Dream Series

AD-2

Dual-rate A/D converter

with
Super Noise Shaping

and synchronous
Sample-Rate Conversion (SRC)

Operation Manual

Issue 0.2 11 August 1998

CONTENTS

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Prism Media Products Limited
William James House
Cowley Road
Cambridge
CB4 0WX
UK
Phone: +44-(0)1223-424988
Fax: +44-(0)1223-425023
Email : tech.support@prismsound.com
Web: http:\\www.prismsound.com

1. INTRODUCTION

To get started immediately, please turn to page 6.

The AD-2 Dual-rate A/D converter is intended for professional audio use in applications where a very high level of performance is required. The high performance of the AD-2 was a key design objective and care should be taken when making comparisons to check that consistent measurement units and methods are employed. In this manual, all specifications and measurement results are obtained using the methods of AES17 unless otherwise stated.

The AD-2 can perform a number of tasks:

- analogue to digital conversion, available on two separate outputs which may operate at different sampling rates and wordlengths and on a variety of output formats
- digital sampling rate conversion such as from 96kHz to 44.1kHz
- digital format conversion
  - between various I/O formats such as AES3/SDIF-2 et. al.
  - between “one-wire” and “two-wire” formats for high sampling rates
- digital processing such as wordlength reduction & noise shaping (e.g. for 16-bit CD)
- synchronization of disparate formats such as locking a 96kHz audio recording chain to a 48kHz or 44.1kHz wordclock

1.1. Notational conventions

In this manual the following notational conventions are used for clarity:

Push-buttons in the Edit and Menu boxes are referred to as ‘keys’. Push-buttons in the Configuration/Stores box are referred to as ‘buttons’.

When a Menu Controls key is referred to by name, the name is enclosed in square brackets thus : **[Enter]**.

When a Store Controls button is referred to by name, the name is enclosed in angle brackets thus: **<A-D Modes>**.

When text is quoted from the 2x16 character LCD display the text will be printed in a special font thus : `Level: dBFS`.

When an LED from the System State Indicators is referred to by name, the name will be enclosed in double quotes thus : “24bit”.

1.2. Terminology for high-sampling rate interfaces

A variety of terms are in use regarding high sampling-rate interfaces. For more information about these interfaces see sections 6.2 and 6.3.

1.2.1. Split96 or 2-wire AES3 interfaces

For recording applications requiring 96 or 88.2kHz sampling a solution is to use two channels of a 44.1/48 kHz device for each audio channel at the higher rate.

It is possible to use a machine such as a TASCAM DA-88 with a suitable AES3 interface adaptor (such as the Prism Sound MR-2024T) to record stereo 88.2 or 96 kHz audio. Using the MR-2024T, this can be done with up to 24-bit precision.

This method of interfacing between equipment is referred to variously as ‘Two-wire’ or ‘Split 96kHz’. Using this method, recordings can be made at sample-rates of 88.2 and 96.0kHz.

These recordings cannot be replayed or copied without a suitable D/A converter or format converter and sample-rate converter (for 44.1k/48k CD and DAT).

In the AD-2 menu system, references to this mode of operation are made using the term ‘Split96'; in the Factory Presets the term ‘2wr’ (two-wire) is also used.

1.2.2. Double speed AES3, or 1-wire interfaces

Some manufacturers have implemented high sample-rate interfaces by operating an AES3 interface at twice the normal speed. Equipment with only this type of interface cannot be directly connected to equipment only supporting 2-wire or Split96 operation.

This is often referred to as ‘Double-speed’ or ‘One-wire’ AES.

In addition to high-sample-rate A/D conversion, the AD-2 can provide all the necessary format and sample-rate conversion for monitoring using 44.1k/48k equipment.

The AD-2 supports both 1-wire and 2-wire formats for 88.2 and 96.0kHz operation for digital input and output.

The Prism Sound DA-2 provides D/A conversion at sampling rates from 32kHz to 96kHz and will deal with 2-wire or 1-wire high-sample-rate interfaces in addition to the normal AES3/IEC958 and SDIF-2 interface formats.

2. GETTING STARTED

2.1. Unpacking your AD-2 Dual-rate A/D converter

Check that you have the correct power lead with your AD-2 and that they and the packaging are undamaged. Check that your unit is set for operation at the mains voltage appropriate for your area. See section 7.7 for more details.

**** WARNING **** *If the unit has been transported or stored at a low temperature and is unpacked in a warmer environment there is a danger of condensation. This could cause the AD-2 to malfunction, so to avoid problems, allow the unit to warm up to room temperature for at least 1 hour before use.*

Please keep the packaging for re-use.

2.2. Using the AD-2 for the first time

Be ready to check the firmware revision number when the unit is powered on for the first time. Following switch on, this is briefly displayed as follows:

```
Prism Sound
Dream AD-2 V1.0x     ; The 'x' means that this digit may be any number.
```

If a different version is indicated, contact Prism Sound or your local supplier.
The AD-2 will perform brief initialization, in which all the LEDs are turned on momentarily *(this allows a quick visual check of the LEDs)*. The unit will settle with the following text at the start of the first line of the LCD display:

```
Level : dBFS
```

On leaving the factory, the settings of the AD-2 will be those of A-D mode Factory Preset #1, which are as follows:

- A-D mode
- Main output at 96kHz sampling in 2-wire (Split96) format using both XLR outputs; Main also on the BNC connectors in Split96.
- Aux output on TOSlink optical and RCA Phono outputs, set to 96kHz sampling, 24-bit.
- External Wordclock reference enabled (defaults to internal if none).
- Analogue input amplitude for full digital code (0dBFS) set at +18dBu. This is consistent with line-up at +4dBu/0VU with 14dB headroom.

If these settings are not suitable, either use the Set-up Wizard or check the table of presets in sections 2.3 and 2.4 and select one using the method described on page 11.

AD-2 front panel layout

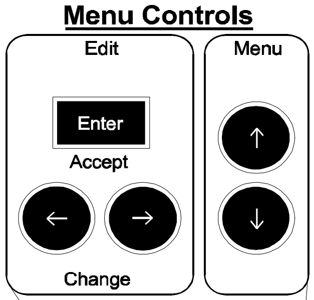
The AD-2 front panel controls and indicators are organised in 4 groups: System state indicators; Meter; Menu controls and Store Controls.

Operation

The quickest way to change the AD-2 configuration is by recalling one of the stores.

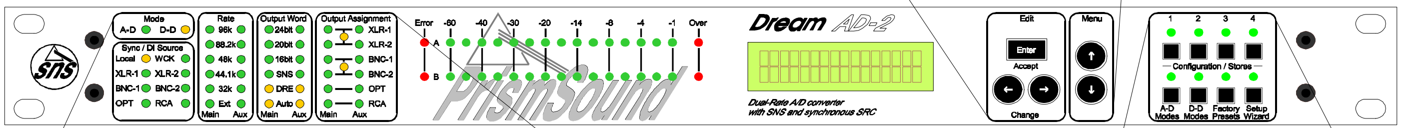
Alternatively, use the SETUP WIZARD feature (in the Store Controls group) to create simple A-D configurations. The SETUP WIZARD helps you through a procedure to set the most important parameters.

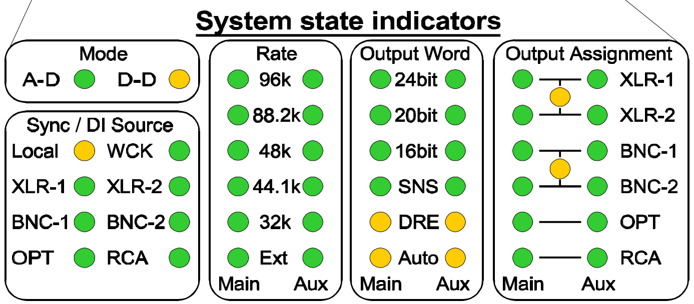
After customizing the AD-2 settings it is advisable to save them to one of the user stores.



All AD-2 parameters can be set individually using the menu system. Use the "Menu" arrow keys to scroll through them and the "Edit" keys to change the settings.

After choosing the store that does what you need you can fine-tune settings using the menu controls.





The System state indicators show a combination of the currently selected settings and some information about operating conditions - such as an unlocked digital input.

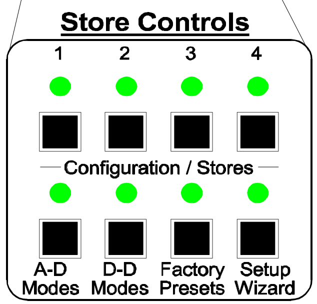
Preview a store's text description by selecting "A-D" (or D-D) and "Factory" (otherwise user-programmable) and then pressing one of the four store buttons.

A description is shown but the store is not loaded until "Enter" is pressed.

Save your settings by first selecting the correct bank (A-D or D-D) and store ("Factory" must not be selected).

If the store is NOT empty, you will need to press -> to switch from 'load' to 'save'.

Press "Enter". The store name will be displayed. Press "Enter" again to accept and "Enter" again to confirm.



Stores:
A-D Factory presets x 4
A-D User Stores x 4
D-D Factory presets x 4
D-D User stores x 4

2.3. A-D mode Factory Presets

A-D MODES						
Store	Store number		1	2	3	4
	Text desc'n		A-D:96k,24b 2XLR	A-D:96k,24b 1XLR	A-D:44k1,24b&16b	A-D:96/24, 44/16
Sync/ DI	Sync source		WCK or INT*	WCK or INT*	WCK or INT*	WCK or INT*
	Sync/DI port		WCK BNC	WCK BNC	WCK BNC	WCK BNC
	DRE decode		OFF**	OFF**	OFF**	OFF**
Line-up	I/P for 0dBFS		+18dBu***	+18dBu***	+18dBu***	+18dBu***
	Left ch. trim		0dB***	0dB***	0dB***	0dB***
	Right ch. trim		0dB***	0dB***	0dB***	0dB***
Main O/P	Sample Rate		96.0 kHz	96.0 kHz	44.1 kHz	96.0 kHz
	Wordlength / DRE encode		24-bit Linear**	24-bit Linear**	24-bit Linear**	24-bit Linear**
	Ports	XLR1	**U**Split96 (2-wire) LEFT CH.	**U** at 2x speed (1-wire)	**U** AES3 @44.1k	**U**Split96 (2-wire) LEFT CH.
		XLR2	**U**Split96 (2-wire) RIGHT CH.	**U** at 2x speed (1-wire)	**U** AES3 @44.1k	**U**Split96 (2-wire) RIGHT CH.
		BNC1	**U**Split96 (2-wire) LEFT CH.	**U** at 2x speed (1-wire)		
		BNC2	**U**Split96 (2-wire) RIGHT CH.	**U** at 2x speed (1-wire)		
		Opt.		In the Factory Presets, these output ports are used for the Aux Output		
		RCA				
Aux O/P	Sample Rate		(Follows Main)	(Follows Main)	(Follows Main)	Set to 44.1 kHz
	Wordlength / DRE encode		24-bit Linear**	24-bit Linear	16-bit with SNS Noise-Shaping (Curve 2)	16-bit with SNS Noise-Shaping (Curve 2)
	Ports	XLR1		In the Factory Presets, these output ports are used for the Main Output		
		XLR2				
		BNC1			**U**SDIF-2 LEFT CH.	**U**SDIF-2 LEFT CH.
		BNC2			**U**SDIF-2 RIGHT CH.	**U**SDIF-2 RIGHT CH.
		Opt.	**U** at 2x speed	**U** at 2x speed	**U** IEC958/SPDIF	**U** IEC958/SPDIF
		RCA	**U** at 2x speed	**U** at 2x speed	**U** IEC958/SPDIF	**U** IEC958/SPDIF

* WCK may be any standard rate (32, 44.1, 48, 88.2 or 96kHz). If none is present, the AD-2 defaults to Internal sync.

** DRE modes are not included in the Factory Presets. See sections 3.8 and 4.6.

*** The default line-up setting is digital full code (0dBFS) at +18dBu with no fine trim. Setting of line-up by stores is possible, but is initially disabled (preferences menu) see section 4.6.

2.4. D-D mode Factory Presets

D-D MODES						
Store	Store number		1	2	3	4
	Text desc'n		SRC:AES644,24&16	SRC:2wr644,24&16	SNS2:AES616b,AES	SNS2:2wr616b,AES
Sync/ DI	Sync source		DI*	DI*	DI*	DI*
	Sync/DI port		AES/XLR1 32, (44.1), 48, 88.2, 96kHz	2-wire/XLR1&2 88.2, 96kHz	AES/XLR1 32-96kHz	2-wire/XLR1&2 88.2, 96kHz
	DRE decode		OFF**	OFF**	OFF**	OFF**
Main O/P	Sample Rate		44.1 kHz	44.1 kHz	As Input (32-96kHz)	88.2 or 96.0 kHz (as input)
	Wordlength / DRE encode*		24-bit Linear	24-bit Linear	16-bit with SNS Noise-Shaping (Curve 2 or 2/96)	16-bit with SNS Noise-Shaping (Curve 2 or 2/96)
	Ports	XLR1	**U** AES3	**U** AES3	**U** AES3	**U**AES3(1-wire)
		XLR2	**U** AES3	**U** AES3	**U** AES3	**U**AES3 (1-wire)
		BNC1				
		BNC2		In the Factory Presets, these output ports are used for Aux. Output.		
		Opt.				
		RCA				
Aux O/P	Sample Rate		Follows Main (44.1 kHz)	Follows Main (44.1 kHz)	Follows Main (32-96kHz)	Follows Main (88.2/96kHz)
	Wordlength / DRE encode*		16-bit with SNS Noise-Shaping (Curve 2)	16-bit with SNS Noise-Shaping (Curve 2)	16-bit with SNS Noise-Shaping (Curve 2)	16-bit with SNS Noise-Shaping (Curve 2)
	Ports	XLR1		In the Factory Presets, these output ports are used for Main Output		
		XLR2				
		BNC1	**U**SDIF-2 LEFT CH.	**U**SDIF-2 LEFT CH.	**U**SDIF-2 LEFT CH.	**U**SDIF-2 LEFT CH.
		BNC2	**U**SDIF-2 RIGHT CH.	**U**SDIF-2 RIGHT CH.	**U**SDIF-2 RIGHT CH.	**U**SDIF-2 RIGHT CH.
		Opt.	**U**IEC958/SPDIF	**U**IEC958/SPDIF	**U**IEC958/SPDIF	**U** IEC958/SPDIF 2x speed/1wire
		RCA	**U**IEC958/SPDIF	**U**IEC958/SPDIF	**U** IEC958/SPDIF	**U** IEC958/SPDIF 2x speed/1wire

* If no DI is present, the AD-2 defaults to Internal sync.

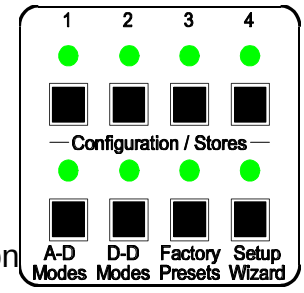
** DRE modes are not included in the Factory Presets.See sections 3.8 and 4.6.

2.5. Selecting one of the Factory Preset configurations

If the configuration at power-up is not suitable for your application, you may find that another Factory Preset will be satisfactory.

2.5.1. Preview and select a Factory Preset

To view the text descriptions of the Factory Preset configurations:



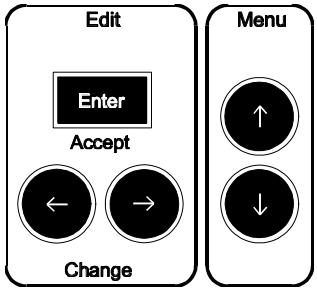
Step 1 Select **<A-D Modes>** or **<D-D Modes>**

Step 2 Select **<Factory Presets>**

Step 3 Select each preset **<1>** to **<4>**

Check the description in the display. The LED above each button will flash while in preview mode.

Repeat step 3 until you have chosen the store that seems most suitable.



Pressing the store button a second time will return the AD-2 unchanged to the normal operating state; alternatively this control will time out and the unit will revert to normal automatically after about 30 seconds without changing any settings.

Step 4 To recall the store press **[Enter]**.

If, having tried all of the stores, none is suitable you may either use the menu system (see section 4.6) to create a fully-customized configuration, or for simple A-D modes you may use the 'Setup Wizard' (see section 4.3).

2.6. Check the analogue line-up (headroom)

Connect a source of analogue audio to the inputs at the rear of the unit. Ensure that the source is playing audio and check the meters on the front of the AD-2. A useful check is to send a 0VU line-up tone. If all is well, this should illuminate the AD-2 meters up to the -14dB division (in practice the LED at -14 may be on **OR** off for nearly exact 0VU line-up with +18dBu headroom).

2.6.1. Adjust the maximum analogue input level (line-up)

Step 1 repeatedly press the **[9]** button in the Menu panel until `A-D Mode Setup` is displayed in the top line of the display

Step 2 press “Enter”

Step 3 Use the**[6]** and **[7]** buttons to set the desired maximum input level. It is not necessary to manually return to the normal operating display as the AD-2 will time out automatically, but this can be done manually by repeatedly pressing **[8]**. For more information about this adjustment, refer to section 4.6.

NOTES :
Take care to check that the source is at the correct level before adjusting the AD-2 maximum input level.

The maximum analogue input level setting is included in stored configurations and can therefore be changed by selecting another store. However, this can be disabled in the ‘Preferences’ menu and the disabled state is the default on leaving the factory.

Connect one of the AD-2 outputs to a **suitable** digital recorder or D/A converter.

The Prism Sound DA-2 D/A converter is highly recommended as a companion for the AD-2. Select monitoring of the AD-2 output on the recorder or D/A converter.

Ensure that if 24-bit output is used from the AD-2 that the recorder and/or D/A converter is capable of handling 24 bits.

Monitor the recorder or D/A output and check that the source is properly reproduced. You may now proceed with recording.

2.7. Synchronization

The synchronization settings for the A-D Factory Presets are all similar. An external wordclock is specified on the BNC WCK input connector. A wordclock signal may be provided at any of the standard rates and the AD-2 will lock to it even though its outputs may be running at a different, fixed sample rate. *For more information about synchronization of the AD-2, see section 5.*

If a sync source is not connected, the AD-2 will by default operate from its internal precision clock reference.

2.8. Introduction to the Setup Wizard

The Setup Wizard helps you create custom A-D configurations. It provides choices of sample rate, wordlength, synchronization, maximum input level and digital interface format.

The Setup Wizard will allocate Main Output to all output connectors.

To use the Setup Wizard, press the **<Setup Wizard>** button on the far right of the AD-2 front panel and follow the prompts in the LCD display. The first prompt will be:

```
* Setup Wizard *
Enter to start.
```

Press **[Enter]**, and the following will be displayed:

```
To configure a
basic A-D mode..
```

Press **[Enter]** to continue, then you will see:

```
Use Internal
  Ref Sync?
```

At this point, you may confirm the internal sync selection or change it using the **[7]** and **[6]** (Edit/Change) keys. Repeated use of either key will cycle through the list of alternative selections.

When the desired selection is displayed, confirm it using the **[Enter]**/Accept key.

Continue with the process of selecting settings until you see:

```
Setup Wizard is
now finished...
```

Press **[Enter]** and you will see:

```
You can save
this setup...
```

Press **[Enter]** and you will see:

```
Empty stores ->
are flashing...
```

At this point, if you have not already saved any configurations to user stores, all of the store LEDs above buttons **<1>** to **<4>** will be flashing.

If you do not wish to store your setup, simply press **[Enter]**, ignore the prompt to select a store and press **[Enter]** again. You will see:

```
Setup not
  Saved
```

Then press **[Enter]** to finish.

If you wish to store your custom setup, press one of the 4 store buttons; you can overwrite an existing store if you wish - in this case you could select one that was not flashing.

You will then see:

```
Setup saved as
xxxxxxxxx by Wzd
```

Press **[Enter]** to finish and return to the normal level display.

You may then wish to modify the setup such as to set an alternative function and output connector for the Auxiliary output.

Do this by using the **[9]** and **[Enter]** keys to select the relevant menu or sub-menu; edit/change the parameter with the **[7]** and **[6]** keys and confirm the new selection with **[Enter]**.

For more details see section 4.6.

3. FREQUENTLY-ASKED QUESTIONS (FAQs)

This section provides several ‘how to ....’ answers in response to a range of frequently-asked questions.

3.1. What do the flashing ! ! ! Characters mean in the display?

These indicate a warning condition and further explanation can be seen by pressing **[6]**.

A common display is

```
Warnings: [Lvl]
*Bad External DI
```

This means that a Digital Input (DI) signal is expected but not present or is incorrect..

In the default state of the AD-2, if an external Wordclock is not connected, this warning is shown accompanied by a solid ON “Local” LED and a flashing “WCK” LED.

If this display appears at other times, use the **[6]** key to investigate. See Section 4.6.

3.2. Can I assign the Aux output to one of the XLR connectors?

Yes, but take care not to confuse the functions of XLR 1 & 2 if you assign them separately with Main and Aux generating different audio formats.

3.3. How can I enable headroom setting by the stores?

The AD-2 allows you to set the input level at which digital full-scale (0dBFS) is reached using the `0dBFS:` setting in the `A-D Mode Setup` sub-menu. The headroom limit can be considered as being the same as the maximum input level. Clipping will occur cleanly at this point. Then use the **[9]** key to get to the `Preferences` Menu. Press **[Enter]**. Press **[9]** repeatedly until `Load A-D Gains:N` is displayed. Then use the **[6]** key to change the setting to `Yes` and finally Press **[Enter]**.

Once you have done this, any future store save and load operations will respectively set and restore the store’s maximum input level (line-up) setting.

USE THIS WITH GREAT CARE!

3.4. Can I drive 2 wire and 1-wire 96kHz at the same time?

Yes. You could use any of the A-D Factory Presets 1, 2 or 4 as a base or you could start with the Set-up Wizard and set 96k 1-wire 24-bit output.

Then, you must modify the resulting setup to obtain the formats you need.

Starting from A-D Factory Preset 2;

Factory Preset Store 2 places the Main Output on the XLR and BNC connectors in 1-wire (2x speed) AES-3id format. XLR1 & 2 can then be configured as 2-wire, leaving 1-wire (i.e. 2x speed AES3) 96k on the BNC outputs.

First ensure that Factory Preset Store 2 is loaded. Press **<A-D Modes>**, then **<Factory Presets>**, then **<2>**. You should see `A-D:96k,24b 1XLR`. Press **[Enter]** to load the store.

Then, use the **[9]** key to select the `Dig O/P Assign` menu; press **[Enter]** and then press **[9]** until the `XLR2 O/P:Main` display is obtained.

Use **[7]** to select `Split96` and then press **[Enter]**. Check that the yellow “Link” LED is now on adjacent to the XLR1 & 2 LEDs in the “Output Assignment” box.

Now, the XLRs are driving 2-wire and the BNCs are driving 1-wire, 2x speed AES3.

3.5. How do I do sample-rate conversion?

A common requirement is down-conversion from a high sample-rate to a low rate such as 44.1kHz for CD release.

Press **<D-D Modes>**, **<Factory Presets>** and then **<1>** for 1-wire or **<2>** for 2-wire and then **[Enter]** to load the store.

See section 2.4 for details of Factory Preset stores D-D 1 and 2. To change the output sample rate from the preset 44.1kHz, press **[9]** until `Main O/P Setup` is displayed, then **[Enter]**.

Use the **[7]** and **[6]** keys to select the desired output sample-rate and then press **[Enter]** to confirm the selection.

3.6. Can the AD-2 convert up to 96kHz from 44.1kHz?

Yes. Use D-D Factory Preset Store 1 as a base. (Store 2 will be less useful as it specifies 2-wire input and this would need to be changed.)

Press **<D-D Modes>**, **<Factory Presets>** and then **<1>**. Press **[Enter]** to load the store.

See section 2.4 for details of D-D Factory Preset stores.

Now change the output sample rate from the preset 44.1kHz to 96 or 88.2kHz. Press **[9]** until `Main O/P Setup` is displayed, then **[Enter]**. Use the **[7]** and **[6]** keys to select the desired high sampling rate, followed by **[Enter]** to confirm the selection.

The AD-2 is now ready to up-convert using AES3 input on input XLR1 and generating 1-wire (2x speed) output on XLR1 and XLR2.

3.7. How do I change the synchronization to AES3?

This can be set starting from any of the A-D mode Factory Presets by using the Menu controls. Start using the **[9]** control to locate the `D-D Mode Setup` sub-menu. Press **[Enter]** and then use the **[7]** and **[6]** keys to select XLR1 or XLR2. Confirm the selection with **[Enter]**.

You may like to save this in a user store. See section 4.5.2 for details.

The AD-2 can accept sync at a frequency which differs from its outputs. For more information about the highly flexible synchronization modes of the AD-2, see section 5.

3.8. What is DRE?

Dynamic Range Enhancement (DRE) is a process designed for the increasing the dynamic range of 16-bit recording channels, such as DAT, CD-R, or 1630+U-matic, when further post-processing is required. It requires an encode process on recording and a decode process on playback. It is suitable for applications where 20-bit dynamic performance is desired of the recorder but only a 16-bit recorder is available, and where the requirement for a decode process is not a problem. The AD-2 Dual-rate A/D converter can encode DRE signals from analogue or digital sources, and can also decode them (in digital to digital mode) to transfer the high resolution signal, encoded on a 16-bit tape, onto a 20 bit digital audio workstation. (The Prism Sound Dream DA-2 can be used to provide analogue monitoring of the encoded signal.)

4. OPERATION REFERENCE

To reduce front-panel and operational complexity, the control of the AD-2 is provided by means of various preset configurations complemented by a menu system which allows access to all operating parameters individually.

You may choose a variety of methods to obtain your desired configuration:

- Menu system
- Factory Preset stores
- User stores (if loaded)
- Setup Wizard

All the control settings are saved in permanent memory so that they are remembered when the unit is off.

4.1. General configuration rules

The AD-2 is a powerful and flexible tool and these benefits bring with them a degree of complexity.

In addition to the operating methods mentioned above, there are several guidelines that are worth remembering when trying to set up complex configurations.

1. Sampling rate for Main and Aux can generally be set independently. However, only Aux can be set to 32kHz sampling.

2. If Aux is high-rate (88.2 or 96.0kHz) then the sample-rates for Main and Aux must be the same.

3. In A-D mode, if Main is low rate (44.1 or 48.0kHz) the sample-rates for Main and Aux must be the same.

4. If the AD-2 is sample-rate converting in D-D mode so that there are different input and output sample-rates, then Main and Aux must run at either the input sample rate or the sample-rate-converted rate.

5. Aux may not drive Split96 (2-wire) format.

4.2. To reset the AD-2 to its factory default state

USE THIS WITH CARE, AS THE USER STORES WILL BE CLEARED.

Use the **[9]** key to enter the menu system and hold it down until `Preferences` is displayed. Press **[Enter]**, then press **[9]** until you see:

```
Reload Factory
Defaults/Stores?
```

Press **[Enter]** and at the prompt `Enter to Accept` press **[Enter]** again.

4.3. Setup Wizard

The Setup Wizard helps you create custom A-D configurations. It provides choices of sample rate, wordlength, synchronization, maximum input level and digital interface format.

The Setup Wizard will allocate Main Output to all output connectors.

If you require an Auxiliary output with different settings, you can use the result of the Setup Wizard as a base and then change the Auxiliary output and Output connector assignments using the Menu system.

To use the Setup Wizard, press the **<Setup Wizard>** button on the far right of the AD-2 front panel and follow the prompts in the LCD display. The first prompt will be:

```
* Setup Wizard *
 Enter to start.
```

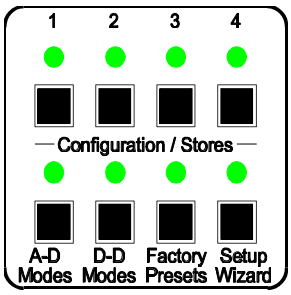
From this point forward, continue or confirm a selection using the **[Enter]**/Accept key or change the selection using the **[7]** and **[6]** (Edit/Change) keys. Repeated use of either key will cycle through the list of alternative selections.

When the desired selection is displayed, confirm it using the **[Enter]**/Accept key.

Continue with the process of selecting settings until you see:

```
You can save
this setup...
```

Press **[Enter]** and you will see:




```
Empty stores ->
are flashing...
```

At this point for each empty user store, the corresponding LED above the store button will be flashing.

<u>If you do not wish to store</u> your setup, simply press **[Enter]**, ignore the prompt to select a store and press **[Enter]** again. You will see:

```
Setup not
   Saved
```

Then press **[Enter]** to finish. Alternatively..

<u>If you wish to store</u> your custom setup, press one of the 4 store buttons; you can overwrite an existing store if you wish - in this case you could select one that was not flashing. You will then see:

```
Setup saved as
xxxxxxxxx by Wzd
```

Note : The Setup Wizard creates a text description which is displayed in the bottom line of the display (xxxxxx's indicate where the description is displayed). This is the text description for the store. It can be changed by editing the store description according to section 4.5.4.

Note: The LED's continue flashing after store selection - your selection, whether an empty or used store, is confirmed after the next step....

Press **[Enter]** to finish and return to the normal level display.

You may then wish to modify the setup such as to set an alternative function and output connector for the Auxiliary output. See section 4.6.

4.4. Program level meter

The Program level meter is a peak reading meter with one sample attack time and normal or peak hold display modes.

The exact level is displayed on the LCD display (in its normal mode of operation) for both left and right channels.

The default mode is 'normal' in which transient meter deflections will be followed by a controlled decay of the indication and where the occurrence of overloads is momentary ["Over" indicator ON]. *[Overs are stretched for a minimum period so that brief overs*

will still be clearly visible]. Also, the text display of peak level is updated sufficiently slowly that the values can be read while the signal amplitude is changing.

Using the **[Enter]** key the hold mode can be toggled between normal and indefinite hold. For indefinite hold mode, the peak level displayed in the LCD will not decay but will be replaced each time higher peak levels are detected.

The highest level measured since indefinite hold was selected will be indicated by a single LED in the bargraph meter being lit while the dynamic signal level is still indicated by a moving bar. For test tones, the single LED showing the peak level may not be evident until the test tone is removed or reduced in level.

4.4.1. Overload threshold

The overload threshold is -0.05dBFS.

The overload need only be present for one sample in order to trigger the overload detector. This serves as a warning only, and the ultimate test is to listen. Any filtering of overload indications is regarded by Prism Sound as potentially dangerous.

4.4.2. “Error” indicator

The “Error” indicator may be lit for the following reasons only:

- Digital Input (DI) out of lock : LED on continuously
- Digital Input (DI) experiencing Bi-phase or Parity errors or or sample-slipping : LED flashing.

4.5. Store Controls

The AD-2 has a large number of control parameters and to simplify and speed up its operation a system of preset stores is provided, complemented by a menu system for adjustment of any parameter individually.

The best way of using the AD-2 is to become familiar with the contents of the Factory Preset stores and to select the one which is the best fit with your requirement. Then you can customize it by changing just a few parameters.

The configuration can then be saved in one of the user stores for re-use.

The AD-2 stores are organised in two banks of two stores : There are ‘Factory Preset’ and ‘User’ banks in each of the ‘A-D Modes’ and ‘D-D Modes’ banks. The following table shows the store system organisation:

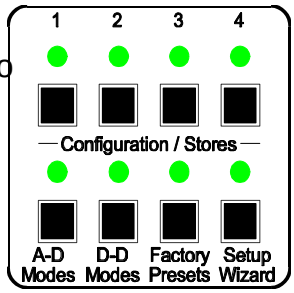
Store system organization					
MODE	Store No.	1	2	3	4
A-D		Factory Preset	Factory Preset	Factory Preset	Factory Preset
A-D		User	User	User	User
D-D		Factory Preset	Factory Preset	Factory Preset	Factory Preset
D-D		User	User	User	User

For details of the Factory Preset stores, see sections 2.3 and 2.4.

4.5.1. Preview the description and load settings from a store

Before loading a new store it is advisable to preview the store description. This is accomplished by the following procedure:

Step 1 From the normal `Level:` display, press either the **<A-D Modes>** button or the **<D-D Modes>** button to select the desired mode.



Step 2 If you wish to preview a Factory Preset store, press **<Factory Presets>** and/or check that the corresponding LED is lit.

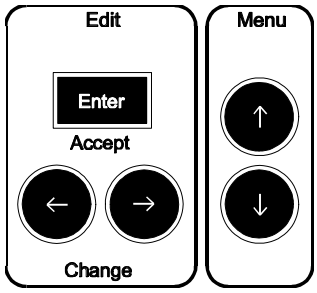
Step 3 Press the selector button for the desired store i.e. one of **<1>** to **<4>**. The corresponding LED will flash.

Step 4 Inspect the text description.

Step 5 Repeat steps 3 & 4 to preview other stores if desired.

You may then cancel the preview by pressing the same store button again *[or by pressing either the **[8]** or **[9]** keys, or by double pressing any other store button **<1>** to **<4>** or **<Setup Wizard>**].*

Step 6 To load the store, when in preview mode, press the **[Enter]** key. This will set the AD-2 to the settings contained in the selected store.

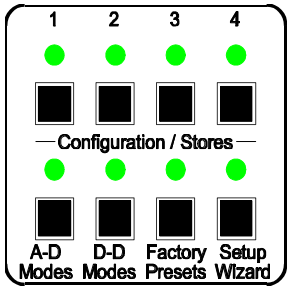


4.5.2. Save settings to a user store

Prior to saving the AD-2 settings to one of the user stores you will probably have created a custom configuration by one of the following methods:

- Using the (A-D modes) Setup Wizard (without saving at that time)
- Using an existing store (Factory Preset or User) and modifying it
- Creating it from scratch using the Menu controls

Before saving your settings to a user store it is advisable to preview the store to check that it is empty or to make sure that you will not overwrite something that you wish to keep.



Step 1 From the normal `Level:` display, press either the **<A-D Modes>** button or the **<D-D Modes>** button to select the appropriate mode.

Step 2 If you wish to preview a Factory Preset store, press **<Factory Presets>** and/or check that the corresponding LED is lit.

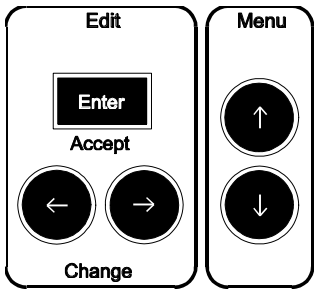
Step 3 Press the selector button for the desired store i.e. one of **<1>** to **<4>**. The corresponding LED will flash.

Step 4 Inspect the text description. If the store is empty, the display will read `Empty Store`.

Step 5 Repeat steps 3 & 4 to preview other stores if desired.

You may then cancel the preview by pressing the same store button again *[or by pressing either the **[8]** or **[9]** keys].*

4.5.2.1. Saving to an empty store using the default store description



Step 6 Press the **[Enter]** key. A default store description will be displayed in the top line of the display. *[The description can be edited at this point or later - see below.]*

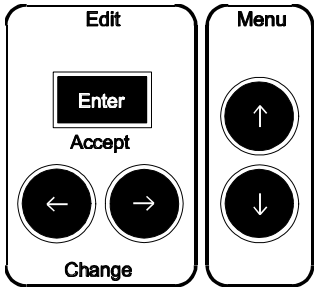
Step 7 Press the **[Enter]** key again to accept the default description. Finally, you will be prompted to confirm the save operation with:

`Enter to save`

Step 8 Press **[Enter]** again to confirm. Your current settings will be stored. Alternatively, press **[8]** or **[9]** or the button under the flashing store LED to cancel the store operation *[or double press any other store button **<1>** to **<4>** or **<Setup Wizard>**.]*

4.5.2.2. Saving over an existing store using the default store description

Step 6 Change the store operation from 'Load' to 'Save' by pressing the **[6]** key.



Step 7 Press **[Enter]**. A default store description will be displayed in the top line of the display. *[The description can be edited at this point or later - see below.]*

Step 8 Press the **[Enter]** key again to accept the default description. Finally, you will be prompted to confirm the save operation with:

```
Enter to save
```

Step 9 Press **[Enter]** again to confirm. Your current settings will be stored. Alternatively, press **[8]** or **[9]** or the button under the flashing store LED to cancel the store operation *[or double press any other store button **<1>** to **<4>** or **<Setup Wizard>**.]*

4.5.2.3. Saving a store with your own store description

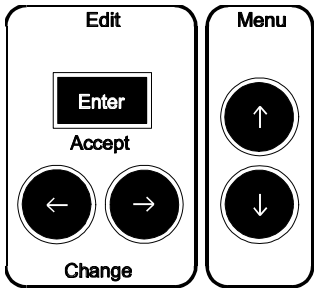
If you are saving to an empty store, use the procedure of section 4.5.2 up to and including Step 6 in section 4.5.2.1.

If you are saving to a store that has already been used, follow the procedure of section 4.5.2 up to and including Step 7 in section 4.5.2.2.

A default store description will be displayed in the top line of the display with a prompt to continue, such as:

```
A-D User #1                ;note: the first character will be flashing
[fns] Enter=End
```

Step A Optional : You may clear the description or select the default by pressing the **[7]** key. The **[7]** and **[6]** keys are used to move the character edit cursor along the display. There are two additional positions which can be visualized as being between the two ends of the display. These correspond to two functions which are :



`Deflt` and `Clear`

The function (if selected) will be displayed on the bottom line of the display. To activate the function press **[9]** or **[8]**. To abort the edit at any time while changing the description double press any store button **<1>** to **<4>** or **<Setup Wizard>**.

Step B You will be presented either with a text description with the first character flashing, or with a blank string with a flashing cursor in the first character position.

Move the cursor to the desired position using the **[7]** and **[6]** keys.

Step C Edit the character using the **[8]** and **[9]** keys. The character is selected from a list of ASCII characters shown in the table below. Hold down the edit keys to auto-repeat and search quickly for the desired character.

Step D Repeat Steps B & C until the desired description has been set.

Step E Press **[Enter]** to finish editing the description.

Step F Press **[Enter]** again to Save the store. Alternatively, press **[8]** or **[9]** or the button under flashing store LED to cancel the store operation *[or double press any other store button **<1>** to **<4>** or **<Setup Wizard>**.]*

4.5.3. Character set for store descriptions

6	!	“	#	$	%	&	‘	(	)	*	+	,	-	.	/	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
@		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	[	-	]	^
_	`	a	b	c	d	e	f	g	h	I	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	{	|	}	

4.5.4. Editing the text description of a user store

This is performed by first loading the store as described in section 4.5.1 and then saving it with your new text description as described in sections 4.5.2.2 and 4.5.2.3.

4.6. Menu system operation

The Menu system of the AD-2 provides access to all operating parameters so that custom configurations of both A-D and D-D modes can be created and preferences such as LED brightness and LCD contrast (and others) can be set.

It is advisable to store a custom configuration once it has been created.
Section 4.5 explains the procedure for storing your settings.

All the control settings are saved in permanent memory so that they are remembered when the unit is off.

4.6.1. Normal Display - Peak Level indications

The normal display of the AD-2 once powered and initialized is:

```
Level: dBFS
< llll <> rrrr >
```

Where `llll` and `rrrr` are the peak amplitudes for the left and right channels, expressed in dBFS (decibels relative to digital clip level). These are normally displayed using a zero-attack peak hold algorithm with automatic decay to zero.

Indefinite peak hold is available and may be selected by pressing **[Enter]** at the normal display level. The level units indication will change from `dBFS` to `HOLD` and back for subsequent operations.

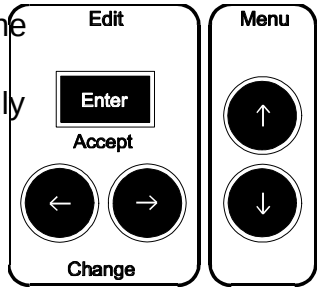
The ‘HOLD’ settings also applies to the Program Meter display. See section 4.4 for more detail.

A string of exclamation marks `!!!` may be seen from time to time at the top right of the LCD display. This indicates a warning condition and the detail of the warning(s) can be inspected using the **[6]** key.

If more than one warning condition is present, the various conditions will be displayed in rotation on the bottom line of the display.

Press the **[6]** key again to return to the normal `Level:` display.

4.6.2. Navigating the menus



You may enter the menu system from the normal state using the **[9]** key. You may leave it by using the **[8]** key; if leaving from some point deeper in the menu system press the key repeatedly until the normal display is obtained. *You can also leave by double-pressing any store button **<1>** to **<4>** or double-pressing the **<Setup Wizard>**.*

Alternatively, leave the controls until the AD-2 times out. The display will revert to normal automatically after a preset time which can be set in the preferences menu (see below).

When navigating the menu system two types of display will be encountered. These are:

4.6.2.1. Sub-Menus

The sub-menus announce their purpose and prompt you to press **[Enter]** or **[7]** or **[6]** to go into the sub-menu. Alternatively, **[9]** will skip past to the next main menu item. Once in a sub-menu, **[8]** can be used to reverse out or **[9]** can be used repeatedly to the end of the sub-menu and automatically on to the next main-menu item.

Example:

```
Main O/P Setup      ; this is a sub-menu, and
[Enter]             ; shows that [Enter] will select the sub-menu
```

4.6.2.2. Parameter selections

These display the parameter description and current setting.

Example:

```
Mode:          A-D      ; this allows setting of A-D or D-D mode, and
A-D D-D                 ; shows that A-D is selected.
```

The A-D on the top line is the current setting. On the bottom line is the set of choices. The current position of the selection cursor is indicated by the selection flashing (in the example above this is indicated by a double underline: A-D). If there are more than can be accommodated on the display then the **[7]** and **[6]** keys can be used to move the selection cursor and to scroll the list. This is indicated by 6 and 7 at the ends of the display.

4.6.3. Changing the settings

When you have found the parameter that you want to change, use the **[7]** and **[6]** keys to select the setting that you want.

Most AD-2 settings require confirmation of the change by pressing **[Enter]**. You will see that the new setting is then displayed on the first line of the display. You can then reverse out of the menus with **[8]** or wait for the unit to time out *[or double-press any store button **<1>** to **<4>**, or double-press the **<Setup Wizard>**].*

Settings that **do not require confirmation** are :

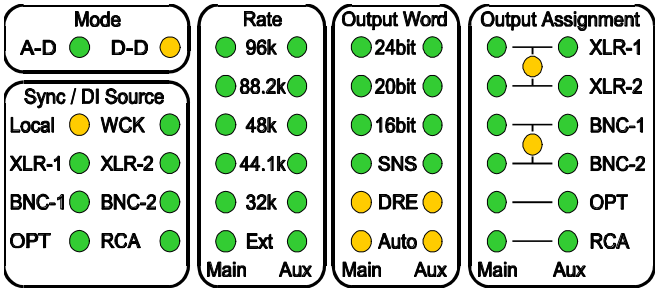
- All of sub-menu A-D Mode Setup
  - Peak input level (headroom limit)
  - Left and Right channel gain trims
- In sub-menu Preferences
  - LED Brightness
  - LCD Backlight brightness
  - LCD Contrast

4.7. Menu system reference

Level Display Screen	!!! **[6]**	Warnings Screen	**[6]**back to Level Display
Mode: A-D, D-D			
Sync Source: Int, DI			
Main Output Setup	**[Enter]**	fs: 44.1, 48, 88.2, 96, =DI	
		Wordlength: 16b, 20b, 24b	
		Quantizer: Flat, SNS1, SNS2, SNS3, SNS4	
		DRE Encode: Off, On	
Aux Output Setup	**[Enter]**	fs: 32, 44.1, 48, 88.2, 96, =Main, =DI	
		Wordlength: 16b, 20b, 24b	
		Quantizer: Flat, SNS1, SNS2, SNS3, SNS4	
		DRE Encode: Off, On	
A-D Mode Setup	**[Enter]**	0dBFS: +5dBu to +28dBu in 0.5dBu steps	
		ChA Gain Trim: ±0.5dB in 0.05dB steps	
		ChB Gain Trim: ±0.5dB in 0.05dB steps	
D-D Mode Setup	**[Enter]**	DI: XLR1, XLR2, XLR S96, BNC1, BNC2, BNC S96, BNC SDIF-2, RCA, OPTO	
		DRE Decode: Off, On	
Digital Output Assign	**[Enter]**	XLR1: Main, Aux	
		XLR2: Main, Aux, S96	
		BNC1: Main, Aux	
		BNC2: Main, Aux, S96, SDIF-2	
		OPTO: Main, Aux	
		RCA: Main, Aux	
Preferences	**[Enter]**	Menu Timeout: 30s, 2m, 5m, Off	
		LED Brightness: 0..15	
		LCD Backlight Brightness: 0..15	
		LCD Contrast: 0..15	
		Load Analogue Gains from Stores: No, Yes	
		Reload Factory Defaults and Clear Stores...	

4.8. System State Indicator LEDs

In general the LED indications are quite self-explanatory but there are some which deserve further explanation.



4.8.1. Flashing LED indicators

In general a flashing indicator provides a warning of some desired condition which is not attained or is not attainable.

Common examples are :

" Synchronization set to external WCK and none connected.
- This is a functional configuration an needs no adjustment unless the application demands that an external sync be used. If so, connect one to the WCK BNC input. The LED will stop flashing when the WCK signal is detected correctly.

" An illegal configuration is requested using the menu controls.
- This could be a condition such as attempting to set Split96 for the AUX output on the BNC output connectors. This is not possible. In this case the Yellow “Link” led between the “BNC-1” and “BNC-2" LEDS will be flashing.

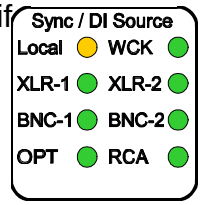
In both cases, further explanation of the warning condition can be found using the Menu controls. The LCD display will show three exclamation marks ！！！. Pressing the **[6]** key will reveal a warning condition. If there is more than one, they will be slowly cycled through on the display until **[6]** is pressed again.

It is possible to go directly from the warnings display mode to the menu controls using **[9]** or to the setup wizard using **<Setup Wizard>** or to the store system using one of the **<1>** to **<4>** store buttons.

4.8.2. Mode indicators

There are two indicators in this group and they show the current mode of the AD-2: A-D or D-D.

4.8.3. Sync/DI indicators



These indicate if the synchronization source is internal or external and if external, the type of synchronizing signal.

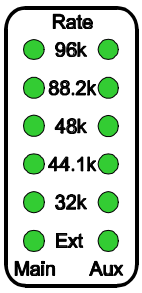
If the AD-2 is in D-D mode, the input signal format is indicated.

For more information about synchronization modes, see section 5. For information about digital inputs, see section 6.2.

When a ‘Split96' DI source or synchronizing source is selected both LEDs will be lit for the respective format (XLR 1&2 and BNC-1&2).

If LEDs other than “Local” are flashing, the most likely cause is that an inappropriate or non-functional reference is connected or no reference is connected.

4.8.4. Rate indicators

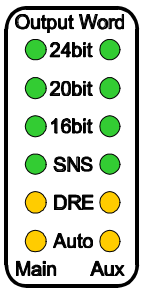


These indicate the sample-rate for the Main and Aux output channels.

Main cannot be set to 32kHz.

“Ext” indicates that the output channel (Main or Aux) is running at the same rate as DI or an external Sync source (depending on mode of operation).

4.8.5. Output Word Indicators



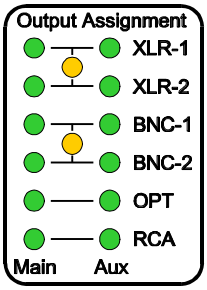
These indicate the wordlength settings for the Main and Aux output channels.

“SNS” indicates that the Prism Sound Super-Noise-Shaping system is active on the respective output. This provides a less noisy result when used in conjunction with wordlength settings of less than 24 bits. For more information see section 9.

“DRE” indicates that the Prism Sound Dynamic Range Enhancement system is active on the respective output. This system is designed to be used with 16-bit recorders and so when DRE is selected the output wordlength will be indicated as “16bit”. For an explanation of this feature, see section 3.8.

“Auto” indicates the state of the auto-dither system, which can intelligently set itself on or off according to various conditions such as an input of digital zero or input of a wordlength less than or equal to the output wordlength. For more information see section 7.3.2.

4.8.6. Output Assignment Indicators



These show the routing of the Main and Aux channels to the various output connectors and give some indications about the format.

In between the XLR-1 and XLR-2 indicators and similarly between the BNC-1 and BNC-2 indicators are yellow LEDs which indicate a link between the two outputs.

This can have two alternative meanings:

4.8.6.1. Split96 or 2-wire mode

This LED is lit when either connector pair are configured in the Split96 or 2-wire mode for either 88.2 or 96.0kHz sampling. For more information see section 6.3.

4.8.6.2. SDIF-2 format

This indicates that the SONY SDIF-2 format is selected. This may operate at low or high sample rates but may only be selected on the BNC outputs. See section 6.3.

5. SYNCHRONIZATION MODES

In A-D mode, the AD-2 Dual-rate A/D converter can be operated as either a clock master or a clock slave. This is determined by the setting of the ‘Sync Mode’ menu.

If the Sync Mode is set to ‘Int’, then the Main and Aux output rates are set to the rates requested in their respective menus, and are referenced to the AD-2s internal precision reference.

If the Sync Mode is set to ‘DI’, then an external reference sync is used. The type of external sync to be used, and on which connector, is defined in the ‘D-D Mode Setup’ menu: this may be an AES3, AES-3id, IEC958 or an SDIF-2 wordclock reference.

An unusual feature of the AD-2 is that this reference may be at *any standard rate* (i.e. 32kHz, 44.1kHz, 48kHz, 88.2kHz or 96kHz) and the Main and Aux outputs will be locked to it precisely, *whether or not they are set to sample at the same rate as the reference*. For example, a house sync at 48kHz may be used to synchronize an AD-2 producing simultaneous 44.1kHz and 96kHz outputs.

Alternatively, if the Main or Aux path is set to ‘=DI’ rather than having a particular sampling rate specified, then that output path will sample at exactly the same rate as the external reference. If an AES3 reference sync is selected and is designated as ‘Split96', then the sample rate of an output path following DI is set to twice the incoming AES3 frame rate (i.e. 88.2kHz or 96kHz).

In D-D mode, the AD-2 Dual-rate A/D converter can similarly be operated as either a clock master or a clock slave as determined by the setting of the ‘Sync Mode’ menu.

Normally, D-D Mode operation will be in external (’DI’) mode, where the AD-2 is locked to the incoming digital audio signal (as specified in the ‘D-D Mode Setup’ menu). This does not mean that the Main and Aux path outputs must necessarily be at the same rate as the digital input - they may be specified to produce a different, sample-rate-converted output rate - but in any case their sampling frequency will bear a fixed relationship to the incoming digital audio signal. Each of the Main or Aux outputs can be *precisely* fixed to the incoming data rate by either selecting the same output rate for that path as the current input rate, or by selecting the rate as ‘=DI’ to make the path follow the rate of the incoming data, even if it changes.

If the Sync Mode is set to ‘Int’ in D-D Mode, then the AD-2 acts as a clock master: i.e. it determines its output data rates from its high-precision internal clock, even though it must accept its digital input data at the correct sampling rate (or, actually, at a standard rate *in fixed relationship* to its output rate, since it may be rate-converting). It is therefore essential that the sourcing equipment is locked to one of the outputs of the AD-2 if correct interfacing is to be achieved.

Operating the AD-2 as a clock master in D-D Mode may be desirable in a number of situations, such as when processing the output of a digital audio workstation, or when connected to an A-D converter with a poor-quality clock.

In either A-D or D-D mode, the question arises as to what output rates would be assumed by Main or Aux output paths if they are set to ‘=DI’ but no external reference or digital input is present (or if the Sync Mode is set to ‘Int’). In all such cases, the path’s sampling rate defaults to 96kHz.

In all cases, care must be taken to ensure that the other digital audio equipment in the system is either 'locked' to, or synchronous with, the AD-2.

6. CONNECTORS

6.1. Analogue input connectors

Conventional connections from a balanced analogue source should use a screened twisted pair lead. The AD-2 input pins 2 (+) and 3 (-) should be wired to the two conductors of the pair and pin 1 to the cable screen. The other end of the cable should be connected in a similar manner with the screen connecting to the chassis of the source.

The AD-2 should be connected to an unbalanced analogue source using a screened twisted pair lead, connected to the AD-2 as described above but at the analogue source, pins 3 and 1 of the cable should both be connected to the output shield connection. This provides shield continuity without the possibility of ground currents flowing down the signal conductors.

6.2. Digital input connectors

The AD-2 Dual-rate A/D converter can accept digital audio inputs in a variety of formats. These are:

AES3	professional AES/EBU on an XLR connector;
AES3 'Split96'	professional AES/EBU on two XLR connectors, one per channel at 88.2kHz or 96kHz sample rates;
AES-3id	professional AES/EBU on a BNC connector;
AES-3id 'Split96'	professional AES/EBU on two BNC connectors, one per channel at 88.2kHz or 96kHz sample rates;
IEC958	consumer on an RCA/phono connector;
Optical	consumer on a TOSLINK connector;
SDIF-2	professional on two BNC connectors plus wordclock;
DSD*	one-bit data stream on two BNC connectors plus clock, *subject to an upgrade option*

Two female XLR digital input connectors are fitted, which are used for either AES3 or Split96 operation.

Three BNC digital input connectors are fitted, two of which are used for either AES-3id, Split96, SDIF-2 or (with upgrade option) DSD operation. The third BNC is a wordclock input for use with SDIF-2 inputs, or simply as a reference sync in A-D mode. The wordclock connector doubles as a DSD clock input in that mode.

IEC958 (phono) and optical input connectors are dedicated, single function.

The desired digital input format is selected in the 'D-D Mode Setup' menu. See sections 4.6 and 4.7.

Note on Split96 operation: 'Split96' is a format for passing hi-sampled (88.2kHz or 96kHz) signals on AES3 or AES-3id carriers at conventional bit-rates. This is achieved by using a single AES3 carrier per hi-rate channel (it would normally carry a stereo channel). This format has the advantage that conventional, low-rate, multichannel storage media can often be used to record 88.2kHz or 96kHz data. The format is described in [Ref.8].

6.3. Digital output connectors

The AD-2 Dual-rate A/D converter can generate digital audio outputs in a variety of formats. These are:

AES3	professional AES/EBU on an XLR connector;
AES3 'Split96'	professional AES/EBU on two XLR connectors, one per channel at 88.2kHz or 96kHz sample rates;
AES-3id	professional AES/EBU on a BNC connector;
AES-3id 'Split96'	professional AES/EBU on two BNC connectors, one per channel at 88.2kHz or 96kHz sample rates;
IEC958	consumer on an RCA/phono connector;
Optical	consumer on a TOSLINK connector;
SDIF-2	professional on two BNC connectors plus wordclock;
DSD*	one-bit data stream on two BNC connectors plus clock, *subject to an upgrade option*

Two female XLR digital output connectors are fitted, which are used for either AES3 or Split96 operation.

Three BNC digital output connectors are fitted, two of which are used for either AES-3id, Split96, SDIF-2 or (with upgrade option) DSD operation. The third BNC is a wordclock output for use with the SDIF-2 output, or simply as a reference sync to other equipment. The wordclock connector doubles as a DSD clock output in that mode.

IEC958 (phono) and optical output connectors are dedicated, single function.

The format and path assignment (Main or Aux) for each digital output connector is selected in the 'Digital Output Assign' menu, as described in section 4.6 and 4.7.

Note on Split96 operation: 'Split96' is a format for passing hi-sampled (88.2kHz or 96kHz) signals on AES3 or AES-3id carriers at conventional bit-rates. This is achieved by using a single AES3 carrier per hi-rate channel (it would normally carry a stereo channel). This format has the advantage that conventional, low-rate, multichannel storage media can often be used to record 88.2kHz or 96kHz data. The format is described in [Ref.8].

6.4. Interconnect screens - the pin 1 conditions

‘Screen' connects directly to the chassis for the digital XLR outputs and all BNC connectors. Screen connects via a capacitor to the chassis for the digital XLR inputs.

The RCA digital coaxial connections are transformer isolated with the screen coupled to the chassis using a capacitor at the connector.

The analogue input connector screens are connected to the chassis via a parallel combination of resistor and capacitor. These components limit the shield currents that could flow down the signal cables but provide continuity at radio frequencies.

6.5. Connector table

Viewed from the rear, left to right, the connectors are as follows:

	IEC320 - 3 pin		Mains power inlet
A	XLR-Female	Analogue	Channel A or Left
B	XLR-Female	Inputs	Channel B or Right
DI1	XLR-Female		AES3 and external REF (DARS)
DI2	XLR-Female		AES3
DI3	OPTICAL	Digital	IEC958 optical
DI4	RCA-phono	Inputs	IEC958 coaxial
DI5 (L)	BNC-75S		Multiple format AES-3id, SDIF-2 or DSD*
DI6 (R)	BNC-75S		Multiple format AES-3id, SDIF-2 or DSD*
WCK	BNC-75S		Word-clock input (or DSD* clock)
DO5 (L)	BNC-75S		Multiple format AES-3id, SDIF-2 or DSD*
DO6 (R)	BNC-75S		Multiple format AES-3id, SDIF-2 or DSD*
WCK	BNC-75S	Digital	Word-clock output (or DSD* clock)
DO4	RCA-phono	Outputs	IEC958 consumer format
DO3	OPTICAL		IEC958 consumer format
DO1	XLR-Male		AES3
DO2	XLR-Male		AES3

XLR wiring conventions for both analogue and digital connections are:
Pin 1: Screen, Pin 2: Positive ('+', 'hot'), Pin 3: Negative ('-', 'cold');
*DSD inputs and outputs are a future upgrade option;

7. TECHNICAL SPECIFICATION

Specifications quoted in this section are to AES17-1991 (ANSI S4.51-1991) [Ref. 3], band-limited 20Hz-20kHz, at 96kHz sampling rate and output resolution of 24-bits, except where stated. Analogue specifications are quoted with analogue input sensitivity set to +18dBu (for digital full scale output) except where stated, and after a 30 minute warm-up period.

Specifications, offered in good faith, are subject to change without notice. Errors and omissions excepted.

7.1. A-D mode Performance Specification

7.1.1. Distortion and noise

Dynamic range or signal-to-noise ratio (input sensitivity:+28dBu=0dBFS, 1kHz@-60dBFS):

typical:	131.5dB (unweighted RMS)
worst case:	>129.0dB CCIR-RMS
	>131.0dB (A weighted RMS)
	>129.0dB (unweighted RMS)

Dynamic range or signal-to-noise ratio (input sensitivity:+18dBu=0dBFS, 1kHz@-60dBFS):

typical:	128.0dB (unweighted RMS)
	>127.0dB CCIR-RMS
	>129.0dB (A weighted RMS)
	>127.0dB (unweighted RMS)

Total harmonic distortion and noise (1kHz@ -1dBFS):

typical,	<-108.0dBFS (0.00045%) (unweighted RMS)
worst case,	<-105.0dBFS (0.00063%) (unweighted RMS)

Intermodulation distortion: <-90dB

Note: The intermodulation test from AES17 uses 18kHz and 20kHz signals at -6.03dBFS each. The result is the ratio of the total output rms signal level to the rms sum of the 2nd and 3rd order modulation products at 2kHz and 16kHz.

Spurious aharmonic levels:<-130dBFS (1kHz@ -1dBFS)

Note: Highest level of any aharmonic spurious component

Any spurious levels: <-112dBFS signals to -1dBFS
<-130dBFS signals below -20dB FS
<-140dBFS signals below -60dB FS

Note: Highest level of any harmonic distortion component

7.1.2. Interference susceptibility

CMRR: >110dB (50Hz)
>85dB (15kHz)

Crosstalk: <-130dB (50Hz, -1dBFS in either channel, other terminated)
<-140dB (15kHz, -1dBFS in either channel, other terminated)

7.1.3. Gain-related

Frequency response:

32kHz sampling rate: <10Hz to >14.5kHz (±0.05dB)
<0.3Hz to >14.95kHz (-3dB)
44.1kHz sampling rate: <10Hz to >19.5kHz (±0.05dB)
<0.3Hz to >20.25kHz (-3dB)
48kHz sampling rate: <10Hz to >20.0kHz (±0.05dB)
<0.3Hz to >21.20kHz (-3dB)
88.2kHz sampling rate: <10Hz to >30.0kHz (±0.05dB)
<0.3Hz to >34.00kHz (-3dB)
96kHz sampling rate: <10Hz to >32.0kHz (±0.05dB)
<0.3Hz to >36.00kHz (-3dB)

Full-scale input signal level:
Sensitivity is adjustable so that the input level for 0dBFS (full scale) input can be preset from +5dBu to +28dBu in 0.5dB steps with fine trim of ±0.5dB in steps of 0.05dB.

Gain error: < 0.05 dB for all settings

Overload LED threshold: 0.05dB below full-scale

Level-dependent logarithmic gain linearity: << 3dB at -144dBFS

Note: This is a measurement of the output level of a 996.115Hz tone with respect to the input level. The output level at 997Hz is measured using 32 averages of an 8192 point FFT with a rectangular window. This method has much higher resolution than the test in AES17, which specifies a third-octave band-pass filter to eliminate noise. Even so, the signal level measurements are still dominated by the noise floor at -144dB FS.

7.1.4. Phase-related

Group delay: Nominally 102/fs (1.06ms at fs=96kHz)

Phase linearity error (5Hz - 20kHz): <1E

Inter-channel phase deviation (5Hz - 20kHz): < 0.5E

Absolute phase: Correct

Note: Negative analogue inputs produce a negative digital output. Thus if pin 2 of the input connector is negative with respect to pin 3 the most significant bit of the (2s complement) digital output is set. This is in accordance with the standards IEC268-12(1969) and AES14.

7.1.5. Jitter

Sampling jitter rejection:

Jitter attenuation slope:	80dB per decade
Corner frequency:	approx 80Hz
Attenuation above 500Hz:	> 60dB

Intrinsic conversion jitter: <18ps RMS

7.2. Analogue Inputs

The analogue inputs are connected via a pair of 3-pin female XLR connectors with positive and negative signal polarities on pins 2 and 3 respectively. Pin 1 is coupled to the chassis using a capacitor and resistor to limit screen currents and provide EMC coupling.

Differential input impedance:	20 kS (pin 2 to pin 3)
Common mode input impedance:	>200 kS (pin 1 to 2 or 3)
Common-mode range:	70 V

7.3. D-D mode Performance Specification

7.3.1. General

With the input and output sample-rates synchronised, the D-D path of the AD-2 is transparent to 24-bit audio data, unless redithering is selected.

Dither can be selected as 'flat' i.e. optimal triangular-probability-density-function (TPDF) unweighted noise, or one of four proprietary noise-shaper (SNS) characteristics may be selected. Noise shaper spectra are shown in section 9. The dither and SNS characteristics are automatically adjusted independently for the Main and Aux output paths according to wordlength and sampling rate.

7.3.2. Auto-dither-defeat

The AD-2 automatically prevents unwanted dither being added. In the case of the output wordlength of either Main or Aux paths being the same or longer than that of the incoming data, dithering of that path is over-ridden, and the path's 'auto-dither-defeat' LED is lit. This feature also operates when 'digital black' (i.e. all-zero) input data is detected, so preserving digital black at the output.

7.3.3. Group delay

Group delay (no SRC): Nominally 68/fs (0.71ms at fs=96kHz)

7.3.4. Sample-rate-conversion

The AD-2s synchronous sampling-rate-converter (SSRC) produces negligible noise and distortion and is much superior in this respect compared to conventional 'asynchronous' sample-rate-converters.

For the 96kHz to 44.1kHz sample-rate-conversion case:

Dynamic range or signal-to-noise ratio (1kHz@-60dBFS):
141.70dB (unweighted RMS)

Total harmonic distortion and noise (1kHz@ -1dBFS):
-135.0dBFS (0.00002%) (unweighted RMS)

Maximum spurious component (1kHz@-1dBFS):
-157.6dBFS (unweighted RMS)

Roll-off frequencies:

32kHz (lesser of input and output) rate: >14.5kHz (±0.05dB)
>14.95kHz (-3dB)

44.1kHz (lesser of input and output) rate>19.5kHz (±0.05dB)
>20.25kHz (-3dB)

48kHz (lesser of input and output) rate: >20.0kHz (±0.05dB)
>21.20kHz (-3dB)

88.2kHz (lesser of input and output) rate>32.0kHz (±0.05dB)
>33.25kHz (-3dB)

96kHz (lesser of input and output) rate: >35.0kHz (±0.05dB)
>36.35kHz (-3dB)

7.4. Digital Inputs

7.4.1. Input Resolution

Digital input resolution/wordlength: 24 bits

The AD-2 resolves all the data bits of the digital interface formats. Input signals are not truncated and hence truncation distortion does not occur.

Note: In conformance with the digital audio interface specifications, all signals with professional channel status that indicate that the auxiliary audio data bits do not carry the main audio signal will have the lower 4 bits masked off to avoid non-audio data adding to the audio. Consumer and SDIF-2 format inputs can accept 24-bits if presented.

Overload LED threshold: 0.05dB below full-scale

7.4.2. Balanced AES3 XLR inputs:

Input impedance: 110Ω.

These conform with the professional interface, AES3-1992 [Ref. 1], with transformers for improved isolation. However, data encoded according to the consumer format of IEC958 [Ref. 4] is also decoded correctly.

The two XLR inputs can be configured to accept 'Split96' format inputs for 88.2kHz and 96kHz signals with one channel per bearer in accordance with [Ref.8]. The XLR input selection indicators are both illuminated if the inputs are being handled in this way.

Pin 1 of the XLR connectors is connected to the chassis via a capacitor and the signal is presented differentially across pins 2 and 3. The phase of pins 2 and 3 is unimportant.

7.4.3. Optical input:

This input is physically compatible with the Toshiba ‘TOSLINK' fibre-optic connector, and data encoded according to professional (AES3-1992) or consumer (IEC958) formats is correctly decoded.

7.4.4. Coaxial (RCA) consumer input:

Input impedance: 75S.

This input conforms to the coaxial specification of IEC958 and, for improved isolation, has transformer isolation with the screen capacitively coupled to the chassis. Data encoded according to professional (AES3-1992) or consumer (IEC958) formats is correctly decoded.

7.4.5. Multi-function coaxial (BNC) professional inputs:

Input impedance: 75S.

The connectors can be configured to operate as coaxial AES3 (AES-3id), SDIF-2, or DSD* inputs.

* DSD operation is subject of an upgrade option.

7.4.5.1. BNC inputs operating as AES-3id or IEC958 format inputs.

These conform to the AES-3id recommendation [Ref. 7]. However data encoded according to professional (AES3-1992) or consumer (IEC958) formats is correctly decoded.

The BNC inputs can be configured to accept 'Split96' format inputs for 88.2kHz and 96kHz signals with one channel per bearer in accordance with [Ref.8]. The BNC input selection indicators are both illuminated if the inputs are being handled in this way.

7.4.5.2. BNC inputs operating as SDIF-2 (Sony) format inputs

In this mode the inputs conform with the interfaces initially used by the Sony PCM-1610/1630 PCM encoder. The signal on BNC1 is the left channel and that on BNC2 is the right channel.

The BNC input selection indicators are both illuminated if the inputs are being handled in this way.

Note: Signals in this format are D.C. coupled at TTL levels and transmitted most significant bit (MSB) first in non-return to zero (NRZ) format. A synchronization pattern identifies the start of a new sample word. Some

implementations of this interface do not use the synchronization pattern to identify the sample word boundary. Such equipment will often require delays to be carefully matched before it will work correctly. The AD-2 Dual-rate A/D converter uses a rugged algorithm to correctly decode SDIF data independent of delays or phase.

7.4.6. Coaxial wordclock (WCK) input

This input can be used to lock the AD-2 Dual-rate A/D converter to a sample rate square wave, or word-clock.

Input impedance:	75S
Input level:	200mV to 10V pk-pk
Mark-space ratio:	40:60 to 60:40
Sync reference point:	Rising edge

This input is ac coupled so that in addition to operation with the TTL levels of SDIF-2 word clock sources it will also work with lower signal levels, such as from a double or triple terminated source, with an optimum noise margin.

Note: When using WCK synchronization the digital outputs of the AD-2 Dual-rate A/D converter are timed so that the start of the sample frame is coincident with the timing reference point (the rising edge of WCK). Specified delay measurements are also made from the timing reference point. This input is not required if the AD-2 Dual-rate A/D converter is configured as clock master.

7.4.7. BNC inputs operating in DSD mode

When the coaxial inputs are set to DSD mode they receive a heavily oversampled pulse density modulated input signal on the two coaxial data inputs, one for each channel. The data is TTL-level as described in the section above.

7.4.8. Coaxial clock input operating as DSD input clock

When the coaxial inputs are set to DSD mode, the normal wordclock input format changes to a DSD bit-clock. Data is clocked into the AD-2 on the rising edge of the clock. The clock is TTL-level as described in the section above.

Note: DSD operation of the BNC inputs requires an upgrade option.

7.4.9. General behaviour with IEC958/AES3 format inputs

Jitter Tolerance

Above 12kHz:	0.5UI	(88.6ns at fs = 44.1kHz)
50Hz to 12kHz:	Increases with falling jitter frequency.	
	e.g.	0.75UI at 8kHz
		30UI at 200Hz
Below 50Hz:	> 128UI	(22.7us at fs=44.1kHz)

Note: Jitter tolerance is a measure of the ability of a receiver to correctly decode a digital interface signal which has jitter. Like most other jitter parameters it is normally measured in unit intervals. A unit interval (UI) corresponds to the smallest nominal time interval in the interface signal, for the AES3 or IEC958 interface formats there are 128 unit intervals per sample. Therefore at a sample frequency of 44.1kHz the unit interval is 177 ns. References 5 and 6 explain interface jitter in more detail.

7.5. Digital Outputs

7.5.1. Audio resolution on digital outputs

The AES3, AES-3id, SDIF-2 and both IEC958 outputs can provide up to 24 bits of audio data. The output wordlength is selectable in the menu for the path which is configured to drive each output (Main or Aux).

Note: To avoid truncation distortion care must always be taken to match the signal word length to the input word length of following equipment. Often equipment is limited to a 16-bit input resolution and further truncation will occur at that equipment if the signal is not re-dithered. This can be done by setting the output word-length of the AD-2 appropriately. The word-length reduction may be achieved in a fully compatible way by using dither or SNS noise-shaping. Alternatively the DRE coding system may be used to store high resolution audio onto 16-bit channels. In the latter case DRE de-coding must be used before the signal is further processed or played back.

7.5.2. Balanced AES3 (AES/EBU) professional outputs

These conform with the professional interface, AES3-1992, with transformers for improved isolation.

Pin 1 of the XLR connector is connected to the chassis and the signal is output differentially across pins 2 and 3.

Output impedance: 110Ω ± 20%
Output level: 4V ± 10% (terminated)
Rise/fall time: 15ns ± 20% (terminated)

This output will always carry professional channel status, see section 7.5.12.

The XLR outputs can be configured to generate 'Split96' format for 88.2kHz and 96kHz signals with one channel per bearer in accordance with [Ref.8].

7.5.3. Optical consumer format

This output is physically compatible with the Toshiba `TOSLINK' fibre-optic connector. It carries consumer format channel status, see section 7.5.12.

7.5.4. RCA coaxial consumer format (IEC958)

This conforms with the unbalanced interface defined in IEC958 ed.1 clause 5.3 and IEC958 ed.2 part 3. Electrically, it is floating with the screen capacitively coupled to the chassis. It carries consumer format channel status, see section 7.5.12.

Output impedance:	75 S ± 10%
Output level:	0.5 V ± 10% (terminated)
Rise/fall time:	22 ns ± 20% (terminated)

7.5.5. BNC coaxial professional format outputs (AES-3id)

When set to AES-3id format, the multi-function BNC coaxial data outputs act as follows:

These outputs have the data format of AES3 on a BNC coaxial connector. This format is described in AES-3id [ref. 7].

Output impedance:	75 S
Load impedance:	75 S
Output level:	1.0 V ± 0.2 V
DC offset:	<50mV
Rise/fall time:	37 ns

The BNC outputs can be configured to generate 'Split96' format for 88.2kHz and 96kHz signals with one channel per bearer in accordance with [Ref.8].

7.5.6. BNC coaxial SDIF-2 (Sony) format, L and R.

When set to SDIF-2 format, the multi-function BNC coaxial data outputs act as follows.

These outputs conform with the interfaces initially used by the Sony PCM-1610/1630 PCM encoder and often called SDIF-2. Signals in this format are at TTL levels and are transmitted most significant bit (MSB) first in non-return to zero (NRZ) format. A synchronization pattern identifies the start of a new sample word.

Output impedance:	approximately 30 S
Load impedance:	75 S
Output level:	2.8 V ± 0.5 V (when terminated in 75 S)
Rise/fall time:	30 ns

In A-D mode, the emphasis and copy permit flags are set for no emphasis and copy permit.

In D-D mode the emphasis flag is copied from the input stream, and the copy permit flag is set to allow copying.

Note: J17 emphasis cannot be indicated on the SDIF-2 outputs.

7.5.7. Coaxial SDIF-2 (Sony) wordclock format

This output carries a TTL level square wave at the sample rate. The rising edge coincides with the start of a sample frame on the digital outputs. The wordclock rate matches the sampling rate of whichever of Main or Aux output paths is assigned to the BNC1 output, unless the BNCs are set to ‘Split96' format in which case the wordclock rate is set to the Split96 frame rate, i.e. half the sampling rate.

Electrically, the wordclock output is identical to the SDIF-2 L and R outputs.

This output is used to synchronize equipment that is using the SDIF-2 data outputs, or any other equipment which can accept a wordclock reference sync.

7.5.8. BNC DSD output data

When the BNC outputs are set to DSD mode they transmit heavily oversampled pulse density modulated output signals, one channel per connector. The data is TTL-level as described in the section above.

7.5.9. Coaxial DSD output clock

When the BNC outputs are set to DSD mode, the normal coaxial wordclock output format changes to a DSD bit-clock. Data outputs change the falling edge of the output clock, and may be clocked into a receiving device on the rising edge.

Note: DSD operation of the BNC outputs requires an upgrade option.

7.5.10. Validity bit on AES3 and IEC958 format digital outputs

In A-D mode the validity bit is transmitted as zero which indicates that the audio data is suitable for conversion to analogue using linear PCM decoding.

In D-D mode, if a reception error is detected then the validity flag on the AES3 or IEC958 output is set, otherwise it is passed through from the input unless the selected input is SDIF-2 format when it is set to zero.

7.5.11. User bit on AES3 and IEC958 format digital outputs

In A-D mode the output user data bit is zero.

In D-D mode the user data from the input is passed through to the output. This allows D-D processes, such as SNS noise shaping, to be performed with CD or DAT subcodes intact. If the selected input is SDIF-2 format then the user data bit is zero.

7.5.12. Channel status bit on AES3 and IEC958 format digital outputs

In A-D mode the channel status is internally generated with appropriate fields correctly set according to the operating conditions. The consumer format outputs carry the category code for ADC with copyright information and copy permit.

In D-D mode, principal input channel status fields, such as emphasis, are passed through to the output; other fields are internally generated. The overall status information is processed into professional or consumer format for each output type.

NOTE: for AES3 and AES-3id outputs in Split96 mode, the channel status fields which describe the channel mode are set to indicate Split96, as newly proposed in ref. 2, 8.

7.5.13. Jitter characteristics common to all digital outputs

Jitter peaking: less than 1dB
Jitter attenuation slope: 80dB per decade
Corner frequency: approx 80Hz
Attenuation above 500Hz: > 60dB

7.6. Synchronization

Lock range: ±0.15% of a standard sampling rate:

Nominal	Minimum Range
32 kHz	31.96 to 32.04 kHz
44.1 kHz	44.03 to 44.17 kHz
48 kHz	47.93 to 48.07 kHz
88.2 kHz	88.07 to 88.33 kHz
96 kHz	95.86 to 48.14 kHz

Lock-up time: 2 s

Digital input to digital output timing difference: < 5% of a sample period

Note: This is referred to the first transition of an AES3 or IEC958 frame or the rising edge of word clock.

Internal high-precision clock accuracy: ±5 ppm

D-D mode reference-to-input timing variation, before sample slip:
±25% of sample period

Note: The AES11-1991 synchronization standard [2] requires an input synchronization window of ±25% of a sample period without hysteresis.

7.7. Power

7.7.1. Mains voltage: Externally set using selector as follows:

Nominal setting	Range
'100V'	90-110VAC
'120V'	110-130VAC
'220V'	190-220VAC
'240V'	220-260VAC

7.7.2. Consumption: 30W

7.8. Physical Dimensions

Weight: 8.8 lb (4 Kg)
Width: 19 inch (483mm) (rack-mountable)
Height: 1U (44mm)
Depth: 10.25 inches (260mm)

7.9. Fuses

Other than the external mains fuse, the following parts can only be accessed by removing the equipment top cover. This should only be undertaken by qualified personnel. There are no user serviceable parts inside this unit.

There is one mains fuse in the IEC320 mains inlet. If this fuse is blown it should be replaced by a similar value and type. (20x5mm 250V 2AT anti-surge)

There are five fuses internal to the unit, located close to the main heatsink. If these fuses have blown, a fault has occurred and the unit should be returned to the manufacturer or agent for service. The fuse types and applications are:

F3	-	Analogue 5V supply
F4, F5	-	Digital 5V and 3V3 supplies
Type: 2AT		Wickman TR5 subminiature type no. 19372K/2A

F1, F2	-	Analogue input supplies
Type:	0.5AT	Wickman TR5 subminiature type no. 19372K/500mA

8. PERFORMANCE PLOTS

8.1. Dynamic Range

Figure 19 shows a Dynamic Range plot of the AD-2 in A-D mode sampling at 96kHz.

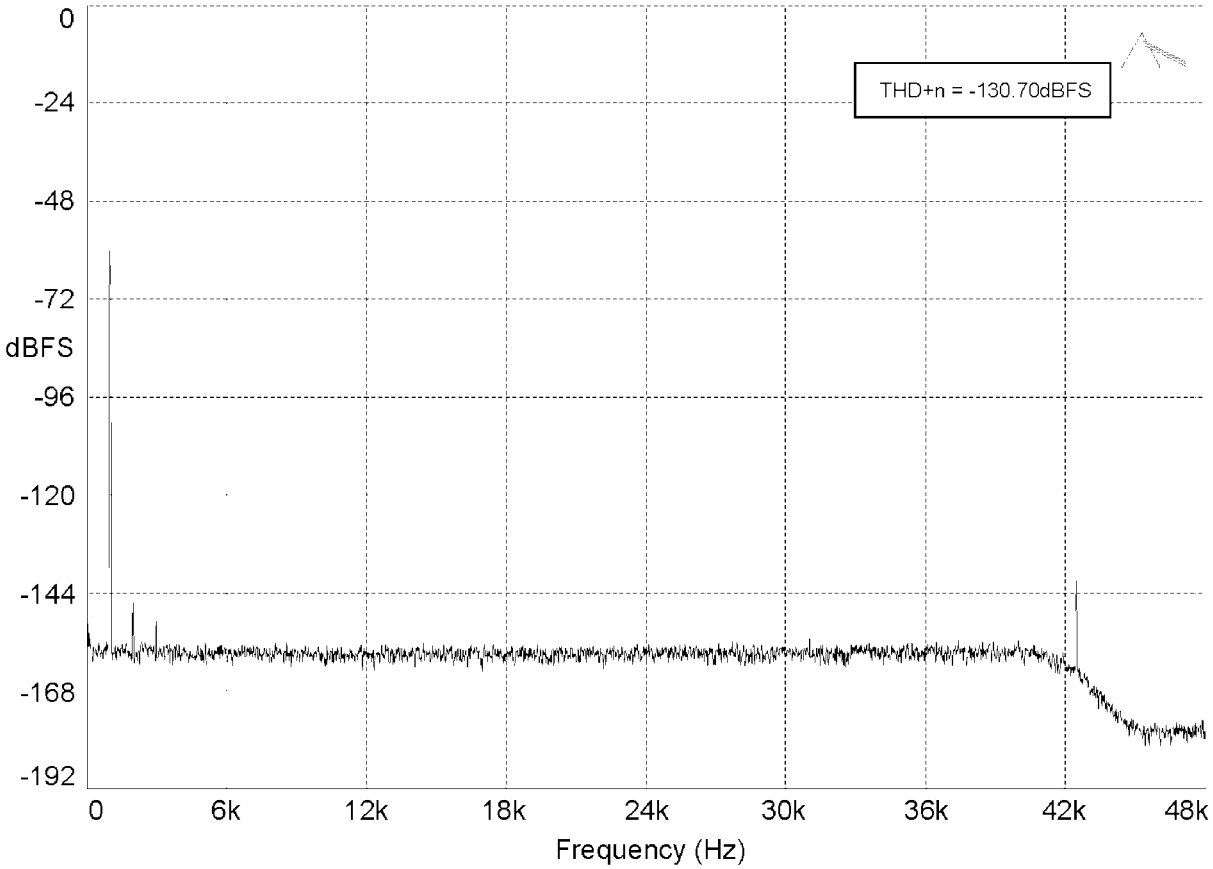


Figure 21: A-D mode Dynamic Range, at +28dBu sensitivity, 1kHz sine @ -60dBFS

Apart from its unrivalled dynamic range (measured as 130.70dB in the test above) which ensures that the AD-2s noise lies well below that of any practical analogue source, the AD-2 also has an exceptionally *clean* noise floor, free from spuriae and interference components.

8.2. THD+n

Figure 20 shows a THD+n plot of the AD-2 in A-D mode sampling at 96kHz.

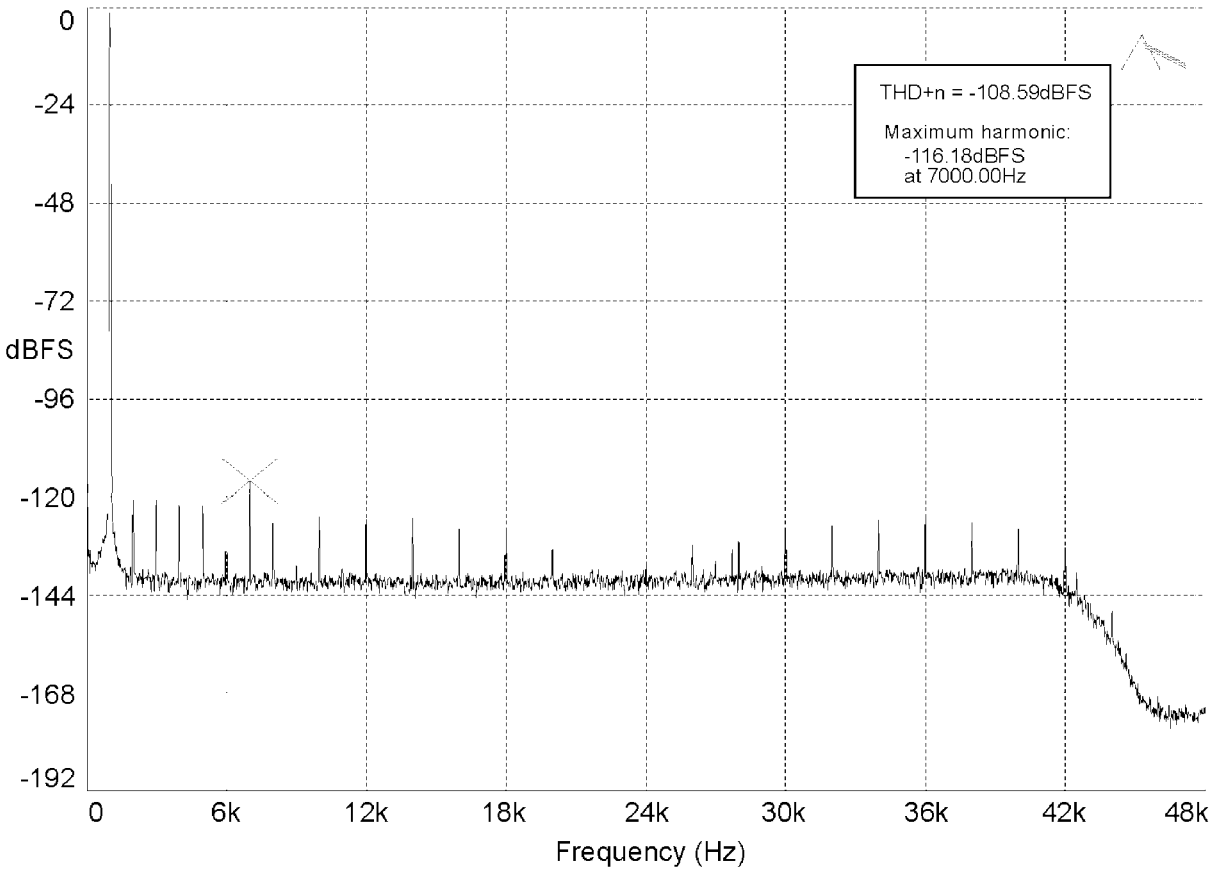


Figure 22: A-D mode THD+n, at +18dBu sensitivity, 1kHz sine @ -1dBFS

Although the -108.59dBFS full-scale THD+n figure is, in itself, state-of-the-art, the absence of aharmonic spuriae gives the large-signal handling of AD-2 an entirely analogue quality.

8.3. SRC (Sample-rate converter)

Figure 21 shows a THD+n plot of the AD-2 in D-D mode, sample-rate-converting a 24-bit, 96kHz-sampled 1kHz full-scale sinewave to 44.1kHz sampling rate.

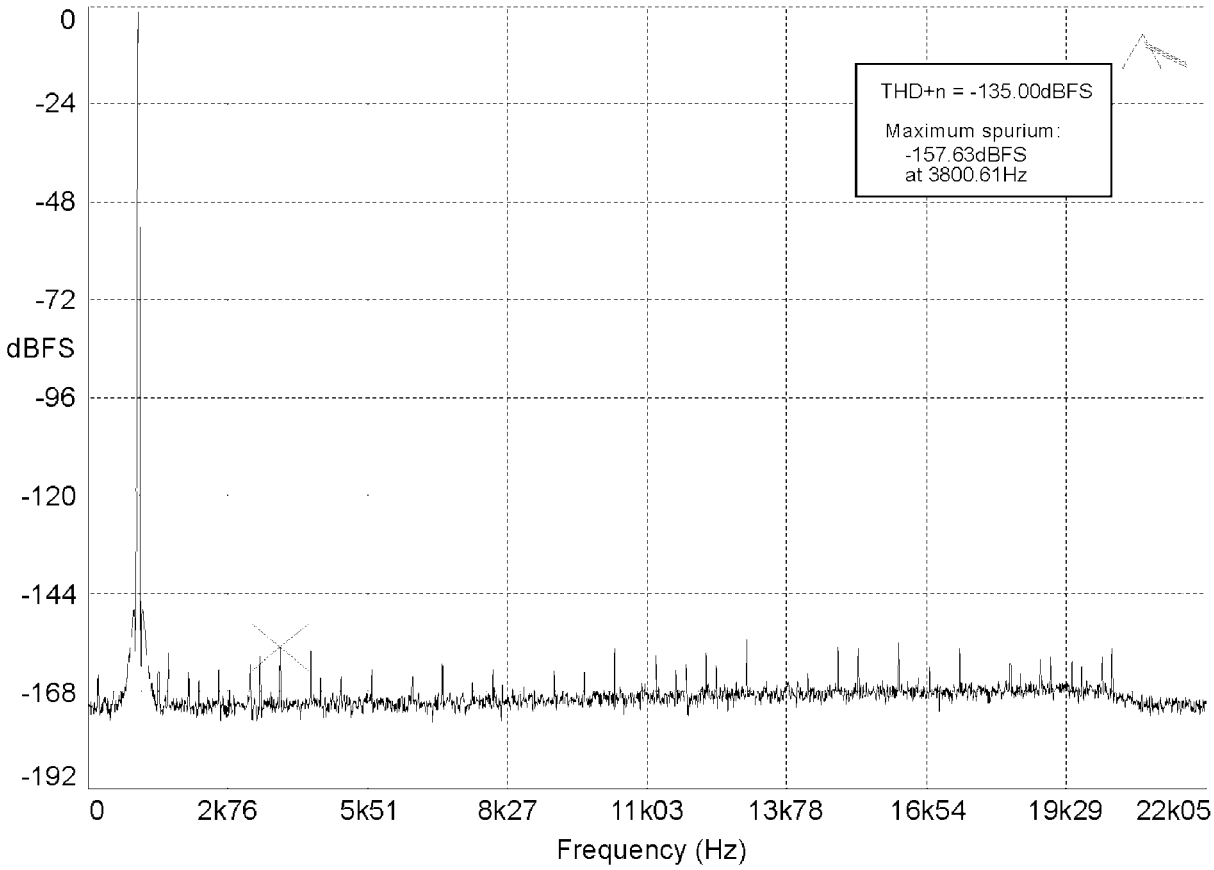
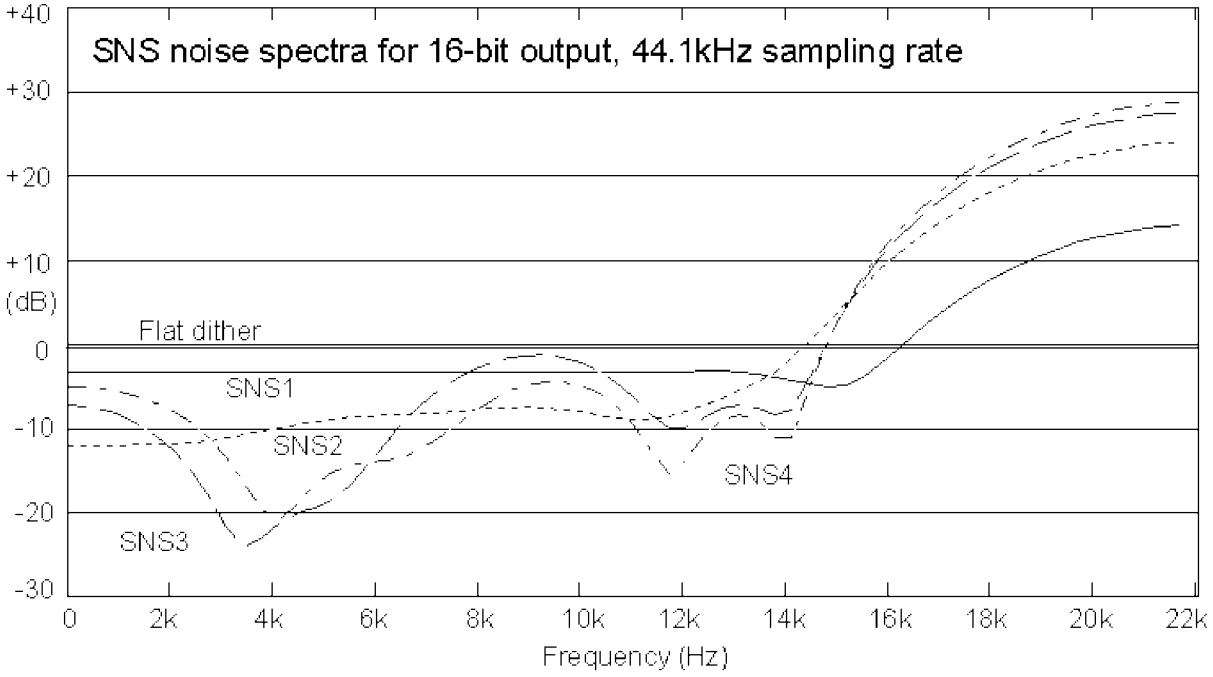
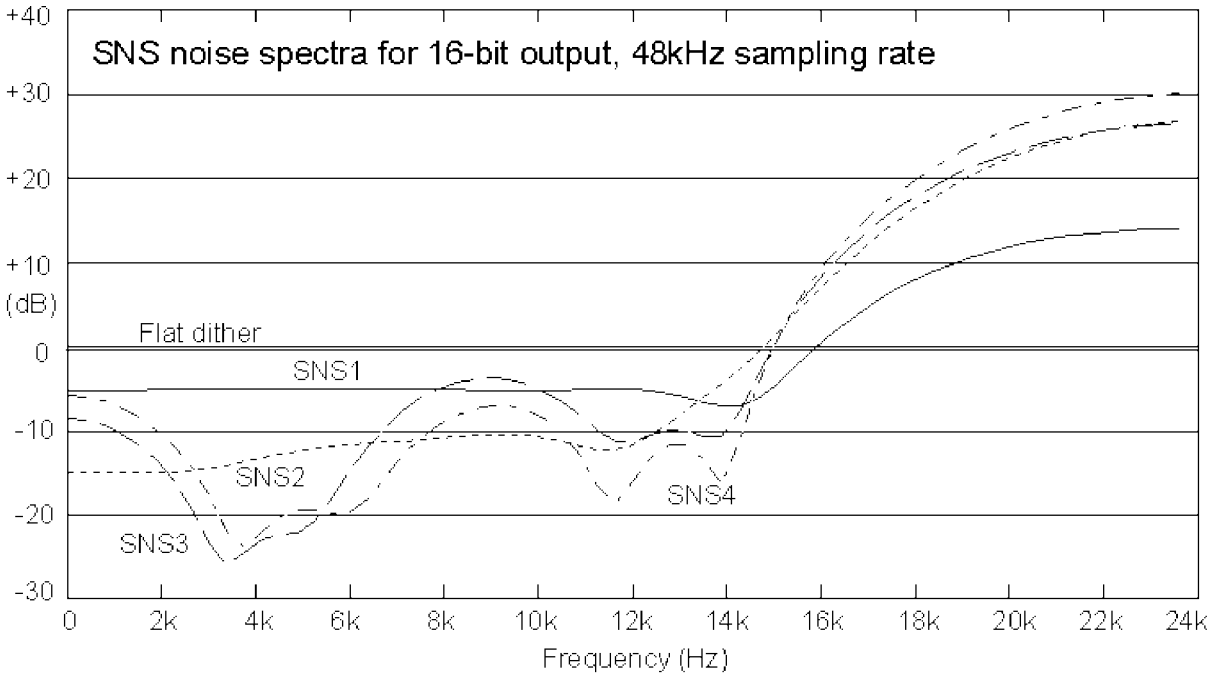


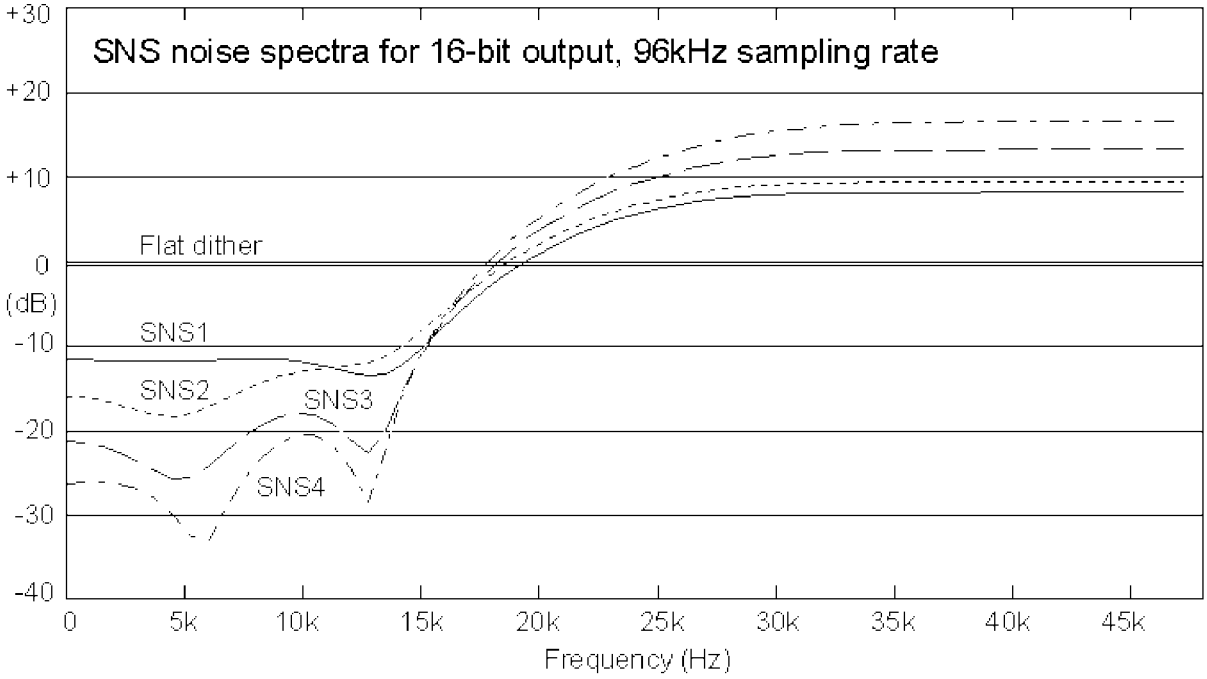
Figure 23: D-D SRC mode THD+n, 96kHz-to-44.1kHz, 1kHz sine @ 0dBFS

The largest spurious component in the test above is -157.63dBFS. This figure represents a huge improvement over competitive asynchronous rate converters, whose imprecise conversions produce large and obtrusive aharmonic distortion components; these distortions have given sample-rate-converters their characteristic 'sound' in the past.

9. SNS NOISE SHAPER CHARACTERISTICS






SNS noise spectra for 16-bit output, 96kHz sampling rate
+30
+20
+10
0
(dB)
-10
-20
-30
-40
Flat dither
SNS1
SNS2
SNS3
SNS4
0
5k
10k
15k
20k
25k
30k
35k
40k
45k
Frequency (Hz)

10. ELECTROMAGNETIC COMPATIBILITY

This equipment is intended for use in an electromagnetically controlled environment. To maintain the performance specification it should not be subject to strong magnetic fields (such as in the immediate vicinity of a power amplifier or cathode ray tube) and all connections should be terminated as described in the relevant sections of this manual. This is also required to ensure that emissions are within applicable norms and that it does not interfere with other equipment.

All coaxial connections should be made using a properly screened 75Ω cable with the screen connected to the outer of the connector at both ends. All XLR connections should use a screened twisted pair cable with the screen connected to pin 1 of the XLR connector at both ends. In the case of the digital XLR connections this cable should be of 110Ω impedance.

11. REFERENCES

[1] AES3-1992 - ` Recommended Practice for Digital Audio Engineering - Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data' *J. Audio Eng. Soc.*, Vol 40 No. 3, pp 147-165 (June 1992)

[2] AES11-1991 - `AES Recommended Practice for Digital Audio Engineering - Synchronization of Digital Audio Equipment in Studio Operations' *J. Audio Eng. Soc.*, Vol. 39 No. 3, pp 155-162 (March 1991)

[3] AES17-1991 - `AES Standard Method for Digital Audio Engineering - Measurement of Digital Audio Equipment' *J. Audio Eng. Soc.*, Vol. 39 No. 12, pp 961-975 (December 1991)

[4] IEC958 - `Digital Audio Interface' International Electrotechnical Commission 1989

[5] Julian Dunn, Barry McKibben, Roger Taylor and Chris Travis - `Towards Common Specifications for Digital Audio Interface Jitter' Preprint 3705, presented at the 95th AES Convention, New York, October 1993

[6] Julian Dunn and Ian Dennis - `The Diagnosis and Solution of Jitter-Related Problems in Digital Audio Systems' Preprint 3868, presented at the 96th AES Convention, Amsterdam, February 1994.

[7] AES-3id-1995 - `AES information document for digital audio engineering - Transmission of AES3 formatted data by unbalanced coaxial cable' *J. Audio Eng. Soc.*, Vol. 43 No. 10, pp 827-844 (October 1995)

[8] Draft AES3-1992 Amendment 3-xxxx - Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data' (still in preparation, July 1998)

FURTHER INFORMATION

Enquiries about this product should be addressed to :

Prism Media Products Limited
William James House
Cowley Road
Cambridge
CB4 0WX
UK
Phone: +44-(0)1223-424988
Fax: +44-(0)1223-425023
Email : tech.support@prismsound.com
Web: http:\\www.prismsound.com

Prism Media Products Limited
William James House
Cowley Road
Cambridge
CB4 0WX UK
E-mail : sales@prismsound.com
Web : www.prismsound.com

Tel: +44 (0)1223 424988
Fax: +44 (0)1223 425023