

# DNS2000

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Dialogue noise suppressor



**CEDAR** 

CEDAR Audio Limited  
[www.cedaraudio.com](http://www.cedaraudio.com)

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# INTRODUCTION

In 2000, CEDAR Audio launched the DNS1000 dynamic noise suppressor. This was a stand-alone, desktop-format unit designed specifically for film production, dubbing, outside broadcast (remote) and studio noise suppression.

The format of the DNS1000 was ideal for replacing analogue units that had been in use for many years, and for use in situations where rapid setup and processing was required 'on the fly'. However, it did not offer automation, nor could it be linked to a digital audio workstation other than by its audio connectors. So we designed the DNS2000...

The DNS2000 is a combination of a rackmount unit that provides audio I/O and nearly 200MFLOPS of processing power, plus control system software for your Pro Tools (Mac or PC) host system. You can apply it equally to recorded signals and to live signals at the point of recording or transmission.

With just a single USB control connection between the DNS2000 hardware and the host, the DNS2000 is very simple and quick to install. Once you have loaded the DNS Control System software (and, if using the DNS2000 with a PC, the hardware driver) you can control all aspects of its operation from within Pro Tools, and automate all its operating parameters. Quality, speed and simplicity are paramount considerations in the DNS2000 design, and its features include the following:

## **Near zero latency**

The DNS2000 has a group delay of less than 10 samples (typically less than 1/200th of a frame) so there is no loss of lip-sync when using it.

## **Connectivity**

The DNS2000 can be used with both Pro Tools (Mac) and Pro Tools (PC) systems.

## **Flexibility**

The DNS2000 will handle a wide range of noise suppression requirements.

## **Speed and ease of use**

The DNS2000 offers a carefully designed user-interface that maximises speed of use.

## **Audio interfaces**

The DNS2000 incorporates a 24-bit digital audio interface conforming to both AES/EBU and SPDIF standards.

## **Universal power supply**

Its universal power supply means that a DNS2000 will work anywhere in the world.

## **Powerful processor**

A 40-bit floating point DSP processor delivers up to 198MFLOPS so that the DNS2000 will handle the most complex processing requirements.

## SYSTEM REQUIREMENTS

### Macintosh OS X users:

The DNS2000 should be used with Pro Tools version 8 or later. Any Macintosh with a free USB port running Mac OS X 10.5.x or later and Pro Tools will support the DNS Control System and DNS2000 processor unit.

### DNS2000 firmware

To run the DNS2000 software under OS X, the DNS2000 hardware will require version 6 firmware (or higher). Units originally shipped with firmware versions 3, 4 or 5 for use with V1 or V2 software must be upgraded. Once you have installed the Control System, the firmware upgrader will appear at:

#### **Applications/CEDAR/DNS2000FirmwareUpgrader**

Run this programme and then follow the on-screen instructions to upgrade the firmware.

### PC users:

The DNS2000 should be used with Pro Tools version 8 or later. Any PC with a free USB port running Windows XP, Vista or 7 and a suitable version of Pro Tools will support the DNS Control System and DNS2000 processor unit.

### DNS2000 firmware

To run the DNS2000 software under Windows, the DNS2000 hardware will require version 6 firmware (or higher). Units originally with firmware versions 3, 4 or 5 for use with V1 or V2 software must be upgraded. Once you have installed the DNS Control System, the firmware upgrader will appear in your Start menu as:

#### **All Programs/CEDAR Audio Ltd/Pro Tools/DNS2000/DNS2000 Firmware Upgrader**

Run this programme and then follow the on-screen instructions to upgrade the firmware.

## **SAFETY INSTRUCTIONS**

Read these instructions, and follow them.

### **Water and moisture**

The DNS2000 rackmount processor must not be exposed to rain or moisture. Furthermore, if the DNS2000 is brought directly from a cold environment into a warm one, moisture may condense inside it. This, in itself, will not cause damage, but may cause electrical shorting. This could damage the DNS2000, and even cause danger to life. Always allow the DNS2000 to reach ambient temperatures naturally before connecting the mains power.

### **Mounting and ventilation**

You should place the DNS2000 on a flat, stable surface or mount it in a standard 19" equipment rack. Use the supplied rubber feet to avoid scratching the surface, or the rackmounting accessories, as appropriate. Do not subject the DNS2000 to strong sunlight, excessive dust, mechanical vibration or periodic shocks. The unit is not susceptible to excessive heat build-up, but should be installed away from heat sources such as radiators and audio devices that produce large amounts of heat.

### **Power sources**

The DNS2000 features a universal power supply that will work safely on any mains supply in the range 85V to 260V, 50Hz or 60Hz AC only. The unit should always be grounded (earthed), and you should route power cables so that they will not be walked on or pinched.

### **Connections**

Turn off the power to all equipment before making any connections.

### **Cleaning**

Clean the DNS2000 only with a dry cloth. Never use abrasive pads or liquid cleaners such as alcohol or benzene.

### **Damage requiring service**

The DNS2000 contains no user-serviceable parts and should on no account be opened or dismantled by unauthorised personnel. It should be returned to qualified service agents when it has been exposed to liquids, when it fails to function correctly, when it has been dropped, or when the case is damaged.

## ASSUMED KNOWLEDGE

This manual assumes that you are fully conversant with your Mac or PC system(s), and that you know how to operate Pro Tools. It will refer to operations that are common to these products, but will not attempt to explain them.

### Troubleshooting Non-CEDAR Components

If you encounter problems with your Macintosh®, OSX®, your PC, Microsoft Windows®, or Pro Tools®, please refer to the relevant manuals, or contact the dealer that supplied these to you.

Unless appointed independently as authorised dealers for the following products, CEDAR Audio's dealers will not attempt to provide technical support for:

- Macintosh computers
- Mac OSX
- PCs of any description
- Microsoft Windows
- Digidesign hardware
- Digidesign software

## CONTACT INFORMATION

### Headquarters

Address:	CEDAR Audio Ltd, 20 Home End, Fulbourn, Cambridge, CB21 5BS, UK
Telephone and Fax:	T: +44 1223 881771      F: +44 1223 881778
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### USA Office

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Telephone and Fax:	T: +49 5481 945087      F: +49 5481 945088
Email:	info@cedaraudio.de

### Web

English language:	<a href="http://www.cedaraudio.com">www.cedaraudio.com</a>
German language:	<a href="http://www.cedaraudio.de">www.cedaraudio.de</a>

### Worldwide Dealer List

For an up-to-date dealer list, please visit [www.cedaraudio.com](http://www.cedaraudio.com), and click on 'Contact Us' followed by 'Worldwide Dealer List'.

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# SETTING UP THE DNS2000 HARDWARE

## Unpacking

Unpack the DNS2000 carefully. Save the carton and all packing materials since you may need them to transport the unit in the future. In addition to this manual, the DNS2000 and its packaging, the box should contain the following:

- mains connection lead and USB cable
- software CD-ROM
- rackmounting accessories and rubber feet
- warranty registration card.

## Installation Site

To maintain reliability and prolong operating life, observe the following environmental considerations:

- the temperature should be maintained between 5 and 30 Celsius
- relative humidity should be in the range 30% to 80% non-condensing
- strong magnetic fields should not exist nearby.

## Rear Panel Connections



## Audio

The DNS2000 offers two audio connection standards. It passes its signal to both outputs irrespective of the input used. The standards are:

- Digital SPDIF format
- Digital AES/EBU format.

The processor will lock onto the first input that provides a valid clock. It is not affected by channel status data and will echo any such data directly to the outputs.

## USB

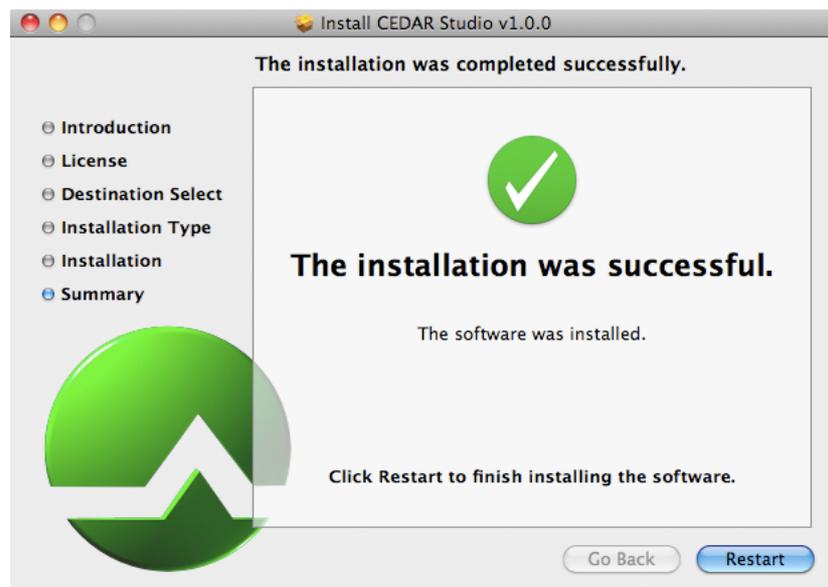
The USB connection allows you to control the DNS2000 hardware using your Pro Tools system. You must connect the two using a USB cable.

## INSTALLING THE DNS CONTROL SYSTEM – MAC

- Insert the CD.
- Ensure that any older versions of the plug-in (if any) are archived and removed from the plug-in folder.
- Double-click on the installer package:  
**CEDARStudioInstaller.mpkg**
- Follow the instructions offered by the installer.
- Ensure that you have sufficient space on your drive.



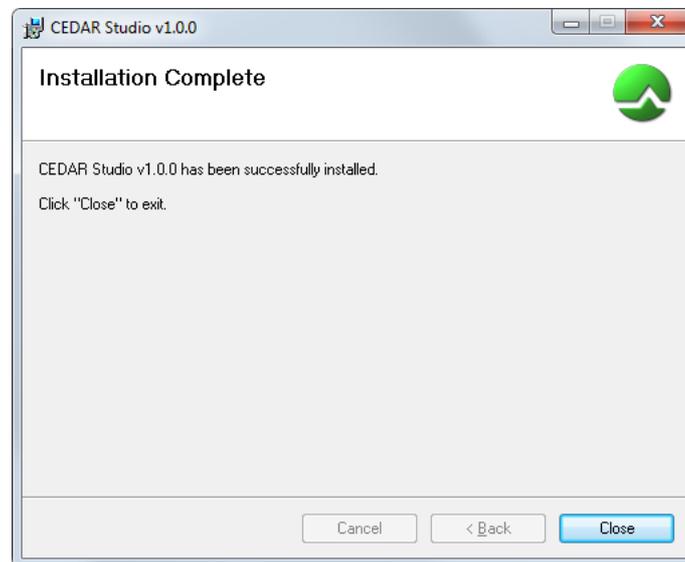
- Press the Continue button when prompted and the software will be installed. A message will appear to tell you that the operation has been completed successfully.



## INSTALLING THE DNS CONTROL SYSTEM – PC

You will need to install two pieces of software: the Control System, plus a driver that allows the PC to communicate with the DNS2000 hardware.

- Insert the CD.
- Double-click on the installer package:  
**setup.exe**
- Follow the instructions offered by the installer.
- Press the Next button when prompted and the software will be installed. A message will appear to tell you that the operation has been completed successfully.
- When the installation is complete, click on Close.



### DNS2000 driver:

Before connecting and using a DNS2000 for the first time on a given PC you will need to install the hardware driver.

- Locate the appropriate driver installation software in the **\Win\Driver** folder on the CD that came with your DNS2000.
- If you are running a 32-bit version of Windows run the file:  
**CEDARUSBInstaller\_x86.exe**
- If you are running a 64-bit version of Windows run the file:  
**CEDARUSBInstaller\_x64.exe**

A wizard will guide you through the installation.



When the wizard has completed installation, the following screen will appear to confirm that the software has been successfully installed.



## Windows Security

During the installation, the wizard will ask whether you trust software from CEDAR Audio Ltd. (The exact message will differ according to which version of Windows you are running.)

Click on the appropriate button to proceed.

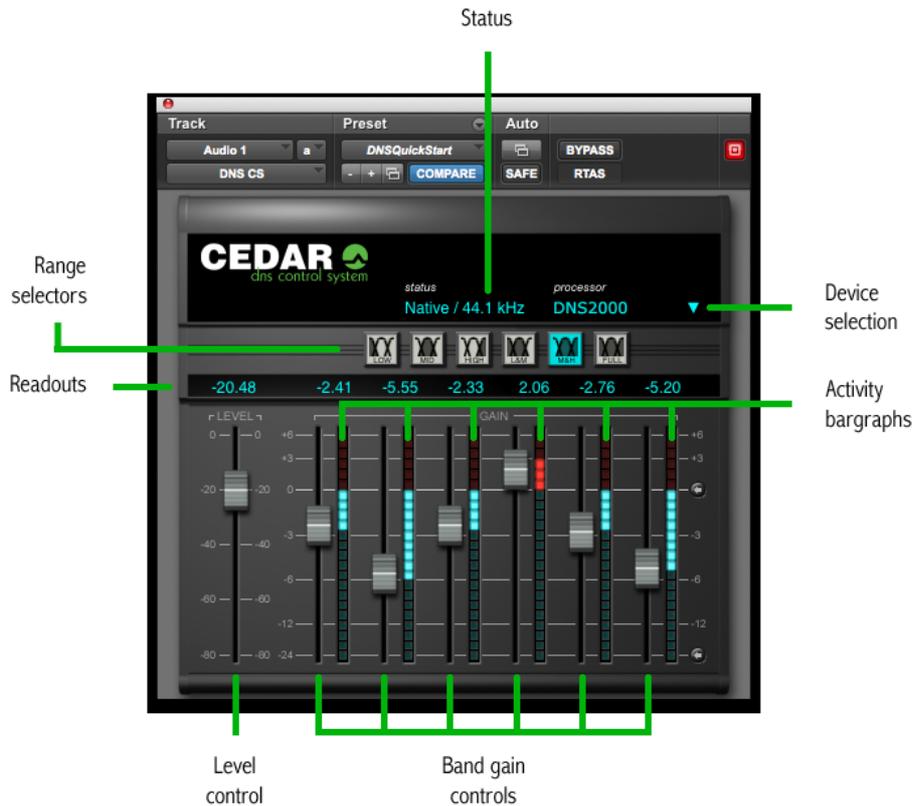


*Windows XP security message*



*Windows 7 security message*

## DNS CONTROL SYSTEM – CONTROLS



### Range Selectors

The Range Selectors concentrate the unit's activity into the desired part of the audio spectrum. Selecting any of these ranges concentrates all of the filters within the DNS2000's filter bank across that part of the audio spectrum.

Range	Frequencies covered
Low	20Hz - 400Hz
Mid	200Hz - 6kHz
High	4kHz - 18kHz
Low+Mid	20Hz - 6kHz
Mid+High	200Hz - 18kHz
Full Range	20Hz - 18kHz

### Level Control

The Level Control tells the DNS2000 how much noise is present in the input.

## Band Gain Controls

The DNS2000 divides a signal into a large number of well-defined bands. Sophisticated digital filters analyse each of these bands and suppress the noise independently in each. The innovative design of this filter bank allows you to adjust the DNS2000 using relatively few controls.

The Band gain controls determine the maximum amount of processing that the DNS2000 will apply in each band.

## Activity Bargraphs

These offer a visual indication of the activity in each of the bands.

## Device Selection

You can connect the DNS Control System to any of the following three CEDAR products:

- DNS One
- DNS2000
- DNS3000

The drop-down list on the plug-in displays all the DNS processors that are currently available, and it allows you to select which processing engine will be controlled by this instance of the DNS Control System.

### The DNS Network Scanner

If you have DNS3000s on the same network as the Pro Tools system supporting your DNS2000, you can use the Scan Network option to detect these and assign them for local use.

## Status

If no processing engine is connected and/or selected, the I/O status will read **No processor**.

If the DNS Control System has successfully connected to a DNS2000 the following status messages may occur:

Message	Explanation
XLR / 44.1kHz	If printed in blue, everything is working correctly. If in orange, the sample rate is out of range.
RCA / 48.0kHz	If printed in blue, everything is working correctly. If in orange, the sample rate is out of range.
---/-----	Unknown input status and unknown sample rate.
No lock	No valid audio signal has been detected at the input.

If the DNS Control System has not connected successfully with the DNS2000 processing engine the following status messages may occur:

Message	Explanation
No unit connected	No DNS2000 hardware has been detected.
Unknown error	Another error has occurred. Further investigation will be required.

## Generic Pro Tools Plug-in Controls

The standard Pro Tools plug-in facilities are provided. These have generic operation, and are described in the Pro Tools documentation.

## Automation

The Band Gain settings, the Level and the Range Selectors appear in the Plug-In Automation screen and, together with the Pro Tools bypass control, may be automated in standard Pro Tools fashion.

# HARDWARE INDICATORS



## USB LEDs

### Link

When lit, this indicates a valid USB connection.

### Data

This flashes when Pro Tools communicates with the DNS2000 via the USB input.

## Input LEDs

### AES, SPDIF

The lit LED indicates which audio input is in use. If the LEDs are flashing alternately, there is no valid audio being presented to either of the DNS2000 processor's inputs.

### Peak

These LEDs indicate the audio input level. The upper row shows the level on Channel 1, the lower row shows the level on Channel 2. If the red '0' LED lights continuously for about one second, this indicates input clipping.

The DNS2000 is capable of applying gain to the signal, so the absence of input clipping does not guarantee the absence of output clipping.

## Off / On LEDs - Channel 1 & Channel 2

These LEDs indicate whether the channel is selected to process.

## Range LEDs - Channel 1 & Channel 2

The three LEDs Low, Mid and High indicate which range(s) is/are selected for processing.

## Gain LEDs - Channel 1 & Channel 2

The twelve Activity LEDs for each channel offer a visual indication of the activity in each of the six bands controlled by the Band Gain controls.

Both LEDs off: Less than  $\pm 0.5$ dB activity

Cut (green) LED dim: Between 0.5dB and 3dB attenuation

Cut (green) LED bright: Greater than 3dB attenuation

Boost (red) LED dim: Between 0.5dB and 3dB gain

Boost (red) LED bright: Greater than 3dB gain

Each band controls numerous filters. Therefore, the Activity LEDs for a given band display the overall activity in that band, and are not necessarily indicative of the action of any single filter at that moment.

## USE

Launch the DNS Control System, which is an RTAS plug-in, in the usual fashion. Remember that the Control System software is precisely what it claims to be: a control system. It performs no audio processing. To process an audio stream you must route it via the DNS2000 rackmount unit. You can do this, for example, by using an insert point within the Pro Tools mixer.

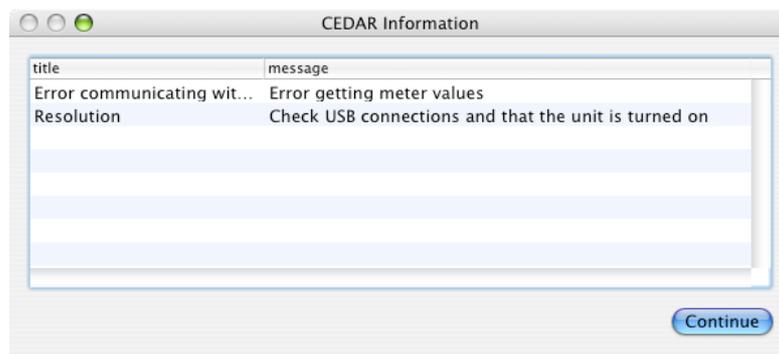
### Selecting a DNS2000 Processor

You can launch the DNS Control System (DNS CS) on your Pro Tools system, but until you tell it which processor to use, it will do nothing.

The drop-down list on the DNS Control System displays any DNS2000 units plus all other available processors (DNS One, DNS3000) connected to your system. If there is a DNS2000 serial number shown in the list, it is available for use on your system.

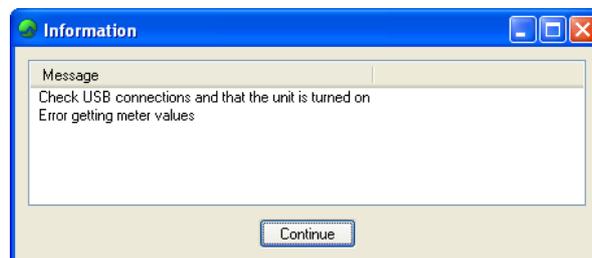
#### OS X users:

The following error message (or similar) indicates that - perhaps because of a power failure, or because the USB connection has been severed - there is an error communicating with the DNS2000 processor that you have requested.



#### PC Users:

The following error message (or similar) indicates that - perhaps because of a power failure, or because the USB connection has been severed - there is an error communicating with the DNS2000 processor that you have requested.



### Range Selector

With a DNS2000 unit correctly connected and recognised by the Control System, you should identify the frequency range or ranges in which the unwanted noise lies, and select any of six possible processing ranges by clicking on the appropriate buttons.

With practise, you will be able to identify the range by ear. Until then, you may prefer to use the methods described in the following case studies.

## Level Control

Your next job will be to identify the noise level of the audio. With the appropriate range selected, pull all six Band Gain controls and the Level control down fully or use the **DNSQuickStart** preset to do so. Now increase the Level slowly. At first, you will hear very little happen but, at some point determined by the noise content of the recording, you will hear the noise disappear. You should attempt to determine the point at which this occurs.

When the Band Gain controls are fully down, maximum processing occurs for any given Level setting, thus making identification of the noise easier

## Band Gain Controls

Once you have chosen the range and determined the Level, you control the action of the DNS2000's filter bank using the Band Gain controls.

The six faders represent six frequency bands (each containing multiple filters) distributed from lower frequencies (left) to higher frequencies (right) across the selected range.

You will use the Band Gain controls to control the amount of noise attenuation performed in each band, adjusting them to suppress as much noise as possible without introducing unwanted artefacts into the desired signal.

Noise suppression occurs in a given band when the fader is below 0dB. However, there are occasions when you might wish to boost the signal in a given band, and you can do this by moving the appropriate fader above 0dB.

## Creating generic settings files

If you save a Settings file in the Pro Tools Librarian menu window with 'None' selected as the DNS processor, you can reload this file when connected to a given DNS and the control parameters will be retrieved without changing the selection. The DNSQuickStart file is an example of such a file, and can be used to initialise the control settings of any DNS.

If a DNS is specified when you save a Settings file, your system will attempt to reconnect to it when you reload that file.

## Tutorials

The following three tutorials illustrate ways to use the DNS2000. They may not be the ways that you choose to operate it for all jobs, but they will get you started.

## **SUPPRESSING TRAFFIC NOISE AND OTHER AMBIENT SOUND**

The DNS2000 can suppress background noises such as road traffic, aircraft, air conditioning, wind, rain, and many other common soundstage, location, and outside broadcast (remote) problems that contaminate audio. If your signal exhibits any of these problems, you can suppress them as follows.

### **First, identify the frequency range(s) in which the noise lies.**

You should be able to do this by listening to the problem. However, if this proves difficult, you can use the following method.

It is not important that you find the perfect settings at the first attempt. In particular, you will be able to refine your Level and Band Gain settings once you have found the correct range.

Begin as follows:

Ensure that the DNS 2000 is not in Bypass

Select Full Range

- Set all six Band Gain controls to -24dB
- Move the Level control to -80 and then raise it until the noise disappears

At this point you have determined an approximate setting for the Level. This is necessary for determining the range but it is likely that you will refine this later in the procedure.

When the Level is close to the ideal setting, you should see the Activity Bargraphs in the Control System flicker in response to the signal content.

Now continue as follows:

- Raise the Band Gain controls to 0dB (no processing occurs)
- Adjust the Band Gain controls to suppress the noise

You should always attempt to suppress the noise with the minimum of damage to the desired signal.

In all likelihood, you will find that the leftmost Band Gain controls are pulled down significantly, whereas the central and rightmost are close to 0dB. This tells you that the problem does not lie in the upper frequencies, so you should use the Range Selectors to select Low+Mid. Then repeat the steps marked '•'.

If you now find that you are using all six faders in similar fashion, it is likely that the noise is distributed across the entire Low+Mid range. However, if the suppression is still heavily biased towards the left-hand faders, you should now select the Low range and repeat the procedure.

If you select Low alone and cannot suppress the noise, it is probable that there is considerable noise energy in the Mid band, so you should return to using Low+Mid ranges.

For many problems such as traffic noise, the noise will lie primarily in the range 50Hz - 1.5kHz. In this case, Low+Mid will be the correct choice.

### **Second, optimise the Level control.**

Listening carefully to the audio, refine the Level setting so that the noise is correctly identified without introducing audible artefacts. If this proves difficult, you can return the Band Gain controls to -24dB for this stage.

The DNS2000 takes a short period to settle after moving the Level control (especially in the lower ranges) so you should not adjust it rapidly.

### Third, refine the Band Gain controls for optimum suppression.

Set all six Band Gain controls to 0dB. Now increase and decrease the gain in each band separately while listening to the effect that each has on the noise. This will identify the bands that contain the majority of the noise. (Do not be alarmed if all six bands contain significant noise. This is not unusual.)

Let's assume that the greatest improvement occurs when you reduce the gain in bands 3 and 4. This suggests that the noise is concentrated in an approximate range of 200Hz to 1kHz. You should now find the optimum positions for all six faders. The greatest cuts will lie in bands 3 and 4, whereas bands 1, 2, 5 and 6 should remain as close to 0dB as possible to ensure that minimal signal damage occurs in the bands that do not contain much noise.

The final configuration might look like this:



## SUPPRESSING TAPE HISS

The DNS2000 can suppress the tape hiss that mars many older recordings. It will also improve the signal/noise ratio of dialogue tapes that have been poorly copied as well as those that are several generations old.

### First, identify the frequency range(s) in which the noise lies.

You should follow the procedure laid down in the previous example to determine the range(s) in which the problem lies. For most instances of tape hiss, you will find that the Mid+High ranges are most appropriate. In a few cases you may find that the High range alone is most suitable.

It is not as common to require suppression in the Low range because hiss is usually less prominent at lower frequencies, and it may also be masked by the genuine audio in the range.

### Second, optimise the Level control.

To determine the correct Level, you should again follow the procedure described previously.

### Third, refine the Band Gain controls for optimum suppression.

As in the first tutorial example, you should start with all six Band Gain controls at 0dB. You should then increase and decrease each control individually to find the bands that contribute most hiss to the signal. Because tape hiss often exhibits a white profile at Mid and High frequencies, you may find that satisfactory results are achieved with the Band Gain controls set in a horizontal line.

However, hiss is generally less annoying at very high audio frequencies. Consequently, you may be able to reduce the amount of processing in the uppermost bands. This will help to ensure that any low amplitude signal components lying at high frequencies (which provide much of the 'air', 'ambience' or 'life' in a signal) are passed with little or no attenuation.

The final configuration might look like this:



## SUPPRESSING EXCESSIVE REVERBERATION

In many situations, the DNS2000 can suppress excessive reverberation. This can be useful in TV production when you need to match the audio from a large recording studio or soundstage to visual images set in a small room or other enclosed space. Suppressing reverberation can also be beneficial in increasing the intelligibility of poor dialogue recordings.

The method used to suppress reverberation is quite different from that applied in the previous examples, and is as follows:

### First, set the range in which the reverberation lies.

In general, reverberant spaces include soft materials that absorb high frequencies more rapidly than middle and lower frequencies. Even bare rooms with hard walls include these soft materials: they are the people who are speaking.

Consequently, you will find that Low+Mid is almost always the most appropriate combination of ranges for suppressing reverberation.

### Second, set the Band Gain controls.

You should set all six Band Gain controls to -24dB. This will ensure that (if the Level is set correctly) the DNS2000 applies maximum suppression to the tails of the sound.

### Third, optimise the Level control.

Starting at its minimum position (-80dB) increase the Level control slowly. At some point before full noise suppression becomes apparent, you will hear the tails of louder sounds become truncated.

You can adjust the amount of truncation of the reverb using the Level control rather than the Band Gain controls.

The final configuration might look like this:



## SPECIFICATIONS

### General

Power supply: 85–260VAC; 50–60Hz

Dimensions: 1U rackmount, 20cm depth

### Audio

I/O type: Digital PCM

Sample rates: 44.1, 48 kHz

I/O resolution: 24 bits

Data formats: SPDIF or AES/EBU

Processor power: 198MFLOPS

Process resolution: 40 bits

Latency: <10 samples

## EMC REGULATIONS

In order to comply with EMC regulations, you must connect the DNS2000 using metal-shelled connectors and good quality shielded cable suitable for digital audio.

### Declaration of conformity

Date of issue: 1 April 2002

Equipment: CEDAR DNS2000

Manufacturer: CEDAR Audio Ltd

Address: 20 Home End, Fulbourn, Cambridge CB21 5BS, UK

This is to certify that the aforementioned equipment, when used in accordance with the instructions in this manual, fully conforms to the protection requirements of the following EC Council Directives: on the approximation of the laws of the member states relating to:

■ 89/336/EEC Electromagnetic Compatibility

Applicable standards: EN 55103-1:1996 EN 55103-2:1996

■ 73/23/EEC Low Voltage Equipment

Applicable standard: EN 60065:1998

E&OE. The Company reserves the right to change specifications without notice.

# LICENCE AND LIMITED WARRANTY

## 1. DEFINITIONS

In this Licence and Limited Warranty the following words and phrases shall bear the following meanings:

'the Company' is CEDAR Audio Limited of 20 Home End, Fulbourn, Cambridge CB21 5BS, UK;

'the System' means an instance of the DNS2000 sound-reprocessing system comprising hardware and software held on non-volatile memory ('firmware') developed by the Company;

'this Document' means this Licence and Limited Warranty.

## 2. ISSUE AND USE OF THE SYSTEM

2.1 The terms and conditions of this Document are implicitly accepted by any person or body corporate who shall at any time use or have access to the System, and are effective from the date of supply of the System by CEDAR Audio Limited to its immediate customer.

2.2 The Company hereby grants to the Licensee and the Licensee agrees to accept a non-exclusive right to use the System.

## 3. PROPERTY AND CONFIDENTIALITY

3.1 The System contains confidential information of the Company and all copyright, trade marks, trade names, styles and logos and other intellectual property rights in the System including all documentation and manuals relating thereto are the exclusive property of the Company. The Licensee acknowledges that all such rights are the property of the Company and shall not question or dispute the ownership of any such rights nor use or adopt any trading name or style similar to that of the Company.

3.2 The Licensee shall not attempt to reverse engineer, modify, copy, merge or transcribe the whole or any part of the System or any information or documentation relating thereto.

3.3 The Licensee shall take all reasonable steps to protect the confidential information and intellectual property rights of the Company.

## 4. LIMITED WARRANTY AND POST-WARRANTY OBLIGATIONS

4.1 The Company warrants that the System will perform substantially in accordance with the appropriate section of its accompanying product manual for a period of one year from the date of supply to the Company's immediate customers.

4.2 The Company will make good at its own expenses by repair or replacement any defect or failure that develops in the System within one year of supply to the Company's immediate customer.

4.3 The Company shall have no liability to remedy any defect, failure, error or malfunction that arises as a result of any improper use, operation or neglect of the System, or any attempt to repair or modify the System by any person other than the Company or a person appointed with the Company's prior written consent.

4.4 In the case of any defect or failure in the System occurring more than twelve months after its supply to the Company's immediate customer the Company will at its option and for a reasonable fee make good such defect or failure by repair or replacement (at the option of the Company) subject to the faulty equipment having first been returned to the Company. The Company will use reasonable efforts to return repaired or replacement items promptly, all shipping, handling and insurance costs being for the account of the Licensee.

4.5 The above undertakings 4.1 to 4.4 are accepted by the Licensee in lieu of any other legal remedy in respect of any defect or failure occurring during the said period and of any other obligations or warranties expressed or implied including but not limited to the implied warranties of saleability and fitness for a specific purpose.

4.6 The Licensee hereby acknowledges and accepts that nothing in this Document shall impose upon the Company any obligation to repair or replace any item after a time when it is no longer produced or offered for supply by the Company or which the Company certifies has been superseded by a later version or has become obsolete.

## 5. FORCE MAJEURE

The Company shall not be liable for any breach of its obligations hereunder resulting from causes beyond its reasonable control including, but not limited to, fires, strikes (of its own or other employees), insurrection or

riots, embargoes, container shortages, wrecks or delays in transportation, inability to obtain supplies and raw materials, or requirements or regulations of any civil or military authority.

#### 6. WAIVER

The waiver by either party of a breach of the provisions hereof by the other shall not be construed as a waiver of any succeeding breach of the same or other provisions, nor shall any delay or omission on the part of either party to exercise any right that it may have under this Licence operate as a waiver of any breach or default by the other party.

#### 7. NOTICES

Any notices or instruction to be given hereunder shall be delivered or sent by first-class post or telecopier to the other party, and shall be deemed to have been served (if delivered) at the time of delivery or (if sent by post) upon the expiration of seven days after posting or (if sent by telecopier) upon the expiration of twelve hours after transmission.

#### 8. ASSIGNMENT AND SUB-LICENSING

The Licensee may at his discretion assign the System and in doing so shall assign this Licence its rights and obligations to the purchaser who shall without reservation agree to be bound by this Licence. The original Licensee and any subsequent Licensees shall be bound by the obligations of this Licence in perpetuity.

#### 9. LIMITATION OF LIABILITY

The Company's maximum liability under any claim including any claim in respect of infringement of the intellectual property rights of any third party shall be, at the option of the Company either:

- (a) return of a sum calculated as the price received for the System by the Company from its immediate customer depreciated on a straight line basis over a one year write-off period; or
- (b) repair or replacement of those components of the System that do not meet the warranties contained within this Document.

The foregoing states the entire liability of the Company to the Licensee.

#### 10. CONSEQUENTIAL LOSS

Even if the Company has been advised of the possibility of such damages, and notwithstanding anything else contained herein the Company shall under no event be liable to the Licensee or to any other persons for loss of profits or contracts or damage (whether direct or consequential) arising in connection with the System or any modification, variation or enhancement thereof and including any documentation or data provided by the Company or for any other indirect or consequential loss.

#### 11. ENTIRE AGREEMENT

The Company shall not be liable to the Licensee for any loss arising in connection with any representations, agreements, statements or undertakings made prior to the date of supply of the System to the Licensee.

#### 12. TERMINATION

This Licence may be terminated forthwith by the Company if the Licensee commits any material breach of any terms of this Licence. Forthwith upon such termination the Company shall have immediate right of access to the System for the purpose of removing it.

#### 13. SEVERABILITY

Notwithstanding that the whole or any part of any provision of this Document may prove to be illegal or unenforceable the other provisions of this Document and the remainder of the provision in question shall remain in full force and effect.

#### 14. HEADINGS

The headings to the Clauses are for ease of reference only and shall not affect the interpretation or construction of this Document.

#### 15. LAW

This Document shall be governed by and construed in accordance with English law and all disputes between the parties shall be determined in England in accordance with the Arbitration Act 1950 and 1979.

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