

dScope Series III

Applications Manual

by Rachel Wilkinson, Ian Heaton, Liam Elliott

This manual is also available as 'on-line help' from the dScope software. You can access the on-line help from the 'Help' menu. The on-line version is context-sensitive: by pressing F1, you can get immediate help for whichever menu or dialogue box you are currently using.

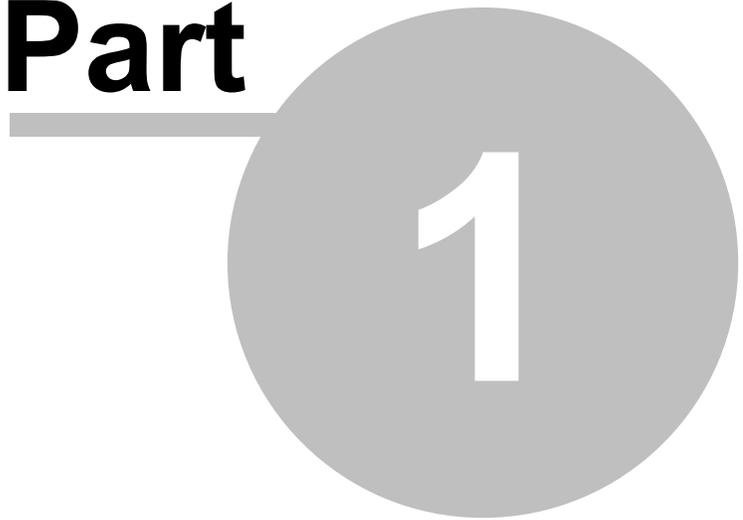
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Part



General information

1 General information

Manual revision history

Rev	Date	Author	Notes
1.00	28th January 2003	R.Wilkinson	To accompany software 1.00
1.10	10th June 2004	I.A.Heaton	To accompany software 1.10
1.11	14th July 2005	L.R.Elliott	To accompany software 1.11
1.20	5th January 2007	L.R.Elliott	To accompany software 1.20
1.40	3rd December 2010	I.A.Heaton	Updated AES17 tests
1.43	5th November 2012	I.A.Heaton	Auto Sequence added

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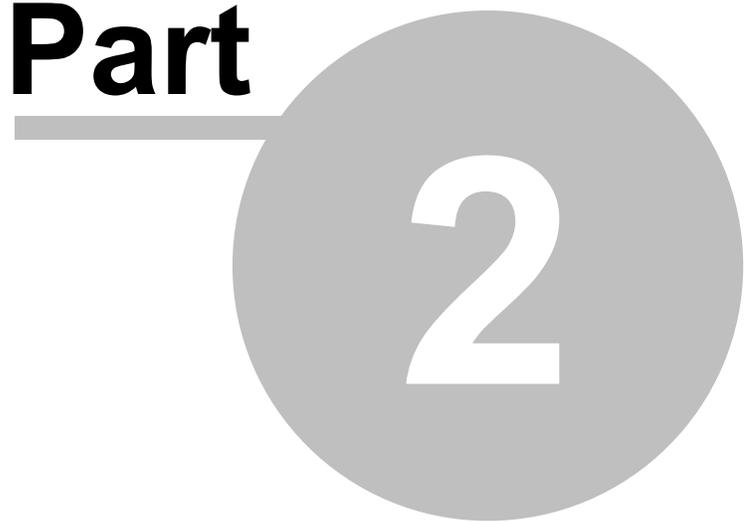
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Part



Applications introduction

2 Applications introduction

This volume of the dScope Operation Manual describes how dScope can be used in a variety of applications.

For a description of AES17 testing, see the [AES17](#) section.

For a description of Dolby Digital 2-channel testing, see the [Dolby Digital 2-channel](#) section.

For a description of Dolby Digital 5.1-channel testing, see the [Dolby Digital 5.1-channel](#) section.

For a description of Encoded Transport Stream Generation, see the [Encoded Transport Stream Generation](#) section.

For a description of Auto Sequence, see the [Auto Sequence](#) section.

2.1 About this manual

The dScope Series III Applications Manual is provided in two different formats: as a conventional printed manual, and also as 'online help' which can be viewed whilst operating the dScope. The printed version is also provided in 'electronic' format, as a 'pdf' file, with the dScope software. These files can be viewed and printed using the Adobe Acrobat Reader, which can be downloaded free at www.adobe.com. Updates of the manuals are available from the Prism Sound website at www.prismsound.com.

When viewed on-line, the manual pages are accompanied by a navigation area to the left. Therein, a "Contents" section shows a hierarchical map of the entire document from which desired pages can be selected. Next to "Contents", the "Index" section allows instant access to pages describing particular topics. The "Search" section lists all pages containing a particular word or phrase, and the "Favorites" section can be used to save page locations for future reference.

When viewed as on-line help, each page is headed by a title block which shows the name of the page, plus some links on the right-hand side. The upper row of links refer to topics above the current page in the manual's hierarchy. Below, a "See Also" link often appears which accesses a pop-up box containing a list of related topics.

Within the body of each page, certain font and highlighting conventions are used:

Links to other parts of the manual are shown [like this](#).

Buttons on the dScope dialogue boxes are designated, for example, [OK]

and Results are referred to, for example, as <amplitude>

Code samples are shown in this font...



Noteworthy items are indicated like this.

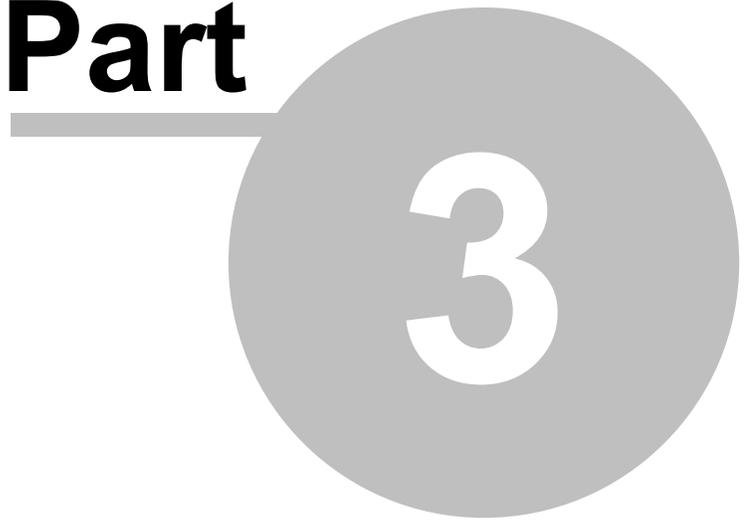


Important warnings are designated like this.



This symbol designates warnings of risk of electric shock.

Part



Auto Sequence

3 Auto Sequence

Auto Sequence is a dScope Series III application that sets out to do three main things:

1. Provide a framework in which to create and run a sequence of Tests without the need to write any automation code.
2. Enable automated limit checking of results and keep track of overall pass/fail.
3. Provide an automated means of generating test reports and storing results.

The following section contains an [overview](#) of the Auto Sequence application.

For more information about how Auto Sequence works, see [How it Works](#).

- See [Running Auto Sequence](#) for how to use Auto Sequence.
- See [Setting up a Test Sequence](#) for details on configuring your own tests.
- See [Looping and Multi-channel tests](#) for details of how to test multi-channel devices.
- See [Reporting](#) for information about HTML and Excel reports.
- See [Settings and Options](#) for details of setting preferences.

3.1 Overview

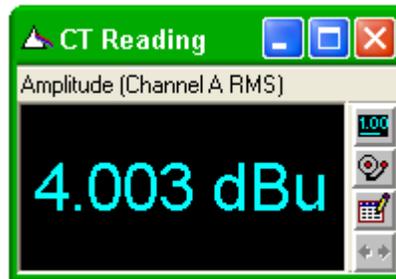
Basic Principles

The basic idea is to create a Sequence of dScope Configurations that can be run one after another in order to test all the different parameters that are required. The function of Auto Sequence is to manage the selection and execution of these Configurations, keeping track of [pass/fail criteria](#) and generating reports. If the Configurations are set up appropriately, Auto Sequence can work out what is expected and intelligently determine what to include in the report and what parameters, if any, to limit check.

This documentation is for Version 1.00, November 2012

3.1.1 How it Works

A Sequence consists of a series of dScope Configurations. As each Configuration is loaded, Auto Sequence will look for Readings, Sweeps and FFT-derived Traces set up within it. A Reading in this context, (with a capital "R", also known as a "Reading Window") is a dScope window containing a single measurement result as shown below:



Within a Reading are the result itself, its units, and settings for the name of the Reading, the number of decimal places to display the result, limit values to check against, etc. Auto Sequence uses these settings to determine if and how the measurement should be limit checked and how the result should be displayed in the report.

Likewise a Configuration can contain a Sweep. This defines which parameter is to be swept, over what range and what measurements are to be taken at each step. For each Sweep Result, Limit Lines can be used to check for pass/fail. Auto Sequence looks at each Configuration and determines firstly whether a Sweep is set up or not, and secondly, what to do if there is a Sweep present. Fundamentally, if a Sweep is set up, Auto Sequence will run it and export the graph to the [HTML report](#). If there are limits set up, these will be used to check for pass/fail. The appearance of the graph in the HTML report is controlled by the graph export settings which are also saved within each Configuration.

FFT-derived Traces are those that are based on captured buffers of data and include FFT spectra and FFT responses derived from multi-tones as well as time domain Traces such as the Scope Trace and impulse response Trace. These will be exported and limit checked if the FFT parameters are set in such a way that Auto Sequence can determine when they are ready for export. In practice this means that if the FFT buffer averaging is turned on and set to "once" or the trigger mode is set to "single shot", the FFT will be acquired and the graphs exported and limit checked.

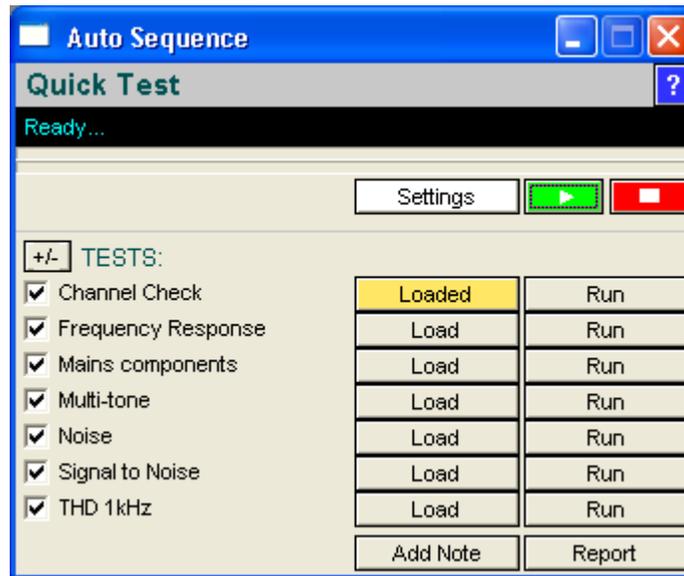
If a Digital Input is selected and the Digital Inputs panel is set to check for data integrity (Channel Check) this is also checked and reported.

Auto Sequence itself is a single script that provides two main interfaces for managing Test Sequences. When it is first started it provides a "host" interface for Sequence selection as shown below:



This very simply looks at the dScope installation for the "\\Configurations\Sequences\" folder (usually found at C:\Program Files\Prism Sound\dScope Series III\Configurations\Sequences\) and lists all the sub-folders that it finds. Each sub-folder is expected to contain the Configurations for the Test Sequences to be performed.

Selecting a Sequence in this dialogue box opens the selected folder and displays the contents in the Sequence dialogue box which will look something like the one below:



This is an alphabetical list of the Configurations found in the selected folder. To the left are check boxes to set which Tests will be run in the sequence. To the right are buttons to manually load the Configuration and to run the Tests contained in it. If the [Run] button for a particular Test is clicked, it will first load the associated Configuration if it isn't already loaded then run the Test.

At the top of the form are buttons to change [settings](#) and a couple of "transport" buttons: the  [Run Sequence] button and  [stop] button.

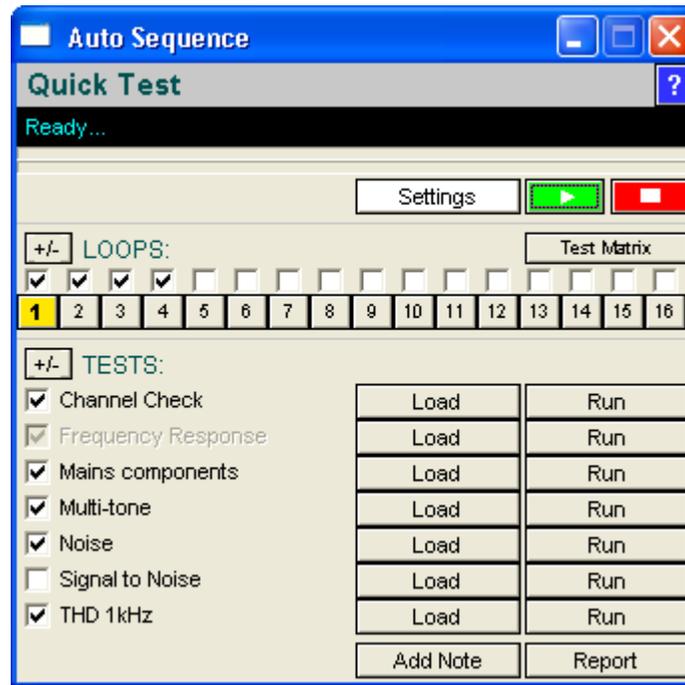
At the bottom are buttons to enter notes and generate an [HTML report](#).

Exiting a Sequence

To exit the Sequence view and select another Sequence, just close the dialogue box (using the Windows' "X") and you will be returned to the host dialogue box where you can select a different Sequence. Close this and you will exit the application.

Looped Sequences

A sequence of Tests may also be repeated a number of times. Each repetition of the Test Sequence is termed a "Loop"



This allows multi-channel devices or different device configurations to be tested.

See [Looping and Multi-Channel Tests](#) for more information.

3.1.2 How Pass/Fail is assessed

A [Sequence](#) passes when all the [required Tests](#) within it have been completed and have passed.

A required Test is one that is checked for inclusion in the Sequence.

A Test passes when all the measurements within it have been completed and are within limits.

The overall pass/fail is continuously assessed as the Test Sequence progresses.

Any Tests that do not have limit checking within them do not contribute to the pass/fail, but will still be required to be run for the Sequence to be marked as completed.

Changing which Tests are required dynamically updates the pass/fail (eg, de-selecting the only Test that fails in a sequence will cause the Test Sequence to be re-assessed and passed.)

[Looped Tests: Which Tests are Required?](#)

With [Looped Tests](#), the Tests that are required in each Loop are independent (the same Tests don't have to be run in each Loop). Any particular Test can be enabled or disabled for all Loops using the Test Master controls in the [Test Matrix](#). Likewise, any particular Loop can be enabled or disabled using either the main Auto Sequence interface or the Test Matrix. For a Test to be required for the pass/fail, the following three conditions must be met:

- it must be checked.
- it must be in an enabled Loop.
- its Test Master must be enabled.

See the [Test Matrix](#) for more information.

3.1.3 Requirements

Software

- dScope Series III version 1.43 or later
- ScriptDlg.dll version 1.00 or later (included with dScope)
- Windows XP, Vista or 7, 32 bit or 64 bit.

Hardware

- Prism Sound dScope Series III

NB: Auto Sequence will work with all versions of the dScope Series III family, but Configurations loaded as part of a Sequence may have features that are not supported on all versions.

Installation

Auto Sequence is installed by default with dScope Series III software from version 1.43.

The Auto Sequence application consists of a single .dss dScope script called "Auto Sequence.dss". It is expected to reside in the dScope \Scripts\Automation folder (typically C:\Program Files\Prism Sound\dScope Series III\Scripts\Automation). In addition, if the ability to export all the Configuration settings to the report is required, another script is needed called "Auto Sequence Settings Reporter.dss" which needs to be in the same folder.

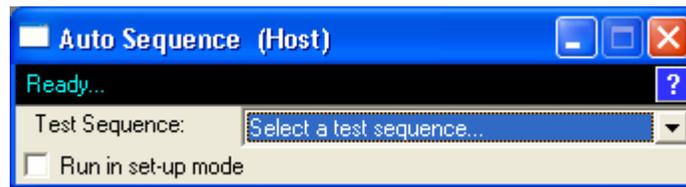
3.2 Running Auto Sequence

Auto Sequence can be run in several different ways:

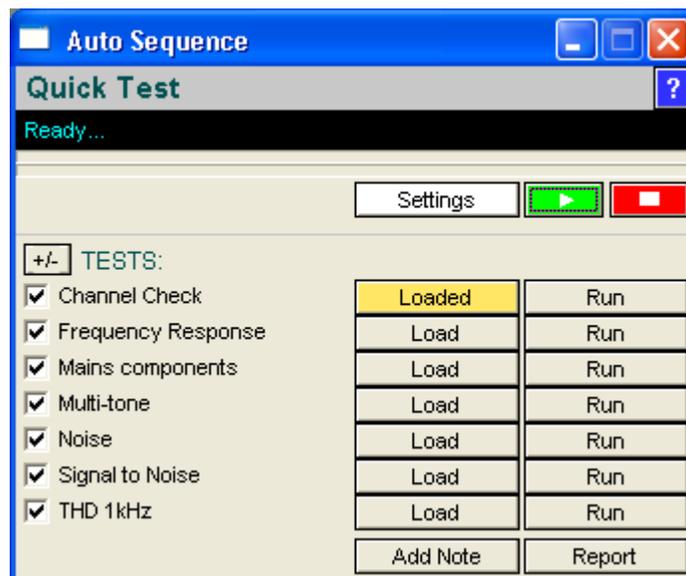
- from the dScope [Applications] button on the "User Bar".
- from the dScope "Automation" menu by selecting "Run Script" and then selecting "Auto Sequence.dss".
- from the dScope [Run Script...] toolbar button and then selecting "Auto Sequence.dss".
- If configured, from the dScope [Auto Sequence] User Bar button.

3.2.1 Selecting a Sequence

When Auto Sequence is first run, you will be presented with the dialogue box below:



This is referred to as the "Host". Use the drop list to select which Test Sequence to run. This will load a separate dialogue box with the details from the selected Test Sequence similar to the one below:



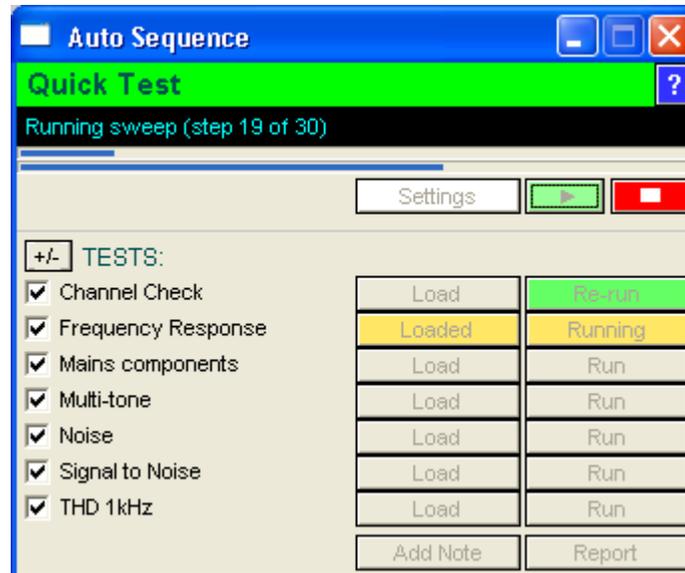
To select a different Sequence, close the current Sequence (using the Windows "X" in the title bar) and you will be taken back to the host interface. Closing this will exit from Auto Sequence.

Run in Set-up Mode check box

If the "Run in Set-up Mode" check box in the host dialogue box is checked, when the sequence dialogue box is opened it will include additional controls for setting up and configuring Test Sequences, mainly through the use of additional [automation scripts](#). For more information, see [Script Set-up Mode](#).

3.2.2 Running a Sequence

After loading a Test Sequence to run, clicking the  [Run Sequence] button will run all the checked Tests in the Sequence starting at the top and working down to the bottom. As it progresses, each Configuration is loaded in turn and the measurements found in it are run. The dialogue box shows the process as below:



In the above screen-shot, the header bar tells us the name of the Test Sequence and is coloured according to whether the overall Test Sequence is passing or failing. If it is passing (as above) this will be green. It will be red for failure and it will remain grey if there is no limit checking encountered. The status bar below this tells us what Auto Sequence is currently doing (“Running Sweep: (step 19 of 30)” in this case...”).

Progress Bars

There are two progress bars: the top one shows the overall progress through the Sequence of checked Tests, and the second one shows the progress through parts of the Tests such as Sweeps, FFT buffer captures, and Channel Check periods.

Sequence Progress Indication

Looking at the [Load] and [Run] buttons in the screen shot above, we can see that the [Run] button for "Channel Check" is coloured green and says “Re-run” on it indicating that this Test has been run and passed. There are three possible states after a Test has been run:

- **Blue** - Test completed and no limit checking found
- **Green** - Test completed and passed all limit checks
- **Red** - Test completed and failed limit checks

A Test that has not been run will be grey and the currently running test will be amber. A test that has been started but failed to complete will be marked as failed. This happens if, for example, a digital input is selected but fails to lock.

When all the selected Tests have completed, the buttons will be enabled again. At this point, you can go back to any of the Tests and run them again in isolation by clicking on their [Run] button (which will now say “Re-run”) You may want to do this, for example, if a particular Test has failed.

The results for each Test are kept and updated when they are re-run. In this way it is possible to make adjustments and re-run a failed Test within a Sequence until the entire Sequence passes and then create the report. The report will contain the results from the latest version of each Test that was run.

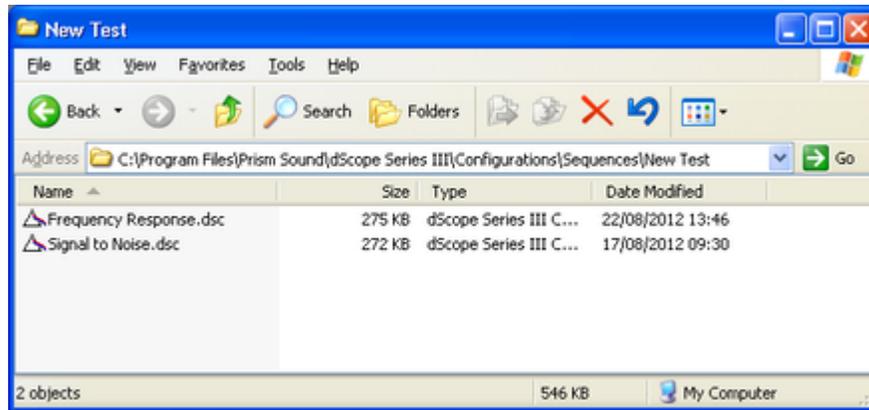
3.2.3 Exiting Auto Sequence

To exit Auto Sequence, simply close the dialogue boxes using the Windows' "X" in the title bar. You will need to do this twice: once in order to close the Sequence menu and again in order to close the host menu.

If Excel is in use and is visible (See [Excel Reporting](#)), you will be asked whether you want to save the spreadsheet when you exit the Sequence.

3.3 Setting up a Test Sequence

Setting up a Test Sequence consists of placing a series of dScope Configurations that constitute the required Tests in a sub-folder of the <dScope>\Configurations\Sequences\ folder. For example, if you had two Tests: "Frequency Response.dsc" and "Signal to Noise.dsc" that you wanted to run as a your new Test Sequence, you would create a folder called "Digital Test" (for example) as a subfolder of the Sequences folder and put the Configurations in it.



When you run Auto Sequence it would list "Digital Test" as one of the available Test Sequences. When you selected it, it would show the two Configurations as separate Tests that would be run one after the other in alphabetical order.

3.3.1 Changing a Test

Each Test is just a dScope Configuration that follows a few fairly simple rules. See [Setting up Configurations for Test](#) for more on this. Once a Configuration is changed, use the normal [Save] button on the dScope toolbar to keep the changes.

If you are using Excel to save results, changing a Test can cause the Test Sequence to be no longer compatible with the Excel spreadsheet. From a practical perspective, it helps if you configure your Test Sequence entirely before attempting to create an Excel spreadsheet for it. See the section on [Excel Reporting](#) for details.

3.3.2 Add another Test to a Sequence

To add a Test to a Sequence, simply save another Configuration in the same folder. Quite often you can do this most easily by selecting an existing Configuration in the Sequence, modifying it and using "Save As" to save it with the name of the new Test. These will appear in the user interface list the next time the Sequence is loaded.

3.3.3 Remove a Test from a Sequence

To permanently remove a Test from a Test Sequence, delete the Configuration from the sequence folder.

To disable a Test so that it doesn't appear in the list of Tests, you can also rename it, placing a tilde (~) in front of its name. For example, to stop a Test called "THD.dsc" from appearing in the list, rename it to "~THD.dsc".

To temporarily disable a Test, uncheck it in the user interface. It will then not be run and not be included in the pass/fail evaluation.

3.3.4 Changing the order of Tests in a Sequence

The Tests are loaded in alphanumeric order. To change the order they are executed, you can rename them with a letter or numeric prefix to change the sort order.

3.3.5 Setting up Configurations for Test

One of the main aims of this application is to provide a test framework that can be set up without resorting to scripting. In order to achieve this, the Configurations that constitute the Test must be set up in a particular way. The following sections of this chapter describe the requirements.

[Basic Rules](#)

[Configuring Readings](#)

[Configuring Sweeps](#)

[Configuring FFT Spectra and Multi-tones](#)

[Setting up the Trace Window for export](#)

[Checking digital data integrity](#)

3.3.5.1 Basic Rules

As Auto Sequence runs through a set of Tests it will open each Configuration and look for Readings, Sweeps, Channel Check and FFT based results. How you configure these will affect the limit checking and the way the report appears.

Some specific rules are below:

Readings from any of the following results can be used:

- Signal Analyzer RMS amplitude
- Signal Analyzer Frequency
- Signal Analyzer inter-channel phase
- Continuous-Time Detector
- FFT Detectors
- Digital Output Reference Sync frame rate
- Digital Output Reference Sync frame rate deviation
- Digital Inputs frame rate
- Digital Inputs frame rate deviation
- Digital Inputs carrier amplitude
- Digital Inputs jitter amplitude
- Digital Inputs carrier phase

FFT Detectors

- If FFT Detectors are used, they must begin at FFT Detector 1 and be in a continuous series (detector 1, 2, 3, 4 etc.). The script checks for FFT Detector Readings starting at FFT Detector number 1 and will stop looking if the FFT Detector it requests doesn't exist. This is to avoid having to check for the possibility of 40 FFT Detectors being present with gaps in the series.

Sweeps

- Sweep Results must start using Sweep Result 1 and be in a continuous series. For example, using Results 1, 2 and 3 will work. Attempting to use 1, 3 and 4 will result in only Result 1 being used. Auto Sequence checks for Sweeps starting at Result number 1 and stops looking when it finds an unused Sweep Result.
- If you are using Sweeps, the Trace window must be open on the current page of the Configuration or the graph export to the report will fail with a warning message.
- If you don't want a Sweep to run, set the source for "Result 1" in the Sweep set-up to "none"
- Sweeps should not be set up with "Append to existing Sweeps" turned on as it makes re-tests difficult.

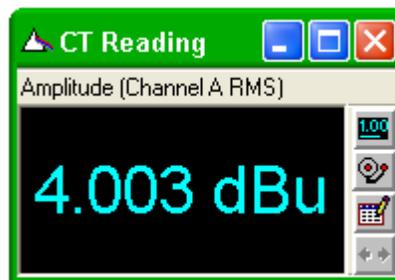
- Nested Sweeps can be used, but not with limit checking.
- Sweeps with a measured X axis can be used, but the Excel header will contain the X axis results from the measurements taken while the spreadsheet was being configured. These do not get updated when the Sweep is re-run in subsequent tests and therefore are not the measured X axis results from the Sweep data in the spreadsheet rows.

Traces

- If you want FFT-based Traces (FFT spectrum, or derived Traces such as FFT responses from multi-tones) you need to set the FFT Parameters such that they will turn off by themselves at an appropriate point if the script turns them on. In practice this means that if the FFT Buffer Averaging mode is set to "Once" or the Trigger Mode is set to "Single Shot", the script assumes you want to keep the FFT Trace in the Report and will limit check any Traces derived from the FFT Traces that have limits set. This includes FFT responses as used in multi-tones and time domain Traces that are based on the FFT buffer capture (Scope Traces, CTA output Traces, impulse responses).
- Only FFT-based Traces with fewer than 100 points are exported to Excel.

3.3.5.2 Configuring Readings

To limit check a measurement result or to make it appear in a report, a Reading must be created. A Reading in this context, with a capital "R" is a dScope window containing a single measurement result as shown below:



They are created by clicking on the measurement result in one of the analyzer windows and dragging it out onto the page. Once created, click on the buttons on the right to configure the Reading. Please see the dScope Series III Operation manual for further information on creating and using Readings.

Within each Reading's settings (accessed through the buttons on its right edge) are enough controls to determine how that Reading will appear in the report and how it will be limit checked. The report will contain a table for each Reading as below:

CTA Readings		
Amplitude (Channel A RMS)	4.003 dBu	> 100 dBu
Amplitude (Channel B RMS)	4.000 dBu	> 100 dBu
Settings: 22 Hz - 22 kHz, unweighted RMS		

This takes the name of each row from the name of the Reading (this defaults to the name of the Reading's function but can be edited). The result is displayed with the same precision (decimal places or significant figures) as the Reading is set up to display. The limits used are read from the Reading and displayed in the grey area to the right.

The HTML report defaults to reporting the settings of the CTA in the same table as any Readings derived from it as above. Likewise FFT Detector settings are also reported. Both these are optional (see the [Settings menu](#)).

Since Auto Sequence cannot tell whether the Signal Generator is in use, it defaults to not reporting it, but reporting can be turned on in the [Settings dialogue](#) box, in which case it reports the settings in a table as below:

Generator Settings	
Channel A:	sine, 4 dBu at 1000 Hz
Channel B:	sine, 4 dBu at 1000 Hz

3.3.5.3 Configuring Sweeps

Sweeps are configured in two main parts within the dScope user interface: the Sweep Set-up and the Trace Window Graph Export settings. The former determine how the Sweep is performed and the latter determine how it will appear in the report. Please refer to the dScope Series III Operation manual for how to set up a sweep and how to set up Limit Lines.

Fundamentally, if a Sweep is configured in a dScope Configuration, it will be run by Auto Sequence. If a Sweep has Limit Lines applied, it will be limit checked.

Use the  [Graph Print/Export Setup] button to configure how the exported graph will appear in the HTML report, making use of the "export preview" option. It will be exported as .png graphics.

If you do not want any Sweeps to be run in a Configuration, simply set the source for "Result 1" in the Sweep configuration to "none".

3.3.5.4 Configuring FFT Spectra and Multi-tones

In order to facilitate the use of FFT spectra (for example, measuring and displaying the noise floor of a product) and the use of Multi-tones, Auto Sequence needs a means of telling from the Configuration when this is required and when the requirement has been met. This is achieved by setting the FFT Parameters in such a way that the trigger will turn off when the required spectrum has been acquired. There are two ways to achieve this:

1. Turn on FFT buffer averaging and set it to "Once" in the FFT Parameters dialogue box, or
2. Set the Trigger mode to "Single Shot" in the FFT Parameters dialogue box.

Once set like this, when the Test is run, Auto Sequence will start the FFT trigger and wait until the trigger has turned off before limit checking any of the FFT-based graphs that have Limit Lines and exporting the Trace(s) to the report. If the FFT Parameters are not set in such a way that the FFT trigger would turn off, the FFT Traces will not be exported or checked, although any FFT Detector Readings would still be checked using the settling details in the Configuration.

The Traces that are limit checked are:

- FFT Traces.
- FFT Traces derived from the output of the CTA.
- FFT Responses (eg, frequency response, noise response, distortion response etc. from multi-tones).
- Time domain Traces (including impulse response Traces)

The process of setting up a multi-tone is not described here. Please see the dScope Series III Operation manual for the multi-tone generation and analysis settings in conjunction with setting up Limit Lines for Traces.

When using the Multi-tone generation and analysis tools, you can set limits on any of the FFT responses and the FFT Detector Readings, but they are checked separately; Detectors are checked simply because they are there, but responses will only be checked and reported if the FFT trigger is set to turn off.

Only FFT results with fewer than 100 data points are exported to Excel.

3.3.5.5 Setting up the Trace Window for export

The Trace window is exported if either a Sweep is performed or FFT-based Traces are set to be exported. If both are present, the Trace window will be exported more than once. You can configure this and see a preview by using the  [Graph/print export setup] button on the Trace Window toolbar. It is the Export options that are used by Auto Sequence. You can use the [Export Preview] button to see how the graph will appear in the report.

Note that the Trace Window must be open on the current page in the Configuration in order for graph exports to work.

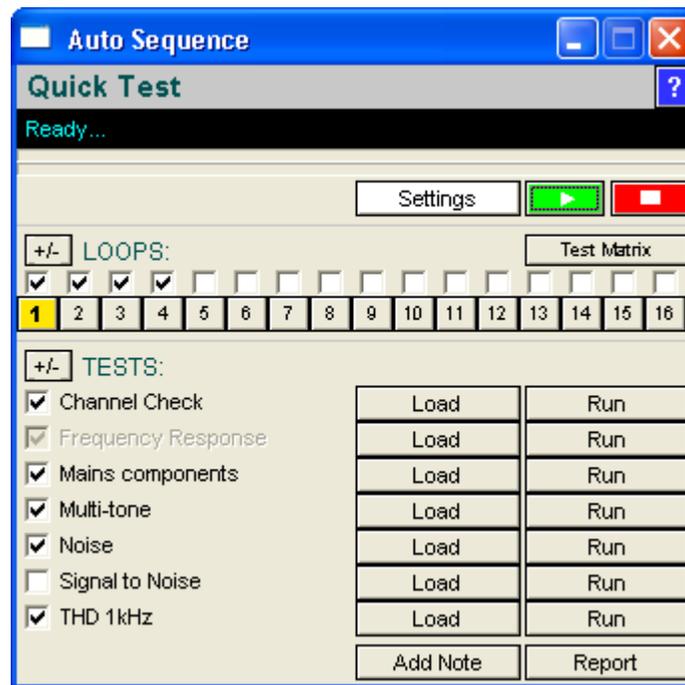
3.3.5.6 Checking digital data integrity

If the Configuration is set up with a digital input selected and the digital input is set to use “Channel Check”, Auto Sequence will check firstly for the presence of the Channel Check sequence (a specific test pattern for digital data), and if found, will check it for [a set period](#) (default 10 seconds). The Channel Check sequence must be detected on the selected digital input and maintained for the required period without errors for it to pass.

3.4 Looping and Multi-Channel Tests

In order to cater for repeating a Sequence a number of times (for example, on a multi-channel device, or at different device settings) Auto Sequence can manage multiple repeats of the same Sequence. We term these “Loops” and each Loop is individually accessed and controlled.

Setting up Loops simply consists of adding Loop files to the sequence configurations folder. A Loop file is a dScope Configuration or script that defines the conditions for the Loop. If more than one Loop file is found in the Sequence configurations folder, Auto Sequence will detect it and change the appearance of the user interface to allow control of the looped Sequence as shown below:



In this example, there are 16 Loop files defined in the folder and there are consequently 16 corresponding Loop buttons and check boxes. Entire Loops can be disabled using the Loop check boxes in which case they will not be run and will not be required for the pass/fail. The interface will support up to 48 Loops which would give three rows of Loop buttons.

Each Loop is one pass through the Tests. Each Loop has independent selection of Tests within it (the same selection of Tests doesn't have to be run on each Loop). This is controlled using the [Test Matrix](#) and the Test check boxes on the left of the form. The latter are for the currently selected Loop. Changing the selected Loop by clicking on the Loop buttons loads the settings and results for that Loop and may therefore show different check boxes checked. A Test can be turned off for all Loops using the Test Master controls in the [Test Matrix](#) (accessed using the [Test Matrix] button).

3.4.1 Defining Loop files

When a Test Sequence is loaded, Auto Sequence checks the sequence folder for the presence of “Loop files”. These are either dScope Configurations or scripts with the names “Loop_1.dsc”, “Loop_2.dsc” (Configurations) or “Loop_1.dss”, “Loop_2.dss” (scripts). The presence of either file type is sufficient to make the Sequence run in Loop mode. The script looks first for Loop_1, then Loop_2 etc. If only Loop_1 is found, no changes will appear on the user interface. If more than 1 Loop file is found, Loop buttons are placed on the interface for each one until either a Loop file is not found or the number of Loop files hits 48 (the limit of buttons that are accommodated by the form).

When the Test Sequence is run or the Loop button is pressed, Auto Sequence will look first for a Loop Configuration (.dsc) file and load that, and secondly for a script (.dss) and run that. At each Loop you can define either or both.

Typically a Loop file will define a connection to the equipment under test (for example, setting up switcher channels that have been saved in a Channel Array in a dScope Configuration) or will configure the device itself using automation accessed via the Loop script.

Loop Files and partial Configurations

dScope also supports the concept of “partial Configurations”. These can be very useful in Loop mode. The idea is that a dScope Configuration can be saved *without* some of its settings, meaning that loading this Configuration will not overwrite the settings in the previously loaded Configuration. For example, all the Test Configurations could be saved without their soundcard channel mappings and the Loop files could be saved with just their soundcard channel mappings. When the Loop file is loaded it will set the channel mappings, which will not be overwritten by the other Configurations in the remainder of the Sequence.

To achieve this, if you use the  [Save Configuration As] button on the dScope toolbar (or the equivalent “Save As” option in the dScope file menu), you will see a tree structure on the right with the settings to be saved shown with a blue check and the ones that are not saved and restored with a red cross. Simply click on these to toggle their state.

Loop Script Files

There are a range of things that can be done with a script file that can't be done with a Configuration, not least the changing of device settings. Using a dScope script it is possible to control external devices and automation, increment a setting, or simply put up a message box asking the operator to change the channel selection of the current mode of operation. The Loop script will be run after the Loop Configuration file (if present).

Loop script files should be dScope automation files and can be written using the dScope script editor. How to do this is beyond the scope of this documentation. Please refer to the [Prism Sound website](#) and the dScope Series III Scripting documentation.

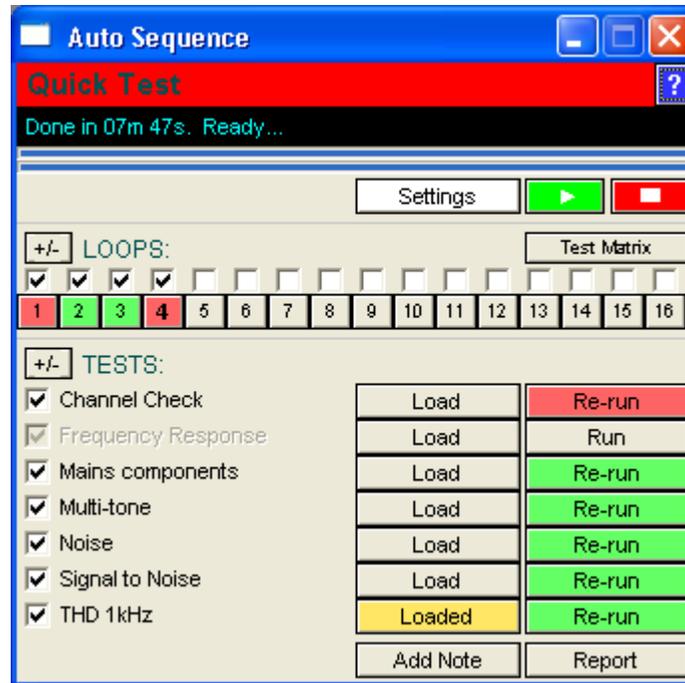
Test Level Loops

In addition to looping the entire Sequence, it is possible to loop just a single Test within a Sequence. An example of where you might want to do this is if you wanted to run the same Test at several different sample rates. To achieve this, you would save a Loop script with the same name as the Configuration with “_Loop_1.dss” at the end instead of the usual “.dsc”. For example, if your Configuration was called “Noise.dsc”, you would save a script with the name “Noise_Loop_1.dsc” in order to set up the conditions for the first pass through this Test. You could then set up “Noise_Loop_2.dsc”, “Noise_Loop_3.dsc” etc, to repeat the Test three times with different conditions. When a Test is repeated in this way, the pass/fail for this Test consists of the overall pass/fail of all the Loops. As far as the HTML report and spreadsheet are concerned, this is one long Test that just happens to measure the same thing a number of times. Each Loop will contribute to the HTML report and the Excel spreadsheet.

3.4.2 Looping behaviour

When Loops are set up, running a Sequence runs each Loop in turn. Within each Loop, it loads and runs the Loop files first and then runs the sequence of Tests. As each Loop is completed, the Loop buttons change colour to indicate whether the Tests in that Loop passed or failed. At the end of the Sequence of Loops you can click on the Loop buttons to go back and reload a Loop that failed, and the interface will be updated to indicate which Test within that Loop failed, enabling you to re-run just that Test, or, if preferred, you can click the Loop button a second time to run the entire set of Tests for

that Loop again.



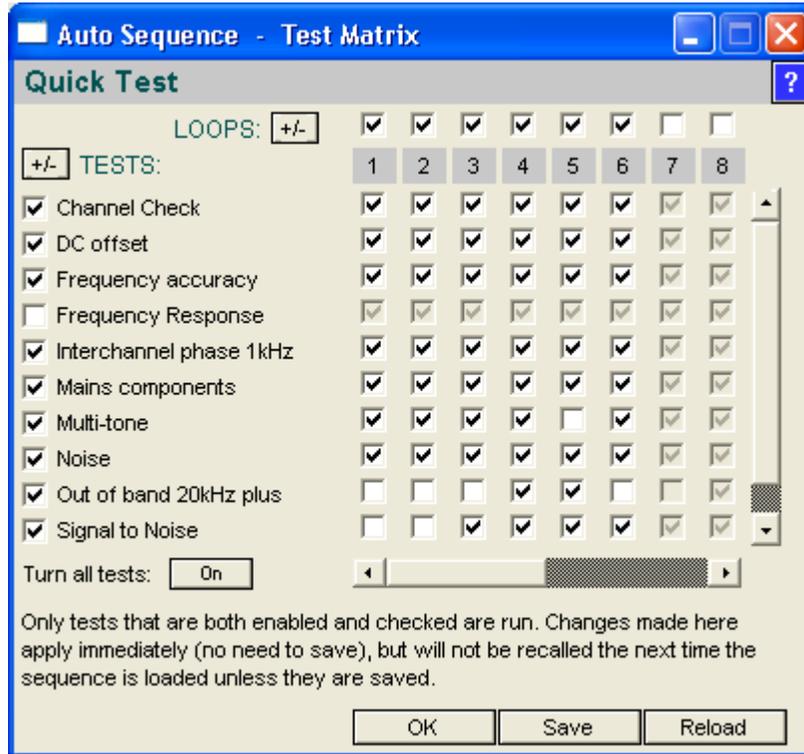
In the screen-shot above, the Sequence has 16 Loop files, but only the first four are set to run. Each time the Loop runs, it is set to run all the Tests except the "Frequency Response" Test which is disabled for all Loops (using the Test Master check boxes found in the [Test Matrix](#)). The required Sequence has been completed. Loops 2 and 3 have passed, but the "Channel Check" Test in Loop 4 has failed as indicated by the red "Re-run" button. At least one Test in Loop 1 has also failed, but we wouldn't know which one unless we clicked on the Loop 1 button to load it. Loop 4 is currently selected (indicated by the bold "4" in the Loop button). In order to get the entire Sequence to pass, we would re-run any Tests in any Loops that had failed by first selecting the Loop and then re-running the Test within the Loop that had failed.

If you were testing a modular device with one module tested per Loop (eg, a console with multiple channel strip modules) and one channel failed and had been replaced with a new module, you would need to re-run the entire Sequence for that module Loop. This can be done by selecting the Loop for that module (by clicking its Loop button), and then clicking it again to run the Sequence of Tests.

3.4.3 Test Matrix: setting which tests run

The Test Matrix is a two dimensional view of a Looped Test Sequence with each Loop as a column and each Test as a row and check boxes to set which Loops, Tests and Loop/Test combinations are enabled.

On the main interface of Auto Sequence there are already check boxes for the Loops and Tests within the current Loop. If, however, you want more control over which Tests are run, you can do so with the "Test Matrix" accessed from the button with the same name. This is shown below.



Here, only the Tests that are both enabled *and* checked will be performed and are required for the pass/fail results.

- Along the top are the Loop Master check boxes: if these are unchecked, the Tests below this Loop are shown disabled and the Loop will not run. These check boxes are functionally the same as the Loop check boxes on the main Sequence interface
- Down the left side are the Test Master controls - these are NOT the same as the ones on the main interface. If these are unchecked, the Test will not run in *any* Loop. Tests in this state are shown as disabled in the Sequence interface.
- In the main body of the Test Matrix are check boxes for individual Tests within each Loop. These ARE equivalent to the check boxes down the left side of the Sequence interface, where only one column is shown at a time for the currently selected Loop. A Test is only run if both the Loop and the Test Master it belongs to are checked, AND it is checked itself. This is shown by check boxes which are both checked *and* enabled.

In the above screen shot it can be seen that only Loops 1 through 6 will be run. Furthermore, the "Frequency Response" Test is disabled in all Loops and there are several Tests near the bottom that are not run on certain Loops.

- To turn all Loop Masters on or off, use the Loop [+/-] button
- To turn all Test Masters on or off, use the Test [+/-] button
- To turn all Tests on or off, use the "Turn all Tests [on/off] button.

Saving which Tests get run

When you first open the Test Matrix for a new Test Sequence, all the Tests and Loops are enabled. Making changes in the Test Matrix changes which Tests are required right away in the current session. If you want to keep the changes for the next time you load the Sequence, you will need to save them or they will get overwritten the next time the Test Sequence is loaded.

Along the bottom of the Test Matrix are the following buttons:

- [OK]: simply closes the Test Matrix - any changes you have made will have been applied already. This is the same as closing the dialogue box with the Windows' "X" in the title bar.
- [Save]: Saves the current state of the Test Matrix to disk.
- [Reload]: Reloads the saved state of the Test Matrix from disk - useful as an undo or reset function.

There is no "Cancel" button as changes to the Test Matrix are applied instantly. You *can* make changes while a Test Sequence is running. Auto Sequence checks whether a Test is required just before loading it. If the Test is already loaded, it will continue the Test to the end. The pass/fail will be updated automatically.

3.5 Reporting

Auto Sequence has two reporting mechanisms: an HTML report containing tables of results and graph export images, and a Microsoft Excel export of Reading results and Sweep data.

[HTML Reporting](#)

[HTML reporting options](#)

[Excel Reporting](#)

[Excel operations](#)

[Excel pass/fail indication](#)

3.5.1 HTML Reporting

Every time an individual Test is run, Auto Sequence collects the results and graphics ready for compilation into an HTML report which happens when the [Report] button is clicked. When a Test Sequence is started using the  [Run Sequence] button, the entire report is reset. As each Test is completed it adds its section to the overall report. After the Sequence has run you can re-test any individual Test if it has failed. Re-running an individual Test within a Sequence overwrites the previous results for that Test. After each re-test the overall pass/fail is re-assessed and the compiled information that goes to make up the report is updated. The HTML report is not updated until the [Report] button is clicked again.

Clicking the [Report] button generates an HTML report containing details of the most recent run of each of the Tests that have been performed and opens it in the default browser.

QUICK TEST REPORT																
Overall Result: PASS																
SUMMARY:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
<input checked="" type="checkbox"/> Channel Check	✓	✓	✓	✓												
<input type="checkbox"/> Frequency Response																
<input checked="" type="checkbox"/> Mains components	✓	✓	✓	✓												
<input checked="" type="checkbox"/> Multi-tone	✓	✓	✓	✓												
<input checked="" type="checkbox"/> Noise	✓	✓	✓	✓												
<input checked="" type="checkbox"/> Signal to Noise			✓	✓												
<input checked="" type="checkbox"/> THD 1kHz	✓	✓	✓	✓												

KEY: ✓ = Test passes, X = Test fails, OK = Test has run but has no limit checking, ✓ = Test passes but is not required,
 ✗ = Test fails but is not required, ✗ = Test has failed to run or has not completed, ? = Test is required but has not been run.

[Back to top](#)

Loop 1, Test 1: Channel Check: PASSED

Measured at 24/10/2012 14:03:23

Generator Settings	
Channel A:	Off
Channel B:	Off

Digital Inputs Channel Check	
Channel Check (Both channels)	PASS 24bits for 4s

Other Readings		
Frame rate	40,000,005 Hz	Not limit checked.
Frame rate deviation	0.0 PPM	Not limit checked.
Carrier amplitude	1.18 V	Not limit checked.
Jitter amplitude	53.0 ns p-p	Not limit checked.

HTML reports work in two “modes” depending on whether the option to “[Save a new report for every Test](#)” is checked. ([Settings](#) menu). If this is checked (default), every time the Test Sequence is run, it will create uniquely named HTML reports and graphics. The name is made up of the serial number/reference (if entered), the date and time of the report, and an indicator of pass (P) or fail (F).

If the “Save a new report for every Test” is not checked, a generic report is saved and is overwritten every time a new Test is performed. In this mode, if you want to keep a copy of the report, you will need to save it with a different name or, for portability, print it to PDF. Note that the graphics also will get overwritten each time a new Test is performed, so it is not sufficient to simply rename the HTML file.

[Where are HTML reports stored?](#)

HTML reports are stored in a sub-folder of the dScope Results\Sequences\ folder with the same name as the Sequence. For example, in a default dScope installation, for a Test Sequence called “Analogue Test”, the HTML reports would be stored in "c:\Program Files\Prism Sound\dScope Series III\Results\Sequences\Analogue Test".

[Adding Notes](#)

You can add a simple note to the report by clicking the [Add Note] button before clicking the [Report] button. This opens a dialogue box which will accept up to four lines of text to be included in the report. The [Previous] button allows you to re-call the previous entry in this dialogue box and make changes to it before saving.

[Changing HTML reporting Options](#)

Because the HTML report is compiled while the Test Sequence is running, changes to HTML reporting options take effect the next time a Test Sequence is run.

3.5.1.1 HTML Reporting options

Within the [Settings menu](#) are options for HTML Reporting:

Save a new report for every Test

If this is checked, every new HTML report will be generated with a new name and with separate graphics exports. If this option is not checked, the same generic report file name is re-used to generate the report and this report file will be overwritten each time the Test Sequence is run. You may want to do this if you don't want to keep the HTML reports or if you have saved PDF copies etc. The default is to save a new report.

Report Generator Settings

With this option selected, the HTML report will contain an overview of the settings used on the dScope Generator at each Test during the Sequence. The default is not to report these settings.

Report CTA Settings

With this option selected, the HTML report will contain an overview of the settings used on the dScope Continuous-Time Analyzer (CTA) with every Reading derived from the CTA. The default is to report these settings.

Report FFT Detector Settings

With this option selected, the HTML report will contain an overview of the settings used on the dScope FFT Detector with every Reading derived from that Detector. The default is to report these settings.

Report dScope details and global settings

With this option selected, the HTML report will contain an overview of the dScope hardware used to make the measurements including its serial number, hardware configuration, software versions, calibration history and some global option settings. Unlike the other options for HTML reports above, this part of the report is compiled when the [Report] button is pressed and changes to this setting therefore take place immediately. The default is not to report these settings.

Document Full dScope Configuration

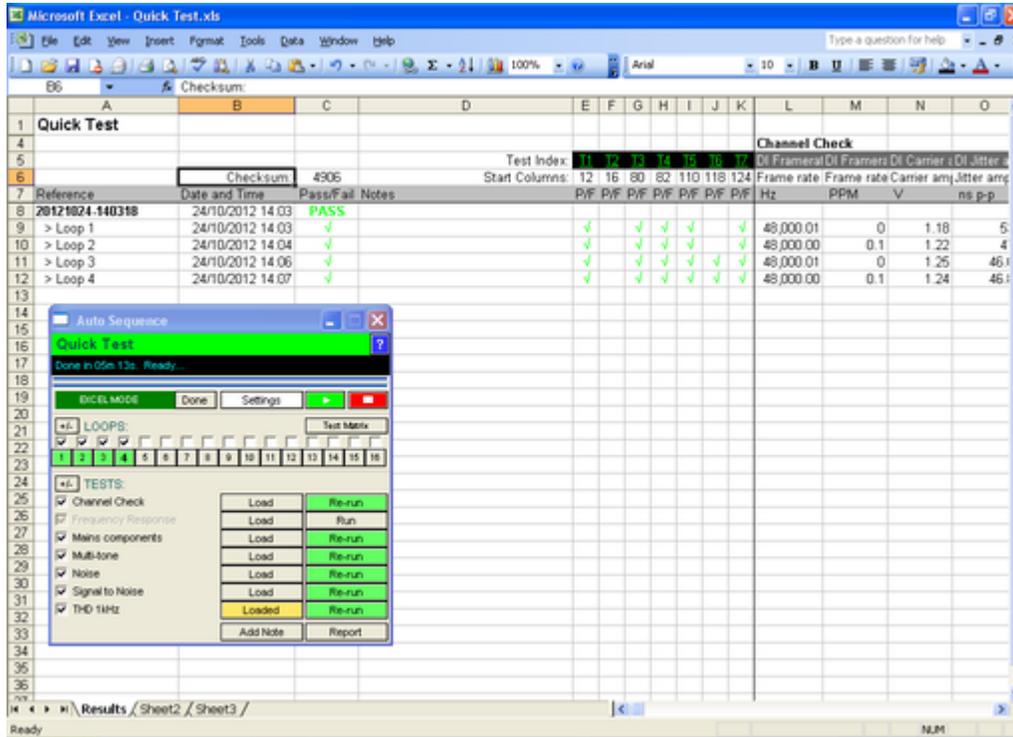
This option uses a separate script to retrieve and report several hundred dScope Configuration settings for each Test and include them at the bottom of the HTML report. These are only retrieved on the first Loop, and selecting this option tends to create very large reports.

Changing HTML reporting Options

Because the HTML report is compiled while the Test Sequence is running, changes to HTML reporting options take effect the next time a Test Sequence is run.

3.5.2 Excel Reporting

Auto Sequence can automatically create a spreadsheet from a Test Sequence and store measured data in it. The data are arranged with a new column for each measured result and a new row for each time the Test Sequence is run. In general you do not need to do anything with Excel directly – Auto Sequence will open Excel, create a spreadsheet if needed, configure it to the current Test, write to it directly and save periodically.



In the screen-shot above, the entire spreadsheet was generated by Auto Sequence without having to do anything manually in Excel.

The HTML and Excel reports are not mutually exclusive. For example, you could set up Auto Sequence to export the results to Excel and not to save a new HTML report for each Test. When a Test failure occurs, the spreadsheet indicates which Test failed, but not which result within the Test or what the limits were – this information is available in the HTML report so a quick diagnosis can be provided without using additional storage for results.

The spreadsheet is saved at the end of every Test Sequence, and again after every re-test. You are prompted if you want to save and exit Excel when an Auto Sequence Test Sequence is closed. It is recommended that you do. If you do not, you should save manually and close before re-starting a new Test Sequence.

NB: Auto Sequence cannot tell whether an Excel spreadsheet is already in use. If you open a Test Sequence that uses Excel and its spreadsheet is already open, Excel will open a read-only copy. You will be prompted about this. You can write results to a read-only spreadsheet, but obviously you cannot save it using the same name. To resolve it, close Auto Sequence and Excel and start Auto Sequence again. It will open Excel itself. To avoid this happening, make sure Excel is closed before starting Auto Sequence.

Using Excel Directly while running Auto Sequence

Auto Sequence attempts to "lock" Excel whenever it runs a Sequence, Loop or individual Test. It does this by taking Excel out of "Interactive" mode so that you cannot interact with it using the keyboard or

mouse for the duration of the Test. While Auto Sequence has control of the spreadsheet in this way, you will see a white small arrow head next to the "Excel Mode" indication in Auto Sequence.

When Auto Sequence has finished with Excel, it releases it again and you can use it normally. There is one caveat to this: if you edit the spreadsheet, you must commit your changes before attempting to run a Test: don't leave the spreadsheet in "Edit Mode" with the cursor in a cell or the formula bar. When Excel is in "Edit Mode" it can't be automated and Auto Sequence will not be able to get a lock and the Tests will not be run.

The "Done" button

When in Excel Mode after running a Test Sequence a [Done] button appears next to the "Excel Mode" indication. The purpose of this is to let Auto Sequence know that you are done with the current Test and are ready to move on. After the Sequence has been completed, you are normally in a "re-test" mode where you can re-run individual Tests and Loops. Normally clicking the  [Run Sequence] button again will make the break with the previous Test and start the next one, but if you wanted to exit this "re-test" mode without starting another Sequence you would press the [Done] button.

An example will make this clearer: Consider the case where you have just run a Test Sequence and the results have been saved to the spreadsheet, and you want to run another Test but with a particular Test disabled. If you just click the checkbox to disable the Test, the measurements for the Test you have just performed would be updated, showing that the Test was not required. This is unlikely to be what you intended. Clicking the [Done] button breaks the link with the existing Test and allows you to make set-up changes ready for the next Sequence.

You do not need to press the [Done] button to run another Sequence; clicking the  [Run Sequence] button does this automatically.

Limitations

The reports sent to Excel do not contain the same level of detail as the HTML reports and are more for storing results of individual measurements. Although pass fail is indicated for each Test, the individual pass / fail for each measurement is not indicated, nor are the limits.

Results that are exported:

- All results from [supported Readings](#)
- Sweep Results except sensed Sweeps
- FFT response Traces with 100 points or less.

Sweeps with a measured X axis are not supported

Sweeps with a measured X axis *are* exported to Excel, but the x axis values recorded in the header are the ones recorded when the spreadsheet was configured and not when the subsequent measurements were taken. They should be treated with caution as they are likely to be incorrect.

Excel limitations on numbers of rows and columns

Excel versions before Excel 2007 (version 12) had a worksheet size limit of 65536 rows and 256 columns. In version 12 (Excel 2007) this increased to 1048576 rows and 16384 columns. Auto Sequence automatically monitors this and warns if the Configuration would use more columns than are available. Note that the spreadsheet size (in MB/GB) and the time taken to save it will probably become an issue before the spreadsheet is full, especially in Excel 2007 and later. Versions of Excel before Version 9 (Excel 2000) have not been tested.

3.5.2.1 Excel operations

Creating a Spreadsheet

To create a spreadsheet for a Test Sequence, simply go to the Auto Sequence [Settings menu](#), turn on “Export Readings and Sweeps to Excel” and follow the instructions. Auto Sequence will create the spreadsheet for you. When you first run the Sequence it will configure the spreadsheet by writing in headers as it progresses through the Test Sequence. Please don't stop it while it does this. After the spreadsheet has been configured, every time the sequence is run it will write the measurement data in the first available row.

How Auto Sequence manages spreadsheets

Auto Sequence has some fairly straightforward rules for how it works out what to do with spreadsheets. Understanding them will enable you to make the most of this feature and to work out what has happened if things go wrong:

1. Spreadsheet Creation:

If you enable exporting results to Excel or open a Sequence where it is enabled, Auto Sequence first checks whether a spreadsheet already exists for this Sequence. If the spreadsheet is not there, Auto Sequence will offer to create it. If you say yes, it creates it but leaves it blank.

The spreadsheets have the same name as the Sequence and are in a sub-folder of the Results \Sequences folder also named the same as the Sequence. For example, a Test Sequence called “Digital Test” would have a spreadsheet at: c:\Program Files\Prism Sound\dScope Series III \Results\Sequences\Digital Test\Digital Test.xls

2. Spreadsheet Configuration:

Once Auto Sequence has opened the spreadsheet it checks the contents of cell A1 (top left):

- If it is empty it assumes the spreadsheet has not yet been configured; it will configure the spreadsheet with the headers as it runs the first Test Sequence.
- If it contains the name of the Test Sequence, it will assume all the headers have already been written and will only write the measured data to the first available row.
- If it contains anything else, the Sequence will stop with a warning that Auto Sequence is not sure it is writing to the right spreadsheet. This is to prevent overwriting data in the wrong spreadsheet.

In order for Auto Sequence to configure the spreadsheet, you will need to run the Test Sequence. Auto Sequence will look out for information to be written to the spreadsheet as the Tests run and write in headers for all the data it finds. It also writes in an index for the Tests (“T1”, “T2” etc.) which are hyperlinks to the columns where the test data for that Test is stored. It also records the “start column” number for each Test. The start column allows Auto Sequence to work out where to write data from each Test separately, which is important if some Tests are disabled or if you need to re-run a particular Test after the Sequence has completed. Please do not change these column numbers.

When configuring a spreadsheet for a Test Sequence that contains multiple Loops, Auto Sequence will attempt to configure the spreadsheet by only running Loop 1 as this should contain enough information to set up the spreadsheet headers. If a particular Test is not enabled in Loop 1, Auto Sequence will look for the first Loop in which it is enabled and run it there. For example, if all the Tests are enabled in Loop 1 except Test 5, Auto Sequence will run Loop 1 up until it gets to Test 5 and then look for the first Loop where Test 5 is used. If this is Loop 3 for example, Auto Sequence will load Loop 3, then run Test 5, then re-load Loop 1 and resume with the rest of the Tests. While configuring the spreadsheet, Auto Sequence will ignore the Test Master controls, meaning that a Test that is disabled with the Test Master in the [Test Matrix](#) will still be run.

If a Test is disabled in all Loops (the Test is not checked in any of the Loops) it will be left blank in the spreadsheet and no space will be reserved for results from that Test. If such a test is subsequently enabled in one or more loops and contains results to be written to the spreadsheet, running it will cause an error.

Archiving a spreadsheet

To archive a spreadsheet, use the [Archive] button in the [“Settings” menu](#). This will copy the spreadsheet in the [same folder](#) where it currently resides with a new name based on the current date and time.

Clearing a Spreadsheet

To clear the data from a spreadsheet, you can use the [Clear Data] button in the Auto Sequence [“Settings” menu](#). This simply clears all the rows where data has been written. It does not clear the headers.

Re-setting a spreadsheet

If you make changes to a Test within a Sequence (add or remove a Reading, or change the number of Sweeps or Sweep points for example) you will need to re-set the spreadsheet to take these changes into account. If you have data you want to keep, first follow the instructions for archiving a spreadsheet above, then delete the spreadsheet and allow Auto Sequence to re-create it with the new settings. You can also clear the contents of the spreadsheet and unfreeze the panes, but this is probably no easier than deleting the entire spreadsheet.

Changing a Test Sequence after setting up a spreadsheet

Auto Sequence sets up a spreadsheet based on the number of Tests in a Sequence and the number of applicable measurements within each Test. It keeps a record of the column in which to start recording the results of each Test and can therefore run each of the Tests independently. Once the spreadsheet has been configured, you should consider both the spreadsheet layout and the dScope Configurations frozen, and not change either. In practice, Auto Sequence runs a series of checks on the spreadsheet and Sequence and will stop and warn you so as to avoid data corruption if it finds anomalies. (There is one exception - it cannot tell if the number of results changes in the last Test in the Sequence). It does not check many of the changes you could make, such as the units or bandwidth of a measurement that would make your data invalid. If you need to make a change to a Test, the simplest way is to archive, delete or rename the spreadsheet and start again.

Running Excel Hidden

By default, Auto Sequence runs Excel visible. This is set by the “Run Excel visible to user” option in the settings menu. If this is unchecked, Excel starts up hidden (with no user interface or task-bar button). Most things work identically in this mode with the exception that you are not prompted to save and exit when closing a Test Sequence (it is saved and closed automatically) ...and of course you can't see the spreadsheet! If you get "read-only" errors in this mode, but can't see Excel open, check that there are no instances of Excel running hidden in the Process list in Task Manager.

Automatically Scrolling the Spreadsheet

In the settings menu you can set whether Auto Sequence scrolls the spreadsheet up so that new Tests appear at the top of the spreadsheet each time a new Test Sequence is started. If this is off, the newest Tests appear at the end of the spreadsheet and may be off the screen. This setting is on by default.

3.5.2.2 Excel pass/fail indication

The spreadsheet is updated every time a Test is run, or whenever the check boxes which determine which Tests are required are changed. The overall pass/fail for the Sequence is written into column C of the spreadsheet. The pass/fail for each individual Test is written to separate columns underneath the test index for that Test. In this way it is easy to see whether a particular Test passes or fails.

The indication for the overall Sequence pass/fail and for the Test columns is as below:

Overall Sequence pass/fail indication

(PASS) - means that the overall Test Sequence is currently passing, but all the Tests have not yet been completed.

PASS - (bold) means that the overall Test Sequence has passed and all [required](#) Tests have been completed

FAIL - (bold) means that the overall Test Sequence has failed (any Test has failed)

N/A - means that there has been no limit checking performed (yet) and therefore pass/fail is not applicable.

Individual Test pass/fail indication

"-" (grey hyphen) indicates that the Test is not [required](#).

? - in a Test column indicates that the Test is required, but hasn't yet been performed

v - in a Test column indicates that the Test has passed

[v] - in a Test column indicates that the Test passed, but isn't checked for inclusion.

X - in a Test column indicates that the Test has failed

(X) - in a Test column indicates that there was a problem running the Test - most likely a digital input did not lock or a soundcard returned no data and the Test timed out.

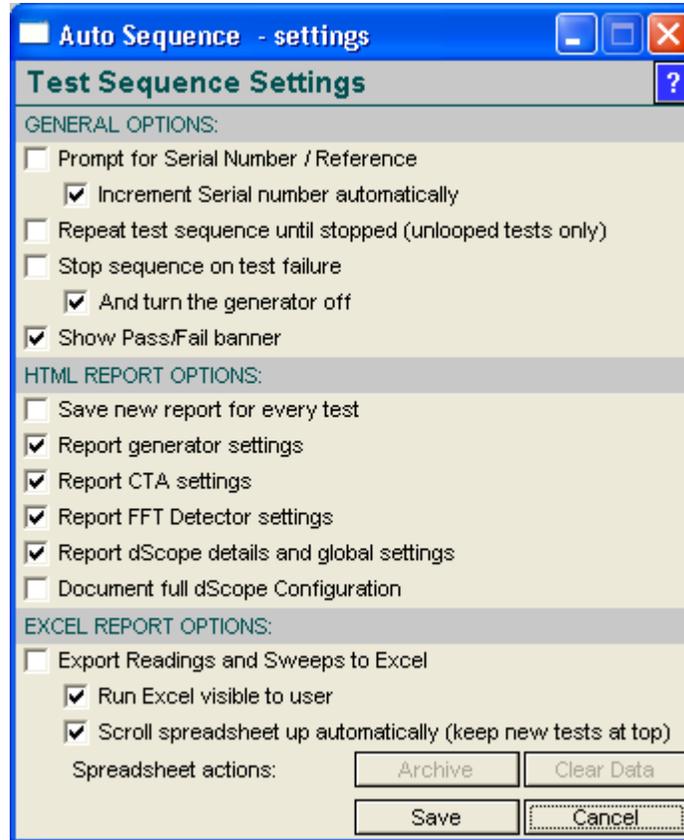
[X] - in a Test column indicates that the Test has been run and failed, but isn't checked for inclusion in the Test results anyway.

OK - in a Test column indicates that the Test has run but there was no limit checking found.

[OK] - in a Test column indicates that the Test has run and there was no limit checking found but the Test wasn't required anyway.

3.6 Settings and Options

Within any Test Sequence there are a number of settings and options available from the "settings" dialogue box. When a new Sequence is set up, these are set to default values. Once they are saved, they are stored and recalled with the Test Sequence. The settings are accessed from the [Settings] button on the sequence form and bring up a form as shown below:



- [Prompt for Serial Number / Reference](#)
- [Increment Serial Number automatically](#)
- [Repeat Test Sequence until stopped](#)
- [Stop Sequence on Test failure](#)
- [Show Pass/Fail banner](#)
- [HTML Reporting Options](#)
- [Excel Reporting Options](#)

3.6.1 Prompt for Serial Number / Reference

When a Test is started, this brings up a dialogue box for entering a serial number or reference to be added to the report or written to the spreadsheet. There are some limitations about what characters can be used here, as it is also used to generate file names for the HTML reports and therefore any characters that cannot be used in Windows file names cannot be used here.

If [using Excel](#), the reference used here appears in column A of the spreadsheet.

3.6.2 Increment Serial Numer Automatically

If the option to prompt for serial numbers is set, this will look at whether the previously used Serial Number / Reference was numeric and, if so, increment it by 1 and present this for use in the serial number / reference prompt dialogue box. If the option to prompt for serial numbers is not set, it has no effect.

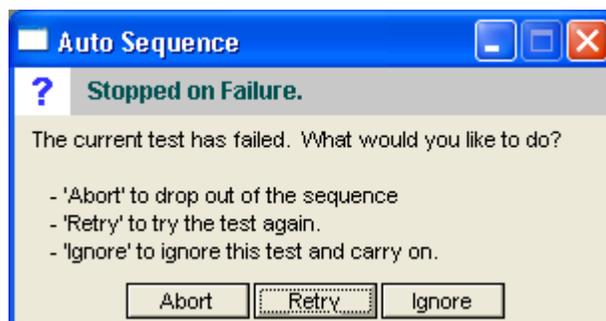
3.6.3 Repeat test sequence until stopped

This is functionally the same as continually pressing the  [Run Sequence] button again as soon as the Test Sequence has completed. If there are no prompts or message boxes set up, this can run multiple Tests repeatedly unattended. It can also be used in conjunction with the "[Stop Sequence on Test Failure](#)" to run complex soak tests checking for multiple conditions over time and stopping on failure. With the option to "[prompt for the serial number](#)", it can be used to automatically test the next device upon entering its serial number or reference, making it unnecessary to click the  [Run] button. With an additional barcode reader, this process can also be automated. With the addition of a [start-up script](#) that waits for a particular condition to be met (eg, detection of a particular signal) the Test Sequence can be run automatically each time a new device is connected.

This option is not yet available with looped Sequences.

3.6.4 Stop sequence on test failure

Should a Test within a Sequence fail, the script can be set to stop at the point of failure. This stops at the end of the Test in question (and not at the point of failure within a Sweep etc) and presents a message box with the following options:



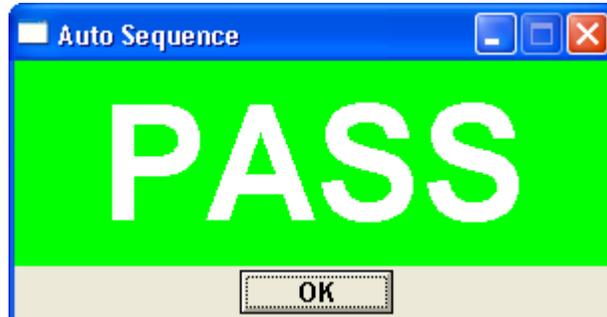
- [Abort]: aborts the Test Sequence, leaving the current dScope settings and allowing fault finding to be done.
- [Retry]: retries the failed Test.
- [Ignore]: Ignores the failure and carries on testing the rest of the Sequence (leaves the Test in a "Failed" state).

...and turn the generator off

There is an additional option in the options dialogue box to turn the generator off when the Sequence is stopped in this way. This can be particularly useful for unattended Tests where leaving the generator on could cause problems (eg, power amplifier test at full power).

3.6.5 Show Pass/Fail banner

By default, if any limit checking is encountered during the running of a Test Sequence a Pass/Fail banner will be shown at the end with the accumulated pass/fail status of all the Tests. This can be turned off (the pass/fail status is also displayed by the colour of the header of the Auto Sequence dialogue box). This banner does not appear if there is no limit checking encountered in the Sequence.



3.7 Appendix

Contains the following reference material:

[Advanced Topics](#)

- [Automation Scripts](#)
- [Script Set-up Mode](#)
- [HTML Reporting Extensions](#)
- [Additional Options](#)

[Trouble Shooting](#)

[Flow Diagram](#)

3.7.1 Advanced Topics

Although it is possible to chain a Sequence of Configurations together and get overall pass/fail, for many more complex real-world tests, more is needed. This section covers:

[Automation Scripts](#) - additional scripts that run at certain points in the Sequence execution

[Set-up Mode](#) - an alternative view of the Auto Sequence interface that makes editing of automation scripts easier

[HTML Reporting extensions](#) - Ways of customizing the appearance of the HTML reports

[Additional Options](#) - things you can change in the script itself to change its behaviour

3.7.1.1 Automation Scripts

Although one of the main aims of Auto Sequence is to avoid scripting, allowing scripting within the framework makes quite a lot of things possible that would otherwise not be achievable using Configurations alone. Examples of this would be things like setting up inputs and outputs, setting references for measurements etc.

Making scripts available simply consists of creating scripts with a consistent naming convention within the Sequence folders. As the Sequence progresses, Auto Sequence checks for the presence of scripts at specific stages and, if they are found, they are executed. These scripts cannot change any Auto Sequence variables (eg, pass/fail etc.) but can be used to write to the HTML report. See [HTML Reporting Extensions](#) later.

There are currently five places where scripts are executed for each Test (see also the [flow diagram](#)):

1. **At the start of a Test Sequence** – this is the “Start-up” script and will only run when the Sequence is run from the  [Run Sequence] button.
2. **After the Configuration has been loaded** - These are referred to as “post load” scripts and will be run when the configuration is loaded as part of the sequence or when you press a Test [Load] button.
3. **Before the Test is run.** This is a “pre run” script and executed when the Test is run in the Sequence or when the [Run] button is pressed for any particular Test. It is executed before the actual Test is conducted.
4. **After the Test is run.** This is a “post run” script and is executed after a Test has been run as part of a sequence or when the [Run] button is pressed. It is executed immediately after the Test has been run.
5. **At the end of a Test Sequence** – This is the clean-up script and will only run after the Sequence is run from the  [Run Sequence] button and the Sequence has completed without aborting.

For types 2, 3, and 4 above, there are two types scripts: an “all” version and an individual version. The “all” one is the same script run for all the Tests, and the individual ones are specific to a particular Test. More details below.

Start-Up Scripts

When the  [Run Sequence] button is pressed, one of the first things that happens is that Auto Sequence looks for the presence of a script called “startup.dss” in the sequence folder. If found, it is executed before any of the Tests are run.

Post-Load Scripts

After each Configuration is loaded, Auto Sequence can run one or two scripts. First it checks for the presence of an overall script called “all_postload.dss” (none of these names are case sensitive), then for a specific script for the current Configuration.

Note that clicking the [Run] button for any particular Test will check whether the Configuration for that Test is already loaded. If it is not loaded it will be loaded and any postload scripts will be executed at that point. If the Configuration is already loaded it is not re-loaded and any postload scripts will not be executed.

Run a script after each Configuration is loaded

If you want to run a single script after every Configuration is loaded (for example to set a different soundcard input selection from the one saved with the Configurations), you can do this by saving a script with the name “all_postload.dss” within the sequence folder. After each Configuration is loaded, the Auto Sequence application checks for the presence of this file and executes it if found.

Run a specific script after a particular Configuration is loaded

For some types of Test you may want to run a short script after the Configuration has loaded – for example, you may want to put up a prompt for the operator to make a change to the EUT settings. You can do this by creating a script with the same name as the Configuration but with “_postload.dss” at the end of it in the sequence folder. For example if your Configuration is called “Frequency Response.dsc” you would create a script called “Frequency Response_postload.dss” and this would get run after the Configuration had been loaded either as that Test is run as part of a Test Sequence or when the [Load] button is clicked for that Test. This is run immediately after the “all_postload.dss” script if present.

Pre-Run scripts

These are scripts that are run before any Tests defined in the Configuration. This is one of the first things done when the [Run] button is clicked for any particular Test.

Run a script before each Test is run

If you want to run a single script before each Test is run (for example, to check that you have digital lock when measuring a digital input), you can do this by saving a script with the name “all_pre.dss” within the sequence folder. The Auto Sequence application checks for the presence of this file and executes it if found before it runs any specific “pre” scripts defined for a Configuration and before it runs whatever Tests are set up in the Configuration.

Run a specific script before a particular Test is run

It can be helpful to run a specific script before running the Tests set up in a Configuration. This could be to set up dBr references or run a regulation routine for example. You can do this by creating a script in the sequence folder with the same name as the Configuration but with “_pre.dss” at the end of it. For example if your Configuration is called “Frequency Response.dsc” you would create a script called “Frequency Response_pre.dss” and this would get run after the “all_pre.dss” script (if present) but before any Tests that are set up in the Configuration. This also runs when the [Run] button is pressed for a particular Test.

Post-Run scripts

These are scripts that are executed after the Tests set up in the Configuration have been run.

Run a script after each Test is run

If you want to run a single script after each Test is run, you can do this by saving a script with the name "all_post.dss" within the sequence folder. The Auto Sequence application checks for the presence of this file and, if found, executes after it has run whatever Tests are set up in the Configuration. This cannot write to the report, but it can write to the notes area of the Trace window, [HTML extension files](#) and rename Traces etc. if required.

Run a specific script after a particular Test is run

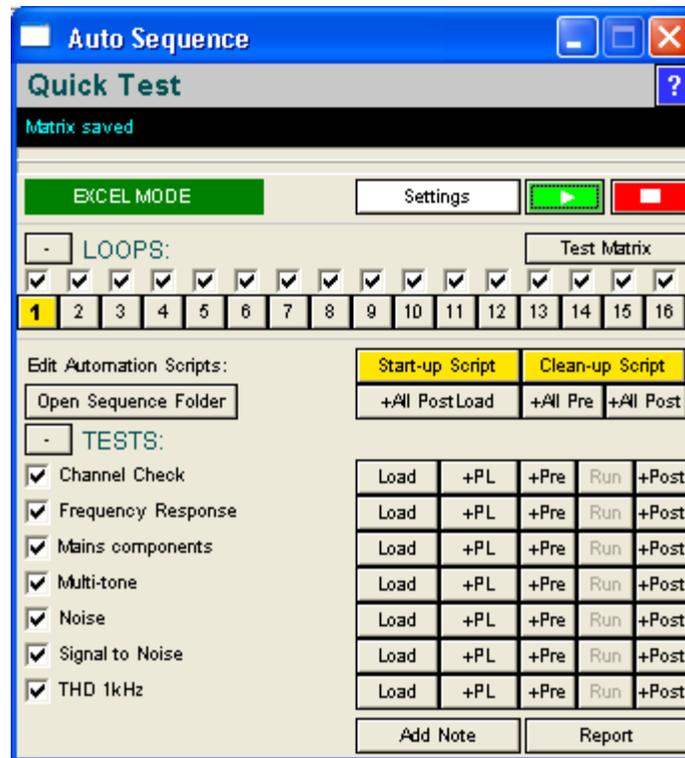
It may be helpful to run a specific script after running the measurements set up in a Configuration. Although you cannot write directly to the report, you can write to [HTML extension files](#), change the name of the Trace window or write to the notes area of the Trace window which you can set to be exported to the report. There may be other things you might like to do after the Test has run but before the pass/fail or reporting is done. You can do this by creating a script in the sequence folder with the same name as the Configuration but with "_post.dss" at the end of it. For example if your Configuration is called "Frequency Response.dsc" you would create a script called "Frequency Response_post.dss" and this would get run after the "all_post.dss" script (if present). This also runs when the [Run] button is pressed for a particular Test, after the Test has been run.

Clean-up Script

When the  [Run Sequence] button is pressed, one of the last things that happens is that Auto Sequence looks for the presence of a script called "cleanup.dss" in the sequence folder. If found, it is executed after all of the Tests have been run if the Tests have not been aborted. This could be used, for example, to turn the generator off or alert the operator that the Test has completed.

3.7.1.2 Script Set-up Mode

To assist in setting up scripts for a particular Test Sequence, you can run the Auto Sequence script in a set-up mode by checking the “Run in set-up mode” check box before selecting a Test Sequence. This changes the appearance of the user interface so that there are buttons to open each of the possible scripts or create them if they don't exist.



Existing scripts are shown with the button for that script shaded yellow – where there is no script it will show a plus sign. Clicking on the former will open the script in the defined editor. Clicking on the latter asks if you want to create the script. If you select [yes], it will create a new (empty) dScope automation script with the correct file name.

The [Open Sequence Folder] button opens Windows Explorer in the folder where the Configurations and scripts are stored for this Sequence.

3.7.1.3 HTML Reporting Extensions

Auto Sequence compiles the HTML report in memory as it progresses through the Test Sequence. At the end of the Test Sequence, if a Test is re-run, it will overwrite just the part of the report for that Test. When the [Report] button is pressed, it compiles the report as an HTML (text) file from the data held in memory from the Test Sequence. To add flexibility to this arrangement, the script will import additional HTML files from the Test Sequence folder if present. There are three types of file that get imported:

HTML Report Header

In order to be able to incorporate a custom header (with company logo etc), the report generation looks for a file called "header.html" in the Test Sequence folder. If present the text contained in this file will be inserted into the report. This makes up the first part of the report to appear after the <body> tag.

Example:

To insert a logo and the name of the company in bold text at the top of the page, you could save a file called "header.html" in the Test Sequence folder containing the following:

```
<table>
  <tr>
    <td><img src = "logo.png" alt = "Logo"></td>
    <td><H1>Company Name</H1></td>
  </tr>
</table>
<hr>
```

For this to work, you would also need to save the logo graphic into the [HTML results folder](#) for this sequence.

HTML Report Footer

In order to be able to incorporate a custom footer, the report generation looks for a file called "footer.html" in the Test Sequence folder. If present the text contained in this file will be inserted into the report right at the end, just before the closing </body> tag.

Example:

To insert a footer with a copyright notice in small grey text you could create a file called "footer.html" in the test sequence folder containing the following:

```
<div style = "width:100%; text-align: center; font-size: 10px; color: #999; ">
  <br><hr><br>
  &copy; Copyright 2012 - Company Name Ltd.
</div>
```

Test specific HTML

In order to be able to include additional notes in each Test section of the report, the report generation will also look for HTML files with the same name as the Configuration it's intended to accompany (eg, if the Configuration is called "frequency response.dsc" the associated HTML file would be called "frequency response.html").

Example:

To insert a note at the frequency response test to say that the test was performed with de-emphasis turned off you could save a file called "frequency response.html" in the test sequence folder containing the following:

```
<fieldset>
  <legend> <b>NOTE:</b> </legend>
  This test is performed with the de-emphasis turned OFF.
</fieldset>
<br><br>
```

This would create a box with the title "NOTE:" that contained the note text and which is positioned at the end of the Frequency Response Test section of the report.

Any of these files could be created manually or they can be created or added to by any of the scripts that can be run within the Test Sequence. For example, the Start-up script could scan a serial number bar-code and write the serial number into the header file, or another instrument, under the control of the dScope script could make a measurement and the script could write its results into the report.

3.7.1.4 Additional Options

In addition to the options available for each Sequence, there are some global options available within the Auto Sequence script itself which change the way it behaves. To change these requires editing the script "Auto Sequence.dss" in a text editor. These changes will get overwritten the next time the Auto Sequence script is updated.

Setup Mode Lockout

By default, the script will present a check box for running the Test Sequence in a "setup mode" - this gives access to additional features useful for configuring a Test Sequence. If this is not desirable in a production environment, it can be disabled by setting the value of bSetupLockout to "true".

Define a Script Editor

By default when in Script Setup Mode, scripts are opened in Notepad. You can change this by changing the command line for the editor to use. Set this in the constant strEditor. The script contains an example for starting Crimson Editor.

Channel Check Time

By default Auto Sequence will check that digital data integrity is maintained for 10 seconds (using "Channel Check") - this period can be adapted by changing the value of the variable dChannelCheckTime (in seconds) .

Digital Input Lock Timeout time

By default, when a Configuration is set to measure using a digital input, Auto Sequence will wait for up to 5 seconds for the selected digital input to lock. You can change this period by changing the value of dDigitalLockTimeout. (in seconds)

Soundcard Data Timeout time

When a soundcard is selected for analysis in a dScope Configuration, by default Auto Sequence will wait for up to 5 seconds for data to be received from the soundcard. This period can be changed by editing the value of dSoundCardDataTimeout (in seconds).

3.7.2 Trouble Shooting

The information below includes some quick guidance on some of the error messages you may see, what they mean and what you can do about them.

Unsupported Settings!

You may get this message after loading a dScope Configuration with features that are not supported on the version of dScope you are using. For example, if you are using an analogue only dScope Series III, but the Test Configuration has the digital input selected, you will see this message.



IMPORTANT: Some settings fall back to alternative settings when not supported – for example, if a Configuration with a digital input selected is loaded on an analogue only dScope, it will fall back to using the analogue input. Depending on how this is connected, it may successfully run the Test, but will not be the right result!

Spreadsheet Closed? Couldn't read from the spreadsheet.

You may get this if Auto Sequence has opened a spreadsheet and it has been closed or crashed in the background. It simply means that Auto Sequence has attempted to write to the spreadsheet but it has been unable to and has returned an error. The quickest and easiest resolution is to close Excel (if it's running) and restart Auto Sequence. You may also get a similar message if you have left the Excel spreadsheet in "Edit Mode" (with the cursor still in a cell or in the Formula Bar).

"Sequence and Spreadsheet Mismatch!" Or "Excel Test Data Mismatch!"

Auto Sequence sets up the Excel spreadsheet based on the number of Tests it finds, and the number of results within those Tests the first time it runs in Excel mode. If you see this error, it means that something has happened that means the number of Tests and results no longer matches the number of columns allocated to them in the spreadsheet.

The most common reason is that a Configuration has been changed (new Readings, different number of Sweep points etc.) or a new Configuration has been added or one removed. If this is the case and you want to keep the new Configurations in the Sequence, it's probably easiest to rename the existing spreadsheet and let Auto Sequence re-create it based on the new set-up.

Another possibility is that the Test Sequence was created with a different version of dScope hardware than the one now running it. For example, if the Test Sequence incorporates digital carrier measurements, but is run on an Analogue only dScope, these Readings will not be available and there will be missing columns of data. In this case the error message will be along the lines that the spreadsheet has allocated X data points for this Test but it has used (something less than X). The only way around this is to use a version of dScope that supports all the features needed for the Sequence.

When developing a Test Sequence for use with different versions of hardware, it may help to use the dScope model number emulation. For example, if you are developing a test in the design lab using a full dScope Series III and the test will be deployed on a production line using dScope Series IIIA (analogue only) hardware, you can set the dScope to run in IIIA hardware emulation while developing the tests. This option is found in the "Utility" menu under "Options" -> "Miscellaneous" -> "Hardware".

Spreadsheet Columns Full

This is most likely to occur with a Sequence using a lot of Sweep data on versions of Excel before

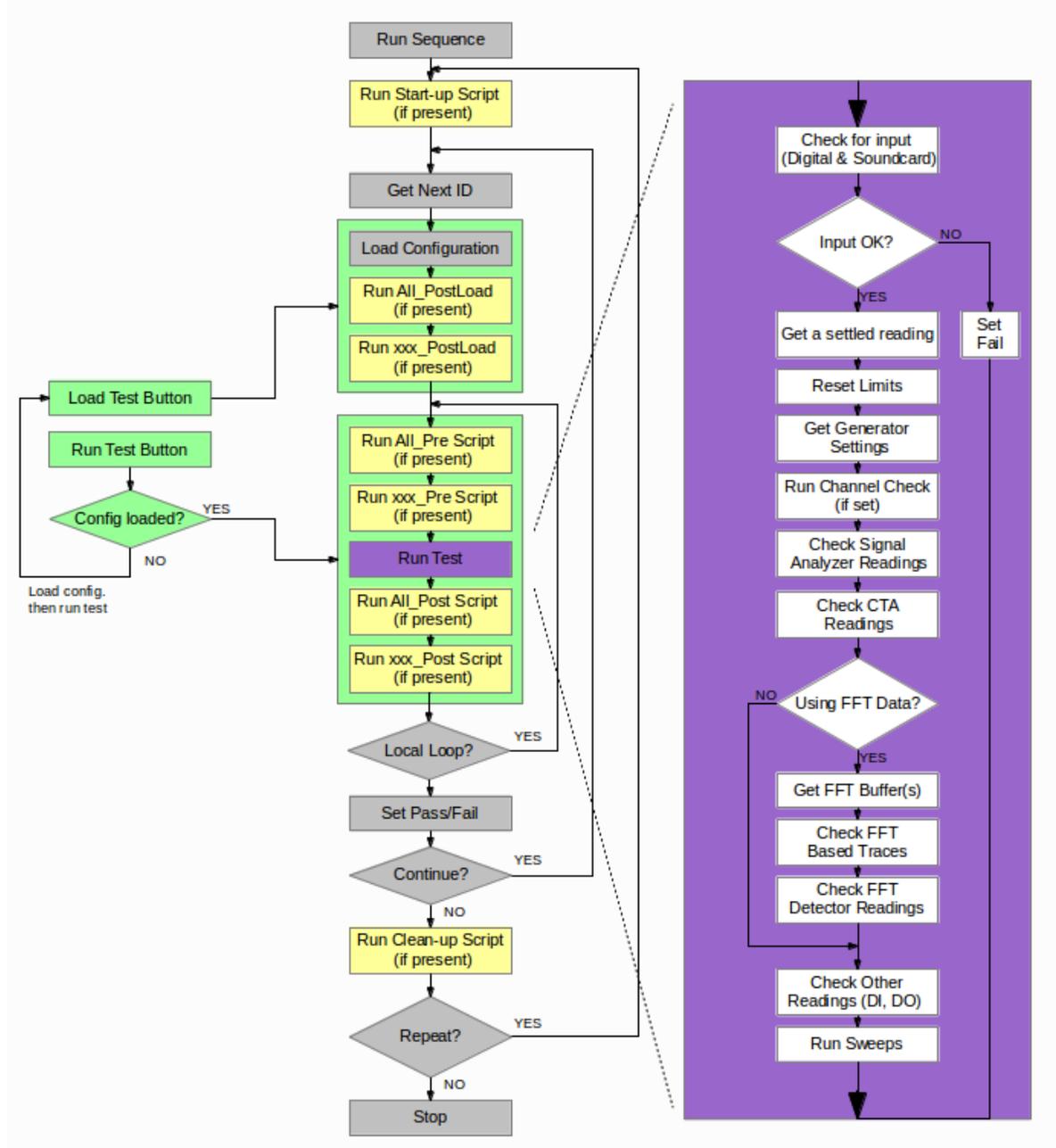
Excel 2007 which only have 256 columns available. It essentially means that there aren't enough columns in Excel to accommodate all the measurements defined in the Test Sequence. You will either need to reduce the number of measurements made, or upgrade Excel to version 2007 or later (versions from Excel 2007 have 16384 columns).

Wrong Spreadsheet?

When Auto Sequence creates the spreadsheet for a particular Test Sequence, it puts the name of the Sequence in the top left cell (cell A1). When it opens a spreadsheet it checks that the name of the Sequence is the same as the one in the spreadsheet. If not, you will get this error in order to protect against data corruption. This is only likely to occur if you change the title of the spreadsheet manually.

3.7.3 Flow Diagram

The flow diagram below illustrates the behaviour of Auto Sequence. Yellow boxes indicate the execution of scripts (where these are present). The green areas show which sections run when the [Load] and [Run] buttons are clicked. An overview of the "Run Tests" routine is shown in purple. This diagram does not show the looping behaviour, however this follows much the same path as the "continue" loop.



3.8 Glossary

Configuration: A dScope Configuration is a snapshot of the dScope settings that can be saved and recalled.

Loop: A Loop in Auto Sequence is one pass through the Tests in a Sequence.

Partial Configuration: a dScope Configuration where only a subset of the available settings are saved and recalled.

Reading: a dScope "Reading" (capital R) is a window that can be created from any dScope Result by dragging it out onto an empty part of the screen. Readings allow the display and limit checking of Results.

Required: in Auto Sequence a Test is "required" when it is set to be included in the Test Sequence and its pass fail results contribute to the overall pass/fail. In non-looped sequences this will be if the check box next to it is checked. In looped Sequences, both the Loop and the Test Master that the individual Test belongs to must also be checked in the [Test Matrix](#).

Sequence: a Sequence is a series of Tests. In a looped Sequence, this will consist of a series of Loops, each containing a Sequence of Tests.

Test: An Auto Sequence Test is all the measurements based on a single dScope Configuration. It can contain many different measurement results.

Test Matrix: In a looped Sequence, the [Test Matrix](#) is a two dimensional representation of all the Tests that will be conducted in a Sequence, with each row representing the Tests and each column representing the Loops.

Part

4

AES17

4 AES17

The dScope can perform conformity testing of digital audio products (such as A-D or D-A converters), according to the AES17 standard, quickly and easily. A set of simple-to-follow scripts and accompanying configurations are provided that guide you through each test. These are installed automatically from the dScope's installation CD; updates may be obtained from www.prismsound.com, or by contacting Prism Sound or your local distributor. Contact details are provided in the [General information](#) section.

Copies of the AES17-1998 standard can be purchased from www.aes.org, from where it is also possible to download a single copy of the standard free of charge. Sections 3 and 4 of AES17-1998 outline many more definitions and also general measurement conditions not included in this document.

The following section contains an [overview](#) of AES17 testing with the dScope.

4.1 Overview

The following sections describe how to perform the standard test methods outlined in AES17-1998 using Prism Sound dScope Series III.

To run the dScope's AES17 tests, either select the 'Applications: AES17' option from the default User Bar (if configured), or else simply run the script 'AES17 Tests.dss' by selecting "Run Script" from the Automation menu. This script provides access to all of the individual AES17 tests from a two-level menu.

On running the script, the user is presented with the [I/O Set-up dialogue](#) in order to define the configuration of the [EUT](#), after which selection of the individual tests from the menus is limited to those which apply to that type of EUT.

The buttons on the first menu correspond to the sub-sections in AES17. Each button opens up a sub-menu containing buttons for each of the tests available; clicking on an individual test button automatically loads the appropriate configuration and runs the test script. In between the tests, the EUT I/O input and output configuration details can be modified by clicking the [EUT I/O Setup] button.

Also on each sub-menu is a help button, indicated by a question mark. This functions in a manner very similar to the Windows "What's This?" help feature. Clicking on the help button turns on the help feature which is indicated by the button turning green. At this point, the next test button selected will open the relevant help page from this help manual instead of running the test.

The scripts automatically perform each test, prompting the user for any required information. In cases where graphs are generated, it is possible to print the graph or to export it as a Windows metafile, complete with a title, legend and notes, by using the Print/Export Graph dialogue box.

For detailed information about all of the dScope's AES17 tests, see the following [AES17 tests reference](#) section.

It is possible for users to construct their own scripts to run single or multiple AES17 tests without the need for entry through the menu system. In this case, the appropriate section of 'AES17 Tests.dss' (which includes loading of the appropriate dScope configuration and occasionally special weighting filters) can be cut and pasted into the user's own script. It is possible to add features such as automatic logging of results and graphs to a report document or database.

Directory structure

On installation, the AES17 test files are contained in four directories as follows:

Configurations are in <dScope root>\Configurations\AES17

Scripts are in <dScope root>\Scripts\Automation\AES17

Filter definitions are in <dScope root>\FFT Detector Weighting Filters\AES17

Sweep Data Tables are in <dScope root>\Sweep Data Tables\AES17

The launcher script, "AES17 Tests.dss" is in <dScope root>\Scripts\Automation

4.2 AES17 tests reference

The AES17 tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Input characteristics](#)

[Output characteristics](#)

[Linear response](#)

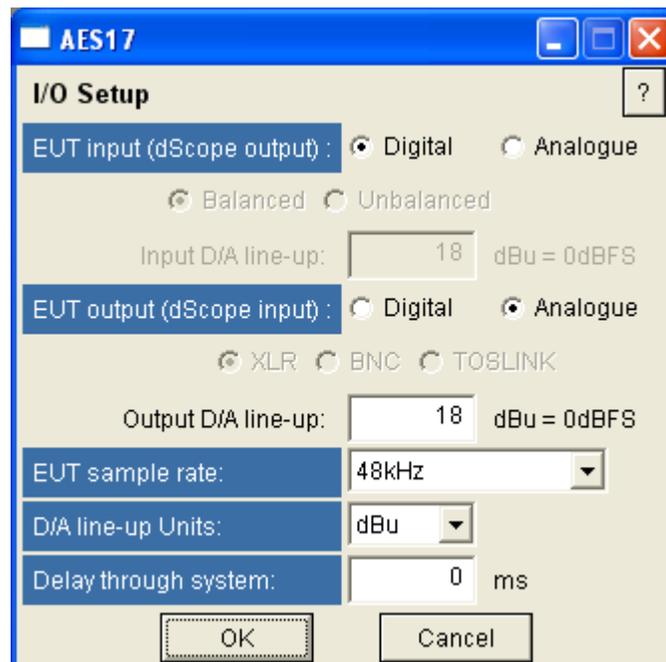
[Amplitude non-linearity](#)

[Signal-to-noise](#)

[Cross-talk and separation](#)

4.2.1 I/O Setup

Upon starting the AES17 tests, it is necessary to set up the configuration so that the appropriate tests are used and appropriate levels are applied. In particular, if the D/A Line-up values are not correctly set, the results of any tests relying on them will be incorrect. This screen is also accessible from any of the other menus using the EUT I/O Setup button. A typical screen is shown below:



The I/O setup screen has the following features:

EUT input (dScope output): This is used to select the type of input that is being measured on the

EUT. Depending on the selection here, the tests available in the menus will change. Some tests are available for both digital and analogue inputs, but give different results depending on which is selected. If an analogue input is specified, whether it is balanced or unbalanced must also be specified.

Input D/A Line-up: This is used to enable the dScope signal generator analogue output amplitude to be set in terms of dBFS for the EUT. The figure specified here should be the analogue level at the EUT input that causes the digital signal within the EUT to go [full scale](#). This parameter is measured in the [Input for full scale amplitude test](#) in the [Input Characteristics](#) menu, but an approximate value should be entered here before commencing with the test in order to protect the EUT from excessive levels. The test also searches within a pre-defined range around the level set by this parameter, so it is important that it is of the right order of magnitude before commencing with the test or it will not complete successfully. The unit for this parameter can be changed by selecting from the drop list at the bottom of this dialogue box. The same unit is used for both input and output D/A Line-up settings.

NB: For equipment with input gain controls, this value will not remain valid if the gain is changed. It is important to make sure it is correct for the test being undertaken.

EUT output (dScope input): This is used to select the type of output being measured on the EUT. Depending on the selection here, the tests available in the menus will change. Some tests are available for both digital and analogue outputs, but give different results depending on which is selected. If a digital output is specified, which type of connector must also be specified. The selected digital output connector will also determine which digital input on the dScope will be used for measurement.

Output D/A Line-up: This is used to enable the measuring of analogue output parameters in terms of dBFS for the EUT. The figure specified here should be the analogue level on the EUT outputs that is caused by a 997Hz 0dBFS digital signal within the EUT. This parameter is measured in the [Output Amplitude at Full Scale](#) in the [Output Characteristics](#) menu, but an approximate value should be entered here in order to protect the EUT from excessive levels. The test also searches within a pre-defined range around the level set by this parameter, so it is important that it is of the right order of magnitude before commencing with the test or it will not complete successfully. The unit for this parameter can be changed by selecting from the drop list at the bottom of this dialogue box. The same unit is used for both input and output D/A Line-up settings.

NB: For equipment with output gain controls, this value will not remain valid if the gain is changed. It is important to make sure it is correct for the test being undertaken.

EUT Sample rate: The sample rate of the EUT is selected here. For EUTs with digital inputs, this will set the digital output sample rate of the dScope. For equipment that only has analogue inputs and outputs, but is digitally sampled internally, enter the internal sample rate if known. For equipment incorporating sample rate conversion, the appropriate sample rate should be selected depending on whether the parameter being measured is on the input or output side.

Delay through system: Enter the delay through the EUT here in ms. The purpose of this entry is to allow the dScope to wait until the changes made in the generator have propagated through the audio chain to the analyzer before making measurements. It only needs to be approximate. If in doubt, set this a little higher rather than lower as the consequence of setting it too high will simply be slower tests whereas the consequence of setting it too low when there is significant latency could be incorrect results, if the test signal from the generator has yet to reach the analyzer when the measurement is taken. For devices with analogue inputs and analogue outputs, or digital inputs and digital outputs, the delay can be measured using the "Delay through device" test in the "Linear Response" group. For most devices such as AD or DA converters where the latency is likely to be less than 10ms it will be sufficient to leave this at zero.

OK and Cancel: Selecting the OK button exits this dialogue and uses the values and settings as selected. Selecting Cancel exits the dialogue but retains previously set parameters UNLESS the units for the D/A Line-up have been changed, in which case the values in the D/A Line-up boxes have already been updated and will not revert to previously stored values.

4.2.2 Level Search Routines

For several of the tests in the AES17 standard, the level that causes a particular condition is required. These are automated within the dScope AES17 tests. The below explains how the search routines work, where they are used and what errors may occur.

Find the maximum input amplitude

Used in [Input for full-scale amplitude](#) and [Maximum input amplitude](#) tests.

This search routine looks for the input amplitude that causes one of three conditions: For systems where the digital signal is accessible, it finds the input level that causes 0dBFS at 997Hz. For systems where the digital signal is not accessible or cannot be made to reach 0dBFS, it looks for the level that causes 1% distortion or 0.3dB compression, whichever comes first. It does this in two stages. The first stage is to ramp the level fed into the unit from a level 12dB below a defined starting level (typically the input D/A Line-up) in 3dB steps. When any of the conditions are met, the search switches to a binary search routine between the last two input levels to narrow down the search further. The tolerances are set in the script and are to within 0.01dB for full scale amplitude, 0.01 % for THD+N and 0.01dB for compression. The routine then returns the level that caused the condition and which condition was met. When measuring the second channel of a two channel device, the first stage is skipped and the search goes directly to the binary search in a range +/-3dB of the value found for the first channel.

If any of the conditions are already breached at the starting point, the search cannot complete and a message will display. Usually this can be remedied by adjusting the input D/A line-up figure. Sometimes a message will display that the conditions were not met within the search range. This may mean that the dScope is not capable of generating sufficient voltage to cause any of the conditions to be met, but may also occur if there is a set-up problem. Another error condition occurs when the binary search does not converge. This can happen with soft knee compression or compression with long release times that do not allow the search routine to settle correctly. It can also happen if there is a big difference between the channels when measuring channel B.

Find the maximum output amplitude

Used in [Output amplitude at full scale](#), [Maximum output amplitude](#) and [Maximum signal level vs frequency](#) tests.

This is essentially identical in principle to the Find the Maximum input amplitude routine described above, only it returns the output level rather than the input level. The same type of error messages are generated.

Find the input that causes a set output level

Used in [Signal-to-noise ratio or noise in the presence of signal](#) (-60dBFS search routine) and [Low level noise modulation](#) (-40dBFS search routine). This routine is also used when searching for digital full scale signals (ie, when finding [Input for full-scale amplitude](#) with a EUT with a digital output.)

This search routine looks for the input level that causes a specified output level. It is considerably simpler than the routines described above. It also uses two stages. The first stage finds the required level within 3 dB and the second narrows it down to within 0.01dB. The first stage works by making the assumption that the unit's gain can be found by subtracting the input D/A Line-up from the output D/A Line-up and sets the starting point for input based on this. It then steps in 3dB steps up or down depending on the result of the measured output level. When the level is found within 3dB, it switches to a binary search until the required level is found. This routine may fail if there is any compression with a long release time.

4.2.3 Input characteristics

The Input characteristics tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Suppression of alias components](#)

[Susceptibility to RF interference](#)

[Overload behaviour](#)

[Input for full-scale amplitude](#)

[Maximum input amplitude](#)

[Input logarithmic-gain stability](#)

[Digital audio input format](#)

[Jitter susceptibility](#)

4.2.3.1 Suppression of alias components

Applies to: EUTs with analogue inputs.

Aim: To measure the [alias components](#) in the [EUT](#) when presented with out-of-band HF components at its analogue input.

Method

The suppression of alias components is measured using a sinusoidal stimulus with amplitude -20 [dBFS](#). The frequency of the signal is first set to 997Hz in order to establish an output reference level. Once the reference level has been established and set in the dScope, the signal is swept from four times the sampling frequency or 192kHz (whichever is lower) to the [folding frequency](#).



It is currently not possible to make this measurement as stated in the AES17 standard using the dScope, since the specified sweep range could extend to 192kHz. Using a dScope with 192kHz analogue sample rate it is only possible to generate frequencies up to about 90kHz. However, this frequency range is adequate to reveal aliasing under most conditions.

For measurements made at the analogue output of the EUT, the signal is filtered with the [standard low-pass filter](#), which may be cascaded with a notch filter at the frequency of the applied stimulus, if necessary, to suppress input to output leakage. After filtering, the measured RMS amplitude is expressed relative to the amplitude resulting from the reference measurement.

If the measurement is made at the digital output of the EUT, then the signal should be filtered with a notch filter at the frequency of the applied stimulus unless the input signal exceeds the folding frequency. The RMS amplitude of the remaining signal is then measured and is expressed relative to the amplitude resulting from the reference measurement.

The results are presented for both channels as a graph in dB relative to the output reference amplitude.

4.2.3.2 Susceptibility to RF interference

 **This test is still 'under consideration' by the AES, and is not yet included in the AES17 standard.**

4.2.3.3 Overload behaviour

Applies to: EUTs with analogue inputs.

Aim: To identify undesirable overload behaviour in A/D converters, a condition commonly called 'rollover'.

Method

The unweighted THD+N is measured for a 997Hz sinusoidal input to the [EUT](#) at +3dBFS and –3dBFS, the result is the ratio of the two results (i.e. the difference in dB) and is expressed in dB for both channels.

4.2.3.4 Input for full-scale amplitude

Applies to: EUTs with analogue inputs.

Aim: To determine the maximum input amplitude before digital clipping with normal device settings.

Method

The input gain controls are set to the reference position supplied by manufacturer or to the normal operating position if no reference position is specified. Other controls should be adjusted to minimise the potential for overload in the output circuitry.

The measurement is made using a 997Hz sinusoidal stimulus.

If the measurement is to be made at the digital output of the [EUT](#), and if digital [full-scale amplitude](#) can be reached, then the measurement is made by adjusting the amplitude of the test signal until digital full-scale is just achieved at the output.

If the measurement is to be made at the analogue output of the EUT, or if the digital output is used but digital full-scale amplitude cannot be achieved, then the measurement is made by adjusting the amplitude of the test signal until 1% THD+N or 0.3dB compression occurs. The result is defined to be 0.5dB below this amplitude.

The result is displayed for both channels in dBu and V (RMS).

See also: [Level Search Routines](#) for fault finding with this test.

4.2.3.5 Maximum input amplitude

Applies to: EUTs with analogue inputs.

Aim: To determine the maximum input amplitude for correct operation.

Method

The input gain controls are set so as to allow the maximum possible input amplitude to be accommodated. Other controls should be adjusted to minimise the potential for overload in the output circuitry.

The measurement is made using a 997Hz sinusoidal stimulus.

If the measurement is to be made at the digital output of the [EUT](#), and if digital [full-scale amplitude](#) can be reached, then the measurement is made by adjusting the amplitude of the test signal until

digital full-scale is just achieved at the output.

If the measurement is to be made at the analogue output of the EUT, or if the digital output is used but digital full-scale amplitude cannot be achieved, then the measurement is made by adjusting the amplitude of the test signal until 1% THD+N or 0.3dB compression occurs.

The result is displayed for both channels in dBu and V (RMS).

See also: [Level Search Routines](#) for fault finding with this test.

4.2.3.6 Input logarithmic-gain stability

Applies to: EUTs with analogue inputs.

Aim: To determine the long-term gain stability of the [EUT](#) input.

Method

The test signal for the input logarithmic-gain stability test is a 997Hz sinusoid 6dB below [full-scale amplitude](#).

The output amplitude of the EUT is measured for at least one hour. The user is invited to confirm that the EUT has been adequately warmed-up prior to starting the test. After one hour (or when the test is manually interrupted) the maximum amplitude variation above and below the first measurement value is displayed in dB for both channels.

Note that if the test is specified to be made at the analogue output of the EUT, the input logarithmic-gain stability cannot be separated from the output logarithmic-gain stability, and so the test's menu button and results are re-designated as the 'system logarithmic-gain stability'.

4.2.3.7 Digital audio input format

Applies to: EUTs with digital audio inputs.

Aim: To test the compliance with the specified digital audio input format.

Method

This test displays the dScope's Digital Outputs and Output Channel Status (simple mode) dialogue boxes so that the operator can vary parameters of the dScope's digital output in order to verify that any required responses by the EUT happen correctly. After completion of the required tests, the [Finish] button on the pop-up should be clicked to complete the test.

4.2.3.8 Jitter susceptibility

The Input jitter susceptibility tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Analogue-to-digital jitter susceptibility](#)

[Digital-to-analogue jitter susceptibility](#)

[Digital-to-digital jitter susceptibility](#)

Note that only one of the above appears in the menu, dependent on the I/O domains selected in the EUT I/O Setup.

4.2.3.8.1 Analogue-to-digital jitter susceptibility

Applies to: EUTs with analogue inputs and digital audio outputs.

Aim: To measure the [jitter susceptibility](#) of the [EUT](#) when presented with jitter of varying frequency at its Reference Sync input.

Method

This test can only be performed if the EUT has an AES11 Reference Sync input.

The analogue input of the EUT is driven with a -3dBFS sinusoidal stimulus at $f_s/4$ (where f_s is the sample rate of the EUT). The Reference Sync input of the EUT is connected to the digital output of the dScope, which is driven with a carrier signal whose phase is jittered with a sinusoidal jitter signal.

The frequency of the jitter signal is varied from 80 Hz to 20kHz in octave steps. The jitter amplitude is set at the high frequency jitter tolerance limit of the interface, which is nominally set at $1/(512 \times \text{frame rate})$. The THD+N of the EUT output is measured at each step and then the results are graphed for both channels.

The measurement may be repeated for other input signal frequencies. Two useful frequencies might be $f_s/192$ and 997Hz. The operator is asked whether or not to repeat the test for these frequencies.

4.2.3.8.2 Digital-to-analogue jitter susceptibility

Applies to: EUTs with digital audio inputs and analogue outputs.

Aim: To measure the [jitter susceptibility](#) of the [EUT](#) when presented with jitter of varying frequency at its digital or reference input.

Method

The digital input of the EUT is driven with a -3dBFS sinusoidal stimulus at $f_s/4$ (where f_s is the sample rate of the EUT). The digital input carrier is phase-modulated with a sinusoidal jitter signal.

The frequency of the jitter signal is varied from 80 Hz to 20kHz in octave steps. The jitter amplitude is set at the high frequency jitter tolerance limit of the interface, which is nominally set at $1/(512 \times \text{frame rate})$. The THD+N of the EUT output is measured at each step and then the results are graphed for both channels.

The measurement may be repeated for other input signal frequencies. Two useful frequencies might be $f_s/192$ and 997Hz. The operator is asked whether or not to repeat the test for these frequencies.

If the equipment under test has a Reference Sync input other than the digital audio input, then the test should be repeated with this input driven from the dScope's digital output as well.

4.2.3.8.3 Digital-to-digital jitter susceptibility

Applies to: EUTs with digital audio inputs and outputs.

Aim: To measure the [jitter susceptibility](#) of the [EUT](#) when presented with jitter of varying frequency at its digital or reference input.

Method

The digital input of the EUT is driven with a -3dBFS sinusoidal stimulus at $f_s/4$ (where f_s is the

sample rate of the EUT). The digital input carrier is phase-modulated with a sinusoidal jitter signal.

The frequency of the jitter signal is varied from 80 Hz to 20kHz in octave steps. The jitter amplitude is set at the high frequency jitter tolerance limit of the interface, which is nominally set at $1/(512 \times \text{frame rate})$. The THD+N of the EUT output is measured at each step and then the results are graphed for both channels.

The measurement may be repeated for other input signal frequencies. Two useful frequencies might be $f_s/192$ and 997Hz. The operator is asked whether or not to repeat the test for these frequencies.

If the equipment under test has a Reference Sync input other than the digital audio input, then the test should be repeated with this input driven from the dScope's digital output as well.

4.2.4 Output characteristics

The Output characteristics tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Out-of-band spurious components](#)
[Suppression of imaging components](#)
[Output amplitude at full-scale](#)
[Maximum output amplitude](#)
[Output-level stability](#)
[Digital audio output format](#)

4.2.4.1 Out-of-band spurious components

Applies to: EUTs with analogue outputs.

Aim: To measure the total of HF components beyond the audio band which are output from the [EUT](#)'s D/A converter, with no signal applied.

Method

The analogue output of the EUT is measured with no test-signal stimulus. The total RMS amplitude of all the components above the [upper band-edge frequency](#) of the EUT is measured for both channels, and expressed in [dBFS](#). Components within the audio band are excluded by using the [standard high-pass filter](#).

The spectrum of the spurious components for both channels can be viewed graphically on Page 2 if required.

4.2.4.2 Suppression of imaging components

Applies to: EUTs with analogue outputs.

Aim: To measure the total of HF [imaging components](#) beyond the audio band which are output from the [EUT](#)'s D/A converter, as a result of applied audio-band signals.

Method

The analogue output of the EUT is measured with a -20 [dBFS](#) sinusoidal stimulus applied, swept from 10Hz to the [upper band-edge frequency](#) or 10kHz (whichever is the lower). Components within the audio band are excluded by using the [standard high-pass filter](#). The total RMS amplitude of all the

components above the upper band-edge frequency of the EUT is measured for both channels at each frequency, and plotted graphically. The greatest result for each channel, expressed in [dBFS](#), is also presented at the end of the test.

4.2.4.3 Output amplitude at full-scale

Applies to: EUTs with analogue outputs.

Aim: To determine the amplitude of the analogue outputs of the [EUT](#) when presented with an input at [full-scale amplitude](#), with any gain controls set to their nominal position.

Method

During this test any gain controls in the EUT should be adjusted to minimise the potential for overload in the input circuitry, apart from any output gain controls which should be set to their nominal position.

If the EUT input is being driven in the digital domain, the result is obtained by driving the input with a 997Hz sinusoidal stimulus at [0dBFS](#) and recording the RMS output amplitude.

If the EUT input is being driven in the analogue domain, the result is obtained by driving the analogue input with a 997Hz sinusoidal stimulus whose amplitude is adjusted so as to produce 1% THD+N or 0.3dB amplitude compression (whichever occurs at lower amplitude). The result is 0.5dB below the RMS output amplitude under this condition.

The result is displayed in dBu and V (RMS) for both channels.

See also: [Level Search Routines](#) for fault finding with this test.

4.2.4.4 Maximum output amplitude

Applies to: EUTs with analogue outputs.

Aim: To determine the maximum undistorted amplitude of the analogue outputs of the [EUT](#).

Method

During this test any gain controls in the EUT should be adjusted to minimise the potential for overload in the input circuitry, apart from any output gain controls which should be set to produce maximum undistorted output amplitude.

For the purposes of this test, an undistorted output is one which has <1% THD+N and <0.3dB amplitude compression.

If the EUT input is being driven in the digital domain, the result is obtained by driving the input with a 997Hz sinusoidal stimulus at [0dBFS](#) and recording the RMS output amplitude.

If the EUT input is being driven in the analogue domain, the result is obtained by driving the analogue input with a 997Hz sinusoidal stimulus whose amplitude is the maximum which produces an undistorted output, and recording the RMS output amplitude.

The result is displayed in dBu and volts for both channels.

See also: [Level Search Routines](#) for fault finding with this test.

4.2.4.5 Output-level stability

Applies to: EUTs with analogue outputs.

Aim: To determine the long-term level stability of the [EUT](#) output.

Method

The test signal for the output logarithmic-gain stability test is a 997Hz sinusoidal stimulus at 6dB below [full-scale amplitude](#).

The output amplitude of the EUT is measured for at least one hour. The user is invited to confirm that the EUT has been adequately warmed-up prior to starting the test. After one hour (or when the test is manually interrupted) the maximum amplitude variation above and below the first measurement value is displayed in dB for both channels.

Note that if the test is specified to be made using the analogue input of the EUT, the output logarithmic-gain stability cannot be separated from the input logarithmic-gain stability, and so the test's menu button and results are re-designated as the 'system logarithmic-gain stability'.

4.2.4.6 Digital audio output format

Applies to: EUTs with digital audio outputs.

Aim: To test the compliance with the specified digital audio output format.

Method

This test displays the dScope's Digital Inputs and Input Channel Status (simple mode) dialogue boxes so that the operator can vary parameters of the EUT and check that any required variations in the output format or Channel Status happen correctly. After completion of the required tests, the [Finish] button on the pop-up should be clicked to complete the test.

4.2.5 Linear response

The Linear response tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Amplitude vs frequency](#)

[Phase vs frequency](#)

[Delay through a device](#)

[Polarity](#)

4.2.5.1 Amplitude vs frequency

The Amplitude vs frequency tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Frequency response](#)

[Maximum signal level vs frequency](#)

4.2.5.1.1 Frequency response

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the variation in the [EUT](#)'s gain with applied frequency.

Method

The EUT is stimulated with a sine stimulus swept from 10Hz to the [upper band-edge frequency](#) in third-octave steps. In order to prevent overload in systems that use emphasis, the frequency response is measured at -20dBFS. Prior to measurement, the output of the EUT is passed through a band-pass filter centred at the frequency of the stimulus, in case significant amounts of aliasing or noise are present. The RMS output amplitude of the EUT is graphed against frequency, expressed in dB relative to the RMS output amplitude at 997Hz.

4.2.5.1.2 Maximum signal level vs frequency

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the maximum signal amplitude which can be handled by the [EUT](#) against frequency.

Method

The measurement is made using a sinusoidal stimulus with adjustable frequency and amplitude. The output of the EUT is monitored with a level meter and a notch-filter-based THD+N analyzer. The analyzer includes a standard low-pass filter at the [upper band-edge frequency](#).

The stimulus frequency is swept from 10 Hz to the upper band-edge frequency in octave steps, and at each frequency the stimulus amplitude is adjusted so that the output is on the threshold of having either >1% THD+N or >0.3dB amplitude compression. The maximum signal level for that frequency is then measured as the RMS amplitude of the EUT output. The results for both channels are graphed against frequency in either dBu or V (RMS) as specified by the operator.

See also: [Level Search Routines](#) for fault finding with this test.

4.2.5.2 Phase vs frequency

The Phase vs frequency tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Phase response](#)

[Group delay](#)

[Inter-channel phase response](#)

4.2.5.2.1 Phase response

 This test is not currently implemented.

4.2.5.2.2 Group delay

 This test is not currently implemented.

4.2.5.2.3 Inter-channel phase response

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the variation in the [EUT](#)'s inter-channel phase with applied frequency.

Method

The EUT is stimulated with a sine stimulus swept from 10Hz to the [upper band-edge frequency](#) in third-octave steps. In order to prevent overload in systems that use emphasis, the inter-channel phase response is measured at -20dBFS. The inter-channel phase of the EUT is graphed against frequency, expressed in degrees.

If emphasis is used in the device, then the results should be reported both with and without emphasis.

4.2.5.3 Delay through a device

Applies to: EUTs with analogue inputs and analogue outputs only.

Aim: To measure the delay through the [EUT](#).

Method

The delay through the device is measured by passing a bin-centres signal through the EUT to channel A of the Analyzer. The same signal is also routed directly to the Analyzer on channel B. By performing a cross-correlation between the two Analyzer channels, the impulse response of the system is found. The position of the impulse in the buffer gives the delay through the device, and is displayed in ms for analogue devices and in both ms and samples for digital.

NB: This test cannot be performed cross-domain, and measures on channel A only. The maximum delay that can be measured is 1.36 seconds for analogue paths, and $(2^{16})/fs$ seconds for digital paths (where fs is the sample rate). Digital devices must be synchronous with the dScope Generator.

4.2.5.4 Polarity

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To determine whether the [EUT](#) inverts the absolute phase of the signal.

Method

The test stimulus is an asymmetric square wave at -10dBFS, 2kHz with 75% duty cycle. The dScope's FFT Analyzer is used with an FFT Detector Calculation script to determine the polarity of the waveform at the Analyzer. It does this by checking the polarity of each sample, and expressing the ratio of positive to negative samples in dB. Since the generator signal has three times more positive samples than negative, a non-inverting channel will give positive readings and an inverting channel will give negative readings. Each channel is reported as 'non-inverting', 'inverting' or 'indeterminate'. The script will display 'indeterminate' in the event that the resulting waveform is not clearly positive or negative (ratio of positive to negative samples not >3dB or <-3dB). A display of the waveform is also given for visual confirmation.

4.2.6 Amplitude non-linearity

The Amplitude non-linearity tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Level-dependent logarithmic gain](#)

[Intermodulation distortion \(IMD\)](#)

[Signal modulation noise](#)

[Low-level noise modulation](#)

[Total harmonic distortion and noise \(THD+N\)](#)

4.2.6.1 Level-dependent logarithmic gain

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the change in gain of the [EUT](#) with signal amplitude, sometimes called 'deviation from level linearity'.

Method

A 997Hz sinusoidal stimulus is applied at [-5dBFS](#). The output of the EUT is measured after passing through a 1/3 octave 997Hz band-pass filter. The gain of the EUT is calculated as being the ratio of its output amplitude to its input amplitude. The narrow-band noise floor of the EUT is also measured using the same band-pass filter, but with the stimulus muted.

The stimulus is reapplied, and its amplitude is then reduced in 5dB steps, until it is within 5dB of the measured narrow-band noise floor, noting the output amplitude at each step and calculating the inferred EUT gain. The results are graphed for each channel, with relativity to the gain measured at [-5dBFS](#) expressed in dB, as a function of the applied amplitude. At the end of the test, a worst-case gain deviation (in dB) is also reported for each channel.

When the A/D and D/A portions are available separately, this test should be repeated for each section independently.

4.2.6.2 Intermodulation distortion (IMD)

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the intermodulation distortion of the [EUT](#), using the two most common techniques.

Method

The first IMD test uses a twin-tone stimulus with one tone at the [upper band-edge frequency](#) and the other tone 2kHz below that. The amplitudes of the tones are equal, with the combined peak amplitude adjusted to equal the peak amplitude of an equivalent sine wave at [full-scale amplitude](#). An FFT technique is used to measure the second- and third-order difference components for each channel. This type of test is often referred to as a 'CCIF' IMD test.

The second IMD test also uses a twin-tone stimulus, but in this case the tones are at 41Hz and 7993Hz. The amplitude of the higher frequency tone is a quarter of the amplitude of the lower one. As before, the combined peak amplitude is adjusted to equal the peak amplitude of an equivalent sine wave at full-scale amplitude. The components caused by modulation of the high frequency by the low frequency are measured and expressed relative to the amplitude of the high frequency tone, in dB, for each channel. This type of test is often referred to as a 'SMPTE/DIN' IMD test.

4.2.6.3 Signal modulation noise

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure signal modulation components produced by gain modulation in the [EUT](#).

Method

A sinusoidal stimulus is applied at -5dBFS with a frequency of 0.4999 times the [upper band-edge frequency](#). An FFT of the 1000Hz frequency band above half the upper band-edge frequency is displayed for each channel, so that any modulation products can be identified (the AES17 standard is restricted to products within a 500Hz frequency band above the upper band-edge frequency). The Y-scales and cursors are calibrated in dB, relative to the stimulus tone.

This FFT method is more useful than the 1/3 octave filter method described in the AES17 standard, since it allows individual components to be identified and measured if required.

4.2.6.4 Low-level noise modulation

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure variations in the noise floor of the [EUT](#) produced by the presence of low-level LF signals. These are often the result of incorrect dithering.

Method

In preparation for the test, the idle-channel noise of the EUT over a 22Hz..22kHz bandwidth is first measured. Then, a 41Hz sinusoidal stimulus is applied at to the EUT at an amplitude such as to produce an output amplitude of -40dBFS . A bank of 21 FFT Detectors are set up, each one notching out the 41Hz tone from the EUT output and measuring the residual in a different 1/3 octave band between 200Hz and 20kHz. The measured amplitude of each Detector is recorded for the initial -40dBFS output amplitude.

The amplitude of the stimulus is then reduced in 10dB steps, until it is below the idle-channel noise amplitude. At each step, the amplitude readings of all the FFT Detectors are recorded.

A single result is presented for each channel, that being the maximum difference in measured amplitude in any single Detector from its initial recorded result for a -40dBFS output amplitude. In addition, a graphical output is provided showing the worst case deviation in each of the 21 1/3 octave bands.

See also: [Level Search Routines](#) for fault finding with this test.

4.2.6.5 Total harmonic distortion and noise (THD+N)

The THD+N tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Total harmonic distortion and noise vs frequency](#)

[Total harmonic distortion and noise vs level](#)

4.2.6.5.1 Total harmonic distortion and noise vs frequency

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the THD+N of the [EUT](#) against frequency.

Method

A -1 dBFS sinusoidal stimulus is applied to the EUT, successively at each octave frequency between 20Hz and half the [upper band-edge frequency](#). The output of the EUT is passed through a [standard notch filter](#) at the frequency of the stimulus, and also through a low-pass filter at the upper band-edge frequency (or at 20kHz, whichever is the lower). The RMS amplitude of the residual is measured for each stimulus frequency.

The results are presented graphically, with THD+N (in % relative to the amplitude of the stimulus) being plotted for each channel against stimulus frequency.

The test is then repeated with a stimulus amplitude of -20 dBFS, the results being overlaid on the original graph.

4.2.6.5.2 Total harmonic distortion and noise vs level

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the THD+N of the [EUT](#) against amplitude.

Method

A 997Hz sinusoidal stimulus is applied to the EUT, successively at a range of amplitudes 10dB apart between 0 dBFS and -80 dBFS. The output of the EUT is passed through a [standard notch filter](#) at the frequency of the stimulus, and also through a low-pass filter at the [upper band-edge frequency](#) (or at 22kHz, whichever is the lower). The RMS amplitude of the residual is measured for each stimulus amplitude.

The results are presented graphically, with THD+N (in %, relative to the amplitude of the stimulus) being plotted for each channel against stimulus amplitude.

4.2.7 Signal-to-noise

The Signal-to-noise tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Idle channel noise](#)

[Idle channel noise spectrum](#)

[Signal-to-noise ratio or noise in the presence of signal](#)

[Power-line \(mains\) related products](#)

4.2.7.1 Idle channel noise

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the output noise of the [EUT](#) with no signal present.

Method

If the EUT has a digital input, it is fed with a digital-zero signal; if the EUT has an analogue input it is terminated with 50R (or 25R if unbalanced).

The RMS amplitude of the output noise of the EUT is measured via the [standard weighting filter](#). The result is reported for both channels, in [dBFS](#) (in the case of an analogue measurement, this is equivalent to dB below the specified [D/A line-up](#)), and designated as 'dBFS CCIR-RMS'.

4.2.7.2 Idle channel noise spectrum

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the output noise spectrum of the [EUT](#) with no signal present.

Method

If the EUT has a digital input, it is fed with a digital-zero signal; if the EUT has an analogue input it is terminated with 50R (or 25R if unbalanced).

The RMS amplitude of the output noise of the EUT is measured via the [standard weighting filter](#) in a range of 1/3 octave bands between 20Hz and the [upper band-edge frequency](#). The result is graphed for each channel in [dBFS](#) (in the case of an analogue measurement, this is equivalent to dB below the specified [D/A line-up](#)).

4.2.7.3 Signal-to-noise ratio or noise in the presence of signal

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the output noise of the [EUT](#) in the presence of signal.

Method

The EUT is fed with a 997Hz sinusoidal stimulus at an amplitude 60dB below its maximum signal amplitude (-60 [dBFS](#)).

The output of the EUT is passed through a [standard notch filter](#) at the frequency of the stimulus, and also through the [standard weighting filter](#). The RMS amplitude of the residual is measured for both channels, in [dBFS](#) (in the case of an analogue measurement, this is equivalent to dB below the specified [D/A line-up](#)), and designated as 'dBFS CCIR-RMS'.

See also: [Level Search Routines](#) for fault finding with this test.

4.2.7.4 Power-line (mains) related products

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure power-line (mains) related products in the output noise of the [EUT](#).

Method

If the EUT has a digital input, it is fed with a digital-zero signal; if the EUT has an analogue input it is terminated with 50R (or 25R if unbalanced). The operator nominates either 50Hz or 60Hz power-line frequency.

The RMS summation of the signal components in the EUT output at the power-line (mains) frequency and its second through fifth harmonic is reported for both channels, in [dBFS](#) (in the case of an analogue measurement, this is equivalent to dB below the specified [D/A line-up](#)).



Note: only components at the power-line (mains) frequency and its second through fifth harmonics are included in this test. Artifacts from a high-frequency switching power supply are classified as spurious components.

4.2.8 Cross-talk and separation

The Cross-talk and separation tests are arranged in the following subsections, which correspond to the equivalent subsections of the AES17 standard:

[Inter-channel cross-talk and separation](#)

[Non-linear inter-channel cross-talk](#)

[Input-to-output leakage](#)

4.2.8.1 Inter-channel cross-talk and separation

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the inter-channel cross-talk between the channels of the [EUT](#) at a range of frequencies.

Method



This test is configured to measure interchannel cross-talk between the two channels of a two-channel or stereo EUT. It can easily be adapted to measure inter-channel cross-talk for a larger number of channels, or separation between a number of alternative inputs.

The input of the EUT's driven channel is fed with a sinusoidal stimulus at -20 [dBFS](#) which is swept in octave steps from 10Hz to the [upper band-edge frequency](#). The input to the un-driven channel (if digital) is fed with a digital-zero signal or (if analogue) is terminated with 50R (or 25R if unbalanced).

At each frequency, the ratio of the RMS amplitude of the output of the un-driven channel (measured through a 1/3 octave band-pass filter at the stimulus frequency) to the RMS amplitude of the output of the driven channel is measured, and displayed graphically in dB against frequency. The un-driven and driven channels are reversed and the test is repeated. The two channels are overlaid on the same axes so that worst-case cross-talk can be easily seen.

4.2.8.2 Non-linear inter-channel cross-talk

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the non-linear inter-channel cross-talk between the channels of the [EUT](#) at HF and LF.

Method

High-frequency non-linear cross-talk

This is measured by driving the input of the EUT with a -20 dBFS sinusoidal stimulus at the [upper band-edge frequency](#) on the channel to be measured, and a $+3$ dBFS sinusoidal stimulus at 3kHz below that frequency on the other channel.

At the output of the measured channel of the EUT, the ratio of the second-order difference frequency component at 3kHz to the overall signal amplitude is measured. Also, the ratio of the third-order IM component at 6kHz to the overall signal amplitude is measured. These are reported as the even-order non-linear cross-talk and odd-order non-linear cross-talk, in dB, for each channel.

Low-frequency non-linear cross-talk

This is measured by driving the input of the EUT with a -20 dBFS sinusoidal stimulus at HALF the [upper band-edge frequency](#) on the channel to be measured, and a $+3$ dBFS sinusoidal stimulus at 40Hz on the other channel.

At the output of the measured channel of the EUT, the ratio of the amplitude of the modulation sidebands (introduced on the high-frequency tone by the low-frequency tone in the hostile channel) to the overall signal amplitude is measured. This is reported in dB for each channel.

4.2.8.3 Input-to-output leakage

Applies to: EUTs with analogue or digital inputs and analogue or digital outputs.

Aim: To measure the input-to-output leakage ('feed-through') of the [EUT](#) at a range of frequencies.

Method

Both inputs of the EUT are driven with a sinusoidal stimulus at 0 dBFS which is swept in octave steps from 10Hz to the [upper band-edge frequency](#). The EUT is put into a mode where all its outputs are muted.

At each frequency, the RMS amplitudes of the EUT's outputs are measured through a 1/3 octave band-pass filter at the stimulus frequency. The results are expressed in dBFS, and displayed graphically against frequency for both channels. The two channels are overlaid on the same axes so that worst-case leakage can be easily seen.

4.3 Glossary

The following definitions are used in the AES17 standard and in the dScope implementation of the AES17 tests:

Aliasing components - Aliasing can take place when a frequency above the [folding frequency](#) of an [EUT](#) is applied to its analogue input (or where internal down-sampling occurs). Aliasing is manifest by the appearance of a spurious frequency component at the EUT's output, below the folding frequency by the same frequency as the input stimulus is above the folding frequency. Thus the stimulus has been 'folded' about the folding frequency. See also [imaging components](#).

D/A line-up - A setting of the dScope's Inputs and Outputs which relates the maximum analogue amplitude to the maximum digital amplitude. It is expressed as an analogue amplitude which corresponds to 0dBFS (full-scale digital). This feature of the dScope is especially useful in measuring [EUTs](#) with both analogue and digital ports (as is common in applying the AES17 standard) since it allows settings or measurements in one domain to be expressed in the units of the other. For example, an A/D converter can be stimulated with a signal 1dB below that which will produce full-scale output by setting the dScope's analogue generator amplitude to -1dBFS, provided that the dScope has been set to the appropriate D/A line-up for the converter.

dBFS - A logarithmic unit used to express signal amplitude in digital and mixed-domain systems in terms of the maximum amplitude which can be accommodated by an [EUT](#). A 0dBFS signal has the same RMS amplitude as a sine whose peaks just touch the maximum level of the system. A -6dBFS signal has half this amplitude, for example. Note that for non-sine signals such as square waves or DC it is possible for the system to accommodate amplitudes greater than 0dBFS. In the dScope it is possible to specify or measure analogue signal amplitudes in dBFS, in which case the [D/A line-up](#) is used as a reference.

EUT - 'Equipment under test'.

Folding frequency - Half the sample rate of the [EUT](#). Input frequencies above the folding frequency are subject to [aliasing](#). Where an EUT applies internal down-sampling, the folding frequency is half of the lowest internal sample rate employed.

Full-scale amplitude - A signal whose amplitude is the maximum which can be accommodated by the [EUT](#). In the case of a sine, this amplitude is 0dBFS. For systems where the output is accessible in the digital domain, full scale is defined as the RMS voltage of a 997Hz sine wave whose positive peak value reaches the positive digital full scale. For systems where the digital signal is not accessible, or where digital full scale cannot be reached, full scale is defined as the level 0.5dB below that where 1% THD+N or 0.3dB compression occurs (whichever comes first) at the EUT output for a 997Hz sine wave.

Imaging components - Imaging can take place in an [EUT](#) with a D/A converter or which performs digital up-sampling. It is manifest by the appearance at the EUT's output of a spurious frequency component above the [folding frequency](#) by the same frequency as the stimulus is below it. It is caused by insufficient stop-band attenuation in the EUT, and is most noticeable close to the folding frequency. See also [aliasing components](#).

Jitter susceptibility - The effect on an [EUT](#) of jitter present on its reference sync input (which may also be its data input). Such effects may include jitter passed to the EUT's digital output or, if the EUT includes A/D, D/A or SR conversion, distortion of the audio signal owing to sampling jitter. In severe cases, loss of digital data at the EUT's input can also occur.

Standard high-pass filter - A high-pass filter with a stop-band beginning at the [upper band-edge frequency](#) of the [EUT](#). This filter is used to measure 'out of band' components.

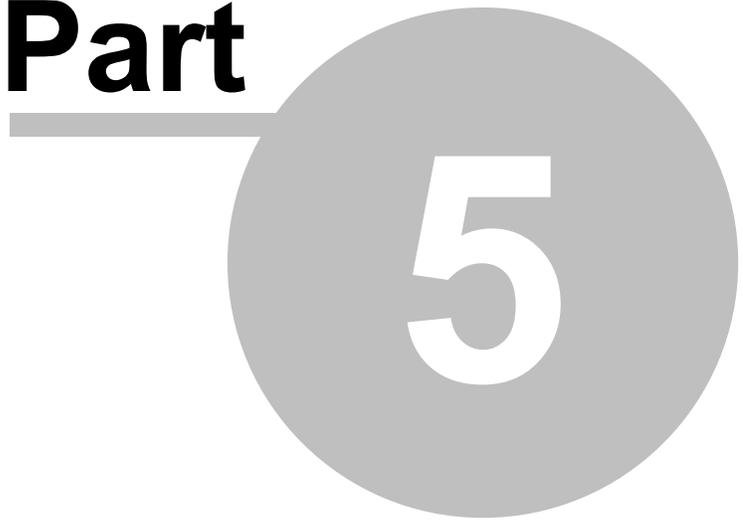
Standard low-pass filter - A low-pass filter with a pass-band up to the [upper band-edge frequency](#) of the [EUT](#). This filter is used to restrict measurements to 'in band' components.

Standard notch filter - A band-reject filter with a Q between 1 and 5, for example the dScope's band-reject filter at the '1/3 octave' setting.

Standard weighting filter - A weighting filter with a response according to CCIR468, but normalised to have unity gain at 2kHz, for example the dScope's 'CCIR468-2k' weighting filter.

Upper band-edge frequency - The maximum frequency to be measured, which must be less than the [folding frequency](#) of the [EUT](#). In most cases, the upper band-edge frequency is 20kHz unless this is restricted by the sample rate of the EUT. The dScope implementations of the AES17 tests always set the upper band-edge frequency to 20kHz.

Part



Dolby Digital 2-channel

5 Dolby Digital 2-channel

The dScope can perform conformance testing of Dolby Digital 2-channel replay devices such as DVD players (in conjunction with the [Dolby DVD Test DVD](#)), or set-top-boxes (in conjunction with the equivalent .ac3 test files).

An easy-to-use script and accompanying Configurations are provided which provides a menu of all available tests, and guides you through each test. This script and the accompanying Configurations are installed automatically from the dScope's installation CD; updates may be obtained from www.prismsound.com, or by contacting Prism Sound or your local distributor. Contact details are provided in the [General information](#) section.

Details of how to get started with Dolby Digital 2-channel testing are in the [Overview](#) section.

5.1 Overview

This document describes how to perform the two-channel tests required by Dolby Laboratories for DVD players and broadcast consumer products, as specified in the [Dolby Test Procedure document](#), using a Prism Sound 'dScope Series III' audio analyzer. For details of the individual tests, refer to the [Dolby Digital 2-channel tests reference](#) section of this manual.

Running the tests

The dScope's Dolby Digital 2-channel tests are accessed from the Default User Bar of the dScope, under "Applications:Dolby Digital 2-channel" if that User Bar is configured, or alternatively by running the "Dolby Digital 2Ch.dss" launcher script by selecting "Run Script" from the Automation menu. The launcher script presents a tests menu, from which each test may be automatically performed, with prompting for the required tracks from the [Dolby Digital Test DVD](#).

Additional help during testing

When starting the launcher script, the operator is prompted to select whether additional help is required in either (or both) of the following areas:

- Test methods;
- Test specifications (pass/fail limits);

If either of these is selected, then additional message boxes are generated during running of each test which describe the selected parameter(s) for that test.

Note about Reference Level

The first test listed in the tests menu is the 'Reference Level' test. This test establishes an ideal 'full-scale' amplitude reading for the Dolby Digital device under test. This level is used as a reference in most of the other tests, and so it is important that the Reference Level test is performed first. Failure to do so will result in an error message when other tests are attempted.

Collection of results

When a test from the test menu has been executed, its button becomes italicised in the test menu to indicate that it has been completed. Results of completed tests are retained by the script, and any graphical results are automatically exported to .EMF files in the 'Dolby Exports' folder within the main dScope program folder. Having completed the desired tests, the operator is asked (upon exiting from the tests menu) whether or not to create a document of the completed test results. If this option is selected, a Microsoft Word document is created containing all results and plots, also in the 'Dolby Exports' folder.

Customising the tests

This document describes the automatic execution of the Dolby Digital 2-channel tests, one at a time, from a tests menu under the control of a central 'launcher script'. The script loads a dScope Configuration for the selected test, and then starts the test, prompting the operator to play the relevant track on the test DVD. The results of each test are presented for operator scrutiny, but precise 'pass/fail' limits are not applied (principally because few limits are specified by Dolby for the tests).

Since the launcher script and Configurations are 'soft', it is possible to customise the process according to requirements. For example:

- The execution of whichever tests were required could be automated as a single operation, with track-prompts;
- Pass/fail limits could be applied, with an overall pass/fail report generated;

Note that minor or temporary changes to a test Configuration can be made manually before clicking the button to start the test.

Dolby Test Procedure document and Test DVD

The following reference document and test DVD are relevant to these tests, and are available from Dolby Laboratories:

- Dolby Digital Two-Channel Consumer Broadcast Products Test Procedure, Version 2.0, Issue 3
- Dolby Digital Test DVD, version 1.0 or 1.5

Testing devices other than DVD players

The tests provided are tailored for testing 2-channel DVD players; however, it is also possible to test other Dolby Digital 'Consumer broadcast equipment' such as set-top-boxes. In such cases it is necessary to provide test stimuli in other format than DVD, for example by using the '.ac3' files detailed in the [Dolby Digital 2-channel tests reference](#) section of this document.

Compatibility with Audio Precision System 2 test files and .ac3 files

The Dolby Test Procedure document details the Audio Precision System 2 test files for the analogue and digital domain tests. When using dScope Series III these are replaced with the equivalent dScope Configuration files, as listed below and at the beginning of each test in the [Dolby Digital 2-channel tests reference](#) section.

The .ac3 files mentioned in the Dolby Procedure are included in this document for reference. In most (but not all) cases the tracks on the DVD are the same as the .ac3 files.

Dolby accreditation

This document does NOT describe all the requirements that must be met in order to achieve accreditation from Dolby Laboratories. Please refer to Dolby documentation for full details. Note that to comply with the Dolby Laboratories' requirements, additional tests outlined in the Dolby procedure (such as listening and functional tests) must also be completed and documented.

Folder structure

On installation, the Dolby Digital 2-channel test files are contained in two folders as follows:

Configurations are in <dScope root>\Configurations\Dolby\2-channel
The launcher script, "Dolby Digital 2Ch.dss" is in <dScope root>\Scripts\Automation

The following Configurations are used during Dolby Digital 2-channel testing:

Ref Level Track 8.dsc
Max Output Level Track 72.dsc
Dialog Normalization Track 23.dsc
Dynamic Range Compression 2 Ch Track 22.dsc
Dynamic Range Compression 5 Ch Track 61.dsc
DownMix Tracks 41 and 42.dsc
Separation L Track 26.dsc
Separation R Track 27.dsc
Frequency Response Track 19.dsc
THD vs Frequency Track 19.dsc
THD vs Level Track 24.dsc
Signal to Noise Ratio Track 13.dsc
Inter-channel Phase Track 19.dsc
Eye Pattern Track 19.dsc
Jitter Spectrum Track 19.dsc
Category Code Track 19.dsc
Audio Data Bit Track 19.dsc

5.2 Dolby Digital 2-channel tests reference

The Dolby Digital 2-channel tests are described in detail in the two following sections:

[Analogue domain tests](#)

[Digital domain tests](#)

5.2.1 Analogue domain tests

The following analogue domain tests are available, and are described in the following sections:

[Reference Level](#)
[Maximum Output Level](#)
[Dialog Normalization](#)
[Dynamic Range Compression](#)
[Downmix](#)
[Separation](#)
[Frequency Response](#)
[THD vs Frequency](#)
[THD vs Level](#)
[Signal to Noise](#)
[Inter-channel Phase](#)

For each test, the appropriate Track of the Dolby Digital Test DVD is listed and also, for non-DVD player testing, the Dolby test file (.ac3).

Setting up

The analogue domain tests are measured at the analogue line outputs of the [EUT](#). Please make sure that the following connections have been made:

- Left Channel analogue output of Dolby Digital device to the dScope's Analogue Input A
- Right Channel analogue output of Dolby Digital device to the dScope's Analogue Input B

NB: For unbalanced consumer equipment **WITHOUT GROUND REFERENCE** (such as portable CD or DVD players or set-top-boxes) use the RCA/PHONO–XLR adaptor provided to connect the EUT's analogue outputs to the dScope's XLR inputs rather than using the normal (ungrounded) RCA/PHONO–BNC adapter. In some cases, results may be improved by also grounding the chassis of the EUT to the dScope's front-panel chassis terminal.

If the EUT has loudspeaker outputs *only*, then all tests should be performed at these outputs. Note that some specifications are different in this case.

5.2.1.1 Reference Level

dScope Configuration:	Ref Level Track 8.dsc
Track Number:	8
Corresponding AP Test File:	Reflvl.at2
.ac3 Test File:	2_ref2k.ac3
Duration:	30 sec
Test Signal Description:	997Hz at –20dBFS (L & R)

Description

The Reference Level test is used to obtain the ideal [full-scale output amplitude](#) (FS) of the [EUT](#).

Throughout testing the ideal FS amplitude of the EUT will be used as a reference amplitude.

Method

Play Track 8 and then click the [OK] button to start the test.

The test track contains a -20dBFS sinusoidal stimulus at 997Hz. The measured amplitude at the output of the EUT is increased by 20dB and entered as the dScope's dBr reference amplitude. This value is used as the 0dBFS reference amplitude in all subsequent tests unless otherwise noted.

A 0dBFS signal is not used to establish the reference amplitude since clipping, compression or other issues may limit the EUT's output under this condition.

Specification

No specification is provided. A Reference Level of around 2V RMS might be typical for an unbalanced consumer output.

5.2.1.2 Maximum Output Level

dScope Configuration:	Maximum Output Level Track 72.dsc
Track Number:	72
Corresponding AP Test File:	2_MaxL.at2 & 2_MaxR.at2
.ac3 Test File:	
Duration:	30 sec
Test Signal Description:	30Hz at 0dBFS

Description

This test measures the maximum output of the [EUT](#) with a 5-channel signal.

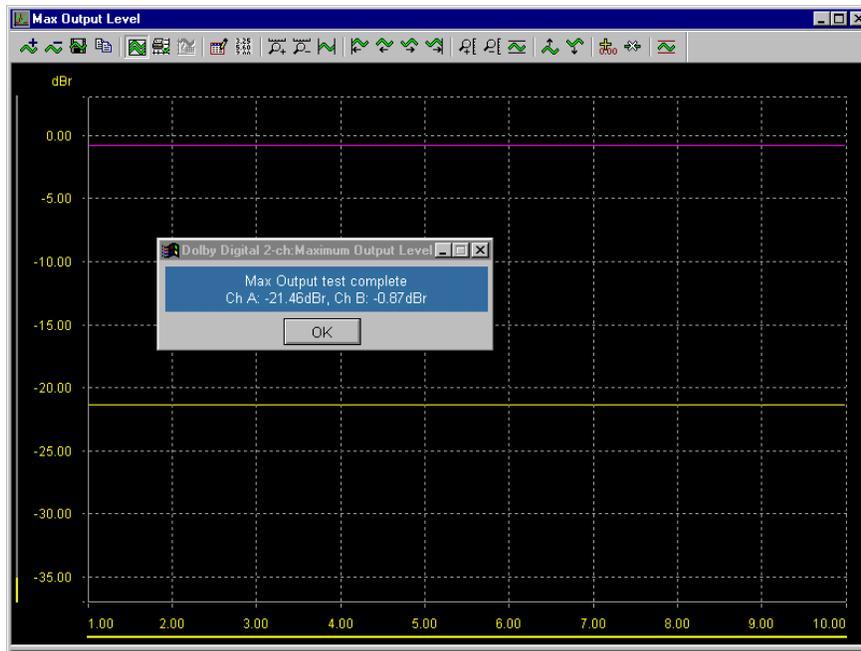
Method

If the output level of the line output is variable, the volume control should be set to the maximum position.

Play Track 72 and then click the [OK] button to start the test.

The test plots the left and right channel amplitudes against time for the duration of the test track. At

the end, the left and right amplitudes are reported in a message box.



Specification

No precise specification is provided. A tolerance of ± 1 dB from the design norm is a reasonable guideline of acceptability.

Note: A 20dB imbalance between the channels is expected when an Lt/Rt downmix is performed.

5.2.1.3 Dialog Normalization

dScope Configuration:	Dialog Normalization Track 23.dsc
Track Number:	23
Corresponding AP Test File:	2_dnswp.at2
.ac3 Test File:	2_dnswp.ac3
Duration:	60 sec
Test Signal Description:	1kHz at 0dBFS

Description

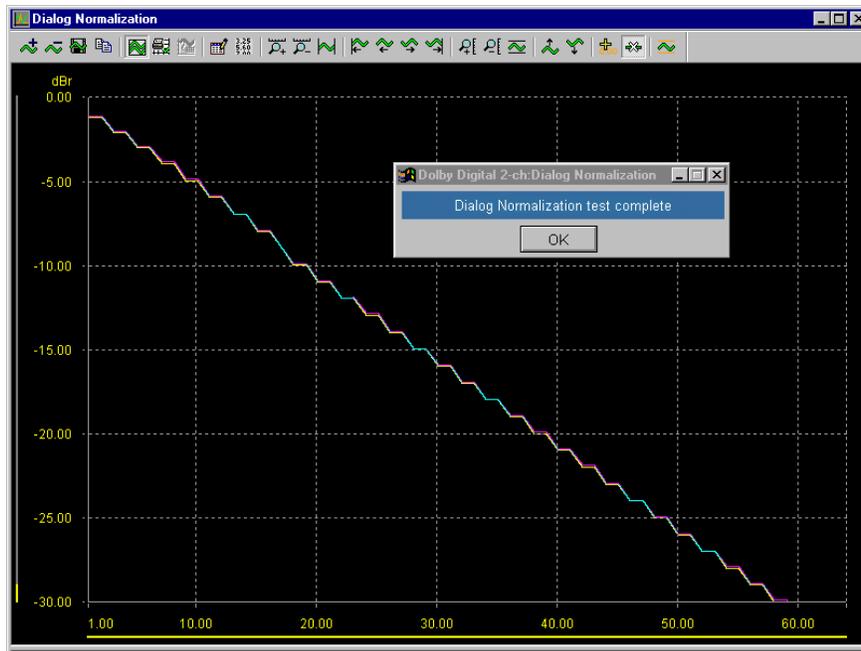
This test ensures that dialog normalization is turned on and functioning. Dialog normalization allows the decoder to control the output level of the product based on metadata provided in the bitstream.

Method

Play Track 23 and then immediately click the [OK] button to start the test.

The test track contains a full-scale signal that is stepped down by 1dB every two seconds using Dialog Normalization attenuation. The test plots the output amplitude for both channels every 500ms

for 64s, measured through a 1kHz band-pass filter.



Specification

The sweep should show that output level dropping by 1dB every 2 seconds over a 30dB range. If compression is turned on, the output level should be flat for 3 seconds before beginning to drop.

5.2.1.4 Dynamic Range Compression

dScope Configuration:	Dynamic Range Compression 2 Ch Track 22.dsc; Dynamic Range Compression 5 Ch Track 61.dsc
Track Number:	22 and 61
Corresponding AP Test File:	2_comp.at22
.ac3 Test File:	2_k5comp.ac3
Duration:	60 sec each file
Test Signal Description:	400Hz sweep 0dBFS to -60dBFS (- 60dBFS to 0dBFS for .ac3 file) (2ch) 400Hz sweep 0dBFS to -60dBFS (5ch)

Description

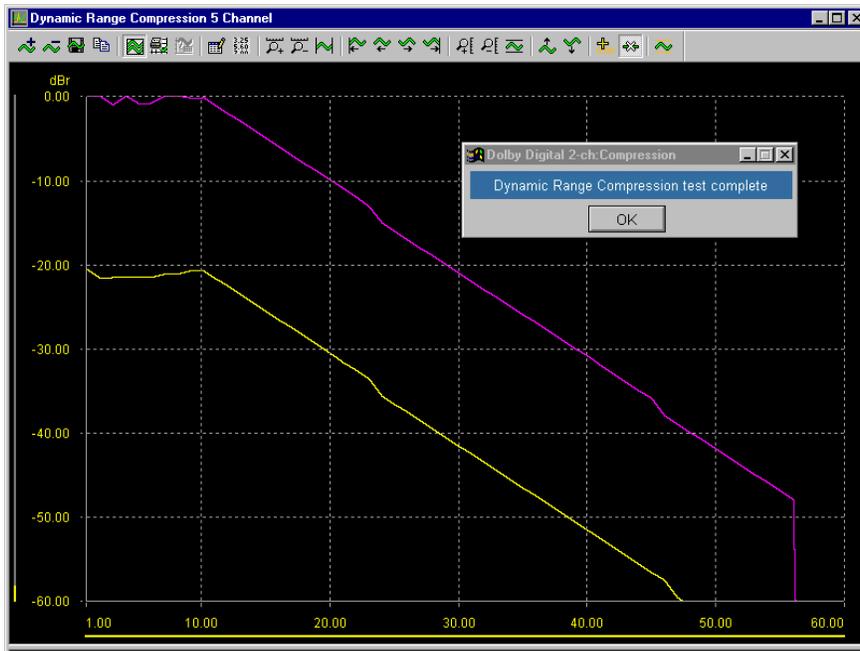
This test checks for proper functionality of [EUT](#)'s dynamic range control in both 2-channel and 5.1-channel modes.

Method

If the EUT offers compression ON and compression OFF modes, the test should be repeated for each mode.

Play Track 22 and immediately click the [OK] button to start the test; when prompted, play Track 61 and immediately click the [OK] button to resume.

The dScope measures the amplitude of each output channel against track time (and hence against level), using a 400Hz band-pass filter to reduce the effects of noise.



Specification

Results should be:

Track	Compression mode	Result
22	OFF	Output decreases linearly from 0dBFS to -60dBFS.
22	ON	Output flat (-3dBr) for 3s then decreases linearly.
61	BOTH	Output flat for 11s then decreases linearly. May note a 20dB difference in level depending on type of downmixing in EUT.

The plots above show: (Track 22): Compression OFF; (Track 61): illustrating flat response for 11 seconds and a 20dB difference in level.

5.2.1.5 Downmix

dScope Configuration:	Downmix Tracks 41 and 42.dsc
Track Number:	41 and 42
Corresponding AP Test File:	Dwnmix2s.at2 and Dwnmix2o.at2
.ac3 Test File:	Dwnmix2s.ac3 and Dwnmix2o.ac3
Duration:	30 sec
Test Signal Description:	400Hz at -20dBFS (-27.66 LS & RS)

Description

This test ensures that the [EUT](#) can properly downmix a 5.1-channel bitstream into 2-channel output.

All DVD players are required to implement an Lt/Rt downmix. A Lo/Ro downmix may be provided as a user-selectable option. An Lt/Rt downmix is essentially a surround compatible stereo output (Track 42). An Lo/Ro downmix is for standard stereo output (Track 41).

NB: Since most DVD players only support an Lt/Rt downmix, the scripted version of this test only exercises Lt/Rt mode, using Track 42.

Method

Play Track 42 and then immediately click the [OK] button to start the test.

The Dolby Digital test tracks are such that when the correct downmix is performed, the signals in the L,R,C,LS & RS channels cancel producing very little output. The dScope measures the outputs of each channel using a 400Hz band-pass filter to eliminate the effects of noise.



Specification

If the correct downmix is being performed, the output should be less than -60dBr for both channels.

5.2.1.6 Separation

dScope Configuration:	Separation L Track 26.dsc Separation R Track 27.dsc
Track Number:	26 and 27
Corresponding AP Test File:	2_997L.at2 & 2_997_R.at2
.ac3 Test File:	2_997L.ac3 & 2_997_R.ac3
Duration:	30 sec
Test Signal Description:	997Hz at 0dBFS (left and right)

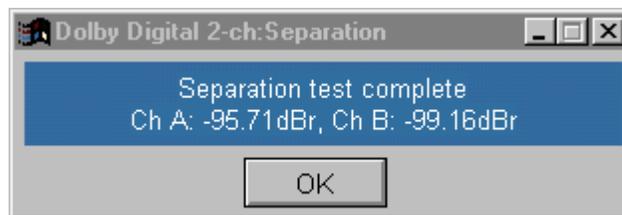
Description

This test measures the left-to-right and right-to-left cross-talk between the [EUT](#) outputs at [full-scale amplitude](#).

Method

Play Track 26 and then click the [OK] button to start the test; when prompted, play Track 27 and click the [OK] button to resume.

The dScope measures the amplitude of the non-driven channel, via a 997Hz band-pass filter to exclude noise, and reports the result for each channel.



Specification

No precise specification is provided. As a guide, separation should generally be better than 85dB at 997Hz.

5.2.1.7 Frequency Response

dScope Configuration:	Frequency Response Track 19.dsc
Track Number:	19
Corresponding AP Test File:	2_frqswp.at2
.ac3 Test File:	2fstplr.ac3
Duration:	60 sec
Test Signal Description:	20Hz to 20kHz sweep at -20dBFS

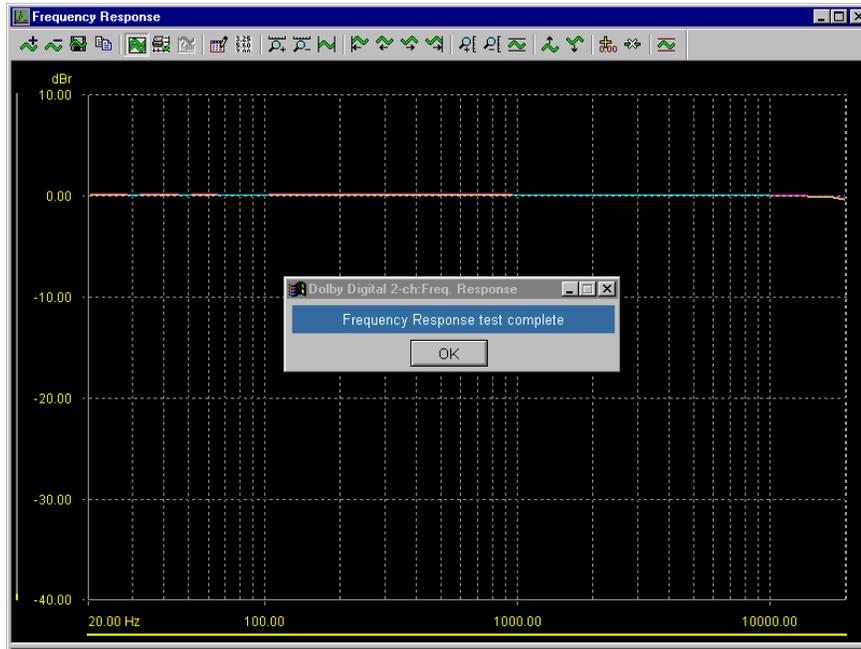
Description

This test plots the frequency response of the [EUT](#) at [-20dBFS](#).

Method

Click the [OK] button to start the test, and then play Track 19.

The dScope senses the 60 logarithmically-spaced frequencies on the test track, measures the amplitude at each (using a band-pass filter to exclude noise), and produces a plot of the results for both channels. Note that the output scale is referenced to the nominal -20dBFS level of the test stimulus.



Specification

For line outputs, the response should be within $+0.5/-1\text{dB}$ of the 1kHz level from 20Hz to 20kHz; for headphone and speaker outputs, the response should be within $+0.5/-1\text{dB}$ of the 1kHz level from 30Hz to 20kHz.

5.2.1.8 THD vs Frequency

dScope Configuration:	THD vs Frequency Track 19.dsc
Track Number:	19
Corresponding AP Test File:	2_thdfreq.at2
.ac3 Test File:	2fstplr.ac3
Duration:	60 sec
Test Signal Description:	20Hz to 20kHz sweep at -20dBFS

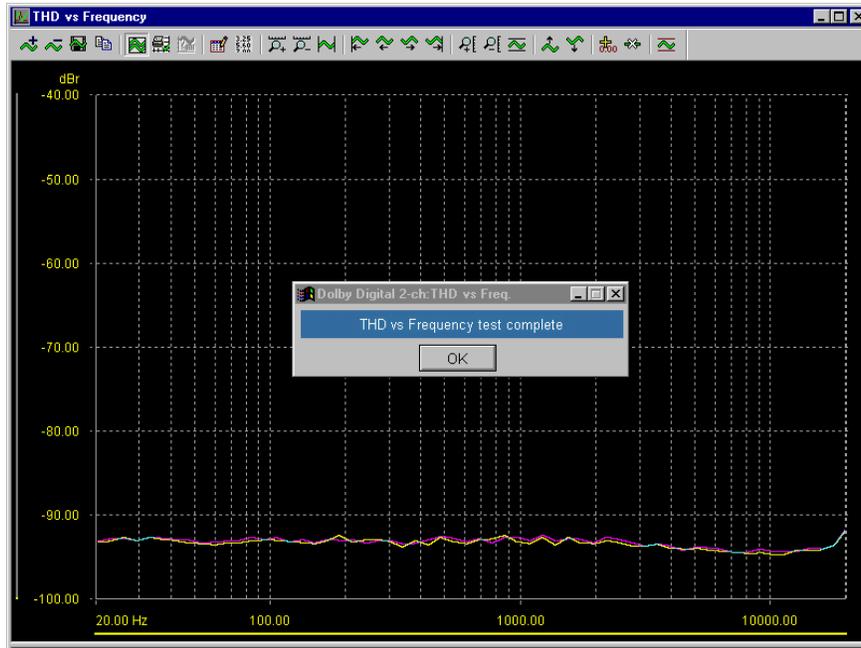
Description

This test produces a plot of the THD+N of the [EUT](#) against frequency, at 20dB below [full-scale amplitude](#).

Method

Click the [OK] button to start the test, and then play Track 19.

The dScope senses the 60 logarithmically-spaced frequencies on the test track, measures the THD +N at each, and produces a plot of the results for both channels.



Specification

Across the frequency range, the THD+N for line outputs should be less than -60dB and for headphone or speaker outputs, less than -57dB .

5.2.1.9 THD vs Level

dScope Configuration:	THD vs Track 24.dsc
Track Number:	24
Corresponding AP Test File:	2_thdvl.at2
.ac3 Test File:	2_aswp4ka.ac3
Duration:	120 sec
Test Signal Description:	0dBFS to -120dBFS sweep at 4kHz

Description

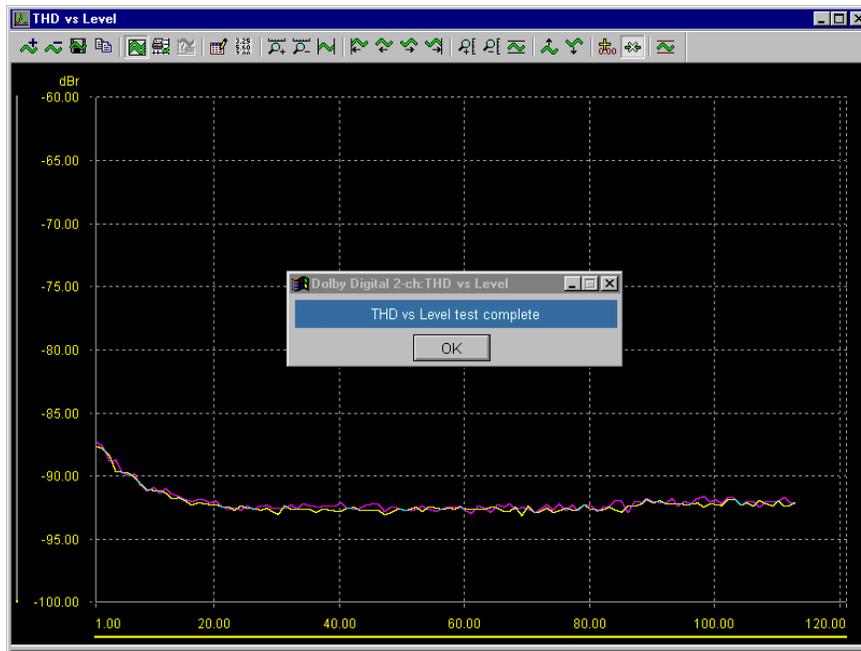
This test produces a plot of the THD+N of the [EUT](#) against level, from 0dBFS to -120dBFS , at 4kHz.

Method

Play Track 24 and then immediately click the [OK] button to start the test.

The dScope plots THD+N against time for both channels during the 120s of the test track; this

corresponds to a sweep from 0dBFS to –120dBFS.



Specification

Across the amplitude range, the THD+N for line outputs should be less than –60dBr and for headphone or speaker outputs, less than –57dBr.

5.2.1.10 Signal-to-noise

dScope Configuration:	Signal to Noise Ratio Track 13.dsc
Track Number:	13
Corresponding AP Test File:	2_dnr.at2
.ac3 Test File:	2_200a60.ac3
Duration:	60 sec
Test Signal Description:	200Hz at –60dBFS

Description

This test measures the noise floor of the [EUT](#) relative to a notional nominal –20dBFS signal amplitude. This is done in the presence of a small signal (200Hz at –60dBFS) so that the EUT cannot mute its D/A converter.

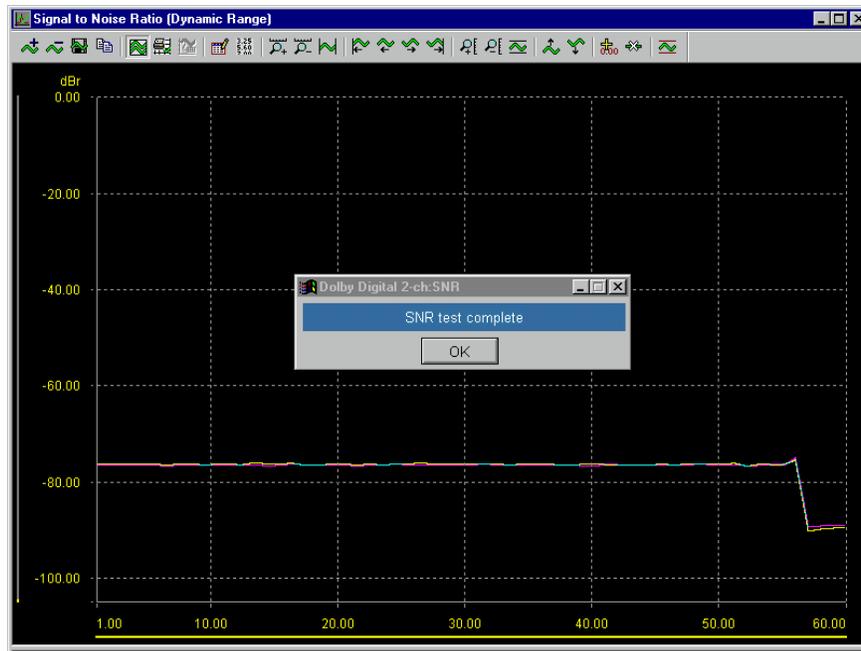
Method

Play Track 13 and then click the [OK] button to start the test.

The dScope measures the residual amplitude of both EUT output channels, after a 200Hz notch filter, band-limited between 22Hz and 22kHz, and using a CCIR–2k weighting filter.

Note that this test is performed as a sweep against track time (even though it could actually be a

single spot measurement) for consistency with the Dolby test procedure.



Specification

The signal-to-noise, relative to a -20dBFS level, for line outputs should be less than -65dBr and for headphone or speaker outputs, less than -60dBr .

5.2.1.11 Inter-channel Phase

dScope Configuration:	Inter-channel Phase Track 19.dsc
Track Number:	19
Corresponding AP Test File:	
.ac3 Test File:	2fstplr.ac3
Duration:	60 sec
Test Signal Description:	20Hz to 20kHz sweep at -20dBFS

Description

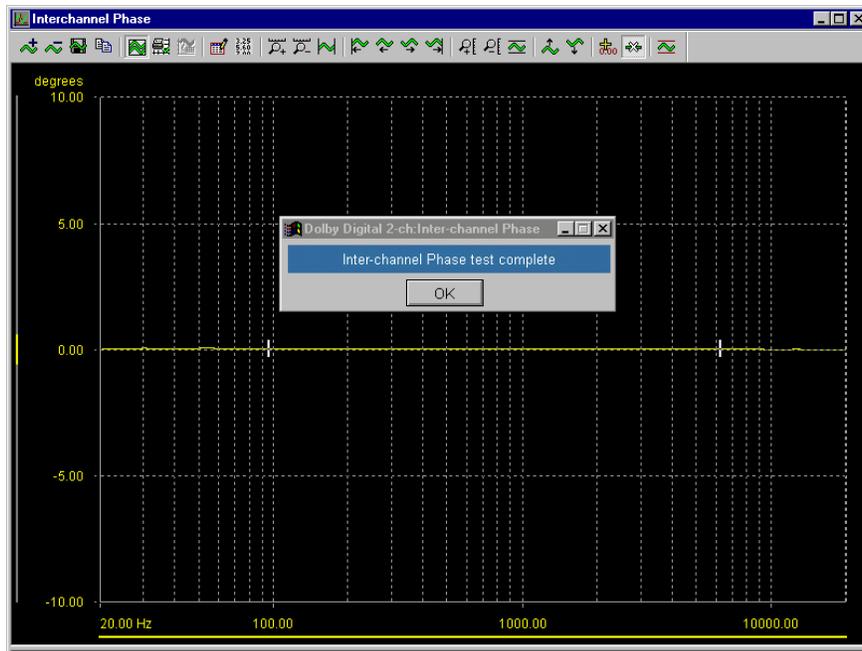
This test measures the inter-channel phase of the [EUT](#) between 20Hz and 20kHz at -20dBFS .

Method

Click the [OK] button to start the test, and then play Track 19.

The dScope senses the 60 logarithmically-spaced frequencies on the test track, measures the inter-

channel phase at each, and produces a plot of the results.



Specification

No precise specification is provided. As a guide, phase matching well within 1 degree should be preserved over the frequency range.

5.2.2 Digital domain tests

The following digital domain tests are available, and are described in the following sections:

[Eye Pattern](#)
[Jitter Spectrum](#)
[Category Code](#)
[Audio/Data Bit](#)

For each test, the appropriate Track of the Dolby Digital Test DVD is listed and also, for non-DVD player testing, the Dolby test file (.ac3).

Setting up

The digital domain tests are measured at the digital outputs of the [EUT](#). Please make sure that the following connection has been made:

- Digital Output of the EUT to the dScope's Digital Input BNC, using the provided RCA/PHONO-BNC adapter.

5.2.2.1 Eye Pattern

dScope Configuration:	Eye Pattern Track 19.dsc
Track Number:	(any)
Corresponding AP Test File:	Digeye.at2
.ac3 Test File:	(any)
Duration:	
Test Signal Description:	

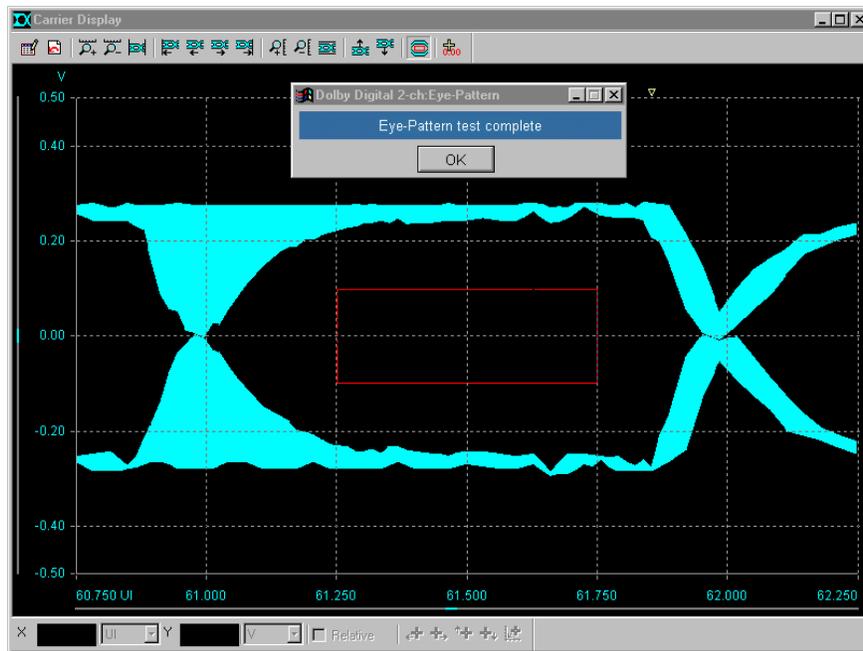
Description

This test displays the eye pattern of the [EUT](#)'s digital output carrier, as an indication of whether it will be acceptable to any receiving device.

Method

Play Track 19 and then click the [OK] button to start the test.

The plot shows the best and worst-case excursions of a data cell within the [IEC60958](#) carrier (in this case the second cell of the [Channel Status](#) bit of the B-channel, since this cell is active even if no audio is playing). The eye pattern is built up over several passes of the yellow cursor at the top of the window.



Specification

Dolby Laboratories does not provide a precise specification, however the red box on the plot shows the minimum eye region specified by the IEC60958 standard, into which the eye pattern should not transgress if reliable reception is to be guaranteed.

5.2.2.2 Jitter Spectrum

dScope Configuration:	Jitter Spectrum Track 19.dsc
Track Number:	(any)
Corresponding AP Test File:	Digjitr.at2
.ac3 Test File:	(any)
Duration:	
Test Signal Description:	

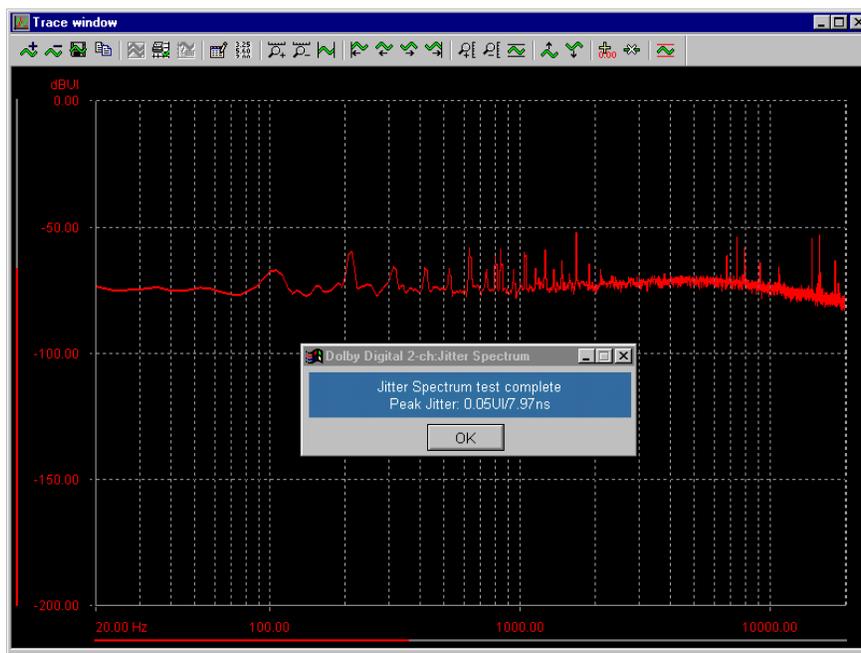
Description

This test measures the worst-case peak [jitter](#) of the [EUT](#)'s digital output carrier, and also displays the spectrum of the jitter. Excessive jitter can lead to the output data being irrecoverable by a receiving device. Even moderate jitter can result in degraded audio performance in a subsequent D/A converter if its design is inadequate in rejecting the incoming jitter from its sampling clock.

Method

Play Track 19 and then click the [OK] button to start the test.

The dScope can measure various types of jitter in a variety of different ways. In this case, the [data jitter](#) from the EUT's digital output carrier is demodulated and fed to the dScope's analogue Signal Analyzer. An FFT is calculated to show the spectrum of the jitter, and the peak level of the jitter is also measured.



Specification

Dolby Laboratories does not provide a precise specification, however a peak jitter limit of 0.25UI (unit intervals) is suggested in the [IEC60958](#) standard as a worst-case specification. In general, the figure should not exceed 0.1UI.

5.2.2.3 Category Code

dScope Configuration:	Cat Code Track 19.dsc
Track Number:	(any)
Corresponding AP Test File:	Chanstat.at2
.ac3 Test File:	(any)
Duration:	
Test Signal Description:	

Description

This test checks that the Category Code embedded in the [Channel Status](#) of the [EUT](#)'s digital output carrier correctly identifies the EUT, as defined in the [IEC60958](#) standard.

Method

Play Track 19 and then click the [OK] button to start the test.

The Category Code field of the Channel Status is read from the EUT's digital output carrier. The value is shown both as a binary value, and also decoded. The example below shows the results for DVD playback.



Note that during this test, the dScope's Digital Inputs dialogue box is open to enable the operator to note other parameters of the EUT's digital output, for example wordlength, sample rate and valid bits.

Specification

The Category Code should be correct for the Dolby Digital device being tested.

5.2.2.4 Audio/Data Bit

dScope Configuration:	Audio Data Bit Track 19.dsc
Track Number:	(any)
Corresponding AP Test File:	Chanstat.at2
.ac3 Test File:	(any)
Duration:	
Test Signal Description:	

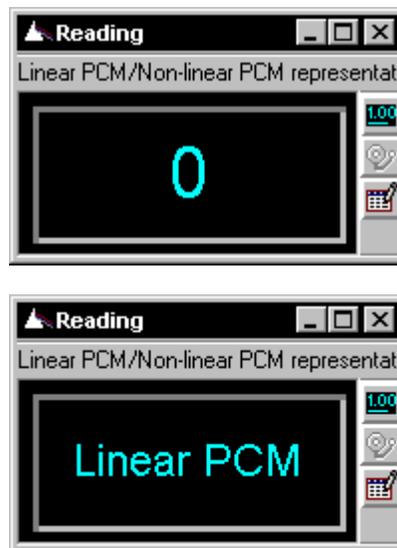
Description

This test checks that the 'non-audio' bit embedded in the [Channel Status](#) of the [EUT](#)'s digital output carrier operates correctly as defined in the [IEC60958](#) standard.

Method

Play Track 19 and then click the [OK] button to start the test.

The 'non-audio bit' field of the Channel Status is read from the EUT's digital output carrier. The value is shown both as a binary value, and also decoded. The example below shows the results for a DVD player digital output in 'audio' (i.e. linear PCM) mode.



Note that during this test, the dScope's Digital Inputs dialogue box is open to enable the operator to note other parameters of the EUT's digital output, for example wordlength, sample rate and valid bits.

Specification

The 'non-audio' bit should be set to 0 ('audio', i.e. linear PCM) when outputting PCM, and 1 ('non-audio', or at least not linear PCM) when outputting undecoded Dolby Digital bitstreams. Note that many two-channel DVD players cannot output Dolby Digital bitstreams at their digital output, which therefore shows 'audio' (i.e. PCM) all the time.

5.3 Glossary

The following definitions are used in the Dolby Digital test procedure and in the dScope implementation of the Dolby Digital tests:

Channel Status - status information embedded in an AES3 or [S/PDIF](#) digital interface, one bit per channel per sample-period, which accumulate into a 192-bit frame for each channel every 192 sample-periods. The frame is arbitrarily split into many fields of various lengths, with diverse functions as described in the appropriate interface standard document. The definitions of the fields and their meanings are different for 'Consumer' Channel Status (where the first bit of the frame is 0, used in S/PDIF) and 'Professional' Channel Status (where the first bit is 1, used in AES3). Originally conceived to add functionality to digital equipment interconnects, the proliferation of outputs with sloppy Channel Status implementation and inputs which mute if any unexpected Channel Status is received has led, like the Babel Fish, to much entirely unnecessary conflict.

D/A line-up - A setting of the dScope's Inputs and Outputs which relates the maximum analogue amplitude to the maximum digital amplitude. It is expressed as an analogue amplitude which corresponds to 0dBFS (full-scale digital). This feature of the dScope is especially useful in measuring [EUTs](#) with both analogue and digital ports since it allows settings or measurements in one domain to be expressed in the units of the other. For example, an A/D converter can be stimulated with a signal 1dB below that which will produce full-scale output by setting the dScope's analogue generator amplitude to -1dBFS, provided that the dScope has been set to the appropriate D/A line-up for the converter.

Data jitter - A type of interface jitter. Data jitter is that part of the interface jitter which is caused by variations in the duty cycle of the AES3 or [IEC60958](#) carrier acting with high-frequency losses in the transmission medium (e.g. cable capacitance) such that edge timing in the carrier is modulated by the activity of the data bits. This is distinct from fs jitter, which is inherent in the carrier source. dScope can measure data jitter and fs jitter independently, so that the cause of jitter problems can be identified. Also referred to as 'inter-symbol interference'.

dBFS - A logarithmic unit used to express signal amplitude in digital and mixed-domain systems in terms of the maximum amplitude which can be accommodated by an [EUT](#). A 0dBFS signal has the same RMS amplitude as a sine whose peaks just touch the maximum level of the system. A -6dBFS signal has half this amplitude, for example. Note that for non-sine signals such as square waves or DC it is possible for the system to accommodate amplitudes greater than 0dBFS. In the dScope it is possible to specify or measure analogue signal amplitudes in dBFS, in which case the [D/A line-up](#) is used as a reference.

EUT - 'Equipment under test'.

Eye-diagram - The AES3 and IEC60958 standards define acceptable carrier degradation in terms of amplitude and edge-timing using an eye-diagram, which shows the minimum acceptable differential carrier amplitude over a defined period within 1 UI of the carrier. This can be verified on the dScope using the Carrier Display feature.

Eye-narrowing - The dScope can measure the worst-case narrowing of the eye of an AES3 or IEC60958 carrier. This is essentially a measurement of data jitter, and can be referred to the [eye-diagram](#) in the AES3 or IEC60958 standards.

Folding frequency - Half the sample rate of the [EUT](#). Input frequencies above the folding frequency are subject to aliasing. Where an EUT applies internal down-sampling, the folding frequency is half of the lowest internal sample rate employed.

fs - Abbreviation for sample rate.

FS - [Full-scale amplitude](#).

Full-scale amplitude - A signal whose amplitude is the maximum which can be accommodated by the [EUT](#). In the case of a sine, this amplitude is [0dBFS](#).

IEC60958 - A two-channel digital audio interface standard, as provided at the dScope's Digital Output and Input. Also known as S/PDIF this format is used in consumer applications usually with an unbalanced phono/RCA copper or TOSLINK optical connection. It carries audio wordlengths up to 24 bits, plus Valid bit, User bit, [Channel Status](#) and Parity bit per channel.

IMD - Intermodulation Distortion. When a signal consists of more than one frequency, a non-linear device under test will produce the original frequencies plus an infinite number of IMD products, given by

$$(a * F1) + (b * F2) + (c * F3) + \dots$$

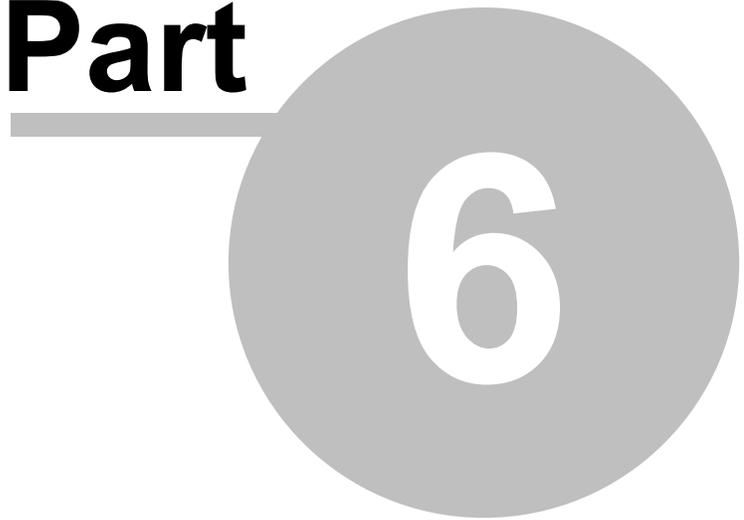
where (a, b, c) etc. are all possible integer numbers, and (F1, F2, F3) etc. are the frequencies of the original tones.

Jitter - Variation in edge-timing of a clock. In audio systems, manifestations are interface jitter and sampling jitter.

S/PDIF - [IEC60958](#).

UI - (Unit Interval). A UI of an AES3 or [IEC60958](#) carrier is 1/128 of the frame period, the duration of a single biphasic-mark 'cell', or half a bit period.

Part



Dolby Digital 5.1-channel

6 Dolby Digital 5.1-channel

The dScope can perform conformance testing of Dolby Digital 5.1-channel replay devices such as DVD players (in conjunction with the [Dolby DVD Test DVD](#)), when operating in 5.1-channel and two-channel modes.

An easy-to-use script and accompanying Configurations are provided which shows a menu of all available tests, and guides you through each test. This script and the accompanying Configurations are installed automatically from the dScope's installation CD; updates may be obtained from www.prismsound.com, or by contacting Prism Sound or your local distributor. Contact details are provided in the [General information](#) section.

Details of how to get started with Dolby Digital 5.1-channel testing are in the [Overview](#) section.

6.1 Overview

This document describes how to perform the 5.1-channel tests required by Dolby Laboratories for DVD players and broadcast consumer products, as specified in the [Dolby Test Procedure document](#), using a Prism Sound 'dScope Series III' audio analyzer. For details of the individual tests, refer to the [Dolby Digital 5.1-channel tests reference](#) section of this manual.

This document is not meant as a replacement for the Dolby Digital Test Procedure document, and all tests should be performed with reference to that document for full details of the tests.

[Two-channel tests](#)

The Dolby Digital 5.1-channel DVD Test Procedure requires that 5.1-channel DVD players are also tested in two-channel mode. To perform these tests, configure the DVD player for two-channel mode and refer to the manual for [Dolby Digital 2-channel testing](#).

[Running the tests](#)

The dScope's Dolby Digital 5.1-channel tests are accessed from the Default User Bar of the dScope, under "Applications:Dolby Digital 5.1-channel" if that User Bar is configured, or alternatively by running the "Dolby Digital 6Ch.dss" launcher script by selecting "Run Script" from the Automation menu. The launcher script presents a tests menu, from which each test may be automatically performed, with prompting for the required tracks from the [Dolby Digital Test DVD](#).

Before launching the menu, the script will prompt you for the name and serial number of the Product. This will be used to store test results; see [Collection of results](#) (below) for more details.

[Automatic testing using a Switcher](#)

The Dolby Digital 5.1-channel tests can be run using an I/O Switcher, a [dS-NET](#) peripheral. The I/O Switcher is a 16-into-2 relay switcher, which can be used for switching either analogue or digital (AES3) audio signals. For each test, the switcher can speed up testing by switching each of the channels of the Dolby Digital 5.1-channel output in turn into the dScope's analogue inputs, thus eliminating the need for repeated plugging and unplugging of cables. See I/O Switchers in the dS-NET Peripherals manual for further details.

If an I/O Switcher is not available, the 5.1-channel tests can still be performed, but the operator will have to manually change the inputs to the dScope by plugging and unplugging cables. At the start of the test, the launcher script will prompt whether the I/O Switcher is to be used; if so, then the script assumes that the switcher has an address of 0. This can be changed in the script if required.

Additional help during testing

When starting the launcher script, the operator will be prompted to select whether additional help is required in either (or both) of the following areas:

- Test methods;
- Test specifications (pass/fail limits);

If either of these is selected, then additional message boxes are generated during running of each test which describe the selected parameter(s) for that test.

Note about Reference Level

The first test listed in the tests menu is the 'Reference Level' test. This test establishes an ideal 'full-scale' amplitude reading for the Dolby Digital device under test. This level is used as a reference in most of the other tests, and so it is important that the Reference Level test is performed first. Failure to do so will result in an error message when other tests are attempted.

Collection of results

When a test from the test menu has been executed, its button becomes italicised in the test menu to indicate that it has been completed. The results of each graphical test test are saved as an EMF file, in preparation for inclusion in a document at the end.

The files are saved in a subfolder which is made up of the name of the product and its serial number. The operator is prompted for these at the beginning of the test, and exported graphs are then saved to a subfolder of the dScope's Graph Exports folder of the form <Graph Exports Folder>\Dolby\5_1-channel\Product\SerialNum
e.g. if the Product name is "A360" and the serial number is "043", and the dScope's Graph Exports folder is left as the default, then the folder will be:
<dScope program folder>\Graph Exports\Dolby\5_1-channel\A360\043\

Note: Unlike the Dolby Digital two-channel tests, results are available only during the test and are not written to a Word document. This feature is a planned addition for the future.

Customising the tests

This document describes the automatic execution of the Dolby Digital 5.1-channel tests, one at a time, from a tests menu under the control of a central 'launcher script'. The script loads a dScope Configuration for the selected test, and then starts the test, prompting the operator to play the relevant track on the test DVD. The results of each test are presented for operator scrutiny, but precise 'pass/fail' limits are not applied (principally because few limits are specified by Dolby for the tests).

Since the launcher script and Configurations are 'soft', it is possible to customise the process according to requirements. For example:

- The execution of whichever tests were required could be automated as a single operation, with track-prompts;
- Pass/fail limits could be applied, with an overall pass/fail report generated;

Note that minor or temporary changes to a test Configuration can be made manually before clicking the button to start the test.

Dolby Test Procedure document and Test DVD

The following reference document and test DVD are relevant to these tests, and are available from Dolby Laboratories:

- Dolby Digital 5.1-Channel DVD Player Test Procedure, Issue 3
- Dolby Digital Test DVD, version 1.0 or 1.5
- Dolby Digital AutoTest DVD, version 2.0

Compatibility with Audio Precision System 2 test files

The Dolby Test Procedure document details the Audio Precision System 2 test files for the analogue and digital domain tests. When using dScope Series III these are replaced with the equivalent dScope Configuration files, as listed below and at the beginning of each test in the [Dolby Digital 5.1-channel tests reference](#) section.

Dolby accreditation

This document does NOT describe all the requirements that must be met in order to achieve accreditation from Dolby Laboratories. Please refer to Dolby documentation for full details. Note that to comply with the Dolby Laboratories' requirements, additional tests outlined in the Dolby procedure (such as listening and functional tests) must also be completed and documented.

Folder structure

On installation, the Dolby Digital 5.1-channel test files are contained in two folders as follows:

Configurations are in <dScope root>\Configurations\Dolby\6-channel
 The launcher script, "Dolby Digital 6Ch.dss" is in <dScope root>\Scripts\Automation
 Scripts for individual tests are in <dScope root>\Scripts\Automation\Dolby

The following Configurations are used during Dolby Digital 5.1-channel testing:

Ref Level Track 30.dsc
Rel Output Level Track 28_2.dsc
Max Output Level Track 65-69.dsc
Max Output Level Track 70-73.dsc
Dialog Normalization Track 62.dsc
Dynamic Range Compression Track 61.dsc
Frequency Response Track 43-48.dsc
THD vs Frequency Track 43-47.dsc
THD vs Level Track 63.dsc
Signal to Noise Ratio Track 35.dsc
DownMix Track 41-42.dsc
DownMix Overload Track 60.dsc
Low Frequency Overload Track 70-73.dsc
Relative Phase Track 55-56.dsc
Level Trim Controls Track 30.dsc
Centre Channel Delay Track 56.dsc
Pro Logic Functionality Track 5-6.dsc
Pro Logic Centre Channel Evaluation Track 8 and 19.dsc
Pro Logic Surround Delay Track 36_2.dsc
Noise Sequencer.dsc

6.2 Dolby Digital 5.1-channel tests reference

The Dolby Digital 5.1-channel tests are described in detail in the two following sections:

[Analogue domain tests](#)

[Digital domain tests](#)

6.2.1 Analogue domain tests

The following analogue domain tests are available, and are described in the following sections:

[Reference Level](#)

[Relative Output Level](#)

[Maximum Output Level](#)

[Dialog Normalization](#)

[Dynamic Range Compression](#)

[Frequency Response, Bass Redirection](#)

[THD vs Frequency](#)

[THD vs Level](#)

[Signal-to-Noise](#)

[Downmix](#)

[Downmix Overload](#)

[Low Frequency Overload](#)

[Relative Phase](#)

[Level Trim Controls](#)

[Dolby Digital Centre Channel Delay](#)

[Dolby Digital Surround Channel Delay](#)

[Noise Sequencer](#)



The following Pro Logic tests are not currently implemented in the Dolby Digital 5.1-channel test scripts:

- Pro Logic Functionality
- Pro Logic Centre Channel Evaluation
- Pro Logic Surround Channel Delay

Setting up

The analogue domain tests are measured at the analogue line outputs of the [EUT](#). The connections between the DVD player and the dScope will depend on whether an I/O Switcher is being used for the test; please follow the on-screen instructions when the test script is started.



For unbalanced consumer equipment WITHOUT GROUND REFERENCE (such as portable CD or DVD players or set-top-boxes) use the RCA/PHONO–XLR adaptor provided to connect the EUT's analogue outputs to the dScope's XLR inputs rather than using the normal (ungrounded) RCA/PHONO–BNC adaptor. In some cases, results may be improved by also grounding the chassis of the EUT to the dScope's front-panel chassis terminal.

If the EUT has loudspeaker outputs *only*, then all tests should be performed at these outputs. Note that some specifications are different in this case.

6.2.1.1 Reference Level

dScope Configuration:	Ref Level Track 30.dsc
Track Number:	30
Corresponding AP Test File:	5_reflevel
Duration:	30 sec
Test Signal Description:	997Hz at -20dBFS
Channels:	L, C, R, Ls, Rs

Description

The Reference Level test is used to obtain the ideal [full-scale output amplitude](#) (FS) of the [EUT](#). Throughout testing this ideal FS amplitude will be used as a reference amplitude.

Method

Select track 30, wait until the track has started playing, and then click the [OK] button to start the test.

The test track contains a -20dBFS sinusoidal stimulus at 997Hz. The measured amplitude at the output of the EUT is increased by 20dB and entered as the dScope's dBr reference amplitude. This value is used as the 0dBFS reference amplitude in all subsequent tests unless otherwise noted.

A 0dBFS signal is not used to establish the reference amplitude since clipping, compression or other issues may limit the EUT's output under this condition.

Specification

No specification is provided. A Reference Level of around 2V (RMS) might be typical for all channels except the Sub, which will probably be around 400mV.

6.2.1.2 Relative Output Level

dScope Configuration:	Rel Output Level Track 28_2.dsc
Track Number:	28 (AutoTest DVD v2.0)
Corresponding AP Test File:	N/A
Duration:	200 sec
Test Signal Description:	3kHz at -20dBFS / 30Hz at -20dBFS
Channels:	L, C, R, Ls, Rs, Sub

Description

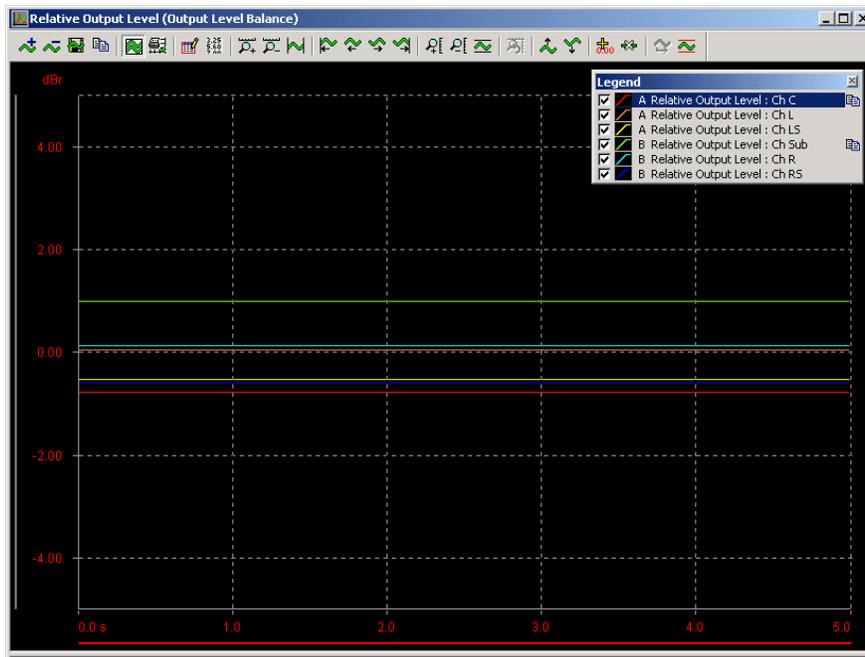
The Relative Output Level (Output Level Balance) test is used to test the relative balance of the DVD player's outputs.

Method

Set all trim/level controls to their nominal positions. Select track 28 from the **AutoTest DVD V2.0**, wait until the track has started playing, and then click the [OK] button to start the test.

The test track contains tones at an amplitude of -20dBFS. Stereo sweeps are done for the Left and

Right channels, then Left Surround and Right Surround, and finally Centre and Sub.



Specification

With the trim/balance controls set to their nominal positions, any individual output (except the Sub) should be within 1.0dB of any other output.

6.2.1.3 Maximum Output Level

dScope Configuration:	Max Output Level Track 65-69.dsc Max Output Level Track 70-73.dsc
Track Number:	65-73
Corresponding AP Test File:	N/A
Duration:	30 sec (each track)
Test Signal Description:	Tracks 65-69: 997Hz at 0dBFS Tracks 70-72: 30Hz at 0dBFS Track 73: 30Hz at -3dBFS
Channels:	Tracks 65-69,71: L, C, R, Ls, Rs Track 70: Sub only Tracks 72-73: L, C, R, Ls, Rs, Sub

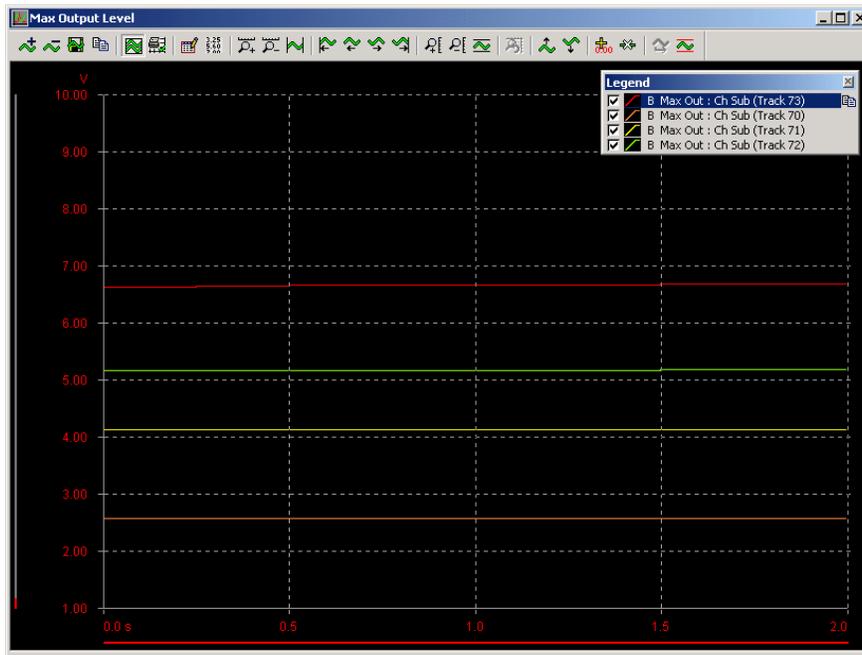
Description

This test measures the worst-case maximum output of the [EUT](#) with a 5-channel signal. Since compression can affect the level of a 5.1-channel full-scale signal, this test involves playing a 0dBFS sine wave for each channel separately.

Method

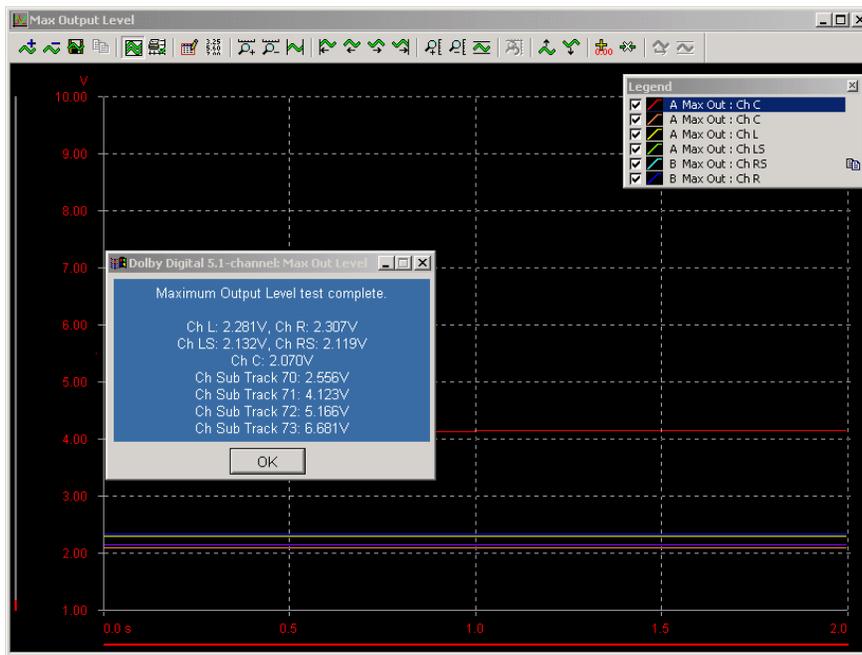
Turn compression Off, and set all trim/balance controls to their maximum positions.

Part 1 of this test involves measuring the maximum output amplitude for the Sub. When prompted, select track 70 on the DVD player. Wait until the track is playing then click the [OK] button to start the test. Repeat this process when prompted for tracks 71 to 73.



Part 2 measures the maximum output amplitude for the other channels. When prompted, select track 66 on the DVD player. Wait until the track is playing then click the [OK] button to start the test. Repeat this process when prompted for tracks 65 and 67 to 69.

At the end of the test, the maximum amplitudes will be displayed for each channel.



Specification

The DVD player should operate within a maximum RMS level of $2.0V \pm 10\%$ at any output.

6.2.1.4 Dialog Normalization

dScope Configuration:	Dialog Normalization Track 62.dsc
Track Number:	62
Corresponding AP Test File:	5_dnsweep
Duration:	64 sec
Test Signal Description:	1kHz at 0dBFS
Channels:	L, C, R, Ls, Rs

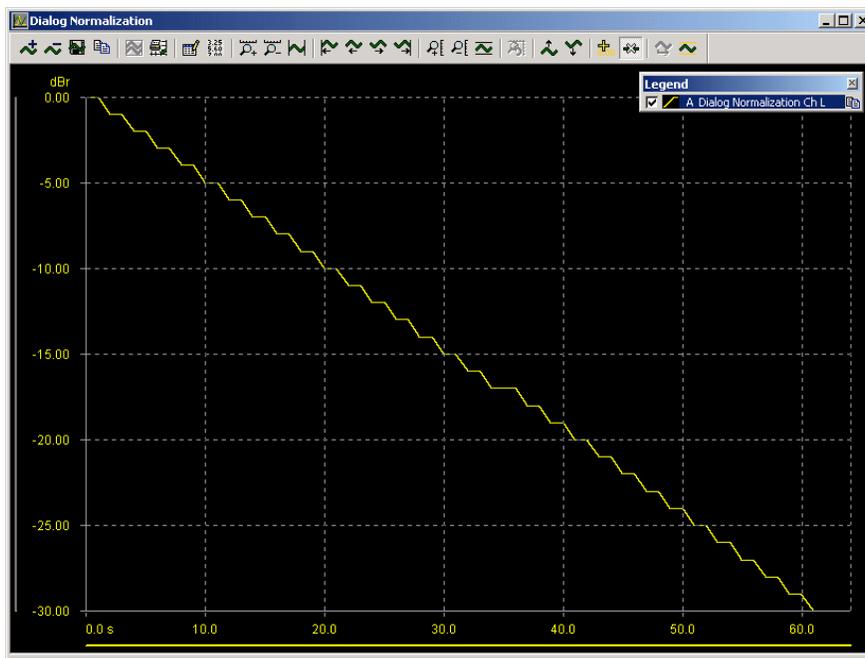
Description

This test ensures that dialog normalization is turned on and functioning. Dialog normalization allows the decoder to control the output level of the product based on metadata provided in the bitstream.

Method

Play track 62 and as soon as the track has started, click the [OK] button to start the test.

The test track contains a full-scale signal that is stepped down by 1dB every two seconds using Dialog Normalization attenuation. The test plots the output amplitude for the left channel every 500ms for 64s, measured through a 1kHz band-pass filter.



Specification

The sweep should show the output level dropping by 1dB every 2 seconds over a 30dB range. If compression is turned on, the output level should be flat for 3 seconds before beginning to drop.

6.2.1.5 Dynamic Range Compression

dScope Configuration:	Dynamic Range Compression Track 61.dsc
Track Number:	61
Corresponding AP Test File:	5_dcomp
Duration:	60 sec (each track)
Test Signal Description:	400Hz Sweep, 0 to -60dBFS
Channels:	L, C, R, Ls, Rs

Description

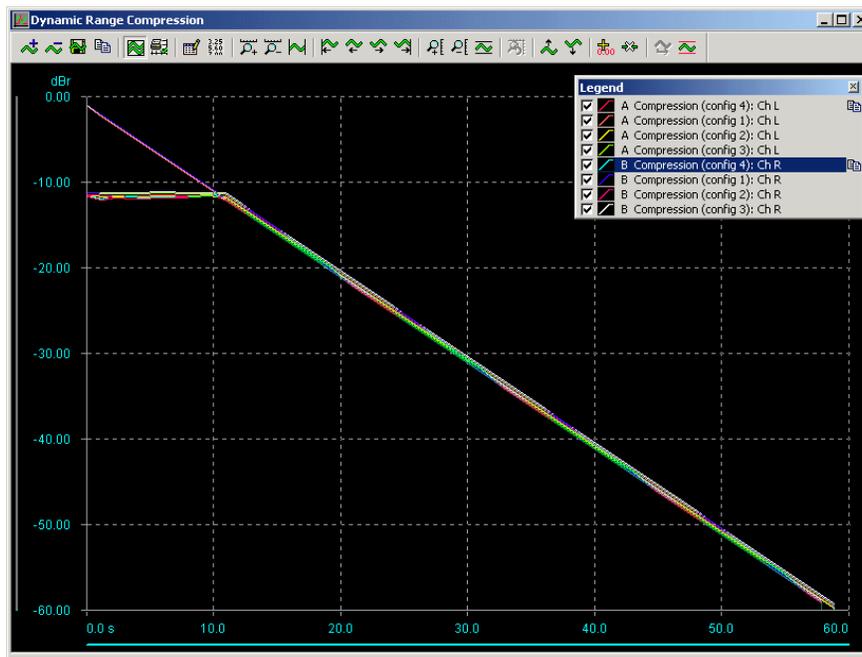
This test verifies that dynamic range compression is functioning correctly during bass redirection.

Method

The test is firstly performed with the Sub ON and all the pother speakers set to "small". The other parts of the test have the Sub turned OFF, the left and right speakers set to "large", and all combinations of "large"/"small" for the other speakers.

For each test, play track 61 and when the track has started playing, immediately click the [OK] button to start the test.

The dScope measures the amplitude of each output channel against track time (and hence against level), using a 400Hz band-pass filter to reduce the effects of noise.



Specification

The following results should be expected:

No compression	Output decreases linearly
Line mode (variable)	Output is flat for variable line mode compression, then decreases linearly.
Full Line Mode	Output is flat at -11dBFS for 11 seconds, then decreases linearly.
RF Mode	Output is flat at -22dBFS for 22 seconds, then decreases linearly.

6.2.1.6 Frequency Response, Bass Redirection

dScope Configuration:	Frequency Response Track 43-48.dsc
Track Number:	43-48
Corresponding AP Test File:	N/A
Duration:	60 sec (each track)
Test Signal Description:	-20dBFS sweep, 20Hz to 20kHz (Sub 20Hz to 120Hz)
Channels:	L (track 43), C (track 44), R (track 45), Ls (track 46), Rs (track 47), Sub (track 48)

Description

This test verifies frequency response, bass management and downmix levels for all downmix modes.

Test 1 assumes that all speakers are "small", so removes the low frequencies from the main channels, adds them to the signal from the Sub, and the Sub channel outputs the sum of these signals.

Test 2 applies bass redirection in the case that some of the main channel loudspeakers are "large" and capable of low frequency reproduction. In this case the low frequencies are filtered from the "small" speakers, summed together with the signal from the Sub, and reproduced by the "Large" speakers (usually left and right).

Note: Some DVD players implement a limited version of bass redirection called "Simplified bass redirection". In this case, high-pass filters are not applied to the front channels, so their response curves are flat and the bass from the front channels is not redirected to the subwoofer.

Method

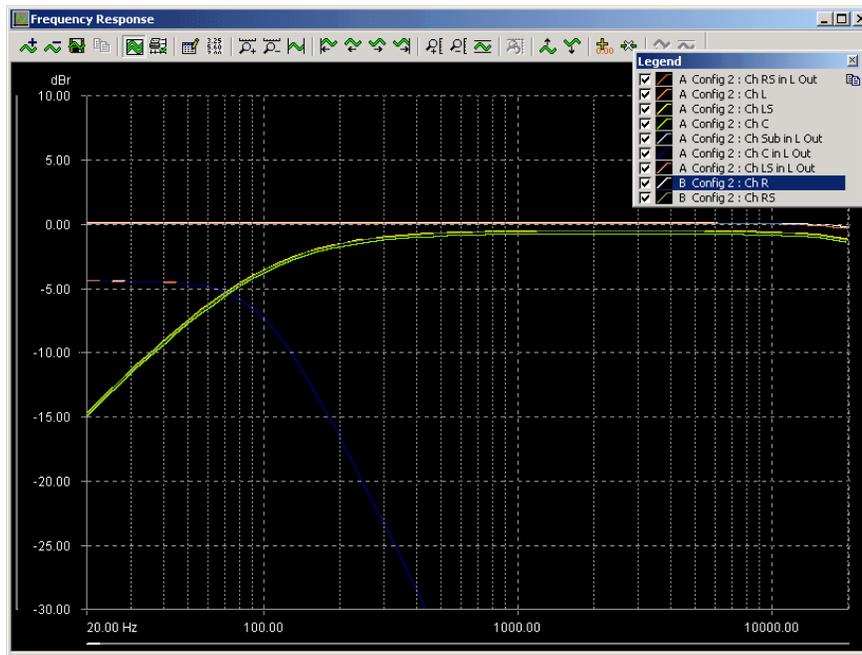
Turn the Subwoofer ON, and set speakers to "small" where possible.

This method uses a sensed sweep from 20Hz to 20kHz to plot frequency responses for each of the channels. For Test 1, the low frequencies are removed from the main channels and redirected to the

Sub:



For Test 2, the Left and Right outputs will show a flat frequency response with no redirected bass present at the Sub output.



Specification

For the first test, all the main channel signals should have very similar frequency response curves, rolling off at lower frequencies. The Sub signal redirected from the front speakers should be distinct and around 10dB higher than the other channels at low frequencies. If Simplified Bass Management is used, the Left and Right outputs will show a flat response and no bass will be redirected to the Sub.

For the second test, the Left and Right frequency responses should be flat. If Simplified Bass

Management is used, there will be no signal from the Sub present at the Left and Right outputs.

6.2.1.7 THD vs Frequency

dScope Configuration:	THD vs Frequency Track 43-47.dsc
Track Number:	43-47
Corresponding AP Test File:	5_thdfreq
Duration:	60 sec (each track)
Test Signal Description:	-20dBFS sweep, 20Hz to 20kHz
Channels:	L (track 43), C (track 44), R (track 45), Ls (track 46), Rs (track 47)

Description

This test produces a plot of the THD+N of the [EUT](#) against frequency, at 20dB below [full-scale amplitude](#).

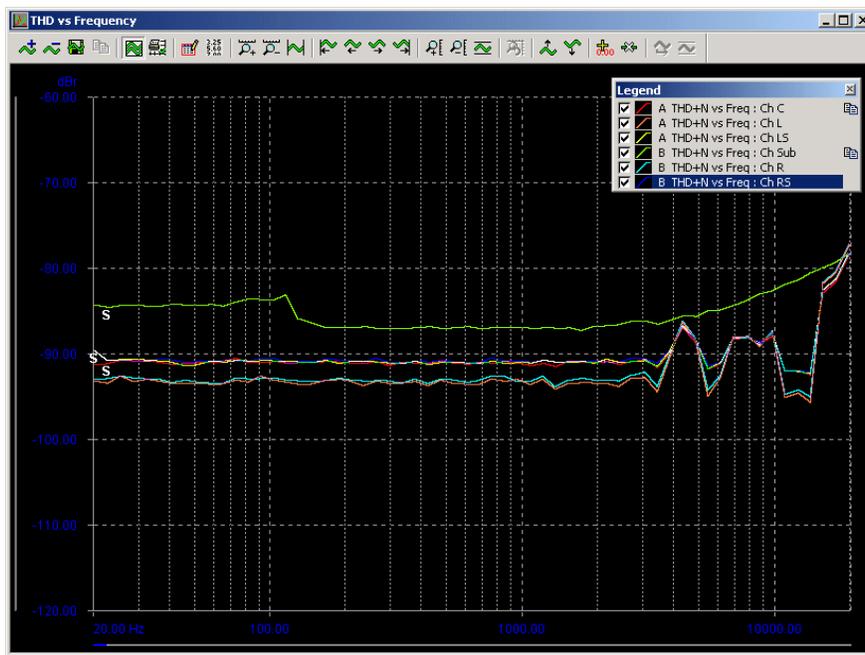
Method

If possible, set all speakers to "large".

The script will perform sweeps for each pair of channels in turn. For each test, you will be asked to play track

Click the [OK] button to start the test, and then play track 49.

The dScope senses the 60 logarithmically-spaced frequencies on the test track, measures the THD +N at each, and produces a plot of the results for both channels.



Specification

Across the frequency range, the THD+N for line outputs should be less than -60dBr and for headphone or speaker outputs, less than -57dBr . At higher frequencies, it is usual to see an increase in distortion.

6.2.1.8 THD vs Level

dScope Configuration:	THD vs Level Track 63.dsc
Track Number:	63
Corresponding AP Test File:	5_thdivl
Duration:	120 sec
Test Signal Description:	4kHz sweep, 0 to -120dBFS
Channels:	L, C, R, Ls, Rs

Description

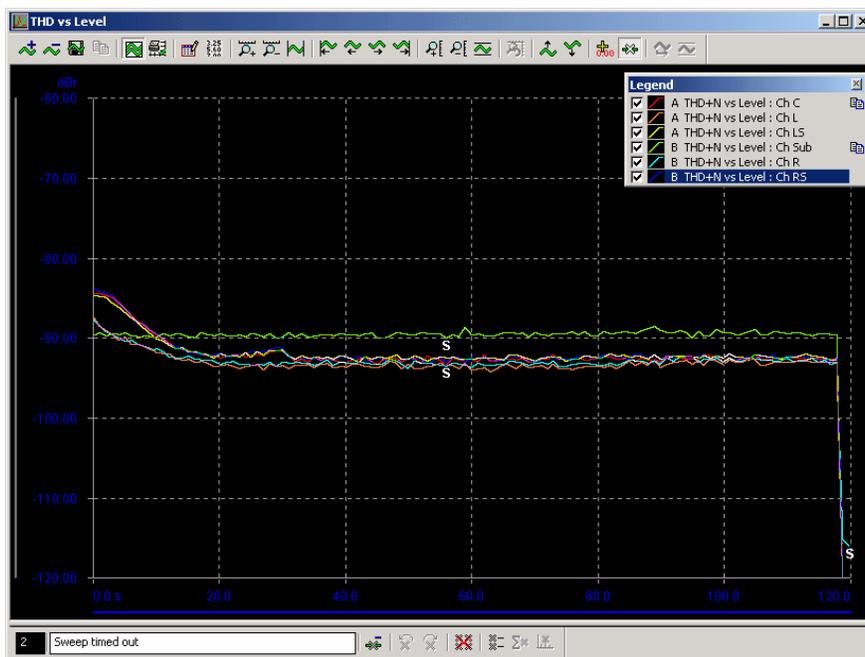
This test produces a plot of the THD+N of the [EUT](#) against level, from 0dBFS to -120dBFS , at 4kHz .

Method

If possible, set all speakers to "large".

Play track 63 and then immediately click the [OK] button to start the test.

The dScope plots THD+N against time for the each channel for the 120s of the test track; this corresponds to a sweep from 0dBFS to -120dBFS .



Specification

Across the amplitude range, the THD+N for line outputs should be less than -60dB and for headphone or speaker outputs, less than -57dB . Typically, the THD+N will decrease slightly for the first 10 or 20dB and then reach a low, constant level.

6.2.1.9 Signal-to-Noise

dScope Configuration:	Signal to Noise Ratio Track 35.dsc
Track Number:	35
Corresponding AP Test File:	5_dnr
Duration:	60 sec
Test Signal Description:	200Hz, -60dBFS
Channels:	L, C, R, Ls, Rs

Description

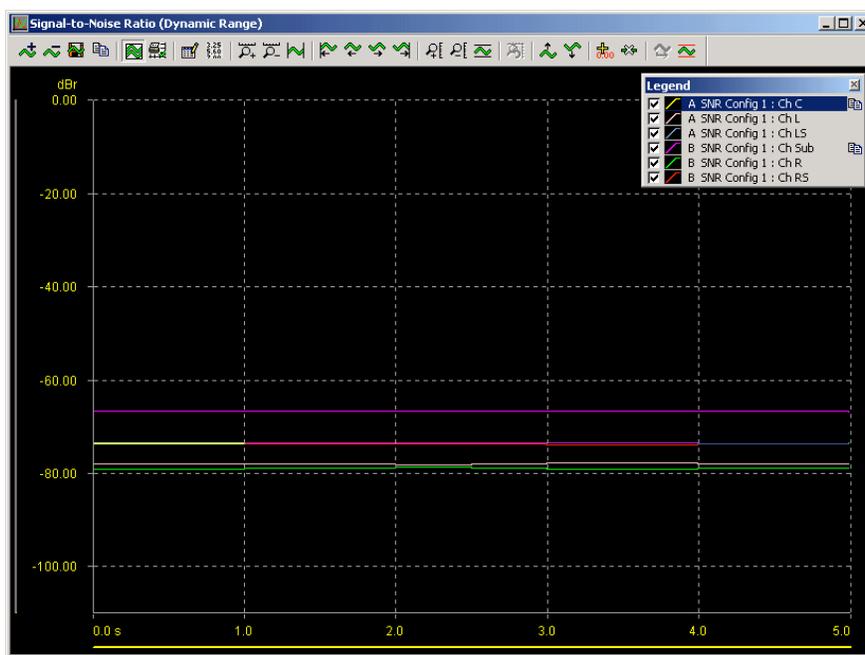
This test measures the noise floor of the [EUT](#) relative to a notional nominal -20dBFS signal amplitude. This is done in the presence of a small signal (200Hz at -60dBFS) so that the EUT cannot mute its D/A converter.

Method

Play track 35 and then click the [OK] button to start the test.

The dScope measures the residual amplitude of all channels, after a 200Hz notch filter, band-limited between 22Hz and 22kHz, and using a CCIR-2k weighting filter. Note that this test is performed as a sweep against track time (even though it could actually be a single spot measurement) for consistency with the Dolby test procedure.

The first part of the test measures the noise level for each channel with the Sub turned On and all speakers set to "small". The second part repeats the measurements with the Sub turned Off and the front speakers set to "large".



Specification

No specification is given.

6.2.1.10 Downmix

dScope Configuration:	Downmix Track 41-42.dsc
Track Number:	41-42
Corresponding AP Test File:	2_dwnmix
Duration:	30 sec (each track)
Test Signal Description:	400Hz; level and phase vary depending on the channel.
Channels:	L, C, R, Ls, Rs

Description

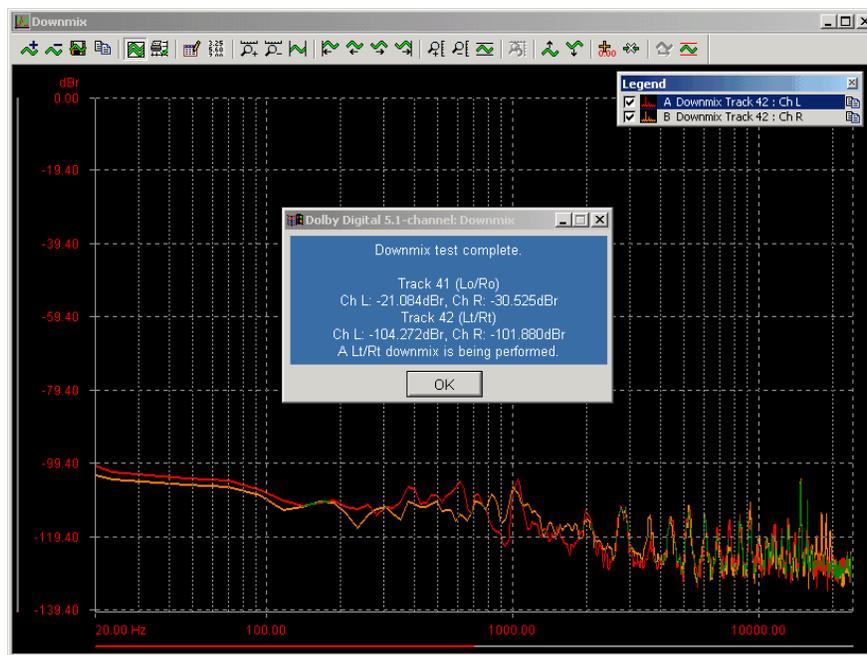
This test ensures that the [EUT](#) can properly downmix a 5.1-channel bitstream into 2-channel output.

All DVD players are required to implement an Lt/Rt downmix. A Lo/Ro downmix may be provided as a user-selectable option. An Lt/Rt downmix is essentially a surround compatible stereo output (track 42). An Lo/Ro downmix is for standard stereo output (track 41).

Method

Play track 41 and then click the [OK] button to start the test. When prompted, play track 42 and then click the [OK] button.

The Dolby Digital test tracks are such that when the correct downmix is performed, the signals in the L,R,C,Ls & Rs channels cancel producing very little output. The dScope measures the outputs of each channel using a 400Hz band-pass filter to eliminate the effects of noise.



Specification

Either track 41 or track 42 should result in complete cancellation of the signals. If this is the case, then Downmix has been implemented correctly.

6.2.1.11 Downmix Overload

dScope Configuration:	Downmix Overload Track 60.dsc
Track Number:	60
Corresponding AP Test File:	N/A
Duration:	30 sec
Test Signal Description:	2kHz; 0dBFS
Channels:	L, C, R, Ls, Rs

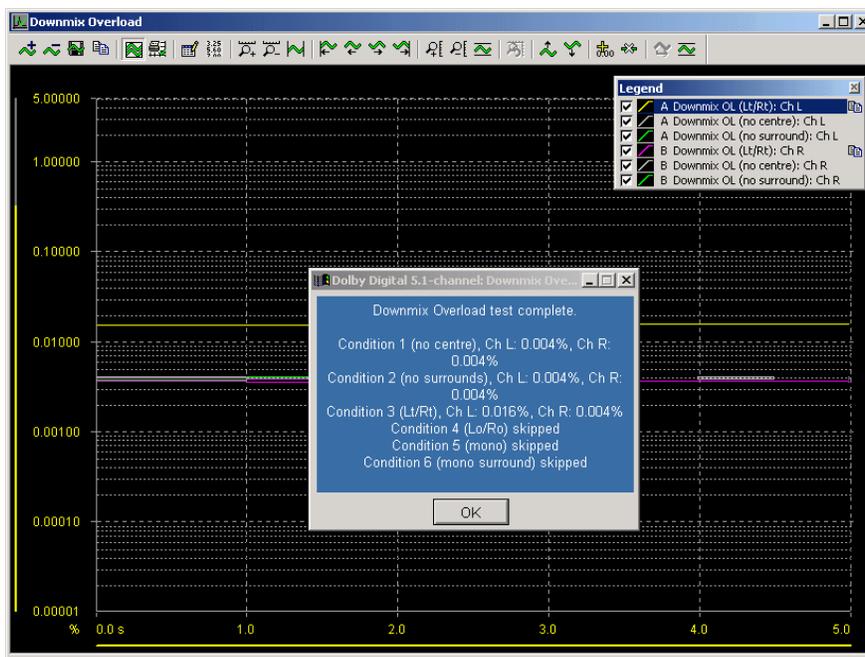
Description

This test ensures that channel levels are adjusted correctly during Downmix situations by checking for distorted output in the presence of a full-scale tone in all five channels.

Method

Play track 60 and then click the [OK] button to start the test. This test is repeated for the following settings of the DVD player, if applicable:

- No Centre channel
- No Surround channels
- Stereo Lt/Rt downmix
- Stereo Lo/Ro downmix
- Mono
- Mono Surround



Specification

The distortion should be less than 3% THD+N for all conditions measured.

6.2.1.12 Low Frequency Overload

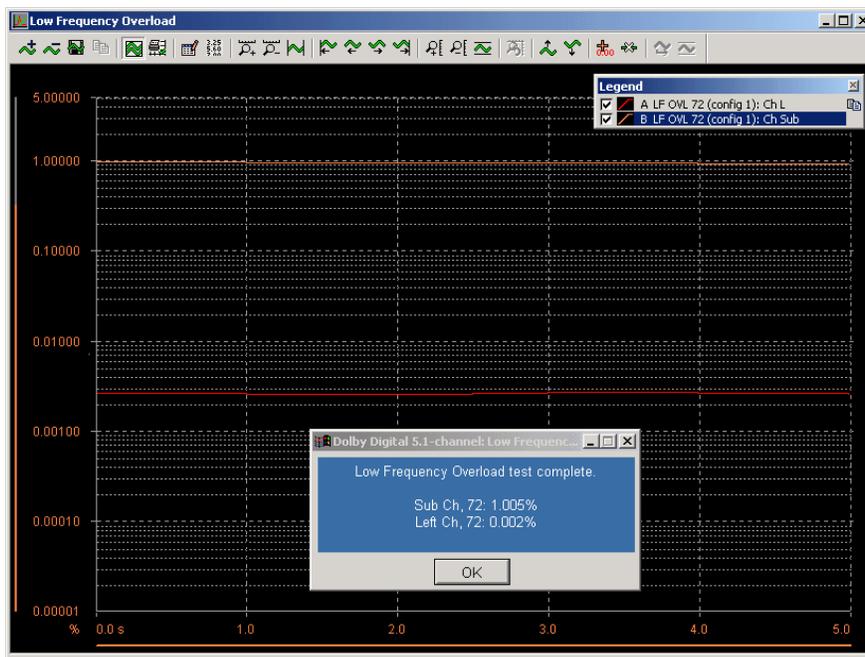
dScope Configuration:	Low Frequency Overload Track 70-73. dsc
Track Number:	70-73
Corresponding AP Test File:	N/A
Duration:	30 sec (each track)
Test Signal Description:	30Hz; 0dBFS (tracks 70, 71 & 72) 30Hz; -3dBFS (track 73)
Channels:	L, C, R, Ls, Rs

Description

This test ensures correct handling of bass redirection, which involves summation of signals.

Method

Four tracks containing 30Hz sweeps are played in order of descending overload probability. For each Sweep, the Sub is firstly measured with all other channels set to "small", and then the Left and Right channels are measured with bass redirection on (i.e. the Left and Right channels set to "large" with the Sub turned off).



If the Low Frequency Overload test passes on one of the tracks, subsequent testing is not necessary. The script will detect this and will only prompt for the next track if the previous track caused the overload test to fail.

Specification

The distortion should be less than 3% THD+N for the Sub and the Left channel.

6.2.1.13 Relative Phase (Polarity)

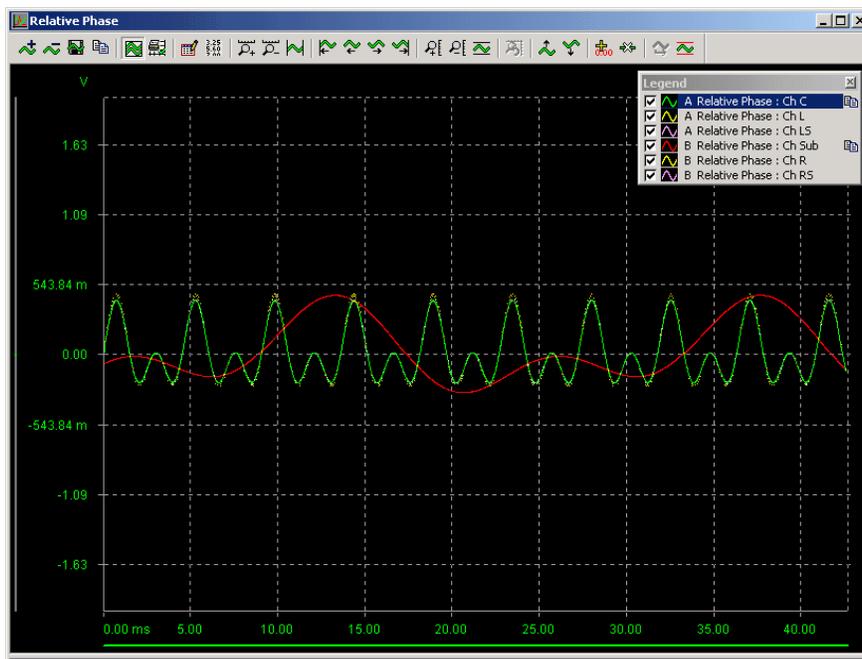
dScope Configuration:	Relative Phase Track 55-56.dsc
Track Number:	55-56
Corresponding AP Test File:	N/A
Duration:	60 sec (each track)
Test Signal Description:	Track 55: Asymmetrical 400Hz tone, -20dBFS; Track 56: 1ms positive pulse.
Channels:	Track 55: L, C, R, Ls, Rs, Sub Track 56: L, C, R, Ls, Rs

Description

This test confirms that relative phase is preserved at the line outputs of the DVD player. Track 55 is the best track for this test since it contains a signal in the Sub channel; track 56 can be used to check the results from track 55 if necessary.

Method

Set all speakers to "large" and play track 55. When the track has started, click [OK] to start the test.



Specification

The Trace window should show that the polarity of the signal is the same on all channels.

6.2.1.14 Level Trim Controls

dScope Configuration:	Level Trim Controls Track 30.dsc
Track Number:	30
Corresponding AP Test File:	N/A
Duration:	30 sec
Test Signal Description:	997Hz, -20dBFS
Channels:	L, C, R, Ls, Rs

Description

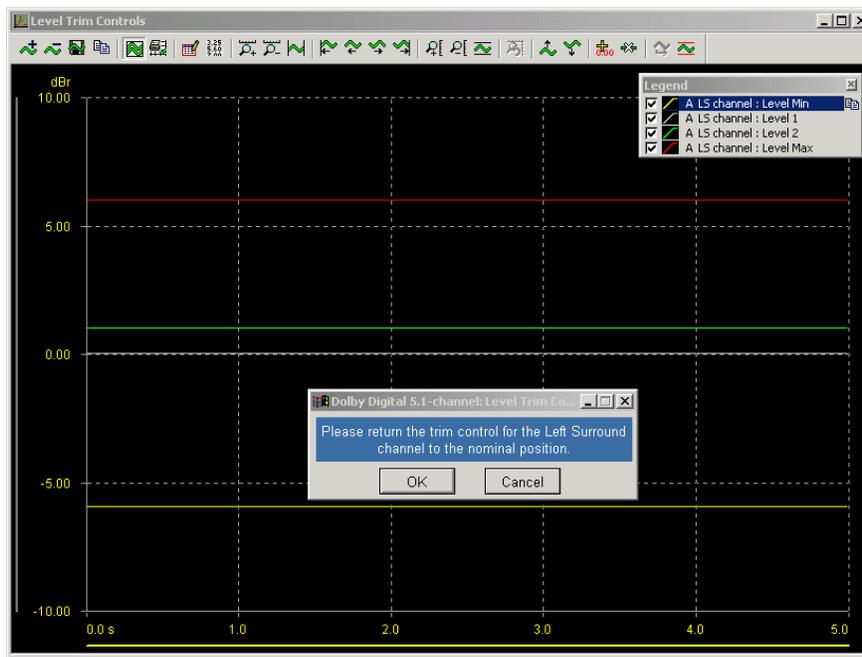
This test verifies the operation of level trim and/or balance controls, if provided.

Method

Set all level trim/balance controls to their nominal positions.

The script will go through each channel in turn, and ask whether the channel has trim/balance controls. If it has, then the test will be performed for the channel.

For each channel with level/trim controls, play track 30 and then click the [OK] button to start the test. The nominal level of the channel will be recorded and a Sweep performed. Increment the trim for the channel by one step, then restart track 30 and click [OK] again. The Sweep will be repeated at this new level. This process will be repeated again for the minimum and maximum level of the trim control.



Specification

Each trim control should have a range of at least 10dB and should be adjustable in steps of 1dB or smaller.

6.2.1.15 Dolby Digital Centre Channel Delay

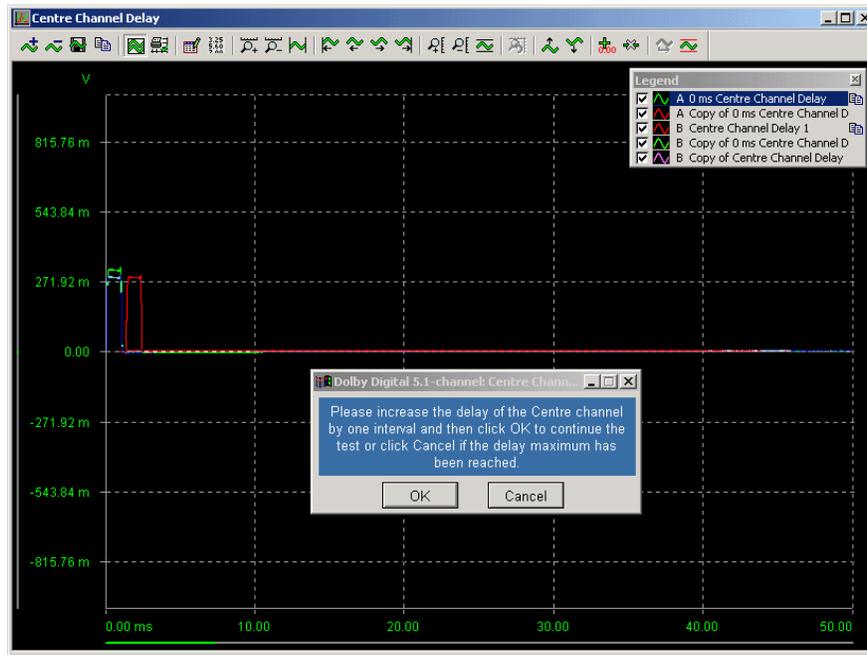
dScope Configuration:	Centre Channel Delay Track 56.dsc
Track Number:	56
Corresponding AP Test File:	N/A
Duration:	60 sec
Test Signal Description:	1ms, -20dBFS pulse with 40ms cycle.
Channels:	L, C, R, Ls, Rs, Sub

Description

This test measures the delay between the Left and Centre outputs. The Scope Trace is triggered from the left channel, and the Centre channel triggers at the same time, showing the delay on the Trace window.

Method

Play track 56, and as soon as the track has started, click [OK] to begin the test.



Specification

If the Centre channel delay is variable, it should range from 0 to 5ms and increment in steps of 1ms or less.

6.2.1.16 Dolby Digital Surround Channel Delay

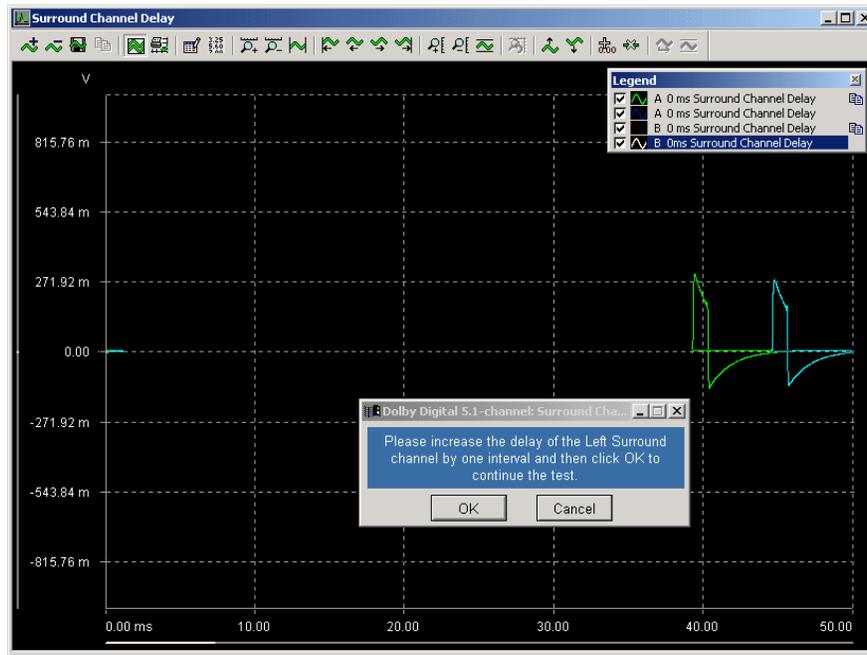
dScope Configuration:	Centre Channel Delay Track 56.dsc
Track Number:	56
Corresponding AP Test File:	N/A
Duration:	60 sec
Test Signal Description:	1ms, -20dBFS pulse with 40ms cycle.
Channels:	L, C, R, Ls, Rs, Sub

Description

This test measures the delay between the Left and Surround outputs. The Scope Trace is triggered from the left channel, and the Surround channel triggers at the same time, showing the delay on the Trace window.

Method

Play track 56, and as soon as the track has started, click [OK] to begin the test.



Specification

If the Surround channel delay is variable, it should range from 0 to 15ms and increment in steps of 5ms or less.

6.2.1.17 Noise Sequencer

dScope Configuration:	Noise Sequencer.dsc
Track Number:	N/A
Corresponding AP Test File:	N/A
Duration:	N/A
Test Signal Description:	Internal Noise Sequencer of the DVD Player
Channels:	L, C, R, Ls, Rs, Sub

Description

This test measures the level and performance of the noise sequencer of the DVD Player.

Method

Turn on all channels of the DVD player and the noise sequencer. Click [OK] to start the test.

Specification

The noise sequencer level should be -30dBFS at all outputs in Dolby Digital 5.1-channel mode and in Pro Logic mode with a cycle time of between one and two seconds.

6.2.2 Digital domain tests

The following digital domain tests are available. They are described in detail in the relevant section of the Dolby Digital 2-channel manual in the following sections:

[Eye Pattern](#)
[Jitter Spectrum](#)
[Category Code](#)
[Audio/Data Bit](#)

Setting up

The digital domain tests are measured at the digital outputs of the [EUT](#). Please make sure that the following connection has been made:

- Digital Output of the EUT to the dScope's Digital Input BNC, using the provided RCA/PHONO-BNC adapter.

6.3 Glossary

The following definitions are used in the Dolby Digital test procedure and in the dScope implementation of the Dolby Digital tests:

Channel Status - status information embedded in an AES3 or [S/PDIF](#) digital interface, one bit per channel per sample-period, which accumulate into a 192-bit frame for each channel every 192 sample-periods. The frame is arbitrarily split into many fields of various lengths, with diverse functions as described in the appropriate interface standard document. The definitions of the fields and their meanings are different for 'Consumer' Channel Status (where the first bit of the frame is 0, used in S/PDIF) and 'Professional' Channel Status (where the first bit is 1, used in AES3).

D/A line-up - A setting of the dScope's Inputs and Outputs which relates the maximum analogue amplitude to the maximum digital amplitude. It is expressed as an analogue amplitude which corresponds to 0dBFS (full-scale digital). This feature of the dScope is especially useful in measuring [EUTs](#) with both analogue and digital ports since it allows settings or measurements in one domain to be expressed in the units of the other. For example, an A/D converter can be stimulated with a signal 1dB below that which will produce full-scale output by setting the dScope's analogue generator amplitude to -1dBFS, provided that the dScope has been set to the appropriate D/A line-up for the converter.

Data jitter - A type of interface jitter. Data jitter is that part of the interface jitter which is caused by variations in the duty cycle of the AES3 or [IEC60958](#) carrier acting with high-frequency losses in the transmission medium (e.g. cable capacitance) such that edge timing in the carrier is modulated by the activity of the data bits. This is distinct from fs jitter, which is inherent in the carrier source. dScope can measure data jitter and fs jitter independently, so that the cause of jitter problems can be identified. Also referred to as 'inter-symbol interference'.

dS-NET - A proprietary serial interface used to connect peripherals such as I/O Switchers to the dScope.

dBFS - A logarithmic unit used to express signal amplitude in digital and mixed-domain systems in terms of the maximum amplitude which can be accommodated by an [EUT](#). A 0dBFS signal has the same RMS amplitude as a sine whose peaks just touch the maximum level of the system. A -6dBFS signal has half this amplitude, for example. Note that for non-sine signals such as square waves or DC it is possible for the system to accommodate amplitudes greater than 0dBFS. In the dScope it is possible to specify or measure analogue signal amplitudes in dBFS, in which case the [D/A line-up](#) is used as a reference.

EUT - 'Equipment under test'.

Eye-diagram - The AES3 and IEC60958 standards define acceptable carrier degradation in terms of amplitude and edge-timing using an eye-diagram, which shows the minimum acceptable differential carrier amplitude over a defined period within 1 UI of the carrier. This can be verified on the dScope using the Carrier Display feature.

Eye-narrowing - The dScope can measure the worst-case narrowing of the eye of an AES3 or IEC60958 carrier. This is essentially a measurement of data jitter, and can be referred to the [eye-diagram](#) in the AES3 or IEC60958 standards.

Folding frequency - Half the sample rate of the [EUT](#). Input frequencies above the folding frequency are subject to aliasing. Where an EUT applies internal down-sampling, the folding frequency is half of the lowest internal sample rate employed.

fs - Abbreviation for sample rate.

FS - [Full-scale amplitude](#).

Full-scale amplitude - A signal whose amplitude is the maximum which can be accommodated by the [EUT](#). In the case of a sine, this amplitude is [0dBFS](#).

IEC60958 - A two-channel digital audio interface standard, as provided at the dScope's Digital Output and Input. Also known as S/PDIF this format is used in consumer applications usually with an unbalanced phono/RCA copper or TOSLINK optical connection. It carries audio wordlengths up to 24 bits, plus Valid bit, User bit, [Channel Status](#) and Parity bit per channel.

IMD - Intermodulation Distortion. When a signal consists of more than one frequency, a non-linear device under test will produce the original frequencies plus an infinite number of IMD products, given by

$$(a * F1) + (b * F2) + (c * F3) + \dots$$

where (a, b, c) etc. are all possible integer numbers, and (F1, F2, F3) etc. are the frequencies of the original tones.

Jitter - Variation in edge-timing of a clock. In audio systems, manifestations are interface jitter and sampling jitter.

S/PDIF - [IEC60958](#).

UI - (Unit Interval). A UI of an AES3 or [IEC60958](#) carrier is 1/128 of the frame period, the duration of a single biphasic-mark 'cell', or half a bit period.

Part



Encoded Stream Generation

7 Encoded Stream Generation

NB: These tests can only be performed with a dScope model number that supports digital I/O.

The dScope can perform testing of surround-sound decoders using pre-encoded files, and an intuitive selection interface. Two sets of files are currently available - one for testing of [Dolby Digital](#) decoders, the other for [DTS](#).

The encoded files, together with scripts for ease of file selection, are provided on the dScope installation CD in a folder called **Encoded Stream Generation**. If you have installed the dScope as a download from the Prism Sound web site then you will need to download the surround sound decoder test files installation from the [Support downloads](#) section of the web site.

You will need to run the setup.exe file, which will install all the files and scripts into the relevant subfolders of the dScope program folder. For further details of the files installed, see [Installation files](#).

7.1 Overview

This document describes the provision made by the dScope software for testing of surround sound decoders.

How it works

In its current form, the dScope simply allows selection of a number of pre-defined test streams, encoded using the [Dolby Digital](#) or [DTS](#) encoding process. These tones can be loaded into the dScope's Signal Generator, and played into the inputs of a surround sound decoder. The outputs of the decoder can then be routed back to the dScope's inputs for audio analysis.

NB: These test streams are not intended to provide a complete solution for conformance testing, but are targeted towards development and production testing to allow quick and easy selection of test tracks without the extra expense of a test DVD or external encoding hardware. Due to the nature of the encoding process, it has only been possible to provide test tones that repeat over a limited number of samples. For this reason, the signals supplied do not allow testing where a swept signal is required, since sweeps require changes of signal throughout the encoded stream.

A number of test streams have been provided for each encoding process, together with scripts that allow files to be selected according to user-selectable criteria. For example, it is easy to search for files that contain a particular signal in the Left channel, or that are encoded for a certain set of channels (e.g. 2.0, 3/2/1, etc).

To use this feature, you will need to install the encoded files and relevant scripts; for further details, see [Installation files](#), below.

Setting up the EUT

Connect the Digital Outputs of the dScope to the EUT, using XLR cables for an AES3 input, or coaxial cables for a S/PDIF input. Then connect the relevant pair of output channels (e.g. Left/Right, Left Surround/Right Surround) of the EUT to the dScope's Analogue Inputs.

These tests can also be performed in conjunction with a dS-NET I/O Switcher. The I/O Switcher is a 16-into-2 relay switcher, which can be used for switching either analogue or digital (AES3) audio signals. The switcher can speed up testing by switching each of the output channels of the multi-channel EUT output in turn into the dScope's Analogue Inputs, thus eliminating the need for repeated

plugging and unplugging of cables. The relevant channels can be selected in the dScope software using the dScope's I/O Switcher control panel or Channel Array Control Panel. See I/O Switchers in the dS-NET Peripherals manual for further details.

Loading files into the dScope's Signal Generator

Any of the individual encoded .WAV files can be loaded directly into the dScope's Signal Generator by selecting "User waveform" as the function. However, since the file names are not obvious, the easiest way to access the files is via the selection scripts provided. Two scripts are provided; one for Dolby Digital files ("DD files interface.dss" and the other for DTS files ("DTS files interface.dss"). These can be run directly using the Run Script command on the dScope's Automation menu, or alternatively by selecting the [Applications] button from the User bar (if the default User bar is in use).



The buttons on the Applications menu for selection of encoded transport streams will only appear if the files have been correctly installed, and the relevant file selection scripts are present in the dScope's "Scripts\Automation" subfolder.

Channel Status

Note that when a Dolby Digital or DTS encoded stream is loaded into the dScope's Signal Generator, the dScope does not change any of the other settings of the Digital Outputs (except to turn off dither at the Digital Outputs). You may need to change other settings, for example the output Channel Status, to allow the decoder to correctly recognise the transport stream. For further details of the relevant Channel Status, refer to the IEC 61937 document *Digital audio - Interface for non-linear PCM encoded audio bitstreams applying IEC 60958*.

Dolby / DTS accreditation

This document does NOT describe any requirements that must be met in order to achieve accreditation from Dolby Laboratories or Digital Theatre Systems. Please refer to the relevant documentation for full details.

Installation files

The following sets of files will be installed (note: all folders are relative to the dScope program folder):

Folder	File name(s)	Details
.\User wavetables\ DD encoded files	*.wav	Dolby Digital encoded audio files.
	*.xml	Index files for the encoded audio files; each index file matches a single audio file and contains details of the encoding parameters. NB: "0000.xml" does not match a specific audio file, but contains details of the default encoding parameters; all other index files contain details of any differences to the parameters in this file.
	interface.ini	Single file created from the index files, containing details of the drop-lists to include on the file selection interface.
	index.xml	Single index file created from other index files (for faster searching).
.\User wavetables\ DTS encoded files	*.wav	DTS encoded audio files.
	*.xml	Index files for the encoded audio files; each index file matches a single audio file and contains details of the encoding parameters. NB: "0000.xml" does not match a specific audio file, but contains details of the default encoding parameters; all other index files contain details of any differences to the parameters in this file.
	interface.ini	Single file created from the index files, containing details of the drop-lists to include on the file selection interface.
	index.xml	Single index file created from other index files (for faster searching).
.\Scripts \Automation	DD Files	File selection script for Dolby Digital encoded files
	DTS Files	File selection script for DTS encoded files
	Interface.dss	

7.2 Glossary

Dolby Digital - An encoding system that digitally compresses multiple discrete channels of audio (e.g. left front, center, right front, left surround, right surround, and LFE) into a single bitstream.

DTS - Digital Theater Systems surround is an audio encoding format similar to Dolby Digital, digitally compressing multiple discrete channels of audio into a single bitstream.

LFE - Low Frequency Effects. The .1 channel of a Dolby Digital or DTS soundtrack. The LFE is strictly low-frequency information (20 to 120 Hz, with 115 dB of dynamic range) that's added to the soundtrack for extra effect. This track does not inherently contain all the bass of the soundtrack.

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