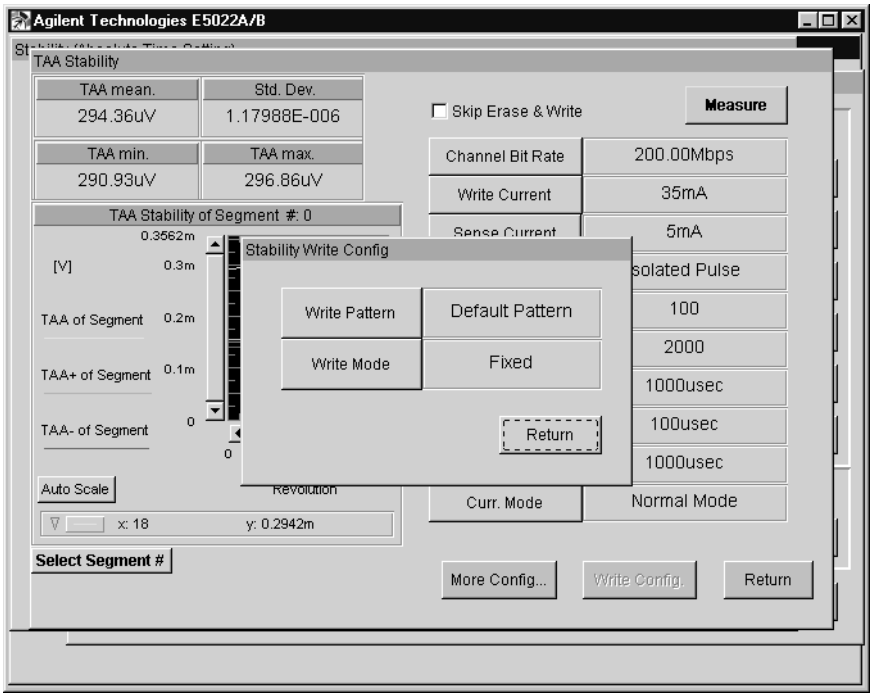
Read Time — Specifies the amount of time to read the data. Minimum value is 20[µsec] and maximum value is 10[msec]. Refer to "hpe5022_measureAbsStability" function of the programming manual for details.

Curr. Mode — Specifies the current polarity. When "Normal Mode" is selected, write current polarity is the same as read current polarity. If "Reverse Mode" is selected, the read current polarity is the opposite of the write current polarity. Only the universal head amplifier supports the reverse and off modes.

4. Click on the [Write Config] button, to set the write excitation pattern of the stability measurement.

   In order to effectively use the write mode "continuous" the user must set the repetitive period of the selected data pattern to 1T, 2T, 4T and/or 8T in the [Pattern Config] menu. Refer to the "hpe5022_stabilityWriteModeConfig" function of the programming manual for details.

Figure 3-40 Stability Write Configuration Menu

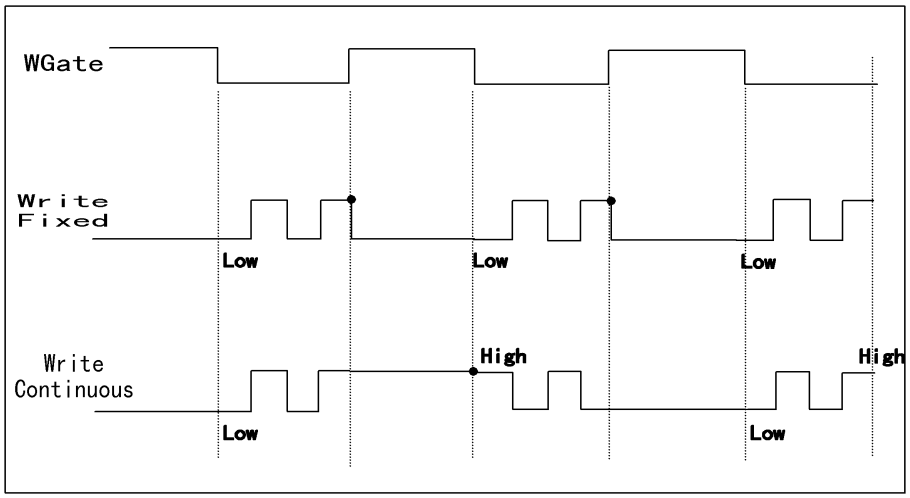


NOTE If the attached head amplifier does not support "continuous" write current function, a system error "hpe5022_ERROR_NSUP_CONF" will be displayed, when you set the

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[Write Mode] to “Continuous”.

Figure 3-41 **Write Mode**



Write Pattern Specifies the write excitation pattern for stability measurement.

Write Mode Specifies the write data polarity when writing the data. When ‘Fixed’ is selected the write current direction of each write operation is the always the same for all segments. When ‘Continuous’ is selected the write current direction at the beginning of write operation is the same as the last current direction of the previous write. Refer to the programming manual for details.

5. Click on the [Measure] button to start measurement. To show the measurement results of a particular segment, click on [Select Segment #] and enter the segment number.

Measurement Display

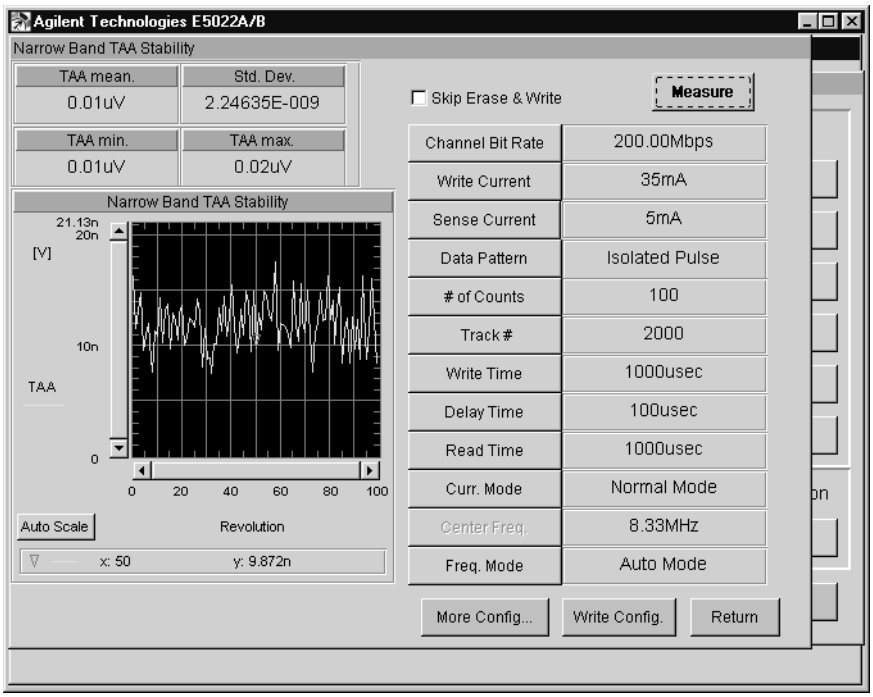
The menu shows the measurement results of TAA, TAA+ and TAA- from the specified number of counts [# of Counts]. The mean, minimum, maximum and standard deviation of the TAA are all displayed on the upper portion of the graph.

6. Click the [Return] button to return to the Stability menu.

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1. Click on [Narrow Band TAA] to open the Narrow Band TAA menu.

Figure 3-42 **[Narrow Band TAA] Menu**



NOTE For Stability measurement of Narrow Band TAA, tracks are unsectored.

2. Set the parameters, click on each button to enter a new value.

Skip Erase & Write — Selects the type of measurement sequence. Erease and write sequences are not done when this is checked.

Channel Bit Rate — Specifies the speed at which data bits are written on the media per second [bps].

Write Current — Specifies the current applied to the write head.

Sense Current — Specifies the current applied to the read head.

Data Pattern — Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.

# of Counts — Specifies the number of measurement counts. where, *count = revolution x segment*

Track# — Specifies the track number to be tested.

Write Time — Specifies the time to write the data. Minimum value is 1[µsec] and maximum value is 10[msec]. Refer to "hpe5022_measureAbsStability" function of

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the programming manual for details.

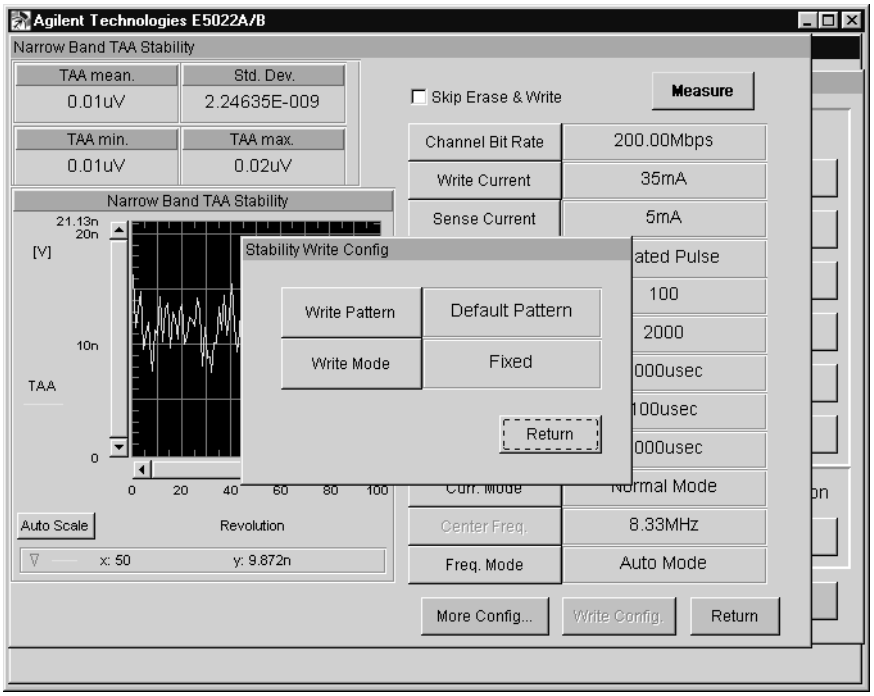
Delay	Specifies the distance in time between write and read operation. This parameter represents the delay time when to read the data after write. Minimum value is zero and maximum value is 10[msec]. Refer to “hpe5022_measureAbsStability” function of the programming manual for details.
Read Time	Specifies the amount of time to read the data. Minimum value is 800[µsec] and maximum value is 10[msec]. Refer to “hpe5022_measureAbsStability” function of the programming manual for details.
Curr. Mode	Specifies the current polarity. When “Normal Mode” is selected the write current polarity is the same as the read current polarity. When reverse mode is selected the read polarity is reversed. Only the universal head amplifier supports the reverse and off functions.
Center Freq.	Specifies the measurement frequency of the spectrum analyzer.
Freq. Mode	Specifies the type of frequency mode to measure the Narrow Band TAA. When ‘Auto Mode’ is selected, the measurement frequency is set to the fundamental frequency of the data pattern. When ‘Fixed Mode’ is selected, measurement frequency is set to the frequency specified by the parameter [Center Freq.].

3. Click on the [Write Config] button, to set up the write excitation pattern.

   In order to effectively use the write mode “continuous” you must set the transition period of the selected data pattern to a value of 1T, 2T, 4T and 8T in the [Pattern Config] menu. Refer to the “hpe5022_stabilityWriteModeConfig” function of the programming manual for details.

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Figure 3-43 Stability Write Configuration



Write Pattern — Specifies the write excitation pattern for stability measurement.

Write Mode — Specifies the write data polarity when writing the data. When 'Fixed' is selected the write current direction of each write operation is the always the same. When 'Continuous' is selected the write current direction at the beginning of write operation is the same as the last current direction of the previous write. Refer to the programming manual for details.

4. Click the [Measure] button to start measurement. Results are displayed after measurement.

Measurement Display — The window shows the measurement results of TAA from the specified number of counts [# of Counts]. The mean, minimum, maximum and standard deviation of the measured narrow band TAA are displayed on the upper right portion of the menu.

5. Click the [Return] button to return to the Measure menu.

See also — See the "Absolute Stability Measurement function" section in Chapter 3 of the programming manual.

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Narrow Band TAA (Parametric)

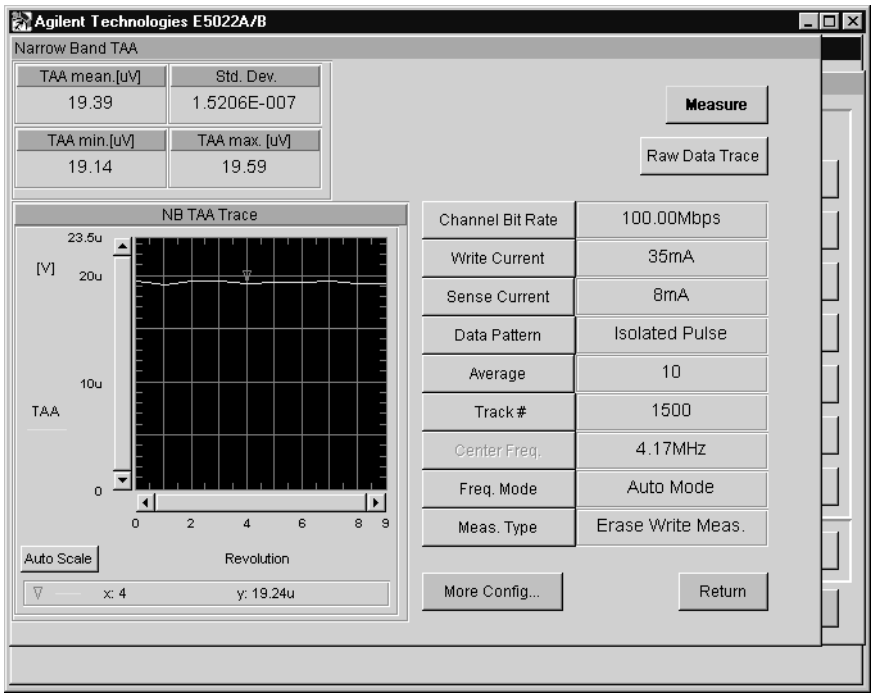
Overview

This section describes the Narrow Band TAA measurement. Narrow Band TAA is measured by the spectrum analyzer where low signal level measurement is possible.

Measurement Procedure

1. To open the Narrow Band TAA menu, click on the [Narrow Band TAA] button from the Parametric frame of the Measure menu.

Figure 3-44 **Narrow Band TAA Menu**



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Data Pattern	Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
Average	Specifies the number of revolutions to get the average results.
Track #	Specifies the track number to be tested.

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Center Freq. — Specifies the measurement frequency of the spectrum analyzer. This parameter can only be used if [Freq.Mode] is set to “Manual”.

Freq. Mode — Specifies the setting of the measurement frequency. Select either Auto Mode or Manual Mode. If Auto is selected the measurement frequency is automatically set. If Manual is selected the frequency specified by Center Freq. will be used to measure.

Meas. Type — Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to perform a DC erase, write data then measure. 2)[Write Meas.] means to write a data, then measure. 3)[Meas.] means to measure only.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

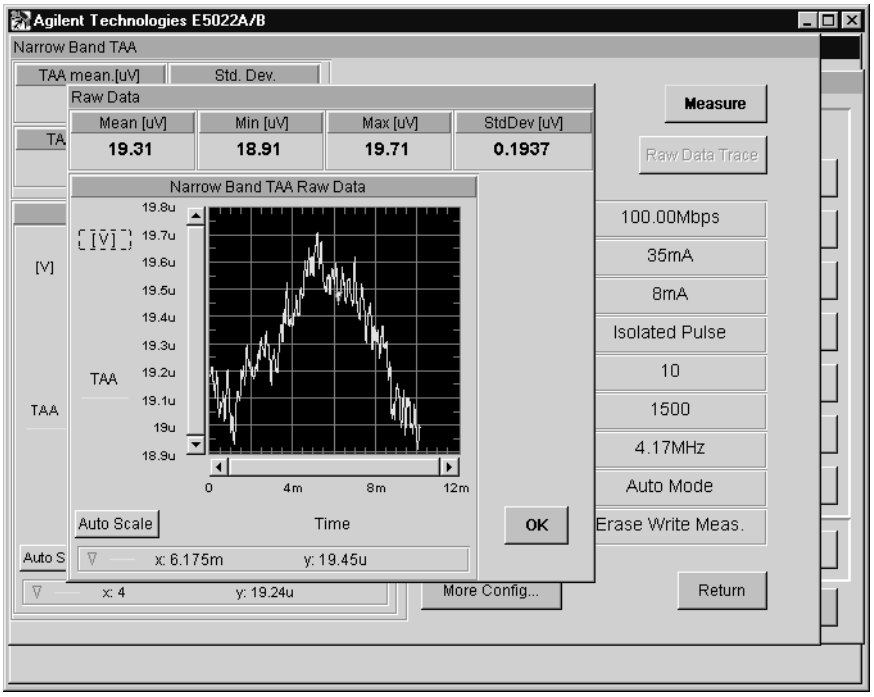
3. Click the [Measure] button to start measurement.

Measurement Display

The upper portion of the window shows the mean, minimum, maximum and standard deviation of the Narrow Band TAA. The graph displays the measured Narrow Band TAA for each revolution.

4. Click on the [Raw Data Trace] button to display the results of Raw Data. This button is not activated on the 4395A.

Figure 3-45 Raw Data Display



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Measurement Display

The Raw Data represents the original data used to calculate the narrow Band TAA.

The upper portion of the graph shows the mean, maximum, minimum and std. deviation of the raw data.

5. Click the [Return] button to return to Measure menu.

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Waveform Analysis (Parametric)

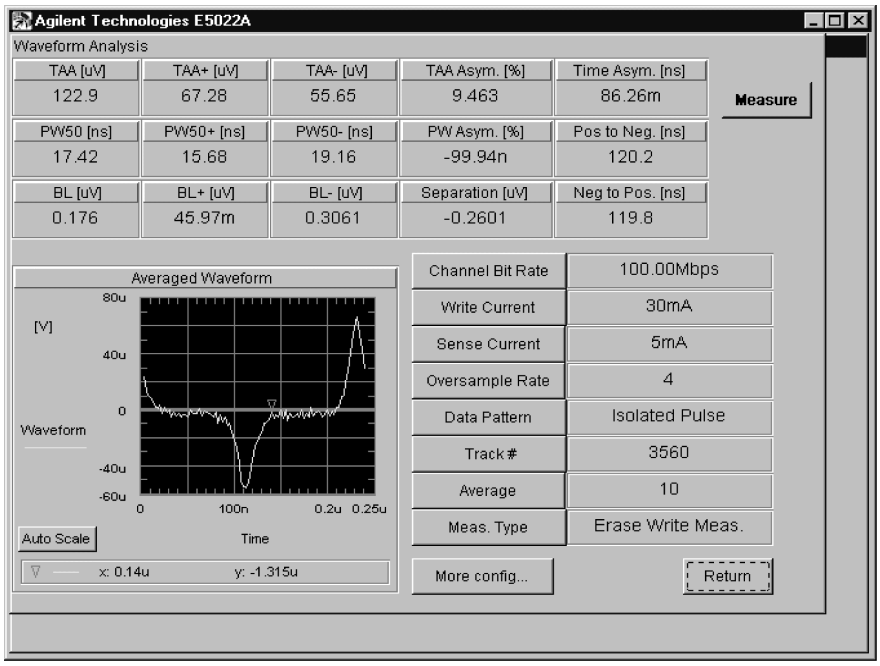
Overview

This section describes the parametric measurement by waveform analysis. Waveform analysis is performed by an oscilloscope. If an oscilloscope is not installed in your system, this measurement can not be executed.

Measurement Procedure

1. To open the Waveform Analysis menu, click on the [Waveform Analysis] button from the Parametric frame of the Measure menu.

Figure 3-46 Waveform Analysis Menu



2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate — Specifies the speed at which data bits are written on the media per second [bps].

Write Current — Specifies the current applied to the write head.

Sense Current — Specifies the current applied to the read head.

Oversample Rate — Specifies the sampling rate of the oscilloscope. The sampling rate of the oscilloscope is specified by the (channel bit rate) x (oversample rate).

Data Pattern — Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.

Track # — Specifies the track number to be tested.

Average — Specifies the number of revolutions to get the average results.

Meas. Type — Specifies the type of measurement sequence.

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1)[Erase Write Meas.] means to perform a DC erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click the [Measure] button to start measurement. Results are displayed after measurement.

Measurement Display

The number of waveform periods are averaged and displayed on the window. The upper portion of the window shows the TAA, PW and Baseline results.

4. Click the [Return] button to return to Measure menu.

See also See the “Waveform measurement function” section in Chapter 3 of the programming manual for the parameter range and its detailed description.

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Absolute Polarity (Parametric)

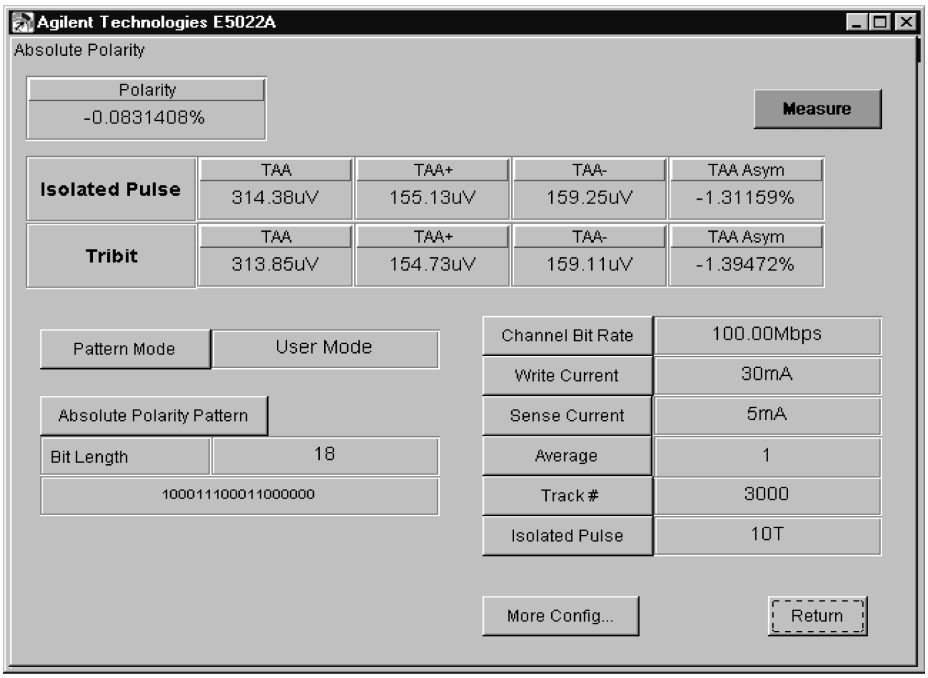
Overview

This section describes the Absolute Polarity measurement. Absolute polarity is measured by the parametric module. This test is used to detect the pinned layer reversal of the GMR head by measuring the TAA asymmetry of the Isolated Pulse TAA and Tribit TAA.

Measurement Procedure

1. To open the Absolute Polarity menu, click on the [Absolute Polarity] button from the Parametric frame of the Measure menu.

Figure 3-47 **Absolute Polarity Menu**



2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Average	Specifies the number of revolutions to get the average results.
Track #	Specifies the track number to be tested.
Isolated Pulse	Specifies the repetitive period of the isolated pulse pattern.
Pattern Mode	Specifies the configuration of the data pattern. Select either ‘Auto Mode’ or ‘User Mode’. When ‘Auto Mode’ is selected, the combination of isolated pulse and tribit data pattern will be used automatically. When ‘User Mode’ is selected, the [Absolute Polarity Pattern] button becomes active. This

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allows the user to specify a new data pattern.

Absolute Polarity Pattern — Specifies the data pattern defined by the user. This button becomes active when the [Pattern Mode] is set to 'User Mode'. When you click this button a popup window will appear that allows the user to specify a new data pattern. Consequently, [Bit Length] will reflect the specified data pattern.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on the [Measure] button to start measurement. Results are displayed after measurement.

Measurement Display The measurement window shows the average TAA, TAA+, TAA- and TAA Asymmetry for both Isolated Pulse and Tribit patterns. It also shows the computed absolute polarity in terms of percentage.

4. Click the [Return] button to return to Measure menu.

See also See the Chapter 4 "Absolute Polarity Test" on page 254 and also the "Absolute Polarity measurement function" in Chapter 3 of the programming manual for more details.

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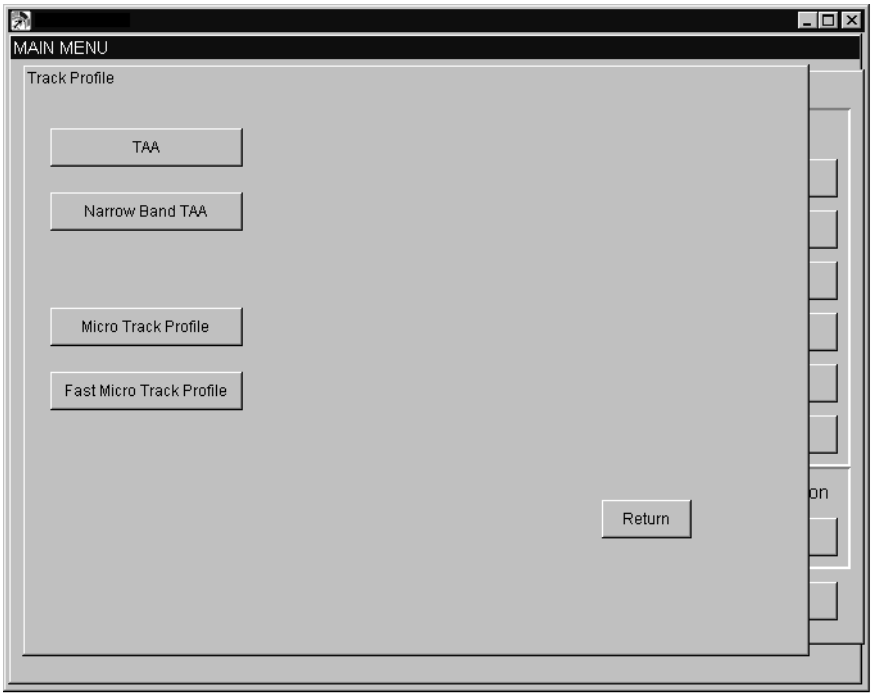
Track Profile Measurement (Parameter Sweep)

This section describes the track profile measurement. Track profile measurement is used to measure the track profile, the narrow band track profile and micro track profile. This measurement is measured by the parametric module. While narrow band track profile and the micro track profile measurements are measured by the spectrum analyzer.

TAA Track Profile Measurement

1. To open the Track Profile menu, click on the [Track Profile] button from the Parameter Sweep frame of the Measure menu.

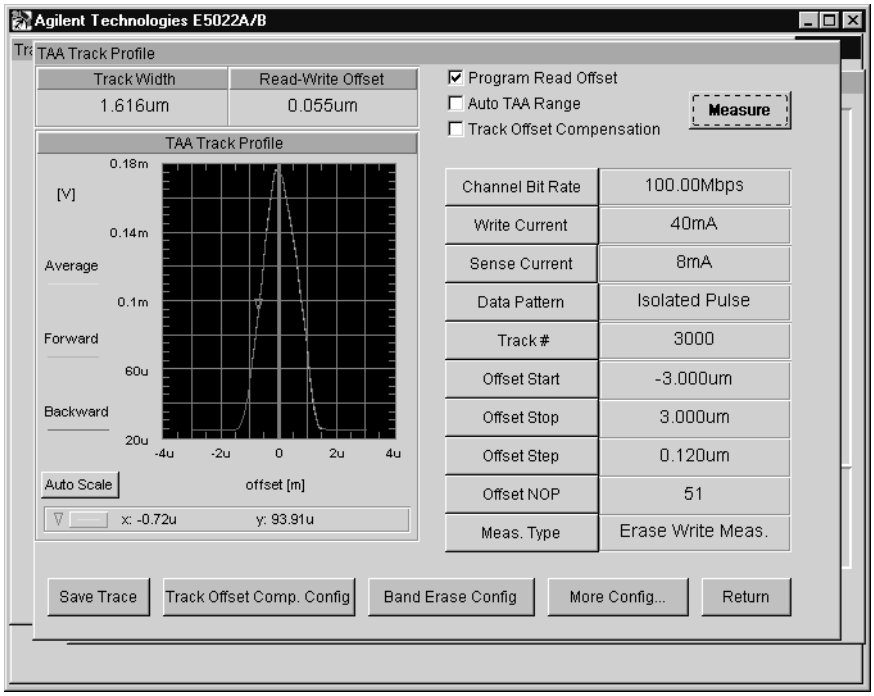
Figure 3-48 **Track Profile Menu**



2. Click on [TAA] button from the Track Profile menu to open the TAA Track Profile menu.

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Figure 3-49 **TAA Track Profile Menu**



3. Set the parameters, click on each button to enter a new value.

Program Read Offset — Specifies the auto setting of the read-write offset when track profile is performed. If you check this box the write offset and read offset of the [Spinstand] menu will change automatically. The write offset is set to zero while the read offset is set to the “Read-Write Offset” value of this measurement.

Auto TAA Range — (Specifies the TAA range to auto mode.) Checking this box will eliminate an overflow of TAA measurement. The range automatically adjusts itself to an appropriate range when an overflow occurs. See “hpe5022_isolatedPulseReferenceTaaAuto” of the programming manual.

Track Offset Compensation — Checking this box will activate a track offset compensation function. See “Track Offset Compensation Function” on page 274.

Channel Bit Rate — Specifies the speed at which data bits are written on the media per second [bps].

Write Current — Specifies the current applied to the write head.

Sense Current — Specifies the current applied to the read head.

Data Pattern — Specifies the data pattern to be written on the test track. To set the data pattern, click on the

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[Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.

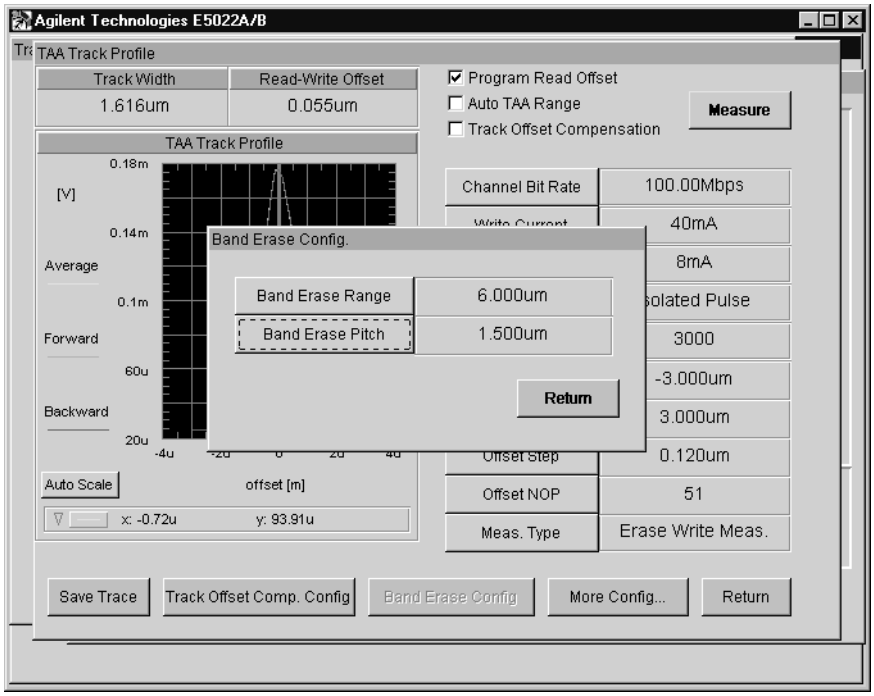
Track #	Specifies the track number to be tested.
Offset Start	Specifies the starting point of the head offset in measuring the TAA track profile.
Offset Stop	Specifies the stopping point of the head offset in measuring the TAA track profile.
Offset Step	Specifies the step by which the head is moved in measuring the TAA track profile. When you set this parameter with [Offset Start] and [Offset Stop], [Offset NOP] will be computed and updated automatically.
Offset NOP	Specifies the number of measurement points to build the track profile. When you set this parameter with [Offset Start] and [Offset Stop], [Offset Step] will be computed and updated automatically.
Meas. Type	Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to perform a DC band erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.

NOTE When “hpe5022_SEQ_ER_WR_M” is selected in the “hpe5022_measureTrackProfile” function, a DC erase is performed as erase sequence, however, when [Erase Write Meas.] is selected, the band erase is performed in this VEE measurement program. In the VEE measurement program perform, the “hpe5022_measureTrackProfile” function is done in the mode of “hpe5022_SEQ_WR_M” after band erase.

4. Click the [Band Erase] button to open the band erase window. Band erase is executed only when the selected measurement sequence in [Meas. Type] parameter is “Erase Write Meas”.

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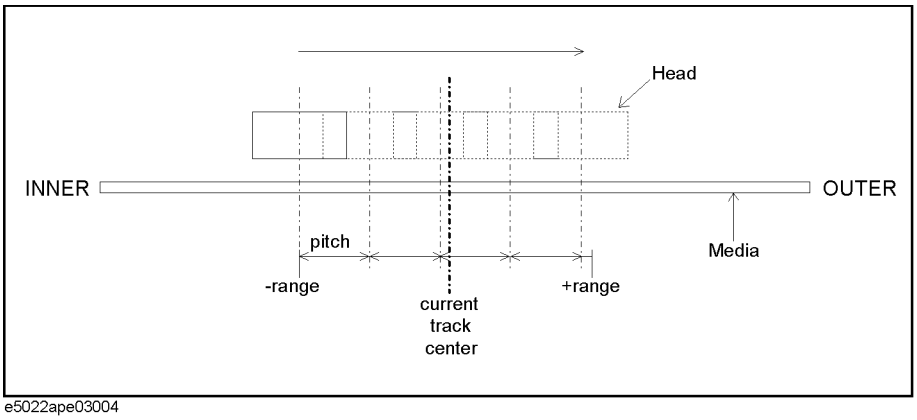
Figure 3-50 TAA Track Profile Menu - Band Erase Setting



Band Erase Range Specifies the range of band erase.

Band Erase Pitch Specifies the erase pitch of band erase.

Figure 3-51 Parameter of Band Erase

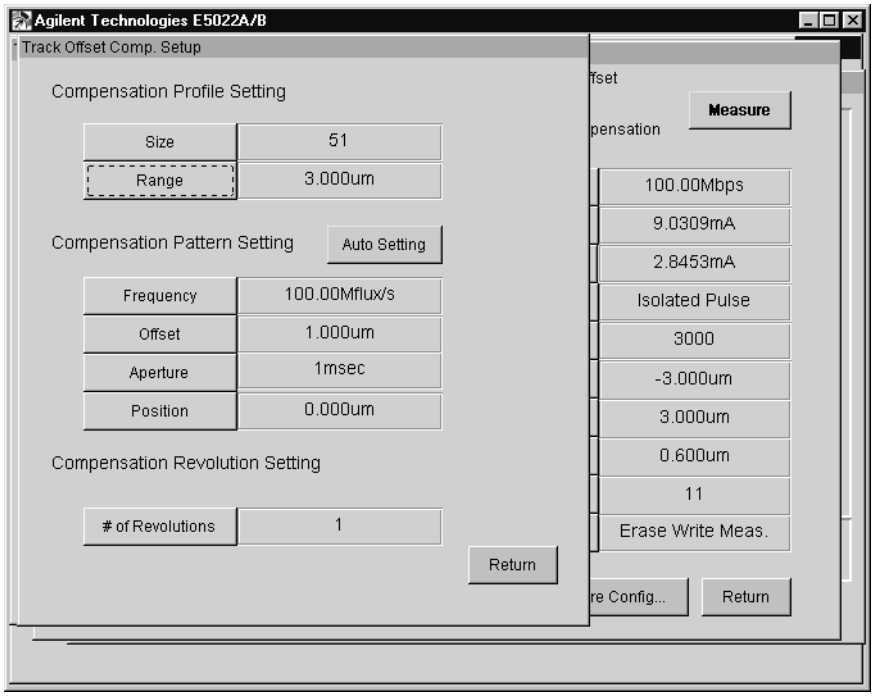


e5022ape03004

5. Click the [Track Offset Compen Config.] button to open the Track Offset Conpmenband window. See also the “Track Offset Compensation Function” on page 274 for each parameters.

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Figure 3-52 TAA Track Profile Menu - Track Offset Compensation Setup



- Compensation Profile Setting

  Size — Specifies the track profile points for a calibration sequence in the track offset compensation sequence.

  Range — Specifies the track profile range for a calibration sequence in the track offset compensation sequence.

- Compensation Pattern Setting

  Auto Setting — Checking this box will define a compensation pattern setting automatically.

  Frequency — Specifies a frequency of the burst patterns.

  Offset — Specifies a offset position of the burst patterns.

  Aperture — Specifies a aperture time of the burst patterns.

  Position — Specifies a burst pattern position from the track center.

- Compensation Revolution Setting

  # of Revolution — Specifies the average counts to measure a position error signal (PES). The burst pattern is measured during revolutions specified by this number and calculates a PES from the averaged value.

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6. Click on the [Measure] button to start measurement. Results will be displayed after measurement.

   The measured results of the track profile are displayed on this menu. This menu also reports the computed ‘Track Width’ and ‘Read/Write Offset’.

NOTE Click on the “Save Trace” button to save the swept measurement data. A file menu will pop up that will require the user to enter a file name (e.g., FileName.csv).

7. Click the [Return] button to return to Track Profile menu.

See also

8. See “Track Offset Compensation Function” on page 274 and the “Track Profile measurement function” section in Chapter 3 of the programming manual for the parameter and detailed description.

NOTE Track Offset Compensation can not be used when the system has E4402B 3GHz spectrum analyzer.

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Micro Track Profile Measurement

Overview

The micro track profile measurement is used to predict the width of the read head. It measures the narrow band track profile after creating a micro track.

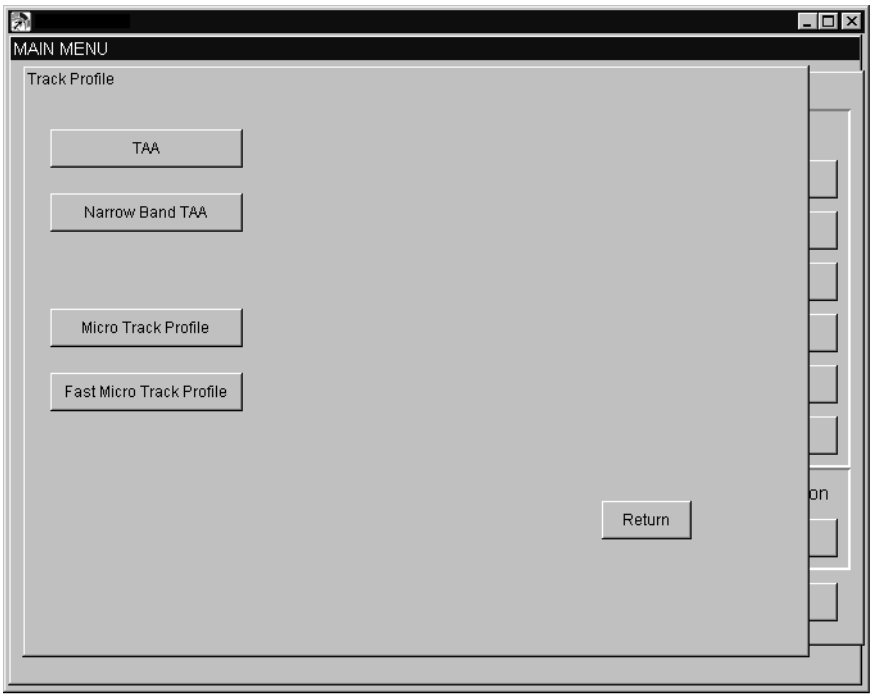
There are two types of micro track profile measurement, a micro track profile and a fast micro track profile measurements.

One method is to create a micro track by erasing both sides of the track step by step until a specified level of the TAA is reached. When this TAA level is reached the narrowed track becomes a ‘micro track’, and the read width is measured based on this ‘micro track’.

Measurement Procedure

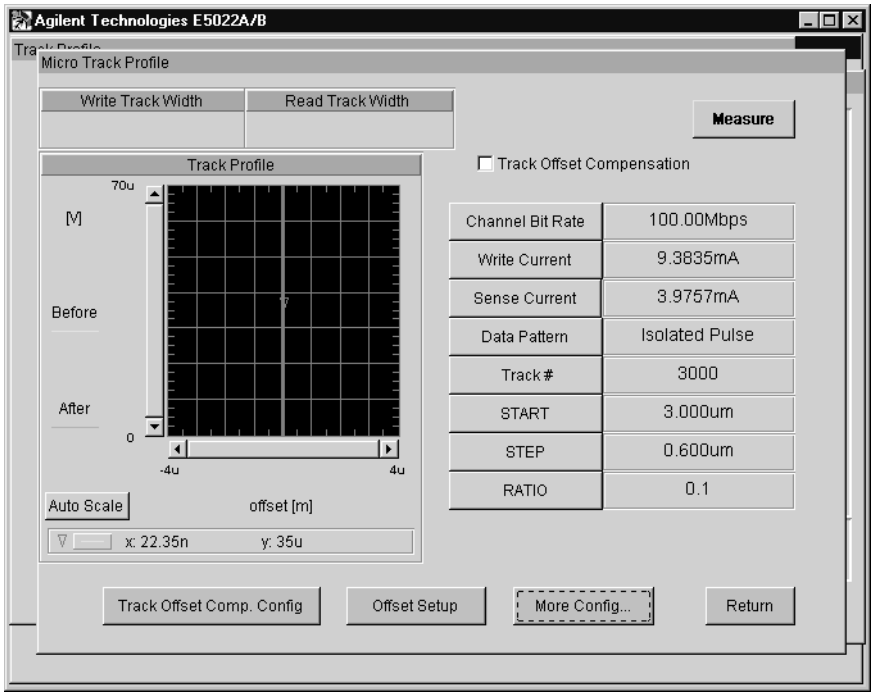
1. To open the Micro Track Profile menu, click on [Micro Track Profile] button from the Track Profile menu.

Figure 3-53 **Track Profile Menu**



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Figure 3-54 **Micro Track Profile Menu**



2. Set the parameters, click on each button to enter a new value.

Track Offset Compensation — Checking this box will activate a track offset compensation function. See “Track Offset Compensation Function” on page 274.

Channel Bit Rate — Specifies the speed at which data bits are written on the media per second [bps].

Write Current — Specifies the current applied to the write head.

Sense Current — Specifies the current applied to the read head.

Data Pattern — Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.

Track # — Specifies the track number to be tested.

Start — Specifies the starting point of erase offset in building a micro track. See “Micro Track Profile Measurement” on page 286 for details.

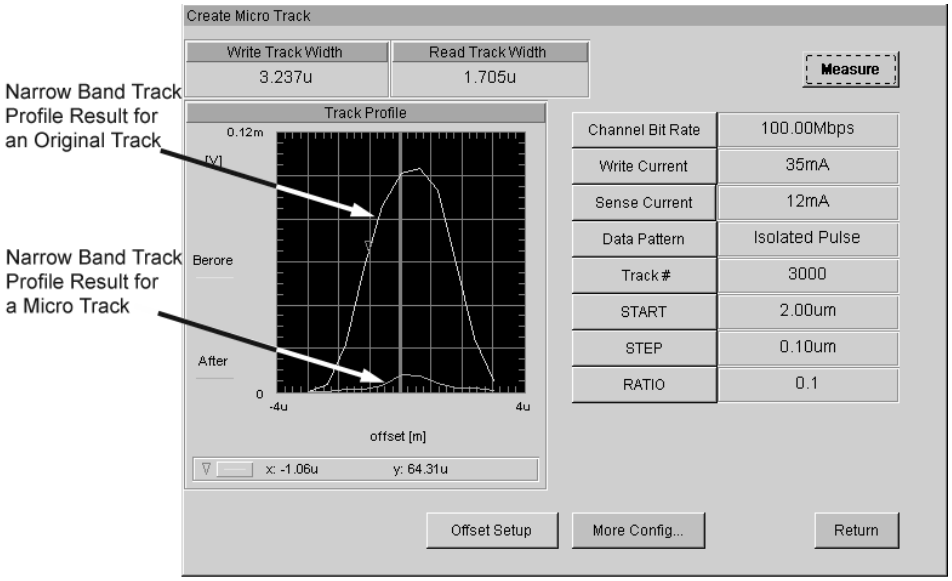
Step — Specifies the step by which to erase the test track in order to create a micro track. See “Micro Track Profile Measurement” on page 286 for details.

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Ratio — Specifies the ratio for micro track profile measurement. When this ratio is reached the erase offset will stop.Compares the TAA level of micro track from the original track. This ratio is defined as (TAA of Narrow Band Micro Track Profile) / (TAA of Narrow Band Track Profile). See “Micro Track Profile Measurement” on page 286 for details.

3. Click the [Track Offset Compen Config.] button to open the Track Offset Conpmenband window. This is the same as one in the track profile measurement.
4. Click on [Measure] button to start measurement.

Figure 3-55 **Micro Track Menu - Result**



Measurement Display — The Narrow Band Track Profile resulting from the original track and micro track are both displayed on the window. The Write Track Width is computed from the results of the Narrow Band Track whereas the Read Track Width is computed from the results of the Micro Track.

NOTE To observe the resulting waveform of the original track using the “hpe5022_measureTrackProfile” function, set the sequence type as “hpe5022_SEQ_ER_WR_M” and the measure function as “hpe5022_MEAS_NB_TAA”. To create a micro track use the “hpe5022_createMicroTrack”function. To observe the resulting waveform of the micro track using the “hpe5022_measureTrackProfile” function, set the sequence type as “hpe5022_SEQ_M” so as not to erase the micro track.

5. Click the [Return] button to return to Measure menu.

See also See the “Micro Track function” in Chapter 3 of the programming manual for the parameter

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range and its detailed description.

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Fast Micro Track Profile Measurement

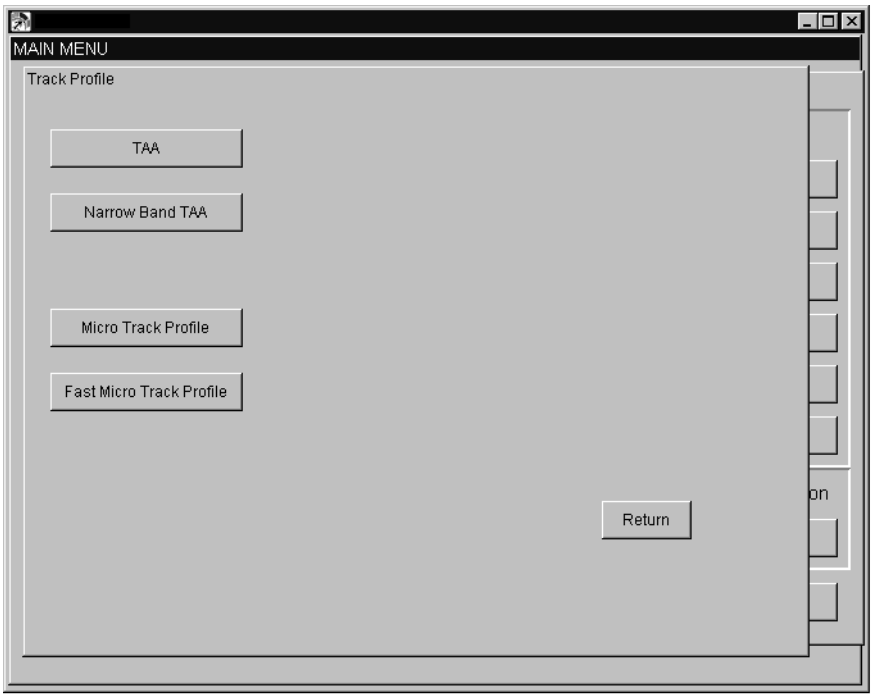
Overview

This measurement allows a faster micro track profile measurement. There is no TAA level monitoring during erase operation, erase is performed at once which allows for faster measurement.

Measurement Procedure

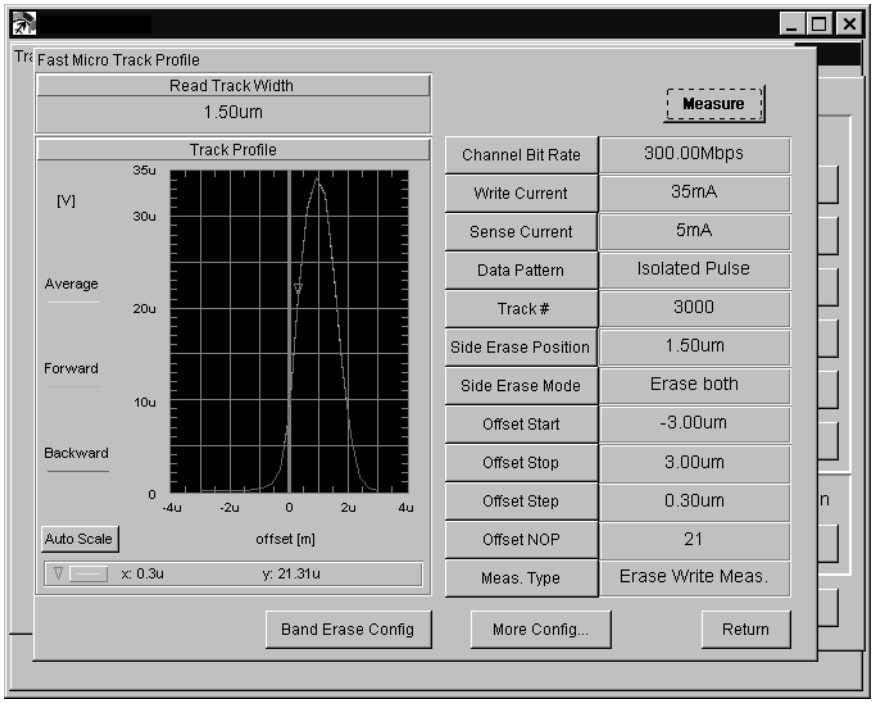
1. To open the Fast Micro Track Profile menu, click on [Fast Micro Track Profile] button from the Track Profile menu.

Figure 3-56 **Track Profile Menu**



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Figure 3-57 **Fast Micro Track Menu**



2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Data Pattern	Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
Track #	Specifies the track number to be tested.
Side Erase Position	Specifies the position to erase the side of the track in creating a micro track.
Side Erase Mode	Specifies the erase method. When “Erase Both” is selected, both sides of the track will be erased. When “Erase Single Side” is selected, only one side of the track will be erased. See “hpe5022_measureMicroTracProfile” function.
Offset Start	Specifies the starting point of the head offset in measuring the TAA track profile.
Offset Stop	Specifies the stopping point of the head offset in measuring the TAA track profile.

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Offset Step	Specifies the step by which the head is moved when measuring the TAA track profile. If you set this parameter with [Offset Start] and [Offset Stop], [Offset NOP] will be computed and updated automatically.
Offset NOP	Specifies the number of measurement points to build the track profile. If you set this parameter with [Offset Start] and [Offset Stop], [Offset Step] will be computed and updated automatically.
Meas. Type	Specifies the type of measurement sequence. 1) [Erase Write Meas.] means to perform a DC band erase, write data, erase sides of the track then measure. 2) [Write Meas.] means to write data, erase sides of the track, then measure.

NOTE When “hpe5022_SEQ_ER_WR_M” is selected in the “hpe5022_measureMicroTrackProfile” function, three track erase is performed as erase sequence, however, when [Erase Write Meas.] is selected, the band erase is performed in this VEE measurement program. In the VEE measurement program perform, the “hpe5022_measureMicroTrackProfile” function is done in the mode of “hpe5022_SEQ_WR_M” after band erase.

3. Click on [Measure] button to start measurement.

   The narrow band track profile resulting from the micro track are displayed on the window. The read track width is defined as the width at half amplitude level of the track profile result.

4. Click on the [Return] button to return to Measure menu.

See also See the “Micro Track function” in Chapter 3 of the programming manual for the parameter range and its detailed description.

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Write Current Sweep (Parameter Sweep)

Overview

This section describes the Write Current Sweep measurement. Write Current Sweep measurement is used to measure the TAA, PW, 5th Harmonic NLTS, Overwrite, and Narrow Band TAA.

Measurement Procedure

1. To open the Write Current Sweep menu, click on the [Write Current Sweep] button from the Parameter Sweep frame of the Measure menu.

Figure 3-58 **Write Current Sweep Menu**

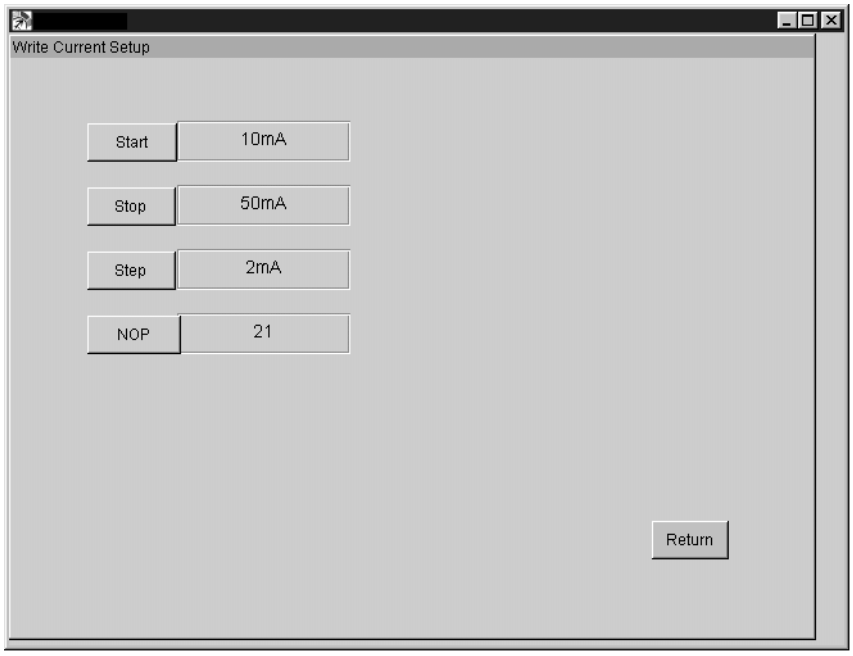


NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

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Figure 3-59 Write Current Setup menu



2. Set the parameters of write current sweep.

   Start Specifies the starting point to sweep the write current.

   Stop Specifies the stopping point to sweep the write current.

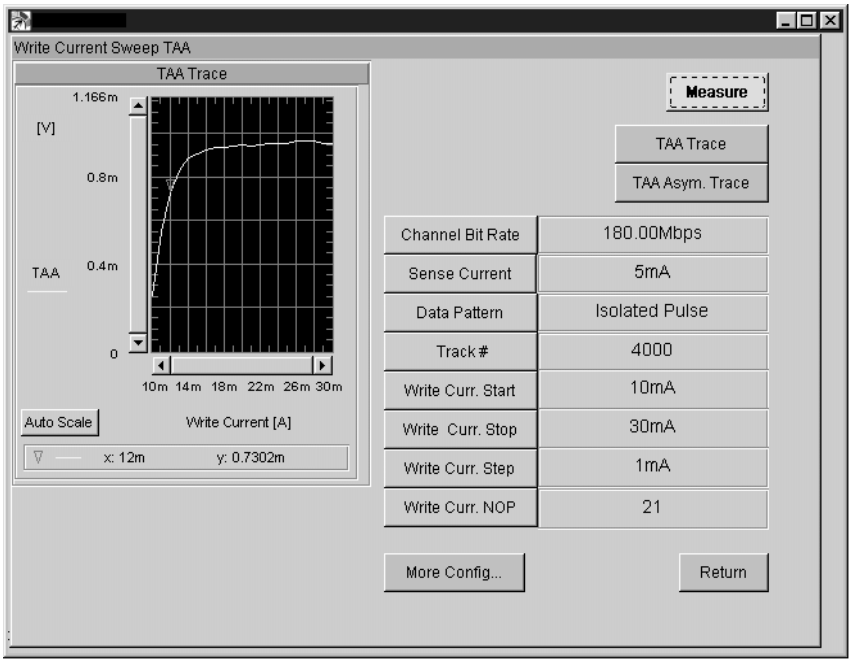
   Step Specifies the step by which write current is incremented while measuring TAA. If you set this parameter with Start and Stop, NOP will be computed and updated automatically.

   NOP Specifies the number of points in measuring TAA relative to the change in write current. If you set this parameter with Start and Stop, Step will be computed and updated automatically.

3. Click the [Return] button to return to Write Current Sweep menu
4. Select the parameter you want to measure. As an example TAA is selected to open the Write Current Sweep TAA menu.

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Figure 3-60 **Write Current Sweep TAA Menu**



5. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Sense Current	Specifies the current applied to the read head.
Data Pattern	Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
Track #	Specifies the track number to be tested.
Write Curr. Start	Specifies the starting point of write current.
Write Curr. Stop	Specifies the stopping point of write current.
Write Curr. Step	Specifies the step by which write current is incremented while measuring TAA. If you set this menu with [Write Curr.Start] and [WriteCurr.Stop], [Write Curr NOP] will be computed and updated automatically.

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Write Curr. NOP

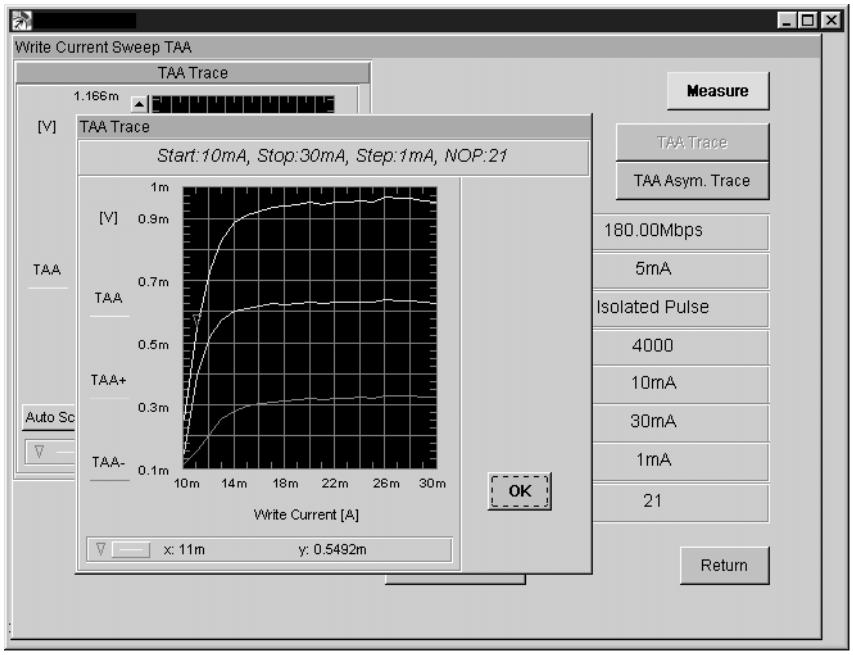
Specifies the number of points in measuring TAA relative to the change in write current. If you specify this parameter with [Write Curr. Stop] and [Write Curr. Step], [Write Curr. Step] will be computed and updated automatically.

NOTE

The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

6. Click on the [Measure] button to start measurement. When [Auto Scale] is pressed the graph scale will adjust itself automatically to its maximum and minimum values.
7. Click on the [TAA Trace] button to open the TAA Trace window.

Figure 3-61 TAA Trace Window



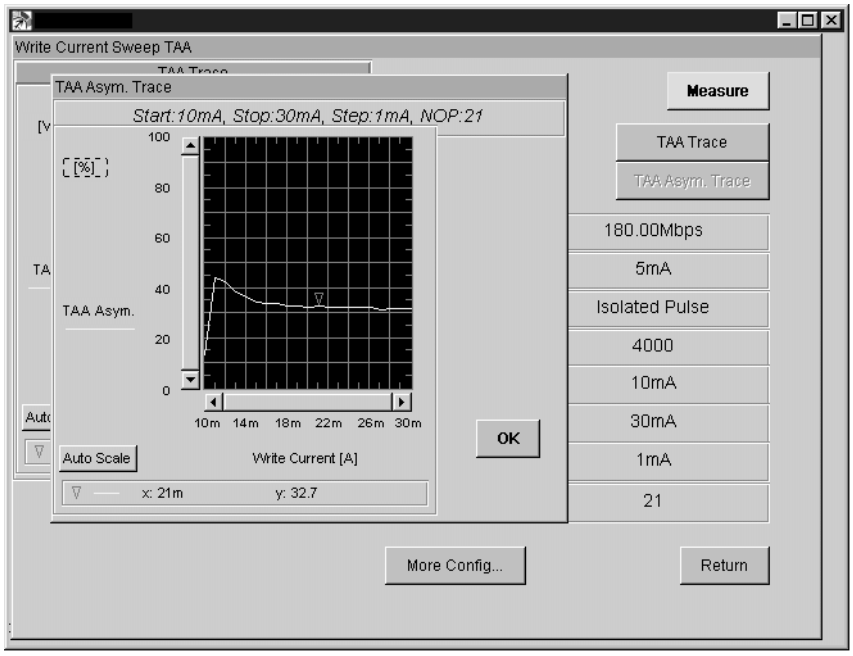
Measurement Display

The window shows the results of Write Current Sweep for TAA, TAA+ and TAA- respectively.

8. Click [OK] to return to TAA menu.
9. Click on the [TAA Asym. Trace] button to open the TAA Asym Trace window.

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Figure 3-62 **TAA Asym.Trace Window**



Measurement Display

The window shows the results of TAA Asymmetry of the write current sweep.

10. Click [OK] to return to Write Current Sweep TAA menu.
11. Click the [Return] button to return to Measure menu.

Sense Bias Sweep (Parameter Sweep)

Overview

This section describes the sense bias sweep measurement. Sense Bias Sweep measurement is used to measure the TAA, PW, 5th Harmonic NLTS, Overwrite and Narrow Band TAA.

Measurement Procedure

The measurement procedure is the same as the Write Current Sweep. Refer to Write Curr. Sweep measurement.

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Roll Off (Parameter Sweep)

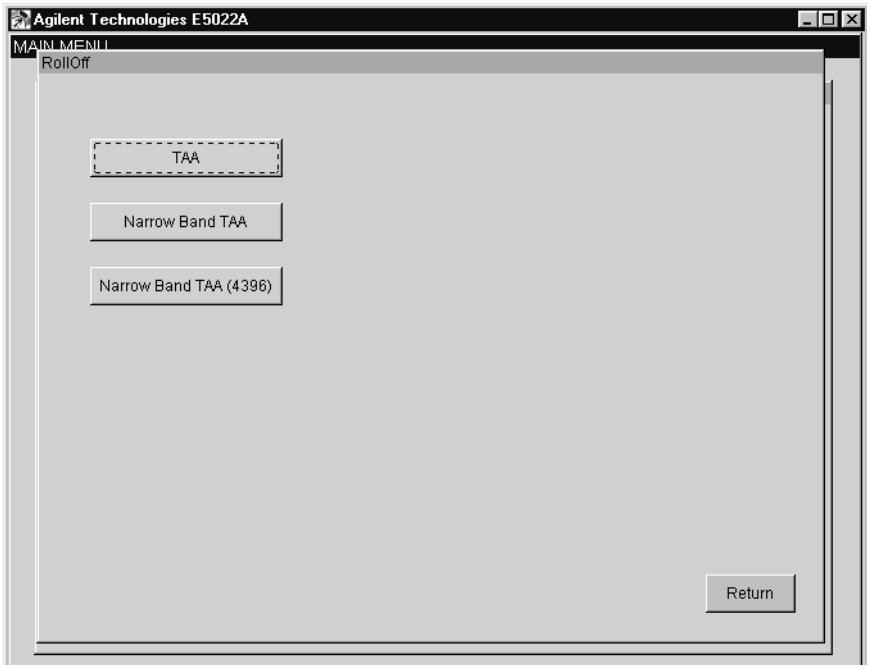
Overview

This section describes the Roll Off measurement. Roll Off measurement is used to measure the TAA and Narrow Band TAA.

Measurement Procedure

1. To open the Roll Off menu, click on the [Roll Off] button from the Parameter Sweep frame of the Measure menu.

Figure 3-63 Roll Off Menu



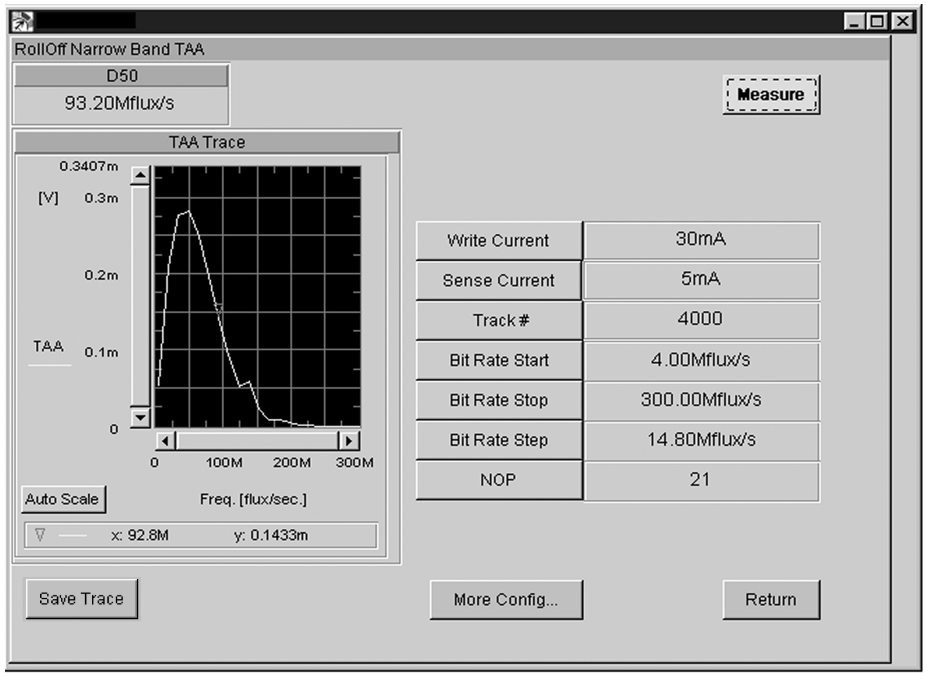
NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Select desired measurement from the rolloff menu.
3. Set the parameters, click on each button to enter a new value.

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Figure 3-64 **Roll Off Narrow Band TAA Menu**



Write Current — Specifies the current applied to the write head.

Sense Current — Specifies the current applied to the read head.

Track # — Specifies the track number to be tested.

Bit Rate Start — Specifies the starting point of the flux frequency.

Bit Rate Stop — Specifies the stopping point of the flux frequency.

Bit Rate Step — Specifies the step by which bit rate is incremented while measuring TAA. When you specify this parameter, [NOP] will be computed and updated automatically.

NOP — Specifies the number points in measuring TAA relative to the change in bit rate. When you specify this parameter, [Bit Rate Step] will be computed and updated automatically.

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NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

4. Click the [Measure] button to start measurement. When [Auto Scale] is pressed the graph scale will adjust itself automatically to its maximum and minimum values.

Measurement Display

The window shows the Roll-Off results. The upper portion of the window shows the computed flux density at PW50.

NOTE Click on the “Save Trace” button to save the swept measurement data. A file menu will pop up that will require the user to enter a file name (e.g., FileName.csv).

5. Click the [Return] button to return to Measure menu.

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Channel Bit Rate (Parameter Sweep)

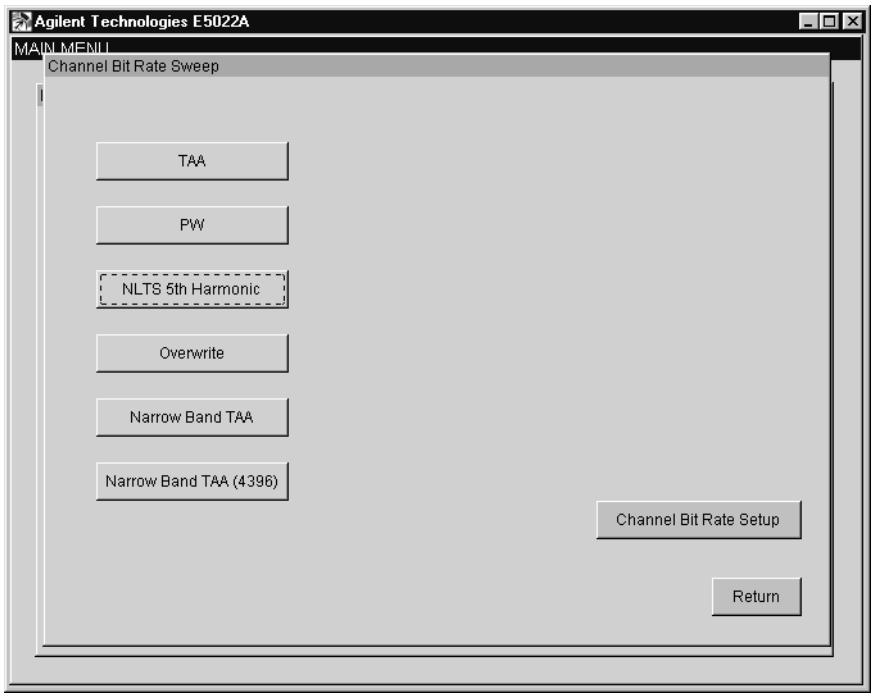
Overview

This section describes the Channel Bit Rate measurement. Channel Bit Rate measurement is used to measure the TAA, PW, NLTS 5th Harmonic, Overwrite and Narrow Band TAA.

Measurement Procedure

1. To open the Channel Bit Rate menu, click on the [Channel Bit Rate] button from the Parameter Sweep frame of the Measure menu.

Figure 3-65 Channel Bit Rate Sweep Menu



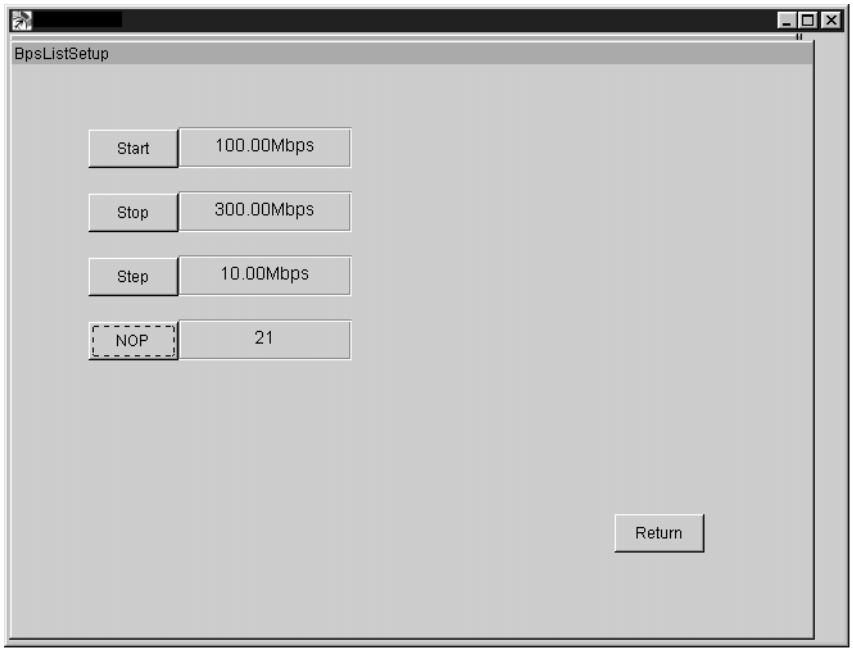
NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

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Figure 3-66 Channel Bit Rate Menu



3. Set the parameters for channel bit rate sweep.

   Start Specifies the starting point of the channel bit rate.

   Stop Specifies the stopping point of the channel bit rate.

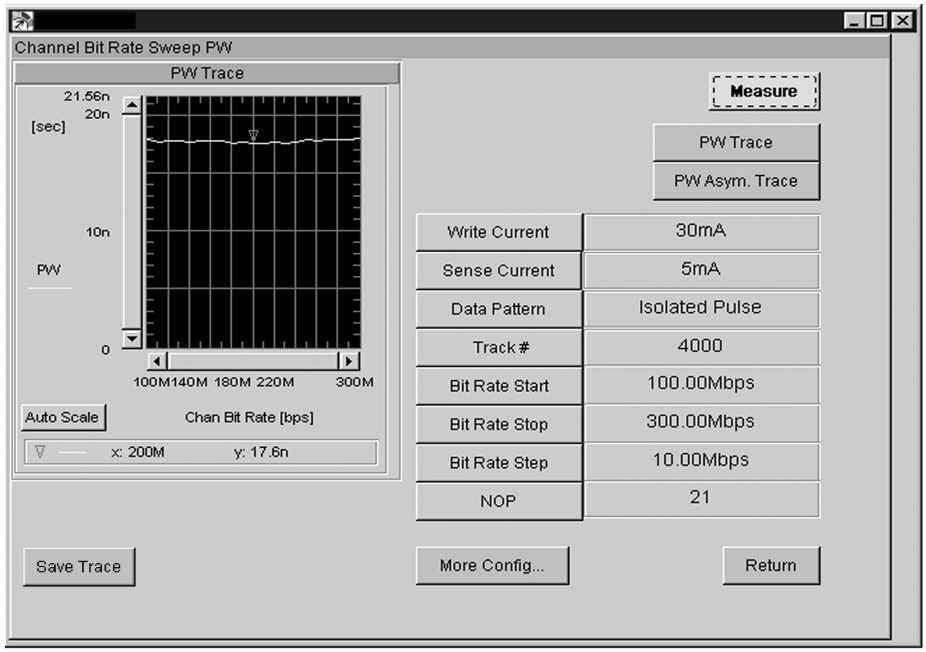
   Step Specifies the step by which channel bit rate is incremented while measuring TAA. When you specify the Step parameter together with Start and Stop parameters, NOP will be computed and updated automatically.

   NOP Specifies the number of points to measure TAA relative to the change in channel bit rate. If NOP is specified together with Start and Stop parameters, Step will be computed and updated automatically.

4. Click the [Return] button to return to Channel Bit Rate Sweep menu.
5. Select the parameter you want to measure. In this example, [PW] is selected.

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Figure 3-67 Channel Bit Rate Sweep PW Menu



6. Set the parameters, click on each button to enter a new value.

Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Data Pattern	Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
Track #	Specifies the track number to be tested.
Bit Rate Start	Specifies the starting point of the channel bit rate.
Bit Rate Stop	Specifies the stopping point of the channel bit rate.
Bit Rate Step	Specifies the step by which channel bit rate is incremented while measuring PW. When you set this parameter with [Bit Rate Start] and [Bit Rate Stop], [NOP] will be computed and updated automatically.
NOP	Specifies the number of points to measure PW relative to the change in channel bit rate. When you set this parameter with [Bit Rate Start] and [Bit Rate Stop], [Bit Rate Step] will be computed and updated automatically.

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NOTE The Bit Rate Start, Bit Rate Stop, Bit Rate Step and Bit Rate NOP are all reflected in both Channel Bit Rate Set Up menu and Channel Bit Rate Sweep PW menus.You can use either of the two menus to set the parameters.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

7. Click the [Measure] button to start measurement. When [Auto Scale] is pressed the graph scale will adjust itself automatically to its maximum and minimum values.

NOTE Click on the “Save Trace” button to save the swept measurement data. A file menu will pop up that will require the user to enter a file name (e.g., FileName.csv).

8. Click on the [PW Trace] button to view the PW, PW+ and PW-. Click on the [PW Asym. Trace] button to view the results.
9. Click the [Return] button to return to Measure menu.

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Write Precompensation Sweep (Parameter Sweep)

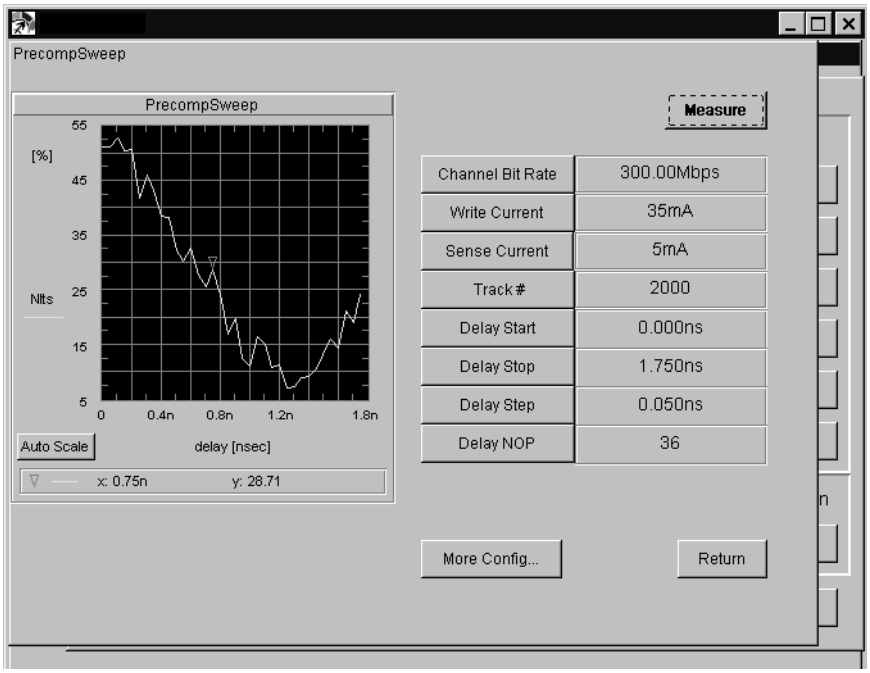
Overview

This section describes the Write Precompensation Sweep. Write Precompensation Sweep measurement can be used to observe the TAA, PW, 5th Harmonic NLTS, Overwrite and Narrow Band TAA.

Measurement Procedure

1. To open the Precompensation Sweep menu, click on the [Precomp Sweep] button from the Parameter Sweep frame of the Measure menu.

Figure 3-68 **Precompensation Sweep Menu**



NOTE Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

NOTE Before you measure write precompensation sweep, you must set the “Precomp Pattern Select” to “001”(prebit) from the [Precomp. Config] menu. And set the [NLTS-5th] parameter to ‘ON’ from the Precomp Status frame of the [Precomp. Config] menu.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Track #	Specifies the track number to be tested.
Delay Start	Specifies the time to start the delay for write precompensation.

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Delay Stop	Specifies the time to stop the delay for write precompensation.
Delay Step	Specifies the step by which the time delay is incremented from [Delay Start] to [Delay Stop]. When you set this parameter with [Delay Start] and [Delay Stop], [NOP] will be computed and updated automatically.
NOP	Specifies the number of points to measure NLTS. When you set this parameter with [Delay Start] and [Delay Stop], [Delay Step] will be computed and updated automatically.

NOTE

The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click the [Measure] button to start measurement.
4. Click the [Return] button to return to Measure menu.

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Standard Triple Track Measurement

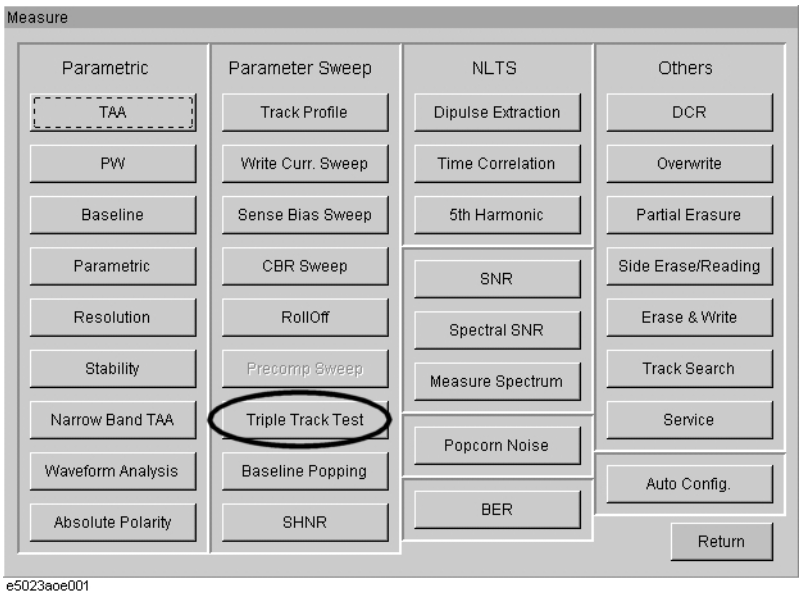
Overview

This section describes the standard Triple Track Measurement. This measurement allows you to evaluate the characteristics of head offset versus TAA.

Measurement Procedure

1. To open the Triple Track Test menu, click on the [Triple Track Test] button from the Parametric Sweep frame of the Measure menu.

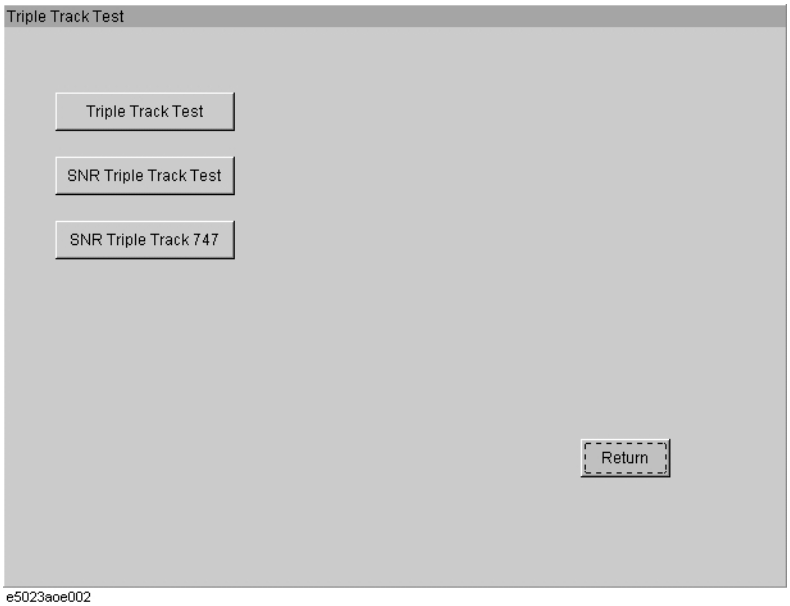
Figure 3-69 Measure Menu



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2. Click [Triple Track Test] button to open the Standard Triple Track Test menu.

Figure 3-70 Triple Track Test Menu

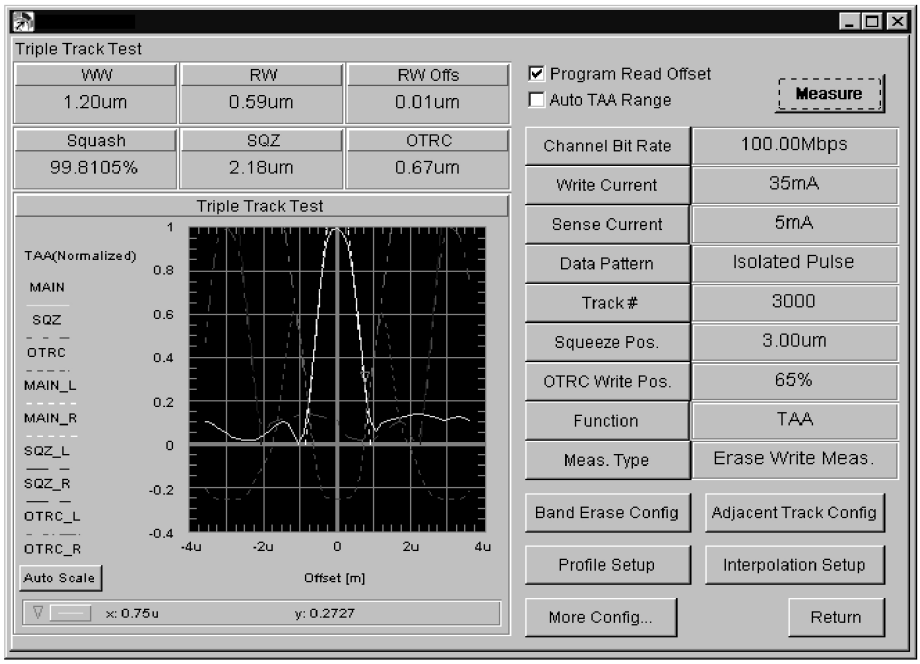


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3. Set [Program Read Offset] and [Auto TAA Range] check boxes.

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Figure 3-71 Triple Track Menu



NOTE Before you execute this measurement, you must execute the auto configuration to set the input range automatically, or set the input range manually.

Program Read Offset Specifies the auto setting of the read-write offset after the track profile is measured. If checked the write offset and read offset of the [Setup] menu will be changed and updated automatically and this will be used in subsequent tests. The write offset is set to zero while the read offset is set to the read-write offset “RW Offs” value of this measurement.

Auto TAA Range (Specifies the TAA range to auto mode). If checked, it will eliminate an overflow in TAA measurement. The input range automatically adjusts itself to an appropriate range when an overflow occurs. See “hpe5022_isolatedPulseReferenceTaa Auto” of the programming manual. for details.

4. Set the parameters, click on each button to enter a new value.

Channel Bit Rate Specifies the speed at which data bits are written on the media per second [bps].

Write Current Specifies the current applied to the write head.

Sense Current Specifies the current applied to the read head.

Track # Specifies the track number to be tested.

Squeeze Pos. Specifies the distance between the test track

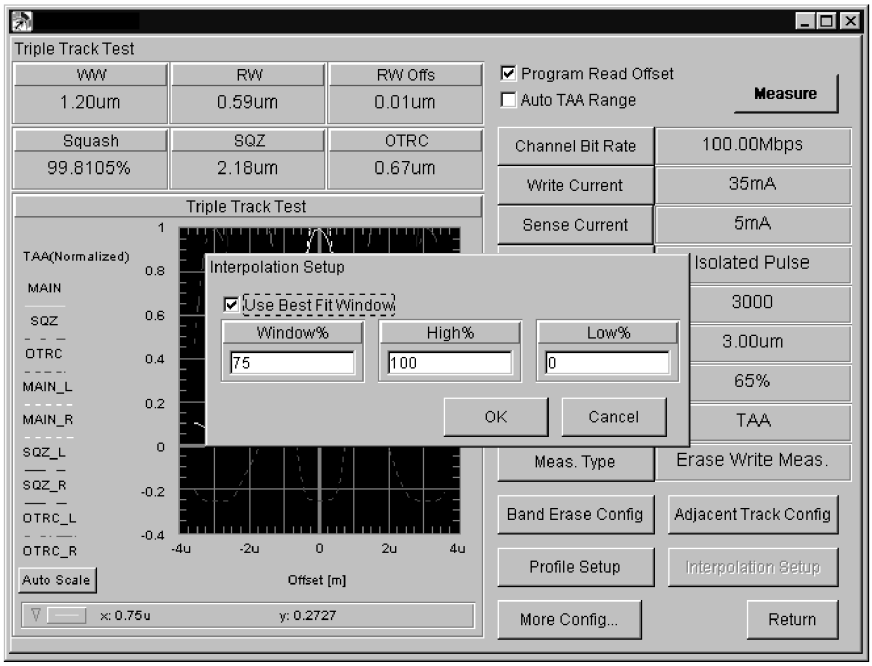
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	and the adjacent track (i.e, squeezing track).See measurement definitions on Chapter 4.
OTRC Write Pos.	Specifies the distance where the write data track is written. (not the same as squeezing track). This distance is expressed as percentage of the write width. See measurement definitions on Chapter 4.
Function	Select the parameter to be profiled as either TAA or Narrow Band TAA.
Meas. Type	Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to perform a band erase, write a specified data then measure the parameter. 2)[Write Meas.] means to write a data, then measure. 3) [Meas.] means to measure only.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

5. Click the [Interpolation Setup] button to open the Interpolation Setup menu.

Figure 3-72 Interpolation Setup Menu



Use Best Fit Window	Specifies the use of best fit window. If checked, the specified window size (%) will be shifted between the high and low thresholds in order to get the best correlation to plot the interpolation lines. If unchecked, the high and low threshold settings will be

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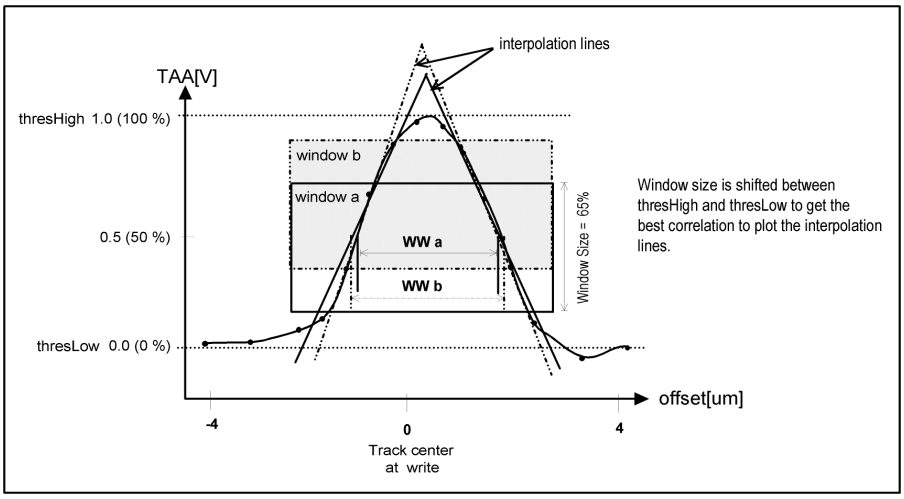
used to plot the interpolation lines. Refer to Figure 3-73 on page 129.

Window% — Specifies the size of the window to be used in finding the best correlation to plot the interpolation lines.This value is expressed as percentage between the high and low threshold settings.

High% — Specifies the maximum threshold value for interpolation.

Low% — Specifies the minimum threshold value for interpolation.

Figure 3-73 Best Fit Window

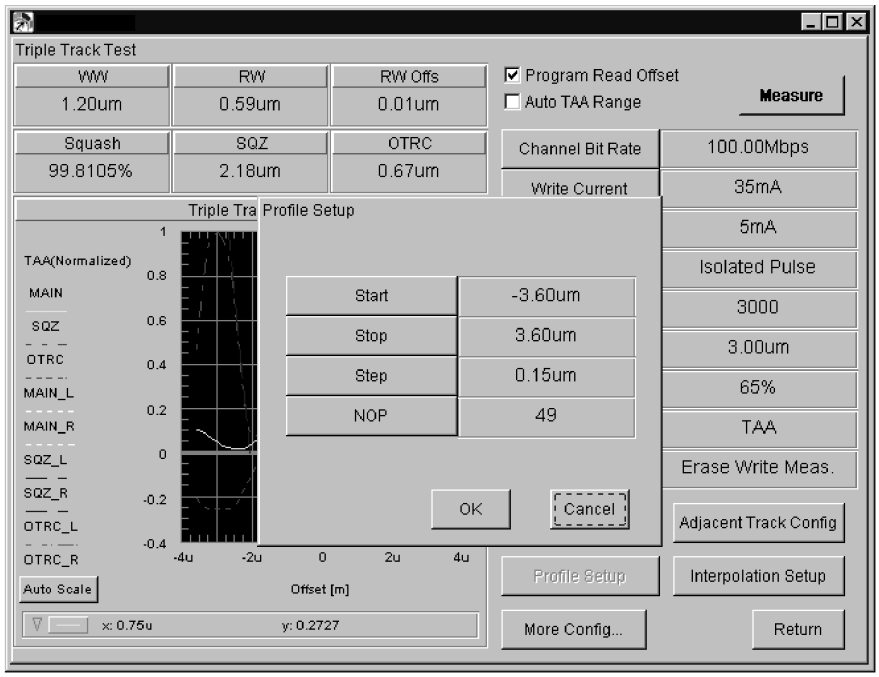


When best fit window is used, the specified window size (%) is shifted between the threshold high and threshold low. The purpose is to find the best correlation between the limits in order to plot the interpolation lines. As shown in the figure above, variations in plotting the interpolation lines will affect the accuracy in predicting write width, read width and read-write offsets.

6. Click the [Profile Setup] button to open the Profile Setup menu.

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Figure 3-74 **Profile Setup Menu**



Offset Start — Specifies the starting point of the track offset in building the track profile.This point is defined as the distance in [µm] from the track center.

Offset Stop — Specifies the stopping point of the track offset in building the track profile. This point is defined as the distance in [µm] from the track center.

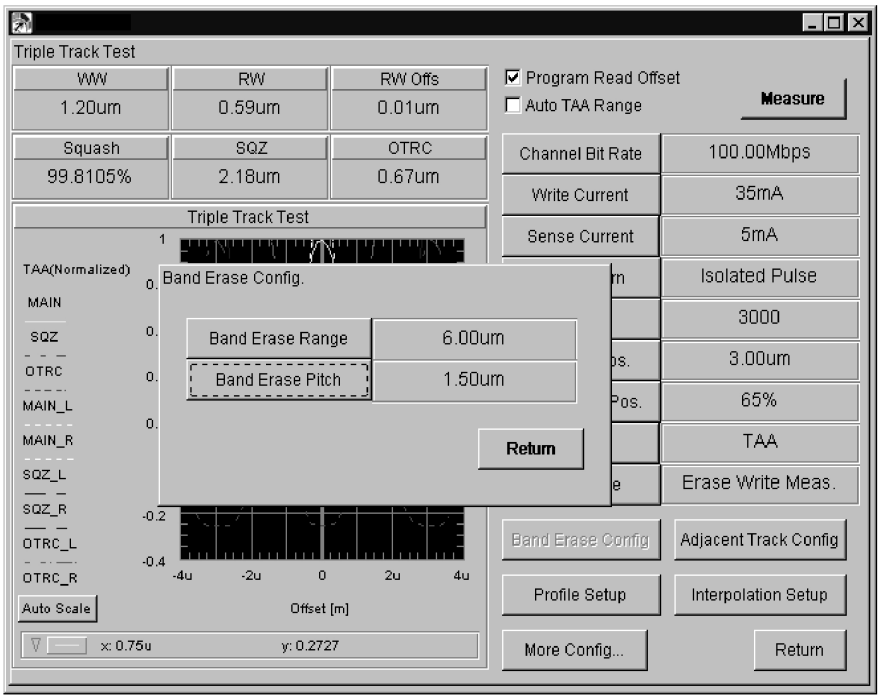
Offset Step — Specifies the step by which the head is moved while measuring TAA in order to build the track profile. By setting this parameter with Offset Start and Offset Stop, Offset NOP will be computed and updated automatically.

Offset NOP — Specifies the number of offset points. By setting this parameter with Offset Start and Offset Stop, Offset Step will be computed and updated automatically.

7. Click on the [Band Erase] button to open the Band Erase Configuration menu.

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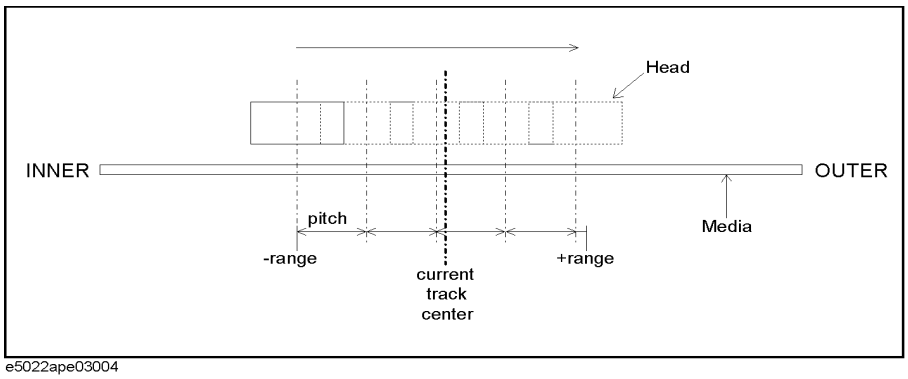
Figure 3-75 Band Erase Configuration menu



Band Erase Range Specifies the range for band erase.

Band Erase Pitch Specifies the erase pitch for band erase. Erase pitch is the distance between the centers of two adjacent tracks.

Figure 3-76 Parameter of Band Erase

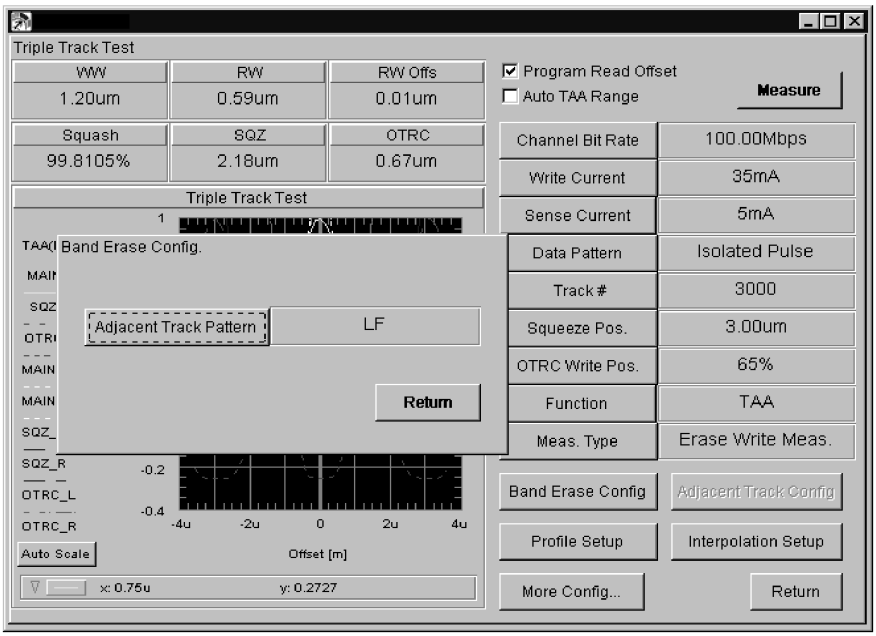


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8. Click on [Adjacent Track Config] button to set the data pattern of the adjacent track.

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Figure 3-77 **Adjacent Track Configuration Menu**



Adjacent Track Pattern Specifies the data pattern of the adjacent track. DC and AC erase can be selected as a data pattern.

9. Click the [Measure] button to start measurement.

Measurement Display

The upper portion of the menu shows the measurement results of the WW (Write Width), RW (Read Width), RW (Read Write) offset, Squash, Squeeze and OTRC. The lower left side of the graph shows the Track Profile, Squeeze and OTRC waveform. OTRC is expressed in terms [µm].

10. Click the [Return] button to return to Measure menu.

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SNR Triple Track Measurement

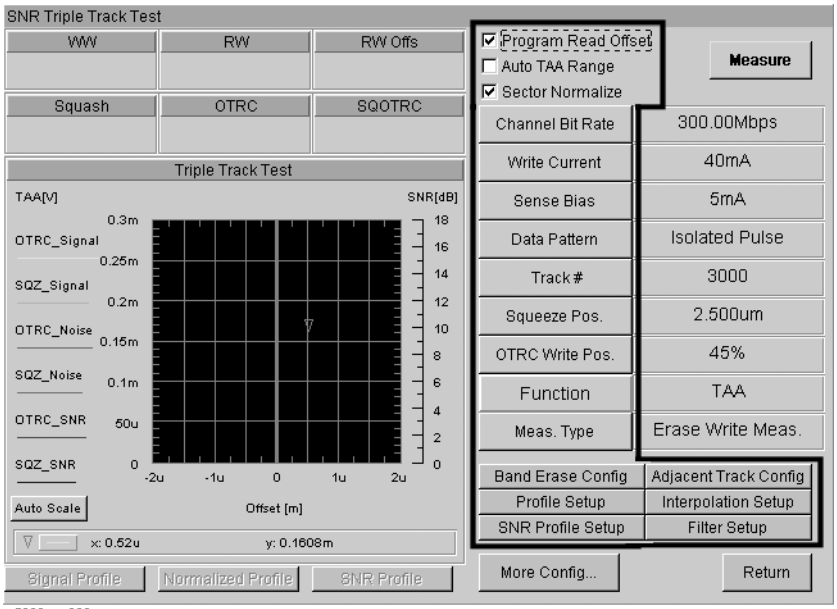
Overview

This section describes the SNR Triple Track Measurement. This measurement allows you to evaluate the characteristics of head offset versus TAA.

Measurement Procedure

1. Set the input range using the auto configuration, or set the input range manually.
2. Click [Triple Track Test] button in Measure Menu (see Figure 3-69 on page 126).
3. Click [SNR Triple Track Test] button to open the SNR Triple Track Test menu (see Figure 3-70 on page 126).
4. In the SNR Triple Track Test menu, set [Program Read Offset], [Auto TAA Range], and [Sector Normalize] check boxes (see Figure 3-78).

Figure 3-78 SNR Triple Track Test Parameter Setup Buttons and Check Boxes



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Program Read Offset (check box) — Specifies the auto setting of the read-write offset after the SNR track profile is measured. If checked the write offset and read offset of the [Setup] menu will be changed and updated automatically and this will be used in subsequent tests. The write offset is set to zero while the read offset is set to the read-write offset "RW Offs" value of this measurement.

Auto TAA Range (check box) — Specifies the TAA range to auto mode. If checked, it will eliminate an overflow in TAA measurement. The input range automatically adjusts itself to an appropriate range when an overflow occurs. See "hpe5022_isolatedPulseReferenceTaa Auto" of the programming manual for details.

Sector Normalize (check box) — Specifies the sector normalization. If checked, sector normalization will be performed.

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5. Set the following parameters.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Bias	Specifies the sense bias applied to the read head.
Data Pattern	Specifies the data pattern to the write head.
Track #	Specifies the track number to be tested.
Squeeze Pos.	Specifies the distance between the test track and the adjacent track (i.e, squeezing track). See measurement definitions on Chapter 4.
OTRC Write Pos.	Specifies the distance where the write data track is written. (not the same as squeezing track). This distance is expressed as percentage of the track pitch. See measurement definitions on Chapter 4.
Meas. Type	Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to perform a band erase, write a specified data then measure the parameter. 2)[Write Meas.] means to write a data, then measure. 3) [Meas.] means to measure only.

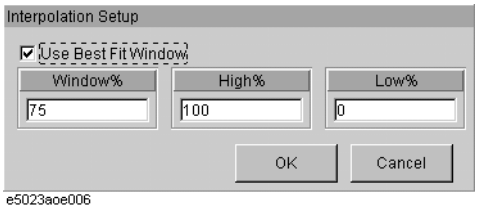
NOTE

You cannot change the **Function** parameter. It is fixed to TAA in the SNA Triple Track Test.

The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the **Configuration** menu will automatically update similar parameters in this menu.

6. Click [Interpolation Setup] button to open the Interpolation Setup menu.

Figure 3-79 Interpolation Setup Menu



Use Best Fit Window	Specifies the use of best fit window. If checked, the specified window size (%) will be shifted between the high and low thresholds in order to get the best correlation to plot the interpolation lines. If unchecked, the high and low threshold settings will be used to plot the interpolation lines. Refer to Figure 3-80 on page 135.
Window%	Specifies the size of the window to be used in

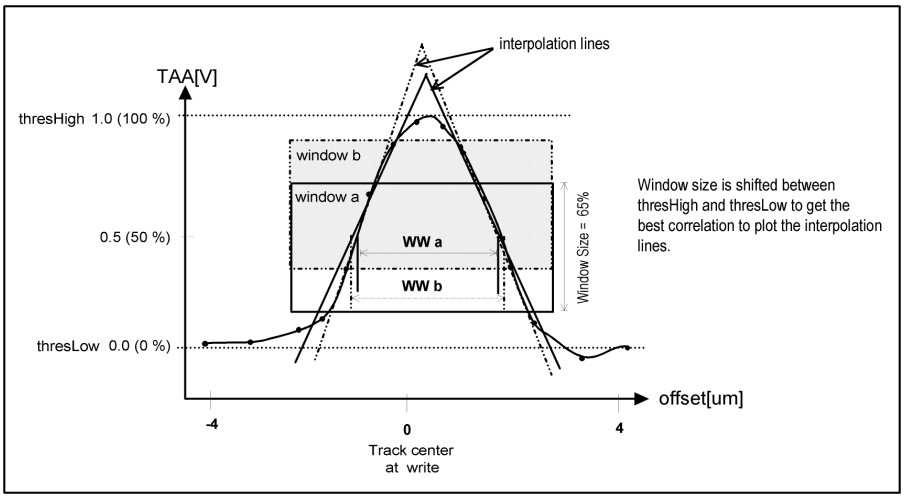
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finding the best correlation to plot the interpolation lines.This value is expressed as percentage between the high and low threshold settings.

High% Specifies the maximum threshold value for interpolation.

Low% Specifies the minimum threshold value for interpolation.

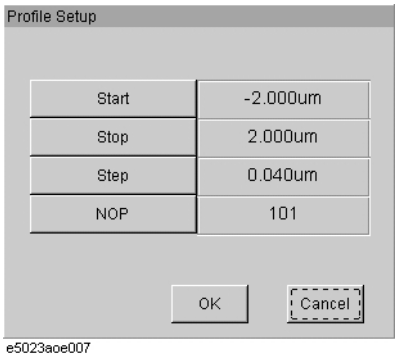
Figure 3-80 Best Fit Window



When best fit window is used, the specified window size (%) is shifted between the threshold high and threshold low. The purpose is to find the best correlation between the limits in order to plot the interpolation lines. As shown in the figure above, variations in plotting the interpolation lines will affect the accuracy in predicting write width, read width and read-write offsets.

7. Click [Profile Setup] button to open the Profile Setup menu.

Figure 3-81 Profile Setup Menu



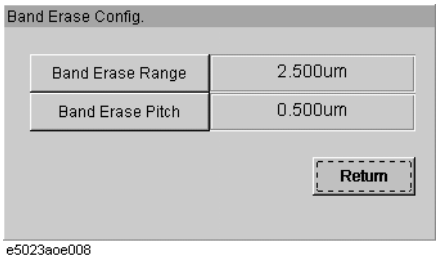
Start Specifies the starting point of the track offset in building the track profile.This point is defined as the distance in [µm] from the track center.

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Stop	Specifies the stopping point of the track offset in building the track profile. This point is defined as the distance in [µm] from the track center.
Step	Specifies the step by which the head is moved while measuring TAA in order to build the track profile. By setting this parameter with Offset Start and Offset Stop, Offset NOP will be computed and updated automatically.
NOP	Specifies the number of offset points. By setting this parameter with Offset Start and Offset Stop, Offset Step will be computed and updated automatically.

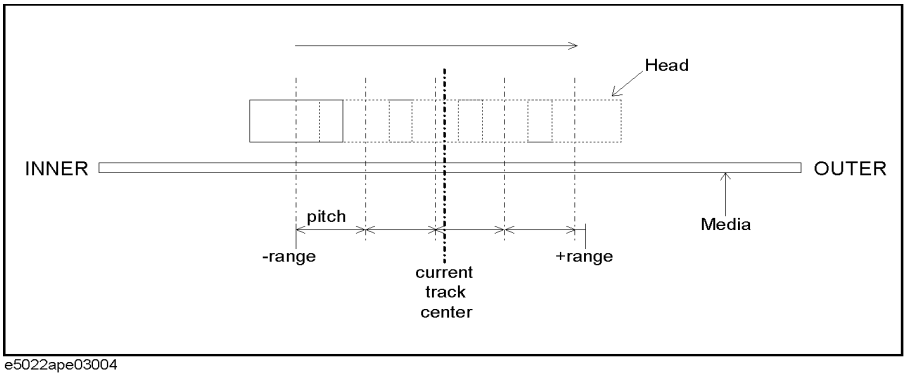
8. Click [Band Erase] button to open the Band Erase Configuration menu.

Figure 3-82 Band Erase Configuration menu



Band Erase Range	Specifies the range for band erase.
Band Erase Pitch	Specifies the erase pitch for band erase. Erase pitch is the distance between the centers of two adjacent tracks.

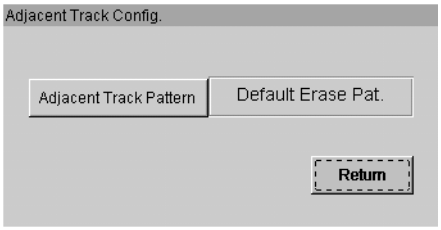
Figure 3-83 Parameter of Band Erase



9. Click [Adjacent Track Config] button to set the data pattern of the adjacent track.

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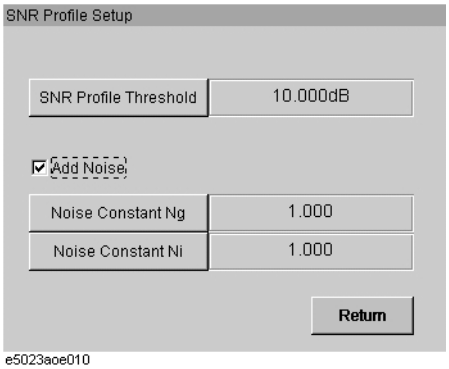
Figure 3-84 **Adjacent Track Configuration Menu**



Adjacent Track Pattern — Specifies the data pattern of the adjacent track. DC and AC erase can be selected as a data pattern.

10. Click [SNR Profile Setup] button to open the SNR Profile Setup Dialog Box and set SNR Profile.

Figure 3-85 **SNR Profile Setup Dialog Box**



SNR Profile Threshold — Specifies the SNR profile threshold.

Add Noise (check box) — Selects to add noise or not.

Noise Constant Ng — Specifies the Gaussian noise constant (Ng).

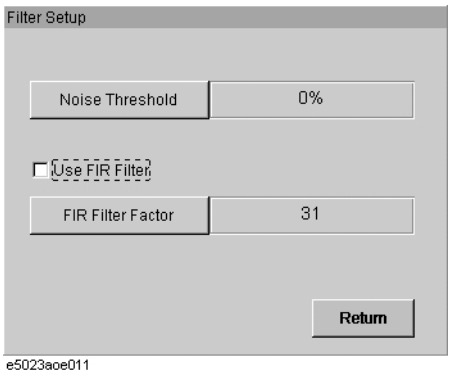
Noise Constant Ni — Specifies the interference noise constant (Ni).

NOTE See ""OTRC SNR[ ]" and "Squeezed SNR[ ]" Calculation, and "OTRC (Unsqueezed OTRC)" and "Squeezed OTRC" Calculation" on page 299 for the definition of each setup parameter.

11. Click [Filter Setup] button to open the Filter Setup dialog box and setup the filter configuration.

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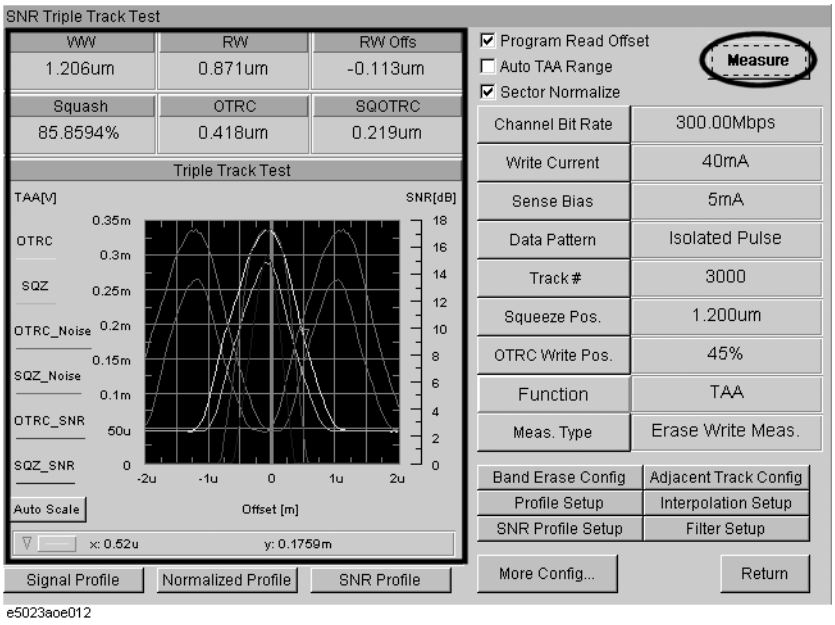
Figure 3-86 Filter Setup Dialog Box



Noise Threshold	Specifies the noise threshold.
Use FIR Filter (check box)	Selects to use FIR filter or not.
FIR Filter Factor	Specifies the FIR filter factor.

12. Click [Measure] button to start measurement.

Figure 3-87 Measurement Execution



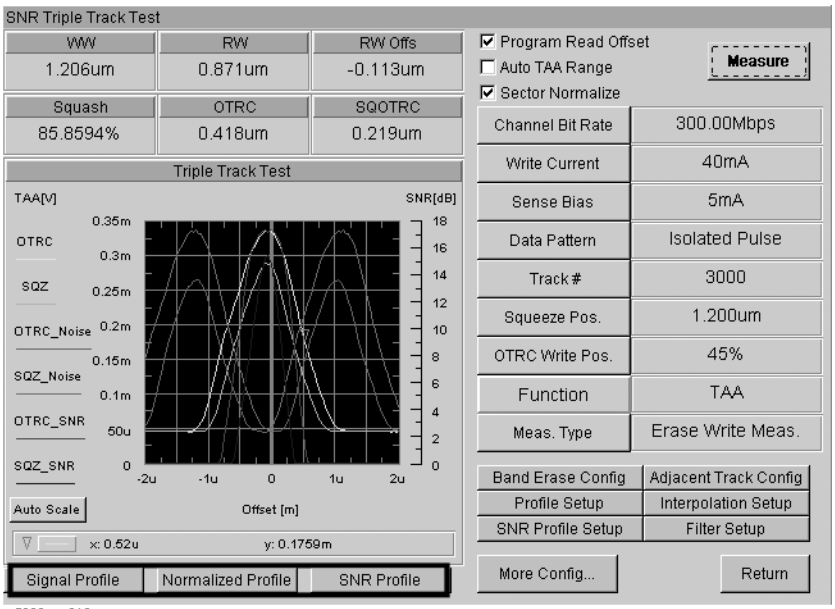
Measurement Display

The upper portion of the menu shows the measurement results of the WW (Write Width), RW (Read Width), RW (Read Write) offset, Squash, Squeeze and OTRC. The lower left side of the graph shows the Track Profile, Squeeze and OTRC waveform. OTRC is expressed in terms [µm].

13. To observe the signal track profile, click [Signal Profile] button.

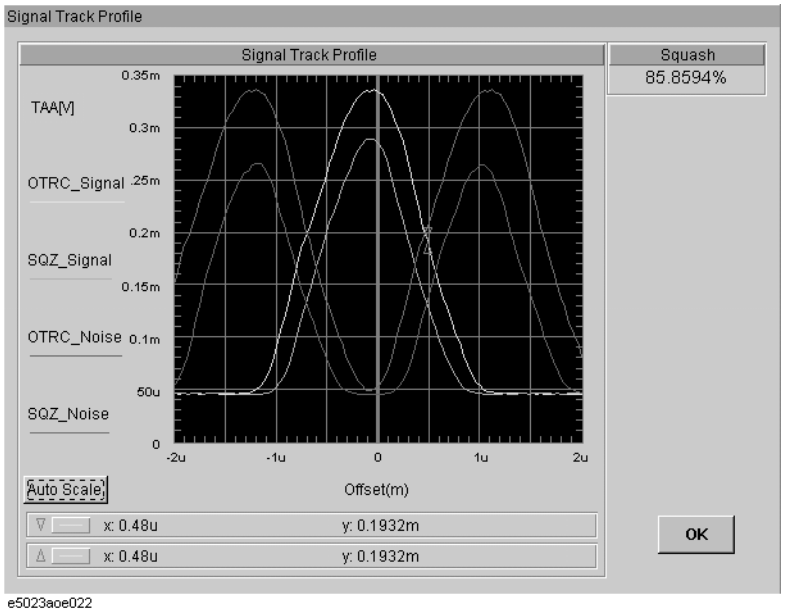
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Figure 3-88 Trace Display Buttons



e5023aoe013

Figure 3-89 Signal Track Profile Display

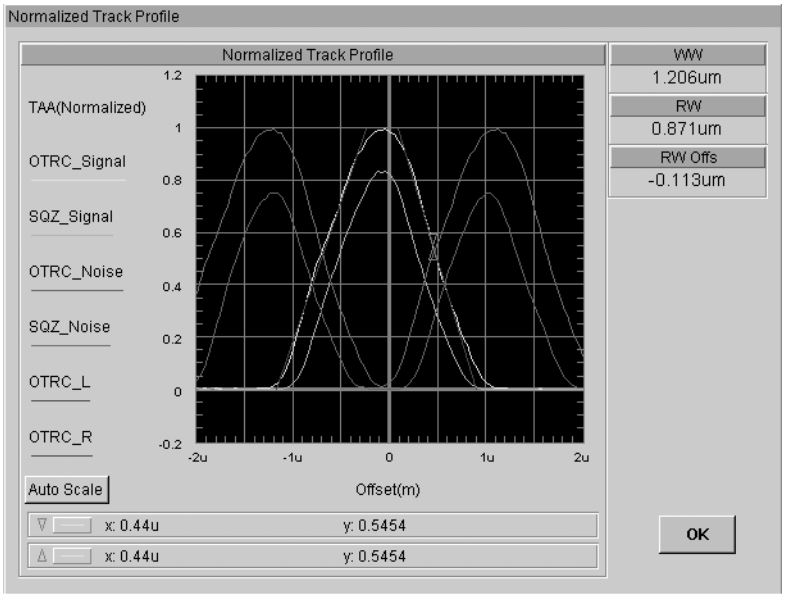


e5023aoe022

14. To observe the normalized traces, click [Normalized Profile] button (see Figure 3-88 on page 139).

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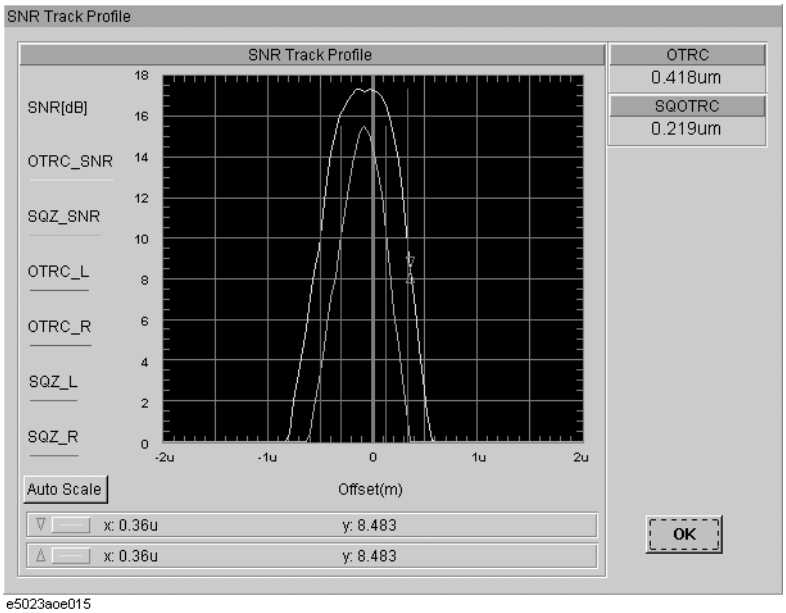
Figure 3-90 **Normalized Trace Display**



e5023aoe014

15. To observe the SNR traces, click [SNR Profile] button (see Figure 3-88 on page 139).

Figure 3-91 **SNR Trace Display**



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16. Click [Return] button to return to Measure menu.

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SNR Triple Track 747 Test

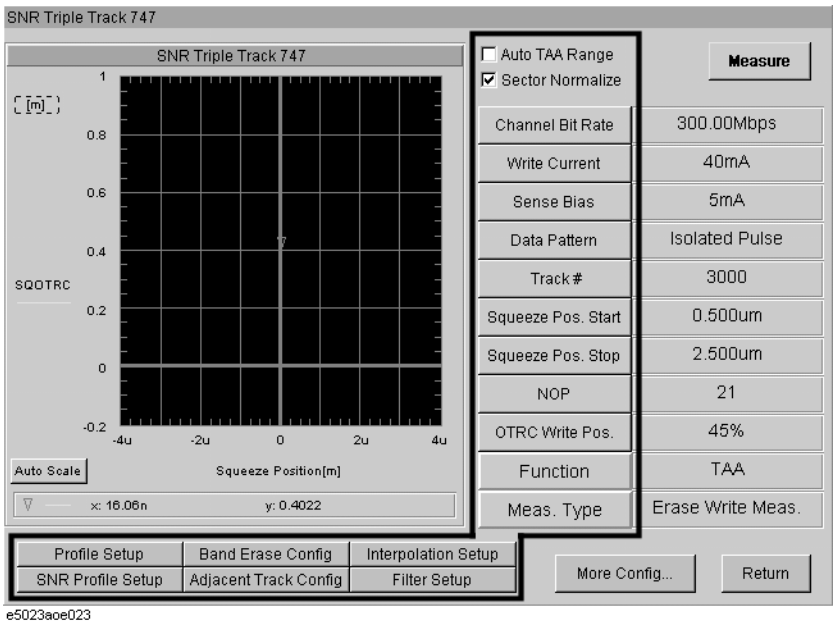
Overview

This section describes the SNR Triple Track 747 Test. You can obtain the 747 characteristics through the squeezed OTRC evaluation in the SNR Triple Track Test.

Measurement Procedure

1. Set the input range using the auto configuration, or set the input range manually.
2. Click [Triple Track Test] button in Measure Menu (see Figure 3-69 on page 126).
3. Click [SNR Triple Track 747] button to open the SNR Triple Track 747 Test menu (see Figure 3-70 on page 126).
4. In the SNR Triple Track 747 test menu, set each parameter using the parameter setup buttons and check boxes.

Figure 3-92 SNR Triple Track 747 Parameter Setup Buttons and Check Boxes



e5023aoe023

Squeeze Pos. Start — Specifies the start squeeze position.

Squeeze Pos. Stop — Specifies the stop squeeze position.

NOP — Specifies the number of measurement points between start and stop squeeze position.

NOTE

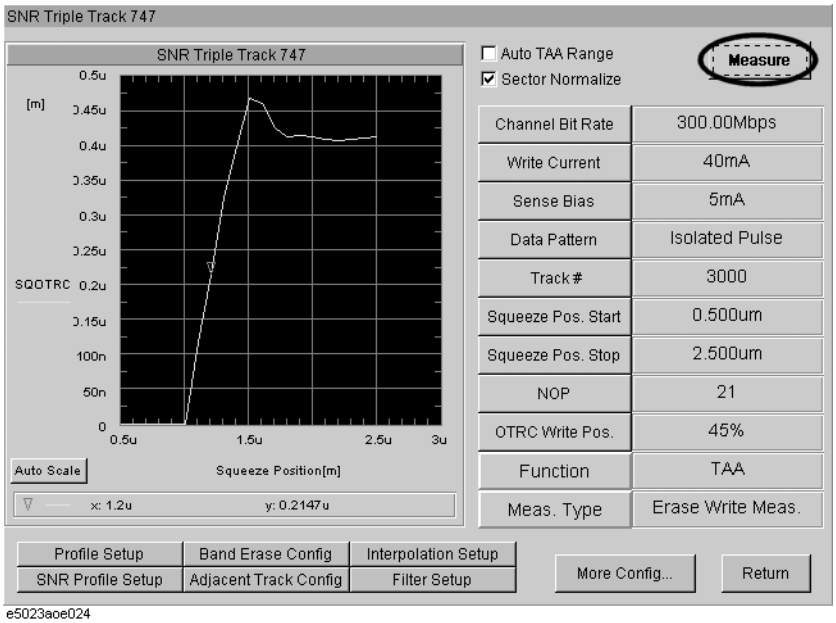
Refer to step 4 on page 133 through step 11 on page 137 for the definitions of the other keys and check boxes.

You cannot change the setup of **Function** and **Meas. Type** parameters. **Function** is fixed to "TAA" and **Meas. Type** is fixed to "Erase Write Meas." in the SNA Triple Track 747 Test.

5. Click [Measure] button to start measurement.

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Figure 3-93 SNR Triple Track 747 Measurement



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Baseline Popping Measurement

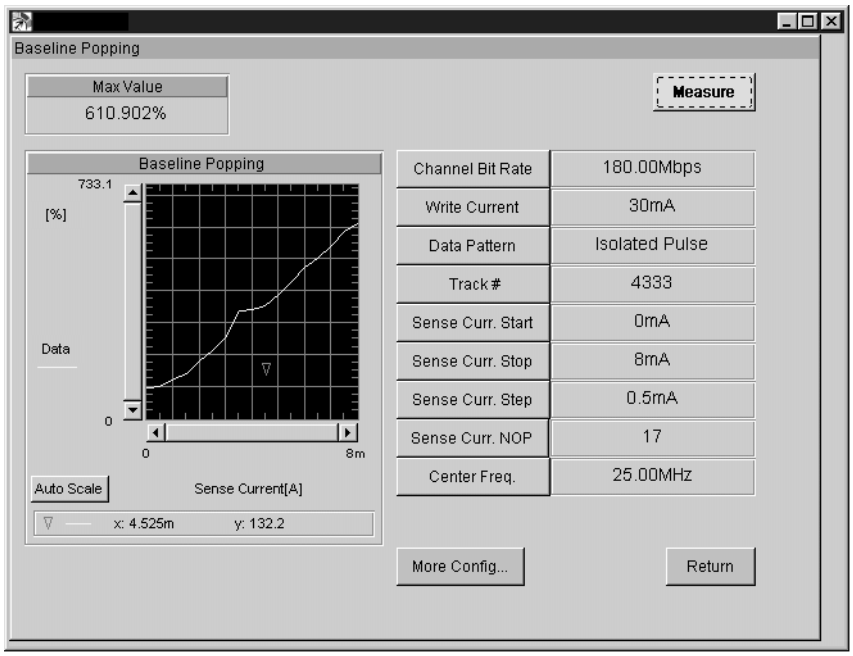
Overview

This section describes the Baseline Popping Measurement. This measurement allows you to evaluate the Narrow Band TAA level.

Measurement Procedure

1. To open the Baseline Popping menu, click on the [Baseline Popping] button from the Parameter Sweep frame of the Measure menu.

Figure 3-94 Baseline Popping Menu



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Data Pattern	Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
Track #	Specifies the track number to be tested.
Sense Curr. Start	Specifies the starting point of the sense current.
Sense Curr. Stop	Specifies the stopping point of the sense current.

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Sense Curr. Step	Specifies the step by which sense current is incriminated while measuring Narrow Band TAA. When you set this parameter with [Sense Curr. Start] and [Sense Curr. Stop], [NOP] will be computed and updated automatically.
NOP	Specifies the number of points to measure Narrow Band TAA relative to the change in sense current. When you set this parameter with [Sense Curr. Start] and [Sense Curr. Stop], [Sense Curr. Step] will be computed and updated automatically.
Center Freq.	Specifies the measurement frequency for baseline popping test.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on the [Measure] button to start measurement.

Measurement Display

The left portion of the window shows the results of Narrow Band TAA as a function of change in the sense current.

4. Click the [Return] button to return to Measure menu.

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Sub-Harmonic Noise Ratio (SHNR)

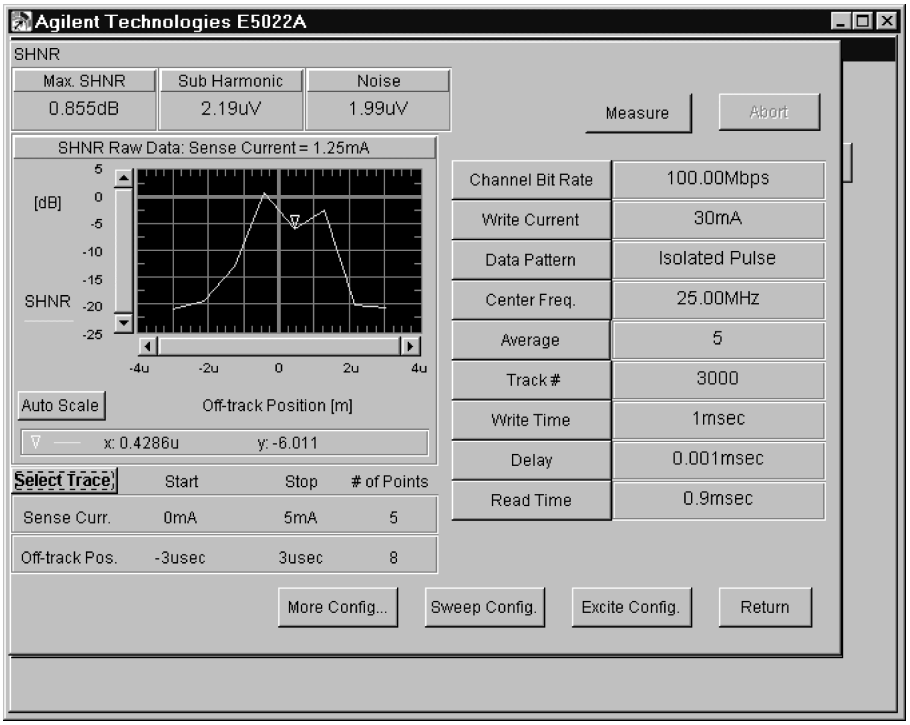
Overview

This section describes the SHNR measurement. This test is used to detect baseline popping of MR/GMR heads by measuring the sub-harmonics noise ratio.

Measurement Procedure

1. To open the SHNR menu, click on the [SHNR] button from the Parameter Sweep frame of the Measure menu.

Figure 3-95 **SHNR Menu**



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate — Specifies the speed at which data bits are written on the media in bits per second [bps].

Write Current — Specifies the current applied to the write head.

Data Pattern — Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.

Center Freq. — Specifies the measurement frequency of the spectrum analyzer.

Average — Specifies the number of revolutions to get the average results.

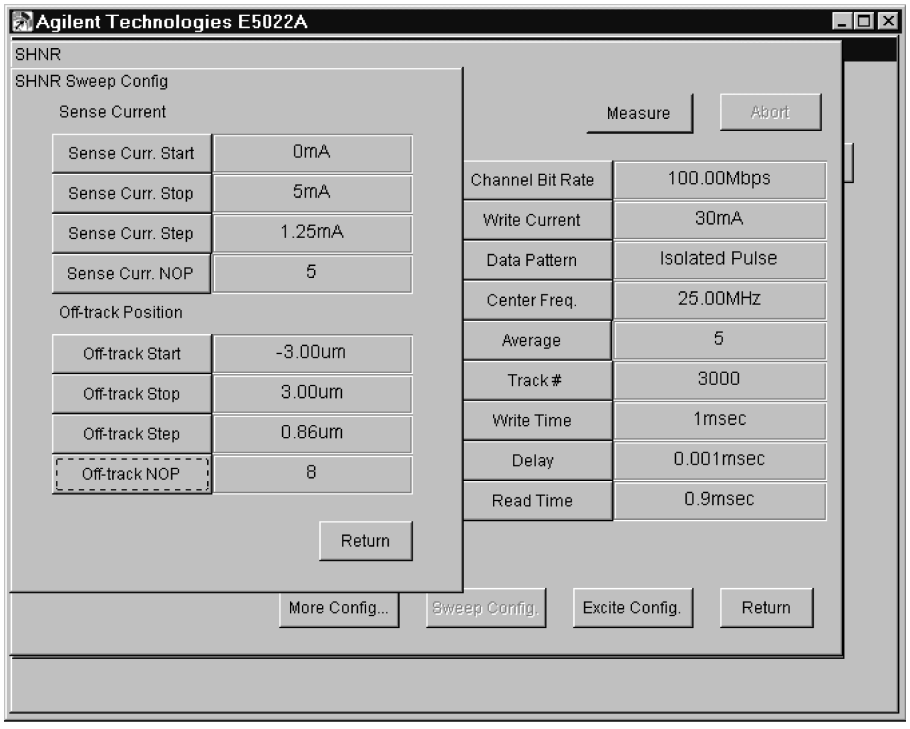
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Track #	Specifies the track number to be tested.
Write Time	Specifies the time to perform write excitation. This parameter is expressed in terms of [msec].
Delay	Specifies the distance in time between write excitation and read operation. This parameter represents the delay time when to read the data after write. This parameter is expressed in terms of [msec].
Read Time	Specifies the amount of time to read the data. This parameter is expressed in [msec].

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on [Sweep Config] to set the sense current and off-track position parameters.

Figure 3-96 Sweep Configuration Menu



Sense Curr. Start	Specifies the starting point of the sense current.
Sense Curr. Stop	Specifies the stopping point of the sense current.

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Sense Curr. Step — Specifies the step by which sense current is incremented while measuring SHNR. When you set this parameter, Sense Curr [NOP] will be computed and updated automatically.

Sense Curr. NOP — Specifies the number of sense current points to measure relative to the change in sense current. When you set this parameter, [Sense Curr. Step] will be computed and updated automatically.

Off-track Start — Specifies the starting point of the off-track position in measuring SHNR.

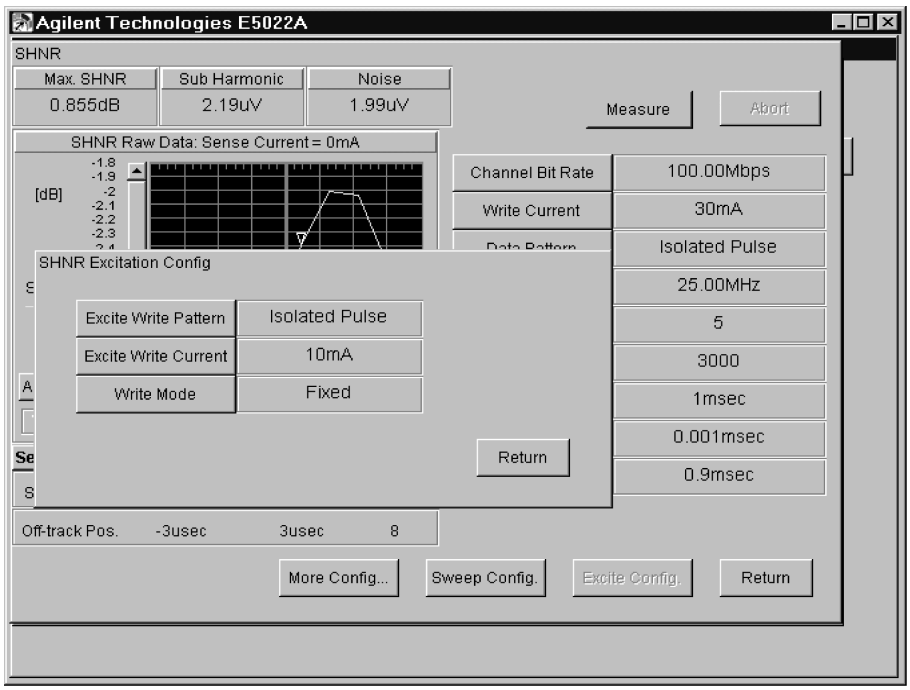
Off-track Stop — Specifies the stopping point of the off-track position in measuring SHNR.

Off-track Step — Specifies the step by which the head is moved in measuring SHNR. When you set this parameter [Off-track NOP] will be computed and updated automatically.

Off-track NOP — Specifies the number of measurement points. When you set this parameter [Off-track Step] will be computed and updated automatically.

4. Click on [Excite Config.] button to set the write excitation parameters of the SHNR measurement.

Figure 3-97 Excite Configuration Menu



Excite Write Pattern — Specifies the data pattern for write excitation.

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Excite Write Current	Specifies the write excitation current.
Write Mode	Specifies the write current direction when writing data. When ‘Fixed’ is selected the write current direction at the start of each write operation is the always the same. When ‘Continuous’ is selected the write current direction at the beginning of write operation is the same as the last current direction of the previous write. Refer to “hpe5022_shnrWriteModeConfig” function of the programming manual for details.

5. Click on the [Measure] button to start measurement.

Measurement Display

The upper left portion of the window shows the calculated results of ‘Max. SHNR’, ‘Sub Harmonic’ and ‘Noise’. The plotted graph displays the raw data of the SHNR for a particular value of “Sense Current” selected from [Select Trace].

Select Trace	Selects the sense current whose raw data is to be plotted on the graph. When you click this parameter, a list box will pop up which contains a list of sense current. This sense current list is automatically calculated and displayed on the list box based on the specified ‘Sense Current’ parameters of the “Sweep Configuration Menu”.

6. Click the [Return] button to return to Measure menu.

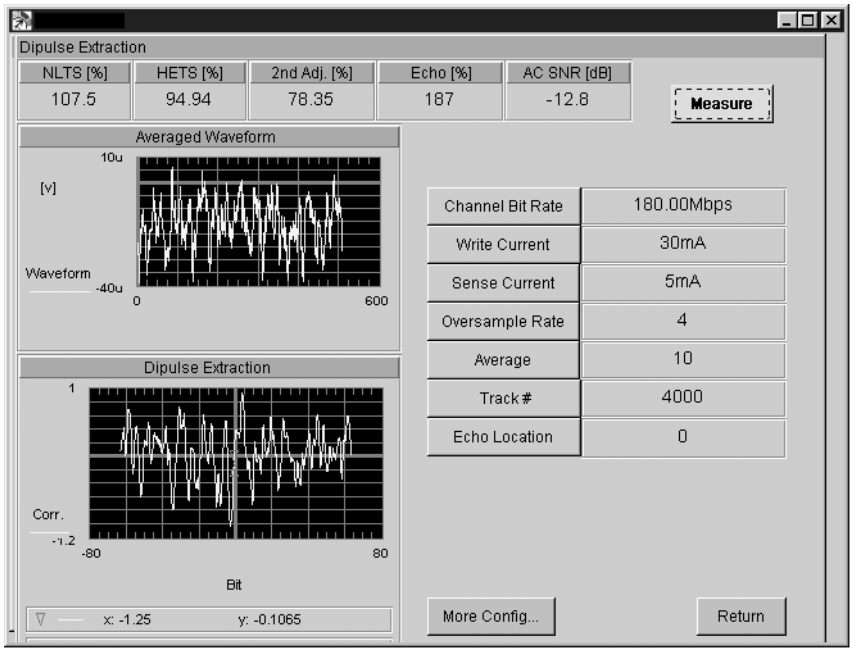
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Dipulse Extraction (NLTS)

The Dipulse Extraction (NLTS) is measured by an oscilloscope. If an oscilloscope is not installed in the system, this measurement can not be measured

1. To open the Dipulse Extraction menu, click on the [Dipulse Extraction] button from the NLTS frame of the Measure menu. Also refer to the "Pattern Configuration Menu" on page 57 to set the precompensation delay pattern.

Figure 3-98 Dipulse Extraction Menu



NOTE Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Oversample Rate	Specifies the sampling rate for the oscilloscope. The sampling clock of the oscilloscope is set to a value of (channel bit rate) x (oversample rate) or higher.
Average	Specifies the number of revolutions for measurement to be averaged. See the "hpe5022_wave Average" function in the programming manual.

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Track #	Specifies the track number to be tested.
Echo Location	Specifies the echo location for the result named “Echo” on the top of the display.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on the [Measure] button to start measurement.

Measurement Display

The number of waveform periods are averaged and displayed on the graph. By specifying the echo location value, the NLTS, HETS (Hard Easy Transition Shift) and 2nd Adj (2nd Adjacent NLTS) are computed automatically. If PRBS (Pseudo Random Bit Sequence) is changed, the echo location will change automatically.

PRBS	Measurement	Echo Location
X^7+X^3+1	NLTS	25.5
	HETS	-30.5
	2nd Adj	45.5
X^9+X^5+1	NLTS	-221.5
	HETS	129.5
	2nd Adj	234.5

See “NLTS Measurement” on page 259 for AC SNR.

NOTE To observe the resulting waveform of the Averaged Waveform use the “hpe5022_waveAverageData_Q” function. To observe the resulting waveform of the Dipulse Extraction use “hpe5022_waveDipulseExtraction_Q” function. The results of NLTS, HETS, 2nd Adj and Echo are returned by the “hpe5022_waveDipuseExtractionNlts_Q” function using their echo locations.

Time Correlation NLTS

Overview

The Time Correlation (NLTS) is performed by an oscilloscope. If an oscilloscope is not installed in the system, this measurement can not be performed.

Measurement Procedure

The measurement procedure for Time Correlation NLTS is the same as Dipulse Extraction NLTS. Refer to Dipulse Extraction NLTS for the measurement procedure.

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5th Harmonic (NLTS)

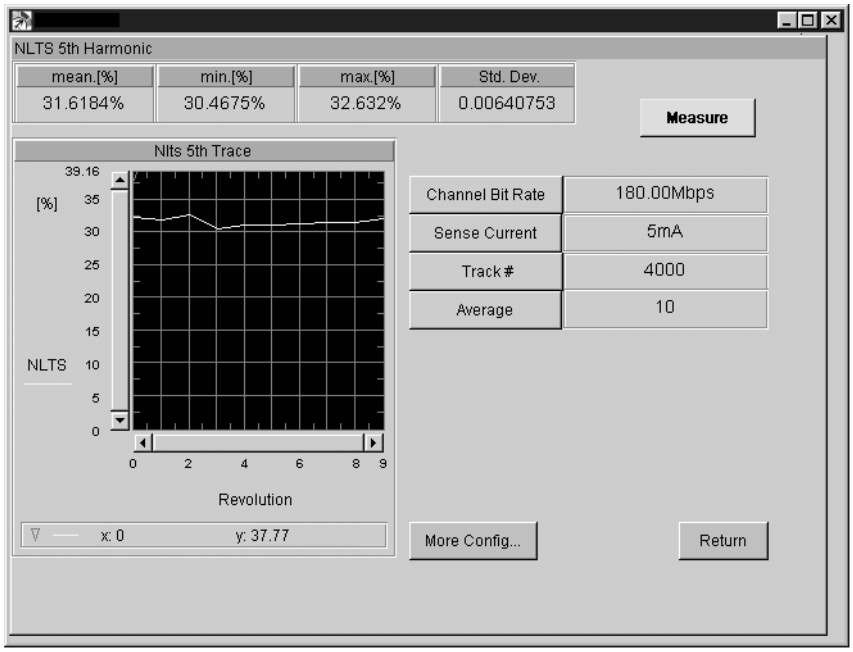
Overview

The 5th Harmonic (NLTS) is measured by a spectrum analyzer.

Measurement Procedure

1. To open the NLTS 5th Harmonic menu, click on the [5th Harmonic] button from NLTS frame of the Measure menu. Also refer to “Pattern Configuration Menu” on page 57 to set the precompensation delay pattern.

Figure 3-99 **NLTS 5Th Harmonic Menu**



2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Sense Current	Specifies the current applied to the read head.
Track #	Specifies the track number to be tested.
Average	Specifies the number of revolutions for measurement to be averaged. See the “hpe5022_wave Average” function in the programming manual.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on the [Measure] button to start measurement.

   The NLTS and its maximum, minimum and standard deviation values are all displayed on the menu.

4. Click the [Return] button to return to Measure menu.

NOTE See the “hpe5022_nlts5th_Q”function for NLTS and “hpe5022_nlts5thStatic_Q” for NLTS

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5th min., NLTS 5th max. and Std. Dev.

See also

See the “NLTS (5th Harmonic) measurement function” section in Chapter 3 of the programming manual for the parameter range and its detailed descriptions.

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SNR Measurement

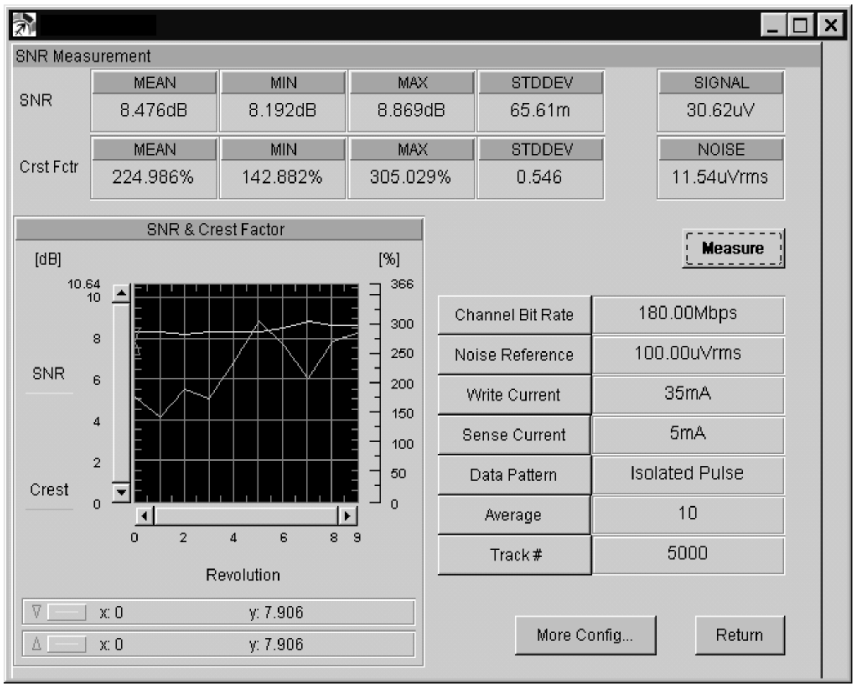
Overview

This section describes the SNR (Signal To Noise Ratio) measurement. SNR allows you to measure and compare the signal levels of an erased track and an overwritten track.

Measurement Procedure

1. To open the SNR menu, click on the [SNR] button from the Measure menu.

Figure 3-100 SNR Measurement Menu



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Noise Reference	Specifies the reference level to measure noise. Input the estimated noise level.
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Data Pattern	Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
Average	Specifies the number of revolutions to get the averaged results.

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Track # Specifies the track number to be tested.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on the [Measure] button to start measurement.
4. Click the [Return] button to return to Measure menu.

Measurement Display

The mean, minimum, maximum and standard deviation of the SNR and Crest Factor are displayed on the upper portion of the menu. The lower portion of the menu plots the measured SNR and Crest Factor. The upper right side of the menu shows the measured signal and noise which are measured in terms of volt peak-to peak and volt (rms) respectively.

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Spectral SNR Measurement

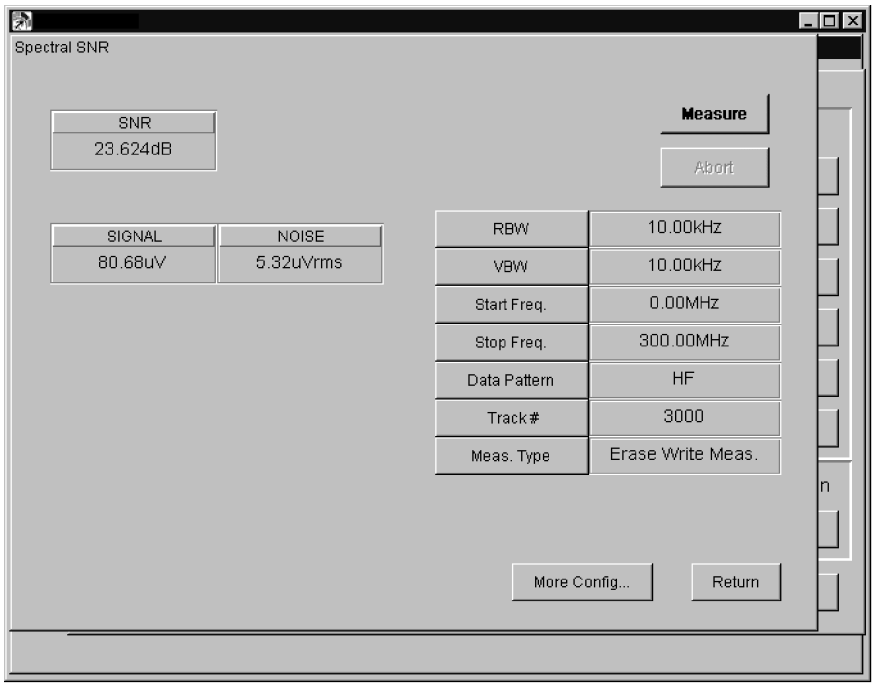
Overview

This section describes the SNR (Signal To Noise Ratio) measurement using the spectrum analyzer. SNR allows you to measure and compare the signal levels of an erased track versus an overwritten track.

Measurement Procedure

1. To open the Spectral SNR menu, click on [Spectral SNR] button from the Measure menu.

Figure 3-101 Spectral SNR Measurement Menu



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

RBW

Specifies the resolution band width. Narrowing RBW will widen the dynamic range. However, depending on the frequency span, the measurement speed may become very slow when you set this below 10kHz. The values which can be set by vary by Spectrum analyzer the system has. If the system has 4395A or E5040A, the RBWs of 3k, 10k, 30k, 100k, 300k and 1MHz can be set. If the system has the optional E4402B 3GHz spectrum analyzer, 3MHz and 5MHz RBWs can be set additionally. When you use other than the above values, the closest and lower value is set automatically.

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VBW	Specifies the video band width. Narrowing VBW will reduce the noise variations. And widening VBW results to a faster measurement. If the system has E4402B 3GHz spectrum analyzer or 4395A, this value is clipped to a largest (and not greater than it) value within the range from RBW/300 to RBW and among 10, 30, 100, 1k, 3k, 10k, 30k, 100k, 300k, 1M and 3MHz. (IF the system has the 4395A, the maximum value is 1MHz.) When only E5040A is installed in the system, the VBW value is clipped to the value of RBW.
Start Freq.	Specifies the starting frequency of the spectrum analyzer for spectrum measurement. If the system has 4395A, the frequency range is from 0Hz (min) to 500MHz (max). If the system has E4402B 3GHz spectrum analyzer with the E5040A, the frequency range is 0Hz (min) to 3GHz (max).
Stop Freq.	Specifies the stopping frequency of the spectrum analyzer for spectrum measurement. If the system has 4395A, the frequency range is from 0Hz (min) to 500MHz (max). If the system has E4402B 3GHz spectrum analyzer with the E5040A, the frequency range is 0Hz (min) to 3GHz (max).
Data Pattern	Specifies the data pattern to be written on the test track. To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
Track #	Specifies the track number to be tested.
Meas. Type	Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.

NOTE To set the erase type i.e. (DC+ / DC-/AC), click on [More Config.] to open the setup menu and select the type in the [Erase Type] button.

3. Click on the [Measure] button to start measurement. When [Auto Scale] is pressed, the graph scale will adjust itself automatically to its maximum and minimum values.
4. Click the [Return] button to return to Measure menu.

Measurement Display

The upper left side of the menu shows the measured SNR in terms of dBm, the measured ‘Signal’ in terms of volts and ‘Noise’ in terms of rms volts.

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Spectrum Measurement

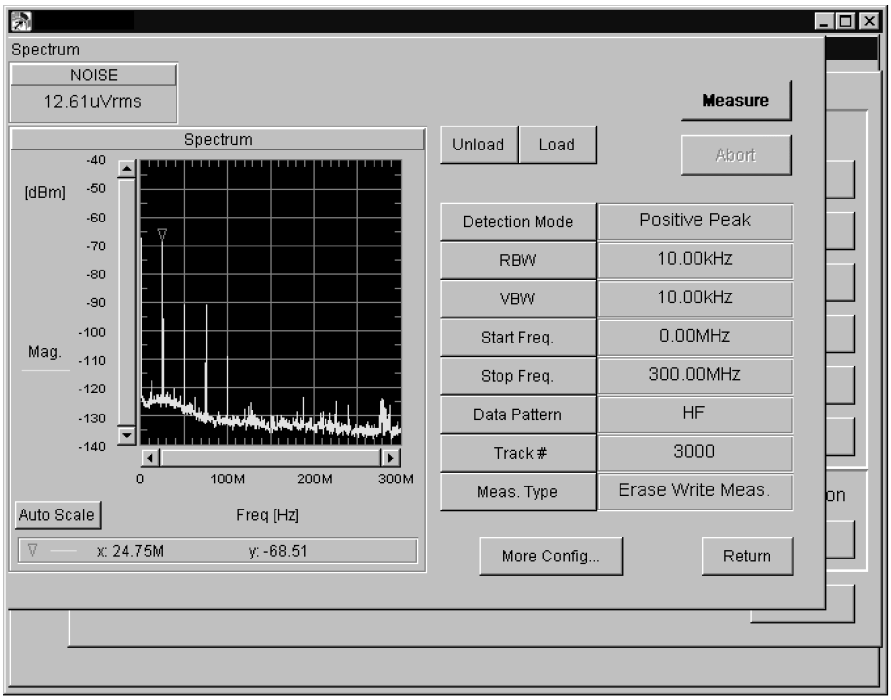
Overview

This section describes the measurement of noise signal using a spectrum analyzer.

Measurement Procedure

1. To open the Spectrum Measurement menu, click on [Measure Spectrum] button from the Measure menu.

Figure 3-102 **Spectrum Measurement Menu**



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

Unload — Unloads the head from the media. Head noise is measured.

Load — Loads the head on the media. Media noise is measured.

Abort — Aborts unexpected long measurements.

2. Set the parameters, click on each button to enter a new value.

Detection Mode — Specifies the detection mode of the signal analyzer. Select ‘sampling mode’ when measuring noise. And select ‘positive peak mode’ when measuring the signal. Refer to the “hpe5022_setupSpectrum” function of the programming manual for details.

RBW — Specifies the resolution band width. Narrowing RBW will widen the dynamic range. However, depending on the frequency

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	span, the measurement speed may become very slow when you set this below 10kHz. The values which can be set by vary by Spectrum analyzer the system has If the system has 4395A or E5040A, the RBWs of 3k, 10k, 30k, 100k, 300k and 1MHz can be set. If the system has the optional E4402 3GHz spectrum analyzer, 3MHz and 5MHz RBWs can be set additionally. When you use other than the above values, the closest and lower value is set automatically.
VBW	Specifies the video band width. Narrowing VBW will reduce the noise variations. And widening VBW results to a faster measurement. If the system has E4402B 3GHz spectrum analyzer or 4395A, this value is clipped to a largest (and not greater than it) value within the range from RBW/300 to RBW and among 10, 30, 100, 1k, 3k, 10k, 30k, 100k, 300k, 1M and 3MHz. (IF the system has the 4395A, the maximum value is 1MHz.) When only E5040A is installed in the system, the VBW value is clipped to the value of RBW.
Start Freq.	Specifies the starting frequency of the spectrum analyzer for spectrum measurement. If the system has 4395A, the frequency range is from 0Hz (min) to 500MHz (max). If the system has E4402B 3GHz spectrum analyzer with the E5040A, the frequency range is 0Hz (min) to 3GHz (max).
Stop Freq.	Specifies the stopping frequency of the spectrum analyzer for spectrum measurement. If the system has 4395A, the frequency range is from 0Hz (min) to 500MHz (max). If the system has E4402B 3GHz spectrum analyzer with the E5040A, the frequency range is 0Hz (min) to 3GHz (max).
Data Pattern	Specifies the data pattern to be written on the test track.To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
Track #	Specifies the track number to be tested.
Meas. Type	Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.

NOTE To set the type of DC erase i.e. (DC+ / DC-/AC), click on [More Config.] to open the setup

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menu and select the type in the [Erase Type] parameter.

3. Click the [Measure] button to start measurement. When [Auto Scale] is pressed, the graph scale will adjust itself automatically to its maximum and minimum values.
4. Click the [Return] button to return to Measure menu.

Measurement Display

The measurement window shows the measured noise expressed in terms of rms volts. The plotted spectrum shows the measured signal since positive peak is chosen as the detection mode.

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Popcorn Noise Test

Popcorn Noise Test when using E5038A/B

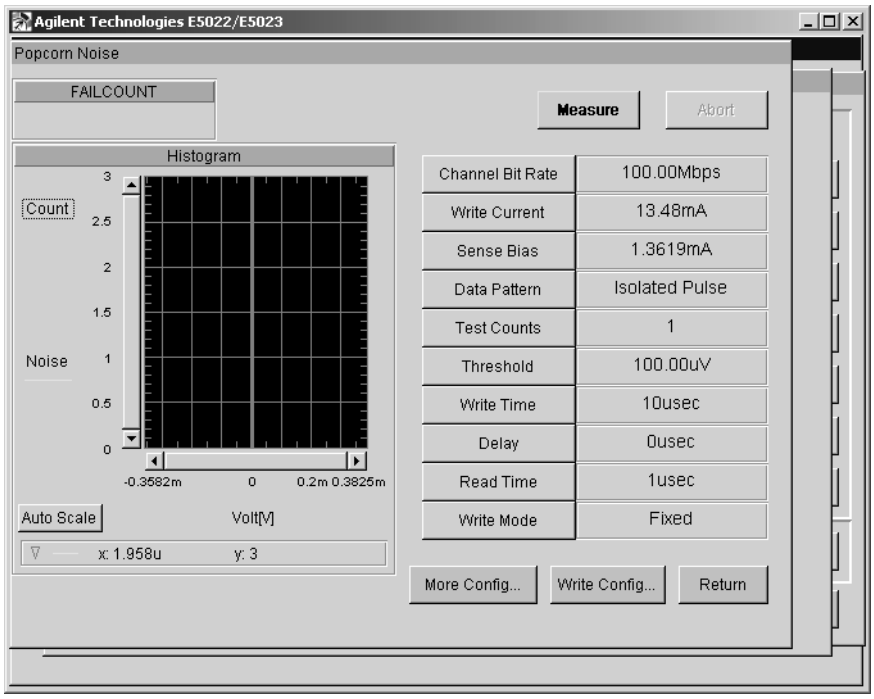
Overview

This section describes the Popcorn Noise Measurement. This measurement allows you to analyze the head noise after write operation. Popcorn noise is detected when it exceeds a specified level (threshold level) at a specified time.

Measurement Procedure

1. To open the Popcorn Noise menu, click on the [Popcorn Noise] button.

Figure 3-103 Popcorn Noise Menu



Abort Aborts unexpected long measurements.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate Specifies the speed at which data bits are written on the media per second [bps].

Write Current Specifies the current applied to the write head.

Sense Bias Specifies the current applied to the read head.

Test Counts Specifies the number of counts for popcorn noise. This parameter can be set from 1 (min) to 1,000,000 (max).

Threshold Specifies the threshold level as the limit to detect popcorn noise. Popcorn noise is detected when it reaches this level.This parameter is expressed in volts [V].

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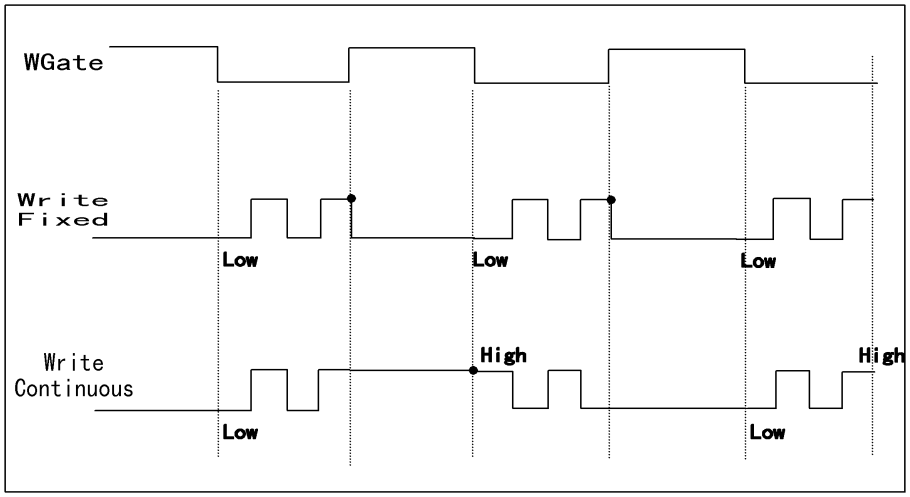
Write Time — Specifies the time to write the data. This parameter is expressed in terms of [µsec].

Delay — Specifies the distance in time between write and read operations. This parameter represents the delay time when to read the data after write. This parameter is expressed in terms of [µsec].

Read Time — Specifies the amount of time to read the data. This parameter is expressed in [µsec].

Write Mode — Specifies the write data polarity when writing the data. When 'Fixed' is selected the write current direction of each write operation is the always the same. When 'Continuous' is selected the write current direction at the beginning of write operation is the same as the last current direction of the previous write. Refer to the programming manual.

Figure 3-104 Write Mode



When [Write Mode] is set to "fixed", the write current direction at the beginning of each write operation is always the same. On the other hand, when [Write Mode] is set to "continuous" the write current direction is the same as the last current direction of the previous write operation. Each time it alternates it allows you to check the polarity of the output pulse at the end of the previous write. You must set the repetitive period of the data pattern T to 1T, 2T, 4T and 8T due to the system's internal constraints. If you use other repetitive periods of the data pattern, E5022/E5023 system can not guarantee the change of write current polarity. This function makes it possible for popcorn noise measurement (i.e. failcount) to achieve an acceptable level of TAA under similar usage of the drive. Before this function was introduced, the write current direction always starts at a constant direction, thus you can only observe one side of the output.

NOTE If the attached head amplifier does not support "continuous" write current function, a system error "hpe5022_ERROR_NSUP_CONF" will be displayed, when you set the [Write Mode] to "Continuous".

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NOTE

The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

Write Config

Select the data pattern for the write excitation. This allows you to select the different data patterns for write excitation from the standard data pattern independently. This also allows you to select the erase patterns as a write pattern.

3. Click on the [Measure] button to start measurement.

Measurement Display

The upper left portion of the window shows the [FAILCOUNT]. Fail count represents the number of times that popcorn noise has occurred.

4. Click the [Return] button to return to Measure menu.

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Popcorn Noise Test using E5041A

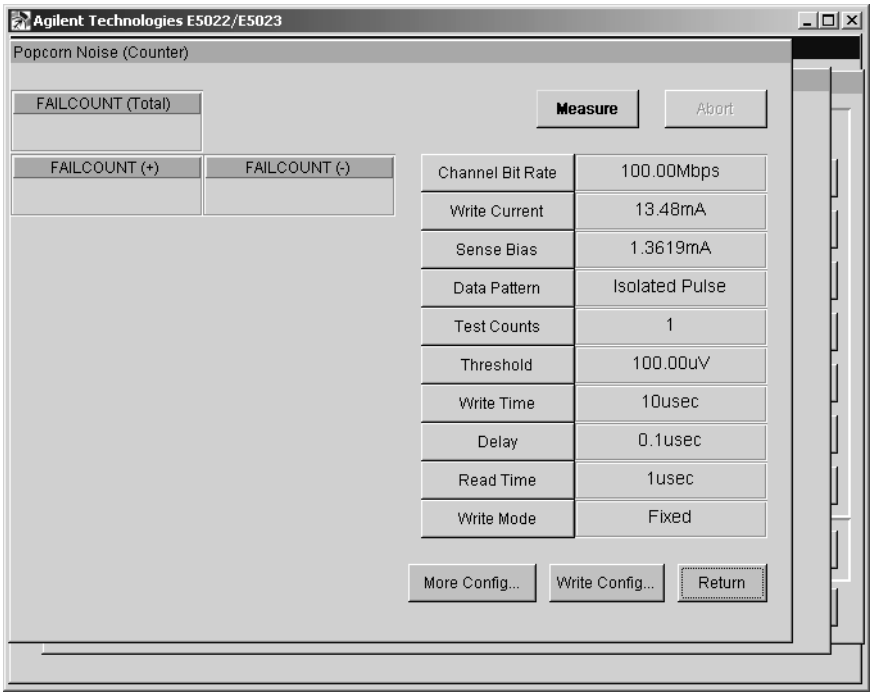
Overview

The Agilent E5041A is a dual counter module designed to detect and count the number of noise spikes in the read head. This measurement is used to measure the head noise called popcorn noise, which occurs shortly after the write operation.

Measurement Procedure

1. To open the Popcorn Noise Counter menu, click on the [Popcorn Noise Counter] button from the main popcorn noise menu

Figure 3-105 Popcorn Noise Counter Menu



Abort Aborts unexpected long measurements.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate Specifies the speed at which data bits are written on the media per second [bps].

Write Current Specifies the current applied to the write head.

Sense Bias Specifies the current applied to the read head.

Test Counts Specifies the number of test counts. The setting range is from 1(min) to 1,000,000(max).

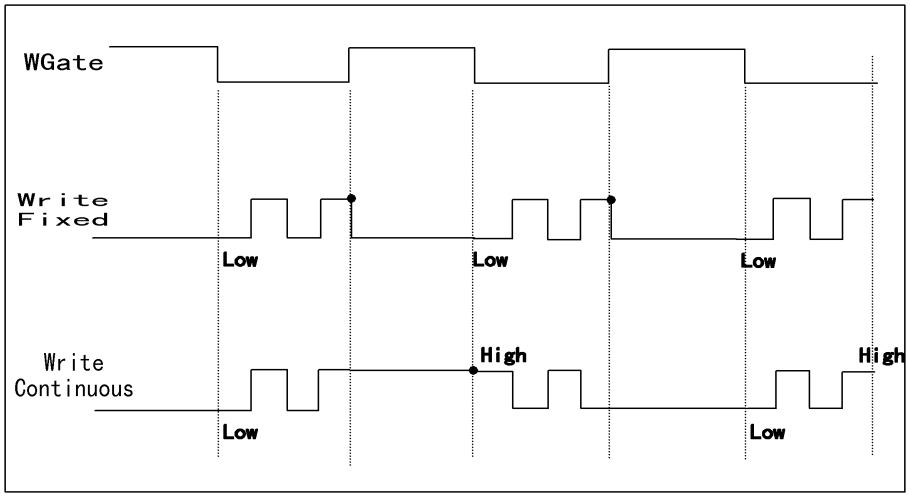
Threshold Specifies the threshold level as the limit to detect popcorn noise. Popcorn noise is detected when it reaches this level.This parameter is expressed in volts [V].

Write Time Specifies the time to write the data. This parameter is expressed in terms of [µsec].

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Delay	Specifies the distance in time between write and read operation. This parameter represents the delay time when to read the data after write. This parameter is expressed in terms of [µsec].
Read Time	Specifies the amount of time to read the data. This parameter is expressed in [µsec].
Write Mode	Specifies the write current direction when writing data. When ‘Fixed’ is selected the write current direction at the start of each write operation is the always the same. When ‘Continuous’ is selected the write current direction at the beginning of write operation is the same as the last current direction of the previous write. Refer to the programming manual “hpe5022_popcornNoiseCtWriteModeConfig ” on page 659 for more details.

Figure 3-106 Write Mode



When [Write Mode] is set to “fixed”, the write current direction at the beginning of each write operation is always the same. On the other hand, when [Write Mode] is set to “continuous” the write current direction is the same as the last current direction of the previous write operation. Each time the write current alternates it allows you to check the polarity of the output pulse at the end of the previous write. You must set the repetitive period of the data pattern T to 1T, 2T, 4T and 8T due to the system’s internal constraints. If you use other repetitive periods of the data pattern, E5022/E5023 system can not guarantee the change of write current polarity. This function makes it possible for popcorn noise measurement (i.e. failcount) to achieve an acceptable level of TAA under similar usage of the drive. Before this function was introduced, the write current direction always starts at a constant direction, thus you can only observe one side of the output.

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Write Config

Select the data pattern for the write excitation. This allows you to select the different data patterns for write excitation from the standard data pattern independently. This also allows you to select the erase patterns as a write pattern.

NOTE If the attached head amplifier does not support “continuous” write current function, a system error “hpe5022_ERROR_NSUP_CONF” will be displayed, when you set the [Write Mode] to “Continuous”.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on the [Measure] button to start measurement.

Measurement Display

The upper left side of the window shows the total number of detected popcorn noise “FAILCOUNT(Total)”. Failcount (total) is the sum of Failcount(+) and Failcount (-) as detected by their respective thresholds. Refer to the programming manual “hpe5022_measurePopcornNoiseCt” function for details.

4. Click the [Return] button to return to Measure menu.

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Bit Error Test Measurement

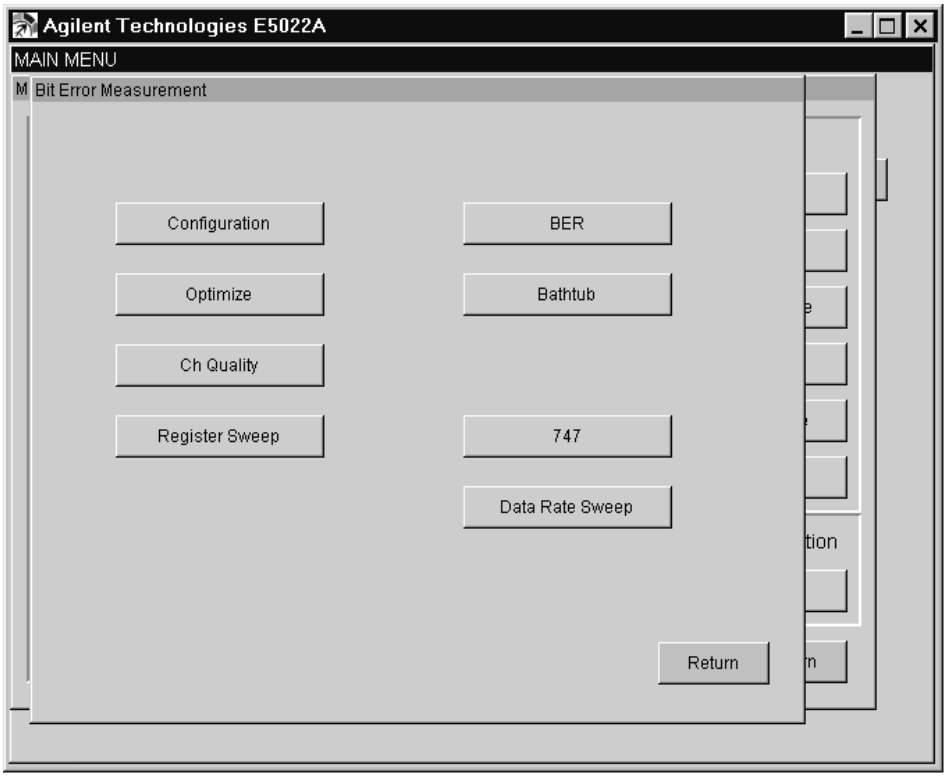
Overview

The Agilent E5039A/B/C is a Bit Error Rate Test Module designed to allow users to measure the bit error rate characteristics of the head and media with a customer specified channel IC. The parameters of the channel IC is programmable according to test requirements and measurement applications. In general, BER is used to measure what fraction of the total bits are in error.

Measurement Procedure

Click on [BER] button from the measurement menu to open the Bit Error Measurement menu.

Figure 3-107 **Bit Error Measurement Menu**

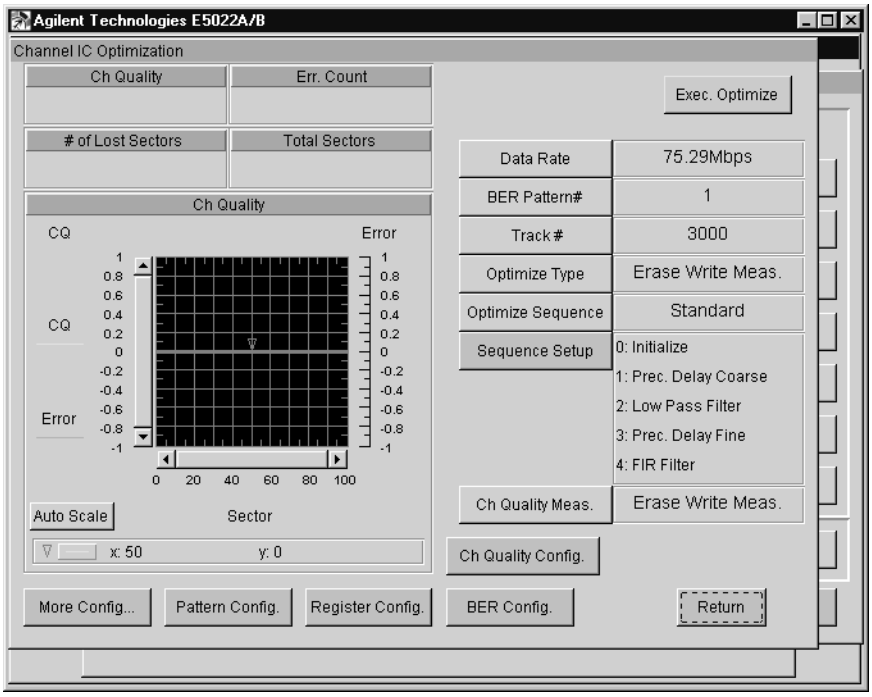


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[Optimize] Menu

Measurement Procedure

Click on the [Optimize] button to open the optimization menu.



Optimization enables the channel IC to operate at optimum performance. Optimization is necessary whenever you change the user data rate, endec parameters, etc. prior to measurement. Optimization enables you to operate the Equalizer and filter settings at maximum performance. It also allows you to evaluate the write precompensation.

Exec. Optimize — Optimizes the selected parameters in the [Sequence Setup] menu.

5. Set the parameters, click on each button to enter a new value.

Data Rate — Specifies the number of data bits to be recorded per second.

BER Pattern # — Specifies the pattern number to be used to write the data pattern. The data pattern of the selected pattern number must be specified in the [Pattern Config.] menu in advance.

Track # — Specifies the track number to be tested.

Optimize Type — Selects the sequence type. This selects if it executing a erase and a write before the optimization. When the “Optimize Only” is selected, the optimization of write precompensation must be turned off.

Optimize Sequence — Specifies the type in the optimization. Allows the user to select either ‘Standard” or “Custom” optimization.

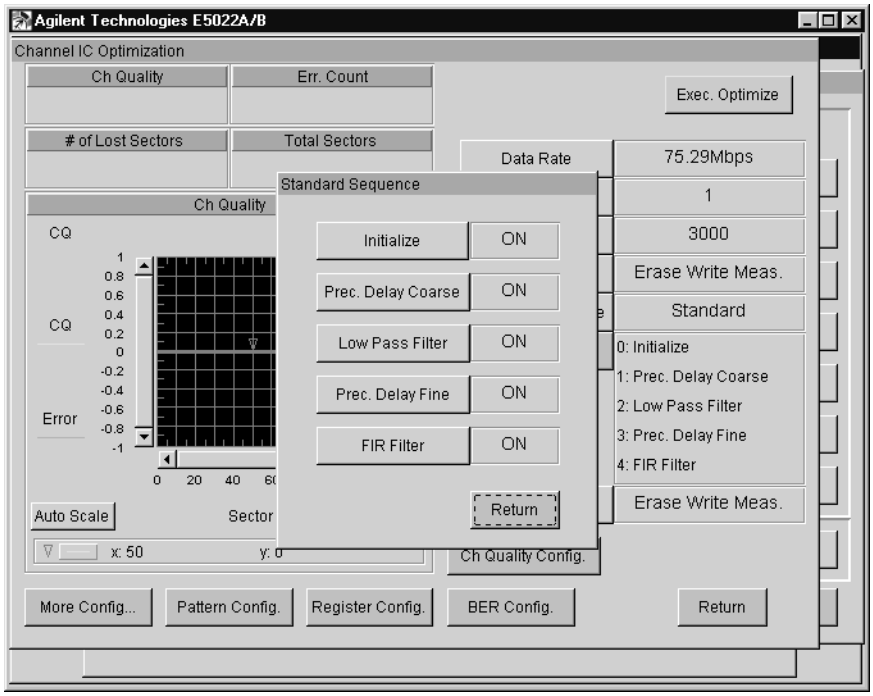
Sequence Setup — A configuration menu will pop up when you

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click this button. Consequently, the corresponding selected parameters in this menu will be shown automatically in the sequence setup frame.

Ch Quality Meas. Selects the sequence type of the channel quality measurement.

[Optimize] > [Sequence Setup] (When Optimize Sequence is Standard)



When “Optimize Sequence” is set to standard, the following optimization parameters can be set up:

Initialize Specifies the initialization of registers to a given value before executing the optimization.

Prec. Delay Coarse Optimizes the precompensation delay to reduce magnetic non-linearity effects. This parameter precompensates one preceding bit of the data pattern. Refer to “Precompensation Setting Menu” to set the parameters.

Low Pass Filter Optimizes the low-pass filter. If [ON] is selected, the boost gain, cut-off frequency and group delay are operated at optimum performance.

Prec. Delay Fine Optimizes the precompensation delay to reduce magnetic non-linearity effects. This parameter precompensates two preceding bits of the data pattern. Refer to “Precompensation Setting Menu” to set the parameters.

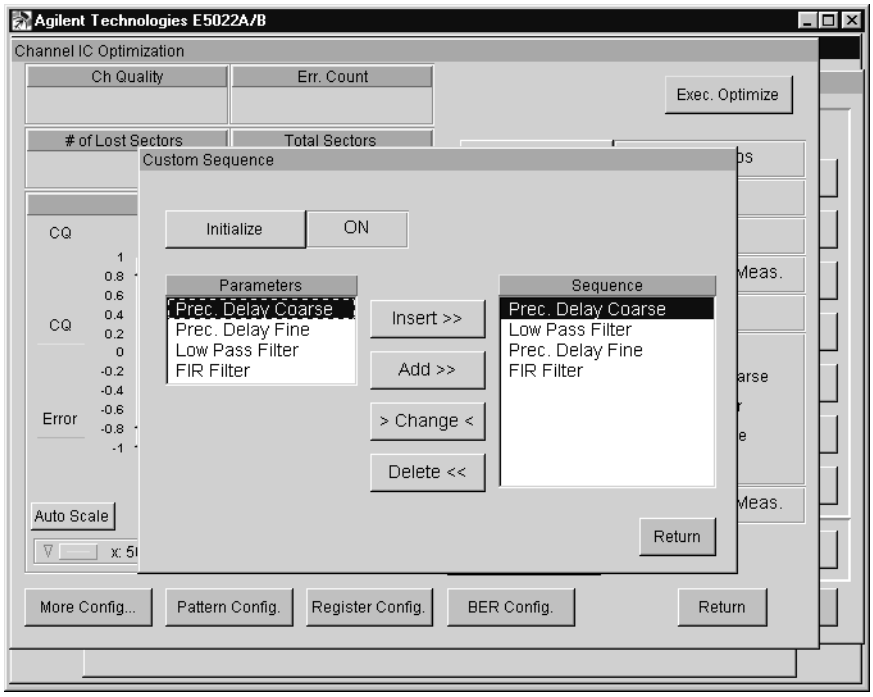
FIR Filter Optimizes the FIR Filter’s tap coefficient for

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good reshaping and better equalization of the read-back pulses.

When “Optimize Sequence” is set to custom, the user can set up the sequence in any order as required by measurement applications.

[Optimize] > [Sequence Setup] (When Optimize Sequence is Custom)



To add or insert a new parameter, select it in the ‘Parameters’ list and click on **[Insert>>]** and/or **[Add>>]** button. To edit or remove a previously set up parameter, select it in the ‘Sequence’ list and click on **[Change]** and/or **[Delete]** button. The setup parameters will be displayed on the sequence frame of the [Optimize] menu.

6. Click the [Return] button to return to [Optimize] menu.
7. Click on the [Exec. Optimize] button to execute optimization.
8. Click the [Return] button to return to BER main menu.

The [More Config.], [Pattern Config.], [Register Config.], [BER Config.] and [Ch Qual. Config.] buttons are used for additional configuration settings. Click on any of these buttons to set a new parameter value as required by measurement applications.

Measurement Results

The upper left portion of the main menu shows the [Ch Quality], [Error Count], [# of Lost Sectors] and [Total Sectors]. [Error Count] counts the number of detected error bytes per sector. The [# of Lost Sectors] counts the sector where the synchronous pattern is not detected. [Total Sectors] represents the total number of sectors measured.

[Configuration] Menu

The [Configuration] menu is provided in the Agilent Technologies E5039A/B ‘Manual Supplement’ because configuration is dependent on each channel IC characteristics.

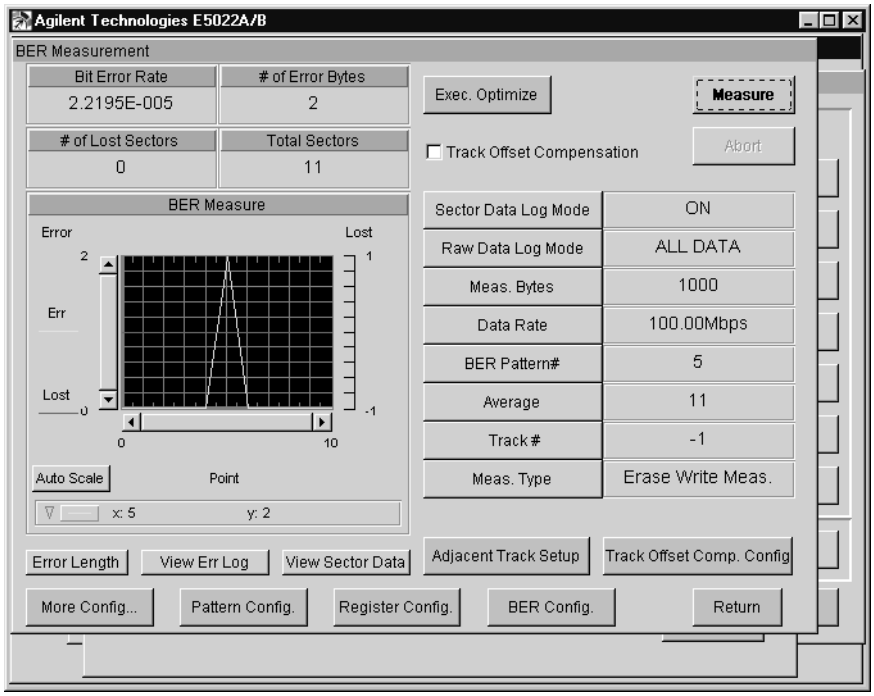
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[BER] Menu

Measurement Procedure

1. Click on [BER] button to open the BER Test menu.

Figure 3-108 **Ber Menu**



Exec. Optimize — Optimizes the setup parameters in the [Optimize] menu for optimum measurement results. Optimization is required whenever you change the 'User Data Rate' and 'ENDEC' parameters.

Abort — Aborts long measurements of BER.

Track Offset Compensation — Checking this box will activate a track offset compensation function. See "Track Offset Compensation Function" on page 274.

2. Set the parameters, click on each button to enter a new value.

Sector Data Log Mode — Specifies the logging mode of the sector data. If [ON] is selected, the number of error bytes for each sector is counted and displayed on the [View Sector Data]. If [OFF] is selected, the number of error counts for a particular sector is not counted and it deactivates the [View Sector Data] button. Refer to the "hpe5022_BER_berDataLoggingMode" function of the programming manual for details.

Raw Data Log Mode — Specifies the logging mode of the raw data. If [All Data] is selected, all error data are logged.

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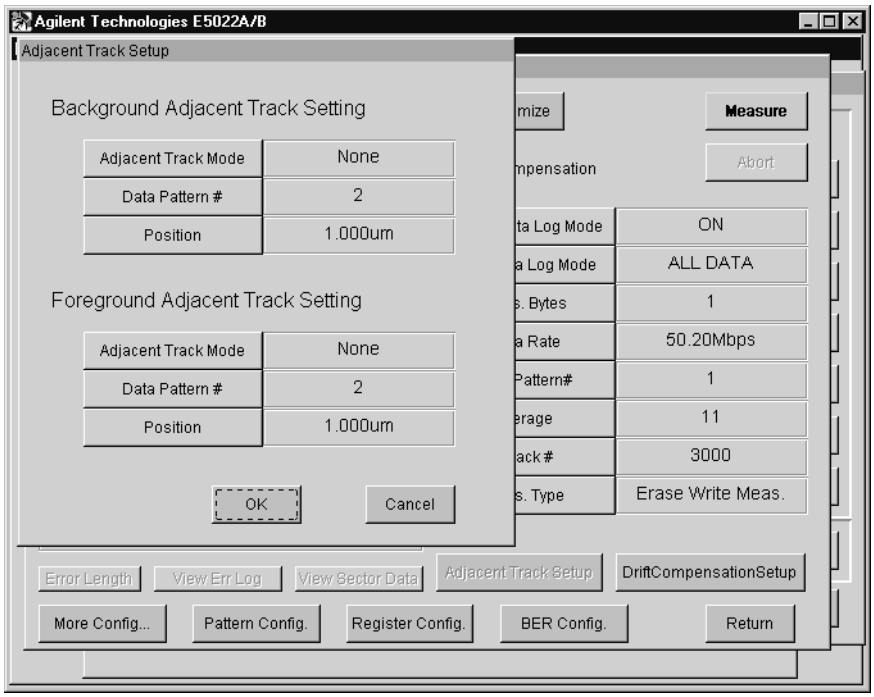
	If [Last Revolution] is selected, only the error data of the last revolution is logged. The [View Err Log] displays the logged error data. Refer to the "hpe5022_BER_berDataLoggingMode" function of the programming manual for details.
Meas. Bytes	Specifies the number of bytes to be measured.
Data Rate	Specifies the number of user data bits to be recorded on the media per second. The range should be from 50Mbit/s to 800 Mbit/s. Refer to the "hpe5022_BER_userDataBitRate" function of the programming manual for details.
BER Pattern #	Specifies the pattern number to be used for bit error rate measurement. The data pattern of the selected pattern number must be specified in the [Pattern Config.] menu in advance.
Average	Specifies the number of tests to get the average result. Average is equal to the number of times a measurement sequence is repeated. Refer to "hpe5022_BER_berMeas ByteCount" function of the programming manual for details.
Track #	Specifies the track number to be tested.
Meas. Type	Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.

NOTE To set the erase type i.e. (DC+ / DC- / AC), click on [More Config.] to open the setup menu and select the type in the [Erase Type] button.

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3. Click on the [Adjacent Track Setup] button to set up the adjacent track parameters. The setup parameters in this menu will automatically update similar parameters in the Bathtub menu.

Figure 3-109 Adjacent Track Menu



Background Adjacent Track Setting

Adjacent Track Mode — Specifies the type of background adjacent track.

Data Pattern # — Specifies the data pattern to be written on the background adjacent track.

Position — Specifies the position to write the background adjacent track. The adjacent track position can be set from 0[µm] min. to 6[µm] max. See Figure 3-110.

Foreground Adjacent Track Setting

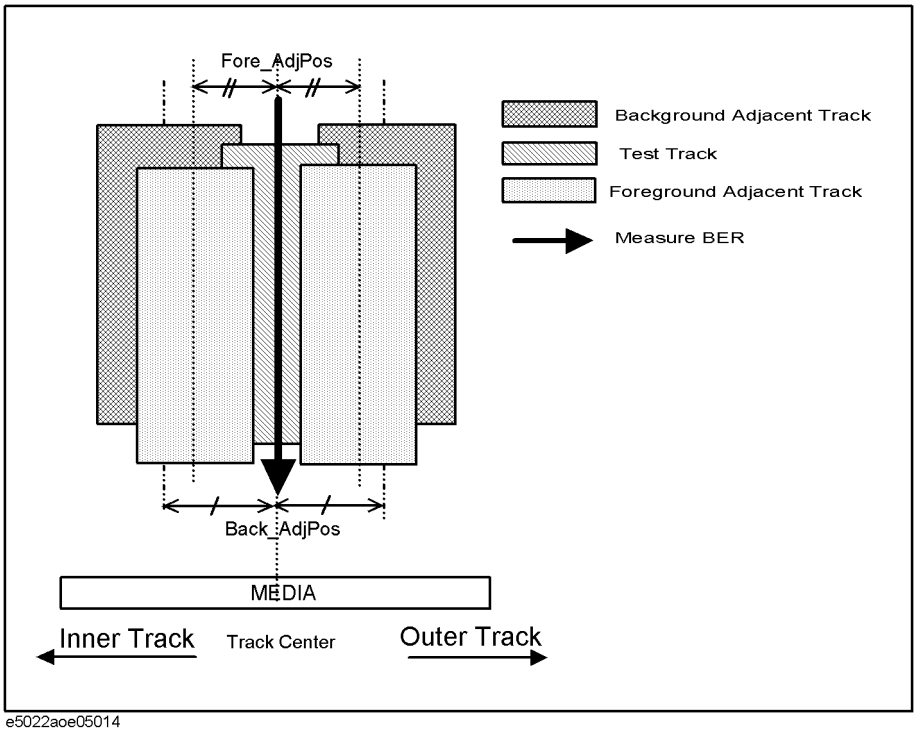
Adjacent Track Mode — Specifies the type of foreground adjacent track.

Data Pattern # — Specifies the data pattern to be written on the foreground adjacent track.

Position — Specifies the position to write the foreground adjacent track. The adjacent track position can be set from 0[µm] min. to 6[µm] max. See Figure 3-110.

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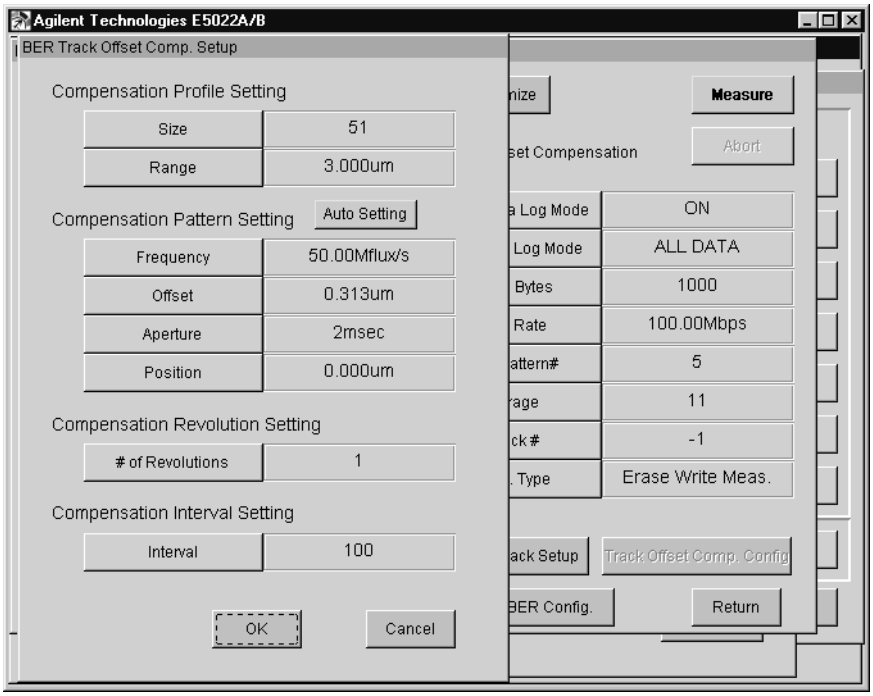
Figure 3-110 Adjacent Track Position



e5022aoe05014

4. Click the [Drift Compensation Setup] button to open the Track Offset Compensation window.

Figure 3-111 BER Menu - Track Offset Compensation Setup



- Compensation Profile Setting

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Size	Specifies the track profile points for calibration sequence in the track offset compensation sequence.
Range	Specifies the track profile range for calibration sequence in the track offset compensation sequence.

- Compensation Pattern Setting

Auto Setting	Checking this box will define a compensation pattern setting automatically.
Frequency	Specifies a frequency of the burst patterns.
Offset	Specifies a offset position of the burst patterns.
Aperture	Specifies a aperture time of the burst patterns.
Position	Specifies a center position of the burst patterns from the track center.

- Compensation Revolution Setting

# of Revolution	Specifies the average counts to measure a position error signal (PES). The burst pattern is measured for revolutions specified by this number and calculates a PES from the averaged value.

- Compensation Interval Setting

Interval	Specifies the interval counts for the track offset compensation. Reading a burst pattern and compensating a head position are performed at each revolution specified by this value.

5. Click the [Measure] button to start measurement.

Measurement Display

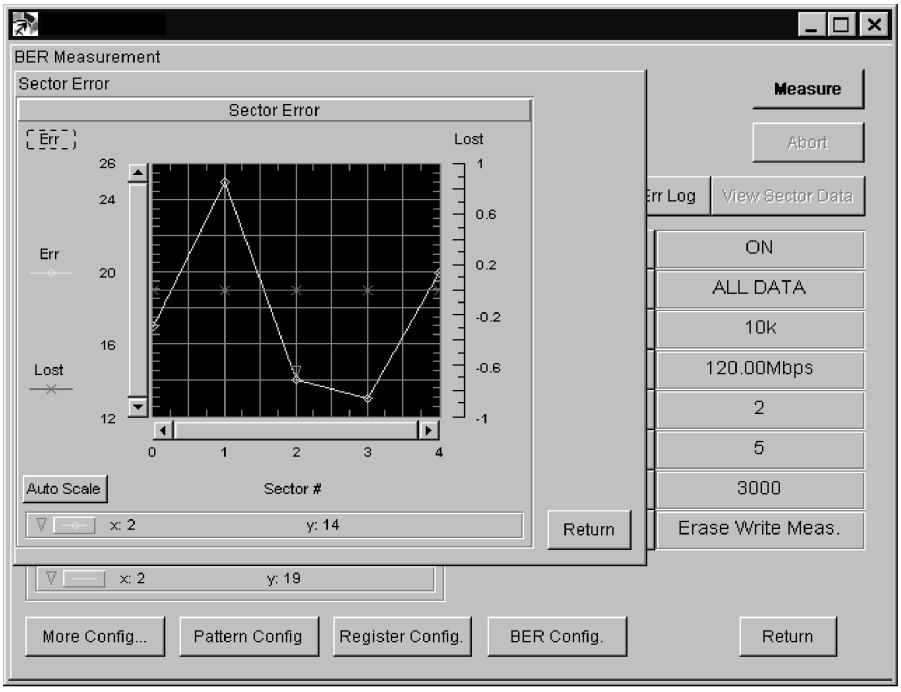
The upper left portion of the menu shows the [Bit Error Rate], [# of Error Symbols], [# of Lost Sectors] and [Total Sectors]. The [# of Error Symbols] counts the number of detected error bytes per sector. The [# of Lost Sectors] counts the sector where the synchronous pattern is not detected. The [Total Sectors] on the other hand, counts the total number of sectors including the lost sectors. This value is affected by the specified [Average] counts and the amount of [Meas Bytes] measured bytes.

The [More Config.], [Pattern Config.], [Register Config.] and [BER Config.] buttons are added on this menu for additional configurations. Click on any of these buttons to set a new parameter value as required by measurement applications. The [BER Config.] menu have the same setting and format as the [Configuration] of the BER Main menu.

6. Click on [View Sector Data] button to open the view sector window. When you click on [Auto Scale] the graphic scale will adjust itself automatically to its maximum and minimum values.

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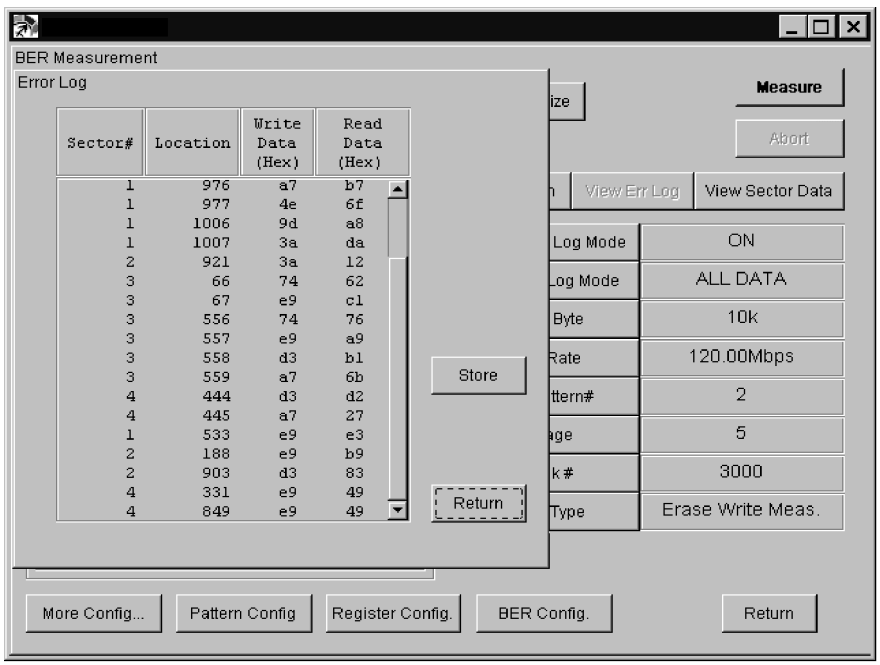
[BER] > [View Sector Data] Window



The [View Sector Data] allows you to monitor the number of error symbols per sector, i.e., the number of detected error bytes per sector as reported by ‘Err’ graph line. The ‘Lost’ graph line on the other hand reports the lost sectors when the sync-pattern is not detected.

7. Click on [View Err Log] button to open the view error logging window.

[BER] > [View Err Log] Window

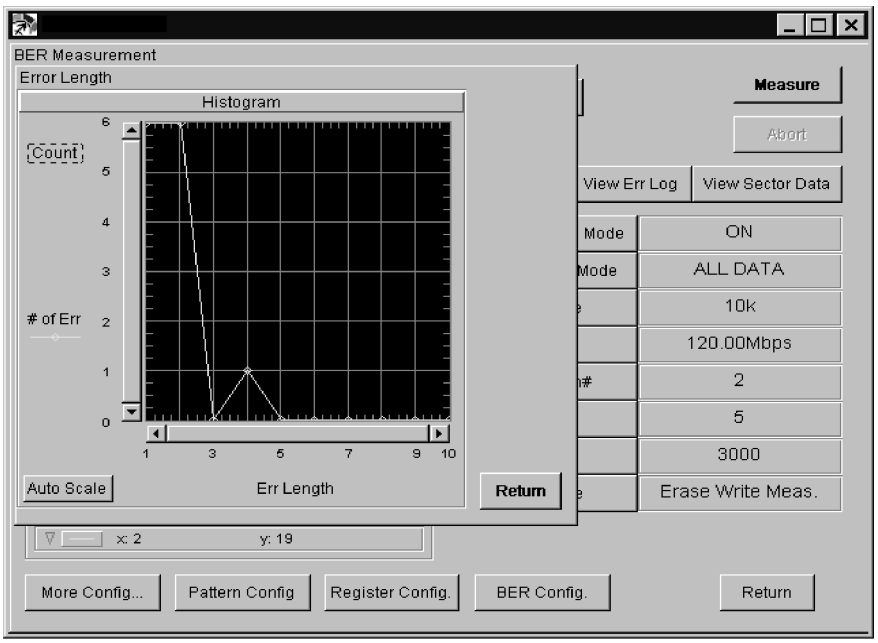


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This table shows the originally written/read data of each sector where data error is detected.

8. Click on [Error Length] button to open the error length window.

[BER] > [Error Length] Window



This window shows the length of the counted errors.

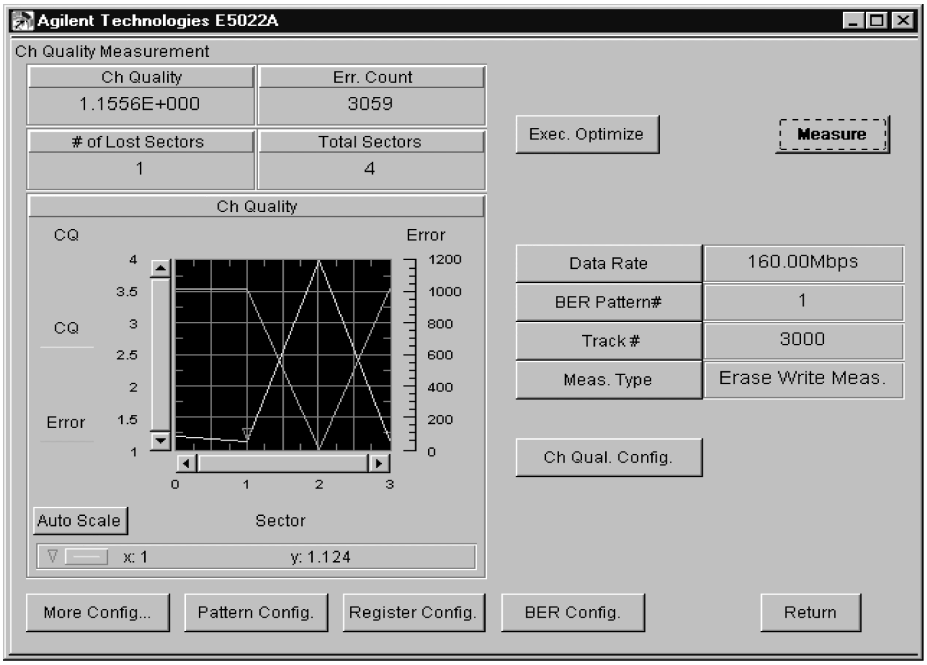
9. Click the [Return] button to return to BER menu.

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[Ch Quality] Menu

Measurement Procedure

1. Click on the [Ch Quality] button to open the Channel Quality Measurement menu.



It is important to determine the quality of the channel IC, any non-linear distortions in the channel will degrade the error rate performance of the system. When channel quality measurement is performed, it executes the measurement sequence for one cycle only, i.e., there is no average measurement for channel quality.

Exec. Optimize — Executes the optimization of the parameters set at [Optimize] menu for optimum measurement results. Optimization is required whenever you change the ‘User Data Rate’ and ‘Endec’ parameters.

2. Set the parameters, click on each button to enter a new value.

Data Rate — Specifies the number of data bits to be recorded on the media per second. A user data is supplied to the encoder, after encoding this user data is transformed into a channel data. The channel data is the actual data written on the media. A channel data rate on the other hand, defines how many encoded bits are written on the media per second, i.e. after encoding. The range should be from 50Mbit/s to 800 Mbit/s. Refer to the “hpe5022_BER_userDataBitRate” function of the programming manual for details.

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BER Pattern #	Specifies the pattern number to be used to write the data pattern. The data pattern of the selected pattern number must be specified in the [Pattern Config.] menu in advance.
Track #	Specifies the track number to be tested.
Meas. Type	Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.

NOTE To set the type of erase type i.e. (DC+ / DC- / AC), click on [More Config.] to open the setup menu and select the type in the [Erase Type] button.

3. The [More Config.], [Pattern Config.], [Register Config.], [BER Config.] and [Ch Qual. Config.] buttons are used for additional configuration settings. Click on any of these buttons to set a new parameter value as required by measurement. The [BER Config.] menu have the same setting and format as the [Configuration] of the BER Main menu.
4. Click the [Measure] button to start measurement.

Measurement Display

The upper left portion of the menu shows the [Ch Quality], [Error Count], [# of Lost Sectors] and [Total Sectors]. [Error Count] counts the number of detected error bytes per sector. The [# of Lost Sectors] counts the sector where the synchronous pattern is not detected. [Total Sectors] represents the total number of sectors measured.

5. Click the [Return] button to return to BER menu.

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Data Rate Sweep

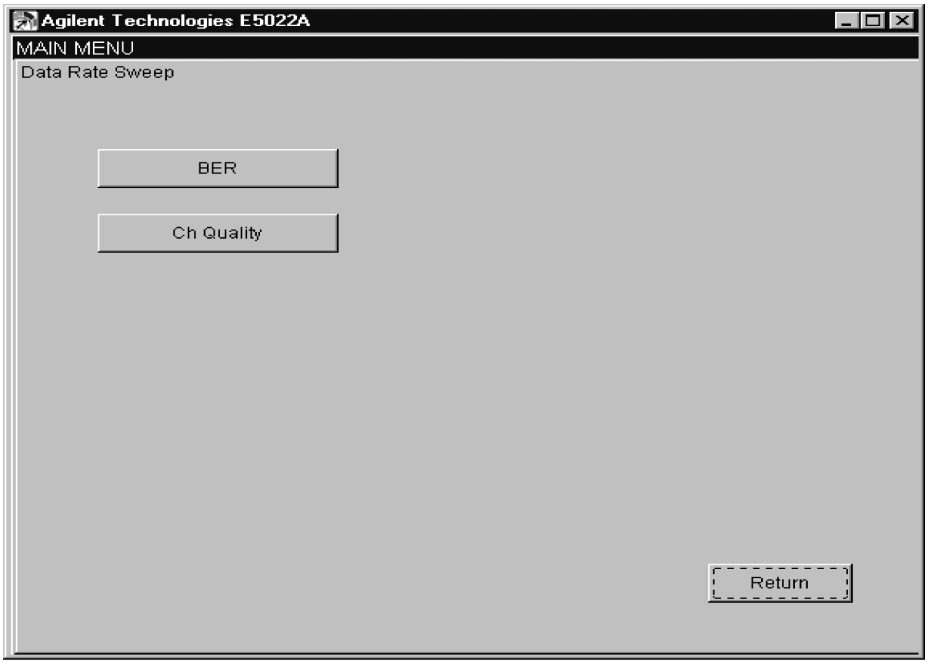
Overview

This section describes the Data Rate Sweep measurement. Data Rate Sweep measurement is used for both bit error rate and channel quality measurements.

Measurement Procedure

1. To open the Data Rate Sweep menu, click on the [Data Rate Sweep] button from the BER Main menu.

Figure 3-112 **Data Rate Sweep Menu**



NOTE

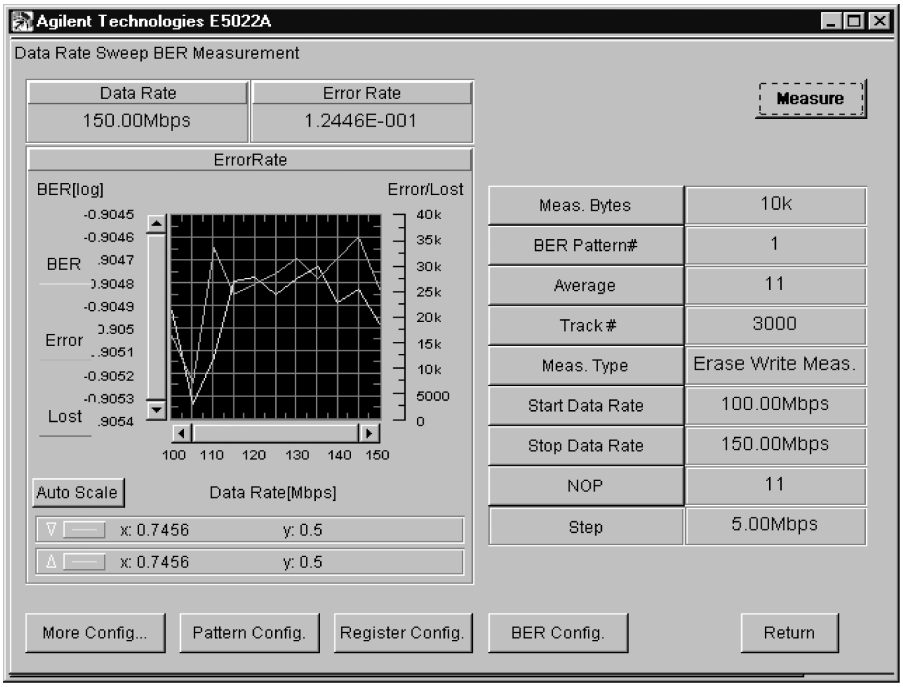
Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

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[Data Rate Sweep] BER Menu

1. Click on [BER] button to open the BER measurement menu of the data rate sweep.

[Data Rate Sweep] > [BER] Menu



2. Set the parameters, click on each button to enter a new value.

Meas. Bytes — Specifies the number of data bytes to be measured.

BER Pattern # — Specifies the pattern number to be used for bit error rate measurement. The data pattern of the selected data pattern number must be specified in the [Pattern Config.] menu in advance.

Average — Specifies the number of tests to get the average result. Average is equal to the number of times a measurement sequence is repeated. Refer to “hpe5022_BER_berMeas ByteCount” function of the programming manual for details.

Track # — Specifies the track number to be tested.

Meas. Type — Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.

Start Data Rate — Specifies the starting point of the data rate.

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Stop Data Rate	Specifies the stopping point of the data rate.
NOP	Specifies the number of points to sweep the data rate.
Step	Displays the step by which data rate is incremented. This parameter is computed and updated automatically when you specify [NOP].

NOTE

To set the erase type (DC+ / DC- / AC), click on [More Config.], to open the setup menu and select the type in the [Erase Type] parameter.

3. The [More Config.], [Pattern Config], [Register Config.] and [BER Config.] buttons are added for additional configurations. Click on any of these buttons to set a new parameter value as required by measurement applications. The [BER Config.] menu have the same setting and format as the [Configuration] of the BER Main menu.
4. Click the [Measure] button to start measurement. When [Auto Scale] is pressed the graph scale will adjust itself automatically to its maximum and minimum values.

Measurement Display

The upper left portion of the menu shows the computed [Error Rate] based on the displayed [Data Rate] as pointed by the arrow in the graph scale.

5. Click the [Return] button to return to BER Main menu.

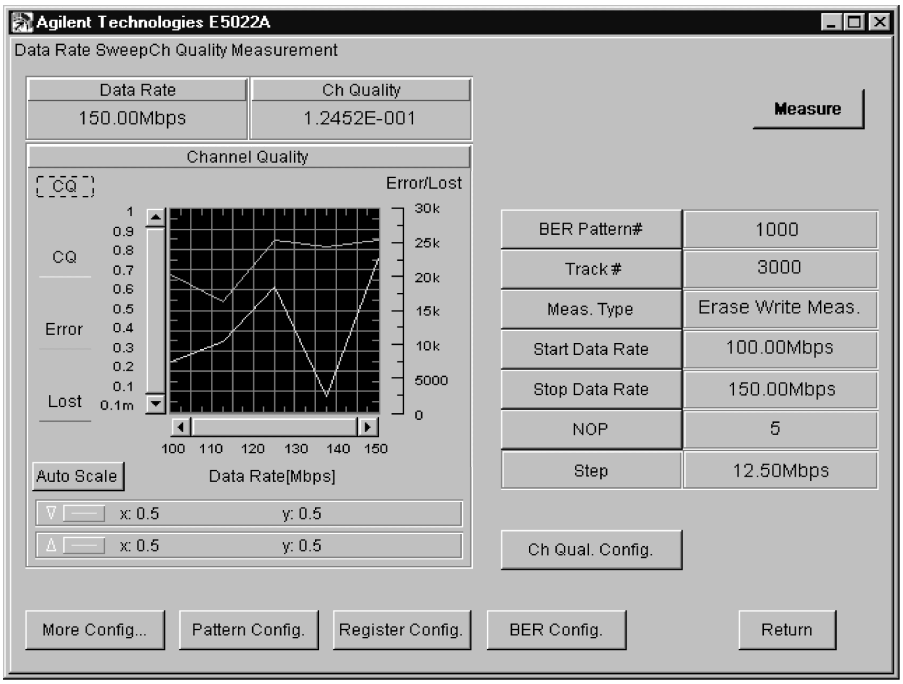
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[Data Rate Sweep] Ch. Quality Menu

Measurement Procedure

1. Click on [Ch Quality] button to open the BER measurement menu of the data rate sweep.

[Data Rate Sweep] > [Ch Quality] Menu



2. Set the parameters, click on each button to enter a new value.

BER Pattern #	Specifies the pattern number to be used for bit error rate measurement. The data pattern of the selected data pattern number must be specified in the [Pattern Config.] menu in advance.
Track #	Specifies the track number to be tested.
Meas. Type	Specifies the type of measurement sequence. 1) [Erase Write Meas.] means to erase, write data then measure. 2) [Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.
Start Data Rate	Specifies the starting point of the data rate.
Stop Data Rate	Specifies the stopping point of the data rate.
NOP	Specifies the number of points to sweep the data rate.
Step	Displays the step by which data rate is incremented. This parameter is computed and updated automatically when you specify [NOP].

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NOTE To set the erase type (DC+ / DC- / AC), click on [More Config.], to open the setup menu and select the type in the [Erase Type] parameter.

3. The [More Config.], [Pattern Config], [Register Config.], [BER Config.] and [Ch Qual. Config.] buttons are added for additional configurations. Click on any of these buttons to set a new parameter value as required by measurement applications. The [BER Config.] menu have the same setting and format as the [Configuration] of the BER Main menu.
4. Click the [Measure] button to start measurement. When [Auto Scale] is pressed the graph scale will adjust itself automatically to its maximum and minimum values.

Measurement Display

The upper left portion of the menu shows the computed [Ch Quality] based on the displayed [Data Rate] as pointed by the arrow in the graph scale.

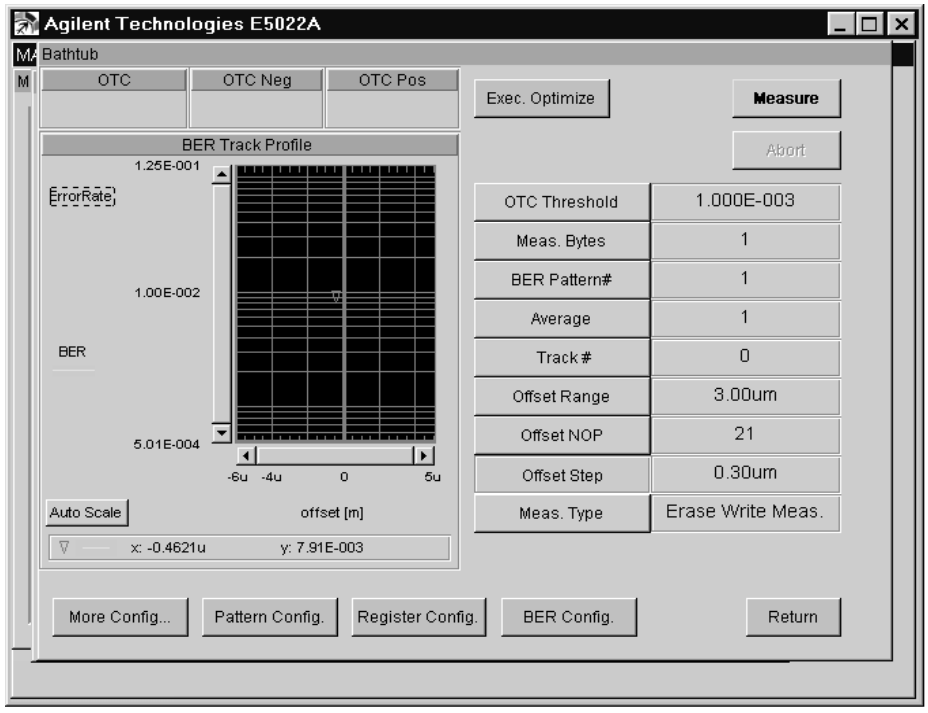
5. Click the [Return] button to return to BER Main menu.

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[Bathtub] Menu

Measurement Procedure

1. Click on the [Bathtub] button from the BER Main menu to open the bathtub menu.



Exec. Optimize — Optimizes the setup parameters in the [Optimize] menu for optimum measurement results. Optimization is required whenever you change the 'User Data Rate' and 'Endec' parameters.

Abort — Aborts unexpected long measurements.

2. Set the parameters, click on each button to enter a new value.

OTC Threshold — Specifies the off-track capability threshold. The threshold limit can be set from 0 min. to 1 max.

Meas. Bytes — Specifies the number of bytes to be measured.

BER Pattern # — Specifies the pattern number to be used to write the data pattern. The data pattern of the selected pattern number must be specified in the [Pattern Config.] menu in advance.

Average — Specifies the number of revolutions to get the average result. Average count is equal to the number of times a measurement sequence is repeated.

Track # — Specifies the track number to be tested.

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Offset Range	Specifies the range of the track offset sweep. The maximum range is 6[µm]. Refer to the 'hpe5022_measureTrackProfile' of the programming manual for details.
Offset NOP	Specifies the number of offset points to build the bath tub curve. The offset NOP range can be set from 1 (min). to 201 (max).
Offset Step	Specifies the step by which the head is moved to build the bath tub curve. This parameter is computed and updated automatically when [Offset Range] and [Offset NOP] parameters are specified.
Meas. Type	Specifies the type of measurement sequence. 1)[Erase Write Meas.] means to erase, write data then measure. 2)[Write Meas.] means to write data, then measure. 3) [Meas.] means to measure only.

NOTE To set the erase type (DC+ / DC- / AC), click on [More Config.], to open the setup menu and select the type in the [Erase Type] parameter.

3. The [More Config.], [Pattern Config], [Register Config.]and [BER Config.] buttons are added for additional configurations. Click on any of these buttons to set a new parameter value as required by measurement applications. The [BER Config.] menu have the same setting and format as the [Configuration] of the BER Main menu.
4. Click on the [Measure] button to start measurement.

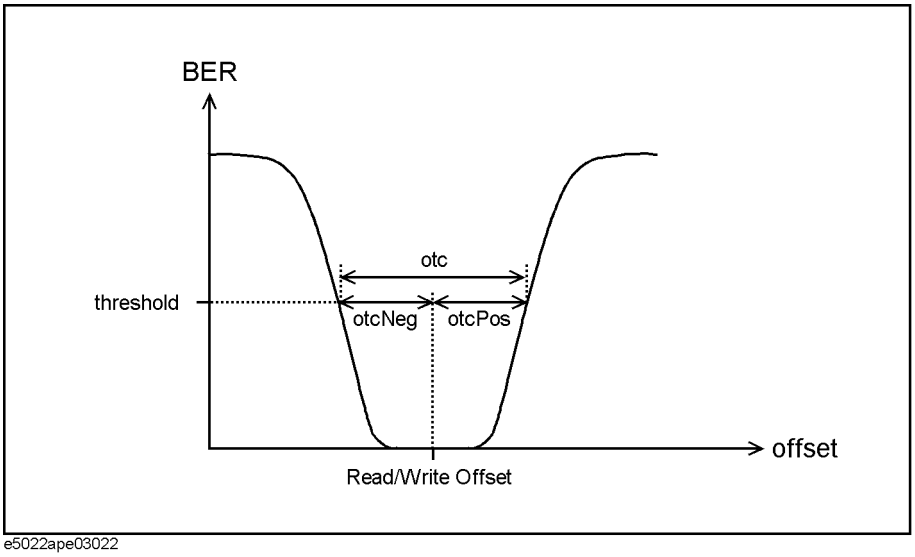
Measurement Display

The upper left side of the menu shows the measured off-track capability OTC. The graph on the other hand shows the *bathtub* characteristic curve of the track profile. OTC Pos. represents the affordable off-track from the Read/Write offset to the right side of the curve. And OTC Neg. represents the affordable off-track from the Read/Write offset to the left side of the curve. OTC represents the total affordable off-track.

An explanation of the bath tub characteristic curve is explained in the 'Measurement Definition' Chapter 5 of the operation manual.

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Figure 3-113 OTC Definitions



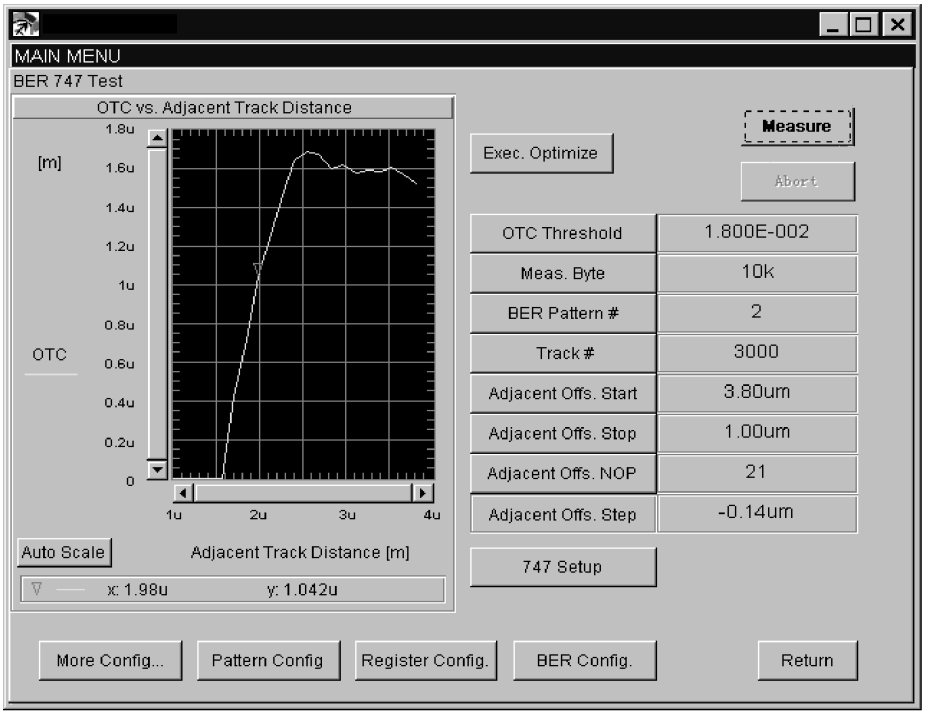
5. Click the [Return] button to return to BER Main menu.

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[747] Test

Measurement Procedure

1. Click on the [747] button to open the 747 measurement menu.



Exec. Optimize — Optimizes the setup parameters in the [Optimize] menu for optimum measurement results. Optimization is required whenever you change the 'Data Rate' and 'Endec' parameters.

Abort — Aborts unexpected long measurement.

2. Set the parameters, click on each button to enter a new value.

OTC Threshold — Specifies the off-track capability threshold. If an adjacent track is written close to the data track, the off-track capability of the system becomes limited.

Meas. Byte — Specifies the number of bytes to be measured.

BER Pattern # — Specifies the pattern number to be used to write the data pattern.The data pattern of the selected pattern number must be specified in the [Pattern Config.] menu in advance.

Track # — Specifies the track number to be tested.

Adjacent Offs. Start — Specifies the starting point of the adjacent track offset. This point is defined as the distance in [µm] between the track center and the adjacent track. The adjacent offset range

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can be set from 0[µm] min. to 6[µm] max.

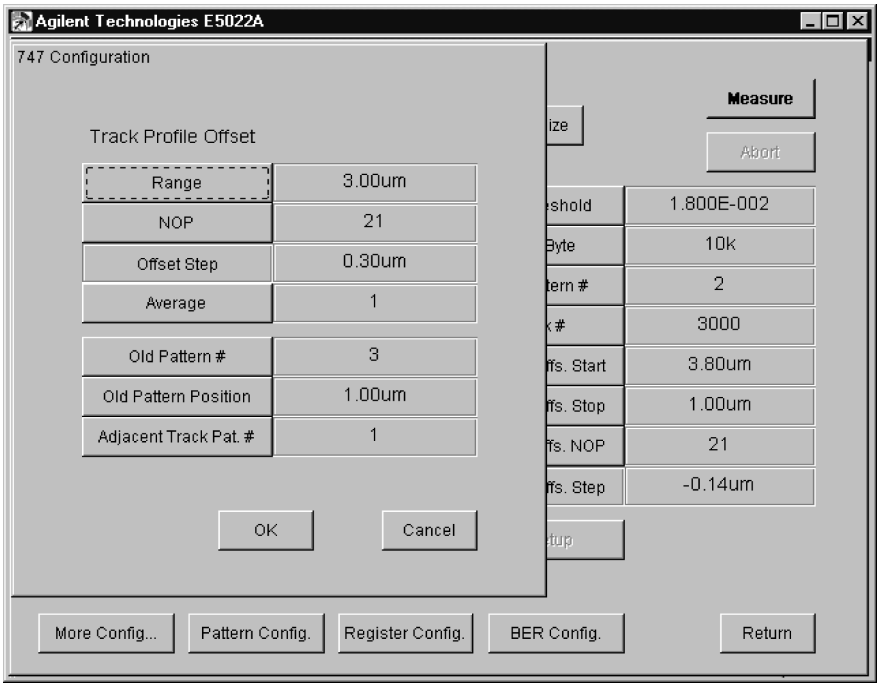
Adjacent Offs. Stop — Specifies the stopping point of the adjacent track offset. This point is defined as the distance in [µm] between the track center and the adjacent track. The adjacent offset range can be set from 0[µm] min. to 6[µm] max.

Adjacent Offs. NOP — Specifies the number of points to be measured between 'Adjacent Offs.Start' and 'Adjacent Offs. Stop'. If you set this parameter with [Adjacent Offs.Start] and [Adjacent Offs. Stop], then [Adjacent Offs.Step] will be computed and updated automatically. The NOP can be set from 1 min. to 201 max.

Adjacent Offs. Step — Specifies the step by which the adjacent track position is decremented to measure and plot the 747 curve. If you set this parameter with [Adjacent Offs. Start] and [Adjacent Offs. Stop], [Adjacent Offs. NOP] will be computed and updated automatically.

3. Click on the [747 Setup] button to set the parameters before you proceed to measurement.

[747] > [747 Setup]



Range — Specifies the range by which to build the track profile. The range can be set from 0 min. to 6[µm] max.

NOP — Specifies the number of points or increments to build the track profile within the specified

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range. The NOP range should be from 1 min. to 201 max. Refer to the “hpe5022_BER_747 Config” function of the programming manual for details.

Offset Step	Specifies the step by which the head is moved to measure track profile. This parameter is computed and updated automatically when [Range] and [NOP] parameters are specified.
Average	Specifies the number of track profile measurements to be averaged.
Old Pattern #	Specifies the old data pattern to be written at the old pattern position. The selected pattern number must be specified in the [Pattern Config.] menu in advance.
Old Pattern Position	Specifies the position of the old data pattern written on the track. This pattern is overwritten by the [BER Pattern #] specified in the 747 test menu. The position range can be set from -6[µm] min. to 6[µm] max.
Adjacent Trk. Pat. #	Specifies the pattern number to be used to write the data pattern of the adjacent track. The selected pattern number must be specified in the [Pattern Config.] menu in advance.

4. Return to the 747 measurement menu after setting the parameters.
5. The [More Config.], [Pattern Config], [Register Config.] and [BER Config.] buttons are added for additional configurations. Click on any of these buttons to set a new parameter value as required by measurement applications.
6. Click on [Measure] to start measurement.

Measurement Display

The graph shows the resulting OTC vs. Offset characteristic curve of the 747 measurement. In order to get good results, three data patterns should be set properly in the [747 Setup] menu, namely; [BER Pattern #], [Old Pattern #] and [Adjacent Track Pat. #]. The menu shows how much off-track can be afforded between the data track and the read head for a fixed error rate level at a specified distance from an adjacent track. The analysis of the 747 test measurement is explained in the ‘Measurement Definition’ of the Operation Manual.

7. Click on the [Return] button to return to BER Main menu.

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[Register Sweep] Menu

The measurement procedures for [Register Sweep] menu is provided in the ‘Manual Supplement’ because it is channel IC dependent. Refer to the ‘Manual Supplement’ for details.

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DCR Measurement

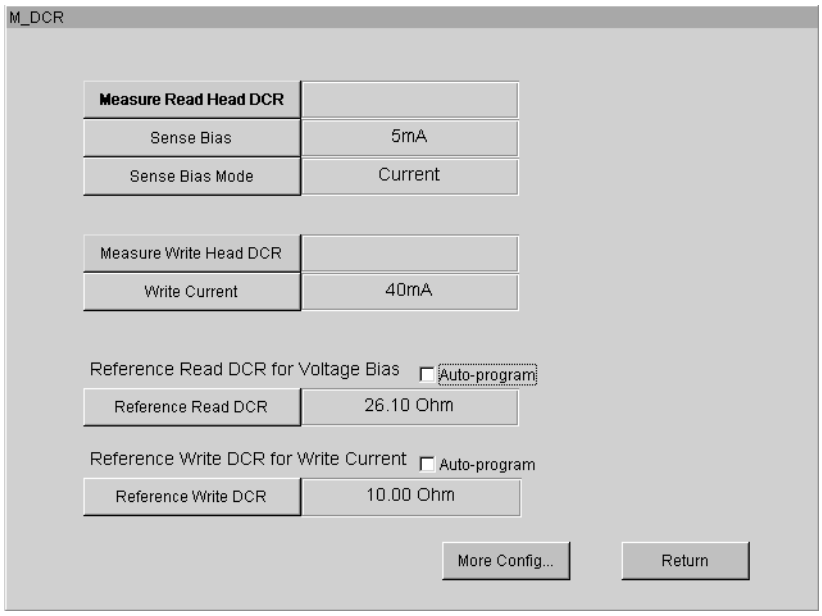
Overview

This section describes the dc resistance measurement of the head. When this measurement is performed, the head is unloaded and the spindle stops rotating.

Measurement Procedure

1. To open the DCR menu, click [DCR] button from the “Others” frame of the Measure menu.

Figure 3-114 DCR Menu



2. Click [Sense Bias] or [Write Current] button to set.
3. Click [Reference Read DCR] button (for voltage bias) to specify the DC resistance of the MR head. This value is required when the current bias type in the setup menu is set at the voltage. When Auto-program is checked, the measured read DC resistance is set automatically.
4. Click [Reference Write DCR] button (for write current) to specify the DC resistance of the write head. When Auto-program is checked, the measured write DC resistance is set automatically.
5. Click [Measure Read Head DCR] button to measure DC resistance of the MR head.
6. Click [Measure Write Head DCR] button to measure DC resistance of the write head.
7. Click [Return] to return to Measure menu.

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Overwrite Measurement

Overview

This section describes the Overwrite Measurement. This measurement is performed by a spectrum analyzer.

Measurement Procedure

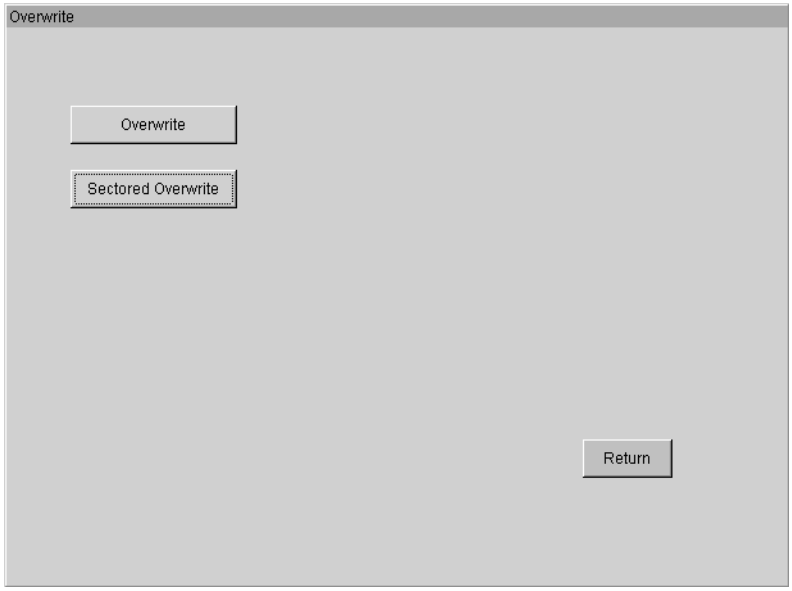
1. To open the Overwrite Selection Menu, click [Overwrite] from the Measure menu.

NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Click [Overwrite] to open the Overwrite Menu.

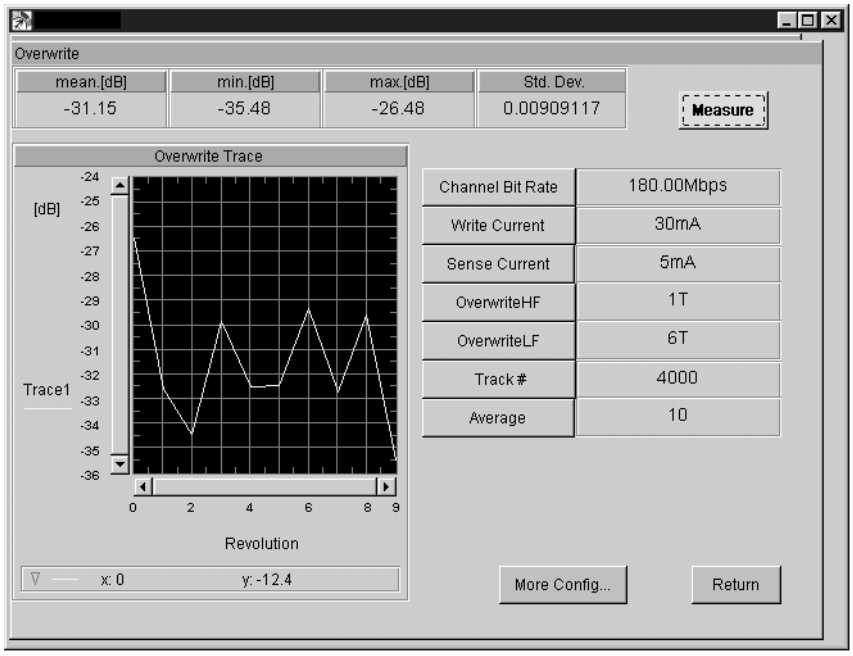
Figure 3-115 Overwrite Selection Menu



3. Set the parameters. Click each button to enter a new value.

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Figure 3-116 Overwrite Menu



Channel Bit Rate — Specifies the speed at which data bits are written on the media per second [bps].

Write Current — Specifies the current applied to the write head.

Sense Current — Specifies the current applied to the read head.

OverwriteHF — Specifies the repetitive period of the HF pattern for overwrite measurement.

OverwriteLF — Specifies the repetitive period of the LF pattern for overwrite measurement.

Track # — Specifies the track number to be tested.

Average — Specifies the number of revolutions to get the average results.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

4. Click the [Measure] button to start measurement.

Measurement Display The menu shows the mean, minimum, maximum and standard deviation of the measured Overwrite.

5. Click on the [Return] button to return to Measure menu.

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Sectored Overwrite Measurement

Overview

This section describes the Sectored Overwrite Measurement. This measurement is performed by a spectrum analyzer.

Measurement Procedure

1. To open the Overwrite Selection Menu, click [Overwrite] in the Measure menu.

NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Click [Sectored Overwrite] to open the Sectored Overwrite Menu.

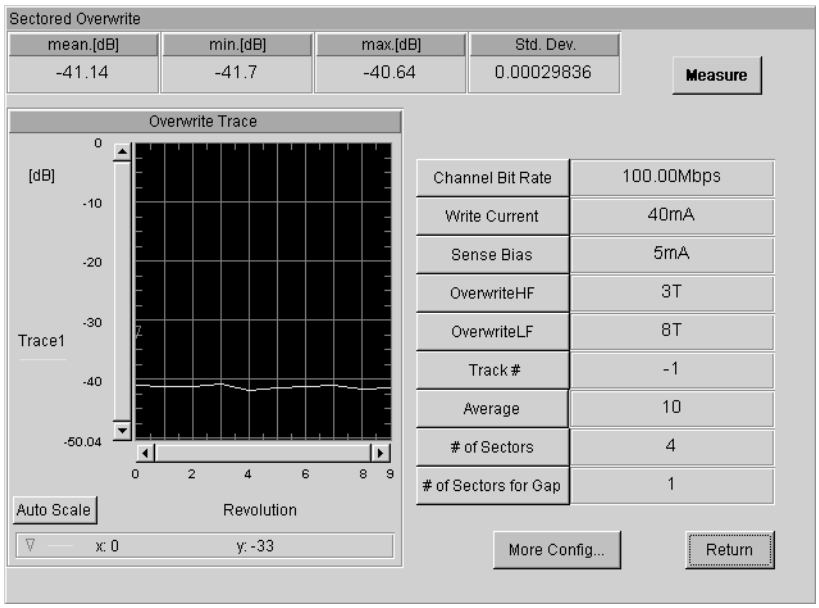
Figure 3-117 Overwrite Selection Menu



3. Set the parameters. Click each button to enter a new value.

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Figure 3-118 **Sectored Overwrite Menu**



Channel Bit Rate — Specifies the speed at which data bits are written on the media per second [bps].

Write Current — Specifies the current applied to the write head.

Sense Bias — Specifies the sense bias applied to the read head.

OverwriteHF — Specifies the repetitive period of the HF pattern for overwrite measurement.

OverwriteLF — Specifies the repetitive period of the LF pattern for overwrite measurement.

Track # — Specifies the track number to be tested.

Average — Specifies the number of revolutions to get the average results.

# of Sectors — Specifies the number of sectors to divide.

# of Sectors for Gap — Specifies the number of sectors to skip after writing one sector.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Bias that have been set in [Configuration] menu will automatically update similar parameters in this menu.

4. Click [Measure] button to start measurement.

Measurement Display The menu shows the mean, minimum, maximum and standard deviation of the measured Sectored Overwrite.

5. Click [Return] button twice to return to Measure menu.

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Partial Erasure Measurement

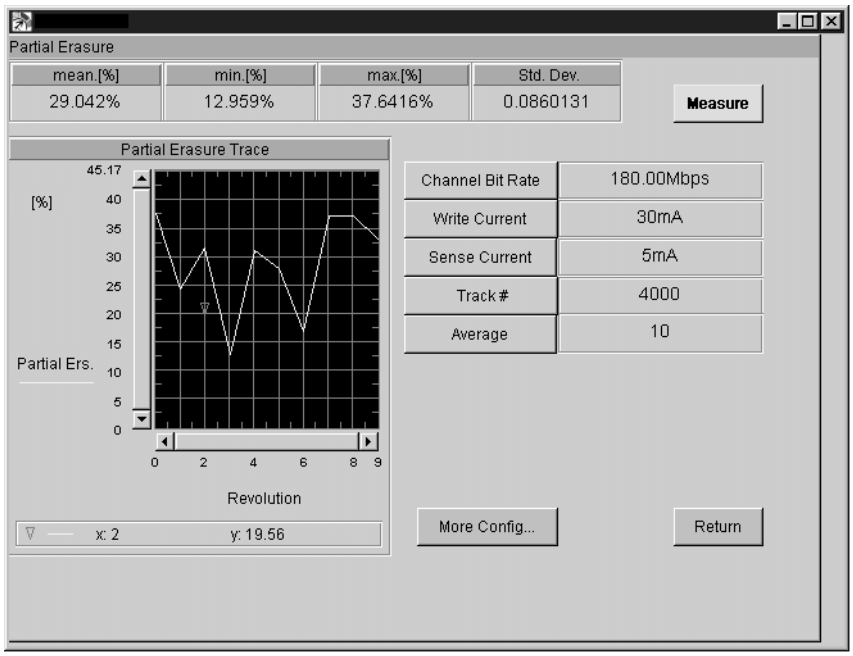
Overview

This section describes the Partial Erasure Measurement. This measurement is performed by a parametric module.

Measurement Procedure

1. To open the Partial Erasure menu, click on the [Partial Erasure] button from the Measure menu.

Figure 3-119 Partial Erasure Menu



NOTE Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Track #	Specifies the track number to be tested.
Average	Specifies the number of revolutions to get the average results.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on the [Measure] button to start measurement.

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Measurement Display

The menu shows the mean, min, max and std.deviation of the measured Partial Erasure.

The graph displays the partial erasure result for every revolution.

4. Click on the [Return] button to return to Measure menu.

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Side Reading Measurement

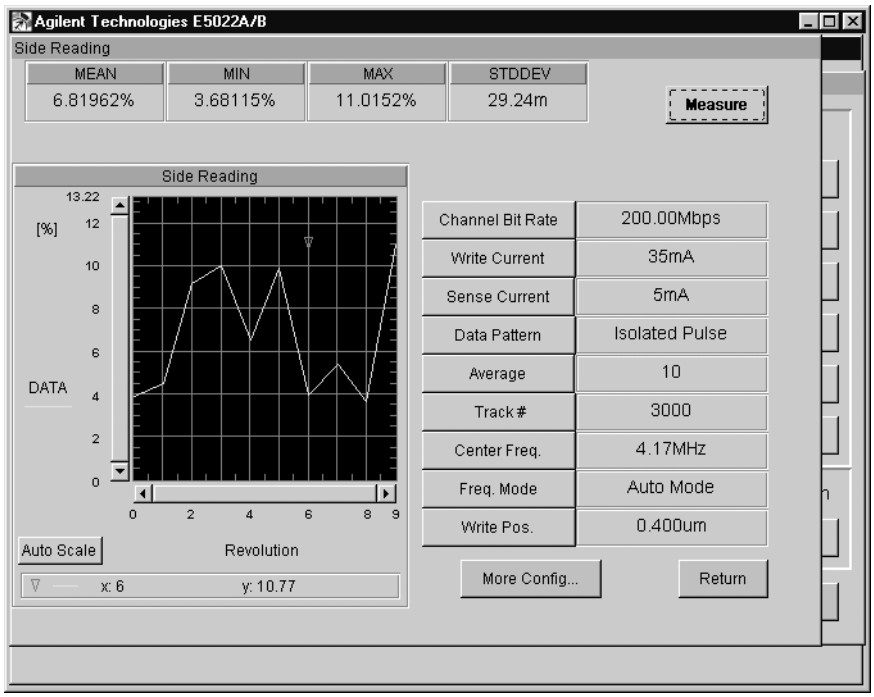
Overview

This section describes the side reading measurement. This measurement is performed by a spectrum analyzer or a spectrum measurement module.

Measurement Procedure

1. To open the side reading menu, click on the [Side Erase/Reading] [Side Reading] button from the Measure menu.

Figure 3-120 Side Reading



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Data Pattern	Selects the data pattern for this measurement.
Average	Specifies the number of revolutions to get the average results.
Track #	Specifies the track number to be tested.
Center Freq.	Specifies the measurement frequency of the spectrum analyzer. This parameter can only be used if [Freq. Mode] is set to “Manual”.

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Freq. Mode	Specifies the setting of the measurement frequency. Select either Auto Mode or Manual Mode. If Auto is selected the measurement frequency is automatically set. If Manual is selected the frequency specified by Center Freq. will be used to measure.
Write Pos.	Specifies the write position for both side tracks.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on the [Measure] button to start measurement.

Measurement Display

The menu shows the mean, min, max and std.deviation of the measured side reading. The graph displays the side reading result for every revolution.

4. Click on the [Return] button to return to Measure menu.

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Side Erase Measurement

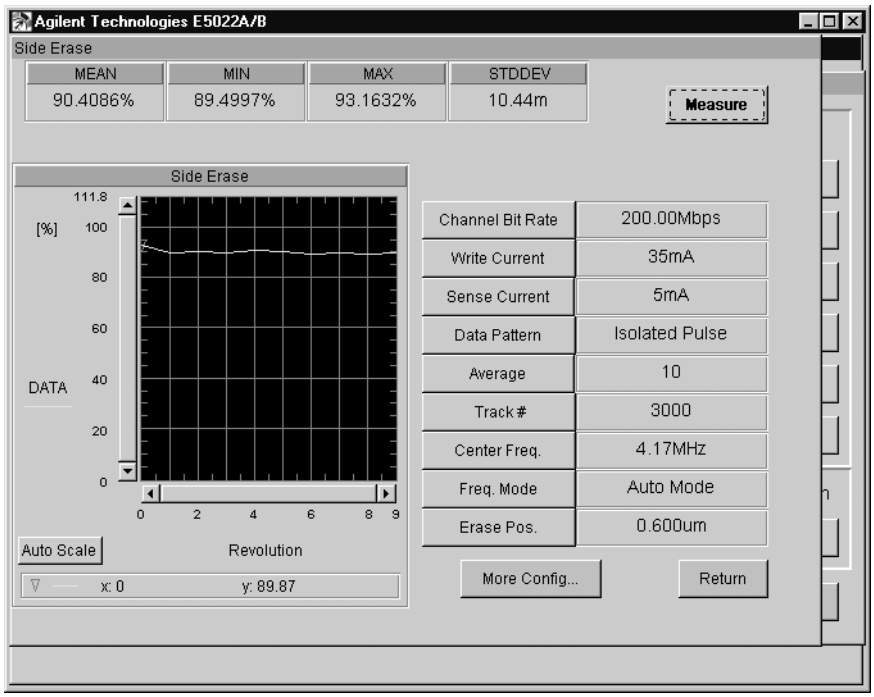
Overview

This section describes the side erase measurement. This measurement is performed by a spectrum analyzer or a spectrum measurement module.

Measurement Procedure

1. To open the side erase menu, click on the [Side Erase/Reading] [Sid Erase] button from the Measure menu.

Figure 3-121 Side Erase



NOTE

Before you execute this measurement, you should set an appropriate input range or execute the Auto Configuration to set the input range automatically.

2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Write Current	Specifies the current applied to the write head.
Sense Current	Specifies the current applied to the read head.
Data Pattern	Selects the data pattern for this measurement.
Average	Specifies the number of revolutions to get the average results.
Track #	Specifies the track number to be tested.
Center Freq.	Specifies the measurement frequency of the spectrum analyzer. This parameter can only be used if [Freq. Mode] is set to “Manual”.

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Freq. Mode	Specifies the setting of the measurement frequency. Select either Auto Mode or Manual Mode. If Auto is selected the measurement frequency is automatically set. If Manual is selected the frequency specified by Center Freq. will be used to measure.
Erase Pos.	Specifies the erase position for both side of the track.

NOTE The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

3. Click on the [Measure] button to start measurement.

Measurement Display

The menu shows the mean, min, max and std.deviation of the measured side erase. The graph displays the side erase result for every revolution.

4. Click on the [Return] button to return to Measure menu.

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Track Search

Overview

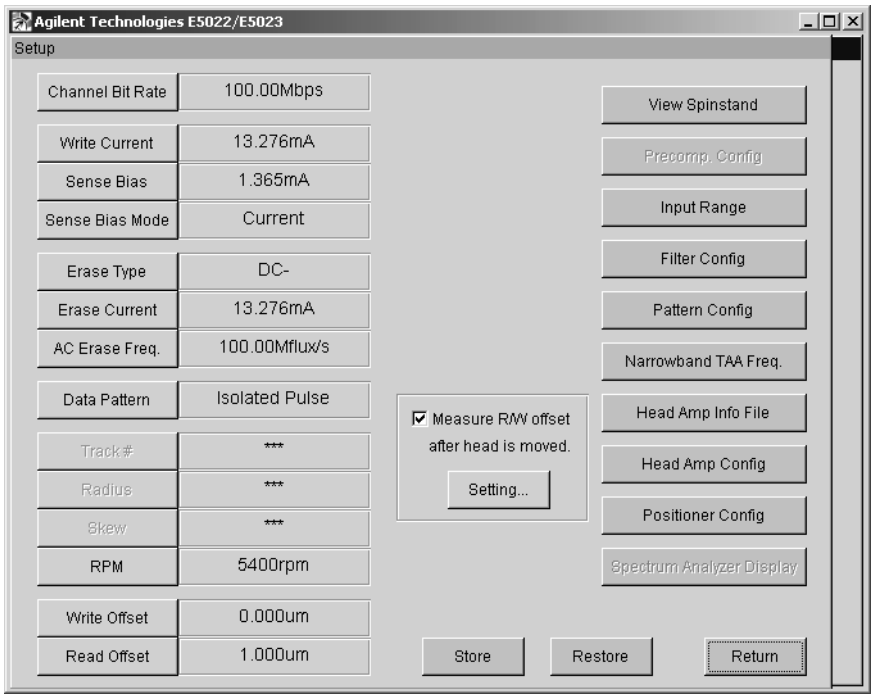
This section describes the track search measurement. This function allows you to write a track by one head and then read it by another head.

Measurement Procedure

NOTE

Before the track search is performed, the toggle switch of “Measure R/W offset after head is moved” must be not checked.

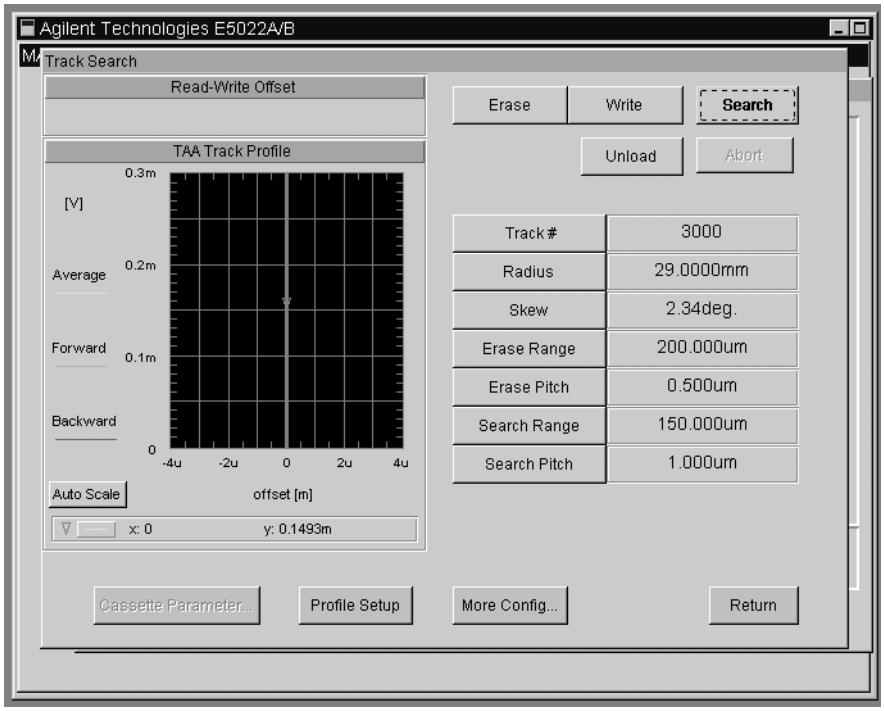
Figure 3-122 **Setup Menu**



1. To open the Track Search menu, click on the [Track Search] button of the Measure menu.

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Figure 3-123 Track Search Menu



2. Set the parameters, click on each button to enter a new value.

Track #	Specifies a track number of the start position. After the track search is done, this shows -1 and Radius/ Skew show where the track is. Either ‘track#’ or ‘radius’/’skew’ should be specified.
Radius	Specifies a Radius of the start position. After the track search is done, this shows the position where the track is. Either ‘track#’ or ‘radius’/’skew’ should be specified.
Skew	Specifies a skew of the start position. Even after the track search is done, this is not change.
Band Erase Range	Specifies the range of erase. Clicking [Erase] button erases a whole area between minus this value to plus this value from the start position specified in ‘track #’ or ‘radius’/’skew’.
Band Erase Pitch	Specifies a pitch of the erase. The head is moved by this pitch, then continue to erase a track.
Search Range	Specifies the range of search a track. Clicking [Search] button searches a track between minus this value to plus this value from the start position specified in ‘track #’ or ‘radius’/’skew’.

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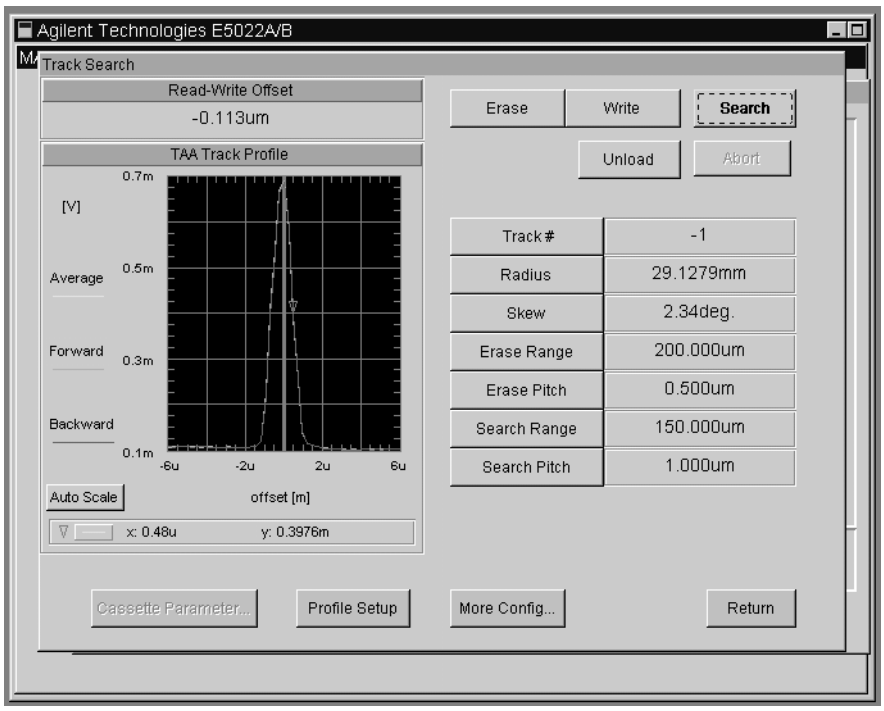
Search Pitch Specifies a pitch of the search a track.

3. Click on the [Erase] button to erase a whole specified area.
4. Click on the [Write] button to write a track at the specified start position. A data pattern, channel bit rate and write current can be set in [More Config.].
5. Click on the [Unload] button to unload a head, then replace the HGA. If necessary, the HGA dimension and cassette part number should be set by clicking on the [Cassette Parameter].

   Even when a head is unloaded, the spindle is still running to avoid a media slipping.
6. Click on the [Search] button to find a track. After finding a track, the head position is changed where it is by actuating X-Y stages. Then, a track profile measurement is made. Its result (profile curve and read/write offset) is displayed on the left of the screen. The setting of the track profile measurement can be specified by clicking on the [Profile Setup].

NOTE A value of the read/write offset result does not affect a read offset in the setup menu.

Figure 3-124 Track Search Result



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Erase & Write

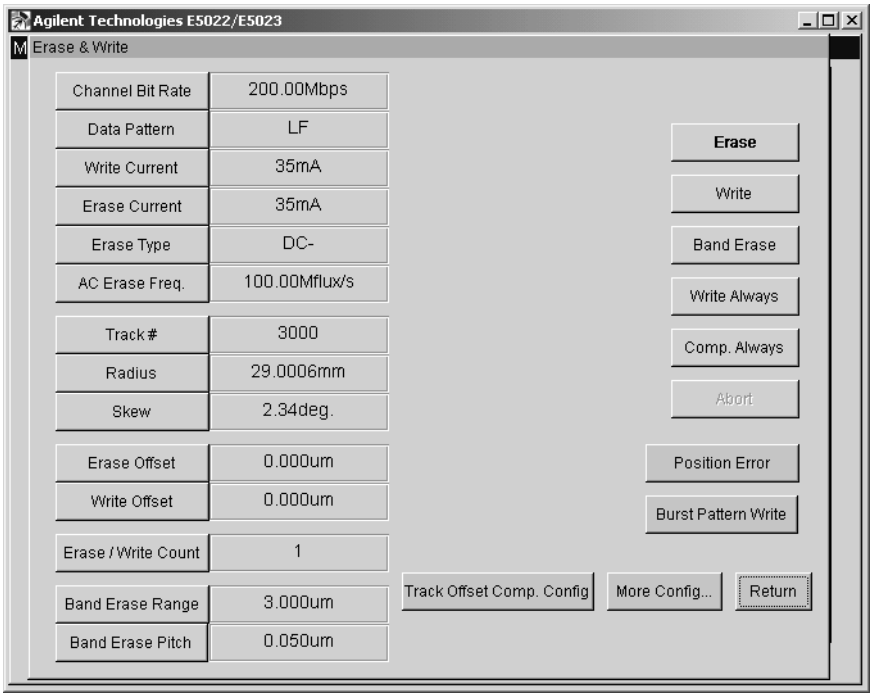
Overview

This section performs the erase and write data independently and compensates/monitors the head position.

Procedure

1. To open the Erase & Write menu, click on [Erase & Write] button from Other frame of the Measure menu.

Figure 3-125 Erase & Write Menu



NOTE

The parameter values of Channel Bit Rate, Write Current and Sense Current that have been set in the [Configuration] menu will automatically update similar parameters in this menu.

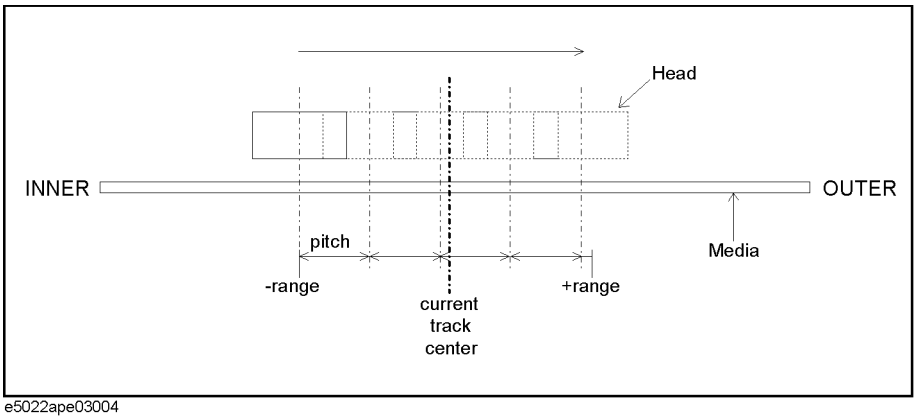
2. Set the parameters, click on each button to enter a new value.

Channel Bit Rate	Specifies the speed at which data bits are written on the media per second [bps].
Data Pattern	Specifies the data pattern to be written on the test track.To set the data pattern, click on the [Configuration] > [Setup] > [Pattern Config] buttons to open the data pattern menu.
Write Current	Specifies the current applied to the write head.
Erase Current	Specifies the amount of current to erase.
Erase Type	Specifies the erase type. The erase type could either be DC+, DC- or AC.
AC Erase Frequency	Specifies the frequency for ac erase.
Track #	Specifies the track number to be tested.

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Radius	Specifies the current position of the head radius. Click on the [Radius] button to set the position. During head unloading the [****] symbol will appear.
Skew	Specifies the current angular position of the head skew. Click on the [Skew] button to set the position. During head unloading the [****] symbol will appear.
Erase Offset	Specifies the erase track offset. Moves the head from the center of the track to its specified position. Inward direction is positive.
Write Offset	Specifies the write track offset. Moves the head from the center of the track to its specified position. Inward direction is positive.
Erase/Write Count	Specifies the number of over-erase and over-write. If this is set over 2, the data is written or erased for revolutions specified by this.
Band Erase Range	Specifies the erase range for band erase.
Band Erase Pitch	Specifies the erase pitch for band erase.

Figure 3-126 Parameter of Band Erase



e5022ape03004

3. When required by measurement applications, click on the [Erase], [Write], [BandErase], [WriteAlways] and [Write Burst Pattern] buttons. When Write Always is used, click on [Abort Write] button when the user wants to terminate writing.
4. Clicking on the [Comp Always] allows you to stay the head position at a required position by using the track offset compensation function.

   The recommended procedure is described below.

   a. Setup a configuration of the function by clicking on the [Track Offset Comp. Config]. The menu under the [Track Offset Comp. Config] is the same as one in the track profile measurement. See the “TAA Track Profile Menu - Track Offset Compensation Setup” on page 103.

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b. Click on the [Erase] or [Band Erase] button to erase a track, if necessary.

c. Click on the [Write] button to wirte a data pattern.

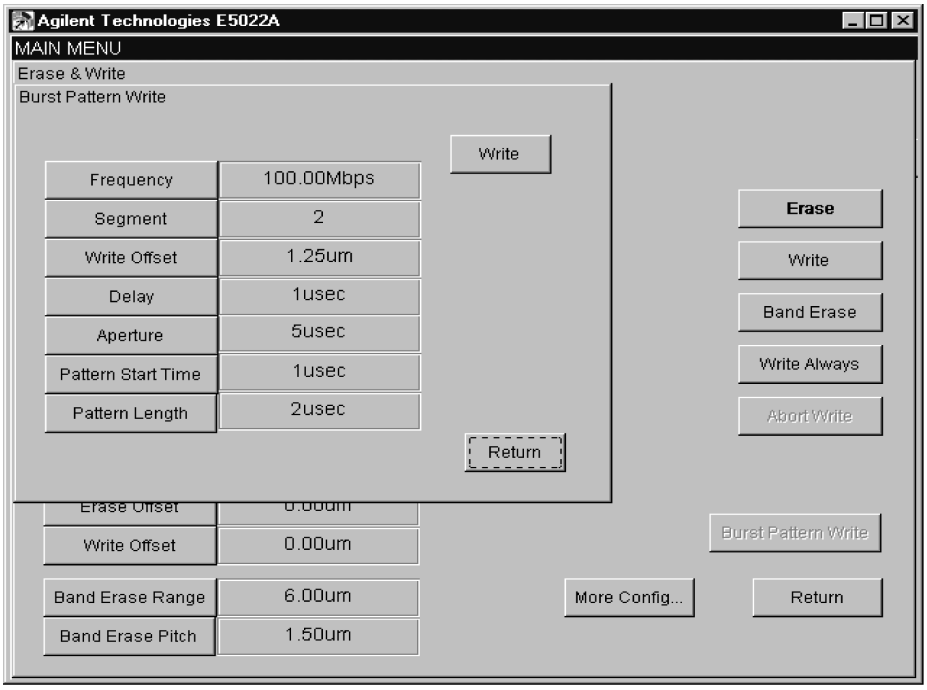
d. Click on the [Comp. Always] button to stay the read head at the center of burst pattern. The [Comp. Always] should be clicked just after the [Write] is clicked. Because there might be some drift of the head if the interval between them is long.

5. Click on the [Return] button to return to Measure menu.

Burst Pattern Write

1. Click the [Burst Pattern Write] button to open the Burst Pattern Write menu. The bust pattern write is only to write a burst pattern. When you want to compensate the position, use the track offset compensation function such as [Comp. Always].

Figure 3-127 [Erase&Write] >[Burst Pattern Write] Menu



2. Set the parameters, click on each button to enter a new value.

Frequency — Specifies the frequency at which burst pattern is written.

Segment — Specifies the number of sections a track is to be divided.

Write Offset — Specifies the write offset position from the track center.

Delay — Specifies the time distance between segment trigger and write gate. See Figure 3-128 on page 208.

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Aperture	Specifies the length of time to open the write gate. See Figure 3-128 on page 208.
Pattern Start Time	Specifies the starting time to write the burst pattern. See Figure 3-129 on page 208.
Pattern Length	Specifies the length of time to write the burst pattern. See Figure 3-129 on page 208.

Figure 3-128 Delay / Aperture

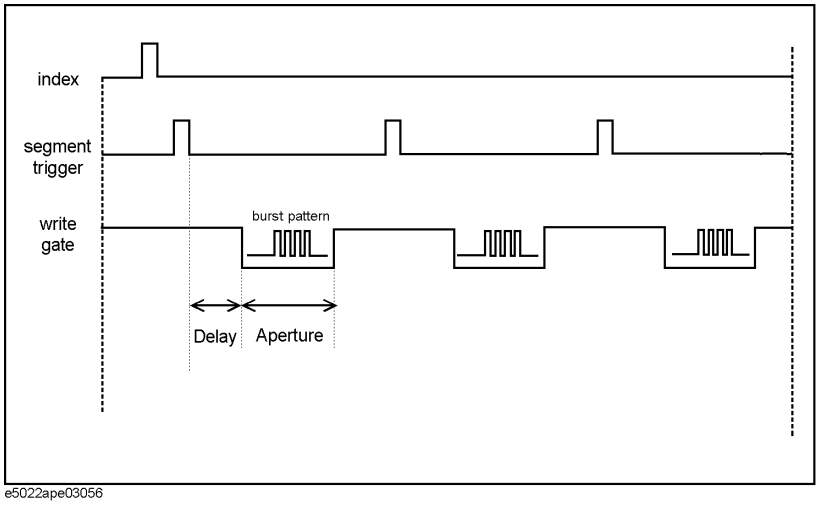
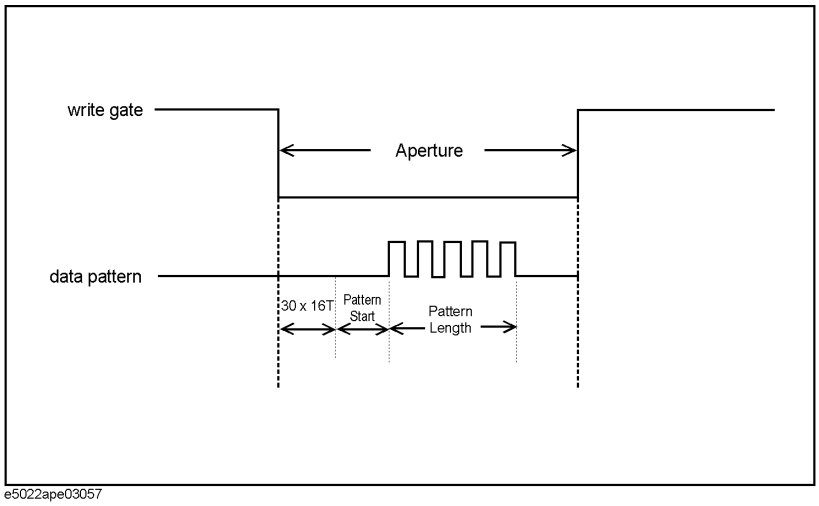


Figure 3-129 Write Timing of Burst Pattern



NOTE Due to internal constraints of E5037A (data generator module), data writing is actually delayed by a value of **30**× **16T** (T=1/ f, where f is the frequency of the burst pattern). Thus, the user must compensate this value when setting the burst length. Refer to “hpe5022_burstPatternConfig” function of the programming manual for details.

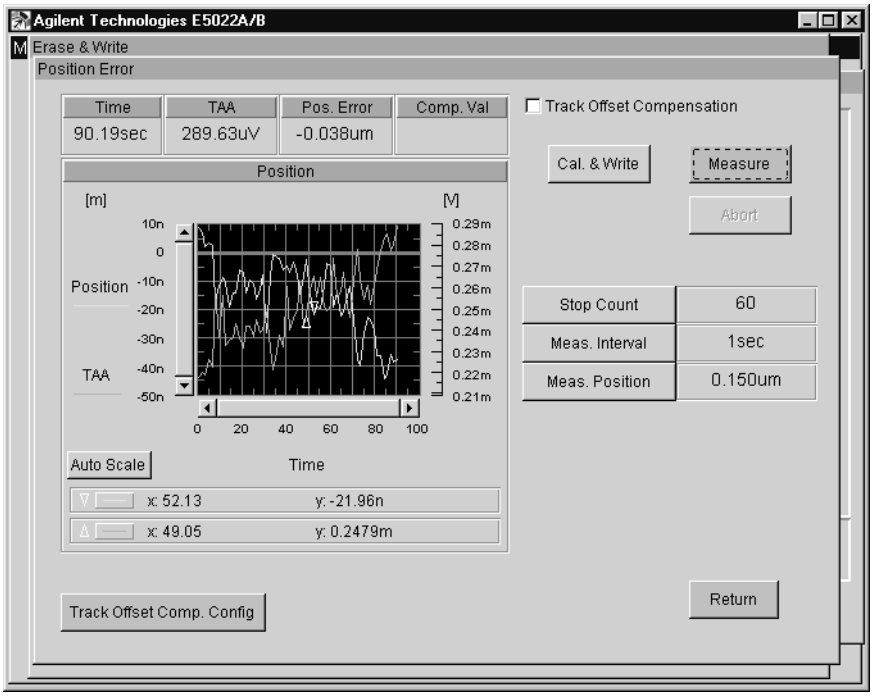
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Position Error Monitor

This function allows you to monitor the head position drift with or without the track offset compensation function.

1. Click the [Position Error] button to open the position error menu. Once the position error menu open, the state of the track offset compensation is turned on. This means, the burst patterns area is assigned in the first certain portion of the track.

Figure 3-130 [Erase&Write] >[Position Error] Menu



2. Set the parameters, click on each button to enter a new value.

Track Offset Compensation	Activates the track offset compensation function. When it is not checked, the position error is monitored without the position compensation.
Cal & Write	Executes the calibration for track offset compensation and writes the burst patterns.
Stop Count	Specifies how many times the monitor/compensation sequence(s) is repeated.
Meas. Interval	Specifies the interval time of the monitor/compensation. Increase this value when you want to monitor for a long time.
Meas. Position	Specifies the offset position where the drift is monitored. TAA is also measured at this position. You should consider the read/write offset for setting this value.

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Track Offset Comp. Config	Opens the Track Offset Compensation Configuration menu. This menu is the same as one in the track profile measurement. See the “TAA Track Profile Menu - Track Offset Compensation Setup” on page 103.
Measure	Executes monitoring a head drift. The head drift and TAA at the measurement position is measured during this measurement.
Abort	Abort the monitoring.

Result

The upper portion of the window shows the time, TAA, the position error (drift) when the track offset compensation check box is off and the compensation value when the track offset compensation check box is on,

The graph displays the compensation value or position error and TAA versus time.

NOTE

When the track offset compensation is turned off, if the position error exceeds approximately one-third of the write track width, the “hpe5022_ERROR_DATA_CORRUPT” error may be displayed. This is because the position error can monitor within the range that the Position Error Signal (PES) is linear.

If the error is displayed although the position error is within the one-third of the write track width, increase the ‘size’ or reduce the ‘range’ of the compensation profile setting in the “TAA Track Profile Menu - Track Offset Compensation Setup” on page 103.

Track Offset Compensation can not be used when the system has E4402B 3GHz spectrum analyzer.

3. Click the [Return] button to exit the position error menu. The state of the track offset compensation is turned off. This means, the data area is assigned in the whole track.

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Auto Alignment

Overview

Auto alignment is used to determine the center position of the spindle. Once the auto alignment is completed, the alignment data will be saved in the non volatile memory of the spinstand. This data contains each individual data of the up face and down face HGAs. See “Auto Alignment” on page 317 for basic concept of the auto alignment.

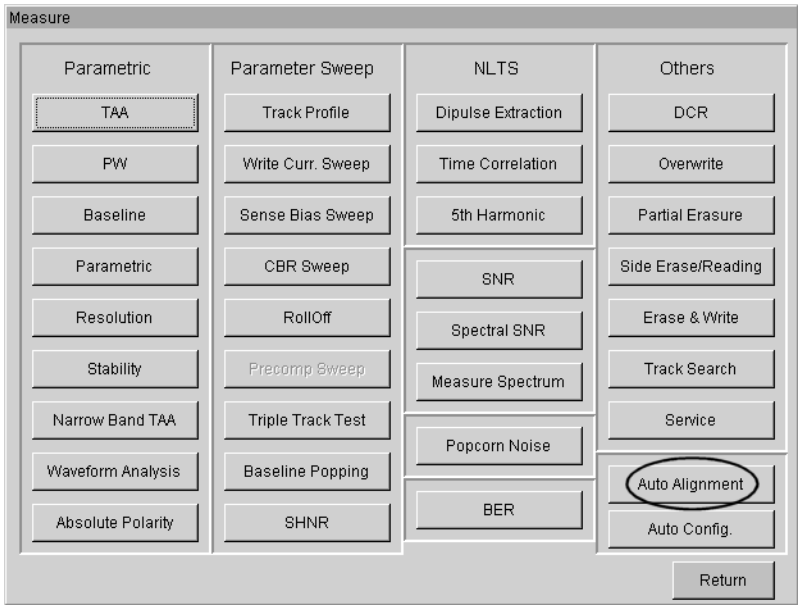
NOTE

When you perform the auto alignment using the VEE measurement program (Test Environment) or auto alignment functions of the “hpe5022_32.dll,” the spinstand must have the initial alignment data in the non-volatile memory because the spinstand cannot perform the erase and write operation in the auto alignment process without the alignment data. If the alignment data is lost by some trouble, you must first restore the data using the recovery disk (shipped with the spinstand) and then overwrite it by the auto alignment.

Procedure

1. To open the Auto Alignment menu, click [Auto Alignment] button.

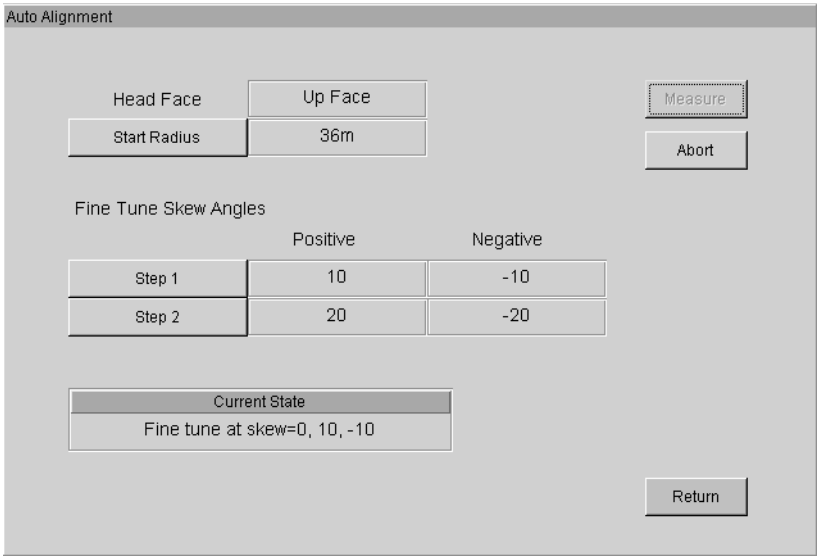
Figure 3-131 Measure Menu



2. To set the parameters, click each button to enter a new value.

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Figure 3-132 **Auto Alignment Menu**



Start Radius Specifies the auto alignment start position of the head as radius from the spindle center [meter]. The default value is as follows:

Disk Type	Default Start Radius
1.8 inch	0.018 meter
2.5 inch	0.0255 meter
3.5 inch, 3 inch	0.036 meter

Step 1 Specifies a pair of skew angles (positive and negative values) at which the fine tune (step 1) is performed.

Step 2 Specifies a pair of skew angles (positive and negative values) at which the fine tune (step 2) is performed.

NOTE The positive and negative skew angles should be from 3.0° to 30.0° and from –60.0 to –3.0 respectively.

3. Click [Measure] button to start the auto alignment. In the Current State box in the auto alignment menu, the auto alignment status is displayed. See “Auto Alignment” on page 317 for the detailed auto alignment algorithm.

Status Message	Process
Preprocessing	Performing the band erase and writing one track at the position of radius = “start radius” and skew = 0°.

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Status Message	Process
Rough tune	Finding the skew = 0° position by searching the written track.
Fine tune first step	Searching the skew = 0°, +3°, –3° positions on the track and calculating the spindle center position.
Fine tune at skew = 0, “step 1 positive,” “step 1 negative”	Searching the skew = 0, “step 1 positive” and “step 1 negative” positions on the track and calculating the spindle center position. The “step 1 positive” and “step 1 negative” values are set by [Step 1] button.
Fine tune at skew = 0, “step 2 positive,” “step 2 negative”	Searching the skew = 0, “step 2 positive” and “step 2 negative” positions on the track and calculating the spindle center position. The “step 2 positive” and “step 2 negative” values are set by [Step 2] button.
Storing data	Storing the obtained spindle center coordinates data in the non-volatile memory of the spinstand.
Finished	The auto alignment is completed.
Error occurred	An error occurred during the auto alignment.

4. Click [Return] button to return to Measure menu.

NOTE

Allowable error is about ±10 mm for the radius direction and about ±5 mm for the skew direction. In case that the head position is too far away from the assumed position, the error “hpe5022_ERROR_PEAK_NOT_FOUND” will take place.

After finishing the alignment, the result is written to the alignment log file. The log file is generated to “<INSTALL DIR>\bin\AutoAlignDown.log” for down face, and “<INSTALL DIR>\bin\AutoAlignUp.log” for up face. Where “<INSTALL DIR>” is the directory where the E5022/E5023 software is installed (C:\Program Files\Agilent\E5022).

When the alignment is failed, error log file is generated to “<INSTALL DIR>\bin\error.log.”

Auto alignment must be performed for both up face and down face HGAs.

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Service

Overview

The service menu allows you to evaluate the spinstand performance. Contact Agilent Technologies for information.

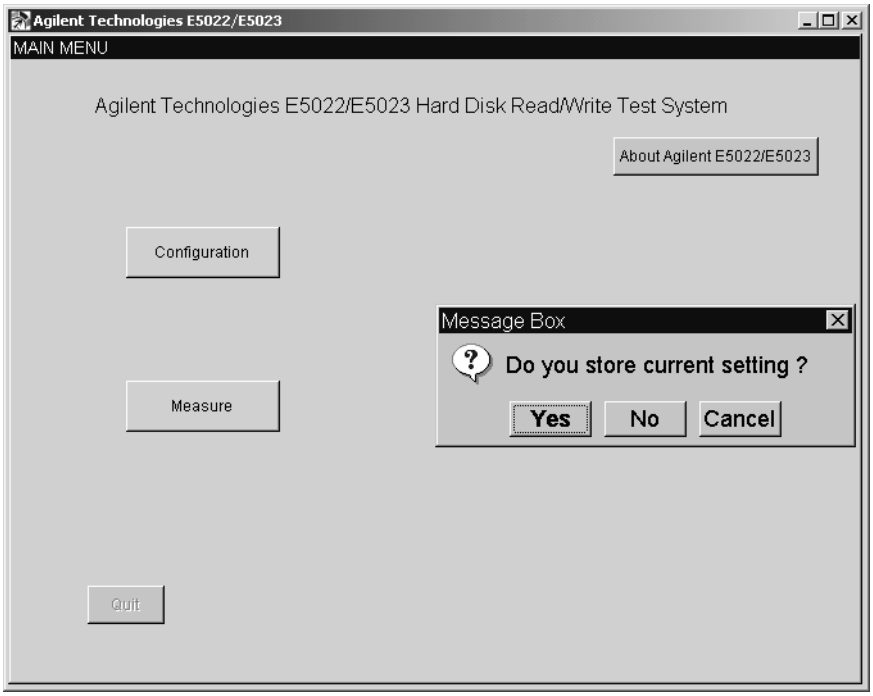
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Exit the VEE measurement program

1. Click on the [Quit] button from the Measure menu. A pop-up window will appear that will ask the user to store the current setting. If “yes” is selected the parameters set in the Configuration menu will be saved. This newly saved parameters will be the default parameters in the configuration menu the next time the user runs the program.

NOTE To end the program make sure that you click the [Quit] button. If you click the VEE stop button (i.e, the ‘x’ mark on the upper right corner of the menu) to end the program, it could cause an initialization failure of the VEE program the next time you run the program.

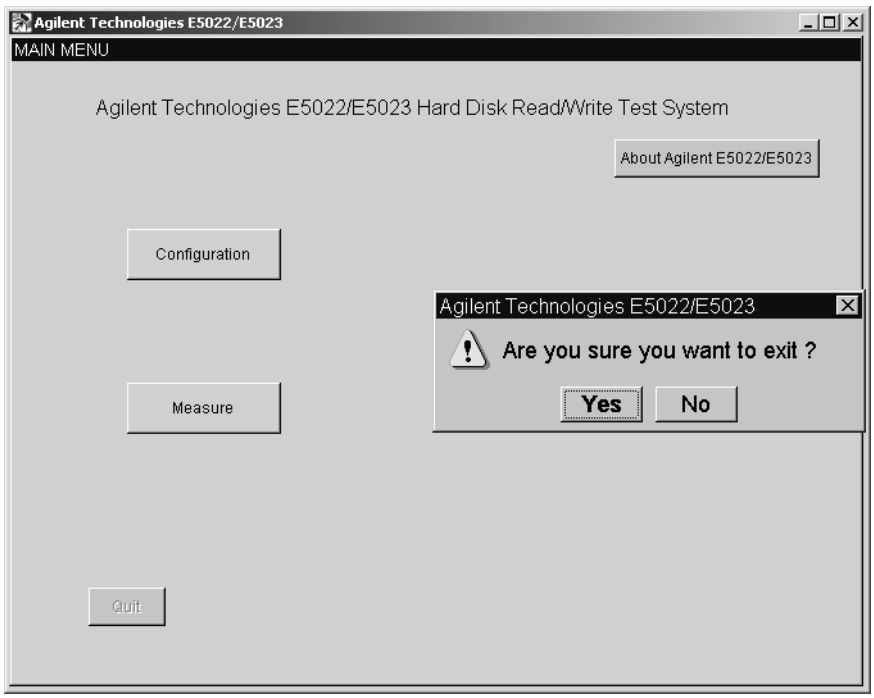
Figure 3-133 Storing the current setting



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2. Click [Yes] to end the program.

Figure 3-134 End the Program



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4 Configuration

This chapter provides the information about the measurement configurations of E5022/E5023.

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Configuration

The channel bit rate, data pattern, common setup parameters and spinstand related setups are all performed in the configuration menu.

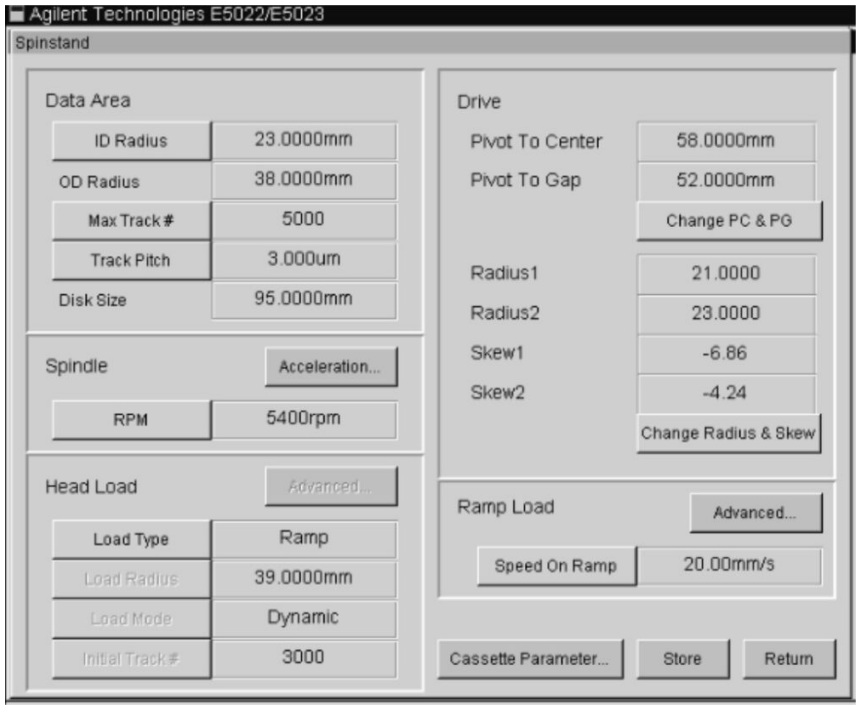
The [Setup] handles the common setup parameters while the [Spinstand] handles the spinstand related settings. Once the drive is running the spinstand related settings can not be changed.

Advance Configuration

View Spinstand

1. Click on [Configuration] > [Spinstand] to view the set parameters of the spinstand.

Figure 4-1 **Spinstand**



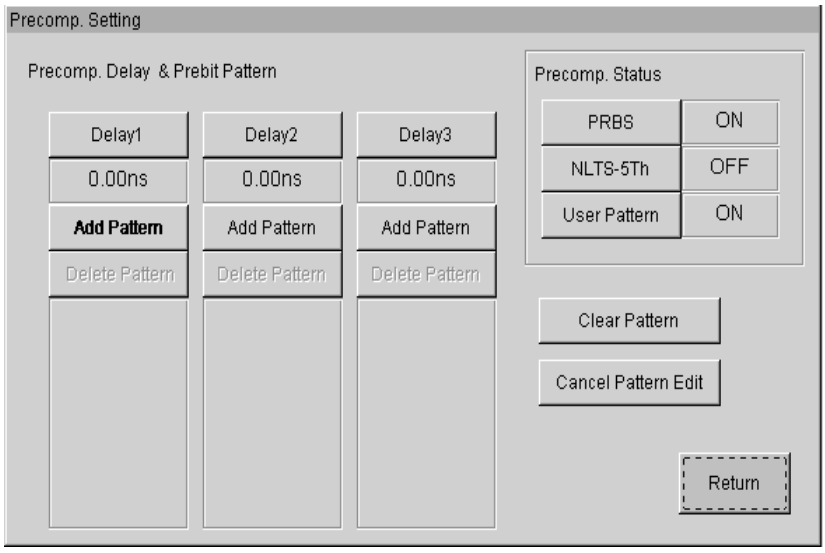
2. The parameters specified in the [Spinstand] menu will automatically update similar parameters in this menu.
3. Click [Advanced...] to set the spindle speed for head loading/unloading.
4. Click [Return] to return to Setup Menu.

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Precompensation Setting Menu

1. Click on [Configuration] > [Setup] > [Precomp. Config] to open the precompensation menu.

Figure 4-2 **Precompensation Setting Menu**



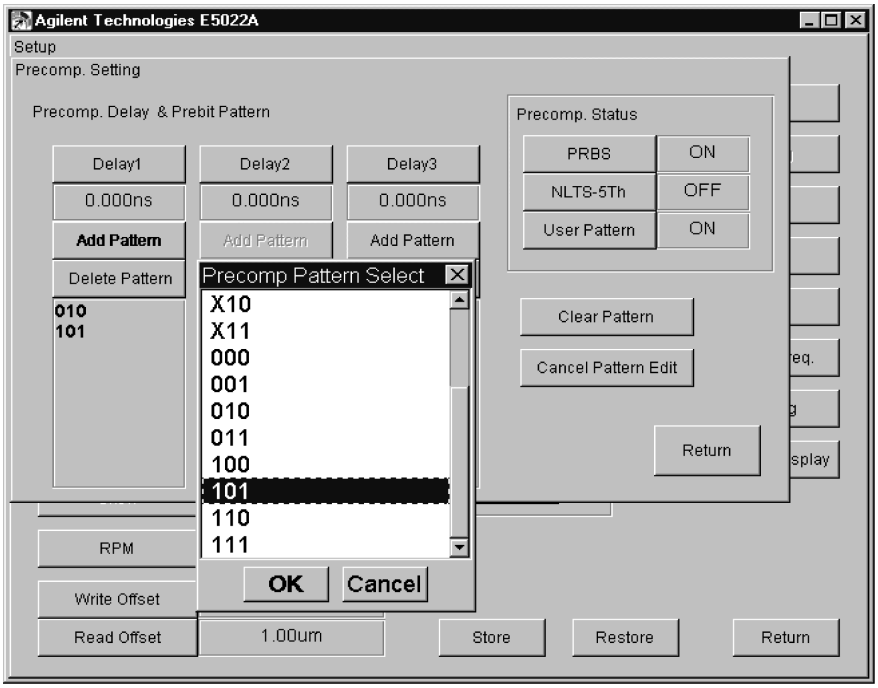
The Agilent E5022/E5023 can delay the write timing of the write operation when writing the data pattern. This timing delay is defined as three bits off the target bit (prebit or postbit). Three timing delays can be added to the time position of the write data bits. And three data patterns can be selected to precompensate the data, namely; ‘PRBS’ (pseudo random bit sequence), ‘NLTS 5th’ and ‘User Defined Pattern’.

- Three types of data pattern can be selected for precompensation delay from the ‘Precomp Status’ frame.
- Click on [Delay1], [Delay2] and/or [Delay3] to set the delay time. Each corresponding [Add Pattern] is used to select the type of precompensation pattern as shown in Figure 4-3.
- When you click on [Add Pattern] a dialog box ‘Precomp Pattern Select’ will pop-up. Select the type of precompensation pattern for the specified data pattern of ‘Precomp Status’ frame as shown in Figure 4-3.
- To delete any precompensation pattern previously selected, click on [Delete Pattern] and select the precompensation pattern to be deleted as shown in Figure 4-3.

NOTE Although, the DLL function of Agilent E5022/E5023 supports both the prebit and postbit, the VEE measurement program supports only the prebit. See the “hpe5022_precompPattern” function in the programming manual for details.

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Figure 4-3 **Precomp Pattern Select Menu**



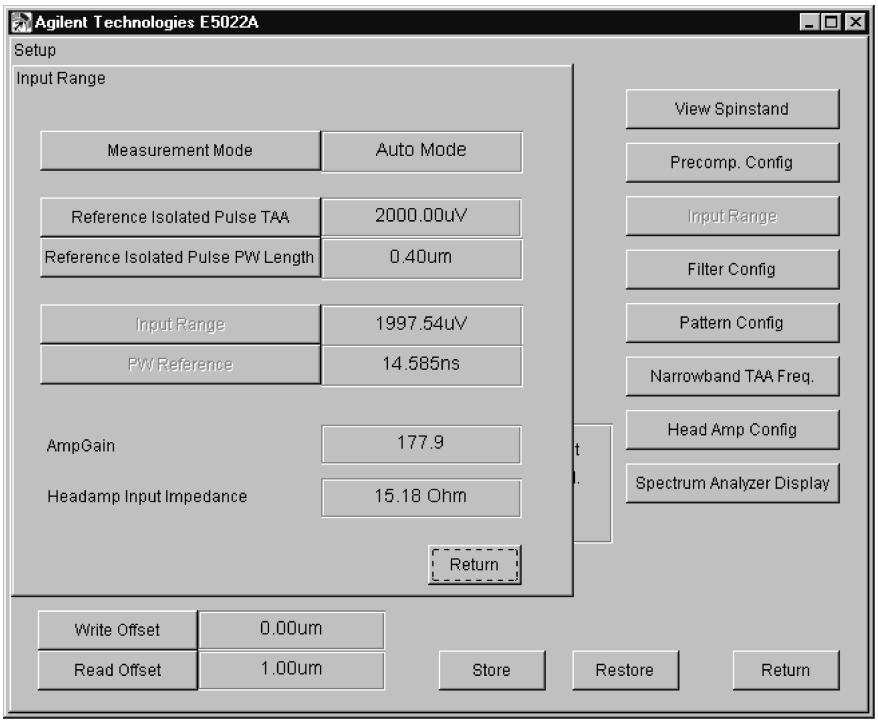
2. Click on [OK] to set the precompensation pattern
3. Click the [Return] button to return to setup menu.

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Input Range Menu

1. Click on [Configuration] > [Setup] > [Input Range] button to display the input range menu.

Figure 4-4 **Input Range Menu**



Measurement Mode — Specifies the type of input range setting. When "Auto Mode" is selected the input range is set automatically by the [Auto Configuration]. When "Manual Mode" is selected the input range can be set manually by the user. Consequently, this will activate the [Input Range] and [PW Reference] buttons.

Reference Isolated Pulse TAA — Specifies the reference TAA of the isolated pulse.

Ref. Isolated Pulse PW Length — Specifies the reference PW Length of the isolated pulse.

Input Range — Sets the input range manually when [Measurement Mode] is set to "Manual Mode".

PW Reference — Sets the pulse width reference manually when [Measurement Mode] is set to "Manual Mode".

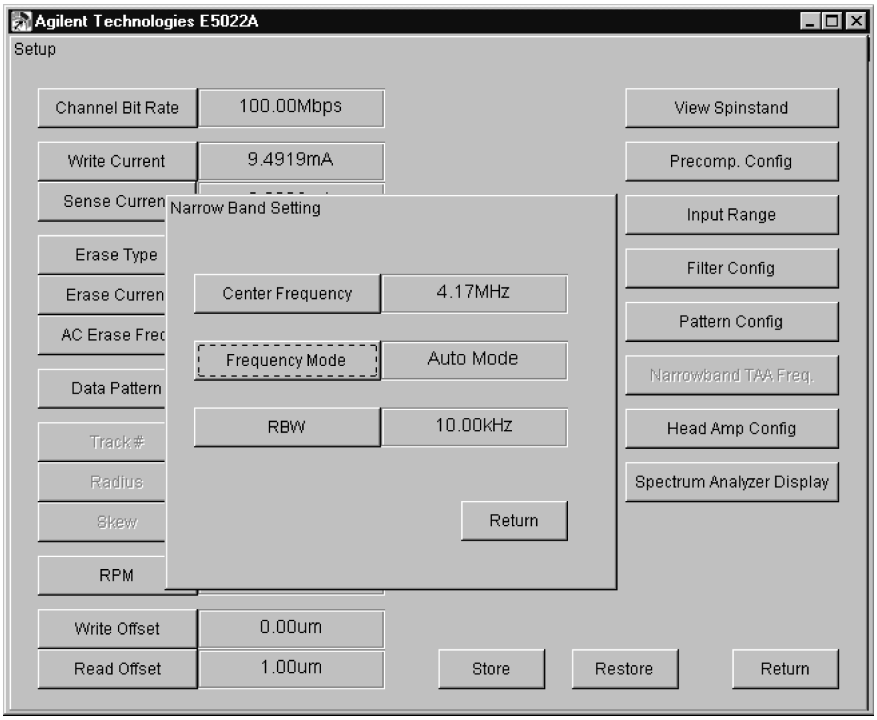
See "Input Range Control & Auto Configuration" on page 308 for more details.

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Narrow Band TAA Frequency Menu

1. Click on [Configuration] > [Setup] > [Narrow Band TAA Freq.] to open the Narrow Band Setting menu.

Figure 4-5 **Narrow Band TAA Measurement Setting Menu**



Center Frequency — Specifies the center frequency of the spectrum analyzer when Narrow Band TAA is measured. This can only be used if the Frequency Mode is set to ‘manual’.

Frequency Mode — Specifies the type of measurement frequency. Two frequency modes can be selected, namely; auto and manual modes.If “Auto Mode” is selected, the measurement frequency is set automatically with relative to the channel bit rate and data pattern. If “Manual Mode” is selected, the frequency set by the ‘Center Frequency’ is used.

RBW — Specifies the resolution band width when spectrum analyzer is used for Narrow Band TAA measurement. Decreasing the RBW will widen the dynamic range.

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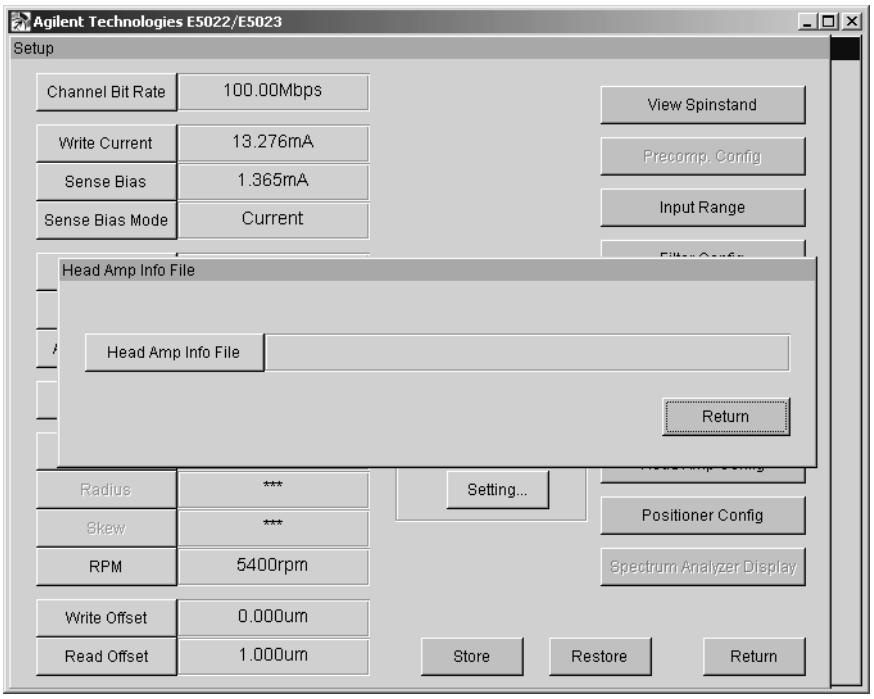
Head Amplifier Information File Menu

1. Click on [Configuration] > [Setup] > [Head Amp Info File] to open Head Amp Info File menu.

   Generally, the system detects which head amplifier is installed automatically because it refers the information in the EEPROM in the head amplifier and reads the corresponding information file under the system software directory.

   This function allows you to use the head amplifiers without the EEPROM in itself. The system reads the specified information file. The assistance from Agilent is required when users develop the information files.

Figure 4-6 **Head Amp Info File Menu**



Head Amp Info File Specifies the file name of the head amplifier information.

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Head Amplifier Configuration Menu

The head amplifier configuration menu depends on the installed E5035.

- When the system has the E5035A:

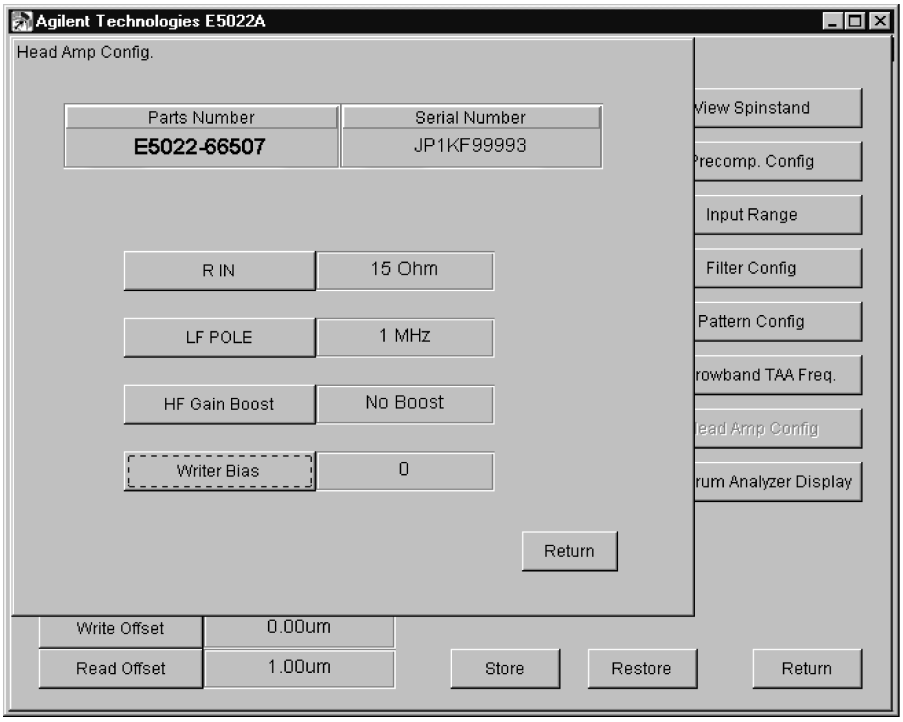
  1. Click on [Configuration] > [Setup] >[Head Amp Config.] to open the head amplifier configuration menu.

     When the property of the installed head amplifier is supported by the DLL, the [Head Amp Setup] menu will pop up. This menu allows the user to set up the parameters of the head amplifier as shown in Figure 4-7. This menu also displays the parts number and serial number of the currently installed head amplifier.

     — Example (E5022-66507)

     In VEE program the RIN, LF Pole, HF Gain Boost and Writer Bias parameters can be configured when TDA 5360 type amplifier is used. The parameters that can be set in the “Head Amp Setup” depends on the property of each head amplifier being used.

Figure 4-7 Example of Head Amp Config. Menu using (E5022-66507)



RIN — Specifies the type of reader input resistance. Select either 15, 18, 23 or 30 ohms.

LF POLE — Specifies the type of low frequency pole to be selected. Select either 1MHz, 2MHz, 3MHz or 4MHz.

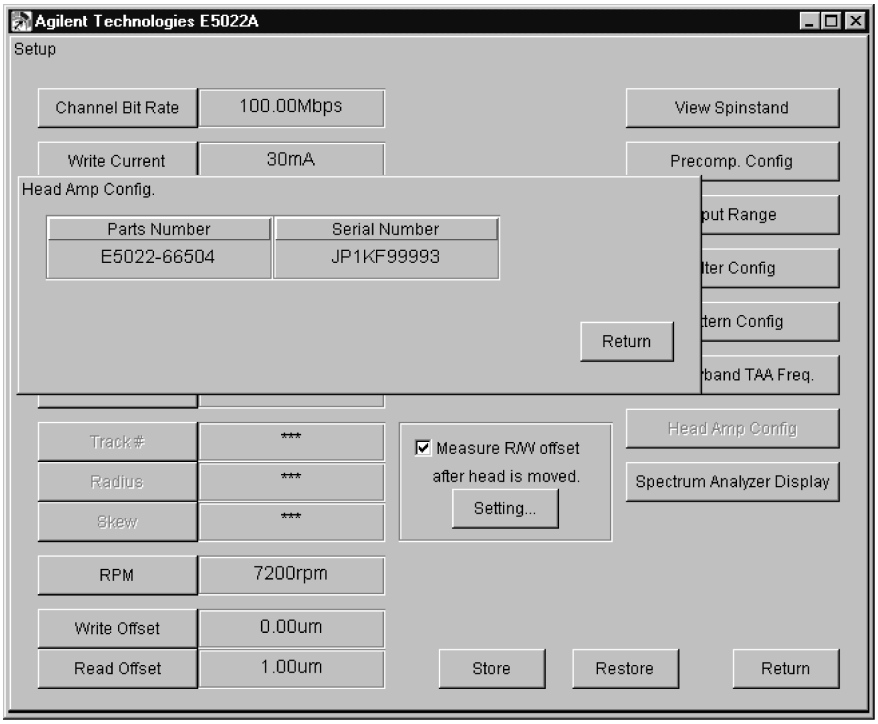
HF Gain Boost — Specifies the type of high frequency gain boost to be selected. There are 16 values to be selected.

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Writer Bias	Specifies the value for writer bias register. The user must enter a real number from 0 to 7.

NOTE When the property of the installed head amplifier is not supported by the DLL, only the parts number and serial number will be displayed.

Figure 4-8 [Head Amp Config.] Menu (E5035A)



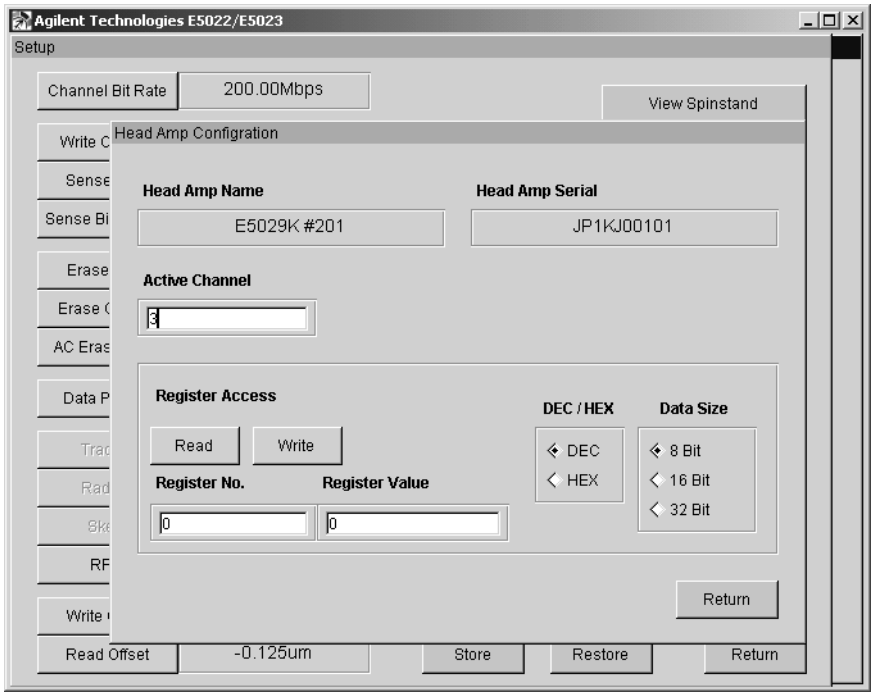
- When the system has the E5035B:

  1. Click on [Configuration] > [Setup] >[Head Amp Config.] to open the head amplifier configuration menu.

     The head amplifier configuration menu allows you to set the data at any register oin the head amplifier IC.

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Figure 4-9 [Head Amp Config.] Menu (E5035B)



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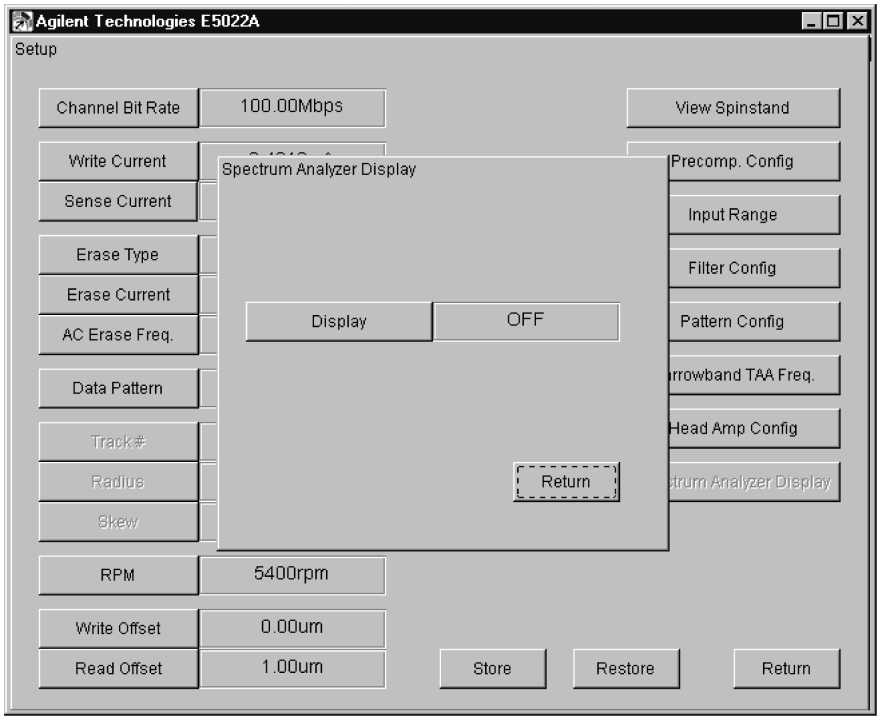
Spectrum Analyzer Display

1. Click on [Configuration] > [Setup] > [Spectrum Analyzer Display] to open the spectrum analyzer display setting. This parameter allows you to view the waveform on the screen of the spectrum analyzer. This parameter is set to [ON] when the spectrum analyzer is used manually. Press [Local] on the spectrum analyzer's front panel to activate the spectrum analyzer.

NOTE The LCD display of the spectrum analyzer is usually in the off-state when measurement is in progress.

NOTE This function can be activated when the system has the 4395A spectrum analyzer. When the system has E4402B 3GHz spectrum analyzer, the waveform is always displayed on the analyzer's display.

Figure 4-10 Spectrum Analyzer Display Menu



2. Click the [Return] button to return to Setup menu.

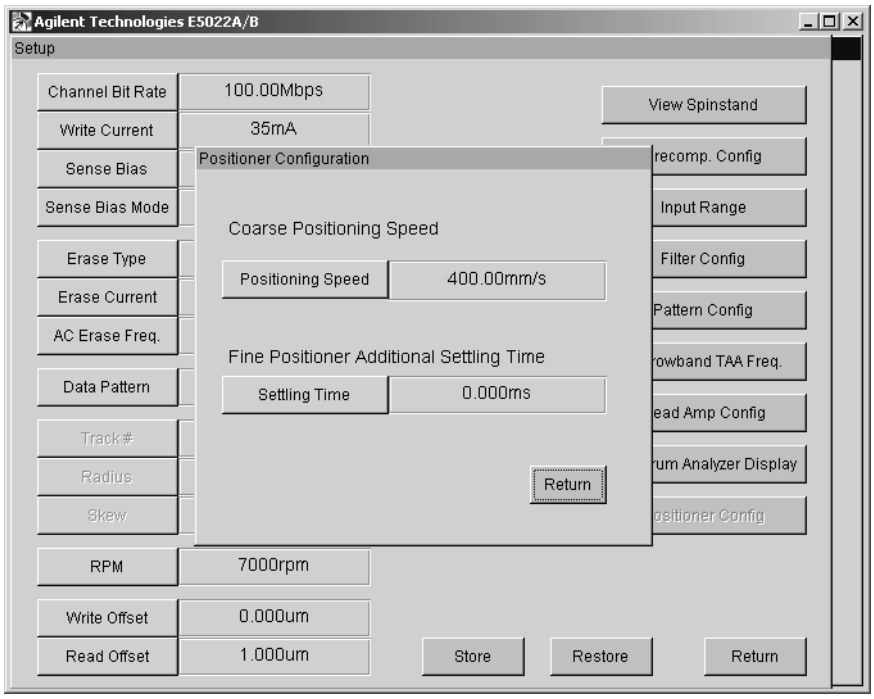
NOTE This function can be activated when the system has the 4395A spectrum analyzer. When the system has E4402B 3GHz spectrum analyzer, the waveform is always displayed on the analyzer's display.

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Positioner Configuration

1. Click on [Configuration] > [Setup] > [Positioner Config] to open the menu about the head positioning.

Figure 4-11 **Positioner Configuration Menu**



Positioning Speed — Specifies a velocity of the head movement by the coarse stage. The head movement speeds at not only on-media but also off-media (movement between the loading/unloading and the home positions) are changed. The speed of the piezo movement is not changed.

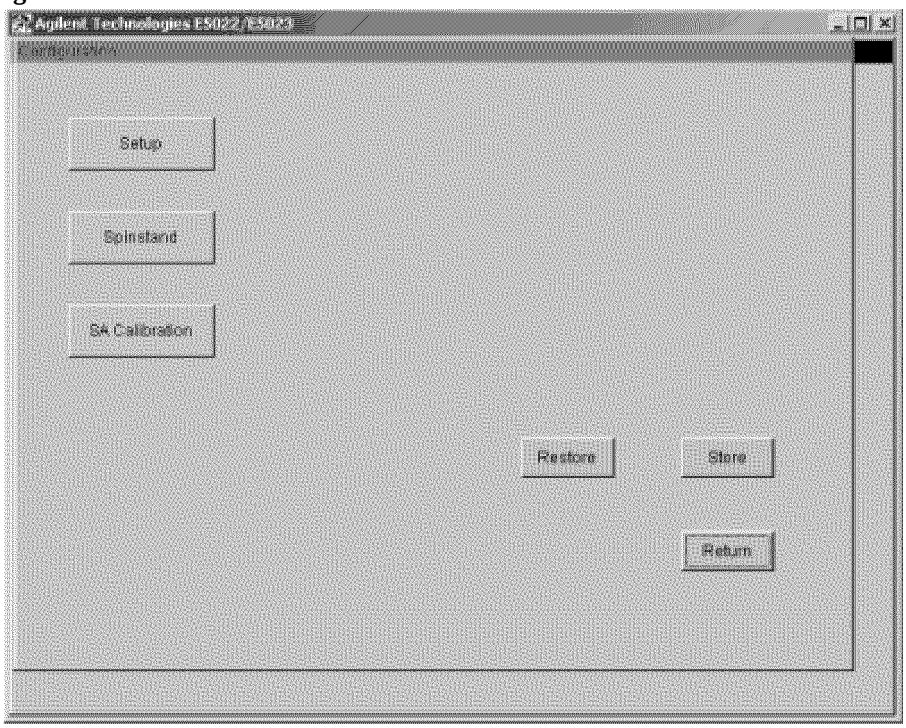
Settling Time — Specifies a additional wait time after the fine positioning (piezo movement) before the next step start.

Normally, the piezo is moved during one or two spindle revolutions, then the write/read sequences is done at the next revolution. If you wait one or two more revolution before the write/read sequences start, the piezo position might be more stable. So that, this might improve the measurement stability. The time of (one revolution period)*n [n=0, 1, 2, 3..] is recommended to input.

2. Click the [Return] button to return to Setup menu.

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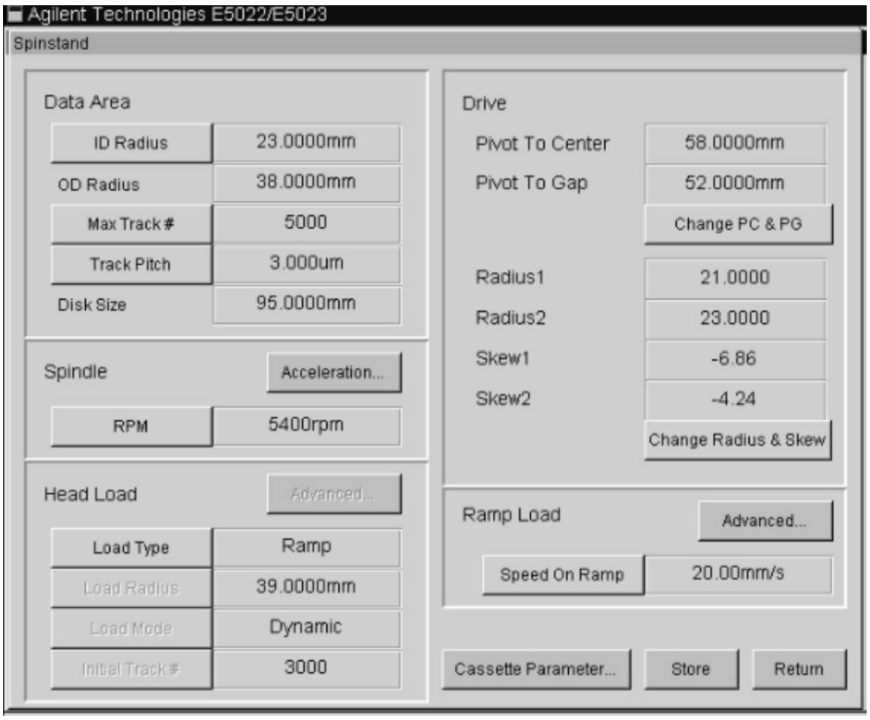
Figure 4-12 **Configuration Menu**



Spinstand Configuration Menu

1. Click on [Configuration] > [Spinstand] to open the Spinstand menu.

Figure 4-13 **Spinstand Menu**



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The track boundary is specified in the Data Area frame. See “Data Area” on page 314.

ID Radius — Specifies the radius from the center of the disk to the innermost track.

OD Radius — Shows the radius from the center of the disk to the outermost track. This is computed from the parameters [ID Radius], [Max Track #] and [Track Pitch]. OD Radius = ID Radius + (Max Track # * Track Pitch).

Max Track # — Specifies the number of the innermost track. The outermost track number starts at 0. The number of tracks is equal to the number of specified tracks plus 1.

Track Pitch — Specifies the distance between the centers of two adjacent tracks.

Disk Size — Shows the size of the disk. This parameter is specified at the factory.

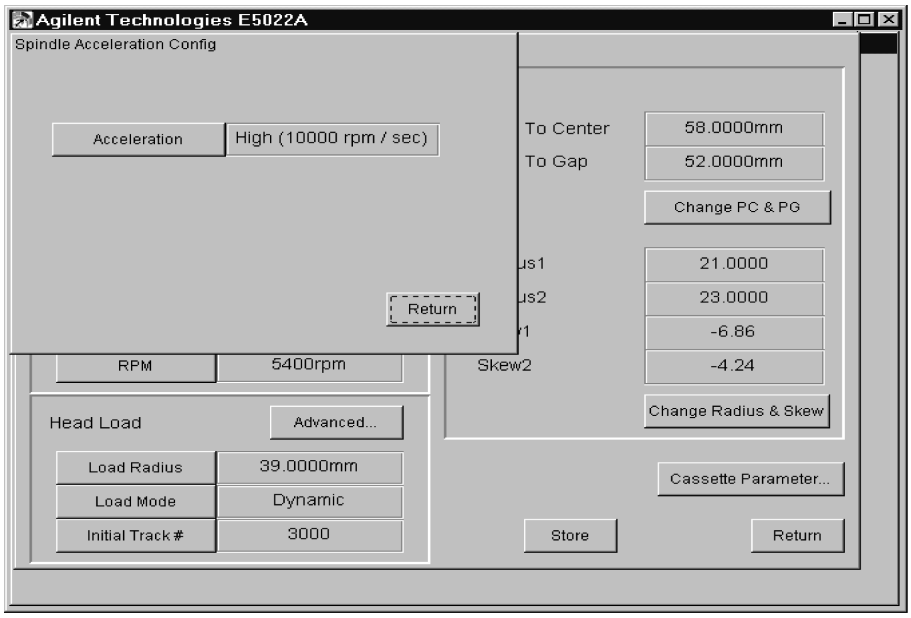
In Spindle Frame, the speed and acceleration of the spindle rotation can be specified.

RPM — Specifies the speed of spindle rotation.

Acceleration — Specifies the acceleration of the spindle rotation.

Acceleration	**[rpm/sec]**
Slow Acceleration	2500
Fast Acceleration	10000

Figure 4-14 Spindle Acceleration



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Head Load Frame, head loading configuration is set by the parameters below.

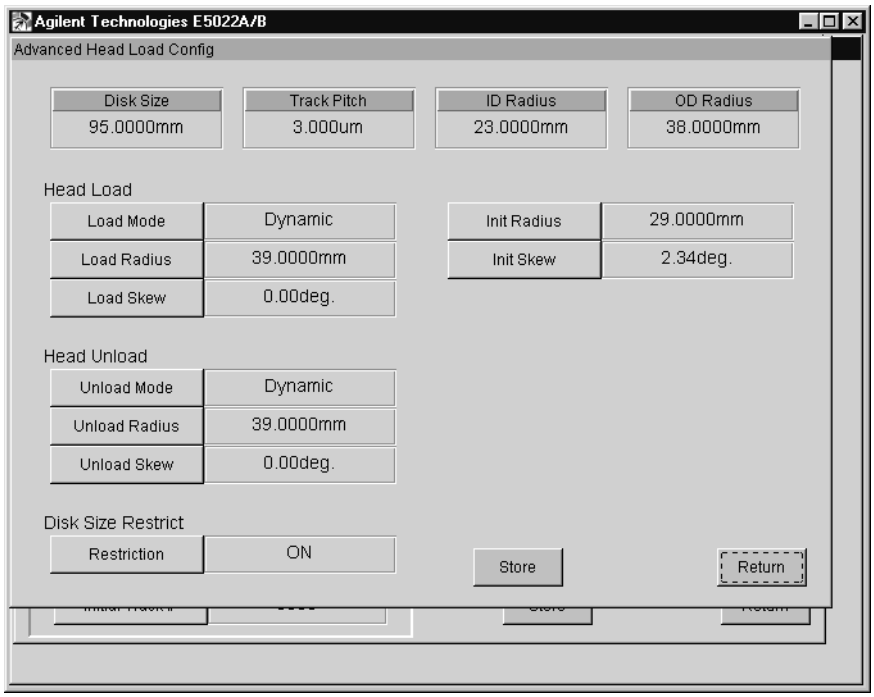
Load Type	Specifies the type of loading as Normal, Ramp and Tilt. The Ramp allows you to use the ramp load wich is available with the E5010C/E5013A Option 320. The Tilt allows you to use the tilt load which is available with the E5010C/E5013A Option 310.
Load Radius	This parameter is defined as the radius of the head at initial loading. This is no the same as initial radius.
Load Mode	Specifies the type of loading as either Dynamic or Static Loading. Dynamic is a type of loading where the spindle rotation is continuous when the head is loaded and/or unloaded. Static is a type of loading where the spindle rotation stops during loading and unloading of the head, thus resetting the rotation is required.
Initial Track #	This parameter specifies the initial track where the head moves initially right after loading.

NOTE When the [***] is displayed, see the advanced head load configuration menu.

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The [Advanced] menu in the “Head Load Frame” allows the user to set the rpm speed different for head loading and head unloading. Click this button to open the ‘Advanced Head Load Configuration’ menu.

Figure 4-15 Advanced Head Load Configuration menu



The [Load Radius] and [Load Mode] parameters specified in the [Spinstand] menu will automatically update similar parameters in this menu. However, when you set parameters in this menu different from the ‘Head Load frame’, the [****] symbol will appear in the [Spinstand] menu which indicates that ‘Head Load Configuration’ has already been specified in this menu.

NOTE

When skew parameters are set below -30 degrees the E5022/E5023 system can not guarantee a track offset of ± 6µm, this could result to an error “hpe5022_ERROR_INV_PARAMETER”. When the skew angle is set below -30 degrees the user may need to uncheck the [Measure R/W offset] parameter in the [Setup] menu or set the range of the background track offset to a value lower than ± 6µm to avoid generating an error. Refer to “hpe5022_headLoadConfigEx” function of the programming manual for details.

Load Mode Specifies the type of head loading. Select either Dynamic, Static or Change RPM. When [Dynamic] is selected the spindle rotation is continuous as the head loads. When [Static] is selected the spindle rotation stops as the head loads. [Change RPM] allows the user to specify the spindle speed rpm independent from the unload mode. See “hpe5022_headLoadConfigEx” of the programming manual to specify this parameter within its limit.

Load Radius Specifies the radius when the head is loaded.

Load Skew Specifies the skew angle when the head is loaded.

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Unload Mode	Specifies the type of head unloading. Select either Dynamic, Static or Change RPM. [Dynamic] is when the spindle rotation is continuous as the head unloads. [Static] is when the spindle rotation stops as the head unloads. [Change RPM] allows you to specify the spindle speed rpm independent from the load mode. See “hpe5022_headLoadConfigEx” of the programming manual to specify this parameter within its limit.
Unload Radius	Specifies the radius when the head is unloaded.
Unload Skew	Specifies the skew angle when the head is unloaded.
Restriction	Selects a status of the head position restriction. This function allows you to set the loading/unloading position and the moved position at the outside of the media. When “On” is selected, the head position and loading/unloading position must be inside of the disk size. When “Off” is selected, the head position and loading/unloading position can be set outside of the disk size.
Initial Radius	Specifies the initial radius after loading the head (i.e, after load radius).
Initial Skew	Specifies the initial skew angle after loading the head (i.e, after loading).

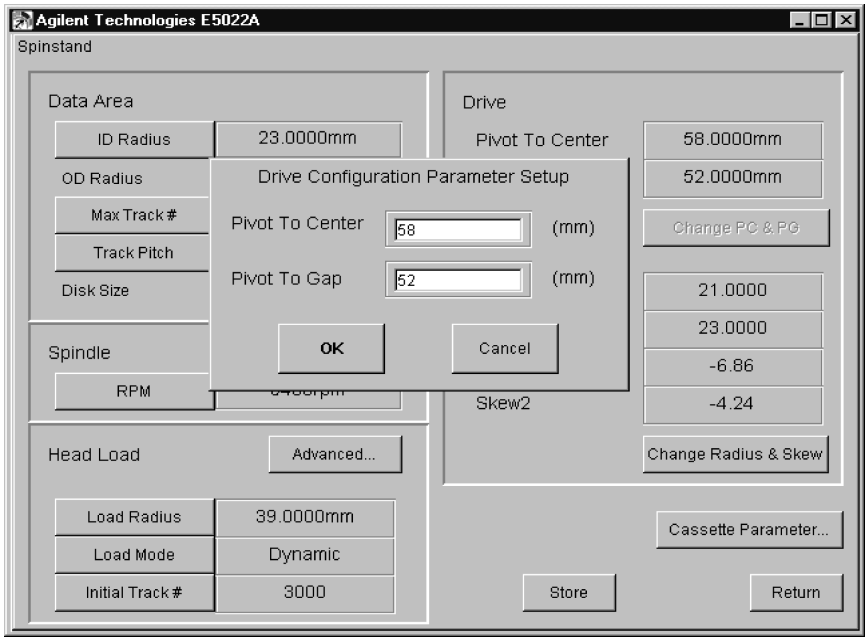
The upper portion of the window shows the disk size, track pitch, inner radius and outer radius. It acts as a reference guide when you set the above parameters relative to disk size and data area.

Click on [Change PC&PG] and [Change Radius & Skew] buttons from the “Drive Frame” to set the pivot to center, pivot to gap, radius1, radius2, skew1 and skew2 parameters.

When you set the pivot to center and pivot to gap, skew1and skew2 are automatically computed and updated relative to the specified radius. See “Drive Configuration” on page 310.

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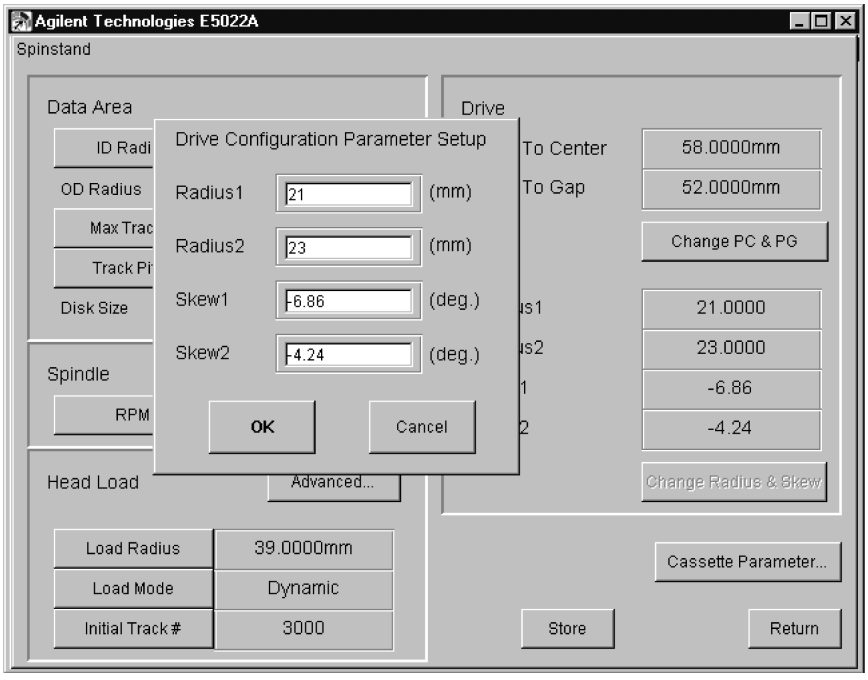
Figure 4-16 **Pivot to Center and Pivot to Gap setting menu**



Pivot to Center Specifies the distance between the pivot and the center of the spindle.

Pivot Gap Specifies the distance between the pivot and the reference point of the HGA.

Figure 4-17 **Skew and Radius setting display**



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Radius 1 Radius that can be defined optionally at any point within the data area of the media.

Radius 2 Radius that can be defined optionally at any point within the data area of the media.

Skew 1 Specifies the head skew angle relative to Radius 1.

Skew 2 Specifies the head skew angle relative to Radius 2.

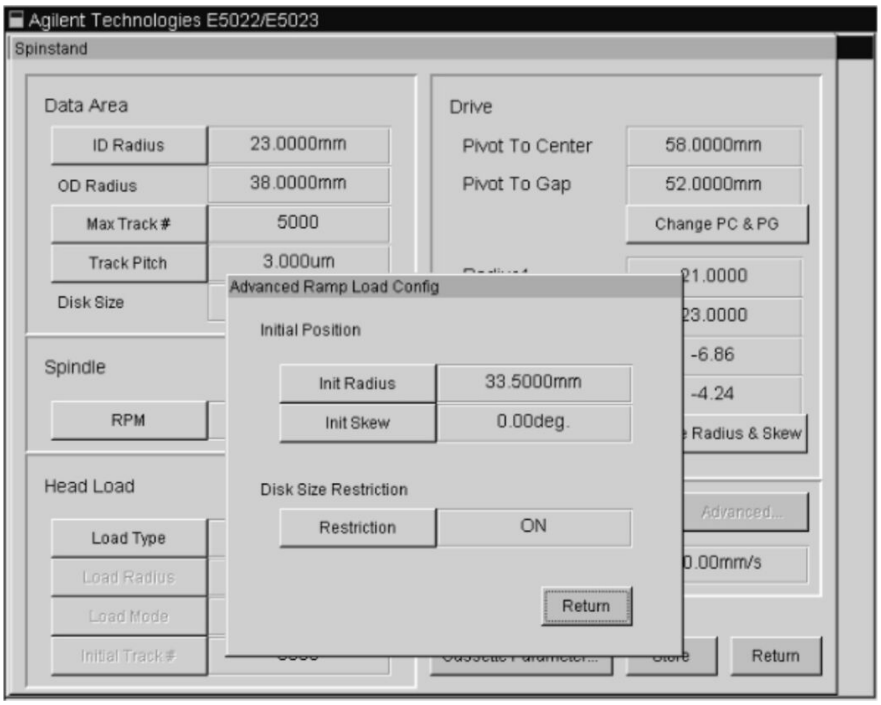
The upper portion of the window shows the pivot to center, pivot to gap, radius1/radius2, and skew1/skew2.

[Speed On Ramp] and [Advanced...] buttons on the “Ramp Load” frame are available when the Ramp load is specified as the Load Type.

Speed On Ramp Specifies the head speed between the ramp load position and the media load position.

Click on [Advanced...] button on the “Ramp Load” frame to set the initial radius, initial skew and disk size restriction.

Figure 4-18 Advanced Ramp Load Config Menu



Init Radius Specifies the radius, that the head is moved to after the head is loaded.

Init Skew Specifies the skew angle, that the head is moved to after the head is loaded.

Restriction Selects a status of the head position restriction. This function allows you to set the loading/unloading position and the moved position at the outside of the media. When “On” is selected, the head position and loading/unloading position must be inside of the disk size. When “Off” is selected, the head position and loading/unloading position can be set outside of the disk size.

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5 Measurement Definition

This chapter provides the definition of the Agilent E5022/E5023 measurements. The Agilent E5022/E5023 is provided with a set of Windows Dynamic Link Libraries (DLLs) and a demo program written in VEE that calls these DLLs. The DLL syntax is in the Programming Manual. This chapter also contains the detailed information on how measurements are performed.

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Measurement Parameters

The Agilent E5022/E5023 can measure various parameters related to the disk - head interface of a hard disk. The measurement parameters are listed in the first row of Table .

Track Average Amplitude (TAA), Pulse Width (PW) and Baseline (BL) can be measured by either the parametric module or an oscilloscope. (The oscilloscope is installed as an option.)

TAA can also be measured by a spectrum analyzer. In this case the TAA is referred to as narrow band TAA (NB TAA).

TAA (not NB TAA) and PW measurements include the waveform positive and negative peak parameters as well as asymmetry.

Baseline measurement (BL) includes the waveform positive and negative parameters as well as separation.

“Parametric” measurement in the Agilent E5022/E5023 is defined as a measurement that includes TAA, PW, Baseline and resolution as a group.

Also, Agilent E5022/E5023 allows you to observe a measurement parameter versus a swept parameter, such as a read offset and a write/sense current. That is called a ‘parametric sweep’ measurement. Table also shows you which measurement parameters can be measured by a ‘sweep’ measurement. For example, a narrow band TAA measurement can be observed with sweep measurements of track profile, write current, sense current, channel bit rate, and roll off.

Measurement Parameter versus Sweep Parameter

Meas. Parameter	Inst.*1	Sweep Parameter						Other
		Track Profile	Write Current	Sense Current	Channel Bit Rate	Rolloff	Pre compensation	Stability
TAA	PM	√	√	√	√	√		√
	OS							
PW	PM		√	√	√			√
	OS							
Baseline	PM				√			
	OS							
Resolution	PM							
Narrow Band TAA	SA	√	√	√	√	√		
Time Asymmetry	OS							
NLTS by 5th harmonic	SA		√	√	√		√	

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Measurement Parameter versus Sweep Parameter

Meas. Parameter	Inst.*1	Sweep Parameter						Other
		Track Profile	Write Current	Sense Current	Channel Bit Rate	Rolloff	Pre compensation	Stability
NLTS by Time Correlation	OS							
NLTS by Dipulse Extraction	OS							
SNR	PM							
Spectral SNR	SA							
Spectrum	SA							
Overwrite	SA		√	√	√			
Partial Erasure	SA							
Baseline Popping	SA							
Popcorn	PM							
Bit Error	BET	√						
Channel Quality	BET							

*1.Abbreviations: PM: Parametric Module, SA: Spectrum Analyzer, OS: Oscilloscope, BET: Bit Error Test Module, √: Supported

In addition, the Agilent E5022/E5023 can create a micro track. Measuring a track profile using the micro track function allows the read head width to be calculated.

Also, the Agilent E5022/E5023 can measure the D.C. resistance (DC-R) of the head. The spinstand interface module measures this parameter.

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Measurement Parameter Definition

This section provides the parameter definitions for measurements. The TAA, PW, Baseline and Resolution parameters can be measured by a parametric module or an oscilloscope. There is a slight difference in measurement definition between the two.

TAA Measurement

The TAA is defined as the average peak-to-peak amplitude measurement for a period.

Oscilloscope

When an oscilloscope is used for TAA measurement, TAA is measured as the average peak-to-peak amplitude for several waveform periods. The number of waveform periods is specified by the “hpe5022_waveAverage” function.

TAA positive and TAA negative are the average amplitudes between the real-time-measured baseline and peaks. The baseline definition is shown in Figure 5-4.

Parametric Module

When parametric module is used for TAA measurement, it is measured as the average peak-to-peak amplitude for a number of disk revolutions. The number of revolutions for averaging is specified by the ‘ave.’ parameter.

TAA positive (TAA+) is the average amplitude between the baseline reference specified by the “hpe5022_baselineReference” function and the positive peaks. TAA negative (TAA-) is measured between the baseline reference and the negative peaks.

TAA Asymmetry is defined as :

Equation 5-1 **TAA Asymmetry Definition**

$$TAA_{Asymmetry} = \frac{TAA_{positive} - TAA_{negative}}{TAA_{positive} + TAA_{negative}}$$

Modulation defined as the modulation of amplitude during one revolution. TAA data of the last revolution of TAA measurement is used to calculate. $TAA_{RawDataMax}$ is a maximum amplitude level in the last revolution. $TAA_{RawDataMin}$ is a minimum one. TAA is an averaged amplitude level in the last revolution.

Equation 5-2 **Modulation Peak to Peak Definition**

$$Modulation_{PeaktoPeak} = \frac{TAA_{RawDataMax} - TAA_{RawDataMin}}{TAA}$$

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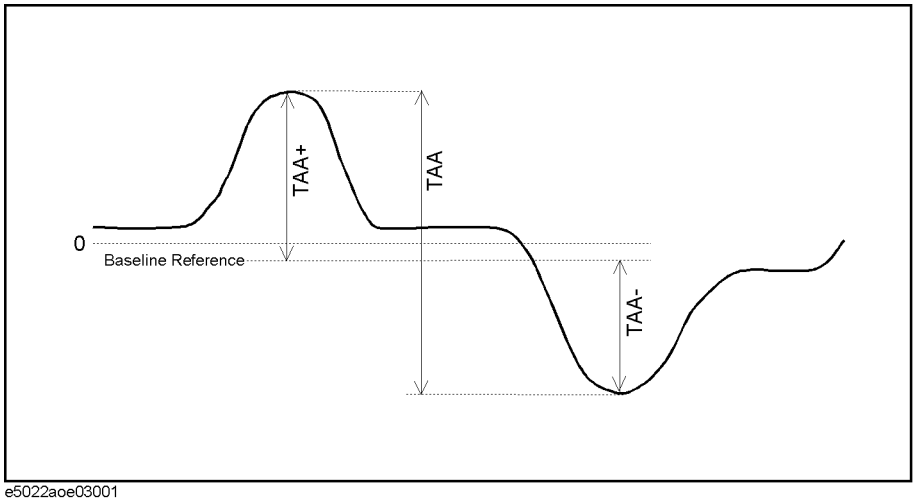
Equation 5-3 **Modulation Positive Definition**

$$Modulation_{Pos} = \frac{TAA_{RawDataMax} - TAA}{TAA}$$

Equation 5-4 **Modulation Negative Definition**

$$Modulation_{Neg} = \frac{TAA_{RawDataMin} - TAA}{TAA}$$

Figure 5-1 **TAA Measurement Definition**



e5022aoe03001

When the parametric module is used for TAA measurement, the module requires a rough pulse width value to measure the TAA. The reason is as follows:

The sensitivity of the peak detector in the module is changed depending on the pulse width. As the pulse width becomes narrower, the gain of the peak detector becomes lower. So that the module can compensate the measured amplitude level for pulse width.

The pulse width value is calculated from the PW reference value which is specified by the “hpe5022_pwReference” function. See “Input Range Control & Auto Configuration” on page 308..

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PW (Pulse Width) Measurement

PW is defined as the average of the widths for a number of positive and negative pulses. It is formed at a specific voltage level of the readback pulse. The Agilent E5022/E5023 measures it and averages PW for several periods.

Oscilloscope

When an oscilloscope module is used for PW measurement, PW is measured as the average pulse width for a number of waveform periods. The number of waveform periods is specified by the “hpe5022_waveAverage” function.

The threshold voltage is given as a percentage level between the real-time-measured baseline and TAA levels. The baseline definition is shown in the Figure 5-4. The threshold level can be set by the “hpe5022_wavePw_Q”.

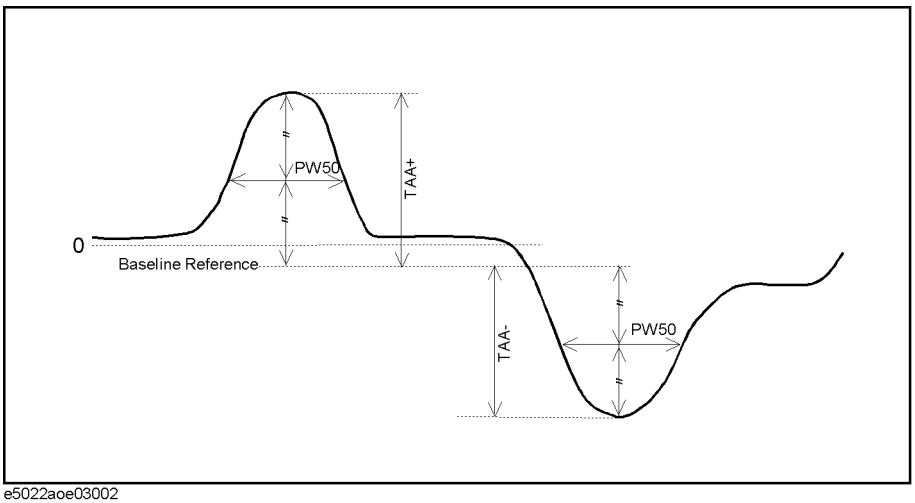
Parametric Module

When the parametric module is used for PW measurement, it is measured as the average pulse width for a number of revolutions. The number of revolutions is specified by the ‘ave’ parameter.

The threshold voltage is given as a percentage level between the baseline reference specified by the “hpe5022_baselineReference” function and the TAA levels. PW positive (PW+) is the average of the widths for positive peaks, and PW negative (PW-) is the average for negative peaks

The threshold level for PW can be set by the “hpe5022_pwThreshold” function.

Figure 5-2 **Track Mode PW Measurement Definition**



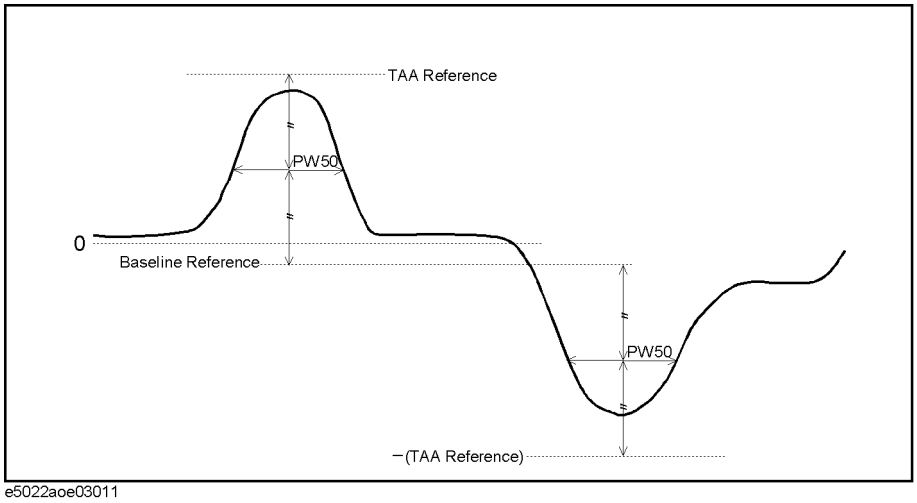
e5022aoe03002

When tracked mode is selected in “hpe5022_pwThreshold”, the TAA level serves as a reference of PW, and becomes the real-time-measured TAA value. (Figure 5-2)

When the fixed mode is selected, TAA level is defined by the “hpe5022_taaReference” function. (Figure 5-3)

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Figure 5-3 **Fixed mode PW Measurement Definition**



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The PW Asymmetry is defined as follows:

Equation 5-5 **PW Asymmetry Definition**

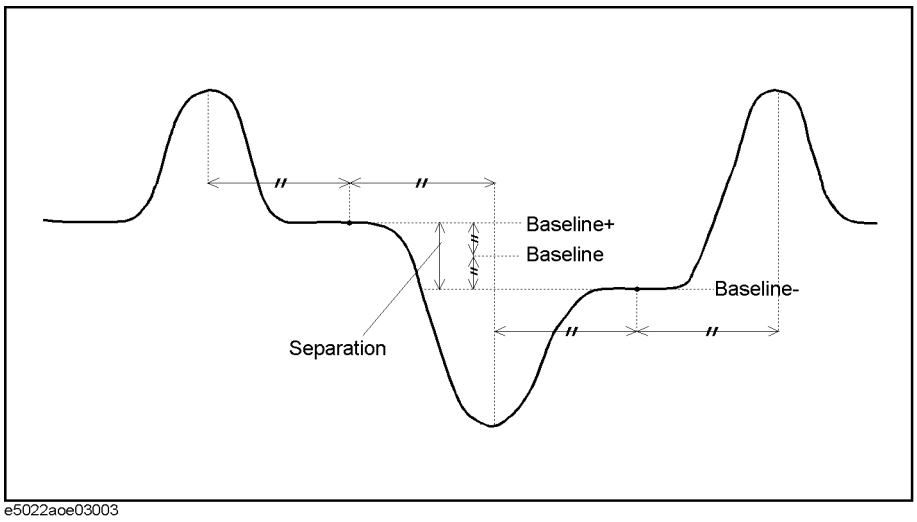
$$PW_{Asymmetry} = \frac{PW_{positive} - PW_{negative}}{PW_{positive} + PW_{negative}}$$

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Baseline Measurement

Baseline positive (baseline+) is the amplitude half way between a positive peak and a negative peak. Baseline negative (baseline-) is the amplitude measured half way between a negative peak and a positive peak. Baseline is the average amplitude level between baseline+ and baseline-. Baseline Separation is the amplitude level between baseline+ and baseline-.

Figure 5-4 **Baseline Definition**



The Agilent E5022/E5023 can measure the baseline by a parametric module or oscilloscope.

Oscilloscope

When an oscilloscope is used to measure a baseline, the above definition is used.

Parametric Module

When parametric module is used to measure a baseline, it has a specified threshold level which is defined as a percentage of TAA+ or TAA- . The threshold level is defined by “hpe5022_baselinePllThreshold”. The default is a threshold level of 50%. In general it is not necessary to change this.

The module observes points on the positive slopes at the threshold level. (Points A and B in the Figure 5-5).

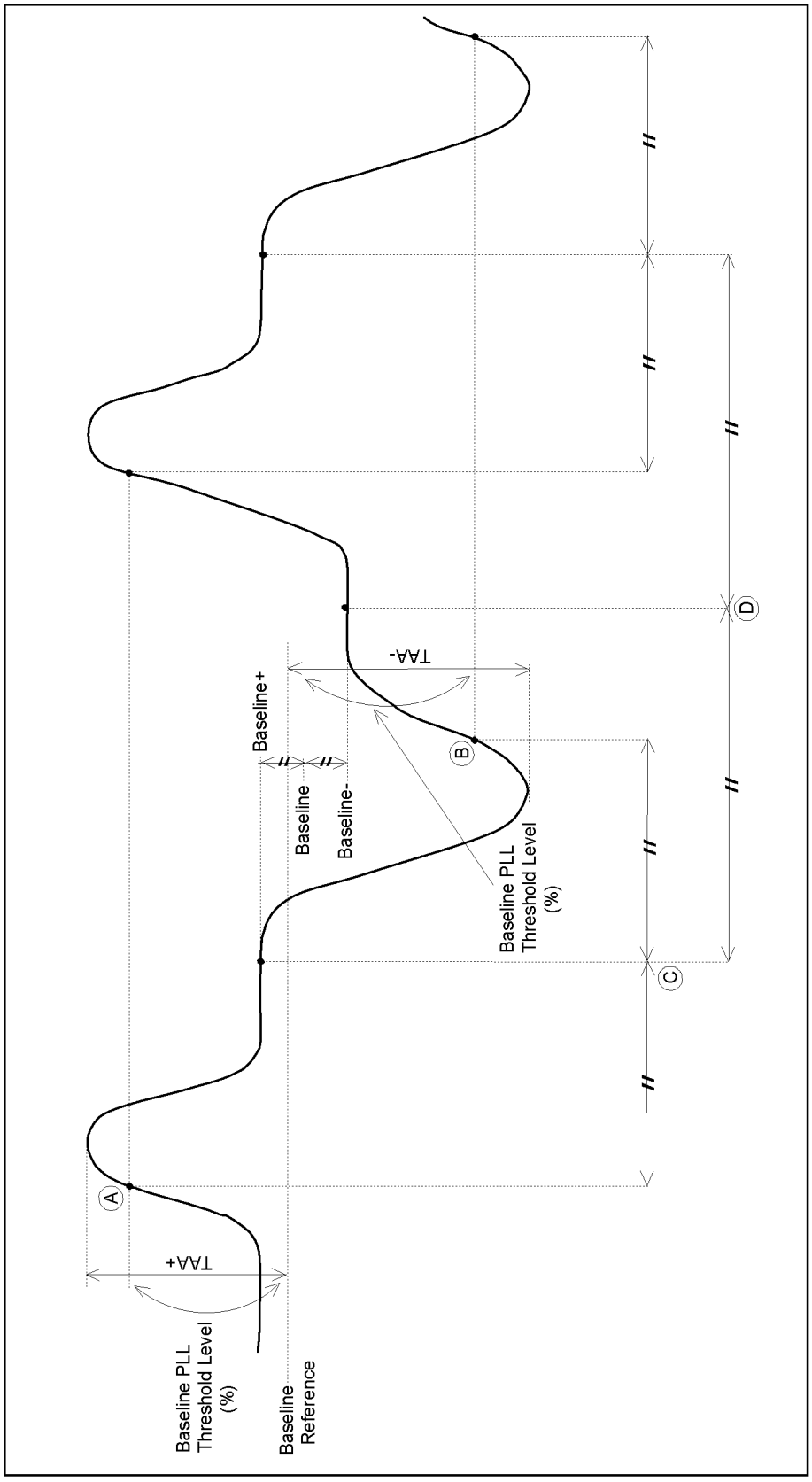
Baseline+ is defined as the amplitude level at the center (point C in the Figure 5-5) of points A and B in the time domain. (the position of point C can be changed, explained in the latter part of this section)

Baseline- is defined as the amplitude level at the center of baseline+ and the next baseline+ points (point D in the Figure 5-5) in the time domain.

Baseline is the average amplitude between baseline+ and baseline-.

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Figure 5-5 **Baseline Measurement Definition using the Parametric Module**

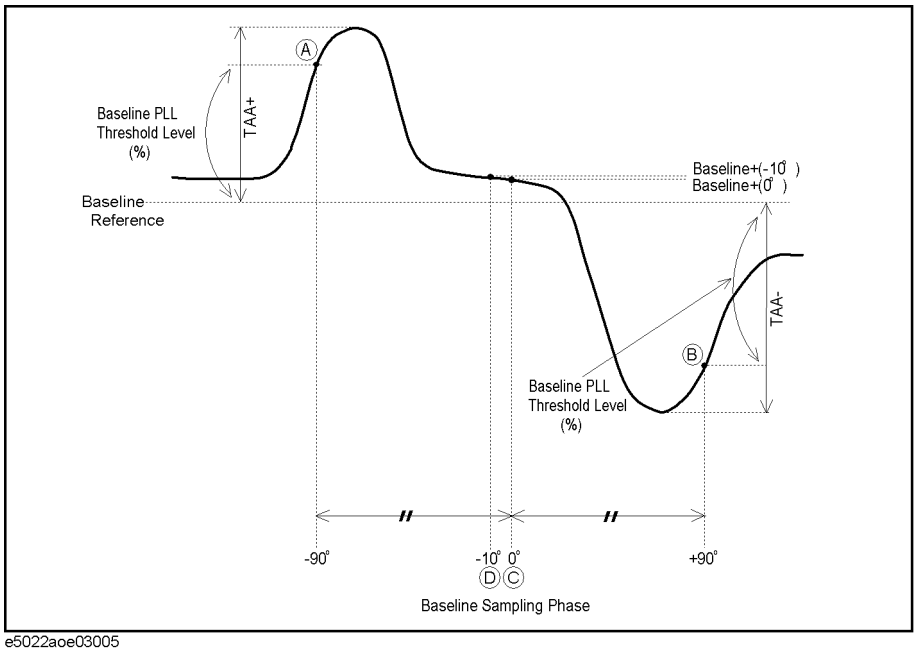


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At default setting, point C is centered between points A and B. It can be changed using the “hpe5022_baselineSamplingPhase” function. As shown in Figure 5-6, points C, A and B are defined as 0 degree, -90 degrees and 90 degrees, respectively for this function.

The value specified by the “hpe5022_baselineSamplingPhase” function defines an observation point for the baseline. For example, when the value is set at -10 degrees, the baseline+ amplitude level is observed not at point C but at point D.

Figure 5-6 **Baseline Sampling Phase Definition**



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Resolution Measurement

Resolution is defined as the ratio of the TAA resulting from two frequencies (HF and LF) written on the same track with the same write current. Resolution is measured by a parametric module. Both TAA_{HF} and TAA_{LF} are expressed in volts [V].

Resolution is an old test method which is used to measure the effect of how close together transitions occur. The HF-TAA divided by the LF-TAA is the resolution and is expressed in terms of percentage. For modern thin film media the number can go as high as 100%.

Resolution is defined as:

Equation 5-6 **Resolution Definition**

$$Resolution = \frac{TAA_{HF}}{TAA_{LF}}$$

The measurement sequence of Resolution is as follows.

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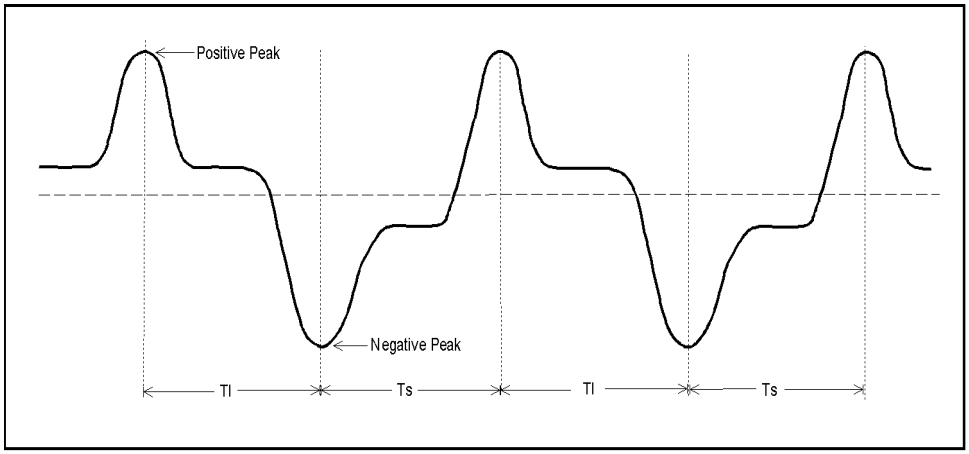
1. Erase the track as specified by the “hpe5022_erase” function.
2. Write HF (high frequency) data pattern given by the function “hpe5022_hfPattern”.
3. Measure the HF-TAA.
4. Erase the track as specified by the “hpe5022_erase” function.
5. Write LF (low frequency) data pattern given by the function “hpe5022_lfPattern”.
6. Measure the LF-TAA.
7. Iterate steps 1 to 6 to get the average of measurement results.

Time Asymmetry Measurement

Time asymmetry is used to determine the pinned layer reversal of the GMR head. Time asymmetry is defined as 1/4 the difference between the adjacent pulse pair spacings, T_l and T_s, averaged over many pulse pair spacings. This method is considered as traditional, since it requires more complex measurement equipment and longer measurement time. In time asymmetry, if the transition time from positive pulse to negative pulse is less than the transition time from negative pulse to positive pulse, the head is said to be normal. If it’s the opposite then the head is considered damaged.

Time asymmetry can be measured by waveform measurement (using an oscilloscope.)

Figure 5-7 **T_l and T_s Definition**



time asymmetry

Equation 5-7 **Time Asymmetry Definition**

$$TimeAsymmetry = \frac{1}{N}\sum_{i=1}^{N}\left|\frac{T_l - T_s}{4}\right|$$

- Tl denotes the time distance from positive peak transition to negative peak transition (p-n).

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- Ts denotes the time distance from negative peak transition to positive peak transition (n-p).
- N denotes the number of transitions to be averaged.

  Time Asymmetry is also used in measuring the hard transition shift (HTS) based on the timing difference between the positive and negative peaks of the low frequency signal written on the magnetic medium after the medium was DC erased.

Narrow Band TAA Measurement

Narrow band TAA is defined as the average amplitude for several revolutions. Because it is measured by a spectrum analyzer, you can measure small amplitude signals due to the spectrum analyzer's sensitivity. Unlike the TAA measurement, where parametric module and oscilloscope are used.

The Agilent E5022/E5023 measures the peak voltage at the fundamental frequency of the data pattern. For example: if the HF data pattern is selected, the repetitive period is set at 2T and the channel bit rate is set at 100 Mbps. When the frequency mode is auto in the "hpe5022_narrowBandTaaFreqMode" function, the center frequency of the spectrum analyzer is set at 25 MHz and the spectrum analyzer measures the amplitude at this frequency.

Stability Measurement

Stability measurement is used to observe the amplitude variation of signals during the write-read iterations of the head in individual sectors (segments) on a track. A write data pattern is written for one revolution. After that the previously written track is divided into segments by controlling the write operation and read operations. In order to divide the track into segments as shown in Figure 5-8. The previously written data pattern is overwritten for a short time which is called write excitation. This is followed by a delay time before the previously written data is read.

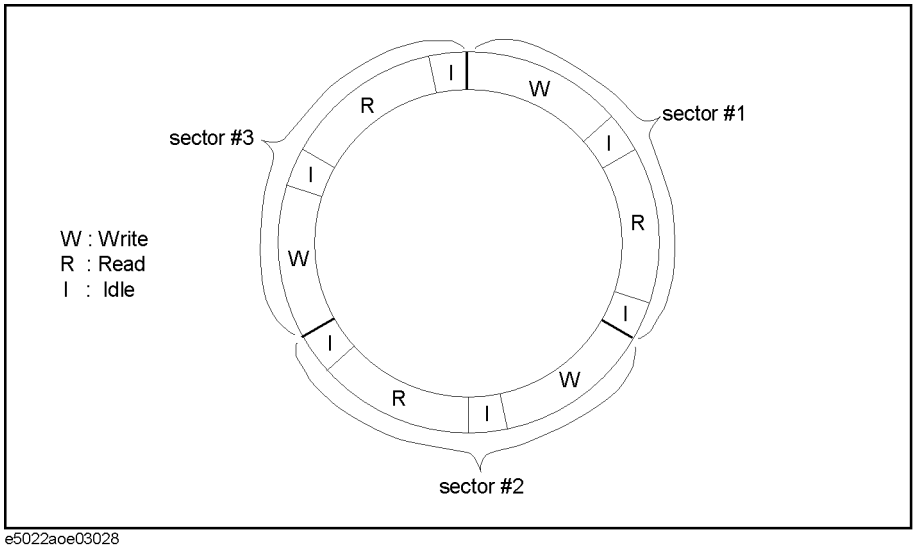
E5022/E5023 allows the user to achieve a higher throughput when track is divided into sectors. For example, if the user decides to measure the TAA for ten loops, you can reduce this to five provided that the track is divided into two sectors. By shortening the time to measure it allows the test have a higher throughput.

The measurement sequence is as follows:

1. Write a data pattern on the track for one revolution.
2. Read the written data from the specified segment (sector) as defined by the write and read ratio.
3. Calculate the TAA or PW of the read data.

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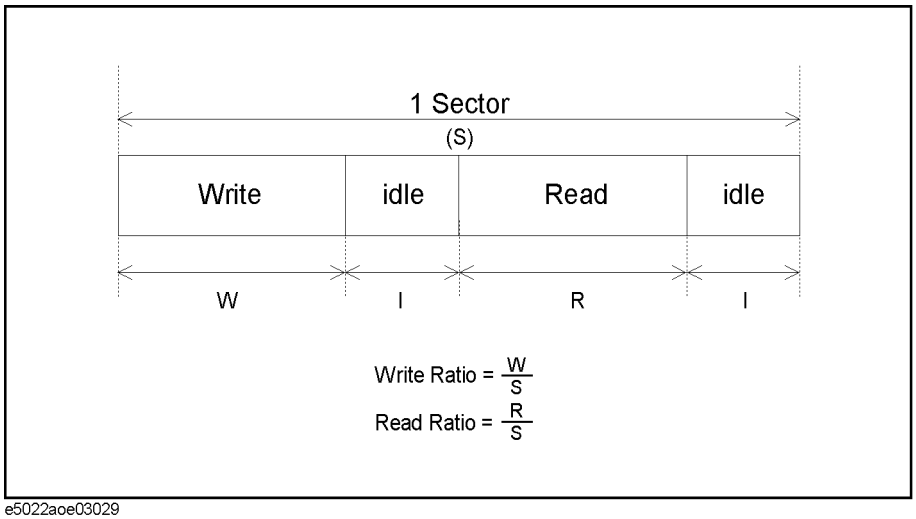
Figure 5-8 **Read-write iteration in each segment (sector)**



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The length of write and read in each sector can be specified by the write ratio and read ratio parameters. The portion named “I” is defined as an idle section or delay time.

Figure 5-9 **Write/Read Ratios**



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The illustration above shows the partition of the write ratio, read ratio and idle in a single sector. See the Stability Functions in the Programming Manual.

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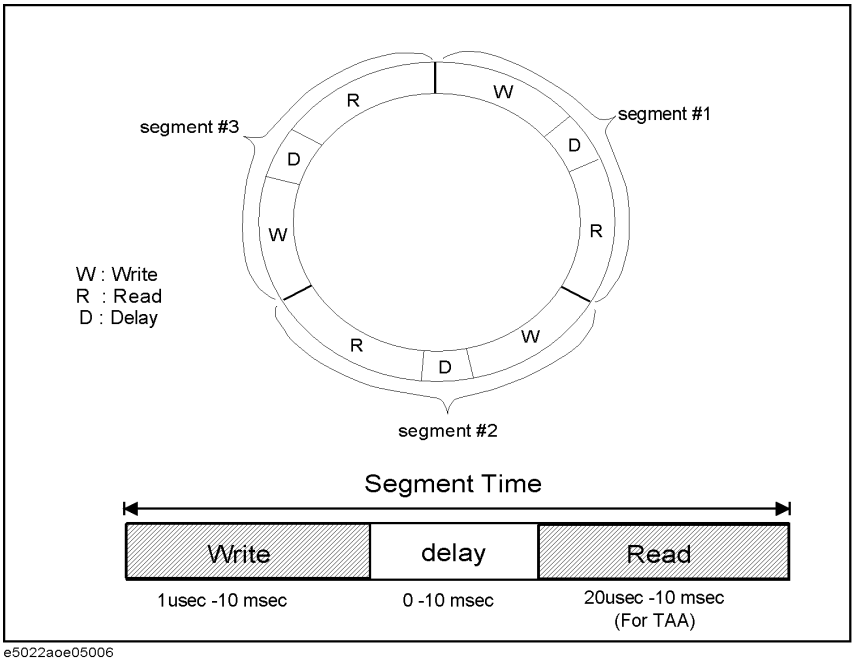
Stability Measurement by Absolute Time

The objective of this test is to evaluate head instability by measuring the TAA, TAA Asymmetry etc. in terms of absolute time. This test allows the user to set up the write and read operation in each segment (sector) as a function of absolute time so that test results can be closely correlated similar to popcorn noise test. See Figure 5-10 on page 250.

One of the causes of head instability is popcorn noise which occurs shortly after write operation. This noise spikes causes head instability because write current pulse produces thermal transients in the head that affects the read-back signal. In order to evaluate head instability more accurately in addition to popcorn noise measurement, Agilent E5022/E5023 allows the user to measure TAA Stability with a programmable gate time setting for write operation, read operation and time delay in terms of absolute time.

In previous measurement applications the length of write and read operation is set in terms of ratio relative to the segment (sector) length. This method does not provide sufficient test results to evaluate the head instability. Measurement sequence of this test is similar to “Stability Measurement” on page 248 except for gate time setting.

Figure 5-10 **Segment Setting by Absolute Time**



With this newly incorporated function in measuring stability, the user should decide the number of measurement counts (i.e, counts) by setting the write time, delay and read time. The number of segments per revolution and the number of total revolution is automatically computed by the system. Refer to the equations provided on the next page.

The user may use the equations provided on page 209 as reference equations in determining the total number of measurement counts. “Segment”, refers to the number of times a track is to be divided, calculated as shown in Equation 5-8. “Revolution”, refers to the number of track rotations, calculated as shown in Equation 5-9. And “Counts”, refers to the total number of stability measurements, calculated as shown in Equation 5-10. Refer to the programming manual for details about the measurement sequence.

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Equation 5-8 **Segment**

$$Segment = \frac{60}{RPM \times SegTime}$$

Equation 5-9 **Revolution**

$$Rev = \frac{Counts}{Segment}$$

Equation 5-10 **Counts**

$$Counts = Rev \times Segment$$

NOTE There is a gate timing restrictions that the user must compensate when the spindle speed (RPM) is set up. When RPM is set below 2400[rpm], the system will automatically set the spindle speed to 2400[rpm]. When RPM is set ≥ 2400 [rpm], the system will execute the spindle speed specified by the user.

Table 5-1 **Restrictions in Setting the Gate Time**

RPM = spindle speed, when spindle speed ≥ 2400 rpm
RPM = 2400 rpm, when spindle speed < 2400
TrackTime = 60/RPM
SegmentTime = writeTime + delay + readTime
TrackTime - writeTime ≥ 100 µsec.
TrackTime - SegmentTime ≥ 30 µsec. (For TAA, PW)
TrackTime - SegmentTime ≥ 100 µsec. (For Narrow Band TAA)

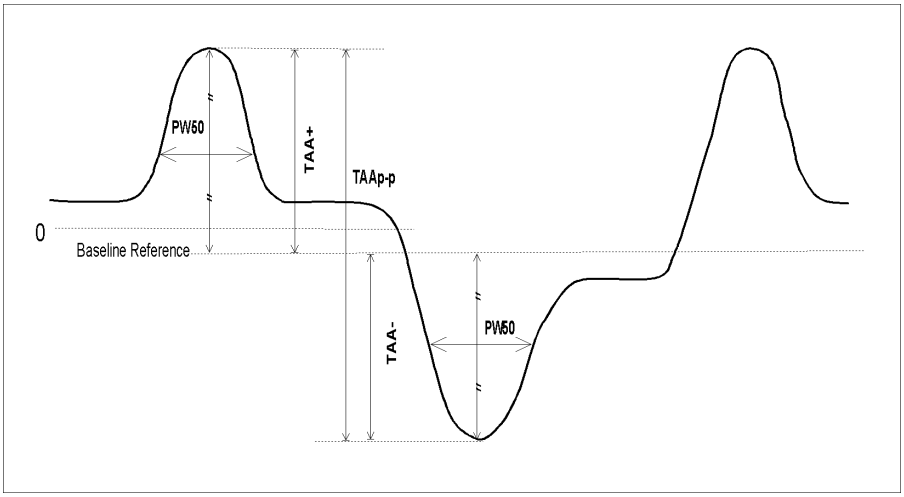
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Waveform Analysis Measurement

The Waveform Analysis measurement requires the use of an oscilloscope in order to evaluate the waveform characteristics of the read signal. It measures the standard TAA, PW50 and Baseline parameters.

This measurement is a graphical plot of the read TAA voltage vs. time as observed through an oscilloscope. The problem in working with an oscilloscope is that it takes longer time to measure, but this is usually used in trouble shooting the test system. The Agilent E5022/E5023 measures the TAA, PW50, Baseline and Time Asymmetry parameters in order to evaluate the head performance.

Figure 5-11 **Measurement of TAA and PW50 Parameters**



Equation 5-11 **TAA Asymmetry Definition**

$$TAA_{Asymmetry} = \frac{TAA_{positive} - TAA_{negative}}{TAA_{positive} + TAA_{negative}}$$

As shown in Figure 5-11 *TAAp-p* is measured as the average peak-to-peak amplitude for several waveform periods. *TAA positive* is defined as the average amplitude measured between the baseline reference and the positive peak value. While *TAA negative* is defined as the average amplitude measured between the baseline reference and the negative peak value. With *TAA Asymmetry* defined as the ratio between the difference of positive and negative TAA and the peak-to-peak TAA. TAA Asymmetry simply reports the amount of non-linearity of the read back signal. At high recording densities it may not be a problem, but it could affect other measurement parameters such as partial erasure and NLTS.

Equation 5-12 **PW Asymmetry Definition**

$$PW_{Asymmetry} = \frac{PW_{positive} - PW_{negative}}{PW_{positive} + PW_{negative}}$$

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PW positive is measured as the average pulse width at 50% of the positive TAA signal. While PW negative is measured as the average pulse width at 50% of the negative TAA signal. PW Asymmetry is defined by Equation 5-12.

Another important parameter in the analysis of waveform is the measurement of baseline. *Baseline positive (Baseline+)* is the amplitude measured half way between the positive and negative peaks (i.e., p to n order). And baseline negative (Baseline-) is the amplitude measured half way between the negative and positive peaks (i.e., n to p order). Baseline is the average amplitude level measured between the *Baseline+* and *Baseline-*. While *Separation* is defined as the amount of baseline shift between Baseline + and Baseline -.

Separation occurs due to *track edge effect* during write operation. Head geometry such as untrimmed write heads, unequal write pole widths and fringing fields create a transverse component that changes sign alternately as the write head gap is switched. As a result, dipoles with alternating directions are written at the track edges. A *dipole* is a pair of magnetic poles that is separated by a fixed distance having opposite polarity or signs.

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Absolute Polarity Test

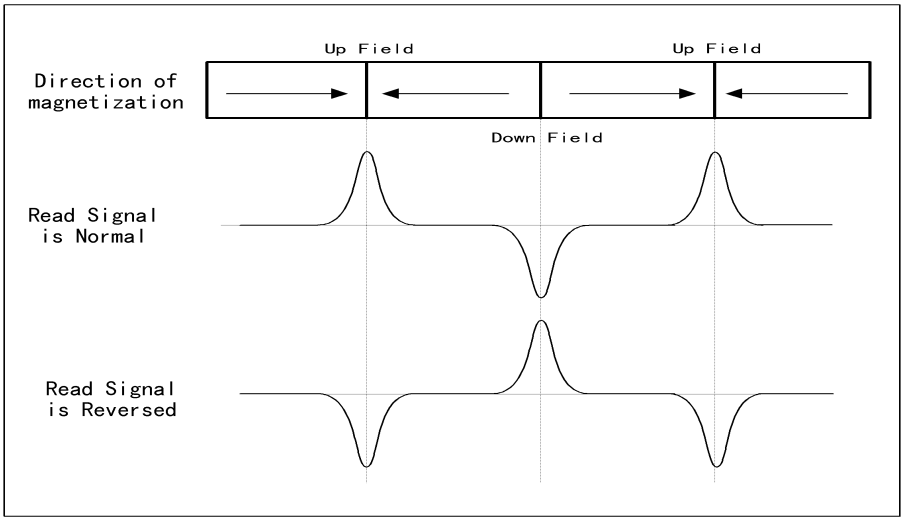
The *absolute polarity* test is used to detect the pinned layer reversal of the GMR head. When pinned layer reversal occurs the polarity of the read pulse reverses indicating a damaged head. TAA measurement of the 1-3 bit data pattern (i.e. combined pattern of isolated pulse and tribit pulses) is the simplest way of detecting pinned layer reversal. Heads with pinned layer reversal can be detected only by measuring the TAA of an isolated pulse pattern and TAA of a bit pattern. The 1-3 bit data pattern proposed below is used for measuring the pulse polarity and, consequently, for detecting pinned layer reversal. This simple method can be used as a substitute from the traditional time asymmetry method, a method that requires more complex measurement equipment and longer measurement time. In time asymmetry, if the transition time from positive pulse to negative pulse is less than the transition time from negative pulse to positive pulse, the head is said to be normal. If it's the opposite, the head is considered damaged.

When using E5022A, the user must measure the "Absolute Polarity" of the standard head (i.e, a good head) beforehand. The result of the standard head will serve as the basis in determining the condition of the head to be tested. If the result is positive then a positive value of 'Absolute Polarity' must be followed for normal pinned layer of the head. If the result is negative then a negative value of 'Absolute Polarity' must be followed for normal pinned layer of the tested head. Consequently, if the tested head yields a value (i.e, absolute polarity) whose sign is opposite to the result of the standard head then the pinned layer of the tested head is reversed. Without a standard reference, the [Absolute Polarity Measurement] of E5022/E5023 cannot determine the pinned layer condition of the head. This is because the head coil can be winded in either directions such that the resulting initial pulse of the read signal changes accordingly. The direction of the resulting initial pulse is also affected by the output polarity of the Head Amplifier.

In general, when the polarity of the output pulse is in the same direction as the media's magnetization, the head's pinned layer is said to be normal. On the other hand, if the polarity of the output pulse is in opposite direction to the media's magnetization, then the head's pinned layer is reversed.

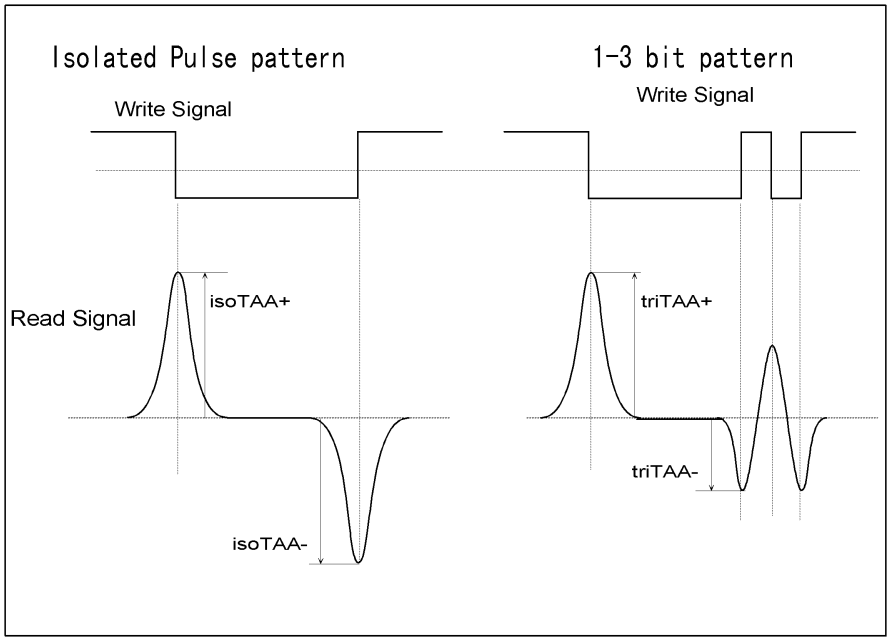
The explanation of "Absolute Polarity" written in this section (shown in Figure 5-12) assumes the positive initial pulse of the read signal for normal pinned layer.

Figure 5-12 **Normal and Reversed read signal**



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Figure 5-13 **Normal Pinned Layer**



There are two conditions in determining the pinned layer reversal, namely, ‘normal pinned layer’ and ‘pinned layer reversal’. For normal pinned layer, if the output pulse satisfies the condition in Figure 5-13 then pinned layer is normal.

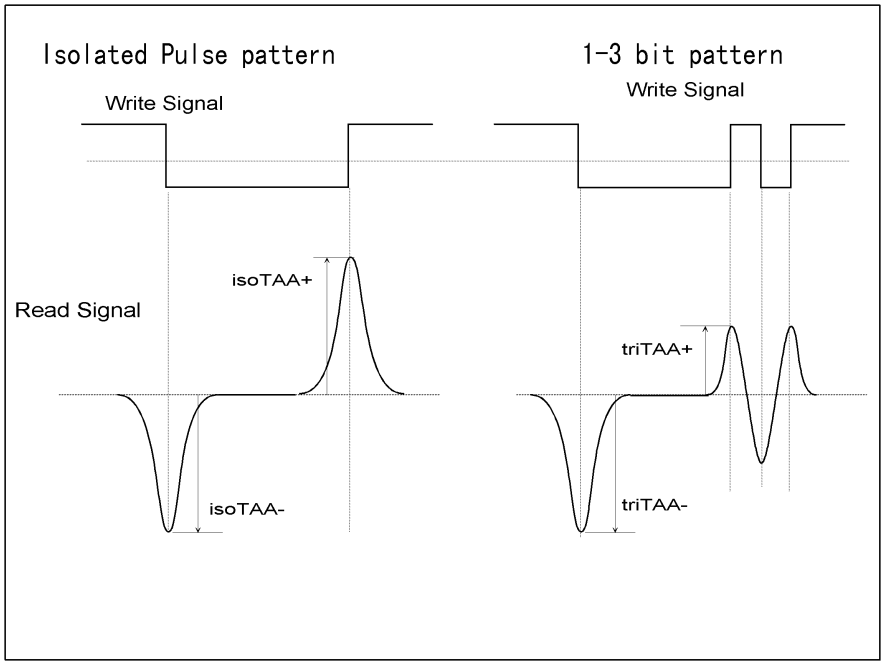
Equation 5-13 **Condition for Normal Pinned Layer**

$$\left(\frac{TriTAA+}{IsoTAA+}\right) > \left(\frac{TriTAA-}{IsoTAA-}\right)$$

As shown in Equation 5-13,TAA- of tribit (TriTAA-) is smaller than the TAA of Isolated Pulse (IsoTAA-). Since three consecutive transitions (tribit) are written the resulting pulse will be affected by ISI (intersymbol interference) resulting in a smaller and compressed TriTAA-.

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Figure 5-14 **Pinned Layer Reversal with Symmetrical TAA**



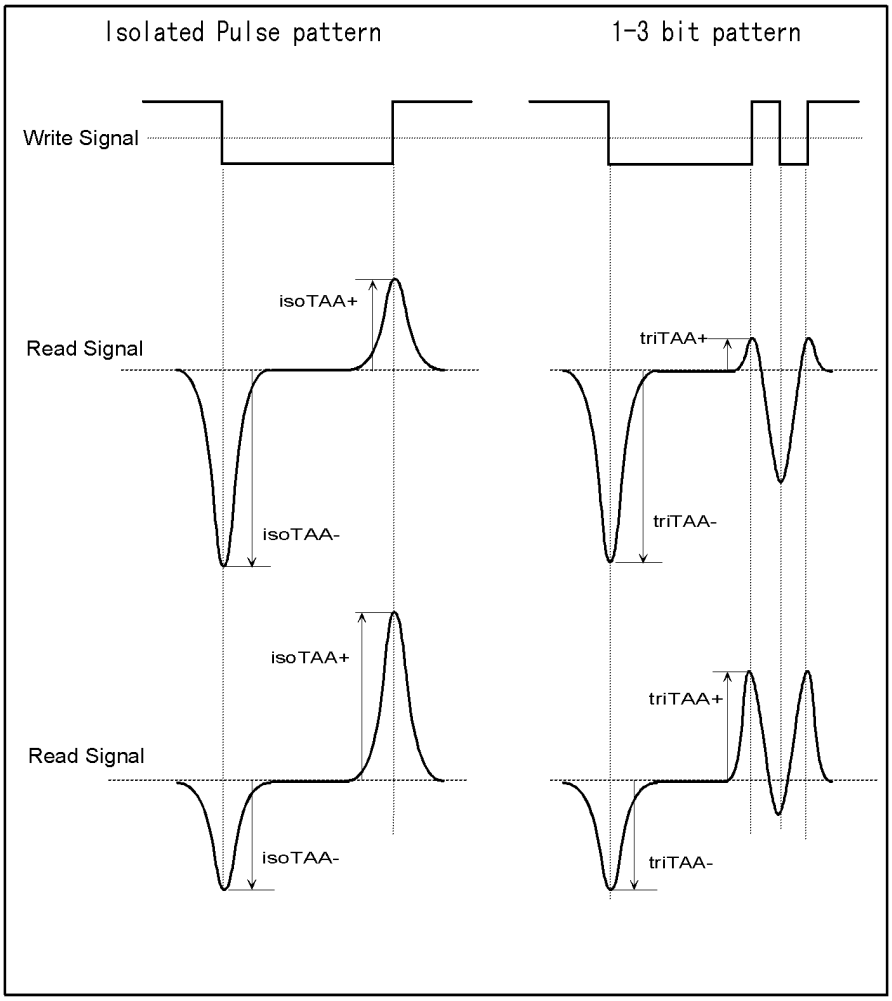
Equation 5-14 **Condition for Pinned Layer Reversal with Symmetrical TAA**

$$\left(\frac{triTAA+}{isoTAA+}\right) < \left(\frac{triTAA-}{isoTAA-}\right)$$

The pinned layer is reversed when the output pulse becomes opposite to the direction of the media's magnetization. From the illustration above if the output pulse of triTAA+ is smaller than isoTAA+ and assuming that triTAA- is the same as isoTAA-, then the pinned layer is reversed satisfying the condition above.

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Figure 5-15 **Pinned Layer Reversal with Asymmetrical TAA**



In another case similar to Equation 5-14, even if TAA is asymmetrical, the inequality of pinned layer reversal never changes since triTAA- is always the same as isoTAA- and triTAA+ is always smaller than isoTAA+. This condition also satisfies Equation 5-14.

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Equation 5-15 **Absolute Polarity**

$$AbsPol = \frac{\left(\frac{triTAA+}{isoTAA+}\right) Ð \left(\frac{triTAA Ð}{isoTAA Ð}\right)}{\left(\frac{triTAA+}{isoTAA+}\right) + \left(\frac{triTAA Ð}{isoTAA Ð}\right)}$$

Absolute polarity is computed from the given equation above. Analyzing Equation 5-15, in simple terms if “Absolute Polarity” > 0, then the pinned layer is normal and the head is considered good. If “Absolute Polarity” < 0, then the pinned layer is reversed and head is assumed to be damaged.

NOTE If the initial pulse of Figure 5-13 is isoTAA- (i.e, a negative pulse) then the pinned layer for “Absolute Polarity” < 0 is normal. And when “Absolute Polarity” > 0 then the pinned layer is reversed. Read second paragraph of “Absolute Polarity Test” on page 254.

The measurement sequence of Absolute Polarity Test is as follows.

1. Write the isolated pulse pattern.
2. Measure TAA of isolated pulse by denoting TAA+ and TAA- of the isolated pulse as isoTAA+ and isoTAA- respectively.
3. Write the 1-3 bit pattern or user defined absolute polarity pattern
4. Measure (Tribit -TAA) by denoting TAA+ and TAA- of the 1-3 bit pattern as triTAA+ and triTAA- respectively.
5. Iterate steps 1to 4 for averaging.

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NLTS Measurement

Agilent E5022/E5023 has three methods of measuring Non Linear Transition Shift (NLTS). Ideally the location of the transitions when the track is read is where they were written. But in actual case the location of the transitions changes since it is influenced by its neighboring transitions i.e. how close they are to previous and following transitions.

- 5th Harmonic (Harmonic Elimination) Method
- Dipulse Extraction Method
- Time Correlation Method

5th Harmonic NLTS is measured using a spectrum analyzer while Dipulse Extraction and Time Correlation NLTS are done with an oscilloscope.

5th Harmonic Method

This is a popular way of measuring NLTS. The Agilent E5022/E5023 writes the 30 bit data pattern (110000001000000110000001000000), then measures the amplitude of the 5th harmonic of this pattern $E(5f_0)$, where f_0=1/30T. Next, it writes a reference pattern consisting of isolated transitions separated by 15T (repetition period of this sequence is 30T) and measures the amplitude of the same harmonics of this new pattern $X(5f_0)$.

NLTS is defined as:

Equation 5-16 **NLTS 5th Harmonic method Definition**

$$NLTS = \frac{E(5f_0)}{2\pi \times 5f_0 \times X(5f_0)}$$

Where f_0=1/30T

Dipulse Extraction Method

Dipulse extraction is a method used for quantifying the amount of nonlinear distortion present in the recording and playback process. The detailed description of this method is given in a paper by D.Palmer, P.Ziperovich, R.Wood and Howell “Identification of Non-linear Effects Using Pseudo Random Sequences: -IEEE Transactions on Magnetics”, vol. 23, 5, pp.2377-2379, 1987.

The detailed calculation sequence is described in Chapter 3 of the Programming Manual.

Time Correlation Method

Time correlation is a method that measures the SNR and the cross correlation coefficient of the time domain readback voltages that result from writing a pseudo random sequence.

The algorithm for this method is given in the IDEMA Test and Measurement Committed PRML Working Group Working Paper, “Nonlinear Distortion Measurement Techniques” Issued on July 1995.

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SNR Definition The Agilent E5022/E5023 uses several periods of the waveform, when averaging factor is specified, SNR will be defined as:

Equation 5-17 **SNR Calculation Formula**

$$SNR = \frac{1}{m-1}\sum_{n=1}^{m-1}\frac{r[V(t),V(t+nNT)]}{1-r[V(t),V(t+nNT)]}$$

Where N = The length of Pseudo Random Bit Sequence, m= averaging factor (Specified by the “hpe5022_waveAverage” function.), the formula of $r[]$ is shown in “Correlation Definition”.

Time Correlation Definition The formula in computing Time Correlation is shown below.

Equation 5-18 **Time Correlation Calculation Formula**

$$TimeCorrelation = \frac{1}{m-1}\sum_{n=1}^{m-1} r[V(t),V(t+nNT)]$$

Where N = The length of Pseudo Random Bit Sequence, m= averaging factor (Specified by the “hpe5022_waveAverage” function.), the formula of $r[]$ is shown in “Correlation Definition”.

NLTS Definition NLTS is defined as:

Equation 5-19 **NLTS Calculation Formula**

$$NLTS = -\frac{2}{m-1}\sum_{n=1}^{m-1} r[V(t),V(t+nNT+D)]\left(1+\frac{1}{SNR}\right)T$$

Where D is the specified Delay (echo location), N = The length of Pseudo Random Bit Sequence, m= averaging factor (Specified by the “hpe5022_waveAverage” function), the formula of $r[]$ is shown in “Correlation Definition”.

Correlation Definition Correlation is defined as:

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Equation 5-20 **Correlation Calculation Formula**

$$r[V(t),V(t+NT)] = \frac{\frac{1}{NT}\int_0^{NT} V(t)V(t+NT)dt - \overline{V(t)V(t+NT)}}{\sqrt{[\overline{V(t)^2} - (\overline{V(t)})^2] + [\overline{V(t+NT)^2} - (\overline{V(t+NT)})^2]}}$$

$$\overline{V(t)} = \frac{1}{NT}\int_0^{NT} V(t)dt$$

$$\overline{V(t)^2} = \frac{1}{NT}\int_0^{NT} V(t)^2 dt$$

Signal to Noise Ratio (SNR)

SNR is the measurement ratio between the peak to peak TAA signal and the noise signal measured in ‘rms’ from an erased track. The measurement is performed by the parametric module.

Equation 5-21 **SNR**

$$SNR = 20\log\frac{V_{ppTAA}}{V_{rmsNoise}}$$

SNR is measured from the equation given above, where

Equation 5-22 **Crest Factor**

$$CrestFactor = \frac{V_{MaxNoise}}{V_{ppTAA}}$$

V_{ppTAA} defined as the peak to peak voltage of the TAA. $V_{MaxNoise}$ is defined as the maximum voltage for one revolution of the erased track.

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The detailed measurement sequence is described in Chapter 3 of the programming manual.

Spectral SNR (SNR measurement by a spectrum analyzer)

The spectrum analyzer is a convenient tool in measuring noise media. Spectral SNR is the ratio between the narrow band TAA amplitude level and the noise signal measured in ‘rms’ for the range of specified frequencies. The narrow band TAA amplitude level is the amount of the amplitude levels at fundamental and harmonic frequencies.

Equation 5-23 **Spectral SNR**

$$SNR[dB] = 20\log\frac{NarrowBandTaa_{atFundamental+harmonic}}{V_{rmsNoise}}$$

Popcorn Noise Test

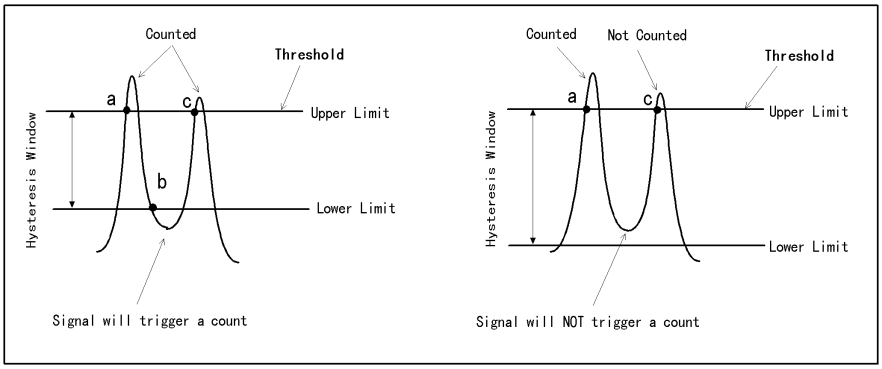
Popcorn noise test is used to detect the head noise referred to as popcorn noise, which occurs shortly after the write operation. The Agilent E5022/E5023 allows you to measure popcorn noise with a programmable time delay after write. Popcorn noise are noise spikes and can be attributed to stress in the magnetic yoke of the head. It occurs after write because write current pulse produces *thermal transients* in the head even after write. Since thermal noise causes the occurrence of popcorn noise, a longer delay time from write to read could affect the accuracy of popcorn noise detection. When using the E5022/E5023 to measure popcorn noise you might wonder why the head remains unloaded from the media when you re-measure. This is because this type of test has nothing to do with the media noise (i.e, it’s not concerned with media noise). Its main concern is to measure head (popcorn) noise caused by domain instability in the magnetic yoke. Popcorn noise pulses have a very high frequency, which means that they are fast noise spikes. The channel’s filter should have a high-frequency cut-off to ensure accurate measurement.

Popcorn Noise Test using E5041A (Dual Counter Test Module)

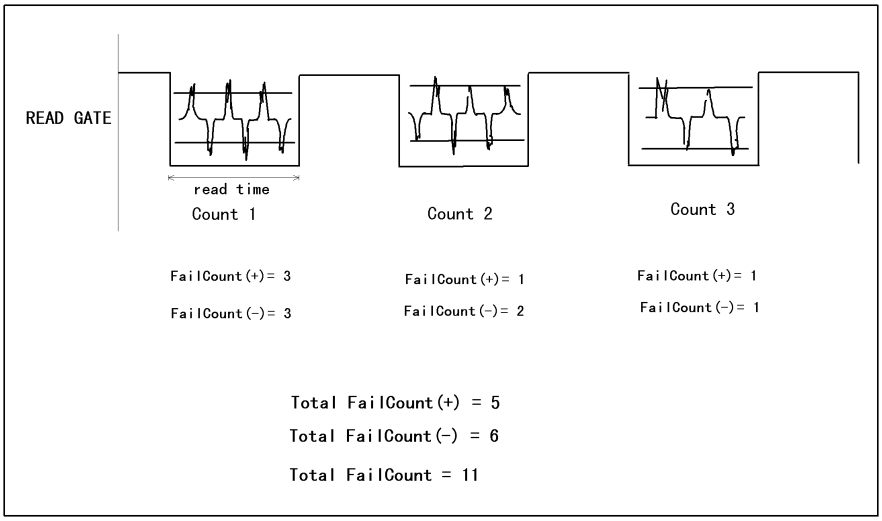
The Agilent E5041A is a dual counter module designed to detect and count popcorn noise. E5041A has two threshold levels that detect popcorn noise for both positive and negative amplitudes of the input signal. Each threshold has its own hysteresis window that is used to trigger the popcorn noise count.

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Figure 5-16 **Counting Popcorn Noise**



In order to trigger a count, the input signal must cross both the threshold level and the lower limit of the hysteresis window at points a and b. If the lower peak of the input signal does not cross the lower limit of the hysteresis window, this will not trigger a count even if the next peak amplitude crosses over the threshold level at point c. As shown in Figure 5-16 (left) a narrow hysteresis window translates to high sensitivity in detecting popcorn noise particularly at low amplitudes.



Count # specifies the number of times to count popcorn noise. As shown in the figure above, for each count# the detected popcorn noise for both positive and negative amplitudes are counted as failcount(+) and failcount(-) by their respective thresholds. If the number of counted popcorn noise exceeds the maximum number of allowable failcounts, the excess failcounts will not be counted. Refer to “hpe5022_popcornNoiseCt_Q” function of the programming manual for details.

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Bit Error Test

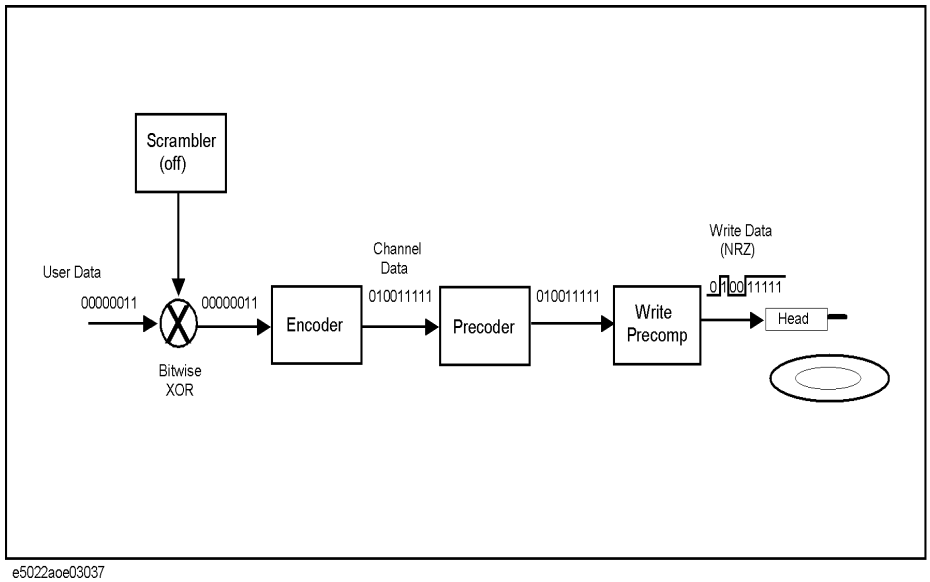
System of Read Channel IC

The Agilent E5039A/B/C is a Bit Error Rate Test Module designed to allow users to measure the bit error rate characteristics of the head and media with a customer specified read channel IC. The parameters of the read channel IC is programmable according to test requirements.

Bit error test is used to determine what fraction of the total bits are in error. The *read channel IC* is the main electronic component, it determines how much data can be stored in a given area on a media. The amount of data stored per track is constant, so bits are more tightly packed on the inner track than the outer track. As data storage becomes more dense, data bits begin to interfere with their neighbors (known as *intersymbol interference* or *ISI*). Highly advanced signal processing techniques are required to recover the data and the recording clock.

An illustration of the write signal flow is shown below. The *scrambler* is added into the data path in order to minimize the probability of recording repetitive patterns onto the media. After scrambling, the user data is supplied to an encoder. An *encoder* adds additional spacings between transitions in order to limit distortions caused by intersymbol interference (ISI). After encoding the user data is transformed into a channel data. The *channel data* is the actual data written on the media but needs to be transformed into some means of magnetization such as NRZ (non-return to zero). The rate at which encoded data bits are written on a track is called *channel data rate*. Write precompensation is used to reduce or eliminate the magnetic non-linearity effects. *Precoding* shapes the signal before it enters the read channel IC in order to limit the occurrence of ISI. Since precoding in the magnetic channel is limited to shifting the positions of the transitions around, it does not allow for full equalization at the receiver. Thus the equalizer must be optimized.

Figure 5-17 **Write Signal Flow**



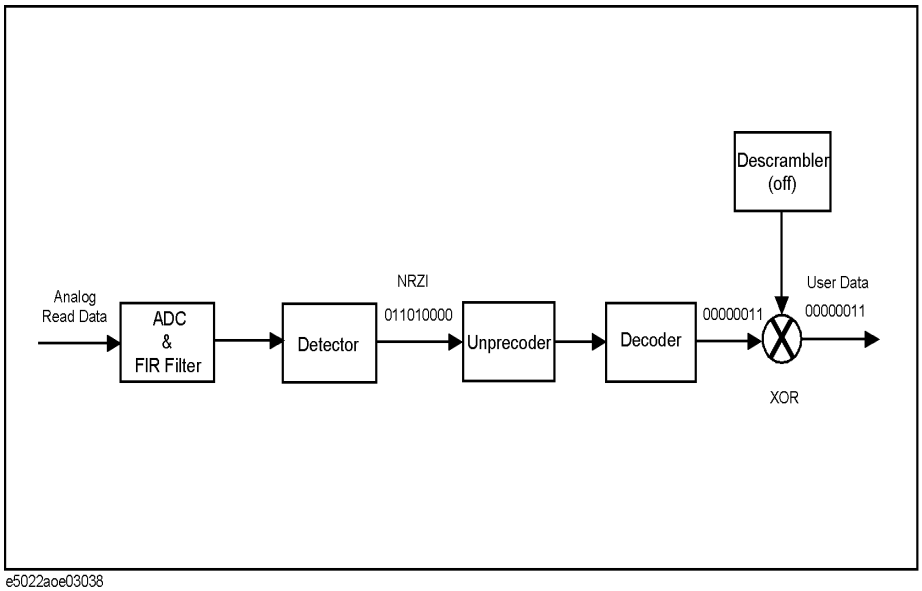
Because data are written in analog waveform the readback signal must also be read in analog before converting it to digital for error detection. The read channel IC must have an advanced digital filtering, data processing and data feedback techniques in order to modify and reshape the readback signal; so that the data written on the disk is accurately detected

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by the read channel IC's detector. *Filter equalization* modifies the data sample so that they cluster around the target values, zero, positive and negative value. The length of time delay (tap) determines the impulse response of the equalizer. The output signal of the analog filter is quantized using an ADC (analog to digital converter), the digitized data is then equalized for partial response.

The *Detector* is used to detect the entire sequence bits at a time as it receives data sample, it doesn't decode immediately whether the sample is '1' or '0' in the original write data. Instead, it compares sequences of samples with sequences of possible samples. It then uses a comparator to determine what an entire sequence of data bits should be. After detection, the read channel decodes the data into the original user data sequence. Figure 5-18, "Read Signal Flow," illustrates a typical signal flow coming from the read head.

Figure 5-18 Read Signal Flow



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On-Track BER Measurement

BER Measurement Feature in E5022A

A unique characteristic of the Agilent E5039A/B/C BER Test Module is that it detects the number of errors in terms of bytes, such that the user must specify the number of error bits to be counted per byte in order to compute the system's bit error rate (BER) performance. This characteristic is shown by the parameter '# of Error Symbols' from the [BER Measurement] menu of the VEE Program.

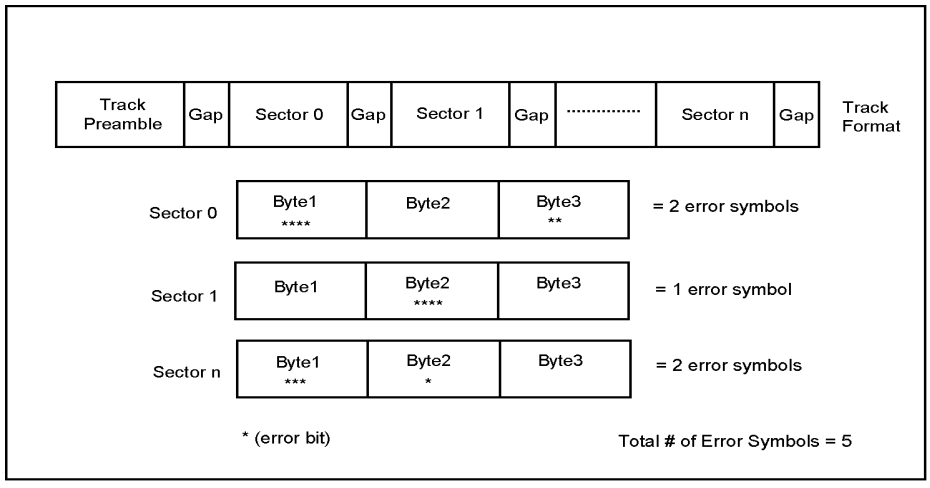
BER is measured from the following equation.

Equation 5-24 Equation for solving BER

$$BER = \frac{ErrorBitsPerByte \times ErrorSymbol}{(TotalSector - LostSector) \times DataBytePerSector \times 8}$$

- Error-Bits/Byte, this parameter must be specified in the 'BER Configuration' menu. This parameter specifies the number of error bits to be counted per byte.
- Total Sector, counts to the total number of sectors including lost sector in a track.
- Lost Sector, counts the number of sectors where the synchronous pattern is not detected.
- Error Symbol, counts the number of detected error bytes per sector.(Figure 5-19)
- DataBytePer Sector, specifies the amount of data in bytes to be recorded per sector. This parameter is specified in the [Data] parameter from the Data Format frame of the 'BER Configuration' menu.
- 8, is a constant factor of eight bits per byte.

Figure 5-19 Number of Error Symbols



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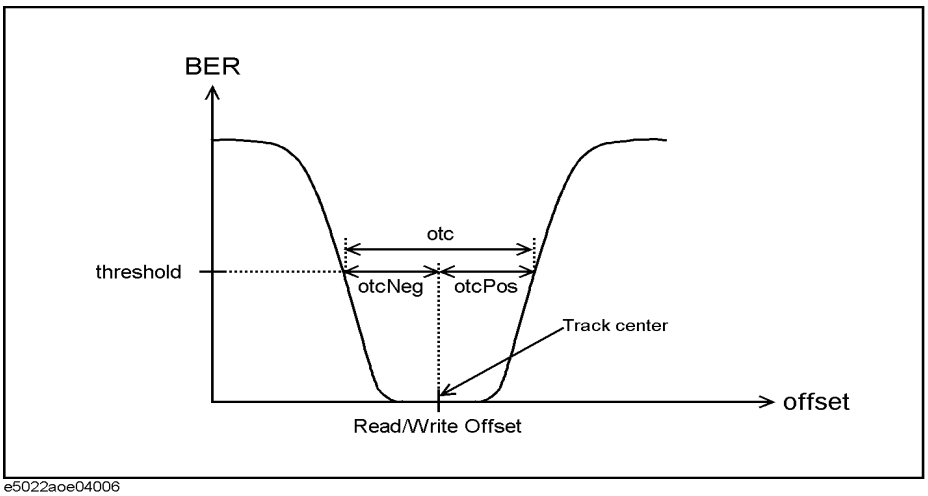
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Bathtub Measurement

This test is done by optimizing the BER at the track center then moving a small step and optimizing and measuring BER. This is done towards the ID (inner diameter) then back to the track center and again towards the OD (outer diameter). Assuming that only the data track is written and no adjacent track, then only signal noise from the media will limit the read/write offset. If an adjacent track is written closer to the data track, the affordable offset becomes limited since the head picks up the interference signal of the adjacent track. As a result, it will narrow the otc. From the illustration below ‘otcPos’ and ‘otcNeg’ are measured from the track center to the right and left sides of the bathtub curve. As the head is shifted off the track center the bit error rate becomes poorer and gets better when the head is closer to the track center.

When performing the bathtub test, first write the test track. The read head which is centered on the test track reads the written data pattern. The read data pattern is evaluated and compared with the original data sequence. The measured error rate at the center of the track is relatively low and is referred to as the “on-track error rate”. As head is gradually displaced from the center of the track by a short distance, the data is read again and bit error measurement is made. This procedure is repeated with step-by-step displacements of the read head and measurements of the bit error rate. The displacement of the head that results in this bit error rate is referred to as the OTC (off-track capability).

Figure 5-20 **Bathtub Characteristic Curve**



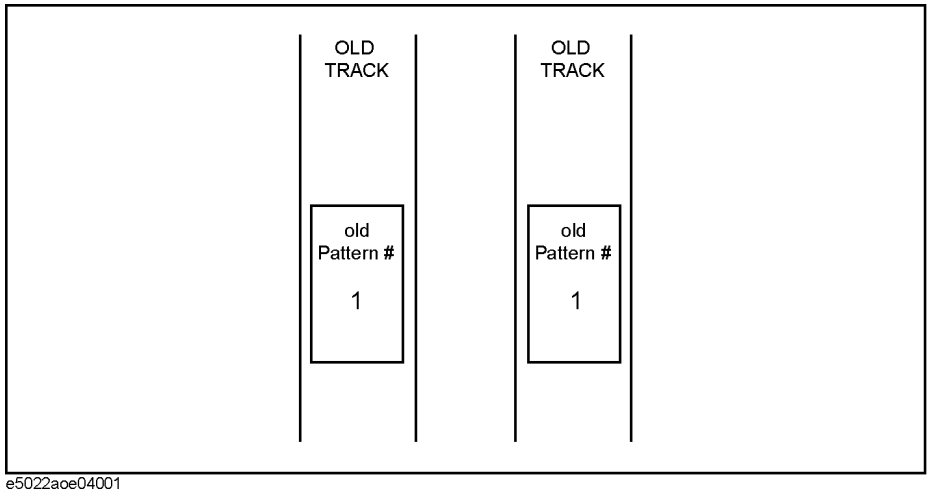
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Analysis of the 747 Test

The purpose of the 747 test is to determine the off-track capability of the magnetic recording system. The off-track capability helps us to know how close tracks of information can be written on a magnetic media without picking up the interference signal of its adjacent track. The *off-track capability* is measured between the center of the data track and the center of the head gap. The 747 test is also used to determine the maximum track pitch in order optimize the number of *tracks per inch (TPI)* of a magnetic recording system.

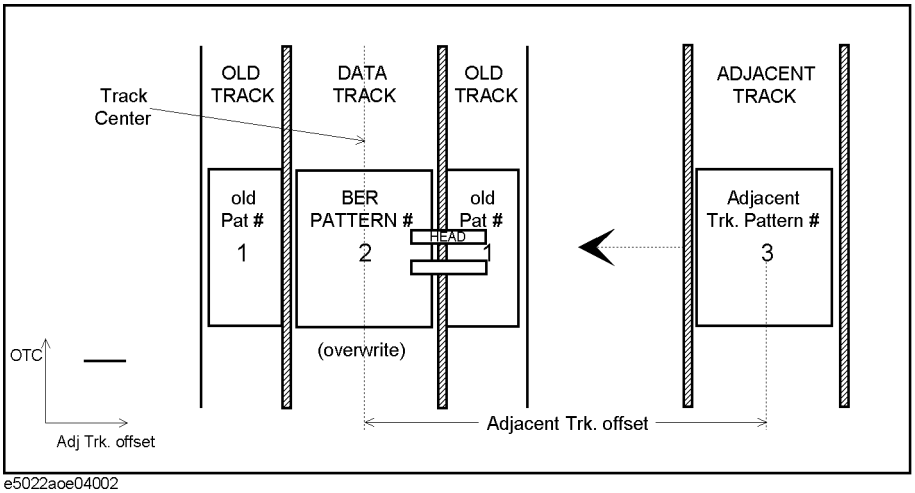
When a head is shifted off the track center, it picks up some part of the readback-signal from the data track and some noise signal from the media. When an adjacent track is written close to the data track, it limits the *off-track capability* (OTC) of the recording system, as it picks up interference signal from the adjacent track.

Figure 5-21 **Old Data Pattern are written first**



In performing the 747 test, we must first write the old track or old information with a fixed distance from the data track.

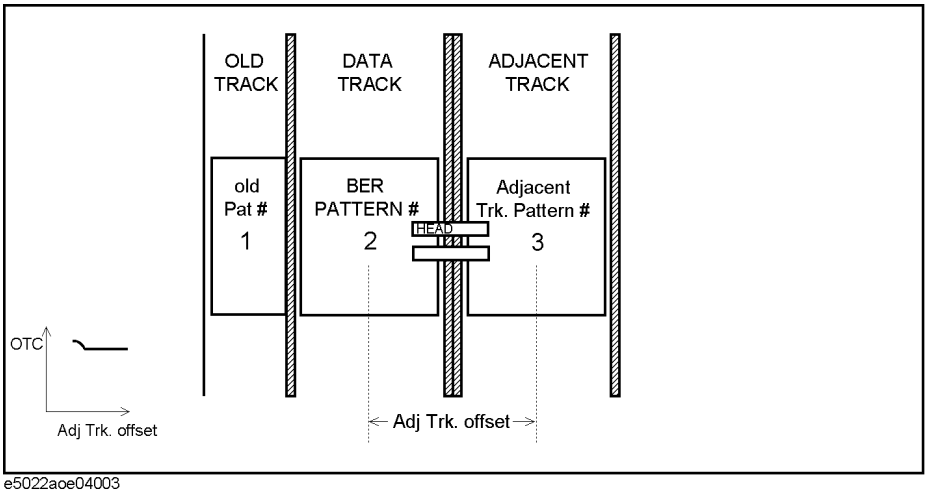
Figure 5-22 **The old data pattern is overwritten by the data track**



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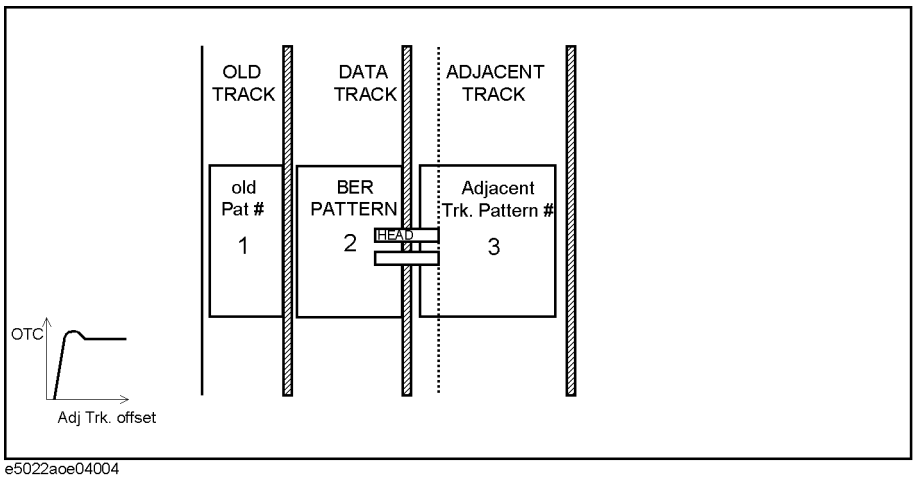
1. When an adjacent track is far, only noise from the media and the written old data limit the off-track capability. So the affordable off-track is relatively constant as shown above.

Figure 5-23 **The adjacent track is written next to the data track.**



2. When the adjacent track is written next to the data track, the erase bands of both tracks form an *erased strip* on the media. This *erase strip* decreases the interference signal of the adjacent track, and as a result it increases the OTC required to reach a specified level as shown in Figure 5-23.

Figure 5-24 **The data track is overwritten by the adjacent track.**



3. When the adjacent track is written close enough to overwrite the data track. The read head starts to pick up the interference signal from this adjacent track, thus decreasing the affordable off-track as shown in Figure 5-24. The process by which the adjacent track is brought closer to the data track for step-by-step measurement of the OTC is called *squeeze*.

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Figure 5-25 **Characteristic curve of the 747 test**

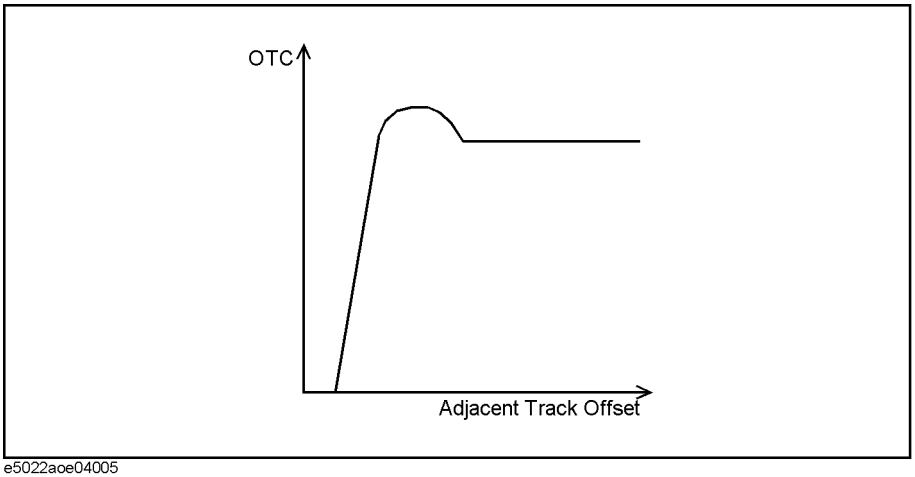


Figure 5-25 shows how much off-track (OTC) can be afforded between the data track and the read head for a fixed error rate level for a specific distance to an adjacent track. The 747 test is an excellent test to determine the optimum number of tracks per inch. At the peak of the 747 hump you are at the closest distance from the track center with the widest OTC, i.e. the optimum point.

The measurement procedure of the 747 test is as follows:

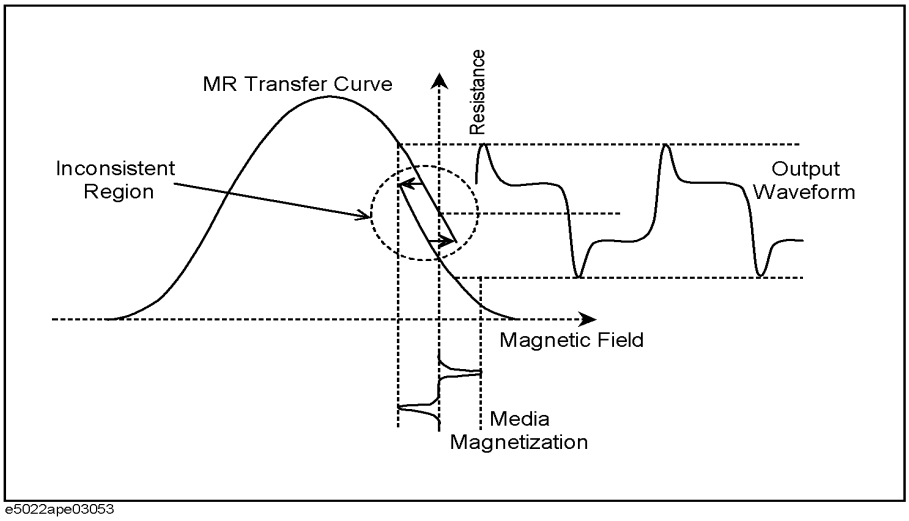
1. Write an old data with a fix position from the data track.
2. Overwrite the old data track with a new data track.
3. Write an adjacent track with a particular distance offset from the data track.
4. Measure the off-track capability (OTC).
5. Decrease the adjacent track offset, then iterate steps 4 and 5.

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SHNR (Sub-Harmonic Noise Ratio)

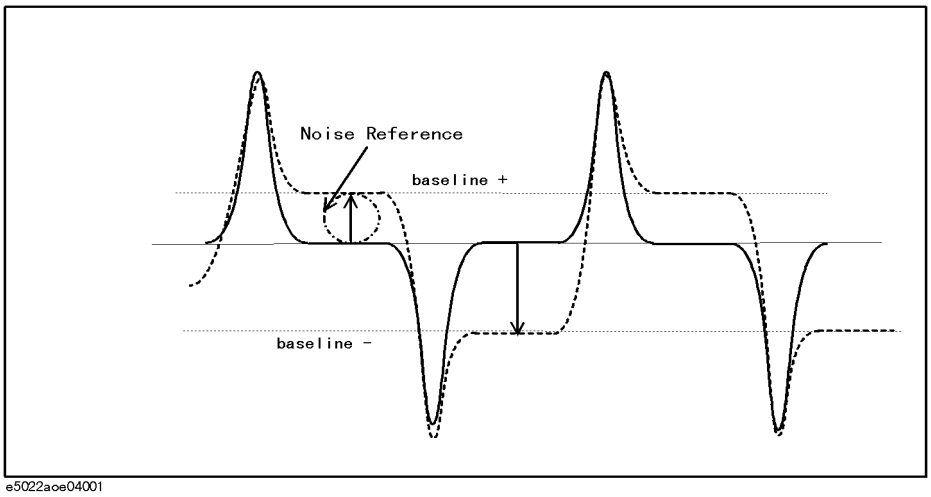
The SHNR measurement is closely tied with baseline popping measurement. This test is used to detect baseline popping of MR/GMR heads by measuring the sub-harmonics noise ratio. In general, some form of biasing is applied to the MR element in order to achieve linearity of the output signal. However, the region where biasing is applied is inconsistent with the MR response curve as shown in Figure 5-26. This inconsistency results in the distortion of the output signal that affects the signal to noise ratio overtime. One of the factors that causes distortion of the output signal is Barkhausen Noise. Barkhausen noise are noise spikes that occur due to discontinuous irreversible domain wall motion of the head.

Figure 5-26 **MR Response Curve**



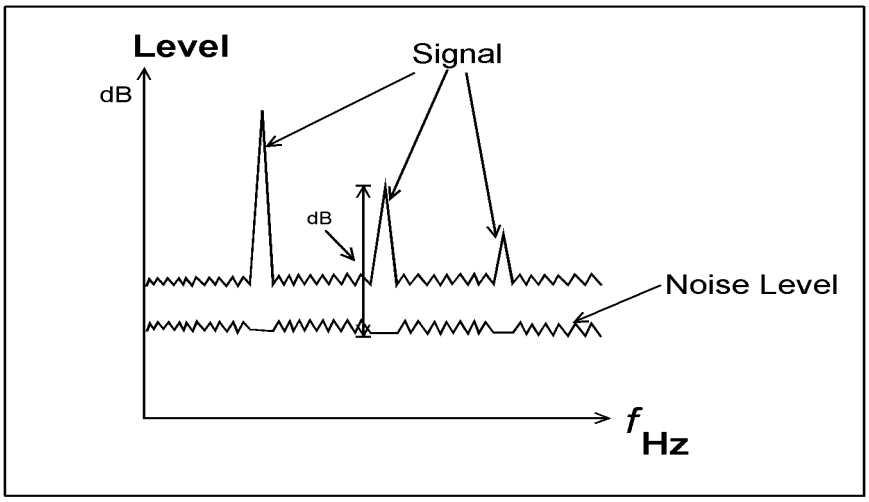
It is also important to realize that even when optimum biasing is applied to the MR head its output is inherently non-linear due to hysteresis. Thus an MR element will always have its baseline+ and baseline- differ very much. As shown in Figure 5-27 the dashed line shows the degree of deviation from the normal output pulse.

Figure 5-27 **Noise Reference**



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In measuring SHNR, the noise reference and signal (i.e, Narrow Band TAA) is measured by the spectrum analyzer at the frequency specified by “hpe5022_shnrConfig” function. At various frequencies the amplitude of the signal will vary over time. In general, SHNR is measured at low frequency where signal to noise ratio is poor. When baseline popping occurs the measured noise (noise reference) will distort the output signal which degrades the performance of the MR head.



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Measurement Sequence of SHNR is as follows:

1. Perform three track erase.
2. Move the head to the read offset.
3. For sense current = ib[0] to ib[ib_points-1].
4. Measure the signal and denote the result as Noise_Ref[i]. This noise reference is measured at the frequency specified by “hpe5022_shnrConfig” function.
5. Next sense current go to **step 3**.
6. Write data at the track center specified by “hpe5022_write” function.
7. For read offset = ‘offtrk_pos[0]’ + ‘readOffset’ to offtrk_pos[offtrk_pos_points-1] + readOffset.
8. For sense current = ib[0] to [ib_points-1].
9. Let Sum TAA = 0
10. For average = 1 to n
11. Perform write excitation during wrTime. (‘wrTime’ is specified by the “hpe5022_shnrConfig” function.)
12. Wait for delay time to elapse. (‘delay’ is specified by the “hpe5022_shnrConfig” function.)
13. Measure the Narrow Band TAA (i.e, TAA) during rdTime. (‘rdTime’ is specified by the “hpe5022_shnrConfig” function). Narrow Band TAA is measured at the frequency specified by “hpe5022_shnrConfig” function similar to step 4.
14. Get the summation of the measured TAA (i.e, Sum_TAA= Sum TAA + TAA).
15. Next average go to **step 10.**

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16. Calculate the average TAA = Sum_TAA/ n
17. Next sense current go to **step 8**.
18. Next read offset go to **step 7**.
19. For ib_index = 0 to (ib_points-1)
20. Calculate the SHNR data as;

    SHNR_DATA(ib_index) = 20log (Max (Aver_TAA[ib_index]) / Noise_Ref[ib_index])

Equation 5-25 Calculation of SHNR

$$SHNRdata = 20\log\left(\frac{MaxAverTAA}{NoiseRef}\right)$$

21. Next sense current go to **step 19**.
22. Denote SHNR as the maximum SHNR from the data array (i.e, SHNR = Max (SHNR_DATA[]).

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Track Offset Compensation Function

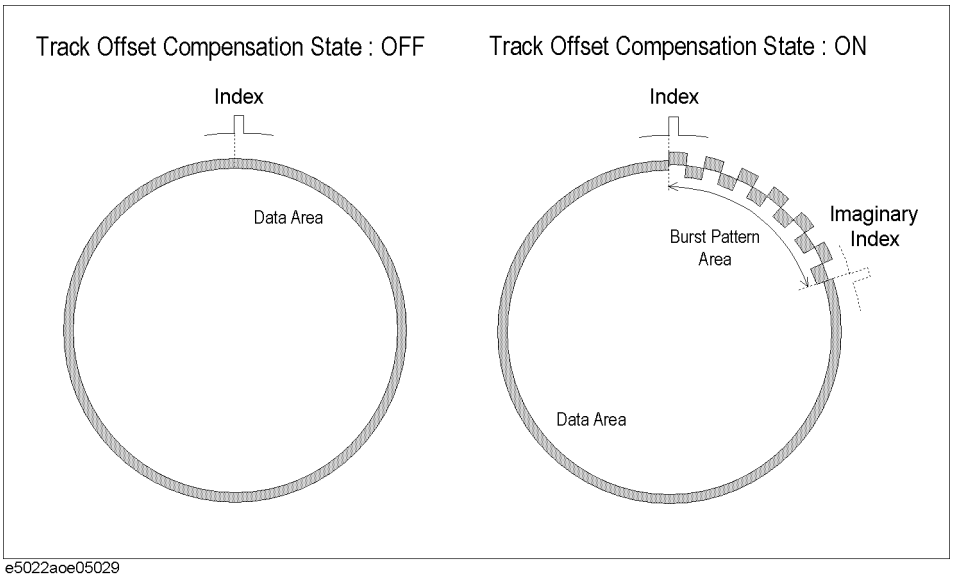
The track offset compensation function compensates the read head position according to the read back signal from the burst patterns. Even if the read head position drifts from the center of the write position due to temperature changes, long period elapses and etc. this function locates the read head at the center of write position.

NOTE Track Offset Compensation can not be used when the system has E4402B 3GHz spectrum analyzer.

Track Offset Compensation State

When you want to use this track offset compensation function, the function should be turned on (hpe5022_trackOffsetCompState). In the case of ON, a track is divided into two portions: a burst pattern area and a data pattern area.

Figure 5-28 Track Offset Compensation State



When you use gate functions in the UDS function, if the track offset function is turned on, the gate of read/write is delayed in the period of burst pattern as if the index pulse is located at the imaginary index position. (Figure 5-28)

The burst pattern area is used for the Track Offset Compensation function. The Track Offset Compensation can be divided into four sequences: Calibration, Write Burst Pattern, Read Burst Pattern, and Head Offset Compensation.

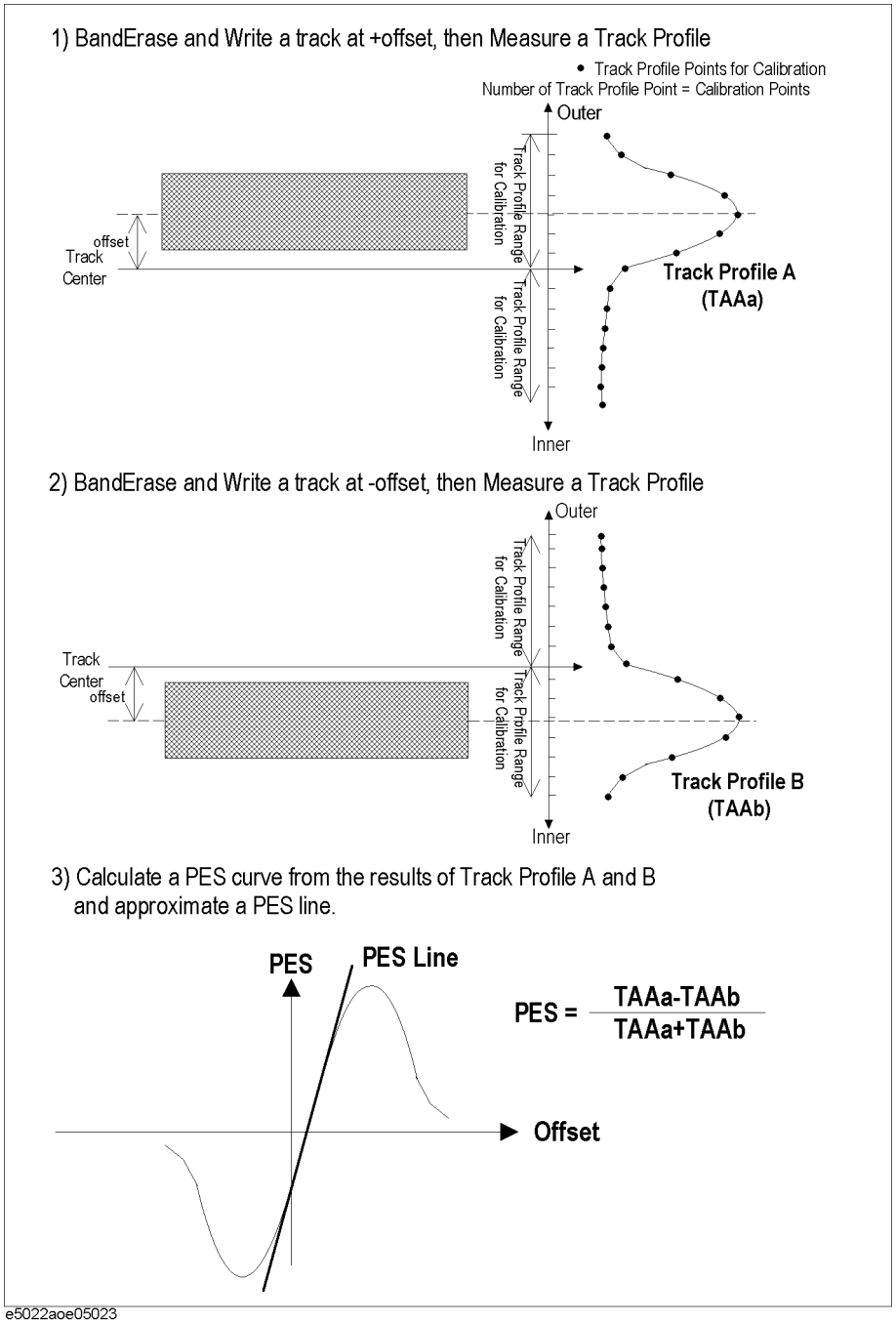
Calibration

Calibration Sequence measures the track profiles for both side tracks and determines the PES (Position Error Signal) Line. As shown in Figure 5-29, the both side tracks' pattern frequency and offset position are the same as a burst's pattern frequency and offset position. The PES Line is used to find a compensation distance from a burst pattern. The formula to calculate a PES is shown in Figure 5-29. The PES line is calculated from a PES plot. The lead square approximation is used to find a PES line from its plot. Both the

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calibration and the write burst pattern sequences are performed by the "hpe5022_writetrackOffsetCompPattern" function.

Figure 5-29 **Calibration Sequence**



Write Burst Pattern

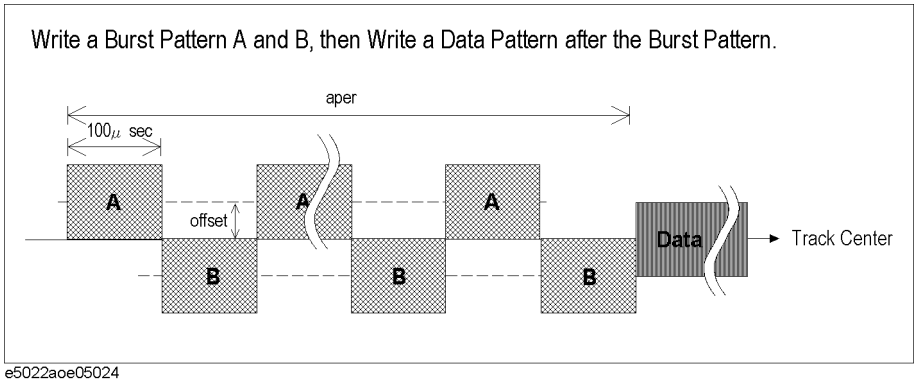
Write Burst Pattern sequence writes the burst patterns in the first portion of the track. The data pattern will be written after the burst pattern later during the measurement sequence such as hpe5022_measureTAA. Both the calibration and the write burst pattern sequences

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are performed by the “hpe5022_writetrackOffsetCompPattern” function.

The burst pattern is defined by a write offset, an aperture time and a pattern frequency. These three parameters can be set by users. Also, the function allows you to set these parameters automatically. In auto mode, the offset is set at the half of write track width. The aperture time is set at 2×10^{-3} second, however, if an aperture time of 2×10^{-3} second exceed a half of the track, the aperture time set at a half of the track. The pattern frequency is set at the peak of roll off measurement result. See the “hpe5022_trackOffsetCompPatternAuto” function in the programming manual in detail.

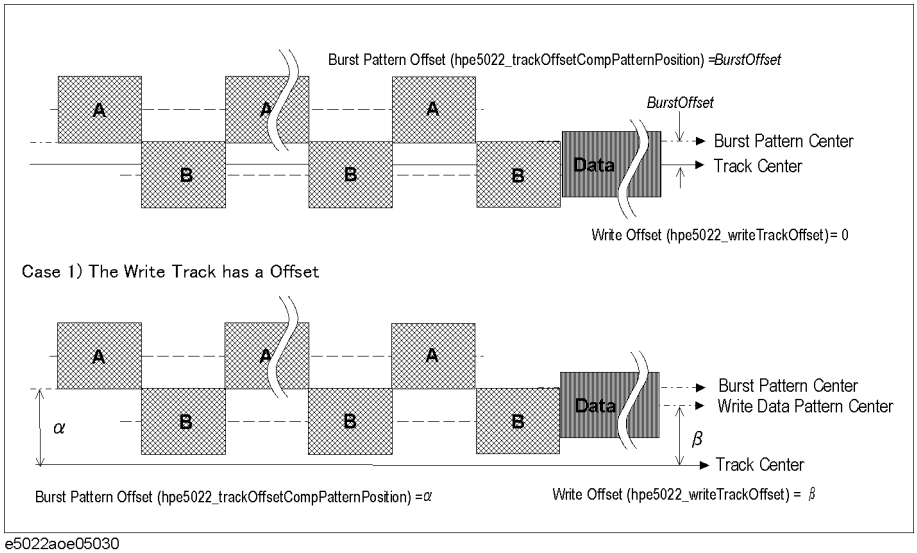
Figure 5-30 **Write Burst Pattern Sequence**



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The burst pattern position is able to have a offset from the track center. The “hpe5022_trackOffsetCompPatternPosition” function defines the offset position. This function allows you that the head position stays at not only the track center but also a certain offset position from the track center.

Figure 5-31 **Burst Pattern Position**



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Writing a data pattern should be executed just after the burst pattern is written. In other words, the function including a write sequence, such as hpe5022_measureTrackProfile(hpe5022_SEQ_ER_WR_M or hpe5022_SEQ_WR_M) function, should be executed just after the “hpe5022_writetrackOffsetCompPattern” is executed. Because there might be some drift between the data pattern and the burst pattern

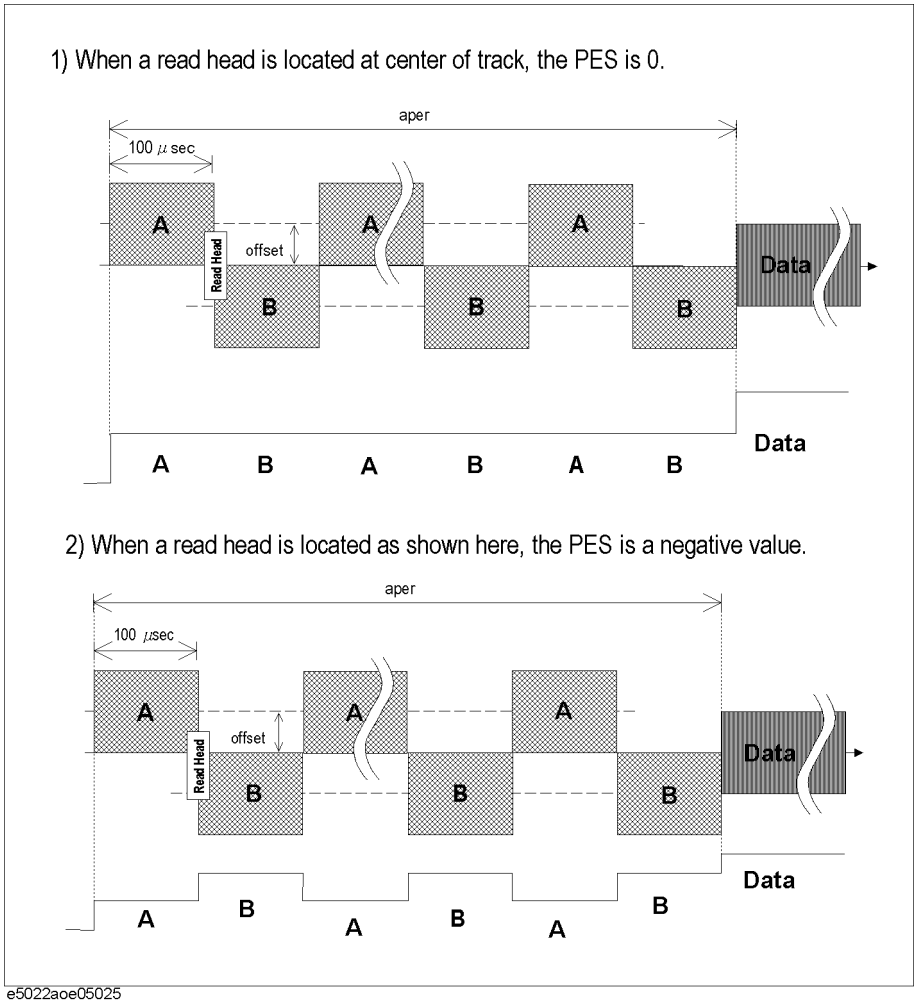
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if their interval is too long.

Read Burst Pattern

Read Burst Pattern sequence reads the burst pattern and calculate the PES from the read-back signal. As shown in Figure 5-32, the read back signals from the patterns A and B are monitored and calculates the PES value. The PES value determines the distance of compensation using the result of calibration sequence. For example, when the PES is zero, the read head located at the center of track. When the PES is not zero, the value determines how far from the center of track by using a PES line. Both the read burst pattern and the Position compensation sequences are performed by the "hpe5022_executeTrackOffsetComp" function. See the function in the programming manual in detail.

Figure 5-32 **Read Burst Pattern Sequence**



Position Compensation

A distance of the head drift can be calculated according the PES in the read burst pattern sequence. The distance is set as the value of the position compensation.

The position compensation shifts the origin of whole data area. The positions of the tracks

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center are shifted by this compensation as shown in Figure 5-33.

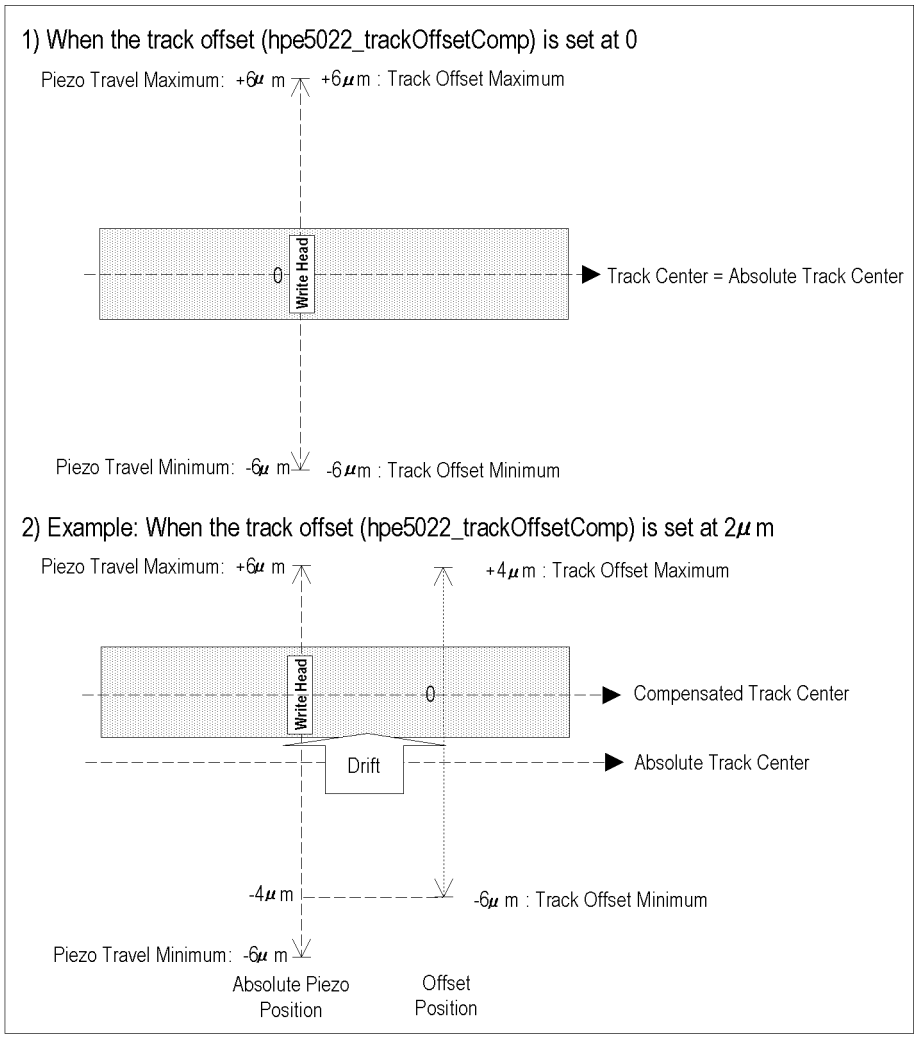
For example, when the position compensation is set at +2µm, the track center is shifted by +2µm. This means that the origin of all tracks was shifted.

When the position compensation is set, the travel range of track offset is also changed. Normally the piezo travel range is -6µm to +6µm. If position compensation value (hpe5022_trackOffsetCompVaule) is set at +2µm, the offset range will be -6µm to +4µm. The maximum offset range is ±6µm.

The value of the position compensation is reset at 0 when the calibration sequence is executed.

Both the read burst pattern and the position compensation sequences are performed by the "hpe5022_executeTrackOffsetComp" function. See the programming manual in detail.

Figure 5-33 **Track Offset Compensation**



Sample Track Offset Compensation Sequence Flow

Although the track offset compensation function is effective for all of measurements, the track profile, the micro track profile and the bit error rate measurements and erase&write menu has this capability in the VEE measurement program.

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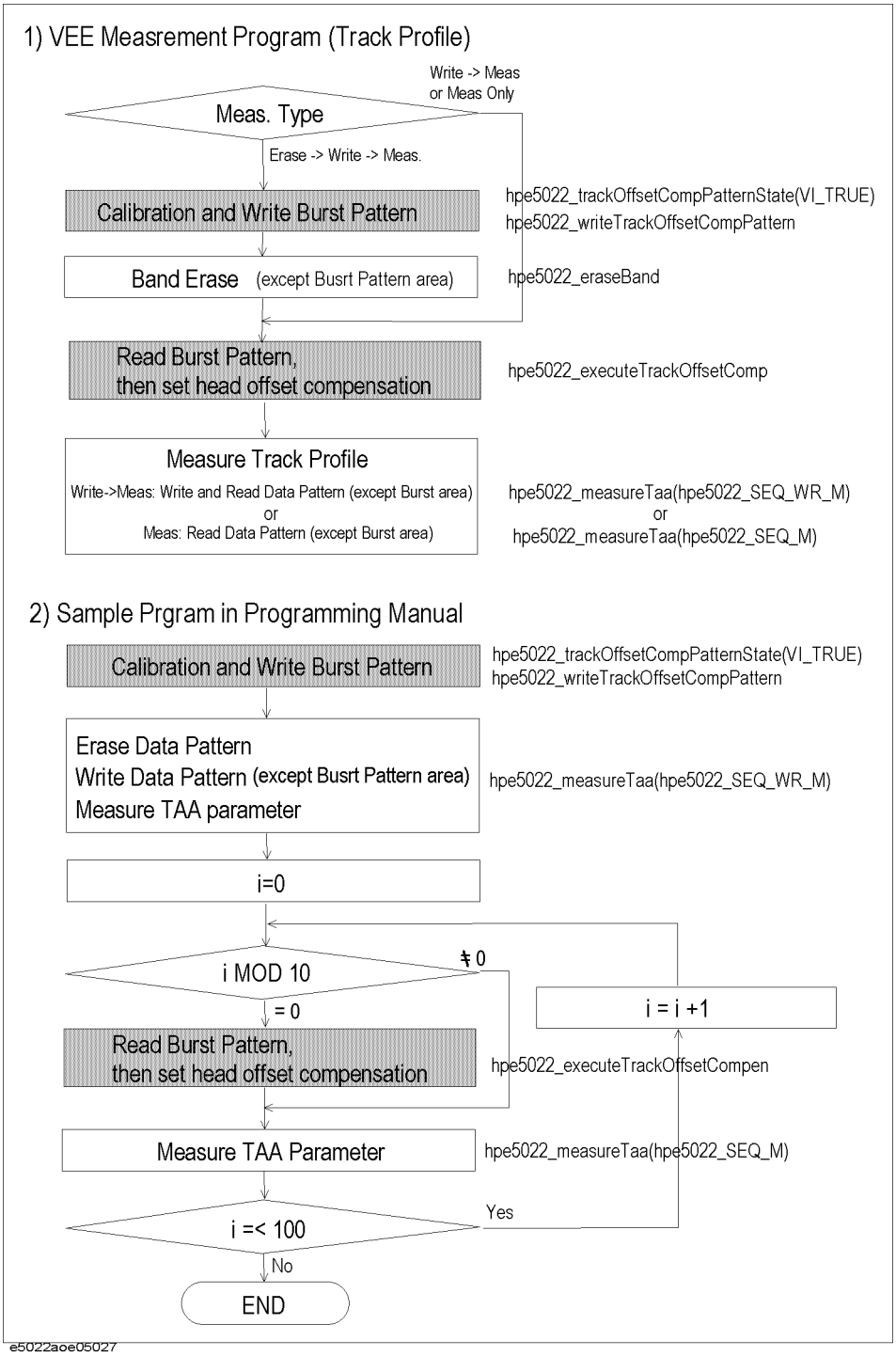
Sample sequences of track offset compensation function is shown in Figure 5-33.

In the track profile measurement in the VEE measurement program, the head position is compensated just once before the sequences of writing and reading a data pattern.

In the sample program shown in the programming manual, the sequences of reading burst pattern and setting the head offset compensation are performed each 10 revolution during measuring TAA parameters. Off course, you can create your own flow for the other measurements in your programming.

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Figure 5-34 **Track Offset Compensation Sequence Flow**



Track Offset Compensation in Create Micro Track and Bit Error Test

The create micro track and the bit error test take a quite long time to measure and a head position is inclined to drift during a measurement sequence. Therefore, the track offset compensation function allows you to compensate the position automatically, without executing the “hpe5022_executeTrackProfileComp” function, during one measurement

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sequence in the create micro track and the bit error test.

In the create micro track, the head position is compensated before erasing a positive side edge when the track offset compensation state is turned on. See the programming manual for detailed sequence.

In the bit error test, the position is compensated at each revolution specified by the “hpe5022_BER_trackOffsetCompInterval” function when the track offset compensation state is turned on. The E5022A reads the data several revolutions in this test in order to make a small bit error rate measurement. In this case, this function reads the burst data and compensates the head position at each revolution specified by the “hpe5022_BER_trackOffsetCompInterval” function.

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Write Bursts Function

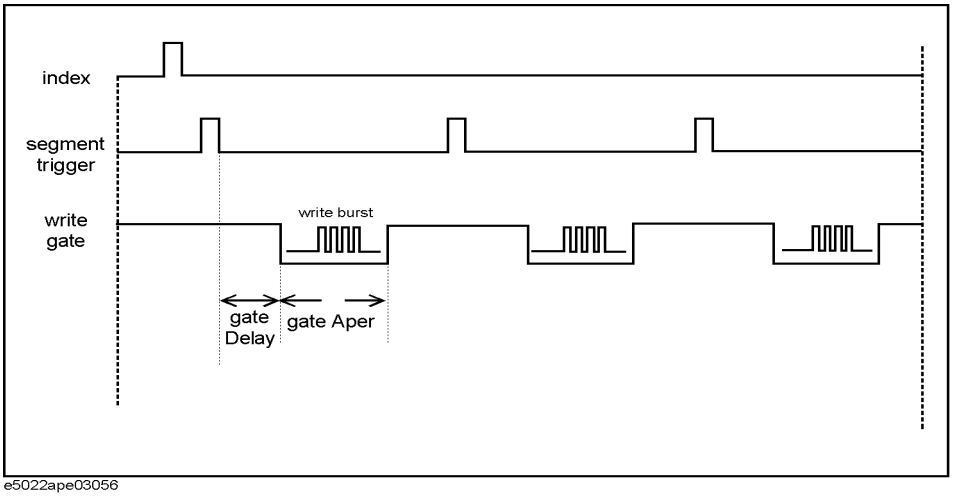
The Write Bursts Function allows users to write a burst pattern. This function only writes burst patterns. It has no capability to compensate the position. When you want to compensate the position, see “Track Offset Compensation Function” on page 274.

This function will only allow one burst pattern to be written for each track rotation. Thus in order to write multi-burst pattern the user must set the gate parameters for each track rotation.

Procedure in writing Multi-Bursts Pattern is as follows:

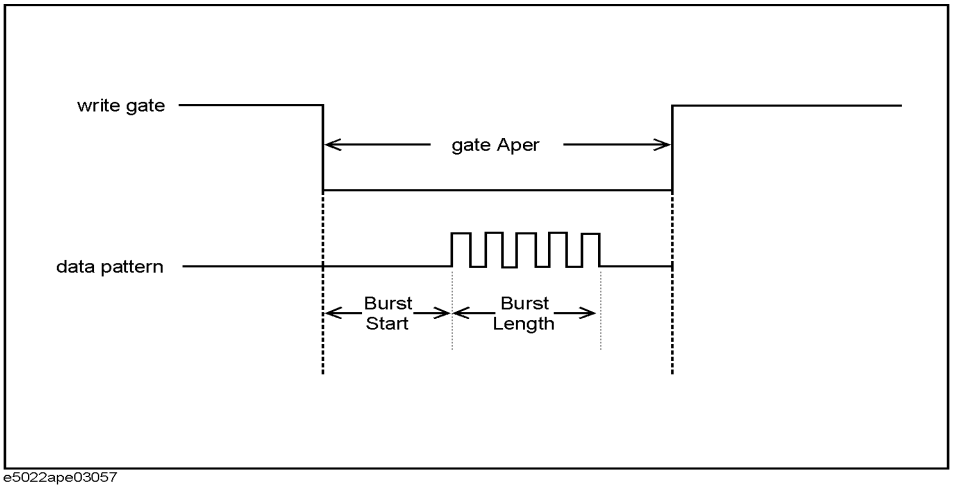
1. Set the number of segments per track.
2. Set the write track offset.
3. Set the gate delay and gate aperture parameters. See Figure 5-35 on page 282

Figure 5-35 Write Gate Timing



4. Set the burst start and burst length parameters using “hpe5022_burstPatternConfig” function. See Figure 5-36 on page 282.

Figure 5-36 Write Timing of Burst Pattern



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5. Set the frequency at which burst pattern is written using “hpe5022_burstFrequencyConfig” function.
6. Write the burst pattern by executing “hpe5022_writeBurst” function.
7. Repeat steps 2 to 6 and change the parameters (i.e. burst start, gate delay etc.) for multi-burst pattern.

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Parametric Sweep Measurement Definitions

Track Profile Measurement

Track Profile is a graphical plot of the read head voltage as a function of the read head position on a written track. It is also used to observe the TAA, PW and Narrow Band TAA. The Agilent E5022/E5023 allows you to select forward, backward or both directions for head displacement. Measurements of track profile and micro-track profile are often carried out to observe the influence of fringing fields for components integration in a drive.

The Track Profile measurement serves as a preliminary step prior to error rate test, i.e., before bit error rate test. It is also used to observe the effect of fringing fields and to study the asymmetry in the output signal across the track. ‘Fringe’ are magnetic fields that occur at the edges of the head it is a part of the head construction. It serves as a guard band between two separate adjacent tracks. Guard bands serves as a buffer to avoid track misregistrations. It has a different magnetic orientation and can re-magnetize the medium.

Factors that influence fringing fields is as follows.

1. Coercivity, high coercivity for hard magnetic material such as media and low coercivity for soft magnetic material such as magnetic head.
2. Head geometry.
3. Degree of asymmetry in the head read/write response.

Building the Track Profile

Measurement procedure in building the track profile is as follows:

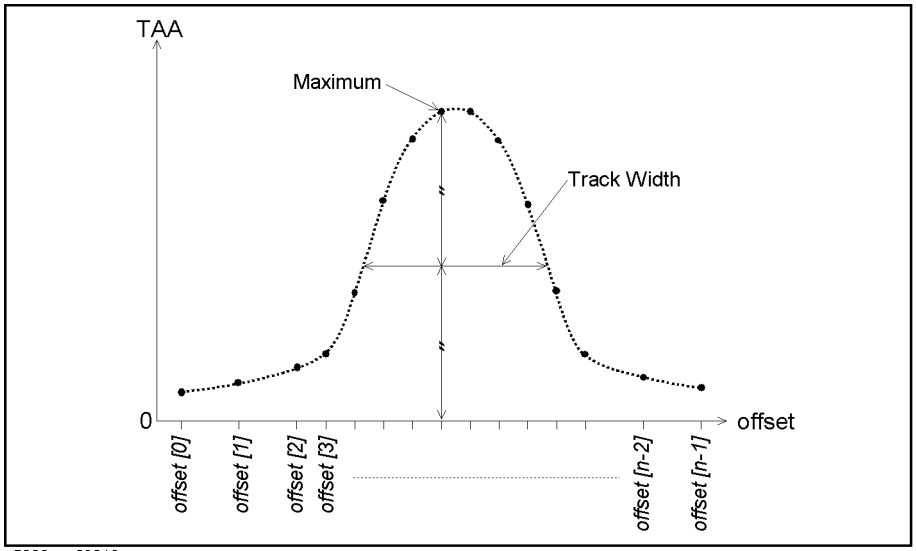
1. DC erase the track and its vicinity in order to provide a noise-free medium background.
2. Write the test track.
3. Read the test track when the head center is at the position sufficiently far from the left side of test track. Then progressively step-up the head displacement as defined by ‘head offset’ to the right side of the test track and measure the output voltage.
4. Continue to step-up the head offset until full trace of the curve is obtained.

Using Track Profile Test to measure the Width of the Read/Write Head

The track profile can also be used to measure the width of the write and read head. The write head width is observed by calculating the width at half amplitude level of the Track Profile. The same way, the read head width is observed by calculating the width at half amplitude level of the Micro Track Profile. The read head width is also observed by calculating from the Track Profile measurement. The “hpe5022_calculateRWOffsetAndWidth_Q” returns the write/read head widths from the track profile curve. This function is not available in the VEE measurement program.

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Figure 5-37 **Write Head Width Definition**

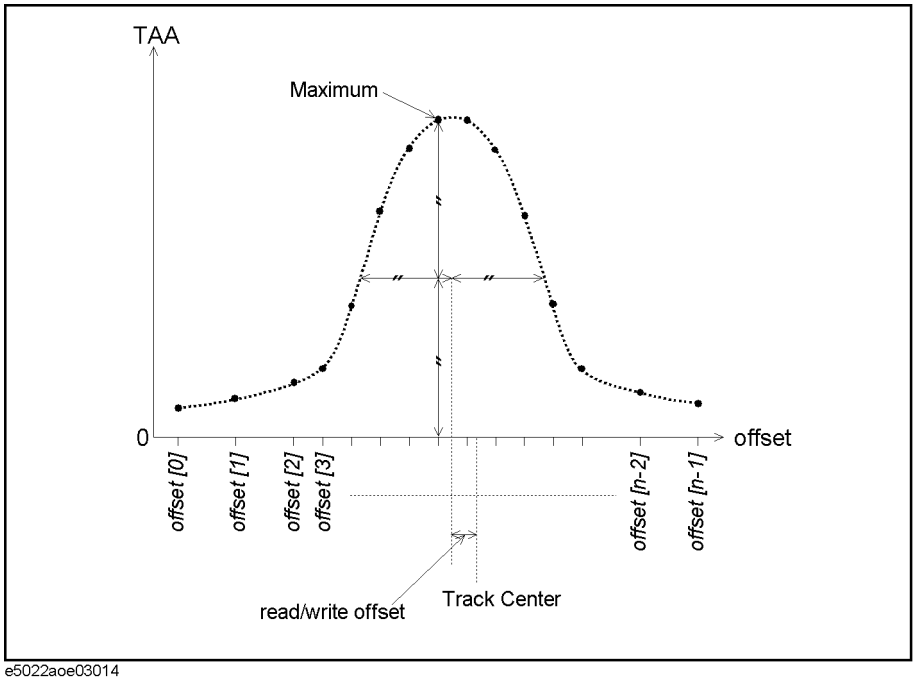


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The output signal remains constant until the center of the head offsets from the center of the test track by 1/2 ($Write_{width}$ - $Read_{width}$), this serves as protection against any track misregistration of this magnitude, also called “guard bands”. In practice, in general it is the irregular output of the track profile that gives the most useful information, for this helps the user to evaluate the performance of the read head.

As shown in Figure 5-37. Linear interpolation is applied at each point to determine the Track Profile.

Figure 5-38 **Read-Write Offset Definition**



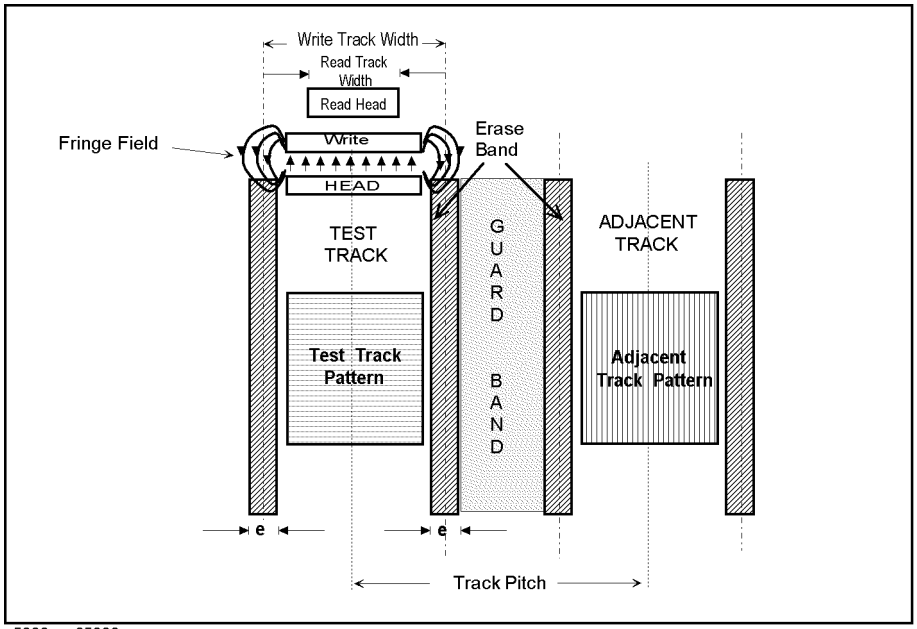
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Read-write offset is defined as the distance between the center of the track profile’s track

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width and the track center, as shown in Figure 5-38. The track center is defined as the position of the head during write sequence.

Figure 5-39 **Track Geometry**



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General Definition of Track Geometry is as follows:

- *Track Pitch* is defined as the distance between the centers of two adjacent tracks.
- *Erase Band* (*e*) is defined as the magnetic pattern created by the fringe field whose magnetic orientation is different from the written data pattern created by the write head. It protects the test track from picking up other signals from its neighboring tracks, i.e., *intersymbol interference* or *ISI* from adjacent track.
- *Guard Band* acts to separate two adjacent tracks in order to avoid track misregistration. Ideally its length extends between centers two erase bands of two adjacent tracks.
- *Write Width* is defined as the width of the written track plus 50 percent of the erase band. As data is written along the track, the write head produces a *fringe field* that re-magnetizes the media on each side of the track. However this field has a different magnetic orientation and gradient such that it shouldn't interfere with the read signal output. The fringe field is an inherent characteristic of the write head due to the head's construction.
- *Read Width* is defined as the width of the read head.

Micro Track Profile Measurement

For diagnostics of read/write operations it is often useful to plot the track profile measured by a very narrow read element. This test serves as a diagnostic tool in determining the effect of fringing fields in the read signal. Ideally, the Micro Track Profile will have a sharp apex at the center when the head is at the center of the written track. If the apex is rounded, it indicates that fringe signal is being pick-up by the read head.

Using Micro Track Profile in Measuring the Read Head Width.

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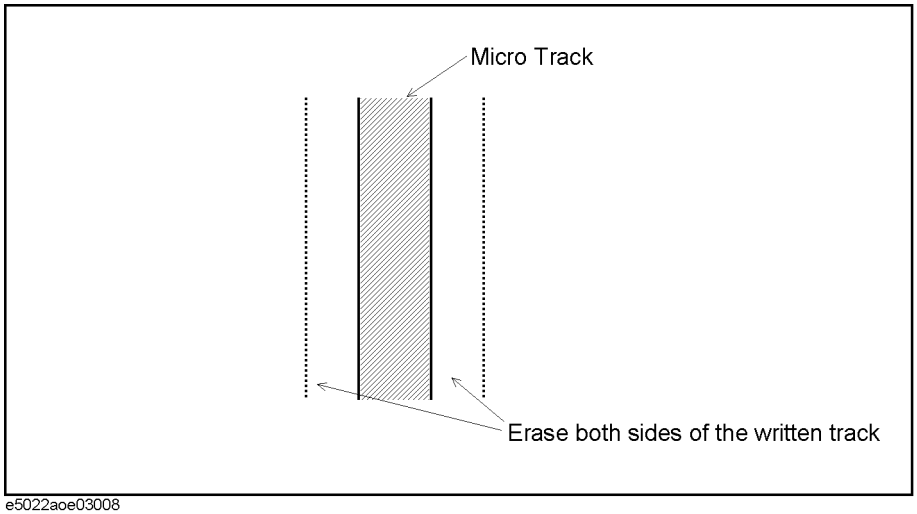
Measurement procedure is as follows:

This measurement is divided into two parts. The first part is to create a micro track and the second part is to measure the track profile of the micro track.

Create Micro Track

Micro track is created by erasing both sides of the track as shown in Figure 5-40, resulting to a narrowed track. Refer to the programming manual “hpe5022_configMicroTrack” for details.

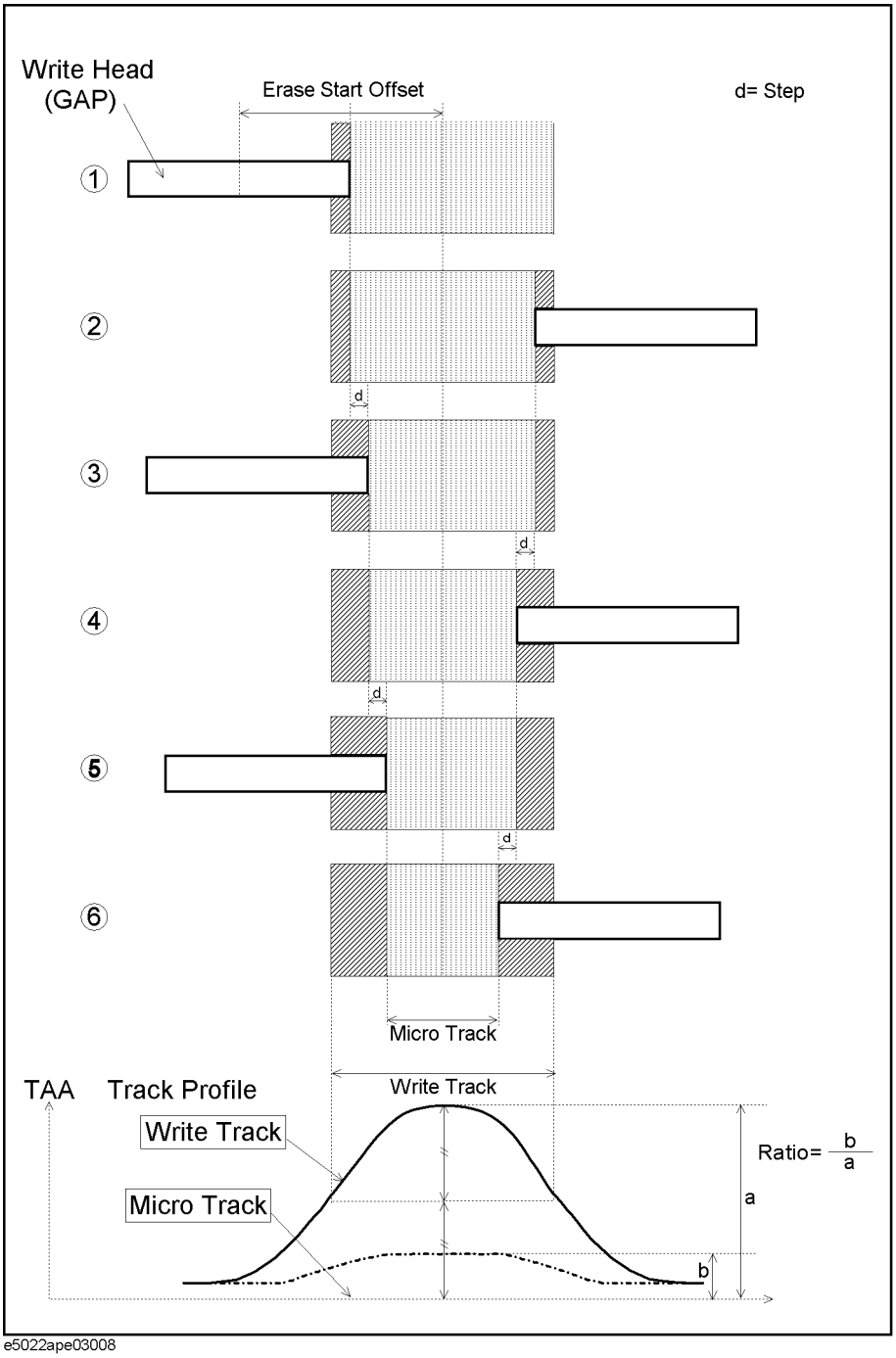
Figure 5-40 **Micro Track**



In order to create a micro track, the erase start offset, erase step (width) and its ratio (how much of the original TAA of a track is to be transformed to a micro track) have to be specified. Refer to Figure 5-41.

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Figure 5-41 **Parameters to create a Micro Track**

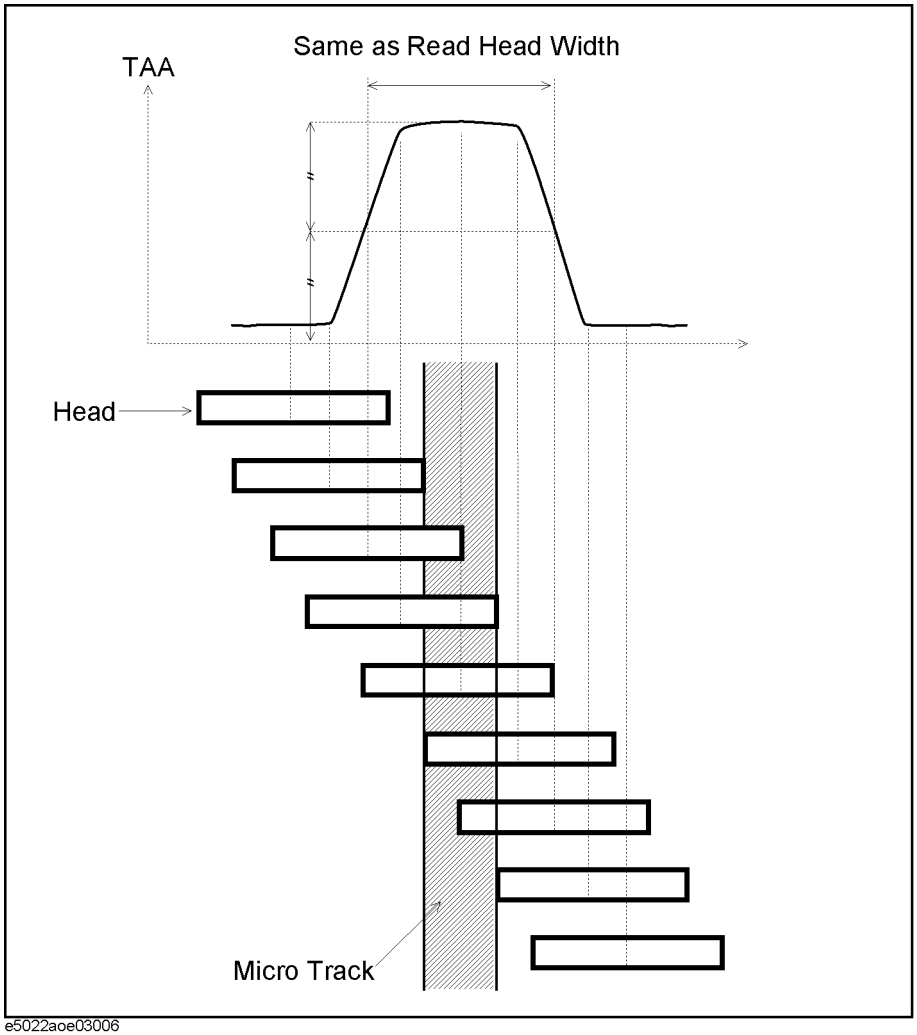


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Track Profile Measurement for a Micro Track (Micro Track Profile)

Measuring the track profile relative to micro track will allow you to compute the read head width, as shown in Figure 5-42. From the illustration above the half amplitude width of the micro track becomes the width of the read head.

Figure 5-42 **Micro Track Profile Measurement**



Fast Micro Track Profile Measurement

The fast micro track profile measurement is another method to make a micro track profile measurement. The measurement speed is faster than one described in previous section. This method creates a micro track by erasing side(s) of track at the specified width. There is no level monitoring during erase. This method includes a sequence to create micro track and to measure the narrow band TAA track profile. That is why the measurement speed is faster. Detailed measurement sequence is described in the programming manual. See the “hpe5022_measureMicroTrackProfile” function.

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Write Current Sweep Measurement

Write current sweep is a measurement of the TAA, narrow band TAA, PW, Overwrite and NLTS by 5th Harmonic method. The typical shape of this curve is a flat part at low currents, i.e. nothing is happening then a rising part as more DC bias causes better operation, then another flat part where there is saturation.

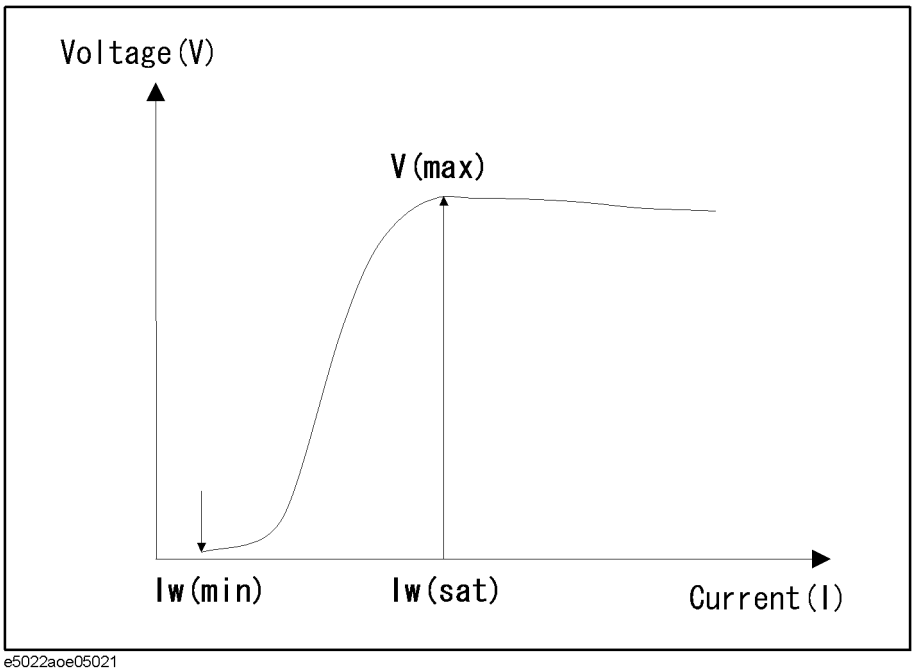
Typical values of write current are set at the left portion of the region just before it reaches the saturation level. Typical value of write current is 30 - 40 [mA] for modern MR and GMR heads.

There are important factors that need to be considered in determining the appropriate value of the write current. These are the following:

1. The write current should be large enough to saturate the media during write process.
2. As erasure of previously written data is necessary to reduce error rates. The write current should be large enough to achieve an acceptable overwrite.
3. The write current influences the erase bands on the sides of the track width. An increase in the write current will increase the fringe field, this increases the width of the erase band and the interference between adjacent tracks.

The detailed measurement sequence is described in Chapter 3 of the programming manual.

Figure 5-43 **Write Current Saturation**



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Analyzing the illustration of Figure 5-43 for small currents the medium does not saturate and voltage output is low. At some value the signal voltage is at maximum and any further increase in current beyond this point will not add to voltage. At voltage maximum the write current is saturated Iw(sat).

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Sense Current Sweep Measurement

Sense current sweep is a measurement of the TAA, narrow band TAA, PW, Overwrite and NLTS by 5th Harmonic method. In theory the sense current head curve would be very similar to the write current curve. In practice, the read head is heated by the DC bias and the head will burn out due to over heating before the curve gets out of the rising region. When doing a sense current sweep “Do not increase the current from the normal value used for reading” unless you plan on destroying the head. A typical GMR sense current value would be 5 [mA].

The detailed measurement sequence is described in Chapter 3 of the programming manual.

Channel Bit Rate Sweep Measurement

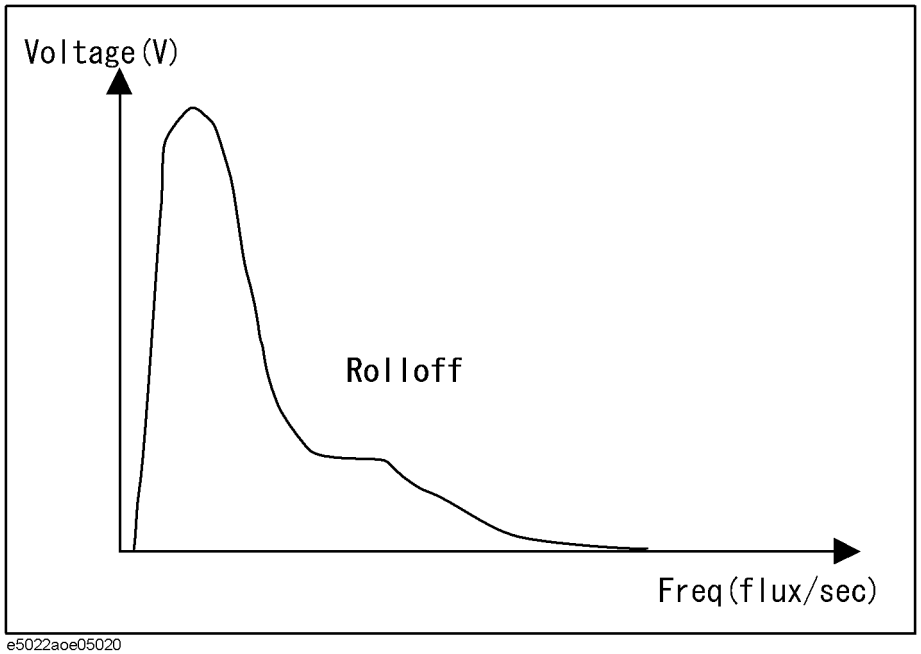
Channel bit rate sweep is a measurement to observe the special characteristics of TAA, narrow band TAA, PW, Baseline, Overwrite or NLTS by 5th harmonic method with respect to channel bit rate. In addition, it has the function to calculate bit density.

The detailed measurement sequence is described in Chapter 3 of the programming manual.

Roll-off Measurement

Roll-off is a kind of channel bit rate sweep measurement that uses 1T data pattern. It can only measure TAA and narrow band TAA. For this measurement, flux frequency is used as the input (sweep) parameter instead of channel bit rate.To measure “Roll-Off”, the track radius and RPM are used along with bit rate to determine the spacings between transitions.

Figure 5-44 **Roll-off curve**



Roll-off is the graphical plot of the voltage signal as a function of flux change density. To plot the roll-off curve a series of 111... pattern is written throughout the track at an

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optimized current. The sequence pattern is then read and zero-to-peak voltage is measured. This process is repeated for higher density of the same pattern until the voltage signal becomes too small.

The detailed measurement sequence is described in Chapter 3 of the programming manual.

Precompensation Sweep Measurement

Precompensation Sweep is a measurement to observe the special characteristics of NLTS by 5th harmonic method for sweep values of write precompensation. The write precompensation value data is set as a delay time from the original transition.

The detailed measurement sequence is described in Chapter 3 of the programming manual.

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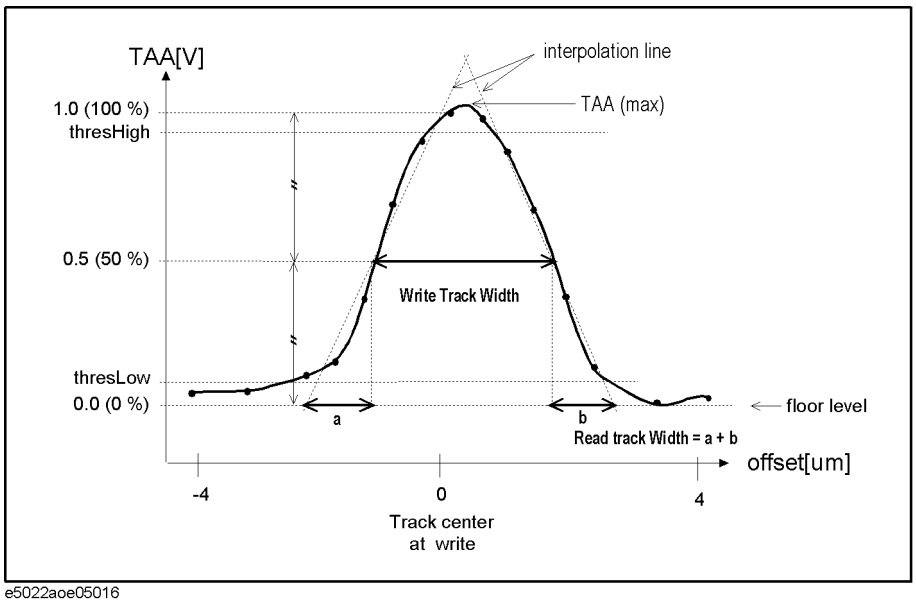
Standard Triple Track Test

The Standard Tripe Track Test is used to measure the write width, read width, write-read offset, *squash*, *squeeze* and *off-track read capability* (OTRC) parameters of the written signal. This test performs the track profile as it measures the effect on how adjacent tracks and erased signals interfere with one another. Standard test parameters such as Resolution, PW50, Roll-off, etc. do not predict the off-track capability of the head. Although BERs' 747 test and Bathtub tests are considered the best method in evaluating the off-track performance of the head, it requires the use of read channel IC, a more complex and expensive hardware. The triple track test is a good alternative solution in determining the off-track performance of the head.

Measurement procedure of the Triple Track Test is as follows:

1. Perform band erase to eliminate noise from the media.
2. Write the data at the track center.
3. Measure the track profile of the TAA from the written test track.
4. Specify the interpolation range which includes the threshold and window size settings. Refer to Figure 3-73, "Best Fit Window," on page 129 for details.
5. Measure the distance between the interpolation lines at 50% threshold and denote the measured distance as the *write track width*.
6. Measure the distance between the interpolation lines at 0% threshold (i.e., floor level). Subtract the write track width from this result and denote the new width as the *read track width*.

Figure 5-45 Measurement of Write Track Width and Read Track Width

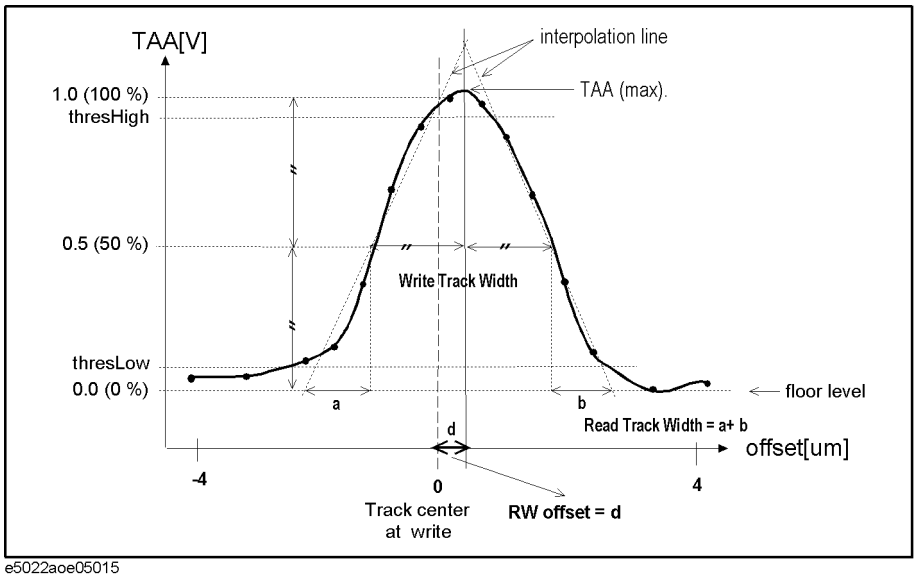


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7. Measure the distance between the center of the track (i.e, at zero offset) and the center of the write track width. And denote the measured distance as *read/write offset (RW offset)*.

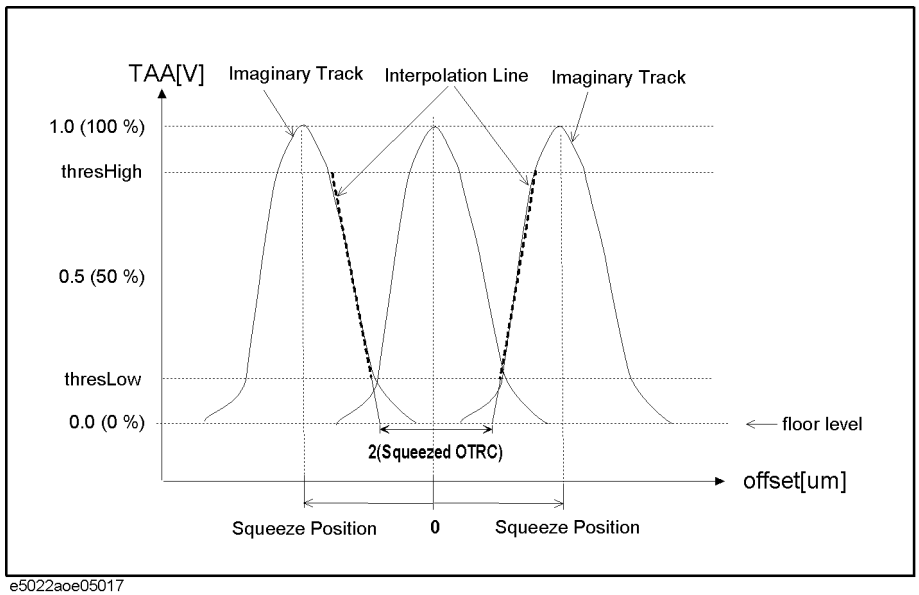
Figure 5-46 Measurement of Read Write Offset



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8. Plot the original track profile at ±(Squeeze position) as an imaginary track profile as shown in Figure 5-47.
9. Calculate the distance between the two interpolation lines at 0% threshold. *Squeezed OTRC* is calculated as one-half the difference between the right and left interpolation lines at floor level.

Figure 5-47 Computation of Squeeze OTRC



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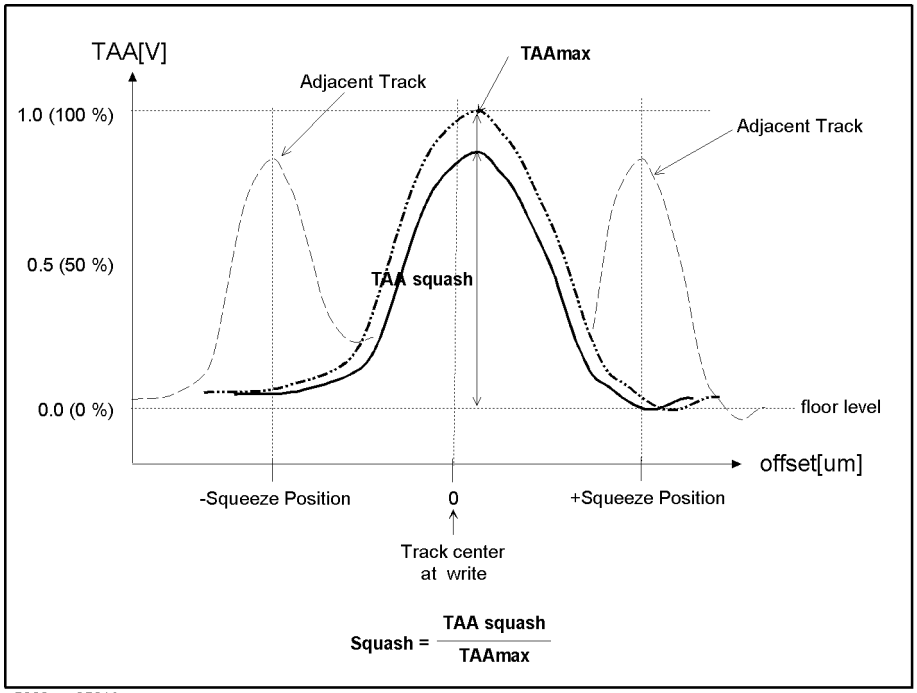
10. Write adjacent track data pattern (specified by hpe5022_tripleTrackAdjacent

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TrackConfig) at the *squeeze position* on each side of the test track.

11. Measure TAA (or Narrow Band TAA) at the same point where the maximum TAA was previously measured. Calculate *squash* as the ratio of the TAA squash and TAAmax. The remaining TAA signal is measured as percentage of the original track amplitude referred to as *squash*. Squash allows you to measure the effect on track profile amplitude when an adjacent erased signal is written close to the test track.

Figure 5-48 Calculation of Squash



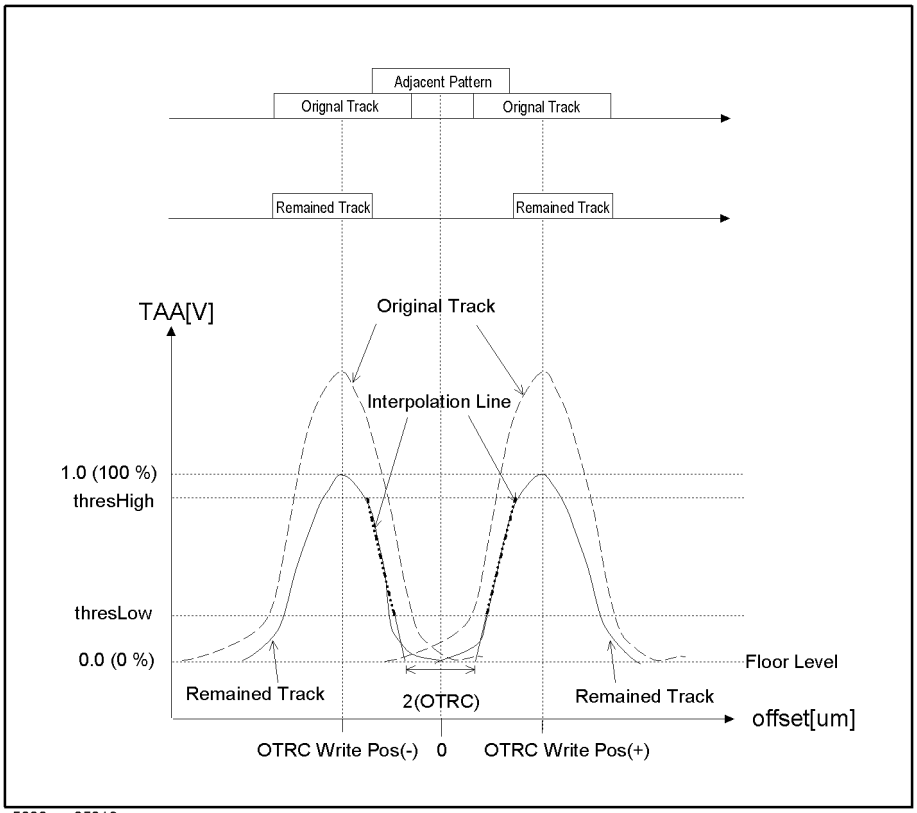
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12. Write the data track on both sides of the previously written test track as specified by [OTRC Write Position]. [OTRC Write Position] is written at a distance from the test track relative to the write width ratio (%).

13. Write the adjacent track data pattern (specified by hpe5022_tripleTrack AdjacentTrack Config) at the center of the track. Since it is written at the track center of the previously written test track, it simply overwrites the previous signal.

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Figure 5-49 Measurement of OTRC



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14. Measure the distance between the two interpolations at the 0% threshold. And calculate half the difference as *OTRC* (*off-track read capability*). As shown in Figure 5-49 the the allowable OTRC is affected on how close the data tracks are written closer to the adjacent track. It should also be noted that since the adjacent track is to overwrite the previous written signal, it must be written at optimum write current. Otherwise, a poor overwrite could result in residual signal that could affect or degrade the OTRC performance of the head.

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SNR Triple Track Test

The SNR Tripe Track Test is used to evaluate the OTRC (unsqueezed OTRC) and squeezed OTRC using both the signal and off-track noise at each test point.

Measurement procedure of the SNR Triple Track Test is as follows:

Note: In this description, data name with [ ] shows that the data type is an array.

1. Track Profile Measurement

   a. Perform band erase to eliminate noise from the media.
   b. Write data and adjacent data pattern at four different sectors of the track as follows:

Table 5-2 Write Data Pattern for Each Sector

Sector #	Profile Name	Write Pattern
0	*"Data[ ]"*	Data pattern at track center
1	*"Squashed Data[ ]"*	Data pattern at track center
		Adjacent data pattern at + squeezePos
		Adjacent data pattern at – squeezePos
2	*"Side Noise ID[ ]"*	Data pattern at + otrcWrPos
		Adjacent data pattern at track center
3	*"Cockpit Noise[ ]"*	Data pattern at + otrcWrPos
		Data pattern at – otrcWrPos
		Adjacent data pattern at track center
		Adjacent data pattern at + squeezePos
		Adjacent data pattern at – squeezePos
4	*"Side Noise OD[ ]"*	Data pattern at – otrcWrPos
		Adjacent data pattern at track center

NOTE

Squeeze position is described as a distance in meter from the test track. OTRC write position is described as a ratio to the track pitch.

   c. Measure the track profile of the TAA for each sector at once.

2. Sector Normalization
   If sector normalization check box is selected, execute the sequence for sector normalization and all profile data are normalized.
3. *"Noise Floor"* Calculation
   Calculate *"Noise Floor"* using both *"Data[ ]"* and *"Squashed Data[ ]."* See "Noise Floor Calculation Method" on page 302 for the calculation algorithm.
4. *"OTRC Signal[ ]"* and *"Normalized OTRC Signal[ ]"* Trace Calculation

   a. Remove *"Noise Floor"* from *"Data[ ]"* using the following equation:

   $$Data1[\ ] = \sqrt{Data[\ ]^2 - NoiseFloor^2}$$

   b. Perform smoothing for *"Data1[ ]."* The derived trace is called *"Data2[ ]."*
   c. *"OTRC Signal[ ]"* is derived from the following equation:

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$$OTRC\ Signal[\ ] = \sqrt{Data2[\ ]^2 + NoiseFloor^2}$$

d. Normalize *"OTRC Signal[ ]"* as the maximum and minimum values of *"OTRC Signal[ ]"* are converted to 1 and 0 respectively. The obtained data is called *"Normalized OTRC Signal[ ]."*

5. *"Squeezed Signal[ ]"* and *"Normalized Squeezed Signal[ ]"* Calculation

a. Remove *"Noise Floor"* from *"Squashed Data[ ]"* using the following equation:

$$Squashed\ Data1[\ ] = \sqrt{SquashedData[\ ]^2 - NoiseFloor^2}$$

b. Perform smoothing for *"Squashed Data1[ ]."* The result is called *"Squashed Data2[ ]."*

c. *"Squeezed Signal[ ]"* is derived from the following equation:

$$Squeezed\ Signal[\ ] = \sqrt{SquashedData2[\ ]^2 + NoiseFloor^2}$$

d. Normalize *"Squeezed Signal[ ]"* as the maximum and minimum values of *"OTRC Signal[ ]"* are converted to 1 and 0 respectively. The obtained data is called *"Normalized Squeezed Signal[ ]."*

6. *"OTRC Noise[ ]"* and *"Normalized OTRC Noise[ ]"* Calculation

a. Remove *"Noise Floor"* from *"Side Noise ID[ ]"* using the following equation:

$$Side\ Noise\ ID1[\ ] = \sqrt{SideNoiseID[\ ]^2 - NoiseFloor^2}$$

b. Perform smoothing for *"Side Noise ID1[ ]."* The result is called *"Side Noise ID2[ ]."*

c. Remove *"Noise Floor"* from *"Side Noise OD[ ]"* using the following equation:

$$Side\ Noise\ OD1[\ ] = \sqrt{SideNoiseOD[\ ]^2 - NoiseFloor^2}$$

d. Perform smoothing for *"Side Noise OD1[ ]."* The result is called *"Side Noise OD2[ ]."*

e. Compose *"SideNoiseID2"* and *"Side Noise OD2"* using the following equation (the composite data is called *"Side Noise2[ ]"*):
If *Side Noise ID2[] > Side Noise OD2[]*
Side Noise 2[ ] = Side Noise ID2[ ]
Else,
Side Noise2[ ] = Side Noise OD2[ ]

f. *"OTRC Noise[ ]"* is derived from the following equation:

$$OTRC\ Noise[\ ] = \sqrt{SideNoise2[\ ]^2 + NoiseFloor^2}$$

g. Normalize *"OTRC Noise[ ]"* as the maximum and minimum values of *"OTRC Signal[ ]"* are converted to 1 and 0 respectively. The obtained data is called *"Normalized OTRC Noise[ ]."*

7. *"Squeezed Noise[ ]"* and *"Normalized Squeezed Noise[ ]"* Calculation

a. Obtain *"Squeezed Noise[ ]"* by combining two *"OTRC Signal[ ]"* profile plotted at ± squeeze position.

b. Remove *"Noise Floor"* from *"Cockpit Noise[ ]"* using the following equation:

$$Cockpit\ Noise1[\ ] = \sqrt{CockpitNoise[\ ]^2 - NoiseFloor^2}$$

c. Perform smoothing for *"Cockpit Noise1[ ]."* The result is called *"Cockpit Noise2[ ]."*

d. *"Squeezed Noise [ ]"* is derived from the following equation:

$$Squeezed\ Noise\ [\ ] = \sqrt{SqueezedNoise[\ ]^2 + CockpitNoise2^2}$$

e. Normalize *"Squeezed Noise[ ]"* as the maximum and minimum values of *"OTRC*

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Signal[ ]" are converted to 1 and 0 respectively. The obtained data is called *"Normalized Squeezed Noise[ ]."*

8. *"OTRC SNR[ ]"* and *"Squeezed SNR[ ]"* Calculation, and *"OTRC (Unsqueezed OTRC)"* and *"Squeezed OTRC"* Calculation

   a. Calculate *"OTRC SNR[ ]"* profile from *"OTRC Signal[ ]"* and *"OTRC Noise[ ]."*
   If *OTRCSignal'[ ] > OTRC Noise' [ ]*
   and *OTRC Noise'[ ] + Ng* ≠ 0
   and *Ng + Ni* ≠ 0, then

   $$OTRC\ SNR[\ ] = 10 \times \log \frac{OTRCSignal'[\ ]^2 + addNoise \times SNg^2}{(OTRCNoise'[\ ] \times Ni)^2 + (NNg \times Ng)^2}$$

   Else,
   OTRC SNR[ ] = 0
   where,

   $$OTRCSignal'[\ ] = \sqrt{OTRCSignal[\ ]^2 - SNg^2}$$

   $$OTRCNoise'[\ ] = \sqrt{OTRCNoise[\ ]^2 - NNg^2}$$

   Ng: Gaussian noise constant (user-defined)
   Ni: Interference constant (user-defined)
   SNg: Gaussian noise of *"OTRC Signal[ ]"* profile (see "Gaussian Noise Level Calculation Method" on page 302)
   NNg: Gaussian noise of *"OTRC Noise[ ]"* profile (see "Gaussian Noise Level Calculation Method" on page 302)
   addNoise: 1 or 0 (user-defined)

   b. Calculate *"Squeezed SNR[ ]"* profile from *"Squeezed Signal[ ]"* and *"Squeezed Noise[ ]."*
   If *Squeezed Signal'[ ] > Squeezed Noise' [ ]*
   and *Squeezed Noise'[ ] + Ng* ≠ 0
   and *Ng + Ni* ≠ 0, then

   $$Squeezed\ SNR[\ ] = 10 \times \log \frac{SqueezedSignal'[\ ]^2 + addNoise \times SNg^2}{(SqueezedNoise'[\ ] \times Ni)^2 + (NNg \times Ng)^2}$$

   Else,
   Squeezed SNR[ ] = 0
   where,

   $$Squeezed\ Signal'[\ ] = \sqrt{SqueezedSignal[\ ]^2 - SNg^2}$$

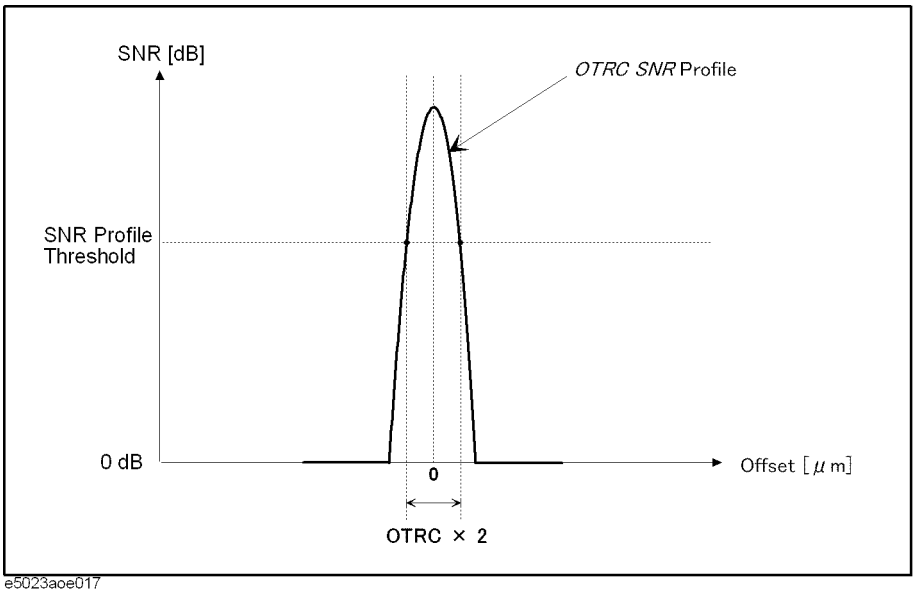
   $$Squeezed\ Noise'[\ ] = \sqrt{SqueezedNoise[\ ]^2 - NNg^2}$$

   Ng: Gaussian noise constant (user-defined)
   Ni: Interference constant (user-defined)
   SNg: Gaussian noise of *"Squeezed Signal[ ]"* profile (see "Gaussian Noise Level Calculation Method" on page 302)
   NNg: Gaussian noise of *"Squeezed Noise[ ]"* profile (see "Gaussian Noise Level Calculation Method" on page 302)
   addNoise: 1 or 0 (user-defined)

   c. Calculate *"OTRC (Unsqueezed OTRC)"* value from *"OTRC SNR[ ]"* profile (see Figure 5-50).

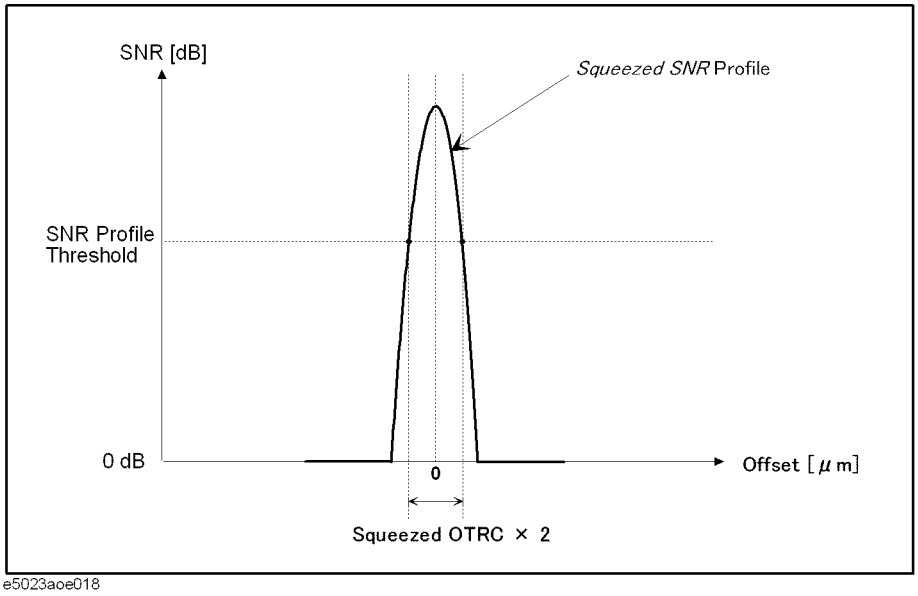
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Figure 5-50 ***OTRC* (Unsqueezed OTRC) Evaluation**



d. Calculate *"Squeezed OTRC"* value from *"Squeezed SNR[ ]"* profile (see Figure 5-51).

Figure 5-51 ***Squeezed OTRC* Evaluation**

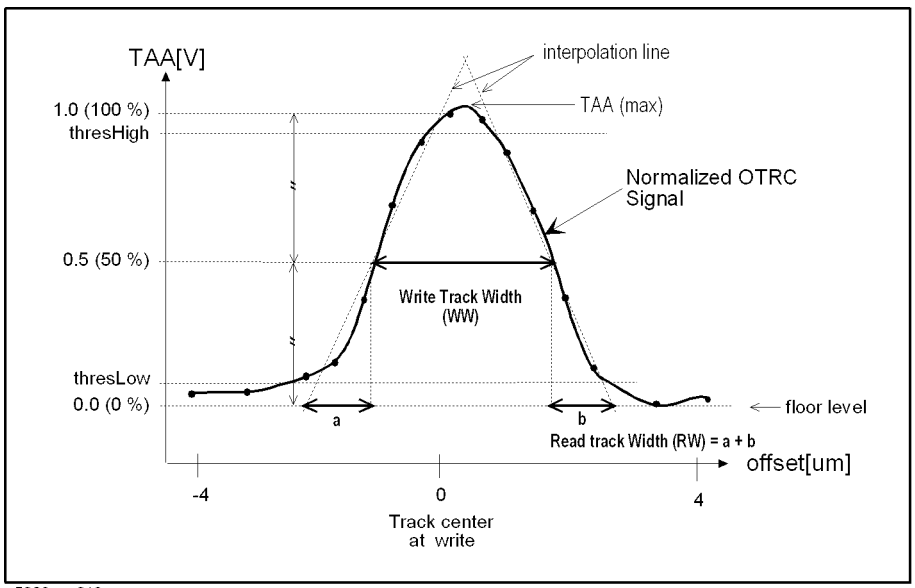


9. *"WW," "RW," "RW Offset,"* and *"Squash"* Evaluation

   a. For the *"Normalized OTRC Signal,"* specify the interpolation range which includes the threshold and window size settings. Refer to Figure 3-80, "Best Fit Window," on page 135 for details.
   b. Calculate the distance between the interpolation lines at 50% threshold and denote the measured distance as the *"Write Track Width (WW)."*
   c. Calculate the distance between the interpolation lines at 0% threshold (i.e., floor level). Subtract the write track width from this result and denote the new width as the *"Read Track Width (RW)."*

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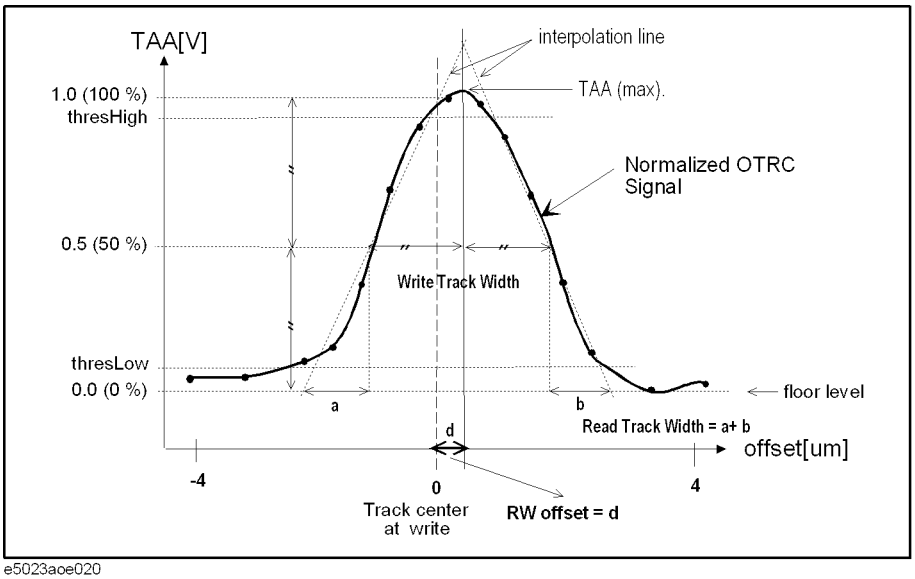
Figure 5-52 Evaluation of Write Track Width and Read Track Width



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d. Calculate the distance between the center of the track (i.e, at zero offset) and the center of the write track width. And denote the measured distance as *"Read/Write Offset (RW offset)."*

Figure 5-53 Evaluation of Read Write Offset



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e. Calculate *"Squash"* using the following equation:

$$Squash = \frac{TAAsquash}{TAAmax}$$

where,
TAAmax: *"OTRC Signal[ ]"* value at maximum TAA position
TAAsquash: *"Squeezed Signal[ ]"* value at *"TAAmax"* position

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Gaussian Noise Level Calculation Method

If a track profile data array and noise threshold ratio are described as *"profileData[ ]"* and *"noiseThr"* respectively, the Gaussian noise level (*"gaussianNoiseLevel"*) is calculated as follows:

1. Obtain maximum value (*"max"*) and minimum value (*"min"*) of *"profileData[ ]."*
2. Calculate noise threshold level (*"noiseThrLevel"*) using the following equation:

   $noiseThrLevel = (max - min) \times noiseThr + min$

3. Calculate Gaussian noise level using the following ezuation:

   $gaussianNoiseLevel = \frac{sum}{count}$

   where,
   count: number of elements whose values are below *"noiseThrLevel"*
   sum: sum of element's values below *"noiseThrLevel."*

Noise Floor Calculation Method

Noise Floor is calculated as follows:

1. Calculate noise level (*"noiseLevelD"*) from *"Data[ ]"* and noise threshold ratio (*"noiseThr"*) in accordance with "Gaussian Noise Level Calculation Method" on page 302.
2. Calculate noise level (*"noiseLevelS"*) from *"SquashedData[ ]"* and noise threshold ratio (*"noiseThr"*) in accordance with "Gaussian Noise Level Calculation Method" on page 302.
3. Calculate noise floor (*"NoiseFloor"*) using the following equation:

   $NoiseFloor = \frac{noiseLevelD + noiseLevelS}{2}$

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Baseline Popping

V_{erase} is defined as the voltage level measured by the first value of the read current specified from the read current list when the track has been dc erased. V_{rms} is defined as the voltage level measured by changing the read current from the list. From this two quantities Baseline Popping can be computed by the equation below.

The detailed measurement sequence is described in Chapter 3 of the programming manual.

Equation 5-26 Baseline Popping

$$BaselinePopping = \frac{V_{rms}}{V_{erase}}$$

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Other Measurement Definitions

Overwrite Measurement

When old data is overwritten with new data, remnants of previous transitions remain. They are not completely erased. The overwrite measurement measures the overwrite ratio of a new data signal with respect to the residual signal from the data previously recorded on the disk.

As the worst case condition occurs when high frequency (HF) data is written over low frequency (LF) data, these patterns are usually used for this measurement.

The Agilent E5022/E5023 uses an independent test pattern for this type of test. These are the overwrite HF and overwrite LF data patterns. Agilent E5022/E5023 measures the RMS signal amplitudes of the original LF signal and the residual LF signal after overwriting it by an HF data pattern. They are measured by a spectrum analyzer at the LF fundamental frequency. In general, high frequency pattern is characterized by having more 111.. 11 bits than 0's. And low frequency is characterized by having more 0's than 1's in a given pattern.

Overwrite is defined as:

Equation 5-27 **Overwrite Definition**

$$OW(dB) = 20\log\frac{V_{residual}}{V_{original}}$$

Since $V_{residual}$ is always less than $V_{original}$ the quantity will always be a negative value. In general, a -30 [dB] and smaller overwrite is considered good while that of less than -25 [dB] is will be unacceptable for commercial drive.

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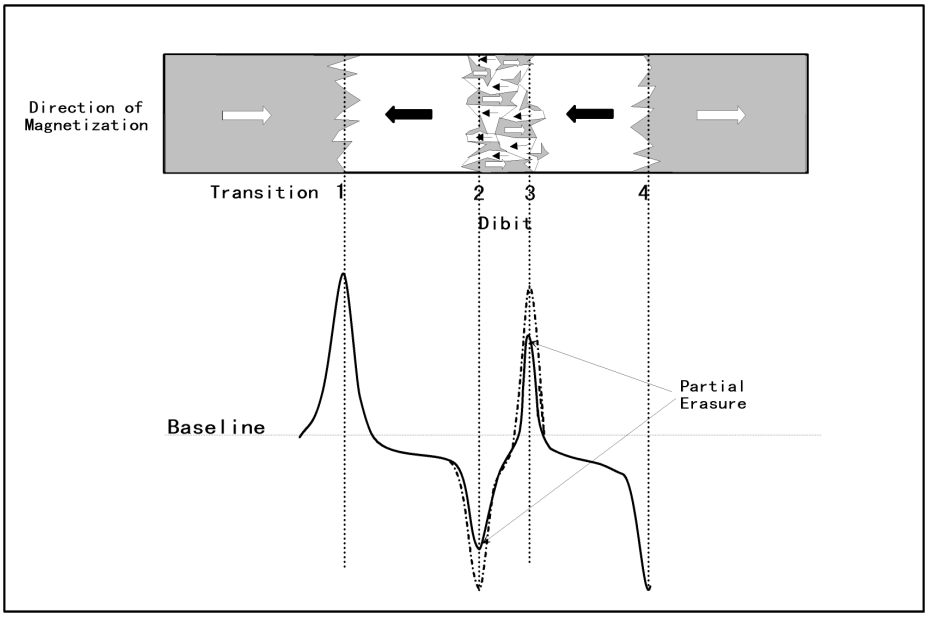
Partial Erasure Measurement

Partial Erasure is also referred to as ‘nonlinear amplitude loss’ that occurs at high recording densities when two transitions (*dibit*) are written closely with a narrow separation, resulting to amplitude loss of the read back signal when data is read.

As shown in Figure 5-54, isolated transition 1 is written with a typical zigzag structure and is isolated from other transitions. Transitions 2 and 3 are closely written forming a dibit. When transition 3 is being written, it produces a demagnetization field which is opposite to the direction of the media’s magnetization. This demagnetization field is largest at the transitions tips and closest to the previously written data.

Since the separation between transitions 2 and 3 is too narrow. The zigzag tips of transitions 2 and 3 will cause the demagnetization field to reverse the magnetization between the tips resulting to a partial erasure of transitions 2 and 3, splitting it into isolated granules of magnetization.

Figure 5-54 **Partial Erasure**



Equation of Partial Erasure is defined as:

Partial Erasure is executed by writing a 3T data pattern and by measuring its amplitude (*V3T*) at the third harmonic frequency. Then, 1T data pattern is written and measure the amplitude (*V1T*) at the same frequency.

Equation 5-28 **Partial Erasure Definition**

$$PE = \frac{1}{2} Đ \frac{V_{1T}}{6 \times V_{3T}}$$

Partial Erasure does not cause bit shift errors since it is not influenced by ‘non-linear

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transition shifts or NLTS'. It cannot be precompensated i.e., partial error is severe limitation of the magnetic recording.

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Data Pattern

The Square Waveform pattern, 5th Harmonic NLTS pattern and Pseudo Random Bit sequence have been provided for Agilent E5022/E5023. For a square waveform there are six data patterns namely, the HF, LF, Isolated Pulse, Repetitive, Overwrite HF and Overwrite LF pattern. For each of these patterns the user can set the number of interval repetition. Although the repetition interval depends on the setting range basically it is the same. User Defined Pattern has also been provided to allow the user to decide which data pattern is to be used.

The table below shows the type of data patterns that can be used for the following measurements.

Data Patterns to be used for the following measurements

Measurement	Data pattern to be used
Parametric Test	HF Pattern, LF Pattern and Isolated Pulse Pattern
5th Harmonic NLTS	5th Harmonic NLTS Data Pattern
Overwrite	Overwrite HF and Overwrite LF
Partial Erasure	1T or 3T Data Pattern
SNR	HF Pattern

Write Precompensation

A write precompensation can be performed for Agilent E5022/E5023, it is a three bit off the target bit, this could either be pre-target bit or post-target bit. This function actually delays the time to write the data. There are three types of timing delay for precompensation and each of these timing delays can be set by the precompensation delay pattern.

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Input Range Control & Auto Configuration

The Agilent E5022/E5023 requires an approximate level of the input signal in order to set the input range. This is because it does not dynamically auto range. Also, when parametric module is used for parametric measurement the input signal of the pulse width (PW) must be specified.

The Agilent E5022/E5023 provides two methods in determining these parameters. This method can be specified by the “hpe5022_measureMode” and the VEE demo Program’s Measure Mode function.

- When measure mode is set to Manual:

  The approximate level of the input signal is set by the “hpe5022_inputRange”. While the approximate pulse width of the input signal can be set by the “hpe5022_pwReference” function.

- When measure mode is set to Auto:

  The Agilent E5022/E5023 has a function that computes the approximate level of the input signal and Pulse Width with respect to the change in channel bit rate, head radius, data pattern under test and spindle speed.

  When typical TAA and PW length values for an isolated pulse measurement are known, the approximate value of the input signal and pulse width can be calculated from to the principle of superposition. Typical TAA and PW length values can be set by the “hpe5022_isolatedPulseReference” function.

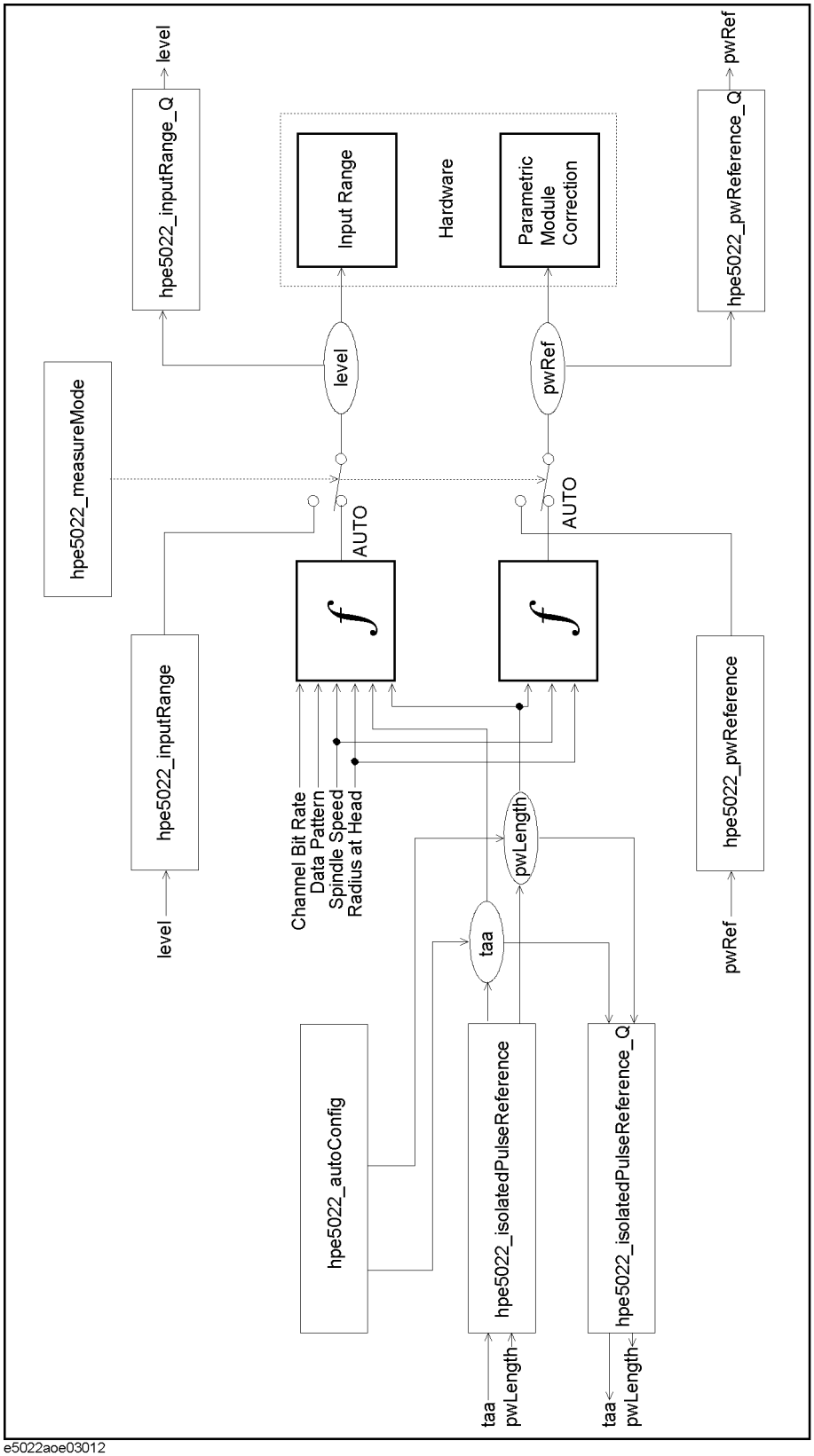
Also, the Agilent E5022/E5023 has an auto configuration function that sets an isolated pulse pattern automatically. Which also allows you to input typical TAA and PW length values. After executing the “hpe5022_autoConfig” function, whatever values specified by the “hpe5022_isolatedPulseReference” function will be set automatically.

Under normal operation Measure Mode is usually set to Auto. Although setting the TAA and the PW length makes measurement possible, if a waveform cannot be measured from the input values of the Input Range and PW Reference using the superposition theorem, then Measure Mode will have to be set to manual. In this case you have to input the approximate level and pulse width of the waveform to be measured.

Figure 5-55 shows the relation among these functions and parameters.

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Figure 5-55 **Relation between Input Range & Auto Configuration Functions**



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Drive Setup/Control

This section explains how the spindle and head are setup and controlled. The setup specifies the necessary parameters to be set until the drive is on (i.e. the spindle is running and the head is loaded). Control, on the other hand specifies the parameters after the drive is on (i.e. moving the head to the track to be tested).

Drive Setup

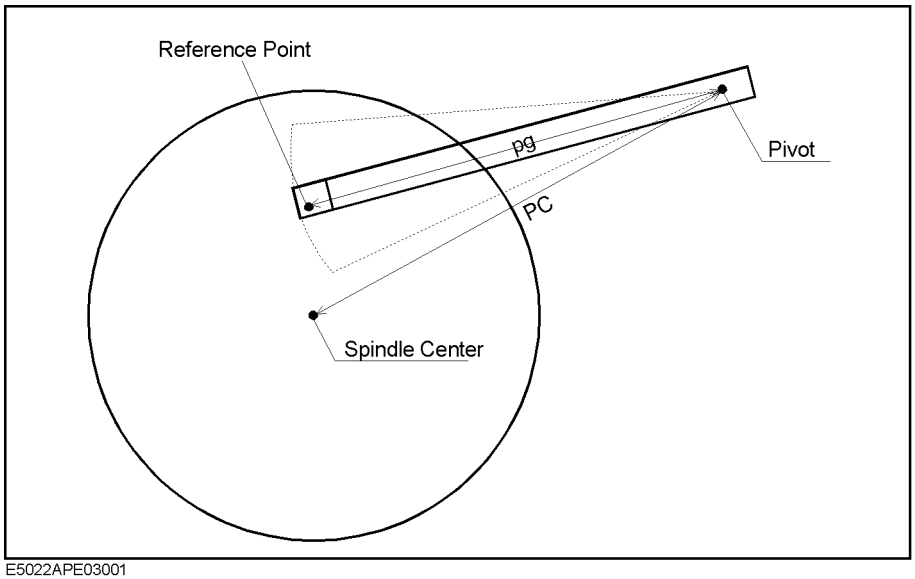
A drive setup is done to configure the drive: the HGA dimensions and Agilent cassette number. In the drive setup, a proper configuration and area restriction for the HGA and Agilent cassette must be established in order to avoid contact with the spindle. This setup needs to be done before the drive is on.

Drive Configuration

Although the spinstand adopts an X-Y stage, the Agilent E5022/E5023 simulates the real drive by changing the head position and head skew angle depending on the specified track number. Parameters are required to achieve this simulation and Agilent E5022/E5023 provides two ways to achieve this.

1. The first way is to specify the dimensions of the spindle center, pivot and reference point. Refer to Figure 5-59 on page 313 for the reference point. In programming function, these dimensions are set by the “hpe5022_driveConfigPivot” function. The required parameters are shown in Figure 5-56.

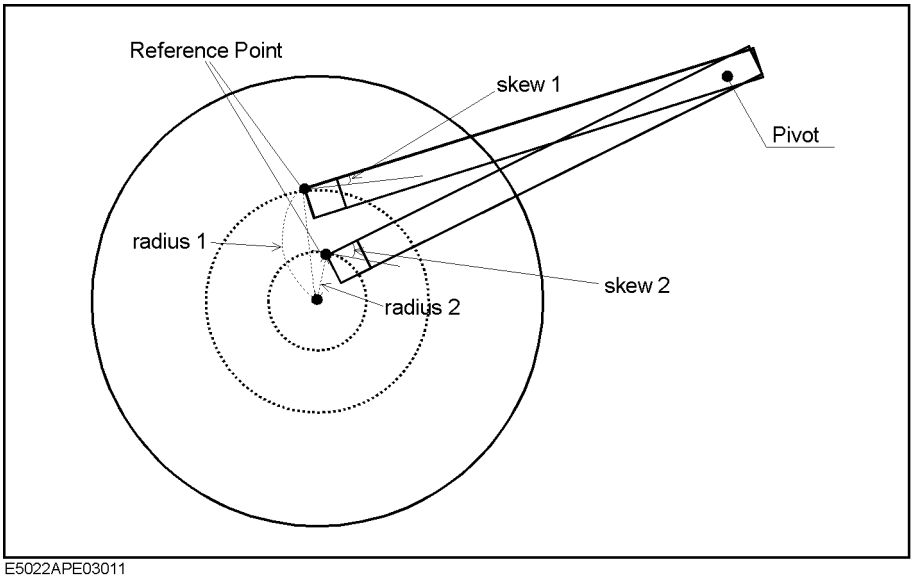
Figure 5-56 Drive Configuration Parameters (Pivot, Spindle Center, Reference Point)



2. The second way is to specify the head radius and its head skew angle within the limits of the data area. This parameters can be specified by the “hpe5022_driveConfigSkewAngle” function. Required parameters are shown in Figure 5-57.

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Figure 5-57 Drive Configuration Parameters (Radius, Skew Angle)



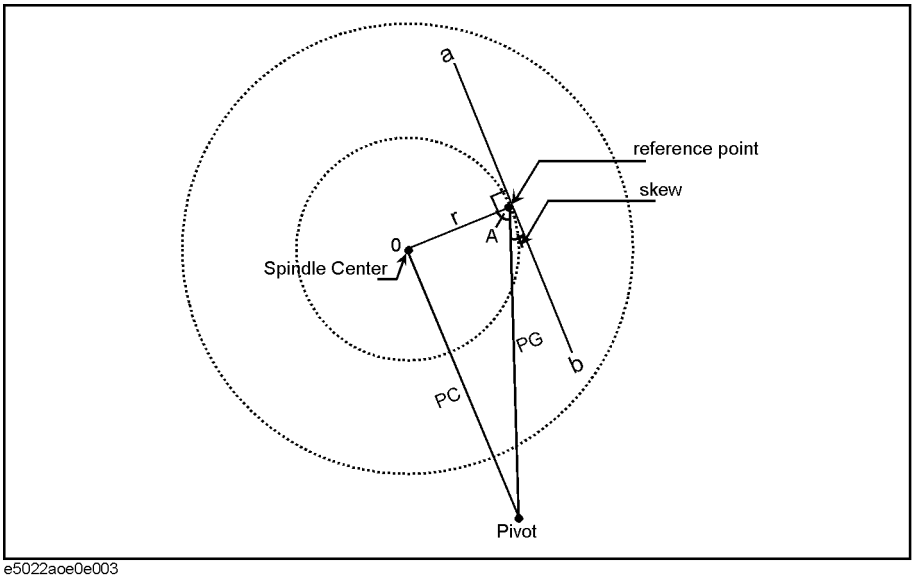
Computation of Skew

Equations for solving Skew Angle An equation must be established that will show the relationship of these parameters in determining skew angle with respect to radius.

r	The radius between spindle center and reference point.
skew	The skew angle created relative to the reference point. It is also defined as the angle formed when the head is not perpendicular to the spindle.
Pivot point	Rotating axis of the pivot arm.
PC	Pivot to Center, is the distance from pivot point to spindle center.
PG	Pivot to Gap, is the distance from pivot point to gap.

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Figure 5-58 **Relationship of each parameter in solving skew angle**



Assuming that pivot to center (PC), pivot to gap (PG) and the radius (r) are known parameters, by applying the Law of Cosine in solving triangles we will be able to establish the following equations.

Equation 5-29 **Using the Law of Cosine**

$$PC^2 = PG^2 + r^2 - 2rPG \times \cos A$$

From the given illustration we can see that radius r is perpendicular to tanget line a-b.Thus, solving for skew angle we can subtract angle A from the right angle.

Equation 5-30

$$skew = 90 - A$$

By substituting equation 4-16 to 4-17 we can prove equation 4-18.

Equation 5-31

$$skew = 90 - \operatorname{acos}\left\{\frac{(r^2 + PG^2 - PC^2)}{(2rPG)}\right\}$$

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Simplifying equation 4-18, will give us the general equation in determining skew.

Equation 5-32 **Definition of Skew**

$$skew = \text{asin}\left\{\frac{(r^2 + PG^2 - PC^2)}{(2rPG)}\right\}$$

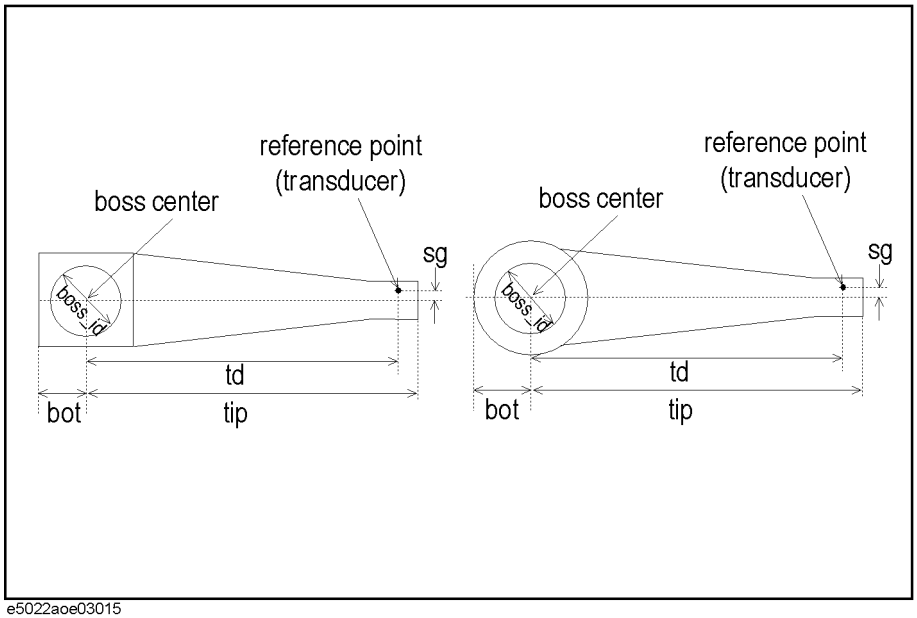
By substituting the known quantities of PC, PG and radius (r) in equation 4-19 you will be able to determine the skew angle.

- r is the radius or perpendicular distance from spindle center to head gap.
- PG is the distance from pivot to head gap.
- PC is the distance from pivot to spindle center.

HGA Dimension

To prevent contact with the spindle and other objects. A proper configuration of the HGA dimension and its reference head position (reference point) has to be established. When the write track offset is set at zero (0), the reference point will be located at the center of the track during a write sequence. When the read track offset is set at zero (0), the reference point will be located at the center of the track during a read sequence. Generally, the reference point is the same position as the write head point in a slider. Parameters are set by the “hpe5022_hgaDimension” function.

Figure 5-59 **HGA Dimension Parameters**



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Agilent Cassette Part Number

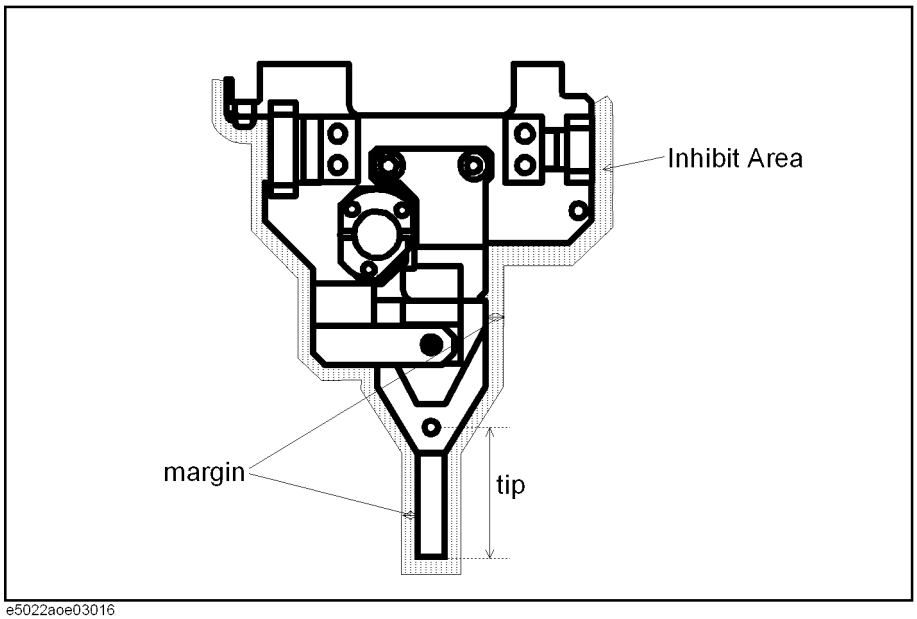
The Agilent E5022/E5023 contains the information of the dimension of the Agilent cassette, this is to prevent the head and the cassette from bumping into the spindle. Enter the down head's Agilent part number of the HGA cassette to be used. If an upper face of the head is to be used then enter its corresponding Agilent part number.

Agilent part number is labeled on the HGA cassette. An example would be "E5010-61121". Parameters can be set by the "hpe5022_hgaCassette" function. If a new cassette is to be used, whose information is not in the system an error "hpe5022_ERROR_NSUP_HGA_CASSETTE" will occur. In this case the DLL (Dynamic Link Library) for the cassette must be installed.

Inhibit Area Margin

An inhibit area or marginal distance has to be specified to keep the head and cassette from bumping into the spindle. Parameters are set by the "hpe5022_inhibitMargin" function. This value is set at 1mm in the VEE Demo program.

Figure 5-60 **Inhibit Area Margin**

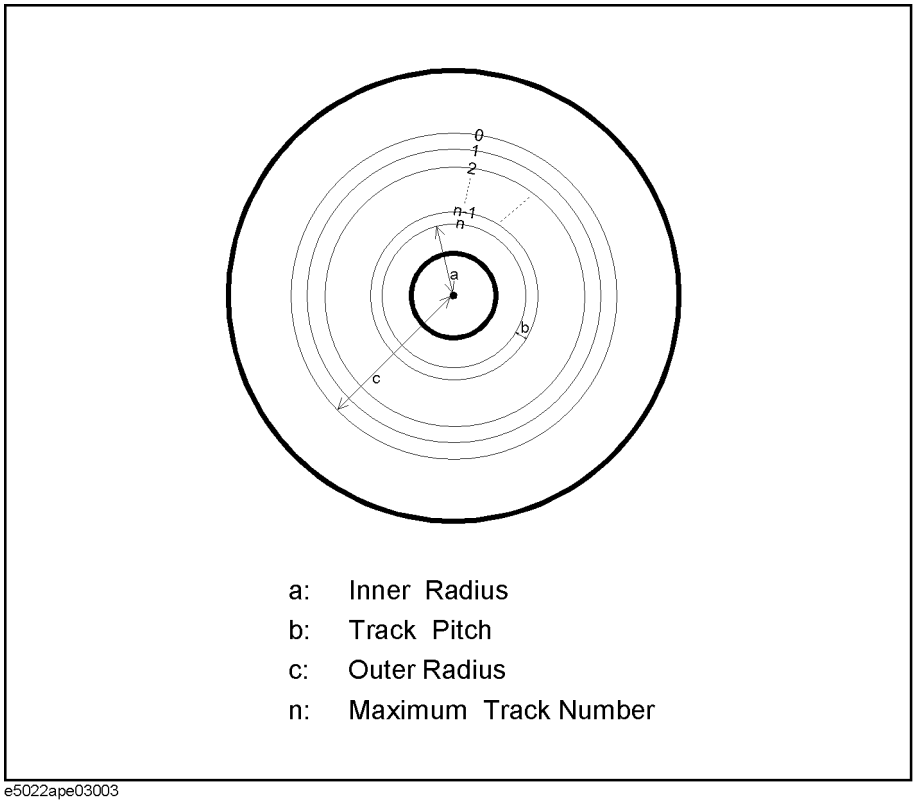


Data Area

The number of tracks and track area of a media can be specified by the data area. This can be done by setting the radius of the innermost track, track interval and the maximum track number. The outermost track number is set to zero. To compute for the number of tracks add 1 to the maximum track number. This also defines the center position for each track. Parameters are set by the "hpe5022_dataArea" function.

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Figure 5-61 **Data Area**



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Head Loading Configuration

Head loading configuration is done when you set the rotation of the spindle either to stop its rotation or allow it to continue when the head moves to its initial track number to load or unload. There are two types of head loading namely dynamic and static loading. Dynamic loading is when the rotation of the spindle is continuous during loading and unloading operation.While Static loading is when the rotation of the spindle stops during both loading and unloading of the head, thus restarting the rotation. Parameter setting can be done by the “hpe5022_headLoadConfig” programming function.

The advanced head loading configuration is also available. This function allows you to set the spindle rotation speed and head load position where the head is loaded or unloaded. Parameters such as load rpm, load radius, load skew, initial radius, initial skew, unload rpm, unload radius and unload skew are specified in this function before proceeding to any measurements. Parameter setting can be done by the “hpe5022_headLoadConfigEx” programming function.

Drive Control

Drive control can be done after you have finished all drive settings (i.e, the drive is on, the spindle is rotating and the head is loaded). At this point you can control the track offset operation. Also, it is possible to set the write offset and read offset even if the drive is on.

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Drive ON/OFF

Disk clamping, rotation of the spindle and head loading are all performed during the Drive ON state. While the Drive OFF performs the head unloading, stops the spindle rotation, unclamps the disk and moves the head to the home position. Parameters can be set by the “hpe5022_driveState” programming function.

Spindle Rotation Speed

To set parameter for spindle rotation speed use the “hpe5022_spindleSpeed” function and set the required rpm.

Write Track Offset

You can set the write track offset within the measurement sequence in order to write the data. To write the data, the head should move automatically to its writing position as specified by the write track offset. Write track offset can be set either before or after the drive on state. To set the parameter use the “hpe5022_writeTrackOffset” programming function.

Read Track Offset

You can set the readtrack offset within the measurement sequence in order to read the data. To read the data, the head should move automatically to its reading position as specified by the read track offset. Read track offset can be set either before or after the drive on state. To set the parameter use the “hpe5022_readTrackOffset” programming function.

Track No

The head is moved to the specified track number and sets the skew angle automatically as it moves on the specified track. Parameter setting for this function can be done by the “hpe5022_track” programming function.

Head and Skew Configuration

The head position and skew angle will be set automatically, after setting the data area and drive configuration and track number. However, you can also set the head position and skew angle manually as required by measurement. To set the parameters use the “hpe5022_headPosition” programming function.

Head Load On/Off

Head loading and unloading can be done even while the drive is on either by dynamic loading or static loading. To set the parameters use the “hpe5022_headLoad” programming function.

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Auto Alignment

Auto alignment is a process to determine the X and Y coordinates of the spindle center based on an actual written data track evaluation. The spindle center coordinates are important because it is the reference position when the spinstand places the head on a specific location on the media. Auto alignment is performed when the spinstand is shipped from the factory. However, if the individual differences of the HGA's dimensions or other dimensional errors are critical for your measurement, you can perform the auto alignment in order to eliminate such errors. The auto alignment is also performed when some of the spinstand mechanical parts are replaced for repair.The auto alignment must be performed for both up and down face HGAs.

Auto Alignment Algorithm

The VEE measurement program (Test Environment) performs the auto alignment in accordance with the following algorithm.

1. Preprocessing

   Perform the band erase and write a data pattern at the position of radius = "start radius" and skew = 0°. "start radius" should be set manually in advance using the auto alignment menu.

2. Rough tune (see Figure 5-62)

   Find a rough skew = 0° position on the track by searching the written track.

3. Fine tune first step (see Figure 5-62)

   Using the skew = 0° coordinates (obtained by the rough tune) and start radius data, move the head to the three positions (skew = 0°, +3°, –3°) on the track, determine the accurate coordinates of the three positions by searching the trace, and calculate spindle center coordinates.

4. Fine tune (step 1) (see Figure 5-62)

   Using the spindle center coordinates obtained in the previous step, move the head to three positions (skew = 0°, "step 1 positive," "step 1 negative") on the track, determine the accurate coordinates of the three positions by searching the track, and calculate more accurate spindle center coordinates. "step 1 positive" (positive skew angle for step 1) and "step 1 negative" (negative skew angle for step 1) should be set manually in advance using the auto alignment menu.

5. Fine tune (step 2) (see Figure 5-62)

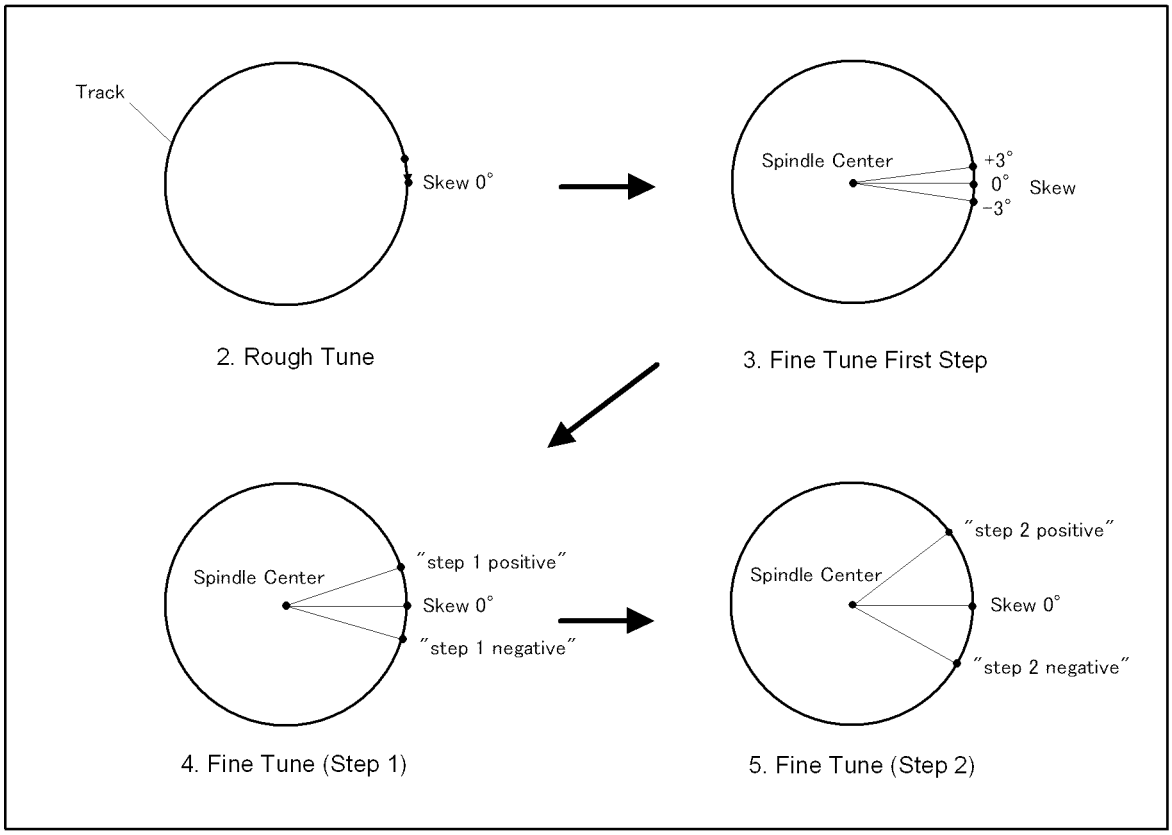
   Using the spindle center coordinates obtained in the previous step, move the head to three positions (skew = 0°, "step 2 positive," "step 2 negative") on the track, determine the accurate three positions by searching the track, and calculate more accurate spindle center coordinates. "step 2 positive" (positive skew angle for step 2) and "step 2 negative" (negative skew angle for step 2) should be set manually in advance using the auto alignment menu.

6. Storing data

   Save the spindle center coordinates data obtained in the previous step in the non-volatile memory of the spinstand.

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Figure 5-62 Auto Alignment Algorithm



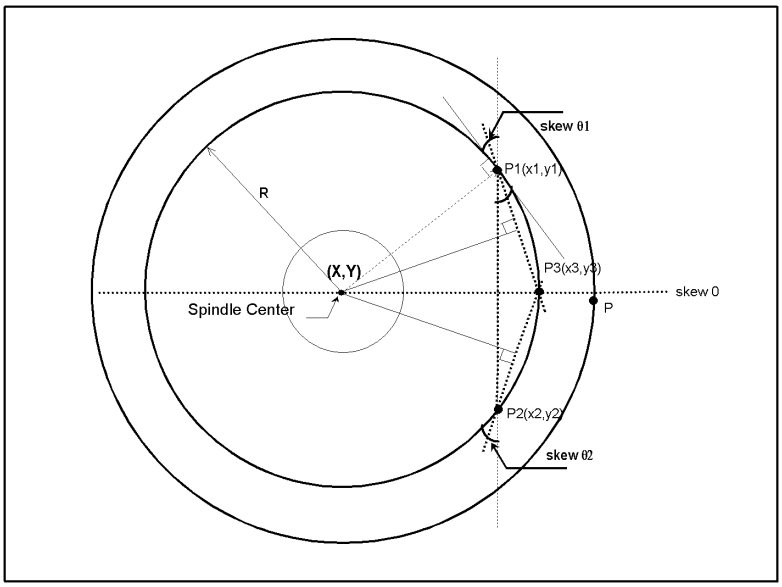
NOTE Available setup ranges for positive skew angles (“step 1 positive” and “step 2 positive”) and negative skew angles (“step 1 negative” and “step 2 negative”) are 3.0 to 30.0 and –3.0 to –60.0 respectively.

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Spindle Center Calculation

The calculation of the spindle center coordinates in the above steps 3 to 5 is based on the following concept:

Figure 5-63 **X-Y Coordinates of Spindle Center**



As shown in the illustration above, determining the spindle center in terms of X-Y coordinates requires three conditions to be satisfied (i.e, three known arbitrary points where the circle passes through) in order to measure the alignment data.

1. Determine the P1 (X_1,Y_1) coordinates at Skew q_1
2. Determine the P2 (X_2,Y_2) coordinates at Skew q_2
3. Determine the P3 (X_3,Y_3) coordinates at Skew 0.

The X-Y coordinates of the spindle center can be computed mathematically relative to points P1, P2 and P3. As an example, it is important that we determine points P1,P2 and P3 coordinates at the track center of radius R as accurately as possible, since the computation in finding the coordinates of the spindle center is dependent on it. By connecting a line between points P1-P3 and P2-P3 you can establish trigonometric equations between these three points that will be used to determine the center of the spindle (X,Y).

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6 Specifications

This chapter describes the specifications of Agilent E5022/E5023

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E5022A/B Specifications

These specifications are the performance standards or limits against which the system is tested.

NOTE E5022A/B, E5035A, E5037A/B, E5038A and E5039A are obsolete products.

Write Characteristics

Table 6-1

Data Clock:	1 kbps resolution, Arbitrary patterns E5037A: 50 Mbps to 600 Mbps (750 Mbps, Opt. 002) E5037B: 50 Mbps to 1 Gbps
Data Pattern:	HF LF Isolated Pulses (ISOL) Overwrite HF, Overwrite LF User Defined Repetitive Pattern: nT Pseudo-Random Patterns: 2^x-1, x=3 to 10 NLTS Test Pattern (5th harmonic method): 100000011000000 Reference Pattern for NLTS: 15T User Defined Patterns (128 Kbits max repetitive)

Write Pre-Compensation (E5037A Only):

Table 6-2

Compensation Level :	3 level
Pattern Selection :	3 bits (preceding / following)
Maximum Shift:	±1.9 nsec
Resolution :	2 psec
Accuracy :	60 psec 30 psec (typical)

Read Channel

Table 6-3

Bandwidth:	1 GHz @ -3dB

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Table 6-3

Filters:	Four selectable filters

Bit Error Measurement (Agilent E5039A)

Table 6-4

Data Rate:	50 Mbps to 800 Mbps (depends on the Data Rate of a PRML chip)
Input Level:	< 400 mVp-p (isolated pulse)
Reference Clock:	1M to 100 MHz (TTL Level)
Measurement Data:	128 kByte (max) / Segment 8 Segment (max)
Bit Error Rate:	$\leq 1 \times 10^{9}$
Number of Sectors/track:	≤ 1,024 Sectors
Number of Symbol Error Count:	65,536 Symbols (max)
Error Memory:	Record the error codes and offset address values for up to 65,536 symbols
Symbol Error Length Histogram:	65,536 counts (for the length 1 to 10)

General Information

(Please refer to the “Site Preparation Guide” for more details)

Operating Temperature and Humidity:

Table 6-5

Temperature:	23±5C°
Humidity	15% to 80% RH, Non-condensation

Power Requirements:

Table 6-6

Number of plugs :	2 (in case the system is rack-mounted)
Voltage :	100/120/220/230/240 V ± 10%
Frequency :	50/60 Hz

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Physical Specifications:

Table 6-7

Spinstand :	Size: 600 mm(W) ×760 mm(D) × 1020 mm(H) Weight: About 300 kg
Measurement bay :	600 mm(W) × 905 mm(D) × 1600 mm(H) or 2000 mm(H)
Necessary working space :	about 2 m × 1.5 m

Measurement Functions

DC Resistance Measurement

Measures the DC resistance of the MR sensor of an MR head in the head-unloading condition.

TAA (Track Average Amplitude) Measurement

Table 6-8

Parameters:	TAA+, TAA-, TAAp-p, TAA asymmetry, Modulation, TAA Raw data (Amplitude Level at every 5µsec.)
Data Pattern:	HF, LF, ISOL
Absolute Measurement Accuracy:	For sinusoidal wave @Agilent E5038A input ±6 % ±3 % (Typical)
	For any waveform @Agilent E5038A input ±5 % (Typical)

Narrow Band TAA Measurement

Table 6-9

Parameters:	Amplitude of the basic frequency contents of the read back signal (rms)
Data Pattern:	HF, LF, Isolated Pulse, Repetitive, NLTS-5th, User defined pattern
Dynamic Range:	70 dB

PW (Pulse Width) Measurement

Table 6-10

Parameters:	PW+, PW-, Average, PW asymmetry

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Table 6-10

Measurement Range:	3 nsec to 30 nsec
Data Pattern:	Isolated Pulse
Range of PW% (PWxx):	PW20 to PW80
Absolute Measurement Accuracy:	±10 % of reading + 150 psec ±5 % + 150 psec (typical)

BL (Baseline) Measurement

Table 6-11

Parameters:	Baseline+, Baseline-, Average, Baseline separation
Data Pattern:	Isolated Pulse
Measurement Accuracy:	±5 % of TAAp-p (@ Input Range = Signal Level)

Resolution Measurement

Table 6-12

Parameters:	Resolution (%) [TAA_{HF} / TAA_{LF} × 100 (%)]
Accuracy:	±10 % (Typical)

NLTS Measurement: 5’th Harmonics

Table 6-13

Parameters:	NLTS (%) [$Level_{test}$/$Level_{reference}$×100 (%)]
Accuracy:	± 2%

Overwrite Measurement

Table 6-14

Parameters:	Overwrite (dB) [($Level_{LF}$ /$Level_{OW}$) dB]
Accuracy:	±0.2 dB

SNR (Signal To Noise Ratio) Measurement

Table 6-15

Parameters:	S/N (dB) [Peak Detected TAA / rms Noise (dB)] or [Signal / rms Noise (dB)]

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Spectral SNR Measurement

Table 6-16

Parameters:	S/N (dB) [Signal / rms Noise (dB)]

Spectrum Measurement

Table 6-17

Parameters:	Power (dBm)

Sub Harmonic Noise Ratio Measurement

Table 6-18

Parameters:	SHNR (dB)

Parameter Sweep Measurements

Table 6-19

Write Current Sweep (Write Current Saturation):	TAA, NB-TAA, PW, BL, Overwrite, NLTS
Sense Current Sweep (MR Bias Saturation):	TAA, NB-TAA, PW, BL, Overwrite, NLTS
Write Frequency Sweep (Roll-off, Channel Bit Rate Sweep):	Roll Off TAA, NB-TAA Channel Bit Rate Sweep TAA, NB-TAA, PW, Overwrite, NLTS
Write Pre-compensation Sweep (only 1 level):	NLTS
Head Position Sweep (Track Profile):	TAA, NB-TAA

Other Measurements

Combination Measurements of TAA and PW

Table 6-20

Parameters:	TAA+, TAA-, TAAp-p, TAA asymmetry (HF), TAA+, TAA-, TAAp-p, TAA asymmetry (LF), Resolution, TAA+, TAA-, TAAp-p, TAA asymmetry (Isolated Pulse), PW+, PW-, PW average, PW asymmetry Resolution

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Micro Track Profile Measurement

Table 6-21

Measurement Parameters:	Read track width, Write track width

Stability Measurement (TAA cov, PW cov)

Table 6-22

Number of Segment per one track:	1 to 80 segments (Maximum number of segment s per one track depends on Write/Read time settings and spindle rotation speed.)
Total Segments:	1 to 1000 segments
Parameters:	Standard Deviation of TAA, Max, Min for each segment

Popcorn Noise Measurement

Table 6-23

Number of Segment per one track:	1 to 100 segments (Maximum number of segment s per one track depends on Write/Read time settings and spindle rotation speed.)
Total Segments:	1 to 10,000 segments
Parameters	E5038A: Histogram by 20 MHz sampling E5041A: Error Counts

Triple Track Test

Table 6-24

Parameters:	Write track width, Read track width, Read/Write offset, Maximum TAA, Squash Ratio, OTRC, Squeezed OTRC

Measurements using the Oscilloscope

Table 6-25

Analysis:	Average the data over the repetitive cycle of data pattern.
	For HF, LF, and Isolated Pulse patterns : TAA+, TAA-, TAAp-p, TAA asymmetry PW+, PW-, PW asymmetry, PW time asymmetry BL+, BL-, BL separation
	For a Pseudo Random pattern : NLTS: Auto correlation, Di-pulse extraction Level of an echo at a specified location

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Table 6-25

	S/N ratio by auto correlation method

Measurements using the Agilent E5039A Bit Error Test Module

- OTC Measurement
- 747 Measurement
- Channel Resister Sweep Measurement
- Channel Quality Monitor Function
- Automatic Channel Optimization Function

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E5023A Specifications

These specifications are the performance standards or limits against which the system is tested.

NOTE E5043B and E5039B are obsolete products.

Write Characteristics

Table 6-26 **(Option 415: E5037C 1.5 Gbps Data Generator Module + E5043A/B, Option 426: E5037D 2.6 Gbps Data Generator Module + E5043C)**

E5023A-415 (1.5 Gbps Data Rate Option)	
Channel Bit Rate:	50 Mbps to 1.5 Gbps (Arbitrary patterns), 1 kbps resolution
Edge Accuracy:	± 10 ps (typical) @ 1.5 Gbps (E5043A), ± 15 ps (typical) @ 1.5 Gbps (E5043B)

E5023A-426 (2.6 Gbps Data Rate Option)	
Channel Bit Rate:	50 Mbps to 2.6 Gbps (Arbitrary patterns), 1 kbps resolution
Edge Accuracy:	± 10 ps (typical) @ 2.6 Gbps (E5043C)

Data Pattern:	HF LF Isolated Pulses (ISOL) Overwrite HF, Overwrite LF User Defined Repetitive Pattern: nT Pseudo-Random Patterns: 2^x-1, x=3 to 10 NLTS Test Pattern (5th harmonic method): 100000011000000 Reference Pattern for NLTS: 15T User Defined Patterns (128 Kbits max repetitive)

Read Channel

Table 6-27 **(E5036A Filter Matrix Module)**

Bandwidth:	1 GHz @ -3dB

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Table 6-27 (E5036A Filter Matrix Module)

Filters:	Four selectable filters

Bit Error Measurement

Table 6-28 (E5039B Bit Error Rate Measurement Module) (Optional)

Data Rate:	50 Mbps to 1.2 Gbps (depends on the Data Rate of a PRML chip)
Input Level:	< 400 mVp-p (isolated pulse)
Reference Clock:	1M to 100 MHz (TTL Level)
Measurement Data:	128 kByte (max) / Segment 8 Segment (max)
Bit Error Rate Range:	$\leq 1\times10^{-9}$
Number of Sectors/track:	≤ 1,024 Sectors
Number of Symbol Error Count:	65,536 Symbols (max)
Error Memory:	Record the error codes and offset address values for up to 65,536 symbols
Symbol Error Length Histogram:	65,536 counts (for the length 1 to 10)

Table 6-29 (E5039C Bit Error Rate Measurement Module) (Optional)

Data Rate:	50 Mbps to 2.6 Gbps (depends on the Data Rate of a PRML chip)
Data Pattern:	Arbitrary 4 kBytes × 4 segments
Input Signal Level:	< 400 mVp-p (isolated pulse)
Bit Error Rate Range:	$\leq 1\times10^{-9}$
Number of Sectors/track:	≤ 1,024 Sectors
Number of Symbol Error Count:	65,536 Symbols (max)
Error Logging:	512 k Symbols (8 bit/symbol)
Burst Error Counter:	4,095 burst errors that exceed given threshold error length (1 to 31)
Lost Sector Counter:	1,024 counts/track, number of unsynchronized sector
BER Functions:	Multiple register sweep, Error threshold, User sync pattern, Sector ignore

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General Information

(Please refer to the “Site Preparation Guide” for more details)

Warm-up Time

Table 6-30

Warm-up Time:	30 min.

Operating Temperature and Humidity:

Table 6-31

Temperature:	23 ± 5 C°
Humidity	15% to 80% RH, Non-condensation

Power Requirements:

Table 6-32

Number of plugs :	2 (in case the system is rack-mounted)
Voltage :	100/120/220/230/240 V ± 10%
Frequency :	50/60 Hz

Physical Specification

Table 6-33

Measurement Bay:	600 mm (W) × 905 mm (D) × 2020 mm (H)
Necessary Working Space:	About 2 m × 1.5 m

Measurement Functions

TAA (Track Average Amplitude) Measurement

Table 6-34

Parameters:	TAA+, TAA-, TAAp-p, TAA asymmetry, Modulation, TAA Raw data (Amplitude Level at every 5µsec.)
Data Pattern:	HF, LF, ISOL

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Table 6-34

Absolute Measurement Accuracy:	For sinusoidal wave @Agilent E5038B input ±6 % @ <600 MHz, ±4 % (typical) ±7 % @ 600 to 750 MHz
	For any waveform @Agilent E5038B input ±5 % (typical)

Narrow Band TAA Measurement

Table 6-35

Parameters:	Amplitude of the basic frequency contents of the read back signal (rms)
Data Pattern:	HF, LF, Isolated Pulse, Repetitive, NLTS-5th, User defined pattern
Dynamic Range:	70 dB

PW (Pulse Width) Measurement

Table 6-36

Parameters:	PW+, PW-, Average, PW asymmetry
Measurement Range:	1.5 nsec to 35 nsec
Data Pattern:	Isolated Pulse
Range of PW% (PWxx):	PW20 to PW80
Absolute Measurement Accuracy:	± (10 % of reading + 50 psec) ± (5 % + 50 psec) (typical)

BL (Baseline) Measurement

Table 6-37

Parameters:	Baseline+, Baseline-, Average, Baseline separation
Data Pattern:	Isolated Pulse
Measurement Accuracy:	±5 % of TAAp-p (@ Input Range = Signal Level)

Resolution Measurement

Table 6-38

Parameters:	Resolution (%) [TAA_{HF} / TAA_{LF} × 100 (%)]

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Table 6-38

Accuracy:	±10 % (Typical)

NLTS Measurement: 5’th Harmonics

Table 6-39

Parameters:	NLTS (%) [$Level_{test}$/$Level_{reference}$×100 (%)]
Accuracy:	±2 %

Overwrite Measurement

Table 6-40

Parameters:	Overwrite (dB) [($Level_{LF}$ /$Level_{OW}$) dB]
Accuracy:	±0.2 dB

SNR (Signal To Noise Ratio) Measurement

Table 6-41

Parameters:	S/N (dB) [Peak Detected TAA / rms Noise (dB)] or [Signal / rms Noise (dB)]

Spectral SNR Measurement

Table 6-42

Parameters:	S/N (dB) [Signal / rms Noise (dB)]

Spectrum Measurement

Table 6-43

Parameters:	Power (dBm)

Sub Harmonic Noise Ratio Measurement

Table 6-44

Parameters:	SHNR (dB)

Parameter Sweep Measurements

Table 6-45

Write Current Sweep (Write Current Saturation):	TAA, NB-TAA, PW, BL, Overwrite, NLTS

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Table 6-45

Sense Current Sweep (MR Bias Saturation):	TAA, NB-TAA, PW, BL, Overwrite, NLTS
Write Frequency Sweep (Roll-off, Channel Bit Rate Sweep):	Roll Off TAA, NB-TAA Channel Bit Rate Sweep TAA, NB-TAA, PW, Overwrite, NLTS
Write Pre-compensation Sweep (only 1 level):	NLTS
Head Position Sweep (Track Profile):	TAA, NB-TAA

Other Measurements

Combination Measurements of TAA and PW

Table 6-46

Parameters:	TAA+, TAA-, TAAp-p, TAA asymmetry (HF), TAA+, TAA-, TAAp-p, TAA asymmetry (LF), Resolution, TAA+, TAA-, TAAp-p, TAA asymmetry (Isolated Pulse), PW+, PW-, PW average, PW asymmetry Resolution

Micro Track Profile Measurement

Table 6-47

Measurement Parameters:	Read track width, Write track width

Stability Measurement (TAA cov, PW cov)

Table 6-48

Number of Segment per one track:	1 to 80 segments (Maximum number of segment s per one track depends on Write/Read time settings and spindle rotation speed.)
Total Segments:	1 to 1000 segments
Parameters:	Standard Deviation of TAA, Max, Min for each segment

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Popcorn Noise Measurement

Table 6-49

Number of Segment per one track:	1 to 100 segments (Maximum number of segment s per one track depends on Write/Read time settings and spindle rotation speed.)
Total Segments:	1 to 10,000 segments
Parameters	E5038A: Histogram by 20 MHz sampling E5041A: Error Counts

Triple Track Test

Table 6-50

Parameters:	Write track width, Read track width, Read/Write offset, Maximum TAA, Squash Ratio, OTRC, Squeezed OTRC

Measurements using the Oscilloscope

Table 6-51

Analysis:	Average the data over the repetitive cycle of data pattern.
	For HF, LF, and Isolated Pulse patterns: TAA+, TAA-, TAAp-p, TAA asymmetry PW+, PW-, PW asymmetry, PW time asymmetry BL+, BL-, BL separation
	For a Pseudo Random pattern : NLTS: Auto correlation, Di-pulse extraction Level of an echo at a specified location S/N ratio by auto correlation method

Measurements using the Agilent E5039B/C Bit Error Test Module

- OTC Measurement
- 747 Measurement
- Channel Resister Sweep Measurement
- Channel Quality Monitor Function
- Automatic Channel Optimization Function

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E5010B Spinstand Specifications

NOTE E5010B is the obsolete product.

X-Y Stage (Coarse Positioning Stage):

Table 6-52

Stage Type:	Air Bearing, dual axis stage with vacuum lock down feature
Stage Travel :	140 mm × 100 mm (5.5" × 4")
Linear Scale Resolution:	100nm (4 µ")
Position Repeatability :	5 µm (200 µ")
Position Accuracy:	15 µm (600 µ")
Skew Range:	$+30^{o}$ (max), -60^{o} (min)

Piezo Stage (Fine Positioning Stage):

Table 6-53

Stage Type:	Piezo translator operated flexure substage
Stage Travel :	15 µm (600 µ")
Travel Resolution:	2.5 nm (0.1 µ")
Position Accuracy:	50 nm (2 µ")
Position Repeatability:	5 nm (0.2 µ"), 1 σ

Spindle:

Table 6-54

RPM :	1,000 to 15,000 rpm
RPM Accuracy:	0.1 % @ ≥3,000 rpm
RPM Jitters:	0.01 % @ ≥3,000 rpm
Asynchronous Rotational Error:	1 µ" axial/radial @ ≥3,000 rpm
Asynchronous Position Jitters: (Non Repeatable Runout)	< 10 nm (< 0.4 µ"), 1 σ
Rotational Direction :	CW, CCW
Clamp Size:	2.5”, 3.0/3.5"
Bearing:	Air Bearing

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Table 6-54

Motor:	Brushless DC, programmable

Air Supply Requirements:

Table 6-55

Pressure :	724 kPa (min), 827kPa (max) (105psi (min), 120psi (max))
Flow :	0.00048 m^3/s (1.02scfm) (min)

Vacuum Requirements:

Table 6-56

Pressure :	-70 kPa (min) (-20.5 inHg)
Flow:	0.00022 m^3/s (0.47 scfm) (min)

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E5010C Spinstand Specifications

NOTE E5010C is the obsolete product.

X-Y Stage (Coarse Positioning Stage):

Table 6-57

Stage Type:	Air Bearing, dual axis stage with vacuum lock down feature
Stage Travel :	140 mm × 100 mm (5.5" × 4")
Linear Scale Resolution:	100 nm (4 µ")
Position Repeatability :	5 µm (200 µ")
Position Accuracy:	15 µm (600 µ") @ 23±1 °C
Skew Range:	–30° to +30°

Piezo Stage (Fine Positioning Stage):

Table 6-58

Stage Type:	Piezo translator operated flexure substage
Stage Travel :	15 µm (600 µ")
Travel Resolution:	1.7 nm (0.07 µ")
Positioning Repeatability:	1.7 nm (0.07 µ"), 1 σ @ ±1 µm
Asynchronous Positioning Jitter:	1.7 nm (0.07 µ"), 1 σ @ ≤ 15,000 rpm

Spindle:

Table 6-59

RPM :	1,000 to 20,000 rpm
RPM Accuracy:	±0.0005 % @ 15,000 rpm (typical)
RPM Jitters:	±0.0025 % @ 15,000 rpm (typical)
Asynchronous Rotational Error:	1 µ" axial/radial @ > 3,000 rpm
Rotational Direction :	CW, CCW
Clamp Size:	1.8”, 2.5”, 3.0/3.5"
Bearing:	Air Bearing
Motor:	Brushless DC, programmable

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Operating Temperature and Humidity:

Table 6-60

Temperature:	23 ± 5 C°
Humidity	15% to 80% RH, Non-condensation

Power Requirements:

Table 6-61

Number of plugs :	2 (Spinstand and Fan on the Cover)
Voltage :	100/120/220/230/240 V ± 10%
Frequency :	50/60 Hz

Air Supply Requirements:

Table 6-62

Pressure :	724 kPa (min), 827kPa (max) (105psi (min), 120psi (max))
Flow :	0.00048 m^3/s (1.02scfm) (min)

Vacuum Requirements:

Table 6-63

Pressure :	-70 kPa (min) (-20.5 inHg)
Flow:	0.00022 m^3/s (0.47 scfm) (min)

Physical Specification

Table 6-64

Spinstand Size and Weight w/o Cover	600 mm (W) × 760mm (D) × 1020 mm (H), approximately 300 kg
Spinstand Size and Weight with Cover	700 mm (W) × 850mm (D) × 1270 mm (H), approximately 330 kg
Necessary Working Space:	About 2 m × 1.5 m

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A Manual Changes

This appendix contains the information on the updated firmware versions or configurations of the Agilent Technologies E5022A/B and E5023A. The information in this manual applies directly to an Agilent Technologies E5022A/B or E5023A whose firmware/software revision is listed on the title page of this manual.

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Changes in Revision B.04.00 from Revision B.03.10

Add 3 GHz spectrum measurement capability option (E5023A-300)’s information.

Update products information.

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Changes in Revision B.xx.xx from Revision B.02.50

See the readme.htm and readme_config.htm files.

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Changes in Revision B.02.50 from Revision B.02.20

The following functions have been supported.

- The tilt load function is supported which is available only in the E5010C/E5013A spinstand with the tilt loading mechanism. In the VEE measurement program, it is available to set the “Tilt” as the head load type.
- The ramp load function is supported which is available only in the E5010C/E5013A spinstand with the ramp loading mechanism. In the VEE measurement program, it is available to set the “Ramp” as the head load type, and to set the ramp load related parameters. In addition, the ramp load positioning utility is added in the [Agilent Hard Disk ReadWrite Test System] group which is a tool to determine the ramp load position and the media load postision.

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Changes in Revision B.02.20 from Revision B.02.00

The SNR Triple Track Test function has been added.

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Changes in Revision B.02.00 from Revision B.01.10

See the readme.htm file. Select windows start menu [Programs][Agilent Hard Disk ReadWrite Test System] [README]

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Changes in Revision B.01.10 from Revision B.01.00.02

1. Supports E5023A System.

   The system calibration (Cable-loss compensation) function has been added. The calibration factor is installed in PC. The value is stored into PC at the factory shipment. The value is the same for all systems as far as the provided cables are used. Generally user don't care about this.

2. Supports E5029K head amplifier.

   The method to set the head amplifier control has been changed. In case of the E5029H/J, the head amplifier property method is adapted. In case of the E5029K, users can set the values at any register in the head amplifier IC. This allows users to control the head amplifier more flexible.

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Service Release for Revision B.01.00

Changes at Revision B.01.00.02

1) The following cassette has been supported.

* E5029E Opt. 002 Cascade for the Universal Head Amplifier

2) The following cassette has been supported.

* E5029K Opt. 101 Universal Head Amplifier for the Cascade

Bug Fixes

1) In the TMR measurement, "Unable to convert Text to Real" was displayed when the peak signal was not found in the track profile measurement.

2) In the triple track profile measurement, the auto range was failed when a signal is detected only at the right side of the track profile measurement.

Changes at Revision B.01.00.01

1) The function stops the spindle rotation with clamping the media has been added.

* hpe5022_motorStateEx()

2) The TMR and Randomize Track Profile measurements have been added in the VEE measurement program as a service function.

Bug Fixes

1) When the hpe5022_headPosition() function was executed while spindle was not rotating, the cassette face was not detected properly.

2) In case of the E5010C and E5013A, the HLM position at system initialization has been changed from the unload position to the load position. This is because the load position is preferable when the cassette is attached on the HLM from the mechanical durability point of view.

3) The overwrite measurement sequence has been changed.

The three-track-erase has been added at the first in the sequence.

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Changes in Revision B.01.00 from Revision A.04.30.03

1. Supports E5023A System.

   The system calibration (Cable-loss compensation) function has been added. The calibration factor is installed in PC. The value is stored into PC at the factory shipment. The value is the same for all systems as far as the provided cables are used. Generally user don't care about this.

2. Supports E5029K head amplifier.

   The method to set the head amplifier control has been changed. In case of the E5029H/J, the head amplifier property method is adapted. In case of the E5029K, users can set the values at any register in the head amplifier IC. This allows users to control the head amplifier more flexible.

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Service Release for Revision A.04.30

Changes at Revision A.04.30.07

1) The following head amplifier is supported

* E5029J Opt.701 E5029-66701

Changes at Revision A.04.30.06

1) The following head amplifier is supported

* E5029H Opt.H37 E5022-66537

Bug Fixes

1) In the triple track profile measurement, the auto range was failed when a signal is detected only at the right side of the track profile measurementt

Changes at Revision A.04.30.05

1) The following head amplifier is supported

* E5029H Opt.H36 E5022-66536

Bug Fixes

1) When the hpe5022_headPosition() function was executed while spindle was not rotating, the cassette face was not detected properly.

2) In case of Amplifier On Cassettes, the head could not be located at the area over radius 45mm.

Changes at Revision A.04.30.04

1) The following cassette is supported

* E5029D Opt.012 E5010-61321/61322 VM8020 FIC

2) The following cassette's DLL is modified.

* E5029D Opt.002 E5010-61221/61222

3) The function allows you to use an external data source has been added.

* hpe5022_writeDataSource

* hpe5022_writeDataSource_Q

4) The DCR measurement with a Voltage/Power MR bias has been added.

* hpe5022_measureReadHeadDcrEx()

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5) The function stops the spindle rotation with clamping the media has been added.

* hpe5022_motorStateEx()

Changes at Revision A.04.30.03

1. Supports the following head amplifier.
   - E5029H Opt.H35 E5022-66535
   - E5029J Opt.702 E5022-66702
2. The maximum number of repeat for multiple write/erase is extended from 1000 to 1000000.

Bug Fixes

1. In case of using the E5029D (Amplifier on casstte type) with the E5012A spinstand, the auto alignment failed to perform.

Changes at Revision A.04.30.02

1. Supports the following head amplifier.
   - E5029J Opt.004 E5022-66004
2. Functions control/query the I/O port on the spinstand controller has been added.

Bug Fixes

1. The selftest of the E5040A might fail even the hardware has no trouble.
2. At revision A.04.30.01 and in case of E5010B spinstand, the auto alignment might fail. Unknown Error [0xbffc0d12] was displayed.
3. The setting menus of the following head amplifiers were not displayed in the VEE measurement program.
   - E5029H Opt.H33 E5022-66533 VM8020
   - E5029H Opt.H34 E5022-66534 CXA3541N
4. The hpe5022_idn_Q() function did not return the system serial number.
5. The spectrum SNR measurement result at 1MHz RBW on the E5040A was not correct.

Changes at Revision A.04.30.01

1. Supports the following head amplifiers.
   - E5029H Opt.H33 E5022-66533 VM8020
   - E5029H Opt.H34 E5022-66534 CXA3541N
2. Function Applying a MR bias by Voltage/Power has been added.

   This function allows you to set a MR bias type at either current, voltage, or power. You can use at voltage and/or power only if the installed head amplifier has the capability to select. The function allows you to sweep with the MR bias type(s) also has been added.
3. Position Error Query Function has been added.

   This function allows you to monitor the position error (drift).
4. Fine Positioning Additional Settling Time Function has been added.

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This function allows you to move the piezo. You can move it even if the drive is turned off. This mean, you can move the piezo even if the head is at the home position.

Bug Fixes

1. The dll file for the E5029J Opt.107 head amplifier was not installed at revision A.04.30.

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Changes in Revision A.04.30 from Revision A.04.20.04

1. A capability to change a center position of the burst patterns in the track offset compensation function has been added.

   This function allow you to stay the read head at a positon which has offset from the track center.

2. A capability to locate a head and load/unload at the outside of a media has been added.
3. A capability to change the head movement speed has been added.
4. The channel optimization without an erase and/or a write has been added.
5. Supports the E5029J Opt.190 E5022-66109/E5022-66110 SR1759.

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Service Release for Revision A.04.20

Changes at Revision A.04.20.04

1. For the VM8020 head amplifiers (E5029J Opt.215, 217 and E5029H Opt.H32), the function allows you to turn off the sense current during the write sequence has been deleted. This is because this function sometime does not work on the VM8020. The symptom is that sense current does not flow.

   The property of "hpe5022_HAP_SENS_CURR_POL_OFF" has been deleted.

   Note: E5029J Opt 613 has not had this function since the time of its release.

2. For the VM8020 head amplifiers (E5029J Opt.215, 217, 613 and E5029H Opt.H32), the function allows you to change the D1/D2 bits on the register 15 has been added.

   The property of "hpe5022_HAP_PROP_xxxxx_LC" has been added.

3. For the SR1750 head amplifiers (E5029J Opt.203 and E5029H Opt.H15 and H26), the function allows you to change the mode of dummy head connection at the beginning of write sequence.

   This function allows you to prevent to destroy a write head due to a spike current. However, this function sometimes causes the trouble of the write current shutdown.

   The property of "hpe5022_HAP_PROP_xxxxx_ACCMD" has been added.

Changes at Revision A.04.20.03

1. Supports the following head amplifiers.
   - E5029H Opt.H32 E5022-66532 VM8020
   - E5029J Opt.627 E5022-66627/E5022-66628 Mercury
2. Supports the following cassettes.
   - E5029C Opt.C21 E5010-61168
   - E5029C Opt.009 E5010-61292

     (Cassettes for down face have already been released.)
3. Supports the 1.8 inch clamp.

   Auto Alignment and Spinstand tool are modified for 1.8 inch clamp.
4. Setting Menus for Clamp Size and Spinstand Type in Spinstand Tool have been modified.

   The "SET" buttons in the Clamp Size and the Spinstand Type Setting Menus have been changed to "SAVE". The function of this buttons has been changed to not only "set" but also "set" and "save" of the setting. Before this revision, it was necessary to click the "save" button in the DAC Bias Adj. menu after setting the value.

Bug Fixes

1. Bit Error Test in VEE Measurement Program

   Symptom: At revision A.04.20.02, the "offset" value in the "Ber Track Offset Comp. Setup" menu can not be changed.

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2. Oscilloscope Initialization Problem

   Symptom: Agilent 54845A (4CH 8G/sa Oscilloscope) does not change at 2 channel mode at initialize. This might occur when a PC is a Pentium III model.

3. Ranging Problem in Auto Disk Alignment.

   Symptom: Overflow error might occur when a low noise level head is used.

4. Current Setting Problem in Universal Head Amplifier

   Symptom: There is a case that the current setting might be not changed.

Changes at Revision A.04.10.02

1. Track Offset Compensation Capability during the Sequences of the Create Micro Track and the Bit Error Test has been added.

   This function allow you to compensate a head position automatically during one measurement sequence in the Create Micro Track and the Bit Error Test, when the track offset compensation state has been turned on.

2. Narrow Band TAA Raw Data Function has been added.

   This function allows you to observe the raw data of the narrow band TAA measurement.

3. In the Option P13/14, the values of "hpe5022_BER_CIC_MS452A_PROP_FIR" property has been modified.

4. In the Option P22, the property of "hpe5022_BER_CIC_88C5200_PROP_FIR_COEF_MODE" has been added.

Bug Fixes

1. The "hpe5022_trackOffsetCompPatternAuto" function

   This function determines the frequency, the offset and aperture time of the burst pattern automatically. Until the previous revision, a narrow band TAA roll off measurement was used to determine the burst pattern. It was changed to a TAA roll off measurement at this revision.

2. The optimization is modified in E5039A Options P13/P14 and P22.

3. At revision A.04.20.01, the Band Erase in the track profile measurement and triple track profile measurement in the measurement program does not work properly.

Changes at Revision A.04.10.01

1. Supports the following cassette.

   - E5029C Opt.C21 E5010-61167/E5010-61168

2. Track Search Function has been added.

   This function searches a track in the specified area. This function allows you to write a track by one HGA and then read it by another HGA.

3. Wide Band Erase Function has been added.

   This function allows you to erase a whole specified area beyond +-6 micro meter (Piezo movement Range).

4. The DLLs for the following head amplifier is modified.

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- E5029J Opt.215 E5022-66215/E5022-66216 VM8020
- E5029J Opt.217 E5022-66217/E5022-66218 VM8020

Note: VM802010BXD1 is supported and VM802010BXB1 is not supported.

Bug Fixes

1. Symptom: In the cassette of E5029D Opt. 009 (E5010-61291/E5010-61292), the cassette might contact with the shroud.

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Changes in Revision A.04.20 from Revision A.04.10.03

1. The multiple-write and multiple-read functions have been added.

   This functions allow you to write or erase for several revolutions.

2. The sense current polarity functions has been added.

   This function allows you to change the sense current polarity on write sequence.

   (Some head amplifiers does not have this capability.)

3. The track offset compensation function has been added.

   The function allows you to compensate the head position by reading the burst pattern.

   (In VEE program, only the track profile measurement has this capability)

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Service Release for Revision A.04.10

Changes at Revision A.04.10.03

1. Supports the following Head Amplifiers
   - E5029J Opt.613 E5022-66613/E5022-66614 VM8020
2. Supports the following Cassette
   - E5029D Opt.009 E5010-61291/E5010-61292

Changes at Revision A.04.10.02

1. Supports the following Head Amplifiers
   - E5029J Opt.107 E5022-66107/E5022-66108 SR1759-2

Changes at Revision A.04.10.02

1. The following bug is fixed
   - Symptom: When click on [Head Amp Config] under [Setup][Configuration] on the VEE program, only installed head amplifier's part number and its serial number are displayed and you can not set the control parameters, such as gain, bias and overshoot. This is happen on head amplifiers which has a property function except E5029J Option 609 (E5022-66609/E5022-66610). This is a bug in the VEE Program and the functions are no problem.

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Changes in Revision A.04.10 from Revision A.04.00.01

1. Supports the following Cassettes.
   - E5029C Opt.019 E5022-61163/E5022-61164
   - E5029C Opt.020 E5022-61165/E5022-61166
2. Supports the E5011A small profile spinstand.
3. The following measurements are added.
   - Side Erase
   - Side Reading
4. In stability measurements, the "Skip Erase & Write" sequence can be selectable.
5. In a micro track, the minimum step is changed from 50 nm to 1 nm.

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Service Release for Revision A.04.00

Changes in Revision A.04.00.01 from Revision A.04.00

1. Supports the following Head Amplifiers
   - E5029J Opt.215 E5022-66215/E5022-66216 VM8020
   - E5029J Opt.217 E5022-66217/E5022-66218 VM8020
   - E5029J Opt.219 E5022-66219/E5022-66210 VM8030
   - E5029J Opt.221 E5022-66221/E5022-66222 VM8030
   - E5029J Opt.607 E5022-66607/E5022-66608 SR1760
2. E5029J #002 (E5022-66002, Buffer Board for Amp on Cassette) has the serial number JP1KI00157 and below are not supported. Contact to Agilent if you have the Buffer Board.
3. In Bit Error Measurement, the Adjacent Track Pattern can be determined.
   - hpe5022_BER_adjacentTrackPattern
   - hpe5022_BER_adjacentTrackPattern_Q

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Changes in Revision A.04.00 from Revision A.03.81.04

1. Supports the following Head Amplifier for an Amplifier on Cassette.
   - E5029J Opt.607 E5022-66607/E5022-66608 SR1760
2. Supports the following new modules.
   - E5037B 1Gbps Data Generator Module
   - E5040A Spectrum Measurement Module
3. Discontinued the Codeword Protection for Oscilloscope Option

   The codeword is no longer required during the system software installation.
4. The calculation methods of squeeze profile and squeeze OTRC in the triple track profile test have been changed.

   E5022A/B employs the following method in order to measure a Squeeze OTRC.

   a. Measure one track profile.

   b. Plot the imaginary track profiles at both side of the measured track profile.

      In other words, the both side of track profiles are copies of the measured track profile.

   c. Calculate Squeeze OTRC by two imaginary track profiles.

   The following things have been changed in the calculation of Squeeze OTRC and plotting imaginary track profiles.

   - Squeeze OTRC

     On revision A.3.81.04 and below, the squeeze OTRC is calculated from the rounded imaginary track profile. On the other hand, on revision A.04.00 and above, it is calculated from the not-rounded imaginary track profile as shown in Figure A-1.

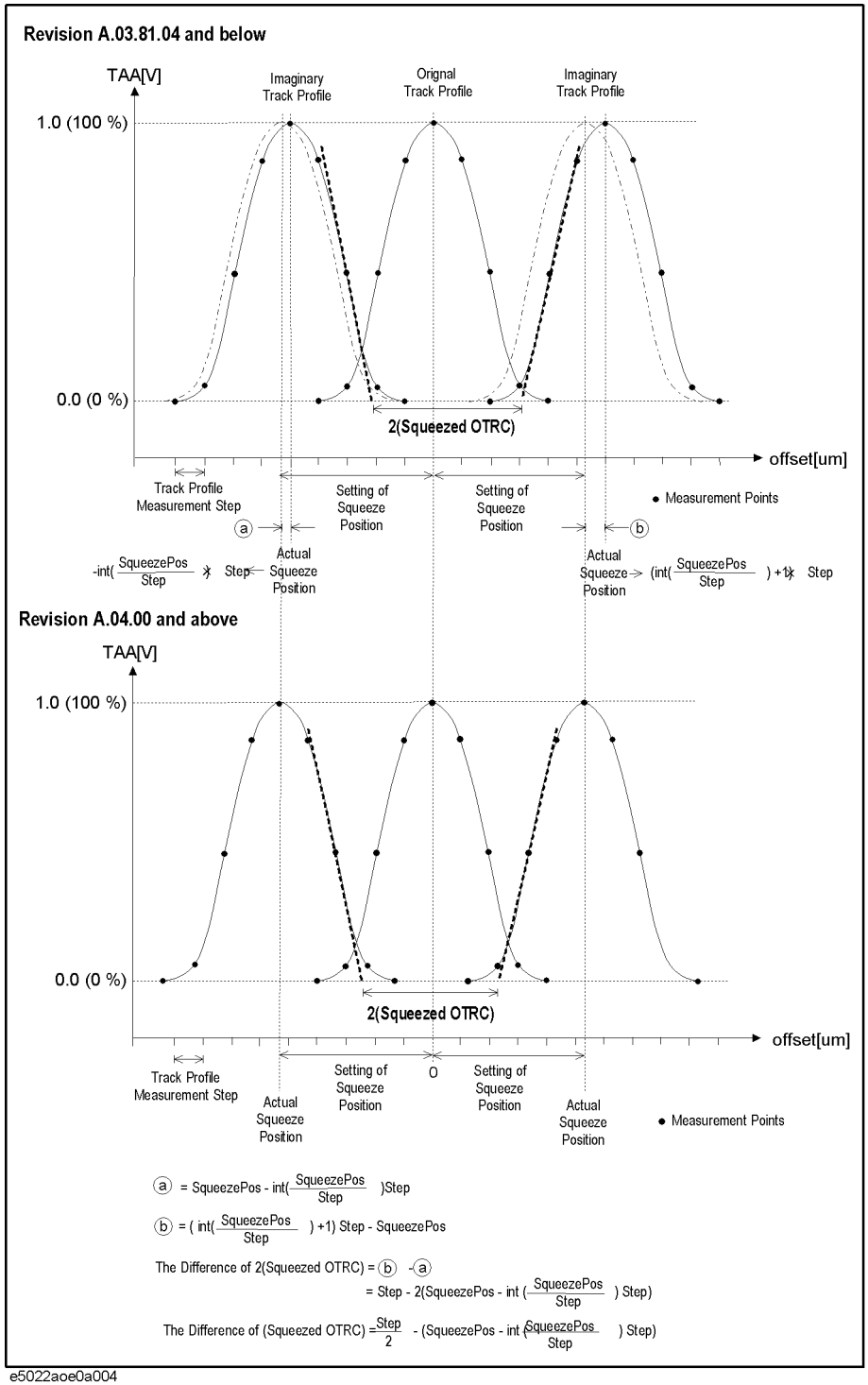
     As a result, the measurement result of the Squeeze OTRC between the revisions will be different as shown in Equation A-1.

Equation A-1 The difference of Squeeze OTRC

$$\frac{Step}{2} - \left(SqueezePos - int\left(\frac{SqueezePos}{Step}\right) \times Step \right)$$

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Figure A-1 Changes on Squeeze OTRC



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- Squeeze Profile

  The imaginary track profiles are plotted on both side of the original track profile at the setting of squeeze position apart from the original track profile position. In the E5022A/B triple track profile sequence, the imaginary track profile position is rounded to the step of track profile measurement as shown in Figure A-2.

  On revision A.03.81.04 and below, the right imaginary track profile position is rounded at:

Equation A-2 Right Imaginary Track Profile Position in Revision A.03.81.04 and below

$$\left(int\left(\frac{SqueezePos}{Step}\right)+1\right)\times Step$$

On revision A.04.00 and above, the right imaginary track profile position is rounded at:

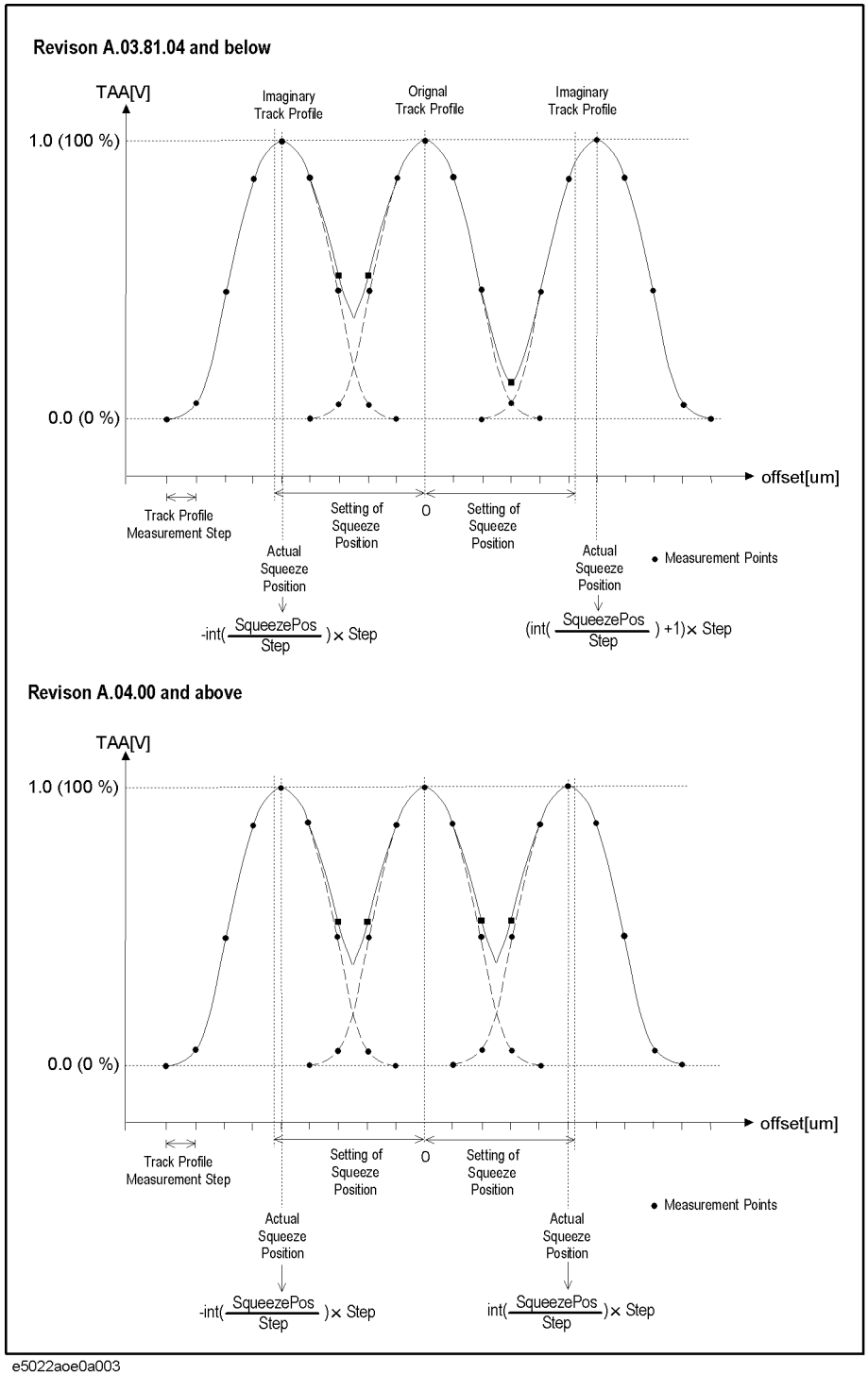
Equation A-3 Right Imaginary Track Profile Position in Revision A.04.00 and above

$$int\left(\frac{SqueezePos}{Step}\right)\times Step$$

The left side of the imaginary track profile is the same for both revision.

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Figure A-2 Changes on Squeeze Profile



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Service Release for Revision A.03.81

Changes in Revision A.03.81.04 from Revision A.03.81.03

1) Supports spectrum measurements using 4396B.

When 4396B is connected with E5022A system, user can measure the following measurements.

* RollOff

* CBR Sweep

* Spectrum

* Spectral SNR

2) Supports E5029J Opt105(E5022-66105, SR1759)

Changes in Revision A.03.81.03 from Revision A.03.81.02

1) Supports a new E5029J Opt 002 (E5022-66002, Buffer Board for Amp on Cassette)

Note: E5029J Opt 002 has the serial number JP1KI00158 and above must use this revision or above.

2) For E5029H Opt.H30 (E5022-66530), a capability to measure a write DCR is added.

Changes in Revision A.03.81.02 from Revision A.03.81.01

1) Supports the following Head Amplifiers

* E5029H Opt.024 E5022-66524 M61871BFP

* E5029H Opt.029 E5022-66529 HDL6D002

* E5029H Opt.030 E5022-66530 S3146/47

2) Supports E5039A option P22.

3) When the hpe5022_setupXXXXX functions related to E5038A, such as hpe5022_setupTaa(), are performed repeatedly, the measurement speed will be improved.

Changes in Revision A.03.81.01 from Revision A.03.81

1) Supports the following Head Amplifiers

* E5029H Opt.026 E5022-66526 SR1750

* E5029H Opt.031 E5022-66531 TDA5360

2)Modificaiton

2-1) E5029H Opt.015(E5022-66515)

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Service Release for Revision A.03.81

Problem Description:

In case of using E5029H Opt.015, when the measurement interval is more than about 1 minute, next first measurement result is not good. After one bad measurement result, the result becomes good if the interval is less than about 1 minute.

Cause: At the revision 3.81 and below, the SR1750 was set at IDLE mode at unload position. This causes the problem. At this service release, the SR1750 was set at SLEEP mode at unload position.

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Changes in Revision A.03.81 from Revision A.03.70

For VEE program, the following measurements have been added.

- *Stability Measurement (Absolute Time Setting),* This test allows the user to set up the write and read operation in each segment as a function of absolute time so that test results can be closely correlated similar to popcorn noise test.

For VEE program, the following parameters have been added and/or modified:

- The following spindle speed limitations must be taken into account, when the user specifies the 'RPM' parameter in the [Setup] menu. When RPM is set below 2400, the system will automatically set the spindle speed to 2400[rpm]. When RPM is set above 2400, then the user's specified spindle speed will be used. Refer to the "hpe5022_measureStability" and "hpe5022_measureAbsStability" functions of the programming manual for details.

Spindle Speed Limitations
RPM = spindle speed, when spindle speed ≥ 2400 [rpm]
RPM = 2400 rpm, when the spindle speed is set below 2400 [rpm

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Changes in Revision A.03.70 from Revision A.03.60

For VEE program, the following measurements have been added and/or modified:

- [Burst Pattern Write] has been added in the Erase&Write menu. This allows the user to write multi-burst patterns on the disk which are used as position information for microactuator test.
- [Data Rate Sweep] has been added in the BER's main menu. This measurement adopts both the channel quality [Ch Quality] and bit error rate [BER] measurement.

For VEE program, the following parameters have been added and /or modified:

- The parameter "Endec" has been removed from the BER Measurement menu of BER.
- The parameter "Endec" has been removed from the Ch Quality Measurement menu of BER.
- The parameter "Ch Qual. Config" has been added in the Ch Quality Measurement menu of BER. This parameter depends on each read channel IC.
- The parameter "Ch Qual. Config" has been added in the Optimize menu of BER. This parameter depends on each read channel IC.
- The parameter "Save Trace" has been added in the CBR Sweep, RollOff and Track Profile (except Micro Track and Fast Micro Track) measurement menus as shown in Table A-1. This allows the user to save swept measurement data in VEE.

Table A-1 Save Trace Parameter

Main Menu	Measurement Menu	Trace Window
Track Profile	TAA	
	Narrow Band TAA	
CBR Sweep	TAA	TAA Trace
		TAA Asym. Trace
	PW	PW Trace
		PW Asym Trace
	NLTS 5th Harmonic	
	Overwrite	
	Narrow Band TAA	
RollOff	TAA	TAA Trace
		TAA Asym. Trace
	Narrow Band TAA	

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For VEE program, modifications for [Head Amp Config] parameter is as follows:

- The parts number and serial number of the installed head amplifier can be shown in the [Head Amp Config.] menu.

When you click on [About Agilent Technologies E5022A] the parts number and serial number of the head amplifier board will be reported. If the BER module is installed in the system, the name of its read channel IC will also be reported.

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Changes in Revision A.03.60 from Revision A.03.50

For VEE program, the following measurements have been added and/or modified:

- SHNR (sub-harmonic noise ratio) measurement has been added. This measurement allows the user to measure the signal to noise ratio and to detect baseline popping over various sense current and off-track positions.
- The “Optimize” menu in BER Measurement has been modified. This modified version allows the user to measure the channel quality right after setting up the sequence. Also the user can select the type of sequence setup, either “Standard Sequence” or “Custom Sequence” can be selected for optimization.

For VEE program, the following parameters have been added and/or modified:

- The parameter “Acceleration” has been added in the [Spinstand] menu. This parameter allows the user to change the acceleration of the spindle rotation in order to avoid disk slip.
- The minimum ‘skew’ angle setting in the “Setup” and “Advanced Head Load Configuration” menu has been increased from -30 to -60 degrees.
- The maximum and minimum number of repetitive periods that can be set in the [Pattern Config] menu for the following data patterns have been modified as follows:

Table A-2 Number of Repetitive Periods

Data Pattern	Min.(Old)	Min.(New)	Max. (Old)	Max. (New)
Overwrite LF	4	**1**	20	**50**
Overwrite HF	1	**1**	4	**50**
LF	4	**1**	20	**50**
HF	1	**1**	4	**50**
Isolated Pulse	5	**1**	50	**50**

The instructions for Auto Alignment Program have been moved to the Service Manual. Refer to the service manual for details.

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Changes in Revision A.03.50 from Revision A.03.40

For VEE program, the following measurements have been added and/or modified:

- Popcorn Noise Test using E5041A (dual counter module) has been added. Software Rev 3.50 supports this new popcorn noise test when you install E5041A.

- The Absolute Polarity measurement has been modified. The user can specify his own data pattern by setting the [Pattern Mode] parameter to “User Mode”.

Fast Auto Alignment Program, the auto alignment program has been modified for faster alignment. It takes approximately 5 minutes to complete the alignment compared to its previous version (Rev 3.40 and earlier) that takes roughly 30 minutes to finish.

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Changes in Revision A.03.40 from Revision A.03.30

For VEE program, the following measurements have been added :

- The Absolute Polarity Test is added. This test is used to detect the pinned layer reversal of the GMR head by measuring the TAA asymmetry of both the Isolated pulse and Tribit pulse.
- Narrow Band TAA is added in the Stability Measurement.

The following parameters have been added and /or modified:

- For Stability Measurement, the parameters “Write Pattern” and “Write Mode” have been added in [Write Config] menu. The “Write Pattern” parameter is used to set the stimulus write pattern different from the original write data pattern. The “Write Mode” allows the user to choose the same or alternative last polarity of write.
- For Popcorn Noise Measurement, the parameter “Write Mode” is added.
- Data patterns are displayed in ‘MHz’ except for PRBS and User Define in the [Pattern Config] menu.
- For Stability Measurement of TAA/PW, the number of sectors (segments) per track has been increased from 5 to 80 sectors.

More user defined write patterns were added, three additional patterns for each Repetitive and User Defined pattern. Refer to the programming manual for details.

Shroud Interlock, the spindle stops when the shroud cover is open.

User definable write/read gate, the user can specify where to write or read on a track. Refer to the programming manual for details.

Bug Fix, software bugs that were found too late to be fixed before the release of revision (Rev A.03.30) have been fixed in Rev A.03.40.

- The “hpe5022_narrowBandTaa_Q” function doesn’t return the average measurement results instead it returns the total sum of all measurement points.
- When the “hpe5022_isolatedPulseReferenceAuto” function is set to VI_TRUE, the query of the Narrow Band TAA Track Profile returns an error message.

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Changes in Revision A.03.30 from Revision A.03.2x

As a result of the spin off from Hewlett-Packard Company, the Hewlett-Packard name brand and HP logos will all be changed to Agilent Technologies and Agilent Technologies logos effective November 1, 1999. From this transition period all existing documents that refer to Hewlett-Packard will be changed to Agilent Technologies.

For VEE Program, the function to [Abort] long measurement has been added in the following :

- [BER] (without optimize) test of the bit error measurement
- [747] test of the bit error measurement
- [Bath Tub] test of the bit error measurement
- Popcorn Noise measurement
- Spectral SNR measurement
- Spectrum Measurement

The number of sequences that can be setup have been increased from 25 to (approximately) 50 sequences. This depends on the measurement sequence.

Motion program enhancement, this eliminates unnecessary noise pops during home and measurement positions.

The spinstand firmware should be downloaded from the installer when you upgrade software Rev3.21 to Rev3.30.

Importing the library and including declaration file for software Rev3.30 and later revisions.

When you update the system software the new destination directory for Rev 3.30 will be C:\Program Files\Agilent\E5022. In line with this the set PATH of the “autoexec.bat” will be changed. In addition the path name of the import library of E5022A VEE will also be changed. Before you install software Rev3.30 it is recommended that you uninstall Rev3.21. However, when you uninstall Rev3.21and earlier revisions, use the installer process to uninstall. “. Do not use the “Control Panel>>Add/Remove Program” icon or any other manual means to uninstall.

- You must import the library file and include the declaration file at the beginning of every program that contains Agilent Technologies E5022A function calls.

  When you create your own application programs either by VEE, Visual Basic or Visual C++, you need to do the following.

  — For VEE, the file “hpe5022_32.dll” under the directory “c:\Program Files\Agilent\E5022\bin” should be imported. The file named “hpe5022_vee.h” under the directory “c:\Program Files\Agilent\E5022\include” should be included as a definition file. For Rev3.30 you need to change the path name of the “hpe5022_32.dll” and recompile the .vxe files

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— For Visual Basic, the file “hpe5022.bas” under the directory “c:\Program Files\Agilent\ E5022\include” should be added in the development environment as an object file.

— For C language, the file “hpe5022.h” under the directory “c:\Program Files\Agilent\E5022\include” should be included. The file named “hpe5022_32.lib” under the directory “c:\Program Files\Agilent\E5022\lib” should be linked. You need to change the path setting of the “include/LIB” files in the development environment for software Rev3.30.

When downgrading Rev3.30 to software Rev3.21 and earlier revisions.

Since you can not use both Rev3.30 and Rev3.21 at the same time i.e, it can not co-exist. When you downgrade software Rev3.30 to software Rev3.21 and earlier revisions, you need to do the following.

- Uninstall software Rev3.30. See “Note” on page 41
- Install software Rev3.21 or earlier software revisions.

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Changes in Revision A.03.2x from Revision A.03.10

- The fast micro track profile measurement is added to provide a faster measurement of the micro track profile.
- For TAA measurement, The parameter of modulation has been added as a measurement result.
- For Spectrum Measurement and Spectral SNR Measurement, the video band width (VBW) is added as a parameter.
- The customer designed cassettes can be used by setting the dimension of the cassette.
- The format of store/restore is changed so that all parameters can be saved. As file format is retrievable, you can restore files saved from the previous revision. It is recommended that you restore files saved from the previous revision.

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Changes at Revision A.03.10 from Revision A.03.00

- The parameter ‘Average’ is added in the following measurement menus.
  - BER Measurement
  - 747 Measurement
  - Bath tub Measurement
  - Channel Quality Measurement
- For Bit Error measurement, the ‘Initialize for Optimization’ parameter is added in the Optimize Menu.
- For Popcorn Noise Measurement, the read aperture time parameter has been added that allows you to set the time to read the data. Also, the number of segments per track is set automatically.
- For Triple Track Measurement, the data pattern for adjacent track can be selected. Also DC and AC data patterns can be selected as erase pattern.
- For the spectrum analyzer, the display can be turned on which allows you to observe the measurement waveform.
- The function of the read/write offset is set automatically after the head movement.This has been added in the setup menu. When this function is turned on, the track profile measurement is done automatically after track number is changed, then read/write offset is set. This function is valid only for the HP VEE demo program.
- The serial number of the system and each module is made viewable in the “About Agilent E5022A” menu.

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Changes at Revision A.03.00 from Revision A.02.1x

- The auto disk alignment program is changed. This improves the accuracy of the auto alignment.
- For VEE program, the following measurements have been added.
  - BER Measurement Functions
  - Spectrum Measurement Functions
  - Spectral SNR Measurement Functions
- The maximum value of Max Track in the spinstand menu is changed from 20,000 to 1,000,000
- The maximum value of segment # in the popcorn measurement menu is changed from 5 to 10.

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Changes at Revision A.02.1x from Revision A.02.0x

- Extension Head Load Configuration is added.
- Popcorn Measurement is added.
- The definition of SNR measurement has changed. Inputting the noise level reference is required.
- The baseline parameter is deleted from the parametric measurement.
- Program Read Offset function is added on the TAA Track Profile and Triple Track Profile measurement. (This function is in VEE Demo Program only.)
- Auto TAA Range function is added on the TAA Track Profile and Triple Track Profile measurement.
- Meas. Type function is added for TAA, PW, Baseline, Waveform Analysis, Narrow band TAA and SNR measurements.
- The triple track profile measurement is changed as follows
  - Performing the three track erase process is selectable.
  - The value of OTRC Write Pos. is changed from the absolute value to the ratio value of write track width.
  - Band Erase Configuration Menu is added.

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B Error Messages

This appendix describes possible error messages that will appear on the PC monitor and LCD display of the spinstand when you operate Agilent E5022A.

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Error Messages on PC Monitor Display

Table shows the error messages that could appear on the PC monitor display when you use a demo program or other programs created by the user.

Error Messages on PC Monitor Display

Error Code	Description
hpe5022_ERROR_AUTO_CONFIG_FAILED	The auto configuration has failed. Check if the parameter and head is correct.
hpe5022_ERROR_AUTO_RANGE_FAIL	The auto range has failed. Check if the parameter and head is correct.
hpe5022_ERROR_CAL_DATA_CORRUPT	Calibration data stored in the system or head amplifier board was corrupt. Need to perform the calibration again.
hpe5022_ERROR_CAL_FAILED	Calibration is failed. Check the configuration and cabling, then re-try the calibration.
hpe5022_ERROR_CLOSE	Unable to close some components (instruments and the spinstand).
hpe5022_ERROR_CONFLICT_PREC_PATTERN	The precompensation pattern has conflict.
hpe5022_ERROR_D50_NOT_FOUND	Can’t find the D50 parameter point. Check the result of the roll off measurement.
hpe5022_ERROR_DATA_CORRUPT	The measurement data is corrupt. Check if your measurement sequence is correct.
hpe5022_ERROR_EXCESS_TRACK_DATA	The data overflows a track at one revolution. Change the setting of the user data rate, rpm, track number, track format or sector format.

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Error Messages on PC Monitor Display

Error Code	Description
hpe5022_ERROR_FILE_ACCESS	Data log file in the auto alignment operation can not be created.
hpe5022_ERROR_FUNCTION_NOT_LOADED	Unable to load the DLL file. Perform the E5023A installation software or check if the file is installed in the PC. The location of DLL file is described in Chapter 2 of the programming manual.
hpe5022_ERROR_HARD	Detected a hardware error in the system.
hpe5022_ERROR_HARD_HAMP	Detected a hardware in the head amplifier board.
hpe5022_ERROR_HARD_MISS	The media or HGA cassette is missing or the selected hardware is not installed. Check if they are placed properly.
hpe5022_ERROR_INACCURATE_BER	Too many Bit Error Rate happens and measurement result is not correct. Need to optimize the measurement.
hpe5022_ERROR_INTERNAL	Unexpected internal error occurred.
hpe5022_ERROR_INTERLOCK	The spinstand is out of air or vacuum or emergency switch has been turned on. Check if air or vacuum is supplied to the spinstand or reset the emergency switch.
hpe5022_ERROR_INV_BAS_HNDL	Detected the invalid base segment handle parameter in UDS. Check your program.
hpe5022_ERROR_INV_BAS_ID	Detected the invalid base segment ID parameter in UDS. Check your program.

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Error Messages on PC Monitor Display

Error Code	Description
hpe5022_ERROR_INV_DATA_SIZE	In the user defined data pattern, the length of specified data pattern is shorter than the specified user data bit length.
hpe5022_ERROR_INV_DATA_TYPE	The specified data pattern for the user define data pattern includes an invalid character. (either binary nor hexadecimal)
hpe5022_ERROR_INV_DRIVE_CONDITION	The spinstand drive is in improper condition When this message is displayed while the drive is on, turn off the drive. If this is displayed while the drive is off, turn on the drive.
hpe5022_ERROR_INV_GATE_TIME	Gate setting is invalid in the BER measurement. Check your program.
hpe5022_ERROR_INV_ID	The handle ID is invalid. Check if the handle ID in your program is correct.
hpe5022_ERROR_INV_PARAMETER	The parameter is out of range.
hpe5022_ERROR_INV_POSITION	The specified head position is in the inhibit area. Check the HP part number of cassette, the inhibit area, the HGA dimension, the data area and the specified track number.
hpe5022_ERROR_INV_REGISTRY_DATE	Detected the invalid registry data.
hpe5022_ERROR_INV_SEG_HNDL	Detected the invalid segment handle parameter in UDS. Check your program.
hpe5022_ERROR_INV_SEG_ID	Detected the invalid segment ID parameter in UDS. Check your program.

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Error Messages on PC Monitor Display

Error Code	Description
hpe5022_ERROR_INV_SEQ	Sequence is invalid. Check your program.
hpe5022_ERROR_INV_SEQ_HNDL	Detected the invalid sequence handle parameter in UDS. Check your program.
hpe5022_ERROR_INV_SETUP	Detected an error in operation. There must be some illegal set-up in the parameters. Check your program.
hpe5022_ERROR_INV_TRIG_PORT	Invalid trigger port is selected as the parameter 'trigPort'.
hpe5022_ERROR_MEM_ALLOC	Can't allocate enough memory. Reboot your PC.
hpe5022_ERROR_MEMORY	Check sum error occurred in the calibration data or user data.
hpe5022_ERROR_MICRO_TRACK_FAILED	Failed to create a micro track. The measured TAA level did not reach the specified level. Check the parameters for micro track measurement.
hpe5022_ERROR_MOTOR_FAULT	An error is detected in the motor or servo of the spinstand. Check the spinstand and restart the system.
hpe5022_ERROR_NO_OPTION	An option is not installed to perform the required measurement and function.
hpe5022_ERROR_NOT_INIT	System is not initialized. Check if the required modules and options are installed.
hpe5022_ERROR_NDEF_HGA	The cassette parameters and type are undefined. Specify the cassette parameter.

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Error Messages on PC Monitor Display

Error Code	Description
hpe5022_ERROR_NSUP_CHAN_IC	The DLL for the installed channel IC is not installed. Install the E5039B/C option software.
hpe5022_ERROR_NSUP_CONF	Detected software configuration errors. Check your program.
hpe5022_ERROR_NSUP_FUNC	Detected a mismatch between measurement functions, firmware and hardware. Check the revisions of those.
hpe5022_ERROR_NSUP_HAMP	The installed head amplifier is not supported. Check if the DLL file named head amplifier's part number is in the directory of "c:\Program Files\Agilent\E5022\bin\". If there is no the DLL file, update the E5023A software or contact Agilent Technologies for DLL file.
hpe5022_ERROR_NSUP_HGA_CASSETTE	The specified HGA cassette type is not supported. Check the specified Agilent Parts number. If it is correct, check if the DLL file named Agilent cassette's part number is in the directory of "c:\Program Files\Agilent\E5022\bin\". If there is no the DLL file, update the E5023A software or contact Agilent Technologies for DLL file.
hpe5022_ERROR_NSUP_PREC	Write Pre-compensation function is not supported on the current system configuration. (Pre-compensation is supported only with E5037A.)

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Error Messages on PC Monitor Display

Error Code	Description
hpe5022_ERROR_NSUP_SENS_CURR_POL	The head does not support the reverse polarity on a stability measurement. Set the polarity at normal.
hpe5022_ERROR_OPEN	Unable to open some components in initialization. (instruments and the spinstand).
hpe5022_ERROR_OPT_FAIL	The optimization is failed.
hpe5022_ERROR_OVERFLOW	An overflow is detected in the parametric module. Perform the auto configuration (input range) or Check if the setting parameter is correct.
hpe5022_ERROR_PARAMETER_SET_FAILED	The acquisition parameters are invalid for an oscilloscope. Reduce the value of the over sampling rate, the wave averaging factor or the channel bit rate.
hpe5022_ERROR_PEAK_NOT_FOUND	The peak can’t be found in the track profile result. Check if the track profile is performed properly.
hpe5022_ERROR_PES_DATA	Effective position error signal data can not be measured.
hpe5022_ERROR_PLL_UNLOCK	The PLL is unlocked. Check if the parameter setting is correct.
hpe5022_ERROR_QUEUE_OVERFLOW	Error queue overflows.
hpe5022_ERROR_RESAMP_FAILED	The waveform resampling has failed.
hpe5022_ERROR_REVISION	The revision between system software and module firmware in not same. Reinstall E5023A software.

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Error Messages on PC Monitor Display

Error Code	Description
hpe5022_ERROR_RESET	Unable to reset on some components (instruments and the spinstand).
hpe5022_ERROR_SERCH_TRACK_FAILED	Detected an error and failed the operation in searching the track.
hpe5022_ERROR_SEG_COMPLETE	Segment is already completed in UDS. Check your program.
hpe5022_ERROR_SEG_IN_EDIT	Segment is not completed in UDS. Check your program.
hpe5022_ERROR_SELFTEST	Unable to perform selftest on some components (instruments and the spinstand)
hpe5022_ERROR_SEQ_COMPLETE	Sequence is already completed in UDS. Check your program.
hpe5022_ERROR_SEQ_IN_EDIT	Sequence is not completed in UDS. Check your program
hpe5022_ERROR_SEQ_NOT_SETUP	Sequence is not set-up in UDS. Check your program.
hpe5022_ERROR_SHROUD_OPEN	The shroud cover is open. Close the shroud cover when the drive is on.
hpe5022_ERROR_SPINSTAND_SPECIFIC	Detected the spinstand specific errors.
hpe5022_ERROR_STAGE_INHIBIT_POS	The target position of a head is set in the inhibit area on the media.
hpe5022_ERROR_THRESHOLD_NOT_FOUND	The threshold level is not found for PW measurement or OTC calculation.
hpe5022_ERROR_THERMAL_ASPERITY	Thermal Asperity Detected. Check the head and media. This error occurs when the overflow is detected but the average of measurement is under the limit.

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Error Messages on PC Monitor Display

Error Code	Description
hpe5022_ERROR_TOO_MANY_RETRY	Spinstand stage is not positioned within a certain range after retry. Call Agilent Service office.
hpe5022_ERROR_TRACK_OFFSET_COMP_FAILED	Track offset compensation is failed. Check if the all measurement conditions are correct.
hpe5022_ERROR_UNAVAILABLE_PINNO	Unavailable pin number is assigned for the S/S TTL I/O. Check the available pin number.
hpe5022_ERROR_UNDERFLOW	An underflow is detected in the parametric module. Perform the auto configuration (input range) or check if the setting parameter is correct.

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Error Messages on the LCD of the Spinstand Controller

The table below shows the error messages that could appear in the LCD on the front panel of the spinstand.

Error Message for LCD on the Spinstand Front Panel

Error Message	Description
Neg Limit Fault, Axis (1, 3)*1	The encoder of X or Y stage is over the limit. Reset the spinstand.
Pos Limit Fault, Axis (1, 3)	The encoder of X or Y stage is over the limit. Reset the spinstand.
Amp Fault, Axis (1, 3 or 5)	Amplifier could be in malfunction. Contact the Agilent Technologies office.
Encoder error, Axis (1, 3 or 5)	The encoder might be in malfunction. Contact the Agilent Technologies office.
Air Interlock Fault	The spinstand is out of air or vacuum or emergency switch has been turned on. Check if air or drawn air is supplied to the spinstand or reset the emergency switch.

*1. Axis 1 : X stage (Spindle Stage) , Axis 3: Y stage (HLM Stage), Axis 5: spindle

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Error Messages of the Auto Disk Alignment

The table below shows the error messages that could appear when Auto Disk Alignment is performed.

Table B-1 Error Message at Auto Disk Alignment

Error Message	Description
Can't converge the track position	The starting position is wrong or the X-Y positioning could be inaccurate. Retry the auto disk alignment. If it fails again, contact the Agilent Technologies service center

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C Cassette and Z-Height Adjustment

This appendix provides the information about the cassette and its Z-Height Adjustment for E5022A/B.

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Z-height Adjustment for E5029C/D Cassettes

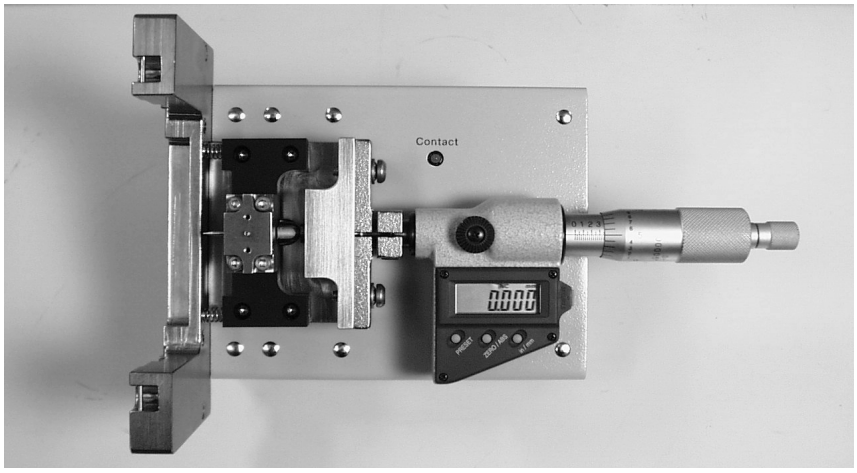
The Z-height adjustment tool is used to adjust the Z-height of the HGA mount face. The Z-height Adjustment tool is included in the Agilent E5029C Option Zxx (xx represents a two-digit number). This section provides the Z-height adjustment procedure of E5029C Option C11. Other cassettes have the same adjustment procedure.

Table C-1 Required Tools

Tools	Size
Hex Screwdriver	1.5 mm
Hex Screwdriver	0.89 mm
Hex Screwdriver	0.71 mm
Slotted Screwdriver	

1. Prepare the Z-height Adjustment tool. The Z-height Adjustment tool is included in the Agilent E5029C Option Zxx (xx represents a two-digit number).

Figure C-1 Z-height adjustment tool

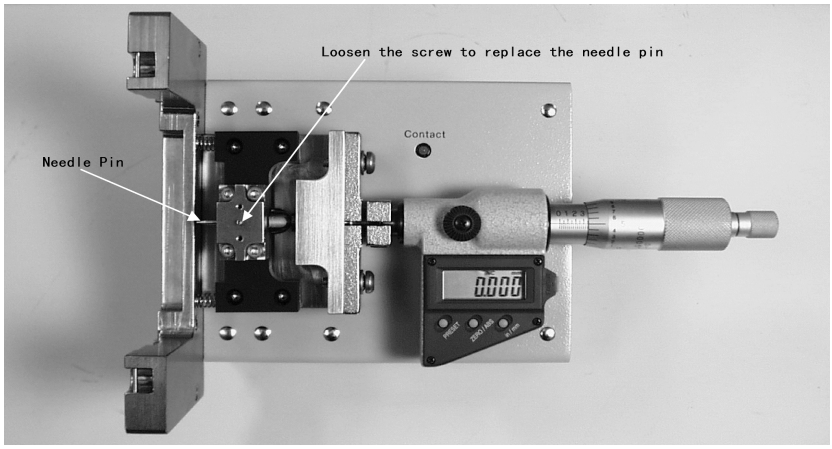


2. Select one of the three pin holes that will be used to measure the cassette's Z-height as shown in Figure C-2 and Figure C-3.

NOTE The location of the needle pin of the Z-height tool (i.e. short, medium or long) should match the length of the HGA Mount block assembly in which the user decides to use. Refer to Figure C-12.

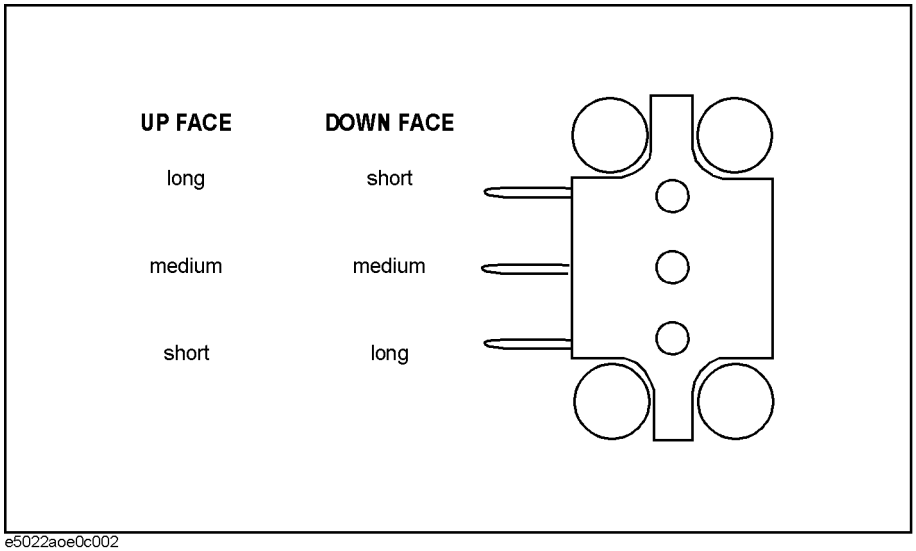
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Figure C-2 Needle Pin Replacement



3. To replace the needle pin in Figure C-2, use a 0.71-mm hex screwdriver to loosen the screw that locks the needle pin. Then select the pin hole to be used for measurement as shown in Figure C-3.

Figure C-3 Needle Pin Position



e5022aoe0c002

4. Rotate the micrometer knob downwards to keep needle pin away.
5. Attach the zero gauge cassette (shown in Figure C-4) on the Z-height adjustment tool completely. The user can use either sides (i.e, down face or up face) of the tool as long as the locking pin of the cassette is compatible with the docking hole of the Z-height tool as shown in Figure C-5.

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Figure C-4 Zero Gauge Cassette

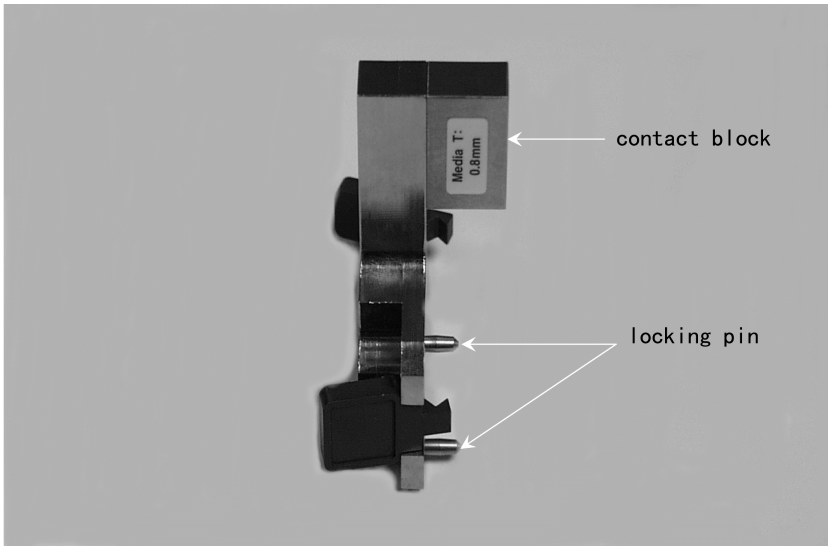
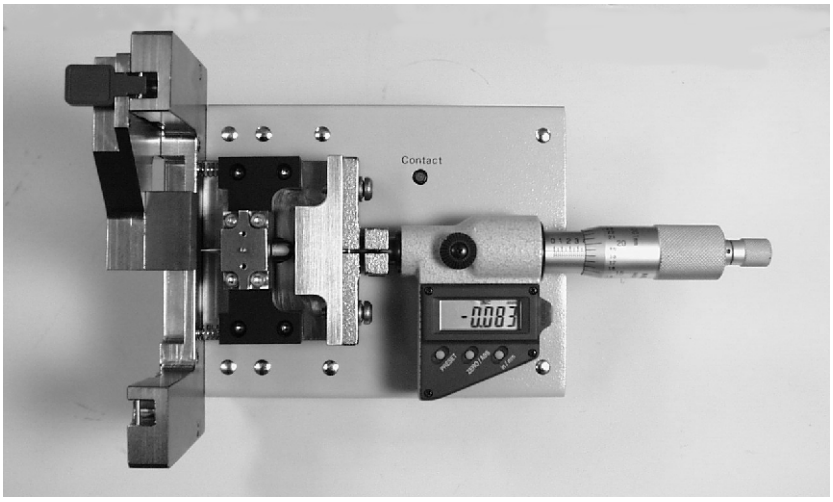


Figure C-5 Attaching Zero Gauge Cassette (Down Face)



NOTE When the FIC length of cassette is adjustable such as E5029C Option C11, the letters “s” (short length), “m” (medium length) and “l” (long length) is added as subscript to the cassette’s part number (e.g, “E5010-61145s”, “E5010-61145m” or “E5010-61145l”). Refer to Figure 3-3, “Cassette Parameter Setup Menu.”

6. Rotate the micrometer knob upwards until the needle pin touches the contact block of the zero gauge cassette as shown in Figure C-5.
7. Check the LED of the Z-height tool. When the needle pin touches the contact block the LED will turn on. At this stage, stop rotating the micrometer knob.
8. Push the “ZERO/ABS” button to set the zero height value to zero.
9. Remove the zero gauge cassette.
10. Rotate the micrometer knob upwards and set the micrometer reading to the required

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height. The “R” reading can be calculated from the equations below.

NOTE For standard disk thickness (0.8-mm), the micrometer reads direct Z-height (i.e, R=Z). For non-standard disk thickness (e.g, 1.0-mm and others), the user must compensate the “R” value by using the equations below.

In case of mm :

$$R = ÐZÐ(T Ð 0.8)$$

R = Read setting (mm)

Z = Z-height (mm)

T = disk thickness (mm)

In case of inch :

$$R = Ð Z Ð (T Ð 0.0315)$$

R = Read setting (inch)

Z = Z-height (inch)

T = disk thickness (inch)

Table C-2 Example in setting the Z-height

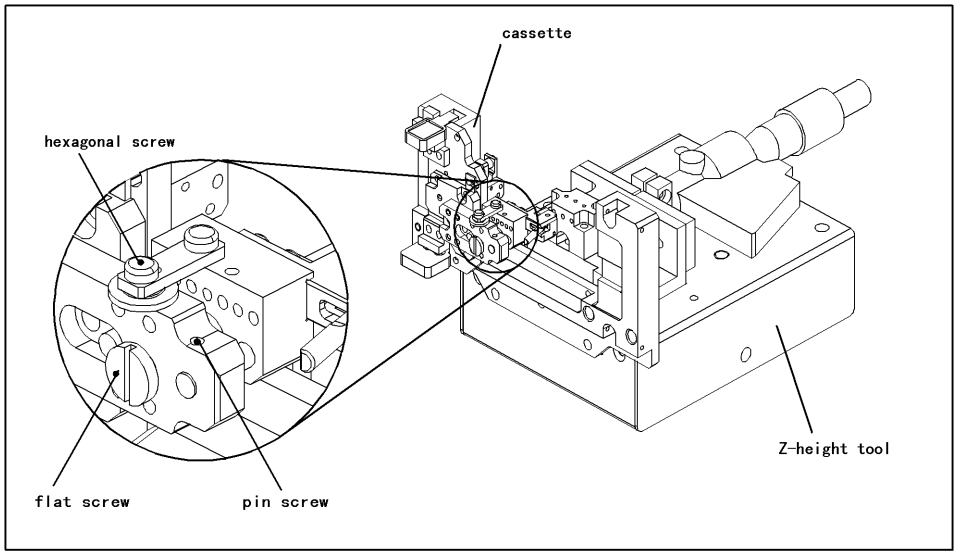
Disk Thickness (T)	Z-height (Z)	Read setting (R)
0.8 mm (standard)	0.65 mm	-0.65 mm
1.0 mm (non-standard)	0.65 mm	-0.85 mm

11. Before attaching the cassette to be adjusted, slightly loosen the pin and the hexagonal screws located on top of the cassette as shown in Figure C-6 (i.e, magnified view). To adjust the pin screw use a 0.89-mm or 0.035” hex screwdriver, to adjust the hexagonal screw use a 1.5-mm hex screwdriver.

NOTE When working on **step 10** DO NOT ATTACH the cassette on the Z-height adjustment tool yet.

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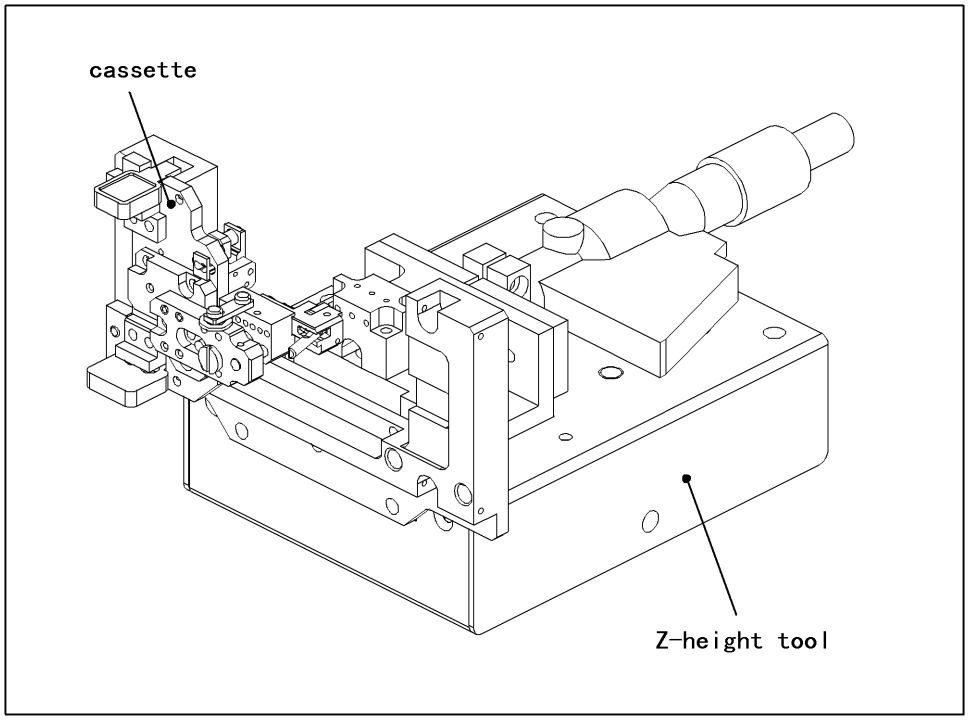
Figure C-6 Adjusting the height of the cassette



e5022aoexc004

12. Loosen the flat screw located on top of the cassette as shown in Figure C-6 until the Z-height is almost at its highest position. Use a slotted screw driver.
13. Attach the cassette to the Z-height adjustment tool as shown in Figure C-7.

Figure C-7 Attaching the Cassette

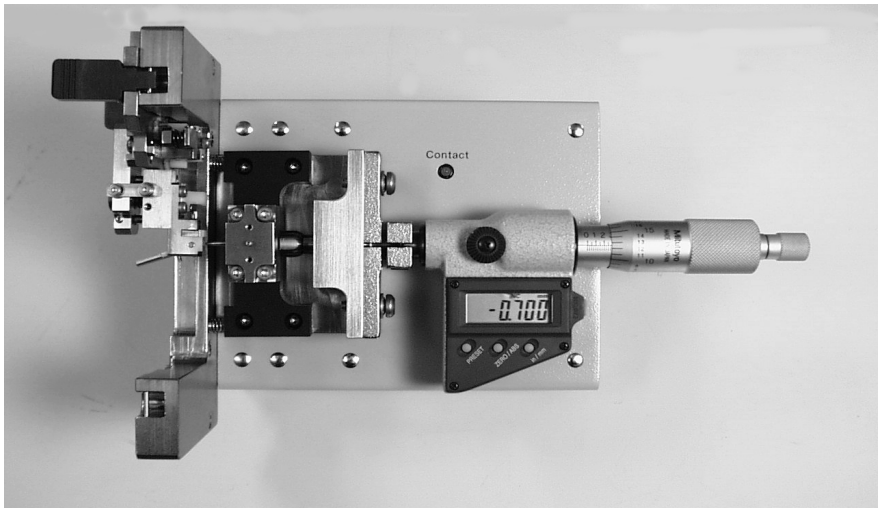


e5022aoexc005

14. Slowly tighten the flat screw until the LED turns on.

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Figure C-8 Measuring the Z-height of the Cassette



15. Carefully tighten up the pin screw and the hexagonal screw to fix the Z-height position.

NOTE When you tighten up the hexagonal screw (upper), the torque of the driver must be 0.1N·m (1 Kgf·cm).

16. Remove the cassette from the Z-height adjustment tool.

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Battery Replacement Procedure for Micrometer and Z-height Tool

Z-height tool has batteries inside. This section provides the battery replacement procedure.

Table C-3 Required Tools

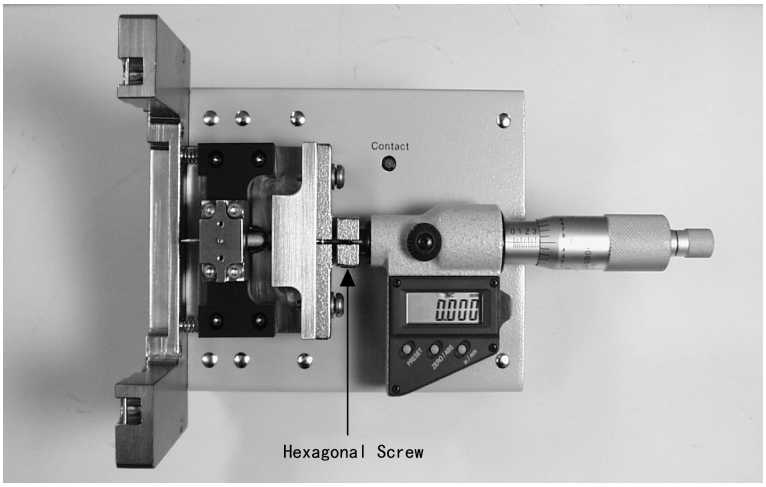
Tools	Size
Hex Screwdriver	2.5 mm
Hex Screwdriver	2.0 mm
Cutting Pliers	
Slotted Screwdriver / Coin	

Table C-4 Required Parts

Parts	Part Number	Qty.
Button type battery 1.55V	commercially available (SR44 / LR44)	1
Lithium battery 3V	1420-0338	1
Cable tie	1400-0249	1

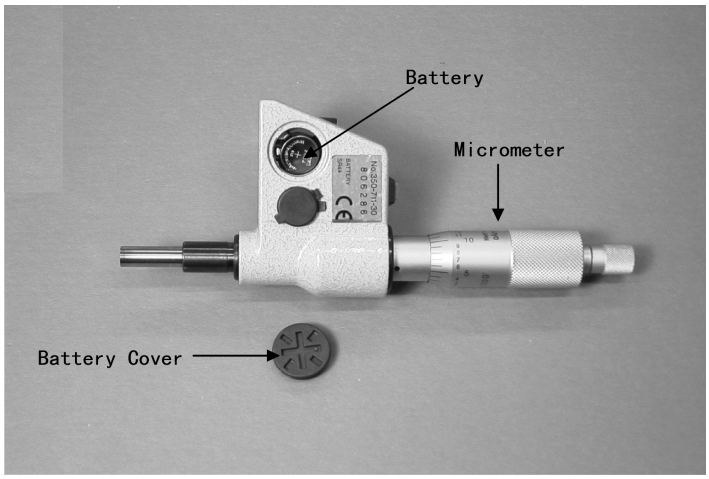
1. Remove the micrometer as shown in Figure C-9, use a 2.5-mm hex screwdriver to loosen the hexagonal screw that locks the micrometer.

Figure C-9 Removing the micrometer



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2. Remove the battery cover (black button) by turning it counter-clockwise using slotted screwdriver or coin.



3. Remove the battery and replace it with a 1.55-V button type battery (SR44 or LR44). This battery is commercially available. Typically this battery lasts for one year.
4. Replace the battery cover by turning it clockwise using a slotted screwdriver or coin.
5. Turn the Z-height tool down face and remove **6** hexagonal flat screws from the bottom cover of the Z-height tool using 2-mm hex screwdriver as shown in Figure C-10.

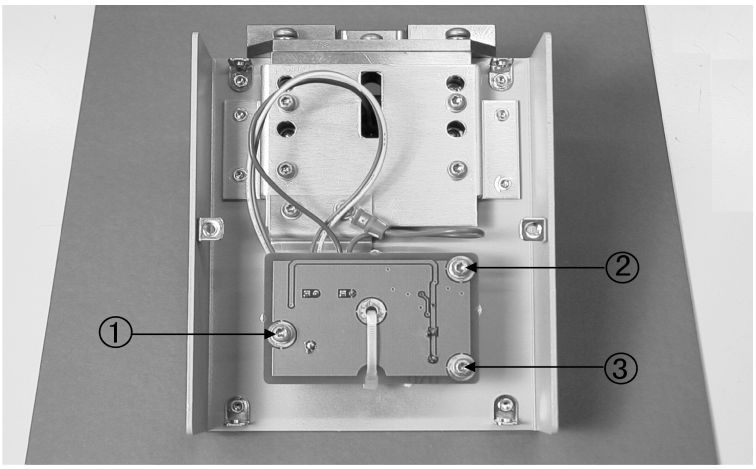
Figure C-10 Removing the bottom cover



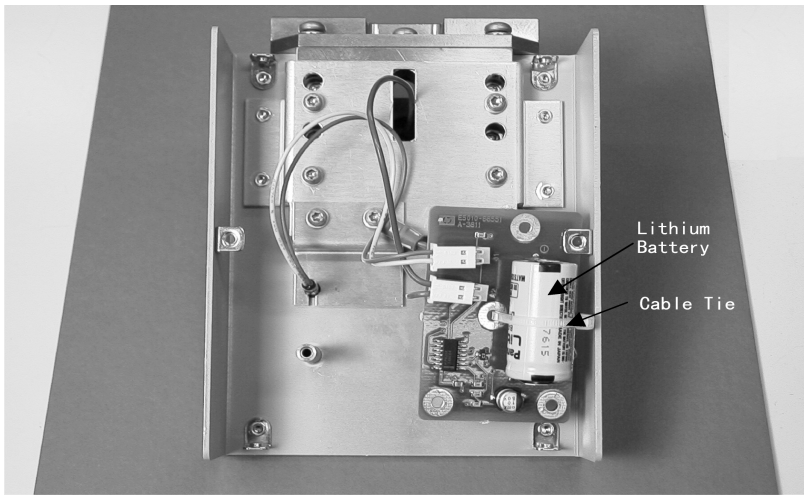
6. Unscrew **3** hexagonal round screws from the pc board using a 2-mm hex screwdriver as shown in Figure C-11.

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Figure C-11 Removing the pc board



7. Remove the cable tie with a cutting plier.



8. Remove the lithium battery and replace it with a new one. The battery is not soldered to the pc board, it is connected to the pc board through the battery holder. The battery rating is 3V, 2/3A. (Refer to Table C-4).

NOTE Observe correct polarities when you replace the battery.

9. Wrap the battery with a cable tie. (cable tie part number: 1400-0249).
10. Replace the pc board to its original location as in Figure C-11.
11. Screw 3 hexagonal round screws using 2-mm hex screwdriver.
12. Replace the bottom cover into the Z-height tool housing.
13. Screw 6 hexagonal flat screws using 2-mm hex screwdriver.
14. Replace the micrometer into the slot of the Z-height tool.
15. Tighten up the hexagonal screw as shown in Figure C-9 to fix the micrometer using 2.5-mm hex screwdriver.

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Adjusting the FIC length

The length of the FIC can be adjusted if it is FIC type cassette. This length can be adjusted in three different settings i.e., short, medium or long. This procedure shows the E5029C option C11. Other cassettes have the same adjustment procedure.

Table C-5 Required Tools

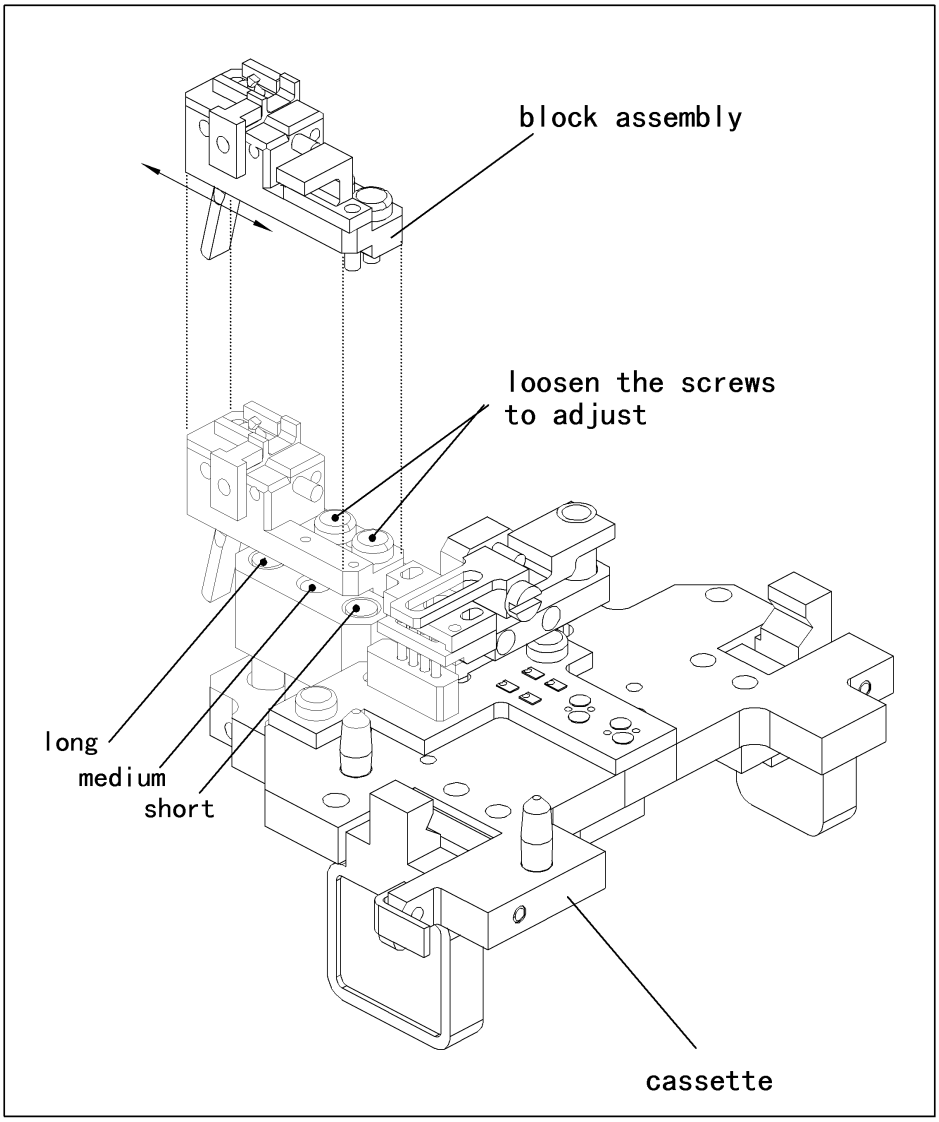
Tools	Size
Hex Screwdriver	1.5 mm

1. Before measuring the Z-height of the cassette, you must set the length of the HGA mount block assembly. This length can be adjusted into three different settings i.e., short, medium or long as shown in Figure C-12.
2. Remove the two screws as shown in Figure C-12 using a 1.5-mm hex screwdriver.
3. Slowly tighten up the screws after setting the desired length of the FIC block.

NOTE The location of the needle pin of the Z-height tool (i.e. short, medium or long) should match the length of the HGA Mount block assembly in which the customer decides to use. Refer to Figure C-7.

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Figure C-12 Adjusting the HGA Mount block assembly



e5022aoexc003

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QM Stopper Replacement Procedure

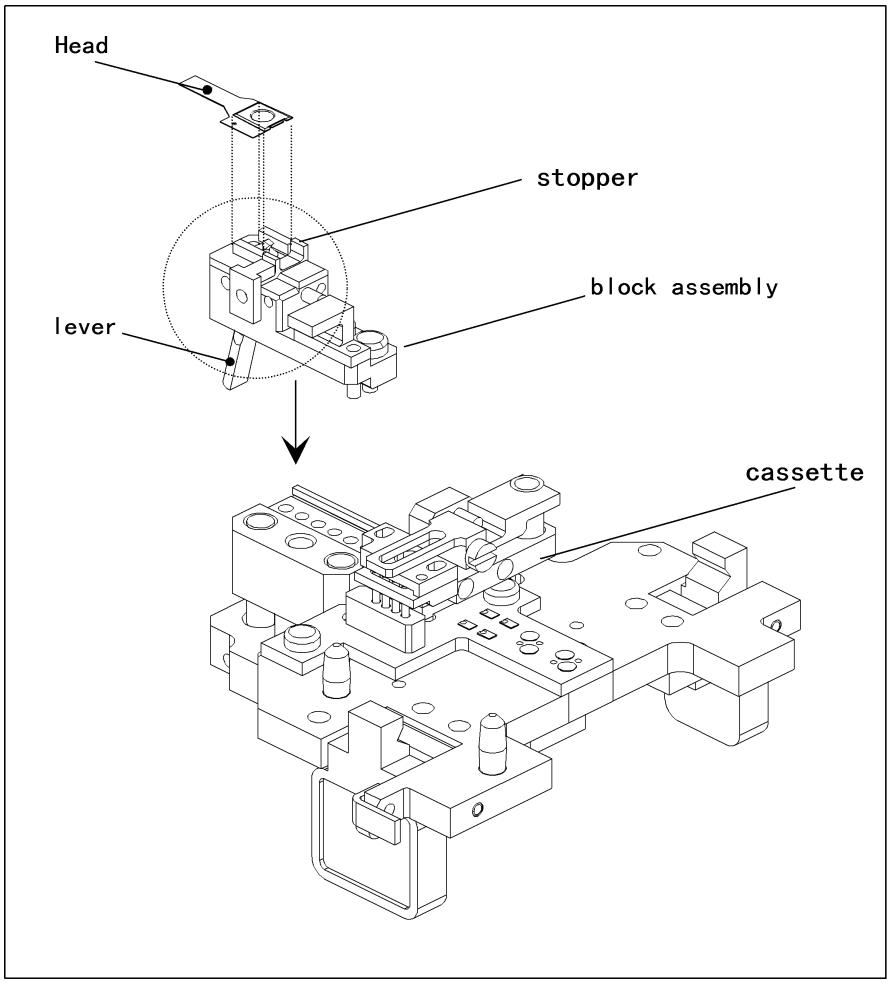
The type of HGA bottom can be changed on some cassettes. This procedure shows the E5029C option C11 type. Other cassettes have the same replacement procedure.

Table C-6 Required Tools

Tools	Size
Hex Screwdriver	1.5 mm
Hex Screwdriver	0.71 mm
Long Nose Pliers	

1. Set the stopper of the block assembly relative to the type of head to be used for measurement.

Figure C-13 FIC block disassembly

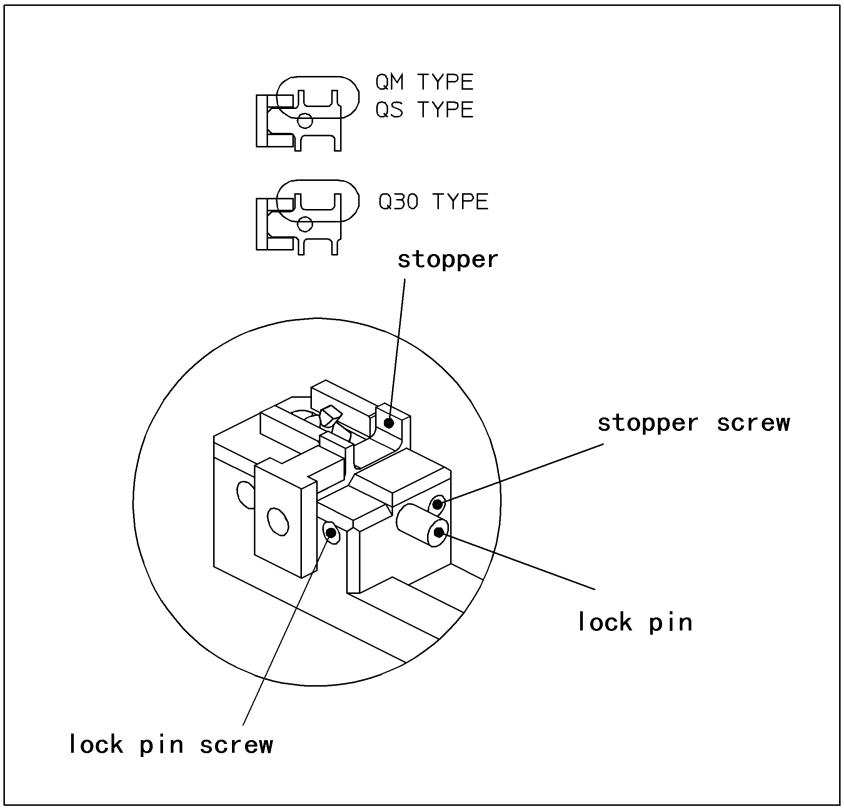


e5022aoexc001

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2. To set the type of stopper to be used, first disassemble the HGA Mount block assembly from the cassette as shown in Figure C-13. Use a 1.5-mm hex screwdriver to remove 2 hexagonal screws from the block assembly.

Figure C-14 Removing the stopper from the block assembly



e5022aoexc002

3. Loosen the lock pin screw using a 0.71-mm (0.028”) hex screwdriver.
4. Loosen the stopper screw using a 0.71-mm (0.028”) hex screwdriver.
5. Remove the lock pin using a long nose pliers.
6. Attach the type of stopper to be used either QM/QS or Q30 type.
7. Insert the lock pin. The lock pin is slightly protruded outside the assembly.
8. Slowly tighten up the lock pin screw and stopper screw using a 0.71-mm (0.028”) hex screwdriver.

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D Measurement Using 4396B

This appendix provides the information when you make a measurement using high frequency spectrum analyzer 4396B. Users can use their own 4396B in order to make a high frequency spectrum measurements.

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Introduction for Measurement using 4396B

The high frequency spectrum measurement is available when 4396B is connected with E5022/E5023 system. Although Agilent does not provide 4396B as a option of E5022A, users can use 4396B as one of module such as 4395A. The available measurements are:

- Spectral SNR Measurement
- Spectrum Measurement
- Channel Bit Rate Sweep Measurement for Narrow Band TAA
- Roll Off Measurement for Narrow Band TAA

NOTE When the system has the optional E4402B 3GHz spectrum analyzer, the 4396B can not be used on the system.

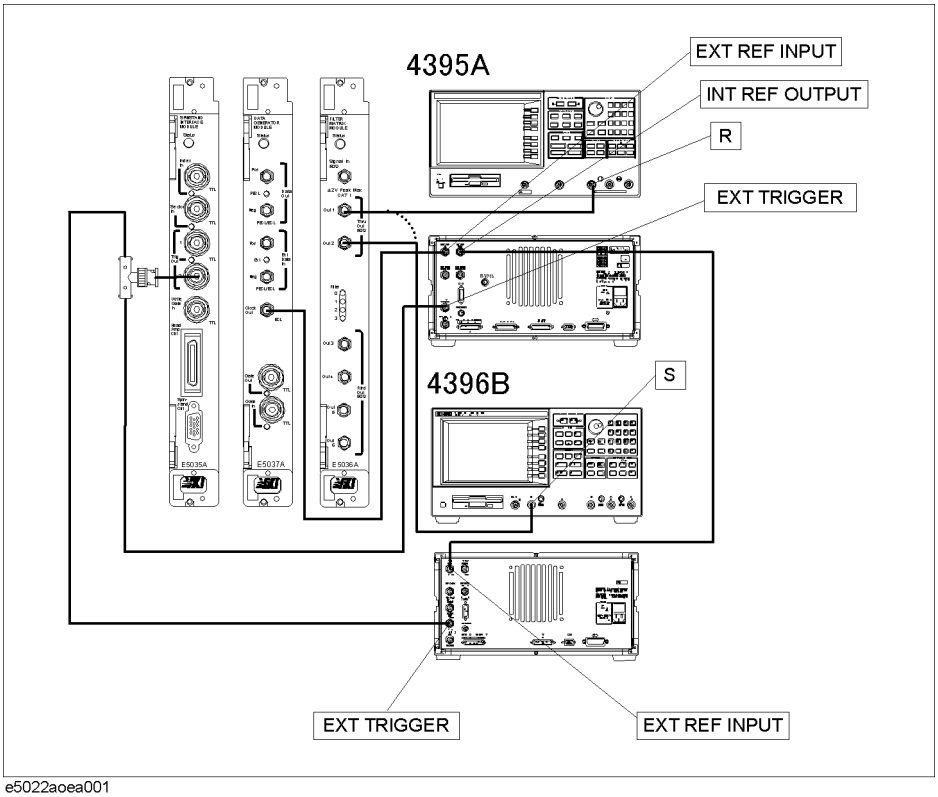
4396B Connection

Figure D-1 shows the connection of 4396B. When your system does not have E5039A/B/C, connect the “Out 2” port on E5036A with the “S” port on 4396B. However, when your system has E5039A/B/C, the port is used. In this case, you have to swap one of the cables with the cable for 4396B input S when you begin to make a measurement for 4396B.

The GPIB cable should be connected with 4396B. Its address of 4396B must be set at 18.

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Figure D-1 Connection for 4396B



e5022aoea001

Required Parts

Table D-1 shows the required parts for 4396B measurement.

Table D-1 Recommended Parts List

Description	Connection		Part Number
BNC(m)-BNC(m) Cable	E5035A “Trig Out 2”	4396B “ExtTrigger”	E5022-61613
BNC(m)-BNC(m) Cable	4395A “Ext Ref Output”	4396B “Ext Ref Input”	E5022-61613
SMA(m)-SMA(m) Cable	E5036A “Filtrd Out 2” or E5036A “Filtrd Out 1”	4396A “Input S”	E5022-61623
SMA(m)-N(m) Adapter	4396A “Input S”		1250-1250
BNC Tee (m) (f) (f) Adapter	E5035A“Trig Out 2”		1250-0781*1

*1. When your system has E5039A/B/C, the adapter (Part Number 21900) made by Amphenol Corporation is recommended because of spacing between the other cables.

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Making a Measurement

The VEE measurement program detects 4396B automatically during its initialization process. Then, the menu for 4396B measurement is available under the following measurement button of the main menu. The display and usage for measurement are the same as ones for 4395A.

- SNR
- Measure Spectrum
- CBR Sweep
- Roll Off

When you create a program by yourself, the resource name of 4396B must be added in hpe5022_init() function. See the programming manual for detail. The functions for 4396B measurement are described in the chapter 5 of the programming manual.

NOTE Once you change the setting of 4396B after pressing [local] button on its front panel in order to observe your desired measurement, the E5022/E5023 measurement using 4396B becomes invalid after that.

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E Module/Head Amplifier/Cassette/Filter Lists

This appendix provides the information of head amplifiers, cassettes and filters.

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Module

Table E-1 Supported Revision for Each Module

Module	Opt.	Description	Supported Revision
E5035A*1		Spinstand I/F Module	A.01.00 and above
E5035B		Spinstand I/F Module	B.01.00 and above
E5036A		Filter Matrix Module	A.01.00 and above
E5037A*1		Data Generator Module	A.01.00 and above
E5037B*1		1 Gbps Data Generator Module	A.04.00 and above
E5037C		1.5 Gbps Data Generator Module	B.01.00 and above
E5037D		2.6 Gbps Data Generator Module	B.03.00 and above
E5038A*1		Parametric Measurement Module	A.01.00 and above
E5038B		Parametric Measurement Module	B.01.00 and above
E5039A*1	P10	Bit Error Test Module	A.03.30 and above
	P11		A.03.30 and above
	P12		A.03.40 and above
	P13/P14		A.04.20 and above
	P20		A.03.30 and above
	P21		A.03.30 and above
	P22		A.03.81.02 and above
	P30		A.03.30 and above
E5039B*1	All	Bit Error Test Module	B.01.00 and above
E5039C	All	Bit Error Test Module	B.02.50 and above
E5040A		Spectrum Measurement Module	A.04.10 and above
E5041A		Dual Counter Module	A.03.50 and above
E5043A		Head Amplifier Control	B.01.00 and above
E5043C		Head Amplifier Control	B.03.00 and above
4395A*1		Spectrum Analyzer	A.01.00 and above
4396B		Spectrum Analyzer	A.03.81.04 and above
E4402B		Spectrum Analyzer	B.04.00 and above
		Oscilloscope	A.01.00 and above

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Table E-1 Supported Revision for Each Module

Module	Opt.	Description	Supported Revision
E5010B*1		Spinstand	A.01.00 and above
E5011A*1		Small Profile Spinstand	A.04.10 and above
E5010C*1		High TPI Spinstand	B.01.00 and above
E5013A		High TPI Small Profile Spinstand	B.01.00 and above

*1. Obsolete.

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E5029C Cassettes

Table E-2 E5029C Cassettes List

Option Number	Down Face Part Number	Up Face Part Number	Support Firmware Revision
C01	E5010-61121	E5010-61122	All Revision
C02	E5010-61147	E5010-61148	A.03.10 and above
C03	E5010-61125	E5010-61126	All Revision
C04	E5010-61129	E5010-61130	All Revision
C05	E5010-61149	E5010-61150	A.03.10 and above
C06	E5010-61151	E5010-61152	A.03.10 and above
C07	E5010-61133	E5010-61134	All Revision
C08	E5010-61153	E5010-61154	A.03.10 and above
C09	E5010-61141	E5010-61142	All Revision
C11	E5010-61145	E5010-61146	A.03.30 and above
C15	E5010-61157	E5010-61158	A.03.30 and above
C16	E5010-61159	E5010-61160	A.03.60 and above
C18	E5010-61161	E5010-61162	A.03.60 and above
C19	E5010-61163	E5010-61164	A.04.10 and above
C20	E5010-61165	E5010-61166	A.04.10 and above
C21	E5010-61167	E5010-61168	A.04.20.01 and above

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E5029D Amplifier on Cassette

Table E-3 E5029D Amplifier on Cassettes List

Opt. No	Down Face Part Number	Up Face Part Number	Z-Height Tool Option Number	Z-Height Tool Part Number	Support Firmware Revision
001	E5010-61211	E5010-61212	Z01	E5010-61531	A.03.70 and above
002	E5010-61221	E5010-61221	Z02	E5010-61532	A.03.70 and above
003	E5010-61231	E5010-61232	Z03	E5010-61531	A.03.81 and above
006	E5010-61261	E5010-61262	Z06	E5010-61533	A.03.81 and above
008	E5010-61281	E5010-61282	Z08	E5010-61532	A.04.00 and above
009	E5010-61291	E5010-61292	Z09	E5010-61533	A.04.10.02 and above
012	E5010-61291	E5010-61292	Z09	E5010-61533	A.04.10.02 and above

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E5029E Amplifier on Cassette

Table E-4 E5029E Amplifier on Cassettes List

Opt. No	Down Face Part Number	Up Face Part Number	Z-Height Checker Fixture Option Number	Support Firmware Revision
001	E5012-60011	E5012-60012	500	B.01.00 and above
002	E5012-60021	E5012-60022	501	B.01.01 and above
003	E5012-60031	E5012-60032	500	B.01.01 and above
004	E5012-60041	E5012-60042	500	B.01.00 and above
005	E5012-60051	E5012-60052	500	B.01.00 and above
006	E5012-60061	E5012-60062	500	B.01.10 and above
007	E5012-60071	E5012-60072	500	B.01.10 and above

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E5029H Head Amplifiers

Table E-5 E5029H Head Amplifiers List

Option Number	Part Number	Supported Firmware Revision
H09	E5022-66509	A.03.60 and above
H10	E5022-66511	All Revisions
H11	E5022-66513	All Revisions
H12	E5022-66512	All Revisions
H13	E5022-66510	All Revisions
H14	E5022-66514	A.03.20 and above
H15	E5022-66515	A.04.00 and above
H16	E5022-66516	A.03.60 and above
H18	E5022-66518	A.03.60 and above
H19	E5022-66519	A.03.50 and above
H20	E5022-66520	A.03.60 and above
H21	E5022-66521	A.03.50 and above
H23	E5022-66523	A.03.60 and above
H24	E5022-66524	A.03.81.02 and above
H25	E5022-66525	A.03.60 and above
H26	E5022-66526	A.04.00 and above
H28	E5022-66528	A.03.70.02 and above
H29	E5022-66529	A.03.81.02 and above
H30	E5022-66530	A.03.81.02 and above
H31	E5022-66531	A.03.81.01 and above
H32	E5022-66532	A.04.20.03 and above
H33	E5022-66533	A.04.20.02 and above
H34	E5022-66534	A.04.20.02 and above
H35	E5022-66535	A.04.30.03 and above
H36	E5022-66536	A.04.20.05 and above
H37	E5022-66537	A.04.30.06 and above

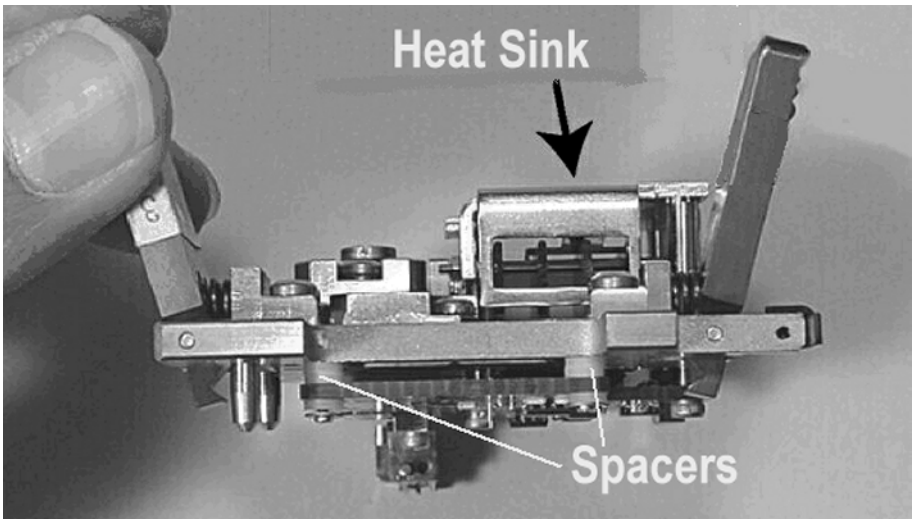
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E5029J Buffer Board

Table E-6 E5029J Buffer Boards List

Option Number	Part Number	Description
001	E5022-66001	For universal head amplifiers
002	E5022-66002	For commercial head amplifiers
003	E5022-66003	For SSI 833
004	E5022-66004	For commercial head amplifiers (for the thermal-drift-performance-improved cassette)*1

*1. The thermal-drift-performance-improved cassette has the head think and the spacers between board and its base. See the picture below.



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E5029J Head Amplifiers for Amplifier on Cassette

Table E-7 E5029J Head Amplifiers List

Opt.	Face	Board P/N	Lever P/N	Support Firmware Revision
101	DN	E5022-66101		A.03.70 and above
	UP	E5022-66102		
201	DN	E5022-66201	E5010-61701	
	UP	E5022-66202	E5010-61702	
213	DN	E5022-66213	E5010-61707	
	UP	E5022-66214	E5010-61708	
223	DN	E5022-66223	E5010-61701	
	UP	E5022-66224	E5010-61702	
401	DN	E5022-66401	E5010-61707	
	UP	E5022-66402	E5010-61708	
403	DN	E5022-66403	E5010-61707	
	UP	E5022-66404	E5010-61708	
301	DN	E5022-66101		
	UP	E5022-66102		
601	DN	E5022-66601		
	UP	E5022-66602		
611	DN	E5022-66611	E5010-61731	
	UP	E5022-66612	E5010-61732	
617	DN	E5022-66617	E5010-61733	
	UP	E5022-66618	E5010-61734	
607	DN	E5022-66607	E5010-61713	A4.00.01 and above
	UP	E5022-66608	E5010-61714	
619	DN	E5022-66619	E5010-61713	
	UP	E5022-66620	E5010-61714	
203	DN	E5022-66203	E5010-61701	A.03.70 and above
	UP	E5022-66204	E5010-61702	

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Table E-7 E5029J Head Amplifiers List

Opt.	Face	Board P/N	Lever P/N	Support Firmware Revision
215	DN	E5022-66215	E5010-61701	A.04.00.01 and above
	UP	E5022-66216	E5010-61702	
217	DN	E5022-66217	E5010-61707	A.04.00.01 and above
	UP	E5022-66218	E5010-61708	
613	DN	E5022-66213	E5010-61751	A.04.10.03 and above
	UP	E5022-66214	E5010-61752	
219	DN	E5022-66219	E5010-61701	A.04.00.01 and above
	UP	E5022-66220	E5010-61702	
221	DN	E5022-66221	E5010-61707	A.04.00.01 and above
	UP	E5022-66222	E5010-61708	
209	DN	E5022-66209	E5010-61701	A.03.81 and above
	UP	E5022-66210	E5010-61702	
103	DN	E5022-66103	N/A	A.03.81 and above
	UP	E5022-66104		
105	DN	E5022-66105	N/A	A.03.81.04 and above
	UP	E5022-66106		
109	DN	E5022-66109	N/A	A.04.30 and above
	UP	E5022-66110		
107	DN	E5022-66107	N/A	A.04.10.02 and above
	UP	E5022-66108		
627	DN	E5022-66127	E5010-61715	A.04.20.03 and above
	UP	E5022-66128	E5010-61716	

Table E-8 E5029J Head Amplifiers List

Opt.	Board P/N (Up/Down)	Down Lever P/N	Up Lever P/N	Support Firmware Revision
701	E5029-66701			A.04.30.07 and above
703	E5029-66703			A.04.40 and above
704	E5029-66704			A.04.40 and above

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E5029K Buffer Board

Table E-9 E5029K Buffer Boards List

Option Number	Part Number for Onstage Buffer Board	Part Number for Connection Board	Description
001	E5023-66504	E5023-66505	For universal head amplifiers
002*1	E5023-66506	E5023-66507	For commercial head amplifiers
004	E5023-xxxx	E5023-xxxx	For commercial head amplifiers

*1. Obsolete.

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E5029K Head Amplifiers for Amplifier on Cassette

Table E-10 E5029K Head Amplifiers List

Opt.	Board P/N	Down Lever P/N	Up Lever P/N	Support Firmware Revision
101	E5023-66101			B.01.00.02 and above
201	E5023-66201	E5012-60701	E5012-60702	B.01.00 and above
202	E5023-66202	E5012-60703	E5012-60704	B.01.00 and above
203	E5023-66203			B.01.10 and above
207	E5023-66207			B.01.20 and above
209	E5023-66209	E5012-60701	E5012-60702	B.01.20 and above

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E5029F Filter Board

Table E-11 E5029F Filter Boards List

Option Number	Part Number	Filter Type	Frequency
F01	N/A	Low Pass Sets	100/200/300/400 MHz
F02	E5036-66575	Low Pass	75 MHz
F03	E5036-66571	Low Pass	100 MHz
F04	E5036-66576	Low Pass	150 MHz
F05	E5036-66572	Low Pass	200 MHz
F06	E5036-66577	Low Pass	250 MHz
F07	E5036-66573	Low Pass	300 MHz
F08	E5036-66574	Low Pass	400 MHz
F09	E5036-66578	Band Pass	15 MHz
F10	E5036-66579	Band Pass	30 MHz
F11	E5036-66511	Low Pass	350 MHz
F12	E5036-66512	Low Pass	450 MHz
F13	E5036-66513	Low Pass	500 MHz
F14	E5036-66514	Low Pass	160 MHz
F30	E5036-66531	Band Pass	0.5 to 2 MHz
F31	E5036-66532	Band Pass	3 to 80MHz
F32	E5036-66533	Band Pass	10 to 80 MHz
F33	E5036-66534	Band Pass	0.5 to 3.5MHz
F34	E5036-66535	Band Pass	0.5 to 4 MHz
F35	E5036-66536	Band Pass	3 to 130 MHz
F98	E5036-66599	Through	
F99	E5036-66598	Blank	

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F Cable Loss Compensation for E5023A

This appendix provides the information about the cable loss compensation for E5023A.

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Introduction

Since the cable loss is not negligible in the high bit rate measurement, E5023A compensates the cable loss.

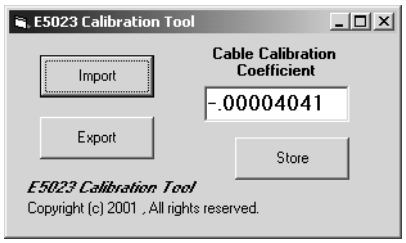
The cable loss factor is stored in the PC. It is a typical value which is determined from the standard cables furnished with E5023A. Generally, user does not care about this since it is installed at the factory shipment. When you upgrade the E5022A to the E5023A and replace the PC with one does not have the value, you have to install this value.

Installation of the Compensation Factor

Execute the program named “caltool.exe” in order to install the calibration loss factor into the PC. You can download it from the website of “Service & Support” at the URL “http:\\dst.tm.agilent.com\”.

1. Execute the “caltool.exe” program on the PC.
2. The Figure F-1 is displayed. The current stored value is displayed in the text box.

Figure F-1 Caltool Dialogue



3. Input the value for the cable compensation in the text box, then click on the [store] button. The value of the provided cables for E5023A is -0.00004041.
4. The [Import] and [Export] buttons allow you to store the value into a file.

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G E5029K Connection Board Maintenance

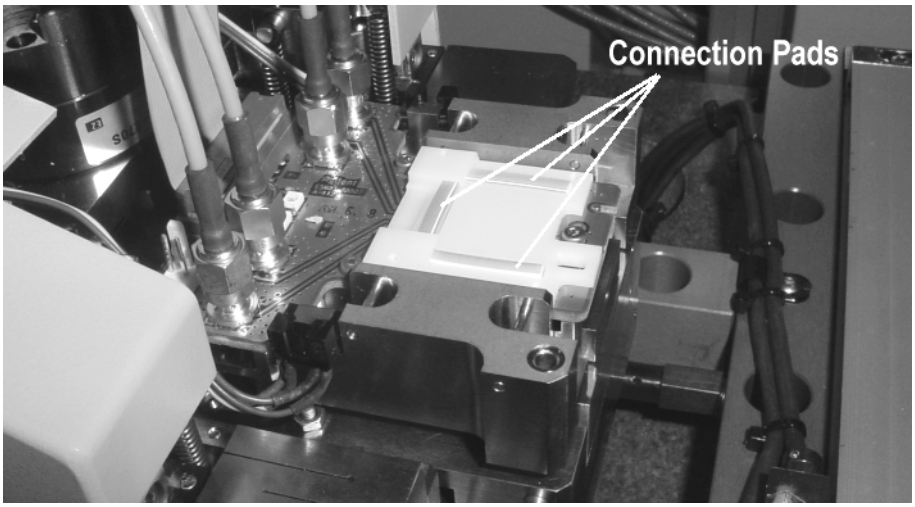
This appendix describes how to maintenance of the connection board.

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Connection Pads Maintenance

The connection board has pads to contact between the cassette and the connection board.

Figure G-1 **Connection Pads**

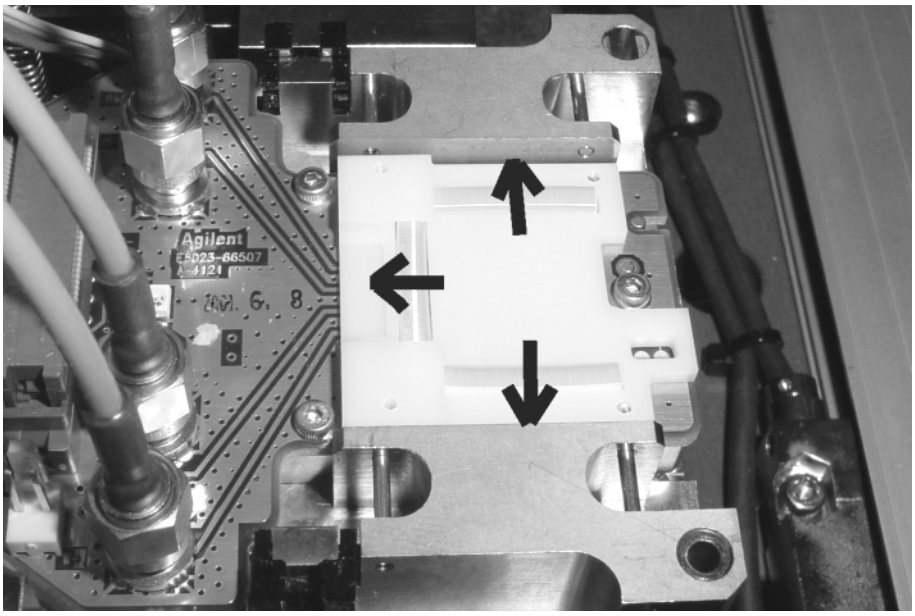


Cleaning the Pads

To clean contamination, use a cotton swab with alcohol. Wipe them from the inside out as shown in Figure G-2.

CAUTION Do not wipe them from the outside in. This causes damage on the pads.

Figure G-2 **Direction of Cleaning the Pads**



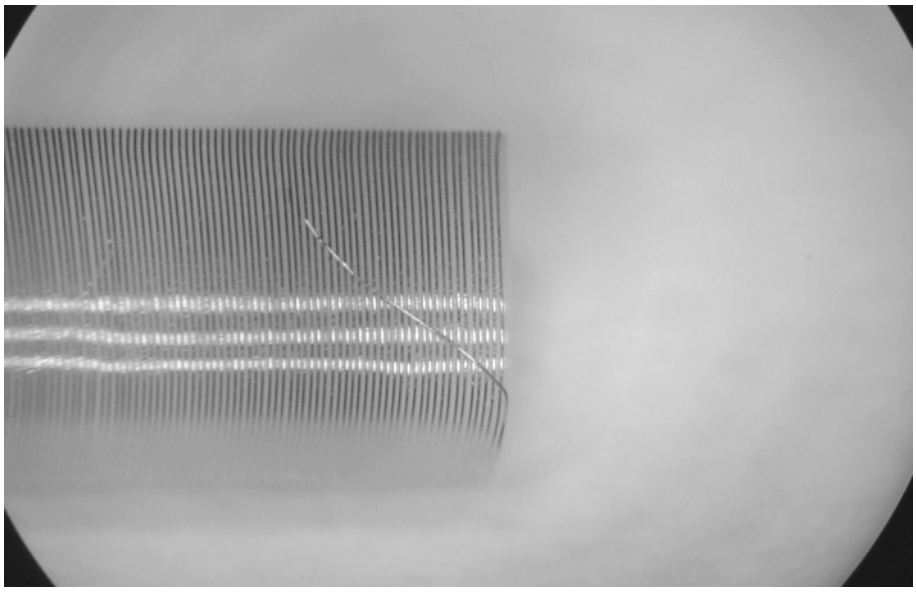
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Inspecting the Pads Condition

The life time is approximately 100,000 contacts. However, improper operation might damage the wire on the pad as shown in Figure G-3. This causes the short circuit between the terminals on the connection board.

Four sets of this are furnished with the system as spares. When you need them more, order PN E5029-65001 (10 sets of pads).

Figure G-3 **Damaged Connection Pad**

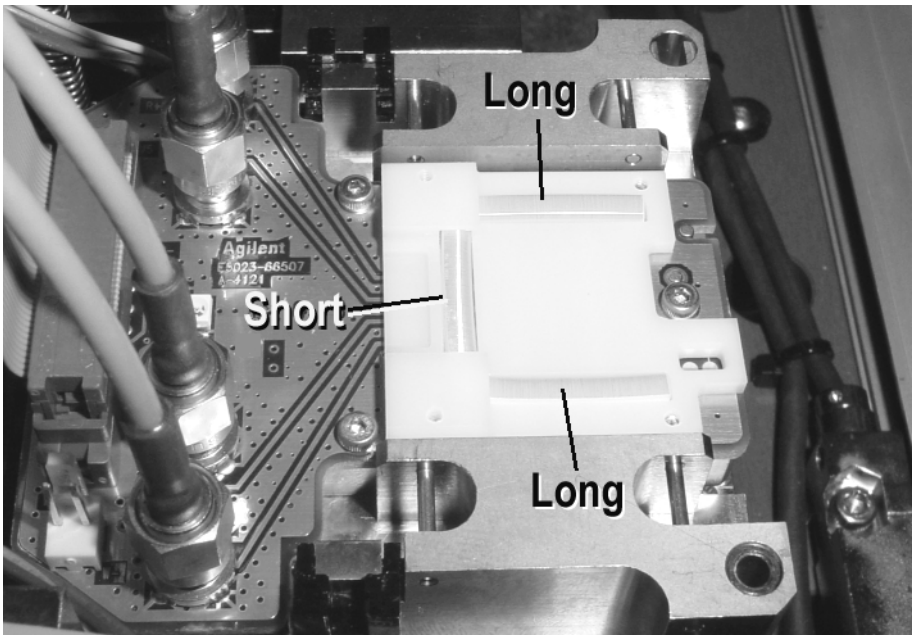


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Connection Pad Replacement

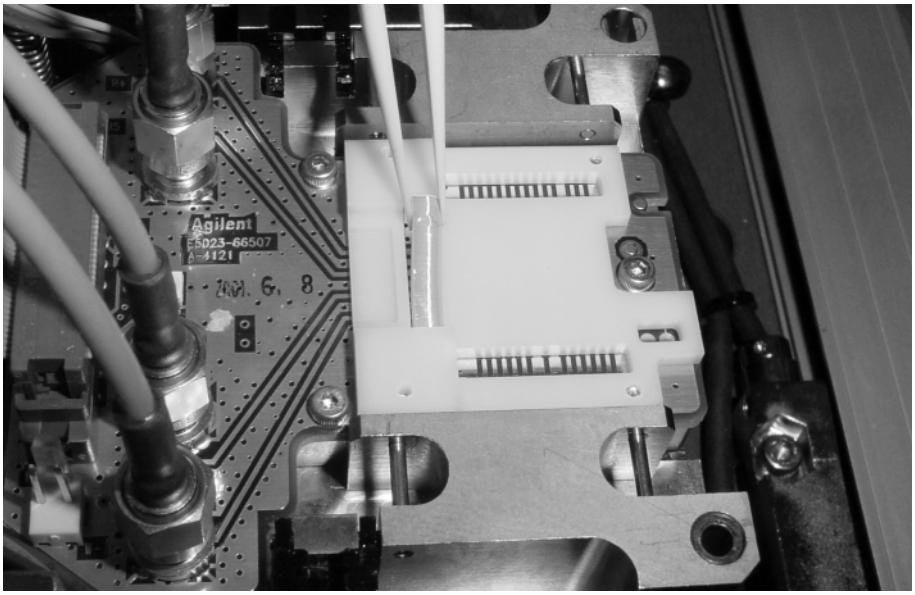
Step 1. There are two length of the connection pads as shown in Figure G-4.

Figure G-4 **Pad Length**



Step 2. Remove the connection pads from the connection board with tweezers. First, remove the long pads, then remove the short one.

Figure G-5 **Removing Pads**



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CAUTION Do not re-use the pads once you remove them with tweezers. Because the pads might have been damaged by tweezers.

Step 3. Clean the ditchs and confirm there is no dust.

Step 4. Mount the new short pad on the board with fingers. Do ware gloves. Do not use tweezers. The orientation of the pad is shown in Figure G-7.

Figure G-6 Mounting the Short Pad

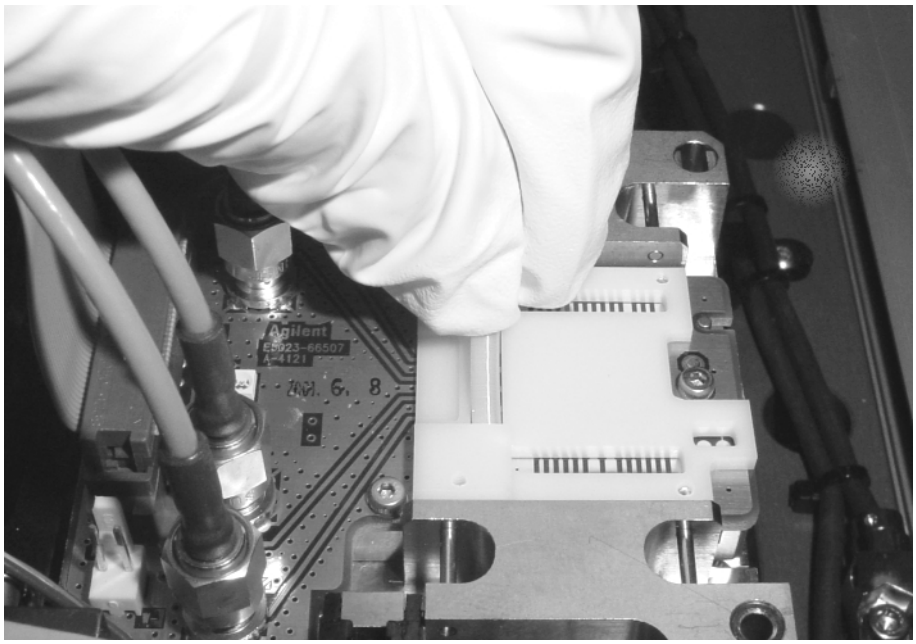
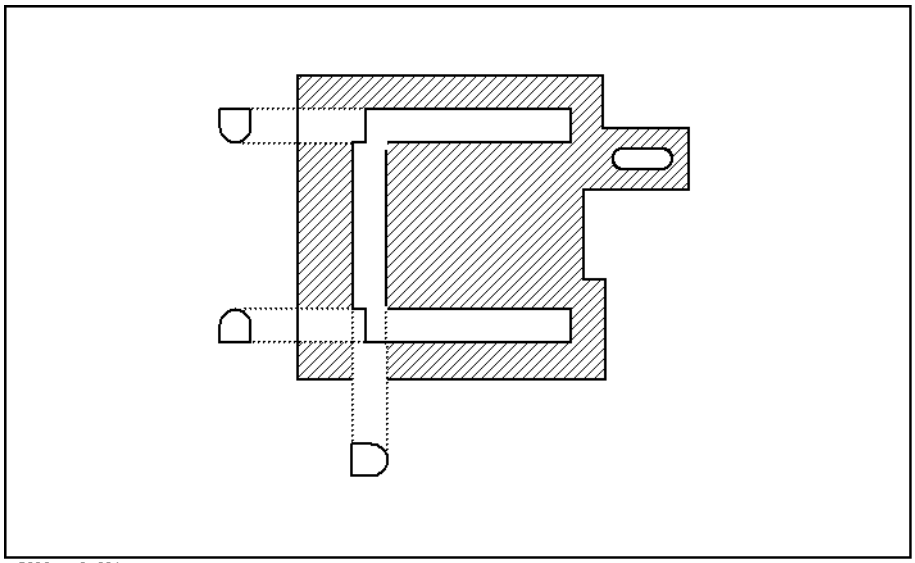


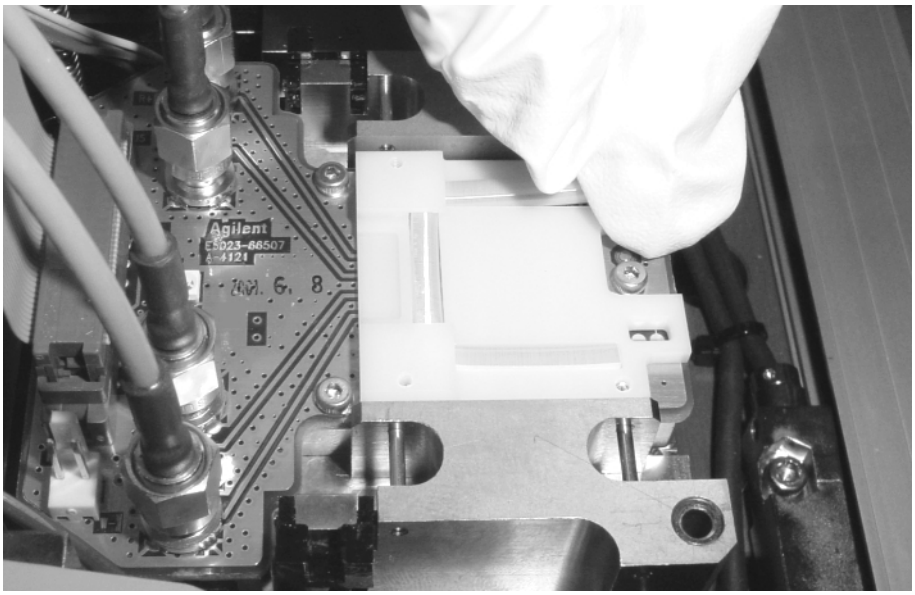
Figure G-7 Pads Orientation



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Step 5. Mount the new long pads with fingers.

Figure G-8 Mounting the Long Pad



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H Ramp Load

This appendix describes how to perform a ramp load.

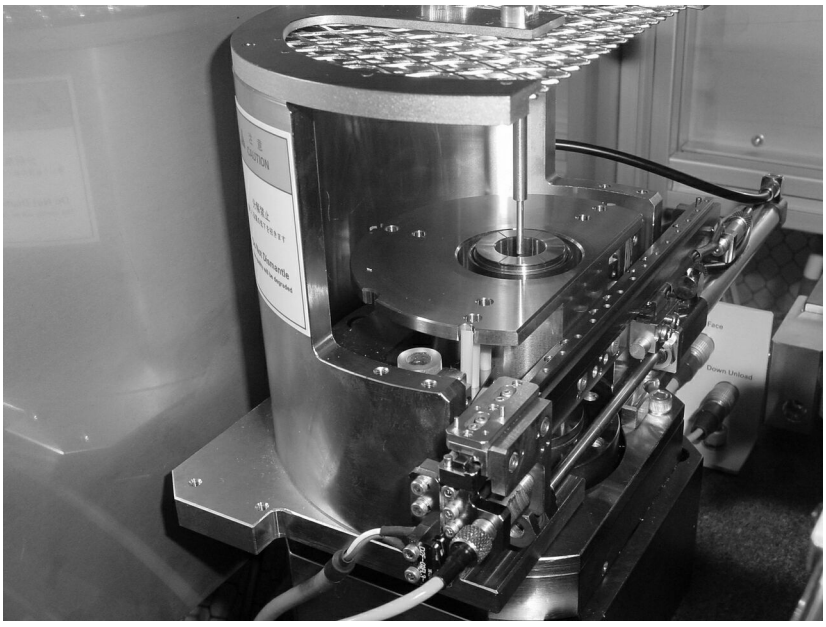
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Ramp Load

The ramp load provides the function to load and unload the hard disk head without damage whose suspension has the a lift tab. The ramp loading mechanism is installed to the media support assembly as shown in Figure H-1.

NOTE At the E5022/E5023 system software revision B.02.50 and above support the ramp load.

Figure H-1 Ramp Loading Mechanism (Picture is E5013A)

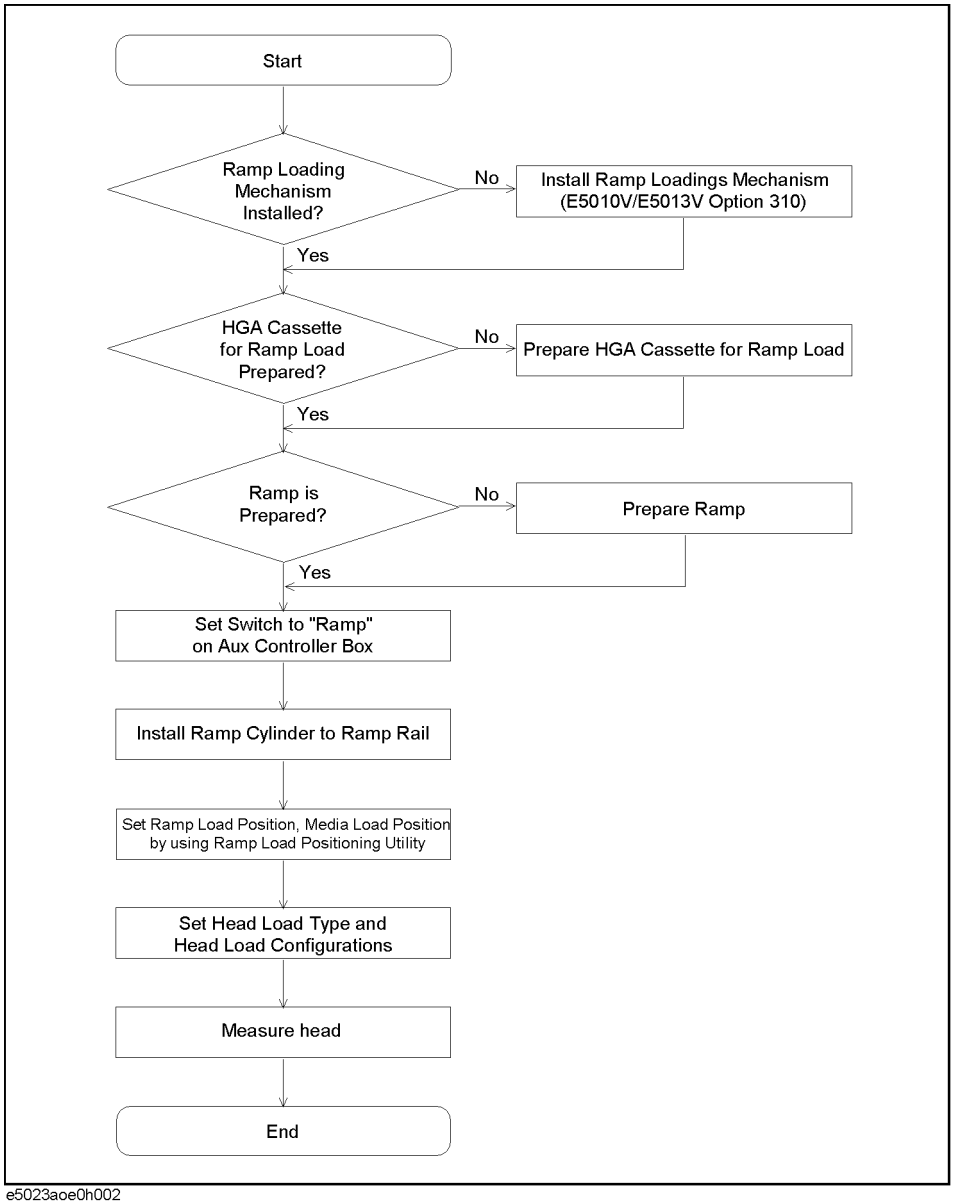


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Overview

Follow in the order as shown in Figure H-2 to prepare the measurement with the ramp load.

Figure H-2 **Preparation and Measurement Flowchart**



Ramp Loading Mechanism Installation

The ramp loading mechanism can be installed on the media support of the E5013A spinstand. If you have the E5011A spinstand, you need to upgrade the E5011A to E5013A before installing it. The E5013V-320 is the upgrade kit for the ramp loading mechanism which can be installed at on-site, In addition, to install both a power supply unit and a head loading Aux controller are necessary which are ramp loading mechanism related products.

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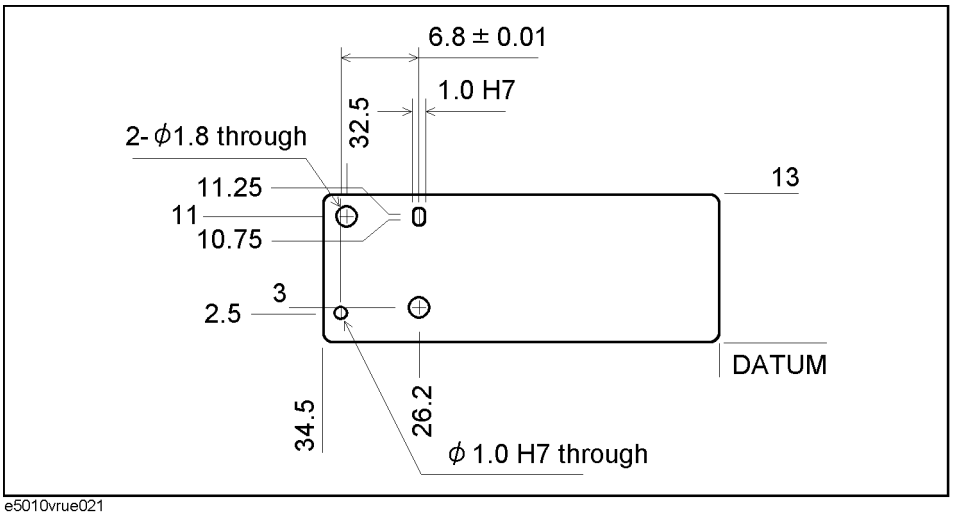
Ramp and HGA Cassette for Ramp Load Preparation

Agilent does not supply the ramp and HGA cassette for the ramp load. You need to prepare them yourself. Agilent submits the information about the ramp and cassette dimensions to make them in advance.

The ramp plate for 3.5 inch is already included in the ramp loading mechanism whose thickness is 3 mm. You can use not only it with the ramp but also the ramp plate you made with the ramp.

Figure H-3 shows the ramp plate dimensions for reference.

Figure H-3 Ramp Plate Dimensions



e5010vrue021

When the media is changed with the different thickness one, you can use the same ramp by changing the ramp plate. The thickness of the ramp plate (X_4) as shown in Figure H-4 is defined the following equation.

Table H-1 Ramp Plate Thickness

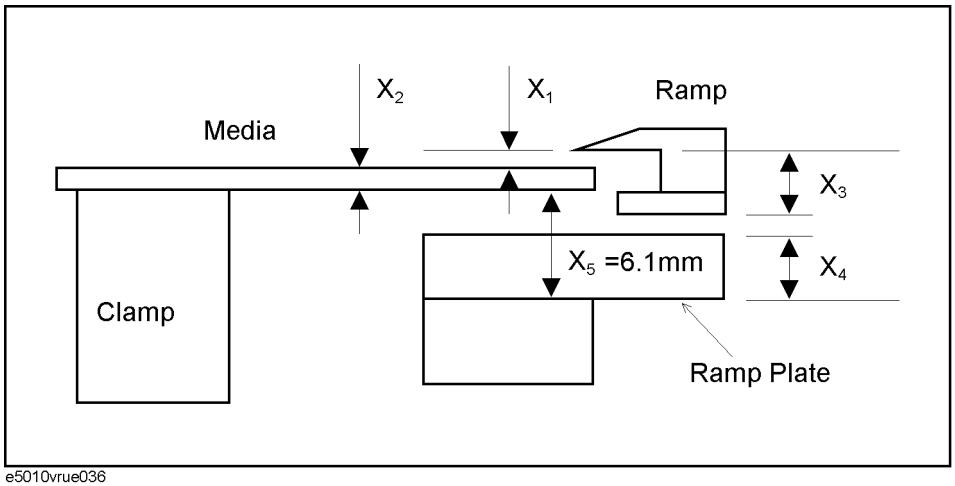
	Value (mm)	Description
X_1	---	Relative height between media surface and tip of ramp
X_2	---	Media thickness
X_3	---	Ramp height
X_4	**$6.1+X_1+X_2-X_3$**	Ramp plate thickness
X_5	6.1	Relative height between disk clamp surface and reference position of the ramp loading mechanism. Relative height is already adjusted at the factory.

CAUTION If the media surface is higher than tip of the ramp ($X_1 \leq 0$), the ramp hits the media.

CAUTION If the dimension of the ramp you made is out of standard pattern, the ramp hits to the head, HGA cassette or the HLM.

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Figure H-4 **Ramp Plate Thickness**



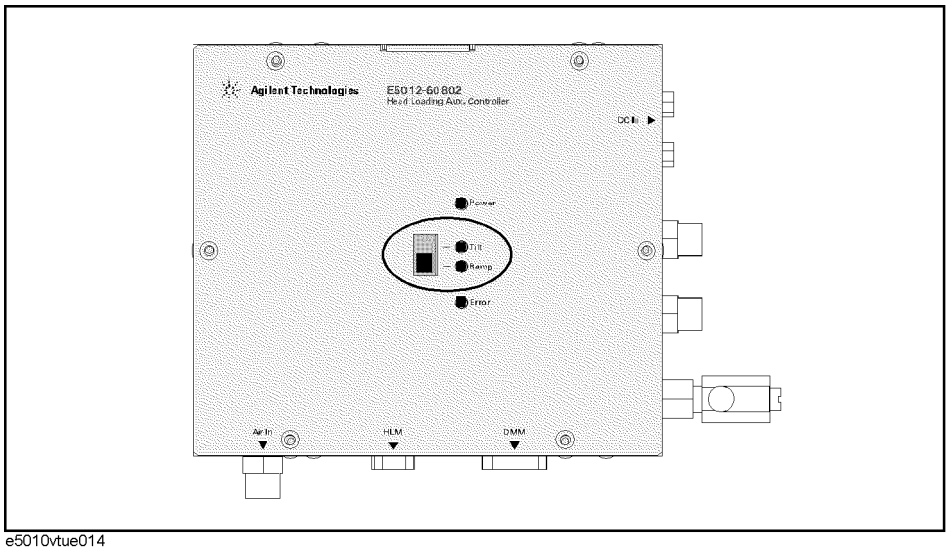
e5010vrue036

Head Loading Aux Controller Setting

Follow the procedure below to set the head loading Aux controller.

The head loading Aux controller can be used both the tilt loading mechanism and the ramp loading mechanism. There is a switch on it which changes the tilt mode or the ramp mode. Set it to “Ramp” side as shown in Figure H-5, then LED is illuminated.

Figure H-5 **Set Switch to Ramp**



e5010vtue014

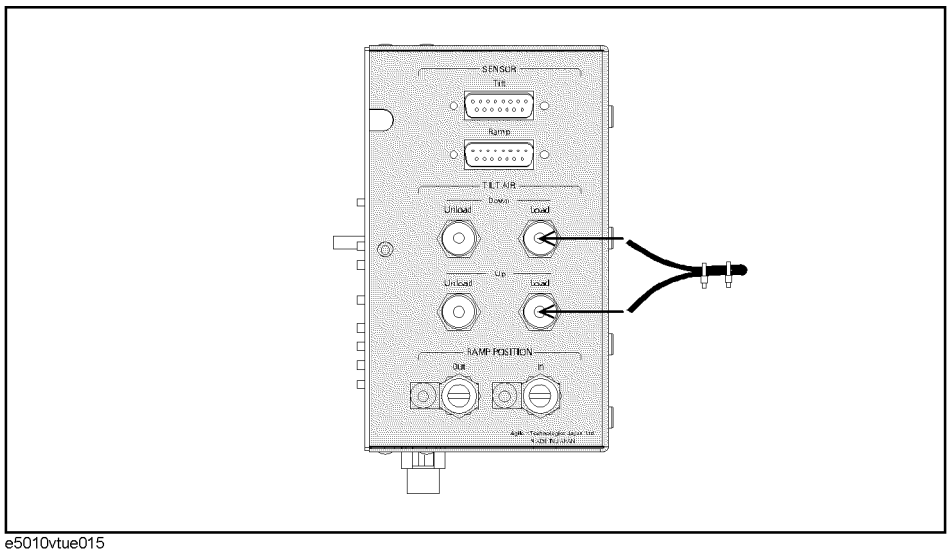
Plug the air fitting of **TILT AIR Down Load** and **TILT AIR Up Load** on the Aux controller as sown in Figure H-6 using an air stopper assembly.

WARNING **The air stopper assembly and two plugs as shown in Figure H-6 are included in the Aux controller. Usually, plug the air fitting of TILT AIR Down Load and TILT AIR Up Load using the air stopper assembly. Because, there is a possibility that the plug blows off from the air fitting, when high air pressure is applied to the Aux controller**

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suddenly. It is more dangerous, when the plug for air stopper blows off from the air fitting.

Figure H-6 Plug the Air Fitting using Air Stopper Assembly



e5010vtue015

The LED on it shows the status of the ramp loading mechanism. Assignment of the LED is as follows.

Table H-2 LED Assignment

LED	Description
Power	When DC 24V is supplied from the power supply unit, LED is illuminated.
Tilt	When switch is set to “Tilt”, LED is illuminated.
Ramp	When switch is set to “Ramp”, LED is illuminated.
Error	This LED is illuminated under the following situation. • The system performs the Ramp In, But the ramp is still in Ramp Out position. • The system performs the Ramp out, But the ramp is still in Ramp In position.

Ramp Cylinder Installation

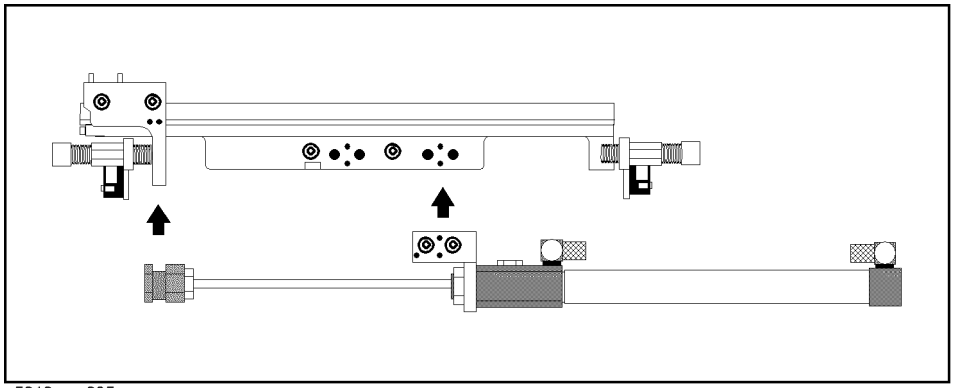
Install the ramp cylinder assembly to the ramp rail assembly.

For UP face, tighten the two screws with 2.0 mm hex key to install the ramp cylinder assembly to the ramp rail assembly as shown in Figure H-7.

For DOWN face, tighten the two screws with 2.0 mm hex key to install the ramp cylinder assembly to the ramp rail assembly as shown in Figure H-8.

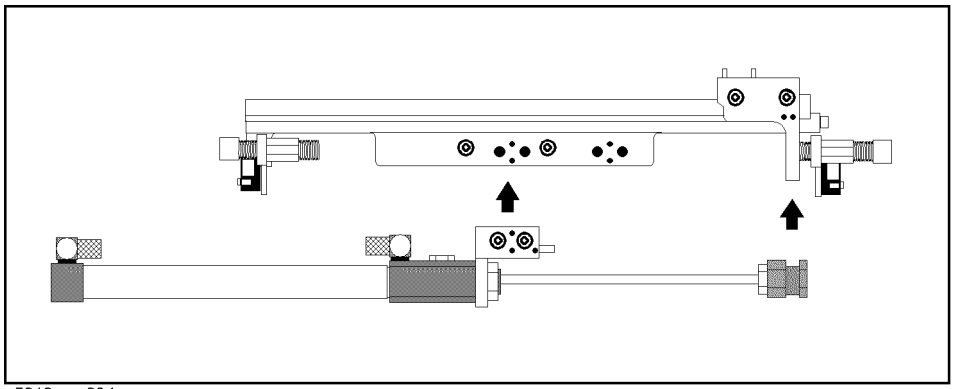
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Figure H-7 **Ramp Cylinder Installation (UP Face)**



e5010vrue025

Figure H-8 **Ramp Cylinder Installation (DOWN Face)**



e5010vrue024

Ramp Load Position and Media Load Position Determining

Store the ramp load position and media load position to the E5023 system with referring “Ramp Load Positioning Utility” on page 441.

Measurement with Ramp Load

Follow the procedure below to start the measurement.

Step 1. Place the media onto the disk clamp.

CAUTION If the media size and the ramp type is mismatched, the ramp hits to the media. For example, the ramp for 2.5” is attached in spite of the 3.5” media is placed.

Step 2. Place the HGA cassette on the HLM.

CAUTION If the media size and the ramp type is mismatched, the ramp hits the media. For example, the ramp for 2.5” is attached in spite of the 3.5” media is placed.

Step 3. Launch the VEE measurement Program.

Specifies the Load Type to “Ramp” in the “Head Load Frame” with referring “Spinstand

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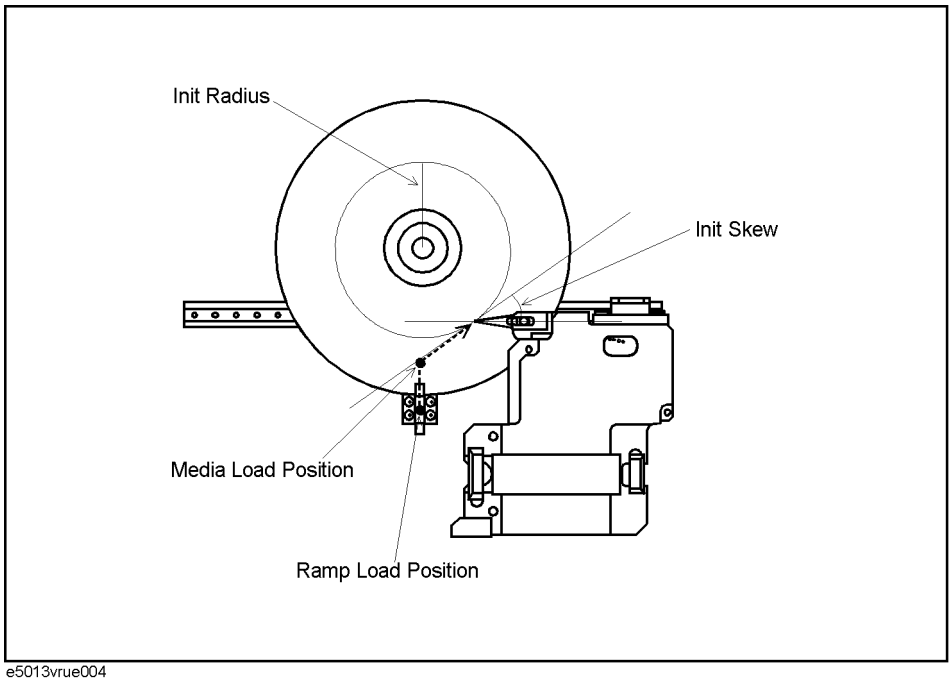
Configuration Menu” on page 229. Next, specifies the speed on ramp, init radius, init skew, head position restriction, and the other parameters.

The init radius and the init skew are defined as follows.

init radius A radius that the head is moved to after the head is loaded.

init skew A skew angle that the head is moved to after the head is loaded. The init skew range is -60° to 30°.

Figure H-9 Init Radius and Init Skew



Start the measurement. The loading sequence is as follows.

1. The ramp moves to the Ramp In position from the Ramp Out position as shown in Figure H-10.
2. The head moves to the ramp load position from the home position which is specified by using the ramp load positioning utility.
3. The head is loaded.
4. The head moves to the media load position with the specified speed which is specified by using the ramp load positioning utility.
5. The ramp moves to the Ramp Out position from the Ramp In position.
6. The head moves to initial track which is specified by the **init radius** and the **init skew**.

Unload the head. The unloading sequence is as follows.

1. The ramp moves to the Ramp In position from the Ramp Out position as shown in Figure H-10.
2. The head moves to the media load position from the initial track.

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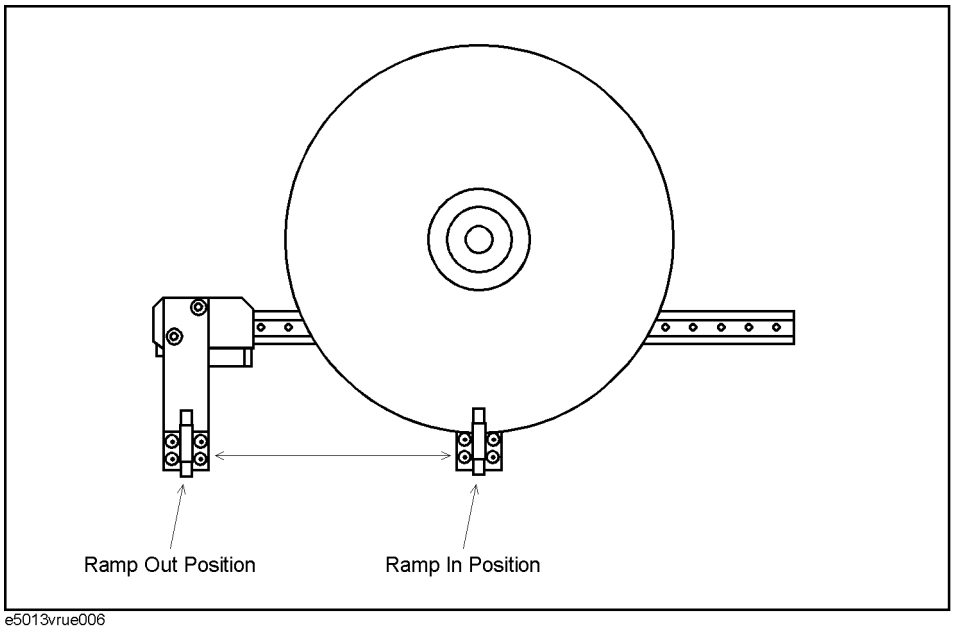
3. The head moves to the ramp load position with the specified speed.
4. The head is unloaded.
5. The ramp moves to the Ramp Out position from the Ramp In position.

The Ramp In position and the Ramp Out position are defined as follows.

Ramp In A position where the ramp onto the media as shown in Figure H-10. The head is loadable when the ramp is in Ramp In position.

Ramp Out A position where the ramp is out of the media as shown in Figure H-10. Usually, the ramp is in Ramp Out position during the measurement to avoid the collision with the HLM.

Figure H-10 Ramp In and Ramp Out Position (Picture is UP Face)



e5013vrue006

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Ramp Loading Mechanism Maintenance

It requires to check a rod of the air cylinder every 10,000 head down action. If it is stained, clean the rod with cloth and grease the rod.

It requires to check a floating joint of the air cylinder every 50,000 head down action. If it is stained, clean the rod with cloth and grease the floating joint.

The air cylinder on the ramp loading mechanism has life span due to fatigue and it requires replacement every 1,000,000 head down action.

Tools Required

- 2.0 mm Hex Key
- Miniature Driver
- Diagonal Cutting Plier
- Silicon Grease
- Lint Free Cloth

Parts Required

Table 6-65 Parts Number for Air Cylinder

Description	Part Number
Air Cylinder	TBA

Cleaning Procedure

For details, refer to the E5013A service manual.

Replacement Procedure

For details, refer to the E5013A service manual.

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Ramp Load Positioning Utility

Before the hard disk head measurement with the ramp load, it is necessary to specify the ramp load position and the media load position as shown in Figure H-11.

The Ramp Load position and the Media Load position are defined as follows.

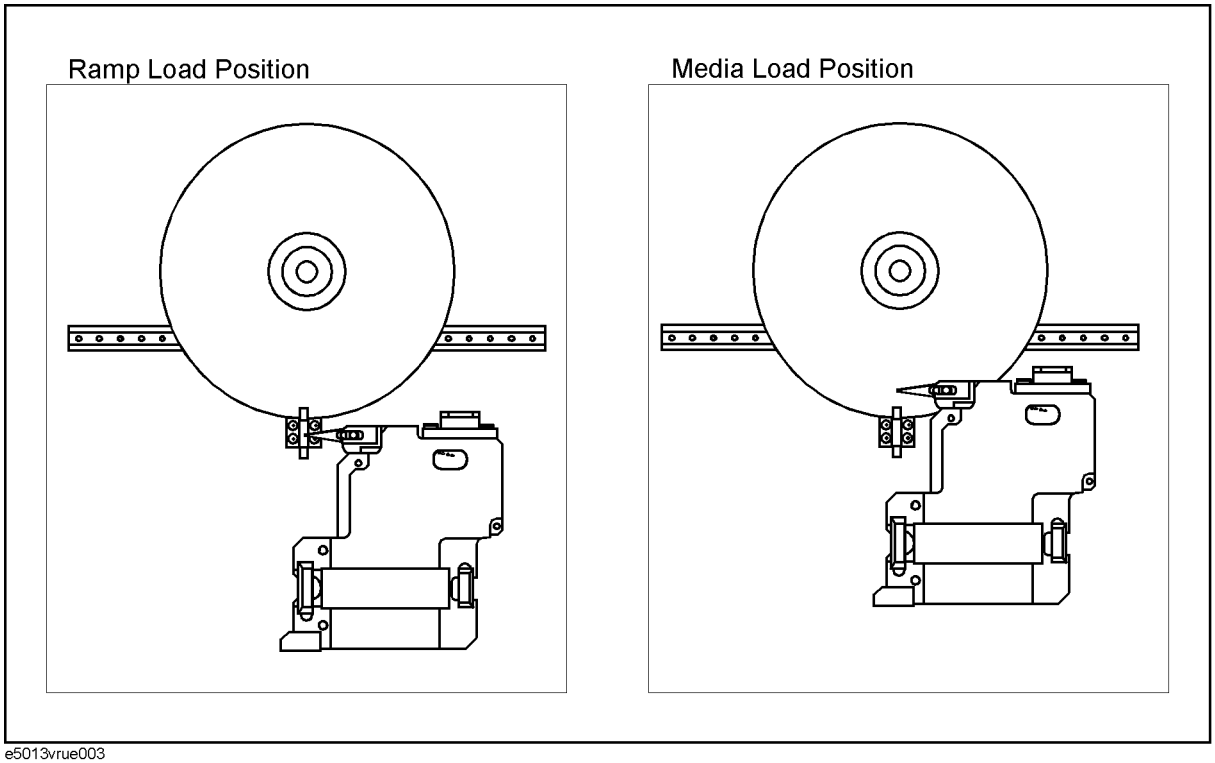
Ramp Load Position A load position where the head onto the ramp.

Media Load Position A load position where the head onto the media.

The ramp load positioning utility is a tool used in determining the ramp load position and the media load position. Once the ramp load positioning is completed, the positioning data will be saved in the E5023 system.

CAUTION When the media size, media thickness, or a kind of the heads is changed, re-positioning is required. Perform the ramp load positioning, or else the crush is occurred around the ramp loading mechanism.

Figure H-11 Ramp Load Position and Media Load Position



e5013vrue003

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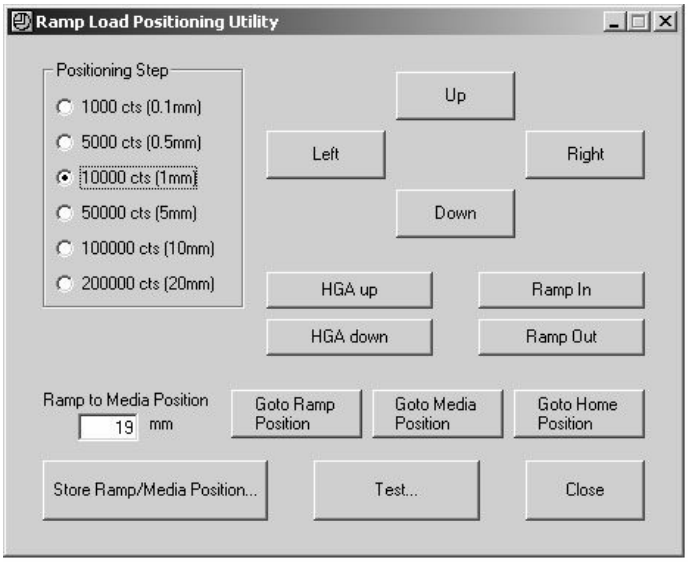
Overview

The ramp load positioning utility has the following menu windows.

Main Menu

The task list of the buttons in the main menu is as follows.

Figure H-12 **Main Menu**



Positioning Step Select the amount of the step. Each step is defined as the distance travelled by the stage each time the direction button is pressed. It range from 0.1mm to 20mm. use a large step value to move the head close enough to the required location, then use a smaller step value for fine adjustment.

Up/Down/Right/Left Move the head toward the up, down, right, or left side of the media.

HGA up Perform the unload.

HGA down Perform the load.

Ramp In Move the ramp to the Ramp In position.

Ramp Out Move the ramp to the Ramp Out position.

Goto Ramp Position Unload the head and move it to the ramp load position.

Goto Media Position Unload the head and move it to the media load position.

Goto Home Position Unload the head and move it to the home position.

Ramp to Media Position Enter the distance between the ramp load position and the media load position.

Store Ramp/Media Position... Save the positioning data, ramp load position and media load position.

Test... Open the “Ramp Load Test” menu as shown in Figure H-13.

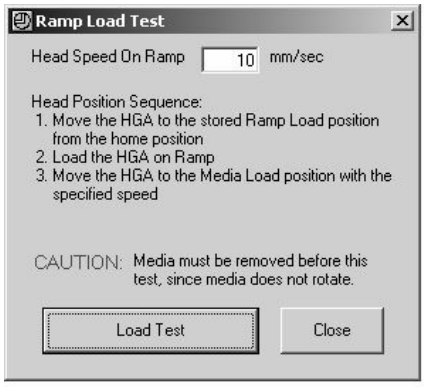
Close Close the ramp load positioning utility.

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Ramp Load Test Menu (Sub Menu)

The task list of the buttons in the “Ramp Load Test” menu is as follows.

Figure H-13 **Ramp Load Test Menu**



Head Speed On Ramp Specifies the head movement speed between the ramp load position and the media load position.

Load Test Move the head in order below.

1. Move the head to the home position.
2. Move the head to the ramp load position, then load the head.
3. Move the head to the media load position with specified the head speed.

Close Return to main menu.

Procedure of Ramp Load Positioning

Follow the procedure below to perform the ramp load positioning.

NOTE The ramp load positioning data contains each individual data of the UP face and the DOWN face cassette. Perform the ramp load positioning each individual HGA face, UP face and DOWN face cassette.

Step 1. Launch the ramp load positioning utility by the following mouse procedure, then the window as shown in Figure H-12 is displayed.

Start - Agilent Hard Disk Read Write Test System - Ramp Positioning Utility

Step 2. Place the HGA cassette on the HLM.

Step 3. Click on the **HGA up** button, then the head is unloaded.

Step 4. Click on the **Ramp In** button, then the ramp is moved to the Ramp In position.

When the HGA face, UP or DOWN is mismatched between the ramp loading mechanism and the HGA cassette, or the switch on the Aux controller is still set to “Tilt”, the error information as shown in Appendix H-14 is displayed.

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Figure H-14 **Error Information**

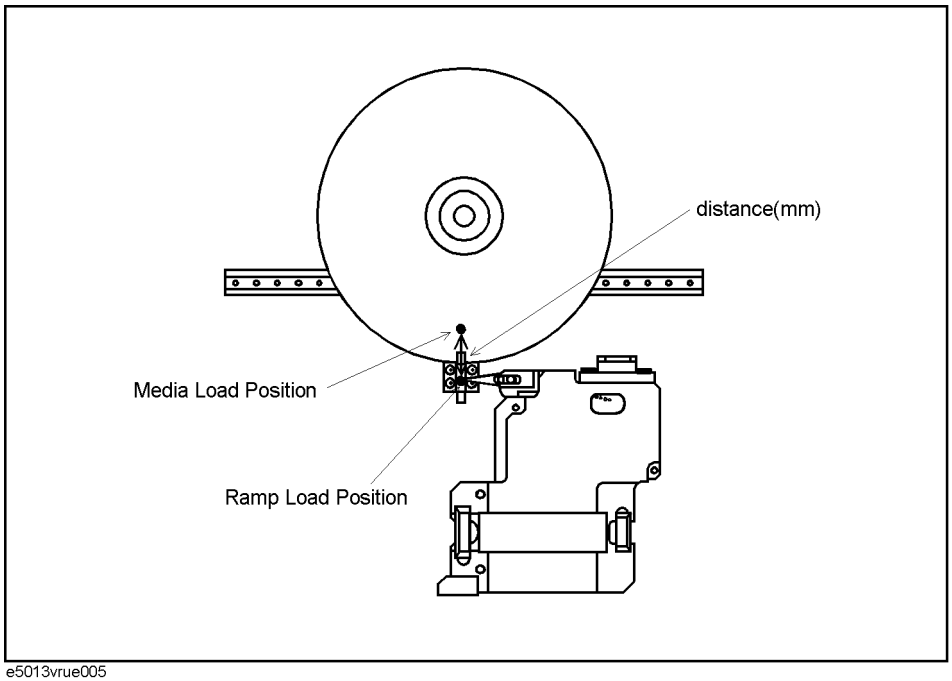


Step 5. Select the amount of the step from **0.1mm** to **20mm**. Move the head above the ramp load position as shown in Figure H-11 using the **Up**, **Down**, **Right** and **Left** buttons.

Step 6. Click on the **HGA down** button to lower the head on the ramp load position.

Enter the distance between the ramp load position to the media load position into the **Ramp to Media Position** text box.

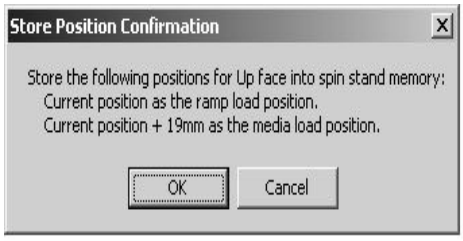
Figure H-15 **Distance between Ramp Load Position and Media Load Position**



e5013vrue005

Step 7. If ok, click on the **Store Ramp/Media Position...** button, then the box such as Figure H-16 is displayed. If ok, click on the **OK** button then ramp load position and the media load position are stored into the spinstand.

Figure H-16 **Store Position Confirmation Box**



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NOTE The current head position is specified as the ramp load position. And, the position is specified as the media load position which is the distance you entered away from the current head position toward to the media.

Step 8. If necessary to perform the ramp load test, click the **Test** button then “Ramp Load Test” menu as shown in Figure H-13 is displayed. Click the **Load Test** button, then the head is moved in order. Click the **Close** button to return to the main menu.

CAUTION Remove the media from the disk clamp before ramp load test because the media does not rotate during this test.

Step 9. Click the **Close** button of the main menu, then the ramp load positioning utility is closed.

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Glossary

A

Absolute Polarity The absolute polarity test is used to detect the pinned layer reversal of the GMR head.

B

Bath Tub Test A type of BER test that is used to determine the number of tracks per inch.

Bit Error Test A type of measurement that is used to determine what fraction of the total bits are in error.

D

Drive Configuration A configuration that determines the head position and skew angle. Since the spinstand adopts an x-y stage method, a simulating real drive head movement is required. This configuration is used to achieve the calculation of the simulation.

M

Measurement Mode A mode that sets an input range and a PW reference. “Input Range Control & Auto Configuration” on page -308.

Measurement Type A sequence type of measurement. There are three sequence types: 1) a sequence to erase the track(s), write the specified data and execute measurement. 2) a sequence to write the data and make a measurement. 3) a sequence to measure only.

P

Popcorn Noise Popcorn Noise are random noise spikes that occur when the head changes its operation from write to read.

PW reference A rough PW value to make measurements on a parametric module. See “TAA Measurement” on page -240.

R

Resolution This is an old test method that is used to measure the effect on how close transitions occur.

S

Sense Current Current that is supplied to the head to read the data is called “sense current”. When a magnetic inductive head is used as a device under test, it is called read bias current. Typical GMR sense current value would be 5 [mA].

Sweep Measurement A sweep measurement allows you to observe a characteristic of a measured parameter while changing a parameter. For example, the channel bit rate sweep measurement observes the characteristics of either TAA or PW while changing the channel bit rate.

T

T A unit used to express the fundamental period of the channel bit period.

Thermal Asperity When the sense current flows through the MR element of the read head it undergoes joule heating. In general, the MR sensor operates

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somewhere between 20^{o}C to 50^{o}C above normal temperature inside the disk drive. When the MR sensor travels at high velocity with respect to the media and hits a high spot on the media such as mechanical scratch, debris or corrosion spots. Its temperature will rise almost instantaneously upon contact and decline gradually to its normal operating temperature. Such an occurrence is referred to as *thermal asperity.* This thermal noise spikes distorts the readback signal of the read head.

U

User defined Data pattern A pattern where the user can specify his own data pattern.

W

Write Current Current that is supplied to the head to write the data is called “write current”. Typical value of write current is 40 [mA] for modern MR and GMR head.

Waveform Analysis A type of measurement which uses an oscilloscope.This includes parametric measurements such as TAA, PW and Baseline. It also supports the NLTS by Time Correlation method and NLTS by Dipulse Extraction method.

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